Judd Lake
Sockeye Salmon Smolt
Data Report
2010–2012

Prepared by:
CIAA Staff
2013

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DISCLAIMER

The Cook Inlet Aquaculture Association (CIAA) conducts salmon enhancement and restoration projects in Area H, Cook Inlet and associated waters. As an integral part of these projects a variety of monitoring and evaluation studies are conducted. The following data report is a synopsis of the monitoring and evaluation studies conducted for Judd Lake. This Judd Lake Data Report encompasses data collected from the 2010–2012 sockeye salmon smolt migrations.

The purpose of the data report is to provide a vehicle to distribute the information produced by the monitoring and evaluation studies. Data collected each year are presented with a summary of the information previously collected for comparative purposes. These reports are intended to provide a general description of project activity and are not an exhaustive evaluation of any restoration or enhancement project. The information presented in this report has not undergone an extensive review. As reviews are completed, the information may be updated and presented in other reports.

The Judd Lake Data Report was prepared by CIAA under award of the Alaska Sustainable Salmon Fund (45918) from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce, administered by the Alaska Department of Fish and Game (ADF&G). The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration, the U.S. Department of Commerce, or ADF&G.

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ACKNOWLEDGEMENTS

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TABLE OF CONTENTS

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LIST OF FIGURES

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LIST OF TABLES

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LIST OF APPENDICES

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ABSTRACT

As part of the continued evaluation of lakes in the Susitna River watershed to determine the sockeye salmon (*Onchorhynchus nerka*) abundance in key salmon producing lakes with and without northern pike (*Esox lucius*), Cook Inlet Aquaculture Association and the Alaska Department of Fish and Game agreed to monitor sockeye salmon smolt migrations from Judd Lake. Judd Lake was not known to have a population of invasive northern pike.

Limnological conditions are a key component in understanding Judd Lake productivity and rearing conditions throughout this monitoring study. Staff collected water chemistry samples 4 times each in 2010 and 2011; and zooplankton 5 times each in 2010 and 2011, and 6 times in 2012.

During the 2010 smolt migration, staff monitored environmental conditions from 17 May through 27 June. Water levels fluctuated 1.5 ft during that time period. Stream temperatures averaged 6.0ºC (±2.4) [mean ± standard deviation] and ranged from 2.0 to 11.0ºC. Air temperatures averaged 16.0ºC (±4.8) and ranged from 8.0 to 22.0ºC. Twelve percent of the days were clear, 36% were partly cloudy, 38% were overcast and 14% had measured rainfall.

The smolt migration was enumerated from 17 May through 26 June. During that time, 64,329 sockeye salmon smolt were captured while migrating from Judd Lake. Trap efficiency data were collected once. After the first trap efficiency test, a period of flooding occurred from 22 May through 4 June, after which time total fish counts were possible. With a 95% confidence, the estimated number of sockeye smolt migrating from Judd Lake was 81,295 (±3,194). Other fish captured during that time were 4,191 coho salmon smolt (*O. kisutch*), 11 rainbow trout (*O. mykiss*), and 114 Arctic char (*Salvelinus alpinus*).

Throughout the migration, staff collected 245 sockeye salmon smolt, and took scale samples, weight, and measurements for fork length. Two samples were unreadable for age, so a total of 243 samples were used for analysis. Based on the samples read, there were 4 age classes. Within the sample, age-1 was the most abundant age class (51.9%), followed by age-2 (47.3%), age-3 (0.8%), and age-4 (0.4%). The average length of the sampled age-1 sockeye salmon smolt was 72.0 mm (±1.1) and the average weight was 3.1 g (±0.2). Although there were only 2 fish in the age-2 class, the average length of the age-2 sockeye salmon smolt was 84.2 mm (±1.2) and the average weight was 5.4 g (±0.3). The length of the age-3 sockeye salmon smolt was 132.0 mm and the weight was 22.7 g. The length of the age-4 sockeye salmon smolt was 147.0 mm and the weight was 33.4 g.

During the same time period, staff also collected 276 coho salmon smolt, took scale samples, weight, and measurements for fork length. Even though the project was focused on sockeye salmon, coho salmon were also sampled when present. Twenty-three samples were unreadable

for age, so a total of 253 samples were used for analysis. Based on the samples read, there were 3 age classes. Within the sample, age-2 was the most abundant age class (71.5%), followed by age-3 (16.2%) and age-1 (12.3%). The average length of the sampled age-2 coho salmon smolt was 125 mm (±5.0) and the average weight was 21.0 g (±1.0). The average length of the sampled age-3 coho salmon was 148 mm (±3.0) and the average weight was 21.0 g (±1.0). The average length of the sampled age-1 coho salmon smolt was 94 mm (±5.0) and the average weight was 8.6 g (±1.7).

