Population Dynamics of the St. Marys River Fish Community 1975-2017

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Abstract- The St. Marys River fish community was jointly assessed by the member agencies of the St. Marys River Fisheries Task Group under the Great Lakes Fishery Commission in 2017, the 9th such survey since 1975. A gillnet based survey, 44 nets sets each survey year resulted in indices of abundance and population status. Abundance of two cool water species of importance, Walleye and Yellow Perch, were not significantly lower than the 2013 estimates, and have remained stable in the River since 2006. Smallmouth Bass abundance has varied since 2002, with significant peaks in 2006 and 2013. Cisco have maintained stable but lower overall abundance within the River in 2017; however, Northern Pike have continued to increase since 2002, with the highest River abundance reached in 2017. Growth rates, as indicated by length at age at capture, were generally near or below regional averages and may reflect the northern latitude of the St. Marys River. Total annual mortality rates were 59% for Yellow Perch, 49% for Northern Pike, 48% for Smallmouth Bass, 62% for Cisco, and 61% Walleye but were generally deemed within acceptable ranges for these species. Diets varied by species and reflected both piscine prey and invertebrates, especially crayfish. Ruffe were documented for the first time in the Fish Community Survey in 2017, and were reported by anglers in the upper river during the same year. Round gobies continued to be observed in the diets of some predators indicating that they continue to persist 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 cold water from Lake Superior also results in cold water habitat beneficial for salmon and trout species. 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 $8.5 million USD (Godby et al. 2019).

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 to accommodate international shipping traffic (Edsall and Gannon 1993). The River was designated as an Area of Concern in the 1987 Great Lakes Water Quality Agreement (GLWQA, 1987). 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 includes 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 (Fielder 2002). Formed in 1997, representatives of the various management authorities and federal agencies as well as area universities work together for periodic assessment of 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. Four 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 this 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) 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 of which is 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 St. Marys River Fisheries Task Group. They were the Sault Tribe Natural Resources Department (STNRD), Michigan Department of Natural Resources (MDNR), Ontario Ministry of Natural Resources and Forestry (OMNRF), and the United States Fish and Wildlife Service (USFWS). Net set locations were divided throughout the St. Marys River (Figure 1). Data were organized into seven distinct areas based on habitat and geographic regions within the river; Upper River, Lake Nicolet, Lake George, Lake Munuscong, St. Joseph Channel, Raber Bay and Potagannissing Bay (Figure 1, Table 1) for the purpose of some analyses. Many analyses include results from previous surveys for comparison purposes (Schorfhaar 1975; Miller 1981; Grimm 1989; Fielder and Waybrant 1998; Fielder et al. 2004; Fielder et al. 2007; Schaeffer et al. 2011, Schaeffer et al 2016).

The catch from each lift was identified, weighed (round weight) and measured for total length. Five species of special interest, Walleye, Yellow Perch, Smallmouth Bass, Northern Pike, Cisco, had scales or dorsal spines were collected for aging (see Appendix 1 for a complete listing of all the common and scientific names of fishes mentioned in this report). These same species were internally inspected for sex, maturity (according to the methods of Fielder and Waybrant (1998)), and stomach contents. Stomach contents were identified when possible and enumerated. All Walleye stocked into the St. Marys River were marked with oxytetracycline (OTC) prior to release. All collected Walleye otoliths were examined to determine if collected individuals were stocked or wild fish.

Catch-per-unit-of-effort (CPUE) was calculated in two ways: full net; the total number of each species per net lift per 304.8 m of net across all mesh sizes and the second; traditional net; the total number of each species per net lift from four meshes: 50.8 mm, 63.5 mm, 76.2 mm, and 114.3 mm in 122 m net length, which was then extrapolated to 304.8 m. This second method of expressing CPUE allowed a more direct comparison with the pre-2002 surveys ("traditional nets"). The CPUE values of the two different methods were compared for each species to determine if there were differences in CPUE based on the "traditional" and "full" meshes fished. Total species composition was also compared between the two different "nets": full net, comprised of ten individually sized mesh panels vs. the traditional, four individual mesh panels extrapolated to the full net length of 304.8 m. .

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.

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. We assessed the differences in CPUE within and between survey years using non-parametric Kruskal-

Wallis (K-W) tests, with Dunn's post-hoc analysis. 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 using SPSS computer software (SPSS 2001) and R 3.5.0 (R Core Team 2018,), the *ridgeline plots* package (*v.0.5.1*; Wilkie, 2018).

Results

In the 2017 survey, a total of 44 nets were set throughout the river over a 4 week period beginning the end of July through late August (Figure 1, Table 1). A total of 3226 fish representing 30 different species were collected. CPUE was calculated in two ways: traditional and full nets, as described in the Methods section above. For the traditional nets, the catches from four meshes (50.8 mm, 63.5 mm, 76.2 mm and 114.3 mm) were extrapolated to fill the 304.8 m, to match the panels of the historical nets and the length of the full nets (Table 2). For the full nets, CPUE was calculated for each species for the full ten mesh panels (Table 3). Mean CPUE for 2017 was compared (Mann-Whitney) between the two nets types for five species: Northern Pike, Cisco, Walleye, Yellow Perch, and Smallmouth Bass. In 2017, mean CPUE was not significantly different between the full and traditional nets for any of the five species. Mean CPUE between the two net-types for these five species was also compared from 2002 (first year of the full 10 individual mesh size nets) through 2017. Only in 2006, where mean CPUE for Northern Pike was significantly higher for the extrapolated traditional net (M-WU; P=0.013), was there a difference between the two net groups for any of the five species.

While there was no difference between the net types for the five individual species, there was a significant difference in the number of species captured by the two net sets. In 2017, the number of species collected in the full nets was significantly higher (M-WU; P=0.01) than in the traditional nets. This was consistent for 2002, 2006, 2009, and 2013 (M-WU; P<0.001; all years). The full mesh nets also had a higher cumulative species catch and collected five additional species not caught in the traditional nets: Coho Salmon, Creek Chub, Longnose Dace, Muskellunge, and White Crappie (see Appendix 2 for full summary of cumulative net catch by net type). Based on the mean CPUE and catch comparisons between the two nets, main results for individual species and main groups were based on the full nets, unless otherwise indicated.

Individual Species CPUE

Yellow Perch:
Yellow Perch abundance continued to demonstrate an overall stability on a river-wide basis but was down relative to the 2013 survey (Table 3), however, this was not significantly lower (K-W test, P=0.371). When examined by river reach, significant differences in abundance between the reaches were noted (K-W Tests, P=0.005). Yellow Perch abundance declined in 3 reaches and increased in the other 4 (Table 4). There were declines in abundance In the Upper River, Lake Munuscong, and Potagannissing Bay. Yellow Perch abundance in the Upper River was the lowest recorded since the survey began in 1975 with an average CPUE of 6.0 in 2017. Lake Munuscong declined from a mean CPUE of 26.0 in 2013 to 10.5 in 2017, while Potagannissing Bay declined from a historical high mean CPUE of 88.5 in 2013 to 56.2 (Table 4). Lake Nicolet and Raber Bay Yellow Perch abundances were consistent in 2017 with only small increases relative to the 2013 survey. There were larger increases in Lake George where mean CPUE went from 38.3 in 2013 to 50.0 in 2017 and the St. Joseph Channel where mean CPUE went from 6.9 in 2013 to 21.5 in 2017 (Table 4).

Northern Pike:
Northern Pike CPUE has continued to increase since 2002, which was the lowest level measured in the survey series (Table 3). Mean CPUE in 2017 (4.09) was significantly greater (K-W test, P=0.04) than in 2002, 2006 and 2009 (Dunn's Test, P = 0.005, P=0.01, P=0.01, respectively), however, not significantly greater than the 2013 survey mean CPUE (x=2.66) (Dunn's Test, P=0.100). Northern Pike CPUE increased in 2017 in four of the six river reaches (Table 4). Catch was significantly lower in the Upper River (K-W test; P=0.005) compared to lakes Nicolet, George and Munuscong (Dunn's Tests; P=0.013, P=0.028, P<0.001, respectively) and CPUE was significantly lower in Potagannissing Bay compared to Lake Munuscong (M-WU Test, P<0.001). Catches remained similar to the 2013 CPUE in Lake George and Lake Munuscong, with increases in Potagannissing Bay, Raber Bay, and Lake Nicolet in 2017.

Walleye:
Mean CPUE of Walleye (3.41) was lower in 2017 compared to the peak CPUE in 2013 (7.58); however, it was not significantly different (M-WU Test, P=0.483). Walleye CPUE has remained stable since 2006, with an increase from the 2002 survey (2.55) (Table 3). The CPUE in 2002 was significantly lower (K-W test, P=0.015), compared to each of the 2006 – 2017 fishing surveys. Within the fishing locations in the river, mean CPUE was the lowest in Lake Nicolet, however, there was no significant difference between the river locations in 2017 (K-W Test; P=0.124)(Table 4).

Smallmouth Bass:
Smallmouth Bass mean CPUE dropped to 2.84 in 2017, just under half the 6.63 mean CPUE reached in 2013 which was the highest in the time series (Table 3). Smallmouth Bass mean CPUE was variable over the last five surveys (Table 3), with significant differences among the years (K-W test, P=0.001). The peak catches in 2006 and 2013 were significantly greater than catches in 2002, 2009, and 2017. All reaches showed declines in Smallmouth Bass abundance with the exception of the St. Joseph Channel which increased from a mean CPUE of 8.1 in 2013 to 9.0 in 2017 (Table 45). The St. Joseph Channel also had the highest Smallmouth Bass abundance of any reach in 2017. This was a change from 2013 when Lake George had the highest abundance (16.2), which was the highest recorded abundance for any reach in the time series. Overall, the mean CPUE was significantly different between the reaches (K-W Test; P=0.025), with the catches in Lake George, St. Joseph Channel and Raber Bay having the largest abundance (Table 4).

Cisco:
The CPUE of Cisco in the full mesh nets was the second lowest of the time series (mean CPUE = 1.02), however, it was not significantly different over time for 2002 -2017 (K-W test, P=0.831) (Table 3). No Cisco were found in three reaches (Nicolet, Munuscong, and Raber) and Cisco occurred in low abundance in the remaining reaches (Table 4). For the reaches with Cisco, there were no significant differences in the catch CPUE. Early in the time series, the lower most reaches of the St. Marys (Raber and Potagannissing) produced large catches of Cisco, but they have largely been in low abundance since at least 2009.

Other Species:
Mean CPUE was calculated for all of the species collected each year. White Sucker mean CPUE remains high and stable, along with Rock Bass and Brown Bullhead, with no difference among years for the surveys from 2002 through 2017 (K-W tests; P=0.382, P= 0.756, P=0.526) (Table 3). Other species including Lake Whitefish, Burbot, and Menominee have remained stable through the survey years, though at lower CPUEs (K-W tests; P=0.645, P= 0.870, P=0.880)(Table 3).

Aquatic Invasive Species (AIS)

Several AIS were captured during the 2017 survey: Alewife, Rainbow Smelt, White Perch, Sea Lamprey, and new in 2017, Eurasian Ruffe (Table 3). Alewife CPUE has remained stable in all years following their peak CPUE in 2002 (K-W test, P<0.001). Rainbow Smelt and White Perch have remained low and stable in all years (K-W tests, P=0.653, P=0.182), while Ruffe CPUE (0.23) was the first for this survey in the St. Marys River (Table 3).

