

**ASSESSMENT OF THE STATUS OF THE
SPORT FISHERY FOR WALLEYE AND
NORTHERN PIKE, AND STATISTICS FOR
YELLOW PERCH AT SHININGBANK LAKE,
SUMMER 1998**

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ABSTRACT

Alberta's fisheries managers developed a walleye management plan in 1995 (Berry 1995) to provide provincial standards for classifying walleye stocks. A similar northern pike management plan has recently been completed (Berry 1999) and one for yellow perch is in the planning stage. The walleye fishery at Shiningbank Lake was classified as stable in 1996 (Alberta Environmental Protection 1996). A daily bag limit of three walleye and a minimum size limit of 430 mm total length (TL) accompanied this classification. A creel survey was conducted in the summer of 1998 in order to assess the status of the walleye fishery, and provide data on the northern pike and yellow perch fisheries.

An extremely low catch rate ($0.029 \cdot h^{-1}$ total catch per unit effort), and an unstable age-class structure indicate that the walleye fishery should be downgraded from stable to the collapsed classification. This would designate Shiningbank Lake as catch and release only for walleye. Preliminary analysis of the data for northern pike suggest that this fishery would fit into the vulnerable category, as six of nine criteria placed it in this category. Based on the northern pike management plan (Berry 1999), such a classification would result in a minimum size limit of 63 cm total length and one fish per day harvest limit in 2000. Some data on yellow perch was collected and reported in anticipation of the development of a yellow perch management plan for Alberta.

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- 1) To collect, evaluate and compare catch rate, age-class structure, age-class stability, growth rate and age at maturity data for walleye, northern pike and yellow perch stocks in Shiningbank Lake.
- 2) To determine changes in angler demographics and attitudes created by current regulatory strategies.
- 3) To commence an ongoing lake monitoring program in the Northern East Slopes that will evaluate the effectiveness of current regulatory strategies designed to recover fish stocks and improve the recreational fishery
- 4) To provide an educational component focused on walleye, northern pike and yellow perch ecology and management.

2.0 METHODS

2.1 Study Site

Shiningbank Lake (56-14-W5M) is a eutrophic lake 463 hectares in area, located approximately 57 kilometres northeast of Edson, Alberta (Figure 1). There are approximately 12.8 kilometres of shoreline and the drainage basin is 151 square kilometres (AENV/NRS/FMD, Edson file data). A day-use area and campground exist at Shiningbank Lake as well as some minor cottage development (approximately 40) (pers comm Kevin Krebs, Yellowhead County, Parks and Recreation, Edson). Walleye, northern pike, yellow perch, lake whitefish (*Coregonus clupeaformis*), burbot (*Lota lota*), white suckers (*Catostomus commersoni*) (Hawryluk 1975) and rainbow trout (*Oncorhynchus mykiss*) (AENV/NRS/FMD, Edson file data) have been reported from Shiningbank Lake. Minnow species also exist in the lake, but have not been reported from fisheries surveys.

Developments and provincial angling regulation changes from 1947 until present are displayed in Table 1. Commercial fishing occurred every year from 1947 until its permanent closure in 1966, except 1962-63 in which no season occurred. In 1979, Shiningbank Lake was removed from the list of lakes in the province that could be commercially fished (AENV/NRS/FMD, Edson file data).

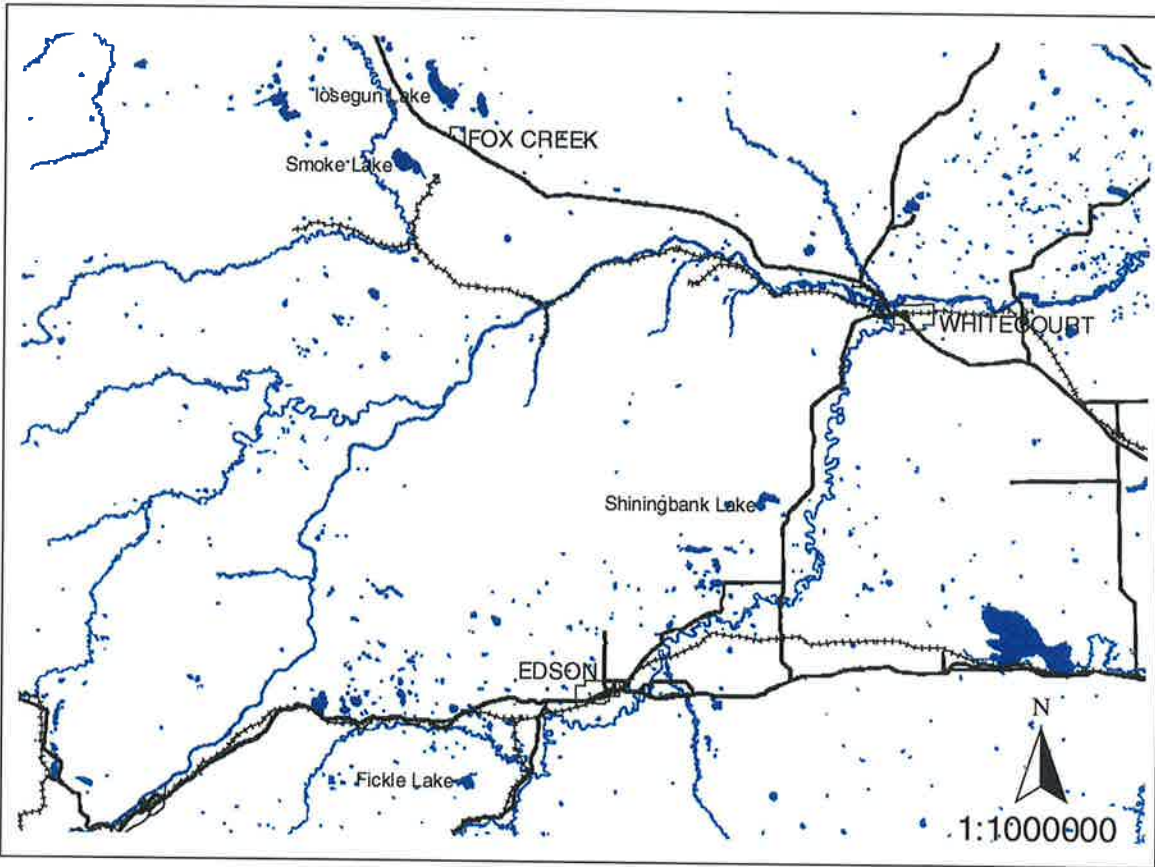


Figure 1. Map displaying the location of Shiningbank Lake.

Table 1. Historical developments and events, and fisheries management regulation changes at Shiningbank Lake.

Year	Development or Event
1947-48 ^a	Commercial fishing commenced (mainly lake whitefish, some walleye and northern pike; annual harvest ranging from a high of 5995 kg in 1949 and a low of 45 kg in 1965)
1949 ^b	Angling regulations: Yellow perch and goldeye: 25 fish of one species or 25 in aggregate Northern pike and walleye: 15 fish of one species or 15 in aggregate Northern pike and walleye, perch and goldeye: 25 fish in aggregate of which not more than 15 may be pike and walleye Minimum size limit of 300 mm FL for walleye Possession limit for the above was twice the daily limit
1960 ^b	Yellow perch: 25 fish; pike, walleye, sauger and goldeye: 15 fish of one species or 15 in the aggregate Size limits did not exist Possession limit for the above was the twice the daily limit
1962-63 ^a	No commercial fishing season
1966 ^a	Commercial fishing season closed due to management concerns
1968 ^b	Yellow perch: no limit
1970 ^b	Northern pike, walleye, sauger and goldeye: 10 fish of one species or 10 in aggregate Possession limit for the above was twice the daily limit
1970 ^c	Assessment of the sport fish population structure and relative abundance of walleye, northern pike, yellow perch and lake whitefish
1972-73	Northern pike, walleye and sauger: daily limit = 10 fish of one species or 10 fish in aggregate, possession limit = 20 of one species or 20 fish in aggregate; no size limits
1974-75	Yellow perch: daily limit = 30, possession limit = 30.
1975 ^c	Assessment of the sport fish population structure and relative abundance
1978-79	Northern pike: daily limit = 10, possession limit = 10; walleye and sauger: daily limit = 10 in aggregate, possession limit = 10 in aggregate
1979 ^a	Shiningbank Lake permanently removed from the list of lakes which could be commercially fished
1979-80	Walleye and sauger: daily limit = 5 in aggregate, possession limit = 10 in aggregate
1982-84 ^d	Shiningbank Lake cottage subdivision built
1984-86 ^d	First loop at Shiningbank Lake Campground completed
1987 ^d	Second loop at Shiningbank Lake Campground completed
1987-88	Walleye and sauger in the aggregate: April 1 to May 15 daily limit = 2, possession limit = 4; May 16 to March 31 daily limit = 5, possession limit = 5
1988-89	Walleye and sauger in the aggregate: April 1 to May 20 daily limit = 2, possession limit = 4; May 21 to March 31 daily limit = 5, possession limit = 5
1989-90	Walleye and sauger combined limit is 3, but none of the walleye may be under 380 mm
1992 ^a	Creel survey conducted from May to August
1996-97	Walleye Management and Recovery Plan implemented: Stable population - 3 walleye and a minimum-size limit of 430 mm, Vulnerable population - 3 walleye and a minimum-size limit of 500 mm, Collapsed population – zero catch limit (Shiningbank Lake classified as Stable); Yellow perch: daily limit = 15, possession limit = 15
1998	Creel survey conducted from May 15 to August 16

a- AENV/NRS/FMD, Edson file data

b- pers comm Dave Berry, AENV/NRS, Edmonton

c-Hawryluk 1975

d-dates are approximate, pers comm Kevin Krebs, Yellowhead County, Parks and Recreation, Edson

2.2 Survey Design

Data was collected using two sampling procedures. The first was an access point creel survey (Hayne 1991). A team of two attendants located at the main boat launch and campground on Shiningbank Lake attempted to interview all anglers as they returned from the lake (complete angling trip). The survey targeted the summer fisheries for walleye, northern pike and yellow perch and covered the period of May 15 to August 16. The creel survey crew consisted of two creel attendants, which conducted surveys at Shiningbank Lake for five consecutive days, during a 14-day rotation. In order to survey anglers during weekends at Shiningbank Lake, days off were always weekdays. By sampling weekends and holiday weekends in particular, the number of angler interviews was maximised which improved the efficiency of sampling effort. Test angling occurred from May 10 to August 16, with effort spread fairly equally throughout the season.

Since not all anglers used the station occupied by the creel attendants, on-lake surveys were performed to determine the ratio of use at the survey point. This involved one attendant approaching anglers on the lake and asking them which launch they had used. Forty-four launch usage trips were made and daily totals were calculated for the 28 survey days (Appendix 1). All estimates of total number of angler hours, total harvest, catch, etc. were multiplied by the boat-weighted mean ratio of use.

The second sampling procedure involved "test angling". This consisted of angling on the lake and recording time fished and fork length (FL) or total length of all fish captured. Test angling was conducted to collect additional information on the size frequency distribution of the fish populations. Due to the minimum size limit of 430 mm TL for walleye, sport anglers did not provide precise size distribution data on walleye <430 mm. Also, since anglers often released smaller northern pike and yellow perch, the lengths of fish returned for measurement to the creel attendants were also biased for these species. Creel attendants, regional fisheries (ACA and AENV/NRS) staff and volunteer anglers conducted test angling from May 10 to August 16, 1998. The test fishery catch per unit of effort (CUE) was not included in the calculation of angler effort as the CUE's for both fisheries were not directly comparable.

2.3 Angler Interviews

Anglers were asked a series of questions following the completion of their angling trip (Appendix 2). The questions included the number of hours fished, number of walleye, northern pike and yellow perch kept and released. The fish kept and released were divided into size classifications outlined on the survey sheet (Appendix 2), and were recorded according to their respective size range.

Questions were also asked regarding method, target species, use of electronics, angler age and angler residence. Creel attendants made a subjective evaluation of each angler's skill level, and noted angler gender. Children and anglers with little equipment and knowledge regarding fishing were considered novice. Anglers with sponsorship advertisements on boats and other equipment, and/or a variety of rods and tackle were considered professionals. All other anglers were considered to have moderate skill. Results of the target species, use of electronics, methods and skill levels of anglers are displayed in Appendices 11, 12, 13 and 14.

Each angler was also asked a series of questions related to the quality of the fishery (Appendix 3). Anglers were asked to rate their fishing experience from 1=poor to 5=excellent. The questions asked related to the number of fish caught, size of the fish caught and the quality of the overall fishing experience. These data are presented in Appendix 4.

Creel attendants recorded the month, day, time of return and number of anglers in a party. The day of sampling was coded 1=Monday to 7=Sunday and 8=holidays. Anglers were identified on the creel forms by a party and angler number. These numbers started at 1.1 at the beginning of each day (e.g. two anglers in the same party would be identified as 1.1 and 1.2).

All data was recorded in pencil on data sheets, which was summarised each day and kept in binders. Data collected during the field portion of the creel survey was entered into a Microsoft Excel spreadsheet by data entry technicians using double entry verification.

2.4 Future Management Recommendation Questionnaire

During the latter part of the survey (August 1 to 16), anglers were asked a series of questions regarding their opinion on possible future management options. The questionnaire consisted of seven questions (Appendix 5), three pertaining to walleye and four to northern pike.

2.5 Fish Biological Data

Creel attendants measured fork or total lengths (mm) of fish kept by anglers, weighed fish (g) and acquired ageing structures (*i.e.* opercula (lethal) or pelvic fin spines (non-lethal) for walleye, cleithra (lethal) or pelvic fin rays for pike (non-lethal)). The biological data obtained for walleye, northern pike and yellow perch are displayed in Appendices 17, 18 and 19. Ageing structures were placed in sample envelopes, dried and stored for future analysis. During busy times, not all fish could be sampled, so creel attendants were instructed to attempt to obtain samples from as wide a size distribution as possible. This may have introduced some bias into the age and size distributions from the sport fishery. If this is the case, these distributions may be flatter in appearance than the true catch would have shown, as the more commonly caught age and size-classes would have been neglected in favour of samples from fish of uncommon sizes.

Creel attendants also determined the sex and maturity of fish that were lethally sampled. For these fish, stomach contents were examined and identified to vertebrate species and abundance, and invertebrates were identified to approximate number and order. Stomach contents were not analysed for this report, although these data were entered into an Excel spreadsheet and were archived at the Edson area office (ACA computer files).

Upon completion of fieldwork for the creel survey, the four creel attendants who conducted the surveys in the Northern East Slopes Region determined fish ages. Ageing specimens were prepared and ages were determined for each fish according to Mackay *et al.* (1990). Cleithra were the primary structures used to age pike, pelvic fin spines for walleye and anal fin spines were used for yellow perch. If different ageing structures were used (pelvic fin rays for pike, opercula for walleye), the type of alternate structure was recorded. Each fish was aged by at least two people, in most cases by three people and sometimes by all four individuals. Each person determined an age independently and then results were compared. At least two

people had to agree on the age in order for it to be considered correct. Ages were determined based on the number of complete annuli visible. Ages at sampling were converted to decimal ages based on annulus formation on May 15. The number of days from the date the ageing structure was obtained to May 15 was determined and was divided by 365 days to determine the proportion of a full year. This number was then added to the number of annuli observed to obtain the age at sampling (*e.g.* a walleye pelvic fin spine showing 4 annuli, collected on July 1 yielded an age of 4.129 years).

Scatterplots of weight against length and length against age were made for all three fish species to identify outliers. Any outliers identified were investigated to ensure proper values were input into the spreadsheets and samples sometimes had to be re-aged to determine if age values were initially identified correctly. Obvious outliers were eliminated from analyses if they could not be rectified and were deemed unrealistic.

2.6 Determination of Basic Sport Fishery Parameters

Following data verification, fork lengths were converted to total lengths for estimation of some sport fishery parameters. For walleye the equation was $TL_{max} = 1.0413*FL + 7.3977$. The northern pike equation was $TL_{max} = 1.03336*FL + 16.678$. The perch equation was $TL_{max} = (FL+0.41)/0.97$ (Mackay *et al.* 1990). Equations for walleye and northern pike were from 1989 length data from Wolf, Touchwood and Seibert Lakes in the Northeast Boreal Region (from Patterson and Sullivan 1998). Calculation of maximum total lengths enabled determination of the number of legal and sub-legal walleye caught.

To summarise angler survey data and estimate total effort and fish harvest (for the period of May 15 to August 16), creel data parameters (*i.e.* number of anglers, number of hours fished, number of walleye harvested) were stratified into five categories. Weekdays included Monday (day 1) through Thursday (day 4). Fridays (day 5) were considered a separate category, as the mean hours fished fell between that of other weekdays and weekends. Weekends included Saturday (day 6) and Sunday (day 7). Holidays (day 8) and holiday weekends made up the final stratum. Totals, means and variances of creel data parameters were calculated for each day category using Microsoft Excel (Appendix 6).

The estimated number of hours angled, anglers and fish harvested were determined by weighting the totals obtained from the angler surveys by the available days in each stratum during the period of May 15 to August 16 (Appendix 7). Variances of these estimates were calculated for each stratum.

All data entry was done in Microsoft Excel. Statistical analysis and graphics construction was done in either Excel or Statistica (StatSoft 1995). All raw data is stored in the Edson ACA office. All digital data and analyses are stored on ACA computers in Edson and also on compact discs.

2.7 Estimation of Compliance and Reporting Bias

Several fishery parameters relating to compliance and reporting bias can be calculated from test angling and sport angling data by using parameters displayed in Table 2. These parameters were not calculated for this report and can be calculated for walleye only, as this is the only species with restrictive enough regulations to justify the analysis.

Table 2. Definition of parameters relating to compliance and reporting bias and how each is calculated (from Patterson and Sullivan 1998).

Parameter	Definition	Calculated
Illegal Harvest	Proportion of walleye that should have been released because of the minimum size limit, but were illegally harvested.	The number of sub-legal walleye observed kept by anglers divided by the number of sub-legal walleye estimated caught by anglers.
Non-Compliance	Proportion of anglers who reported illegally keeping sub-legal walleye, when presented with the opportunity to do so.	The number of anglers reported keeping sub-legal walleye divided by the number of anglers reported catching sub-legal walleye.
Encounter Rate	Probability of encountering an angler, on the lake whom is in possession of an illegal walleye.	One-half the number of anglers observed keeping sub-legal walleye divided by the number of anglers observed at the lake (this value represents the encounter rate of illegal anglers when incomplete-trip interviews are conducted, as are commonly conducted by enforcement staff).
Exaggeration Rate	Difference between the number of sub-legal walleye that the anglers report releasing and the estimated number they released.	The number of sub-legal walleye reported caught by anglers divided by the number of sub-legal walleye estimated caught by anglers.

Exaggeration rate calculation:

The required parameters are estimated as follows:

i) # sub-legal walleye _(estimated, creel) = # sub-legal _(test) / # legal _(test) * # legal _(creel)

ii) # anglers catching sub-legal walleye = # legal _(creel) / # successful anglers * # sub-legal _(estimated, creel)

Confidence limits for the estimate of the number of sub-legal walleye caught are calculated following Overton (1971). The procedure is similar to a Lincoln mark-recapture population estimate for sampling with replacement.

The analogous parameters are:

N (population estimate) = number of walleye caught (legal and sub-legal) in creel

x (sub-sample of N) = number of walleye caught in the test fishery

r (marked animals in sub-sample) = number of legal walleye caught in test fishery

M (marked animals in population) = number of legal walleye in creel

The binomial approximation of confidence limits is used, resulting in asymmetrical confidence limits.

