Spring Adult and Fall Juvenile Walleye Population Surveys within the 1854 Ceded Territory of Minnesota, 2004

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

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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 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 data bases 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 (Newman 1992; Stone 1992; Stone and Slade 1992; Goyke et al. 1993 and 1994; Ngu and Kmiecik 1993; and Borkholder 1994, 1995, and 1996).

The 1854 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 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.

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; Borkholder 1994 and 1995). In order to rapidly sample fish populations, Fond du Lac and the 1854 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 in the recapture sample. 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 walleye remain in the shallows 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 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 2004 was to obtain adult walleye population estimates (PE) during the spring spawning period using mark - recapture data. Due to personnel and time constraints, trap netting was not used. Our electrofishing PE estimates might be biased towards males in the populations, and thus, are conservative. However, by cooperating with the Area MN DNR offices, we obtain a second PE from the State's summer gill net assessments, with which to compare to the spring only electrofishing PE.

A second benefit of the spring electrofishing surveys is that it allows us to identify and determine key and critical spawning sites, i.e. where catch rates are the highest.

The second part of our 2004 walleye surveys targeted juvenile (age-1) and young-of-the-year (age-0) individuals in the fall. The purpose for assessing juvenile and fingerling individuals often is to evaluate recruitment and year-class strength, which was our objective for the fall assessments.

Methods

Spring Assessments

Lakes within the 1854 Ceded Territory of Minnesota were identified by MNDNR Area Managers for electrofishing surveys. These included Wild Rice Lake Reservoir (Duluth Area); Ninemile Lake (Finland Area); and Ball Club, Elbow, and Devilfish 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 the respective walleye populations. Marked walleye would then be available during the summer gill net assessments conducted by the DNR, thus providing a second population estimate. Additionally a reconnaisance assessment on Whiteface Reservoir (Duluth Area) was conducted to see if significant numbers of spawning walleye could be located for a future tagging study.

Electrofishing was performed at night using two boom shocking boats, both equipped with a Smith-Root Type VI-A electrofisher unit 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 meter (Ben Meadows Co., Atlanta, GA) or a Fisher Scientific Digital Conductivity Meter.

Electrofishing surveys were planned to begin soon after ice-out, and continue for as long as 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 previous marks, and the sex determined (male, female, unknown) based upon visual identification of gametes. Walleye that had been marked during any previous nights' collections were counted as recaptured fish. Unmarked individuals were marked by the removal of the second full dorsal fin spine. On Wild Rice Lake Reservoir, St. Louis County, walleye were marked by removal of both a dorsal fin spine and the anal spine, to differentiate 2004 marked individuals from previously marked fish. The dorsal fin spine from five individuals per centimeter group per sex was kept and placed in a labeled envelope for aging. 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, as 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 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.

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 10 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 Authority (Borkholder 1996, 1997, and 1998; Borkholder and Edwards 1999, 2000, 2003, & 2004). Sampling stations were repeated from previous years' surveys.

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

Results and Discussion

Spring Assessments

Wild Rice Lake Reservoir

Electrofishing activities were conducted on Wild Rice Lake Reservoir from 26 to 28 April (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 82.5 to 153.2 adults per hour and 83.5 to 154.4 total walleye per hour of sampling (Table 1). At an 80% confidence interval, mean CPUE for Wild Rice Lake, determined using each sampling station, was 102.6 ± 19.5 adults per hour and 103.3 ± 19.7 total walleye per hour of sampling effort. Catch rates among the sampling stations varied, and ranged from 6.3 adult walleye per hour (EF-1, 27 April 2004) to 360.2 adults per hour (EF-5, 28 April 2004) (Figure 1). Catch rates at station EF-1 depended upon the evening, and ranged from 6.3 to 172.7 adults per hour.

The length frequency of the walleye sampled is presented in Figure 2. Additional species observed included yellow perch, white sucker, northern pike, golden shiner pumpkinseed, and bluegill.

Table 2 presents the 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 3924 (Table 2). The adjusted Petersen estimate is 3754 ± 1394, with a 13.4% CV (Table 2).

In August 2004 the Minnesota Department of Natural Resources performed a standardized net assessment on Wild Rice Lake Reservoir (Jon Meerbeek, MN DNR, Duluth Area Fisheries). Of 154 walleye (> 254 mm) sampled in the gill nets trap nets, only 7 were observed to have the mark from the spring sampling. The adjusted Petersen estimate using both the summer and spring data is 18,400 ± 15,268, with a 32.3% CV (Table 2). The Schumacker and Eschmeyer population estimate from the gill net data is 5210 (Table 2). The summer net Petersen estimate is much greater than the spring estimate, likely due to relatively few recaptured individuals. This is not nearly as problematic with the Schumacker and Eschmeyer population estimate as this estimate relies upon all sampling dates.

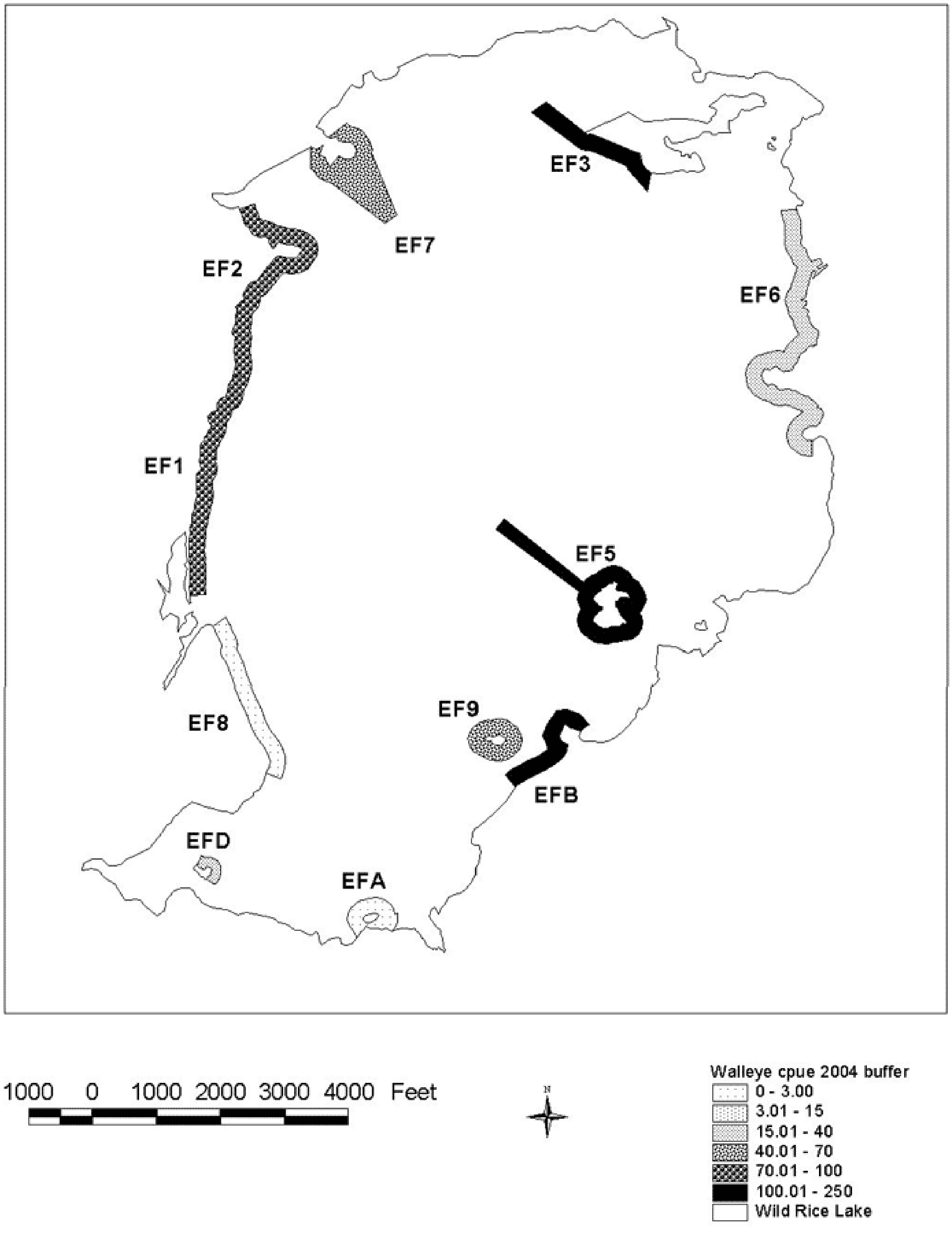

Figure 1- Wild Rice Lake, St. Louis Co. Walleye CPUE 2004 sampling stations

Table 1. Summary of night time electrofishing activities on three lakes surveyed within the 1854 Ceded Territory, Minnesota, during Spring 2004.

ID #	County	Lake	Area (Acres)	Max Depth	Date	Water Temp (F)	Conductivity*	Shocking Time (sec)	Voltage (PDC)	Pulse Width (ms)	Amps Drawn	# WAE**	CPUE WAE***
69-0375	St. Louis	Whiteface Reservior	5600	35.0	29-Apr-04	48.1	56.4	16964	1061	7	5	100 / 111	41.7 / 43.4
69-0371	St. Louis	Wild Rice Lake	2127	11.0	25-Apr-04	49	113.8	6446	884	3.5	-------	152 / 152	90.8 / 90.8
					26-Apr-04	46.5	121.8	7421	707 / 884	6 / 3	5	194 / 194	98.5 / 98.5
					27-Apr-04	46	122.7	6486	707 / 884	4 / 3	4.5	200 / 202	82.5 / 83.5
					28-Apr-04	48	116.8	7076	707 / 884	5 / 3	5	394 / 397	153.2 / 154.4
					30-Apr-04	50	120.7	4769	707 / 884	5 / 3	5	149 / 151	97.5 / 98.8
38-0033	Lake	Ninemile	296	40.0	01-May-04	48	66.3	11342	1061	7	5	171 / 384	52.5 / 66.0
					02-May-04	46	59.0	5881	1061	4	-------	142 / 163	85.7 / 98.0
					03-May-04	49	60.1	4363	884	6	5	143 / 163	115.4 / 130.5
16-0096	Cook	Elbow	437	9.0	04-May-04	43	30.3	4892	1061	4	-------	246 / 267	180.6 / 194.1
					05-May-04	46	29.5	3698	1061	4	-------	189 / 213	195.6 / 220.3
16-0182	Cook	Ball Club	196	25.0	04-May-04	43	-------	8507	1061	6	5	221 / 233	79.0 / 82.6
					05-May-04	43	-------	7027	1061	6	5	246 / 258	109.6 / 115.1
					06-May-04	44	-------	5769	1061	6	5	240 / 263	137.3 / 150.6
16-0029	Cook	Devilfish	396	40.0	06-May-04	41	21.4	8869	1061	7	3.5	81 / 120	29.9 / 48.1
					07-May-04	43.5	28.5	11504	1061	7	3.5	95 / 136	37.1 / 51.2
					08-May-04	47	19.8	9639	1061	7	3	66 / 118	22.2 / 41.0

* Water conductivity measured in microSiemens / cm

** WAE = walleye. Numbers in column represent the number of "stock" sized walleye (>254mm (10 inches)) collected / the total number of walleye collected, including individuals < 10 inches.

*** 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)) / CPUE of all walleye sampled, including those < 10 inches.

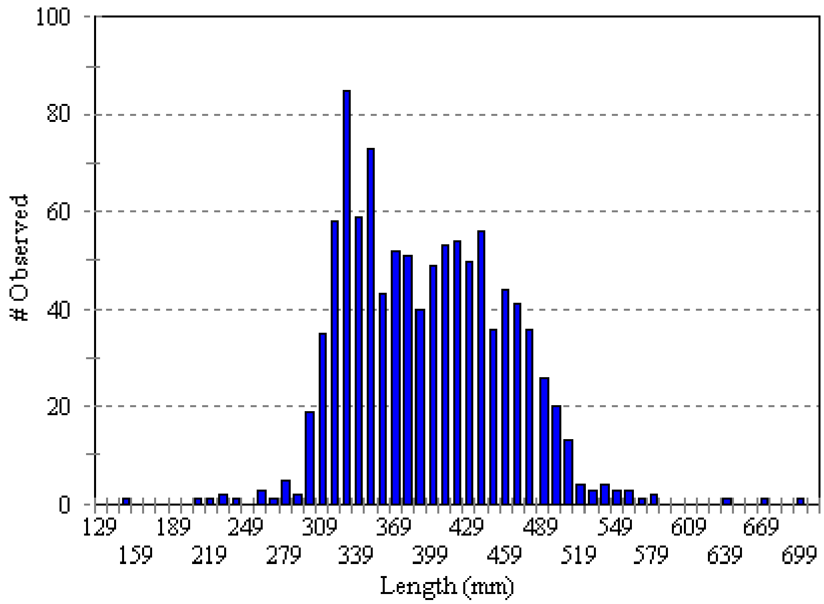

Figure 2. Length frequency distribution of walleye sampled from Wild Rice Lake Reservoir, St. Louis County, MN, during Spring 2004 electrofishing assessments.

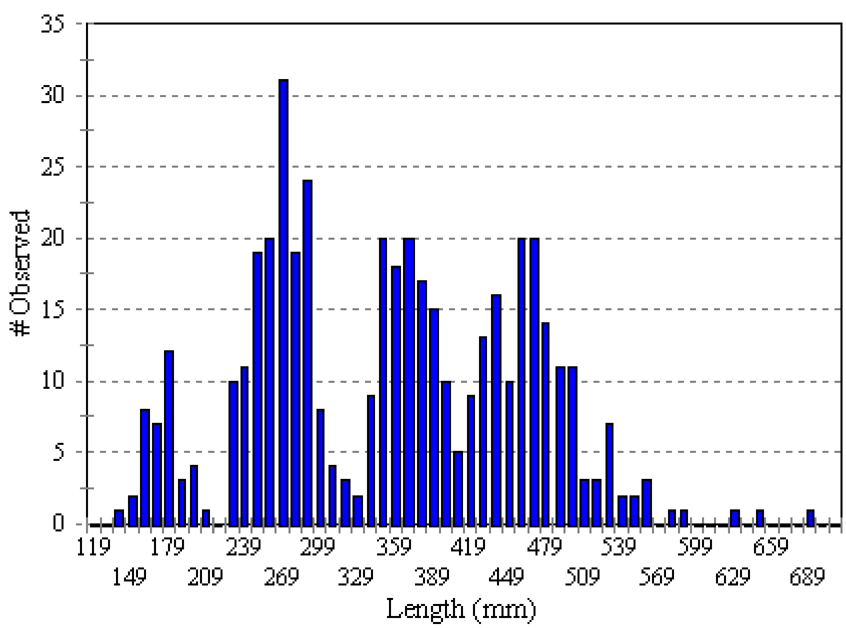

Figure 4. Length frequency distribution of walleye sampled from Ninemile Lake, Lake County, MN, during Spring 2004 electrofishing assessments

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Table 3 presents the age data for the walleye collected from Wild Rice Lake. Of the 1033 fish sampled, 890 were assigned to ages 3 through 7. This suggests that either fishing pressure may be excessive, or a few very strong year classes are recruiting into the fishery. Table 4 presents back-calculated lengths at each age class for walleye collected from Wild Rice Lake. Catch-curve analysis of ages 3 through 14 suggests a total mortality of 45.25% (R^2 = .818).

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 52.1 ± 3.1 (Table 5) suggests the population is balanced (Anderson and Weithman 1978). The summer gill net PSD (48.8 ± 8.8) is not significantly different than the PSD estimate from the spring electrofishing survey (χ^2=0.47, 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 was in the proportion of *preferred* individuals observed, where a higher proportion was observed in the gill net survey (Table 5).