Species of Concern

A total of 26 Lake Sturgeon were captured in 2017, the highest of any year in the survey series. Mean CPUE was significantly higher in 2017 (0.59) (K-W tests, P<0.001) than any of the other survey years (Table 3). Lake Sturgeon were collected in four of the six netting locations below the Compensating Works: Lake George, Lake Munuscong, Raber and Potagannissing bays, with the majority captured in Lake Munuscong (N=11). Sturgeon ranged in size from 330 mm to 865 mm. The increase in Lake Sturgeon catch in the nets is the highest net CPUE since 1975 (Table 3).

Age, Maturity and Condition

Scales and dorsal spines were collected for aging from Yellow Perch, Walleye, Smallmouth Bass, and Cisco and cleithra for Northern Pike. These fish were also examined for sex, maturity and stomach contents. In addition to aging, walleye otoliths were also collected. These were examined for oxytetracycline marks to determine whether the individual fish was of native or stocked origin.

Yellow Perch:
The 2016 age-1 Yellow Perch year class was not well represented throughout the river, but they may not have fully recruited to the gear yet as has been the case in past surveys. Age-2 fish made up 35% of the Yellow Perch catch river-wide (Table 5). Relative to the MI average the Yellow Perch growth index was +9 in 2017 an increase over the 2013 value of +3 (Table 5).

The total annual mortality rate for Yellow Perch on a river-wide base has been declining since the 2006 survey where it peaked at 0.70 and is down to 0.41 in 2017 (Table 6). Total annual mortality for Yellow Perch declined markedly from 2013 to 2017 in Lake Nicolet, Lake George, and Raber Bay (Table 6). The highest Yellow Perch total annual mortality rate among those reaches that it was calculated for was Lake Munuscong at 0.76 an increase from the 2013 survey mortality rate of 0.63. All size classes in the 2017 maturity schedule for Yellow Perch were above 50% (Table 7). The maturity schedule for Yellow Perch indicates higher proportion of smaller sized females mature relative to the 2013 survey (Chong et al. 2015). Females were fully mature at about 22 cm in total length. Yellow Perch condition, based on mean relative weight, remained high in 2017, similar to the previous years' surveys (Table 8). The condition was lowest in the Yellow Perch caught in the St. Joseph Channel (64) compared with the Yellow Perch from Lake George, where condition was the highest at 102 (Table 8).

Walleye:
Walleye were captured in all age classes 1-14 with the exception of age 10 year class (Table 9). The majority of the fish captured (92%) were in the 1 through 6 age class, with age-2 Walleye having the highest CPUE during the survey (1.98). Mean length-at-age for Walleye in the 2017 survey was slightly below the state of Michigan average. The growth index, which compares length-at-age to the state average, was -1 mm (Table 9). Total annual mortality for walleye in 2017 (39%) stayed fairly consistent with the 2013 (32%) and 2009 (38 %) surveys (Table 6). Walleye maturity began at 34 cm, however full maturity for all fish was not achieved until 49 cm in total length (Table 7). Walleye condition increased in 2017, similar to condition measured in 2006 and

previous surveys, increased from the surveys in 2009 and 2013 (Table 8). Walleye condition was relatively stable across all fishing locations in the St. Marys River in the 2017 surveys (Table 8).

Walleye otoliths were examined for oxytetracycline marks. Otoliths were collected from 118 of the 150 fish caught. Of the 118 fish examined, 41 (34.9%) were from hatchery stock. Hatchery stocked fish were found in every reach except Munuscong Bay. Age-1 had the highest percentage of stocked fish with 54%, followed by age-2 at 38%.

Smallmouth Bass:
Smallmouth Bass were captured in all age classes from one though ten, with a mean age of 4 (Table 10). The majority of the fish captured (91%) were aged 2-6. CPUE was highest for age 3 and age 5 (0.8). Smallmouth Bass growth index was lower than the Michigan State average at -14, however, this growth rate was higher than in previous years (Table 10). Smallmouth Bass total annual mortality increased in 2017 to 0.52 from a value of 0.35 in 2013 (Table 6). The Smallmouth Bass size at 50% maturity was difficult to determine given the variability in the data (Table 7). Female Smallmouth Bass achieved 100% maturity by 30 cm which is slightly below the 36 cm Michigan minimum length limit. Smallmouth Bass continue to exhibit a high condition level (92-108) in the St. Marys River in each of the six fishing locations where they were collected. It has remained stable in all of the river wide surveys since 1995 (Table 8).

Northern Pike:
Northern Pike were found in all age classes from 1 – 10, with the mean age from the catch 4 years (Table 11). CPUE was greatest for age 4 fish (1.0). The majority of fish (90%) were in the age range 2 – 6, with a size range of 445 – 655 cm (Table 11). Northern Pike 2017 (-68) growth index in the St. Marys River as compared to the Michigan Stage average dropped from the index calculated in 2013 (-53) , to the lowest calculated since 2009 (-71). In 2017, overall length-at-age was approximately 68 mm smaller than the Michigan statewide average lengths-at-age for Northern Pike (Table 11). Northern Pike annual mortality remained relatively stable in 2017 compared to the previous years' surveys in 2013, 2002 and 1995, but lower than the rates calculated in 2006 and 2009 (Table 6). Maturity of female Northern Pike was inconsistent until 63 cm in total length (Table 7). Northern Pike condition has remained stable across the years in which the survey has been conducted (Table 8). Condition was highest for Northern Pike sampled from Lake George (97), however, is not much higher than the lowest condition, from the Upper River (85) (Table 8).

Cisco:
Cisco age structure was dominated by the 2016 and 2015 year classes (Table 12) but in all, ten cohorts were represented. Generally Cisco grew faster than the state of Michigan average or the Ontario North Channel average rates (Table 12) and condition as indicated by W_r was within the range previously observed (Table 8). Cisco totally annual mortality was 0.39 in 2017, also within the range observed in previous surveys (Table 6). Female Cisco were consistently mature after 33cm in 2017 (Table 7). Cisco condition has remained stable throughout the survey period (Table 8), but was highest in Lake George when compared with the other three collection locations (Table 8).

Length/Weight Regressions

Length/weight regression equations and Von Bertalanffy growth equations for five notable species are presented in Appendix 3. Length frequency distributions for these species from the survey catch are presented in the Appendix 4 Figures.

Diet

Stomach contents were analyzed for Walleye, Northern Pike, Smallmouth Bass, Yellow Perch, and Cisco. Contents were reported as incidence (percent void and percent with contents) and proportion of occurrence which is the percent of the identified prey items in the total of all prey items consumed by that species (Table 13). The diet of Walleye, at the time of the survey, was dominated by Rainbow Smelt (18.4%), Threespine Stickleback (10.5%) and Cisco at 7.9% (Table 14). Only Walleye were found with Alewife as a food species (5.3%) in the St. Marys River. Crayfish figured prominently in the diet of all other species examined, except Walleye (Table 13). Northern Pike continue to have the most varied diet, with 10 identified fish species utilized as prey (Table 13). Round Goby have become part of the food chain in Walleye (2.6%), Northern Pike (10.2%), and Yellow Perch (7.0%). The proportion of crayfish in the Smallmouth Bass diet declined from 54.9% in 2013 to 36.8% in 2017 coincident with increases in Yellow Perch (13.2%) and Unidentified Insects (15.8%) in their diet (Table 13, Chong et al. 2015). The 2017 diet of Yellow Perch was comparable to previous years (Chong et al. 2015). In 2017, crayfish returned to a great proportion of the diet at 51.1%, similar to the 2006 diet at 60%. This was an increase from the 2013 survey, where by crayfish had fallen to 9.1% of the diet. Almost 94% of the Cisco examined had empty stomachs. For those with food, the identified species were Mayfly and Water Flea each of which comprised 33.3% of the diet. Unidentified fish were the remainder of the stomach contents at 33.3% (Table 13).

Sea Lamprey Wounding

The incidence of Sea Lamprey wounding among all of the species sampled was low (Table 14). Wounds were observed in four species on five different fish. Wounding was only observed on fishes collected from two sampling locations; four fishes in Potagannissing Bay and one in Munuscong Bay, Wounding rates ranged from 0.1% (White Sucker) to 3.8% (Lake Whitefish), however, the overall wounding rate for Cisco was 4.4% (Table 14). Three fish had A wounds (Ebener et al. 2006); White Sucker and Lake Whitefish (A1) and one Cisco (A2), while the remaining two fish, Cisco and Northern Pike each had one B1 wound. The total Cisco wounding rate was slightly higher than the 2017 rate (3.9%) No Sea Lamprey wounds were observed on Walleye, Yellow Perch, or Rock Bass in 2017 (Table 14). When examining the wounding rate based on location capture, wounding rates increased to 0.4% (White Sucker), 1.7% (Northern Pike), 5.3% (Lake Whitefish) and 12.5% (Cisco).

Discussion

Walleye

Walleye fell to the sixth most abundant species (as measured by full mesh net CPUE; Table 3) in the St. Marys River during the 2017 survey with Yellow Perch, White Suckers, Rock Bass, Brown Bullhead, and Northern Pike all having a higher CPUE in 2017. Overall, Walleye CPUE has remained stable in the survey years 2006-2017, after increasing from a survey low in 2002. While the mean CPUE was the lowest in Lake Nicolet for the seven river regions, it was not significantly so. Overall in 2017, Walleye appear to be well distributed throughout the St. Marys River.

The decline in the CPUE for 2017 and the variance over the survey years can largely be attributed to the CPUE in Lake George. While CPUE has remained relatively stable in the other reaches, in Lake George, CPUE was highly variable with peaks in 2009 (26.7) and 2013 (34.2) compared with lower CPUE in the years 2002 (8.8), 2009 (9.6) and 2017 (7.9). Water depth may play a role in net efficiency in the Lake George, as lake levels have been highly variable over the past 10 years. .

Walleye CPUE have been traditionally low in Munuscong Bay while at the same time being a popular walleye destination for anglers. Munuscong Bay consists mainly of shallow, warmer water with the deeper cooler water located in or near the shipping channel. Anglers have reported that walleye are found in or near the shipping channel during the traditional survey time period (mid-July through late August); however, our inability to safely set nets in or near the shipping channel may be contributing to a lower CPUE for Munuscong Bay.

Mean CPUE of Walleye in the St. Marys River community survey in 2017 was 5.11, after the survey high of 11.25 in 2013. Age-1 to age-6 had the highest CPUE during the survey, corresponding to the 2011-2016 year classes with walleye up to age-14 captured. In comparison to the St. Marys River, Saginaw Bay is a shallow productive bay of Lake Huron that is well known for its walleye fisheries. While being less productive the St. Marys, Saginaw Bay had similar CPUE to the St. Marys River from 1998-2004 (Chong et.al 2014). With the decline of alewife in Saginaw Bay (Fielder and Thomas 2014), overall walleye production in Saginaw Bay far exceeds the found in the St. Marys River.

