Summer Sport Fishery and Special Harvest License at Pigeon Lake, Alberta, 2007

Alberta Conservation Association

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Conservation Report Series Type
Data

ISBN printed: 978-0-7785-8180-2
ISBN online: 978-0-7785-8181-9
Publication No.: T/206

Suggested citation:
Patterson, B. 2008. Summer sport fishery and special harvest licence at Pigeon Lake, Alberta, 2007. Data Report, D-2008-012, produced by the Alberta Conservation Association, Sherwood Park, Alberta, Canada. 21 pp. + App.

Cover photo credit: David Fairless

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EXECUTIVE SUMMARY

In 2006, Alberta Sustainable Resource Development (ASRD) initiated a pilot project on Pigeon, Newell and Wolf lakes that allowed anglers to harvest walleye from these previously closed fisheries through a Special Harvest License (SHL). Successful applicants purchased a unique license and tag (i.e., similar to big game hunting application and draw methods) that permitted them to harvest walleye within a specified length category (i.e., > 50 cm, 50 - 43 cm, < 43 cm total length, TL). Anglers not in possession of a SHL followed the provincial regulation for each lake (i.e., zero bag limit / catch-and-release).

To monitor the effects of SHL regulations on the sport fishery at Pigeon Lake, the Alberta Conservation Association (ACA) conducted a summer angler survey from 19 May to 27 August 2007. The survey focused primarily on the walleye sport fishery, although we also collected data on the northern pike sport fishery. We collected information on angling effort, catch, and population structure, and calculated uncertainty in angler survey parameters using a bootstrapping method. To collect yield and biological data, we conducted angler surveys in combination with test angling. Finally, we compared results of this study with those from previous surveys at Pigeon Lake during the summers of 1999, 2003 and 2006.

During the 2007 survey period, we estimated 14,760 angling-trips (95% CI = 13,045 – 16,594, n = 3,706 anglers) and 42,870 angling-h (95% CI = 37,917 – 48,507, n = 10,959 h). Angling-pressure was 4.4 h/ha (95% CI = 3.8 – 5.0). However, angling pressure associated with SHL anglers was a small portion of the sport fishery; only 22% or 3,247 anglers interviewed held a SHL. Angling pressure during the 2006 SHL season was slightly higher (by 5%) than pressure during the 2007 SHL season. In addition, angling pressure has increased nearly four-fold since 1999. Of SHL anglers interviewed in 2007, 37% had not fished Pigeon Lake the previous year; this increase in SHL participation may indicate a growing interest in the program.

SHL holders were permitted to harvest walleye from 18 May to 3 September 2007. During the survey period (19 May to 27 August 2007), we estimated that anglers with SHL tags harvested 2,729 walleye (95% CI = 2,277 – 3,245, n = 644). We estimated that

157,629 walleye (95% CI = 136,812 – 179,439, n = 37,741) were released by all anglers (regular and SHL anglers combined), of which, SHL anglers released 15,199 walleye (95% CI = 9,846 – 21,849, n = 10,909). The sport fishery harvested 0.27 kg/ha of walleye and 0.42 kg/ha of pike. The yield associated with the release mortality of walleye (estimated to be 5.3%) was 0.83 kg/ha (95% CI = 0.55 – 1.20) or approximately three times that of the SHL harvest. We estimated that anglers harvested 509 pike (95% CI = 177 – 1,130, n = 73) during the survey period. SHL anglers accounted for 8% of the pike harvest. Anglers released 2,417 pike (95% CI = 1,999 – 2,946, n = 567). Based on proportion of the catch, SHL anglers released 22% of captured pike. The yield associated with pike harvest and release mortality was 0.44 kg/ha.

According to Alberta's Walleye Management and Recovery Plan, catch rates of walleye were high. The length and age distributions of harvested walleye ranged from 427 to 718 mm TL and age-7 to 10 and 13. Growth of walleye was moderately slow and almost all harvested walleye were reproductively mature fish. The length distributions of harvested walleye and test-angled walleye were very similar (with the exceptions of individual fish < 430 mm and > 550 mm TL). This similarity suggests that anglers were not selecting the largest fish in their SHL length-category, and instead were harvesting the sizes of fish vulnerable to angling.

Relatively few pike were observed in angler harvests; thus, we also conducted test fishing to help categorize the pike fishery. The estimated catch rate for pike was extremely low; the total rate was 0.028 pike/h (legal-size harvest rate = 0.005 pike/h, protected-size release rate = 0.023 pike/h). Based on test fishery data, we found the size distribution of pike in Pigeon Lake to be severely truncated, possibly due to size-selective mortality and high angling pressure. The size distribution of pike was also unstable, primarily supported by protected-size fish (i.e., < 630 mm TL) with legal length pike (> 630 mm TL) at very low numbers. However, the relative density of small pike was substantial and may indicate considerable recruitment to the sport fishery in the near future. The relative stock density (RSD) and the proportional stock density (PSD) also indicated a truncated size distribution. The percent success and Gini coefficient both indicated the chance of catching a pike was very low. These parameters, including the extremely low catch rate, indicate a highly exploited pike fishery in Pigeon Lake.

ACKNOWLEDGEMENTS

The Alberta Conservation Association funded this work. I thank Troy Furukawa, Brendan Ganton, Shane Wood and Lindsay West for conducting the field component of this work; spending long days test angling and interviewing anglers on land and lake. I also thank Alberta Sustainable Resource Development, in particular Vance Buchwald, Mitch Visser, Miles Grove and Jason Cooper for providing accommodation at the Fish and Wildlife cabin at Grandview Point and collaborating on the survey's methods. I am grateful to the anglers who contributed their time and fish to this study and the Alberta Summer Temporary Employment Program (STEP) for financially supporting Lindsay West.

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1.0 INTRODUCTION

Prior to the mid 1990s, high angling pressure and high fish harvest rates resulted in the over-harvest of walleye (*Sander vitreus*) and northern pike (*Esox lucius*) populations in several Alberta lakes (Sullivan 2003). To recover or maintain Alberta's walleye and pike fisheries, the Alberta Government implemented new management strategies for walleye in 1996 and for pike in 1999 (Berry 1995, 1999). Walleye in Pigeon Lake were likely extirpated by the 1960's. To restore this fishery, 18.4 million walleye fry and fingerlings were stocked into Pigeon Lake between 1994 and 1999. In 1996, the walleye fishery at Pigeon Lake was classified as a stocked lake and a zero possession limit (catch-and-release regulation) was implemented. In 1999, the pike fishery at Pigeon Lake was classified as stable-recreational (vulnerable) and a 63 cm (maximum total length, TL) size limit and three fish possession limit were implemented. In 1999 and 2003, creel surveys were conducted on the lake to evaluate the status of these sport fisheries. Results from these surveys indicated that angling pressure had increased significantly since 1999 and that estimated incidental yield of walleye from release mortality was considerable. In addition, these surveys indicated low densities and yield of pike. Based on these surveys, the pike regulation was modified in 2005 to a one fish possession limit (≥ 63 cm TL).

Recognizing the potential effect of high angling-pressure to contribute to mortality (yield) of walleye through release (incidental) mortality, Alberta Sustainable Resource Development (ASRD) implemented a Special Harvest License (SHL) regulation on Pigeon Lake in 2006 as part of a larger pilot project to evaluate this licensing system as a potential tool for fisheries management. The SHL regulation was also implemented on Newell and Wolf lakes. The SHL allowed anglers to harvest walleye from these previously closed fisheries. Similar to Alberta's big game hunting licence system, anglers applied for a limited number of licenses within 'small', 'medium' and 'large' size-categories (i.e., ≤ 43 cm, 43 - 50 cm, ≥ 50 cm TL). Anglers whose applications were successfully drawn were allowed to purchase the license and related tag for fish in a specified size range. Anglers not in possession of a SHL followed the provincial regulation for the lake (i.e., zero bag limit / catch-and-release). Theoretically, the SHL regulation should allow fisheries managers more control over walleye harvest aiding in the management of recovering populations.

As part of the evaluation of the SHL program, the Alberta Conservation Association (ACA) conducted a creel survey on Pigeon Lake in 2006 to gather information on angler effort and catch, and an informal social survey to collect information on angler characteristics and their opinions on the SHL regulation and walleye management in general. A creel survey is a non-invasive technique that can effectively estimate parameters (e.g., angler use, sport fish yield) used in fisheries management. The goal of this study (2007) was to continue creel surveys at the lake to allow for continued evaluation of the status of the sport fishery and the SHL program. The specific objectives of our study were to:

i. Provide ASRD with current data describing the sport fishery;

ii. Quantify angler effort and catch, and compare results with previous surveys;

iii. Determine success rates for anglers possessing a SHL; and

iv. Collect biological information from harvested sport fish.

2.0 STUDY AREA

Pigeon Lake is a large, eutrophic lake with a surface area of 9,748 ha and a maximum depth of 9.1 m (Mitchell and Prepas 1990) located approximately 60 km southwest of Edmonton, Alberta (Figure 1). The lake is part of the Battle River drainage basin. The major inlet into Pigeon Lake is Tide Creek, which flows into the northwest bay, and the outlet is Pigeon Lake Creek, which flows out of the southern end of the lake. There are also a number of small unnamed creeks that flow in/out of the lake. The watershed of Pigeon Lake is highly developed for a variety of human land uses, and because of the lake's proximity to the cities of Edmonton and Red Deer, the lake is subject to intense recreational use. There are several summer villages, unincorporated subdivisions, day-use areas, campgrounds and golf courses located along or near the lake.

