# Marge Lake 2018

## Swan Valley Sport Fishing Enhancement Inc.

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MANITOBA FISH AND WILDLIFE ENHANCEMENT FUND

Manitoba

# Executive Summary

SVSFE has been interested in establishing a self-sustaining walleye population in Marge Lake since 2010. In 2018, Swan Valley Sport Fish Enhancement Inc. (SVSFE) technicians set out to survey Marge Lake using various methods to monitor the current walleye populations and associated natural recruitment.

To assess walleye populations, trap nets were set in replicated locations from 2012 and 2014 to compare catch data. Walleye populations have decreased since 2012 despite having regulated zero angler harvest and steady sub-adult stocking. Walleye in Marge Lake are showing marginal growth and signs of population suppression. To assess recruitment, seine locations were replicated in the same sites from 2014-2018 for comparison. Seining results illustrates not only the presence or absence of naturally recruited walleye, but also the amount of available forage. One naturally recruited walleye was found in 2018 and total forage numbers increased compared to previous years.

New management recommendations have been made in regards to harvest and stocking rate. It is recommended harvest be opened to the anglers at a limit of 2 walleye and a slot restricting harvest of walleye between 45-70cm. Following the consultation stage the new regulation should be set by the spring of 2021. It is then recommended that a follow-up assessment on population dynamics be conducted in the summer of 2023. Information from the assessment will help managers determine a long-term walleye stocking strategy. The current recommendation is 12.5 fish/ha every 2-3 years, which is subject to adjustments following 2023 assessments. Continuing to monitor walleye populations through the trap netting program, occurring every 4 years, will illustrate the effects from changes in management practices and stocking strategies to help manage Marge Lake in future years.

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# 1.0 Historical Data

Historically, Marge Lake has been a northern pike fishery. In the early 1970s splake were introduced into Marge Lake followed by walleye fry introduced in the mid 1970's. Test netting was done in 1978 to determine if splake and walleye stocking were a success, no splake or walleye were caught. No work on Marge Lake was conducted for some time until 1992; Fisheries Branch evaluated the lake to see if smallmouth bass stocking was a viable option. Results determined that the lake would without a doubt sustain a bass population, however downstream migration into the Shell River system would be a serious concern (Kansas, 1992). Bass stocking was rejected by the stocking committee, due to connectivity and potential invasion into the Shell River system. No stocking occurred until 1998 when 200,000 walleye fry were re-introduced. Assessments in 2000 indicated an absence of walleye, with a species composition of northern pike, white sucker, and yellow perch. This was followed by 400,000 walleye fry stocked in 2000. In the late 2000's further consideration of making Marge Lake a walleye fishery were explored. Morphology, habitat, dissolved oxygen results, good forage base, few predators all indicated this was a walleye lake (Rowe, 2013). Due to unsuccessful stocking in the past, in correspondence to the Beautiful Lake Walleye Transfer, 399 adult walleye were stocked into Marge Lake in October 2010 with the intention of establishing a self-sustaining walleye fishery. Since 2010, Marge has been an annual recipient of the Beautiful Lake Walleye Transfer, with the exception of 2013 (Table 1).

Table 1: Number of Beautiful Lake sub-adult walleye stocked in Marge Lake from 2010-2017

| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| # of walleye received from Beautiful Lake Walleye Transfer | 0 | 399 | 585 | 125 | 0 | 569 | 50 | 1,530 | 943 | 4,201 |

To ensure the walleye had the opportunity to grow to maturity, a zero limit for walleye was implemented in 2010 for Marge Lake, which remains the regulation to this day. A quick gill net assessment on the stocking survival of stocked adult walleye was done in 2011 by Manitoba Fisheries branch. Rowe(2011) stated "There is adequate habitat and forage to support all life stages of walleye". Recommendations were to keep stocking walleye until a self-sustaining fishery was developed. In 2012, SVSFE technicians assessed Marge Lake via trap nets with the objectives to; assess the walleye survival and to determine if walleye were successfully reproducing in their new location. Results indicated a good survival rate with high recapture numbers but again no evidence of natural recruitment resulting in a need for further assessments. In the late summer of 2013, SVSFE technicians found evidence of natural recruitment in Marge Lake. This evidence, however small, determined that walleye were spawning in Marge Lake, however suitable spawning areas and condition of these sites were highly unknown. In 2014, it was found that walleye do, in fact, utilize the Marge Creek during critical spawning periods. Fertilized walleye eggs in the spring and young of the year walleye by late summer were documented. The trap netting program from 2012 was replicated in 2014 with results that indicated low natural mortality but a lack of sexually mature fish(>450mm). Since 2013, one night of seining every year has been allocated to assess walleye recruitment with the following results in Table 2.

Table 2: Number of Young of the Year(YOY) walleye captured seining 2013-2017 in Marge Lake

| | Walleye Recruitment Seining Results | | | | |
|---|---|---|---|---|---|
| | 2013 | 2014 | 2015 | 2016 | 2017 |
| # of YOY Walleye | 1 | 2 | 4 | 0 | 0 |

# 2.0 Study Rationale

Marge Lake has exclusively been stocked with sub-adult walleye from the Beautiful Lake Walleye Transfer since 2010 with intentions of creating a mature, self-sustaining walleye population. Swan Valley Sport Fish Enhancement Inc. applied to the Fish and Wildlife Enhancement Fund(FWEF) in 2017 to conduct the following research on Marge Lake in 2018:

1. Monitor current populations of walleye and observe trends by replicating the trap netting program created and replicated in 2012 & 2014, respectively.

2. Assess the absence or presence of walleye natural recruitment while documenting the abundance of forage species through mid-summer seining.

3. Adjust or create new management objectives for Marge Lake to fully optimize the lake use and development.

# 3.0 Study Area

Marge lake is located on the west side of PTH 366, approximately 3 kilometers north of East Blue Lake in the Duck Mountain Provincial Park in Manitoba. The lake is 43.1 ha, with 15.31 ha littoral habitat, a maximum depth of 21.3 m and an average depth of 6.8 m. The lake has one outflow in the northwest corner and one inflow in the northeast corner from Cache Lake. Access to Marge Lake is a small trail off PTH 366 restricted to smaller boats, canoeists and kayakers. Additionally, there is a fishing dock located at this site.

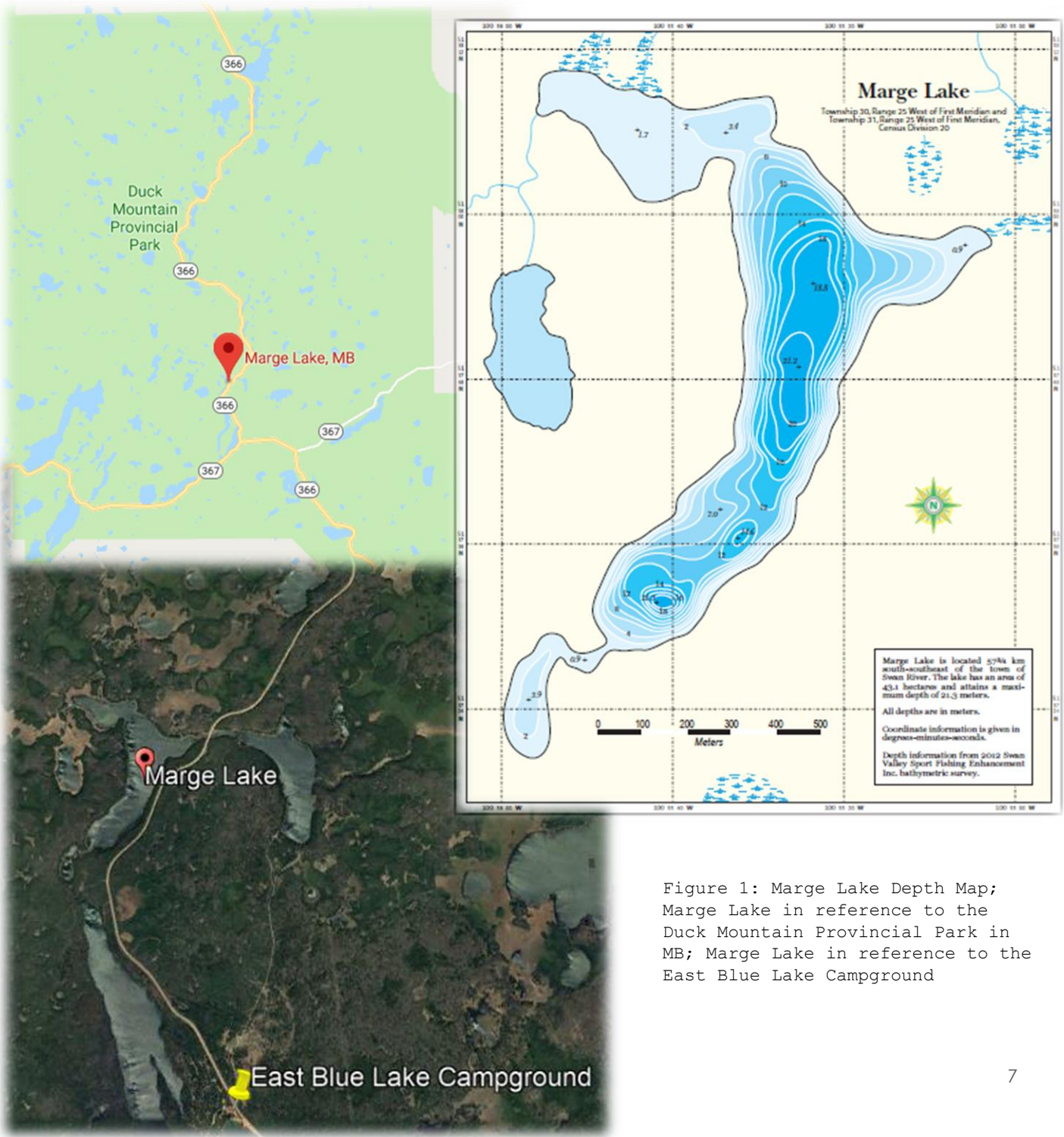



Figure 1: Marge Lake Depth Map; Marge Lake in reference to the Duck Mountain Provincial Park in MB; Marge Lake in reference to the East Blue Lake Campground

# 4.0 Methods

**Trap Netting**

A live release trap netting program was developed in 2012 for Marge Lake and replicated in 2014 and 2018. Trap net sites were chosen according to depth suitability and walleye targetability. Sampling occurs in the spring post-spawn usually between 12 and 24°C. Custom designed trap nets had two funnels and cribs (10" funnel and 4" funnel). The idea was to allow smaller fish to swim to the back and the larger fish would stay in the front portion of the trap. The trap is 4 ft wide x 11 ft long x 6 ft high. Leads are 100 ft and the mesh for the leads and trap is 1 3/4". Six trap nets were set overnight for 20-24 hours. Game fish such as walleye and northern pike were aged, measured for fork/total length and weighed. White suckers were only measured for a fork length.

