Population Dynamics of the St. Marys River Fish Community 1975-2022

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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 2022, the 10th such survey since 1975. A gillnet based survey, 44 nets sets each survey year resulted in indices of abundance and population status for multiple species. The abundance of Yellow Perch, a cool water species of importance, has remained stable in the river through the six surveys conducted between 2002 and 2022, while Walleye were significantly lower than the previous surveys in 2017 and 2013. Smallmouth Bass abundance has varied since 2002, with significant peaks in 2006 and 2013 and an increase in 2022 compared to the 2017 survey. Northern Pike declined in the 2022 survey compared to the previous years, however, catches remained stable between the river reaches. Cisco catches increased in the 2022 survey and were among the highest since the 2002 survey. Lake Sturgeon had the highest CPUE of any point in the survey history in 2022. Growth rates, as indicated by length at age at capture, were generally near or below Michigan regional averages and may reflect the northern latitude of the St. Marys River. Total annual mortality rates were 50% for Yellow Perch, 32% for Northern Pike, 30% for Smallmouth Bass, 47% for Cisco, and 30% for Walleye but were generally deemed within acceptable ranges for these species. Diets varied by species and included both piscine prey and invertebrates, especially crayfish. Ruffe continued to be documented and were located in the Lake George reach for the first time in the survey. Round gobies continued to be observed in the diets of some predators indicating that they continue to persist in the river fish community. Sea Lamprey wounding rates were the highest in the 2022 survey, compared to the 2002-2017 time-series, for both the number of species and the total percent wounded, most likely the result of the delayed lampricide applications due to the Covid-19 pandemic in 2020 and 2021. Recommended are timing future surveys with full river-wide creel surveys, in conjunction with the Lake Huron Cooperative Science and Monitoring Initiative (CSMI) year to provide the maximum information for the St. Marys River fish community.

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 $15.2 million USD (Godby et al. 2024).

Despite the varied habitat types and high-quality water source, the St. Marys River has been the subject of considerable anthropogenic alteration and degradation (Ripley et al. 2011). 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; 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 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 (SMRFTG) (Fielder 2002). Formed in 1997, the SMRFTG is comprised of representatives from the various management authorities and federal agencies as well as area universities who work together to conduct 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 relative 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 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 (Liston et al, 1986; 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) 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: Sault Tribe Natural Resources Department (STNRD), Michigan Department of Natural Resources (MDNR), Ontario Ministry of Natural Resources (OMNR), Department of 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). 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. 2014; Schaeffer et al. 2017, O'Connor et al. 2019).

The catch from each lift was identified, weighed (round weight) and measured for total length. All fish collected were examined for Sea Lamprey wounds using Ebner et al. (2006). Five species of special interest, Walleye, Yellow Perch, Smallmouth Bass, Northern Pike, Cisco, had scales or dorsal spines 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. Walleye stocked into the St. Marys River are marked with oxytetracycline (OTC) prior to release allowing assessment of stocked vs. wild recruitment to the fishery. Walleye otoliths collected in the survey were examined for the presence of OTC marks to determine the proportion of stocked vs. 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 by multiplying the catch by a correction factor of 2.5. 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 at 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.

We tested for differences in the means between two independent samples using 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 ANOVA with Tukey HSD or the non-parametric Kruskal-Wallis (K-W) tests, with Dunn's Test post-hoc analysis as appropriate. 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 2022 survey, a total of 44 nets were set throughout the river over a 4 week period beginning August 1 through August 23, 2022 (Figure 1, Table 1). A total of 3,438 fish representing 36 different species were collected, including two new species for this survey: Lake Chub and Silver Lamprey. 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 (correction factor of x 2.5), 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 2022 was compared (Mann-Whitney) between the two nets types for five species: Northern Pike, Cisco, Walleye, Yellow Perch, and Smallmouth Bass. In 2022, mean CPUE was not significantly different for any of the five species for the net comparisons, corrected traditional vs. full (Mann-Whitney; all $P>0.05$). This is consistent with the results found in O'Connor et al., 2018.

Total number of species caught was also compared between the traditional nets and the full nets for the years 2002-2022. The total number of species sampled when including all meshes (mean species catch= 30.5) compared with traditional meshes (mean species catch= 25.5) was significantly greater (Mann-Whitney; $P=0.003$). This is consistent with the results found in O'Connor et al., 2018, for years 2002-2017, with the full net meshes collecting significantly more species than the four traditional meshes. In 2022, the full mesh nets had higher cumulative species catch, with 11 species not collected in the traditional net configuration (see Appendix 2 for full catch summary), including the two new species (Lake Chub, Silver Lamprey) for the survey.

Individual Species CPUE

Yellow Perch:

Yellow Perch abundance continues to demonstrate an overall stability on a river-wide basis. While CPUE was lower in 2022 (25.57) compared to 2017 (31.53), when comparing all years from 2002 through 2022, CPUE was not significantly different between years (ANOVA, $P=0.715$) (Table 3). When examined by river reach in 2022, differences in abundance between the reaches were noted, however, they were not significantly different (ANOVA, $P=0.05$) (Table 4). Individual reaches were compared among years for the 2002 through 2022 surveys, using ANOVA or K-W Tests (based on Levene's Test). Overall, statistically significant differences were not found between the survey years within the river reaches ($P>0.05$), however, CPUE differences were noted between the survey years. Yellow Perch CPUE showed a declining trend in four reaches and increased in the other three. The declines were in Lake Nicolet, Lake George, St. Joseph Channel and Potagannissing Bay. With a CPUE of 18.5, Yellow Perch abundance increased 208% in the Upper River compared to the 2017 survey but was still the second lowest in the series. CPUE continued to decrease in Potagannissing Bay, dropping to 28.3 in 2022 from 56.2 in 2017 and a series high in

2014 of 88.5. The CPUE in Lake Munuscong increase in 2022 to 20.0 from 10.5 in 2017, similar to the CPUEs from 1987 through 2013. Raber Bay had a CPUE of 71.0 in 2022 which is the highest in the survey series (Table 4).

Northern Pike:

After an increasing trend from 2009-2017, Northern Pike CPUE declined in 2022 (K-W Test, P=0.051), with the 2022 CPUE lower than in 2017 (Dunn's Test, P=0.022) (Table 2). In 2022, CPUE was not significantly different between the reaches (ANOVA, P=0.618). Comparing the catches among reaches from 2002 through 2022, Northern Pike CPUE increased in the Upper River (Site 404, Table 4), however, this increase was not significant (K-W Test, P=0.436). While the 2022 CPUEs for the remaining locations declined compared to previous surveys, they were not significantly lower. The largest decrease occurred in Lake Munuscong (ANOVA, P=0.062), where CPUE dropped by 62% (Table 4).

Walleye:

Mean catch per unit effort (CPUE) of walleye was significantly different between the years 2002 through 2022 (K-W Test, P<0.001), with CPUE lower in 2022 (3.30) compared with 2017 (5.11) (Dunn's Test, P=0.029), 2013 (11.25) (Dunn's Test, P=0.007), and 2006 (11.18) (Dunn's Test, P=0.001) (Table 3). Walleye CPUE peaked at 11.25 in 2013 (Table 3). In 2022, Walleye catch was significantly different between the reaches (K-W Test, P=0.011), with the highest CPUE in Raber Bay (13.0) and the lowest in the St. Joseph Channel (0.0) (Table 4). Walleye CPUE remained stable within the individual reaches over the surveys between 2002 and 2022 (Table 4) with the exception of Potagannissing Bay (K-W Test, P=0.018), with the 2022 CPUE (2.2) significantly lower (Dunn's Test, P=0.016) than the peak CPUE in 2006 (18.8).

Smallmouth Bass:

Smallmouth Bass mean CPUE increased to 4.60 in 2022, which is just under the highest mean CPUE in the times series at 7.76 reached in 2013 (Table 3). Smallmouth Bass mean CPUE was variable over the last six surveys (Table 3), with significant differences among the years (K-W Test, P=0.013). The peak catches in 2006 and 2013 were significantly greater than catches in 2002, 2009, and 2017 (Dunn's Tests), while the 2022 CPUE (4.60) was not significantly lower than the 2013 (7.76) CPUE (Dunn's Test P=0.142) (Table 3). In the 2022 survey, catch between the reaches was significantly different (K-W Test, P=0.013), with the greatest catch in the St. Joseph Channel (24.0) (Table 4).

Comparing among the reaches from 2002 through 2022, all reaches showed increases in Smallmouth Bass abundance with the exceptions of Lake George and Potagannissing Bay (Table 4). Lake George declined from a mean CPUE of 7.1 in 2017 to 3.87 (2022) (Table 4), though this was not significantly lower than the previous surveys (K-W Test, P=0.288). Potagannissing Bay also declined, with a mean CPUE of 0.2 in 2022 compared with the 2017 CPUE of 3.8, though not significantly (K-W Test, P=0.77) (Table 4). The 2022 Lake Munuscong CPUE (3.3) is higher than in 2017 (3.0), however, there is variability among the catches during the series (K-W Test, P=0.054). The 2006 CPUE (13.8) is higher than the other survey years (Dunn's Tests), with the exception of the 2013 survey (Dunn's Test, P=0.758). The St. Joseph Channel had the highest Smallmouth Bass abundance of any reach in 2022 with a CPUE of 24.0, the highest of the time series. CPUE in the St. Joseph Channel has remained stable through this timeseries (K-W Test, P=0.588) (Table 4).

Cisco:

Cisco CPUE increased to 9.03 in the 2022 survey, among the highest CPUEs of the time series (Table 3). Cisco abundance has been variable throughout the 2002 through 2022 surveys, however, abundance is not significantly different among the years (K-W Test, P=0.903). Catches between the river reaches in the 2022 survey were not significantly different (K-W Test, P=0.544), with catches in all reaches except the Upper River (Table 4). Comparing within the river reaches for the survey years 2002 through 2022, there were no significant differences to CPUE for any of the reaches (ANOVA or K-W Test as appropriate). Historically, the lower most reaches of the St. Marys (Raber and Potagannissing bays) had the highest CPUE with 62.7 in Raber Bay in 1979 being the highest on record followed by 54.0 in Potagannissing Bay in 1987 (Table 4). In 2022, the highest CPUE was in Lake George 25, followed by Raber Bay with 24.5 (Table 4).

