Status of Sport Fishes in Graham Lake, Alberta, 2004

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Greg Fortier, Tyler Johns, and John Tchir

Alberta Conservation Association
Bag 900-26
Peace River, Alberta, Canada
T8S 1T4

Report Series Editor
PETER AKU
P.O. Box 40027
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Fax: (780) 422-6441
Email: info@ab-conservation.com
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EXECUTIVE SUMMARY

Increased access in the Red Earth area in the Northwest region of Alberta, resulting from the development of new roads, has raised concerns about impacts of potential increases in angling pressure on sport fish populations of lakes in the region, including Graham Lake. The present study was conducted on Graham Lake to generate quantitative data on abundance, population structure, and growth of four major sport fish species, walleye (*Sander vitreus*), northern pike (*Esox lucius*), lake whitefish (*Coregonus clupeaformis*), and yellow perch (*Perca flavescens*), that can be used to assess impacts of the increased fishing pressure.

A total of 635 sport fish were captured during the survey of which lake whitefish was the most abundant, accounting for 42.4% of the catch; walleye, northern pike, and yellow perch constituted 13.9, 4.3, and 12.8% of the total catch, respectively.

Catch-per-unit-effort (CPUE) for walleye ranged from 1.26 to 8.13 fish/100m^2/24h with a mean (±95% CI) of 5.14 ± 2.60 fish/100m^2/24h (n = 10). Of the 88 walleye sampled, 63.6% were females and 36.4% were males, resulting in a female to male sex ratio of 1.75:1. Length of females ranged from 109 to 645 mm FL with a mean (±SD) of 470.5 ± 155.70 mm (n = 56) while that of males ranged from 186 to 581 mm with a mean of 471.3 ± 99.83 mm (n = 32). Males ranged in age from 3 to 16 y with a mean (±SD) of 11.7 ± 3.41 y (n = 29) while age of females ranged from 1 to 17 y with a mean of 9.7 ± 5.26 y (n = 54). Overall mean age of the catch was 10.4 ± 4.77 y (n = 83).

CPUE for northern pike ranged from 0.38 to 3.43 fish/100m^2/24h with a mean of 1.46 ± 1.00 fish/100m^2/24h (n = 10). Of the 27 northern pike sampled, 74.1% were females and 25.9% were males, resulting in a female to male sex ratio of 2.86:1. Length of females ranged from 570 to 888 mm FL with a mean of 719.3 ± 75.17 mm (n = 20) while that of males ranged from 418 to 654 mm with a mean of 572.1 ± 78.08 mm (n = 7). Males ranged in age from 3 to 13 y with a mean of 7.8 ± 3.37 y (n = 6) while age of females ranged from 4 to 16 y with a mean of 9.7 ± 2.98 y (n = 19). Overall mean age of the catch was 9.2 ± 3.11 y (n = 25).

CPUE for lake whitefish ranged from 12.38 to 17.46 fish/100m^2/24h with a mean of 14.76 ± 4.91 fish/100m^2/24h (n = 10). Of the 265 lake whitefish sampled, 64.5% were females and 35.5% were males, resulting in a female to male sex ratio of 1.82:1. Length of females ranged from 260 to 581 mm FL with a mean of 450.3 ± 50.16 mm (n = 171) while that of males ranged from 252 to 526 mm with a mean of 439.6 ± 43.89 mm (n = 94). Males ranged in age from 2 to 12 y with a mean of 8.1 ± 2.55 y (n = 59) while age of females ranged from 2 to 16 y with a mean of 9.16 ± 2.93 y (n = 68). Overall mean age of the catch was 8.7 ± 2.8 y (n = 127).

CPUE for yellow perch ranged from 1.62 to 5.81 fish/100m^2/24h with a mean of 4.55 ± 2.45 fish/100m^2/24h (n = 10). Of the 79 yellow perch sampled, 91.1% were females and 8.9% were males, resulting in a female to male sex ratio of 10.29:1. Length of females ranged from 93 to 238 mm FL with a mean of 158.7 ± 18.67 mm (n = 72) while that of males ranged from 88 to 181 mm with a mean of 140.9 ± 29.00 mm (n = 7). Males ranged in age from 2 to 4 y with a mean of 3.2 ± 0.75 y (n = 6) while age of females ranged from 2 to 7 y with a mean of 3.2 ± 0.65 y (n = 71). Overall mean age of the catch was 3.2 ± 0.64 y (n = 79).

The results of the present study provide important baseline information that can be used by resource managers to quantify the effects of anticipated increases in angling pressure on sport fish population in Graham Lake.

Key words: Graham Lake, walleye, northern pike, lake whitefish, yellow perch, catch-per-unit-effort, age, growth, size distribution, angler harvest.

ACKNOWLEDGEMENTS

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1.0 INTRODUCTION

1.1 General introduction

Increased access in the Red Earth area in the Northwest region of Alberta, resulting from the development of new roads, has raised concerns about impacts of potential increases in angling pressure on sport fish populations of lakes in the region, including Graham Lake. Currently Graham Lake is easy to access and has a developed boat launch. Increased traffic in the Red Earth area could result in a direct increase of angling at Graham Lake due to the existing facilities.

1.2 Study objectives

To assess impacts of the anticipated increased accessibility on Graham Lake sport fishery, we conducted a stock assessment survey between 6 and 10 September 2004 to generate baseline data on abundance, population structure, and growth of four major sport species, walleye (*Sander vitreus*), northern pike (*Esox lucius*), lake whitefish (*Coregonus clupeaformis*), and yellow perch (*Perca flavescens*) in the lake. The data generated in our study will aid in formulating management guidelines for the sports fishery on the lake.