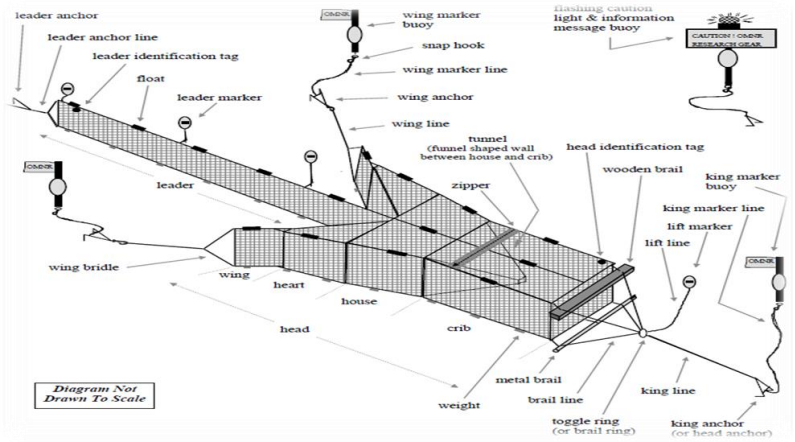



Figure 2: An example a trap net (not identical to the ones used in Marge Lake)

**Seining**

The nylon beach seines used in this study were a total of 28ft long and made with 1/4 inch mesh. A 4ft wide and 6ft deep pocket (bag) was incorporated in the bunt (middle) of the net which is designed to keep more fish and prevent fish from escaping. Areas sampled were essentially any viable areas, with as little debris as possible (i.e. boulders, snags, woody debris) that could complicate movement and sampling. Night seining was optimal since characteristic habitat of young-of-the-year walleye often include; sandy, hard-packed areas during the night (Stevens, 1990). Sample distances varied significantly from site to site, as "seineable substrate" isn't usually constant. Young-of-the-year were sampled first to avoid mortality and measured for fork length. Forage species were counted and released. Level of abundance was measured in catch-per-unit effort (CPUE); in this case, catch per meter of shoreline sampled. A total of 5 seines were executed at Marge Lake in 2018.

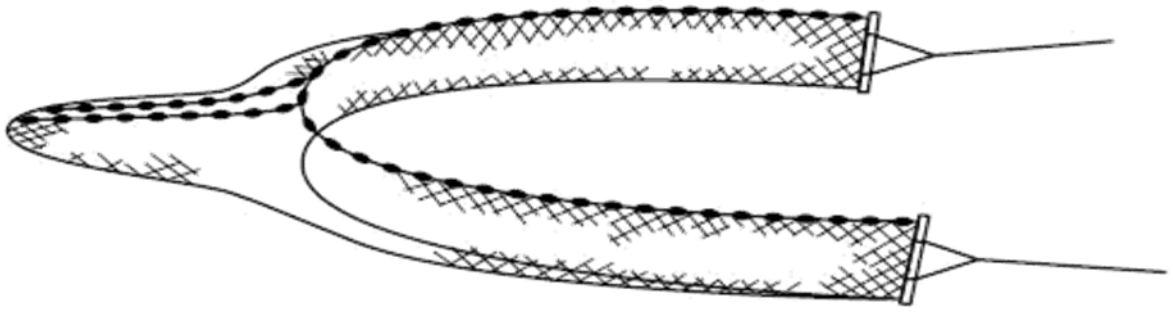




Figure 3: An example a of a seine net similar to the one used in Marge Lake

# 5.0 Results

**Trap Netting Results**

Post spawn trap netting was conducted during the week of June 18th-21st, 2018. Trap netting efforts equated to a total of 135.77 fishing hours. Six different sites from previous years trap netting were replicated with 2 nets in the water at a time(Figure 4). The water remained 19-21°C throughout the program.

Sought after data included various measurements pertaining the overall health of the walleye fishery. More specifically, protocol was designed to monitor catch-per-unit effort (CPUE). Evaluating number of fish caught by hours of trap netting is represented as # of fish caught per hour. CPUE is much more reliable for reflecting changes in population density within a lake (Schneider, 1998b) than differences in density between lakes. By comparing annual CPUE, managers can rate the success or failure of the program over time. Secondly, evaluating the current species composition and size/age distributions compared to other years to determine general walleye 'health'. Data collected from fish include length (mm), weight (g), sex (if applicable), and tag information analyzed for recapture growth rates.

A total of 52 fish were captured in 2018 and of these, 46% were walleye (Figure 5). Also illustrated in Figure 5 are the species composition from the 3 years of data collected. Walleye composition has remained dominant throughout the program, however total catchment of all species for 2014(n=65) and 2018(n=52) is only 1/3 of what is was in 2012 (n=195). Northern pike species composition has tripled in 2018 compared to 2012/2014.

Walleye CPUE has decreased from 0.97 fish/hour to 0.18 fish/hour since 2012 (Figure 6). CPUE by site had some considerable differences. Site 3 has experienced the largest walleye CPUE drop from 2.42 fish/hour in 2012 to 0.13 fish/hour in 2018 (Figure 7). Northern pike CPUE has increased in all sites in 2018(Figure 8). Northern pike ranged from 395 mm to 502 mm in fork length.

Walleye length frequencies for 2018 displayed fish in all sizes classes compared to previous years(Figure 9). Following the trend in previous years, walleye between 401-450mm were most frequent, at 42% of the catch. Walleye length/weight relationships remain consistent from 2012, 2014 and 2018(Figure 10).

Recapture growth data from 2018(n=3) indicates, on average, walleye between 401-450 mm are growing 4.4 mm/year. For walleye 451-450 mm, a growth of 4.75 mm a year is average(Figure 11). In 2014, the 401-450 mm range was much higher at 14.9 mm/year but walleye 451-500mm were very similar at 6 mm/year. Included in recapture data is also average growth in weight(g). On average, walleye from 2014-2018 in the 401-450mm range gain 20.6g/year(51g in 2012-2014). The 451-500mm range from 2014-2018 gains an average of 42.5g/year(-25.1g in 2012-2014) (Figure 11).

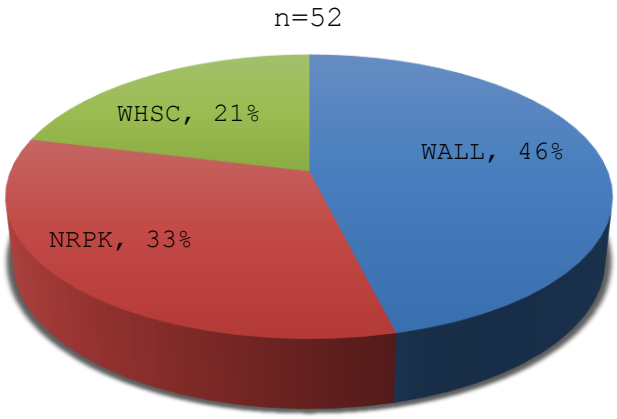
The strongest age class for walleye in 2018 was age 2, which corresponds with the 'super-stocking' that occurred in 2016 (Figure 12). A condition factor(k) was applied to the Marge Lake walleye. The condition factor utilizes the weight(g) and fork length(mm) in a formula to determine a relative robustness(Carlander 1950). The average k value in Marge lake is 0.96(Figure 13). According to Carlander(1950) k values >1.02 were excellent, 0.89-0.97 average, and <0.83 were poor.

# 5.0 Results

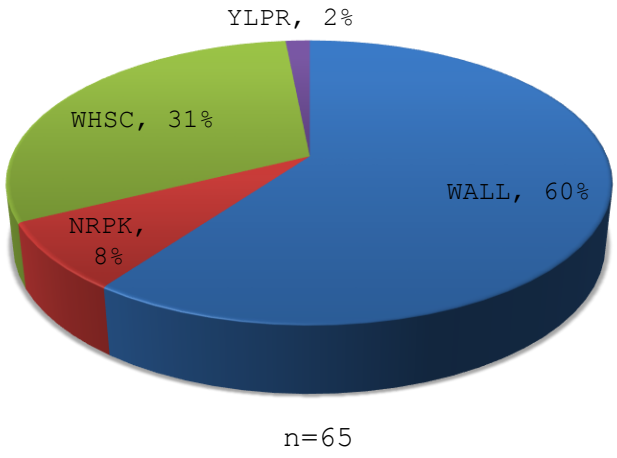

Figure 4: An image of the trap netting site locations replicated in 2012,2014 & 2018

# 5.0 Results

## 2018 SPECIES COMPOSITION




## 2014 SPECIES COMPOSITION




## 2012 SPECIES COMPOSITION

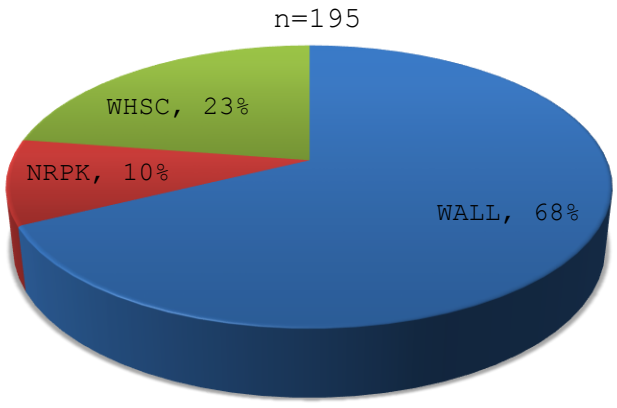





Figure 5: Species composition pie charts for fish captured in 2012,2014 & 2018 in Marge Lake