Mean length-at-age for Walleye in the 2017 survey was slightly below the state of Michigan average. The growth index, which compares length-at-age to the state average, was -1mm. The St. Marys is fed by outflow from Lake Superior; the cold water from Lake Superior may be what leads the St. Marys to being less productive than other bodies of water throughout Michigan. Total annual mortality for Walleye in 2017 (39%) stayed fairly consistent with the 2013 (32%) and 2009 (38 %) surveys. Mortality is largely attributed to fish angling pressure and predation.

The St. Marys has received stocked Walleye for decades and more consistently since the Walleye stocking protocol was developed in 2008. Hatchery reared fish are OTC marked prior to stocking for identification purposes. River-wide, 34% of the walleye captured were identified as stocked. Stocked fish were found in every reach except Munuscong Bay, with the Upper River having the highest percentage of stocked fish at 92%. The Walleye stocking program began in 2008 and was completed in 2018. The results of this study are currently in preparation for publication.

Rainbow Smelt were the most common identified prey item (32%) followed by Threespine Stickleback (26%) based on identifiable contents of the stomachs of the walleye captured during the survey. This is consistent with what was observed in the 2013 survey. Condition, as measured by mean relative weight increased in 2017 to the 2006 and previous year levels. Relative weights were uniformly high throughout the river in 2017.

Ontario fishing regulations presently include no length limits in the St. Marys River while Michigan maintains a 38 cm minimum length limit on the same species. Common fishing regulations between Ontario and Michigan within the St. Marys River would provide continuity for this species.

Northern Pike

Coastal wetlands provide critical spawning and nursery habitat for Northern Pike. The Lake Superior outflows via the St. Marys River are set by the International Joint Commission (IJC) and controlled through the Compensating Gates at the head of the rapids. Great Lakes water levels, and Lake Superior in particular increased since 2013(ACE 2019) , which has led to an increase in St. Marys River water levels and in increased river flows since 2014 and have remained high through 2017. These higher water levels have led to an increased wetted coastal wetland, which in turn have provided more spawning and nursery habitat for Esocids. In 2017, Northern Pike gillnet CPUE continued to improve, reversing the downward trend that began in 2002 (Table 3). Although the CPUE has not returned to pre-2002 levels, it has rebounded to more than double that of its lowest point, measured in 2009. Northern Pike CPUE continued to increase in four river reaches (Lake Nicolet, St. Joseph Channel, Raber Bay, Potagannissing Bay) and in two reaches (Lake George and Lake Munuscong) CPUE is comparable to the higher CPUE's measured in 2013 (Table 5). In the Upper River, Northern Pike catch has remained scarce since 1995 (Table 5).

An increase in the number of age-5 and younger pike (Table 10) coupled with the lowest total annual mortality rate calculated for the survey series (Table 7), provide support for the hypothesis that the increased higher water levels have provided for improved Northern Pike juvenile production in the St. Marys River. In addition to the younger fish, fish were collected in all age brackets from six to 10, continuing the improvement trends noted in the 2013 survey, which also found reduced mortality rates from previous surveys (Chong et al. 2015).

Northern Pike growth slowed somewhat in 2017 compared with the previous survey, with overall lengths-at-age being approximately 68 mm smaller than the Michigan statewide average lengths-at-age for that species (Table 10). Maturity of female Northern Pike began at 42 cm but was inconsistent until 63 cm in total length (Table 12), an increase from the 2013 survey when consistent sexual maturity was reached by 55 cm (Chong et al. 2015).

While abundance has not rebounded to the peak of 1987, cautious optimism for continued improvement in Northern Pike populations remain as river levels have remained high through 2018 and potentially continue throughout 2019, based on current Lake Superior water levels.

This survey series has admittedly not been particularly effective at tracking Esocid populations, particularly Muskellunge (Schaeffer et al. 2011). Once again, Muskellunge were not captured during this survey, but they do remain an important part of the fish community and provide a popular sport fishery. The 2017 creel survey of the St. Marys River, which was a companion project to this fish community survey, estimated that 214 muskies were caught in the St. Marys River during the open-water season that year (Godby et al. In Progress). The mean age of Northern Pike captured in the sport fishery was 4.6, while the mean age in this fishery-independent survey was 4.0. Mean length in the sport fishery was 676 mm and was 552 mm in this gillnet survey. These differences could point to gear selectivity; i.e., gill nets aren't effectively sampling older/larger Northern Pike. It is also likely that the sport fishery selects for larger (older) pike. There is also a difference in Northern Pike regulations between Michigan and Ontario. Michigan has a 610 mm (24 in) minimum size limit, while Ontario does not have a minimum size limit. In 2017, approximately 12% of the Northern Pike sampled during the creel survey were less than 610 mm. It is important to continue both the fishery-independent survey and the creel survey of the sport fishery in order to get a complete picture of the fish community.

Yellow Perch

Yellow Perch are an important feature of the St. Marys River fishery. Their recreational harvest ranges from 39,241 to a high of 125,000 (Godby et al. 2019) exceeded in harvest only by that of Cisco. Yellow Perch abundance in the St. Marys River decreased in 2017 but the mean CPUE of 31.5 is just below the survey average of 33.2 and the overall trend remains positive since the first survey in 1975. Potagannissing Bay showed the largest decline in abundance but still has the highest mean CPUE among survey reaches at 56.2. Lake George was a close second to Potagannissing Bay with an average CPUE of 50.0. The Upper River was last surveyed in 2006 and had the 3rd highest Yellow Perch mean CPUE that year, and dropped to the lowest value in the St. Marys in 2017 with a mean CPUE of 6.0 which is also the lowest value recorded for this reach.

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. Mean size at age in 2017 is consistent with the 2013 survey with a few older larger sized Yellow Perch in the catch which is reflected in the lower total annual mortality rate. Relative to the Michigan average for Yellow Perch the growth index for the St. Marys River remains positive.

Generally, the total annual mortality rates were within sustainable levels; however some reach-specific rates are high and consistent with heavy exploitation.

Smallmouth Bass

Smallmouth Bass abundance in the St. Marys River declined in 2017 after reaching a time-series high in 2013 (Table 3). The declines in Smallmouth Bass abundance occurred in all reaches except the St. Joseph Channel (Table 5). The central portion of the river appears to provide good habitat for Smallmouth Bass. The decrease in river-wide mean CPUE of Smallmouth Bass coincides with an increase in the total annual mortality rate (Table 7). Mean age of Smallmouth Bass has declined in three consecutive surveys with fewer older fish in the catch (Table 9). The Smallmouth Bass diet in the St. Mary's River remains relatively simple still depending heavily on crayfish but with a shift towards a few prey fish species including Yellow Perch, and insects (Table 14).

Cisco

Prior to the large scale collapses of many native fish stocks in Lake Huron in the mid Twentieth Century, Cisco were the most abundant pelagic fish in the lake (Koelz 1929) resulting in substantial commercial fishery yields (Baldwin et al. 2009). After collapse, the Lake Huron stock of Cisco only is found in the northern most regions including the St. Marys River (Dobiesz et al. 2005, Ebener 2012). The exact morphotype of the remnant Lake Huron Cisco is not necessarily consistent with the historic artedii form (Eshenroder et al. 2016) and may reflect local adaption since the larger scale collapse.

Cisco in the St. Marys River appear to be less abundant in recent years although overall trends in gillnet CPUE were not significantly different. Cisco in the St. Marys River will concentrate in cooler deeper water in summer months and make something of an upstream migration for spawning purposes (Fielder 2000). Thus their collection in an August survey may reflect distribution as much as trends in abundance. Cisco usage of the St. Marys River might be affected by climate change. Cisco in the St. Marys River are most consistently encountered when spawning (MDNR unpublished data) or in the recreational fishery during the mayfly (*Hexagenia limbatea*) emergence in midsummer (Fielder et al. 2002).

Growth rate of Cisco improved some in 2017 compared to 2013 and was greater than regional averages (Table 12). This may be consistent with lower Cisco abundances and lower population densities resulting in concomitant faster growth rates. The biological metrics including growth rate, mortality, maturity, and condition do not point to a sustainability concern for Cisco, with the exception of the age structure which is dominated by younger fish that could be an indicator of population stress due to exploitation.

Cisco spawning in Potagannissing Bay have become part of an annual gamete collection along with those from the Les Cheneaux Islands performed by the USFWS to provide for culture and reintroduction in central Lake Huron (USFWS unpublished data). It is not readily clear the extent to which St. Marys River Cisco may comingle with those from the Les Cheneaux Islands and the

North Channel but Cisco movement in the region is the subject of a new study being conducted by the USGS Great Lakes Science Center.

AIS

The encroaching presence of invasive species was evident within the St. Marys River during this assessment. As the river is home to international shipping, it remains especially vulnerable to invasive species transfer both from within the Great Lakes and from International ports. Twelve invasive and or non-native species were noted including Round Gobies, which were found to be a diet item (Table 13). Of remark was the discovery of Eurasian Ruffe in the upper River (Table 3), likely due to natural dispersal into the river from Whitefish Bay of Lake Superior where they have been observed in recent years (U.S. Geological Survey 2018). Two other Ruffe were captured in Little Lake George during 2017 by an angler (S. Chong, OMNRF, Personal Communication). The current status and potential impacts of this species is unknown, as no Ruffe were captured during follow-up sampling during late 2017 and in 2018 by the USFWS (A.Bowen, USFWS, Personal Communication).

Round Goby were present in the diet of a low number of predators collected during the 2017 assessment (Table 13). However this information has limited use to reflect the abundance of Round Goby in The River because Gobies were not vulnerable to the sampling gear and were likely underrepresented in the diet as indicated by a high reporting of unidentified fish remains. In the 2017 survey, identified Round Goby were found in fish collected from Potagannissing Bay to Lake Nicolet, indicating that they may be present in a large area of the River. Round Goby first appeared as a dietary item during the 2013 assessment (Chong et al. 2015); and they were collected in other River surveys conducted by the USFWS (Schaeffer et al. 2017) and commonly reported by anglers (U.S. Geological Survey 2018). The appearance of Round Goby and Ruffe indicate that invasive species from both the lower and upper lakes can find their way to the St. Marys River.

White Perch, first documented in 2002, were collected in low numbers during the assessment (Table 3). Other invasives have been documented during other efforts conducted within the river, including but not limited to Tubenose Goby, Dreissenids (*Dreissena polymorpha* and *Dreissena bugensis*), and Rusty Crayfish (*Orconectes rusticus*). Crayfish are an important component of the diet of many fish in the St. Marys River, and the presence of Rusty Crayfish and potential invasion of the Red Swamp Crayfish (*Procambarus clarkia*) pose threats for both native crayfish and habitat in the St. Marys River.

Nuisance blooms of the algae, Didymo (*Didymosphenia geminate*), were documented in the upper St. Marys River shortly after the 2013 survey; the blooms have the potential to develop thick mats over rocks that may affect spawning substrate and invertebrate habitat. Didymo is well suited to cold oligotrophic waters and the Lake Superior source makes the St. Marys potentially ideal for colonization.