2.0 STUDY AREA

Graham Lake is located approximately 45 km east of Red Earth, Alberta (Figure 1). It has a surface area of 4170 ha, an average depth of 8.0 m, and a maximum depth of 14.6 m. Access to the lake is directly off a gravel road. There is also a concrete boat launch. The lake supports natural populations of white sucker (*Catostomus commersoni*), longnose sucker (*Catostomus catostomus*), cisco (*Coregonus artedi*), lake whitefish, northern pike, burbot (*Lota lota*), yellow perch, and walleye.

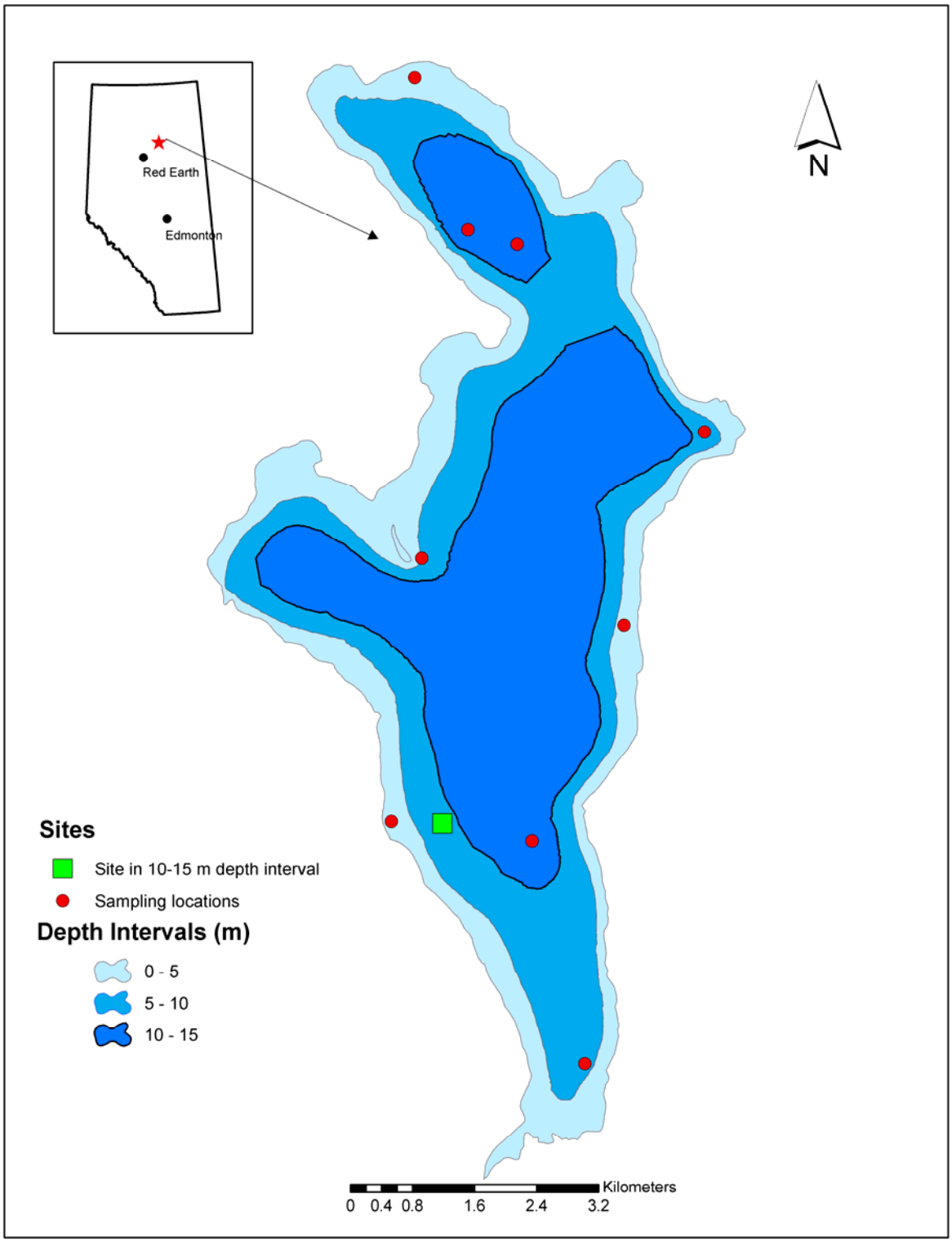

Figure 1. Map of Graham Lake showing sampling locations for 2004. Inset is map of the province of Alberta.

3.0 MATERIALS AND METHODS

3.1 Sampling design

We used multi-mesh benthic gill nets to capture fish. Each net comprised of five 15 x 2.4 m panels of different mesh sizes 38, 63, 89, 114, and 140 mm (stretch measure) and connected in sequential order.

Sampling sites were selected in a stratified-random fashion using three depth strata, set at 5-m intervals. Table 1 shows the stratification and the proportion of lake surface area represented by each stratum. Sampling effort was allocated proportionately to surface area of the three depth strata (Table 1). A total of 10 gill nets were deployed and their locations were geo-reference using a Garmin 12 handheld GPS unit. Sample sites were randomly selected using Arcview GIS version 3.1, with a minimum distance of 500 m between sites. Nets were set at depths ≥ 2 m for approximately 24h. Nets were set perpendicular to the shoreline; if a net extended beyond its depth stratum then it was reset at an angle. The orientation of the largest or smallest mesh of each net in relation to the shore was random.

Table 1. Distribution of fish sampling effort by depth strata in Graham Lake, Alberta 2004. One net was set at each site, thus, the total number of nets equals the total number of sampling sites.

