Spring Adult and Fall Juvenile Walleye Population Surveys within the 1854 Ceded Territory of Minnesota, 2015

A Joint Effort of the 1854 Treaty Authority and the
Fond du Lac Resource Management Division

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Introduction

Under the Treaty of 30 September 1854, the Fond du Lac, Grand Portage, and Bois Forte Bands of Lake Superior Chippewa entered into an agreement with the United States of America. Under this agreement, these three Bands retained certain hunting, fishing, and gathering rights in the land ceded under this treaty.

Along with the right to utilize a resource comes the responsibility to manage and monitor the resource. Bands have assumed an increased responsibility to monitor fish populations and to develop long-term databases to set harvest quotas and to monitor the effects of tribal harvest. Fishery assessment surveys by Native American organizations have been performed for many years in both reservation and ceded territory waters of Wisconsin, Michigan, and Minnesota. Fond du Lac and the 1854 Treaty Authority have been actively involved with fish assessments since 1994 (Borkholder 1994a).

The 1854 Treaty Authority and Fond du Lac Resource Management Division work to protect and enhance the natural resources of the 1854 Ceded Territory for the three Bands. Cooperating with local Minnesota Department of Natural Resources (DNR) offices, the 1854 Treaty Authority and Fond du Lac identify priority natural resource projects for areas within the Ceded Territory. One goal is to assist with walleye (*Sander vitreus*) assessments in the Ceded Territory. Walleye have always been a traditional subsistence resource for Fond du Lac and the Lake Superior Chippewa Bands. A 1994 survey conducted by Fond du Lac indicated that walleye were the primary game fish sought by Fond du Lac band members in the 1854 Ceded Territory (Borkholder 1994b).

Three techniques are typically utilized for the sampling of adult fish populations from within inland bodies of water; gill nets, trap (fyke) nets, and electrofishing gear. Gill nets are typically set for longer periods of time (10 - 18 hours), and can result in high fish mortality. Trap nets have been used for the sampling of adult walleye populations, but catch rates are low compared to electrofishing (Goyke et al. 1993 and 1994). Electrofishing is an effective and rapid method for sampling large areas, and has been used to sample walleye populations by other Native American agencies (Ngu and Kmiecik 1993; Goyke et al. 1993 and 1994) and within Northeastern Minnesota for many years (Borkholder 1994a and 1995). In order to maximize the number of fish handled and marked during the 2015 spawning season, Fond du Lac and the 1854 Treaty Authority chose once again to utilize electrofishing gear for these surveys.

Population estimates can be made using mark - recapture data (Ricker 1975). In this type of assessment, fish are collected, marked (fin clips, tags, etc.), and returned to the water. Population

estimates are based upon the ratio of marked fish to unmarked fish within subsequent recapture samples. Accurate estimates are obtained when a large portion of the population is marked, usually 10% to 30% (Meyer 1993).

Surveying adult walleye populations using just electrofishing gear will usually result in conservative estimates of the adult stock. Walleye spawn in shallow water, where they are vulnerable to electrofishing gear. Male walleyes remain in the shallow water following spawning and have an extended spawning period, while females retreat to deeper water (Meyer 1993). Thus, females are only vulnerable to the sampling gear for a short period of time. The Great Lakes Indian Fish and Wildlife Commission and the U.S. Fish and Wildlife Service utilize trap nets to aid in the sampling of walleye females, thus improving the accuracy of their population estimates. Given time and personnel constraints, we have chosen to accept conservative population estimates as a trade-off to the extra effort required to trap net for additional females.

The first objective of our assessments in 2015 was to obtain adult walleye population estimates (PE) during the spring spawning period using mark - recapture data. Our electrofishing PEs may be biased towards males in the populations, and thus are presumed conservative estimates of population abundance. However, by cooperating with the MN DNR area offices, another PE is obtained using the State's summer gill net data, with which to compare to the spring-only electrofishing PE. An additional benefit of the spring electrofishing surveys is that it allows biologists to identify and determine key and critical spawning sites, i.e. where catch rates are the highest.

The second objective of our 2015 walleye surveys targeted juvenile (age-1) and young-of-the-year (age-0) individuals in the fall. The purpose for assessing age-0 and age-1 individuals is to evaluate recruitment and year-class strength, and to continue developing long-term data sets using this data.

Methods

Spring Assessments

Lakes within the 1854 Ceded Territory of Minnesota were identified during meetings between MNDNR Area Managers and Tribal biologists. The objective was to obtain adult walleye population estimates using mark-recapture methods and to determine the age structure and growth rates of the walleye population within the lakes surveyed. Fin clipped and colored floy-tagged walleye would then be available during summer gill net assessments. In June, Fond du Lac used short-term gill nets to sample the walleye populations, and obtain a second population estimate. A third estimate was obtained by the MNDNR in the course of conducting their standard summer gill net surveys.

Electrofishing was performed at night using boom-shocking boats equipped with Smith-Root electrofisher units and two Smith-Root umbrella anode arrays (Smith-Root, Vancouver, WA). Pulsed direct current was used to minimize injuries to the fish. Surface water temperature was taken prior to the beginning of each night's assessment activity. Ambient water conductivity measurements were taken using either a Hanna HI8733 conductivity or a Fisher Scientific Digital Conductivity Meter.

Electrofishing surveys were planned to begin soon after ice-out, and continue for as long as un-tagged walleye were abundant in the samples or when the percentage of recaptured individuals approached or exceeded 30%. Adult and juvenile walleye immobilized by the electrofishing gear were collected. Collected fish were placed into a 90-gallon tank equipped with an aerator and given time to recover. Walleye were measured to the nearest millimeter (mm), examined for fin clips and / or floy tags, and the sex determined (male, female, unknown) based upon visual identification of gametes. Walleye that had been floy-tagged during any previous nights' collections were counted as recaptured fish (Appendix 1). All individuals (> 254 mm) were marked using non-numbered colored floy tags (orange color for 2015) (Super Swiftachment Fasteners available from the Dennison Fastener Division, Framingham, Massachusetts). The reason for this was because after many years of clipping dorsal fin spines, it would be impossible to differentiate 2015 marked fish from previously clipped individuals. A dorsal fin spine from five individuals per centimeter group and per sex was removed and placed in a labeled envelope for later aging in the lab. Following marking and spine collection, walleyes were released away from the shoreline.

Mark and recapture data were used to calculate adult walleye population estimates using both the Schumacher and Eschmeyer formula for multiple recapture surveys and the adjusted Petersen Method for single census (Ricker 1975). The Schumacher and Eschmeyer formula was used to take advantage of multiple evenings of recapture data. Walleye less than 254 mm (10 inches, "stock" size defined by Anderson 1976 and 1978) were excluded from population estimates.

Spines from adults were cleaned using bleach to remove the layer of skin on the bone. Spines were set in epoxy resin and sectioned (0.3 to 0.5 mm thick) using a Buehler Isomet™ low speed bone saw. Spines were examined using a microfiche reader. Annual rings were counted (McFarlane and Beamish 1987), and marked on overhead transparency sheets. Each spine's annuli were digitized into a computer using the DisBCal89 program (Frie 1982). DisBCal89 was used to back-calculate length-at-age estimates, using no transformation and a standard intercept of 27.9 mm.

Fall Assessments

Presumed age-0 and age-1 walleye immobilized by the electrofishing gear were collected. Collected fish were placed into a 90-gallon tank of lake water and given time to recover. Walleye were measured to the nearest mm. Scales were taken for age analysis from five fish per cm group prior to release.

Sampling stations used were either those established during previous electrofishing surveys by the MN DNR or by Fond du Lac and the 1854 Treaty Authority (Borkholder 1996, 1997, and 1998; Borkholder and Edwards 1999, 2000, 2002, 2003, 2004, 2010, & 2011). Sampling stations were repeated from previous years' surveys.

Walleyes were aged by counting annuli on scales viewed under a microfiche reader (Borkholder 1996 and 1997). Walleye ages were used to estimate CPUE (number of walleye / hour of electrofishing) of juvenile (age-1) and young-of-the-year (age-0) individuals.

Results and Discussion

Spring Assessments

Prairie Lake (DOW 69-0848)

Electrofishing activities were conducted on Prairie Lake, St. Louis County, on 14 – 17 April (Figure 1). Dates of electrofishing activities, water temperature, water conductivity, shocking time, the voltage and amps, the number of walleye collected, and the number caught per hour of electrofishing (CPUE) are presented in Table 1. CPUE ranged from 0.0 (EF5, 14 April) to 180.2 (EF3/4, 16 April) adult walleye per hour of sampling (Figure 1). At a 95% confidence interval, mean CPUE for Prairie Lake, determined using each sampling station, was 55.1 ± 34.0 adult walleye (>254mm) per hour of sampling effort.

The length frequency of the walleye sampled in Prairie Lake is presented in Figure 2. Walleye as large as 679 mm (26.7 inches) were observed in the survey. Incidentally, four walleyes were observed to have dorsal fin clips from previous surveys. Additional species observed included black crappie, bowfin, northern pike, white sucker, and yellow perch.

Walleyes larger than 254 mm were marked with a non-numbered orange floy tag along the distal portion of the soft dorsal fin. Table 2 presents the population estimates based upon mark-recapture data. The electrofishing Schumacher and Eschmeyer population estimate is 318 (Table 2). The adjusted Petersen estimate is 325 ± 86, with an 8.3% CV (Table 2). The population estimates presented in Table 2 represent the population abundance of walleye using the sampled areas for

spawning (Figure 1), and are not estimates of the walleye population within the entire lake. During summer 2015, the Minnesota Department of Natural Resources performed a standardized net assessment in Prairie Lake (MN DNR, Duluth Area Fisheries). Sixteen (16) walleyes (> 275 mm) were sampled in the gill nets that would have been 254 mm during the May assessments. No walleyes were observed to have the orange floy tag from the spring sampling (Appendix 1). No population estimates were calculated from the summer gill net assessments.

The EF population estimates from this survey are much lower than those observed in 2000 (Table 2) (Borkholder and Edwards 2001). Fond du Lac and the 1854 Treaty Authority dropped Prairie from the annual fall juvenile surveys after the 2004 survey, following several years of not observing many age-0 or age-1 walleyes. This lack of reproduction and recruitment may be reflected in the lower population estimates observed in 2015 (Petersen *N*=325) relative to that calculated after the 2000 sampling season (Petersen *N* = 1361).

Table 3 presents the age data for the walleye collected from Prairie Lake. Of the 237 unique fish sampled, 212 were assigned to ages 4 - 8. Total annual mortality (*A*) of the Prairie Lake population was estimated twice using two subsets of the data and the equation $A = 1 - e^{(Z)}$, where *Z* is the slope of the catch-curve relationship, and an estimate of instantaneous total annual mortality (Figure 3) (Chapman and Robson 1960). Using all of the age data, *A* was estimated at 28.5% (Figure 3, black line). Using only ages 7 – 11, *A* was estimated at 54.8% (Figure 3, red line). Using catch curve analysis assumes that, 1) there are no aging errors, 2) constant recruitment, 3) Z is constant over time, and 4) above a certain age (sexual maturity for this data set) all individuals within the population are equally vulnerable to the sampling gear (Smith et al., 2012). For our walleye surveys, generally male walleyes are fully mature and vulnerable by age 5. The data suggests that, if recruitment was constant (assumption 2), full recruitment may not have been observed until age-7 (Figure 3). That is probably not the case. Thus, we may have violations in our assumptions of either constant recruitment or no aging errors. We assume that the true estimate of natural mortality lies somewhere between our two estimates.

Total annual mortality (*A*) estimated using the MNDNR's gill net data was 6.1% (Figure 3, green triangles), much lower than the estimates from the spring electrofishing assessment. Our spring estimate was made using 237 mature walleyes, age 4 – 18. The estimate from the gill and trap net assessment was made using 22 fish age 2 – 10. Table 4 presents back-calculated lengths-at-age for walleye collected from Prairie Lake, as determined using dorsal fin spines.

Stock density indices are used to quantify the size structure of a population. Proportional stock density (PSD) was first proposed by Anderson (1976 and 1978), and is simply a measurement of the

proportion of the fish observed larger than a predetermined "quality" length divided by the number of fish observed larger than a predetermined "stock" length. For walleye, "stock" length fish are those larger than 10.0 inches (254 mm), and "quality" length fish are those larger than 15.0 inches (381 mm). Gabelhouse (1984) proposed further separating "quality" fish into "preferred" (walleye > 20.0 inches / 508 mm), "memorable" (walleye > 25.0 inches / 635 mm), and "trophy" length fish (walleye > 30.0 inches / 762 mm), and calculating a relative stock density (RSD), or proportion, for each category. For example, RSD S-Q is the proportion of walleye in the sample between "stock" length (10.0 inches / 254 mm) and "quality" length (> 15.0 inches / 381 mm), divided by the total number of walleye sampled larger than 10.0 inches.

PSD and RSD values determined by our spring electrofishing sampling and summer gillnet survey are presented in Table 5. The electrofishing PSD was 73.4 ± 5.6 (Table 5). Further, there is a large portion of the population less than 15.0 inches (25.4% of sample) that will be growing and recruiting into this "quality" 15-inch category over the next few years. The summer gill net PSD (55.6 ± 23.0) was not significantly different than the PSD estimate from the spring electrofishing survey (χ^2=2.65, P>0.05, critical Chi-square value of 3.841). No significant differences were observed between any of the RSD metrics determined using electrofishing data or gill net data (Table 5).

PSD metrics calculated from the 2000 electrofishing assessments are included for comparison (Table 5) (Borkholder and Edwards. 2001). Significant differences were observed between the 2015 PSD and the 2000 PSD (χ^2=127.1, P<0.05, critical Chi-square value of 3.841), and between the RSD Q-P (χ^2= -11.3, P<0.05, critical Chi-square value of -1.64), and RSD P-M (χ^2=-3.7, P<0.05, critical Chi-square value of -1.64) of the two assessments. This is largely attributable to many more individuals observed in 2000 between 10.0 and 15.0 inches (N=381), than what was observed in our 2015 survey (N=63).

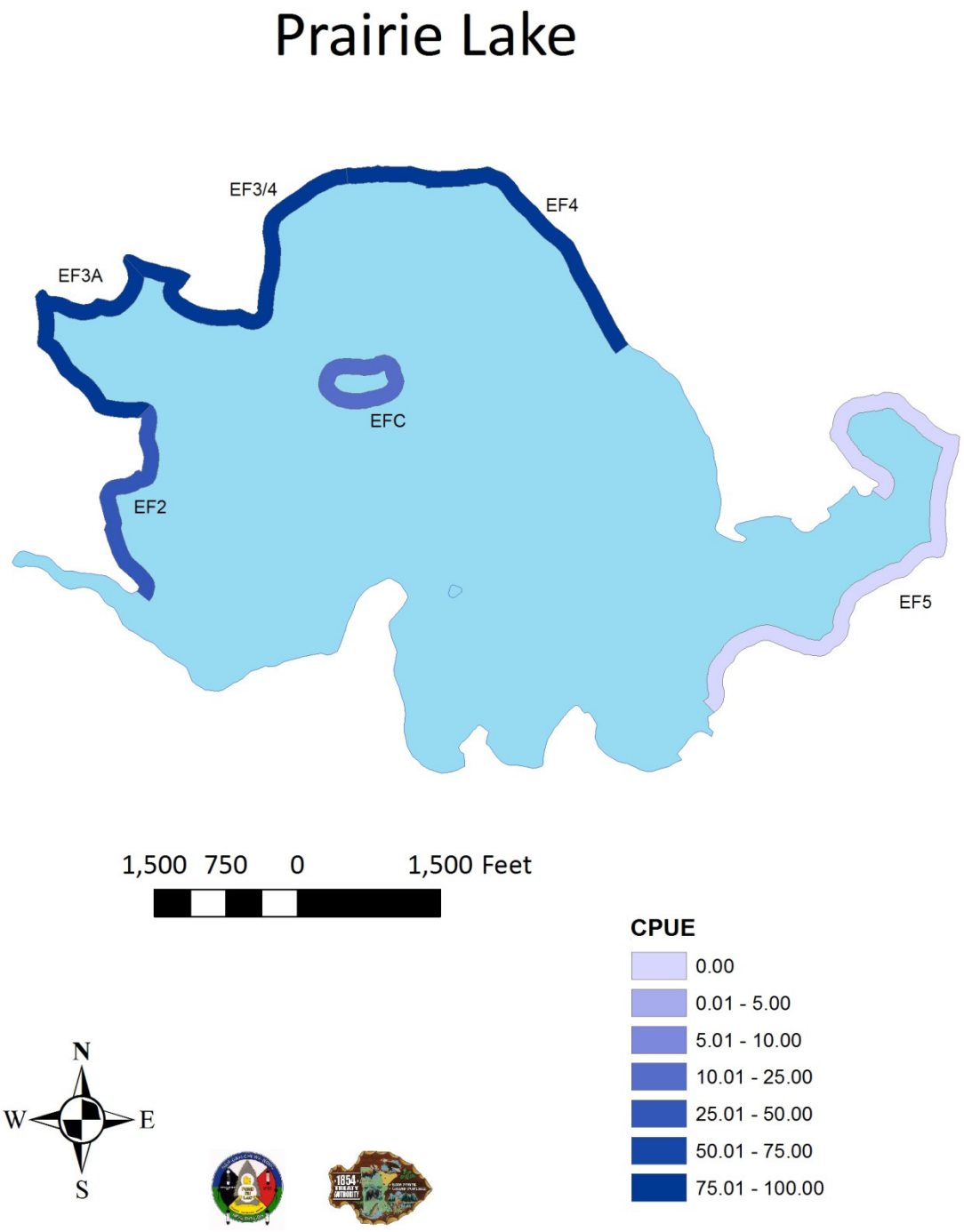

Figure 1. Catch per hour (CPE) of adult walleyes (fish larger than 254 mm) by electrofishing station, on Prairie Lake, St. Louis County, during Spring 2015 electrofishing surveys.

