FISH STOCK ASSESSMENT
OF
KUSAWA, LABERGE AND TESLIN LAKES
1996

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TR - 97 - 1

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

I am grateful to Ryan Hennings, Kevin Johnstone and Gerry Kuzyk for the help with the field work and data collection. Nick deGraff provided editorial comments and participated greatly in the data analysis for this report. Don Toews honest review of the final draft was a tremendous help in getting this report done. Thanks for all the help and encouragement.

1.0 INTRODUCTION

In 1989 the Yukon Territorial Government assumed the management and administrative responsibility of the freshwater fisheries' resource from the Federal Government. As part of the transfer agreement, assessment programs were initiated to establish the status of the fisheries' resource within the Territory. Lakes with significant fisheries involving several user groups and potential allocation conflicts, and where limited stock information was available, became assessment priorities. Consequently, Lake Laberge and Teslin Lake, due to their active commercial, domestic and native food fisheries were surveyed during the summers of 1991 and 1992. Kusawa Lake was assessed in 1993 because of limited available stock information.

1.1 KUSAWA LAKE

From 1960 to 1967 Kusawa Lake had a combined commercial quota of 6,804 kilograms (15,000 pounds) of lake trout and lake whitefish. Reports from commercial harvesters indicated that the area north of the Primrose River was unproductive, but substantial catches were made in the South, particularly in the shallow sections of the lake (Seigal 1984). In 1968 the commercial fishery was closed to develop Kusawa Lake as a recreational site.

There are no historic records of fish harvest for either the Indian Food Fishery (IFF) or domestic subsistence fishery on Kusawa Lake. In 1995 five IFF licences and one

domestic subsistence licence were issued, with less than 100 kilograms of lake trout being harvested between them, per year.

Sportfishing is a popular activity on Kusawa Lake, though the lake is prone to high winds which frequently makes it difficult to get on the lake to fish. The most important sport fish species are Lake trout, *Salvelinus namaycush* and Arctic grayling, *Thymallus arcticus.* An angler harvest survey conducted in 1991 indicated that anglers harvested approximately 500 kilograms of lake trout from June to August (YTG files). Over 80% of the anglers were non-residents of the Yukon.

Fishing derbies were promoted by the Whitehorse Kiwanis Club on Kusawa Lake in the early 1980's during June. Records over a four year period indicate a total of 92 lake trout were killed. Live release derbies have been held on Kusawa Lake in June of 1995 and 1996. In both years the derbies attracted large numbers of entrants. In 1995 results show that fifteen lake trout were caught with nine lake trout killed. In 1996 twelve lake trout were caught with eight lake trout killed (YTG files).

1.2 LAKE LABERGE

Due to its accessibility and proximity to Whitehorse, Lake Laberge has been fished for commercial, domestic and native subsistence purposes for over a century. Commercial lake trout harvest has been highly sporadic over this period. Historic records suggest that Lake Laberge was the first Yukon lake to be fished commercially for lake trout. From 1908

to 1916 over 9,806 kilograms (21,620 pounds) of lake trout were caught. Over the next 60 years lake trout harvests were infrequent and records kept are unreliable (Seigal, 1984). Recent statistics (1980-1990) show an annual commercial harvest of approximately 2,000 kilograms of lake trout per year (YTG files).

Catch records from the period of 1916 to 1970 were not kept for the Indian Food Fishery (IFF) on Lake Laberge. Recent statistics from the past decade (1980-1990) suggest annual harvests of all species of no more than 1,000 kilograms per year. It was not until 1974 that records were kept of the domestic fishery on Lake Laberge. From 1974 to 1983 approximately 434 kilograms of lake trout were harvested (Seigal 1984). Records from 1984 until 1990 indicate a total harvest of 1,022 kilograms of lake trout over this period.

The sportfishery on Lake Laberge is small and consists largely of Whitehorse anglers and local cottage owners (YTG files). The development of this fishery was in direct result of the construction of the Alaska Highway in 1942. Existing roads to the southern basin of the lake was upgraded to allow access to military facilities. Three species principally sportfished for are Lake trout, *Salvelinus namaycush*, Burbot, *Lota lota* and Northern pike, *Esox lucius*.

In 1990 fish from Lake Laberge were tested for contaminants by Environment Canada and found to have elevated levels of toxaphene. After further testing, Health and Welfare Canada issued a health warning regarding the consumption of lake trout flesh and burbot liver on Lake Laberge. The commercial fishery on Lake Laberge was closed and the three

remaining licences retired. Domestic fishing for lake trout was restricted by limiting the annual harvest of lake trout to 25 kilograms per licence to allow for incidential catches. Records showed that IFF harvest was greatly reduced after the 1990 fishing season. The IFF lake trout catch in 1990 totaled 212.5 kilograms. In 1995 there were three IFF licences issued on Lake Laberge; no production was recorded. Domestic subsistence fishers continue to fish Lake Laberge, but on a reduced level. From 1990 until 1994 domestic harvesters reported a total harvest of 89 kilograms of lake trout. There were three domestic subsistence licences issued in 1995 for Lake Laberge (YTG files)(Appendix IV).

1.3 TESLIN LAKE

Teslin Lake at present supports a popular sportfishery and one commercial licence. In 1961 a commercial catch quota was established at 5,900 kilograms (13,000 pounds) based on a harvesting rate of .5 kg per hectare of lake whitefish and lake trout. This figure was reduced in 1968 to 2,270 kilograms (5,000 pounds) to resolve conflicts between commercial and recreational sportfishing interests. Recent statistics (1980-1995) show an annual commercial harvest of lake trout of 150 kilograms per year. The most important commercial species are Lake Trout, *Salvelinus namaycush*, Lake Whitefish, *Coregonus clupeaformis*, Broad Whitefish, *Coregonus nasus,* Burbot, *Lota lota*, Northern Pike, *Esox lucius* and incidential catches of Inconnu, *Stenodus leucichthys*.

Historical records show an important IFF during the first 10 years of the 1900's which harvested an estimated 5,443 kilograms (12,000 pounds) of lake trout. Indian food fishing

on Teslin Lake has continued over the years. (currently eight IFF licences are issued annually).

Historic records show that a total of seventy-two domestic licences were issued on Teslin Lake between 1974-1985, with reported harvest levels of lake trout varying between 3 kilograms to 139 kilograms per year. In the last ten years the number of licences and the amount of fish harvested has declined (YTG files). In 1995 two domestic licences were issued with a combined lake trout quota of 50 kilograms. No lake trout were caught. (Appendix IV).

The sport fishery on Teslin Lake involving both resident and non-resident anglers began to develop rapidly after the Alaska Highway was completed in 1942. The highway provided a number of access points to the north basin of the lake. In 1992 Yukon Fisheries Section conducted an angler harvest survey on Teslin Lake. The survey results indicated that anglers harvested at least 800 kilograms of lake trout during the open water season. The survey also found that 61% of anglers fishing Teslin Lake were local Teslin residents, while 25% were non-residents of the Yukon. (YTG files).

2.0 OBJECTIVES

The primary objective of this survey was to determine the status of the important commercial, sport and food fish species within Kusawa, Laberge and Teslin Lakes. Specific objectives of this study were:

1. To determine the abundance of lake trout and lake whitefish relative to other lakes in the Yukon.
2. To determine the biological population parameters for lake trout and lake whitefish.
3. To determine lake trout production and harvest capacity.
4. Based on the findings of objectives 1 through 3, make recommendations on harvest management for these three lakes.

3.0 STUDY AREAS

3.1 Kusawa Lake

Kusawa Lake is located approximately 80 kilometers (50 miles) west of the City of Whitehorse at 60° 20' north latitude and 136° 22' west longtitude at an elevation of 671 meters. Kusawa Lake is an s-shaped lake 75 kilometers in length and 14,200 hectares in area. The Takhini River drains from the north end of Kusawa Lake, flowing out to the confluence with the Yukon River near Whitehorse. Kusawa Lake is the receiving waters of the Primrose River, Upper Takhini River, Kusawa River and Devil Hole Creek, and a number of smaller drainage basins. The Primrose River is of glacial origin and is the

primary source of glacial silt deposition into the North basin of the lake. The upper Takhini and Kusawa Rivers are also glacial, and contribute silt to the southern basin.

Access to the lake is by way of the Alaska Highway at kilometer 1542 (mile 958), and then south along the Kusawa Lake access road for approximately 24 kilometres (39 miles). Road access is to the northern most portion of the lake only. Kusawa is a popular lake with campers and boaters. There are two Yukon government campgrounds, the first one situated on the Takhini River near the confluence to the lake, the second located on the lake to provide boat access. There are a small number of cottages on Kusawa Lake, with access limited to summer road travel only.

3.2 Lake Laberge

Lake Laberge is the most northernly part of the headwater lakes of the Yukon River drainage. The lake is located in south-central Yukon at 61° 11' north latitude and 135° 12' west longitude, 30 kilometres (19 miles) downstream from the City of Whitehorse. Lake Laberge has an area of 20,100 hectares and an elevation of 628 meters. Lake Laberge is approximately 50 kilometres (31 miles) long, has an average width of 4 kilometres (2.4 miles), and is oriented in a north-south direction. Access is limited to the southern basin of Lake Laberge through the Yukon government campground, or through several rural residential subdivisions (Shallow Bay, Jackfish Bay and Deep Creek). Access to the northern portion of the lake is by boat only.

Lake Laberge is the receiving waters of the Yukon River and its tributaries, the largest being the Takhini River. The Takhini River provides a substantial input of water to Lake Laberge (19% of total Yukon River inflows) and, during times of high flow, large amounts of glacially deposited sediments erode from its banks and are carried into the lake (Kirkland and Gray, 1986). A number of smaller tributaries also flow into Lake Laberge such as Laberge Creek, Laurier Creek, Horse Creek, Pilot Creek and Fox Creek. Lake Laberge was also the receiving water of primary treated sewage from the City of Whitehorse until the fall of 1996, when a new secondary sewage treatment facility went into operation.

3.3 Teslin Lake

Teslin is a headwaters' lake of the Teslin River, a tributary of the Yukon River system located in the south-central Yukon at 60° 30' north latitude and 132° 00' west longitude. Teslin Lake lies across the British Columbia-Yukon border with approximately half the lake in the two respective jurisdictions. Teslin Lake is 35,400 hectares in area and has an elevation of 683 meters. The Alaska Highway crosses the lake at Nisutlin Bay, at the town of Teslin, and then follows the lake shore to the north end of the lake. There is a Yukon Government campground located near Teslin that provides boat access to the lake. Access to the southern end of the lake is by boat only.

Teslin Lake has a drainage area of 11,140 square miles and is the receiving waters of seven major rivers; the Jennings, Morley, Swift, Nisutlin, North, Teslin and Glady's Rivers.

At the south end of the lake, where the Jennings River enters, is the site of historic Johnson Town, which is now abandoned.

4.0 METHODS AND MATERIALS

4.1 Lake Morphometry

Kusawa Lake was depth sounded with a Lorance LNS 200 sonar in August 1993. A transducer was mounted on the transom of the survey boat and 251 soundings were made along 21 transects. Lake Laberge was previously depth sounded by the National Water Research Institute, Pacific and Yukon Region, Environment Canada (Pharo, 1981). The number of soundings made is unknown. Teslin Lake was depth sounded in July 1944. A total of 177 soundings were made along 28 transects according to the methods described in W.A. Clemens (1944).

4.2 Physical and Chemical Limnology

Water quality data for Kusawa Lake was obtained from Lindsey et al. 1981, and data for Lake Laberge was taken from Godin and Jack, 1984. Field measurements of surface water quality were collected for Teslin Lake between July 15 - 17, 1992 at two stations within the lake. Water was collected using a Kemmer water bottle. Variables included pH, total alkalinity, total hardness, total dissolved solids (TDS) and conductivity. TDS and conductivity were determined with a HACH kit, model 44600. All other chemical analyses were determined using a HACH water ecology test kit, model A1-36B. Water chemistry locations for Teslin Lake are shown in Appendix I.

4.3 Morphoedaphic Index and Yield

Computed mean depths and observed TDS values for each lake were used to determine morphoedaphic indices (MEI). MEI's were then used to calculate the maximum sustainable yield (MSY) for all species using the following equation:

$\log_{10}MSY=0.05(temp)+0.28(\log_{10} MEI)+0.236$ (Schlesinger and Regier, 1982).

The temperature variables used in the above equation are from annual air temperature data collected from atmospheric weather stations (Environment Canada, 1982). The calculated MSY for all species was then partitioned using the present lake trout biomass in the experimental gillnet catch data to determine the lake trout MSY.

4.4 Index Gillnetting

Index gillnetting was performed during the months of June, July, and August. The experimental fishing effort was based upon an objective of obtaining a minimum of 250 lake whitefish. Gillnet gangs were set off points of land perpendicular to shore. Each standard gang consisted of seven sinking multifilament gillnets with mesh sizes arranged in the following order: 3.8 cm, 11.4 cm, 6.4 cm, 8.9 cm, 12.7 cm, 10.2 cm and 7.6 cm. Each gillnet was 22.9 meters long and 2.4 meters deep. Gangs were set overnight for approximately 24 hours. An effort was made to set nets in a variety of shoreline habitats in each lake. Set locations for each lake are shown in Appendix I.

Lake trout, lake whitefish, round whitefish, broad whitefish, arctic grayling and northern pike were measured using fork length, while for burbot total length was used. Fish were sampled for weight, sex, sexual maturity, age and stomach contents. Lake whitefish, broad whitefish and round whitefish stomach contents were examined using a dissecting microscope. Stomach contents from northern pike, burbot and lake trout were identified visually in the field. Longnose sucker and least cisco were measured and weighed only.

For age determination, otoliths were used, except for northern pike where cleithrums were used. Otoliths were embedded in Arladite epoxy, which is clear, hard and has a low refractive index. The otolith was then sectioned transversely, using an isomet low-speed saw. A microscope was used to read the annuli. Cleithrums were cleaned and read visually by holding up to a bright light.

Lake whitefish from all three lakes were sampled for the parasite *Triaenophorus crassus*. Broad whitefish were only sampled from Teslin Lake. Fish were sampled by filleting the fish and shaving the fillets into thin slices at right angles to the backbone. The numbers of cysts were totalled for all samples, and the rate of infestation (cysts/45kgs) was determined by using the following formula:

{cyst count/sample weight (kgs)} * 100 = rate of infestation

4.5 Other Calculations

Total mortality rates (Z) were calculated according to Robson and Chapman (1961). Only the descending limb of the catch curve and age classes with more than five fish were used in the analysis.

The mean weighted age at sexual maturity was calculated using the corrected version of Abrasov's (1967) original equation (Lysack, 1980). Only fish less than or equal to 20 years of age were used in the analysis.

The relationship between weight (w) and length (l) defines the body condition of a fish population and can be expressed as $W=CL^3$. The coefficient C is multiplied by 10^5 to produce the condition factor. This formula implies that where CF=1 growth is isometric. Average condition factors were calculated for lake trout and lake whitefish for all three lakes surveyed. Lake trout were grouped in 5 cm length classes, while lake whitefish which are smaller, were grouped in 1 cm length classes.

Length-weight scatter plots were curve fitted by least square's regression of logarithmical transformed data. Von Bertalanffy growth curves were derived from age/length scatter plots using an empirical method as described by Payne (1990).

5.0 RESULTS

5.1 Lake Morphometry

The surface areas, volumes and depth variables for each lake are presented in table 1. Teslin is the largest of the three surveyed lakes, with more than twice the surface area of Kusawa Lake, and double the volume of Lake Laberge. The northern basin of Teslin Lake, with a maximum depth of 110 meters (360 feet) is much shallower than the southern basin which has a maximum depth of 214 meters (702 feet). Relatively shallow depths are present at the extreme south and north ends of Teslin lake. Kusawa and Laberge Lakes are quite similar in morphology, and have comparable mean and maximum depths. Bathometric maps for each lake are presented in figures 1 to 3.

5.2 Physical and Chemical Limnology

All three surveyed lakes can be generally characterised as deep, cold oligotrophic lakes with steep shorelines and low dissolved nutrients. Total hardness varied between each lake with Teslin and Kusawa Lakes having relatively soft water (5.5 and 15.0 mg/l respectively) and Lake Laberge having considerably harder water. (45.6 mg/l) (table 2). Values of Total Dissolved Solids were low on all three lakes. The three lakes are pH neutral or slightly alkaline.