# 5.0 Results

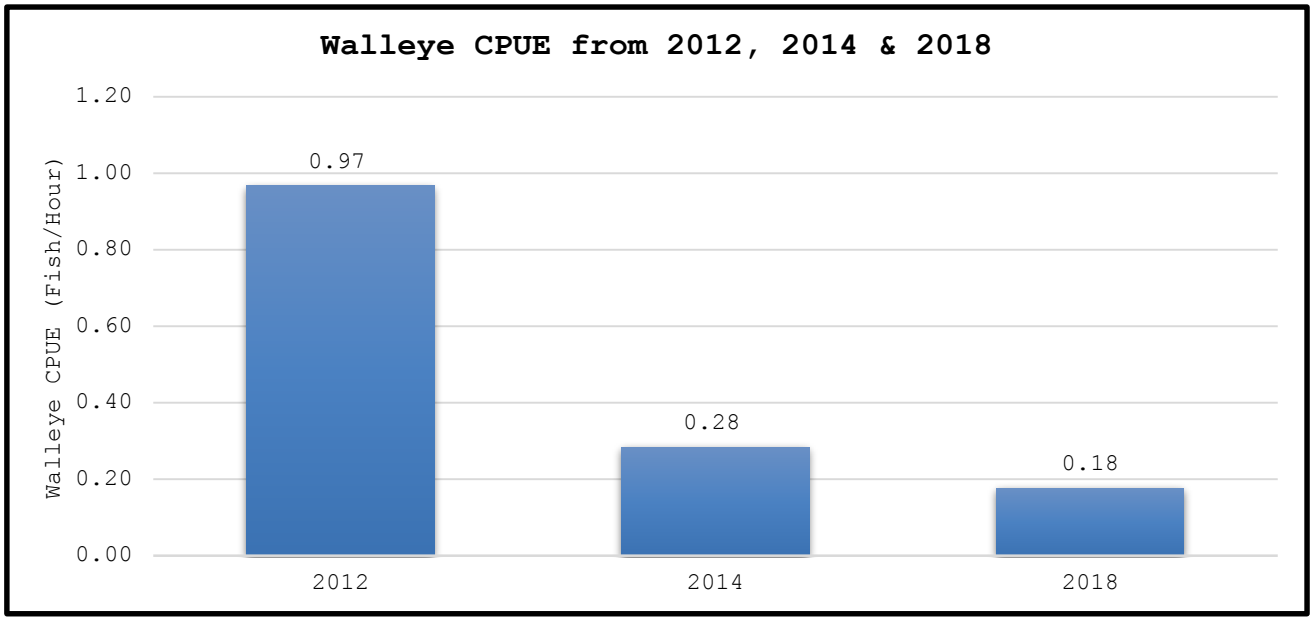



Figure 6: Total trap netting catch per unit effort(CPUE)of walleye in 2012,2014 & 2018 in Marge Lake

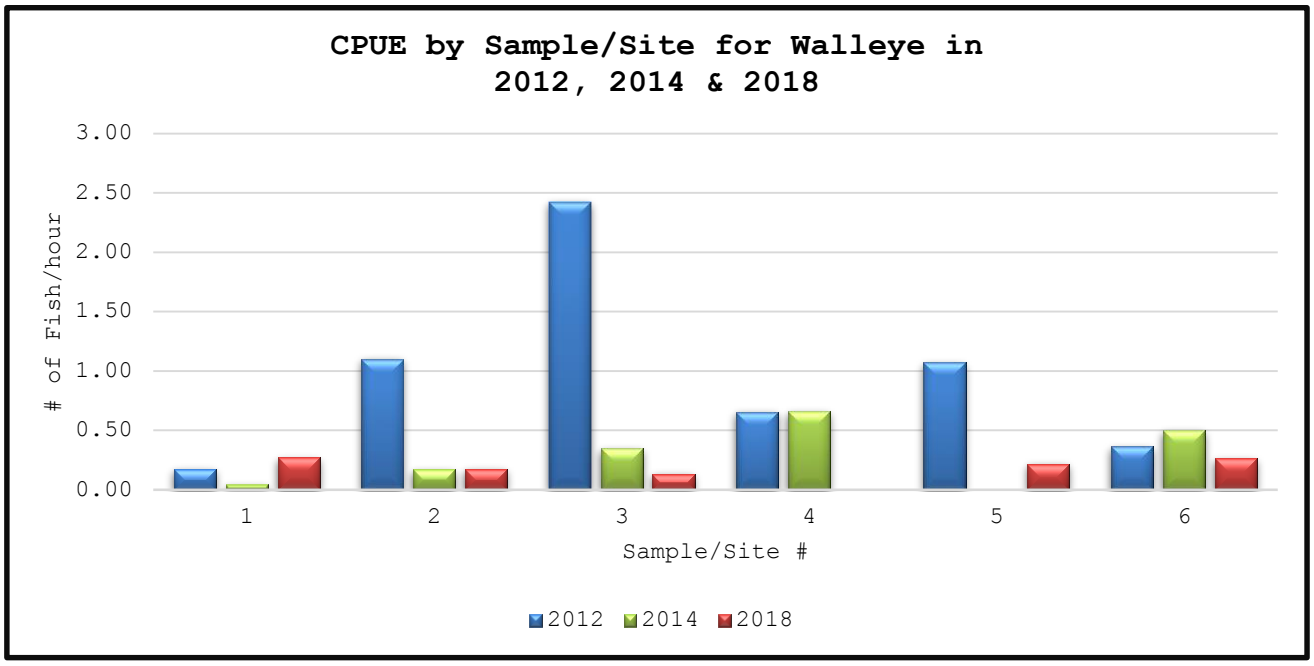
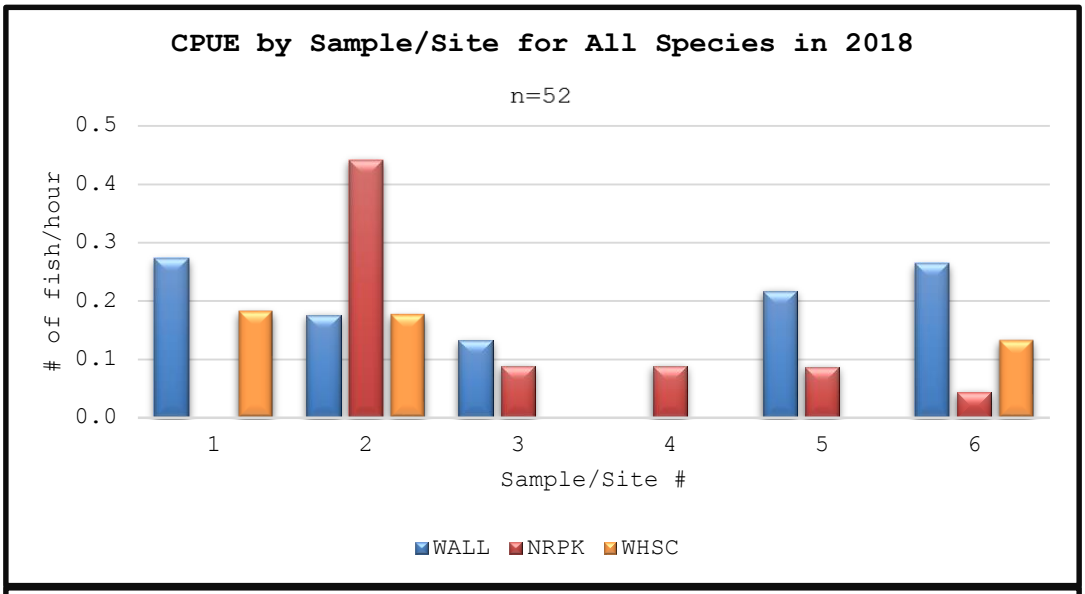
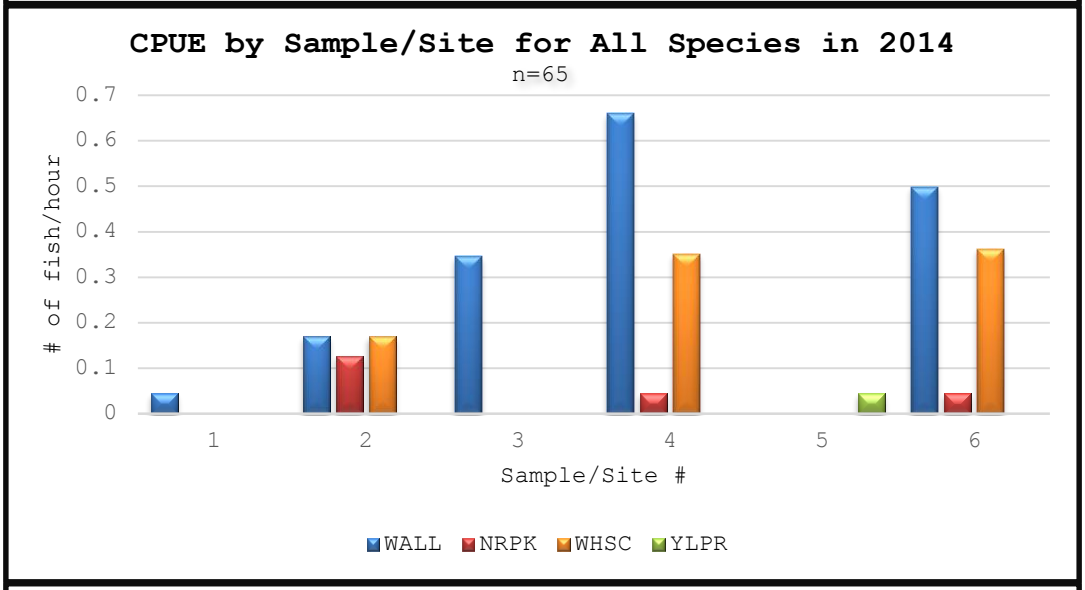



Figure 7: Trap netting catch per unit effort(CPUE)of walleye per site in 2012,2014 & 2018 in Marge Lake

# 5.0 Results



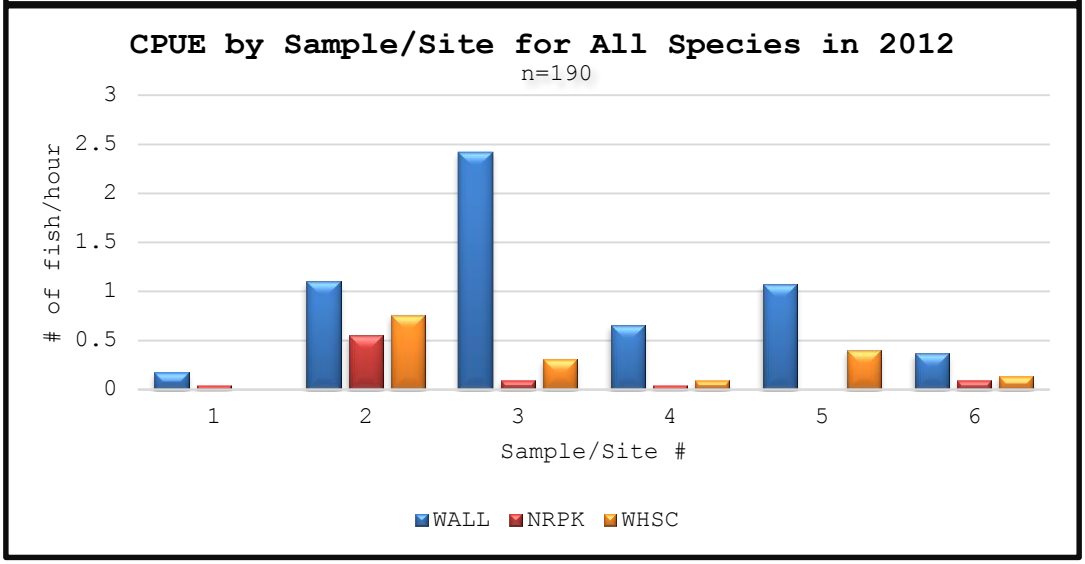






Figure 8: Total trap netting catch per unit effort for all species at each site for 2012,2014 & 2018 in Marge Lake