The standardisation of catch rates can be further modified by the exaggeration factor to obtain catch rates that take into account reporting bias. "In many lakes, anglers appear to misreport the number of fish (mainly walleye) they release (pers comm Mike Sullivan, AENV/NRS, Edmonton)." Often this is in the form of an exaggeration, with anglers reporting more fish released than were likely caught. We did not make a correction for reporting bias in the values presented in this report. These calculations are complex and require assumptions regarding the release rates of harvestable-sized fish, and having a consistent size-relationship between

test and sport anglers. To prevent possible misinterpretation of reported catch rates, we felt that these calculations were best left to individuals requiring that specific information. The data needed to make the adjustments are presented in Table 2.

2.8 Data Interpretation and Presentation

To present test-angling data with those of the sport anglers on graphs, the catch rates for the sport fishery were weighted by the harvested catch per unit of effort (HCUE) and the test fishery catch rates were weighted by the TCUE. Weighting the catch rates this way allowed for meaningful comparisons between the two fisheries, as it was expected that test anglers captured a representative sample of the angling-susceptible portion of the fish populations. The length and age-frequency of test-angled fish should therefore be representative of the catchable portion of the population, whereas sport anglers released smaller fish at a greater rate than larger fish, thus biasing the sample returned to the creel. Total frequencies would not allow an adequate comparison between test and sport anglers, as sport angling effort vastly exceeds that of test anglers. Also, direct comparisons of catch rates would not be valid, as test anglers did not represent average anglers. Thus, by weighting the test angler data according to the sport anglers reported catch rates, the frequency of capture of fish of various sizes and ages were standardised.

3.0 RESULTS AND DISCUSSION

From May 15 to August 16, 1179 anglers were interviewed, which combined for a total of 2538 angling hours (Appendix 8). The boat-weighted mean ratio of use was 1.35, meaning that the ratio of use of the surveyed access point to the whole lake use was 1:1.35. This translates to a proportion of use of 0.74 at this access point. From this value and the proportion of the season sampled at Shiningbank Lake, it was estimated that 31.6% of the total angler effort was surveyed from May 15 to August 16. The total estimated number of anglers was 3779 from May 15 to August 16, with an estimated effort of 8033 hours (Appendix 7) or 17.3 angler-hours per hectare. Of 79 lakes in the Northeast Boreal Region that were creeded in the past, only 11 had higher fishing pressure than that observed at Shiningbank Lake in 1998 (pers comm Bill Patterson, ACA, Edmonton).

Anglers had total catch rates of $0.029 \bullet h^{-1}$ for walleye, $0.591 \bullet h^{-1}$ for northern pike and $0.142 \bullet h^{-1}$ for yellow perch (Table 3). The estimated number of (legal and sub-legal) walleye harvested was 57. The estimated number of northern pike and yellow perch harvested were 1550 and 417, respectively. The reported number of walleye (legal and sub-legal) harvested was 18. The reported number of northern pike and yellow perch harvested during the days surveyed from May 15 to August 16 was 490 and 132 respectively. Five of the 18 walleye that were reported harvested did not meet the minimum length requirement. The total number of sport-angled hours reported for May, June, July and August were 593, 649.5, 876 and 419.5 respectively and test-angled hours for those same months were 45.5, 56, 75 and 34.5 hours, respectively. The ratio of sport to test angled hours for each month was similar, indicating test angling should be representative of the time period for the sport fishery sample.

Table 3. Summary of reported catch rates from summer angling surveys (sport-caught fish) conducted in 1985, 1992, 1993 and 1998, and from winter angling surveys (sport-caught fish) conducted in 1995 and 1996 at Shiningbank Lake. The HCUE for walleye includes legal and sub-legal walleye.

YEAR	Summer Angling Data				Winter Angling Data	
	1985 ^a	1992 ^a	1993 ^a	1998	1995 ^a	1996 ^a
Number of days surveyed	5	20	3	36	2	1
Number of anglers interviewed	35	179	13	1179	30	5
Number of angling hours reported	227	568	47	2538	103	22
Number of angling hours estimated	---	---	---	8033.1	---	---
WALLEYE						
Walleye kept / angler-hour (HCUE)	---	0.065	0.021	0.007	0	0
Walleye rel. (<380 mm TL) / angler-hour	---	---	---	0.015	0	0
Walleye rel. (380-500 mm TL) / angler-hour	---	---	---	0.007	0	0
Walleye rel. (>500 mm TL) / angler-hour	---	---	---	0	0	0
Total walleye rel. / angler-hour (RCUE)	---	0.312	0.064	0.022	0	0
Total walleye caught / angler-hour (TCUE)	0.013	0.377	0.085	0.029	0	0
NORTHERN PIKE						
Pike kept / angler-hour (HCUE)	---	0.384	0.340	0.193	0.126	0.045
Pike rel. (<500 mm TL) / angler-hour	---	---	---	0.297	0	0
Pike rel. (>500 mm TL) / angler-hour	---	---	---	0.101	0	0
Total pike rel. / angler-hour (RCUE)	---	0.482	0.128	0.398	0	0
Total pike caught / angler-hour (TCUE)	0.41	0.866	0.468	0.591	0.126	0.045
YELLOW PERCH						
Perch kept / angler-hour (HCUE)	---	0.011	---	0.052	0.369	0.091
Perch rel. (<200 mm TL) / angler-hour	---	---	---	0.079	---	---
Perch rel. (>200 mm TL) / angler-hour	---	---	---	0.011	---	---
Total perch rel. / angler-hour (RCUE)	---	0.021	---	0.090	0.670	0.455
Total perch caught / angler-hour (TCUE)	0.075	0.032	---	0.142	1.039	0.545

^a - AENV/NRS/FMD, Edson file data

3.1 Walleye Status

3.1.1 Age-class Distribution

Walleye displayed a wide age-class distribution with nine age classes being represented (Figure 2). The mean age of sport-caught walleye was 8 (n=14), while the mean for test-caught walleye was 6.5 years (n=11). Age classes for test fishery data ranged wider due to sampling of fish under the protected size limit. The test-caught walleye, which were generally released, more accurately defined the age structure of the population. With an overall mean age of 7.4 and a wide catch distribution at low density, this parameter indicates this population is collapsed (Table 4).

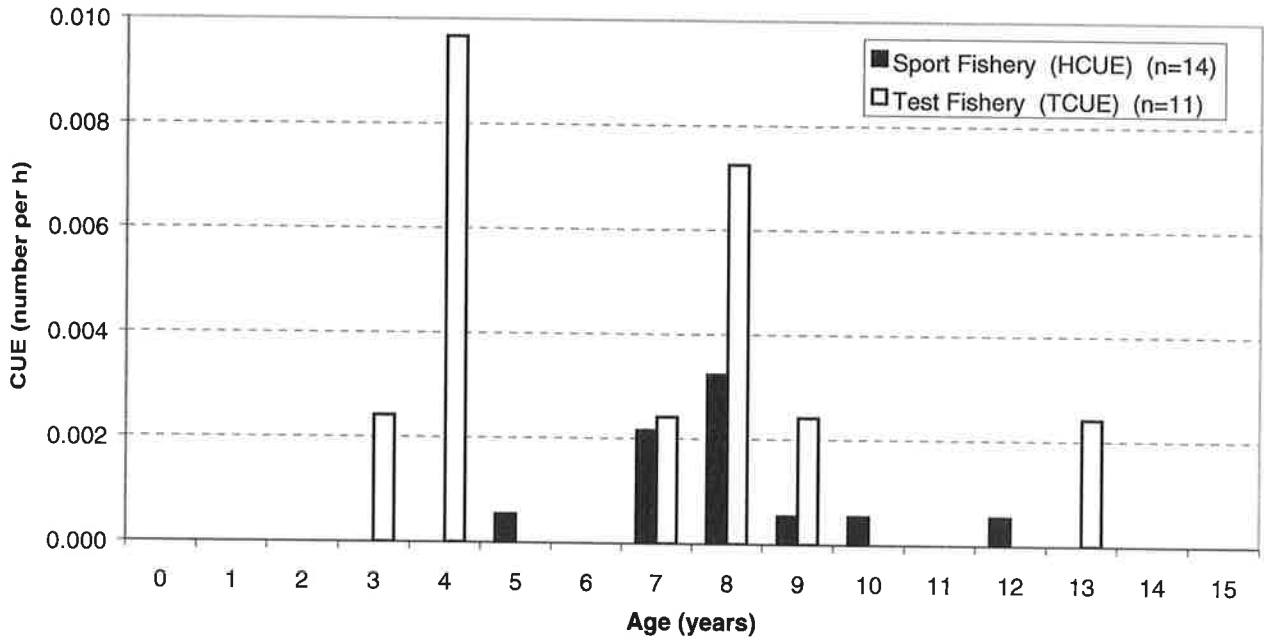


Figure 2. Age-class distribution of walleye caught from May 15 to August 16, 1998 at Shiningbank Lake. The TCUE is the total number of walleye caught (kept and released) per hour. The HCUE is the total number of walleye kept per hour. The HCUE and TCUE were weighted by the number of anglers. Walleye were aged using pelvic fin spines and opercula.

Table 4. Criteria for classifying the status of the walleye fishery in Shiningbank Lake. (Modified for Shiningbank Lake from Sullivan 1994)

	TROPHY	STABLE	VULNERABLE	COLLAPSED
Age-class distribution	Wide: 8 or more age-classes mean age >9	Wide: 8 or more age-classes, mean age 6 - 9 years	Narrow: 1 - 3 age-classes mean age = 4 - 6 few old (> 10 years) fish	Wide or Narrow mean age = 6 - 10
Shiningbank Lake, 1998				* Mean age = 7.4 years; angler harvest wide at very low densities; Mean age sport = 8, Mean age test = 6.5
Age-class Stability	Very stable 1 - 2 age-classes out of smooth catch curve	Relatively stable 2 - 3 age-classes out of smooth catch curve	Unstable 1 - 3 age-classes support fishery	Stable or unstable Recruitment failures
Shiningbank Lake, 1998				* Unstable with recruitment failures
Length-at-age	Very slow 50 cm (FL) in 12 - 15 years	Slow 50 cm (FL) in 9 - 12 years	Moderate 50 cm (FL) in 7 - 9 years	Fast 50 cm (FL) in 4 - 7 years
Shiningbank Lake, 1998		Approximately 9.1 years for sport and test caught fish combined		
Catch rate	Kept > 1 - 2 / h Rel. < 0.5 / h	Kept 0.25 - 0.75 / h Rel. > 0.5 / h	Kept 0.1 - 0.25 / h Rel. < 0.5 / h	Kept < 0.05 / h Rel. < 0.05 / h
Shiningbank Lake, 1998				Kept = 0.007 / h, Released = 0.022 / h (Sport-caught fish)
Age-at-maturity	Females 10 - 20 Males 10 - 16	Females 8 - 10 Males 7 - 9	Females 7 - 8 Males 5 - 7	Females 4 - 7 Males 3 - 6 Ages will vary with Age-class distribution
Shiningbank Lake, 1998			Females 8 (n=4), Males 7 (n=5) (Sport and Test-caught)	

* Note: age-class distribution and stability were difficult to assess due to the very small sample size of walleye.

3.1.2 Age-class Stability

The age-class stability of walleye was considered weak, but the low sample size made it difficult to assess this classification criterion. Two age classes (age 6 and 11) lacked representation and only one fish (Figure 2) represented many age classes. Walleye less than three years did not appear vulnerable to the sport fishery and walleye greater than 13 were also absent from the catch. The current age-class stability is considered unstable and recruitment failures exist.

3.1.3 Length-at-age

A line of best fit (logarithmic) yielded an age of approximately nine years for a fish of 500 mm FL (Figure 3). This growth rate corresponds with that of a stable walleye population, even though most other parameters indicate that the walleye population is collapsed.

The age and length data we observed were similar to those found from a previous study. Hawryluk (1988) found a very similar relationship for pelvic spine-aged walleye captured during a spawning survey (Figure 3). Both Hawryluk's (1988) data and the data from 1998 showed slower growth than earlier samples of scale-aged walleye (Hawryluk 1975). Based on 1970 and 1975 data (Hawryluk 1975), 500 mm FL walleye were determined to be approximately 4 to 6 years old, corresponding to a collapsed status.

The best fit (logarithmic) line for 1970 was, however, shifted to the left of the 1998 line, which may have been the result of underageing of fish in 1970, overageing fish from 1998, or a combination of both. The fish from 1970 were aged using scales while the specimens in 1998 were aged using fin spines. Erickson (1983) stated that older walleye were difficult to age using scales and to a lesser extent dorsal spine sections because of crowding of the annuli at the edge on fish greater than five or six years old. The majority of walleye for which ageing samples were obtained in 1998 were five years old or greater, and all were at least three years old. Otoliths would likely have provided more conclusive ageing results. Since otoliths were not used in any of the years, it is possible that errors in ageing occurred due to the use of different ageing structures and the different personnel conducting the ageing.

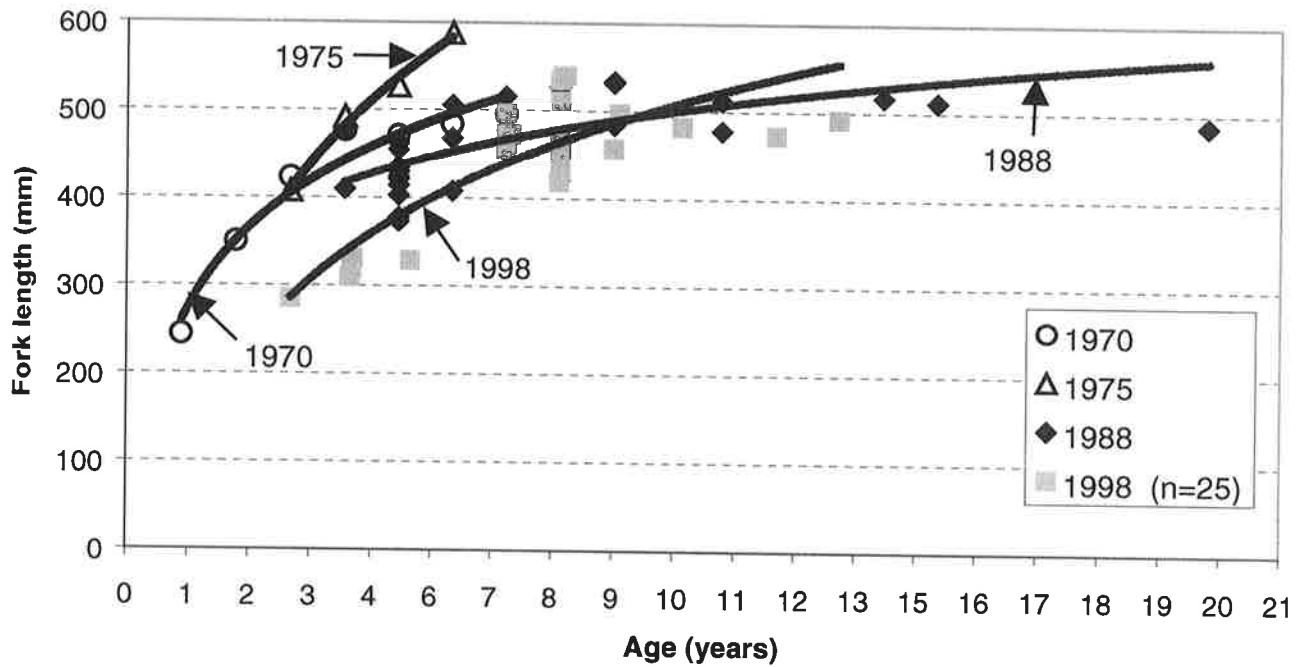


Figure 3. Fork length plotted against age for walleye. (Shiningbank Lake, 1998) The values obtained for 1970 and 1975 were mean fork lengths for specific age-classes (Hawryluk 1975). Walleye from 1988 were aged using pelvic fin spines; fish from 1998 were aged using pelvic fin spines and opercula, while scales were used to age walleye from 1970 and 1975. Walleye samples from 1998 were obtained from May 15 to August 16. The lines are the best-fit logarithmic curves.

3.1.4 Catch Rate

The reported TCUE for walleye by sport anglers in Shiningbank Lake, was $0.029 \cdot h^{-1}$ (Table 4). The reported HCUE (legal and sub-legal) and RCUE (released catch per unit of effort) for sport anglers were $0.007 \cdot h^{-1}$ and $0.022 \cdot h^{-1}$ respectively. The catch rates from 1998 were similar to those obtained from creel surveys with small sizes in the past, with the exception of 1992, which reported a TCUE of $0.377 \cdot h^{-1}$ (AENV/NRS/FMD, Edson file data). The catch rates in 1992 may have been inflated as a result of experimental design. Campground staff conducted the 1992 creel survey as time permitted. Most of the interviews conducted in 1992 were during the evenings, which may be a possible reason for the inflated catch rates. Information from mid-day angling could have lowered the overall catch rates. One angler also reported to have caught 41 walleye in 4.5 hours, which is unbelievable based on present success rates. Alternatively, the 1992 catch rates could have been accurate which would indicate a significant decline in the density of walleye.

3.1.5 Age-at-Maturity

Only 15 fish caught by both sport and test anglers were identified by sex: 9 males, 6 females and 1 immature (Figure 4). Male walleye were mature by seven years of age, while females were mature by eight years. These ages were the earliest where maturity could be confirmed, and both sexes may mature at younger ages. Due to the minimum size limit of 430 mm TL, the sample was biased because smaller fish were not killed and therefore, were not identified to sex or maturity. We can conclude that the age-at-maturity for males and females corresponds with a vulnerable population. If younger mature fish were sampled (as would be expected with larger sample sizes) the age-at-maturity parameter may have also indicated a collapsed population. All legal-sized fish (>430 mm TL) sampled in Shiningbank Lake were mature (Figure 5). Data obtained from a walleye spawning survey conducted in 1988 at Shiningbank Lake, indicated that male walleye were maturing as early as four years, while females began to mature as young as five years of age (AENV/NRS/FMD, Edson file data).

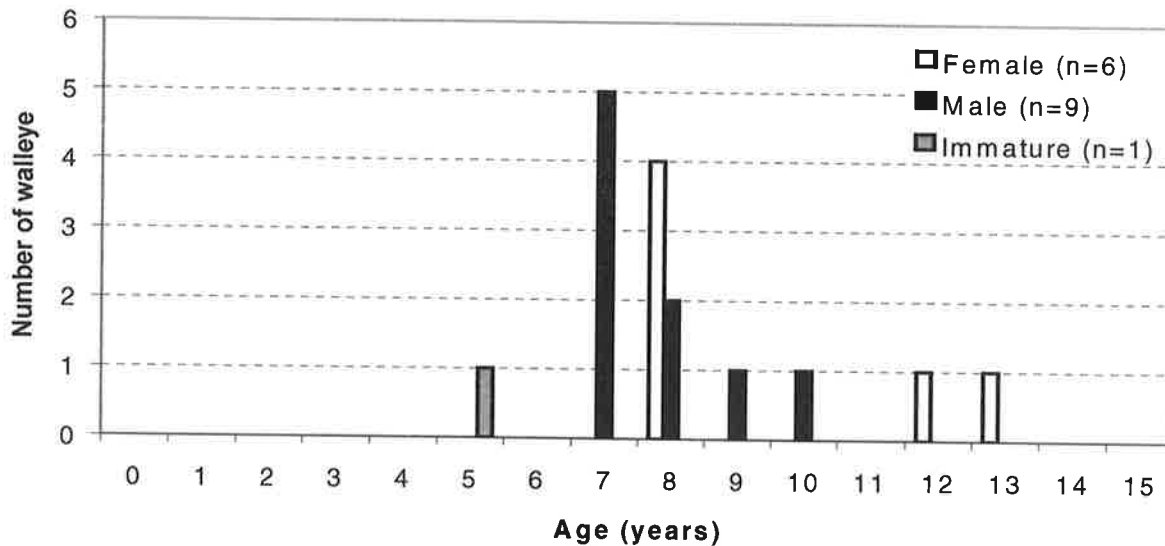


Figure 4. Number and sex of walleye caught at Shiningbank Lake from May 15 to August 16, 1998. Walleye data were obtained from sport and test angling, using pelvic fin spines and opercula for ageing.

