LAKE TROUT POPULATION ASSESSMENT

LOWER SNAFU LAKE

2010

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

No lake trout were captured in Lower Snafu in 2010, indicating that the lake trout population is very small. For a lake of its size and productivity, we would expect a much larger population. When these results are viewed in the context of other studies and historical information, they suggest that the lake trout population in Lower Snafu Lake is highly depleted.

Key Findings

- No lake trout were captured in Lower Snafu Lake in 2010.
- The lake trout population is very small and, given all available information, 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 Lower Snafu Lake using SPIN in 2010, and using small-mesh netting in 1995, 2000, and 2005. 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

Lower Snafu Lake is located approximately 25 km southeast of Jakes Corner along the Atlin Road (Figure 1). The lake belongs to a chain of lakes collectively referred to as Snafu Lakes. The lakes lie within the traditional territory of the Carcross/Tagish First Nation. The 2 lakes most used by anglers are generally referred to as Lower and Upper Snafu lakes and are separated by an approximately 1.5 km segment of Snafu Creek. The 2010 assessment sampled Lower Snafu Lake only, and so results only pertain to that lake. Lower Snafu is approximately 9.5 km long and covers an area of 284 hectares (ha). Mean depth is 6.3 m and maximum depth is 25 m. The lake is divided into several distinct basins, connected by narrows. The lake is fed by several small creeks but its main inflow is Snafu Creek.

