Assessment of the Summer Sport Fishery for walleye *(Sander vitreus)* and Northern Pike (*Esox lucius*) at Orloff Lake, Alberta, 2004

Alberta Conservation Association

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EXECUTIVE SUMMARY

To maintain and recover Alberta's walleye and pike fisheries, Alberta Sustainable Resource Development (ASRD) developed and implemented new management strategies in 1996 for walleye and in 1999 for northern pike (hereafter pike). Orloff Lake, located north of Athabasca, Alberta, was classified as having a vulnerable walleye fishery between 1996 and 2004 (Alberta Guide to Sportfishing Regulations 1996 and 2004). This classification resulted in the implementation of a regulation that allowed anglers to harvest three walleye (daily maximum bag limit) with a minimum size limit of 50 cm total length (TL). From 1999 to 2004, the pike fishery was classified as a stable-recreational fishery, allowing sport anglers to harvest three pike (daily maximum bag limit) with a minimum size limit of 63 cm TL.

Alberta Conservation Association (ACA) creel surveys are conducted in support of the management of Alberta's sport fisheries. Creel surveys provide the field data that are used by ASRD to manage sport fisheries and support management strategies. ASRD walleye and pike management strategies are based on estimates of how harvest pressure can alter the impact of management decisions (Berry 1995). Since the inception of ASRD's walleye and pike management strategies, the sport fishery at Orloff Lake has not been assessed by neither ASRD nor ACA. Anecdotally, the lake was reportedly receiving increased angling pressure over historic levels. Hence, ASRD requested that ACA conduct a creel survey during the summer of 2004 to provide an estimate of angler effort and stock yields for walleye and pike. Based on angler interviews conducted between 23 May and 16 August 2004, an estimated 488 anglers (95% CI = 361 - 663, n = 202) fished Orloff Lake for 1,749 h (95% CI = 1,285 - 2,404, n = 684) for a angling pressure of 0.95 angler-hrs/ha; hrs/ha (95% CI = 0.70 - 1.31).

Estimated angler harvest of walleye was 286 fish (95% CI = 186 - 429, n = 120), which had an estimated mean weight of 1.544 kg (95% CI = 1.419 - 1.676 kg) per fish. This produced an estimated yield of 0.24 kg/ha (95% CI = 0.16 - 0.37). Anglers released an estimated 697 walleye (95% CI = 451 - 1,085, n = 257), for an estimated total yield (harvest + hooking mortality) of 0.25 kg/ha (95% CI = 0.220 - 0.399).

Estimated angler harvest of pike was 106 fish (95% CI = 67 - 170, n = 40), with a mean weight of 1.980 kg (95% CI = 1.772 - 2.223 kg) per fish. This produced an estimated yield of 0.12 kg/ha (95% CI = 0.07 - 0.18). Anglers reported a pike release rate of 0.367 fish/h, which translates to an estimated catch and release of 1,293 pike (95% CI = 1,022 - 1,667, n = 322). The estimated total yield of pike was 0.15 kg/ha (95% CI = 0.11 - 0.22).

ACKNOWLEDGEMENTS

The Alberta Conservation Association (ACA) funded this creel survey. The creel clerks made an essential contribution to this project: Tara Lantz, Michelle Wells and James Witzke who creeled Orloff Lake. Seasonal staff members were challenged on more than a few occasions by the ATV ride into Orloff Lake and numerous boat maintenance issues. Thanks to Chris Davis and Daryl Watters (ASRD Fisheries Staff) for test angling Orloff Lake.

The ACA would also like to acknowledge Alberta Sustainable Resource Development (ASRD) for use of their cabin on Orloff Lake by the crewmembers, Human Resources and Development Canada for seasonal staff funding, and The Fishin' Hole store for providing discounts on angling equipment.

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1.0 INTRODUCTION

1.1 General introduction

Management strategies for walleye (*Sander vitreus*) and northern pike (*Esox lucius*, hereafter pike) prior to 1996 and 1999, respectively, focused on province-wide regulations designed to manage harvest at fisheries experiencing average exploitation rates. Fisheries receiving heavier than average exploitation had not been adequately protected with these regulations and many have declined or collapsed. Evidence suggests heavier than average exploitation can be attributed to a disproportionately high number of anglers exploiting fishing opportunities at relatively few lakes. Prior to 1995, high numbers of anglers per lake (312.5 anglers/ha, mid-1990s), combined with high fish harvests, resulted in the over-harvest of many fish populations in Alberta (Sullivan 2003a). To aid the recovery of these fisheries, two new management strategies were implemented in 1996 (Alberta's Walleye Management Recovery Plan) (Berry 1995) and 1999 (Alberta's Northern Pike Management and Recovery Plan) (Berry 1999). Through the strategies identified in these two recovery plans, the fishery at each lake was assessed and assigned a status category (i.e., collapsed, vulnerable, or stable), based on estimates of angler pressure, yield, and population structure. The sport fishing regulation (for walleye or pike) was then modified by Alberta Sustainable Resource Development (ASRD) based on the status rating (Sullivan 1998).

In 1996, the Walleye Management and Recovery Plan (WMRP) was implemented and Orloff Lake was subsequently classified as a vulnerable walleye fishery (Berry 1995). This classification resulted in a regulation that permitted anglers to harvest three walleye (daily maximum bag limit) each with a minimum size limit of 50 cm total length (TL).

Based on the 1999 Northern Pike Management and Recovery Plan (NPMRP) a province-wide sport fishing regulation was implemented thereby classifying the majority of pike fisheries, including Orloff Lake, as stable-recreational fisheries (Berry 1999). A stable-recreational classification permitted sport anglers to harvest three pike (daily maximum bag limit) each with a minimum size limit of 63 cm TL. In 2001, Alberta Fisheries, based on public consultation (Daryl Watters, Alberta Sustainable

Resource Development, Edmonton, Alberta, pers. comm.), modified the sport fishing regulation to a daily harvest of one pike >63 cm TL.

1.2 Study rationale

The 2004 creel survey at Orloff Lake was the first angler survey at this lake known to the author. With Alberta's increasing population and increasing accessibility into remote fisheries, discussions between Alberta Conservation Association (ACA) and ASRD suggested it was timely and important to survey the walleye and pike fisheries at Orloff Lake. As a result, a project was jointly developed by the ACA and ASRD to collect data to update the current walleye and pike classification at Orloff Lake. To that end, the ACA conducted a summer creel survey at Orloff Lake during 2004. Creel surveys are a non-invasive technique that can effectively estimate the parameters required (e.g., angler use, sport fish yield and sport fishery structure) for management.

The purpose of the survey was to evaluate the status of walleye and pike fisheries at Orloff Lake and provide ASRD with current data describing these fisheries for the summer of 2004.

2.0 STUDY AREA

Orloff Lake is located in the Athabasca River drainage, approximately 90 km north of Athabasca, Alberta (Figure 1). It has a surface area of 1,830 ha (ASRD and Alberta Environment Unpublished data) and access is by all-terrain-vehicle (e.g., quad) along cut lines. The major inlet, Drowned Horse Creek, flows into Orloff Lake from the northeast. The lake is drained at the southwest end via Otter Creek, which flows into Otter Lake. There is no anthropogenic development at the lake except for a few rustic camping areas and a trappers cabin. An ASRD Fish and Wildlife Officers' (FWO) cabin is located on the south shore of Orloff Lake.

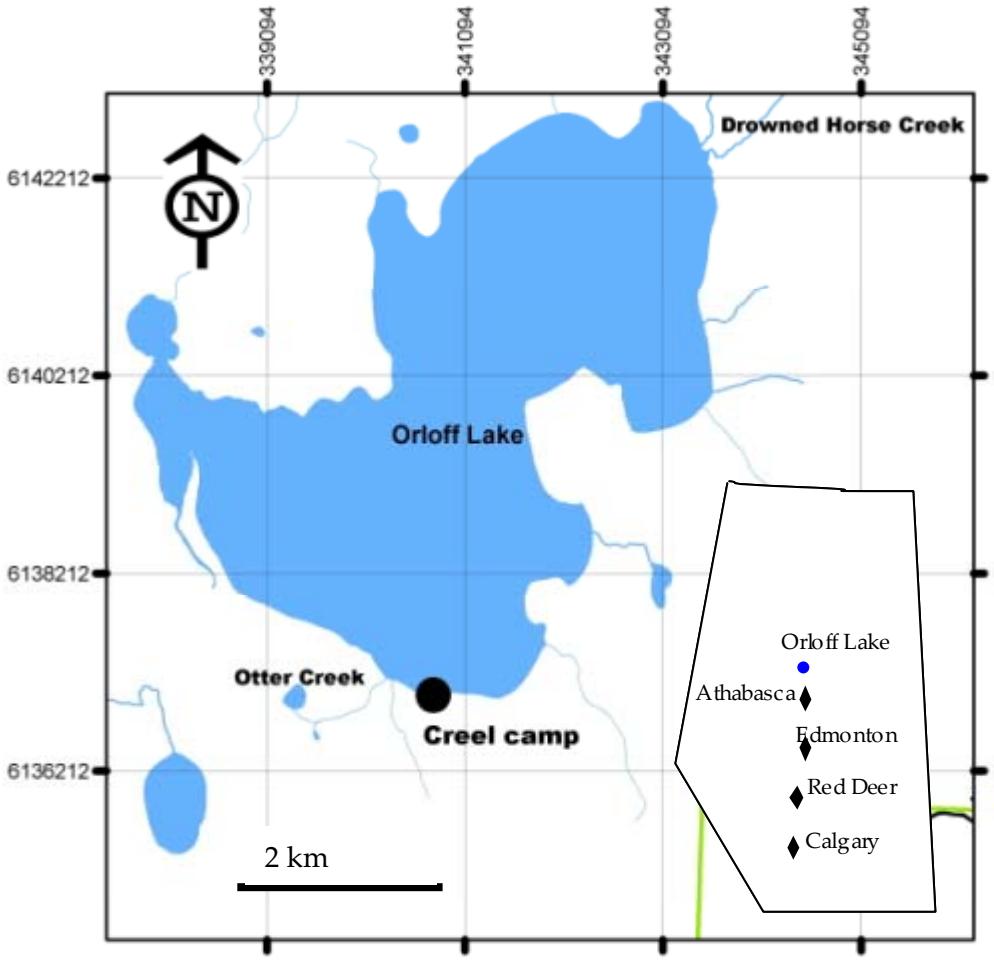

Figure 1. Location of Orloff Lake, Alberta and the 2004 creel survey site. The location of the creel camp (FWO cabin) is indicated by the black dot. The majority of the access is along the cut lines directly south of the creel camp.