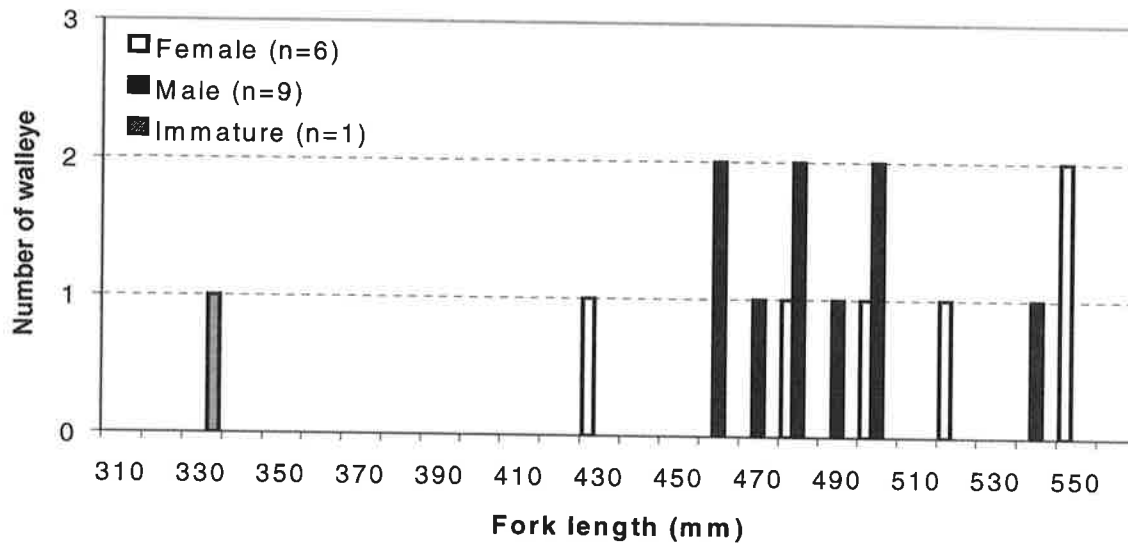


Figure 5. Frequencies of sex and maturity of sport and test-caught walleye by length in Shiningbank Lake from May 15 to August 16, 1998.

3.1.6 Summary

Three of the five parameters used to classify walleye fisheries placed Shiningbank Lake into the collapsed category (Table 4), including catch rate, which is used as an index of fish density. Age-class distribution and stability were placed in the collapsed category, although age-class distribution was wide. All age classes occurred at extremely low densities and are therefore unstable (vulnerable to over-exploitation).

3.2 Northern Pike Status

3.2.1 Catch Rate

Catch rates for sport anglers in Shiningbank Lake were fairly low at $0.193 \cdot h^{-1}$ (HCUE) and $0.591 \cdot h^{-1}$ (TCUE). These values placed the pike fishery in the vulnerable (low risk) and vulnerable (no risk) categories, respectively. The total catch rate was, however, on the lower end of the scale for “no risk” populations (Table 5).

3.2.2 Angler Success Rate

Of all sports anglers, 46% ($n=545$) captured at least one pike and 22% ($n=261$) harvested at least one (Appendices 9 and 10). Both of these success rates placed the Shiningbank Lake northern pike in the vulnerable (low risk) category. These rates also indicate that, of the anglers that caught pike, nearly half (48%) kept at least one.

Table 5. Criteria for classifying northern pike fisheries in Alberta and values for classification of Shiningbank Lake in 1998 (modified for Shiningbank Lake from Sullivan 1998).

	TROPHY	STABLE	VULNERABLE (NO RISK)	VULNERABLE (LOW RISK)	COLLAPSED
CUE (kept) Shiningbank Lake, 1998	>0.8	>0.8	0.3-0.8	0.1-0.3 0.193 HCUE (Sport-caught fish)	<0.1
CUE (total) Shiningbank Lake, 1998	>2	1-2	0.5-1 0.591 TCUE (Sport-caught fish)	0.2-0.5	<0.2
Success (% anglers) Shiningbank Lake, 1998	100%	>70%	>40%	20-40% 22% harvested 1 or more fish, 46% caught 1 or more fish	<20%
GINI (total) Shiningbank Lake, 1998	<0.3	0.3-0.5	0.5-0.7 0.66 (Sport anglers)	0.7-0.9	>0.9
Mean weight Shiningbank Lake, 1998	>2 kg	1-2 kg	<1 kg 0.994 kg (Sport- caught fish)	0.5-1.5 kg	0.5-3.5 kg
Number of Measureable Age- classes (CUE>0.02) Shiningbank Lake, 1998	>10	7-12	3-7 7 (Sport and test fishery)	1-2	0
Growth Rate (lake specific) Shiningbank Lake, 1998	Slow	Slow Approximately 10 years at 63 cm TL for sport and test caught fish combined	Increasing	Increasing	Fast
PSD (%) Shiningbank Lake, 1998	>80	>40 67 (Sport anglers)	<40	Variable 20-70	Variable 10-100
RSD:stock-quality Shiningbank Lake, 1998	<20	<50 33 (Sport anglers)	>50	Variable 30-90	Variable 0-90

3.2.3 GINI Coefficient

The GINI coefficient (0.66) indicated that the catch of northern pike in Shiningbank Lake was not distributed evenly amongst anglers (Figure 6). In fact, 10% of the anglers (catching four or more pike) accounted for more than half the total catch (Appendix 10). Such a skewed distribution of angler catches implies a population of vulnerable (no risk) status.

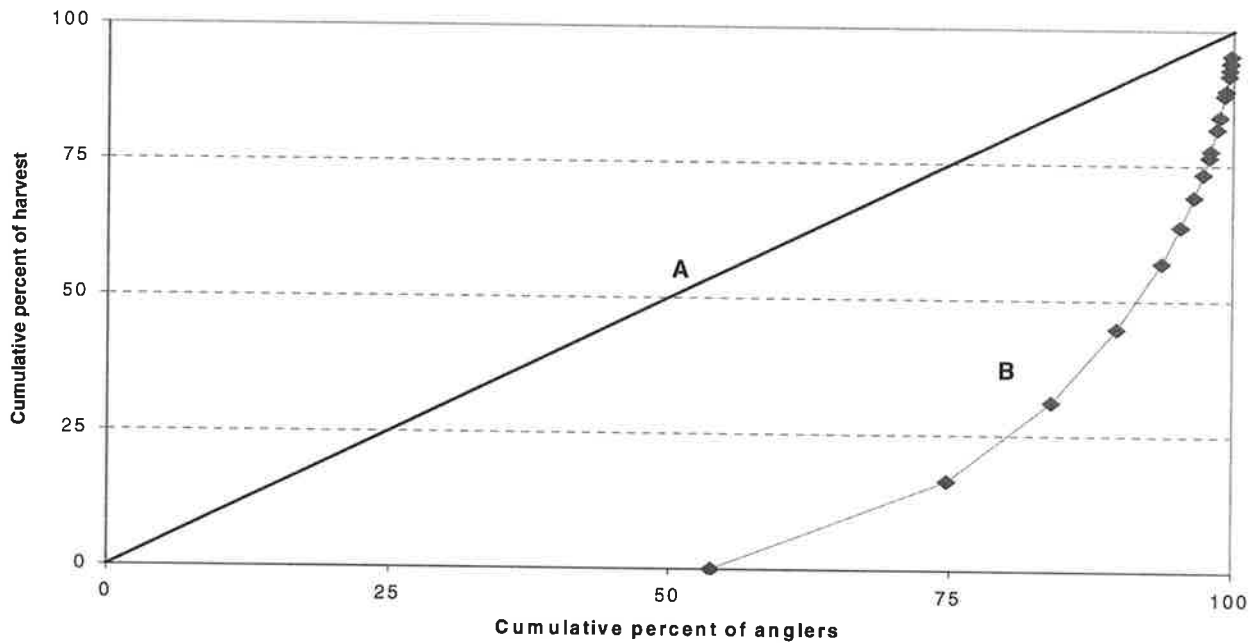


Figure 6. Lorenz curve for the Shiningbank Lake northern pike sport fishery, illustrating departure of the catch from equality. Line A represents perfect equality of catch among anglers (a GINI coefficient of 0), and line B shows the distribution of the harvest of northern pike for Shiningbank Lake in 1998 (GINI =0.66). (Modified from Baccante 1995, with data from Shiningbank Lake, 1998).

3.2.4 Mean Weight

Northern pike returned during the creel survey averaged approximately one kilogram in weight (mean = 0.994 kg), fitting into the vulnerable (no risk) category. The mean weight, as reported, would be expected to be inflated from the average of all caught fish, because it indicates only sport angler catches and sport anglers tend to release smaller-sized fish.

3.2.5 Age-class Distribution

The age-class distribution for northern pike appeared healthy (Figure 7) and there do not appear to be recruitment failures as was seen in the walleye fishery. Sport anglers were catching fish from ages three to thirteen. Old fish were probably not abundant in Shiningbank Lake as evident by the low catch rates. Most fish younger than three years were less susceptible to angling, therefore a creel survey does not provide good information on this portion of the population. Seven age classes, including three age classes which were not consistently returned from the creel data, but which were returned from the test fishery were considered measurable ($CUE > 0.02 \text{ fish} \cdot \text{h}^{-1}$, ages 3 to 8, and 11). The age-class distribution lists the population as vulnerable (no risk) according to the classification criteria.

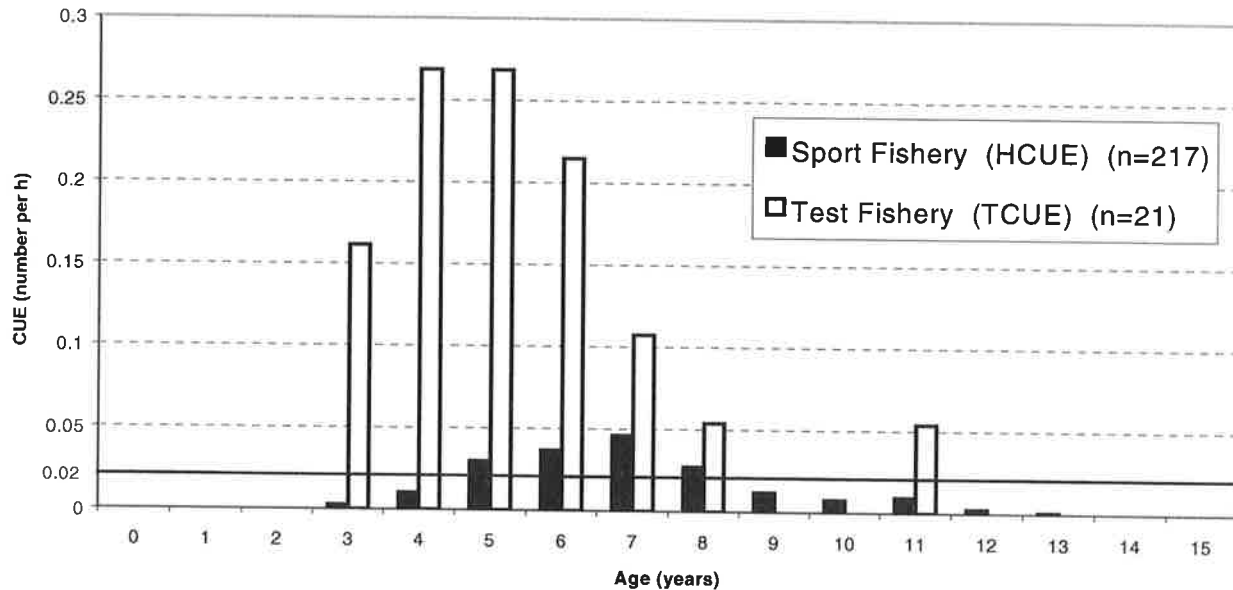


Figure 7. Age-class distributions of northern pike caught by both sport and test anglers in Shiningbank Lake from May 15 to August 16, 1998. The TCUE and HCUE were weighted by the number of anglers. The line at 0.02 CUE was used to classify the number of measurable age classes for northern pike.

3.2.6 Length-at-age

A 630 mm TL minimum size limit (595 mm FL) as proposed for 1999 corresponds to a fish approximately 10 years of age (Figure 8). A slow growth rate is typical of a stable population according to the classification criteria.

The best-fit logarithmic curves for 1970, 1975 and 1998 were very similar. The difference between the placement of the curves may be the result of variation in ageing as discussed in section 3.1.3. Mean ages for age classes in 1970 and 1975 were used, while 1998 data consisted of individual fish.

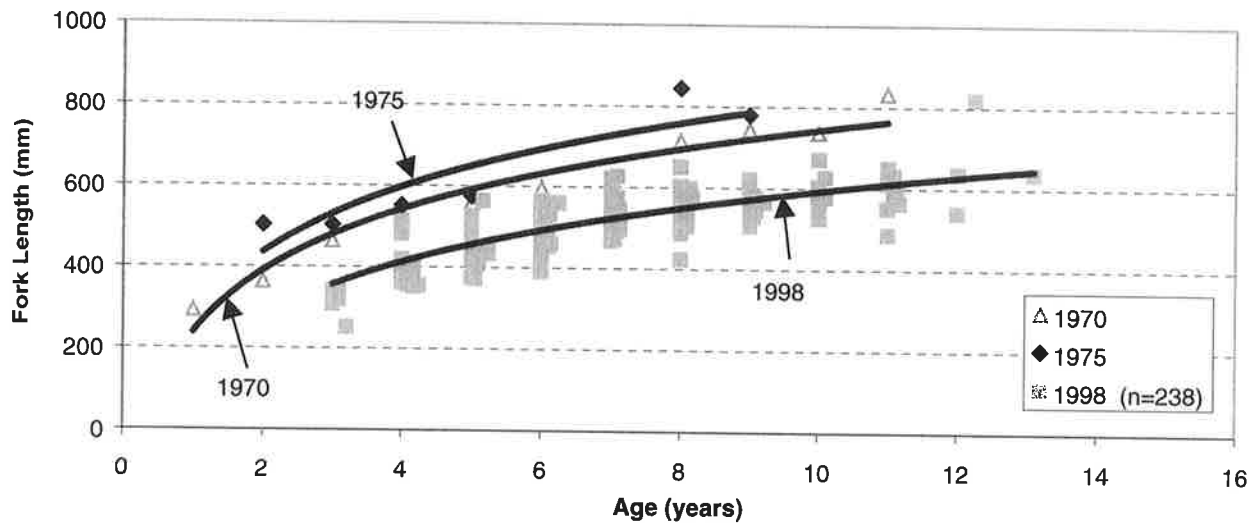


Figure 8. Fork length plotted against age for northern pike at Shiningbank Lake. The values obtained for 1970 and 1975 were mean fork lengths for specific age-classes (Hawryluk 1975). Northern pike from 1970 and 1975 were aged using scales and fish from 1998 were aged using cleithra. Northern pike from 1998 were caught from May 15 to August 16, 1998. The lines are the best-fit logarithmic curves.

3.2.7 Proportional Stock Density

The proportional stock density (PSD) is defined as the number of northern pike harvested equal to or greater than 530 mm TL as a proportion of those that are equal to or greater than 350 mm TL. A higher PSD value indicates a larger average size and a greater proportion of fish of quality, preferred, memorable and trophy sizes (Gabelhouse 1984). Managers have indicated that these fisheries are considered as higher quality fisheries by anglers (from Gabelhouse 1984). The PSD determined for harvested pike was 67. No standards exist by which to compare the Shiningbank population to other Alberta lakes, however “balanced” populations of other species are recommended to be in the range of 40-70 (Gabelhouse 1984). Using the PSD for harvested pike, in accordance with the northern pike management plan (Berry 1999), this population would be stable.

As with other parameters determined from the catch included in the creel, PSD calculations were biased because of the proportion of larger fish that were harvested, compared to those actually caught. In contrast to the harvest-calculated PSD, test angling yielded a PSD of 39. This indicates a poorer quality fishery than was suggested by the harvest data alone, and presents a truer distribution of the size-structure in the population. Test angling data will become more important in the future, as anglers are forced to release pike with the introduction of a minimum size.

3.2.8 Relative Stock Density

The relative stock density for stock to quality northern pike (RSD S-Q) was measured as the proportion of harvested fish between 350 and 529 mm TL relative to the number of pike ≥ 350

mm TL. This makes it the reciprocal of the PSD. The RSD S-Q for harvested pike was calculated to be 33, which corresponds with a stable classification. As with PSD, this was quite different from the RSD S-Q of 61 determined from test angling data.

3.2.9 Summary

A summary of some selection criteria discussed at the technical workshop on the classification of pike fisheries (November 16-18, 1998) and others proposed by Michael Sullivan (Provincial Sportfishing Specialist) have recently been summarised in the northern pike management plan (Berry 1999). The northern pike fishery at Shiningbank Lake generally fits into the vulnerable category with six of nine criteria falling under this proposed classification.

3.3 Selected Parameters for the Yellow Perch Fishery

Currently in Alberta, there are no formal guidelines to manage yellow perch. A summary of potential parameters, the same ones used for walleye, is presented here with the expectation that similar parameters will be used.

3.3.1 Age-class Stability and Distribution

Yellow perch displayed strong age-class distribution with only two age classes lacking representation (Figure 9). The lack of data from age classes one and two for sport-caught fish was likely because these fish were too small for most anglers to bother keeping. Ageing structures were not obtained from one and two year old fish, although test anglers caught fish from 85-165 mm (FL) (Figure 10). Some of these size-classes most likely had ages of one and two years. Two fish with an age of approximately three months (age 0) may have been underaged since they measured >80 mm FL.

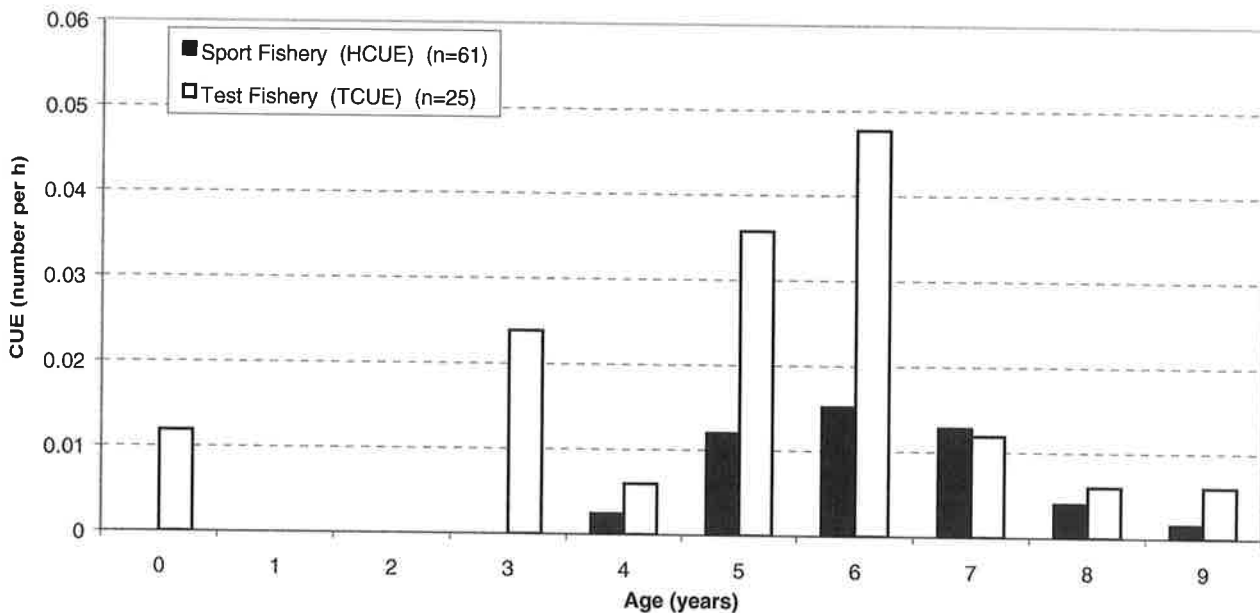


Figure 9. Age-class distribution of yellow perch caught by both sport and test anglers in Shiningbank Lake from May 15 to August 16, 1998. The TCUE and HCUE were weighted by the number of anglers.