Other Species:

Mean CPUE was calculated for all of the species collected in each survey (Table 3). White Sucker mean CPUE remains high and stable among the years (ANOVA, P=0.715). Rock Bass (K-W, P+0.785), Brown Bullhead (ANOVA, P=0.910), Lake Whitefish (K-W, P=0.553), Burbot (K-W, P=0.660), and Menominee (K-W, P=0.846) have remained stable from 2002-2022, though at lower CPUEs. Silver and Shorthead Redhorse Suckers were combined into Moxostoma spp. for comparison amongst the survey years, as individuals were not always identified to species early in the survey series. Between the years, Moxostoma spp. CPUE has varied significantly (K-W, P=0.002), with 2009 having the highest CPUE compared to previous surveys (Dunn's Test, P=0.04, Table 3) and remained high in 2013. While CPUE was lower in 2002, it was not significantly lower than the peak 2009 CPUE (Dunn's Test, P=0.130).

Aquatic Invasive Species (AIS)

Catch rates for aquatic invasive species were generally low in the survey. Species including Ruffe (0.11), White Perch (<0.01), and Carp (<0.01) had low catch rates, while the catch rate for Rainbow Smelt (2.95) was low in general but second highest in the catch series for this species after 1975 (4.97) (Table 2).

Ruffe continued to persist in the Upper River at Site 1 where four Ruffe (135-185 mm) were captured during the current survey, the same area where Ruffe (10 fish) were new to the survey in 2017. One other Ruffe (139 mm) was captured downstream approximately 44 miles east in Lake George at Site 10.

Other AIS not vulnerable to the survey gear were encountered as dietary items by species of special interest. Round Goby remains were present in a small percentage of the stomachs of predators examined including Northern Pike, Smallmouth Bass, Yellow Perch, and Cisco (Table 13). Similarly, spiny water fleas (*Bythotrephes longimanus*) were found in up to 17.5 and 20.6 percent of Smallmouth Bass and Yellow Perch stomachs, respectively, and were a minor component of Northern Pike and Cisco diets. Dreissenids composed a small percentage of the diet of Yellow Perch. Rainbow Smelt was more prominent in the diet and occurred in 39 percent of Walleye stomachs that were not void. White Perch remains composed a small percentage of Northern Pike stomachs.

Lake Sturgeon

A total of 37 Lake Sturgeon were captured in 2022, the highest of any year in the survey series. Catch rates were compared between the two net "types", traditional nets and the full nets. CPUE for Lake Sturgeon was significantly higher (M-WU, P= 0.017) in the full nets. Mean CPUE was

significantly different between years (K-W Test, P<0.001) with CPUE in 2017 (0.59) and 2022 (0.84) significantly higher than any of the other expanded mesh survey years (Dunn's Test, P< 0.002; Table 3). Mean CPUE in 2017 and 2022 were not statistically different (Dunn's Test, P=0.333). Lake Sturgeon were collected in five of the six netting locations below the Compensating Works: Lake George, Lake Munuscong, Raber Bay, Potagannissing Bay, and St. Joseph Island with the majority captured in Lake Munuscong (N=26). Sturgeon ranged in size from 427 mm to 1150 mm (Appendix 4).

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 structures, 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 2021 age-1 Yellow Perch year class was not well represented throughout the river (Table 5), similar to the 2017 FCIN survey. Age -2 fish made up 41.6 % of the Yellow Perch catch followed by age-3 at 31 % and age-4 at 19.2 %. Relative to the MI average Yellow Perch growth index was -1 in 2022 a decrease from 2017 value of +9.

The total annual mortality rate for Yellow Perch (0.50) on a river-wide basis increased from the 2017 survey (0.41) but falls well below the peak rates seen in the time series (Table 6). Total annual mortality for Yellow Perch increased from 2017 to 2022 in Lake Nicolet, Lake George and Raber Bay while declining in Munuscong Bay and staying stable in Potagannissing Bay and the Upper River. Yellow Perch in the St. Marys River start to mature at 13 cm and were fully mature at 26 cm (Table 7). Yellow Perch condition, based on mean relative weight, remained high in 2022, similar to previous years (Table 8). Mean relative weight was more consistent a crossed all reaches in 2022 than in 2017 with Potagannissing Bay lowest at 86 and St. Joseph highest at 100.

Walleye:

Walleye were captured in all age classes 1 thru 13. The majority (80%) of the fish captured were in the 2 through 6 age class, with age 3 having the highest catch per unit effort (CPUE) during the survey (0.5). Mean length-at-age for walleye in the 2022 survey was slightly below the state of Michigan average. The growth index, which compares length-at-age to the state average was -2mm (Table 9). The -2mm growth index is fairly consistent with the growth index from 2017 (-1mm). Total annual mortality for walleye in 2022 (30%) was slightly below the 2017 survey (39%) and comparable to 2013 (32%) (Table 6). Walleye maturity began at 30 cm, total length, however full maturity was not achieved until 51 cm in total length (Table 7). Walleye condition was consistent with 2017 survey which was an increase from 2013 and 2009 (Table 8). Walleye condition was stable across all fishing locations in the 2022 survey. Walleye otoliths were examined for oxytetracycline marks to distinguish stocked from wild fish. Of the 101 fish examined 53 (52%) were of hatchery origin. The majority of the hatchery stocked fish were in the 2-4 age class (68%). Stocked Walleye were caught in each reach with the exception of St. Joseph Channel.

Smallmouth Bass:

Smallmouth Bass were captured in all age classes from one through thirteen, with a mean age of 4.4 (Table 10). The majority of the fish captured (75%) were age 2-6. CPUE was highest for age 3 (0.7). The Smallmouth Bass growth index was lower than the Michigan State average at -23 (Table 10). Smallmouth Bass total annual mortality in 2022 was the lowest in the time series with a value of 0.30 (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 33 cm which is slightly below the 36 cm Michigan minimum length limit. Smallmouth Bass continue to exhibit a high condition level (96-108) in the St. Marys River in each of the six fishing locations where they were collected. Smallmouth Bass condition has remained stable in all of the river wide surveys since 1995 (Table 8).

Northern Pike:

The total annual mortality rate for Northern Pike in the river decreased in 2022 compared to 2017 and is at its lowest in the survey series (Table 6).

Northern Pike growth rates improved in 2017 relative to previous years, with overall lengths-at-age being approximately 9 mm larger than the statewide average, with the observed growth index second highest in the survey series (Table 11). Northern Pike ages 0 through 7 were present in the survey and sizes up to 786 mm in total length were caught. The mean age of Northern Pike in the survey was 2.8 (Table 11). Maturity of female Northern Pike was consistent at total lengths of 52 cm and greater (Table 7). Mean relative weight of Northern Pike in the St. Marys River decreased slightly in 2022 compared to 2017 but is still within the historical range (Table 8).

Cisco:

The mean length (273mm) and mean age (2.4) of Cisco caught in 2022 was the lowest on record (Table 12) with a high proportion of the catch being age-1 (44%) fish, suggesting a strong recruitment event in 2021. Cisco age structure was dominated by the 2021 and 2022 year classes (Table 12) and in all, nine cohorts were represented. Cisco grew faster than the state of Michigan average or the Ontario North Channel average rates (Table 12) and condition as indicated by Wr was within the range previously observed (Table 8). Cisco totally annual mortality was 0.47 in 2022, which is the second highest observed since 1995 (Table 6). Female Cisco were consistently mature after 31cm in 2022 (Table 7). Cisco condition has remained stable throughout the survey period (Table 8), but was highest in Lake Nicolet when compared with the other reaches (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). Northern Pike had the highest percent of empty stomachs (70.5%) followed by Walleye (63.2%). Alewife were not identified as a prey item for any species examined in the 2022 survey. Walleye diet, for identified prey items, was dominated by Rainbow Smelt

(20.5%), followed by Yellow Perch (5.15) and Salmonids and Cyprinids (2.6% for each). Yellow Perch were consumed by Walleye (5.1%), Northern Pike (17.9%), and Smallmouth Bass (2.9%). Crayfish were found in Smallmouth Bass (4.3%), Cisco (1.8%), and Yellow Perch (1.3%). Round Goby remained a prey item for Northern Pike (3.6%), Smallmouth Bass (2.9%), and Yellow Perch (1.8%) and Dreissenid mussel sp. were found in Yellow Perch (0.3%). Water Flea were found in all species examined except Walleye stomachs (Table 13). Yellow Perch had the most varied diet with 18 items, while Walleye had the fewest with 6. Unidentified fish remains were found in all species (Table 13).

Sea Lamprey Wounding

The incidence of Sea Lamprey wounding among all of the species sampled was high in 2022, with 31 fish wounded across 12 species (Table 14). While wounding rates were still the highest among the salmonid species sampled, in 2022 five non-salmonid species also were also wounded. Lake Sturgeon (8%), Northern Pike (4%), Silver Redhorse (4%), Smallmouth Bass (1%) and White Sucker (0.2%). Overall, 2022 had the most species wounded between 2002-2022 (Table 15).

Discussion

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 2022 but the mean CPUE of 25.6 was not significantly different from the previous survey average of 32.7 and the overall trend remains positive since the first survey in 1975. Potagannissing Bay showed the largest decline of the reaches falling from 56.2 in 2017 to 28.3 in 2022. Raber Bay exhibited the highest CPUE of any reach along with the largest increase from 44.2 in 2017 to 71.0 in 2022 which is also the highest value recorded for this reach. The Upper River experienced the highest percentage increase of 105 % but still remained well below the long-term average. 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 2022 is near the state average at -1. Relative to the Michigan average for Yellow Perch the growth index for the St. Marys River is slightly negative which is not surprising given its relative northern latitude. River wide annual mortality (.50) increased slightly from 2017 but stayed below average for the survey series.

Yellow Perch had the most varied diet of any of the fish examined in 2022, with 18 prey items. The dominant prey in 2022 was Water Flea (21.2%), followed by Mayfly (9.2%), and Trout-Perch (3.1%). While Crayfish were identified (1.3%), they were a substantially smaller component of the identified diet than in 2017 survey where they made up 51.1% of the diet and lower than previous surveys, where the lowest measured Crayfish proportion was 9.1% of the diet (Chong et al. 2015).

