# Walleye Population Surveys on Six Lakes within the 1854 Ceded Territory of Minnesota, Spring 2001

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 are taking 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 the sampling of 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 are marked, usually 10% to 30% (Meyer 1993).

Surveying 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. Population estimates based upon electrofishing data alone, where females are not as vulnerable to the sampling gear, 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).

For this survey, adult walleye population estimates were made using mark - recapture data. Due to personnel and time constraints, trap netting was not used. Thus, our estimates might be biased towards males in the populations. A second benefit of these surveys is that it allows us to identify and determine key and critical spawning sites, i.e. where catch rates are the highest.

## Methods

Six lakes within the 1854 Ceded Territory of Minnesota were selected for night-time electrofishing surveys (Table 1). Murphy Lake (DOW# 69-0035) is located south of Eveleth, in Central Lakes, St. Louis County. Wilson Lake (DOW# 38-0047) is located northeast of Finland, in Lake County. Four Mile Lake (DOW# 16-0639) is located just to the northeast of Wilson Lake, in Cook County. Aspen Lake (DOW# 16-0204) is located on the Clearwater Lake Road, north on the Gunflint Trail out of Grand Marais, in Cook County. Flour Lake (DOW# 16-0147) is located just north of Aspen Lake, also on the Clearwater Lake Road. Tom Lake (DOW# 16-0019) is located north of Hovland, in Cook County. The objective was to obtain adult walleye (*Stizostedion vitreum*) 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.

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 cur-

Table 1. Summary of night time electrofishing activities on six lakes surveyed within the 1854 Ceded Territory, Minnesota, during Spring 2001.

| 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*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69-0035 | St. Louis | Murphy | 71.0 | 5.0 | 30-Apr-01 | 53 | 82.7 | 9965 | 884 | 3 | 3.5 | 12 / 15 | 4.3 / 5.4 |
| | | | | | 01-May-01 | 52 | 82.8 | 4147 | 884 | 4 | 3 | 9 / 9 | 7.8 / 7.8 |
| | | | | | 02-May-01 | 58 | 86.8 | 3674 | 884 | 3 | 3.75 | 5 / 6 | 11.8 / 11.8 |
| | | | | | | | | | | | TOTALS | 26 / 30 | |
| 16-0639 | Cook | Four Mile | 572.0 | 19.5 | 03-May-01 | 45 | 35.5 | 11030 | 1061 | 7 | 4.5 | 219 / 225 | 71.5 / 73.4 |
| | | | | | 04-May-01 | 51 | 36.8 | 7213 | 1061 | 4 | 4 | 206 / 211 | 102.8 / 105.3 |
| | | | | | 05-May-01 | 53 | 41.1 | 6306 | 1061 | 4 | 4 | 217 / 217 | 123.9 / 123.9 |
| | | | | | | | | | | | TOTALS | 642 / 653 | |
| 38-0047 | Lake | Wilson | 622.0 | 53.0 | 04-May-01 | 43 | 45.0 | 8577 | 1061 | 6 | 4 | 64 / 65 | 26.9 / 27.3 |
| | | | | | 06-May-01 | 43 | 48.8 | 8742 | 1061 | 4.5 | 4 | 95 / 95 | 39.1 / 39.1 |
| | | | | | 07-May-01 | 44 | | 8264 | 1061 | 4.5 | 4 | 166 / 168 | 72.3 / 73.2 |
| | | | | | | | | | | | TOTALS | 159 / 160 | |
| 16-0204 | Cook | Aspen | 131.0 | 29.0 | 09-May-01 | 52 | 57.6 | 4762 | 1061 | 3 | 4 | 65 / 76 | 49.1 / 57.5 |
| | | | | | 10-May-01 | 50 | 56.9 | 3551 | 1061 | 3.5 | 4 | 40 / 45 | 40.6 / 45.6 |
| | | | | | | | | | | | TOTALS | 105 / 121 | |
| 16-0147 | Cook | Flour | 334.8 | 75.0 | 10-May-01 | 47 | 60.1 | 9620 | 1061 | 4 | 4 | 44 / 44 | 16.5 / 16.5 |
| | | | | | | | | | | | TOTALS | 44 / 44 | |
| 16-0019 | Cook | Tom | 576.0 | 35.0 | 08-May-01 | 45 | 32.6 | 15381 | 1061 | 5.75 | 4.5 | 286 / 328 | 66.9 / 76.8 |
| | | | | | 09-May-01 | 50 | 30.6 | 9831 | 1061 | 5 | 4 | 203 / 238 | 74.3 / 87.2 |
| | | | | | | | | | | | TOTALS | 489 / 566 | |

* Water conductivity measured in microSiemens / cm.

** WAE = walleye. Numbers in column represent the number of "stock" sized walleye (> 254 mm (10.0 inches)) / the total number of walleye col lected, including individuals < 10 inches.

*** CPUE = catch per unit effort, computed as per hour of electrofishing. Numbers in column prepresent CPUE for "stock" sized walleye / CPUE of rent (P-DC) was used to minimize injuries to the fish. Surface water temperature was taken at the beginning of each evening. 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 revive. 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. 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). Previous walleye surveys have traditionally utilized the adjusted Peterson formula (Goyke et al. 1993 and 1994, and Ngu and Kmiecik 1993). 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.

Spines from adults were cleaned using bleach to remove the layer of skin on the bone. Spines were set in epoxy resin and 0.3 to 0.5 mm thin sections made 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 then 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, personal communication).

## Results and Discussion

*Murphy Lake*

Electrofishing activities were conducted on Murphy Lake from 30 April to 2 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 4.3 to 11.8 adults per hour and 5.4 to 11.8 total walleye per hour of sampling (Table 1). At an 80% confidence interval, mean CPUE for Murphy Lake, determined using each sampling station, was 5.2 ± 2.5 adults per hour and 6.5 ± 2.5 total walleye per hour of sampling effort. The length frequency of the walleye sampled is presented in Figure 2. Additional species observed included yellow perch, northern pike, white sucker, bluegill, crappie, largemouth bass, and spottail shiner.

Catch rates of adult walleye were highest along stations EF3, EF3/4, and EFC. Few walleye were sampled along stations EF1, EF4, EFA, EFB, and EFD (Figure 1). One of the goals for Murphy Lake was to determine whether periodic stocking had produced a self-sustaining naturally-reproducing walleye population. The first night of sampling effort identified the majority of the shoreline as being unsuitable spawning habitat. Subsequent evenings of sampling on the limited spawning habitat failed to locate large numbers or aggregations of walleyes. We therefore shifted our effort to another lake.

Table 2 presents the population estimates based upon mark-recapture data. The Schumacker and Eschmeyer population estimate from electrofishing data is 208 (Table 2). Upper and lower confidence limits were not available due to the single recaptured individual. The adjusted Petersen estimate is 81 ± 75, with a 47.1% CV (Table 2).

Table 3 presents the expanded age frequency distribution for the walleye collected from Murphy Lake. Table 4 presents back-calculated lengths at each age class for walleye collected from Murphy Lake. Back-calculated lengths for this population appear to be higher than other area populations. This is probably the result of the low sample size; only six individuals older than age 4 were sampled.

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,

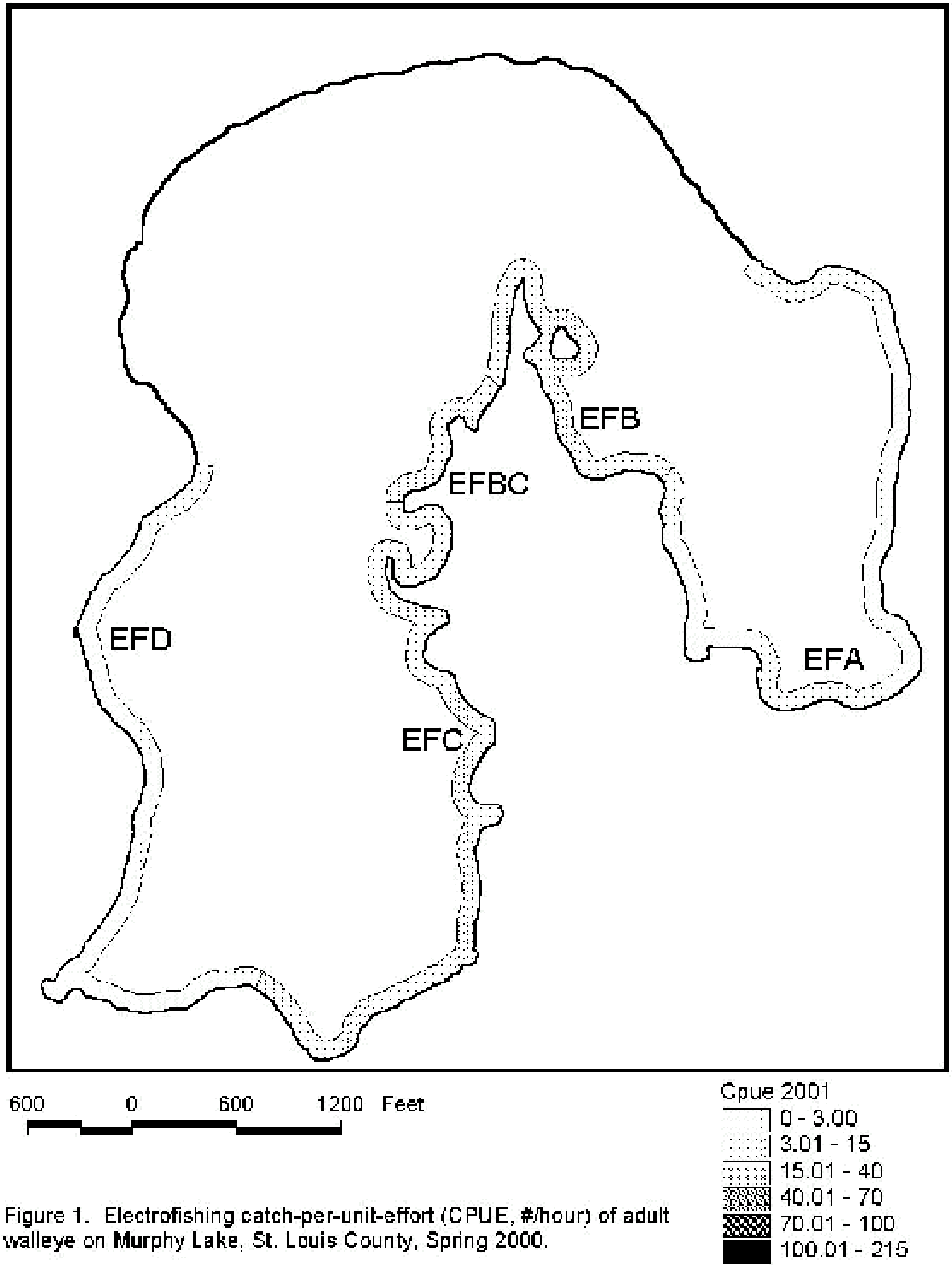


Figure 1. Electrofishing catch-per-unit-effort (CPUE, #/hour) of adult walleye on Murphy Lake, St. Louis County, Spring 2000.

