Lake Monitoring Program: Lesser Slave Lake Stock Assessment

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Suggested citation:

Fortier G.N., Tchir J.P. 2004. Lake Monitoring Program: Lesser Slave Lake Stock Assessment. Technical report, produced by Alberta Conservation Association Bag 900-26, Peace River, Alberta, Canada.

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ACKNOWLEDGEMENTS

The author(s) acknowledge the following individuals, agencies, and corporations for their contributions and assistance in delivering the project.

This program is funded by Alberta angler's whose contributions fund the Fisheries Management Enhancement Program. We would like to thank the following individuals and/or organizations for their in-kind and logistical support:

Alberta Conservation Association employees: James Aiken, Lorraine Sawdon and Chad Sherburne. As well as Alberta Sustainable Resource Development employees: Martin Brilling and Jim Rosin.

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1.0 INTRODUCTION

The NW Boreal Lake Monitoring Program began in 1999–2000. The objective of the program is to provide pertinent trend data for various water bodies and fish species in order to augment regional population monitoring programs. Data collection techniques have been standardized to allow for comparisons to be made between different lakes, over time, providing accurate, current information to fisheries managers to base their decisions on.

In order to successfully manage local fisheries, it is essential to monitor sport-fish populations. This can be accomplished through repeated sampling to determine temporal changes in population structure attributed to management strategies and environmental effects. Angler surveys provide information on harvest, effort, and abundance of sport-fish species. The coupling of angler surveys with test-netting which assesses abundance and other population parameters will allow us to gauge effectives of the test netting to provide an index measure of abundance. The results of this project will provide fisheries managers with current fisheries information and allow us to improve our current monitoring strategies to benefit fisheries management.

2.0 STUDY AREA

Lesser Slave Lake is located south east of the town of Slave Lake, Alberta. Test-netting was conducted from September 2 - 5 in 2003 and September 5 - 9 in 2000 (figures 1 and 2). Test netting locations for the East and West basin are presented in Tables 1 and 2, respectively. The lake supports natural populations of white sucker (*Catostomus commersoni*), longnose sucker (*Catostomus catostomus*), cisco (*Corregonus artedi*) lake whitefish (*Corregonus clupeaformis*), northern pike (*Esox lucius*), burbot (*Lota lota*), yellow perch (*Perca flavescens*), and walleye (*Sander vitreum*).

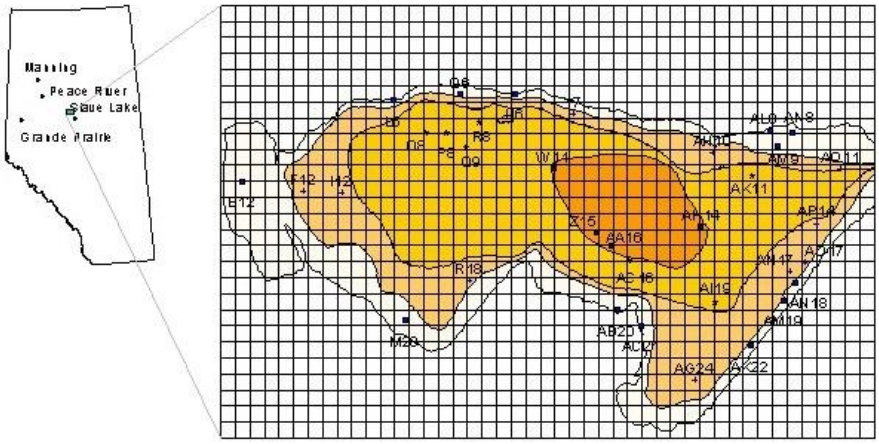

Figure 1. Lesser Slave Lake, west basin, bathymetric map showing 0-5m, 5-10m, 10-15m, and >15m intervals as well as sample sites used in 2003.

Table 1. UTM coordinates of test-netting locations for west basin of Lesser Slave Lake, Alberta

Site	x	y	Depth (m)	Site	x	y	Depth (m)
B12	558498.00	6146955.00	0-5m	F12	562724.00	6146385.00	5-10m
AN8	596374.09	6150060.56	0-5m	AQ11	599710.00	6147788.23	5-10m
AK22	593458.36	6136733.92	0-5m	R18	574181.93	6140865.68	5-10m
Q6	573495.67	6152365.47	0-5m	AG24	589662.00	6134585.00	5-10m
U6	577280.00	6152383.00	0-5m	AH10	590865.00	6148819.00	5-10m
AB20	584290.66	6138933.59	0-5m	AP14	598040.00	6144427.00	5-10m
AC21	585969.59	6137950.34	0-5m	O8	571170.20	6150102.24	10-15m
AL8	594894.32	6150067.92	0-5m	AK11	593579.66	6147448.56	10-15m
				Q9	573890.00	6149212.00	10-15m
				R8	574874.51	6150776.58	10-15m

W11	579931.76	6147785.22	10-15m
AA16	583977.43	6142979.83	15-20m

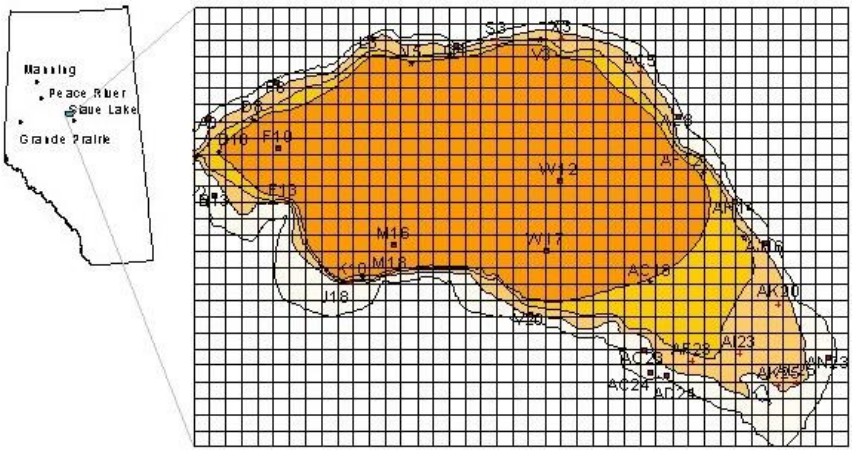

Figure 2. Lesser Slave Lake, east basin, bathymetric map showing 0-5m, 5-10m, 10-15m, and >15m intervals as well as sample sites used in 2003.

Table 2. UTM coordinates of test-netting locations for east basin of Lesser Slave Lake, Alberta

Site	x	y	Depth
A8	602918.76	6150065.31	0-5m
AN23	641728.00	6135431.00	0-5m
F6	607230.40	6152297.06	0-5m
AJ16	637875.19	6142465.75	0-5m
Q4	618473.10	6154605.43	0-5m
V20	623065.99	6138037.74	0-5m
AC23	630305.00	6135880.00	0-5m
AH14	635950.66	6144937.33	0-5m
F13	607694.54	6145080.10	5-10m
J18	611847.00	6140141.00	5-10m
M18	614345.17	6140598.59	5-10m
AK20	638687.00	6138776.00	5-10m
X3	625089.57	6155079.64	5-10m
AC5	630024.19	6153046.29	5-10m
B10	603563.00	6148100.00	10-15m
AF12	633928.00	6146856.00	10-15m
K18	612581.99	6140412.81	10-15m
N5	615668.00	6153600.00	10-15m
F10	607315.07	6148291.73	15-20m
W12	624946.59	6146298.40	15-20m

3.0 MATERIALS AND METHODS

3.1 General sampling methods

Eighteen sampling sites were randomly selected and stratified by depth following Lake monitoring protocol (Wilcox *et al*. 2000). Sites were sampled using multi-mesh benthic gill nets set for approximately 24 hours. Fork lengths, weights, sex, maturity, ageing structures, and stomach contents were examined and recorded for each managed fish species (lake whitefish, northern pike, yellow perch, and walleye) and fork lengths were obtained for all other species captured.

Ageing structures were collected from all sport fish. Lake whitefish were aged using scales collected below the dorsal fin region on the left side. Northern pike were aged using the left cleithrum. Yellow perch and walleye were aged using sections of the left pelvic fin rays (McKay et al. 1990).

3.2 Statistical analyses

3.2.1 Relative Stock Density

The five-cell model (stock, quality, preferred, memorable, and trophy) proposed by Gablehouse (1984) was used to identify predominant length classes of fish. A sub-stock category was added to the model in order to include smaller sized fish. These cells were also used to examine length related trends in stomach contents.

