LAKE TROUT POPULATION ASSESSMENT

FISH LAKE

2010

Prepared by

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Summary

Environment Yukon has been surveying important fish stocks since 1991. We use these surveys to detect population changes and monitor population health. Along with angler harvest surveys, these data are also used to assess the sustainability of fisheries.

Environment Yukon works with First Nations, RRCs, and user groups to determine priority lakes for surveys. Criteria for identification of priority lakes include accessibility for anglers, sensitivity of the fish population, and management concern. The surveys focus on lake trout, an indicator of the health of northern lake ecosystems.

We surveyed Fish Lake using SPIN (Summer Profundal Index Netting) in 2009 and 2010. The 2009 survey was the first SPIN survey done in Yukon. The purpose of the 2010 survey was to assess the repeatability of SPIN and confirm the 2009 estimates. Environment Yukon sampled Fish Lake using a different index netting technique in 1996, 2001, and 2006. SPIN provides more statistically robust data and improves confidence in survey results (Sandstrom 2009; Jessup and Millar 2011).

Lake wide CPUE (catch per unit effort) in 2010 was 2.01, which is high for Yukon lakes surveyed to date. We found no difference in CPUE between 2009 and 2010, although the 2010 catch data was highly variable and power to detect changes was low. Lake trout density was estimated at 38.9 lake trout / hectare in 2009 and 29.7 lake trout / hectare in 2010.

Key Findings

- Fish Lake is a small lake with a high density of small lake trout.
- We found no difference in the size of the lake trout population between 2009 and 2010. Our 2010 index of the lake trout population was 24% lower than in 2009, but this difference was not statistically significant. Our confidence in our estimate in 2010 was lower because of more variable data.
- Differences in estimates between 2009 and 2010 may have been a product of environmental conditions, because the surveys were done at different times of the summer.

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Introduction

Each year, Environment Yukon conducts assessments of fish populations, with a focus on lake trout. Between 1991 and 2009, over 100 Yukon lakes were surveyed using small-mesh netting, a method based on the index netting techniques described by Lester et al. (1991). Beginning in 2010, we began to assess fish populations using a new method, Summer Profundal Index Netting (SPIN; Sandstrom and Lester 2009). SPIN provides more statistically robust data and improves confidence in survey results (Jessup and Millar 2011).

We choose lakes for assessment based on the size of the active recreational fishery, the aboriginal subsistence fishery, and the commercial and domestic fisheries, as well as other available information. Lakes with heavy harvest pressure are surveyed on a regular basis.

SPIN assessments involve setting gillnets at various sites in the lake and recording the catch and biological information about each fish caught. The survey usually tells us:

- relative abundance of lake trout as measured by an index (CPUE, or catch per unit effort);
- changes in relative abundance from previous surveys;
- the estimated density (number of lake trout per hectare) and abundance (number of lake trout) in the lake;
- length and weight of individual lake trout as well as other species captured; and
- age and diet of any fish killed.

Environment Yukon surveyed Fish Lake using SPIN in 2009 and 2010. The 2009 survey was the first SPIN survey done in Yukon. The 2010 survey was intended to test repeatability and confirm the 2009 estimates. Environment Yukon surveyed the lake using small-mesh netting in 1996, 2001, and 2006. Differences between the 2 methods mean that results from SPIN surveys cannot be compared statistically with the small-mesh netting surveys. Here we report the results of the 2009 and 2010 SPIN surveys and make only subjective comparisons with previous surveys.

Study Area

Fish Lake is located approximately 15 km southwest of Whitehorse at the end of the Fish Lake Road (Figure 1). The lake sits more than 300 mm elevation higher than downtown Whitehorse. The lake is approximately 11 km long and covers an area of 1386 hectares. Mean depth is 16.5 m and maximum depth is 37 m. The lake is fed by several small creeks as well as the Bonneville Lakes chain. At one time the lake drained via Fish Creek and Jackson Creek to the Ibex River. Hydroelectric development in the 1950s diverted most flows from Fish Lake which now enter the Yukon River through McIntyre Creek, although some flows still go towards the Ibex through an overflow spillway at Jackson Lake. The lake lies within the traditional territory of the Kwanlin Dun First Nation.

There is a boat launch at the lake and a private campground nearby. Fish Lake is a prominent feature in the Whitehorse area and is highly valued by local area residents and many user groups. The recreational fishery at Fish Lake has been managed with General Regulations since 1990. Lake trout catch and possession limits are 3 and 6 respectively. Only one lake trout may be over 65 cm. In addition to lake trout, the lake contains Arctic grayling and round whitefish.

