Spring Adult and Fall Juvenile Walleye Population Surveys within the 1854 Ceded Territory of Minnesota, 2009

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 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 more than a decade (Borkholder 1994a and 1995). In order to maximize the number of fish handled and marked during the 2009 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. Population estimates based solely upon spring electrofishing data alone will be conservative estimates, lower than the true population size. 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.

The first objective of our assessments in 2009 was to obtain adult walleye population estimates (PE) during the spring spawning period using mark - recapture data. Our electrofishing PE estimates may be biased towards males in the populations, and thus, are no doubt conservative estimates. However, by cooperating with the MN DNR area offices, a second 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 2009 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. Lakes chosen for the 2009 spring survey were Wild Rice Lake (Duluth Area), Windy and Harriet Lakes (Finland Area), and Tait Lake (Grand Marais Area). The objective was to obtain adult walleye (*Sander vitreus*) population estimates using mark-recapture methods and determine the age structure and growth rates of each respective walleye population. Fin clipped walleye would then be available during the summer gill net assessments conducted by the DNR, thus providing a second population estimate.

Electrofishing was performed at night using boom-shocking boats equipped with Smith-Root Type VI-A 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 the sex determined (male, female, unknown) based upon visual identification of gametes. Walleye that had been fin clipped during any previous nights' collections were counted as recaptured fish (Appendix 1). All individuals (> 254 mm) were marked by the removal of the third full dorsal fin. 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^{TM} 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

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 1 September 2009. Unfortunately, due to an unseasonably warm September where water temperatures actually increased as the month progressed, the 20^{o}C threshold was exceeded on a majority of the lakes.

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, 2000a, 2002a, 2003, & 2004). Sampling stations were repeated from previous years' surveys. New stations were established on Harriet and Tait Lakes.

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

Wild Rice Lake

Electrofishing activities were conducted on Wild Rice Lake Reservoir on 28 – 30 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 for each night ranged from 40.7 to 56.6 adult walleye per hour of sampling (Table 1). At an 80% confidence interval, mean CPUE for Wild Rice Lake, determined using each sampling station, was 47.9 ± 19.5 adult walleye (>254mm) per hour of sampling effort. Catch rates ranged from 12.4 adult walleye per hour (EF6, 29 April) to 83.3 adults per hour (EF5, 28 April) (Figure 1). Due to storms and strong winds, we were limited in where we could safely sample, and were unable to sample the many of the same locations as in the 2000 and 2004 surveys. We ended the survey after the third evening due to forecasted storms again for the next several nights, and low catch rates.

The length frequency of the walleye sampled is presented in Figure 2. Walleye as large as 645 mm (25.4 inches) were observed in the survey. Incidentally, 8 of the 13 largest walleyes sampled in 2009 were recaptured individuals from previous surveys. A total of 12 walleyes were observed with marks from previous surveys, i.e. missing dorsal fin spines. Additional species observed included sunfish species, white sucker, black crappie, and northern pike.

Table 2 presents various population estimates based upon mark-recapture data for both the spring electrofishing survey and the summer gill-net assessment. The Schumacker and Eschmeyer population estimate from the electrofishing data is 6732 (Table 2). The adjusted Petersen estimate is 3150 ± 9470, with a 69.9% CV (Table 2). The 2009 population estimate of walleyes larger than 254 mm (10.0 inches) is much higher than those obtained in 2000 and 2004 (Table 2), but due to the issues encountered with limited sampling and wind, there should be little weight placed on these PEs.

In July 2009, the Minnesota Department of Natural Resources performed a standardized net assessment on Wild Rice Lake (MN DNR, Duluth Area Fisheries). Two hundred fifty six (256) walleyes (> 265 mm) were sampled in the gill nets that would have been 254 mm during the May assessments, with only four of those observed to have a fin clip from the spring sampling. The adjusted Petersen estimate using both the summer and spring data is 5962 ± 7670, with a 40.4% CV (Table 2). The Schumacker and Eschmeyer population estimate from the net data is 7307 (Table 2). These estimates are considerably larger than those obtained in 2000 and 2004 (Table 2). This is probably due to the low numbers of fish marked in spring and the low number of recaptured fish observed in the gill net, and not a significant increase in walleye numbers in Wild Rice Lake. Subsequent surveys in future years will be needed to verify this observation.

Table 3 presents the age data for the walleye collected from Wild Rice Lake. Of the 117 unique fish sampled, 83 were assigned to ages 4 through 8. The 2001 (age-8) year class was observed to be stronger than normal during previous fall electrofishing surveys (Borkholder and Edwards 2002b) (Figure 3). Unfortunately, our fall age-0 and age-1 assessment data does not include the other cohorts due to an inability to launch our electrofishing boats into Wild Rice Lake during this time period. The presence of thick aquatic macrophyte beds have, until 2009, made it impossible to navigate our boats and electrofish effectively. Instantaneous mortality (Z) of the Wild Rice Lake population was estimated at 20.2% (Figure 4). Total annual mortality (A) was estimated to be 18.3%. Table 4 presents back-calculated lengths at age for walleye collected from Wild Rice Lake.

The relationship between age-0 and age-1 fall electrofishing data and spring 2009 adult data is presented in Figure 5. The weak relationships observed between the adult data and the age-0 and age-1 data is probably due to the many years that have passed between the fall assessments, and the years of natural and angling mortality that have undoubtedly affected adult walleye abundance by 2009. The fall data were all collected between 1994 and 2001, and correspond to 2009 adult ages of 8 to 15 years old.

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 of 74.8 ± 7.9 (Table 5) suggests a balanced population, characterized by fish larger than 15.0 inches (Anderson and Weithman 1978). The summer gill net PSD (53.1 ± 6.1) is significantly different than the PSD estimate from the spring electrofishing survey (χ^2=15.5, P<0.05, critical Chi-square value of 3.841), although this is probably due to Fond du Lac not sampling very many mature spawning fish in the 10 – 15 inch range, which were sampled well by the MNDNR gill nets. No significant differences were observed in any of the RSD metrics between the electrofishing and gill net assessments during 2009 assessments (Table 5). PSD metrics calculated from the 2000 and 2004 electrofishing assessments are included for comparison (Borkholder and Edwards 2001 & 2003). Significant differences were observed between the 2009 PSD and the 2004 PSDs (χ^2=21.5, P<0.05, critical Chi-square value of 3.841), but not between the 2009 PSD and the 2000 PSD (χ^2=1.6, P>0.05, critical Chi-square value of 3.841). This would suggest that the stock structure has changed little over the last decade.

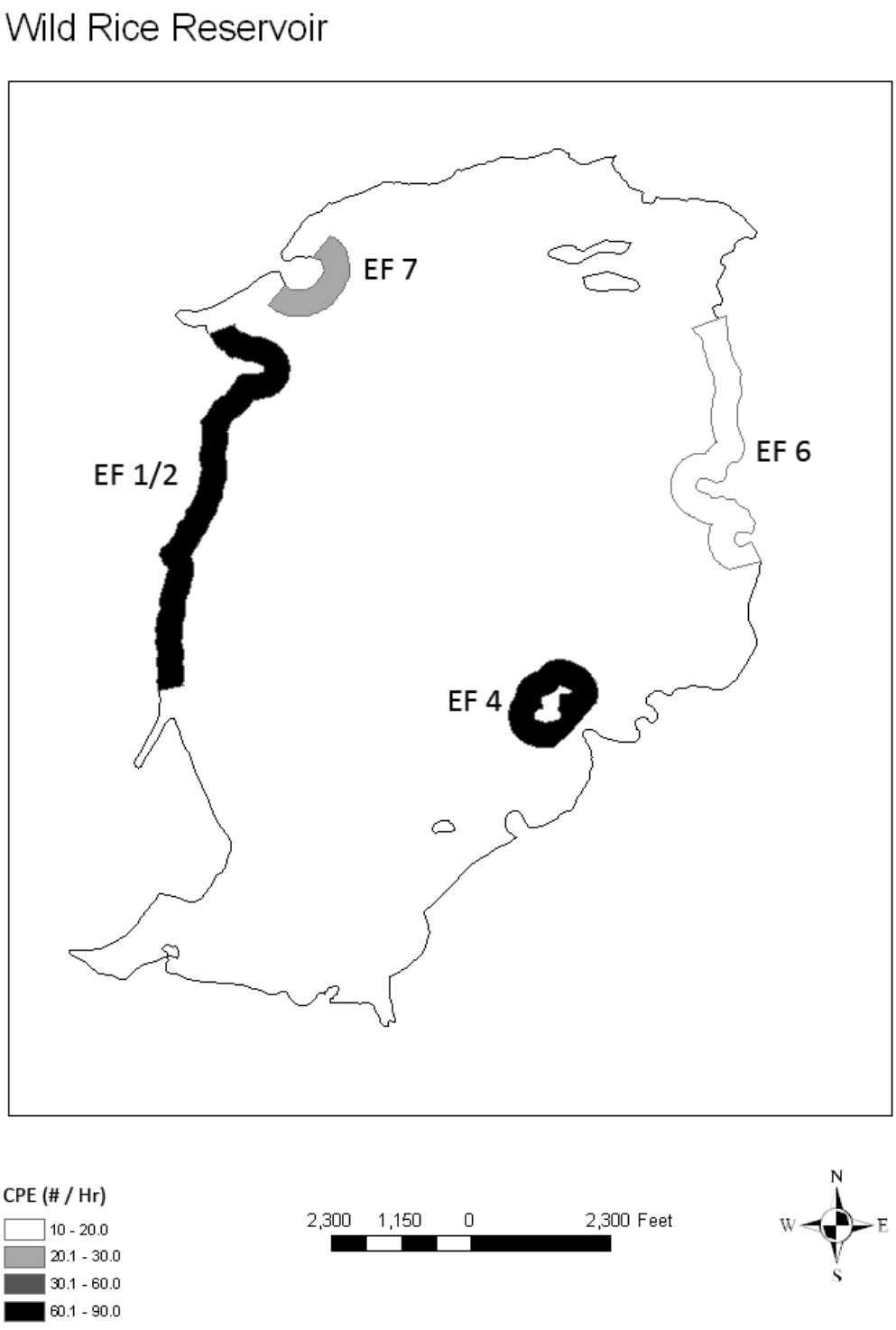

Figure 1. Catch per hour (CPE) of adult walleyes on Wild Rice Lake Reservoir, St. Louis County, during spring 2009 electrofishing surveys.

Table 1. Summary of electrofishing activities on four lakes surveyed within the 1854 Ceded Territory, Minnesota, during Spring 2009.

ID #	County	Lake	Area (Acres)	Max Depth	Date	Water Temp (F)	Conductivity[1]	Shocking Time (sec)	Voltage (PDC)	Amps	# WAE[2]	CPUE WAE[3]
69-0371	St. Louis	Wild Rice Reservoir	2127	11	4/28/2009	46	100.7	3270	707	4.5	42	46.2
					4/29/2009	46	101.5	2916	707	5	33	40.7
					4/30/2009	49	104.9	2610	707	5	41	56.6
38-0048	Lake	Harriet	265	37	5/7/2009	53	26.6	11502	1061	5	118	36.9
					5/8/2009	48	44.1	4915	1061	4.5	123	90.1
38-0068	Lake	Windy	450	39	5/8/2009	43	18.1	6083	High (45%)[4]	0.5	251	148.5
					5/9/2009	42	24.5	4245	High (40%)	0.25	199	168.8
					5/10/2009	43	25.5	2553	High (40%)	0.5	106	149.5
16-0384	Cook	Tait	338	15.0	5/9/2009	45	25.4	9038	1061	2.5	197	78.5
					5/10/2009	47	28.3	13193	1061	4	426	116.2
					5/11/2009	46	29.1	13350	1061	4	469	126.5

[1] Water conductivity measured in microSiemens / cm.

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

[3] 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)).

[4] The 1854 Treaty Authority began using a new Smith-Root controller in 2009, that does not indicate actual voltage, but rather HIGH or LOW, and a % Power, which is reported.

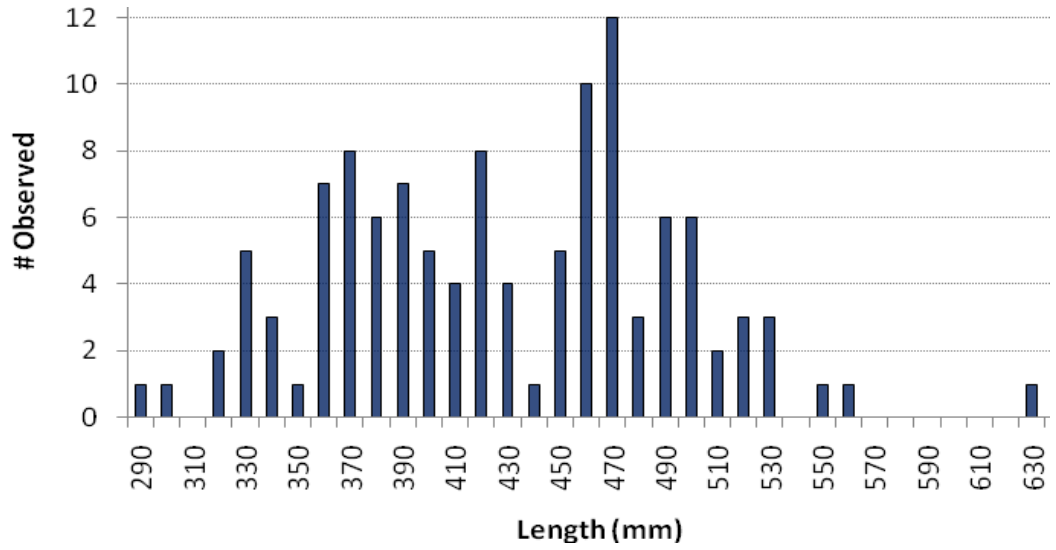

Figure 2. Length frequency distribution of walleye sampled from Wild Rice Lake Reservoir, St. Louis County, MN, during spring 2009 electrofishing assessments. Bars do not include counts of recaptured individuals. Only a single 470 mm individual was recaptured.

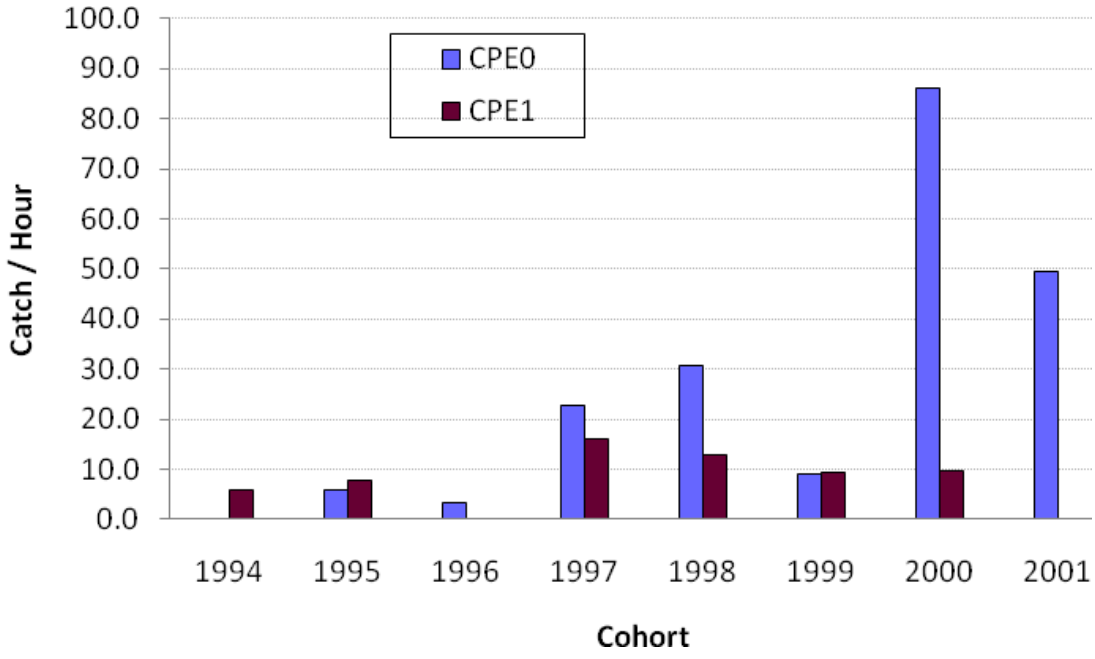

Figure 3. Catch per hour of age-0 and age-1 walleyes from Wild Rice Lake, from 1994 until 2001.