Despite the presence of invasive species, the fish community of the St. Marys River is relatively healthy; and historically, invasives have remained low in abundance in the River (Pratt and O’Connor 2011, Ripley et al. 2011, and Schaeffer et al. 2017). Even so, concerns remain regarding potential impacts that newly introduced species or other threatening species may have on the St. Marys River fish community.

Lake Sturgeon

Lake Sturgeon were collected in small numbers in the 1975 through 1987 surveys (Table 2) and again in 2002 (Table 3), however, the largest capture of Lake Sturgeon over the time series occurred in 2017. Lake Sturgeon were captured in 67% of the netting areas below the Compensation Works, in the lacustrine areas of the River, with the greatest number of fish captured in Lake Munuscong. These areas are more likely representative of Lake Sturgeon habitat during summer months, providing feeding and home range habitats for a variety of juvenile Lake Sturgeon. Lake Sturgeon are more likely to be captured in the faster flowing areas of the river, the Upper River and Lake Nicolet, during the spring spawning migration. Our catch of Lake Sturgeon is likely also limited based on mesh size as our largest mesh fished is 14 cm (5.5'), where most nets targeting Lake Sturgeon use mesh sizes 20 cm (8") and greater (Pratt et al 2016). The increase in Lake Sturgeon CPUE to its highest overall and the increase in both the number of reaches and distribution with those reaches for Lake Sturgeon catch are promising for an increase in abundance within the River.

Sea Lamprey Wounding Rates

Overall, Sea Lamprey wounding rates remain low in the St. Marys River, with 0.2% of the total fish collected exhibiting a Sea Lamprey wound. Of the 29 non-lamprey species collected in 2017, four species had individuals with wounds ranging from A1 to B1 (Ebener et al 2006). Of the seven survey locations, marked fishes were only collected in two places in 2017: Potagannissing Bay and Lake Munuscong. When examining the wounding rate based on the location of capture, wounding rates increased to 0.4% (White Sucker), 1.7% (Northern Pike), 5.3% (Lake Whitefish) and 12.5% (Cisco). Sea Lamprey management within the St. Marys River encompasses both assessment of adult and larval populations within the river as well as targeted treatment of larval populations. Assessment and control of the Sea Lamprey population within the St. Marys River remains a priority for DFO-SLCC and USFWS.

Special Concerns

Of special concern for the St. Marys River and much of the Great Lakes is the potential for introduction and spread of high risk species including Asian carp, Northern Snakehead, Golden Mussel (*Limnoperna fortunei*), and Killer Shrimp (*Dikerogammarus villosus*, Currie et al. 2017, Herborg et al. 2007, and Sieracki et al. 2014). Researchers have predicted via modeling that Northern Snakehead, Bighead Carp, Black Carp, Grass Carp and Silver Carp would be compatible with most of the USA, Mexico, and southern Canada (Herborg et al. 2007), which would include the St. Marys River. Grass Carp recruitment has been documented in the Lake Erie watershed (Chapman et al. 2013), and dispersal modeling studies based on origins in western Lake Erie (Maumee Bay) indicate that Grass Carp would not likely move into the St. Marys River area quickly due to food resources present within Lake Erie; however if Grass Carp were to establish in southern Lake Michigan, they may disperse into the St. Marys River area within approximately 10 to 20 years based on natural movements (Currie et al. 2017). Furthermore, tagging studies conducted in the St. Marys River and Welland Canal suggest that Grass Carp may move up and downstream through lock areas via natural dispersal (Currie et al. 2017). Modeling has also predicted a potential pathway for the spread of Golden Mussel and Killer Shrimp within the upper Great Lakes vicinity via ballast water discharge (Sieracki et al. 2014).

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 and has proved difficult to extract the needed information. Creel survey resources should be saved for when a river-wide survey can be conducted and ideally 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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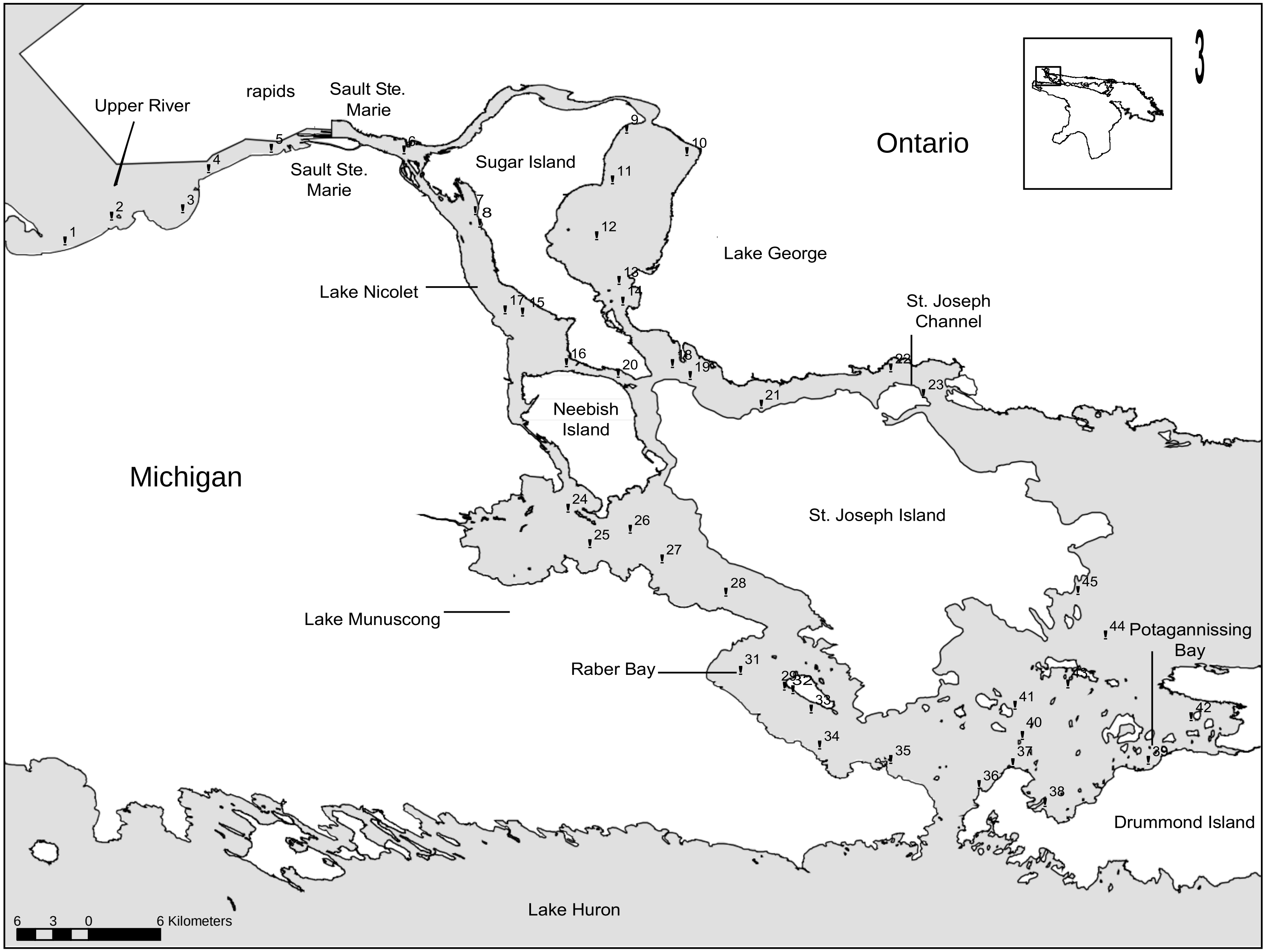


! Net set locations

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 in 2017. See Figure 1 for location of each net number.

Area	Station numbers	Agency
Upper River	1, 2, 3, 4, 5	MDNR
Lake Nicolet	6, 7, 8, 15, 16, 17, 20	USFWS
Lake George	9, 10, 11, 12, 13, 14	STNRD, OMNRF,
Lake Munuscong	24, 25, 26, 27, 28	MDNR
St. Joseph Channel	18, 19, 21, 22, 23	OMNRF
Raber Bay	29, 31, 32, 33, 34, 35	STNRD
Potagannissing Bay	36, 37, 38, 39, 40, 41, 42, 43, 44, 45	MDNR & OMNRF

Table 2. Mean Catch-Per-Unit-of-Effort (CPUE) of all species collected from the St. Marys River 1975 through 2017. 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, 2009, 2017, 39 in 2013, 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		2017	
Alewife	1.64	(0.57)	0.23	(0.12)	0.19	(0.11)	15.11	(12.22)	3.92	(3.52)	0.00	(0.00)	0.06	(0.06)	0.39	(0.18)	0.00	(0.00)
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)	0.06	(0.06)
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)	0.06	(0.06)
Bloater	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.06	(0.06)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Bluegill	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)	0.06	(0.06)
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)	0.06	(0.06)
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)	0.00	(0.00)
Brown Bullhead	6.41	(3.16)	0.76	(0.50)	6.67	(3.51)	2.56	(1.36)	4.43	(2.28)	3.38	(1.69)	3.52	(2.68)	3.22	(2.18)	10.51	(8.53)
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)	0.00	(0.00)
Burbot	0.05	(0.04)	0.00	(0.00)	0.00	(0.00)	0.05	(0.05)	0.06	(0.06)	0.00	(0.00)	0.17	(0.10)	0.20	(0.15)	0.11	(0.08)
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)	0.00	(0.00)
Channel Catfish	0.00	(0.00)	0.00	(0.00)	0.09	(0.05)	0.00	(0.00)	0.00	(0.00)	0.15	(0.15)	0.00	(0.00)	0.13	(0.13)	0.00	(0.00)
Chinook Salmon	0.00	(0.00)	0.03	(0.03)	0.46	(0.29)	0.08	(0.05)	0.28	(0.12)	0.15	(0.10)	0.06	(0.06)	0.20	(0.11)	0.06	(0.06)
Cisco	14.12	(5.13)	22.40	(11.28)	18.98	(8.34)	9.80	(3.40)	4.38	(2.51)	3.53	(1.84)	10.23	(4.31)	4.08	(2.21)	1.70	(0.59)
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)	0.00	(0.00)
Freshwater Drum	0.00	(0.00)	0.00	(0.00)	0.03	(0.03)	0.00	(0.00)	0.34	(0.17)	0.59	(0.24)	0.17	(0.10)	0.07	(0.07)	0.00	(0.00)
Gizzard Shad	0.00	(0.00)	0.00	(0.00)	0.12	(0.12)	0.05	(0.05)	0.11	(0.11)	0.00	(0.00)	0.00	(0.00)	0.07	(0.07)	0.00	(0.00)
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)	0.34	(0.17)
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)	0.06	(0.06)
Lake Whitefish	1.15	(0.41)	0.55	(0.25)	2.10	(0.99)	0.73	(0.37)	0.85	(0.41)	0.29	(0.18)	2.33	(1.13)	0.46	(0.21)	0.80	(0.44)
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)	0.00	(0.00)
Longnose Gar	0.00	(0.00)	0.03	(0.03)	0.06	(0.04)	0.00	(0.00)	0.06	(0.06)	0.07	(0.07)	0.00	(0.00)	0.07	(0.07)	0.00	(0.00)
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)	1.59	(0.79)
Menominee	0.83	(0.44)	0.52	(0.30)	0.00	(0.00)	1.49	(0.55)	0.80	(0.34)	0.22	(0.12)	3.35	(1.80)	0.92	(0.79)	5.23	(2.68)
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)	0.00	(0.00)

Table 2 continued.

