Population Dynamics of the St. Marys River Fish Community 1975-2013

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Abstract- The St. Marys River was jointly assessed by the member agencies of the St. Marys River Fishery Task group under the Great Lakes Fishery Commission in 2009 and 2013, the 7th and 8th such survey, respectively, since 1975. A gillnet based survey, 44 nets sets each survey year resulted in indices of abundance and population status. Three cool water species of importance; Walleye, Yellow Perch, and Smallmouth Bass, exhibited increasing abundance. Two species of importance; Cisco and Northern Pike indicated stable but overall lower abundances relative to earlier surveys. Growth rates, as indicated by length at age at capture, was generally near or below regional averages and may reflect the northern latitude of the St. Marys River. Total annual mortality rates were 64% for Yellow Perch and as high as 72% for Northern Pike but were generally deemed within acceptable ranges for most species. Diets varied by species and reflected both piscine prey and invertebrates, especially crayfish. No new invasive species were documented in 2009 or 2013 in gillnet collections but round gobies were observed in the diets of some predators indicating that they are now established in the river fish community. Recommended are timing future surveys with full river-wide creel surveys for maximum information and to increase the frequency of both.

Introduction

The St. Marys River supports a highly diverse fish community reflecting its varied habitat types. Most of the St. Marys constitutes cool water habitat typical of the nearshore Great Lakes environs, but owing to its Lake Superior water source and deeper reaches near the mouth of the river, cold water habitat also results in salmon and trout species inhabiting the river seasonally. The fish community supports recreational, commercial and subsistence fisheries. Recreational fishing effort can be substantial, amounting to as much as one third the total of the Michigan waters of Lake Huron and has been valued at $11 million in economic activity (Fielder et al. 2002).

Despite the varied habitat types and high quality water source, the St. Marys River has been the subject of considerable anthropogenic alteration and degradation. The river is channelized throughout much of its reach so as to accommodate international shipping traffic (Edsall and Gannon 1993). The River is designated as an 'Area of Concern' stemming from contamination from a variety of sources (EPA 2017). Fishery management challenges also result from the complications of shared resources across multiple fisheries and jurisdictions (Fielder 2002). The St. Marys River constitutes the international boundary water between Michigan and Ontario and include Native American and Canadian First Nations as well. Fishery management is coordinated through the Great Lakes Fishery Commission's Lake Huron Committee and assessment through its St. Marys River Fisheries Task Group (SMRFTG) which it formed in 1997 (Fielder 2002). The SMRFTG has representatives from the various management authorities and federal agencies as well as area universities and works collaboratively to periodically assess the fish community. A river fishery assessment plan was developed in 2002 that included the need for and outlined a protocol for a fish community assessment for the St. Marys River (Gebhardt et al. 2002).

The objectives of this survey are to assess and provide information on the abundance, growth, mortality and size structure of important fish populations found in the St. Marys River; to make comparisons to previous surveys; and to comment on the overall current status of certain notable species.

Study Site

The St. Marys River is a connecting channel between Lakes Superior and Huron (Figure 1). The river flows southeasterly about 112 km and empties into Lake Huron at De Tour, Michigan but also drains into Ontario's North Channel through the St. Joseph Channel and Potagannissing Bay. Three large islands divide the river flow into these various channels and the river is bordered on the northeast by Ontario and Michigan on the other side. The river includes a variety of lacustrine reaches; specifically Lake Nicolet, Lake George, Lake Munuscong, and Raber Bay. For practical purposes, and for this study, Potagannissing Bay is also considered part of the St. Marys River. The rapids at Sault Ste. Marie is perhaps one of the most well-known features of the river, although today 93% of the river flow is diverted for hydroelectric generation (Edsall and Gannon 1993). The St. Marys River aquatic habitat includes an expanse of coastal wetlands that provide spawning and nursery habitat for fish (Albert 2003). Duffy et al. (1987) describes in detail the ecological and physical characteristics of the St. Marys River.

Methods

This study followed the fish community assessment procedure recommended by Gebhardt et al. (2002) which in turn was based on the methods used by past surveys (Schorfhaar 1975; Miller 1981; Grimm 1989; Fielder and Waybrant 1998; Fielder et al. 2004; Fielder et al. 2007; Schaeffer

et al. 2011) so as to allow comparability. Multifilament nylon gillnets were used to collect fish in this study. In this survey and since 2002 the nets measured 1.8 m deep by 304.8 m long and were comprised of ten different mesh sizes. Each mesh was in a 30.5 m long panel. Mesh sizes were; 38.1mm, 50.8 mm, 63.5 mm, 76.2 mm, 88.9 mm, 101.6 mm, 114.3 mm, 127.0 mm, 139.7 mm, and 152.4 mm stretch measure. The survey nets in 1975, 1979, 1987, and 1995 only utilized four mesh sizes; 50.8 mm, 63.5 mm, 76.2 mm and 114.3 mm stretch measure mesh and panels were 30.5 m in length. Nets were fished overnight on the bottom for all surveys.

Field work was jointly conducted by the member agencies of the SMFTG. They were the Bay Mills Indian Community (BMIC), Chippewa Ottawa Resource Authority (CORA), Michigan Department of Natural Resources (MDNR), Ontario Ministry of Natural Resources and Forestry (OMNRF), Fisheries and Oceans Canada (DFO), and the United States Fish and Wildlife Service (USFWS). Net set locations were divided throughout the St. Marys River (Figure 1). For the purpose of some analyses, data were organized by seven different distinct areas (Table 1, Figure 1). The upper St. Marys River above the compensating works at the head of the rapids was not sampled in the 2013 survey.

The catch from each lift was identified, weighed (round weight) and measured for total length. Scales or dorsal spines were collected for aging from Walleye (see appendix 1 for a complete listing of all the common and scientific names of fishes mentioned in this report), Yellow Perch, Smallmouth Bass, Northern Pike, all Salmonines, and Cisco. These same species were internally inspected for sex, maturity (according to the methods of Fielder 1998), stomach contents, and for Salmonids; visceral fat index scoring (according to the methods of Goede 1989). Stomach contents were identified when possible and enumerated. Stomach contents of certain species of interest are reported as incidence (percent void and percent with contents) and proportion of occurrence which is the percent of that prey item in the total of all prey items consumed by that species.

Catch-per-unit-of-effort (CPUE) was expressed two ways; first, the total number of each species per net lift or number per 304.8 m of net across all mesh sizes was determined while the second was to express CPUE based only on the catch collected from the same mesh sizes used in past surveys (prior to 2002). This second method of expressing CPUE allowed a more direct comparison for trend purposes and was standardized (extrapolated when necessary) to 304.8 m of net length. In 2006, 8 net sets from Potagannissing Bay were excluded from this expression of CPUE due to a lack of separation in the data by mesh size. The CPUE values of the two different methods are also contrasted to explore comparability.

Total annual mortality was derived using the Robson-Chapman method (Van Den Avyle and Hayward 1999) on certain species of interest. Age information was also organized by CPUE so as to compare year class strength. Growth rate was expressed as mean length-at-age-at-capture and compared to Michigan averages according to Schneider et al. (2000) and to Lake Huron averages for those species. The Lake Huron data were means of total length from the North Channel of Lake Huron for collections made in similar times of the year (OMNR unpublished data). Survey growth rate averages were also compared to data from past surveys. Condition was expressed as relative weight (Wr; Ney 1999). Growth parameters were further explored via length / weight relationships and Von Bertalanffy growth equations (Van Den Avyle and Hayward 1999) for some species.

Statistical analyses included comparison of means via the nonparametric Kruskal-Wallis (K-W) test. Testing for differences of means between two independent samples used the t-test where possible and the Mann-Whitney U (M-WU) test when the assumption of normality could not be met. Nonparametric procedures were used because gillnet CPUE data were rarely normally distributed. Comparison of the mean CPUE values between the expanded mesh nets (full

complement of mesh sizes fished) and the traditional mesh panels alone (used by past surveys) were standardized to a uniform total net length of 304.8 m to ensure comparability. Some data and means from past surveys were recalculated for reporting and comparison purposes in this report and may differ slightly from those reported by past authors. Length / weight analysis used log transformed data for linear regressions. All statistical tests were performed at the significance level of $P \leq 0.05$ and followed the methods of Sokal and Rohlf (1981). Analysis was performed with the aid of SPSS computer software (SPSS 2001).

Results

A total of 3,871 specimens were collected in the 2009 survey and 3,917 specimens collected in the 2013 survey representing 30 and 35 different species respectively. The mean CPUE of Walleye was lower in 2009 however the 2013 mean CPUE was the greatest measured during the survey series and exceeded the previous high in 2002 (Table 2). The mean Walleye CPUE was significantly different among the survey years (K-W test; $P<0.001$) as was Yellow Perch (K-W test $P=0.024$), Yellow Perch abundance continues to demonstrate overall stability (Table 2). When examined by river reach (Table 3), two large changes in Yellow Perch abundance stood out with a decline in Lake George from a mean CPUE of 81.2 in 2009 to 38.3 in 2013 and an increase in Potagannissing Bay from 31.8 in 2009 to 88.5 in 2013. Neither of these changes were significantly different however (M-WU; $P=0.310$ & $P=0.393$ respectively).

Northern Pike mean CPUE continued to decline to its lowest measured level in 2009 however rebounded in 2013 and there was a significant difference among surveyed years (K-W test; $P<0.001$). Smallmouth Bass mean CPUE dropped in 2009 from its previous peak value reached in 2006 but rebounded to its highest level in the time series in 2013 (Table 2). Similarly, there was a significant difference in mean CPUE of Smallmouth Bass (K-W test; $P<0.001$). Cisco mean CPUE (10.23) in 2009 was close to its long-term average, but dropped considerably to 4.08 in 2013 (Table 2). Rock Bass mean CPUE remains high and white sucker mean CPUE was stable relative to past survey years (Table 2). The exotic White Perch, first collected in 2002, was absent in the 2009 survey but appeared again in 2013 at a lower abundance than observed in 2006 (Table 2).

As stated in the methods, the gillnet specifications used in the 2002 and later surveys differed from past survey years in that additional meshes were added. The CPUEs summarized in Table 2 were standardized to only include the catch from those mesh sizes in common with all survey years to allow comparison. It remains possible that some of the available catch was spread over more mesh sizes in the two recent surveys, thereby lowering the CPUE value of the traditional meshes alone. If so, the mean CPUE of the full mesh complement fished in 2002 and 2006 would be greater than that of the traditional meshes alone. This was again explored in 2009 and 2013 by comparing the mean CPUE of each species between the expanded mesh net (full complement of mesh sizes fished; 10 panels) and the traditional mesh sizes (4 panels) (Table 4). Under this comparison, the mean CPUE of Cisco was higher but not significantly different in the traditional mesh than the expanded mesh in both 2009 (M-WU test; $P=0.917$) and 2013 (M-WU test; $P=0.968$). Mean CPUE was higher for Northern Pike in the traditional mesh compared to the expanded mesh but not significantly so in either 2009 (M-WU test; $P=0.908$) or 2013 (M-WU test; $P=0.369$). The CPUE from the expanded mesh catch was also lower than the traditional mesh for Walleye but not significantly lower in either 2009 (M-WU test; $P=0.990$) or 2013 (M-WU test; $P=0.540$). There was no significant difference in the mean Smallmouth Bass CPUE in 2009 (M-WU test; $P=0.100$) or 2013 (M-WU test; $P=0.454$). The 2009 vs. 2006 Yellow Perch mean CPUE was not significantly different (M-WU test; $P=0.331$) nor was the 2009 vs. 2013 mean CPUE significantly different (M-WU test; $P=0.841$) (Table 4). However there is a significant difference in Yellow Perch CPUE values among years from 1975-2013 (K-W test; $P=0.024$).