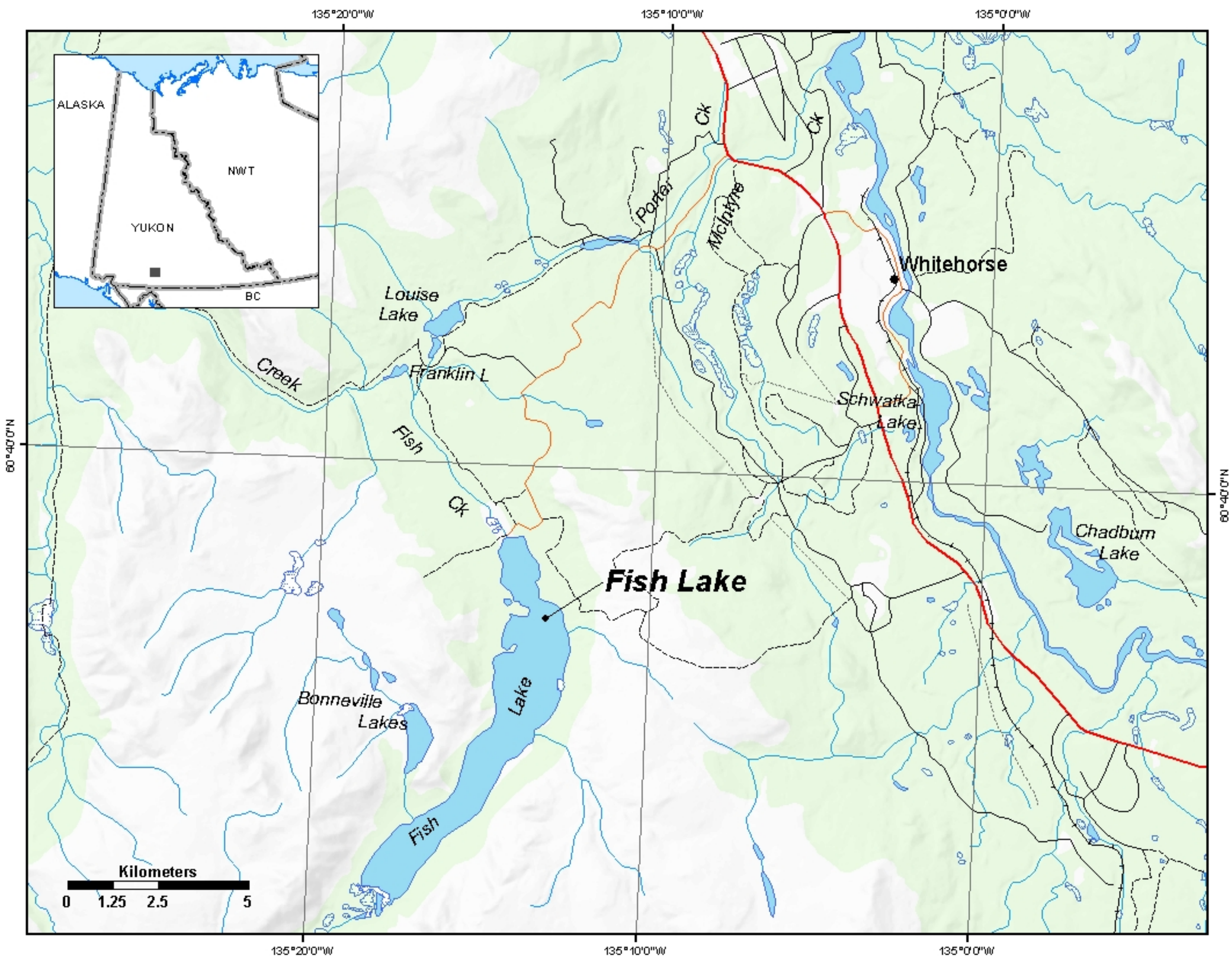

Figure 1. Location of Fish Lake, Yukon.

Methods

We followed the Summer Profundal Index Netting (SPIN) method for lake trout assessment (Sandstrom and Lester 2009, Jessup and Millar 2011). Gillnets were set at different depths throughout the lake to capture lake trout. Each 64 m gillnet was made up of 8 panels of monofilament web with mesh sizes from 57 mm to 127 mm. Each net was set for 2 hours.

Fish Lake was sampled on August 19 and 20, 2010. We set a total of 29 nets, partitioned between 4 depth strata (Table 1). We initially weighted the number of sets (effort) in each stratum by the surface area of the stratum. However, we adjusted the distribution of effort during the survey by concentrating on those strata with the highest catch rates. We chose the locations for setting the nets within each stratum randomly by using random point generation in ArcGIS 9.3. Any clumped distributions of points were dispersed manually to ensure coverage of the entire lake.

Table 1. Effort breakdown by stratum.

Stratum (depth range)	Area		Number of Sets	
	ha	%	No.	%
0-10 m	530	38	7	24
10-20 m	301	22	9	31
20-30m	281	20	7	24
30+m	274	20	6	21
Total	1386	100	29	100

Catch per unit effort (CPUE), or the number of lake trout of "harvestable" size (300 mm and up) caught per net was calculated for each stratum. The total stratified lakewide CPUE was calculated as:

$$\text{Lakewide CPUE} = \sum(\text{CPUE}_i \bullet W_i)$$

where:

CPUE_i = selectivity adjusted CPUE of stratum $_i$

W_i = area of stratum $_i$ / lake area

And the standard deviation as:

$$SD = \sum(SD_i \bullet W_i)$$

where:

SD_i = standard deviation of stratum $_i$

W_i = area of stratum $_i$ / lake area

CPUE is considered an index of abundance and changes in the CPUE are thought to reflect actual changes in the lake trout population. Therefore, CPUE can be compared between surveys and used to detect population growth or decline. The method excludes fish below 300 mm because they are not usually captured by anglers.

We then converted CPUE to density (fish/ha) based on an empirical relationship between CPUE and fish density that has been established for Ontario lakes (Sandstrom and Lester 2009). From this, we estimated absolute abundance (i.e., the total population size) by multiplying density by lake size (number of fish/ha • lake area (ha) = number of fish in lake). Before we can be fully confident in our estimates of density and absolute abundance, the relationship between CPUE and density must be verified for Yukon lakes.