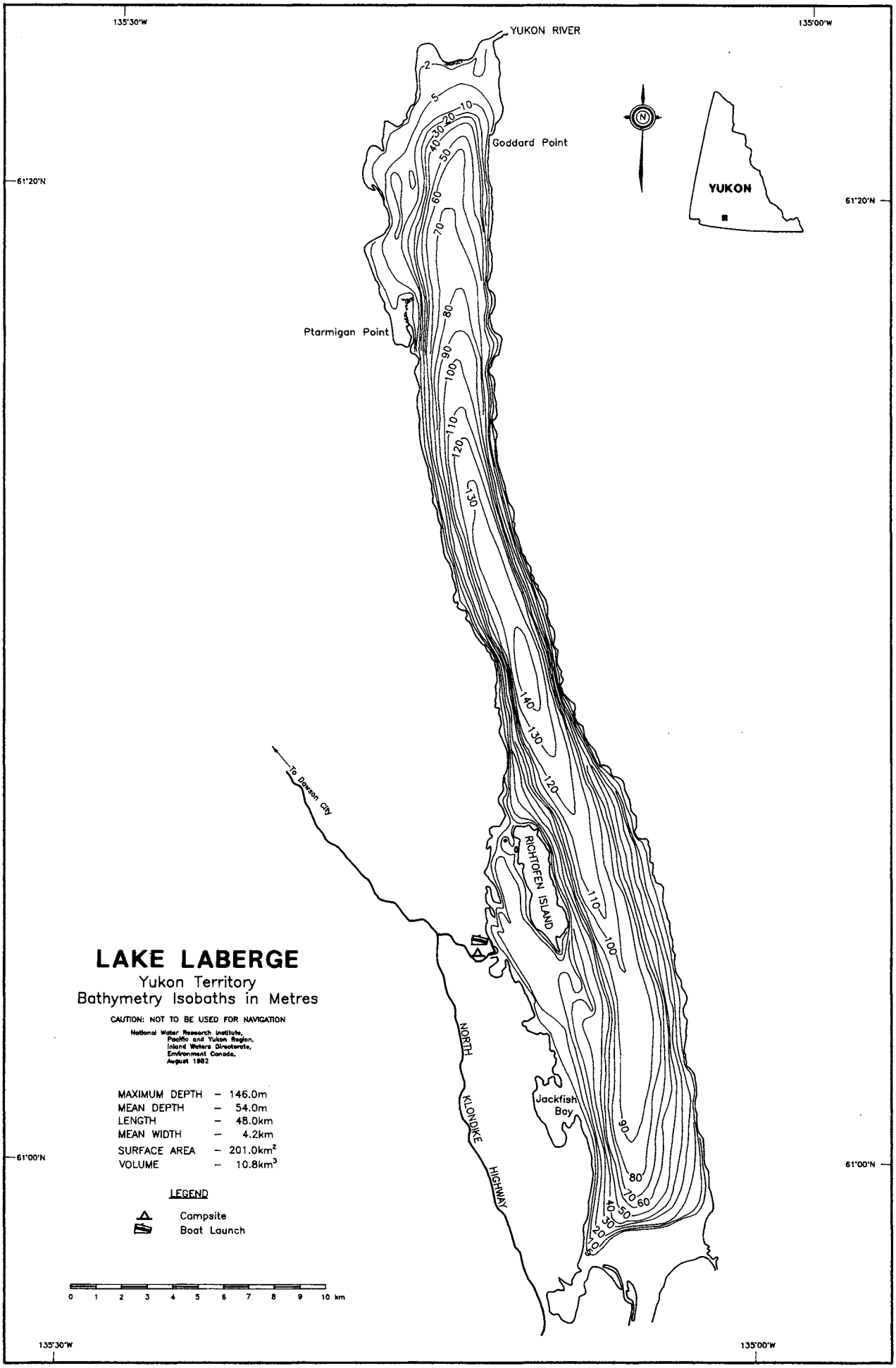


Figure 1 Bathymetry Map of Lake Laberge, Yukon Territory

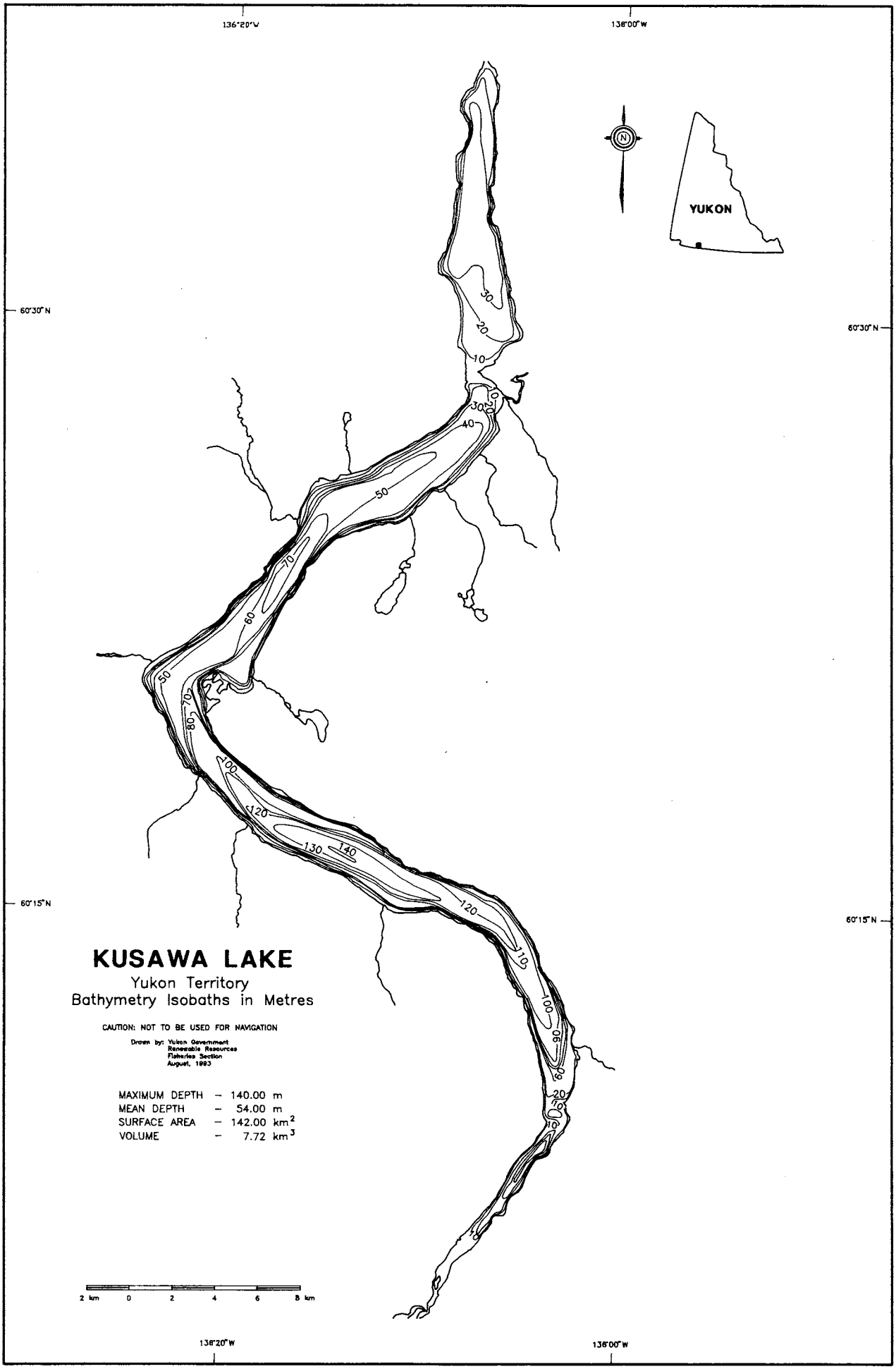


Figure 2 Bathymetry Map of Kusawa Lake, Yukon Territory

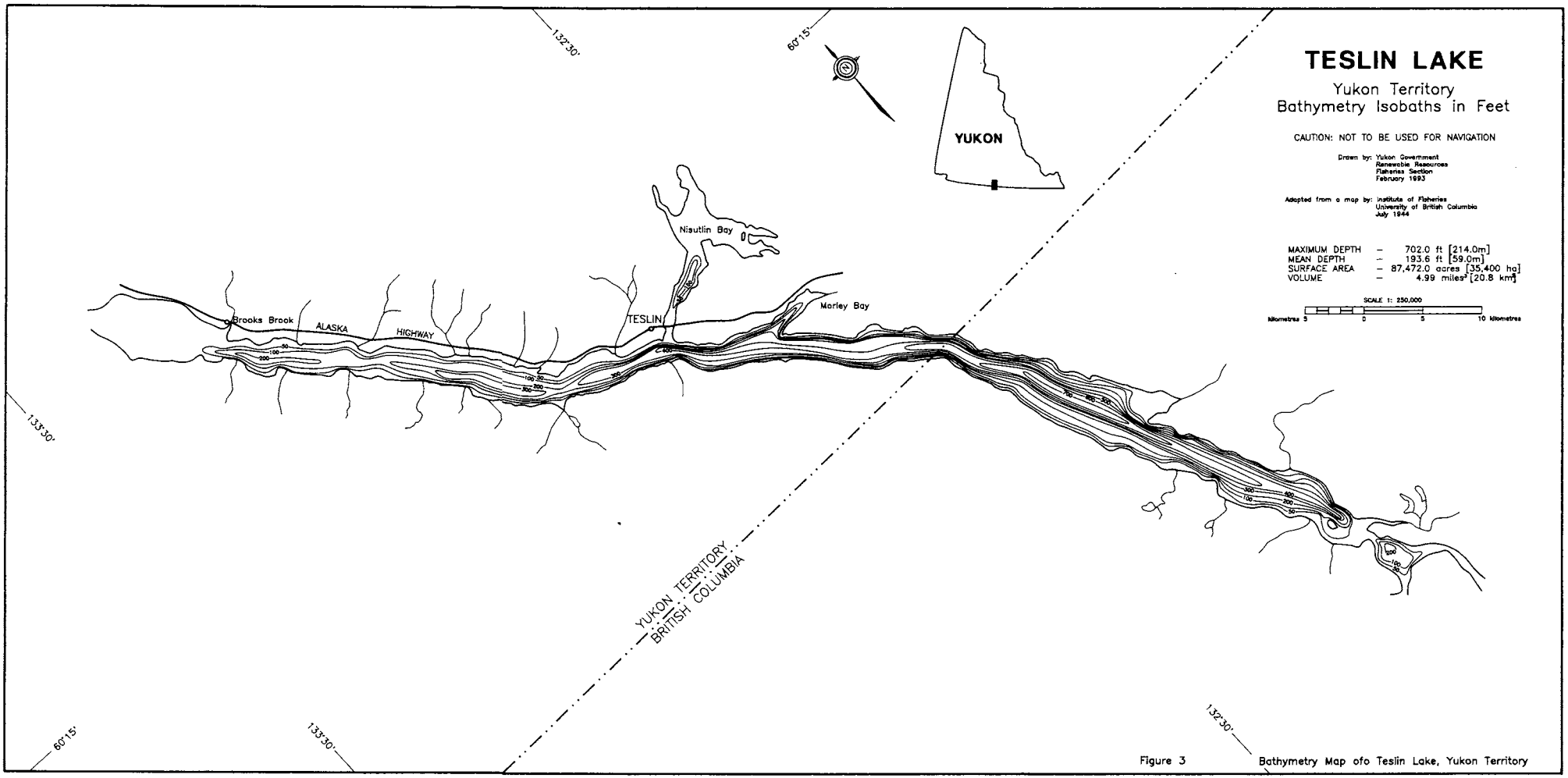


Figure 3 Bathymetry Map ofo Teslin Lake, Yukon Territory

Table 1. Morphometric Data for Kusawa, Laberge and Teslin Lakes.

Variable	Kusawa	Laberge	Teslin
Surface Area (ha)	14,200	20,100	35,400
Volume (km^3)	7.7	10.8	20.8
Maximum depth (m)	140	146	214
Mean depth (m)	54	54	59

Table 2. Chemistry Data for Surface Water from Kusawa, Laberge and Teslin Lakes.

Variable	Kusawa[1]	Laberge[2]	Teslin
Total alkalinity (mg/l)	-	38.4	2.2
Total hardness (mg/l)	15.0	45.6	5.5
TDS (mg/l)	40	68	64
Conductivity (µS/cm)	40	63	128
pH	7.0	7.9	7.8
Number of Stations	1	1	2
Sampling Date	Aug. 10/70	July 10-12/78	July 15-17/92

[1] Lindsey et al. 1981.
[2] Godin and Jack 1984.

5.3 Morphoedaphic Index and Yield

The morphoedaphic index (MEI), maximum sustainable yield (MSY), for all species, and the MSY and potential yield for lake trout, for each lake, are shown in table 3. Lake Laberge had the highest MEI (1.26) but the lowest lake trout MSY (2,251 kgs) because of low relative abundance compared to other species. Kusawa Lake had the lowest MEI (.74) but the highest lake trout MSY of (8,810 kgs) because of high relative abundance. Teslin, the largest of the three lakes, had the highest all species MSY (50,625 kgs) and lake trout MSY (9,112 kgs), although percent lake trout caught was low. Resulting MSY's for lake trout, expressed in kilograms per hectare, ranged from 0.11 (Laberge) to 0.62 (Kusawa).

5.4 Species Composition and Catch per Unit Effort

The species composition was quite varied between each lake. The dominant catch by weight on Lake Laberge was longnose sucker (50.1%), while on Teslin Lake the catch of longnose sucker was insignificant. Lake trout was the dominant catch by weight on Kusawa Lake, (44.6%), more than twice that of Teslin Lake (18.5%) and approximately seven times that of Lake Laberge (7.0%). The gillnet catches also indicate that lake trout was the dominant predator species on Kusawa Lake, with northern pike and burbot completely absent from the gillnet sets. Burbot catches on Lake Laberge were more than double those of lake trout. On Teslin Lake, burbot and lake trout catch by weight, were comparable, with incidental catch of northern pike (table 4).

Table 3. Calculated morphoedaphic indices (MEI), mean annual temperatures and maximum sustainable yields (MSY) for lake trout within Kusawa, Laberge and Teslin Lakes.

VARIABLE	LAKE		
	Kusawa	**Laberge**	**Teslin**
MEI	.74	1.26	1.08
Temperature[1](°C)	-1.2	-1.2	-1.8
Surface Area (ha)	14,200	20,100	35,400
MSY[2] all species (kgs)	19,579	32,159	50,625
Lake Trout Biomass (%)	45	7	18
MSY Lake Trout (kgs)	8,810	2,251	9,112
MSY Lake Trout (kgs/ha)	.62	.11	.26

[1] mean annual air temperature (Environment Canada, 1982)

[2] calculated from the MSY/surface area and using the equation $\log_{10}$ MSY = .050 TEMP + .280 $\log_{10}$ MEI +.236 (Schlesinger & Reiger, 1982)

Table 4. Species composition, as percentage of the total catch biomass, from summer index netting on Kusawa, Laberge and Teslin Lakes, 1991-1993.

SCIENTIFIC NAME	SPECIES	LAKE		
		Kusawa	Laberge[1]	Teslin
Salvelinus namaycush	lake trout	44.6	7.0	18.5
Coregonus clupeaformis	lake whitefish	21.9	19.3	22.3
Coregonus nasus	broad whitefish	9.3	.4	24.6
Coregonus sardinella	least cisco	-	5.7	7.4
Prosopium cylindraceum	round whitefish	1.8	.1	2.3
Catostomus catostomus	longnose sucker	21.3	50.1	1.1
Lota lota	burbot	-	16.9	17.0
Esox lucius	northern pike	-	.4	6.4
Thymallus arcticus	arctic grayling	1.1	.1	.4

[1] capture of migrating chinook salmon (Oncorhynchus tshawytacha) excluded from analysis

Of the three whitefish species caught, lake whitefish dominated the catch by weight on Kusawa Lake (21.9%), and Lake Laberge (19.3%), while on Teslin Lake catches of broad whitefish (24.6%) and lake whitefish (22.3%) were equal. Round whitefish and arctic grayling catches were insignificant on all three lakes. Least cisco were completely absent from Kusawa Lake catches and made up only a minor percentage of the catch within Lake Laberge (5.7%) and Teslin Lake (7.4%). Incidental catches of migrating chinook salmon occurred on Lake Laberge only.

The catch per unit effort (CPUE) of lake trout, which is an index or relative measure of abundance, was highest on Kusawa Lake at 9.22fish/100m/24hr (table 5). This is approximately five times that for Laberge and Teslin Lakes. CPUE for burbot was higher than for lake trout on Laberge and Teslin Lakes. Lake Laberge had the highest overall, CPUE at 91.18fish/100m/24hr, more than double the CPUE for Kusawa and Teslin Lakes. The highest single species CPUE of all three lakes, was longnose sucker on Lake Laberge at 32.21fish/100m/24hr.

Table 5. Relative catch per unit effort (CPUE) data from summer index netting on Kusawa, Laberge and Teslin Lakes, 1991-1993.

UNIT	SPECIES	LAKE		
		Kusawa	Laberge	Teslin
#/100m/24hr	lake trout	9.22 ± 3.06	2.11 ± .65	2.03 ± .93
	lake whitefish	12.14 ± 9.31	28.12 ± 17.11	9.08 ± 2.45
	broad whitefish	2.57 ± 2.18	.19 ± .15	6.42 ± 2.72
	least cisco	-	19.27 ± 20.80	15.62 ± 19.52
	round whitefish	2.37 ± 4.41	.86 ± 1.44	1.25 ± .53
	longnose sucker	7.38 ± 7.47	32.21 ± 8.41	1.02 ± .72
	burbot	-	8.15 ± 2.25	4.33 ± 1.37
	northern pike	-	.10 ± .12	.64 ± .49
	chinook salmon	-	.07 ± .09	-
	arctic grayling	.71 ± .80	.09 ± .12	.20 ± .32
	species combined	34.38 ± 20.51	91.18 ± 22.34	40.60 ± 19.94
kg/100m/24hr	lake trout	12.01 ± 3.99	3.61 ± 1.11	4.56 ± 2.09
	lake whitefish	6.00 ± 4.60	10.37 ± 6.31	5.38 ± 1.45
	broad whitefish	2.55 ± 2.16	.20 ± .16	6.03 ± 2.56
	least cisco		2.29 ± 2.32	1.86 ± 2.32
	round whitefish	.46 ± .46	.08 ± .13	.55 ± .23
	longnose sucker	5.91 ± 5.98	26.56 ± 6.93	.28 ± .20
	burbot	-	8.93 ± 2.46	4.17 ± 1.32
	northern pike	-	.28 ± .33	1.54 ± 1.18
	chinook salmon	-	.37 ± .48	-
	arctic grayling	.31 ± .35	.03 ± .04	.09 ± .14
	species combined	27.23 ± 16.25	49.05 ± 12.02	24.60 ± 12.08

5.5 Age and Growth

5.5.1 Lake trout

Age specific mean fork lengths and weights of lake trout from all three lakes are presented in tables 6 to 8.

Of the 143 lake trout caught on Kusawa Lake ages ranged from 3 to 40 years, with a mean age of 13.19 years and a modal age of 9 years. Of the 51 lake trout caught on Lake Laberge, ages ranged from 4 to 39 years, with a mean age of 11.72 years and a modal age of 9 years. Of the 59 lake trout caught on Teslin Lake, ages ranged from 4 to 42 years, with a mean age of 16.62 years and a modal age of 9 years (figure 4).

Length-weight scatter plots and linear equations are presented in figure 5 and table 9 respectively for each lake. For any given length, lake trout from Lake Laberge averaged the greatest weight, while Kusawa lake trout averaged the least.

On average, the highest condition factors for lake trout were obtained on Lake Laberge, (1.83), while the lowest was found on Kusawa Lake (.80) (figure 6). Laberge and Teslin Lakes were consistently averaging over one which indicates that lake trout from these lakes were relatively fat or heavy for any given length.

Table 6. Age specific mean fork lengths and weights of lake trout from Kusawa Lake, 1993.

AGE	MALE			FEMALE			COMBINED[1]		
	n	Mean Length (mm)	Mean Weight (gm)	n	Mean Length (mm)	Mean Weight (gm)	n	Mean Length (mm)	Mean Weight (gm)
3	3	230.33	133.33				6	214.67	108.33
4	2	281.50	200.00				3	296.00	233.33
5	2	296.50	275.00				3	301.00	266.67
6	2	374.00	575.00				3	336.00	416.67
7	7	397.43	707.14	2	344.50	400.00	11	376.91	586.36
8	5	438.00	900.00	5	388.40	620.00	11	406.55	731.82
9	7	432.57	800.00	5	428.40	800.00	12	430.83	800.00
10	3	409.33	650.00	1	362.00	500.00	4	397.50	612.50
11	1	380.00	500.00	4	444.50	887.50	5	431.60	810.00
12	4	426.00	725.00				4	426.00	725.00
13	3	432.00	850.00	4	471.50	1125.00	7	454.57	1007.14
14	4	595.00	2812.50	1	540.00	1400.00	5	584.00	2530.00
15	3	615.00	3250.00	3	417.67	833.33	6	516.33	2041.67
16	2	435.00	850.00	4	506.00	1662.50	6	482.33	1391.67
17	7	532.43	1700.00	4	590.75	2325.00	11	553.64	1927.27
18	2	510.00	1200.00	3	578.33	1966.67	5	551.00	1660.00
19	4	537.50	1912.50	4	511.25	1550.00	8	524.38	1731.25
20	4	591.50	2200.00	2	525.00	2175.00	6	569.33	2191.67
21	1	730.00	4500.00	1	395.00	600.00	2	562.50	2550.00
22	1	470.00	1000.00	1	455.00	700.00	2	462.50	850.00
23	2	607.50	3100.00	1	505.00	1200.00	3	573.33	2466.67
24				1	730.00	5000.00	1	730.00	5000.00
28	1	605.00	2150.00				1	605.00	2150.00
29	1	880.00	7500.00				1	880.00	7500.00
37				1	810.00	7700.00	1	810.00	7700.00
40	1	815.00	4400.00				1	815.00	4400.00

[1] includes fish of unknown sex

Table 7. Age specific mean fork lengths and weights of lake trout from Lake Laberge, 1991.

AGE	MALE			FEMALE			COMBINED[1]		
	n	Mean Length (mm)	Mean Weight (gm)	n	Mean Length (mm)	Mean Weight (gm)	n	Mean Length (mm)	Mean Weight (gm)
4							1	315.00	325.00
5				3	388.33	650.00	4	373.80	570.00
6	3	510.00	1500.00				3	510.00	1500.00
7	3	516.67	1816.67				5	479.00	1450.00
8				1	415.00	700.00	4	401.50	700.00
9	2	460.00	1075.00	6	500.00	1679.17	8	490.00	1528.00
10				2	460.00	1087.50	2	460.00	1087.50
11				1	420.00	800.00	1	420.00	800.00
12				1	560.00	2000.00	1	560.00	2000.00
13	1	430.00	700.00				1	430.00	700.00
14				4	518.75	1912.50	4	518.80	1913.00
17				1	550.00	2150.00	1	550.00	2150.00
18	1	550.00	2150.00				1	550.00	2150.00
19	2	620.00	2700.00				2	620.00	2700.00
21	1	610.00	2900.00				1	610.00	2900.00
23	1	750.00	7725.00				1	750.00	7725.00
27	1	560.00	2375.00				1	560.00	2375.00
28				1	540.00	2100.00	1	540.00	2100.00
39	1	720.00	5000.00				1	720.00	5000.00

[1] includes fish of unknown sex

Table 8. Age specific mean fork lengths and weights of lake trout from Teslin Lake, 1992.

