Trapper Lake Sockeye Enhancement Project

Evaluation Studies 2006-2007

Prepared for:

The Transboundary River Panel
Pacific Salmon Commission
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Abstract

Approximately 900,000 Little Trapper origin sockeye fry (brood year 2006) were outplanted into Trapper Lake at two separate sites on June 19, 2007. The 2007 Trapper Lake fry outplant assessment studies included limnological sampling, littoral zone beach seine surveys, hydroacoustic surveys, and mid-water trawling. As well as lengths and weights and otolith analysis, the diet of sampled juvenile nerkids was also examined. The physical limnological parameters (temperature profiles, and Secchi depth) examined were similar to those found in previous Trapper Lake limnological investigations. The 2007 zooplankton biomass and species composition did not alter significantly from the values obtained in earlier studies. Calanoid copepods are the dominant zooplankton taxa. The littoral zone beachseine surveys indicated outplanted sockeye fry were the dominant fish species occupying the littoral zone during the summer, but decreased significantly after mid-September. The 2007 hydroacoustic estimates indicated the pre-outplant limnetic kokanee population was approximately 23,000 and the total fall (mid-September) limnetic nerkid population was approximately 150,000. This suggests a fall fry population of approximately 130,000 and outplanted to fall fry survival of approximately 12%. Mid-water trawl catches were low, likely due to trawl net avoidance. The length and weight data indicted the outplanted fry growth rate was similar to that observed at most other transboundary lakes that have received outplanted sockeye fry. The diet analysis indicated that all the kokanee sampled and the outplanted fry in the limnetic zone fed almost exclusively on calanoid copepods. Within the littoral zone the outplanted fry had a wider dietary regime including dipteran insects (larvae and pupae) and cladoceran as well as cyclopoid zooplankton. Dipteran insects constituted (by weight) the largest proportion of dietary items. Some habitat partitioning between kokanee and outplanted sockeye fry with the fry solely inhabiting the littoral zone from June through late August. It was assumed, based on hydroacoustic and beach seine surveys the outplanted fry had moved offshore to occupy limnetic habitats along with the resident kokanee. The preliminary 2007 Trapper Lake assessment results indicate the growth and survival of the outplanted sockeye fry warrant continuation of this enhancement program in 2008.

1.0 Introduction

Feasibility studies to investigate the sockeye salmon enhancement potential of Trapper Lake were initiated in 2004. Trapper Lake was identified as a potential sockeye salmon enhancement site in 1988 due to its apparent under-utilized sockeye fry rearing potential (PSC 1988). An enhancement project involving outplanted sockeye was initiated at Trapper Lake in 1990 and terminated five years later due to lower than expected outplanted sockeye smolt production. As a consequence in 1995 all the Taku River sockeye enhancement effort was transferred to Tatsamenie Lake, which at that time was perceived to have greater enhancement potential. Since the abandonment of the Trapper Lake enhancement project, experience at the other Transboundary outplant candidate lakes indicated that the poor fry to smolt survival of the outplanted Trapper Lake enhanced fish may have been a function of outplant and fish culture techniques rather than the juvenile sockeye rearing potential of Trapper Lake (PSC 2001). It was also observed that returning sockeye salmon from the enhancement program were nearly successful at negotiating a falls/velocity barrier near the outlet of Trapper Lake. This, coupled with the identified presence of non-anadromous sockeye (kokanee), indicated that anadromous sockeye had negotiated the barrier in the past and may presently do so under favourable water conditions.

It is estimated that if successful the Trapper Lake project could result in a sustained increase in sockeye production from the Taku River of 10,000 to 40,000 adult sockeye (Mercer 2005). From 2004 through 2007 the Pacific Salmon Commission under the auspices of the Northern Fund financed preliminary feasibility studies to examine improving sockeye access to Trapper Lake and the establishment of a self-sustained anadromous sockeye population. Brian Mercer, a contract biologist, has been retained by the northern fund in affiliation with DFO and ADF&G as the project facilitator.

The feasibility studies conducted in 2004 – 2005 were detailed in a previous report issued to Northern Panel members at the February 2006 PSC meeting. These studies indicated the project was technically feasible. However the B.C. Fish Transplant Committee members raised several concerns during the permit application process in 2005. The Committee requested that the applicants conduct a detailed biological risk/benefit assessment of the project.

In 2006 a detailed risk assessment of the Trapper Lake sockeye enhancement project was submitted to the B. C. Fish Transplant Committee. This report, *Summary of Identified Biological Risks of the Trapper Lake Sockeye Enhancement Project*, was submitted to the transplant committee in 2006 as well as members of the Transboundary River Panel of the PSC in February 2007. This report recommended that a cautious stepped approach be adopted toward this project. Therefore, fish transplant applications in 2006 and 2007 were for outplants of a maximum of 1,000,000 sockeye fry each year. In addition to fry outplants, in brood year (BY) 2007 approximately 100,000 fertilized eggs were planted into the substrate of Tunjony Creek. Tunjony Creek was identified as the principal potential spawning habitat within the system. It was considered that some of the uncertainty relating to incubation potential, juvenile nerkid carrying capacity, and potential sockeye smolt production as well as potential biological risks of the project could be examined through the resumption of sockeye fry outplanting into Trapper

Lake. In addition, fry outplants may the presence and degree of kokanee/sockeye niche overlap.

Applications were also made in 2006 and 2007 to DFO (SEP Vancouver) for a Section 4 (Fisheries Act) exemption in order to import live fish (from Snettisham Hatchery) into Canada. This is an exemption that currently is granted to the other Transboundary River sockeye enhancement programs. The exemption was granted in both years.

The 2006 and 2007 fish transplant applications allowing the outplanting of up to 1,000,000 sockeye fry were approved in both years. As occurred in 2006, an egg take was conducted at Little Trapper Lake in August/September 2007. Approximately 800,000 eggs are incubating at Snettisham Hatchery in Alaska at the time of this report writing. In addition, 120,000 fertilized sockeye eggs were planted into Tunjony Creek in September 2007. The details of the 2007 egg take and fertilized egg planting are provided in a separate report (Mercer 2007).

This report will detail the results of the Trapper Lake assessment studies conducted in 2007. Specifically the report will examine the results of investigations into primary lake productivity, zooplankton, and assessment of outplanted sockeye fry and resident nerkids.

1.1 Location

Trapper Lake is located at the headwaters of the Taku River system within the upper Kowatua Creek drainage (Figure 1) in northwestern British Columbia. The lake system is situated within the eastern portion of the coastal cordillera. It is in a transitional area between coastal and interior bio-climatic zones. Trapper Lake is situated in a remote area of British Columbia and is accessible only by air. The nearest towns of Atlin and Telegraph Creek are approximately 165 km and 110 km distant.

1.2 Description of system

Trapper Lake lies at an elevation of 790 meters, has a shoreline length of approximately 20 km, and a surface area of approximately 543 hectares. The bathymetry of Trapper Lake is congruent with the steepness of the surrounding glacier scoured topography. The lake has a mean depth of approximately 90 meters with a maximum of 124 meters. Trapper Lake is ultra-oligotrophic and exhibits many of the physicochemical characteristics typical of lakes receiving seasonal inflows of glacially turbid water. The area is subject to strong winds, the lake is persistently wind mixed and does not stratify.

The Taku River system supports significant runs of chinook, coho, pink, chum, and sockeye salmon, as well as steelhead (TTC 2004). The 1994-2007 annual average run size of Taku River sockeye is approximately 260,000. It is unlikely that anadromous sockeye currently ascend the falls into Trapper Lake. However, Little Trapper Lake located 2 km downstream is a significant sockeye producer in the system. It is estimated that the Little Trapper sockeye stocks contributed

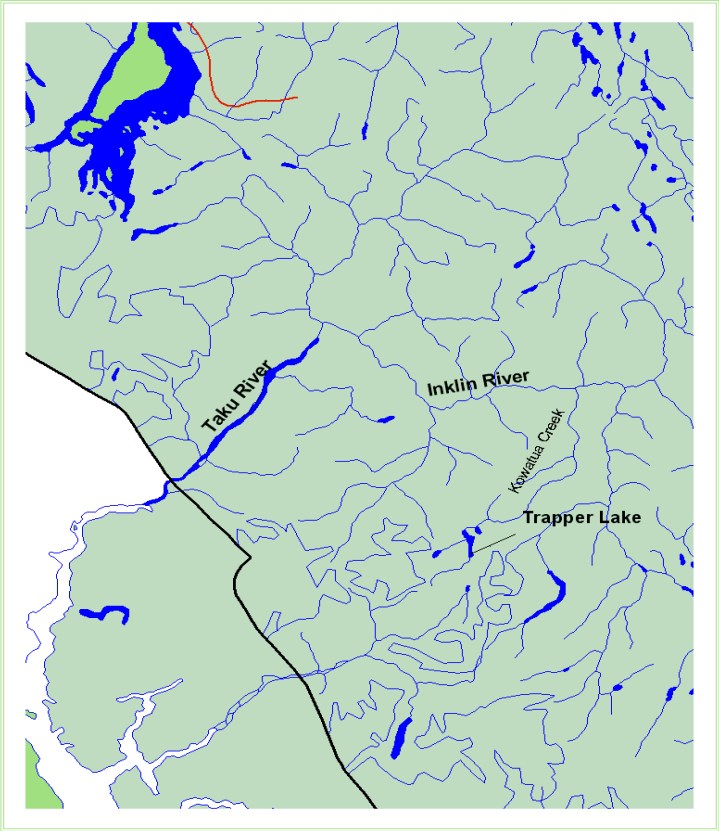


Figure 1. Location of Trapper Lake in the Taku River Watershed.

approximately 21% or 55,000 annually (1994-2006 average) to the total Taku River sockeye run size (TTC 2006). A sockeye enumeration weir has operated at the outlet to Little Trapper Lake from 1983 through 2007. During this period annual spawning escapements have averaged 12,860 (range 6,000 – 31,000). Little Trapper Lake sockeye spawn in the inlet stream connecting Little Trapper and Trapper lakes, with 90% of the spawning within 1 km of the inlet (Figure 2). The Little Trapper sockeye are broodstock source for the 2007 and 2008 sockeye fry outplants into Trapper Lake.