Northern Pike

Northern Pike abundance (CPUE) was lower in 2022, despite having an increasing trend from 2009-2017. Interestingly, Northern Pike harvest and harvest rate in the recreational fishery were higher in 2022 compared to 2017 (Godby et al. 2024).

Northern Pike have likely benefited from higher water levels in the St. Marys River in the past decade (USACE 2019). The higher water levels typically increase coastal wetlands throughout the system, providing good spawning and nursery habitat for pike in the form of flooded vegetation.

Great Lakes water levels have generally been higher since about 2013, and Lake Superior outflows controlled through the Compensating Works on the St. Marys River have generally been higher. Although pike have benefited from the higher water levels in the past decade, it is unknown why their abundance declined in 2022.

The mean age of Northern Pike in the netting survey is lower than the mean age of Northern Pike in the accompanying Creel Survey. The mean age of Northern Pike in this netting survey was 2.8, while the mean age of harvested fish in the creel survey was 3.9 (Godby et al. 2024). While the netting survey captures all sizes of Northern Pike that have recruited to the gear, the fisheries-independent creel survey is comprised of fish in the recreational harvest, which is reflective of minimum size limits established for the sport fisheries. As expected, this results in the mis-match of mean age between the two surveys.

Northern Pike in the St. Marys River preyed primarily on other fish, as would be expected based on their position in the food chain as a top predator. While 70.5% of the stomachs examined were empty, consistent with the 2017 survey (72.8%), the remainder contained other fish. Unidentified fish remains (partially digested) were the most common prey item found in the stomachs of Northern Pike (50.0%), followed by Yellow Perch (17.9%), Trout-Perch (10.7%), Rainbow Smelt (3.6%), and Johnny Darter (3.6%) (Table 13). Crayfish were not identified in Northern Pike in 2022 but they were a large part of the diet (16.3%) in 2017.

We acknowledge that this survey design has not traditionally been effective at evaluating Esocid populations, especially Muskellunge (Schaeffer et al. 2011). Muskellunge are typically not captured in this survey and were not part of the catch in 2022. Muskellunge also did not show up in the companion creel survey (Godby et al. 2024). We do know from angler reports and photos, however, that Muskellunge are a popular target for anglers in the St. Marys River system at certain times of the year. The design for this survey, including timing and gear placement, make Muskellunge an elusive component of the fish community.

Walleye

Walleye fell to the seventh most caught species (as measured by traditional mesh net CPUE; Table 3) in the St. Marys River during the 2022 survey with Yellow Perch, White Sucker, Cisco, Rock Bass, Smallmouth Bass, and Northern Pike all having higher CPUE in 2022. In the 2022 survey, Walleye appeared to be well distributed throughout the river, however, the 2022 Walleye CPUE declined compared with the peaks of 2006 and 2013 and was also lower than the 2017 survey. The surveys conducted from 2006-2017 showed an increase in Walleye CPUE compared to the survey low of 2002. While no Walleye were caught in the traditional mesh size in St. Joseph channel in 2022, fish were caught in the expanded meshes. Within the reaches, CPUE has remained stable between the survey years, with the exception of Potagannissing which was significantly lower in the 2022 survey year.

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), 2017 (7.9), and 2022 (4.2). Water depth may play a role in net efficiency in Lake George, as lake levels have been highly variable over the past 10 years.

Walleye CPUE has 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). The inability to safely set nets in or near the shipping channel therefore, may be contributing to a lower CPUE for Munuscong Bay.

Mean length-at-age for Walleye in the 2022 survey was slightly below the state of Michigan average. The growth index, which compares length-at-age to the state average, was -2 mm. 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 fell slightly in 2022 (30%) but stayed fairly consistent with the 2017 (39%) and 2013 (32%) 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, 53 % of the walleye captured were identified as stocked. Stocked fish were found in every reach with the exception of the St. Joseph Channel, with the Upper River having the highest percentage of stocked fish at 63.2%.

Of the 106 walleyes captured in the survey 67 of them (63.2%) had stomachs that were void. Of the stomachs that contained contents, unidentifiable fish remains was the most common stomach content found in walleyes (69.2%) followed by Rainbow Smelt (20.5%), which was consistent with the 2017 survey (18.4; O'Connor et al. 2019). Condition, as measured by mean relative weight remained stable at 83 in 2022 compared to 87 in 2017. River wide Walleye condition was lower in the 2009 and 2013 surveys at 57 and 56 respectively. In earlier surveys Walleye condition ranged from 87 in 2006 up to 102 in 1995 (Table 8). Relative weights were uniformly high throughout the river in 2022.

Smallmouth Bass

Smallmouth Bass abundance in the St. Marys River rebounded after declining in the 2017 survey, almost reaching a time-series high in 2022 based on the CPUE in the expanded mesh (Table 3). The increase in CPUE in 2022 relative to past surveys was less pronounced when comparing the traditional mesh CPUE (Table 3). The increase in Smallmouth Bass abundance was most pronounced in the St. Joseph Channel (Table 5). The St. Joseph Channel has had the highest CPUE among the 7 reaches surveyed in all but one year since 2002 when it was first included in the survey (Table 4). The central portion of the river appears to provide good habitat for Smallmouth Bass. The increase in river-wide mean CPUE of Smallmouth Bass coincides with a decline in the total annual mortality rate (Table 7). Mean age of Smallmouth Bass (4.4) increased in 2022 with a broader age range in the catch from 1-13 compared to 1-10 in 2017 (Table 9). The Smallmouth Bass diet in the St. Mary's River was dominated by prey fish and water fleas representing a shift compared to the 2017 survey where crayfish were the dominant prey item and water fleas were absent in Smallmouth Bass stomachs (Table 14). Northern Pike, Yellow Perch and Round Goby were among the identified fish species in Smallmouth Bass stomachs in 2022 (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 is primarily 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 mean relative abundance in the St. Marys River increased in 2022 compared to the series low in the 2017 survey. The increase in 2022 relative abundance is supported by strong Age-1 and Age-2 Cisco which represent 78.8% of the catch. 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 was consistent in 2022 compared to 2017 (Table 12). Combined with the increased relative abundance in 2022, the biological metrics including growth rate, mortality, maturity, and condition do not point to a sustainability concern for Cisco. In the 2022 survey, only 40.2% of the Cisco had empty stomachs, compared with 93.8% in the 2017 survey. Diet in the 2022 survey was more varied, with 13 items compared with two in the 2017 survey. Mayfly (24.8%), Zooplankton (22.1%), Amphipods (21.2%), and Caddis/Damsel/Stone flies (8.0%), were the majority of the items identified in the 2022 survey.

AIS

AIS persist in the St. Marys River and remain a concern. They were present in low abundance in the current survey but through time some species have become more widely distributed. Some AIS are present but not readily detected with the gill net survey gear and their detection and status relies on other information such as agency surveys or findings reports. The St. Marys River is a connecting channel between Lake Superior and Lake Huron and is a natural pathway by which invasives may move from one area to another through assisted or unassisted range expansion. Ruffe is one example from the current survey that is expanding downstream toward Lake Huron. Ruffe were accidentally introduced to the Duluth-Superior harbor in western Lake Superior in the 1980s (Pratt et al. 1992) and colonized the south shore of Lake Superior. They were captured in the upper river at the eastern end of Lake Superior in the 2017 survey. Ruffe moved into Lake Huron waters below the compensating works at Sault Ste. Marie and unique individuals were captured at Little Lake George and Raber Bay pre-2020 (USGS 2024a). Their pending impact on the fishery and ecosystem of the St. Marys River remains unknown. A review by Gutsch and Hoffman (2016) of native and non-native Ruffe ranges states that Ruffe has "caused substantial ecological damage in North America, parts of Western Europe, Scandinavian countries, and the United Kingdom." Ruffe mature early and have an extended spawning season in North America which may allow them to become abundant quickly. Ruffe also readily adjust to local environmental and habitat features. The dietary niche of Ruffe can overlap with other native species including Trout-Perch and Yellow Perch (Ogle et al. 1995), both common in the St. Marys River. Ruffe have also been known to feed on Cisco eggs in Lake Superior (Selgeby 1998) which could be problematic for St. Marys River Cisco and other whitefish if there is heavy egg predation. It is currently unknown what the effect of Ruffe will have on other species in the St. Marys River, compared with other known invasion locations (Savino and Kolar 1996, Bronte et al. 1998). However, it seems there have been fewer widespread problems with Ruffe in Lake Superior than initially anticipated (Savino and Kolar 1996, Bronte et al. 1998).

Other invasives exist in the St. Marys River including Round Goby and Tubenose Goby, benthic species found in the lower St. Marys River that are slowly expanding according to AIS targeted surveys (A. Bowen, personal communication, USGS 2024b and USGS 2024c). Rusty crayfish (*Faxonius rusticus*) is established in portions of Potagannissing Bay and near the Munuscong River

but have been reported as far upstream as Sault Ste. Marie according to the USGS Nonindigenous Aquatic Species (NAS) Database (nas.er.usgs.gov, USGS 2024d). Dreissenids and spiny water flea have been present in the diet of FCIN survey species as early as 2002 (O'Connor et al. 2019). Dreissenids are abundant in the lower river and captured as bycatch in trawls as far upstream as Munuscong Bay (A. Bowen, USFWS personal communication), however, they have been also been reported near Sault Ste. Marie according to the USGS NAS Database (USGS 2024e). Didymo (*Didymosphenia geminata*), a nuisance algae species, has been problematic and present in large blooms in the St. Marys River.

Lake Sturgeon

Lake Sturgeon CPUE was highest in 1975 followed by low catches until the 2017 and 2022 surveys (Table 2). Mean CPUE has increased over the last 20 years, with 2017 and 2022 values significantly higher than any in the expanded mesh survey series. Lake Sturgeon were captured in 83% of the netting areas below the Compensation Works, with the greatest number of fish captured in Lake Munuscong. This is consistent with 2017 survey results when the greatest number of fish were also captured in this reach. An ongoing acoustic telemetry study will provide information on the habitat use of both juvenile and adult sturgeon throughout the river, but preliminary results indicate both Lake Munuscong and Raber Bay reaches are areas of high juvenile Lake Sturgeon use. Our catch of Lake Sturgeon may be limited by mesh size as our largest mesh fished is 152.4 mm (6.0"), where most nets targeting Lake Sturgeon use mesh sizes 203.2 mm (8.0") and greater to increase the chance of catching larger fish (Pratt et al. 2016). The increase in Lake Sturgeon CPUE in 2017 and 2022, presence of multiple age classes, and increase in both the number of reaches and distribution of catch indicate an increase in abundance within the St. Marys River.

