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**Assessment of the Summer Sport
Fishery for Walleye and Northern Pike
at Smoke Lake, Alberta, 2005**



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Assessment of the Summer Sport Fishery for Walleye and Northern Pike at Smoke Lake, Alberta, 2005

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EXECUTIVE SUMMARY

To ensure recovery and sustainability of Alberta's walleye and pike fisheries, Alberta Sustainable Resource Development (ASRD) implemented new management strategies in 1996 and 1999 for walleye (*Sander vitreus*) and northern pike (*Esox lucius*). Based on criteria in the new walleye strategy, Smoke Lake was classified as having a stable walleye fishery. This classification resulted in several regulation modifications between 1996 and 2004. Currently (2004), anglers are permitted to harvest two walleye (daily possession limit) with a minimum size limit of 60 cm total length (TL). Similarly, from 1999 to 2005, the pike fishery was classified as a stable-recreational fishery and anglers were allowed to harvest three pike with a minimum size limit of 63 cm TL. To examine the impacts of these management strategies on the walleye and pike fisheries, the Alberta Conservation Association (ACA) conducted a creel survey on the lake during the summer of 2005. The Smoke Lake study is part of a three-year project to estimate angler effort and fish stock yields for walleye and pike on several lakes in Alberta.

Based on angler interviews conducted between 20 May and 21 August 2005, an estimated 1,358 anglers (95% CI = 1,181 - 1,562, n = 493) fished Smoke Lake for 2,842 h (95% CI = 2,428 - 3,301, n = 1,024.25) for an angling pressure of 2.96 h/ha (95% CI = 2.53 - 3.44). No walleye were observed harvested in the sport fishery during the survey. Anglers released an estimated 7,167 walleye (95% CI = 6,105 - 8,293, n = 2,636) for an estimated total yield (harvest + 4.6% incidental mortality) of 0.241 kg/ha (95% CI = 0.227 - 0.283).

Anglers harvested an estimated ten pike (95% CI = 5 - 16, n = 4), with a mean weight of 2.26 kg/fish. This translates to a yield of 0.022 kg/ha (95% CI = 0.010 - 0.041). Anglers reported a pike release rate of 0.196 fish/h and released an estimated 553 pike (95% CI = 449 - 669, n = 204), resulting in a total yield (harvest + incidental mortality) of 0.046 kg/ha (95% CI = 0.032 - 0.065).

ACKNOWLEDGEMENTS

Alberta Conservation Association (ACA) funded this creel survey. The ACA is particularly thankful to Tara Furukawa and Jennifer Meachem, the seasonal technicians, who interviewed many anglers, spent numerous hours test-angling and managed the data in a way that ensured its safety. We also acknowledge Shane Wood for his review of this report.

We also thank Alberta Sustainable Resource Development (ASRD), Stony Plain Fisheries Management, for providing the use of a truck, fuel, and camping supplies. Thanks to ASRD, Fox Creek, Alberta, for the use of the bunkhouse, and the town of Fox Creek for allowing the crew to stay free-of-charge at the Smoke Lake Campground. Thanks also to Human Resources and Development Canada for providing funding for seasonal staff 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 levels of average fisheries. Fisheries receiving heavier than average exploitation were not adequately protected by these regulations and many declined or collapsed. Ultimately, this 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, WMRP; Berry 1995) and in 1999 (Alberta's Northern Pike Management and Recovery Plan, NPMRP; Berry 1999). Through the strategies identified in these two recovery plans, each fishery was assessed and assigned a status category (i.e., collapsed, vulnerable, or stable), based on measures of angler pressure, yield, and population structure.

In 1996, the WMRP was implemented and Smoke Lake was classified as a stable walleye fishery (Alberta Government 1996). This classification resulted in a regulation that permitted anglers to harvest three walleye (daily maximum bag limit) each with a minimum size limit of 43 cm total length (TL). From 2000 to 2003, the regulation for walleye was modified and the daily possession limit was reduced to two walleye with a minimum size limit of 50 cm TL. In 2004, the minimum size limit was increased to 60 cm TL.

Following the implementation of the NPMRP in 1999, a province-wide sport fishing regulation was implemented thereby classifying the majority of pike fisheries, including Smoke 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.

1.2 Study rationale

The Alberta Conservation Association (ACA) conducted a creel survey in 2005 at Smoke Lake to provide information on angler use, sport fish yield and sport fishery structure. Creel surveys are a non-invasive technique that can effectively estimate the parameters required for management (e.g., angler use, sport fish yield and sport fishery structure). Management plans for walleye and pike were designed to use creel survey data, therefore data gathered in this report will be used to manage the walleye and pike sport fisheries. Furthermore, Smoke Lake was identified for inclusion in a larger study conducted by ASRD that examines the effect of fishing harvest on walleye populations in Alberta lakes (Stephen Spencer, Alberta Sustainable Resource Development, Spruce Grove. pers. comm.); thus, data gathered here will be used in this larger study.

2.0 STUDY AREA

Smoke Lake is located about 245 km northwest of Edmonton, and 9 km southwest of Fox Creek, Alberta (Figure 1). The lake has a surface area of 959 ha (Mitchell and Prepas 1990), with public vehicle access west of Highway 43. Smoke Creek, the major inflow to the lake, flows into the southeast bay, and the outflow, an unnamed creek is located on the west side which joins to the Little Smoky River and eventually flows into the Smoky River to the west (Figure 1).

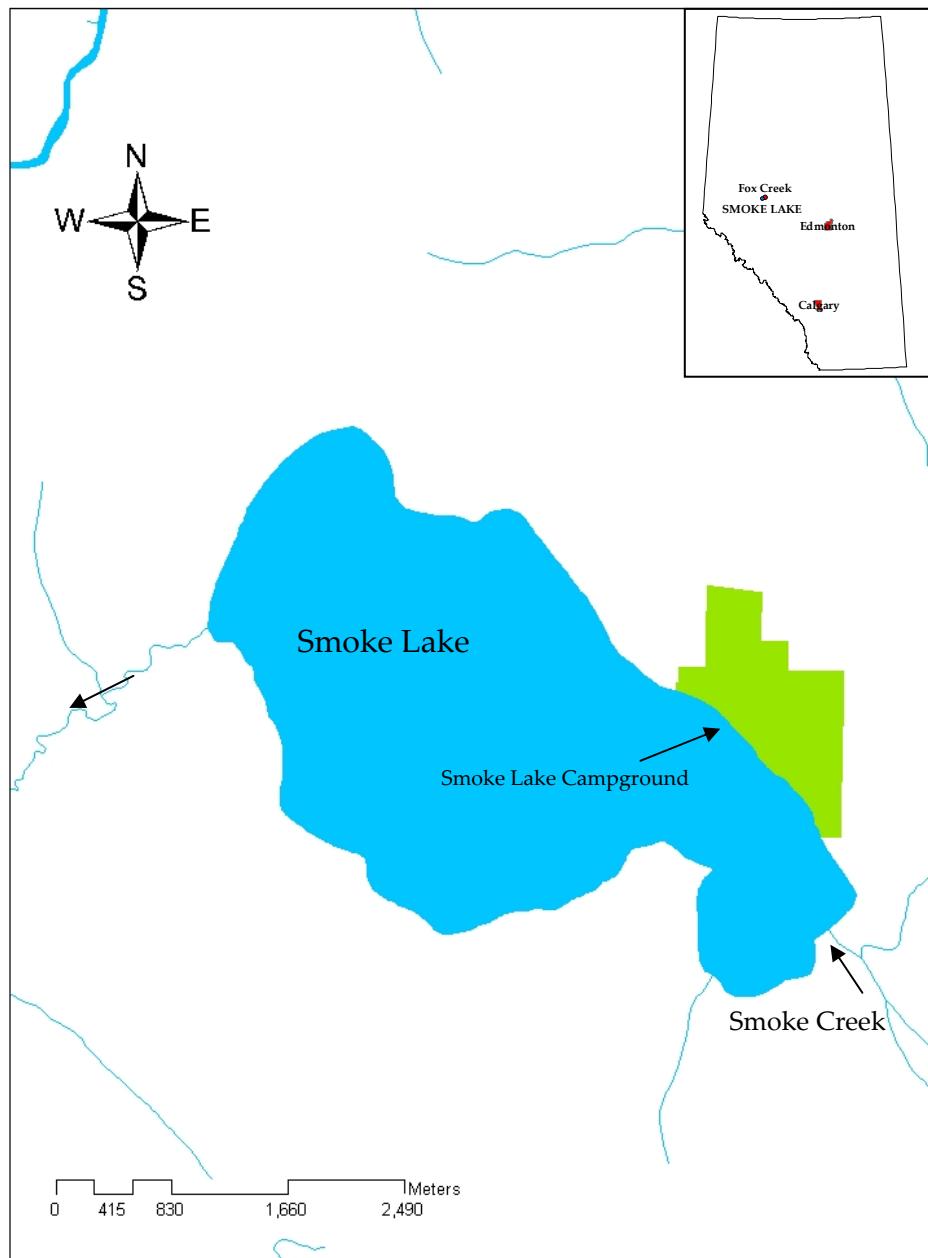


Figure 1. Map of Smoke Lake, Alberta. Major inflow and outflow creeks are indicated by arrows.

