Integrated Walleye Enhancement Project Assessments

FEF Project 13 – 063

Part One

Swan Valley Sport Fishing Enhancement Inc.

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Summary

SVSFE strongly supports walleye management with the objective of creating self sustaining walleye fisheries. Walleye are one of the most targeted species in the area by anglers. Some lakes are easily influenced by various factors in a short period of time therefore monitoring these fisheries are essential. For that reason SVSFE and WSD have partnered together with the goal to actively manage local walleye fisheries by enhancing them through habitat improvement, stocking, research and education.

In recent years this partnership has; initiated regulation changes, identified walleye compositions and frequencies, enhanced walleye populations through adult stocking, created/enhanced walleye spawning habitat, identified local walleye behavior and habitat requirements, and introduced walleye to new waterbodies creating new fishing opportunities.

Due to the positive results from these practices and efforts, SVSFE set out to continue monitoring activities within an Integrated Walleye Assessment in the 2014 field season. This project included the following activities:

1. Monitoring the walleye spawn on two newly re-introduced walleye lakes - Beaver Lake and Marge Lake. Both lakes have been established with walleye through the Adult Walleye Transfer project with the intentions of creating a new walleye fishery for anglers. Results from 2013 recruitment monitoring indicated stocked walleye were reproducing but results were very minimal. Continued monitoring of these waterbodies & following the spawning success is necessary in determining future lake management.

2. Monitoring walleye populations through trap netting in Beaver and Marge Lakes. This would indicate the survival of stocked fish, provide population estimates and species compositions. This information will aid in determining whether any changes are required in stocking practices and regulations.

3. Young of the year (YOY) assessments through mid summer seining. These assessments would indicate recruitment success of walleye on Beaver Lake and Marge Lake.

4. OTC Analysis of YOY walleye, therefore determining natural recruitment success in both Bell and North Steeprock Lakes. OTC sampling included utilization of the Electro-shocking boat. OTC analyzing is part of the FEF project: 10-004 Multi-Year OTC. The objective is to determined how walleye within these waterbodies are being sustained, and how significant provincial stocking is to the walleye population. It will also help verify decisions for future walleye stocking and management for North Steeprock and Bell Lake.

5. Walleye fry stocking in rearing ponds/lakes. Assisting WSD in fry stocking and rearing walleye to a larger size prior to their release therefore increasing their chance of survival.

Summary

Marge Lake

In terms of Marge Lake the research conducted over the 2014 field provided very significant results. Data analyzed from these efforts have determined a good representation of the lake's overall health, natural recruitment success, and most importantly suggestions for "the next step" in terms of lake management. With regards to spring monitoring, SVSFE technicians determined that walleye utilize Marge Creek during critical periods for spawning; a occurrence previously unknown. Not only were walleye observed utilizing Marge Creek, fertile walleye eggs were also identified in the creek, and young-of-year walleye were discovered through late summer seining. End of spring trap netting (ESTN) suggested a walleye population estimate that closely resembled adult stocking records, suggesting very low rate of natural mortality. Trap-netting also suggested a low composition of mature females, suggesting that more time is required for stocked sub-adults to reach maturity. ESTN also suggested a good representation of multiple age classes, however a lacking in sizes >450mm (prime spawning frequency). It is likely that natural recruitment success with increase once a higher percentage of Marge Lake's walleye reach maturity. A full discussion of results and suggestions for future Marge Lake management can be found on page 72. Overall, SVSFE is satisfied with Marge Lake's progression, and eager to continue monitoring this project lake.

Beaver Lake

With regards to Beaver Lake the research conducted over the 2014 field provided very significant results. Data analyzed from these efforts have determined a good representation of the lake's overall health, natural recruitment success, and most importantly suggestions for "the next step" in terms of lake management. Unfortunately, SVSFE found no evidence on natural recruitment on Beaver Lake in 2014. At this point SVSFE is not deterred by this result, as evidence of successful recruitment was found in 2013. Aside from the irregularly late spring, Beaver Lake experienced a sum of unusual conditions including fluctuating water levels and temperatures throughout the critical season. ESTN suggested a much lower population estimate when compared to adult stocking records, suggesting sufficient harvest which was expected. Growth from recaptures suggested exceptional walleye growth in Beaver Lake averaging 44mm a year growth amongst all age classes. It also became evident that with this exceptional growth, that approximately 30% of the walleye sample were >450cm (prime spawning frequency), suggesting a growing mature/protected population. A full discussion of results and suggestions for future Beaver Lake management can be found on page 74. Overall, SVSFE is satisfied with Beaver Lake's progression, and eager to continue monitoring this project lake.

Summary

Bell Lake

In terms of Bell Lake, few results could be drawn because 2014 OTC analysis has not yet been completed from the hired external source. However with 2013 OTC results, a few preliminary conclusions can be drawn. From the full 2013 sample 36/38 (95%) of the walleye had no OTC mark, or were naturally recruited, which is extremely encouraging. However, with low catches of YOY walleye over both years, SVSFE has preliminarily concluded that some unknown environmental factor is hindering juvenile walleye survival. At this point, it has been determined that predation is likely the cause because of Bell Lake's extremely low composition/abundance of forage minnows. Not to mention the healthy populations of northern pike and walleye in terms of predators. A full discussion of results and suggestions for future Bell Lake management can be found on page 74. Overall, SVSFE is satisfied with Bell Lake's progression, and eager to continue monitoring this project lake.

North Steeprock Lake

In terms of North Steeprock Lake, few results could be drawn because 2014 OTC analysis has not yet been completed from the hired external source. However with 2013 OTC results, a few preliminary conclusions can be drawn. With regards to the 2013 sample, 76/114 (67%) had no mark and were therefore naturally recruited, and from the young-of-year age class exclusively 37/51 (51%) of the fish had no mark and were therefore naturally recruited. These ratios are very encouraging. Interestingly, catch on the east shore was "phenomenal" over both years suggesting very popular juvenile walleye habitat. Aside from these preliminary ratios, no other mentionable observations are relevant at this point. A full discussion of results and suggestions for future North Steeprock Lake management can be found on page 75. Overall, SVSFE is satisfied with North Steeprock Lake's progression, and eager to continue monitoring this project lake.

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2.0 Study Rationale

SVSFE strongly supports walleye management with the objective of creating self-sustaining fisheries. When a fishery becomes a sustainable entity, stocking efforts can be concentrated elsewhere in lakes that require it. Each spring walleye fry is limited for each Manitoban region, meaning proper allocation of these fry is of top priority. In order to understand which lakes require supplemental stocking and which do not, it becomes important to understand natural recruitment success.

In the summer of 2014 SVSFE technicians conducted a study regarding natural recruitment success of walleye in four local fisheries. These lakes included Beaver Lake, and Marge Lake in the Duck Mountains, along with North Steeprock Lake and Bell Lake in the Porcupine Hills. Using various methods, this study had three objectives:

1. To assess the success of spawning and monitor walleye populations in lakes recently re-introduced with adult walleye. These lakes include Beaver Lake and Marge Lake. These lakes have all been stocked with adult walleye in previous years in correlation to the Beautiful Lake Adult Walleye Transfer. Determining recruitment success, and overall condition of the fishery sets precedence in lake management plans, as it would suggest if these fish are reaching maturity and successfully reproducing within their new habitat. Secondly, to determine the success of naturally reproduced walleye compared to success of stocked walleye survival at both Bell and North Steeprock Lakes. It is beneficial to further understand if these waterbodies require supplemental stocking.

2. To assess the state of the adult walleye population in both Marge and Beaver Lakes. This was determined through an end of spring trap netting program

3. To identify the presence of suitable walleye spawning habitat/preferred YOY habitat in each of these lakes and to observe and document these areas. Results will indicate whether rehabilitation, protection, or enhancement of these areas are necessary.

With this relevant information, corresponding with relevant ongoing studies, technicians and lake managers can determine proactive management techniques, including potential mitigation, changes in regulation, and habitat enhancement if required.

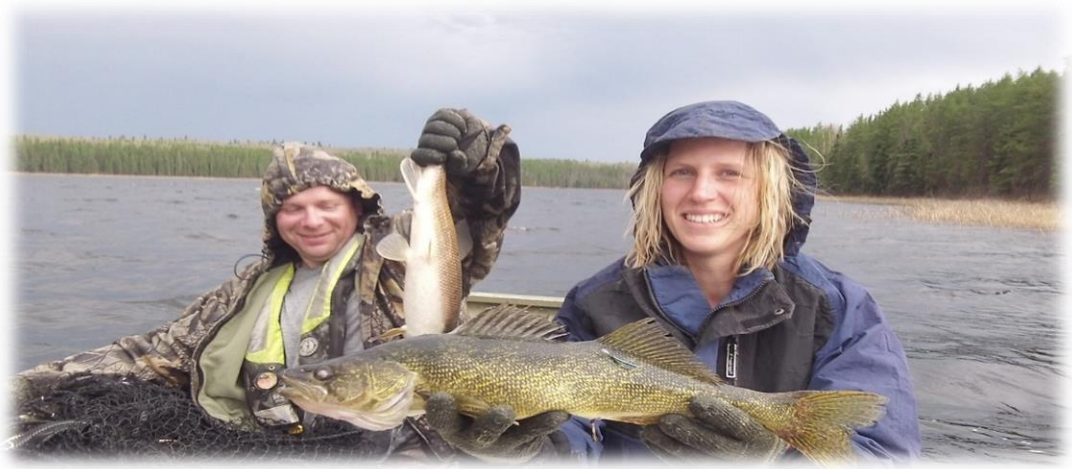


Figure 1: Marge Lake Walleye

3.0 Background Information

Each lake has unique histories and therefore requires special attention. Relevant managerial history and assessments pertaining to each lake are as follows:

3.1 Beaver Lake

Historically, Beaver Lake had been solely a northern pike fishery. In September of 1975, assessments were conducted and species composition consisted of northern pike, yellow perch, johnny darter, emerald shiner, spottail shiner, brook stickleback, and creek chub. In 1982, a decision was made to stock 200,000 walleye fry. By 1987, because of limited walleye success, the Beaver Lake Reclamation Project was initiated. Chemical reclamation removed all rough fish and in 1988, 16,000 brook & rainbow trout were introduced. Throughout the 1990s, fingerling-plus size rainbow trout continued to be stocked and in the 2000s splake were introduced. From 2000-2010 fingerling-plus size and adult rainbow trout and splake were stocked (Manitoba Government, 2012).

Following the 2010 & 2011 Stocked Trout Assessments (FEF Projects 10-011, 10-030 & 10-039) conducted by SVSFE, review of results with stocking committee and fisheries management initiated the decision to reintroduce walleye. In correspondence to the Beautiful Lake Walleye Transfer (FEF Project 10-039), 548 adult walleye were stocked into Beaver Lake in September 2011 with the intention of establishing a self-sustaining walleye fishery. In 2012, during SVSFE's Integrated Fisheries Assessment #2 (Mission Walleye) (Prj. 11-035), technicians assessed Beaver Lake 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 no evidence of natural recruitment resulting in need for further assessments (Urban & Badger, 2013).

In the summer of 2013, with correspondence to *Evaluating Walleye Recruitment Success*(Prj. 12-042), SVSFE technicians found evidence of natural recruitment in Beaver Lake. One young of year walleye was found during a night seine on the east (windswept) shoreline. This evidence, however small, determined that successful walleye spawning was occurring in Beaver Lake, however suitable spawning areas and condition of these sites were highly unknown.

In 2014, in order to enhance walleye spawning habitat, SVSFE acquired funding from RCFPP (Recreational Fisheries Conservation Partnership Program) to create two artificial spawning shoals on Beaver Lake. These two shoals, which are now located on the east and south-east shorelines were created by placing rock of varying sizes(Mean=300mm), atop the ice, at pre-surveyed locations (Figure 101).

In the spring of 2014, a new regulation was initiated on Beaver Lake. This regulation (walleye limit of 2, and walleye between 45cm and 70cm must be released) replaced the previous general southern division regulation (limit of 4 walleye/sauger). This regulation was requested to fisheries branch because angler reports suggested high fishing quality on Beaver Lake. This regulation was implemented primarily to protect the fisheries mature population (450-700mm).

In 2012, 2013, and 2014 – 90, 882, and 737 adult walleye were transferred from Beautiful Lake to Beaver Lake respectively. A total of 2,257 adult walleye have been stocked into Beaver Lake since 2011. Through angler reports and tagged fish submissions, Beaver Lake has appeared to become a very popular walleye fishery over the past few years.

3.0 Background Information

3.2 Marge Lake

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 no 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. To ensure that the walleye had the opportunity to reproduce, a zero limit for walleye was implemented in 2010 for Marge Lake, which remains the regulation to this day. In 2011, 585 adult walleye were stocked into Marge Lake corresponding with the Beautiful Lake Walleye Transfer (FEF project 10-039).

In 2012, during SVSFEs Integrated Fisheries Assessment #2 (Mission Walleye)(FEF Project 11-035), technicians assessed Marge Lake 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 need for further assessments. In the fall of 2012, an additional 125 walleye were stocked into Marge Lake via the Beautiful Lake Transfer (FEF project 11-035).

Figure 2: Marge Lake Walleye Transfer

In the summer of 2013, with correspondence to *Evaluating Walleye Recruitment Success* (Prj. 12-042), SVSFE technicians found evidence of natural recruitment in Marge Lake. One young of year walleye was found during a night seine on the southern beach of Marge Lake. This evidence, however small, determined that successful walleye spawning was occurring in Marge Lake, however suitable spawning areas and condition of these sites were highly unknown.

In the fall of 2014, a total of 569 adult walleye were transferred to Marge Lake in correspondence to the Beautiful Lake Walleye Transfer (FEF project 11-035). To date, a total of 1,678 adult walleye have been stocked into Marge Lake since 2010 (Figure 2).

3.0 Background Information

3.3 Bell Lake

Bell Lake has been intermittently stocked with walleye since 1959 (Table 1). Over the years, multiple studies have been conducted on Bell Lake, but the extent of natural reproduction remains unknown. A Bell Lake survey was conducted in 1992 suggested that Bell Lake is a "reasonably good walleye fishery that has been maintained mostly by natural recruitment" (Yakes, 1992). The study also suggested that "recruitment does not appear to be a problem", "observed numerous rocky shoals in the lake that appeared to be adequate for walleye spawning" (Yakes, 1992).

2012 & 2013 Trap Netting (FEF Projects 11-035 & 12-024) carried out by SVSFE technicians indicated "walleye populations are characterized to have a fair density (3.9 walleye/hectare) with frequencies of mature fish increasing" (Urban 2013). Pending age results will help further understand the walleye population dynamics. Seining results during this time found low densities and diversity of forage fish with no signs of walleye recruitment. It was also stated that water levels of the lake and later spawning periods of walleye may be influencing the success of spawning/recruitment.

Table 1: Bell Lake Stocking Records

Year	Number	Age
1959	500,000	Eyed Eggs
1976	500,000	Fry
1987	200,000	Fry
1990	300,000	Fry
1992	300,000	Fry
1994	300,000	Fry
1995	300,000	Fry
1996	300,000	Fry
1997	200,000	Fry
1997	16,036	Fingerlings
2000	200,000	Fry
2001	200,000	Fry
2002	200,000	Fry
2003	300,000	Fry
2004	300,000	Fry
2005	300,000	Fry
2006	300,000	Fry
2007	300,000	Fry
2008	300,000	Fry
2008	650	Fingerlings
2009	100,000	Fry
2010	100,000	Fry
2011	200,000	Fry
2012	300,000	Fry
2013	200,000	Fry
2014	200,000	Fry
Total	**6,416,686**	

3.0 Background Information

3.4 North Steeprock Lake

North Steeprock Lake has been intermittently stocked with walleye since 1959 (Table 2). Over the years, multiple studies have been conducted on North Steeprock Lake, but the extent of natural reproduction is unknown. A survey was conducted in 1992 that suggested recruitment of walleye as a problem which may be due to; poor spawning habitat and/poor fry survival after spawning (Yake, 1992). A telemetry study was conducted in 1998 to identify potential walleye spawning habitat. It was determined the majority of fish (5/8) visited the inflowing river inlet during critical periods suggesting spawning may be occurring here. In 2009, SVSFE technicians observed a 100% visual on walleye spawning in this inlet significantly upstream (Urban 2009). Further studies, including walleye tagging in 2009 and trap netting in 2012 & 2013, found walleye populations were fair to moderate (3.7 walleye/hectare) with large walleye being the average sized fish. "Lower numbers of smaller walleye could indicate recent challenges with recruitment success " (Urban, 2013). It was apparent through seining results, forage was highly available with high densities of spottail shiners. These studies have concluded recent walleye recruitment was potentially occurring as YOY walleye were found in seine catches during both years of the trap netting program. However, this was an unknown variable because of annual fry stocking.

Table 2: North Steeprock Lake Stocking Records

Year	Species	Number	Age
1959	Walleye	500,000	Eyed Eggs
1986	Splake	50,000	Fingerlings
1986	Lake Trout	30,000	Fingerlings
1990	Walleye	500,000	Fry
1994	Walleye	12,000	Fingerlings
1995	Walleye	200,000	Fry
1995	Walleye	24,166	Fingerlings
1996	Walleye	62,967	Fingerlings
1997	Walleye	24,844	Fingerlings
1999	Walleye	150,000	Fry
2002	Walleye	400,000	Fry
2003	Walleye	300,000	Fry
2004	Walleye	200,000	Fry
2013	Walleye	400,000	Fry
2014	Walleye	400,000	Fry
•Total Walleye Fingerlings		**123,977**	
•Total Walleye Fry & Eggs		**3,050,000**	

4.0 Methods

4.1 Study Area

The study area included a total of four lakes; Beaver Lake, and Marge Lake (Duck Mountain Provincial Park) and Bell Lake and North Steeprock (Porcupine Provincial Forest). From the Town of Swan River; Beaver Lake is located 59.7 kilometers southeast, Marge Lake is 79 kilometers southeast, Bell Lake is 60.4 kilometers north and North Steeprock Lake 71.6 kilometers north (Figure 3).

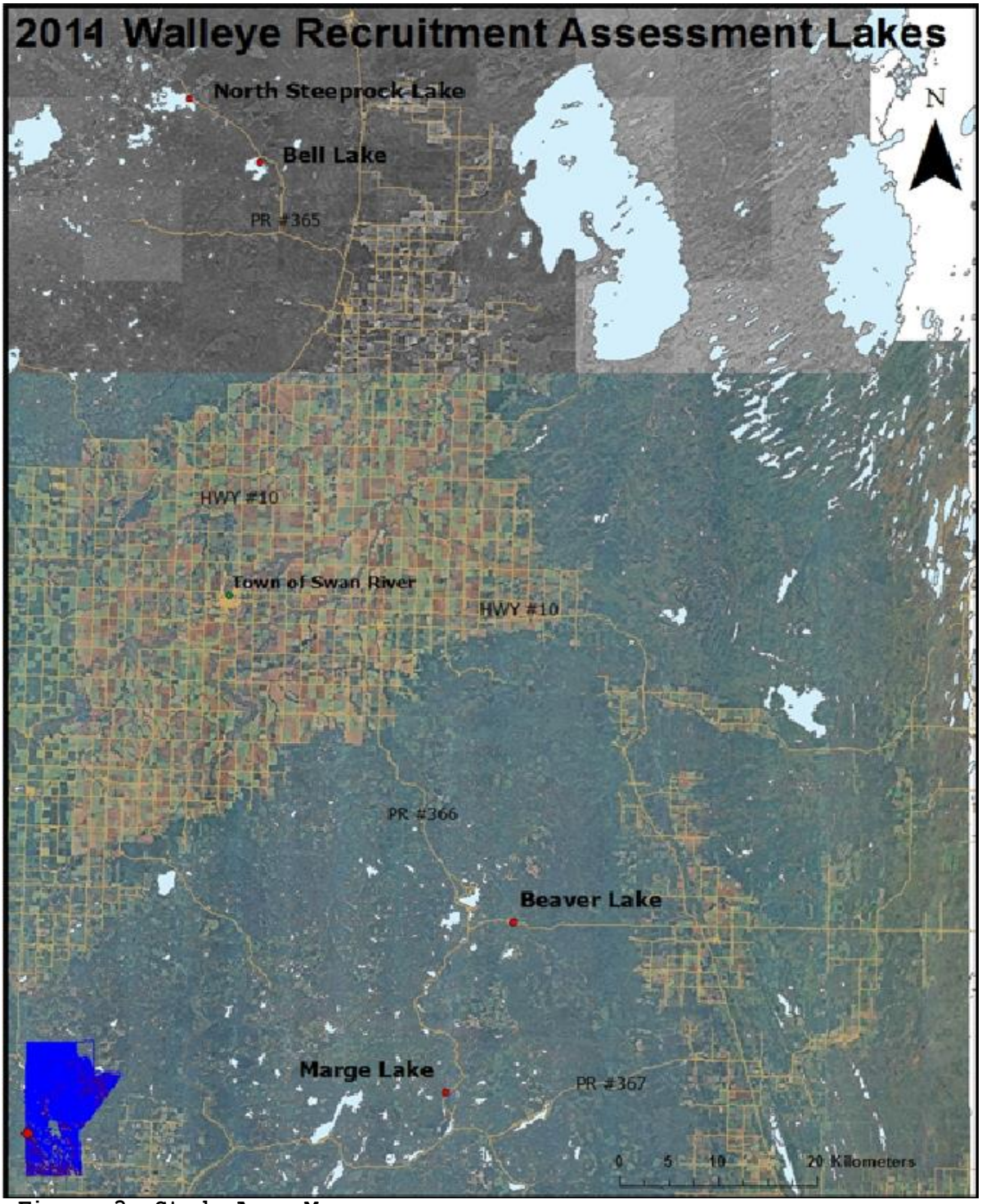


Figure 3: Study Area Map

4.0 Methods

4.2 Study Period

This study occurred over the spring, summer and fall of 2014 (Figure 4). Lake specific study periods are summarized as follows:

Marge Lake

Observational monitoring on Marge Lake began on April 17th, 2014 and continued through ice out until post spawn when temperature logger was immobilized on June 19th, 2014. Kick sampling, guzzling, and drift netting occurred on June 8th, 2014. Marge Lake trap netting (ESTN), to monitor walleye populations and general species composition occurred from June 16th-19th, 2014. Seining for evidence of natural recruitment occurred during the day on August 25th, and during the night on August 28th, 2014.

Beaver Lake

Observational monitoring on Beaver Lake began April 17th, 2014 and continued through ice out until post spawn when temperature logger was immobilized on June 18th, 2014. Kick-sampling, guzzling, and spawning mat evaluations occurred June 9-12th, 2014. Beaver Lake trap netting (ESTN), to monitor walleye populations and general species compositions occurred from June 9th-12th, 2014. Seining for evidence of natural recruitment occurred during the day on August 26th, and during the night on August 27th, 2014.

Bell Lake

Electrofishing for young-of-year walleye on Bell Lake occurred on the night of September 9th 2014 from 9:00pm until 12:00am. Seining/scouting for potential young-of-year walleye habitat was unnecessary this year because high percentage locations were previously determined during the 2013 portion of the particular OTC study.

North Steeprock Lake

Electrofishing for young-of-year walleye on North Steeprock Lake occurred on the night of September 8th 2014 from 8:00pm until 10:10pm. Seining/scouting for potential young-of-year walleye habitat was unnecessary this year because high percentage locations were previously determined during the 2013 portion of this particular OTC study.

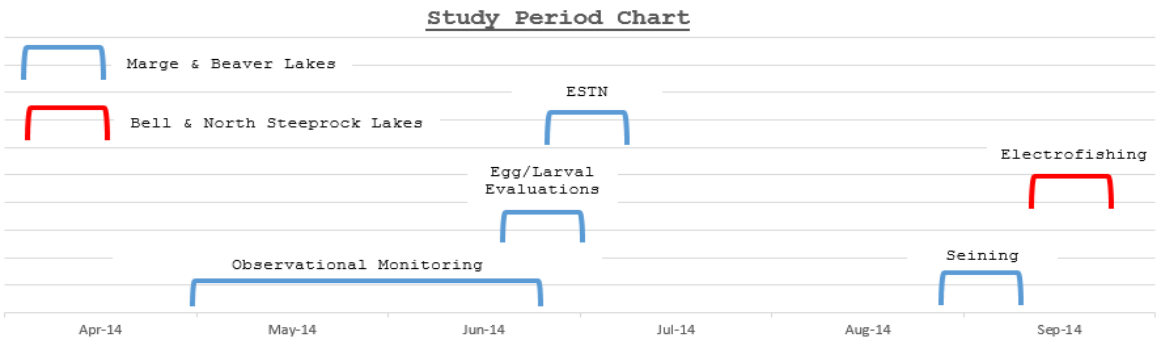


Figure 4: Study Period Chart

4.0 Methods

4.3 Beaver and Marge Data Gathering

Multiple methods were used to help understand natural recruitment success in Beaver and Marge Lake. Methods are summarized as follows:

Observational Monitoring (Pre-spawn/Spawn):

Observational spring monitoring was conducted on Marge and Beaver Lakes during the spring of 2014. In terms of evaluating the spawn, different objectives were set for each of the two targeted lakes. Marge Lake objectives were to follow the spawn closely in order to determine specific spawning locations. Since initial adult walleye stocking in Marge Lake (2011); SVSFE and local Fisheries Branch representatives have been curious if walleye would/have been utilizing a small inflowing tributary (Marge Creek) for spawning activity (Figure 5). Evidence of this would determine if Marge Creek needed to be rehabilitated, which has been a common concern since initial walleye introductions in 2011 (Rowe, 2012). In terms of Beaver Lake, the pre-spawn/spawning observational objectives were to simply monitor the walleye's progress. Once it became evident that the spawn had transpired, post spawn evaluations would be executed. Note that this disproportionate effort is strictly due to limited human and material resources. Pre-spawn/spawn methods are summarized as follows:

Observing/Spotlighting

Observational monitoring occurred nightly from May 6th until June 3rd 2014. Over this duration, visits to Marge (creek) occurred every evening and visits to Beaver (spawning shoals) occurred every-other evening. In this time period, SVSFE technicians used a custom protocol where multiple environmental parameters/indicators were documented (Figure 96). Environmental parameters recorded included water temperature, water TDS, water acidity, water conductivity, air temperature, wind direction, wind speed, cloud cover, precipitation, moon phase, and photoperiod along with environmental indicators including the presence of walleye, suckers, pike, minnows, invertebrates, amphibians, birds, and mammals amongst other general observations. These different parameters were documented as an effort to correlate different environmental indicators with walleye spawning activity. A total of four minnow traps were set at Marge Creek and were checked daily to document minnow spawning/activity. Spotlighting for walleye spawning activity occurred nightly, and technicians generally were on site monitoring between 10:00pm and 1:00am. If fish activity was observed, technicians drew maps to document the areas that different species utilized.

Figure 5: Marge Creek April 17th, 2014

4.0 Methods

4.3 Beaver and Marge Data Gathering

Trap Netting (Pre-Spawn)

Spring observational trap netting occurred on Marge Lake exclusively. A total of twelve trap nets were set in six different locations on Marge Lake from immediate "ice out" (May 21st) until May 27th, 2014. Nets used were custom lake superior style trap-nets (Figure 7). Nets would fish for 24 hour durations and would be moved to different locations if walleye catches were low or absent. Net locations were pre-determined and based on conversations between SVSFE and local fisheries biologists. The intention of this protocol was primarily to locate a sample of 100 walleye to determine a mature male (MM) to mature female (MF) ratio while acquiring other valuable information. Through trap-netting, SVSFE were also able to track the walleye geographically during these critical periods. Technicians were also able to monitor how far along the spawn was by using a [0-3] scale representing spawn stage; For example, 0=no eggs/milk, 1=difficult to sex, 2=spawning (easy to sex), and 3=releasing milk/eggs without effort. While trap-netting technicians also fully sampled (measured, weighed, sexed, and tagged) all game species, therefore providing SVSFE with valuable data regarding lake species composition, length/weight frequencies, age frequencies, and growth through angler recapture submissions. Suckers were sexed, measured, and clipped providing SVSFE with valuable information on the sucker population including population estimates, sex ratios, size distribution, and length frequencies.

Angling/Gill Netting

Spring observational gill netting/angling occurred on Beaver Lake exclusively. A total of six short set gill nets were set in one productive location from May 24th-May 30th, 2014. The net used was three panels of 2.5" green monofilament. The net was set for 20 minute durations at a popular angling location west of the boat launch. Angling occurred while waiting for the gill nets, and fish were angled 4/6 times fishing (3/6 walleye), and (1/6 splake). The intention of this protocol was to simply catch mature walleye to see how far into the spawn they were by using a [0-3] scale representing spawn stage as explained above. While angling/gilling, techs fully sampled (measured, weighed, sexed, and tagged) all game species, therefore providing SVSFE with valuable data regarding lake species composition, length/weight frequencies, age frequencies, and growth through angler recapture submissions. Suckers were sexed, measured, and clipped providing SVSFE with valuable information on the sucker population including population estimates, sex ratios, size distribution, and length frequencies.

Figure 6: Gill Net Walleye

Figure 7: Angled Walleye

4.0 Methods

4.3 Beaver and Marge Data Gathering

Egg and Larval Evaluations(Post-Spawn): Once technicians were convinced that the spawn had concluded and some time was allocated for fertilization and egg development; walleye egg and fry evaluations were initiated. Post-spawn egg and larval evaluation methods are as follows:

Guzzling:

Guzzling occurred on Marge Lake June 8th, 2014 and Beaver Lake on June 9th,11th & 12th 2014. On Marge Lake a total of 9 sites were guzzled (representing lakes natural substrate), and Beaver Lake a total of 20 sites were guzzled (16 on enhanced shoal, and 4 representing lakes natural substrate). Sites were chosen semi-randomly at sites of varying depths, distances from shore, and substrates representing potential walleye spawning habitat. Guzzling was conducted using a manual, hand pump guzzler. Sites were guzzled using a steel 1 square meter sample plot and were guzzled 60 seconds with 30 seconds flush as per State of Michigan DNR survey methods protocol.

Figure 8: Guzzling

Kick Sampling:

Kick sampling occurred on Marge Lake (Marge Creek) on June 8th 2014, and on Beaver Lake (inflowing tributary from Cluff Lake) on June 11th, 2014. A total of 5 sites were kick-sampled in Marge Creek, and a total of 3 sites were kick-sampled in Beaver's tributary. In both sampled creeks, sites were chosen semi-randomly at different reaches of each creek where substrates appeared to represent walleye spawning habitat. One technician would "kick-up" underlying substrate (1 square meter) for 30 seconds, while a second technician would hold a lift net approximately 1 meter down stream from sample plot. Following each 30 second kick-sample technicians would lift the next and sample the catch. This method is custom of a Manitoba Conservation and Water Stewardship kick sampling protocol.

Figure 9: Kick-Sampling

Spawning Mats:

Spawning Mats were used exclusively at Beaver Lake. A total of twelve spawning mats were placed at Beaver Lake immediately following ice-out (May 19th, 2014). Spawning mats were placed exclusively on the newly constructed spawning shoals with 8 placed on the east shoal, and 4 placed on the south-east shoal. Random "lifts" were performed on various dates between May 24th until they were pulled out indefinitely on June 9th, 2014. Spawning mat locations were chosen at random at varying depths and substrates throughout the shoals. The spawning mats were constructed using synthetic furnace filters fastened to cinder blocks, a design deemed successful in southern Manitoba. For each lift egg counts, minnows (fatheads), and invertebrate species were counted.

Figure 10: Spawning Mats

4.0 Methods

4.3 Beaver and Marge Data Gathering

Drift Netting:

Drift netting occurred on Marge Lake (Marge Creek) on June 8th 2014. Two drift nets were used; one in the upper reaches of Marge Creek, and one in the lower/middle reaches of Marge Creek. These particular larval drift nets were anchored to shore and float perpendicular the stream capturing young larval fish as they are flushed downstream through a conical funnel into a fine mesh trap (Figure 11). These two drift nets were set simultaneously and fished for two hours from 12:00pm until 2:00pm.

Figure 11: Drift Netting

Trap Netting (ESTN – Post Spawn)

End of spring trap netting (ESTN), is a standard live release trap netting program designed to estimate the relative abundance of a fish stock and provide other biological measures to assess the status of walleye populations (Skinner, 2004). ESTN is a very specific protocol used by Ontario Ministry of Natural Resources to monitor and assess walleye fisheries. This technical protocol requires that sampling occur in spring when water temperatures are between 12°C and 18°C, among many other strict formalities. ESTN requires that on multi-year studies that sites, and water temperature are accurately replicated from year to year. For this particular trap netting study, SVSFE was to replicate a ESTN study done on Beaver and Marge Lakes in 2012. Replication requires that six trap nets be set in each lake for 24 hour durations at temperatures from 13-16°C.

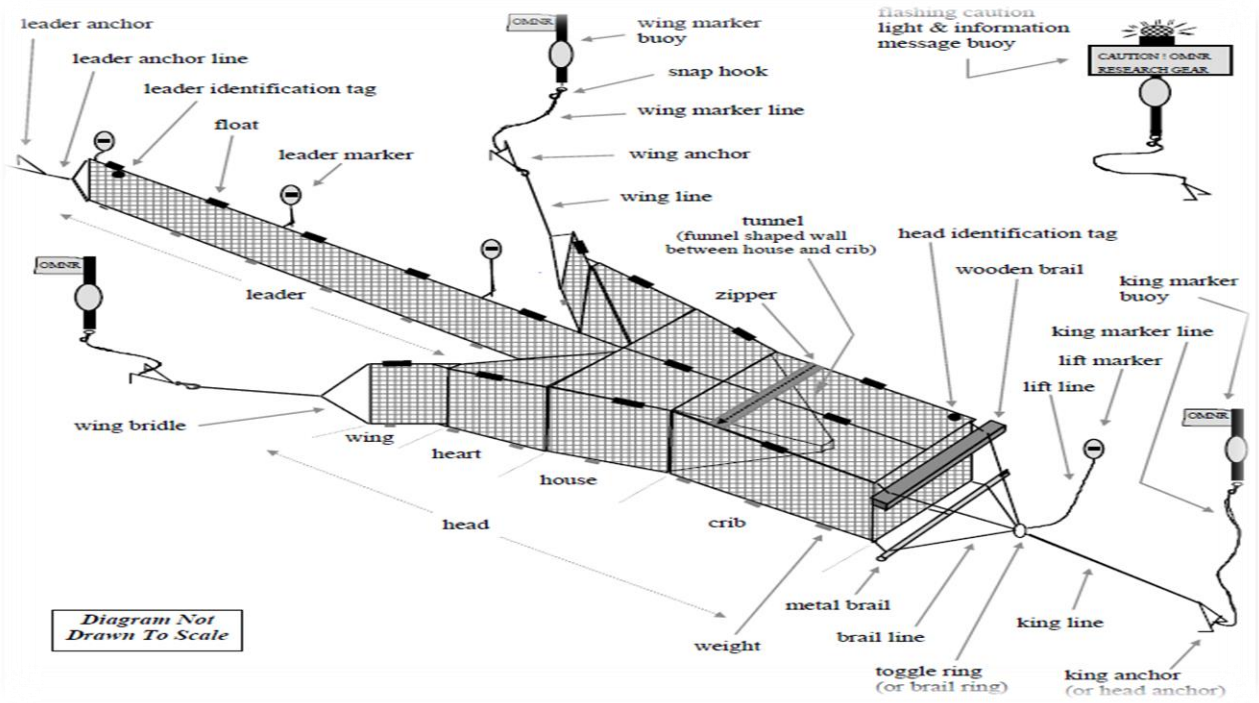


Figure 12: Lake Superior Trap Net

4.0 Methods

4.3 Beaver and Marge Data Gathering

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. The seine net had an attached weight line on the bottom and a float line on the top to keep the net vertical in the water while entrapping fish. Areas sampled were essentially any viable areas, with as little debris as possible (i.e. boulders, snags, woody debris) that could complicate movement and therefore sampling. Sandy, hard packed and clean areas were selected as often as possible representing walleye young-of-the-year habitat (Kerr, 1997). During the sampling period, seining took place during both high and low light conditions (day & night). Night seining was necessary since characteristic habitat of young-of-the-year walleye often include; sandy, hard-packed areas during the night (Stevens, 1990). Technicians in chest-waders, attached the weighted line around their ankle and with float line in hand, ran the seine parallel to shore. Technicians would designate one person to deep water(max 1.3 m) and one to shallow water(min 0.2 m), running the seine as fast as possible along the shoreline to alleviate the possibility of fish from out-swimming the net. Sample distances varied significantly from site to site, as "seinable substrate" isn't usually constant. Once the designated distance was reached, technicians would assemble at the shoreline by the "deep water sampler" circling towards the "shallow water sampler". Once both samplers were within close proximity to each other near the shoreline, they would pull the net in while keeping the weight line on the bottom of the lake to prevent fish escapement. The catch was then designated to sample tubs in a swift motion, disallowing smaller forage species to sneak through the 1/4 inch mesh. Once fish were in the sampling tubs, forage species and young-of-the year were counted. Young-of-the-year were often sampled first thus avoiding mortality and measured for fork length. Forage species were counted quickly, and released. Level of abundance was then measured in catch-per-unit effort (CPUE); in this case, catch per meter of shoreline sampled. A total of 16 seines were executed at Marge Lake and a total of 11 seines were executed in Beaver Lake in 2014.