3.0 MATERIALS AND METHODS

3.1 Survey design

From 23 May to 16 August 2004 an access site survey (Pollock et al. 1994) was conducted at a single access point at Orloff Lake. The access point to the lake was a trail head located near the ASRD Fish and Wildlife Officers (FWO) cabin. Two creel clerks interviewed anglers as they returned from completed trips of angling. Eleven lake activity surveys were also conducted throughout this survey period. Test angling was conducted throughout the survey period to collect additional information on the size distribution of walleye and pike populations.

3.2 Creel survey

3.2.1 Angler interviews

Upon returning to the survey access point, all angling parties were asked a series of questions regarding the number of hours fished, number of each species kept and released, the number of anglers, angling method, targeted species, use of electronics, use of barbless hooks and residence. These data were recorded on a creel survey data form (Appendix 6.1). Creel clerks made a subjective evaluation of each angler's skill level. Children and anglers that lacked equipment and knowledge regarding fishing were classified as novices. Anglers that demonstrated clear superiority in equipment and knowledge were classified as professionals. All other anglers were considered to have moderate skill.

3.2.2 Spatial extent of survey

This access site creel survey was conducted at a trailhead located near the ASRD FWO cabin at Orloff Lake, which is located on the south shore. Access points not surveyed included trailheads and a few campgrounds located around the lake.

3.2.3 Temporal extent of sampling

The creel survey was stratified into weekdays (Monday-Thursday) and weekend days (Friday-Sunday and statutory holidays). Each day was surveyed from 0830 to 2300 hours. All anglers who returned from fishing to the trailhead located near the ASRD FWO before 0830 or after 2300 were not interviewed. Survey dates and summary information are listed in Appendix 6.2. Surveys were conducted for five consecutive days during a 14-day rotation, repeating this schedule seven times throughout the summer.

3.3 Lake activity surveys

Lake activity surveys provide a site-use ratio (e.g., 72 anglers out of 92 interviewed used the access site surveyed as their landing site; Appendix 6.3) that is used to extrapolate creel survey parameters (e.g., number of anglers, number of hours, number of fish caught) to temporal and spatial strata that are not surveyed. Lake activity surveys include interviewing anglers on the lake as they were randomly encountered by boat. The lake activity interview was identical to the access site interview but includes the location of angler party landing (i.e., where the boat is going to touch shore at the end of the angling trip). The surveys had a temporal stratification of weekdays and weekend days and two shifts (i.e., 0800 - 1530 and 1530 - 2300) that reflected angler use. Table 1 summarizes the number of surveys per stratum. Eleven lake activity surveys were conducted during the survey period. For safety, lake activity surveys were completed by two crewmembers.

Table 1. Summary of the lake activity surveys during each temporal stratum conducted at Orloff Lake 2004. Survey day (i.e., weekday / weekend day), and survey shift (i.e., 08:00-15:30 / 15:30-23:00).

Day strata	Shift strata	Number of lake activity surveys per strata
Weekdays	0800 - 1530	1
	1530 - 2300	2
Weekend day	0800 - 1530	3
	1530 - 2300	5

3.4 Test angling

Since sport anglers were required to release walleye and pike that were shorter than the minimum size limit (walleye 50 cm, pike 63 cm TL), creel clerks could not obtain any information regarding these protected-length fish. Hence, test angling was conducted throughout the survey period to collect additional information on the size frequency distribution of walleye and pike populations. Test angling consisted of creel clerks as well as ACA and ASRD fisheries staff, all with varying skill levels, fishing Orloff Lake for walleye and pike using lures, baits, and adopting techniques that would normally be used in the sport fishery. Test anglers recorded the number of hours fished, and the fork length (FL, ±1mm), of all fish caught. Ageing structures collected included the first three rays of the left pelvic fin for walleye and pike. All fish caught during the test fishery were released. To reduce handling time, weights from test fishery-sampled fish were not collected. Therefore, weight was estimated using a length-weight regression (WT = (1E-05)(FL)(2.9941), r^2 = 0.91, df = 8 97, P < 0.001) after applying a FL to TL conversions. The ratio of legal-length fish to protected-length fish sampled during the test fishery was assumed to be equal to the corresponding ratio from the sport fishery (Sullivan 2003b). These ratios were compared to determine the angler exaggeration rate, and to estimate the total catch rates for walleye and pike. Calculated weights of fish caught during the test fishery were applied to incidental mortality and total yield calculations. The catch rate calculated from the test fishery was not included in any of

the calculations regarding sport angler catch rate, effort (hours) or pressure (hours/hectare; hrs/ha).

3.5 Biological fish data

Creel clerks, when permitted, collected biological data from fish that were harvested by anglers. Data collected included FL (±1 mm), total weight to the nearest (±10 g), ageing structures, sex and state of maturity. Ageing structures collected included the left operculum and the first three rays of the left pelvic fin for walleye, the left cleithrum and the first three rays of the left pelvic fin for pike, and the left operculum and the anal fin for yellow perch. Sample material and ages were determined according to Mackay et al. (1990). Sex and state of maturity of each fish was determined following Duffy et al. (2000).

3.6 Data management and analysis

Field data were recorded on field data forms in pencil by creel clerks and then transcribed into Microsoft Excel files by a professional data entry service using double entry verification. Prior to analysis, frequency distributions of each creel survey parameter were calculated and the original data sheets and creel daily journals used to investigate and verify outliers. Scatter plots of weight-length and length-age were generated to identify outliers. Outliers were identified visually and omitted if measurement or recording error was suspected.

I used a bootstrap technique to calculate estimates and confidence intervals for number of anglers, number of hours, angling pressure (hrs/ha), harvest and yield (i.e., kg/ha) of sport fish (i.e., walleye and pike). Sullivan (2004) summarized bootstrapping as 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 (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).

Each site-use ratio (e.g., 72 anglers out of 92 interviewed used the access site being surveyed as their landing site) collected from the lake activity surveys, as a binomial probability, has a range of variation. I simulated this binomial (using Microsoft Excel's Random Number Generation), thereby creating a list of possible site-use ratios, with a range of variation that is correlated to the size of the original data sample (Sullivan 2004).

Each parameter that was obtained from creel survey data (e.g., number of anglers, number of hours, number of fish caught, kg/ha) was estimated to include spatial and temporal strata that were not surveyed. Each parameter and estimate is presented as a likelihood profile, using the simulation procedure described above and combined by multiplying the likelihood profiles. A flow chart describing the steps for calculating estimates for each creel site and for the survey is presented in Figure 2.

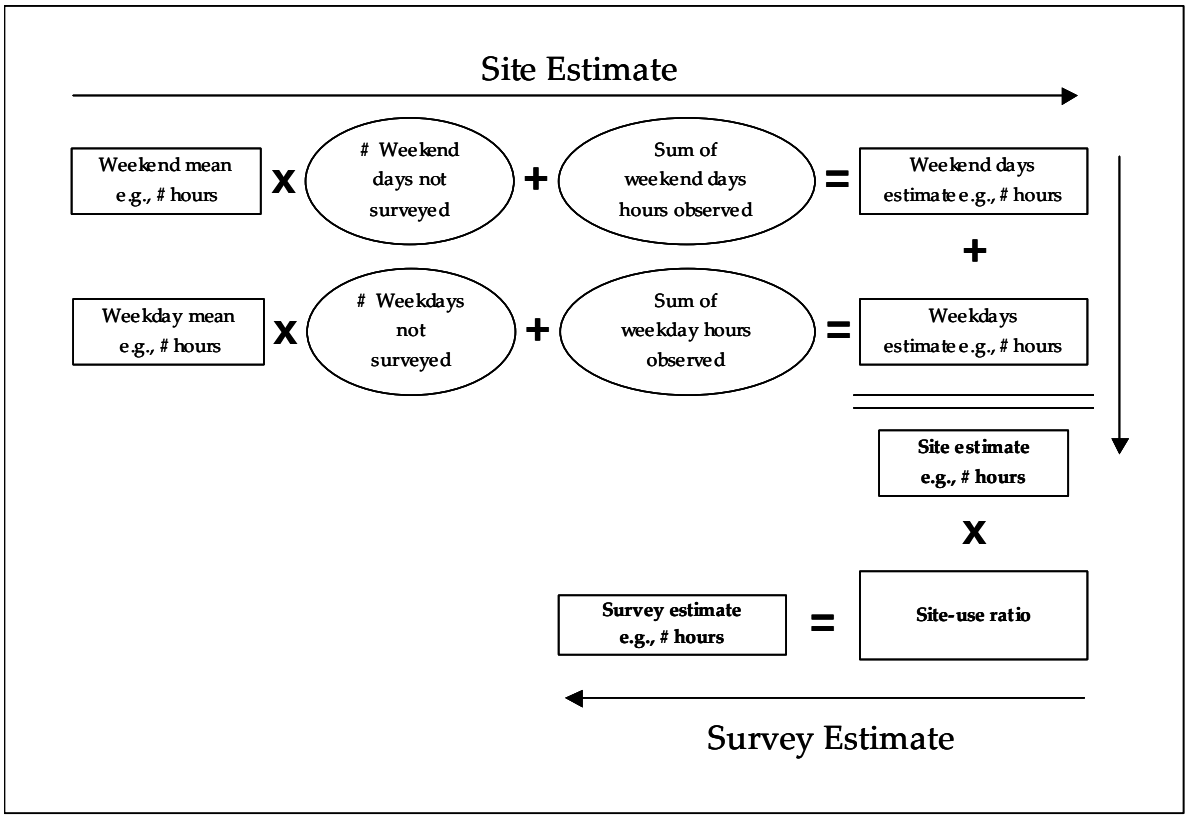

Figure 2. Flow chart outlining the process used for estimating parameters collected from the creel site and extrapolated to a survey estimate for Orloff Lake, 2004. Circles represent values with no variance (i.e., observed data) and rectangles represent data with variation (i.e., likelihood profiles).