During the 2011 smolt migration, staff monitored environmental conditions from 17 May through 26 June. Water levels fluctuated 1.5 ft during that time period. Stream temperatures averaged 5.0ºC (±2.67) and ranged from 2.0 to 9.0ºC. Air temperatures averaged 9.0ºC (±5.8) and ranged from 0.0 to 18.0ºC. Twenty-four percent of the days were clear, 46% were partly cloudy, 15% were overcast, and 15% had measured rainfall.

The smolt migration was enumerated from 17 May through 26 June. During that time, 138,033 sockeye salmon smolt were captured migrating from Judd Lake. Trap efficiency data were collected on 7 occasions. Total counts were possible from 14 June through 26 June. With a 95% confidence, the estimated number of sockeye salmon smolt migrating from Judd Lake was 280,547 (±20,250). The goal of 1,000 smolt released was achieved for 6 of the 7 sampling periods. Other fish captured during that time were 3,566 coho salmon smolt, 15 Chinook salmon smolt (*O. tshawytscha*), and 9 rainbow trout.

Throughout the migration, staff collected 1,100 sockeye salmon smolt, took scale samples, weight, and measurements for fork length. Four samples were unreadable for age, so a total of 1,096 samples were used for analysis. Based on the samples read, there were 2 age classes. Within the sample, age-1 was the most abundant age class (50.4%), followed by age-2 (49.6%). The average length of the sampled age-1 sockeye salmon smolt was 58.8 mm (±0.4) and the average weight was 1.9 g (±0.1). The average length of the age-2 sockeye salmon smolt was 76.2 mm (±1.2) and the average weight was 4.8 g (±0.4).

During the same time period, staff also collected 638 coho salmon smolt, took scale samples, weight, and measurements for fork length. Nineteen samples were unreadable for age, so a total of 619 samples were used for analysis. Based on the samples read, there were 4 age classes. Within the sample, age-2 was the most abundant age class (59.3%), followed by age-3 (35.2%), age-1 (5.3%), and age-4 (0.2%). The average length of the sampled age-2 coho salmon smolt was 119.0 mm (±1.5) and the average weight was 18.2 g (±0.7). The average length of the age-3 coho salmon smolt was 129.0 mm (±1.6) and the average weight was 21.9 g (±0.9). The average length of the age-1 coho salmon smolt was 84.0 mm (±6.2) and the average weight was 7.0 g (±1.9). The age-4 coho salmon smolt was 155.0 mm long and weighed 34.8 g.

During the 2012 smolt migration, staff monitored environmental conditions from 20 May through 26 June. Water levels fluctuated 1.4 feet during that time period. Stream temperatures averaged 5.0ºC (±2.7) and ranged from 2.0 to 8.0ºC. Air temperatures averaged 13.0ºC (±5.8) and ranged from 6.0 to 22.0ºC. None of the days were clear, 66% were partly cloudy, 21% were overcast, and 13% had measured rainfall.

The smolt migration was enumerated from 19 May through 25 June. During that time, 45,838 sockeye salmon smolt were captured while migrating from Judd Lake. Trap efficiency data were collected on 12 occasions. However, only 4 mark-recapture tests met the goal of 1,000 smolt released. Total counts were possible from 15 June through 17 June. With a 95% confidence, the estimated number of sockeye smolt migrating from Judd Lake was 234,113 (±16,451). Other fish captured during that time were 1,974 coho salmon smolt, 9 Chinook salmon smolt, and 164 Arctic char.

Throughout the migration, staff collected 840 sockeye salmon smolt, took scale samples, weight, and measurements for fork length. One sample was unreadable for age, so a total of 839 samples were used for analysis. Based on the samples read, there were 4 age classes. Within the sample, age-1 was the most abundant age class (91.5%), followed by age-2 (7.9%), age-0 (0.5%), and age-3 (0.1%). The average length of the sampled age-1 sockeye salmon smolt was 62.6 mm (±0.4) and the average weight was 2.0 g (±0.1). The average length of the age-2 sockeye salmon smolt was 75.3 mm (±1.4) and the average weight was 3.5 g (±0.2). The average length of the age-0 sockeye salmon smolt was 50.3 mm (±3.7) and the average weight was 0.8 g (±0.1). The length of the age-3 sockeye salmon smolt was 101.0 mm and the weight was 9.5 g.

During the same time period, staff collected 609 coho salmon smolt, took scale samples, weight and measurements for fork length. Forty samples were unreadable for age so 569 were used for analysis. Based on the samples read, there were 3 age classes. Within the sample, age-2 was the most abundant age class (61.0%), followed by age-3 (30.9%), and age-1 (8.1%). The average length of the sampled age-2 coho salmon smolt was 116.0 mm (±1.7) and the average weight was 16.1 g (±0.9). The average length of the age-3 coho salmon smolt was 134.0 mm (±2.2) and the average weight was 25.3 g (±2.9). The average length of the age-1 coho salmon smolt was 83.0 mm (±2.7) and the average weight was 5.6 g (±0.6).

