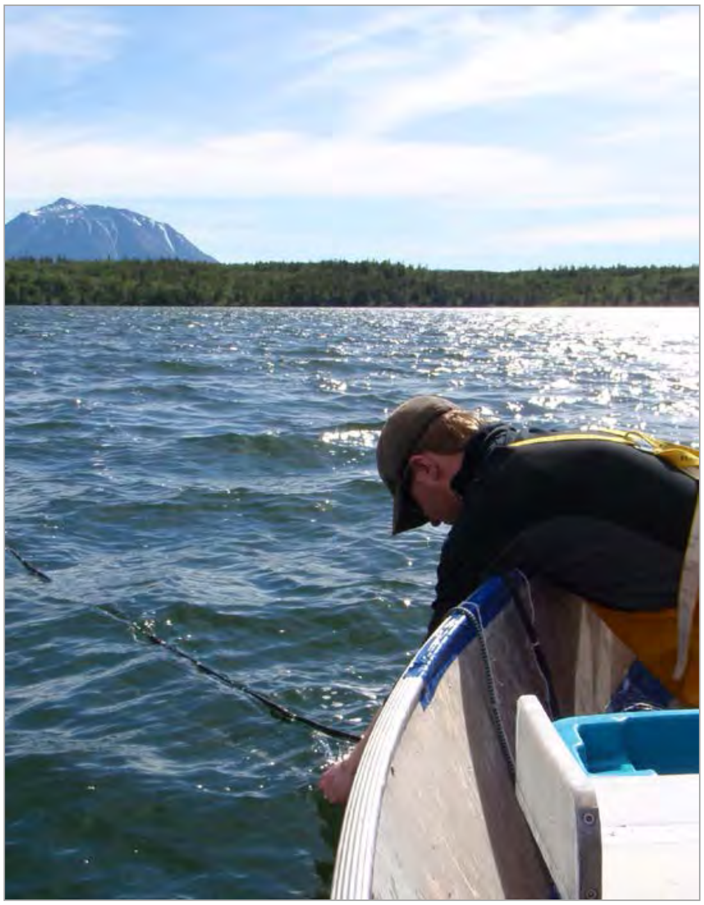
LAKE TROUT POPULATION ASSESSMENT

TARFU LAKE

2010



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Yukon
Environment
Environnement

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 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 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 Tarfu Lake in 2010 using SPIN (Summer Profundal Index Netting). Environment Yukon previously surveyed the lake using a different index netting techniques in 1995, 2000, and 2005. SPIN provides more statistically robust data and improves confidence in survey results (Jessup and Millar, 2011).

The 2010 survey captured few lake trout. Lake-wide CPUE (catch per unit effort) was 0.20 and lake trout density was estimated at 1.7 lake trout / hectare. Based on lake characteristics such as size and productivity, and viewed in the context of other surveys, we believe that the population is depleted.

Key Findings

- Tarfu Lake has a low density of lake trout.
- Given all available information, the lake trout population in Tarfu Lake is 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 Tarfu Lake using SPIN in 2010 and using small-mesh netting in 1995, 2000, and 2005. Differences between the 2 methods mean that results from the 2010 survey cannot be compared statistically with past surveys. Here we report the 2010 results and make only subjective comparisons with previous surveys.

Study Area

Tarfu Lakes are a small chain of lakes located approximately 35 km southeast of Jakes Corner along the Atlin Road (Figure 1). Tarfu Lakes lie within the traditional territory of the Carcross/Tagish First Nation. This survey only pertains to Tarfu Lake itself as no sampling was done in Little Tarfu Lake, although there is connectivity between the 2 lakes. Tarfu Lake is approximately 4.5 km long and covers an area of 404 ha. Mean depth is 11.6 m and maximum depth is 33 m. Several small, unnamed creeks flow into the lake but the main surface inflow is Tarfu Creek. The lake drains via Tarfu Creek into the Lubbock River, part of the Yukon River watershed.

There is a popular government campground and boat launch located on the lake and Tarfu receives a high amount of angling pressure for its size (Environment Yukon, *in prep*). Fish species present in the lake include lake trout, northern pike, Arctic grayling, and round whitefish. The recreational fishery at Tarfu Lakes has been managed with Special Management Waters regulations since 2001; from 1993 to 2000 it was managed with Conservation Waters regulations.

