LAKE TROUT POPULATION ASSESSMENT

LEWES LAKE

2010

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Environment

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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 Lewes Lake using Summer Profundal Index Netting (SPIN) twice in 2010. One survey was done in June and another in August to see if the method would give similar results at two points in time over the course of the open-water season.

The lakewide CPUE (catch per unit effort) in June (3.31 fish/net) was greater than the CPUE in August (2.06 fish/net). High surface temperatures and low dissolved oxygen levels at depth effectively limited lake trout habitat and distribution during the August survey; lake trout activity and movement were likely affected, explaining the difference in CPUE seen between the two surveys.

Our results highlight the importance of measuring temperature and dissolved oxygen before doing surveys to ensure that we effectively target lake trout, and that comparisons are made between surveys done under similar conditions. For the best results and most useful comparisons, future surveys on Lewes Lake should be done in late June.

Key Findings

- Lewes Lake has a high density of small lake trout suggesting that the population status is healthy.
- In late summer high surface water temperature and low dissolved oxygen in deeper waters limits lake trout habitat and their access to available resources; this may put stress on the population.
- Temperature and dissolved oxygen profiles should be measured at the start of all surveys. Only surveys done under similar water conditions should be compared.

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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 Lewes Lake using SPIN in June and August, 2010. We surveyed the lake using small-mesh netting in 1997 and 2002. Differences between the two methods mean that results from SPIN surveys cannot be compared statistically with the small-mesh netting surveys. Here we report the results of the 2010 surveys and make only subjective comparisons with previous surveys.

Study Area

Lewes Lake is located near the South Klondike Highway between Whitehorse and Carcross (Figure 1) in the Yukon River watershed. The lake is approximately 2.5 km long and covers an area of approximately 137 ha. The lake has a mean depth of 17 m and a maximum depth of 40 m. The lake has no major surface water inputs and drains intermittently, depending on beaver dams, into the Watson River and then to Bennett Lake. Fish species present in the lake include lake trout, Arctic grayling, and round whitefish.

Lewes Lake is in the traditional territory of the Carcross/Tagish First Nations. There are a number of permanent residences along the access road and a few makeshift campsites near the lake. There is no boat launch, limiting the size of boats that can be used on the lake. The recreational fishery at Lewes 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.

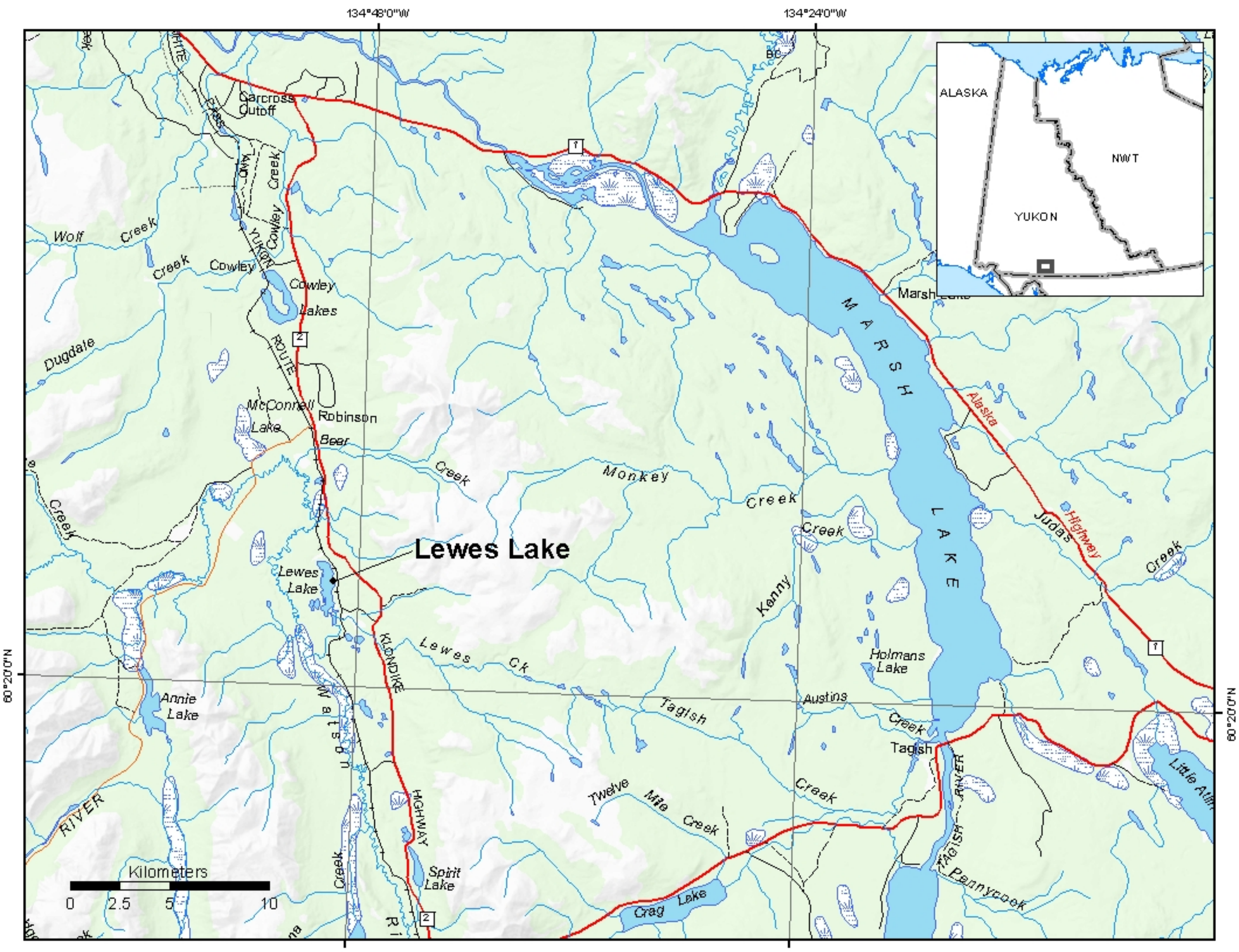

Figure 1. Location of Lewes Lake, Yukon.