Northern Pike	9.04	(1.77)	8.07	(1.31)	12.69	(2.11)	9.26	(1.64)	2.61	(0.61)	3.82	(0.81)	3.01	(0.75)	5.13	(1.29)	6.99	(1.26)
Pink Salmon	0.00	(0.00)	0.00	(0.00)	2.78	(1.38)	0.55	(0.20)	0.28	(0.15)	0.22	(0.12)	0.06	(0.06)	0.13	(0.09)	0.00	(0.00)
Pumpkinseed	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.97	(0.56)	0.66	(0.66)	0.85	(0.53)	0.00	(0.00)	0.28	(0.19)
Rainbow Smelt	4.97	(2.45)	1.64	(0.69)	1.02	(0.47)	0.86	(0.50)	0.40	(0.21)	0.44	(0.22)	1.65	(1.14)	1.51	(1.06)	2.05	(1.04)
Rainbow Trout	0.03	(0.03)	0.13	(0.07)	0.22	(0.22)	0.00	(0.00)	0.06	(0.06)	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)	0.45	(0.20)	1.25	(0.41)	3.75	(1.19)	1.32	(0..39)	0.45	(0.17)
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)	7.67	(2.01)
Ruffe	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)	0.06	(0.06)
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)	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)	0.57	(0.57)
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)	3.69	(1.17)
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)	0.00	(0.00)
Sucker spp.	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)	0.00	(0.00)
Sunfish spp.	0.13	(0.08)	0.13	(0.11)	1.54	(0.89)	0.65	(0.47)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Trout-Perch	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.56	(0.56)	0.00	(0.00)	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)	5.11	(0.79)
White 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)	0.23	(0.23)	0.20	(0.15)	0.00	(0.00)
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)	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)	22.27	(4.04)
White Perch	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.34	(0.17)	0.74	(0.42)	0.00	(0.00)	0.39	(0.20)	0.11	(0.08)
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)	31.53	(8.17)
Unknown Sps.	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.11	(0.08)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)

[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 (CPUE) of all species collected from the St. Marys River in 2002 - 2017 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 net sets in 2002, 2009, 2017 and 39 in 2013. While 42 nets were set in 2006, however, the traditional mesh CPUE values in 2006 reflect a sample size of 34 net sets, due to data recording limitations.

	2002		2006		2009		2013		2017	
Species[a]	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh
Alewife	10.61 (0.21)	3.92(3.52)	1.12 (0.73)	0.00 (0.00)	0.23 (0.16)	0.06 (0.06)	1.61 (0.72)	0.39 (0.18)	0.18 (0.16)	0.00 (0.00)
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)	0.02 (0.02)	0.06 (0.06)
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)	0.02 (0.02)	0.06 (0.06)
Bloater	0.02 (0.02)	0.06(0.06)	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)
Bluegill	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)	0.02 (0.02)	0.06 (0.06)
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)	0.02 (0.02)	0.06 (0.06)
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)	0.00 (0.00)	0.00 (0.00)
Brown Bullhead	2.59 (1.21)	4.43(2.28)	2.79 (1.13)	3.38 (1.69)	1.89 (1.30)	0.06 (0.06)	3.11 (2.16)	0.00 (0.00)	4.66 (3.57)	10.51 (8.53)
Brown 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)	0.00 (0.00)	0.00 (0.00)
Burbot	0.09 (0.04)	0.06(0.06)	0.07 (0.05)	0.00 (0.00)	0.16 (0.06)	0.17 (0.10)	0.24 (0.17)	0.20 (0.15)	0.18 (0.08)	0.11 (0.08)
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)	0.00 (0.00)	0.00 (0.00)
Channel Catfish	0.02 (0.02)	0.00 (0.00)	0.31 (0.20)	0.15 (0.15)	0.11 (0.08)	0.00 (0.00)	0.13 (0.07)	0.13 (0.13)	0.09 (0.07)	0.00 (0.00)
Chinook	0.64 (0.21)	0.28(0.12)	0.29 (0.16)	0.10 (0.08)	0.05 (0.03)	0.06 (0.06)	0.11 (0.06)	0.20 (0.11)	0.05 (0.03)	0.06 (0.06)
Cisco	2.84 (1.35)	4.38(2.51)	3.62 (1.50)	3.53 (1.84)	6.64 (2.47)	10.23 (4.31)	2.71 (1.51)	4.08 (2.21)	1.02 (0.39)	1.70 (0.59)
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)	0.00 (0.00)	0.00 (0.00)
Freshwater	0.43 (0.18)	0.34(0.17)	1.12 (0.35)	0.59 (0.24)	0.41 (0.15)	0.17 (0.10)	0.37 (0.11)	0.07 (0.07)	0.09 (0.05)	0.00 (0.00)
Gizzard Shad	0.09 (0.09)	0.11(0.11)	0.02 (0.02)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.03 (0.03)	0.07 (0.07)	0.00 (0.00)	0.00 (0.00)
Lake Sturgeon	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)	0.59 (0.27)	0.34 (0.17)
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)	0.11 (0.11)	0.06 (0.06)
Lake Whitefish	0.77 (0.35)	0.85(0.41)	0.50 (0.20)	0.29 (0.18)	1.48 (0.66)	2.33 (1.13)	0.42 (0.27)	0.46 (0.21)	0.59 (0.26)	0.80 (0.44)
Largemouth	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)	0.00 (0.00)	0.00 (0.00)
Longnose Gar	0.2 (0.02)	0.06(0.06)	0.07 (0.05)	0.07 (0.07)	0.00 (0.00)	0.00 (0.00)	0.11(0.08)	0.07 (0.07)	0.00 (0.00)	0.00 (0.00)
Longnose	1.20 (0.56)	2.10(1.00)	1.29 (0.59)	1.99 (1.26)	1.61 (0.66)	2.61 (1.15)	0.18 (0.14)	0.13 (0.09)	1.18 (0.68)	1.59 (0.79)
Menominee	0.36(0.15)	0.80(0.34)	0.86 (0.54)	0.18 (0.11)	1.75 (0.89)	3.35 (1.80)	0.45 (0.35)	0.92 (0.79)	2.55 (1.28)	5.23 (2.68)
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)	0.00 (0.00)	0.00 (0.00)

Table 3 continued.

Northern Pike	1.55(0.33)	2.61(0.61)	1.69 (0.40)	3.82* (0.81)	1.82 (0.37)	3.01 (0.75)	2.66 (0.65)	5.13 (1.29)	4.09 (0.73)	6.99 (1.26)
Pink Salmon	0.39(0.22)	0.28(0.15)	0.14 (0.07)	0.22 (0.12)	0.02 (0.02)	0.06 (0.06)	0.00 (0.00)	0.13 (0.09)	0.00 (0.00)	0.00 (0.00)
Pumpkinseed	0.41(0.23)	0.97(0.56)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.11 (0.07)	0.28 (0.19)
Rainbow Smelt	0.25(0.11)	0.40(0.21)	1.40 (0.51)	0.44 (0.22)	0.84 (0.49)	1.65 (1.14)	1.18 (0.72)	1.51 (1.06)	1.00 (0.50)	2.05 (1.04)
Rainbow Trout	0.02(0.02)	0.06(0.06)	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.	0.50(0.14)	0.40(0.18)	0.36 (0.20)	0.44 (0.25)	3.07 (1.32)	3.30 (1.21)	0.74 (0.19)	0.86 (0.33)	0.29 (0.13)	0.17 (0.13)
Rock Bass	5.95(1.15)	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)	4.18 (1.09)	7.67 (2.01)
Ruffe	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)	0.23 (0.23)	0.06 (0.06)
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)	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)	0.05 (0.03)	0.57 (0.57)
Shorthead RH	0.00 (0.00)	0.00 (0.00)	0.57 (0.22)	0.81 (0.36)	0.30 (0.14)	0.28 (0.12)	0.54 (0.19)	0.46 (0.21)	0.18 (0.08)	0.28 (0.12)
Silver RH	0.02(0.02)	0.06(0.06)	0.00 (0.00)	0.00 (0.00)	0.30 (0.14)	0.17 (0.10)	0.05 (0.04)	0.00 (0.00)	0.14 (0.06)	0.00 (0.00)
Redhorse (all)	0.52 (0.15)	0.45 (0.20)	0.93 (0.28)	1.25 (0.41)	3.66 (1.31)	3.75 (1.19)	1.33 (0.29)	1.32 (0.39)	0.48 (0.14)	0.45 (0.17)
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)	2.84 (0.83)	3.69 (1.17)
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)	0.00 (0.00)	0.00 (0.00)
Sucker spp.	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)	0.00 (0.00)	0.00 (0.00)
Sunfish spp.	0.00 (0.00)	0.00 (0.00)	0.26 (0.22)	0.66 (0.66)	0.39 (0.21)	0.85 (0.53)	0.05 (0.04)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Trout-Perch	0.05(0.03)	0.56(0.56)	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)
Unknown	0.05(0.03)	0.11(0.08)	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)
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)	3.41 (0.50)	5.11 (0.79)
White Bass	0.02(0.02)	0.00 (0.00)	0.02 (0.02)	0.07 (0.07)	0.30 (0.19)	0.23 (0.23)	0.11 (0.08)	0.20 (0.15)	0.00 (0.00)	0.00 (0.00)
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)	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)	16.04 (2.22)	22.27(4.04)
White Perch	0.16(0.09)	0.34(0.17)	0.50 (0.22)	0.74 (0.42)	0.05 (0.05)	0.00 (0.00)	0.26 (0.10)	0.39 (0.20)	0.16 (0.09)	0.11 (0.08)
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	29.34 (5.65)	31.53 (8.17)

- * In 2006, Northern Pike CPUE was significantly higher in the traditional net vs. the full net set.

Table 4. Mean catch-per-unit-of-effort is number per 304.8 m (1000 ft.) collected from the seven habitat areas of the St. Marys River 1975 - 2017 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	2017	6.0 (3.6)	10.0 (8.8)	50.0 (23.0)	10.5 (2.2)	21.5 (5.9)	44.2 (14.8)	56.2 (30.0)
	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	2017	0.0 (0.0)	6.7 (2.4)	10.0 (2.5)	10.0 (4.3)	7.5 (2.8)	6.7 (2.0)	3.2 (2.1)
	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	2017	5.0 (5.0)	2.1 (0.8)	7.9 (1.5)	2.0 (0.5)	5.5 (1.4)	6.7 (1.4)	6.5 (1.8)
	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)

Table 4 continued

	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)
Smallmouth Bass	2017	0.0 (0.0)	1.1 (0.7)	7.1 (4.8)	3.0 (1.5)	9.0 (4.2)	2.5 (1.3)	3.8 (3.5)
	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)	1.3 (1.3)
	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)	1.3 (1.3) [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	2017	0.5 (0.5)	0.0 (0.0)	4.6 (1.9)	0.0 (0.0)	4.0 (4.0)	0.0 (0.0)	2.5 (1.0)
	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 5. Catch-per-unit-of-effort (CPUE) of Yellow Perch by age for 2017 and mean length-at-age at capture for the St. Marys River, August-September, 1979-2017 by river location. 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 3.