The catch and possession limit for lake trout is one fish per day and all lake trout over 65 cm must be released. Only barbless hooks are permitted.

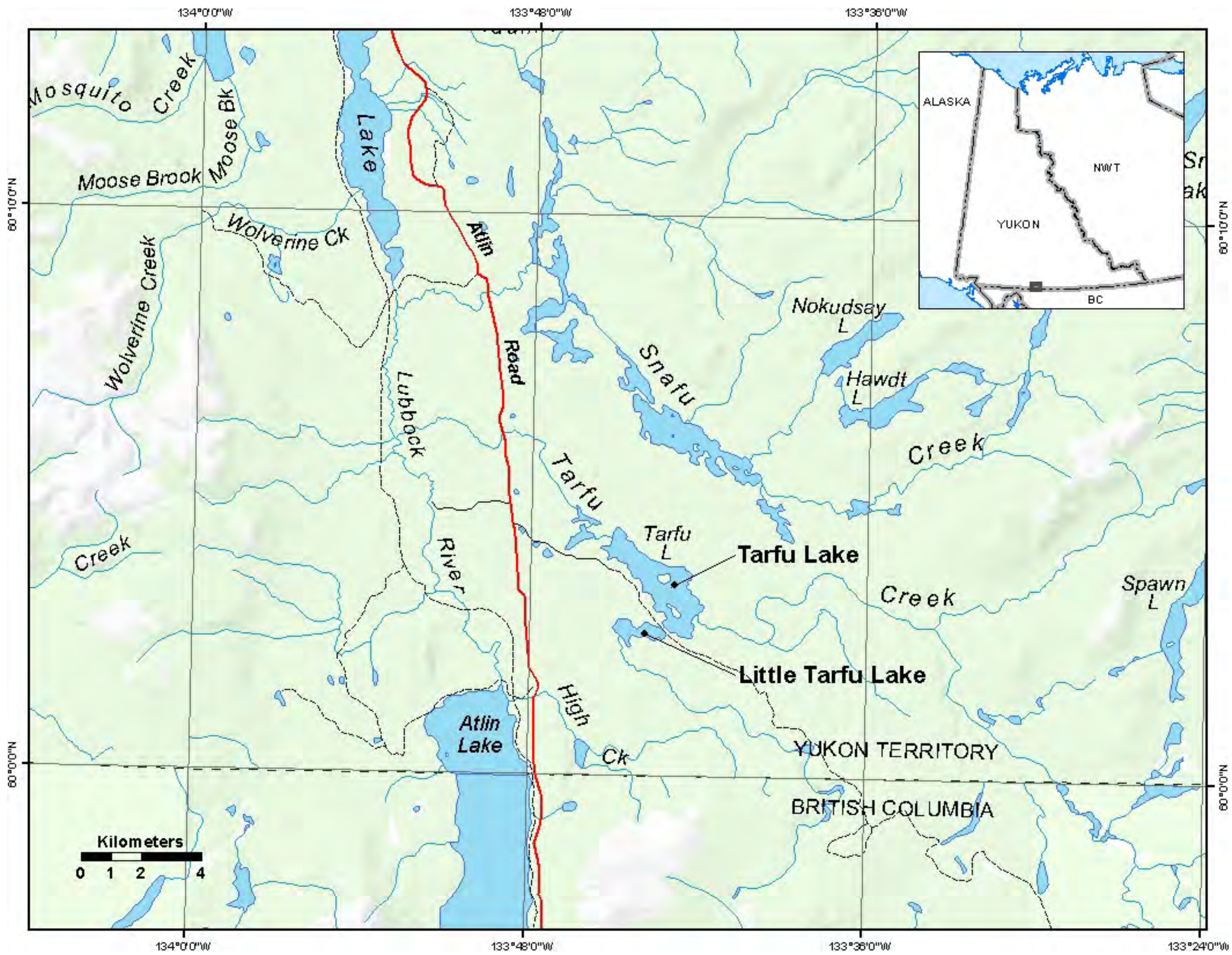

Figure 1. Location of Tarfu Lakes, Yukon.

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.

