

An Assessment of the Summer Sport Fishery for Walleye and Northern Pike at Pigeon Lake, 2003

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**An Assessment of the Summer Sport
Fishery for Walleye and Northern
Pike at Pigeon Lake, 2003**

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EXECUTIVE SUMMARY

To recover or maintain Alberta's walleye and pike fisheries, Alberta Natural Resources Service implemented new management strategies in 1996 for walleye and in 1999 for pike. Walleye in Pigeon Lake were likely extirpated by the 1960's. To restore this important fishery 18.4 million walleye fry and fingerlings were stocked into Pigeon Lake between 1994 and 1999. Consequently, in 1996 the walleye fishery at Pigeon Lake was classified as a stocked lake and a zero daily limit (catch and release regulation) was implemented. In 1999, based on a new northern pike management strategy, the pike fishery at Pigeon Lake was classified as stable-recreational (vulnerable) and a 63 cm (maximum total length, TL) size limit, 3 fish daily limit was implemented.

In 1999 a creel survey was conducted at Pigeon Lake to quantify sport angling effort directed at the re-established walleye fishery and to assess the pike stock. Results from these efforts showed that angling pressure and the associated yield of walleye and pike were low. Based on criteria listed in the pike management strategy, the results of the 1999 creel survey indicated the pike stock was likely collapsed.

In this report we describe the results of a creel survey conducted from 23 May to 1 September 2003 and compare these data with those collected using similar methods in Pigeon Lake in 1999. Results from these efforts indicated that 7,646 anglers fished Pigeon Lake for 31,517 hours or 3.3 hours/hectare (h/ha) during the 3-month period in 2003. In contrast, angling pressure in 1999 was 1.2 h/ha. Comparisons of the incidental yield between 1999 and 2003 also differed substantially; incidental yield in 2003 (1.0 kilograms/hectare, kg/ha) was about 4-fold higher than that in 1999 (0.023 kg/ha). Similarly, the sport yield of pike (harvest + incidental mortality) in 2003 (0.047 kg/ha) was about 25% higher than that in 1999 (0.035 kg/ha). There was no walleye or pike recruitment observed during the survey period and the usage of the stocked walleye population has increased greatly since 1999.

The pike stock in Pigeon Lake appears to be on the verge of collapse. Observed and estimated catch rates were extremely low. Older and larger pike made up the catch and there was no evidence of recruitment. Anglers had low success in catching legal-size pike and there was a high level of inequality in the distribution of catch.

ACKNOWLEDGMENTS

I thank Michelle Wells and Jared Williams, the seasonal crewmembers who interviewed scores of anglers, spent many long and potentially hazardous hours boating on Pigeon Lake and managed the creel and biological data in away that ensured its safety and integrity.

I would also like to thank Alberta Fish and Wildlife and Alberta Parks for collaborating on this project, the use of their cabin on Pigeon Lake, and for providing boat and vehicle storage at the Provincial Park warehouse. Human Resources and Development Canada provided partial funding to seasonal staff and The Fish'n' Hole provided discounts on equipment.

Also, I would like to acknowledge Dr. Michael Sullivan and Vance Buchwald of Alberta Fish and Wildlife and David Park (ACA) for reviewing and providing essential improvements to this report.

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1.0 INTRODUCTION

Walleye (*Sander vitreus*) and northern pike (*Esox lucius*) populations in Alberta have been subjected to heavy fishing pressure for many years. Most populations show signs of over-harvest, with many experiencing significant declines. Management strategies prior to 1995 focused on province-wide regulations designed to manage harvest at average fisheries. Fisheries receiving heavier than average exploitation have not been adequately protected with these regulations and consequently many have declined or collapsed. To aid the recovery of these fisheries, new Provincial management strategies were implemented; Alberta's Walleye Management and Recovery Plan (WMRP) (Berry 1995) and Alberta's Northern Pike Management and Recovery Plan (NPMRP) (Berry 1999). Both strategies require that each lake population be evaluated as to its degree of exploitation and then placed in one of these categories: collapsed, vulnerable, or stable. The fishery is assigned a standard sport fishing regulation based on this status (Sullivan 1994).

Walleye in Pigeon Lake are thought to have been extirpated by the 1960's (Thomas et al. 1999). Patterson (2000) identified the collapse of the commercial walleye fishery by the early 1960s. An attempt to re-establish the fishery by stocking 142,500 walleye fingerlings in 1979, 1980 to 1984 appeared to have failed. In contrast, the additional stocking of 18,394,500 walleye fry and fingerlings from 1994 to 1999 appears to have re-established a population. Since Pigeon Lake has been stocked with walleye, the WMRP assigned a collapsed status and therefore a sport fishery regulation of catch and release (zero limit). The regulation for the walleye sport fishery during the 2003 season was catch and release. In 1999, based on the NPMRP, the pike fishery at Pigeon Lake was classified as stable-recreational (vulnerable) and a 63 cm (maximum total length, TL) size limit, 3 fish daily limit on pike was implemented in the sport fishery. Based on the criteria used to classify pike stocks in Alberta and historical information, a previous creel survey (Patterson 2000) assessed the pike fishery as collapsed. The daily bag limit for pike was reduced from three to one fish for the 2004 sportfishing season. The size limit remained unchanged from 63 cm maximum TL.

The purpose of this report is two-fold. The primary purpose of this study was to assess levels of the angling pressure directed at walleye in Pigeon Lake including quantifying

levels of incidental mortality of this species. A secondary objective was to quantify angling pressure and harvest rates of pike and to a lesser extent, that for yellow perch in Pigeon Lake.

2.0 STUDY AREA

Pigeon Lake (TWP 46, 47 RNG 1, W5) is a eutrophic lake located about 60 km southwest of the City of Edmonton (Figure 1). It has a surface area of 9,748 ha and a maximum depth of 9.1 m (Mitchell and Prepas 1990). The shoreline is highly developed with over 2,300 private cottages, 10 summer villages, 9 unincorporated subdivisions, 8 youth and church group camps, 3 Provincial Parks, 5 golf courses, and several private campgrounds, day-use areas and boat-launches. Pigeon Lake is located in the Battle River Basin. The main inlet is Tide Creek, which is located along the western shoreline. A more complete description of the physical, chemical and biological characteristics of Pigeon Lake are provided in Mitchell and Prepas (1990).

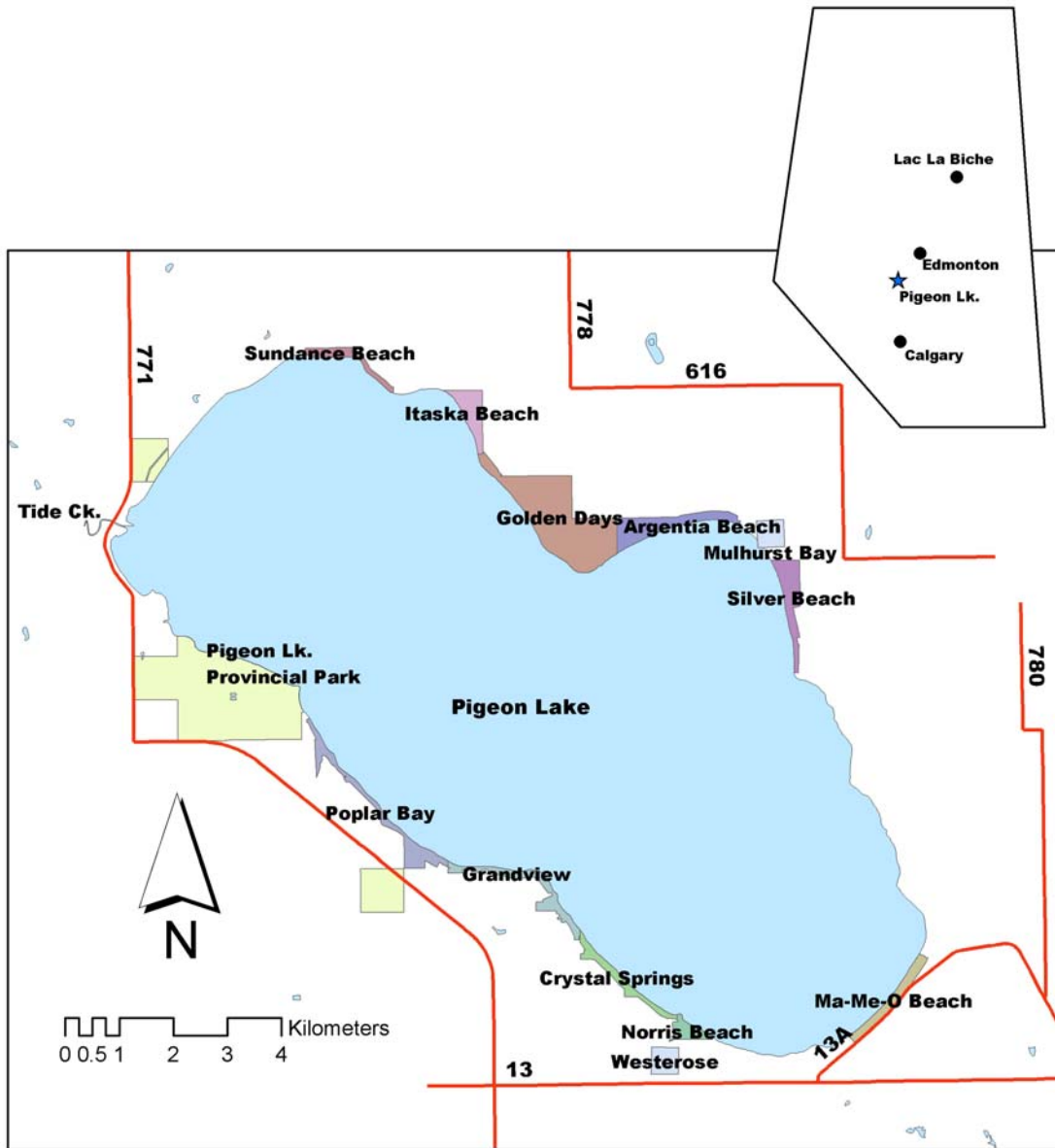


Figure 1. Location of Pigeon Lake in central Alberta. The creel survey was completed from the two access sites of the Mulhurst Bay boat launch and the Pigeon Lake Provincial Park boat launch.