The St. Marys River encompasses a large variety of habitats. Some indication can be derived of where changes in abundance have occurred by examining trends in CPUE by river reach. Northern Pike exhibited a substantial decline in CPUE within Lake George in 2006 compared to past survey years but has since rebounded in the 2009 and 2013 surveys (Table 3), although the CPUE was not significantly different between 2006 and 2009 (M-WU test; P=0.145). For Cisco, Raber Bay and St. Joseph Channel had by far the highest mean CPUEs for the survey in 2013, with 16.7 and 6.9 Cisco per 304.8 m respectively. The CPUE (1.0) for Cisco in Potagannissing Bay in 2013 was the lowest recorded for the survey series, after a very high catch rate (34.0) in that bay in 2009 (Table 3). These values, however, were not statistically different (M-WU test P=0.052). No real patterns of increased Cisco recruitment related to strong year classes were observed (Table 5). The river-wide abundance of Smallmouth Bass was significantly lower in 2009 than both 2006 (M-WU test; P=0.002) and 2013 (M-WU test; P=0.023). Increases in 2013 Smallmouth Bass were driven mainly by gains in Lake George followed by Lake Munuscong and the St. Joseph Channel reaches of the St. Marys River. Another record river-wide mean CPUE of Walleye was reached in 2013 driven primarily by gains in the Lake George, and Potagannissing Bay reaches. Yellow Perch mean CPUE increased over the 2006 and 2009 surveys with the largest increase in Potagannissing Bay. Yellow Perch exhibited strong year classes from 2009 through 2011 (ages 2-4; Table 6). The 2012 year class (age-1) was not well represented throughout the river, but may not have fully recruited to the gear yet. Age-3 fish made up 48% of the Yellow Perch catch river-wide.

The general trend in total annual mortality rate among the species it was estimated for was a decrease in 2013 relative to the recent record (Table 7). Total annual mortality for Yellow Perch increased from 2006 to 2013 in Lake George, St. Joseph Channel, and Raber Bay (Table 7). Despite those reach-specific increases, river-wide total annual mortality of Yellow Perch declined over that time period, likely driven from decreases in Potagannissing Bay and Lake Munuscong. Generally, all the total annual mortality rates were largely within sustainable levels; however, the Yellow Perch river-wide rate, as well as some reach-specific rates, are high and consistent with heavy exploitation.

Walleye growth rate, as indicted by mean-length at age 3, increased significantly from 394 mm in 2009 to 420 mm in 2013 (T-test; P= 0.032) and continues a general trend of increased growth rate since the survey series began in the mid-1970s (Table 8). River-wide, Yellow Perch growth was consistent with the statewide and Ontario North-Channel average growth rates (Table 6). Mean length at age-3 (at capture in August) increased significantly from 172 mm in 2009 to 186 mm in 2013 (T-test; P<0.001). Cisco were growing above average based on 2009 survey results, but growth had slowed considerably by 2013 when growth rates were significantly below average (P<0.001) (Table 5). Northern Pike exhibited an improved growth rate in 2006 across all ages (Table 9). Smallmouth Bass continue to grow slower than the Michigan state average rate for length at age, but better than the Ontario Lake Huron average rate (Table 10). The 2013 mean size at age 3 is slightly up from 2009 as is the overall mean length (Table 10).

Just over half of the female Yellow Perch were sexually mature by the time they were 18 cm in total length, which is the minimum size limit for Michigan sport anglers (Table 11). Females were fully mature at about 23 cm in total length. These sizes at maturity are about the same as they were in 2006. The Smallmouth Bass size at 50% maturity was difficult to determine given the variability in the data (Table 11). Female Smallmouth Bass are achieving 100% maturity by 38 cm which is slightly above the 36 cm Michigan minimum length limit. Maturity of female Northern Pike did not follow a consistent threshold (Table 11), possibly a result of low sample size. The 61 cm Michigan minimum length limit appears to be within the range of maturity for pike. Ontario presently maintains no length limits in the St. Marys River except on Walleye in the Lake George

vicinity where a 46 cm maximum length limit is in place. Michigan maintains a 38 cm minimum length limit on the same species. Female Walleye achieved 100% maturity around 46 cm total length in 2013 (Table 11).

The diet of Yellow Perch was different in 2013 compared to previous years. There appears to be a decline in the occurrence of crayfish in Yellow Perch diet in 2013. In 2006, for instance, crayfish occurrence in Yellow Perch diet was over 60%, but that prey item dropped to 9.1% in 2013 (Table 12). The diet of Walleye, at the time of the survey, was dominated by Rainbow Smelt (11.8%), threespine stickleback (11.8%) and Alewife at 8.1% (Table 12). Walleye and Northern Pike were the two species of those sampled utilizing alewives in the St. Marys River. Crayfish figured prominently in the diet of all other species examined, except Walleye (Table 12). The most varied diet was that of Northern Pike which utilized a variety of fish species as prey. Condition, as indicated by relative weight, was largely unchanged for most species, but there may be some indication of a declining trend in Walleye (Table 13). Walleye condition was lowest in Raber Bay. Smallmouth Bass continue to exhibit a high condition level in the St. Marys River.

The incidence of sea lamprey wounding among all of the species sampled was low (Table 14). No sea lamprey wounds were observed on Walleye, Lake Whitefish, Northern Pike or Rock Bass in 2013 (Table 14). Cisco had the highest marking rate (3.9 %) matching the rate observed in 2006. White Sucker exhibited the largest range of wound classification, but this may have been an artifact of their relatively large sample size. Length/weight regression equations and Von Bertalanffy growth equations for five notable species are presented in Appendix 2. Length frequency distributions for these species from the survey catch are presented in Appendix 3.

Discussion

Walleye

Walleye remain the fourth most abundant species (as measured by CPUE) in the St. Marys River during the 2013 survey, behind Yellow Perch, White Suckers, and Rock Bass (Table 2). Walleye CPUE (11.28) in 2013 was the highest measured over the survey series (1975-2013). Catch for this species had been remarkably stable over previous surveys, with CPUE values ranging from 3.58 in 2002 to the previous high of 7.47 in 1987 followed by new highs in 2006 and 2013 (Table 2). The Upper River was not surveyed in 2013 but saw a decline in Walleye CPUE in 2009 relative to 2006 as was the case at all sites except Raber Bay which increased in 2009 (Table 3). However, the overall trend in relative abundance going back to 1975 continues to be positive.

The 2013 increase in Walleye CPUE is being driven primarily by large increases in Lake George (34.2) and increasing or stable CPUE in the St. Joseph Channel, Raber Bay and Potagannissing Bay. Fielder et al. (2002) hypothesized that increases in abundance in Lake George may be due to Walleye length limits imposed in both Ontario and Michigan waters, the only reach in the survey to have dual regulations. Although incongruent in combination (OMNR is a maximum length limit and MDNR is a minimum length limit), the two acting in concert may be limiting the harvest and building the population. These regulations may also protect Walleye which undertake seasonal migrations into Lake George following spawning in Lake Munuscong (Liston et al. 1986).

In addition to the dual regulations, increases in Walleye abundance in Lake George may also be the result of Walleye stocking on the Michigan side of that reach. A total of 68,951 spring fingerling Walleye were stocked in Lake George in 2004-2006. A limited dataset (2004 and 2006, N=52)

show 28.8% of the age-0 Walleye captured during fall electrofishing surveys in Lake George were of hatchery origin (SMRFTG, unpublished data).

Walleye CPUE peaked at 4.2 in Lake Munuscong in 2006 and have since dropped to an all-time low of 0.5 for the survey series. Angler reports during the survey indicated that more Walleye are in the deeper, cooler waters of the shipping channel. Catch rates may be higher if nets could be set in the channel, but shipping traffic precludes that option.

Age-1 to Age-4 Walleye had the highest CPUE during this survey, corresponding to the 2009-2012 year classes with Walleye up to age-14 captured. The 2003 year class was especially strong for percid natural reproduction in other parts of the Great Lakes as well and this year class is still detectable in the data as age-10 Walleye (Fielder et al. 2008, Fielder and Thomas 2006, Thomas and Haas 2007). Relative contributions of natural reproduction and stocking to the St. Marys River Walleye population should become evident as data on recruitment trends are collected through annual fall Walleye evaluations.

The St. Marys River Fisheries Task Group coordinates an annual fall Walleye electrofishing survey to evaluate year class strength throughout the St. Marys River and assess the contribution of stocking. While some member agencies had been doing similar work since 1992, the coordinated, river-wide fall surveys began in 2004. The 2004 year-class had the highest CPUE in the fall electrofishing surveys since 2002, which also corresponded as the strongest year class in the 2006 gillnet survey. The mean CPUE for age-0 Walleye in 2003 and 2005, however, was lower than the average since 1992 (SMRFTG, unpublished data). The Walleye recruitment study is described in the St. Marys River Walleye Stocking and Evaluation Plan.

Mean CPUE of Walleyes in the St. Marys River fish community survey in 2013 was 11.25, after reaching a low for the survey series in 2002 at 3.58. Walleye CPUE in Saginaw Bay using similar gear averaged 6.6 to 13.0 from 1998-2004 (Fielder and Thomas 2006). Saginaw Bay is a shallow, productive bay of Lake Huron that is well known for its Walleye fishery, and has seen strong year classes of wild Walleye since 2003. Although the St. Marys River is much less productive, the 2006 Walleye catch rate in the St. Marys River put it well in the range of CPUE values seen in Saginaw Bay.

Total annual mortality (38%) for Walleye was slightly lower in 2006 compared to the 2002 (49%) and 1995 (51%) values (Table 7). Losses and extractions of Walleye from the St. Marys River are primarily due to angling and predation. Angler harvest in the Walleye fishery can be as much as 25,000 (Fielder et al. 2002). Based on a creel survey done from 1999-2000, Walleye are the second most sought after species in the St. Marys River sport fishery (Fielder et al. 2002).

Mean length-at-age for Walleye in the 2006 survey was slightly above the state of Michigan average. The growth index, which compares length-at-age to the state average, was +9 mm. The 2002 survey was the only other in the survey series that showed an above average growth index for this species in the St. Marys River. The above average growth indicates that Walleye are growing very well, considering that the river originates from cold Lake Superior outflow. Compared to mean-lengths-at-age for Walleye from the North Channel in 2006 (OMNR, unpublished data), however, St. Marys River Walleye had a growth index of -35 mm (Table 8).

Rainbow Smelt and Threespine Sticklebacks were the most common prey item (11.8% occurrence) for Walleye based on the examination of stomach contents of fish captured during the survey. This is a shift from the Walleye diet found in 2002, in which Alewife were more abundant in the diet, with Rainbow Smelt occurring much less frequently. The switch in Walleye diet from Alewife to

Rainbow Smelt may be reflective of a lake-wide decline in Alewife abundance in Lake Huron (Riley and Roseman 2013).
Condition, as measured by mean relative weight was lower in 2009 than 2013. Relative weights were uniformly low throughout the river. The lower condition value may be a result of the increased abundance of Walleye observed in the 2013 survey; that is, more fish competing for food resources.

Northern Pike

Northern Pike gillnet CPUE showed some improvement by the 2013 survey (Table 2). An area by area examination indicated an improvement in the relative abundance of Northern Pike in Lake George and Potagannissing Bay (Table 3). The coastal wetlands of the river were considerably affected by the low spring water levels from 2008 - 2013 which may be having a negative effect on pike spawning success. Mortality has not changed appreciably since the 1995 survey (Table 7).

The Northern Pike age distribution improved in 2013 after being dominated by younger individuals in surveys from the early 2000s (Table 9). The improving age structure may be resulting from a return to lower mortality rates by 2013. Growth of Northern Pike remains largely unchanged.