3.2.2 Relative weight (Wr)

Relative weight (Wr) is a measure of condition calculated by applying an individual's weight and total length to a species-specific equation. Total length measurements were not taken during sampling due to time related factors. Therefore a calculated total length was used. The conversion equations were obtained from Ryerson 1998. Wege and Anderson (1978) introduced relative weight as the following formula:

$$Wr = (W / Ws) *100$$

Where W is the measured weight of the fish and Ws is the standard weight of a fish of the same length. Ws is species specific and determined by several different

authors. Standard weight equations for northern pike (*Esox lucius*) and walleye (*Sander vitreus*) were adapted from D.W. Willis (1989) and Murphy *et al.* (1990).

Wr varies with such parameters as sex, length, time of year, and maturity. Using a total sample mean Wr is inappropriate without first checking for differences within that sample (Blackwell 2000). Variation associated with length can be identified through visual inspection of Wr plotted against length.

4.0 RESULTS

The following results are provided and presented for each managed species found in Lesser Slave Lake. These consist of cisco (*Corregonus artedi*), lake whitefish (*Corregonus clupeaformis*), northern pike (*Esox lucius*), yellow perch (*Perca flavescens*), and walleye (*Sander vitreum*). The results are intended to provide fisheries mangers information to assist with management decisions.

4.1 Cisco (*Corregonus artedi*)

Cisco accounted for 3.7% of the total catch, 64 individuals. They were captured at a rate of 1.071 fish per 100m^2 in a 24-hour period in 2003.

Of all Relative Stock Density (RSD) classes the quality class (300mm – 409mm fork length) was the most predominant and included 52.5% (n=32) of all cisco (Figure 3). The Proportional Stock Density was also 52.5% (i.e., 52.5% of cisco were greater than 299mm fork length).

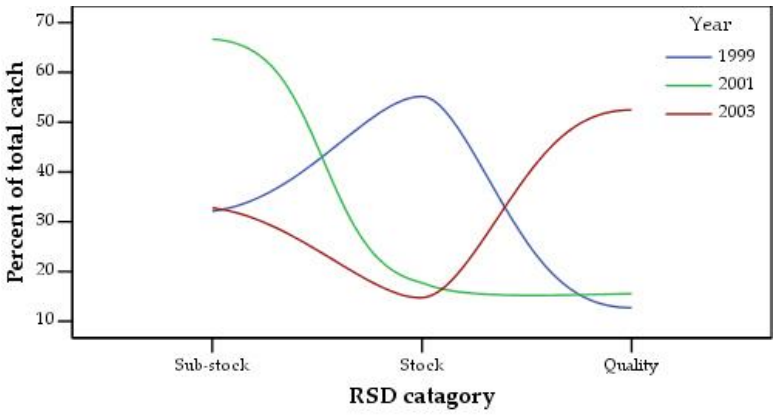

Figure 3. Relative Stock Density of cisco in Lesser Slave Lake from three years (1999 n=165, 2001 n=90, 2003 n=64).

Male fork lengths ranged from 153mm to 404mm with a mean of 249.8mm. Female fork lengths ranged from 134mm to 372mm with a mean of 282.0mm. Figure 4shows the fork length distributions of all cisco from 1999-2003.

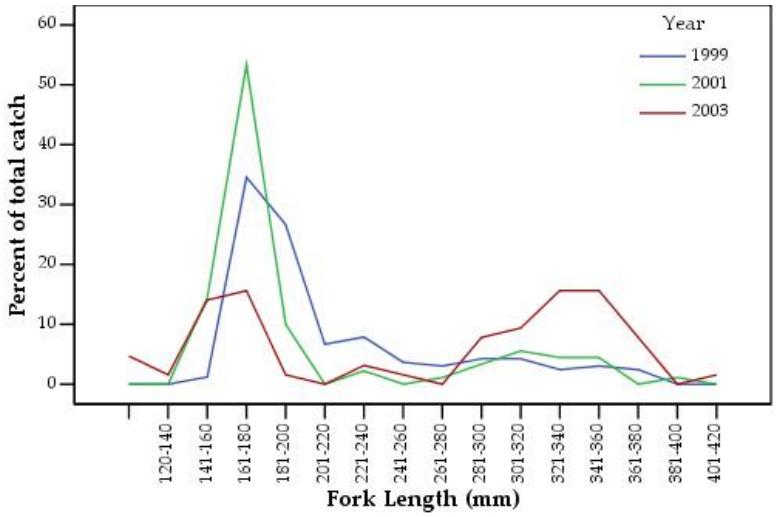

Figure 4. Fork length distributions of cisco as determined from samples collected during test-netting from Lesser Slave Lake (1999 n=165, 2001 n=90, 2003 n=64).

The length distribution of cisco in 2003 is bimodal with modes of 141-180mm and 321-360mm. In 1999 and 2001 the most frequent size was between 161-180mm for both years. All three years show strong representation of 161-180mm fish. We speculate that this is the result of gear selectivity where fish of this size are captured more efficiently than other sizes.

In 2003 an insufficient number of cisco were examined for any stomach contents analysis to be performed. Of 64 cisco caught only 4 were examined for stomach contents. Stomach contents analyses were not performed in 1999 or 2001. Relative weight was not used to analyse cisco due to an absence of a total length conversion equation.

4.2 Lake Whitefish (*Coregonus clupeaformis*)

Lake whitefish accounted for 44.3% of the total catch, 762 individuals. They were captured at a rate of 13.021 fish/ 100m^2/ 24-hours in 2003.

Of all Relative Stock Density (RSD) classes the preferred class (410mm – 479mm fork length) was most predominant and included 55.8% (n=426) of all lake whitefish (Figure 5). The Proportional Stock Density was 97.5% (i.e., 97.5% of lake whitefish were greater than 299mm fork length).

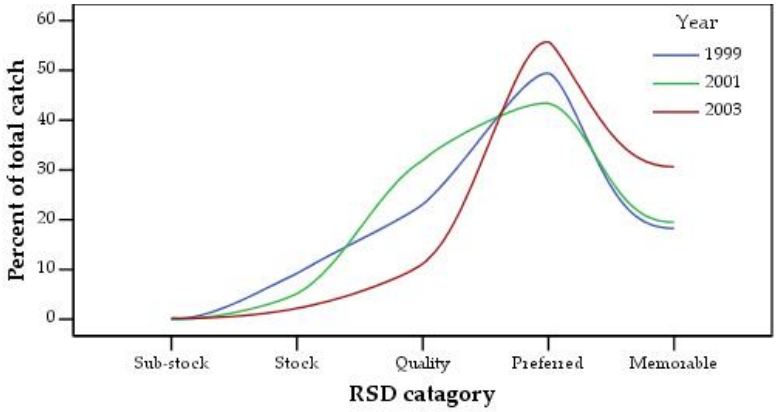

Figure 5. Relative Stock Density of lake whitefish in Lesser Slave Lake from three years (1999 n=750, 2001 n=523, 2003 n=762).

Females consisted of 52.4% (n=400) of the sample, males 47.4% (n=362). Male fork lengths ranged from 172mm to 541mm with a mean of 451.3mm. Female fork lengths ranged from 172mm to 561mm with a mean of 454.6mm. Figure 6 shows the fork length distributions of all lake whitefish from 1999-2003.

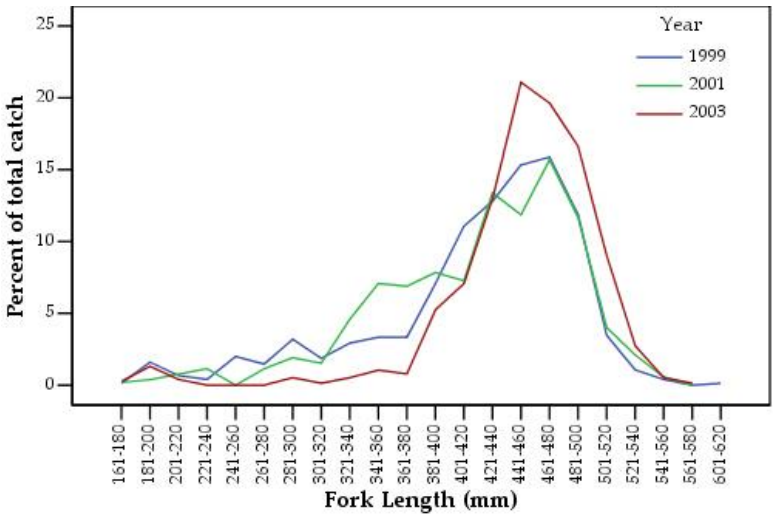

Figure 6. Fork length distributions of lake whitefish as determined from samples collected during test-netting of Lesser Slave Lake (1999 n=750, 2001 n=523, 2003 n=762).

The most frequent size of lake whitefish in 2003 was between 441mm and 460mm. In 1999 and 2001 461-480mm was the most frequent size for both years. All three years show strong representation of 441-480mm fish. We speculate that this is the result of gear selectivity where fish of this size are captured more efficiently than other sizes.