3.0 MATERIALS AND METHODS

An access point creel survey (Pollock et. al 1994) was completed from 23 May to 1 September 2003 (Figure 1). Two crewmembers completed creel surveys by alternating between the Pigeon Lake Provincial Park and the boat launch located within the Town of Mulhurst. A schedule of 10 survey days (Friday through to the second Sunday of the shift) was interspersed with a 4-day period where angler surveys were not completed. This schedule was repeated 7 times during the study. The 8th shift extended between 29 August and 1 September. The creel survey had a temporal stratification of weekdays (Monday-Thursday) and weekend days (Friday-Sunday, including statutory holidays). Each survey day was creeled from 0800 to 2300. Initially the creel survey was evenly distributed between the Provincial Park and the Town of Mulhurst. Early analysis of the roving survey data indicated a disproportionate amount of effort from the Provincial Park. It became apparent that the Mulhurst boat launch was not being utilized to the same degree as the Provincial Park boat launch. Consequently, the survey days at Mulhurst were reduced and the survey focused at the Provincial Park. Therefore, 15/74 weekdays and 22/33 weekend days were surveyed at the Provincial Park and 3/74 weekdays and 5/33 weekend days were surveyed at the boat launch in the Town of Mulhurst. The crewmembers also conducted 27 roving creel surveys. These were scheduled throughout the survey period. With no prior knowledge of daily angler effort, the roving surveys were equally stratified amongst weekdays and weekends, mornings, afternoons and evenings.

All anglers, whether returning to the survey access point or intercepted during the roving surveys, were asked a series of questions regarding their time spent angling, angling party size, numbers of each species kept and released, target species, angling method, use of electronics (e.g. fish finder), residence and whether hooks were barbed or barbless (Appendix 6.1). A subjective evaluation of each angler's skill level was also made. Children and adults with little equipment, knowledge or seriousness were considered to be novice anglers. Professional anglers demonstrated clear superiority in equipment and knowledge. All other anglers were classified as having a moderate skill level.

The ratio of protected-length fish to legal-length fish reported by anglers was compared to similar ratios caught during test fishing to estimate the total catch rate for pike. Test angling was completed throughout the survey period. The ratio of legal-length fish sampled by the test fishery was assumed to be equal to the corresponding ratio from the sport fishery (Sullivan 2003). Test anglers were instructed to catch pike using lures and techniques they would normally utilize. The fork lengths (± 1 mm) of all test-angled pike were measured and a pelvic fin section was removed for aging. All test-angled fish were released.

Catch rates (catch-per-unit-effort (CPUE)) were calculated as total ratio estimators (Malvestuto 1983). Catch refers to the number of fish caught, which includes harvested and reported released fish. Total estimated catch rate refers to the calculated estimate of the catch rate used to compare the test fishery length and age-class distributions to the sport harvest distributions (Sullivan 2003). Harvest rate and reported release rate are the rates calculated from the catch and number of angler-hours reported by anglers to the creel clerk (Sullivan 2003).

If permitted, sport fish retained by anglers were sampled for biological information that included fork length (± 1 mm), maximum TL (± 1 mm) and weight (± 10 g). One or more skeletal structures were also removed to determine the age of the fish. For this purpose, the left pelvic fin and cleithrum of pike, the left pelvic fin and operculum of walleye, and the left operculum and or anal fin of yellow perch were collected. Ages were determined following Mackay et al. (1990). Sex and state of maturity of each fish were determined following Olynyk (1980).

All field data were recorded in pencil on field data forms. These data were transcribed into computer files by a commercial keypunch service using double entry verification. Prior to analysis, all data were again subjected to a verification procedure. These involved calculating frequency distributions of all creel survey parameters and using field diaries and notes to verify outlying values. Biological samples were verified by plotting weight measurements against the dependent variable of length, and length measurements against the dependent variable of age. Outlying values were identified visually and eliminated if measurement error was suspected.

At Pigeon Lake, anglers could access the fishery from many other access points other than the creel survey sites. Anglers were asked a series of questions regarding their angling and landing location as they were intercepted during the roving surveys. For example, the binomial of angling hours from the creel survey site / total angling hours collected (i.e., 1,369/1,780) was used to simulate the distribution of effort.

Estimates from the creel survey data followed protocols outlined in Sullivan (2004). An example of the steps involved is shown in Figure 2. I used a bootstrap technique to calculate estimates and confidence intervals for number of anglers, number of angling hours, angling pressure (i.e., hours/hectare, h/ha), harvest and yield (i.e., kilograms/hectare, kg/ha) of fish. Sullivan (2004) summarized that bootstrapping is a statistical procedure whereby an original sample of the population is subsequently re-sampled and a new mean calculated. Bootstrap samples are assumed to approximate the distribution of values that would have arisen from repeatedly sampling the original population (Haddon 2001). Sullivan (2004) explains that repeating this procedure thousands of times results in a distribution of possible means describing the likelihood of the true (i.e., population) mean being within that distribution. This group of means represents the distribution of possible means from data with the same scale of variation as observed in the original data set. Frequentist parameter estimates (e.g., means) are typically equal to maximum-likelihood estimates (MLE) for the parameters of the specified probability density function (Gotelli 2004). Empirical confidence intervals (95% CI) were calculated following Haddon (2001). The final proportions (i.e., probability densities) were standardized to range between 0 and 1 (Paul et al. 2003).

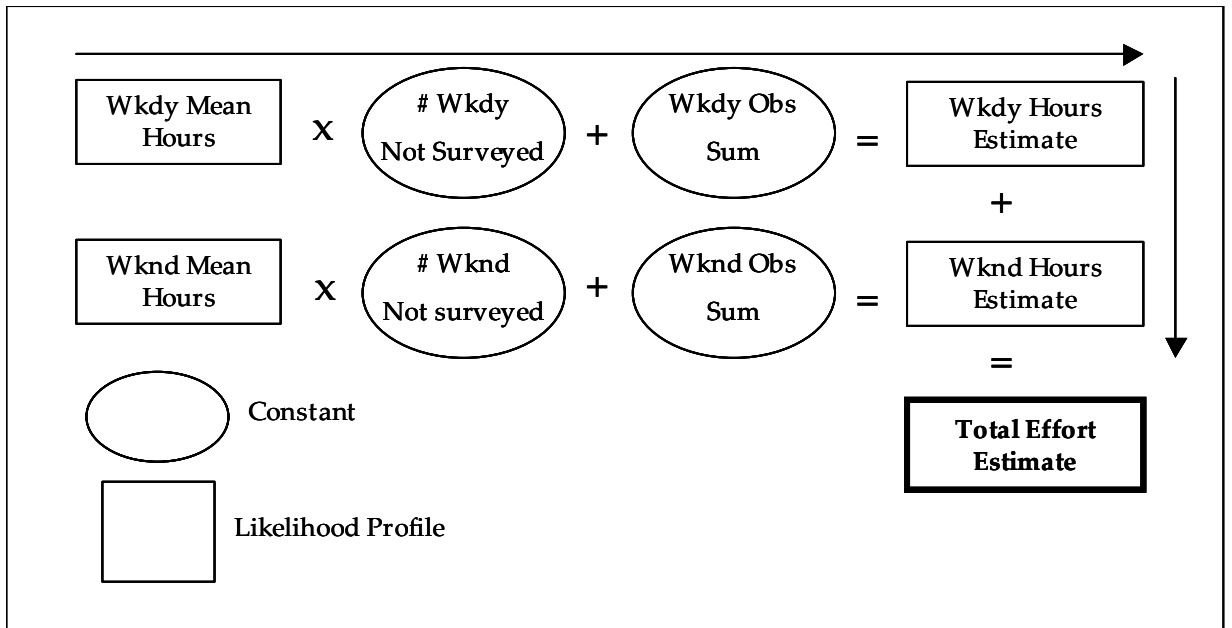


Figure 2. A flow chart describing the mathematical operations used to estimate parameters from the sport fishery at Pigeon Lake 2003. Circles denote values with no variance. Rectangles denote values with probability density functions. Bold outline denote derived parameters used in the assessment of the sport fishery (e.g., Total effort, hours).

Gini coefficients and associated Lorenz curves were calculated using an Excel macro based on Baccante (1995). Proportional Stock Density (PSD %) and Relative Stock Density (RSD stock - quality) classifications were calculated using fork lengths and the size categories suggested by Gablehouse (1984). All data and analyses are stored in the Provincial Governments Fisheries Management Information System (FMIS) that is managed by Alberta Sustainable Resource Development (ASRD).

Lastly, biological samples were also collected from 26 sport-harvested pike. The creel staff sampled 37 pike in 17 trips and 71.5 hours. A volunteer test fishery was held July 5 and 16 anglers from the local chapters of the Western Walleye Council and Alberta Fish and Game Association attended. In 56 hours of angling, ACA fisheries staff sampled 202 walleye.

4.0 RESULTS

4.1 Angler survey

The majority (i.e., 56.5% of the 3,150 angling hours) of total angling effort was initiated from the Provincial Park access point. The access points and the angling effort from the access points, collected during the roving survey, are listed in Appendix 6.2. The angler and biological data collected from anglers accessing Pigeon Lake through the Provincial Park were utilized in this report.

During the survey period at the Provincial Park, 1,816 anglers were interviewed (Table 1 and Appendix 6.3.) The maximum likelihood estimate (MLE) of the total number of anglers was 7,646 (95% CI = 6,439 - 8,891) (Figure 3). The MLE of effort was 31,517 h (95% CI = 24,780 - 38,863) (Figure 4). This results in an angling pressure MLE of 3.3 h/ha (95% CI = 2.6 - 4.0) (Figure 5). The estimates of anglers, effort and pressure increased significantly since the 1999 survey.

Table 1. Observed, reported and estimated catch rates of anglers who initiated angling trips from the Provincial Park in 1999 and 2003, Pigeon Lake, Alberta.