Finally, we compared the lakewide CPUE between years using a Welch's t-test. We assessed the results of the test using a significance value (alpha) of 0.10, where many biological studies use an alpha of 0.05. Alpha is the "type-1 error rate", which is the likelihood of concluding a change has occurred when it really has not (i.e., a false positive). Alpha is inversely related to beta, the "type-2 error rate", which is the likelihood of concluding no change has occurred when one really has (a false negative). Statistical power is the chance of detecting a change when one has occurred and is defined as 1 minus beta. When alpha is increased, beta is reduced and we increase our power to detect changes. The result is that we are more likely to detect changes in the population (both increases and decreases), but the rate at which we will falsely detect a change is also higher. This approach provides for more precautionary monitoring and an ability to detect problems at an earlier stage.

We used SPIN Support Systems Ver. 9.04 for calculations of density, and population size, as well predictions of power and sample size for future surveys. We used R ver. 2.14.1 to calculate and compare stratified lakewide CPUE.

We measured, weighed, and released all fish captured. Any fish that died was sampled for age (using otoliths or ear "bones") and diet (stomach contents).

Results and Discussion

CPUE, Density, and Population Size

We captured a total of 50 lake trout (not including 3 fish <300 mm) in 2010 (see Appendix 1 for set and capture locations and Appendix 2 for capture details). We also captured Arctic grayling and round whitefish in this survey. Total mortalities were 17 lake trout (32% mortality rate), 1 Arctic grayling (25%), and 7 round whitefish (29%). We collected stomachs and otoliths from all fish killed.

We adjusted the total catch for net selectivity bias based on the lengths of lake trout captured, resulting in a selectivity-adjusted total catch of 69 lake trout. After weighting the data by catch in each strata, we found a lake-wide CPUE of 2.04 (SE = 0.52). This was compared to the lake wide CPUE from 2009 of 2.64 (SE = 0.38). We found no difference in CPUE between 2009 and 2010 (two-tailed Welch's $t_{df=49} = 0.89$, $P = 0.38$). While populations naturally fluctuate, barring exceptional circumstance such as a large mortality event, or a major increase in fishing pressure, natural mortality should generally equal recruitment and any changes between 2 adjacent years should be small.

There were notable differences in the distribution of catches in particular stratum between surveys (Table 2). In 2010, catches were substantially lower in the 1st and 3rd strata, higher in the 4th stratum, and marginally higher in the 2nd stratum. These differences may be explained by differences in timing of the surveys; the 2010 survey was carried out later in the season (August 19-20 in 2010 compared to July 24-25 in 2009). Water parameters that are important to fish, such as temperature and dissolved oxygen, change through the summer and influence the distribution of lake trout. Differences in these parameters between surveys are likely to affect relative catch rates across the strata. In extreme cases where parameters differ greatly between surveys, catch data and population estimates may not be comparable (Jessup and Millar 2012).

Table 2. Selectivity-adjusted catch and CPUE by stratum.

Stratum (depth range)	2009			2010		
	# Sample Sites	Catch	CPUE	# Sample Sites	Catch	CPUE
1 (0-10 m)	11	36	3.29	7	8	1.15
2 (10-20 m)	8	28	3.45	9	42	4.64
3 (20-30 m)	6	11	1.89	7	5	0.71
4 (30+ m)	6	8	1.27	6	14	2.29
Total	31	83		29	69	

Lake trout density in 2010 was estimated at 30.1 lake trout / hectare and lake wide abundance was estimated as 41,787 (68% confidence interval: 31,770 – 52,486). This is lower (but not statistically different) than the 2009 estimates of 38.9 lake trout / hectare and lake wide abundance of 53,870 (68% confidence interval: 42,794 – 65,826). Note that before full confidence can be placed on estimates of density and population size, the relationship between CPUE and density should be tested in Yukon.

Biological Characteristics

Average length and weight of lake trout in 2010 was 426 mm and 946 g respectively. Average length of lake trout in 2009 was 431 mm; weight was not recorded. There was no detectable difference in length ($t_{df=116} = 0.38$, $P = 0.70$) between surveys, although the mode of the length distribution was smaller in 2010 (Figure 2).