3.0 MATERIALS AND METHODS

3.1 Creel survey

An access point creel survey (Pollock et al. 1994) was conducted from 25 May to 21 August 2005 at the Smoke Lake Campground located at the southeast side of the Lake (Figure 1). Angling access to the lake is limited to the campground. Two creel clerks collected angler and sport fishery data as anglers returned from completed angling trips. 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 fishing in their party, angling method, targeted species, use of electronics, use of barbless hooks and residence. These data were recorded on a creel survey data form (Appendix 1). At the time of the interview, 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 novice. Anglers that demonstrated clear superiority in equipment and knowledge were classified as professionals. All other anglers were considered to have moderate skill.

The creel survey was stratified into three strata; weekdays (Wednesdays and Thursdays), weekend days (Fridays, Saturdays and statutory holidays), and Sundays (weekend days). Each day (Wednesday - Saturday) was surveyed from 0830 – 2300h. Sundays (travel days) were surveyed from 0830 – 1800h. To account for Sundays' unsurveyed period (1800 – 2300h) in the creel estimates (e.g., number of anglers, number of angling hours, and yield), the unsurveyed period was assumed to have the same characteristics as the surveyed period. Anglers who returned from fishing trips before 0830h or after 2300h were interviewed at the campground at the next convenient juncture. Survey dates and summary information are listed in Appendix 2. Surveys were conducted for five consecutive days during a 14-day rotation. The other five consecutive days were spent conducting a parallel creel survey at Iosegun Lake, Alberta (Watkins and Patterson 2006) and the remaining four days were days-of-rest. This rotation cycle was repeated seven times throughout the summer.

3.2 Test angling

Test angling was conducted throughout the survey period to collect information on the length and age distributions of walleye and pike populations. Since sport anglers were required to release walleye and pike that were shorter than the minimum size limit (walleye 60 cm TL, pike 63 cm TL), creel clerks could not obtain information regarding these protected-length fish from the sport harvest. Test angling was conducted by creel clerks, as well as ACA and ASRD fisheries staff and volunteers, all of varying skill levels. Test angling for walleye and pike was performed using lures, baits, and techniques that would normally be used in the sport fishery. Test anglers recorded the number of hours fished, and the fork length (FL, ± 1 mm), of all fish caught. Ageing structures collected included non-lethal structures: the first three rays of the left pelvic fin for walleye and pike. All fish caught during test angling were released. To reduce handling time, weight was not measured on fish captured during test angling. Therefore, weight was estimated using a walleye length-weight regression ($WT = 1E - 05FL^{2.9641}$, $r^2 = 0.92$, $df = 895$, $P < 0.001$, unpublished data) and a pike length-weight regression ($WT = 2E - 01FL^{2.8779}$, $r^2 = 0.92$, $df = 849$, $P < 0.001$, unpublished data) containing fork length-total length and length-weight conversions.

The ratio of legal-length fish to protected-length fish sampled during test angling 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 then to estimate total catch rates for walleye and pike. A calculated weight of fish caught during test angling was applied to incidental mortality, and thus, to total yield calculations. The catch rate calculated from test angling was not included in any of the calculations regarding sport angler catch rate, effort (h) or pressure (h / ha).

3.3 Biological fish data

When permitted, creel clerks collected biological data from fish that were harvested by anglers. Data collected included fork length (± 1 mm), total wet weight (± 10 g), ageing structures, sex and state of maturity (Duffy et al 2000). Ageing structures collected included the left operculum 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 first annulus tightly surrounding the focus indicates year one, but samples were aged by a modified method that promotes consistent age determination. The following equation (1) was used to help identify the 1st annulus (Watkins and Spencer, in prep.):

$$(1) \quad S_c = FR (L_0) / L_C$$

where,

S_c = radius of fin ray cross-section at capture,

FR = fin ray radius,

L_0 = length at age-0,

L_C = length of the fish at capture.

3.4 Data management and analysis

Field data were recorded on forms 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 were used to verify outliers. Scatter plots of weight-length and length-age were also generated to identify outliers. Outliers, identified by visual inspection, were omitted if measurement or recording errors were suspected.

A bootstrap technique was used to calculate estimates and confidence intervals for number of anglers, angling hours, angling pressure (h/ha), harvest, catch and yield (i.e., kg/ha) of walleye and pike. Sullivan (2004) summarized that bootstrapping is a statistical procedure whereby an original sample of the population is subsequently resampled 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). By repeating this procedure thousands of times, a distribution of possible means is obtained that describes 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). Calculated empirical confidence intervals (95% CI) were completed according to Haddon (2001). The final proportions (i.e., probability densities) were standardized to range between 0 and 1 (Paul et al. 2003).

Each parameter that was obtained from the creel survey data (e.g., number of anglers, angling hours, number of fish caught, fish harvest) was estimated to include 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 adding or multiplying the likelihood profiles. A flow chart describing the steps for calculating estimates for the survey is presented in Figure 2.

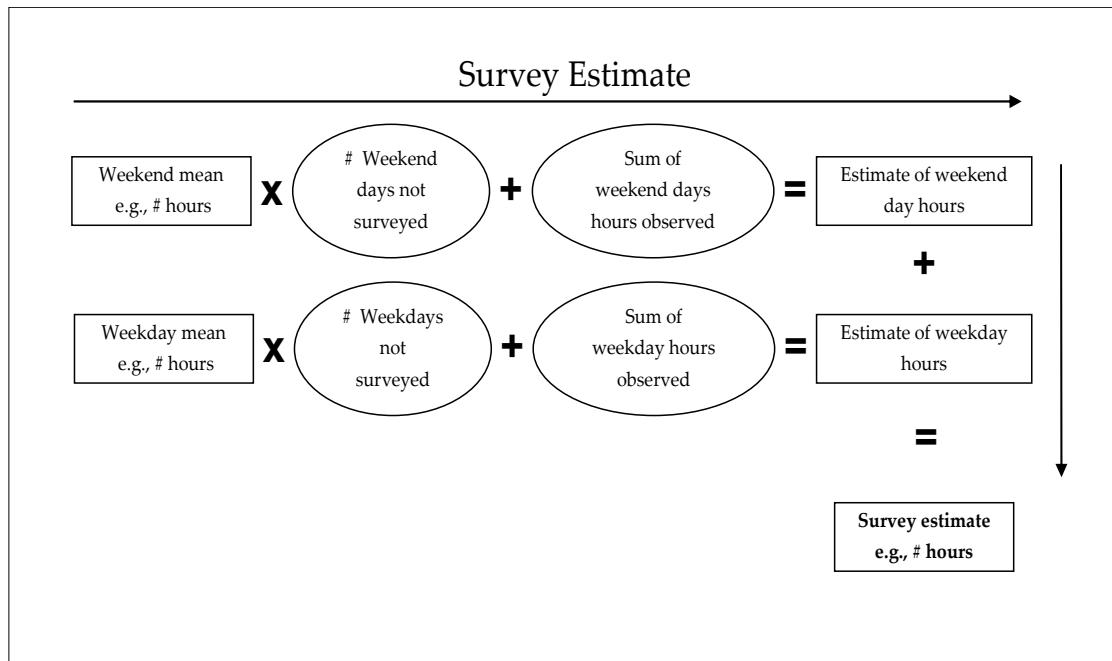


Figure 2. Flow chart outlining the process used to estimate parameters collected from the creel site and to create extrapolated data to a survey estimate for Smoke Lake 2005. Circles represent values with no variance (i.e., observed data) and rectangles represent data with variation (i.e., likelihood profiles).

Hooking mortality contributes to the overall yield of sport fish. Hooking mortality, or incidental mortality, was determined for walleye at Smoke Lake following a multivariate analysis as suggested by Reeves (2004). The analysis by Reeves (2004) includes a multiple regression used to calculate hooking mortality from 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). The hooking mortality estimate (4.6%) was applied to the estimated number of fish released by anglers. The total harvest estimate was determined by combining the resulting hooking mortality estimate (fish released X 4.6%) with the angler harvest estimate.

To portray fish growth as a function of time (i.e., length-at-age), the von Bertalanffy growth equation (2) was used (von Bertalanffy 1938):

$$(2) \quad L_t = L_\infty (1 - e^{-k(t - t_0)})$$

where,

L_∞ = maximum theoretical length that can be attained,

k = growth coefficient,

t = time of age in years,

t_0 = time in years when length would theoretically be equal to 0,

e = exponent for natural logarithms

L_∞ , t_0 , and k were calculated using the Fishery Analysis and Simulation Tools version 2.1 (Slipke and Maceina, 2001). The length-at-age data were fitted to the growth model by applying the equation independently to each average fork length per age-class.

The NPMRP includes metrics that describe the distribution of catch, proportional stock density, and relative stock density. To quantify catch inequality among anglers for pike, Gini coefficients and angler success rates were calculated (Baccante 1995). A Gini coefficient of zero indicates all anglers caught an equal amount of fish, whereas a one indicates one person captured all fish. To quantify the size-classes of 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 \geq 530 mm total length (TL), as a proportion of pike that are 350 - 529 mm TL. A high PSD value indicates a larger portion of mature fish, and likely indicates a 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 \geq 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 these calculations.