AGE	MALE			FEMALE			COMBINED[1]		
	n	Mean Length (mm)	Mean Weight (gm)	n	Mean Length (mm)	Mean Weight (gm)	n	Mean Length (mm)	Mean Weight (gm)
4							1	305.00	200.00
5							2	297.50	300.00
6				1	440.00	800.00	2	432.50	700.00
7				1	395.00	700.00	2	367.50	550.00
8				3	476.67	1333.33	6	420.83	900.00
9	3	586.00	2366.67	4	541.25	2000.00	8	545.38	2000.00
10	1	425.00	900.00				1	425.00	900.00
12	1	600.00	3400.00				2	650.00	3700.00
13	1	480.00	1300.00	2	665.00	3650.00	3	603.33	2866.67
14	2	527.50	1850.00				2	527.50	1850.00
15	1	540.00	1700.00	1	485.00	1400.00	2	512.50	1550.00
16	1	740.00	4600.00	1	635.00	3500.00	3	591.67	2933.33
17				1	595.00	3500.00	1	595.00	3500.00
18	1	640.00	2700.00				1	640.00	2700.00
19	1	550.00	1700.00				1	550.00	1700.00
20	1	550.00	1700.00				1	550.00	1700.00
22	1	540.00	1750.00				1	540.00	1750.00
26	1	525.00	1600.00	1	540.00	1700.00	2	532.50	1650.00
27				1	535.00	1700.00	1	535.00	1700.00
30	1	745.00	4600.00				1	745.00	4600.00
31	1	615.00	4000.00				1	615.00	4000.00
32	2	741.50	4950.00				2	741.50	4950.00
33	2	660.00	3550.00				2	660.00	3550.00
35	1	840.00	8500.00				1	840.00	8500.00
40				1	625.00	3000.00	1	625.00	3000.00
42	1	820.00	7200.00	1	490.00	1500.00	2	655.00	4350.00

[1] includes fish of unknown sex

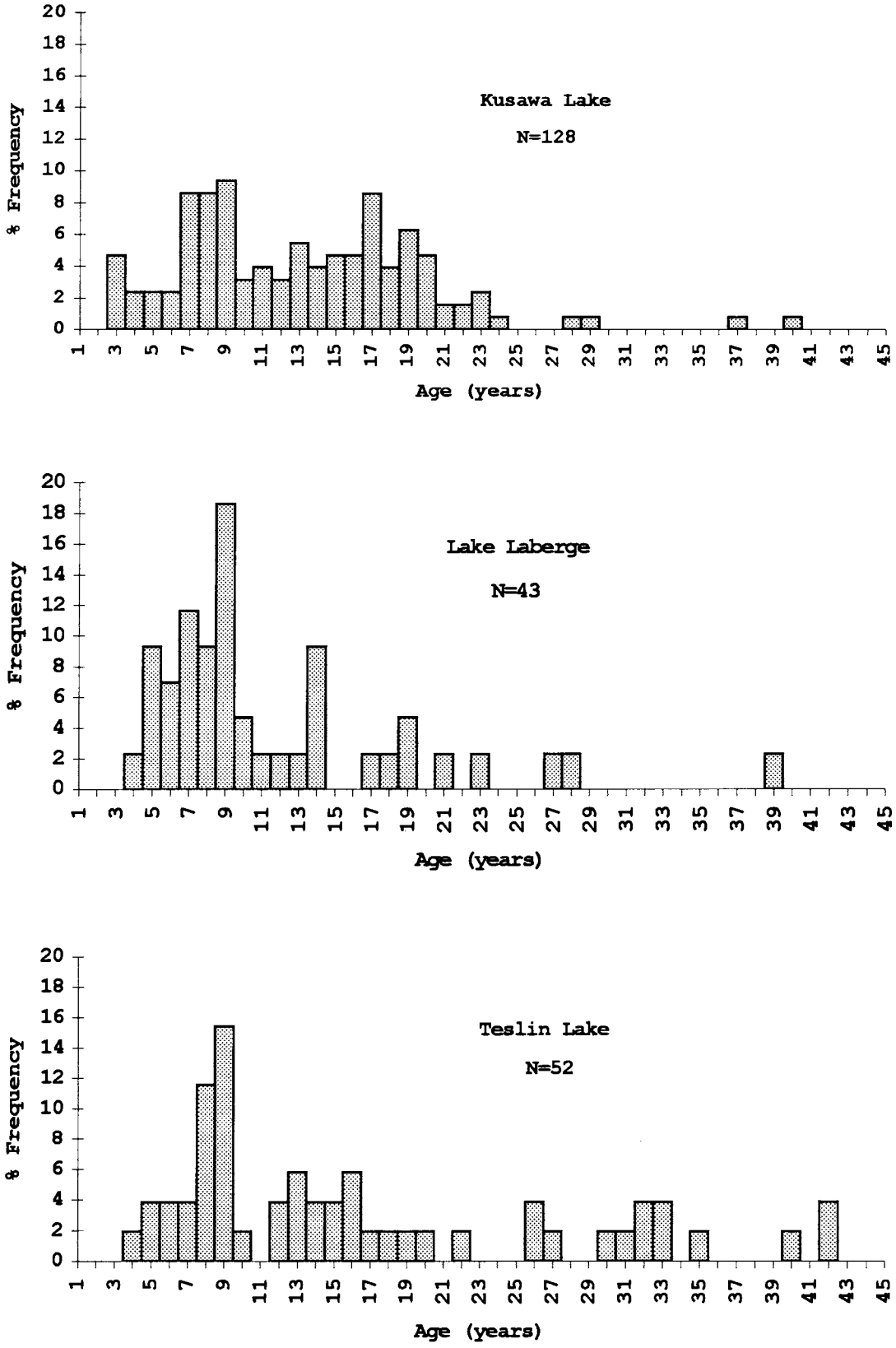
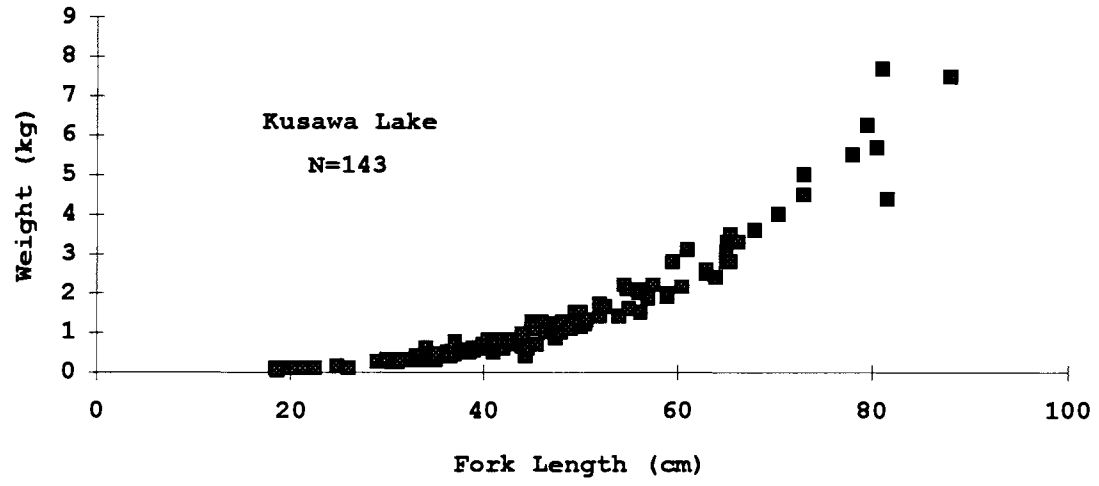
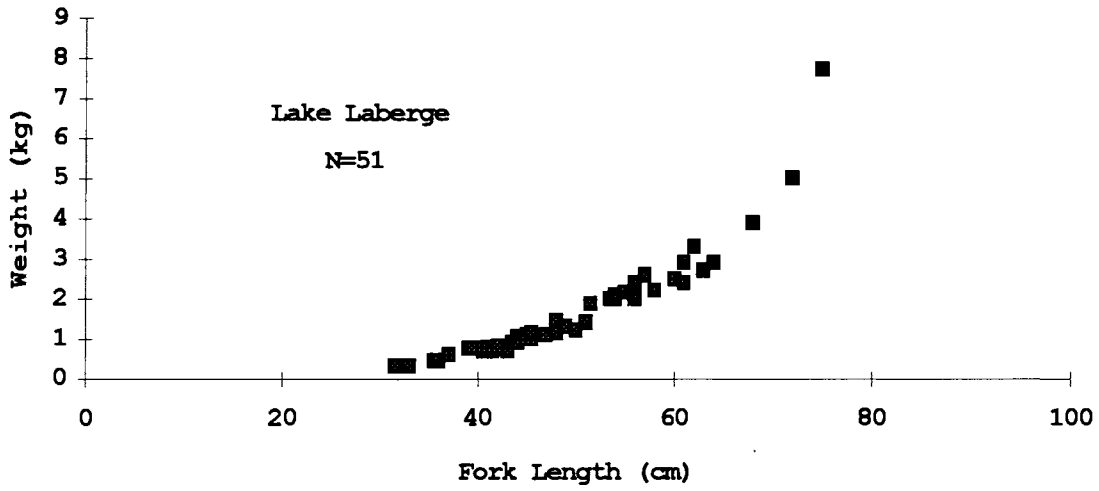


Figure 4. Age frequencies of lake trout caught in index nets on Kusawa, Laberge and Teslin Lakes, 1991-1993.





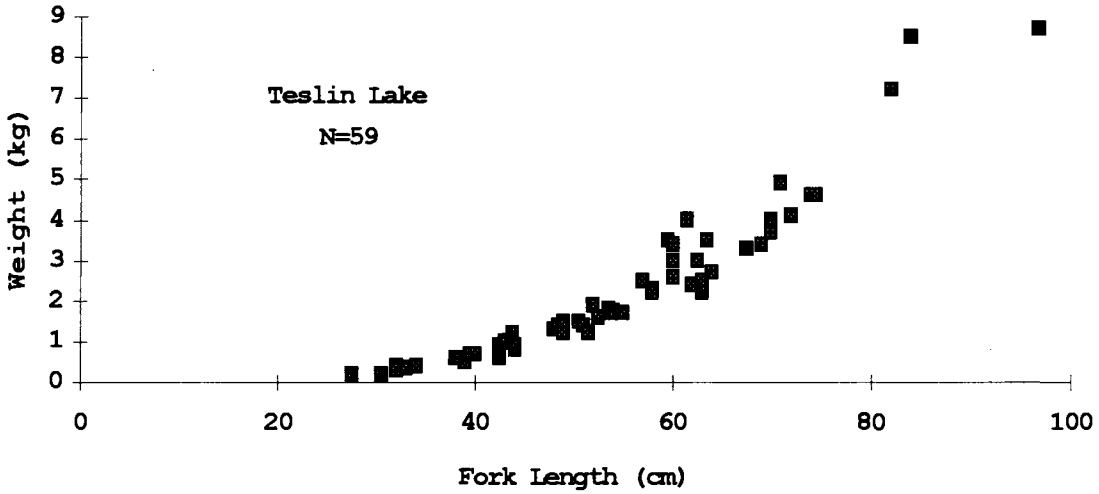


Figure 5. Length-weight scatter plots of lake trout from Kusawa, Laberge and Teslin Lakes, 1991-1993.

Table 9. Sex specific length-weight relationships of lake trout from Kusawa, Laberge and Teslin Lakes, 1991-1993.

Lake	Sex	Length-Weight Equation	n	r^2
Kusawa	M	Log weight = -5.42 + Log length (3.25)	53	.9524
	F	Log weight = -5.18 + Log length (3.11)	79	.9733
	Combined	Log weight = -5.22 + Log length (3.14)	143	.9692
Laberge	M	Log weight = -6.06 + Log length (3.66)	19	.9580
	F	Log weight = -5.42 + Log length (3.28)	25	.9741
	Combined	Log weight = -5.61 + Log length (3.40)	51	.9760
Teslin	M	Log weight = -4.86 + Log length (2.96)	26	.9347
	F	Log weight = -5.21 + Log length (3.16)	21	.9546
	Combined	Log weight = -5.34 + Log length (3.23)	59	.9694

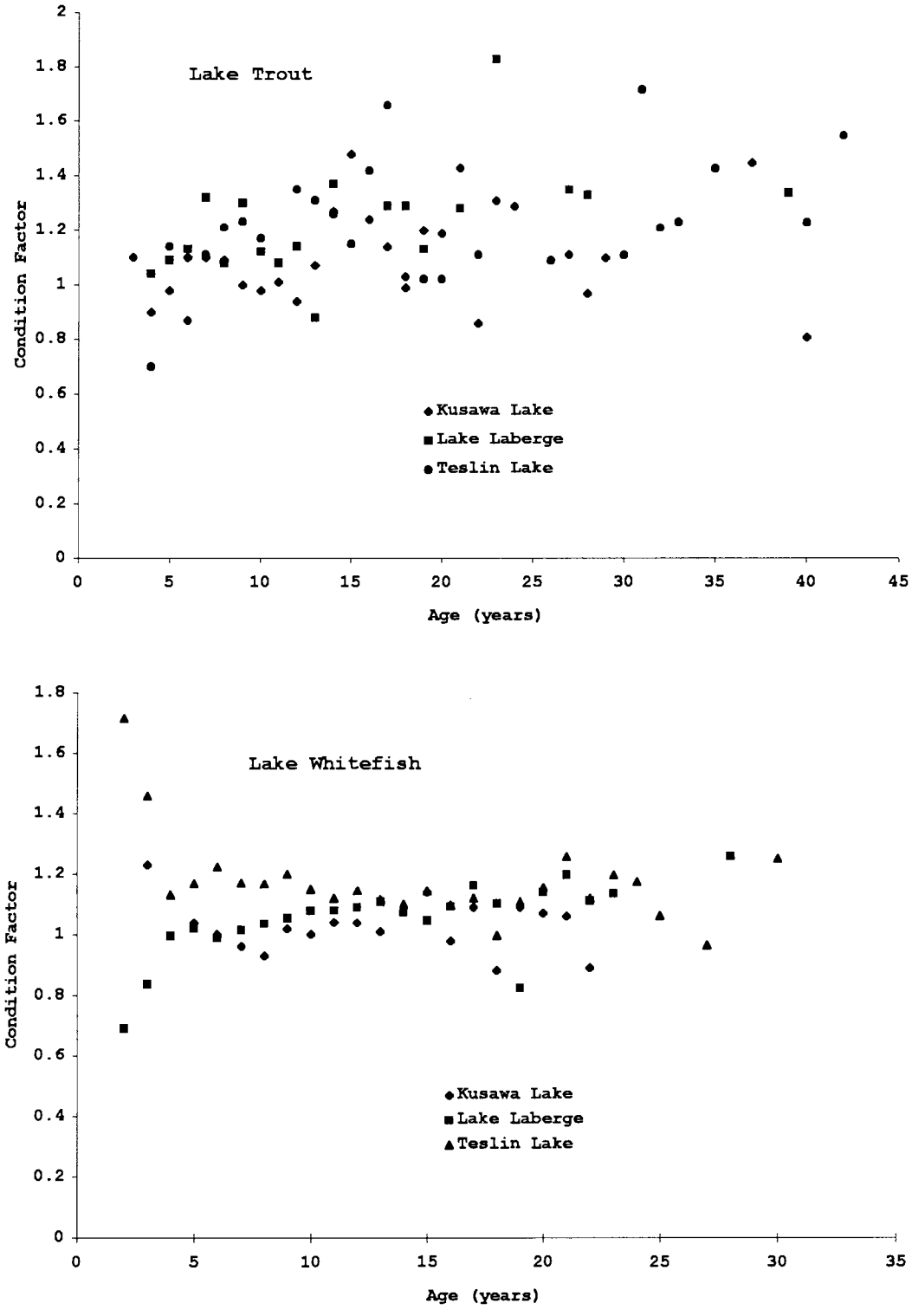


Figure 6 Condition factors at age of lake trout and lake whitefish from Kusawa, Laberge and Teslin Lakes, 1991-1993.

Length frequency histograms for lake trout are presented in figure 7. Lake trout from Kusawa Lake ranged from 185 to 880 millimetres in length, with a mean length of 457 millimetres and a modal length of 340 millimetres. Lake trout from Lake Laberge ranged from 315 to 750 millimetres in length, with a mean length of 497 millimetres and a modal length of 560 millimetres. Lake trout from Teslin Lake ranged from 275 to 968 millimetres in length, with a mean length of 540 millimetres and a modal length of 540 millimetres. The average length of lake trout from Teslin Lake was greater than for either Kusawa or Laberge Lakes.

Age-length scatter plots and Von Bertalanffy growth variables for lake trout are presented in figure 8 and table 10. Due to the small sample size for lake trout on Laberge and Teslin Lakes, no growth parameters could be calculated.

Of observed lake trout stomachs containing food items, invertebrates predominated the diet within Kusawa Lake, fish within Lake Laberge, and a combination of invertebrates and fish within Teslin Lake (table 11).

5.5.2 Lake Whitefish

Age specific mean fork lengths and weights of lake whitefish from gillnet catches from each lake are presented in Tables 12 to 14.

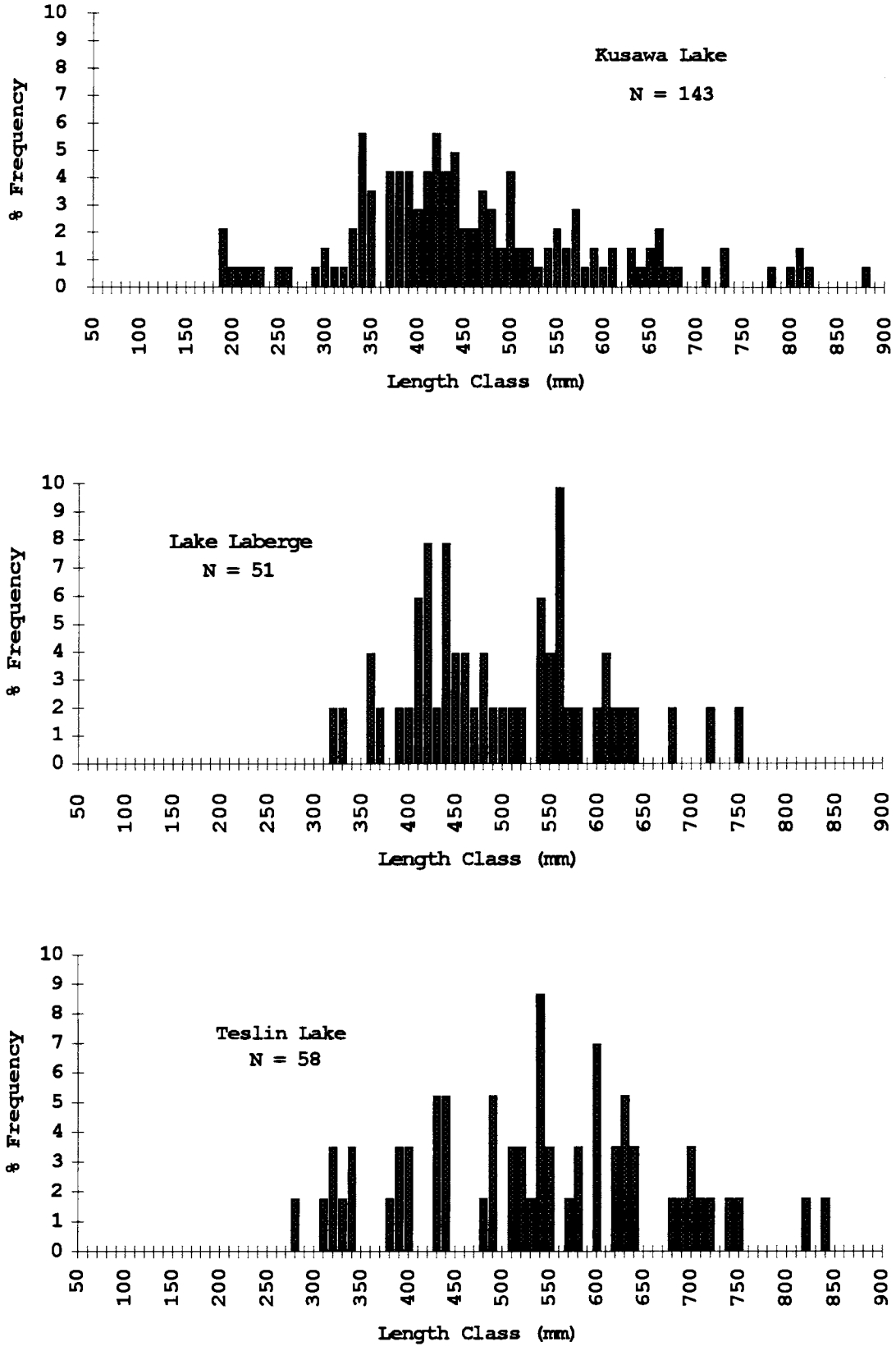
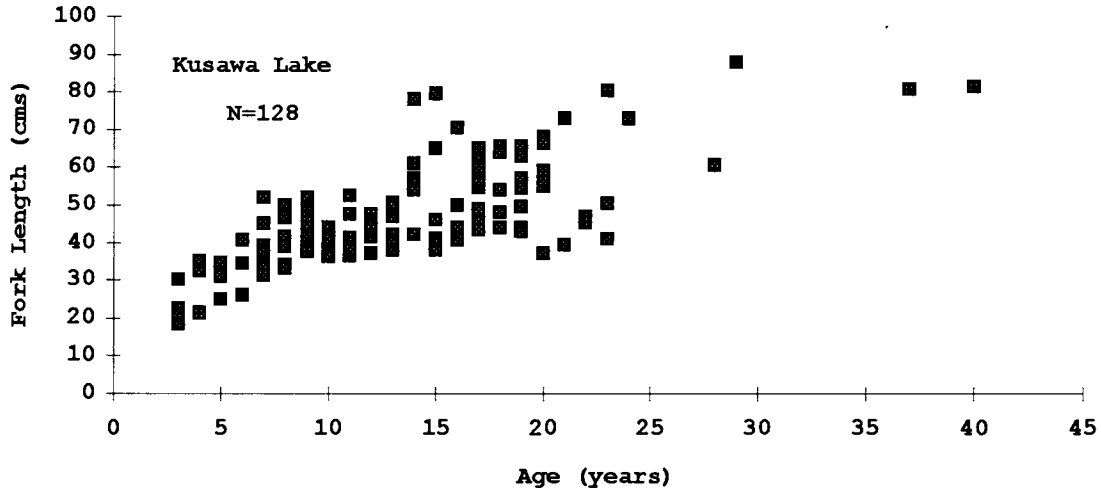
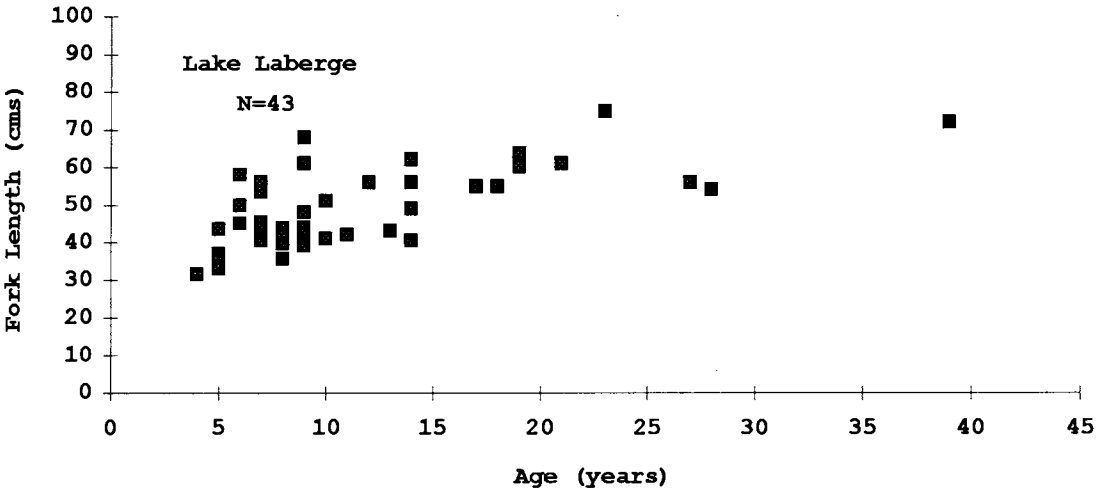


Figure 7. Length frequencies of lake trout caught in index nets on Kusawa, Laberge and Teslin Lakes, 1991-1993.