Table 2. Walleye population estimates for Wild Rice, Harriet, Windy, and Tait Lakes, Spring 2009. Estimates are for walleye larger than 254 mm (10.0 inches). EF denotes population estimates determined from spring electrofishing data. GN refers to population estimates determined from gill net samples collected in the summer following marking with the electrofishing surveys. Rows of shaded data indicate population estimates from previous surveys, and are presented for comparison purposes.

Lake	Population Estimate[1]	95% Confidence Limits Lower	Upper	Estimate[2]	C.V.[3]
W. Rice – EF_{2000}	3283	3074	1446	2695 ± 817	10.9%
W. Rice – GN_{2000}	4290	2897	6153	6519 ± 4248	25.3%
W. Rice – EF_{2004}	4307	3742	658	4368 ± 1552	12.8%
W. Rice – GN_{2004}	3924	3333	47774	3443 ± 1278	13.4%
W. Rice – EF_{2009}	6732	969	------	3150 ± 9470	69.9%
W. Rice – GN_{2009}	7307	3499	------	5962 ± 7670	40.4%
Harriet – EF_{2009}	202	Not Calculated due to a single *df*		202 ± 191	7.5%
Harriet – GN_{2009}	356	------	------	761 ± 645	19.7%
Windy – EF_{1999}	225	204	250	133 ± 56	9.8%
Windy – EF_{2009}	713	541	1044	783 ± 338	10.0%
Windy – GN_{2009}	950	505	7829	2541 ± 1970	24.4%
Tait – EF_{2009}	1593	1544	1645	1584 ± 416	6.4%
Tait – GN_{2009}	1720	1372	2303	2212 ± 983	14.0%

[1] Schumacher and Eschmeyer population estimate.
[2] Adjusted Petersen population estimate, with 95% confidence interval.
[3] Coefficient of variation for the Petersen estimate.

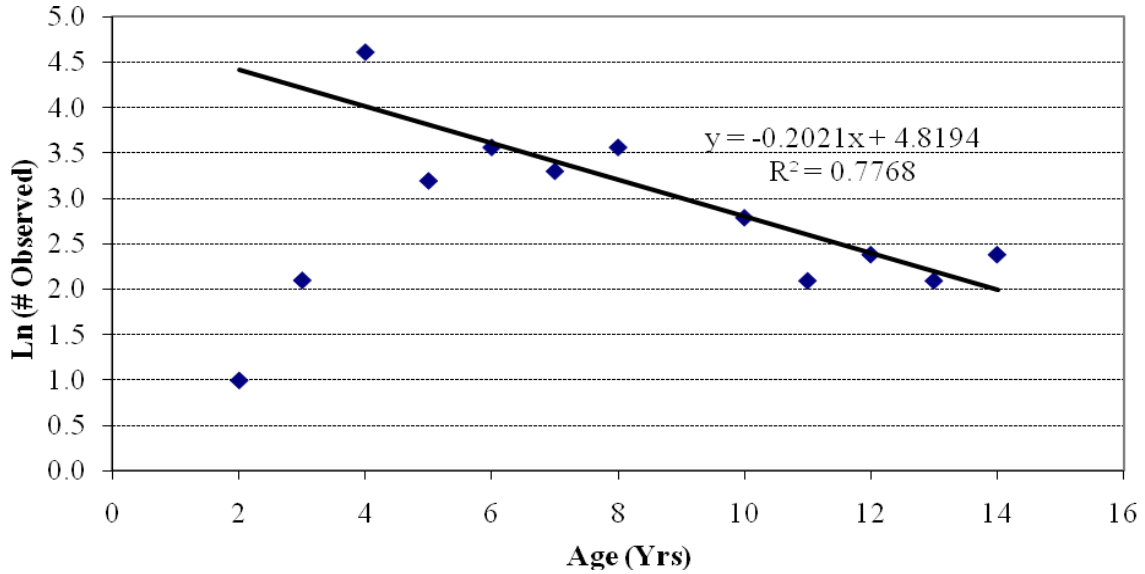

Figure 4. Instantaneous mortality (*Z*) of walleye from Wild Rice Lake. Estimates are made from April 2009 electrofishing data.

Table 3. Age frequency distribution of walleye from Wild Rice Lake, St. Louis County, spring 2009, based upon the number of fish sampled and aged per size category.

Length Group			Age														
Inches	mm	N Sampled	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
10.0	254																
10.5	267																
11.0	279	1	1														
11.5	292																
12.0	305	1		1													
12.5	318	2	2														
13.0	330	8	1	7													
13.5	343																
14.0	356	7		7													
14.5	368	10		7	3												
15.0	381	9		7	1												
15.5	394	8		5	2												
16.0	406	4		2		1											
16.5	419	8		1	1	3	2										
17.0	432	5			2	2	1										
17.5	445	5				1	2	2									
18.0	457	10				4	1	3		1							
18.5	470	14				2	2	4	2		2	2					
19.0	483	4						2		2							
19.5	495	8					2	1	1	1	1	1		1			
20.0	508	3										1	1				1
20.5	521	4						1		1				1			
21.0	533	2												1	1		
21.5	546	1											1				
22.0	559	1												1			
22.5	572																
23.0	584																
23.5	597																
24.0	610																
24.5	622	1											1				
25.0	635	1								1							
TOTAL		117	4	37	9	13	10	13	3	6	3	4	3	4	1	0	1

Table 4. Back-calculated lengths at age for walleye collected from Wild Rice Lake Reservoir, St. Louis County, Minnesota, April 2009.

Age Class	N	Length (mm)	Length (in)
1	97	107	4.2
2	97	195	7.7
3	97	283	11.1
4	93	349	13.8
5	60	387	15.2
6	52	422	16.6
7	41	444	17.5
8	32	462	18.2
9	22	474	18.7
10	20	491	19.3
11	14	492	19.4
12	12	507	20.0
13	9	526	20.7
14	6	520	20.5
15	2	511	20.1
16	1	499	19.6
17	1	508	20.0

Table 5. Proportional Stock Density (PSD) and Relative Stock Densities (RSD) with 95% confidence intervals for walleye sampled from Wild Rice Lake (St. Louis Co.), Harriet and Windy Lakes (Lake Co.), and Tait Lake (Cook Co.) 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
Wild Rice – EF_{2009}	74.8 ± 7.9	25.2 ± 7.9	63.5 ± 8.8	10.4 ± 5.6	0.9 ± 1.7
Wild Rice – GN_{2009}	53.1 ± 6.1	46.9 ± 6.1	40.2 ± 6.0	11.7 ± 3.9	1.2 ± 1.3
Wild Rice – EF_{2004}	52.1 ± 3.1	47.9 ± 3.1	49.7 ± 3.1	2.1 ± 0.9	0.2 ± 0.3
Wild Rice – EF_{2000}	69.0 ± 3.0	31.0 ± 3.0	67.4 ± 3.0	1.6 ± 0.8	0.0 ± 0.0
Harriet -- EF_{2009}	72.3 ± 6.8	27.7 ± 6.8	62.0 ± 7.4	8.4 ± 4.2	1.8 ± 2.0
Harriet -- GN_{2009}	32.9 ± 10.0	67.1 ± 10.0	24.7± 9.2	7.1 ± 5.4	1.2 ± 2.3
Windy -- EF_{2009}	25.9 ± 4.2	74.1 ± 4.2	24.1± 4.0	0.9 ± 0.9	0.7 ± 0.8
Windy -- GN_{2009}	28.2 ± 9.6	71.8 ± 9.6	24.7± 9.2	2.4 ± 3.2	1.2 ± 2.3
Windy – EF_{1999}	38.9 ± 6.8	61.1 ± 6.8	37.4 ± 6.7	1.0 ± 1.4	0.5 ± 1.0
Tait -- EF_{2009}	47.8 ± 3.3	52.2 ± 3.3	46.7± 3.3	1.0 ± 0.7	0.1 ± 0.2
Tait -- GN_{2009}	57.9 ± 11.1	42.1 ± 11.1	55.3 ± 11.2	2.6 ± 3.6	0.0 ± 0.0

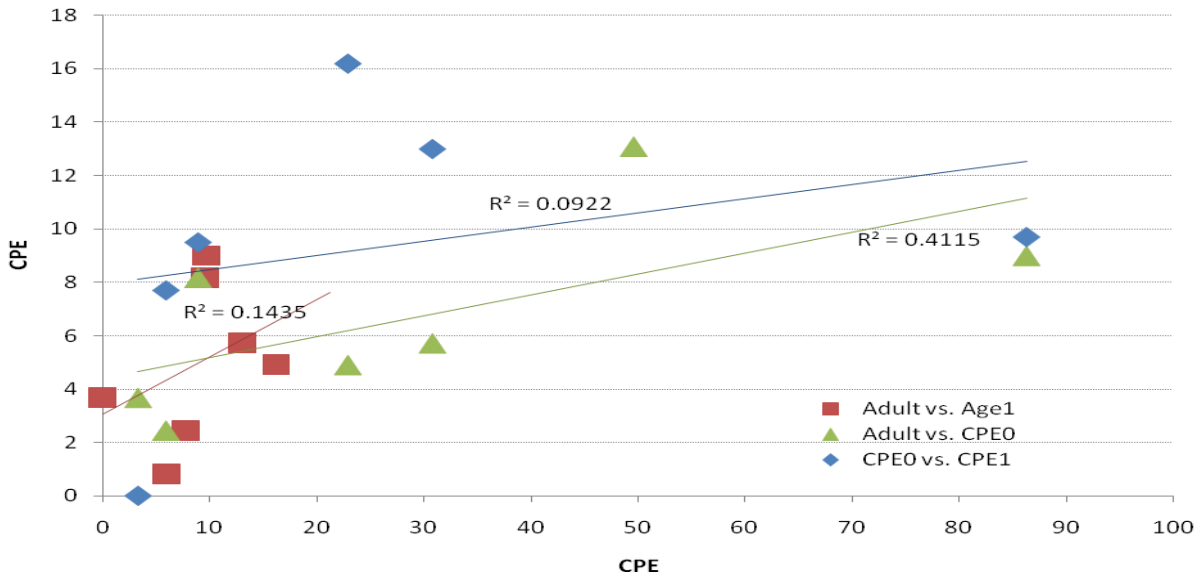

Figure 5. Relationship between spring 2009 electrofishing catch rates (#/hr) of adult walleyes in the MN DNR gill nets and the same cohort when sampled as age-0 and age-1 in the fall, in Wild Rice Lake.

Harriet Lake

Electrofishing activities were conducted on Harriet Lake from 7 – 8 May (Figure 5). Dates of electrofishing activities, mean water temperature, mean 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 for each night ranged from 36.9 adult walleye per hour of sampling on the first night when the entire shoreline was surveyed, to 90.1 on the second night when only the best habitat was surveyed (Table 1). Catch rates ranged from 0.0 walleye / hour (EF2, 7 May) to 183.0 walleye / hour (EF5, 7 May) (Figure 6). At an 80% confidence interval, mean CPUE for Harriet Lake, determined using each sampling station, was 39.4 ± 26.9 adults per hour of sampling effort. Areas characterized by soft bottom substrates were identified during the first evening of the survey, and were not repeated on the second night. Walleyes were not using these areas of the lake for spawning activities. Additional species observed included yellow perch, white sucker, northern pike, black crappie, and burbot.

The length frequency of the walleye sampled from Harriet Lake is presented in Figure 7. Table 6 presents the age data for the walleye collected from Harriet Lake. Of the 170 walleye sampled, 123 were assigned ages 3 - 9. Table 7 presents back-calculated lengths at age for walleye collected from Harriet Lake. Instantaneous mortality (*Z*) for the Harriet Lake walleye population is estimated at 24.4% (Figure 8). Total annual mortality (*A*) was estimated to be 21.7%.

Table 2 presents the population estimates based upon mark-recapture data. The electrofishing Schumacker and Eschmeyer population estimate is 202 (Table 2). The electrofishing adjusted Petersen estimate is 202 ± 191, with a 7.5% CV (Table 2). During summer 2009, the Minnesota Department of Natural Resources performed a standardized net assessment on Harriet Lake (MN DNR, Finland Area Fisheries). Eighty-four walleyes (> 264 mm) were sampled in the gill nets that would have been 254 mm during the May assessments, with 18 of those observed to have a fin clip from the spring sampling. The adjusted Petersen estimate using both the summer and spring data is 761 ± 645, with a 19.7% CV (Table 2). The Schumacker and Eschmeyer population estimate from the net data is 356 (Table 2).

PSD and RSD values determined by our spring electrofishing sampling are presented in Table 5. The electrofishing PSD of 72.3 ± 6.8 (Table 5) suggests the population is balanced (Anderson and Weithman 1978). The gill net PSD of 32.9 ± 10.0 was significantly different from the electrofishing PSD estimate (χ^2=36.0, P<0.05, Table 5).

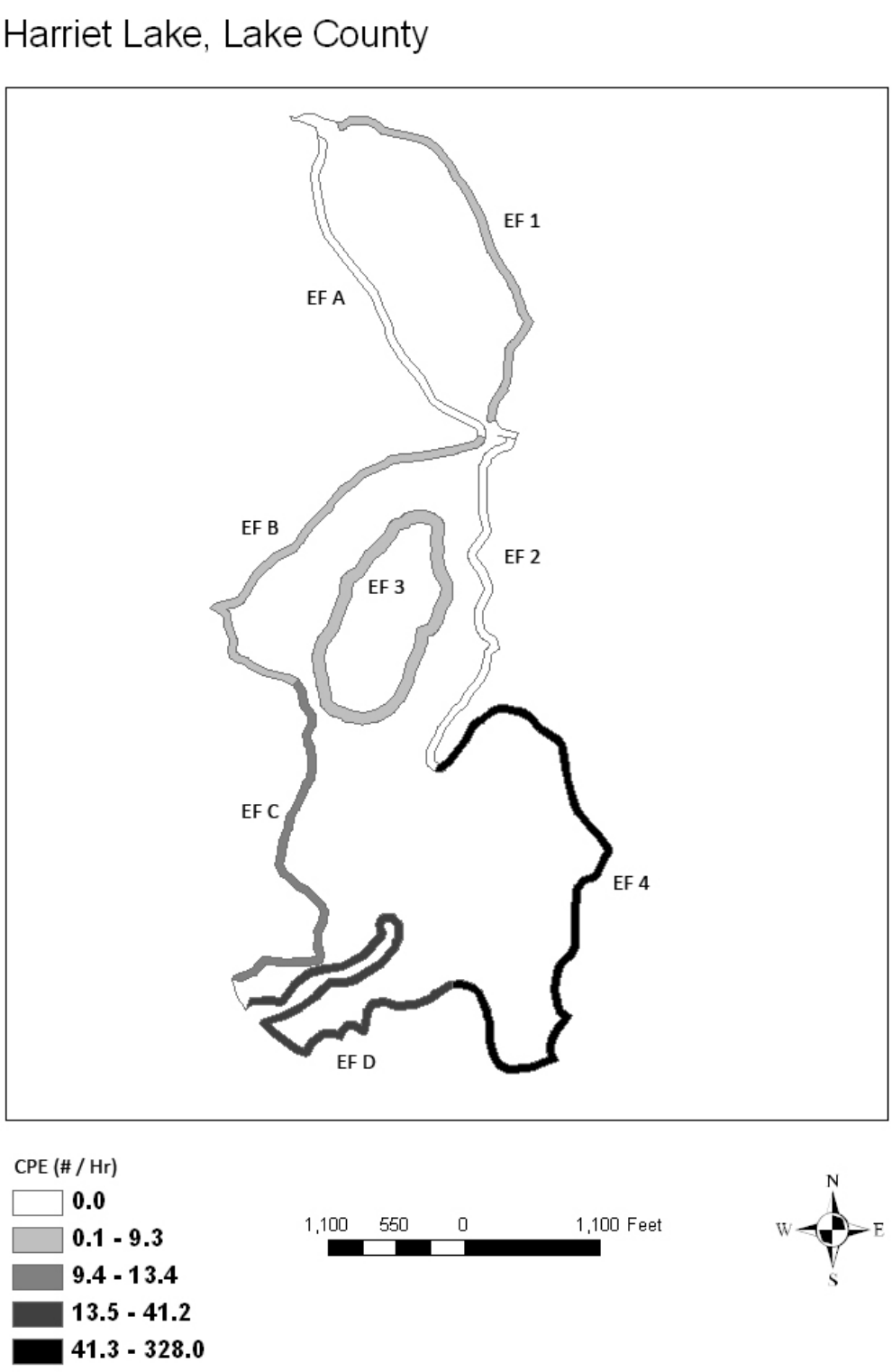

Figure 6. Catch per hour (CPE) of adult walleyes on Harriet Lake, Lake County, during spring 2009 electrofishing surveys.