Parameter & Area	Age 1	2	3	4	5	6	7	8	9	10	Mean age	Mean length	Growth index
Upper River													
Number	1	10	2	2	5	2	1						
CPUE	0.2	0.4	0.6	0.8	1	1.2	1.4						
Frequency (%)	4.3	43.5	8.7	8.7	21.7	8.7	4.3						
Mean length													
2017	140	156	226	187	257	296	285				3.0	204	+10
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		11	7	2	11	5	2	1					
CPUE		1.6	1.0	0.3	1.6	0.7	0.3	0.1					
Frequency (%)		28.2	17.9	5.1	28.2	12.8	5.1	2.6					
Mean length													
2017		152	207	214	248	278	311	326			4.0	221	+13
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 5. Continued.

Parameter & Area	Age 1	2	3	4	5	6	7	8	9	10	Mean age	Mean length	Growth index
Lake George													
Number	2	60	27	42	17	16	18	3	1				
CPUE	0.3	5.6	21.2	7.0	2.0	1.8	1.8	1.0	0.2				
Frequency (%)	1.1	32.3	14.5	22.6	9.1	8.6	9.7	1.6	0.5				
Mean length													
2017	145	148	182	216	249	273	271	394	316		3.8	192	+3
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	2	29	15	17	14	11	5			2			
CPUE	0.4	5.8	3.0	3.4	2.8	2.2	1.0			0.4			
Frequency (%)	2.1	30.5	15.8	17.9	14.7	11.6	5.3			2.1			
Mean length													
2017	149	159	174	199	234	261	260			327	3.8	200	-5
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 5. Continued.

Parameter & Area	Age 1	2	3	4	5	6	7	8	9	10	Mean age	Mean length	Growth index
Lake Munuscong													
Number	6	118	7	15	9	3	1						
CPUE	1.2	23.6	1.4	3	1.8	0.6	0.2						
Frequency (%)	3.8	74.2	4.4	9.4	5.7	1.9	0.6						
Mean length													
2017	140	148	173	205	224	274	207				2.5	162	-4
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	2	37	15	63	12	5	4		1				
CPUE	0.3	6.2	2.5	10.5	2.0	0.8	0.7		0.2				
Frequency (%)	1.4	26.6	10.8	45.3	8.6	3.6	2.9		0.7				
Mean length													
2017	136	148	206	209	238	270	293		305		3.6	194	+6
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 5 Continued.

Parameter & Area	Age 1	2	3	4	5	6	7	8	9	10	Mean age	Mean length	Growth index
Potagannissing Bay													
Number		81	162	72	22	17	6		1				
CPUE		8.1	16.2	7.2	2.2	1.7	0.6		0.1				
Frequency (%)		22.4	44.9	19.9	6.1	4.7	1.7		0.3				
Mean length													
2017		154	185	229	301	315	300		379		3.3	190	+28
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	13	346	235	213	90	59	37	4	3	2			
CPUE	0.3	7.9	5.3	4.8	2.0	1.3	0.8	0.1	0.1	0.0			
Frequency (%)	1.3	34.5	23.5	21.3	9.0	5.9	3.7	0.4	0.3	0.2			
Mean length													
2017	141	151	186	216	255	284	277	377	333	327	3.3	190	+9
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 6. Comparison of total annual mortality (A) rates for select fish species in the St. Marys River, computed from fish collected in experimental mesh gillnets 1995-2017.

Species	Area, if not total for the river	1995	2002	2006	2009	2013	2017
Yellow Perch	Upper River	0.25	0.54	0.70	0.63	Not sampled	0.59
	Lake Nicolet	0.38	0.70	0.59	---	0.61	0.39
	Lake George	0.40	0.52	0.43	0.69	0.55	0.42
	St. Joseph Channel	Not sampled	0.64	0.50	---	0.71	---
	Lake Munuscong	0.41	0.61	0.78	0.62	0.63	0.76
	Raber Bay	0.44	0.63	0.49	---	0.71	0.50
	Potagannissing Bay	0.60	0.57	0.96	0.67	0.55	0.59
	River Total	0.38	0.68	0.70	0.64	0.60	0.41
Northern Pike		0.58	0.52	0.61	0.72	0.52	0.51
Walleye		0.51	0.49	0.38	0.38	0.32	0.39
Cisco		0.31	0.39	0.40	0.48	0.25	0.38
Smallmouth Bass		0.36	0.37	0.55	0.50	0.35	0.52

Table 7. 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 2017.

	Species				
Length (cm)	Walleye	Smallmouth Bass	Northern Pike	Yellow Perch	Cisco
13	---	---	---	50	---
14	---	---	---	79	---
15	---	---	---	63	---
16	---	---	---	76	---
17	---	---	---	73	---
18	---	---	---	87	---
19	---	0	---	77	0
20	---	---	---	94	0
21	---	100	---	97	100
22	---	0	---	98	---
23	0	---	---	100	0
24	---	---	---	93	---
25	---	0	---	100	100
26	0	33	---	100	---
27	---	---	---	100	0
28	---	100	---	100	100
29	---	100	---	94	67
30	0	87	---	100	50
31	100	100	---	92	50
32	33	100	---	100	0
33	80	100	---	100	100
34	100	100	---	100	100
35	25	100	---	100	100
36	50	100	---	100	100
37	0	100	---	100	100
38	0	100	---	100	100
39	25	100	0	---	100
40	---	100	---	---	100
41	---	100	---	---	100
42	---	100	50	---	100
43	100	100	---	---	100
44	80	100	---	---	100
45	100	100	---	---	100
46	100	100	0	---	100
47	100	100	50	---	100

Table 7. Continued.

	Species				
Length (cm)	Walleye	Smallmouth Bass	Northern Pike	Yellow Perch	Cisco
48	67	---	100	---	---
49	100	100	75	---	---
50	100	---	100	---	---
51	100	---	50	---	---
52	100	---	83	---	---
53	100	---	100	---	---
54	100	---	83	---	---
55	100	---	100	100	---
56	100	---	100	---	---
57	100	---	100	---	---
58	100	---	100	---	---
59	100	---	67	---	---
60	100	---	100	---	---
61	100	---	100	100	---
62	100	---	33	---	---
63	100	---	100	---	---
64	100	---	100	---	---
65	100	---	100	---	---
66	100	---	100	---	---
67	---	---	100	---	---
68	---	---	100	---	---
69	---	---	100	---	---
70	---	---	100	---	---
71	---	---	100	---	---
72	---	---	100	---	---
73	---	---	100	---	---
74	---	---	100	---	---
75	---	---	100	---	---
76	---	---	100	---	---
77	---	---	100	---	---
78	---	---	100	---	---
79	---	---	100	---	---
80	---	---	100	---	---
81	---	---	100	---	---
82	---	---	100	---	---
83	---	---	100	---	---

Table 8. Mean relative weight of select species, by area and river wide, for the St. Marys River, August - September 2017; River wide total values for 1995-2017 are presented for comparison.

Location	Walleye	Yellow Perch	Smallmouth Bass	Northern Pike	Cisco
Upper River	86	97	---	85	---
Lake Nicolet	91	95	108	94	---
Lake George	94	102	101	97	114
Lake Munuscong	84	97	106	96	---
St. Joseph Channel	77	64	92	87	79
Raber Bay	87	95	97	96	86
Potagannissing Bay	86	92	98	96	82
River wide 2017	87	93	100	95	90
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 9. Catch-per-unit-of-effort (CPUE) of Walleye by age for 2017 and mean length-at-age at capture for the St. Marys River, August- September, 1979-2017. 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 2017 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 3.

	Age														Mean	Mean	Growth
Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	age	length	index
Number	13	34	21	20	24	24	5	1	1		2	2	1	2			
CPUE	0.3	1.9	0.9	0.6	0.5	0.6	0.1	0.1	0.0		0.1	0.1	0.1	0.1			
Frequency (%)	8.7	22.7	14.0	13.3	16.0	16.0	3.3	0.7	0.7		1.3	1.3	0.7	1.3			
Mean length																	
2017	234	334	381	428	477	509	492	557	582		631	608	586	657	4.2	463	-1
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 10. Catch-per-unit-of-effort (CPUE) of Smallmouth Bass by age 2017 and mean length-at-age at capture for the St. Marys River, August - September, 1987-2017. 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 3.

	Age														Mean	Mean	Growth
Parameter	0	1	2	3	4	5	6	7	8	9	10	11	12	13	age	length	index
Number		6	12	37	21	33	11	1	1	2	1						
CPUE		0.1	0.3	0.8	0.5	0.8	0.3	<0.1	<0.1	<0.1	<1.0						
Frequency (%)		4.8	9.6	29.6	16.8	8.8	8.8	0.8	0.8	1.6	0.8						
<u>Mean length</u>																	
2017		190	244	296	317	369				438					4.0	323	-14
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. Catch-per-unit-of-effort (CPUE) of Northern Pike by age 2017 and mean length-at-age at capture for the St. Marys River, August - September, 1987-2017. 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 2017 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 3.

	Age																
Parameter	0	1	2	3	4	5	6	7	8	9	10	11	12	13	Mean age	Mean length	Growth index
Number		5	16	34	42	27	9	4	2	2	1						
CPUE		0.1	0.4	0.8	1.0	0.6	0.2	<0.1	<0.1	<0.1	<0.1						
Frequency (%)		3.5	11.3	23.9	29.6	19.0	6.3	2.8	1.4	1.4	0.7						
Mean length																	
2017		378	445	503	561	612	655	637	660	763	851				4.0	552	-68
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 12. Catch-per-unit-of-effort (CPUE) of Cisco by age 2017 and mean length-at-age at capture for the St. Marys River, August - September, 1995-2017. 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 2017 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 Table3.

	Age														Mean	Mean	Growth
Parameter	0	1	2	3	4	5	6	7	8	9	10	11	12	13	age	length	index
Number		10	15	3	2	3	4	3	2	1			1				
CPUE		0.2	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1				
Frequency (%)		22.7	34.1	6.8	4.5	6.8	9.1	6.8	4.5	2.3			2.3				
Mean length																	
2017		214	304	318	324	401	407	419	416	472			417		3.5	318	+32
2013		196	249	272	269	293	314	351	390	384	388	427			4.7	292	-15
2009		207	260	343	366	379	382	398	404	413					3.7	316	+41
2006		213	232	281	326	387	378	386	377	412					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 13. Incidence and percent of occurrence of food items (based on stomach content identification) for select species from the St. Marys River, August – September 2017. Note percent occurrence may total more than 100% due to multiple food species in stomach.

