LAKE TROUT POPULATION ASSESSMENT

PINE LAKE

2010

Prepared by
Lars Jessup and Nathan Millar

Environment
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Yukon Fish and Wildlife Branch
TR-11-16

Acknowledgements

Treharne Drury, Harry Smith, Sandy van Dijk, and Lorne LaRocque assisted with the survey. Jean Carey and Rob Florkiewicz reviewed and edited the report.

Copies available from:

Yukon Department of Environment
Fish and Wildlife Branch, V-5A
Box 2703, Whitehorse, Yukon Y1A 2C6
Phone (867) 667-5721, Fax (867) 393-6263
Email: environmentyukon@gov.yk.ca

Also available online at www.env.gov.yk.ca

Suggested citation:

JESSUP, L., AND N. MILLAR. 2011. Lake trout population assessment: Pine Lake 2010. Yukon Fish and Wildlife Branch Technical Report TR-11-16, Whitehorse, Yukon, Canada.

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 Pine Lake in 2010 using SPIN (Summer Profundal Index Netting). Environment Yukon previously surveyed the lake using a different index netting technique in 1993, 2001, and 2006. SPIN provides more statistically robust data and improves confidence in survey results (Jessup and Millar, 2011).

The 2010 SPIN survey captured only 2 lake trout, resulting in a lake-wide CPUE (catch per unit effort) of 0.07 and an estimated density of 1.4 lake trout / hectare. For a lake of its size and productivity, Pine Lake has a very small population of lake trout. When these results are viewed in the context of other studies, they suggest that the lake trout population in Pine Lake is depleted.

Key Findings

- There are very few lake trout in Pine Lake.
- The lake trout population is probably depleted.

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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 Pine Lake using SPIN in 2010 and using small-mesh netting in 1993, 2001, and 2006. Differences between the two methods mean that results from this survey cannot be compared statistically with past surveys. Here we report the 2010 results and make only subjective comparisons with previous surveys.

Study Area

Pine Lake is near the community of Haines Junction along the Alaska Highway (Figure 1). It is in the traditional territory of the Champagne and Aishihik First Nations. The lake is approximately 5.5 km long and covers an area of approximately 603 hectares. It has a mean depth of 14.7 m and a maximum depth of 28 m. The drainage basin upstream of Pine Lake is very small and the lake is fed chiefly by Marl Creek and a few other small, unnamed creeks. The lake drains via Pine Creek into the Dezadeash River, part of the Alsek River watershed.

Pine Lake has a number of permanent residences along the north shore. It also has a government campground with boat launch and a popular day use area on the southwest side. Fish species present in the lake include lake trout, northern pike, lake whitefish, and burbot.

Environment Yukon has managed the recreational fishery on Pine Lake with Special Management Waters regulations since 2004. The catch and possession limit for lake trout is one fish per day and all fish over 65 cm must be released. Only barbless hooks are permitted.