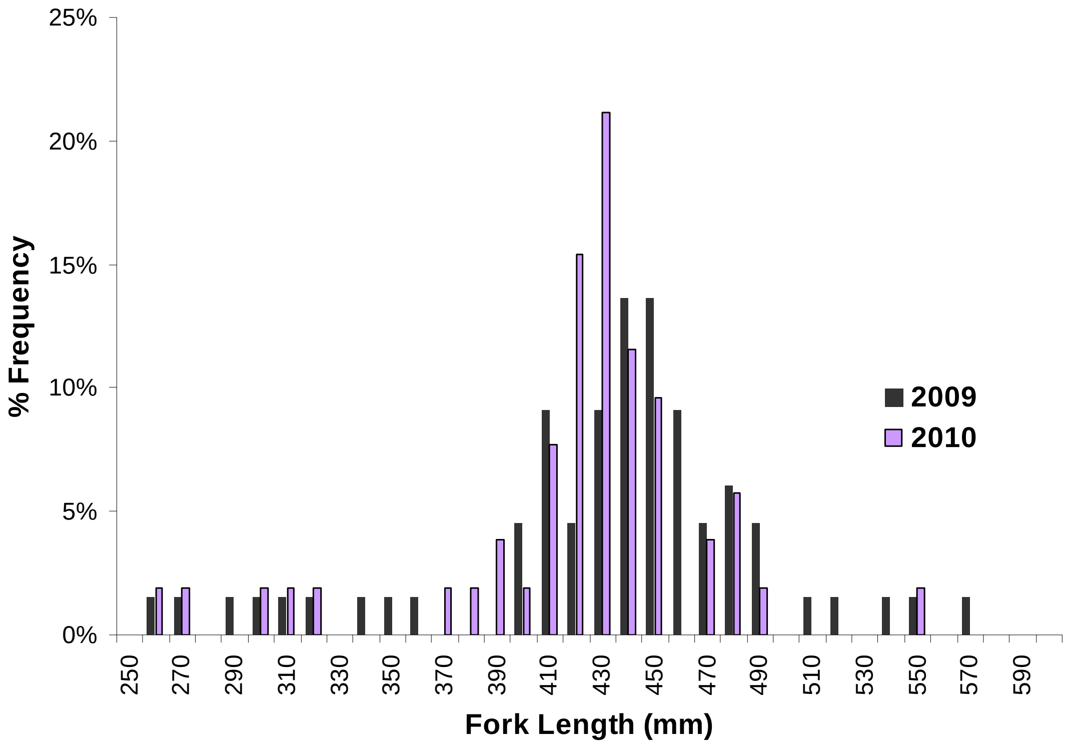

Figure 2. Length distribution of lake trout in 2009 and 2010.

Stomachs retained for diet analysis from Fish Lake in 2010 revealed a mostly invertebrate-feeding population of lake trout (Table 3). Combined with the observed length and age data, stomach contents can reveal whether a lake contains small-body lake trout that feed mostly on invertebrates or large-body lake trout that feed mostly on fish. Maximum size and size at maturity is smaller and growth is slower in the small-body, invertebrate-eating life history form than the large-body, fish-eating form. Based on stomach and length data the majority of lake trout in Fish Lake are the small-body type. Otoliths were also retained from mortalities for age analysis but results are not yet available.

Table 3. Stomach contents of sampled lake trout.

	Volume (%)
Non-biting midges	65
Scuds, Sideswimmers	15
Pond snails	6
Water fleas	5
Clams, Mussels	2
Lake trout	2
Unidentified fish	2
Unidentified invertebrates	2
Orb snails	1
Caddisflies and vegetation	Trace

Results from Previous Surveys

Results from previous small-mesh netting surveys are presented in Table 4. These surveys used a method that is quite different from the current method. Nets were set from shore out into the lake only sampling the littoral (nearshore) zone, mesh material and mesh sizes were different, set duration was only one hour compared with 2 hours, and effort was lower. Small-mesh index netting surveys showed a stable CPUE between 1996 and 2001, near the average for small-body, productive lakes, and then a decrease between 2001 and 2006 (Table 4). Variability in catch rates from small-mesh surveys can be high (Jessup and Millar 2011); the decrease in small-mesh CPUE between 2001 and 2006 may also be a product of sample variability, rather than population decline. As SPIN survey estimates are more robust (Jessup and Millar 2011), we place much greater weight on the 2009 and 2010 SPIN survey findings of a high-density lake trout population.

Table 4. Fish Lake CPUE data from small-mesh netting surveys.

	1996	2001	2006	Yukon Average (37 small body, productive lakes)
Number of sets	8	10	10	
Lake trout caught	8	12	6	
CPUE	1.0	1.2	0.6	1.19

Environment Yukon has carried out one angler harvest survey on Fish Lake, in 2010. This survey showed that a relatively high amount of angler effort and harvest occurs on Fish Lake, and that angler success is average when compared to other Yukon lakes (Millar et al. 2011).

Population Status and Conclusions

Smaller, more productive lakes with small-body lake trout usually have higher densities than larger, less productive lakes with large-body lake trout (Burr 1997). Lakes that have fewer competing predator species (lake trout, northern pike, and burbot) are also expected to have higher densities than lakes with more predators (Carl et al. 1990).

We found that Fish Lake has a high density of small-body lake trout. When compared to other Yukon lakes surveyed with SPIN to date, Fish Lake has a relatively high density of lake trout (Appendix 3). Fish Lake is a small lake with small-body lake trout and no other top predators and moderate productivity for a Yukon lake. Therefore, we expected a density higher than large-body lakes such as Sekulmun, but lower compared to similar lakes with higher productivity such as Caribou. Our findings match this expectation, so in the context of the lakes surveyed to date, the population in Fish Lake appears to be healthy.

Future Surveys

We carried out surveys in back-to-back years to assess the repeatability of SPIN. We expected similar results in the 2 years as the lake trout population should not change measurably in that time. While CPUE was approximately 24% less in 2010 than in 2009, this was not a statistically significant difference, nor do we think it reflects a true change in population abundance.

Given the difference in timing of the surveys, it is possible that environmental conditions in the lake were different in 2009 than they were in 2010, but we did not have available equipment to measure oxygen or temperature in either year. Differences in environmental conditions can affect fish distributions (as we found) and behaviour, in turn altering catchability and CPUE between years. Profiles of temperature and dissolved oxygen should be taken before every survey which will also help focus the sampling effort and describe lake conditions.

