CREEL CENSUS OF KATHLEEN LAKE AND RIVER, HAINES JUNCTION, YUKON TERRITORY, 1990.

by
Clive Osborne

SR-91-1

Yukon
Renewable Resources

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1990 - 1991

ABSTRACT

Kathleen Lake is the largest lake within the Kluane Park reserve and provides a multiple use recreational area for Haines Junction residents and park visitors year round. Parks Canada and the Yukon Territorial Government conducted a creel census of Kathleen Lake and River in the summer of 1990 in order to provide baseline harvest and fish population information with which to initiate a management plan.

The target species appears to be lake trout for fishermen angling both the lake and the river. The estimated harvest this year for lake trout and arctic grayling from both river and the lake was 121 fish (139 kgms.) and 295 fish (113 kgms.) respectively. The catch per unit effort (number of fish per angling hour) and harvest per unit effort (number of fish retained per angling hour) for lake trout was slightly less for the river than the lake. The lake figures are substantially less (4-9 x) than data from the early 1980's indicating a decline in angling quality. Growth rates for both lake trout and arctic grayling appear to be slow while survival rates appear to be high for lake trout and moderate for arctic grayling. Both species show positive allometric growth (ie fish are heavy relative to their length) and are in good condition. Too few rainbow and kokanee were caught to make meaningful analyses of harvest rates and population parameters.

Lake trout harvest was 5% of the estimated maximum sustained yield during the summer. Inclement weather kept fishermen off the lake such that 1990 may have been an atypical year in terms of fishing effort. There is evidence to suggest that fishing effort during the spring ice fishing season on the lake is increasing. As the park develops and the community of Haines Junction grows, the recreational use and fishing pressure on the lake will increase. Maximum sustained yields were calculated for lake trout, arctic grayling, kokanee and round whitefish using test netting composition data and morphoedaphic and climatic indices. A harvest target level of 10% of the species specific maximum sustained yields is recommended to ensure a high quality fishery. This target level for lake trout is 216.53 kilograms (0.063 kilograms/ha.) or approximately 188 fish.

ACKNOWLEDGEMENTS

The author would like to express his appreciation to Michelle Sheppard who conducted the summer creel census and produced a thorough summary of the data. Thanks goes also to Lorne Larocque and Ray Breneman for providing background data. Advice on data analysis and editorial comments on the text were provided by Nick de Graff and Don Toews and were much appreciated. Also a thanks goes to Lori Simpson for her typing expertise on this report.

LIST OF TABLES

LIST OF FIGURES

List of Appendices

Appendix

1 INTRODUCTION

Kathleen Lake is located approximately 32 kilometers south of Haines Junction on the Haines Highway, a southern extension of the Alaska Highway. It is situated entirely within the borders of Kluane National Park and serves as a source to the Kathleen River and its chains of three shallow lakes. The Haines Highway, which serves as a border to the park, crosses the river as it exits the lake (Figure 1).

In recent years, with increasing public visitation to the park and greater use by local residents in the spring fishery, both the lake and the river are coming under heavy fishing pressure. Parks Canada entered into an agreement with the Fisheries Branch of the Department of Renewable Resources, Yukon Territorial Government in January 1991 for the joint management of the fish stocks of the Kathleen system. In anticipation of this agreement, the Fisheries Branch undertook a creel census study during the summer of 1990.

The objectives of this study were to 1.) determine the harvest of each species, 2.) determine the level of angling effort, 3.) determine relative angling quality in terms of catch per unit effort for each species, 4.) collect biological data from the catch to estimate the sustainable yields and evaluate fishing pressure. 5.) formulate future management strategies for the maintenance of a high quality fishery.

1.2 Description of the Study Area

The following description of the Kathleen River drainage has been taken from Wickstrom (1983). The Kathleen River is a tributary of the Alsek River drainage and drains into the Dezadeash River. The river has a two meter falls near its confluence with the Dezadeash River which serves as a barrier to upstream movements of fish from the lower drainage. Sockeye Lake (72.8 ha., 27.4 m. maximum depth, 17.3 m. mean depth) is the highest lake in the drainage. Louise Lake (490 ha., 76.5 m. maximum depth, 47.6 m mean depth.) follows Sockeye Lake which is, in turn, drained by Kathleen Lake. Kathleen is the largest lake within the Kluane Park Boundaries (3.376 ha., 111 m, maximum depth, 52.2 m. mean depth). The lake is roughly triangular in shape with a smaller western basin. The north eastern bay is shallow relative to the south shore and western basin (figure 2).

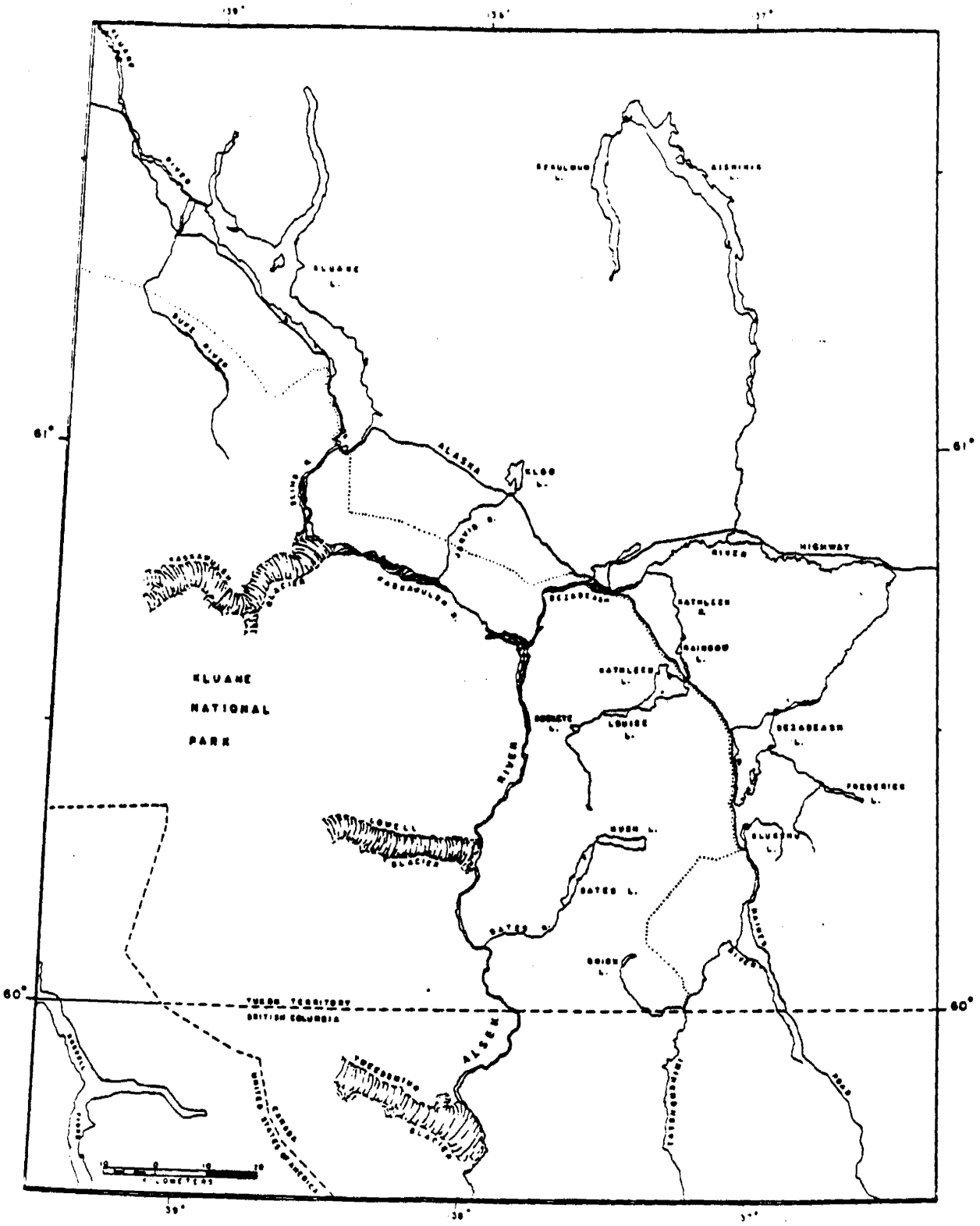
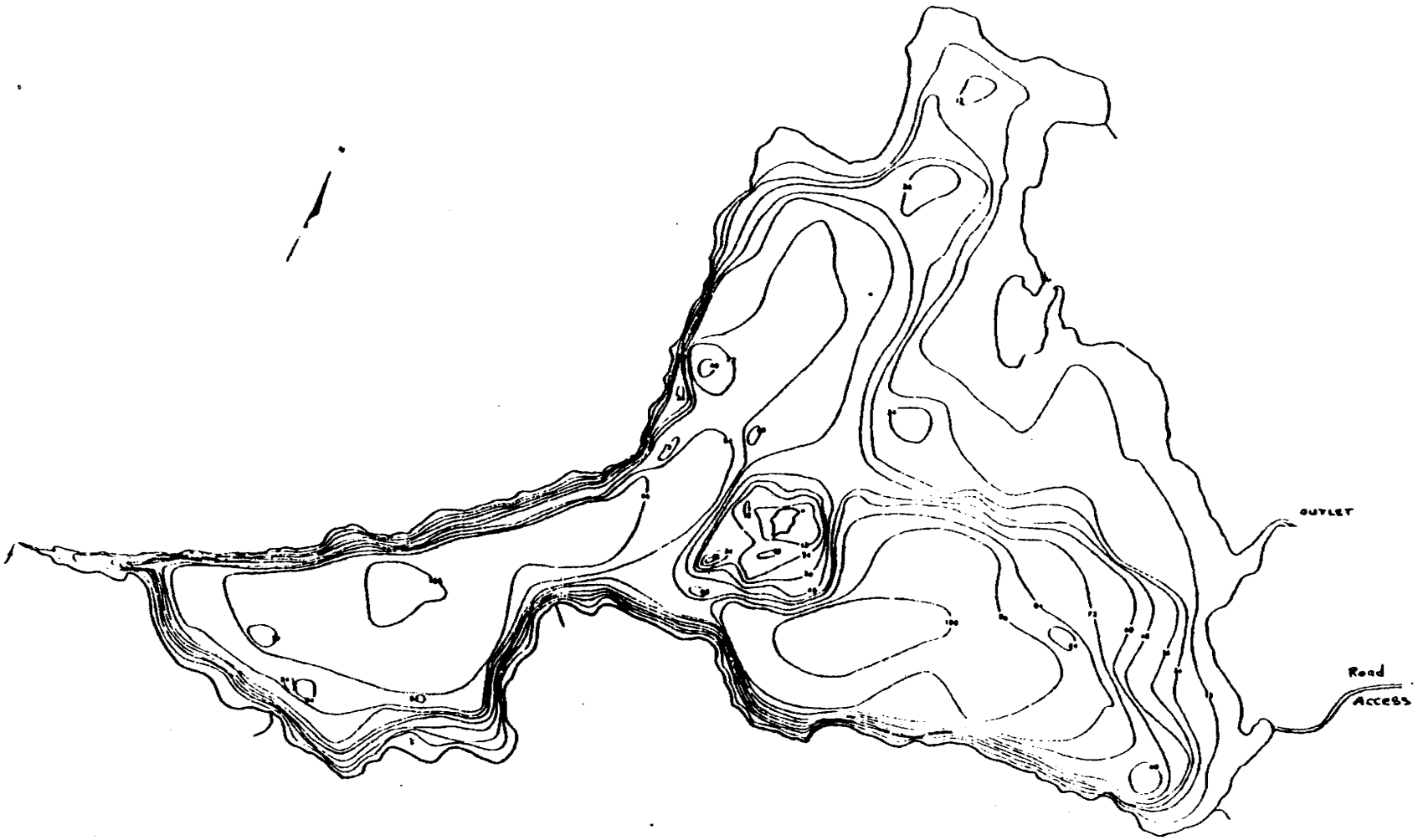


Figure 1 Location of Kathleen Lake
Taken from Wickstrom, 1983.