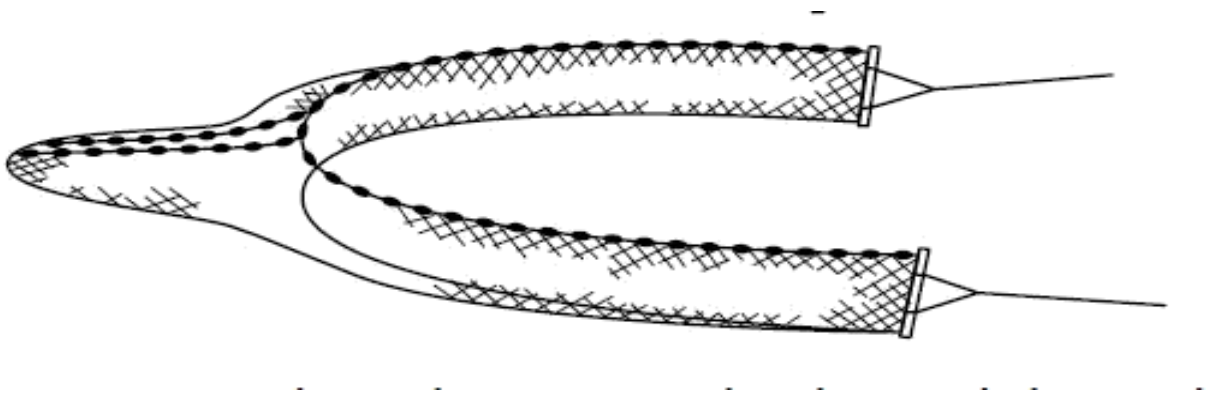


Figure 13: Beach Seine

4.0 Methods

4.4 North Steeprock Lake and Bell Lake Data Gathering

OTC Analysis & Electro-fishing

OTC analysis is a method of determining natural recruitment success in selected water bodies. This two-year study was conducted on both Bell, and North Steeprock Lakes in 2013 and 2014. SVSFE's OTC methodology is summarized as follows:

STEP 1:

The first step to an OTC analysis project begins in the hatchery. Since 2003, the Whiteshell and Swan Creek hatcheries (the two major walleye hatcheries in Manitoba) have been marking walleye fry using Oxytetracycline (OTC). OTC is a non-lethal, non-toxic internal dying agent that imprints a mark on boney structures of fish (i.e. Otoliths). Prior to stocking, recently hatched walleye fry are immersed in an OTC solution for 6-7 hours; thus dying their bony structures. Efficacy trials (for the Whiteshell Hatchery) at this time have reached the 95+% mark (Kansas, 2013). Efficacy trials have never been conducted on Swan Creek OTC fry. On May 30th, 2013 Bell Lake was stocked with 200,000 and North Steeprock Lake was stocked with 400,000 OTC walleye fry supplied by the Whiteshell hatchery. The following year on June 3rd 2014, Bell Lake was stocked with 200,000, and North Steeprock Lake was stocked with 400,000 OTC walleye fry supplied by the Whiteshell hatchery. Fry were released in various areas of each lakes to ensure dispersal on May 30th (2013), and June 2nd (2014).

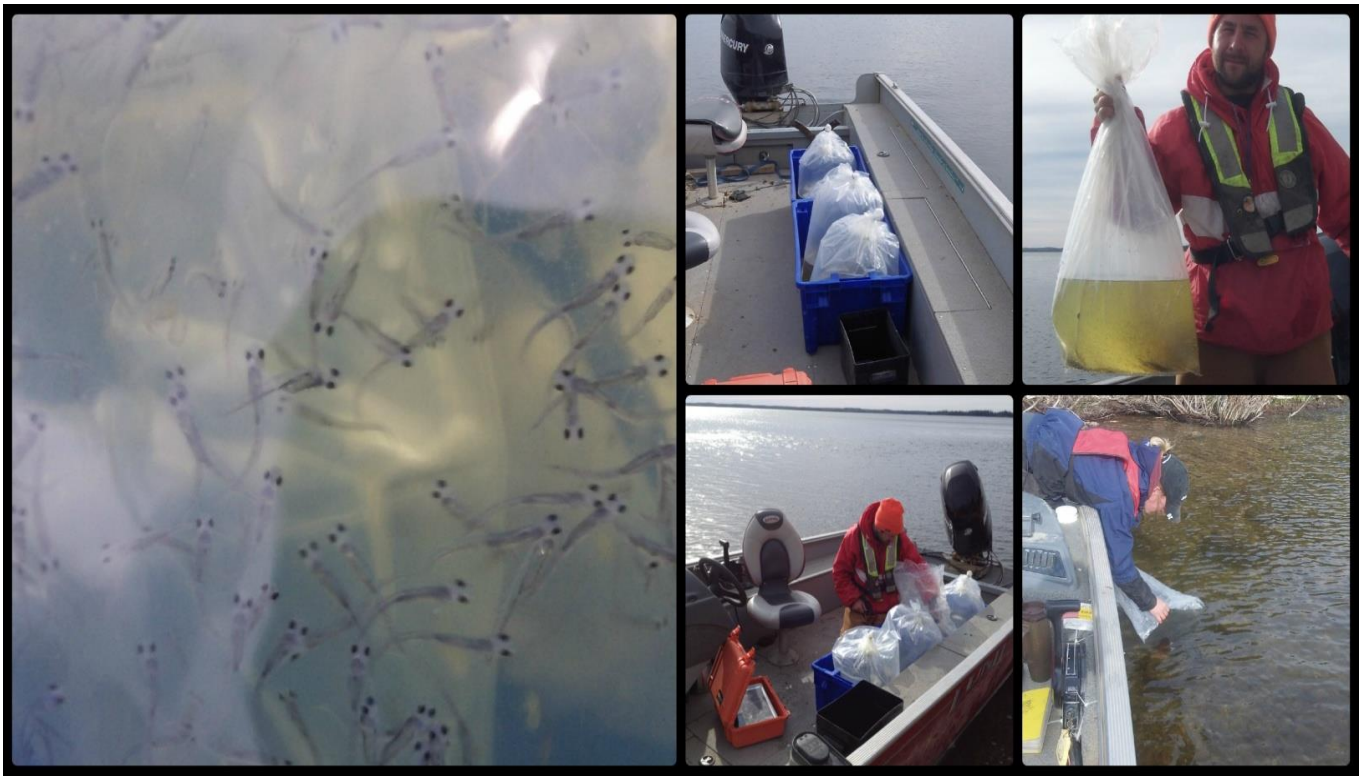


Figure 14: Walleye Fry Stocking

4.0 Methods

4.4 North Steeprock Lake and Bell Lake Data Gathering

STEP 2:

In the fall of each year (2013 & 2014), SVSFE along with various Fisheries Branch biologists re-visited these two candidate lakes in order to capture young-of-year walleye for analysis. Work was conducted on North Steeprock Lake on September 9th, 2013 and September 8th, 2014. On Bell lake, capture was conducted on September 10th, 2013 and September 9th, 2014. Young-of-year capture methods are summarized as follows:

Electrofishing was the method used to target YOY walleye for analysis. In 2013, sample transects were predetermined and chosen based on a variety of substrates where young of the year were expected to be (sandy beaches with interspersed gravel, cobble, rock) but included various habitat compositions and fish cover. All sites were marked and a route was created to simplify navigation during the process. Over both years, sampling was conducted at night (9pm-2am) to increase capture rates. In 2014, sites were determined based on successful sites from 2013. Electro-fishing is a essentially a catchment method that has to ability to electrify the water and temporarily stun fish within the immediate area (Figures 15, 16). This fishing method is also known as "Boom" shocking. It is called boom shocking because the specialized boat has two booms that are rigged off the front of the bow and suspended over the water. Hanging from these booms are multiple electrodes which are lowered accordingly until they are partially submerged in the water prior to "shocking". These are the positive electrodes (anodes); the negative electrodes (cathodes) are located alongside the boat and are also suspended in the water. Once current is initiated, DC current flows between electrodes while stunning fish in the immediate area. Working output is usually 4-10 amperes, but should be adjusted to water conductivity, size of fish targeting, and fish recovery time to avoid injury to the spine or gills (Schneider, 2000). Conductivity at North Steeprock during the time of sampling was 160_{u}s and all transects used 60 pulse/sec, 500 volts at 60 – 70% power in 2013. Amperes ranged from 6.8 – 8 during shocking. Conductivity at Bell Lake was found to be 140_{u}s and transects were shocked with 60 pulses/sec, 500 volts at 75% power. Amperes ranged from 7.0 – 7.5 in 2013. Shocking settings were replicated in 2014, as relevant parameters (i.e. conductivity) remained the same from year to year. While fishing along transects, two dip netters would be located on the fishing platform with one along the shore side of the boat (Figure 16). Netters would capture stunned walleye and place them in the live well located in the center of the boat. Following the completion of each transect all walleye were counted, recorded, bagged (labelled with transect number) and placed on ice for later sampling. Seconds and amp ranges were also recorded for each transect.

Figure 15: E-Boat (Outside)

Figure 16: E-Boat (Inside)

4.0 Methods

4.4 North Steeprock Lake and Bell Lake Data Gathering

STEP 3:

All walleye were later sampled for fork length(mm) and weight(to a tenth of a gram using a digital scale). Otoliths were placed in 1.5 ml micro-tubes to protect them from being damaged during shipping and the number of otoliths extracted were recorded (Figure 17). Otolith samples were sent with the Eastern Region Biologist, Ken Kansas as part of the Multi Year OTC Project (FEF Project 10-004), and further preparation and identification of OTC marks are to be conducted by a private agency - Dr. Daniel Isermann, assistant professor of fisheries and co-director of the Fisheries Analysis Center and the University of Wisconsin-Stevens Point. Dan has a long history in fisheries research, and has extensive experience in estimating the age of fish from calcified structures. His ability to detect OTC marks has been repeatedly verified through blind trials, and has done OTC work for more than a dozen state agencies and academic institutions (Kansas, 2013). 2013 OTC analysis from Dan and his assistants at The University of Wisconsin-Stevens Point arrived in April, 2014. 2014 OTC analysis is expected to arrive in the spring of 2015.

Figure 17: OTC Otolith Sampling

5.0 Results

5.1 Marge Lake Results (Pre Spawn/Spawn Observations)

Marge Creek Fish Usage Observations Chart

	EFFORT				SPECIES PRESENT					
DATE	Observing	Spot-lighting	Snorkeling	Minnow Traps	MINNOW	INVERTS	NRPK	WHSC	WALL	COMMENTS & OBSERVATIONS
6-May-14	X	X		X		X				Mouth of Creek Frozen
7-May-14	X	X		X	X	X	X			Mouth of Creek Ice Free - NRPK in MT
8-May-14	X	X		X		X				
9-May-14	X	X		X	X	X	X			Smaller NRPK Observed in Creek
10-May-14	X	X		X	X	X	X			Smaller NRPK Observed in Creek
11-May-14	X	X		X	X	X	X			NRPK in Grass by Temp Logger
12-May-14	X	X		X	X	X				
13-May-14	X	X		X	X	X				Water 5cm (up)
14-May-14	X	X		X	X	X				Shallow Bays on other Lakes Ice Free (Wellman, Glad, Two-Mile)
15-May-14	X	X		X	X	X				Heard very few frogs
16-May-14	X	X		X	X	X	X		X	Smaller Walleye observed in Mouth of Creek
17-May-14	X	X		X	X	X	X			Ice off other lakes (Perch, Chain, Spray); Multiple pike oberved
18-May-14	X	X		X	X	X	X			
19-May-14	X	X		X	X	X				Marge Lake is Ice Free. Water temp dropped significantly
20-May-14	X			X	X	X				Didn't spotlight - still sunlight
21-May-14	X			X	X	X				Didn't spotlight - still sunlight
22-May-14	X			X	X	X				Didn't spotlight - still sunlight
23-May-14	X	X		X	X	X				Lots of Frogs (Environmental Indicator of Walleye Spawn)
24-May-14	X	X		X	X	X		X		First appearance of WHSC staging in Creek
25-May-14	X	X		X	X	X				Lots of Yellow Perch, no WHSC
26-May-14	X	X			X	X	X	X		Lots of WHSC congregating in pool
27-May-14	X	X		X	X	X	X	X		
28-May-14	X	X	X	X	X	X	X	X		WHSC Staging in Pool and Spawning in Riffles
29-May-14										NO EFFORT - VERY BAD THUNDERSTORM
30-May-14	X			X	X	X		X	X	WHSC in full force, few walleye in lower reaches
31-May-14	X		X	X				X		WHSC in Full Force
31-May-14	X	X			X	X	X	X	X	At Night: Multiple Walleye in Lower Portions, WHSC Everywhere
1-Jun-14	X	X	X		X	X	X	X	X	WALL & WHSC Active in all Reaches of Creek
2-Jun-14	X	X		X	X	X		X		Very few WHSC (Comparatively)
3-Jun-14	X	X		X	X	X	X	X	X	Very few WHSC, over 12 WALL in Lower Reaches

Figure 18: Marge Creek Effort Chart

5.0 Results

5.1 Marge Lake Results (Pre-Spawn/Spawn Observations)

Marge Creek Diagram

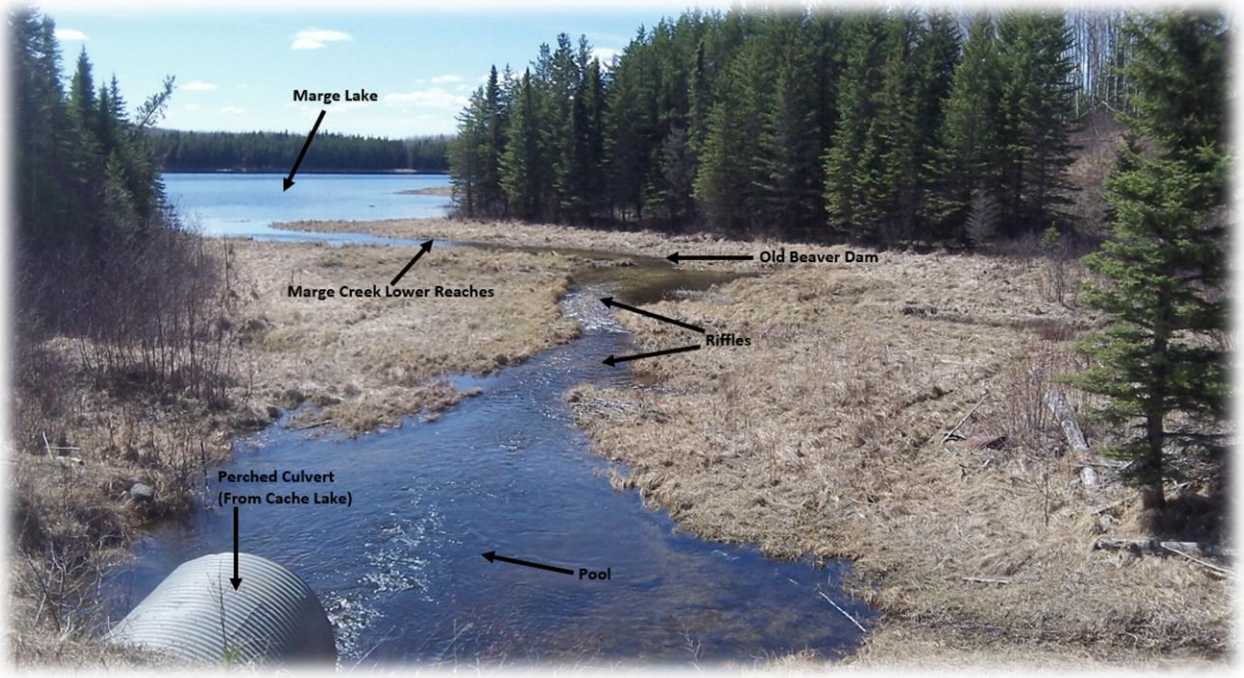


Figure 19: Marge Creek Diagram

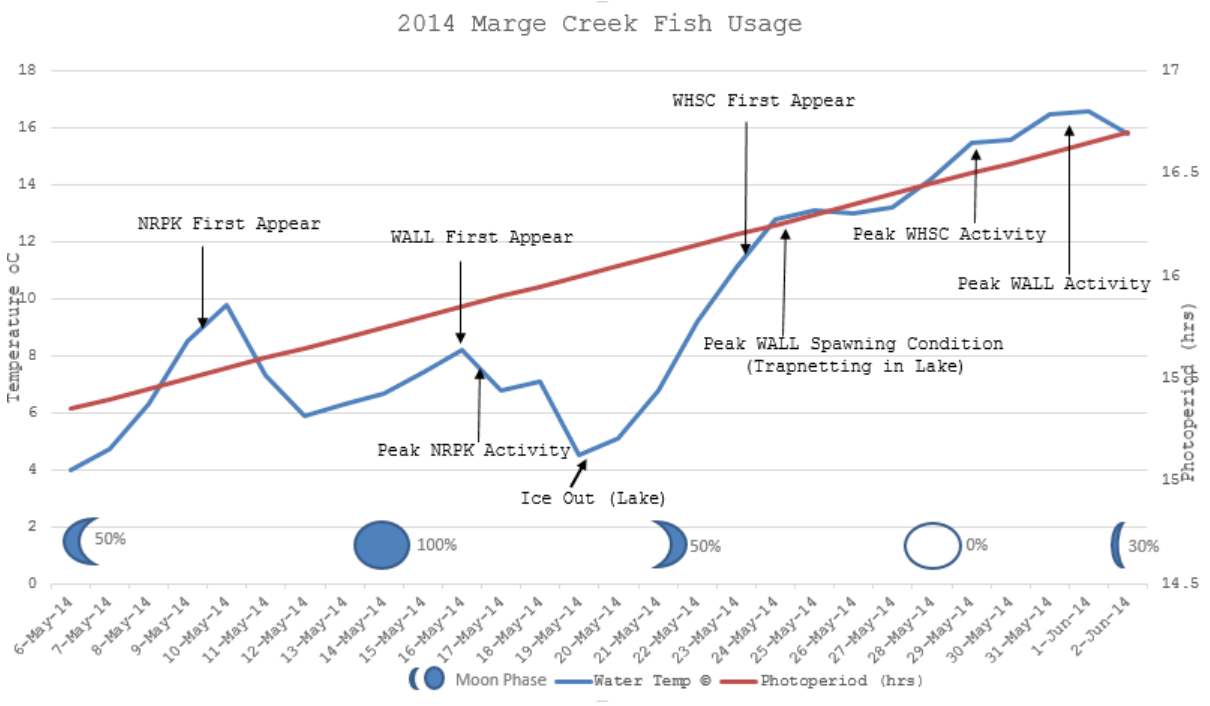


Figure 20: Marge Creek Fish Usage

5.0 Results

5.1 Marge Lake Results (Pre-Spawn/Spawn Observations)

Marge Creek was monitored nightly from May 6th to June 3rd, 2014 with intention of documenting walleye spawning. In the past it has been suggested that walleye may utilize Marge Creek during critical periods, however this phenomena was highly unknown as the lake itself appears to provide suitable walleye spawning habitat. Questions regarding creek dynamics (flow, substrate, temperature suitability, etc.) during critical periods were commonly discussed topics amongst SVSFE and Fisheries Branch personnel. Also, discussion regarding creek substrate rehabilitation/enhancement has been heavily discussed (Rowe, 2012). For this reason, visits to Marge Creek occurred during night, as a female walleye typically spawn out in one night and returns to deeper water (Raabe, 2006). Over the course of the monitoring period, technicians noted creek utilization from multiple species. Northern pike were commonly visualized in the creek and were likely spawning, however actual spawning activity was never visualized. Peak pike activity was documented on May 17th (7°C). White sucker were most dominant species, and were documented spawning in Marge Creek. Suckers first appeared May 23rd (12°C), peak spawning activity was documented on May 29 (15°C), and was concluded by June 2nd (16°C). Walleye were first visualized in Marge Creek on May 16th (8°C), however due to the size of this individual it has been hypothesised that this particular fish was likely immature and feeding. On the night(s) of May 30th, 31st, and June 1st (14.2°C-15.6°C) larger and likely mature walleye were noted in the riffles and pool of Marge Creek (Figure 21). For white sucker, spawning grounds may be similar and in close proximity to those used by the walleye, but the sucker spawns later and in shallower water (Ontario DNR, 2014). Although uncommon, white sucker and walleye have been documented spawning at the same time but in slightly different habitats (Corbett, 2011). A study in Apsley Creek, Ontario observed walleye and white sucker spawn overlapping in time, but white suckers spawned mainly in the riffle zone, and rarely in the quite water surrounding the riffle. In contrast, walleye spawned more in the quiet water than in the riffle (Corbett, 2011). Interestingly, these findings are very similar to the observations conducted on Marge Creek. Although actual spawning activity was not visualized, variables including - walleye location, walleye size, and time of night is has been hypothesised that walleye were spawning in the deeper transitional waters from the Marge Creek Pool to the first set of riffles (Figure 21). Between May 29th and June 3rd, SVSFE technicians visualized multiple walleye congregating in the lower reaches of Marge Creek (1-12 individuals on any given night). Due to the size of these fish (200mm-300mm) it is unknown whether these fish were staging in the lower reaches pre-spawn, or if there were simply feeding on the abundance of forage in the creek.