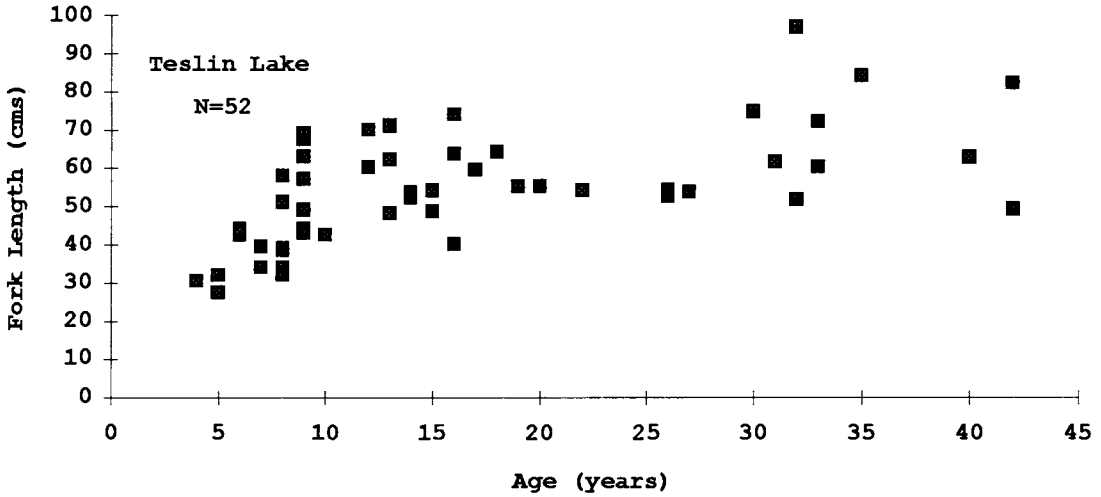


Figure 8. Age-length scatter plots of lake trout from Kusawa, Laberge and Teslin Lakes, 1991-1993.

Table 10. Von Bertalanffy growth variables for lake trout from summer index netting on Kusawa, Laberge and Teslin Lakes, 1991-1993.

Lake	Sex	$L^{\infty}{}'$ (mm)	K′	Age Range	N
Kusawa	Male	748	.085	7-9,17	26
	Female[1]	-	-	-	-
	Combined	802	.067	3,7-9,11,13-20	99
Laberge[1]	-	-	-	-	-
Teslin[1]	-	-	-	-	-

[1] insufficient sample size to calculate growth parameters

equation: $l_t = l_{\infty}\{l - e^{-k(t-to)}\}$

Table 11. Diet analysis by species for fish from summer index netting on Kusawa, Laberge and Tesiln Lakes, 1991-1993.

Lake	Species	Food Items																		
		Unidentified Fish	Unidentified Coregonids	Lake Whitefish	Least Ciscoe	Longnose Sucker	Burbot	Slimy Sculpin	Unidentified Invertebrates	Bivalves (clams)	Gastropods (Snails)	Caddis-flies	Stone-flies	May-flies	Midge Flies	Aquatic Beetles	Amphipods	Leeches	Water Mites	Terrestrial Insects
Kusawa	Lake Trout	21	6	3				2	3	1	11	9	1	4	15	8				13
	Lake Whitefish								3	93	106	8			77	1		4	69	
	Broad Whitefish									29	9	3		1	34					
	Arctic Grayling										1				2	11				77
Laberge	Lake Trout	24																		
Tesiln	Lake Trout	24			3				4						3		2			
	Lake Whitefish	1							29	66	175				42				6	
	Broad Whitefish									95	51				96					
	Round Whitefish									4	8				5					
	Northern Pike				5	1	1													
	Burbot	32			10			5	1						1					
	Arctic Grayling								5											1

Table 12. Age specific mean fork lengths and weights of lake whitefish from Kusawa Lake, 1993.

AGE	MALE			FEMALE			COMBINED[1]		
	N	Mean Length (mm)	Mean Weight (gm)	N	Mean Length (mm)	Mean Weight (gm)	N	Mean Length (mm)	Mean Weight (gm)
3	1	290.00	300.00				1	290.00	300.00
5	3	334.00	383.33	1	360.00	500.00	4	340.50	412.50
6	6	337.33	383.33				6	337.33	383.33
7	5	336.00	350.00	3	341.67	416.67	9	335.00	361.11
8	4	368.00	450.00	3	342.33	383.33	7	357.00	421.43
9	7	353.00	435.71	10	349.10	445.00	17	350.71	441.18
10	19	350.11	423.68	11	367.91	504.55	32	355.28	448.44
11	9	356.89	466.67	9	364.00	505.56	18	360.44	486.11
12	6	370.83	550.00	7	363.71	492.86	14	364.50	503.57
13	7	368.57	492.86	8	374.13	543.75	15	371.53	520.00
14	4	393.00	637.50	7	371.00	564.29	11	379.00	590.91
15	3	401.67	666.67	3	385.00	716.67	6	393.33	691.67
16	1	380.00	500.00	1	420.00	750.00	2	400.00	625.00
17	2	370.00	550.00	1	400.00	700.00	3	380.00	600.00
18	1	371.00	450.00				1	371.00	450.00
19				1	346.00	450.00	1	346.00	450.00
20	1	415.67	800.00	1	385.00	500.00	4	408.00	725.00
21				4	401.25	687.50	4	401.25	687.50
22	1	395.00	550.00				1	395.00	550.00

[1] includes fish of unknown sex

Table 13. Age specific mean fork lengths and weights of lake whitefish from Lake Laberge, 1991.

AGE	MALE			FEMALE			COMBINED[1]		
	N	Mean Length (mm)	Mean Weight (gm)	N	Mean Length (mm)	Mean Weight (gm)	N	Mean Length (mm)	Mean Weight (gm)
2							9	190.56	47.78
3							46	190.00	57.39
4	1	275.00	200.00				19	207.89	89.47
5	5	306.00	275.00	5	291.00	265.00	20	283.90	233.75
6	19	305.53	282.89	7	305.71	282.14	40	298.20	262.50
7	18	307.22	293.06	18	318.61	334.72	44	309.77	301.70
8	37	318.12	325.68	43	324.88	353.02	96	318.55	334.69
9	36	330.83	377.78	44	326.82	367.61	85	327.67	370.59
10	26	346.35	449.04	34	343.38	433.09	66	342.17	432.20
11	27	341.67	410.19	22	350.23	481.82	50	344.80	442.50
12	21	342.86	434.52	27	355.93	487.04	49	350.82	470.92
13	14	355.00	466.07	12	360.00	497.92	30	351.33	480.00
14	9	345.00	452.78	9	367.78	505.56	20	358.95	496.25
15	11	385.45	595.45	11	358.64	481.82	22	372.05	538.64
16	9	354.44	455.56	9	365.00	536.11	19	364.21	527.63
17	3	398.33	700.33	5	384.00	625.00	10	378.00	627.60
18	2	382.50	562.50	4	390.00	681.25	6	387.50	641.67
19				1	365.00	400.00	1	365.00	400.00
20	3	388.33	641.67	4	427.50	900.00	7	410.71	789.29
21	1	385.00	650.00	1	365.00	500.00	3	378.67	650.00
22	1	420.00	800.00	2	405.00	750.00	3	410.00	766.67
23				1	395.00	700.00	1	395.00	700.00
28				1	430.00	1000.00	1	430.00	1000.00

[1] includes fish of unknown sex

Table 14. Age specific mean fork lengths and weights of lake whitefish from Teslin Lake, 1992.

AGE	MALE			FEMALE			COMBINED[1]		
	N	Mean Length (mm)	Mean Weight (gm)	N	Mean Length (mm)	Mean Weight (gm)	N	Mean Length (mm)	Mean Weight (gm)
2							1	180.00	100.00
3							2	190.00	100.00
4							4	215.00	112.50
5	1	235.00	150.00	4	285.00	250.00	7	260.71	207.14
6	3	335.00	458.33	4	300.00	325.00	7	315.00	382.14
7	4	320.00	412.50	20	322.25	387.50	25	320.20	384.00
8	12	331.25	416.67	22	315.05	368.18	34	320.76	385.29
9	16	334.69	440.63	15	359.00	560.00	31	346.45	498.39
10	15	363.67	546.67	7	369.29	592.86	22	365.45	561.36
11	7	401.43	685.71	13	374.62	607.69	20	384.00	635.00
12	13	404.23	723.08	11	385.00	686.36	25	397.20	718.00
13	8	379.38	612.50	7	401.43	714.29	15	389.67	660.00
14	7	410.00	742.86	11	419.55	822.73	18	415.83	791.67
15	4	402.50	737.50	13	414.23	815.38	17	411.47	797.06
16	1	465.00	1200.00	1	435.00	800.00	2	450.00	1000.00
17	6	431.67	900.00	9	413.89	794.44	15	421.00	836.67
18	3	411.67	666.67	1	415.00	800.00	4	412.50	700.00
19	2	427.50	825.00	1	420.00	900.00	3	425.00	850.00
20	1	440.00	950.00	2	432.50	950.00	3	435.00	950.00
21				2	407.50	850.00	2	407.50	850.00
22				2	415.00	800.00	2	415.00	800.00
23				2	430.00	950.00	2	430.00	950.00
24				1	440.00	1000.00	1	440.00	1000.00
25	1	445.00	900.00	1	465.00	1100.00	2	455.00	1000.00
27	1	495.00	1100.00	1	460.00	1000.00	2	477.50	1050.00
30				1	400.00	800.00	1	400.00	800.00

[1] includes fish of unknown sex

Lake whitefish on Kusawa Lake ranged in age from 3 to 22 years, with a mean age of 11.29 years and a modal age of 10 years. Lake Laberge lake whitefish ranged in age from 2 to 28 years, with a mean age of 9.48 years and a modal age of 8 years. In Teslin Lake lake whitefish ranged in age from 2 to 30 years, with a mean age of 11.37 years and a modal age of 8 years (figure 9). Lake Laberge had the lowest mean age for whitefish in the three lakes surveyed.

Length-weight scatter-plots and linear relationships for lake whitefish are presented in figure 10 and table 15 respectively for each lake. Lake whitefish from Teslin Lake had the lowest average weight for any given length. Length-weight relationships for lake whitefish were comparable between Kusawa and Laberge Lakes.

On average, the highest condition factors for lake whitefish were on Teslin Lake, (1.69), while the lowest were on Lake Laberge, (.60) figure 6.

The lengths of lake whitefish on Kusawa Lake ranged from 290 to 457 millimetres, with a mean length of 362 millimetres and a modal length of 370 millimetres. Lake whitefish on Lake Laberge ranged from 165 to 505 millimetres, with a mean length of 319 millimetres and a modal length of 330 millimetres. On Teslin Lake lake whitefish ranged from 180 to 495 millimetres, with a mean length of 366 millimetres and a modal length of 420 millimetres (figure 11). Teslin Lake had the largest lake whitefish on average.

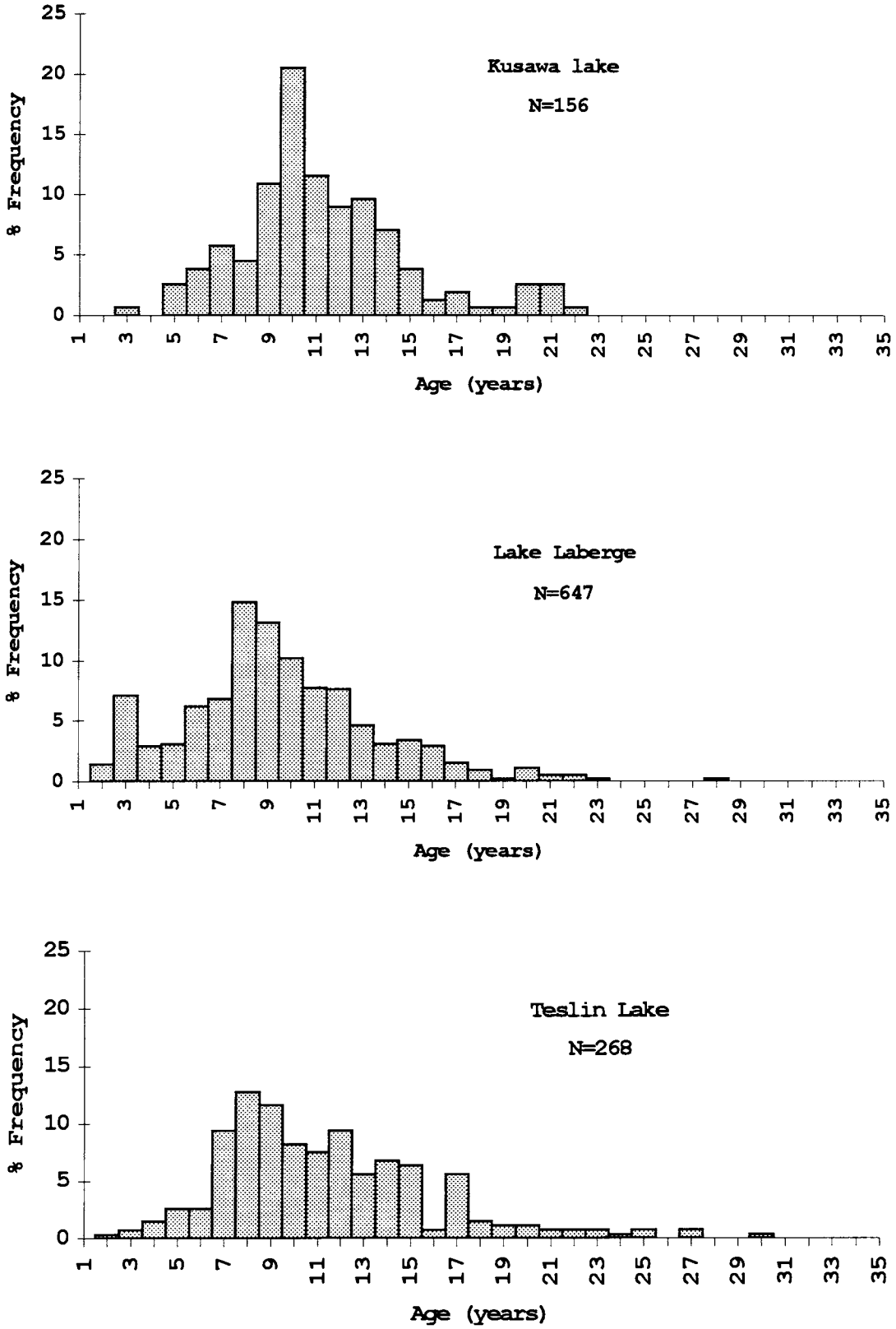
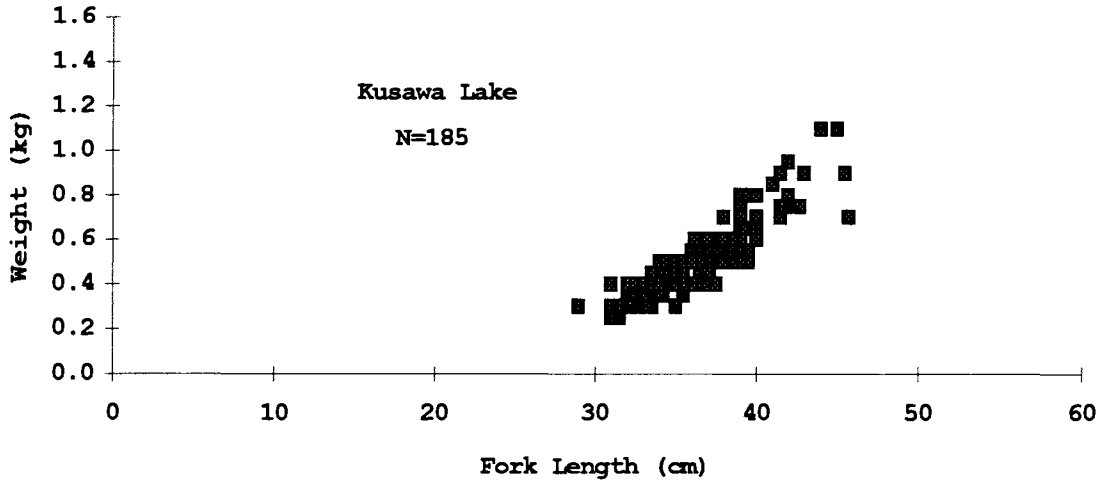
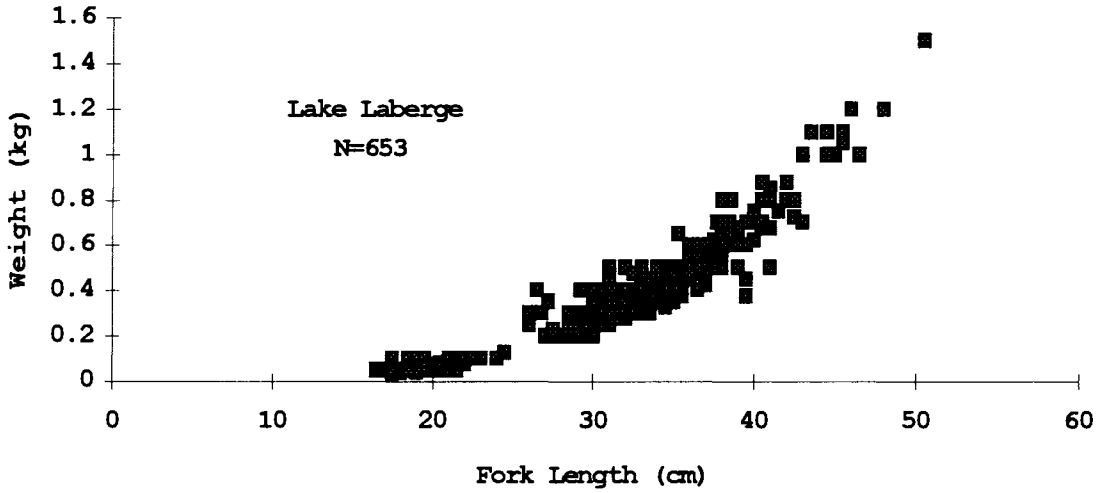


Figure 9. Age frequencies of lake whitefish caught in index nets on Kusawa, Laberge and Teslin Lakes,1991-1993.





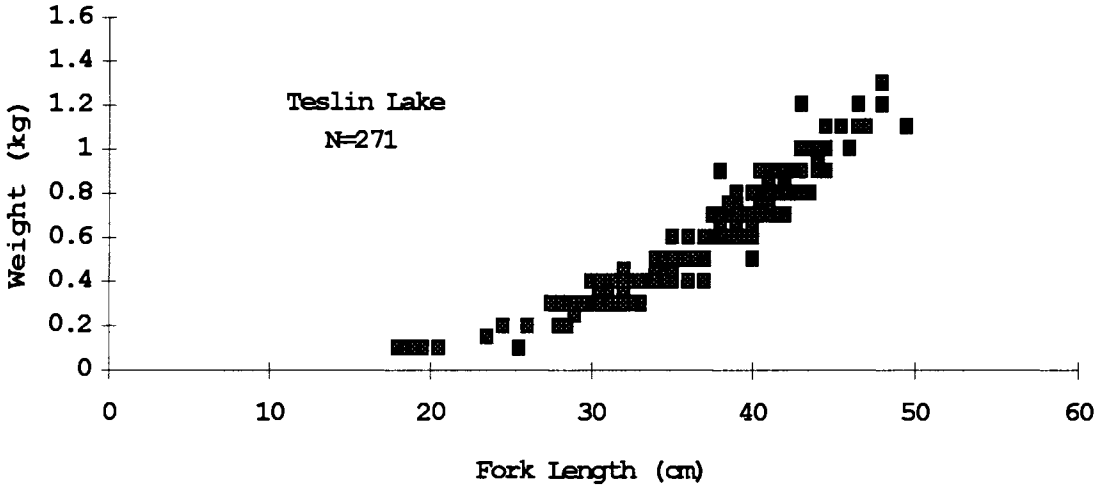


Figure 10 Length-weight scatter plots of lake whitefish from Kusawa, Laberge and Teslin Lakes, 1991-1993.

Table 15. Sex specific length-weight relationships of lake whitefish from Kusawa, Laberge and Teslin Lakes, 1991-1993.