KATHLEEN LAKE

Taken from Wickstrom, 1983

Kathleen Lake (60 degrees 35´ N 137 degrees 18´ W), at an elevation of 731m., has freeze-up occurring at mid to late December. This exceptional late freeze-up is a consequence of thorough vertical mixing of the water column caused by incessant katabatic winds generated by the nearby Lowell Glacier, 40 km, to the west. Break-up is more normal for a lake of this altitude occurring in late May and early June. As may be expected for a lake of this altitude, mean depth and location, Kathleen Lake has high dissolved oxygen and low specific conductivity levels relative to other lakes in the park (Wickstrom 1978).

Kathleen Lake is drained by the Kathleen River (figure 3) with its chain of small, narrow, warm, shallow, productive lakes. (Lower Kathleen, Rainbow, and Crescent lakes).

A single road from the Haines Highway provides access to the lake and to day use and longer term camping areas along the shore. Approximately 10 small cottages, mostly owned by local residents, are located on the west shore serviced by the road. Kathleen River is reached directly from the Haines Highway where it crosses the river. The day use area and boat landing at the highway bridge were the sites where most of the angler interviews were conducted for the lake and river respectively.

1.3 The Fishery

Kathleen Lake provides a lake trout (Salvelinus namaycush), Kokanee (Oncorhynchus nerka), rainbow trout (Oncorhynchus mykiss) and arctic grayling (Thymallus arcticus) sport fishery. Kokanee are taken most often in the spring while lake trout are caught later in the season. Lake trout are suspected to make a biannual movement between Kathleen lake and the lower river / Lower Kathleen lake. Round Whitefish (Prosopium cylindricum) are abundant in the lake but are rarely taken by anglers (Wickstrom 1983). Burbot (Lota lota) and Pygmy Whitefish (Prosopium coulteri) have been caught in test netting but occur in low numbers. This year´s creel census reveals that 80% of the anglers were trolling from boats while the remainder were fishing from shore (Sheppard, 1990.) There is increasing evidence that in recent years there has been a significant increase in angling effort during late winter ice fishing season. No study of this fishery has been conducted to date.

Arctic grayling, lake trout, rainbow trout and round whitefish are taken in the Kathleen River. Sixty three percent of the fishermen interviewed in this year´s creel census were angling while 34% were fly fishing (Sheppard, 1990). Although, there is

road access to Rainbow Lake, most of the fishing effort on the Kathleen River takes place from shore between Kathleen Lake and Lower Kathleen Lake.

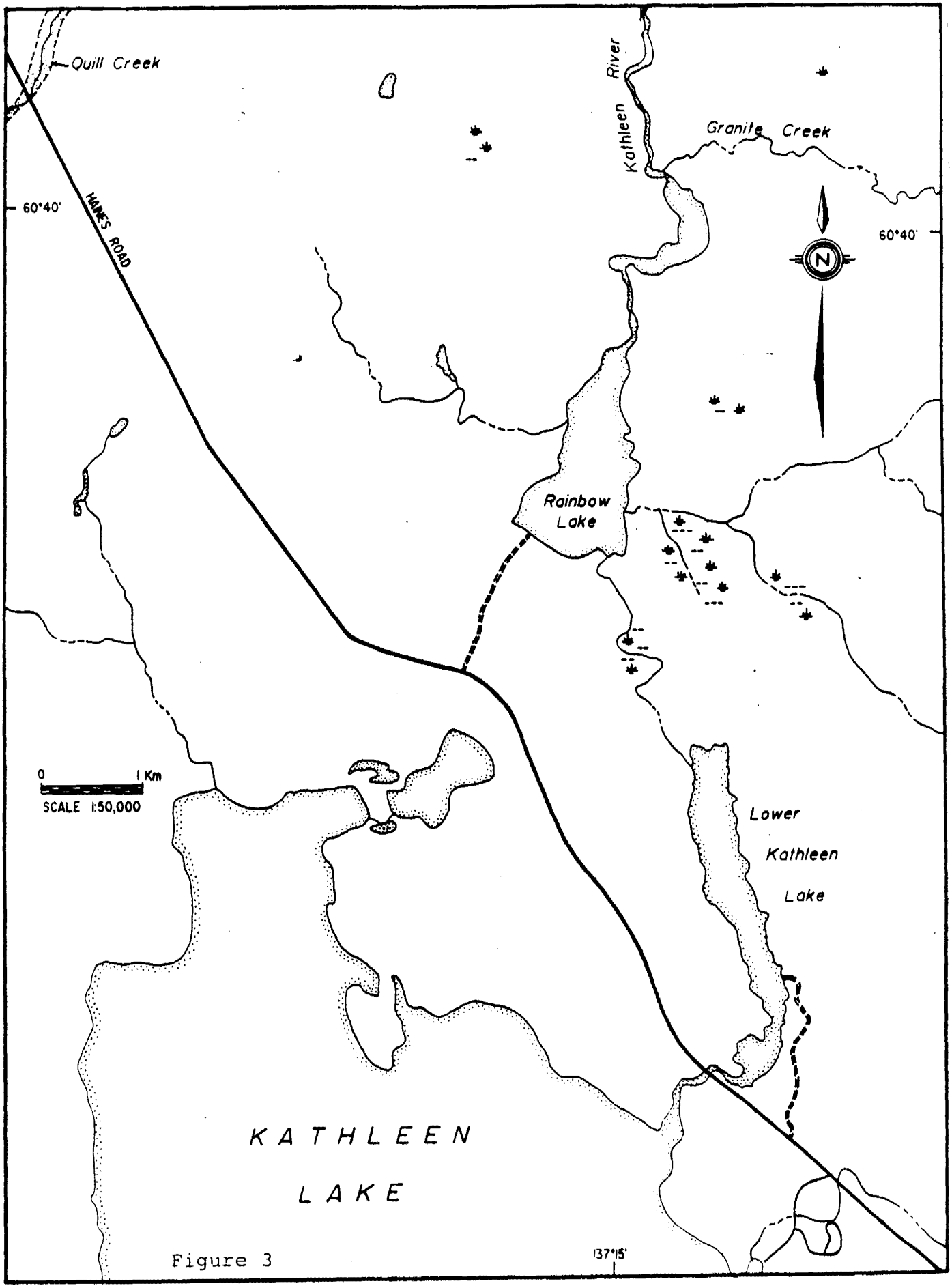

Quill Creek
Kathleen River
Granite Creek
60°40'
HAINES ROAD
60°40'
N
Rainbow Lake
0 1 Km
SCALE 1:50,000
Lower Kathleen Lake
KATHLEEN LAKE
137°15'

Figure 3

2 MATERIALS AND METHODS

2.1 Creel Census

Catch per unit effort (CUE), harvest per unit effort (HUE) and biological data were collected by stationary lake and stream side angler sampling where all anglers were interviewed upon completion of the days fishing. If anglers were agreeable, otoliths were taken for age determination, stomach contents were sampled, sexual maturity was determined and length (fork) and weight measurements were made from all fish retained.

The following information was requested from each angler party:

1. Number of anglers in the party.
2. Country of Origin if not a Yukon resident.
3. Method of fishing and number of rods used.
4. Number of hours spent fishing.
5. Number of fish caught and released or consumed during shore lunch.

Harvest and total effort estimates were determined using a stratified random sample design. The sample unit was the day and an attempt was made to intercept all anglers that fished that day. It was suspected that there would be a significant difference in fishing effort and harvest between week-end day or week day stratum which were sampled at 50% and 30% respectively. As the census progressed into September, it became evident that fishing effort on the Kathleen River was increasing substantially so sampling effort was increased accordingly. Upon analysis, the Kathleen River data was separated into another 2 strata, September week-end days and September week days.

2.2 Biological Sampling

Fish sampled were measured for fork length (+/-0.1 mm), girth (+/-1mm.), interorbital distance (+/-0.1mm) and weight (+/-10 gyms.) The gonads were examined for sex and maturity. Gonadal maturation was assessed according to the following categories:

Immature - no gonad development

Maturing - gonads developing but filling less than 2/3 of body cavity

Mature - gonads filling greater than 2/3 of the body cavity

Ripe - gonads filling body cavity, milt or eggs free in body cavity, eggs completely round, testes white, fish in spawning condition

Spent - gonads collapsed and flaccid

Otoliths were taken and cut into thin sections and annuli were counted under a microscope at 10 x. Stomach contents were also examined cursorily for invertebrate or fish content.

2.3 Analyses

An estimate of angling effort and the number of fish by species caught and of the number of fish retained (harvest) was derived by the following formula for a stratified random estimate.

$$\hat{Y} = \Sigma(N_{(i)} \hat{\bar{Y}}_{(i)})$$

Where Y = estimate

$N_{(i)}$ = Total number of sample units in stratum i

$\hat{\bar{Y}}_{(i)} = \bar{y}_{(i)}$ = (stratum sample mean)

and the formula for the variance estimator

$$V(Y) = \Sigma(N^2_{(i)} N \, V(\hat{\bar{Y}}_{(i)})$$

Where V = the variance of the estimate

and $V(\hat{\bar{Y}})_{(i)} = S^2_{(i)}$ = stratum sample variance

As catch per unit effort data follows a poisson distribution the V(Est. (Y) was not calculated and poisson confidence intervals were calculated by the formula (Ricker 1975)

$$C.L.= Y = 1.92 +/- 1.96\sqrt{(Y + 1)}$$

Age - Frequency distributions were constructed for both sexes separately and combined for arctic grayling and for combined sexes only for lake trout. The mean age of maturity was calculated using Abrasov's Estimate (Abrasov, 1967) from age specific maturity schedules.

Mean length / age data was also fitted to the Von Bertalanffy expression with modifications proposed by the Population Dynamics Working Group of the Ministry of Natural Resources, Province of Ontario (1990). The asymptotic size was determined empirically using the mean of largest 5% of the sample. The expression -ln (1 - L(t) / L(max.) was regressed against age and the slope of the line was forced through the origin to counter the bias in the youngest age classes. The slope of the regression yields an estimate of K'; the growth coefficient. Regressions were run on ages 4-7 for females, on ages 4-8 for males and ages 4-8 for combined sexes for arctic grayling and on two segments for lake trout combined sexes, ages 6-9 and 9-14.