Northern Pike diet continues to be predominantly fish (85%) reflecting six different species consumed (Table 12). Fish species consumed by Northern Pike included Yellow Perch, White Sucker, Threespine Stickleback, Alewife and Round Goby. Crayfish (11.8%) and snails (2.9%) were the only invertebrates noted. Northern Pike condition remained largely unchanged. Maturity of females was consistently achieved by Northern Pike 55cm in length. No sea lamprey wounding was observed for Northern Pike.

Yellow Perch

Yellow Perch relative abundance in the St. Marys River increased in 2013, with the second highest mean CPUE in this survey series. Yellow Perch year classes from 2010 and 2011 were particularly strong. Abundance was highest in the lower river reaches. The St. Joseph Channel and Lake Nicolet had relatively low abundance of Yellow Perch.

Growth, as a density dependent indicator of population status relative to carrying capacity of the habitat and available prey base suggests that the Yellow Perch population of the St. Marys River is not depressed. Although there was a significant increase in mean length at age-3 in 2013, overall the growth rates are consistent with regional averages. The decline in the occurrence of crayfish in the diet was also noted in the neighboring Les Cheneaux Islands area. Fish, including unidentified fish remains, occurred in just over 50% of the stomachs in the St. Marys. Of note is the appearance of Round Goby in Perch diets in 2013, occurring in 7% of samples suggesting this invasive species is becoming more established in the river.

Yellow Perch are an important feature of the St. Marys River fishery. Their recreational harvest ranges from 62,000 to a high of 125,000 in most years (T. Kolb. MDNR Personal Communication), exceeded in harvest only by that of Cisco. The Yellow Perch population of the St. Marys River appears not to be limited by the same impediments that have beleaguered the Saginaw Bay Yellow Perch population since 2003 where in spite of good reproductive success, recruitment failures have led to a decline and virtual collapse of the recreational and commercial fisheries (Fielder and Thomas 2014). The recruitment limitations in Saginaw Bay are attributed to very high natural mortality between age-0 and age-1 life stages which in turn is attributed to the lack of prey buffering stemming from the loss of Alewives and Cisco before that. It is not entirely clear how the

food web functions within the fish community in the St. Marys River but the healthy local Cisco population may afford the needed predation buffer that Yellow Perch lack in Saginaw Bay.

Smallmouth Bass

Smallmouth Bass continue to increase in abundance in the St. Marys River reaching a new time-series high in 2013 (Table 2). This increase was evident throughout the river (Table 3). The central portion of the river appears to provide good habitat for Smallmouth Bass. The increase in river-wide mean CPUE of Smallmouth Bass may be partly driven by a decline in the total annual mortality rate (Table 7). In addition, with an increase in mean CPUE, growth rates have also improved. Condition of Smallmouth Bass is high and may reflect the quality of habitat and preferred prey such as crayfish and Round Goby. In all, Smallmouth Bass diet in the St. Mary's River remains relatively simple depending heavily on crayfish and a few prey fish species.

Cisco

Overall Cisco abundance was on an upward trend in 2009, but 2013 again saw another drop in abundance (Table 2). It should be noted that the distribution of Cisco in the river at this time of year makes it difficult to accurately describe the population, and likely contributes to the variability observed in their catch rates over time. Growth rates and mortality rates are still indicative of a healthy Cisco population (Table 5 and Table 7).

Cisco mean CPUE was higher in 2009 and 2013 than the record low in 2002, but in 2013 was well below its long term average (Table 2). Raber Bay again dominated the Cisco catch, followed by the St. Joseph Channel. Waters near Lime Island in Raber Bay continue to be popular for Cisco fishing, particularly during the mid- to late-summer. Angler reports in recent years indicate declining catches of Cisco there, which is consistent with the survey results since 2006. Although Cisco CPUE rebounded well in 2009 (34.0) in Potagannissing Bay, it dropped off precipitously again in 2013 (1.0) (Table 3). The OMNRF changed the sport fishing harvest regulations for Cisco in 2008. Prior to 2008 there was no limit on Cisco harvest in Ontario waters and a 12 fish limit in Michigan. In 2008 a limit of In spite of this large decline, the two catch rates are not significantly different (P=0.052)

Special Concerns

As a thoroughfare for international shipping, The St. Marys River remains vulnerable to invasion by new exotic species. So far, sampling has detected no Eurasian Ruffe. That invasive species has been documented in the Tahquamenon River, 55 km west of the Sault Locks (Czypinski et al. 2006). A species with similar traits as that of Yellow Perch may find highly suitable conditions if and when it reaches the St. Marys River. Similarly, Asian Carp species in the Lake Michigan watershed pose a substantial threat to all the Great Lakes but it is especially productive rivers like the St. Marys that have demonstrated to be greatly affected by these invasive species. If Asian Carp species ever become established in the Great Lakes, The St. Marys River fish community will undoubtedly be substantially perturbed and altered as a result.

Shortly after the 2013 survey, Didymo (*Didymosphenia geminate*), an algae that is well suited to cold oligotrophic waters was documented in the upper St. Marys River. The cold Lake Superior water that flows through the St. Marys River makes the river potentially ideal for habitat for Didymo . Didymo has the potential to develop thick mats over rocks potentially affecting spawning substrate and invertebrate habitat. Didymo can impact manmade structures such as Sea Lamprey traps that require the algal growths to be cleaned off periodically. White Perch, first documented in

2002 and the appearance of Round Goby indicate that invasive species from the lower lakes can find their way to the St. Marys River. Crayfish are an important component of the diet of many fish in the St. Marys River. The presence of the invasive Rusty Crayfish (*Orconectes rusticus*) and potential invasion of the Red Swamp Crayfish (*Procambarus clarkii*) pose threats for native crayfish species but also habitat in the St. Marys River.

Information Needs

As noted in past survey reports; continued monitoring of the fish community in the St. Marys River remains essential. The frequency should be increased in accordance with the original St. Marys River Fishery Assessment Plan (Gebhardt et al. 2002), possibly timed with future years of lake wide intensive monitoring sponsored by the US EPA. More information is needed on reproductive success and recruitment of all species. The addition of a trawling or electrofishing survey would be greatly beneficial to the understanding of the fish community within the river. The creel survey operated jointly between the MDNR and OMNR has been fragmented in most years making it difficult to extract the needed information. Creel survey resources should be directed at more frequent river-wide surveys which would ideally be timed to coincide with the fish community survey. The overall management of the St. Marys River fishery resources would greatly benefit from the development of river-wide joint fish community objectives. These objectives would allow the development of management strategies and a better context with which to interpret findings from the Fish Community Index Surveys. The development of common recreational fishing regulations between Ontario and Michigan remains a need. Development of fish community objectives will drive this effort in addition to the continued assessment of the dynamics of the fish community.

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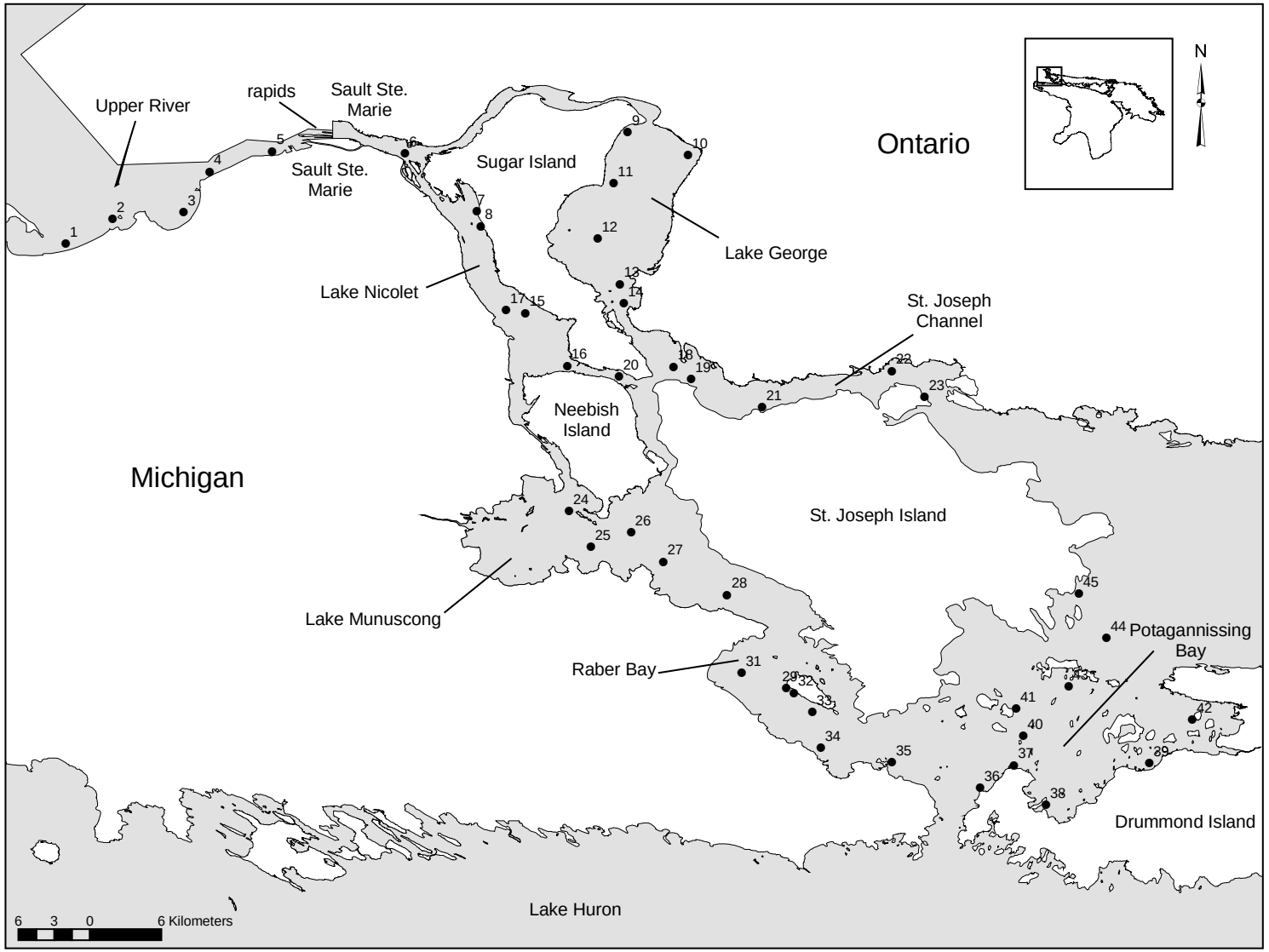


Figure 1. St. Marys River and location of gillnet sets (stations). See Table 1 for effort by year and agency.

Table 1. Net set locations used to define areas within the St. Marys River for the purpose of certain data analyses, along with a list of the agencies that performed the field work 2009 and 2013. See Figure 1 for location of each net number.