Hooking mortality likely contributes to the overall yield of sport fish. Hooking mortality, or incidental mortality, was determined for walleye at Orloff Lake following a multivariate analysis (Reeves 2004). Reeves (2004) used a linear regression approach that included the covariates; month of capture, hooking location (e.g., stomach, gill, inner mouth), capture depth and water temperature, length category of walleye caught, angling gear (e.g., bobber, crank bait), and hook type (e.g., jig, treble) as explanatory variables. The total harvest estimate was determined by applying the resulting hooking mortality estimate (fish released X 3.6%) to the angler harvest estimate.

To quantify catch inequality among anglers for pike, Gini coefficients and angler success rates were calculated (Baccante 1995). A Gini coefficient of 0 indicates all anglers caught an equal amount of fish while a 1 indicates one person captured all fish.

To quantify size-class for pike, proportional stock density (PSD) and relative stock density (RSD) classifications were calculated (Gablehouse 1984). The PSD is the number of pike harvested that are equal to or greater than 530 mm TL, as a proportion of pike that are 350 – 529 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 greater than or equal to 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.

All data were stored in the Fisheries Management Information System (FMIS) of Alberta Sustainable Resource Development (ASRD).

4.0 RESULTS

4.1 Angler survey

While anglers had access to Orloff Lake from many points, we focused angler interviews at the access point identified as the highest use area by ASRD Fish and Wildlife Officers, Athabasca district office. Based on lake activity counts during the survey period, 78% of all angling effort was conducted from this access site (Appendix 6.1). In 2004, 202 anglers were interviewed between 23 May and 16 August (Table 2). During this period the estimated number or maximum likelihood estimate (MLE) of anglers was 488 (95% CI = 361 - 663, n = 202; Figure 3), with an estimated effort of 1749 angler-hrs (95% CI = 1,285 - 2,404, n = 684; Figure 4) and angling pressure of 0.95 angler-hrs/ha (95% CI = 0.70 - 1.31; Figure 5). By comparison to other Alberta lakes surveyed in the 1990s, Orloff Lake received very low angling pressure (Figure 6). A summary result of angler interviews is provided in Appendix 6.2.

Table 2.. Summary of observed, reported, and estimated catch rates of anglers from summer surveys conducted at Orloff Lake in 2004.

Creel Data	2004
Number of days surveyed	34
Number of anglers interviewed	202
Number of angling hours reported	684.00
Walleye Data	
Kept/ angler-hour	0.175
Released legal-size/ angler-hour	0.032
Released protected-size/ angler-hour	0.344
Total walleye/ angler-hour	0.551
Northern Pike Data	
Kept/ angler-hour	0.058
Released legal-size/ angler-hour	0.104
Released protected-size/ angler-hour	0.367
Total northern pike/ angler-hour	0.529
Yellow Perch Data	
Kept/ angler-hour	0 fish
Released/ angler-hour	0.004 (3 fish)

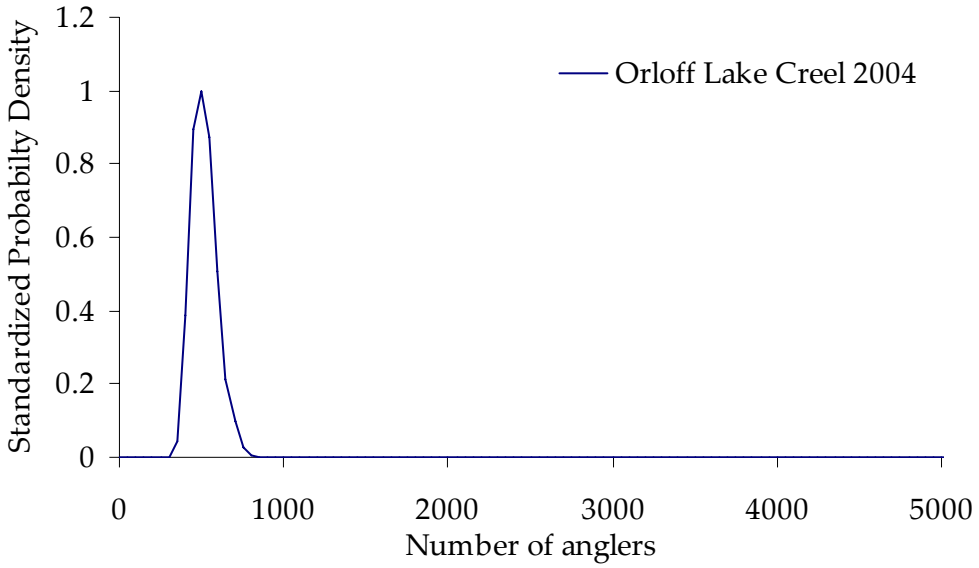

Figure 3. Standardized probability density function of anglers at Orloff Lake in 2004 (MLE = 488 anglers; 95% CI = 361 - 663).

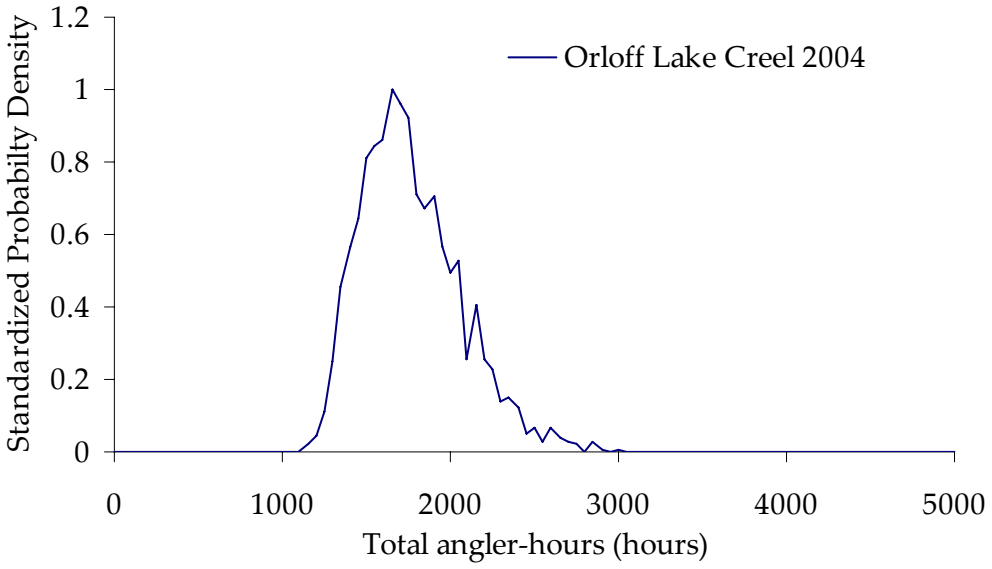

Figure 4. Standardized probability density function of angler-hours at Orloff Lake in 2004 (MLE = 1,749 angler-hrs; 95% CI = 1,285 - 2,404).

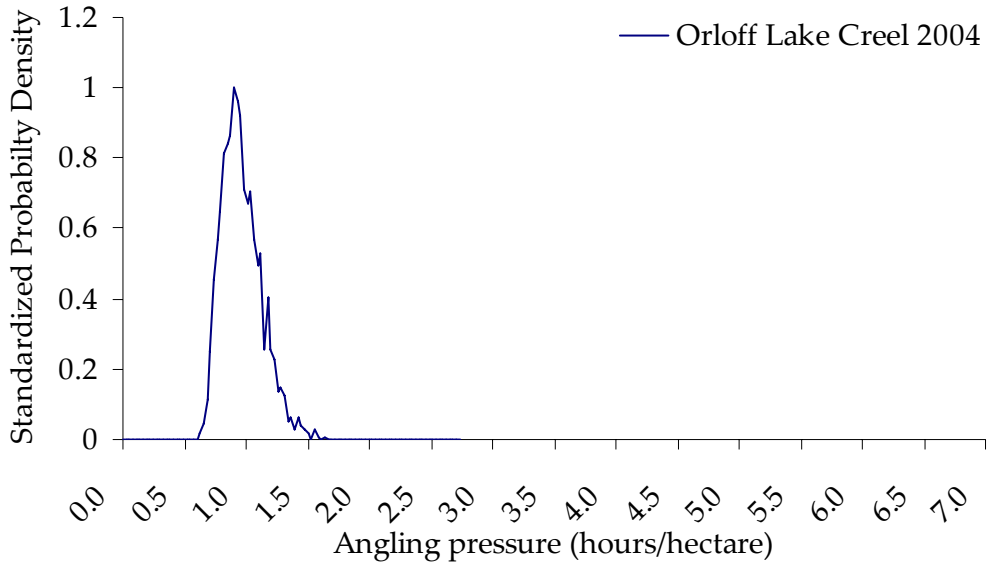

Figure 5. Standardized probability density function of angling pressure at Orloff Lake in 2004 (MLE = 0.95 hrs/ha; 95% CI = 0.70 - 1.31).