Mortality and survival rates were determined by regressing the logarithm of the numbers of fish in each age class against age from the most abundant age class to the oldest age class (descending limb of the frequency distribution). The slope of the regression is an estimate of the Instanteneous Rate of Mortality (Everhart and Youngs, 1981). All older age classes were used in the calculations for arctic grayling while age classes greater than 14 were eliminated from the lake trout calculation because of small numbers in each class. Survival (S) and annual mortality (A) rates were determined according to the following relationships:

$$Z = -\ln (S)$$
$$S = 1 - A$$

Survival and mortality rates were also calculated using the Robson - Chapman method (Everhart and Youngs, 1975).

An estimate of the maximum sustained yield for Kathleen Lake was determined using an estimate of Ryder's morphoedaphic index (MEI) of 3.11 (Wickstrom, 1983). combined with a climatic index using mean annual air temperature. The equation used for MSY estiamte is:

$$\log (10)MSY + 0.050\ TEMP + 0.280 \log (10)MEI + 0.236$$

and was taken from Schlesinger and Regier (1982). The value used for TEMP in the equation was -3.2, the mean annual temperature over a thirty year period (Environment Canada, 1982). Temperature was found to account for 74% of the total variability of MSY from intensively fished lakes and 62% from moderately fished lakes while the MEI accounted for from 7 to 9 percent of the variability.

3 RESULTS

3.1 Angler Interviews and Effort

The following information has been taken from Sheppard, (1990). A total of 283 fishermen fishing the Kathleen River were interviewed. The majority of the fishermen were from the Yukon (51%). The remaining fishermen were American (24%), out of territory Canadians (18%) and others (7%) (mainly Swiss). A total of 45 fishermen fishing Kathleen Lake were interviewed. Of these, 80% were from the Yukon, mostly from Haines Junction. The remainder were out of territory Canadians (13%) and Americans (7%).

Angling Effort

Table 1 shows the distribution of catch and harvest by species. Estimates of the total number of anglers and the total number of hours fished over the census period is presented in Table 2. A total of 160 rod hours were fished on Kathleen Lake by 45 fishermen over the census period. Ninety percent of the rod hours fished by 87% of the anglers occurred on weekend days.

A total of 596.75 hours were fished on Kathleen River by 283 fishermen. Angling effort peaked during the period August 20 to September 25 with 79% of all anglers for the season expending 81% of the total rod hours. During the period September 1 - 25, 58.7% of rod hours fished took place on weekend days compared with 75.8% for the period June 1 - Aug. 31.

TABLE I

SUMMARY OF INTERVIEW CATCH, HARVEST AND CATCH/EFFORT DATA FROM THE CREEL CENSUS ON KATHLEEN LAKE AND KATHLEEN RIVER, SUMMER, 1990

Species	Catch	Harvest	Catch/Unit Effort	Harvest/Unit Effort
Kathleen Lake				
Arctic Grayling	45	4	0.28	0.02
Lake Trout	30	18	0.19	0.11
Kokanee	6	6	0.04	0.04
Rainbow Trout	4	1	0.03	0.01
Total	**85**	**28**	**0.54**	**0.18**
Total Rod Hours Fished = 160				
Kathleen River				
Arctic Grayling	904	154	1.52	0.26
Lake Trout	90	52	0.15	0.09
Rainbow Trout	4	1	0.03	0.01
Round Whitefish	6	5	0.01	0.01
Unknown	2	0	0.003	0
Total	**1065**	**222**	**1.79**	**0.38**
Total Rod Hours Fished = 596.25				

TABLE 2 STRATIFIED RANDOM ESTIMATE OF NUMBER OF ANGLERS AND ANGLING EFFORT (ANGLER HOURS) FOR KATHLEEN LAKE AND RIVER BASED ON SUMMER CREEL CENSUS, 1990

ORIGIN	TOTAL ANGLER DAYS	TOTAL ANGLER HOURS	HRS. FISHED/ ANGLER DAY
Kathleen Lake			
Yukon	36	129	3.6
Canadian	6	15	2.5
U.S.A.	3	16	5.3
Other	0	0	0
Sample	Total 45	Total 160	Mean 3.6
Estimate	Total 131	Total 468	Mean 3.6
Confidence Interval	(111-156)	(427-513)	
Kathleen River			
Yukon	144	305.75	2.1
Canadian	68	154.75	2.3
U.S.A.	51	105.75	2.1
Other	20	.30	1.5
Sample	Total 283	Total 596.25	Mean 2.1
Estimate	Total 562	Total 1071.40	Mean 1.0
Confidence Interval	(517-611)	(1020-1126)	

3.2 Catch and Harvest

A summary of the estimates of fish caught and harvested by anglers over the summer creel period is presented in Table 3. Estimated total harvest by weight are summarized in Table 4 and further analyzed by stratum in Appendix 1. The sample size for all species sampled from Kathleen Lake is not large enough to make any statistical inference regarding a difference in catch between the two strata (weekend days vs. week days). However, the sample size for the Kathleen River was adequate and differences between strata were tested using a non parametric X^2 (Chi Squared) test. Both the catch and the harvest for September (strata 3 & 4) were significantly higher than for June - August (strata 1 & 2) for both lake trout and arctic grayling ($p=0.5$, $df=3$, one-tailed test) but not significantly different for rainbow trout. For arctic grayling, the catch, but not the harvest, was significantly higher for weekends strata (1 & 3) than for weekdays strata (2 & 4). For lake trout and rainbow trout, both the catch and the harvest were significantly higher for weekend days.

3.3 Biological Data

The biological data detailing age, fork length, weight, sex, maturity and condition for all fish sampled during the creel census is presented in Appendix 2. This data is summarized into age specific mean length, weight, condition factor and frequency in Tables 5. Biological characters of fish caught by anglers are summarized in Table 6.

Mean length and mean weight were plotted against age for lake trout and arctic grayling in Figure 4. Age - Frequency distributions for both species are presented in Figure 5. Length - Frequency distributions for lake trout, both sexes combined, are presented in Figure 6 and for arctic grayling, both sexes combined in Figure 7 and females and males in Figure 8.

Age of arctic grayling averaged 3.7 years and ranged from 1 to 8 for males and 1 to 7 years for females. Lake trout age averaged 13.2 years and ranged from 6 - 28 for both sexes combined. The mean length and weight for arctic grayling in the sample was 319 mm. (12.6 inc.) and 384 grams (0.8 lbs) and for lake trout the mean length and weight was 444 mm. (17.5 in.) and 1153 gms. (2.54 lbs.).

TABLE. 3 ESTIMATED TOTAL CATCH AND HARVEST FOR KATHLEEN LAKE AND KATHLEEN RIVER BASED ON SUMMER CREEL CENSUS, 1990

Species	Total Number of Fish Caught	95% Confidence Interval (Poisson)	% Frequency	Total Number of Fish Retained	95% Confidence Interval (Poisson)	% Frequency
Kathleen Lake						
Arctic Grayling	108.9	(90.1-131.2)	51	9.8	(5.2-18.1)	15
Lake Trout	89.6	(72.8-110.2)	42	52.7	(40.2-68.9)	80
Rainbow Trout	13.1	(7.7-22.4)	6	3.3	(1.2-9.3)	5
Total	211.6	(184.9-242.1)	100	65.8	(51.7-83.7)	100
Kathleen River						
Arctic Grayling	1733.3	(1653.6-1816.8)	86	284.6	(253.4-319.6)	77
Lake Trout	121.6	(101.8-145.2)	6	68	(53.6-86.2)	18
Rainbow Trout	165.5	(142.1-192.7)	8	18.8	(10.1-26.5)	5
Total	2020.7	(1930.7-2110.7)	100	371.4	335.50-411.4)	100

TABLE 4 ESTIMATED TOTAL HARVEST BY WEIGHT FOR KATHLEEN LAKE AND KATHLEEN RIVER BASED ON SUMMER CREEL CENSUS, 1990.

Species	Total Weight (kgs) of Fish Retained	95% Confidence Interval	% Frequency
Kathleen Lake			
Arctic Grayling	3.62	(1.92-6.69)	6.6
Lake Trout	50.96	(38.87)-66.62)	93.4
Rainbow Trout	---	---	---
Total	**54.58**	**(49.03-63.97)**	**100.0**
Kathleen River			
Arctic Grayling	105.27	(93.72-118.21)	59.3
Lake Trout	65.75	(51.83-83.35)	37.0
Rainbow Trout	6.49	(3.48- 9.97)	3.7
Total	**177.51**	**(153.24-205.62)**	**100.0**

FW5/DT3/Est1
91 07 09

ABLE 5 LAKE TROUT & ARCTIC GRAYLING AGE SPECIFIC MEAN LENGTHS, WEIGHTS AND CONDITION FACTOR-KATHLEEN LAKE/RIVER CREEL CENSUS-1990

SPECIES	AGE	NUMBER	FREQUENCY %	MEAN LENGTH	MEAN WEIGHT	MEAN CONDITION FACTOR
LAKE TROUT						
	6	4	6	386	675	1.13
	7	3	5	425	800	1.21
	8	4	6	413	858	1.18
	9	9	15	402	763	1.15
	10	8	13	410	775	1.10
	11	3	5	419	841	1.13
	12	4	6	456	1046	1.06
	13	4	6	425	950	1.21
	14	5	8	442	971	1.12
	15	1	2	365	525	1.08
	16	4	6	439	941	1.10
	19	1	2	400	675	1.05
	20	2	3	436	1000	1.22
	21	3	5	457	1025	1.07
	22	1	2	594	3150	1.50
	24	1	2	458	1000	1.04
	25	2	3	607	3660	1.32
	26	1	2	490	1400	1.19
	28	2	3	426	862	1.12
	TOTAL	**62**	**100**			
	MEAN			**445**	**1154**	**1.16**
ARCTIC GRAYLING						
	1	4	3	265	172	0.94
	2	24	16	295	295	1.05
	3	45	29	299	282	1.01
	4	40	26	321	368	1.03
	5	25	16	322	377	1.05
	6	10	7	341	534	1.08
	7	5	3	393	658	1.00
	TOTAL	**153**	**100**			
	MEAN			**319**	**384**	**1.02**

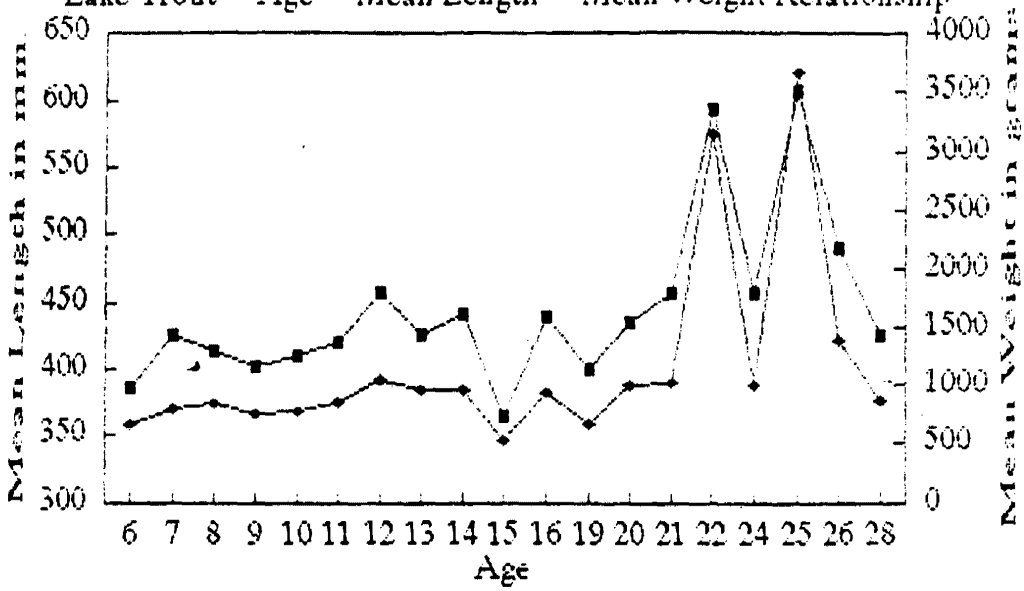
FW5/MI1/AG1
91 09 13

TABLE 6 SUMMARY OF BIOLOGICAL CHARACTERISTICS OF FISH CAUGHT IN THE CREEL CENSUS

Species	Mean Age of Catch	Fk.	Mean Length (mm)	Mean Weight (gms)	Mean Age of Maturity	N
A. Grayling	3.7		319.39	383.77	3.0	62
Lake Trout	13.2		444.85	1153.68	7.7	153
Rainbow Trout	3.5		299.75	345.00		8
Kokanee	4.0		309.71	450.00		7