# 5.0 Results

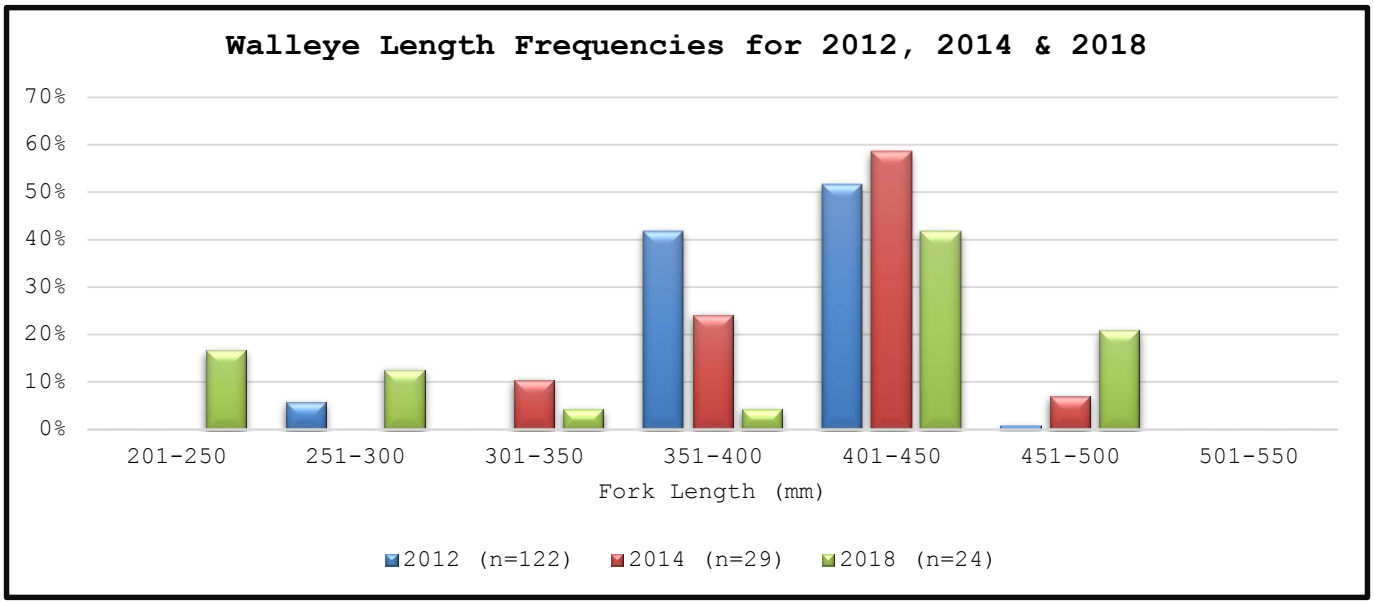



Figure 9: Walleye fork length frequency in trap netting for 2012, 2014 % 2018 in Marge Lake

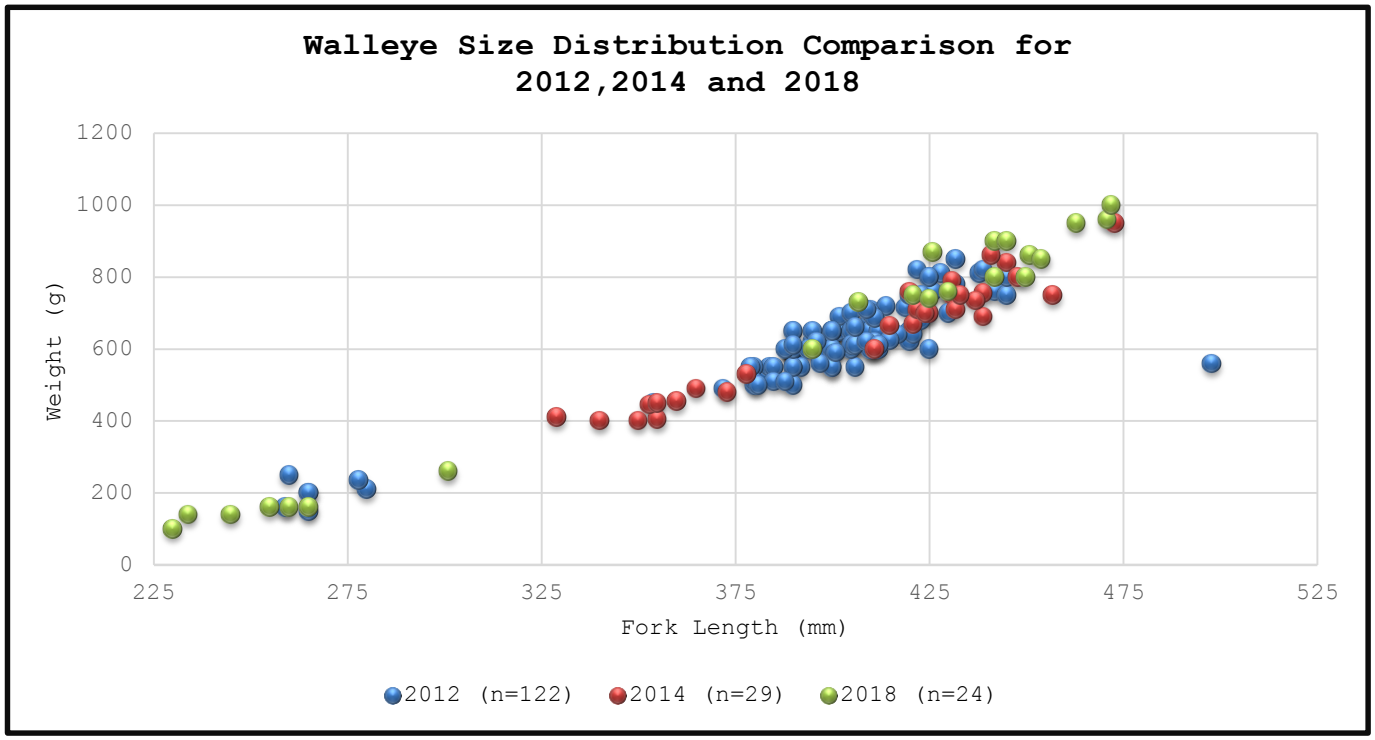
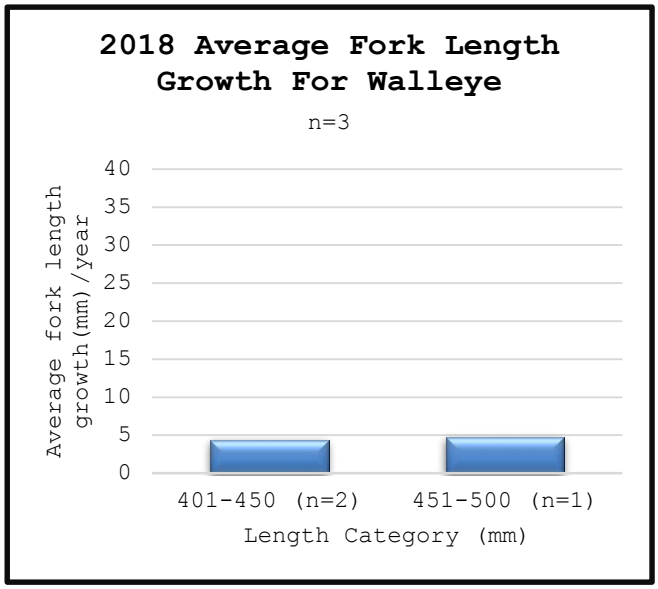
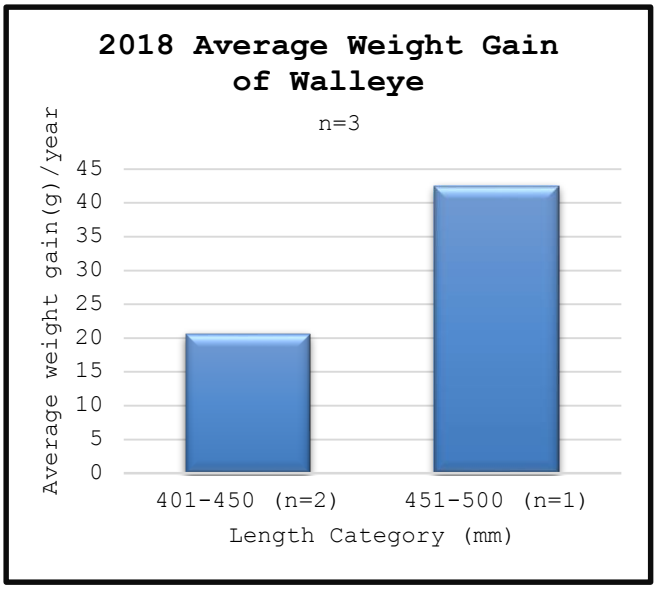
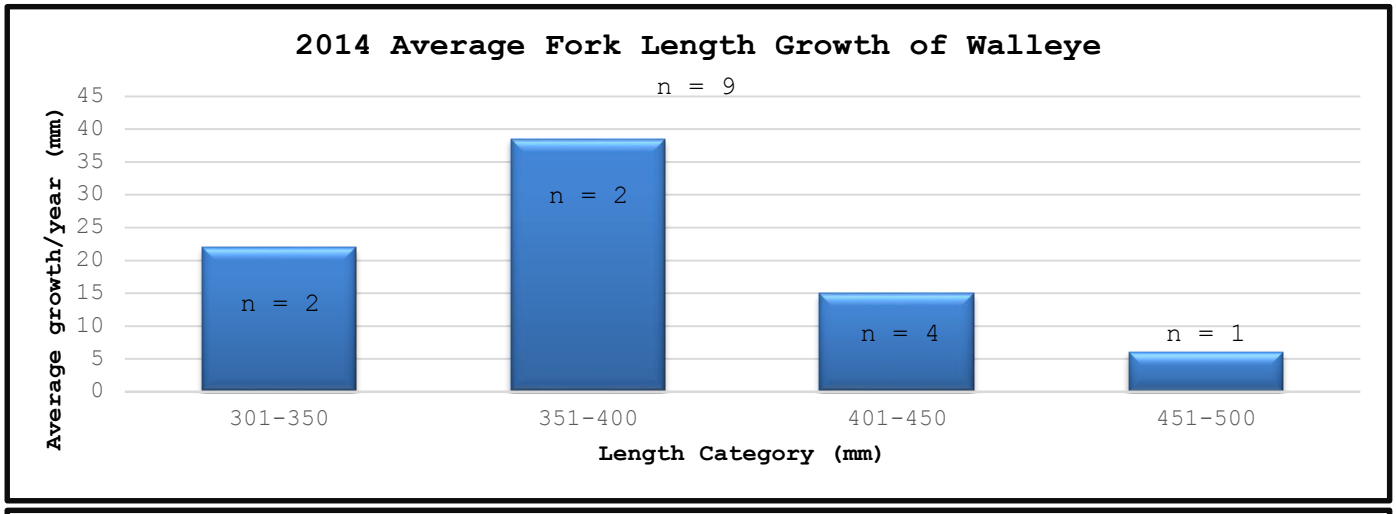