Figure 21: Marge Creek Observation

5.0 Results

5.1 Marge Lake Results (Pre-Spawn/Spawn Trap-netting)

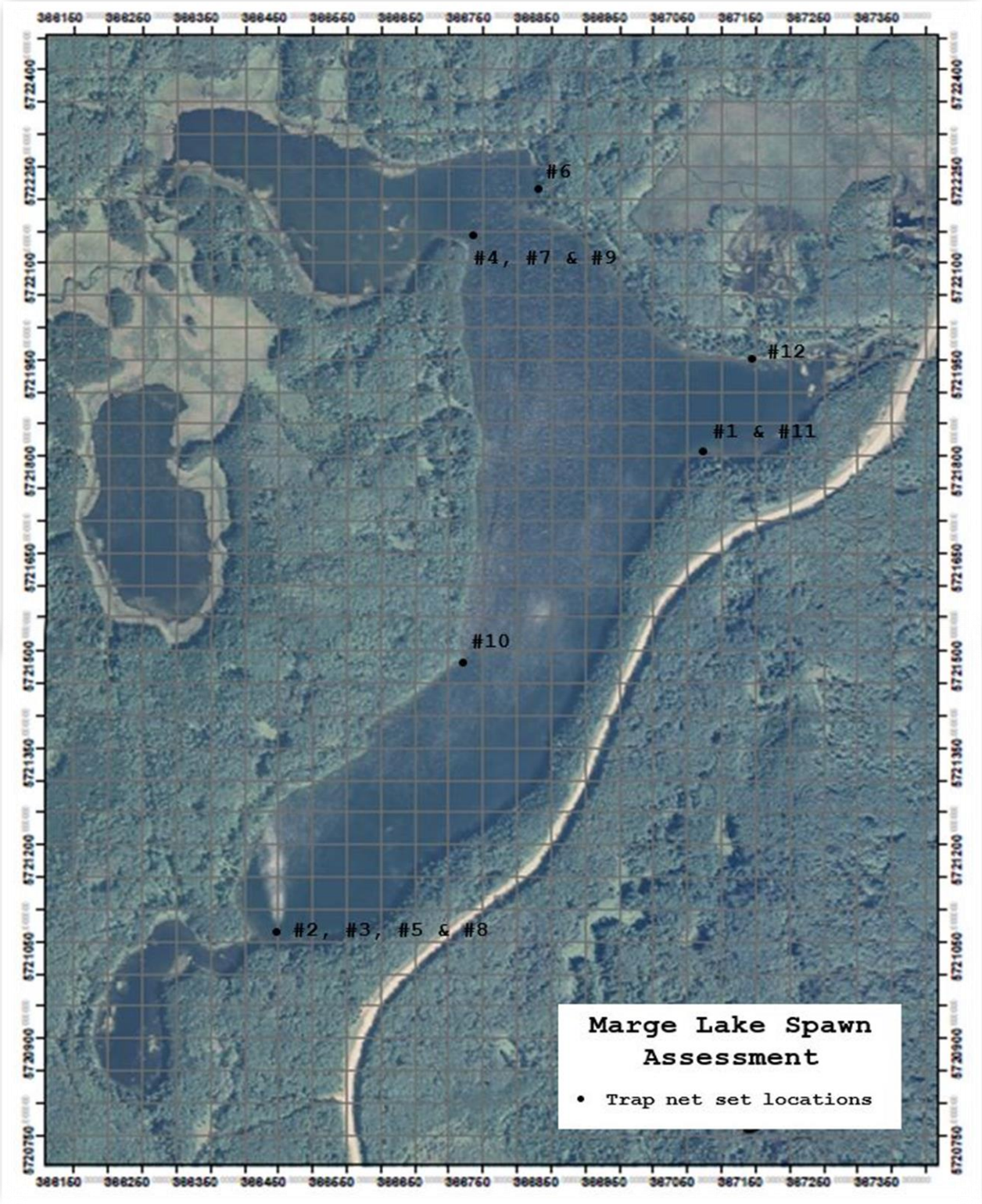


Figure 22: Marge Lake Pre-Spawn Trap Locations

5.0 Results

5.1 Marge Lake Results (Pre-Spawn/Spawn Trap-netting)

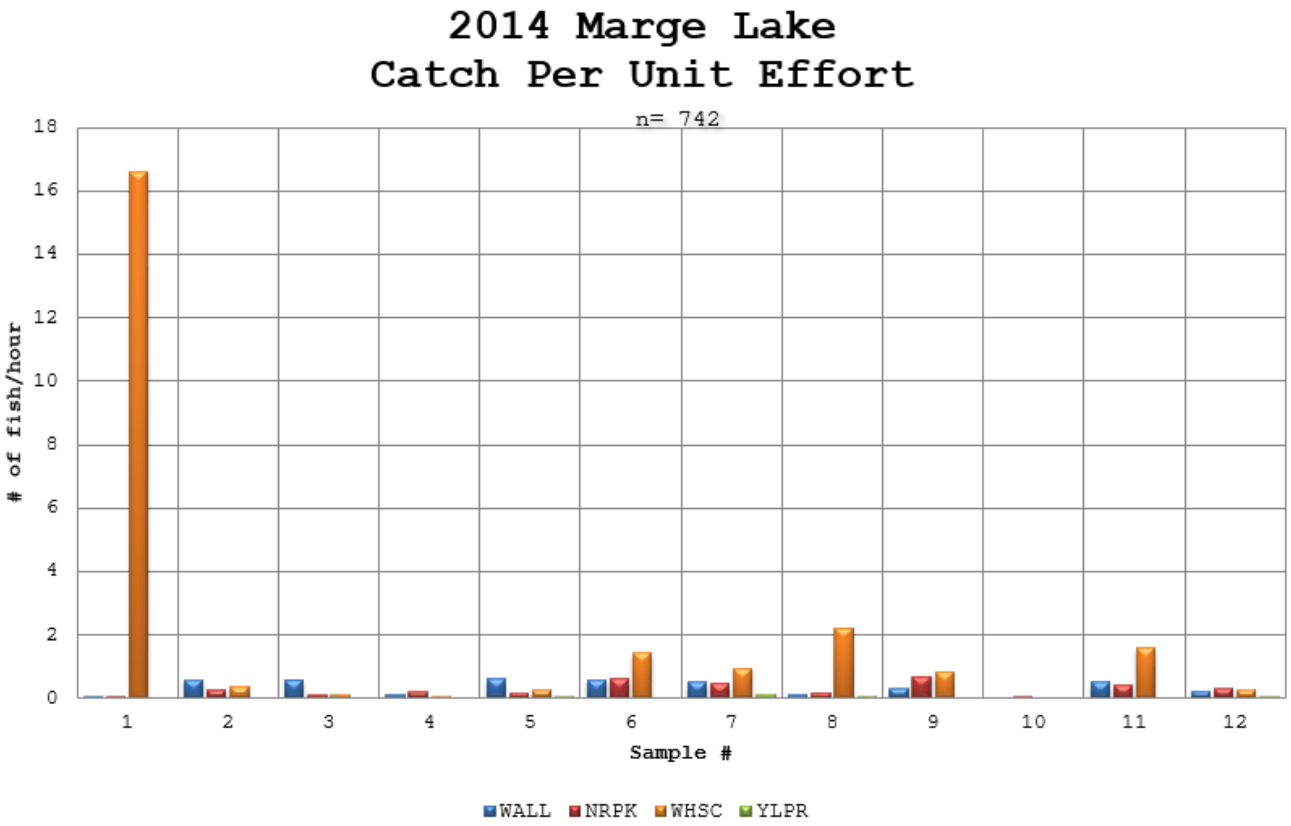


Figure 23: Marge Lake Pre-Spawn CPUE

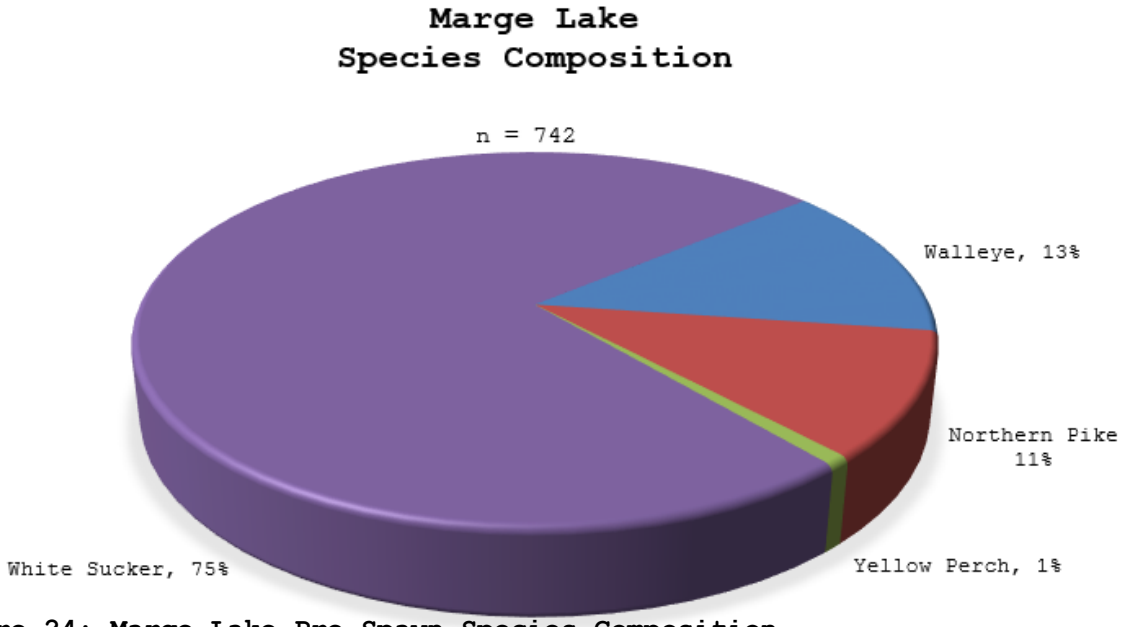


Figure 24: Marge Lake Pre-Spawn Species Composition

5.0 Results

5.1 Marge Lake Results (Pre-Spawn/Spawn Trap-netting)

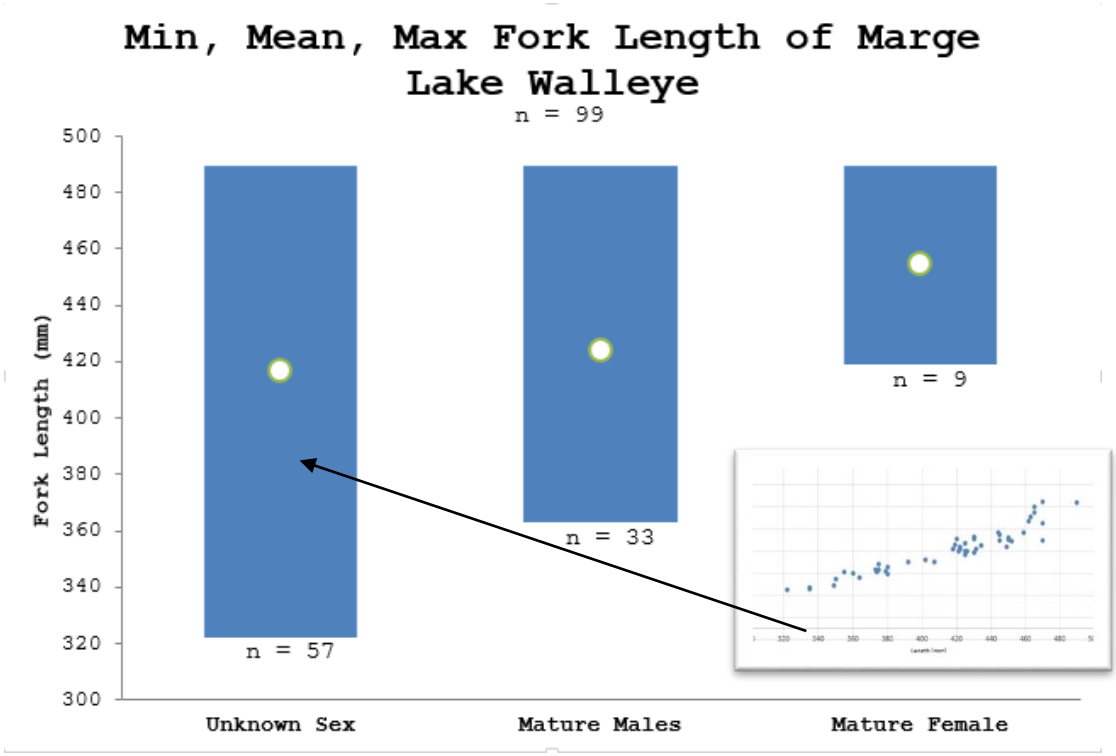


Figure 25: Marge Lake Pre-Spawn Sex Length Frequencies

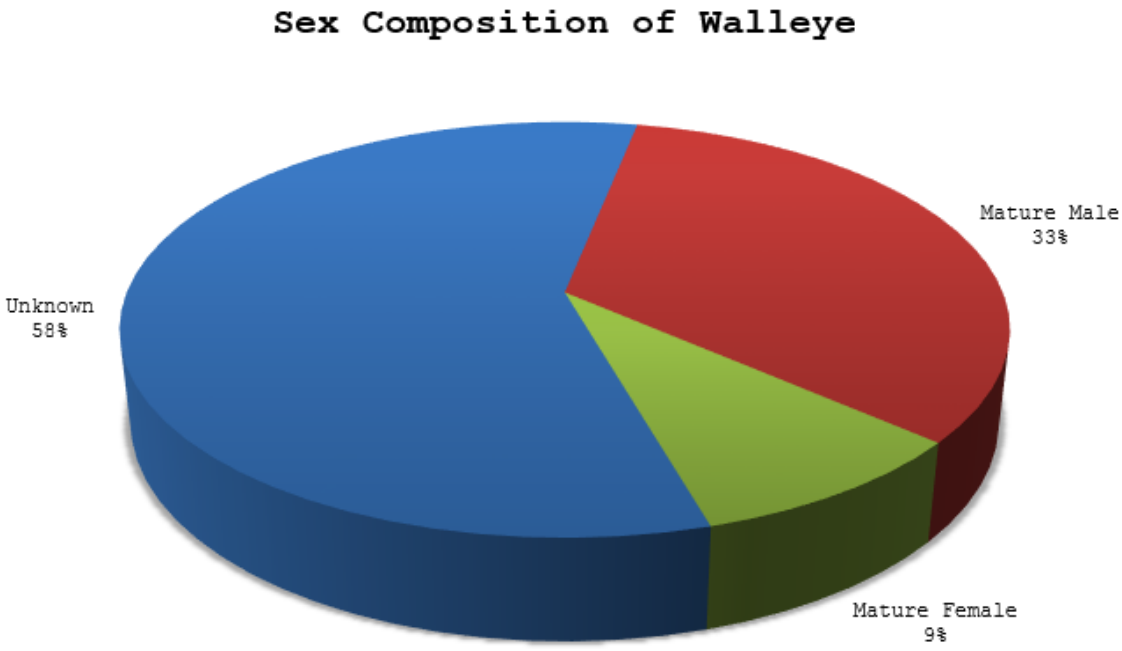


Figure 26: Marge Lake Pre-Spawn Walleye Sex Composition

5.0 Results

5.1 Marge Lake Results (Pre-Spawn/Spawn Trap-netting)

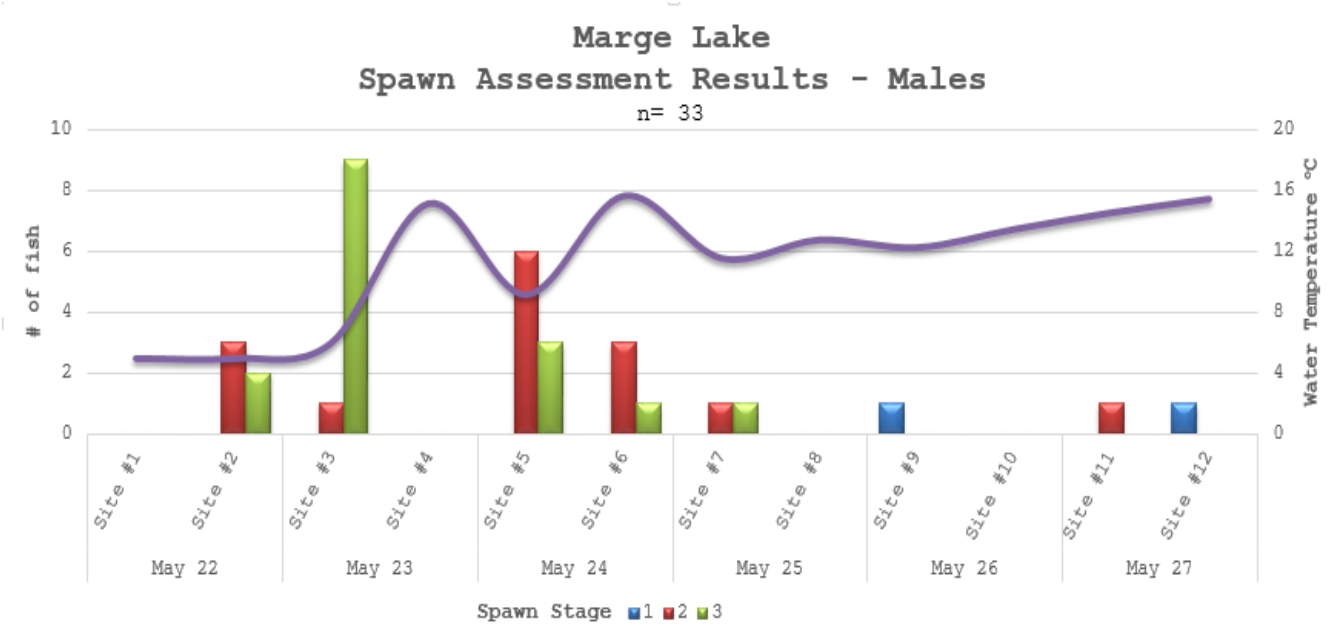


Figure 27: Marge Lake Pre-Spawn Male Capture

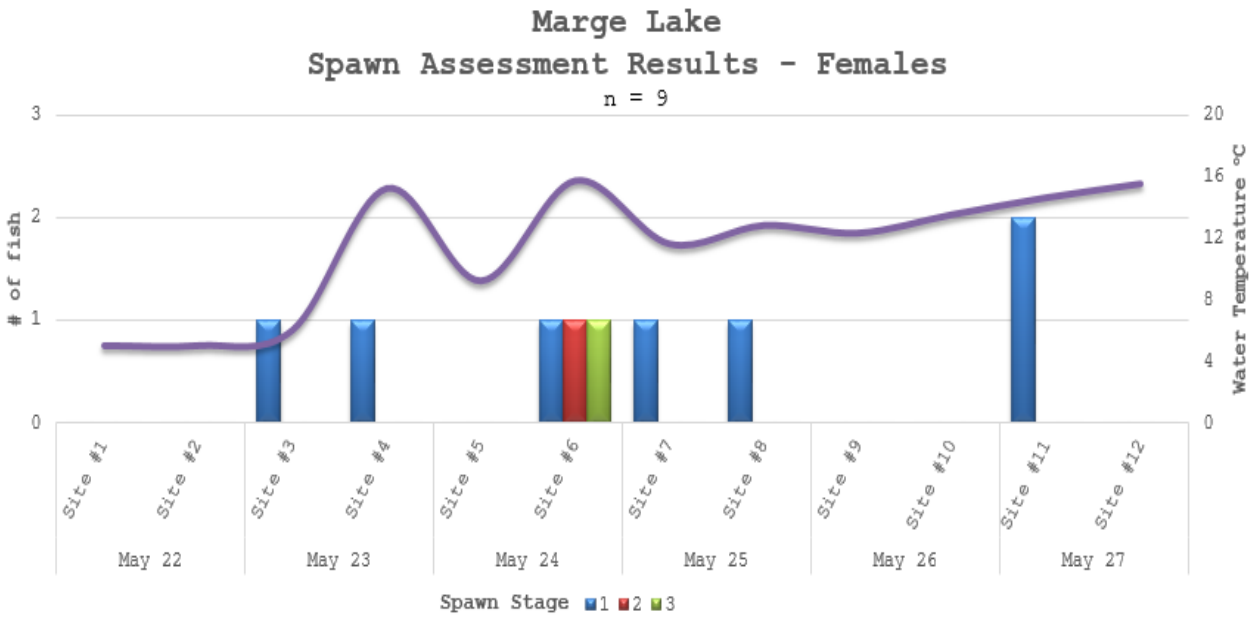


Figure 28: Marge Lake Pre-Spawn Female Capture

5.0 Results

5.1 Marge Lake Results (Pre-Spawn/Spawn Trap-netting)

Pre-spawn trap netting occurred from immediate "ice out" (May 21st) until May 27th, 2014 where a total of 12 nets were set in six different locations on Marge Lake. The intention of this portion of the study was to determine a mature sex ratio of 100 sampled walleye as well as to determine geographic locations of spawning walleye. In terms of geographic distribution, spawning walleye were found throughout the lake, and therefore no definitive correlations were determined. Interestingly, trap-net # 1 which was set near Marge Creek yielded 373 white suckers in one 24 hour set. It has been hypothesised that this was a pre-spawn migration to Marge Creek. In terms of data acquired from spawning walleye, many interesting points were noted. A sample of 99 walleye were sampled: 9 mature females (9%), 33 mature males (33%), and 57 unidentified (58%) suggesting that for every mature female there is 3.6 mature males. In terms of mature walleye length frequencies, data collected during this portion of the study correlates with walleye biological statistics. Females mature on average at 400mm, and males mature on average at 325mm (Hartman, 2009). However, the 58% of unidentified fish raises some questions. Length frequencies of then unknown sex sample is represented in (Figure 25). The size and age at which walleye reach sexual maturations is dependant on water temperature, lake fertility, and food availability (Colby, 1979). Fluctuations in water temperature, especially decreasing water temperatures may prolong spawning or result in females retaining eggs (Derback, 1947). Because these length frequencies represent those that could be mature, it has been hypothesised that either that these fish have yet to reach maturation do to unknown environmental factors, or have retained eggs as a result of prolonged cold spring temperatures. Prime spawning condition correlating with dates and water temperatures were also noted. It was noted that male had reached prime condition on May 23rd(12°C), whereas females were noted to be ripest on May 24th (14°C) (Figure 27,28). Walleye have been observed spawning in water temperatures ranging from 2.2-15.6°C (Neimuth, 1959).

Figure 29: Marge Lake Mature Female (Spawn-Stage 2)

5.0 Results

5.1 Marge Lake Results (Post-Spawn Egg/Larval Evaluations)

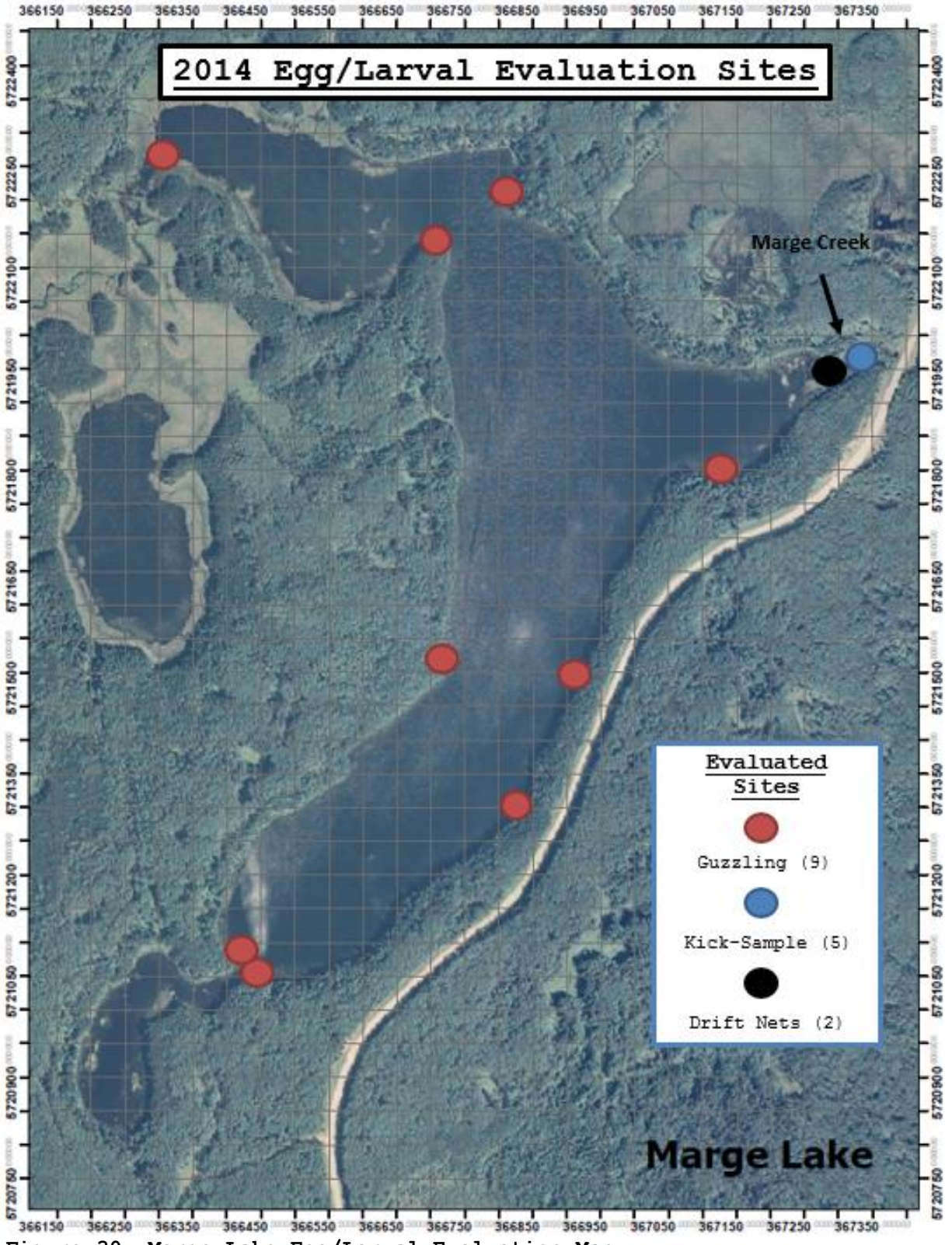


Figure 30: Marge Lake Egg/Larval Evaluation Map

5.0 Results

5.1 Marge Lake Results (Post-Spawn Egg/Larval Evaluations)

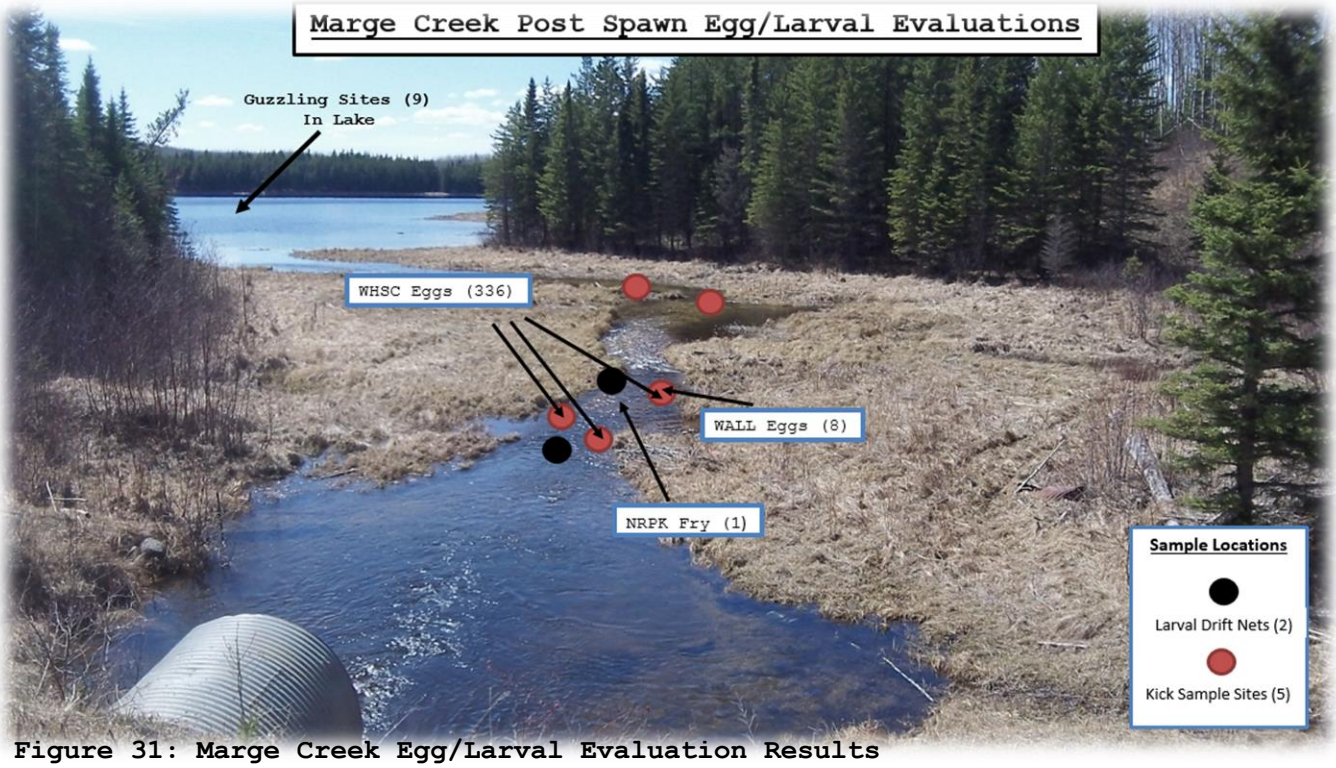


Figure 31: Marge Creek Egg/Larval Evaluation Results

Figure 32: Marge Creek WHSC Eggs

Figure 33: Marge Creek Pike Larvae

Figure 34: Marge Creek Substrate

Figure 35: Marge Creek Walleye Egg (left)

5.0 Results

5.1 Marge Lake Results (Post-Spawn Egg/Larval Evaluations)

Post-spawn egg/larval evaluations on Marge Lake/Creek occurred on June 8th, 2014. Methods used included guzzling, drift netting, and kick sampling. The sample date was selected based on incubation rates (6 days to eye, and 10 days to hatch at 14°C) for walleye (North/South Consultants, Unknown) based on visual spawning activity (May 31st) from observational portion of study. A total of nine sites were guzzled on the lake at varying depths in varying substrates thus simulating a fair representation of potential lake spawning habitats (Figures 30, 36). Results from guzzling produced no eggs of any species, therefore signifying no *evidence* of lake spawning. Invertebrates noted included gammarus, mayflies, clams, and chronomids. Two drift nets were set in Marge Creek for 2.5 hour durations (Figure 31). The upstream drift net collected 1 white-sucker fry. The downstream net interestingly multiple white sucker fry and eggs, along with 1 northern pike larvae (Figure 33). This interesting find suggests that Northern Pike also utilize Marge Creek for spawning, an occurrence that was assumed but not proven. Referring this larval stage to water-temperature and northern pike egg development literature technicians were able to determine the estimated date of northern pike spawning. Based on larval stage, it was determined that the fry was approximately 10 days old when it was discovered on June 8th, suggesting it hatched on May 28th. Water temperature on May 28th was 13°C; Northern Pike eggs hatch in 8 days at 13°C (North/South Consultants, Unknown), suggesting that northern pike spawning occurred around May 20th, 2014 which is interesting as that date correlates with "peak northern pike activity" in Marge creek observational monitoring. Kick sampling was a very effective post-spawn evaluation tool in Marge Creek. With a total of 5 sample sites; 362 white sucker eggs, 15 white sucker fry, and 8 walleye eggs were discovered (Figures 32, 35). Interestingly, spawning dates were correlated with incubation temperatures based on contemporary literature. In terms of the white suckers, eggs should take approximately 9 days to hatch at 14°C, which correlated perfectly with spawning observations on May 30th. In terms of walleye, eggs should take approximately 10 days to hatch at 14°C, which again correlates to observational monitoring on May 29th, 2014 (North/South Consultants, Unknown). It is also interesting that white sucker eggs were discovered in exact areas where they were observed spawning, as expected due to white sucker eggs retaining adhesiveness throughout the incubation period (Schneberger, 1977). The walleye eggs, however were found downstream of the area where walleye were believed to be spawning. As water hardens the external membrane, walleye eggs loose adhesiveness and settle or more with stream or wave actions (Johnson, 1961). Interestingly, eggs were found in slacker waters immediately downstream the main riffle structures.

Figure 36: Marge Lake Guzzle Site

Figure 37: Creek Kick-Sample Site

5.0 Results

5.1 Marge Lake Results (Post-Spawn ESTN)

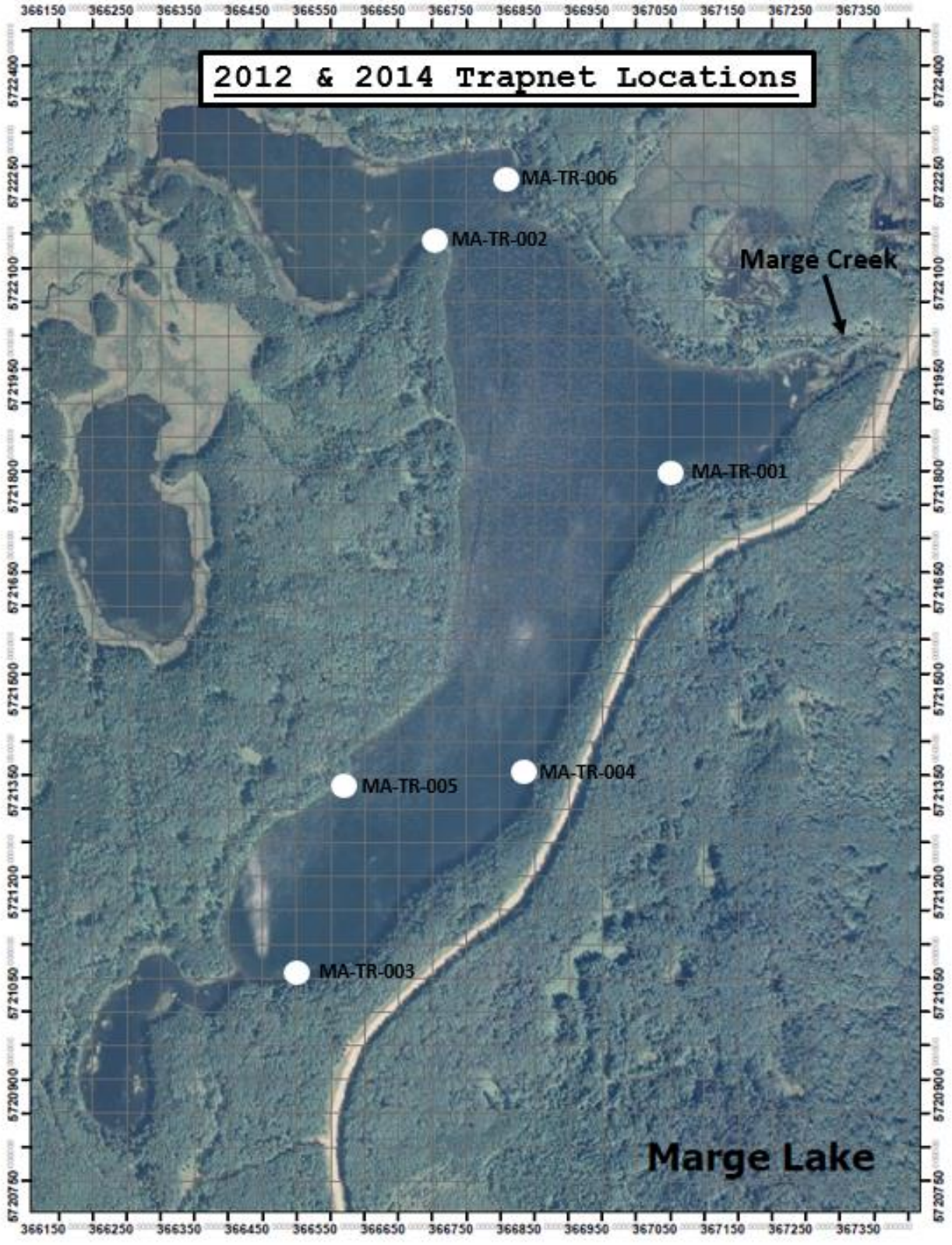


Figure 38: Marge Lake ESTN Sites

5.0 Results

5.1 Marge Lake Results (Post-Spawn ESTN)

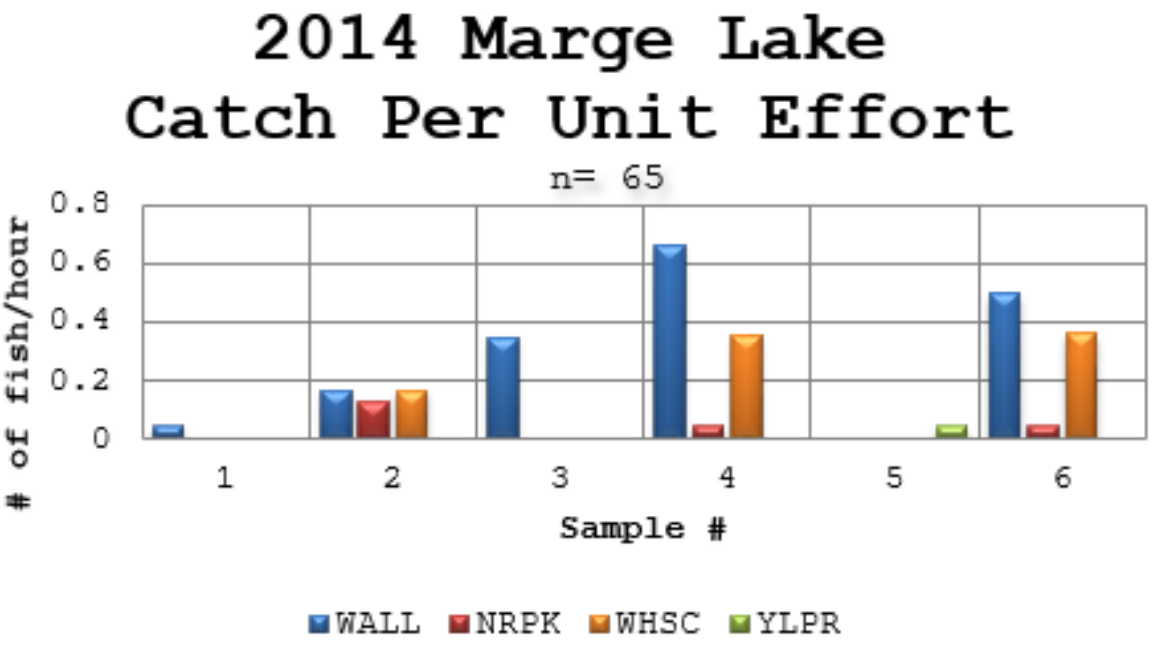


Figure 39: 2014 Marge Lake ESTN CPUE

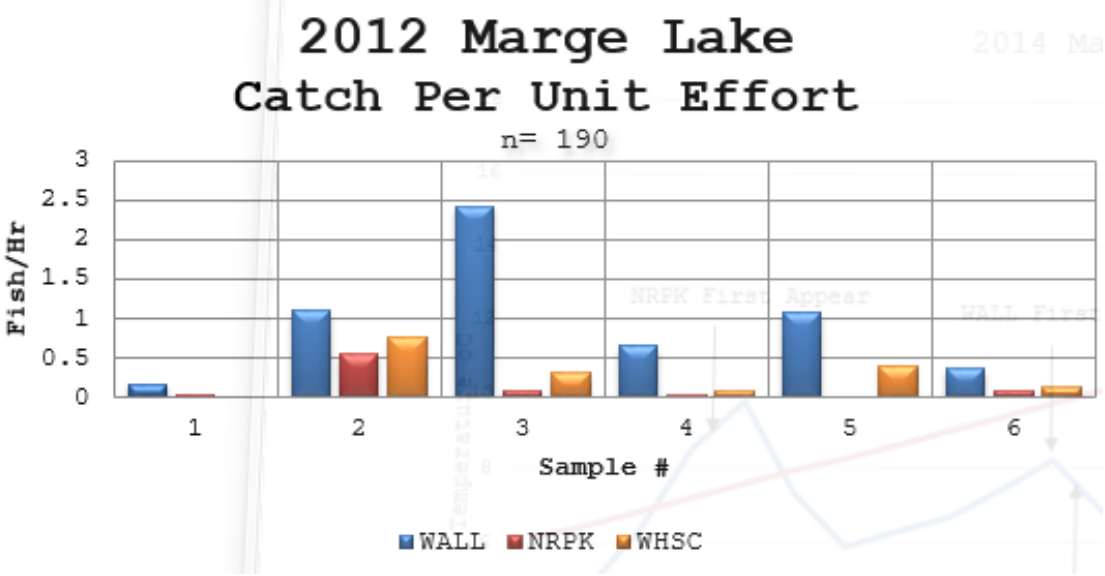


Figure 40: 2012 Marge Lake ESTN CPUE

5.0 Results

5.1 Marge Lake Results (Post-Spawn ESTN)

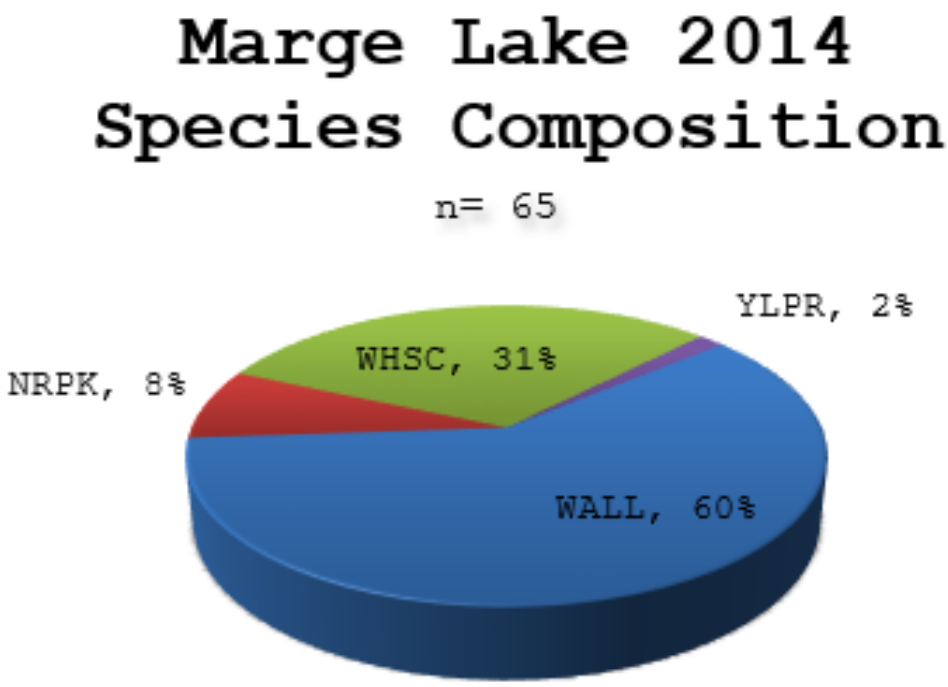


Figure 41: 2014 Marge Lake ESTN Species Composition

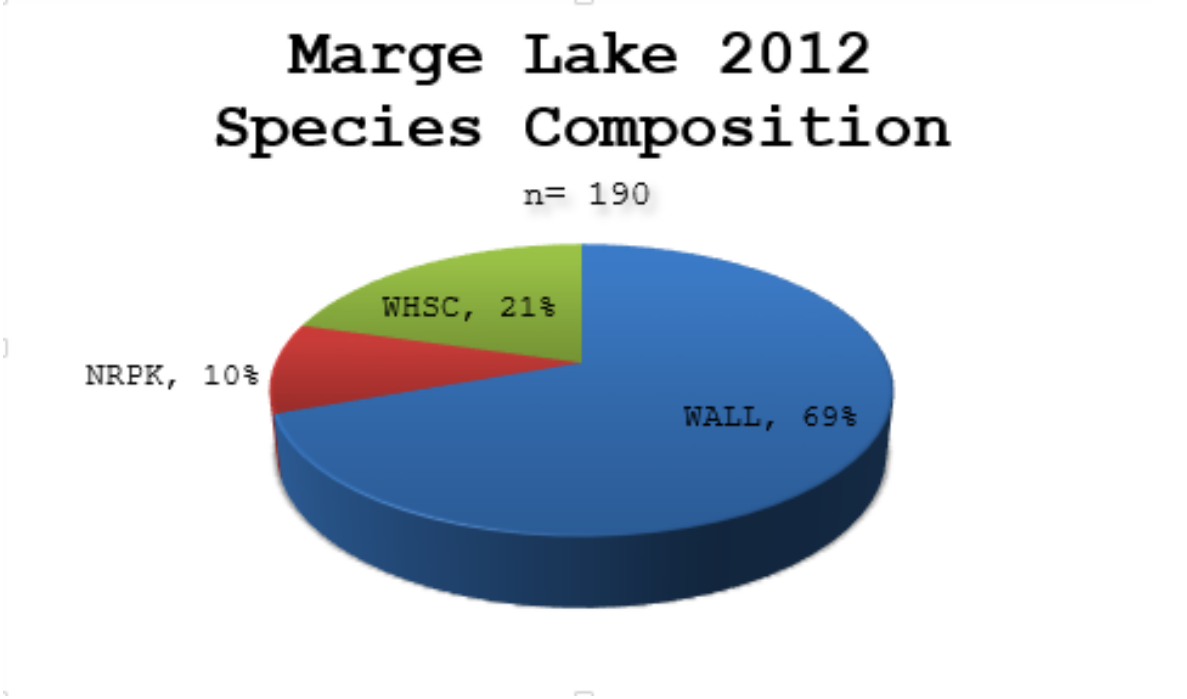


Figure 42: 2012 Marge Lake ESTN Species Composition

5.0 Results

5.1 Marge Lake Results (Post-Spawn ESTN)

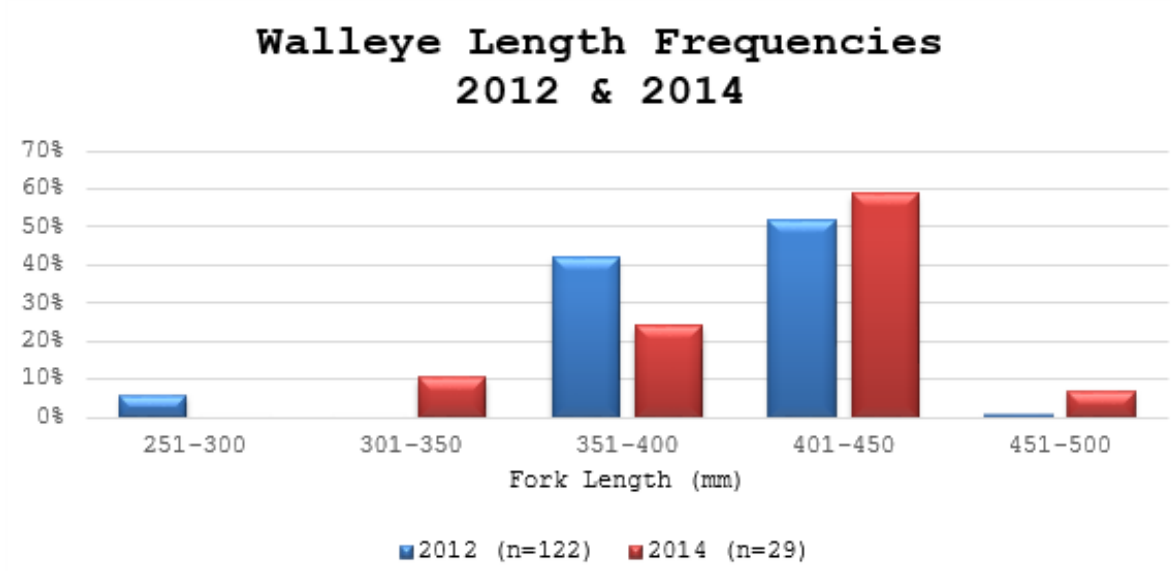


Figure 43: Marge Lake Walleye Length Frequencies (2012,2014)