Depth stratum (m)	Proportion of lake surface area (%)	Number of sites
0-5	26.7	3
5-10	31.5	3
>10	41.8	4

3.2 Data collection

Biological data collected from all captured fish included fork length (FL), total length (TL), and weight. Sex, maturity, and stomach contents were determined through internal examination of sacrificed fish. Ageing structures were also removed from sacrificed fish and aged following methods in Mackay et al. (1990). Left pelvic fin rays

were collected for ageing walleye and yellow perch, cleithra were collected to age northern pike, and scales were collected for ageing lake whitefish. All data on sport fish, as well as non-sport fish species (number caught, FL, and weight) were entered into the Provincial Government Fisheries Management Information System (FMIS), Project Location ID 6276. Stomach content data were collected and archived as requested by Alberta Sustainable Resource Development but not included in this report.

3.3 Data analyses

The abundance of each species, expressed as catch-per-unit-effort (CPUE, fish/100m^2 of net/24h) was calculated at each sampling site and used to estimate the mean CPUE ($\pm$ 95% confidence interval (95% CI)). CPUE values were reported for each depth stratum, as well as a grand mean for all depth strata combined (whole-lake). Total catch-per-unit-effort (TCUE) is the total catch of each fish species over the total effort applied.

Length-frequency and age-frequency distributions were used to examine the population structure of each species. Distributions of length and age were shown in relation to CPUE (y-axis).

We established relationships between FL and TL for walleye and northern pike from fish captured in this study, as well as those captured during a parallel angler survey on the lake (FMIS project location ID 6344). In order to reduce sampling time, TL was not measured for all fish. Plotting FL and TL measurements of individual fish, where both were recorded, we fitted the following linear regression models to walleye and northern pike.

Walleye:	TL = 1.058 FL + 2.01; (R^2 = 0.999, n = 88).
Northern pike:	TL = 1.033 FL + 16.64; (R^2 = 0.998, n = 27).

Fish maturity was described as the age at which 50% of the fish are mature. The length at which 50% of fish were mature was also reported. Growth rate of fish was described using the von Bertalanffy (1938) growth model:

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

where:

L_t = length at age t

L_∞ = the asymptote or final maximum size

K = the rate at which the growth curve approaches the asymptote

t = age

t_0 = a time scaler, the hypothetical time when the fish was size zero

To account for sexual variations in growth rate, the von Bertalanffy model was fitted separately for male and female fish. The parameter used to estimate growth in the von Bertalanffy model is K i.e., the rate at which the fish approaches maximum size (L_∞). High values of K represent fast growth and are usually associated with low L_∞. Due to small sample sizes of small fish, t_0 was fixed at zero to reduce bias in the growth function.

4.0 RESULTS

4.1 Walleye

Walleye accounted for 13.9% of the total catch (i.e., 88 individuals of the 635 fish captured). TCUE was 4.81 fish/100m^2/24h. Mean CPUE for depth intervals ranged from 1.26 to 8.13 fish/100m^2/24h with a whole-lake mean of 5.14 fish/100m^2/24h (Table 2).

Table 2. Mean catch-per-unit-effort (CPUE) of walleye in gill nets during the 2004 stock assessment at Graham Lake, Alberta. n = number of nets.

Depth stratum (m)	CPUE (fish/100m^2/24h)		n
	Mean	95% CI (±)	
0-5	1.26	0.96	3
5-10	5.02	5.41	3
>10	8.13	3.09	4
Whole-lake	5.14	2.60	10

Of the 88 walleye sampled where sex could be determined, 63.6% were females and 36.4% were males, resulting in a female:male sex ratio of 1.75:1. Male and female walleye length distributions are shown in Figure 2. Length of males ranged from 186 to 581 mm FL with a mean (± SD) of 471.3 ± 99.83 mm (n = 32), while that of females ranged from 109 to 645 mm with a mean of 470.5 ± 155.70 mm (n = 56). Walleye size distribution does not appear to be truncated at the minimum size limit (50 cm TL or 47.0 cm FL) for angler harvest.

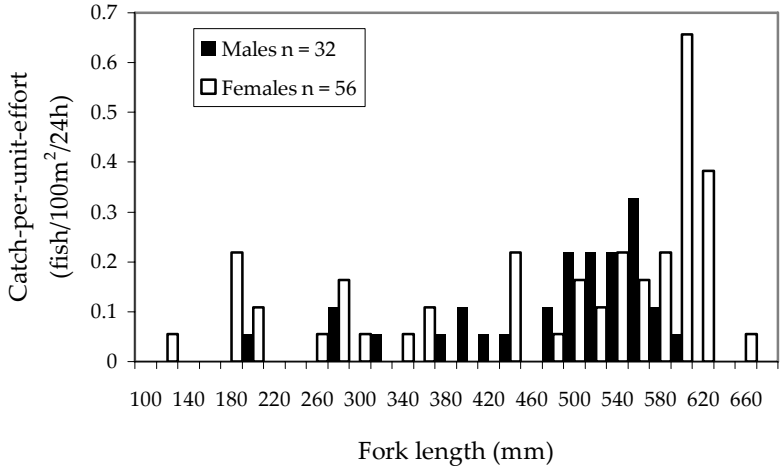

Figure 2. Length distributions of male and female walleye captured in Graham Lake during the 2004 gill net survey.

Males ranged in age from 3 to 16 y with a mean of 11.7 ± 3.41 y (n = 29) while age of females ranged from 1 to 17 y with a mean of 9.7 ± 5.26 y (n = 54; Figure 3). The overall mean age of the catch was 10.4 ± 4.77 y (n = 83). The strongest cohorts for both male and female walleye were ages-13 and -15. The age-13 cohort represents 22.9% of all walleye while the age-15 cohort represents 19.3%.