CREEL DATA	1999	2003
Number of days surveyed	34	37
Number of anglers interviewed	630	1,816
Number of angling hours reported	1,975.25	6,570.00
WALLEYE DATA		
Released/h	0.304	2.972
NORTHERN PIKE DATA		
Number of fish kept/h	0.011	0.007
Number of fish released/h	0.148	0.116
Observed total/h	0.159	0.123
Estimated number of fish released/h	0.029	0.008
Estimated total number of fish/h	0.038	0.015
YELLOW PERCH DATA		
Number of fish kept/h	0.060	0.0002 (1 fish)
Number of fish released/h	0.316	0.005

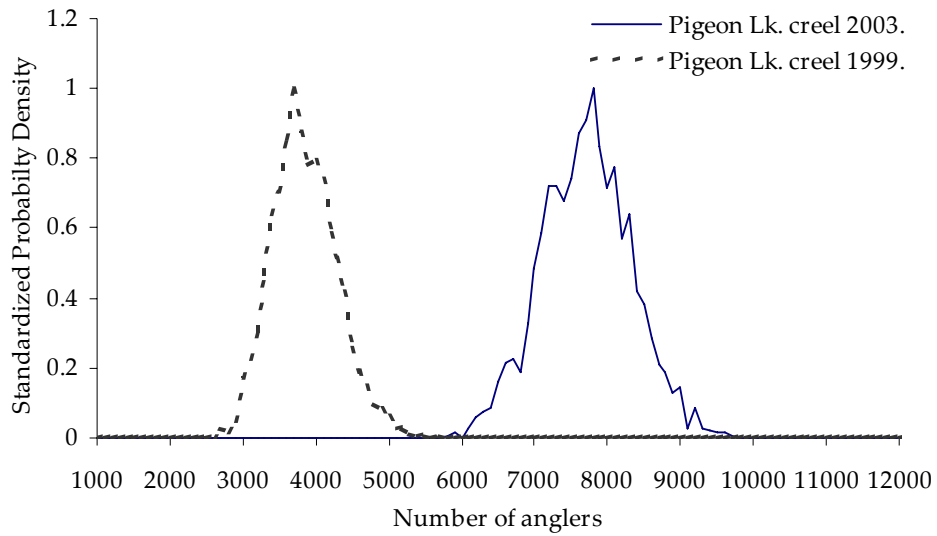


Figure 3. A comparison of probability density function of the total number of anglers at Pigeon Lake, in 1999 and 2003. The maximum likelihood estimates (MLE) of anglers from the 1999 and 2003 surveys were 3,776 anglers (95% CI = 2,980 - 4,737) and 7,646 anglers (95% CI = 6,439 - 8,891), respectively.

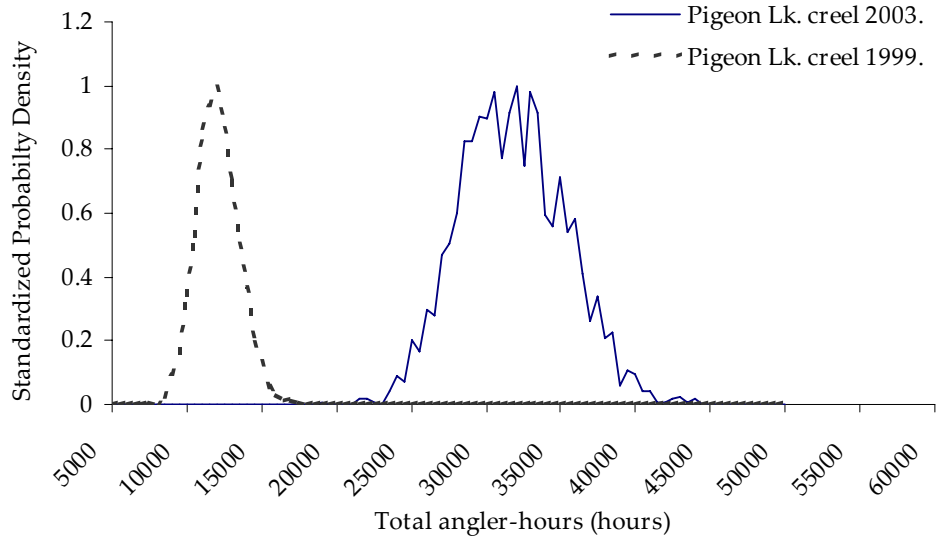


Figure 4. A comparison of the probability density function of the number of hours that anglers expended at Pigeon Lake in 1999 and 2003. The MLE of angler-hours (h) from the 1999 and 2003 surveys were 11,769 h (95% CI = 9,663-15,052) and 31,517 h (95% CI = 24,780 - 38,863) hours, respectively.

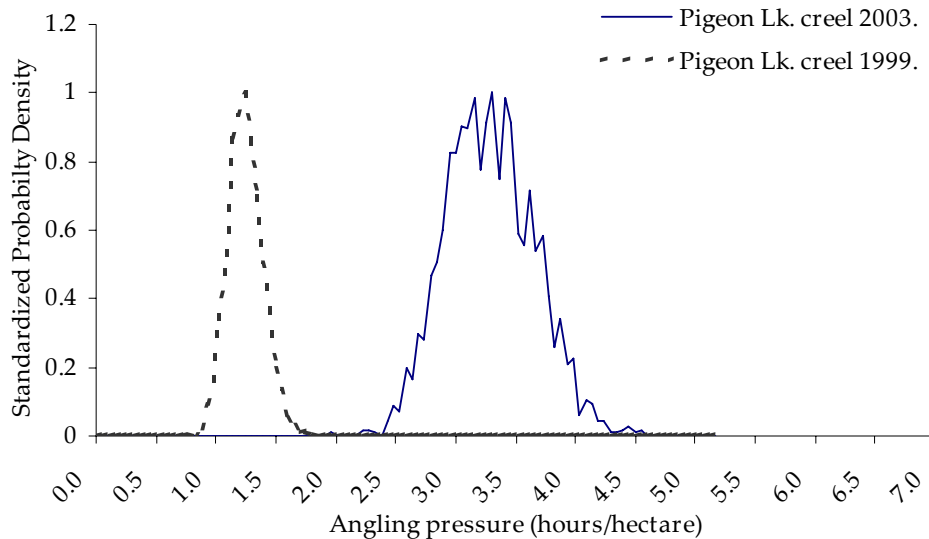


Figure 5. A comparison of the probability density function of angling pressure at Pigeon Lake in 1999 and 2003. The MLE of angling pressure (hours/hectare, h/ha) from the 1999 and 2003 surveys were 1.2 h/ha (95% CI = 1.0 - 1.6) and 3.3 h/ha (95% CI = 2.6 - 4.0), respectively.

4.2 Walleye yield

The 2003 creel survey did not detect illegal harvest of walleye in Pigeon Lake. The release rate reported by anglers was 2.97 walleye/h. Sullivan (2003) explains that the exaggeration of catch rates may be a low catch rate phenomenon, therefore, the release rate reported by anglers during this survey is likely not exaggerated and probably reflects a moderately high density of walleye. The estimate of released walleye was 66,067 fish (95% CI = 50,598 - 81,075) (Figure 6). The estimate of released walleye from the 1999 survey was 3,355 fish (95% CI = 2,182 - 4,785).

Calculating an incidental mortality of 5.6% from multivariate analysis using a progress report by Reeves (2004) and the MLE mean weight of 2,324 g (95% CI = 2,215 - 2,426) for released walleye (Figure 7), the estimated yield during the 2003 survey from incidental harvest was 1.0 kg/ha (95% CI = 0.68 - 1.09) (Figure 8). Since the 1999 survey, the numbers of walleye released, their mean weight and the incidental yield have increased significantly.

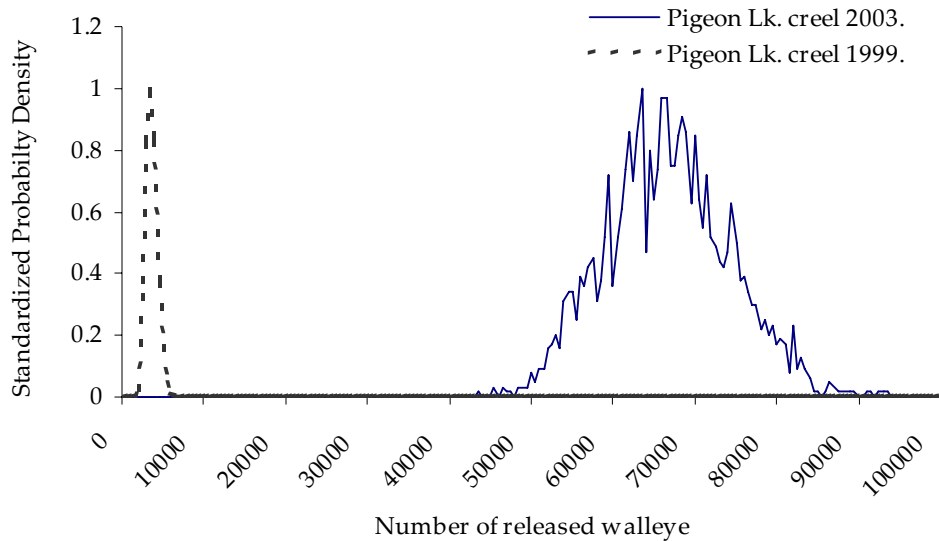


Figure 6. A comparison of the probability density function of the number of released walleye by the sport fishery from Pigeon Lake in 1999 and 2003. The MLE of walleye released from the 1999 and 2003 surveys was 3,355 fish (95% CI = 2,182 - 4,785) and 66,067 fish (95% CI = 50,598 - 81,075), respectively.

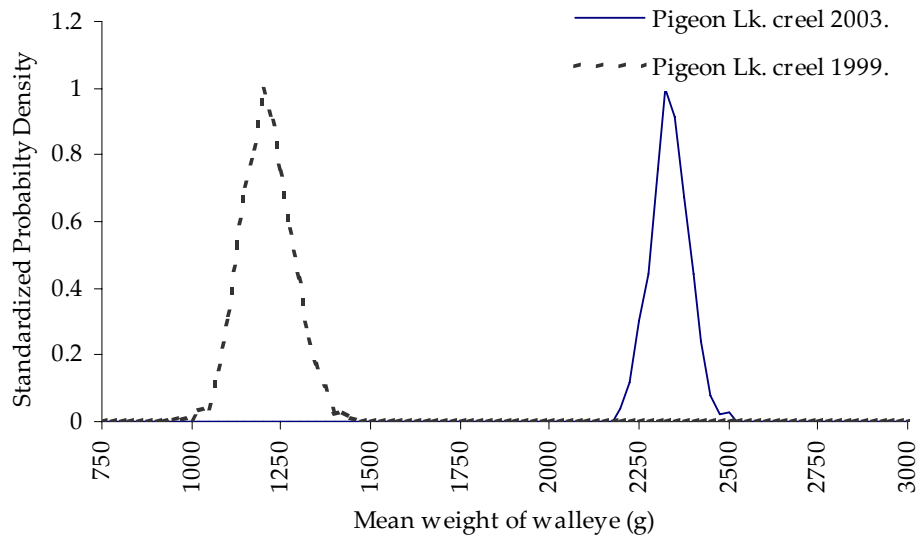


Figure 7. A comparison of the probability density function of the mean weight of walleye released by the sport fishery from Pigeon Lake in 1999 and 2003. The MLE of walleye mean weight (g) from the 1999 and 2003 surveys were 1,202 g (95% CI = 1,066 - 1,357) and 2,324 g (95% CI = 2,215 - 2,426), respectively.