Sea Lamprey Wounding Rates

During Covid, Sea Lamprey control treatments were delayed. This resulted in an increase in the number of feeding Sea Lampreys throughout the Great Lakes. This trend is reflected in the number of lamprey wounds noted during the 2022 netting survey. Sea Lamprey wounding rates were higher in both the number of species wounded (12) and the total percent of species wounded (34%) when compared to the 2002-2017 surveys. It is expected that as treatments resume post Covid that the wounding rates for all species will be reduced in the 2027 survey.

Special Concerns

Of concern to the St. Marys River is the potential invasion or colonization by invasive carp (Bighead Carp, Silver Carp, Grass Carp, and Black Carp), Northern Snakehead, Tench, Roach or other new invasive fish species that are not currently found in the vicinity of the river but would be problematic if they became established. The St. Marys River supports a relatively healthy ecology, and invasive species impacts could disrupt the health and balance of the ecosystem. Generally, invasive species compete with native species for valuable habitat or food resources but can also directly prey on native species. In addition, many invasives tolerate a variety of environmental conditions and can adapt to new environments. The ultimate issue is that invasive species can disrupt the food chain and ecological balance and ultimately jeopardize species diversity – including impacts on habitats. This is especially problematic for the diverse and robust fish community of the St. Marys River, which supports a large sport fishery.

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

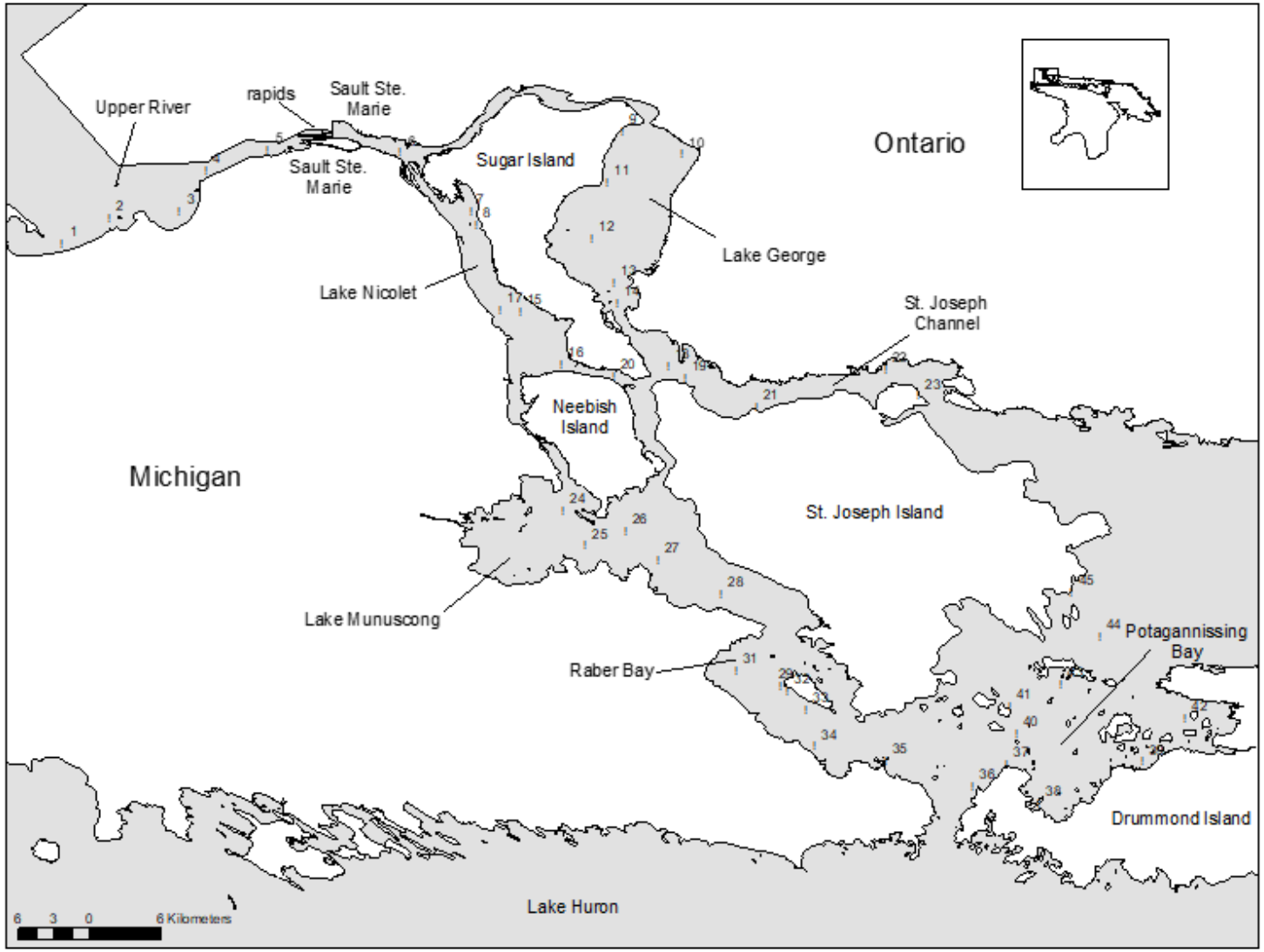


Table 1. Net set locations used to define areas within the St. Marys River for the purpose of certain data analyses, along with a list of the agencies that performed the field work in 2022. See Figure 1 for location of each net number.

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	SSMTCI, 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	MDNR, SSMTCI
Potagannissing Bay	36, 37, 38, 39, 40, 41, 42, 43, 44, 45	MDNR, OMNR, DFO

Table 2. Mean Catch-Per-Unit-of-Effort (CPUE) of all species collected from the St. Marys River 1975 through 2022. 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, 2022, 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	2022
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)	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)	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)	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)	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)	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)	0.06 (0.06)	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)	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)	2.22 (1.34)
Brown Trout	0.03	0.00	0.03	0.09	0.00	0.00	0.00	0.00	0.00	0.00

Species[a]	1975	1979	1987 [b]	1995 [c]	2002	2006	2009	2013	2017	2022
	(0.03)	(0.00)	(0.03)	(0.07)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Burbot	0.05	0.00	0.00	0.05	0.06	0.00	0.17	0.20	0.11	0.06
	(0.04)	(0.00)	(0.00)	(0.05)	(0.06)	(0.00)	(0.10)	(0.15)	(0.08)	(0.06)
Carp	0.16	0.00	0.03	0.00	0.00	0.07	0.00	0.07	0.00	0.00
	(0.08)	(0.00)	(0.03)	(0.00)	(0.00)	(0.07)	(0.00)	(0.07)	(0.00)	(0.00)
Channel Catfish	0.00	0.00	0.09	0.00	0.00	0.15	0.00	0.13	0.00	0.00
	(0.00)	(0.00)	(0.05)	(0.00)	(0.00)	(0.15)	(0.00)	(0.13)	(0.00)	(0.00)
Chinook Salmon	0.00	0.03	0.46	0.08	0.28	0.15	0.06	0.20	0.06	0.06
	(0.00)	(0.03)	(0.29)	(0.05)	(0.12)	(0.10)	(0.06)	(0.11)	(0.06)	(0.06)
Cisco	14.12	22.40	18.98	9.80	4.38	3.53	10.23	4.08	1.70	9.03
	(5.13)	(11.28)	(8.34)	(3.40)	(2.51)	(1.84)	(4.31)	(2.21)	(0.59)	(4.01)
Coho Salmon	0.03	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00
	(0.03)	(0.00)	(0.00)	(0.05)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Freshwater Drum	0.00	0.00	0.03	0.00	0.34	0.59	0.17	0.07	0.00	0.06
	(0.00)	(0.00)	(0.03)	(0.00)	(0.17)	(0.24)	(0.10)	(0.07)	(0.00)	(0.06)
Gizzard Shad	0.00	0.00	0.12	0.05	0.11	0.00	0.00	0.07	0.00	0.00
	(0.00)	(0.00)	(0.12)	(0.05)	(0.11)	(0.00)	(0.00)	(0.07)	(0.00)	(0.00)
Lake Sturgeon	0.99	0.03	0.09	0.00	0.00	0.00	0.00	0.07	0.34	0.28
	(0.96)	(0.03)	(0.05)	(0.00)	(0.00)	(0.00)	(0.00)	(0.07)	(0.17)	(0.17)
Lake Trout	0.00	0.31	0.00	0.00	0.00	0.07	0.17	0.07	0.06	0.11
	(0.00)	(0.31)	(0.00)	(0.00)	(0.00)	(0.07)	(0.17)	(0.07)	(0.06)	(0.11)
Lake Whitefish	1.15	0.55	2.10	0.73	0.85	0.29	2.33	0.46	0.80	1.82
	(0.41)	(0.25)	(0.99)	(0.37)	(0.41)	(0.18)	(1.13)	(0.21)	(0.44)	(1.49)
Largemouth Bass	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.07)	(0.00)	(0.00)	(0.00)	(0.00)
Longnose Gar	0.00	0.03	0.06	0.00	0.06	0.07	0.00	0.07	0.00	0.00
	(0.00)	(0.03)	(0.04)	(0.00)	(0.06)	(0.07)	(0.00)	(0.07)	(0.00)	(0.00)
Longnose Sucker	0.94	1.07	4.26	2.85	2.10	1.99	2.61	0.13	1.59	0.63
	(0.51)	(0.49)	(2.46)	(1.33)	(1.01)	(1.26)	(1.15)	(0.09)	(0.79)	(0.47)
Menominee	0.83	0.52	0.00	1.49	0.80	0.22	3.35	0.92	5.23	1.36
	(0.44)	(0.30)	(0.00)	(0.55)	(0.34)	(0.12)	(1.80)	(0.79)	(2.68)	(0.81)
Muskellunge	0.00	0.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.43)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Northern Pike	9.04	8.07	12.69	9.26	2.61	3.82	3.01	5.13	6.99	3.64
	(1.77)	(1.31)	(2.11)	(1.64)	(0.61)	(0.81)	(0.75)	(1.29)	(1.26)	(0.89)
Pink Salmon	0.00	0.00	2.78	0.55	0.28	0.22	0.06	0.13	0.00	0.00
	(0.00)	(0.00)	(1.38)	(0.20)	(0.15)	(0.12)	(0.06)	(0.09)	(0.00)	(0.00)
Pumpkinseed	0.00	0.00	0.00	0.00	0.97	0.66	0.85	0.00	0.28	0.57
	(0.00)	(0.00)	(0.00)	(0.00)	(0.56)	(0.66)	(0.53)	(0.00)	(0.19)	(0.57)
Rainbow Smelt	4.97	1.64	1.02	0.86	0.40	0.44	1.65	1.51	2.05	2.95