Table 3. Age frequency distribution of walleye from Murphy Lake, St. Louis County, Spring 2001, 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 152 | 1 | | | | | | | | | |
| 6.5 | 165 | 1 | | | | | | | | | |
| 7 | 178 | | | | | | | | | | |
| 7.5 | 191 | | | | | | | | | | |
| 8 | 203 | 1 | | | | | | | | | |
| 8.5 | 216 | 1 | | | | | | | | | |
| 9 | 229 | | | | | | | | | | |
| 9.5 | 241 | | | | | | | | | | |
| 10 | 254 | 2 | 2-3 | | | 2 | | | | | |
| 10.5 | 267 | | | | | | | | | | |
| 11 | 279 | 3 | 3-3 | | | 3 | | | | | |
| 11.5 | 292 | 3 | 3-3 | | | 3 | | | | | |
| 12 | 305 | 3 | 3-3 | | | 3 | | | | | |
| 12.5 | 318 | 2 | 2-3 | | | 2 | | | | | |
| 13 | 330 | 1 | 1-3 | | | 1 | | | | | |
| 13.5 | 343 | 1 | 1-4 | | | | 1 | | | | |
| 14 | 356 | 1 | 1-4 | | | | 1 | | | | |
| 14.5 | 368 | 1 | 1-4 | | | | 1 | | | | |
| 15 | 381 | | | | | | | | | | |
| 15.5 | 394 | | | | | | | | | | |
| 16 | 406 | | | | | | | | | | |
| 16.5 | 419 | | | | | | | | | | |
| 17 | 432 | | | | | | | | | | |
| 17.5 | 445 | | | | | | | | | | |
| 18 | 457 | | | | | | | | | | |
| 18.5 | 470 | | | | | | | | | | |
| 19 | 483 | | | | | | | | | | |
| 19.5 | 495 | 1 | 1-6 | | | | | | 1 | | |
| 20 | 508 | | | | | | | | | | |
| 20.5 | 521 | 2 | 2-7 | | | | | | | 2 | |
| 21 | 533 | | | | | | | | | | |
| 21.5 | 546 | | | | | | | | | | |
| 22 | 559 | 2 | 1-7, 1-8 | | | | | | | 1 | 1 |
| 22.5 | 572 | 2 | 1-8 | | | | | | | | 2 |
| 23.0 | 584 | | | | | | | | | | |
| 23.5 | 597 | | | | | | | | | | |
| TOTAL | | 28 | | 0 | 0 | 14 | 3 | 0 | 1 | 3 | 3 |

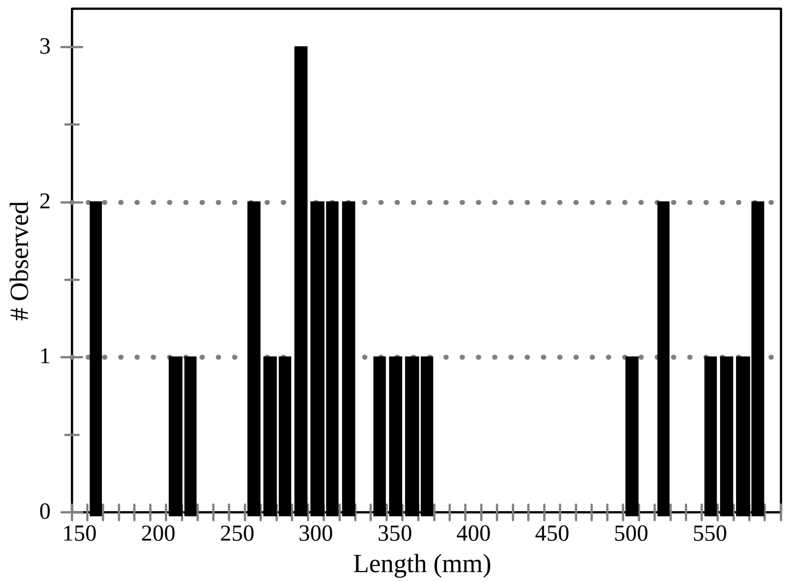


Figure 2.  Length frequency distribution of walleye sampled from Murphy Lake, St. Louis County, MN, during Spring 2001 electrofishing assessments.

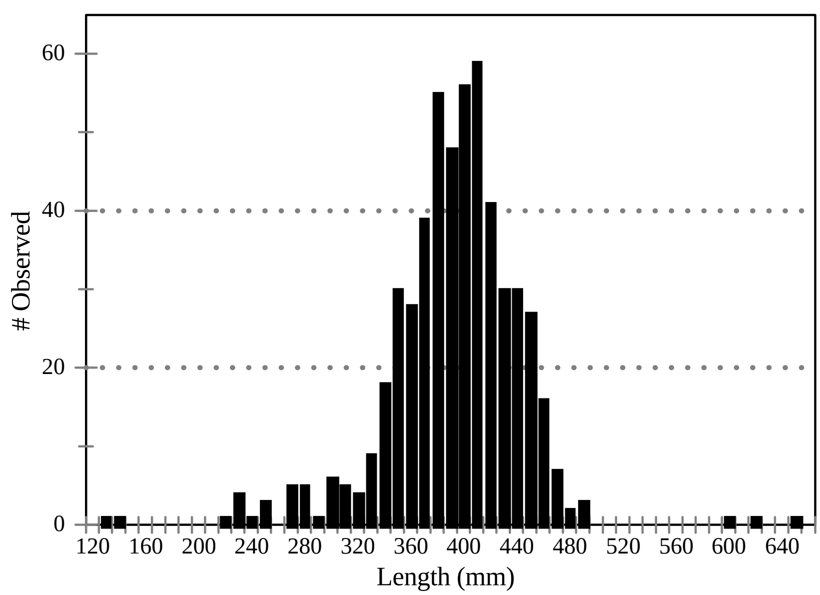


Figure 4.  Length frequency distribution of walleye sampled from Four Mile Lake, Cook County, MN, during Spring 2001 electrofishing assessments.

“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 are presented in Table 5. The electrofishing PSD of 32.0 ± 18.3 (Table 5) suggests the population is balanced (Anderson and Weithman 1978), though this PSD is at the low end of the range for balanced populations. Gilliland (1985) reported that the PSD value determined from a sample of 150 largemouth bass was essentially the same as the PSD value determined from a sample of 500 individuals. Care needs to be taken when interpreting a PSD value based upon such a low sample size, only 24 individuals.

Table 2. Walleye population estimates for Murphy, St. Louis County; Wilson Lake, Lake County; and Fourmile, Aspen, and Tom Lakes, Cook County, Minnesota, for Spring 2001. 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. A population estimate was not obtained for Flour Lake in 2001.

| Lake | Population Estimate #1[1] | 95% Confidence Limits Upper | Lower | Population Estimate #2[2] | C.V.[3] |
|---|---|---|---|---|---|
| Murphy - EF | 208 | —— | —— | 81 ± 75 | 47.1% |
| Wilson - EF | 683 | 885 | 556 | 690 ± 190 | 14.1% |
| Wilson - GN | —— | —— | —— | 5768 ± 4165 | 36.8% |
| Fourmile - EF | 873 | 1416 | 631 | 821 ± 106 | 6.6% |
| Fourmile - GN | —— | —— | —— | 2758 ± 1405 | 26.0% |
| Aspen - EF | 189 | 189 | 189 | 186 ± 61 | 16.7% |
| Tom - EF | 735 | 735 | 735 | 732 ± 124 | 8.7% |

[1] Schumacher and Eschmeyer population estimate.
[2] Adjusted Petersen population estimate.
[3] Coefficient of variation for the Petersen estimate.

Table 4. Back-calculated lengths at each age class for walleye collected from Murphy Lake, St. Louis County, Minnesota, Spring 2001.

| Age Class | N | Length (mm) | Length (in) |
|---|---|---|---|
| 1 | 22 | 115 | 4.5 |
| 2 | 22 | 208 | 8.2 |
| 3 | 22 | 295 | 11.6 |
| 4 | 10 | 374 | 14.7 |
| 5 | 6 | 452 | 17.8 |
| 6 | 6 | 493 | 19.4 |
| 7 | 5 | 534 | 21.0 |
| 8 | 3 | 573 | 22.6 |

Table 5. Proportional Stock Density (PSD) and Relative Stock Densities (RSD) with 95% confidence intervals for walleye sampled from Murphy Lake, St. Louis County; Wilson Lake, Lake County; and Fourmile, Aspen, Tom, and Flour Lakes, Cook County, Minnesota. Values are for spring electrofishing (EF) in 2001 and MN DNR gill netting (GN) during summer 2001, except for the 1994 electrofishing (EF) sample from Wilson Lake and the 1995 electrofishing sample from Fourmile Lake.

| Lake | PSD | RSD S-Q | RSD Q-P | RSD P-M | RSD M-T |
|---|---|---|---|---|---|
| Murphy - EF | 32.0 ± 18.3 | 68.0 ± 18.3 | 4.0 ± 7.7 | 28.0 ± 17.6 | 0.0 ± 0.0 |
| Wilson - $EF_{2001}$ | 28.3 ± 3.8 | 71.7 ± 3.8 | 23.8 ± 3.6 | 4.3 ± 1.7 | 0.2 ± 0.4 |
| Wilson - $EF_{1994}$ | 77.8 ± 4.0 | 22.2 ± 4.0 | 64.1 ± 4.6 | 13.2 ± 3.3 | 0.5 ± 0.7 |
| Wilson - $GN_{2001}$ | 26.4 ± 7.9 | 73.6 ± 7.9 | 22.3 ± 7.4 | 3.3 ± 3.2 | 0.8 ± 1.6 |
| Fourmile - $EF_{2001}$ | 70.5 ± 3.9 | 29.5 ± 3.9 | 70.0 ± 3.9 | 0.4 ± 0.5 | 0.2 ± 0.4 |
| Fourmile - $EF_{1995}$ | 72.2 ± 4.4 | 27.8 ± 4.4 | 72.2 ± 4.4 | 0.0 ± 0.0 | 0.0 ± 0.0 |
| Fourmile - $GN_{2001}$ | 58.9 ± 12.9 | 41.1 ± 12.9 | 55.4 ± 13.0 | 0.0 ± 0.0 | 3.6 ± 4.9 |
| Aspen - EF | 59.0 ± 9.4 | 41.0 ± 9.4 | 46.7 ± 9.5 | 12.4 ± 6.3 | 0.0 ± 0.0 |
| Aspen - GN | 62.5 ± 33.6 | 37.5 ± 33.6 | 37.5 ± 33.6 | 25.0 ± 30.0 | 0.0 ± 0.0 |
| Flour - EF | 40.9 ± 14.5 | 59.1 ± 14.5 | 22.7 ± 12.4 | 13.6 ± 10.1 | 2.3 ± 4.4 |
| Tom - EF | 48.3 ± 4.8 | 51.7 ± 4.8 | 46.4 ± 4.8 | 1.9 ± 1.3 | 0.0 ± 0.0 |
| Tom - GN | 35.3 ± 22.7 | 64.7 ± 22.7 | 29.4 ± 21.7 | 5.9 ± 11.2 | 0.0 ± 0.0 |

*Four Mile Lake*

Electrofishing activities were conducted on Four Mile Lake on 3 - 5 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 71.5 to 123.9 adults per hour and 73.4 to 123.9 total walleye per hour of sampling (Table 1). At an 80% confidence interval, mean CPUE for Four Mile Lake, determined using each sampling station, was 108.0 ± 22.9 adults per hour and 110.4 ± 22.1 total walleye per hour of sampling effort. The length frequency of the walleye sampled is presented in Figure 4. Additional species observed included yellow perch, northen pike, white sucker, and crappie.