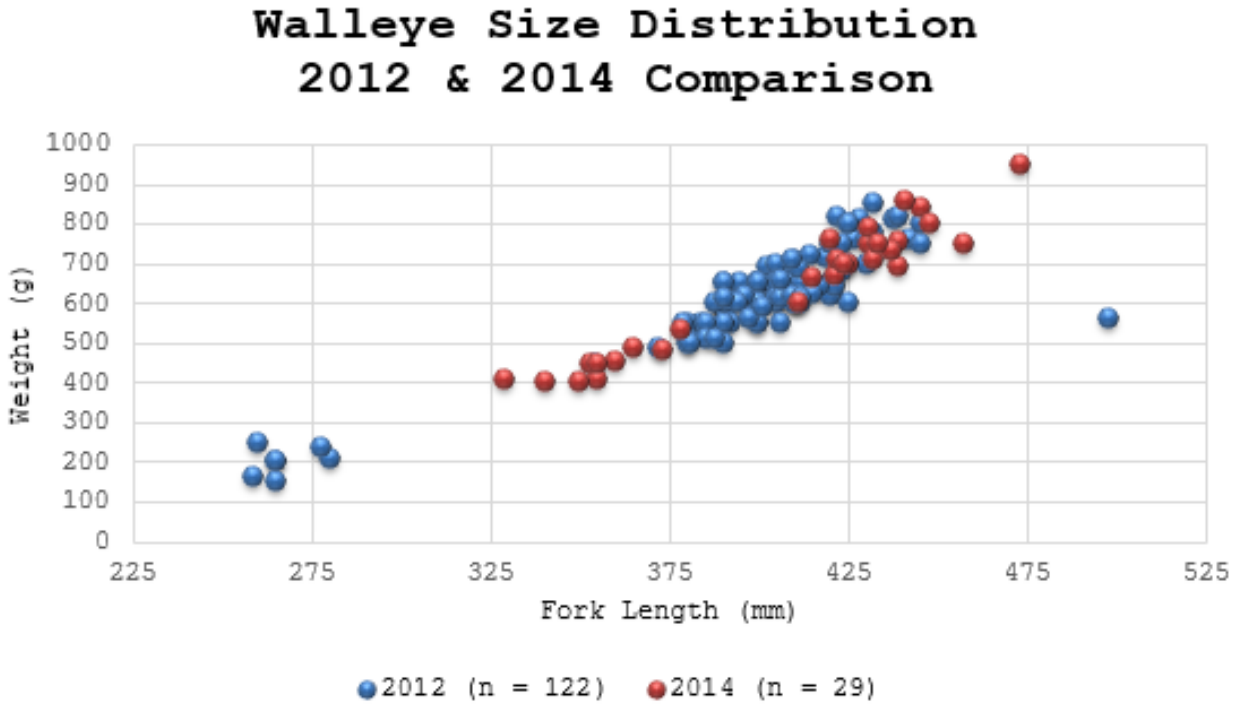


Figure 44: Marge Lake Walleye Size Distribution (2012,2014)

5.0 Results

5.1 Marge Lake Results (Post-Spawn ESTN)

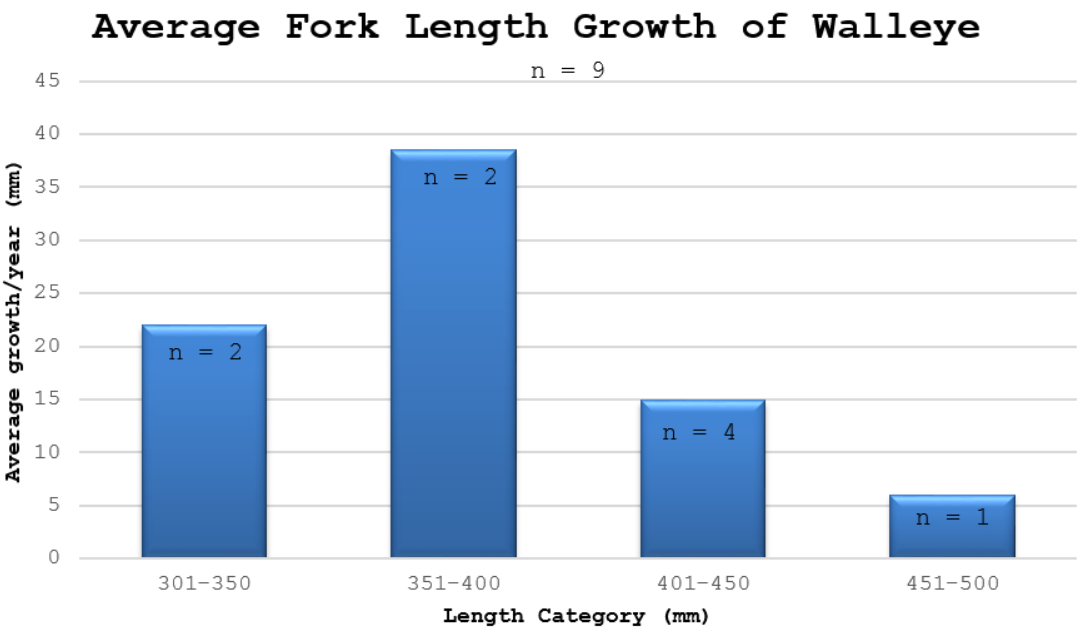


Figure 45: Marge Lake Walleye Length Growth (2012-2014)

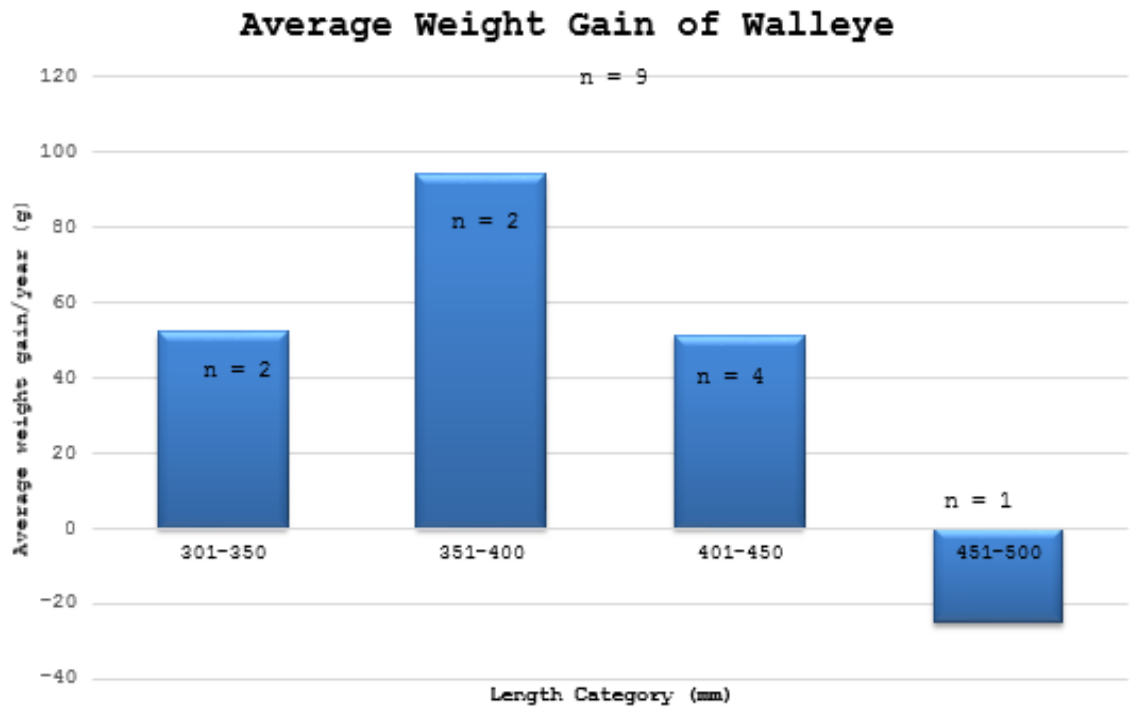


Figure 46: Marge Lake Walleye Weight Gain (2012-2014)

5.0 Results

5.1 Marge Lake Results (Post-Spawn ESTN)

Post spawn ESTN was conducted during the week of June 16th-19th, 2014. Sought after data included various measurements pertaining the overall health of the walleye fishery. More specifically, protocol was to determine catch-per-unit effort (CPUE) per site in order to compare geographical information to 2012 CPUE results. Secondly was to determine overall species frequency and compare it to 2012 trap-netting data. It was also decided to compare walleye length frequencies and size distributions from each year of trap netting in order to determine growth rates. Data collected from fish include length (mm), weight (g), sex (if applicable), and are tagged for potential recapture growth data. Lastly, using this protocol it is possible to determine population estimates based on recapture data through the Chapman-Peterson model.

It is important to state that when the trap-netting (ESTN) protocol was conducted, Marge Lake had sufficient time to recover (fish-mixing) from the spring trap netting efforts. In terms of CPUE, it is interesting to state that popular walleye sites remained similar from year to year. More specifically, sites 3, 4, and 6 were all productive walleye post-spawn habitats in both 2012 and 2014 (Figure 38). Sites 3, and 6 are both shallow bays where forage is abundant; in correspondence to seining results (2012,2013,2014). Site 4 is a good representation of the entire east shore, and is arguably the only place where it is possible to set a net on the east shore (steep drop-offs). It is interesting to state that species compositions remained very similar, even though and additional 125 adults were introduced in the fall of 2012, and significantly less fish were captured in 2014 (65 vs. 190). In terms of length frequencies, there is a notable a shift in age (length) classes, as expected. Interestingly, there were only 2 fish in the (450-700mm) range, which is the provincial slot for "prime spawners". In terms of growth rates, smaller fish (301-400mm) are growing 29.5mm per year on average, and larger fish (401-500) are growing 10.5mm per year on average (Figure 97). In terms of weight average growth of all recaptures was 50.5 grams per year. In general fish between 350-400mm are showing most growth. There was one larger fish that was captured during the pre-spawn trap-netting, and was recaptured during to post spawn trap-netting that appeared to be an outlier as it lost weight (25g). The hypothesis regarding this particular fish is that was a spawned out female (Figure 46). Estimated populations were calculated from trap-netting recaptures using the Chapman-Peterson method. Of the 39 walleye sampled during 2014, 6 were recaptures from 2012, indicating and estimated walleye population of 676 (density of 24.69 walleye per hectare). The statistical error was relatively large with 95% certainty that the true number lies between 214 and 985. In a walleye study in Ontario on Henderson Lake, walleye populations of 10.4 fish/hectare with strong year classes was considered a high density of adult fish and a healthy population (Amtstaetter, 2004). Walleye populations in Marge Lake appear to have a strong density with a low density of adult fish and a younger classification of year classes.

Figure 47: Marge Lake Walleye

5.0 Results

5.1 Marge Lake Results (Post-Spawn Seining)

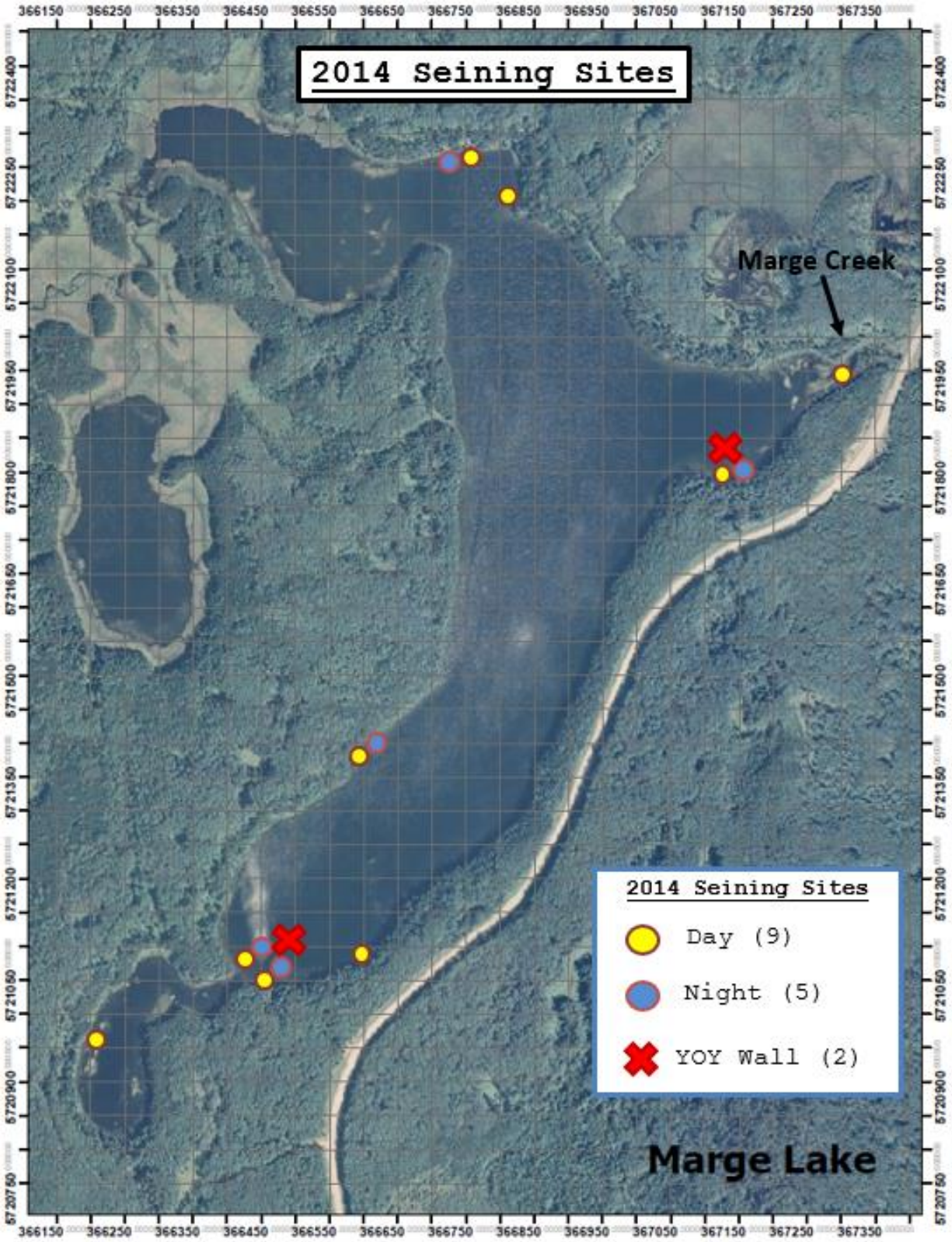


Figure 48: Marge Lake Seining Sites

5.0 Results

5.1 Marge Lake Results (Post-Spawn Seining)

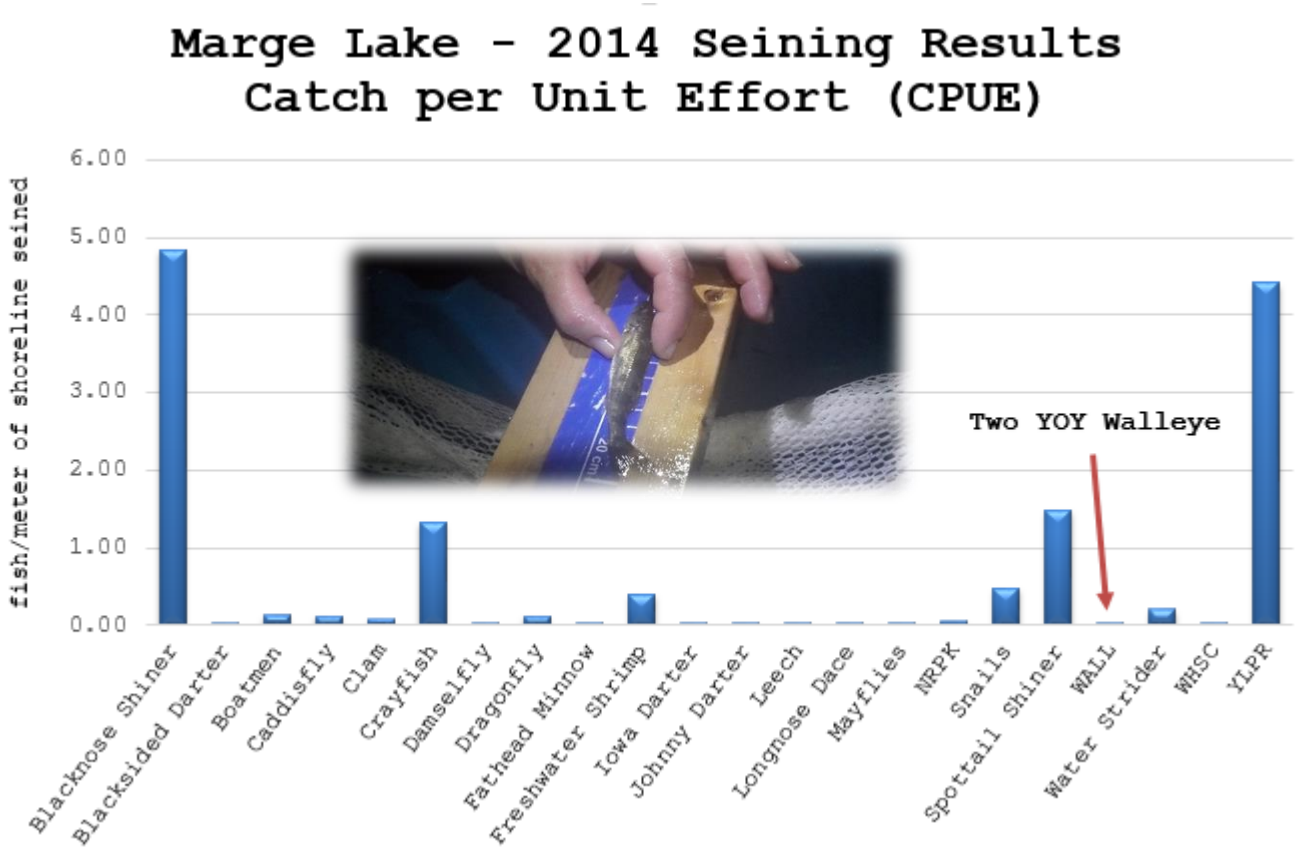


Figure 49: Marge Lake Seining Results (CPUE)

A total 14 seines were executed in the late August 2014 (9 day seines, and 5 night seines). Seining results captured a total of 2 young-of-year walleye, which is double to capture rate from 2013 results (1 YOY walleye). The first walleye was captured on the south shore of the north east bay near marge creek during a night seine, where substrate was a firm silt substrate with medium fish cover in the form of woody debris and macrophytes. The second young-of-year walleye was captured on the south shore during a night seine, where substrate was a firm silt substrate with medium fish cover in the form of woody debris and macrophytes. It is interesting to state that in the south shore is where the 2013 young-of-year was captured. Young-of-the-year walleye have been captured in a diversity of habitat types; muddy substrates, vegetated areas, sandy shoals, and gravel shorelines (Savoie, 1983). It is important to state that of total areas seined, the CPUE equated to 0.005 walleye per meter sampled. With regards to forage, it appears that forage availability and composition does not appear to be an issue in Marge Lake. Crayfish captures were significantly lower in 2014 as opposed to 2013. A total of 19 northern pike were caught in multiple sites with a total CPUE of 0.05 pike per meter sampled. Blacknose shiners and yellow perch appeared to be the most prolific forage species; important food sources of adult walleye (Figure 49).

5.0 Results

5.2 Beaver Lake Results (Pre Spawn/Spawn Evaluations)

Beaver Lake Effort Chart

	EFFORT					SPECIES PRESENT				
DATE	Observing	Spot-lighting	Angling	Gill-Netting	Spawning-Mats	MINNOWS	SPLAKE	WHSC	WALL	COMMENTS & OBSERVATIONS
5-May-14	X									Lake Still Very Frozen
6-May-14										
7-May-14	X	X			X					Installed 4 Spawning Mats on Each Shoal, Initiated Temp Logger
8-May-14										
9-May-14	X	X				X				
10-May-14										
11-May-14	X	X				X				Lake Level Rising, Still Very Frozen
12-May-14	X	X			X	X				Loons Present
13-May-14										
14-May-14	X	X				X				Frogs Present, Beaver Present, Grousse Present
15-May-14										
16-May-14	X									Ice Retreated Significantly, YLPR on Shoal, Mosquitos Present
17-May-14										
18-May-14	X	X				X			X	Spotlighted East Shoal: Multiple Minnow , 1 WALL (30-35mm)
19-May-14	X									East Side of Lake is Ice Free
20-May-14	X	X				X				Still Ice on West Side of Lake
21-May-14	X									
22-May-14	X									Beaver Dam (North) Blew Out, Lake Level Up Significantly
23-May-14	X		X			X	X			Angled Trophy (51.15cm) Splake off Dock, Lake Ice Free
24-May-14	X			X		X		X	X	Gill # 1: 3 WALL (Almost Full Spawn), Multiple WHCS (Small, Immature)
25-May-14	X									
26-May-14	X			X		X		X	X	Gill # 2: 3 WALL (No Sex Data), Multiple WHSC (Small, Immature)
27-May-14	X		X	X		X		X	X	Gill # 3: 2 WALL (Nearing Full Spawn), Multiple WHSC-Mostly Immature
28-May-14	X			X	X	X		X	X	Gill # 4: 4 WALL (3 Mature Males in Full Spawn)
29-May-14										
30-May-14	X		X	X		X		X	X	Gill # 5: 3 WALL Collected No Sex Data (Potentiall Immature)
31-May-14	X		X			X			X	Angled 1 Wall (Mature Male in Full Spawn)
1-Jun-14										
2-Jun-14	X	X				X				Spotlighted Both Shoals (11-11:30pm) No Evidence of Activity

Figure 50: Beaver Lake Monitoring Effort Chart

5.0 Results

5.2 Beaver Lake Results (Pre-Spawn/Spawn Evaluations)

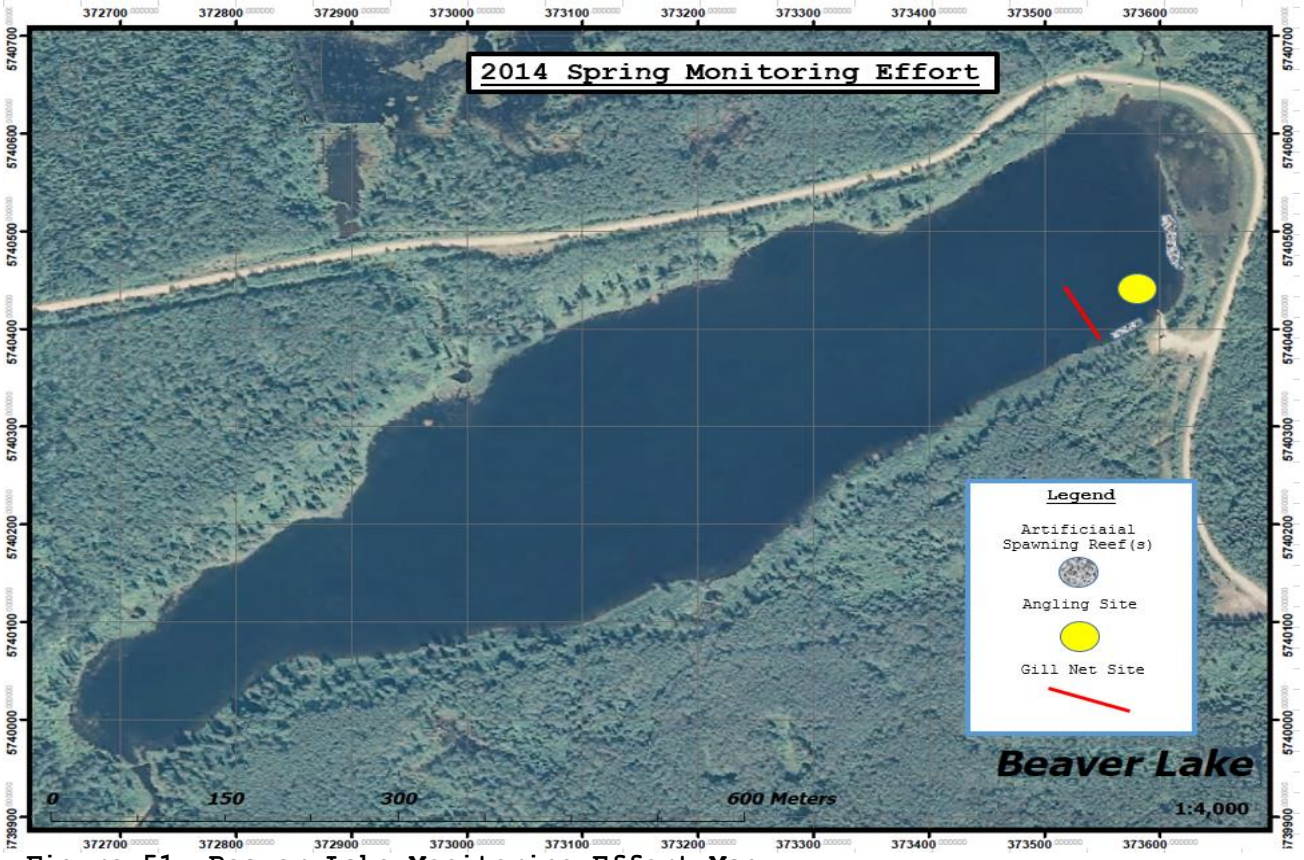


Figure 51: Beaver Lake Monitoring Effort Map

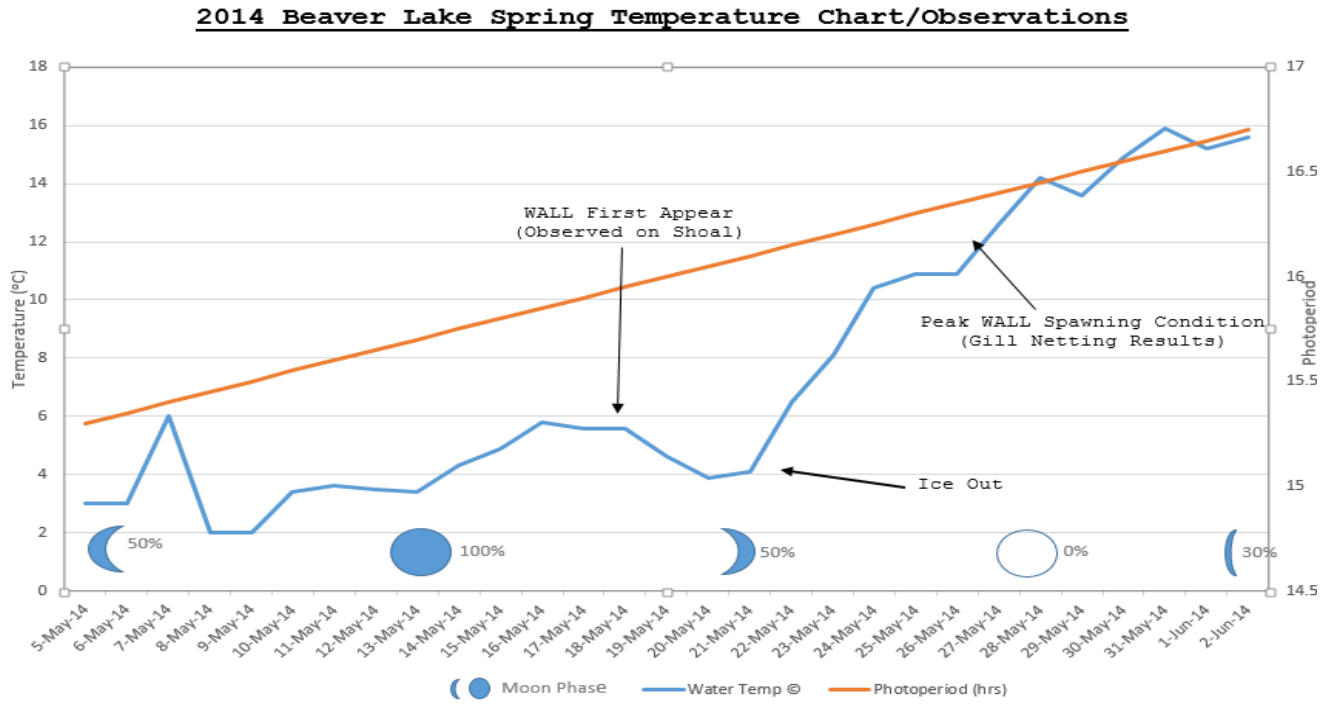


Figure 52: Beaver Lake Monitoring Observations

5.0 Results

5.2 Beaver Lake Results (Pre-Spawn/Spawn Evaluations)

Beaver Lake was monitored every other night from May 6th to June 3rd, 2014 with the primary intention of evaluating fish utilization of the newly constructed spawning shoals. Since initial adult walleye introductions in 2011; SVSFE along with Fisheries Branch personnel have been curious if Beaver Lake provided sufficient walleye spawning habitat. Following the first evidence of natural recruitment (2013 seining results), user groups had determined that spawning may have occurred on the east and/or south east sandy/rocky areas of the lake. As an effort to enhance this habitat, SVSFE added rock to these areas in March of 2014. Spring observational monitoring was focused primarily on these two areas (Figure 51). Over the course of the monitoring period, one walleye was spotlighted on the east shoal on May 18th, 2014 (2 days following first walleye sighting in Marge Creek). When limited success was experienced in terms of observing activity on the shoals because of lake turbidity, technicians then used angling and gill nets to observe fish activity in the area. From May 24th – 30th these methods were used to track progress. Through these methods walleye captured (n=17) were fully sampled, sexed and spawning stage (0-3) were recorded. Over this duration 8 walleye were mature males, and 9 walleye were unidentified, and all ranged from 345mm - 528mm (Figure 53). With reference to this data it becomes evident that not too many conclusions be drawn. The size and age at which walleye reach sexual maturations is dependant on water temperature, lake fertility, and food availability (Colby, 1979). Fluctuations in water temperature, especially decreasing water temperatures may prolong spawning or result in females retaining eggs (Derback, 1947). Because these length frequencies (unidentified) represent those that could be mature, it has been hypothesised that either that these fish have yet to reach maturation do to unknown environmental factors, or have retained eggs as a result of prolonged cold spring temperatures. Prime spawning condition correlating with dates and water temperatures were also noted. It was noted that males had reached prime condition between May 26th(11°C), and May 28th (14°C). These dates also correlated with a new moon which may be a relevant environmental parameter. Walleye have been observed spawning in water temperatures ranging from 2.2-15.6°C (Neimuth, 1959). Based on observational data peak spawning had been determined to occur between May 28th, and May 30th when water temperatures reached 15°C.

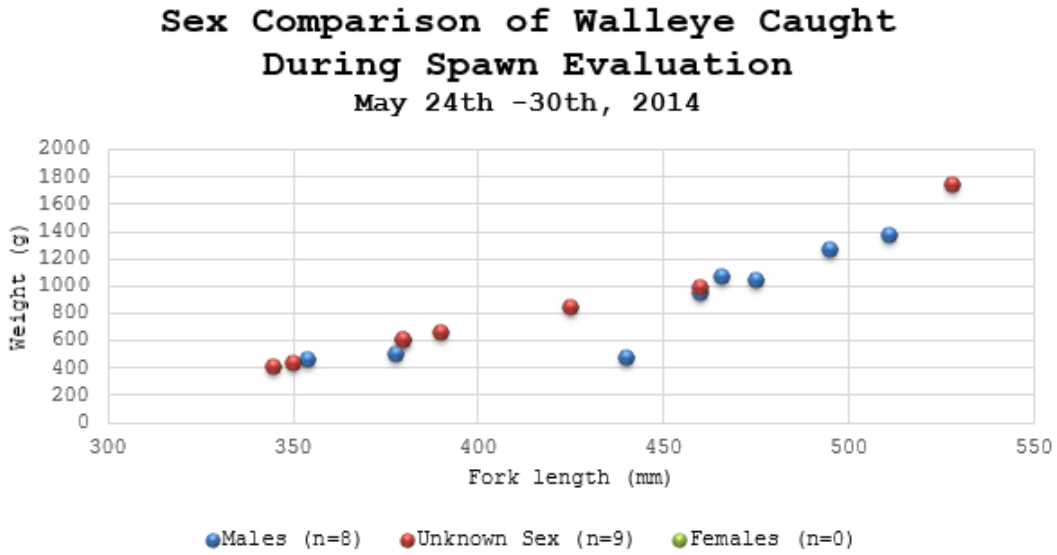


Figure 53: Beaver Lake Sexed Walleye Length Frequencies

5.0 Results

5.2 Beaver Lake Results (Post Spawn Egg/Larval Evaluations)

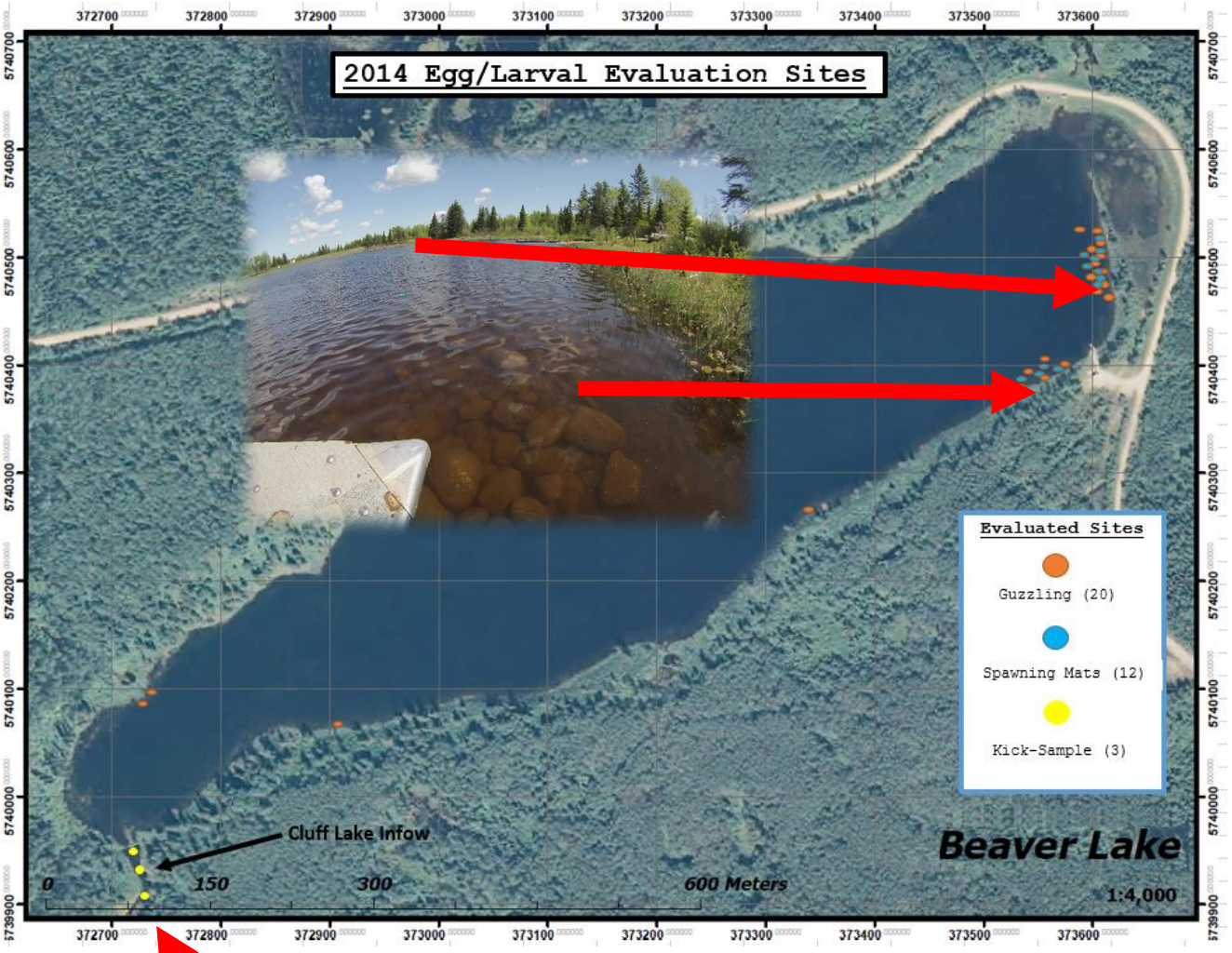


Figure 54: Beaver Lake Egg/Larval Evaluation Map

Figure 55: Cluff Lake Inflow

5.0 Results

5.2 Beaver Lake Results (Post Spawn Egg/Larval Evaluations)

Post-spawn egg/larval evaluations occurred on Beaver Lake on June 9th, 11th and 12th 2014. Methods included guzzling (shoals/lake), spawning mats (shoals), and kick sampling (Cluff Lake inflow). The sample dates were selected based on incubation rates (6 days to eye, and 10 days to hatch at 14°C) for walleye (North/South Consultants, Unknown), based on peak spawning condition (May 31st) from observational portion of study. A total of 16 sites were guzzled on the shoals at varying depths in varying substrates, and 4 sites were guzzled in the lake at varying depths and varying substrates (Figure 54, 56). Results from guzzling produced no eggs of any species, therefore signifying no evidence of lake/shoal spawning.

