Spring Adult and Fall Juvenile Walleye Population Surveys within the 1854 Ceded Territory of Minnesota, 2007

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

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Fond du Lac Resource Management Division, Technical Report #42
1854 Treaty Authority, Resource Management Division, Technical Report #08-01

February 2008

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 rights 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 2007 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 (Frank Stone, U.S.F.W.S., Ashland F.R.O., personal communication).

The first objective of our assessments in 2007 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 2007 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 2007 spring survey were Cascade and White Pine Lakes, (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. All individuals (> 254 mm) were marked by the removal of the second full dorsal fin spine in Cascade Lake, and the third full dorsal fin spine in White Pine Lake. 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, per Duluth Area Fisheries (John Lindgren, MNDNR, personal communication).

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°C and 10.0°C (Borkholder and Parsons, 2001). Warm summer and fall weather required that we postpone our start date by one week from our historical average start date. Fall assessments began in the Grand Marais area on 4 September 2007. With the late start, the 20°C threshold was exceeded in only two 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, 2000, 2002a, 2003, & 2004). Sampling stations were repeated from previous years' surveys. New sampling stations were established on White Pine Lake, Cook County.

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 yearling (age-0) individuals.

Results and Discussion

Spring Assessments

Cascade Lake

Electrofishing activities were conducted on Cascade Lake from 28 April through 1 May (Figure 1). 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 70.9 to 104.5 adult walleye per hour of sampling (Table 1). At an 80% confidence interval, mean CPUE for Cascade Lake, determined using each sampling station, was 82.6 ± 16.7 total walleye per hour and 56.0 ± 13.1 adult walleye per hour of sampling effort. Catch rates among the sampling stations were highest at EF1 and EF2, and lowest at EF4. Catch rates ranged from 0.0 adult walleye per hour (EF5, 1 May 2007) to 116.1 adults per hour (EF1, 28 April 2007) (Figure 1).

The length frequency of the walleye sampled is presented in Figure 2. Walleye as large as 640 mm (25.2 inches) were observed in the survey. Additional species observed included yellow perch, white sucker, 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 1166 (Table 2). The adjusted Petersen estimate is 994 ± 257, with an 8.1% CV (Table 2). The 1998 estimate of walleyes larger than 12.0 inches is essentially the same as those obtained in 2007 (Table 2) for walleyes larger than 10.0 inches. While not completely comparable, the estimates do suggest the population has changed little over the last decade (Borkholder and Edwards 1999).

In August 2007, the Minnesota Department of Natural Resources performed a standardized net assessment on Cascade Lake (Steve Persons, MN DNR, Grand Marais Area Fisheries). Data from the

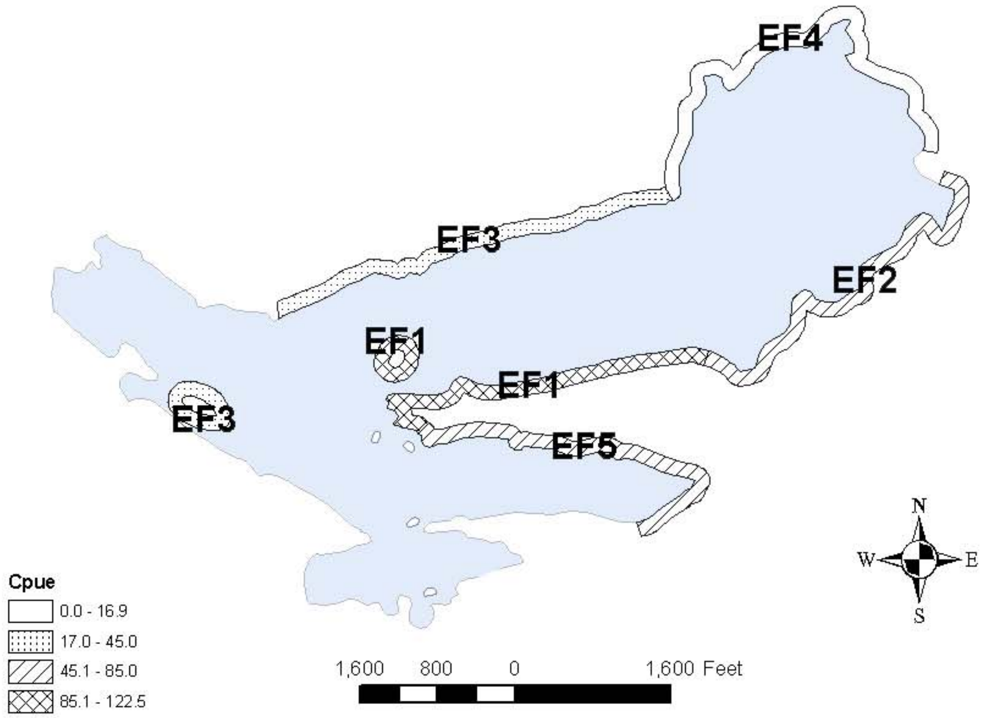

Figure 1. Catch per hour (CPUE) of adult walleyes on Cascade Lake, Cook County, during spring 2007 electrofishing surveys.

Table 1. Summary of electrofishing activities on two lakes surveyed within the 1854 Ceded Territory, Minnesota, during spring 2007.

ID #	County	Lake	Area (Acres)	Max Depth	Date	Water Temp (F)	Conductivity[1]	Shocking Time (sec)	Voltage (PDC)	Amps	# WAE[2]	CPUE WAE[3]
16-0346	Cook	Cascade	415	17	4/28/07	51	27.7	11925	1061	3	235	70.9
					4/29/07	51	26.5	11058	1061	3	124	45.6
					4/30/07	51	18.1	6616	1061	3	140	104.5
					5/1/07	49.5	17.4	6084	1061	3	73	87.0
16-0369	Cook	White Pine	342	10	4/29/07	59	54.6	8117	1061	4.5	57	25.3
					4/30/07	59	49.1	8039	1061	4	88	39.4
					5/1/07	56	58.5	5388	1061	4	72	48.1

[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 unmarked 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)). This CPUE represents the mean CPUE for each night over all stations sampled.

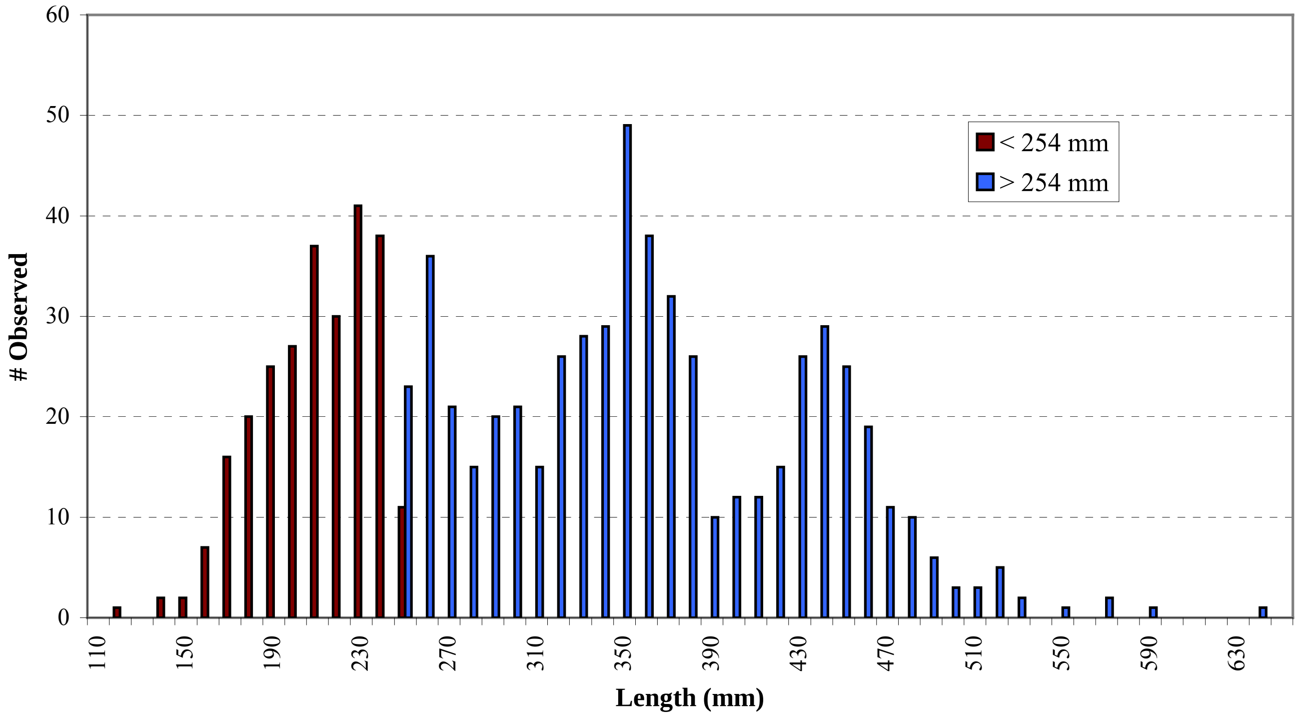

Figure 2. Length frequency distribution of walleye sampled from Cascade Lake, Cook County, MN, during spring 2007 electrofishing assessments. Bars do not include counts of recaptured individuals.