PSD metrics between 2000 and 2004 electrofishing surveys were significantly different (χ^2=59.18 P<0.05, critical Chi-square value of 3.841, Table 5), suggesting that there was a higher proportion of quality sized individuals (15 to 19.9 inches), in the Wild Rice population in 2000. While significant, there doesn't seem to be any reason for concern, as there appears to be a large number of walleye larger than 15 inches in 2004, as well as a large number of smaller individuals, likely from a few strong year classes (Table 3), that will soon be fully recruited into the Wild Rice fishery.

Table 2. Walleye population estimates for Wild Rice Lake Reservoir (St. Louis County), Ninemile Lake (Lake County), and Elbow, Ball Club, and Devilfish Lakes (Cook County), Spring 2004. 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.

Lake	Population Estimate #1[1]	95% Confidence Limits Upper	Lower	Population Estimate #2[2]	C.V.[3]
W. Rice - EF	3924	4770	3333	3754 ± 1394	13.4 %
W. Rice - GN	5210	12,449	3294	18,400 ± 15,268	32.3 %
Ninemile - EF	728	787	678	793 ± 348	10.2 %
Ninemile - GN	975	1626[4]	696	1780 ± 1189	21.0%
Elbow - EF	664	664[5]	664	661 ± 265	9.3 %
Ball Club - EF	1216	1812[6]	915	1521 ± 638	9.7%
Ball Club - GN	1397	2320[6]	1000	2258 ± 1147	21.6%
Devilfish - EF	495	620[6]	412	494 ± 341	16.0%
Devilfish - GN	736	4036[6]	405	2018 ± 2721	42.4%

1 Schumacher and Eschmeyer population estimate.
2 Adjusted Petersen population estimate.
3 Coefficient of variation for the Petersen estimate.
4 Due to low recapture sample , 80% Confidence Limits had to be calculated.
5 Upper and Lower 95% Confidence Limits are the same due to only a single degree of freedom.
6 Due to low recapture sample size, 90% Confidence Limits were calculated.

Table 4. Back-calculated lengths at each age class for walleye collected from Wild Rice Lake Reservoir, St, Louis County, Minnesota, Spring 2004.

Age Class	N	Length (mm)	Length (in)
1	243	112	4.4
2	243	210	8.3
3	235	294	11.6
4	191	347	13.7
5	154	391	15.4
6	134	425	16.7
7	94	453	17.8
8	57	475	18.7
9	39	484	19.1
10	23	484	19.1
11	19	495	19.5
12	15	506	19.9
13	5	522	20.6
14	2	585	23.0
15	1	479	18.9
16	1	486	19.1
17	1	494	19.4

Table 3. Age frequency distribution of walleye from Wild Rice Lake Reservoir, St. Louis County, spring 2004, based upon the number of fish sampled and aged per size category.

Length Group Inches	mm	N	Ages	1	2	3	4	5	6	7	8	9	10	11	12	13	14	17
6	152	1																
6.5	165																	
7	178																	
7.5	191	1																
8	203																	
8.5	216	3	2-2		3													
9	229	1	1-2		1													
9.5	241	1	1-2		1													
10	254	3	2-2		3													
10.5	267	5	1-2, 3-3		1	4												
11	279	6	1-2, 2-3		2	4												
11.5	292	28	9-3			28												
12	305	71	8-3, 3-4			52	19											
12.5	318	94	8-3, 4-4			63	31											
13	330	84	10-3, 3-4, 1-5			60	18	6										
13.5	343	73	3-3, 8-4			20	53											
14	356	62	1-3, 10-4, 1-5, 1-7			5	48	5		5								
14.5	368	66	6-4, 5-5				36	30										
15	381	55	2-4, 4-5, 6-6				9	18	28									
15.5	394	55	1-4, 3-5, 5-6, 2-7				5	15	25	10								
16	406	74	5-5, 5-6, 2-7					31	31	12								
16.5	419	69	1-5, 10-6, 3-7, 2-8					4	43	13	9							
17	432	60	4-6, 5-7, 1-10						24	30	6							
17.5	445	52	4-6, 5-7, 1-8, 1-9						19	24	5	5						
18	457	51	2-6, 4-7, 4-8, 3-9, 2-12, 1-13						6	13	13	10			6	3		
18.5	470	51	4-6, 6-7, 3-9, 1-11, 3-12						12	18		9		3	9			
19	483	22	2-7, 3-8, 1-9, 1-13, 1-17							6	8	3				3		3
19.5	495	21	3-7, 2-8, 3-9, 1-10, 2-11, 2-12							5	3	5	2	3	3			
20	508	5	1-8, 1-11, 2-12								1			1	3			
20.5	521	4	1-7, 2-10, 1-13							1			2			1		
21	533	5	2-7, 1-8, 2-9							2	1	2						
21.5	546	4	1-7, 2-8, 1-9							1	2	1						
22	559	2	2-8								2							
22.5	572	1	1-9									1						
23.0	584																	
23.5	597																	
24	610																	
24.5	622	1	1-9															
												1						
25	635																	
25.5	648																	
26	660	1	1-12												1			
26.5	673																	
27	686																	
27.5	699	1	1-14														1	
TOTAL		1033			11	235	220	109	188	139	50	36	4	7	23	7	1	3

Table 5. Proportional Stock Density (PSD) and Relative Stock Densities (RSD) with 95% confidence intervals for walleye sampled from Wild Rice Lake Reservoir, St. Louis County; Ninemile Lake, Lake County; and Elbow, Ball Club, and Devilfish Lakes, Cook County, Minnesota. Values are for spring electrofishing (EF) in 2004 and MN DNR gill netting (GN) during summer 2004.
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Lake	PSD	RSD S-Q	RSD Q-P	RSD P-M	RSD M-T
W. Rice - EF_{2004}	52.1 ± 3.1	48.0 ± 3.1	49.7 ± 3.1	2.1 ± 0.9	0.2 ± 0.3
W. Rice - GN_{2004}	48.8 ± 8.8	51.2 ± 8.8	32.0 ± 8.2	16.8 ± 6.6	0.0 ± 0.0
Ninemile - EF_{2004}	48.1 ± 5.1	51.9 ± 5.1	42.2 ± 5.0	5.4 ± 2.3	0.5 ± 0.8
Ninemile - GN_{2004}	50.7 ± 11.5	49.3 ± 11.5	38.4 ± 11.2	9.6 ± 6.8	2.7 ± 3.7
Elbow - EF_{2004}	82.4 ± 4.3	17.6 ± 4.3	74.8 ± 4.9	7.6 ± 3.0	0.0 ± 0.0
Elbow - GN_{2004}	69.6 ± 18.8	30.4 ± 18.8	43.5 ± 20.3	21.7 ± 16.9	4.4 ± 8.3
Ball Club - EF_{2004}	47.7 ± 4.1	52.3 ± 4.1	42.7 ± 4.1	5.0 ± 1.8	0.0 ± 0.0
Ball Club - GN_{2004}	30.8 ± 17.7	69.2 ± 17.7	29.9 ± 17.5	3.8 ± 7.4	0.0 ± 0.0
Devilfish - EF_{2004}	44.2 ± 6.8	55.8 ± 6.8	40.4 ± 6.7	3.8 ± 2.6	0.0 ± 0.0
Devilfish - GN_{2004}	21.0 ± 13.0	79.0 ± 13.0	10.5 ± 9.8	10.5 ± 9.8	0.0 ± 0.0

Ninemile Lake

Electrofishing activities were conducted on Ninemile Lake on 1 through 3 May (Figure 3). 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 52.5 to 115.4 adults per hour and 66.0 to 130.5 total walleye per hour of sampling (Table 1). At an 80% confidence interval, mean CPUE for Ninemile Lake, determined using each sampling station, was 77.8 ± 13.3 adults per hour and 91.4 ± 13.5 total walleye per hour of sampling effort. Additional species observed included yellow perch, white sucker, and northern pike.

Catch rates among the sampling stations varied. Catch rates were highest in the back of the southernmost bay (EF-Bay), and along the eastern and southern stations (EF-1s, EF-4, EF-A, EF-B, EF-C, and EF-D), and were lowest in the stations along the north and western shorelines (EF-1, EF-2, EF-2f, and EF-3), areas characterized by soft bottom substrates (Figure 3).

The length frequency of the walleye sampled is presented in Figure 4.

Table 2 presents the population estimates based upon mark-recapture data. The electrofishing Schumacker and Eschmeyer population estimate is 728 (Table 2). The electrofishing adjusted Petersen estimate is 793 ± 348, with an 10.2% CV (Table 2). Our sampling covered all of the suitable habitat available for use by spawning walleyes.

In July 2004, the Minnesota Department of Natural Resources performed a standardized net assessment on Ninemile Lake (Don Smith and Ron Van Bergen, MN DNR, Finland Area

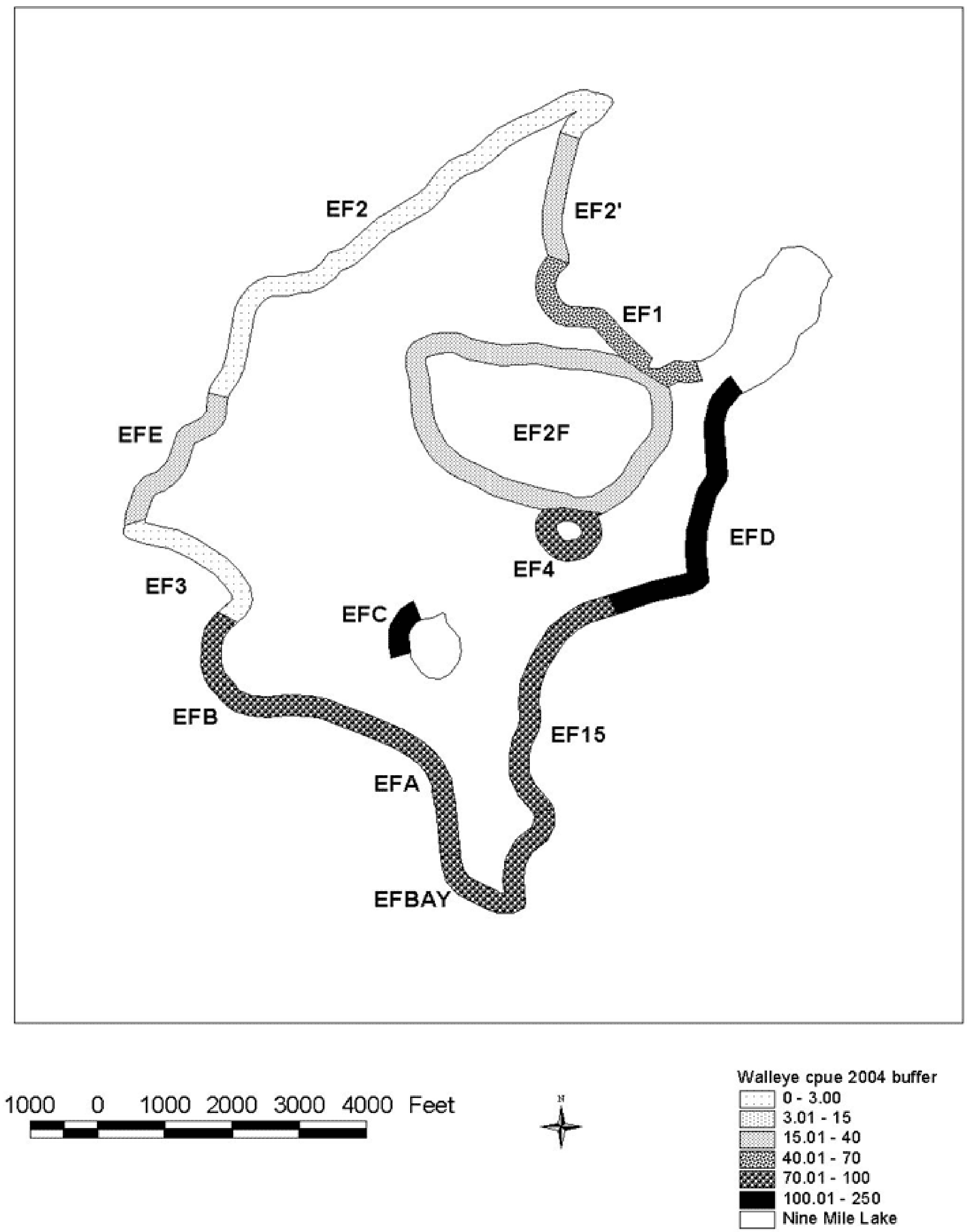

Figure 3 - Nine Mile Lake, Lake Co. Walleye CPUE 2004 sampling stations

Fisheries). Of the 73 walleye larger than 254mm sampled in both the gill nets and trap nets, 16 were observed to have the mark from the spring sampling. The adjusted Petersen estimate from the summer data is 1780 ± 1189, with a 21.0% CV, and the Schumacher and Eschmeyer estimate is 975 (Table 2).

Table 6 presents the age data for the walleye collected from Ninemile Lake. Table 7 presents back-calculated lengths at each age class for walleye collected from Ninemile Lake.

PSD and RSD values determined by our spring electrofishing sampling are presented in Table 5. The electrofishing PSD of 48.1 ± 5.1 (Table 5) suggests the population is balanced (Anderson and Weithman 1978), with a significant portion of stock-length fish (RSD S-Q = 51.9 ± 5.1) recruiting to the fishery. In 2004, significant differences in the proportion of "quality" length fish were not observed between the electrofishing and gill net assessments (Table 5). Both gear types suggest that there is a large proportion of 10 - 15 inch walleye recruiting into the fishery.

Age data (Table 6) and length data (Figure 4) suggests that either angling pressure may be a bit high, or there have been some weak year classes over the last decade. In the spring survey, few individuals were sampled older than 7 years, and only 22 individuals were sampled larger than 20.0 inches (RSD P-M = 5.41, RSD M-T = 0.54, Table 5). Catch-curve analysis suggests that, thru age 9, total mortality is 33.4%. Further work may need to address this issue, as we only have fall recruitment data since 1997.

Table 7. Back-calculated lengths at each age class for walleye collected from Ninemile Lake, Lake County, Minnesota, Spring 2004.

Age Class	N	Length (mm)	Length (in)
1	170	119	4.7
2	170	248	9.8
3	127	342	13.5
4	84	400	15.7
5	68	441	17.4
6	61	470	18.5
7	46	496	19.5
8	14	535	21.1
9	7	567	22.3
10	1	517	20.4
11	1	528	20.8
12	1	542	21.3
13	1	548	21.6
14	1	557	21.9

Table 6. Age frequency distribution of walleye from Ninemile Lake, Lake County, spring 2004, based upon the number of fish sampled and aged per size category.