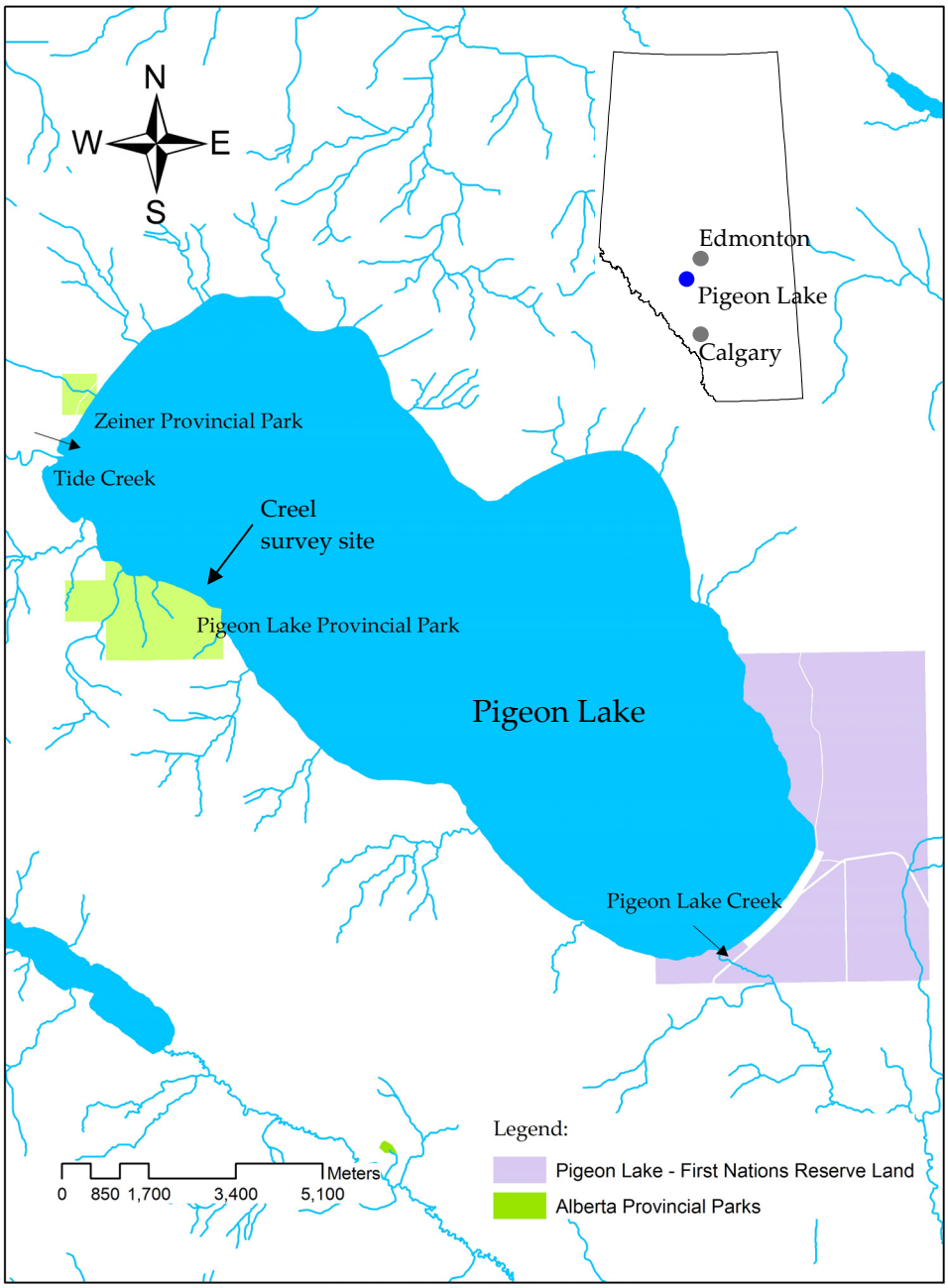

Figure 1. A map of Pigeon Lake, Alberta. The arrows indicate the direction of flow of creeks in and out of Pigeon Lake. Inset is a map of Alberta showing the location of the lake within the province.

3.0 MATERIALS AND METHODS

We conducted a creel survey at Pigeon Lake from 19 May to 27 August 2007 from the Pigeon Lake Provincial Park located along the west shore of the lake (Figure 1). In 2007, SHL holders were permitted to harvest walleye between 18 May to 3 September.

3.1 Angler survey design

This study consisted of an access point survey (Pollock et al. 1994), a series of ratio-of-use (ROU) surveys, and test angling. Access points not surveyed included numerous residential/cottage developments, other campgrounds and a number of boat launches (private and public).

Upon returning to the survey access point, all anglers were asked a series of questions regarding the number of hours fished, number of each species kept and released, residency, and questions associated with the SHL (e.g., tag license holder, size of walleye tags). Data were recorded on a standardized angler survey form (Appendix 1). Two clerks, working in rotating shifts, conducted the angler survey. Shifts were five days (Thursday to Monday) followed by two days off. Sixteen shifts were completed. There were 108 days (46 weekend days, 62 weekdays) in the survey period (19 May to 3 September 2007) with each survey day stratified into AM (0830 to 1530) and PM (1530 to 2300) shifts or strata; therefore, 216 sampling units (92 weekend strata, 124 weekday strata) were available. Weekend day strata included Fridays, Saturdays, Sundays and one statutory holiday.

3.2 Ratio-of-use survey

Ratio-of-use (ROU) surveys were conducted to establish a ratio that was used to extrapolate angler survey data (e.g., hours, fish caught, number of anglers) to spatial strata that were not surveyed. The ROU surveys used the same interview questionnaire as the access point angler survey and included a question regarding the location of where each angling party's boat will touch shore after the completed fishing trip. The same temporal stratification as the angler survey was applied to the ROU. These surveys were conducted by both creel clerks for safety reasons. Since the catch

data collected from the ROU surveys were from incomplete trips, none of this information was used in the catch-per-unit-effort (CPUE) calculations.

3.3 Test angling

Since sport anglers (except those with SHL tags) were required to release all walleye, and any pike that were shorter than the minimum size limit (63 cm TL), creel clerks could only obtain data from harvested walleye and legal-size pike. Test angling was conducted throughout the survey period to collect additional information on sizes of walleye and pike in Pigeon Lake. In addition, the ratio of legal-length fish to protected-length fish sampled during test angling was used as a reference to correct release rates (i.e., fish released/h) for pike reported by anglers (Sullivan 2003). The catch rate calculated from test angling was not included in any calculations regarding sport angler catch rate, effort (h) or fishing pressure (h/ha).

Test angling consisted of creel survey clerks, as well as ACA and ASRD fisheries staff and volunteers of varying skill levels, fishing for walleye and pike using lures, baits, and techniques that would normally be used by the average angler. Test anglers recorded the number of hours fished, and the fork and total lengths of all fish caught (FL and TL, respectively, ± 1 mm). Ageing structures collected included the first three rays of the left pelvic fin for pike and walleye. All fish caught during test angling were released. To reduce handling time of captured fish, weights were not collected during test angling. Rather, weights were estimated using the following length-weight regressions for pike and walleye (unpublished data from creel surveys conducted during the 1980s and 1990s).

$$\text{Pike WT} = (7E\text{-}06)\,(\text{TL})^{(2.9762)},\ r^2 = 0.93,\ df = 234,\ P < 0.0001$$

$$\text{Walleye WT} = (8E\text{-}06)\,(\text{TL})^{(3.0145)},\ r^2 = 0.91,\ df = 898,\ P < 0.0001$$

3.4 Additional biological fish data

Creel clerks, when permitted, collected additional biological data from fish harvested by anglers. Data collected included FL and TL (± 1 mm), total weight to the nearest (± 10 g), ageing structures, sex, and state of maturity. Sex and state of maturity of walleye and pike were determined following Duffy et al. (2000). Ageing structures collected

included otoliths and the first three rays of the left pelvic fin for walleye and the left cleithrum and the first three rays of the left pelvic fin for pike. MacKay et al. (1990) suggest that the 1st annulus tightly surrounding the focus indicates year one. Ages were determined by a modified method that promotes consistent age determination. The following equation was used to help identify the 1st annulus (Watkins and Spencer, in prep.):

$$S_c = FR\ (L_0) / L_c$$

where,

S_c = radius distance from the focus to 1st annulus of fin ray cross-section at capture,

FR = fin ray radius,

L_0 = length at age-0, and

L_c = length of the fish at capture.

To quantify and categorize size-classes of pike, proportional stock density (PSD) and relative stock density (RSD) classifications were calculated following procedures in Gablehouse (1984). The PSD is the number of pike caught that are ≥ 530 mm TL, expressed as a proportion of the number of fish ≥ 350 mm TL. A high PSD value indicates a larger portion of mature fish, and therefore can be interpreted as reflecting a more stable population. The RSD (stock-quality) is the proportion of pike caught between 350 and 529 mm TL relative to the total number of pike ≥ 350 mm TL. Sport anglers were required to release pike less than 63 cm TL (protected-length fish); therefore, pike caught and sampled during test angling were used for RSD calculations.

3.5 Data management and analysis

Field data were recorded on standardized data forms by creel clerks and then transcribed into Microsoft Excel files by a professional data entry service using double entry verification (Appendix 1). Prior to analysis, frequency distributions were calculated per angler survey parameter to identify outliers. Scatter plots of weight-length and length-age were also generated to identify outliers in the biological data. The original data sheets and angler survey daily journals were used to investigate and

verify outliers. Outliers were omitted if measurement or recording error was suspected.

We used a bootstrap technique to calculate parameter estimates and confidence intervals for number of anglers, number of hours (h), angling pressure (h/ha), harvest and yield (i.e., kg/ha) of walleye and pike. Each bootstrapped parameter estimate was calculated using data from the creel survey and included temporal and spatial strata that were not surveyed. Bootstrapping is a statistical procedure whereby an original sample of the population is subsequently re-sampled and a new mean calculated (Haddon 2001). Bootstrap samples are assumed to approximate the distribution of values that would have arisen from repeated sampling of the original population. By repeating this procedure thousands of times, the likelihood of the true (population) mean being within a distribution of possible means can be determined.

The steps we used to estimate parameters have been summarized in Figure 2 and followed Sullivan (2004). Our first step resampled the original data set 5,000 times per temporal strata and calculated a mean that represented the distribution of possible means having the same scale of variation as observed in the original data set. Next, we multiplied the estimated means by the number of weekdays not surveyed, and then added the total observed value (e.g., angling-h, number of anglers). The projected estimates from each temporal stratum were combined representing values for the entire sampling period. To account for spatial strata not surveyed, values were multiplied by ROU estimates (5,000). ROU estimates were randomly generated from values within the binomial confidence interval of the ratio of total number of boats surveyed as fishing to total number of boats surveyed as fishing and returning to the access site (Pigeon Lake Provincial Park). Empirical confidence intervals (95% CI) for the mean of the final whole lake estimates were calculated following Haddon (2001).