Methods

We used the Summer Profundal Index Netting (SPIN) methodology 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 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.

We surveyed Lewes Lake twice in 2010: first on June 26-27 and then on August 16, 17, and 21. We conducted 2 surveys to evaluate the repeatability of this method over the course of the open-water season, and to determine how changing environmental factors might affect population estimates.

In each survey we set a total of 24 nets, divided between 4 10-m depth strata (Table 1, Appendix 2). The number of nets set in each stratum was initially determined by stratum size (surface area). Set locations for the first survey were chosen using random point generation with ArcGIS 9.3. During the second survey, we attempted to use the same locations as the first survey but moved some effort out of the first strata because of low catches. SPIN methods allow for this movement of effort if warranted by low catches and it should not affect the survey accuracy or comparability between surveys.

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 for each survey 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 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 compared the lakewide CPUE between the 2 surveys using a Welch's t-test. We converted CPUE to density (fish/ha) based on an empirical relationship between CPUE and density established in Ontario lakes. 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). Note that before we can be fully confident in the estimates of density and abundance, the relationship between CPUE and density must be verified for Yukon lakes.

Table 1. Effort breakdown by stratum.

Stratum (depth range)	Area (ha)	% Area	June		August	
			No. Samples	% Sample	No. Samples	% Sample
0-10 m	46	35%	8	33%	6	25%
10-20 m	36	27%	7	30%	9	38%
20-30 m	30	23%	6	25%	6	25%
30-40+ m	19	15%	3	12%	3	12%
Total	131	100%	24	100%	24	100%

We measured, weighed, and released all fish captured. The relationship between a fish's weight and length can be described by its condition factor (K) and is calculated as: K = (Weight (g)/Length (cm^3)) • 100 (Ricker 1975). The heavier a fish is at a given length, the better its condition. At the individual level, K can be an indication of fish health. We averaged K over the entire catch and used it this as an indication of overall condition of lake trout within the population. We used a t-test to compare the length, weight, and condition factor of lake trout between the June and August surveys. Any fish that died was sampled for age (using otoliths or ear "bones") and diet (stomach contents).

We used SPIN Support Systems Ver. 9.04 for calculations of density, and population size, as well as for predictions of power and sample size for future surveys. We used R ver. 2.14.1 to calculate and compare stratified lakewide CPUE, as well as mean length, weight, and condition factor of lake trout between the June and August surveys. Temperature and dissolved oxygen profiles were taken in the same location after both surveys using a multi-parameter probe (YSI 600QS; YSI Inc., Yellow Springs, OH).

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 less than 15˚C and dissolved oxygen is greater than 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 and 12°C (Mackenzie-Grieve and Post 2006). The *optimal* dissolved oxygen level for lake trout is 7 or more mg/L (Evans 2005).

Temperature and dissolved oxygen profiles for June and August show that the lake was strongly stratified during both surveys, with the thermocline (zone of steep temperature gradient) being shallower in June (8.5-10.5 m) than in August (10.5-12.5 m) (Figures 2 and 3). In June, lake trout habitat was not limited by temperature because water was no warmer than 12.2°C. Dissolved oxygen values were not obtained due to equipment malfunction. However, as lake trout were captured in even the deepest water during the June survey, it is unlikely that dissolved oxygen levels were low anywhere in the lake (Table 2). We estimate that 100% of the lake volume was optimal lake trout habitat in June when considering temperature and dissolved oxygen.

The August profiles indicate lake trout habitat was limited by both low dissolved oxygen and high temperature (Figure 3). Suitable habitat was restricted to 11.4 vertical meters of the water column (7.0-18.4 m deep, or about 6.7 ha^3 volume) and optimal habitat was only 4.7 vertical meters (11.8-16.5 m, or about 3.8 ha^3 volume). Given a total lake volume of 21.64 ha^3, only 31% of the lake was suitable habitat and only 18% of the lake was optimal habitat. This restriction of available habitat was reflected by low catches of lake trout in the deep (> 20 m) and shallow (< 10 m) strata in August (Table 2).