Lake	Sex	Length-Weight Equation	N	r^2
Kusawa	M	Log weight = -5.34 + Log length (3.13)	99	.8182
	F	Log weight = -5.86 + Log length (3.34)	81	.7665
	Combined	Log weight = -5.65 + Log length (3.25)	185	.8081
Laberge	M	Log weight = -5.50 + Log length (3.20)	252	.8474
	F	Log weight = -4.65 + Log length (2.87)	274	.8142
	Combined	Log weight = -5.77 + Log length (3.31)	653	.9465
Teslin	M	Log weight = -4.28 + Log length (2.74)	105	.9167
	F	Log weight = -4.98 + Log length (3.01)	155	.9306
	Combined	Log weight = -4.52 + Log length (2.83)	271	.9373

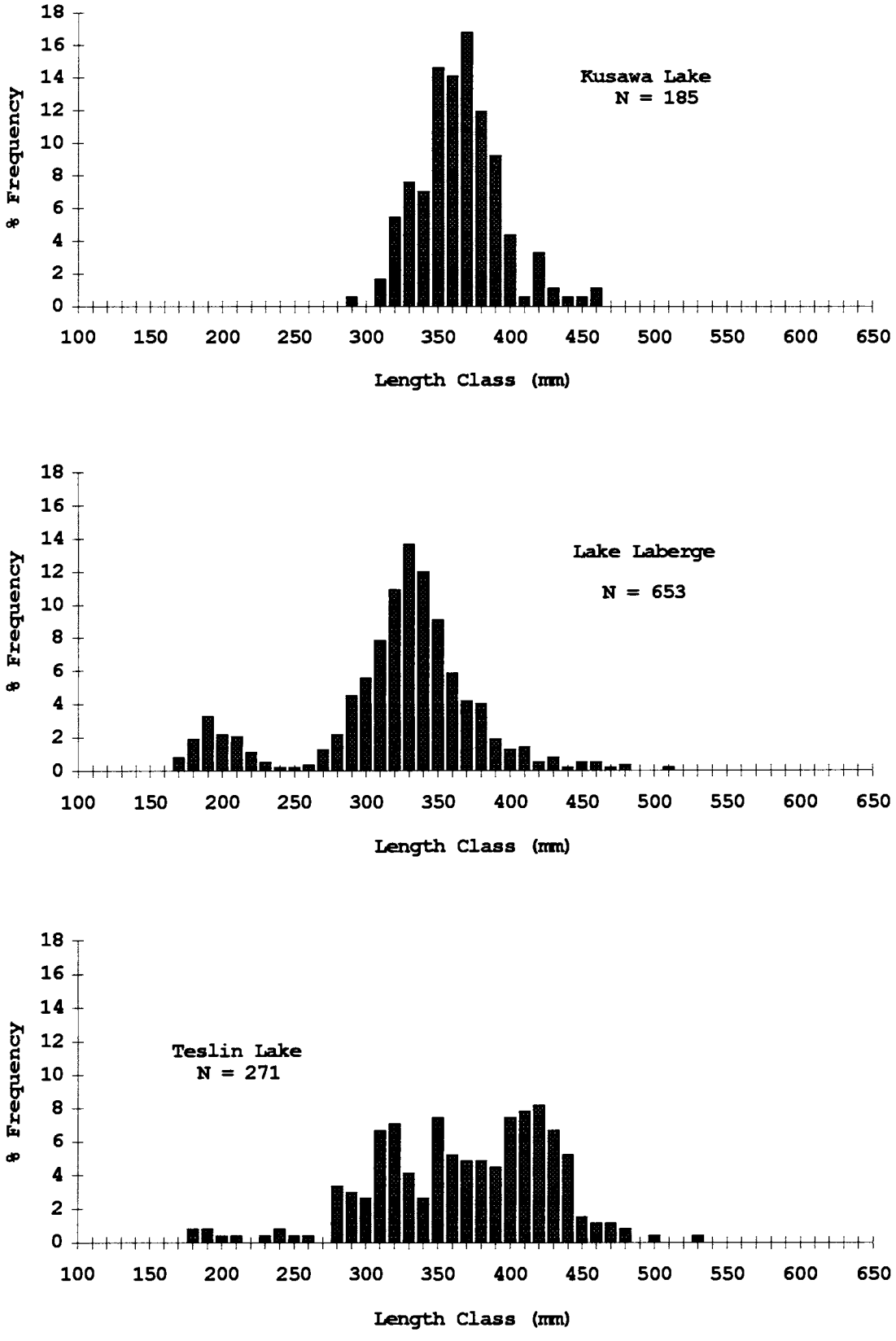


Figure 11. Length frequencies of lake whitefish caught in index nets on Kusawa, Laberge and Teslin Lakes,1991-1993.

Age-length scatter plots and Von Bertalanffy growth variables are presented in figure 12 and table 16. Growth coefficients were generally greatest on Kusawa Lake. Calculated asymptotic sizes ($L\infty$) for Laberge and Teslin Lakes were comparable and greater than those for Kusawa Lake.

Bivalves, gastropods and midges were predominant in the diet of both lake and broad whitefish within Kusawa and Teslin Lakes based on examination of stomachs which contained food. Other items included aquatic beetles, caddis flies, fish, leeches, water mites and terrestrial insects (Table 11).

5.6 Mortality

Mortality and survival rates for lake trout and lake whitefish by lake are presented in Table 17. Sample sizes for lake trout caught on Laberge and Teslin Lakes were too small to establish mortality and survival rate. Annual survival rates calculated as outlined by Robson-Chapman varied from .616 (Kusawa Lake) to .759 (Teslin Lake) for lake whitefish. The overall highest instantaneous mortality for lake whitefish was on Kusawa Lake (.485).

5.7 Maturity

Mean ages of maturity (MAM) for combined sexes of lake trout from Kusawa Lake were 5 years below those of Laberge and Teslin Lakes (Table 18). First onset of sexual maturity begins at age 6 on Kusawa and Laberge Lakes and 2 years later on Teslin Lake, with the

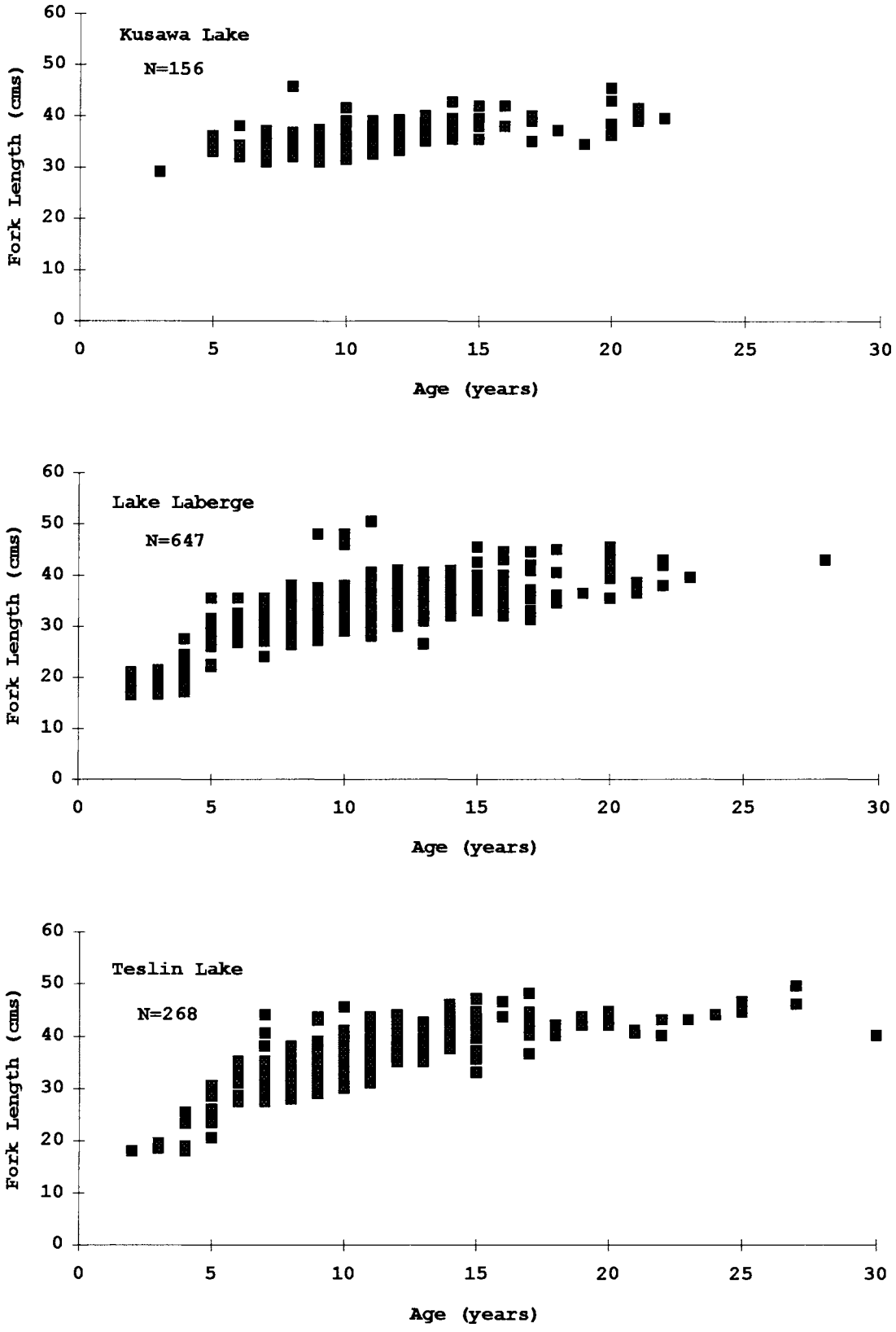


Figure 12. Age-length scatter plots of lake whitefish from Kusawa, Laberge and Teslin Lakes, 1991-1993.

Table 16. Von Bertalanffy growth variables for lake whitefish from summer index netting on Kusawa, Laberge and Teslin Lakes, 1991-1993.

Lake	Sex	$L^{\infty\prime}$	K'	Age Range	N
Kusawa	Male	446	.157	6,7,9-13	59
	Female	418	.178	9-14	52
	Combined	435	.164	6-15	135
Laberge	Male	437	.135	5-16	232
	Female	447	.128	5-17	246
	Combined	464	.112	2-18,20	638
Teslin	Male	468	.151	8-14,17	84
	Female	459	.156	7-15,17	128
	Combined	468	.148	5-15,17	236

equation: $l_t = l_\infty\{l - e^{-k(t-to)}\}$

Table 17. Robson-Chapman mortality and survival rates for lake trout and lake whitefish from summer index netting on Kusawa, Laberge and Teslin Lakes, 1991-1993.

Lake	Species	Instantaneous Mortality (Z)	Annual Mortality (A)	Annual Survival (S±1.96 S.E.)	Age Classes (years) used in calculation
Kusawa	Lake Trout	.176	.161	.839±.013	11,13-20
Laberge		*	*	*	*
Teslin		*	*	*	*
Kusawa	Lake Whitefish	.485	.384	.616±.033	11-15
Laberge		.307	.265	.735±.007	9-18,20
Teslin		.276	.241	.759±.011	9-15,17

* insufficient sample size for calculation

Table 18. Mean ages of maturity for lake trout and lake whitefish from summer index gillnetting on Kusawa, Laberge and Teslin Lakes, 1991-1993.

Lake	Species	Mean Age of Maturity (years)		
		Male	Female	Combined
Kusawa	Lake Trout	7.98	6.84	7.41
Laberge		*	*	12.29
Teslin		*	*	11.78
Kusawa	Lake Whitefish	7.85	*	7.00
Laberge		12.31	8.75	10.46
Teslin		10.89	8.48	9.31

* insufficient sample size for calculation

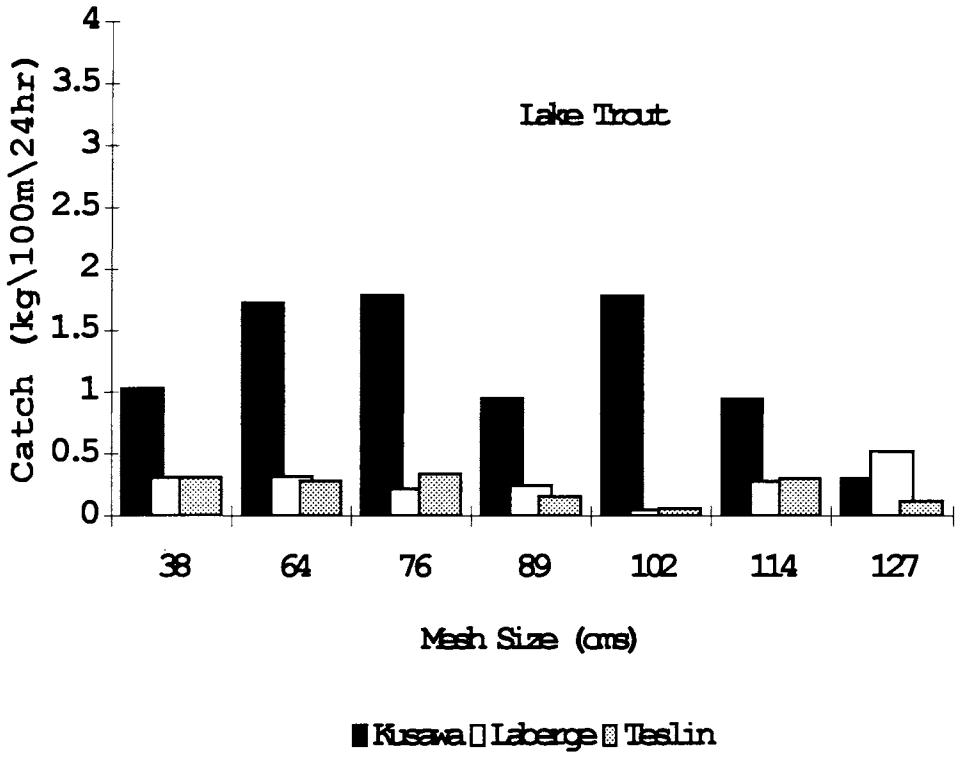
bulk of maturation complete by age 13. The mean ages of maturity for lake whitefish (sexes combined) were lowest on Kusawa Lake at 7.00, to a high of 12.31 for males, on Lake Laberge. Female lake whitefish on Laberge and Teslin Lakes were 3-4 years younger at first age of maturity than males. First onset of sexual maturity for lake whitefish begins at age 5 with the bulk of maturation complete by age 11. Lake trout and lake whitefish maturity at age tables for each lake are presented in appendix II.

5.8 Mesh Size Effects

The effects of gillnet mesh size on lake trout and lake whitefish catches are presented in appendix III. Mean lengths, weights and percentages of mature fish generally increased with mesh size. This relationship was more pronounced in lake whitefish. The frequency of lake trout catches was fairly evenly distributed amongst all seven mesh sizes (within all three lakes). A mesh size of 6.4 cm (2.5 inches) maximized catches of lake whitefish throughout each lake surveyed. The larger mesh sizes of 11.4 cm to 12.7 cm were least effective in the capture of lake whitefish on all three lakes (Figure 13).

5.9 Lake Whitefish Cyst Infestation

Infestation rates of *Triaenophorus crassus* in lake whitefish ranged from a low of 128 cysts per 45 kilograms on Teslin Lake, to a high of 267 cysts per 45 kilograms on Lake Laberge (Table 19). On Teslin Lake, infestation rate of *Triaenophorus crassus* in Broad whitefish was 42 cysts per 45 kilograms.



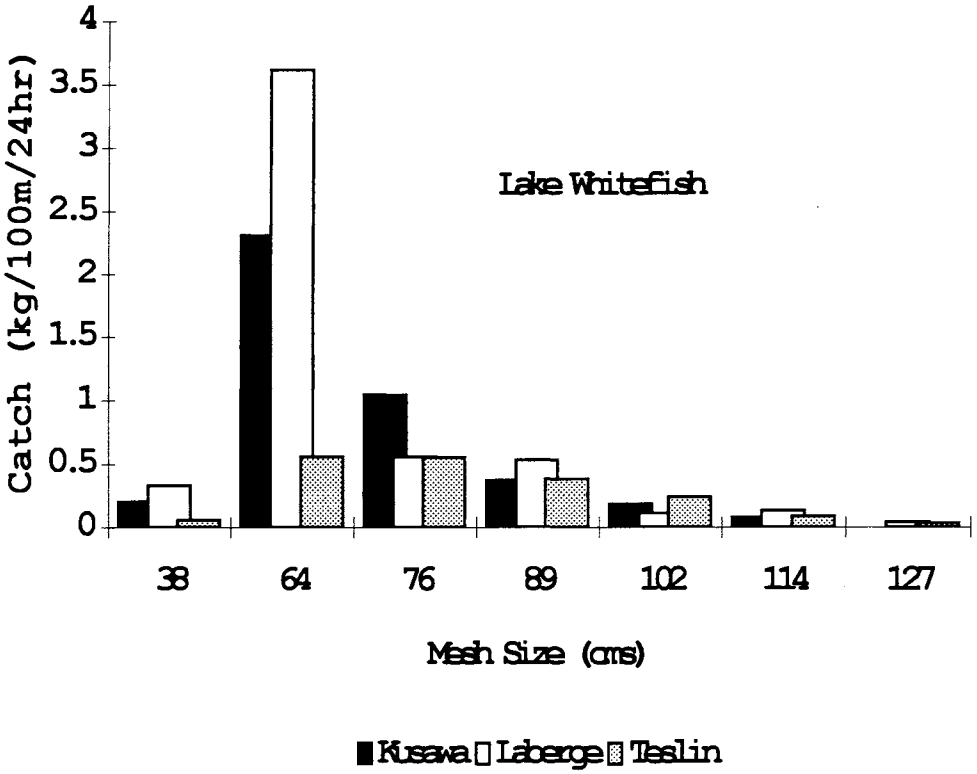


Figure 13. Mesh size effects of catches of lake trout and lake whitefish from index netting in Kusawa, Laberge and Teslin Lakes, 1991-1993.

Table 19. Lake Whitefish and Broad Whitefish Infestation rates of *Triaenophorus crassus* cysts from Kusawa, Laberge and Teslin Lakes, 1991-1993.

SPECIES	VARIABLE	LAKE		
		Kusawa	Laberge	Teslin
Lake Whitefish	Sample Weight (kgs)	28.9	10.9	26.9
	Cyst count	142	64	76
	Mean cysts per fish	2.8	2.2	1.8
	Infestation Rate (cysts/45kgs)	223	267	128
	Sample Size	51	29	42
Broad Whitefish	Sample Weight (kgs)	-	-	20.3
	Cyst count	-	-	19
	Mean cysts per fish	-	-	.46
	Infestation Rate (cysts/45kgs)	-	-	42
	Sample Size	-	-	41

DISCUSSION

6.1 Lake Productivity

Calculated MEI values for each lake surveyed are similar to those calculated for lakes of a similar size in the Yukon, deGraff (1992). The MEI values for Laberge and Teslin Lakes were comparable, while Kusawa Lakes' MEI was twice as low as that for Lake Laberge (Table 3).

The MEI values associated with these three lakes are a result of the low total dissolved solids' values, Kusawa (40mg/l), Laberge (68mg/l), and Teslin (64mg/l) and the high mean depth. The lower MEI values are associated with northern lakes where low concentrations of nutrients and cold deep water associated with low mean annual air temperature which results in low water temperatures and long ice covered seasons, severely limit any lake productivity. All three lakes are typically oligotrophic.

6.2 Lake Trout

The percentage of the catch as lake trout biomass was quite varied among all three lakes studied. The figure of 7% for Lake Laberge is quite low compared to results from previously surveyed lakes within the Territory (YTG files). Of ten lakes surveyed previously, lake trout biomass on Lake Laberge was four to five times lower than seven of the lakes surveyed, and approximately half that of the other two lakes surveyed. Kusawa

Lake had the second highest lake trout biomass of all ten lakes surveyed at 44.6%. Relative catch per unit effort for lake trout was lowest on Teslin Lake (table 5). This corresponds with low angling success of the sport fishery associated with this lake (YTG files). Of lakes surveyed to date, Kusawa Lake had one of the highest lake trout catch per unit effort recorded, 9.22/100m/24hrs, slightly less than Tagish Lake, which had the highest catch per unit effort of 11.3/100m/24 hrs (YTG files).

The mean ages of sexual maturity that were calculated in this study may be overestimated due to the difficulties in determining maturity, and differentiating immature gonadal tissue with those of mature non-spawning (resting) fish. Determining maturity of fish while in the field is difficult and can vary depending on who is assessing the maturity of the fish. A mature fish has been defined as a fish that will spawn or has spawned in the year of capture, or a fish that has spawned at some time, not necessarily in the year of capture, (Healey, 1970). In some instances mature, older aged (non-spawning) fish were misidentified as immature. It is well established that mature lake trout do not spawn every year (McPhail and Lindsay, 1970).

There appears to be only a slight difference between males and females in the age of attaining maturity on the three lakes in this study. Age at first maturity for female lake trout ranged from 9 years on Teslin Lake to 10 years on Kusawa Lake and 12 years on Lake Laberge. Age at first maturity for male lake trout ranged from 7 on Lake Laberge to 9 on Kusawa and Teslin Lakes. In Southern Ontario lakes females tend to mature at age 8,

while in northern Ontario lake trout mature two years later. This is similar to maturity schedules for Yukon lakes.

Size at first maturity of lake trout varied from a fork length of 336 mm for Kusawa Lake (a relatively unexploited lake) to more than 510 mm for Lake Laberge (heavily exploited). Lake trout from Kusawa Lake were smaller on average than those from exploited populations such as Lake Laberge. Mean age of first maturity for lake trout on three unexploited lakes surveyed in 1990 show similar results to those fish from Kusawa Lake varying around 336 mm - 350 mm. Lake trout from Lake Laberge are the largest reported size at first maturity.

The growth in length and in weight of young lake trout in Lake Laberge is faster than the growth of lake trout of the same age in Kusawa and Teslin Lakes. At age 4 Lake Laberge lake trout were 315mm in length compared to lake trout from Kusawa (296mm), and Teslin (305mm) Lakes. It should be noted that after the eighth year of life the growth in length is comparable in all three lakes and increases at a steady rate.

Generally, there is an increase in condition of lake trout with increase in size and age. The higher the condition factor the heavier the fish is for a given length. Larger size groups within Lake Laberge have high condition factors indicating ample forage base. Based on the condition factors that were calculated on all three lakes, lake trout from Kusawa and Teslin Lakes were similar averaging close to 1.0, while condition factors for Lake Laberge were 1.2. If the amount of food available increases the condition will likely increase. Thus

the high condition factors for lake trout for Lake Laberge corresponds with the large forage base available for lake trout on Lake Laberge.

