LAKE TROUT POPULATION ASSESSMENT
AND
MULTI-YEAR SPIN SURVEY COMPARISON

FISH LAKE 2012

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LAKE TROUT POPULATION ASSESSMENT AND MULTI-YEAR SPIN SURVEY COMPARISON FISH LAKE 2012

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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 and impact of fisheries.

Environment Yukon works with First Nations, Renewable Resources Councils, and user groups to determine priority lakes for surveys. Criteria for identification of priority lakes include accessibility, sensitivity, and management concern. The surveys focus on lake trout and lake whitefish, indicators of the health of northern lake ecosystems.

We surveyed Fish Lake in 2012 using SPIN (Summer Profundal Index Netting; Sandstrom and Lester 2009). Environment Yukon previously surveyed the lake using SPIN in 2009 and 2010 (Jessup and Millar 2012). Multiple SPIN surveys on Fish Lake are part of Environment Yukon's evaluation of the repeatability of the SPIN method on Yukon lakes. Environment Yukon also surveyed Fish Lake using a different netting technique in 1994, 2001, and 2006. SPIN provides more statistically robust data and improves confidence in survey results (Jessup and Millar 2011).

The 2012 SPIN survey captured 122 lake trout, resulting in a lake-wide numerical CPUE (catch per unit effort) of 3.71 lake trout per net, and a lake-wide biomass CPUE of 2.25 kg of lake trout per net. The estimated density of lake trout in Fish Lake was 54.4 lake trout per hectare. The lake trout CPUE and density estimates from the 2012 Fish Lake SPIN survey were very high – considerably higher than 2009 and 2010 Fish Lake SPIN survey estimates.

Key Findings

- Fish Lake is a medium-sized, productive lake with a high density of small-bodied lake trout.
- The CPUE and density estimates from the 2012 SPIN survey of Fish Lake were much higher than those from SPIN surveys in 2009 and 2010.
- The 2012 Fish Lake SPIN survey provided less reliable information on lake trout abundance in Fish Lake than the 2009 and 2010 SPIN surveys.
- Differences in environmental conditions among repeated SPIN surveys likely contributed to dissimilar results; environmental factors should be taken into consideration when planning SPIN surveys and comparing their results.

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Introduction

Each year, Environment Yukon conducts assessments of fish populations, with a focus on lake trout and lake whitefish. 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.

The SPIN assessment involves 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 and biomass of lake trout and lake whitefish as measured by an index (CPUE, or catch per unit effort);
- changes in relative abundance and biomass from previous surveys;
- for lake trout, 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 and lake whitefish, as well as other species captured; and
- age, sex, maturity and diet of any fish killed.

Environment Yukon surveyed Fish Lake using SPIN in 2009 and 2010 (Jessup and Millar 2012). The 2012 SPIN survey was intended to continue the assessment of repeatability of the SPIN method on Yukon lakes. Here we report the 2012 SPIN results and compare them with results from 2009 and 2010 SPIN surveys.

Environment Yukon also surveyed Fish Lake using small-mesh netting surveys in 1996, 2001, and 2006. Differences between this method and SPIN mean that results from the SPIN surveys cannot be compared statistically.

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 an elevation of 1,120 m above sea level, more than 300 m higher than downtown Whitehorse. The lake is approximately 11 km long and covers an area of 1,386 ha. Mean depth is 16.5 m and maximum depth is 37 m.