Figure 10: Walleye fork length(mm) and weight(g) distribution in trap netting for 2012, 2014 % 2018 in Marge Lake

# 5.0 Results



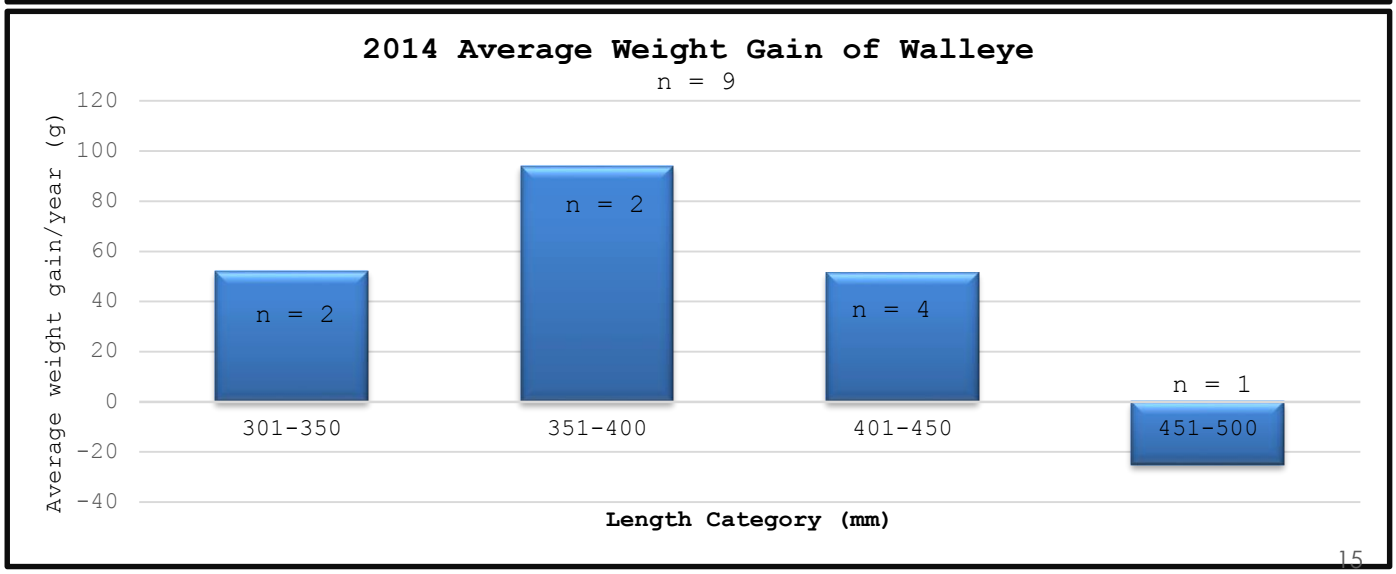






Figure 11: Average fork length(mm) growth and weight(g) gain on recaptured tagged fish per year on walleye for years 2014-2018 and 2012-2014 in Marge Lake

# 5.0 Results

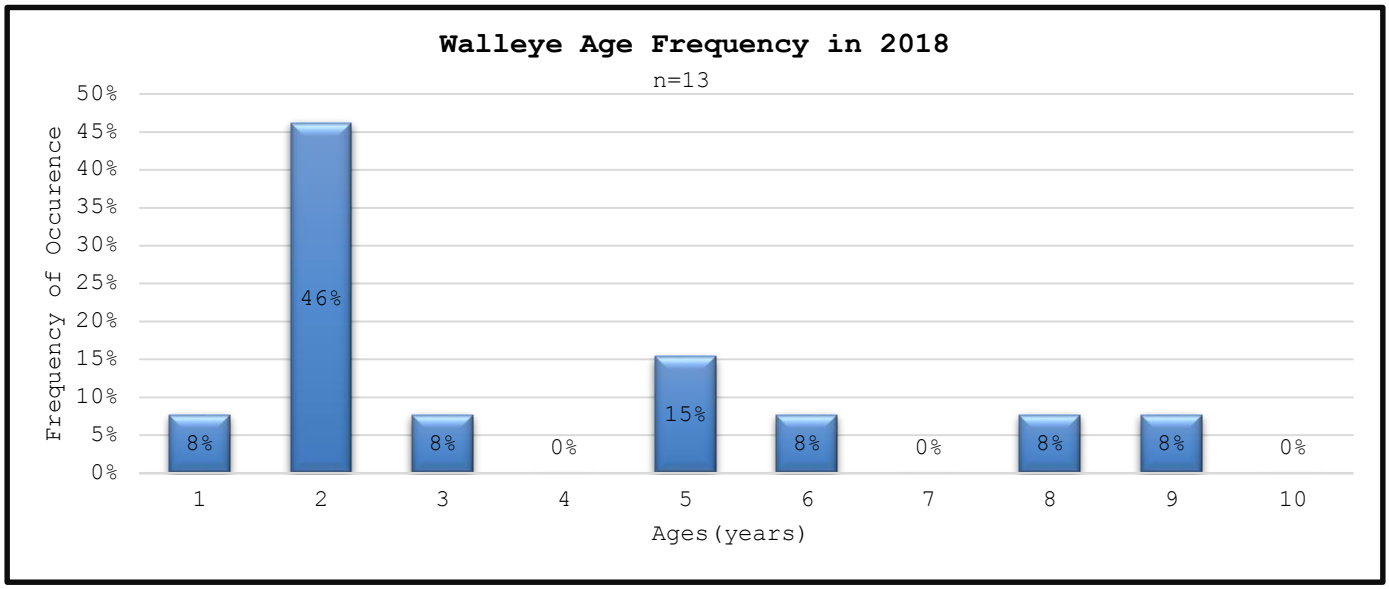



Figure 12: Walleye age frequency for 2018 in Marge Lake

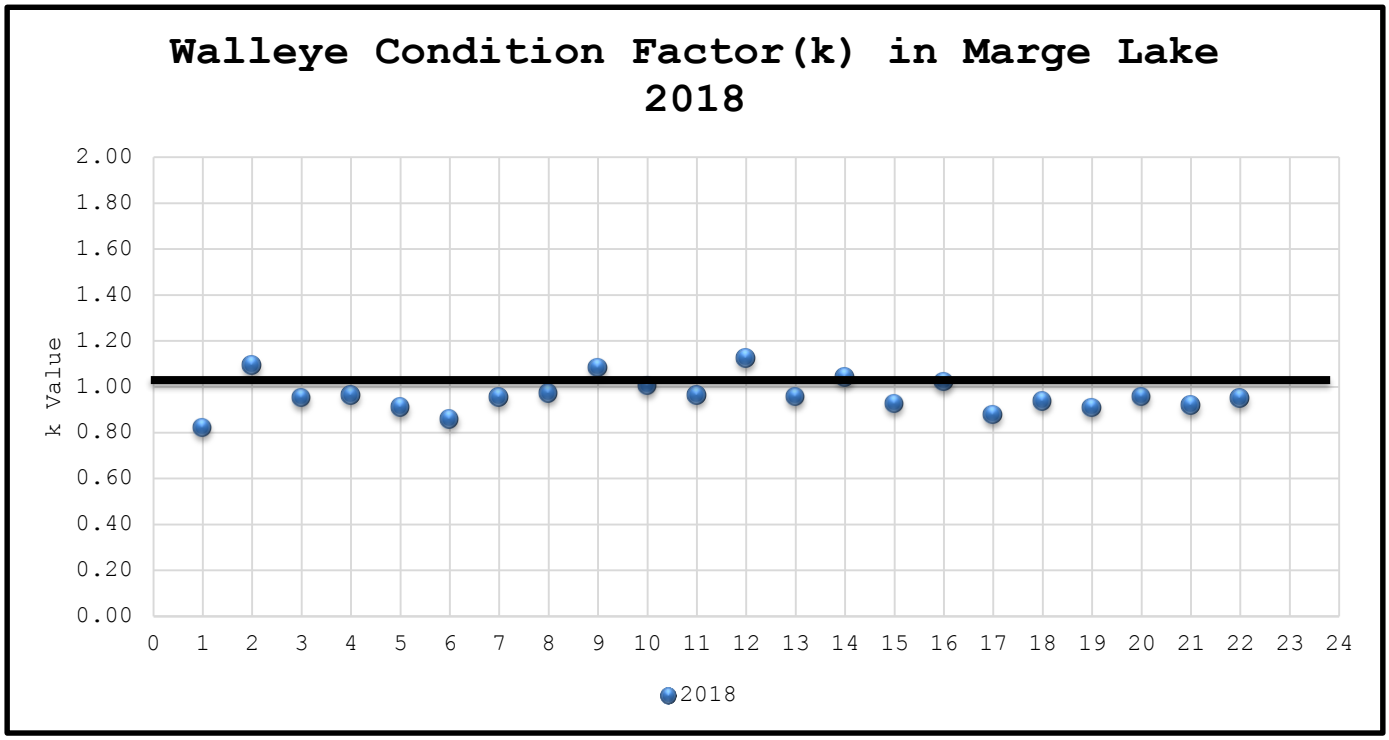



Figure 13: Walleye condition factors(k)for 2018 in Marge Lake

# 5.0 Results

**Seining Results**

A total of 5 replicated seines were executed on the night of September 6th/2018 from 9 pm until midnight. Catch per unit effort was measured in meters of shoreline sampled. Approximately 175 meters of shoreline was sampled in total. One young of the year (YOY) walleye was captured at Site 5(Figure 14) with a fork length of 140 mm. Table 3 displays the seining results since 2013. 2018 marks the first year since 2015 a YOY walleye has been captured.


Figure 14: An image of the seine locations for 2014-2018 in Marge Lake

Table 3: Marge Lake Walleye Recruitment Seining Results from 2013-2018

| | Walleye Recruitment Seining Results | | | | | |
|---|---|---|---|---|---|---|
| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
| # of YOY Walleye | 1 | 2 | 4 | 0 | 0 | 1 |

Figures 15 through 19 display the total catches per meter of shoreline seined for years 2014-2018. Crayfish, blacknose shiners and yellow perch have been the most prolific forage species found in Marge Lake with the largest CPUE in years 2014-2018. Following stocking of 569 sub-adult sized fish (AVG FL=244mm) in the fall of 2014, the total amount of forage species seined in 2015 dropped from n=2595 to n=418 when replicated in the same sites. Figure 20 illustrates the fluctuations in the total amount of forage seined each year as well as the corresponding stockings of walleye.