Examination of the age distributions revealed a well-represented groups of 5 and 6-year-old fish in 1999 corresponding with the large size class of 400mm to 440mm lake whitefish (Figure 7). This group is observed in 2001 as a strong representation of 7 and 8-year-old fish with mean lengths of 443mm and 461mm, respectively. These cohorts are also visible in the 2003 age distribution but are no longer a dominant group. In 2001 large classes of 3 and 4-year-old fish, with mean lengths of 351mm and 376mm respectively, correspond to the greater proportions of 320mm to 380mm fish of the length distribution.

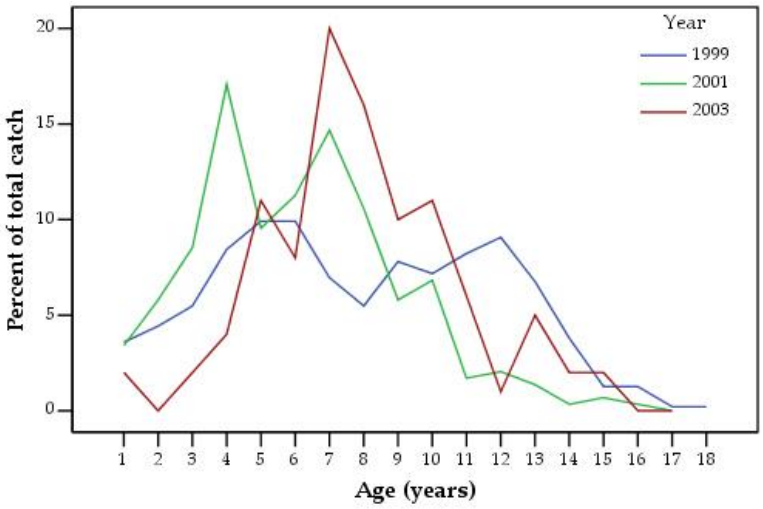

Figure 7. Age distributions of lake whitefish as determined from samples collected during test-netting of Lesser Slave Lake (1999 n=474, 2001 n=293, 2003 n=100).

Stomach contents of 207 lake whitefish were examined in 2003. Of those, 50.7% were found to have empty stomachs. Remaining fish were found to have zooplankton 28.0%, insect larvae 19.8%, bivalves 0.1%, and eggs 0.1% (Figure 8).

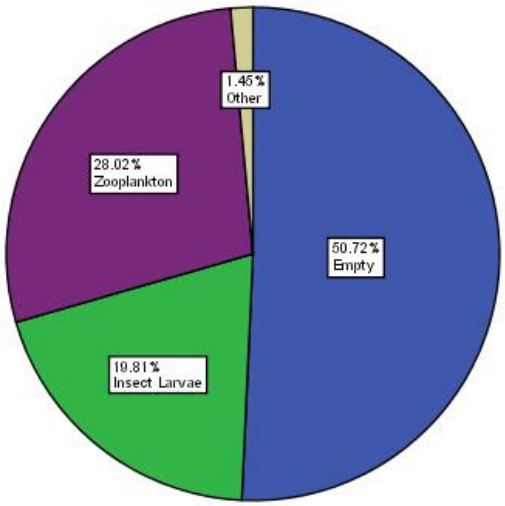

Figure 8. Stomach contents from all lake whitefish sampled in 2003 from Lesser Slave Lake (n=207).

Samples were then separated into RSD length categories to provide insight in length related trends in diet (Figure 9, Figure 10, Figure 11, Figure 12). Sub-stock and trophy classes had insufficient sample sizes to plot.

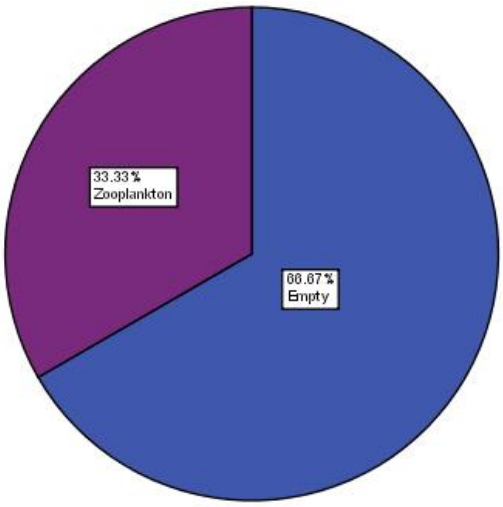

Figure 9. Stomach contents from 2003 Stock class (180mm - 299mm fork length) lake whitefish from Lesser Slave Lake (n=17).

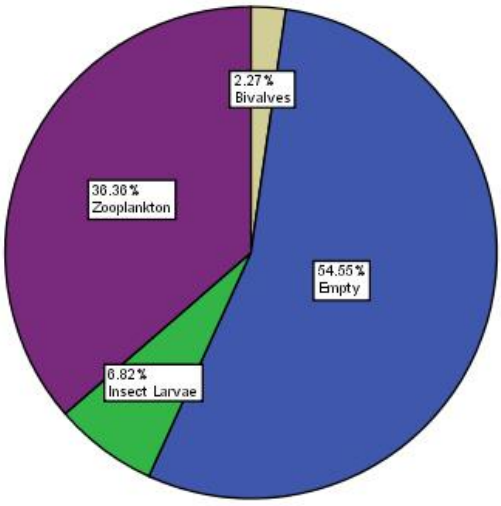

Figure 10. Stomach contents from 2003 Quality class (300mm - 409mm fork length) lake whitefish from Lesser Slave Lake (n=85).

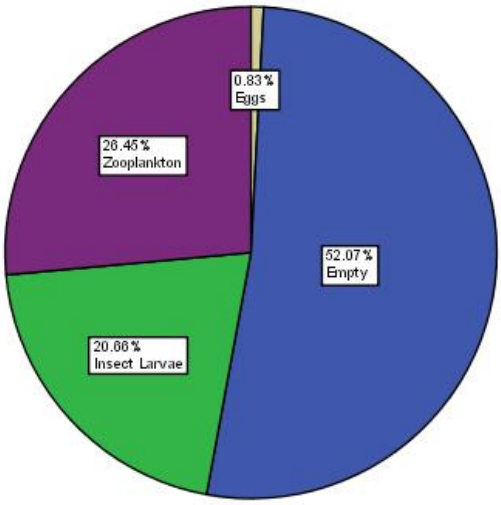

Figure 11. Stomach contents of 2003 Preferred class (350mm – 529mm fork length) lake whitefish from Lesser Slave Lake (n=426).

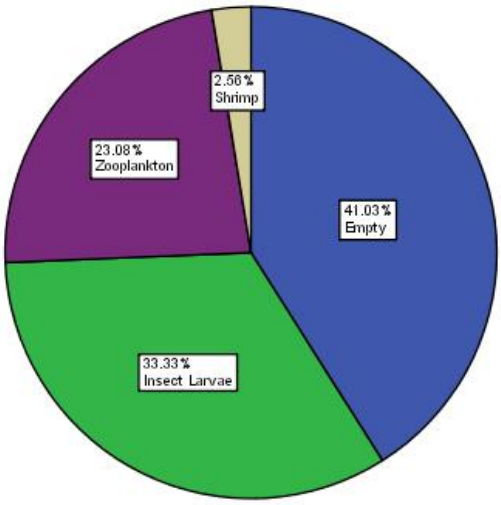

Figure 12. Stomach contents of 2003 memorable class (480mm – 609mm fork length) lake whitefish from Lesser Slave Lake (n=234).

With increasing fork length there appears to be a reduction in fish with empty stomachs as well as a slight reduction in (number or amount of) zooplankton. This is accompanied by a substantial increase in the number of fish feeding on insect larvae.

Relative weight was not used to analyse lake whitefish due to an absence of a standard weight equation in literature.

4.3 Northern pike (*Esox lucius*)

Northern pike accounted for 5.6% of the total catch, 97 individuals. They were captured at a rate of 1.649 fish/ 100m^2/ 24-hours in 2003.

Of all Relative Stock Density (RSD) classes the quality class (530mm – 709mm fork length) was the most predominant and included 49.5% (n=48) of all northern pike (Figure 13). The Proportional Stock Density was 71.2% (i.e., 71.2% of northern pike were greater than 529mm fork length).

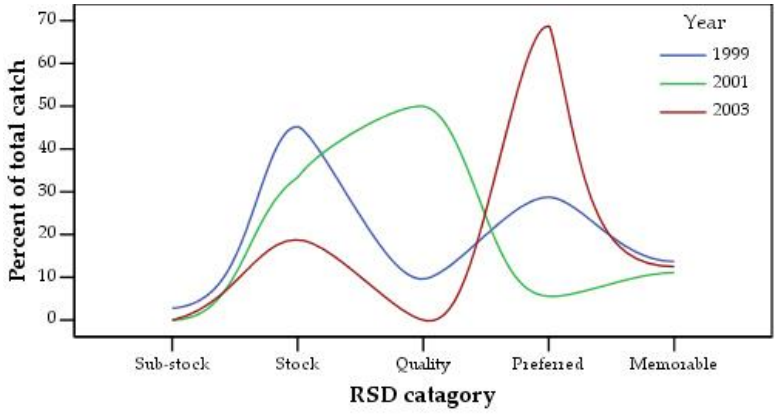

Figure 13. Relative Stock Density of northern pike in Lesser Slave Lake from three years (1999 n=127, 2001 n=90, 2003 n=97).