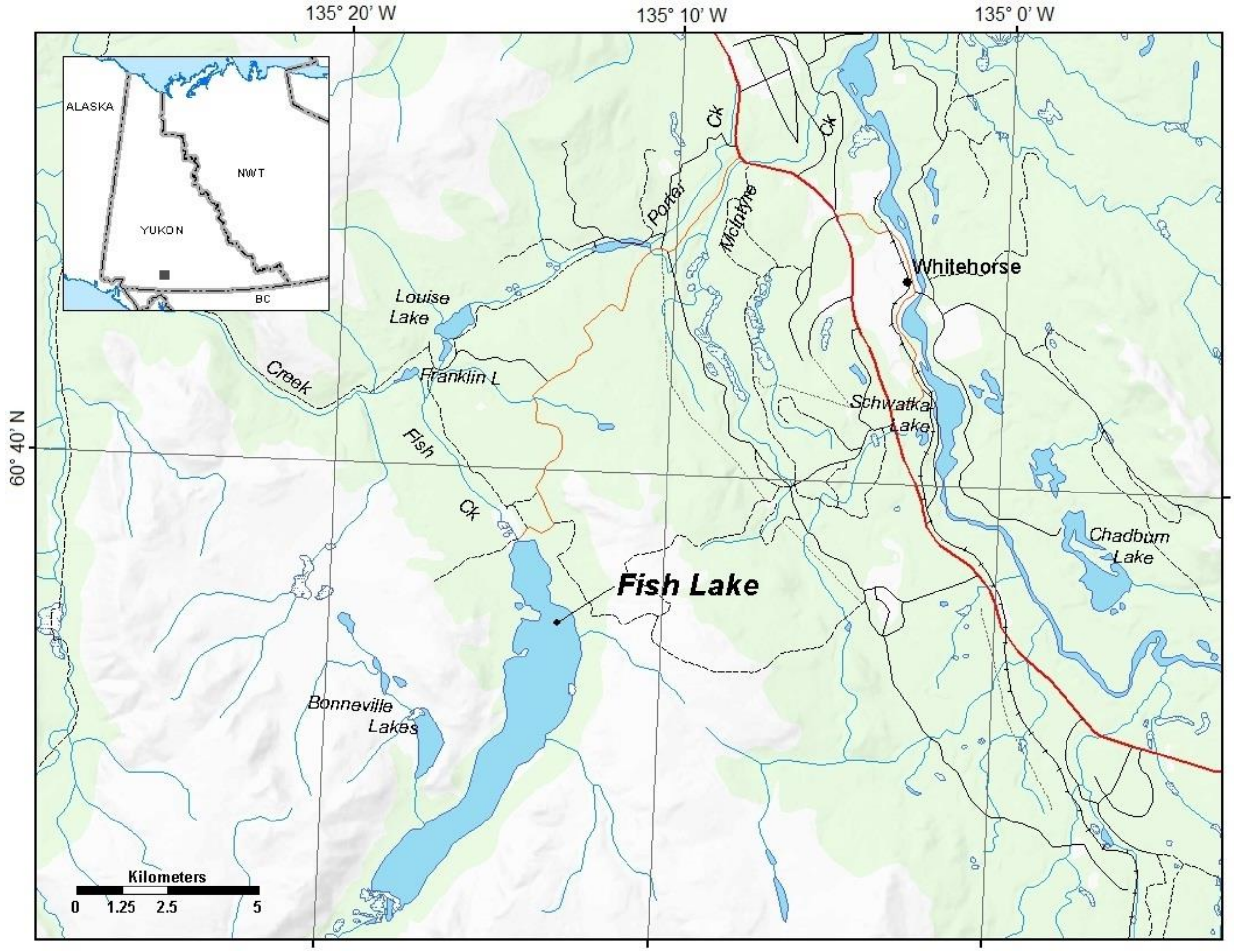

Figure 1. Location of Fish Lake, Yukon**.**

The lake is fed by several small creeks as well as the Bonneville Lakes chain. Fish Lake is relatively productive compared to other Yukon lakes, with total dissolved solids (a measure of nutrients in the water) of 116 mg/l. Fish Lake lies within the traditional territory of the Kwanlin Dün First Nation.

At one time Fish 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. During high flows, some water is still diverted to the Ibex River through an overflow spillway at Franklin Lake.

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 Waters Regulations since 1990. The catch limit for lake trout is 3 fish per day, with 6 in possession. Only one lake trout over 65 cm may be in possession.

The catch and possession limits for Arctic grayling are 5 and 10, respectively, with only one Arctic grayling longer than 40 cm in possession. In addition to lake trout and Arctic grayling, round whitefish are also present in Fish Lake.

Methods

We followed the SPIN method for lake trout capture (Sandstrom and Lester 2009; Jessup and Millar 2011). Gillnets were set on the bottom at different depths throughout the lake to capture lake trout and determine CPUE. Each 64-m gillnet was made up of 8 panels of monofilament web with mesh sizes from 57 mm to 127 mm. We set each net for 2 hours.

Survey effort

We surveyed Fish Lake 4 – 6 July 2012. We set a total of 45 nets, divided among 4 depth strata (Table 1, Appendix 2). We initially weighted the number of nets set in each stratum by the surface area of the stratum. After the first day, distribution of effort was adjusted by concentrating on those strata with the highest lake trout 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 manually dispersed to ensure coverage of the entire lake.

Table 1. Effort breakdown by stratum, Fish Lake 2012.

Stratum	Depth range	Area (ha)	Area (%)	Nets Set	Nets Set (%)
1	**0 - 10 m**	532	38%	12	27%
2	**10 - 20 m**	301	22%	12	27%
3	**20 - 30 m**	281	20%	11	24%
4	**> 30 m**	274	20%	10	22%
Total		1,388	100%	45	100%

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). To calculate population-wide percent volume of diet items, we examined the volume of diet items in the stomach of each fish. We also took the fullness of each stomach into account. Each stomach was weighted equally when calculating the population-wide percent volume.

We calculated the lake-wide numerical catch per unit effort (CPUE) as the number of lake trout of “harvestable” size (300 mm and up) caught per net.

The method excludes fish below 300 mm because they are not usually captured by anglers.

Following SPIN protocols, this numerical CPUE was calculated using catch numbers adjusted to account for net selectivity bias based on the lengths of lake trout captured (Sandstrom and Lester 2009).

CPUE is considered an index of abundance, and changes in CPUE are understood to reflect actual changes in the lake trout population. CPUE can therefore be compared between surveys and used to detect population growth or decline.

We also calculated a lake-wide biomass CPUE for lake trout, as the kilograms of lake trout (300 mm and up) caught per net, using Cochran's area-weighted mean and standard deviation for random stratified samples (Cochran 1977, Krebs 1999). We did not adjust lake trout biomass CPUE for net selectivity bias.