Length Group Inches	mm	N Sampled	Ages	1	2	3	4	5	6	7	8	9	10	11	12	13	14
4.5	114																
5	127	1		1													
5.5	140	6		6													
6	152	6		6													
6.5	165	16		16													
7	178	5	1-1	5													
7.5	191	4		4													
8	203																
8.5	216	7			7												
9	229	14	6-2		14												
9.5	241	23	10-2		23												
10	254	39	10-2		39												
10.5	267	27	8-2		27												
11	279	25	3-2, 1-3		19	6											
11.5	292	9	6-2, 1-3		8	1											
12	305	4	4-3			4											
12.5	318	3	2-3			3											
13	330	11	5-3			11											
13.5	343	31	7-3			31											
14	356	23	7-3, 2-4			18	5										
14.5	368	20	7-3, 1-4			18	2										
15	381	19	7-3, 1-4			17	2										
15.5	394	9	1-3, 5-4, 1-6			1	7		1								
16	406	9	1-3, 5-4, 1-5			1	7	1									
16.5	419	16	1-4, 3-5, 2-6, 1-7				2	7	5	2							
17	432	19	1-4, 1-5, 4-6, 1-7				3	3	10	3							
17.5	445	18	1-6, 5-7						3	15							
18	457	27	1-5, 1-6, 5-7					4	4	19							
18.5	470	15	4-7, 1-8							12	3						
19	483	11	1-5, 2-6, 3-7, 1-8					2	3	5	2						
19.5	495	13	1-6, 3-7, 1-8, 2-9						2	6	2	4					
20	508	3	1-6, 1-7, 1-9						1	1		1					
20.5	521	7	1-6, 5-7, 1-8						1	5	1						
21	533	4	1-6, 2-7, 1-8						1	2	1						
21.5	546	3	1-7, 1-8, 1-14							1	1						1
22	559																
22.5	572	1	1-7							1							
23.0	584	1	1-8								1						
23.5	597																
24	610																
24.5	622	1	1-9									1					
25	635																
25.5	648	1	1-9									1					
26	660																
26.5	673	1	1-9									1					
27	686																
27.5	699																
TOTAL		445		38	136	111	28	16	30	72	10	8	0	0	0	0	1

Elbow Lake

Electrofishing activities were conducted on Elbow Lake on 4 and 5 May (Figure 5). Table 1 presents mean water temperature, conductivity, number of walleye sampled, and CPUE for walleye. CPUEs for each night were quite high (Table 1), relative to other lakes, as crews only sampled areas known to be used by spawning walleyes. Based upon our results in 2000 (Borkholder and Edwards 2001), crews did not sample the areas of Elbow known to be devoid of concentrations of spawning walleyes. At an 80% confidence interval, mean CPUE for Elbow Lake, determined using catch data from each sampling station, was 186.6 ± 49.6 adults per hour and 204.5 ± 53.3 total walleye per hour of sampling effort. Length frequency data of walleye collected is presented in Figure 6. Additional species observed included yellow perch, white sucker, and northern pike.

Table 8 presents the age frequency distribution. Back-calculated length-at-age estimates are presented in Table 9.

Table 2 presents the two population estimates based upon mark-recapture data. The electrofishing Schumacker and Eschmeyer population estimate is 664 (Table 2). The electrofishing adjusted Petersen estimate is 661 ± 265, with a 9.3% CV (Table 2).

In August 2004, the Minnesota Department of Natural Resources performed a standardized net assessment on Elbow Lake (Paul Eiler and Steve Persons, MN DNR, Grand Marais Area Fisheries). No recaptured individuals were noted in the field sheets. Therefore, a second population estimate is not available.

In 2000, we performed similar spring electrofishing assessments on Elbow Lake. The Schumacker and Eschmeyer population estimate we calculated in 2000 was 550, and the Petersen estimate of 538 (CV 16.4%) (Borkholder and Edwards 2001). Comparing our 2000 estimates with those from this year's assessments, it appears that the abundance of spawning adult walleye has not changed noticeably. Our fall age-0 and age-1 walleye survey results suggest that recruitment has been fairly consistent recently. Strong age-0 cohorts were observed in 2001, 2002, and 2003, and were subsequently observed as age-1 individuals.

PSD and RSD values determined by our spring electrofishing sampling are presented in Table 5. Samples collected by electrofishing during spring 2000 and again in 2004 (PSD_{2000}= 66.7 ± 5.9, PSD_{2004} = 82.4 ± 4.3) showed significant differences in PSD values between the two years (χ^2 = 17.81, P<0.05, critical Chi-square value of 3.841) (Table 5). While significantly different, both spring samples suggest well-balanced walleye populations, with the 2004 sample having a higher proportion of "quality" length walleye than the 2000 sample.

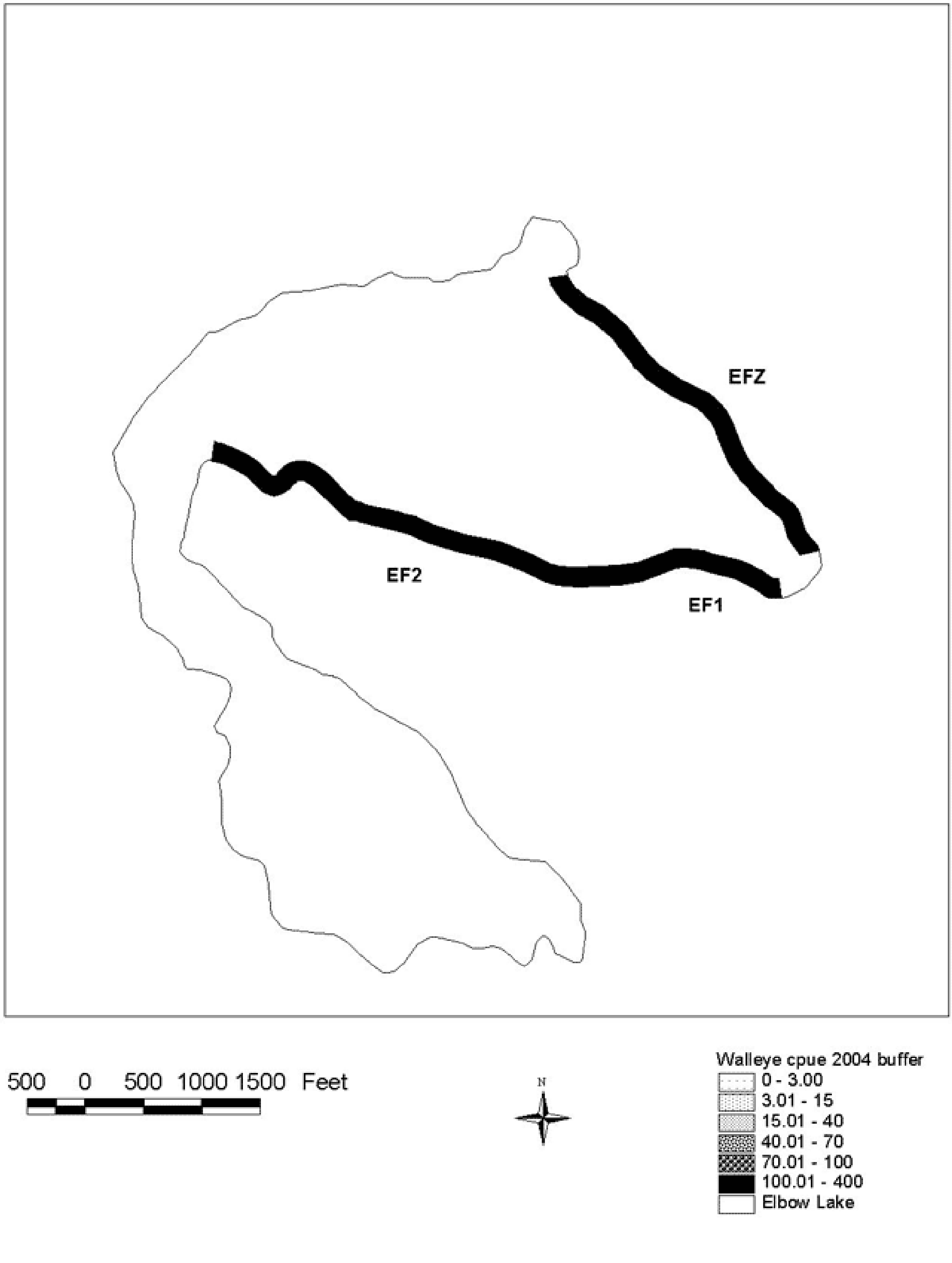

Figure 5 - Elbow Lake, Cook Co. Walleye CPUE 2004 sampling stations

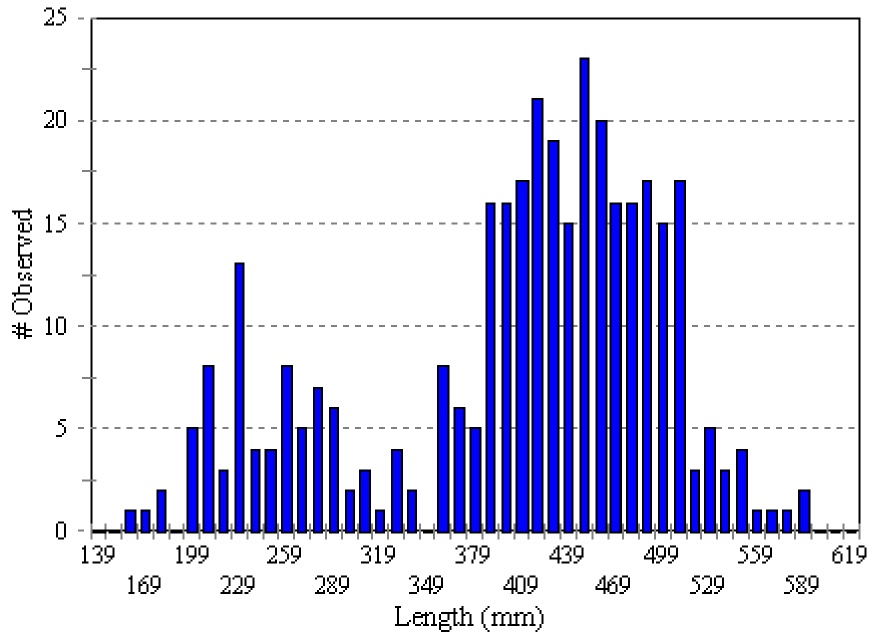

Figure 6. Length frequency distribution of walleye sampled from Elbow Lake, Cook County, MN, during Spring 2004 electrofishing assessments.

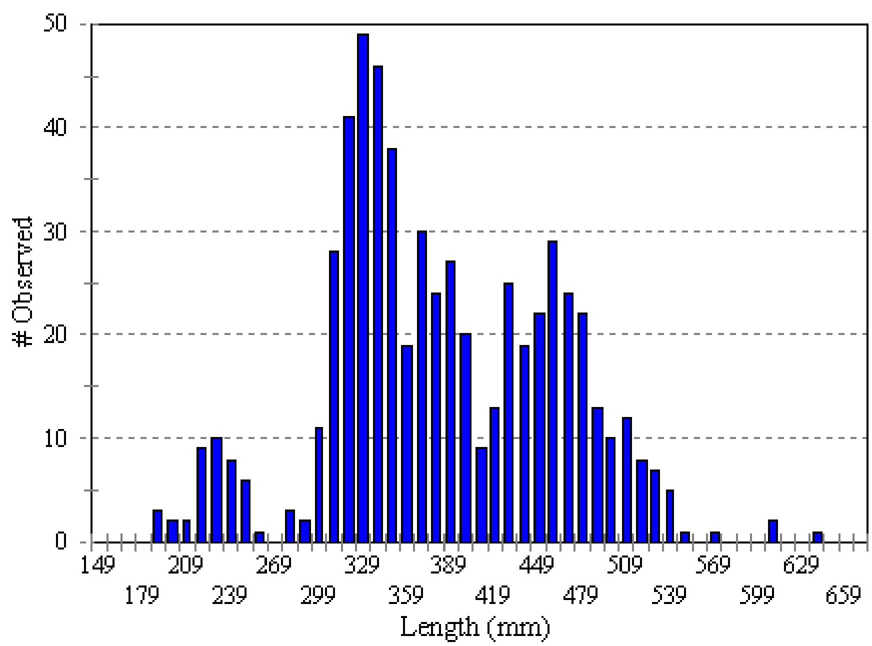

Figure 8. Length frequency distribution of walleye sampled from Ball Club Lake, Cook County, MN, during Spring 2004 electrofishing assessments.

Table 8. Age frequency distribution of walleye from Elbow Lake, Cook County, spring 2004, based upon the number of fish sampled and aged per size category.

Length Group Inches	mm	N Sampled	Ages	1	2	3	4	5	6	7	8	9	10	11	12	13	14
4.5	114																
5	127																
5.5	140																
6	152	1															
6.5	165	2															
7	178	1															
7.5	191	7															
8.0	203	9															
8.5	216	13															
9.0	229	4	1-2, 1-3		2	2											
9.5	241	8	2-2, 3-3, 1-4		3	4	1										
10.0	254	6	1-2, 2-3		2	4											
10.5	267	9	4-3			9											
11.0	279	7	2-3			7											
11.5	292	3	1-3			3											
12.0	305	3	2-3			3											
12.5	318	4	1-4				4										
13.0	330	2	2-3			2											
13.5	343	5	1-4, 2-5				2	3									
14.0	356	8	4-4, 1-5				6	2									
14.5	368	6	2-4, 1-5, 1-7				3	2		1							
15.0	381	25					9	6	6	3							
15.5	394	14	1-4, 1-5, 2-6				4	4	7								
16.0	406	30	2-4, 4-5, 1-6				9	17	4								
16.5	419	27	4-5, 3-6					15	12								
17.0	432	19	1-5, 3-6, 1-8					4	11		4						
17.5	445	27	1-6, 2-7						9	18							
18.0	457	21	3-6, 1-7, 1-8, 1-9						11	4	4	4					
18.5	470	20	1-5, 1-6, 1-7, 3-8, 1-11					3	3	3	9			3			
19.0	483	22	2-7, 1-9, 1-12, 1-13							9		4			4	4	
19.5	495	20	1-9, 4-10, 1-12									3	14		3		
20.0	508	7	2-8, 1-13								5					2	
20.5	521	5	3-10, 1-12										4		1		
21.0	533	4	1-8, 2-11								1			3			
21.5	546	3	1-7, 1-8							1	1						
22.0	559	1	1-14														1
22.5	572	3	1-9, 1-13									1				1	
23.0	584																
23.5	597																
TOTAL		346			7	34	38	56	63	38	23	12	18	6	9	7	1

Table 9. Back-calculated lengths at each age class for walleye collected from Elbow Lake, Cook County, Minnesota, Spring 2004.

Age Class	N	Length (mm)	Length (in)
1	101	112	4.4
2	101	195	7.7
3	97	268	10.6
4	80	337	13.3
5	68	390	15.4
6	52	424	16.7
7	38	450	17.7
8	30	473	18.6
9	21	484	19.1
10	17	496	19.5
11	10	503	19.8
12	7	511	20.1
13	4	530	20.9
14	1	563	22.2

Because of such a small sample size from the DNR gill net assessment (N = 23), we were unable to detect any significant differences in PSD between the two gear types, gill nets and electrofishing (χ^2 = 2.32, P>0.05, critical Chi-square value of 3.841) (Table 5).

Between both of the two gear types in 2004, only 33 individuals (N_{total} = 331) sampled were larger than 508 mm (20.0 inches). This may reflect a situation where either mortality (angling harvest) is cropping out the larger individuals from the population, or food resources are limited. Growth rates at the earliest ages do not appear to be too slow, relative to other area populations, thus suggesting that angling mortality might be limiting this population. Future studies are being planned to address this situation, e.g. a tagging study beginning in 2005.

Ball Club Lake

Electrofishing activities were conducted on Ball Club Lake on 4, 5, and 6 May (Figure 7). Table 1 presents mean water temperature, conductivity, number of walleye sampled, and CPUE for walleye. CPUE for each night ranged from 79.0 to 137.3 adults per hour and 82.6 to 150.6 total walleye per hour of sampling (Table 1). At an 80% confidence interval, mean CPUE for Ball Club Lake, determined using catch data from each sampling station, was 101.5 ± 17.2 adults per hour and 108.0 ± 17.8 total walleye per hour of sampling effort. Additional species observed included northern pike, yellow perch, and white sucker.

Catch rates among the sampling stations varied (Figure 7). We did not sample the shallow, muck-bottomed bays. Catch rates were highest around the two islands (EF2), the two small reefs adjacent to EF2 (EFreef and EF6), and along EF-1point (Figure 7).