Females consisted of 61.9% (n=60) of the sample, males 38.1% (n=37). Female fork lengths ranged from 210mm to 890mm with a mean of 605.9mm. Male fork lengths ranged from 212mm to 917mm with a mean of 556.3mm. Figure 14 shows the fork length distributions of all northern pike from 1999-2003.

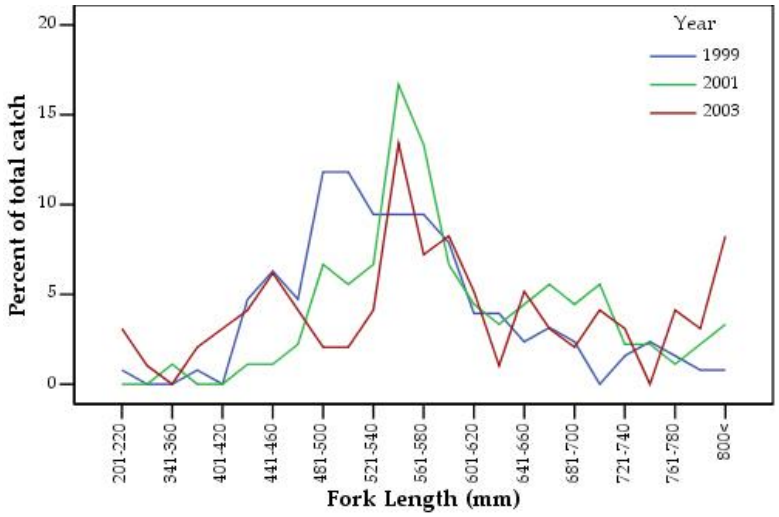

Figure 14. Fork length distributions of northern pike as determined from samples collected during test-netting from Lesser Slave Lake (1999 n=127, 2001 n=90, 2003 n=97).

The most frequent size class of northern pike in 2001 and 2003 was between 541mm and 560mm comprising approximately 17% and 13%, respectively, of the total catch. The strongest size class in 1999 was between 480mm – 520mm and comprised approximately 24% of the total catch.

Examination of the age distributions shows a strong class of 3-year-old northern pike in 1999 with a mean fork length of 518mm (Figure 15). This cohort is also seen in 2001 as 5-year-old fish with a mean fork length of 579mm. This cohort is no longer seen as a dominant class in 2003. We speculate that this represents mortality resulting from angler harvest. With a mean total length of 648mm (fork length of 611mm) 7-year-old fish in 2003 exceed the size limit regulation (630mm) that is currently applied to northern pike in Lesser Slave Lake.

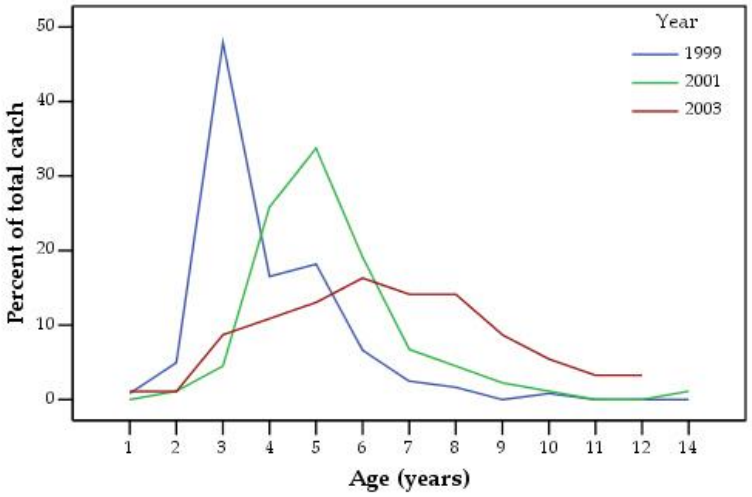

Figure 15. Age distributions of northern pike as determined from samples collected during test-netting from Lesser Slave Lake (1999 n=121, 2001 n=89, 2003 n=92).

Stomach contents of 35 northern pike were examined in 2003. Of those, 68.6% (24 individuals) were found to have empty stomachs. Remaining fish were found to have fish species (31.4%, 11 individuals) in their stomachs(Figure 16). The large proportion empty stomachs may be due to the absence of appropriate sized prey during this time of year as well regurgitation of stomach contents has been observed in fish caught in nets.

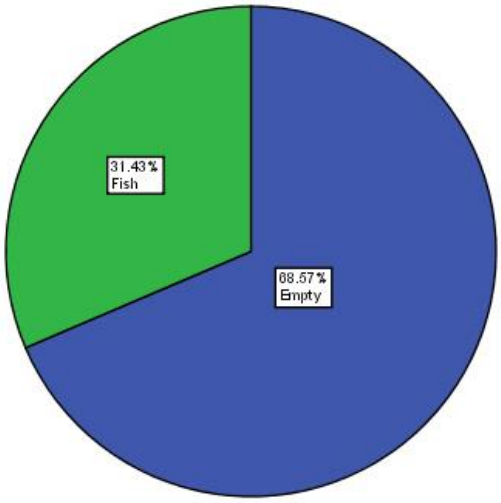

Figure 16. Stomach contents from all northern pike sampled in 2003 from Lesser Slave Lake (n=35).

Samples were then separated into RSD length categories to provide insight in length related trends in diet (Figure 17,Figure 18, Figure 19). Sub-stock, Memorable, and Trophy classes had insufficient sample size to plot.

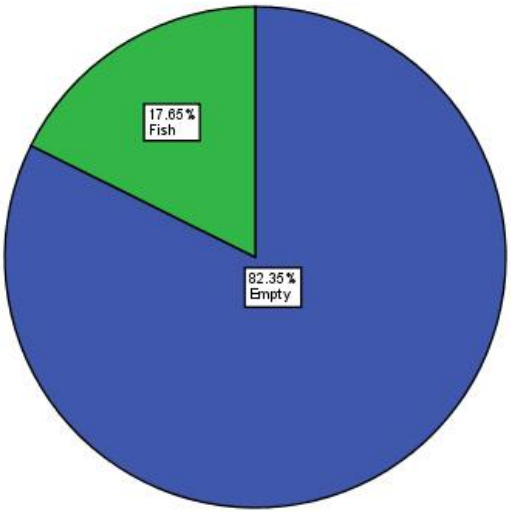

Figure 17. Stomach contents of 2003 Stock class (350mm – 529mm fork length) northern pike from Lesser Slave Lake (n=6).

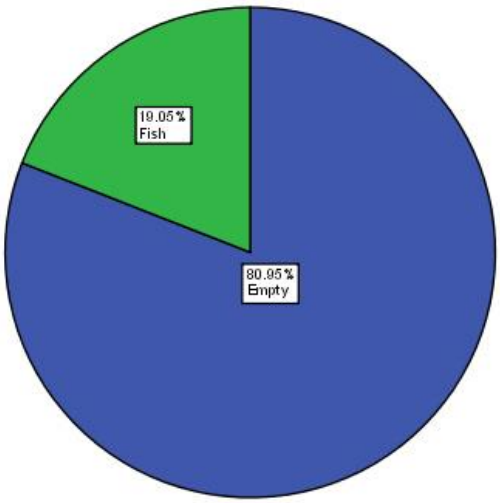

Figure 18. Stomach contents of 2003 Quality class (530mm – 709mm fork length) northern pike from Lesser Slave Lake (n=21).

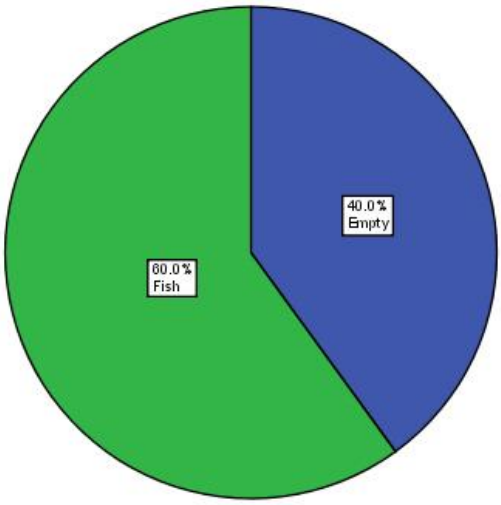

Figure 19. Stomach contents of 2003 Preferred class (710mm – 859mm fork length) northern pike from Lesser Slave Lake (n=5).