Catch rates among the sampling stations varied. Catch rates were highest along stations EFA, EFB, EFC, EFD and EF4, and were lowest along stations EF1, EF2, EF3, and EFE (Figure 3).

Table 2 presents the three population estimates based upon mark-recapture data. The electrofishing Schumacker and Eschmeyer population estimate is 873, with upper and lower 95% confidence limits of 1416 and 631, respectively (Table 2). The electrofishing adjusted Petersen estimate is 821 ± 106, with a 6.6% CV (Table 2). Our sampling covered most of the habitat available for use by spawning walleyes.

In August 2001, the Minnesota Department of Natural Resources performed a standardized net assessment on Four Mile Lake (Ron Van Bergen, MN DNR, Finland Area Fisheries). Of the 64 walleye sampled, 10 were observed to have the mark from the spring sampling. The adjusted Petersen estimate from the summer data is 2758 ± 1405, with a 26.0% CV (Table 2).

In 1995, we performed similar spring electrofishing assessments on Four Mile Lake (Borkholder 1995). The Schumacker and Eschmeyer population estimate we calculated in 1995 was 916, with upper and lower 95% confidence limits of 997 and 847, respectively. Comparing our 1995 estimates with those from this year's assessments, it appears that the abundance of spawning adult walleye has not changed significantly since 1995.

Table 6 presents the age data for the walleye collected from Four Mile Lake. Of the 544 fish sampled, 82.4% (488) were assigned to ages 4, 5, 6, and 7. Table 7 presents back-calculated lengths at each age class for walleye collected from Four Mile Lake. Back-calculated estimates for ages 1 through 3 were slightly lower than what was observed in our sample, and may

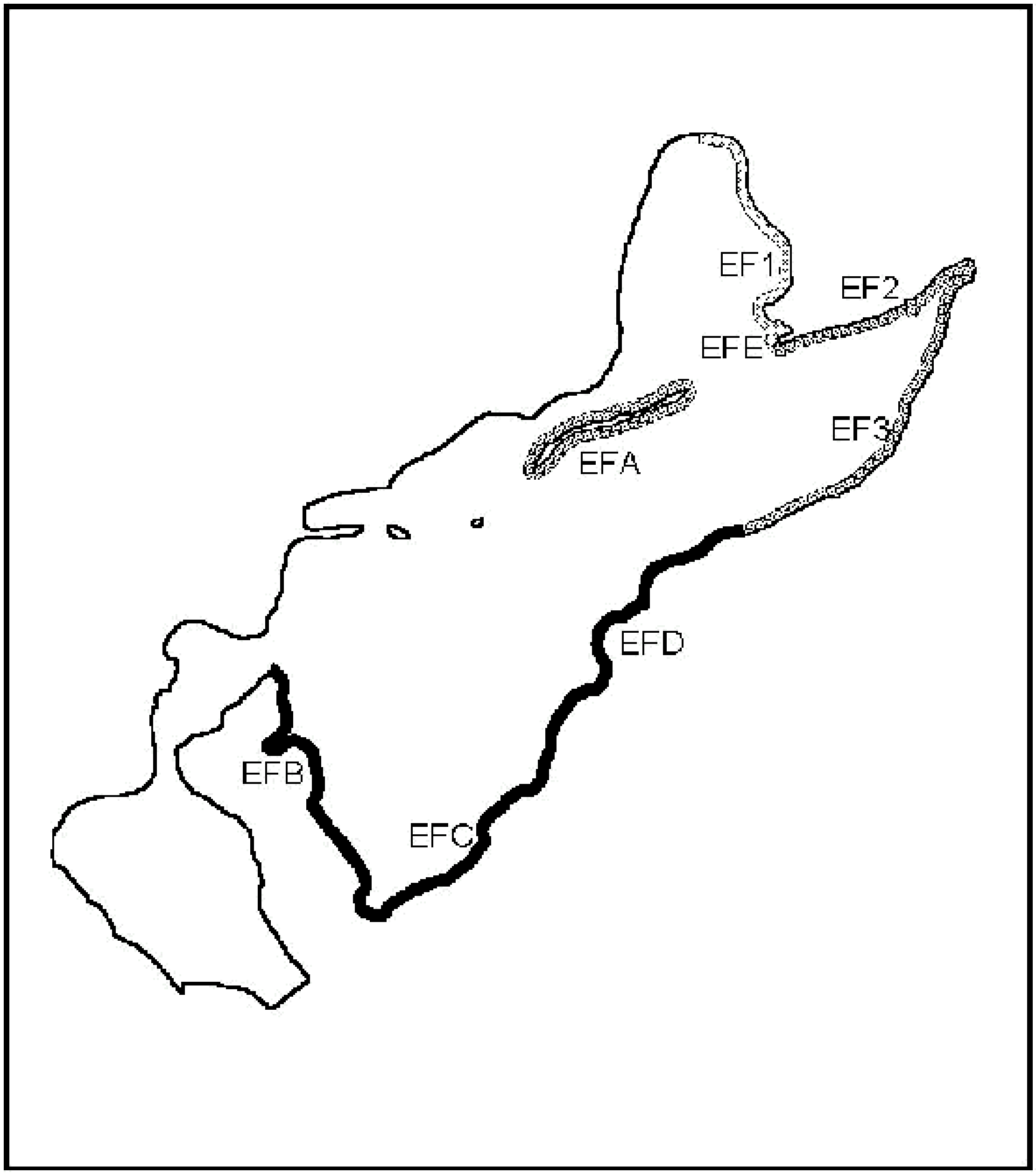


Figure 3. Electrofishing catch-per-unit-effort (CPUE, #/hour) of adult walleye on Four Mile Lake, St. Louis County, Spring 2000.

Table 6. Age frequency distribution of walleye from Four Mile Lake, Cook County, Spring 2001, based upon the number of fish sampled and aged per size category.

| Length Inches | Group mm | N Sampled | Ages | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.0 | 127 | 2 | 1-1 | 2 | | | | | | | | | | | | | |
| 5.5 | 140 | | | | | | | | | | | | | | | | |
| 6.0 | 152 | | | | | | | | | | | | | | | | |
| 6.5 | 165 | | | | | | | | | | | | | | | | |
| 7.0 | 178 | | | | | | | | | | | | | | | | |
| 7.5 | 191 | | | | | | | | | | | | | | | | |
| 8.0 | 203 | | | | | | | | | | | | | | | | |
| 8.5 | 216 | 1 | 1-2 | | 1 | | | | | | | | | | | | |
| 9.0 | 229 | 4 | 3-2 | | 4 | | | | | | | | | | | | |
| 9.5 | 241 | 4 | 2-2 | | 4 | | | | | | | | | | | | |
| 10.0 | 254 | | | | | | | | | | | | | | | | |
| 10.5 | 267 | 5 | 3-3 | | | 5 | | | | | | | | | | | |
| 11.0 | 279 | 6 | 3-3 | | | 6 | | | | | | | | | | | |
| 11.5 | 292 | 4 | 4-3 | | | 4 | | | | | | | | | | | |
| 12.0 | 305 | 10 | 8-3, 1-4, 1-5 | | | 8 | 1 | 1 | | | | | | | | | |
| 12.5 | 318 | 4 | 2-3, 1-4 | | | 2 | 1 | | | | | | | | | | |
| 13.0 | 330 | 17 | 1-3, 4-4, 1-5 | | | 3 | 11 | 3 | | | | | | | | | |
| 13.5 | 343 | 27 | 6-4 | | | | 27 | | | | | | | | | | |
| 14.0 | 356 | 35 | 15-4, 1-5 | | | | 33 | 2 | | | | | | | | | |
| 14.5 | 368 | 50 | 7-4, 5-5, 2-6 | | | | 25 | 18 | 7 | | | | | | | | |
| 15.0 | 381 | 71 | 2-4, 7-5, 6-6, 2-7 | | | | 8 | 29 | 25 | 8 | | | | | | | |
| 15.5 | 394 | 67 | 7-5, 5-6, 2-7 | | | | | 33 | 24 | 10 | | | | | | | |
| 16.0 | 406 | 71 | 3-5, 11-6, 5-7 | | | | | 11 | 41 | 19 | | | | | | | |
| 16.5 | 419 | 54 | 1-5, 3-6, 8-7, 1-8 | | | | | 4 | 13 | 33 | 4 | | | | | | |
| 17.0 | 432 | 40 | 1-5, 5-6, 4-7, 2-8, 1-9 | | | | | 3 | 16 | 12 | 6 | 3 | | | | | |
| 17.5 | 445 | 35 | 2-6, 4-7, 1-8, 2-9, 1-10, 1-11 | | | | | | 6 | 13 | 3 | 6 | 3 | 3 | | | |
| 18.0 | 457 | 24 | 2-6, 1-7, 1-8, 3-9, 1-10 | | | | | | 6 | 3 | 3 | 9 | 3 | | | | |
| 18.5 | 470 | 7 | 1-7, 1-9, 2-12, 1-14 | | | | | | | 1 | | 1 | | | 3 | | 1 |
| 19.0 | 483 | 5 | 1-6, 2-8, 1-12 | | | | | | 1 | | 2 | | | | 1 | | |
| 19.5 | 495 | | | | | | | | | | | | | | | | |
| 20.0 | 508 | | | | | | | | | | | | | | | | |
| 20.5 | 521 | | | | | | | | | | | | | | | | |
| 21.0 | 533 | | | | | | | | | | | | | | | | |
| 21.5 | 546 | | | | | | | | | | | | | | | | |
| 22.0 | 559 | | | | | | | | | | | | | | | | |
| 22.5 | 572 | | | | | | | | | | | | | | | | |
| 23.0 | 584 | | | | | | | | | | | | | | | | |
| 23.5 | 597 | 1 | 1-9 | | | | | | | | | 1 | | | | | |
| 24.0 | 610 | 1 | 1-13 | | | | | | | | | | | | | 1 | |
| 24.5 | 622 | | | | | | | | | | | | | | | | |
| 25.0 | 635 | | | | | | | | | | | | | | | | |
| 25.5 | 648 | 1 | 1-10 | | | | | | | | | | | 1 | | | |
| 26.0 | 660 | | | | | | | | | | | | | | | | |
| TOTAL | | 544 | | 0 | 9 | 28 | 106 | 104 | 139 | 99 | 18 | 20 | 6 | 4 | 4 | 1 | 1 |

be the result of Lee's phenomenon (Lee 1912), where back-calculated lengths of older fish are smaller than the mean lengths observed in the population. Sample sizes for the oldest age groups were low. Back-calculated estimates for ages 4 and older generally agree with those observed in our collection.

Samples collected by electrofishing during spring 1995 and again in 2001 ($PSD_{1995}$ = 72.2 ± 4.4, $PSD_{2001}$ = 70.5 ± 3.9) showed no significant differences in PSD values between the two years ($\chi^2$ = 0.32, $P$>0.05, critical Chi-square value of 3.841) (Table 5). The PSD values from both years suggest that there is a high proportion of "quality" length walleye (381 mm; 15.0 inches) relative to all walleye > 254 mm (10.0 inches). No significant differences in any RSD values were observed between the 1995 and 2001 samples.