Species[a]	1975	1979	1987 [b]	1995 [c]	2002	2006	2009	2013	2017	2022
	(2.45)	(0.69)	(0.47)	(0.50)	(0.21)	(0.22)	(1.14)	(1.06)	(1.04)	(1.21)
Rainbow Trout	0.03	0.13	0.22	0.00	0.06	0.00	0.00	0.00	0.00	0.00
	(0.03)	(0.07)	(0.22)	(0.00)	(0.06)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Redhorse spp.	0.65	0.55	0.62	1.69	0.45	1.25	3.75	1.32	0.45	0.00
	(0.29)	(0.20)	(0.17)	(0.53)	(0.20)	(0.41)	(1.19)	(0..39)	(0.17)	(0.00)
Shorthead Redhorse	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.22)
Silver Redhorse	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.22)
Rock Bass	6.20	2.29	11.67	5.57	11.42	14.34	7.84	12.57	7.67	6.53
	(2.25)	(0.67)	(2.42)	(1.35)	(2.77)	(3.66)	(1.96)	(3.56)	(2.01)	(1.42)
Ruffe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.11
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.06)	(0.11)
Sculpin	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.04)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Sea Lamprey	0.00	0.03	0.00	0.12	0.00	0.00	0.06	0.00	0.57	0.00
	(0.00)	(0.03)	(0.00)	(0.09)	(0.00)	(0.00)	(0.06)	(0.00)	(0.57)	(0.00)
Smallmouth Bass	0.89	0.26	4.66	3.77	2.27	6.32	1.82	7.76	3.69	4.60
	(0.45)	(0.14)	(2.23)	(0.95)	(0.59)	(1.76)	(0.53)	(2.36)	(1.17)	(1.54)
Splake	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.19)	(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	0.05	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.05)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Sunfish spp.	0.13	0.13	1.54	0.65	0.00	0.00	0.00	0.00	0.00	0.00
	(0.08)	(0.11)	(0.89)	(0.47)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Trout-Perch	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.06
	(0.00)	(0.00)	(0.00)	(0.00)	(0.56)	(0.00)	(0.00)	(0.00)	(0.00)	(0.06)
Walleye	4.27	4.14	7.47	3.92	3.58	11.18	6.02	11.25	5.11	3.30
	(1.56)	(1.73)	(1.92)	(0.83)	(1.04)	(2.97)	(1.29)	(2.88)	(0.79)	(0.94)
White Bass	0.00	0.00	0.00	0.00	0.00	0.07	0.23	0.20	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.07)	(0.23)	(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)	(0.00)	(0.00)
White Sucker	21.48	13.85	25.68	20.00	24.7	17.65	23.07	20.39	22.27	17.78
	(3.94)	(2.20)	(5.46)	(2.47)	(3.93)	(2.52)	(3.70)	(3.84)	(4.04)	(2.33)
White Perch	0.00	0.00	0.00	0.00	0.34	0.74	0.00	0.39	0.11	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.17)	(0.42)	(0.00)	(0.20)	(0.08)	(0.00)
Yellow Perch	23.02	25.68	49.48	29.97	25.3	37.21	35.34	41.71	31.53	25.57
	(6.28)	(4.93)	(7.16)	(5.85)	(4.50)	(8.94)	(7.62)	(14.95)	(8.17)	(5.15)

[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 - 2022 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, 2022 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.

Species[a]	2002		2006		2009		2013		2017		2022	
	Expanded mesh	Traditional mesh	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)	0.00 (0.00)	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)	0.09 (0.05)	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)	0.05 (0.03)	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)	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)	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)	0.02 (0.02)	0.06 (0.06)	0.23 (0.23)	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)	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)	1.70 (0.76)	2.22 (1.34)

Species[a]	2002		2006		2009		2013		2017		2022	
	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh
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)	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)	0.07 (0.04)	0.06 (0.06)
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)	0.05 (0.03)	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)	0.09 (0.05)	0.00 (0.00)
Chinook Salmon	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)	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)	6.23 (2.45)	9.03 (4.01)
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)	0.02 (0.02)	0.00 (0.00)
Freshwater Drum	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)	0.16 (0.08)	0.06 (0.06)
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)	0.00 (0.00)	0.00 (0.00)
Lake Chub	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)	0.05 (0.05)	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)	0.84 (0.35)	0.28 (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)	0.07 (0.07)	0.11 (0.11)
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)	0.98 (0.64)	1.82 (1.49)
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)	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)	0.02 (0.02)	0.00 (0.00)
Longnose Sucker	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)	0.34 (0.23)	0.63 (0.46)
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)	0.68 (0.38)	1.36 (0.81)
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)	0.02 (0.02)	0.00 (0.00)
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)	2.25 (0.50)	3.64 (0.89)
Pink	0.39	0.28	0.14	0.22	0.02	0.06	0.00	0.13	0.00	0.00	0.05	0.00

Species[a]	2002		2006		2009		2013		2017		2022	
	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh
Salmon	(0.22)	(0.15)	(0.07)	(0.12)	(0.02)	(0.06)	(0.00)	(0.09)	(0.00)	(0.00)	(0.03)	(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)	0.05 (0.05)	0.57 (0.57)
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)	1.68 (0.66)	2.95 (1.21)
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)	0.02 (0.02)	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)	0.00 (0.00)	0.00 (0.00)
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)	3.39 (0.74)	6.53 (1.42)
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)	0.11 (0.09)	0.11 (0.11)
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)	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)	0.00 (0.00)	0.00 (0.00)
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)	0.32 (0.11)	0.45 (0.22)
Silver Lamprey	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)	0.02 (0.02)	0.00 (0.00)
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)	0.61 (0.18)	0.45 (0.22)
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)	0.93 (0.44)	0.91 (0.54)
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)	3.73 (0.97)	4.60 (1.54)
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)	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)	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)	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)	0.05 (0.05)	0.06 (0.06)
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)	2.45 (0.60)	3.30 (0.94)
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)	0.00 (0.00)	0.00 (0.00)

Species[a]	2002		2006		2009		2013		2017		2022	
	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh	Expanded mesh	Traditional mesh
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)	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)	13.64 (1.69)	17.78 (2.33)
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)	0.02 (0.02)	0.00 (0.00)
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)	29.34 (5.65)	31.53 (8.17)	38.23 (5.85)	25.57 (5.15)

- * 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 - 2022 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	2022	18.5 (9.4)	7.5 (6.3)	25.8 (16.2)	20.0 (3.4)	13.5 (12.3)	71.0 (9.9)	28.3 (14.8)
	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	2022	0.5 (0.5)	5.4 (3.8)	4.6 (1.8)	3.8 (2.8)	7.0 (3.3)	3.0 (2.0)	2.0 (1.0)
	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)

Species	Year	Upper River	Lake Nicolet	Lake George	Lake Munuscong	St. Joseph Channel	Raber Bay	Potagannissing Bay
	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	2022	2.0 (1.4)	0.7 (0.5)	4.2 (1.4)	2.9 (1.2)	0.0	13.0 (6.5)	2.2 (0.9)
	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)
	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	2022	0.5 (0.5)	2.5 (1.8)	3.8 (2.3)	3.3 (1.0)	24.0 (9.3)	3.5 (3.5)	0.2 (0.2)
	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	2022	---	4.6 (4.6)	25.0 (20.8)	1.2 (1.2)	6.5 (6.5)	24.5 (23.4)	5.2 (2.0)

Species	Year	Upper River	Lake Nicolet	Lake George	Lake Munuscong	St. Joseph Channel	Raber Bay	Potagannissing Bay
	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 2022 and mean length-at-age at capture for the St. Marys River, August 1979-2022 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 from certain net sets and therefore may not total to the overall CPUE for this species as reported in Table 3.