Data from this creel survey were stored in the provincial government's Fisheries Management Information System (FMIS) that is maintained by Alberta Sustainable Resource Development (ASRD).

4.0 RESULTS AND SUMMARY

4.1 Angler surveys

In 2005, 493 anglers were interviewed between 25 May and 21 August 2005 (Table 1). Summaries of data from angler interview are provided in Appendix 2. During this period, an estimated 1,358 anglers (95% CI = 1,181 - 1,562, n = 493; Appendix 3) fished for 2,842 h (95% CI = 2,428 - 3,301, n = 1,024.25; Appendix 4) or 2.96 angler-h/ha (95% CI = 2.53 - 3.44; Appendix 5). Compared to results of creel surveys at other Alberta lakes (unpublished data), Smoke Lake received a low number of total anglers (Figure 3).

Table 1. Summary of observed and reported catch rates of anglers from the 2005 Smoke Lake creel survey.

Creel Data	2005
Number of days surveyed	35
Number of anglers interviewed	493
Number of angling h reported	1024.25
Walleye Data	
Kept/h	0.00
Released/h	2.54
Total walleye/h	2.54
Northern Pike Data	
Kept/h	0.003
Released/h	0.192
Total northern pike/h	0.196

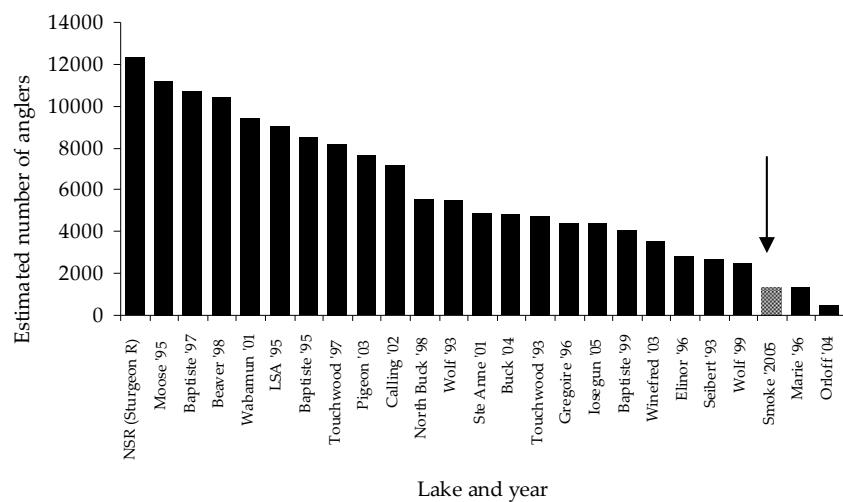


Figure 3. Estimated number of anglers from creel surveys conducted at Alberta lakes during the 1990s and 2000s (on average Victoria Day long weekend, mid-May to late August; unpublished data). Data from the creel survey at Wolf Lake in 2005 is shown by the hatched bar.

4.2 Walleye harvest and yield

Anglers released an estimated 7,167 walleye (95% CI = 6,105 - 8,293, n = 2,636; Appendix 6). According to Sullivan (2003b) using data from 20 Alberta lakes, angler exaggerations of walleye catch rates are negatively correlated with release rates. Based on the relationship between reported protected-length walleye and exaggeration estimates ($y = 1.09x^{-0.28}$, $r^2 = 0.66$, df = 19, P < 0.001; Sullivan 2003b), the exaggeration factor was 0.87. Assuming this equation can be applied to Smoke Lake, this result indicates anglers exaggerated their catch rates by < 1%.

No sport harvest of walleye was observed. By applying an incidental mortality of 4.6% and a mean weight of 0.696 kg (95% CI = 0.659 - 0.744) for protected-size walleye from test angling, the incidental mortality of walleye released by anglers was 332 walleye or 0.241 kg/ha (95% CI = 0.227 - 0.283). Data collected on walleye from test angling are provided in Appendix 7.

Based on the scarcity relationship ($y = 1.25x^{-0.84}$, $r^2 = 0.66$, df = 19, P < 0.01) between illegal harvest and catch rate of protected-length walleyes (Sullivan 2002), illegal harvest was estimated to be about 0.57%. Sullivan (2002) states the average illegal harvest based on data from 20 walleye fisheries was 18.4%. Therefore, illegal harvest likely resulted in an insignificant increase in yield at Smoke Lake.

4.3 Walleye sport fishery assessment

The following subsections are listed according to biological characteristics used by the WMRP in the determination of management status categories (i.e., stable, vulnerable, collapsed). Given that no walleye were observed harvested by the sport fishery during the 2005 survey, the test angling samples were used to describe the age-class distribution and the length-at-age relationship of walleye. We assumed the ratio of legal-length to protected-length fish sampled during test angling was equal to the corresponding ratio from the sport fishery.

4.3.1 Catch Rate

The total reported catch rate of walleye during the creel survey was 2.54 fish/h. There were no walleye reported harvested by anglers; thus, the total reported catch rate is simply the reported release rate. Compared to results of creel surveys of other Alberta lakes surveyed since 1993 (unpublished data), Smoke Lake had a high catch rate (Figure 4).

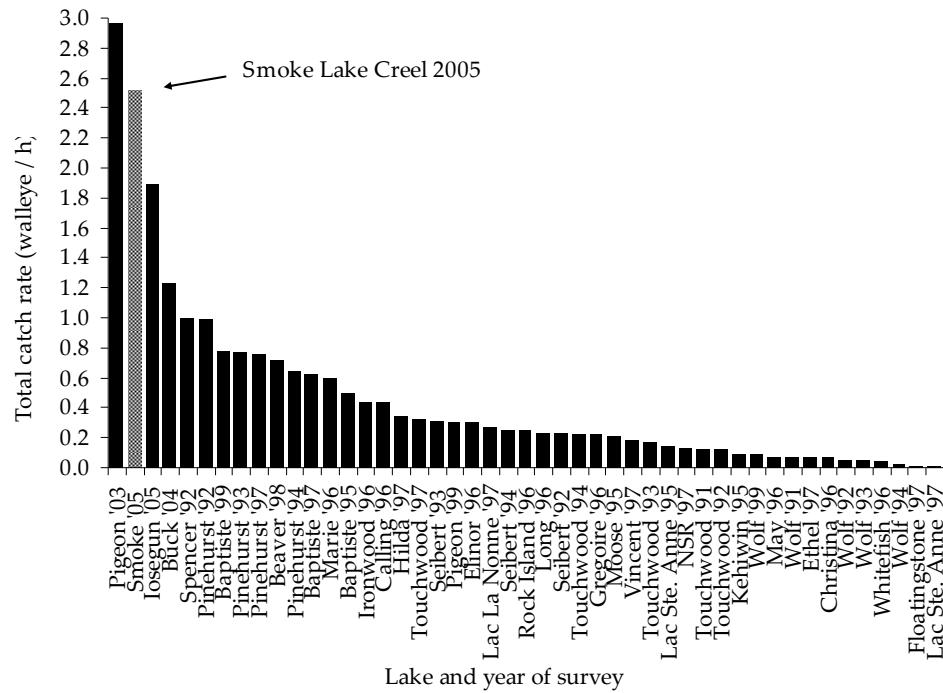


Figure 4. Total catch rates (walleye/h) from creel surveys conducted in the 1990s and 2000s (unpublished data). The range of total catch rates was 2.97 to 0.003 walleye/h. The textured bar is data from Smoke Lake in 2005 (2.54 walleye/h).

4.3.2 Age-class distribution and stability

The age-class distribution was fairly wide (Figure 5) with six age-classes being represented. Three age-classes (6 to 8 y) supported the fishery. There was evidence of

low recruitment with low numbers of young walleye 200 – 400 mm FL (Figure 6) sampled. Age-classes older than 9 y were absent and the mean age was 6.7 y ($n = 200$).

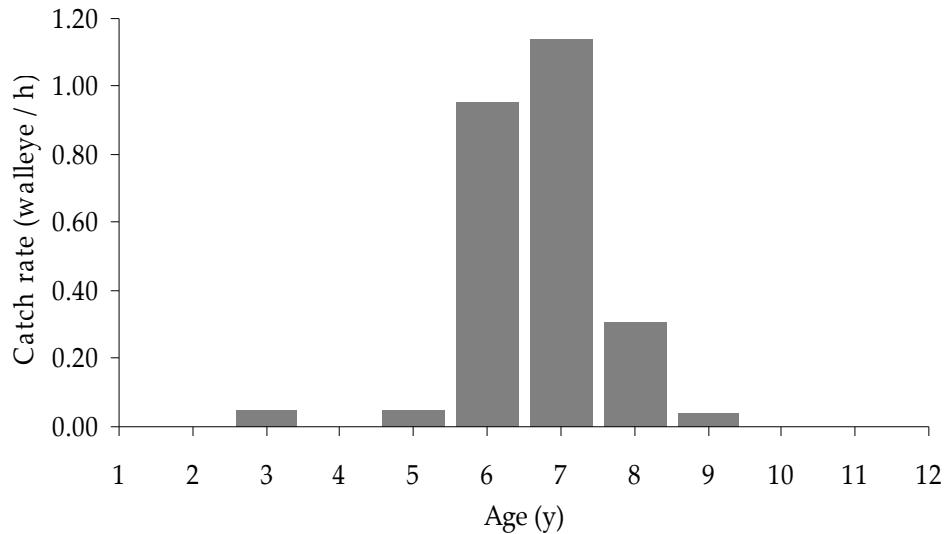


Figure 5. Age-class distribution of walleye sampled during test angling at Smoke Lake in 2005. Mean age of walleye was 6.7 y ($n = 200$).