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INTRODUCTION AND PURPOSE

To better understand the recent low adult sockeye salmon (*Onchorhynchus nerka*) returns to Upper Cook Inlet, Cook Inlet Aquaculture Association (CIAA), in cooperation with the Alaska Department of Fish and Game (ADF&G), is assessing sockeye salmon populations at several key salmon producing lakes with and without northern pike (*Esox lucius*) in the Susitna River drainage. The overall objective of this effort is to enumerate smolt and adult returns and to assess the characteristics of these populations in terms of age composition, sex and size. When present, coho salmon were also sampled for age composition, sex, and size. Additionally, for some lake systems, CIAA and/or ADF&G are recording environmental conditions and water quality measurements as well as collecting genetic samples, and performing mark-recapture studies, and hydroacoustic surveys. The goal is to collect sound biological data to provide the foundation on which decisions for management and rehabilitation strategies can be made. Understanding the adult-to-juvenile relationship will allow management biologists to analyze and evaluate the production and rearing condition of each lake.

The enumeration of salmon smolt migrations from Judd Lake was completed all years of a three-year effort (2010–2012) to enumerate juvenile sockeye salmon migrations from the Susitna River drainage. Even though the project was focused on sockeye salmon, coho salmon were also sampled when present. Judd Lake was chosen for enumeration because it is one of the three main sockeye salmon producing lakes in the drainage. Invasive northern pike were not present in Judd Lake during this study period.

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PROJECT AREA

Judd Lake is located in the Yentna River basin of the Susitna River drainage, approximately 97 kilometers northwest of Anchorage, Alaska (Figure 1). The lake is located at 61º34' W latitude and 151º33' N longitude. It lies in the Tordrillo Mountains, has a surface elevation of 299 meters, and a surface area of 1.3 x $10^6 m^2$ (Figure 2) (Glick, 2011). Talachulitna Lake, located approximately 3 km to the west, drains to Judd Lake and is Judd Lake's main tributary. The lake's discharge forms the Talachulitna River, which is a tributary of the Skwentna River. Talachulitna River typically has clear flow, even during times of high water. It often floods when springtime runoff occurs and high water periods can last well in to June.