We converted numerical CPUE to density (lake trout/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 lake trout/ha • lake area (ha) = number of lake trout in lake).

Before we can be fully confident in our estimates of density and absolute abundance, the relationship between lake trout CPUE and density must be verified for Yukon lakes.

Comparison with Previous SPIN Surveys

We compared the lakewide numerical CPUE from 2009, 2010 and 2012 SPIN surveys using pairwise Welch's t-tests.

Results and Discussion

Temperature and Dissolved Oxygen

Temperature and dissolved oxygen are water quality variables critical to lake trout, and they determine suitable and optimal habitats within a lake. Lake trout habitat has been defined as *suitable* where temperatures are below 15 ˚C and dissolved oxygen is above 4 mg/L (Clark et al. 2004). Outside these levels (i.e., temperature above 15 ˚C and dissolved oxygen below 4 mg/L) the habitat is *unsuitable* for lake trout. The *optimal* temperature range for Yukon lake trout is between 2 ˚C and 12 ˚C (Mackenzie-Grieve and Post 2006). The *optimal* dissolved oxygen level for lake trout is ≥7 mg/L (Evans 2005).

We took a temperature and dissolved oxygen profile near the middle of Fish Lake on 5 July 2012. The lake was unstratified, with temperatures ranging between 7.2 °C at the surface to 5.8 °C near the bottom (Figure 2). Temperatures were optimal (≤12 °C) at all depths. Dissolved oxygen levels were optimal (>7 mg/L) from the surface down to the bottom at 35 m (Figure 2). Overall, water conditions were optimal through the entire water column.

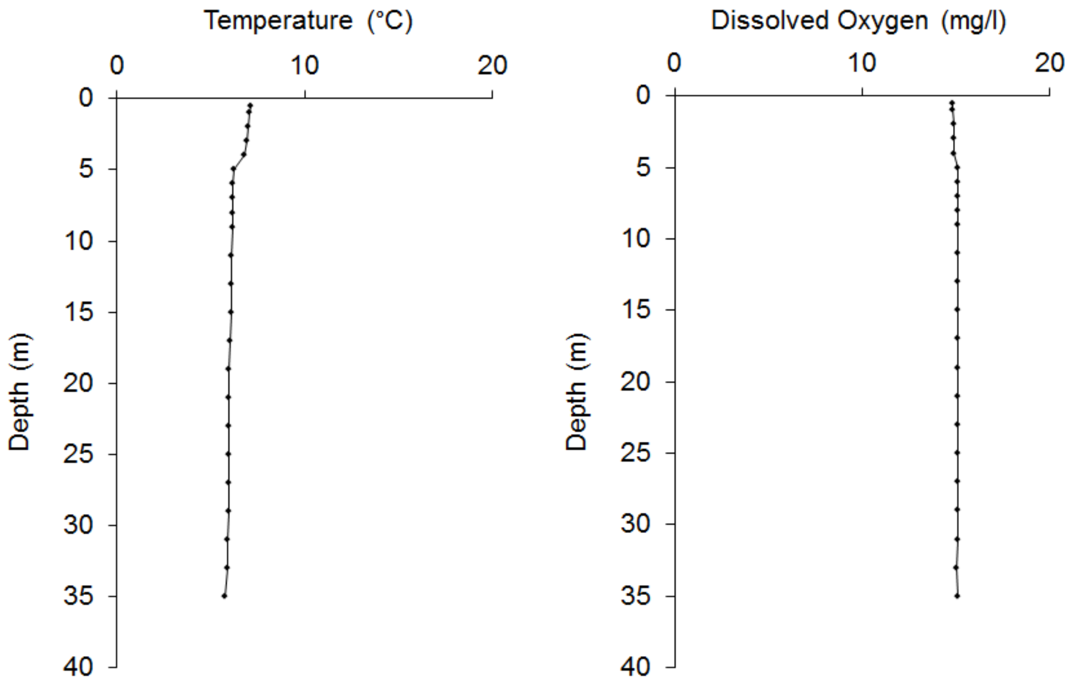

Figure 2. Temperature and dissolved oxygen profiles of Fish Lake measured 5 July 2012.

Catch (CPUE), Density, Biomass, and Population Size

We captured 122 lake trout in 2012. Of these, 99 trout were longer than 300 mm fork length; our analyses are based on these fish.

We adjusted the catch to account for net selectivity bias based on the lengths of lake trout captured. The selectivity-adjusted total catch was 146 lake trout (Table 2). After weighting the data by catch in each stratum, we found a lake-wide numerical CPUE of 3.71 lake trout/net (SE = 0.62).

Table 2. Selectivity-adjusted lake trout catch (no. of fish) by stratum, Fish Lake 2012.

Stratum	Depth Range	Nets Set (%)	Lake Trout Caught	Lake Trout Caught (%)
1	0 - 10 m	27%	74	51%
2	10 - 20 m	27%	42	29%
3	20 - 30 m	24%	8	6%
4	> 30 m	22%	21	15%
Total		100%	146	100%

We calculated a biomass CPUE for lake trout without adjusting catch for net selectivity (based on information in Table 3). After weighting the data by catch in each stratum, we found a lake-wide biomass CPUE for lake trout of 2.25 kg/net (SE = 0.22).