1.3 Objectives

The eventual goal of the project is to provide improved and reliable access to Trapper Lake for returning adult sockeye salmon and establish a permanent self-sustained anadromous sockeye population in the lake. The goals of the project are consistent with and will contribute to the bilateral obligations to increase transboundary river sockeye production as per Annex IV, Chapter 1, section (b) (iv) of the Pacific Salmon Treaty.

The specific objectives of the 2007 lake assessment investigations were:

Continue monitoring and collecting baseline information of bio-physical characteristics of Trapper Lake including chlorophyll *a* levels, total phosphorus, secchi depths, temperature profiles, and zooplankton community structure and biomass.

Examine outplanted sockeye fry and resident nerkid habitat use, growth, diet, and population dynamics.

This report primarily details the results of the 2007 field season investigations. Ongoing investigations in 2008 will document over winter fry growth and potential age 1+ smolt production. It is anticipated in-depth analysis and interpretation of the results of the BY 2006 fry outplants will be presented in a detailed report as part of a Canadian Environmental Assessment Act (CEAA) review application after the 2008 field season is concluded.

2.0 Methods

2.1 Limnological Sampling

Three limnological surveys were conducted at Trapper Lake in 2007. Two site specific sampling stations were used at Trapper Lake (Figure 2). These sites are used consistently and are the same as used in previous limnological investigations at this lake. At each of these stations secchi depth, temperature profiles, water sampling (chlorophyll *a* and total phosphorus TP), and zooplankton sampling was completed.

Water clarity was measured using a standard 20 cm diameter Secchi disc. The disc was lowered into the water perpendicular to the surface until no longer visible, then the disc was slowly raised until it was visible to the observer. The depth at which the disc became visible was read off the metered line and recorded.

Water temperature profiles were determined using a YSI temperature meter with a probe at the end of a 30 m weighted cable.

Trapper Lake primary productivity was monitored by sampling for total phosphorus and chlorophyll *a* in the upper water column. Water samples were collected in 2 cm x 12m long "Tygon" tube lowered into the upper 12 meters of the water column. The water from the tube was decanted into a clean plastic pail. This water was filtered through a 100 micron mesh filter into an opaque 1 liter container. After the sample collection procedures were complete a portion of the water was poured into glass test tubes for TP determination. Another portion (500 ml) was filtered through a pre-ashed 47 mm 0.45 micron Millipore HA filter to collect chlorophyll *a* (phytoplankton) for quantitative analysis. The chlorophyll coated filters were stored frozen until they were shipped, along with the TP samples at the end of the field season to the DFO Cultus Lake Laboratory for analysis.

Zooplankton samples were collected at each limnological station using a standard SCOR zooplankton net ($0.25m^2$ opening , 100 micron mesh size). A 5 kg weight was attached to the bottom of the net to allow descent to the required depth on the metered line. Zooplankton sampling depths at both stations were 25 m. Once at depth the net was hauled to the surface at a rate of approximately 0.5 m/sec. The contents of the net were carefully rinsed into the codend and emptied into 500 ml jars containing a preservative solution of 4% formalin.

2.2 Outplanted Sockeye Fry and Resident Nerkid Investigation

2.2.1 Littoral Zone Sampling

Beach seines were performed during each of the six littoral zone surveys conducted in 2007. Five separate beach seine sites were designated and consistently used for all the surveys (Figure 2.) The beach seining was carried out using a 30 m x 3.8 m seine net (0.64 cm mesh size wings, 0.32 mesh size bunt) deployed from the 5 m aluminum skiff at Trapper Lake. The beach seines were used to index the relative abundance and size of juvenile nerkids utilizing the littoral zone of the lake. An approximate count and identification by species was made of all beach seine catches. A sub-sample was taken from each capture site if the total number of fry captured exceeded 50. The samples collected were enumerated and preserved in 95% ethanol. The wild and outplanted nerkids were identified by examining for the presence of an otolith mark in the laboratory.

2.2.2 Hydroacoustic Surveys and Midwater Trawl Sampling

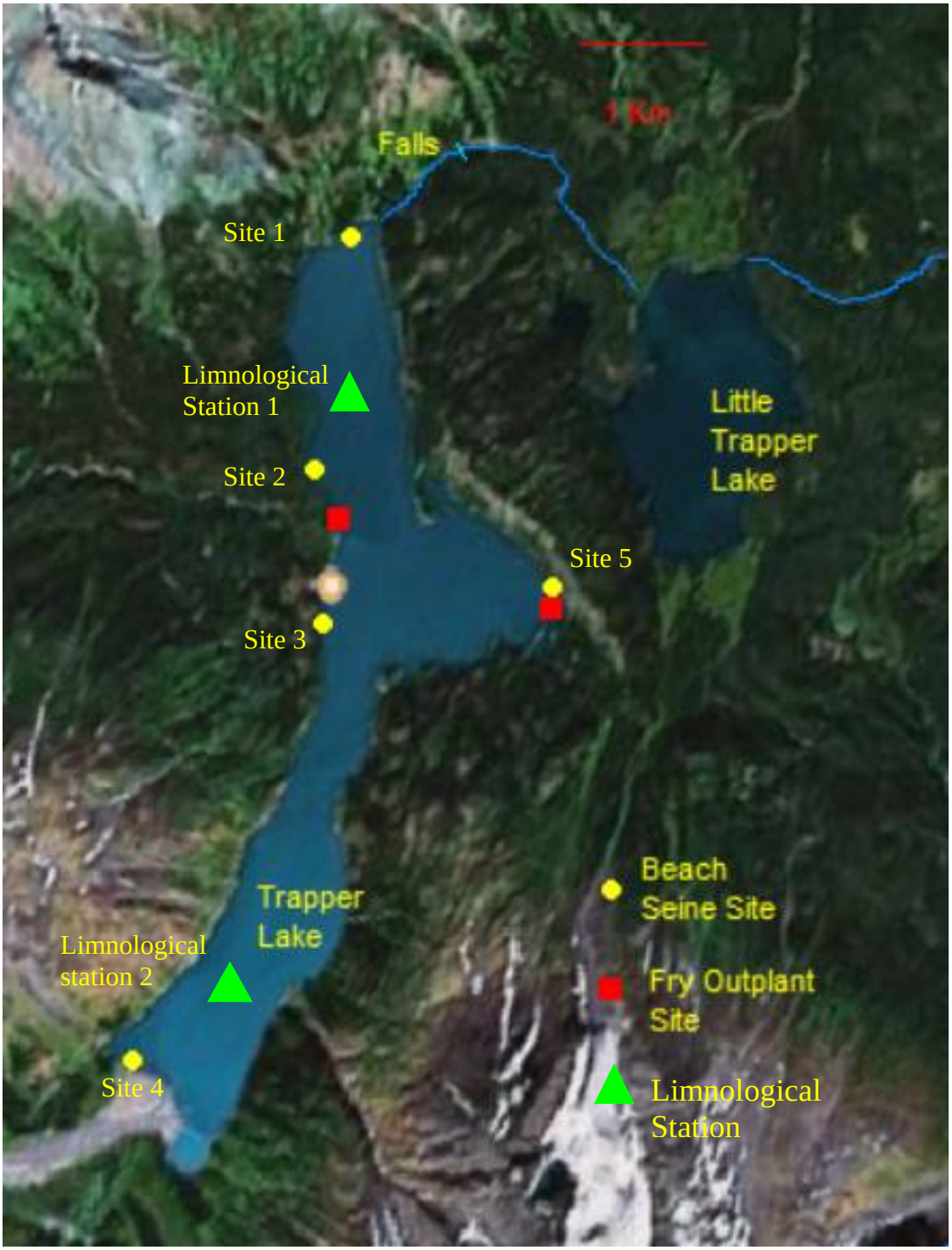
Hydroacoustic surveys were conducted to assess the abundance of wild and outplanted juvenile nerkid populations. A total of five hydroacoustic surveys were completed at Trapper Lake in 2007. One survey was conducted on June 13 prior to the out plant of the hatchery incubated sockeye fry. The remaining four surveys were conducted at approximately one month intervals with the last survey on September 21.

Hydroacoustic surveys were conducted using a Biosonics DT-X 200 khz split beam echosounder. The echosounder settings used for all surveys were: Time Varied Gain = 40, threshold –75 dB, 4 pings/sec., and a depth of 150 m. The echosounder was interfaced with a Toshiba laptop computer. All survey transect data was stored on the computer using time/date stamped files.

Mid-water trawling was carried out to supply data on limnetic zone fish species and age composition represented by the acoustic targets, particularly the outplanted and wild nerkid population. A 2m x 2m x 7.5 m trawl net was constructed of low drag knotless stretch mesh, with mesh sizes ranging from 7.62 cm at the opening to 0.65 cm at the codend. Two 10 kg lead "cannonballs" were affixed to the bottom cross stringer of the net to weight the net as well as maintain the 2 m x 2 m opening at depth.

Mid-water trawls were conducted during darkness in areas of the lake where targets were observed to be dense. In confined areas where linear tows were not feasible, circular tows were conducted. For surface trawls a horizontal sinusoidal pattern was maintained to avoid towing the net in the prop wash of the boat. Tow velocity was as fast as the power of the motor would allow, approximately 1 m/sec. A more powerful motor (25 hp – maximum rated for the boat) was procured in August in an attempt to increase trawl speeds to increase the number of fish captured. Warp angles during the tows were approximately 17 degrees. An approximate ratio of 3:1 (3 meters of line out per meter depth) was used to calculate the trawl depth for each survey.

Figure 2. Trapper lake .



All fish captured in mid-water trawl samples were preserved in 95% ethanol for subsequent analysis in the lab.

2.2.3 Diet Analysis

Analysis of the stomach contents of the juvenile nerkid and other resident fish species was performed on preserved sub-samples of the fish collected from the beach seine and trawl samples. Gastric contents were removed from each fish examined using a dissecting microscope and standard dissection techniques. The primary dietary items targeted by the juvenile fish sampled were zooplankton and insects. Recognizable food items were identified to the genus level for zooplankton and to the order level for the various life history stages of insects. The dry weight of the stomach contents of selected sub-samples was determined as well as total number of organisms.