Fig. 4 Kathleen Lake Creel Census – 1990

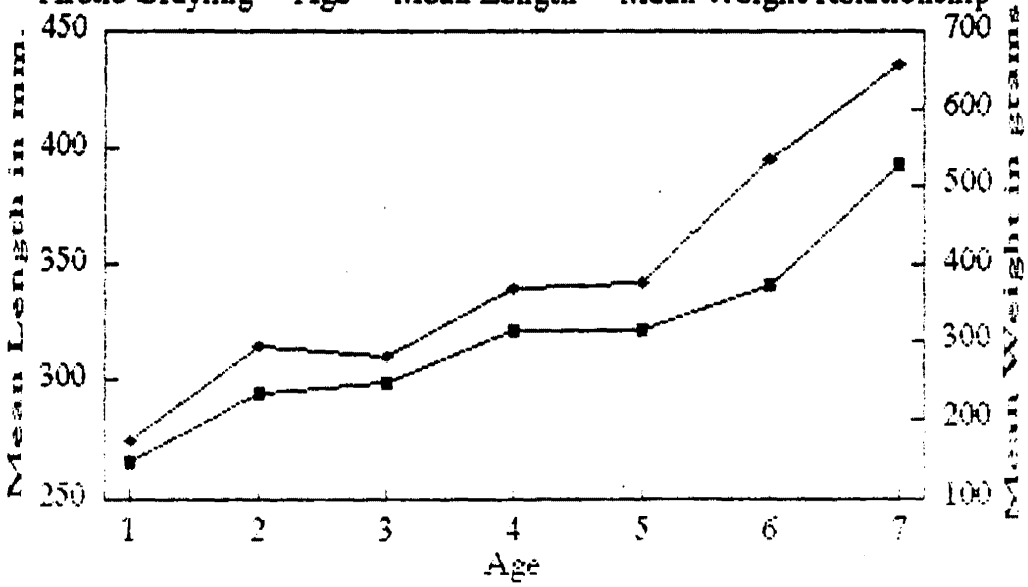
Lake Trout – Age – Mean Length – Mean Weight Relationship



N = 60

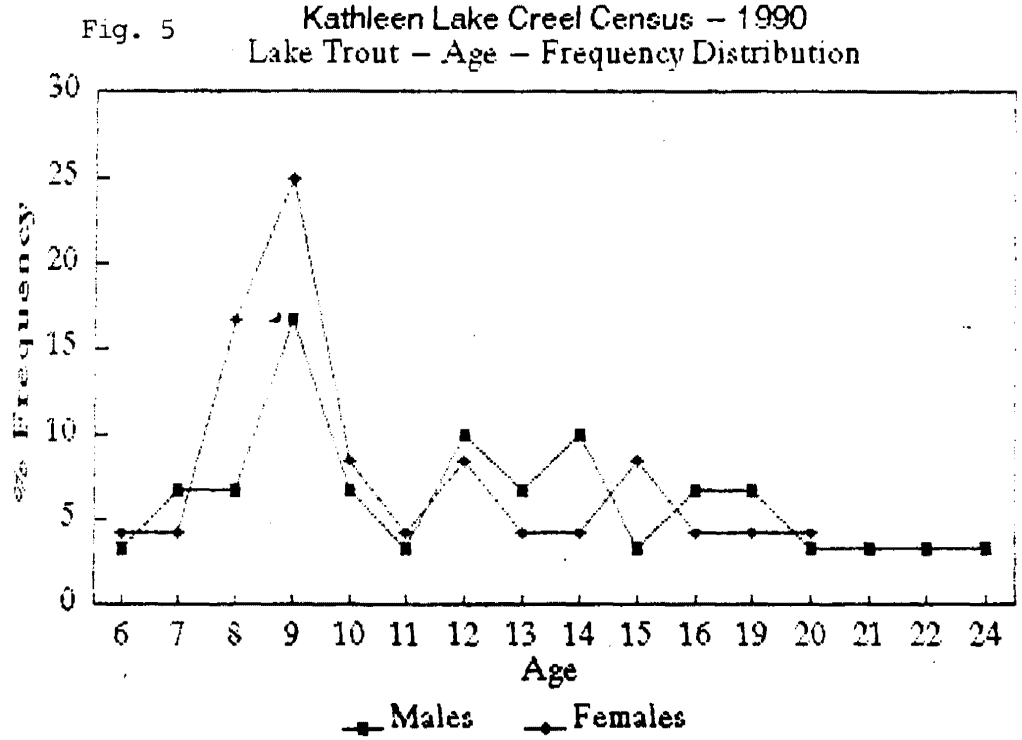
Kathleen Lake Creel Census – 1990

Arctic Grayling – Age – Mean Length – Mean Weight Relationship



N = 143

Fig. 5



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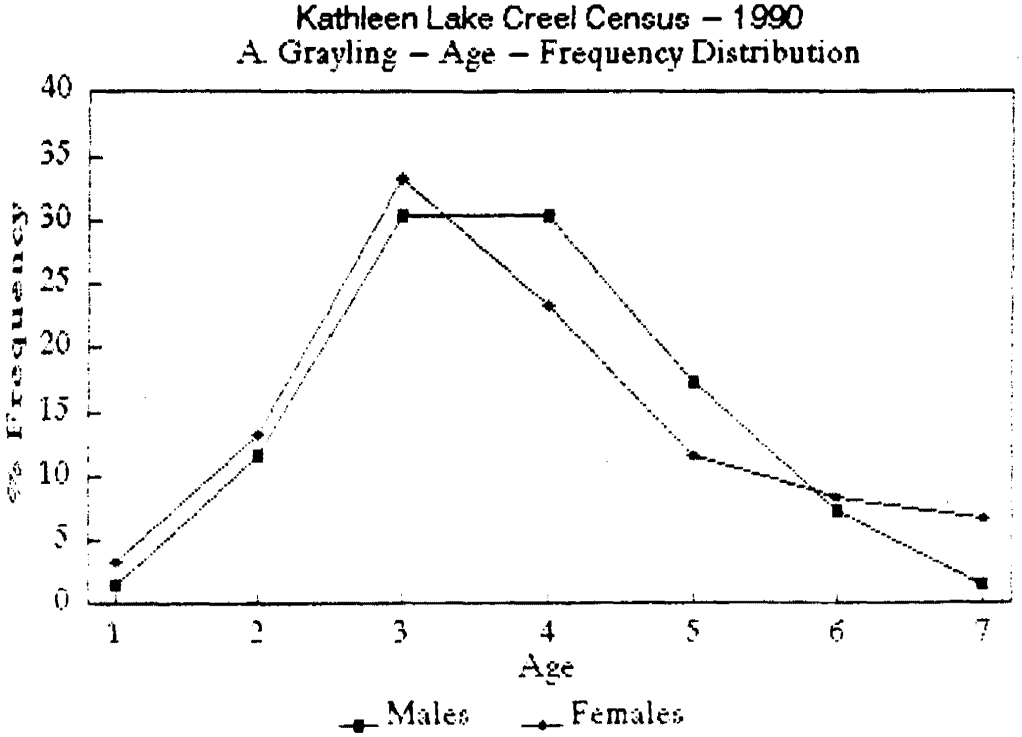
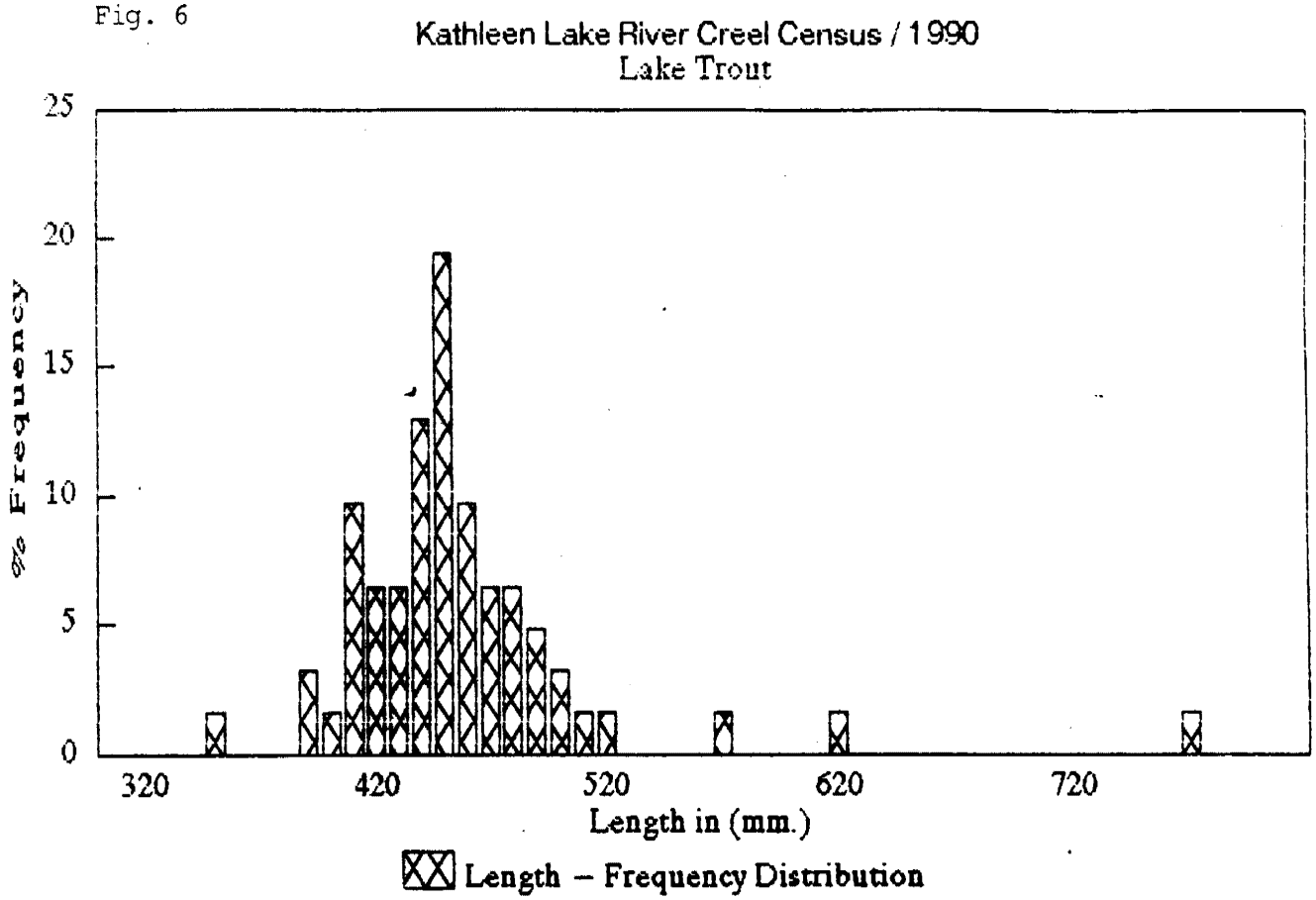