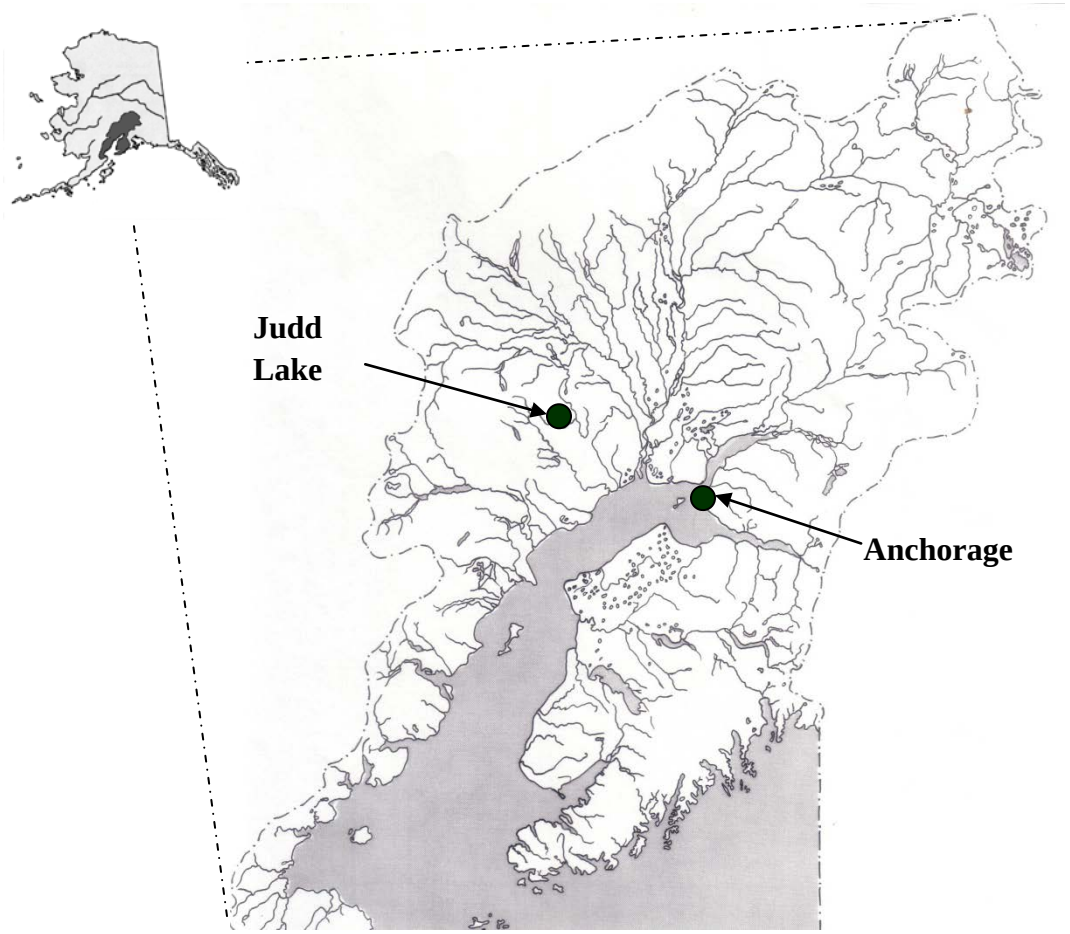

Figure 1: Judd Lake in relation to Cook Inlet and Alaska

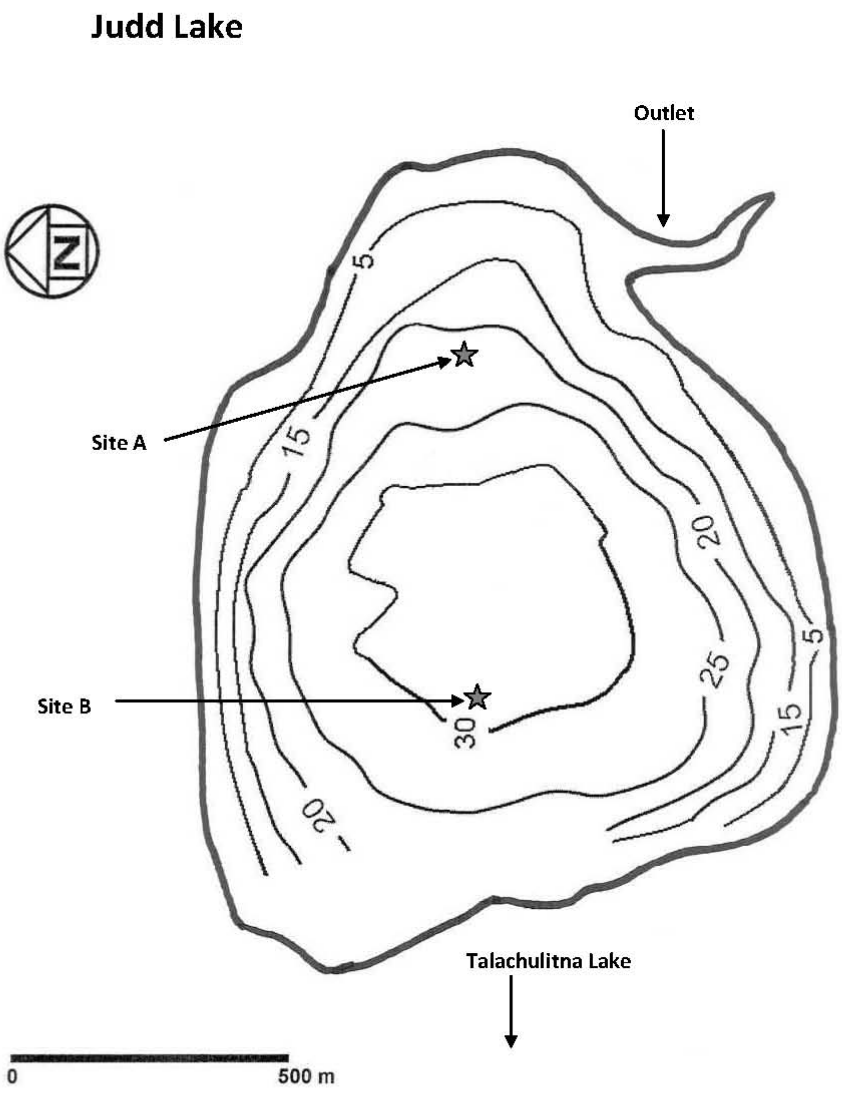

Figure 2: Bathymetric map of Judd Lake with limnology sampling sites

METHODS

Limnological Sampling

To assess water quality, researchers collected limnological samples between June and September of each year (2010, 2011, and 2012). The study plan did not include water chemistry data collection in 2012. Each sample consisted of a primary (A), and secondary (B) site (Figure 2). Measurements taken at the primary site were dissolved oxygen, temperature, light penetration profile, Secchi disk transparency, and zooplankton densities. Water samples taken at both 1 m and the hypolimnion were analyzed by ADF&G for phosphorous, carbon, chlorophyll a, phaeophytin a, nitrogen, calcium, magnesium, iron, conductivity, pH, alkalinity, turbidity, and color. Euphotic zone depth (EZD) was also reported for the primary site. The secondary site was sampled for zooplankton and Secchi disk transparency only. Sample collection and analysis procedures are described in Koenings, et al. (1987).