Length frequency data of walleye collected is presented in Figure 8. Age frequency data is in Table 10. Back-calculated length at age estimates are presented in Table 11.

Table 2 presents the two population estimates based upon mark-recapture data. The electrofishing Schumacker and Eschmeyer population estimate is 1216 (Table 2). The electrofishing adjusted Petersen estimate is comparable at 1521 ± 638, with a 9.3% CV (Table 2).

In July 2004, the Minnesota Department of Natural Resources performed a standardized net assessment on Ball Club Lake (Paul Eiler and Steve Persons, MN DNR, Grand Marais Area Fisheries). Using just the gill net data, sample size is too low for comparison. We have thus included both the gill net and trap net data. Fifty-eight walleye sampled were larger than 254mm (10.0 inches), 14 of which were observed to have a clipped spine. These data provided an adjusted Petersen estimate of 2258 ± 1147 (21.6% CV, Table 2) and a Schumacker and Eschmeyer population estimate of 1397 (Table 2).

PSD and RSD values determined by our spring electrofishing sampling are presented in Table 5. The metrics illustrate that there are a lot of fish in the 10.0 - 14.9 inch range (RSD S-Q = 52.3). These fish should provide a quality fishery in the near future. Catch curve analysis suggests a total mortality on this population of 34.1% (R^2 = .929), with age classes represented out to 16 years.

Comparing the two gear types in 2004, no significant differences in the proportion of “quality” length fish were observed between the electrofishing collection and the net surveys (χ^2 = 1.36, P>0.05, Chi-square value of 3.841) (Table 5).

Table 11. Back-calculated lengths at each age class for walleye collected from Ball Club Lake, Cook County, Minnesota, Spring 2004.

Age Class	N	Length (mm)	Length (in)
1	167	99	3.9
2	167	201	7.9
3	156	293	11.5
4	128	362	14.2
5	99	409	16.1
6	77	437	16.9
7	60	458	18.0
8	51	472	18.6
9	43	481	18.9
10	36	490	19.3
11	25	496	19.5
12	22	506	19.9
13	15	519	20.4
14	9	513	20.2
15	5	521	20.5
16	1	545	21.4

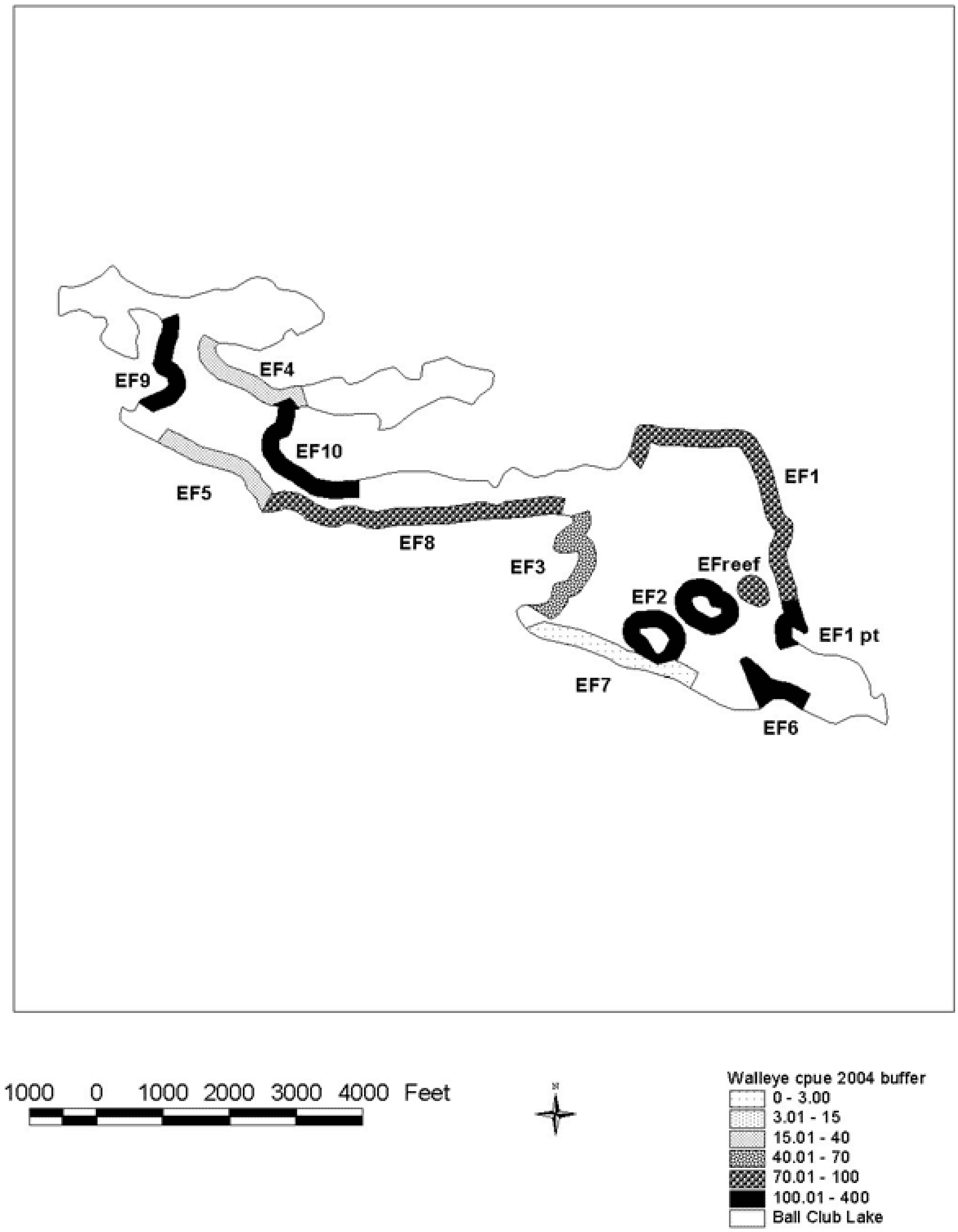

Figure 7 - Ball Club Lake, Cook Co. Walleye CPUE 2004 sampling stations

Table 10. Age frequency distribution of walleye from Ball Club Lake, Cook County, spring 2004, based upon the number of fish sampled and aged per size category.

Length Group Inches	mm	N Sampled	Ages	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
8	203																		
8.5	216	8	3-2		8														
9	229	11	5-2		11														
9.5	241	5	3-2		5														
10	254	1	1-3			1													
10.5	267	4	2-3			4													
11	279	3	3-3			3													
11.5	292	26	7-3			26													
12	305	46	5-3, 1-4			38	8												
12.5	318	56	5-3, 3-4			35	21												
13	330	61	3-3, 2-4, 1-5			31	20	10											
13.5	343	35	3-3, 4-4			15	20												
14	356	34	6-4				34												
14.5	368	29	5-4				29												
15	381	37	4-4, 4-5				19	19											
15.5	394	14	4-4, 3-5				8	6											
16	406	14	3-5, 2-6, 1-10					7	5				2						
16.5	419	33	6-5, 2-6					25	8										
17	432	24	5-6, 1-7						20	4									
17.5	445	32	3-5, 3-6, 2-7, 1-8					11	11	7	4								
18	457	32	1-5, 2-6, 3-7, 1-9, 1-11					4	8	12		4		4					
18.5	470	25	2-6, 2-8, 1-9, 3-10						6		6	3	9						
19	483	16	1-6, 1-8, 3-10, 4-12, 1-13, 1-15						1		1		4		6	1		1	
19.5	495	13	1-7, 2-8, 3-9, 1-10, 1-11, 1-12, 1-13							1	3	4	1	1	1	1			
20	508	14	1-7, 1-8, 2-9, 2-10, 2-12, 2-14, 1-15							1	1	3	3		3		3	1	
20.5	521	6	1-5, 1-7, 1-11, 1-13, 1-14, 1-15					1		1				1		1	1	1	
21	533	4	2-13, 1-15, 1-16													2		1	1
21.5	546																		
22	559																		
22.5	572																		
23.0	584																		
23.5	597	2	1-8, 1-10								1		1						
24	610																		
24.5	622	1	1-13													1			
TOTAL		586			24	153	159	83	59	27	16	14	21	6	10	7	4	5	1

Devilfish Lake

Electrofishing activities were conducted on Devilfish Lake on 6, 7 & 8 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. CPUE for each night ranged from 22.2 to 37.1 adults per hour and 41.0 to 51.2 total walleye per hour of sampling (Table 1). At an 80% confidence interval, mean CPUE for Devilfish Lake, determined using each sampling station, was 30.5 ± 7.0 adults per hour and 47.2 ± 8.7 total walleye per hour of sampling effort. Additional species observed included yellow perch and white sucker.

Catch rates among the sampling stations varied, but were relatively low compared to other lakes. Catch rates were highest around the large island (EF6) and along EF3 (Figure 9). The section of shoreline between EF2 and EF3 was not surveyed, due to poor habitat and previous experience that indicated walleyes do not use this portion of the lake for spawning activities (Borkholder and Edwards 1999).

The length frequency of the walleye sampled is presented in Figure 10. Table 12 presents the age data for the walleye collected from Devilfish Lake. Table 13 presents back-calculated lengths at each age class for walleye collected from Devilfish Lake.

Table 2 presents the population estimates based upon mark-recapture data. The electrofishing Schumacker and Eschmeyer population estimate is 495 (Table 2). The electrofishing adjusted Petersen estimate is 494 ± 341, with an 16.0% CV (Table 2). Our sampling covered all of the suitable habitat available for use by spawning walleyes (Figure 9).

In September 2004, the Minnesota Department of Natural Resources performed a standardized net assessment on Devilfish Lake (Paul Eiler and Steve Persons, MN DNR, Grand Marais Area Fisheries). Of the 45 walleye larger than 254mm sampled in both the gill nets and trap nets, only 4 were observed to have the mark from the spring sampling. While probably meaningless due to low numbers of recaptured individuals, the adjusted Petersen estimate from the summer data is 2018 ± 2721, with a 42.4% CV (Table 2).

PSD and RSD values determined by our spring electrofishing sampling are presented in Table 5. The electrofishing PSD of 44.2 ± 6.8 (Table 5) suggests the population is balanced (Anderson and Weithman 1978), with a significant portion of stock-length fish (RSD S-Q = 55.8 ± 6.8) recruiting to the fishery. In 2004, significant differences in the proportion of "quality" length fish were not observed between the electrofishing and gill net assessments (Table 5), most likely due to a low sample size for the net assessment. No differences were observed in PSD and RSD values between electrofishing assessments in 2004 and 1998 (Borkholder and Edwards 1999).

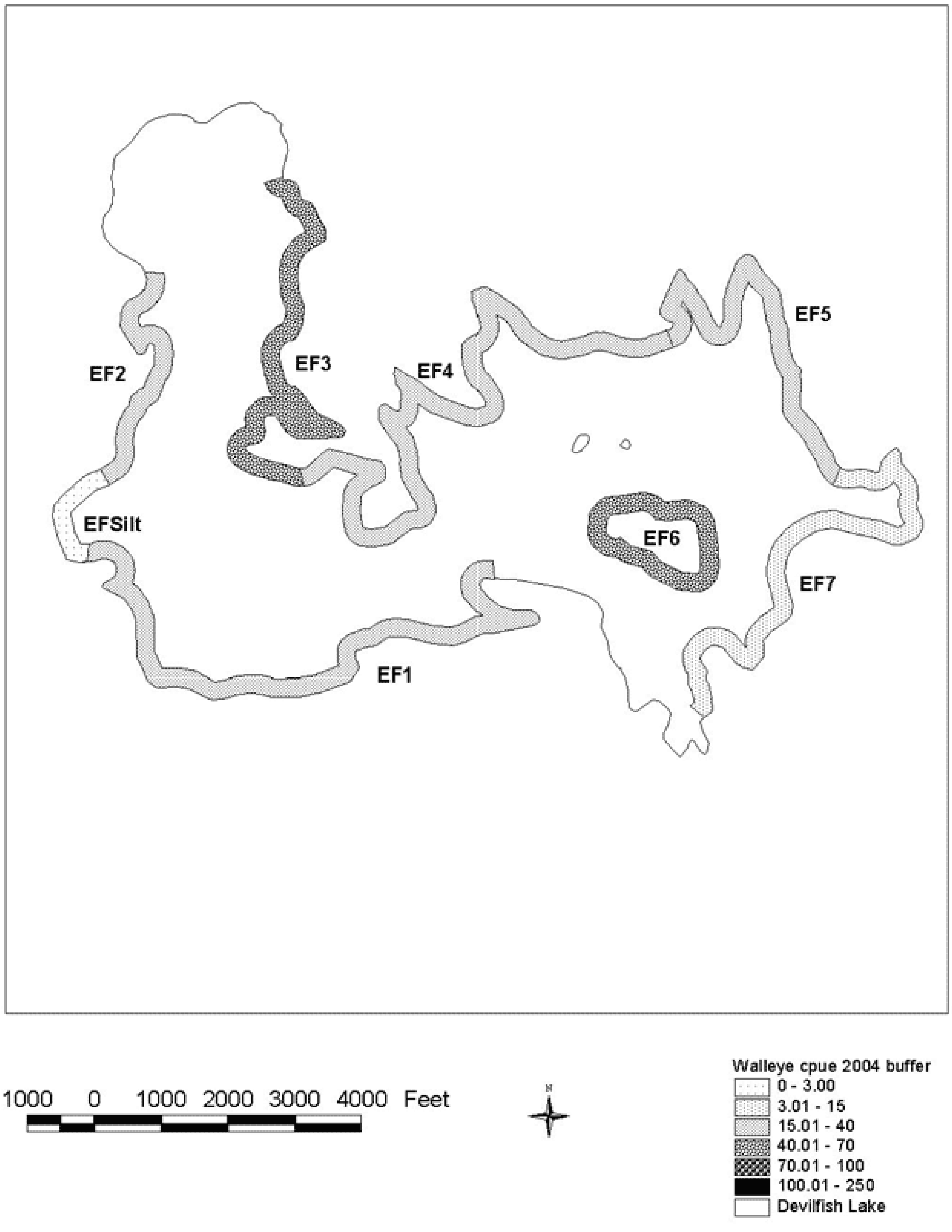

Figure 9 - Devilfish Lake, Cook Co. Walleye CPUE 2004 sampling stations

Table 12. Age frequency distribution of walleye from Devilfish Lake, Cook County, spring 2004, based upon the number of fish sampled and aged per size category.

Length Group															
Inches	mm	N Sampled	Ages	1	2	3	4	5	6	7	8	9	10	11	12
6.5	165														
7	178	1													
7.5	191	1													
8	203	6													
8.5	216	14	1-2, 1-3		7	7									
9	229	42	2-2, 3-3		17	25									
9.5	241	71	1-2, 5-3		12	59									
10	254	40	5-3			40									
10.5	267	18	5-3			18									
11	279	7	6-3			7									
11.5	292	5	3-3			5									
12	305	3	1-3, 2-4			1	2								
12.5	318	5	1-3, 3-4			1	4								
13	330	8	5-4, 2-5				6	2							
13.5	343	11	2-4, 3-5, 2-6				3	5	3						
14	356	11	6-4, 4-5				7	4							
14.5	368	8	2-4, 5-5, 1-6				2	5	1						
15	381	13	1-5, 2-7, 1-9, 1-10					3		5		3	3		
15.5	394	19	2-4, 2-6, 1-7, 2-8, 1-10				5		5	2	5		3		
16	406	16	3-7							16					
16.5	419	16	2-5, 1-6, 1-7, 5-10							16					
17	432	10	1-5, 1-8, 4-10, 1-11					1			1		7	1	
17.5	445	2	1-10										2		
18	457	6	1-6, 3-9, 1-10, 1-12						1			3	1		1
18.5	470	2	2-10										2		
19	483														
19.5	495														
20	508	2	1-8, 1-10								1		1		
20.5	521	3	3-9									3			
21	533														
21.5	546														
22	559														
22.5	572	1	1-9									1			
23.0	584														
23.5	597														
24	610	1	1-9									1			
24.5	622	1	1-10										1		
TOTAL		343			36	163	29	20	10	39	7	11	20	1	1

Table 13. Back-calculated lengths at each age class for walleye collected from Devilfish Lake, Cook County, Minnesota, Spring 2004.