N = 143

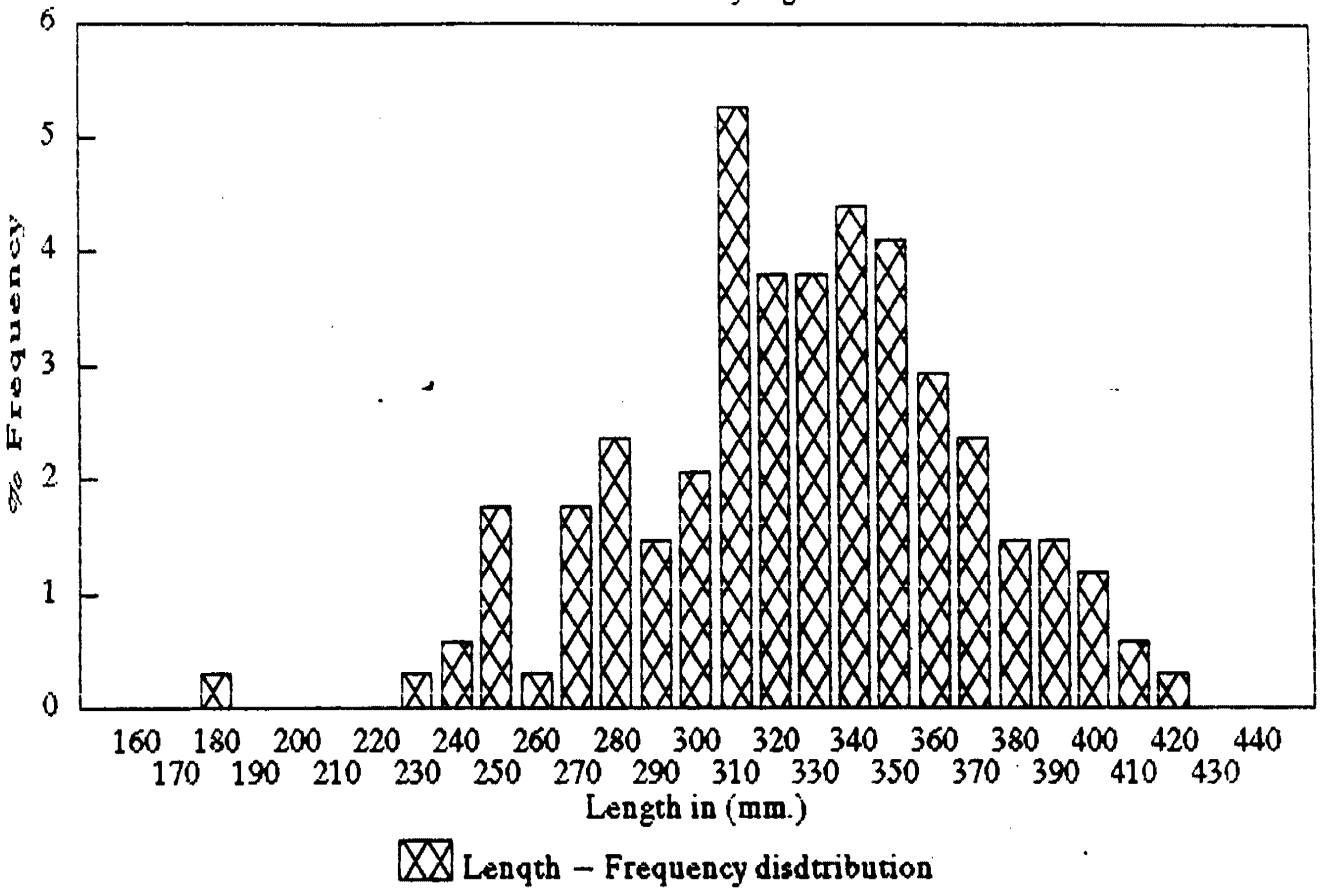
Fig. 6


Kathleen Lake River Creel Census / 1990
Lake Trout
25
20
15
10
5
0
% Frequency
320
420
520
620
720
Length in (mm.)
Length – Frequency Distribution

N = 60

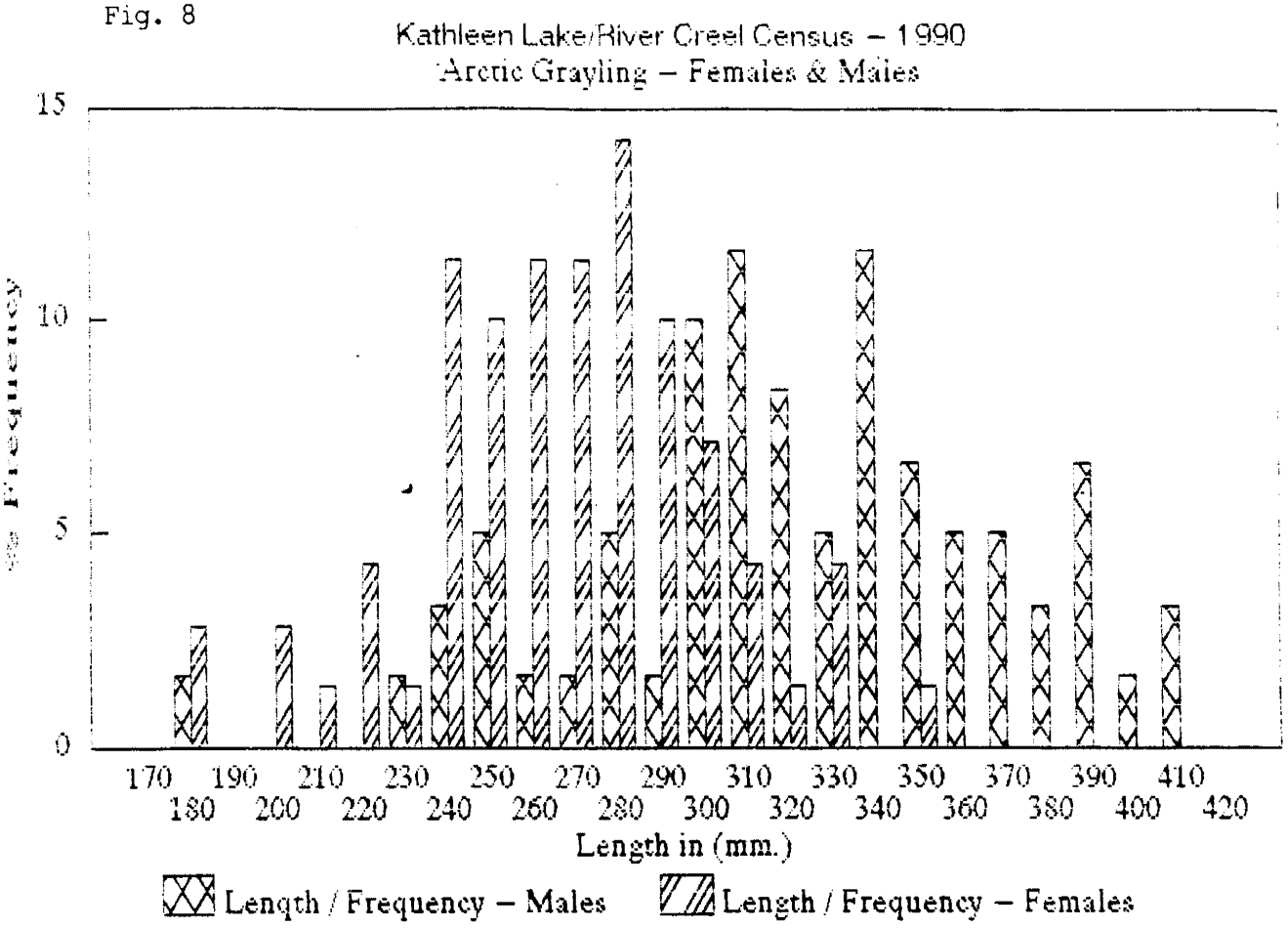
Fig. 7

Kathleen Lake/River Creel Census – 1990
Arctic Grayling



N = 143

Fig. 8



N (M.) = 70
N (F.) = 60

Age and Growth

The length-weight regression showed positive allometric growth for lake trout and for arctic grayling (Table 7). The length - weight coefficient is unusually high for lake trout females. This may be a function of the fall pre - spawning conditions of which many of the lake trout sampled were taken.

The results of the exponential and Von Bertalanffy growth regressions for lake trout and arctic grayling are presented in Table 9. Both regressions revealed very slow growth for arctic grayling. It is thought that age may be consistently underestimated which contributes to the slow growth indicated by the regression. Another contributing factor may be the under - representation of younger age classes in the harvest. Arctic grayling are known to be territorial with the largest and strongest fish occupying the most advantageous positions at the head of pools (Morrow, 1980). These fish would be targeted by anglers and sampled in the creel survey.

Growth was very slow for lake trout using both regressions. The exponential growth curve has a very low correlation coefficient (0.3295) indicating a poor fit due to small sample size. The Von Bertalanffy relationship is thought to more accurately reflect the true growth rate and is generally regarded as a better fit of growth in fish. The Von Bertalanffy growth coefficient for lake trout is very low compared to figures for Ontario using the same age analysis.

Mortality and Survival Rates

Mortality and survival rates determined by both the exponential and Robson - Chapman methods are presented in Table 10. The differences in mortality and survival appear to be consistent for both lake trout and arctic grayling. As these estimates are likely to be overestimates of mortality (Gaboury, 1982), the regression estimate is considered closer to reality for lake trout. It would appear that survival for lake trout is quite high while it is moderately high for arctic grayling.