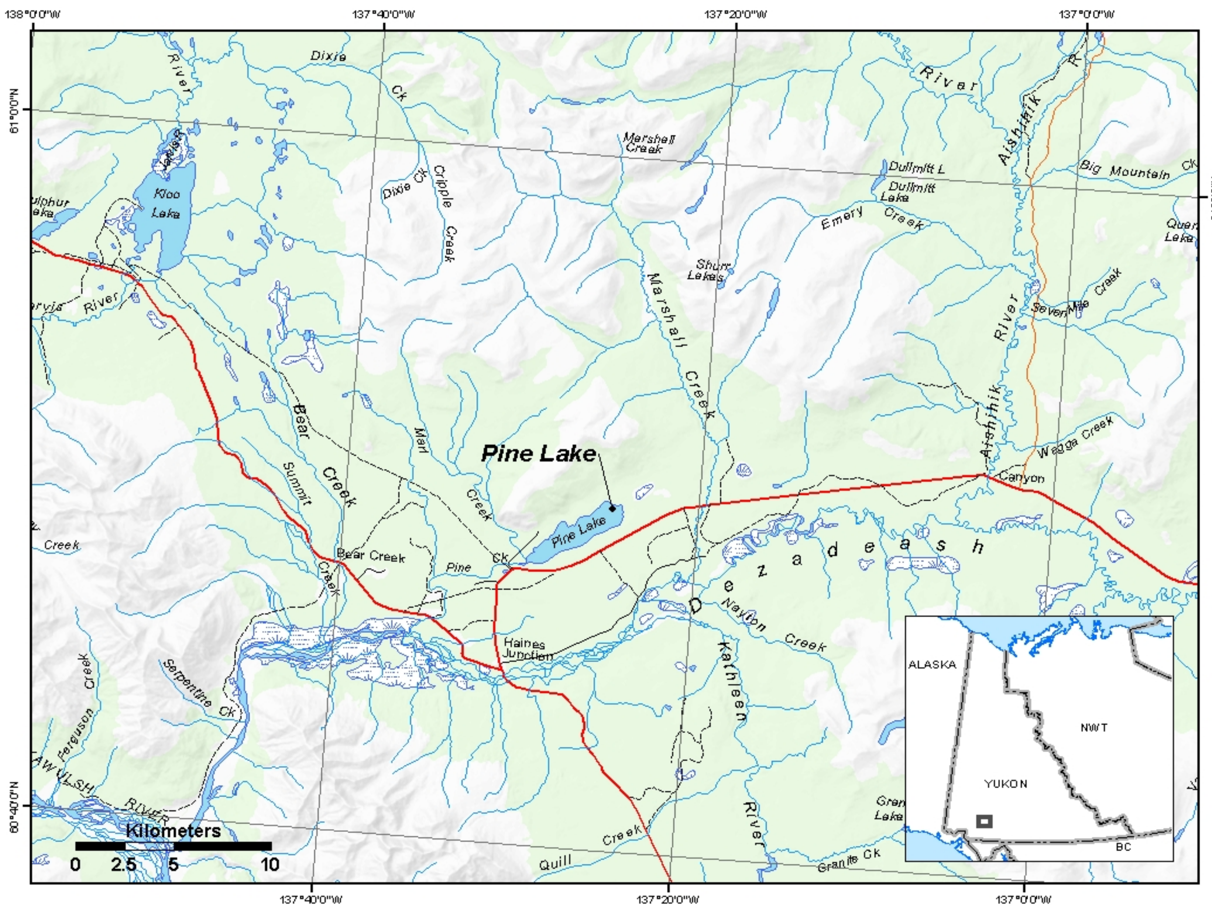

Figure 1. Location of Pine Lake, Yukon.

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.

We surveyed Pine Lake on July 5, 6, and 7, 2010. We set a total of 27 nets, divided among 3 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	184	31%	6	22%
10-20 m	206	34%	12	45%
20-30 m	213	35%	9	33%
Total	603	100%	27	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 = surface area of stratum $_i$ / lake surface 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 smaller than 300 mm because they are not usually captured by anglers.

We converted CPUE to density (fish/ha) based on an empirical relationship between CPUE and fish density that has been established for Ontario lakes. 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.

We used SPIN Support Systems Ver. 9.04 for calculations of CPUE, density, and population size, as well predictions of sample size and power for future surveys. 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 2 lake trout on Pine Lake (see Appendix 1 for set and capture locations and Appendix 2 for capture details). After weighting the data by catch in each strata, we found a stratified lake-wide CPUE of 0.07 (SE = 0.05).

We estimated lake trout density at 1.4 trout/ha, which is very low compared to other Yukon lakes surveyed to date (Appendix 3). When density is multiplied by lake area, we get a population estimate of 842 lake trout (68% confidence interval: 0 – 3,915). 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.

Results from Previous Surveys

Small-mesh netting surveys in 1993 (32 sets), 2001 (10 sets), and 2006 (10 sets) did not capture lake trout. 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 (for 2001 and 2006). We can only make subjective comparisons with these data, but they suggest that the lake trout population has been small since at least 1993.