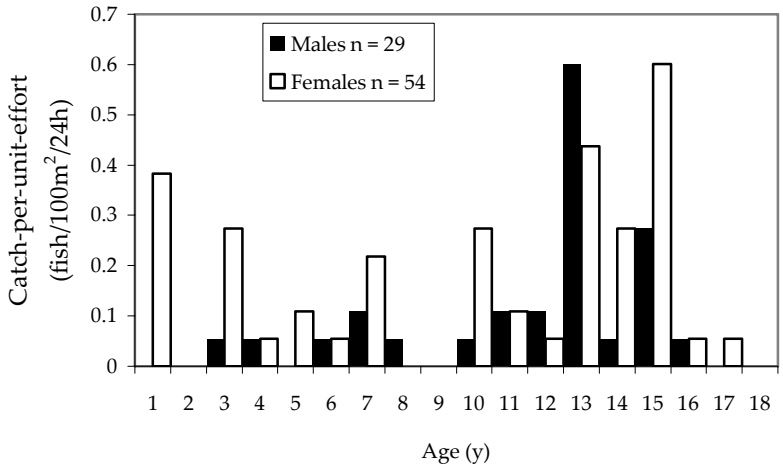

Figure 3. Age distributions of male and female walleye captured in Graham Lake during the 2004 gill net survey.

When fitted to the von Bertalanffy growth function, male walleye showed an L_∞ of 582.9 mm FL and a growth coefficient K of 0.177 (Figure 4). Females showed an L_∞ of 624.2 mm FL and a growth coefficient K of 0.191 (Figure 4) thereby, attaining larger sizes and at a faster rate than males.

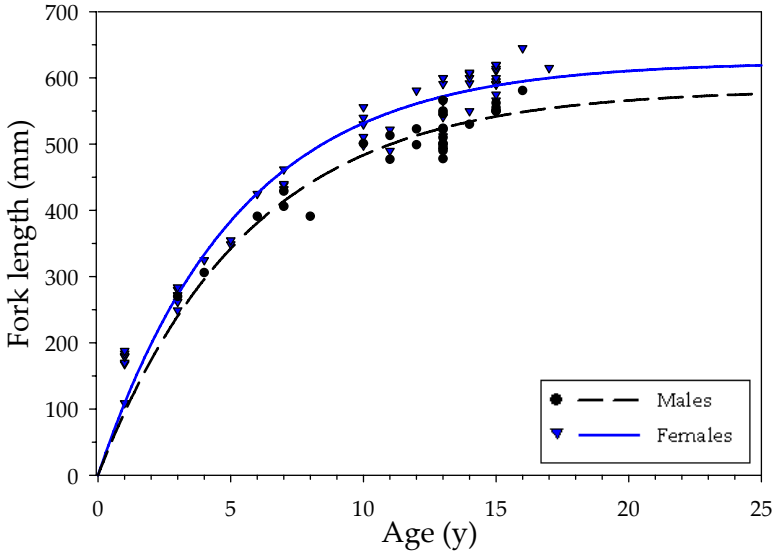

Figure 4. von Bertalanffy growth curves for male and female walleye from Graham Lake, Alberta, 2004. von Bertalanffy growth parameters. a) Males: L_∞ = 582.9, K = 0.177, n = 29; b) Females: L_∞ = 624.2, K = 0.191, n = 54.

The proportion of mature walleye in each age- and length-class is shown in Tables 3 and 4. While sample sizes of each age-class were insufficient to determine the point of 50% maturity, males likely mature by age-8 and females by age-10 y. The data also shows that 50% of male walleye are mature by 350 mm FL and females by 500 mm FL.

Table 3. Proportion of mature walleye in each age-class from gill nets during the 2004 stock assessment at Graham Lake, Alberta.

Age (y)	Males		Females	
	% mature	n	% mature	n
1	-	-	0	7
3	0	1	0	5
4	0	1	0	1
5	-	-	0	2
6	100	1	0	1
7	50	2	25	4
8	100	1	-	-
10	100	1	100	5
11	100	2	100	2
12	100	2	100	1
13	100	11	100	8
14	100	1	100	5
15	100	5	100	11
16	100	1	100	1
17	-	-	100	1

Table 4. Proportion of mature walleye in each length-class from gill nets during the 2004 stock assessment at Graham Lake, Alberta.

Fork length (mm)	Males		Females	
	% mature	n	% mature	n
150	0	1	0	1
200	-	-	0	6
250	0	2	0	1
300	0	1	0	4
350	66.7	3	0	2
400	50	2	0	1
450	100	6	25	4
500	100	13	75	4
550	100	4	100	8
600	-	-	100	17
650	-	-	100	8

4.2 Northern pike

Northern pike accounted for 4.3% of the total catch (i.e., 27 individuals of the 635 fish captured). TCUE was 1.48 fish/100m²/24h. Mean CPUE for depth intervals ranged from 0.38 to 3.43 fish/100m²/24h with a whole-lake mean of 1.46 fish/100m²/24h (Table 5).

Table 5. Mean catch-per-unit-effort (CPUE) of northern pike in gill nets during the 2004 stock assessment at Graham Lake, Alberta. n = number of nets.

Depth stratum (m)	CPUE (fish/100m²/24h)		n
	Mean	95% CI (±)	
0-5	3.43	1.80	3
5-10	0.38	0.38	3
>10	0.79	0.61	4
Whole-lake	1.46	1.00	10

Of the 27 northern pike sampled where sex could be determined, 74.1% were females and 25.9% were males, resulting in a female:male sex ratio of 2.86:1. Male and female northern pike length distributions are shown in Figure 5. Length of males ranged from 418 to 654 mm FL with a mean of 572.1 ± 78.08 mm (n = 7), while that of females ranged from 570 to 888 mm with a mean of 719.3 ± 75.17 mm (n = 20). Northern pike size distribution has not been truncated at the minimum size limit (i.e., 63 cm TL or 59.7 cm FL) for angler harvest.