TABLE 7 LENGTH (mm) - Weight (gm) RELATIONSHIPS OF LAKE TROUT AND ARCTIC GRAYLING FROM KATHLEEN LAKE AND RIVER

Species	Sex	Equation	N	Correlation Coefficient (r^2)
Lake Trout	F	$Weight = 1.30 \times 10^{-6}\ length^{3.743}$	26	0.9174
	M	$Weight = 2.91 \times 10^{-6}\ length^{3.222}$	30	0.9278
	Combined	$Weight = 1.45 \times 10^{-6}\ length^{3.339}$	60	0.9164
A. Grayling	F	$Weight = 3.89 \times 10^{-6}\ length^{3.163}$	60	0.9500
	M	$Weight = 8.71 \times 10^{-7}\ length^{3.428}$	70	0.8400
	Combined	$Weight = 3.63 \times 10^{-6}\ length^{3.178}$	142	0.9000

TABLE 8 EXPONENTIAL AND VON BERTELANFFY GROWTH CURVES OF LAKE TROUT AND ARCTIC GRAYLING FROM KATHLEEN LAKE RIVER

		EXPONENTIAL			VON BERTALANFFY				
Species	Sex	Length=a*age ^{b}	Correlation Coefficient (r^2)	N	L(max)	Growth Efficient K'	Age Range	Correlation Coefficient (r^2)	N
Arctic Grayling	Male	$Y = 261.769\ X^{0.0247}$	0.832	68	404	0.4738	4-8	0.9393	36
	Female	$Y = 259.429\ X^{0.0247}$	0.8911	59	400.33	0.4409	4-7	0.6175	26
	Combined Sexes	$Y = 254.430\ X^{0.0239}$	0.9223	127	402.33	0.4478	4-8	0.6624	61
Lake Trout	Combined Sexes	$Y = 371.966\ X^{0.0046}$	0.3295	60	626	0.1373 0.0983	6-9 9-14	-4.433 -0.612	20 33

FW5/LS1/EVB1
91 09 13

TABLE 9 MORTALITY AND SURVIVAL RATES ESTIMATED BY REGRESSION AND THE ROBSON - CHAPMAN METHOD

Species	Robson - Chapman				Regression			
	Z	A	S	Confidence Limits	Z	Correlation Coefficient	A	S
Lake Trout	0.1824	0.1667	0.8333	+/-0.040	0.0382	r^2=0.5081	0.0374	0.9625
A. Grayling	0.6343	0.4697	0.5303	+/-0.3464	0.2511	r^2=0.9373	0.222	0.778

* Limits on Est. S = 2 x Standard Error

Sex and Maturity

Maturity schedules for both arctic grayling and lake trout are presented in Appendix 3.

Kathleen River arctic grayling began to mature at age 2 for both sexes. Ninety two percent of the females compared to 85.7% of the males were mature at age 4. The mean age of maturity was 3.0 years. It has been found that fish respond to fishing pressure by maturing at younger ages and smaller lengths. Arctic grayling appear to be maturing at their smallest possible size.

The age class strength of lake trout from both the lake and river was too variable to make any conclusions except to state that 100% were mature at 8 years for females and at 11 years for males. The mean age of maturity for both sexes was 7.7 years.

The sex ratio of the sampled fish was 0.86 females to 1 male for arctic grayling and 0.90 females to 1 male for lake trout.

4 DISCUSSION

4.1 Catch per Unit Effort

The 1990 creel census shows a marked decrease in the number of anglers counted fishing Kathleen Lake compared to 1980 and 1981. In 1990, there were 45 fishermen counted, in 1980 there were 1056 counted from May 26 - August 10, and in 1981 there were 1143 fishermen counted from May 16 - September 10 (Wickstrom, 1982). The low number of anglers may be attributed to adverse weather conditions prevalent in the 1990 season where fishermen were not observed on the lake for 99% of the creeled days (Sheppard, 1990).

Wickstrom (1982) reported catch per unit effort (rod-hour) statistics for his 1980 - 81 creel censuses. These numbers are compared with the current study in the following table:

TABLE 10 COMPARISON OF CATCH PER UNIT EFFORT (NUMBER OF FISH CAUGHT PER ROD/HOUR)

	1980	1981	1990
LAKE TROUT	0.10	0.18	0.19
A. GRAYLING	0.12	0.07	0.28
RAINBOW TROUT	0.008	0.005	0.09
KOKANEE	0.061	0.135	0.037

The catch per unit effort does not appear to differ significantly among the census years.

The mean catch per unit effort (CUE) of 0.16 for lake trout for the three years may be compared with data collected for other lakes in the Yukon. Horler (1989) presents lake trout catch per unit effort (CUE) statistics from 11 censuses of 9 lakes. These statistics expressed as number per rod hour range from 0.13 to 1.98 with a mean of 0.80. Horler (1983) reports CUEs of 0.14, 0.14, and 0.13 for three larger lakes in the southern Yukon; Marsh, Tagish and Fox Lakes.

The CUE of 0.28 for arctic grayling taken from Kathleen Lake may also be compared to six lakes surveyed by Horler (1989, Tables 3-9). CUEs range from 0.8 to 6.0 with a mean of 2.46. The CUEs for Marsh, Tagish and Fox Lakes (Horler, 1983) were 1.9, 0.2 and 0.74 respectively suggesting that the arctic grayling population is small in Kathleen lake and fish are caught incidentally while anglers are fishing for lake trout and rainbow trout.

The CUE for arctic grayling on the Kathleen River of 1.51 may be compared to 0.068 for the Upper Naknek River in Alaska (Minard, 1989) and to 1.04 for the Frances River in the Yukon (Horler, 1989) suggesting they are abundant and easy to catch. The rainbow trout CUE of 0.09 may be compared to 0.57 for the Upper Naknek River indicating a low abundance in the Kathleen River.

4.2 Age - Frequency Distribution

The age - frequency distributions seem to indicate that both the lake trout and arctic grayling populations are fairly stable and healthy. Most of the older age classes in both species are represented in the catch and none of the age classes is completely missing except for lake trout greater than 16 years of age. With a sample size of only 60 fish, it is not unusual to see missing older age classes in lake trout for a lake of this size. As lake trout have a great longevity, stocks just thin out and don't respond well to exploitation. Therefore, lake trout can appear to have a healthy age composition but have a low abundance. For arctic grayling, the bulk of the catch is occurring at or near the age for first maturity suggesting that there is moderately high fishing pressure.

4.3 Yield

An estimate of yield may be obtained by calculating the product of the estimated number of fish kept by anglers and the mean weights. The following table presents yield estimates for 1990 compared to those found by Wickstrom (1983):

TABLE 11 COMPARISON OF LAKE TROUT YIELD ESTIMATES DETERMINED FROM CREEL CENSUSES CONDUCTED IN 1980, 1981, AND 1990

	KILOGRAMS	KILOGRAMS/HECTARE
KATHLEEN LAKE & RIVER 1990	60.8	0.018
KATHLEEN LAKE 1981	563.639	0.167
KATHLEEN LAKE 1980	254.065	0.075

The 1990 yield for the lake represents a 4 fold reduction of the 1980 yield and a 9 fold reduction over the 1981 yield.

The maximum sustained yield (MSY) estimate for Kathleen Lake is 1.64 kgms./ha (5,536.6 kgms.) using a mean annual temperature of -3.2 degrees C. in Haines Junction. A species specific MSY may be obtained using species composition by weight data from a test netting program conducted in 1973 by Wickstrom (1979). The species composition of the total biomass caught in the nets and the allocation of the total MSY to each species are presented in the following table:

TABLE 12 SPECIES MSY AND COMPOSITION FOR KATHLEEN LAKE

SPECIES	% COMPOSITION	MSY KILOGRAMS	MSY KILOGRAMS/HECTARE
Lake Trout	47.8	2646.5	0.78
Arctic Grayling	4.0	221.5	0.065
Kokanee	5.0	276.8	0.082
Round Whitefish	42.8	2325.4	0.71

4.4 Sources of Error

Sampling Error

Kathleen Lake and River were sampled at the same time during the census and a technician would move between the lake and the river during the sample day. There is the possibility that parties were missed at one site while the other site was being sampled. This source of error becomes significant if one of the sites becomes "busy". This may be avoided if the lake and the river were sampled as discreet censuses and sampled at a reduced rate if necessary.

It became apparent that fishing effort on weekends was significantly greater than on week days. It is recommended that the sampling effort for a given stratum be allocated proportional to current known variability (variance) in the fishing effort for that stratum.

The sample unit for this study has been defined as the fishing day. The accuracy of the stratified random estimate is predicated on a complete sampling of the sample unit. There is a tendency for census takers to leave the scene early if fishermen are not present for the better part of the day. It is advisable to avoid incomplete sampling of the unit and preferable to reduce the sample effort (number of days) if necessary.

Ageing

Fundamental to the precision of any creel census is the accuracy of age determination from fish bony structures. Annual rings from thin sections of otoliths are very reliable indicators of age providing sections are thin enough to read. Efforts to provide good thin section preparation and interpretation will increase significantly the precision of the analyses of biological data and to the resultant conclusions.

4.5 Management Implications

Sustained Yield

Using the MSY for lake trout of 2646.5 kilograms and the mean weight from the creel census harvest, the maximum sustained yield would be 2294 fish. O'Connor (1978) has suggested a figure of 15% of the MSY as optimum sustained yield for a high quality sport fishery. This level of exploitation was derived from data collected from lakes at more southerly latitudes and lakes in the north would be less productive. Therefore a figure of 10% of the MSY may reflect an optimum sustained yield (OSY) for northern lakes. The target OSY for Kathleen Lake would then be approximately 230 fish. The harvest of 121 fish during the summer of 1990 suggests that fishing pressure is 52% of the optimum level.

Horler (1985) has reported a mean lake trout composition of 34% from test netting of lakes in the Yukon. Using this composition level, the lake trout MSY would be 1882.4 fish and the OSY (10%) would be 188 pieces.

Regulation

The low age - specific mean weights and the low exponential and Von Bertalanffy growth coefficients suggest that lake trout in Kathleen Lake are quite slow growing fish. This fact along with low numbers of other species taken in the lake harvest suggest that this is a relatively unproductive lake. There is a danger that the MSY for lake trout determined on 1 year's test fishing results may be too high due to sampling bias. Also, the test fishing was conducted 17 years ago and species composition may have changed significantly in the interim. To error on the side of conservation, it is recommended that the lower level of optimum sustained yield be used as a management target. This level would be 188 pieces. In addition, the spring ice fishery should be monitored to give an overall estimate for the year.

Lake trout appears to be the target species for fishermen on the Kathleen River as the reported catch was 1.7 x the harvest (number kept) while the reported catch for arctic grayling was 5.7 x the harvest. Arctic grayling appear to be experiencing a moderately high fishing pressure as survivorship is 0.5 - 0.7. The low mean length of 322.85 mm. and mean weight of 369.87 grams along with the young mean age of maturity may infer that the stock is being stressed by exploitation. It is recommended that a catch and release fishery be implemented for the river to improve survivorship. It also recommended that a tagging study be implemented in the Kathleen system to define spring and fall movements of lake trout in the river for stock differentiation.

The harvest and the catch per unit effort for rainbow trout are so low for both the lake and the river that total catch and release management is advisable for this species. This is supported by reported angler perception of a significant decline in angling quality on the river as compared to years past.