Age Class	N	Length (mm)	Length (in)
1	121	90	3.5
2	121	174	6.8
3	117	252	9.9
4	87	300	11.8
5	65	328	12.9
6	46	351	13.8
7	39	383	15.1
8	32	419	16.5
9	28	448	17.6
10	19	446	17.6
11	2	444	17.5
12	1	464	18.3

Age data (Table 13) and length data (Figure 10) suggests that growth in this population may be slower than other regional lakes. Catch curve analysis indicates a total mortality of 41.5% (R^2 = .694), with age classes up to 12 years observed. Only 8 individuals larger than 20 inches were sampled. Our fall survey data indicates that a large 2001 year class (age-3 in 2004), should soon start to recruit into the fishery. We will continue to monitor this in the future.

Whiteface Reservoir

A single evening of sampling was conducted on Whiteface Reservoir, with the main focus being to locate spawning habitat, and to investigate whether we could identify enough walleye spawning concentrations to justify including this population in a tagging study that will begin in 2005. Sampling occurred on 29 April 2004, using the two tribal electrofishing boats, and a third provided by the MN DNR—Duluth Area Fisheries. Results reported here are from the two tribal electrofishing crews.

Electrofishing crews investigated much of the shoreline available in Whiteface, targeting locations of suspected spawning, or based upon substrate data made available by the MN DNR—Duluth Area Fisheries. “On-time” was recorded at 16,964 seconds (Table 1). A total of 100 adult walleye were sampled. Age frequency distribution is presented in Table 14, while lengths observed are presented in Figure 11.

Based upon such low numbers observed, at this point we’ve decided not to include Whiteface Reservoir into a future tagging study.

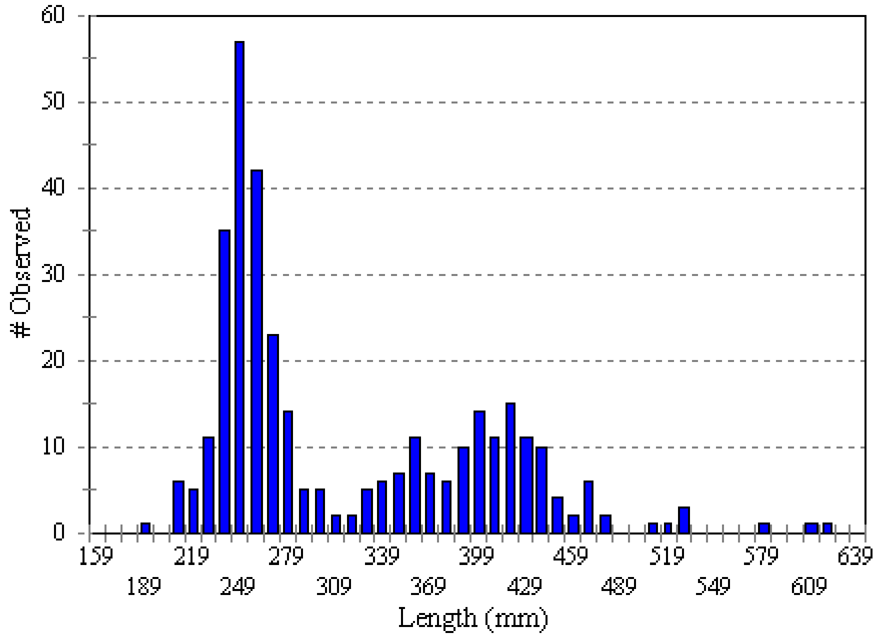

Figure 10. Length frequency distribution of walleye sampled from Devilfish Lake, Cook County, MN, during Spring 2004 electrofishing assessments.

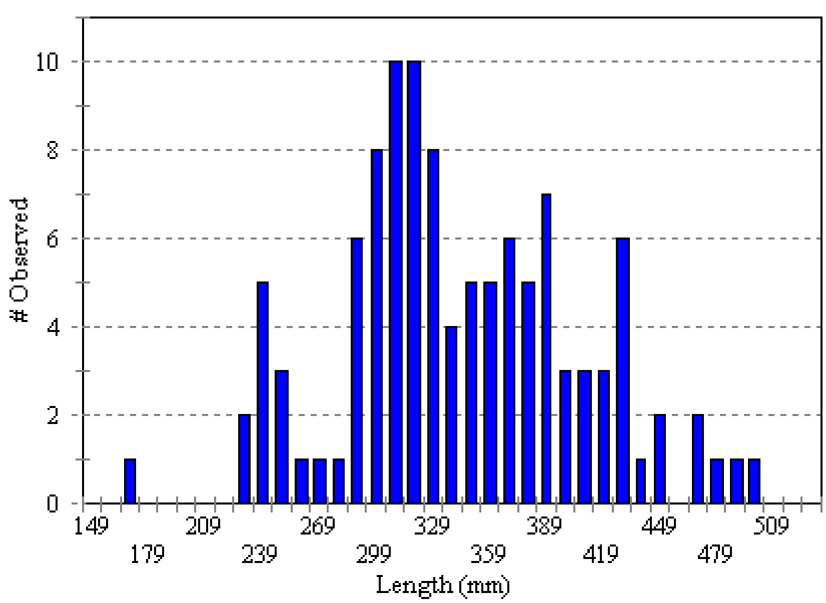

Figure 11. Length frequency distribution of walleye sampled from Whiteface Reservoir, St. Louis County, MN, during Spring 2004 electrofishing assessments.

Table 14. Age frequency distribution of walleye from Whiteface Reservoir, St. Louis County, spring 2004, based upon the number of fish sampled and aged per size category.

Length Group Inches	mm	N Sampled	Ages	1	2	3	4	5	6	7	8	9	10	11
6	152													
6.5	165	1		1										
7	178													
7.5	191													
8	203													
8.5	216	2			2									
9	229	5	2-2		5									
9.5	241	3	3-2		3									
10	254	2	1-2, 1-3		1	1								
10.5	267	1	1-3			1								
11	279	7	6-3			7								
11.5	292	14	12-3, 1-4			13	1							
12	305	13	8-3, 4-4			9	4							
12.5	318	9	7-3, 2-4			7	2							
13	330	8	3-3, 1-4, 1-5, 1-6, 1-8			4	1	1	1		1			
13.5	343	3	1-3, 2-5			1		2						
14	356	9	2-4, 5-5, 1-6, 1-8				2	5	1		1			
14.5	368	6	4-5, 2-6					4	2					
15	381	6	2-4, 2-5, 2-6				2	2	2					
15.5	394	6	3-5, 2-6, 1-8					3	2		1			
16	406	2	1-6, 1-7						1	1				
16.5	419	7	1-6, 2-7, 4-8						1	2	4			
17	432	3	2-9, 1-10									2	1	
17.5	445													
18	457	2	1-8, 1-9								1	1		
18.5	470	1	1-9									1		
19	483	2	1-10, 1-11										1	1
19.5	495													
TOTAL		112		1	11	43	12	17	10	3	8	4	2	1

Fall Assessments

Table 15 presents a summary of each evening of electrofishing assessments. CPUE for age-0 walleye ranged from 0.0 fish per hour (Eagle, Prairie, and Little Wilson Lakes) to 179.4 fish per hour of electrofishing (Dumbbell Lake) (Table 15). CPUE for age-1 walleye ranged from 0.6 fish per hour (Prairie Lake) to 130.2 fish per hour of electrofishing (West Twin Lake) (Table 15). Figures 12 - 37 present length frequency data for each of the lakes surveyed. Table 16 presents the mean length for age-0 and age-1 individuals sampled during fall 2004 assessments. Mean lengths for age-0 walleye ranged from 79 mm (3.1 inches, Ball Club Lake) to 133 mm (5.2 inches, Crooked Lake). Mean lengths for age-1 walleye ranged from 165 mm (6.5 inches, Little Wilson Lake) to 242 mm (9.5 inches, Shagawa 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 64.3, and our mean $CPUE_{1+}$ is 31.2. Using the mean $CPUE_{Age\text{-}0}$ as one criteria, average or better 2004 year classes were observed in 5 of the lakes (Table 15). Average or better 2003 year classes (age-1 walleye) were observed in 19 of the lakes (Table 15). 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 2004 were smaller than mean lengths observed during previous years' surveys. This is no doubt a result of the cooler than average summer experienced in northern Minnesota. 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 overwinter 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 average mean length of age-0 walleye observed since 1995 in our electrofishing assessments is 130 mm in lakes not stocked by the DNR with fingerling walleye prior to our assessments. Using the mean length criteria of 130 mm for average year classes, average or better 2004 year classes may only be present in one of the lakes surveyed (Crooked, Table 16). In the future, we will be further investigating the predictive power mean length and CPUE of age-0 has 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 gill net data for adults from the DNR. Continued monitoring of walleye young-of-the-year and year-1 fish will give a better picture of recruitment patters of walleye over time in these lakes, and give managers a better understanding of walleye population.

Acknowledgments

The Fond du Lac Division of Resource Management and the 1854 Authority wish to acknowledge and thank the Fond du Lac Fishery Technicians; and Sonny Myers, Darren Vogt, and Carlye Olson, 1854 Authority, for their hard work in the field. E.J. Isaac's (Northland College) assistance in the field is also acknowledged. Enforcement support at the landings by Leo Vidal, Jeff Poskie, and Ralph LaPlant (1854 Authority) and by Jason Loons, Dave Gitzen, and Duane Barney (Fond du Lac) was also appreciated. Tim Krohn, Fond du Lac Resource Management, provided the GIS maps with the walleye CPUE data. Gill net data from the Minnesota Department of Natural Resources was provided by Steve Persons and Paul Eiler, Grand Marais Area Office; Don Smith and Ron Van Bergen, Finland Area Office; and Deserae Hendrickson and Jon Meerbeek, Duluth Area Office.

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Table 15. Total number and catch-per-unit-effort of age-0 and age-1 walleye collected by the 1854 Authority and the Fond du Lac Division of Resource Management from twenty seven lakes within the 1854 Ceded Territory of Northeastern Minnesota during Fall 2004.

Lake	Date	Temp (F)	Temp (C)	Cond.[1]	YOY Total[2]	Total1+[3]	Total both	Seconds	CPUE YOY[4]	CPUE 1+[5]	CPUE both
Aspen	04-Sep-04	66	18.9	50.4	26	64	90	4387	21.34	52.52	73.85
Ball Club	09-Sep-04	63	17.2	28.4	5	21	26	3639	4.95	20.77	25.72
Cadotte	22-Sep-04	61	16.1	33.1	97	108	205	7604	45.92	51.13	97.05
Caribou	07-Sep-04	65	18.3	64.1	10	47	57	5843	6.16	28.96	35.12
Cascade	02-Sep-04	65	18.3	25.9	44	66	110	4838	32.74	49.11	81.85
Crescent	07-Sep-04	66	18.9	-------	6	18	24	4610	4.69	14.06	18.74
Crooked	30-Sep-04	50	10.0	49.8	61	7	68	4486	48.95	5.62	54.57
Devilfish	08-Sep-04	62	17.0	21.2	4	92	96	6899	2.09	48.01	50.09
Dumbbell	27-Sep-04	63	17.2	72.3	262	11	273	5257	179.42	7.53	186.95
Eagle	14-Sep-04	70	21.1	136.2	0	6	6	6763	0.00	3.19	3.19
Elbow	10-Sep-04	63	17.2	38.4	3	40	43	3517	3.07	40.94	44.01
Fourmile	28-Sep-04	58	14.4	53.2	51	12	63	5705	32.18	7.57	39.75
Homer	02-Sep-04	67	19.4	-------	1	3	4	5250	0.69	2.06	2.74
Island Reservoir	16-Sep-04	64	17.8	77.7	6	128	134	8663	2.49	53.19	55.69
Ninemile	30-Sep-04	61	16.1	57.4	161	52	213	5929	97.76	31.57	129.33
North McDougal	27-Sep-04	62	17.0	68.2	180	72	252	6032	107.43	42.97	150.40
Pike	08-Sep-04	66	18.9	-------	73	4	77	2863	91.79	5.03	96.82
Prairie	20-Sep-04	65	18.3	120.7	0	1	1	5543	0.00	0.65	0.65
Shagawa	23-Sep-04	64	18.3	86.4	251	37	288	9726	92.91	13.70	106.60
Silver Island	29-Sep-04	58	14.4	39.7	31	30	61	4035	27.66	26.77	54.42
Tom	01-Sep-04	65	18.3	-------	2	60	62	7428	0.97	29.08	30.05
Two Island	09-Sep-04	67	19.4	-------	11	9	20	6219	6.37	5.21	11.58
West Twin	10-Sep-04	68	20.0	-------	6	150	156	4147	5.21	130.21	135.42
Whiteface Reservoir	13-Sep-04	67	19.4	59.1	51	87	138	5822	31.54	53.80	85.33
Wilson	28-Sep-04	63	17.2	45.7	2	27	29	2129	3.38	45.66	49.04
Windy	29-Sep-04	63	17.2	30.4	32	47	79	3984	28.92	42.47	71.39
Little Wilson	28-Sep-04	62	17	45.4	0	4	4	2589	0.00	5.56	5.56

[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 16. Mean length for age-0 and age-1 walleye sampled during fall 2004 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)
Aspen (Cook)	4 September	108	216
Ball Club (Cook)	9 September	79 (N=5)	186
Cadotte (St. Louis)	22 September	129	229
Caribou (Cook)	7 September	100	204
Cascade (Cook)	2 September	110	191
Crescent (Cook)	7 September	119 (N=6)	204
Crooked (Lake)	30 September	133	239 (N=7)
Devilfish (Cook)	8 September	83 (N=4)	182
Dumbbell (Lake)	27 September	118	194
Eagle (Carlton)	14 September	——	211 (N=6)
Elbow (Cook)	10 September	81 (N=3)	175
Fourmile (Lake)	28 September	102	196
Homer (Cook)	2 September	107 (N=1)	200 (N=3)
Island Lake (St. Louis)	16 September	123	180
Ninemile (Lake)	30 September	127	231
North McDougal (Lake)	27 September	96	171
Pike (Cook)	8 September	104	219 (N=4)
Prairie (St. Louis)	20 September	---	177 (N=1)
Shagawa (St. Louis)	23 September	110	242
Silver Island (Lake)	29 September	118	186
Tom (Cook)	1 September	102 (N=2)	185
Two Island (Cook)	9 September	84	200 (N=9)
West Twin (Cook)	10 September	93 (N=6)	194
Whiteface (St. Louis)	13 September	116	210
Wilson (Lake)	28 September	90 (N=2)	181
Windy (Lake)	29 September	109	188
Little Wilson (Lake)	28 September	—	165 (N=4)

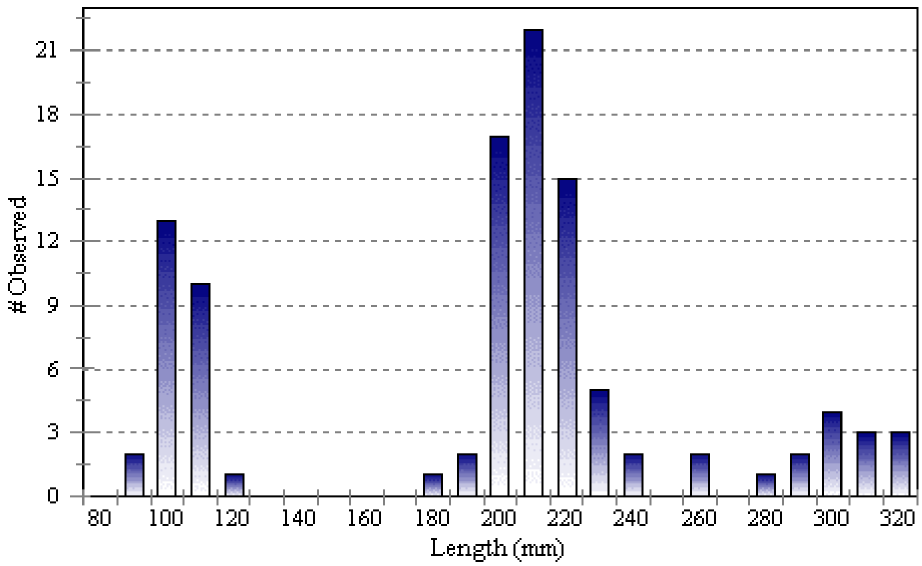

Figure 12. Length frequency distribution of walleye collected from Aspen Lake, Cook County, during fall 2004 electrofishing assessments.