Environmental Conditions

To assess the environmental conditions during the sockeye salmon smolt migration at Judd Lake percent cloud cover was visually estimated, water level fluctuation recorded to the nearest 0.01 ft, precipitation measured to the nearest millimeter and water and air temperatures (Celsius) were recorded at 5:00 PM daily. Standard CIAA procedures were followed for collecting these observations (CIAA, 2010, 2011, 2012).

Smolt collection

To enumerate the smolt migration, a collection facility was temporarily placed in the Talachulitna River, approximately 500 meters downstream from the outlet of Judd Lake. Two types of traps were used for smolt collection. The first was an inclined plane trap installed in mid-to-late May and was comprised of an inclined plane, double compartment live box, and an adjustment support. The adjustment supports were an A-frame which rests on the substrate and samples shallow reaches (up to 4 ft deep) of the stream. The inclined plane trap was stationed in the main flow of the river and used only during ice-out and spring runoff conditions. The second type of trap used was installed after the spring runoff period. It was comprised of a modified fyke net and a two compartment live box. The fyke net had two leads composed of vexar paneling, which were anchored upstream to each bank and functioned by directing fish into the live box. The use of this type of trap enabled staff to sample the entire width of the river when water levels reached lower levels (approximately 3 ft deep or less).

Smolt enumeration

Mark-recapture dye tests were conducted weekly whenever sufficient numbers of smolt were available, to determine the efficiency of the inclined plane traps. The 95% confidence level (expressed in numbers of smolt) of the estimated total smolt migration was calculated annually. Low confidence levels indicate a greater level of precision in estimating the total smolt migration. Staff attempted to use 1,000 smolt for each dye test. Dye testing still occurred in

instances when fewer than 1,000 smolt were captured, but the resulting trap efficiencies had large confidence levels and care should be taken when interpreting those results. Captured smolt were marked with Bismark Brown Dye and released upstream of the traps after a short holding period for adjustment to the dye. The numbers of recaptures were counted for 3 days following release. Each test had an efficiency value that may vary as environmental factors change during the smolt migration. A detailed description of smolt mark/recapture procedures is available in the CIAA Mark/Recapture Manual (2010).

Typically, traps are checked at least 5 times daily and all smolts enumerated. There were a number of days within all 3 years in which some hourly or daily data were not available due to either trap malfunction or flood conditions. Hours during which smolt were unable to be enumerated are represented by "ND" in the summary appendices.

Statistical procedures for estimating the population of migrating smolts (*N*) followed the *simple stratified M-R design* for One-Site sampling experiments described by Carlson et al. (1998) where:

U = total unmarked population size;

N = total population size;

Nh = total population size in stratum h;

uh = total number of unmarked smolt captured in stratum h;

Mh = number of marked smolt released in stratum h;

mh = number of marked smolt recaptured in stratum h;

L = number of strata or periods; and

$$\hat{U} = \sum_{h=1}^{L} \hat{N}_h - M_h = \sum_{h=1}^{L} \frac{u_h (M_h + 1)}{m_h + 1}$$

The variance of the population estimate *v*(*N*) and the 95% confidence interval (*CI*) were estimated as:

$$v(\hat{N}) = \sum_{h=1}^{L} v(\hat{N}_h) = \sum_{h=1}^{L} \frac{(M_h + 1)(n_h + 1)(M_h - m_h)(n_h - m_h)}{(m_h + 1)^2 (m_h + 2)};$$

And,

$$(CI) = \hat{N} \pm 1.96\sqrt{v(\hat{N})}\,.$$

This method assumes:

- All marked fish released upstream pass the trap before the next release of marked fish;
- The probability that a dyed or unmarked fish enters the trap equals the trap efficiency for all dyed or marked fish;
- Fish are captured or not captured in the trap independently of the fate of other fish;
- All fish entering the trap are counted, and;
- Trap efficiencies do not change significantly during the mark-recapture period.