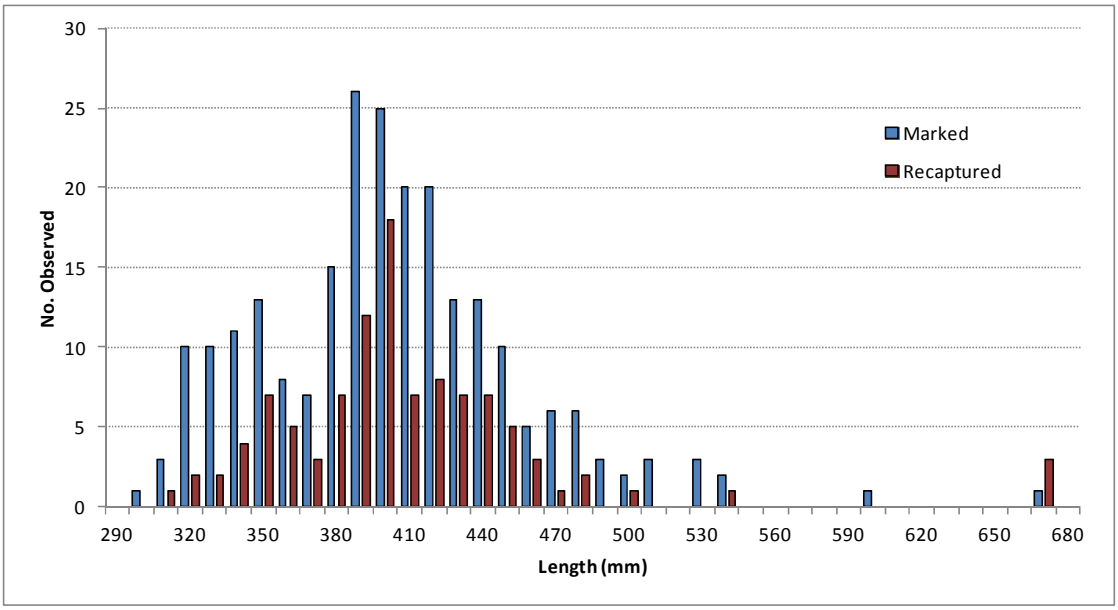

Figure 2. Length frequency distribution of walleye sampled from Prairie Lake, St. Louis County, MN, during spring 2015 electrofishing assessments. Length frequency distribution of recaptured walleyes is shown in red bars.

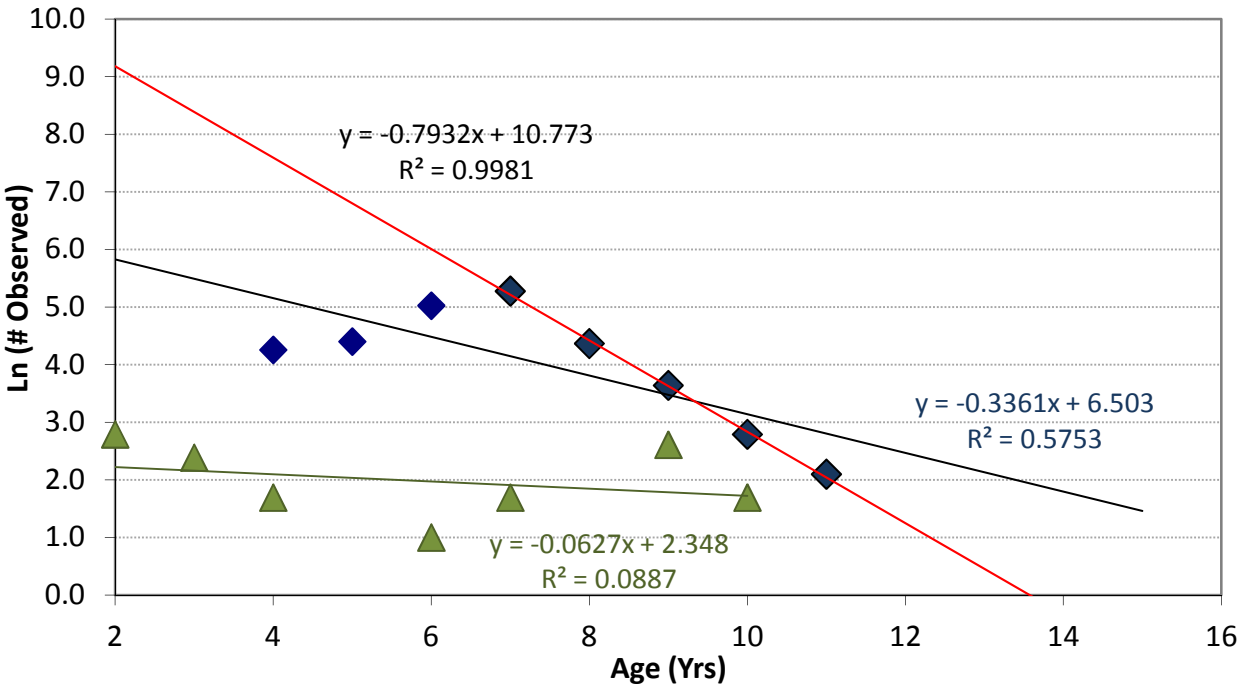

Figure 3. Catch curve analysis of walleyes in Prairie Lake, 2015, showing instantaneous mortality (*Z*). Estimates are made from April 2015 electrofishing data (blue diamonds), and from summer 2015 gill net assessments by the MNDNR (green triangles). Black line uses all of the electrofishing age data, while red line uses only ages 7 – 11.

Table 1. Summary of electrofishing activities on Prairie Lake (St. Louis County), and Fourmile, Tait, and Elbow Lakes (Cook County), Minnesota, during Spring 2015.

ID #	County	Lake	Area (Acres)	Max Depth (ft)	Date	Water Temp (F)	Conductivity[1]	Shocking Time (sec)	Voltage (PDC)[2]	Amps[3]	# WAE[4]	CPUE WAE[5]
69-0848	St. Louis	Prairie	794	47	4/14/2015	46		6396	Low	1.5	81	45.6
					4/15/2015	49		1095	Low	1.5	18	59.2
					4/16/2015	50	131	7828	Low	1.5	168	77.3
					4/17/2015	48	137	3754	Low	1.5	76	72.9
16-0639	Cook	Four Mile	593	20	4/20/2015	40	40	11141	High / 1061	2 / 4	79	25.5
					4/23/2015	39	33	16460	High / 1061	1.5 / 4	135	29.5
					4/24/2015	39	33	13313	High / 1061	1.5 / 4	131	35.4
					4/25/2015	44	37	12904	High / 1061	1.5 / 4	80	22.3
16-0384	Cook	Tait	355	15	4/29/2015	47	34	17102	High / 1061	2 / 3	205	43.2
					4/30/2015	50	35	15955	High / 1061	2.5 / 3	268	60.5
					5/1/2015	53	36	14697	High / 1061	2 / 4	293	71.8
16-0096	Cook	Elbow	408	9	5/2/2015	51	31.6	7339	884	4	354	173.6
					5/3/2015	55	30.9	5645	1061	4	231	147.3

[1] Water conductivity measured in microSiemens / cm.

[2] Voltage is reported as actual voltage recorded from the SmithRoot Type VI-A, or as Low / High from the SmithRoot 5.0 GPP

[3] Amps are reported as from the 1854 Treaty Authority Boat / Fond du Lac Boat. In the case of Prairie, only the 1854 boat was used. For Elbow, only the FDL boat was used.

[4] WAE = walleye. Numbers in column represent the number of "stock" sized walleye (>254mm (10 inches)) collected. Includes marked and recaptured individuals.

[5] CPUE = catch per unit effort, computed as per hour (3600 sec) of electrofishing. Numbers in column represent CPUE for "stock" sized walleye (>254mm (10 inches)).

Table 2. Walleye population estimates for Prairie Lake (St. Louis County) and Fourmile, Tait, & Elbow Lakes (Cook County), Spring 2015. Estimates are for walleye larger than 254 mm (10.0 inches). EF denotes population estimates determined from spring electrofishing data. ST_GN refers to population estimates determined from short term gill net samples collected in June, while GN refers to population estimates from samples collected during the MNDNR's summer netting assessments. GN/TN includes all of the MNDNR data from both the gill nets and trap nets. Rows of shaded data indicate population estimates from previous surveys, and are presented for comparative reasons only.

Lake	Population Estimate[1]	No. / Acre	95% Confidence Limits Lower	Upper	Estimate[2]	C.V.[3]
Prairie – EF_{2015}	318	0.4	299	340	325 ± 86	8.3 %
Prairie – GN_{2015}	N/A		N/A	N/A	N/A	N/A
Prairie – EF_{2000}	1582	2.0	1167	2452	1361 ± 469	12.4%
Prairie – GN_{2000}	1637	2.1	1255	2351	1350 ± 1136	32.7%
Four Mile – EF_{2015}	1053	1.8	790	1581	1033 ± 551	16.8%
Four Mile – ST_GN_{2015}	1747	2.9	---	---	13250 ± 20942	56.9%
Four Mile – EF_{2011}	1872	3.2	1419	2751	2129 ± 991	14.6%
Four Mile – GN_{2011}	2938	5.0	1546	29417	8190 ± 6029	26.5%
Tait Lake – EF_{2015}	1284	3.6	1144	1461	1302 ± 467	8.3%
Tait Lake – ST_GN_{2015}	1370	3.9	1115	1778	1682 ± 927	32.7%
Tait Lake – GN_{2015}	1359	3.8	1102	1772	1768 ± 1255	22.3%
Tait Lake – EF_{2013}	2027	5.7	1902	2170	2042 ± 647	10.0%
Tait Lake – GN_{2013}	1970	5.5	1906	2039	1884 ± 1088	20.8%
Elbow Lake – EF_{2015}	1386	3.4	1386[4]	1386[4]	1373 ± 651	11.0%
Elbow Lake – GN_{2015}	1716	4.2	994	6284	4111 ± 4986	38.1%
Elbow – EF_{2010}	1353	3.3	1070	1841	1265 ± 456	8.4%
Elbow – GN_{2010}	1650	4.0	887	11887	13,860 ± 24,877	56.4%

1 Schumacher and Eschmeyer population estimate.
2 Adjusted Petersen population estimate, with 95% confidence interval.
3 Coefficient of variation for the Petersen estimate.
4 Unable to calculate upper and lower confidence limits with one degree of freedom (1 *df*)

Table 3. Age frequency distribution of walleye from Prairie Lake, St. Louis County, Spring 2015, based upon the number of fish sampled and aged per size category.

Length Group		N										
Inches	mm	Sampled	4	5	6	7	8	9	10	11	12	18
12	305	2			2							
12.5	318	13			7	6						
13	330	16			9	6	1					
13.5	343	13			8		4	1				
14	356	11				2	4	5				
14.5	368	8				2	4		2			
15	381	21		10	7	4						
15.5	394	39		4	3	27		4				
16	406	26			19	7						
16.5	419	22			6	1	15					
17	432	17			4	10	1	1				
17.5	445	16			1	9	3	1	1			
18	457	6			2	2	2					
18.5	470	8			1	3		3	1			
19	483	5					2	2	1			
19.5	495	4					3	1				
20.0	508	3				2		1				
20.5	521											
21.0	533	5							3	2		
21.5	546											
22.0	559											
22.5	572											
23.0	584											
23.5	597	1								1		
24.0	610											
24.5	600											
25.0	635											
25.5	648											
26.0	660											
26.5	673	1										1
	TOTAL	237	26	30	56	72	29	14	6	3	0	1

Table 4. Back-calculated lengths-at-age for walleye collected from Prairie Lake, St. Louis County, Minnesota, Spring 2015.

Age Class	N	Length (mm)	Length (in)
1	124	116	4.6
2	124	190	7.5
3	124	250	9.8
4	124	302	11.9
5	115	347	13.7
6	98	387	15.2
7	69	421	16.6
8	39	449	17.7
9	23	477	18.8
10	11	507	20
11	4	547	21.5
12	1	540	21.3
13	1	585	23
14	1	599	23.6
15	1	616	24.3
16	1	633	24.9
17	1	653	25.7
18	1	679	26.7

Table 5. Proportional Stock Density (PSD) and Relative Stock Densities (RSD) with 95% confidence intervals for walleye sampled from Prairie Lake (St. Louis County) and Fourmile, Tait, & Elbow Lakes (Cook County), Minnesota. Values are for spring electrofishing (EF) and MN DNR gill netting (GN) surveys conducted during the year indicated.

Lake	PSD	RSD S-Q	RSD Q-P	RSD P-M	RSD M-T
Prairie – EF_{2015}	73.4 ± 5.6	26.6 ± 5.6	69.2 ± 5.9	3.8 ± 2.4	0.4 ± 0.8
Prairie – GN_{2015}	55.6 ± 23.0	44.4 ± 23.0	44.4 ± 23.0	11.1 ± 14.5	0.0 ± 0.0
Prairie – EF_{2000}	30.3 ± 4.1	69.7 ± 4.1	29.7 ± 4.0	0.6 ± 0.7	0.0 ± 0.0
Prairie – GN_{2000}	27.8 ± 20.7	72.2 ± 20.7	27.8 ± 20.7	0.0 ± 0.0	0.0 ± 0.0
Four Mile -- EF_{2015}	56.8 ± 5.1	43.3 ± 5.1	53.7 ± 5.1	2.5 ± 1.6	0.6 ± 0.8
Fourmile – EF_{2011}	57.0 ± 3.7	43.0 ± 3.7	56.6 ± 3.7	0.4 ± 0.5	0.0 ± 0.0
Fourmile – GN_{2011}	40.1 ± 8.2	59.8 ± 8.2	37.2 ± 8.1	2.9 ± 2.8	0.0 ± 0.0
Tait -- EF_{2015}	28.7 ± 3.5	71.3 ± 3.5	27.9 ± 3.5	0.6 ± 0.6	0.2 ± 0.3
Tait -- GN_{2015}	36.8 ± 15.3	63.2 ± 15.3	23.7 ± 13.5	10.5 ± 9.8	2.6 ± 5.1
Tait -- EF_{2013}	44.5 ± 3.3	55.5 ± 3.3	44.2 ± 3.3	0.3 ± 0.4	0.0 ± 0.0
Tait -- GN_{2013}	40.5 ± 15.8	59.4 ± 15.8	40.5 ± 15.8	0.0 ± 0.0	0.0 ± 0.0
Elbow -- EF_{2015}	50.7 ± 4.6	49.3 ± 4.6	43.6 ± 4.6	5.5 ± 2.1	1.5 ± 1.1
Elbow -- GN_{2015}	45.2 ± 15.1	54.8 ± 15.1	33.3 ± 14.3	11.9 ± 9.8	0.0 ± 0.0
Elbow -- EF_{2010}	25.4 ± 3.5	74.6 ± 3.5	16.5 ± 3.0	7.1 ± 2.1	1.8 ± 1.1
Elbow -- GN_{2010}	34.9 ± 14.2	65.1 ± 14.2	20.9 ± 12.2	11.6 ± 9.6	2.3 ± 4.5

Four Mile Lake (DOW 16-0639)

Electrofishing activities were conducted on Four Mile Lake, Cook County, on 20 – 25 April (Figure 4). Dates of electrofishing activities, water temperature, water conductivity, shocking time, the voltage and amps, the number of walleye collected, and the number caught per hour of electrofishing (CPUE) are presented in Table 1. CPUE ranged from 0.0 (EF3, 20 April) to 53.6 (EFB, 23 April) adult walleye per hour of sampling (Figure 4). At a 95% confidence interval, mean CPUE for Four Mile Lake, determined using each sampling station, was 25.1 ± 6.3 adult walleye (>254mm) per hour of sampling effort.

The length frequency of the walleye sampled in Four Mile Lake is presented in Figure 5. Walleye as large as 710 mm (28.0 inches) were observed in the survey. Additional species observed included black crappie, northern pike, white sucker, and yellow perch.

Walleyes larger than 254 mm were marked with a non-numbered orange floy tag along the distal portion of the soft dorsal fin. Table 2 presents the population estimates based upon mark-

recapture data. The electrofishing Schumacker and Eschmeyer population estimate is 1053 (Table 2). The electrofishing adjusted Petersen estimate is 1033 ± 551, with a 16.8% CV (Table 2). The population estimates presented in Table 2 represent the population abundance of walleye using the sampled areas for spawning (Figure 4), and are not estimates of the walleye population within the entire lake. The EF estimates from this electrofishing survey are lower than those observed in 2011 (Table 2) (Borkholder and Edwards 2012), but appear to be similar to previous surveys (Figure 6).

In June 2015, Fond du Lac personnel spent one week setting experimental gill nets for short periods of time (20 to 60 minutes), in an attempt to get an unbiased population estimate (Schwarz 2009). Gill nets were constructed similar to those used in Mille Lacs Lake, and were 400 feet long, by 6 feet deep. Four 100-foot panels were tied into a single net, with mesh sizes of 1.25, 1.5, 2.0, and 2.5 inches, measured knot-to-knot, or bar. A total of 72 walleye were sampled (Figure 7), with only a single recaptured individual observed. This produced unreasonable population estimates of 13,250 ± 20,942 (Table 2). Table 6 presents the mean length of walleye sampled for each gill net mesh size in this study. 84% of the fish sampled were observed in the two smallest mesh panels (Table 6).