Area	Station numbers	Agency
2009		
Upper River	1, 2, 3, 4, 5	BMIC
Lake Nicolet	6, 7, 8, 15, 16, 17, 20	USFWS
Lake George	9, 10, 11, 12, 13, 14	CORA, OMNR, DFO
Lake Munuscong	24, 25, 26, 27, 28	MDNR
St. Joseph Channel	18, 19, 21, 22, 23	OMNR & DFO
Raber Bay	29, 31, 32, 33, 34, 35	CORA & MDNR
Potagannissing Bay	36, 37, 38, 39, 40, 41, 42, 43, 44, 45	MDNR & OMNR
2013		
Upper River	1, 2, 3, 4, 5	Not surveyed
Lake Nicolet	6, 7, 8, 15, 16, 17, 20	USFWS
Lake George	9, 10, 11, 12, 13, 14	CORA, OMNR, DFO
Lake Munuscong	24, 25, 26, 27, 28	MDNR
St. Joseph Channel	19, 21, 22, 23	OMNR & DFO
Raber Bay	29, 31, 32, 33, 34, 35	CORA & BMIC
Potagannissing Bay	36, 37, 38, 39, 40, 41, 42, 43, 44, 45	MDNR & OMNR

Table 2. Mean Catch-Per-Unit-of-Effort (CPUE) of all species collected from the St. Marys River 1975 through 2013. Means are based on number per 304.8 m (1000 ft) of gillnet representing the traditional mesh sizes, with standard error of the mean in parentheses. Total nets set were 32 each in 1975 and 1979, 27[b] in 1987, 51[c] in 1995, 44 in 2002, and 42 in 2006, although only 34 sets are represented here due to data recording limitations. The St. Joseph Channel portion of the St. Marys was added to the survey series beginning in 2002.

Species[a]	1975		1979		1987[b]		1995[c]		2002		2006		2009		2013	
Alewife	1.64	(0.57)	0.23	(0.12)	0.19	(0.11)	15.11	(12.22)	0.11	(0.11)	0.00	(0.00)	0.06	(0.06)	0.39	(0.18)
Atlantic Salmon	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.09	(0.07)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.07	(0.07)
Black Crappie	0.03	(0.03)	0.00	(0.00)	0.25	(0.22)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.26	(0.13)
Bloater	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.28	(0.21)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Bowfin	0.03	(0.03)	0.03	(0.03)	0.40	(0.40)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Brook Trout	0.03	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(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)	0.06	(0.06)	3.38	(1.69)	0.06	(0.06)	0.00	(0.00)
Brown Trout	0.03	(0.03)	0.00	(0.00)	0.03	(0.03)	0.09	(0.07)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Burbot	0.05	(0.04)	0.00	(0.00)	0.00	(0.00)	0.05	(0.05)	0.34	(0.17)	0.00	(0.00)	0.17	(0.10)	0.20	(0.15)
Carp	0.16	(0.08)	0.00	(0.00)	0.03	(0.03)	0.00	(0.00)	0.00	(0.00)	0.07	(0.07)	0.00	(0.00)	0.07	(0.07)
Channel Catfish	0.00	(0.00)	0.00	(0.00)	0.09	(0.05)	0.00	(0.00)	0.06	(0.06)	0.15	(0.15)	0.00	(0.00)	0.13	(0.13)
Chinook Salmon	0.00	(0.00)	0.03	(0.03)	0.46	(0.29)	0.08	(0.05)	0.00	(0.00)	0.10	(0.08)	0.06	(0.06)	0.20	(0.11)
Cisco	14.12	(5.13)	22.40	(11.28)	18.98	(8.34)	9.80	(3.40)	0.80	(0.34)	3.53	(1.84)	10.23	(4.31)	4.08	(2.21)
Coho Salmon	0.03	(0.03)	0.00	(0.00)	0.00	(0.00)	0.05	(0.05)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Freshwater Drum	0.00	(0.00)	0.00	(0.00)	0.03	(0.03)	0.00	(0.00)	0.06	(0.06)	0.59	(0.24)	0.17	(0.10)	0.07	(0.07)
Gizzard Shad	0.00	(0.00)	0.00	(0.00)	0.12	(0.12)	0.05	(0.05)	0.40	(0.21)	0.00	(0.00)	0.00	(0.00)	0.07	(0.07)
Lake Sturgeon	0.99	(0.96)	0.03	(0.03)	0.09	(0.05)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.07	(0.07)
Lake Trout	0.00	(0.00)	0.31	(0.31)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.07	(0.07)	0.17	(0.17)	0.07	(0.07)
Lake Whitefish	1.15	(0.41)	0.55	(0.25)	2.10	(0.99)	0.73	(0.37)	0.06	(0.06)	0.29	(0.18)	2.33	(1.13)	0.46	(0.21)
Largemouth Bass	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.07	(0.07)	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)	3.92	(3.52)	0.07	(0.07)	0.00	(0.00)	0.07	(0.07)
Longnose Sucker	0.94	(0.51)	1.07	(0.49)	4.26	(2.46)	2.85	(1.33)	2.10	(1.01)	1.99	(1.26)	2.61	(1.15)	0.13	(0.09)
Menominee	0.83	(0.44)	0.52	(0.30)	0.00	(0.00)	1.49	(0.55)	0.06	(0.06)	0.18	(0.11)	3.35	(1.80)	0.92	(0.79)
Muskellunge	0.00	(0.00)	0.68	(0.43)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)

Table 2 continued.

Northern Hogsucker	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.05	(0.05)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Northern Pike	9.04	(1.77)	8.07	(1.31)	12.69	(2.11)	9.26	(1.64)	4.43	(2.28)	3.82	(0.81)	3.01	(0.75)	5.13	(1.29)
Pink Salmon	0.00	(0.00)	0.00	(0.00)	2.78	(1.38)	0.55	(0.20)	0.00	(0.00)	0.22	(0.12)	0.06	(0.06)	0.13	(0.09)
Rainbow Smelt	4.97	(2.45)	1.64	(0.69)	1.02	(0.47)	0.86	(0.50)	2.61	(0.61)	0.44	(0.22)	1.65	(1.14)	1.51	(1.06)
Rainbow Trout	0.03	(0.03)	0.13	(0.07)	0.22	(0.22)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Redhorse spp.	0.65	(0.29)	0.55	(0.20)	0.62	(0.17)	1.69	(0.53)	0.40	(0.29)	1.25	(0.41)	3.30	(1.21)	0.46	(0.28)
Rock Bass	6.20	(2.25)	2.29	(0.67)	11.67	(2.42)	5.57	(1.35)	11.42	(2.77)	14.34	(3.66)	7.84	(1.96)	12.57	(3.56)
Sculpin	0.05	(0.04)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	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)	0.00	(0.00)	0.00	(0.00)	0.06	(0.06)	0.00	(0.00)
Smallmouth Bass	0.89	(0.45)	0.26	(0.14)	4.66	(2.23)	3.77	(0.95)	2.27	(0.59)	6.32	(1.76)	1.82	(0.53)	7.76	(2.36)
Splake	0.34	(0.19)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Sunfish spp.	0.13	(0.08)	0.13	(0.11)	1.54	(0.89)	0.65	(0.47)	0.97	(0.56)	0.66	(0.66)	0.85	(0.53)	0.00	(0.00)
Trout-Perch	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.34	(0.17)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Walleye	4.27	(1.56)	4.14	(1.73)	7.47	(1.92)	3.92	(0.83)	3.58	(1.04)	11.18	(2.97)	6.02	(1.29)	11.25	(2.88)
White Bass	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.85	(0.41)	0.07	(0.07)	0.23	(0.23)	0.20	(0.15)
White crappie	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
White Sucker	21.48	(3.94)	13.85	(2.20)	25.68	(5.46)	20.00	(2.47)	24.7	(3.93)	17.65	(2.52)	23.07	(3.70)	20.39	(3.84)
White Perch	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	4.38	(2.51)	0.74	(0.42)	0.00	(0.00)	0.39	(0.20)
Yellow Perch	23.02	(6.28)	25.68	(4.93)	49.48	(7.16)	29.97	(5.85)	25.3	(4.50)	37.21	(8.94)	35.34	(7.62)	41.71	(14.95)

[a] See Appendix 1 for a complete list of common and scientific names of fishes mentioned in this report.

[b] Mean CPUEs for 1987 are calculated from a restored data set that lacked five net sets compared to those summarized in Grimm 1987.

[c] Mean CPUEs for 1995 included the influence of 3.81 cm (1.5 inch) mesh net on some sets performed in the Raber and Potagannissing area of the river. This effort was incorporated in to the calculation of CPUE but may still have slightly inflated mean CPUE for certain species such as Yellow Perch and Alewife.

Table 3. Mean catch-per-unit-of-effort is number per 304.8 m (1000 ft.) collected from St. Marys River 1975 - 2013 based on catch from traditional mesh sizes. Standard error of the mean is in parentheses.

Species	Year	Upper River	Lake Nicolet	Lake George	Lake Munuscong	St. Joseph Channel	Raber Bay	Potagannissing Bay
Yellow Perch	2013	---	9.3 (3.1)	38.3 (13.2)	26.0 (8.8)	6.9 (5.2)	41.2 (13.1)	88.5 (54.4)
	2009	35.0 (32.6)	5.0 (2.3)	81.2 (26.5)	22.5 (3.2)	11.5 (2.3)	61.7 (16.4)	31.8 (18.8)
	2006	40.0 (16.8)	29.5 (12.9)	66.2 (28.2)	25.0 (5.4)	16.5 (5.7)	57.0 (46.0)	1.2 (1.2)[b]
	2002	26.5 (11.1)	20.7 (7.8)	42.5 (20.5)	17.0 (4.6)	54.5 (18.3)	17.9 (7.3)	11.8 (6.0)
	1995	39.0 (17.2)	21.6 (10.2)	42.3 (22.6)	20.3 (2.5)	---	27.0 (6.8)[a]	29.6 (11.5)
	1987	33.9 (15.9)	30.4 (27.1)	65.0 (19.0)	30.0 (4.9)	---	41.4 (4.8)	62.5 (16.3)
	1979	43.1 (9.0)	18.9 (9.5)	26.2 (11.0)	9.2 (2.1)	---	9.8 (5.0)	37.3 (11.7)
	1975	25.3 (16.6)	13.9 (10.0)	31.8 (10.0)	11.2 (6.0)	---	6.0 (3.6)	33.5 (16.4)
Northern Pike	2013	---	4.3 (3.1)	10.0 (4.5)	11.5 (5.3)	6.9 (2.8)	2.1 (0.8)	0.8 (0.8)
	2009	0.0 (0.0)	0.7 (0.5)	7.08 (2.08)	7.0 (3.2)	4.5 (1.8)	3.8 (1.4)	0.5 (0.5)
	2006	1.0 (0.6)	2.5 (1.4)	4.2 (1.4)	5.0 (2.2)	10.0 (2.8)	1.5 (0.6)	0.0 (0.0) [b]
	2002	0.0 (0.0)	0.4 (0.4)	21.7 (14.7)	0.0 (0.0)	7.5 (6.3)	0.4 (0.4)	2.2 (1.8)
	1995	2.5 (1.6)	8.1 (3.4)	16.3 (4.5)	18.4 (5.5)	---	12.8 (3.4)	1.6 (1.2)
	1987	6.9 (5.0)	2.9 (2.1)	27.0 (5.2)	15.6 (3.0)	---	11.7 (3.2)	8.0 (3.0)
	1979	1.9 (0.3)	4.7 (3.5)	14.3 (3.3)	11.8 (4.6)	---	6.0 (2.6)	6.5 (1.4)
	1975	4.4 (4.0)	11.7 (7.1)	17.3 (7.8)	9.3 (2.6)	---	5.0 (3.0)	7.1 (2.4)
Walleye	2013	---	1.8 (0.7)	34.2 (12.9)	0.5 (0.5)	6.2 (2.2)	15.8 (4.5)	8.8 (3.8)
	2009	6.0 (3.0)	1.4 (0.7)	9.6 (5.6)	1.0 (1.0)	6.0 (2.0)	17.9 (3.9)	2.5 (1.2)
	2006	15.5 (6.2)	4.0 (1.7)	26.7 (14.0)	4.2 (1.7)	3.5 (1.9)	8.5 (4.4)	18.8 (6.2) [b]
	2002	2.5 (2.5)	1.1 (0.5)	8.8 (3.6)	1.0 (1.0)	3.0 (1.5)	7.9 (5.6)	1.8 (1.2)
	1995	2.5 (0.8)	5.6 (3.1)	2.0 (6.9)	2.8 (0.9)	---	3.6 (1.1)	5.4 (2.1)
	1987	1.1 (0.7)	0.8 (0.0)	8.0 (3.5)	3.1 (1.4)	---	21.9 (8.0)	6.3 (2.4)
	1979	0.0 (0.0)	1.1 (0.7)	4.0 (2.8)	2.9 (1.0)	---	5.6 (2.8)	6.3 (4.8)
	1975	0.0 (0.0)	4.7 (2.0)	5.0 (4.0)	2.9 (1.8)	---	2.1 (1.4)	6.5 (4.1)

Table 3 continued.