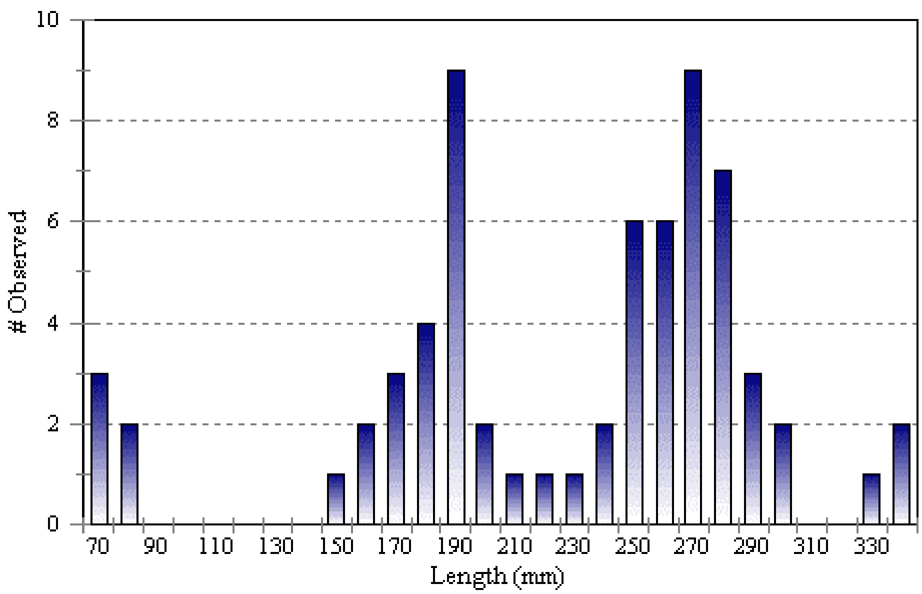

Figure 13. Length frequency distribution of walleye collected from Ball Club Lake, Cook County, during fall 2004 electrofishing assessments.

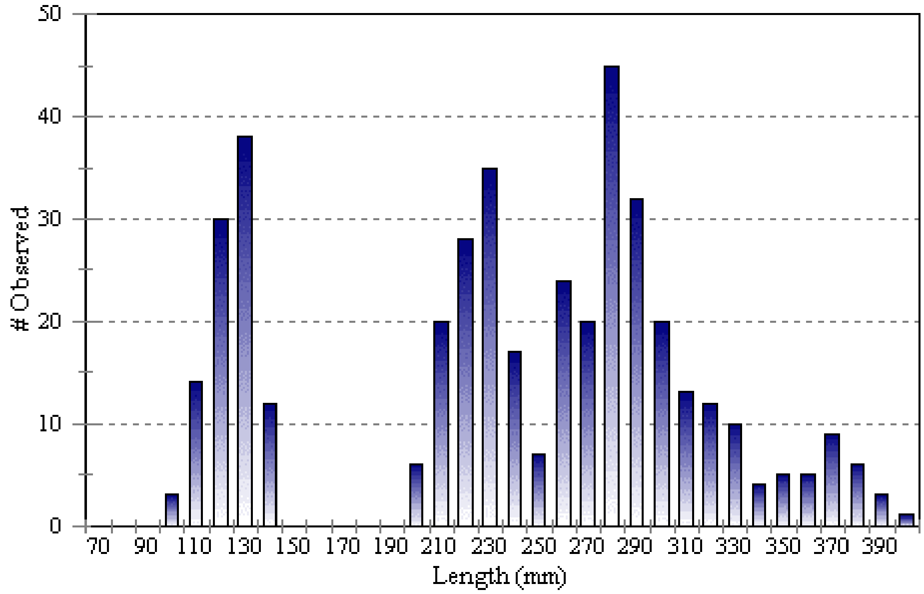

Figure 14. Length frequency distribution of walleye collected from Cadotte Lake, St. Louis County, during fall 2004 electrofishing assessments.

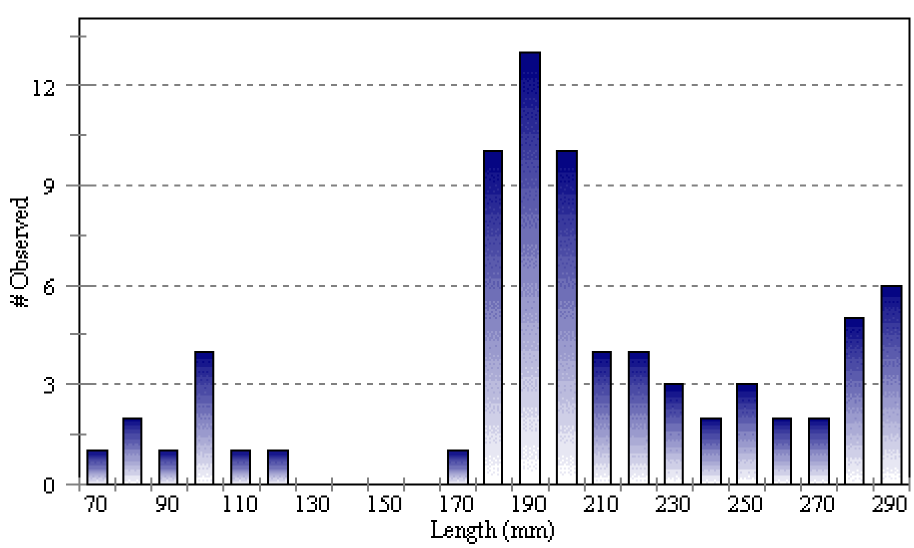

Figure 15. Length frequency distribution of walleye collected from Caribou Lake, Cook County, during fall 2004 electrofishing assessments.

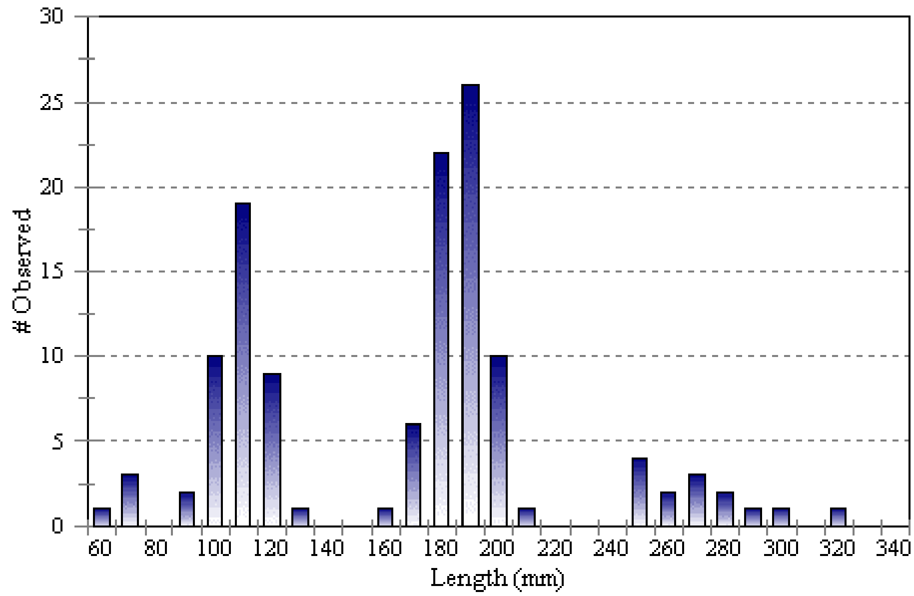

Figure 16. Length frequency distribution of walleye collected from Cascade Lake, Cook County, during fall 2004 electrofishing assessments.

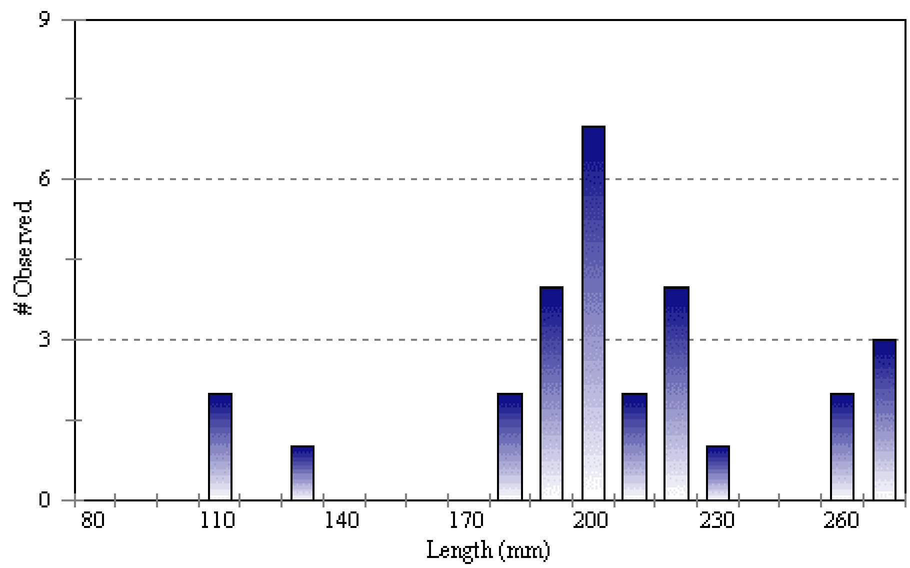

Figure 17. Length frequency distribution of walleye collected from Crescent Lake, Cook County, during fall 2004 electrofishing assessments.

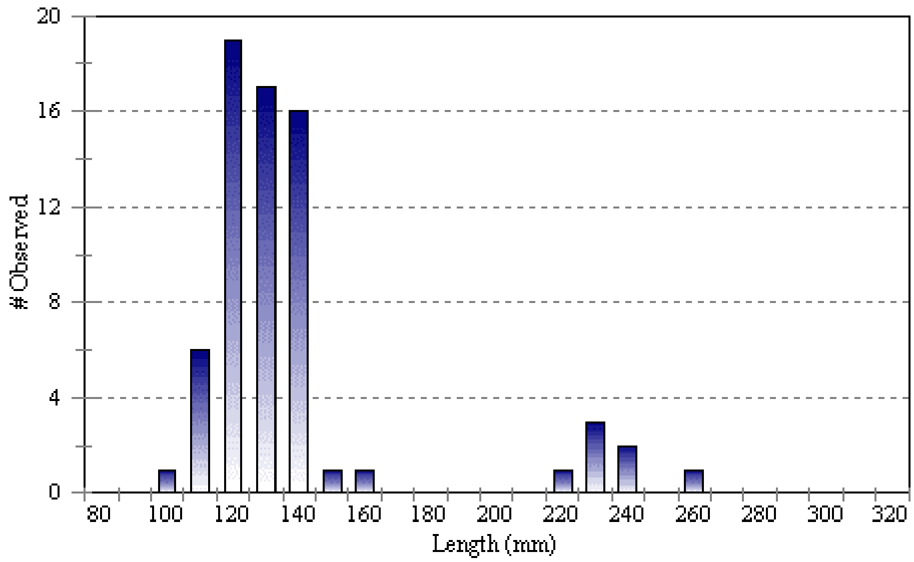

Figure 18. Length frequency distribution of walleye collected from Crooked Lake, Lake County, during fall 2004 electrofishing assessments.

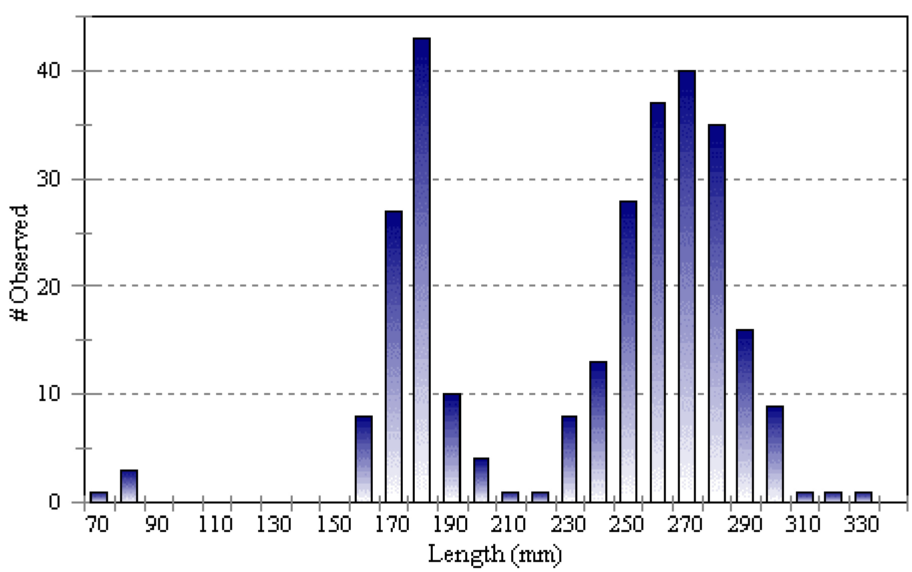

Figure 19. Length frequency distribution of walleye collected from Devilfish Lake, Cook County, during fall 2004 electrofishing assessments.

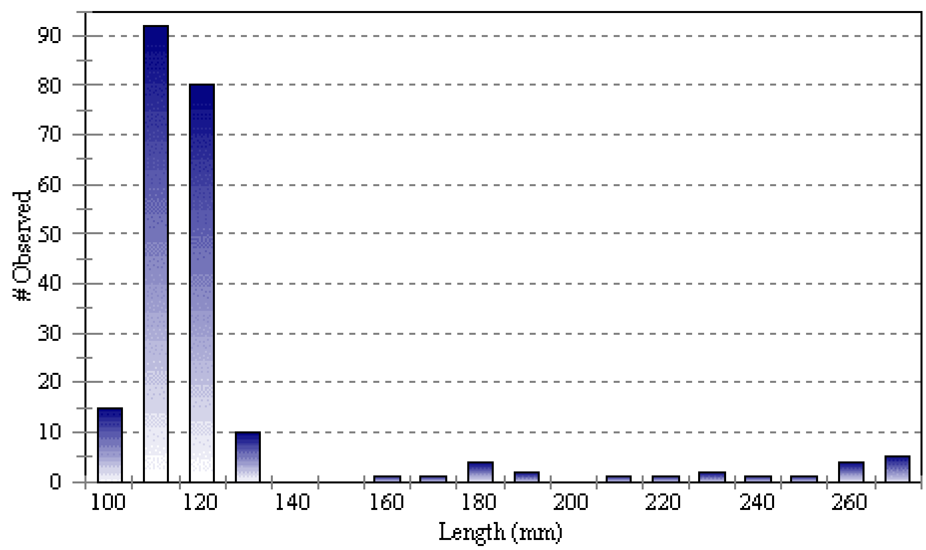

Figure 20. Length frequency distribution of walleye collected from Dumbbell Lake, Lake County, during fall 2004 electrofishing assessments.