Environment Yukon carried out angler harvest ("creel") surveys on Pine Lake in 1990, 2002, and 2009. A sharp decline in angler success occurred between 2002 and 2009, which may suggest population decline

(Millar and Jessup 2011). The most recent creel survey on Pine Lake measured a total of 1,185 angler hours, or 2.2 hours / hectare, which is among the highest effort per hectare of any Yukon recreational fishery (Millar and Jessup 2011).

Biological Characteristics

Table 3 shows the average length and weight of fish captured. Incidental mortalities included one lake trout (mortality rate 50%) and 23 lake whitefish (mortality rate 35%). Stomachs and otoliths were retained from mortalities for diet and age analysis.

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. The stomach from the one lake trout was empty, although it is likely that the lake trout are of the small-body type. The lake trout, a female with a 545 mm fork length, was 23 years old.

Table 2. Average length and weight of fish caught.

	No. Caught	Fork Length (mm)	Weight (g)
Lake trout	2	503	1600
Lake whitefish	66	529	2287

Population Status and Conclusions

Pine Lake is a small lake with a very low density of lake trout. Previous netting surveys suggested that density may have been low as far back as 1993, but we do not have other baseline information with which to make conclusions. In the absence of empirical or historical data, we broadly characterized the potential of Pine Lake's lake trout population based on lake characteristics and subjective comparisons to other lakes.

The presence of multiple predators (lake trout, burbot, and northern pike) means that we would expect lower densities of lake trout in Pine Lake than in a lake where these species are absent (Carl et al. 1990). However, smaller, more productive lakes (like Pine) usually have high fish densities when compared to larger, less productive lakes (Burr, 1997). We would expect Pine Lake to have a higher density than a large, unproductive lake such as Sekulmun. We would also expect Pine Lake to have a greater density of lake trout than Tarfu Lake, which is a similar size, has similar productivity, but is a large-bodied population. We should note that Tarfu Lake is also heavily exploited by a recreational fishery so does not necessarily represent natural population levels. CPUE and density from Pine Lake was lower than for either of those lakes (see Appendix 3).

Based on the very low density seen in 2010, lake characteristics, and the history of high angling pressure, we believe that the lake trout population in Pine Lake is depleted. The high level of angling activity on this lake remains a risk to the lake trout population.

Future Surveys

A main goal of the SPIN surveys is to track potential population changes by detecting differences in CPUE between surveys. Our usual management target is the detection of 25% changes in CPUE, but this magnitude of change does not make sense in this context: we only captured 2 lake trout, so an increase in CPUE of 25% is 0.5 lake trout - not a meaningful increase. In addition, detecting significant changes in very small populations may pose some problems for this method.

The CPUE on Pine Lake will have to increase much more than 25% before we can use it to robustly conclude a population recovery. Therefore, further SPIN surveys are likely to be most useful when there has been a substantial increase in fish numbers.