Both stock and quality classes show similar proportions of empty stomachs and consumed fish. Preferred class northern pike show a smaller portion of empty stomachs but only 5 of 18 stomachs in this class were examined. With a small sample size of preferred class northern pike (n=5) we cannot be confident that it provides appropriate representation of the population. Therefore we can only conclude that northern pike in Lesser Slave Lake are primarily feeding on fish at this time of year.

Very few immature northern pike were captured in all years (1999 n=3, 2001 n=2, 2003 n=6) therefore immature fish were not included in relative weight (Wr) analysis. No significant difference was found between the mean Wr of males and females at the α=0.05 level (independent sample t-test). Therefore male and female Wr were pooled. In order to select a length range for Wr analysis, northern pike data were visually inspected by plotting Wr against total length (Figure 20). Sizes showing excessive variability were omitted from analysis. The length range was also selected in order to isolate any length related trends in Wr.

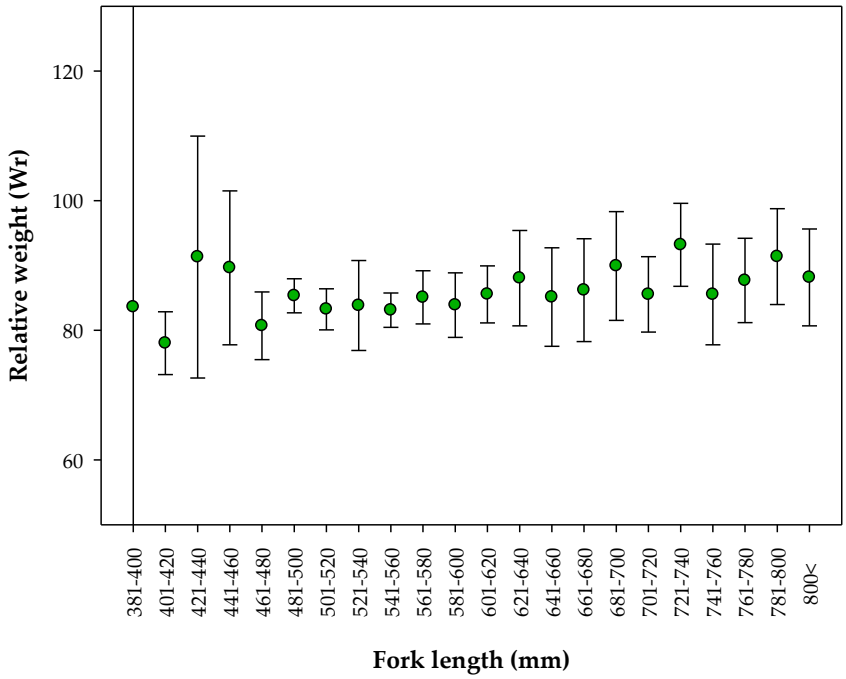

Figure 20. Mean relative weight (Wr) and 95% confidence intervals of 20mm length classes of mature northern pike from Lesser Slave Lake.

Northern pike samples from 480mm to 620mm fork length were selected for analysis of Wr. Fish outside of this range showed greater variability in Wr values, likely to be attributed to sample size. The mean and range of Wr values is shown in Table 3 for northern pike of the selected size range for each year. Figure 21 shows the mean Wr from all years.

Table 3. Mean, maximum, and minimum relative weight (Wr) of 480-620mm fork length northern pike from Lesser Slave Lake.

Year	Mean Wr	Low	High
1999	87.20	72.81	106.23
2001	85.35	48.14	100.65
2003	76.94	53.97	97.25

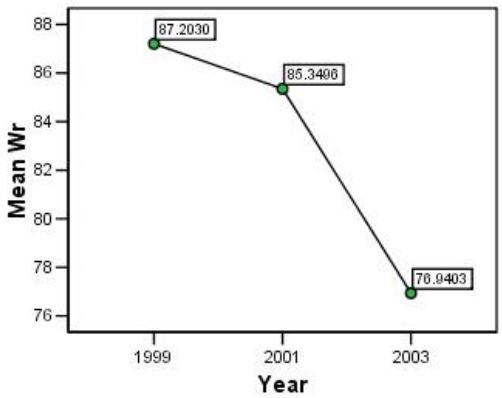

Figure 21. Mean relative weight of mature northern pike between 480mm and 620mm fork length from Lesser Slave Lake.

Using ANOVA, significant differences were found between the three-year's mean Wr (α=0.05). Bonferonni post-hoc analysis provided evidence that 1999 and 2003 differed ($p<0.001$) with the mean Wr being 10.26 points lower in 2003. Wr in Years 2001 and 2003 were also found to be significantly different ($p<0.001$) with 2003 8.41 points lower. No significant difference was found between 1999 and 2001 Wr at a significance level of α=0.05 ($p=0.717$). Therefore we can be 95% certain that the condition of mature northern pike in Lesser Slave Lake has declined since 1999.

4.4 Yellow Perch (*Perca flavescens*)

Yellow perch accounted for 2% of the total catch, 16 individuals. They were captured at a rate of 0.272 fish/ 100m^2/ 24-hours in 2003.

Of all Relative Stock Density (RSD) classes the preferred class (250mm – 299mm fork length) was the most predominant and included 68.8% (n=11) of all yellow perch (Figure 22). The Proportional Stock Density was 81.2% (i.e., 81.2% of yellow perch were greater than 199mm fork length). These ratios are very unlikely to be representative of the actual population as the sample size was very small (n=16).

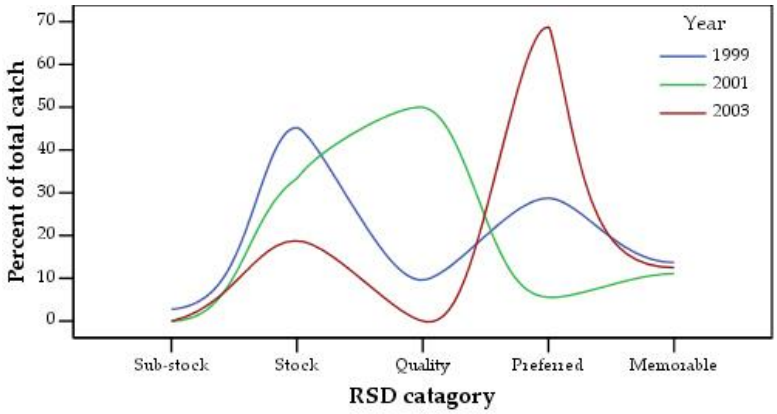

Figure 22. Relative Stock Density of yellow perch in Lesser Slave Lake from three years (1999 n=73, 2001 n=18, 2003 n=16).

Females consisted of 93.8% (n=15) of the sample, males 6.3% (n=1). The only male yellow perch captured had a fork length of 135mm. Female fork lengths ranged from 143mm to 314mm with a mean of 255.4mm. Figure 23 shows the fork length distributions for all yellow perch from 1999-2003.

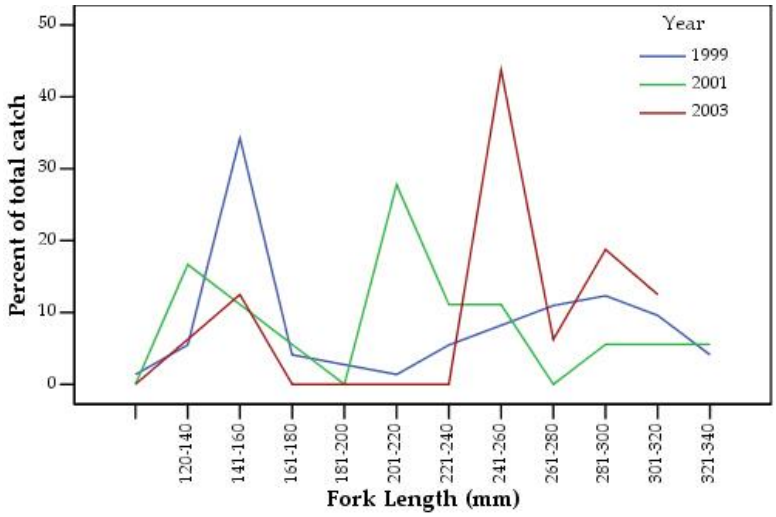

Figure 23. Fork length distributions of yellow perch as determined from samples collected during test-netting of Lesser Slave Lake (1999 n=73, 2001 n=18, 2003 n=16).

Distributions from 2001 (n=18) and 2003 (n=16) may not be representative of the actual population due to small sample size. The most frequent size of yellow perch in 2003 was between 241mm and 260mm composing approximately 42% of the total catch. In 2001 the most frequent size was 201-220mm and in 1999 it was 141-160mm. These fork length modes may represent the progression of a strong cohort through time. The yellow perch age distribution from 1999 is shown in Figure 24.