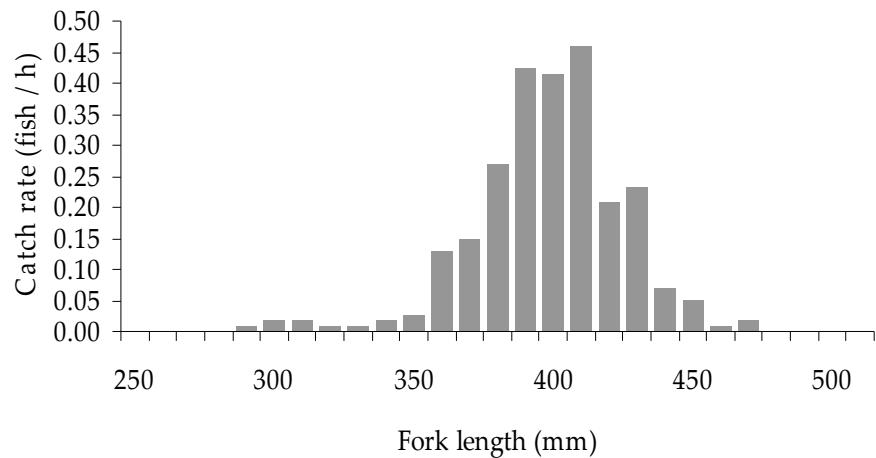


Figure 6. Length-class distribution of walleye sampled during test angling at Smoke Lake in 2005. Mean length was 394 mm ($n = 293$).

4.3.3 Length-at-Age

The length-at-age relationship for walleye indicates slow growth and suggests walleye grow to 50 cm FL in approximately 10 years (Figure 7).

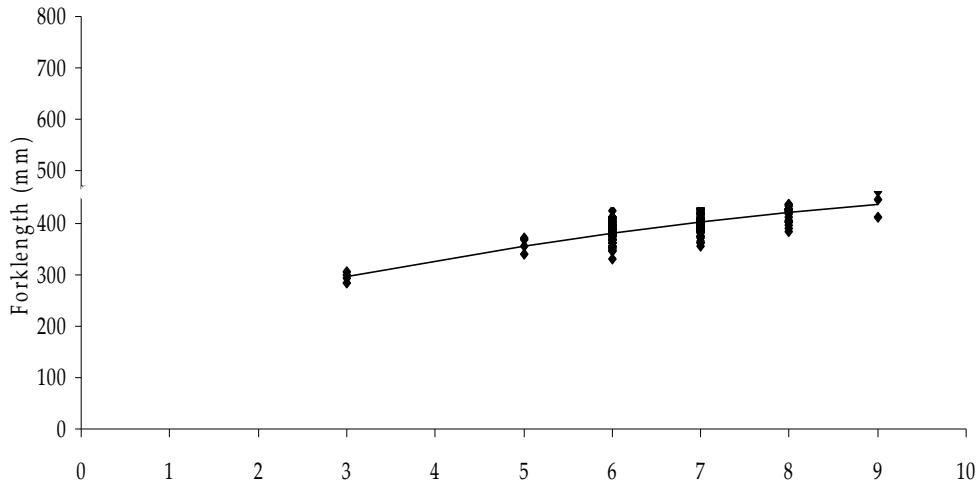


Figure 7. Length-at-age relationship for test angled walleye from Smoke Lake in 2005. Line is the von Bertalanffy growth curve.

4.3.4 Age-at-maturity

The number of samples collected was inadequate to determine age-at-maturity.

4.4 Northern pike harvest and yield

During the 2005 survey, anglers harvested an estimated 10 pike (95% CI = 5 - 16, n = 4; Appendix 8) with a mean weight of 2.26 kg/fish (95% CI = 1.99 - 3.07, n = 3), resulting in a yield of 0.022 kg/ha (95% CI = 0.010 - 0.041; Appendix 9). Biological data collected from harvested pike are presented in Appendix 10.

Anglers released an estimated 543 pike (95% CI = 437 - 659, n = 208). Assuming the pike released by the sport fishery had the same incidental mortality rate as walleye (4.6%) and a mean weight of 0.896 kg/fish (95% CI = 0.782 - 1.017 kg), the incidental mortality of pike was 25 fish or 0.023 kg/ha (95% CI = 0.018 - 0.029). Therefore, the total sport yield of pike during the 2005 survey period was 0.046 kg/ha (95% CI = 0.032 - 0.065).

4.5 Northern pike sport fishery assessment

The status of the pike sport fishery was evaluated using the stock classifications described in the NPMRP (Berry 1999) and criteria listed by Sullivan (1998).

4.5.1 Catch rate

The total reported catch rate (harvest + release) of pike during the creel survey was 0.196 fish/h. The observed harvest rate of the four legal-length pike (> 63 TL) was 0.003 fish/h and the reported release rate was 0.192 fish/h.

4.5.2 Age-class distribution

The age-class distribution of pike sampled (test angling and sport fishery), ranged from 2 to 9 y (Figure 8). Ages-7, 8 and > 9 y were absent from the sample. All age-classes caught during test angling and harvested by the sport fishery were measurable (i.e., age-class catch rate > 0.002 fish/h) except for the age-9 cohort.

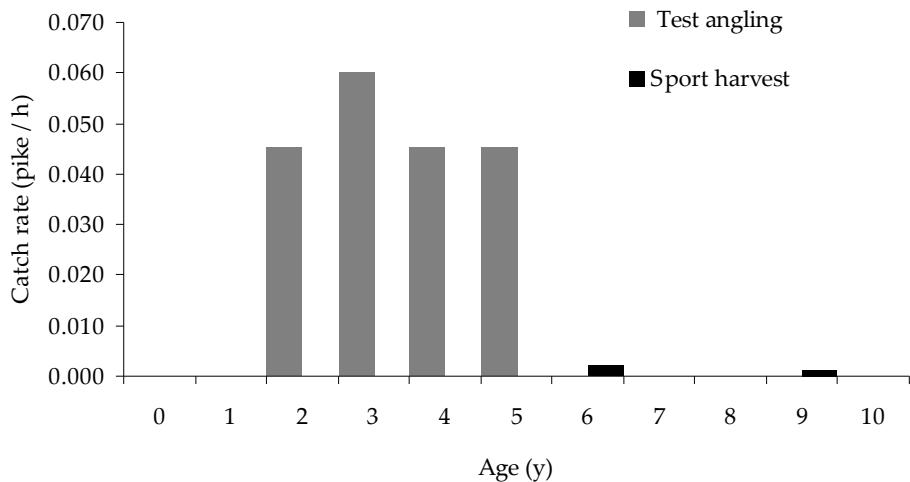


Figure 8. Age-class distribution of northern pike harvested by the sport fishery (mean age = 7.0 y, $n = 3$) and sampled by test anglers (mean age = 3.5 y, $n = 13$) at Smoke Lake in 2005.

4.5.3 Length-at-age

According to the NPMRP, the length-at-age of pike at Smoke Lake in 2005 indicated a moderate rate of growth, with pike on average reaching 630 mm TL (593 mm FL) by approximately age-6 (Figure 9). According to Sullivan (1998), this length-at-age indicates a vulnerable pike population.

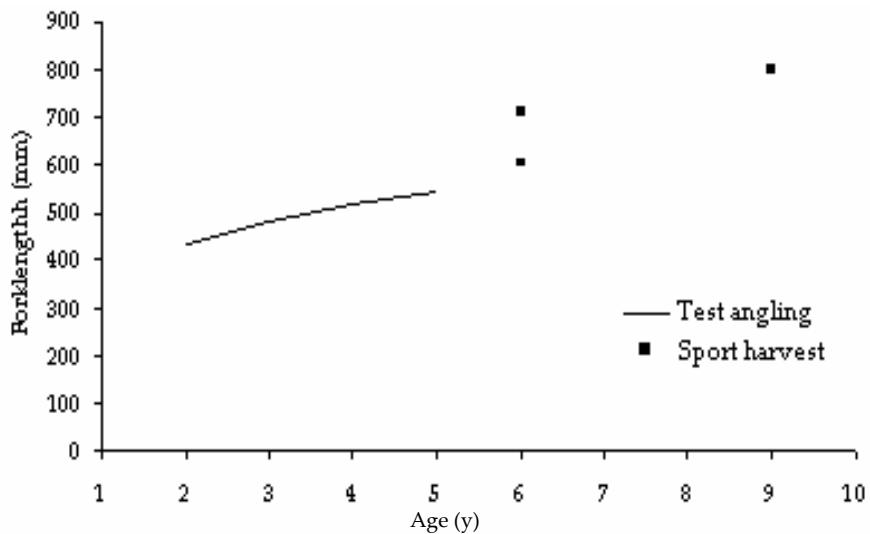


Figure 9. Length-at-age relationship for test angled and sport harvested pike collected during the Smoke Lake creel survey in 2005. A von Bertalanffy growth curve generated from test angling data is shown. A similar curve could not be generated for sport harvested pike due to small sample sizes ($n = 3$); therefore, a scatterplot is shown.