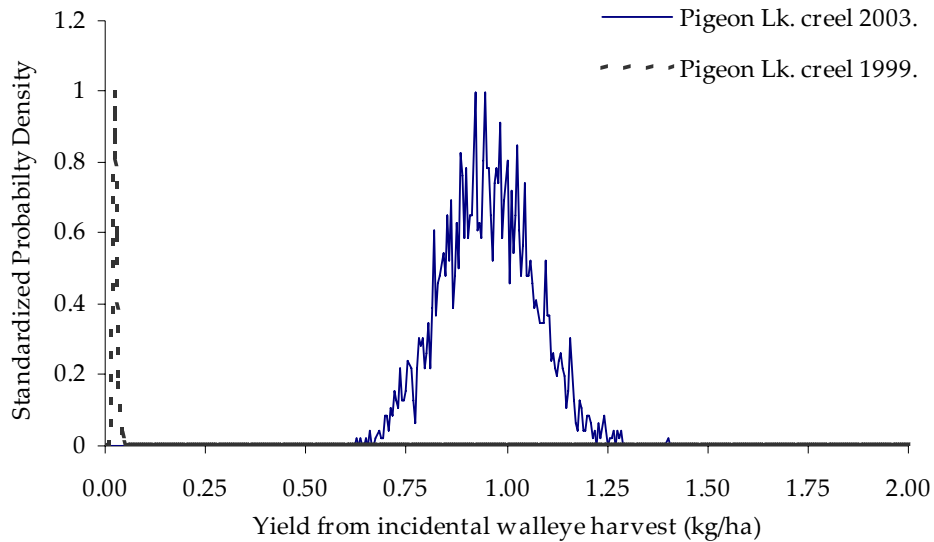


Figure 8. A comparison of the probability density function of yield from incidental walleye harvest from Pigeon Lake in 1999 and 2003. The maximum likelihood estimate of the yield (kg/ha) of walleye from the 1999 and 2003 surveys were 0.023 kg/ha (95% CI = 0.015 - 0.034) and 1.0 kg/ha (95% CI = 0.68-1.09), respectively.

4.3 Pike harvest and yield

The estimated harvest of pike during the 2003 survey was 165 fish (95% CI = 109 - 243) (Figure 9). The mean weight of a harvested pike was 2649 g (95% CI = 2,189 - 3,162) (Figure 10). The estimated yield of pike harvested by anglers during the survey period was therefore 0.047 kg/ha (95% CI = 0.030 - 0.072). The yield of pike harvested by anglers during the 1999 survey was 0.035 kg/ha (95% CI = 0.023 - 0.051).

Anglers reported a release rate of 0.116 pike/h. Using the ratio of protected-length to legal-length pike sampled during the test fishery, an estimated release rate of 0.008 pike/h was calculated. This suggests anglers exaggerated their release rate by 14 times. The estimated release rate results in an estimate of 252 released pike.

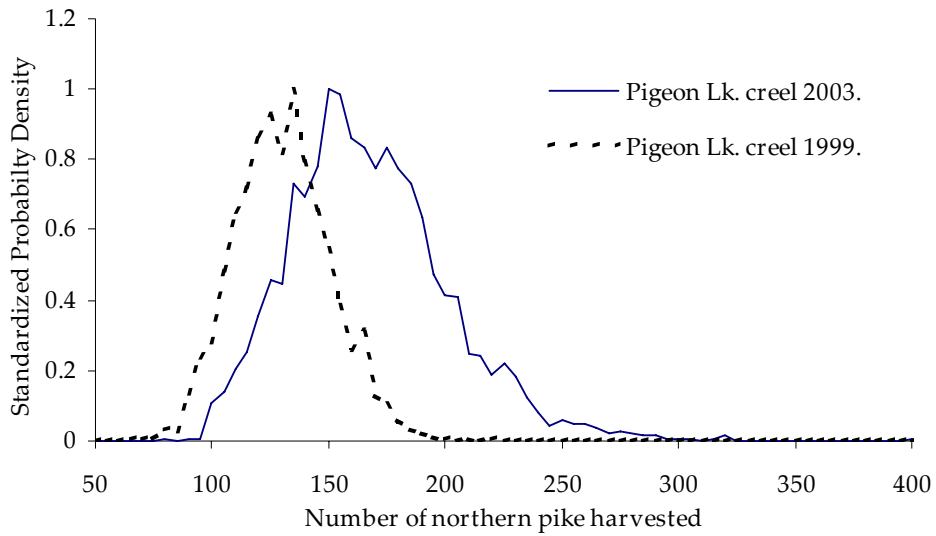


Figure 9. A comparison of the probability density function of the pike sport fishery harvest from Pigeon Lake in 1999 and 2003. The MLE of pike harvest from the 1999 and the 2003 surveys were 128 fish (95% CI = 92 - 170) and 165 fish (95% CI = 109 - 243) fish, respectively.

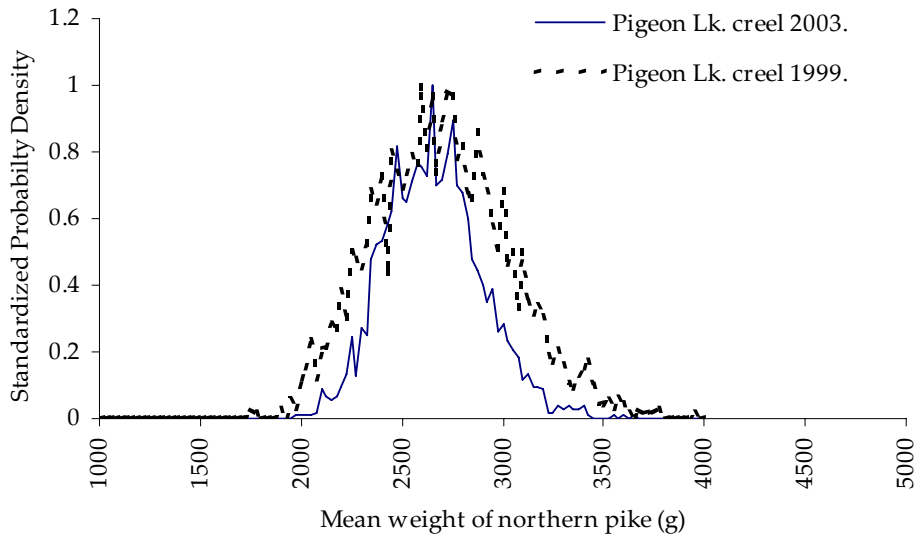


Figure 10. A comparison of the probability density function of the mean weight of pike harvested by the sport fishery from Pigeon Lake, 2003. The MLE of pike mean weight (g) from the 1999 and 2003 surveys were 2,681 g (95% CI = 2,068 - 3,384) and 2,649 g (95% CI = 2,189 - 3,162), respectively.

Assuming a conservative 5% incidental mortality from hooking and handling and a mean weight of 1,978 g (converted from the mean FL from the test fishery), the incidental mortality of pike by anglers was approximately 13 pike or 0.003 kg/ha. The estimated incidental mortality by anglers from the 1999 survey was 17 pike or 0.003 kg/ha. For the 2003 survey, the total sport yield of pike (harvest plus incidental mortality) was therefore approximately 178 pike (0.050 kg/ha). The yield of pike has increased since the 1999 survey but not significantly (Figure 11).

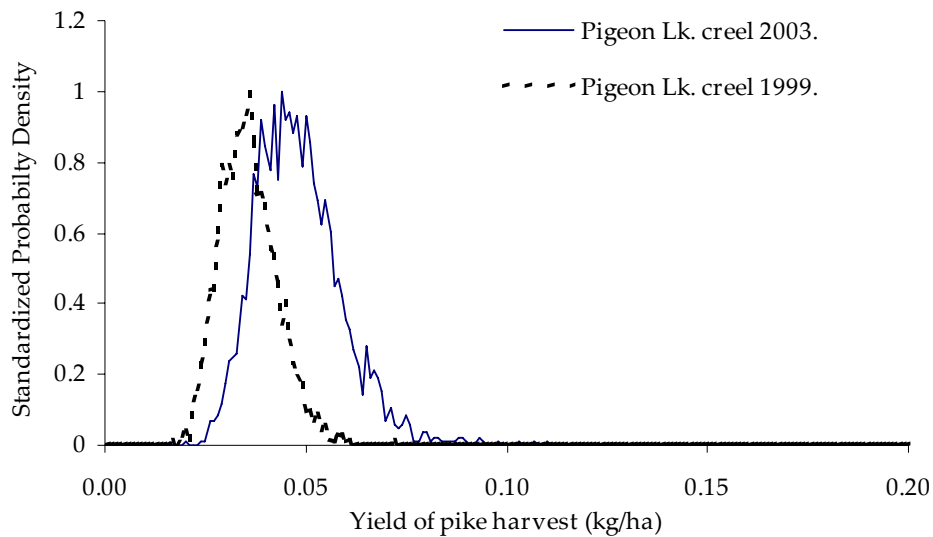


Figure 11. A comparison of the probability density function of the yield of pike harvested by the sport fishery from Pigeon Lake in 1999 and 2003. The MLE of the yield of pike (kg/ha) from the 1999 and 2003 surveys were 0.035 kg/ha (95% CI = 0.036 - 0.069) and 0.047 kg/ha (95% CI = 0.030 - 0.072), respectively.

4.4 Assessment of the walleye sport fishery

According to the Provincial Government WMRP, Pigeon Lake is a stocked walleye fishery and is therefore classified as collapsed and managed for no harvest (Berry 1995). Characteristics of the walleye fishery at Pigeon Lake were compared to the criteria listed in the WMRP.

Since no biological data could be collected from the sport fishery, biological data collected during the volunteer test fishery (TF, Appendix 6.4) and the fall walleye index netting (FWIN) were analyzed and compared to the WMRP criteria.

4.4.1 Age-class distribution and stability

Both age-class distributions, sampled by the test fishery and FWIN (Figures 12 and 13), indicate a narrow distribution with few ages supporting the distribution. Both samples had a mean age of 6 y. Both the sport fishery catch rate (2.97 walleye/h) and the FWIN (49.3 walleye/net) indicate very high densities. These catch rates are relatively high for Alberta (Figure 14 and 15).