# 5.0 Results

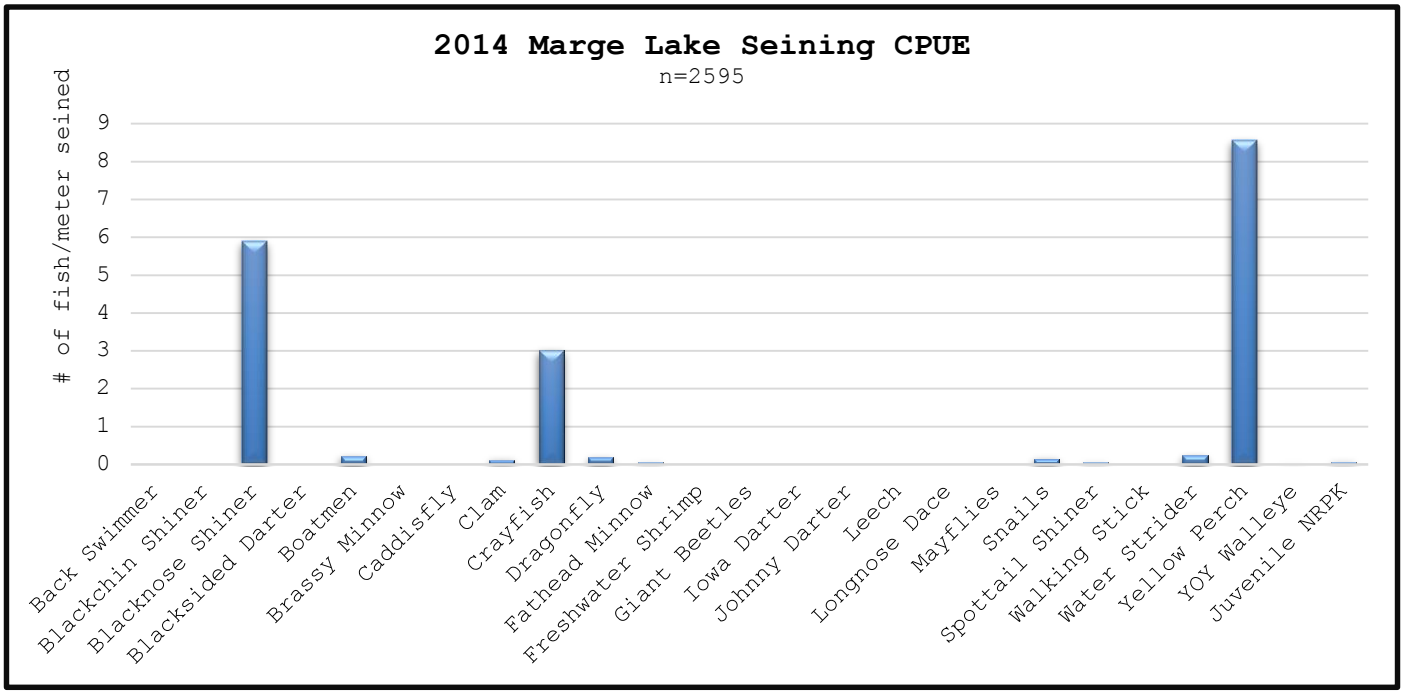



Figure 15: Number of fish/forage per meter seined for all species captured on Marge Lake in 2014

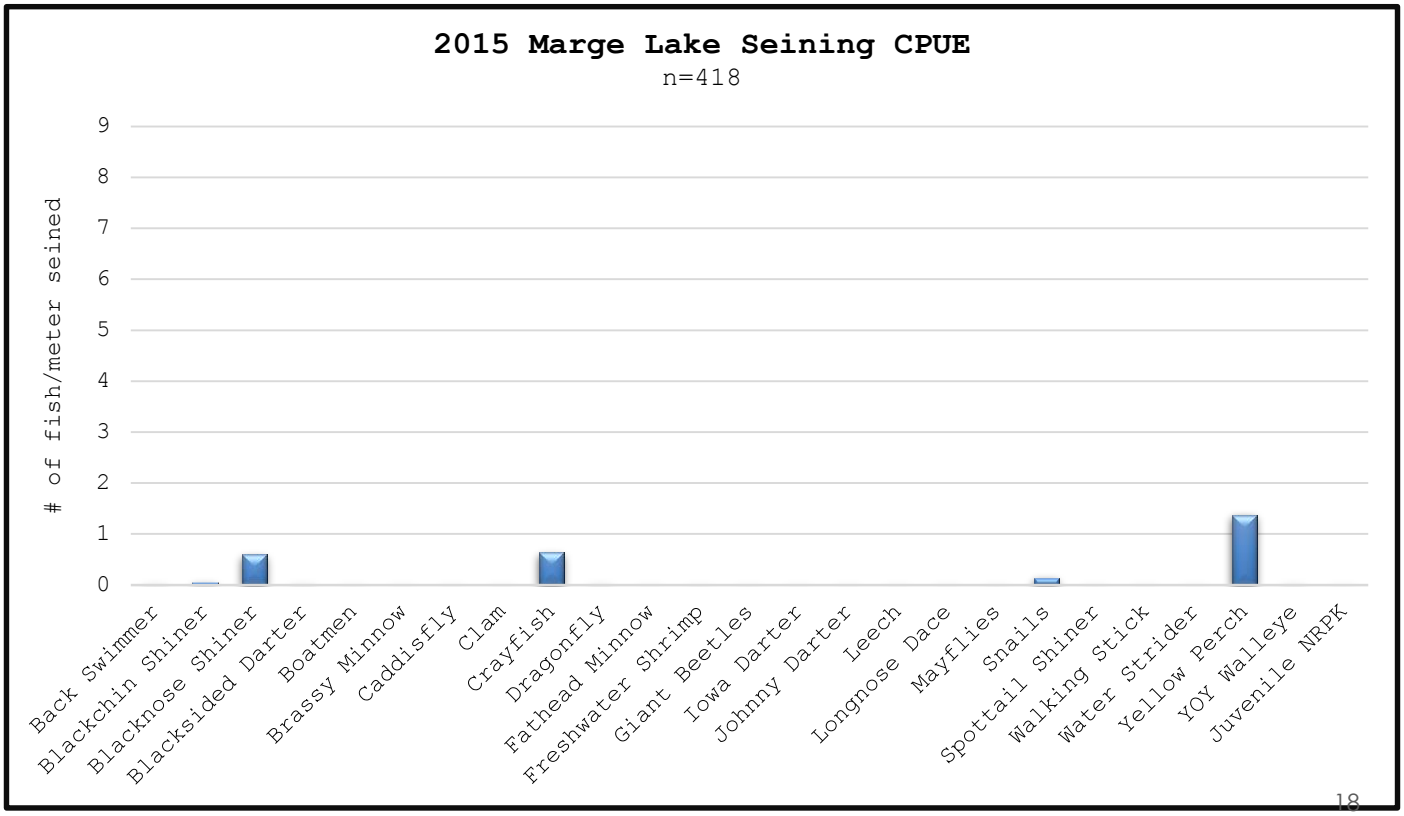





Figure 16: Number of fish/forage per meter seined for all species captured on Marge Lake in 2015

# 5.0 Results

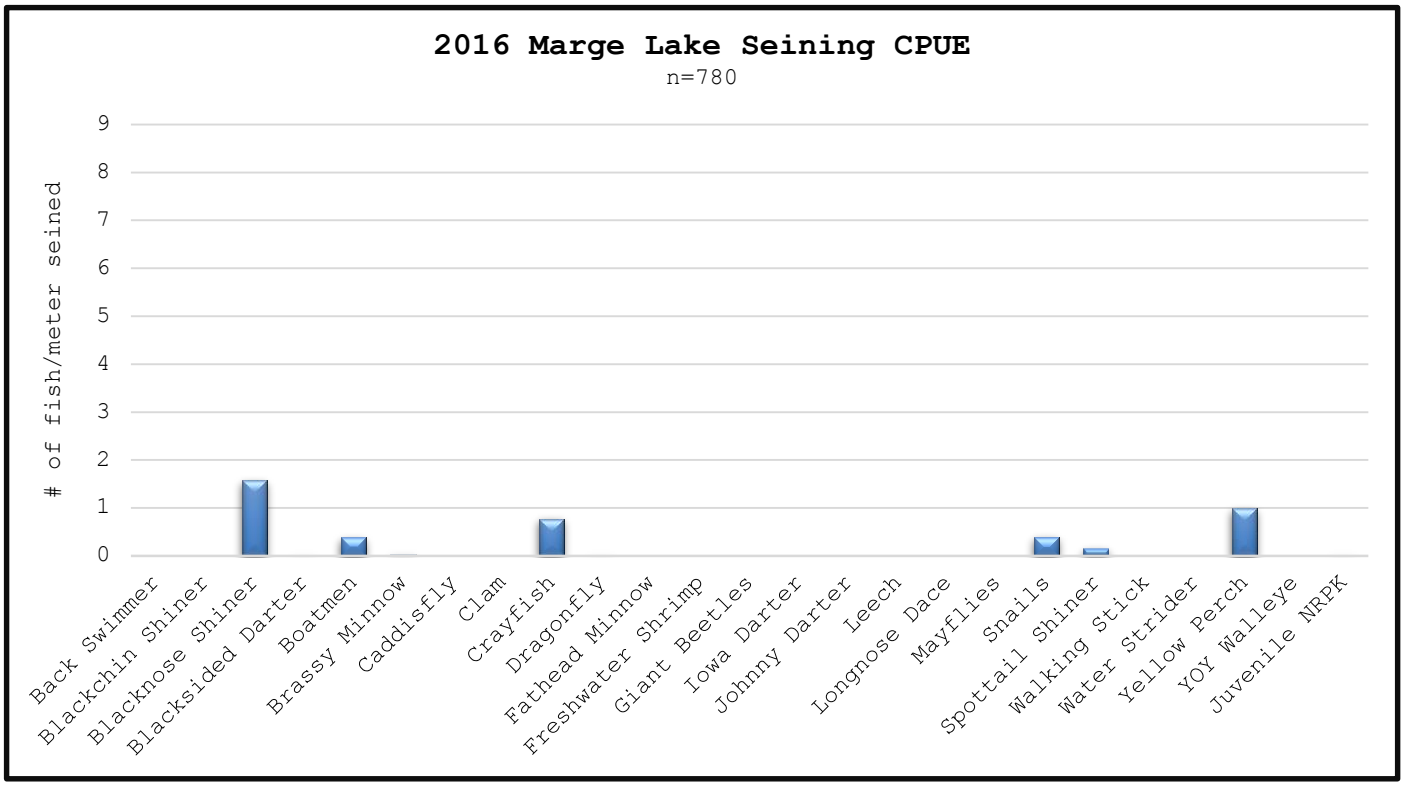



Figure 17: Number of fish/forage per meter seined for all species captured on Marge Lake in 2016