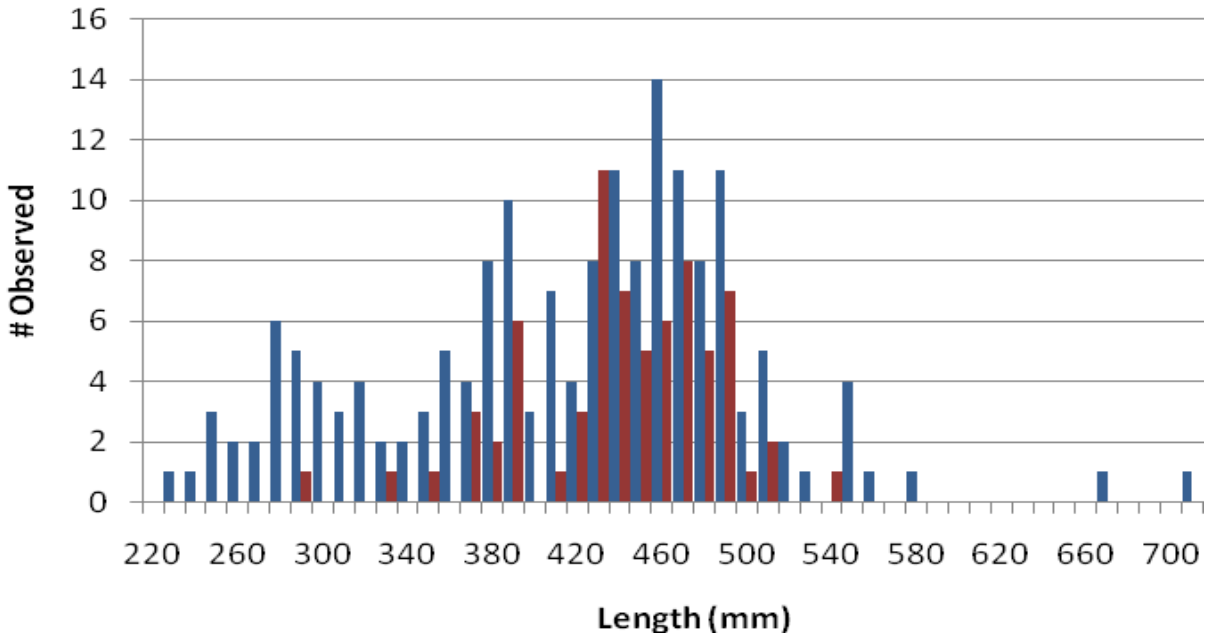

Figure 7. Length frequency distribution of walleye sampled from Harriet Lake, Lake County, MN, during spring 2009 electrofishing assessments. Blue bars represent unmarked walleyes observed, while red bars represent the length frequency of the recaptured walleyes observed.

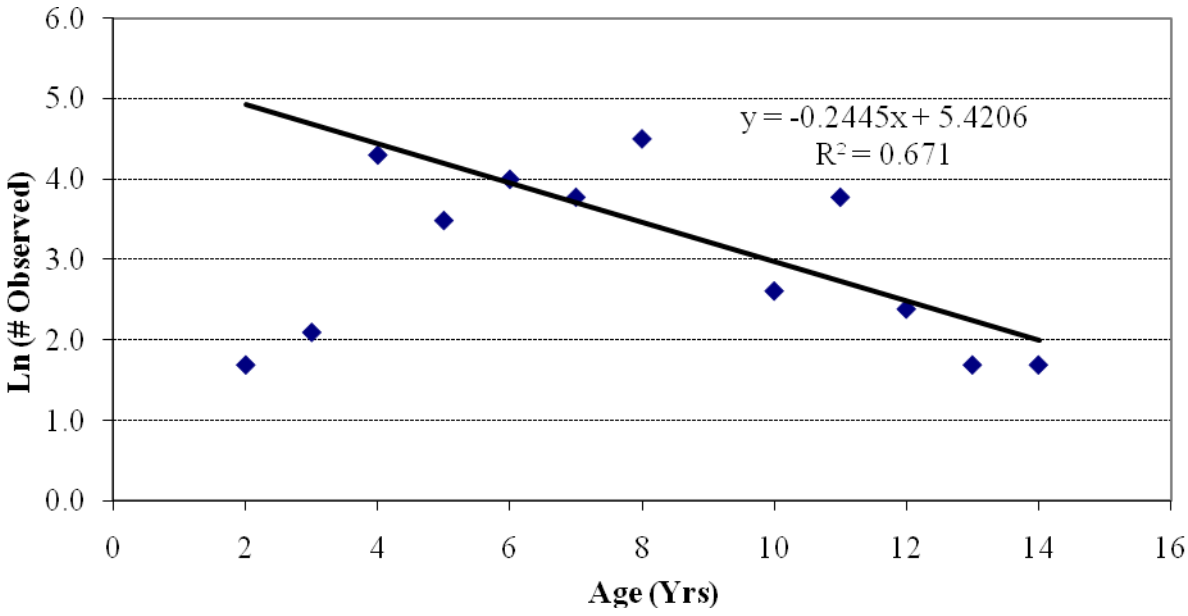

Figure 8. Instantaneous mortality (*Z*) of walleye from Harriet Lake. Estimates are from May 2009 electrofishing data.

Table 6. Age frequency distribution of walleye from Harriet Lake, Lake County, spring 2009, 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	15	16
9.0	228.6	1															
9.5	241.3	2															
10.0	254	4	2	1													
10.5	266.7	2		1	1												
11.0	279.4	6		3	3												
11.5	292.1	7		1	6												
12.0	304.8	4			4												
12.5	317.5	5		1	4												
13.0	330.2	3			2	1											
13.5	342.9	4			3	1											
14.0	355.6	5			2	2	1										
14.5	368.3	6				3	3										
15.0	381	11			1	3	5	1									
15.5	393.7	8			1	2	3	1									
16.0	406.4	7					3	1	3								
16.5	419.1	6					1	2	1	2							
17.0	431.8	11					2	2	5	2							
17.5	444.5	13					1	7	2	1		1					
18.0	457.2	15					1		6	4		4					
18.5	469.9	13							5	4	1	3					
19.0	482.6	15						1	7		3	4	1				
19.5	495.3	5								1		1	1	1			
20.0	508	6						1	1			2	1				
20.5	520.7	1							1								
21.0	533.4	1											1				
21.5	546.1	4							2	1				1			
22.0	558.8	1										1					
22.5	571.5	0															
23.0	584.2	1									1						
26.0	660.4	1													1		
28.0	711.2	1														1	
29.0	736.6	1															1
TOTAL		170	2	7	27	12	20	16	33	15	5	16	4	2	1	1	1

Table 7. Back-calculated lengths at each age class for walleye collected from Harriet Lake, Lake County, Minnesota, May 2009.

Age Class	N	Length (mm)	Length (in)
1	146	92	3.6
2	146	168	6.6
3	146	239	9.4
4	139	297	11.7
5	108	354	13.9
6	97	398	15.7
7	78	435	17.1
8	64	463	18.2
9	38	475	18.7
10	28	500	19.7
11	22	510	20.1
12	10	551	21.7
13	6	597	23.5
14	4	648	25.5
15	2	718	28.3
16	1	737	29

Windy Lake

Electrofishing activities were conducted on Windy Lake on 8 – 10 May (Figure 9). Dates of electrofishing activities, mean water temperature, mean 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. Based upon the 1999 electrofishing survey, and the catch rates observed lakewide, only stations EF2 and EF4 were surveyed in 2009. CPUE for each night ranged from 148.6 to 168.8 adult walleye per hour of sampling (Table 1). At an 80% confidence interval, mean CPUE for Windy Lake, determined using each sampling station, was 155.0 ± 20.4 adult walleye (>254mm) per hour of sampling effort. Catch rates ranged from 119.7 adult walleye per hour (EF2, 9 May) to 201.0 adults per hour (EF4, 9 May) (Figure 9).

The length frequency of the walleye sampled is presented in Figure 10. While walleye as large as 767 mm (30.2 inches) were observed in the survey, the majority of the fish sampled were between 320 mm and 400 mm (12.6 – 15.7 inches, Figure 10). Incidentally, only a single walleye was observed that was a recaptured individual from the 1999 survey, a 577 mm male aged at 14-years. Additional species observed included white sucker, black crappie, burbot, troutperch, sculpin, logperch, rock bass, whitefish, and northern pike.

Table 2 presents various population estimates based upon mark-recapture data for both the spring electrofishing survey and the summer gill-net assessment. The Schumacker and Eschmeyer population estimate from the electrofishing data is 713 (Table 2). The adjusted Petersen estimate is 372 ± 338, with a 10.0% CV (Table 2). This estimate is largely of that portion of the population using the lake's outflow creek for spawning activities. The 2009 population estimate of walleyes larger than 254 mm (10.0 inches) is higher than that estimated in 1999 (Table 2), but due to the limited portion of the lake actually sampled, there should be little weight placed on these PEs.

During summer 2009, the Minnesota Department of Natural Resources performed a standardized net assessment on Windy Lake (MN DNR, Finland Area Fisheries). Seventy-six walleyes (> 265 mm) were sampled in the gill nets that would have been 254 mm during the May assessments, with twelve of those observed to have a fin clip from the spring sampling. The adjusted Petersen estimate using both the summer and spring data is 2541 ± 1970, with a 24.4% CV (Table 2). The Schumacker and Eschmeyer population estimate from the net data is 950 (Table 2).

Table 8 presents the age data for the walleye collected from Windy Lake. Of the 431 unique fish sampled, 389 were assigned to ages 4 through 8. The 2002 (age-7) and 2003 (age-6) year class were observed to be stronger than normal during previous fall electrofishing surveys (Borkholder and Edwards 2002b) (Figure 11). Of interest, the 1998 cohort was observed to be exceptional (Figure 11, Borkholder and Edwards 1999), and individuals in this cohort are still observed in the population (Table 8).

Instantaneous mortality (*Z*) of the Windy Lake population was estimated at 48.9% (Figure 12). Total annual mortality (*A*) was estimated to be 38.7%. Table 9 presents back-calculated lengths at age for walleye collected from Windy Lake.

The relationship between age-0 and age-1 fall electrofishing data and spring 2009 adult data is presented in Figure 13, for ages 3 - 9. Weak relationships were observed between the adult data and the age-0 and age-1 data for data through the 1995 cohort, suggesting that the use of this older data to forecast adult populations in Windy Lake may be limited. However, when just using more recent data, the 2000 cohort through the 2006 cohort, the data suggests that the use of fall age-1 electrofishing assessments can be used to forecast strong and weak year classes once they recruit into the adult population (Figure 13).

PSD and RSD values determined by our spring electrofishing sampling and summer gillnet survey are presented in Table 5. The electrofishing PSD of 25.9 ± 4.2 (Table 5) suggests a population characterized by smaller individuals, less than 15.0 inches (Anderson and Weithman 1978). The summer gill net PSD (28.2 ± 9.6) is not significantly different than the PSD estimate from the spring electrofishing survey (χ^2=0.19, P>0.05, critical Chi-square value of 3.841). No significant differences were observed in any of the RSD metrics between the electrofishing and gill net assessments during 2009 assessments (Table 5). PSD metrics calculated from the 1999 electrofishing assessments are included for comparison (Borkholder and Edwards 2000b). Significant differences were observed between the 2009 PSD and the 1999 PSD (χ^2=10.81, P<0.05, critical Chi-square value of 3.841), and between the 2009 RSD Q-P and the 1999 RSD Q-P (χ^2=-3.29, P<0.05, critical Chi-square value of -1.64). This would suggest that the stock structure has changed into one dominated by smaller, stock to quality sized individuals. This could be a result of either overharvest or recent strong year classes recruiting into the population. A creel survey would be necessary to determine angler use of Windy Lake. Our fall assessment data does not identify any particularly strong year classes in the last four or five years, but rather consistent reproduction (Figure 11). We have no data on most of the year classes that would have been observed as mature fish in the 1999 survey.