4.5.4 Age-at-maturity

The number of samples collected was inadequate to determine age-at-maturity.

4.5.5 Mean weight

The mean weight of pike > 63 cm TL observed during the 2005 creel survey was 2.27 kg ($n = 3$, range = 2.00 - 3.07). According to Sullivan (1998), a mean weight of > 2 kg can reflect a stable population. However, a mean weight calculation based on three fish is highly uncertain.

4.5.6 Proportional and relative stock density

Due to the small sample size ($n = 3$), proportional and relative stock densities could not be calculated. Based on designations in Gablehouse (1984), one pike harvested was “quality” size (53 - 70 cm) and the other two pike were “preferred” size (71 - 85 cm).

4.5.7 Angler success rate and Gini coefficient

Only 0.2% of all anglers interviewed were successful in catching one or more pike > 63 cm TL (legal-length), assuming all legal pike caught were harvested. The Gini coefficient was 0.79, indicating a high level of inequality in the catch of pike (Baccante 1995). Both success and Gini metrics include the anglers’ reports of released pike. Since the low catch rates were likely exaggerated (Sullivan 2003b), the percent success is likely lower than calculated and the Gini coefficient is likely higher than calculated.

4.6 Summary of walleye and pike fishery assessments

4.6.1 Walleye fishery assessment

There was no walleye observed harvested during the creel survey and anglers reported a release rate of 2.54 fish/h. Generally, Smoke Lake had high densities of 6 - 8 y walleye and weak representation of younger fish, indicating weak recruitment. There were no walleye > 9 y observed and growth was slow.

4.6.2 Pike fishery assessment

Only three pike were harvested during the creel survey and anglers reported releasing very few fish (0.192 fish/h). The age-class distribution from test angling indicates that the fishery is supported by four age-classes of pike (2 – 5 y). Growth was moderate. Sport anglers had very poor success and there was substantial inequality in the distribution of the catch.

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6.0 APPENDICES

Appendix 1. An example of the 2005 creel survey field form.

2005 Smoke / Iosegun Lake Creel Survey										Page #
Complete Trip Data										
 Lake: Smoke / Iosegun (circle one) <input checked="" type="checkbox"/> Crew = _____										
 UNIVERSITY OF ALBERTA										
Date	Day	Time	Anglers	Residence	Time fishing	Species Caught	Angling Regulations:			
							Month	WALL limit 2 over 60 cm NRPK limit 3 over 63 cm YLPR limit 15 LKWH limit 10 BURB limit 10	Iosegun Lake WALL limit 3 over 43 cm NRPK limit 3 over 63 cm YLPR limit 15 LKWH limit 10 BURB limit 10	Sheer Rules - NO Blank Spots - Horizontal lines = 03 - Vertical lines = as between Anglers 1 thru 9 - # anglers in each party 1, 2, 3..
Month _____ Date _____ Day Code 24hr clock i.e. 15 = 3:00 p 1/4 hrs = 0, 25, 5, 75 Party # i.e. 017 Angler # 1 thru 9										
Location hours 10's hours 1's 1/4 hrs = 0, 25, 5, 75 # WALL KEPT # WALL RELEASED # NRPK KEPT # NRPK RELEASED # YLPR KEPT # YLPR RELEASED # LKWH KEPT # LKWH RELEASED Angling Method Target Skill Electronics										
Day Code 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday 7 = Sunday 8 = Holiday										
Method 1 = Artificial 2 = Leeches 3 = Commercial Baits 4 = Seined Baits 5 = Deworms 6 = Scents baits 7 = Aspirated										
Target 1 = WALL 2 = NRPK 3 = YLPR 4 = LKWH 5 = BURB										
Skill 1 = Novice 2 = Average 3 = Pro 4 = Guided 5 = Test Angling										
Residence Code 1 = Fox Creek 2 = Whitecourt 3 = Mayerthorpe 4 = Valleyview / Gr. Prairie 5 = Edson / Hinton 6 = Gr. Cache 7 = Edmonton / Area 8 = Swan Hills / Slave Lake 9 = Cold Lake and West 10 = Athabasca 11 = Peace River and Acre 12 = South of Ft. Vermilion 13 = Calgary Area 14 = East of Red Deer 15 = Lethbridge and North 16 = Out of Province 17 = U.S. 18 = Other County										
TOTALS										

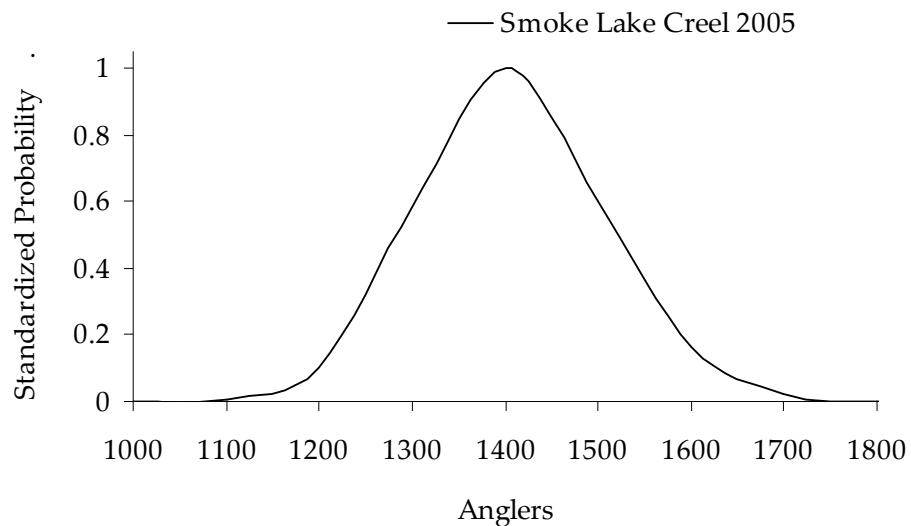
Appendix 2. Daily summary of creel survey data collected during the 2005 Smoke Lake creel survey. Species codes: WALL = walleye, NRPK = northern pike, YLPR = yellow perch.

Date	Anglers	Angling (h)	WALL Harvested	WALL Released	NRPK Harvested	NRPK Released	YLPR Caught
25 - May	0	0.00	0	0	0	0	0
26 - May	8	15.00	0	18	0	6	0
27 - May	10	16.25	0	34	1	9	0
28 - May	14	40.00	0	38	0	3	0
29 - May	6	22	0	53	0	2	0
8 - Jun	3	4.50	0	8	0	0	0
9 - Jun	5	10.00	0	57	0	5	0
10 - Jun	31	38.50	0	166	0	13	0
11 - Jun	58	93.25	0	292	0	29	0
12 - Jun	10	10.50	0	42	0	1	0
22 - Jun	0	0.00	0	0	0	0	0
23 - Jun	0	0.00	0	0	0	0	0
24 - Jun	0	0.00	0	0	0	0	0
25 - Jun	13	23.00	0	47	1	12	0
26 - Jun	10	15.00	0	75	0	2	0
6 - Jul	11	23.00	0	139	0	1	0
7 - Jul	3	8.50	0	13	0	2	0
8 - Jul	28	60.25	0	179	0	14	0
9 - Jul	18	36.00	0	187	1	4	0
10 - Jul	16	37.00	0	77	0	15	0
20 - Jul	7	5.00	0	0	0	2	0
21 - Jul	12	26.25	0	61	0	3	0
22 - Jul	8	20.00	0	43	0	3	0
23 - Jul	30	100.75	0	239	0	35	0
24 - Jul	14	34.50	0	129	0	12	0
3 - Aug	16	46.50	0	78	0	2	0
4 - Aug	14	26.50	0	13	0	5	0
5 - Aug	16	28.50	0	118	0	0	0
6 - Aug	19	39.00	0	91	0	7	0

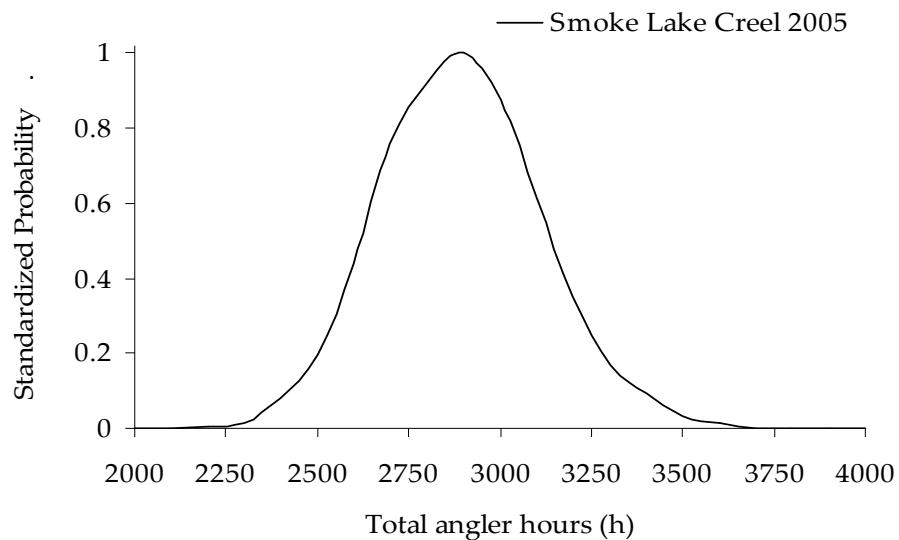
Appendix 2. Continued.