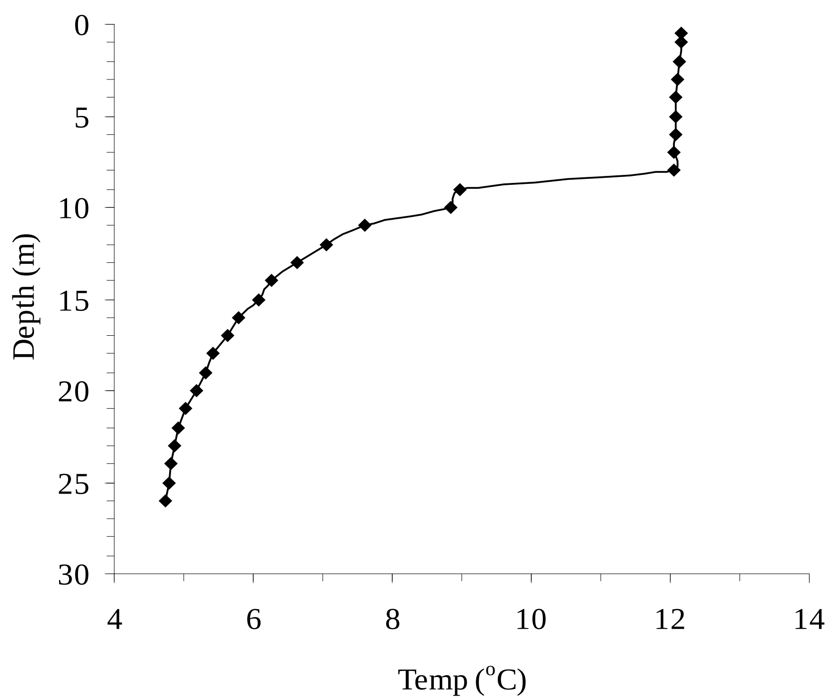

Figure 2. Temperature profile taken on June 27, 2010.

Temperature does not exceed 12.2°C and therefore was not a factor in limiting lake trout habitat or distribution. The lake was strongly stratified with the thermocline at 8.5m.

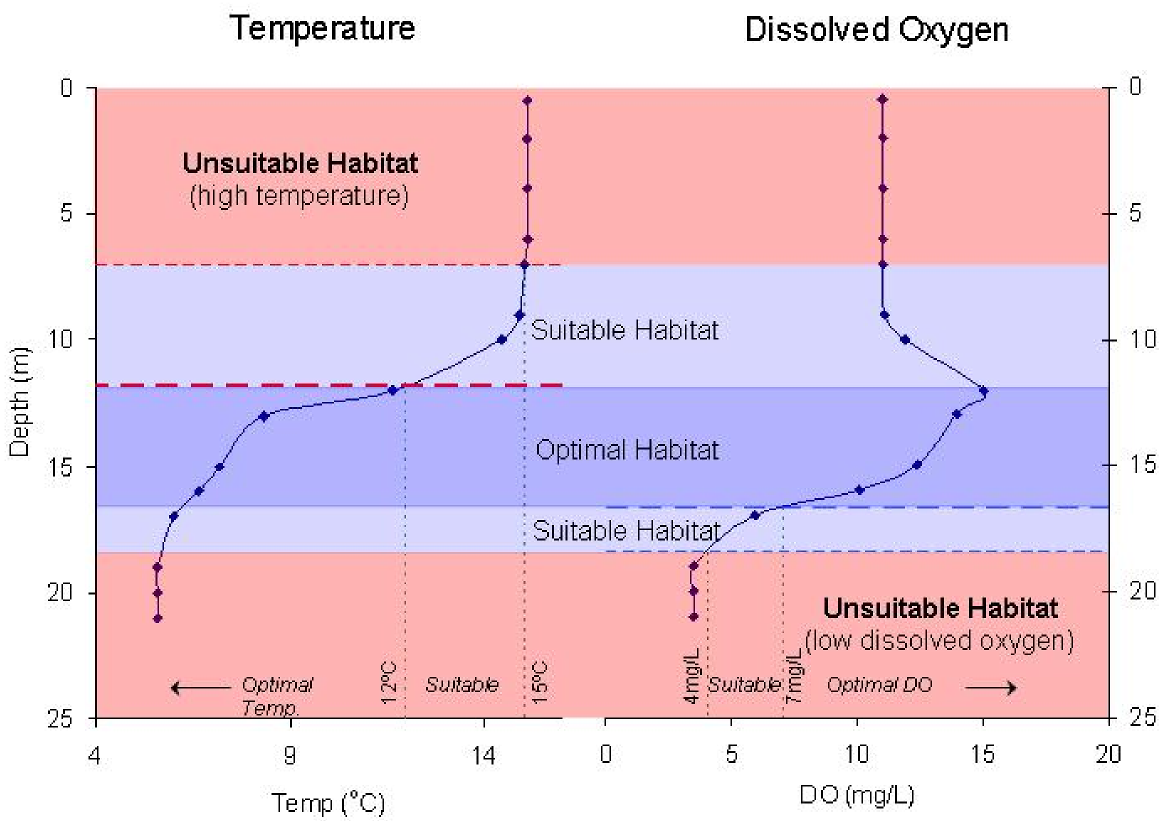

Figure 3. Temperature and dissolved oxygen profiles for Lewes Lake taken on August 23, 2010.

Showing the limit of optimal (<12°C and >7mg/L DO) and suitable (<15°C and >4mg/L DO) lake trout habitat.

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

	June			August		
Stratum (depth range)	**# Sample Sites**	**Catch**	**CPUE**	**# Sample Sites**	**Catch**	**CPUE**
1 (0-10 m)	8	15	1.88	6	9	1.56
2 (10-20 m)	8	49	6.18	9	41	4.57
3 (20-30 m)	5	7	1.47	6	5	0.82
4 (30-40 m)	3	13	4.26	3	2	0.51
Total	24	85	3.31	24	57	2.06

CPUE, Density, and Population Size

We captured a total of 53 lake trout in the June survey (see Appendix 2 for set and capture locations and Appendix 3 for capture details). This total was adjusted for net selectivity bias based on the lengths of lake trout captured, resulting in a selectivity-adjusted total catch of 85 lake trout. After weighting the data by catch in each strata, we found a lake-wide CPUE of 3.31 (SD = 2.19). This is high compared with other Yukon lakes surveyed to date (Appendix 1).