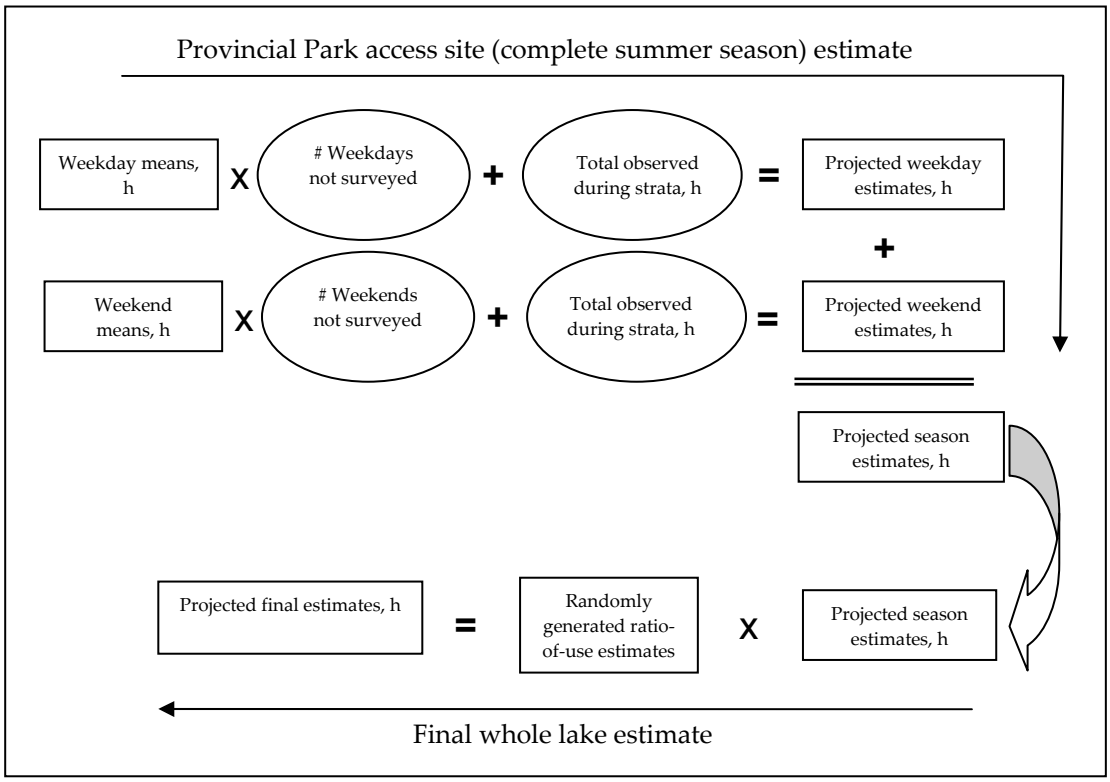

Figure 2. A flow chart outlining the steps for estimating parameters for the Pigeon Lake angler survey in 2007 (also see Sullivan 2004). Circles represent values with no variance and rectangles represent 5,000 estimates. The parameter angling-hours (h) was used as an example.

Incidental mortality likely contributes to the overall yield of sport fish through injury or stress of captured and released fish (Reeves 2004). We assumed that pike and walleye had similar incidental mortalities (Muoneke and Childress 1994). A mean incidental mortality was calculated from data collected on walleye from nine previous angler surveys by Reeves (2004). Reeves (2004) used a multiple regression approach to calculate incidental mortality using month of capture, incidental location (e.g., stomach, gill, inner mouth), capture depth, water temperature, length category of walleye caught, angling gear (e.g., bobber, crank bait), and hook type (e.g., jig, treble). The total yield estimate was determined by adding the predicted incidental mortality estimate (i.e., fish released x incidental mortality) with the angler harvest estimate. Calculated weights of fish caught during test angling (see Section 3.3) were used to determine the yield (expressed as kg and kg/ha) associated with incidental mortality.

Anglers' success rates can influence their perception and use of the fishery. Gini coefficients and angler success rates were calculated following Baccante (1995) to quantify catch inequality among anglers for pike. A Gini coefficient of zero indicates all anglers caught equal numbers of fish and a coefficient of one indicates that a single angler caught the entire catch.

All data were stored in the Fisheries Management Information System (FMIS) of ASRD, project identification number 7705.

4.0 RESULTS

4.1 Survey effort

Out of the 216 possible temporal sampling units, 66 (31%) were surveyed (Table 1). Survey dates and daily summaries of data collected during these shifts are provided in Appendix 2.

Table 1. Available and surveyed sampling units for the Pigeon Lake angler survey in 2007.

Sample unit	# available	# surveyed	% surveyed
Weekend AM	46	16	35%
Weekend PM	46	16	35%
Weekday AM	62	14	22%
Weekday PM	62	20	32%

Twenty-six ROU surveys were conducted (Table 2). The angler survey site received 49% (95% CI = 46 – 52, n = 1,216 anglers) of the angling effort on Pigeon Lake during the angler survey period.

Table 2. Available and surveyed sampling units for which ratio-of-use surveys were conducted during the Pigeon Lake angler survey in 2007.

Sample unit	# available	# surveyed	% surveyed
Weekend AM	46	8	17%
Weekend PM	46	7	15%
Weekday AM	62	6	10%
Weekday PM	62	5	8%

4.2 Angler surveys and effort

During the survey period (19 May to 27 August), 3,706 anglers were interviewed by creel clerks. Based on daily summaries and journals maintained by creel clerks, it was determined that 12 anglers were not interviewed due to the very busy access point. These anglers accounted for only 0.3% of the number of interviews conducted. The number of interviews per survey day ranged from 2 to 258 (mean ± SE = 92 ± 10.8).

During the survey period, 3,706 angling-trips and 10,959 angling-h were recorded. In total, we estimated 14,760 angling-trips (95% CI = 13,045 - 16,594) and 42,870 h (95% CI = 37,917 – 48,507). This angling effort resulted in an angling pressure of 4.4 h/ha (95% CI = 3.8 – 5.0). Average angling-trips were 2.8 h in length (range = 0.6 - 3.7, SE = 0.10). Average party size was 2.6 anglers (95% CI = 2.5 - 2.7, n = 3,706). For comparison, results of angler surveys conducted in 1999, 2003, 2006 and 2007 are listed in Table 3.

Of the 3,706 anglers interviewed in 2007, 749 or 20% held a SHL. SHL holders averaged 1.28 trips (range = 1 – 5, SE = 0.03, n = 548). In total, SHL anglers made 3,237 angling-trips (95% CI = 2,829 – 3,694, n = 749) and fished 10,954 angling-h (95% CI = 9,544 – 12,560, n = 2,642.75). Of the anglers who held a SHL, 37% had not fished the lake the previous year. Of the 749 anglers who had a SHL, 47% held a 43 – 50 cm TL tag and 52% held a > 50 cm TL tag. Seven anglers (1%) were recorded by creel clerks as having a small tag (i.e., < 43 cm TL); however, no licenses of this type were available in 2007. Therefore, reporting error was responsible.

Table 3. Observed and estimated survey parameters from summer creel surveys conducted at Pigeon Lake during 1999, 2003, 2006 and 2007. Catch rates were calculated as total ratio estimators (Malvestuto 1983).

Observed / Estimated	1999	2003	2006	2007
Angling trips	630 / 7,646	1,816 / 3,776	3,608 / 12,941	3,706 / 14,760
Angling-hours, h	1,975 / 11,769	6,570 / 31,517	11,512 / 44,198	10,959 / 42,870
Est. angling pressure, h/ha	1.2	3.3	4.6	4.4
Walleye				
SHL harvested/h	NA	NA	0.07	0.24
< 43 cm TL	NA	NA	0.00	0.17[a]
43 – 50 cm TL	NA	NA	0.28	0.39
> 50 cm TL	NA	NA	0.07	0.13
SHL released/h	NA	NA	4.99	4.13
Released/h	*0.30	*2.97	4.14	3.44
Northern pike				
Harvested/h	0.01	<0.01	<0.01	<0.01
Released/h	0.15	0.12	0.04	0.05

*catch-and-release regulation.

[a]There were no SHL licenses available in 2007 for walleye < 43 cm. Thus, this harvest rate denotes licenses that were erroneously reported by anglers as being from this size category.

4.3 Walleye harvest and yield

Overall, harvest rates of walleye increased by 3.4 times from 2006 to 2007, whereas release rates in the walleye sport fishery and the SHL fishery showed marginal declines (both by 17%) from 2006 to 2007 (Table 3). The decline in release rates is interesting given that the 2006 sampling season occurred during late summer (August to September), when catch rates are typically lower than early to middle season (June to July). Thus, the change in release rates was likely due to time of survey and SHL season; catch rates decline through the summer season. Alternatively, the change in rates may indicate a decline in walleye abundance from 2006 to 2007.

In 2007, SHL anglers harvested an estimated 2,729 walleye (95% CI = 2,277 - 3,245, n = 644). Harvested walleye had a mean weight of 0.955 kg (95% CI = 0.927 - 0.988, n = 250) resulting in a yield of 0.27 kg/ha (95% CI = 0.22 - 0.32, n = 250). Five walleye were harvested by non-SHL anglers. Biological data collected from harvested walleye are listed in Appendix 3.

Sport and SHL anglers released an estimated 157,629 walleye (95% CI = 136,812 – 179,439, n = 37,741). The expected incidental mortality of walleye (i.e., percentage of released fish expected to die as a result of being caught, e.g., hooking mortality) was estimated to be 5.3% (95% CI = 4.2 - 6.6, n = 9 studies). Applying this level of incidental mortality to the estimate of released walleye, the additional number of fish mortalities was 8,404 (95% CI = 5,761 - 11,843, n = 8,354). It was assumed that released walleye had the same mean weight as those harvested because the catch was distributed across the entire size range of the walleye population. The resulting yield of walleye resulting from incidental mortality was an additional 0.83 kg/ha (95% CI = 0.55 – 1.20, n = 250), or approximately three times the yield from the harvest. The total yield (sport fishery and incidental mortality) was 1.09 kg/ha (95% CI = 0.77 – 1.52).

SHL anglers reported releasing a substantial number of walleye; an estimated 15,199 walleye were released by these anglers (95% CI = 9,846 – 21,849, n = 10,909). Using the same incidental mortality rate (5.3%) applied above, the additional number of walleye mortalities from being caught and released by SHL anglers was 823 (95% CI = 414 – 14,442), resulting in a yield of 0.08 kg/ha (95% CI = 0.04 – 0.14).