SITE #	BOTTOM TYPE					DEPTH(m)	RESULTS
	BO	CO	GR	SA	SI/FINE		
East Shoal-1			40	60		0.57	No eggs found, Only invertebrates (chronomids, grammerus, mayfly, watermite, snails, dragonfly
East Shoal-2				20	80	1.22	
East Shoal-3			15	75	10	0.48	
East Shoal-4	60	40				0.56	
East Shoal-5	25	25	25	25		0.52	
East Shoal-6	50	40	10			0.85	
East Shoal-7	25	25		50		0.45	
East Shoal-8	30	50		20		1.1	
East Shoal-9	40	20		40		0.45	
East Shoal-10	45	30	15	10		1.3	
East Shoal-11			80		20	0.55	
SE Shoal-12	20	20		30	30	0.58	
SE Shoal-13	50	50				0.75	
SE Shoal-14	40	30	15	10		0.51	
SE Shoal-15	100					1.15	
SE Shoal-16	20	70	10			0.57	
NW Inflow-17		30	50	20		0.2	
NW Inflow-18			25		75	0.35	
South Shore-19			75		25	0.2	
South Shore-20			25		75	0.2	
Overall % of substrate on shoals	32%	25%	13%	21%	9%	0.73	Avg Depth (m)
Overall % of substrate at lake sites	0%	8%	44%	5%	44%	0.24	Avg Depth (m)

Figure 56: Beaver Lake Guzzling Results

A total of 8 spawning mats were placed on the east shoal and a total of 4 were placed on the south-east shoal for the duration of the study. Spawning mats on the east shoal were placed at minimum depths of 0.45m and maximum depths of 1.1m with an average depth of 0.71m. Spawning mats on the south-east shoal were placed at minimum depths of 0.41m and maximum depths of 0.8m with an average depth of 0.66m. Spawning mats were lifted and checked for eggs on various occasions throughout the study. Unfortunately, no eggs from any species were discovered on the spawning mats. Invertebrate utilization included snails, leeches, chronomids and gammmarus. Two of the eight spawning mats had spawning male fathead minnows using the spawning mats crevice as a spawning structures (Figure 57).

Figure 57: Spawning Fathead Discovered Inside Spawning Mat

5.0 Results

5.2 Beaver Lake Results (Post Spawn Egg/Larval Evaluations)

Kick-Sampling was a very effective, yet unexpected post spawn evaluation tool in Beaver Lake. Upon post spawn evaluations, SVSFE technicians discovered a "blown out" section of the beaver dam which usually restricts flow from a small creek that flows from Cluff Lake to Beaver Lake. It became evident immediately that spawning fish had been advancing through this small hole and have been utilizing the creek for spawning as eggs were visible immediately upon arrival. It is important to state that on an average year (including the past 3 years), this area is flooded out and silted in because of the Beaver Dam restricting flow. However, upon this particular year flow had revealed picture-esc spawning habitat in terms of gravel, cobble, sand and boulders. In the spring of 2014, high water had blown out multiple Beaver Dams in the Duck Mountains. A total of three sites were sampled in this creek, with one at each reach of the creek (lower, middle, upper). In total from the three samples; a total of 368 eyed white sucker eggs were discovered, suggesting high utilization rates by suckers. Interestingly, spawning dates were correlated with incubation temperatures based on contemporary literature. In terms of the white suckers, eggs should take approximately 9 days to hatch at 14°C, which correlated perfectly with spawning observations on May 31th (North/South Consultants, Unknown). Unfortunately no walleye eggs were discovered, however habitat appeared to be suitable.

Figure 58: Cluff Lake Inflow Kick-Sampling

5.0 Results

5.2 Beaver Lake Results (Post Spawn ESTN)

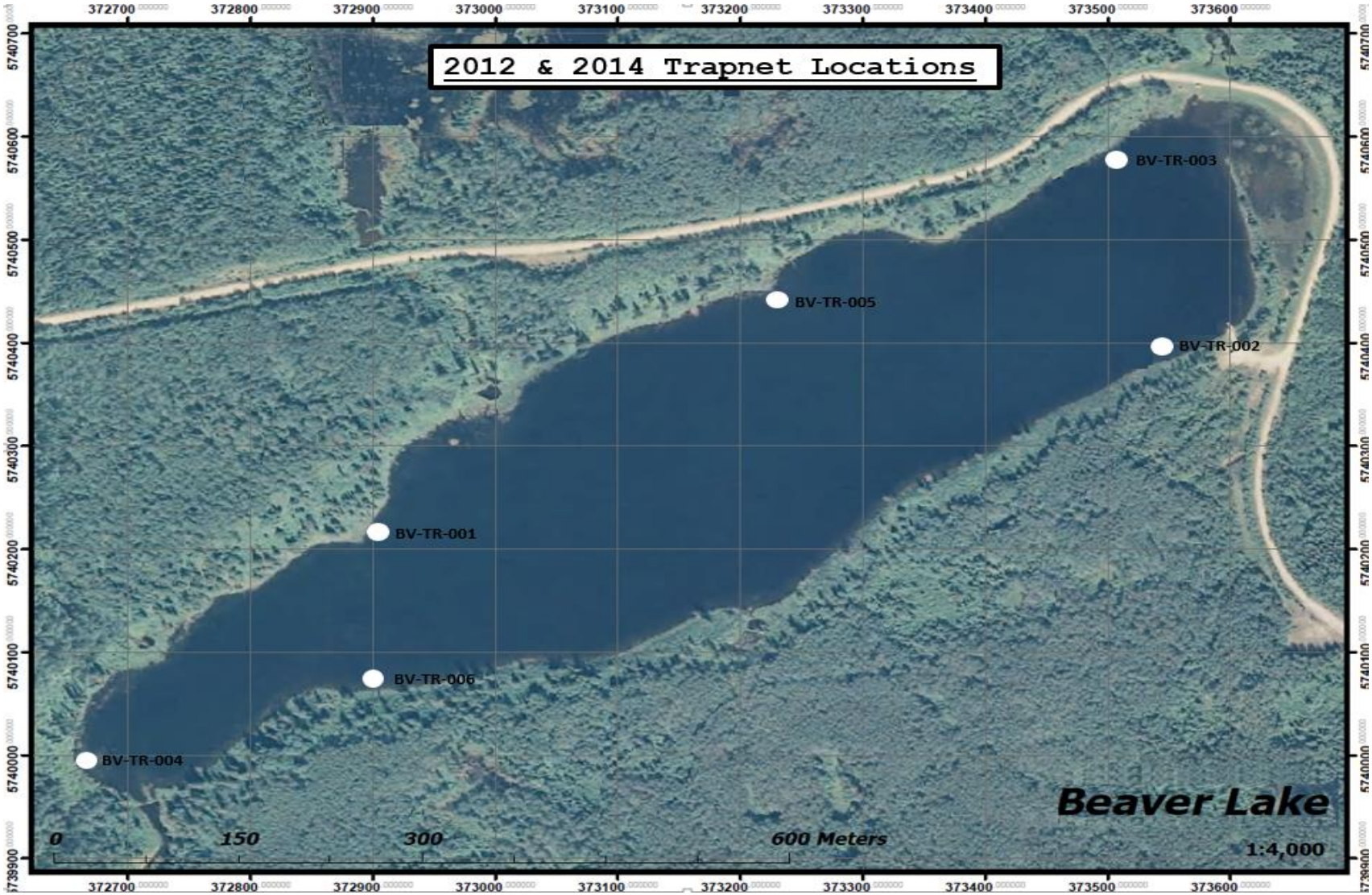


Figure 59: Beaver Lake ESTN Sites

5.0 Results

5.2 Beaver Lake Results (Post Spawn ESTN)

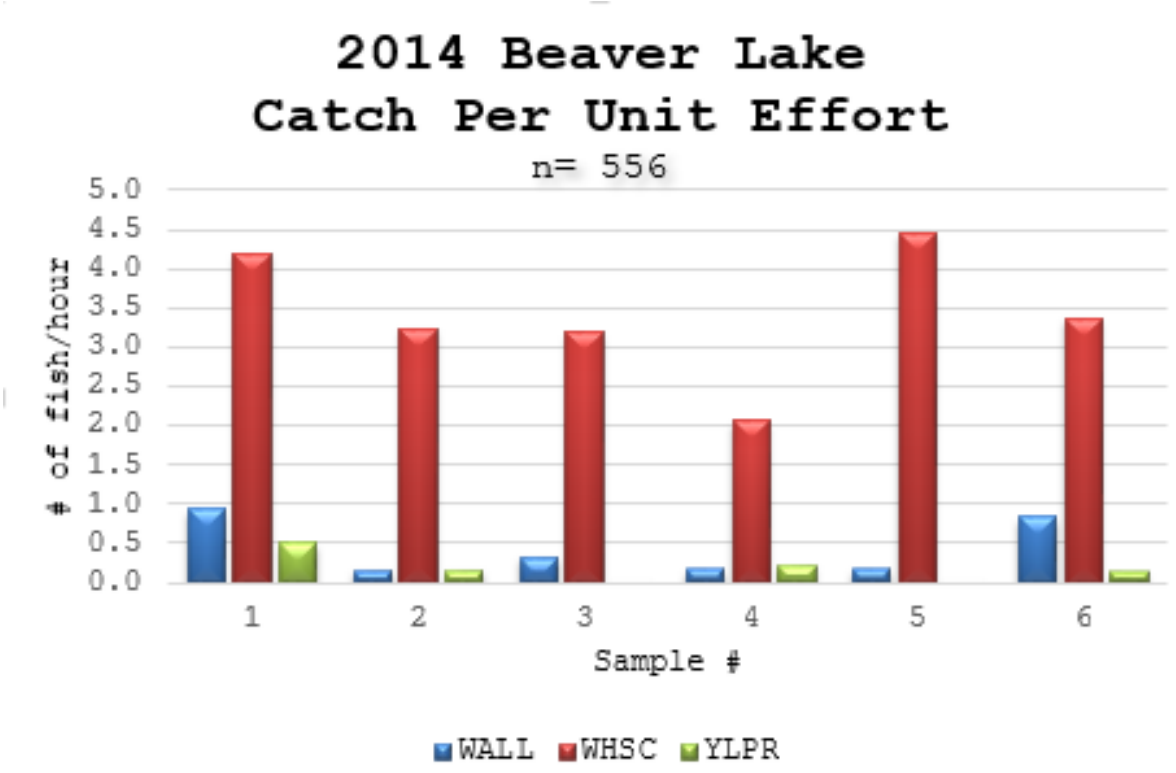


Figure 60: 2014 Beaver Lake ESTN CPUE

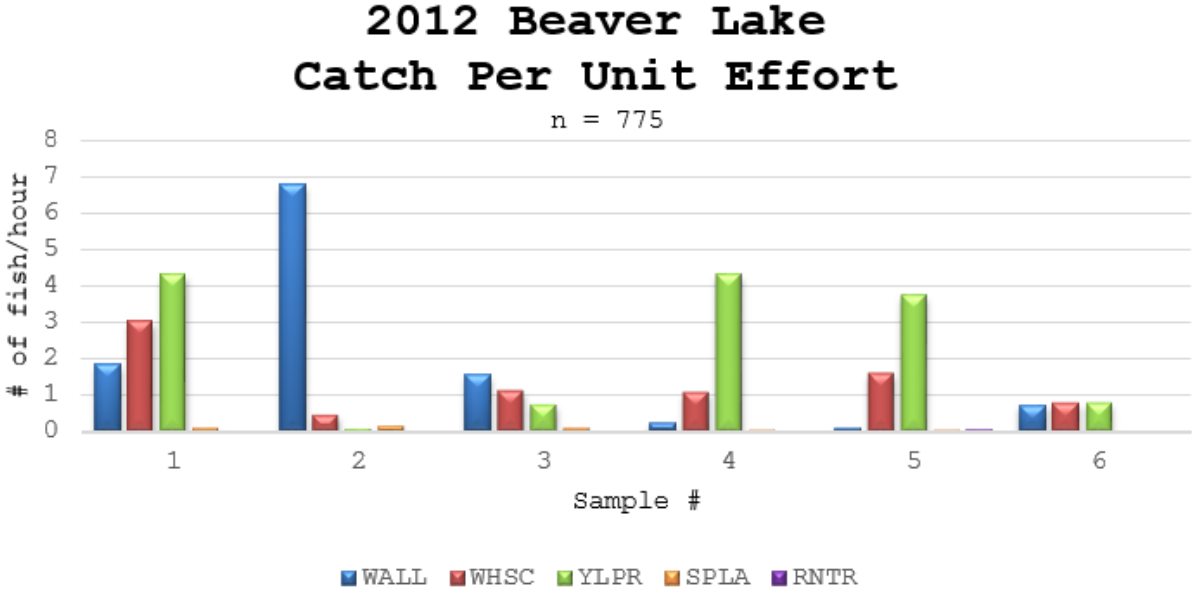


Figure 61: 2012 Beaver Lake ESTN CPUE

5.0 Results

5.2 Beaver Lake Results (Post Spawn ESTN)

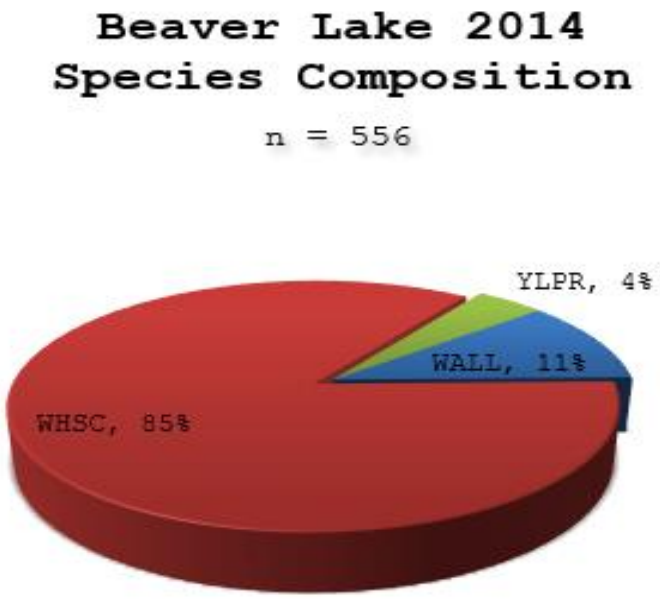


Figure 62: 2014 Beaver Lake ESTN Species Composition

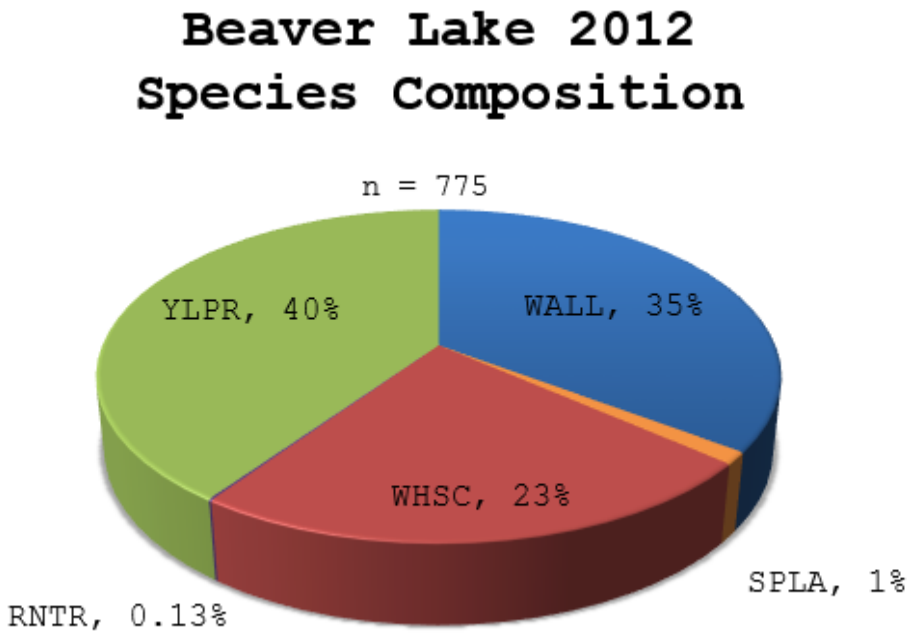


Figure 63: 2012 Beaver Lake ESTN Species Composition

5.0 Results

5.2 Beaver Lake Results (Post Spawn ESTN)

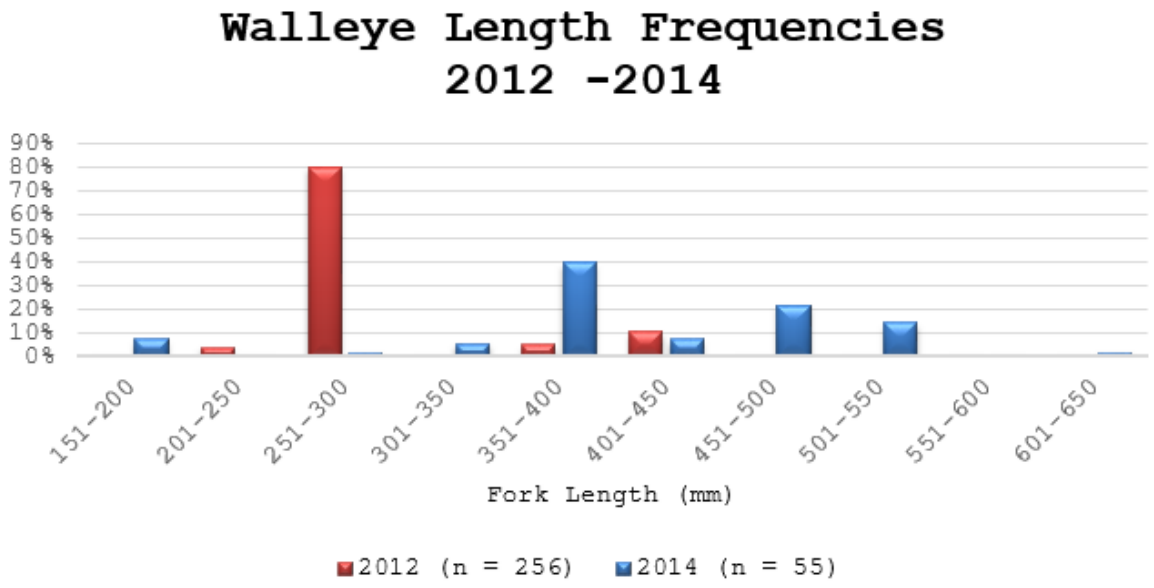


Figure 64: Beaver Lake Walleye Length Frequencies (2012, 2014)

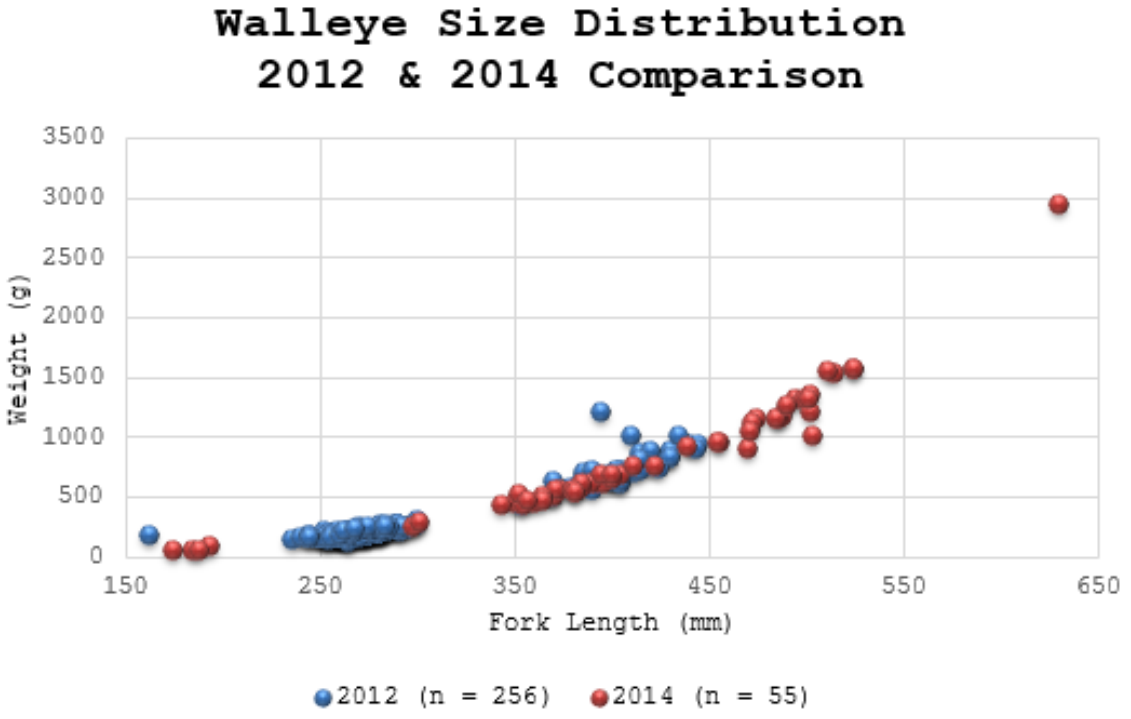


Figure 65: Beaver Lake Walleye Size Distribution (2012, 2014)

5.0 Results

5.2 Beaver Lake Results (Post Spawn ESTN)

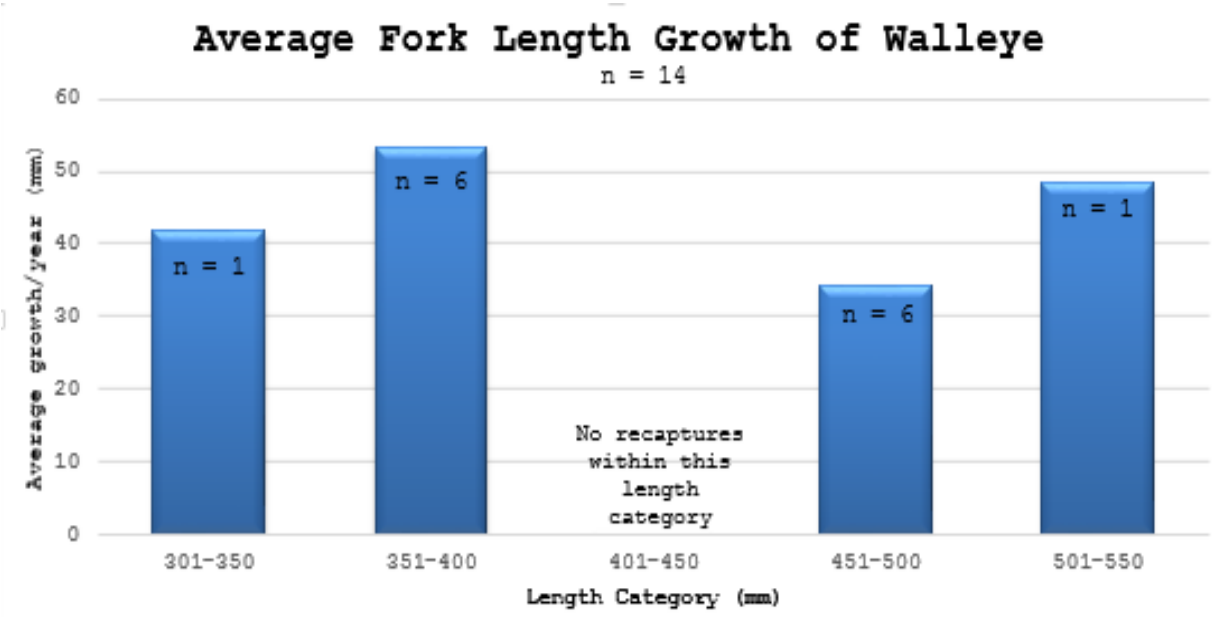


Figure 66: Beaver Lake Walleye Length Growth (2012-2014)

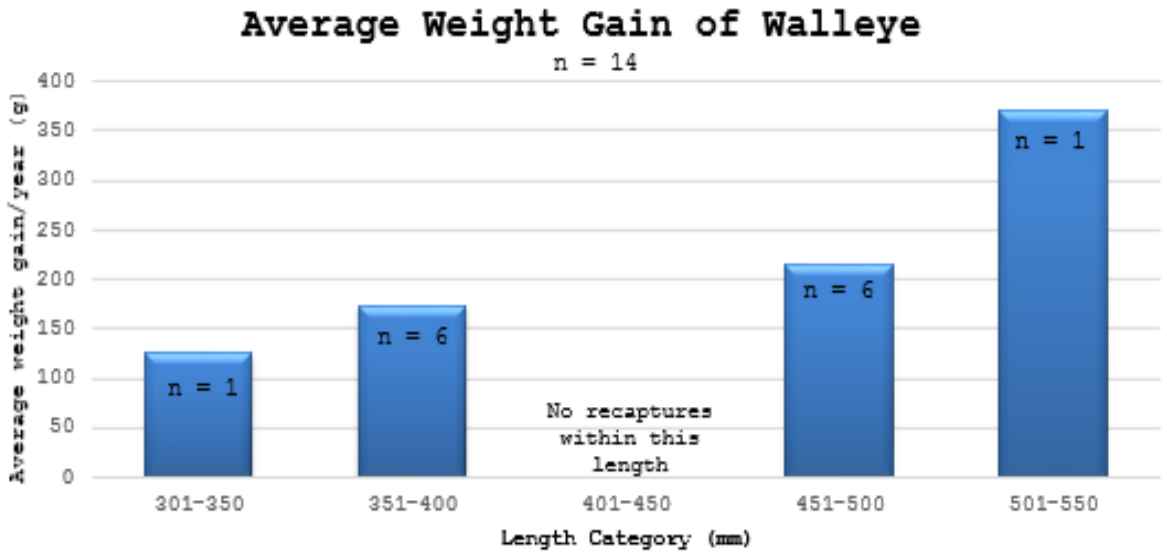


Figure 67: Beaver Lake Walleye Weight Gain (2012-2014)

5.0 Results

5.2 Beaver Lake Results (Post-Spawn ESTN)

Post spawn ESTN was conducted during the week of June 9th-12th, 2014. Sought after data included various measurements pertaining the overall health of the walleye fishery. More specifically, protocol was to determine catch-per-unit effort (CPUE) per site in order to compare geographical information to 2012 CPUE results. Second was to determine overall species frequency and compare it to 2012 trap-netting data. It was also decided to compare walleye length frequencies and size distributions from each year of trap netting in order to determine growth rates. Data collected from fish include length (mm), weight (g), sex (if applicable), and are tagged for potential recapture growth data. Lastly, using this protocol it is possible to determine population estimates based on recapture data through the Chapman-Peterson model.

In terms of CPUE, it is interesting to state that most popular walleye sites remained similar from year to year. More specifically, sites 1 and 6 were both productive walleye post-spawn habitats in both 2012 and 2014. Sites 1 and 6 are located on a lake-wide shallow shelf with an abundance of fish cover, which is likely a post spawn feeding area. Site 2 was very productive in 2012, but not in 2014. It is interesting to state that site 2 is a popular angling area and also the area where short set gill nets were set during 2014 spring evaluations. Reasoning for this may me due to habitat change as a result of the recently constructed shoal, however highly unknown. In terms of CPUE, walleye catch averages are down, 0.44 fish/hour in 2014 from 1.87 fish/hour in 2012. White sucker CPUE is up, 3.42 fish/hour in 2014 from 1.35 fish/hour in 2012, and yellow perch CPUE is down 0.17 fish/hour from 2.32 fish/hour in 2012. Also, no trout species were captured in the 2014 ESTN protocol. It is interesting to state that species compositions were very different from 2012 to 2014 despite similar sample sizes. It is hypothesised that white sucker numbers were high because of the late spawn in 2014. White suckers captured were still spawning, and therefore remained in the shallows during the sample period despite similar mean water temperatures (14.38°C) in 2012, and in 2014 (13.66°C). It has been hypothesised that walleye numbers are declining because of angling success in previous years. Beaver Lake is quickly becoming a popular walleye angling destination in the Duck Mountains and lower catches may be directly related to fishing pressure. Yellow perch numbers are also down, this has been hypothesised to be directly related to walleye predation, as many walleye sampled during this study regurgitated yellow perch remains on various occasions (Figure 68).

Figure 68: Regurgitated Yellow Perch

5.0 Results

5.2 Beaver Lake Results (Post-Spawn ESTN)

In terms of length frequencies, there is a notable a shift in age (length) classes, as expected. In the fall of 2011, two distinct length frequencies were stocked into Beaver Lake via the Beautiful Lake adult walleye transfer (251-300mm and 351-450mm). During 2012 ESTN results it was determined that these fish grew very little and remained generally the same size over their first winter(2011-2012). With regards to 2014 ESTN, it was determined that walleye in the 251-300mm were now within the 350-400mm, and the walleye in the 351-400mm range were now in the 450-550mm length frequency (Figure 64). It is also interesting to state that these walleye made up 80% of the walleye sample in 2012, and now make up for 47% of the walleye sample in 2014. This is likely a result of angling pressure, as these fish would have been a harvestable size from late 2012 to the spring of 2014. In the spring of 2014, a new regulation was implemented for Beaver Lake, which indicates that all walleye between (450-700mm) must be released as an attempt to protect mature fish. With regards to this ESTN protocol, it was determined that 39% of this sample (n=20) fell within this protected slot. In addition, concerns were identified when only 7% of (151-200mm) walleye were captured for the reason that 882 individuals within this length frequency were stocked via the Beautiful Lake walleye transfer in the fall of 2013 (Figure 70). SVSFE was eager to capture these recently stocked fish in order to determine survival and growth rates. At this point it is highly unknown whether there was high mortality due to stress of the transfer and/or predation, or whether sample method restricted catch ability.

In terms of growth rates, smaller fish (301-400mm) are growing 47.5mm per year on average, and larger fish (401-500) are growing 32.4mm per year on average, which is interesting because in comparison to Marge Lake smaller fish (301-400mm) are growing 29.5mm per year on average, and larger fish (401-500) are growing 10.5mm per year on average. Total average of all recaptures indicate and average growth of 44 mm per year. In terms of weight average growth of all recaptures is 202 grams per year on average, which is interesting because Marge Lake's average growth of all recaptures is 50.5 grams per year. Walleye in the (351-400mm) range displayed the most growth in both length and weight, which is expected as walleye do most of their growth during their first few years of life (Kerr, 1997).

Estimated populations were calculated from trap-netting recaptures using the Chapman-Peterson method. Of the 60 walleye sampled during 2014, 21 were recaptures from 2012, indicating and estimated walleye population of 571 (density of 27.7 walleye per hectare). The statistical error was relatively large with 95% certainty that the true number lies between 380 and 761. In a walleye study in Ontario on Henderson Lake, walleye populations of 10.4 fish/hectare with strong year classes was considered a high density of adult fish and a healthy population (Amtstaetter, 2004). Walleye populations in Beaver Lake appear to have a strong density with a low density of sub-adult fish and a older classification of year classes. Beaver lake stocking includes 1521 since 2011; 548 adults and sub-adults in 2011, 89 in 2012, and 884 fingerlings & two mature adults in 2013. With regards to stocking and population estimates it has been hypothesised that there may be a low survival rate of fingerling stocking and significant harvesting rates.