	Walleye	Northern Pike	Smallmouth Bass	Yellow Perch	Cisco
Incidence					
No. stomachs examined	141	180	122	716	32
% void	73.0	72.8	68.9	62.0	93.8
Percent of Occurrence					
Unidentified fish remains	44.7	44.9	28.9	15.8	33.3
Crayfish	---	16.3	36.8	51.1	---
Alewife	5.3	---	---	---	---
Rainbow Smelt	18.4	4.1	---	---	---
Mayfly	---	---	---	---	33.3
Logperch	---	4.1	---	---	---
Unidentified zooplankton	---	---	---	---	---
Menominee	---	2.0	---	---	---
Trout-Perch	---	6.1	---	---	---
Yellow Perch	7.9	10.2	13.2	2.2	---
Cisco	---	---	---	---	---
Sculpin	2.6	2.0	---	---	---
Johnny Darter	5.3	2.0	---	---	---
Unidentified insects	2.6	2.0	15.8	26.1	---
Ninespine Stickleback	---	---	---	---	---
Threespine Stickleback	10.5	10.2		---	---
Stickleback sp.	---	---	2.6	0.4	---
Snails	---	2.0	2.6	---	---
White Sucker	---	2.0	---	---	---
Round Goby	2.6	10.2	---	7.0	---
Vegetation	---	2.0	2.6	0.4	---
Water Flea	---	---	---	---	33.3

Table 14. Percent of sea lamprey wounds by species exhibiting wounding from the St. Marys River, August - September 2017. N denotes sample size of specimens examined for wounds. Wounds scored according to Ebner et al. (2006).

Species	N	A1	A2	A3	A4	B1	B2	B3	B4	Total
Walleye	150	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow Perch	1291	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cisco	45	0.0	2.2	0.0	0.0	2.2	0.0	0.0	0.0	4.4
Lake Whitefish	26	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8
Northern Pike	180	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.6
White Sucker	706	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Rock Bass	184	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*
Bluegill	*Lepomis macrochirus*
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*
Pumpkinseed	*Lepomis gibbosus*
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*
Shorthead Redhorse	*Moxostoma macrolepidotum*
Silver Redhorse	*Moxostoma anisurum*
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*

Appendix 1 continued.

White Perch	*Morone americana*
White Sucker	*Catostomus commersoni*
Yellow Perch	*Perca flavescens*

Appendix 2. Total catch and cumulative species by net set type: Full Mesh Nets (all 10 mesh panels) and Traditional Mesh Nets (4 meshes, extrapolated to 304.8 m) for the surveys years 2002 to 2017. High-lighted are new species for each year.

	Cumulative Full Mesh Nets					Cumulative Traditional Mesh Nets				
Species	2002	2006	2009	2013	2017	2002	2006	2009	2013	2017
Alewife	467	47	10	61	8	69		1	6	
Atlantic Salmon				1	1				1	1
Black Crappie		1		10	1				4	1
Bloater	1					1				
Bluegill				2	1					1
Bowfin					1					1
Brown Bullhead	114	117	85	118	205	78	46	62	49	185
Burbot	4	3	7	9	8	1		3	3	2
Carp	2	8		2			1		1	
Channel Catfish	1	13	5	5	4		2		2	
Chinook Salmon	28	12	2	4	2	5	2	1	3	1
Cisco (Lake Herring)	125	152	292	103	45	77	48	180	62	30
Coho Salmon		1		1						
Creek Chub			9							
Freshwater Drum	19	47	18	14	4	6	8	3	1	
Gizzard Shad	4	1		1		2			1	
Lake Sturgeon	1		5	5	26				1	6
Lake Trout		6	7	2	5		1	3	1	1
Lake Whitefish	34	21	65	16	26	15	4	41	7	14
Largemouth Bass		1					1			
Longnose dace			1							
Longnose Gar	1	3		4		1	1		1	
Longnose Sucker	53	54	71	7	52	37	27	46	2	28
Moxostoma sp.	22	15	135	29	7	7	6	58	13	3

Appendix 2 continued.

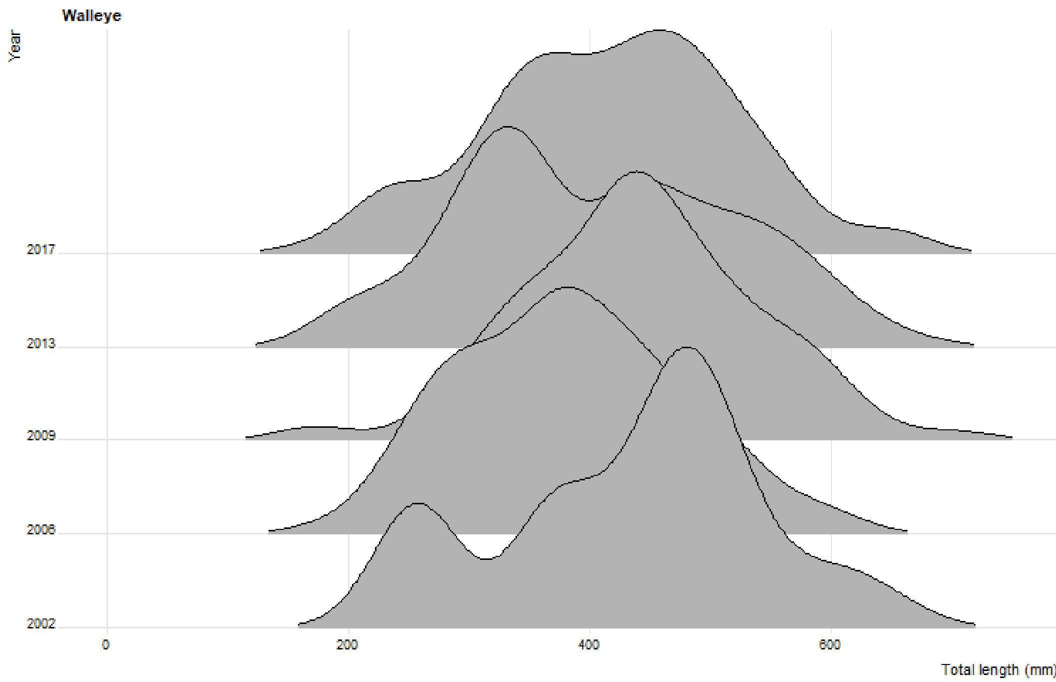
Muskellunge				1						
Northern Pike	68	71	80	101	180	46	52	53	78	123
Pink Salmon	17	6	1	6		5	3	1	2	
Pumpkinseed	18	11	17	2	5	17	9	15		5
Rainbow Smelt	11	59	37	45	44	7	6	29	23	36
Rainbow Trout	1					1				
Rock Bass	262	245	182	285	184	201	195	138	191	135
Round Whitefish (Menonimee)	16	36	77	17	112	14	3	59	14	92
Ruffe					10					1
Sea Lamprey			1		2			1		1
Shorthead Redhorse		24	13	21	8		11	5	7	5
Silver Redhorse	1		13	2	6	1		3		
Smallmouth Bass	65	183	76	252	125	40	86	32	118	65
Trout-perch	2					1				
Unknown fish species	2	1				2				
Walleye	112	254	215	288	150	63	152	106	171	90
White Bass	1	1	13	4			1	4	3	
White Crappie	1									
White Perch	7	21	2	10	7	6	10		6	2
White Sucker	827	751	795	661	706	436	240	407	310	392
Yellow Perch	1031	1677	1637	1828	1291	446	506	622	634	555
Total Catch	3318	3842	3871	3917	3226	1585	1421	1873	1715	1776
Species Count	32	31	29	34	30	27	25	24	29	26
Cumulative Total	32	37	40	43	45	27	33	34	37	40
New Species	0	5	3	3	2	0	6	1	3	3

Appendix 3. Length-weight regression equations and von Bertalanffy growth equations for select species from the St. Marys River August – September 2017. 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.

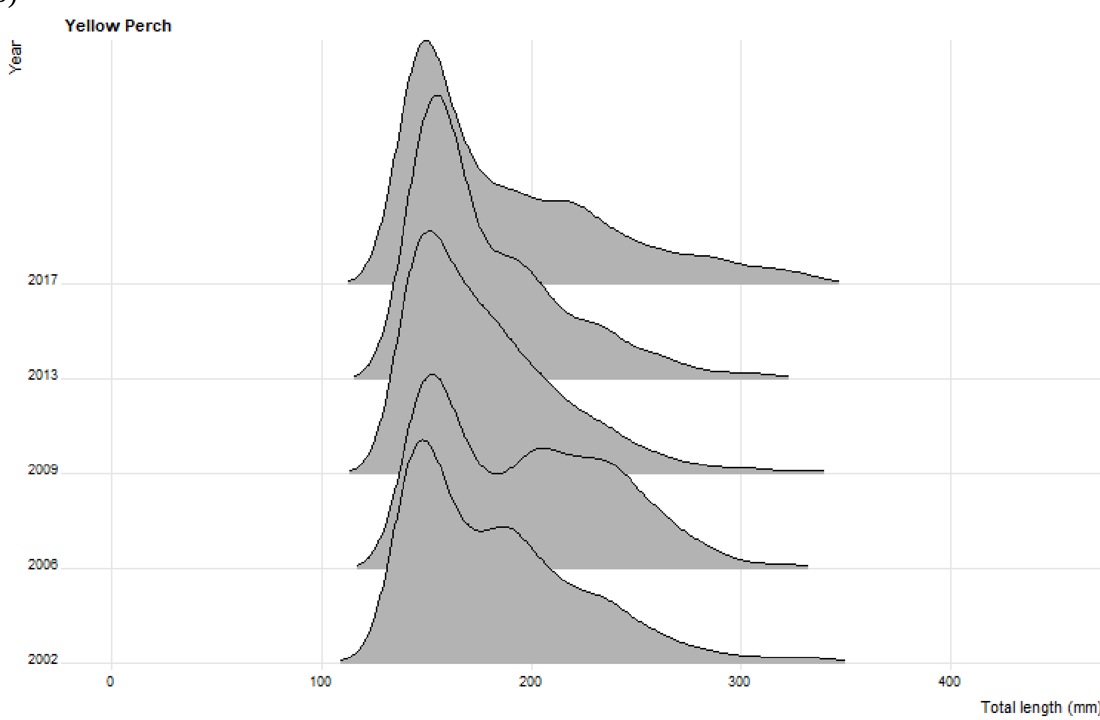
Species	Length/Weight Equation	Len/Wt r^2	Von Bertalanffy Equation	K	L∞	t_o
Walleye	log(wt)=3.223 log(len)-5.626	0.98	$L_t=610[1-e^{-0.2708(t-0.26)}]$	0.2708	610	0.26
Yellow Perch	log(wt)=3.118 log(1en)-5.170	0.90	$L_t=348[1-e^{-0.2293(t-0.26)}]$	0.2293	348	0.26
Smallmouth Bass	log(wt)=3.240 log(1en)-5.435	0.96	$L_t=545[1-e^{-0.1703(t+1.51)}]$	0.1703	545	-1.51
Northern Pike	log(wt)=3.044 log(1en)-5.355	0.94	$L_t=721[1-e^{-0.2537(t+1.91)}]$	0.2537	721	-1.91
Cisco	log(wt)=3.291 log(1en)-5.759	0.87	$L_t=464[1-e^{-0.3348(t+2.32)}]$	0.3348	464	-2.32

Appendix 4. Length frequencies from survey catch of; (a) Walleye, (b) Yellow Perch, (c) Smallmouth Bass, (d) Northern Pike, (e) Cisco, and (f) Lake Sturgeon from the St. Marys River Fish Community Index Netting Surveys 2002 to 2017.