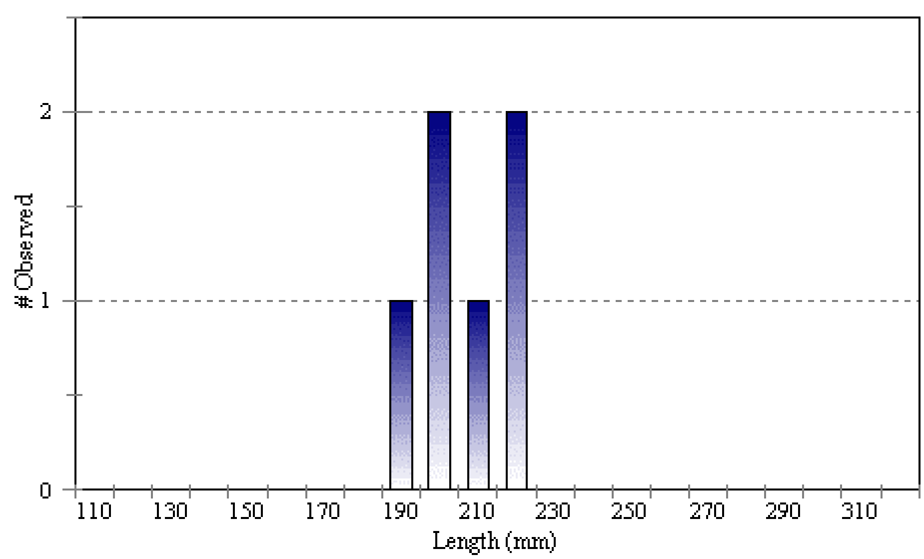

Figure 21. Length frequency distribution of walleye collected from Eagle Lake, Carlton County, during fall 2004 electrofishing assessments.

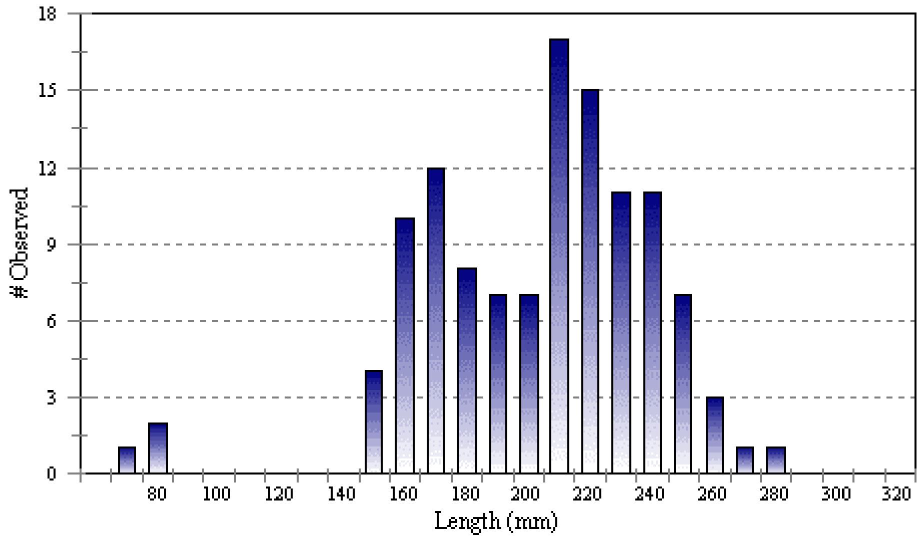

Figure 22. Length frequency distribution of walleye collected from Elbow Lake, Cook County, during fall 2004 electrofishing assessments.

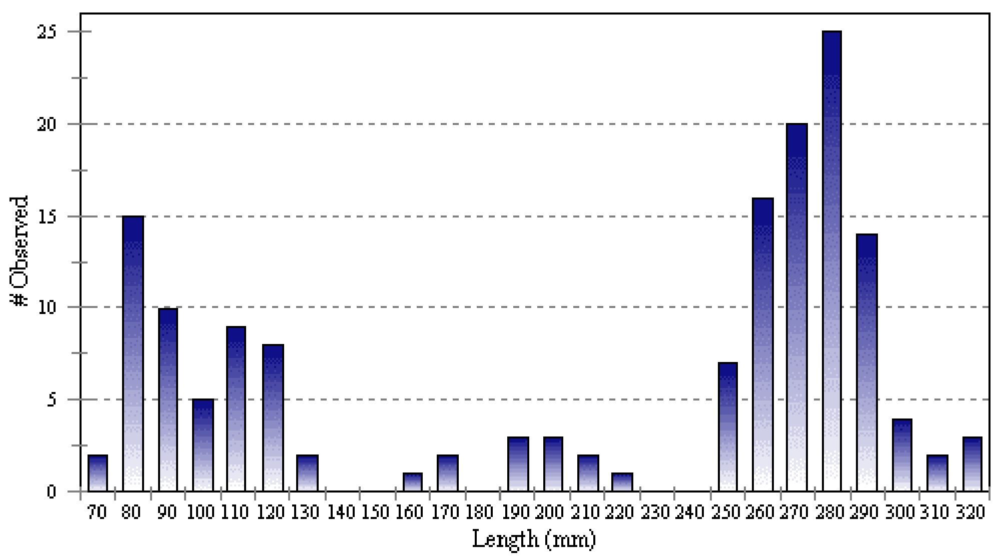

Figure 23. Length frequency distribution of walleye collected from Four Mile Lake, Cook County, during fall 2004 electrofishing assessments.

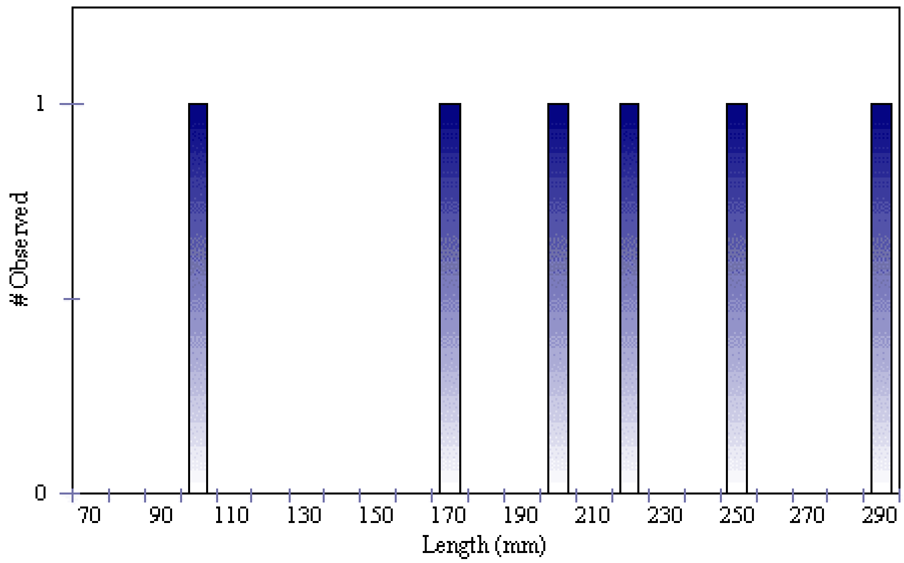

Figure 24. Length frequency distribution of walleye collected from Homer Lake, Cook County, during fall 2004 electrofishing assessments.

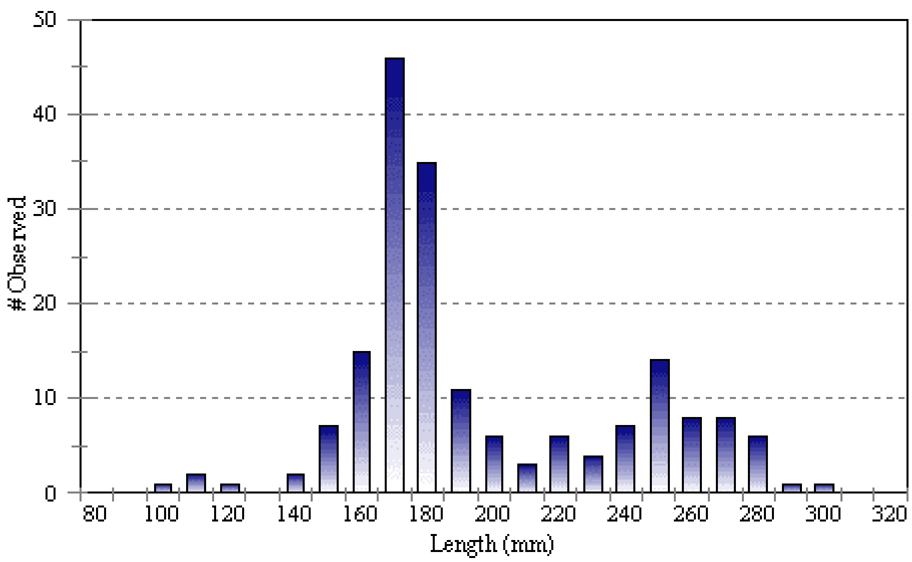

Figure 25. Length frequency distribution of walleye collected from Island Lake Reservoir, St. Louis County, during fall 2004 electrofishing assessments.

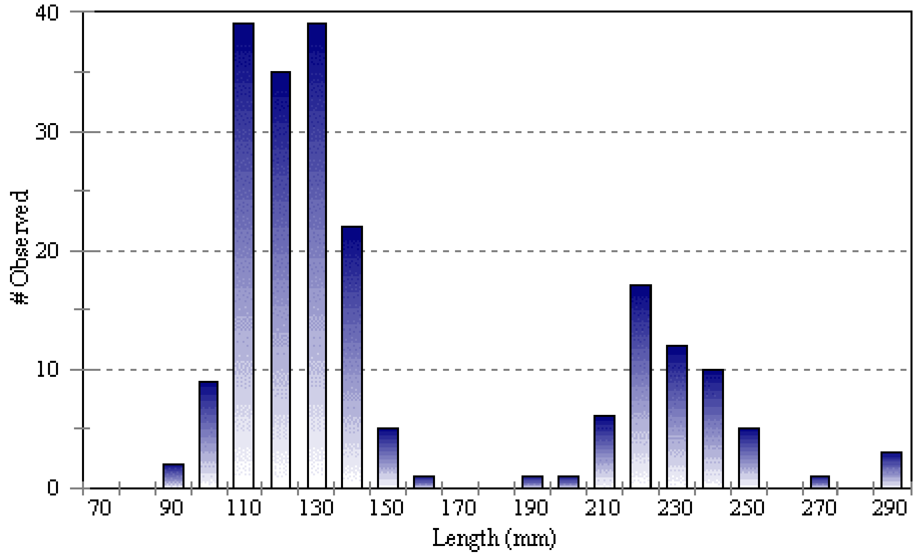

Figure 26. Length frequency distribution of walleye collected from Ninemile Lake, Lake County, during fall 2004 electrofishing assessments.

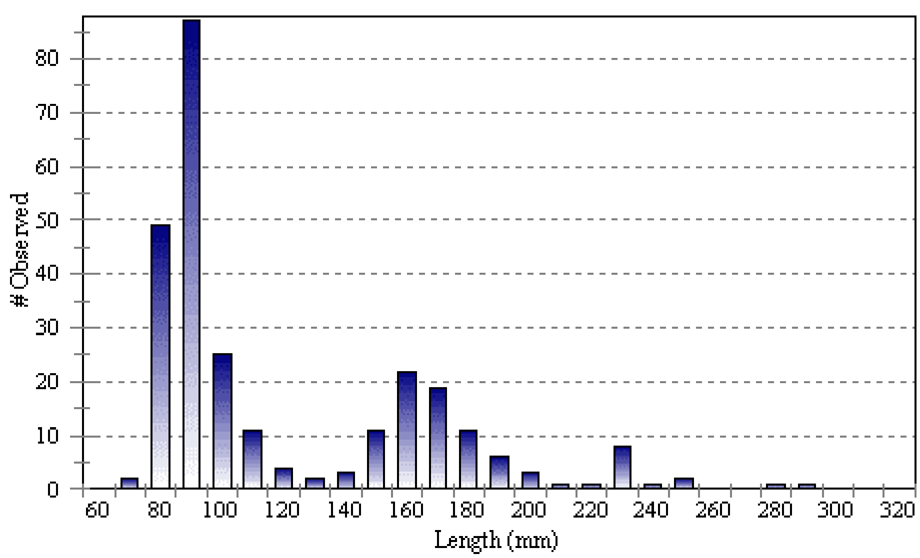

Figure 27. Length frequency distribution of walleye collected from North McDougal Lake, Lake County, during fall 2004 electrofishing assessments.

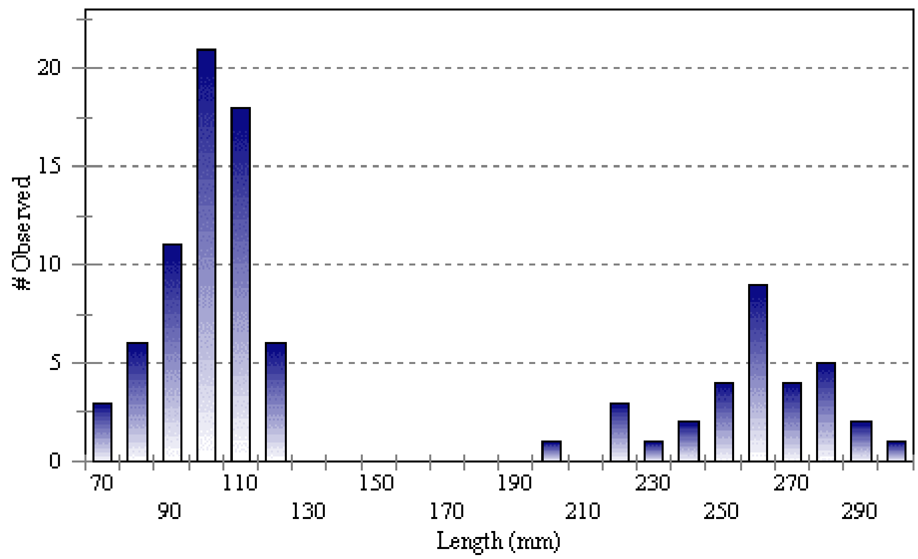

Figure 28. Length frequency distribution of walleye collected from Pike Lake, Cook County, during fall 2004 electrofishing assessments.