2.2.4 Fry Length Weight and Otolith Mark Sampling

The length and weight of the sampled juvenile fish were determined to the nearest mm and 0.1 gm. The presence and absence of an otolith thermal mark was determined by removal of the otolith using a dissecting microscope and standard dissecting procedure. All samples were consecutively numbered to allow for cross-referencing. Both otoliths from each sampled fish were mounted on glass slides using thermoplastic glue and viewed under a light microscope at 30-X power.

3.0 Results

3.1 Limnological Sampling

The secchi depths recorded during all the surveys are shown in Table 1. The secchi depth values ranged from 1.2 through 4.5. In general the water clarity in 2007 was highest in the early summer and in the fall. This is typical of glacial fed lakes which receive the highest inputs of turbid particulates in mid-summer. Water clarity in a glacially influenced system like Trapper Lake may vary depending on the prevailing temperatures during the period before the sampling occurs.

Temperature profiles collected in 2007 at Trapper Lake are illustrated in Figure 3. The temperature profiles were very similar at both sampling sites during each survey. In the interests of clarity the mean of the temperature at both sites is depicted for the survey date shown. The profiles indicate some warming of surface waters. However, there is no evidence of stratification during any period the surveys were conducted.

Table 1. Trapper Lake Secchi depths recorded in 2006 and 2007.

Date	Site	Secchi Depth (m)
July 28 -06	1	4.5
September 15-06	1	1.2
June 16-07	1	2.9
June 16-07	2	3.2
August 8-07	1	2.0
August 8-07	2	2.0
September 18-07	1	3.7
September 18-07	2	3.4
Mean 2006		2.9
Mean 2007		2.9

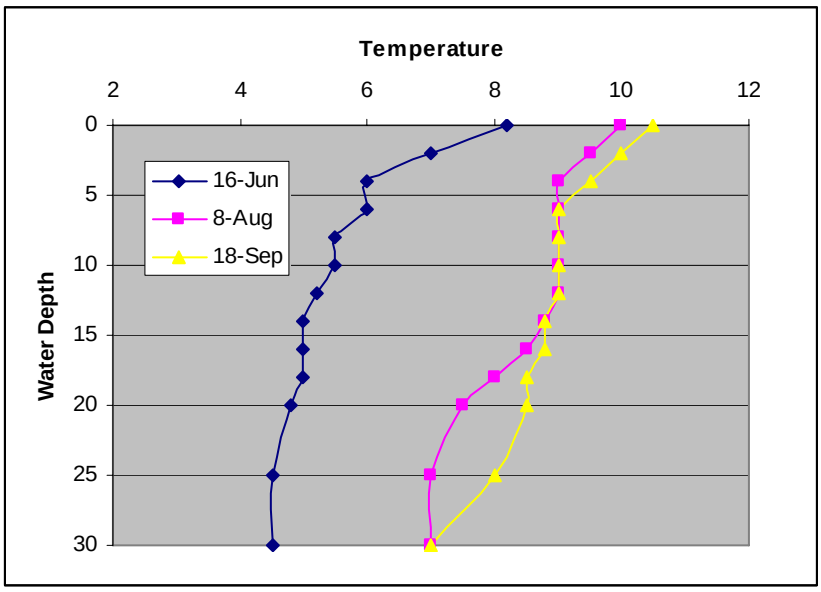


Figure 3. Trapper Lake 2007 water temperature profiles at site 1.

Trapper Lake is situated in a mountainous valley in the lee side of the coast mountains. Due to the topography the area is subject to frequent strong katabatic winds during the summer and fall. The absence of thermal stratification in the lake is likely a result of the constant wind mixing that occurs at this site during the open water seasons.

All the water chemistry samples (TP and chlorophyll *a*) collected for Trapper Lake in 2007 were destroyed during the shipping process. The Trapper Lake samples were shipped along with other Transboundary lake samples to the DFO Laboratory at Cultus Lake. The shipping of the samples was conducted by DFO Whitehorse staff who unfortunately were not familiar with

proper shipping protocol for dangerous and hazardous goods. The samples were intercepted by Transport Canada and destroyed. The results of two surveys conducted in 2006 are presented in Table 2.

Table 2. Total Phosphorus and Chlorophyll *a* values for Trapper Lake samples collected in 2006.

Site	**Date**	**Depth** (m)	**TP** ug/L	**Chlorophyll 0.45u** ug/L	**Phaeophytin 0.45u** ug/L	**Corrected Chl. 0.45u** ug/L
1	06/07/28	12 m consolidated	10.20	0.20	0.05	0.18
1	06/09/15	12 m consolidated	10.2	0.42	0.03	0.40
1	06/09/15	12 m consolidated	10.8	0.40	0.04	0.35

Zooplankton sampling results for 2006 and 2007 are presented below in Table 3. These results are similar to the zooplankton species composition and biomass levels that were found during previous years sampling (PSC 1988, Mercer 2006). The Trapper Lake zooplankton species composition and biomass fluctuates on a seasonal basis with peak zooplankton biomass usually occurring in August. Zooplankton species composition and biomass is considered a leading indicator of sockeye fry rearing capacity and the juvenile nerkid carrying capacity of the lake. The Trapper Lake zooplankton population consists predominantly of cyclopoids, rotifers and nauplii. As expected, the numeric and biomass predominant zooplankter throughout the sampling period was cylcopoid copepods (Figure 4). The scarcity of clodoceran zooplankters is characteristic of northern glacially fed lakes. The limnetic zooplankton population in relation to biomass, species composition, and length has remained relatively constant during all the years that sampling has occurred, independent of fry outplant levels.

However, as will be noted below in the dietary analysis results, cladocerans and calanoid copepods did constitute a relatively large component of the diet of sockeye sampled from the littoral zone, particularly in fish sampled in the latter part of the season. Cladocerans and calanoid copepods typically are the preferred dietary items of lake rearing juvenile sockeye. In addition, dipteran insect larvae and pupae represented a large component of the sockeye diet but these too were proportionately under-represented in the limnetic zone plankton samples. It is apparent that zooplankton sampling in the limnetic zone does not provide a representative sample of the overall zooplankton population structure of Trapper Lake. It is recommended that in 2008 littoral zone zooplankton sampling be implemented in combination with limnetic zone sampling.

Table 3. Zooplankton biomass and species composition in Trapper Lake 2005 and 2007.

Table 3(a). Mean Annual Zooplankton Wet Biomass (mg/m3) - Trapper Lake.

Year	BY	Date	Station	Total (minus LGB)	*Bosmina* sp.	*Daphnia* sp.	*Cyclops* sp.	nauplii	rotifers	Other groups*	N
2005	2004	23-Jun	1	222.00	1.00	1.00	217.00	2.00	0.00	0.00	
2005	2004	31-Jul	1	160.00	0.00	2.00	157.00	0.00	0.00	0.00	
2005	2004	1-Sep	1	147.00	0.00	17.00	126.00	2.00	1.00	0.00	
Mean 2005				**176.33**	**0.33**	**6.67**	**166.67**	**1.33**	**0.33**	**0.00**	3
2007	2006	16-Jun	1	60.00	0.00	0.00	58.00	1.00	0.00	0.00	
2007	2006	16-Jun	2	45.00	0.00	0.00	44.00	1.00	0.00	0.00	
2007	2006	8-Jul	1	261.00	0.00	1.00	260.00	0.00	0.00	0.00	
2007	2006	8-Jul	2	278.00	0.00	1.00	277.00	0.00	0.00	0.00	
2007	2006	18-Sep	1	167.00	0.00	12.00	153.00	1.00	1.00	0.00	
2007	2006	18-Sep	2	74.00	0.00	9.00	63.00	0.00	2.00	0.00	6
Mean 2007:				**159.03**	**0.13**	**4.97**	**152.17**	**0.83**	**0.43**	**0.00**	

* Other groups include calanoid copepods, *Skistodiaptomus* sp. and *Holopedium* sp.

Table 3(b). Mean Annual Zooplankton Density (no./m3) - Trapper Lake.

Year	BY	Date	Station	Total (minus LGB)	*Bosmina* sp.	*Daphnia* sp.	*Cyclops* sp.	nauplii	rotifers	*Other groups	N
2005	2004	23-Jun	1	7742.00	42.70	19.20	5632.00	1920.00	128.00	0.00	
2005	2004	31-Jul	1	10461.00	0.00	50.60	8640.00	234.70	1536.00	0.00	
2005	2004	1-Sep	1	22208.00	9.10	630.90	4160.00	3712.00	13696.00	0.00	
Mean 2005				**13470.33**	**17.27**	**233.57**	**6144.00**	**1955.57**	**5120.00**	**0.00**	3
2007	2006	16-Jun	1	8435.50	0.00	8.60	7936.00	234.70	256.00	0.00	
2007	2006	16-Jun	2	10912.00	0.00	19.20	10624.00	72.00	196.90	0.00	
2007	2006	8-Jul	1	2645.00	0.00	4.80	1328.00	1280.00	32.00	0.00	
2007	2006	8-Jul	2	1527.40	0.00	5.40	1008.00	400.00	113.80	0.00	
2007	2006	18-Sep	1	10574.00	0.00	231.60	4224.00	486.40	5632.00	0.00	
2007	2006	18-Sep	2	11017.00	0.00	384.00	1642.70	24.00	8960.00	0.00	6
Mean 2007:				**9899.22**	**6.91**	**158.79**	**5133.87**	**1031.94**	**3567.07**	**0.00**	

* Other groups include calanoid copepods, *Skistodiaptomus* sp. and *Holopedium* sp.

Table 3(c). Mean Annual Large Beast (LGB) Density (#/m3) - Trapper Lake.

Year				Chironomid larva	Acarina
2005	2004	23-Jun	1	0.20	0.00
2005	2004	31-Jul	1	0.20	0.00
2005	2004	1-Sep	1	0.00	0.00
Mean 2005				0.20	0.00
2007	2006	16-Jun	1	0.60	0.00
2007	2006	16-Jun	2	0.20	0.00
2007	2006	8-Jul	1	0.20	0.00
2007	2006	8-Jul	2	0.20	0.00
2007	2006	18-Sep	1	0.00	0.00
2007	2006	18-Sep	2	0.00	0.00
Mean 2007:				**0.20**	**0.00**

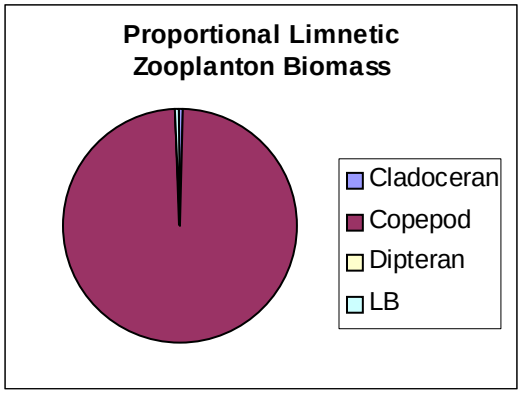


Figure 4. Trapper Lake mean proportion limnetic zooplankton biomass, 2007.