	Age										Mean age	Mean length	Growth index
Parameter & Area	1	2	3	4	5	6	7	8	9	10			
Upper River													
Number	1	37	19	3	8	7	0	1	0	0			
CPUE	0.2	7.4	3.8	0.6	1.6	1.4	0.0	0.2	0.0	0.0			
Frequency (%)	1.3	48.7	25.0	3.9	10.5	9.2	0.0	1.3	0.0	0.0			
Mean length													
2022	148	166	203	284	296	307	353	353			3.1	199	+34
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	5.2	228	-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	0	39	14	17	1	1	1	0	0	0			
CPUE	0.0	6.5	2.3	2.8	0.2	0.2	0.2	0.0	0.0	0.0			
Frequency (%)	0.0	53.4	19.2	23.3	1.4	1.4	1.4	0.0	0.0	0.0			
Mean length													
2022		158	165	198	231	292	275				2.8	173	-30
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			4.1	194	-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	0	163	36	47	4	6	1	0	0	0			
CPUE	0.0	27.2	6.0	7.8	0.7	1.0	0.2	0.0	0.0	0.0			
Frequency (%)	0.0	63.4	14.0	18.3	1.6	2.3	0.4	0.0	0.0	0.0			
Mean length													
2022		144	164	217	251	274	269				2.7	165	-2
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		4.3	202	-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	0	17	29	32	10	2	0	0	0	0	0		
CPUE	0.0	3.4	5.8	6.4	2.0	0.4	0.0	0.0	0.0	0.0	0.0		
Frequency (%)	0.0	18.9	32.2	35.6	11.1	2.2	0.0	0.0	0.0	0.0	0.0		
Mean length													
2022		148	158	180	214	193					3.5	171	-21
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	0	123	42	30	6	4	0	0	0	0			
CPUE	0.0	24.6	8.4	6.0	1.2	0.8	0.0	0.0	0.0	0.0			
Frequency (%)	0.0	60.0	20.5	14.6	2.9	2.0	0.0	0.0	0.0	0.0			
Mean length													
2022		145	170	203	201	204					2.7	159	-16
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		4.3	204	-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	1	137	193	115	21	16	4	1	0	0			
CPUE	0.2	27.4	38.6	23.0	4.2	3.2	0.8	0.2	0.0	0.0			
Frequency (%)	0.2	28.1	39.5	23.6	4.3	3.3	0.8	0.2	0.0	0.0			
Mean length													
2022	132	144	165	195	214	238	256	283			3.2	171	-17
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			4.1	213	+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		87	116	34	5	13	3	1	0	1			
CPUE		10.9	14.5	4.3	0.6	1.6	0.4	0.1	0.0	0.1			
Frequency (%)		33.5	44.6	13.1	1.9	5.0	1.2	0.4	0.0	0.4			
Mean length													
2022		155	187	234	264	314	341	357		384	3.1	185	+22
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			3.1	175	-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	2	603	449	278	55	49	9	3	0	1			
CPUE	<0.1	14.7	11.0	6.8	1.3	1.2	0.2	0.1	0.0	<0.1			
Frequency (%)	0.1	41.6	31.0	19.2	3.8	3.4	0.6	0.2	0.0	0.1			
Mean length													
2022	140	148	172	204	232	269	288	331		384	3.0	173	-1
2017	141	151	186	216	255	284	277	377	333	327	3.4	190	+9
2013		156	186	208	249	275	280	281			3.2	180	+3
2009		150	172	204	237	251					3.8	180	-6
2006		155	174	220	236	246	280	290			2.5	196	-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	4.1	197	-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 1995-2022.

Species	Area, if not total for the river	1995	2002	2006	2009	2013	2017	2022
Yellow Perch	Upper River	0.25	0.54	0.70	0.63	Not sampled	0.59	0.54
	Lake Nicolet	0.38	0.70	0.59	---	0.61	0.39	0.69
	Lake George	0.40	0.52	0.43	0.69	0.55	0.42	0.74
	St. Joseph Channel	Not sampled	0.64	0.50	---	0.71	---	0.75
	Lake Munuscong	0.41	0.61	0.78	0.62	0.63	0.76	0.60
	Raber Bay	0.44	0.63	0.49	---	0.71	0.50	0.61
	Potagannissing Bay	0.60	0.57	0.96	0.67	0.55	0.59	0.62
	River Total	0.38	0.68	0.70	0.64	0.60	0.41	0.50
Northern Pike		0.58	0.52	0.61	0.72	0.52	0.51	0.38
Walleye		0.51	0.49	0.38	0.38	0.32	0.39	0.30
Cisco		0.31	0.39	0.40	0.48	0.25	0.38	0.47
Smallmouth Bass		0.36	0.37	0.55	0.50	0.35	0.52	0.30

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 2022.

	Species				
Length (cm)	Walleye	Smallmouth Bass	Northern Pike	Yellow Perch	Cisco
13	---	---	---	22	---
14	---	---	---	48	---
15	---	---	---	53	---
16	---	---	---	46	---
17	---	---	---	45	0
18	---	0	---	59	0
19	---	50	---	66	0
20	---	---	---	79	0
21	---	0	---	93	21
22	---	0	---	89	0
23	---	---	---	100	0
24	---	0	---	96	0
25	---	40	---	95	---
26	---	100	---	100	67
27	---	100	---	100	38
28	---	0	---	100	160
29	---	---	---	100	57
30	100	50	0	100	80
31	0	100	0	100	100
32	50	83	---	100	100
33	0	100	---	100	---
34	---	100	---	100	100
35	33	100	---	100	100
36	25	100	---	100	100
37	---	100	---	100	100
38	0	100	---	100	100
39	---	100	---	---	100
40	50	100	---	---	100
41	100	100	0	---	100
42	50	---	---	---	---
43	100	100	---	---	---
44	100	100	---	---	---
45	100	100	0	---	---
46	---	100	---	---	---
47	---	100	100	---	---

Table 7. Continued.

	Species				
Length (cm)	Walleye	Smallmouth Bass	Northern Pike	Yellow Perch	Cisco
48	100	100	100	---	---
49	100	100	50	---	---
50	66	100	---	---	---
51	100	100	0	---	---
52	100	---	100	---	---
53	---	---	---	---	---
54	100	---	100	---	---
55	100	---	100	100	---
56	100	---	---	---	---
57	100	---	100	---	---
58	100	---	100	---	---
59	100	---	100	---	---
60	100	---	100	---	---
61	---	---	100	100	---
62	---	---	100	---	---
63	---	---	---	---	---
64	---	---	---	---	---
65	100	---	100	---	---
66	---	---	100	---	---
67	---	---	100	---	---
68	---	---	100	---	---
69	---	---	100	---	---
70	---	---	---	---	---
71	---	---	100	---	---
72	---	---	---	---	---
73	---	---	---	---	---
74	---	---	---	---	---
75	---	---	---	---	---
76	---	---	---	---	---
77	---	---	100	---	---
78	---	---	---	---	---
79	---	---	---	---	---
80	---	---	---	---	---
81	---	---	---	---	---
82	---	---	---	---	---
83	---	---	---	---	---

Table 8. Mean relative weight of select species, by area and river wide, for the St. Marys River, August 2022; River wide total values for 1995-2022 are presented for comparison.

Location	Walleye	Yellow Perch	Smallmouth Bass	Northern Pike	Cisco
Upper River	87	89	99	95	---
Lake Nicolet	86	94	104	93	94
Lake George	84	93	96	88	89
Lake Munuscong	85	97	108	94	87
St. Joseph Channel	94	100	98	89	90
Raber Bay	81	88	105	91	91
Potagannissing Bay	80	86	96	97	80
River wide 2022	83	91	100	92	88
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 2022 and mean length-at-age at capture for the St. Marys River, August 1979-2022. 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	2	16	24	21	13	12	4	4	1	3	5	1	1				
CPUE	0.0	0.4	0.5	0.5	0.3	0.3	0.1	0.1	0.0	0.1	0.1	0.0	0.0				
Frequency (%)	1.9	14.8	22.2	19.4	12.0	11.1	3.7	3.7	0.9	2.8	4.6	0.9	0.9				
Mean length																	
2022	265	337	386	446	451	517	511	541	648	552	561	520	548		4.7	437	-2
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					3.8	359	-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 2022 and mean length-at-age at capture for the St. Marys River, August 1987-2022. 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		12	27	31	23	18	18	8	7	3	4	3	1	1			
CPUE		0.3	0.6	0.7	0.5	0.4	0.4	0.2	0.2	0.1	0.1	0.1	<0.1	<0.1			
Frequency (%)		7.7	17.3	19.9	14.7	11.5	11.5	5.1	4.5	1.9	2.6	1.9	0.6	0.6			
Mean length																	
2022		166	235	287	320	349	390	420	427	444	444	469	512	504	4.4	314	-23
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						5.8	302	-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 2022 and mean length-at-age at capture for the St. Marys River, August 1987-2022. 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								Mean	Mean	Growth
Parameter	0	1	2	3	4	5	6	7	8	9	10	11	12	13	age	length	index
Number	14	8	21	19	12	10	9	1									
CPUE Frequency (%)																	
Mean length																	
2022	340	479	550	587	628	668	708	786							2.8	560	
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					2.3	487	-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 2022 and mean length-at-age at capture for the St. Marys River, August 1995-2022. 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		119	76	13	18	12	17	8	2	3							
CPUE		2.7	1.7	0.3	0.4	0.3	0.4	0.2	0.0	0.1							
Frequency (%)		44.4	28.4	4.9	6.7	4.5	6.3	3.0	0.7	1.1							
Mean length																	
2022		223	275	315	350	360	363	385	385	422					2.4	273	+30
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				3.0	284	+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 2022. % void is percent of all fish examined within that species. Percent occurrence is percentage of that item of all the items encountered. 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	106	95	162	1286	189
% void	63.2	70.5	57.4	44.9	40.2
Percent of Occurrence					
Unidentified fish remains	69.2	50.0	47.8	54.0	2.7
Crayfish	---	---	4.3	1.3	1.8
Alewife	---	---	---	---	---
Rainbow Smelt	20.5	3.6	---	1.8	---
Mayfly	---	---	---	9.2	24.8
Emerald Shiner	---	---	---	0.1	---
Logperch	---	---	1.4	---	---
Mysids	---	---	---	0.4	1.8
Unidentified zooplankton	---	---	---	1.7	22.1
Unidentified cyprinid	2.6	---	1.4	0.3	---
Dreissenid mussel sp.	---	---	---	0.3	---
Scuds	---	---	---	---	21.2
Trout-Perch	---	10.7	4.3	3.1	---
Yellow Perch	5.1	17.9	2.9	---	---
Salmonid	2.6	---	---	---	---
Northern Pike			1.4	---	---
Sculpin	---	---	---	0.1	---
Johnny Darter	---	3.6	---		---
Unidentified Darters	---	---	---	0.1	---
Unidentified fish eggs	---	---	---	---	1.8
Dragonflies	---	---	1.4	---	---
Unidentified insects	---	---		3.0	4.4
Caddis/Damsel/Stone Flies	---	---	---	0.1	8.0

Worm	---	---	---	---	0.9
Stickleback sp.	---	3.6	---	---	---
Snails	---	---	---	0.1	---
White Perch	---	3.6	---	---	---
White Sucker	---	3.6	---	---	---
Round Goby	---	3.6	2.9	1.8	---
Other	7.7	---	8.7	4.4	18.6
Water Flea	---	10.7	39.1	21.2	7.1

Table 14. Percent of Sea Lamprey wounds by species exhibiting wounding from the St. Marys River, August 2022. 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
Atlantic Salmon	4	0%	0%	0%	50%	25%	0%	0%	0%	75%
Cisco	274	1.5%	0.7%	0%	0.7%	2.2%	0%	0%	0%	4.4%
Coho Salmon	1	100%	0%	0%	0%	0%	0%	0%	0%	100%
Lake Sturgeon	37	8%	0%	0%	0%	0%	0%	0%	0%	8%
Lake Trout	3	67%	0%	0%	0%	0%	0%	0%	0%	67%
Northern Pike	99	4%	0%	0%	0%	0%	0%	0%	0%	4%
Pink Salmon	2	0%	0%	0%	0%	0%	0%	50%	0%	50%
Rainbow Trout	1	100%	0%	0%	0%	0%	0%	0%	0%	100%
Round Whitefish	30	7%	0%	0%	0%	0%	0%	0%	0%	7%
Silver Redhorse	37	4%	0%	0%	0%	0%	0%	0%	0%	4%
Smallmouth Bass	164	0%	0%	0%	0%	1%	0%	0%	0%	1%
White Sucker	600	0%	0.2%	0%	0%	0%	0%	0%	0%	0.2%

Table 15. Percent of total Sea Lamprey wounds by species for years 2002 – 2022. Wounds were scored according to Ebner et al. (2006), with total wound percent by year.