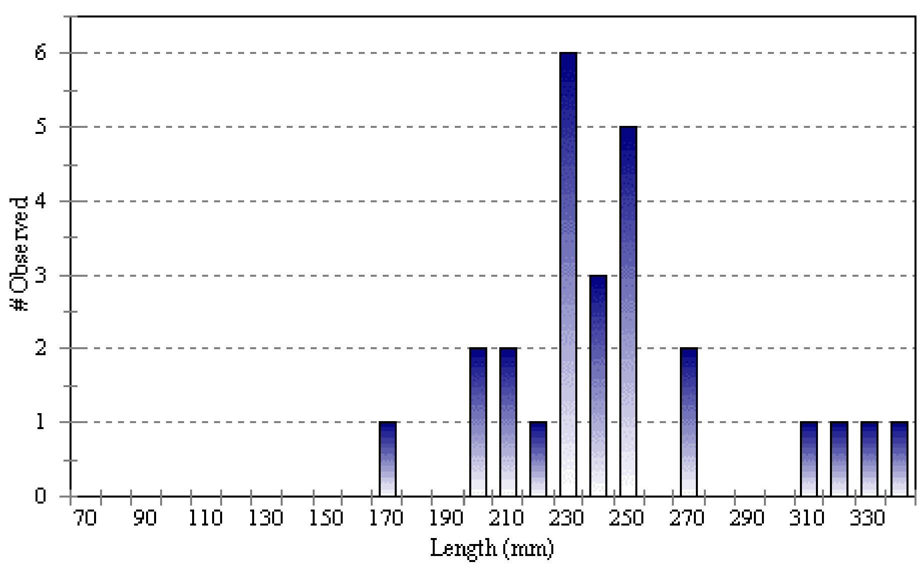

Figure 29. Length frequency distribution of walleye collected from Prairie Lake, St. Louis County, during fall 2004 electrofishing assessments.

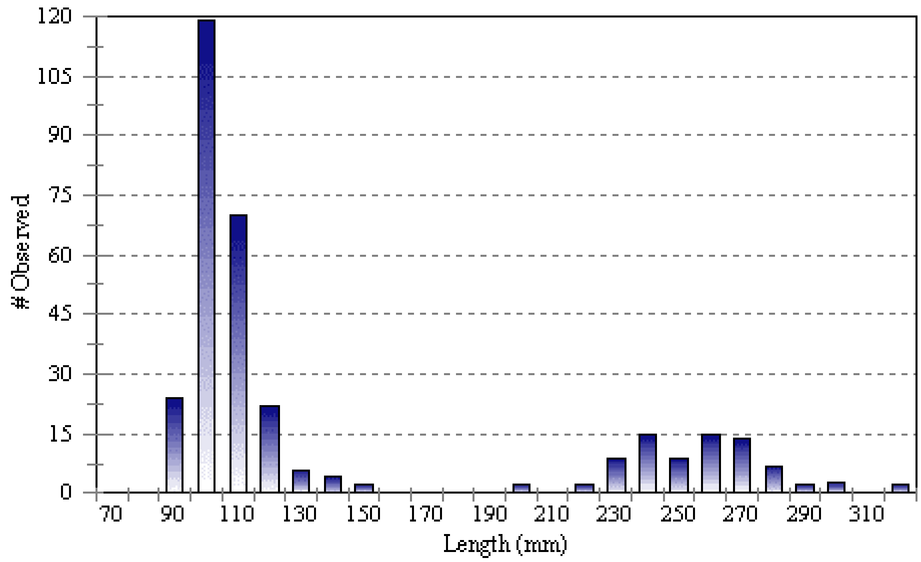

Figure 30. Length frequency distribution of walleye collected from Shagawa Lake, St. Louis County, during fall 2004 electrofishing assessments.

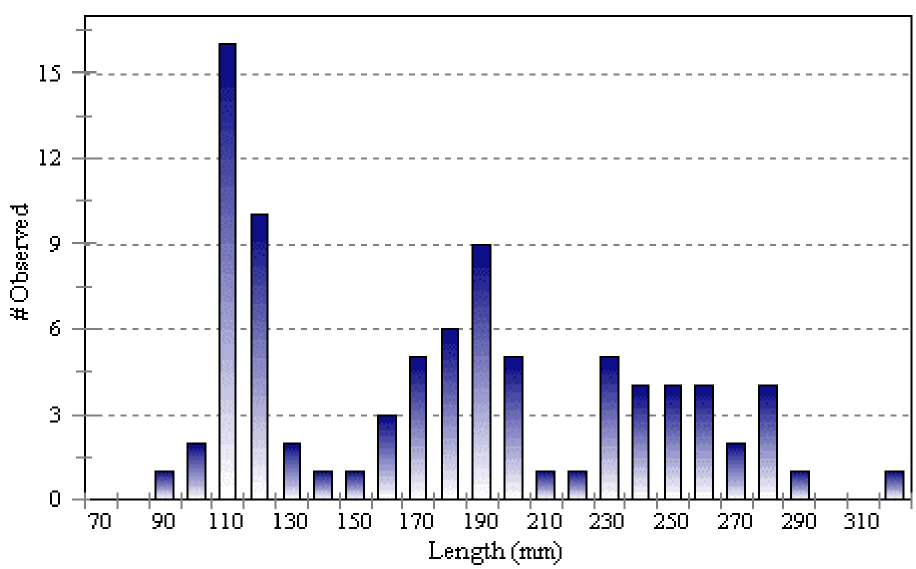

Figure 31. Length frequency distribution of walleye collected from Silver Island Lake, Cook County, during fall 2004 electrofishing assessments.

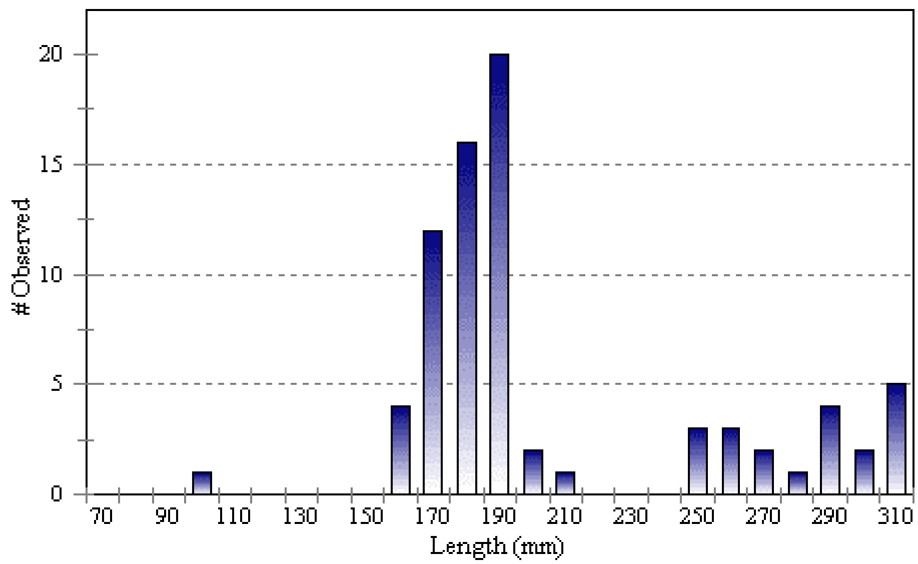

Figure 32. Length frequency distribution of walleye collected from Tom Lake, Cook County, Lake, Cook County, during fall 2004 electrofishing assessments.

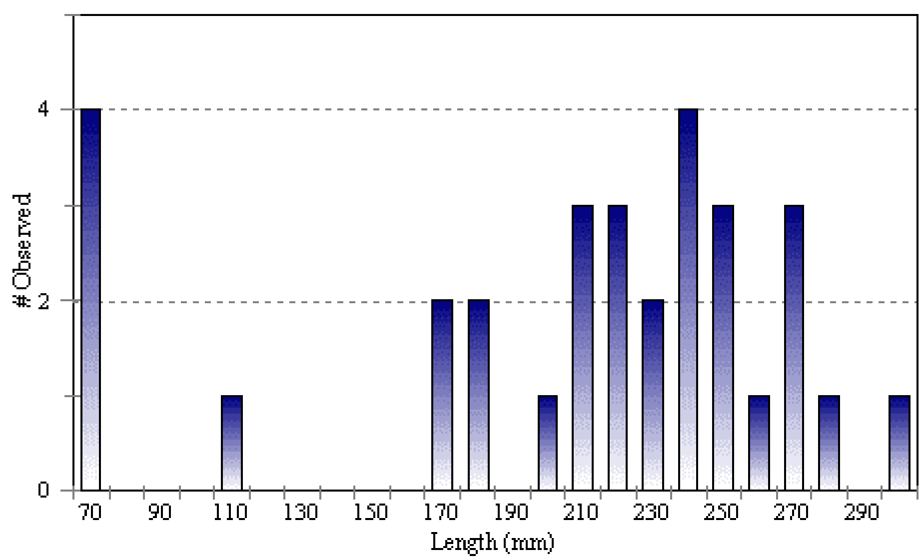

Figure 33. Length frequency distribution of walleye collected from Two Island Lake, Cook County, during fall 2004 electrofishing assessments.

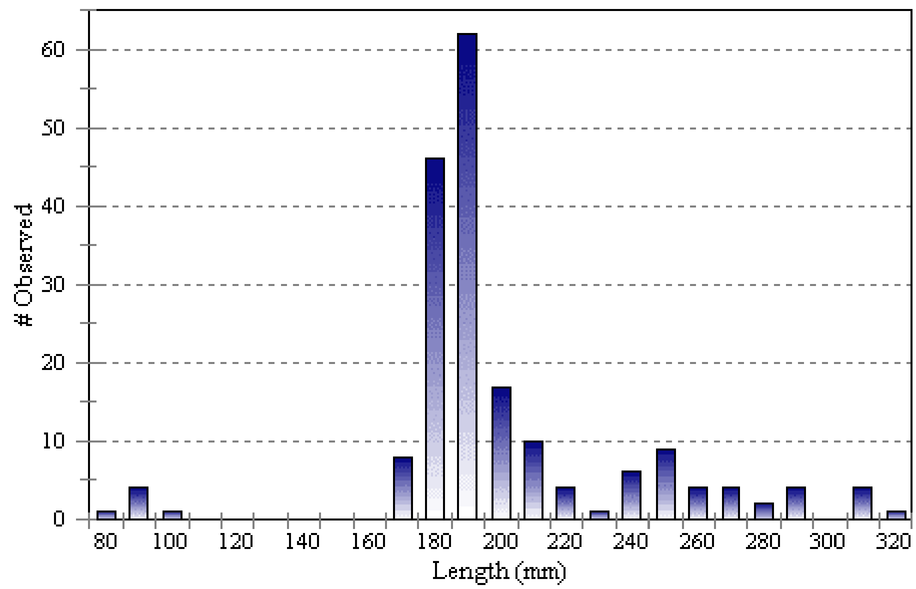

Figure 34. Length frequency distribution of walleye collected from West Twin Lake, Cook County, during fall 2004 electrofishing assessments.

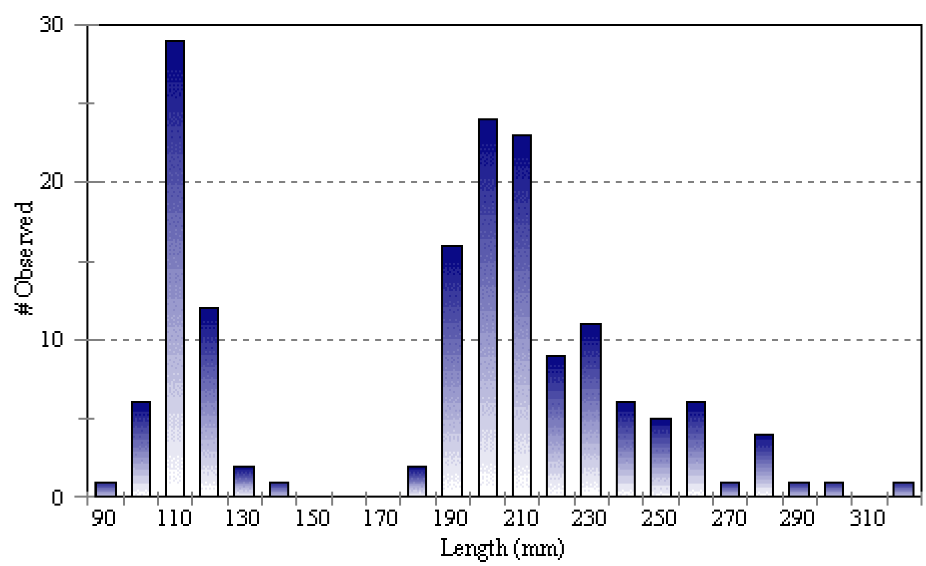

Figure 35. Length frequency distribution of walleye collected from Whiteface Reservoir, St. Louis County, during fall 2004 electrofishing assessments.

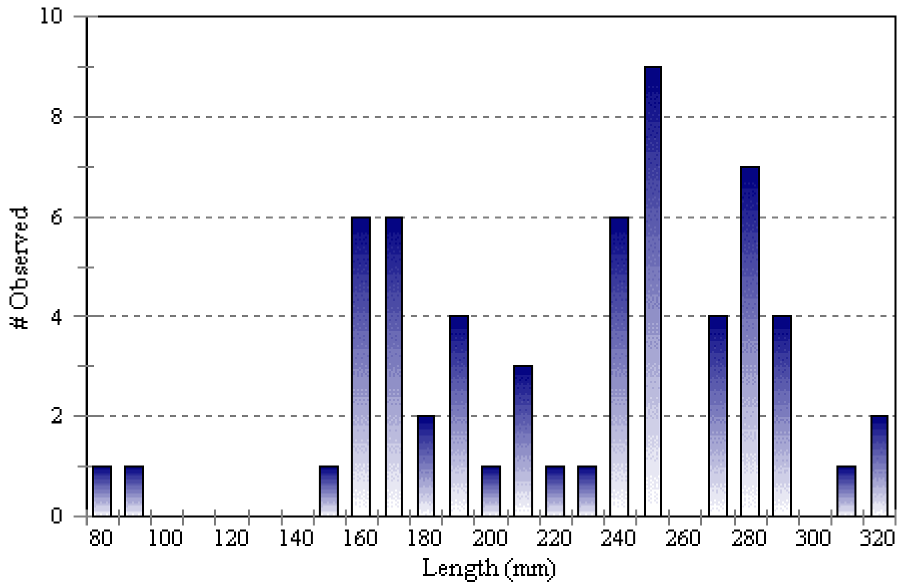

Figure 36. Length frequency distribution of walleye collected from Wilson Lake, Lake County, during fall 2004 electrofishing assessments.

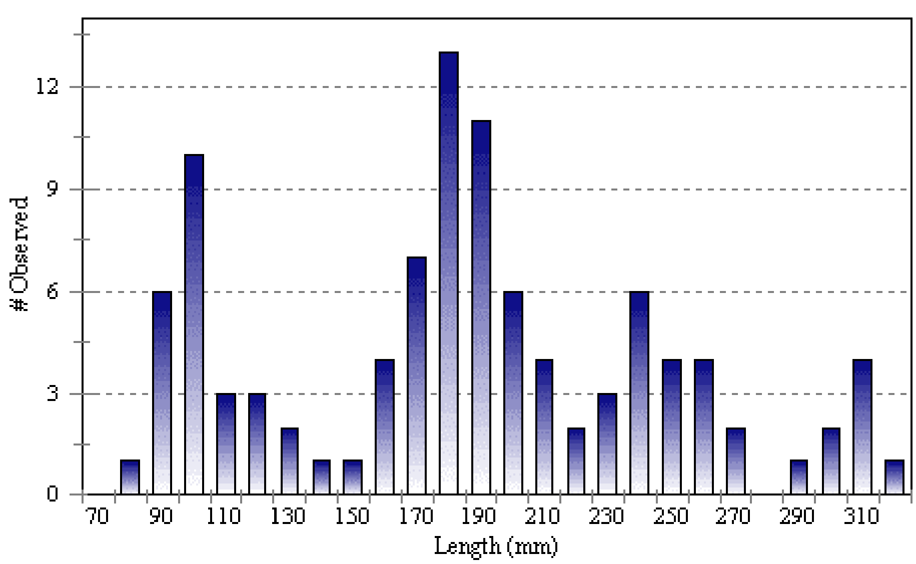

Figure 37. Length frequency distribution of walleye collected from Windy Lake, Lake County, during fall 2004 electrofishing assessments.