3.2 Littoral zone sampling

A combined total of 3,904 fish were captured at the index sites over the course of six separate beach seine surveys conducted at Trapper Lake in 2007. A total of 3 species were identified in the catches: sockeye salmon/kokanee (*Onchorynchus nerka*), Lake Trout (*Salvalinus namaycush*), and Dolly Varden (*Salvalinus malma.* Nerkids (sockeye spp.) were the numerically dominant species captured, with 3,879 age 0+ fry captured at the index sites. A summary of the fish captured during the six beach seine surveys is presented in Table 4 and Figure 5.

Table 4. Summary of beach seine and Trawl catches at Trapper Lake, 2007.

	Beachseine Date	16-Jun	27-Jun	15-Jul	8-Aug	31-Aug	Sept. 18	
	Trawling Date	18-Jun	28-Jun	18-Jul	12-Aug	21-Aug	Sept. 20	**Total**
Beachseine Index catch	Sockeye	0	2200	780	495	400	4	3879
	Kokanee	2	0	1	0	1	4	8
	other	6	5	3	0	0	3	17
	Total	8	2205	784	495	401	11	3904
Trawling	Sockeye	0	0	0	1	8	5	14
	Kokanee	0	0	1	3	10	7	21

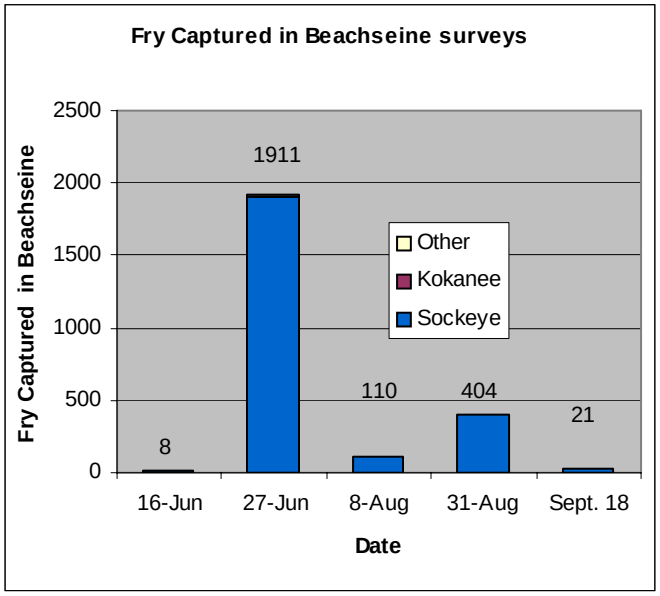


Figure 5. Fry Captured in beachseine surveys at Trapper Lake 2007.

Comparison of relative abundance of fry caught at the beach seine sites indicates the fry generally remained in the northern portions of the lake close to the outplant sites, and did not randomly disperse within the littoral zones of the lake. It is likely the outplant sites offered some of the best littoral rearing habitat in the lake. The steep sided terrain and lack of littoral habtat in the southern part of the system may have influenced fry dispersal.

The number of fry captured in the beachseine index catches increased significantly after the fry were outplanted in mid-June then declined over succeeding surveys to pre-outplant levels It is likely that the declining beach seine catches were a function of attrition (mortality due to predation) as well as movement out of the littoral and into the limnetic zone. Based on the beachseine, trawl, and hydroacoustic results presented below, significant movement of outplanted fry offshore may have occurred during the two week period between the end of August and mid-September.

3.3 Hydroacoustic Surveys and Midwater Trawl Sampling

The 2007 limnetic zone fish population hydroacoustic estimates are presented in Figure 6. The limnetic zone fish population point estimates range from 22,300 in mid June up to 165,000 at the end of August. These estimates represent the total fish population encompassing all species and size classes. However, based on the range of individual acoustical energies associated with the identified individual targets as well as previous years trawling results (PSC 1998, Mercer 2005) it is likely the limnetic fish population is composed almost exclusively of juvenile nerkids.

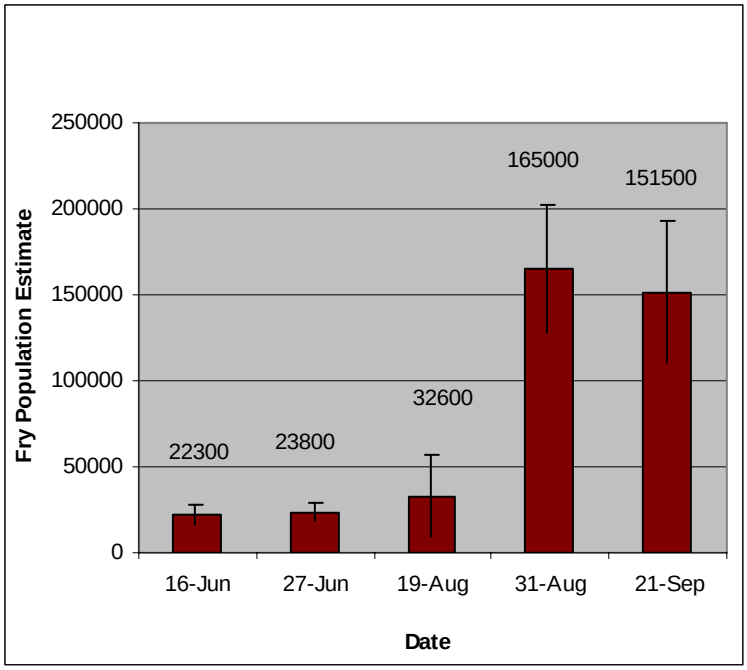


Figure 6. Trapper Lake hydroacoustic fish population estimates 2007. Error bars denote 95% C.I.

The 2007 hydroacoustic survey results were influenced by technical difficulties encountered during the analysis of the resultant echograms. The 2007 survey year was the first year the Biosonics DTX unit was used on this system. The bottom substrate of Trapper Lake was found to exhibit very high acoustical reflectivity using this system.[1] Because of the relatively small size of the prospective fish targets (0.2 gm), high acoustical energy settings were utilized in order not to miss the smaller targets. This coupled with the high bottom reflectivity resulted in the generation of excess acoustical energy in the water column due to the reflection of the rebounding acoustic energy off the surface of the lake. This created "false bottom" acoustical energy in the water column that had to be subtracted from the recorded acoustical energy generated by the fish targets. The echogram presented in Figure 7 illustrates the high reflectivity of the bottom substrate (denoted by the red bottom layer) and resultant false bottom acoustical energy displayed at the 20 m depth on the echogram. In addition, it appeared a significant portion of the targets observed remained near the surface. Typically nerkids display diurnal migration patterns with movement downward in the water column during hours of darkness. For this reason acoustic surveys are conducted at night when the fish are more dispersed in the water column. The Trapper Lake nerkids typically did not disperse and remained near the surface. Since the first meter of the water column is not ensonified fish targets in this area would not be counted. These phenomena presented problems with the echogram analysis and may have affected the veracity of the population estimates generated. The reflected acoustic energy would tend to bias theestimate high, whereas thesurface dwelling fish would have the opposite effect.

[1] Biosonics *Inc*. staff noted that the lake had the highest bottom reflectivity of any they had observed in their collective experience.

The echosounder unit was returned to Biosonics, at their suggestion, to calibrate the unit and to be certain the high relectivity was not the result of a malfunction in the unit. Adjustments to the echosounder settings will be made in 2008 in an attempt to reduce the bottom reflection phenomena.

Based on the hydroacoustic results a complete categorization of the fish population by size class was not possible. However from the known probable age structure of the resident kokanee population it is likely the pre-outplant acoustic estimate of 22,300 represents all age classes (age 1+, 2+, and 3+) except the 0+ fry which would not likely have emerged into the system. This

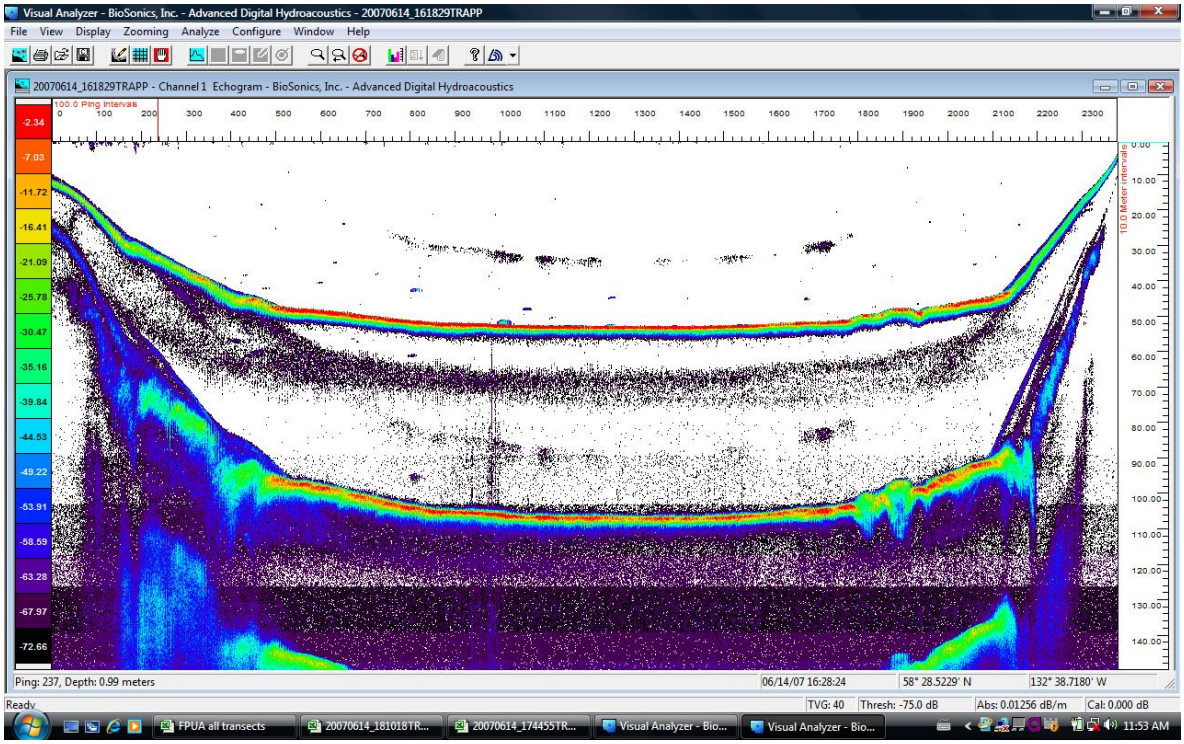


Figure 7. Echogram from 2007 hydroacoustic survey.

estimate of the kokanee population is lower than was encountered in past hydroacoustic estimates (mean = 66,000 Mercer 2006). However it should be noted the 2007 survey was conducted earlier in the season than previous surveys, with more sensitive apparatus.