The proportions of age-1, age-2, age-3, and age-4 smolts were calculated using the data computed from the aforementioned notations and formulas with the following notations and formulas:

U_i = total unmarked population size for age class = i;

U_h = total unmarked population size for stratum = h;

U_{hi}= total unmarked population size for age class i, in stratum = h;

P_i = proportion of unmarked smolt for age class = i;

P_h = proportion of unmarked smolt for stratum = h;

P_{hi}= proportion of unmarked smolt for age class = i, in stratum = h;

a_i = total number of samples of age class = i;

The estimated number of migrating age = i smolt was calculated as:

$$U_i = \sum U_h P_{hi}$$

Proportion of age = i smolt was calculated as:

$$P_i = \frac{1}{U} \sum U_h P_{hi}$$

The variance of the proportion of age = i smolt in stratum = h was calculated as:

$$v(P_{hi}) = \frac{P_{hi}(1 - P_{hi})}{a_h - 1}$$

The variance of the number of age = i smolt in stratum = h was calculated as:

$$v(U_{hi}) = U_h^2 v(P_{hi}) + P_{hi}^{\ 2}(U_h) - v(U_h)(P_{hi})$$

Therefore, the variance of the estimated number of age = i smolt was calculated as:

$$v(U_i) = \sum v(U_{hi})$$

Confidence intervals (95%) estimates for number of age = i smolt are:

$$U_i \pm 1.96\sqrt{v(U_i)}$$

Smolt Characteristics

Age (scales), weight, and length (AWL) data were from a subsample of the migrating smolts. Random samples (up to n=40 for sockeye salmon, and n=20 for coho salmon) were collected daily. Each smolt collected for evaluation was first anesthetized with MS-222, then fork length[1] measured to the nearest millimeter and weighed to the nearest 0.1 gram. Approximately 10 scales were removed from the primary growth area[2] and mounted on a glass slide for subsequent age determination. Procedures for AWL are in the Judd Lake Smolt Procedures Manual (2010, 2011, 2012).

[1] Fork length is defined as the length from the tip of the snout to the fork of the tail.

[2] Primary growth area is located above the lateral line on a diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin.

RESULTS

Limnolgical Sampling

Limnological conditions are a key component in understanding Judd Lake productivity and rearing conditions throughout this monitoring study. Staff collected water chemistry samples 4 times each in 2010 and 2011. No water chemistry samples were collected in 2012. A summary of limnological conditions provided by ADF&G is listed in Table 1. Staff collected zooplankton samples 5 times each in 2010 and 2011, and 6 times in 2012. Seasonal biomass and densities are listed in Table 1. Details pertaining to species and size can be found in Appendices 14–16.

Table 1: Average open water season water quality characteristics of Judd Lake.

AVERAGE WATER QUALITY - 1 METER

Year	TP (ug/l)	TFP (ug/l)	FRP (ug/l)	TKN* (ug/l)	NH3+NH4 (ug/l)	NO2+NO3 (ug/l)	TN:TP	RSi (ug/l)	Org C (ug/l)	Chla (ug/l)	Phaeo (ug/l)	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb (NTU)	Color (Pt)	Ca (mg/l)	Mg (mg/l)	Fe (ug/l)
2010	5.2	2.9	1.5	ND	6.0	341.8	146 :1	3,967	144	1.0	0.3	19	6.4	6.2	0.6	5	2.2	0.5	29
2011	5.1	2.8	2.1	ND	3.5	309.5	136 :1	3,703	221	1.3	0.4	18	6.7	7.3	0.5	12	2.3	0.6	43
2012	Not Sampled											Not Sampled							

AVERAGE WATER QUALITY - MIDHYPOLIMNION

Year	TP (ug/l)	TFP (ug/l)	FRP (ug/l)	TKN* (ug/l)	NH3+NH4 (ug/l)	NO2+NO3 (ug/l)	TN:TP	RSi (ug/l)	Org C (ug/l)	Chla (ug/l)	Phaeo (ug/l)	Sp. Cond (umhos/cm)	pH (SU)	Alk (mg/l)	Turb (NTU)	Color (Pt)	Ca (mg/l)	Mg (mg/l)	Fe (ug/l)
2010	5.8	3.1	1.5	ND	9.5	365.1	141 :1	3,888	142	1.9	0.5	19	6.4	6.0	0.6	6	2.1	0.5	40
2011	6.9	2.6	2.1	ND	7.5	340.8	110 :1	3,731	247	1.3	0.5	18	6.6	7.1	0.5	12	2.3	0.5	56
2012	Not Sampled											Not Sampled							

Year	Secchi Sta	Secchi (m)	Secchi Sta	Secchi (m)	Zooplankton biomass (mg/m^2)	Zooplankton density (no/m^2)	EZD Sta	EZD (m)	EZD Sta	EZD (m)
2010	A	5.9	B	6.1	135	62,125	A	13.7	B	ND
2011	A	6.5	B	6.4	380	150,600	A	16.4	B	ND
2012	A	8.3	B	8.1	220	88,524	Not Sampled		Not Sampled	

ADF&G provided water quality analysis.
EZD and secchi provided by CIAA.
* - TKN was not completed due to malfunctioning equipment.
ND = No Data

Environmental Conditions

During the 2010 smolt migration, staff monitored environmental conditions at 5:00 PM from 17 May through 27 June. Water levels fluctuated 1.5 ft during that time period. Stream temperatures averaged 6.0ºC (±2.4) [mean ± standard deviation] and ranged from 2.0 to 11.0ºC. Air temperatures averaged 16.0ºC (±4.8) and ranged from 8.0 to 22.0ºC. Twelve percent of the days were clear, 36% were partly cloudy, 38% were overcast and 14% had measured rainfall. A total of 95 mm of rain fell during that period.