Table 2. Walleye population estimates for Cascade and White Pine Lakes (Cook County), Spring 2007. Estimates are for walleye larger than 254 mm (10.0 inches) in April. 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	95% Confidence Limits Upper	Estimate[2]	C.V.[3]
Cascade Lake – EF_{2007}	1166	852	1845	994 ± 257	8.1%
Cascade Lake – GN_{2007}	1240	915	1922	1945 ± 1368	25.3%
Cascade Lake – EF_{1998}	1235[4]	1047[4]	1505[4]	1189[4]	8.8%[4]
White Pine -- EF_{2007}	616	452	971	564 ± 483	19.9%
White Pine -- GN_{2007}	N/A	N/A	N/A	N/A	N/A

1 Schumacher and Eschmeyer population estimate.
2 Adjusted Petersen population estimate, with 95% confidence interval.
3 Coefficient of variation for the Petersen estimate.
4 Estimate made in 1998 was for individuals larger than 305 mm (12.0 inches), and thus may not be comparable.

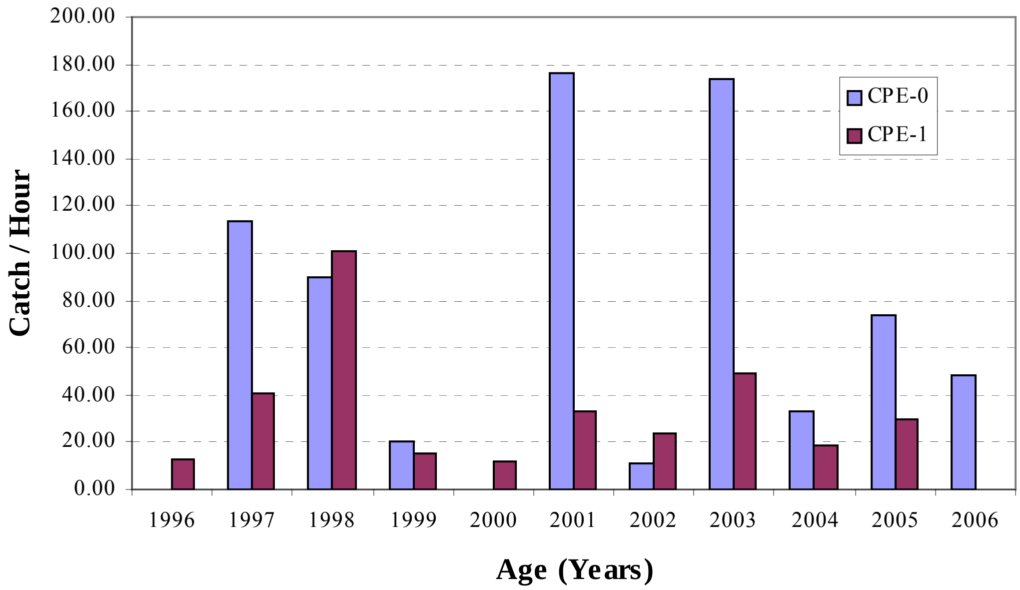

Figure 3. Catch per hour of age-0 and age-1 walleyes from Cascade Lake, from 1996 until 2006.

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first day of the survey was not used, due to some miscommunication regarding fin clips (Steve Persons, personal communication). Thirty-three walleyes (> 267 mm) were sampled in the gill nets that would have been 254 mm during the April assessments, with nine of those observed to have a fin clip from the spring sampling. The adjusted Petersen estimate using both the summer and spring data is 1945± 1368, with a 25.3% CV (Table 2). The Schumacker and Eschmeyer population estimate from the net data is 1240 (Table 2).

Table 3 presents the age data for the walleye collected from Cascade Lake. Of the 574 unique fish sampled, 465 were assigned to ages 3 through 6. The 2001 (age-6) and 2003 (age-4) year classes were observed to be stronger than normal during previous fall electrofishing surveys (Borkholder and Edwards 2002b & 2004) (Figure 3). Total mortality (*Z*) of the Cascade Lake population was estimated at 40.4% (Figure 4). Table 4 presents back-calculated lengths at age for walleye collected from Cascade Lake.

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 37.8 ± 4.0 (Table 5) suggests a balanced population (Anderson and Weithman 1978). The summer gill net PSD (57.1 ± 15.0) is significantly different than the PSD estimate from the spring electrofishing survey (χ^2=6.144, *P*>0.05, critical Chi-square value of 3.841). Significant differences were observed in three of the RSD metrics between the electrofishing and gill net assessments during 2007 assessments (Table 5). PSD metrics calculated from 1998 electrofishing (PSD = 27.6) and gill net data (PSD=51.7) are included for comparison (Borkholder and Edwards 1999.

Table 4. Back-calculated lengths at age for walleye collected from Cascade Lake, Cook County, Minnesota, April 2007.

Age Class	N	Length (mm)	Length (in)
1	158	102.8	4.0
2	158	191.3	7.5
3	156	269.7	10.6
4	133	329.4	13.0
5	106	375.0	14.8
6	88	409.9	16.1
7	54	435.9	17.2
8	48	453.8	17.9
9	39	471.7	18.6
10	26	484.6	19.1
11	15	497.1	19.6
12	9	502.8	19.8
13	4	533.4	21.0
14	3	558.7	22.0

Table 3. Age frequency distribution of walleye from Cascade Lake, Cook County, spring 2007, based upon the number of fish sampled and aged per size category.

Length Group			AGE												
Inches	mm	N Sampled	2	3	4	5	6	7	8	9	10	11	12	13	14
10	254	47	13	34											
10.5	267	33		33											
11	279	18		14	5										
11.5	292	25		17	8										
12	305	25		10	10	5									
12.5	318	30		5	20		5								
13	330	39			29	10									
13.5	343	49			25	12	12								
14	356	52			29	12	12								
14.5	368	39			9	17	13								
15	381	27			3	10	14								
15.5	394	14				8	6								
16	406	13					13								
16.5	419	24					16	4	4						
17	432	31					17			7	3	3			
17.5	445	38					19	13	6						
18	457	23					9	0	5	2	5		2		
18.5	470	13					3	2	5		3				
19	483	13								7			6		
19.5	495	5					1	1		2	1	1			
20	508	5				1			1			1		1	
20.5	521	4						1	1	1					2
21	533	2								1	1				
21.5	546	1										1			
22	559	1									1				
22.5	572	1										1			
23	584	1									1				
23.5	597	0													
24	610	0													
24.5	622	0													
25	635	1													1
TOTALS		574	13	112	138	76	139	20	22	20	16	7	8	1	3

Table 5. Proportional Stock Density (PSD) and Relative Stock Densities (RSD) with 95% confidence intervals for walleye sampled from Cascade and White Pine 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
Cascade Lake – EF_{2007}	37.8 ± 4.0	62.2 ± 4.0	35.0 ± 3.9	2.6 ± 1.3	0.2 ± 0.3
Cascade Lake – GN_{2007}	57.1 ± 15.0	42.9 ± 15.0	47.6 ± 15.1	9.5 ± 8.9	0.0 ± 0.0
Cascade Lake – EF_{1998}	27.6 ± 3.0	72.4 ± 3.0	26.0 ± 3.0	1.6 ± 0.8	0.0 ± 0.0
Cascade Lake – GN_{1998}	51.7 ± 18.2	48.3 ± 18.2	44.8 ± 18.1	6.9 ± 9.2	0.0 ± 0.0
White Pine -- EF_{2007}	59.4 ± 6.7	40.6 ± 6.7	48.3 ± 6.8	11.1 ± 4.3	0.0 ± 0.0
White Pine -- GN_{2007}	85.7 ± 18.3	14.3 ± 18.3	42.9± 25.9	42.9 ± 25.9	0.0 ± 0.0