Smallmouth Bass	2013	---	2.9 (1.8)	16.2 (8.8)	10.5 (3.9)	8.1 (6.9)	4.2 (1.9)	6.8 (6.5)
	2009	1.5 (0.6)	0.0 (0.0)	0.4 (0.4)	2.0 (1.5)	5.0 (2.1)	3.8 (2.1)	1.2 (1.2)
	2006	0.5 (0.5)	4.0 (2.0)	5.0 (1.7)	13.8 (4.6)	16.5 (5.7)	2.5 (1.6)	1.2 (1.2) [b]
	2002	0.0 (0.0)	1.1 (0.7)	4.2 (2.9)	4.5 (1.4)	4.5 (1.8)	2.5 (2.0)	0.8 (0.4)
	1995	0.0 (0.0)	3.1 (3.1)	3.5 (2.0)	8.1 (2.8)	---	5.9 (4.5)	2.5 (1.0)
	1987	0.6 (0.3)	2.1 (1.2)	15.5 (10.6)	7.9 (5.3)	---	2.3 (0.4)	0.2 (0.1)
	1979	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.3 (0.3)	---	0.0 (0.0)	0.6 (0.4)
	1975	0.0 (0.0)	0.0 (0.0)	0.3 (0.2)	1.8 (1.2)	---	0.0 (0.0)	1.4 (1.1)
Cisco	2013	---	0.4 (0.4)	2.5 (1.3)	2.1 (1.5)	6.9 (6.9)	16.7 (12.8)	1.0 (0.7)
	2009	0.0 (0.0)	2.1 (1.5)	0.0 (0.0)	0.0 (0.0)	2.0 (0.9)	14.2 (7.0)	34.0 (16.8)
	2006	0.0 (0.0)	0.5 (0.5)	0.8 (0.5)	0.0 (0.0)	0.5 (0.5)	22.0 (9.4)	0.0 (0.0) [b]
	2002	0.5 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	3.2 (1.2)
	1995	0.0 (0.0)	13.4 (5.9)	3.5 (3.2)	0.0 (0.0)	---	11.7 (9.3)	19.2 (9.8)
	1987	0.0 (0.0)	0.8 (0.8)	3.3 (2.9)	0.8 (0.6)	---	1.2 (1.0)	54.0 (21.1)
	1979	0.0 (0.0)	3.1 (3.1)	0.0 (0.0)	0.0 (0.0)	---	62.7 (62.4)	39.8 (23.8)
	1975	0.0 (0.0)	9.2 (8.3)	0.0 (0.0)	0.1 (0.1)	---	42.5 (17.8)	23.0 (11.7)

[a] Means from these areas included some efforts of 3.51 c, (1.5 in.) mesh. While compensated for in the calculation of CPUE, the influence of the smaller mesh may have slightly inflated the mean for certain species such as Yellow Perch.

[b] Potagannissing Bay mean CPUE values for 2006 reflect only two net sets via the traditional mesh sizes and was probably under-sampled for the purpose of this reach specific analysis.

Table 4. Mean Catch-Per-Unit-of-Effort (CPUE) of all species collected from the St. Marys River in 2002 - 2013 with all ten mesh sizes included (Expanded mesh) and from the traditional mesh (4 mesh sizes). Means are based number per 304.8 m (1000 ft) of gillnet with standard error of the mean in parentheses. There were 44 total nets set in 2002, 42 in 2006, 44 in 2009, and 39 in 2013. The traditional mesh CPUE values in 2006 reflect a sample size of 34 net sets.

Species[a]	2002		2006		2009		2013	
	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh
Alewife	10.61 (7.84)	0.11 (0.11)	1.12 (0.73)	0.00 (0.00)	0.23 (0.16)	0.06 (0.06)	1.61 (0.72)	0.39 (0.18)
Atlantic Salmon	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.03 (0.03)	0.07 (0.07)
Black Crappie	0.00 (0.00)	0.00 (0.00)	0.02 (0.02)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.26 (0.15)	0.26 (0.13)
Bloater	0.02 (0.02)	0.28 (0.21)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Bowfin	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Brook Trout	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Brown Bullhead	2.59 (1.21)	0.06 (0.06)	2.79 (1.13)	3.38 (1.69)	1.89 (1.30)	0.06 (0.06)	3.11 (2.16)	0.00 (0.00)
Brown Trout	0.02 (0.02)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Burbot	0.09 (0.04)	0.34 (0.17)	0.07 (0.05)	0.00 (0.00)	0.16 (0.06)	0.17 (0.10)	0.24 (0.17)	0.20 (0.15)
Carp	0.05 (0.03)	0.00 (0.00)	0.19 (0.12)	0.07 (0.07)	0.00 (0.00)	0.00 (0.00)	0.05 (0.05)	0.07 (0.07)
Channel Catfish	0.02 (0.02)	0.06 (0.06)	0.31 (0.20)	0.15 (0.15)	0.11 (0.08)	0.00 (0.00)	0.13 (0.07)	0.13 (0.13)
Chinook Salmon	0.64 (0.21)	0.00 (0.00)	0.29 (0.16)	0.10 (0.08)	0.05 (0.03)	0.06 (0.06)	0.11 (0.06)	0.20 (0.11)
Cisco	2.84 (1.35)	0.80 (0.34)	3.62 (1.50)	3.53 (1.84)	6.64 (2.47)	10.23 (4.31)	2.71 (1.51)	4.08 (2.21)
Coho Salmon	0.00 (0.00)	0.00 (0.00)	0.02 (0.02)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.03 (0.03)	0.00 (0.00)
Freshwater Drum	0.43 (0.18)	0.06 (0.06)	1.12 (0.35)	0.59 (0.24)	0.41 (0.15)	0.17 (0.10)	0.37 (0.11)	0.07 (0.07)
Gizzard Shad	0.09 (0.09)	0.40 (0.21)	0.02 (0.02)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.03 (0.03)	0.07 (0.07)
Lake Trout	0.00 (0.00)	0.00 (0.00)	0.14 (0.09)	0.07 (0.07)	0.16 (0.14)	0.17 (0.17)	0.05 (0.05)	0.07 (0.07)
Lake Whitefish	0.77 (0.35)	0.06 (0.06)	0.50 (0.20)	0.29 (0.18)	1.48 (0.66)	2.33 (1.13)	0.42 (0.27)	0.46 (0.21)
Largemouth Bass	0.00 (0.00)	0.00 (0.00)	0.02 (0.02)	0.07 (0.07)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Longnose gar	0.02 (0.02)	3.92 (3.52)	0.07 (0.05)	0.07 (0.07)	0.00 (0.00)	0.00 (0.00)	0.11(0.08)	0.07 (0.07)
Longnose Sucker	1.20 (0.56)	2.10 (1.01)	1.29 (0.59)	1.99 (1.26)	1.61 (0.66)	2.61 (1.15)	0.18 (0.14)	0.13 (0.09)
Menominee	0.36 (0.15)	0.06 (0.06)	0.86 (0.54)	0.18 (0.11)	1.75 (0.89)	3.35 (1.80)	0.45 (0.35)	0.92 (0.79)
Muskellunge	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.03 (0.03)	0.00 (0.00)
Northern Hogsucker	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)

Table 4 continued.

Northern Pike	1.55 (0.33)	4.43 (2.28)	1.69 (0.40)	3.82 (0.81)	1.82 (0.37)	3.01 (0.75)	2.66 (0.65)	5.13 (1.29)
Pink Salmon	0.39 (0.22)	0.00 (0.00)	0.14 (0.07)	0.22 (0.12)	0.02 (0.02)	0.06 (0.06)	0.00 (0.00)	0.13 (0.09)
Rainbow Smelt	0.25 (0.11)	2.61 (0.61)	1.40 (0.51)	0.44 (0.22)	0.84 (0.49)	1.65 (1.14)	1.18 (0.72)	1.51 (1.06)
Rainbow Trout	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Redhorse spp.	0.53 (0.27)	0.40 (0.29)	0.93 (0.28)	1.25 (0.41)	3.07 (1.32)	3.30 (1.21)	0.34 (0.15)	0.46 (0.28)
Rock Bass	5.95 (1.45)	11.42 (2.77)	5.81 (1.32)	14.34 (3.66)	4.14 (1.03)	7.84 (1.96)	7.50 (2.06)	12.57 (3.56)
Sculpin	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Sea lamprey	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.02 (0.02)	0.06 (0.06)	0.00 (0.00)	0.00 (0.00)
Smallmouth Bass	1.48 (0.30)	2.27 (0.59)	4.36 (1.21)	6.32 (1.76)	1.73 (0.45)	1.82 (0.53)	6.63 (2.36)	7.76 (2.36)
Splake	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Sturgeon spp.	0.02 (0.02)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.11 (0.09)	0.00 (0.00)	0.13 (0.11)	0.07 (0.07)
Sunfish spp.	0.41 (0.23)	0.97 (0.56)	0.26 (0.22)	0.66 (0.66)	0.39 (0.21)	0.85 (0.53)	0.05 (0.04)	0.00 (0.00)
Trout-Perch	0.05 (0.03)	0.34 (0.17)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Walleye	2.55 (0.65)	3.58 (1.04)	6.07 (1.35)	11.18 (2.97)	4.89 (1.09)	6.02 (1.29)	7.58 (1.81)	11.25 (2.88)
White Bass	0.02 (0.02)	0.85 (0.41)	0.02 (0.02)	0.07 (0.07)	0.30 (0.19)	0.23 (0.23)	0.11 (0.08)	0.20 (0.15)
White crappie	0.02 (0.02)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
White Sucker	18.80 (2.09)	24.77 (3.93)	17.88 (2.47)	17.65 (2.52)	18.07 (2.84)	23.07 (3.70)	17.39 (3.53)	20.39 (3.84)
White Perch	0.16 (0.09)	4.38 (2.51)	0.50 (0.22)	0.74 (0.42)	0.05 (0.05)	0.00 (0.00)	0.26 (0.10)	0.39 (0.20)
Yellow Perch	23.43 (4.25)	25.34 (4.50)	39.92 (7.15)	37.21 (8.94)	37.20 (7.03)	35.34 (7.62)	48.11(12.18)	41.71 (14.95)

Table 5. Catch-per-unit-of-effort (CPUE) of Cisco by age 2013 and mean length-at-age at capture for the St. Marys River, August - September, 1995-2013. For comparison, mean length-at-age is included from past surveys and the Michigan state average length-at-age[1] as well as the Ontario Lake Huron 2006 North Channel (ON NC) average[2]. Unit of effort is one 304.8 m gillnet set. Growth index[1] compares length-at-age to state average and the 2013 year to the NC average. It excludes age groups represented by less than 5 specimens. All lengths and the growth index are in mm. CPUE values by age may omit some un-aged fish and therefore may not total to the overall CPUE for this species as reported in Table 4.