Even though the difference in survey results from this and the previous year's survey were not significant, we did not expect such a large variation in average CPUE. We recommend that at least one additional survey is carried out on Fish Lake to assess the repeatability of the method, using the timing of the 2009 survey (mid to late July). The 2009 survey should be used because data were much less variable and power to detect differences is higher (data not shown).

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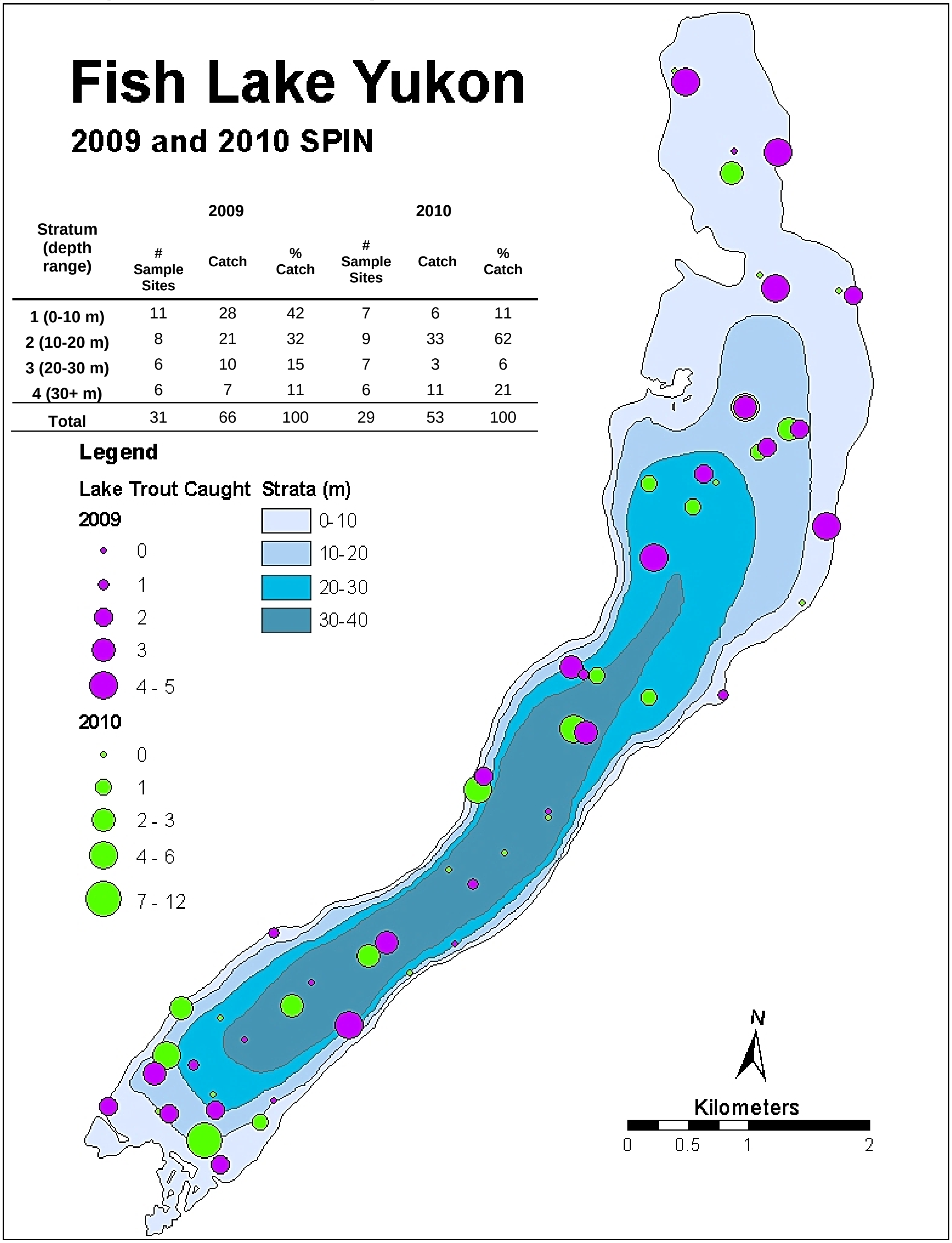
APPENDIX 1 - Fish Lake SPIN set and capture locations (non-adjusted catch data)



Stratum (depth range)	2009 # Sample Sites	2009 Catch	2009 % Catch	2010 # Sample Sites	2010 Catch	2010 % Catch
1 (0-10 m)	11	28	42	7	6	11
2 (10-20 m)	8	21	32	9	33	62
3 (20-30 m)	6	10	15	7	3	6
4 (30+ m)	6	7	11	6	11	21
Total	31	66	100	29	53	100