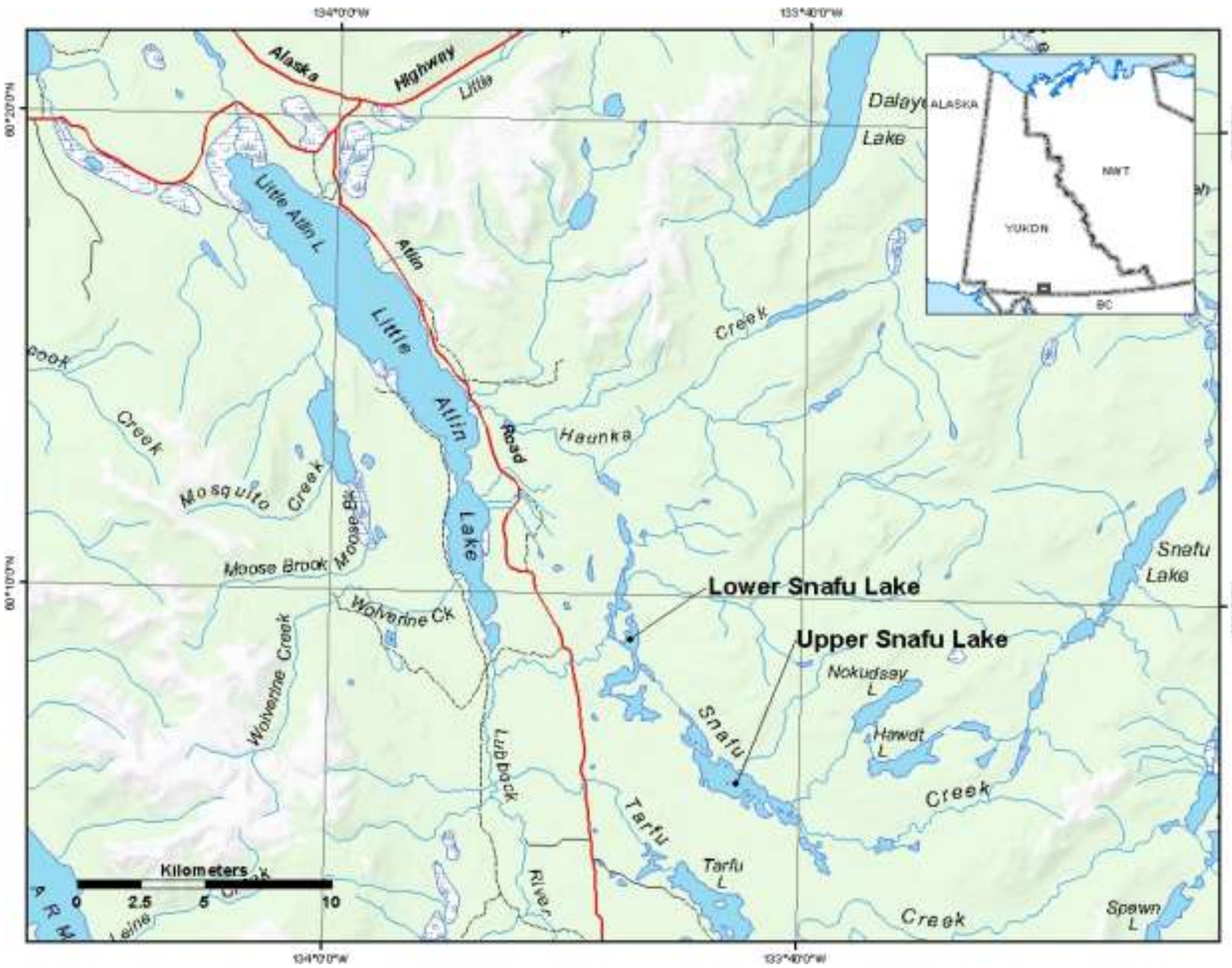

Figure 1. Location of Snafu Lakes, Yukon.

There is a popular government campground and boat launch located on Lower Snafu Lake. Lower Snafu was once renowned for its lake trout and pike angling and the presence of large fish. The Snafu lakes have relatively high species diversity for their size, containing lake trout, northern pike, Arctic grayling, least cisco, lake whitefish, and broad whitefish.

Environment Yukon has managed the recreational fishery on Snafu Lakes with Special Management Waters regulations since 2001. Prior to this, they had been managed with Conservation Waters regulations since 1993. 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.

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 Snafu Lake on 5 – 6 July 2010. We set a total of 22 nets, divided among 2 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 this effort during the survey to place more effort in the deeper strata, where we expected to have a better chance of finding trout. Set locations within each stratum were chosen using random point generation with 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. 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 captured by anglers.

We can convert 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 can estimate 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	224	79	14	64
10–25 m	60	21	8	36
Total	284	100	22	100

Results and Discussion

CPUE, Density, and Population Size

We captured no lake trout in 22 net sets (see Appendix 2 for set locations and Appendix 3 for capture details). Lake whitefish, northern pike, and least cisco were captured and total mortalities were 29 lake whitefish (30% mortality rate).

Since no lake trout were captured, CPUE was 0 and no valid estimates of density or abundance could be made. A CPUE of 0 is the lowest of all lake trout lakes surveyed with SPIN to date (Appendix 1). Although this survey captured no lake trout, angler harvest information from 2010 reports the continued presence of small numbers of lake trout in Lower Snafu Lake: we estimate that only 12 trout were caught all summer (unpublished data). So while we know that estimates of 0 for CPUE and population size are wrong (i.e., there are some fish present, but we did not catch any), they indicate that lake trout in Lower Snafu Lake are at extremely low density.

Results from Previous Surveys

Lower Snafu Lake was sampled using SLIN methods in 1995, 1996, 2000, and 2005. Lake trout were captured in only the 2000 survey (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 indicate that lake trout density was very low at least as far back as 1995. Horler et al. (1983) also sampled Lower Snafu Lake as part of the Yukon River Basin Study. They used different nets again and caught only 2 lake trout for a catch per unit effort of 0.04 lake trout per hour.

Angler harvest surveys have shown low angler success for lake trout as far back as 1991 (0.02 to 0.03 lake trout per hour, Millar et al., *in prep.*). The most recent angler harvest survey (2010) measured a total of 2,697 hours or 9.3 hours / ha of angling effort, one of the highest per hectare effort of all Yukon fisheries. Lower Snafu Lake also historically sustained both commercial and domestic fisheries which could have had large impacts on the lake trout population.

Table 2. CPUE from Lower Snafu Lake SLIN surveys.

	1995	1996	2000	2005	Yukon Average (92 lakes)
Number of sets	12	10	12	10	
Lake trout caught	0	0	2	0	
CPUE	0	0	0.17	0	0.78

Population Status and Conclusions

Based on lake characteristics, we would expect to have found a much higher density of lake trout in Lower Snafu Lake. Smaller, more productive lakes – such as Lower Snafu – can generally be expected to have higher fish densities than larger, less productive lakes (Burr 1997). However, lakes with multiple top predator species (Lower Snafu Lake has both lake trout and northern pike) tend to have lower densities than lakes with only lake trout (Carl et al. 1990). If we consider both lake size and presence of multiple predators, we would expect Lower Snafu (0 fish/ha) to have a higher density than a lake such as Sekulmun (3.7 fish/ha) which is large and unproductive, but lower than a lake such as Kathleen (28.6 fish/ha) with small bodied lake trout and no other predators (see Appendix 1).