Table 3. Non-selectivity-adjusted lake trout catch (biomass in kg) by stratum, Fish Lake 2012.

Stratum	Depth range	Nets Set (%)	Biomass of Lake Trout Caught (kg)	Biomass of Lake Trout Caught (%)
1	0 - 10 m	27%	44	49%
2	10 - 20 m	27%	24	27%
3	20 - 30 m	24%	6	6%
4	> 30 m	22%	16	18%
Total		100%	89	100%

Lake trout density was estimated at 54.4 lake trout / ha, giving a lake-wide abundance estimate of 75,562 lake trout (68% confidence interval: 62,403 – 89,955). Note that before full confidence can be placed on estimates of density and population size, the relationship between CPUE and density in Yukon should be verified.

Of the 122 lake trout we caught, 19 died. This represents a very small proportion of the estimated number of fish in the lake; the survey had a negligible impact on the population.

Size, Age, and Diet

Lake trout populations have different life history strategies, in part depending on the fish community in the lake. Lake trout in lakes with lake whitefish tend to be larger, on average, than lake trout in lakes without lake whitefish. These large-bodied lake trout populations also tend to mature at a larger size, have a larger maximum size, and have lower population densities than small-bodied lake trout populations (typically found in lakes without lake whitefish).

There are no lake whitefish in Fish Lake and lake trout are of the small-bodied life history type. Lake trout caught in the 2012 Fish Lake SPIN survey ranged between 225 mm and 640 mm, with an average fork length of 390 mm (Figure 3). The mean weight of lake trout was 732 g.

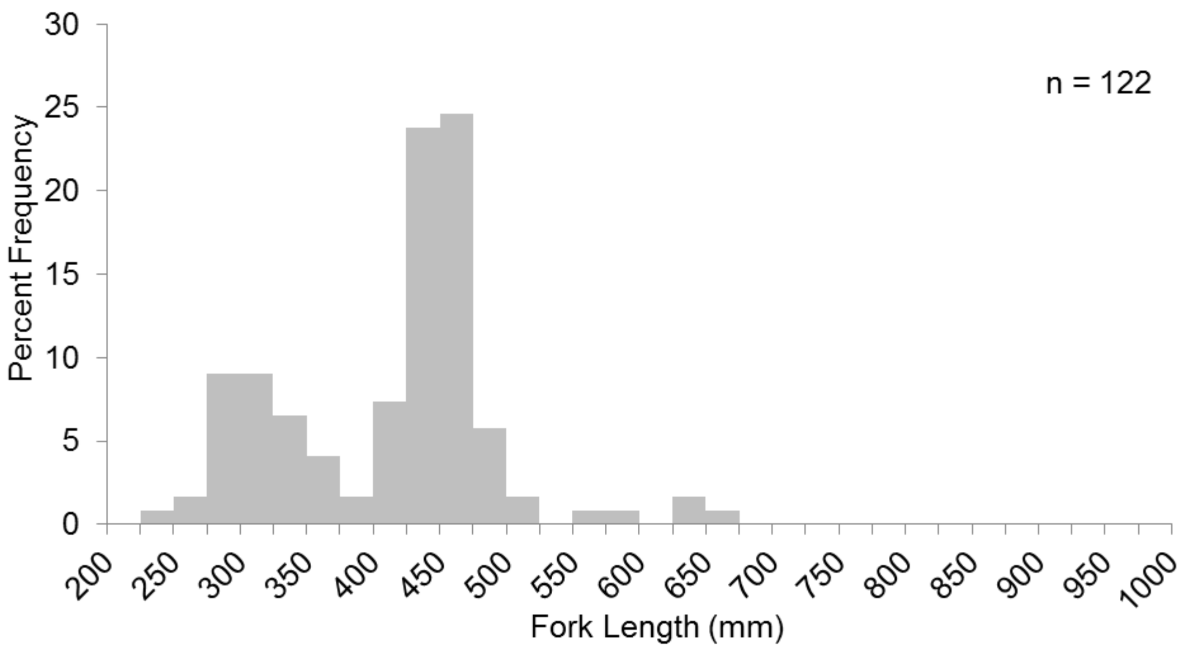

Figure 3. Length distribution of lake trout caught in the Fish Lake SPIN survey, July 2012.

The lake trout that we aged were 7 – 27 years old, with a mean age of 14 (Figure 4). Length-at-age data from this subset of lake trout suggest steady growth in length until age 15, after which growth appears to slow considerably (Figure 5). Interpretation of these data are constrained by low sample sizes, and should be treated with caution.