APPENDIX 2 – Fish Lake SPIN capture details 2010

Date	Effort (Set #)	Stratum	Species	Fork Length (mm)	Weight (g)	Fate	Sex
August 19, 2010	1	1	RW	395	550	RP	
August 19, 2010	2	1	RW	400	550	R	
August 19, 2010	2	1	LT	425	800	D	F
August 19, 2010	3	2	LT	425	900	R	
August 19, 2010	3	2	LT	430	1150	R	
August 19, 2010	3	2	LT	440	950	R	
August 19, 2010	3	2	LT	430	850	R	
August 19, 2010	3	2	LT	485	1300	R	
August 19, 2010	3	2	LT	265	200	R	
August 19, 2010	3	2	LT	425	950	R	
August 19, 2010	4	3	LT	480	1150	D	M
August 19, 2010	5	4	LT	385	600	R	
August 19, 2010	5	4	LT	475	950	R	
August 19, 2010	5	4	LT	470	1150	R	
August 19, 2010	5	4	LT	415	700	R	
August 19, 2010	5	4	LT	260	200	R	
August 19, 2010	5	4	LT	320	350	D	M
August 19, 2010	5	4	LT	545	1450	D	F
August 19, 2010	6	1	LT	440	850	R	
August 19, 2010	6	1	RW	310	250	RP	
August 19, 2010	6	1	RW	300	250	RP	
August 19, 2010	6	1	RW	280	200	RP	
August 19, 2010	6	1	RW	330	350	RP	
August 19, 2010	6	1	RW	375	450	RP	
August 19, 2010	6	1	LT	440	950	D	F
August 19, 2010	6	1	LT	440	950	D	F
August 19, 2010	6	1	RW	415	650	D	M
August 19, 2010	6	1	RW	310	250	D	M
August 19, 2010	6	1	RW	310	300	D	M
August 19, 2010	6	1	RW	330	350	D	M
August 19, 2010	7	1	No Catch				
August 19, 2010	8	2	LT	420	900	RP	
August 19, 2010	8	2	LT	450	1100	D	M
August 19, 2010	9	3	LT	305	300	RP	
August 19, 2010	10	4	No Catch				
August 19, 2010	11	1	No Catch				
August 19, 2010	12	1	AG	315	400	R	
August 19, 2010	12	1	AG	345	450	D	F
August 19, 2010	12	1	AG	350	500	R	
August 19, 2010	12	1	AG	320	400	R	
August 19, 2010	13	2	LT	295	250	R	
August 19, 2010	13	2	LT	420	900	RP	
August 19, 2010	14	3	No Catch				
August 20, 2010	15	2	LT	475	1200	R	
August 20, 2010	15	2	LT	410	1100	R	

AG=Arctic grayling; LT=lake trout; RW=round whitefish
R=released; RP=released, poor condition; D=dead; S=sacrificed; ESC=escaped

Appendix 2 continued.

Date	Effort (Set #)	Stratum	Species	Fork Length (mm)	Weight (g)	Fate	Sex
August 20, 2010	15	2	LT	865	6200	RP	
August 20, 2010	15	2	LT	395	600	D	F
August 20, 2010	16	2	No Catch				
August 20, 2010	17	3	No Catch				
August 20, 2010	18	4	LT	449	800	D	M
August 20, 2010	18	4	LT	445	850	D	F
August 20, 2010	19	4	LT	430	1000	R	
August 20, 2010	19	4	RW	310	250	R	
August 20, 2010	19	4	LT	390	550	D	F
August 20, 2010	20	2	LT	430	800	R	
August 20, 2010	20	2	LT	465	1100	R	
August 20, 2010	20	2	LT	430	1000	R	
August 20, 2010	20	2	LT	445	950	R	
August 20, 2010	20	2	LT	430	850	R	
August 20, 2010	20	2	LT	405	750	R	
August 20, 2010	20	2	LT	415	750	R	
August 20, 2010	20	2	LT	405	800	R	
August 20, 2010	20	2	RW	325	300	R	
August 20, 2010	20	2	LT	415	650	R	
August 20, 2010	20	2	LT	405	850	R	
August 20, 2010	20	2	LT	365	600	D	M
August 20, 2010	20	2	LT	420	750	D	F
August 20, 2010	20	2	RW	410	600	R	
August 20, 2010	20	2	RW	345	350	D	M
August 20, 2010	21	2	LT	435	950	D	M
August 20, 2010	22	3	No Catch				
August 20, 2010	23	4	No Catch				
August 20, 2010	24	4	No Catch				
August 20, 2010	25	1	RW	345	450	RP	
August 20, 2010	25	1	RW	400	650	RP	
August 20, 2010	25	1	LT	420	850	RP	
August 20, 2010	25	1	RW	305	300	R	
August 20, 2010	25	1	RW	345	410	R	
August 20, 2010	25	1	RW	395	650	D	M
August 20, 2010	25	1	RW	390	500	R	
August 20, 2010	25	1	LT	420		Escape	
August 20, 2010	25	1	RW	330	500	R	
August 20, 2010	25	1	RW	310	300	R	
August 20, 2010	26	3	No Catch				
August 20, 2010	27	2	LT	425	950	R	
August 20, 2010	27	2	RW	380	650	D	F
August 20, 2010	27	2	LT	415	900	R	
August 20, 2010	27	2	LT	440	900	D	M
August 20, 2010	27	2	LT	380	650	D	F
August 20, 2010	28	3	LT	450	1000	D	F
August 20, 2010	29	2	LT	430	1000	R	

AG=Arctic grayling; LT=lake trout; RW=round whitefish
R=released; RP=released, poor condition; D=dead; S=sacrificed; ESC=escaped

Appendix 2 continued.