Comparing the two gear types in 2001, i.e. gill nets and electrofishing, significant differences in the proportion of "quality" length fish were observed (Table 5). The 2001 spring electrofishing survey ($PSD_{Electro\ 2000}$ = 70.5) sampled a higher proportion of walleye larger than 381 mm (15.0 inches) compared to the 2001 summer gill net assessments ($PSD_{Gill\ Net\ 2000}$ = 58.9) ($\chi^2$=3.22, $P$<0.05, critical Chi-square value of 3.841). While the argument can be made that spring electrofishing targets only the larger individuals in the population, we did sample 57 walleye smaller than 300 mm (12.0 inches) in 2000. There were no significant differences observed in any of the relative stock density (RSD) indices during 2001 assessments (Table 5), suggesting no differences in the proportion of "preferred" (> 508mm, 20 inches) and "memorable"

Table 7. Back-calculated lengths at each age class for walleye collected from Four Mile Lake, Cook County, Minnesota, Spring 2001.

| Age Class | N | Length (mm) | Length (in) |
|---|---|---|---|
| 1 | 181 | 118 | 4.6 |
| 2 | 180 | 206 | 8.1 |
| 3 | 174 | 280 | 11.0 |
| 4 | 152 | 336 | 13.2 |
| 5 | 116 | 375 | 14.8 |
| 6 | 89 | 407 | 16.0 |
| 7 | 51 | 428 | 16.8 |
| 8 | 24 | 451 | 17.8 |
| 9 | 17 | 469 | 18.5 |
| 10 | 9 | 481 | 18.9 |
| 11 | 6 | 476 | 18.7 |
| 12 | 5 | 498 | 19.6 |
| 13 | 2 | 454 | 17.9 |
| 14 | 1 | 475 | 18.7 |

(> 635mm, 25 inches) length fish between the two gear types. Sample sizes using both gear types were very low, however. There is probably some bias using both sampling gears, which will need to be addressed in later years once we have several additional paired samples.

Between the two gear types, only 5 individuals were sampled larger than 508 mm (20.0 inches). In 1995, we failed to observe a single individual larger than 508 mm. In both years, all of the available walleye spawning habitat was sampled, and large numbers of spawning walleye were collected during both assessments. 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, thus suggesting that angling mortality might be limiting this population. Future studies may be planned to address this situation, e.g. a tagging study.

*Wilson Lake*

Electrofishing activities were conducted on Wilson Lake on 4, 6, and 7 May (Figure 5). Table 1 presents mean water temperature, conductivity, number of walleye sampled, and CPUE for walleye. CPUE for each night ranged from 26.9 to 72.3 adults per hour and 27.3 to 73.2 total walleye per hour of sampling (Table 1). At an 80% confidence interval, mean CPUE for Wilson Lake, determined using catch data from each sampling station, was 38.6 ± 9.6 adults per hour and 39.0 ± 9.5 total walleye per hour of sampling effort. Length frequency data of walleye collected is presented in Figure 6. Additional species observed included white sucker, creek chub, northern pike, yellow perch, northern redbelly dace, and finescale dace. Catch rates for walleye of all sizes, while low in comparison to the other lakes, were the highest along station EF5 and EF6 (Figure 5).

Table 8 presents the age frequency distribution. Back-calculated length-at-age estimates are presented in Table 9, and generally agree with observed lengths during our survey, up to age 13.

Table 2 presents the three population estimates based upon mark-recapture data. The electrofishing Schumacker and Eschmeyer population estimate is 683, with upper and lower 95% confidence limits of 885 and 556, respectively (Table 2). The electrofishing adjusted Petersen estimate is 690 ± 190, with a 14.1% CV (Table 2).

In August 2001, the Minnesota Department of Natural Resources performed a

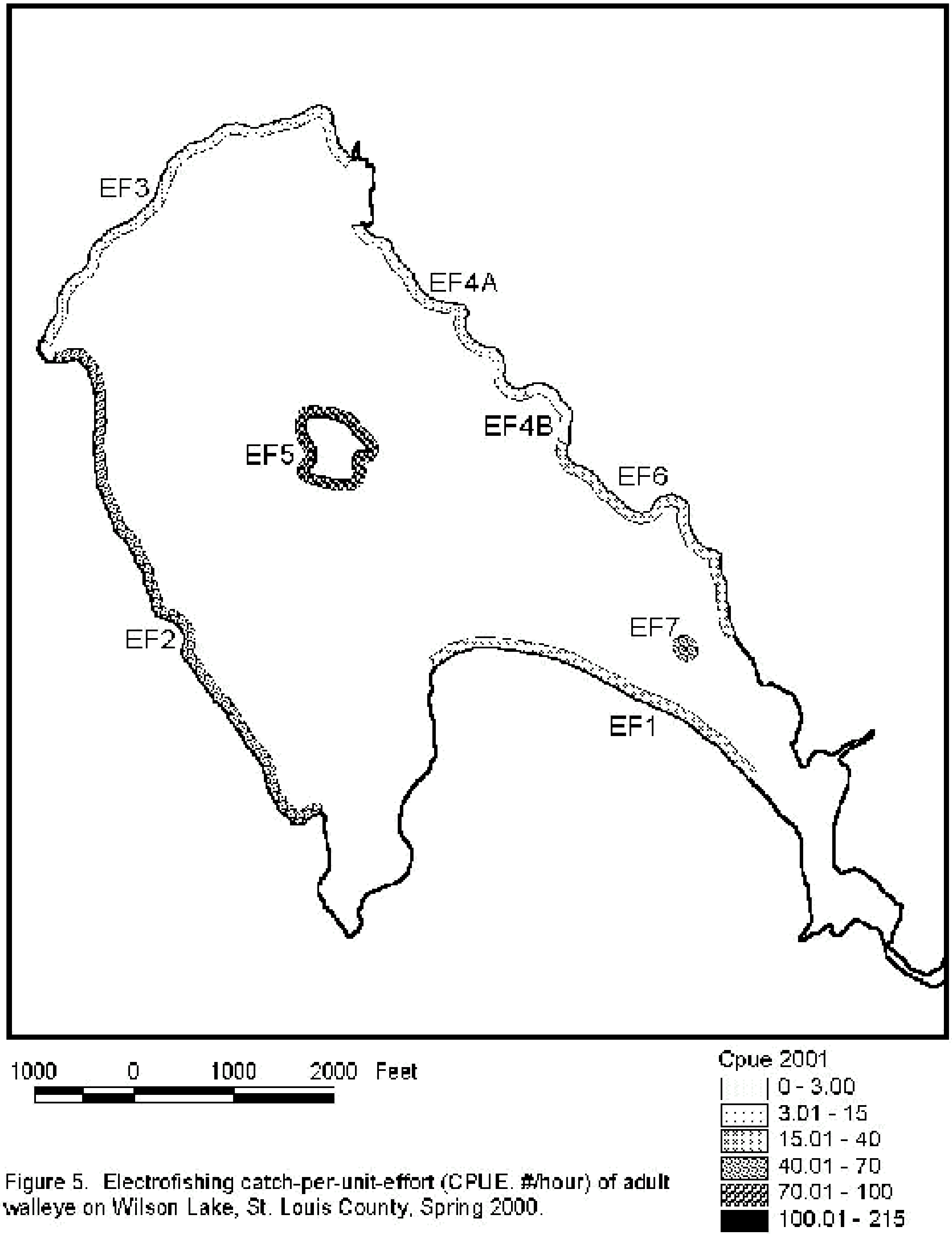


Figure 5. Electrofishing catch-per-unit-effort (CPUE, #/hour) of adult walleye on Wilson Lake, St. Louis County, Spring 2000.

Table 8. Age frequency distribution of walleye from Wilson Lake, Lake County, Spring 2001, 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 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.0 | 102 | | | | | | | | | | | | | | | | |
| 4.5 | 114 | | | | | | | | | | | | | | | | |
| 5.0 | 127 | | | | | | | | | | | | | | | | |
| 5.5 | 140 | | | | | | | | | | | | | | | | |
| 6.0 | 152 | | | | | | | | | | | | | | | | |
| 6.5 | 165 | | | | | | | | | | | | | | | | |
| 7.0 | 178 | | | | | | | | | | | | | | | | |
| 7.5 | 191 | | | | | | | | | | | | | | | | |
| 8.0 | 203 | 1 | 1-2 | | 1 | | | | | | | | | | | | |
| 8.5 | 216 | | | | | | | | | | | | | | | | |
| 9.0 | 229 | 1 | | | | | | | | | | | | | | | |
| 9.5 | 241 | 1 | | | | | | | | | | | | | | | |
| 10.0 | 254 | 2 | 2-3 | | | 2 | | | | | | | | | | | |
| 10.5 | 267 | 1 | 1-3 | | | 1 | | | | | | | | | | | |
| 11.0 | 279 | 1 | 1-3 | | | 1 | | | | | | | | | | | |
| 11.5 | 292 | 3 | 2-3, 1-4 | | | 2 | 1 | | | | | | | | | | |
| 12.0 | 305 | 5 | 1-3, 4-4 | | | 1 | 4 | | | | | | | | | | |
| 12.5 | 318 | 12 | 1-3, 8-4 | | | 1 | 11 | | | | | | | | | | |
| 13.0 | 330 | 24 | 1-3, 6-4 | | | 3 | 21 | | | | | | | | | | |
| 13.5 | 343 | 31 | 8-4 | | | | 31 | | | | | | | | | | |
| 14.0 | 356 | 24 | 3-4, 2-5 | | | | 14 | 10 | | | | | | | | | |
| 14.5 | 368 | 25 | 2-4, 7-5 | | | | 6 | 19 | | | | | | | | | |
| 15.0 | 381 | 29 | 3-4, 3-5 | | | | 14 | 15 | | | | | | | | | |
| 15.5 | 394 | 28 | 1-4, 4-5, 5-6 | | | | 3 | 11 | 14 | | | | | | | | |
| 16.0 | 406 | 21 | 4-5, 4-6 | | | | | 11 | 11 | | | | | | | | |
| 16.5 | 419 | 2 | 1-5, 1-6 | | | | | 1 | 1 | | | | | | | | |
| 17.0 | 432 | 11 | 1-5, 3-6, 2-7, 2-8 | | | | | 1 | 4 | 3 | 3 | | | | | | |
| 17.5 | 445 | 7 | 2-5, 2-6, 1-9 | | | | | 3 | 3 | | | 1 | | | | | |
| 18.0 | 457 | 5 | 2-7, 2-8, 1-9 | | | | | | | 2 | 2 | 1 | | | | | |
| 18.5 | 470 | 7 | 1-7, 2-8, 2-9, 1-10 | | | | | | | 1 | 2 | 2 | 1 | | | | |
| 19.0 | 483 | 6 | 1-8, 1-9, 1-10, 1-13 | | | | | | | | 1 | 1 | 1 | | | 1 | |
| 19.5 | 495 | 10 | 1-8, 6-9, 2-10 | | | | | | | | 1 | 7 | 2 | | | | |
| 20.0 | 508 | 8 | 1-9, 2-10, 1-11, 3-12 | | | | | | | | | 1 | 2 | 1 | 3 | | |
| 20.5 | 521 | 6 | 2-9, 3-10, 1-12 | | | | | | | | | 2 | 3 | | 12 | | |
| 21.0 | 533 | 1 | 1-9 | | | | | | | | | 1 | | | | | |
| 21.5 | 546 | 1 | 1-9 | | | | | | | | | 1 | | | | | |
| 22.0 | 559 | 6 | 2-9, 2-10, 1-11, 1-12 | | | | | | | | | 2 | 2 | 1 | 1 | | |
| 22.5 | 572 | | | | | | | | | | | | | | | | |
| 23.0 | 584 | | | | | | | | | | | | | | | | |
| 23.5 | 597 | | | | | | | | | | | | | | | | |
| 24.0 | 610 | | | | | | | | | | | | | | | | |
| 24.5 | 622 | 1 | 1-13 | | | | | | | | | | | | | 1 | |
| 25.0 | 635 | | | | | | | | | | | | | | | | |
| 25.5 | 648 | | | | | | | | | | | | | | | | |
| 26.0 | 660 | | | | | | | | | | | | | | | | |
| 26.5 | 673 | | | | | | | | | | | | | | | | |
| 27.0 | 686 | 1 | 1-20 | | | | | | | | | | | | | | 1 |
| TOTAL | | 281 | | 0 | 1 | 12 | 104 | 70 | 33 | 6 | 9 | 19 | 11 | 2 | 16 | 2 | 1 |