Since the Bands started their fisheries programs, five spring adult population estimates have been estimated on Four Mile Lake (Figure 6). The MN DNR has participated in the last four surveys. Population estimates, as determined using spring electrofishing, for fish larger than 254 mm (10.0 inches) has not shown any real change over time (Figure 6, blue diamonds). Population estimates calculated from MNDNR summer nets show a steady increase over time (Figure 6, red diamonds).

Table 7 presents the age data for the walleye collected from Four Mile Lake. Total annual mortality (*A*) of the Four Mile Lake population was estimated at 38.6%, using the equation $A = 1 - e^{(Z)}$, where *Z* is the slope of the catch-curve relationship, and an estimate of instantaneous total annual mortality (Figure 8). This is lower than the estimate made during the 2011 survey of 47.0% (Borkholder and Edwards 2012). Table 8 presents back-calculated lengths-at-age for walleye collected from Four Mile Lake, as determined by aging dorsal fin spines.

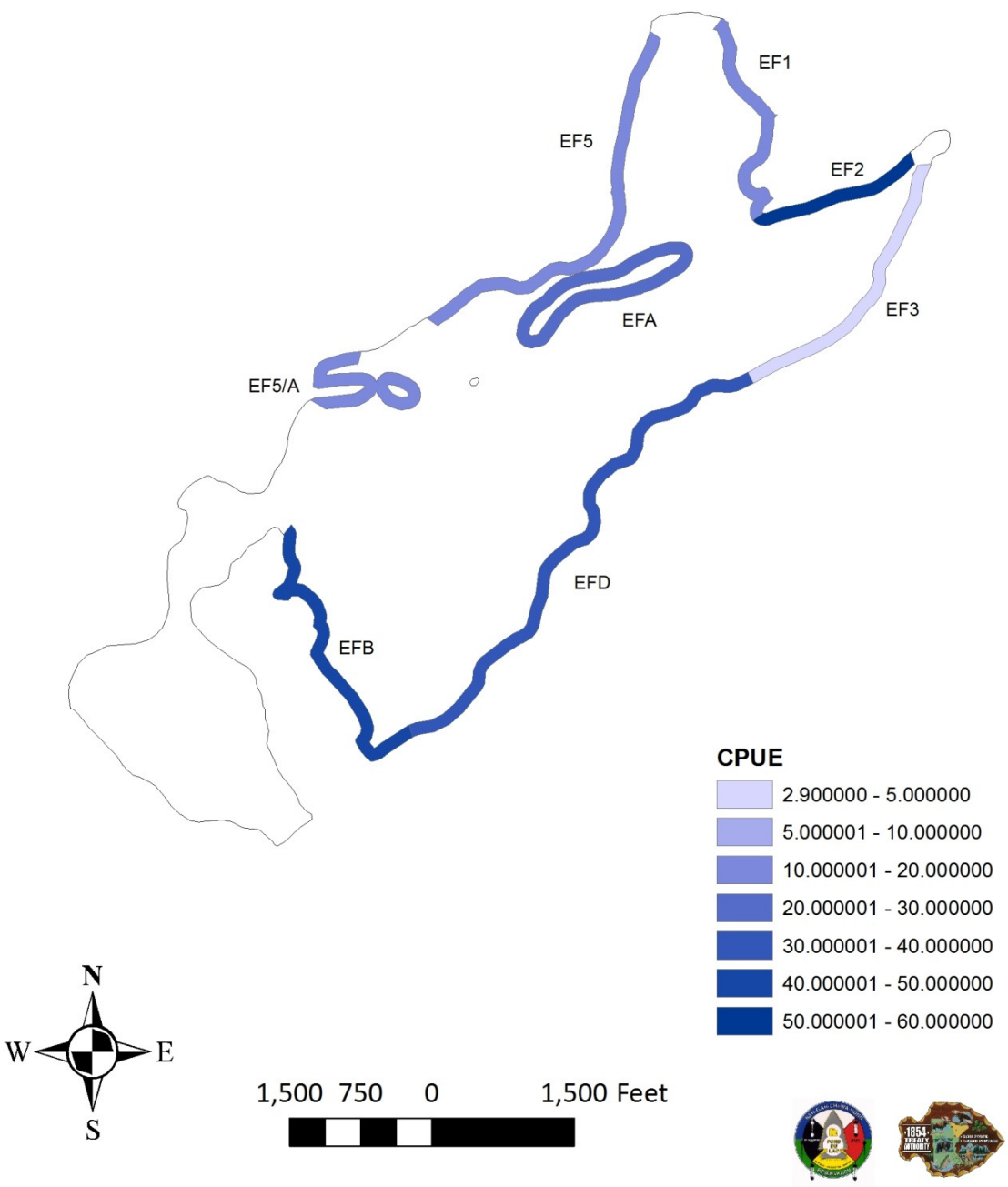

Figure 4. Catch per hour (CPE) of adult walleyes (fish larger than 254 mm) by electrofishing station, on Four Mile Lake, Cook County, during Spring 2015 electrofishing surveys.

PSD and RSD values determined by our spring electrofishing sampling and summer gillnet survey are presented in Table 5. The electrofishing PSD of 56.8 ± 5.1 (Table 5). PSD metrics calculated from the 2011 electrofishing assessments are included for comparison (Table 5) (Borkholder and Edwards, 2012). No significant differences were observed between the 2015 PSD and the 2011 PSD (χ^2=0.006, P>0.05, critical Chi-square value of 3.841). This suggests that the population structure has changed little between the two assessments.

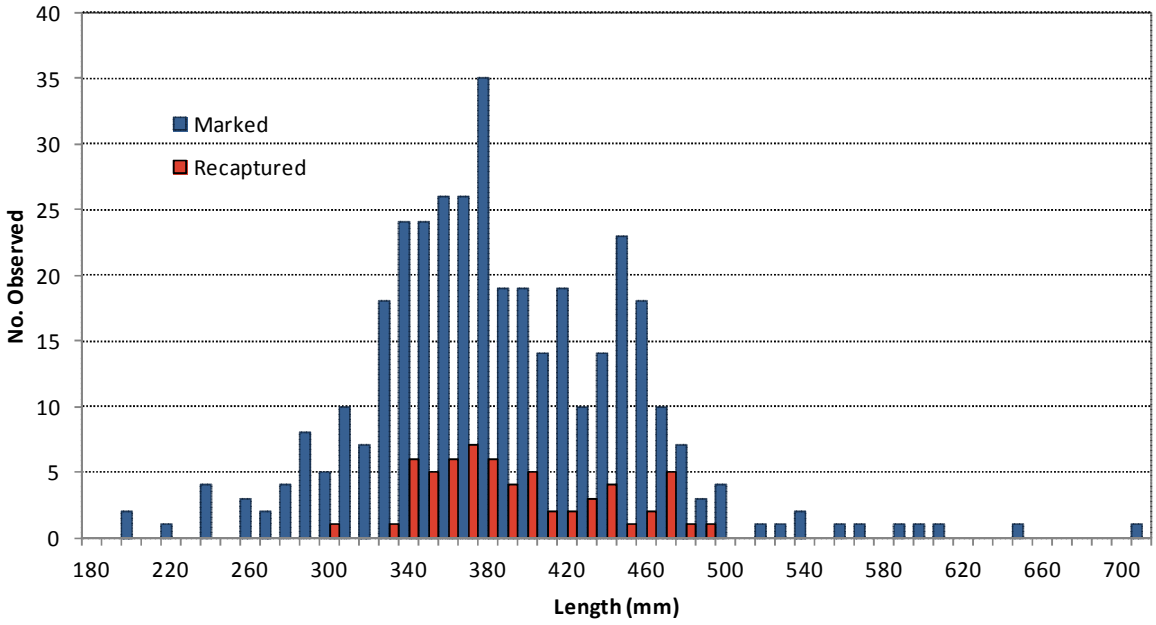

Figure 5. Length frequency distribution of walleye sampled from Four Mile Lake, Cook County, MN, during Spring 2015 electrofishing assessments. Length frequency distribution of recaptured walleyes is shown in red bars.

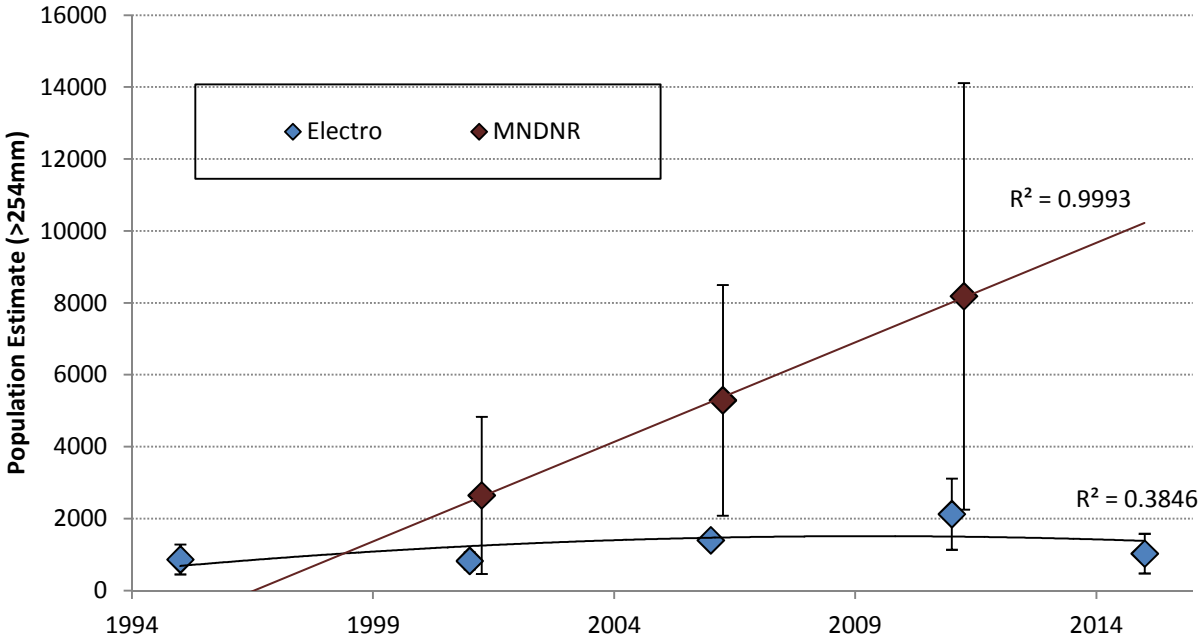

Figure 6. Peterson population estimates (with standard errors) of walleye larger than 254mm in Four Mile Lake, Cook County, MN, determined using the Petersen estimator and data from spring electrofishing surveys (Electro blue diamonds) or subsequent summer gill netting by the MN Department of Natural Resources (MNDNR red diamonds).

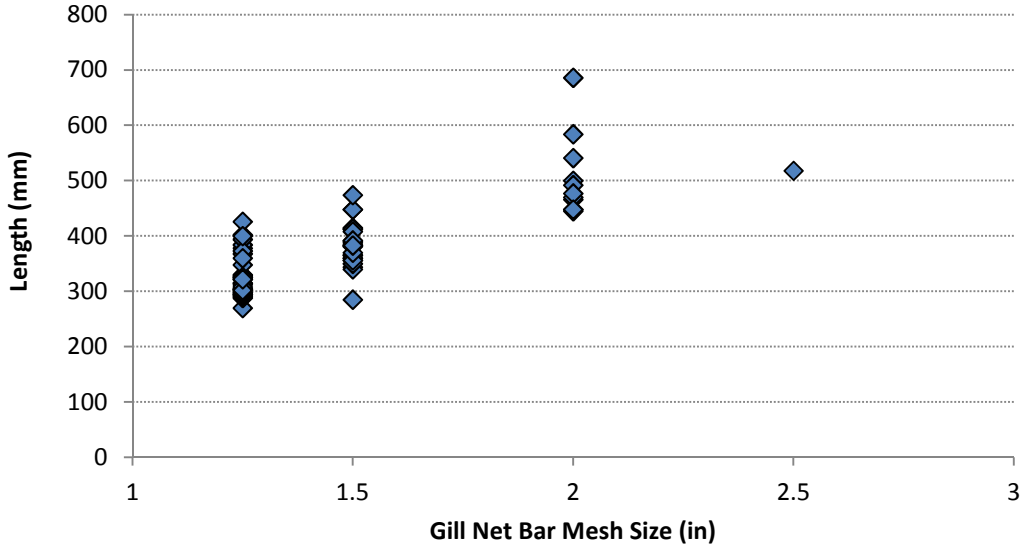

Figure 7. Length of walleye observed during short term gill netting in Four Mile Lake, Cook County, MN, during June 2015.

Table 6. Number and mean length of walleyes, by mesh size, observed in Four Mile and Tait Lakes, Cook County, MN, during short term gill netting surveys in June 2015.

Mesh Size	Number Observed	Mean Length (mm)
Four Mile Lake		
1.25	36	328
1.5	25	383
2.0	11	505
2.5	1	518
Tait Lake		
1.25	16	336
1.5	28	388
2.0	6	486
2.5	3	569

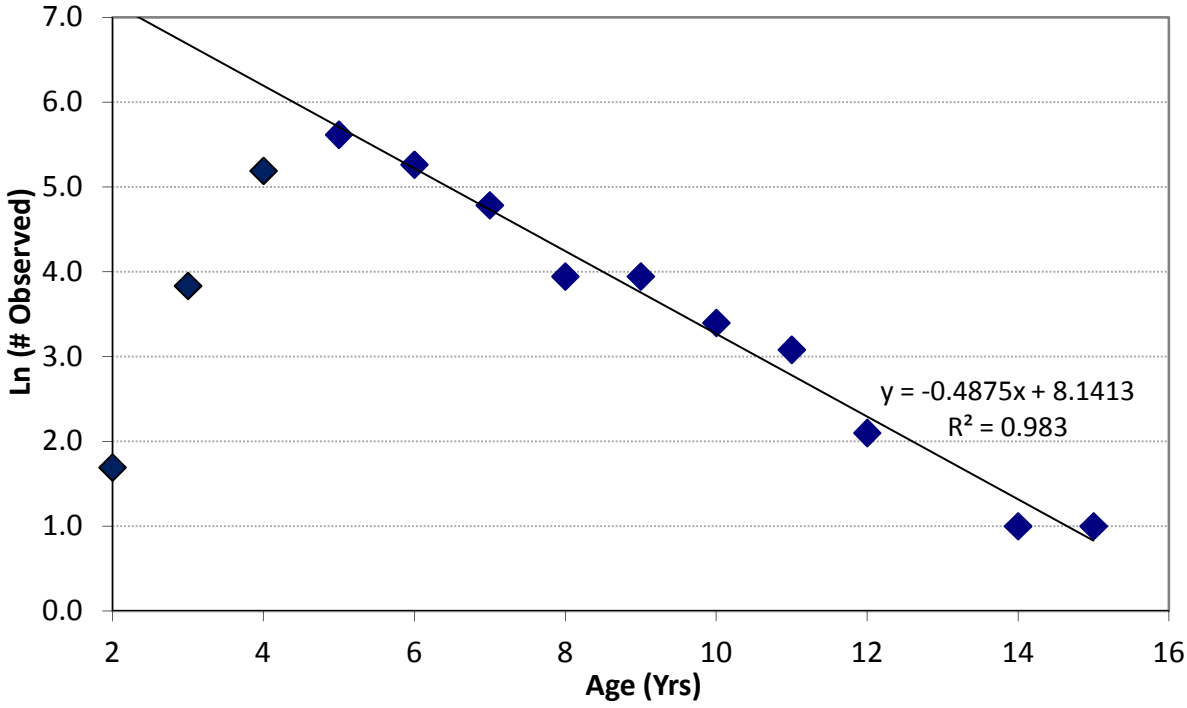

Figure 8. Catch curve analysis of walleyes in Four Mile Lake, 2015, showing instantaneous mortality (*Z*). Estimates are made from April 2015 electrofishing data

Table 7. Age frequency distribution of walleye from Four Mile Lake, Cook County, Spring 2015, based upon the number of fish sampled and aged per size category.

Length Group		N	Age													
Inches	mm	Sampled	2	3	4	5	6	7	8	9	10	11	12	14	15	17
5.0	127	1														
8.0	203	2	2													
8.5	216	1	1													
9.0	229	2														
9.5	241	2		2												
10.0	254	1		1												
10.5	267	4		4												
11.0	279	7		6	1											
11.5	292	6		2	4											
12.0	305	9		1	8											
12.5	318	14		1	13											
13.0	330	25			17	7	1									
13.5	343	27			9	6	9	4								
14.0	356	37			14	21	3									
14.5	368	31				28	3									
15.0	381	37				28	9									
15.5	394	24				8	16									
16.0	406	22				3	11	3	4							
16.5	419	23					11	12								
17.0	432	17					5	7	2	2						
17.5	445	23						16	3	1	3					
18.0	457	21					3		4	13						
18.5	470	12						1	6	1	2	1				
19.0	483	7								1	4	1	1			
19.5	495	5						1			2	2				
20.0	508															
20.5	521	2										2				
21.0	533	2								1		1				
21.5	546															
22.0	559	1														
22.5	572	1														1
23.0	584	1												1		
23.5	597	1											1			
24.0	610	1										1				
25.0	635															
25.5	648	1													1	
26.0	660															
26.5	673															
27.0	686															
27.5	699	1											1			
TOTAL		371	3	17	66	101	71	44	19	19	11	8	3	1	1	1

Table 8. Back-calculated lengths-at-age for walleye collected from Four Mile Lake, Cook County, Minnesota, Spring 2015.