Historic information suggests that Lower Snafu Lake used to have more fish and that the decrease in abundance happened decades ago. As recently as the 1960s, large lake trout (10 – 12 kg) were more abundant (Environment Yukon Lake and Stream Files). However, when the first fish surveys were conducted in the early 1980s, lake trout were already at a low density.

Angler Harvest Surveys conducted since the early 1990s show that the Snafu lakes have one of the highest levels of angling effort per hectare in the entire territory (Millar et al., *in prep.*). A high level of angling pressure sustained over decades has likely reduced the size of the lake trout population and is holding the population at a low level. Increasingly conservative angling regulations (1993/94: Conservation Water – 2 trout catch limit; 2001/02 Special Management Water – 1 trout catch limit) have seemingly not led to an increase in the lake trout population.

When considered together, the results of multiple fish population assessments and angler harvest surveys over 30+ years suggest that the population of lake trout in Lower Snafu Lake has been depleted for some time and that the situation is not improving. The very high level of angling effort on this lake places continued harvest pressure on this small population.

Future Surveys

Because we found the lake trout population in Lower Snafu Lake to be low and depleted, we are most interested in being able to detect any future population increase. Any comparison of future surveys to these results must consider that the density of fish in 2010 was below the detection threshold of the SPIN method. Future surveys of Lower Snafu Lake should be useful in determining this method’s detection threshold: i.e., what is the minimum density of lake trout that a lake must have before it can be detected?

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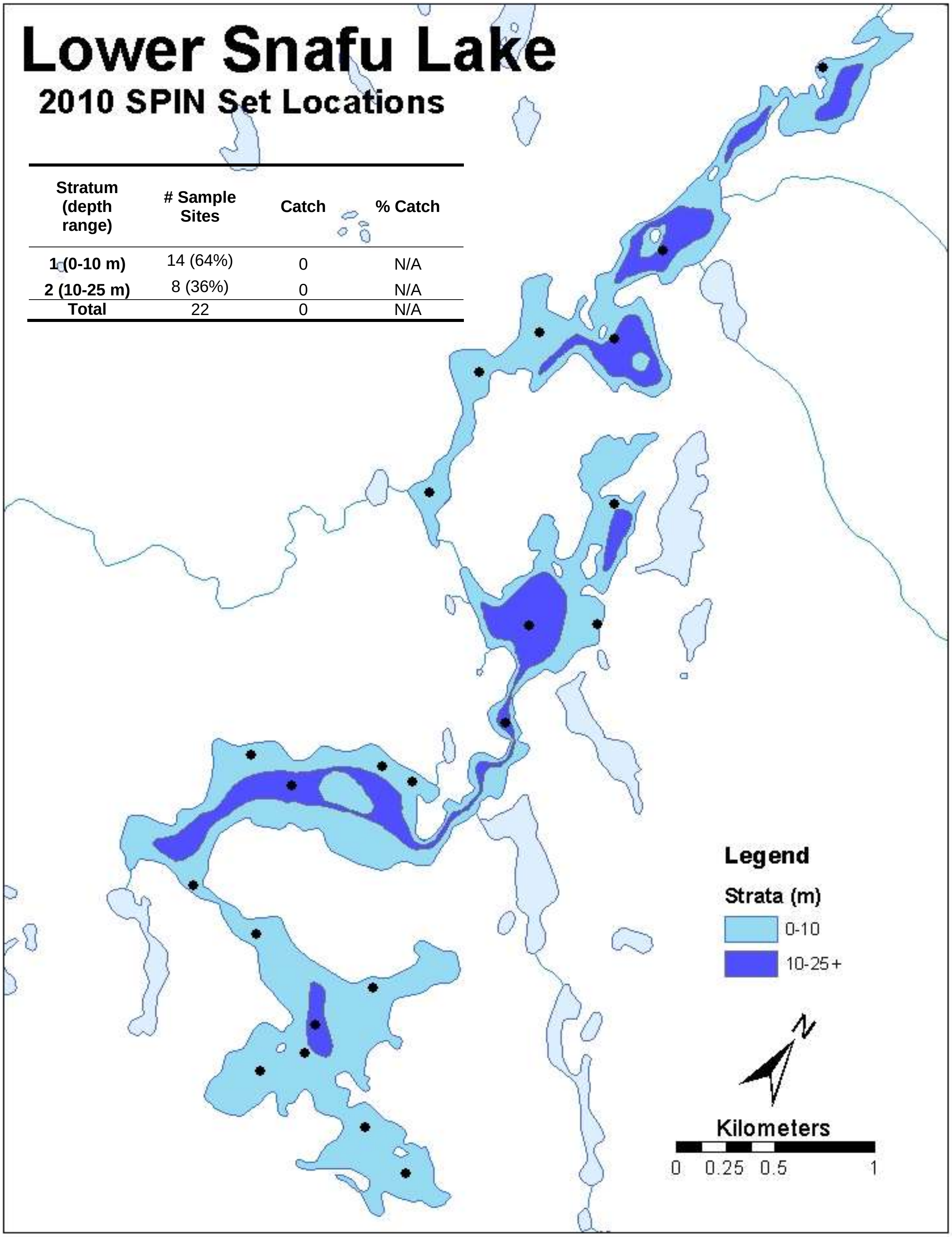
APPENDIX 1 – Estimated CPUE (SPIN) and density from Yukon Lakes to 2011.