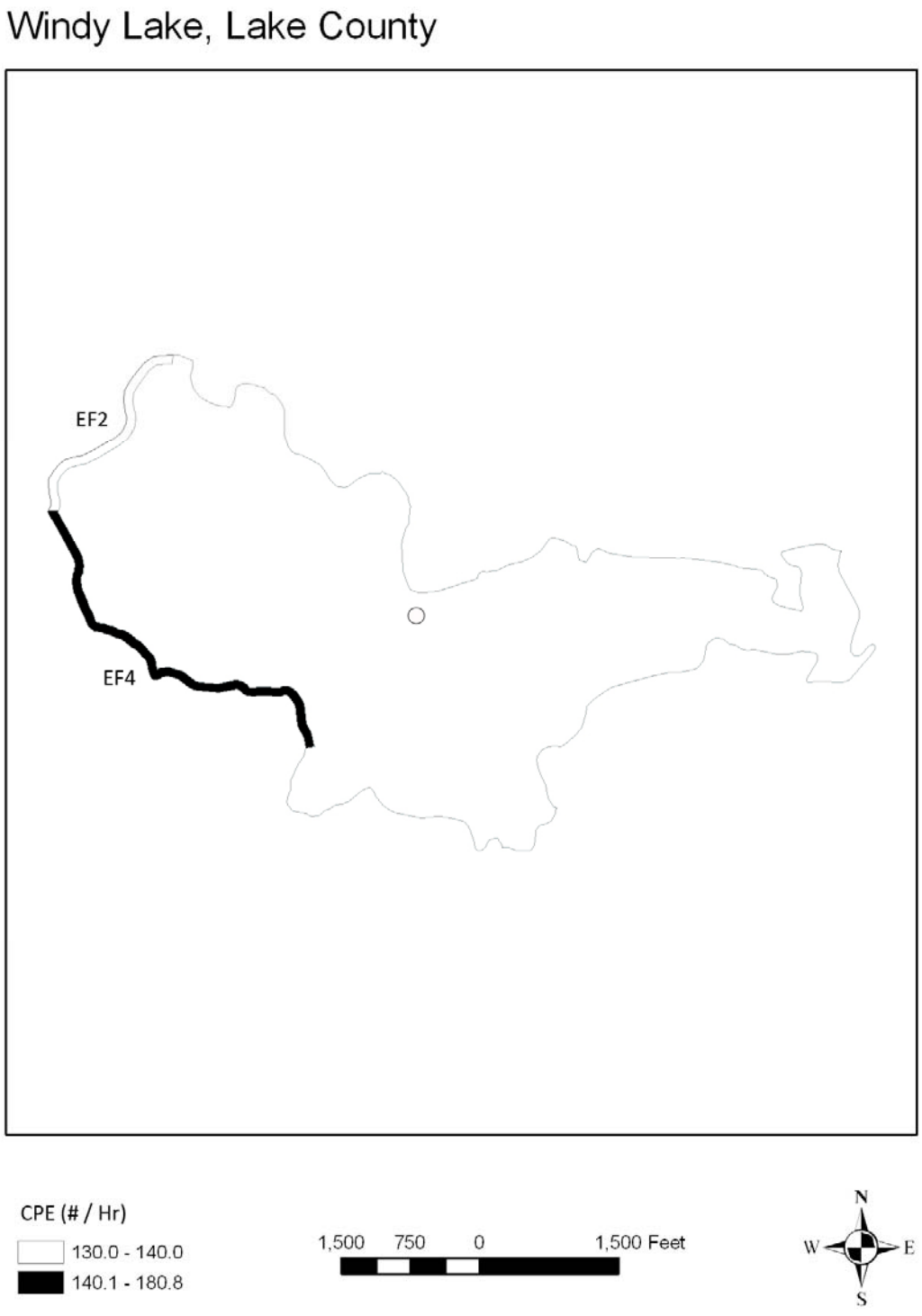

Figure 9. Catch per hour (CPUE) of adult walleyes on Windy Lake, Lake County, during spring 2009 electrofishing surveys.

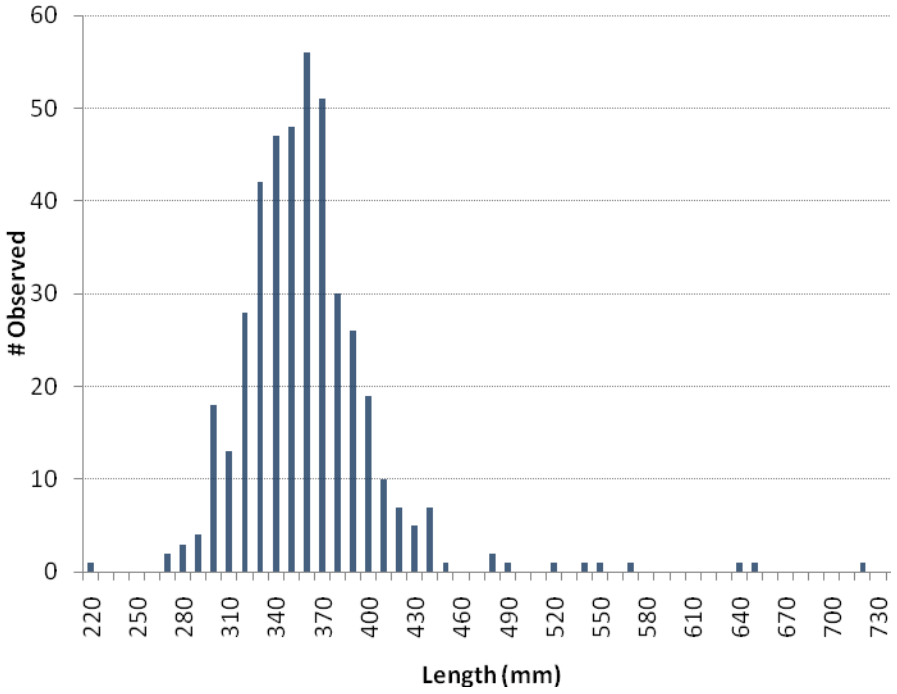

Figure 10. Length frequency distribution of walleye sampled from Windy Lake, Lake County, MN, during spring 2009 electrofishing assessments. Bars do not include counts of recaptured individuals. Recaptured individuals were not measured in Windy Lake, but were only counted.

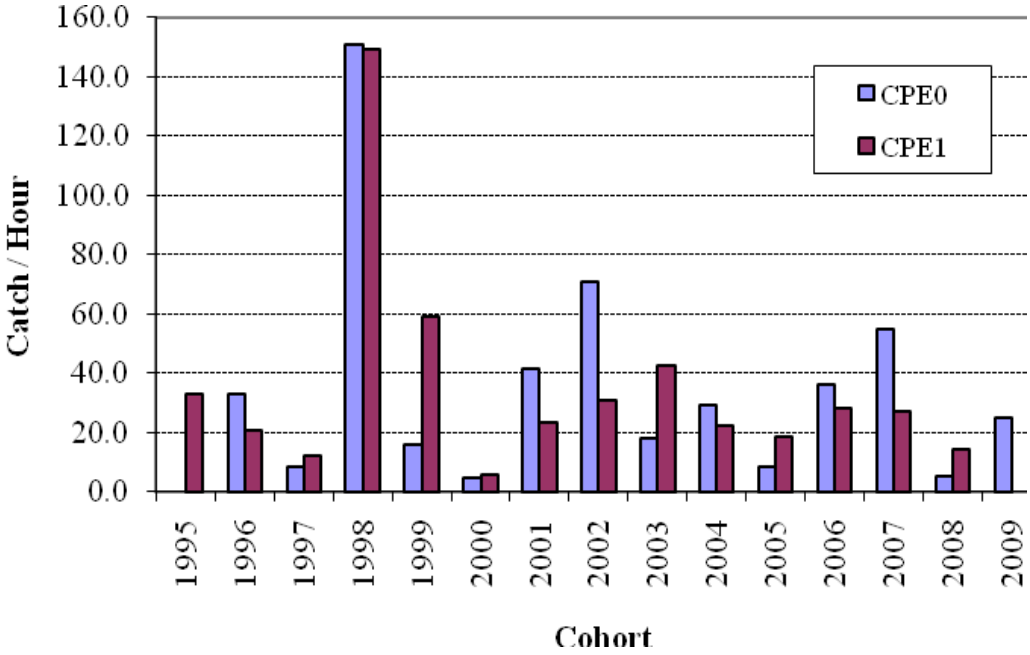

Figure 11. Catch per hour of age-0 and age-1 walleyes from Windy Lake, from 1995 until 2009.

Table 8. Age frequency distribution of walleye from Windy Lake, Cook County, spring 2009, 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	14	15
10.0	254	0													
10.5	267	2	2												
11.0	279	5	5												
11.5	292	10	3	7											
12.0	305	22	2	11	9										
12.5	318	35		18	17										
13.0	330	46		12	29	6									
13.5	343	70			42	14	14								
14.0	356	67				40	13	13							
14.5	368	62				21	10	21	10						
15.0	381	35				14	7	14							
15.5	394	27				5	17	5							
16.0	406	18				4	8	6							
16.5	419	9				1	2	3	1	1					
17.0	432	9				1	3		2	2					
17.5	445	2					2								
18.0	457	1									1				
18.5	470	1									1				
19.0	483	2						1			1				
19.5	495	0													
20.0	508														
20.5	521	1									1				
21.0	533	1								1					
21.5	546	1													1
22.0	559														
22.5	572	1										1			
25.5	597	2												1	1
28.5	610	1									1				
30.0	622	1												1	
TOTAL		431	12	47	97	106	77	63	13	4	5	1	0	2	2

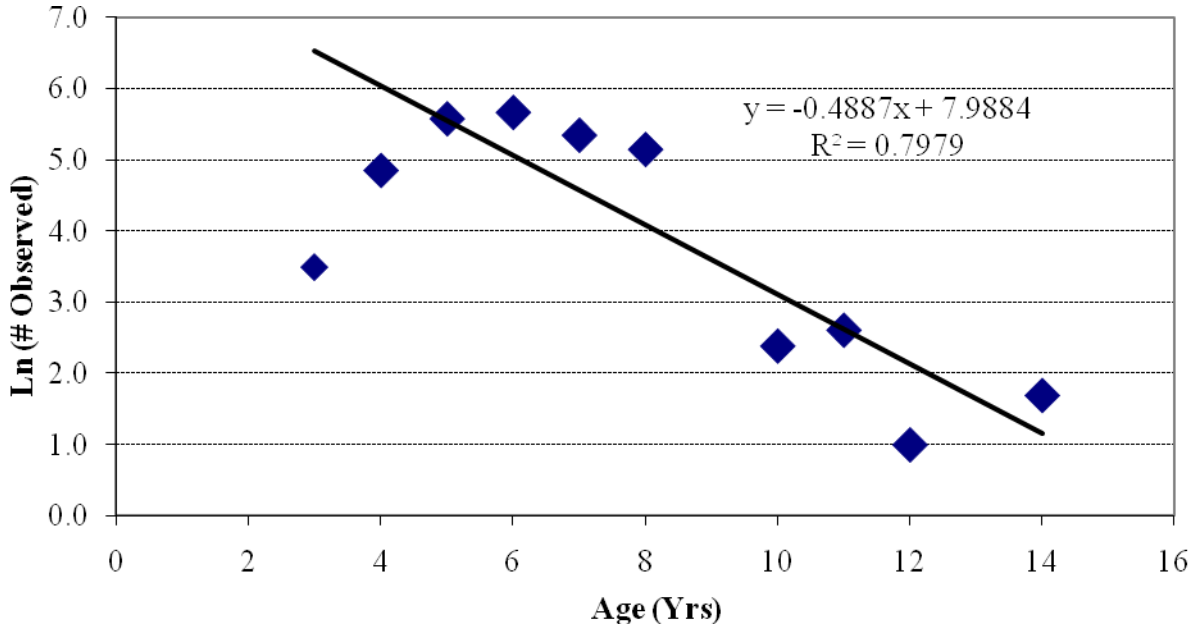

Figure 12. Instantaneous mortality (*Z*) of walleye from Windy Lake. Estimates are from May 2009 electrofishing data.

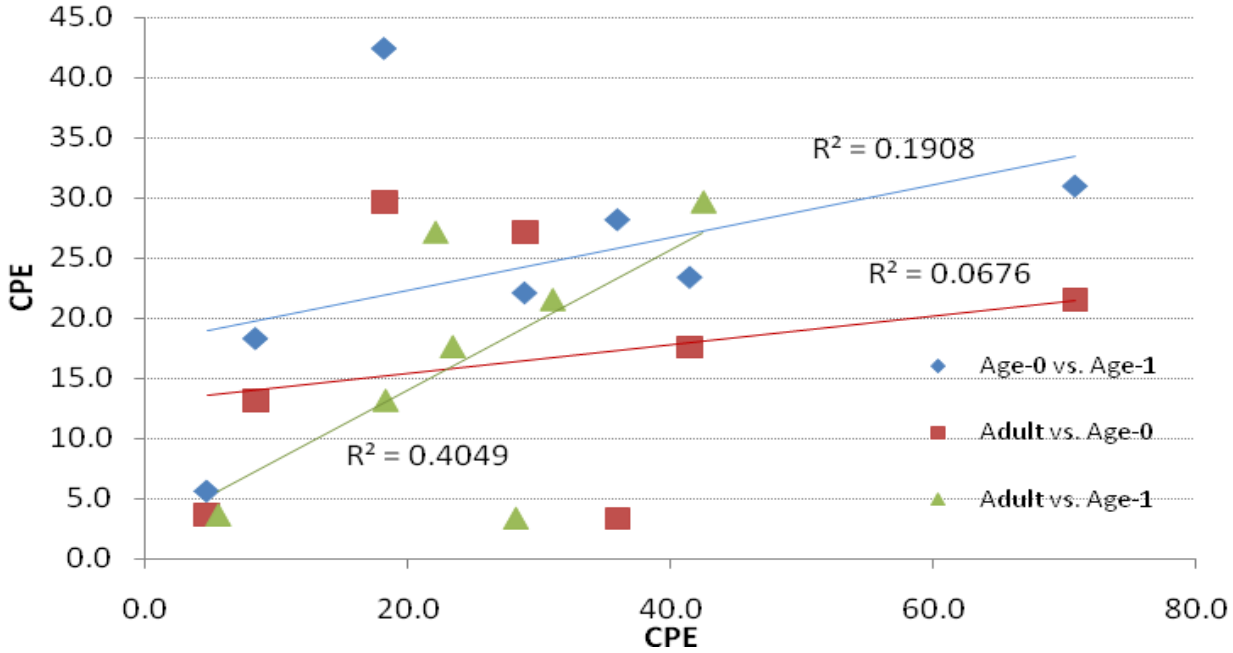

Figure 13. Relationship between spring 2009 electrofishing catch rates (#/hr) of adult walleyes in the MN DNR gill nets and the same cohort when sampled as age-0 and age-1 in the fall, in Windy Lake. Cohorts selected for analysis are from the 2000 year class through the 2006 year class.

Table 9. Back-calculated lengths at each age class for walleye collected from Windy Lake, Lake County, Minnesota, May 2009.

Age Class	N	Length (mm)	Length (in)
1	116	122	4.8
2	116	200	7.9
3	116	264	10.4
4	109	312	12.3
5	96	348	13.7
6	73	379	14.9
7	58	403	15.9
8	33	426	16.8
9	19	464	18.3
10	16	492	19.4
11	11	531	20.9
12	6	558	22.0
13	5	579	22.8
14	5	602	23.7
15	2	604	23.8

Tait Lake

Electrofishing activities were conducted on Tait Lake on 9 – 11 May (Figure 14). Dates of electrofishing activities, mean water temperature, mean 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 for each night ranged from 78.5 to 126.5 adult walleye per hour of sampling (Table 1). At an 80% confidence interval, mean CPUE for Tait Lake, determined using each sampling station, was 109.5 ± 23.9 adult walleye (>254mm) per hour of sampling effort. Catch rates ranged from 33.9 adult walleye per hour (EF1, 9 May) to 259.1 adults per hour (EF5, 11 May) (Figure 14).

The length frequency of the walleye sampled is presented in Figure 15. Walleye as large as 725 mm (28.5 inches) were observed in the survey. Interestingly, a 356 mm (14.0 inch) walleye was sampled

that was a recapture from presumably the 2007 White Pine Lake survey. This suggests that many of these populations in the Superior National Forest may not be isolated units. This individual presumably moved from White Pine in May 2007, up the Tait River through Clara and Wills Lakes, and into Tait Lake by May 2009. Unfortunately, no additional species were noted on the Catch Report Forms.

Table 2 presents various population estimates based upon mark-recapture data for both the spring electrofishing survey and the summer gill-net assessment. The Schumacker and Eschmeyer population estimate from the electrofishing data is 1593 (Table 2). The adjusted Petersen estimate is 1584 ± 416, with a 6.1% CV (Table 2).

In August 2009, the Minnesota Department of Natural Resources performed a standardized net assessment on Tait Lake (MN DNR, Grand Marais Area Fisheries). Seventy five (75) walleyes (> 265 mm) were sampled in the gill nets that would have been 254 mm during the May assessments, with 29 of those observed to have a fin clip from the spring sampling. The adjusted Petersen estimate using both the summer and spring data is 2212 ± 983, with a 14.0% CV (Table 2). The Schumacker and Eschmeyer population estimate from the net data is 1720 (Table 2). Both of these estimates compare well with those obtained from just the spring electrofishing data.