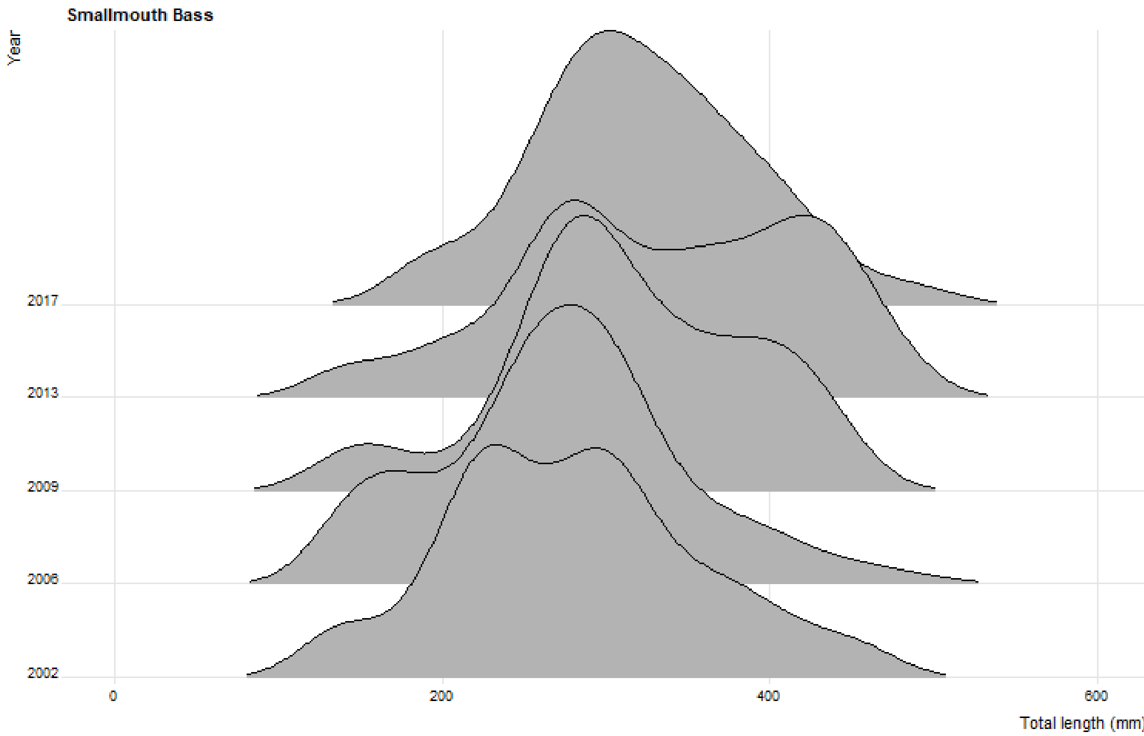
a)



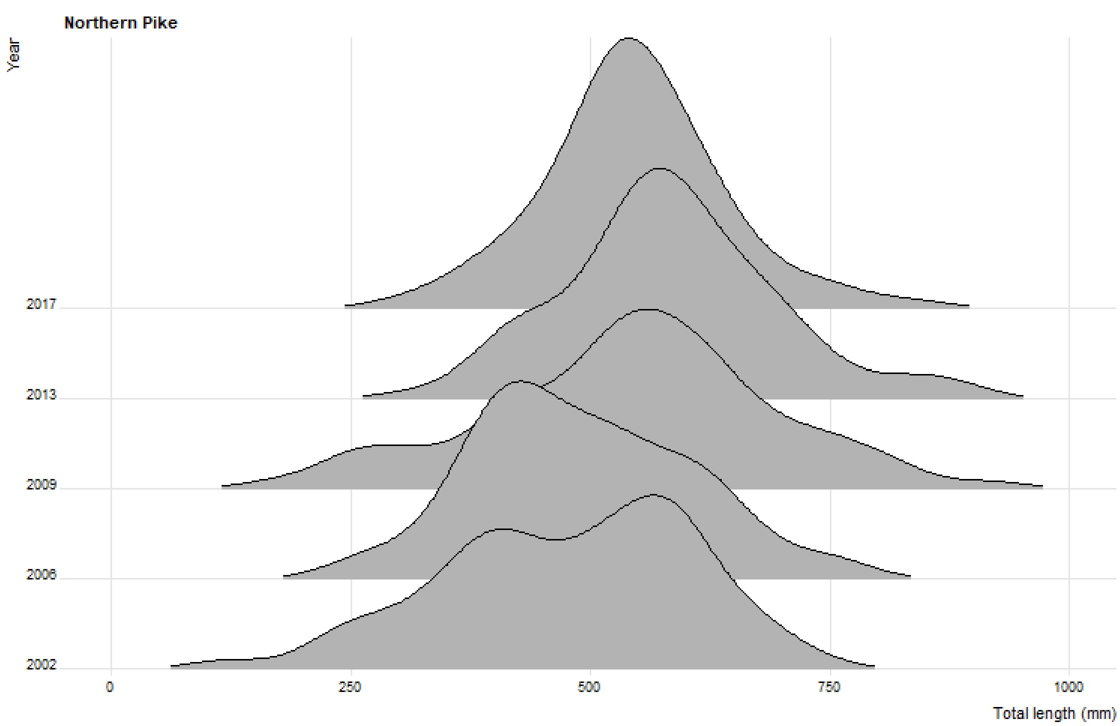
b)



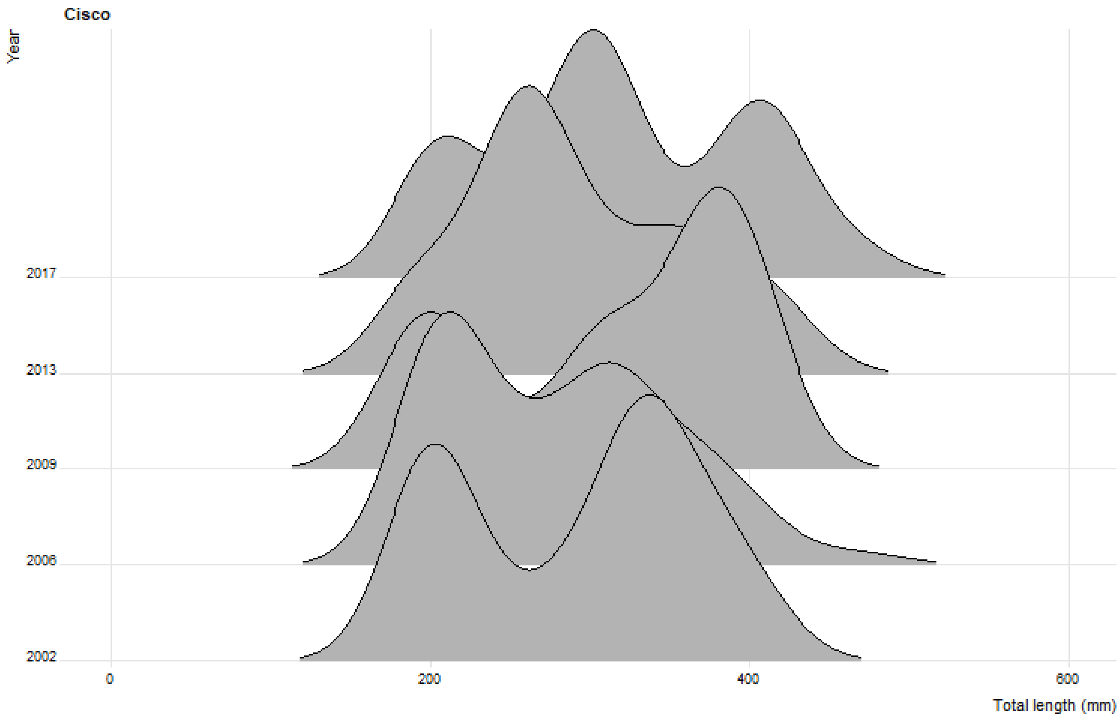
c)


Smallmouth Bass
Year
2017
2013
2009
2006
2002
0
200
400
600
Total length (mm)

d)

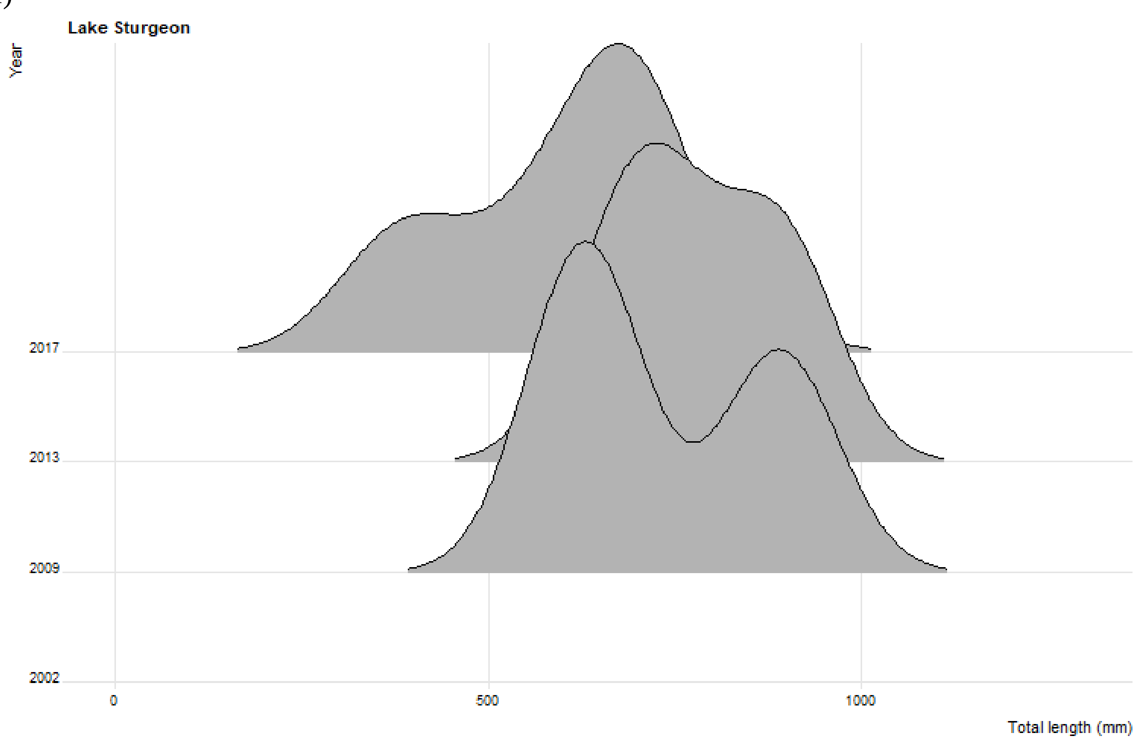

Northern Pike
Year
2017
2013
2009
2006
2002
0
250
500
750
1000
Total length (mm)

e)



Cisco
Year
2017
2013
2009
2006
2002
0
200
400
600
Total length (mm)

f)



Lake Sturgeon
Year
2017
2013
2009
2002
0
500
1000
Total length (mm)