Species	2002	2006	2009	2013	2017	2022
Alewife	0.2%	0%	0%	0%	0%	0%
Atlantic Salmon	0%	0%	0%	0%	0%	75%
Brown Bullhead	1%	0%	0%	0%	0%	0%
Chinook Salmon	4%	17%	0%	25%	0%	0%
Cisco	0%	2%	0%	4%	2%	4.4%
Coho Salmon	0%	0%	0%	0%	0%	100%
Lake Sturgeon	0%	0%	0%	0%	0%	8%
Lake Trout	0%	17%	0%	0%	0%	67%
Lake Whitefish	6%	0%	0%	0%	4%	0%
Longnose Sucker	2%	0%	0%	0%	0%	0%
Northern Pike	0%	0%	0%	0%	0%	4%
Pink Salmon	0%	0%	0%	0%	0%	50%
Rainbow Trout	0%	0%	0%	0%	0%	100%
Rock Bass	1%	0%	0%	0%	0%	0%
Round Whitefish	0%	6%	0%	0%	0%	7%
Silver Redhorse	0%	0%	0%	0%	0%	4%
Smallmouth Bass	0%	0%	0%	0%	0%	1%
Walleye	1%	0%	0%	0%	0%	0%
White Sucker	1%	0.4%	0%	1%	0.1%	0.2%
Yellow Perch	0.7%	0.1%	0%	0.1%	0%	0%
Total Species	31	30	29	34	30	35
Species Wounded	9	6	0	4	3	12
% Species Wounded	29%	20%	0%	12%	10%	34%

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*
Freshwater Drum	*Aplodinotus grunniens*
Gizzard Shad	*Dorosoma cepedianum*
Johnny Darter	*Etheostoma nigrum*
Lake Chub	*Couesius plumbeus*
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*
Ruffe	*Gymnocephalus cernua*
Sculpin	*Cottus bairdi*
Sea Lamprey	*Petromyzon marinus*
Shorthead Redhorse	*Moxostoma macrolepidotum*
Silver Lamprey	*Ichthyomyzon unicuspis*
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*

Common name	Scientific name
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. Total catch and cumulative species by net set type for full mesh nets (all 10 mesh panels) for the surveys years 2002 to 2022. Fish marked with an * are new species for each year.

	Survey Year					
Species	2002	2006	2009	2013	2017	2022
Alewife	467	47	10	61	8	
Atlantic Salmon				1*	1	4
Black Crappie		1*		10	1	2
Bloater	1					
Bluegill				2*	1	
Bowfin					1*	1
Brown Bullhead	114	117	85	118	205	75
Burbot	4	3	7	9	8	3
Carp	2	8		2		2
Channel Catfish	1	13	5	5	4	4
Chinook Salmon	28	12	2	4	2	2
Cisco (Lake Herring)	125	152	292	103	45	274
Coho Salmon		1*		1		1
Creek Chub			9*			
Freshwater Drum	19	47	18	14	4	7
Gizzard Shad	4	1		1		
Lake Chub						2*
Lake Sturgeon	1		5	5	26	37
Lake Trout		6*	7	2	5	3
Lake Whitefish	34	21	65	16	26	43
Largemouth Bass		1*				
Longnose dace			1*			
Longnose Gar	1	3		4		1
Longnose Sucker	53	54	71	7	52	15
Moxostoma sp.	22	15	135	29	7	0
Muskellunge				1*		1
Northern Pike	68	71	80	101	180	99
Pink Salmon	17	6	1	6		2
Pumpkinseed	18	11	17	2	5	2
Rainbow Smelt	11	59	37	45	44	74
Rainbow Trout	1					1
Rock Bass	262	245	182	285	184	149
Round Whitefish (Menonimee)	16	36	77	17	112	30
Ruffe					10*	5
Sea Lamprey			1*		2	1
Shorthead Redhorse		24*	13	21	8	14
Silver Lamprey						1*

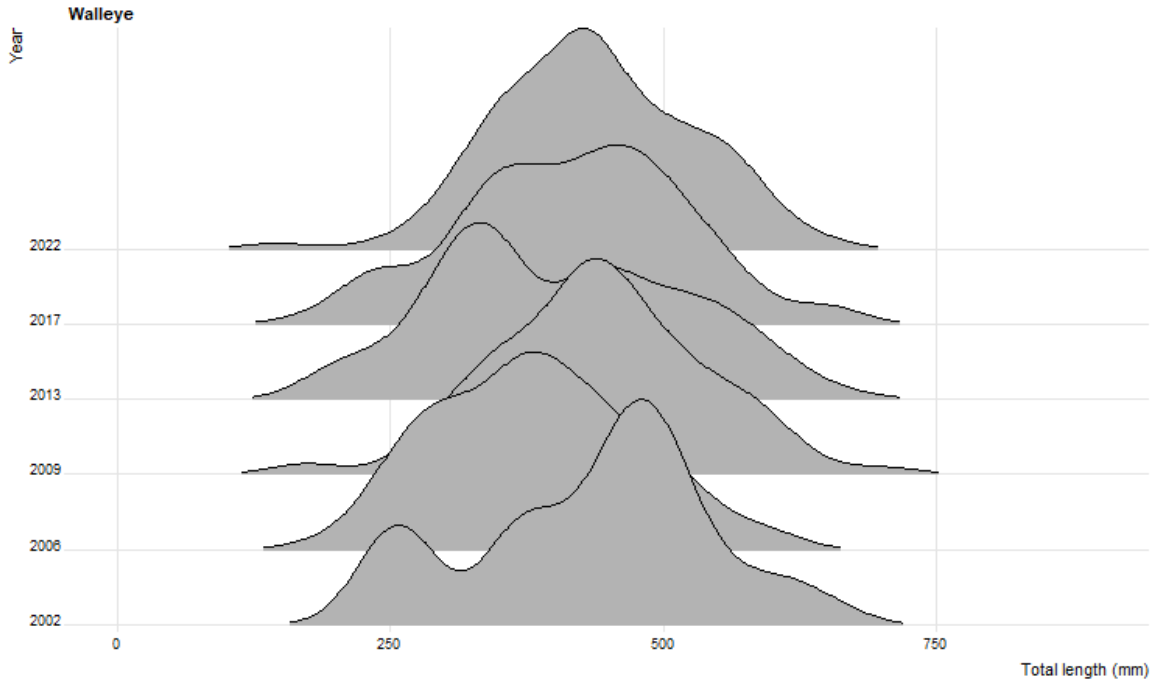
	Survey Year					
Species	2002	2006	2009	2013	2017	2022
Silver Redhorse	1		13	2	6	27
Smallmouth Bass	65	183	76	252	125	164
Trout-Perch	2					2
Walleye	112	254	215	288	150	108
White Bass	1	1	13	4		
White Crappie	1					
White Perch	7	21	2	10	7	1
White Sucker	827	751	795	661	706	600
Yellow Perch	1031	1677	1637	1828	1291	1682
Total Catch	3318	3842	3871	3917	3226	3438
Species Count	32	31	29	34	30	35
Cumulative Total	32	37	40	43	45	46
New Species	0	5	3	3	2	2

Appendix 3. Length-weight regression equations and von Bertalanffy growth equations for select species from the St. Marys River August 2022. 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.