5.0 Results

5.2 Beaver Lake Results (Post Spawn Seining)

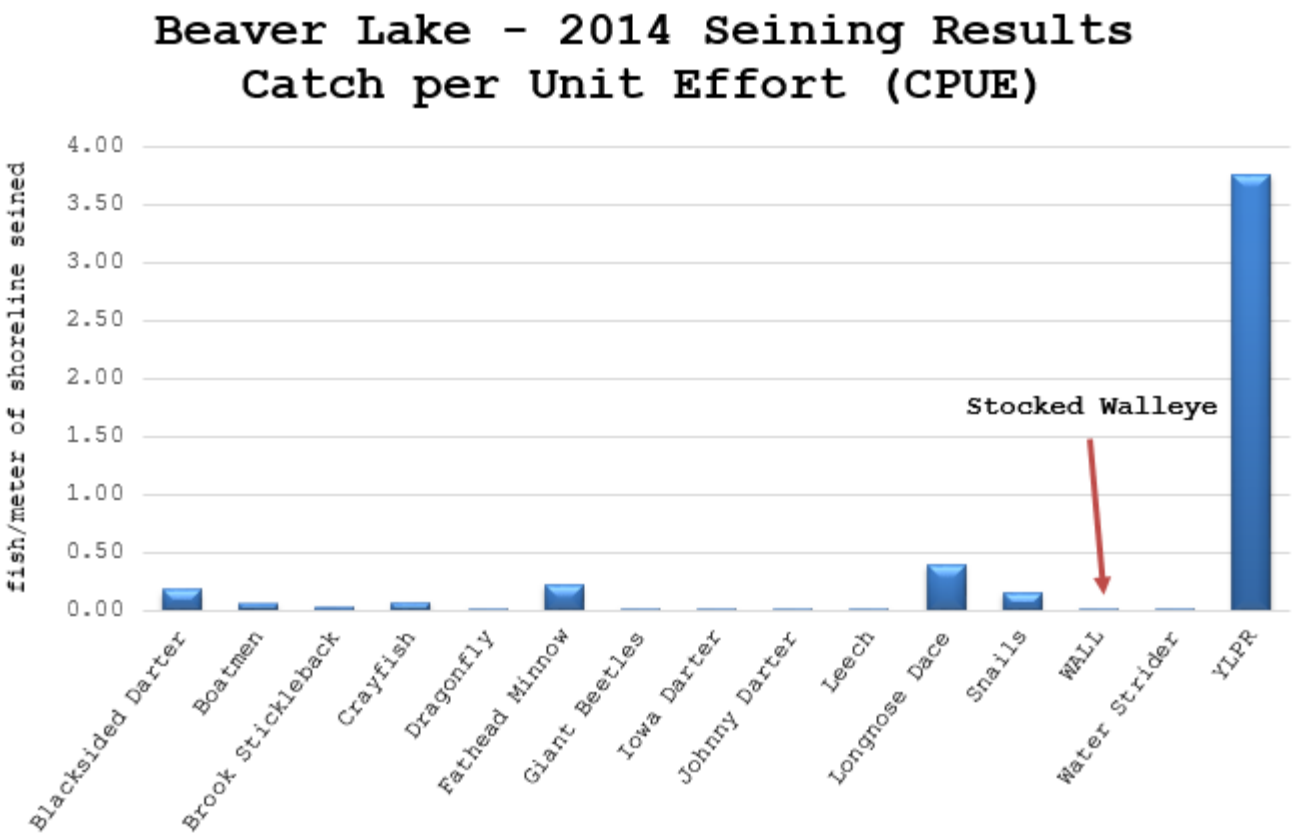


Figure 69: Beaver Lake Seining Results (CPUE)

Figure 70: Beaver Lake Walleye Stock (2013 From Beautiful Lake)

5.0 Results

5.2 Beaver Lake Results (Post Spawn Seining)

A total 11 seines were executed in the late August 2014 (6 day seines, and 5 night seines). Seining unfortunately resulted in 0 young-of-year walleye captured. Beaver Lake has a unique shoreline which consists of almost exclusively mucky areas with interspersed macrophytess and organic debris. For this reason, areas fit to seine are limited. Prior to artificial shoal construction (March 2014), the east shore was the most suitable seining location, and also the area where SVSFE discovered young-of-year walleye in the summer of 2013. Today, because of the enhanced substrate, it is very difficult to seine the area because of snagging and difficulty associated with walking on slippery rock. For this reason, and because of limited success during the YOY evaluations, SVSFE borrowed a backpack shocker from Fisheries Branch. On the night of September 15th, SVSFE and Intermountain Sport Fishing technicians attempted to locate evidence of natural recruitment using shocking as a method. A total of 3 sites were sampled including the entire east shoreline. Unfortunately, no young of year walleye were captured using shocking as a method. Two stocked walleye (2013) were captured in one south shore night seine which represented exceptional growth (65mm in approximately 11 months) and satisfying overall health. Insignificant natural recruitment results may be due to a number of factors. First of all, previous young-of-year habitat is now much more difficult to sample (east shore). Second of all spawning success may have been hindered. For example, 2014's irregularly late spring may have facilitated egg absorption in females. Also, extreme fluctuations in water levels may have disrupted spawning activity. Between May 19th-20th a large beaver dam blew out in the north side of the lake raising water levels significantly (70cm), and dropping water temperatures. Seining and electrofishing results indicate a very abundant forage base in terms of to be yellow perch, which is likely the reason for exceptional walleye growth.

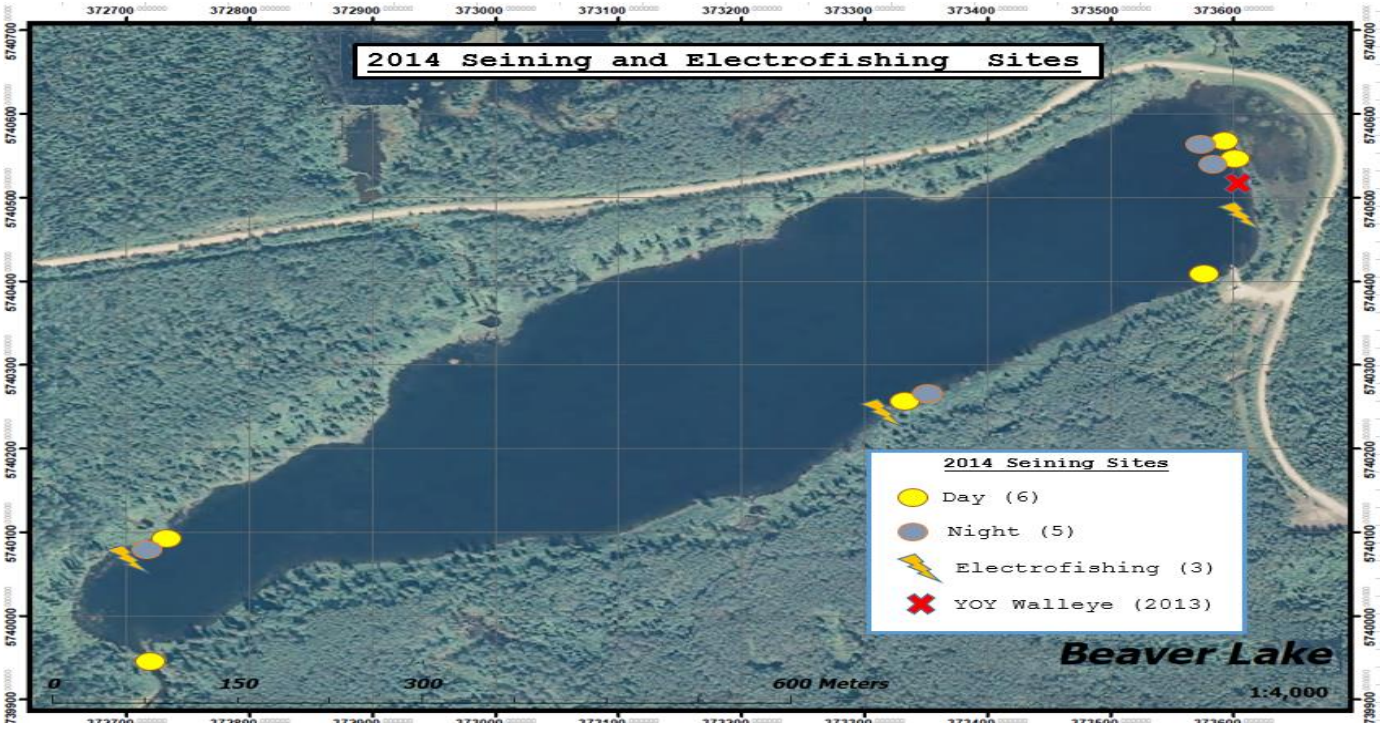
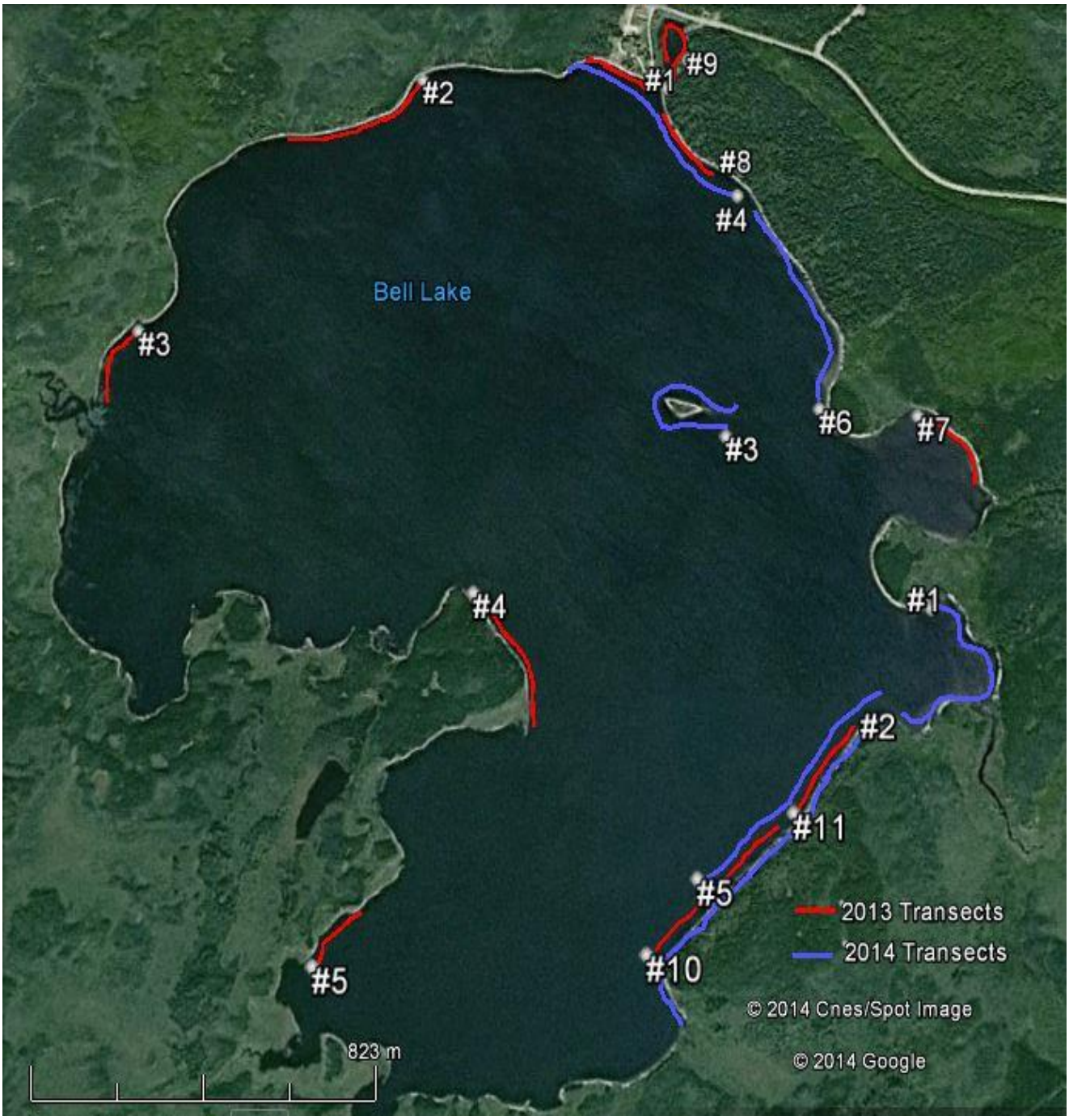


Figure 71: Beaver Lake Seining and Electrofishing Sites

5.0 Results

5.3 Bell Lake Results



Bell Lake Electroshocking Walleye/Transect											
Transect	1	2	3	4	5	6	7	8	9	10	11
2013	6	3	0	2	0	X	2	0	0	19	7
2014	1	14	0	9	12	10					

Figure 72: Bell Lake Electroshocking Sites & Walleye per Transect (2013, 2014)

5.0 Results

5.3 Bell Lake Results

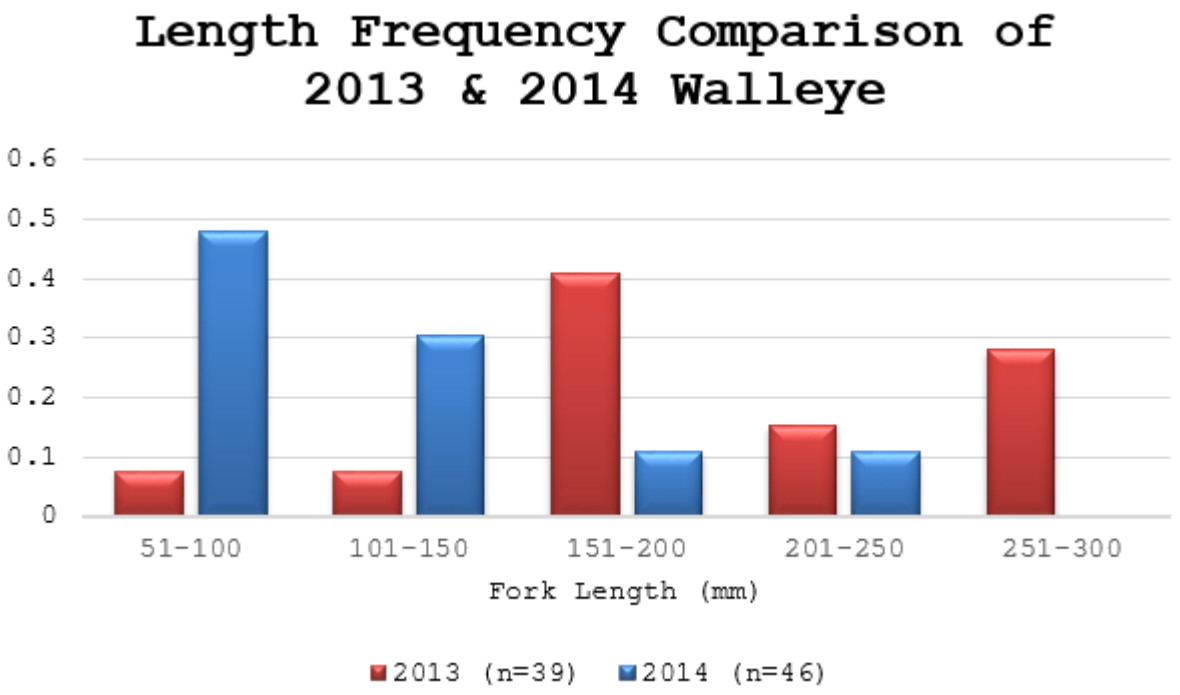


Figure 73: Bell Lake Walleye Length Frequencies (2013,2014)

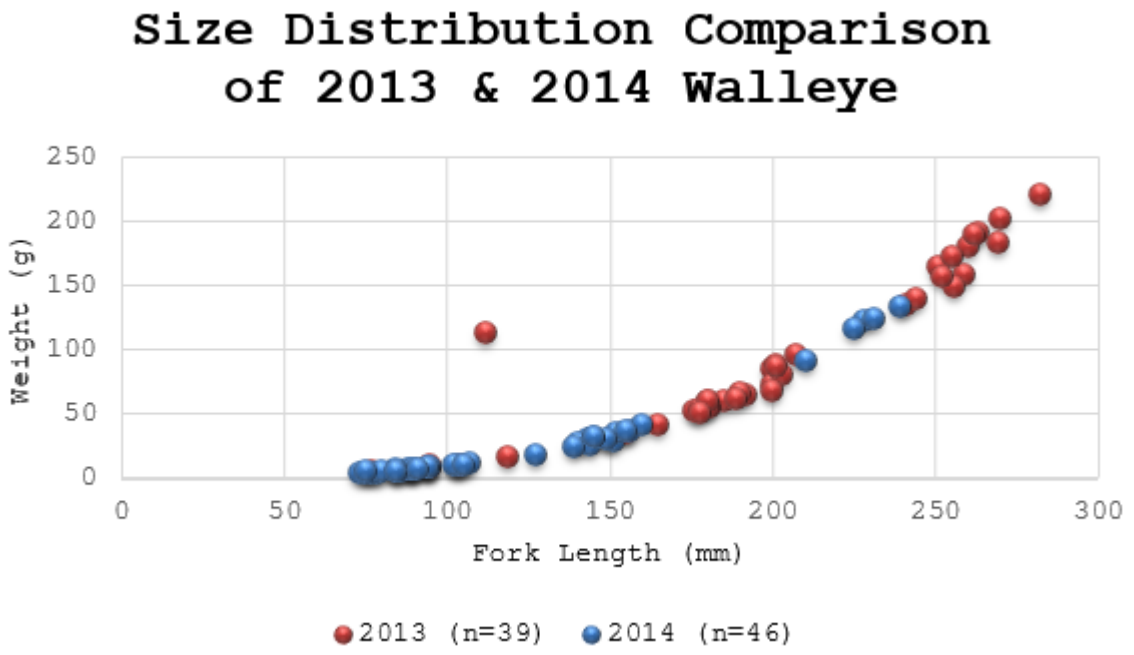


Figure 74: Bell Lake Walleye Size Distribution (2013, 2014)

5.3 Bell Lake Results

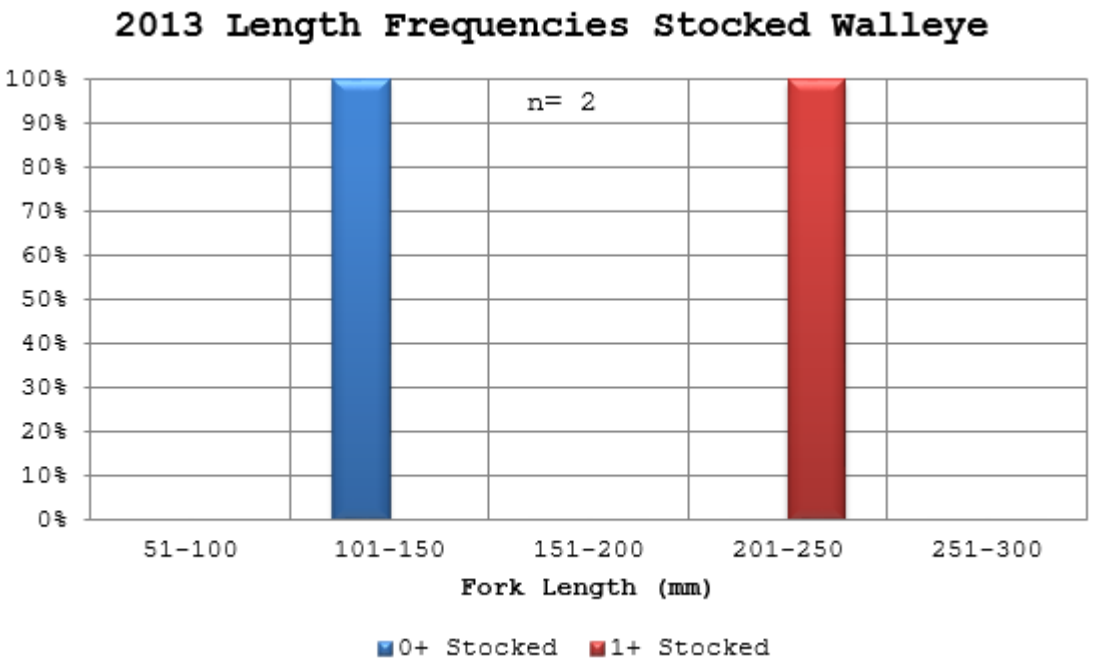


Figure 75: Bell Lake Stocked Walleye Length (2013)

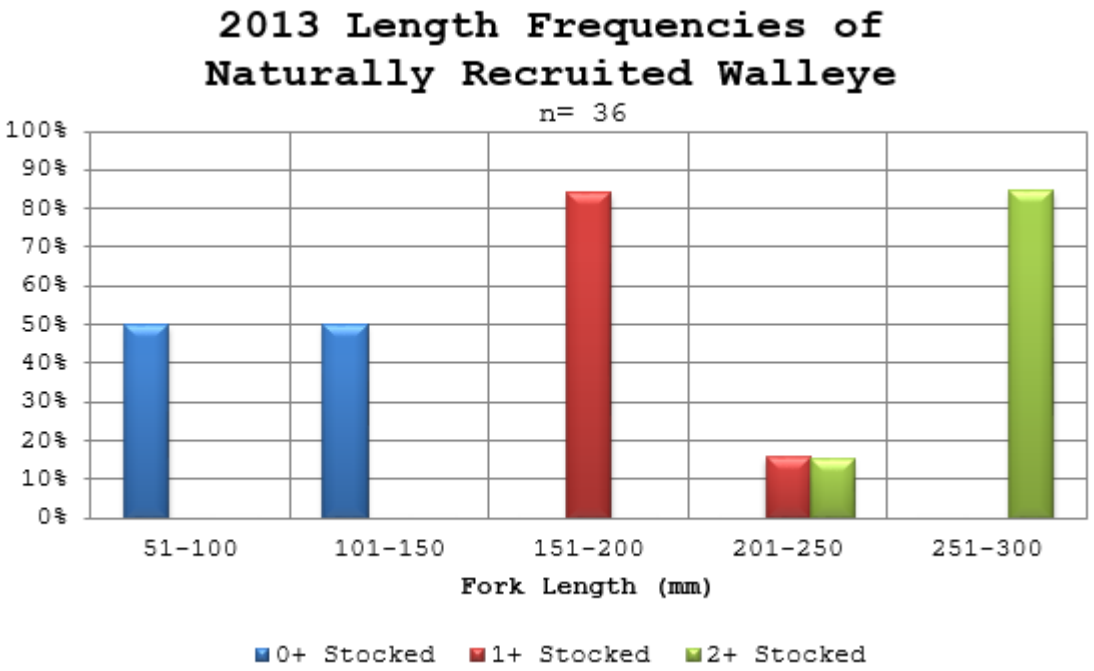


Figure 76: Bell Lake Naturally Recruited Walleye Length (2013)

5.0 Results

5.3 Bell Lake Results

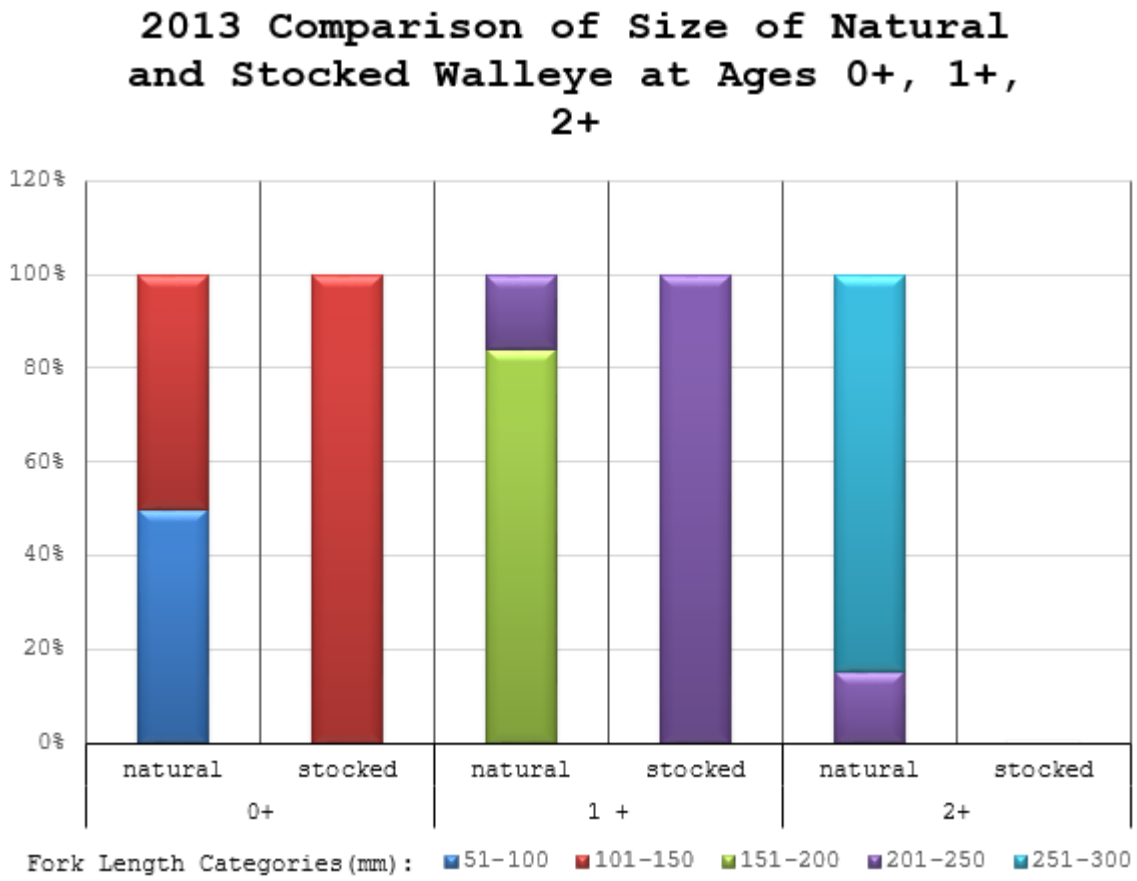


Figure 77: Bell Lake Stocked vs Naturally Recruited Walleye (2013)

2013 Bell Lake Recruitement Success (Stocked vs. Natural) Chart

Year	# marked (OTC)	# no mark (OTC)	Total fish in age class	% of stocked walleye	% of natural recruitment	Total fry Stocked	Hatchery	Date
2013 (0+ fish)	1	4	5	20%	80%	200,000	Whiteshell	30-May-13
2012 (1+ fish)	1	19	20	5%	95%	300,000	Swan Creek	11-May-12
2011 (2+ fish)	0	13	13	0%	100%	200,000	Swan Creek	23-May-11
Total	2	36	38	5%	95%	700,000		

Figure 78: Bell Lake Stocked vs Naturally Recruited Walleye Chart (2013)

5.0 Results

5.3 Bell Lake Results (Summary)

On Bell Lake, oxytetracycline (OTC) sampling was conducted on September 10th, 2013, and September 9th, 2014. The 2013 sample (n=38 fish) were analysed in January 2014, and the 2014 sample (n=46 fish) are expected to be analysed in January of 2015. For this reason, this report will be intermediate as relevant information (2014 OTC results) have yet to be analysed by external parties.

On Bell Lake, a total of 11 transects were shocked in 2013, and 7 in 2014. 2014 sites were selected based on success rates from 2013. The most productive site was the east shore (transects 10, 11 in 2013, and 2, 5 in 2014). The east shore (wind-swept) is sandy with interspersed boulder and cobble and arguably the best representation of young-of-year walleye habitat on Bell Lake (Figure 72).

Length frequency and size distribution charts were plotted from each year(s) sample size (Figures 73, 74). Some conclusions can be drawn from these figures, however the data will be much more relevant once 2014 age/marking lab work is completed. Notably, walleye captured in 2013 were larger than those captured in 2014 on average. This will be interesting once 2014 OTC analysis is received, because of the fact that both years (2013 & 2014) experienced irregularly late springs, and stocking dates were very close (May 30th, and June 2nd respectively). In 2013 days between stocking (fry), and sampling equates to 104(days), whereas in 2014 day between stocking and sampling equates to 100(days), suggesting similar "growth periods" from year to year. Perhaps, this increase of lower length frequencies could be directly related to environmental factors (2014's irregularly cold spring)(Figure 103), or due to an increase in young of year captured. Conclusions will be interesting once the true nature of these fish are determined.

Length frequencies between stocked walleye (OTC marked), and naturally recruited walleye (non-OTC marked) were plotted from 2013's sample (Figures 75, 76). Interestingly, we notice that of the full sample (38 fish), that only 2 were OTC marked; suggesting that of 2013's sample 95% were naturally recruited. Of the stocked fish, we noticed that one was stocked from the Whiteshell Hatchery in the spring of 2013, and one was stocked from the Swan Creek Hatchery in the spring of 2012. From the full sample, age/length frequencies are notable. Regarding the stocked fish (n=2); young of year are within the 100-150mm range, and 1+(years) are within the 201-250mm range. Regarding the naturally reproduced fish (n=38); young of year are within the 51-150mm range, 1+(years) are mostly (85%) within the 151-200mm range, and 2+(years) are mostly (85%) in the 251-300mm range.

Comparison of natural vs stocked length frequencies by age were plotted for Bell Lake (Figure 77). It appears that there are no significant growth patterns comparing natural vs. stocked fish. A larger sample of stocked fish may provide more significant results. Perhaps when 2014 OTC analysis is completed it will display a significant correlation between natural vs stocked growth rates in Bell Lake, as this would be a very interesting phenomena. Finally a chart was created to demonstrate overall recruitment success (Figure 78). In terms of age classes; 80% of 0+ were naturally recruited, 95% of 1+ were naturally recruited, and 100% of 2+ were naturally recruited. In total, 95% of the total sample size were naturally recruited walleye. SVSFE and Fisheries Branch are pleased with these results and eager to receive/analyze results from 2014.

5.0 Results

5.4 North Steeprock Lake Results

North Steeprock Lake Electroshocking Walleye/Transect

Transect	1	2	3	4	5	6	7	8	9	10	11	12
2013	0	0	1	1	1	1	1	1	6	38	41	30
2014	0	78	70	10	28							

Figure 79: North Steeprock Electroshocking Sites & Walleye per Transect (2013, 2014)

5.4 North Steeprock Lake Results

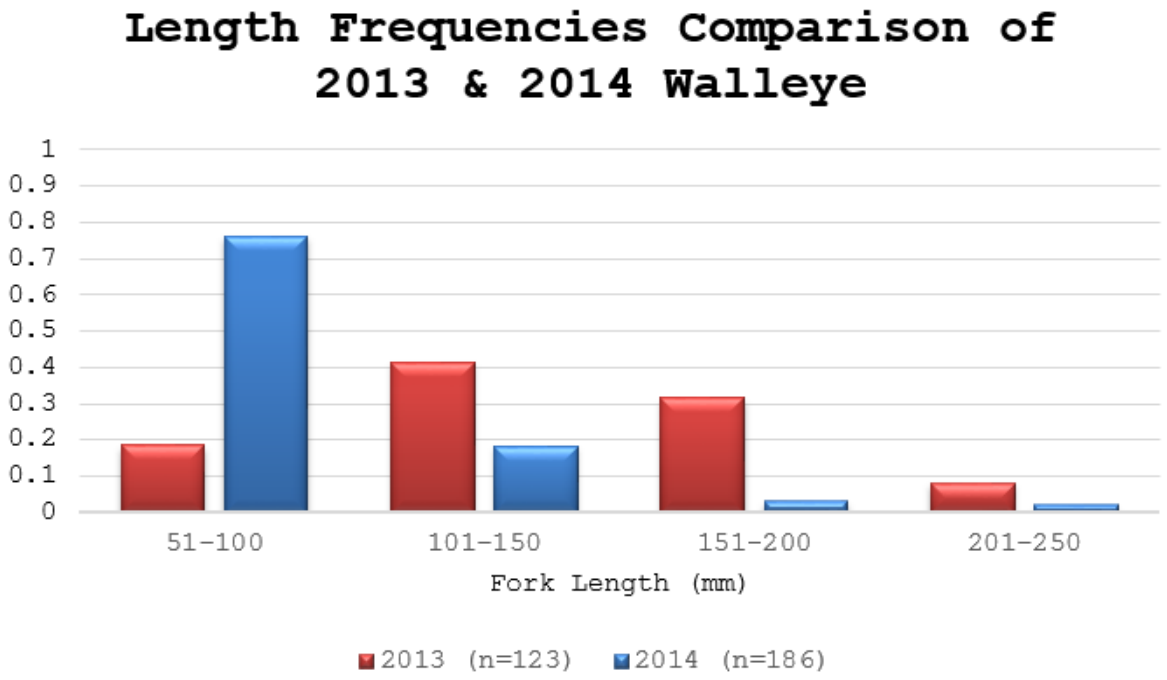


Figure 80: North Steeprock Lake Walleye Length Frequencies (2013, 2014)

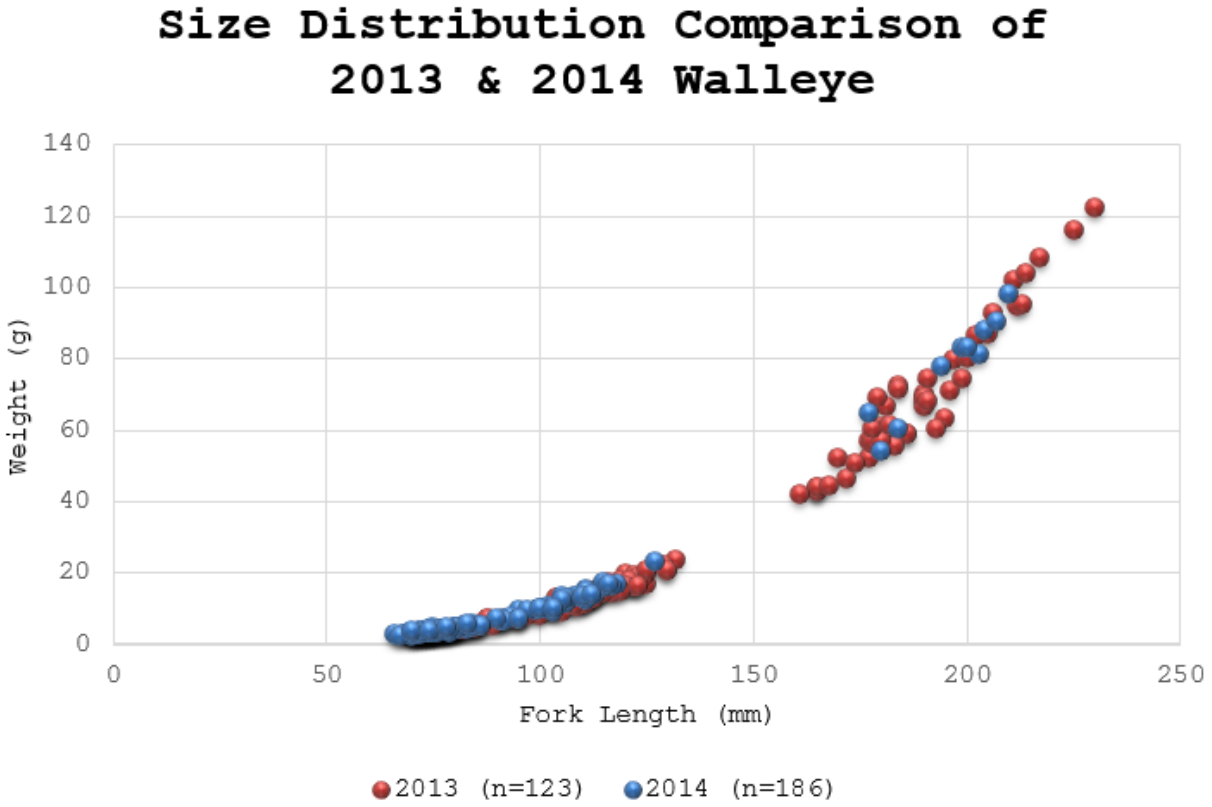


Figure 81: North Steeprock Lake Walleye Size Distribution (2013, 2014)