Calculated mortality rates for lake trout are consistent with reported values for other large Yukon lakes (deGraff, 1992). The age composition and associated mortality rates for Kusawa Lake appear typical of unexploited or lightly exploited lake trout populations. Biased estimates of mortality and growth can result from errors in determining ages of fish. This is a particular problem in slow growing species such as lake trout.

Lake trout are omnivorous and feed upon a broad range of organisms including crustaceans, aquatic and terrestrial insects, many species of fishes and even small mammals (YTG files). Lake trout that feed on plankton are slower growing, smaller, and do not live as long as those that feed mainly on fish (Martin, 1966). In Lake Laberge lake trout fed entirely on fish. Lake trout from Lake Laberge had a higher condition factor at the same size and age than those from Kusawa Lake even though fish also represented a large part of their diet. Kusawa Lake lake trout also fed on invertebrate and aquatic organisms. Lake trout from Teslin Lake fed almost entirely on fish.

6.3 Lake Whitefish

The relative abundance of lake whitefish was similar in all three lakes representing approximately 20% of the biomass of the total catch in survey nets (Table 4). Broad whitefish were caught more frequently than lake whitefish in Teslin Lake, while in Laberge

and Kusawa Lakes catches of broad whitefish were insignificant. Longnose suckers were abundant in Lake Laberge, a biomass more than double that for lake whitefish. In Teslin Lake longnose sucker catches were insignificant, while the biomass of longnose sucker and lake whitefish in Kusawa Lake were similar. Lake Laberge had a CPUE for all species combined that doubles this for Kusawa and Teslin Lakes (Table 5) and a CPUE for lake whitefish that was 2 to 3 times that for the other two lakes.

The earliest age of sexual maturity for lake whitefish was similar on all three lakes at age 5, with all fish maturing by age 14 on Kusawa and Teslin Lakes. Lake Laberge whitefish did not become fully mature until much later at age 19. According to Bodaly, 1986, earliest maturity usually occurs between age 4-7 years with the majority of fish mature by age 9. As was the problem in determining maturity for lake trout the same scenario falls true here. Difficulty occurs when determining whether a fish is mature non-spawning or immature. It is believed that the maturity bias is more significant here than those associated with any ageing errors. Data indicated that the 7-15 year classes dominated the catches of lake whitefish in all three lakes.

Lake whitefish exhibited considerable variability in rate of growth from lake to lake. Three-year-old lake whitefish on Kusawa Lake were 290mm long, while 3 year old fish on Laberge and Teslin Lakes both averaged 190mm in length.

All age compositions and associated mortality rates indicate stocks within all three lakes to be stable and relatively unexploited. Good representation of older age groups combined with the large number of younger year classes are indicative of light exploitation.

Lake whitefish in all three lakes fed primarily upon gastropods and bivalves and are in turn preyed upon by larger piscivorous fish such as lake trout and northern pike.

6.4 Management Concerns

Lake trout are a highly desired species which are vulnerable to exploitation. The vulnerability of lake trout to exploitation is related to its low reproductive potential, slow growth, late maturity and slow turnover rate (Olver, 1988). Exploitation is the most critical factor affecting lake trout in the Yukon.

Lake trout is the target of the commercial fishery on Teslin Lake and by the sport fishery on all three lakes. The following table compares the lake trout maximum sustainable yield (MSY) for each lake and the total allowable harvest from all sectors of the fishery (sport, commercial, domestic and subsistence), at 15% of the MSY to maintain a high quality sport fishery.

LAKE TROUT

LAKE	MSY	15% MSY
KUSAWA	**8,810 kgms**	**1322 kgms**
LABERGE	**2,251 kgms**	**338 kgms**
TESLIN	**9,112 kgms**	**1367 kgms**

To ensure that the total lake trout catch stays well below the 15% MSY, it is important to continue to evaluate the sport fishery and keep harvest records from the net fishery on all three lakes.

Sport fishing surveys generally have shown that while the opportunity to catch fish is important, the number and size of the fish caught are less important compared to other values. The Recreational Fishing Survey conducted in 1990 concluded that of the 10 most important factors affecting the enjoyment of angling, the first 4 related to enjoying nature, relaxing, getting away and spending time with the family. It is also encouraging to know that total fish released was greater than total fish kept. Anglers are releasing more fish now than in the past. This factor will help in the conservation of lake trout stocks and will help to meet the needs and expectations of many Yukon anglers.

Laberge and Teslin Lakes are quite similar in that they have elevated burbot numbers and reduced populations of lake trout. Reduced harvests and slot limits must be implemented to protect less productive lake trout stocks and to allow over-exploited stocks to recover. Teslin Lake was designated as a High Quality Management (HQM) Lake in 1993 with reduced catch limits and a no harvest restriction for lake trout between 65cm and 100cm. In January 1995 a meeting was held with residents of the Teslin community who were concerned about the status of lake trout within Teslin Lake. The consensus was that HQM regulations should be maintained for a 5 year period and reassessed after that time. Lake Laberge has had reduced lake trout harvests since 1990 because of contaminant warnings. The lake trout harvest in both of these lakes fall below the allowable harvest of 15% MSY. Kusawa Lake currently supports a healthy lake trout population and is a relatively unexploited lake. Because of its large size and difficult access it has not received the angler pressure that Laberge and Teslin Lakes have, and has not been

designated HQM status. To maintain this healthy population it is imperative to educate anglers on the importance of the release of slot limit fish, and to eventually impose catch restrictions.

7.0 RECOMMENDATIONS

7.1 Kusawa Lake

(1) Conduct periodic surveys of the sport fishery to obtain better data and to establish the extent of the lake trout harvest by the sport fishery. This data can be used as an index of lake trout abundance.

(2) Re-evaluate the sport fishery regulations to protect lake trout stocks through High Quality Management regulations with reduced catch and possession limits and mandatory release of large lake trout within the slot limit (65cm-100cm).

(3) Encourage the use of under-utilized species such as longnose sucker and lake whitefish, both abundant species in Kusawa Lake.

7.2 Lake Laberge

(1) Monitor the lake periodically to see if the lake trout population are recovering with the lack of exploitation because of the closure of the commercial fishery and the reduced catch by domestic, native subsistence fishers and sports anglers.

(2) Allow the selective use of under-utilized species, especially burbot. A high density of prey species such as lake whitefish and longnose sucker are evident, therefore

allow the use of experimental gillnets and fishing gear to target these under-utilised species.

(3) Periodic index netting surveys to determine changes in lake trout abundance and population structures. Trend-through-time lake trout population data to be collected periodically for a minimum of 10-15 years.

7.3 Teslin Lake

(1) Teslin Lake can maintain the present commercial lake trout fishery without depleting the population. At present there is one commercial harvester with a quota of 125 kilograms of lake trout per year. The estimated sport fishery harvest in 1991 was 800 kilograms. The harvest of these two fisheries combined is below the target of 1,367 kg which represents 15% of the MSY, however subsistence harvests are not included.

(2) Conduct periodic survey's of the sport fishery to monitor lake trout harvest trends.

(3) A commercial fishery on Teslin Lake aimed strictly at lake whitefish would be non-viable because of high parasite counts. Broad whitefish had low parasite counts and could be targeted.

(4) Re-evaluate the sport fishery regulations to protect lake trout stocks through reduced catch limits, mandatory release of fish within a slot limit (65cm-100cm) and targeting other species.

(5) Encourage the use of set-lines to target the burbot population. Exploitation directed at a reduction in the burbot standing crop could result in a an increase in lake trout standing crop.

8.0 References

Abrasov, V.N. 1967. Determination of commercial turnover in natural bodies of water. Problems of Ichthyology. Translated from Russian by American Fisheries Societies. 9: Pages 482-489.

Bodaly, 1986. Biology, exploitation and culture of coregonid fishes in Canada. Department of Fisheries and Oceans.

Brown, R.F., Elson, M.S. and L.W. Steigenberger, 1976. Catalogue of Aquatic Resources of the Upper Yukon River Drainage (Whitehorse Area) Environment Canada PAC 1T-76-4.

Clemens, W.A., R.V. Boughton, and J.A. Rattenbury 1994. A Limnological Study of Teslin Lake, Canada. Management Publication No. 12. British Columbia Fish and Wildlife Branch. Pages 1-77.

Environment Canada. 1982. Canadian climate normals, 1951-1980. Atmospheric Environment Service. Ottawa, Ontario page 15.

Godin, Benoit and M. Jack. Environmental Quality of Lake Laberge, Yukon. Regional Program Report No. 84-03. April 1984, Environment Canada.

Hase, Frank and Eileen. 1993. Teslin, Yukon

Healy, M.C. 1978. The dynamics of exploited lake trout populations and implications for management. Journal of Wildlife Management 42(2): 307-328.

Horler, A. 1982. Estimating fish yield on select Yukon Lakes using the morphoedaphic index. Department of Fisheries and Oceans, Whitehorse.

Horler, A, R.A.C Johnston and G.M.W. Cronkite, 1983. An assessment of the fisheries Resource in 18 lakes within the Yukon Territory, Canada.

Kirkland, R.A., and G.B.J. Gray, Reconnaissance of the Chemical and Biological Limnology in Four large lakes of the Yukon River Basin. 1986. Environment Canada.

Lindsay C.C., K. Patalas, R.A. Bodaly and C.P. Archibald. Glaciation and the Physical, Chemical and Biological Limnology of Yukon Lakes. Western Region. Department of Fisheries and Oceans . Winnipeg, Manitoba. R3T 2N6. May 1981.
Canadian Technical Report of Fisheries and Aquatic Services. Number 966.

Lysack, W. 1980. 1979 Lake Winnipeg fish stock assessment program. Manitoba Department of Natural Resources. MS Report. No. 80-30, 118 pages.

Martin, N.V. 1966. The significance of food habits in the biology, exploitation, and management of Algonquin Park, Ontario, lake trout. Trans. Amer. Fish. Soc. 95(4): 415-422.

O'Conner, J. 1982. Sport Fisheries Biologist. Unpublished data from Manitoba Government files, Department of Natural Resources, Winnipeg, Manitoba.

Olver, C.H., 1988. The Regulation of Harvest in Lake trout Sport Fisheries: A Review and Appraisal.

Payne, N.R., R.M. Korver, D. Maclennon, S.J. Nepszy, B.J. Shuter, T.J. Stewart, and E.R. Thomas. 1990. The harvest potential and dynamics of lake trout stocks in Ontario. Lake trout synthesis, Ontario Ministry of Natural Resources, Toronto, Ontario. 72 pages.

Robson, D.S., and Chapman. 1961. Catch curves and mortality rates. Trans. Amer. Fish. Society. 90: 181-189.

Schlesinger, D.A., and H.A. Regier. 1982. Climatic and morphoedaphic indices of fish yields from natural lakes. Trans. Am. Fish. Society. 111:141-150.

Siegal, N., and C. McEwen. 1984. A Historical overview of fishing in the Yukon. Prep'd by Northern Biomes Ltd for The Department of Fisheries and Oceans Canada. Whitehorse, Yukon.

APPENDIX I
gillnet sample sites
water chemistry sites

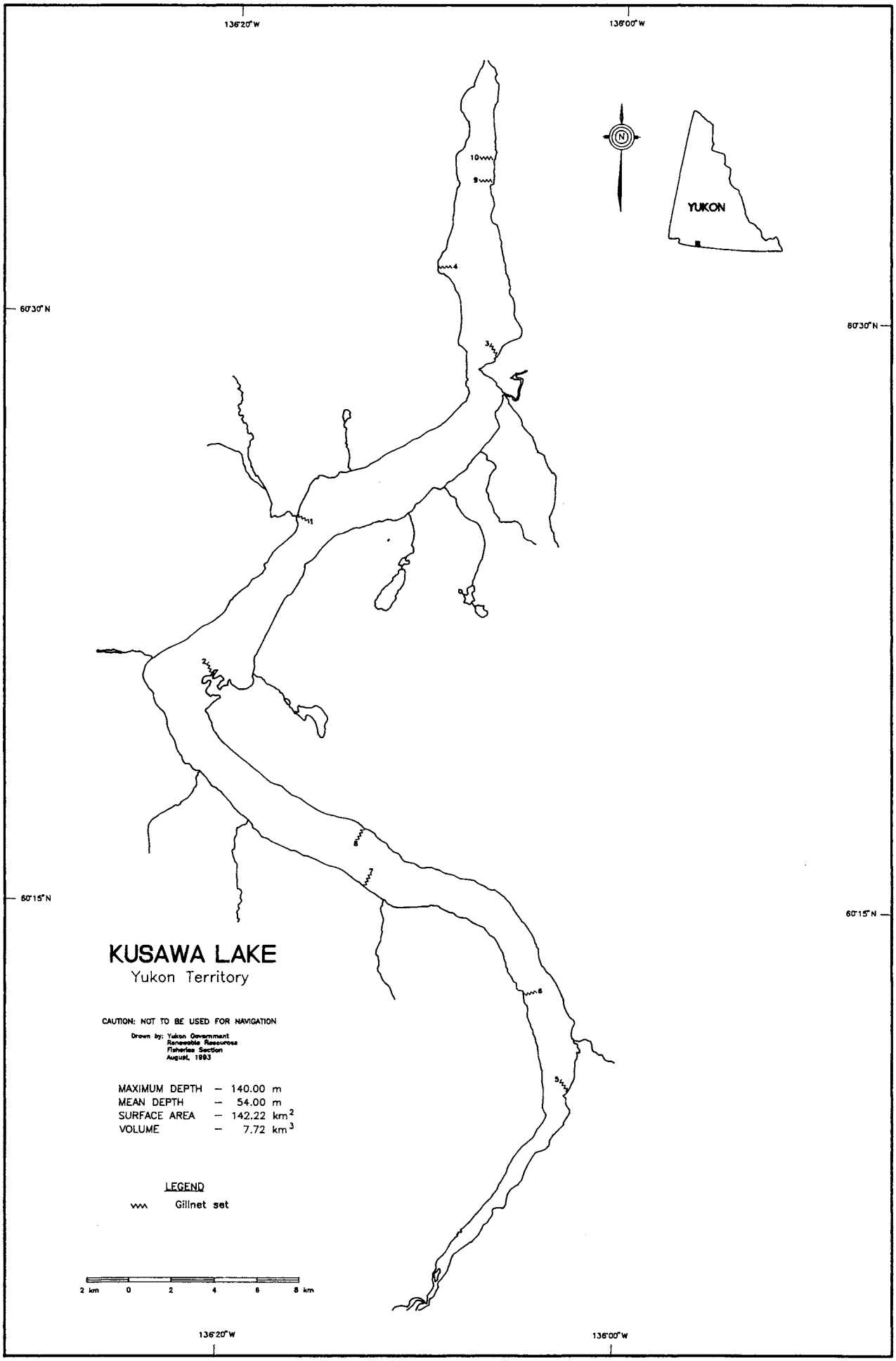


Figure Gillnet Sampling Sites 1993

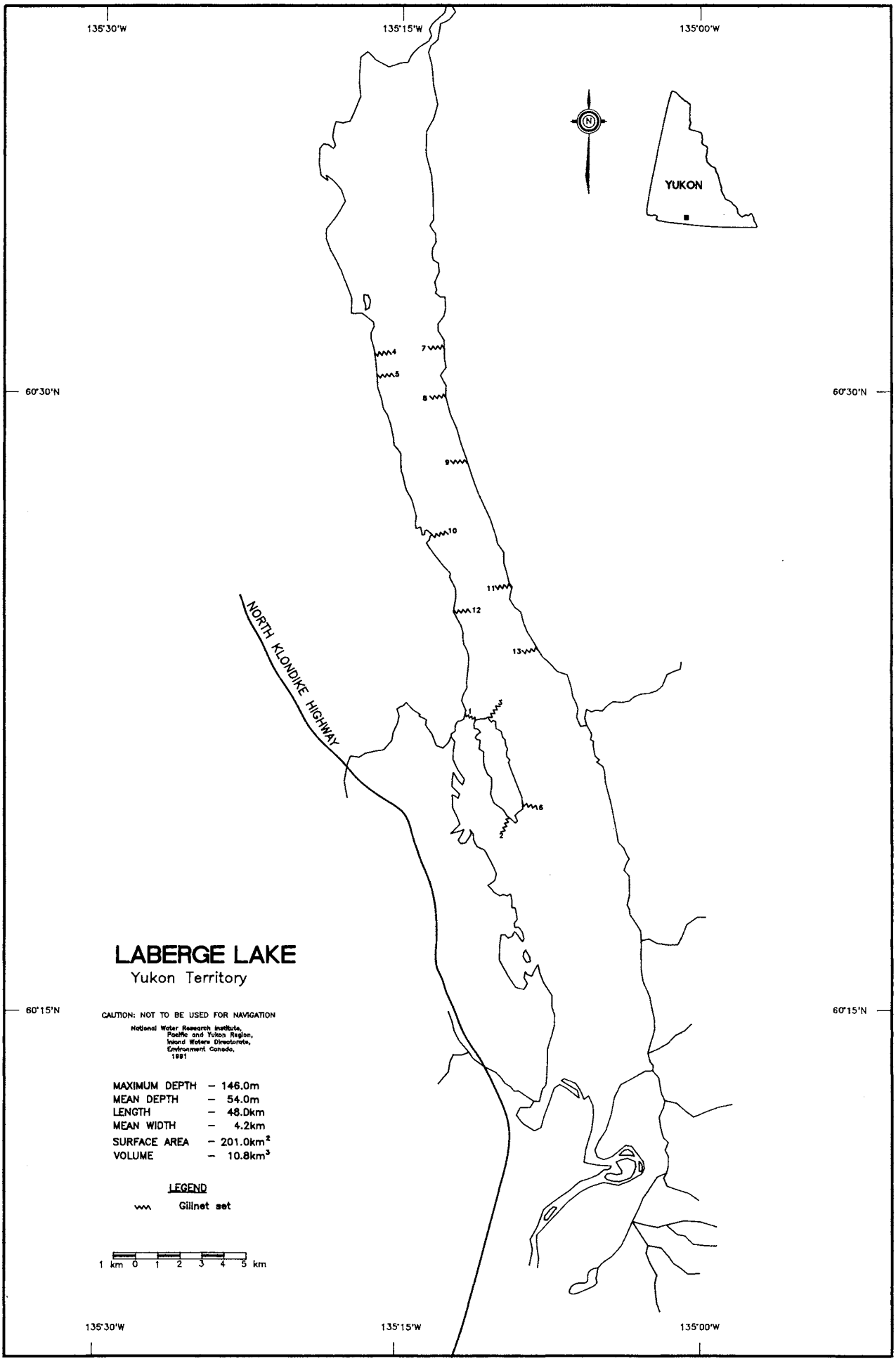
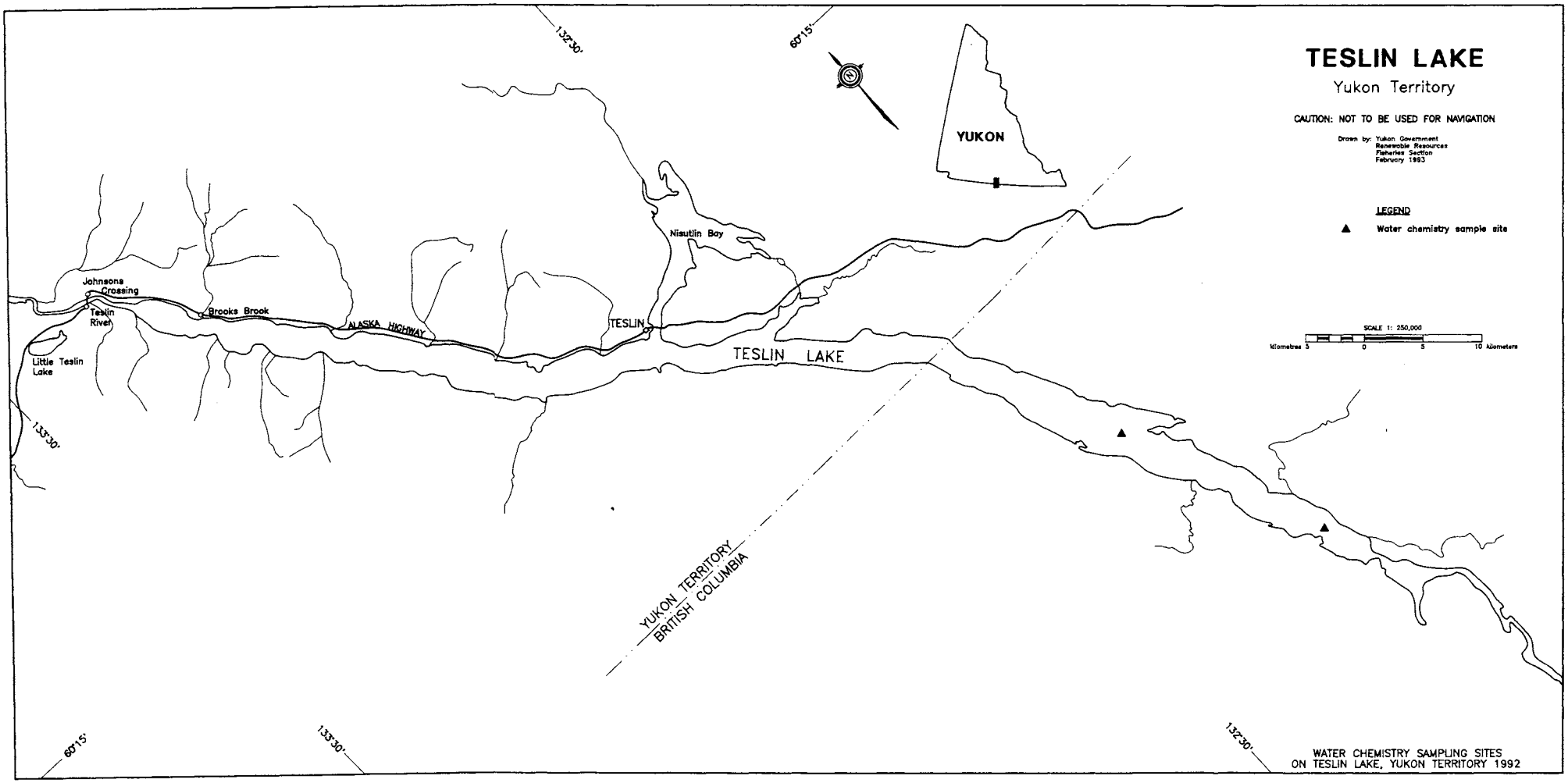
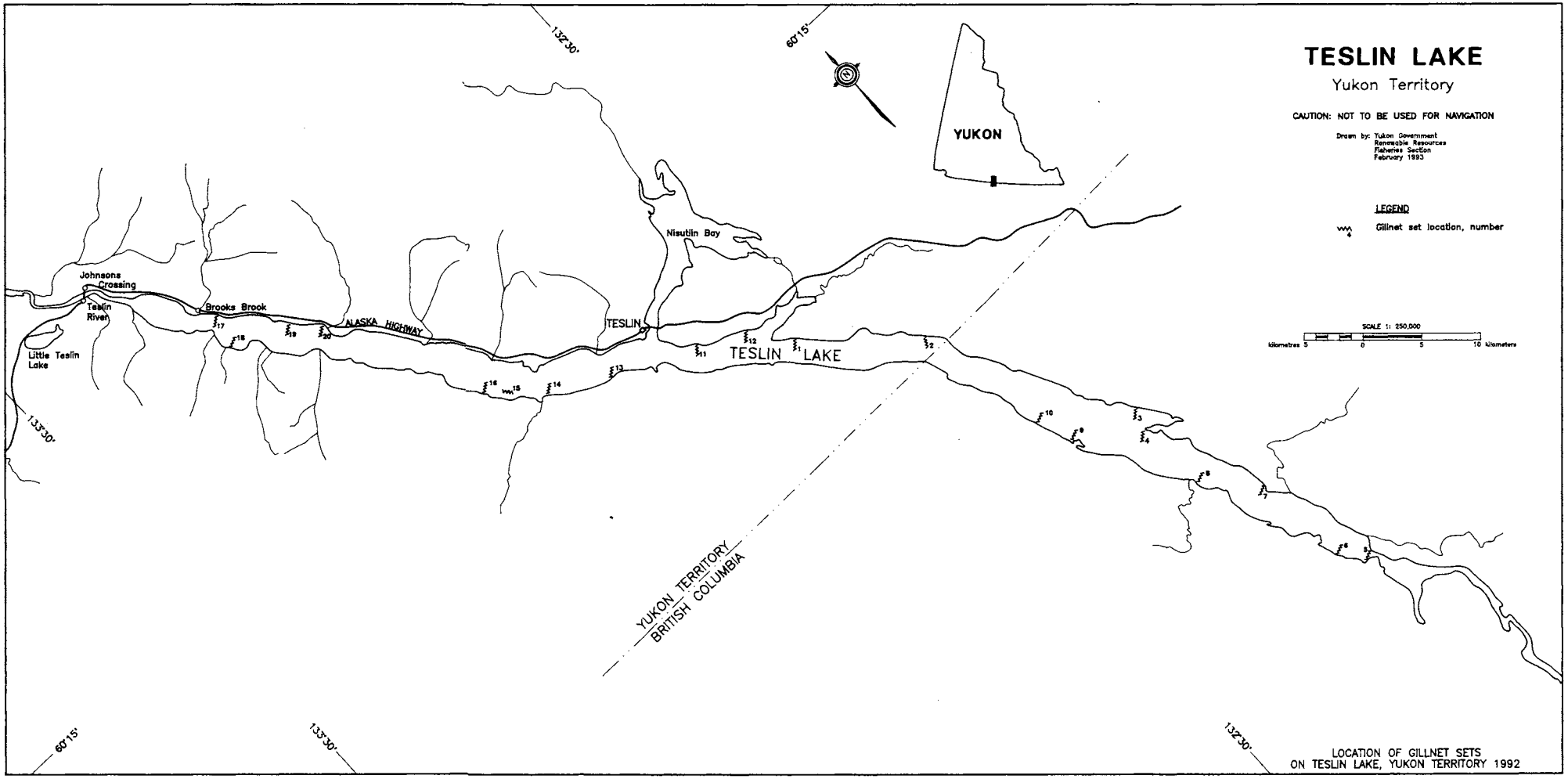