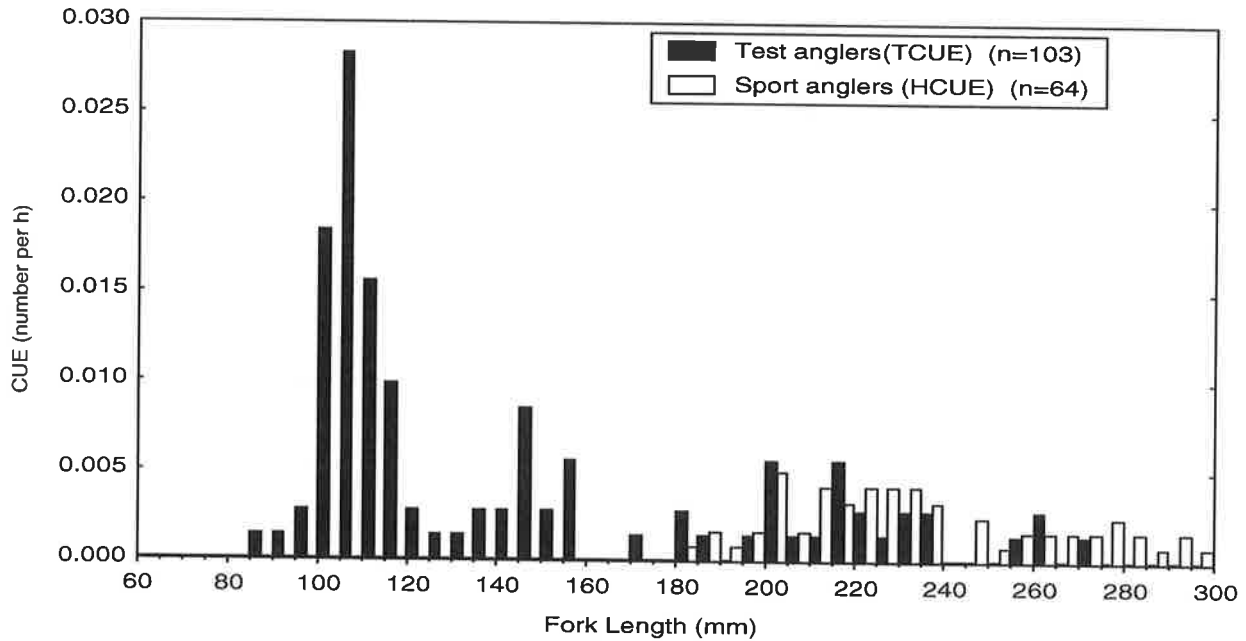


Figure 10. Fork lengths of yellow perch captured in Shiningbank Lake, May 15 to August 16, 1998. Frequency of capture was plotted at a catch rate (number \bullet h⁻¹) for each 10 mm increment. Catch rates for fish angled by project volunteers (test anglers) were weighted by the total (reported released plus observed kept) yellow perch catch rate for anglers interviewed during the creel survey (sport anglers). The sport angler catch frequencies were for kept fish only.

3.3.2 Length-at-age

According to data collected in 1998, yellow perch reached the length of 200 mm TL (194 mm FL) which was used on the creel forms, at approximately four years of age (Figure 11). Results from 1970 and 1975 test-netting indicated that perch were reaching 200 mm at two and three years respectively (Hawryluk 1975). These discrepancies may again be due to the difference in ageing structures from 1970 and 1975 (scales) compared to 1998 (anal fin rays) rather than a decreased growth rate. The best-fit logarithmic line for 1970 was similar to the 1998 line, but it was shifted to the left by two years. The between-year comparisons for yellow perch were similar to those observed for walleye (Figure 3) and northern pike (Figure 8). Concerns exist if once again 1970 fish were underaged and/or 1998 fish were overaged. Also, the 1975 results consisted of a smaller sample size with only three age-classes represented: age 3 (n=6), age 4 (n=7) and age 5 (n=9), which were averaged to identify three points.

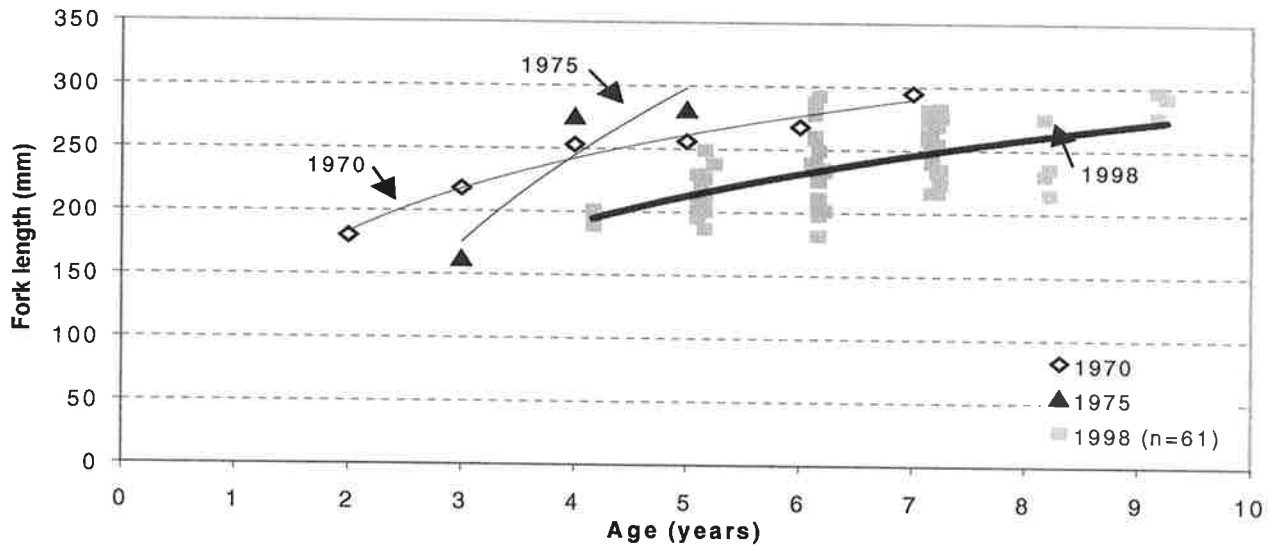


Figure 11. Fork length plotted against age for yellow perch at Shiningbank Lake. The values obtained for 1970 and 1975 were mean fork lengths for specific age-classes (Hawryluk 1975). Yellow perch from 1970 and 1975 were aged using scales while anal fin spines were used to age fish caught by sport anglers from May 15 to August 16, 1998. The lines are the best-fit logarithmic curves.

3.3.3 Catch Rate

The TCUE and HCUE for yellow perch in 1998 were 0.142 and 0.052 fish \bullet h⁻¹ respectively. The 1998 summer catch rates were lower compared to winter creel data obtained from 1995 (TCUE=1.039 \bullet h⁻¹ and HCUE=0.369 \bullet h⁻¹) and 1996 (TCUE=0.545 \bullet h⁻¹ and HCUE= 0.091 \bullet h⁻¹). Higher catch rates for yellow perch are usually observed during the ice-fishing season in February-April, which are likely the result of anglers targeting these species. Only 11% (n=131) of anglers indicated that their target species was yellow perch during the 1998 survey (Appendix 11). These anglers had higher catch rates than the average (TCUE=0.821 \bullet h⁻¹, HCUE 0.290 \bullet h⁻¹).

3.3.4 Age-at-Maturity

At five years, both males and females were mature (Figure 12). The large number of fish with an unknown maturation status may be due to the time of year which sampling occurred. Sampling during the spawning season would allow easier identification of maturity. Again, this information indicates the age in 1998 at which fish were maturing, as smaller perch are less often killed than were larger fish and some of these younger fish may have also been mature.

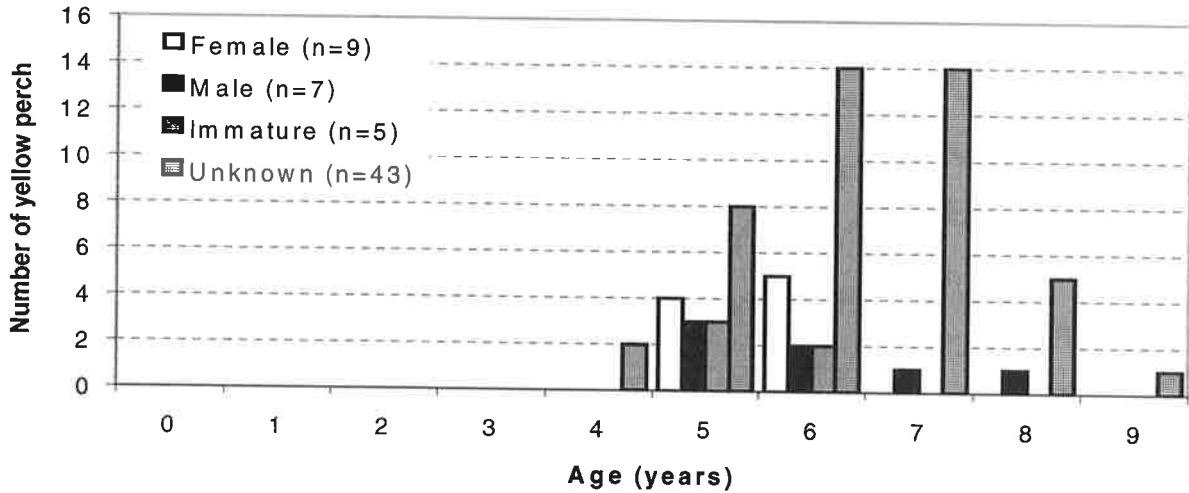


Figure 12. Age and sex of sport and test-caught yellow perch in Shiningbank Lake from May 15 to August 16, 1998. Yellow perch data were aged using anal fin spines.

The smallest fish of known maturity was approximately 200 mm FL (Figure 13). Most fish were maturing at greater than 200 mm, therefore minimum size limits, if introduced, should aim to protect these fish.

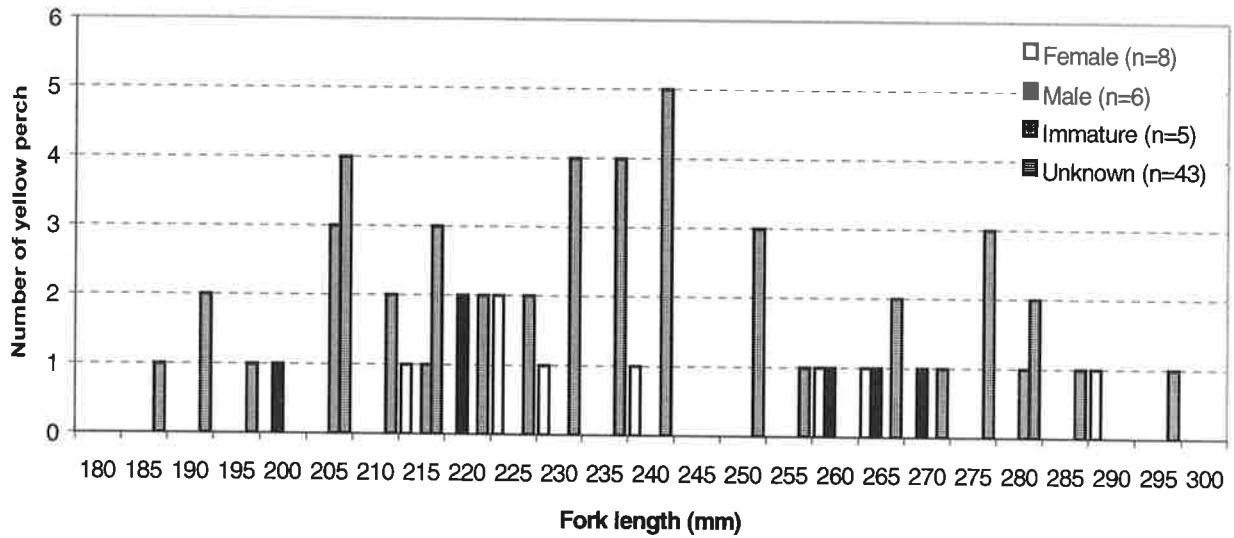


Figure 13. Frequencies of sex and maturity of yellow perch by length caught in Shiningbank Lake from May 15 to August 16, 1998.

3.4 Management Recommendation Questionnaires

Results from 44 angler questionnaires indicated that 50% of anglers believed that the current regulations were not sufficient to protect the walleye population at Shiningbank Lake (Figure 14). Half the respondents thought the regulations were sufficient to protect walleye, even though 96% of anglers did not catch one walleye.

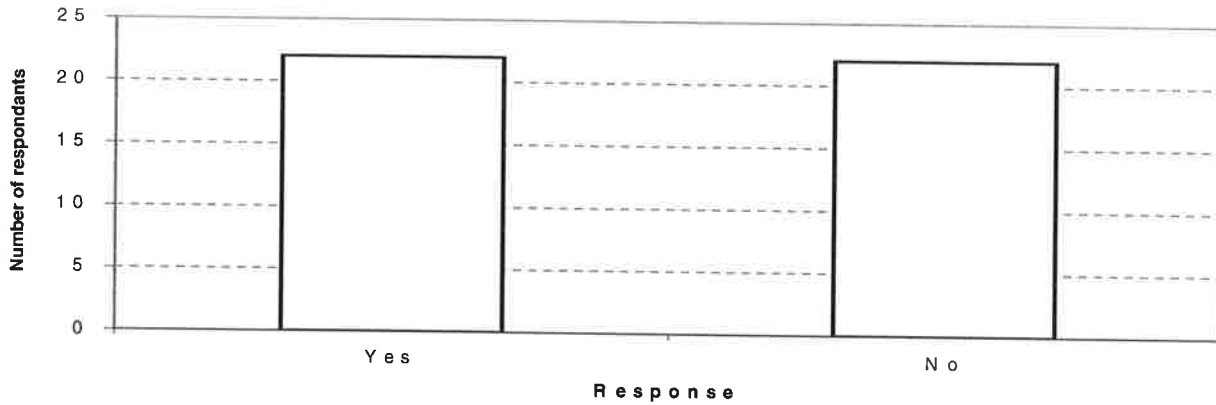


Figure 14. Angler response to the following question asked to anglers at Shiningbank Lake, 1998. Do you think the current regulations are sufficient to protect the walleye population at this lake?

Twenty percent of anglers were in favour of a zero daily bag limit for walleye at Shiningbank Lake (Figure 15). A daily bag limit of 3 fish over 43 cm was chosen by 36% of anglers and it was the only option which yielded greater support than the zero bag limit (Figure 15). Even though 99% of anglers did not harvest a walleye, and 96% of anglers did not release at least one walleye, many anglers wanted to harvest the walleye that they caught. The walleye fishery requires strict protective measures to allow recovery of the population by protecting all fish.

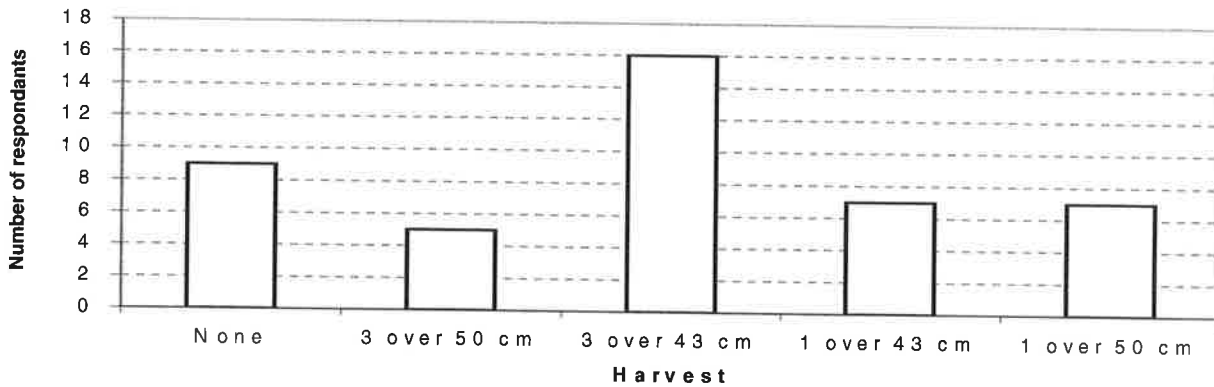


Figure 15. Angler response to the following question asked to anglers at Shiningbank Lake, 1998. What level of harvest for walleye would you prefer to see at this lake?

Sixty percent of anglers would like to see a walleye fishery where moderate numbers of medium-sized fish exist (Figure 16). In order to achieve the goal of a stable walleye fishery desired by most respondents, catch and release regulations are required.

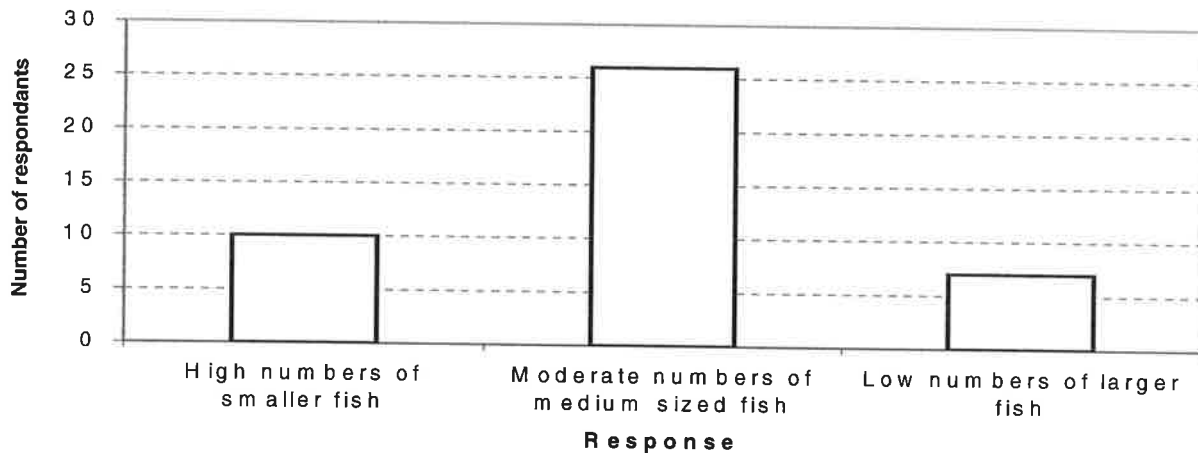


Figure 16. Angler response to the following question asked to anglers at Shiningbank Lake, 1998. What type of walleye fishery would you like to see in this lake?

Of the 44 respondents which filled out the questionnaire, half felt that current regulations protected northern pike in Shiningbank Lake, while half felt that they did not (Figure 17).