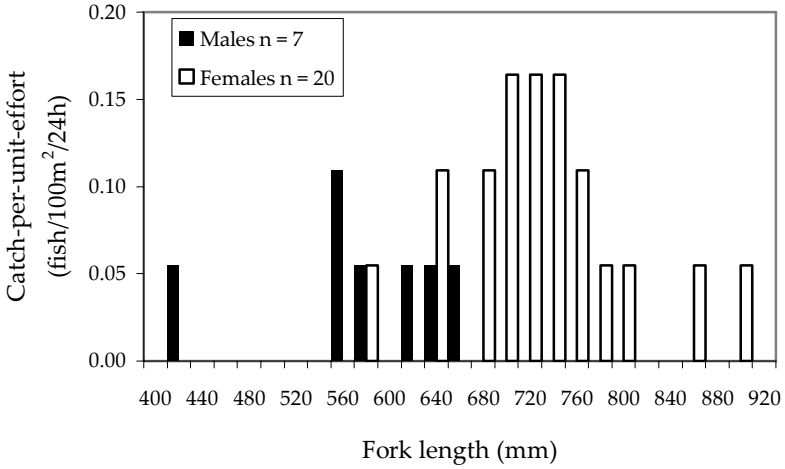

Figure 5. Length distributions of male and female northern pike captured in Graham Lake during the 2004 gill net survey.

Males ranged in age from 3 to 13 y with a mean of 7.8 ± 3.37 y (n = 6) while females ranged from 4 to 16 y with a mean of 9.7 ± 2.98 y (n = 19; Figure 6). The overall mean age of the catch was 9.2 ± 3.11 y (n = 25).

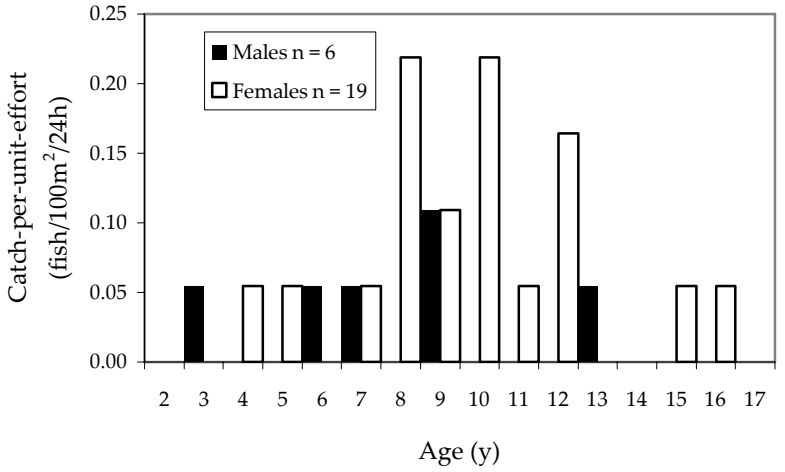

Figure 6. Age distributions of male and female northern pike captured in Graham Lake during the 2004 gill net survey.

When fitted to the von Bertalanffy growth function, male northern pike showed an L_∞ of 657.1 mm FL and a growth coefficient K of 0.322 (Figure 7). Females showed an L_∞ of 810.3 mm FL and a growth coefficient K of 0.258 (Figure 7) thereby, attaining larger sizes and at a slower rate than males.

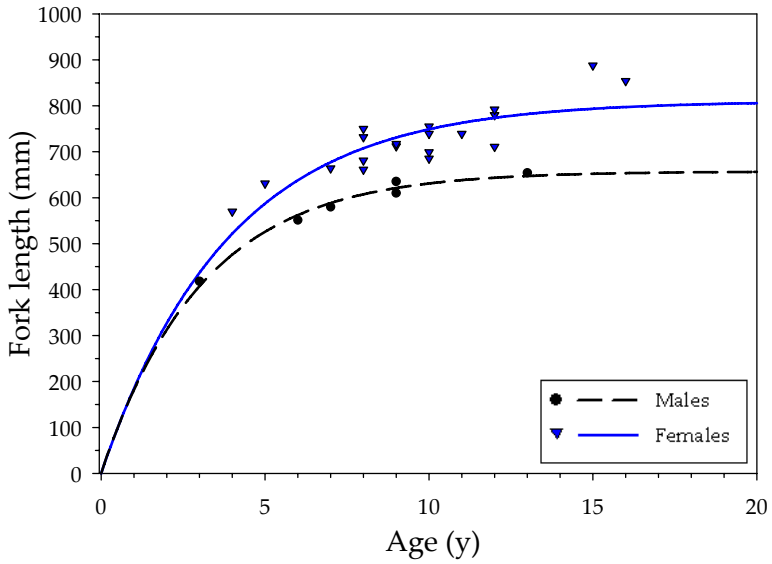

Figure 7. von Bertalanffy growth curves for male and female northern pike from Graham Lake, Alberta, 2004. von Bertalanffy growth parameters: a) Males: L_∞ = 657.1, K = 0.322, n = 6; b) Females: L_∞ = 810.3, K = 0.258, n = 19.

Analyses of male maturity data was inconclusive due to insufficient sample sizes (Tables 6 and 7). All female northern pike captured were deemed to be mature.

Table 6. Proportion of mature northern pike in each age-class from gill nets during the 2004 stock assessment at Graham Lake, Alberta.