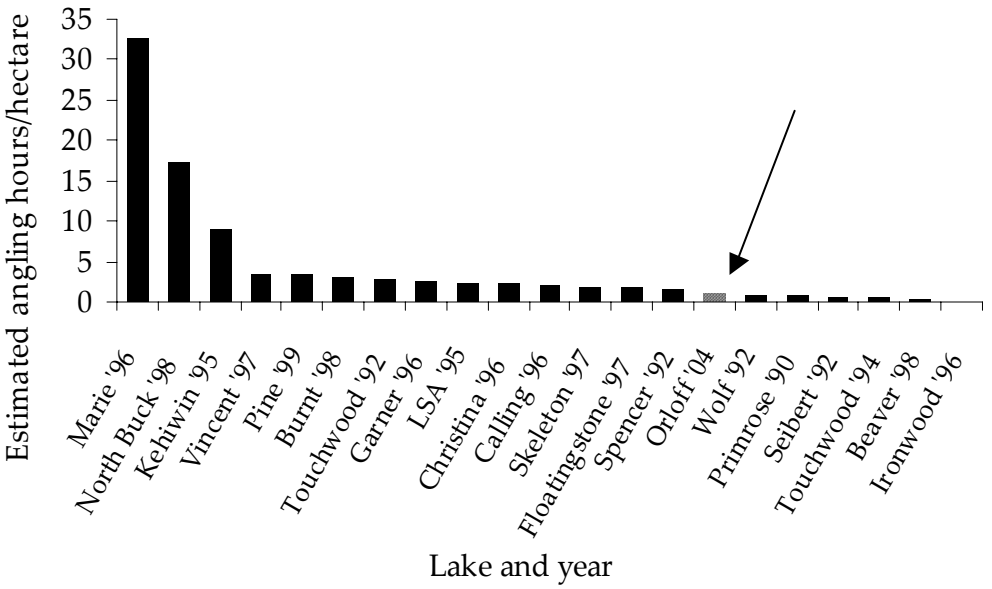

Figure 6. Lakes creel surveyed during the 1990s and 2000s and the angling pressure estimated during those survey periods (on average Victoria Day long weekend, mid-May, to late August). The textured bar and arrow indicates Orloff Lake 2004.

4.2 Walleye harvest and yield

Anglers harvested an estimated 286 walleye (95% CI = 186- 429, n = 120; Figure 7) at Orloff Lake during the 2004 survey. Harvested walleye had a mean weight MLE of 1.544 kg per fish (95% CI = 1.419 - 1.676 kg), which produces a yield MLE of 0.24 kg/ha (95% CI = 0.16 - 0.37; Figure 8). Given the current classification of vulnerable and the related sport fishery regulation, the level of risk associated with the present sport yield of walleye is low. Biological data collected from harvested walleye is provided in Appendix 6.4.

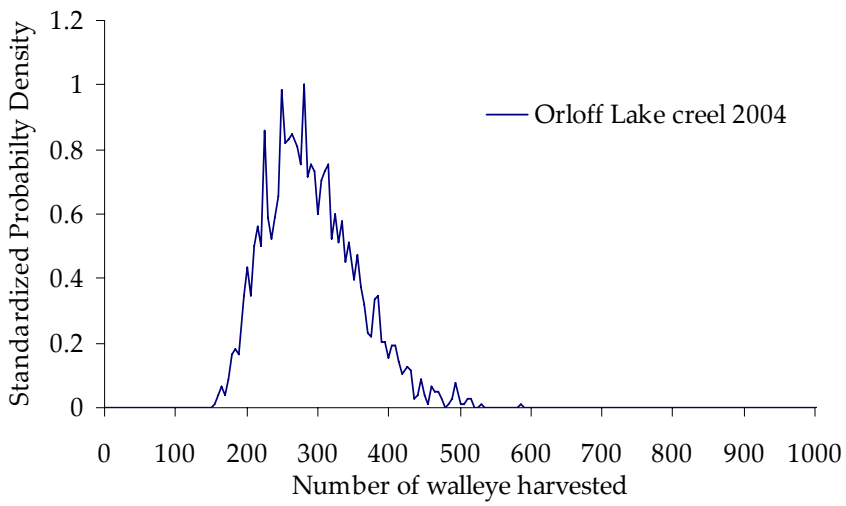

Figure 7. Standardized probability density function of the number of walleye harvested during the sport fishery at Orloff Lake in 2004 (MLE = 286 walleye; 95% CI = 186 - 429).

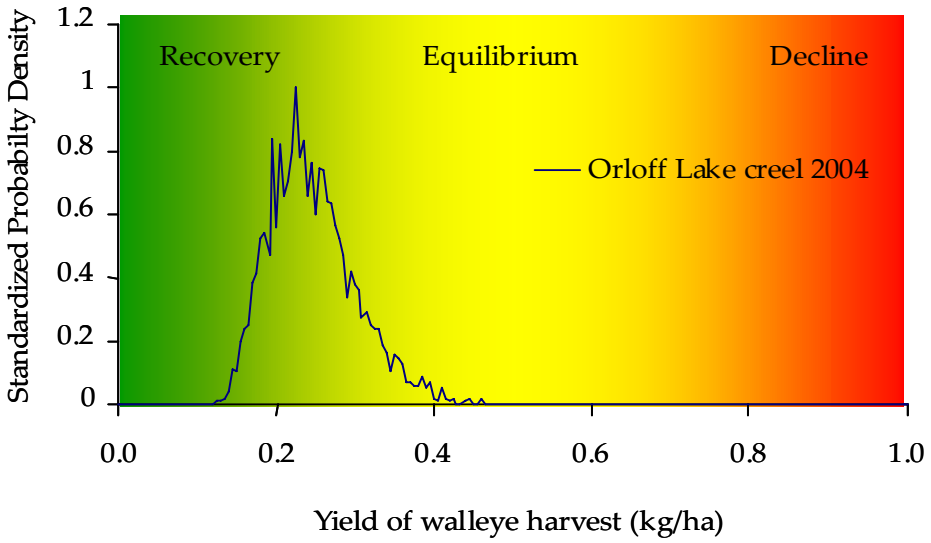

Figure 8. Standardized probability density function of the yield (kg/ha) of walleye harvested during the sport fishery at Orloff Lake in 2004. The categories (recovery, equilibrium and decline) of total allowable catch (TAC) were based on bootstrapped distributions of equilibrium and recovery yields from Alberta walleye fisheries categorized as vulnerable stocks (Sullivan 2004). The MLE of yield of walleye for the survey period was 0.24 kg/ha; 95% CI = 0.16 - 0.37).

Anglers released an estimated 697 walleye (95% CI = 451 - 1,085, n = 257; Figure 9). According to Sullivan (2003b), angler exaggeration of walleye catch rates at 20 Alberta lakes were negatively correlated with release rates. Based on this relationship between reported protected-length walleye and exaggeration (Sullivan 2003b; $y = 1.09x^{-0.28}$, $r^2 = 0.66$, $df = 19$, $P < 0.001$), the exaggeration factor was 1.47. This assumes the equation stated above applies to Orloff Lake, and suggests anglers exaggerated their catch rates by 47%. Taking this correction factor into account, the estimate of walleye released by anglers would be 471 fish (95% CI = 309 - 726).

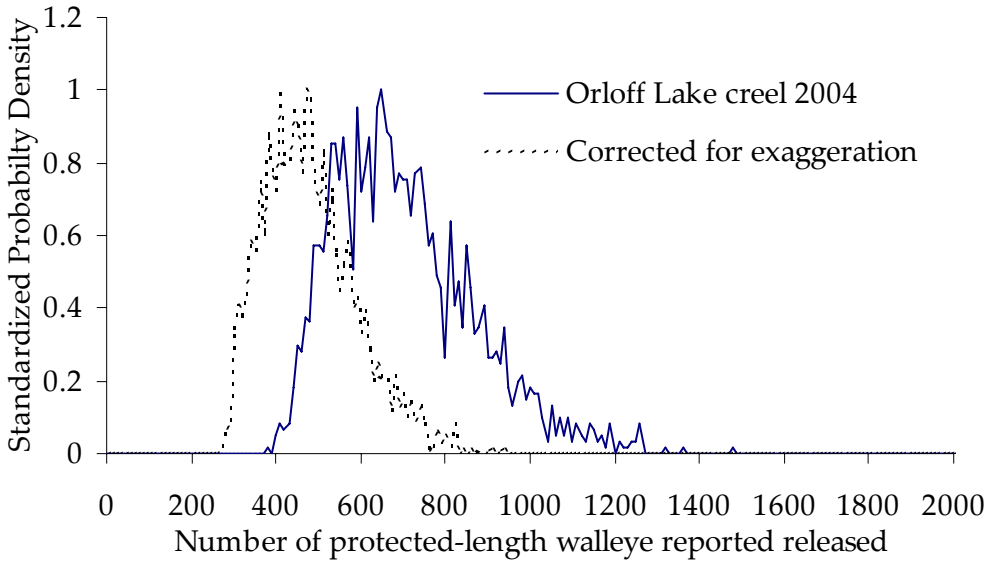

Figure 9. Standardized probability density function of the number of reported released walleye during the sport fishery at Orloff Lake in 2004 (MLE = 694 fish; 95% CI = 451 - 1085) and the corrected number of reported released walleye (MLE = 475; 95% CI = 306 - 718).