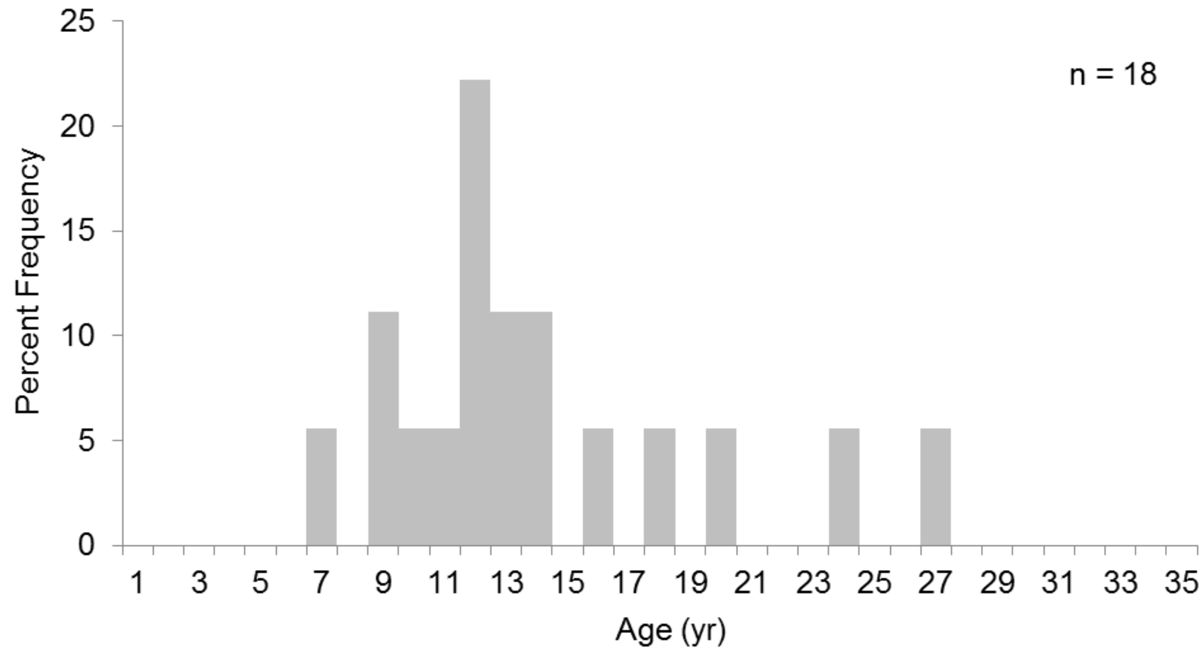

Figure 4. Age distribution of lake trout capture mortalities from Fish Lake SPIN survey, July 2012.

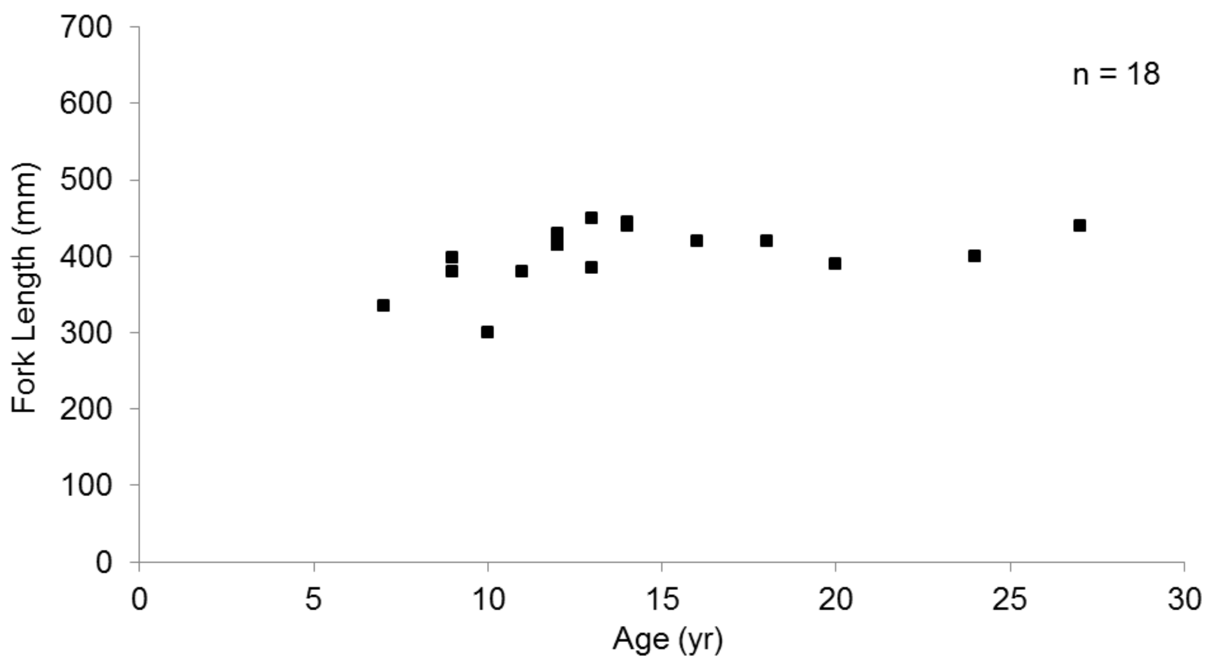

Figure 5. Length at age of lake trout in Fish Lake, July 2012.

We examined 18 lake trout stomachs, which averaged 55.8% full. Scuds, sideswimmers, snails and caddisflies formed the largest proportion of lake trout stomach contents (Table 4).