Age (y)	Males		Females	
	% mature	n	% mature	n
3	0	1	-	-
4	-	-	100	1
5	-	-	100	1
6	100	1	-	-
7	100	1	100	1
8	-	-	100	4
9	100	2	100	2
10	-	-	100	4
11	-	-	100	1
12	-	-	100	3
13	100	1	-	-
15	-	-	100	1
16	-	-	100	1

Table 7. Proportion of mature northern pike in each length-class from gill nets during the 2004 stock assessment at Graham Lake, Alberta.

Fork length (mm)	Males		Females	
	% mature	n	% mature	n
450	0	1	-	-
600	100	3	100	1
650	100	2	100	2
700	100	1	100	5
750	-	-	100	7
800	-	-	100	3
900	-	-	100	2

4.3 Lake whitefish

Lake whitefish accounted for 42.4% of the total catch (i.e., 269 individuals of the 635 fish captured). TCUE was 14.71 fish/100m^2/24h. Mean CPUE for depth intervals ranged from 12.38 to 17.46 fish/100m^2/24h with a whole-lake mean of 14.76 fish/100m^2/24h (Table 8).

Table 8. Mean catch-per-unit-effort (CPUE) of lake whitefish in gill nets during the 2004 stock assessment at Graham Lake, Alberta. n = number of nets.

Depth stratum (m)	CPUE (fish/100m²/24h)		n
	Mean	95% CI (±)	
0-5	13.54	6.16	3
5-10	12.38	10.69	3
>10	17.46	9.42	4
Whole-lake	14.76	4.91	10

Of the 265 lake whitefish sampled where sex could be determined, 64.5% were females and 35.5% were males, resulting in a female:male sex ratio of 1.82:1. Male and female walleye length distributions are shown in Figure 8. Length of males ranged from 252 to 526 mm FL with a mean of 439.6 ± 43.89 mm (n = 94), while that of females ranged from 260 to 581 mm with a mean of 450.3 ± 50.16 mm (n = 171).

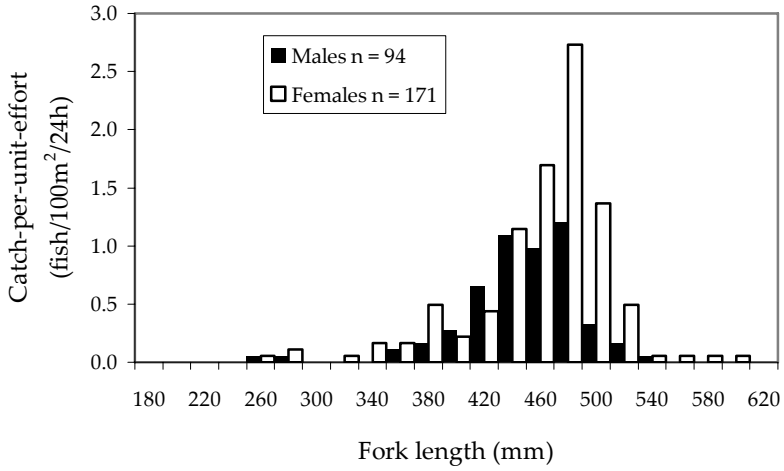

Figure 8. Length distributions of male and female lake whitefish captured in Graham Lake during the 2004 gill net survey.

Males ranged in age from 2 to 12 y with a mean of 8.1 ± 2.55 y (n = 59) while age of females ranged from 2 to 16 y with a mean of 9.16 ± 2.93 y (n = 68; Figure 9). The overall mean age of the catch was 8.7 ± 2.80 y (n = 127).

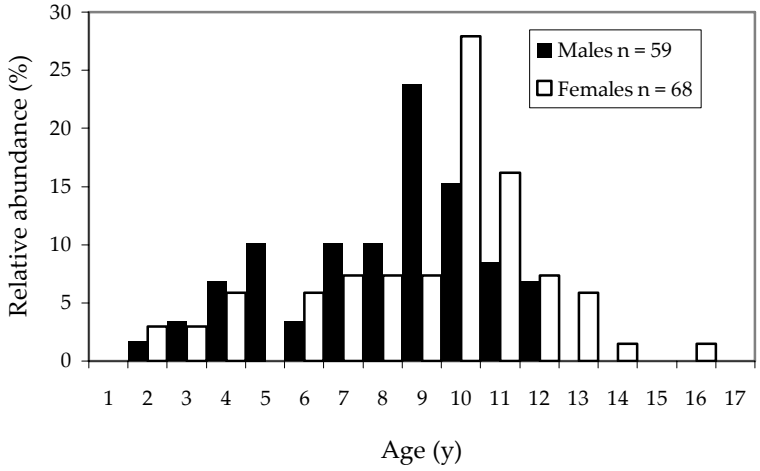

Figure 9. Age distributions of male and female lake whitefish captured in Graham Lake during the 2004 gill net survey. The y-axis could not be presented as catch-per-unit-effort as not all lake whitefish samples were aged. A stratified random sample design was used to select samples to be aged, samples were stratified by length.

When fitted to the von Bertalanffy growth function, male lake whitefish showed an L_∞ of 468.7 mm FL and a growth coefficient K of 0.414 (Figure 10). Females showed an L_∞ of 488.9 mm FL and a growth coefficient K of 0.321 (Figure 10) thereby growing to slightly larger sizes and at a slower rate than males.