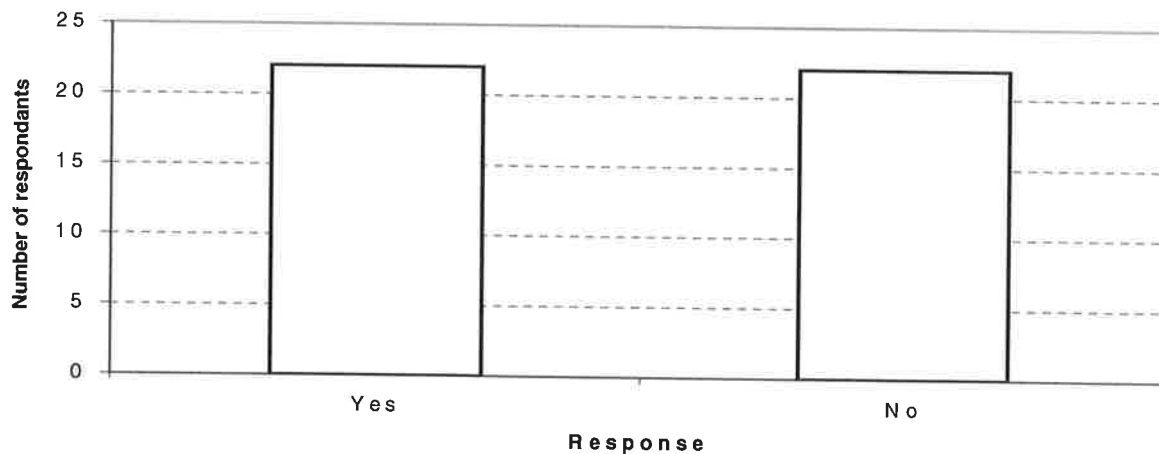


Figure 17. Angler response to the following question asked to anglers at Shiningbank Lake, 1998. Do you feel the current regulations protect northern pike in this lake?

Results from the angler questionnaires, indicated that 66% of the respondents would like to see a northern pike fishery, which consists of moderate numbers of medium-sized fish (Figure 18). A stable northern pike population would provide anglers with the type of fishery desired by most anglers.

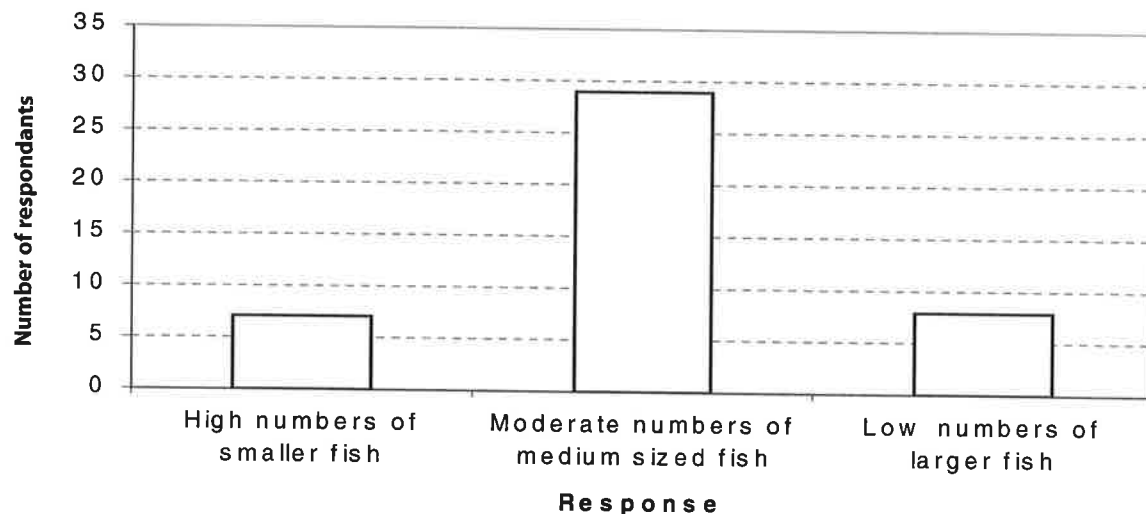


Figure 18. Angler response to the following question asked of anglers at Shiningbank Lake, 1998. What type of northern pike fishery would you like to see in this lake?

Fifty-two percent of anglers who filled out the questionnaire were in favour of a daily bag limit of three fish (Figure 19). This was the most popular response, and it is also the bag limit, which was introduced as part of the 1999-2000 fishing regulations.



Figure 19. Angler response to the following question asked to anglers at Shiningbank Lake, 1998. What do you feel the daily bag limit for pike on this lake should be?

A minimum size limit of 60 cm was the most popular option among questionnaire respondents to protect spawning-sized northern pike (Figure 20). A minimum size limit of 63 cm (TL) was introduced for the 1999-2000 angling season. This size restriction should allow fish to spawn many years under the protection of the minimum size regulation.

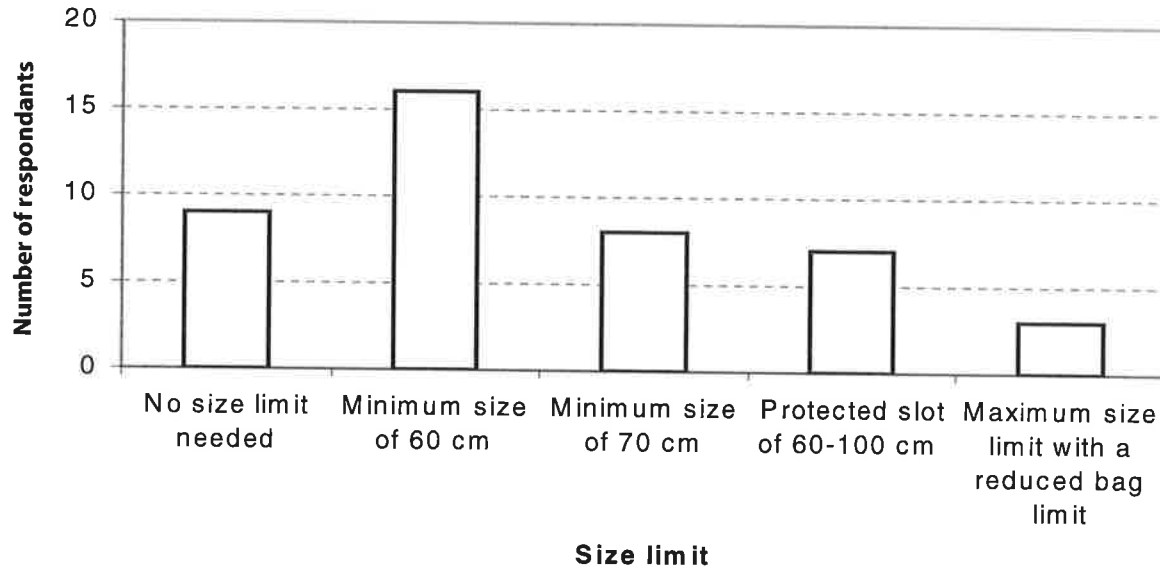


Figure 20. Angler response to the following question asked to anglers at Shiningbank Lake, 1998. What size limit, if any, do you feel should be in place to protect spawning-sized fish?

3.5 Angler Information

Information on angler demographics from Shiningbank Lake is displayed in Appendices 22, 23 and 24. Approximately 77% of the anglers were male and 23% were female at Shiningbank Lake. The average age of the anglers in 1998 at Shiningbank Lake was 34. Of all the anglers interviewed at Shiningbank Lake, over 200 people identified their location of residence as either Edson, Edmonton or Whitecourt.

4.0 CONCLUSIONS AND SUMMARY

The TCUE reported in 1992 for walleye was at least four times greater than catch rates reported in 1993 and 13 times greater than catch rates observed in 1998. Walleye catch rates from 1992 were considerably higher than those displayed in other years, and since this was the most intensive study on Shiningbank Lake prior to 1996, these results were likely used to classify the status of the walleye population in 1996.

According to provincial criteria to classify walleye fisheries, Shiningbank Lake is collapsed. Though a wide age-class distribution exists, with a mean age of 7.4 years of combined sport and test-caught fish, recruitment failures were evident. Walleye displayed a slow growth rate at Shiningbank Lake, reaching 500 mm (FL) at approximately 9.1 years. Reported kept (legal and sub-legal) and released catch rates were low, with respective rates of 0.007 and 0.022 fish•h⁻¹. Age-at-maturity was determined to be at least 7 years for males and 8 years for females, while fish were probably maturing at younger ages. Small sample sizes made it difficult to determine the age and size-structures of the population. The collapsed status would result in a no harvest management strategy to conserve the remaining stock at Shiningbank Lake.

According to the new classification criteria for northern pike (Berry 1999), the Shiningbank Lake population would be considered vulnerable but at no risk of loss of the fishery. In 1999, the default classification has an associated daily bag limit of 3 fish with a minimum size limit of 630 mm TL. This will reduce the harvest of northern pike considerably, due to the small size of fish at Shiningbank Lake. Although 22% of anglers harvested one or more fish, only 11% of pike were >630 mm TL. The new regulations will reduce harvest, while protecting spawning fish and northern pike density should increase. Some fish may spawn for up to six years before reaching the legal-harvestable size. Results from a questionnaire filled out by some anglers (Figures 17 to 20) indicated that 37% are in favour of minimum size limit of 60 cm and 52% support a daily bag limit of 3 pike. The new regulations should accelerate recovery of the pike fishery at Shiningbank Lake.

The lack of a provincial yellow perch management plan made it difficult to assess the status of the fishery relative to management recommendations. The establishment of a management plan for yellow perch in the near future would provide guidelines to help assess the status of the perch fishery in Shiningbank Lake.

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APPENDICES

Appendix 1. Boat survey conducted to determine percentage of anglers surveyed.
(Shiningbank lake, 1998)

Date	Campsite (no. boats)	Day Use (no. boats)	Total	Ratio of use	Total x Ratio of Use
03-Jun-98	2	2	4	2.00	8.00
04-Jun-98	6	4	10	1.67	16.67
05-Jun-98	6	4	10	1.67	16.67
06-Jun-98	3	1	4	1.33	5.33
07-Jun-98	6	3	9	1.50	13.50
17-Jun-98	5	1	6	1.20	7.20
18-Jun-98	2	0	2	1.00	2.00
19-Jun-98	6	2	8	1.33	10.67
20-Jun-98	10	1	11	1.10	12.10
21-Jun-98	14	5	19	1.36	25.79
01-Jul-98	4	0	4	1.00	4.00
02-Jul-98	1	0	1	1.00	1.00
03-Jul-98	6	2	8	1.33	10.67
04-Jul-98	2	0	2	1.00	2.00
05-Jul-98	3	1	4	1.33	5.33
15-Jul-98	4	1	5	1.25	6.25
16-Jul-98	3	2	5	1.67	8.33
17-Jul-98	3	1	4	1.33	5.33
18-Jul-98	4	2	6	1.50	9.00
29-Jul-98	3	0	3	1.00	3.00
30-Jul-98	2	0	2	1.00	2.00
31-Jul-98	4	1	5	1.25	6.25
01-Aug-98	3	0	3	1.00	3.00
02-Aug-98	1	0	1	1.00	1.00
03-Aug-98	0	0	0	---	---
12-Aug-98	2	0	2	1.00	2.00
13-Aug-98	3	0	3	1.00	3.00
14-Aug-98	2	1	3	1.50	4.50
Totals	110	34	144		194.59
Means				1.17	1.35
Std. Dev.				0.27	5.84

Appendix 2. Shiningbank Lake creel survey data form (scaled modified to fit this page).

**1998 SPORT-FISH MONITORING PROGRAM
ALBERTA CONSERVATION ASSOCIATION / NRS**

- Shiningbank Lake -

"Stable" Walleye Fishery

Crew: _____

Page: _____

*all measurements are total length max. (cm)

1998 Date	Month	Day	Day Code	Time (24 h)	Party #	Anglers (1 thru 9) # anglers in party	Hours Hours fished (.0 or .5)	WALL		NRPK		YLPR		Method	Skill	Target	Electronics	Angler gender	Angler age	Angler	Residence	Residence Code	# Fish caught	Size of fish caught	Overall experience	On-lake form	
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Appendix 3. Expectations of Anglers Regarding Fishery Quality questionnaire filled out by anglers at Shiningbank Lake during the summer of 1998.

Expectations of Anglers Regarding Fishery Quality 1998 Sport-fish Monitoring Program

Alberta Conservation Association, Alberta Natural Resources Service, Alberta Fisheries Working Group

PLEASE CIRCLE YOUR ANSWERS BASED ON YOUR EXPECTATIONS OF THIS LAKE .
(LAKE : _____)

1. How long would it take for an average angler to catch a legal-sized walleye at this lake?
 - a) More than one per trip.
 - b) One per trip
 - c) One every two trips
 - d) One every four trips
 - e) Fewer than one every four trips

2. What percent of anglers would catch a walleye they are able to keep at this lake?
 - a) 75% to 100%
 - b) 50% to 75%
 - c) 25% to 50%
 - d) less than 25%

3. Of all the successful walleye anglers at this lake (meaning: of the people fishing here that catch a legal-sized walleye), how many would keep each number of walleye?
Please circle one letter for each category.

One walleye	Two walleye	Three walleye
(a) 75%	(a) 75%	(a) 75%
(b) 50%	(b) 50%	(b) 50%
(c) 25%	(c) 25%	(c) 25%
(d) 10%	(d) 10%	(d) 10%
(e) < 5%	(e) < 5%	(e) < 5%

4. What is the average weight of walleye kept at this lake?
 - a) over 5 lbs.
 - b) 3 – 5 lbs.
 - c) 2 – 3 lbs.
 - d) under 2 lbs.

5. Rank your level of experience fishing at this lake. Please select one answer.
 - a) First time ever.
 - b) Occasional angler.
 - c) Regular angler.
 - d) Expert on this lake.

Thank you for taking time away from your fishing trip,

Appendix 4. Results from the Expectations of Anglers Regarding Fishery Quality questionnaire.

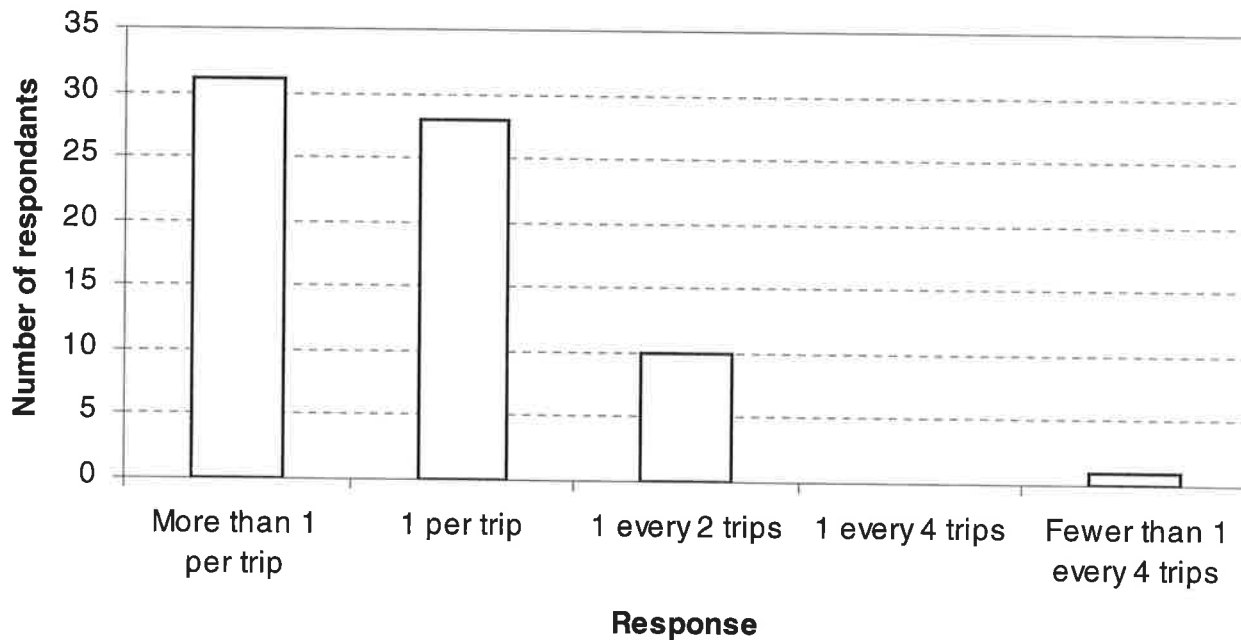


Figure A4.1. Response to the question: "How long would it take for an average angler to catch a legal-sized walleye at this lake?"

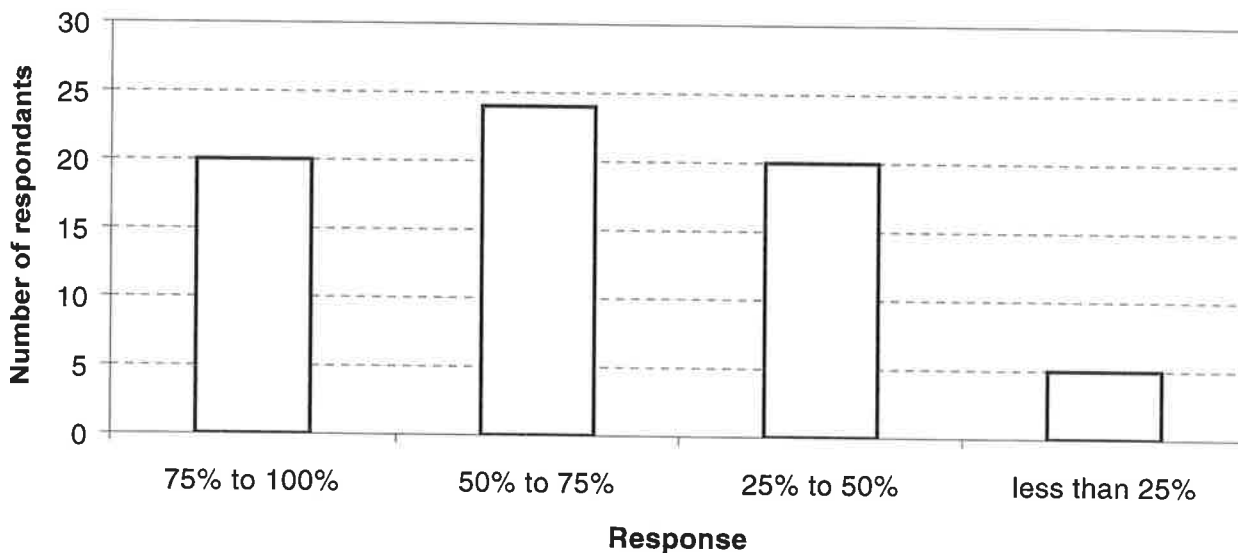


Figure A4.2. Response to the question: "What percent of anglers would catch a walleye they are able to keep at this lake?"