Date	Effort (Set #)	Stratum	Species	Fork Length (mm)	Weight (g)	Fate	Sex
July 24, 2009	1	1	LT	450		R	
July 24, 2009	1	1	LT	440		D	
July 24, 2009	1	1	LT	450		R	
July 24, 2009	1	1	LT	470		R	
July 24, 2009	1	1	LT	520		R	
July 24, 2009	2	2	LT	510		D	
July 24, 2009	2	2	LT	430		R	
July 24, 2009	2	2	LT	550		R	
July 24, 2009	3	3	LT	350		ESC	
July 24, 2009	3	3	LT	460		R	
July 24, 2009	4	4	LT	310		R	
July 24, 2009	4	4	LT	265		R	
July 24, 2009	4	4	LT	284		R	
July 24, 2009	5	1	LT	427		D	
July 24, 2009	5	1	LT	490		R	
July 24, 2009	5	1	LT	410		R	
July 24, 2009	5	1	LT	400		R	
July 24, 2009	6	1	LT	410		D	
July 24, 2009	6	1	LT	400		D	
July 24, 2009	6	1	RW	375		S	
July 24, 2009	6	1	LT	460		R	
July 24, 2009	6	1	LT	418		R	
July 24, 2009	6	1	LT	450		R	
July 24, 2009	6	1	RW	331		S	
July 24, 2009	7	1	LT	480		R	
July 24, 2009	7	1	LT	450		D	
July 24, 2009	8	3	LT	450		D	
July 24, 2009	8	3	LT	410		D	
July 24, 2009	8	3	LT	490		R	
July 24, 2009	8	3	LT	400		R	
July 24, 2009	9	4	No Catch				
July 24, 2009	10	1	No Catch				
July 24, 2009	11	1	AG	357		R	
July 24, 2009	11	1	AG	339		R	
July 24, 2009	11	1	AG	385		R	
July 24, 2009	11	1	AG	376		D	
July 24, 2009	11	1	RW	356		S	
July 24, 2009	11	1	AG	321		D	
July 24, 2009	11	1	RW	382		S	
July 24, 2009	11	1	RW	394		S	
July 24, 2009	11	1	AG	405		R	
July 24, 2009	11	1	AG	395		R	
July 24, 2009	11	1	LT	440		D	
July 24, 2009	11	1	LT	410		D	
July 24, 2009	11	1	RW	417		S	
July 24, 2009	11	1	RW	370		S	
July 24, 2009	11	1	RW	320		D	

AG=Arctic grayling; LT=lake trout; RW=round whitefish
R=released; RP=released, poor condition; D=dead; S=sacrificed; ESC=escaped

Appendix 2 continued.

Date	Effort (Set #)	Stratum	Species	Fork Length (mm)	Weight (g)	Fate	Sex
July 24, 2009	11	1	AG	332		D	
July 24, 2009	11	1	AG	360		R	
July 24, 2009	11	1	RW	400		D	
July 24, 2009	11	1	RW	310		S	
July 24, 2009	11	1	AG	295		R	
July 24, 2009	11	1	AG	360		D	
July 24, 2009	11	1	AG	317		D	
July 24, 2009	11	1	RW	320		D	
July 24, 2009	11	1	AG	355		D	
July 24, 2009	12	2	LT	440		R	
July 24, 2009	12	2	LT	420		R	
July 24, 2009	13	3	LT	460		R	
July 24, 2009	14	4	LT	420		R	
July 25, 2009	15	2	LT	440		R	
July 25, 2009	15	2	LT	440		R	
July 25, 2009	15	2	LT	484		R	
July 25, 2009	16	4	LT	570		D	
July 25, 2009	16	4	LT	332		R	
July 25, 2009	16	4	LT	430		R	
July 25, 2009	17	3	LT	320		R	
July 25, 2009	18	2	LT	410		D	
July 25, 2009	18	2	LT	478		R	
July 25, 2009	18	2	LT	410		R	
July 25, 2009	19	1	RW	370		S	
July 25, 2009	19	1	AG	328		R	
July 25, 2009	19	1	LT	454		D	
July 25, 2009	19	1	LT	460		D	
July 25, 2009	19	1	AG	385		R	
July 25, 2009	20	1	AG	370		R	
July 25, 2009	20	1	AG	375		D	
July 25, 2009	20	1	AG	400		R	
July 25, 2009	20	1	AG	340		D	
July 25, 2009	20	1	AG	365		D	
July 25, 2009	20	1	RW	330		S	
July 25, 2009	20	1	AG	340		R	
July 25, 2009	20	1	RW	333		D	
July 25, 2009	20	1	AG	375		R	
July 25, 2009	20	1	RW	373		S	
July 25, 2009	20	1	RW	446		S	
July 25, 2009	20	1	AG	360		D	
July 25, 2009	20	1	LT	535		R	
July 25, 2009	20	1	AG	320		R	
July 25, 2009	20	1	AG	264		R	
July 25, 2009	20	1	AG	270		R	
July 25, 2009	20	1	AG	335		R	
July 25, 2009	20	1	AG	330		R	
July 25, 2009	20	1	AG	335		R	
July 25, 2009	20	1	AG	325		R	

AG=Arctic grayling; LT=lake trout; RW=round whitefish
R=released; RP=released, poor condition; D=dead; S=sacrificed; ESC=escaped

Appendix 2 continued.