Table 4. Sampled lake trout stomach contents, Fish Lake 2012.

Stomach Content	Frequency of Occurrence	Percent volume
Scuds, sideswimmers	52.9%	29.0%
Pond snails	35.3%	28.8%
Caddisflies	41.2%	17.6%
Orb snails	35.3%	8.0%
Non-biting midges	52.9%	7.0%
Clams, mussels	29.4%	5.7%
Unidentified invertebrates	11.8%	2.0%
Unidentified fish	11.8%	1.8%
Unidentified vegetation	5.9%	trace
Ants	5.9%	trace
Beetles	5.9%	trace

Other Species

The majority of fish caught in the 2012 Fish SPIN survey were lake trout. The only other fish captured were round whitefish (n = 12). Round whitefish ranged between 310 mm and 430 mm fork length, with an average of 363 mm. Only one round whitefish was retained as a capture mortality; age and stomach contents data are not presented. Arctic grayling, while known to be present in Fish Lake, were not caught in this survey.

Results from Previous Small-mesh Surveys

The number of lake trout caught per net in small-mesh netting surveys increased between 1996 and 2001, then decreased between 2001 and 2006 (Table 5). Small-mesh CPUE was lower than the Yukon average for productive lakes (with total dissolved solids greater than 100 mg/l) with small-bodied lake trout (1.19 lake trout/net) in all years surveyed. 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, and set duration was only one hour.

Table 5. Results of small-mesh netting surveys of Fish Lake.

	2006	2001	1996
Nets set	10	10	8
Lake trout caught	6	12	8
Lake trout numerical CPUE (No. fish / net)	0.60	1.20	1.00

Population Status and Conclusions

Lake trout in lakes where lake whitefish are absent tend to be small-bodied, and exist at higher densities compared to lakes where lake whitefish are present. Where lake whitefish are present, lake trout tend to exist at low densities and are large-bodied. Productive lakes like Fish Lake also tend to have higher lake trout densities than less productive lakes (Burr 1997).

We found that Fish Lake had a high density of small-bodied lake trout, compared to other productive lakes without lake whitefish populations (Appendix 1). Some small-bodied lake trout lakes with high productivity (e.g. Caribou, Lewes) have high densities of lake trout similar to Fish Lake while others (e.g. Louise/Jackson, Mush) have much lower densities compared to Fish Lake (Appendix 1). In the case of Louise/Jackson Lake, this likely stems from a depleted lake trout population. Likely causes for low lake trout densities in Mush Lake are less clear. These results, combined with past and current harvest pressure information for Fish Lake, indicate a healthy population of small-bodied lake trout for a lake of its size, fish community and productivity.

Previous small-mesh netting surveys demonstrated variable results over a ten-year span, though were consistently below the average value for productive Yukon lakes with small-bodied lake trout. The power of small-mesh netting surveys to accurately reflect population abundance of lake trout, however, is limited; we consider SPIN survey results to be more reliable indicators of lake trout abundance (Jessup and Millar 2011).

Recreational fishing effort on Fish Lake was slightly above the Yukon average and harvest of lake trout by recreational anglers exceeded sustainable levels in 2010 (Millar et al. 2011). In 2011, the harvest of lake trout over July and August was about half of that found in 2010 (Environment Yukon files). While the population assessments indicate a healthy population of lake trout in Fish Lake, harvest data suggest that angling activity can be heavy in some years and attention should be paid to harvest levels and the impact it may be having on this fish population.

Comparison with Previous SPIN Surveys

We surveyed the lake trout population in Fish Lake in 3 separate years, with different results each time (Table 6). We found a significantly higher lake trout CPUE in 2012 when compared to 2010 (Table 7). The differences between the 2009 and 2010 surveys and between the 2009 and 2012 surveys were not significant (Table 7).

Table 6. SPIN results by survey year.

Survey year	2012	2010	2009
Survey timing	July 4 – 6 (early summer)	August 19 – 20 (late summer)	July 24 – 25 (mid-summer)
CUE	3.71	2.04	2.64
Lower 95 % CI	2.47	1.00	1.88
Upper 95 % CI	4.95	3.08	3.40

Table 7. Results of pairwise comparisons (Welch's t-test) of lake-wide selectivity-adjusted lake trout CPUE (no. of lake trout/net) among SPIN surveys results from 2009, 2010 and 2012.

	Pairwise Comparisons		
	2009 - 2010	**2009 - 2012**	**2010 - 2012**
T	0.93	1.47	2.06
df	52	69	72
P	0.36	0.15	0.04

It is unlikely that the differences in results among the 2009, 2010, and 2012 SPIN surveys of Fish Lake reflect real changes in lake trout population size. Lake trout are long-lived and they reproduce slowly. Aside from drastic and sudden environmental change, or dramatic increase in harvest, it would take many years for a population to increase or decrease to the extent that the change would be measurable through a netting survey like SPIN (Environment Yukon 2010). It is much more likely that the differences in the results of SPIN surveys over this brief 4-year time period stem from changes in environmental conditions between surveys that led to different catch rates.