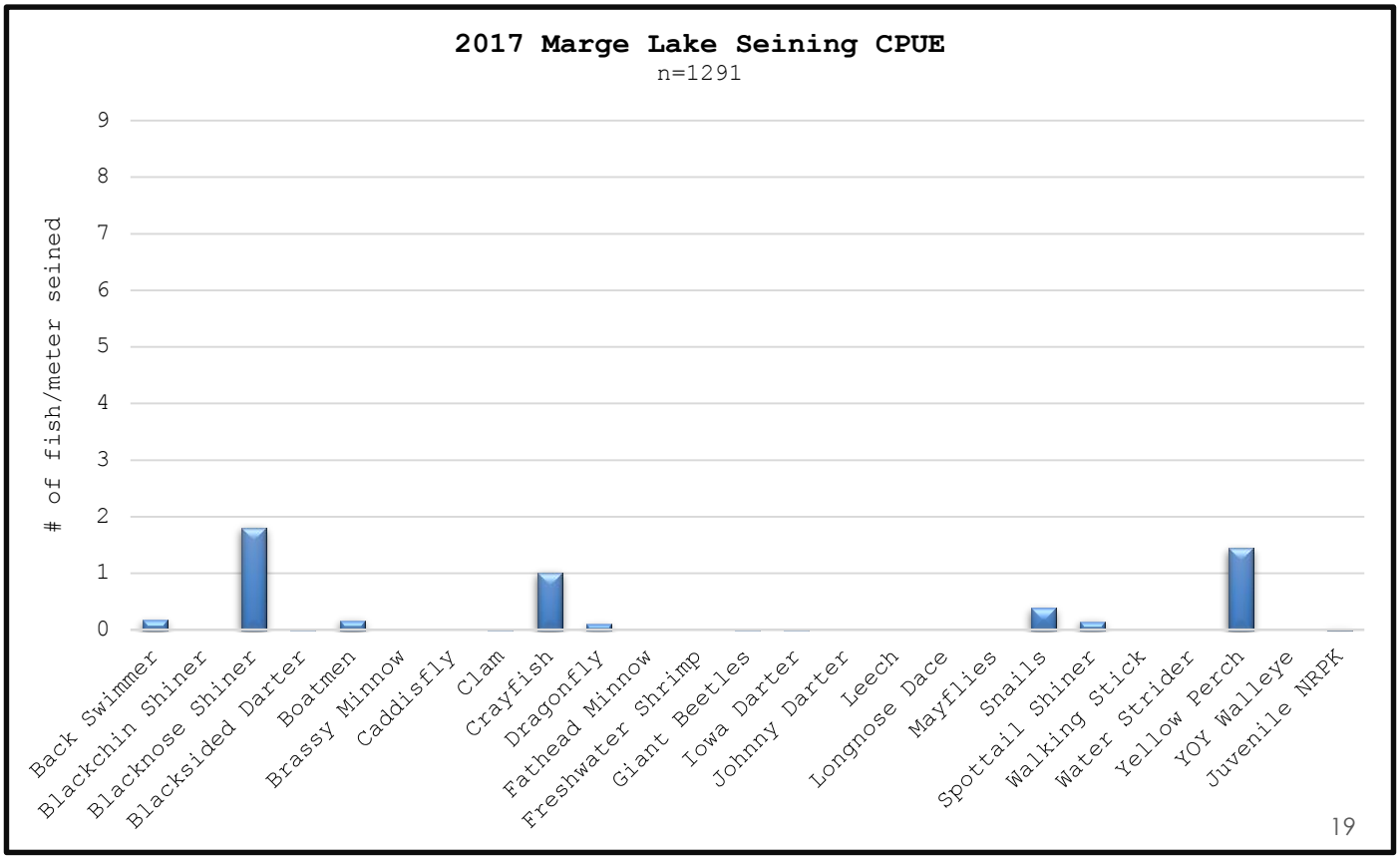





Figure 18: Number of fish/forage per meter seined for all species captured on Marge Lake in 2017

# 5.0 Results

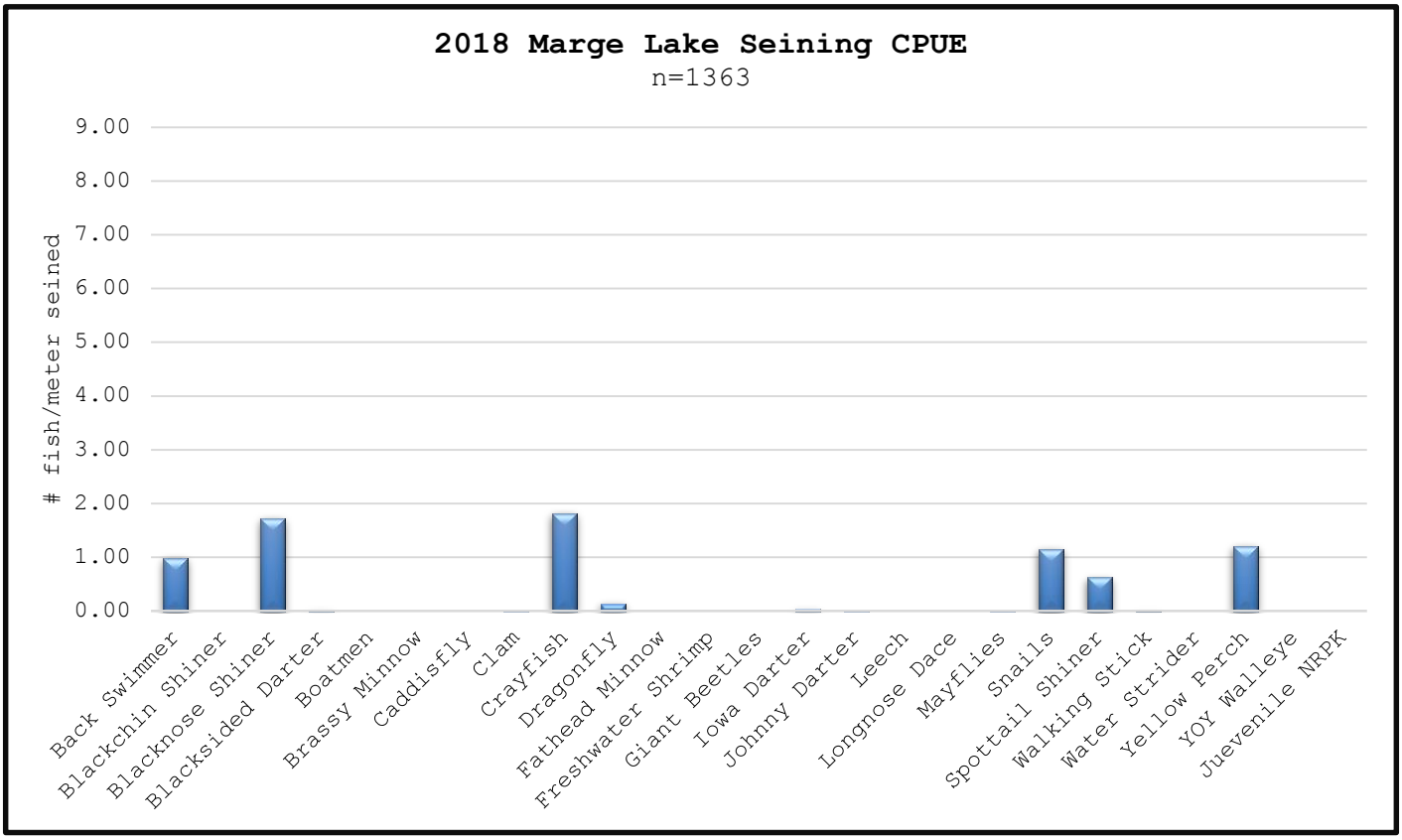



Figure 19: Number of fish/forage per meter seined for all species captured on Marge Lake in 2018

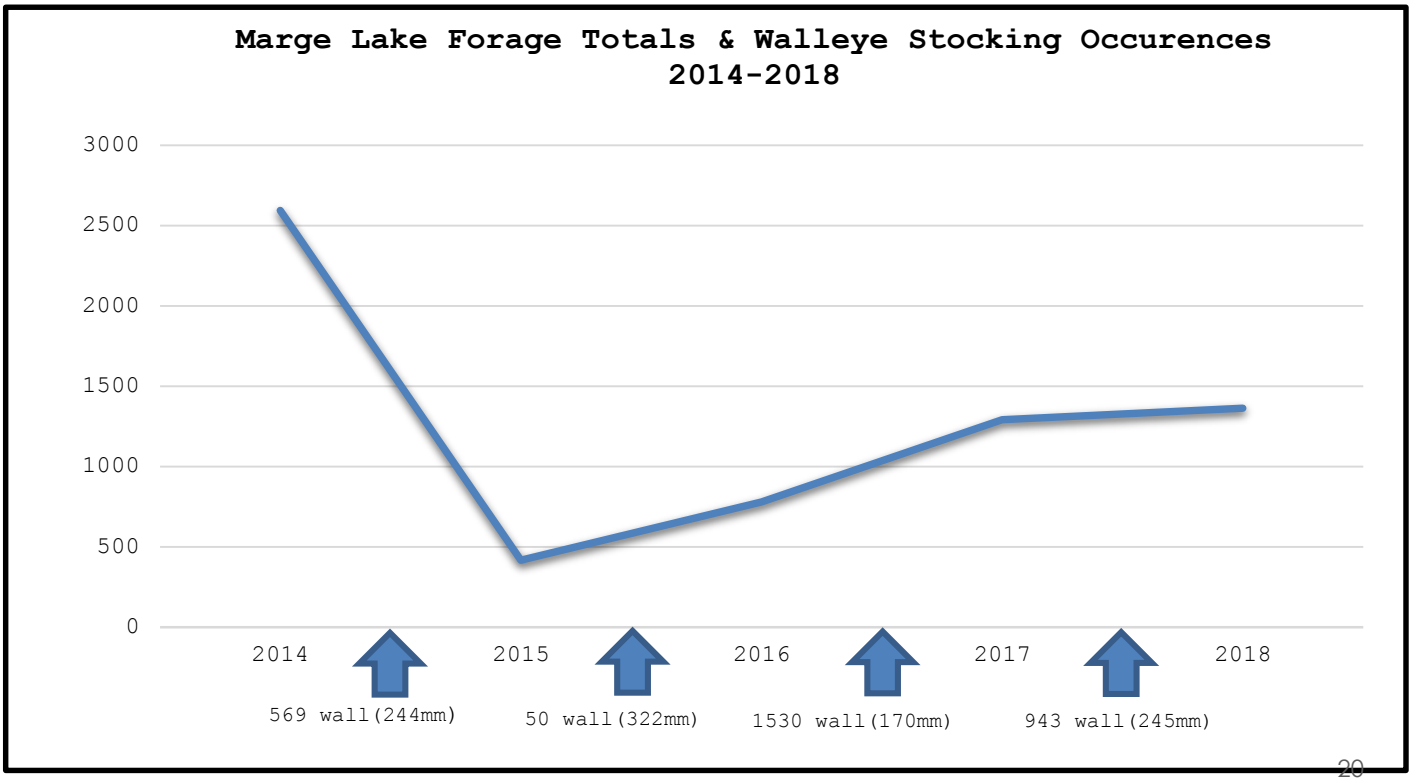





Figure 20: Forage/fish totals for seining and the walleye stocking occurrences in Marge Lake 2014-2018

# 6.0 Discussion

Research on Marge Lake has been ongoing for many years. The amount of information that has been collected (in a manner that is comparable throughout the years) has allowed SVSFE to draw some conclusions to update the overall management of the lake. Marge Lake, at current, is managed as a catch/release walleye fishery with the intention of creating a self-sustaining walleye population. In theory, restricting the harvest of stocked, sub-adult, walleye would allow the population to reach sexual maturity for reproduction. This discussion will literate the current state of fishery and the factors associated with it.