We captured a total of 35 lake trout in the August survey. The selectivity-adjusted total catch was 57 lake trout, and the lake-wide CPUE was 2.06 (SD = 1.51).

Lake-wide CPUE was significantly higher in June than it was in August (2-tailed $t_{df=46} = 2.14$, $P = 0.04$). CPUE declined 38% between June and August.

It is highly unlikely that this decrease in CPUE reflects a true change in the abundance of lake trout in Lewes Lake. In the 6 weeks between surveys, it is not biologically reasonable to expect such large changes in population size; none of the factors that reduce population size (i.e. human harvest or natural mortality) could act so quickly so as to expect a measurable change in this time period. It follows that the difference in catch between these 2 surveys was due to factors other than population change.

The change in catch between the June and August surveys can be explained by changes in the amount of available lake trout habitat and in fish behaviour. The amount of available lake trout habitat in August was limited by low levels of dissolved oxygen at depth and high surface and shallow-water temperatures. As a result, the lake trout population was restricted to the remaining suitable habitat. This resulted in lower catches in both the shallow (0-10 m; combination of unsuitable and suitable habitat) and deep strata (20-30 m and 30-40 m; all unsuitable habitat). The middle stratum (10-20 m) had a mix of optimal, suitable, and unsuitable habitat. In this stratum, fish movements were likely constrained because of marginal habitat conditions, crowding, and reduced food availability. Gill nets are less likely to capture fish if fish movements are restricted, which is the most likely explanation for a reduced catch in the middle stratum.

This result was a good demonstration of how environmental factors affect catch and so must be considered when planning surveys and interpreting results. For Lewes Lake, the August survey results should not be considered in future years as they were affected by environmental conditions. For all lakes surveyed, profiles of temperature and dissolved oxygen should be taken prior to each survey in order to ensure similar conditions between surveys. This is especially true for small lakes with minimal inflows such as Lewes, where deep waters may be without oxygen during late summer.

Lake trout density was measured as 48.6 and 30.5 trout / ha in June and August respectively. Abundance was calculated as 6,369 (68% confidence interval: 5,202 – 7,639) and 3,989 (68% C.I.: 3,039 – 5,005) in June and August respectively. 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

Length, weight, and condition factor are presented in Table 3. There was no detectable difference in length ($t_{df=90} = -1.56$, $P = 0.12$; Figure 4) between surveys. Weight ($t_{df=90} = -3.28$, $P < 0.01$) and condition factor ($t_{df=90} = -4.00$, $P < 0.01$), however, differed significantly between the surveys. For a given length, fish were generally heavier in June (Figure 5). These findings suggest that lake trout in August were less healthy than in June. In a typical lake, we would expect lake trout to gain weight throughout the summer before the onset of spawning and the return of winter.

The noted decline in lake trout condition corresponded with a reduction in available habitat due to high temperature and low dissolved oxygen. We suggest that the reduction in available habitat corresponded to stresses on the fish such as temperature and oxygen stress and increased competition for limited resources, and that this led to a decline in lake trout condition. Coupled with the high densities noted in the surveys, this indicates a limitation of available resources in at least some years. If the conditions in 2010 were not unusual, then late summer conditions might represent a bottleneck to population growth, and the population may be near or at its environmental carrying capacity.

Stomach contents and otoliths were retained from lake trout mortalities. Length-at-age data from this subset of lake trout show steady growth until sexual maturity at ages 10 -12, after which growth slowed considerably (Figure 6). Length-at-age data suggest a small maximum size for lake trout in Lewes Lake. Contents of Lewes Lake lake trout stomachs showed that their diet was 65% chironomids (non-biting midges), 13% amphipods (freshwater shrimp), 11% fish, 9% snails, and trace amounts of other invertebrates. Stomach contents, size and growth rates can reveal whether a lake contains small-bodied lake trout that feed mostly on invertebrates or large-bodied lake trout that feed mostly on fish.

Maximum size and size at maturity are smaller, and growth is slower, in the small-body, invertebrate-eating life history form than the large-body, fish-eating form. Based on stomach, length and length-at-age data, the majority of the lake trout in Lewes Lake are the small-body type.

Table 3. Average length, weight, and condition factor of lake trout.

	Sample size	Fork Length (mm)	Weight (g)	Condition Factor
June	53	364	590	1.20
August	35	352	475	1.06
Average		358	533	1.13