Tarfu Lake was sampled on 7 and 8 July 2010. We set a total of 23 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 by using random point generation in ArcGIS 9.3. Any clumped distributions of points were dispersed manually to ensure coverage of the entire lake.

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. We accounted for net selectivity (the fact that certain sizes of fish are more prone to capture than others) by applying a correction factor to each fish caught, based on its likelihood of capture (see Sandstrom and Lester (2009) for a full rationale of net selectivity). 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 below 300 mm because they are not usually caught 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. 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).

Table 1. Effort breakdown by stratum.

Stratum (depth range)	Area		Number of Sets	
	Ha	%	No.	%
0-10 m	194	48	6	26
10-20 m	66	16	13	57
20-30+m	145	36	4	17
Total	405	100	23	100

Results and Discussion

CPUE, Density, and Population Size

We captured a total of 8 lake trout in 23 net sets (see Appendix 2 for set and capture locations and Appendix 3 for capture details). This survey also captured round whitefish, Arctic grayling, and northern pike. Incidental mortalities included 4 lake trout (50% mortality rate), 23 round whitefish (37%), and 14 Arctic grayling (45%).

We adjusted the total lake trout catch for net selectivity bias based on the lengths of lake trout captured, resulting in a selectivity-adjusted total catch of 9 lake trout. After weighting the data by catch in each stratum, we found a stratified lake-wide CPUE of 0.20 (SE = 0.11). This is low compared with other Yukon lakes surveyed to date (Appendix 1).

Lake trout density was estimated at 1.7 lake trout/ha and lake-wide abundance was estimated at 680 lake trout (68% confidence interval: 52 – 1,319).

Results from Previous Surveys

Results from previous small-mesh netting surveys have shown consistently low CPUE (Table 2). 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. We can only make subjective comparisons with these data, but they suggest that lake trout density has been low since at least 1995.

Table 2. CPUE from Tarfu Lake derived from small-mesh netting surveys.

	1995	2000	2005	Yukon Average (92 lakes)
Number of sets	10	10	10	
Lake trout caught	2	2	3	
CPUE	0.2	0.2	0.3	0.78

Environment Yukon did angler harvest surveys on Tarfu Lake in 1991, 1999, and 2010. Angler success declined steadily since the first survey, which can indicate population decline (Environment Yukon, *in prep*). The 2010 angler harvest survey on Tarfu Lake measured a total of 3,141 hours or 7.5 hours/ha of angling pressure, the third highest of all Yukon fisheries that have been assessed (Environment Yukon, *in prep*).

Biological Characteristics

Average length and weight of lake trout was 567 mm and 2,338 g respectively. The length-frequency distribution is presented in Figure 2.

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. Contents from the one lake trout stomach examined revealed a juvenile northern pike that, combined with the large average size, indicates that this is likely a large-body, piscivorous (fish-eating) population. Mean age of sampled lake trout was 28; the youngest was 21 and the oldest was 46 (Figure 3). Mean age of sampled lake trout from Tarfu Lake was notably higher than average ages of lake trout sampled from other Yukon lakes. Only 4 lake trout were aged, however, so conclusions regarding mean age and length-at-age should be considered with caution.