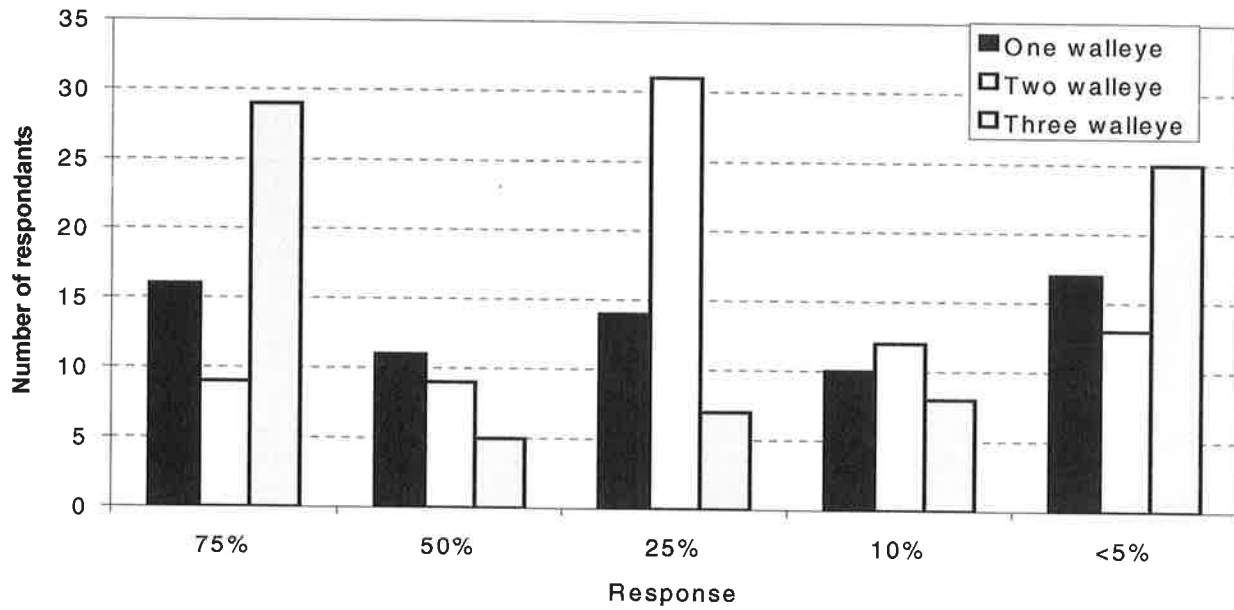


Figure A4.3. Response to the question: "Of all the successful walleye anglers at this lake, how many would keep each number of walleye?"

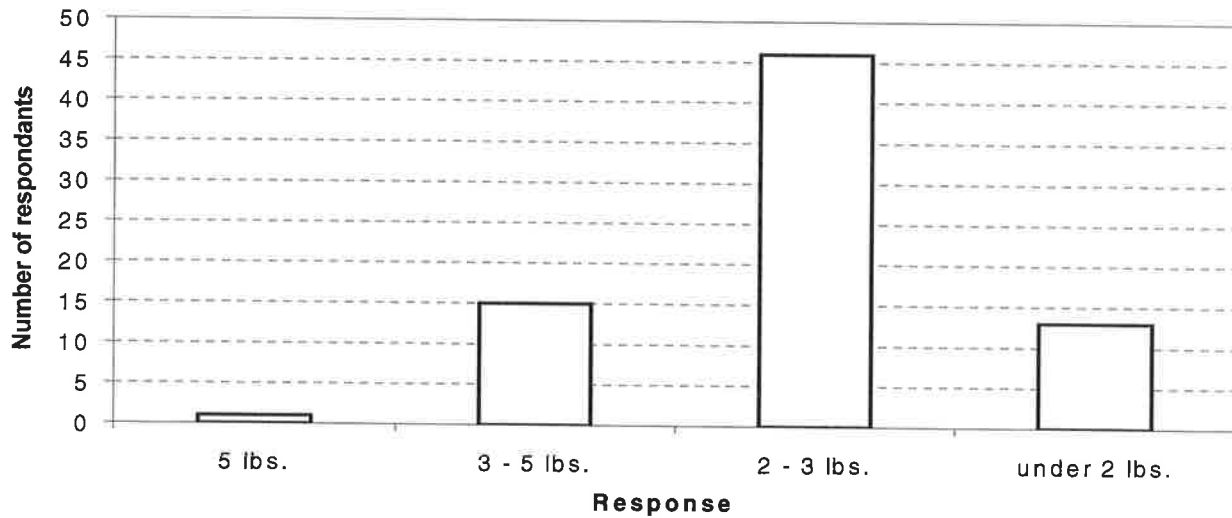


Figure A4.4. Response to the question: "What is the average weight of walleye kept at this lake?"

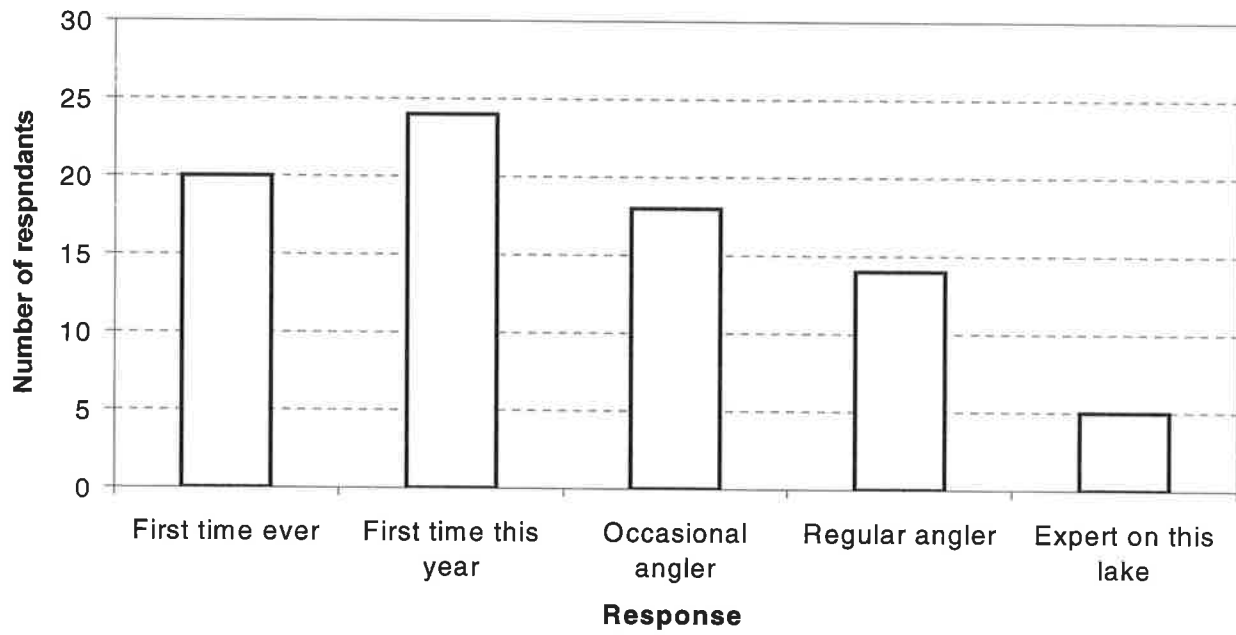


Figure A4.5. Response to the question: "Rank your level of experience fishing at this?"

Appendix 6. Values used for calculation of the total hours angled by category.

	Mean hours/angler	Variance	Mean angler- hours/day	Variance	N
Weekdays	2.225	0.446	52.527	562.665	12
Fridays	2.043	0.089	97.007	1198.25	7
Weekend days	2.042	0.271	106.735	2661.367	14
Holiday Weekend days	2.13	0.199	100.868	3740.044	4
Holidays	2.305	0.32	202.500	10461.76	3

Appendix 7. Sample calculation of weighting parameters for Shiningbank Lake from May 15 to August 16, 1998.

The mean number of hours per angler was determined for each day, which allowed the calculation of the total hours angled. The number of anglers, that were not surveyed, was multiplied by the mean hours per angler for those surveyed. The number of hours angled by both anglers surveyed and those not surveyed at the creel site was multiplied by the mean ratio of use (1.35). The ratio of use was determined by multiplying the daily ratio of use by the total number of boats. These values were summed and divided by the total number of boats to produce a mean weighted ratio of use. To estimate parameters for days not surveyed, the above means of those categories were multiplied by the number of weekdays not surveyed and added to the observed parameters. The same procedure was used for the other four categories (Fridays, weekends, holidays and holiday weekends). Estimated number of anglers, number of hours fished and number of walleye harvested for all categories were added for total estimates.

Date	No. of Anglers	Weekday Hours	Hours/Angler	Mean	Variance	No. of anglers missed	Total angler-hours/day	Total hours	Mean	Variance
19-May-98	4	16	4.000			0	16.0	21.6		
03-Jun-98	11	24	2.182			0	24.0	32.4		
04-Jun-98	19	43	2.263			0	43.0	58.1		
17-Jun-98	21	38	1.810			2	41.6	56.2		
18-Jun-98	11	17	1.545			0	17.0	23.0		
02-Jul-98	20	37	1.850			0	37.0	50.0		
15-Jul-98	29	62.5	2.155			0	62.5	84.4		
16-Jul-98	30	71.5	2.383			0	71.5	96.5		
29-Jul-98	24	58	2.417			0	58.0	78.3		
30-Jul-98	10	27	2.700			2	32.4	43.7		
12-Aug-98	18	35	1.944			0	35.0	47.3		
13-Aug-98	18	26	1.444	2.225	0.446295913	2	28.9	39.0	52.52714286	562.6645
Friday Hours										
15-May-98	26	56.5	2.173			0	56.5	76.3		
05-Jun-98	22	40	1.818			0	40.0	54.0		
19-Jun-98	38	81.5	2.145			0	81.5	110.0		
03-Jul-98	52	107.5	2.067			0	107.5	145.1		
17-Jul-98	50	99	1.980			0	99.0	133.7		
31-Jul-98	28	71	2.536			0	71.0	95.9		
14-Aug-98	30	47.5	1.583	2.043	0.089	0	47.5	64.1	97.00714286	1198.2504
Weekend Hours										
06-Jun-98	57	109	1.912			0	109.0	147.2		
07-Jun-98	31	78.5	2.532			2	83.6	112.8		
20-Jun-98	38	88.5	2.329			0	88.5	119.5		
21-Jun-98	51	130	2.549			3	137.6	185.8		
04-Jul-98	48	105	2.188			0	105.0	141.8		
05-Jul-98	11	29.5	2.682			2	34.9	47.1		
18-Jul-98	46	95	2.065			2	99.1	133.8		
19-Jul-98	27	30	1.111			0	30.0	40.5		
15-Aug-98	51	81	1.588			0	81.0	109.4		
16-Aug-98	13	19	1.462	2.042	0.271	2	21.9	29.6	106.7348776	2661.3666
Holiday Hours										
18-May-98	46	110.5	2.402			2	115.3	155.7		
01-Jul-98	35	83	2.371			0	83.0	112.1		
03-Aug-98	13	21	1.615	2.130	0.199	3	25.8	34.9	100.8677258	3740.0438
Holiday Weekend Hours										
16-May-98	71	155.5	2.190			0	155.5	209.9		
17-May-98	84	254.5	3.030			0	254.5	343.6		
01-Aug-98	51	84.5	1.657			0	84.5	114.1		
02-Aug-98	45	105.5	2.344	2.305	0.320	0	105.5	142.4	202.5	10461.758

	Hours	Anglers
Weekday hours sur.	630.3	283.3559644
Weekday hours est.	1943.5	873.6808902
Friday hours sur.	679.1	332.3474606
Friday hours est.	679.1	332.3474606
Weekend hours sur.	1494.3	731.8511553
Weekend hours est.	1494.3	731.8511553
Holiday hours sur.	302.6	142.0897425
Holiday hours est.	0.0	0
L. Weekend hours sur.	810.0	351.3638689
L. Weekend hours est.	0.0	0
Total	8033.1	3778.887698

	Monday-Thursday	Saturday-Sunday	Holidays	Friday	Holiday weekends
Surveyed	12	14	3	7	2
Off	37	14	0	7	0
Totals	49	28	3	14	2

Appendix 8. Summary of angler survey data for Shiningbank Lake for the period of May 15 to August 16, 1998. Angler interview data are summed for each day surveyed in terms of the total number of anglers interviewed, total angling hours reported and the total numbers of fish observed kept and reported released for 3 species: walleye, northern pike and yellow perch. For released fish, numbers were totalled for different size categories as shown (intervals are in mm total length).

Date	Total Anglers	Total Hours	Walleye			Northern Pike			Yellow Perch			
			Kept	Released (mm TL)		Kept	Released (mm TL)		Kept	Released (mm)		
				<380	380-500		>500	<500		>500	<200	>200
15-May-98	26	56.5	0	1	0	0	14	19	2	0	0	0
16-May-98	71	155.5	3	1	0	0	57	76	15	0	0	0
17-May-98	84	254.5	3	3	0	0	56	67	82	0	0	0
18-May-98	46	110.5	2	0	0	0	25	41	10	0	0	1
19-May-98	4	16	0	0	0	0	16	13	0	0	0	0
3-Jun-98	11	24	0	1	2	0	4	6	3	0	0	0
4-Jun-98	19	43	0	0	0	0	9	17	5	0	0	0
5-Jun-98	22	40	0	0	0	0	13	9	8	0	0	0
6-Jun-98	57	109	1	0	4	0	17	127	33	0	0	0
7-Jun-98	31	78.5	0	0	0	0	16	27	20	0	0	0
17-Jun-98	21	38	0	4	0	0	11	8	3	0	0	0
18-Jun-98	11	17	0	0	0	0	4	7	2	0	0	0
19-Jun-98	38	81.5	3	3	1	0	11	24	5	0	0	0
20-Jun-98	38	88.5	0	3	0	0	21	42	3	2	0	0
21-Jun-98	51	130	0	2	0	0	34	45	14	4	1	0
1-Jul-98	35	83	0	0	0	0	8	27	4	0	0	0
2-Jul-98	20	37	0	0	0	0	3	1	0	4	4	0
3-Jul-98	52	107.5	4	0	3	0	25	17	3	5	6	5
4-Jul-98	48	105	0	2	2	0	13	24	0	9	31	3
5-Jul-98	11	29.5	0	0	0	0	0	13	6	0	0	0
15-Jul-98	29	62.5	0	0	0	0	26	8	1	25	0	0
16-Jul-98	30	71.5	0	2	1	0	8	1	9	14	0	0
17-Jul-98	50	99	0	1	0	0	12	6	1	5	8	6
18-Jul-98	46	95	0	4	2	0	4	13	3	3	4	5
19-Jul-98	27	30	0	3	0	0	2	12	0	4	11	0
29-Jul-98	24	58	0	0	0	0	5	3	2	7	5	0
30-Jul-98	10	27	0	1	0	0	2	5	0	7	0	0
31-Jul-98	28	71	0	0	0	0	10	12	0	6	10	0
1-Aug-98	51	84.5	0	3	2	0	12	23	11	7	12	0
2-Aug-98	45	105.5	1	3	0	0	5	8	4	7	9	0
3-Aug-98	13	21	0	0	0	0	1	5	1	10	1	0
12-Aug-98	18	35	0	0	0	0	16	6	0	0	0	0
13-Aug-98	18	26	1	1	0	0	7	6	5	0	0	6
14-Aug-98	30	47.5	0	0	0	0	8	9	1	3	16	3
15-Aug-98	51	81	0	0	0	0	14	26	1	8	55	0
16-Aug-98	13	19	0	0	0	0	1	1	0	2	28	0
Totals	1179	2538	18	38	17	0	490	754	257	132	201	29

Appendix 9. Catch frequency distribution of harvested walleye, northern pike and yellow perch from May 15 to August 16, 1998 in Shiningbank Lake.

Species	Number kept per angler	Number of anglers	Number harvested	Percent of total anglers	Percent of harvest	Cumulative percent of anglers	Cumulative percent of harvest
Walleye	0	1166	0	98.9	0.0	98.9	0.0
	1	10	10	0.8	55.6	99.7	55.6
	2	1	2	0.1	11.1	99.8	66.7
	3	2	6	0.2	33.3	100.0	100.0
Northern pike	0	918	0	77.9	0.0	77.9	0.0
	1	148	148	12.6	30.2	90.5	30.2
	2	59	118	5.0	24.1	95.5	54.3
	3	31	93	2.6	19.0	98.1	73.3
	4	6	24	0.5	4.9	98.6	78.2
	5	5	25	0.4	5.1	99.0	83.3
	6	6	36	0.5	7.3	99.5	90.6
	7	4	28	0.3	5.7	99.8	96.3
	8	1	8	0.1	1.6	99.9	98.0
	9	0	0	0.0	0.0	99.9	98.0
	10	1	10	0.1	2.0	100.0	100.0
Yellow perch	0	1111	0	94.2	0.0	94.2	0.0
	1	37	37	3.1	28.0	97.3	28.0
	2	11	22	0.9	16.7	98.2	44.7
	3	12	36	1.0	27.3	99.2	72.0
	4	4	16	0.3	12.1	99.5	84.1
	5	3	15	0.3	11.4	99.8	95.5
	6	1	6	0.1	4.5	99.9	100.0

Appendix 10. Catch frequency distribution of the total number of walleye, northern pike and yellow perch caught from May 15 to August 16, 1998 in Shiningbank Lake.

Species	Number caught per angler	Number of anglers	Total caught	Percent of total anglers	Percent of fish caught	Cumulative percent of anglers	Cumulative percent of fish caught
Walleye	0	1129	0	95.8	0.0	95.8	0.0
	1	34	34	2.9	46.6	98.7	46.6
	2	11	22	0.9	30.1	99.6	76.7
	3	3	9	0.3	12.3	99.9	89.0
	4	2	8	0.2	11.0	100.0	100.0
Northern pike	0	634	0	53.8	0.0	53.8	0.0
	1	247	247	20.9	16.5	74.7	16.5
	2	110	220	9.3	14.7	84.1	31.1
	3	68	204	5.8	13.6	89.8	44.7
	4	46	184	3.9	12.3	93.7	57.0
	5	20	100	1.7	6.7	95.4	63.6
	6	14	84	1.2	5.6	96.6	69.2
	7	9	63	0.8	4.2	97.4	73.4
	8	6	48	0.5	3.2	97.9	76.6
	9	2	18	0.2	1.2	98.1	77.8
	10	6	60	0.5	4.0	98.6	81.8
	11	3	33	0.3	2.2	98.8	84.0
	12	5	60	0.4	4.0	99.3	88.0
	13	1	13	0.1	0.9	99.3	88.9
	14	3	42	0.3	2.8	99.6	91.7
	17	1	17	0.1	1.1	99.7	92.8
	18	1	18	0.1	1.2	99.8	94.0
20	1	20	0.1	1.3	99.9	95.3	
35	2	70	0.2	4.7	100.0	100.0	
Yellow perch	0	1067	0	90.5	0.0	90.5	0.0
	1	43	43	3.6	11.9	94.1	11.9
	2	19	38	1.6	10.5	95.8	22.4
	3	16	48	1.4	13.3	97.1	35.6
	4	11	44	0.9	12.2	98.0	47.8
	5	5	25	0.4	6.9	98.5	54.7
	6	5	30	0.4	8.3	98.9	63.0
	7	2	14	0.2	3.9	99.1	66.9
	8	3	24	0.3	6.6	99.3	73.5
	10	2	20	0.2	5.5	99.5	79.0
	11	3	33	0.3	9.1	99.7	88.1
	13	1	13	0.1	3.6	99.8	91.7
	15	2	30	0.2	8.3	100.0	100.0

Appendix 11. Target species of anglers and catch statistics for walleye, northern pike and yellow perch from May 15 to August 16, 1998 at Shiningbank Lake. The number of fish released by anglers is indicated by (Rel.). HCUE is the harvest catch per unit of effort and TCUE is the total catch per unit of effort.