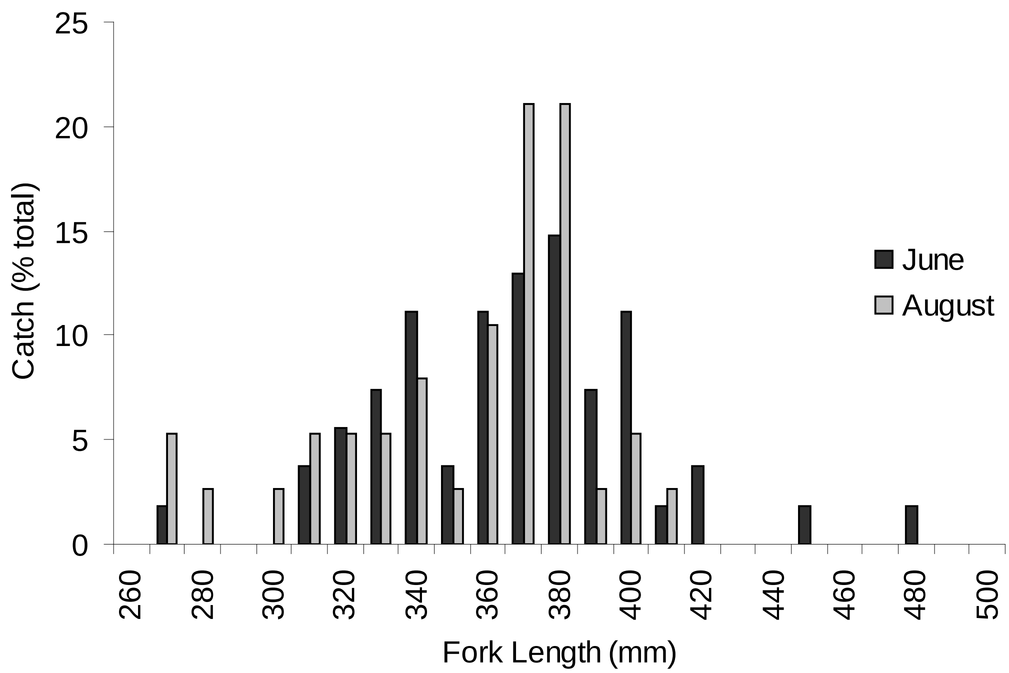

Figure 4. Length distribution of Lewes Lake trout caught in June and August.

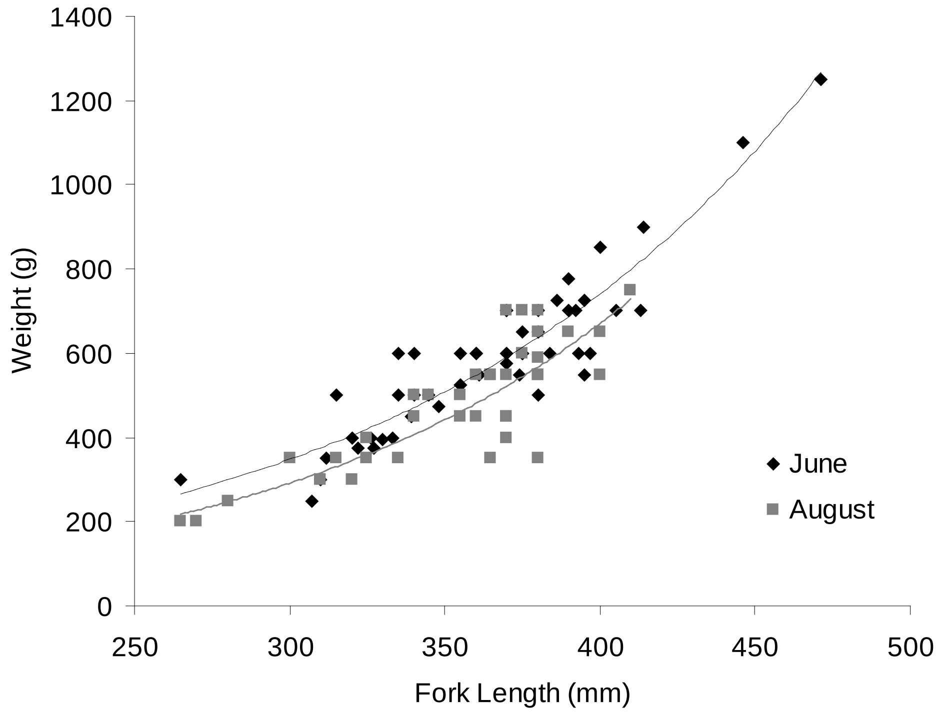

Figure 5. Weight by length of Lewes Lake trout caught in June and August.

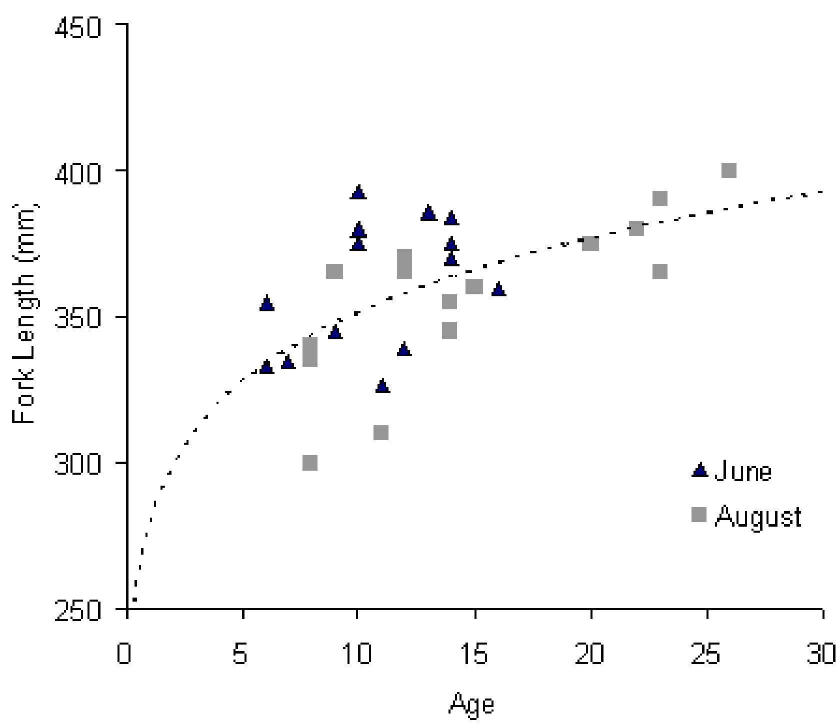

Figure 6. Length at age of Lewes Lake trout caught in June and August.