Based on the preliminary acoustic results in combination with the beach seine results there appeared to be a movement of sockeye fry offshore at the end of August with a corresponding increase in the limnetic zone fish population estimates. The acoustic results suggest the limnetic zone fish population increased by approximately 120,000 from Mid-August to mid September. As the littoral zone fish population was comprised almost exclusively of outplanted fry, The limnetic zone increase likely represents the population of outplanted fry that migrated offshore.

The 2007 results of the limnetic zone trawling are presented in Table 4 and Figure 8. A total of 35 fish (21 kokanee and 14 sockeye) were captured over 30 trawls representing approximately

900 minutes trawling time over the period June 18 through September 20. The total trawl catches in 2007 were low and the overall size of the trawl caught fish was below the previous 2005 average (3.2 gms) at a mean size of 0.7 (range 0.5 –0.9 gm) for the outplanted sockeye fry and 0.2 (range 0.1-0.2) for the trawl caught kokanee. Only age 0+ nerkids were caught in the 2007 trawl samples whereas trawl catches in 2005 and 1991 – 1995 also contained age 1+ nerkids. It is known mid-lake trawling is size selective with net avoidance by the larger age and size classes of fish.

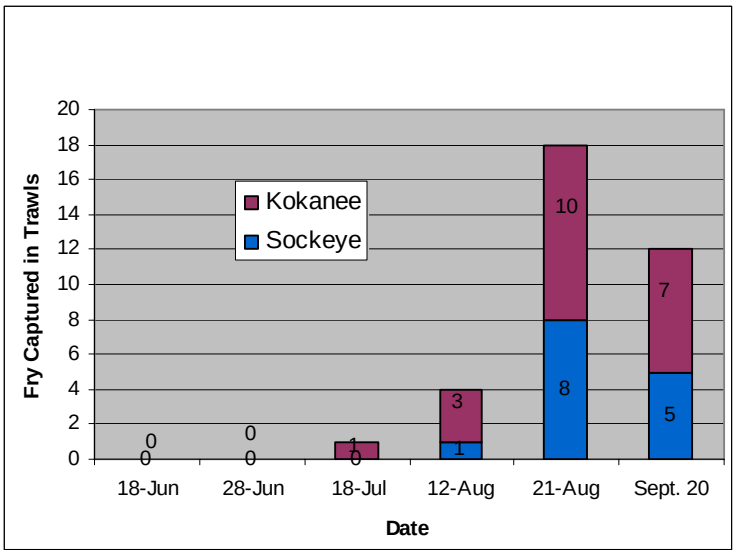


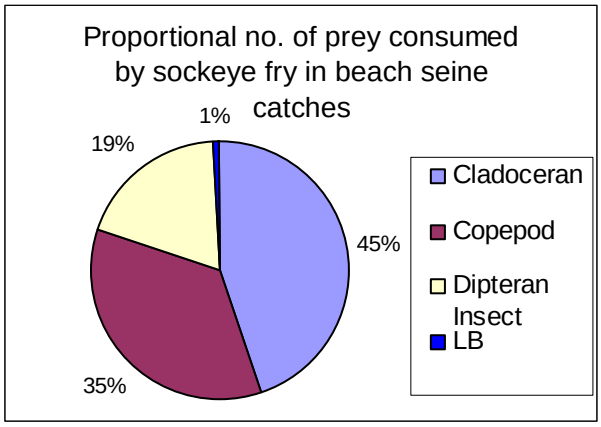
Figure 8. Trapper Lake limnetic zone trawl catches 2007.

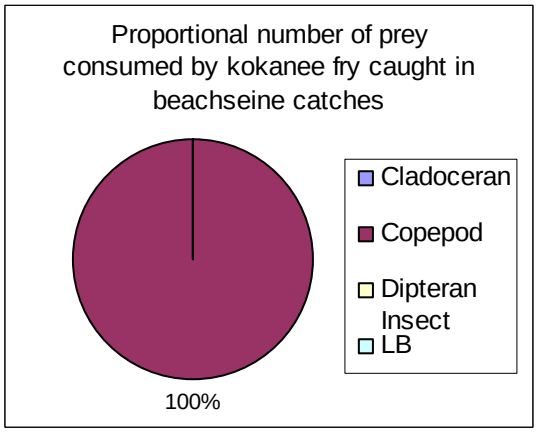
3.4 Diet Analysis

The analysis of dietary items consumed by the outplanted sockeye fry, and resident kokanee are presented in Figures 8a and 8b. The gastric contents of 29 sockeye and 7 kokanee were analyzed from beach surveys conducted June 27 through September 18. Within the beachseine caught sockeye fry, cladocerans were numerically the dominant prey item (45%) followed by copepods (35%), and dipteran insect (larvae and pupae) (19%). The designation "large beast " which comprised less than 1% of dietary items refers to adult insects. Among the kokanee sampled, copepods comprised 100% of the dietary organisms identified.

The proportional dry weight of prey consumed by sockeye fry sampled from the beach seine catches are illustrated in Figure 9. Although zooplankton were numerically the dominant prey item (80%), dipteran insect larvae and pupae represented 70% of the dry weight of the dietary items identified.

The gastric contents from a total of 14 sockeye and 14 kokanee were sampled from trawl caught fish. The proportional number of prey items consumed by sockeye fry and kokanee that were sampled from the trawl catches is presented in Figures 10(a) and 10(b). It was apparent that copepods constituted virtually 100% of the prey items found in the stomachs of the 0+ juvenile nerkids sampled in Trapper Lake in 2007.





Figures 8a and 8b. Proportional number of prey items found in beach seine caught sockeye and kokanee, Trapper Lake 2007.

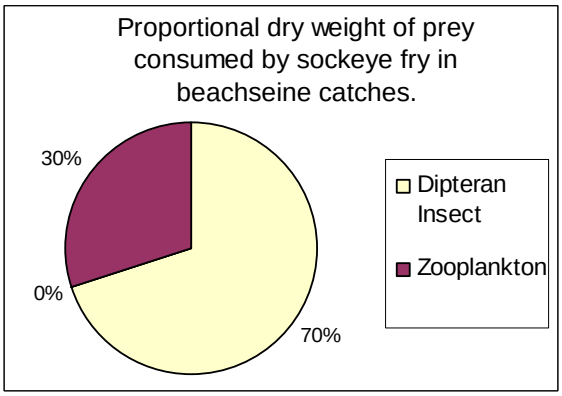
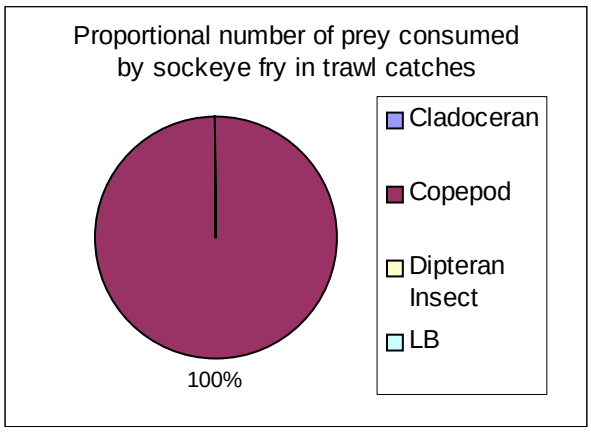
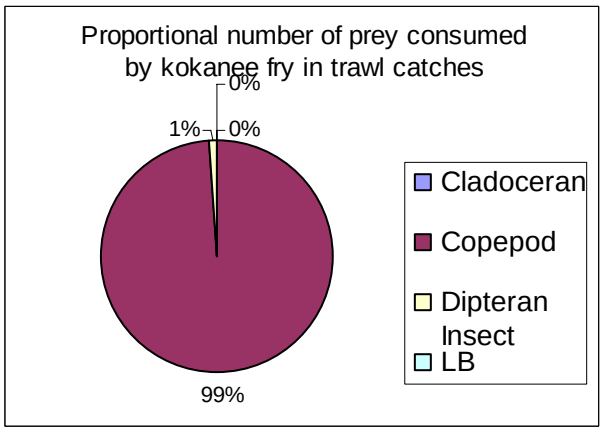


Figure 9. Proportional dry weight of prey items found in beach seine caught sockeye.





Figures 10(a) and 10(b). Proportional number of prey consumed by sockeye fry and kokanee sampled from trawl catches in Trapper Lake, 2007.

The diet composition of beach seine caught sockeye fry varied during the sampling period (Table 5). It appears the ratio of cladocerans/copepods increased over the course of the season, with peak ratios observed during the August 30 sampling event. The proportion of dipteran insects in the stomach contents decreased significantly after the first sampling. As expected, the dipteran pupae/larvae increased as a food item over the course of the season.

Table 5. Proportions of diet items in beach seine caught sockeye over three sampling dates at Trapper Lake 2007.