5 REFERENCES

5.1 References

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APPENDIX 1

APPENDIX 1 STRATIFIED RANDOM ESTIMATE BY STRATUM FOR CATCH AND HARVEST FOR KATHLEEN LAKE CREEL CENSUS, BASED ON SUMMER, 1990

SPECIES	STRATUM	NUMBER OF FISH CAUGHT	95% CONFIDENCE LIMIT INTERVAL	NUMBER OF FISH HARVESTED	95% CONFIDENCE INTERVAL
A. GRAYLING	1	101.3	(83.4-123.1)	2.3	(0.7-7.8)
	2	7.47	(3.7-15.1)	7.47	(3.7-15.1)
TOTAL		108.9	(90.1-131.2)	9.78	(5.2-18.1)
LAKE TROUT	1	30.7	(21.6-43.7)	21.1	(13.8-32.3)
	2	58.97	(45.7-76)	31.57	(22.3-44.6)
TOTAL		89.6	(72.8-110.2)	52.7	(40.2-68.9)
RAINBOW TROUT	1	2.3	(0.7-7.8)	0	0
	2	10.8	(6-19.4)	3.3	(1.2-9.3)
TOTAL		13.1	(7.7-22.4)	3.3	(1.2-9.3)

APPENDIX 1 STRATIFIED RANDOM ESTIMATE BY STRATUM FOR CATCH AND HARVEST FOR KATHLEEN LAKE CREEL CENSUS, BASED ON SUMMER, 1990

SPECIES	STRATUM	NUMBER OF FISH CAUGHT	95% CONFIDENCE LIMIT INTERVAL	NUMBER OF FISH HARVESTED	95% CONFIDENCE INTERVAL
A. GRAYLING	1	724.9	(673.9-779.6)	81.4	(65.5-101.1)
	2	281.8	(250.8-316.7)	52.87	(40.3-69.1)
	3	354	--	37	--
	4	372.6	(336.7-412.4)	113.4	(94.3-136.3)
TOTAL		1733.34	(1653.6-1816.8)	9.78	(5.2-18.1)
LAKE TROUT	1	30.7	(21.6-43.7)	21.1	(13.8-32.3)
	2	58.97	(45.7-76)	31.57	(22.3-44.6)
TOTAL		89.6	(72.8-110.2)	52.7	(40.2-68.9)
RAINBOW TROUT	1	2.3	(0.7-7.8)	0	0
	2	10.8	(6-19.4)	3.3	(1.2-9.3)
TOTAL		13.1	(7.7-22.4)	3.3	(1.2-9.3)

APPENDIX 2

LAKE: MUSH Page: 1

Species: LAKE TROUT

Date	Sample Number	Fork Length(mm)	Weight (gms)	Sex	Maturity	Stomach Contents
31/07/90	1	375	675	M	mature	unknown
"	2	550	1125	F	"	"
"	3	500	1000	F	"	"
1/08/90	4	550	1125	U	unknown	head only

LAKE: MUSH Page: 1

Species: ARCTIC GRAYLING

Date	Sample Number	Fork Length(mm)	Weight (gms)	Sex	Maturity	Stomach Contents
1/08/90	1	375	560	U	unknown	head only
"	2	325	450	U	"	"

APPENDIX 3

MATURITY SCHEDULES - KATHLEEN LAKE/RIVER CREEL CENSUS SUMMER 1990

Arctic Grayling

Sexes Combined

AGE	NUMBER MATURE	PERCENT MATURE	FK. LENGTH	WEIGHT
1	0	0	273	167
2	9	52.9	294	275
3	27	65.9	313	313
4	31	88.6	332	394
5	17	89.4	345	451
6	10	100	374	572
7	3	100	393	658

Females

1	0	0	296	150
2	3	33.3	278	222
3	15	71.4	309	316
4	13	92.8	324	403
5	5	71.4	331	424
6	5	100	385	600
7	3	100	393	658

Males

1	0	0	248	100
2	6	75	320	378
3	13	61.9	317	312
4	18	85.7	337	388
5	13	100	354	467
6	5	100	364	526
8	1	100	396	700

MATURITY SCHEDULES - KATHLEEN LAKE/RIVER CREEL CENSUS SUMMER 1990

AGE	NUMBER	% MATURE	MEAN FK. LENGTH (mm.)	MEAN WEIGHT (gms.)
Lake Trout				
Sexes Combined				
6	1	50	388.00	550.00
7	2	100	404.00	533.33
8	3	100	417.33	858.33
9	7	77.8	408.86	784.38
10	5	62.5	417.20	843.23
11	3	100	419.33	841.67
12	2	66.7	488.50	1387.50
13	3	75	443.33	1066.67
14	4	100	446.67	975.00
16	1	100	458.00	1100.00
19	1	100	400.00	675.00
20	2	100	436.00	900.00
21	3	100	457.33	1025.00
22	1	100	594.00	3150.00
24	1	100	458.00	1000.00
26	1	100	490.00	1400.00
28	1	100	426.00	862.50

APPENDIX 4

Kathleen Lake/River System Tagging Data - Summer 1990

APPENDIX 4

As a supplement to the Kathleen creel census a tagging project was initiated on Crescent, Granite and Rainbow Lakes. The objectives of the study was to determine movements of both rainbow trout and lake trout that are indigenous in the system. With the exception of one application of a peterson disc tag, all fish were tagged with either a green floy-T tag or a white-juvenile spaghetti tag. Tagged fish were primarily captured by angling with barbless spinners, although in some instances gillnets and minnow traps were used. The release condition, although subjective, was coded by the following criteria:

Release Condition	Criteria
1	No noticeable bleeding, no scale loss, instant recovery.
2	Noticeable bleeding, no gill arch damage, minor scale loss, hook/net marks, good recovery.
3	Heavy bleeding usually gill arch damage, excessive handling, heavy scale loss, recovery slow, eye damage.

CR_ _ENT _KE RAI_ V T T

DATE	TAG TYPE	TAG #	LENGTH (MM)	RELEASE CONDITION
90/05/19	red-disc	501	365	2
90/05/20	green-floy	1	265	1
90/05/20	green-floy	2	360	1
90/05/20	white-juvenile	0	280	3
90/05/20	white-juvenile	1	330	3
90/05/20	white-juvenile	2	260	1
90/05/20	green-floy	8	370	3
90/05/20	green-floy	9	380	2
90/05/20	green-floy	10	430	2
90/05/21	green-floy	11	430	2
90/05/21	green-floy	12	350	2
90/05/21	green-floy	13	380	1
90/05/21	green-floy	14	325	3
90/05/21	green-floy	15	325	1
90/05/21	green-floy	16	335	1
90/05/22	green-floy	17	305	1
90/05/22	green-floy	18	310	1
90/05/22	green-floy	19	325	1
90/05/22	green-floy	20	305	2
90/05/22	white-juvenile	3	235	1
90/05/22	white-juvenile	4	245	1
90/05/22	white-juvenile	5	250	1
90/05/22	green-floy	21	310	1
90/05/22	white-juvenile	7	260	1
90/05/22	white-juvenile	8	245	1
90/05/22	white-juvenile	9	240	1
90/05/22	white-juvenile	10	265	1
90/05/22	green-floy	23	320	2
90/05/22	green-floy	25	315	2
90/05/23	white-juvenile	11	275	1
90/05/23	green-floy	26	300	2
90/05/23	green-floy	27	305	1
90/05/23	green-floy	28	290	1
90/05/23	green-floy	29	270	1
90/05/23	green-floy	30	365	2
90/05/23	green-floy	31	295	1
90/05/23	green-floy	32	360	1
90/05/23	white-juvenile	12	285	1
90/05/23	green-floy	33	440	2

90/05/23	white-juvenile	13	235	1
90/05/24	white-juvenile	14	101	1
90/05/24	white-juvenile	15	87	1
90/05/24	white-juvenile	16	69	1
90/05/24	white-juvenile	17	128	1
90/05/24	green-floy	34	285	1
90/05/24	green-floy	35	280	1
90/05/24	green-floy	36	380	1
90/05/24	white-juvenile	18	275	1
90/05/24	white-juvenile	19	125	1
90/05/24	white-juvenile	20	175	1
90/05/24	white-juvenile	21	180	1
90/05/24	white-juvenile	22	275	2
90/05/24	white-juvenile	23	265	2
90/05/24	white-juvenile	24	250	2
90/05/24	green-floy	38	260	2
90/05/24	green-floy	39	350	2
90/05/24	green-floy	40	310	2
90/05/24	green-floy	41	275	2
90/05/24	white-juvenile	25	200	3
90/05/24	white-juvenile	26	180	1
90/05/24	white-juvenile	27	190	1
90/05/24	white-juvenile	28	125	1
90/05/24	white-juvenile	29	260	1
90/05/24	white-juvenile	30	230	1
90/05/25	green-floy	42	415	1
90/05/25	green-floy	43	270	1
90/05/25	green-floy	44	365	1
90/05/25	green-floy	45	375	1
90/05/25	white-juvenile	31	200	1
90/05/25	white-juvenile	32	220	1
90/05/25	white-juvenile	33	310	1
90/05/25	white-juvenile	34	185	1
90/05/25	white-juvenile	35	110	1
90/05/25	white-juvenile	37	180	1
90/05/25	white-juvenile	39	270	1
90/05/25	white-juvenile	40	245	1
90/05/25	white-juvenile	41	135	1
90/05/25	white-juvenile	42	255	1
90/05/25	white-juvenile	43	200	1
90/05/25	white-juvenile	44	145	1

CR	SNJ	KE	GAI	N	J	I
90/05/25	white-juvenile	45	190	1		
90/05/25	white-juvenile	46	175	1		
90/05/25	white-juvenile	47	150	1		
90/05/25	white-juvenile	48	115	1		
90/05/25	white-juvenile	49	100	1		
90/05/25	white-juvenile	50	145	1		
90/05/25	white-juvenile	51	145	1		
90/05/25	white-juvenile	52	110	1		
90/05/25	white-juvenile	53	180	1		
90/05/25	white-juvenile	54	125	1		
90/05/25	white-juvenile	55	170	1		
90/05/25	white-juvenile	56	120	1		
90/05/25	white-juvenile	57	180	1		
90/05/25	white-juvenile	58	145	1		
90/05/25	white-juvenile	59	145	1		
90/05/25	white-juvenile	60	190	1		
90/05/25	white-juvenile	61	135	1		
90/05/25	white-juvenile	62	140	1		
90/05/25	white-juvenile	63	115	1		
90/05/25	white-juvenile	64	155	1		
90/05/25	white-juvenile	65	170	1		
90/05/25	white-juvenile	66	185	1		
90/05/25	white-juvenile	67	170	1		
90/05/25	white-juvenile	68	130	1		
90/05/25	white-juvenile	69	125	1		
90/05/25	white-juvenile	70	140	1		
90/05/25	white-juvenile	71	130	1		
90/05/25	white-juvenile	72	260	1		
90/05/25	white-juvenile	73	135	1		
90/05/25	white-juvenile	74	90	1		
90/05/25	white-juvenile	75	80	1		
90/05/25	white-juvenile	76	115	1		
90/05/25	white-juvenile	77	75	1		
90/05/25	white-juvenile	78	120	1		
90/05/26	white-juvenile	79	120	1		
90/05/26	white-juvenile	80	175	1		
90/05/26	white-juvenile	81	130	1		
90/05/26	white-juvenile	82	130	1		
90/05/26	white-juvenile	83	120	1		
90/05/26	white-juvenile	84	110	1		
90/05/26	white-juvenile	85	75	1		