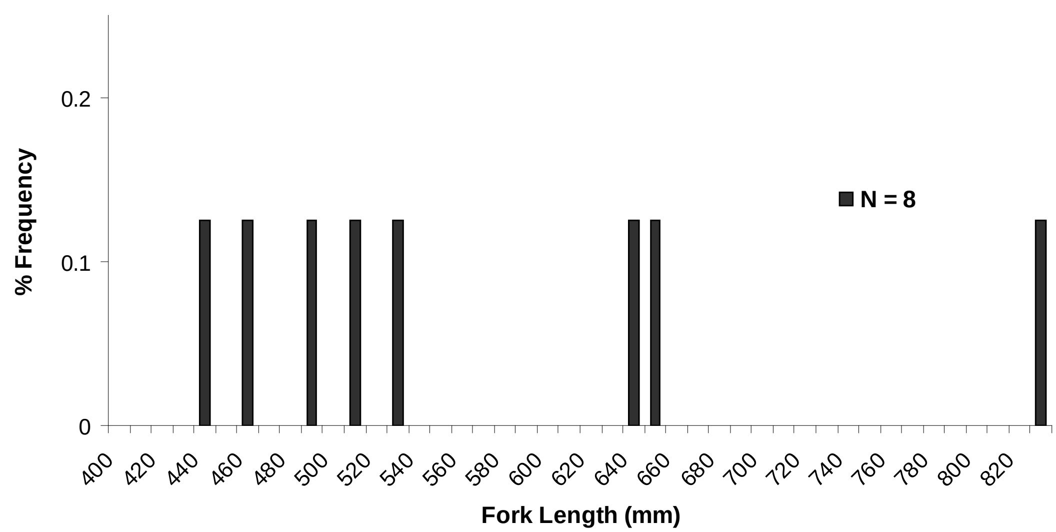

Figure 2. Length frequency distribution of lake trout captured.

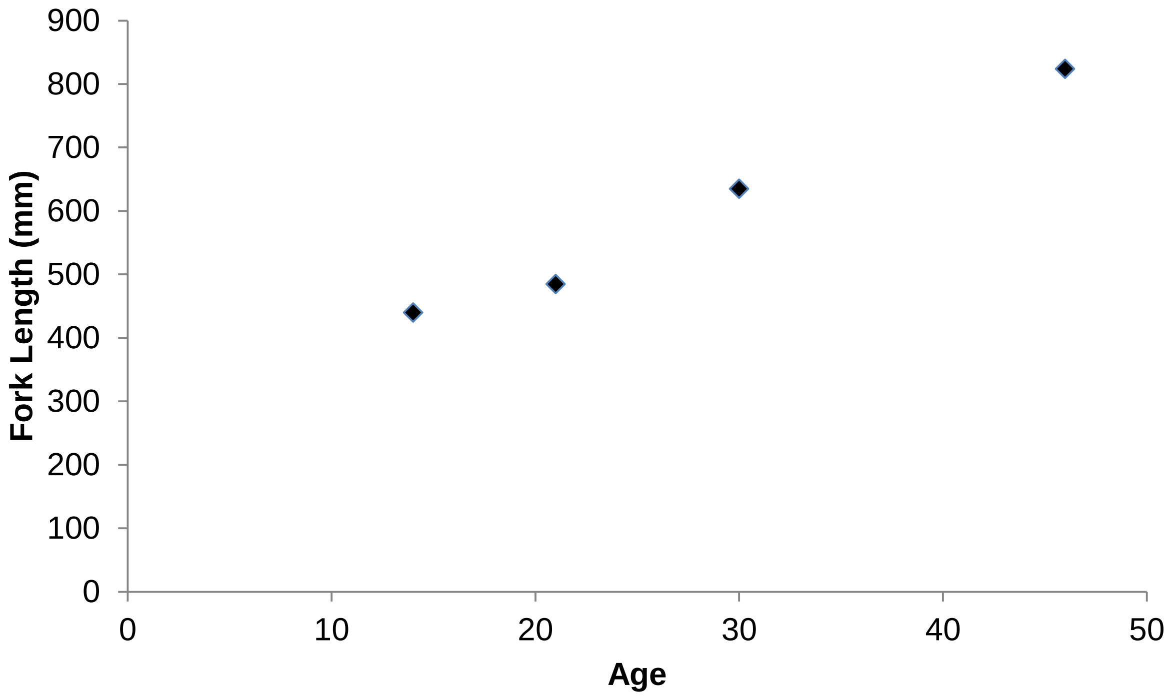

Figure 3. Length-at-age of sampled lake trout.

Population Status and Conclusions

Tarfu Lake is a small lake with a low density of lake trout. Previous netting surveys indicate that density has been low as far back as 1995. We have little other information with which to establish historical baseline conditions, so we broadly characterized the potential of the lake trout population based on lake characteristics and subjective comparisons with other lakes.

Smaller, more productive lakes such as Tarfu can generally be expected to have higher fish densities than larger, less productive lakes such as Sekulmun (Burr 1997). However, lakes with large-bodied lake trout like Tarfu generally have lower densities than lakes with small-bodied lake trout such as Lewes (Burr 1997). Lakes with multiple top predator species (lake trout and northern pike in Tarfu) also tend to have lower densities than lakes with only lake trout, such as Kathleen (Carl et al. 1990). In these terms, we might expect Tarfu Lake (1.7 fish/ha) to have a higher density than a large, unproductive lake such as Sekulmun (3.7 fish/ha), but a lower density than lakes such as Lewes (48.6 fish/ha) or Kathleen (28.6 fish/ha; see Appendix 1 for density from Yukon lakes surveyed to date).