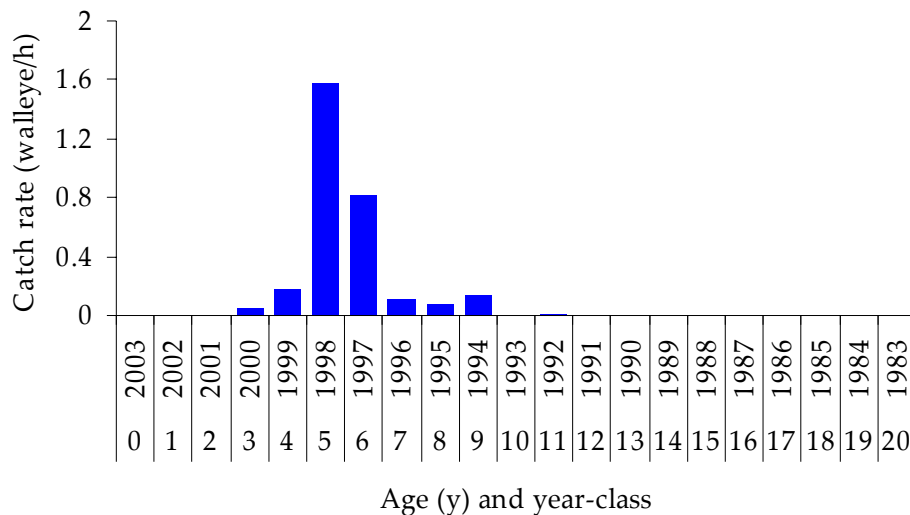


Figure 12. Distribution of age-classes and year-classes of 200 walleye sampled by the volunteer test fishery. The catch rate (2.97 walleye/h) was collected by the creel survey (19,529 walleye / 6,570 angling-hours).

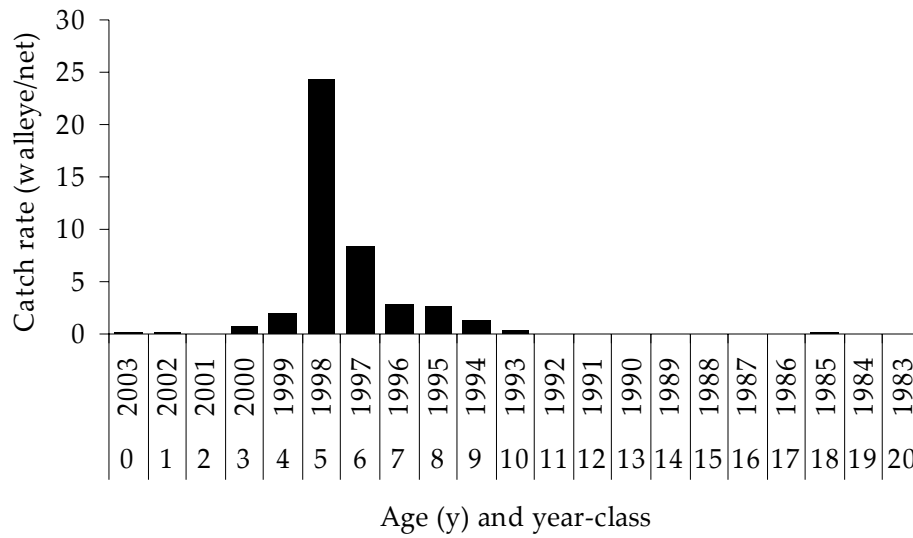


Figure 13. Age-class and year-class distribution of walleye sampled from the FWIN. The FWIN catch rate was 49.3 walleye/net.

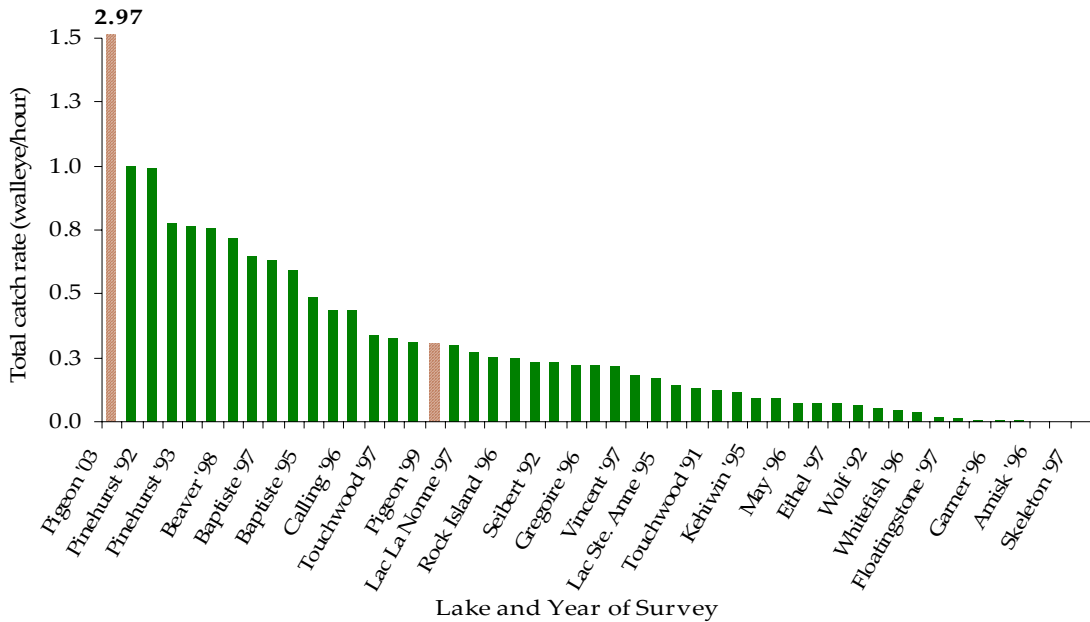


Figure 14. A comparison of total catch rates of walleye (Number/hour) derived from creel surveys conducted between 1990 and 2003 in Pigeon Lake. The range of total catch rates was 0.0 to 2.97 walleye/h. The 1999 (0.30/h) and the 2003 (2.97/h) Pigeon Lake creel surveys are highlighted.

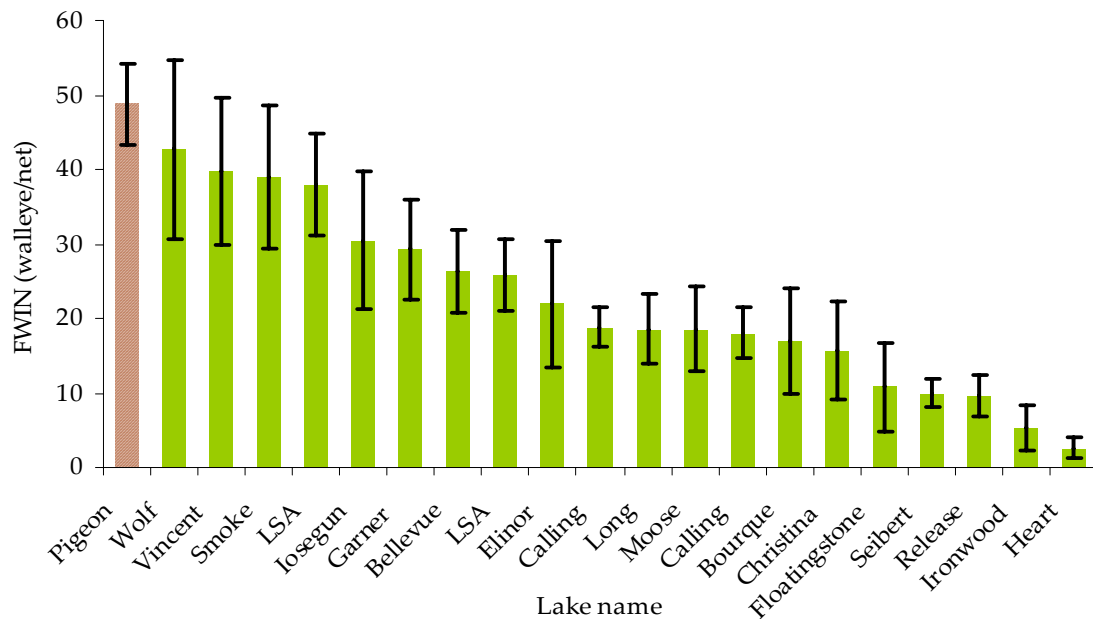


Figure 15. Mean catch rates (\pm 95% confidence intervals) of walleye (number/net) from FWIN (2000 to 2003). The range of catch rates was 2.6-49.3 walleye/net. Pigeon Lake FWIN is highlighted as a hatched fill.

The 1999 to 1994 year-classes represent the years walleye fry and fingerlings were stocked into Pigeon Lake. The 1998 and 1997 year-classes seem to be supporting the sport fishery (Figure 12). The 1998, 1997 and 1996 stockings produced the three strongest year-classes (Figure 13). To confirm whether age-classes recruiting to the fishery were not being overlooked by the sampling techniques, I simulated (i.e., random sampling with replacement of ages following Haddon 2001) walleye age class distributions, using test fishery and FWIN data from Pigeon Lake 2003. The simulations indicated that test angling and FWIN accurately sampled the walleyes' age-class distribution.

4.4.2 Length-at-age

The index of growth of the walleye sampled by the test fishery and the FWIN were very similar (Figure 16). Walleye are growing to 50 cm (TL) size at about ages 6 to 7. This can be considered to be rapid growth, especially given the high density of walleye in Pigeon Lake.