Age Class	N	Length (mm)	Length (in)
1	202	111	4.4
2	202	195	7.7
3	201	266	10.5
4	186	324	12.8
5	144	368	14.5
6	106	403	15.9
7	75	429	16.9
8	51	453	17.8
9	35	478	18.8
10	21	499	19.6
11	15	524	20.6
12	8	547	21.5
13	4	541	21.3
14	3	583	23
15	2	602	23.7
16	1	561	22.1
17	1	572	22.5

Tait Lake (DOW # 16-0384)

Electrofishing activities were conducted on Tait Lake, Cook County, on 29 April – 1 May (Figure 9). Dates of electrofishing activities, water temperature, water conductivity, shocking time, the voltage and amps, the number of walleye collected, and the number caught per hour of electrofishing (CPUE) are presented in Table 1. CPUE ranged from 0.0 (EF6, 29 April) to 102.4 (EF4, 30 April) adult walleye per hour of sampling (Table 1, Figure 9). At a 95% confidence interval, mean CPUE for Tait Lake, determined using each sampling station, was 52.5 ± 13.0 adult walleye (>254mm) per hour of sampling effort.

The length frequency of the walleye sampled in Tait Lake is presented in Figure 10. Walleye as large as 666 mm (26.2 inches) were observed in the survey. Additional species observed included pumpkinseed sunfish, northern pike, white sucker, and yellow perch.

Walleyes larger than 254 mm were marked with a non-numbered orange floy tag along the distal portion of the soft dorsal fin. Table 2 presents the population estimates based upon mark-

recapture data. The electrofishing Schumacker and Eschmeyer population estimate is 1284 (Table 2). The electrofishing adjusted Petersen estimate is 1302 ± 467, with an 8.3% CV (Table 2). During summer 2015, the Minnesota Department of Natural Resources performed a standardized net assessment on Tait Lake (MN DNR, Grand Marais Area Fisheries). Thirty-three (33) walleyes (> 274 mm) were sampled in the gill nets that would have been 254 mm during the April assessments. Eleven individuals were observed to have the orange floy tag from the spring sampling (Appendix 1). The adjusted Petersen estimate using both the summer and spring data is 1768 ± 1255, with a 22.3% CV (Table 2). The Schumacker and Eschmeyer population estimate from this gill net data is 1359 (Table 2). The EF estimates from this electrofishing survey are lower than those observed in 2013 (Table 2) (Borkholder et al. 2014).

In June 2015, Fond du Lac personnel spent one week setting experimental gill nets for short periods of time (20 to 60 minutes), to attempt to get an unbiased population estimate (Schwarz 2009). A total of 53 walleye were sampled (Figure 11), with 19 recaptured individuals observed. This produced a population estimate of 1682 ± 927 (Table 2). Table 6 and Figure 11 present the mean length of walleye sampled for each gill net mesh size in this study. Similar to Four Mile, 83% of the fish sampled were observed in the two smallest mesh panels (Table 6).

Table 9 presents the age data for the walleye collected from Tait Lake. Of the 1140 unique fish sampled, 997 were assigned to ages 2 – 5 (Table 9). Total annual mortality (*A*) of the Tait Lake population was estimated at 38.5%, using the equation $A = 1 - e^{(Z)}$, where *Z* is the slope of the catch-curve relationship, and an estimate of instantaneous total annual mortality (Figure 12). This is higher than the estimates made during both the 2013 survey (31.4%) (Borkholder et al. 2014) and the 2011 survey (35.3%) (Borkholder and Edwards 2012). Total annual mortality (*A*) estimated using the MNDNR's gill net data was 27.3% (Figure 12), and was based on the aging of 37 walleyes age-2 and older, with 12 of those individuals assigned age-2. Table 10 presents back-calculated lengths-at-age for walleye collected from Tait Lake, as determined by aging dorsal fin spines.

PSD and RSD values determined by our spring electrofishing sampling and summer gillnet survey are presented in Table 5. The electrofishing PSD is 28.7 ± 3.5 (Table 5). While low, there was a large number of individuals less than 15.0 inches (71.3% of sample) that will be growing and recruiting into this "quality" 15-inch category over the next few years. Further, more than 500 individuals less than 10 inches were observed, and will be recruiting and sustaining this population well into the future. The summer gill net PSD (36.8 ± 15.3) was not significantly different than the PSD estimate from the spring

electrofishing survey (χ^2=1.16, P>0.05, critical Chi-square value of 3.841), but was only based upon 38 fish stock-sized or larger.

PSD metrics calculated from the 2013 electrofishing assessments are included for comparison (Table 5) (Borkholder et al. 2014). Significant differences were observed between the 2015 PSD and the 2013 PSD (χ^2=39.027, P<0.0001, critical Chi-square value of 3.841). Significant differences were observed between the RSD S-Q metrics of the two assessments (χ^2= -6.25, P<0.05, critical Chi-square value of -1.64. This is a result of strong cohorts of 3, 4, and 5-year old walleyes recruiting into the stock to quality size category.

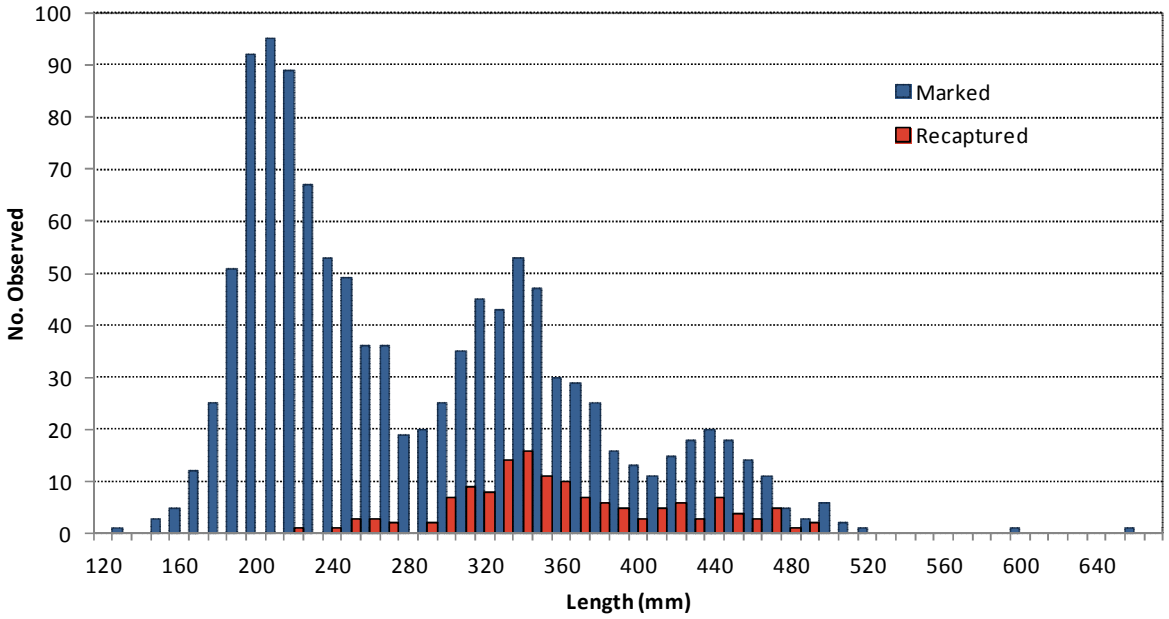

Figure 10. Length frequency distribution of walleye sampled from Tait Lake, Cook County, MN, during Spring 2015 electrofishing assessments. Length frequency distribution of recaptured walleyes is shown in red bars.

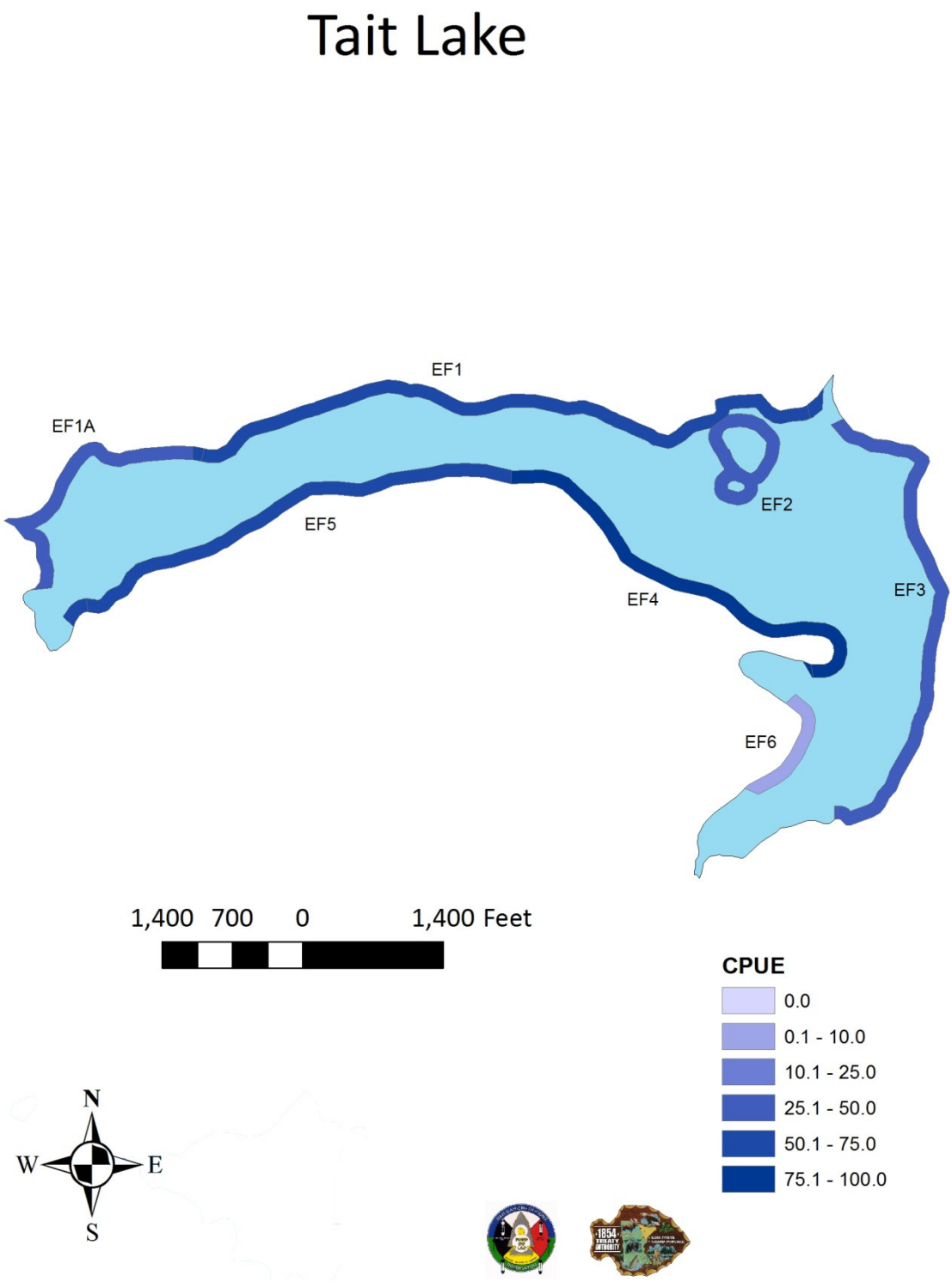

Figure 9. Catch per hour (CPE) of adult walleyes (fish larger than 254 mm) by electrofishing station on Tait Lake, Cook County, during Spring 2015 electrofishing surveys.

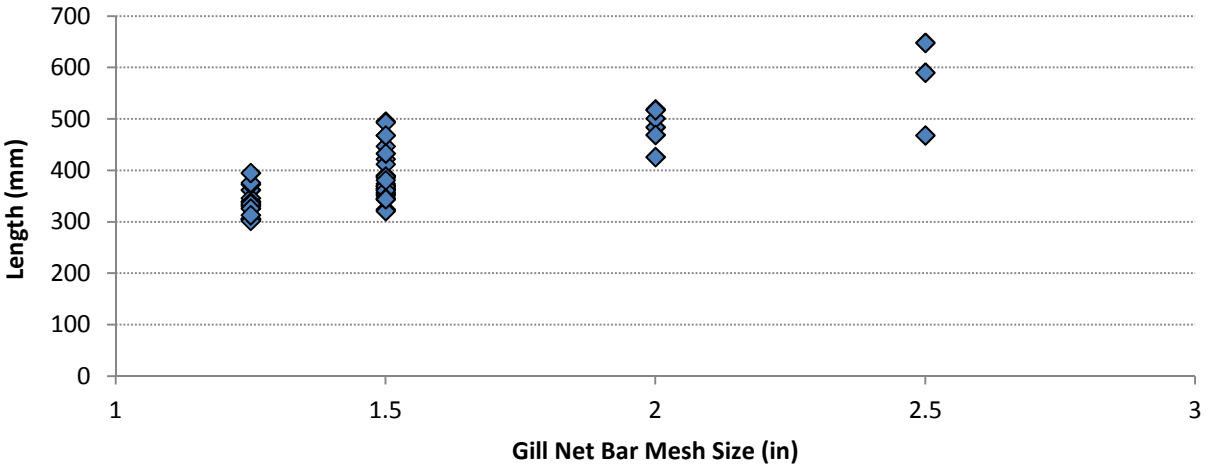

Figure 11. Length of walleye observed during short term gill netting in Tait Lake, Cook County, MN, during June 2015.

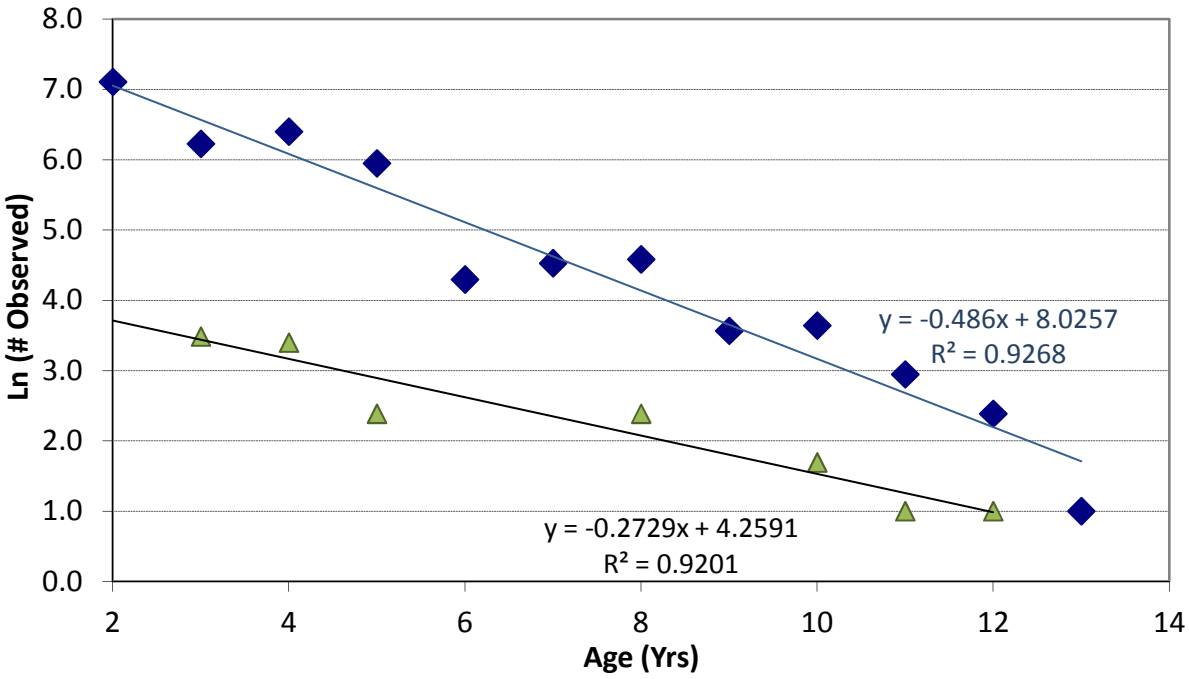

Figure 12. Catch curve analysis of walleyes in Tait Lake, 2015, showing instantaneous mortality (*Z*). Estimates are made from Spring 2015 electrofishing data (blue diamonds), and from summer 2015 gill net assessments by the MNDNR (green triangles).

Table 9. Age frequency distribution of walleye from Tait Lake, Cook County, Spring 2015, based upon the number of fish sampled and aged per size category.

Length Group		N	Age												
Inches	mm	Sampled	2	3	4	5	6	7	8	9	10	11	12	13	14
5.0	127	1													
5.5	140														
6.0	152	5	5												
6.5	165	9	9												
7.0	178	38	38												
7.5	191	84	84												
8.0	203	120	120												
8.5	216	114	114												
9.0	229	79	79												
9.5	241	66		66											
10.0	254	55		55											
10.5	267	43		29	14										
11.0	279	24		21	3										
11.5	292	27			23	4									
12.0	305	42		10	23	9									
12.5	318	62		5	41	15									
13.0	330	51			32	19									
13.5	343	63			26	25	11								
14.0	356	48			27	18		3							
14.5	368	34			15	11	1	6							
15.0	381	26			13	10	3								
15.5	394	20			4	12	1	3							
16.0	406	14				6	1	6			1				
16.5	419	21				9			12						
17.0	432	24					3	9	6	6					
17.5	445	24				3	3		9	3	5				
18.0	457	16						4	3	1	4	4			
18.5	470	13					4	1	2	1	2	1	1		
19.0	483	5										2	3		
19.5	495	7						2	3		2				
20.0	508	2							1	1					
20.5	521	1								1					
23.5	597	1												1	
26.0	660	1													1
TOTAL		1140	449	186	221	141	27	34	36	13	14	7	4	1	1

Table 10. Back-calculated lengths-at-age for walleye collected from Tait Lake, Cook County, Minnesota, Spring 2015.