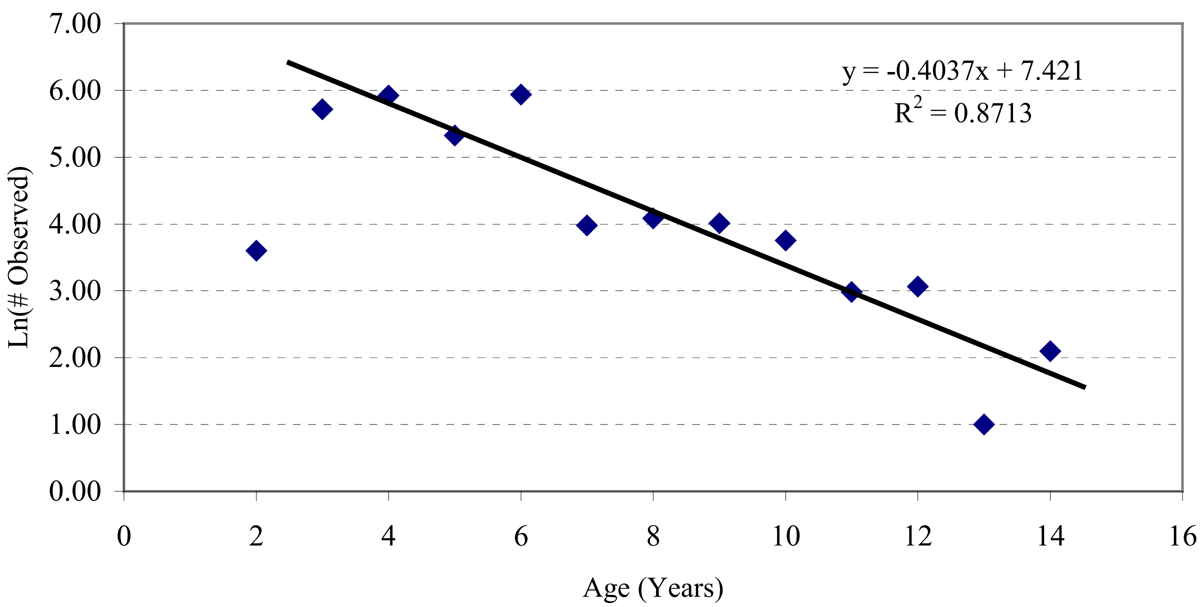

Figure 4. Total mortality (*Z*) of walleye from Cascade Lake. Estimates are made from April 2007 electrofishing data.

White Pine Lake

Electrofishing activities were conducted on White Pine Lake from 29 April through 1 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 25.3 to 48.1 adult walleye per hour of sampling (Table 1). At an 80% confidence interval, mean CPUE for White Pine Lake, determined using each sampling station, was 37.9 ± 7.4 adults per hour and 42.3 ± 7.4 total walleye per hour of sampling effort. Additional species observed included yellow perch, white sucker, northern pike, bluegill, and pumpkinseed.

Catch rates did not vary much between the sampling stations. Areas characterized by soft bottom substrates were surveyed only on the first night, and are labeled as CPE = 0 in Figure 5. We did not sample these stations on subsequent evening surveys after we found that walleyes were not using these areas of the lake for spawning activities.

The length frequency of the walleye sampled from White Pine Lake is presented in Figure 6. Table 6 presents the age data for the walleye collected from White Pine Lake. Table 7 presents back-calculated lengths at age for walleye collected from White Pine Lake. Total instantaneous mortality (Z) for the White Pine Lake walleye population is estimated at 30.2% (Figure 7).

Table 2 presents the population estimates based upon mark-recapture data. The electrofishing Schumacker and Eschmeyer population estimate is 616 (Table 2). The electrofishing adjusted Petersen estimate is 564 ± 483, with a 19.9% CV (Table 2). In September 2007, the Minnesota Department of Natural Resources performed a standardized net assessment on White Pine Lake (Steve Persons, MN DNR, Grand Marais Area Fisheries). Only 15 walleyes were sampled in the six-net survey, and none of these were observed to have our mark from the spring electrofishing. Thus, no additional population estimates are available for White Pine Lake.

PSD and RSD values determined by our spring electrofishing sampling are presented in Table 5. The electrofishing PSD of 59.4 ± 6.7 (Table 5) suggests the population is balanced (Anderson and Weithman 1978). Significant differences in the PSD estimates were not observed between the electrofishing and gill net assessments (χ^2=3.814, P=0.05, Table 5). This may have been a function of the low sample size of the gill net survey (N=14).

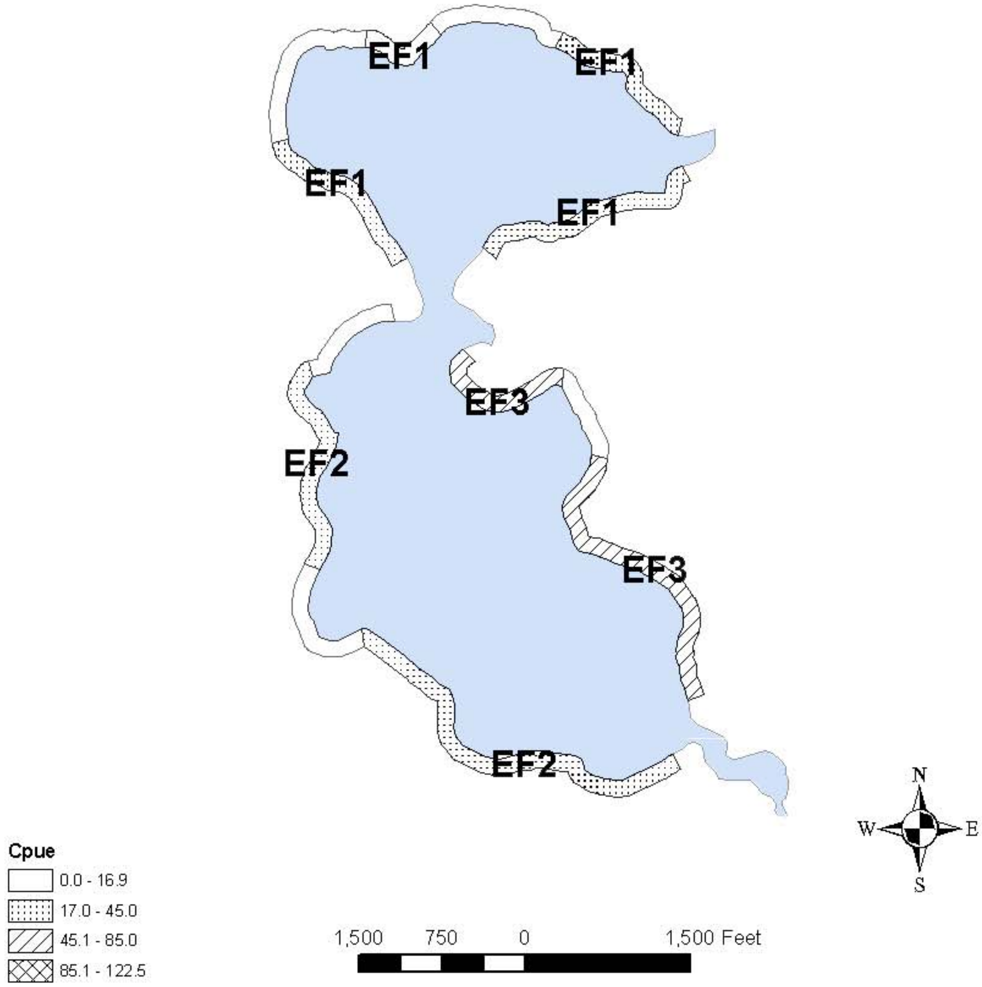

Figure 5. Catch per hour (CPUE) of adult walleyes on White Pine Lake, Cook County, during spring 2007 electrofishing surveys.