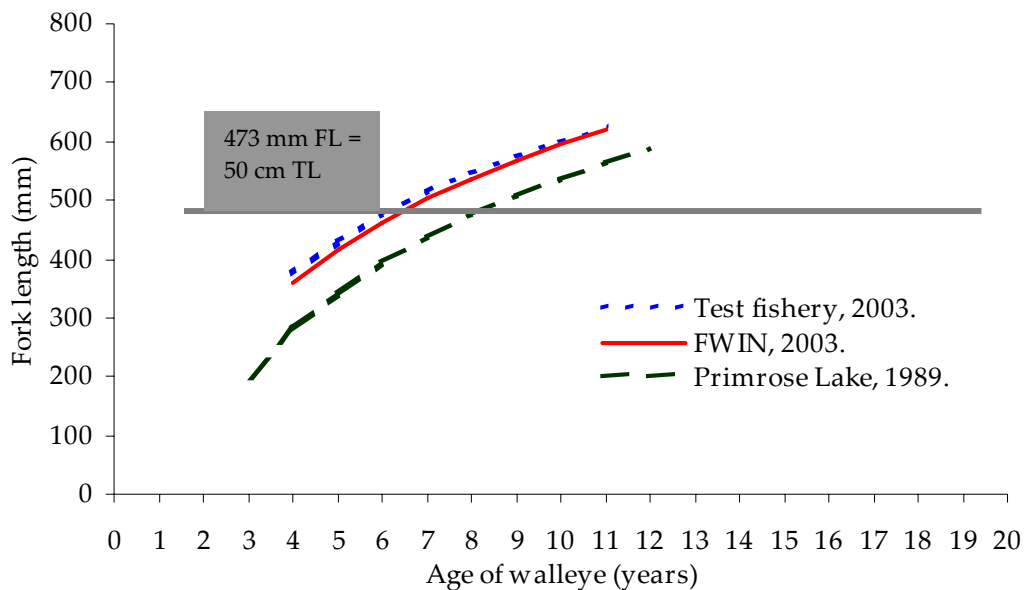


Figure 16. Length-at-age (logarithmic lines-of-best-fit) of walleye from the volunteer test fishery ($n = 97$, $r^2 = 0.67$) and the FWIN ($n = 194$, $r^2 = 0.73$) at Pigeon Lake, 2003. Primrose Lake length-at-age data was collected during a creel census at the Primrose Air Weapons Range ($n = 147$, $r^2 = 0.98$).

4.4.3 Catch rate

The sport fishery catch rate for walleye was very high at 2.97 fish/h. During the creel survey, anglers were 75% successful in catching a walleye. Sullivan (2003) concludes that anglers exaggerate more as fishing success declined. Therefore, the reported catch rate is likely not exaggerated and reflects a high-density of walleye.

4.4.4 Age-at-maturity

The distribution of age-at-maturity of walleye is quite young and mature (Figure 17). Male walleye were first maturing at age 4 and fully mature at age 6. Mature males had a mean age of 6 y. Female walleye were first maturing at age 5 and fully mature at age 9. Mature females had a mean age of 7 y. Along with fast growth, these walleye also have an accelerated maturation schedule.

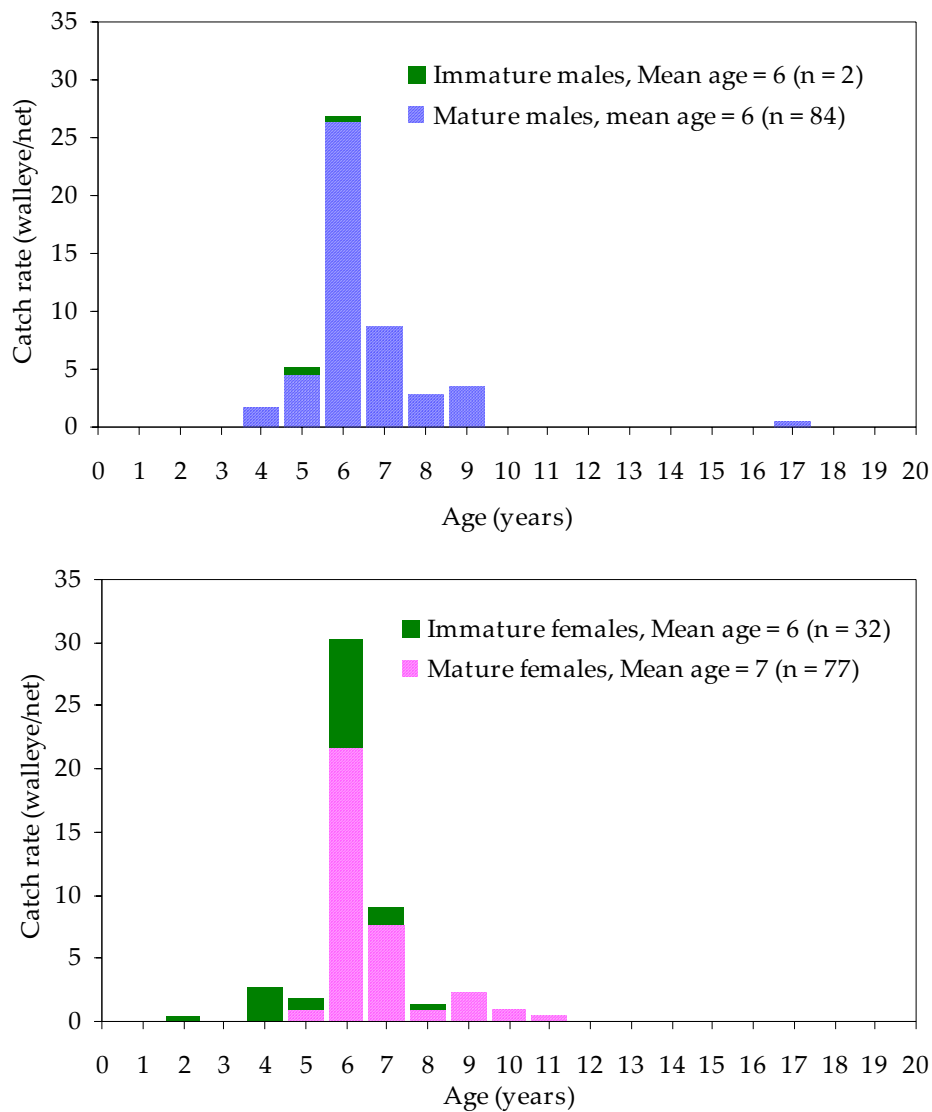


Figure 17. Age-at-maturity of walleye as sampled by the FWIN (ASRD FMIS), Pigeon Lake 2003.

In summary, the age-class distribution was unstable; narrow and supported by three year-classes. All year-classes sampled were stocked into Pigeon Lake. Based on FWIN catches, recruitment is extremely low. There were two small walleye sampled; the sizes suggest one yearling and one age 2 walleye. The sport fishery's and the FWIN catch rates were high for Alberta.

Alberta's classification strategy uses parameters that are not suited for describing an unstable, dynamic, recently stocked fishery like Pigeon Lake. The high density of walleye also exhibits characteristics of a population far below the carrying capacity, indicative of population expansion into a recently unexploited ecosystem. The fishery is not sustainable without recruitment.

4.5 Assessment of the northern pike sport fishery

Characteristics of the pike sport fishery at Pigeon Lake were evaluated using the stock classifications listed in the Northern Pike Management and Recovery Plan (NPMRP) (Berry 1995).

4.5.1 Catch rate

From the 2003 creel survey of Pigeon Lake, the catch rates for pike were extremely low. The harvest rate of legal-length pike (>63 cm TL) was 0.007 fish/h. The reported release rate was 0.116 pike/h. The total catch rate was therefore 0.123/h. The total catch rate during the 1999 survey was 0.159/h. Anglers likely exaggerate their reported catch of pike. From regional studies for walleye at low catch rate lakes, anglers exaggerated their catch by 2 times, on average (Sullivan 2003). Because the pike kept catch rate was extremely low, the reported catch rate is likely less than what was reported by anglers. Following Sullivan (2003), a release catch rate of 0.008 pike/h was estimated. Therefore, the total estimated catch rate for pike was 0.015 fish/h. The total estimated catch rate during the 1999 survey was 0.04 pike/h. These catch rates indicate an extremely low density of pike.

4.5.2 Age-class distribution

The pike harvested were relatively young (Figure 18). Only one pike of the 26 sampled from the sport fishery was a protected-length fish (Figure 19, Appendix 6.5). No age-classes were measurable (had densities >0.02 pike/h) and 1994 and 1993 year-classes were absent in the narrow age-class structure harvested by the sport fishery.

The 2003 length-frequency distribution, compared to the 1999 distribution (Figure 19), is much narrower with catch rates declining dramatically across the smaller fish's distribution. The 2003 test fishery sample (Appendix 6.6) did not reveal any recruitment to the pike fishery as it did in 1999. This narrowing is indicative of a population that is being recruitment-overfished. This substantially adds to the vulnerability of the population.

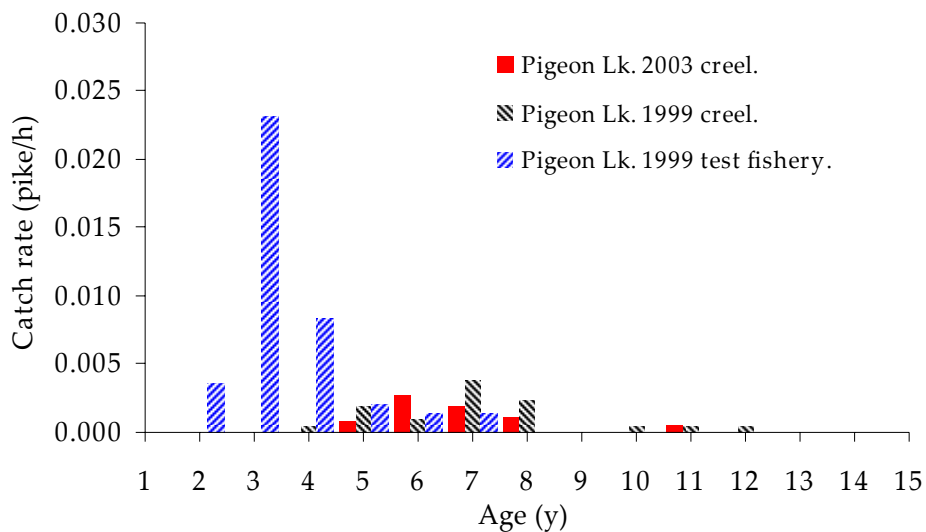


Figure 18. Age-class distributions of sport harvested pike from Pigeon Lake, 2003. The 1999 age-class data came from Patterson 2000.