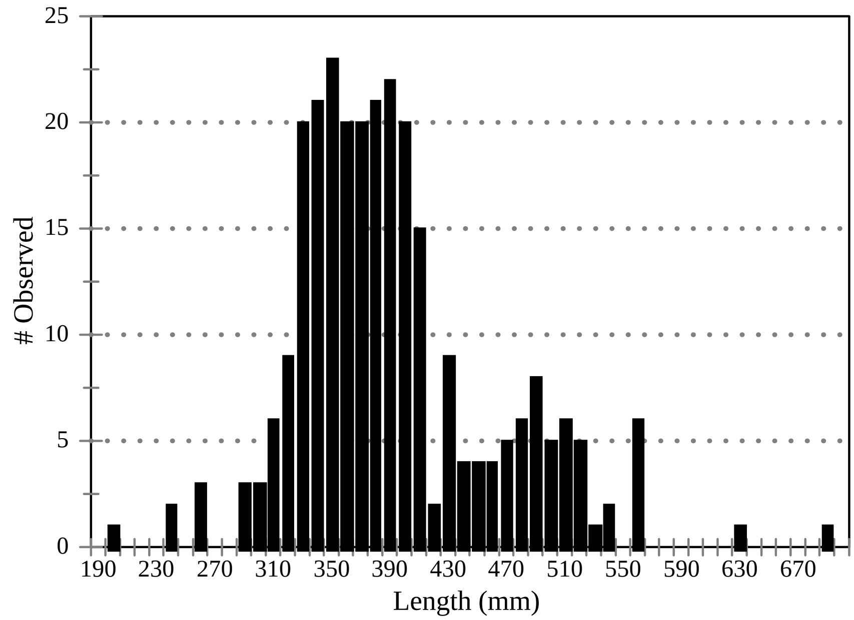


Figure 6. Length frequency distribution of walleye sampled from Wilson Lake, Lake County, MN, during Spring 2001 electrofishing assessments.

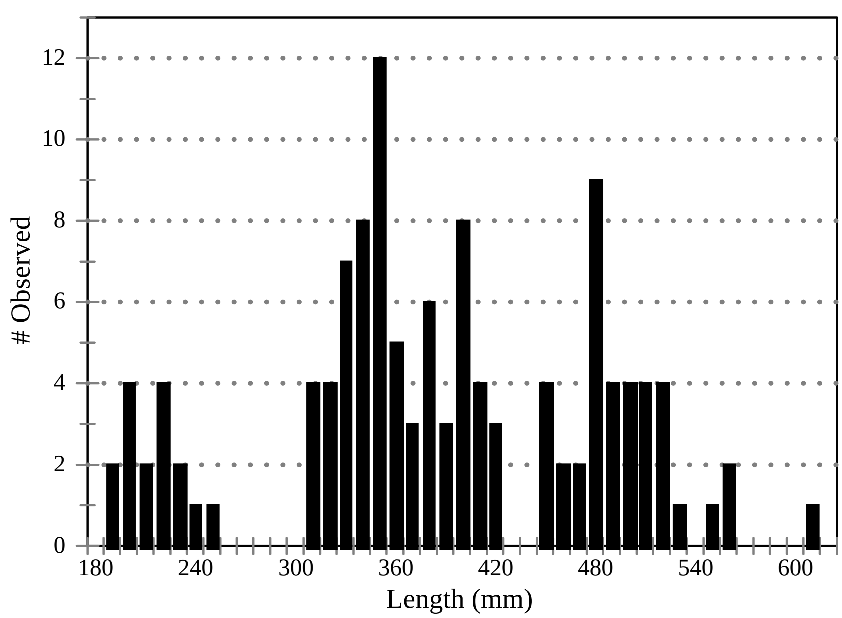


Figure 8. Length frequency distribution of walleye sampled from Aspen Lake, Cook County, MN, during Spring 2001 electrofishing assessments.

standardized net assessment on Wilson Lake (Ron Van Bergen, MN DNR, Finland Area Fisheries). Of the 129 walleye sampled, 5 were observed to have the mark from the spring sampling. The adjusted Petersen estimate from the summer data is 5768 ± 4165, with a 36.8% CV (Table 2). The confidence limit is so high due to the relatively small number of recaptured individuals observed.

In 1994, we performed similar spring electrofishing assessments on Wilson Lake (Borkholder 1994). The Schumacker and Eschmeyer population estimate we calculated in 1994 was 998, with upper and lower 95% confidence limits of 1662 and 713, respectively. Comparing our 1994 estimates with those from this year's assessments, it appears that the abundance of spawning adult walleye may have declined since 1994. Since beginning fall electrofishing assessments, we have never observed a particularly strong year class in Wilson Lake. With the lack of strong recruitment, and continued angling harvest, it seems intuitive that the population might be in a decline. Further monitoring will be necessary, especially in light of the increased angling usage and recent shoreline development projects.

Table 9. Back-calculated lengths at each age class for walleye collected from Wilson Lake, Lake County, Minnesota, Spring 2001.

| Age Class | N | Length (mm) | Length (in) |
|---|---|---|---|
| 1 | 138 | 110 | 4.3 |
| 2 | 138 | 194 | 7.6 |
| 3 | 137 | 271 | 10.7 |
| 4 | 129 | 334 | 13.1 |
| 5 | 91 | 379 | 14.9 |
| 6 | 67 | 412 | 16.2 |
| 7 | 52 | 443 | 17.4 |
| 8 | 47 | 471 | 18.5 |
| 9 | 38 | 497 | 19.6 |
| 10 | 22 | 505 | 19.9 |
| 11 | 11 | 522 | 20.6 |
| 12 | 8 | 536 | 21.1 |
| 13 | 3 | 569 | 22.4 |
| 14 | 1 | 602 | 23.7 |
| 15 | 1 | 622 | 24.5 |
| 16 | 1 | 633 | 24.9 |
| 17 | 1 | 645 | 25.4 |
| 18 | 1 | 663 | 26.1 |
| 19 | 1 | 680 | 26.8 |
| 20 | 1 | 691 | 27.2 |

PSD and RSD values determined by our spring electrofishing sampling are presented in Table 5. Samples collected by electrofishing during spring 1994 and again in 2001 ($PSD_{1994}$ = 77.8 ± 4.0, $PSD_{2001}$ = 28.3 ± 3.8) showed significant differences in PSD values between the two years ($\chi^2$ = 228.4, $P<0.05$, critical Chi-square value of 3.841) (Table 5). The PSD value from 2001 suggest that the proportion of “stock” length walleye (between 10.0 and 14.9 inches) relative to all walleye > 254 mm (10.0 inches) is too high, resulting in an unbalanced population. No significant differences in any RSD values were observed between the 1994 and 2001 samples.

Comparing the two gear types in 2001, i.e. gill nets and electrofishing, no significant differences in the proportion of “quality” length fish were observed (Table 5). No differences in any of the RSD metrics were noted between the two gear types.

Growth does not appear to be limited in this population. Many small yellow perch and shiners were observed, suggesting that food resources may not be limiting growth of walleye. With an apparent absence of any exceptionally strong year classes, angling harvest may be limiting this population. A tagging study might help answer this question.

*Aspen Lake*

Two evenings of sampling were conducted on Aspen Lake; 9 and 10 May (Figure 7). Table 1 presents the statistics for each evening of sampling. A total of 105 adult walleye (121 total walleye) were collected (Table 1). Catch per hour of electrofishing effort for each night ranged from 40.6 to 49.1 adults per hour and 45.6 to 57.5 total walleye per hour of sampling (Table 1). At an 80% confidence interval, mean CPUE for Aspen Lake, determined using catch data from each sampling station, was 73.6 ± 29.2 adults per hour and 77.3 ± 28.8 total walleye per hour of sampling effort. The highest catch rates were observed along stations EF3 and EF5 (Figure 7). Figure 8 shows a length frequency histogram for the walleye sampled. Additional species observed included some white sucker, crappie, and bluegill, and large numbers of northern pike, yellow perch, and juvenile smallmouth bass.

Table 2 presents the population estimates based upon mark-recapture data. The Schumacker and Eschmeyer population estimate (walleye >254 mm, 10.0 inches) based upon electrofishing samples is 189, with no confidence limits due to a single evening of recapture data. The Petersen estimate is 186 ± 61, with a 16.7% CV (Table 2). Sampling was conducted on all of the shore-