Population Status and Conclusions

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

Lewes Lake is a small, productive lake (Appendix 1). It contains small-body lake trout, and lacks other predator species such as northern pike and burbot. We compared density to other small-body lake trout lakes with similar fish communities sampled with SPIN, such as Caribou, Fish, and Louise/Jackson lakes (Appendix 1). Among these lakes, Lewes Lake had a high density of lake trout.

Based on the 2010 surveys, and in the context of lakes surveyed to date, the lake trout population in Lewes Lake is abundant.

Future Surveys

For Lewes Lake, future surveys should be done in June or early July (before habitat becomes limiting) and be compared only with the June 2010 survey. At the current sample size (n = 24), our predicted power to detect changes of 25% in future surveys is 57%. In order to detect change with a power of 80%, sample size for any future surveys should be increased to at least 30 sets. Even with this increase in sample size, the minimum amount of change we will likely be able to detect is around 30%.

Depth profiles of both temperature and dissolved oxygen should be taken prior to the start of each survey to help assess environmental conditions. In addition, profiles will identify areas where lake trout are unlikely to be encountered. This information can be used to vary the distribution of nets in each depth stratum and focus effort where the greatest catches are expected.

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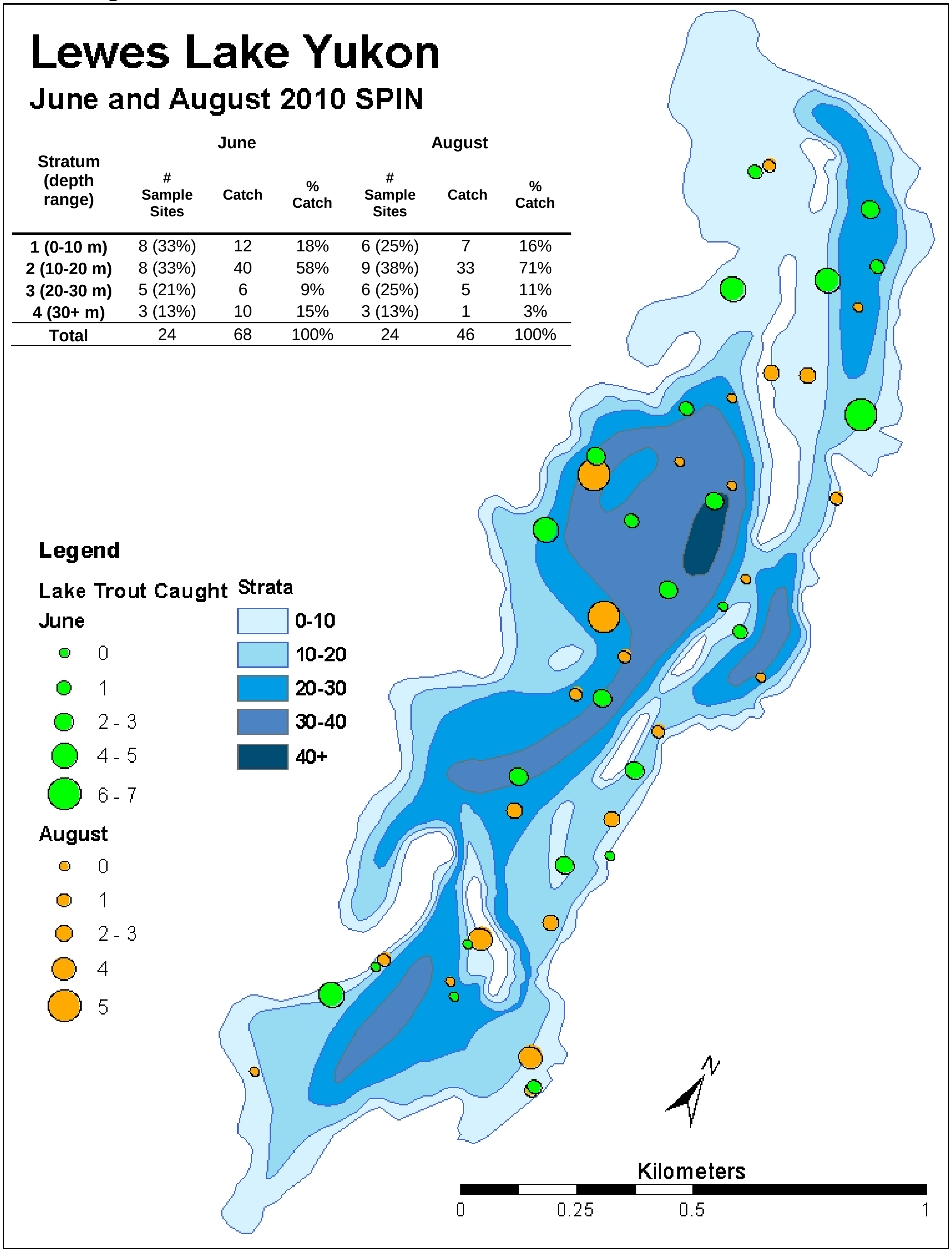
APPENDIX 1 – Estimated CPUE (SPIN) and density from Yukon Lakes to date.