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

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

APPENDIX 2 – Lower Snafu Lake set locations 2010.



Stratum (depth range)	# Sample Sites	Catch	% Catch
1 (0-10 m)	14 (64%)	0	N/A
2 (10-25 m)	8 (36%)	0	N/A
Total	22	0	N/A

APPENDIX 3 – Lower Snafu Lake SPIN capture details 2010

Date	Effort (Set #)	Stratum	[1]Species	Fork Length (mm)	Weight (g)	Fate	Sex
July 5, 2010	1	1	LW	264	300	R	
July 5, 2010	1	1	LW	302	450	R	
July 5, 2010	2	1	LW	318	500	R	
July 5, 2010	2	1	LW	287	400	R	
July 5, 2010	2	1	LW	307	400	R	
July 5, 2010	2	1	NP	554	1450	R	
July 5, 2010	2	1	LW	265	250	D	UNK
July 5, 2010	3	1	LW	253	150	D	M
July 5, 2010	3	1	LW	290	250	R	
July 5, 2010	4	1	LW	372	500	D	M
July 5, 2010	4	1	NP	760	3750	R	
July 5, 2010	4	1	LW	340	500	R	
July 5, 2010	4	1	LW	430	1150	R	
July 5, 2010	4	1	LW	330	500	D	M
July 5, 2010	4	1	LW	305	250	R	
July 5, 2010	4	1	LW	265	200	R	
July 5, 2010	4	1	LW	236	200	R	
July 5, 2010	4	1	LW	276	300	D	F
July 5, 2010	5	2	LW	393	700	R	
July 5, 2010	5	2	LW	366	600	R	
July 5, 2010	5	2	LW	340	500	R	
July 5, 2010	5	2	LW	267	200	D	M
July 5, 2010	5	2	NP	740	3000	R	
July 5, 2010	5	2	LW	397	700	R	
July 5, 2010	5	2	NP	605	1500	R	
July 5, 2010	5	2	LW	260	300	D	UNK
July 5, 2010	5	2	LW	321	450	D	M
July 5, 2010	5	2	LW	330	500	D	M
July 5, 2010	5	2	LW	404	800	R	
July 5, 2010	5	2	LW	379	750	R	
July 5, 2010	5	2	LW	295	400	R	
July 5, 2010	5	2	LW	331	525	R	
July 5, 2010	5	2	LW	341	550	D	F
July 5, 2010	5	2	LW	269	350	R	
July 5, 2010	5	2	LW	352	700	R	
July 5, 2010	5	2	LW	323	500	D	F

[1] LW=lake whitefish; NP=northern pike; LC=least cisco

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

Appendix 3 (Cont'd).