Age Class	N	Length (mm)	Length (in)
1	245	111	4.4
2	245	200	7.9
3	245	273	10.7
4	215	326	12.8
5	149	364	14.3
6	104	397	15.6
7	81	423	16.7
8	65	443	17.4
9	42	455	17.9
10	22	464	18.3
11	11	492	19.4
12	6	522	20.6
13	2	622	24.5
14	1	666	26.2

Elbow Lake (DOW # 16-0096)

Electrofishing activities were conducted on Elbow Lake, Cook County, on 2 – 3 May (Figure 13). Dates of electrofishing activities, water temperature, water conductivity, shocking time, the voltage and amps, the number of walleye collected, and the number caught per hour of electrofishing (CPUE) are presented in Table 1. CPUEs were very high, ranging from 105.5 (EFZ, 3 May) to 229.3 (EF1, 2 May) adult walleye per hour of sampling (Figure 13). At a 95% confidence interval, mean CPUE for Elbow Lake, determined using each sampling station, was 161.8 ± 47.4 adult walleye (>254mm) per hour of sampling effort.

The length frequency of the walleye sampled in Elbow Lake is presented in Figure 14. Walleye as large as 692 mm (27.2 inches) were observed in the survey. Additional species observed included pumpkinseed sunfish, northern pike, white sucker, and yellow perch. Of note, a blue walleye was noted (Figure 42).

Walleyes larger than 254 mm were marked with a non-numbered orange floy tag along the distal portion of the soft dorsal fin. Table 2 presents the population estimates based upon mark-recapture data. The electrofishing Schumacker and Eschmeyer population estimate is 1386 (Table 2).

The electrofishing adjusted Petersen estimate is 1373 ± 651, with an 11.0% CV (Table 2). The population estimates presented in Table 2 represent the population abundance of walleye using the sampled areas for spawning (Figure 13), which includes most of the available spawning habitat. During summer 2015, the Minnesota Department of Natural Resources performed a standardized net assessment on Elbow Lake (MN DNR, Grand Marais Area Fisheries). Thirty-eight (38) walleyes (> 274 mm) were sampled in the gill nets that would have been 254 mm during the spring assessments. Four individuals were observed to have the orange floy tag from the spring sampling (Appendix 1). The adjusted Petersen estimate using both the summer and spring data is 4111 ± 4986, with a 38.1% CV (Table 2). The Schumacker and Eschmeyer population estimate from this gill net data is 1716 (Table 2). The population estimates from this electrofishing survey are the highest observed in four surveys going back to the year 2000 (Figure 15).

Table 11 presents the age data for the walleye collected from Elbow Lake. Total annual mortality (*A*) of the Elbow Lake population was estimated at 34.3%, using the equation $A = 1 - e^{(Z)}$, where *Z* is the slope of the catch-curve relationship, and an estimate of instantaneous total annual mortality (Figure 16). This is lower than the estimate made during 2010 survey (40.4%) (Borkholder and Edwards 2011). Total annual mortality (*A*) estimated using the MNDNR's gill net data was 25.0% (Figure 16), and was based on the aging of 51 walleyes age-3 and older, and 10 individuals assigned to age-2. Table 12 presents back-calculated lengths-at-age for walleye collected from Elbow Lake, as determined by aging dorsal fin spines.

PSD and RSD values determined by our spring electrofishing sampling and summer gillnet survey are presented in Table 5. The electrofishing PSD is 50.7 ± 4.6 (Table 5). The summer gill net PSD (45.2 ± 15.1) was not significantly different than the PSD estimate from the spring electrofishing survey (χ^2=0.33, P>0.05, critical Chi-square value of 3.841), but was only based upon 42 fish stock-sized or larger.

PSD metrics calculated from the 2010 electrofishing assessments are included for comparison (Table 5) (Borkholder and Edwards 2011). Significant differences were observed between the 2015 PSD and the 2010 PSD (χ^2=71.17, P<0.0001, critical Chi-square value of 3.841). No significant differences were observed between any of the RSD metrics of the two assessments.

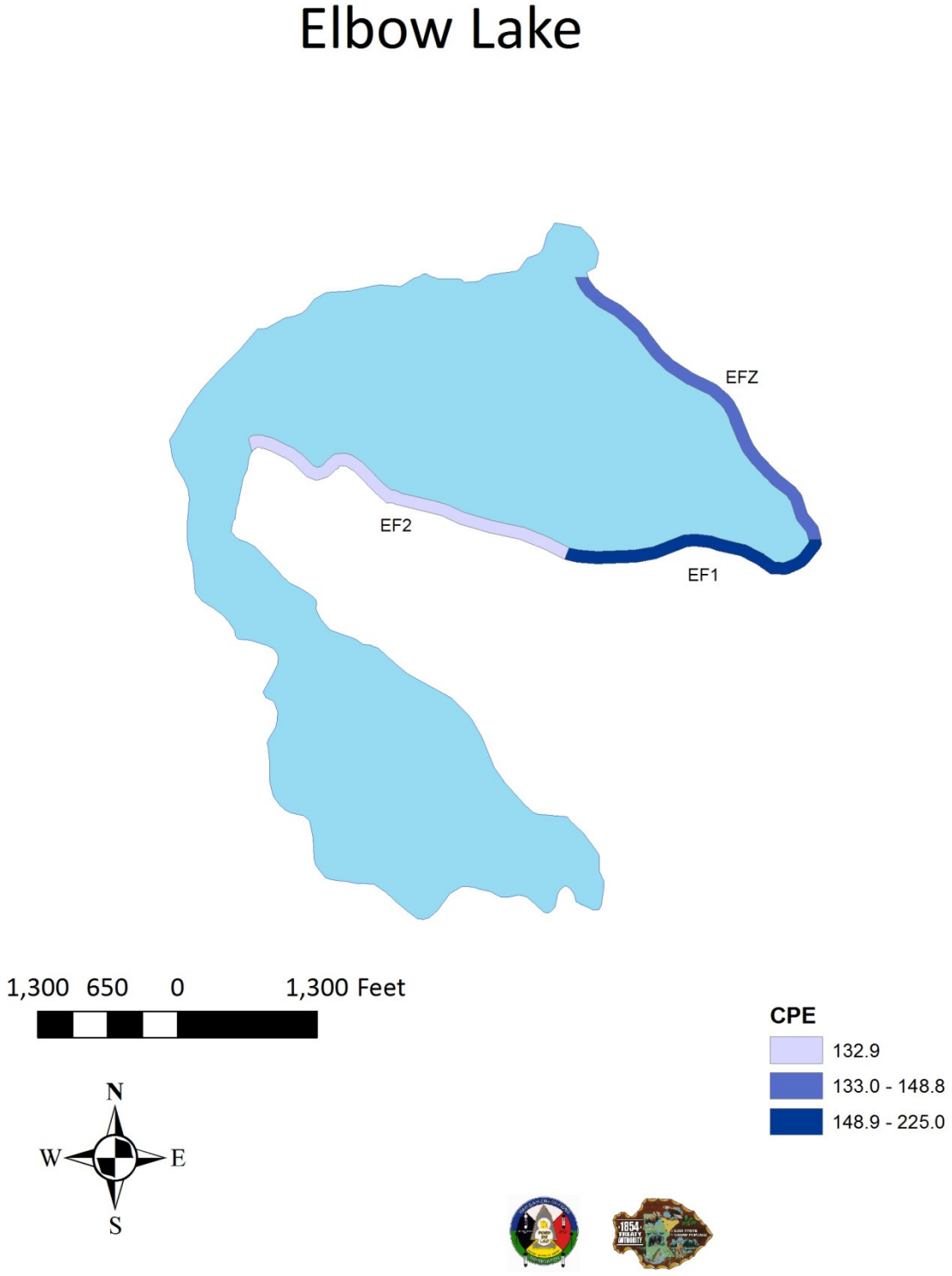

Figure 13. Catch per hour (CPE) of adult walleyes (fish larger than 254 mm) by electrofishing station, on Elbow Lake, Cook County, during Spring 2015 electrofishing surveys.

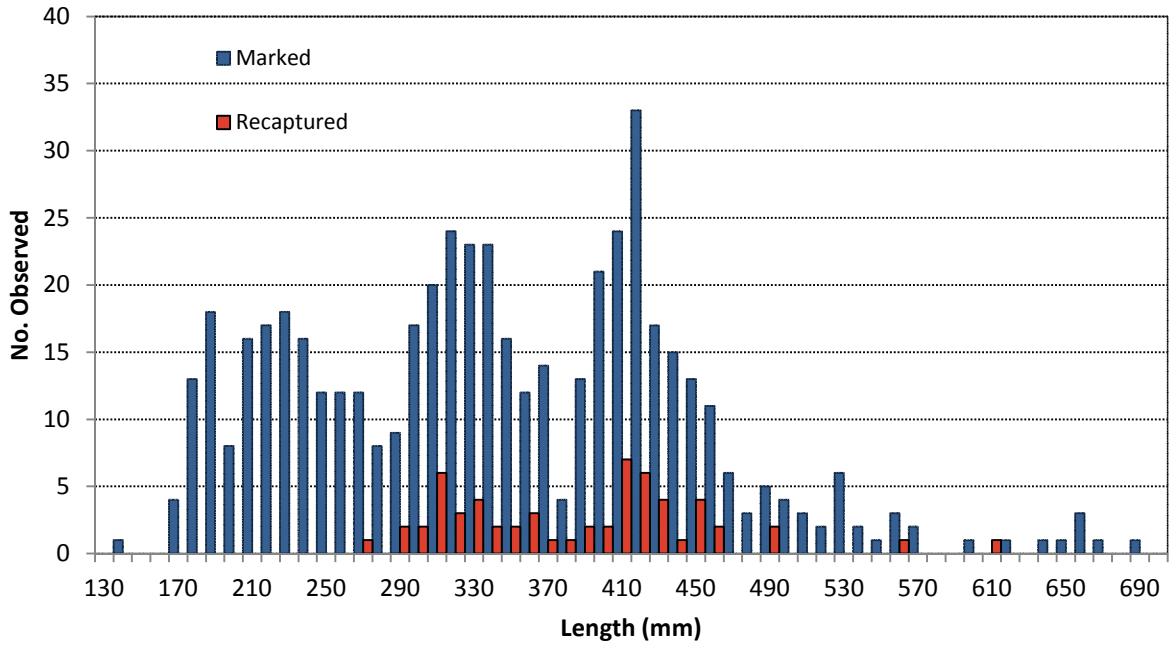

Figure 14. Length frequency distribution of walleye sampled from Elbow Lake, Cook County, MN, during Spring 2015 electrofishing assessments. Length frequency distribution of recaptured walleyes is shown in red bars.

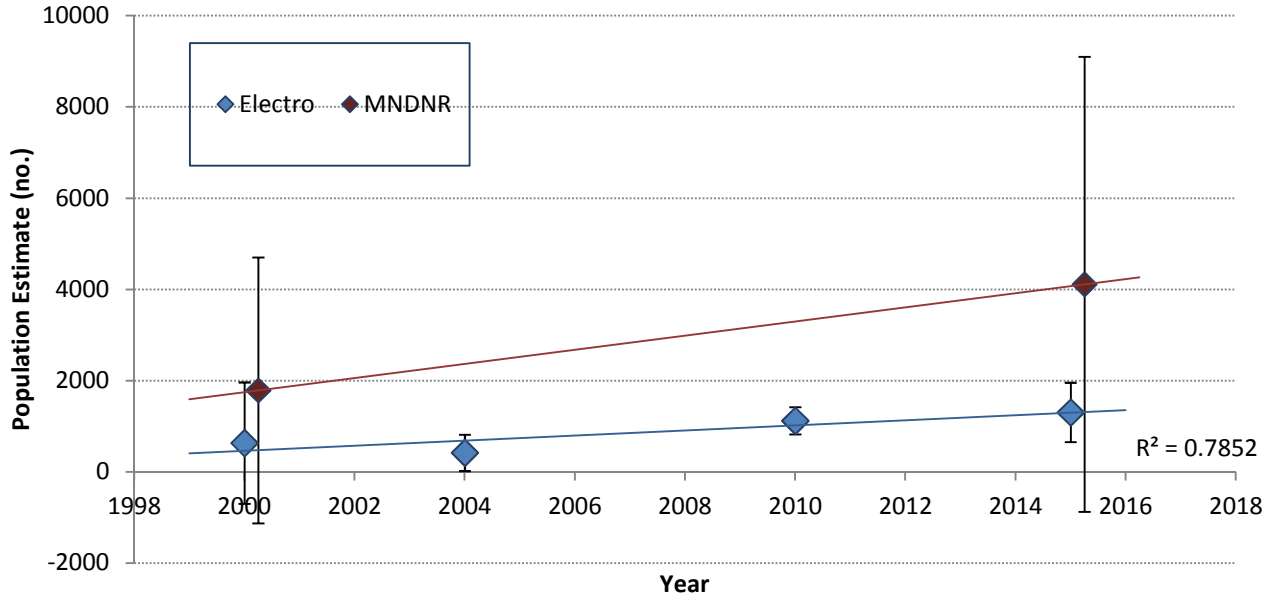

Figure 15. Peterson population estimates (with standard errors) of walleye larger than 254mm in Elbow Lake, Cook County, MN, determined using the Petersen estimator and data from spring electrofishing surveys (Electro blue diamonds) or subsequent summer gill netting by the MN Department of Natural Resources (MNDNR red diamonds).

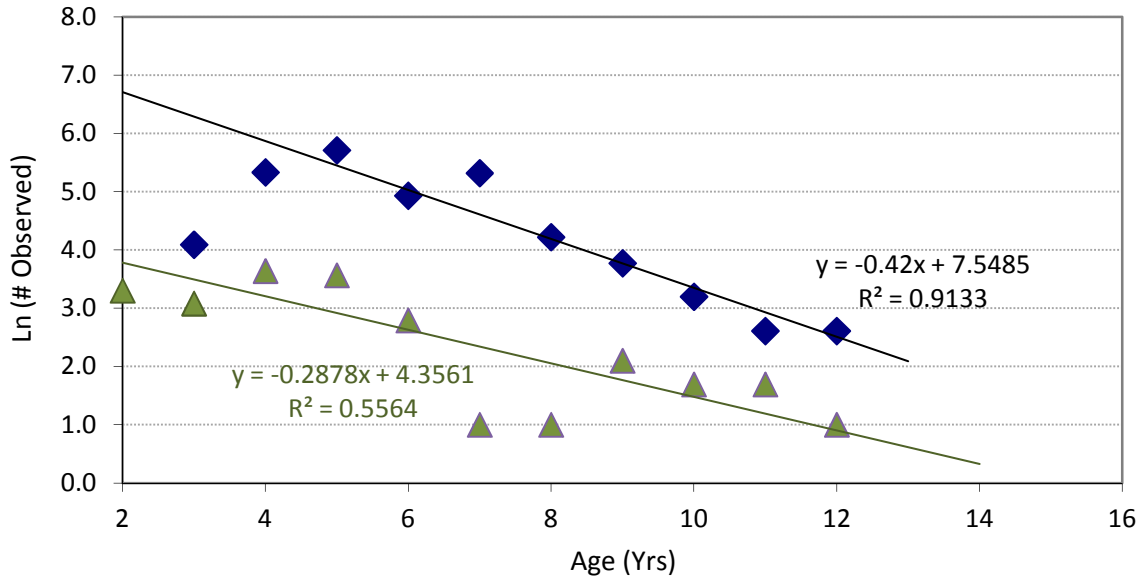

Figure 16. Catch curve analysis of walleyes in Elbow Lake, 2015, showing instantaneous mortality (*Z)*. Estimates are made from Spring 2015 electrofishing data (blue diamonds), and from summer 2015 gill net assessments by the MNDNR (green triangles).

Table 11. Age frequency distribution of walleye from Elbow Lake, Cook County, Spring 2015, based upon the number of fish sampled and aged per size category.

Length Group		N	Age											
Inches	mm	Sampled	3	4	5	6	7	8	9	10	11	12	13	15
5.5	140	1												
6.5	165	3												
7.0	178	15												
7.5	191	21												
8.0	203	11												
8.5	216	24												
9.0	229	24												
9.5	241	16												
10.0	254	16	12	4										
10.5	267	16	10	6										
11.0	279	13		13										
11.5	292	10		10										
12.0	305	26		17	5	5								
12.5	318	30		6	24									
13.0	330	28		11	18									
13.5	343	28		8	13	8								
14.0	356	17		2	15									
14.5	368	14			14									
15	381	9			7			2						
15.5	394	24			7	4	9	4						
16	406	29			4	16	9							
16.5	419	36				12	24							
17	432	22				1	17			3				
17.5	445	19			6	3	6		4					
18	457	12				1	4	6		1				
18.5	470	8					1	5	2					
19	483	6				1	1		4					
19.5	495	2						1	1					
20.0	508	7					1	4		1	1			
20.5	521	4					1		3					
21.0	533	4						2		2				
21.5	546													
22.0	559	5					2	1	1			1		
22.5	572	1							1					
23.0	584													
23.5	597	1								1				
24.0	610	1									1			
24.5	622													
25.5	648	3									1	2		
26.0	660	3										1	1	1
27.0	686	1									1			
TOTAL		510	22	76	111	51	75	25	16	9	5	4	1	1

Table 12. Back-calculated lengths-at-age for walleye collected from Elbow Lake, Cook County, Minnesota, Spring 2015.