Table 10 presents the age data for the walleye collected from Tait Lake. Instantaneous mortality (*Z*) of the Tait Lake population was estimated at 30.3% (Figure 16). Total annual mortality (*A*) was estimated to be 26.1%. Table 11 presents back-calculated lengths at age for walleye collected from Tait Lake.

PSD and RSD values determined by our spring electrofishing sampling and summer gillnet survey are presented in Table 5. The electrofishing PSD of 47.8 ± 3.3 (Table 5) suggests a balanced population (Anderson and Weithman 1978). The summer gill net PSD (57.9 ± 11.1) is not significantly different than the PSD estimate from the spring electrofishing survey (χ^2=2.84, P>0.05, critical Chi-square value of 3.841). The only significant difference observed in any of the RSD metrics between the electrofishing and gill net assessments during 2009 assessments was in the proportion of quality to preferred length walleyes (RSD Q-P) (χ^2= -1.68, P=0.05, critical Chi-square value of -1.64) (Table 5).

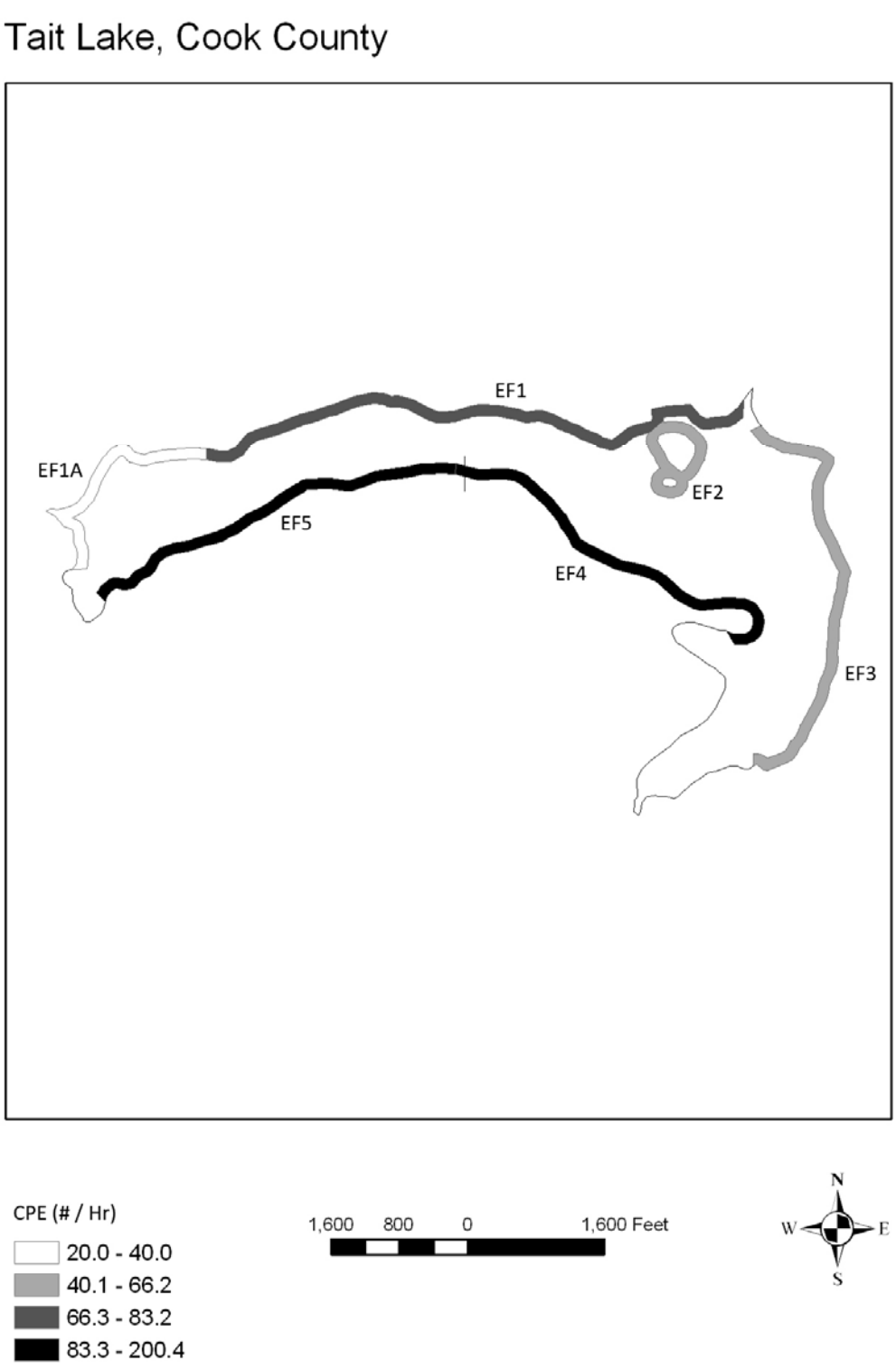

Figure 14. Catch per hour (CPE) of adult walleyes on Tait Lake, Cook County, during spring 2009 electrofishing surveys.

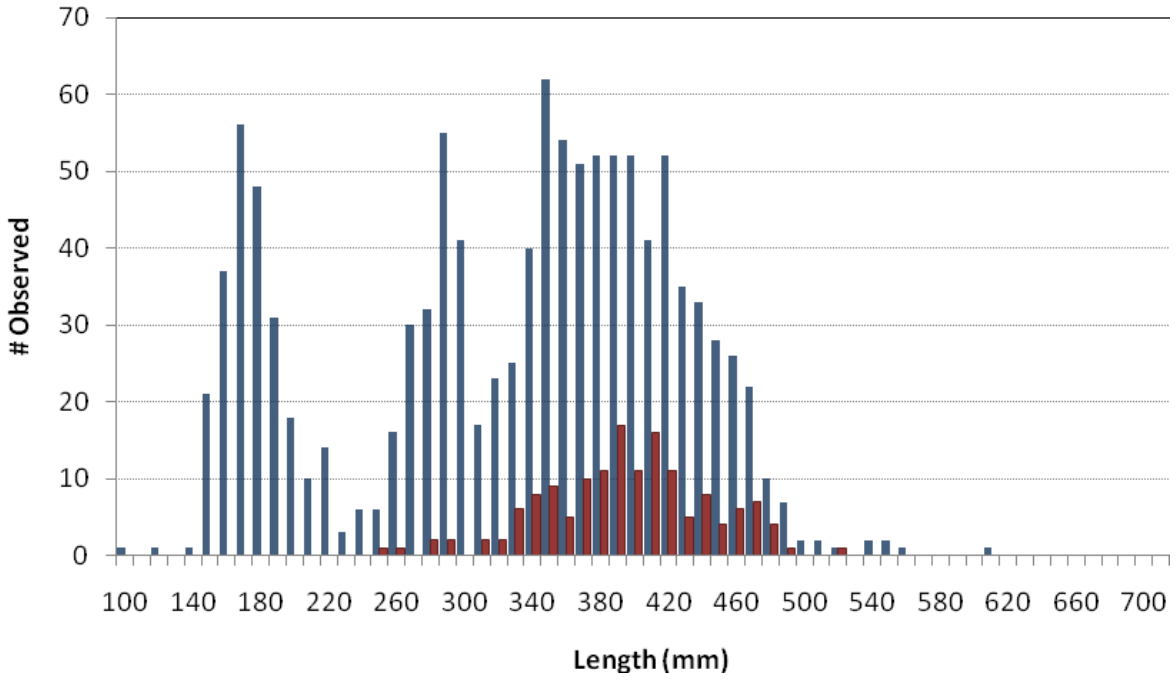

Figure 15. Length frequency distribution of walleye sampled from Tait Lake, Cook County, MN, during spring 2009 electrofishing assessments. Blue bars represent unmarked walleyes observed, while red bars represent the length frequency of the recaptured walleyes observed.

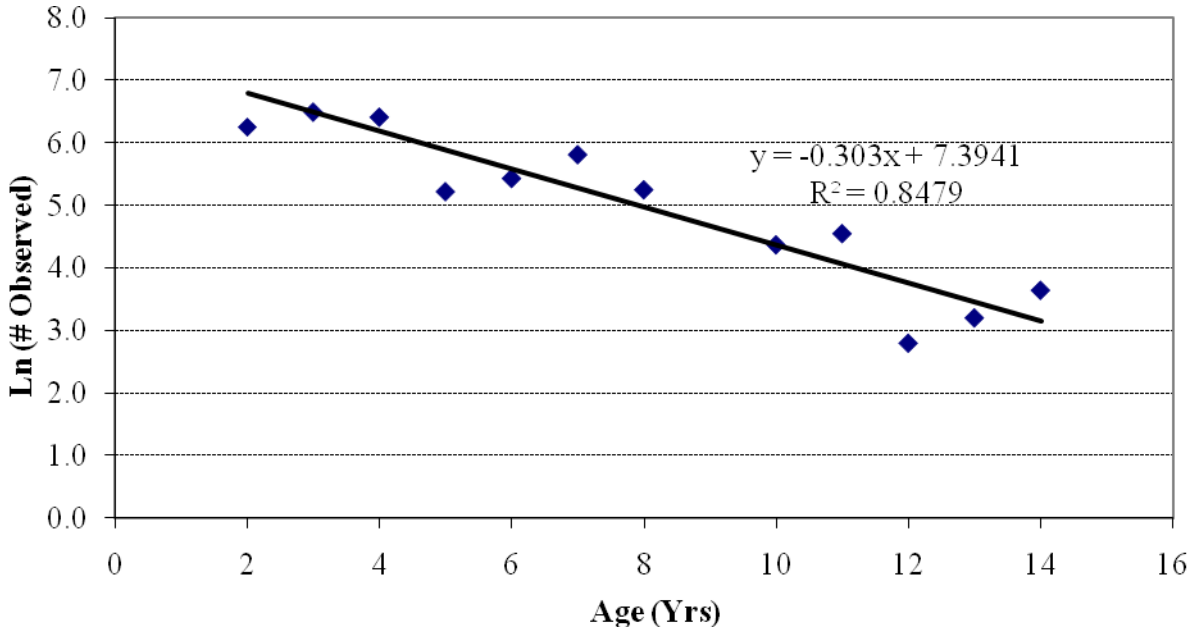

Figure 16. Instantaneous mortality (*Z*) of walleye from Tait Lake. Estimates are from May 2009 electrofishing data.

Table 10. Age frequency distribution of walleye from Tait Lake, Cook County, spring 2009, 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	15	16	21
6.0	152.4	37	37															
6.5	165.1	65	65															
7.0	177.8	60	50	10														
7.5	190.5	35	31	4														
8.0	203.2	19	8	11														
8.5	215.9	16		16														
9.0	228.6	6		6														
9.5	241.3	5		5														
10.0	254	17		17														
10.5	267	34		34														
11.0	279	48		48														
11.5	292	64		64														
12.0	305	33		28	5													
12.5	318	25			25													
13.0	330	32			27	5												
13.5	343	74			66	8												
14.0	356	67			48	19												
14.5	368	61			43	9	9											
15.0	381	71					36	35										
15.5	394	61			10	10	20	20										
16.0	406	61				12		12	24		12							
16.5	419	60				5	11	22	22									
17.0	432	45					5	15	15		5	5						
17.5	445	39						11	6		6	17						
18.0	457	30					3	3			3	3		3	6	6	3	
18.5	470	26						5	2		2	5	2	2	5	2		
19.0	483	10									1	1	1	1	1	1		
19.5	495	5											1	2	1	1		
20.0	508	2										1		1				
20.5	521	1							1									
21.0	533	2										2						
21.5	546	2										1	1					
22.0	559	1																1
22.5	572	0																
23.0	584	0																
23.5	597	0																
24.0	610	1											1					
24.5	622	0																
28.5	724	1													1			
TOTAL		1116	191	243	224	68	84	123	70	0	29	35	6	9	14	10	3	1

Table 11. Back-calculated lengths at each age class for walleye collected from Tait Lake, Cook County, Minnesota, May 2009.

Age Class	N	Length (mm)	Length (in)
1	203	94	3.7
2	203	183	7.2
3	175	256	10.0
4	127	315	12.3
5	97	354	13.9
6	88	389	15.4
7	79	413	16.3
8	59	428	16.9
9	46	441	17.4
10	46	455	17.9
11	40	469	18.5
12	30	478	18.8
13	24	477	18.8
14	17	485	19.1
15	9	477	18.8
16	3	485	19.1
17	1	521	20.5
18	1	532	20.9
19	1	542	21.3
20	1	552	21.7
21	1	560	22.0

Fall Assessments

Table 12 presents a summary of each evening of electrofishing assessments. CPUE for age-0 walleye ranged from 0.0 fish per hour (Elbow & Devilfish Lakes) to 842.7 fish per hour of electrofishing (Pike Lake) (Table 12). CPUE for age-1 walleye ranged from 0.0 fish per hour (Wild Rice Lake) to 82.8 fish per hour of electrofishing (Shagawa Lake) (Table 12). Figures 17 – 42 present length frequency data for each of the lakes surveyed. Table 13 presents the mean length for age-0 and age-1 individuals sampled during fall 2009 assessments. Mean lengths for age-0 walleye ranged from 86 mm (3.4 inches, Ball Club Lake) to 149 mm (5.9 inches, Crooked Lake). Mean lengths for age-1 walleye ranged from 151 mm (5.9 inches, Devilfish Lake) to 231 mm (9.1 inches, Crooked Lake).

Since initiating a regular fall electrofishing program for age-0 and age-1 walleye in 1995, and excluding lakes in years of stocking by the MN DNR and results from this year's assessments, our mean $CPUE_{Age\text{-}0}$ is 79.8, and our mean $CPUE_{1+}$ is 31.0. Using the mean $CPUE_{Age\text{-}0}$ as one criterion, average or better 2009 year classes were observed in five of the lakes (Caribou, Dumbbell (*stocked spring 2009 by MNDNR*), Ninemile, Pike, & Tait Lakes, Table 12). Average or better 2008 year classes (age-1 walleye) were observed in five of the lakes (Crescent, Dumbbell, Harriet, Shagawa, and Whiteface Lakes, Table 8). As data is collected in future MN DNR standard gill net surveys, we should gain further insight as to whether these presumed strong year classes are in fact well represented as adults.

Overall, mean lengths observed in 2009 were smaller than those observed during previous years' surveys, likely due to the unseasonably cool 2009 summer. Several studies have suggested that age-0 walleye need to reach a certain critical size to have a chance at surviving their first winter (Forney 1976; Madenjian et al. 1991). Both Forney (1976) and Madenjian et al. (1991) attributed over-winter size-selected mortality of age-0 walleye to cannibalism. Forney (1976) suggested that this critical size is 175 mm (6.9 inches) in Oneida Lake, New York. If the bulk of the age-0 cohort exceeded this total length by the end of the growing season, the duration of their exposure to cannibalism would be reduced, and recruitment would be relatively high (Forney 1976). If first year growth was slower, age-0 walleye would be exposed to cannibalism by older walleye for longer periods of time.

The mean length of age-0 walleye observed since 1995 in our electrofishing assessments is 126 mm in lakes not stocked by the DNR with fingerling walleye prior to our assessments. Using the mean length criteria of 126 mm for average year classes, average or better 2009 year classes may be present in five of the lakes surveyed (Table 13). In the future, we will be further investigating the predictive power mean length and CPUE of age-0 have on CPUE of 1+ the following sampling season in northern Minnesota lakes, with the goal of determining mean length and CPUE thresholds that can be used to predict year class strength. This will be possible as we continue to combine our electrofishing data with the State's gill net data for adults. Continued monitoring of walleye young-of-the-year and year-1 fish

will give a better picture of recruitment patterns of walleye over time in these lakes, and give managers a better understanding of these walleye populations.