Date	Effort (Set #)	Stratum	Species	Fork Length (mm)	Weight (g)	Fate	Sex
July 25, 2009	20	1	AG	340		R	
July 25, 2009	20	1	AG	285		D	
July 25, 2009	20	1	AG	289		R	
July 25, 2009	21	2	LT	440		D	
July 25, 2009	21	2	LT	425		D	
July 25, 2009	22	4	No Catch				
July 25, 2009	23	3	LT	257		R	
July 25, 2009	23	3	LT	297		R	
July 25, 2009	24	2	No Catch				
July 25, 2009	25	1	RW	340		S	
July 25, 2009	25	1	LT	445		R	
July 25, 2009	25	1	LT	440		R	
July 25, 2009	26	1	AG	380		ESC	
July 25, 2009	26	1	AG	325		R	
July 25, 2009	26	1	LT	480		R	
July 25, 2009	26	1	AG	405		R	
July 25, 2009	26	1	AG	370		D	
July 25, 2009	26	1	RW	345		D	
July 25, 2009	26	1	AG	345		R	
July 25, 2009	26	1	AG	415		ESC	
July 25, 2009	26	1	AG	375		R	
July 25, 2009	26	1	AG	396		D	
July 25, 2009	26	1	RW	367		S	
July 25, 2009	26	1	AG	305		R	
July 25, 2009	26	1	AG	365		R	
July 25, 2009	26	1	AG	295		R	
July 25, 2009	26	1	RW	353		S	
July 25, 2009	26	1	AG	282		R	
July 25, 2009	26	1	AG	370		D	
July 25, 2009	26	1	AG	315		D	
July 25, 2009	26	1	AG	374		D	
July 25, 2009	27	4	No Catch				
July 25, 2009	28	3	No Catch				
July 25, 2009	29	2	LT	457		D	
July 25, 2009	29	2	LT	440		R	
July 25, 2009	30	2	LT	360		R	
July 25, 2009	30	2	RW	410		D	
July 25, 2009	30	2	LT	441		D	
July 25, 2009	30	2	LT	443		D	
July 25, 2009	30	2	LT	425		R	
July 25, 2009	30	2	RW	395		S	
July 25, 2009	30	2	LT	439		R	
July 25, 2009	30	2	LT	430		D	
July 25, 2009	31	1	LT	450		R	
July 25, 2009	31	1	LT	465		R	
July 25, 2009	31	1	RW	390		D	

AG=Arctic grayling; LT=lake trout; RW=round whitefish
R=released; RP=released, poor condition; D=dead; S=sacrificed; ESC=escaped

Appendix 2 continued.

Date	Effort (Set #)	Stratum	Species	Fork Length (mm)	Weight(g)	Fate	Sex
July 25, 2009	31	1	RW	430		S	
July 25, 2009	31	1	RW	404		S	
July 25, 2009	31	1	RW	390		D	
July 25, 2009	31	1	RW	435		S	
July 25, 2009	31	1	RW	374		S	
July 25, 2009	31	1	RW	385		S	
July 25, 2009	31	1	RW	410		S	
July 25, 2009	31	1	RW	399		S	
July 25, 2009	31	1	RW	420		D	
July 25, 2009	31	1	LT	465		R	
July 25, 2009	31	1	RW	380		D	
July 25, 2009	31	1	LT	480		R	
July 25, 2009	31	1	AG	368		R	
July 25, 2009	31	1	RW	403		D	
July 25, 2009	31	1	AG	360		D	
July 25, 2009	31	1	RW	400		D	
July 25, 2009	31	1	RW	365		S	
July 25, 2009	31	1	AG	380		R	
July 25, 2009	31	1	AG	375		R	
July 25, 2009	31	1	AG	389		R	
July 25, 2009	31	1	RW	390		S	
July 25, 2009	31	1	AG	335		R	
July 25, 2009	31	1	AG	320		R	
July 25, 2009	31	1	AG	349		R	
July 25, 2009	31	1	AG	330		R	
July 25, 2009	31	1	AG	394		D	
July 25, 2009	31	1	AG	390		D	
July 25, 2009	31	1	AG	365		D	

AG=Arctic grayling; LT=lake trout; RW=round whitefish
R=released; RP=released, poor condition; D=dead; S=sacrificed; ESC=escaped

APPENDIX 3 – *Estimated CPUE (SPIN) and density from Yukon Lakes to 2011*

Lakes are arranged in descending order of lake trout density (last column). Information on lake trout morphology and life history (small body vs. large body), and the presence of other top predators is included. Lake productivity refers to the annual maximum sustainable yield of all fish in kilograms per hectare. It is estimated following the method proposed by Schlesinger and Regier (1982) of relating mean annual air temperature to the morphoedaphic index (Ryder, 1965). This information is presented so that comparisons can be made between lakes with similar characteristics.

Lake	**Lake Characteristics**				**SPIN Results**		
	Surface Area (ha)	Productivity (kg fish / ha)	Lake Trout Morphology	Other Top Predators	Year	CPUE	Density (fish/ha)
Caribou	51	3.89	Small body	None	2011	3.63	53.2
Lewes	131	3.17	Small body	None	2010	3.31	48.6
Fish	1386	2.44	Small body	None	2009	2.64	38.9
Kathleen	3398	1.87	Small body	None	2011	2.11	31.2
Louise (Jackson)	68	3.27	Small body	Rainbow trout	2011	2.02	29.8
Fish	1386	2.44	Small body	None	2010	2.01	29.7
Kathleen	3398	1.87	Small body	None	2010	1.94	28.6
Ta’tla Mun	3265	2.05	Large body	Pike/burbot	2011	1.00	4.1
Sekulmun	4985	1.16	Large body	Pike/burbot	2010	0.88	3.7
Ethel	4610	1.42	Large body	Pike/burbot	2011	0.30	2.0
Tarfu	405	2.74	Large body	Pike	2010	0.2	1.7
Pine	603	2.87	Small body	Pike/burbot	2010	0.08	1.5
Lower Snafu	284	3.54	Large Body	Pike	2010	0	0