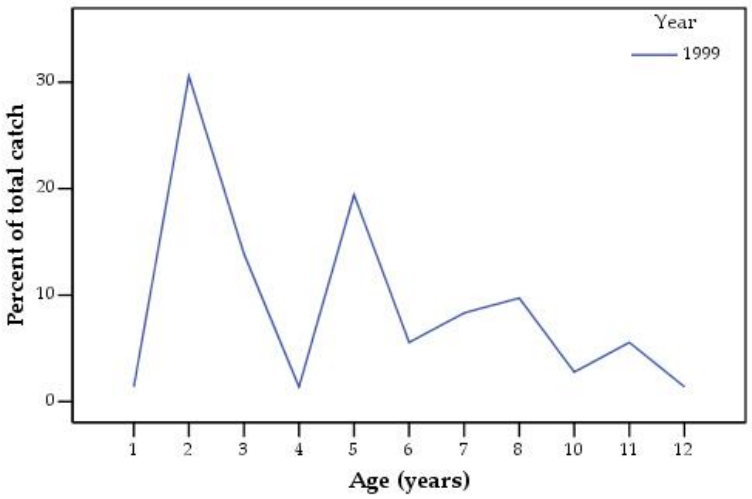

Figure 24. Age distributions of yellow perch as determined from samples collected from Lesser Slave Lake during test-netting of Lesser Slave Lake in 1999 (n=72).

Ages 2, 3, and 5 are the strongest age classes in 1999 composing approximately 30%, 13%, and 18% of the total catch respectively. Due to the small number of yellow perch captured in 2001 (n=18) and 2003 (n=16) no interpretations with respect to ages can be made and their distributions are not shown.

An insufficient number of yellow perch (n=2) were examined for stomach content analysis. Highly variable estimates and curves occurred when length and age data were fitted to the von Bertalanffy growth function. This variation was due to small sample sizes, and therefore results of the von Bertalanffy growth function were not used. Due to the absence of a total length conversion equation, from fork length, relative weight analysis was not used.

4.5 Walleye (*Sander vitreus*)

Walleye accounted for 45.4% of the total catch, 784 individuals. They were captured at a rate of 13.327 fish/ 100m^2/ 24-hours in 2003.

Of all Relative Stock Density (RSD) classes the quality class (380mm – 509mm fork length) was the most predominant and included 56.6% (n=444) of all walleye caught (Figure 25). The Proportional Stock Density was 60.2% (i.e., 60.2% of walleye were greater than 299mm fork length).

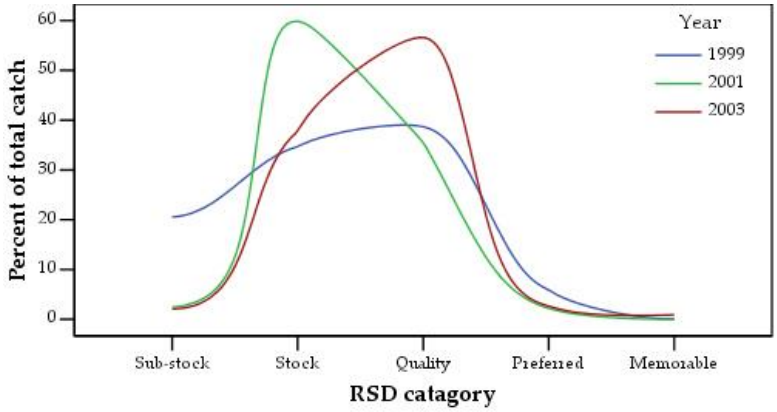

Figure 25. Relative Stock Density of walleye in Lesser Slave Lake from three years (1999 n=876, 2001 n=821, 2003 n=784).

Females consisted of 48.2% (n=378) of the sample, males 51.8% (n=406). Male fork lengths ranged from 157mm to 670mm with a mean of 385.8mm. Female fork lengths ranged from 162mm to 656mm with a mean of 402.6mm. Figure 26 shows the fork length distribution for all three years.

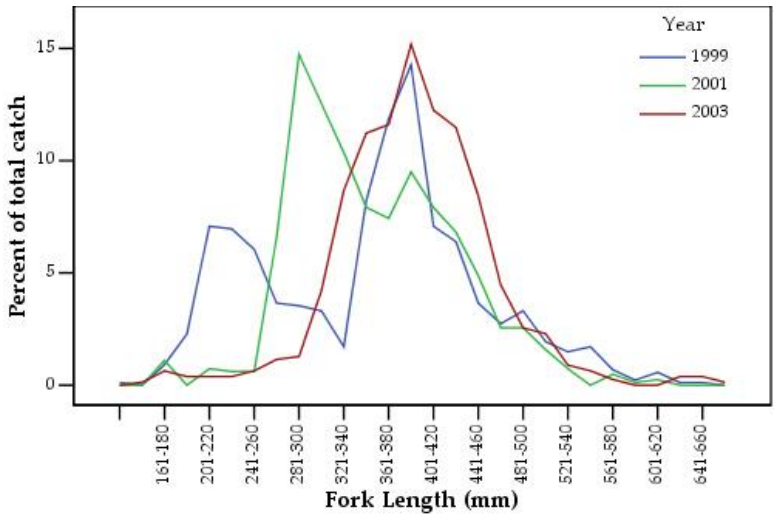

Figure 26. Fork length distributions of walleye as determined from samples collected during test-netting of Lesser Slave Lake (1999 n=876, 2001 n=821, 2003 n=784).

The most frequent sizes of walleye were between 381mm and 400mm in 1999 and in 2003. In 2001 the most frequent size was 281-300mm. Strong representation of 201-240mm in 1999, 281-300mm in 2001, and 381-400mm fish in 2003 possibly represent a strong cohort through time.

Examination of the age distributions shows a strong class of 3-year-old walleye in 1999 with a mean fork length of 260mm (Figure 27). This cohort is also observed in 2001 as 5-year-old fish with a mean fork length of 328mm and in 2003 as 7-year-old fish with a mean fork length of 390mm.

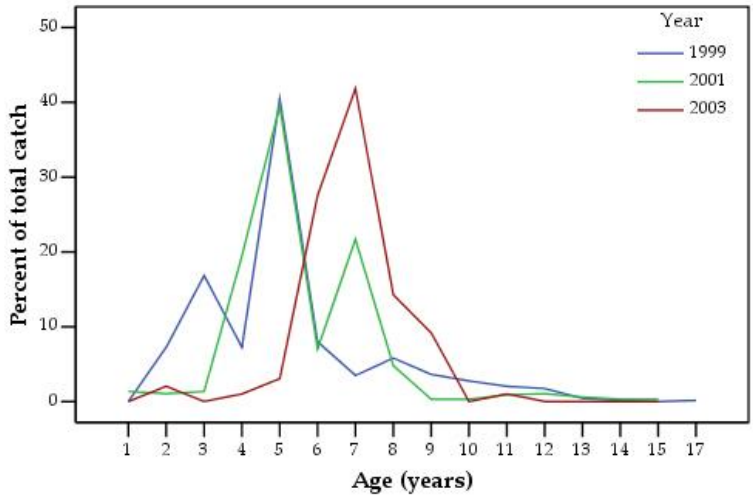

Figure 27. Age distributions of walleye as determined from samples collected during test-netting of Lesser Slave Lake (1999 n=689, 2001 n=668, 2003 n=98).

We speculate that this cohort remains to be the dominant age class in 2003 because it remains below angler harvestable size. With a mean total length of 405mm (fork length of 390mm) 7-year-old fish in 2003 for the most part do not exceed the size limit regulation (430mm total length) that is currently applied to walleye in Lesser Slave Lake. We also recognize that these fish may become harvestable to anglers in 2004 and 2005. Five-year-old walleye are also observed to be a large age class in 1999 with a mean fork length of 381mm. This cohort is also observed in 2001 as 7-year-old fish with a mean fork length of 423mm and in 2003 as 9-year-old fish with a mean fork length of 463mm. This cohort appears to show a decline in age class strength with time, where in 2003 it no longer appears as a strong age class. We speculate that this represents mortality resulting from angler harvest. With a mean total length of 439mm (fork length of 423mm) some of the 7-year-old fish in 2001 exceed the size limit regulation (430mm total length) that is currently applied to northern pike in Lesser Slave Lake. With a mean total length of 480mm (fork length of 463mm) most of the 9-year-old fish in 2003 exceed the size limit regulation.

Stomach contents of 252 walleye were examined in 2003. Of those 48.0% (121 individuals) were found to have empty stomachs, others were found to have fish (45.2%, 114 individuals) and insect larvae (6.8%, 14 individuals) (Figure 28).