The following paragraphs and subsections are presented in accordance with ASRD methods for categorizing walleye and northern pike fishery lakes under the Walleye Management and Recovery Plan (WMRP) and the Northern Pike Management and Recovery Plan (NPMRP) (Berry 1995 and 1999, respectively).

4.4 Angler catch rates and exaggeration

Total catch rate of SHL anglers was 4.37 walleye/h (harvest rate 0.24 walleye/h + reported release rate 4.13 walleye/h). Anglers who did not possess a SHL released 3.23 walleye/h. The release rate of all (SHL and non-SHL) was 3.44 walleye/h. Given that catches reported during this survey were greater than 1.0 walleye/h they were likely not exaggerated and indicated the actual catch of walleye (Sullivan 2003).

4.5 Walleye population structure

No comparison of the length-class or age-class distributions collected from the 2006 and the 2007 SHL harvests was completed because the 2006 season was shorter and later in the year (i.e., months of July, August and September) and because the sample size from that harvest was small (n = 41). However, a comparison of the 2006 and 2007 test angling samples suggested that population structure was similar between years (Figure 3). Fish ranged in size from 374 – 669 mm TL (mean ± SE = 473 ± 3.0 mm) in 2006, and from 335 – 609 mm TL (mean ± SE = 477 ± 2.4 mm; Appendix 4) in 2007.

The distribution of length of walleye from the 2007 SHL harvest was normal, with fish ranging in size from 427 – 718 mm TL (mean ± SE = 496 ± 1.8 mm, Figure 4). The length distributions of harvested walleye (by SHL sport anglers) and of test-angled walleye were similar (if not considering non-harvestable fish < 430 cm TL and individual large walleye in the test sample; Figures 3 and 4). This similarity suggests that sport anglers were not harvesting the largest fish in each SHL length category (i.e., 43 - 50 cm, > 50 cm TL), and were simply harvesting the sizes of fish vulnerable to angling.

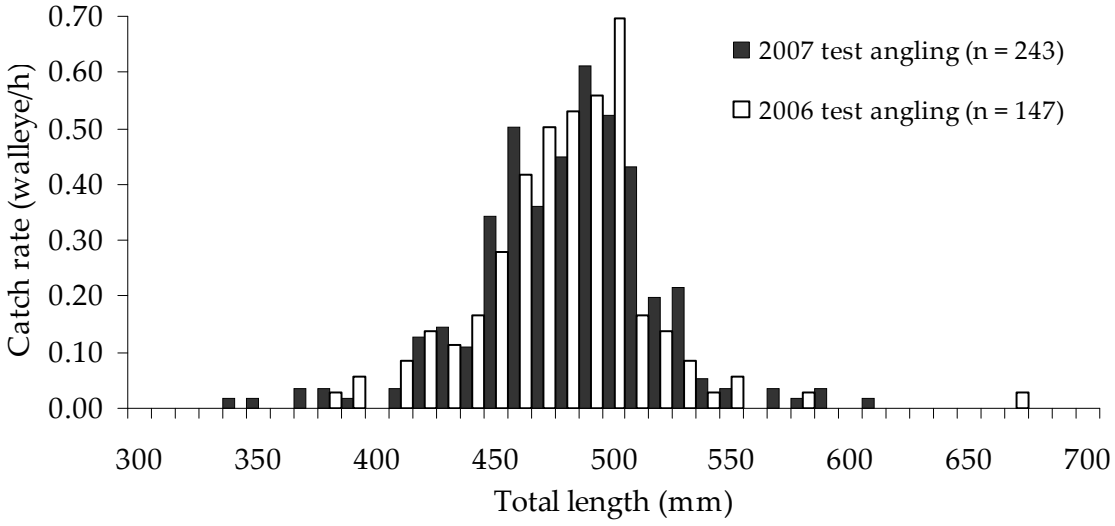

Figure 3. Length-class distribution of walleye captured by test anglers during the Pigeon Lake angler surveys in 2006 and 2007. Catch rates shown are from the SHL sport fishery and are used here to represent density. Use of this catch rate was deemed appropriate because there was no evidence that sport anglers exaggerated their catch.

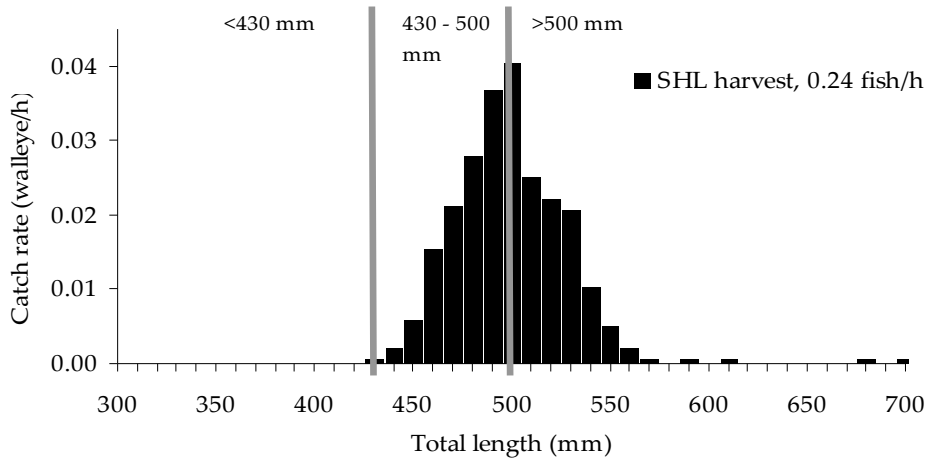

Figure 4. Length-class distribution of walleye harvested by SHL anglers during the Pigeon Lake angler survey in 2007 (n = 327).

In 2007, five age-classes of walleye were harvested by the sport fishery and included age-7 to 10 and 13 (Figure 5). Mean (± SE) age of walleye was 9 ± 0.04 y (n = 298). This age distribution was narrow and potentially unstable with few old fish present in the sample. We estimated that walleye grew to 500 mm FL (the WMRP management criterion, Berry 1995) by age-9 (Figure 6). According to the WMRP, this growth rate indicates moderate growth. However, if anglers' harvests were biased by size limits, then it is possible that walleye were growing to 500 mm FL by age-7 or 8. If so, growth would be considered moderately fast by the WMRP criterion.

Sex and maturity were assessed for 283 walleye sampled from the sport harvest. Of female walleye harvested, 99% (194 of 196) were mature and ≥ 50% of them were mature at age-9 (Figure 7). Of male walleye harvested, 98% (85 of 87) were mature and ≥ 50% of them were also mature at age-9 (Figure 8).

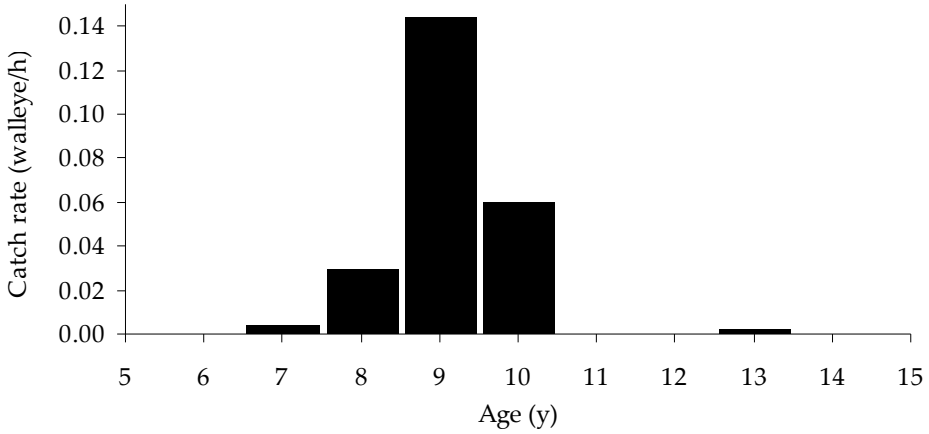

Figure 5. Age-class distribution of walleye harvested by the sport fishery during the Pigeon Lake angler survey in 2007.

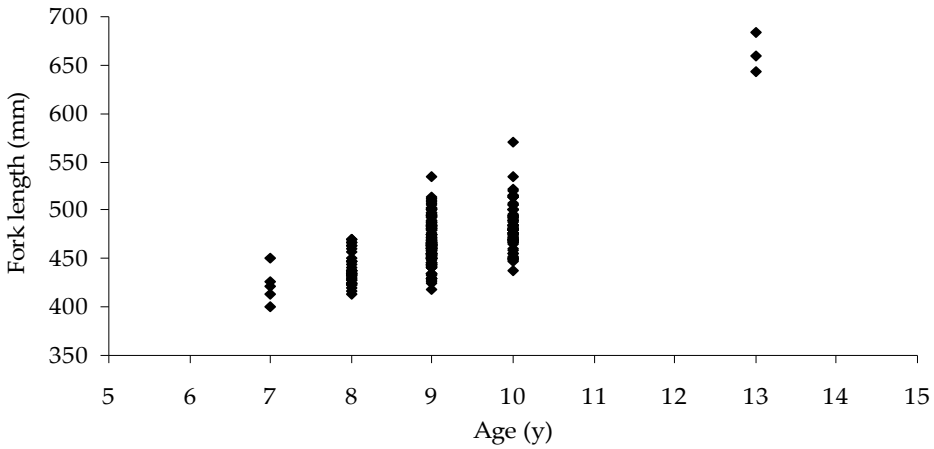

Figure 6. Length-at-age of walleye harvested by anglers during the Pigeon Lake angler survey in 2007 (n = 298).

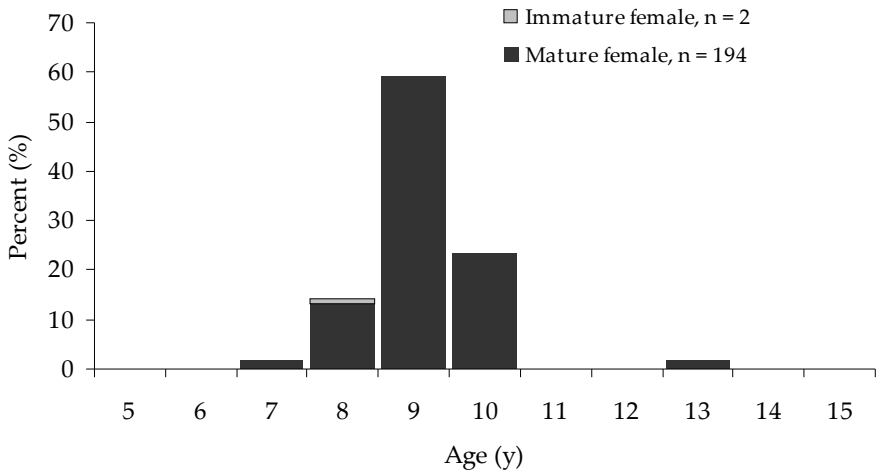

Figure 7. Age-at-maturity of female walleye harvested by anglers during the Pigeon Lake angler survey in 2007.