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 morphodaephic 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
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
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 – Lewes Lake set and capture locations, June and August 2010.



Stratum (depth range)	June # Sample Sites	June Catch	June % Catch	August # Sample Sites	August Catch	August % Catch
1 (0-10 m)	8 (33%)	12	18%	6 (25%)	7	16%
2 (10-20 m)	8 (33%)	40	58%	9 (38%)	33	71%
3 (20-30 m)	5 (21%)	6	9%	6 (25%)	5	11%
4 (30+ m)	3 (13%)	10	15%	3 (13%)	1	3%
Total	24	68	100%	24	46	100%

APPENDIX 3 – SPIN capture details June and August, 2010.

Survey	Date	Effort (Set #)	Stratum	[1]Species	Fork Length (mm)	Weight (g)	Condition Factor	Fate	Sex
August	17	1	1	RW	385	650	1.14	D	M
August	17	2	1	AG	300	400	1.48	R	
August	17	2	1	LT	340	450	1.14	D	F
August	17	2	1	RW	365	600	1.23	R	
August	17	2	1	RW	365	600	1.23	R	
August	17	2	1	RW	350	600	1.40	R	
August	17	2	1	RW	415	850	1.19	D	F
August	17	2	1	RW	380	550	1.00	D	F
August	17	3	3	No Catch					
August	17	4	2	LT	325	400	1.17	R	
August	17	4	2	LT	355	500	1.12	R	
August	17	4	2	LT	380	550	1.00	D	M
August	17	4	2	LT	355	450	1.01	D	M
August	17	4	2	RW	425	800	1.04	D	F
August	17	4	2	RW	465	1100	1.09	D	F
August	17	5	1	LT	365	550	1.13	D	M
August	17	6	3	LT	325	350	1.02	R	
August	17	6	3	LT	370	450	0.89	R	
August	17	6	3	LT	280	250	1.14	R	
August	17	7	2	LT	360	550	1.18	D	F
August	17	7	2	LT	300	350	1.30	D	M
August	17	7	2	RW	480	1200	1.09	R	
August	17	7	2	RW	420	850	1.15	R	
August	17	7	2	RW	340	450	1.14	RP	
August	17	7	2	RW	485	800	0.70	RP	
August	17	7	2	RW	475	1350	1.26	D	M
August	17	7	2	RW	445	1050	1.19	D	F
August	17	7	2	RW	355	450	1.01	D	M
August	18	8	2	LT	310	300	1.01	D	M
August	18	8	2	LT	335	350	0.93	D	F
August	18	8	2	RW	400	700	1.09	R	
August	18	8	2	RW	410	900	1.31	R	

[1] AG=Arctic grayling; LT=lake trout; RW=round whitefish

R=released; RP=released, poor condition; D=dead

Appendix 3 Continued.

Survey	Date	Effort (Set #)	Stratum	[2]Species	Fork Length (mm)	Weight (g)	Condition Factor	Fate	Sex
August	18	9	3	LT	370	450	0.89	R	
August	18	9	3	LT	265	200	1.07	R	
August	18	10	2	No Catch					
August	18	11	2	LT	380	550	1.00	R	
August	18	11	2	LT	360	450	0.96	R	
August	18	11	2	LT	400	650	1.02	R	
August	18	11	2	LT	380	590	1.08	R	
August	18	11	2	LT	365	550	1.13	D	F
August	18	11	2	RW	485	1450	1.27	RP	
August	18	11	2	RW	490	1450	1.23	D	F
August	18	11	2	RW	475	1200	1.12	D	F
August	18	11	2	RW	460	1300	1.34	D	F
August	18	11	2	RW	420	900	1.21	D	F
August	18	12	4	LT	365	350	0.72	D	F
August	18	13	3	No Catch					
August	23	14	4	LT	270	200	1.02	R	
August	23	15	1	AG	290	300	1.23	R	
August	23	15	1	LT	410	750	1.09	R	F
August	23	15	1	LT	400	550	0.86	D	F
August	23	16	2	LT	380	350	0.64	R	
August	23	16	2	LT	310	300	1.01	R	
August	23	17	3	No Catch					
August	23	18	3	No Catch					
August	23	19	1	LT	320	300	0.92	R	
August	23	19	1	RW	490	1400	1.19	D	F
August	23	20	2	LT	390	650	1.10	D	M
August	23	20	2	RW	420	850	1.15	D	M
August	23	20	2	RW	435	950	1.15	D	M
August	23	20	2	RW	440	1000	1.17	D	F
August	23	20	2	RW	345	400	0.97	D	M
August	23	20	2	RW	340	400	1.02	D	M
August	23	21	2	LT	380	650	1.18	R	
August	23	21	2	LT	315	350	1.12	R	

[2] AG=Arctic grayling; LT=lake trout; RW=round whitefish

R=released; RP=released, poor condition; D=dead

Appendix 3 Continued.