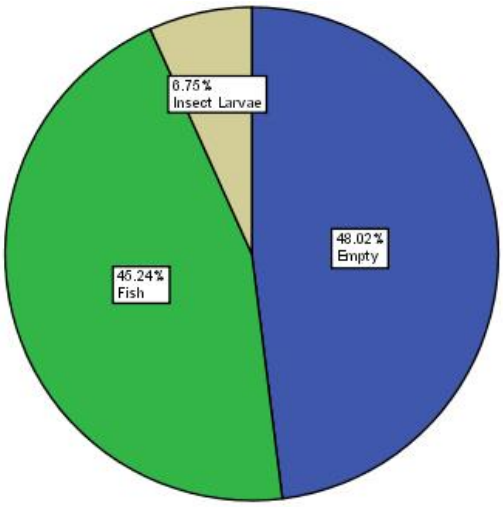

Figure 28. Stomach contents from all walleye sampled in 2003 from Lesser Slave Lake (n=252).

Samples were then separated into RSD length categories to provide insight in length related trends in diet (Figure 29, Figure 30, Figure 31, Figure 32, Figure 33). No Trophy class walleye were captured.

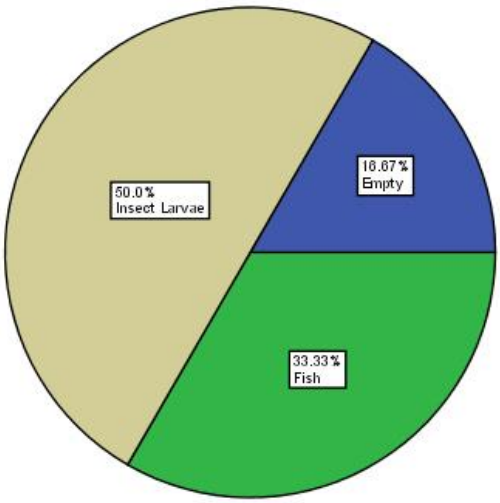

Figure 29. Stomach contents from 2003 Sub-stock class (<250mm fork length) from Lesser Slave Lake walleye (n=6).

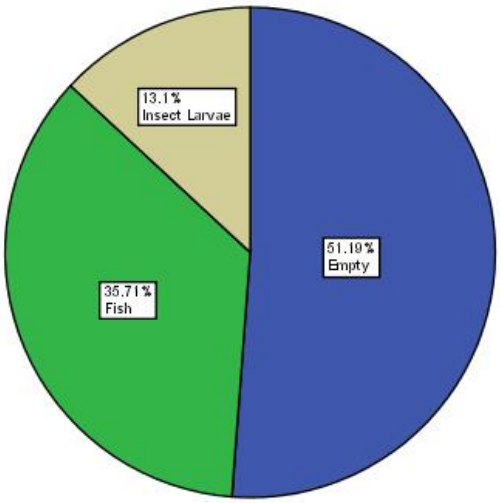

Figure 30. Stomach contents from 2003 Stock class (250mm - 379mm fork length) from Lesser Slave Lake walleye (n=84).

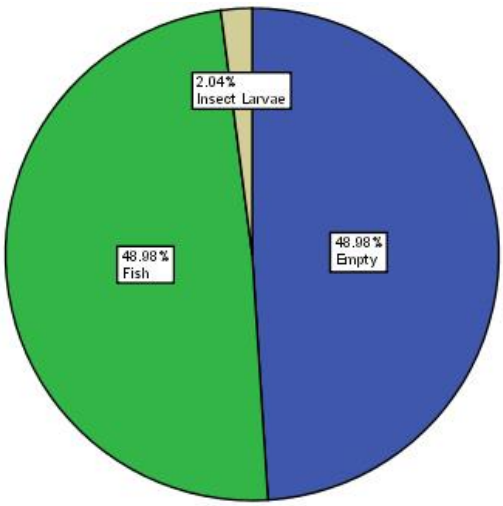

Figure 31. Stomach contents from 2003 Quality class (380mm - 509mm fork length) from Lesser Slave Lake walleye (n=147).

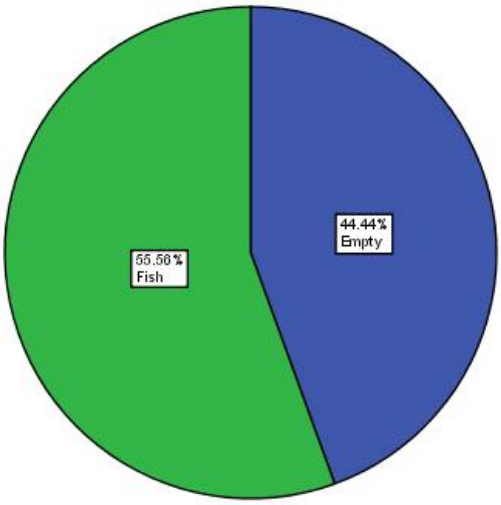

Figure 32. Stomach contents from 2003 Preferred class (510mm - 629mm fork length) from Lesser Slave Lake walleye (n=9).

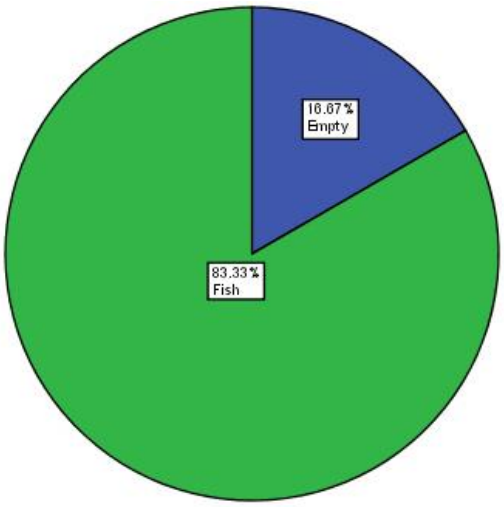

Figure 33. Stomach contents from 2003 Memorable class (630mm - 759mm fork length) from Lesser Slave Lake walleye (n=6).

There appears to be a decreasing trend in the proportion of walleye feeding on insect larvae as fork length increases, with complete absence in Preferred and Memorable classes.

Mature male and female walleye showed a significant difference ($p<0.001$, independent sample t-test) in mean relative weight (Wr) in 2003, 90.24 and 86.74 respectively, therefore Wr analysis was conducted separately for mature male and female walleye. No significant differences were found between immature male and female walleye at the α=0.05 level therefore immature males and females were pooled. Wr data was visually inspected by plotting Wr against total length (Figure 34, Figure 36, Figure 38). This was done to select a length range for analysis. Sizes showing excessive variability were not selected. The range was also selected in order to isolate any length related trends in Wr.

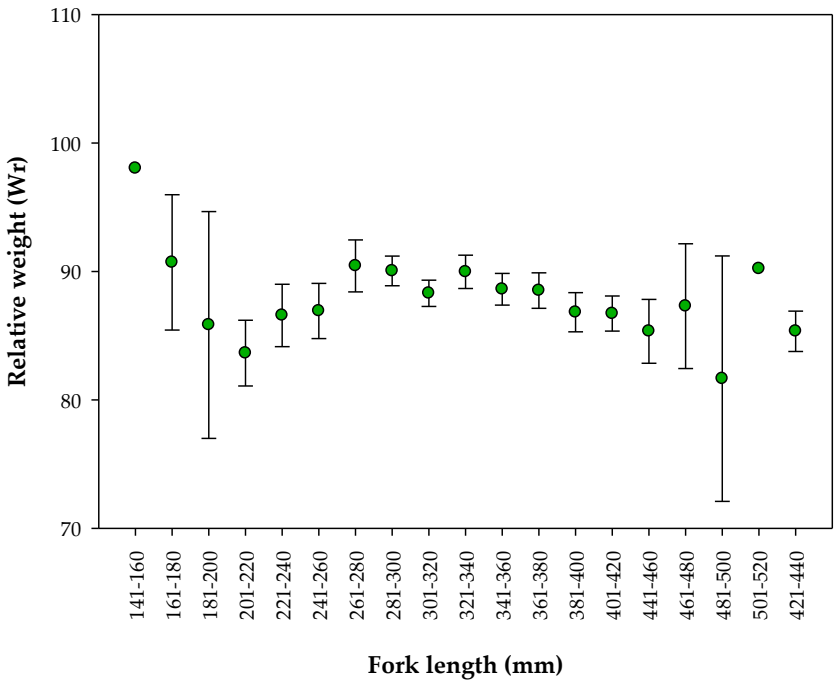

Figure 34. Mean relative weight (Wr) and 95% confidence intervals of 20mm length classes of immature walleye from Lesser Slave Lake.

Immature walleye from 280mm to 380mm fork length were selected for analysis of Wr. Walleye outside of this range showed greater variability in Wr values likely to be attributed to sample sizes. The mean and range of Wr values is shown in Table 4 for immature walleye of the selected size range for each year. Figure 35 shows the mean Wr from all years.

Table 4. Mean, maximum, and minimum relative weight (Wr) of 280-380mm fork length immature walleye from Lesser Slave Lake.