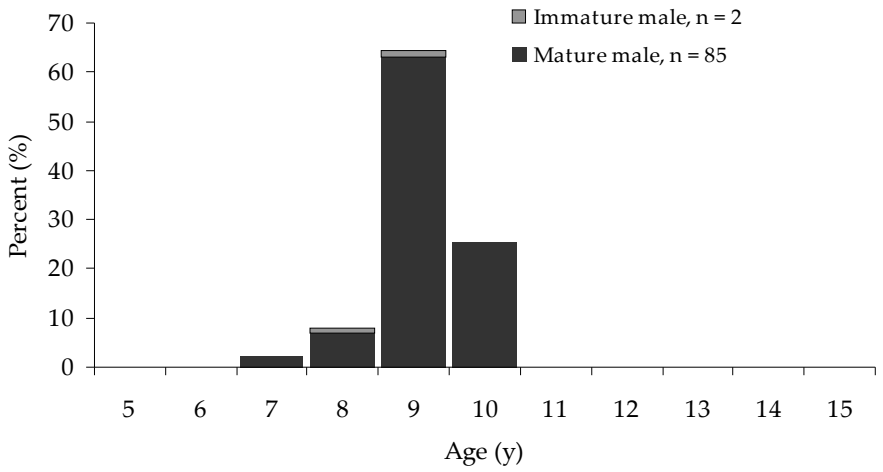

Figure 8. Age-at-maturity of male walleye harvested by anglers during the Pigeon Lake angler survey in 2007.

4.6 Northern pike harvest and yield

During the SHL season, anglers harvested an estimated 509 pike (95% CI = 177 – 1,130, n = 73). Harvested pike had a mean weight of 2.39 kg (95% CI = 1.58 – 3.58, n = 12) resulting in a yield of 0.42 kg/ha (95% CI = 0.23 - 0.69). Biological data collected from harvested pike are listed in Appendix 3.

Anglers released an estimated 2,417 pike (95% CI = 1,999 – 2,946, n = 567). By applying an incidental mortality of 5.3% (95% CI = 4.2 - 6.6, n = 9 studies) to the estimate of released pike, the additional number of fish mortalities was 129 (95% CI = 84 – 194). Protected-length pike (< 630 mm TL) had a mean weight of 1.34 kg (95% CI = 1.13 – 1.65, n = 74). The resulting yield of these pike was an additional 0.02 kg/ha (95% CI = 0.01 – 0.03). Hence, the total yield of pike was 0.44 kg/ha (95% CI = 0.24 – 0.72). The yield resulting from release mortality was a small proportion of the total yield.

4.7 Northern pike catch rates

The total reported catch rate of pike was 0.058 fish/h (harvested 0.007 fish/h + reported released 0.052 fish/h). Of the observed harvested pike, 77% (10 of 13) were legal-size; therefore, the catch rate of legal-length pike was 0.005 fish/h. Following Sullivan (2003) and using the protected-length to legal-length ratio from test angling, I estimated the corrected release rate for pike to be 0.023 fish/h. This indicates anglers exaggerated the catch of pike by two times. Thus, the estimated total catch rate for pike was 0.028 fish/h (legal-sized harvested 0.005 fish/h + estimated released 0.023 fish/h). Generally, the harvest and the reported release rates were very similar during the 2006 and 2007 angler surveys.

4.8 Northern pike population structure

Biological data collected from the pike sport fishery were insufficient to examine population structure (Berry 1999). The 13 fish collected from the sport fishery ranged in size from 580 – 1,250 mm (mean ± SE = 773 ± 55.0 mm). Test anglers captured and measured 74 pike. The distribution of fish lengths from test angling showed a moderately narrow and unstable distribution primarily supported by protected-length pike with legal-size fish (> 630 mm TL) practically absent from the sample (Figure 9).

This truncated distribution likely resulted from size-selective mortality and high angling pressure. The relatively high density of protected-length pike observed in the test fishery may indicate considerable recruitment to the sport fishery in the future.

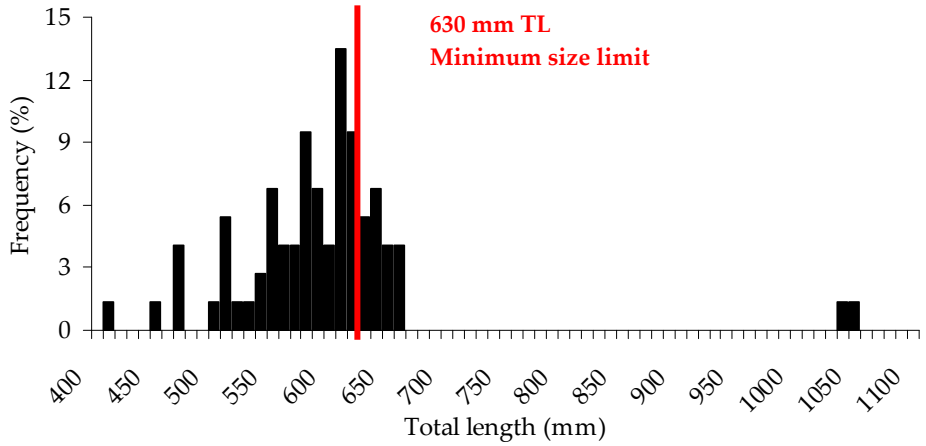

Figure 9. Length-class distribution of pike caught by test anglers during the Pigeon Lake angler survey in 2007 (n = 74).

Relative stock density (RSD) of sampled pike across the various size categories included 30% 'stock-quality' (35 - 52 cm), 68% 'quality' (53 - 70 cm) and 3% 'memorable' (> 86 cm). No 'preferred' (71 – 85 cm) or 'trophy' pike (> 120 cm) were sampled. The PSD (proportion of pike sampled > 53 cm) was 70%. Combined with the low catch rate, both the proportional and relative stock densities suggest a collapsed pike fishery. Angler success in catching legal-length pike was low; only 0.3% of the anglers interviewed during the angler survey were successful. A Gini coefficient of 0.90 indicates a high level of inequality in the catch of pike (Baccante 1995). However, percent success and Gini metric consider anglers' reported released of pike. Since the catch was likely exaggerated (Sullivan 2003), the percent success was likely lower than that calculated and the Gini coefficient was likely higher than that calculated.

4.9 Summary

This survey collected information from the majority of the recreational anglers using Pigeon Lake during the summer angling period in 2007, and was successful at

quantifying angling pressure, harvest and yield of walleye and pike, as well as collecting data on parameters used to categorize the walleye fishery in Pigeon Lake.

Compared to the 2006 angler survey, angling pressure on Pigeon Lake decreased from 4.6 h/ha to 4.4 h/ha; however, pressure has increased by 33% since 2003. While increased angling pressure was significant, angling pressure associated with the SHL as a proportion of the sport fishery was still minor (i.e., 20%).

During this survey, SHL anglers harvested approximately 2,729 walleye, accounting for 25% of the total yield. Further, SHL anglers accounted for 9.6% of captured walleye that were released. Total catch rate of SHL anglers was 4.37 walleye/h (harvested 0.24 walleye/h + reported released 4.13 walleye/h). Anglers who did not possess a SHL released 3.23 walleye/h. The reported release rate from all anglers (SHL and non-SHL) was 3.44 fish/h.

The age and length distributions of walleye harvested versus walleye captured from test angling were very similar. The truncated age distribution with few old pike was somewhat unstable. Growth rate of walleye was average. Walleye grew to 500 mm FL by age-9; however, walleye may reach 500 mm FL by age-7 or 8. The vast majority of the harvest was of mature walleye.

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6.0 APPENDICES

Appendix 1. An example of an angler survey field form used at Pigeon Lake, Alberta in 2007.

Alberta Conservation Association

Alberta SUSTAINABLE RESOURCE DEVELOPMENT

Special Harvest License Regulation Monitoring 2007

Creel Data Sheet

Lake (circle one): Wolf / Pigeon / Newell

Sheet Rules
- No blank spaces
- No french 7s
- Print clearly
- Verical lines = As above…be careful with start and end of line
- Horizontal line = Zeros…be careful with start and end of line
- Total each sheet for daily

Day Code
1 = Monday
2 = Tuesday
3 = Wednesday
4 = Thursday
5 = Friday
6 = Saturday
7 = Sunday
8 = Holiday

MM / DD	Day Code	Time of day 24h clock e.g.,3:00pm =15 (i.e., hour + 12)	1/4 hrs = 0, 25, 5, 75	Party # i.e. 017	Angler number (number each angler within each party 1- #	SHL license holder? No=0, <43=1, 43-50=2, >50=3	Did you fish lake last summer? No=0, Yes=1	Hours fished 10's	Hours fished 1's	1/4 hrs fished= 0, 25, 5, 75	# WALL KEPT	# WALL RELEASED	# NRPK KEPT	# NRPK RELEASED	# YLPR KEPT	# YLPR RELEASED	WIN # (A sample from non SHL-anglers…10/week)	Nearest Centre	Landing (where is your boat going to land?) **Use for Ratio-of-use surveys. Code Pigeon Lk Prov. Park as 'PP'**
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Appendix 2. Daily summary data from the Pigeon Lake angler survey in 2007. Codes: 1 = Monday, 2 = Tuesday, 3 = Wednesday, 4 = Thursday, 5 = Friday, 6 = Saturday, 7 = Sunday, 8 = holiday; WALL = walleye, NRPK = northern pike, YLPR = yellow perch.