Acknowledgments

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Table 12. Total number and catch-per-unit-effort (CPUE) of age-0 and age-1 walleye collected by the 1854 Treaty Authority and the Fond du Lac Resource Management Division from 24 lakes within the 1854 Ceded Territory of Northeastern Minnesota during September 2009.

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	2-Sep	64	17.8	25.2	22	18	5518	14.4	11.7
Cadotte	11-Sep	71	21.7	30.0	89	27	8385	38.2	11.6
Caribou	3-Sep	66	18.9	61.9	274	30	7835	125.9	13.8
Cascade	9-Sep	67	19.4	23.4	22	62	7261	10.9	30.7
Crescent	8-Sep	70	21.1	26.8	39	29	2797	50.2	37.3
Crooked	24-Sep	68	20.0	45.4	29	17	6270	16.7	9.8
Devilfish	1-Sep	64	17.8	19.9	0	54	8403	0.0	23.1
Dumbbell	21-Sep	69	20.6	71.5	227	55	5384	151.8	36.8
Elbow	3-Sep	70	21.1	33.5	0	5	6397	0.0	2.8
Fourmile	22-Sep	70	21.1	47.2	32	12	7073	16.3	6.1
Harriet	23-Sep	69	20.6	54.5	14	62	5186	9.7	43.0
Homer	3-Sep	70	21.1	25.5	1	15	4063	0.9	13.3
Island Reservoir	9-Sep	73	22.8	78.0	50	38	11080	16.2	12.3
Ninemile	21-Sep	70	21.1	59.9	306	27	5229	210.7	18.6
N. McDougal	21-Sep	69	20.6	67.2	42	45	7020	21.5	23.1
Pike	8-Sep	70	21.1	25.5	1446	25	6177	842.7	14.6
Shagawa	10-Sep	72	22.2	83.4	23	271	11781	7.0	82.8
Silver Island	8-Sep	69	20.6	35.7	27	31	5670	17.1	19.7
Tait	2-Sep	68	20.0	37.0	174	28	4534	138.2	22.2
Tom	1-Sep	66	18.9	30.8	1	51	6450	0.6	28.5
Two Island	2-Sep	66	18.9	29.0	60	12	4617	46.8	9.4
West Twin	3-Sep	70	21.1	31.4	39	23	3615	38.8	22.9
Whiteface Res.	11-Sep	74	23.3	58.9	75	72	6671	40.5	38.9
Wild Rice	16-Sep	73	22.8	134.0	33	0	4918	24.2	0.0
Wilson	23-Sep	69	20.6	46.0	32	47	6078	19.0	27.8
Windy	22-Sep	71	21.7	29.6	29	17	4239	24.6	14.4

[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 9. Mean length for age-0 and age-1 walleye sampled during fall 2009 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.

Lake (County)	Date	Age-0 Mean Length (mm)	Age-1 Mean Length (mm)
Ball Club	2-Sep	86	175
Cadotte	11-Sep	107	210
Caribou	3-Sep	104	189
Cascade	9-Sep	96	196
Crescent	8-Sep	125	196
Crooked	24-Sep	149	231
Devilfish	1-Sep	---	151
Dumbbell	21-Sep	123	189
Elbow	3-Sep	---	174 (5)
Fourmile	22-Sep	113	182
Harriet	23-Sep	135	167
Homer	3-Sep	120 (1)	184
Island Reservoir	9-Sep	106	168
Ninemile	21-Sep	113	227
N. McDougal	21-Sep	103	171
Pike	8-Sep	116	198
Shagawa	10-Sep	140	196
Silver Island	8-Sep	123	184
Tait	2-Sep	112	185
Tom	1-Sep	109 (1)	166
Two Island	2-Sep	103	158
West Twin	3-Sep	99	189
Whiteface Res.	11-Sep	121	196
Wild Rice	16-Sep	130	---
Wilson	23-Sep	99	172
Windy	22-Sep	126	202

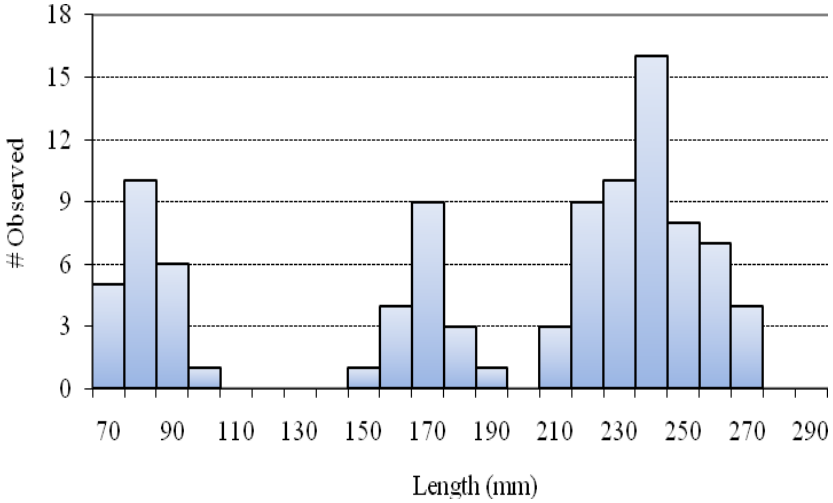

Figure 17. Length frequency distribution of walleye collected from Ball Club Lake, Cook County, during fall 2009 electrofishing assessments.

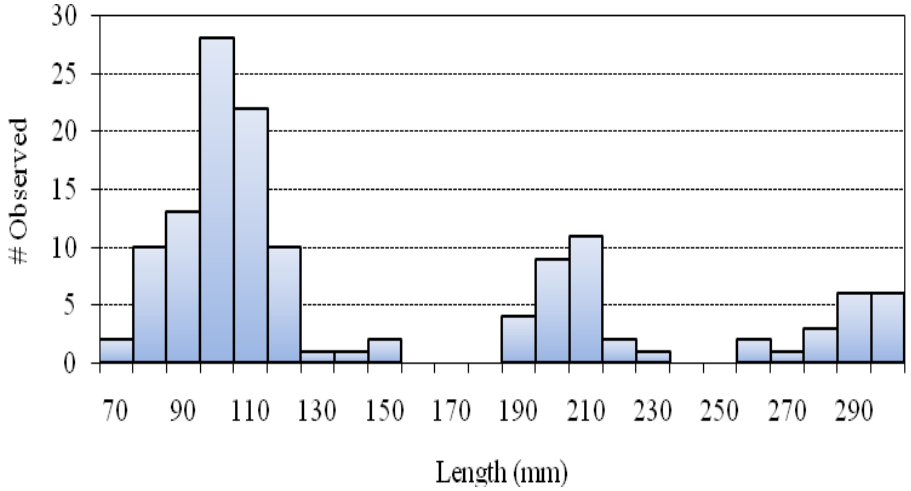

Figure 18. Length frequency distribution of walleye collected from Cadotte Lake, St. Louis County, during fall 2009 electrofishing assessments.

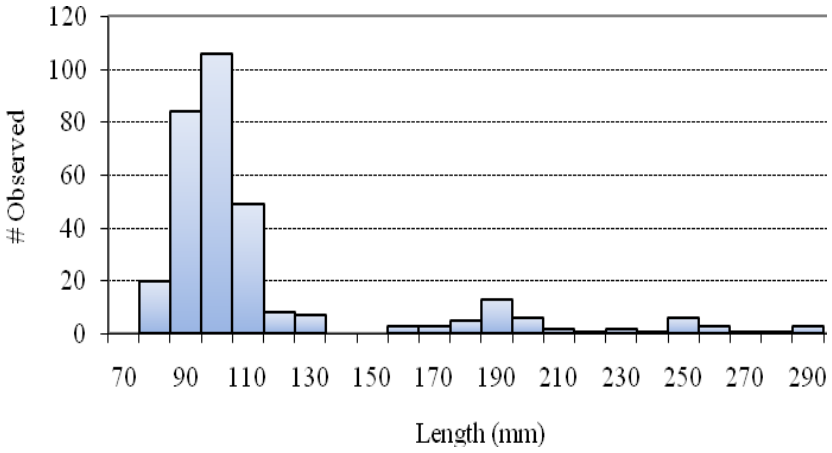

Figure 19. Length frequency distribution of walleye collected from Caribou Lake, Cook County, during fall 2009 electrofishing assessments.

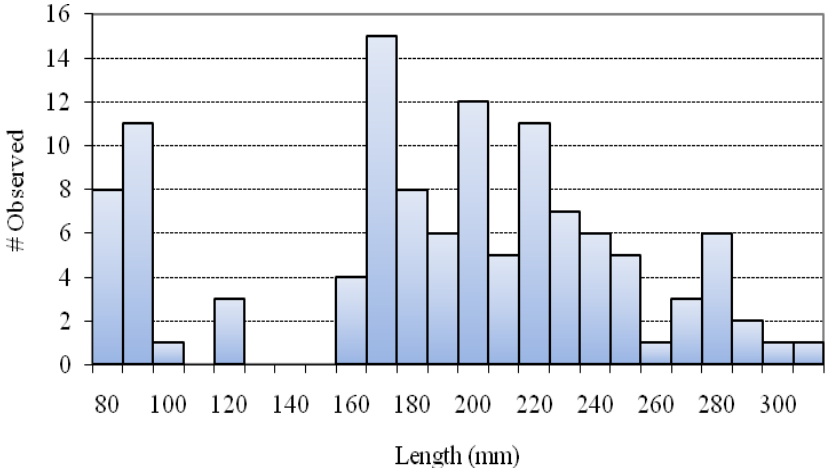

Figure 20. Length frequency distribution of walleye collected from Cascade Lake, Cook County, during fall 2009 electrofishing assessments.

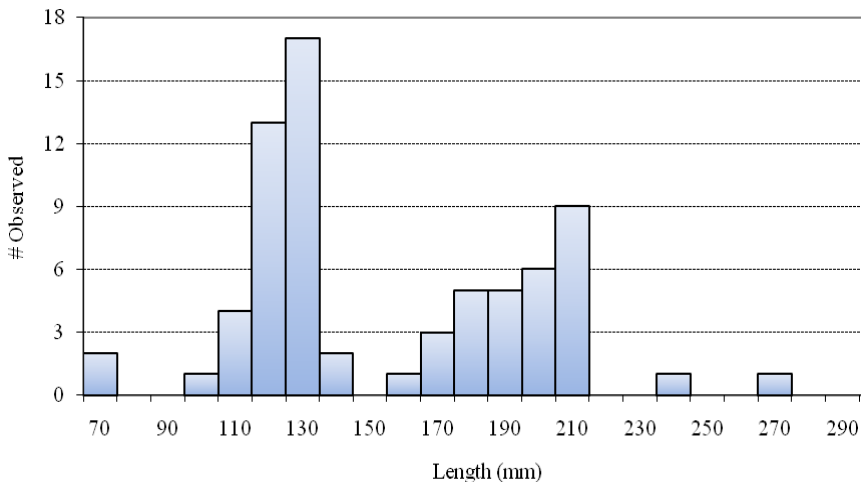

Figure 21. Length frequency distribution of walleye collected from Crescent Lake, Cook County, during fall 2009 electrofishing assessments.

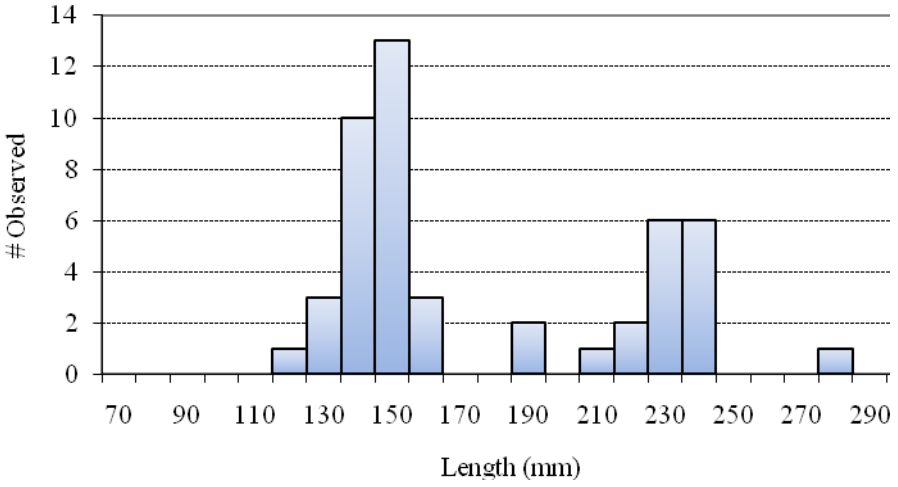

Figure 22. Length frequency distribution of walleye collected from Crooked Lake, Lake County, during fall 2009 electrofishing assessments.

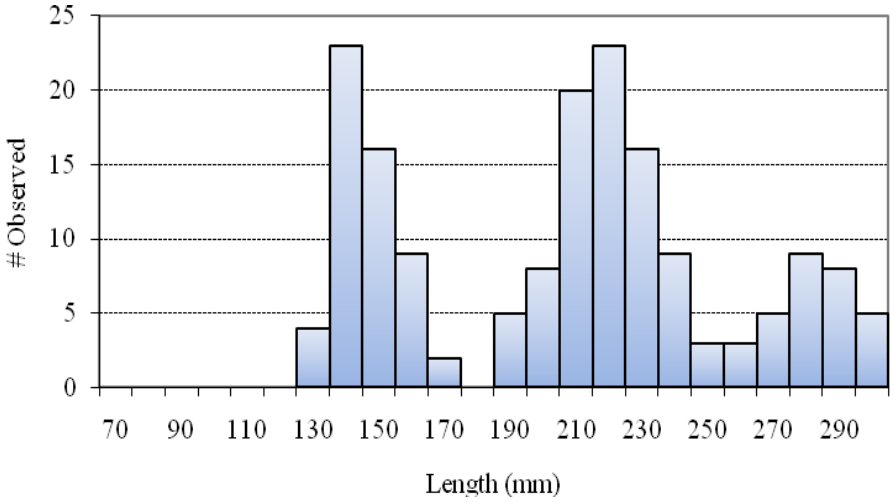

Figure 23. Length frequency distribution of walleye collected from Devilfish Lake, Cook County, during fall 2009 electrofishing assessments.

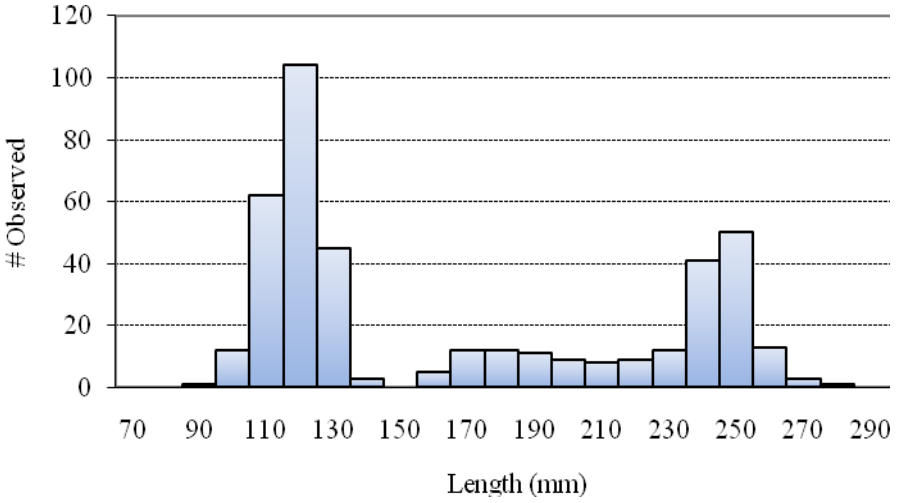

Figure 24. Length frequency distribution of walleye collected from Dumbbell Lake, Lake County, during fall 2009 electrofishing assessments.