Date	Cladoceran	Copepod	Dipteran Insect	LB
8-Aug	36.4%	6.8%	50.0%	6.8%
30-Aug	53.2%	33.0%	13.9%	0.0%
18-Sep	44.6%	35.4%	19.1%	1.0%
Mean	44.0%	25.0%	27.0%	3.5%

3.5 Juvenile Nerkid Length Weight and Otolith Mark Sampling

The outplanted sockeye fry and kokanee length, weight, and otolith mark results are presented in Appendix 1. Table 6 below contains the average weight and number of marked and unmarked fish that were captured in the 2007 beach seine surveys. The marked fish are the outplanted sockeye fry and the unmarked fish are resident kokanee. As illustrated in Figure 5 above, almost all of the fish captured in the littoral zone beach seine surveys were marked sockeye fry. Figure 11 displays the growth of the captured kokanee and outplanted sockeye fry over the course of the sampling period. The mean size of the outplanted sockeye ranged from 0.15 gm at the time of outplanting on June 18[2] up to 1.04 gm on September 18. The kokanee weights ranged from 0.1 through 0.56 gm. It should be noted the kokanee sample sizes were small (10 fish total) and in June and early August no kokanee were captured in the beach seine surveys. The lower kokanee weights exhibited September 18 could be an artifact of the small sample size or the larger size classes may have moved offshore. Figure 12 illustrates the late-August weight and mean daily growth rates of 2007 outplanted sockeye fry at Trapper Lake in 2007 and outplanted sockeye fry sampled at other transboundary lakes in previous years. With the exception of Tuya Lake, the late August Trapper Lake growth rates and fry size are within the range exhibited in several other transboundary lakes.

[2] The mean size of Little Trapper origin sockeye fry at emergence is 0.15 gm, the fry were fed a maintenance diet at Snettisham hatchery during the two week period prior to outplanting.

Table 6. Mean weight and number of marked/unmarked juvenile nerkids captured in beach seine surveys at Trapper Lake 2007.

Date	Marked	Data	Total
27-Jun	Y	Average of Weight	0.15
		Count of Marked	79.00
27-Jun Average of Weight			0.15
27-Jun Count of Marked			79.00
8-Aug	Y	Average of Weight	0.73
		Count of Marked	78.00
8-Aug Average of Weight			0.73
8-Aug Count of Marked			78.00
20-Aug	Y	Average of Weight	0.70
		Count of Marked	2.00
20-Aug Average of Weight			0.70
20-Aug Count of Marked			2.00
30-Aug	N	Average of Weight	0.57
		Count of Marked	3.00
	Y	Average of Weight	0.97
		Count of Marked	69.00
30-Aug Average of Weight			0.95
30-Aug Count of Marked			72.00
18-Sep	N	Average of Weight	0.32
		Count of Marked	6.00
	Y	Average of Weight	1.04
		Count of Marked	10.00
18-Sep Average of Weight			0.77
18-Sep Count of Marked			16.00
Total Average of Weight			0.61
Total Count of Marked			247.00

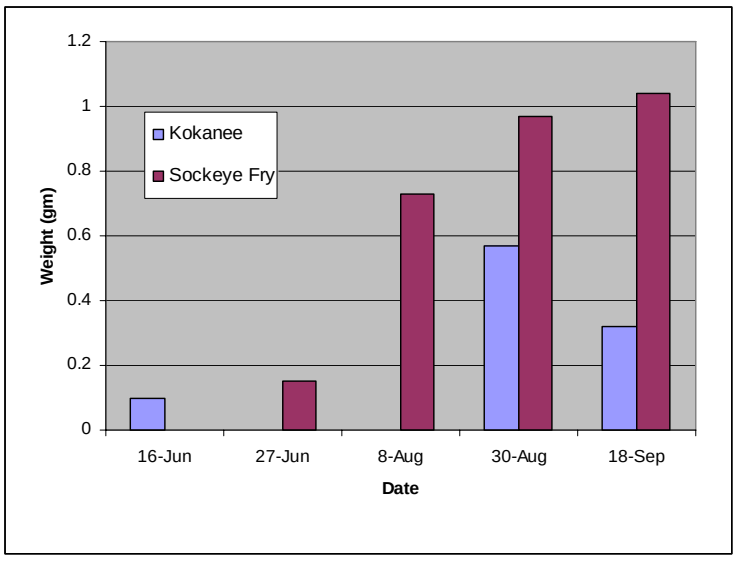


Figure 11. Growth of sockeye fry and kokanee over littoral zone sampling period at Trapper Lake 2007.

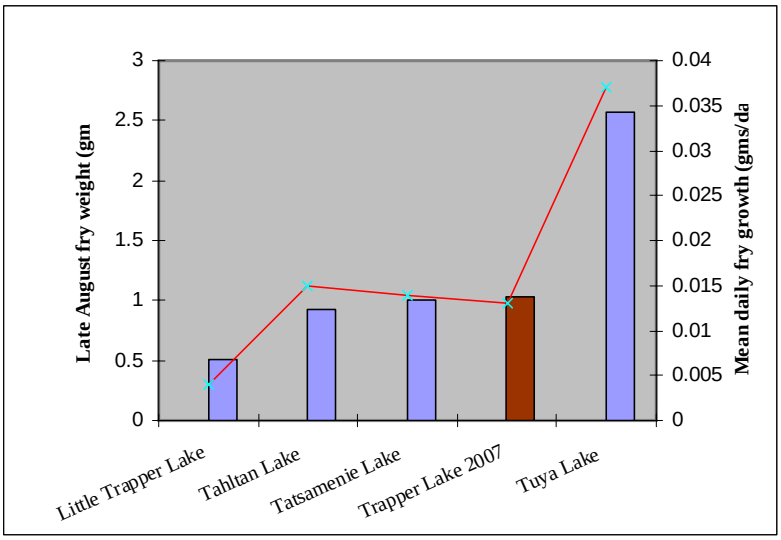


Figure 12. Late August fry weight (bars) and mean daily outplanted sockeye fry growth rate (Source PSC 1998, Riffe and Mercer 2005).

4.0 Discussion

This report presents the results of the evaluation studies associated with the 2007 Trapper Lake sockeye fry outplants. These results cover the period of assessment from mid June through to mid-September 2007. The assessments of the 2007 fry outplants will continue into the early summer of 2008 with a spring hydroacoustic survey, smolt sampling, and evaluation of the fertilized egg planting in Tunjony Creek. The assessment methodology used win 2007 will be continued during the summer/fall of 2008 to monitor the growth and survival of the 2008 fry outplants as well as the fry incubated in Tunjony Creek and the age 1+ (BY2006) fry that may have held over in the lake. In addition baseline limnological data collection will continue on the lake,

A comprehensive analysis of the 2007 results along with the results obtained during the 2008 field season will be compiled as part of the of the CEAA application that is scheduled to be submitted to Fisheries and Oceans as part of the Trapper Lake barrier modification process. The following is a brief discussion of the results of 2007 field season that are presented above.

4.1 Limnogical Sampling

The physical parameter data (Secchi depth, temperature profiles, and water chemistry), as expected, are similar to those observed in previous years (Mercer 2005). These data are primarily influenced by the physiography of the system, which has not changed since collection of the first data set in 1989.

The limnetic zooplankton population was not significantly different in species composition or mean biomass than was found in previous years (Mercer 2005). The preliminary evidence suggests the 2007 sockeye fry outplants did not measurably impact the zooplankton population.

Comparing zooplankton population changes over time prior to 2007 is difficult because the sampling regime was not standardized. Due to seasonal variation and non-standardized sampling events inter-annual comparisons must be judged with caution. There was a noted decline in biomass of cyclopoids (the primary limnetic zone plankton targeted by nerkids in Trapper Lake) at site 2 in the September 18 samples. This would coincide with the purported offshore movement of the sockeye fry. It is not known if this decline is due to seasonal variation or an increase in planktivorous grazing by the movement of fry into the limnetic zone or a combination of the two. Further sampling in 2008 may determine if significant changes in the zooplankton population structure associated with the fry outplants are observed. It is probable that a majority of the age 1+ outplanted fry will smoltify in 2008 but it is expected some of these will remain in the system and outmigrate as age 2+ or perhaps age 3+. The presence of these remaining fish could also impact the zooplankton population over time. Fry outplants were conducted in the system from 1991 through 1994 without significant observable changes (PSC 1998).

4.2 Littoral Zone Sampling

The littoral zone sampling indicated the outplanted fry remained onshore throughout the summer months from the time of outplanting in mid-June until the end of August. Although it is expected there is going to be normal variation in beach seine catches, the surveys suggest that the number of fry in the littoral zone diminished over the sampling period. The diminished fry catches in the September 18 beach seine survey coupled with the increased number of limnetic fry observed in the acoustic surveys at the same time suggest there was significant movement of fry offshore during this period.

The littoral zone sampling also indicated the number of juvenile kokanee using littoral habitat during survey period is low. This suggests there is some habitat partitioning between kokanee and sockeye during the first three months of residency of the age 0+ juveniles.

4.3 Hydroacoustic Surveys and Midwater Trawl Sampling

The hydroacoustic survey on June 16, prior to the fry outplants suggest the 2007 kokanee population in Trapper Lake was lower than the estimates obtained during previous surveys. The average annual population size of the wild nerkids (kokanee) over the five previous survey years was approximately 66,000. This population would be represented by one, two, and three year old age classes.[3] (Mercer 2005). The 2007 resident fish population estimate was approximately 24,000. It is not know if this is a function of different levels of sensitivity and detection between the sounders, or if it was due to actual lower numbers of kokanee. The size of the targets observed in the 2007 June 16 survey seem to indicate that relatively small size classes (< 15 cm) dominate the population.[4] This coupled with trawling results from previous years is suggestive that nerkids are the dominant fish species present. As mentioned above the increase in

[3] Field work conducted by the author in 2005 indicates the Trapper Lake kokanee become sexually mature at age 3+.

[4] The size of the observed acoustic target (fish) is estimated using the reflected acoustic energy based on Love's equation: (Length(cm) = 10log((TSSignal Strength + 64.071) / 19.1) .

population estimates obtained in the late August and September acoustic surveys indicate an increase in the limnetic fish population at this time.

The 2007 mid-water trawl catches were much lower than expected. The reasons for this are not known. It is known that mid-water trawling using the apparatus employed at Trapper Lake and other transboundary lakes is size selective because of net avoidance and it is rare to catch fish over 2-3 gm in size; effectively illiminating age 1+ and greater size classes (Riffe and Mercer 2005, Hyatt 1984). It is possible the age 0+ kokanee population, and hence the BY 2006 kokanee recruitment and 2007 age 0+ kokanee population was indeed low as evidenced by the June 16 acoustic estimate. By the time of the arrival of the outplanted fry into the limnetic zone they may have been too large to be caught in the trawl net.