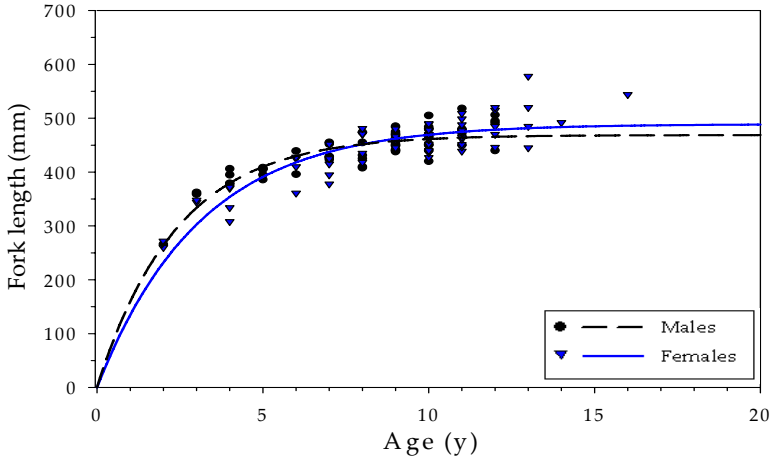

Figure 10. von Bertalanffy growth curve for male and female lake whitefish from Graham Lake, Alberta, 2004. von Bertalanffy growth parameters: a) Males: $L_\infty = 468.7$, K = 0.414, n = 59; b) Females: $L_\infty = 488.9$, K = 0.321, n = 68.

The proportion of mature lake whitefish in each age- and length-class is shown in Tables 9 and 10. The data show that females mature at ≥ 2 y and ≥ 450 mm FL while males appear to reach 50% maturity around 6 y and prior to reaching 400 mm FL.

Table 9. Proportion of mature lake whitefish in each age-class from gill nets during the 2004 stock assessment at Graham Lake, Alberta.

Age (y)	Males		Females	
	% mature	n	% mature	n
2	0	2	100	1
3	0	2	100	2
4	25	4	100	4
5	-	-	100	6
6	75	4	100	2
7	60	5	100	6
8	100	5	100	6
9	100	5	100	14
10	100	19	100	9
11	100	11	100	5
12	100	5	100	4
13	100	4	-	-
14	100	1	-	-
16	100	1	-	-

Table 10. Proportion of mature lake whitefish in each length-class from gill nets during the 2004 stock assessment at Graham Lake, Alberta.

Fork length (mm)	Males		Females	
	% mature	n	% mature	n
300	50	2	0	3
350	-	-	14.3	7
400	90	10	23.1	13
450	100	41	97.7	43
500	100	37	100	92
550	100	4	100	11
600	-	-	100	2

4.4 Yellow perch

Yellow perch accounted for 12.8% of the total catch (i.e., 81 individuals of the 635 fish captured). TCUE was 4.43 fish/100m²/24h. Mean CPUE for depth intervals ranged from 1.62 to 5.81 fish/100m²/24h with a whole-lake mean of 4.55 fish/100m²/24h (Table 11).

Table 11. Mean catch-per-unit-effort (CPUE) of yellow perch in gill nets during the 2004 stock assessment at Graham Lake, Alberta. n = number of nets.

Depth stratum (m)	CPUE (fish/100m²/24h)		n
	Mean	95% CI (±)	
0-5	1.62	3.18	3
5-10	5.8	3.06	3
>10	5.81	4.86	4
Whole-lake	4.55	2.45	10

Of the 79 yellow perch sampled where sex could be determined, 91.1% were females and 8.9% were males, resulting in a female:male sex ratio of 10.29:1. Male and female yellow perch length distributions are shown in Figure 11. Length of males ranged from 88 to 181 mm FL with a mean of 140.9 ± 29.00 mm (n = 7), while that of females ranged from 93 to 238 mm with a mean of 158.7 ± 18.67 mm (n = 72).

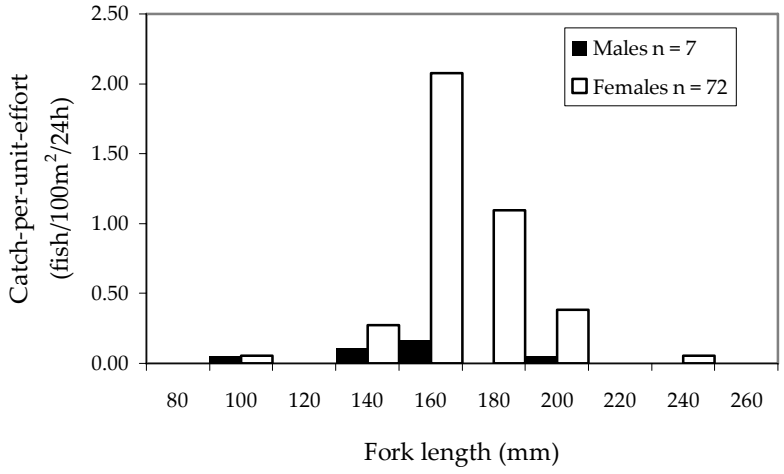

Figure 11. Length distributions of male and female yellow perch captured in Graham Lake during the 2004 gill net survey.

Males ranged in age from 2 to 4 y with a mean of 3.2 ± 0.75 y (n = 6) while age of females ranged from 2 to 7 y with a mean of 3.2 ± 0.65 y (n = 71; Figure 12). The overall mean age of the catch was 3.2 ± 0.64 y (n = 79).