Figure 1991 Gillnet Sampling Sites


TESLIN LAKE
Yukon Territory
CAUTION: NOT TO BE USED FOR NAVIGATION
Drawn by: Yukon Government
Renewable Resources
Fisheries Section
February 1993
LEGEND
Water chemistry sample site
SCALE 1: 250,000
Kilometres 5 0 5 10 Kilometers
YUKON
Nisutlin Bay
Johnsons Crossing
Teslin River
Brooks Brook
ALASKA HIGHWAY
TESLIN
TESLIN LAKE
Little Teslin Lake
YUKON TERRITORY
BRITISH COLUMBIA
60°15'
133°30'
132°30'
WATER CHEMISTRY SAMPLING SITES
ON TESLIN LAKE, YUKON TERRITORY 1992


TESLIN LAKE
Yukon Territory
CAUTION: NOT TO BE USED FOR NAVIGATION
Drawn by: Yukon Government
Renewable Resources
Fisheries Section
February 1993
LEGEND
Gillnet set location, number
SCALE 1: 250,000
Kilometres 5 0 5 10 Kilometers
YUKON
Nisutlin Bay
TESLIN
TESLIN LAKE
ALASKA HIGHWAY
Johnsons Crossing
Teslin River
Brooks Brook
Little Teslin Lake
YUKON TERRITORY
BRITISH COLUMBIA
132°30'
60°15'
133°30'
60°15'
133°30'
132°30'
LOCATION OF GILLNET SETS
ON TESLIN LAKE, YUKON TERRITORY 1992

APPENDIX II
lake trout and lake whitefish maturity at age for each lake

APPENDIX III
mesh size effects

Appendix III Mesh size effects on Lake Trout catches from Kusawa Lake, 1993.

	Mesh Size (cms)						
	3.8	6.4	7.6	8.9	10.2	11.4	12.7
# Caught	20	56	31	10	17	7	2
CPUE (#/100m/24hr)	9.15	25.63	14.19	4.58	7.78	3.20	.92
CPUE (kg/100m/24hr)	10.32	17.28	17.85	9.50	17.87	9.49	2.99
Mean Length (mm)	368.60	392.0	475.03	559.30	579.00	644.29	687.50
Mean Weight (gm)	1127.50	674.12	1258.06	2075.00	2297.06	2964.29	3250.00
# Mature Males	7	14	10	4	7	2	
# Immature Males	1	6	2				
# Mature Females	3	21	16	6	10	5	2
# Immature Females	5	6	3				
% Mature	62.50	74.47	83.87	100.00	100.00	100.00	100.00
# Unknown Maturity	4	9					
Mean Age	10.50	10.17	14.07	15.00	17.47	19.33	28.50
# Unknown Age	4	9	1			1	
Age (years)							
3	(5) 31.25	(1) 2.13					
4	(1) 6.25	(2) 4.26					
5	(1) 6.25	(2) 4.26					
6	(1) 6.25	(1) 2.13	(1) 3.33				
7		(8) 17.02	(2) 6.67	(1) 10.00			
8		(7) 14.89	(2) 6.67	(1) 10.00	(1) 5.88		
9		(5) 10.64	(6) 20.00		(1) 5.88		
10		(3) 6.38	(1) 3.33				
11	(1) 6.25	(4) 8.51					
12	(1) 6.25	(2) 4.26	(1) 3.33				
13		(3) 6.38	(3) 10.00	(1) 10.00			
14		(2) 4.26		(1) 10.00	(2) 11.76		
15	(3) 18.75	(1) 2.13		(1) 10.00	(1) 5.88		
16	(1) 6.25	(2) 4.26	(1) 3.33		(1) 5.88	(1) 16.67	
17	(1) 6.25		(4) 13.33	(2) 20.00	(3) 17.65		(1) 50.00
18			(2) 6.67		(2) 11.76	(1) 16.67	
19		(2) 4.26	(3) 10.00	(1) 10.00	(1) 5.88	(1) 16.67	
20			(1) 3.33	(2) 20.00	(1) 5.88	(2) 33.33	
21		(1) 2.13			(1) 5.88		
22			(1) 3.33		(1) 5.88		
23		(1) 2.13			(1) 5.88	(1) 16.67	
24			(1) 3.33				
25							
26							
27							
28			(1) 3.33				
29					(1) 5.88		
37	(1) 6.25						
40							(1) 50.00

Appendix III Mesh size effects on Lake Trout catches from Lake Laberge, 1991.

	Mesh Size (cms)						
	3.8	6.4	7.6	8.9	10.2	11.4	12.7
# Caught	8	13	4	9	2	3	12
CPUE (#/100m/24hr)	2.30	3.75	1.15	2.58	.57	.86	3.45
CPUE (kg/100m/24hr)	3.97	4.05	2.82	3.13	.66	3.59	6.81
Mean Length (mm)	494.38	441.54	585.00	458.89	472.50	640.00	528.75
Mean Weight (gm)	1728.13	1085.00	2450.00	1213.89	1150.00	4175.00	1975.00
# Mature Males	1	2	2	2		2	4
# Immature Males	1			1			1
# Mature Females	2	2	2	2		1	2
# Immature Females	3	3		2	1		1
% Mature	42.86	57.14	100.00	57.14	0	100.00	75.00
# Unknown Maturity	1	6		2	1		4
Mean Age	16.33	10.25	19.00	9.89	7.50	16.00	11.64
# Unknown Age	2	1	3			1	1
Age (years)							
4							(1) 9.09
5		(3) 25.00			(1) 50.00		
6		(1) 8.33					(2) 18.18
7				(3) 33.33			(2) 18.18
8	(1) 16.67	(3) 25.00					
9	(1) 16.67	(1) 8.33		(3) 33.33		(1) 50.00	(2) 18.18
10		(1) 8.33			(1) 50.00		
11	(1) 16.67						
12		(1) 8.33					
13				(1) 11.11			
14	(1) 16.67			(2) 22.22			(1) 9.09
17	(1) 16.67						
18							(1) 9.09
19		(1) 8.33	(1) 100.00				
21							(1) 9.09
23						(1) 50.00	
27							(1) 9.09
28		(1) 8.33					
39	(1) 16.67						

Appendix III Mesh size effects on Lake Trout catches from Teslin Lake, 1992.

	Mesh Size (cms)						
	3.8	6.4	7.6	8.9	10.2	11.4	12.7
# Caught	10	13	11	10	2	10	3
CPUE (#/100m/24hr)	2.34	3.05	2.58	2.34	.47	2.34	.70
CPUE (kg/100m/24hr)	6.18	5.57	6.72	3.04	1.13	6.04	2.38
Mean Length (mm)	600.00	480.38	548.00	482.30	507.50	587.00	645.00
Mean Weight (gm)	2640.00	1826.92	2604.55	1300.00	2400.00	2580.00	3400.00
# Mature Males	5	3	7	3	1	5	1
# Immature Males		1					
# Mature Females	5	3		3		4	1
# Immature Females		3		1		1	
% Mature	100.00	60.00	100.00	85.71	100.00	90.00	100.00
# Unknown Maturity		3	4	3	1		1
Mean Age	16.67	16.20	19.40	10.78	10.50	21.44	15.67
# Unknown Age	1	5	2	1		4	
Age (years)							
4				(1) 11.11			
5			(1) 11.11		(1) 50.00		
6			(1) 11.11	(1) 11.11			
7		(1) 12.50		(1) 11.11			
8		(2) 25.00	(2) 22.22	(1) 11.11		(1) 16.67	
9	(3) 33.33	(1) 12.50		(3) 33.33		(1) 16.67	
10		(1) 12.50					
12	(1) 11.11						(1) 33.33
13	(1) 11.11					(2) 33.33	
14		(1) 12.50	(1) 11.11				
15		(1) 12.50				(1) 16.67	
16	(1) 11.11	(1) 12.50			(1) 50.00		
17							(1) 33.33
18							(1) 33.33
19				(1) 11.11			
20	(1) 11.11						
22			(1) 11.11				
26			(1) 11.11	(1) 11.11			
27						(1) 16.67	
30	(1) 11.11						
31			(1) 11.11				
32	(1) 11.11		(1) 11.11				

Appendix III Mesh size effects on Lake Whitefish catches from Kusawa Lake, 1993.

	Mesh Size (cms)						
	3.8	6.4	7.6	8.9	10.2	11.4	12.7
# Caught	9	118	38	13	5	2	
CPUE (#/100m/24hr)	4.12	54.00	17.39	5.95	2.29	.92	
CPUE (kg/100m/24hr)	2.01	23.11	10.46	3.71	1.79	.76	
Mean Length (mm)	358.00	351.59	375.39	395.15	413.40	417.50	
Mean Weight(gm)	488.89	427.97	601.32	623.08	780.00	825.00	
# Mature Males	3	45	19	5	3		
# Immature Males	1	19	3	1			
# Mature Females	5	48	16	7	2	2	
# Immature Females		1					
% Mature	88.89	82.30	92.11	92.11	92.31	100.00	
# Unknown Maturity		5					
Mean Age	11.50	10.49	11.66	13.64	16.40	18.50	
# Unknown Age	2	20	5	2			
Age(years)							
3		(1) 1.02					
5		(2) 2.04	(2) 6.06				
6		(5) 5.10	(1) 3.03				
7	(1) 14.29	(6) 6.12	(2) 6.06				
8		(4) 4.08	(2) 6.06	(1) 9.09			
9	(2) 28.57	(14) 14.29	(1) 3.03				
10	(1) 14.29	(24) 24.29	(4) 12.12	(2) 18.18	(1) 20.00		
11	(1) 14.29	(12) 12.24	(4) 12.12	(1) 9.09			
12	(1) 14.29	(11) 11.22	(1) 3.03	(1) 9.09			
13	(1) 14.29	(7) 7.14	(6) 18.18	(1) 9.09			
14		(4) 4.08	(5) 15.15	(2) 18.18			
15		(4) 4.08	(1) 3.03		(1) 20.00		
16				(1) 9.09		(1) 50.00	
17		(1) 1.02	(1) 3.03		(1) 20.00		
18		(1) 1.02					
19		(1) 1.02					
20		(1) 1.02	(1) 3.03		(2) 40.00		
21			(1) 3.03	(2) 18.18		(1) 50.00	
22			(1) 3.03				

Appendix III Mesh size effects on Lake Whitefish catches from Lake Laberge, 1991.

	Mesh Size (cms)						
	3.8	6.4	7.6	8.9	10.2	11.4	12.7
# Caught	101	455	41	41	8	5	2
CPUE (#/100m/24hr)	29.00	130.65	11.77	11.77	2.30	1.44	.57
CPUE (kg/100m/24hr)	4.24	47.05	7.26	6.88	1.45	1.76	.50
Mean Length (mm)	228.79	325.10	375.29	381.00	328.50	478.00	432.50
Mean Weight (gm)	146.24	360.12	616.46	584.78	631.25	1220.00	875.00
# Mature Males	7	69	6	17	5	1	1
# Immature Males	8	96	4	2		1	
# Mature Females	6	142	26	20	3	2	1
# Immature Females	2	64	4				
% Mature	56.52	56.87	80.00	94.87	100.00	75.00	100.00
# Unknown Maturity	78	84	1	2		1	
Mean Age	5.10	9.56	12.78	14.49	14.38	10.00	17.50
# Unknown Age	1	5					
Age (years)							
2	(9) 9.00						
3	(46) 46.00						
4	(18) 18.00	(1) .22					
5	(3) 3.00	(17) 3.78					
6	(1) 1.00	(39) 8.67					
7	(3) 3.00	(39) 8.67	(2) 4.88				
8	(1) 1.00	(92) 20.44	(3) 7.32				
9	(2) 2.00	(79) 17.56	(2) 4.88		(1) 12.50	(1) 20.00	
10	(4) 4.00	(48) 10.67	(8) 19.51	(3) 7.32		(3) 60.00	
11	(4) 4.00	(34) 7.56	(4) 9.76	(7) 17.07		(1) 80.00	
12		(36) 8.00	(4) 9.76	(7) 17.07	(2) 25.00		
13	(4) 4.00	(20) 4.44	(2) 4.88	(4) 9.76			
14	(2) 2.00	(11) 2.44	(4) 9.96	(3) 7.32			
15		(13) 2.89	(3) 7.32	(4) 9.76	(2) 25.00		
16	(2) 2.00	(11) 2.44	(2) 4.88	(2) 4.88	(2) 25.00		
17		(3) .67	(2) 4.88	(4) 9.76			(1) 50.00
18	(1) 1.00	(2) .44	(1) 2.44	(1) 2.44			(1) 50.00
19		(1) .22					
20		(1) .22	(2) 4.88	(3) 7.32	(1) 12.50		
21		(2) .44		(1) 2.44			
22		(1) .22	(1) 2.44	(1) 2.44			
23			(1) 2.44				
28				(1) 2.44			

Appendix III Mesh size effects on Lake Whitefish catches from Teslin Lake, 1992.

	Mesh Size (cms)						
	3.8	6.4	7.6	8.9	10.2	11.4	12.7
# Caught	20	104	74	40	24	7	2
CPUE (#/100m/24hr)	4.69	24.38	17.35	9.38	5.63	1.64	.47
CPUE (kg/100m/24hr)	1.17	11.08	10.94	7.50	4.75	1.64	.49
Mean Length (mm)	267.25	337.70	380.54	409.00	428.54	437.14	455.00
Mean Weight (gm)	250.00	454.33	630.74	800.00	843.75	1000.00	1050.00
# Mature Males	1	13	21	10	11	2	
# Immature Males	2	21	14	1			
# Mature Females	4	31	32	24	13	5	1
# Immature Females	2	21	2	2			
% Mature	55.56	51.16	76.81	91.89	100.00	100.00	100.00
# Unknown Maturity	11	18	5	3			1
Mean Age	6.65	9.56	11.79	13.83	15.67	18.33	13.50
# Unknown Age		2	1			1	
Age (years)							
2	(1) 5.00						
3	(2) 10.00						
4	(4) 20.00						
5	(4) 20.00	(3) 2.94					
6		(5) 4.90	(2) 2.74				
7	(2) 10.00	(16) 15.69	(5) 6.85	(1) 2.50	(1) 4.17		
8	(2) 10.00	(25) 24.51	(4) 5.48	(3) 7.50			
9	(1) 5.00	(16) 15.69	(12) 16.44		(1) 4.17	(1) 16.67	
10	(2) 10.00	(9) 8.82	(6) 8.22	(5) 12.50			
11		(7) 6.86	(8) 10.96	(3) 7.50	(2) 8.33		
12		(5) 4.90	(10) 13.70	(7) 17.50	(2) 8.33		(1) 50.00
13	(1) 5.00	(4) 3.92	(5) 6.85	(3) 7.50	(2) 8.33		
14		(5) 4.90	(6) 8.22	(3) 7.50	(4) 16.67		
15		(3) 2.94	(7) 9.59	(5) 12.50	(1) 4.17		(1) 50.00
16		(1) .98	(1) 1.37				
17	(1) 5.00	(2) 1.96	(2) 2.74	(4) 10.00	(5) 20.83	(1) 16.67	
18			(1) 1.37		(1) 4.17	(2) 33.33	
19				(3) 7.50			
20			(2) 2.74		(1) 4.17		
21			(1) 1.37		(1) 4.17		
22				(1) 2.50	(1) 4.17		
23			(1) 1.37			(1) 16.67	
24					(1) 4.17		
25				(1) 2.50		(1) 16.67	
27				(1) 2.50	(1) 4.17		
30		(1) .98					

APPENDIX IV
production records

Appendix IV Annual Production Records (kilograms) from the Commercial Fishery within Lake Laberge, 1908-91.

YEAR	LAKE TROUT	LAKE WHITEFISH	PIKE	BURBOT	INCONNU	SUCKER	TOTAL
1908-1916	9807	43615	2267	91	0	0	55780
1972	1664	440	0	0	0	0	2104
1973	1868	875	0	0	0	0	2743
1974	821	702	0	0	0	0	1523
1975	1183	207	0	0	0	0	1390
1976	1737	50	0	0	0	0	1787
1977	2433	482	0	0	0	0	2915
1978	348	33	0	0	0	0	381
1979	39	0	0	0	0	0	39
1980	725	421	91	475	0	143	1855
1981	274	488	17	105	0	664	1549
1982	941	248	0	669	43	30	1931
1983	1282	951	549	675	87	1727	5271
1984	2257	1325	0	951	0	71	5604
1985	1501	460	46	2020	199	188	4414
1986	416	62	0	312	27	13	830
1987	378	918	0	114	7	1270	2687
1988	2051	279	32	2788	198	91	5439
1989	1176	483	163	858	204	0	2884
1990	1422	464	0	1459	71	467	3883
1991	101	216	0	503	6	129	956

source: 1906-1979 data from Seigal and McEwan, 1984.
1980-1988 data from Department of Fisheries and Oceans.
1989-1991 data from Yukon Territorial Government.