4.4 Diet Analysis

Analysis of age 0+ kokanee stomach contents from both littoral and limnetic zone sampling indicate they were feeding exclusively on cyclopoid copepods, the dominant plankton taxa in Trapper Lake. Analysis of the stomach contents of the outplanted sockeye fry indicated a much more varied diet. Dipteran insects by weight constitute the largest dietary component of fry sampled from the littoral zone beach seine catches. A significant portion of the diet of sockeye fry in the littoral zone also consisted of cladoceran zooplankton taxa, one of which (*Holopedium sp*.), was hitherto unkown to occur in Trapper Lake. Cladoceran numbers are relatively low in the limnetic zone zooplankton samples but it appears that cladocerans are a significant prey item for fry in the littoral zone particularly in August and September. Cladoceran numbers in the zooplankton samples increased in the August and September samples likely reflecting the longer generational time typical of the larger bodied cladocerans. Many researchers have indicated that preferred prey items for planktivorous nerkids are usually large bodied entomostracan planters such as cladocerans and calanoid copepods (Burgner 1991).

Within the limnetic zone the few sockeye fry sampled contained cyclopoid copepods almost exclusively. Therefore it appears that while there may be some niche portioning between the kokanee and sockeye fry in the littoral zone, within the limnetic zone the prey items targeted upon (cyclopoid copepods) were the same.

4.5 Juvenile Nerkid Length Weight and Otolith Mark Sampling

Otolith mark sampling indicated that almost all the juvenile nerkids captured in the beach seine surveys were outplanted sockeye fry. These results mirror those obtained from beach seine surveys conducted during the earlier enhancement program. The use of littoral zone habit by Little Trapper Lake origin fry has been discussed in a previous report (Mercer 2005). The littoral zone sampling results suggest habitat partitioning is evident between the outplanted fry and the resident juvenile kokanee during the first 2 months of lake residency

The growth of the 2007 sockeye fry outplanted to Trapper Lake appeared to be comparative to that observed in several other Transboundary lakes. The fall fry mean weight of approximately

1.0 gm is similar to that observed from fish sampled during the earlier enhancement period (PSC 1998). It is probable this growth pattern will be similar to that of earlier fry outplants resulting in an age 1+ smolt of approximately 5.0 gm.

Based on the zooplankton population status, fry habitat use, and fry growth and survival the preliminary evidence suggests there is under-utilized juvenile sockeye rearing capacity in Trapper Lake It is apparent however that kokanee and sockeye will both occupy the limnetic zone habitats and likely compete for the same resources throughout a significant portion of their in-lake residency. It is apparent that the assessment in 2007 as well as all previous studies encompass only a relatively small period of growth. Based on the known size of outmigrating 1+ smolts approximately 70% of growth occurs over winter from September through to the following June. More work will be required to determine if some or any habitat portioning occurs in the limnetic zone and if the productive capacity of this habitat is able to sustain, in the long term the mixed population of juvenile nerkids.

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Acknowledgements

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Appendix 1. Length, weight, and thermal mark analysis of fry captured in beach seine surveys and mid-water trawling at Trapper Lake 2007.

Location	Fish #	Date	Length	Weight	Marked	Comments
Trapper Lake Beach Seine Site 1 and 2	101	27-Jun	2.8	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	102	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	103	27-Jun	3.1	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	104	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	105	27-Jun	3.1	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	106	27-Jun	2.8	0.15	n/a	no oto
Trapper Lake Beach Seine Site 1 and 2	107	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	108	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	109	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	110	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	111	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	112	27-Jun	3.3	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	113	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	114	27-Jun	2.9	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	115	27-Jun	2.9	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	116	27-Jun	2.8	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	117	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	118	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	119	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	120	27-Jun	3.3	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	121	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	122	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	123	27-Jun	3.1	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	124	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	125	27-Jun	3.3	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	126	27-Jun	3.3	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	127	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	128	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	129	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	130	27-Jun	3.1	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	131	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	132	27-Jun	2.9	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	133	27-Jun	2.9	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	134	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	135	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	136	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	137	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	138	27-Jun	3.1	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	139	27-Jun	3.1	0.15	Y	
Trapper Lake Beach Seine Site 1 and 2	140	27-Jun	3.1	0.15	Y	
Trapper Lake Beach Seine Site 5	141	27-Jun	3.4	0.15	Y	
Trapper Lake Beach Seine Site 5	142	27-Jun	3.1	0.15	Y	
Trapper Lake Beach Seine Site 5	143	27-Jun	3.3	0.15	Y	
Trapper Lake Beach Seine Site 5	144	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 5	145	27-Jun	3.3	0.15	Y	
Trapper Lake Beach Seine Site 5	146	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 5	147	27-Jun	3.3	0.15	Y	
Trapper Lake Beach Seine Site 5	148	27-Jun	3.3	0.15	Y	
Trapper Lake Beach Seine Site 5	149	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 5	150	27-Jun	3.4	0.15	Y	
Trapper Lake Beach Seine Site 5	151	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 5	152	27-Jun	3.1	0.15	Y	
Trapper Lake Beach Seine Site 5	153	27-Jun	3.4	0.15	Y	
Trapper Lake Beach Seine Site 5	154	27-Jun	2.9	0.15	Y	
Trapper Lake Beach Seine Site 5	155	27-Jun	2.8	0.15	Y	
Trapper Lake Beach Seine Site 5	156	27-Jun	3.3	0.15	Y	
Trapper Lake Beach Seine Site 5	157	27-Jun	2.8	0.15	Y	
Trapper Lake Beach Seine Site 5	158	27-Jun	2.8	0.15	Y	

Location	Fish #	Date	Length	Weight	Marked	Comments
Trapper Lake Beach Seine Site 5	159	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 5	160	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 5	161	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 5	162	27-Jun	2.9	0.15	Y	
Trapper Lake Beach Seine Site 5	163	27-Jun	3.1	0.15	Y	
Trapper Lake Beach Seine Site 5	164	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 5	165	27-Jun	2.9	0.15	Y	
Trapper Lake Beach Seine Site 5	166	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 5	167	27-Jun	3.1	0.15	Y	
Trapper Lake Beach Seine Site 5	168	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 5	169	27-Jun	2.9	0.15	Y	
Trapper Lake Beach Seine Site 5	170	27-Jun	2.9	0.15	Y	
Trapper Lake Beach Seine Site 5	171	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 5	172	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 5	173	27-Jun	2.8	0.15	Y	
Trapper Lake Beach Seine Site 5	174	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 5	175	27-Jun	3.2	0.15	Y	
Trapper Lake Beach Seine Site 5	176	27-Jun	2.9	0.15	Y	
Trapper Lake Beach Seine Site 5	177	27-Jun	3.3	0.15	Y	
Trapper Lake Beach Seine Site 5	178	27-Jun	3	0.15	Y	
Trapper Lake Beach Seine Site 5	179	27-Jun	3.1	0.15	Y	
Trapper Lake Beach Seine Site 5	180	27-Jun	3.1	0.15	Y	
Trapper beach seine site 2	181	8-Aug	5	0.9	Y	
Trapper beach seine site 2	182	8-Aug	4.7	0.7	Y	
Trapper beach seine site 2	183	8-Aug	4.7	0.8	Y	
Trapper beach seine site 2	184	8-Aug	5.3	1.2	Y	
Trapper beach seine site 2	185	8-Aug	4.1	0.5	n/a	
Trapper beach seine site 2	186	8-Aug	4.9	0.8	Y	
Trapper beach seine site 2	187	8-Aug	4.9	0.9	Y	
Trapper beach seine site 2	188	8-Aug	4.7	0.8	Y	
Trapper beach seine site 2	189	8-Aug	6	1.6	n/a	not readable
Trapper beach seine site 2	190	8-Aug	5.1	1.1	Y	
Trapper beach seine site 2	191	8-Aug	5.1	1.1	Y	
Trapper beach seine site 2	192	8-Aug	5	0.9	Y	
Trapper beach seine site 2	193	8-Aug	5	1	Y	
Trapper beach seine site 2	194	8-Aug	4.9	0.9	Y	
Trapper beach seine site 2	195	8-Aug	5	1	Y	
Trapper beach seine site 2	196	8-Aug	4	0.4	Y	
Trapper beach seine site 2	197	8-Aug	5.1	1.1	Y	
Trapper beach seine site 2	198	8-Aug	5.8	1.4	Y	
Trapper beach seine site 2	199	8-Aug	5	1	Y	
Trapper beach seine site 2	200	8-Aug	4.4	0.7	Y	
Trapper beach seine site 2	201	8-Aug	4.3	0.6	Y	
Trapper beach seine site 2	202	8-Aug	4.6	0.7	Y	
Trapper beach seine site 2	203	8-Aug	4.5	0.6	Y	
Trapper beach seine site 2	204	8-Aug	4.3	0.5	Y	
Trapper beach seine site 2	205	8-Aug	4.9	0.9	Y	
Trapper beach seine site 2	206	8-Aug	4.7	0.8	Y	
Trapper beach seine site 2	207	8-Aug	4.6	0.8	Y	
Trapper beach seine site 2	208	8-Aug	4.6	0.8	Y	
Trapper beach seine site 2	209	8-Aug	4.5	0.7	Y	
Trapper beach seine site 2	210	8-Aug	4.6	0.9	Y	
Trapper beach seine site 2	211	8-Aug	4.8	0.9	Y	
Trapper beach seine site 2	212	8-Aug	5.3	1.3	Y	
Trapper beach seine site 2	213	8-Aug	4.3	0.6	Y	
Trapper beach seine site 2	214	8-Aug	4.8	0.9	Y	
Trapper beach seine site 2	215	8-Aug	5	1	Y	
Trapper beach seine site 2	216	8-Aug	4.3	0.6	Y	
Trapper beach seine site 2	217	8-Aug	4.4	0.6	Y	
Trapper beach seine site 2	218	8-Aug	4.5	0.9	Y	
Trapper beach seine site 2	219	8-Aug	4.5	0.8	Y	
Trapper beach seine site 2	220	8-Aug	4.6	1	Y	
Trapper beach seine site 5	221	8-Aug	4.5	0.7	Y	
Trapper beach seine site 5	222	8-Aug	4.7	0.8	Y	