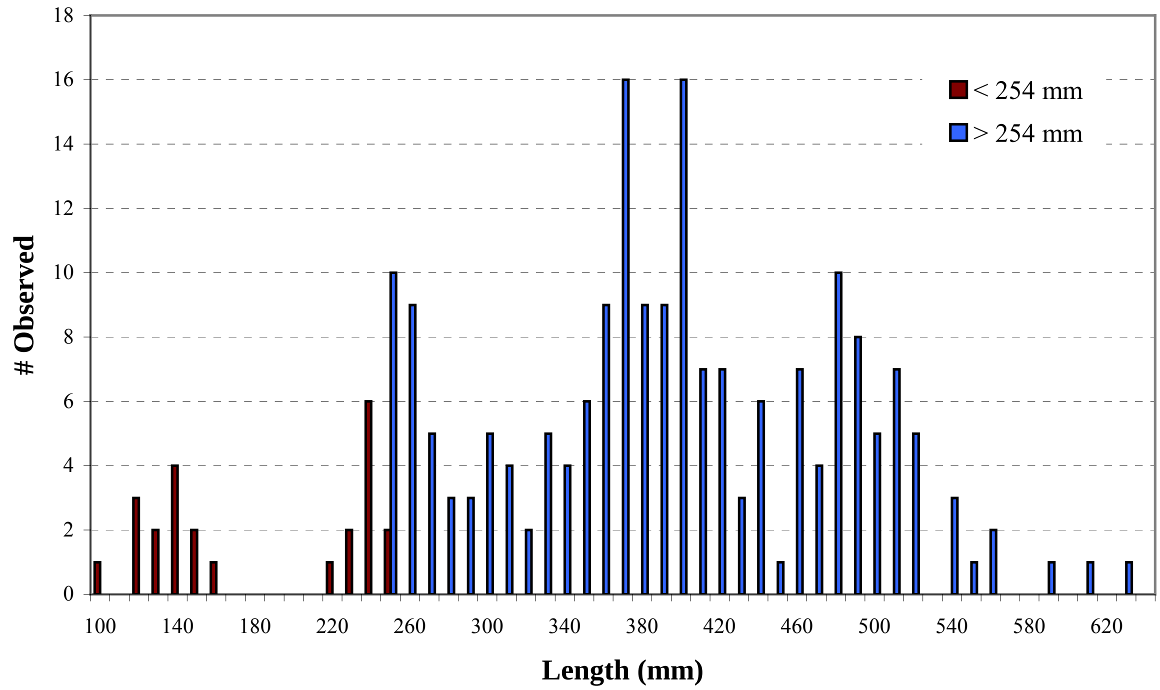

Figure 6. Length frequency distribution of walleye sampled from White Pine Lake, Lake County, MN, during spring 2007 electrofishing assessments. Bars do not include counts of recaptured individuals.

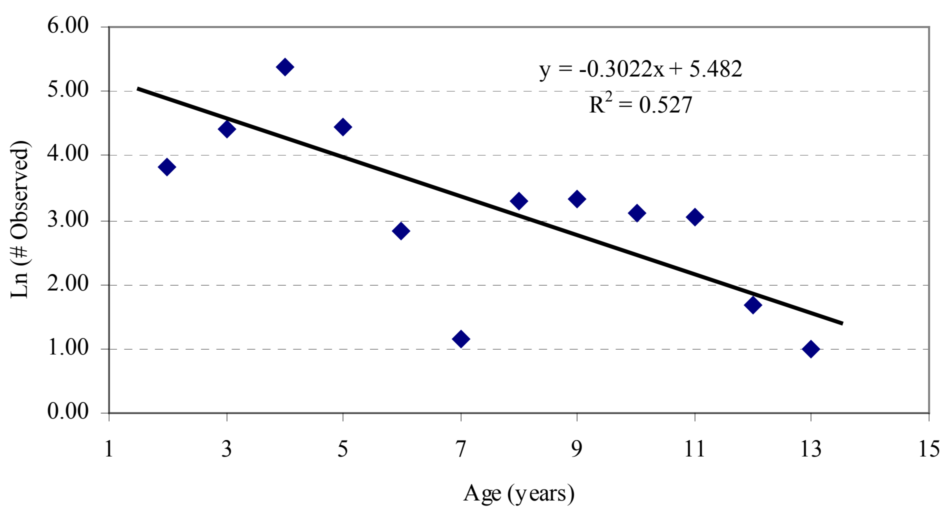

Figure 7. Total mortality (*Z*) of walleye from White Pine Lake. Estimates are from April 2007 electrofishing data.

Table 6. Age frequency distribution of walleye from White Pine Lake, Cook County, spring 2007, based upon the number of fish sampled per size category.

Length Group			AGE											
Inches	mm	N Sampled	3	4	5	6	7	8	9	10	11	12	13	14
10	254	14	12	2										
10.5	267	11	5	6										
11	279	4		4										
11.5	292	3		3										
12	305	9		9										
12.5	318	2		2										
13	330	5		4	1									
13.5	343	6			6									
14	356	10			10									
14.5	368	20			20									
15	381	13			13									
15.5	394	17			15	2								
16	406	12			8	4								
16.5	419	10			4	6								
17	432	6				6								
17.5	445	5				5								
18	457	6				4			2					
18.5	470	6				3	2			2				
19	483	14			2	1	2	1	4	1	2			
19.5	495	11			1		2		2	2	1	1		
20	508	8							2	3	2	2		
20.5	521	5									3	1		1
21	533	3										1	2	
21.5	546	1										1		
22	559	2							1	1				
22.5	572	0												
23	584	1												
23.5	597	1										1		
24	610	1										1		
24.5	622	1								1				
TOTAL		217	17	30	81	31	6	1	10	10	8	8	2	1

Table 7. Back-calculated lengths at each age class for walleye collected from White Pine Lake, Cook County, Minnesota, April 2007.

Age Class	N	Length (mm)	Length (in)
1	145	102.2	4.0
2	145	201.1	7.9
3	134	284.4	11.2
4	107	370.6	14.6
5	63	418.4	16.5
6	40	445.5	17.5
7	34	469.9	18.5
8	33	492.0	19.4
9	25	507.8	20.0
10	17	516.2	20.3
11	9	531.0	20.9
12	3	523.6	20.6
13	1	501.3	19.7
14	1	521.0	20.5

Fall Assessments

Table 8 presents a summary of each evening of electrofishing assessments. CPUE for age-0 walleye ranged from 0.9 fish per hour (Crooked Lake) to 417.2 fish per hour of electrofishing (Fourmile Lake) (Table 8). CPUE for age-1 walleye ranged from 0.9 fish per hour (Homer Lake) to 263.2 fish per hour of electrofishing (Cadotte Lake) (Table 8). Figures 8 - 31 present length frequency data for each of the 24 lakes surveyed. Table 9 presents the mean length for age-0 and age-1 individuals sampled during fall 2007 assessments. Mean lengths for age-0 walleye ranged from 95 mm (3.7 inches, Devilfish Lake) to 149 mm (5.8 inches, White Pine Lake). Mean lengths for age-1 walleye ranged from 182 mm (7.2 inches, Elbow Lake) to 244 mm (9.6 inches, West Twin 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 81.1, and our mean $CPUE_{1+}$ is 29.8. Using the mean $CPUE_{Age\text{-}0}$ as one criterion, average or better 2007 year classes were observed in eleven of the lakes (Table 8). Average or better 2006 year classes (age-1 walleye) were observed in ten of the 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 2007 were larger than those observed during previous years' surveys. 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 127 mm in lakes not stocked by the DNR with fingerling walleye prior to our assessments. Using the mean length criteria of 127 mm for average year classes, average or better 2007 year classes may be present in fourteen 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

The Fond du Lac Division of Resource Management and the 1854 Treaty Authority wish to acknowledge and thank the Fond du Lac Fishery Technicians; and Darren Vogt, and Angela Aarhus, 1854 Treaty Authority, for their hard work in the field. Ken Gebhardt, U.S. Forest Service, provided field assistance himself, as well as several of his staff members. Steve Persons and Paul Eiler (Grand Marais Area Office), and Deserae Hendrickson (Duluth Area Office) provided gill net data from the Minnesota Department of Natural Resources.

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Table 8. 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 fall 2007.