Target species	Total anglers		Percent of anglers		Total hours	Walleye			Northern Pike			Yellow Perch				
	anglers	210	17.8	58.2		496.5	Kept	Rel.	HCUE	TCUE	Kept	Rel.	HCUE	TCUE	Kept	Rel.
Walleye	210	17.8	58.2	496.5	15	18	0.030	0.066	67	180	0.135	0.497	28	43	0.056	0.143
Northern Pike	686	58.2	11.1	1398	0	7	0.000	0.005	367	664	0.263	0.737	3	5	0.002	0.006
Yellow Perch	131	11.1	12.7	299.5	0	14	0.000	0.047	16	58	0.053	0.247	87	159	0.290	0.821
Any species	150	12.7	0.2	338.5	2	16	0.006	0.053	40	109	0.118	0.440	11	23	0.032	0.100
Unknown	2	0.2		5.5	1	0	0.182	0.182	0	0	0.000	0.000	3	0	0.545	0.545
Totals	1179	100		2538	18	55	*0.007	*0.029	490	1011	*0.193	*0.591	132	230	*0.052	*0.142

* Mean HCUE and TCUE which have been weighted by the number of anglers.

Appendix 12. Anglers use of electronic gear and catch statistics for walleye, northern pike and yellow perch from May 15 to August 16, 1998 at Shiningbank Lake. The number of fish released by anglers is indicated by (Rel.). HCUE is the harvest catch per unit of effort and TCUE is the total catch per unit of effort.

Electronics	Total anglers		Percent of anglers		Total hours	Walleye			Northern Pike			Yellow Perch				
	anglers	821 <th>69.6 <th>29.3 <th>1703.5 <th>Kept</th> <th>Rel.</th> <th>HCUE</th> <th>TCUE</th> <th>Kept</th> <th>Rel.</th> <th>HCUE</th> <th>TCUE</th> <th>Kept</th> <th>Rel.</th> <th>HCUE</th> <th>TCUE</th> </th></th></th>	69.6 <th>29.3 <th>1703.5 <th>Kept</th> <th>Rel.</th> <th>HCUE</th> <th>TCUE</th> <th>Kept</th> <th>Rel.</th> <th>HCUE</th> <th>TCUE</th> <th>Kept</th> <th>Rel.</th> <th>HCUE</th> <th>TCUE</th> </th></th>	29.3 <th>1703.5 <th>Kept</th> <th>Rel.</th> <th>HCUE</th> <th>TCUE</th> <th>Kept</th> <th>Rel.</th> <th>HCUE</th> <th>TCUE</th> <th>Kept</th> <th>Rel.</th> <th>HCUE</th> <th>TCUE</th> </th>		1703.5 <th>Kept</th> <th>Rel.</th> <th>HCUE</th> <th>TCUE</th> <th>Kept</th> <th>Rel.</th> <th>HCUE</th> <th>TCUE</th> <th>Kept</th> <th>Rel.</th> <th>HCUE</th> <th>TCUE</th>	Kept	Rel.	HCUE	TCUE	Kept	Rel.	HCUE	TCUE	Kept	Rel.
None	821	69.6	0	1703.5	10	37	0.006	0.028	413	687	0.242	0.646	69	156	0.041	0.132
Depth Sounder	346	29.3	0	809.5	7	18	0.009	0.031	71	318	0.088	0.481	60	74	0.074	0.166
GPS	0	0		---	---	---	---	---	---	---	---	---	---	---	---	---
Depth Sounder and GPS	9	0.8	0	19.5	1	0	0.051	0.051	6	6	0.308	0.615	0	0	0.000	0.000
Other	0	0		---	---	---	---	---	---	---	---	---	---	---	---	---
Unknown	3	0.3		5.5	0	0	0.000	0.000	0	0	0.000	0.000	3	0	0.545	0.545
Totals	1179	100		2538	18	55	*0.007	*0.029	490	1011	*0.193	*0.591	129	230	*0.052	*0.142

* Mean HCUE and TCUE which have been weighted by the number of anglers.

Appendix 13. Angling methods and catch statistics for walleye, northern pike and yellow perch from May 15 to August 16, 1998 at Shiningbank Lake. The number of fish released by anglers is indicated by (Rel.). HCUE is the harvest catch per unit of effort and TCUE is the total catch per unit of effort. Commercial baitfish consists of dead, often frozen fish (e.g. minnows, smelts).

Angling Methods	Total anglers		Percent of anglers		Total hours	Walleye			Northern Pike			Yellow Perch					
	anglers	886	75.1	1843		Kept	Rel.	HCUE	TCUE	Kept	Rel.	HCUE	TCUE	Kept	Rel.	HCUE	TCUE
Artificial						13	26	0.007	0.021	426	869	0.231	0.703	13	14	0.007	0.015
Deworms	100		8.5	253.5	1	13	0.004	0.055	25	39	0.169	0.434	58	123	0.229	0.714	
Commercial Baitfish	73		6.2	147.5	3	4	0.020	0.047	1	2	0.080	0.240	14	16	0.095	0.203	
Miscellaneous	69		5.9	150.5	0	3	0.000	0.020	4	25	0.039	0.284	32	58	0.213	0.598	
Leeches	39		3.3	102	0	6	0.000	0.059	25	33	0.099	0.229	12	15	0.118	0.265	
Scent Baits	7		0.6	25.5	1	0	0.039	0.039	0	14	0.000	0.549	0	0	0.000	0.000	
Seined Baitfish	4		0.3	12.5	0	0	0.000	0.000	9	29	0.060	0.252	0	4	0.000	0.320	
Unknown	1		0.1	3.5	0	0	0.000	0.000	0	0	0.000	0.000	3	0	0.857	0.857	
Totals	1179		100	2538	18	55	*0.007	*0.029	490	1011	*0.193	*0.591	132	230	*0.052	*0.142	

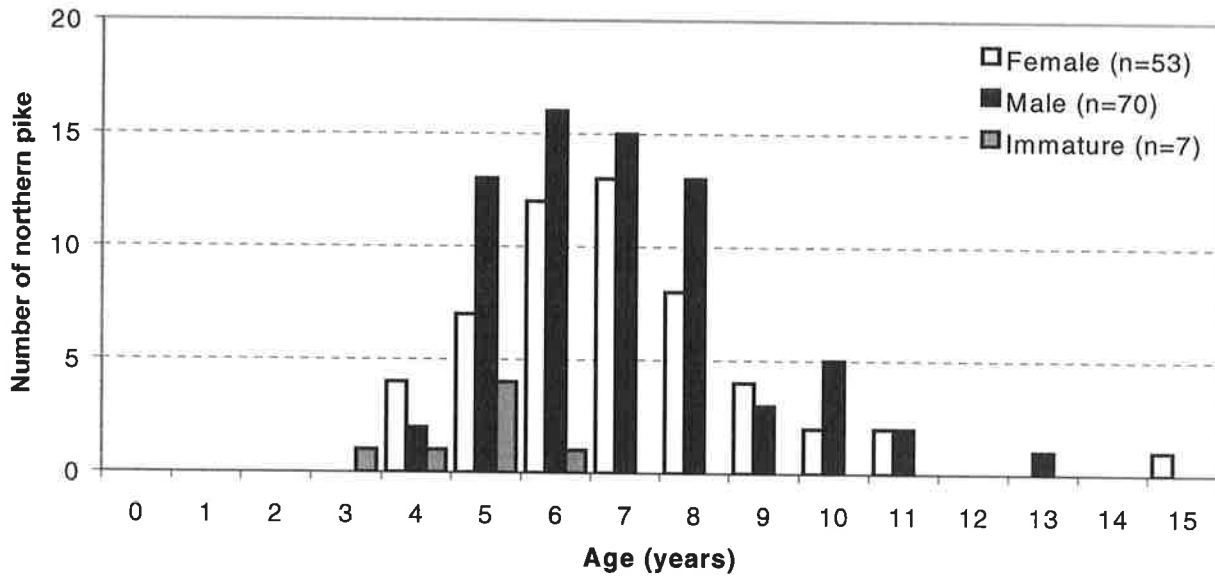
* Mean HCUE and TCUE which have been weighted by the number of anglers.

Appendix 14. Skill levels of anglers and catch statistics for walleye, northern pike and yellow perch from May 15 to August 16, 1998 at Shiningbank Lake. The number of fish released by anglers is indicated by (Rel.). HCUE is the harvest catch per unit of effort and TCUE is the total catch per unit of effort. Skill classification is defined in Section 2.2.

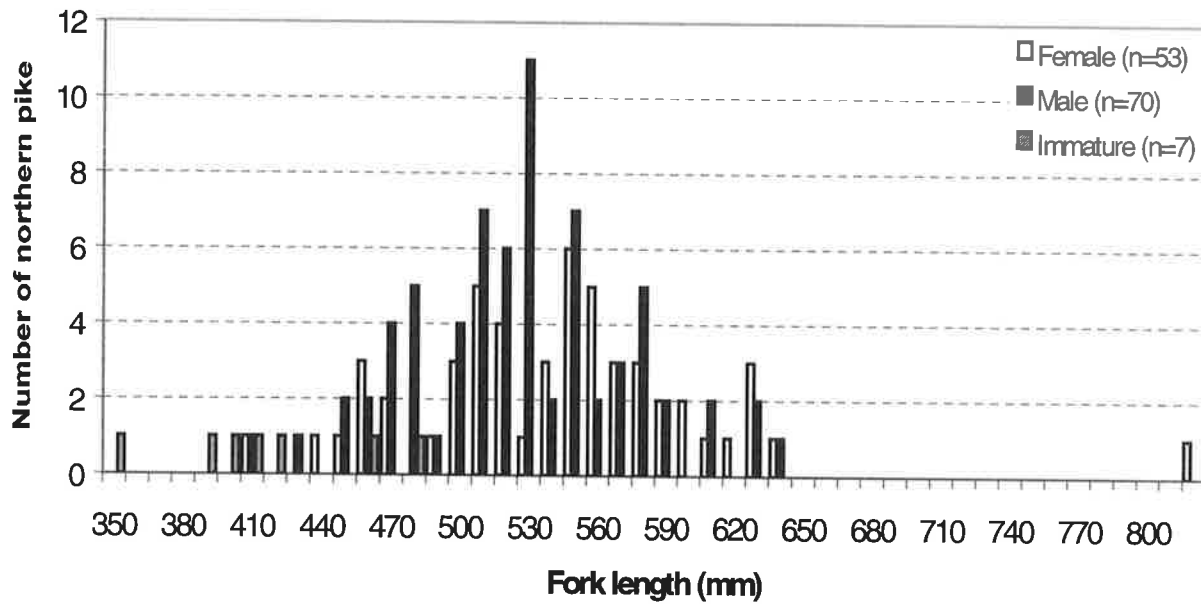
Skill	Total anglers		Percent of anglers		Total hours	Walleye			Northern Pike			Yellow Perch				
	anglers	1179 <th>9.4 <td>186</td> <td>Kept</td> <td>Rel.</td> <td>HCUE</td> <td>TCUE</td> <td>Kept</td> <td>Rel.</td> <td>HCUE</td> <td>TCUE</td> <td>Kept</td> <td>Rel.</td> <td>HCUE</td> <td>TCUE</td> </th>	9.4 <td>186</td> <td>Kept</td> <td>Rel.</td> <td>HCUE</td> <td>TCUE</td> <td>Kept</td> <td>Rel.</td> <td>HCUE</td> <td>TCUE</td> <td>Kept</td> <td>Rel.</td> <td>HCUE</td> <td>TCUE</td>	186		Kept	Rel.	HCUE	TCUE	Kept	Rel.	HCUE	TCUE	Kept	Rel.	HCUE
Novice	111		9.4	186	0	2	0.000	0.011	21	33	0.113	0.290	12	6	0.065	0.097
Average	1056		89.6	2319	11	51	0.005	0.027	469	968	0.202	0.620	117	224	0.050	0.147
Professional	11		0.9	29.5	7	2	0.237	0.305	0	10	0.000	0.339	0	0	0.000	0.000
Unknown	1		0.1	3.5	0	0	0.000	0.000	0	0	0.000	0.000	3	0	0.857	0.857
Totals	1179		100	2538	18	55	*0.007	*0.029	490	1011	*0.193	*0.591	132	230	*0.052	*0.142

* Mean HCUE and TCUE which have been weighted by the number of anglers.

Appendix 15. Age and sex of sport and test-caught northern pike in Shiningbank Lake from May 15 to August 16, 1998. Northern pike data were aged using cleithra and pelvic fin rays.



Appendix 16. Frequencies of sex and maturity of sport and test-caught northern pike by length in Shiningbank Lake from May 15 to August 16, 1998.



Appendix 17. Biological data from sport and test-caught walleye from May 10 to August 16, 1998 in Shiningbank Lake. The sex of fish is displayed as F=female, M=male and I=immature, and were determined from lethal samples. The fish were aged using pelvic fin spines and in some cases opercula.

Fishery	Date caught	Fork length (mm)	Age (years)	Sex
Sport-caught	16-May-98	463	7	M
	16-May-98	455	8	
	16-May-98	497	7	M
	17-May-98	473	7	M
	17-May-98	511	8	F
	17-May-98	430	8	F
	18-May-98	535	8	M
	18-May-98	473	12	F
	6-Jun-98	540	8	F
	19-Jun-98	540	8	F
	19-Jun-98	498	9	M
	19-Jun-98	473	7	M
	2-Aug-98	329	5	I
	13-Aug-98	482	10	M
	Test-caught	10-May-98	419	8
10-May-98		457	7	M
10-May-98		457	9	
10-May-98		470	8	
15-May-98		285	3	
15-May-98		453	8	M
19-Jun-98		310	4	
1-Jul-98		319	4	
1-Jul-98		326	4	
16-Jul-98		492	13	F
16-Jul-98	331	4		

Appendix 18. Biological data from sport and test-caught northern pike from May 10 to August 16, 1998 in Shiningbank Lake. The sex of fish is displayed as F=female, M=male and I=immature, and were determined from lethal samples. The fish were aged using cleithra and in some cases pelvic fin rays.

Fishery	Date caught	Fork Length (mm)	Age (years)	Sex
Sport-caught	15-May-98	547	6	F
	15-May-98	526	5	M
	15-May-98	552	11	M
	15-May-98	486	5	I
	15-May-98	506	6	F
	15-May-98	516	5	
	15-May-98	622	9	F
	15-May-98	603	9	F
	15-May-98	465	5	F
	15-May-98	458	6	F
	15-May-98	584	10	F
	15-May-98	405	4	M
	15-May-98	448	6	F
	15-May-98	438	6	F
	16-May-98	455	6	M
	16-May-98	463	5	M
	16-May-98	481	4	F
	16-May-98	468	7	F
	16-May-98	589	7	
	16-May-98	540	6	F
	16-May-98	492	7	M
	16-May-98	506	6	F
	16-May-98	550	6	M
	16-May-98	603	8	M
	16-May-98	491	5	F
	16-May-98	477	5	M
	16-May-98	520	6	M
	16-May-98	491	4	M
	16-May-98	511	5	M
	16-May-98	470	5	M
	16-May-98	424	6	
	16-May-98	390	6	I
	16-May-98	487	11	
	16-May-98	471	5	
	16-May-98	535	7	M
	16-May-98	442	6	M
	16-May-98	481	5	
	16-May-98	584	10	M
	16-May-98	371	4	
	16-May-98	487	6	
	16-May-98	512	6	M
	16-May-98	651	8	
	16-May-98	492	6	
	16-May-98	555	7	
	16-May-98	516	7	F

Appendix 18. Cont'd.

Fishery	Date caught	Fork Length (mm)	Age (years)	Sex
Sport-caught	16-May-98	530	6	M
	16-May-98	472	6	
	16-May-98	419	5	
	16-May-98	468	5	I
	16-May-98	513	6	
	16-May-98	622	7	
	16-May-98	511	4	F
	16-May-98	530	6	
	16-May-98	603	10	
	17-May-98	506	7	
	17-May-98	419	5	I
	17-May-98	535	6	F
	17-May-98	564	6	M
	17-May-98	516	6	
	17-May-98	492	4	
	17-May-98	497	4	
	17-May-98	651	11	
	17-May-98	622	7	F
	17-May-98	545	7	M
	17-May-98	501	5	F
	17-May-98	518	5	F
	17-May-98	505	5	M
	17-May-98	613	11	
	17-May-98	596	7	
	17-May-98	530	6	
	17-May-98	530	7	
	17-May-98	501	5	
	17-May-98	551	7	
	17-May-98	541	12	
	17-May-98	483	7	
	17-May-98	544	6	
	17-May-98	506	5	
	17-May-98	526	9	
	17-May-98	543	6	
	17-May-98	526	6	
	17-May-98	465	5	
	17-May-98	376	5	
	17-May-98	385	4	
	17-May-98	308	3	
	17-May-98	482	5	M
	17-May-98	439	5	
	17-May-98	479	7	M
	17-May-98	419	4	
17-May-98	543	6		
17-May-98	487	7		

Appendix 18. Cont'd.

Fishery	Date caught	Fork Length (mm)	Age (years)	Sex
Sport-caught	17-May-98	468	5	
	17-May-98	441	5	
	17-May-98	497	6	
	17-May-98	463	6	
	17-May-98	361	4	
	17-May-98	342	3	
	17-May-98	448	5	
	17-May-98	439	5	
	17-May-98	560	9	
	17-May-98	477	6	
	17-May-98	468	5	M
	17-May-98	453	5	
	18-May-98	574	8	M
	18-May-98	473	7	M
	18-May-98	545	9	M
	18-May-98	555	8	
	18-May-98	507	9	
	18-May-98	553	9	M
	18-May-98	613	7	F
	18-May-98	518	7	M
	18-May-98	564	10	M
	18-May-98	521	8	F
	18-May-98	574	8	F
	18-May-98	574	9	
	18-May-98	584	10	M
	18-May-98	555	8	F
	18-May-98	540	7	
	18-May-98	526	10	
	18-May-98	424	8	
	18-May-98	492	8	
	18-May-98	622	11	
	18-May-98	530	6	
	18-May-98	506	7	
	18-May-98	637	12	
	18-May-98	516	7	
	18-May-98	671	10	
	18-May-98	545	8	
	19-May-98	487	8	
	19-May-98	530		
	19-May-98	530	8	
	19-May-98	487	7	
	19-May-98	540	7	
	19-May-98	651	11	
	19-May-98	521	7	
	19-May-98	545	8	

Appendix 18. Cont'd.

Fishery	Date caught	Fork Length (mm)	Age (years)	Sex
Sport-caught	19-May-98	545	9	
	19-May-98	540	8	
	19-May-98	487	7	
	19-May-98	501	7	
	19-May-98	584	9	
	19-May-98	550	7	
	19-May-98	579	7	
	19-May-98	530	7	
	3-Jun-98	516	6	
	3-Jun-98	506	8	M
	3-Jun-98	497	7	
	3-Jun-98	569	8	M
	3-Jun-98	463	6	
	3-Jun-98	506	7	F
	4-Jun-98	511	6	F
	4-Jun-98	593	8	F
	4-Jun-98	521	7	M
	4-Jun-98	506	7	M
	4-Jun-98	535	8	F
	4-Jun-98	502	6	F
	4-Jun-98	516	7	M
	4-Jun-98	529	9	M
	4-Jun-98	395	5	
	4-Jun-98	498	7	F
	4-Jun-98	526	8	M
	4-Jun-98	477	7	M
	5-Jun-98	548	8	F
	5-Jun-98	555	8	F
	5-Jun-98	416	5	
	5-Jun-98	540	8	F
	5-Jun-98	521	8	M
	5-Jun-98	521	8	M
	5-Jun-98	472	7	M
	6-Jun-98	574	7	
	6-Jun-98	395	4	
	6-Jun-98	414	5	
	6-Jun-98	373	5	
	6-Jun-98	429	5	M
	17-Jun-98	584	11	F
	17-Jun-98	560	7	F
	17-Jun-98	511	7	M
	17-Jun-98	521	7	M
	17-Jun-98	521	7	M
	17-Jun-98	501	7	M
	18-Jun-98	468	6	

Appendix 18. Cont'd.