Age Class	N	Length (mm)	Length (in)
1	181	107	4.2
2	181	176	6.9
3	181	242	9.5
4	175	299	11.8
5	147	350	13.8
6	115	396	15.6
7	96	435	17.1
8	66	471	18.5
9	46	499	19.6
10	24	529	20.8
11	16	568	22.4
12	7	624	24.6
13	2	647	25.5
14	1	640	25.2
15	1	668	26.3

Fall Assessments

Catch per unit effort (CPUE) for age-0 walleye has been found to be the highest in the fall when water temperatures are between 20.0^{o}C and 10.0^{o}C (Borkholder and Parsons, 2001). Fall assessments began in the Grand Marais area on 8 September 2015. This 20^{o}C threshold was exceeded on four lakes in 2015 (Table 13). All of the lakes were surveyed before the lakes cooled to below the 10^{o}C lower threshold.

Table 13 presents a summary of each evening of electrofishing assessments. CPUE for age-0 walleye ranged from 0.0 fish per hour (Devilfish & Wild Rice Lakes) to 803.3 fish per hour of electrofishing (Crescent Lake) (Table 13). Catch rates were generally higher than normal, with nine lakes having a CPUE greater than 100 age-0 fish / hour. CPUE for age-1 walleye ranged from 0.0 fish per hour (Devilfish & Dumbbell Lakes) to 39.2 fish per hour of electrofishing (Ninemile Lake) (Table 13). Figures 17 – 41 present length frequency data for each of the lakes surveyed. Table 14 presents the mean length for age-0 and age-1 individuals sampled during fall 2015 assessments. Mean lengths for age-0 walleye ranged from 101 mm (4.0 inches, Two Island Lake) to 179 mm (7.0 inches, Cadotte Lake). Mean

lengths for age-1 walleye ranged from 153 mm (6.0 inches, Wild Rice Lake) to 262 mm (10.3 inches, Cadotte Lake).

Wild Rice Lake Reservoir Largemouth Bass

Eighty-three (83) largemouth bass (*Micropterus salmoides*) were sampled in Wild Rice Lake this fall (Figure 41). Lengths range from 68 mm to 202 mm. The 2015 sample represents the highest catch rate for largemouth bass since they were first observed in this lake in 2009.

Acknowledgments

The Fond du Lac Division of Resource Management and the 1854 Treaty Authority wish to acknowledge and thank the staff that assisted during field work in 2015; Darren Vogt, Christina Maley, Jeffrey Flory, and Jamie McDermid (1854 Treaty Authority); Adam Thompson, John Goodreau, Lance Overland, Terry Perrault, Charlie Nahgahnub, & Gary Martineau (Fond du Lac Resource Management); Chris Beal, Jason Butcher, Jake Carleen, Ben Galetka, Eric LaBuhn, Darren Lilja, Ryan Pennisi, Kristyn Rugg, Harvey Sobieck, Amanda Weberg (U.S. Forest Service). Steve Persons and Mathew Weberg (MNDNR Grand Marais Area Office), Dean Paron and Dick Stern (MNDNR Finland Area Office), and Deserae Hendrickson and Dan Wilfond (MNDNR, Duluth Area Office) provided gill net data from the Minnesota Department of Natural Resources.

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Table 13. Total number and catch-per-unit-effort (CPUE) of age-0 and age-1 walleye collected from 25 lakes within the 1854 Ceded Territory of Northeastern Minnesota during Fall 2015.

Lake	Date	Temp (F)	Temp (C)	Cond.[1]	Age-0 Total[2]	Age-1 Total[3]	Seconds	CPUE Age-0[4]	CPUE 1+[5]
Ball Club	8-Sep	70	21.1	42.0	156	12	4705	119.4	9.2
Cadotte	30-Sep	59	15.0	32.0	115	3	7379	56.1	1.5
Caribou	11-Sep	63	17.2	67.0	348	12	5615	223.1	7.7
Cascade	24-Sep	60	15.6	20.0	127	10	4480	102.1	8.0
Crescent	23-Sep	61	16.1	30.4	760	4	3406	803.3	4.2
Crooked	21-Sep	62	16.7	45.0	7	5	3831	6.6	4.7
Devilfish	9 & 28-Sep	67 / 60	19.4	13.0	0	0	7018	0.0	0.0
Dumbbell	28-Sep	61	16.1	70.2	76.6	0	6359	43.4	0.0
Elbow	11-Sep	62	16.7	37.5	47	14	4227	40.0	11.9
Fourmile	23-Sep	60	15.6	48.0	151	20	5134	105.9	14.0
Harriet	21-Sep	62	16.7	54.0	23	10	4380	18.9	8.2
Island Reservoir	1-Oct	60	15.6	82.0	237	47	8760	97.4	19.3
Ninemile	25-Sep	59	15.0	67.3	35	69	6343	19.9	39.2
N. McDougal	25-Sep	60	15.6	51.0	96	15	4905	70.5	11.0
Pike	10-Sep	67	19.4	57.1	235	62	6396	132.3	34.9
Shagawa	29-Sep	62	16.7	95.2	902	51	11578	280.5	15.9
Silver Island	22-Sep	61	16.1	37.0	76	25	4624	59.2	19.5
Tait	22-Sep	63	17.2	42.6	200	9	7698	93.5	4.2
Tom	9-Sep	69	20.6	34.1	303	32	8097	134.7	14.2
Two Island	8-Sep	69	20.6	30.2	128	8	5413	85.1	5.3
West Twin	11-Sep	64	17.8	26.1	384	6	4810	287.4	4.5
Whiteface Res.	30-Sep	61	16.1	66.0	48	20	6880	25.1	10.5
Wild Rice	16-Sep	68	20.0	134.8	0	3	3447	0.0	3.1
Wilson	21-Sep	64	17.8	47.0	21	13	5732	13.2	8.2
Windy	24-Sep	61	16.1	30.2	13	3	6785	6.9	1.6

[1] Conductivity, measured in MicroSiemens / cm.
[2] Indicates the number of age-0, young-of-the-year, walleye collected in each sample.
[3] Indicates the number of age-1 juvenile walleye collected in each sample.
[4] Indicates the catch rate of age-0 fish (fish per hour, 3600 sec, of electrofishing on time).
[5] Indicates the catch rate of age-1 fish (fish per hour, 3600 sec, of electrofishing on time).

Table 14. Mean length for age-0 and age-1 walleye sampled during fall 2015 assessments within the 1854 Ceded Territory of Northeastern Minnesota. Numbers in parentheses indicate sample sizes, and are presented when mean lengths are based upon few individuals (N=<20).

Lake (County)	Date	Age-0 Mean Length (mm)	Age-1 Mean Length (mm)
Ball Club	8-Sep	114	218 (N=12)
Cadotte	30-Sep	179	262 (N=3)
Caribou	11-Sep	126	222 (N=12)
Cascade	24-Sep	125	198 (N=10)
Crescent	23-Sep	115	218 (N=4)
Crooked	21-Sep	149 (N=7)	214 (N=5)
Devilfish	9 & 28 Sep	---	---
Dumbbell	28-Sep	118	---
Elbow	11-Sep	111	200 (N=14)
Fourmile	23-Sep	129	218 (N=20)
Harriet	21-Sep	123	177 (N=10)
Island Reservoir	1-Oct	156	228
Ninemile	25-Sep	135	178
N. McDougal	25-Sep	135	214 (N=15)
Pike	10-Sep	124	212
Shagawa	29-Sep	139	226
Silver Island	22-Sep	146	211
Tait	22-Sep	114	204 (N=9)
Tom	9-Sep	129	217
Two Island	8-Sep	101	206 (N=8)
West Twin	11-Sep	117	221 (N=4)
Whiteface Res.	30-Sep	143	234 (N=18)
Wild Rice	16-Sep	---	153 (N=3)
Wilson	21-Sep	128	195 (N=13)
Windy	24-Sep	155 (N=13)	213 (N=3)

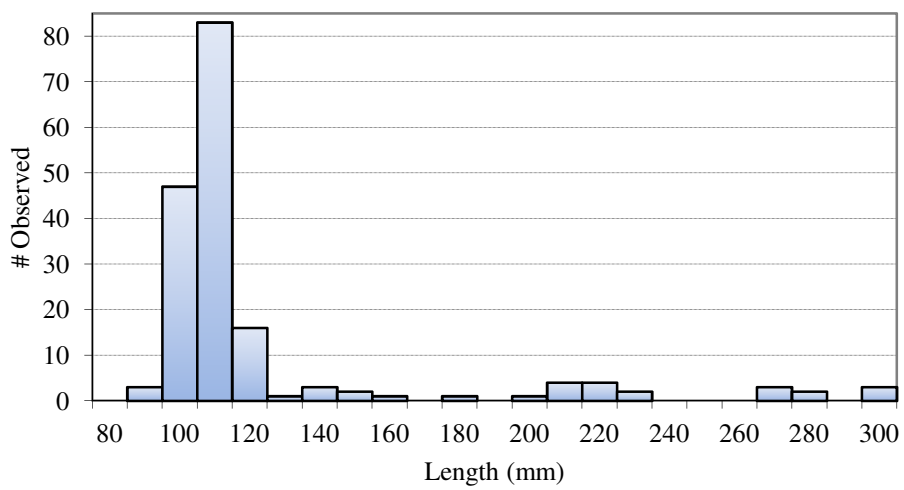

Figure 17. Length frequency distribution of walleye collected from Ball Club Lake, Cook County, during fall 2015 electrofishing assessments.

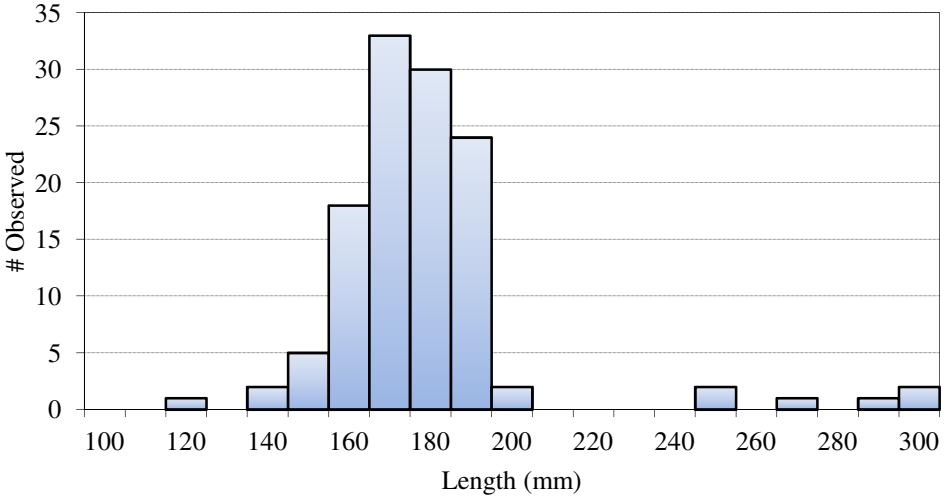

Figure 18. Length frequency distribution of walleye collected from Cadotte Lake, St. Louis County, during fall 2015 electrofishing assessments.

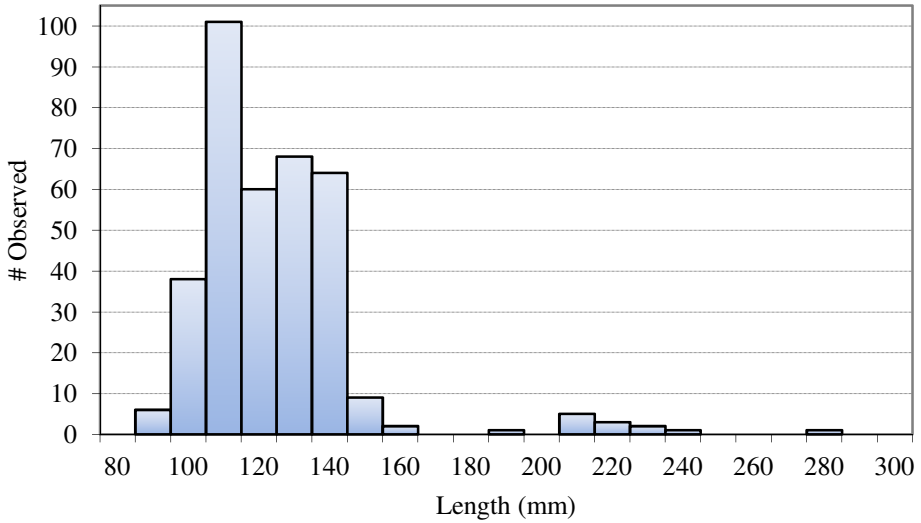

Figure 19. Length frequency distribution of walleye collected from Caribou Lake, Cook County, during fall 2015 electrofishing assessments.

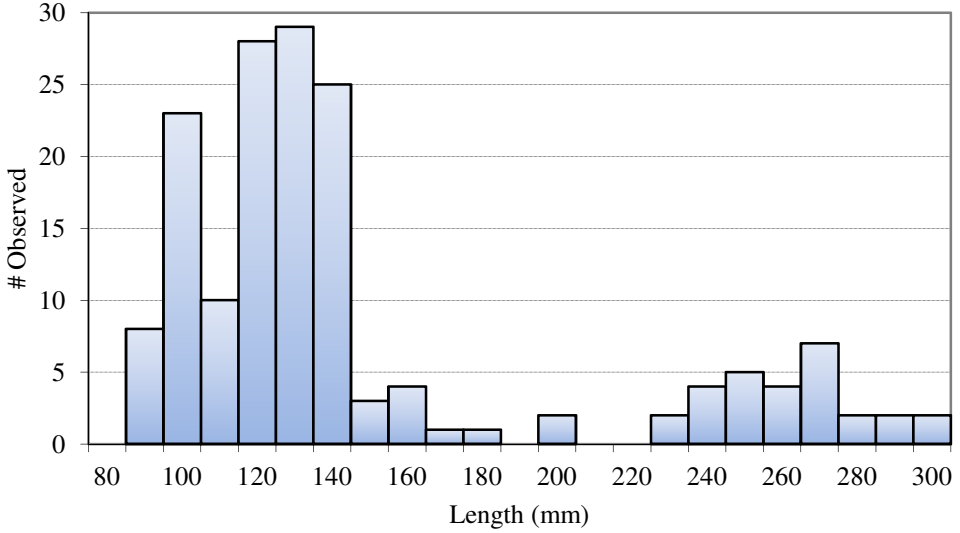

Figure 20. Length frequency distribution of walleye collected from Cascade Lake, Cook County, during fall 2015 electrofishing assessments.

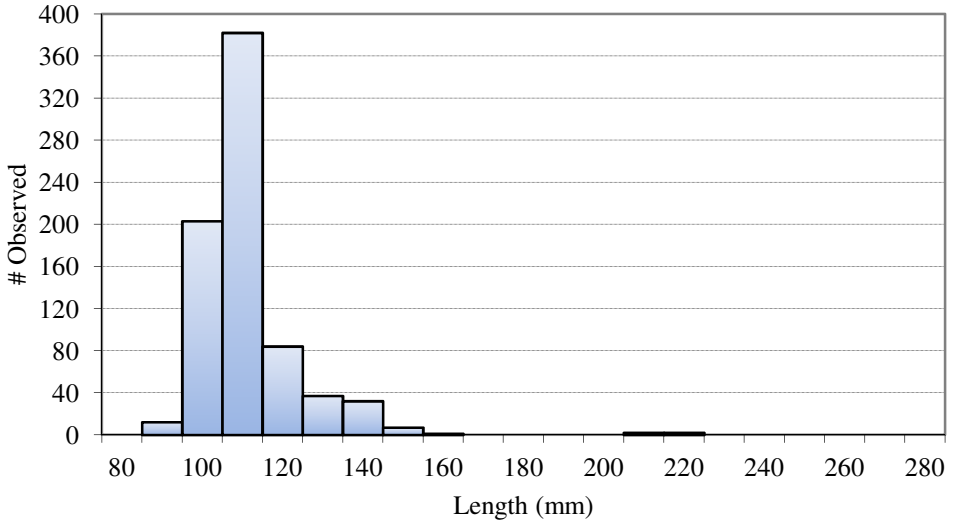

Figure 21. Length frequency distribution of walleye collected from Crescent Lake, Cook County, during fall 2015 electrofishing assessments.

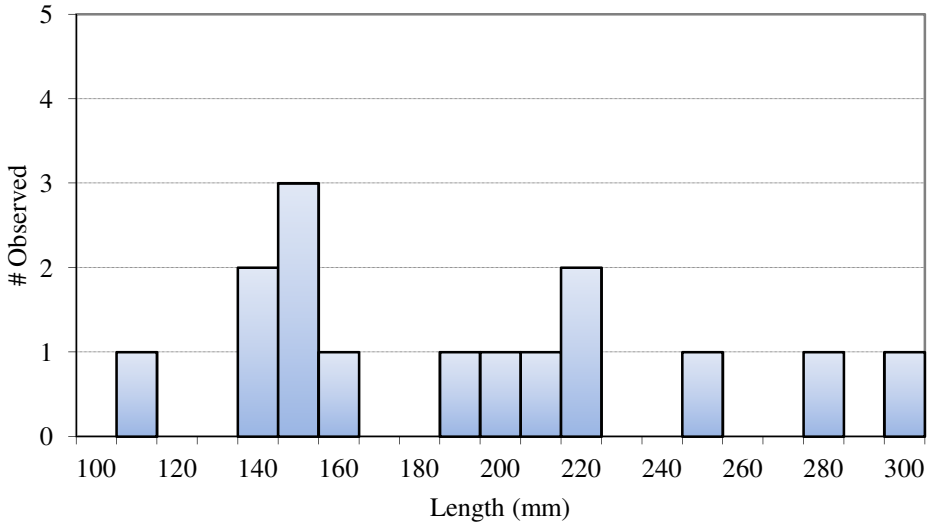

Figure 22. Length frequency distribution of walleye collected from Crooked Lake, Lake County, during fall 2015 electrofishing assessments.