Lake	Date	Temp (F)	Temp (C)	Cond.[1]	YOY Total[2]	Age-1 Total[3]	Seconds	CPUE YOY[4]	CPUE 1+[5]
Ball Club	5-Sep	66	18.9	28.8	203	24	4404	165.9	19.6
Cadotte	17-Sep	58	14.4	22.0	76	540	7387	37.0	263.2
Caribou	7-Sep	67	19.4	71.1	203	8	5415	135.0	5.3
Cascade	24-Sep	60	15.6	27.0	110	48	5201	76.1	33.2
Crescent	7-Sep	67	19.4	29.5	28	12	3598	28.0	12.0
Crooked	20-Sep	54	12.2	48.5	1	3	4226	0.9	2.6
Devilfish	4-Sep	67	19.4	24.2	13	199	6350	7.4	112.8
Dumbbell	18-Sep	59	15.0	76.4	561	33	6001	336.5	19.8
Elbow	6-Sep	67	19.4	45.9	2	53	3460	2.1	55.1
Fourmile	19-Sep	56	13.3	38.5	588	57	5074	417.2	40.4
Homer	11-Sep	61	16.1	26.0	13	1	3931	11.9	0.9
Island Reservoir	14-Sep	62	16.7	73.9	352	193	10424	121.6	66.7
Ninemile	19-Sep	56	13.3	66.2	149	187	5777	92.9	116.5
N. McDougal	18-Sep	61	16.1	46.0	162	165	6377	91.5	93.1
Pike	25-Sep	59	18.3	36.6	436	6	6666	235.5	3.2
Shagawa	13-Sep	61	16.1	82.4	320	109	6542	176.1	60.0
Silver Island	7-Sep	67	19.4	45.0	11	24	3330	11.9	25.9
Tom	4-Sep	67	19.4	39.0	4	99	8112	1.8	43.9
Two Island	5-Sep	69	20.6	35.0	105	13	6569	57.5	7.1
West Twin	12-Sep	59	15.0	33.0	450	21	5074	319.3	14.9
White Pine	10-Sep	64	17.8	61.0	110	8	4242	93.4	6.8
Whiteface Res.	17-Sep	58	14.4	64.1	139	62	8112	61.7	27.5
Wilson	20-Sep	57	13.9	40.2	76	35	6334	43.2	19.9
Windy	19-Sep	59	15.0	33.8	95	49	6246	54.8	28.2

[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 2007 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	5-Sep	107	236
Cadotte	17-Sep	135	238
Caribou	7-Sep	117	242
Cascade	24-Sep	132	207
Crescent	7-Sep	110	217
Crooked	20-Sep	148 (N=1)	213 (N=3)
Devilfish	4-Sep	95	192
Dumbbell	18-Sep	137	238
Elbow	6-Sep	115 (N=2)	182
Fourmile	19-Sep	127	221
Homer	11-Sep	147	227 (N=1)
Island Reservoir	14-Sep	126	207
Ninemile	19-Sep	145	221
N. McDougal	18-Sep	138	205
Pike	25-Sep	120	237
Shagawa	13-Sep	121	237
Silver Island	7-Sep	144	204
Tom	4-Sep	143 (N=4)	222
Two Island	5-Sep	127	227
West Twin	12-Sep	120	244
White Pine	10-Sep	149	237
Whiteface Res.	17-Sep	141	230
Wilson	20-Sep	119	215
Windy	19-Sep	140	235

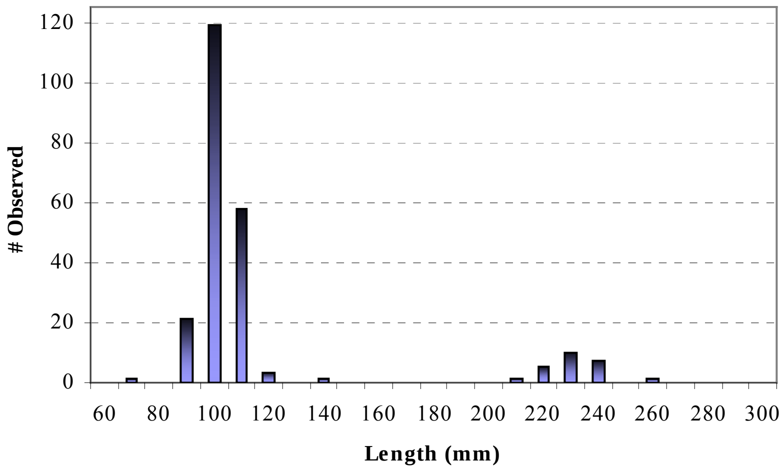

Figure 8. Length frequency distribution of walleye collected from Ball Club Lake, Cook County, during fall 2007 electrofishing assessments.

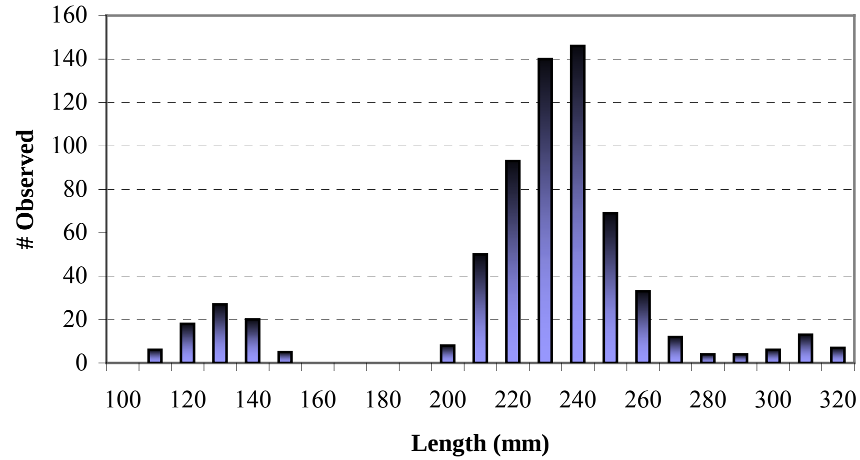

Figure 9. Length frequency distribution of walleye collected from Cadotte Lake, St. Louis County, during fall 2007 electrofishing assessments.

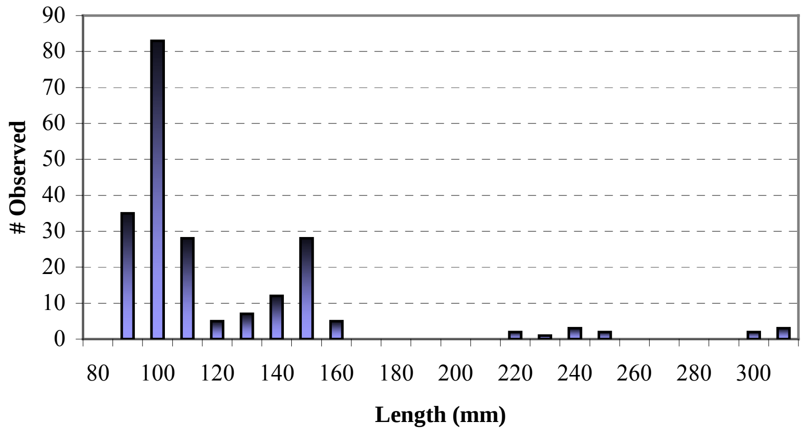

Figure 10. Length frequency distribution of walleye collected from Caribou Lake, Cook County, during fall 2007 electrofishing assessments.

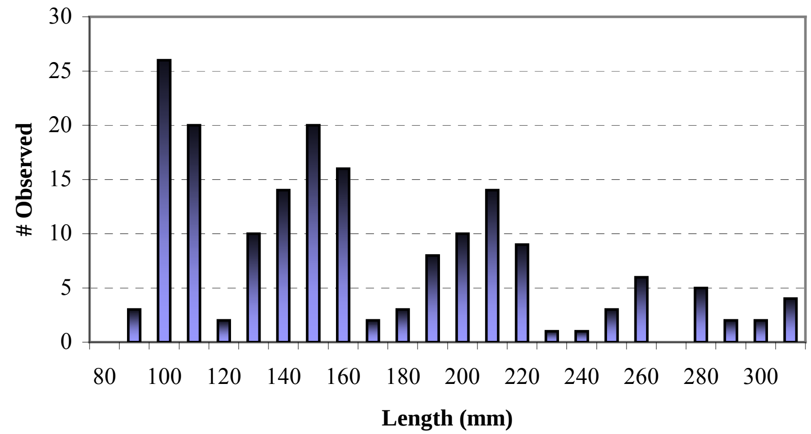

Figure 11. Length frequency distribution of walleye collected from Cascade Lake, Cook County, during fall 2007 electrofishing assessments.

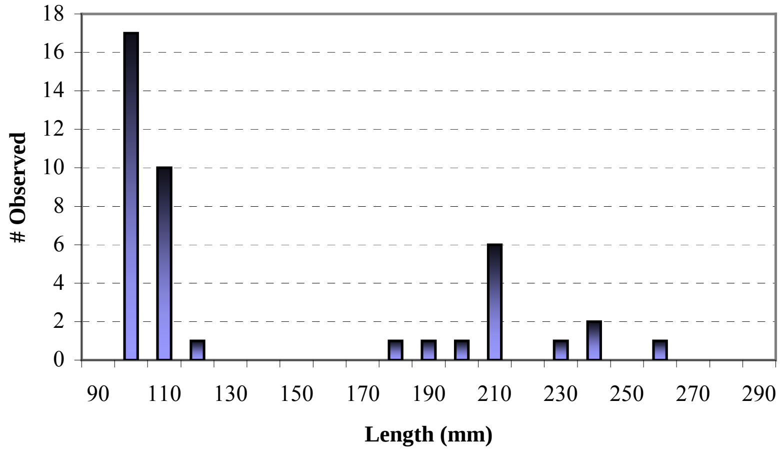

Figure 12. Length frequency distribution of walleye collected from Crescent Lake, Cook County, during fall 2007 electrofishing assessments.