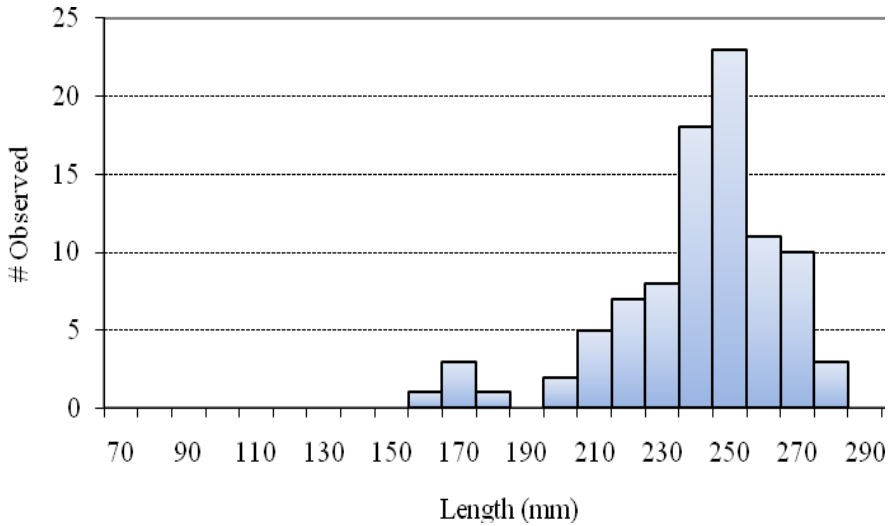

Figure 25. Length frequency distribution of walleye collected from Elbow Lake, Cook County, during fall 2009 electrofishing assessments.

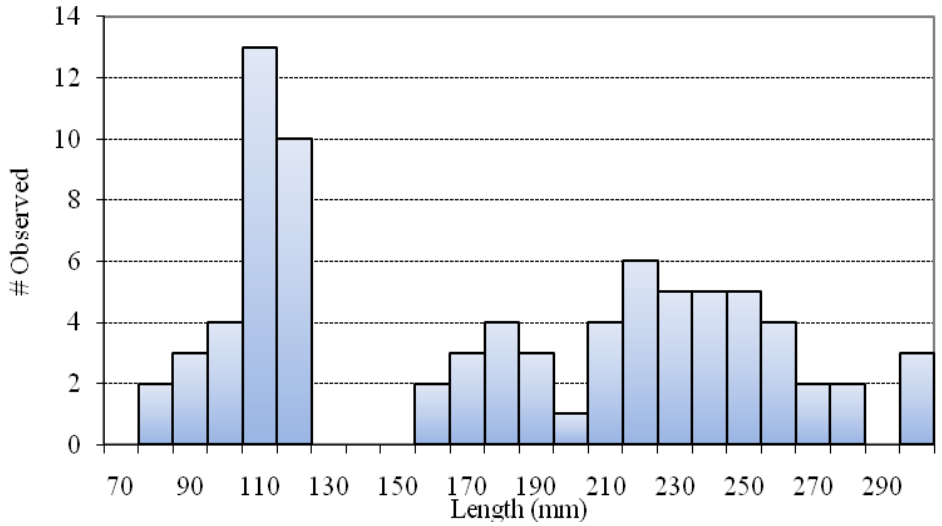

Figure 26. Length frequency distribution of walleye collected from Fourmile Lake, Cook County, during fall 2009 electrofishing assessments.

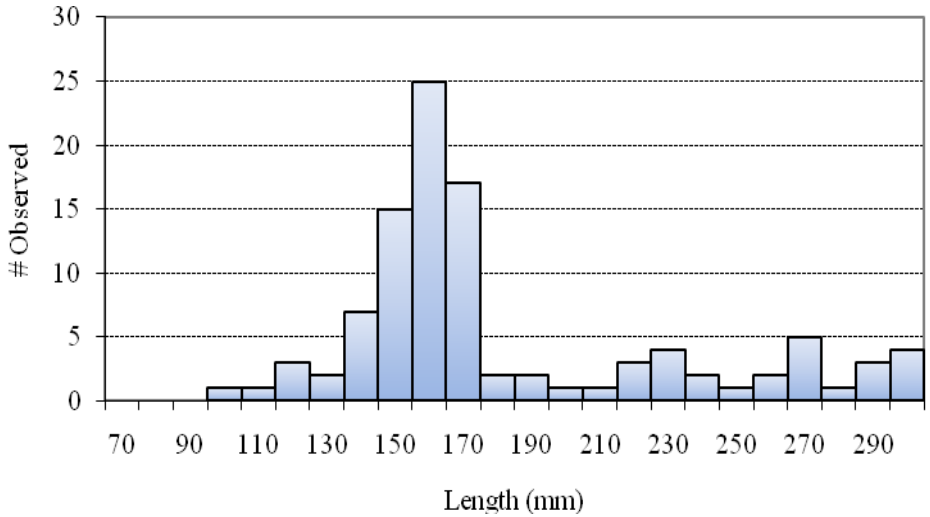

Figure 27. Length frequency distribution of walleye collected from Harriet Lake, Lake County, during fall 2009 electrofishing assessments.

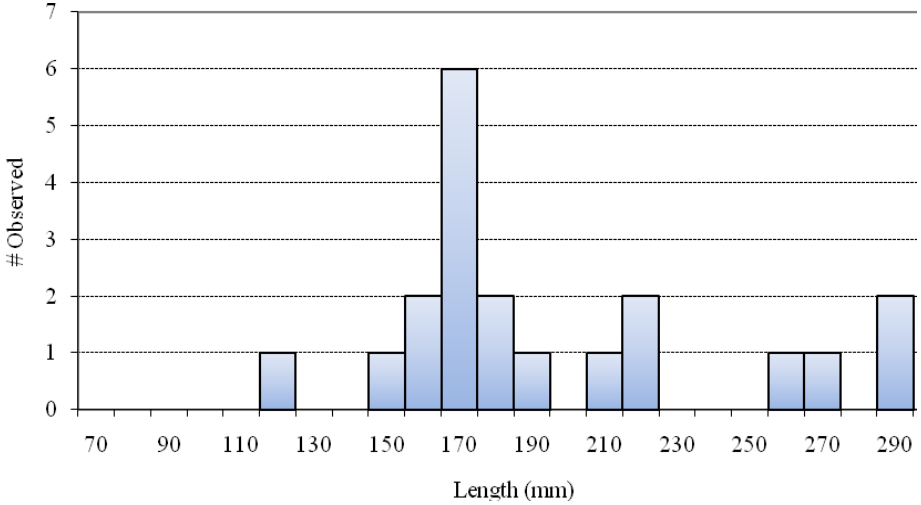

Figure 28. Length frequency distribution of walleye collected from Homer Lake, Cook County, during fall 2009 electrofishing assessments.

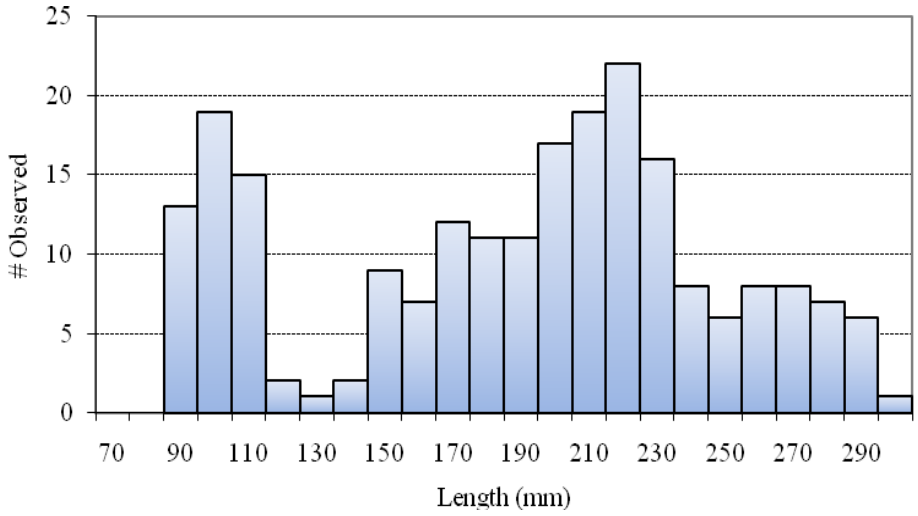

Figure 29. Length frequency distribution of walleye collected from Island Lake Res., St. Louis County, during fall 2009 electrofishing assessments.

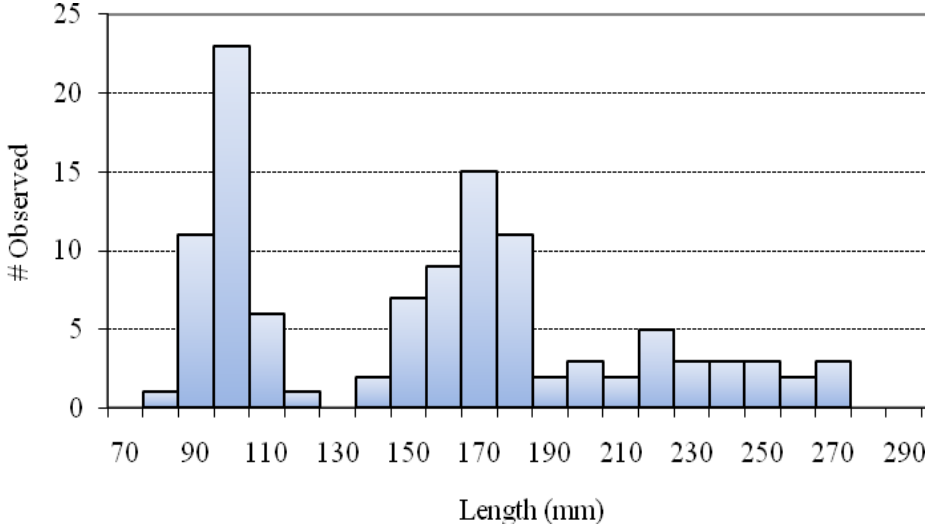

Figure 30. Length frequency distribution of walleye collected from North McDougal Lake, Lake County, during fall 2009 electrofishing assessments.

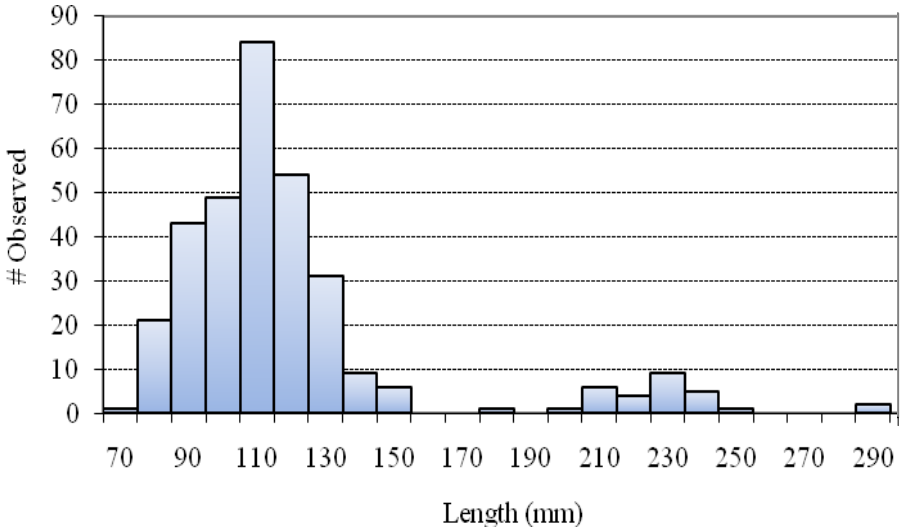

Figure 31. Length frequency distribution of walleye collected from Ninemile Lake, Lake County, during fall 2009 electrofishing assessments.

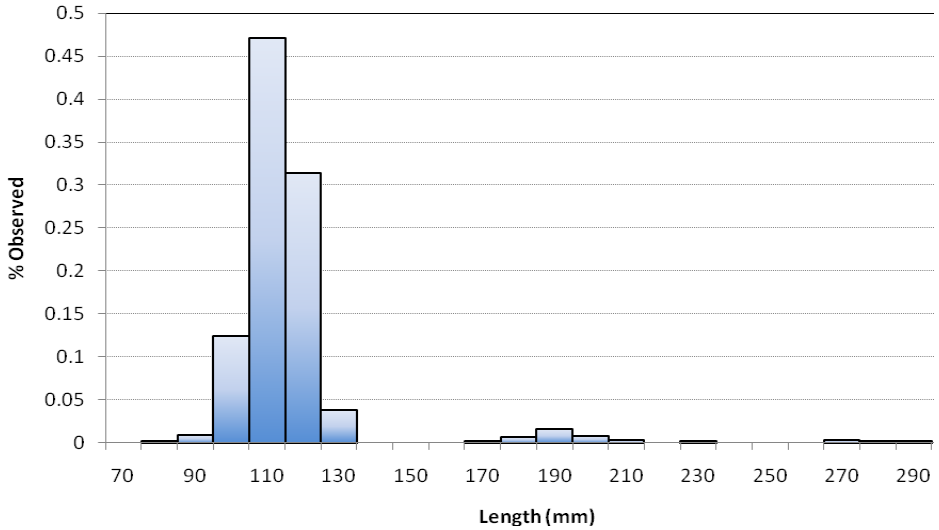

Figure 32. Length frequency distribution of walleye collected from Pike Lake, Cook County, during fall 2009 electrofishing assessments. Note that data is presented as % Observed due to the large number of age-0's not measured but only counted. N=623 for age-0's measured, and N=1446 for age-0's sampled.

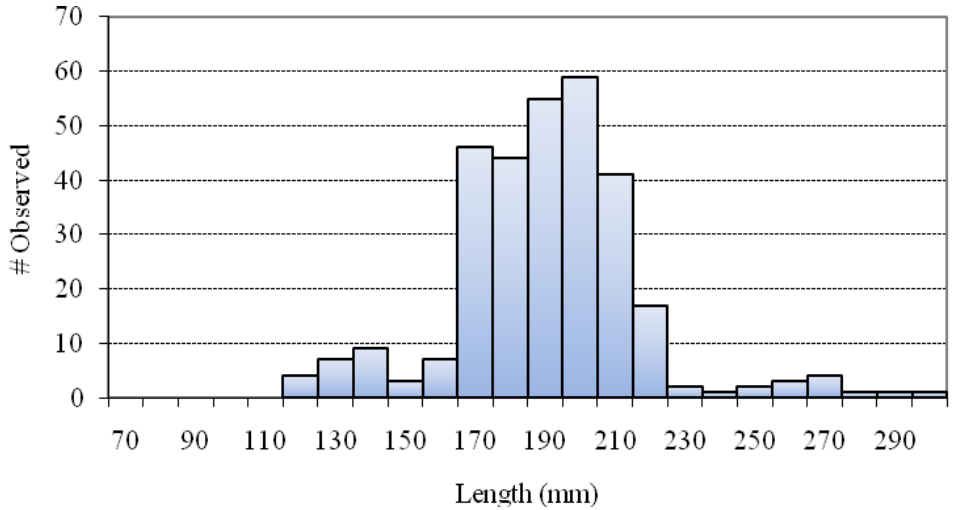

Figure 33. Length frequency distribution of walleye collected from Shagawa Lake, St. Louis County, during fall 2009 electrofishing assessments.