Date	Day	#Anglers	#Hours	WALL Kept	WALL Released	NRPK Kept	NRPK Released	YLPR Kept	YLPR Released
05/19/2007	6	89	252.00	20	544	0	8	0	0
05/20/2007	7	179	564.50	38	1422	0	33	0	0
05/24/2007	4	7	8.00	0	4	0	1	0	0
05/25/2007	5	39	132.00	3	287	0	10	0	0
05/26/2007	6	161	555.50	48	1427	0	15	0	0
05/28/2007	1	5	3.00	0	13	0	0	0	0
06/03/2007	7	184	614.00	26	1572	0	15	1	1
06/07/2007	4	39	129.25	20	613	0	1	0	0
06/08/2007	5	49	160.50	0	879	1	15	0	0
06/10/2007	7	135	461.00	41	1535	2	21	0	0
06/11/2007	1	14	29.75	0	333	0	6	0	0
06/15/2007	5	76	259.50	17	1153	0	12	0	0
06/16/2007	6	86	214.75	8	602	1	19	0	0
06/21/2007	4	30	111.00	5	652	0	6	0	0
06/23/2007	6	116	344.50	43	1081	0	26	0	0
06/24/2007	7	2	4.00	0	0	0	0	0	0
06/25/2007	1	9	20.00	0	101	0	0	0	0
06/29/2007	5	58	181.25	10	1228	0	14	0	0
07/01/2007	7	254	897.00	19	3180	1	28	0	0
07/05/2007	4	51	147.00	0	754	0	8	0	0

Appendix 2. Continued.

Date	Day	#Anglers	#Hours	WALL Kept	WALL Released	NRPK Kept	NRPK Released	YLPR Kept	YLPR Released
07/06/2007	5	91	252.00	9	1112	0	9	0	0
07/07/2007	6	260	759.00	28	2399	0	47	0	0
07/09/2007	7	5	16.00	0	44	0	0	0	0
07/12/2007	4	25	72.50	8	329	0	14	0	0
07/14/2007	6	133	379.75	16	1398	2	26	0	0
07/15/2007	7	126	355.75	22	2014	0	21	2	0
07/20/2007	5	134	324.00	28	1124	21	21	0	0
07/22/2007	7	130	415.25	25	1750	1	24	0	0
07/23/2007	2	66	175.00	5	585	1	8	0	0
07/26/2007	4	52	98.00	6	532	0	18	0	0
07/27/2007	5	119	319.50	21	1179	2	36	0	0
07/28/2007	6	166	403.00	11	1424	1	7	0	0
08/04/2007	6	45	80.50	10	319	1	30	0	0
08/05/2007	7	192	551.00	20	1824	0	17	0	0
08/06/2007	8	171	477.75	45	1439	1	16	0	1
08/12/2007	7	122	367.50	14	952	2	10	0	0
08/17/2007	5	80	241.00	23	469	2	15	0	0
08/18/2007	6	138	402.00	36	814	3	1	0	0
08/26/2007	7	54	147.00	13	564	1	1	0	0
08/27/2007	1	14	34.00	11	90	3	0	0	0

Appendix 3. Biological data collected from fish harvested by sport anglers during the Pigeon Lake angler survey in 2007. Codes: NRPK = northern pike, WALL = walleye; F = female, M = male.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Age (y)
P1	WALL	470	494	950	M	Mature	10
P2	WALL	473	500	790	F	Mature	9
P3	WALL	467	487	800	F	Mature	8
P4	WALL	470	490	1050	F	Mature	8
P5	WALL	450	475	725	M	Mature	9
P6	WALL	474	495	1000	F	Mature	
P7	WALL	460	490	900	F	Mature	
P8	WALL	460	490	850	F	Mature	
P9	WALL	475	500	1000	F	Mature	
P10	WALL	513	536	1250	F	Mature	
P11	WALL	502	530	1200	M	Mature	
P12	WALL	470	496	1000	M	Mature	
P13	WALL	442	462	800	F	Mature	9
P14	WALL	460	484	900	F	Mature	9
P15	WALL	439	466	675	F	Mature	
P16	WALL	480	506	1000	F	Mature	10
P17	WALL	480	513	1100	F	Mature	10
P18	WALL	500	535	1100	F	Mature	9
P19	WALL	493	524	1200	F	Mature	9
P20	WALL	442	465	750	M	Mature	9
P21	WALL	450	478	900	F	Mature	10
P22	WALL	465	484	800	M	Mature	9
P23	WALL	450	474	750	F	Mature	9
P24	WALL	434	455	725	F	Mature	8
P25	WALL	460	483	850	F	Mature	9
P26	WALL	465	485	860	F	Mature	9
P27	WALL	485	505	1150	F	Mature	9
P28	WALL	425	455	700	F	Mature	8
P29	WALL	463	495	875	F	Mature	9

Appendix 3. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Age (y)
P30	WALL	465	492	800	F	Mature	9
P31	WALL	413	440	700	F	Mature	8
P32	WALL	427	461	825	F	Mature	
P33	WALL	417	440	700	M	Immature	8
P34	WALL	462	490	875	F	Mature	9
P35	WALL	456	485	850	F	Mature	9
P36	WALL	438	463	800	F	Mature	
P37	WALL	449	477	1000	F	Mature	9
P38	WALL	498	523	925	M	Mature	9
P39	NRPK	642	681	1600	F	Mature	6
P40	WALL	496	519	1050	M	Mature	9
P41	WALL	512	535	1200	M	Mature	9
P42	WALL	472	505	950	M	Mature	9
P43	WALL	430	456	725	M	Mature	9
P44	WALL	465	491	925	F	Mature	10
P45	WALL	460	483	800	M	Mature	9
P46	WALL	447	475	850	F	Mature	8
P47	WALL	472	497	925	F	Mature	10
P48	WALL	460	492	850	F	Mature	9
P49	WALL	442	466	800	F	Mature	9
P51	WALL	447	475	900	F	Mature	
P52	WALL	463	495	900	F	Mature	8
P53	WALL	440	466	800	F	Mature	9
P54	WALL	516	543	1250	F	Mature	10
P55	WALL	450	472	1000	F	Mature	7
P56	WALL	490	517	925	F	Mature	10
P57	WALL	495	520	1250	F	Mature	9
P58	WALL	474	499	1100	F	Mature	9
P59	WALL	466	488	1050	F	Mature	9
P60	WALL	444	471	700	F	Mature	9
P61	WALL	460	491	850	F	Mature	9

Appendix 3. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Age (y)
P62	WALL	423	447	750	F	Mature	8
P63	WALL	423	450	700	F	Mature	8
P64	WALL	479	510	875	F	Mature	10
P65	WALL	501	532	1075	F	Mature	10
P66	WALL	477	505	950	M	Mature	10
P67	WALL	463	491	900	F	Mature	9
P68	WALL	470	499	1000	F	Mature	9
P69	WALL	467	500	900	F	Mature	10
P70	WALL	468	499	1025	M	Mature	9
P71	WALL	459	486	950	F	Mature	9
P72	WALL	510	540	1400	F	Mature	
P73	WALL	490	524	1050	M	Mature	
P74	WALL	508	535	1250	M	Mature	
P75	WALL	555	585	1525	F	Mature	
P76	WALL	515	546	1250	F	Mature	
P77	WALL	500	530	1150	F	Mature	
P78	WALL	510	534	1250	F	Mature	
P79	WALL	500	527	1075	F	Mature	
P80	WALL	526	554	1300	F	Mature	
P81	WALL	497	527	1100	F	Mature	
P82	WALL	422	446	850	F	Mature	7
P83	WALL	432	460	650	M	Mature	9
P84	WALL	420	446	775	F	Mature	8
P85	WALL	444	466	775	F	Mature	9
P86	WALL	428	453		F	Mature	8
P87	WALL	449	465	950	F	Mature	9
P88	WALL	490	515	950	F	Mature	9
P89	WALL	468	495	925	F	Mature	9
P90	WALL	462	491	800	F	Mature	9
P91	WALL	438	460	800	M	Mature	8
P92	WALL	500	530	1225	M	Mature	10

Appendix 3. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Age (y)
P93	WALL	472	492	1000	F	Mature	9
P94	WALL	452	481	825	F	Mature	9
P95	WALL	455	481	925	F	Mature	
P96	WALL	460	485	1050	F	Mature	8
P97	WALL	450	478	960	M	Mature	9
P98	WALL	450	484	850	M	Mature	10
P99	WALL	480	510	1075	M	Mature	10
P100	WALL	485	508	1000	F	Mature	10
P101	WALL	467	495	900	F	Mature	9
P102	WALL	464	490	950	F	Mature	9
P103	YLPR	290	304	350	F	Mature	
P104	WALL	467	498	950	F	Mature	8
P105	WALL	466	503	875	F	Mature	9
P106	WALL	474	504	1000	M	Mature	9
P107	WALL	459	484	800	F	Mature	9
P108	WALL	433	463	775	F	Mature	8
P109	WALL	496	527	1000	F	Mature	9
P110	WALL	468	498	950	F	Mature	10
P111	WALL	473	501	900	F	Mature	10
P112	WALL	468	483	875	F	Mature	9
P113	WALL	455	477	810	F	Mature	9
P114	WALL	452	484	850	F	Mature	9
P115	WALL	479	506	875	F	Mature	10
P116	WALL	460	486	1000	F	Mature	9
P117	WALL	430	455	750	M	Mature	9
P118	NRPK	870	926	4600	F	Mature	9
P119	NRPK	810	858	3650	F	Mature	9
P120	WALL	455	484	850	F	Mature	9
P121	WALL	460	489	900	F	Mature	10
P122	WALL	477	504	1000	F	Mature	10
P123	WALL	460	490	900	F	Mature	9

Appendix 3. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Age (y)
P124	WALL	461	489	950	F	Mature	9
P125	WALL	487	515	935	M	Mature	10
P126	WALL	456	479	875	M	Mature	9
P127	WALL	481	522	1100	F	Mature	
P128	NRPK	902	955	6000	F	Mature	9
P129	WALL	507	532	1250	F	Mature	10
P130	WALL	460	493	750	F	Mature	9
P131	WALL	465	492	825	F	Mature	9
P132	WALL	445	472	775	M	Mature	9
P133	WALL	660	693	2650	F	Mature	13
P134	WALL	462	498	860	F	Mature	9
P135	WALL	435	460	800	F	Mature	8
P136	WALL	465	493	850	F	Mature	9
P137	WALL	468	500		F	Mature	9
P138	WALL	450	477	900	M	Mature	9
P139	WALL	487	513				9
P140	WALL	495	520				10
P141	WALL	485	511				9
P142	WALL	460	485	900	F	Mature	9
P143	WALL	475	505	1100	M	mature	9
P144	WALL	464	492	850	M	Mature	
P145	WALL	463	479	925	M	Mature	9
P146	WALL	431	460	750	F	Mature	8
P147	WALL	454	484	825	F	Mature	9
P148	WALL	470	493	900	F	Mature	
P149	WALL	440	464	800	M	Mature	9
P150	WALL	440	462	825	F	Mature	9
P151	WALL	482	514	900	M	Mature	10
P152	WALL	465	495	975	F	Mature	9
P153	WALL	489	520	1050	F	Mature	9
P154	NRPK	915	945	5585	F	Mature	11