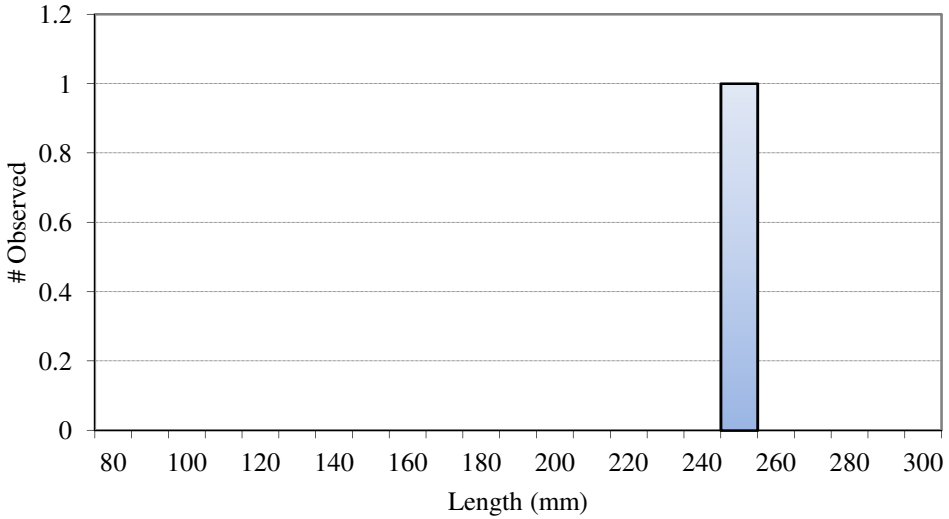

Figure 23. Length frequency distribution of walleye collected from Devilfish Lake, Cook County, during fall 2015 electrofishing assessments.

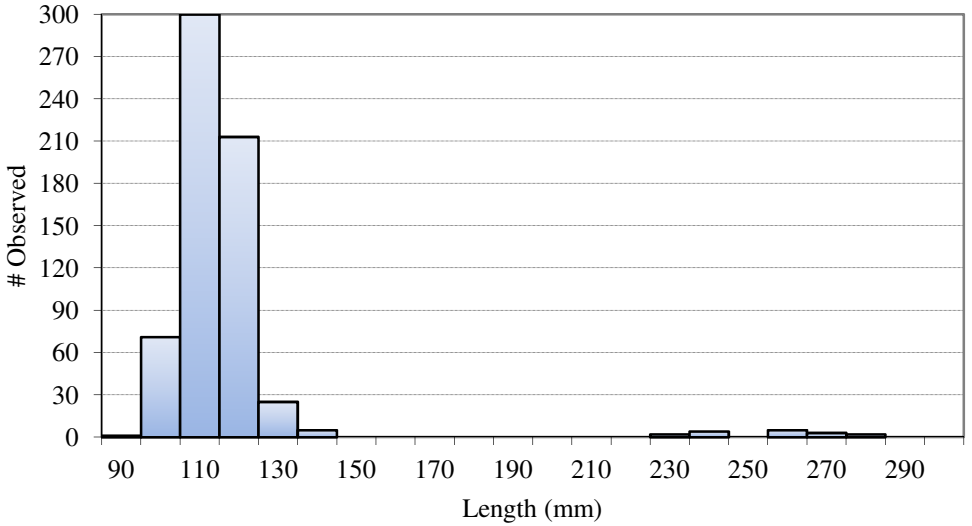

Figure 24. Length frequency distribution of walleye collected from Dumbbell Lake, Lake County, during fall 2015 electrofishing assessments.

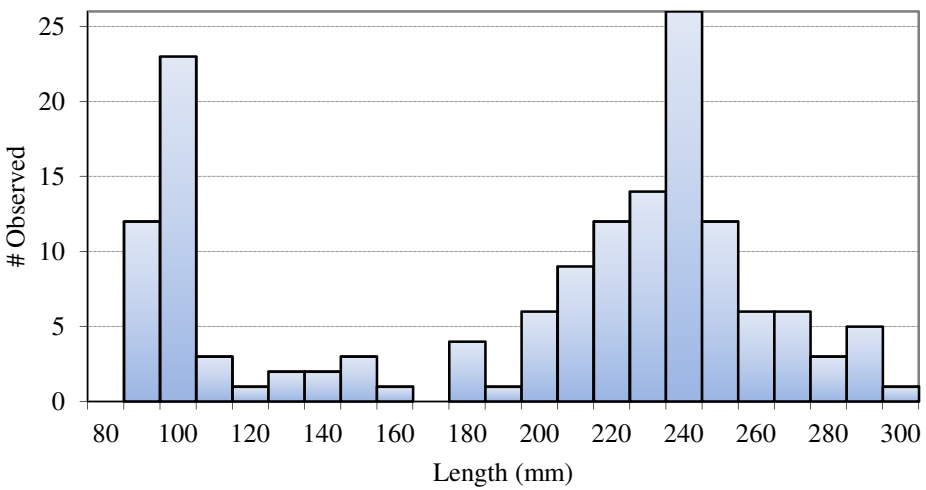

Figure 25. Length frequency distribution of walleye collected from Elbow Lake, Cook County, during fall 2015 electrofishing assessments.

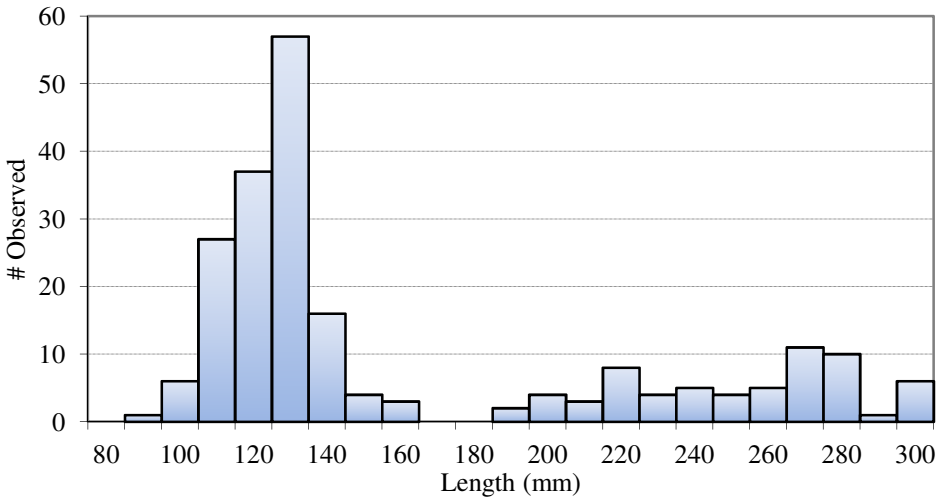

Figure 26. Length frequency distribution of walleye collected from Fourmile Lake, Cook County, during fall 2015 electrofishing assessments.

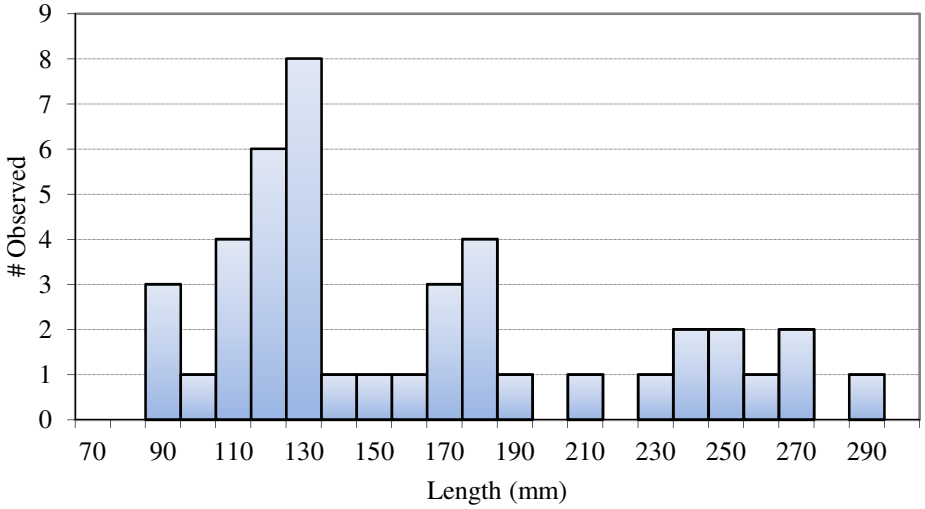

Figure 27. Length frequency distribution of walleye collected from Harriet Lake, Lake County, during fall 2015 electrofishing assessments.

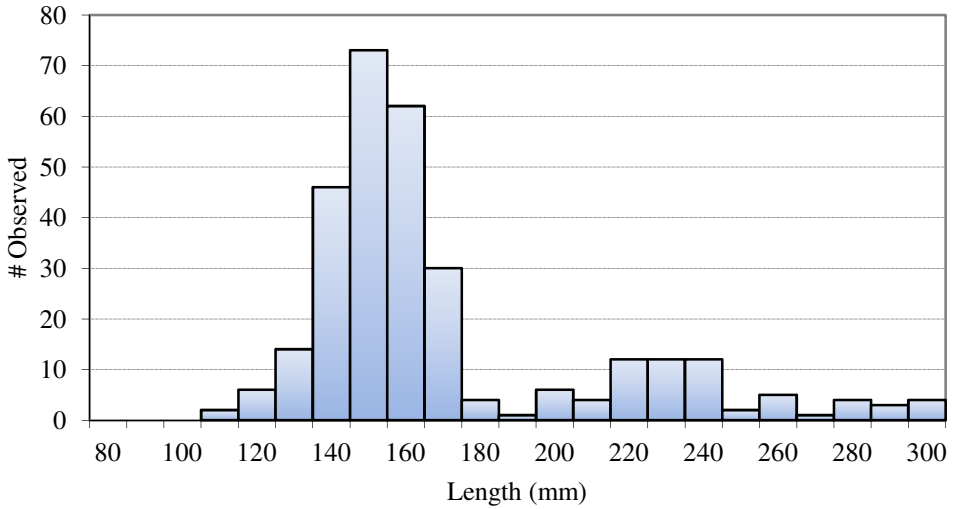

Figure 28. Length frequency distribution of walleye collected from Island Lake Reservoir, St. Louis County, during fall 2015 electrofishing assessments.

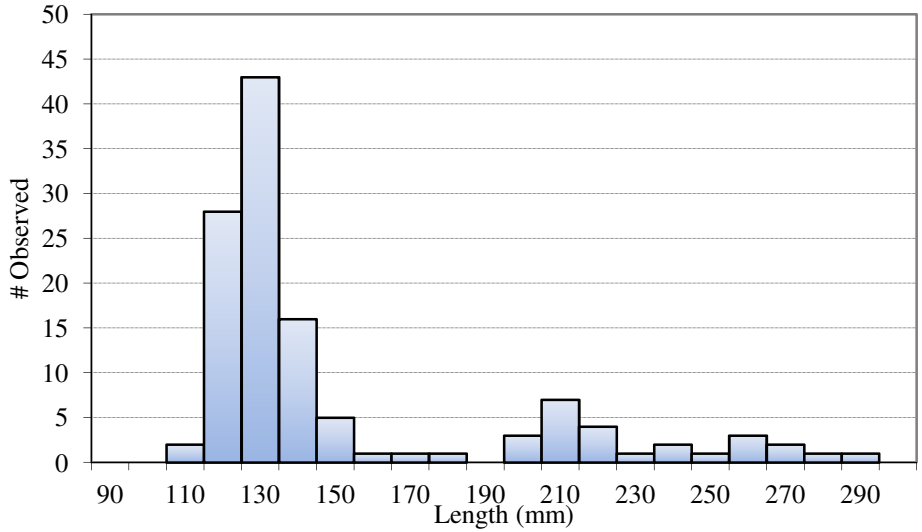

Figure 29. Length frequency distribution of walleye collected from North McDougal Lake, Lake County, during fall 2015 electrofishing assessments.

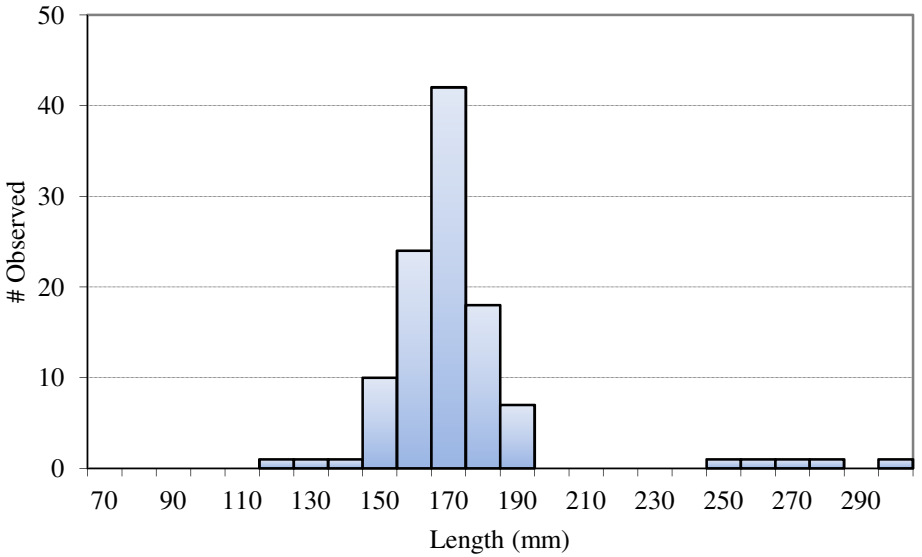

Figure 30. Length frequency distribution of walleye collected from Ninemile Lake, Lake County, during fall 2015 electrofishing assessments.

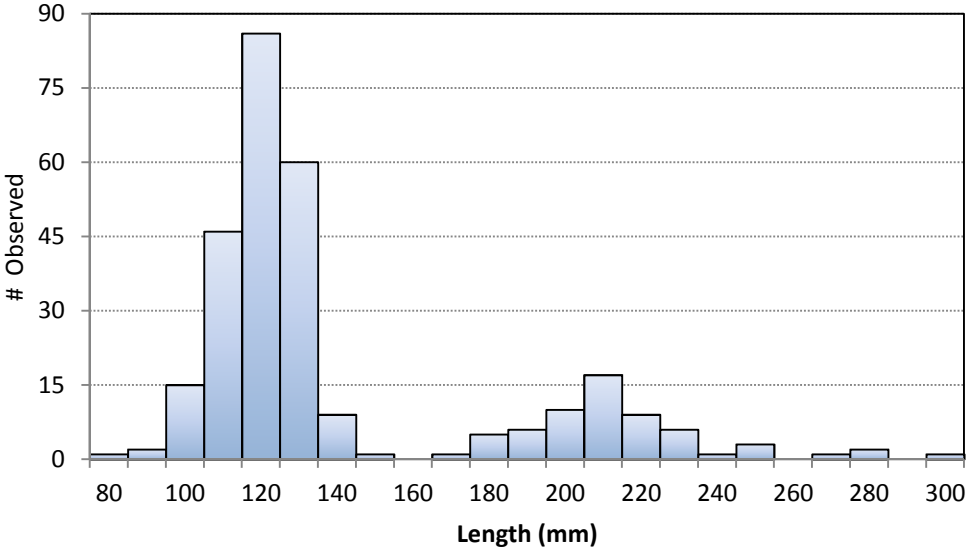

Figure 31. Length frequency distribution of walleye collected from Pike Lake, Cook County, during fall 2015 electrofishing assessments.

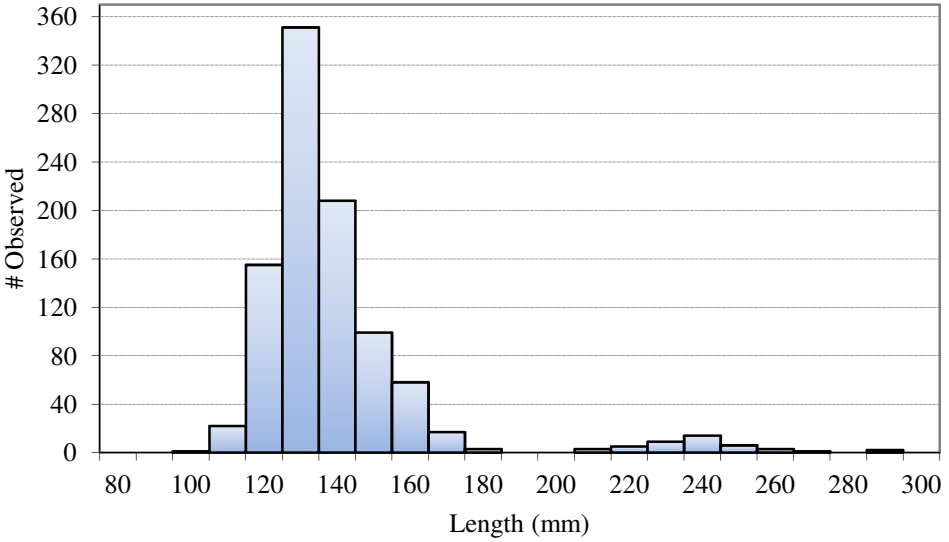

Figure 32. Length frequency distribution of walleye collected from Shagawa Lake, St. Louis County, during fall 2015 electrofishing assessments.