Date	Anglers	Angling (h)	WALL Harvested	WALL Released	NRPK Harvested	NRPK Released	YLPR Caught
7 - Aug	12	27.50	0	51	0	2	0
17 - Aug	7	15.50	0	36	0	1	0
18 - Aug	26	55.50	0	89	1	5	0
19 - Aug	12	15.50	0	17	0	2	0
20 - Aug	32	76.50	0	149	0	8	0
21 - Aug	24	54.00	0	97	0	3	0

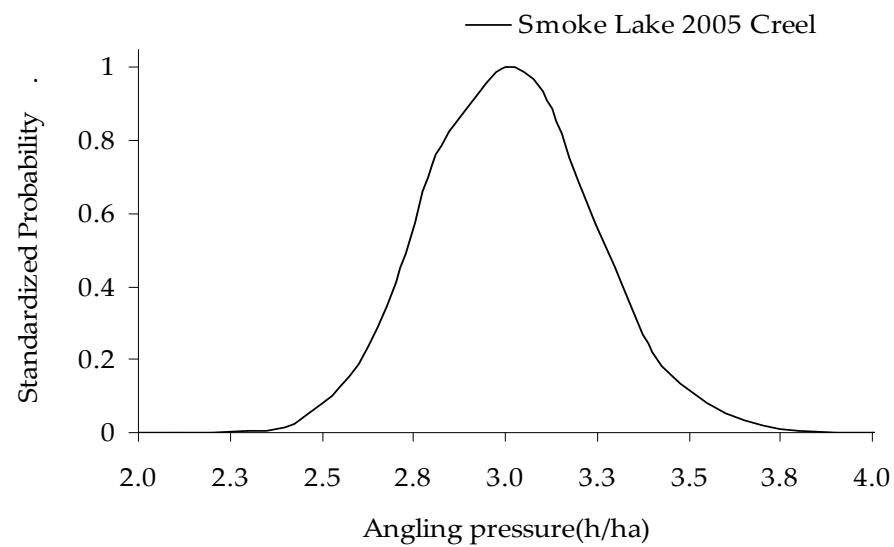
Appendix 3. Standardized probability density function of number of anglers at Smoke Lake in 2005. Estimates are the means of the bootstrap estimates.



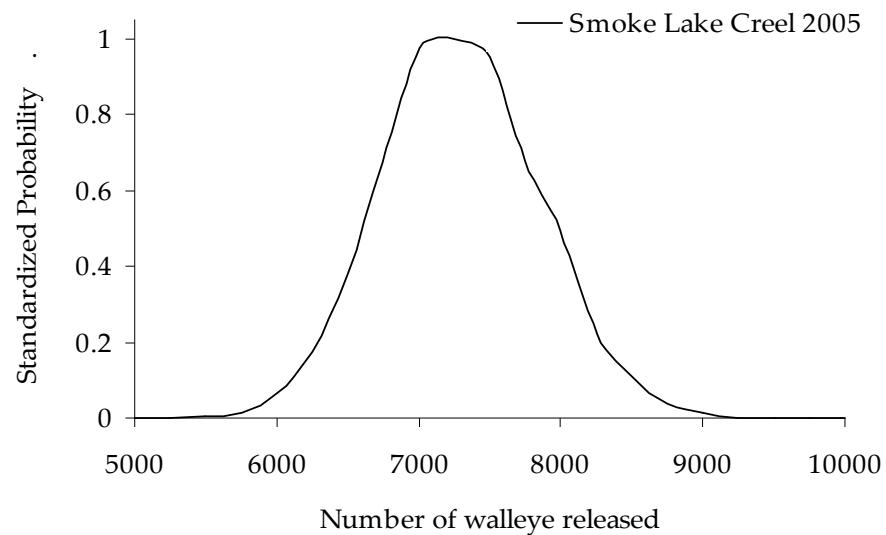
Appendix 4. Standardized probability density function of total angler-hours at Smoke Lake in 2005. Estimates are the means of the bootstrap estimates.



Appendix 5. Standardized probability density function of angling pressure at Smoke Lake in 2005. Estimates are the means of the bootstrap estimates.



Appendix 6. Standardized probability density function of the number of reported released walleye during the sport fishery at Smoke Lake in 2005. Estimates are the means of the bootstrap estimates.



Appendix 7. Biological data collected during test angling at Smoke Lake during the 2005 creel survey. Date, species, fork lengths, and ages of fish captured during test angling at Smoke Lake (2005). Species code: NRPK = northern pike, WALL = walleye.

Activity Date	Sample #	Species	Fork Length (mm)	Weight (g)	Age (y)
25 - May - 2005	1	WALL	355	474	6
25 - May - 2005	2	WALL	428	863	7
26 - May - 2005	3	WALL	387	625	7
26 - May - 2005	4	WALL	380	589	
26 - May - 2005	5	WALL	395	667	
26 - May - 2005	6	WALL	417	794	7
26 - May - 2005	7	WALL	303	285	
26 - May - 2005	8	WALL	400	695	
26 - May - 2005	9	WALL	423	831	
26 - May - 2005	10	WALL	440	943	
26 - May - 2005	11	WALL	375	565	7
26 - May - 2005	12	WALL	406	729	8
26 - May - 2005	13	WALL	387	625	7
26 - May - 2005	14	WALL	420	813	8
27 - May - 2005	15	NRPK	535	1085	5
27 - May - 2005	16	NRPK	400	510	2
28 - May - 2005	17	WALL	385	615	6
28 - May - 2005	18	WALL	405	723	7
28 - May - 2005	19	WALL	306	294	3
28 - May - 2005	20	WALL	410	752	
28 - May - 2005	21	WALL	401	700	
28 - May - 2005	22	NRPK	460	733	3
08 - Jun - 2005	23	WALL	400	695	6
08 - Jun - 2005	24	WALL	393	657	7
08 - Jun - 2005	25	WALL	428	863	7
08 - Jun - 2005	26	WALL	442	957	
08 - Jun - 2005	27	WALL	355	474	

Appendix 7. Continued

Activity Date	Sample #	Species	Fork Length (mm)	Weight (g)	Age (y)
08 - Jun - 2005	28	WALL	381	594	
09 - Jun - 2005	29	WALL	392	651	6
09 - Jun - 2005	30	WALL	396	673	6
09 - Jun - 2005	31	WALL	393	657	
09 - Jun - 2005	32	WALL	396	673	6
09 - Jun - 2005	33	WALL	412	764	
09 - Jun - 2005	34	WALL	398	684	7
09 - Jun - 2005	35	WALL	360	495	6
09 - Jun - 2005	36	WALL	389	635	7
09 - Jun - 2005	37	WALL	382	599	7
09 - Jun - 2005	38	WALL	385	615	6
09 - Jun - 2005	39	WALL	418	800	
09 - Jun - 2005	40	WALL	400	695	7
09 - Jun - 2005	41	WALL	393	657	
09 - Jun - 2005	42	WALL	425	844	8
09 - Jun - 2005	43	WALL	382	599	
09 - Jun - 2005	44	WALL	420	813	
09 - Jun - 2005	45	WALL	388	630	6
09 - Jun - 2005	46	WALL	360	495	
09 - Jun - 2005	47	WALL	404	717	
09 - Jun - 2005	48	WALL	376	570	
09 - Jun - 2005	49	WALL	442	957	
09 - Jun - 2005	50	WALL	369	536	5
09 - Jun - 2005	51	WALL	461	1096	9
09 - Jun - 2005	52	WALL	369	536	
09 - Jun - 2005	53	NRPK	485	841	3
09 - Jun - 2005	54	NRPK	500	911	4
10 - Jun - 2005	55	WALL	382	599	6
10 - Jun - 2005	56	WALL	410	752	
10 - Jun - 2005	57	WALL	427	857	7
10 - Jun - 2005	58	WALL	412	764	7