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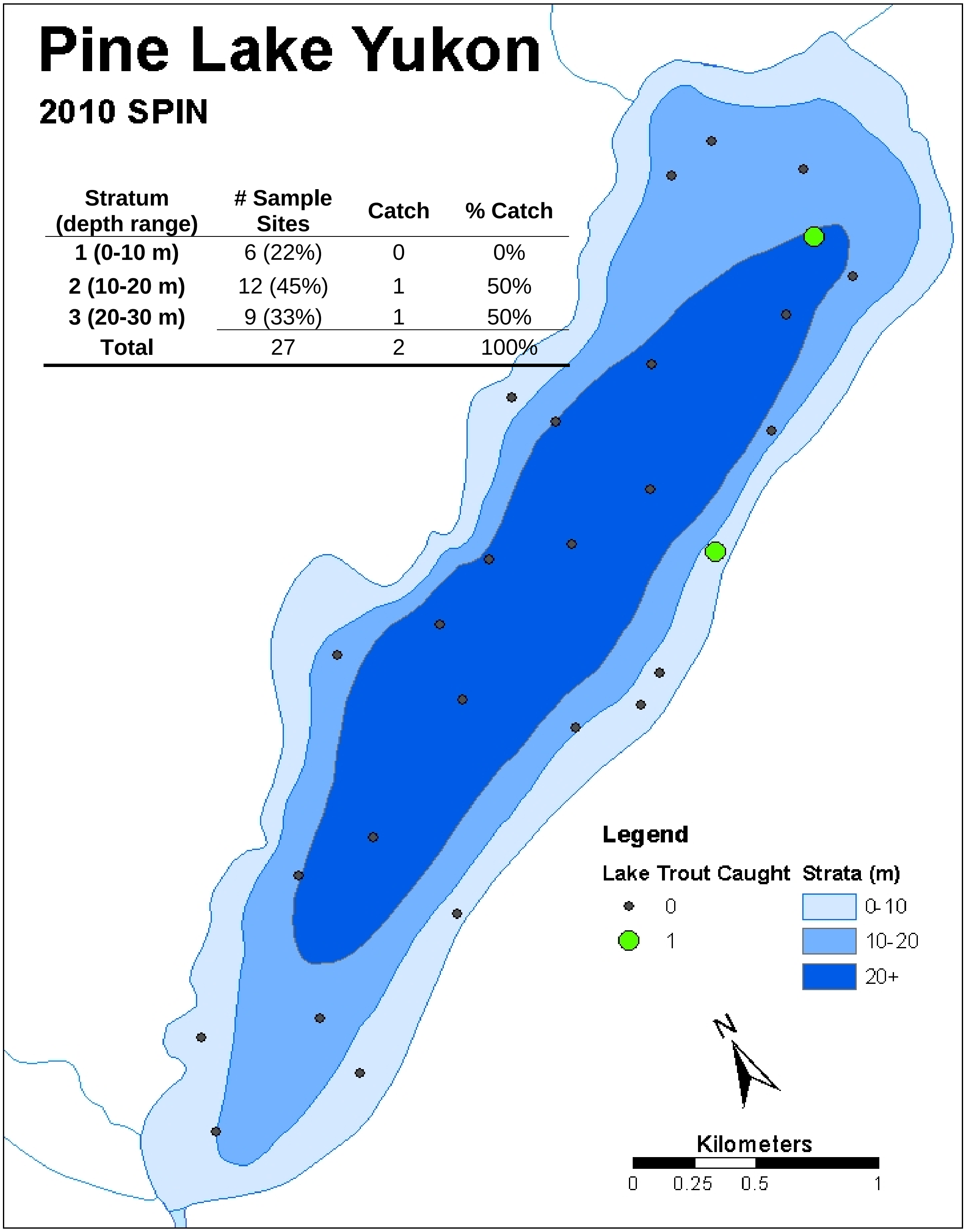
APPENDIX 1 - Pine Lake SPIN set and capture locations 2010.



APPENDIX 2 – Pine Lake SPIN capture details 2010.