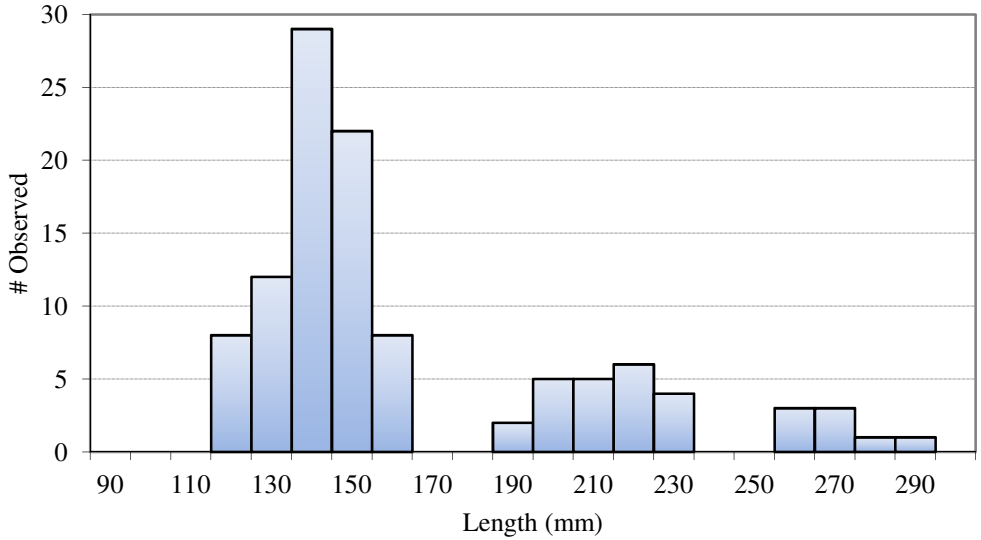

Figure 33. Length frequency distribution of walleye collected from Silver Island Lake, Lake County, during fall 2015 electrofishing assessments.

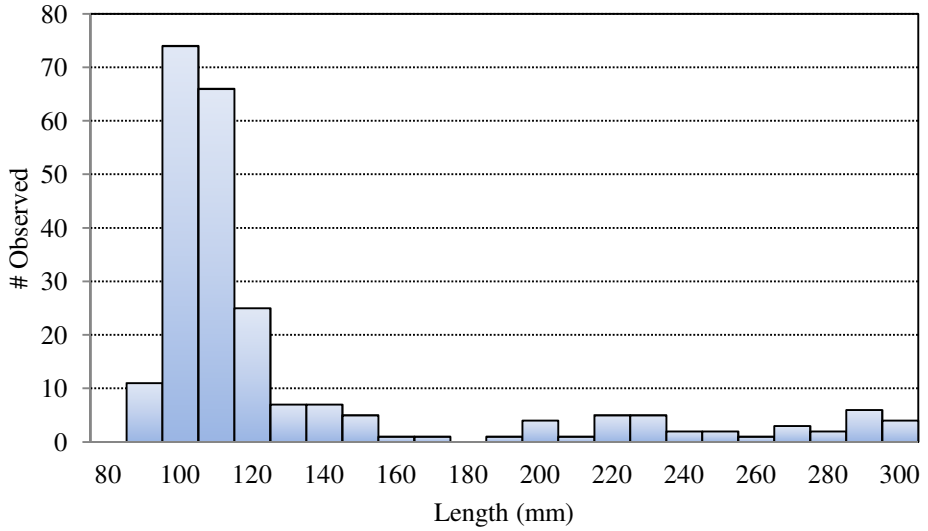

Figure 34. Length frequency distribution of walleye collected from Tait Lake, Cook County, during fall 2015 electrofishing assessments.

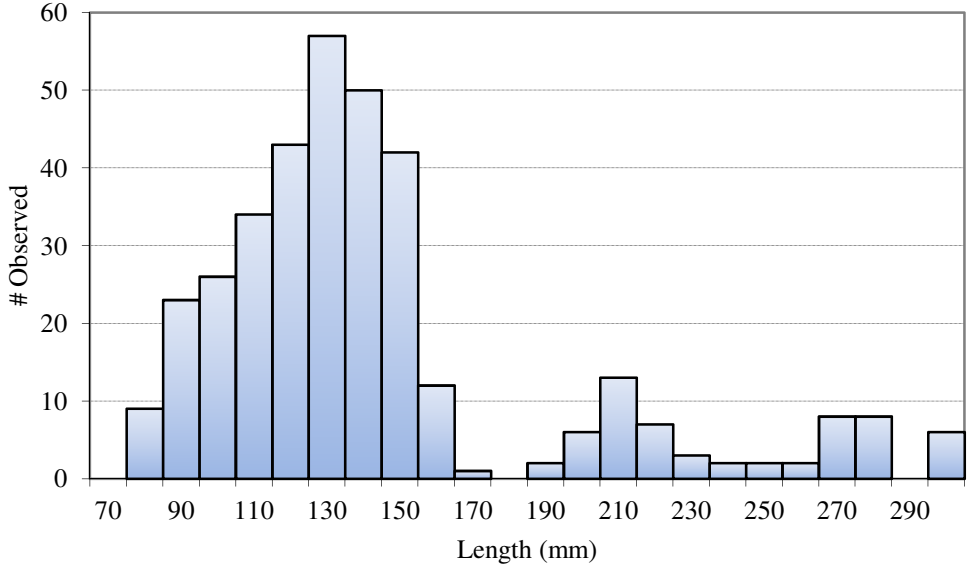

Figure 35. Length frequency distribution of walleye collected from Tom Lake Cook County, during fall 2015 electrofishing assessments.

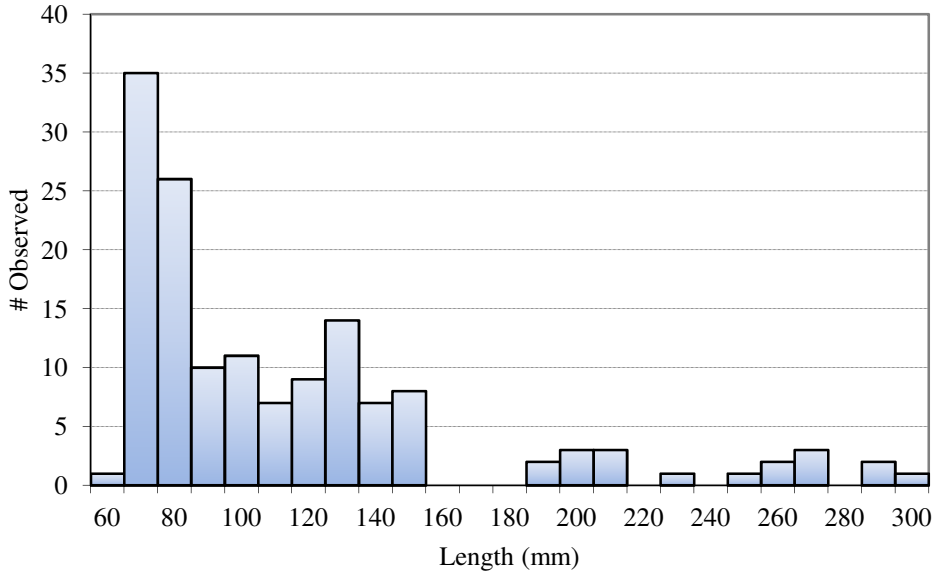

Figure 36. Length frequency distribution of walleye collected from Two Island Lake, Cook County, during fall 2015 electrofishing assessments.

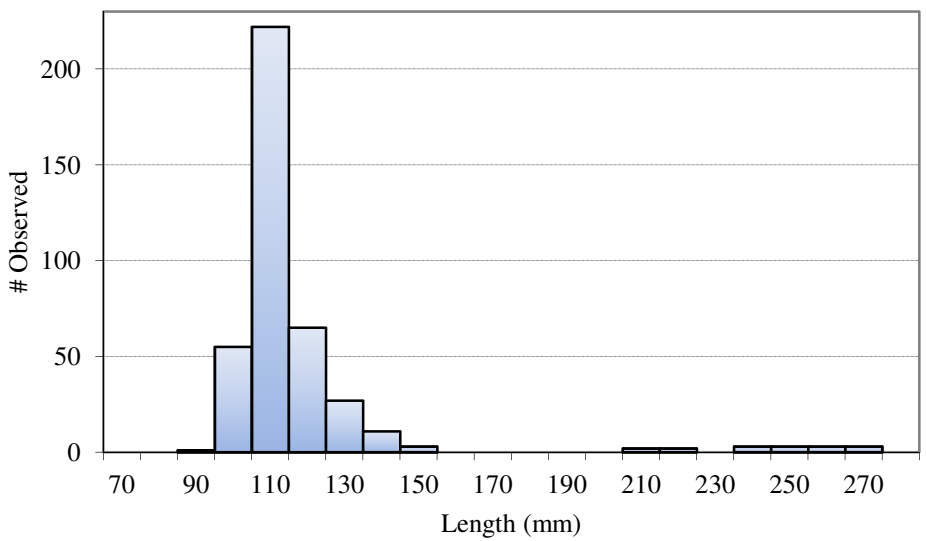

Figure 37. Length frequency distribution of walleye collected from West Twin Lake, Cook County, during fall 2015 electrofishing assessments.

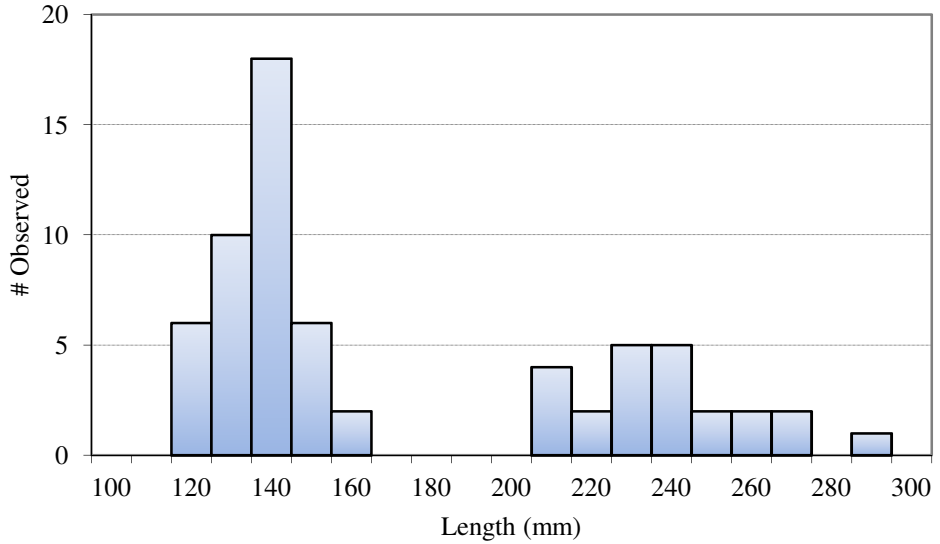

Figure 38. Length frequency distribution of walleye collected from Whiteface Reservoir, St. Louis County, during fall 2015 electrofishing assessments.

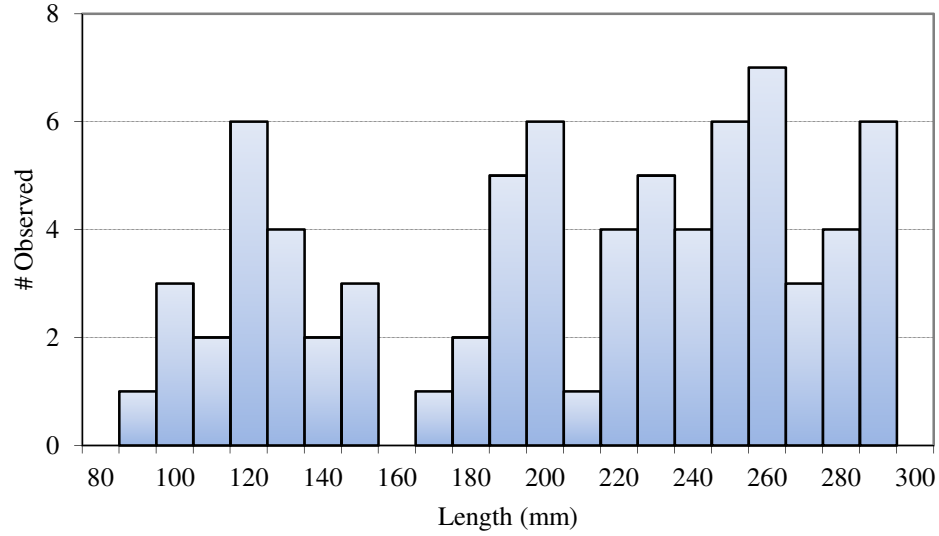

Figure 39. Length frequency distribution of walleye collected from Wilson Lake, Lake County, during fall 2015 electrofishing assessments.

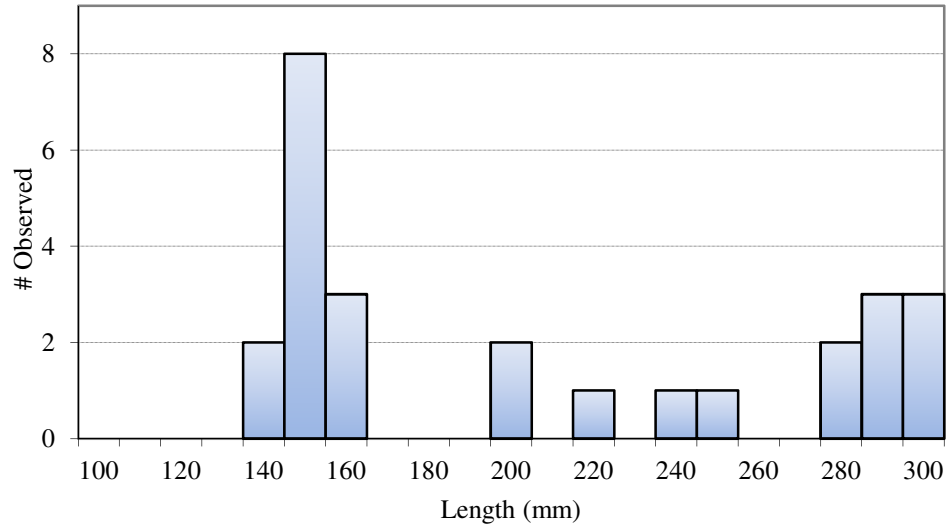

Figure 40. Length frequency distribution of walleye collected from Windy Lake, Lake County, during fall 2015 electrofishing assessments.

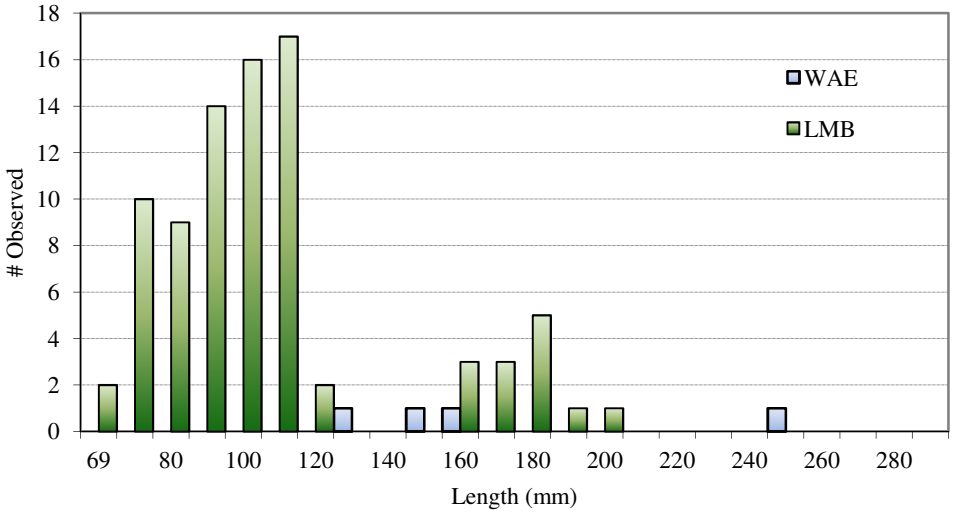

Figure 41. Length frequency distribution of walleye collected from Wild Rice Lake Resevoir, St. Louis County, during fall 2015 electrofishing assessments. Blue bars represent the four walleye sampled while the green bars represent largemouth bass sampled.

Figure 42. "Blue" walleye sampled on Elbow Lake, Cook County, MN in May 2015.

Appendix 1. Nightly Mark / Recapture Data for walleye > 254 mm sampled during spring 2015 assessments in the 1854 Ceded Territory, and for walleye > 275mm observed in MN DNR summer gill net assessments.

Lake	Date	Marked in Population	Daily Catch	Daily Recap
Prairie	14 April	---	81	0
	15 April	81	18	5
	16 April	94	168	52
	17 April	210	76	49
	MNDNR GN	237	16	0
	MNDNR GN / TN	237	18	0
Four Mile	20 April	---	79	0
	23 April	79	135	17
	24 April	197	131	22
	25 April	305	80	23
	June Short Term GN	362	72	1
Tait	29 April	---	205	0
	30 April	205	268	47
	1 May	425	293	95
	June Short Term GN	623	53	19
	MNDNR GN	623	33	11
	MNDNR GN / TN	623	60	16
Elbow	2 May	---	354	0
	3 May	354	231	59
	MNDNR GN	526	38	4
	MNDNR GN / TN	526	49	7