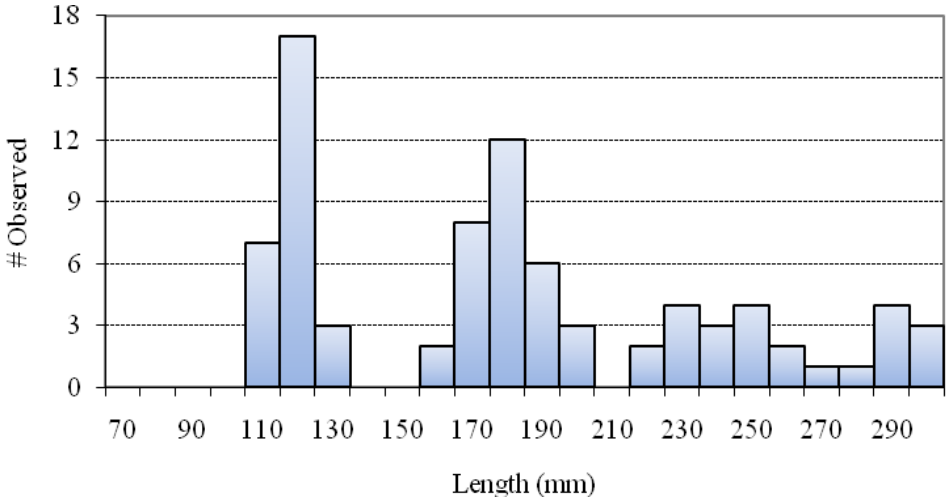

Figure 34. Length frequency distribution of walleye collected from Silver Island Lake, Lake County, during fall 2009 electrofishing assessments.

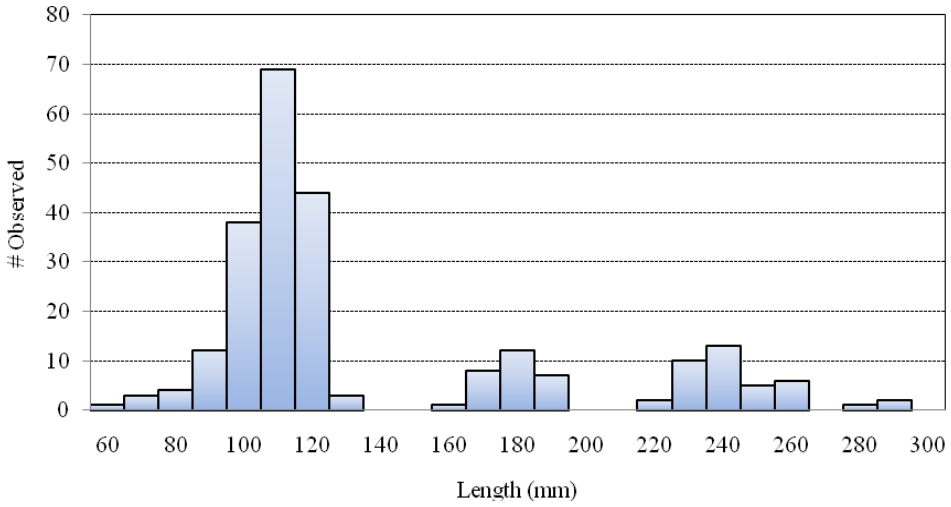

Figure 35. Length frequency distribution of walleye collected from Tait Island Lake, Cook County, during fall 2009 electrofishing assessments.

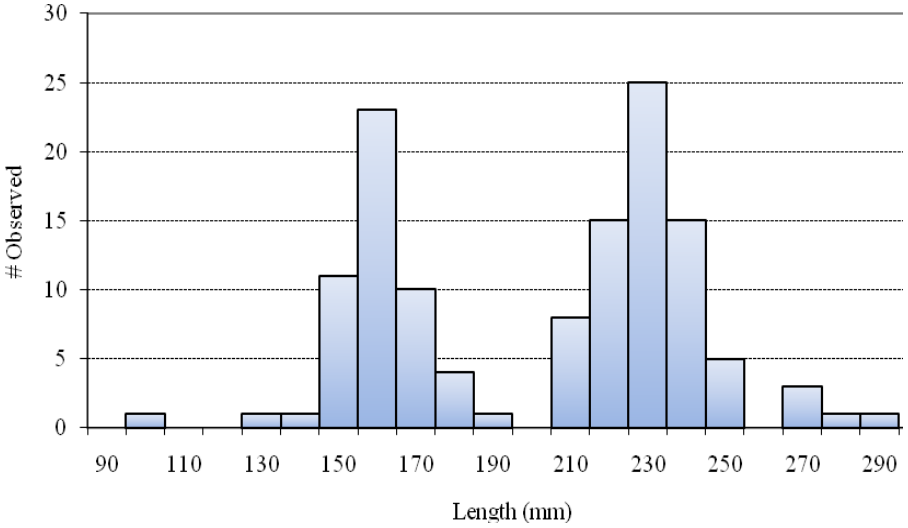

Figure 36. Length frequency distribution of walleye collected from Tom Lake Cook County, during fall 2009 electrofishing assessments.

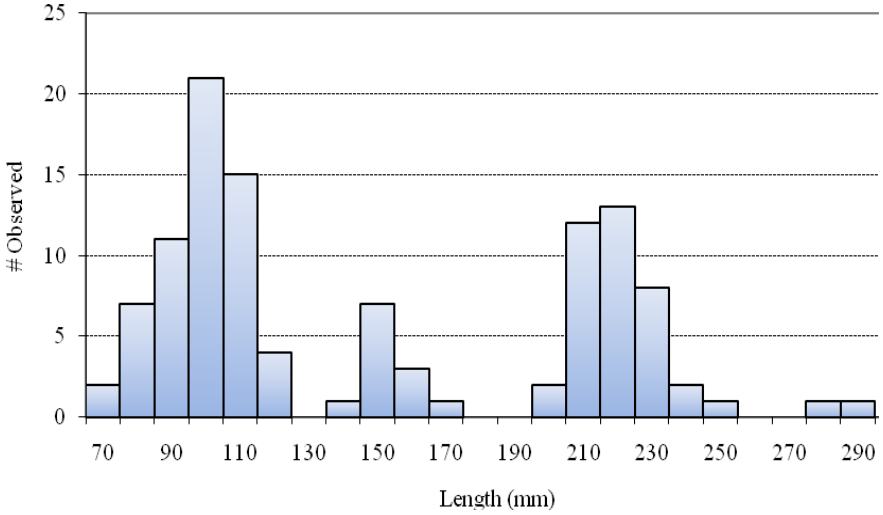

Figure 37. Length frequency distribution of walleye collected from Two Island Lake, Cook County, during fall 2009 electrofishing assessments.

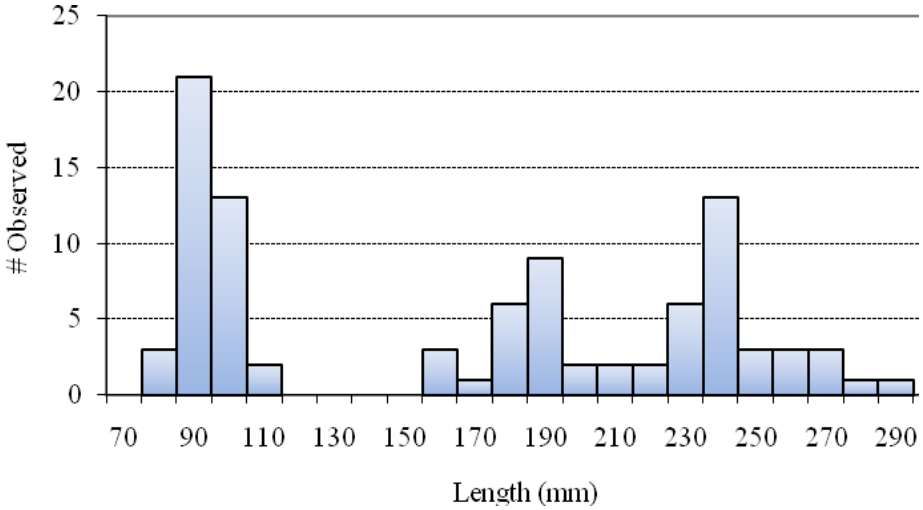

Figure 38. Length frequency distribution of walleye collected from West Twin Lake, Cook County, during fall 2009 electrofishing assessments.

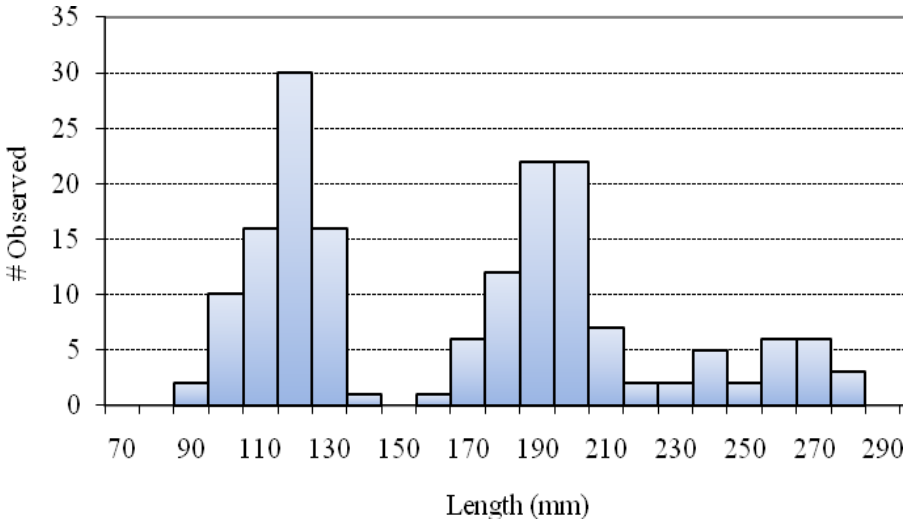

Figure 39. Length frequency distribution of walleye collected from Whiteface Reservoir, St. Louis County, during fall 2009 electrofishing assessments.

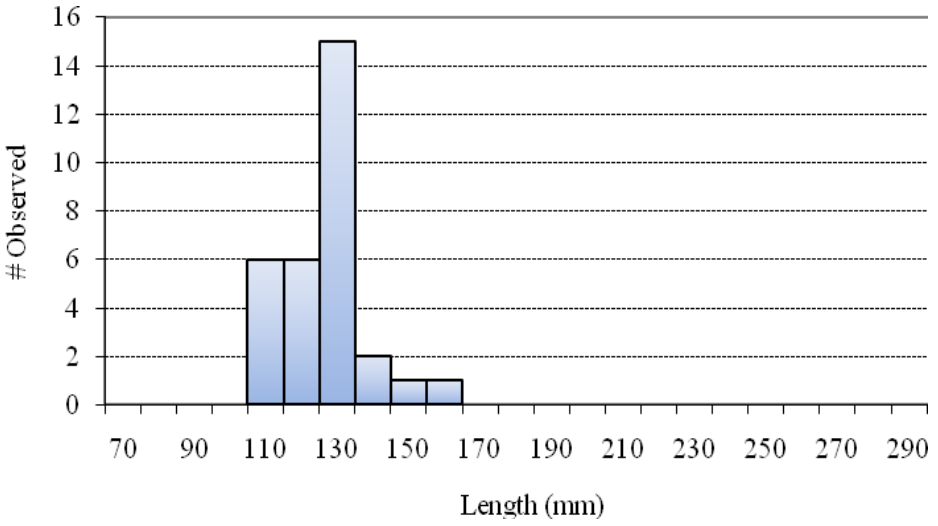

Figure 40. Length frequency distribution of walleye collected from Wild Rice Lake Reservoir, St. Louis County, during fall 2009 electrofishing assessments.

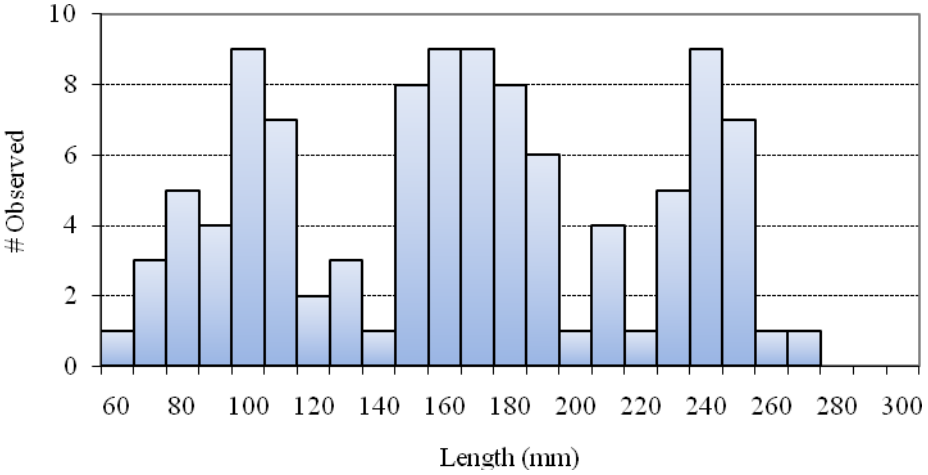

Figure 41. Length frequency distribution of walleye collected from Wilson Lake, Lake County, during fall 2009 electrofishing assessments.

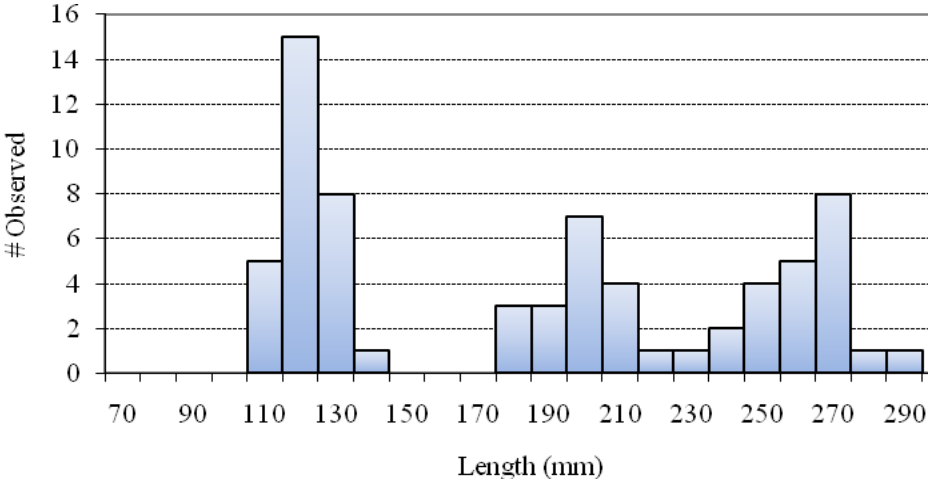

Figure 42. Length frequency distribution of walleye collected from Windy Lake, Lake County, during fall 2009 electrofishing assessments.

Appendix 1. Nightly Mark / Recapture Data for walleye > 254 mm sampled during spring 2009 assessments in Wild Rice, Harriet, Windy, and Tait Lakes Lakes.

Lake	Date	Marked in Population	Daily Catch	Daily Recap
Wild Rice	28 April	--	42	--
	29 April	42	33	1
	30 April	74	41	0
	July GN	115	256	4
Harriet	7 May	--	118	--
	8 May	118	123	72
	Summer GN	169	84	18
Windy	8 May	--	251	--
	9 May	251	199	78
	10 May	372	106	50
	Summer GN	428	76	12
Tait	9 May	--	197	--
	10 May	197	426	51
	11 May	572	469	169
	Summer GN	872	75	29