By applying an incidental mortality of 3.6% and a mean weight of 0.527 kg (based on test fishery data) for released walleye, the incidental mortality of walleye released by anglers was 17 or 0.005 kg/ha. Therefore, the total sport yield of walleye (harvest plus incidental mortality) was 303 walleye (0.25 kg/ha, 95% CI = 0.17 - 0.38).

Based on the scarcity relationship ($y = 1.25x^{-0.84}$, $r^2 = 0.66$, $df = 19$, $P < 0.01$) between illegal harvest of protected size walleyes and catch rate of protected length walleyes (Sullivan 2002), I estimate an illegal harvest of 3.0% at Orloff Lake in 2004. This suggests a minor increase in the estimated yield of walleye. In comparison, the average illegal harvest from 20 walleye fisheries was 18.4% (Sullivan 2002).

4.3 Northern pike harvest and yield

During the 2004 survey, the estimated harvest of pike was 106 (95% CI = 67 - 170, n = 40; Figure 10). The mean weight MLE of harvested pike was 1.980 kg per fish (95% CI = 1.772 - 2.223 kg), resulting in an estimated yield of 0.12 kg/ha

(95% CI = 0.07 - 0.18; Figure 11). Biological data collected from harvested pike is presented in Appendix 6.4.

The MLE for the number of pike released was 1,293 (95% CI = 1022 - 1667, n = 322). I assumed that pike released by the sport fishery had the same incidental mortality rate as walleye (3.6%). Based on the mean weight of 1.418 kg per fish (based on the test fishery), the incidental mortality was 46 pike or 0.04 kg/ha. Therefore, the total sport yield of pike during the 2004 survey was estimated to be 152 pike (0.15 kg/ha, 95% CI = 0.11 - 0.22).

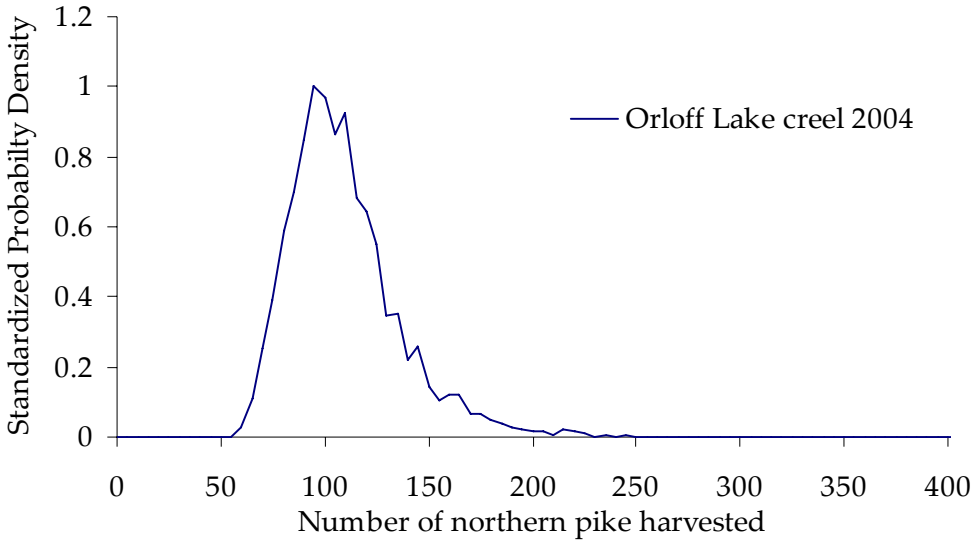

Figure 10. Standardized probability density function of the number of northern pike harvested during the sport fishery at Orloff Lake in 2004 (MLE = 106 pike; 95% CI = 67 - 170).

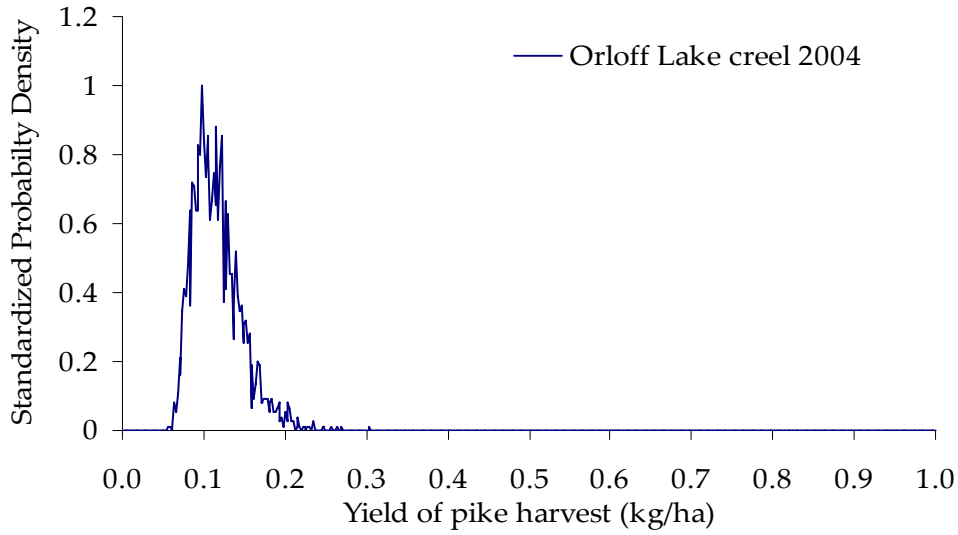

Figure 11. Standardized probability density function of the yield (kg/ha) of northern pike harvested during the sport fishery at Orloff Lake in 2004 (MLE = 0.12 kg/ha; 95% CI = 0.107 - 0.220).

4.4 Walleye sport fishery assessment

The following subsections are listed according to biological characteristics used by ASRD in the determination of management status categories (i.e., stable, vulnerable, collapsed). These categories are described in ASRDs Walleye Management and Recovery Plan (Berry 1995).

4.4.1 Age-class distribution and stability

In 2004 at Orloff Lake, walleye displayed a wide age-class distribution with 15 age-classes derived from test angling and sport fishery, with a mean age of 7.8 y (test angling only; Figure 12). There was no evidence of recruitment or year class failures in this fishery, and the fishery was supported by more than 8 age-classes.

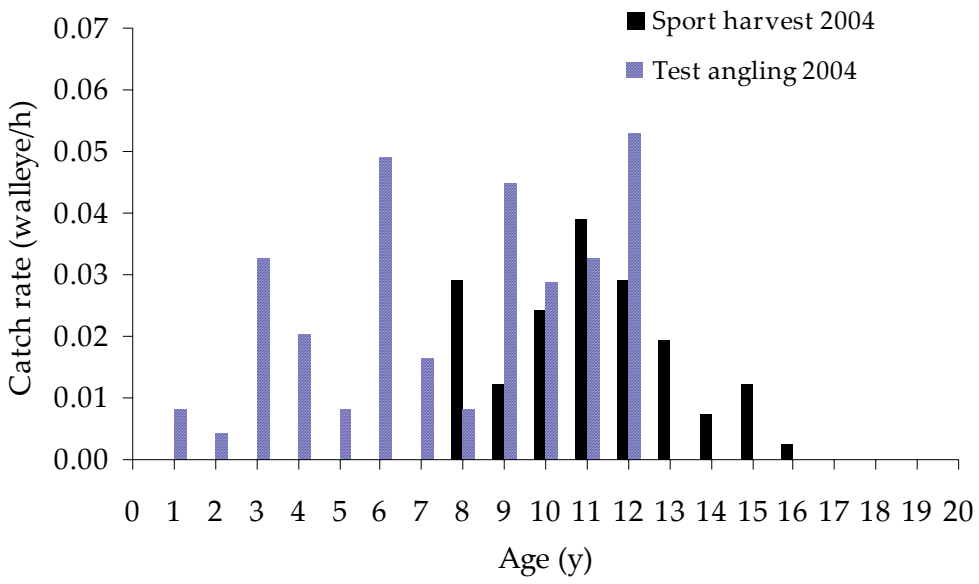

Figure 12. Age-class distribution of walleye sampled from the sport harvest during the creel survey and test sampling during the summer of 2004 at Orloff Lake. The test angling mean age was 7.8, $n = 75$.

4.4.2 Length-at-age

The growth rate (length-at-age) of walleye at Orloff Lake in 2004 was moderate, according to the WMRP. Walleye grew to 50 cm (FL) in approximately 8 to 10 years (Figure 13).

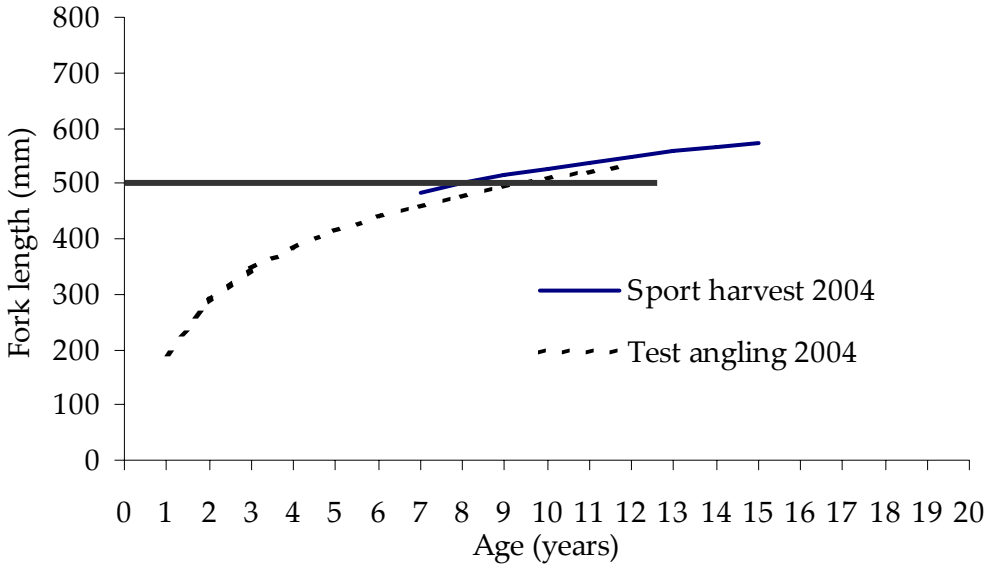

Figure 13. Length-at-age (logarithmic line-of-best-fit) of the 2004 sport harvest (r^2 = 0.31, n = 72) and test angling (r^2 = 0.81, n = 75) samples.