5.4 North Steeprock Lake Results

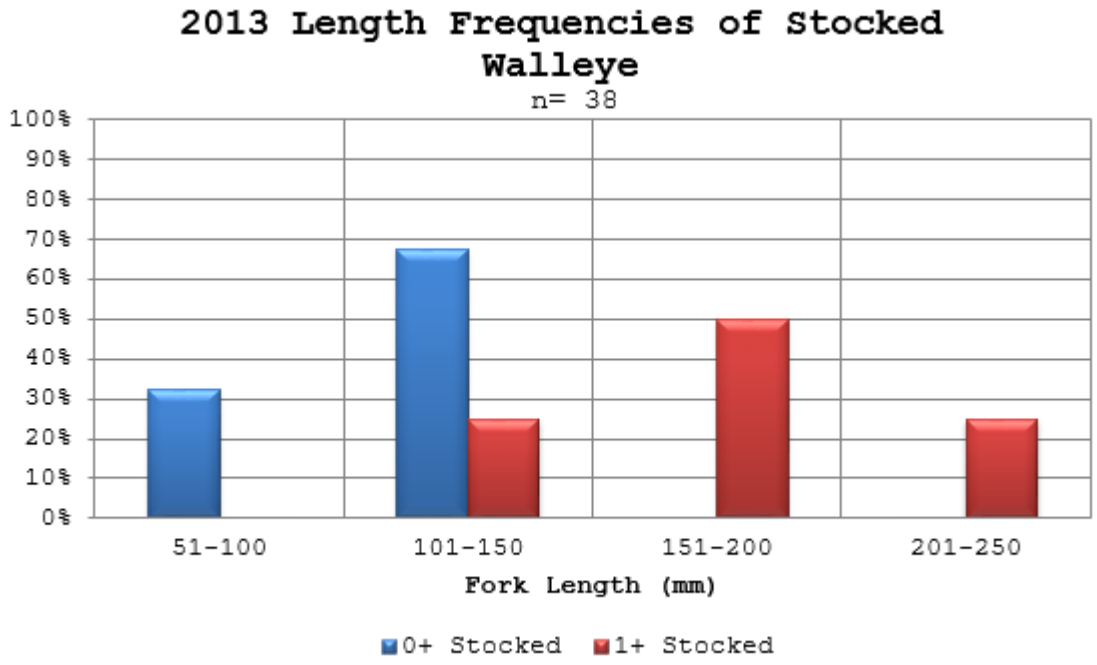


Figure 82: North Steeprock Lake Stocked Walleye Length (2013)

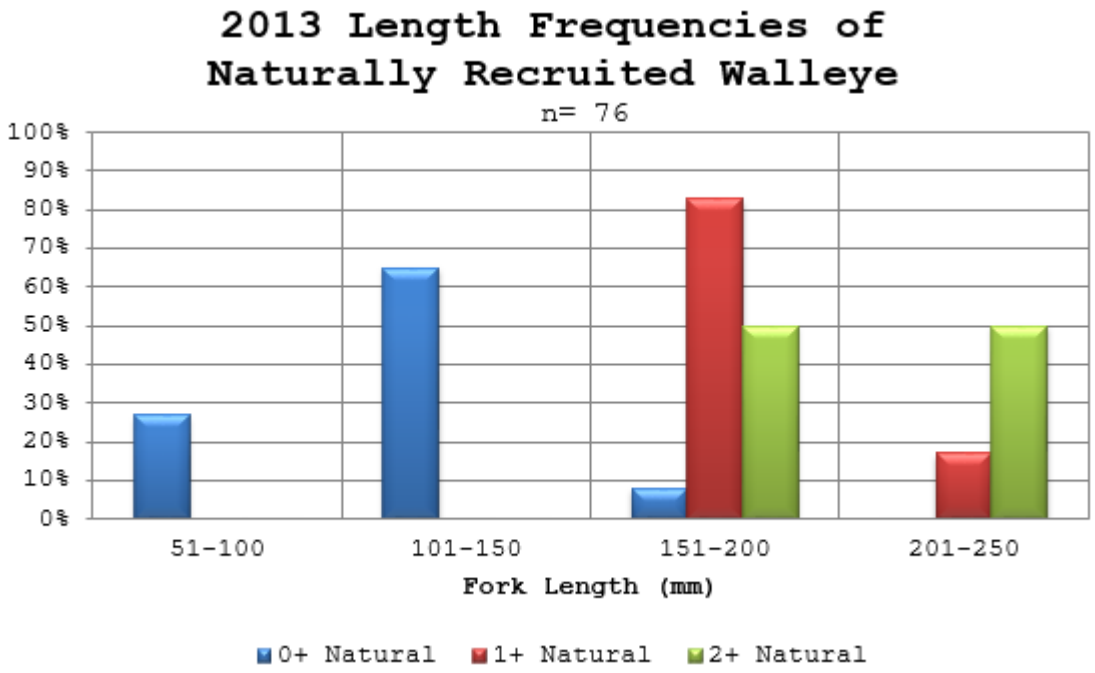


Figure 83: North Steeprock Lake Naturally Recruited Walleye Length (2013)

5.0 Results

5.4 North Steeprock Lake Results

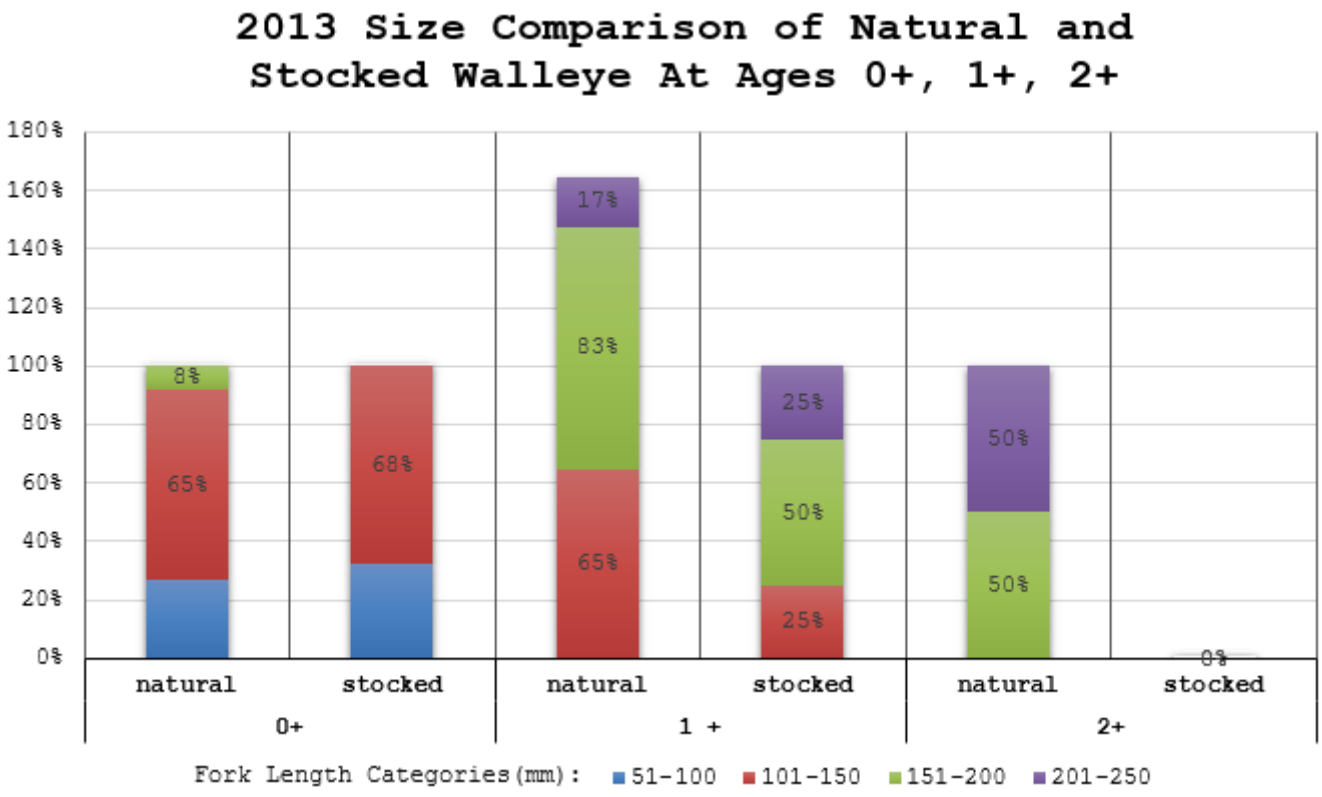


Figure 84: North Steeprock Lake Stocked vs. Naturally Recruited Walleye (2013)

2013 North Steeprock Lake Recruitement Success (Stocked vs. Natural) Chart

Year	# marked (OTC)	# no mark (OTC)	Total fish in age	% of stocked walleye	% of natural recruitment	Total fry Stocked	Hatchery	Date
2013 (0+ fish)	34	37	71	48%	52%	400,000	Whiteshell	30-May-13
2012 (1+ fish)	4	35	39	10%	90%	700,000	Swan Creek	11-May-12
2011 (2+ fish)	0	4	4	0%	100%	300,000	Swan Creek	23-May-11
Total	38	76	114	33%	67%	1,400,000		

Figure 85: North Steeprock Stocked vs. Naturally Recruited Walleye Chart (2013)

5.0 Results

5.4 North Steeprock Lake Results: Summary

On North Steeprock Lake, oxytetracycline (OTC) sampling was conducted on September 9th, 2013, and September 8th, 2014. The 2013 sample (n=123 fish) were analysed in January 2014, and the 2014 sample (n=186 fish) are expected to be analysed in January of 2015. For this reason, this report will be intermediate as relevant information (2014 OTC results) have yet to be analysed.

On North Steeprock Lake, a total of 12 transects were shocked in 2013, and 5 in 2014. 2014 sites were selected based on success rates from 2013. The most productive site was by far the east shore (transects 10, 11 in 2013, and 2, 3 in 2014). Interestingly 73% of the total sample (2013 and 2014) were captured on the east shore. The east(wind-swept) shore is sandy with interspersed cobble and gravel and arguably the best representation of young-of-year walleye habitat on North Steeprock Lake (Figure 79).

Length frequency and size distribution charts were plotted from each years sample size (Figures 80, 81). Not too many conclusions can be drawn from these figures, as relevant 2014 age/marking lab work is not yet completed. On average, walleye captured in 2014 were significantly smaller than those captured in 2013, which interestingly correlated with the sample from Bell Lake. This will be interesting once 2014 OTC analysis is received, because of the fact that both years (2013 & 2014) experienced irregularly late springs, and stocking dates were very close (May 30th, and June 2nd respectively). In 2013 days between stocking (fry), and sampling equates to 103(days), and in 2014 days between stocking and sampling equated to 99(days), suggesting a similar "growing period" from year to year. Perhaps this phenomena could be linked to 2014's irregularly cold and wet spring (specifically June)(Figure 103), or due to an increase in young of year captured in 2014. Optimal temperature for growth at this life stage are in the 22-25°C range, and generally cease at 12°C (Kerr, 1997). This potential hypothesis can be further explored upon the arrival of 2014 OTC results.

Length frequencies between stocked walleye (OTC marked), and naturally recruited walleye (non-OTC marked) were plotted from 2013's sample (Figure 84). Interestingly, we notice that of the full sample (114 fish), that 38 were OTC marked; suggesting that of 67% were naturally recruited (76/114). The highest catches of OTC marks came from the YOY age class. This is interesting because of the fact that technicians were targeting YOY walleye in habitats where they were believed to be, and perhaps lower catches of older (juvenile) fish was due to different preferred habitats. Juvenile walleye tend to seek waters at least 1-3m in depth, are associated with substrate, and utilize aquatic vegetation and other structure for cover (Einfalt, 1997). From the full sample, age/length frequencies are notable. Regarding the stocked fish (n=38); young of year are within the 51-150mm range, and 1+(years) are within the 150-250mm range. Regarding the naturally reproduced fish (n=76); young of year are within the 51-200mm range, 1+(years) are mostly (85%) within the 151-200mm range, and 2+(years) are 50% in the 151-200mm range, and 50% in the 201-250mm range.

5.0 Results

5.4 North Steeprock Lake Results: Summary

Comparison of natural vs stocked length frequencies by age were plotted for North Steeprock Lake (Figure 84). There appears to be no significant growth difference comparing natural vs. stocked YOY (0+). In terms of 1+ walleye there appears to be a slightly higher growth rate for natural fish vs. stocked fish. This could be interesting if it were possible to calculate growth rates of the 1+ naturally reproduced fish. Unfortunately without the unknown (hatching variable), this calculation is not possible. Regardless, one should be weary of this concept because of a relatively small sample size of stocked fish (4/39) in this age class. Finally a chart was created to demonstrate overall recruitment success (Figure 85). In terms of age classes; 80% of 0+ were naturally recruited, 95% of 1+ were naturally recruited, and 100% of 2+ were naturally recruited. In total, 67% of the total sample size were naturally recruited walleye. Results indicated that 52% of the YOY walleye were naturally reproduced, 90% of the 1+(years) fish were naturally reproduced, and 100% of the 2+(years) fish were naturally reproduced.

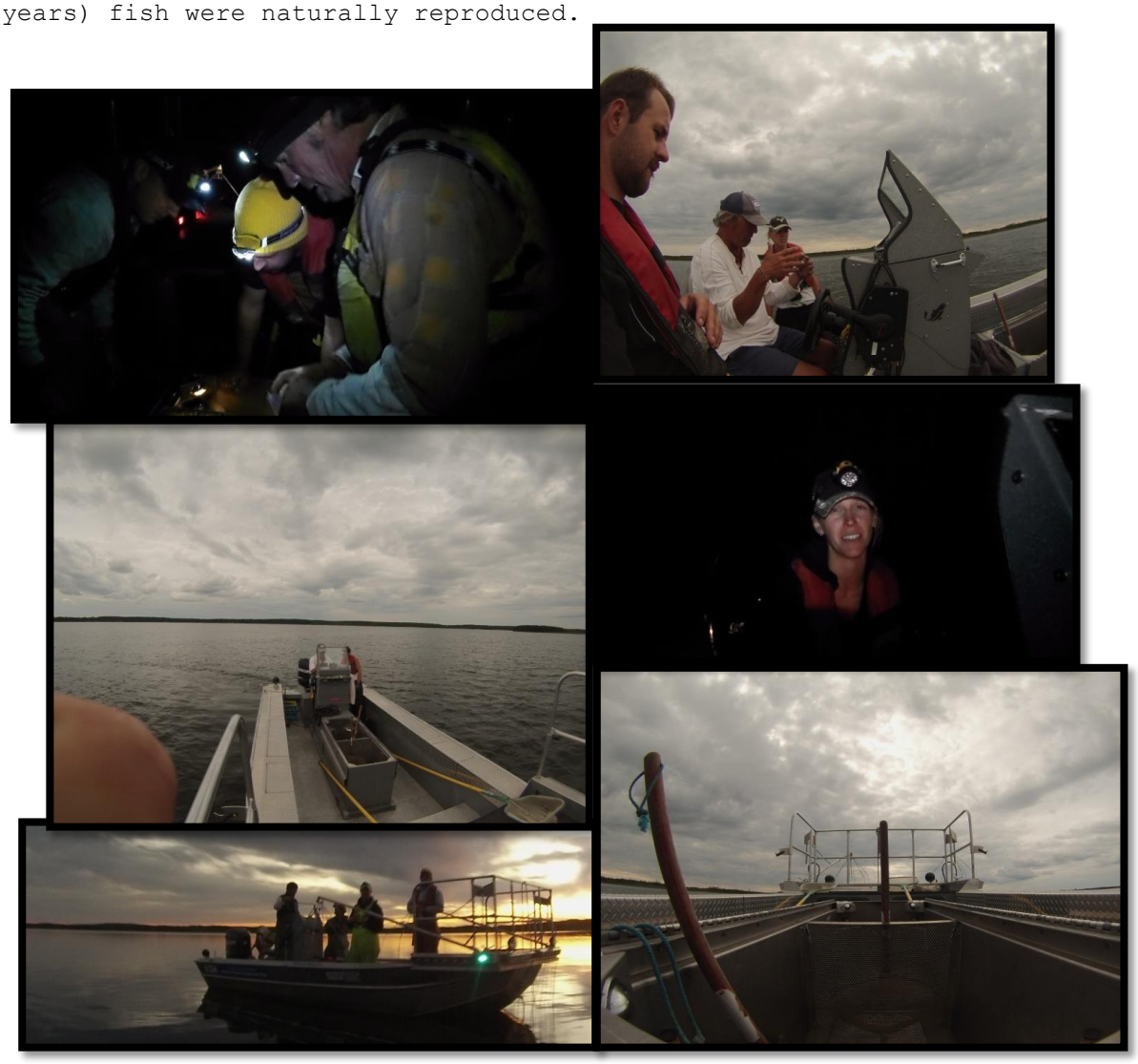


Figure 86: Electroshocking

5.0 Results

5.5 Sources of Error

Sources of error include circumstances that may have influenced results. In terms of observational monitoring many sources of error exist. With regards to spring monitoring at both Marge and Beaver Lake(s), limited time and human resources may have hindered observational results. If it were plausible, full out 24/hour monitoring would have likely produced much more significant results. For example on May 29th no monitoring was conducted on Marge or Beaver Lakes due to a severe electrical storm. This particular date has been considered critical in terms of the spawning period, and due to environmental factors relevant data may have been missed. Also, the "wrong place at wrong time" factor should be considered. This concept is relevant for pre-spawn evaluations including trap netting, gill netting, and angling, which again ties into the idea of limited resources. Avoidance of trapping methods is always a source of effort (see below). Technicians may have been monitoring one location while significant activity may have been occurring in another area, although greatest discretion was used.

With regards to post-spawn egg and larval evaluations sources of error are also present. Post-spawn evaluations methods include kick sampling, drift netting, guzzling, and spawning mats. Site selection is semi-random, and it could be possible that sites chosen were in substrates not utilized by walleye. Human error is also present with the possibility of egg and larval mis-identification. Also timing of the sample period is not ruled out as the optimal sampling period may have been misinterpreted. Methods used for egg/larval evaluation followed protocol suggested by The State of Michigan DNR's Manual of Fisheries Survey Methods 11, in order to avoid potential sources of sampling error.

Regarding post-spawn evaluations in terms of end of spring trap-netting (ESTN) many sources of error exist as this is a very strict protocol used to evaluate walleye populations. First of all individual fish have territories, daily or seasonal movements, or other behavioral patterns which effect vulnerability to sampling (Schneider, 2000). Avoidance is a common source of error; trap netting is a method that can only sample at limited depths (<5m). Bias due to fish behavior includes "trap-happy" or "trap-shy" tendencies, territoriality or other distribution tendencies, and any other behavior which can cause non-random samples (Schneider,2000). Another source of error is failure to distribute marked fish fairly. For example, June 10th trap netting on Beaver Lake riddled technicians with heavy winds. As technicians sampled the fish, the boat drifted on from west to east in correspondence with sampling a releasing fish, thus dispersing fish throughout the entire orientation of the lake. Sometimes, behavior and distribution bias can occur by using one type of gear to collect fish. An example of this becomes possible when referring to Marge Lake pre-spawn trap netting vs. Marge Lake post spawn ESTN. Although sufficient time had passed between sampling periods, the same nets were used in both protocols, suggesting the possibility of "avoidance due to "net-shy" tendencies and may be a factor in the low catch rates for 2014 ESTN. In summary, technicians followed the Standard Ontario DNR ESTN protocol to best avoid these potential sources of error.

5.0 Results

5.5 Sources of Error

In terms of seining, many sources of error exist. Any object that snags a seine or causes it to lift off the bottom can allow fish to escape (Hahn, 2004). Aquatic vegetation, which provides cover for small fish, will often lift the seine net, also allowing fish to escape. In addition to substrate unevenness, snagging on logs, rocks, and other debris will slow down the seining and decrease seining efficiency by allowing fish to escape underneath the net or out swim the moving seine. With every snag increases the chance of holes becoming present in the net. For example, in 2013 during a 200 meter haul on the southeast shore of Beaver Lake, a large hole became present in the seine, this sample was later nullified. Even clean soft substrates cause problems allowing the weight line to act like a dredge, slowing the speed of the seining process and therefore allowing fish to swim out of the seine. This dredging effect was present in the north east bay seine of Marge Lake. This is an area where one walleye was caught, and perhaps more would have been captured if the dredging effect did not occur. With regards to many sites, specifically multiple sites in Beaver, woody debris from beavers and muskrats was often present in potential seining areas. In these situations, technicians would remove the debris and allow a 24 hour duration before seining the site. This may have effected results as fish cover and habitat was removed, thus changing site dynamics. Water turbidity plays a role, the greater the turbidity of the water decreases chances of fish seeing the incoming net. Noise, vibrations and changes in water pressure which are induced by moving seines may deter fish (Hahn, 2004). Lastly and arguably most importantly, seining success is very site specific, as prime conditions increase results significantly. On hard packed, sandy beaches with little debris technicians are able to sample swiftly and efficiently. Due to lack of these areas on Beaver Lake may be the reason YOY were so difficult to locate in 2014.

In terms of electro-fishing, many potential errors also exist. First of all technical error is always a potential. There is always the potential that voltage would be too low to stun targeted species, however unlikely. In some cases, target species would be stunned out of reach of the dip netters, influencing CPUE results. Fish escape is also a common occurrence. When fish reach the electrified boundary they spring back to life and swim in the opposite directions to avoid catchment. Human error is always present. A strong depth perception is required when dipping stunned fish, this may have resulted in missing target species. While shocking, three different safety panels (kick plates) must be initiated in order to facilitate current. On some occasions this safety precaution becomes uninitiated through human error, thus halting current. In this case, a stunned fish will often escape the dip-netting radius as a result of accidental power loss. On occasions, semi-aquatic mammals (ie. beavers) become present while shocking; at this point shocking is temporarily halted, thus influencing results. Error is present during data collection and analysis as well. Arguably, the most important source of error becomes present when analysing the data. With regards to OTC submersion and therefore OTC marking on a particular sample size it is important to state that the source of walleye fry be a limiting factor. For example, the Whiteshell Hatchery has undergone efficacy trials that have resulted in a 95+% confidence regarding OTC fry marking, whereas the Swan Creek Hatchery has not undergone such trials. For this reason, SVSFE must be weary in drawing too many conclusions from fish >1years in 2013, and >2years in 2014, as representing age classes that may have come from the Swan Creek Hatchery.

5.0 Results

5.5 Sources of Error

Without these efficacy trials, results from age classes corresponding with years when fry were stocked from Swan Creek (2011 & 2012) in both Bell and North Steeprock may have to be nullified, and or/omitted. For example, if a 1+ year old walleye, sampled in 2013 was sent away for OTC analysis, and results came back that it was a naturally reproduced fish (had no OTC mark), questions may be raised regarding that particular fish due to the fact that it may have been a stocked fish, but had no mark because of an untrusted OTC submersion method. In other words, with this "untrusted source" the entire sample size from that age class would have to be nullified, or included into the results with hesitation/doubt. It is also very important in the data analysis period to be aware of the confidence level of the "OTC detector"; in the case Dr. Isemann. When preparing/detecting an otolith for the presence of OTC, there is not a simple "yes (OTC marked)/no (not marked)" system. The system of confidences is characterised by 0-3, or X. 0=no mark, 1=mark possible but very hard to tell, 2=mark present but not clear and bright, 3= clear bright mark, a X means the otolith was unreadable (usually because its damaged). One must be weary in terms of the detection confidence. In other words, a large sample of "1" confidence could signify that the marking procedure was amiss (Kansas, 2014). Human error including incorrect data logging is always a potential concern. Over the course of this study SVSFE technicians were mentored with an experienced fisheries branch biologists with extensive experience regarding this type of work, thus avoiding potential sources of error.

Overall, there are potentially many different factors that could have influenced results, but SVSFE technicians and other individuals involved, being aware of this potential did their best to avoid them over the course of this study.

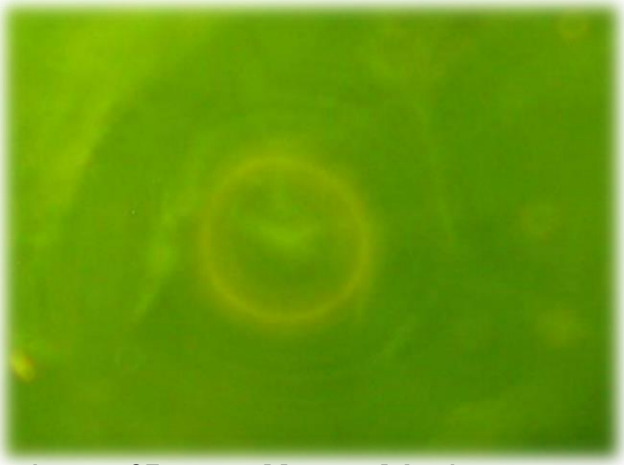


Figure 87: A Yellow Gold Ring, Indicating Presence of OTC

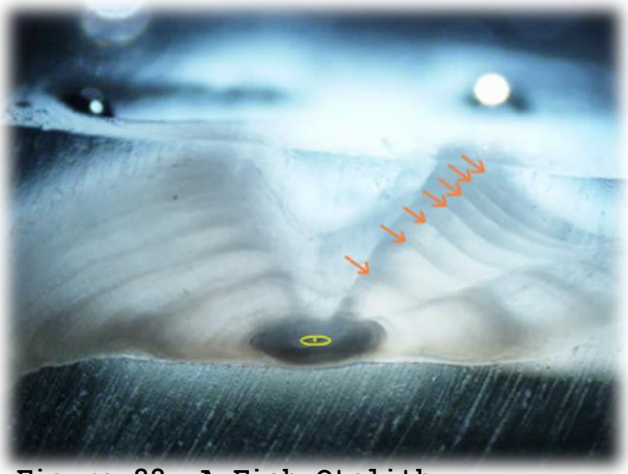


Figure 88: A Fish Otolith (Arrows Indicate Annuli)

Figure 89: Otolith Sample Station

6.0 Discussion/Recommendations

6.1 Marge Lake

In summary, research conducted on Marge Lake over the 2014 field season provided very significant results. Data analysed from these efforts have determined a good representation of the lake's overall health, natural recruitment success, and most importantly suggestions for "the next step" in terms of lake management. First of all, population estimates calculated from ESTN equated to 676 individuals, which comparison to adult stocking records (710 individuals), suggests a very low rate of natural mortality because we know, Marge Lake is currently regulated as a "no kill" walleye fishery. Walleye growth rates in Marge Lake were interesting in comparison to Beaver Lake. Marge and Beaver lakes are very similar in terms of latitude, size, and forage composition/availability, but average walleye growth (all size classes) in Marge Lake equated to 20.74mm/year, and Beaver Lake equated to 44.02mm/year. Growth rates in walleye are influenced by factors such as latitude, productivity of lakes, predator-prey relationships, population density and food quality (Hartman, 2009). It is interesting to state that Beaver Lake is exceptionally more turbid (1.5m secchi depth) than Marge Lake (6m secchi depth). This may be a significant in determining this difference in growth, as walleye a light sensitive walleye tend to prefer turbid waterbodies (Scott & Crossman, 1979).

SVSFE, for the second consecutive year discovered evidence of successful natural recruitment. This evidence is very encouraging, as it suggests that the lake provides walleye with suitable spawning habitat (Marge Creek), and that recently re-introduced walleye are reaching maturity. It is interesting to state of the entire live/release trapping protocols conducted in the spring only 2 walleye were greater than 450mm or within the "prime spawning length frequency". This in interesting comparing to the results of pre-spawn trap netting, which indicated a very low percentage of mature females (8/99). It has been hypothesised that at this point in time, Marge Lake inhibits a small mature population, which is the reasoning of low evidence of recruitment success. It is likely that as Marge Lake's population reaches maturation, recruitment success will increase. With regards to spawning habitat, it has been hypothesised that Marge Creek is very important to multiple species for recruitment; including walleye, northern pike, white sucker, and a variety of forage species; and therefore requires no rehabilitation. In terms of fishing quality it has been determined that Marge Lake is becoming a popular catch and release fishery. This evidence has been acquired from tagged fish, and fish story submissions on the SVSFE website. One angler, Scott Myslichuk was very satisfied with the fishing quality on Marge Lake, and even submitted the link to a video he created while fishing walleye on Marge Lake. Overall, Marge Lake appears to be advancing as a new walleye fishery quite well, and SVSFE is very happy with how the lake is progressing.

Recommendations:

At this point in time, SVSFE is very pleased with Marge Lake's progress, however a few suggestions to further the fishery are recommended. With regards to Marge Creek itself, it has been suggested that the creek is important spawning habitat for a variety of species. The creek provides fish with optimal habitat including a variety of riffles for walleye and white sucker, a variety of weedy areas and for northern pike. The large pool below the perched culvert has also been determined to be a very important staging and resting area for all species.

6.0 Discussion/Recommendations

6.1 Marge Lake Recommendations:

Questions have been discussed in the past regarding the need for creek enhancement, particularly the mid-lower reaches which consist of a mucky substrate. SVSFE has determined through vigorous pre-spawn evaluations and monitoring that enhancement of the creek should not be a priority project. This recommendation is suggested based on the fact that all reaches of the creek are utilized by many different species at different stages of the spawn. For example, the lower (mucky) reaches of Marge Creek provide walleye with important post-spawn feeding habitat. In terms of suggestions one important issue should be addressed. Marge Creek is located perpendicular Highways 366, at a very vulnerable location and arguably the most dangerous corner in the Duck Mountains (Figures 98,99). Historically, the creek has been a popular boat launch for Marge Lake. This "launch" is arguably the easiest place to launch small watercraft on Marge Lake, despite having to drag your boat through a majority of the shallow riffle areas of the creek. With the interest of protecting this vulnerable habitat (especially during critical periods), along with avoiding potential car accidents on this dangerous corner, it is recommended that SVSFE seriously explore the possibility of developing a new boat launch. On the south end of Marge Lake, at the designated route N parking area, there is a short path leading to the shallow south bay of Marge Lake. With a little bush clearing and the installing of a few concrete launching pads this could become an optimal launching area. Boats would be required to paddle a short distance to reach the main lake, however this new launching area would be much safer and wouldn't compromise critical fish spawning habitat. Regarding Marge Creek, it is suggested that a aesthetic fence be installed to deter fishers and other lake users from launching in this area.

With regards to the fishery as a whole, it is recommended that Marge Lake remained closed to all walleye harvest for at least a few more years. For the next few years, Marge Lake should be annually stocked with both fry and/ adults until a sufficient spawning population is established. Not until a fair percentage of walleye are greater that 450mm, and there is a sufficient harvestable population should the fishery be opened to walleye harvest. Regulations should be set at the Duck Mountain standard of a 2 fish limit, and all fish between 450-700mm to be released in order to protect the mature population. At the current time, Marge Lake should be promoted as a catch and release fishery due to the current high fishing quality. SVSFE should used recapture submissions to monitor growth, and follow-up results determine when the fishery should be open to walleye harvest.

Figure 90: Marge Lake Walleye

6.0 Discussion/Recommendations

6.2 Beaver Lake

In summary, research conducted on Beaver Lake over the 2014 field season provided very significant results. Data analysed from these efforts have determined a good representation of the lake's overall health, and suggestions for "the next step" in terms of lake management. First of all, population estimates calculated from ESTN equated to 571 individuals, which in comparison to adult stocking records (1521 individuals), suggests a high percentage of walleye harvest, as was expected. One concern, was the extremely low capture rate of sub-adult walleye transferred from Beautiful Lake in 2013. Reasoning for this may have been due to high mortality due to stress of the transfer, or that capture methods (ESTN) were none-representative of targeting this (1+) age-class. Regardless, SVSFE is eager to determine success of this stocking through angler submissions in the years to come.

Encouragingly, changes in fishing regulation (implemented 2014), now protect all walleye 450-700mm representing the mature population. With regards to 2014 ESTN, approximately 30% of the total catch fall within this protected slot, suggesting a good start to obtaining a large mature population. Walleye growth rates determined through recaptures suggest exceptional growth at 44.02mm/year on average amongst all length frequencies. This exceptional growth has been hypothesised to be directly related to the high yellow perch composition. Unfortunately, no evidence of natural recruitment was discovered in 2014. Reasoning of this may be directly related to fluctuating water levels disrupting the 2014 spawn, or difficult terrain restricting technicians from efficiently sampling form YOY walleye (difficult seining terrain). Regardless, evidence of natural recruitment discovered in 2013 still suggests that the lake provides walleye with viable spawning environments. Perhaps, evidence of natural recruitment was not discovered in 2014 because SVSFE technicians were looking in the wrong places. As discussed earlier, a beaver dam blew on the west side of the lake revealing what appeared to be ideal walleye spawning habitat (inflow from Cluff Lake). It is safe to say that this uncommon "blow out" may have revealed ideal spawning habitat which was previously inaccessible. In previous years, when this dam holds back flow from Cluff Lake, the most ideal spawning habitat on Beaver Lake is located on the east (windswept) spawning shoals, which is where 2014 effort was primarily focused. Perhaps with knowledge of this blow-out, post spawn evaluations may have resulted in different results, and possibly evidence of natural recruitment. Regardless, SVSFE is enthusiastic to announce that walleye have habitat "options" on a yearly basis, with regards to these two potential spawning locations.

Recommendations:

At this point in time, SVSFE is very pleased with Beaver Lake's progress, however a few suggestions to further the fishery are recommended. In terms of spawning habitat, no evidence of recruitment was documented on the recently enhanced spawning shoal. This may be due to the irregular beaver dam blow out on the west side inflow. Regardless, evidence of shoal utilization would be encouraging and likely to occur in the years to come. For this reason, it is recommended to encourage SVSFE directors, SVSFE technicians, and Fisheries Branch personnel to continually monitor the shoal in the years to come. Monitoring should be in terms of annual guzzling, as this method is relatively cheap, and not very time consuming (1 day per/year). If no evidence of egg deposition is documented on the shoal, then light enhancement would be suggested.

6.0 Discussion/Recommendations

6.2 Beaver Lake

Also, it would be suggested to visually monitor how the enhanced shoal develops. For example, how the enhanced substrate continues to settle, if the wave actions continues to clean the rock. Although it is unlikely the shoal will become silted over, it is important to monitor it in the years to come. If for any reason success on the shoal is limited, or the substrate becomes non-optimal there us large library of light enhancement literature that could be referenced.

With regards to managing this "partial put and take" walleye fishery as a whole some recommendations are suggested. It is apparent that there is not yet a large protected mature population. It is likely that once a larger protected population is established, that natural recruitment success will increase. For this reason, future stocking should include introducing larger walleye with a smaller percent of smaller walleye for harvest until natural recruitment appears to be sustaining the population. Of course, the size of adult walleye stocked from the Beautiful Lake Walleye Transfer is highly dependent on if Beautiful Lake winterkills or not. However, if Beautiful Lake survives the winter of 2014/2015, and 2015/2016, it is recommended that the largest walleye be transferred to Beaver Lake.

It would be optimal to continue to monitor Beaver Lake in these early years of walleye population development. If possible, it would be recommended that rotational recruitment and spawn evaluations be completed to assess the effects of stocking, habitat rehabilitation, and fishing quality. As for immediate action, it would be highly suggested that voluntary creel forms be incorporated at Beaver Lake to help monitor fishing pressure and quality. Although this management plan is highly dependent on the cooperation of anglers following lake regulations, SVSFE is confident that this management plan is achievable.