Walleye growth and maturity in Manitoba depends on a multitude of factors such as latitude, lake productivity, predator-prey relationships, population density and food quality (Hartman, 2009). Other factors to play into natural reproduction are spawning habitat availability.

The latitude in which Marge Lake is located limits the growing season. Months of growth typically occur in June-September, during the warm ice-free water temperatures, at approximately 20-24°C(McMahon et al. 1984). Kelso (1972) reported growth ceases at temperatures less than 12°C, leaving walleye a very short window to grow. Marge lake walleye seem to be much slower growing than the surrounding walleye lakes in the same latitude, especially when nearing the size in which maturity should be reached.

Lake productivity is influenced by a multitude of factors. Although biotic lake productivity factors(such as plankton analysis) weren't explored throughout this project, many abiotic factors were. Most interesting was the water clarity. Walleye are very sensitive to the amount of light penetration within lakes which dictates walleye feeding habitat(Lester 2004). A Secchi disk measures the amount of water clarity throughout the water column. Lester(2004) calculated the optimal mean Secchi reading for walleye as 2m. Secchi readings in Marge, at an average of 5m, surpass this optimal mean. This variable is believed to be important in limiting distribution, abundance and survival of walleye (McMahon et al. 1984).

The presence of northern pike is the number one competitor/predator for walleye populations at both larval and adult populations(Colby et al. 1979). A slight increase in the northern pike population in recent years could account for the low recruitment and low abundance of stocked walleye through predation. The large amount of walleye stocked into Marge in recent years should have been evident in the post-spawn trap netting program yet the walleye abundance was at its lowest.

Since initial stocking of sub-adult walleye, the composition of walleye in the fish community has been at the top compared to other native fish species such as white sucker and northern pike. The largest walleye age density corresponds with the year of the largest stocking of sub-adult walleye(2016) to date. Reduction of intraspecific competition between walleye in large age classes would improve conditions for growth and survival(Hartman and Margraf, 1992).

# 6.0 Discussion

Populations were estimated using the Chapman-Peterson Model for each trap netting assessment (2012, 2014, 2018). In 2012, the estimated population closely resembled stocking records at 605 individuals. In 2014, and 2018 populations were estimated at 1033 and 770 respectively despite stocking a total of 3,092 individuals between the two assessments. At a population of 770 individuals, this equates approximately 19 walleye/hectare.

Marge lake contains a rich forage base of aquatic insects and small-bodied fish. In the initial stages of walleye life, the preferred prey is zooplankton and aquatic insects(McMahon et al. 1984). Afterward, adolescence walleye change to a mainly piscivorous diet(Colby et al. 1979). Yellow perch account for large portion of walleye diet, especially in northern areas(McMahon et al. 1984). This appears to hold true in Marge Lake as the most abundant forage species found is yellow perch. Upon a heavy stocking of larger sub-adult walleyes, forage numbers suffered a steep decline. Stocking hasn't decreased in the past years but the forage has appeared to rebound to the increased feeding pressure.

Marge creek has proven in the past to facilitate successful walleye spawning as per past SVSFE project studies. Water velocity and substrate are some of the most important factors in successful walleye spawning. Exchanges or movement of water over clean, gravel ensures an adequate oxygen supply without siltation to developing embryos (Colby et al. 1979). The spawning habitat present at Marge Creek, prior to siltation, was small but much better than current conditions. Recent muskrat and beaver activity has dammed the crucial flow of water from Cache Lake into Marge that encourages walleye spawning. Consequently, recruitment numbers have been at an all-time low since this has happened.

Considerations for an updated management plan are as follows:

1) Stream enhancement

Manual manipulation of this Marge creek would likely be fundamentally challenging and not ideal. Competing with the resident muskrat/beaver populations will be an uphill battle in effort and cost. Most importantly, Marge Lake has not proven to be capable of producing a self-sustaining walleye population even when the creek was suitable for spawning. The desired results are simply not there to justify pursuit of enhancement.

2)Open walleye harvest

Fishing pressure is found to accelerate onset maturity(Scott and Crossman 1998). Populations that have been exploited have more energy available to them because reduced population numbers, reduces intraspecific competition which allows faster growth(Geisler 2012). Lack of suitable habitat and continually stocking has restricted walleye growth and survival. Opening Marge to harvest would relieve intra-specific competition, increase walleye growth/survival and also appease anglers and their ongoing interest in harvesting walleye. It is important to remember Marge is a relatively small lake and a population could be fished out very easily, therefore should be monitored and stocking rates adjusted to maintain a put and grow walleye fishery. To simplify and unify regulations, it is recommended Marge Lake fall under the "Special Regulations for Individual Waters" in the Manitoba Anglers Guide with a limit of 2 walleye and all walleye between 45cm and 70cm be released.

# 6.0 Discussion

3)Stocking rate

Lakes without sufficient spawning habitat should be stocked as a put-grow-and-take fisheries(Morgan 2015). A study by Laarman(1978) monitored over 125 waterbodies to determine walleye stocking success. Laarman found 48% stocking success in lakes that walleye were previously absent, 32% success for maintenance stockings where natural reproduction was limited or absent, 5% success for supplemental plants where efforts were made to augment natural reproducing walleye populations. It is evident that since a walleye population already exists in Marge, and taking into account the state of spawning habitat, management should aim for maintenance stockings of walleye in order to be successful. The Guidelines for Stocking Fish in Ontario(Morgan 2015) for walleye are as follows:

Eyed Eggs: 5000 eggs/ha
Fry: 2000 fry/ha
Summer Fingerlings:100-125 fish/ha
Advanced Fingerlings:25-50 fish/ha
Adult/Sub-Adult Walleye for small lakes 80-450 ha: 150-200 fish total

Marge has proven unsuccessful with fry stocking in the past. Fingerlings and adult walleye stockings from the Beautiful Lake Walleye Transfer in Marge have been proven to be more successful to date. The size of walleye transferred from Beautiful Lake are much larger than the typical advanced fingerling, measuring 170 mm (7”). Furthermore, the age of walleye being transferred can change year to year depending on overwinter survival in Beautiful lake, therefore alternative stocking rates should be considered. It is important to note that stocking on a supplemental basis should only be conducted once every 2-3 years(Morgan 2015). Moreover, stocking walleye at intervals of every 2-3 years will avoid suppression of existing walleye populations (Kerr 2008). With all these factors in mind, it is recommended Marge Lake be stocked with Beautiful Lake walleye every 2-3 years at the rates suggested below, depending on stock size available through the transfer program and monitoring results of success.

1) 150 - 200 sub-adult walleye (>= 1+)
Or
2) ~500 advanced fingerlings (0+). This equates to 12.5 fish/ha, half the recommended rate due to size of Marge Lake and the size of young of the year walleye transferred from Beautiful Lake.

The Marge Lake initiative of creating a self-sustaining walleye population appears to have reached a conclusion. The data collected in previous years has shown some promise but there are too many uncontrollable factors negating success. With a new stocking and harvest strategy in mind, the future of the Marge Lake walleye should be monitored through the standardized trap netting program every four years.

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# 8.0 Literature Cited


Carlander, K. D. (1950). Handbook of Freshwater Fishery Biology: With the First Supplement. WC Brown Company.

Colby, P. J., McNicol, R. E., & Ryder, R. A. (1979). Synopsis of biological data on the walleye. Food and Agriculture Organization of the United Nations. Fisheries Synopsis, 119.

Geisler, M.E. (2012). Stock Assessment of Walleye(Sander vitreus) in Waterhen Lake, MB. Department of Biology. University of Winnipeg. (Manitoba, Canada).

Hartman, G. (2009). A Biological Sypnosis of Walleye (Sander Vitreus). Fisheries and Oceans Canada. Nanaimo, British Colombia

Hartman, K. J., & Margraf, F. J. (1992). Effects of prey and predator abundances on prey consumption and growth of walleyes in western Lake Erie. Transactions of the American Fisheries Society, 121(2), 245-260.

Kelso, J. R. (1972). Conversion, maintenance, and assimilation for walleye, Stizostedion vitreum vitreum, as affected by size, diet, and temperature. Journal of the Fisheries Board of Canada, 29(8), 1181-1192.

Kerr, S. (2008). A survey of walleye stocking activities in North America. Ministry of Natural Resources.

Laarman, P. W. (1978). Case histories of stocking walleyes in inland lakes, impoundments, and the Great Lakes—100 years with walleyes. American Fisheries Society Special Publication, 11, 254-260.

Lester, N. P., Dextrase, A. J., Kushneriuk, R. S., Rawson, M. R., & Ryan, P. A. (2004). Light and temperature: key factors affecting walleye abundance and production. Transactions of the American Fisheries Society, 133(3), 588-605.

McMahon, T. E., Terrell, J. W., & Nelson, P. C. (1984). Habitat suitability information: walleye. FWS/OBS (USA).

Morgan, G.(2015). Walleye Stocking as a Management Tool in Ontario's Inland Lakes. Walleye Aquaculture Workshop.

Schneider, 1998b, Guidelines for interpretation of lake surveys. Study Performance Report for Study 668, Dingell-Johnson Project F-35-R24, Michigan

Scott, W.B. and E.J. Crossman, (1998). Freshwater fishes of Canada. Oakville (Ontario, Canada): Galt House Publications. xx+966 p.

Stephenson, S. A., & Momot, W. T. (1991). Food habits and growth of walleye, Stizostedion vitreum, smallmouth bass, Micropterus dolomieui, and northern pike, Esox lucius, in the Kaministiquia River, Ontario. Canadian field-naturalist. Ottawa ON, 105(4), 517-521.

Stevens, G. (1990) Physical habitat preferences of walleyes in streams in Wisconsin. University of Wisconsin

# 9.0 Appendix-Pictures