Appendix 7. Continued

Activity Date	Sample #	Species	Fork Length (mm)	Weight (g)	Age (y)
10 - Jun - 2005	59	WALL	356	478	7
10 - Jun - 2005	60	WALL	368	532	6
10 - Jun - 2005	61	WALL	361	500	
10 - Jun - 2005	62	WALL	418	800	7
10 - Jun - 2005	63	WALL	395	667	6
10 - Jun - 2005	64	WALL	424	838	8
10 - Jun - 2005	65	WALL	378	579	
10 - Jun - 2005	66	NRPK	472	784	3
11 - Jun - 2005	67	WALL	368	532	6
11 - Jun - 2005	68	WALL	391	646	7
11 - Jun - 2005	69	WALL	339	409	5
11 - Jun - 2005	70	WALL	390	641	6
23 - Jun - 2005	71	WALL	427	857	8
23 - Jun - 2005	72	WALL	403	712	6
23 - Jun - 2005	73	WALL	374	560	6
23 - Jun - 2005	74	NRPK	526	1039	5
24 - Jun - 2005	75	WALL	379	584	
24 - Jun - 2005	76	WALL	393	657	
24 - Jun - 2005	77	WALL	393	657	
24 - Jun - 2005	78	WALL	378	579	
24 - Jun - 2005	79	WALL	313	316	
24 - Jun - 2005	80	WALL	360	495	6
24 - Jun - 2005	81	WALL	421	819	8
24 - Jun - 2005	82	WALL	409	746	
24 - Jun - 2005	83	WALL	426	850	7
24 - Jun - 2005	84	WALL	376	570	6
24 - Jun - 2005	85	WALL	393	657	7
24 - Jun - 2005	86	WALL		0	
24 - Jun - 2005	87	WALL	425	844	8
24 - Jun - 2005	88	WALL	330	375	6
24 - Jun - 2005	89	WALL	431	883	

Appendix 7. Continued

Activity Date	Sample #	Species	Fork Length (mm)	Weight (g)	Age (y)
24 - Jun - 2005	90	WALL	346	436	6
24 - Jun - 2005	91	WALL	380	589	6
24 - Jun - 2005	92	WALL	401	700	
24 - Jun - 2005	93	WALL	420	813	7
24 - Jun - 2005	94	WALL	393	657	
24 - Jun - 2005	95	WALL	411	758	7
24 - Jun - 2005	96	WALL	391	646	7
24 - Jun - 2005	97	WALL	375	565	7
24 - Jun - 2005	98	WALL	435	910	8
24 - Jun - 2005	99	WALL	389	635	7
24 - Jun - 2005	100	WALL	387	625	7
24 - Jun - 2005	101	WALL	385	615	7
24 - Jun - 2005	102	WALL	417	794	
24 - Jun - 2005	103	WALL	410	752	6
24 - Jun - 2005	104	WALL	445	978	9
24 - Jun - 2005	105	WALL	346	436	6
24 - Jun - 2005	106	WALL	425	844	8
24 - Jun - 2005	107	WALL	403	712	8
24 - Jun - 2005	108	WALL	409	746	6
24 - Jun - 2005	109	WALL	425	844	
24 - Jun - 2005	110	WALL	403	712	7
24 - Jun - 2005	111	WALL	409	746	7
24 - Jun - 2005	112	WALL	425	844	8
24 - Jun - 2005	113	WALL	421	819	8
24 - Jun - 2005	114	WALL	397	678	7
24 - Jun - 2005	115	WALL	398	684	
24 - Jun - 2005	116	WALL	391	646	6
24 - Jun - 2005	117	WALL	387	625	7
24 - Jun - 2005	118	WALL	396	673	6
24 - Jun - 2005	119	NRPK	515	983	4
06 - Jul - 2005	120	WALL	382	599	7

Appendix 7. Continued

Activity Date	Sample #	Species	Fork Length (mm)	Weight (g)	Age (y)
06 - Jul - 2005	121	WALL	365	518	
06 - Jul - 2005	122	WALL	386	620	7
06 - Jul - 2005	123	WALL	300	276	3
06 - Jul - 2005	124	WALL	413	770	
06 - Jul - 2005	125	WALL	362	504	6
06 - Jul - 2005	126	WALL	361	500	7
10 - Jul - 2005	127	WALL	382	599	7
10 - Jul - 2005	128	WALL	402	706	7
10 - Jul - 2005	129	WALL	408	740	7
10 - Jul - 2005	130	WALL	385	615	
10 - Jul - 2005	131	WALL	419	806	
10 - Jul - 2005	132	WALL	390	641	6
10 - Jul - 2005	133	WALL	357	482	
10 - Jul - 2005	134	WALL	383	604	6
10 - Jul - 2005	135	WALL	398	684	
10 - Jul - 2005	136	WALL	354	469	5
10 - Jul - 2005	137	WALL	355	474	6
10 - Jul - 2005	138	WALL	350	453	6
10 - Jul - 2005	139	WALL	405	723	7
10 - Jul - 2005	140	WALL	446	985	
10 - Jul - 2005	141	WALL	360	495	6
10 - Jul - 2005	142	WALL	404	717	7
10 - Jul - 2005	143	WALL	402	706	7
10 - Jul - 2005	144	WALL	385	615	7
10 - Jul - 2005	145	WALL	389	635	6
10 - Jul - 2005	146	WALL	352	461	6
10 - Jul - 2005	147	WALL	416	788	7
10 - Jul - 2005	148	WALL	403	712	7
10 - Jul - 2005	149	WALL	452	1029	
10 - Jul - 2005	150	WALL	380	589	6
10 - Jul - 2005	151	WALL	392	651	

Appendix 7. Continued

Activity Date	Sample #	Species	Fork Length (mm)	Weight (g)	Age (y)
10 - Jul - 2005	152	WALL	372	550	
10 - Jul - 2005	153	WALL	406	729	
10 - Jul - 2005	154	WALL	399	689	7
10 - Jul - 2005	155	WALL	407	735	7
10 - Jul - 2005	156	WALL	401	700	7
10 - Jul - 2005	157	WALL	408	740	6
10 - Jul - 2005	158	WALL	394	662	
10 - Jul - 2005	159	WALL	337	401	
10 - Jul - 2005	160	WALL	427	857	
10 - Jul - 2005	161	WALL	395	667	7
10 - Jul - 2005	162	WALL	398	684	
10 - Jul - 2005	163	WALL	411	758	6
10 - Jul - 2005	164	WALL	405	723	7
10 - Jul - 2005	165	WALL	354	469	6
10 - Jul - 2005	166	WALL	387	625	7
10 - Jul - 2005	167	WALL	384	610	
10 - Jul - 2005	168	WALL	408	740	7
10 - Jul - 2005	169	WALL	378	579	6
10 - Jul - 2005	170	WALL	406	729	7
10 - Jul - 2005	171	WALL	399	689	
10 - Jul - 2005	172	WALL	434	903	
10 - Jul - 2005	173	WALL	383	604	7
10 - Jul - 2005	174	WALL	399	689	
10 - Jul - 2005	175	WALL	373	555	6
10 - Jul - 2005	176	WALL	390	641	
10 - Jul - 2005	177	WALL	385	615	
10 - Jul - 2005	178	WALL	413	770	
10 - Jul - 2005	179	WALL	388	630	7
10 - Jul - 2005	180	WALL	399	689	6
10 - Jul - 2005	181	WALL	367	527	6
10 - Jul - 2005	182	WALL	387	625	6

Appendix 7. Continued

Activity Date	Sample #	Species	Fork Length (mm)	Weight (g)	Age (y)
10 - Jul - 2005	183	WALL	401	700	7
10 - Jul - 2005	184	WALL	352	461	6
10 - Jul - 2005	185	WALL			
10 - Jul - 2005	186	WALL	396	673	7
10 - Jul - 2005	187	WALL	410	752	6
10 - Jul - 2005	188	WALL	420	813	
10 - Jul - 2005	189	WALL	380	589	6
10 - Jul - 2005	190	WALL	411	758	6
10 - Jul - 2005	191	WALL	380	589	6
10 - Jul - 2005	192	WALL	366	522	6
10 - Jul - 2005	193	WALL	395	667	
10 - Jul - 2005	194	WALL	405	723	7
10 - Jul - 2005	195	WALL	392	651	
10 - Jul - 2005	196	WALL	394	662	6
20 - Jul - 2005	197	WALL	361	500	6
20 - Jul - 2005	198	WALL	428	863	8
20 - Jul - 2005	199	WALL	384	610	6
20 - Jul - 2005	200	WALL	425	844	7
20 - Jul - 2005	201	WALL	354	469	
20 - Jul - 2005	202	WALL	396	673	6
20 - Jul - 2005	203	WALL	405	723	6
20 - Jul - 2005	204	WALL	392	651	6
20 - Jul - 2005	205	WALL	414	776	7
20 - Jul - 2005	206	WALL	429	870	7
20 - Jul - 2005	207	WALL	387	625	7
20 - Jul - 2005	208	WALL	424	838	8
20 - Jul - 2005	209	WALL	392	651	
20 - Jul - 2005	210	WALL	382	599	6
20 - Jul - 2005	211	WALL	413	770	
20 - Jul - 2005	212	WALL	405	723	7
20 - Jul - 2005	213	WALL	374	560	6