Figure 91: Beaver Lake Walleye

6.0 Discussion/Recommendations

6.3 Bell Lake

In terms of results regarding the Bell Lake OTC study, few results have been determined, as results from 2014 will be much more significant. At present, this project is part of a 5-year OTC study being conducted on multiple lakes in the eastern region, which this project will be referenced to upon completion. In terms of overall natural recruitment, 36/38 (95%) of the sample size had no mark, suggesting they were naturally recruited. However, it important to state the Swan Creek does not do efficacy trials on their OTC fry, so in terms of 1+ and 2+ fish, SVSFE cannot completely trust the results. With regards to the Whiteshell Hatchery, efficiency trials at this time have reached the 95+% mark. In terms of 0+ fish, 4/5 (80%) of the fish were naturally recruited from a trusted age class. These numbers are similar, and based on growth we can assume a much larger sample size (of trusted age classes) from Bell Lake's 2014 sample size. For this reason, few conclusions can be drawn from 2013 OTC results. In terms of observations from 2013, and 2014 sampling, it became apparent that on both years and despite significant effort, a very small sample size was obtained in both years; 39 in 2013, and 46 in 2014. Perhaps these low catches suggest that natural recruitment is low; that fry stocking is unsuccessful, or both.

In correspondence to past studies, a common observation is that Bell Lake has a very low availability of forage minnows. This could potentially be directly related to these low walleye catches. Even though young walleye are seldom observed in the stomachs of adults in field studies, cannibalism could be a decisive factor regulating year-class abundance over a long period of time (Parsons, 1971). This is especially true late in the first season of life when prey density are low, and age 0 walleye were within the size range of forage fish eaten by age 1 walleye and older (Forney, 1976). Perhaps, this low CPUE is YOY walleye is directly related to low forage availability. With regards to 2014, it will be interesting to compare to 2013 OTC analysis. In summary, SVSFE is eager to analyze 2014 OTC results, and compare this data other provincial OTC studies and creating a stocking plan for Bell Lake.

Figure 92: Bell Lake

6.0 Discussion/Recommendations

6.4 North Steeprock Lake

In terms of results regarding the North Steeprock Lake OTC study, few results have been determined, as results from 2014 will be much more significant. At present, this project is part of a 5-year OTC study being conducted on multiple lakes in the eastern region, which this project will be referenced to upon completion. In terms of 2013 overall natural recruitment, 76/114 (67%) of the sample size had no mark, suggesting they were naturally recruited. However, it is important to state the Swan Creek does not do efficiency trials on their OTC fry, so in terms of 1+ and 2+ fish, SVSFE cannot completely trust the results. With regards to the Whiteshell Hatchery, efficiency trials at this time have reached the 95+% mark. In terms of 0+ fish, 37/71 (51%) of the fish were naturally recruited from a trusted age class. This is interesting, as we are obtaining a 52% naturally recruited ratio from the trusted source (Whiteshell), and we are obtaining a 95% naturally recruited ratio from the untrusted source (Swan Creek).

A larger sample of Whiteshell fish are expected in the 2014 portion of this study, and SVSFE will have be hesitant when drawing conclusion from non-Whiteshell age classes. In terms of overall catchment, walleye catchment was very effective once the east shore was discovered. Because of this high CPUE, it can be hypothesized that survival amongst YOY and juvenile walleye (stocked and natural) is not a concern. For this reason, North Steeprock Lake was lightly fingerling stocked in correspondence to the 2014 North lake Walleye Transfer. This light stocking (800 fingerlings total) was decided to avoid intraspecific competition amongst these age classes. The stocked fish decision was simply to "replenish" fish killed for OTC analysis over 2013/2014. In summary, SVSFE is eager to analyze 2014 OTC results, and compare this data other provincial OTC studies and creating a stocking plan for North Steeprock Lake. Stocking recommendations will be further discussed following 2014 OTC analysis.

Figure 93: North Steeprock Lake

6.0 Discussion/Recommendations

6.5 Bell and North Steeprock Lake OTC Recommendations

Suggestion at current for both OTC Lakes are to await 2014 results before drawing too many conclusions. In terms of data analysis, it is recommended to organize the results based on trusted vs. non-trusted age classes. For example, natural vs. stocked ratios should be calculated for age classes representing stocked fish from the Whiteshell Hatchery exclusively, the Swan Creek Hatchery exclusively, and then from the entire sample as a whole. Ratios from the Whiteshell will be the trusted source in which future recommendations will be determined. If ratios are similar from both sources, the data from the entire sample could be considered for determining overall future stocking recommendations.

Guidelines for future management (based on at least 2 year OTC analysis) were provided by Regional Biologist Ken Kansas. Guidelines are as follows (Kansas, 2014):

- Lakes that showed 10-20% natural recruitment should be stocked annually, with 0+ assessments done after 4/5 years to confirm stocking success.
- Lakes that showed 25-75% should be stocked every second year with follow up 0+ assessments
- Lakes that showed 75%+ should not be stocked with walleye fry and left to natural recruitment with subsequent regulations to assist (ie. slot limits)
- Lakes that show a low catch of walleye in general likely have some kind of environmental and/or, species composition and/or, forage at life stage problem.
    - In this case, fingerling stocking should be a serious consideration with follow up non-lethal survey protocols (NSLP) after 2-3 years of such.

Figure 94: Ken Kansas Extracting Otoliths

6.0 Discussion/Recommendations

6.5 Bell and North Steeprock Lake Suggestions

Bell Lake

Currently, it is suggested that no future stocking plans be created for Bell Lake until 2014 results are finalized (expected prior to 2015 stocking). As previously suggested natural recruitment was occurring in Bell Lake, however the low catch of both years suggested that some environmental factor was hindering survival success. In lakes where reproduction of walleye occurs but the population abundance has declined, the cause of the decline should be clearly identified, and management strategies other than stocking to increase walleye abundance should be used (Li, 1996).

In terms of this "unknown environmental factor" hindering YOY walleye survival rates, an interesting assumption should be noted. Regarding Bell Lake's history of fisheries research via Fisheries Branch and SVSFE, a common observation of low forage has been documented (Yake & Kitch, 1998). This could potentially be a factor regarding lower catches of juvenile walleye suggesting cannibalism amongst adult and sub-adult walleye as suggested above. This has been an idea noted and discussed in the past. Suggestions of forage introductions is currently in discussion amongst SVSFE and fisheries branch, and a forage transfer plan is currently in the works. A heavy transfer project is currently scheduled to occur in the spring of 2015 with fathead minnows transferred from Harvey Lake.

A preliminary action plan was discussed and implemented in the fall of 2014, also as a result of low catchment of juvenile walleye. In correspondence to the 2014 North Lake Walleye Transfer, Bell Lake was "super-stocked" with 10,890 walleye fingerlings. The stocking rate was calculated based on Minnesota DNR recommended fingerling stocking rates of at 0.5-1.0 lb fish/acre (see part two for more information).

This will be an interesting effort as SVSFE will be able to track stocking success regarding this particular effort through re-capture markings in the form of the black-spot parasite, or neascus. Neascus is a trematode parasite that fulfills its larval stage as a unsightly "black-spot" on the skin of many fish species. Black-spot was noted to infect close to 100% of the fingerling walleye transferred from North Lake, suggesting that North Lake has a very abundant population of freshwater snails and clams, which are neascus' intermediate hosts. Importantly, through various assessments on Bell Lake, blackspot was never noted on any walleye from this particular lake, suggesting that it is an uncommon parasite to survive in this waterbody. Neascus generally lives in a fish for four years after initial infection (Maine DOFW, 2002). For this reason, SVSFE will be able to track this stocking effort over the next four years thanks to this natural marking method. This mark and recapture will be followed through barrel counts, angler submissions, and potential future lake assessments conducted by either SVSFE, Fisheries Branch, or other entities.

Pending 2014 OTC results, future management practices may include alternate years of fingerling stocking, with non-lethal follow-up assessments on fingerling & forage stocking, natural recruitment and fish population until satisfied results are achieved.

6.0 Discussion/Recommendations

6.5 Bell and North Steeprock Lake Suggestions

North Steeprock Lake

At current, it is suggested that no future stocking plans be created for North Steeprock Lake until 2014 results are finalized (expected prior to 2015 stocking). In terms of 0+ fish from the 2013 results, 37/71 (51%) of the fish were naturally recruited from a trusted age class (0+), and 76/114 (67%) of the entire sample size were naturally recruited. If this result corresponds to 2014 OTC analysis, a new fry stocking plan will likely be initiated for North Steeprock Lake.

Based on guideline suggested at this time by Ken Kansas, "lakes that showed 25-75% natural recruitment should be stocked every second year with follow up 0+ assessments", this may likely become the new lake management plan. If 2014 results follow suit, it will be recommended that North Steeprock Lake is stocked semi-annually, and that follow-up assessments be done on an annual basis until satisfied results are achieved. On years where supplemental stocking did not occur, late summer non-lethal electro-shocking efforts can be conducted at North Steeprock Lake representing sites, water temperature and dates similar to 2013/14 OTC sampling. Walleye capture will be sampled and released, and CPUE & length frequencies calculated. These results will then be compared to past and future recruitment assessments and correlations can be hypothesized. Potential results are difficult to predict, however notable correlations may strengthen evidence of natural recruitment success.

7.0 Appendix

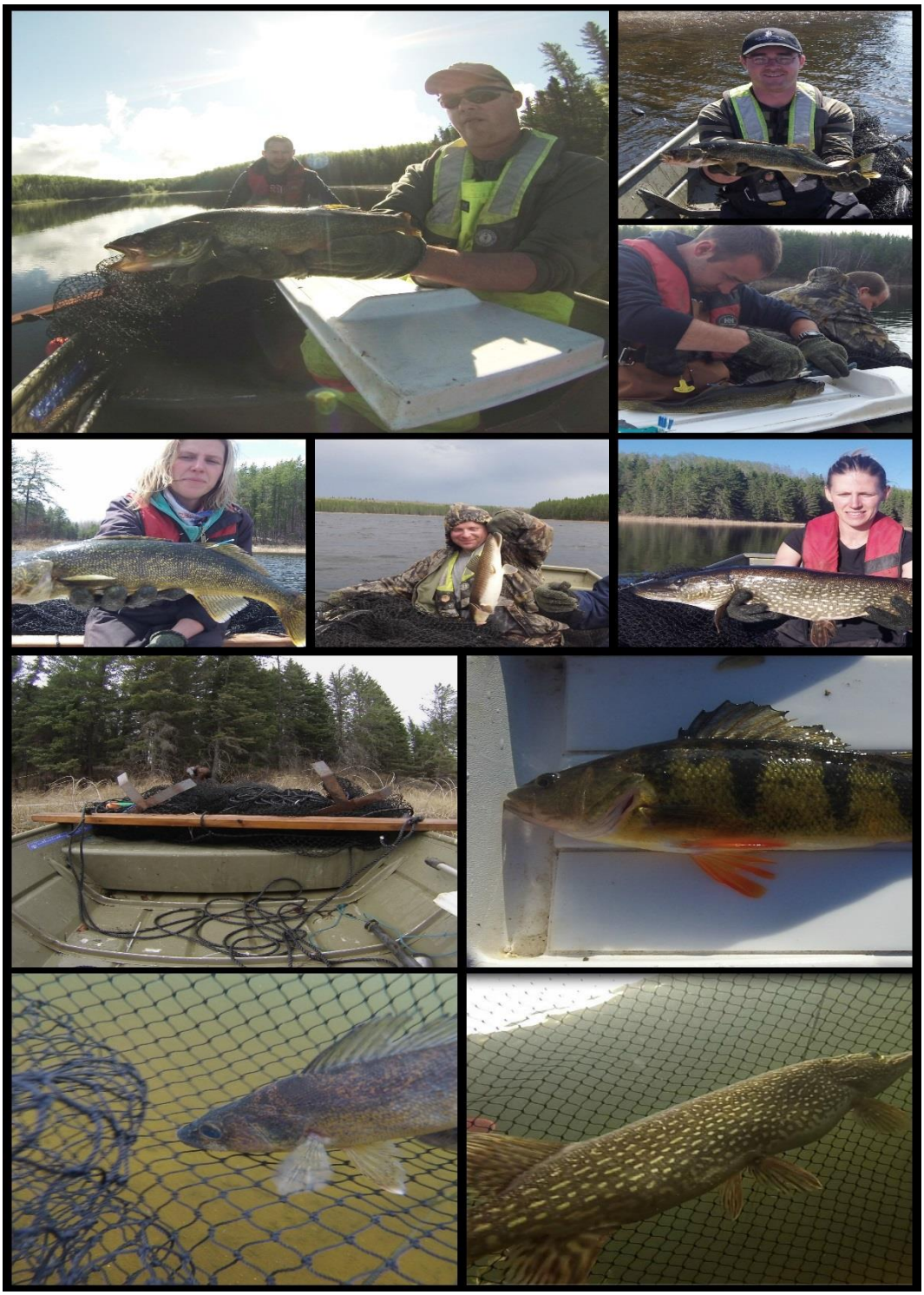


Figure 95: Marge Lake Collage

7.0 Appendix

SVSFE SPAWN OBSERVATION FORM

SITE INFO: Page 1 of 2

Date	Project Code	Waterbody Name	UTM Coordinates	Crew
June 1, 2014	MA-OB-14-028	Marge Creek	—	Holly, Boomer + Bear

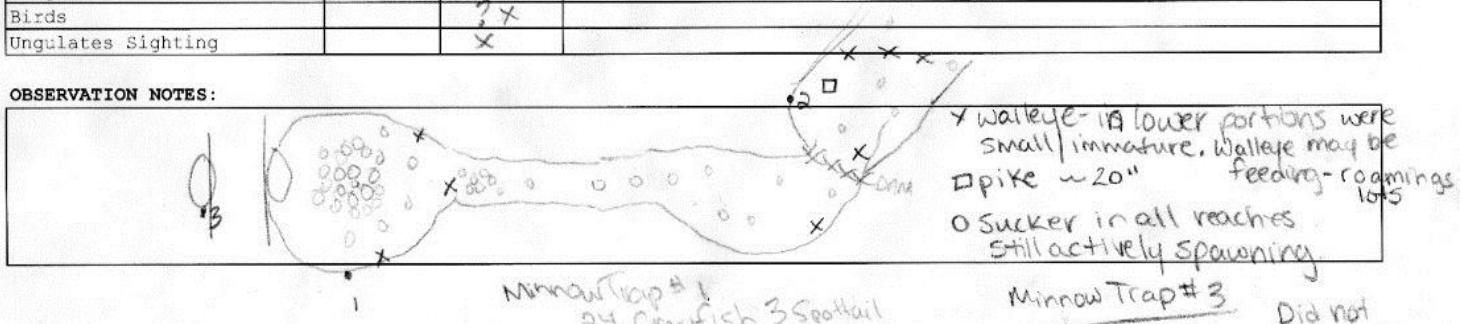
PHYSICAL PARAMETERS:

Air Temp (C°)	Water Temp (C°)	TDS (ppm)	COND (Us)	pH	Lake Level (m)	Wind Direction	Wind Speed (km/h)	Cloud Cover (0-8)	Moon Phases %	Photocycle (hrs)	Precip Type (00-95)
9	15.6(D)	102	205	8.56	5.75"	NE	5-10	8/8	16.4	5:29 9:55	61

Start Time	End Time	Duration	Total Hours Worked
12:30 AM	1:30 AM	1 hr	11 - 2:30 = 3.5

Check List	Yes	No	Comments
Took Pictures		X	DARK
Checked Temp Logger	X		
Walleye Present	X		
Suckers Present	X		
Pike Present	X		
Minnows Present	X		
Invertebrates Present	X		
Frogs		X	
Birds		X	
Ungulates Sighting		X	

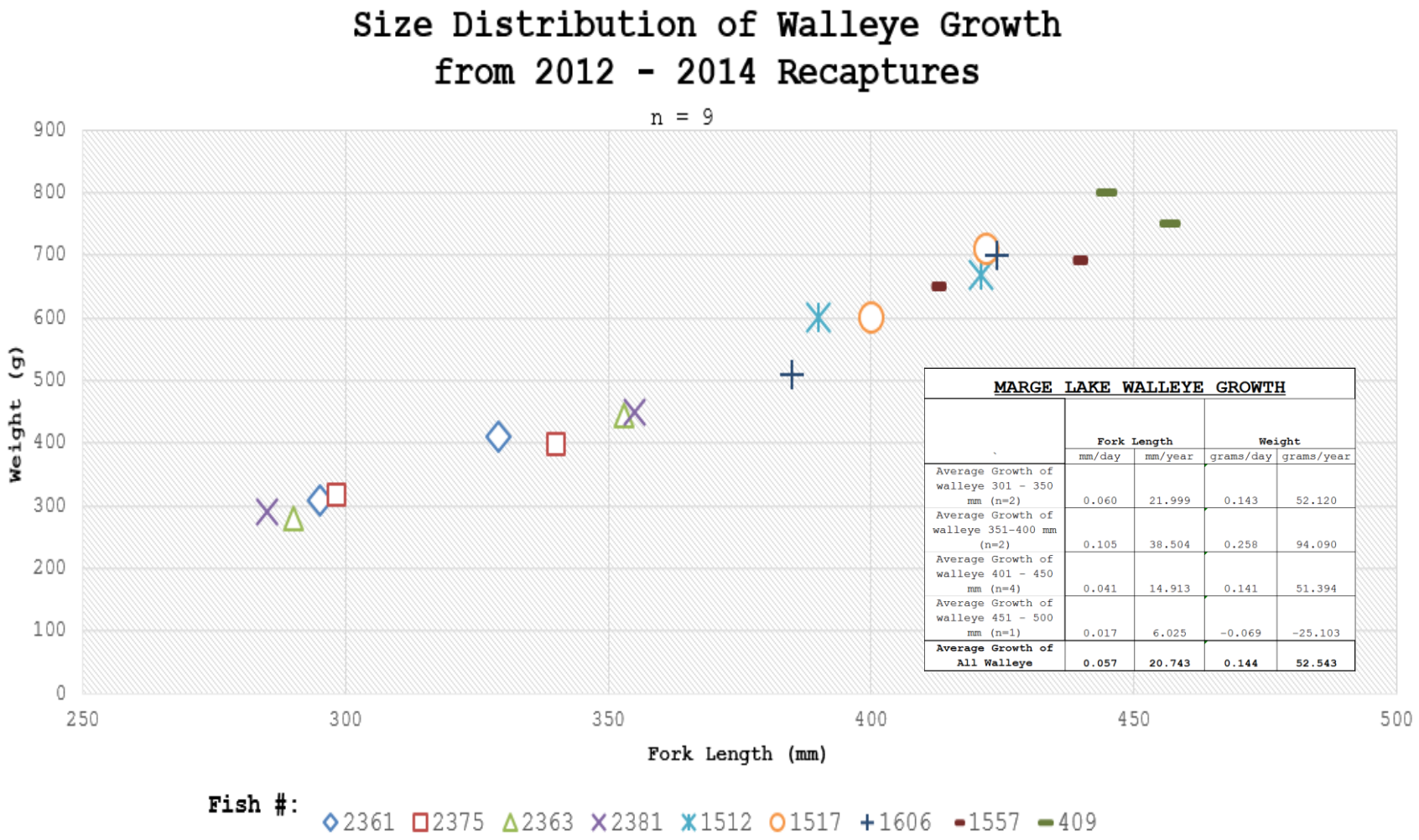
OBSERVATION NOTES:



DATE DATA ENTERED: Jun 25/14 INITIALS: DK DATA VALIDATED BY:

Figure 96: Marge Creek Protocol Form

7.0 Appendix



MARGE LAKE WALLEYE GROWTH

	Fork Length		Weight	
	mm/day	mm/year	grams/day	grams/year
Average Growth of walleye 301 - 350 mm (n=2)	0.060	21.999	0.143	52.120
Average Growth of walleye 351-400 mm (n=2)	0.105	38.504	0.258	94.090
Average Growth of walleye 401 - 450 mm (n=4)	0.041	14.913	0.141	51.394
Average Growth of walleye 451 - 500 mm (n=1)	0.017	6.025	-0.069	-25.103
Average Growth of All Walleye	**0.057**	**20.743**	**0.144**	**52.543**

Figure 97: Marge Lake Walleye Growth From Recaptures

7.0 Appendix

Figure 98: Marge Creek "Parking" at "Launch Area"

Figure 99: Marge Creek "Launching Area" (Bottom Right)

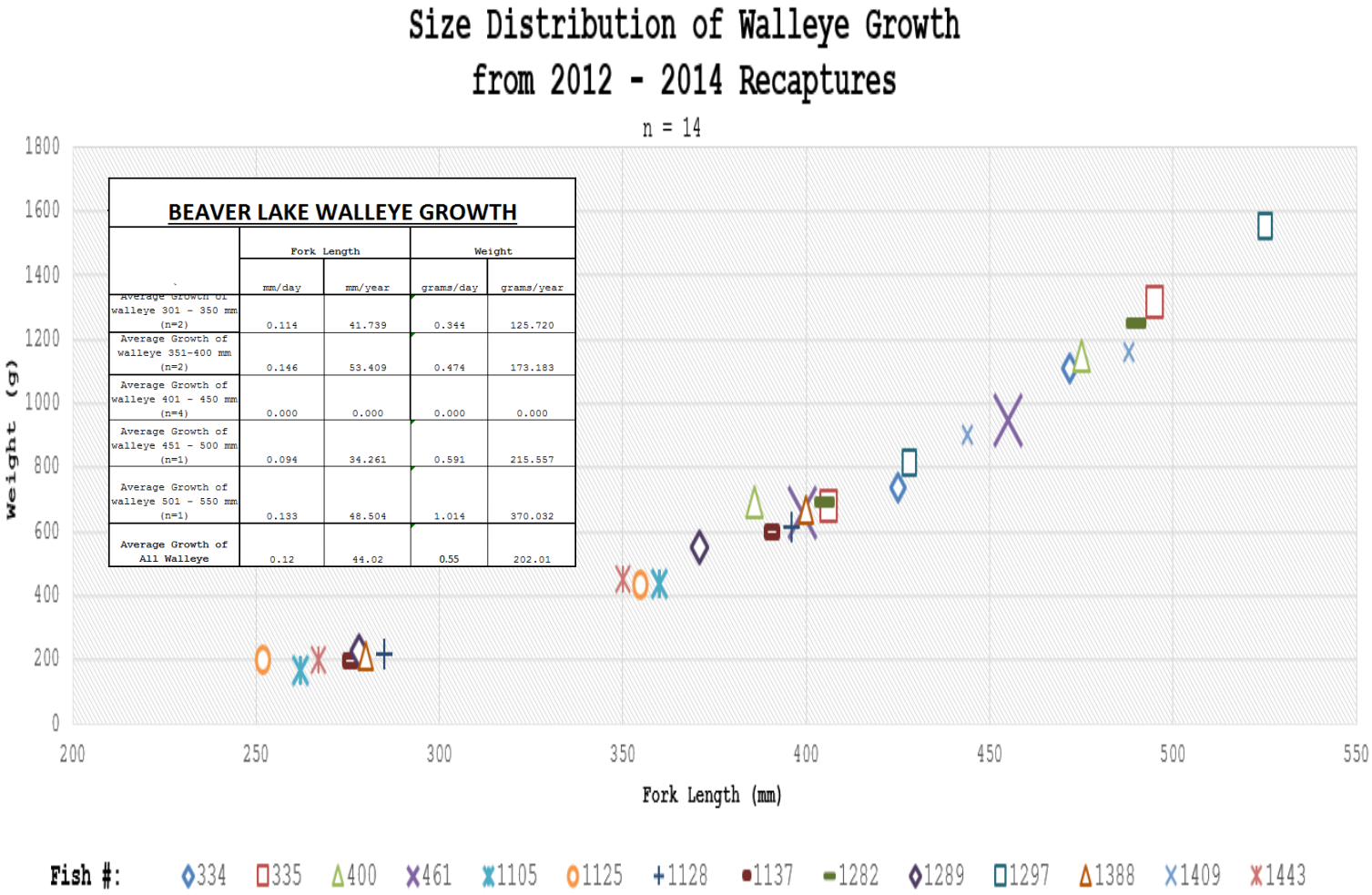
7.0 Appendix

Figure 100: Beaver Lake Collage

7.0 Appendix

Figure 101: Beaver Lake Enhanced Spawning Shoals

7.0 Appendix

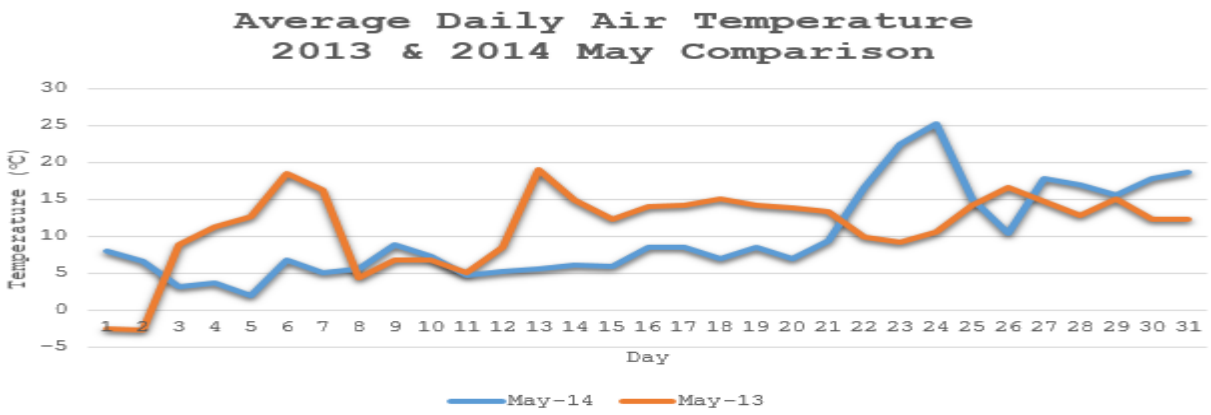


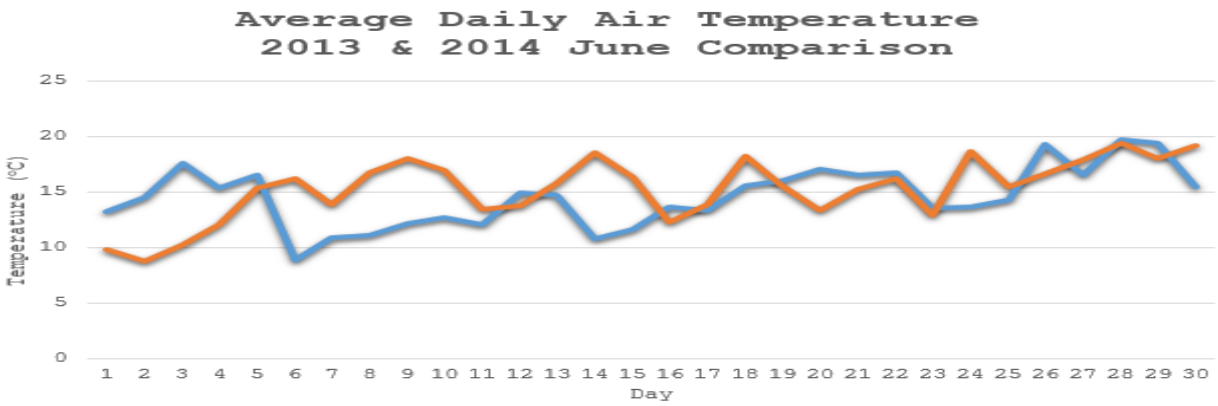
BEAVER LAKE WALLEYE GROWTH

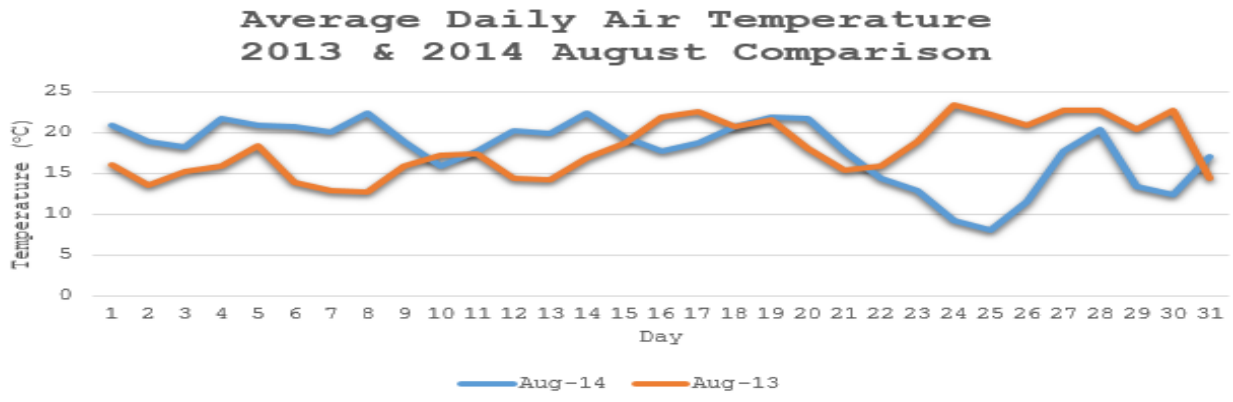
	Fork Length		Weight	
	mm/day	mm/year	grams/day	grams/year
Average Growth of walleye 301 - 350 mm (n=2)	0.114	41.739	0.344	125.720
Average Growth of walleye 351-400 mm (n=2)	0.146	53.409	0.474	173.183
Average Growth of walleye 401 - 450 mm (n=4)	0.000	0.000	0.000	0.000
Average Growth of walleye 451 - 500 mm (n=1)	0.094	34.261	0.591	215.557
Average Growth of walleye 501 - 550 mm (n=1)	0.133	48.504	1.014	370.032
Average Growth of All Walleye	0.12	44.02	0.55	202.01

Figure 102: Beaver Lake Walleye Growth From Recaptures

7.0 Appendix







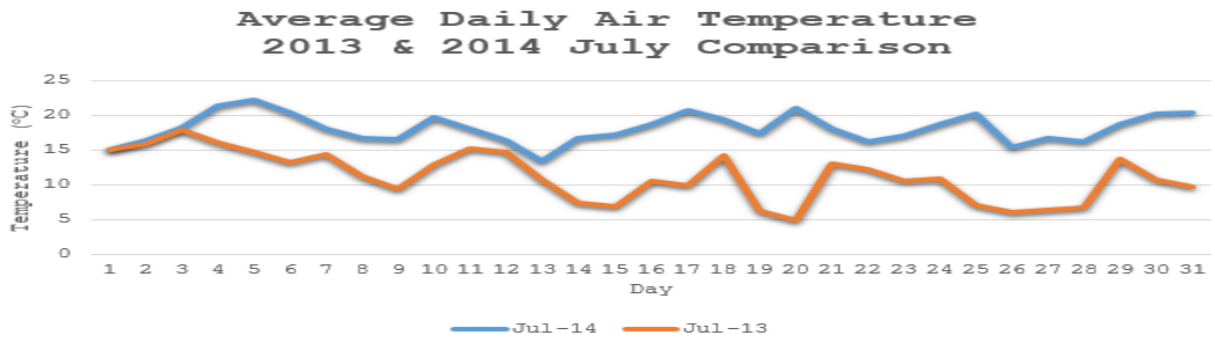


Figure 103: 2013 & 2014 Summer Temperature Comparison

7.0 Appendix

Figure 104: Fry Stocking Collage

7.0 Appendix

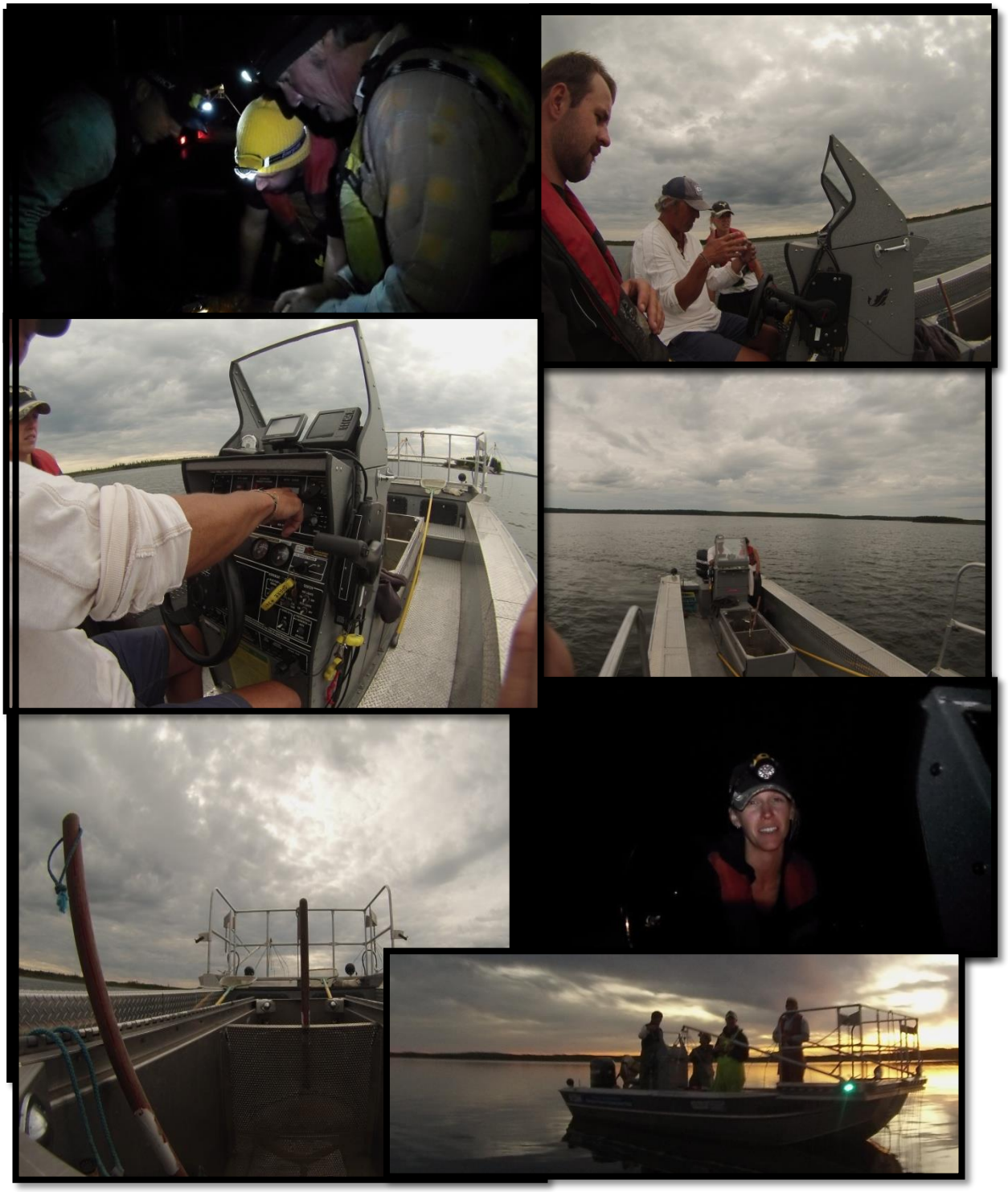


Figure 44: Electrofishing Collage

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