Year	Mean Wr	Low	High
1999	85.67	47.91	113.02
2001	90.17	38.59	114.18
2003	88.13	54.43	113.28

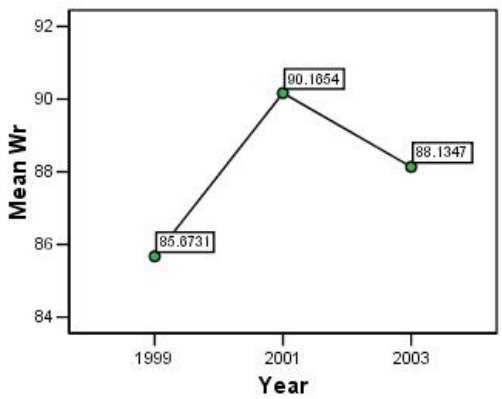

Figure 35. Mean relative weight of immature walleye between 280mm and 380mm fork length from Lesser Slave Lake.

Using ANOVA, significant differences were found between the mean Wr of the three years ($p<0.001$, $\alpha=0.05$). Bonferonni post-hoc analysis showed that 1999 and 2001 ($p<0.001$) and 2003 ($p<0.001$) both showing an increase in Wr. Difference in Wr between 2001 and 2003 were also found to be significant ($p=0.001$) but with a decrease in 2003. Therefore we can be 95% certain that the condition of immature walleye in Lesser Slave Lake has increased overall but a slight decrease in 2003 from 2001.

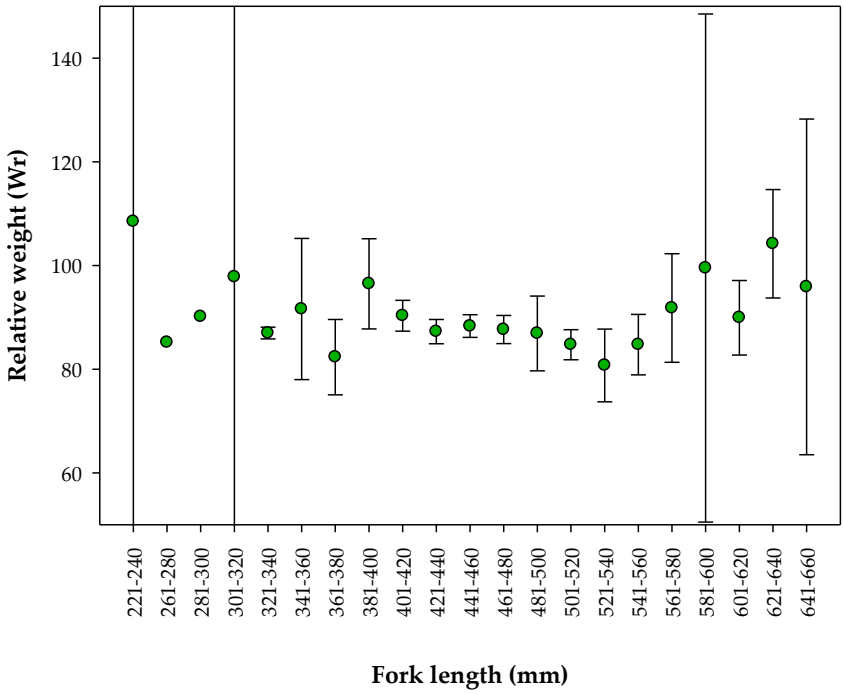

Figure 36. Mean relative weight (Wr) and 95% confidence intervals of 20mm length classes of mature female walleye from Lesser Slave Lake.

Mature female walleye from 400mm to 520mm fork length were selected for analysis of Wr. Walleye outside of this range showed greater variability in Wr values likely to be attributed to sample sizes. The mean and range of Wr values is shown in Table 5 for immature walleye of the selected size range for each year. Figure 37 shows the mean Wr from all years.

Table 5. Mean, maximum, and minimum relative weight (Wr) of 400-520mm fork length mature female walleye from Lesser Slave Lake.

Year	Mean Wr	Low	High
1999	89.84	78.37	105.94
2001	91.26	80.42	115.95
2003	86.87	67.95	114.63

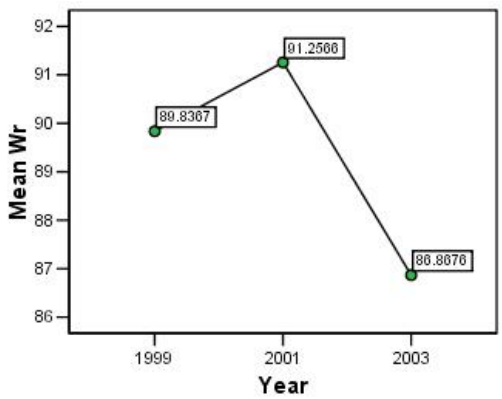

Figure 37. Mean relative weight of mature female walleye between 400mm and 520mm fork length from Lesser Slave Lake.

Using ANOVA, significant differences were found between the mean Wr of the three years (p=0.005, α=0.05). Bonferonni post-hoc analysis found that from 2001 to 2003 there is an increase in mean Wr (p=0.006). Therefore we can be 95% certain that the condition of mature female walleye in Lesser Slave Lake has decreased between 2001 and 2003.

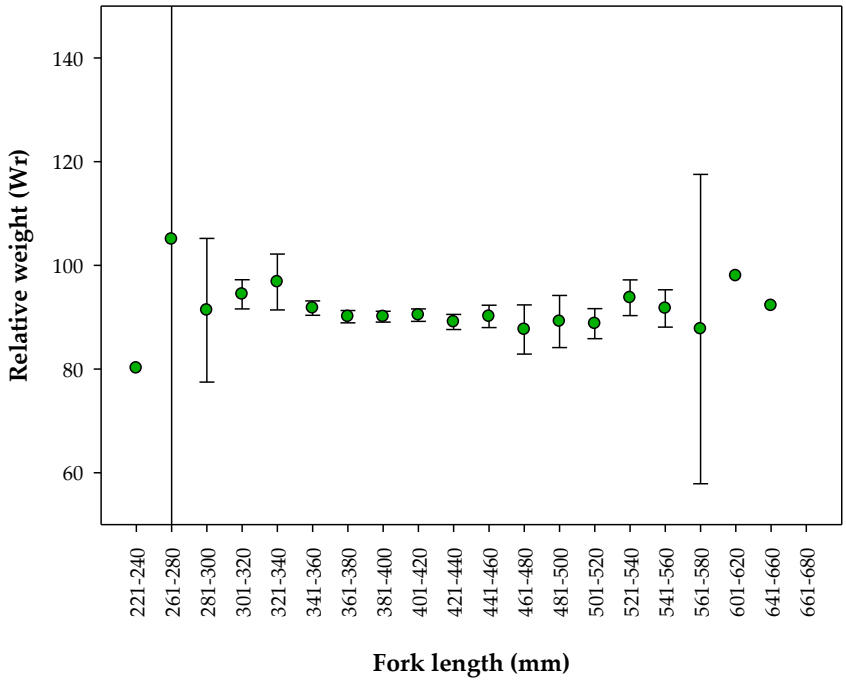

Figure 38. Mean relative weight (Wr) and 95% confidence intervals of 20mm length classes of mature male walleye from Lesser Slave Lake.

Mature male walleye from 340mm to 460mm fork length were selected for analysis of Wr. Walleye outside of this range showed greater variability in Wr values likely to be attributed to sample sizes. The mean and range of Wr values is shown in Table 6 for immature walleye of the selected size range for each year. Figure 39 shows the mean Wr from all years.

Table 6. Mean, maximum, and minimum relative weight (Wr) of 340-460mm fork length mature male walleye from Lesser Slave Lake.

Year	Mean Wr	Low	High
1999	89.67	51.62	106.73
2001	90.40	76.19	115.36
2003	90.45	44.29	107.84

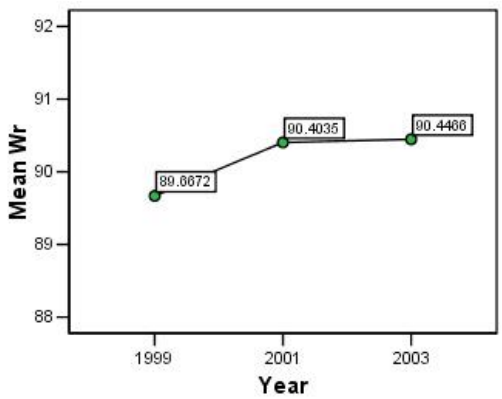

Figure 39. Mean relative weight of mature male walleye between 340mm and 460mm fork length from Lesser Slave Lake.

Using ANOVA, no significant differences were found between the mean Wr of the three years (p=0.456, α=0.05). Therefore we do not detect any change in condition of mature male walleye in Lesser Slave Lake from 1999 to 2003.

6.0 LITERATURE CITED

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