Appendix 3. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Age (y)
P155	WALL	467	495	975	F	Mature	10
P156	WALL	463	494	1000	F	Mature	9
P157	WALL	450	484	960	M	Mature	9
P158	WALL	445	471	850	M	Mature	9
P159	WALL	683	718	2950	F	Mature	13
P160	WALL	453	487	975	F	Mature	9
P161	WALL	471	502		U	Unknown	10
P162	WALL	481	510	1000	F	Mature	9
P163	WALL	644	678	2575	F	Mature	13
P164	WALL	468	498	840	F	Mature	9
P165	WALL	459	486	850	F	Mature	9
P166	WALL	503	530	1250	F	Mature	9
P167	WALL	450	476	900	M	Mature	9
P168	WALL	455	488	750	M	Mature	10
P169	WALL	455	483	850	F	Mature	9
P170	WALL	430	459	800	M	Mature	9
P171	WALL	426	454	750	F	Mature	9
P172	WALL	445	475	825	F	Mature	9
P173	WALL	433	455	800	M	Mature	8
P174	WALL	465	495	925	F	Mature	9
P175	WALL	475	500	975	M	Mature	10
P176	WALL	454	480	850	F	Mature	9
P177	WALL	455	483	725	F	Mature	9
P178	WALL	505	535	1000	M	Mature	10
P179	WALL	500	526	1200	M	Mature	9
P180	WALL	463	490	950	F	Mature	9
P181	WALL	464	495	950	F	Mature	9
P182	WALL	485	513	1000	F	Mature	9
P183	WALL	467	490	925	M	Mature	9
P184	WALL	450	480	850	F	Mature	9
P185	WALL	485	520	1050	F	Mature	10

Appendix 3. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Age (y)
P186	WALL	450	480	825	M	Mature	9
P187	NRPK	619	658	1500	F	Mature	6
P188	WALL	487	515	950	M	Mature	9
P189	WALL	489	522	900	M	Mature	10
P190	WALL	455	479	800	F	Mature	10
P191	WALL	503	530	1050	F	Mature	9
P192	WALL	501	528	1000	F	Mature	10
P193	WALL	450	479	925	F	Mature	9
P194	WALL	470	495	950	F	Mature	9
P195	WALL	457	484	950	F	Mature	8
P196	WALL	453	480	900	F	Mature	9
P197	WALL	485	515	1025	M	Mature	9
P198	WALL	521	553	1225	F	Mature	10
P199	WALL	435	455	675	M	Mature	9
P200	WALL	454	483	825	M	Mature	9
P201	WALL	438	465	800	F	Mature	8
P202	WALL	515	545	1200	M	Mature	10
P203	WALL	482	509	1000	F	Mature	9
P204	WALL	477	506	950	F	Mature	10
P205	WALL	456	485	950	F	Mature	9
P206	WALL	514	545	1150	F	Mature	10
P207	WALL	570	601	1450	F	Mature	10
P208	WALL	492	520	1050	F	Mature	10
P209	WALL	481	519	1000	F	Mature	9
P210	WALL	430	460	850	F	Mature	8
P211	WALL	444	470	900	M	Mature	9
P212	WALL	458	486	900	F	Mature	9
P213	WALL	514	544	1175	M	Mature	10
P214	WALL	496	527	1100	M	Mature	10
P215	WALL	486	505	1050	F	Mature	9
P216	WALL	449	465	725	M	Mature	10

Appendix 3. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Age (y)
P217	WALL	479	498	1000	F	Mature	9
P218	WALL	413	435	750	M	Mature	7
P219	WALL	476	502	1000	F	Mature	9
P220	WALL	464	490	875	F	Mature	9
P221	WALL	479	507	1000	F	Mature	10
P222	WALL	482	504	900	M	Mature	10
P223	WALL	491	511	1050	F	Mature	10
P224	WALL	475	500	1000	F	Mature	10
P225	WALL	453	480	900	F	Mature	
P226	WALL	435	466	900	M	Mature	8
P227	NRPK	550	585	1000	M	Immature	4
P228	NRPK	550	580	1000	M	Immature	5
P229	WALL	470	498	1000	F	Mature	10
P230	WALL	450	478	875	F	Mature	9
P231	WALL	436	454	750	F	Immature	8
P232	WALL	488	523	1050	M	Mature	9
P233	WALL	500	525	1000	F	Mature	10
P234	WALL	485	504	1000	F	Mature	
P235	WALL	450	475	900	M	Mature	9
P236	WALL	462	486	900	F	Mature	9
P237	WALL	426	446	800	M	Mature	7
P238	WALL	428	443	700	F	Immature	8
P239	WALL	514	543	1100	F	Mature	10
P240	WALL	424	450	700	M	Immature	9
P241	WALL	470	496				10
P242	WALL	470	501				10
P243	WALL	484	512				9
P244	WALL	465	490				9
P245	WALL	493	517	950	F	Mature	10
P246	WALL	480	506	1000	F	Mature	10
P247	WALL	535	562	1300	M	Mature	10

Appendix 3. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Age (y)
P248	WALL	493	525	1200	M	Mature	9
P249	NRPK	550	598	1300	F	Mature	3
P250	WALL	495	521	1100	M	Mature	9
P251	WALL	484	510	900	F	Mature	10
P252	WALL	514	539	1300	F	Mature	9
P253	WALL	510	531	900	F	Mature	9
P254	WALL	452	472	900	M	Mature	10
P255	WALL	437	462	800	F	Mature	10
P256	WALL	463	488	900	M	Mature	9
P257	WALL	435	465	800	F	Mature	8
P258	WALL	488	523	900	M	Mature	9
P259	WALL	495	523	1100	F	Mature	10
P260	WALL	447	476	750	M	Mature	10
P261	WALL	468	491	900	F	Mature	
P262	WALL	443	475	900	U	Unknown	9
P263	WALL	441	463	900	F	Mature	
P264	WALL	479	510	1000	F	Mature	9
P265	WALL	494	526	1150	F	Mature	9
P266	WALL	481	512	850	M	Mature	10
P267	WALL	483	506	950	M	Mature	9
P268	WALL	466	502	900	F	Mature	9
P269	WALL	480	511	950	F	Mature	10
P270	WALL	460	488	800	M	Mature	9
P271	WALL	450	480	900	F	Mature	8
P272	WALL	469	493	750	F	Mature	10
P273	WALL	450	478	800	F	Mature	9
P274	WALL	470	500	950	F	Mature	8
P275	WALL	428	452	700	M	Mature	9
P276	WALL	483	510	950			10
P277	WALL	508	534	1150	M	Mature	9
P278	WALL	465	491	950	F	Mature	9

Appendix 3. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Age (y)
P279	WALL	502	530	1025	F	Mature	9
P280	WALL	476	502	850	F	Mature	10
P281	WALL	472	497	825	F	Mature	9
P282	WALL	490	512	925	F	Mature	10
P283	WALL	465	494	840	M	Mature	9
P284	WALL	482	514	1050	F	Mature	9
P285	WALL	505	530	1100	M	Mature	9
P286	WALL	435	461	750	M	Mature	9
P287	WALL	480	510	1000	F	Mature	9
P288	WALL	475	500	875	F	Mature	9
P289	NRPK	1065	1250	8850	F	Mature	11
P290	WALL	465	491	775	M	Mature	9
P291	WALL	424	453	800	M	Mature	8
P292	WALL	434	455	815	M	Mature	9
P293	WALL	520	549	1225	F	Mature	10
P294	WALL	454	480	850	F	Mature	9
P295	WALL	462	485	900	F	Mature	9
P296	WALL	400	427	600	F	Mature	7
P297	WALL	457	484	1175	F	Mature	9
P298	WALL	453	480	875	F	Mature	9
P299	WALL	457	480	775	F	Mature	9
P300	WALL	456	473	800	M	Mature	9
P301	WALL	495	524	900	F	Mature	9
P302	WALL	445	469	800	M	Mature	9
P303	WALL	497	527	1200	F	Mature	9
P304	WALL	480	511	1050	M	Mature	9
P305	WALL	505	535	1125	F	Mature	10
P306	WALL	475	501	950	F	Mature	9
P307	WALL	445	465	960	M	Mature	9
P308	WALL	494	520	1125	F	Mature	10
P309	WALL	472	497	820	M	Mature	9

Appendix 3. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Age (y)
P310	WALL	438	465	825	F	Mature	8
P311	WALL	438	465	900	M	Mature	8
P312	WALL	459	475	850	M	Mature	10
P313	WALL	425	451	725	M	Mature	8
P314	WALL	474	495	1000	F	Mature	9
P315	WALL	466	492	975	F	Mature	9
P316	WALL	485	515	900	M	Mature	9
P317	WALL	448	465	810	F	Mature	8
P318	WALL	483	508	1110	F	Mature	9
P319	WALL	495	520	1230	F	Mature	9
P320	WALL	447	467	900	F	Mature	8
P321	WALL	507	537	1050	M	Mature	9
P322	WALL	449	485	900	F	Mature	10
P323	WALL	500	527	1150	F	Mature	9
P324	WALL	535	560	1050	F	Mature	9
P325	WALL	444	470	900	F	Mature	8
P326	WALL	435	463	850	F	Mature	9
P327	WALL	418	445	750	F	Mature	9
P328	WALL	430	452	800	F	Mature	9
P329	WALL	444	461	800	M	Mature	9
P330	WALL	435	452	925	F	Mature	9
P331	NRPK	618	649	1675	F	Mature	5
P332	NRPK	680	720	2175	F	Mature	6
P333	NRPK	602	647	1400	F	Mature	4
P334	WALL	485	520	1000	F	Mature	10
P335	WALL	483	512	1050	F	Mature	9
P336	WALL	450	479	800	M	Mature	10
P337	WALL	483	508	825	F	Mature	9
P338	WALL	464	491				8
P339	WALL	465	487				9
P340	WALL	440	480				8
P341	WALL	469	493				10
P342	WALL	455	483				9