4.4.3 Catch rate

Catch rates for kept walleye and reported released walleye were 0.175/h and 0.376/h, respectively. The catch rate of legal-length walleye was 0.163/h. The reported protected-length and the legal-length release rates for walleye were 0.344/h and 0.032/h, respectively. Following Sullivan (2003b) and using the protected-length:legal-length ratio from test angling (33:42), an estimated release rate of 0.243 walleye/h was calculated. Therefore, the estimated total catch rate for walleye was 0.306/h.

4.4.4 Age-at-maturity

Data used to estimate the age-at-maturity distribution from sport-harvested walleye were biased since the regulation requires the release of protected-length walleye. Legal length walleye were first harvested at age 4 and all were mature for both male (Figure 14) and female (Figure 15). The mean age of mature male and female walleye was 13 and 18 y, respectively.

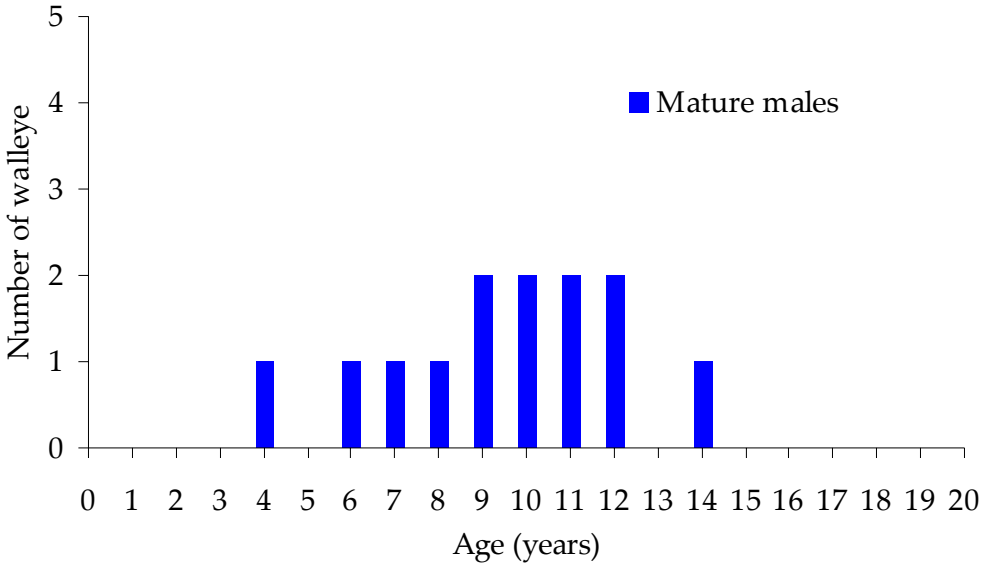

Figure 14. Age-at-maturity of male walleye in 2004 from Orloff Lake, Alberta. Mean age = 13, n = 10.

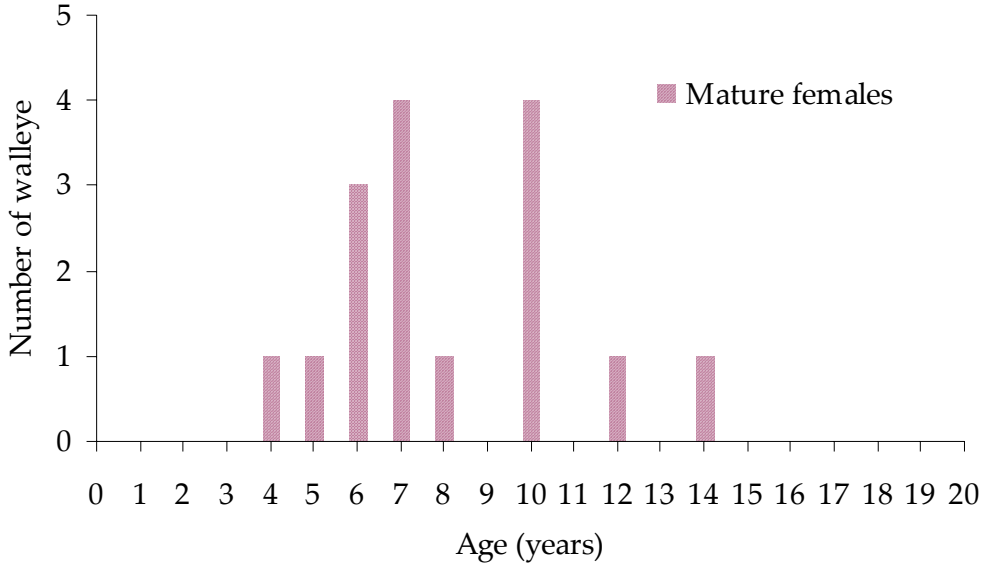

Figure 15. Age-at-maturity of female walleye in 2004 from Orloff Lake, Alberta. Mean age = 8, *n* = 16.

4.5 Northern pike sport fishery assessment

The status of the pike sport fishery was evaluated using the stock classifications described in the Northern Pike Management and Recovery Plan (NPMRP; Berry 1999) and criteria listed in Sullivan (1998).

4.5.1 Catch rate

The total reported catch rate of pike during the creel survey in 2004 was 0.529 pike/h. The observed catch rate of the 25 legal-length pike (>63 cm TL) harvested was 0.044 fish/h. The reported release rate was 0.367 pike/h. The catch rate of pike >63 cm that were kept corresponds to a collapsed pike fishery, whereas the total reported catch rate indicates a vulnerable (no risk) pike fishery, according to Berry (1999). Sullivan (2003b) warns that very low catch rates reported by anglers are exaggerated. Following Sullivan and using the protected-length to legal-length ratio from test angling, I estimated a release rate of 0.040/h. Therefore, the estimated total catch rate for pike was 0.094/h.

4.5.2 Age-class distribution

The age-class distribution of pike harvested during the sport fishery ranged from 1 to 9 y (Figure 16). Eight of 33 pike sampled during the creel survey were protected-length fish. Year-classes 1995 and 1996 were only just measurable (catch rate >0.002 pike/h); the other six year-classes were measurable, including the age-classes calculated for protected-length pike.

4.5.3 Length-at-age

Based on the guidelines suggested by the NPMRP (Berry 1999), the growth rate (length-at-age) of pike was relatively fast, reaching 630 mm TL (593 mm FL) by age 4 (Figure 17).

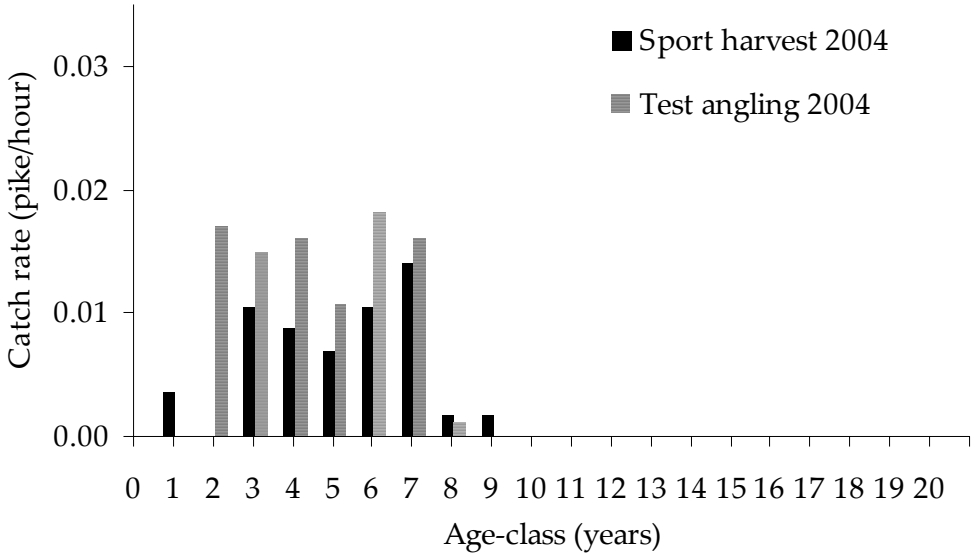

Figure 16. Age-class distribution of northern pike captured by sport anglers during the Orloff Lake creel survey (mean age = 5.1, *n* = 33) and test angling (mean age walleye = 4.5, *n* = 88).