Survey	Date	Effort (Set #)	Stratum	[3]Species	Fork Length (mm)	Weight (g)	Condition Factor	Fate	Sex
August	23	21	2	LT	375	600	1.14	R	
August	23	21	2	LT	370	400	0.79	R	
August	23	21	2	LT	375	700	1.33	D	M
August	23	21	2	RW	450	900	0.99	D	F
August	23	22	3	No Catch					
August	23	23	1	LT	380	700	1.28	R	
August	23	23	1	RW	345	550	1.34	R	
August	23	23	1	RW	440	950	1.12	D	M
August	23	23	1	RW	405	750	1.13	D	F
August	23	23	1	RW	460	1000	1.03	D	F
August	23	23	1	RW	385	800	1.40	D	F
August	23	24	2	LT	340	500	1.27	R	
August	23	24	2	LT	370	550	1.09	R	
August	23	24	2	LT	370	700	1.38	D	F
August	23	24	2	LT	345	500	1.22	D	M
August	23	24	2	RW	465	1300	1.29	R	
August	23	24	2	RW	445	1050	1.19	R	
August	23	24	2	RW	430	1000	1.26	D	F
August	23	24	2	RW	495	1350	1.11	D	F
June	15	1	2	LT	330	395	1.10	R	
June	15	1	2	LT	348	475	1.13	R	
June	15	1	2	LT	386	725	1.26	D	F
June	15	1	2	LT	413	700	0.99	R	
June	15	1	2	LT	310	300	1.01	R	
June	15	1	2	RW	449	1075	1.19	R	
June	15	2	3	No Catch					
June	15	3	1	No Catch					
June	15	4	2	LT	339	450	1.16	D	M
June	15	4	2	LT	333	400	1.08	D	M
June	15	5	3	LT	393	600	0.99	D	F
June	15	7	1	LT	414	900	1.27	R	
June	15	7	1	RW	435	900	1.09	RP	
June	15	9	2	LT	360	600	1.29	D	M

[3] AG=Arctic grayling; LT=lake trout; RW=round whitefish

R=released; RP=released, poor condition; D=dead

Appendix 3 Continued.

Survey	Date	Effort (Set #)	Stratum	[4]Species	Fork Length (mm)	Weight (g)	Condition Factor	Fate	Sex
June	15	9	2	LT	327	375	1.07	D	M
June	15	9	2	LT	326	400	1.15	R	
June	15	10	1	LT	375	650	1.23	D	M
June	15	10	1	LT	384	600	1.06	D	M
June	15	10	1	RW	465	1150	1.14	R	
June	15	10	1	RW	433	1000	1.23	D	M
June	15	10	1	RW	444	1000	1.14	R	
June	15	11	2	LT	380	500	0.91	R	
June	15	11	2	LT	395	550	0.89	R	
June	15	11	2	LT	405	700	1.05	R	
June	15	12	2	LT	304	250	0.89	D	
June	16	13	4	LT	355	525	1.17	R	
June	16	13	4	LT	374	550	1.05	R	
June	16	13	4	LT	312	350	1.15	D	M
June	16	14	4	LT	400	850	1.33	RP	
June	16	14	4	LT	390	775	1.31	D	F
June	16	14	4	LT	471	1250	1.20	R	
June	16	15	3	LT	375	600	1.14		
June	16	16	4	LT	322	375	1.12	D	M
June	16	16	4	LT	355	525	1.17	D	F
June	16	17	3	LT	361	550	1.17	D	F
June	16	17	3	LT	380	650	1.18	R	
June	16	17	3	LT	370	575	1.14	R	
June	16	18	3	No Catch					
June	16	19	1	LT	395	725	1.18	R	
June	16	19	1	RW	455	1200	1.27	R	
June	16	20	2	LT	375	600	1.14	R	
June	16	20	2	LT	370	700	1.38	R	
June	16	20	2	LT	446	1100	1.24	R	
June	16	20	2	LT	320	400	1.22	R	
June	16	20	2	LT	340	500	1.27	D	F
June	16	21	1	LT	390	700	1.18	R	
June	16	21	1	LT	392	700	1.16	R	

[4] AG=Arctic grayling; LT=lake trout; RW=round whitefish

R=released; RP=released, poor condition; D=dead

Appendix 3 Continued.

Survey	Date	Effort (Set #)	Stratum	[5]Species	Fork Length (mm)	Weight (g)	Condition Factor	Fate	Sex
June	16	21	1	LT	355	600	1.34	D	M
June	16	21	1	LT	380	700	1.28	D	F
June	16	21	1	LT	335	500	1.33	D	
June	16	22	2	LT	370	600	1.18	D	M
June	16	22	2	LT	370	700	1.38	R	
June	16	22	2	LT	265	300	1.61	R	
June	16	22	2	LT	340	600	1.53	R	
June	16	22	2	LT	360	600	1.29	R	
June	16	22	2	LT	360	600	1.29	R	
June	16	22	2	LT	379	600	1.10	R	
June	16	22	2	LT	370	600	1.18	R	
June	16	23	1	LT	345	500	1.22	D	F
June	16	23	1	RW	445	1200	1.36	D	F
June	16	23	1	RW	405	900	1.35	D	F
June	16	23	1	RW	420	900	1.21	R	
June	16	23	1	RW	445	1100	1.25	D	M
June	16	24	2	LT	315	500	1.60	R	
June	16	24	2	LT	375	600	1.14	D	
June	16	24	2	LT	335	600	1.60	R	
June	16	24	2	LT	370	700	1.38	R	
June	16	24	2	RW	435	700	0.85	R	

[5] AG=Arctic grayling; LT=lake trout; RW=round whitefish

R=released; RP=released, poor condition; D=dead