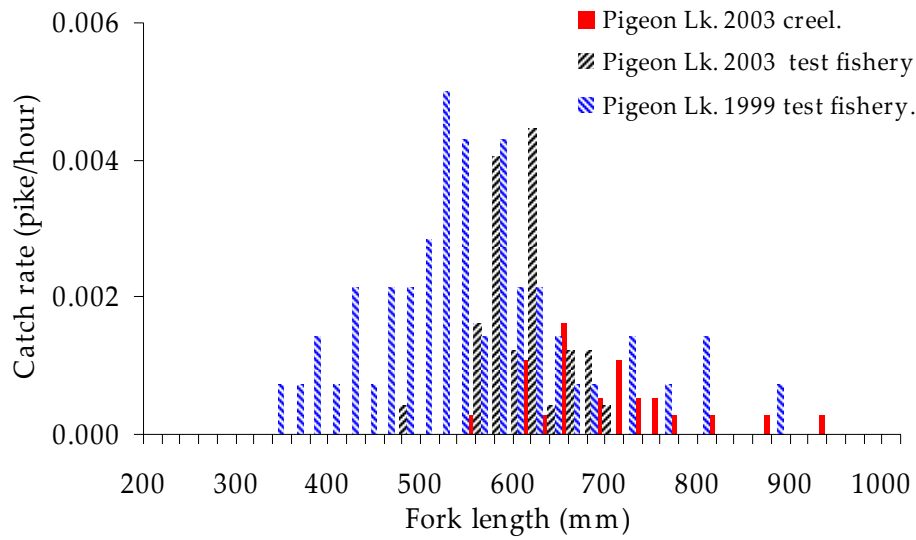


Figure 19. Length frequency distribution of sport harvested and test fishery sampled pike from Pigeon Lake, 2003. The 1999 length data came from Patterson 2000.

4.5.3 Length-at-age

The length-at-age of pike in Pigeon Lake (Figure 20) was relatively fast but has not changed substantially since the 1999 survey.

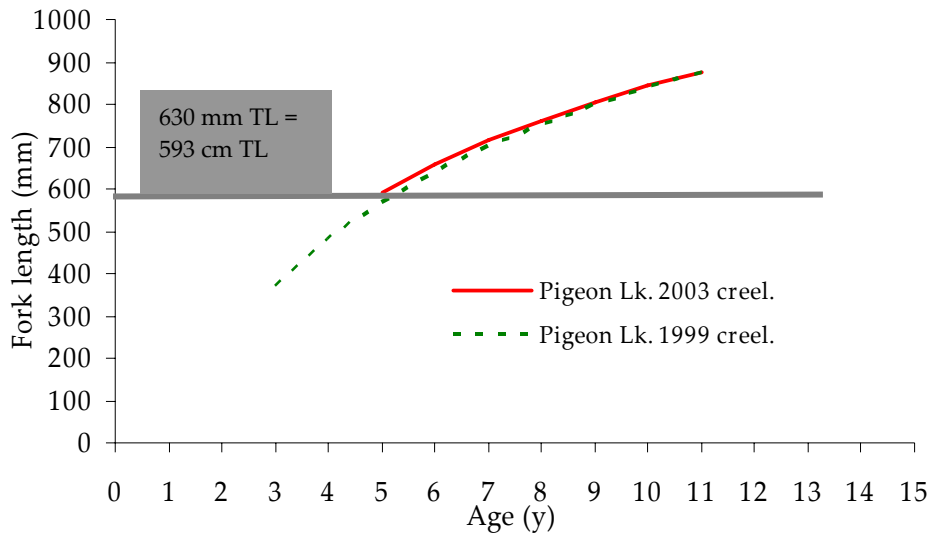


Figure 20. Length-at-age of sport harvested pike from Pigeon Lake, 1999 and 2003.

4.5.4 Mean weight

The mean weight converted from the mean fork length from the portion of the test fishery sample that was >63 cm TL was 2.3 kg. The sport fishery mean weight, from the legal-length pike harvested was 2.7 kg. A relatively high mean weight can indicate a collapsed or stable population. However, when catch rates are extremely low it likely indicates a collapsed population.

4.5.5 Proportional and relative stock densities

Both the Proportional Stock Density (PSD) and Relative Stock Density (RSD) are representative of a collapsed population. A high proportion (95%) of the pike catch in the test fishery was composed of “quality” fish or pike >53 cm TL (Gablehouse 1984).

4.5.6 Percentage success and GINI coefficient

Only 3% of all anglers were successful in catching one or more legal-size pike. There was a high level of inequality in the catch of pike with a GINI coefficient of 0.80 (Baccante 1995). A GINI coefficient of 0 indicates all anglers caught equal numbers of fish and a coefficient of 1 indicates that a single angler caught the entire catch. Both % Success and GINI metrics include the reported released pike, which at very low rates include some exaggeration of catch. If the catch was exaggerated, then % Success could actually be lower than calculated and the GINI coefficient would be higher than calculated.

In summary, since the previous survey, the yield of harvested pike did not change and remained low. The catch rates indicated extremely low densities of pike. The estimated release rate was much lower than the reported release rate. The size range of pike has narrowed since the 1999 survey and there seems to be an absence of recruitment. Length-at-age has not changed substantially since the previous survey. A significant proportion of the catch was composed of “quality” size pike and an extremely low proportion of the catch was composed of “stock” size pike. A relatively high mean weight, at extremely low catch rates, indicates a collapsed population. Because catches are likely exaggerated, % Success is lower than reported and the GINI coefficient is

higher. To the NPMRP, the pike stock appears to be on the verge of collapse but still exhibits characteristics of a low risk vulnerable fishery.

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Appendix 6.2 Percentages of angling effort from access points on Pigeon Lake. This data was collected from 27 roving surveys conducted from May 19 to August 31, 2003. The number of anglers and their angling hours total 1,287 and 3,150 angling hours, respectively. [Pigeon Lake, 2003]

Name of Access Point	Percent
Argentia	0.62
Balsam	0.16
Burnt Birch	1.09
Crystal Spring	1.94
Fisherhome	6.59
Golden Days	1.24
Grandview	5.74
Johnsonia	2.25
Kerr Cap	0.23
Lutheran Camp	0.39
Ma-Me-Oo	2.17
MichellBeach	0.08
Mission	0.93
Moonlight Bay	0.62
Mulhurst	12.41
Mupp	0.00
Norris beach	0.78
Pigeon Lk Reserve	0.08
Popular Bay	1.78
Provincial Park	51.44
Sandholm	0.62
Silver Beach	0.54
Sundance Beach	0.78
Sunset	0.31
Tide Creek	0.54
Vasa	1.10
Viola Beach	0.54
Zeiner	5.04
Total %	100.00

Appendix 6.3 Daily summary of angler survey data in Pigeon Lake, 2003.

Month	Date	# Anglers	# Hours	# WALL		# NRPK		# YLPR	
				Kept	Released	Kept	Released	Kept	Released
	Totals	1,816.00	6,570	0	19,529	49	765	1	31
5	17	30	61.5	0	106	0	7	0	0
5	18	34	58.25	0	108	0	2	0	0
5	19	46	216.5	0	187	4	23	0	0
5	23	35	131	0	323	0	61	0	1
5	24	91	409.5	0	439	0	55	0	0
5	25	55	183.25	0	365	3	42	0	15
5	30	5	27.75	0	97	6	7	0	0
6	1	68	233.5	0	455	6	65	0	0
6	2	10	50	0	137	1	16	0	0
6	3	1	0	0	0	0	0	0	0
6	4	12	46.5	0	262	0	13	0	0
6	5	4	11	0	26	0	0	0	0
6	6	29	92.75	0	285	2	30	0	0
6	7	32	90.25	0	226	0	7	0	0
6	14	167	588.5	0	1142	5	110	0	1
6	17	29	150.5	0	357	3	26	0	0
6	18	29	110	0	284	0	16	0	0
6	19	19	90.25	0	225	1	13	0	0
6	20	25	93.5	0	482	0	26	0	1
6	21	35	97	0	583	0	8	0	0
6	22	6	21	0	55	0	2	0	0
6	29	144	574.25	0	1455	2	27	0	2
7	3	57	208.5	0	788	2	11	0	0
7	4	65	210	0	895	0	7	0	1
7	11	22	97.25	0	410	1	4	1	0
7	15	57	201.75	0	777	0	6	0	1
7	16	28	76	0	199	0	3	0	2
7	17	6	7.5	0	0	0	0	0	0
7	19	204	750.5	0	2350	6	46	0	2
7	28	38	115.75	0	393	1	4	0	0
8	1	11	49	0	246	0	14	0	0
8	9	118	472.75	0	1496	0	42	0	1
8	12	14	42.5	0	62	0	0	0	0
8	13	51	150	0	835	0	14	0	0

Appendix 6.3 Daily summary of angler survey data, con't.

Month	Date	# Anglers	# Hours	# WALL Kept	# WALL Released	# NRPK Kept	# NRPK Released	# YLPR Kept	# YLPR Released
8	17	111	394.5	0	1672	6	31	0	1
8	27	12	43.5	0	147	0	2	0	1
8	30	116	413.75	0	1660	0	25	0	2

Appendix 6.4 Biological data of walleye captured by test fishing in Pigeon Lake, 2003.

Date	Location	Sample #	Fork Length (mm)	Age (years)
Jul-05	Prov. Park	1	426	
Jul-05	Prov. Park	2	408	
Jul-05	Prov. Park	3	363	
Jul-05	Prov. Park	4	445	
Jul-05	Prov. Park	5	460	
Jul-05	Prov. Park	6	495	
Jul-05	Prov. Park	7	440	
Jul-05	Prov. Park	8	455	
Jul-05	Prov. Park	9	417	
Jul-05	Prov. Park	10	538	
Jul-05	Prov. Park	11	473	
Jul-05	Prov. Park	12	457	
Jul-05	Prov. Park	13	407	
Jul-05	Prov. Park	14	476	
Jul-05	Prov. Park	15	515	
Jul-05	Prov. Park	16	423	
Jul-05	Prov. Park	17	543	
Jul-05	Prov. Park	18	413	
Jul-05	Prov. Park	19	407	
Jul-05	Prov. Park	20	443	
Jul-05	Prov. Park	21	420	
Jul-05	Prov. Park	22	371	
Jul-05	Prov. Park	23	464	
Jul-05	Prov. Park	24	482	
Jul-05	Prov. Park	25	407	

Appendix 6.4 Biological data from test fishery caught walleye, con't.