Appendix 7. Continued

Activity Date	Sample #	Species	Fork Length (mm)	Weight (g)	Age (y)
20 - Jul - 2005	214	WALL	404	717	6
20 - Jul - 2005	215	WALL	366	522	6
20 - Jul - 2005	216	WALL	365	518	7
20 - Jul - 2005	217	WALL	423	831	7
20 - Jul - 2005	218	WALL	416	788	8
20 - Jul - 2005	219	WALL	379	584	6
20 - Jul - 2005	220	WALL	410	752	9
20 - Jul - 2005	221	WALL	395	667	6
20 - Jul - 2005	222	WALL	385	615	
20 - Jul - 2005	223	WALL	375	565	6
20 - Jul - 2005	224	WALL	405	723	
20 - Jul - 2005	225	WALL	379	584	
20 - Jul - 2005	226	WALL	417	794	7
20 - Jul - 2005	227	WALL	434	903	8
20 - Jul - 2005	228	WALL	379	584	
20 - Jul - 2005	229	WALL	361	500	7
20 - Jul - 2005	230	WALL	383	604	7
20 - Jul - 2005	307	WALL	415	782	
20 - Jul - 2005	311	NRPK	542	1123	3
21 - Jul - 2005	231	WALL	381	594	7
21 - Jul - 2005	232	WALL	284	231	3
21 - Jul - 2005	233	WALL	398	684	7
21 - Jul - 2005	234	WALL	399	689	7
21 - Jul - 2005	235	WALL	359	491	
21 - Jul - 2005	236	WALL	388	630	6
21 - Jul - 2005	237	WALL	367	527	5
21 - Jul - 2005	238	WALL	294	259	3
21 - Jul - 2005	239	WALL	403	712	
21 - Jul - 2005	240	WALL	380	589	6
21 - Jul - 2005	241	WALL	387	625	6
21 - Jul - 2005	242	WALL	424	838	8

Appendix 7. Continued

Activity Date	Sample #	Species	Fork Length (mm)	Weight (g)	Age (y)
21 - Jul - 2005	243	WALL	395	667	7
21 - Jul - 2005	244	WALL	396	673	8
22 - Jul - 2005	245	WALL	422	825	6
23 - Jul - 2005	246	WALL	378	579	6
23 - Jul - 2005	247	WALL	376	570	6
24 - Jul - 2005	248	WALL	384	610	
24 - Jul - 2005	249	WALL	404	717	7
24 - Jul - 2005	250	WALL	412	764	8
24 - Jul - 2005	251	WALL	420	813	7
24 - Jul - 2005	252	WALL	402	706	7
24 - Jul - 2005	253	WALL	402	706	7
24 - Jul - 2005	254	WALL	401	700	6
24 - Jul - 2005	255	WALL	390	641	6
24 - Jul - 2005	256	WALL	447	993	
24 - Jul - 2005	257	WALL	405	723	7
24 - Jul - 2005	258	WALL	408	740	
24 - Jul - 2005	259	WALL	428	863	
24 - Jul - 2005	260	WALL	389	635	8
24 - Jul - 2005	261	WALL	384	610	8
24 - Jul - 2005	262	WALL	440	943	
24 - Jul - 2005	263	WALL	394	662	
24 - Jul - 2005	264	WALL	369	536	7
24 - Jul - 2005	265	WALL	376	570	
24 - Jul - 2005	266	WALL	429	870	
24 - Jul - 2005	267	WALL	381	594	
24 - Jul - 2005	268	WALL	379	584	
24 - Jul - 2005	269	WALL	391	646	7
24 - Jul - 2005	270	WALL	399	689	7
24 - Jul - 2005	271	WALL	402	706	8
24 - Jul - 2005	272	WALL	421	819	7
24 - Jul - 2005	273	WALL	401	700	8

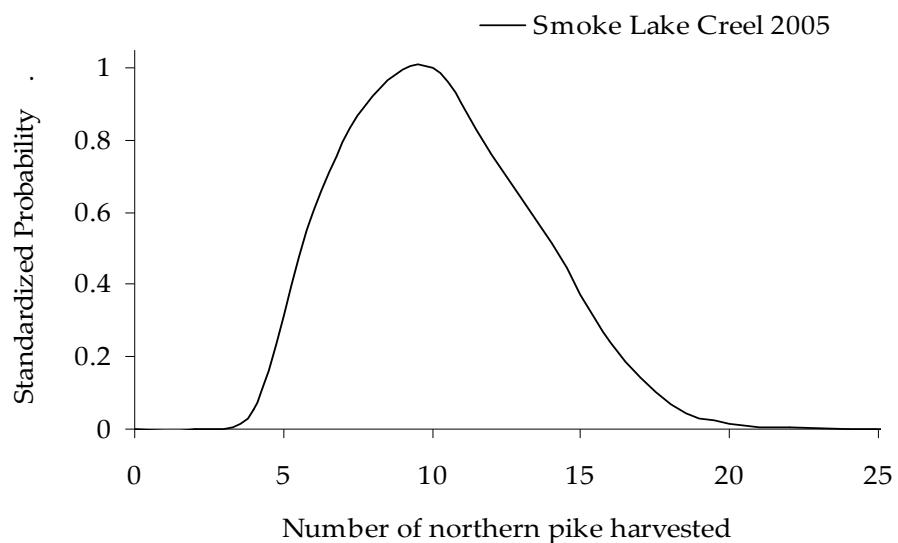
Appendix 7. Continued

Activity Date	Sample #	Species	Fork Length (mm)	Weight (g)	Age (y)
24 - Jul - 2005	274	WALL	462	1103	
24 - Jul - 2005	275	WALL	441	950	
24 - Jul - 2005	276	WALL	437	923	
24 - Jul - 2005	277	WALL	435	910	8
24 - Jul - 2005	278	NRPK	578	1326	5
03 - Aug - 2005	279	WALL	402	706	6
03 - Aug - 2005	280	WALL	407	735	6
03 - Aug - 2005	281	WALL	374	560	7
03 - Aug - 2005	282	WALL	403	712	
03 - Aug - 2005	283	WALL	383	604	
03 - Aug - 2005	284	WALL	402	706	6
05 - Aug - 2005	285	WALL	366	522	6
05 - Aug - 2005	286	WALL	373	555	
05 - Aug - 2005	287	WALL	384	610	7
05 - Aug - 2005	288	WALL	408	740	7
05 - Aug - 2005	289	WALL	375	565	7
05 - Aug - 2005	290	WALL	388	630	7
05 - Aug - 2005	291	WALL	401	700	7
05 - Aug - 2005	292	WALL	382	599	7
05 - Aug - 2005	293	WALL	372	550	6
05 - Aug - 2005	294	WALL	393	657	7
05 - Aug - 2005	295	WALL	397	678	
05 - Aug - 2005	296	WALL	407	735	7
05 - Aug - 2005	297	WALL	385	615	
05 - Aug - 2005	298	WALL	388	630	
05 - Aug - 2005	299	WALL	404	717	7
05 - Aug - 2005	300	WALL	379	584	
05 - Aug - 2005	301	NRPK	440	654	2
05 - Aug - 2005	302	NRPK	450	693	2
05 - Aug - 2005	303	NRPK	513	973	4

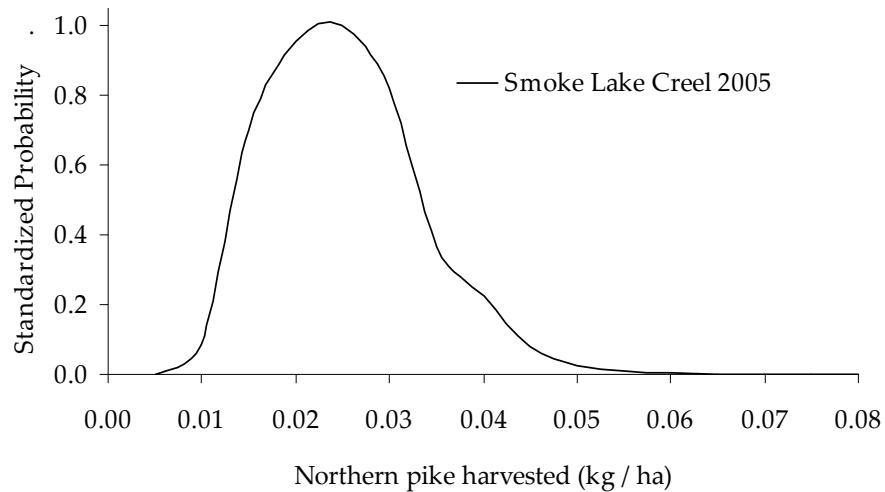
Appendix 7. Continued

Activity Date	Sample #	Species	Fork Length (mm)	Weight (g)	Age (y)
06 - Aug - 2005	304	WALL	405	723	7
06 - Aug - 2005	305	WALL	426	850	7
06 - Aug - 2005	306	WALL	422	825	

Appendix 8. Standardized probability density function of the number of northern pike harvested during the sport fishery at Smoke Lake in 2005. Estimates are the means of the bootstrap estimates.



Appendix 9. Standardized probability density function of the yield (kg/ha) of northern pike harvested during the sport fishery at Smoke Lake in 2005. Estimates are the means of the bootstrap estimates



Appendix 10. Biological data collected from sport fishery during the 2005 creel survey at Smoke Lake. Species code: NRPK = northern pike, Sex code: F = female.

Sample #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity	Age (y)
308	NRPK	600					6
309	NRPK	710	730		F	Mature	6
310	NRPK	799			F	Mature	9

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this project**