Appendix IV Annual Production Records (kilograms) from the Domestic Fishery within Lake Laberge, 1974-94.

YEAR	LAKE TROUT	LAKE WHITEFISH	PIKE	BURBOT	INCONNU	SUCKER	TOTAL
1974	15	13	0	0	0	0	28
1975	27	101	0	0	0	0	128
1976	0	36	0	0	0	0	36
1977	124	185	0	0	0	0	309
1978	167	126	0	0	0	0	293
1979	36	23	0	10	0	16	84
1980	7	0	0	0	0	118	125
1981	41	162	32	98	2	1543	1868
1982	15	30	0	35	0	0	80
1983	2	5	0	0	0	0	6
1984	21	269	0	240	0	30	560
1985	182	353	69	1544	8	416	2573
1986	68	197	29	425	9	11	738
1987	104	9	16	289	0	0	416
1988	30	4	0	126	7	0	167
1989	104	246	15	257	0	148	770
1990	38	287	1	78	0	304	707
1991	11	279	0	476	23	334	1123
1992	30	190	14	410	0	135	764
1993	0	36	0	0	0	0	36
1994	0	102	0	9	0	4	115

source: 1972-1979 data from Seigal and McEwen, 1984.
1980-1988 data from Deptartment of Fisheries & Oceans.
1989-1994 data from Yukon Territorial Government.

Appendix IV Annual Production Records (kilograms) from the Commercial Fishery within Teslin Lake, 1972-94.

YEAR	LAKE TROUT	LAKE WHITEFISH	PIKE	BURBOT	INCONNU	SUCKER	TOTAL
1972	443	558	0	0	0	0	1001
1973	664	1940	0	0	0	0	2604
1974	678	1237	0	0	0	0	1915
1975	1383	875	0	0	0	0	2258
1976	699	1823	0	0	0	0	2522
1977	982	3211	0	0	0	0	4193
1978	482	3256	0	0	0	0	3738
1979	1253	3815	53	955	131	366	6573
1980	302	1471	0	0	0	14	1787
1981	362	1835	93	43	16	41	2390
1982	264	1930	0	0	0	0	2194
1983	546	1526	81	307	18	207	2685
1984	156	885	0	0	0	0	1041
1985	5	15	0	2	0	2	24
1986	68	0	10	0	0	1	79
1987	118	232	0	7	0	0	357
1989	316	615	0	0	0	0	960
1990	137	198	49	24	0	0	415
1991	6	752	86	0	0	0	860
1992	160	485	37	18	36	0	736
1993	82	285	72	34	2	0	475
1994	101	0	0	0	0	0	101

Source: 1972-1978 data from Seigal and McEwen, 1984.
1979-1989 data from Department of Fisheries & Oceans.
1990-1993 data from Yukon Territorial Government.

Appendix IV Annual Production Records (kilograms) from the Domestic Fishery within Teslin Lake, 1975-91.

YEAR	LAKE TROUT	LAKE WHITEFISH	PIKE	BURBOT	INCONNU	SUCKER	TOTAL
1975	29	39	0	0	0	0	58
1976	90	367	0	0	0	0	457
1977	40	89	0	0	0	0	129
1978	68	110	0	0	0	0	178
1979	31	157	4	4	1	8	205
1980	10	62	16	15	37	11	151
1981	139	401	15	74	4	145	776
1982	3	3	0	5	0	0	11
1983	110	150	10	32	0	34	336
1984	0	24	1	1	0	1	27
1985	53	56	28	28	0	43	181
1990	8	122	10	4	26	0	169
1991	0	53	3	0	0	0	56

Source: 1975-1978 data from Seigal and McEwan, 1984.
1979-1985 data from Department of Fisheries & Oceans.
1990-1991 data from Yukon Territorial Government.

Appendix IV Annual Production Records (kilograms) from the Indian Food Fishery, 1909-81.

YEAR	LAKE TROUT	LAKE WHITEFISH	PIKE	BURBOT	INCONNU	SUCKER	TOTAL
1909	671	3348	544	136	0	0	4700
1910	862	4309	907	0	0	0	6078
1911	680	3629	590	0	0	0	4899
1912	680	3357	544	0	0	0	4581
1913	635	2041	0	0	0	0	2676
1914	680	2041	0	0	0	0	2722
1915	544	1814	0	0	0	0	2359
1916	454	1588	0	0	0	0	2041
1981	0	4	5	9	0	5	22

Source: 1909-1916 data from Seigal and McEwen, 1984.
1981 data from Deptartment of Fisheries & Oceans.

Table 11. Diet analysis by species for fish from summer index netting on Kusawa, Laberg

Lake	Species	Unidentified Fish	Unidentified Coregonids	Lake Whitefish	Least Ciscoe	Longnose Sucker	Burbot	Slimy Sculpin	Unidentified Invertebrates	Fo Bival (clar
Kusawa	Lake Trout	21	6	3				2	3	
	Lake Whitefish								3	8
	Broad Whitefish									2
	Arctic Grayling									
Laberge	Lake Trout	24								
Teslin	Lake Trout	24			3				4	
	Lake Whitefish	1							29	6
	Broad Whitefish									9
	Round Whitefish									
	Northern Pike				5	1	1			
	Burbot	32			10			5	1	
	Arctic Grayling								5	

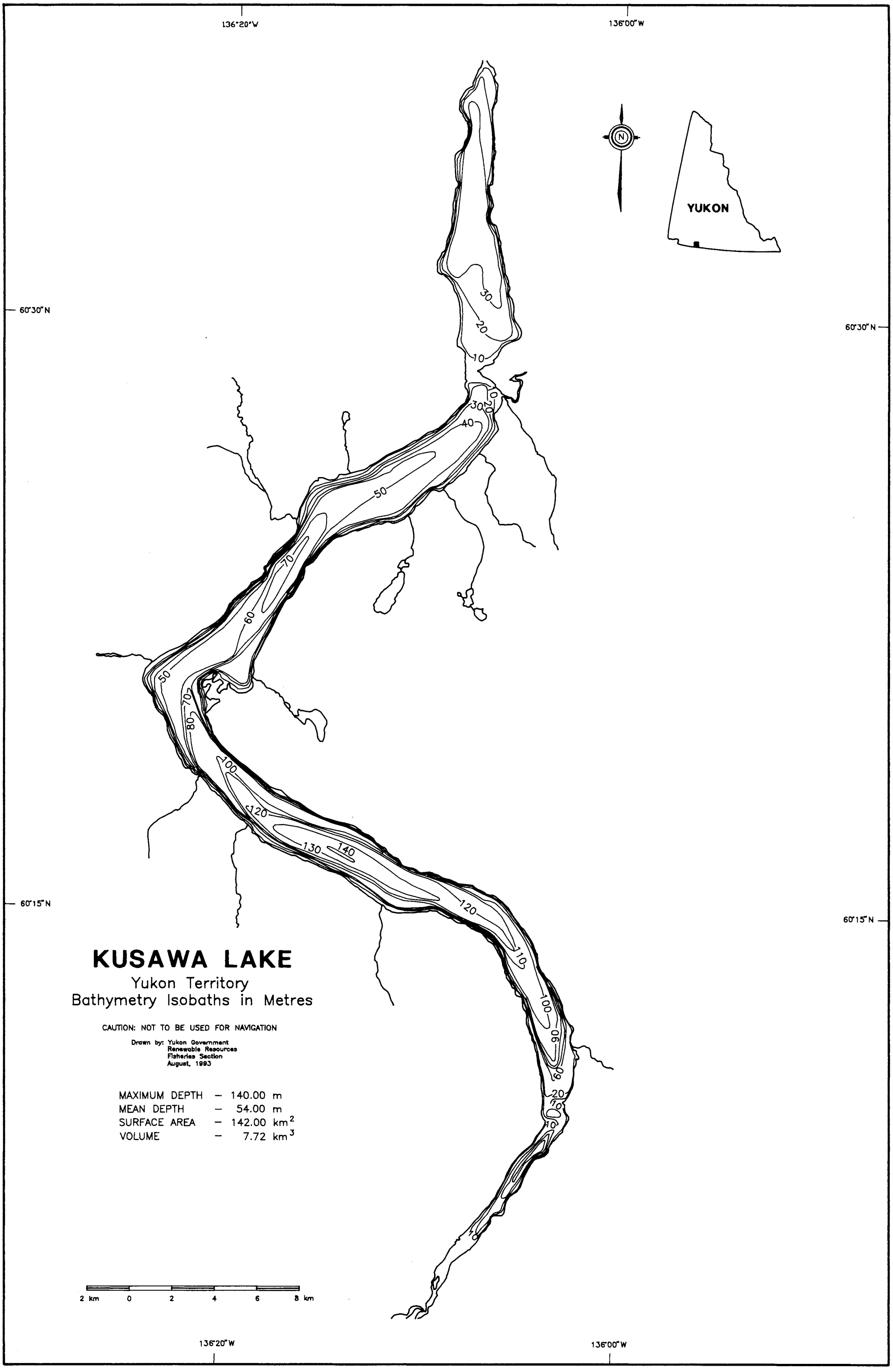


Figure 2 Bathymetry Map of Kusawa Lake, Yukon Territory

135°30'W

135°00'W

YUKON RIVER

61°20'N

Goddard Point

Ptarmigan Point

YUKON

RICHTOFEN ISLAND

To Dawson City

NORTH KLONDIKE HIGHWAY

Jackfish Bay

61°00'N

LAKE LABERGE

Yukon Territory

Bathymetry Isobaths in Metres

CAUTION: NOT TO BE USED FOR NAVIGATION

National Water Research Institute,
Pacific and Yukon Region,
Inland Waters Directorate,
Environment Canada,
August 1982

MAXIMUM DEPTH	–	146.0m
MEAN DEPTH	–	54.0m
LENGTH	–	48.0km
MEAN WIDTH	–	4.2km
SURFACE AREA	–	201.0km^2
VOLUME	–	10.8km^3

LEGEND

Campsite

Boat Launch

0 1 2 3 4 5 6 7 8 9 10 km

Figure 1 Bathymetry Map of Lake Laberge, Yukon Territory

TESLIN LAKE

Yukon Territory
Bathymetry Isobaths in Feet

CAUTION: NOT TO BE USED FOR NAVIGATION

Drawn by: Yukon Government
Renewable Resources
Fisheries Section
February 1993

Adapted from a map by: Institute of Fisheries
University of British Columbia
July 1944

MAXIMUM DEPTH	–	702.0 ft [214.0m]
MEAN DEPTH	–	193.6 ft [59.0m]
SURFACE AREA	–	87,472.0 acres [35,400 ha]
VOLUME	–	4.99 miles³ [20.8 km³]

SCALE 1: 250,000

kilometres 5 0 5 10 kilometres

132°30'

60°15'

133°30'

YUKON

Nisutlin Bay

Brooks Brook

ALASKA HIGHWAY

TESLIN

Morley Bay

YUKON TERRITORY
BRITISH COLUMBIA

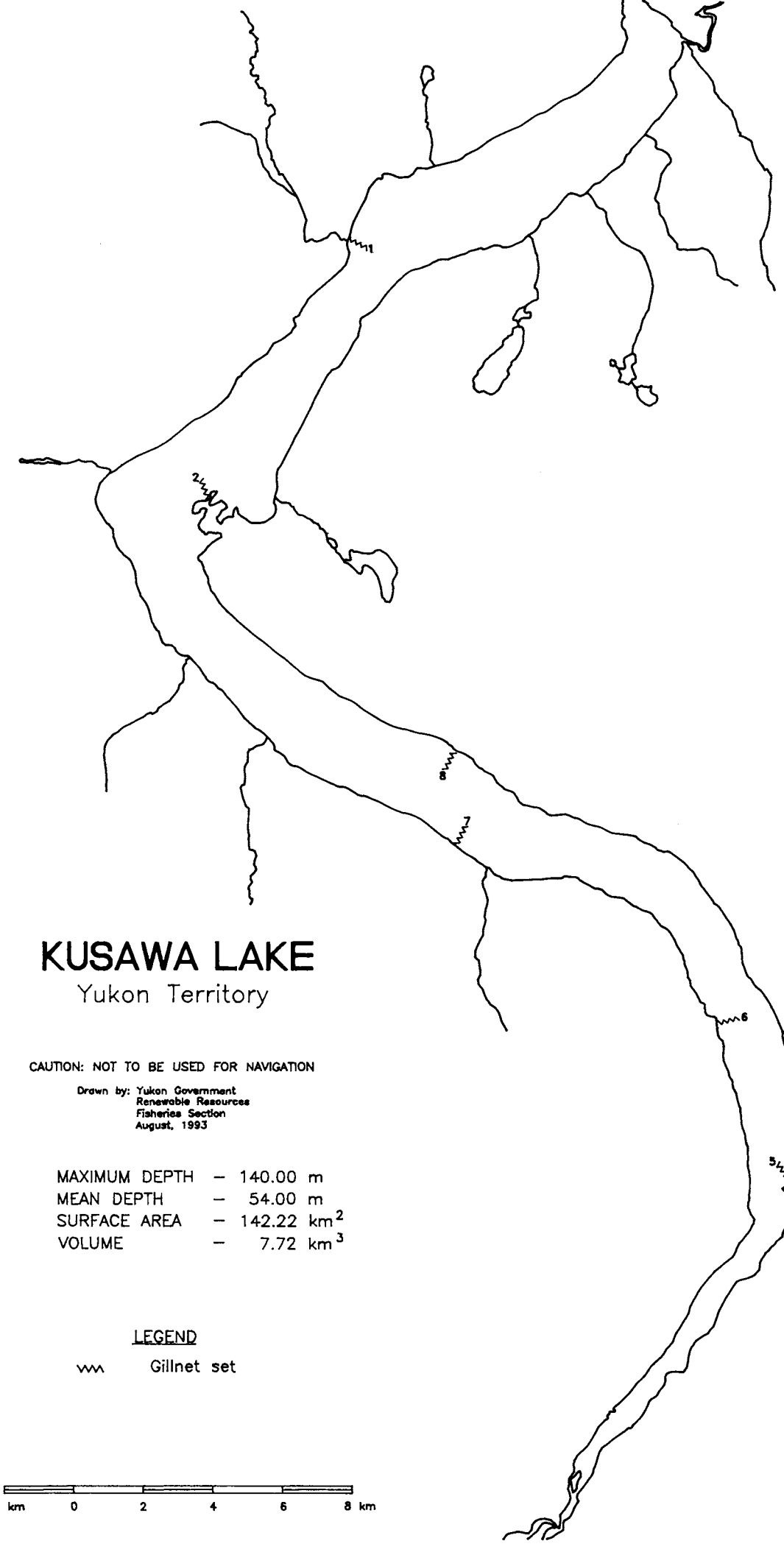
Figure 3 Bathymetry Map ofo Teslin Lake, Yukon Territory

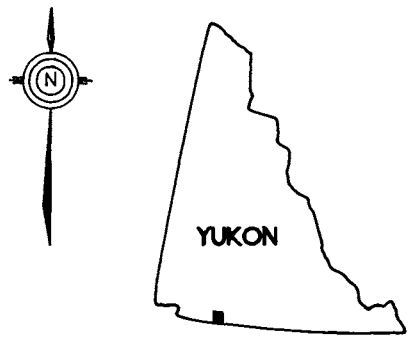
136°20" W

136°00" W

60°30" N

60°15" N





KUSAWA LAKE

Yukon Territory

CAUTION: NOT TO BE USED FOR NAVIGATION

Drawn by: Yukon Government
Renewable Resources
Fisheries Section
August, 1993

MAXIMUM DEPTH	–	140.00 m
MEAN DEPTH	–	54.00 m
SURFACE AREA	–	142.22 km^2
VOLUME	–	7.72 km^3

LEGEND

Gillnet set

2 km 0 2 4 6 8 km

136°20" W

136°00" W

Figure

Gillnet Sampling Sites 1993

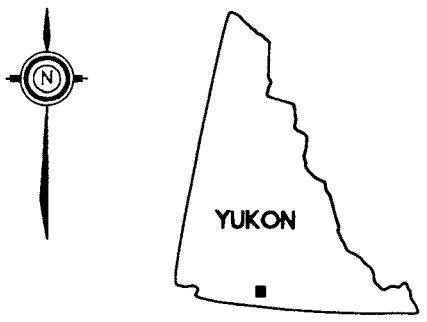
135°30'W

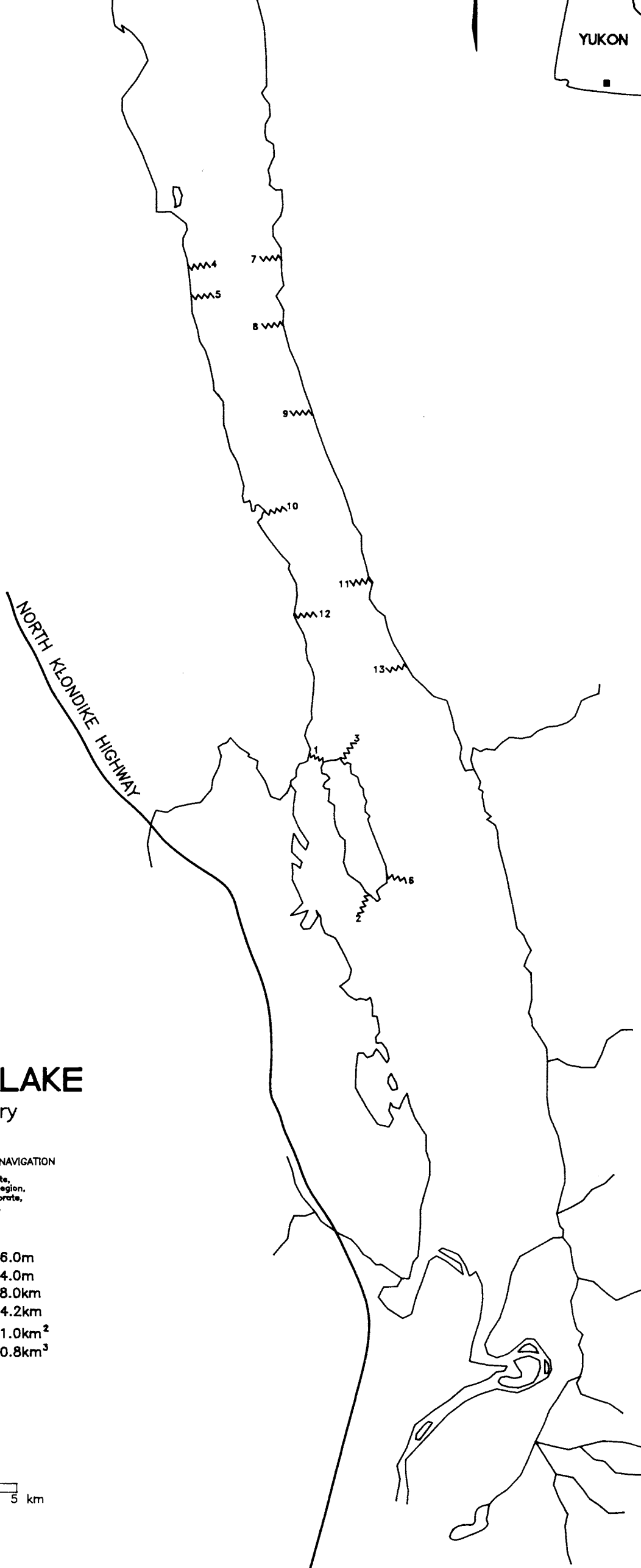
135°15'W

135°00'W

60°30'N

60°30'N





LABERGE LAKE

Yukon Territory

60°15'N

60°15'N

CAUTION: NOT TO BE USED FOR NAVIGATION

National Water Research Institute,
Pacific and Yukon Region,
Inland Waters Directorate,
Environment Canada,
1991

MAXIMUM DEPTH	–	146.0m
MEAN DEPTH	–	54.0m
LENGTH	–	48.0km
MEAN WIDTH	–	4.2km
SURFACE AREA	–	201.0km^2
VOLUME	–	10.8km^3

LEGEND

Gillnet set

1 km 0 1 2 3 4 5 km

135°30'W

135°15'W

135°00'W

Figure 1991 Gillnet Sampling Sites

TESLIN LAKE

Yukon Territory

CAUTION: NOT TO BE USED FOR NAVIGATION

Drawn by: Yukon Government
Renewable Resources
Fisheries Section
February 1993

LEGEND

▲ Water chemistry sample site

SCALE 1: 250,000

kilometres 5 0 5 10 kilometers

132°30'

60°15'

YUKON

Nisutlin Bay

Johnsons Crossing

Teslin River

Brooks Brook

ALASKA HIGHWAY

TESLIN

TESLIN LAKE

Little Teslin Lake

133°30'

YUKON TERRITORY
BRITISH COLUMBIA

60°15'

133°30'

132°30'

WATER CHEMISTRY SAMPLING SITES
ON TESLIN LAKE, YUKON TERRITORY 1992

TESLIN LAKE

Yukon Territory

CAUTION: NOT TO BE USED FOR NAVIGATION

Drawn by: Yukon Government
Renewable Resources
Fisheries Section
February 1993

LEGEND

Gillnet set location, number

SCALE 1: 250,000

kilometres 5 0 5 10 kilometers

132°30'

60°15'

YUKON

Nisutlin Bay

Johnsons Crossing

Teslin River

Brooks Brook

ALASKA HIGHWAY

TESLIN

TESLIN LAKE

Little Teslin Lake

133°30'

YUKON TERRITORY
BRITISH COLUMBIA

60°15'

133°30'

132°30'

LOCATION OF GILLNET SETS
ON TESLIN LAKE, YUKON TERRITORY 1992