Date	Location	Sample #	Fork Length	Age
Jul-05	Prov. Park	26	411	
Jul-05	Prov. Park	27	461	
Jul-05	Prov. Park	28	550	
Jul-05	Prov. Park	29	429	
Jul-05	Prov. Park	30	443	
Jul-05	Prov. Park	31	404	
Jul-05	Prov. Park	32	396	
Jul-05	Prov. Park	33	447	
Jul-05	Prov. Park	34	417	
Jul-05	Prov. Park	35	425	
Jul-05	Prov. Park	36	486	
Jul-05	Prov. Park	37	437	
Jul-05	Prov. Park	38	445	
Jul-05	Prov. Park	39	585	
Jul-05	Prov. Park	40	410	
Jul-05	Prov. Park	41	441	
Jul-05	Prov. Park	42	418	
Jul-05	Prov. Park	43	431	
Jul-05	Prov. Park	44	463	
Jul-05	Prov. Park	45	440	
Jul-05	Prov. Park	46	467	
Jul-05	Prov. Park	47	400	
Jul-05	Prov. Park	48	467	
Jul-05	Prov. Park	49	403	
Jul-05	Prov. Park	50	465	
Jul-05	Prov. Park	51	430	
Jul-05	Prov. Park	52	457	
Jul-05	Prov. Park	53	445	
Jul-05	Prov. Park	54	626	
Jul-05	Prov. Park	55	422	
Jul-05	Sandholm	56	420	
Jul-05	Sandholm	57	407	
Jul-05	Sandholm	58	427	
Jul-05	Sandholm	59	403	
Jul-05	Sandholm	60	360	
Jul-05	Sandholm	61	445	

Appendix 6.4 Biological data from test fishery caught walleye, con't.

Date	Location	Sample #	Fork Length	Age
Jul-05	Sandholm	62	417	
Jul-05	Sandholm	63	515	
Jul-05	Sandholm	64	448	
Jul-05	Sandholm	65	437	
Jul-05	Sandholm	66	441	
Jul-05	Sandholm	67	420	
Jul-05	Sandholm	68	413	
Jul-05	Sandholm	69	404	
Jul-05	Sandholm	70	398	
Jul-05	Sandholm	71	450	
Jul-05	Sandholm	72	415	
Jul-05	Sandholm	73	427	
Jul-05	Sandholm	74	417	
Jul-05	Sandholm	75	556	
Jul-05	Sandholm	76	547	
Jul-05	Sandholm	77	405	
Jul-05	Sandholm	78	429	
Jul-05	Sandholm	79	445	
Jul-05	Sandholm	80	437	
Jul-05	Sandholm	81	440	
Jul-05	Sandholm	82	430	
Jul-05	Sandholm	83	480	
Jul-05	Sandholm	84	479	
Jul-05	Sandholm	85	429	
Jul-05	Sandholm	86	457	
Jul-05	Sandholm	87	418	
Jul-05	Sandholm	88	356	
Jul-05	Sandholm	89	436	
Jul-05	Sandholm	90	415	
Jul-05	Sandholm	91	411	
Jul-05	Sandholm	92	416	
Jul-05	Sandholm	93	452	
Jul-05	Sandholm	94	498	
Jul-05	Sandholm	95	482	
Jul-05	Sandholm	96	390	
Jul-05	Sandholm	97	556	

Appendix 6.4 Biological data from test fishery caught walleye, con't.

Date	Location	Sample #	Fork Length	Age
Jul-05	Sandholm	98	444	
Jul-05	Sandholm	99	358	
Jul-05	Sandholm	100	479	
Jul-05	Sandholm	101	538	
Jul-05	Sandholm	102	426	
Jul-05	Rocky Island	103	404	6
Jul-05	Rocky Island	104	561	9
Jul-05	Rocky Island	105	493	6
Jul-05	Rocky Island	106	417	6
Jul-05	Rocky Island	107	408	5
Jul-05	Rocky Island	108	423	6
Jul-05	Rocky Island	109	430	6
Jul-05	Rocky Island	110	425	6
Jul-05	Rocky Island	111	600	9
Jul-05	Rocky Island	112	503	
Jul-05	Rocky Island	113	545	8
Jul-05	Rocky Island	114	459	6
Jul-05	Rocky Island	115	425	6
Jul-05	Rocky Island	116	488	6
Jul-05	Rocky Island	117	384	5
Jul-05	Rocky Island	118	379	5
Jul-05	Rocky Island	119	464	7
Jul-05	Rocky Island	120	399	5
Jul-05	Rocky Island	121	447	6
Jul-05	Rocky Island	122	459	6
Jul-05	Rocky Island	123	418	6
Jul-05	Rocky Island	124	365	5
Jul-05	Rocky Island	125	427	6
Jul-05	Rocky Island	126	437	5
Jul-05	Rocky Island	127	480	6
Jul-05	Rocky Island	128	429	6
Jul-05	Rocky Island	129	549	
Jul-05	Rocky Island	130	445	6
Jul-05	Rocky Island	131	554	8
Jul-05	Rocky Island	132	419	5
Jul-05	Rocky Island	133	440	5

Appendix 6.4 Biological data from test fishery caught walleye, con't.

Date	Location	Sample #	Fork Length	Age
Jul-05	Rocky Island	134	471	6
Jul-05	Rocky Island	135	428	5
Jul-05	Rocky Island	136	457	6
Jul-05	Rocky Island	137	479	6
Jul-05	Rocky Island	138	480	6
Jul-05	Rocky Island	139	508	8
Jul-05	Rocky Island	140	501	5
Jul-05	Rocky Island	141	426	5
Jul-05	Rocky Island	142	481	5
Jul-05	Rocky Island	143	459	5
Jul-05	Rocky Island	144	462	5
Jul-05	Crystal Springs	145	420	5
Jul-05	Crystal Springs	146	396	5
Jul-05	Crystal Springs	147	595	9
Jul-05	Crystal Springs	148	632	9
Jul-05	Crystal Springs	149	414	5
Jul-05	Crystal Springs	150	485	6
Jul-05	Crystal Springs	151	485	5
Jul-05	Crystal Springs	152	475	5
Jul-05	Crystal Springs	153	570	
Jul-05	Crystal Springs	154	425	5
Jul-05	Crystal Springs	155	427	5
Jul-05	Crystal Springs	156		8
Jul-05	Crystal Springs	157	455	5
Jul-05	Crystal Springs	158	469	6
Jul-05	Crystal Springs	159	573	7
Jul-05	Crystal Springs	160	473	6
Jul-05	Crystal Springs	161	449	6
Jul-05	Crystal Springs	162	434	6
Jul-05	Crystal Springs	163	435	5
Jul-05	Crystal Springs	164	442	6
Jul-05	Crystal Springs	165	402	5
Jul-05	Crystal Springs	166	427	5
Jul-05	Crystal Springs	167	487	5
Jul-05	Crystal Springs	168	372	4
Jul-05	Crystal Springs	169	588	9

Appendix 6.4 Biological data from test fishery caught walleye, con't.

Date	Location	Sample #	Fork Length	Age
Jul-05	Crystal Springs	170	399	5
Jul-05	Crystal Springs	171		4
Jul-05	Crystal Springs	172	457	5
Jul-05	Crystal Springs	173	479	5
Jul-05	Crystal Springs	174	461	5
Jul-05	Crystal Springs	175	470	7
Jul-05	Crystal Springs	176	500	5
Jul-05	Crystal Springs	177	484	5
Jul-05	Crystal Springs	178	450	5
Jul-05	Crystal Springs	179	432	5
Jul-05	Crystal Springs	180	448	5
Jul-05	Crystal Springs	181	565	8
Jul-05	Crystal Springs	182	443	5
Jul-05	Crystal Springs	183	356	4
Jul-05	Crystal Springs	184	427	5
Jul-05	Crystal Springs	185	434	5
Jul-05	Crystal Springs	186	415	4
Jul-05	Crystal Springs	187	481	7
Jul-05	Crystal Springs	188	472	5
Jul-05	Crystal Springs	189	465	5
Jul-05	Crystal Springs	190	385	5
Jul-05	Crystal Springs	191	619	9
Jul-05	Crystal Springs	192	526	7
Jul-05	Crystal Springs	193	513	6
Jul-05	Crystal Springs	194	356	4
Jul-05	Crystal Springs	195	434	5
Jul-05	Crystal Springs	196	500	5
Jul-05	Crystal Springs	197	675	11
Jul-05	Crystal Springs	198	414	5
Jul-05	Crystal Springs	199	378	4
Jul-05	Crystal Springs	200	454	5
Jul-05	Crystal Springs	201	499	6
Jul-05	Crystal Springs	202	478	5

Appendix 6.5. Biological data from sport harvested pike from Pigeon Lake, 2003.

Sample #	Date	Weight (g)	Fork Length (mm)	Total Length (mm)	Sex	Age (years)
1	19-May	2950	740	785		7
2	19-May	6800	930	980		11
3	25-May	4550	875	910		11
4	25-May	1800	655	690		6
5	25-May	3300	775	820		8
6	30-May	2500	720	760		8
7	1-Jun	1850	655	685		6
8	1-Jun	1350	690	730		6
9	1-Jun	2850	754	797		7
10	1-Jun	3750	755	810		7
11	1-Jun	1700	637	675		6
12	2-Jun	2750	720	745		7
13	17-Jun	3050	712	752	f	6
14	17-Jun	1600	644	680	m	6
15	19-Jun	1350	619	660	f	7
16	28-Jun	1360	560	580		5
17	4-Jul	3750	606	645		6
18	4-Jul	1470	605	645		6
19	5-Jul	2750	695	735	f	6
20	11-Jul	1800	654	698	f	7
21	28-Jul	1700	645	680	f	7
22	29-Jun	4550	805	850	m	8
23	4-Aug	2850	730	773		8
24	4-Aug	1950	648	685	m	5
25	4-Aug	2750	710	754	f	6
26	4-Aug	1700	616	652	m	5

Appendix 6.6. Biological data from pike captured as part of the test fishery in Pigeon Lake, 2003.

Sample #	Date	Fork Length (mm)	Total Length (mm)
1	2-Jul	673	698
2	2-Jul	605	646
3	5-Jul	586	615
4	5-Jul	565	587
5	5-Jul	606	642
6	13-Jul	576	614
7	13-Jul	575	611
8	11-Jul	570	611
9	14-Jul	561	606
10	14-Jul	615	637
11	14-Jul	570	604
12	14-Jul	574	605
13	17-Jul	597	634
14	18-Jul	645	686
15	18-Jul	586	624
16	18-Jul	649	697
17	26-Jul	608	634
18	26-Jul	567	593
19	26-Jul	556	591
20	26-Jul	603	631
21	26-Jul	653	691
22	27-Jul	550	592
23	29-Jul	468	500
24	30-Jul	541	576
25	31-Jul	640	680
26	31-Jul	688	700
27	31-Jul	604	642
28	3-Aug	612	651
29	4-Aug	574	605
30	4-Aug	569	610
31	4-Aug	607	649
32	10-Aug	669	673
33	10-Aug	664	695
34	10-Aug	612	651
35	15-Aug	543	579

Appendix 6.6 Biological data from test fishery caught pike, con't.

Sample #	Date	Fork Length	Total Length
36	16-Aug	605	632
37	16-Aug	610	645