	Age													Mean	Mean	Growth
Parameter	0	1	2	3	4	5	6	7	8	9	10	11	12	13	age	length	index
Number		9	24	11	9	6	13	9	5	7	4	2					
CPUE		0.2	0.6	0.3	0.2	0.2	0.3	0.2	0.1	0.2	0.1	<0.1					
Frequency (%)		9.1	24.2	11.1	9.1	6.1	13.1	9.1	5.1	7.1	4.0	2.0					
Mean length																	
2013		196	249	272	269	293	314	351	390						4.7	292	-15
2009		207	260	343	366	379	382	398	404						3.7	316	+41
2006		213	232	281	326		378	386	377						3.2	280	+8
2002		199	240	306	338	374	383	412	416						3.1	292	+26
1995		200	265	330	289	327	379	399	401	412	446						+16
MI average		214	241	267	294	321	347	374	400								
ON NC 2006 average			265	263	329	292	358	377	372	388	372	390	374	393			-17

[1]From Schneider et al. (2000)
[2]Ontario MNR, unpublished data

Table 6. Catch-per-unit-of-effort (CPUE) of Yellow Perch by age for 2013 and mean length-at-age at capture for the St. Marys River, August-September, 1979-2013. For comparison, mean length-at-age is included from past surveys and the Michigan state average length-at-age[1] as well as the Ontario Lake Huron 2006 North Channel average[2] (ON NC). Unit of effort is one 304.8 m gillnet set. Growth index[1] compares length-at-age to Michigan state average and the 2013 year to the North Channel average. It excludes age groups represented by less than 5 specimens. All lengths and the growth indexes are in mm. CPUE values by age may omit some un-aged fish and therefore may not total to the overall CPUE for this species as reported in Table 4.

Parameter & Area	Age 1	2	3	4	5	6	7	8	9	10	Mean age	Mean length	Growth index
Upper River													
Number	---	---	---	---	---	---	---	---	---	---			
CPUE	---	---	---	---	---	---	---	---	---	---			
Frequency (%)	---	---	---	---	---	---	---	---	---	---			
Mean length													
2013	---	---	---	---	---	---	---	---	---	---			
2009		149	195	210							3.1	188	+1
2006	159	186	241	251							2.7	219	+40
2002	146	170	222	251	343		361		373	372	3.0	212	+28
1995		157	184	200	225	244	269	280	298	354			-7
1987				201	216	224	254	264	305	312			-20
1979			183	201	216	259	272	302	295				-6
MI average	127	160	183	208	234	257	277	292	302				---
ON NC 2006	124	173	211	235	243	248	256	276		290			---
Lake Nicolet													
Number		17	45	5	4	4	2	1					
CPUE		2.8	7.5	0.8	0.7	0.7	0.3	0.2					
Frequency (%)		21.8	57.7	6.4	5.1	5.1	2.6	1.3					
Mean length													
2013		150	170	191							3.3	181	-13
2009		153	171	202							3.3	181	-8
2006	143	164	205	235							2.6	188	+17
2002		148	162	197	238	239	328				3.3	177	-10
1995	170	147	172	209	227	250	275	284					-7
1987				196	221	231	287	295					-7
1979			168	185	221	208	244						-18
MI average	127	160	183	208	234	257	277	292	302				
ON NC 2006	124	173	211	235	243	248	256	276		290			-36

Table 6. Continued.

Parameter & Area	Age 1	2	3	4	5	6	7	8	9	10	Mean age	Mean length	Growth index
Lake George													
Number		28	106	35	10	9	9	5					
CPUE		5.6	21.2	7.0	2.0	1.8	1.8	1.0					
Frequency (%)		13.9	52.5	17.3	5.0	4.5	4.5	2.5					
Mean length													
2013		151	171	204	280	291	286	287			3.6	170	+8
2009		148	173	217	263	286					3.5	182	+9
2006	156	172	207	246	246	272					2.3	188	+22
2002	155	153	194	222	269	311	318	315			2.8	185	+12
1995		148	169	206	233	247	242	263	256				-15
1987				198	216	256	264	302	323				-10
1979			173	190	203	249	282	282		297			-12
MI average	127	160	183	208	234	257	277	292	302				
ON NC 2006	124	173	211	235	243	248	256	276		290			+4
St. Joseph Channel													
Number		13	35	5	5	2	5	3					
CPUE		2.6	7.0	1.0	1.0	0.4	1.0	0.6					
Frequency (%)		19.1	51.5	7.4	7.4	2.9	7.4	4.4					
Mean length													
2013		148	157	158	183		231				3.6	167	-37
2009		148	153	165	178	190					3.7	162	-42
2006	149	155	174	194	212	283					2.9	167	+0
2002		147	167	217	259	293					3.2	183	+8
1995													
1987													
1979													
MI average	127	160	183	208	234	257	277	292	302				
ON NC 2006	124	173	211	235	243	248	256	276		290			-48

Table 6. Continued.

Parameter & Area	Age 1	2	3	4	5	6	7	8	9	10	Mean age	Mean length	Growth index
Lake Munuscong													
Number		35	53	27	9	3							
CPUE		5.8	8.8	4.5	1.5	0.5							
Frequency (%)		27.6	41.7	21.3	2.4								
Mean length													
2013		155	177	194	231						3.2	166	-7
2009		142	172	209	265						3.3	184	+1
2006	155	182	227								2.5	205	+31
2002	153	146	180	208	230		275				2.6	1.66	-6
1995		145	177	213	229	239	256	292	278				-11
1987				196	226	279	292	325					+10
1979		203	193	216	239	284	254						+9
MI average	127	160	183	208	234	257	277	292	302				
ON NC 2006	124	173	211	235	243	248	256	276		290			-26
Raber Bay													
Number		26	57	13	6	2							
CPUE		5.2	11.4	2.6	1.2	0.4							
Frequency (%)		25.0	54.8	12.5	5.8	1.9							
Mean length													
2013		158	194	238	261						3.0	188	+17
2009													
2006	157	182	207	223	244	273					3.1	204	+20
2002		152	175	203	246	268					3.3	185	-2
1995	137	152	202	227	236	260	268	269					+4
1987			165	188	231	251	277	297	307	315			-9
1979		185	196	221	272	262							+17
MI average	127	160	183	208	234	257	277	292	302				
ON NC 2006	124	173	211	235	243	248	256	276		290			-3

Table 6. Continued.

Parameter & Area	Age 1	2	3	4	5	6	7	8	9	10	Mean age	Mean length	Growth index
Potagannissing Bay													
Number		110	97	20	4	2	2	1	3				
CPUE		15.7	13.9	2.9	0.6	0.3	0.3	0.1	0.4				
Frequency (%)		46.0	40.6	8.4	1.7	0.8	0.8	0.4	1.3				
Mean length													
2013		160	220	230							2.8	190	+20
2009		152	177	204	239	326					4.6	175	+11
2006	143	181	229	263							2.4	202	+37
2002	157	172	196	247	297	175					2.6	189	+32
1995	133	158	167	208	215	243	275	290					-6
1987					231	262	272	307		330			-1
1979			201	224	249	269	302	323	282				+20
MI average	127	160	183	208	234	257	277	292	302				
ON NC 2006	124	173	211	235	243	248	256	276		290			-3
River-wide													
Number		229	393	105	38	22	18	10	3				
CPUE		6.5	11.2	3.0	1.1	0.6	0.5	0.3	0.1				
Frequency (%)		28.0	48.0	12.8	4.6	2.7	2.2	1.2	0.4				
Mean length													
2013		156	186	208	249	275	280	281					+3
2009		150	172	204	237	251							-6
2006		155	174	220	236	246	280	290					-1
2002	151	153	177	220	258	274	320	315	373	372	3.0	184	+15
1995	140	152	171	211	227	246	260	278	294	354			-7
1987			165	195	223	244	273	296	308	319			-6
1979		196	196	209	229	264	285	302	291	297			+7
MI average	127	160	183	208	234	257	277	292	302				
ON NC 2006	124	173	211	235	243	248	256	276		290			-1

[1]From Schneider et al. (2000)
[2]Ontario MNR, unpublished data

Table 7. Comparison of total annual mortality (A) rates for select fish species in the St. Marys River, computed from fish collected in experimental mesh gillnets 1995-2013.

Species	Area, if not total for the river	1995 total annual mortality	2002 total annual mortality	2006 total annual mortality	2009 total annual mortality	2013 total annual mortality
Yellow Perch	Upper River	0.25	0.54	0.70	0.63	Not sampled
	Lake Nicolet	0.38	0.70	0.59	---	0.61
	Lake George	0.40	0.52	0.43	0.69	0.55
	St. Joseph Channel	Not sampled	0.64	0.50	---	0.71
	Lake Munuscong	0.41	0.61	0.78	0.62	0.63
	Raber Bay	0.44	0.63	0.49	---	0.71
	Potagannissing Bay	0.60	0.57	0.96	0.67	0.55
	River Total	0.38	0.68	0.70	0.64	0.60
Northern Pike		0.58	0.52	0.61	0.72	0.52
Walleye		0.51	0.49	0.38	0.38	0.32
Cisco		0.31	0.39	0.40	0.48	0.25
Smallmouth Bass		0.36	0.37	0.55	0.50	0.35

Table 8. Catch-per-unit-of-effort (CPUE) of Walleye by age for 2013 and mean length-at-age at capture for the St. Marys River, August-September, 1979-2013. For comparison, mean length-at-age is included from past surveys and the Michigan state average length-at-age[1] as well as the Ontario Lake Huron 2006 North Channel (ON NC) average[2]. Unit of effort is one 304.8 m gillnet set. Growth index[1] compares length-at-age to state average and the 2013 year to the NC average. It excludes age groups represented by less than 5 specimens. All lengths and the growth index are in mm. CPUE values by age may omit some un-aged fish and therefore may not total to the overall CPUE for this species as reported in Table 4.

	Age														Mean	Mean	Growth
Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	age	length	index
Number	34	84	23	31	9	12	18	14	4	6	4	3	3	1			
CPUE	1.1	2.6	0.7	1.0	0.3	0.4	0.6	0.4	0.1	0.2	0.1	0.1	0.1	<0.1			
Frequency (%)	13.7	33.9	9.3	12.5	3.6	4.8	7.3	5.6	1.6	2.4	1.6	1.2	1.2	0.4			
Mean length																	
2013	253	335	420	450	450	513	531	576		592					4.0	408	+3
2009		309	394	439	485	529	536	576		592					4.5	440	+2
2006	287	363	391	416	483	520		561							3.0	383	+9
2002	253	312	393	472	530	421	563	552		590	578	660	571	614	4.0	434	+15
1995	209	271	278	363	489	502	560	611		604							-26
1987	240	288	347	407	464	505	549	585	607	660							-17
1979		307	378	447	472	528	513	538									-27
MI average	250	338	386	437	472	516	541	561	582								
ON NC 2006 average		381	410	471	511	538		635		658							-35

[1]From Schneider et al. (2000)
[2]Ontario MNR, unpublished data

Table 9. Catch-per-unit-of-effort (CPUE) of Northern Pike by age 2013 and mean length-at-age at capture for the St. Marys River, August - September, 1987-2013. For comparison, mean length-at-age is included from past surveys and the Michigan state average length-at-age[1] as well as the Ontario Lake Huron North Channel (ON NC) average[2]. Unit of effort is one 304.8 m gillnet set. Growth index[1] compares length-at-age to state average and the 2013 year to the NC average. It excludes age groups represented by less than 5 specimens. All lengths and the growth index are in mm. CPUE values by age may omit some un-aged fish and therefore may not total to the overall CPUE for this species as reported in Table 4.