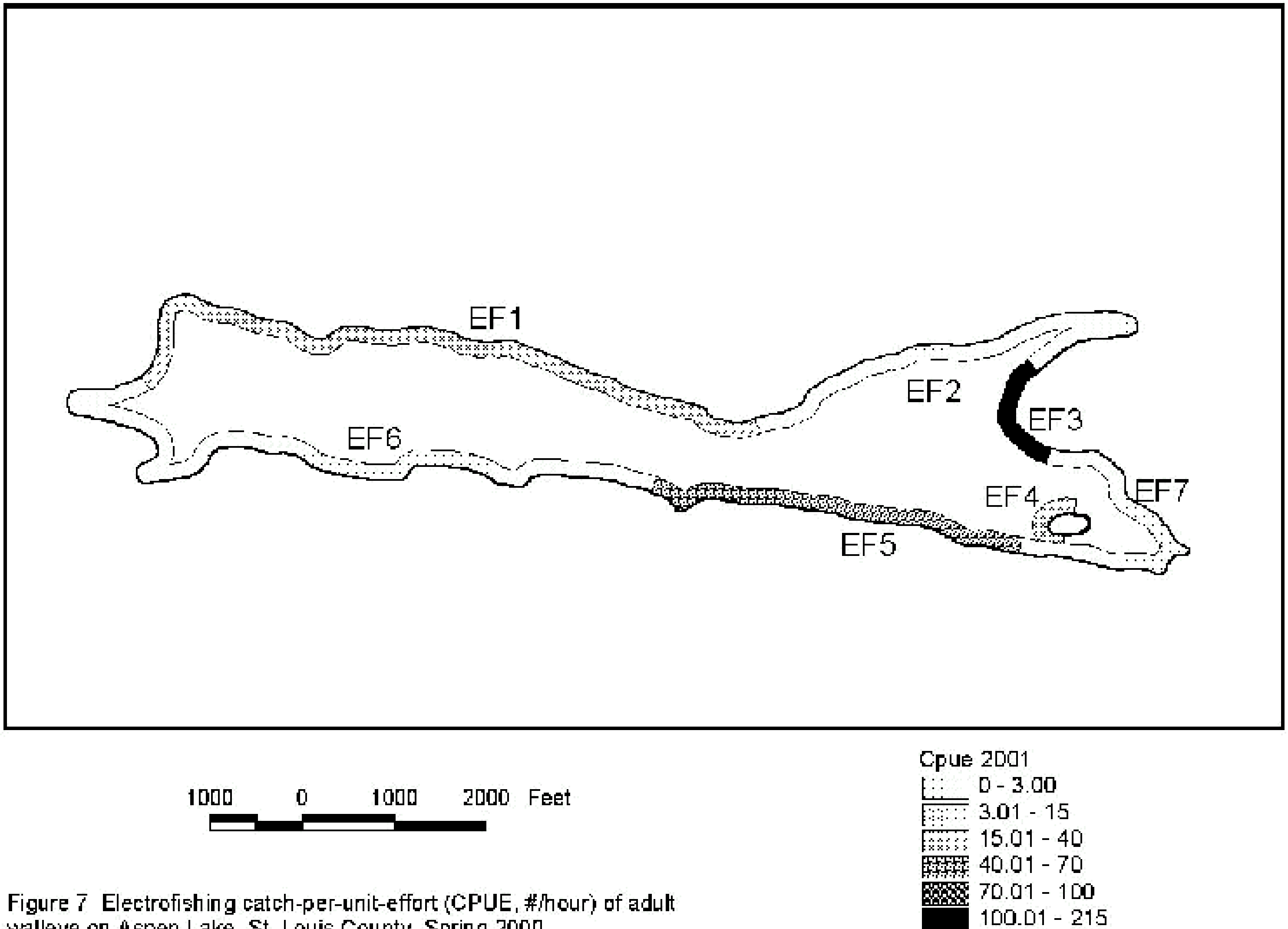


Figure 7 Electrofishing catch-per-unit-effort (CPUE, #/hour) of adult walleye on Aspen Lake, St. Louis County, Spring 2000.

Table 10. Age frequency distribution of walleye from Aspen Lake, Cook County, Spring 2001, 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7.0 | 178 | | | | | | | | | | | | | | | | | |
| 7.5 | 191 | 3 | 2-2 | | 3 | | | | | | | | | | | | | |
| 8.0 | 203 | 5 | 5-2 | | 5 | | | | | | | | | | | | | |
| 8.5 | 216 | 4 | 4-2 | | 4 | | | | | | | | | | | | | |
| 9.0 | 229 | 2 | 2-2 | | 2 | | | | | | | | | | | | | |
| 9.5 | 241 | 2 | 2-2 | | 2 | | | | | | | | | | | | | |
| 10.0 | 254 | | | | | | | | | | | | | | | | | |
| 10.5 | 267 | | | | | | | | | | | | | | | | | |
| 11.0 | 279 | | | | | | | | | | | | | | | | | |
| 11.5 | 292 | | | | | | | | | | | | | | | | | |
| 12.0 | 305 | 1 | 1-3 | | | 1 | | | | | | | | | | | | |
| 12.5 | 318 | 7 | 7-3 | | | 7 | | | | | | | | | | | | |
| 13.0 | 330 | 11 | 8-3 | | | 11 | | | | | | | | | | | | |
| 13.5 | 343 | 11 | 3-3, 2-4 | | | 7 | 4 | | | | | | | | | | | |
| 14.0 | 356 | 9 | 4-3 | | | 9 | | | | | | | | | | | | |
| 14.5 | 368 | 4 | 4-4 | | | | 4 | | | | | | | | | | | |
| 15.0 | 381 | 8 | 1-3, 7-4 | | | 1 | 7 | | | | | | | | | | | |
| 15.5 | 394 | 6 | 4-4 | | | | 6 | | | | | | | | | | | |
| 16.0 | 406 | 7 | 5-4, 1-5 | | | | 6 | 1 | | | | | | | | | | |
| 16.5 | 419 | 3 | 2-4, 1-5 | | | | 2 | 1 | | | | | | | | | | |
| 17.0 | 432 | | | | | | | | | | | | | | | | | |
| 17.5 | 445 | 3 | 2-6, 1-7 | | | | | 2 | 1 | | | | | | | | | |
| 18.0 | 457 | 3 | 1-4, 1-6 | | | | 1 | | 1 | | | | | | | | | |
| 18.5 | 470 | 6 | 1-6, 1-7, 1-9 | | | | | | 2 | 2 | | 2 | | | | | | |
| 19.0 | 483 | 8 | 1-7, 5-9 | | | | | | | 1 | | 7 | | | | | | |
| 19.5 | 495 | 5 | 1-7, 3-9, 1-13 | | | | | | | 1 | | 3 | | | | 1 | | |
| 20.0 | 508 | 4 | 1-8, 1-9, 1-10, 1-13 | | | | | | | | 1 | 1 | 1 | | | 1 | | |
| 20.5 | 521 | 4 | 1-5, 1-9, 1-11, 1-15 | | | | | 1 | | | | 1 | | 1 | | | | 1 |
| 21.0 | 533 | 1 | 1-6 | | | | | | 1 | | | | | | | | | |
| 21.5 | 546 | 1 | 1-12 | | | | | | | | | | | | 1 | | | |
| 22.0 | 559 | 2 | | | | | | | | | | | | | | | | |
| 22.5 | 572 | | | | | | | | | | | | | | | | | |
| 23.0 | 584 | | | | | | | | | | | | | | | | | |
| 23.5 | 597 | | | | | | | | | | | | | | | | | |
| 24.0 | 610 | 1 | 1-11 | | | | | | | | | | | 1 | | | | |
| 24.5 | 622 | | | | | | | | | | | | | | | | | |
| TOTAL | | 121 | | 0 | 16 | 36 | 30 | 5 | 5 | 4 | 1 | 14 | 1 | 2 | 1 | 2 | 0 | 1 |

line. During the summer, the Minnesota Department of Natural Resources performed a standardized net assessment on Aspen Lake (Paul Eiler and Steve Persons, MN DNR, Grand Marais Area Fisheries). It is unclear whether crew members never observed any marked individuals, or whether they forgot to check for marks. Either way, no population estimate is available for Aspen Lake using the summer gill net data.

Table 10 presents the age frequency distribution for Aspen Lake. Table 11 presents the back-calculated lengths at age for the walleye collected from Aspen Lake. The back-calculated lengths are smaller for ages 5 through 8 than those observed in this sample, but generally agree with those observed for the other ages.

PSD and RSD values determined by our spring electrofishing sampling and the summer gill net survey conducted by the MN DNR are presented in Table 5. No significant difference in PSD values between the two samples were observed ($\chi^2$ = 0.04, $P$>0.05, Critical Chi-square value of 3.841). There were no differences observed in any of the RSD metrics, suggesting that both sampling gears collected walleyes of different sizes in the same proportion, and that electrofishing was not selective on the largest individuals. Neither the electrofishing nor gill net surveys sampled many walleye, so reported PSD and RSD values may need to be interpreted with caution.

Table 11. Back-calculated lengths at each age class for walleye collected from Aspen Lake, Cook County, Minnesota, Spring 2001.

| Age Class | N | Length (mm) | Length (in) |
|---|---|---|---|
| 1 | 97 | 120 | 4.7 |
| 2 | 97 | 221 | 8.7 |
| 3 | 83 | 314 | 12.4 |
| 4 | 58 | 374 | 14.7 |
| 5 | 34 | 407 | 16.0 |
| 6 | 31 | 436 | 17.2 |
| 7 | 25 | 454 | 17.9 |
| 8 | 20 | 469 | 18.5 |
| 9 | 19 | 488 | 19.2 |
| 10 | 8 | 496 | 19.5 |
| 11 | 7 | 510 | 20.1 |
| 12 | 5 | 500 | 19.7 |
| 13 | 4 | 500 | 19.7 |
| 14 | 2 | 507 | 20.0 |
| 15 | 2 | 520 | 20.5 |
| 16 | 1 | 530 | 20.9 |
| 17 | 1 | 544 | 21.4 |
| 18 | 1 | 560 | 22.0 |

*Flour Lake*

Sampling was conducted for a single evening on Flour Lake; 10 May (Figure 9). Water temperature, conductivity, and CPUE data are presented in Table 1. A total of 44 adult walleye were collected. At an 80% confidence interval, mean CPUE for Flour Lake, determined using each sampling station, was 19.7 ± 7.8 adults per hour of sampling effort. Catch rates for adult walleye were extremely poor throughout most of the lake. The highest catch rates were observed along stations EF1, EF-Isle, an EFA (Figure 9). Figure 10 shows the length frequency histogram for the walleye sampled. Additional species observed included yellow perch, white sucker, bluegill, whitefish, and large numbers of smallmouth bass.

Table 12 presents the age frequency distribution for Flour Lake. Table 13 presents the back-calculated length at age for the walleye collected. We were unable to locate any concentrations of spawning walleye. We therefore, only sampled for a single evening, and thus do not have any population estimates for Flour Lake.

Table 13. Back-calculated lengths at each age class for walleye collected from Flour Lake, Cook County, Minnesota, Spring 2001.

| Age Class | N | Length (mm) | Length (in) |
|---|---|---|---|
| 1 | 45 | 113 | 4.4 |
| 2 | 45 | 207 | 8.1 |
| 3 | 44 | 292 | 11.5 |
| 4 | 37 | 364 | 14.3 |
| 5 | 15 | 429 | 16.9 |
| 6 | 12 | 467 | 18.4 |
| 7 | 11 | 508 | 20.0 |
| 8 | 6 | 546 | 21.5 |
| 9 | 3 | 590 | 23.2 |
| 10 | 2 | 644 | 25.4 |
| 11 | 2 | 663 | 26.1 |
| 12 | 2 | 681 | 26.8 |
| 13 | 2 | 704 | 27.7 |
| 14 | 1 | 750 | 29.5 |
| 15 | 1 | 770 | 30.3 |
| 16 | 1 | 781 | 30.7 |
| 17 | 1 | 789 | 31.1 |
| 18 | 1 | 800 | 31.5 |