Differences in environmental conditions between surveys could explain the differences in results that we observed. In part, these are due to year-to-year differences in environmental conditions: the summer of 2012, for example, was notably cool and rainy.

Others have found year-to-year weather differences to be important factors: a SPIN survey carried out in Kathleen Lake, Yukon at the same time each summer for 4 consecutive years found considerable differences in lake temperature and some differences (though non-significant) in the estimate of the lake trout population (Wong 2013). In the case of Fish Lake, the differences in environmental conditions are also due to the surveys being carried out at different times each year. In 2010 we carried out the SPIN survey 19 – 20 August (late summer). In 2009, we carried out the survey 24 – 25 July (mid-summer). There was likely some thermal stratification of the lake during these surveys. In 2012, we carried out the SPIN survey 4 – 6 July (early summer) when Fish Lake had not yet stratified (Figure 2).

Table 8. Selectivity-adjusted catch and numerical CPUE (no. of lake trout/net) for SPIN surveys of Fish Lake.

		2009			2010			2012		
Stratum	**Depth Range**	Nets Set	Lake Trout Caught	Lake Trout / Net	Nets Set	Lake Trout Caught	Lake Trout / Net	Nets Set	Lake Trout Caught	Lake Trout / Net
1	**0 - 10 m**	11	36	3.29	7	8	1.15	12	74	6.20
2	**10 - 20 m**	8	28	3.45	9	42	4.64	12	42	3.53
3	**20 - 30 m**	6	11	1.89	7	5	0.71	11	8	0.74
4	**> 30 m**	6	8	1.27	6	14	2.29	10	21	2.13
		31	83		29	69		45	146	

Differences in a lake's environmental conditions impact lake trout behaviour and distribution. For example, the catch of lake trout in shallow water (Stratum 1, 0 – 10 m) differed drastically between surveys (Table 8). When we did the survey in early July (2012), the lake was unstratified and there was optimal temperature and oxygen levels at all depths: we caught many lake trout in shallow water habitats. When we did the survey in late July (2009), we observed only a moderate catch rate in shallow waters. When we did the survey in late August (2010), we observed a low catch rate in shallow waters (Table 8). The pattern suggests a high use of shallow waters (< 10 m) by lake trout in early summer and a reduction of their use of this habitat as the shallow water warms up and becomes less than optimal (though we do not have specific temperature and oxygen data for 2009 and 2010, this warming of shallow waters through the summer is the typical pattern).

Differences in lake trout movement and behaviour because of differences in environmental conditions can affect catch in specific strata as well as the overall population estimate.

Lake trout are most active when environmental conditions are optimal (water temperatures 2 °C – 12 °C, dissolved oxygen levels > 7 mg/L; Evans 2005, Mackenzie-Grieve and Post 2006). Catch rates are a function of both the number of fish in the lake and how much they are moving around. When lake trout are very active, they are more likely encounter a stationary net than when they are moving less. This translates into a higher catch rate and the perception that there are more fish in the lake. When this susceptibility to capture (the 'catchability') of lake trout differs overall between surveys, this can impact the comparability of the population estimates derived from these surveys.

The same pattern, of dissimilar SPIN survey results for the same lake when surveys are conducted under different environmental conditions, was encountered for late June and late August SPIN surveys of Lewes Lake (Jessup *et al*. 2012). Conducted in the same year, SPIN results for August showed a 38% decline in lake trout catch rate compared to the June survey, which could not be attributed to actual population decline over such a short period. In this case, higher temperatures and lower dissolved oxygen levels in the August survey likely limited both distribution and activity levels of lake trout within the lake, reducing catch rates.

Recommendations

Maintain consistent seasonal timing for repeat SPIN surveys

Environmental conditions under which SPIN surveys are conducted can affect distribution and numbers of lake trout captures and estimates of population size and density. Repeat SPIN surveys must be conducted under environmental conditions that match previous surveys as closely as possible. Failing this, differences in survey results may reflect changes in lake conditions rather than lake trout density. In the case where SPIN surveys are carried out under differing environmental conditions, comparisons between survey results should be made with consideration of these differences.

Profile water temperature and dissolved oxygen at the beginning of every survey

Temperature and dissolved oxygen can have profound impacts on the distribution and activity level of lake trout (Evans 2005, Mackenzie-Grieve and Post 2006). Profiles of temperature and dissolved oxygen must be taken before every SPIN survey, both as a record of current conditions, and to examine whether conditions differ from those in previous surveys. Others have found that even when consistent seasonal timing is maintained, lake conditions vary from year to year. It is important that this variation is fully considered.

Establish Yukon-appropriate timing windows for SPIN surveys

The SPIN methodology was developed for Ontario lakes. It constrains sampling to periods when surface waters of the study lakes are > 18 °C. In the case of more northerly systems, the suggestion is to limit sampling to the 4 – 6 weeks of peak summer water temperature (Sandstrom and Lester 2009). We recommend pursuing further refinement of survey timing windows for Yukon.