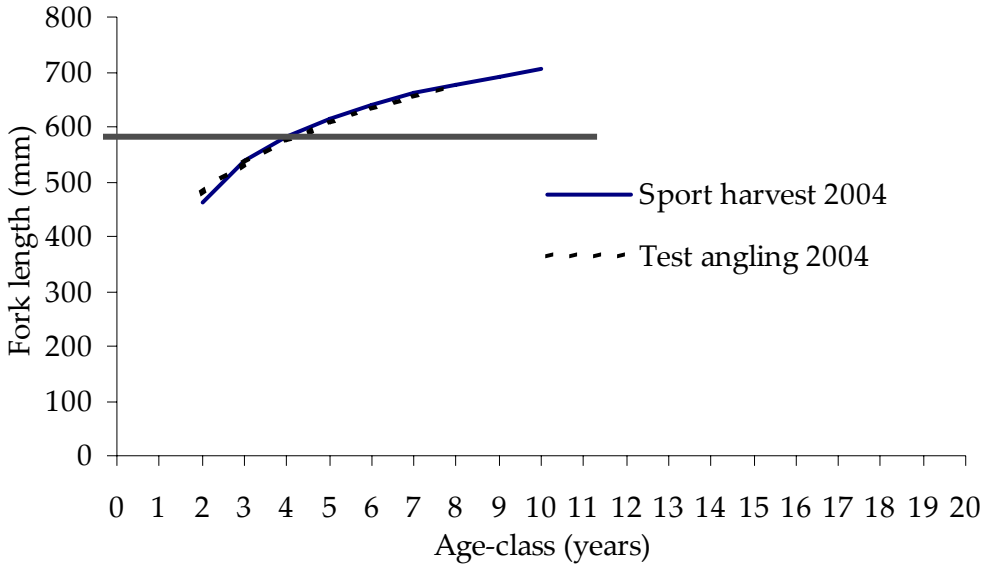

Figure 17. Length-at-age (logarithmic line-of-best-fit) of the 2004 sport harvest (r^2= 0.62, *n* = 33) and test angling (r^2=0.71, *n* = 88) samples.

4.5.4 Mean weight

The mean weight of pike >63 cm TL observed during the 2004 creel survey and test fishery was 2.0 kg per fish (n = 20) and 1.8 kg per fish (n = 49), respectively. Based on guidelines outlined by Sullivan (1998), a mean weight >1.0 kg can indicate recruitment overfishing.

4.5.6 Proportional and relative stock density

The PSD and RSD (stock-quality) associated with a very low catch rate, indicates an exploited pike fishery: 76% of the pike captured were considered "quality" (53-70 cm) and "preferred" (71 - 85 cm) fish (Gablehouse 1984). No pike >86 cm (considered "memorable" or "trophy" [>120 cm]) were sampled.

4.5.7 Angler success rate and Gini coefficient

Forty-one percent of the anglers interviewed during the survey were successful in catching one or more pike >63 cm TL (legal-length). The Gini coefficient was 0.65, indicating a moderate level of inequality in the catch of northern pike (Baccante 1995). Both % Success and Gini metrics include the anglers' reported released pike. Since the catch was likely exaggerated, % Success is likely lower than calculated and the Gini coefficient is likely higher than calculated.

4.6 Stock status summary

4.6.1 Walleye stock classification

According to the ASRD WMRP (Berry 1995), there was some variation in the status of the walleye fishery. Generally, Orloff Lake had moderate densities of walleye aged 3, 4, 6, 7, 9, 10, 11, and 12. The age-class distribution was stable except for the 1996 and 1999 year-classes. Hence, the walleye fishery was composed of moderately slow growing fish, although the age-at-maturity was quite young for both male and female walleye. All fish sampled were mature.

4.6.2 Pike stock classification

According to the ASRD NPMRP (Berry 1995), there was some variation in the assessment of the pike fishery at Orloff Lake in 2004. Generally, the age-class distribution was broad (ages 1 through 9) with very low densities. Growth was fast and most pike caught were larger than 52 cm TL. Sport anglers reported catching legal-size pike and they reported a catch that had a moderate level of inequality.

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6.0 APPENDIX

Appendix 6.1 An example of a creel survey field form.

Page # ________

Crew ______________________

2004 FISHERIES ASSESSMENT

S. Buck, Orloff or Marie Lake (circle one?)

Alberta Conservation Association

Date		Day	Time (24 h clock)			Anglers			Appendices									Interview		Species Caught							
Month	Date	Day Code	Time of day (10s)	Time of day (1s)	Time of day (1/4 hrs = 0, 25, 5, 75)	100s	10s Party # e.g. 017	1s	Landing…"At the end of your trip, where is the boat going to touch land?"	Time spent fishing (10s)	Time spent fishing (1s)	Time spent fishing (1/4 hrs = 0, 25, 5, 75)	Target	Method	Electronics	Skill	Residence…nearest town or city	OBSERVE whether using barbed hooks? 1 = Yes or 2 = No.	1 = complete trip interview or 2 = incompleted trip interview	# WALL kept	# WALL protected-length released	# WALL legal-length released	# NRPK kept	# NRPK protected-length released	# NRPK legal-length released	# YLPR kept	# YLPR released
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		20 interviews/page										.															

SHEET RULES
- NO blank spaces
- ALL spaces must have #s
- NO french 7s
- NO closed 4s
- *Landing* and *Residence* will be numerically coded during data entry…enter the place

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

TARGET
1 = WALL
2 = NRPK
3 = YLPR
4 = LKWH
5 = BRBT
6 = ANYTHING

METHOD
1 = Artificial
2 = Leeches
3 = Commercial Baitfish
4 = Seined Baitfish
5 = Dewworms
6 = Scentbaits
7 = Miscellaneous

ELECTRONICS
1 = Depth Sounder
2 = Depth Sounder + GPS
3 = GPS
4 = None
5 = Other

SKILL
1 = Novice
2 = Average
3 = Professional
4 = Test angling

Appendix 6.2 **Orloff Lake 2004 angler survey daily summary data. Day codes: 1=Monday, 2=Tuesday, 3=Wednesday, 4=Wednesday, 5=Friday, 6=Saturday, 7=Sunday; Species codes: WALL=walleye, NRPK=northern pike, YLPR=yellow perch.**

Date	Day Code	Anglers	Angling Hours	WALL Kept	WALL Released	NRPK Kept	NRPK Released	YLPR Kept	YLPR Released
May 22	6	0	0	0	0	0	0	0	0
May 23	7	11	53	3	4	4	8	0	0
May 24	1	0	0	0	0	0	0	0	0
May 25	2	0	0	0	0	0	0	0	0
May 26	3	0	0	0	0	0	0	0	0
May 27	4	0	0	0	0	0	0	0	0
May 28	5	4	24	3	1	0	21	0	0
May 29	6	0	0	0	0	0	0	0	0
May 30	7	0	0	0	0	0	0	0	0
June 5	6	5	17	0	0	1	18	0	0
June 6	7	3	10.5	0	1	0	3	0	0
June 7	1	5	21	1	0	0	3	0	0
June 8	2	8	20.5	8	4	0	13	0	0
June 18	5	6	30	5	20	3	11	0	0
June 19	6	69	279	58	110	16	119	0	3
June 20	7	26	58.5	8	15	1	20	0	0
June 21	1	2	7	2	3	1	4	0	0
June 22	2	0	0	0	0	0	0	0	0
July 2	5	0	0	0	0	0	0	0	0
July 3	6	20	44	18	27	4	27	0	0
July 4	7	8	24	8	53	1	65	0	0
July 5	1	0	0	0	0	0	0	0	0
July 16	5	4	16	4	9	0	2	0	0
July 17	6	4	16	0	0	1	4	0	0
July 18	7	0	0	0	0	0	0	0	0
July 19	1	0	0	0	0	0	0	0	0
July 20	2	0	0	0	0	0	0	0	0
July 31	6	10	30.5	0	6	4	0	0	0
August 1	7	3	3	0	0	0	0	0	0
August 2	1	0	0	0	0	0	0	0	0
August 3	2	0	0	0	0	0	0	0	0
August 13	5	2	7	0	0	0	0	0	0
August 14	6	6	16	2	4	2	2	0	0
August 15	7	6	7	0	0	2	2	0	0
August 16	1	0	0	0	0	0	0	0	0

Appendix 6.3 **Angling effort and catch data collected during lake activity surveys. This data was collected from 14 lake activity surveys conducted during the survey period.**

Landings	#Anglers	#Hours	Walleye Kept	Walleye Released	Pike Kept	Pike Released
Survey site (south trail)	72	176.0	29	92	12	76
Other	20	61.5	7	70	5	18
Total	92	237.5	36	162	17	94

Appendix 6.4 **Biological data collected from sport angler-harvested fish at Orloff Lake in the summer of 2004. Species codes: WALL=walleye, NRPK=northern pike; Sex code: M=male, F=female.**

Sample number	Species	Fork length (mm)	Total length (mm)	Weight (g)	Sex	Maturity	Age (yrs)
1	WALL	542	563	1600	M	Mature	8
2	NRPK	639	676	1700			7
3	NRPK	613	652	1500			6
4	WALL	539	571	1400	M	Mature	10
5	WALL	485	515	1300	M	Mature	9
6	WALL	489	518	1200	M	Mature	12
7	WALL	486	520	1480			12
8	NRPK	626	660		M	Mature	7
9	NRPK	803	850	3500	F	Mature	7
10	NRPK	711	754	2300	F	Mature	6
11	NRPK	638	675	2100	M	Mature	6
12	NRPK	555	594				3
13	WALL	633	665	2500			15
14	WALL	606	642	2200	F	Mature	12
15	WALL	485	515	1200			11
16	NRPK	627	665	1820	F	Mature	7
17	WALL	510	539	1400	M	Mature	12
18	WALL	560	588	1700	F	Mature	10
19	WALL	475	504	1120	M	Mature	11
20	WALL	561	595	1720	F	Mature	10
21	NRPK	630	661	1660			5
22	NRPK	679	715	2000	F	Mature	6
23	NRPK	675	690	2100	F	Mature	4
24	NRPK	697	735	2400	F	Mature	8
25	NRPK	615	654	1700	M	Mature	4
26	WALL	602	634	2300			12
27	WALL	525	557	1620			10
28	WALL	510	535	1460			7
29	WALL	515	542	1400			9
30	WALL	524	552	1380	M	Mature	14
31	WALL	549	565				9
32	WALL	525	555				9

Appendix 6.4. Continued.