Date	Effort (Set #)	Stratum	[2]Species	Fork Length (mm)	Weight (g)	Fate	Sex
July 5, 2010	6	1	No Fish Caught				
July 5, 2010	7	1	LW	391	1000	R	
July 5, 2010	7	1	LW	371	800	R	
July 5, 2010	8	1	LW	368	600	D	M
July 5, 2010	8	1	LW	280	300	R	
July 5, 2010	8	1	LW	368	600	R	
July 5, 2010	8	1	LW	410	1000	R	
July 5, 2010	8	1	LW	385	800	D	M
July 5, 2010	8	1	LW	285	300	R	
July 5, 2010	8	1	LW	386	800	D	M
July 5, 2010	8	1	LW	315	400	D	M
July 5, 2010	8	1	LW	365	600	D	F
July 5, 2010	8	1	LW	268	300	R	
July 5, 2010	8	1	LW	390	800	R	
July 5, 2010	8	1	LW	396	800	R	
July 5, 2010	8	1	LW	328	500	R	
July 5, 2010	8	1	LW	360	700	R	
July 5, 2010	9	2	LW	385	700	R	
July 5, 2010	9	2	LW	317	350	D	F
July 5, 2010	9	2	NP	713	2300	R	
July 5, 2010	9	2	LW	388	700	R	
July 5, 2010	9	2	LW	327	450	R	
July 5, 2010	10	1	LW	371	650	R	
July 5, 2010	10	1	NP	625	1800	R	
July 6, 2010	11	1	LW	314	400	R	
July 6, 2010	11	1	LW	376	700	D	M
July 6, 2010	11	1	NP	713	2250	R	
July 6, 2010	11	1	LW	291	400	D	F
July 6, 2010	11	1	LW	375	800	R	
July 6, 2010	11	1	LW	339	600	R	
July 6, 2010	11	1	LW	378	850	R	
July 6, 2010	11	1	LW	318	500	R	
July 6, 2010	11	1	LW	317	450	D	M
July 6, 2010	11	1	LW	335	450	R	
July 6, 2010	11	1	LW	334	400	D	M
July 6, 2010	12	1	LW	340	550	R	

[2] LW=lake whitefish; NP=northern pike; LC=least cisco

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

Appendix 3 (Cont'd).

Date	Effort (Set #)	Stratum	Species[3]	Fork Length (mm)	Weight (g)	Fate	Sex
July 6, 2010	12	1	LW	350	600	R	
July 6, 2010	12	1	LW	319	475	R	
July 6, 2010	12	1	LW	237	400	R	
July 6, 2010	12	1	LW	340	600	R	
July 6, 2010	13	2	No Fish Caught				
July 6, 2010	14	2	No Fish Caught				
July 6, 2010	15	2	LW	452	1175	R	
July 6, 2010	16	2	LW	390	800	R	
July 6, 2010	17	1	LW	326	500	R	
July 6, 2010	17	1	LW	348	600	D	F
July 6, 2010	17	1	LW	307	500	R	
July 6, 2010	17	1	LW	391	800	R	
July 6, 2010	17	1	LW	324	500	R	
July 6, 2010	17	1	NP	511	1000	R	
July 6, 2010	17	1	LW	348	650	R	
July 6, 2010	18	2	No Fish Caught				
July 6, 2010	19	2	LW	435	1000	R	
July 6, 2010	19	2	LW	425	1100	D	M
July 6, 2010	20	1	LW	325	500	R	
July 6, 2010	20	1	LW	390	1000	D	M
July 6, 2010	20	1	LW	312	500	R	
July 6, 2010	20	1	LW	325	500	D	M
July 6, 2010	20	1	LW	314	400	R	
July 6, 2010	20	1	LW	345	500	R	
July 6, 2010	20	1	LW	395	900	R	
July 6, 2010	20	1	LW	264	200	R	
July 6, 2010	20	1	LW	327	500	D	M
July 6, 2010	20	1	NP	800	2700	R	
July 6, 2010	20	1	LW	323	400	D	F
July 6, 2010	20	1	NP	640	1700	R	
July 6, 2010	21	1	LW	400	900	D	F
July 6, 2010	22	1	LW	398	800	R	
July 6, 2010	22	1	LC	265	200	R	
July 6, 2010	22	1	LW	395	800	R	
July 6, 2010	22	1	LW	392	800	R	
July 6, 2010	22	1	LW	229	150	R	

[3] LW=lake whitefish; NP=northern pike; LC=least cisco

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

Appendix 3 (Cont'd).

Date	Effort (Set #)	Stratum	[4]Species	Fork Length (mm)	Weight (g)	Fate	Sex
July 6, 2010	22	1	LW	374	650	D	M
July 6, 2010	22	1	LW	438	1100	R	
July 6, 2010	22	1	LW	362	500	R	
July 6, 2010	22	1	NP	550	1200	R	
July 6, 2010	22	1	NP	615	1600	R	

[4] LW=lake whitefish; NP=northern pike; LC=least cisco

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