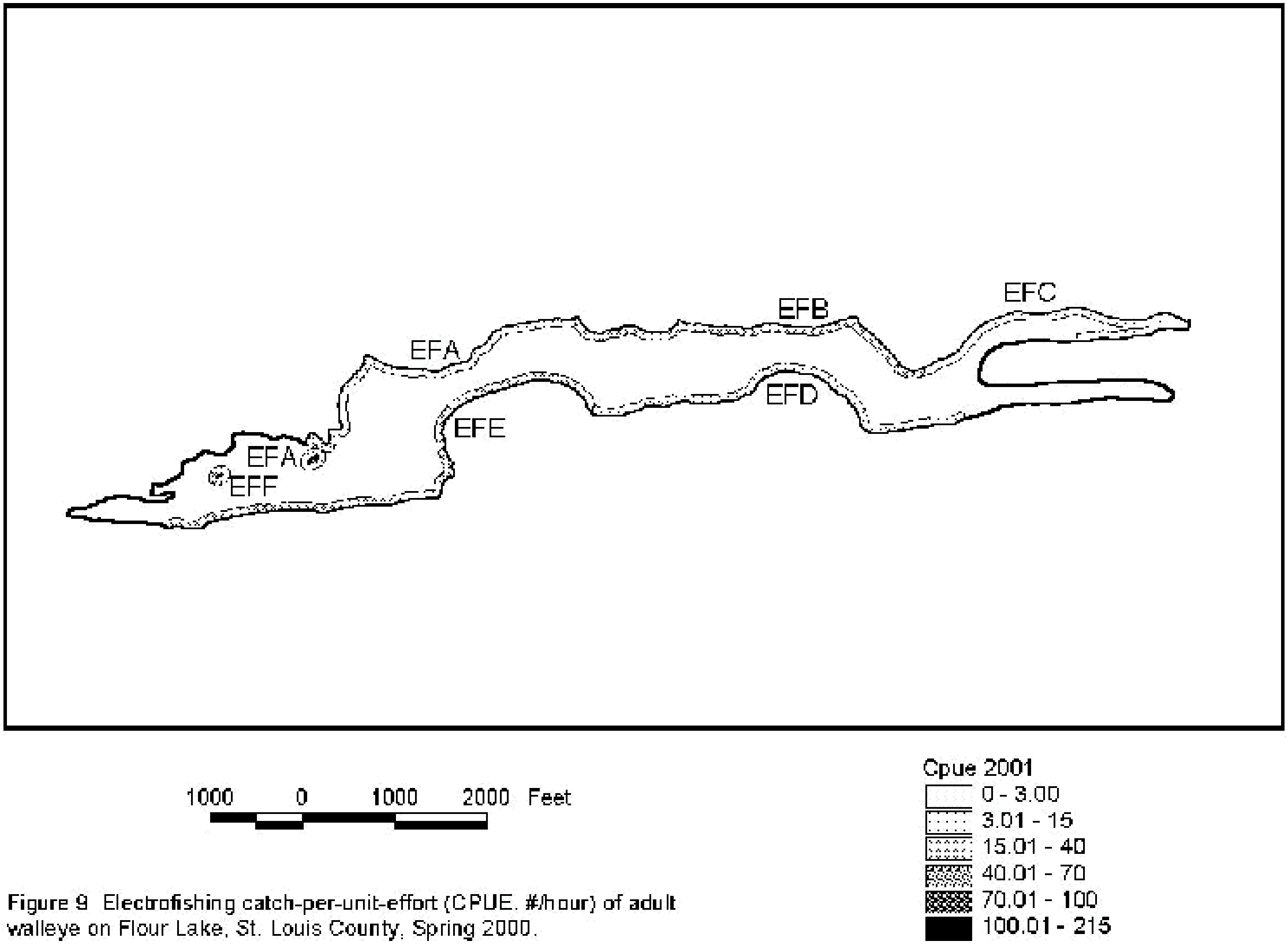


**Figure 9** Electrofishing catch-per-unit-effort (CPUE, #/hour) of adult walleye on Flour Lake, St. Louis County, Spring 2000.

Table 12. Age frequency distribution of walleye from Flour Lake, Cook County, Spring 2001, based upon the number of fish sampled and aged per size category.

| Length Inches | Group mm | N Sampled | Ages | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10.0 | 254 | 1 | 1-2 | | 1 | | | | | | | | | | | | |
| 10.5 | 267 | 3 | 1-2, 2-3 | | 1 | 2 | | | | | | | | | | | |
| 11.0 | 279 | | | | | | | | | | | | | | | | |
| 11.5 | 292 | 1 | 1-3 | | | 1 | | | | | | | | | | | |
| 12.0 | 305 | 1 | 1-3 | | | 1 | | | | | | | | | | | |
| 12.5 | 318 | | | | | | | | | | | | | | | | |
| 13.0 | 330 | 7 | 5-3, 2-4 | | | 5 | 2 | | | | | | | | | | |
| 13.5 | 343 | 6 | 5-3, 1-4 | | | 5 | 1 | | | | | | | | | | |
| 14.0 | 356 | 2 | 1-3, 1-4 | | | 1 | 1 | | | | | | | | | | |
| 14.5 | 368 | 6 | 3-3, 3-4 | | | 3 | 3 | | | | | | | | | | |
| 15.0 | 381 | 2 | 1-3, 1-4 | | | 1 | 1 | | | | | | | | | | |
| 15.5 | 394 | 1 | 1-3 | | | 1 | | | | | | | | | | | |
| 16.0 | 406 | 1 | 1-4 | | | | 1 | | | | | | | | | | |
| 16.5 | 419 | | | | | | | | | | | | | | | | |
| 17.0 | 432 | | | | | | | | | | | | | | | | |
| 17.5 | 445 | 1 | 1-5 | | | | | 1 | | | | | | | | | |
| 18.0 | 457 | 2 | 1-4, 1-5 | | | | 1 | 1 | | | | | | | | | |
| 18.5 | 470 | 1 | 1-4 | | | | 1 | | | | | | | | | | |
| 19.0 | 483 | | | | | | | | | | | | | | | | |
| 19.5 | 495 | 2 | 2-7 | | | | | | | 2 | | | | | | | |
| 20.0 | 508 | 1 | 1-6 | | | | | | 1 | | | | | | | | |
| 20.5 | 521 | 1 | 1-8 | | | | | | | | 1 | | | | | | |
| 21.0 | 533 | 3 | 3-8 | | | | | | | | 3 | | | | | | |
| 21.5 | 546 | 1 | 1-6 | | | | | | 1 | | | | | | | | |
| 22.0 | 559 | | | | | | | | | | | | | | | | |
| 22.5 | 572 | | | | | | | | | | | | | | | | |
| 23.0 | 584 | | | | | | | | | | | | | | | | |
| 23.5 | 597 | | | | | | | | | | | | | | | | |
| 24.0 | 610 | | | | | | | | | | | | | | | | |
| 24.5 | 622 | | | | | | | | | | | | | | | | |
| 25.0 | 635 | | | | | | | | | | | | | | | | |
| 25.5 | 648 | | | | | | | | | | | | | | | | |
| 26.0 | 660 | | | | | | | | | | | | | | | | |
| 26.5 | 673 | 1 | 1-13 | | | | | | | | | | | | | 1 | |
| 31.5 | 800 | 1 | 1-18 | | | | | | | | | | | | | | 1 |
| TOTAL | | 45 | | 0 | 2 | 20 | 11 | 2 | 2 | 2 | 4 | 0 | 0 | 0 | 0 | 1 | 1 |

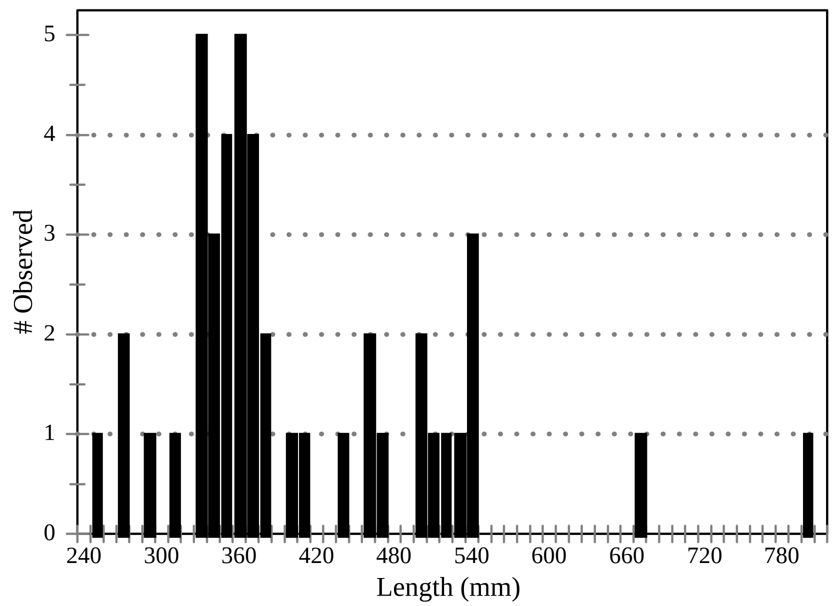


Figure 10. Length frequency distribution of walleye sampled from Flour Lake, Cook County, MN, during Spring 2001 electrofishing assessments.

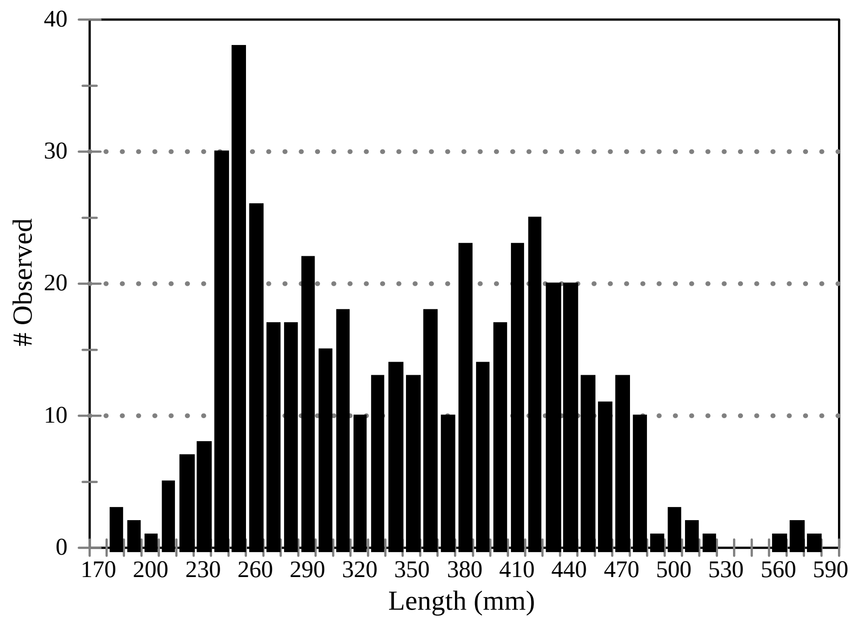


Figure 12. Length frequency distribution of walleye sampled from Tom Lake, Cook County, MN, during Spring 2001 electrofishing assessments.

PSD and RSD values determined by our spring electrofishing sampling are presented in Table 5. The electrofishing PSD of 40.9 ± 14.5 does suggest the population is balanced, though on the lower end of the range of balanced populations (Anderson and Weithman 1978). Our samples were dominated by 254 mm to 381 mm individuals (10 to 15 inch) (RSD S-Q of 59.1 ± 14.5) (Table 5). No PSD values were calculated using the gill net data from the MN DNR's summer assessments. Only 10 individuals > 254 mm (10.0 inches) were observed in their assessments. In addition, they did not observe any marked individuals in their gill nets.