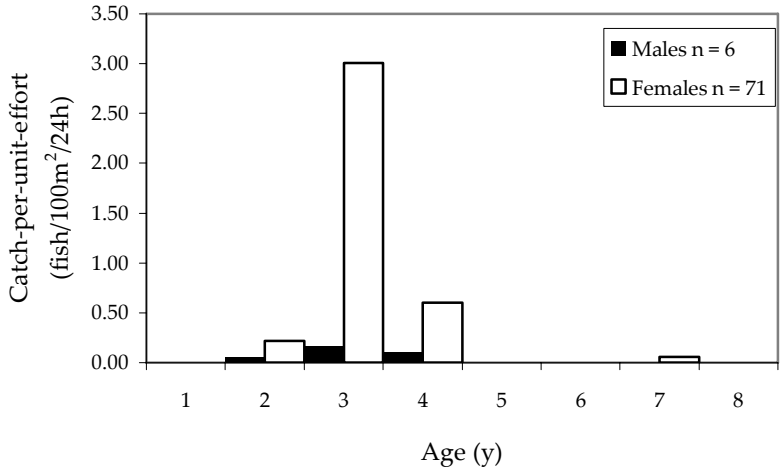

Figure 12. Age distributions of male and female yellow perch captured in Graham Lake during the 2004 gill net survey.

When fitted to the von Bertalanffy growth function, male yellow perch showed an L_∞ of 183.1 mm FL and a growth coefficient K of 0.559 (Figure 13). Females showed an L_∞ of 253.3 mm FL and a growth coefficient K of 0.317 (Figure 13) thereby, reaching larger sizes and at a slower rate than males. With only six observations for male yellow perch their growth equation must be interpreted with caution.

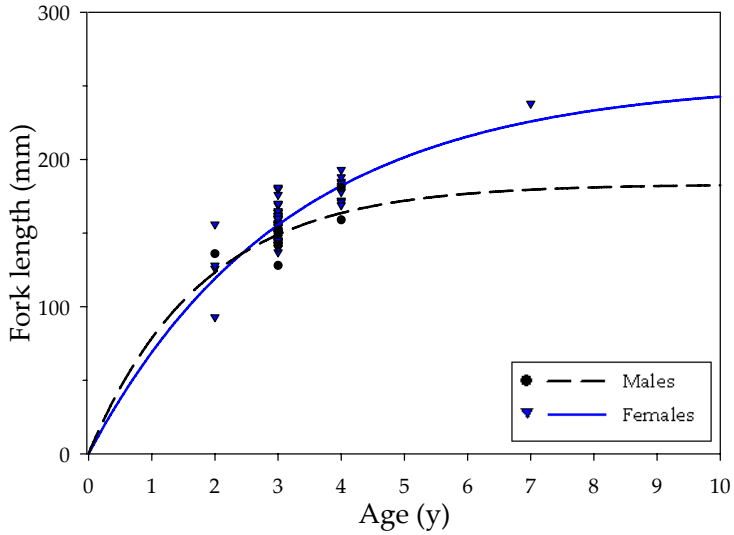

Figure 13. von Bertalanffy growth curve for male and female yellow perch from Graham Lake, Alberta, 2004. von Bertalanffy growth parameters: a) Males: $L_\infty = 183.1$, K = 0.559, n = 6; b) Females: $L_\infty = 253.3$, K = 0.317, n = 71.

The proportion of mature yellow perch in each age- and length-class is shown in Tables 12 and 13. The data show that females reach 50% maturity before 3 y and before they reach 150 mm FL. All males were mature.

Table 12. Proportion of mature yellow perch in each age-class from gill nets during the 2004 stock assessment at Graham Lake, Alberta.

Age (y)	Males		Females	
	% mature	n	% mature	n
2	100	1	50	4
3	100	3	100	55
4	100	2	90.9	11
7	-	-	100	1

Table 13. Proportion of mature yellow perch in each length-class from gill nets during the 2004 stock assessment at Graham Lake, Alberta.

Fork length (mm)	Males		Females	
	% mature	n	% mature	n
100	-	-	0.0	1
150	100	3	95.7	23
200	100	3	97.8	46
250	-	-	100.0	1

4.5 Summary

In Graham Lake, the walleye size distribution does not appear to be truncated at the minimum size limit (50 cm TL or 47.0 cm FL) for angler harvest. In deed, CPUE of fish greater than the 50-cm size limit does not appear to be substantially lower than that of the length classes below it. The size distribution also shows strong representation of fish of all sizes, suggesting that the walleye population at Graham Lake exhibits strong recruitment, as well as longevity.

Our data also suggest that the northern pike size distribution has not been truncated at the minimum size limit (i.e., 63 cm TL or 59.7 cm FL) for angler harvest. Catch-per-unit-effort of northern pike > 63 cm was also not lower than that for smaller fish. Although catch rates were low, the northern pike that were captured exhibited broad size and age distributions.

Improved access (upgraded and new roads) into lakes in the Red Earth area, including Graham Lake, in recent years has raised concern about the potential for increased angling pressure. The results of the present study provide important baseline information that can be used by resource managers to quantify the effects of anticipated increases in angling pressure on sport fish population in Graham Lake.

5.0 LITERATURE CITED

Mackay, W.C., G.R. Ash, and H.J. Norris. 1990. Fish ageing methods for Alberta. R.L. & L. Environmental Services Ltd. In association with Alberta Fish and Wildlife Division and University of Alberta, Edmonton, Alberta. 113 pp.

von Bertalanffy, L. 1938. A quantitative theory of organic growth. Human Biology, 10: 181-213.

6.0 APPENDIX

Appendix 1. Universal transverse mercator (UTM) coordinates (NAD 83, UTM zone 11) of gill net locations in Graham Lake, Alberta, 2004.

Depth stratum (m)	UTM Easting	UTM Northing
0-5	650182	6277938
	649845	6268288
	652815	6270854
5-10	652375	6265180
	650271	6271719
	653918	6273357
10-15	650538[a]	6268282[a]
	651382	6275841
	650867	6275969
	651696	6268063

[a]According to bathymetry coordinate falls within the 5-10 m interval, actual depth at this location was greater than 10 m.

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Alberta

Alberta Conservation Association