	Age																
Parameter	0	1	2	3	4	5	6	7	8	9	10	11	12	13	Mean age	Mean length	Growth index
Number		1	15	25	18	20	12	2	1		3						
CPUE		<0.1	0.4	0.7	0.5	0.6	0.3	<0.1	<0.1		0.1						
Frequency (%)		1.0	15.5	25.8	18.6	20.6	12.4	2.1	1.0		3.1						
Mean length																	
2013			455	525	598	610	685								4.1	583	-53
2009		287	436	520	619										3.0	543	-71
2006	269	429	528	601	642										1.8	491	+13
2002	250	371	455	564	620	669									2.4	477	-34
1995		399	465	538	605	621	722	918		1033							-39
1987		407	468	515	575	672	726	752	754								-39
MI average		422	511	579	635	683	732	780									
ON NC 2002 average		377	483	580	657	749	706										-60

[1]From Schneider et al. (2000)

[2]Ontario MNR, unpublished data

Table 10. Catch-per-unit-of-effort (CPUE) of Smallmouth Bass by age 2013 and mean length-at-age at capture for the St. Marys River, August - September, 1987-2013. For comparison, mean length-at-age is included from past surveys and the Michigan state average length-at-age[1] as well as the Ontario Lake Huron North Channel (ON NC) average[2]. Unit of effort is one 304.8 m gillnet set. Growth index[1] compares length-at-age to state average and excludes age groups represented by less than 5 specimens. All lengths and the growth index are in mm. CPUE values by age may omit some un-aged fish and therefore may not total to the overall CPUE for this species as reported in Table 4.

	Age													Mean	Mean	Growth
Parameter	0	1	2	3	4	5	6	7	8	9	10	11	12	13	age	length	index
Number		9	31	66	43	34	24	11	18	8	1	1					
CPUE		0.2	0.9	1.9	1.2	1.0	0.7	0.3	0.5	0.2	<1.0	<1.0					
Frequency (%)		3.7	12.6	26.8	17.5	13.8	9.8	4.5	7.3	3.3	0.4	0.4					
Mean length																	
2013		148	234	276	349	385	420	430	445	463					4.4	335	-11
2009				271	300	344	363								4.5	313	-44
2006		171	251	282	315	371		391							3.0	273	-18
2002		146	187	222	291	325	376	398	457			457			4.1	281	-61
1995		145		245	263	278	305	340	359								-99
1987				234	268	330	347	371									-72
MI average		178	257	305	356	386	406	434	452	475							
ON NC 2003 average		128	161	175	256	291	240										+94

[1]From Schneider et al. (2000)

[2]Ontario MNR, unpublished data

Table 11. Maturity schedule for five notable species expressed as percent maturity of females by length in the St. Marys River. Fish used in the analysis were collected by gillnets in August - September 2013.

	Species				
Length (cm)	Walleye	Smallmouth Bass	Northern Pike	Yellow Perch	Cisco
13	---	---	---	100	---
14	---	---	---	23	---
15	---	---	---	14	---
16	---	---	---	12	---
17	---	---	---	27	---
18	---	---	---	51	50
19	0	---	---	80	0
20	0	0	---	81	0
21	0	0	---	85	100
22	0	100	---	96	50
23	0	0	---	100	0
24	0	0	---	100	75
25	0	67	---	100	75
26	0	100	---	100	22
27	0	50	---	94	20
28	0	033	---	100	33
29	0	50	---	100	100
30	17	0	---	100	67
31	0	25	---	100	100
32	0	67	---	100	100
33	0	50	---	100	100
34	0	83	---	100	100
35	0	75	---	100	100
36	33	80	---	100	100
37	0	88	---	100	100
38	0	100	---	100	100
39	0	100	---	100	100
40	0	100	---	---	100
41	0	100	---	---	100
42	50	100	0	---	100
43	60	100	0	---	---
44	0	100	0	---	---
45	67	100	0	---	---
46	100	100	0	---	---
47	100	100	0	---	---

Table 11. Continued.

	Species				
Length (cm)	Walleye	Smallmouth Bass	Northern Pike	Yellow Perch	Cisco
48	100	100	0	---	---
49	100	100	50	---	---
50	100	100	---	---	---
51	100	---	100	---	---
52	100	---	67	---	---
53	100	---	100	---	---
54	100	---	50	---	---
55	100	---	100	---	---
56	100	---	100	---	---
57	100	---	100	---	---
58	100	---	100	---	---
59	100	---	100	---	---
60	100	---	100	---	---
61	100	---	100	---	---
62	100	---	100	---	---
63	100	---	100	---	---
64	100	---	100	---	---
65	100	---	100	---	---
66	100	---	100	---	---
67	100	---	50	---	---
68	100	---	100	---	---

Table 12. Incidence and proportion of occurrence of food items (based on stomach content identification) for select species from the St. Marys River, August – September 2013.

	Walleye	Northern Pike	Smallmouth Bass	Yellow Perch
Incidence				
No. stomachs examined	285	100	245	1238
% void	74.7	70.0	53.1	56.0
Percent of Occurrence				
Unidentified fish remains	60.0	64.7	35.8	23.0
Crayfish	1.2	11.8	54.9	9.1
Alewife	8.1	2.9	---	0.3
Rainbow Smelt	11.8	---	---	---
Mayfly	---	---	---	11.4
Gizzard shad	---	---	---	---
Unidentified zooplankton	---	---	---	6.7
Spiny water flea	---	---	---	---
Dragon fly	---	---	---	---
Yellow Perch	1.2	2.9	0.6	---
Cisco	---	---	---	---
Slimy sculpin	---	2.9	---	---
Johnny darter	---	---	---	---
Unidentified terrestrial insects	---	---	0.6	8.8
Ninespine stickleback	---	---	---	18.2
Threespine stickleback	11.8	2.9	1.1	1.0
Snails	---	2.9	0.6	6.7
White sucker	---	2.9	---	---
Round Goby	5.6	2.9	3.5	7.0
Other	---	---	2.9	---

Table 13. Mean relative weight of select species, by area and river wide, for the St. Marys River, August - September 2013; River wide total values for 1995-2009 are presented for comparison.

Location	Walleye	Yellow Perch	Smallmouth Bass	Northern Pike	Cisco
Upper River	---	---	---	---	---
Lake Nicolet	55	93	105	96	105
Lake George	57	100	101	95	90
Lake Munuscong	57	90	104	94	---
St. Joseph Channel	57	84	101	90	81
Raber Bay	53	96	101	93	87
Potagannissing Bay	56	95	106	98	87
River wide 2013	56	96	103	94	87
River wide 2009	57	90	112	101	91
River wide 2006	87	91	109	94	84
River wide 2002	90	94	106	87	89
River wide 1995	102	97	106	91	---

Table 14. Percent of sea lamprey wounds by species exhibiting wounding from the St. Marys River, August - September 2013. N denotes sample size of specimens examined for wounds. Wounds scored according to King and Edsall (1979).

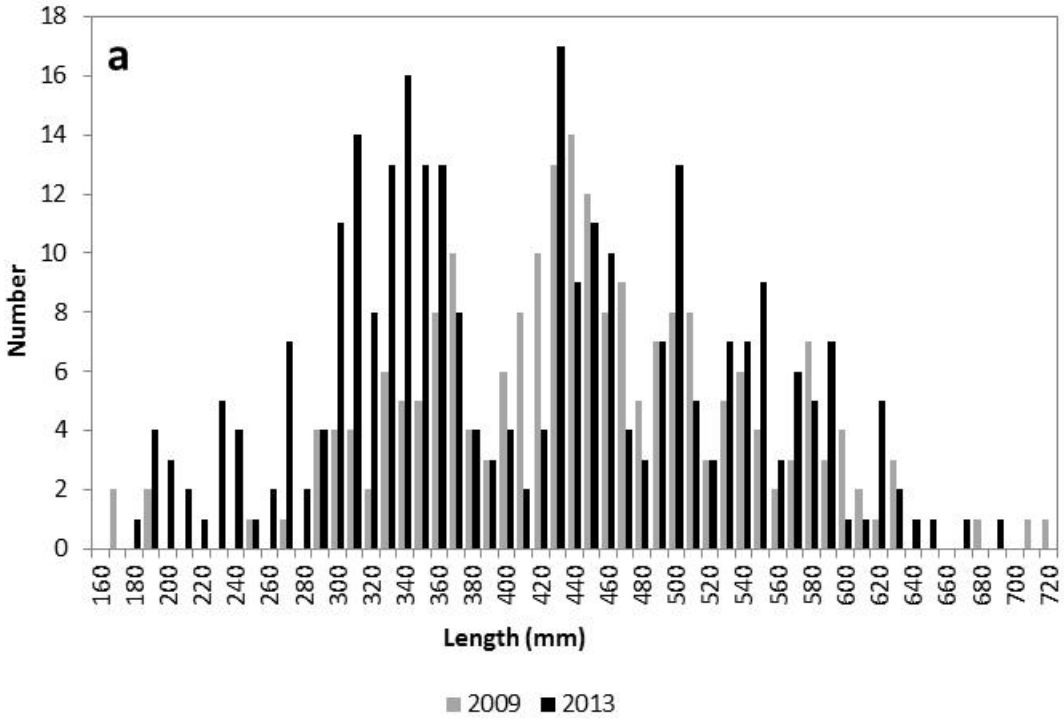
Species	N	A1	A2	A3	A4	B1	B2	B3	B4	Total
Walleye	288	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow Perch	1828	0.0	<0.1	0.0	<0.1	0.0	0.0	0.0	0.0	<0.1
Cisco	103	2.9	1.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9
Lake whitefish	17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northern Pike	101	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
White sucker	661	0.2	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.4
Rock bass	285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 1. Common and scientific names of fishes and other aquatic organisms mentioned in this report.

Common name	Scientific name
Alewife	*Alosa pseudoharengus*
Atlantic Salmon	*Salmo salar*
Black Crappie	*Pomoxis nigromaculatus*
Bloater	*Coregonus hoyi*
Bowfin	*Amia calva*
Brook Trout	*Salvelinus fontinalis*
Brown Bullhead	*Ictalurus nebulosus*
Brown Trout	*Salmo trutta*
Burbot	*Lota lota*
Carp	*Cyprinus carpio*
Channel Catfish	*Ictalurus punctatus*
Chinook Salmon	*Oncorhynchus tshawytscha*
Cisco	*Coregonus artedii*
Coho Salmon	*Oncorhynchus kisutch*
Eurasian Ruffe	*Gymnouphalus cernuus*
Freshwater Drum	*Aplodinotus grunniens*
Gizzard Shad	*Dorosoma cepedianum*
Johnny Darter	*Etheostoma nigrum*
Lake Sturgeon	*Acipenser fulvescens*
Lake Trout	*Salvelinus namaycusn*
Lake Whitefish	*Coregonus clupeaformis*
Largemouth Bass	*Micropterus salmoides*
Longnose Gar	*Lepisosteus osseus*
Longnose Sucker	*Catostomus catostomus*
Menominee	*Prosopium cylindraceum*
Northern Hogsucker	*Hypentelium nigricans*
Northern Pike	*Esox lucius*
Pink Salmon	*Oncorhynchus gorbuscha*
Rainbow Smelt	*Osmerus mordax*
Rainbow Trout	*Oncorhyhus mykiss*
Redhorse spp.	*Moxostoma spp.*
Rock Bass	*Ambloplites rupestris*
Round Goby	*Neogobius melanostomus*
Sculpin	*Cottus bairdi*
Sea Lamprey	*Petromyzon marinus*
Smallmouth Bass	*Micropterus dolomievi*
Splake	*S. fontinalis x S. namaycusn*
Sunfish spp.	*Lepomis spp.*
Muskellunge	*Esox masquinongy*
Trout-Perch	*Percopsis omiscomaycus*
Walleye	*Sander vitreus*
White Bass	*Morone chrysops*
White Crappie	*Pomoxis annularis*
White Perch	*Morone americana*
White Sucker	*Catostomus commersoni*
Yellow Perch	*Perca flavescens*

Appendix 2. Length-weight regression equations and von Bertalanffy growth equations for select species from the St. Marys River August – September 2013. Length/weight equation logs are base 10, weight (wt) is in grams, and 1ength (len) is in mm. Von Bertalanffy equations are based on mean length-at-age data where 't' is age in years.