Appendix 4. Biological data collected from test angling during the Pigeon Lake angler survey in 2007. Species codes: WALL = walleye, NRPK = northern pike.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Age (y)
1	WALL	420	449	8
2	WALL	489	521	9
3	WALL	428	453	8
4	NRPK	542	571	
5	WALL	433	460	9
6	WALL	501	533	10
7	WALL	461	492	9
8	WALL	440	465	9
9	WALL	489	517	9
10	WALL	490	521	9
11	WALL	435	453	9
12	WALL	455	484	9
13	WALL	475	505	9
14	WALL	430	462	8
15	WALL	508	540	10
16	WALL	486	516	9
17	WALL	431	455	8
18	WALL	465	505	9
19	WALL	443	474	9
20	WALL	466	501	9
21	WALL	445	460	9
22	WALL	459	487	9
23	WALL	460	487	9
24	WALL	463	505	9
25	WALL	490	523	9
26	WALL	465	489	9
27	WALL	446	476	9
28	WALL	445	476	9
29	WALL	384	411	8
30	WALL	474	499	9

Appendix 4. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Age (y)
31	NRPK	534	577	
32	WALL	440	470	9
33	WALL	515	546	10
34	WALL	425	455	8
35	WALL	425	451	8
36	WALL	402	428	8
37	NRPK	490	523	
38	NRPK	512	546	
39	NRPK	576	621	
40	WALL	460	487	9
41	WALL	410	436	8
42	WALL	492	519	10
43	WALL	525	550	10
44	WALL	486	522	9
45	WALL	503	527	10
46	WALL	420	450	8
47	WALL	460	495	9
48	WALL	435	457	9
49	WALL	440	467	9
50	WALL	455	483	9
51	WALL	455	485	9
52	WALL	460	489	9
53	WALL	435	460	9
54	WALL	467	497	9
55	WALL	472	497	9
56	WALL	447	475	9
57	WALL	455	485	9
58	WALL	472	497	9
59	WALL	480	509	9
60	WALL	450	480	9
61	WALL	450	477	9

Appendix 4. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Age (y)
62	WALL	472	503	9
63	WALL	460	493	9
64	WALL	476	502	9
65	WALL	470	496	9
66	WALL	454	483	9
67	WALL	445	475	9
68	WALL	450	477	9
69	WALL	442	474	9
70	WALL	540	570	10
71	NRPK	1000	1050	
72	NRPK	534	564	
73	NRPK	543	580	
74	NRPK	534	570	
75	NRPK	520	552	
76	NRPK	505	542	
77	NRPK	552	590	
78	NRPK	566	603	
79	NRPK	610	657	
80	WALL	435	465	9
81	WALL	440	474	9
82	WALL	405	435	8
83	WALL	491	518	10
84	WALL	440	473	9
85	WALL	460	485	9
86	NRPK	505	539	
87	NRPK	580	615	
88	NRPK	438	469	
89	NRPK	540	580	
90	NRPK	380	406	
91	WALL	393	416	8
92	WALL	436	467	9

Appendix 4. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Age (y)
93	WALL	386	409	8
94	WALL	468	500	9
95	WALL	456	483	9
96	WALL	423	448	8
97	WALL	428	452	8
98	WALL	465	486	9
99	WALL	476	503	9
100	WALL	465	493	9
101	WALL	469	498	9
102	WALL	430	455	8
103	WALL	416	444	8
104	WALL	431	458	8
105	WALL	433	460	9
106	WALL	463	494	9
107	WALL	466	493	9
108	WALL	400	430	8
109	WALL	443	472	9
110	WALL	430	458	8
111	WALL	465	497	9
112	WALL	440	460	9
113	WALL	428	455	8
114	WALL	459	487	9
115	WALL	469	499	9
116	NRPK	570	608	
117	NRPK	545	584	
118	NRPK	580	625	
119	WALL	455	479	9
120	NRPK	536	578	
121	NRPK	575	615	
122	NRPK	538	576	
123	NRPK	444	464	

Appendix 4. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Age (y)
124	WALL	466	496	9
125	WALL	448	480	9
126	WALL	458	486	9
127	WALL	491	518	10
128	WALL	454	484	9
129	WALL	430	455	8
130	WALL	474	503	9
131	WALL	476	505	9
132	WALL	445	475	9
133	WALL	454	481	9
134	NRPK	980	1040	
135	NRPK	565	606	
136	WALL	451	478	9
137	WALL	414	441	8
138	WALL	483	511	9
139	WALL	385	414	8
140	WALL	478	508	9
141	WALL	418	495	8
142	WALL	473	501	9
143	WALL	468	502	9
144	WALL	447	476	9
145	WALL	460	488	9
146	WALL	420	446	8
147	WALL	452	484	9
148	WALL	453	481	9
149	WALL	494	523	10
150	WALL	471	495	9
151	NRPK	564	601	
152	NRPK	592	633	
153	WALL	434	460	9
154	WALL	393	419	8

Appendix 4. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Age (y)
155	WALL	399	424	8
156	WALL	430	462	8
157	WALL	413	440	8
158	WALL	539	568	10
159	WALL	439	462	9
160	WALL	488	514	9
161	WALL	454	488	9
162	WALL	436	452	9
163	WALL	434	462	9
164	WALL	444	470	9
165	WALL	408	444	8
166	WALL	463	493	9
167	WALL	434	460	9
168	WALL	438	450	9
169	WALL	480	504	9
170	WALL	492	519	10
171	WALL	409	434	8
172	WALL	390	420	8
173	NRPK	547	583	
174	NRPK	538	572	
175	NRPK	573	608	
176	NRPK	552	588	
177	NRPK	468	499	
178	NRPK	615	656	
179	NRPK	499	535	
180	WALL	464	493	9
181	WALL	410	439	8
182	WALL	491	520	10
183	WALL	440	465	9
184	WALL	444	494	9
185	WALL	462	490	9

Appendix 4. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Age (y)
186	WALL	417	446	8
187	WALL	500	525	10
188	WALL	459	490	9
189	WALL	424	449	8
190	WALL	420	449	8
191	WALL	467	495	9
192	NRPK	565	614	
193	WALL	337	348	7
194	WALL	342	366	7
195	NRPK	555	600	
196	NRPK	481	517	
197	NRPK	509	543	
198	NRPK	520	558	
199	WALL	482	523	9
200	NRPK	415	444	
201	WALL	464	495	9
202	NRPK	590	633	
203	NRPK	438	470	
204	NRPK	576	610	
205	NRPK	570	610	
206	NRPK	510	547	
207	NRPK	467	502	
208	NRPK	575	622	
209	NRPK	558	593	
210	NRPK	600	641	
211	NRPK	574	613	
212	WALL	555	583	11
213	WALL	540	580	10
214	WALL	575	609	11
215	WALL	493	521	10
216	WALL	495	525	10

Appendix 4. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Age (y)
217	WALL	475	504	9
218	WALL	460	492	9
219	NRPK	556	594	
220	NRPK	602	644	
221	NRPK	571	615	
222	NRPK	530	566	
223	NRPK	575	610	
224	NRPK	560	605	
225	NRPK	610	652	
226	NRPK	575	626	
227	NRPK	595	640	
228	NRPK	605	643	
229	NRPK	510	545	
230	NRPK	473	505	
231	NRPK	575	605	
232	NRPK	594	635	
233	NRPK	520	555	
234	WALL	408	431	8
235	WALL	463	487	9
236	WALL	443	470	9
237	WALL	450	485	9
238	WALL	449	476	9
239	WALL	460	490	9
240	WALL	402	426	8
241	WALL	422	448	8
242	WALL	457	479	9
243	WALL	495	522	10
244	WALL	472	499	9
245	WALL	387	412	8
246	WALL	465	500	9
247	WALL	499	530	10

Appendix 4. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Age (y)
248	WALL	479	503	9
249	WALL	490	512	9
250	WALL	485	505	9
251	WALL	350	372	7
252	WALL	475	506	9
253	WALL	484	515	9
254	WALL	467	498	9
255	WALL	458	482	9
256	WALL	468	498	9
257	WALL	444	473	9
258	WALL	502	531	10
259	WALL	467	502	9
260	WALL	555	585	11
261	WALL	438	459	9
262	WALL	459	495	9
263	WALL	419	447	8
267	WALL	433	459	9
268	WALL	319	335	7
269	WALL	434	458	9
270	WALL	428	453	8
271	WALL	449	480	9
272	WALL	435	464	9
273	WALL	455	475	9
274	WALL	461	487	9
275	WALL	439	467	9
276	WALL	446	471	9
277	WALL	409	423	8
278	WALL	467	490	9
279	WALL	435	461	9
280	WALL	365	389	7
281	WALL	420	445	8

Appendix 4. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Age (y)
282	WALL	455	484	9
283	WALL	476	507	9
284	WALL	472	505	9
285	WALL	413	454	8
286	WALL	391	407	8
287	WALL	430	462	8
288	WALL	406	427	8
289	WALL	434	460	9
290	WALL	399	425	8
291	WALL	435	471	9
292	NRPK	594	631	
293	NRPK	472	506	
294	WALL	462	485	9
295	WALL	480	505	9
296	WALL	445	468	9
297	WALL	476	503	9
298	WALL	429	449	8
299	WALL	445	484	9
300	WALL	482	510	9
301	WALL	423	450	8
302	WALL	443	470	9
303	WALL	394	416	8
304	WALL	425	452	8
305	WALL	410	445	8
306	WALL	435	450	9
307	WALL	456	490	9
308	WALL	449	475	9
309	NRPK	550	588	
310	WALL	435	456	9
311	WALL	350	372	7
312	WALL	424	448	8

Appendix 4. Continued.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Age (y)
313	WALL	398	424	8
314	WALL	452	483	9
315	WALL	442	467	9
316	WALL	445	470	9
317	WALL	347	368	7
318	NRPK	570	611	
319	NRPK	575	613	
320	NRPK	475	504	

The Alberta Conservation Association acknowledges the following partner for their generous support of this project

Alberta

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