*Tom Lake*

Sampling was conducted for two evenings on Tom Lake; 8 and 9 May (Figure 11). Water temperatures, conductivity, and CPUE data are presented in Table 1. A total of 489 adult walleye were collected (566 total walleye), with catch rates ranging from 66.9 to 74.3 adults per hour of sampling (Table 1). At an 80% confidence interval, mean CPUE for Tom Lake, determined using each sampling station, was 64.9 ± 14.1 adults per hour and 76.0 ± 14.6 total walleye per hour of sampling effort. Catch rates were fairly consistent throughout most sampling stations, but were the highest along stations EF2 and EF6. Figure 12 shows the length frequency histogram for the walleye sampled. Additional species observed included yellow perch and whitefish.

Table 14 presents the age distribution for Tom Lake. Table 15 presents the back-calculated length at age for the walleye collected. Back-calculated lengths at age were almost identical to those found in Wilson and Four Mile Lakes, but were noticeably lower than in Murphy, Aspen, and Flour Lakes.

Table 2 presents the population estimates based upon mark-recapture data. The Schumacker and Eschmeyer population estimate from electrofishing was 735, with no confidence intervals because of only a single night of recapture data. The Petersen estimate is 732 ± 124 with a 8.7% CV. During the summer, the Minnesota Department of Natural Resources performed a standardized net assessment on Tom Lake (Paul Eiler and Steve Persons, MN DNR, Grand Marais Area Fisheries). Of the 38 walleye sampled in both their gill net and trap net sets larger than 254 mm (10.0 inches) (65 total walleye), no recaptured walleye were observed. It is unclear as to whether the crew failed to sample any marked walleyes, or whether individual walleyes were not examined for marks. Either way, no population estimates are available using this alternate gear type.

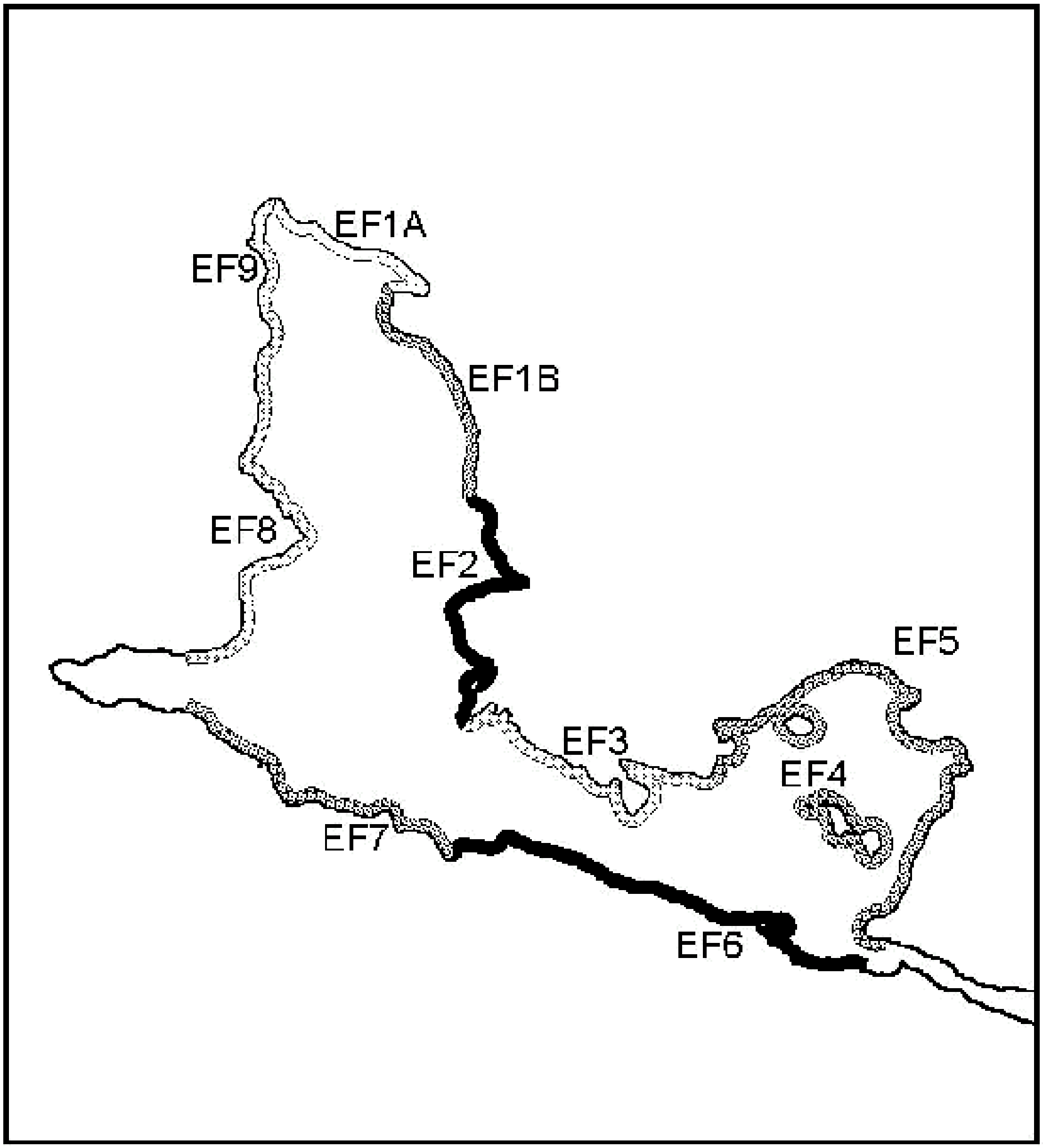


Figure 11. Electrofishing catch-per-unit-effort (CPUE, #/hour) of adult walleye on Tom Lake, St. Louis County, Spring 2000.

Table 14. Age frequency distribution of walleye from Tom Lake, Cook County, Spring 2001, based upon the number of fish sampled and aged per size category.

| Length Inches | Group mm | N Sampled | Ages | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7.0 | 178 | 3 | | | | | | | | | | | | | |
| 7.5 | 191 | 2 | | | | | | | | | | | | | |
| 8.0 | 203 | 2 | 1-2 | | 2 | | | | | | | | | | |
| 8.5 | 216 | 10 | 2-2, 1-3 | | 7 | 3 | | | | | | | | | |
| 9.0 | 229 | 8 | | | | | | | | | | | | | |
| 9.5 | 241 | 49 | 5-2, 1-3 | | 41 | 8 | | | | | | | | | |
| 10.0 | 254 | 39 | 12-3 | | | 39 | | | | | | | | | |
| 10.5 | 267 | 23 | 11-3 | | | 23 | | | | | | | | | |
| 11.0 | 279 | 24 | 10-3 | | | 24 | | | | | | | | | |
| 11.5 | 292 | 23 | 6-3, 1-4 | | | 20 | 3 | | | | | | | | |
| 12.0 | 305 | 19 | 7-3, 5-4 | | | 11 | 8 | | | | | | | | |
| 12.5 | 318 | 16 | 2-3, 5-4 | | | 5 | 11 | | | | | | | | |
| 13.0 | 330 | 18 | 10-4 | | | | 18 | | | | | | | | |
| 13.5 | 343 | 15 | 3-4, 3-5 | | | | 7 | 7 | | | | | | | |
| 14.0 | 356 | 21 | 4-4, 4-5, 1-6 | | | | 9 | 9 | 3 | | | | | | |
| 14.5 | 368 | 15 | 3-5, 4-6 | | | | | 6 | 9 | | | | | | |
| 15.0 | 381 | 27 | 2-5, 2-6, 5-7 | | | | | 6 | 6 | 15 | | | | | |
| 15.5 | 394 | 18 | 1-4, 2-5, 3-6, 1-7 | | | | 2 | 5 | 8 | 3 | | | | | |
| 16.0 | 406 | 30 | 1-5, 1-6, 4-7 | | | | | 5 | 5 | 20 | | | | | |
| 16.5 | 419 | 28 | 5-6, 4-7 | | | | | | 16 | 12 | | | | | |
| 17.0 | 432 | 26 | 3-6, 6-7, 2-8 | | | | | | 7 | 14 | 5 | | | | |
| 17.5 | 445 | 18 | 3-6, 3-7, 1-8, 1-9 | | | | | | 7 | 7 | 2 | 2 | | | |
| 18.0 | 457 | 18 | 1-7, 4-8, 1-9 | | | | | | | 3 | 12 | 3 | | | |
| 18.5 | 470 | 17 | 1-7, 5-8, 3-9, 1-10 | | | | | | | 2 | 8 | 5 | 2 | | |
| 19.0 | 483 | 7 | 2-7 | | | | | | | 7 | | | | | |
| 19.5 | 495 | 2 | 2-9 | | | | | | | | | 2 | | | |
| 20.0 | 508 | 3 | 1-8, 1-10, 1-11 | | | | | | | | 1 | | 1 | 1 | |
| 20.5 | 521 | 1 | 1-12 | | | | | | | | | | | | 1 |
| 21.0 | 533 | | | | | | | | | | | | | | |
| 21.5 | 546 | | | | | | | | | | | | | | |
| 22.0 | 559 | 2 | 1-10, 1-12 | | | | | | | | | | 1 | | 1 |
| 22.5 | 572 | 2 | 1-9, 1-11 | | | | | | | | | 1 | | 1 | |
| 23.0 | 584 | | | | | | | | | | | | | | |
| TOTAL | | 486 | | 0 | 50 | 133 | 58 | 38 | 61 | 83 | 28 | 13 | 4 | 2 | 2 |

PSD and RSD values determined by our spring electrofishing sampling and the summer gill net survey conducted by the MN DNR are presented in Table 5. The electrofishing PSD of 48.3 ± 4.8 (Table 5) suggests the population is balanced. The RSD values indicate that there is an almost equal abundance of 254 mm to 381 mm (10 to 15 inch) spawning walleye in the population (RSD S-Q of 51.7 ± 4.8) as there are 381 mm to 508 mm (15 to 20 inch) walleye in the population (RSD Q-P of 46.4 ± 4.8). The gill net PSD of 35.3 ± 22.7 (Table 5) suggests a higher relative abundance of the smaller "stock" to "quality" length individuals (254 mm - 378 mm; 10.0 - 14.9 inches) than what was observed during spring sampling efforts ($RSD_{Gill\ Net}$ S-Q of 64.7 ± 22.7) (Table 5). Significant differences in PSD values between the two samples were not observed however ($\chi^2$ = 1.11, $P$>0.05, Critical Chi-square value of 3.841). The gill net PSD is based upon 38 fish while the electrofishing sample was calculated using 412 fish. Significant differences between the two gear types need to be interpreted with care, as the number of fish sampled using the gill and trap nets probably is not enough to make accurate inferences as to the size structure of the walleye stock in Tom Lake.

Table 15. Back-calculated lengths at each age class for walleye collected from Tom Lake, Cook County, Minnesota, Spring 2001.

| Age Class | N | Length (mm) | Length (in) |
|---|---|---|---|
| 1 | 184 | 117 | 4.6 |
| 2 | 184 | 198 | 7.8 |
| 3 | 178 | 268 | 10.6 |
| 4 | 127 | 323 | 12.7 |
| 5 | 95 | 366 | 14.4 |
| 6 | 80 | 403 | 15.9 |
| 7 | 58 | 429 | 16.9 |
| 8 | 28 | 466 | 18.3 |
| 9 | 15 | 494 | 19.4 |
| 10 | 6 | 509 | 20.0 |
| 11 | 3 | 529 | 20.8 |
| 12 | 1 | 526 | 20.7 |

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