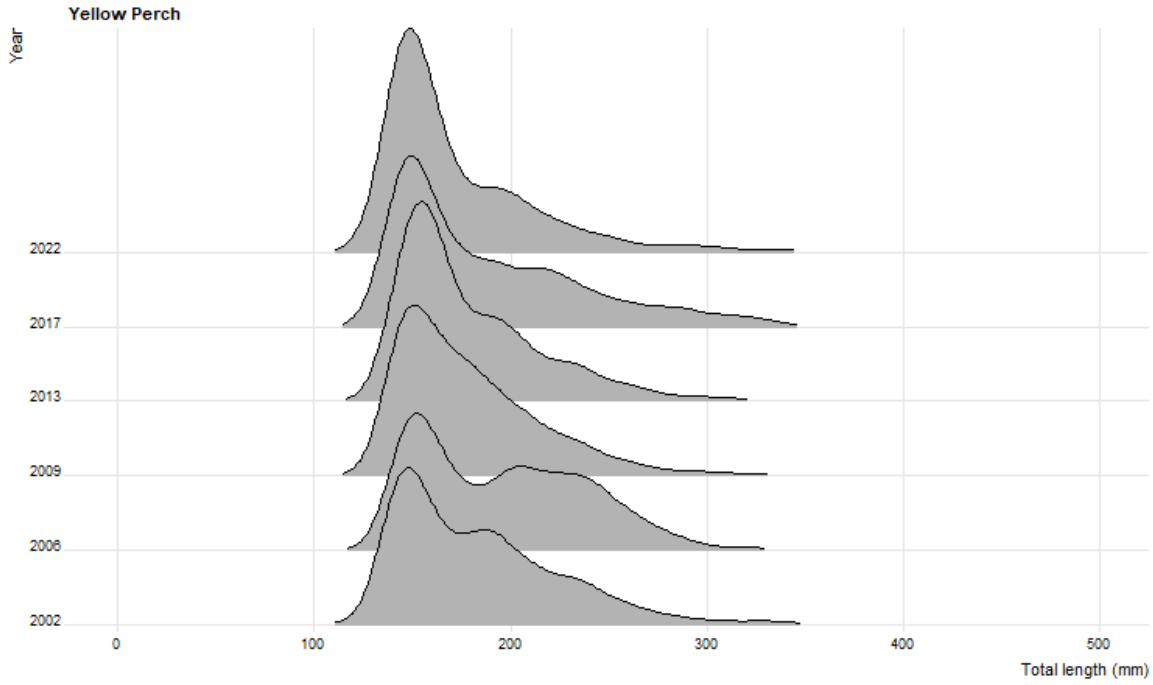
Species	Length/Weight Equation	Len/wt r^2	Von Bertalanffy Equation	K	L∞	t_o
Walleye	log(wt)=3.154 log(len)-5.472	0.96	$L_t=551[1-e^{-0.3882(t+1.12)}]$	0.3882	551	-1.12
Yellow Perch	log(wt)=3.155 log(1en)-5.267	0.94	$L_t=532[1-e^{-0.0734(t-2.3)}]$	0.0734	532	-2.30
Smallmouth Bass	log(wt)=3.292 log(1en)-5.566	0.97	$L_t=538\ [1-e^{-0.1862(t+0.54)}]$	0.1862	538	-0.54
Northern Pike	log(wt)=3.021 log(1en)-5.307	0.98	$L_t=721[1-e^{-0.2537(t+1.91)}]$	0.2537	721	-1.91
Cisco	log(wt)=3.218 log(1en)-5.568	0.94	$L_t=434[1-e^{-0.2787(t+1.39)}]$	0.2787	434	-1.39

Appendix 4. Length frequencies from survey catch of; (a) Walleye, (b) Yellow Perch, (c) Northern Pike, (d) Cisco, and (e) Lake Sturgeon from the St. Marys River Fish Community Index Netting Surveys 2002 to 2022.

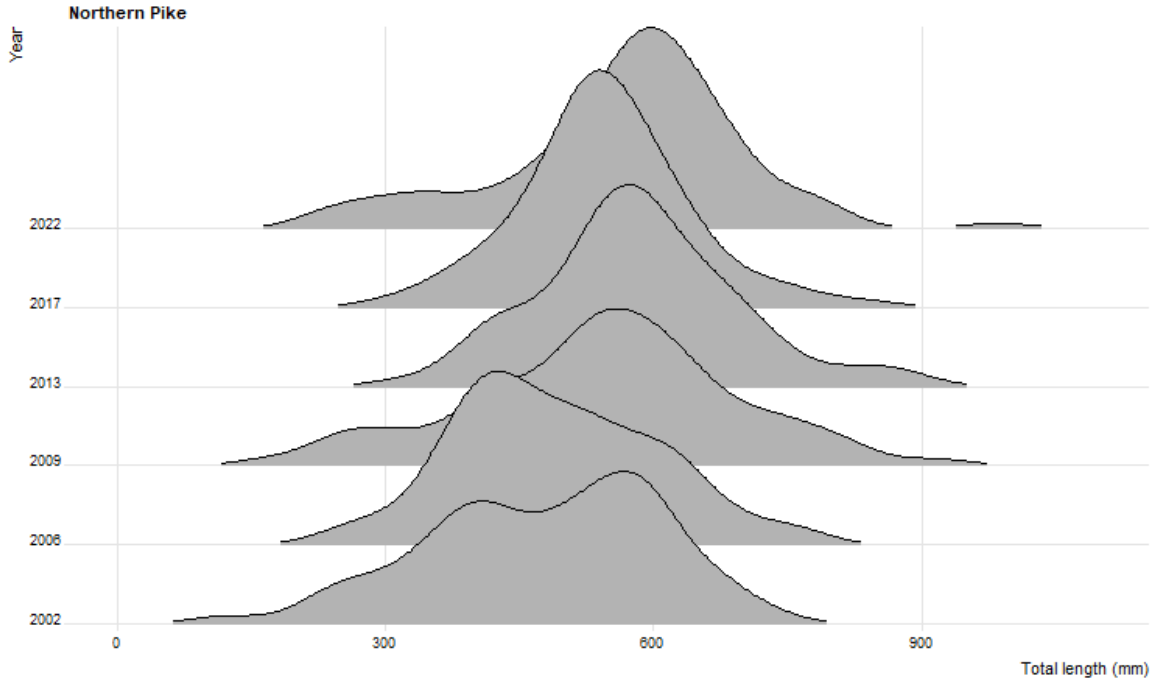
a)



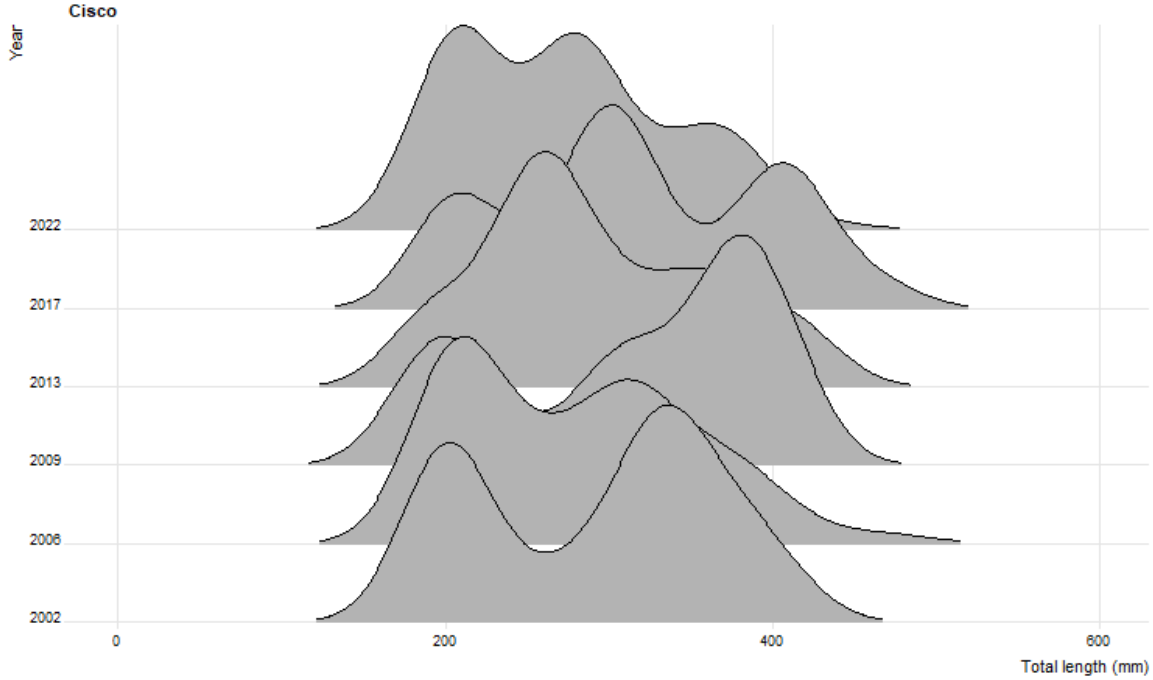
b)



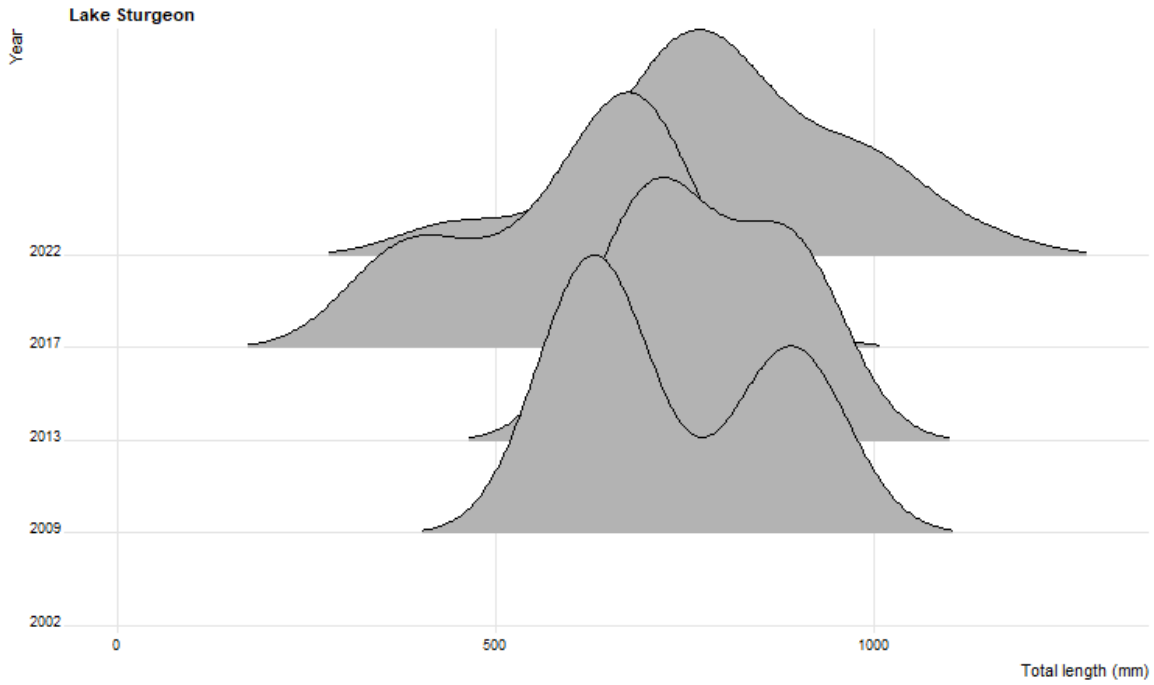
c)


Northern Pike
Year
2022
2017
2013
2009
2006
2002
0
300
600
900
Total length (mm)

d)


Cisco
Year
2022
2017
2013
2009
2006
2002
0
200
400
600
Total length (mm)

e)


Lake Sturgeon
Year
2022
2017
2013
2009
2002
0
500
1000
Total length (mm)