During the 2011 smolt migration, staff monitored environmental conditions at 5:00 PM from 17 May through 26 June. Water levels fluctuated 1.5 ft during that time period. Stream temperatures averaged 5.0ºC (±2.7) and ranged from 2.0 to 9.0ºC. Air temperatures averaged 9.0ºC (±5.8) and ranged from 0.0 to 18.0ºC. Twenty-four percent of the days were clear, 46% were partly cloudy, 15% were overcast, and 15% had measured rainfall. A total of 55 mm of rain fell during that period.

During the 2012 smolt migration, staff monitored environmental conditions at 5:00 PM from 20 May through 26 June. Water levels fluctuated 1.4 ft during that time period. Stream temperatures averaged 5.0ºC (±2.7) and ranged from 2.0 to 8.0ºC. Air temperatures averaged 13.0ºC (±5.8) and ranged from 6.0 to 22.0ºC. None of the days were clear, 66% were partly

cloudy, 21% were overcast, and 13% had measured rainfall. A total of 60 mm of rain fell during that period.

Smolt Enumeration and Characteristics

2010

The smolt migration was enumerated from 17 May through 26 June. During that time, 64,329 sockeye salmon smolt were captured while migrating from Judd Lake. Trap efficiency data were collected once. After the first trap efficiency test, a period of flooding occurred from 22 May through 4 June, after which time total fish counts were possible. With a 95% confidence, the estimated number of sockeye smolt migrating from Judd Lake was 81,295 (±3,194) (Table 2). Other fish captured during that time were 4,191 coho salmon smolt (*O. kisutch*), 11 rainbow trout (*O. mykiss*), and 114 Arctic char (*Salvelinus alpinus*).

Table 2: Estimate of the total Judd smolt migration for 2010

Estimate of the Total Judd Smolt Migration for 2010											
Sample Periods			Total Dyed Smolts Released	Total Dyed Smolts Recovered	Trap Efficiency* (%)	Total Unmarked Captures	Migration Estimate of Unmarked Smolts	Variance Estimate		
No.	begin	end	M_h	m_h	e_n	u_h	U_h	$v(U_h)$	$SE(U_h)$	95% C.L.
1	17-May	21-May	448	224	50.1%	17,492	34,458	2,655,383	1,630	3,194
2	22-May	4-Jun	0	0	100.0%	ND	0	0	-	0
3	5-Jun	26-Jun	0	0	100.0%	46,837	46,837	0	-	0
		Total	**448**	**224**	**50.0%**	**64,329**	**81,295**	**2,655,383**	**1,630**	**3,194**

* - 100% trap efficiency indicates a period of time during which all fish were enumerated and no dye tests were performed.
ND - No fish were captured during this time period due to flooding.

Throughout the migration, staff collected 245 sockeye salmon smolt, and took scale samples, weight, and measurements for fork length. Two samples were unreadable for age, so a total of 243 samples were used for analysis. Based on the samples read, there were 4 age classes. Within the sample, age-1 was the most abundant age class (51.9%), followed by age-2 (47.3%), age-3 (0.8%), and age-4 (0.4%). The average length of the sampled age-1 sockeye salmon smolt was 72.0 mm (±1.1) and the average weight was 3.09 g (±0.2). The average length of the age-2 sockeye salmon smolt was 84.2 mm (±1.2) and the average weight of was 5.4 g (±0.28). The length of the age-3 sockeye salmon smolt was 132.0 mm and the weight was 22.7 g. The length of the age-4 sockeye salmon smolt was 147.0 mm and the weight was 33.4 g (Table 3).

During the same time period, staff also collected 276 coho salmon smolt, took scale samples, weight and measurements for fork length. Twenty-three samples were unreadable for age, so a total of 253 samples were used for analysis. Based on the samples read, there were 3 age classes. Within the sample, age-2 was the most abundant age class (71.5%), followed by age-3 (16.2%) and age-1 (12.3%). The average length of the sampled age-2 coho salmon smolt was 125.0 mm (±5.0) and the average weight was 21.0 g (±1.0). The average length of the sampled age-3 coho salmon was 148 mm (±3.0) and the average weight was 21.0 g (±1.0). The average length of the

sampled age-1 coho salmon smolt was 94.0 mm (±5.0) and the average weight was 8.6 g (±1.7) (Table 4).