Fishery	Date caught	Fork Length (mm)	Age (years)	Sex
Sport-caught	18-Jun-98	506	8	
	18-Jun-98	550	7	
	19-Jun-98	569	7	
	19-Jun-98	627	7	F
	19-Jun-98	472	6	
	19-Jun-98	492	7	M
	19-Jun-98	453	6	F
	19-Jun-98	550	8	M
	19-Jun-98	632	11	F
	19-Jun-98	545	9	M
	19-Jun-98	579	9	M
	19-Jun-98	637	13	M
	20-Jun-98	521	7	M
	20-Jun-98	545	8	M
	20-Jun-98	555	7	F
	20-Jun-98	506	6	M
	20-Jun-98	470	6	M
	20-Jun-98	579	10	M
	20-Jun-98	540	8	F
	20-Jun-98	574	7	F
	21-Jun-98	624	11	M
	21-Jun-98	627	10	M
	21-Jun-98	410	5	F
	1-Jul-98	579	8	F
	1-Jul-98	497	7	F
	3-Jul-98	598	8	F
	3-Jul-98	560	6	F
	3-Jul-98	535	7	F
	3-Jul-98	545	7	F
	4-Jul-98	458	6	M
	4-Jul-98	603	11	M
	4-Jul-98	564	8	F
	15-Jul-98	404	4	I
	16-Jul-98	576	8	M
	17-Jul-98	563	11	F
	30-Jul-98	251	3	
	1-Aug-98	565	9	F
	16-Aug-98	820	12	F

Appendix 18. Cont'd.

Fishery	Date caught	Fork Length (mm)	Age (years)	Sex
Test-caught	15-May-98	550	7	M
	16-May-98	410		
	16-May-98	287		
	16-May-98	450		
	16-May-98	480		
	16-May-98	427		
	16-May-98	538		
	16-May-98	328		
	17-May-98	496		
	17-May-98	435		
	17-May-98	485		
	17-May-98	518		
	17-May-98	500		
	17-May-98	450		
	17-May-98	485		
	17-May-98	550		
	17-May-98	525		
	17-May-98	498		
	17-May-98	380		
	17-May-98	510		
	17-May-98	510		
	17-May-98	505		
	17-May-98	492		
	4-Jun-98	463		
	4-Jun-98	535		
	4-Jun-98	448		
	4-Jun-98	487		
	4-Jun-98	516		
	10-Jun-98	349		
	10-Jun-98	514		
	10-Jun-98	549		
	10-Jun-98	515		
	10-Jun-98	433		
	10-Jun-98	440		
	10-Jun-98	427		
	17-Jun-98	352	3	I
	17-Jun-98	429	5	I
	17-Jun-98	380	4	
	17-Jun-98	356	4	
	17-Jun-98	320	3	
	17-Jun-98	350		
	17-Jun-98	460		
17-Jun-98	475			
17-Jun-98	530			
17-Jun-98	480			

Appendix 18. Cont'd.

Fishery	Date caught	Fork Length (mm)	Age (years)	Sex
Test-caught	17-Jun-98	550		
	17-Jun-98	340		
	17-Jun-98	450		
	17-Jun-98	440		
	18-Jun-98	352	3	
	18-Jun-98	492	6	M
	18-Jun-98	440		
	18-Jun-98	450		
	18-Jun-98	380		
	18-Jun-98	435		
	18-Jun-98	465		
	18-Jun-98	700		
	18-Jun-98	565		
	18-Jun-98	454		
	18-Jun-98	535		
	18-Jun-98	535		
	18-Jun-98	415		
	18-Jun-98	515		
	20-Jun-98	526	8	M
	20-Jun-98	574	11	M
	20-Jun-98	506	6	M
	20-Jun-98	511	7	M
	20-Jun-98	465		
	20-Jun-98	520		
	20-Jun-98	395		
	20-Jun-98	545		
	20-Jun-98	585		
	20-Jun-98	525		
	20-Jun-98	475		
	20-Jun-98	435		
	20-Jun-98	>500		
	23-Jun-98	407		
	23-Jun-98	441		
	23-Jun-98	502		
	23-Jun-98	528		
	23-Jun-98	464		
	23-Jun-98	565		
	23-Jun-98	523		
	23-Jun-98	490		
	23-Jun-98	481		
	23-Jun-98	477		
	23-Jun-98	422		
	23-Jun-98	481		
23-Jun-98	492			
23-Jun-98	476			

Appendix 18. Cont'd.

Fishery	Date caught	Fork Length (mm)	Age (years)	Sex
Test-caught	23-Jun-98	544		
	23-Jun-98	489		
	23-Jun-98	512		
	23-Jun-98	399		
	23-Jun-98	400		
	23-Jun-98	557		
	23-Jun-98	395		
	23-Jun-98	382		
	23-Jun-98	504		
	23-Jun-98	516		
	23-Jun-98	512		
	28-Jun-98	524	6	M
	1-Jul-98	540		
	1-Jul-98	394		
	1-Jul-98	578		
	1-Jul-98	508		
	1-Jul-98	585		
	1-Jul-98	600		
	1-Jul-98	403		
	1-Jul-98	510		
	2-Jul-98	510		
	2-Jul-98	454		
	2-Jul-98	540		
	16-Jul-98	352	4	
	16-Jul-98	563	5	
	16-Jul-98	394	4	
	30-Jul-98	448	5	M
	30-Jul-98	487		
	30-Jul-98	461		
	30-Jul-98	248		
	30-Jul-98	438		
	30-Jul-98	450		
	30-Jul-98	491		
	30-Jul-98	545		
	30-Jul-98	452		
	11-Aug-98	433	5	
	12-Aug-98	560	6	
	12-Aug-98	455	5	F
	12-Aug-98	355	4	
	12-Aug-98	467		
	14-Aug-98	355		

Appendix 19. Biological data from sport and test-caught yellow perch from May 18 to August 14, 1998 in Shiningbank Lake. The sex of fish is displayed as F=female, M=male, I=immature and UK=unknown, and were determined from lethal samples. The fish were aged using anal fin spines.

Fishery	Date caught	Fork Length (mm)	Age (years)	Sex
Sport-caught	18-May-98	310	8	M
	6-Jun-98	245	6	F
	20-Jun-98	215	5	F
	21-Jun-98	203	5	
	21-Jun-98	232	5	F
	21-Jun-98	242	6	F
	21-Jun-98	197	5	M
	3-Jul-98	261	6	M
	3-Jul-98	221	5	M
	3-Jul-98	218	5	M
	3-Jul-98	213	5	I
	3-Jul-98	223	5	F
	4-Jul-98	263	6	M
	4-Jul-98	261	7	
	4-Jul-98	242	6	UK
	4-Jul-98	277	7	UK
	4-Jul-98	271	7	M
	4-Jul-98	291	6	F
	4-Jul-98	228	5	
	4-Jul-98	285	7	
	4-Jul-98	281	6	I
	4-Jul-98	223		
	14-Jul-98	252		UK
	15-Jul-98	208	5	UK
	15-Jul-98	215	5	UK
	15-Jul-98	229	5	UK
	15-Jul-98	212	5	UK
	15-Jul-98	203	5	UK
	15-Jul-98	214	6	UK
	15-Jul-98	266	7	UK
	15-Jul-98	203	6	UK
	15-Jul-98	229	6	UK
	15-Jul-98	189	5	UK
	15-Jul-98	184	6	UK
	15-Jul-98	228	6	UK
	15-Jul-98	252	7	UK
	16-Jul-98	195	4	UK
	16-Jul-98	230	6	UK
	16-Jul-98	232	8	UK
	16-Jul-98	278	8	UK
	16-Jul-98	219	7	UK
	16-Jul-98	295	6	UK
16-Jul-98	191	4	UK	
16-Jul-98	300	9		

Appendix 19. Cont'd.

Fishery	Date caught	Fork Length (mm)	Age (years)	Sex
Sport-caught	17-Jul-98	200	6	
	17-Jul-98	203	4	
	17-Jul-98	280	9	UK
	17-Jul-98	242	7	UK
	2-Aug-98	219	7	UK
	3-Aug-98	236	7	UK
	3-Aug-98	235	6	UK
	3-Aug-98	203	6	UK
	3-Aug-98	204	6	UK
	3-Aug-98	217	8	UK
	3-Aug-98	237	6	UK
	3-Aug-98	238	8	UK
	3-Aug-98	235	7	UK
	3-Aug-98	272	7	UK
	3-Aug-98	258	7	UK
	13-Aug-98	237	7	
	13-Aug-98	286	7	UK
	14-Aug-98	279	7	UK
	14-Aug-98	238	5	UK
	Test-caught	1-Jul-98	223	5
1-Jul-98		206	5	I
1-Jul-98		203	5	I
1-Jul-98		184	5	
1-Jul-98		261	6	F
1-Jul-98		265	6	F
1-Jul-98		206	6	I
30-Jul-98		265	7	UK
30-Jul-98		275	8	UK
12-Aug-98		160	5	
12-Aug-98		143	5	
13-Aug-98		226	7	UK
13-Aug-98		295	9	
13-Aug-98		98		
13-Aug-98		156	3	
13-Aug-98		101	0	
13-Aug-98		219	6	
13-Aug-98		109		
13-Aug-98		198	6	
13-Aug-98		90	0	
13-Aug-98		135	3	
13-Aug-98		146	4	
13-Aug-98		182	3	
13-Aug-98		238	6	UK
13-Aug-98		105	3	
13-Aug-98		220	6	
13-Aug-98		220	6	

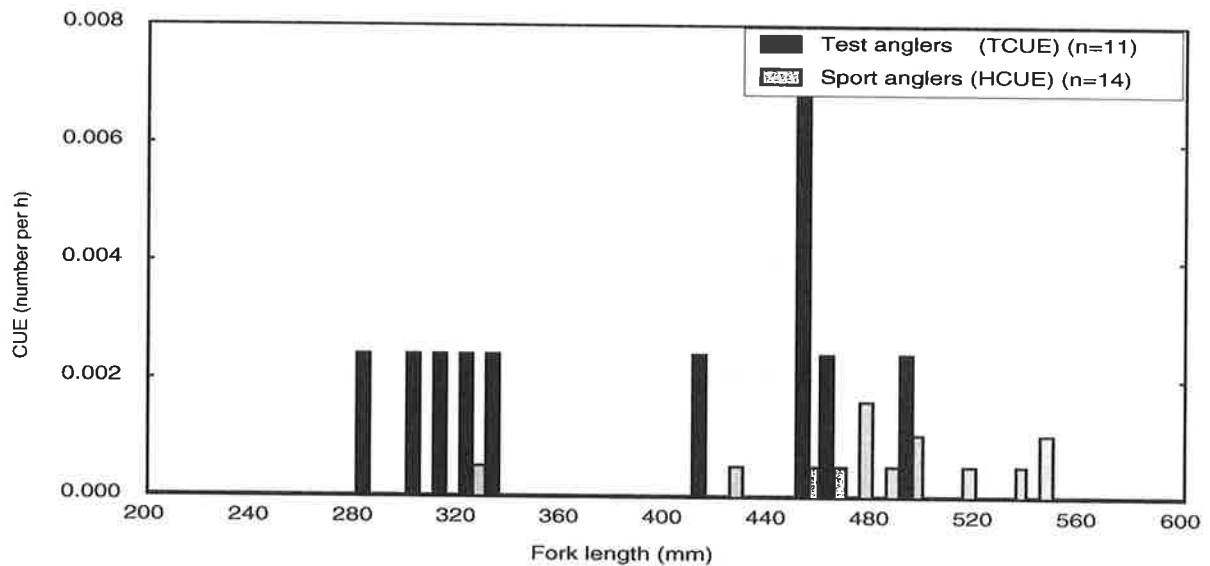
Appendix 19. Cont'd.

Fishery	Date caught	Fork Length (mm)	Age (years)	Sex
Test-caught	13-Aug-98	114		
	13-Aug-98	98		
	13-Aug-98	110		
	13-Aug-98	110		
	13-Aug-98	105		
	13-Aug-98	110		
	13-Aug-98	115		
	13-Aug-98	104		
	13-Aug-98	146		
	13-Aug-98	103		
	13-Aug-98	113		
	13-Aug-98	155		
	13-Aug-98	109		
	13-Aug-98	206		
	13-Aug-98	108		
	13-Aug-98	121		
	13-Aug-98	105		
	13-Aug-98	105		
	13-Aug-98	203		
	13-Aug-98	95		
	13-Aug-98	111		
	13-Aug-98	215		
	13-Aug-98	147		
	13-Aug-98	121		
	13-Aug-98	219		
	13-Aug-98	235		
	13-Aug-98	106		
	13-Aug-98	112		
	13-Aug-98	236		
	13-Aug-98	116		
	13-Aug-98	187		
	13-Aug-98	106		
	13-Aug-98	107		
	13-Aug-98	147		
	13-Aug-98	108		
	13-Aug-98	110		
	13-Aug-98	107		
	13-Aug-98	147		
	13-Aug-98	112		
	13-Aug-98	160		
13-Aug-98	224			
13-Aug-98	226			
13-Aug-98	103			
13-Aug-98	102			
13-Aug-98	171			
13-Aug-98	127			
13-Aug-98	116			
13-Aug-98	119			

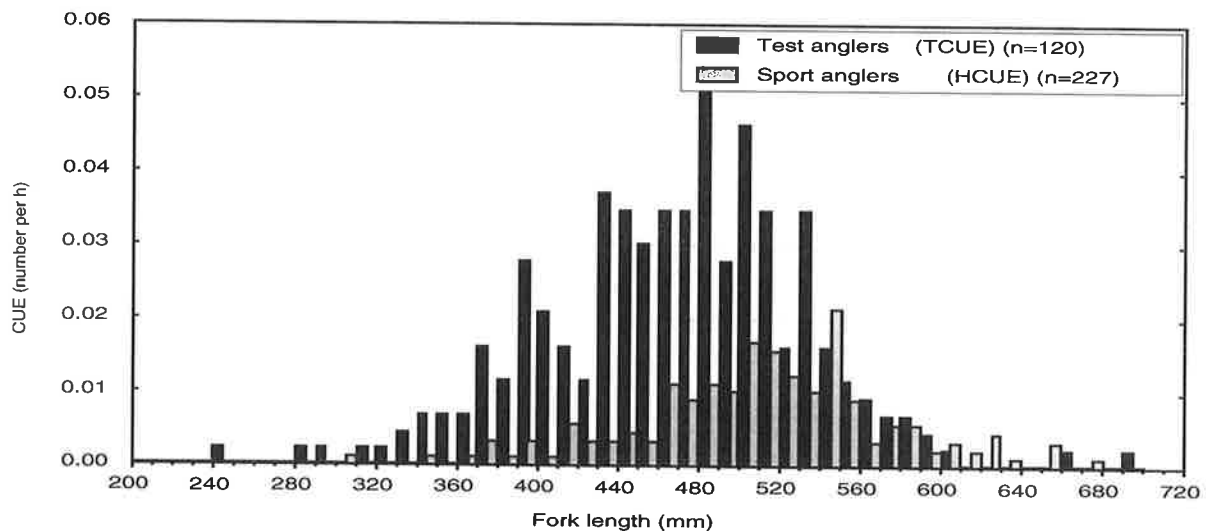
Appendix 19. Cont'd.

Fishery	Date caught	Fork Length (mm)	Age (years)	Sex
Test-caught	13-Aug-98	109		
	14-Aug-98	108		
	14-Aug-98	108		
	14-Aug-98	120		
	14-Aug-98	234		
	14-Aug-98	107		
	14-Aug-98	101		
	14-Aug-98	138		
	14-Aug-98	146		
	14-Aug-98	102		
	14-Aug-98	158		
	14-Aug-98	109		
	14-Aug-98	110		
	14-Aug-98	140		
	14-Aug-98	112		
	14-Aug-98	105		
	14-Aug-98	107		
	14-Aug-98	156		
	14-Aug-98	116		
	14-Aug-98	110		
	14-Aug-98	115		
	14-Aug-98	115		
	14-Aug-98	142		
	14-Aug-98	113		
	14-Aug-98	120		
	14-Aug-98	104		
	14-Aug-98	111		
	14-Aug-98	118		

Appendix 20. Fork lengths of walleye captured in Shiningbank Lake, May 15 to August 16, 1998. Frequency of capture was plotted at a catch rate (number•h⁻¹) for each 10 mm increment. Catch rates for fish angled by project volunteers (test anglers) were weighted by the total (reported release plus observed kept) walleye catch rate for anglers interviewed during the creel survey (sport anglers). The sport angler catch frequencies were for kept fish only.



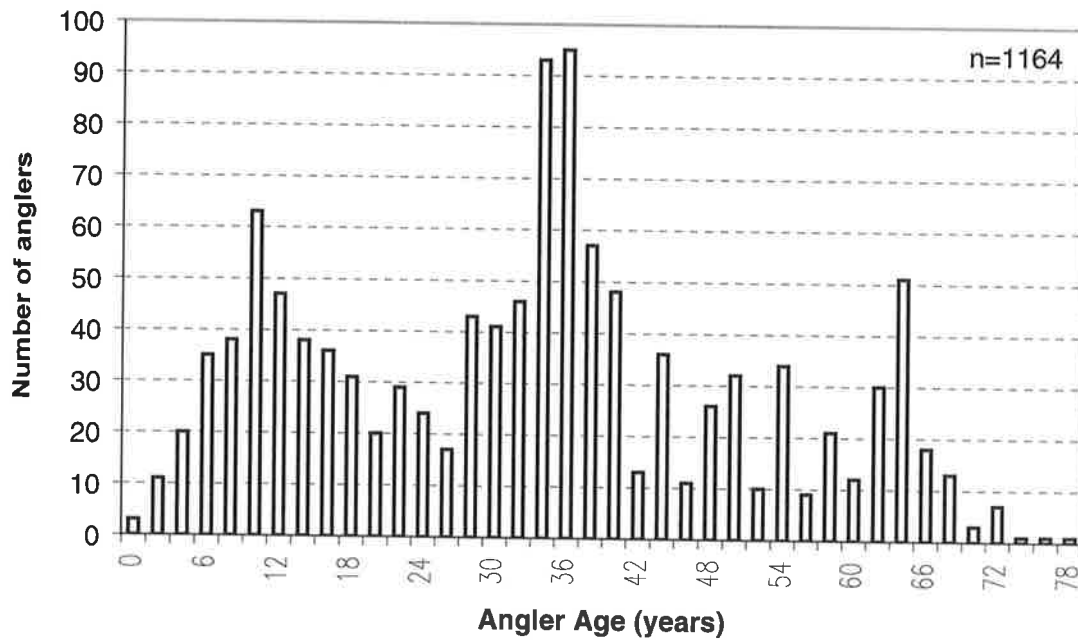
Appendix 21. Fork lengths of northern pike captured in Shiningbank Lake, May 15 to August 16, 1998. Frequency of capture was plotted at a catch rate (number•h⁻¹) for each 10 mm increment. Catch rates for fish angled by project volunteers (test anglers) were weighted by the total (reported release plus observed kept) northern pike catch rate for anglers interviewed during the creel survey (sport anglers). The sport angler catch frequencies were for kept fish only.



Appendix 22. Angler gender at Shiningbank Lake from May 15 to August 16, 1998.

	Number of Anglers	Percentage of Anglers
Male	912	77.3%
Female	266	22.6%
Not recorded	1	0.1%
Totals	1179	100.0%

Appendix 23. Angler age at Shiningbank Lake from May 15 to August 16, 1998.



Appendix 24. Angler residence as given to creel attendants at Shiningbank Lake from May 15 to August 16, 1998