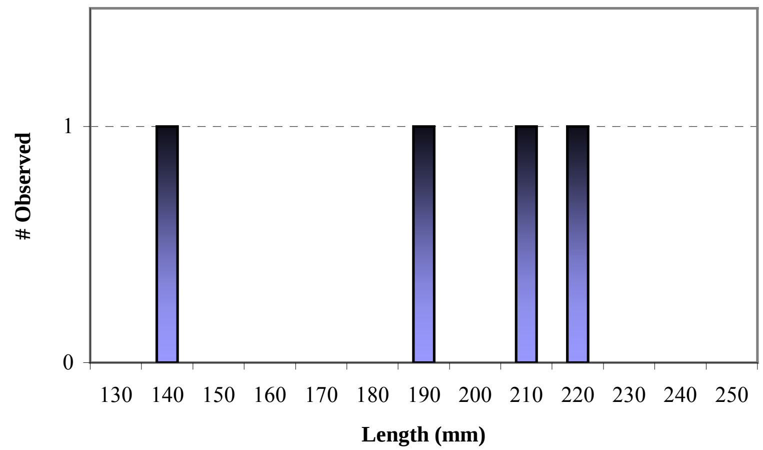

Figure 13. Length frequency distribution of walleye collected from Crooked Lake, Lake County, during fall 2007 electrofishing assessments.

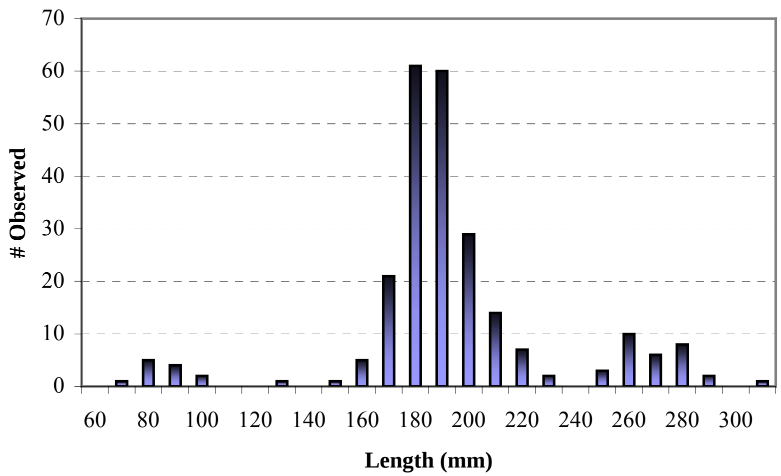

Figure 14. Length frequency distribution of walleye collected from Devilfish Lake, Cook County, during fall 2007 electrofishing assessments.

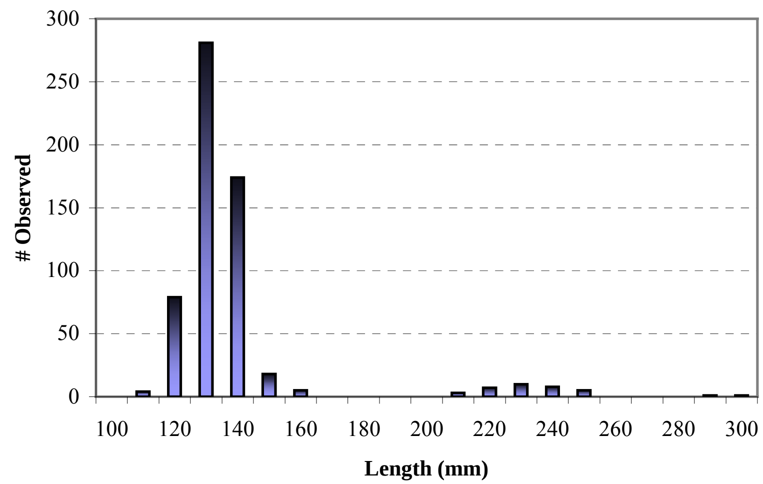

Figure 15. Length frequency distribution of walleye collected from Dumbbell Lake, Lake County, during fall 2007 electrofishing assessments.

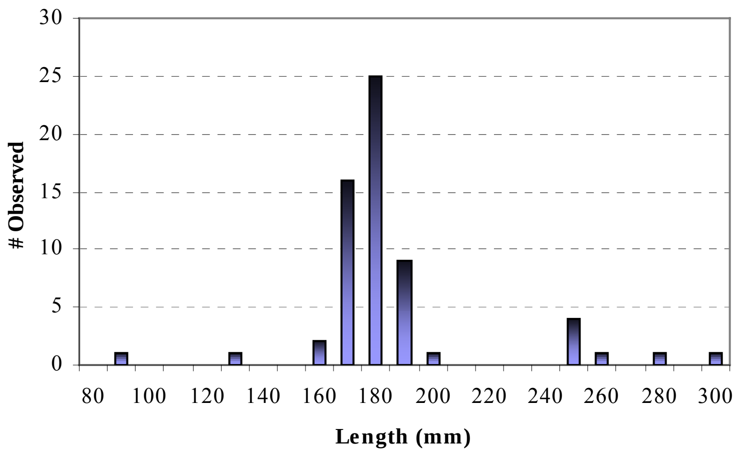

Figure 16. Length frequency distribution of walleye collected from Elbow Lake, Cook County, during fall 2007 electrofishing assessments.

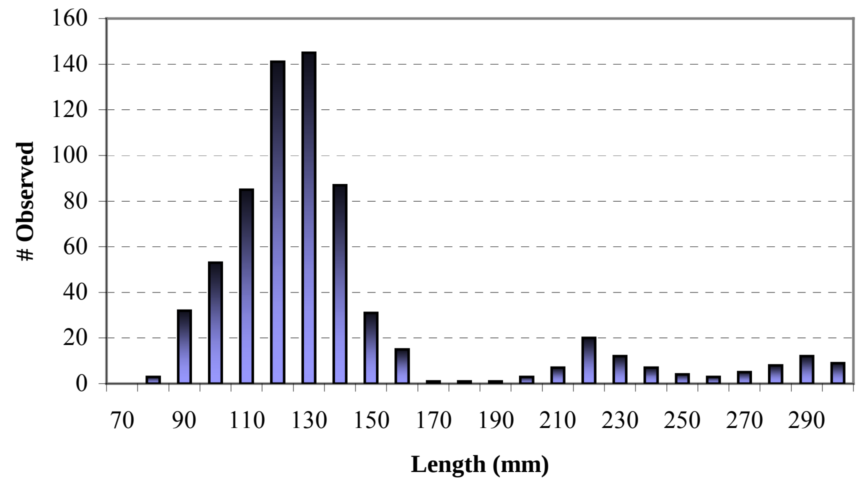

Figure 17. Length frequency distribution of walleye collected from Fourmile Lake, Cook County, during fall 2007 electrofishing assessments.

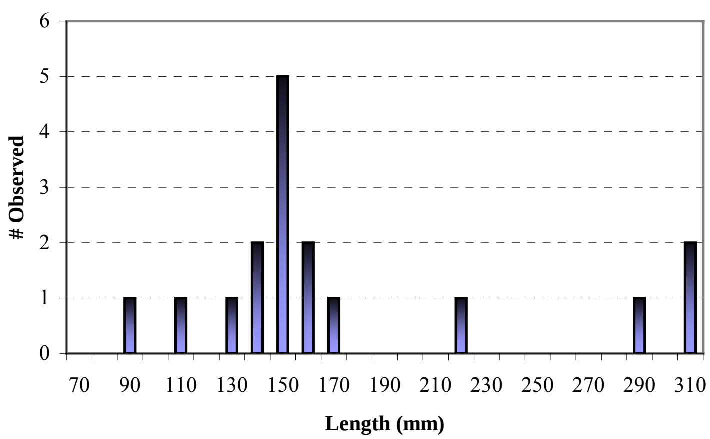

Figure 18. Length frequency distribution of walleye collected from Homer Lake, Cook County, during fall 2007 electrofishing assessments.