Species	Length/Weight Equation	Len/Wt r^2	Von Bertalanffy Equation	K	$L\infty$	t_o
Walleye	log(wt)=3.171 log(len)-5.493	0.97	$L_t=628[1-e^{-0.2525(t+0.85)}]$	0.2525	628	-0.85
Yellow Perch	log(wt)=3.165 log(1en)-5.277	0.91	$L_t=321[1-e^{-0.2477(t+0.42)}]$	0.2477	321	-0.42
Smallmouth Bass	log(wt)=3.196 log(1en)-5.306	0.99	$L_t=506[1-e^{-0.2625(t+0.33)}]$	0.2625	506	-0.33
Northern Pike	log(wt)=2.912 log(1en)-4.994	0.95	$L_t=876[1-e^{-0.1919(t+1.87)}]$	0.1919	876	-1.87
Cisco	log(wt)=3.297 log(1en)-5.764	0.95	$L_t=436[1-e^{-0.1757(t+1.76)}]$	0.1757	436	-1.76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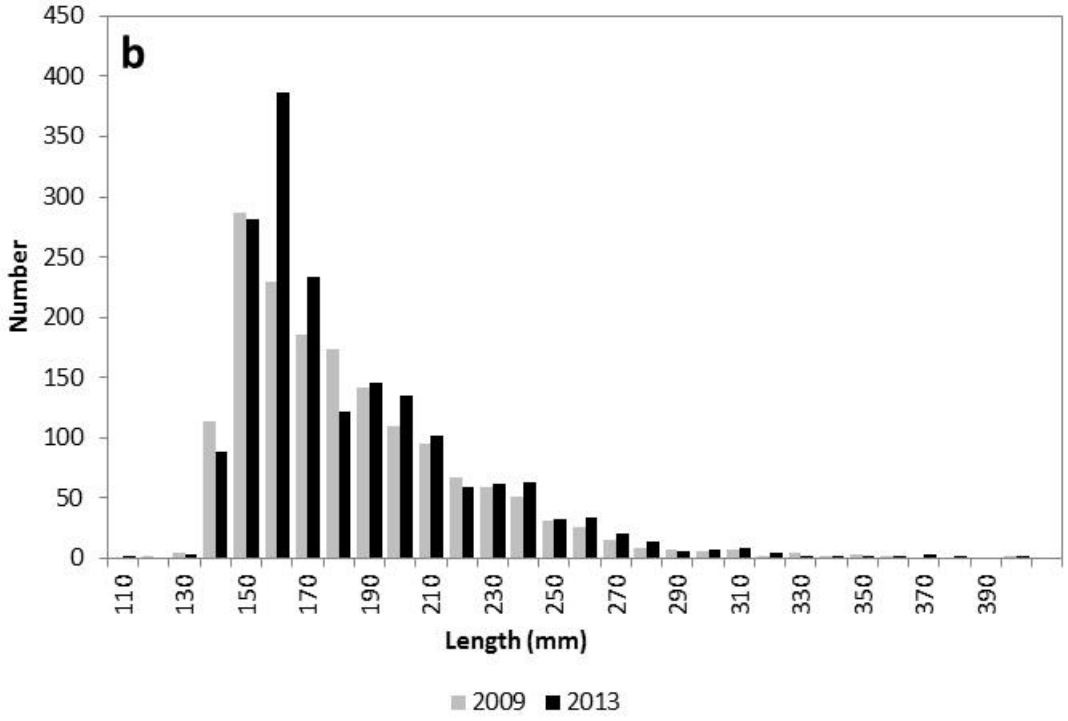
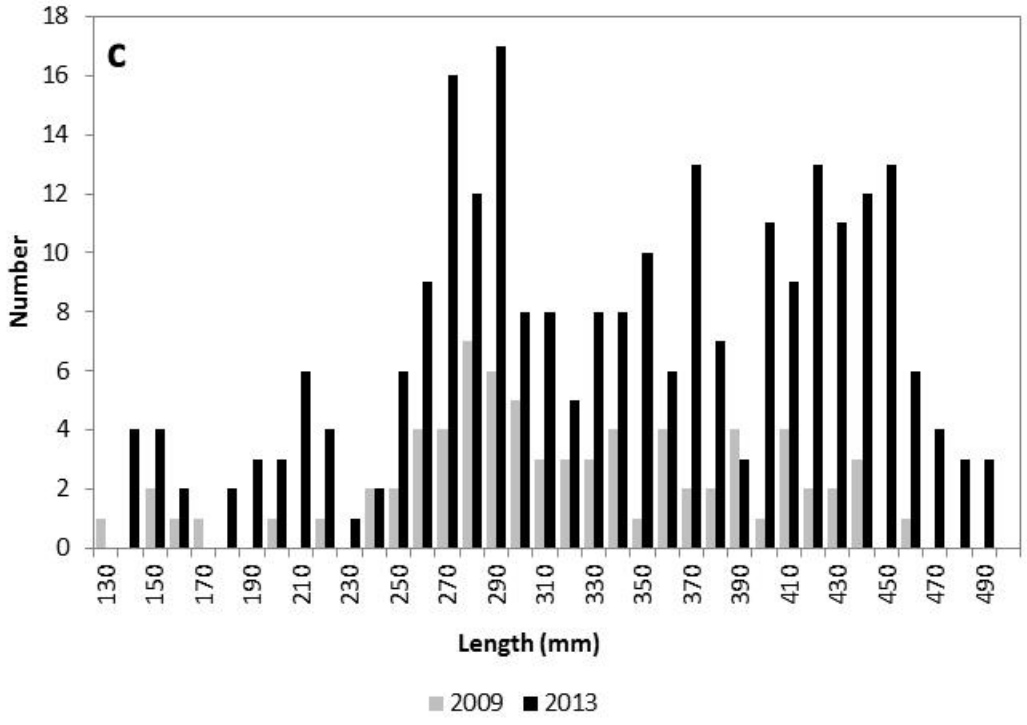
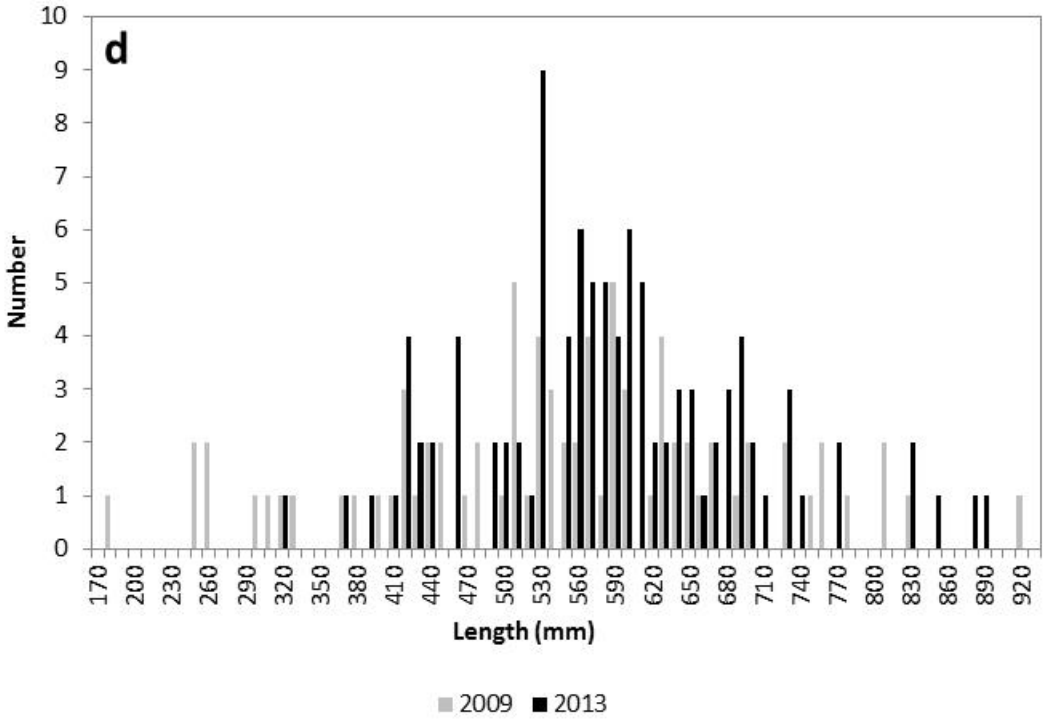
Number
Length (mm)
2009
2013



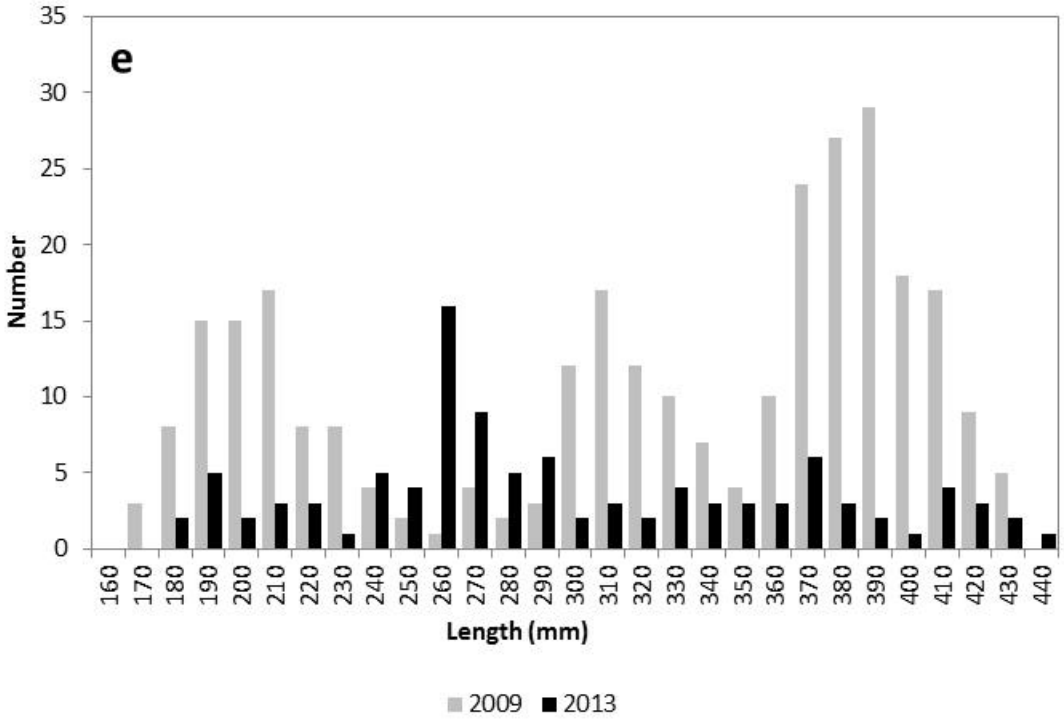
Appendix 3. Length frequencies from survey catch of; (a) Walleye, (b) Yellow Perch, (c) Smallmouth Bass, (d) Northern Pike, and (e) Cisco from the St. Marys River, August and September 2006 .

Appendix 3 continued.


C
Number
Length (mm)
2009
2013



Appendix 3 continued.
Appendix 3 continued.


e
Number
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280
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300
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320
330
340
350
360
370
380
390
400
410
420
430
440
Length (mm)
2009
2013