Based on the low density seen in 2010, expected density based on lake characteristics, and the history of high angling pressure, we believe that the lake trout population in Tarfu Lake is depleted. The declining angler success indicates that some of this depletion may have occurred over the last 20 years. The very high level of angling activity on this lake places continued harvest pressure on this small population.

Future Surveys

At the current sample size (n = 23 net sets), our predicted power to detect future increases in CPUE of 25% is only 20%. We generally target the ability to detect 25% changes in CPUE with a power of 80%. Detecting this magnitude of change, however, does not make sense for Tarfu Lake, because a 25% increase in CPUE would be only 2 more lake trout, which would not necessarily be meaningful at the population level. Therefore, future SPIN surveys will be most useful in in assessing population status only when there has been a substantial increase in lake trout numbers.

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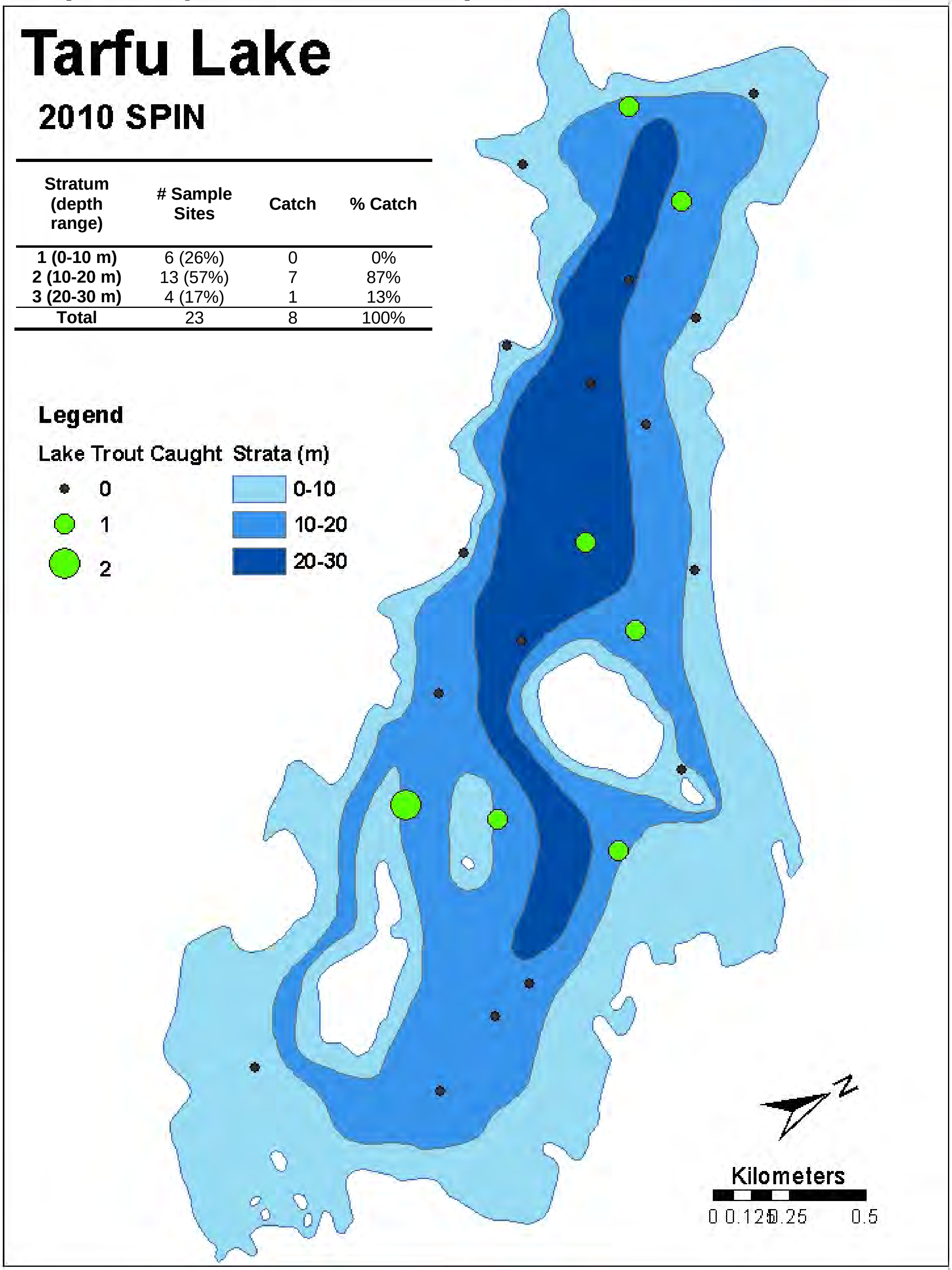
APPENDIX 1 – Estimated CPUE (SPIN) and density from Yukon Lakes to date.