Use the 2009 and 2010 Fish Lake estimates

The 2012 survey was conducted in early July in what was a cold summer and when the lake had not yet thermally stratified. Given the recommended timing windows we believe the 2012 SPIN survey should be considered a less reliable indicator of the actual lake trout population status than the 2009 and 2010 SPIN surveys.

Consider differences in temperature and oxygen levels for other lakes

Given that differences in temperature and dissolved oxygen can impact the catchability and estimates of a lake trout population, consideration to these factors should be given when comparing across lakes. Some lakes have very different temperature and dissolved oxygen regimes than others and these differences may not be compensated for through survey timing.

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Appendix 1 – Characteristics of lake trout populations for Yukon lakes.

Lakes are arranged in descending order of estimated lake trout density. Information on lake productivity, fish community, lake trout body size and SPIN survey sample details are included. Lake productivity refers to the annual maximum sustainable yield of all fish and is estimated from physical and chemical information on each lake, independently of fish information. 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. Density estimates are based on a relationship between CPUE and lake trout density developed for lakes in Ontario; before full confidence can be placed on estimates of density and population size, the relationship between CPUE and density should be established in Yukon.

Lake	Lake Area (ha)	Lake Productivity (kg fish/ha)	Lake whitefish present?	Lake Trout Morphology	Survey Year	No. of Trout Caught*	Mean Fork Length (mm)*	Mean Weight (g)*	Mean No. of Trout per Net (Numerical CPUE)	Mean Weight of Trout per Net (Biomass CPUE; kg)	Estimated Density (No./ha)	Estimated Density (kg/ha)	Population Estimate
Caribou	51	3.89	No	Small body	2012	84	388	630	3.81	1.71	55.9	35.2	2,851
Fish	1,386	2.44	No	Small body	2012	122	390	720	3.71	2.18	54.4	39.2	75,562
Caribou	51	3.89	No	Small body	2011	89	390	654	3.63	1.18	53.2	34.8	2,716
Lewes	131	3.17	No	Small body	2010	92	358	543	3.31	1.35	48.6	25.9	6,369
Fish	**1,386**	**2.44**	**No**	**Small body**	**2009**	**66**	**431**	**†**	**2.64**	**†**	**38.9**	**-**	**53,870**
Kathleen	3,398	1.87	No	Small body	2012	188	466	†	2.18	†	‡	-	‡
Kathleen	3,398	1.87	No	Small body	2011	194	448	†	2.14	†	‡	-	‡
Louise (Jackson)	68	3.27	No	Small body	2011	41	409	971	2.02	1.39	29.8	28.9	2,024
Fish	1,386	2.44	No	Small body	2010	53	426	946	2.01	1.46	29.7	28.1	41,787
Kathleen	3,398	1.87	No	Small body	2013	194	480	†	1.86	†	‡	-	‡
Kathleen	3,398	1.87	No	Small body	2010	121	474	†	1.96	†	‡	-	‡
Dezadeash	7,968	3.18	Yes	Large body	2013	228	641	3,323	1.73	4.92	6.3	20.9	50,590
Mush	1,888	2.25	No	Small body	2012	132	436	†	1.18	†	‡	-	‡
Mandanna	786	2.44	Yes	Large body	2013	58	487	1,449	1.11	1.41	4.4	6.4	3,487

Table Continued

Kluane	40,821	1.64	Yes	Large body	2013	176	552	2,348	1.02	2.01	4.2	9.9	168,712
Tetl’ámǟn	3,141	2.05	Yes	Large body	2011	65	671	4,235	1.00	3.67	4.1	17.4	12,937
Sekulmun	4,985	1.16	Yes	Large body	2010	60	536	2,345	0.88	1.80	3.7	8.7	18,651
Fox	1,602	2.56	Yes	Large body	2013	73	448	1,114	0.75	0.70	3.4	3.8	5,397
Quiet	5,441	1.47	Yes	Large body	2012	170	517	1,781	0.73	1.07	3.3	5.8	17,865
Mayo	9,963	1.20	Yes	Large body	2013	123	456	1,261	0.35	0.14	2.1	2.7	21,229
Frenchman	1,441	2.60	Yes	Large body	2012	15	533	2,475	0.31	0.68	2.0	5.0	2,891
Ethel	4,610	1.42	Yes	Large body	2011	31	573	3,333	0.30	0.71	2.0	6.7	9,102
Tarfu	405	2.74	No (least cisco)	Large body	2010	8	567	2,338	0.20	0.28	1.7	4.0	680
West Twin	153	2.50	Yes	Large body	2013	7	432	1,125	0.15	0.18	1.5	1.7	234
Pine	603	2.87	Yes	Large body	2010	2	503	1,600	0.07	0.11	1.3	2.1	764
Snafu	284	3.58	Yes	Large body	2010	0	-	-	0.00	0.00	-	-	-

** Number of lake trout caught, mean fork length and mean weight all reflect measures for all lake trout (including those <300 mm fork length), without adjusting for net selectivity.*

† Data collected on these surveys were insufficient to accurately determine lake trout weight parameters.

‡ Data not available. Contact Parks Canada for more information on Kathleen and Mush lakes.

Literature Cited

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Appendix 2 – Fish Lake 2012 SPIN set locations.