CRESCENT LAKE - RAINBOW TROUT

90/05/26	white-juvenile	86	80	1
90/05/26	white-juvenile	87	85	1
90/05/26	white-juvenile	88	110	1
90/05/26	white-juvenile	89	70	1
90/05/26	white-juvenile	90	170	1
90/05/26	white-juvenile	91	115	1
90/05/26	white-juvenile	92	200	1
90/05/26	white-juvenile	93	150	1
90/05/26	white-juvenile	94	210	1
90/05/26	white-juvenile	95	170	1
90/05/26	white-juvenile	96	145	1
90/05/26	white-juvenile	97	115	1
90/05/26	white-juvenile	98	140	1
90/05/26	white-juvenile	99	130	1
90/05/26	white-juvenile	100	125	1
90/05/26	white-juvenile	101	180	1
90/05/26	white-juvenile	102	150	1
90/05/26	white-juvenile	103	75	1
90/05/26	white-juvenile	104	75	1
90/05/26	white-juvenile	105	135	1
90/05/26	green-floy	46	310	1
90/05/26	white-juvenile	106	135	1
90/05/26	white-juvenile	107	175	1
90/05/26	white-juvenile	108	230	1
90/05/26	white-juvenile	109	135	1
90/05/26	white-juvenile	110	190	1
90/05/26	white-juvenile	111	200	1
90/05/27	green-floy	48	270	1
90/05/27	white-juvenile	112	210	1
90/05/27	white-juvenile	113	110	1
90/05/27	white-juvenile	114	80	1
90/05/27	white-juvenile	116	115	1
90/05/27	white-juvenile	117	80	1
90/05/27	white-juvenile	118	130	1
90/05/27	white-juvenile	119	155	1
90/05/27	white-juvenile	120	225	1
90/05/27	white-juvenile	121	190	1
90/05/27	white-juvenile	122	170	1
90/05/27	white-juvenile	123	130	1
90/05/27	white-juvenile	124	190	1
90/05/27	white-juvenile	125	145	1

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90/05/27	white-juvenile	126	195	1
90/05/27	white-juvenile	127	200	1
90/05/27	white-juvenile	128	165	1
90/05/27	white-juvenile	129	135	1
90/05/27	white-juvenile	130	117	1
90/05/27	white-juvenile	131	145	1
90/05/27	white-juvenile	132	185	1
90/05/27	white-juvenile	133	130	1
90/05/27	white-juvenile	134	130	1
90/05/27	white-juvenile	135	185	1
90/05/27	white-juvenile	136	150	1
90/05/27	white-juvenile	137	170	1
90/05/27	white-juvenile	138	135	1
90/05/27	white-juvenile	139	130	1
90/05/27	white-juvenile	140	175	1
90/05/27	white-juvenile	141	170	1
90/05/27	white-juvenile	142	215	1
90/05/27	white-juvenile	143	180	1
90/05/27	white-juvenile	144	125	1
90/05/27	white-juvenile	145	165	1
90/05/27	white-juvenile	146	180	1
90/05/27	white-juvenile	147	120	1
90/05/27	white-juvenile	148	70	1
90/05/27	white-juvenile	149	110	1
90/05/27	white-juvenile	150	120	1
90/05/27	green-floy	51	320	3
90/05/27	green-floy	52	265	1
90/05/31	white-juvenile	151	250	1
90/05/31	green-floy	54	310	2
90/05/31	green-floy	55	285	1
90/05/31	white-juvenile	152	130	1
90/05/31	white-juvenile	153	170	1
90/05/31	green-floy	56	330	1
90/05/31	white-juvenile	154	200	2
90/06/01	white-juvenile	155	180	1
90/06/01	white-juvenile	158	210	1
90/06/01	green-floy	57	360	1
90/06/01	white-juvenile	58	340	1
90/06/01	white-juvenile	156	225	1
90/06/01	white-juvenile	157	260	1
90/06/01	white-juvenile	159	270	1

CRESCENT LAKE - RAINBOW TROUT

90/06/01	white-juvenile	160	220	1
90/06/01	green-floy	59	290	1
90/06/01	green-floy	60	270	1
90/06/01	white-juvenile	161	160	1
90/06/01	white-juvenile	162	210	1
90/06/01	white-juvenile	165	220	1
90/06/01	white-juvenile	164	190	1
90/06/01	white-juvenile	165	230	1
90/06/01	white-juvenile	167	295	1
90/06/02	green-floy	61	325	1
90/06/02	green-floy	62	305	1
90/06/02	white-juvenile	168	85	1
90/06/02	white-juvenile	171	135	1
90/06/02	white-juvenile	170	115	1
90/06/02	white-juvenile	163	325	1
90/06/03	white-juvenile	172	120	1
90/06/03	white-juvenile	173	160	1
90/06/03	white-juvenile	174	110	1
90/06/03	white-juvenile	175	130	1
90/06/03	white-juvenile	176	140	1
90/06/03	white-juvenile	178	120	1
90/06/03	white-juvenile	179	85	1
90/06/03	white-juvenile	180	80	1
90/06/03	white-juvenile	181	75	1
90/06/04	white-juvenile	191	160	1
90/06/04	white-juvenile	187	120	1
90/06/04	white-juvenile	189	150	1
90/06/06	white-juvenile	200	180	1
90/06/06	white-juvenile	201	190	1
90/06/06	white-juvenile	202	170	1
90/06/06	white-juvenile	203	155	1
90/06/06	white-juvenile	204	225	1
90/06/06	white-juvenile	205	180	1
90/06/06	white-juvenile	206	190	1
90/06/06	white-juvenile	207	175	1
90/06/06	white-juvenile	208	140	1
90/06/06	white-juvenile	209	130	1
90/06/06	white-juvenile	210	165	1
90/06/06	white-juvenile	211	105	1
90/06/06	white-juvenile	212	205	1
90/06/06	white-juvenile	213	130	1

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90/06/06		white-juvenile		214	145	1
90/06/06		white-juvenile		215	130	1
90/06/06		white-juvenile		216	230	1
90/06/06		white-juvenile		217	175	1
90/06/06		white-juvenile		218	110	1
90/06/06		white-juvenile		219	175	1
90/06/06		white-juvenile		220	195	1
90/06/06		white-juvenile		221	150	1
90/06/06		white-juvenile		222	235	1
90/06/06		white-juvenile		223	125	1
90/06/06		white-juvenile		224	160	1
90/06/06		white-juvenile		225	140	1
90/06/06		white-juvenile		226	200	1
90/06/06		white-juvenile		227	190	1
90/06/06		white-juvenile		228	210	1
90/06/06		white-juvenile		229	180	1
90/06/06		white-juvenile		230	125	1
90/06/06		white-juvenile		231	222	1
90/06/06		white-juvenile		232	160	1
90/06/06		white-juvenile		233	165	1
90/06/06		white-juvenile		234	125	1
90/06/06		white-juvenile		235	140	1
90/06/06		white-juvenile		236	145	1
90/06/06		white-juvenile		237	130	1
90/06/06		white-juvenile		238	140	1
90/06/06		white-juvenile		239	120	1
90/06/06		white-juvenile		240	160	1
90/06/06		white-juvenile		241	155	1
90/06/06		white-juvenile		242	120	1
90/06/06		white-juvenile		243	85	1
90/06/07		white-juvenile		246	120	1
90/06/07		white-juvenile		247	130	1
90/06/07		white-juvenile		248	130	1
90/06/07		white-juvenile		249	85	2
90/06/07		white-juvenile		250	125	1
90/06/07		white-juvenile		251	75	1

CRESCENT LAKE - LAKE TROUT

DATE	TAG TYPE	TAG #	LENGTH (MM)	RELEASE CONDITION
90/05/20	green-floy	5	450	1
90/05/20	green-floy	6	545	2
90/05/20	green-floy	7	485	1
90/05/24	green-floy	37	430	1
90/05/26	green-floy	47	375	1
90/05/27	white-juvenile	115	80	1
90/05/27	green-floy	49	380	1

RAINBOW LAKE - RAINBOW TROUT

DATE	TAG TYPE	TAG #	LENGTH (MM)	RELEASE CONDITION
90/06/04	white-juvenile	182	300	1
90/06/04	white-juvenile	184	320	1
90/06/04	white-juvenile	185	400	1
90/06/04	white-juvenile	186	320	1
90/06/04	white-juvenile	190	385	1
90/06/04	white-juvenile	192	360	1
90/06/04	white-juvenile	194	345	1
90/06/05	white-juvenile	195	360	1
90/06/06	white-juvenile	244	270	1
90/06/06	white-juvenile	245	310	1

RAINBOW LAKE - LAKE TROUT

DATE	TAG TYPE	TAG #	LENGTH (MM)	RELEASE CONDITION
90/06/04	white-juvenile	193	300	1

GRANITE LAKE - RAINBOW TROUT

DATE	TAG TYPE	TAG #	LENGTH (MM)	RELEASE CONDITION
90/05/19	yellow-floy	3	356	2
90/05/19	white-juvenile	400	140	1
90/05/20	yellow-floy	4	330	2
90/05/20	yellow-floy	5	330	1
90/05/20	yellow-floy	6	343	1
90/05/20	yellow-floy	8	381	1
90/05/21	yellow-floy	10	356	2
90/05/21	yellow-floy	11	305	1
90/05/21	yellow-floy	12	356	1
90/05/22	yellow-floy	13	368	1
90/05/23	yellow-floy	15	305	3
90/05/24	yellow-floy	17	343	1
90/05/24	white-juvenile	401	89	1
90/05/24	white-juvenile	402	89	1
90/05/24	yellow-floy	18	178	1
90/05/24	yellow-floy	19	254	1
90/05/24	yellow-floy	21	229	1
90/05/25	white-juvenile	430	330	1

GRANITE LAKE - LAKE TROUT

DATE	TAG TYPE	TAG #	LENGTH (MM)
90/05/23	yellow-floy	16	318
90/05/24	yellow-floy	22	356
90/05/24	yellow-floy	23	432
90/05/24	yellow-floy	24	343
90/05/25	white-juvenile	403	292
90/05/25	yellow-floy	28	343
90/05/25	white-juvenile	415	318
90/05/25	yellow-floy	39	394
90/05/25	yellow-floy	40	432
90/05/25	yellow-floy	42	368
90/05/25	white-juvenile	416	318
90/05/25	white-juvenile	417	305
90/05/25	yellow-floy	43	356
90/05/25	white-juvenile	418	330
90/05/25	white-juvenile	419	305
90/05/25	white-juvenile	420	305
90/05/25	white-juvenile	421	343
90/05/25	white-juvenile	422	318
90/05/25	white-juvenile	424	381
90/05/25	white-juvenile	425	305
90/05/25	white-juvenile	426	305
90/05/25	white-juvenile	427	330
90/05/25	white-juvenile	428	305
90/05/25	white-juvenile	429	330
90/05/25	yellow-floy	29	356
90/05/25	white-juvenile	404	318
90/05/25	white-juvenile	405	318
90/05/25	white-juvenile	406	330
90/05/25	white-juvenile	407	330
90/05/25	white-juvenile	408	356
90/05/25	white-juvenile	409	330
90/05/25	yellow-floy	30	343
90/05/25	yellow-floy	31	330
90/05/25	yellow-floy	35	381
90/05/25	yellow-floy	36	483
90/05/25	yellow-floy	37	330
90/05/25	yellow-floy	38	381
90/05/25	white-juvenile	410	305
90/05/25	white-juvenile	411	305

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90/05/25	white-juvenile	412	318
90/05/25	white-juvenile	413	318
90/05/25	white-juvenile	414	318
90/05/26	white-juvenile	431	343
90/05/26	white-juvenile	432	381
90/05/26	white-juvenile	433	406
90/05/26	white-juvenile	434	318
90/05/26	white-juvenile	435	305