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 Characteristics				SPIN Results		
Lake	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

APPENDIX 2 – Tarfu Lake SPIN set and capture locations 2010 (non-adjusted catch data).



Stratum (depth range)	# Sample Sites	Catch	% Catch
1 (0-10 m)	6 (26%)	0	0%
2 (10-20 m)	13 (57%)	7	87%
3 (20-30 m)	4 (17%)	1	13%
Total	23	8	100%

APPENDIX 3 – Tarfu Lake SPIN capture details 2010.

Date	Effort (Set #)	Stratum	[1]Species	Fork Length (mm)	Weight (g)	Fate	Sex
July 7, 2010	1	1	RW	406	800	R	
July 7, 2010	1	1	RW	398	750	R	
July 7, 2010	2	2	RW	291	300	R	
July 7, 2010	2	2	RW	368	600	R	
July 7, 2010	2	2	LT	824	5900	D	F
July 7, 2010	3	3	No Catch				
July 7, 2010	4	2	RW	404	800	R	
July 7, 2010	4	2	RW	380	600	R	
July 7, 2010	4	2	RW	395	700	R	
July 7, 2010	4	2	RW	388	700	D	M
July 7, 2010	4	2	LT	485	1400	D	F
July 7, 2010	4	2	RW	309	300	R	
July 7, 2010	4	2	RW	360	500	D	F
July 7, 2010	4	2	RW	287	300	D	M
July 7, 2010	5	1	AG	318	500	R	
July 7, 2010	5	1	AG	358	600	D	M
July 7, 2010	5	1	AG	342	600	D	F
July 7, 2010	5	1	AG	345	600	R	
July 7, 2010	5	1	AG	328	500	D	M
July 7, 2010	5	1	AG	290	300	D	F
July 7, 2010	5	1	AG	340	500	D	F
July 7, 2010	5	1	AG	310	500	D	F
July 7, 2010	5	1	AG	355	600	R	
July 7, 2010	5	1	AG	280	300	D	F
July 7, 2010	5	1	NP	712	2650	R	
July 7, 2010	5	1	AG	382	651	R	
July 7, 2010	6	1	AG	330	500	R	
July 7, 2010	6	1	AG	367	600	R	
July 7, 2010	6	1	AG	299	400	D	F
July 7, 2010	6	1	AG	340	500	R	
July 7, 2010	6	1	AG	375	600	R	
July 7, 2010	6	1	AG	365	600	R	
July 7, 2010	7	2	RW	318	400	R	
July 7, 2010	7	2	RW	328	400	R	
July 7, 2010	7	2	RW	330	400	R	
July 7, 2010	7	2	RW	335	400	R	

[1] AG=Arctic grayling; LT=lake trout; RW=round whitefish; NP=northern pike
R=released; D=dead