Location	Fish #	Date	Length	Weight	Marked	Comments
Trapper beach seine site 5	223	8-Aug	5	1	Y	
Trapper beach seine site 5	224	8-Aug	4.5	0.7	Y	
Trapper beach seine site 5	225	8-Aug	4.5	0.7	Y	
Trapper beach seine site 5	226	8-Aug	4.5	0.7	Y	
Trapper beach seine site 5	227	8-Aug	4.8	0.7	Y	
Trapper beach seine site 5	228	8-Aug	4.4	0.6	Y	
Trapper beach seine site 5	229	8-Aug	4.6	0.7	Y	
Trapper beach seine site 5	230	8-Aug	4.6	0.6	Y	
Trapper beach seine site 5	231	8-Aug	4.6	0.7	Y	
Trapper beach seine site 5	232	8-Aug	4.5	0.7	Y	
Trapper beach seine site 5	233	8-Aug	4.6	0.7	Y	
Trapper beach seine site 5	234	8-Aug	4.7	0.8	Y	
Trapper beach seine site 5	235	8-Aug	4	0.4	Y	
Trapper beach seine site 5	236	8-Aug	4.8	0.7	Y	
Trapper beach seine site 5	237	8-Aug	3.9	0.4	Y	
Trapper beach seine site 5	238	8-Aug	4	0.4	Y	
Trapper beach seine site 5	239	8-Aug	4.8	0.7	Y	
Trapper beach seine site 5	240	8-Aug	4.1	0.5	Y	
Trapper beach seine site 5	241	8-Aug	4.3	0.6	Y	
Trapper beach seine site 5	242	8-Aug	4.1	0.5	Y	
Trapper beach seine site 5	243	8-Aug	4.2	0.5	Y	
Trapper beach seine site 5	244	8-Aug	4.3	0.6	Y	
Trapper beach seine site 5	245	8-Aug	4	0.3	Y	
Trapper beach seine site 5	246	8-Aug	4.5	0.6	Y	
Trapper beach seine site 5	247	8-Aug	4.6	0.7	Y	
Trapper beach seine site 5	248	8-Aug	4.5	0.5	Y	
Trapper beach seine site 5	249	8-Aug	4.3	0.6	Y	
Trapper beach seine site 5	250	8-Aug	4.4	0.6	Y	
Trapper beach seine site 5	251	8-Aug	5	0.9	Y	
Trapper beach seine site 5	252	8-Aug	3.9	0.4	Y	
Trapper beach seine site 5	253	8-Aug	4.1	0.5	Y	
Trapper beach seine site 5	254	8-Aug	4.2	0.5	Y	
Trapper beach seine site 5	255	8-Aug	4.3	0.6	Y	
Trapper beach seine site 5	256	8-Aug	4.3	0.6	Y	
Trapper beach seine site 5	257	8-Aug	4.2	0.6	Y	
Trapper beach seine site 5	258	8-Aug	3.9	0.4	Y	
Trapper beach seine site 5	259	8-Aug	4.5	0.7	Y	
Trapper beach seine site 5	260	8-Aug	4.5	0.7	Y	
Trapper beach seine site 5	261	30-Aug	5.8	1.3	Y	
Trapper beach seine site 5	262	30-Aug	5.7	1.3	Y	
Trapper beach seine site 5	263	30-Aug	5.4	1.2	Y	
Trapper beach seine site 5	264	30-Aug	4.9	0.9	Y	
Trapper beach seine site 5	265	30-Aug	5	0.8	Y	
Trapper beach seine site 5	266	30-Aug	5.6	1.2	Y	Start carcass sampling
Trapper beach seine site 5	267	30-Aug	5.6	1	Y	
Trapper beach seine site 5	268	30-Aug	5.3	0.9	Y	
Trapper beach seine site 5	269	30-Aug	5	0.8	Y	
Trapper beach seine site 5	270	30-Aug	5.2	1	Y	
Trapper beach seine site 5	271	30-Aug	5.1	1	Y	
Trapper beach seine site 5	272	30-Aug	5.1	1	Y	
Trapper beach seine site 5	273	30-Aug	5.2	1.2	Y	
Trapper beach seine site 5	274	30-Aug	5.3	1.1	Y	
Trapper beach seine site 5	275	30-Aug	5.7	1.3	Y	
Trapper beach seine site 5	276	30-Aug	5.3	1	Y	
Trapper beach seine site 5	277	30-Aug	5.3	1.1	Y	
Trapper beach seine site 5	278	30-Aug	5	0.9	Y	
Trapper beach seine site 5	279	30-Aug	5.2	1	Y	
Trapper beach seine site 5	280	30-Aug	5.3	0.9	Y	
Trapper beach seine site 5	281	30-Aug	5	0.7	Y	
Trapper beach seine site 5	282	30-Aug	5	0.8	Y	
Trapper beach seine site 5	283	30-Aug	4.7	0.7	Y	
Trapper beach seine site 5	284	30-Aug	5.1	1	Y	
Trapper beach seine site 5	285	30-Aug	4.9	0.7	Y	
Trapper beach seine site 5	286	30-Aug	4.8	0.8	Y	

Location	Fish #	Date	Length	Weight	Marked	Comments
Trapper beach seine site 5	287	30-Aug	4.3	0.6	N	
Trapper beach seine site 5	288	30-Aug	5.1	0.9	Y	
Trapper beach seine site 5	289	30-Aug	4.6	0.7	Y	
Trapper beach seine site 5	290	30-Aug	5	0.8	Y	
Trapper beach seine site 5	291	30-Aug	4.9	0.6	Y	
Trapper beach seine site 5	292	30-Aug	4.3	0.9	N	
Trapper beach seine site3	293	30-Aug	6.8	2.2	Y	
Trapper beach seine site3	294	30-Aug	4.6	0.6	Y	
Trapper beach seine site3	295	30-Aug	5.3	1	Y	
Trapper beach seine site3	296	30-Aug	6.2	1.6	Y	
Trapper beach seine site3	297	30-Aug	5.2	1	Y	
Trapper beach seine site3	298	30-Aug	5.3	1	Y	
Trapper beach seine site3	299	30-Aug	5.6	1.3	Y	
Trapper beach seine site3	300	30-Aug	5.1	0.9	Y	
Trapper beach seine site3	301	30-Aug	5.1	0.9	Y	
Trapper beach seine site3	302	30-Aug	5.6	1.3	Y	
Trapper beach seine site3	303	30-Aug	5.7	1.2	Y	
Trapper beach seine site3	304	30-Aug	5.8	1.2	Y	
Trapper beach seine site3	305	30-Aug	6	1.3	Y	
Trapper beach seine site3	306	30-Aug	4.7	0.7	Y	
Trapper beach seine site3	307	30-Aug	5.3	1	Y	
Trapper beach seine site3	308	30-Aug	5	0.8	Y	
Trapper beach seine site3	309	30-Aug	4.5	0.6	Y	
Trapper beach seine site3	310	30-Aug	5.3	1.1	Y	
Trapper beach seine site3	311	30-Aug	5.5	1.3	Y	
Trapper beach seine site3	312	30-Aug	6	1.3	Y	
Trapper beach seine site3	313	30-Aug	5.3	1	Y	
Trapper beach seine site3	314	30-Aug	4.5	0.6	Y	
Trapper beach seine site3	315	30-Aug	5.3	1	Y	
Trapper beach seine site3	316	30-Aug	5.6	1.3	Y	
Trapper beach seine site3	317	30-Aug	5.4	1.1	Y	
Trapper beach seine site3	318	30-Aug	4.6	0.7	Y	
Trapper beach seine site3	319	30-Aug	5.5	1.2	Y	
Trapper beach seine site3	320	30-Aug	5	0.8	Y	
Trapper beach seine site3	321	30-Aug	5	0.9	Y	
Trapper beach seine site3	322	30-Aug	5	0.7	Y	
Trapper beach seine site3	323	30-Aug	4.7	0.8	Y	
Trapper beach seine site 2	324	30-Aug	4.7	0.5	Y	
Trapper beach seine site 2	325	30-Aug	4.3	0.9	Y	
Trapper beach seine site 2	326	30-Aug	5.1	0.9	Y	
Trapper beach seine site 2	327	30-Aug	5	0.8	Y	
Trapper beach seine site 2	328	30-Aug	5	0.6	Y	
Trapper beach seine site 2	329	30-Aug	4.6	0.5	Y	
Trapper beach seine site 2	330	30-Aug	4.1	0.2		kokanee (no parmarks)
Trapper beach seine site 2	331	30-Aug	3.5	0.6	Y	
Trapper beach seine site 2	332	30-Aug	4.4		Y	
site 4	333	18-Sep		1.9	Y	
site 2	334	18-Sep	6.4	0.3	N	Kokanee ?
site 1	335	18-Sep	3.3	1.1	Y	
site 1	336	18-Sep	5.6	1.1	Y	
site 1	337	18-Sep	5.6	0.9	Y	
site 1	338	18-Sep	5.1	1	Y	
site 1	339	18-Sep	5.7	1	Y	
site 1	340	18-Sep	5.5	0.7	Y	
site 1	341	18-Sep	4.7	0.8	n/a	no otolith
Site 5	342	18-Sep	5.1	1.1	Y	
Site 5	343	18-Sep	5.5	0.7	Y	
Site 5	344	18-Sep	4.8	0.3	N	
Site 5	345	18-Sep	3.9	0.3	N	
Site 5	346	18-Sep	3.8	0.3	N	
Site 5	347	18-Sep	4	0.4	N	
Site 5	348	18-Sep	4	0.3	N	
Trawling	349	9-Aug	3.5	0.7	Y	
Trawling	350	9-Aug	4.6	0.2	N	

Location	Fish #	Date	Length	Weight	Marked	Comments
Trawling	351	9-Aug	3.3	0.2	N	
Trawling	352	9-Aug	3.3	0.1	N	
Trawling	353	20-Aug	3.2	0.5	Y	
Trawling	354	20-Aug	4.6	0.9	Y	
site 4	355	30-Aug	5	0.2	N	
site 3	356	18-Sep	3.4	0.9	Y	