Date	Effort (Set #)	Stratum	Species	Fork Length (mm)	Weight (g)	Fate	Sex
5-Jul-2010	1	2	LW	525	2150	R	
5-Jul-2010	2	3	No Catch				
5-Jul-2010	3	1	LW	500	1950	R	
5-Jul-2010	4	1	LW	500	2000	R	
5-Jul-2010	4	1	LW	580	2800	D	F
5-Jul-2010	4	1	LW	500	1900	R	
5-Jul-2010	5	2	LW	485	1900	R	
5-Jul-2010	5	2	LW	565	2300	D	F
5-Jul-2010	6	3	No Catch				
5-Jul-2010	7	2	LW	510	2000	R	
5-Jul-2010	7	2	LW	480	1700	D	F
6-Jul-2010	8	2	LW	510	1750	R	
6-Jul-2010	8	2	LW	535	2250	R	
6-Jul-2010	8	2	LW	520	2100	R	
6-Jul-2010	8	2	LW	550	2500	D	M
6-Jul-2010	8	2	LW	540	2300	R	
6-Jul-2010	8	2	LW	510	2300	R	
6-Jul-2010	8	2	LW	490	2200	R	
6-Jul-2010	9	3	LW	510	1900	R	
6-Jul-2010	10	1	LW	550	2500	R	
6-Jul-2010	10	1	LW	520	2200	D	F
6-Jul-2010	10	1	LW	490	1700	D	M
6-Jul-2010	10	1	LW	620	4000	D	M
6-Jul-2010	11	1	LW	520	2000	D	F
6-Jul-2010	11	1	LW	530	2000	D	M
6-Jul-2010	11	1	LW	550	3000	D	F
6-Jul-2010	12	3	No Catch				
6-Jul-2010	13	1	LW	565	2750	D	F
6-Jul-2010	13	1	LW	550	2750	D	F
6-Jul-2010	13	1	LW	550	2250	R	
6-Jul-2010	14	2	LW	510	2000	R	
6-Jul-2010	14	2	LW	520	2100	R	
6-Jul-2010	14	2	LW	500	2000	D	M
6-Jul-2010	15	2	LW	590	2800	R	
6-Jul-2010	15	2	LW	520	1900	R	
6-Jul-2010	15	2	LW	Escape			
6-Jul-2010	15	2	LW	500	3500	R	
6-Jul-2010	15	2	LW	550	2500	R	
6-Jul-2010	15	2	LW	520	2100	R	
6-Jul-2010	16	3	No Catch				
6-Jul-2010	17	1	LW	550	2500	D	M
6-Jul-2010	17	1	LW	550	2500	D	F
6-Jul-2010	17	1	LW	560	2750	R	
6-Jul-2010	18	2	LT	460	1250	R	
6-Jul-2010	18	2	LW	560	2800	D	M

Pine Lake SPIN capture details 2010 continued.

Date	Effort (Set #)	Stratum	Species	Fork Length (mm)	Weight (g)	Fate	Sex
6-Jul-2010	18	2	LW	550	2500	R	
6-Jul-2010	18	2	LW	510	2000	R	
6-Jul-2010	18	2	LW	480	1750	R	
6-Jul-2010	18	2	LW	560	2750	R	
6-Jul-2010	18	2	LW	510	2200	R	
6-Jul-2010	18	2	LW	Escape			
6-Jul-2010	19	3	No Catch				
6-Jul-2010	20	2	LW	560	2400	R	
6-Jul-2010	20	2	LW	500	1600	R	
6-Jul-2010	20	2	LW	570	2750	R	
6-Jul-2010	21	3	No Catch				
7-Jul-2010	22	2	LW	500	1900	D	F
7-Jul-2010	22	2	LW	525	2150	R	
7-Jul-2010	23	2	LW	520	2150	R	
7-Jul-2010	23	2	LW	505	2100	R	
7-Jul-2010	23	2	LW	520	2000	D	M
7-Jul-2010	24	2	LW	530	2400	R	
7-Jul-2010	24	2	LW	525	2600	R	
7-Jul-2010	24	2	LW	530	2500	D	M
7-Jul-2010	24	2	LW	490	2100	D	F
7-Jul-2010	24	2	LW	530	2300	R	
7-Jul-2010	25	3	LW	515	2150	D	M
7-Jul-2010	25	3	LT	545	1950	D	F
7-Jul-2010	26	3	LW	520	2500	R	
7-Jul-2010	26	3	LW	525	2000	R	
7-Jul-2010	26	3	LW	535	2400	D	F
7-Jul-2010	26	3	LW	530	2500	D	M
7-Jul-2010	27	2	LW	575	1800	R	
7-Jul-2010	27	2	LW	Escape			

LT=lake trout; LW=lake whitefish
R=released; D=dead

APPENDIX 3 –Estimated CPUE (SPIN) and lake trout density (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
Snafu	284	3.54	Large Body	Pike	2010	0	0