Sample number	Species	Fork length (mm)	Total length (mm)	Weight (g)	Sex	Maturity	Age (yrs)
33	WALL	543	571				9
34	WALL	503	531				8
35	WALL	591	651				12
36	WALL	533	565				9
37	WALL	490	522		M	Mature	9
38	WALL	482	520	1240			10
39	WALL	497	530	1500			11
40	WALL	505	539	1500			11
41	WALL	482	510		F	Mature	7
42	WALL	497	523	1340	F	Mature	7
43	WALL	473	500	1020	M	Mature	10
44	WALL	515	543	1580	M	Mature	11
45	WALL	590	610	2300	F	Mature	14
46	WALL	655	679	2500			14
47	WALL	478	510	1000			11
48	WALL	550	584				10
49	WALL	502	533				8
50	WALL	630	667				13
51	WALL	501	533				
52	WALL	565	603				13
53	WALL	581	615				14
54	WALL	515	545				10
55	WALL	551	583				11
56	NRPK	650	690	1760			4
57	NRPK	638	680	1800			4
58	NRPK	609	645	1560			5
59	WALL	582	612	1940			13
60	WALL	520	551	1500			7
61	WALL	600	632	2200			12
62	WALL	481	508	1100			7
63	WALL	565	591	1760			10
64	WALL	470	496	1100			7
65	WALL	475	504	1240			7
66	WALL	548	580				9

Appendix 6.4. Continued.

Sample lumber	Species	Fork length (mm)	Total length (mm)	Weight (g)	Sex	Maturity	Age (yrs)
67	WALL	497	526				12
68	WALL	495	516				11
69	NRPK	707	745				7
70	WALL	495	525				11
71	WALL	483	571				11
72	WALL	490	520				10
73	WALL	482	513				8
74	WALL	574	602				10
75	WALL	467	499				9
76	NRPK	638	659				6
77	WALL	465	500				7
78	WALL	509	536	3600			11
79	WALL	476	506	1060			11
80	NRPK	735	780	3200			9
81	NRPK	647	690	1900			7
82	NRPK	615	652	1720			7
83	NRPK	425	456				1
84	NRPK	476	503				1
85	NRPK	689	725				7
86	WALL	482	510				7
87	WALL	531	567				14
88	WALL	557	585				10
89	WALL	499	523				9
90	WALL	550	584	1900			10
91	WALL	483	507	1180			7
92	WALL	550	580	1720			10
93	WALL	540	568				8
94	WALL	455	482	980			7
95	NRPK	570	622				4
96	WALL	510	540	1320			7
97	WALL	440	462				
98	WALL	365	386				
99	NRPK	644	660	1640	F	Mature	5
100	WALL	537	560	1640	F	Mature	10

Appendix 6.4. Continued.

Sample number	Species	Fork length (mm)	Total length (mm)	Weight (g)	Sex	Maturity	Age (yrs)
101	NRPK	687	739	2300			5
102	NRPK	637	674	1720	F	Mature	6
103	NRPK	565	603	1180			3
104	WALL	540	577	1640	F	Mature	10
105	NRPK	589	627				3
106	NRPK	700	736				3
107	NRPK	555	590				3
108	NRPK	547	582				3

Appendix 6.5 **Sample number, species, fork lengths and total lengths of fish captured during test angling at Orloff Lake (2004). Species codes: NRPK=northern pike, WALL=walleye.**

Sample number	Species	Fork length (mm)	Total length (mm)	Age (yrs)
1	NRPK	454	480	2
2	NRPK	561	591	7
3	NRPK	554	588	5
4	NRPK	590	630	3
5	NRPK	703	740	7
6	NRPK	410	440	2
7	NRPK	441	468	2
8	NRPK	710	819	7
9	NRPK	566	593	4
10	NRPK	568	606	3
11	NRPK	555	594	4
12	NRPK	580	608	3
13	NRPK	635	670	6
14	NRPK	583	621	7
15	NRPK	580	615	5
16	NRPK	634	670	6
17	NRPK	664	710	7
18	NRPK	594	631	7
19	NRPK	604	653	7
20	NRPK	609	645	6
21	NRPK	628	669	6
22	NRPK	603	641	6
23	NRPK	620	651	6
24	NRPK	607	643	7
25	NRPK	570	604	3
26	NRPK	626	663	5
27	NRPK	595	635	6
28	NRPK	659	698	7
29	NRPK	593	626	7
30	NRPK	770	810	8
31	NRPK	600	642	6
32	NRPK	444	476	2

Appendix 6.5. Continued.

Sample number	Species	Fork length (mm)	Total length (mm)	Age (yrs)
34	NRPK	610	655	6
35	NRPK	414	439	2
36	NRPK	720	762	7
37	NRPK	610	641	4
38	WALL	455	486	9
39	NRPK	570	612	5
40	NRPK	554	590	4
41	NRPK	655	690	6
42	NRPK	602	637	4
43	WALL	402	428	6
44	WALL	474	500	12
45	WALL	417	445	6
46	WALL	506	535	12
47	WALL	470	500	11
48	WALL	466	500	11
49	WALL	515	548	12
50	WALL	495	525	11
51	WALL	314	334	4
52	WALL	538	575	7
53	WALL	431	457	7
54	WALL	330	352	3
55	WALL	493	525	12
56	WALL	544	579	11
57	WALL	477	510	10
58	WALL	481	510	11
59	WALL	520	545	10
60	WALL	308	330	3
61	WALL	532	563	9
62	WALL	346	373	3
63	WALL	490	525	8
64	WALL	434	464	9
65	WALL	490	516	7
66	WALL	502	530	10
67	WALL	597	630	12

Appendix 6.5. Continued.

Sample umber	Species	Fork length (mm)	Total length (mm)	Age (yrs)
68	WALL	501	533	10
69	WALL	572	607	12
70	WALL	336	357	3
71	WALL	503	537	10
72	NRPK	664	703	
73	NRPK	687	730	
74	NRPK	515	548	
75	NRPK	572	604	
76	NRPK	516	552	
77	NRPK	598	640	
78	NRPK	598	632	
79	NRPK	631	671	
80	NRPK	553	587	3
81	WALL	496	530	9
82	WALL	584	615	12
83	WALL	565	594	11
84	WALL	420	445	6
85	WALL	360	384	4
86	NRPK	560	599	4
87	NRPK	519	550	4
88	NRPK	511	543	3
89	NRPK	565	603	4
90	WALL	414	442	5
91	WALL	474	505	9
92	WALL	345	366	3
93	WALL	503	531	12
94	WALL	540	570	10
95	WALL	397	420	6
96	WALL	488	520	12
97	WALL	535	565	11
98	NRPK	530	570	4
99	NRPK	441	474	2
100	NRPK	599	636	4
101	NRPK	597	637	4

Appendix 6.5. Continued.

Sample number	Species	Fork length (mm)	Total length (mm)	Age (yrs)
102	NRPK	674	720	7
103	NRPK	615	655	5
104	NRPK	586	624	6
105	WALL	335	357	3
106	WALL	425	453	5
107	NRPK	560	590	3
108	NRPK	627	665	5
109	NRPK	601	635	5
110	NRPK	633	655	6
111	NRPK	625	655	7
112	NRPK	533	566	3
113	NRPK	468	503	2
114	WALL	469	500	9
115	WALL	465	495	6
116	WALL	407	433	6
117	WALL	335	356	3
118	WALL	210	226	1
119	WALL	497	528	6
120	NRPK	602	638	3
121	NRPK	650	689	5
122	YLPR	185	195	
123	WALL	505	535	12
124	WALL	509	536	6
125	WALL	454	480	7
126	NRPK	642	681	4
127	NRPK	527	556	4
128	NRPK	465	500	2
129	WALL	350	373	3
130	WALL	454	485	9
131	WALL	472	500	8
132	WALL	590	625	12
133	WALL	465	498	6
134	WALL	231	244	1
135	WALL	562	594	9

Appendix 6.5. Continued.

Sample number	Species	Fork length (mm)	Total length (mm)	Age (yrs)
136	NRPK	475	503	2
137	NRPK	468	501	2
138	NRPK	538	572	3
139	NRPK	472	529	2
140	NRPK	610	644	6
141	YLPR	229	238	
142	YLPR	191	201	
143	WALL	454	482	9
144	WALL	614	648	12
145	WALL	505	536	9
146	WALL	348	369	4
147	WALL	490	522	10
148	NRPK	606	647	6
149	NRPK	556	593	3
150	NRPK	500	533	2
151	NRPK	663	705	4
152	NRPK	536	569	3
153	NRPK	454	485	2
154	NRPK	636	669	6
155	NRPK	634	674	6
156	NRPK	550	587	3
157	WALL	555	588	9
158	WALL	500	530	6
159	NRPK	484	516	2
160	WALL	575	610	12
161	WALL	372	394	4
162	WALL	464	493	6
163	WALL	290	313	2
164	NRPK	644	680	4
165	NRPK	591	629	3
166	NRPK	498	530	2
167	NRPK	720	756	7
168	NRPK	604	645	5
169	NRPK	703	746	5

Appendix 6.5. Continued.

Sample number	Species	Fork length (mm)	Total length (mm)	Age (yrs)
170	NRPK	520	554	2
171	NRPK	654	695	6
172	WALL	492	521	11
173	WALL	393	415	4
174	WALL	437	466	6

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