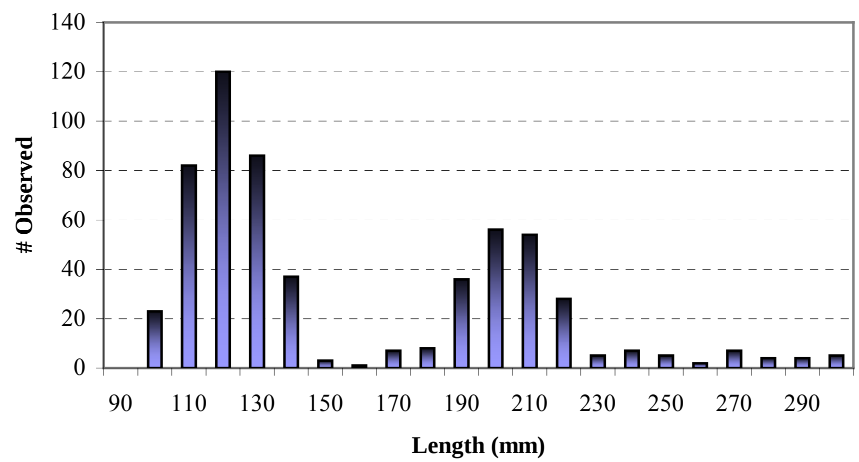

Figure 19. Length frequency distribution of walleye collected from Island Lake Res., St. Louis County, during fall 2007 electrofishing assessments.

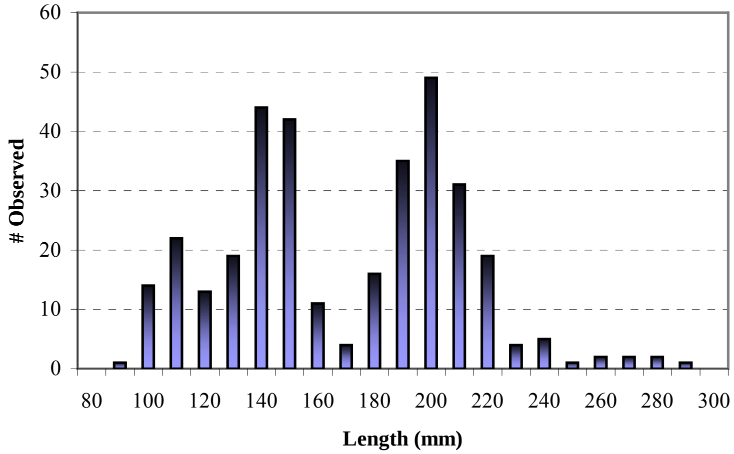

Figure 20. Length frequency distribution of walleye collected from North McDougal Lake, Lake County, during fall 2007 electrofishing assessments.

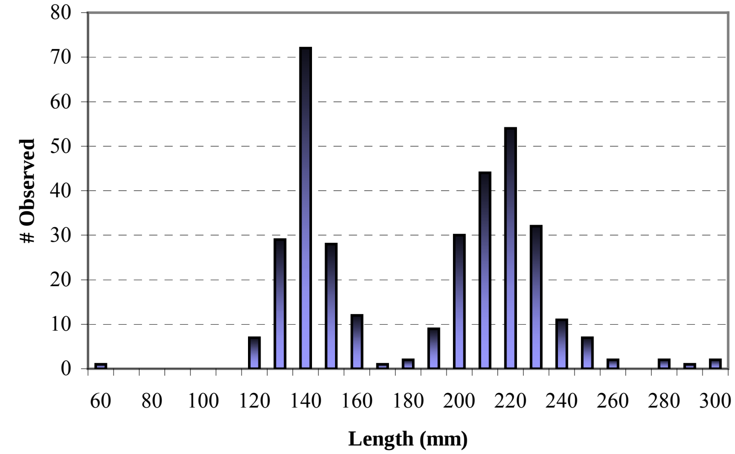

Figure 21. Length frequency distribution of walleye collected from Ninemile Lake, Lake County, during fall 2007 electrofishing assessments.

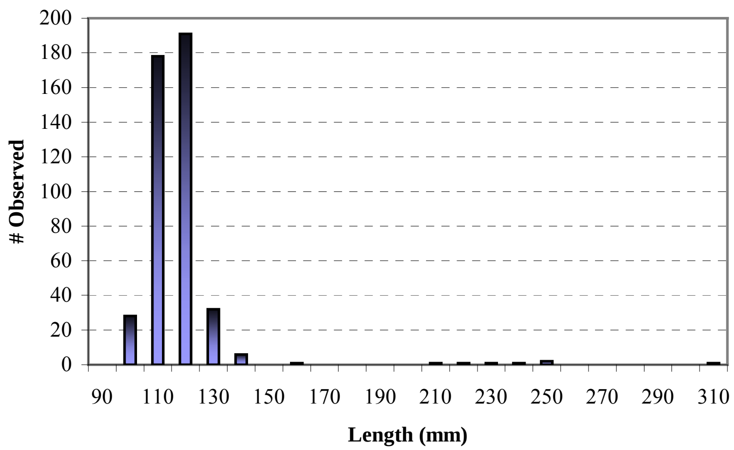

Figure 22. Length frequency distribution of walleye collected from Pike Lake, Cook County, during fall 2007 electrofishing assessments.

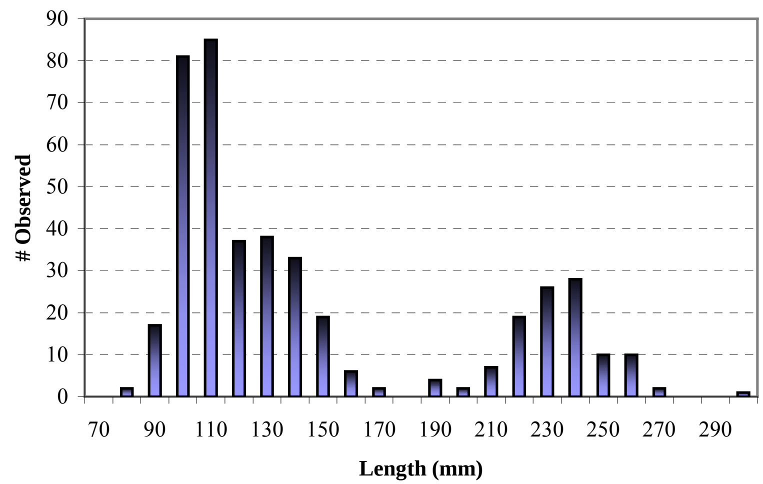

Figure 23. Length frequency distribution of walleye collected from Shagawa Lake, St. Louis County, during fall 2007 electrofishing assessments.

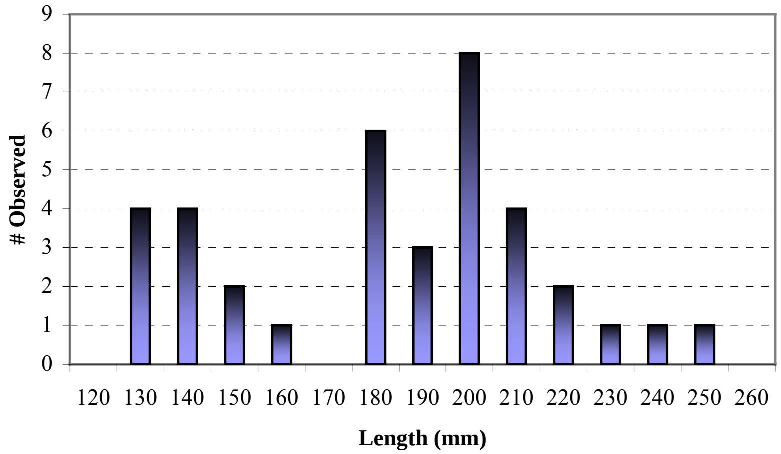

Figure 24. Length frequency distribution of walleye collected from Silver Island Lake, Cook County, during fall 2007 electrofishing assessments.

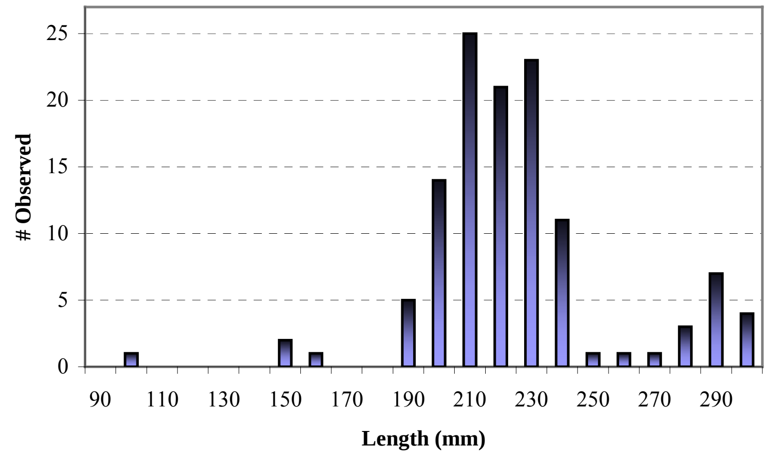

Figure 25. Length frequency distribution of walleye collected from Tom Lake, Cook County, during fall 2007 electrofishing assessments.