Appendix 3 Continued

Date	Effort (Set #)	Stratum	[2]Species	Fork Length (mm)	Weight (g)	Fate	Sex
July 7, 2010	7	2	RW	392	800	R	
July 7, 2010	8	2	RW	361	650	R	
July 7, 2010	8	2	RW	365	600	R	
July 7, 2010	9	2	No Catch				
July 7, 2010	10	1	NP	840	4700	R	
July 7, 2010	10	1	AG	397	800	D	F
July 7, 2010	10	1	NP	865	5800	R	
July 7, 2010	10	1	AG	395	900	R	
July 7, 2010	10	1	AG	385	700	D	M
July 7, 2010	10	1	AG	396	800	R	
July 7, 2010	10	1	AG	389	800	R	
July 7, 2010	10	1	NP	760	3600	R	
July 7, 2010	10	1	AG	300	500	D	F
July 7, 2010	10	1	AG	295	300	R	
July 7, 2010	10	1	AG	270	200	D	F
July 7, 2010	10	1	AG	270	200	R	
July 7, 2010	10	1	AG	348	500	R	
July 7, 2010	10	1	AG	290	400	D	M
July 7, 2010	10	1	AG	290	300	R	
July 7, 2010	10	1	AG	345	500	R	
July 7, 2010	10	1	AG	330	500	D	F
July 8, 2010	11	2	RW	290	200	R	
July 8, 2010	12	1	RW	350	500	R	
July 8, 2010	13	1	No Catch				
July 8, 2010	14	2	LT	648	3200	R	
July 8, 2010	14	2	RW	370	500	R	
July 8, 2010	14	2	RW	380	600	R	
July 8, 2010	14	2	RW	400	700	R	
July 8, 2010	14	2	RW	382	700	R	
July 8, 2010	14	2	RW	405	900	R	
July 8, 2010	14	2	RW	399	800	D	F
July 8, 2010	14	2	RW	356	500	D	F
July 8, 2010	14	2	LT	460	1100	R	
July 8, 2010	14	2	RW	390	700	R	
July 8, 2010	14	2	RW	385	600	R	
July 8, 2010	14	2	RW	390	700	R	
July 8, 2010	14	2	RW	395	750	D	M
July 8, 2010	15	2	LT	530	2000	R	
July 8, 2010	15	2	RW	391	800	D	F

[2] AG=Arctic grayling; LT=lake trout; RW=round whitefish; NP=northern pike
R=released; D=dead

Appendix 3 Continued

Date	Effort (Set #)	Stratum	[3]Species	Fork Length (mm)	Weight (g)	Fate	Sex
July 8, 2010	15	2	RW	308	400	R	
July 8, 2010	15	2	RW	375	700	D	M
July 8, 2010	15	2	RW	410	1000	R	
July 8, 2010	16	2	LT	440	1500	D	M
July 8, 2010	16	2	RW	410	900	D	M
July 8, 2010	16	2	RW	391	800	R	
July 8, 2010	16	2	RW	400	900	R	
July 8, 2010	16	2	RW	378	700	D	F
July 8, 2010	16	2	RW	380	700	R	
July 8, 2010	17	2	RW	410	900	D	F
July 8, 2010	17	2	RW	408	900	R	
July 8, 2010	17	2	RW	395	600	D	M
July 8, 2010	17	2	RW	390	600	R	
July 8, 2010	17	2	RW	338	500	R	
July 8, 2010	17	2	RW	420	900	R	
July 8, 2010	17	2	RW	378	700	D	F
July 8, 2010	17	2	RW	402	800	D	F
July 8, 2010	17	2	RW	380	500	R	
July 8, 2010	17	2	RW	375	500	D	F
July 8, 2010	18	2	RW	416	900	D	F
July 8, 2010	18	2	RW	400	800	D	M
July 8, 2010	18	2	RW	395	700	D	M
July 8, 2010	18	2	LT	635	3000	D	F
July 8, 2010	18	2	RW	370	600	D	F
July 8, 2010	18	2	RW	335	500	R	
July 8, 2010	18	2	RW	400	800	R	
July 8, 2010	19	3	No Catch				
July 8, 2010	20	3	LT	510	600	R	
July 8, 2010	21	2	RW	370	600	R	
July 8, 2010	21	2	RW	365	600	R	
July 8, 2010	21	2	RW	391	750	R	
July 8, 2010	21	2	RW	391	800	D	F
July 8, 2010	21	2	RW	403	900	D	F
July 8, 2010	21	2	RW	383	700	D	M
July 8, 2010	21	2	RW	367	600	D	F
July 8, 2010	22	2	No Catch				
July 8, 2010	23	3	No Catch				

[3] AG=Arctic grayling; LT=lake trout; RW=round whitefish; NP=northern pike
R=released; D=dead