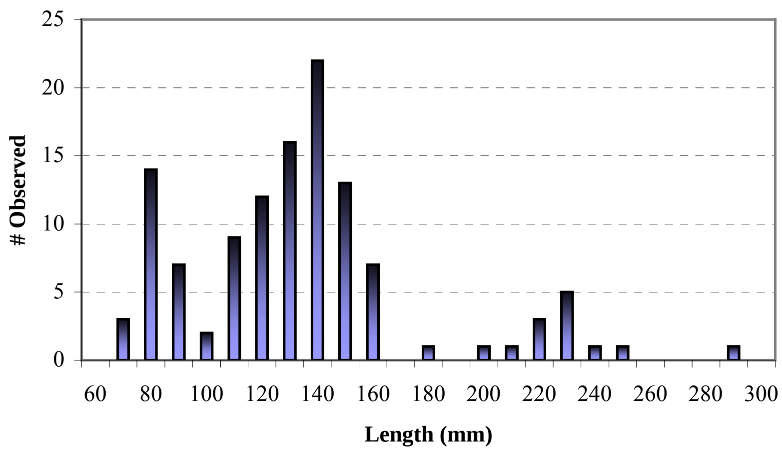

Figure 26. Length frequency distribution of walleye collected from Two Island Lake, Cook County, during fall 2007 electrofishing assessments.

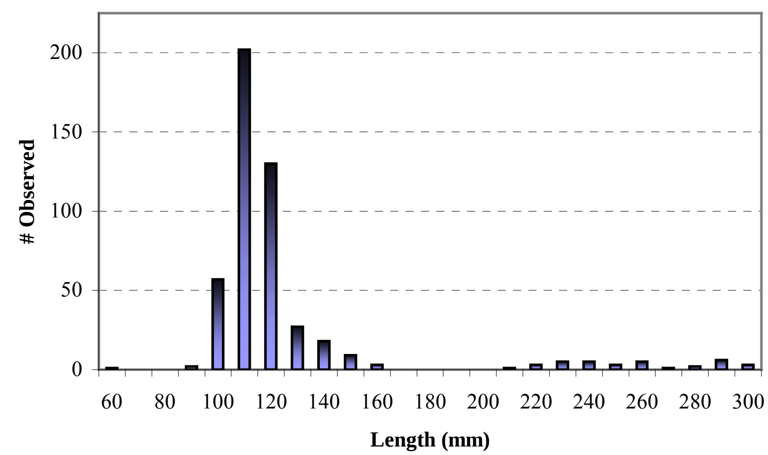

Figure 27. Length frequency distribution of walleye collected from West Twin Lake, Cook County, during fall 2007 electrofishing assessments.

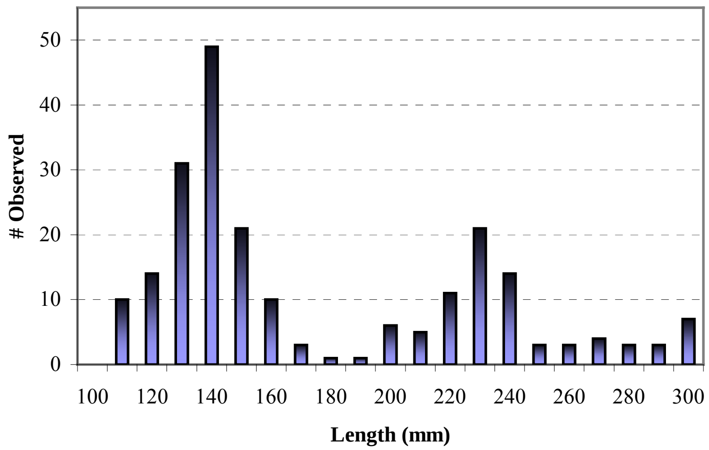

Figure 28. Length frequency distribution of walleye collected from Whiteface Reservoir, St. Louis County, during fall 2007 electrofishing assessments.

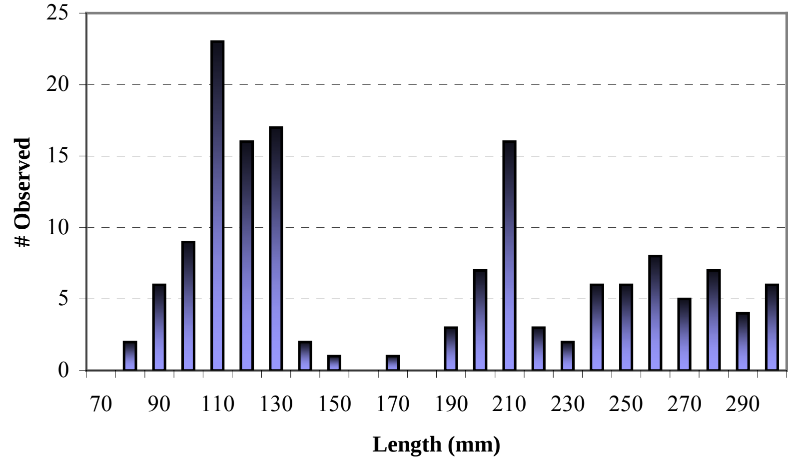

Figure 29. Length frequency distribution of walleye collected from Wilson Lake, Lake County, during fall 2007 electrofishing assessments.

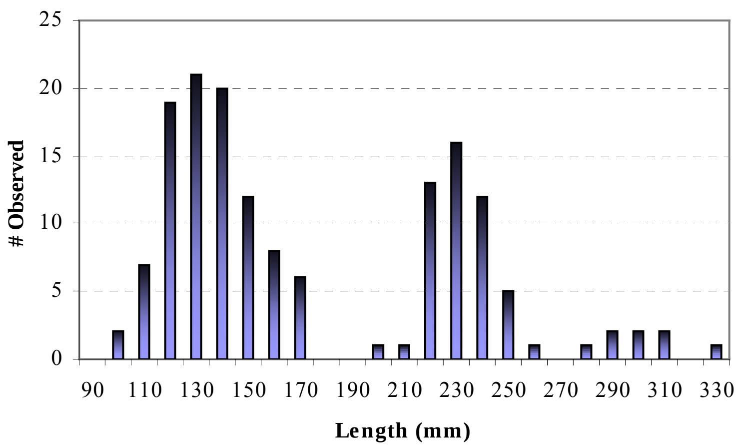

Figure 30. Length frequency distribution of walleye collected from Windy Lake, Lake County, during fall 2007 electrofishing assessments.

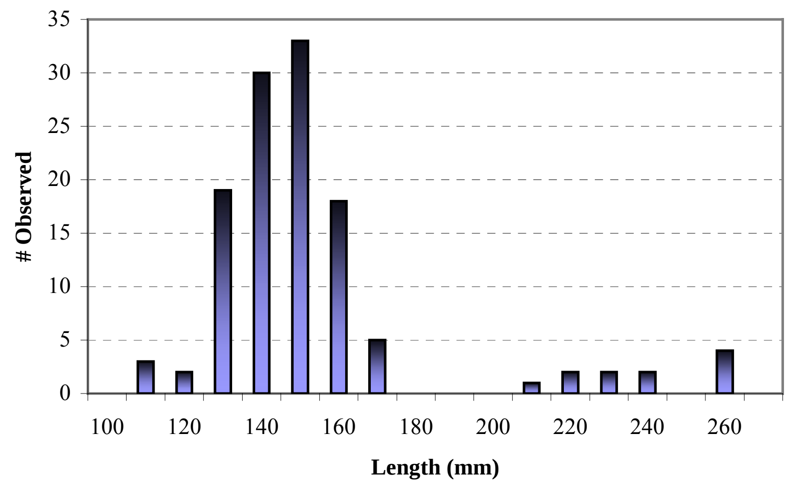

Figure 31. Length frequency distribution of walleye collected from White Pine Lake, Cook County, during fall 2007 electrofishing assessments.

Appendix 1. Nightly Mark / Recapture Data for walleye > 254 mm sampled during spring 2007 assessments in Cascade and White Pine Lakes (Cook County). Individual fish were marked solely by removal of a dorsal fin ray.

Lake	Date	Marked in Population	Daily Catch	Daily Recap
Cascade	28 April	--	235	--
	29 April	235	139	16
	30 April	357	192	52
	1 May	496	149	74
	TOTALS	571		
W. Pine	29 April	0	57	--
	30 April	57	88	6
	1 May	138	72	17
	TOTALS	192		