Table 3: Judd Lake 2010–2012 sockeye salmon smolt AWL summary

	Age Class (%)									
Smolt Year	Age 0	95% C.I.	Age 1	95% C.I.	Age 2	95% C.I.	Age 3	95% C.I	Age 4	95% C.I
2010	NS	NS	51.9%	0.3%	47.3%	0.3%	0.8%	9.0%	0.4%	-
2011	NS	NS	50.4%	0.1%	49.6%	0.1%	NS	NS	NS	NS
2012	0.5%	2.3%	91.5%	0.0%	7.9%	0.4%	0.1%	-	NS	NS
Ave	0.5%		64.6%		34.9%		0.8%		0.4%	
	Mean length (mm)									
Smolt Year	Age 0	SD	Age 1	SD	Age 2	SD	Age 3	SD	Age 4	SD
2010	NS	NS	72.0	1.1	84.2	1.2	132.0	22.7	147.0	-
2011	NS	NS	58.8	0.4	76.2	1.2	NS	NS	NS	NS
2012	50.3	3.7	62.6	0.4	75.3	1.4	101.0	-	NS	NS
Ave	50.3		64.5		78.6		116.5		147.0	
	Mean weight (g)									
Smolt Year	Age 0	SD	Age 1	SD	Age 2	SD	Age 3	SD	Age 4	SD
2010	NS	NS	3.1	0.2	5.4	0.3	22.7	-	33.4	-
2011	NS	NS	1.9	0.1	4.8	0.4	NS	NS	NS	NS
2012	0.8	0.1	2.0	0.1	3.5	0.2	9.5	-	NS	NS
Ave	0.8		2.3		4.5		16.1		33.4	

NS = No Sample

Table 4: Judd Lake 2010–2012 coho salmon smolt AWL summary

	Age Class (%)							
Smolt Year	Age 1	95% C.I.	Age 2	95% C.I.	Age 3	95% C.I	Age 4	95% C.I
2010	12.3%	1.0%	71.5%	0.1%	16.2%	0.8%	NS	NS
2011	5.3%	0.7%	59.3%	0.1%	35.2%	0.2%	0.2%	-
2012	8.1%	0.6%	61.0%	0.1%	30.9%	0.2%	NS	NS
Ave	8.6%		63.9%		27.4%		0.2%	
	Average length (mm)							
Smolt Year	Age 1	SD	Age 2	SD	Age 3	SD	Age 4	SD
2010	94.0	5.0	125.0	1.7	149.0	3.0	NS	NS
2011	84.0	6.2	119.0	1.5	129.0	1.6	155.0	-
2012	83.0	2.7	116.0	1.7	134.0	2.2	NS	NS
Ave	87.0		120.0		137.3		155.0	
	Average weight (g)							
Smolt Year	Age 1	SD	Age 2	SD	Age 3	SD	Age 4	SD
2010	8.6	1.7	20.9	0.9	35.3	2.1	NS	NS
2011	7.0	1.9	18.2	0.7	21.9	0.9	34.8	-
2012	5.6	0.6	16.1	0.9	25.3	2.9	NS	NS
Ave	7.1		18.4		27.5		34.8	

NS = No Sample

2011

The smolt migration was enumerated from 17 May through 26 June. During that time, 138,033 sockeye salmon smolt were captured migrating from Judd Lake (Table 5). Trap efficiency data were collected on 7 occasions. Total counts were possible from 14 June through 26 June. With a 95% confidence, the estimated number of unmarked sockeye salmon smolt migrating from Judd Lake was 280,547 (±20,250). The goal of 1,000 smolt released was achieved for 6 of the 7 sampling periods. Other fish captured during that time were 3,566 coho salmon smolt, 15 Chinook salmon smolt (*O. tshawytscha*), and 9 rainbow trout.

Table 5: Estimate of the total Judd smolt migration for 2011

Estimate of the Total Judd Smolt Migration for 2011											
Sample Periods			Total Dyed Smolts Released	Total Dyed Smolts Recovered	Trap Efficiency* (%)	Total Unmarked Captures	Migration Estimate of Unmarked Smolts	Variance Estimate		
No.	begin	end	M_h	m_h	e_n	u_h	U_h	$v(U_h)$	$SE(U_h)$	95% C.L.
1	17-May	20-May	1,000	239	24.0%	17,817	73,312	17,187,299	4,146	8,126
2	21-May	25-May	1,006	128	12.8%	12,344	95,354	61,634,139	7,851	15,387
3	26-May	30-May	585	104	17.9%	5,692	31,182	7,672,834	2,770	5,429
4	31-May	2-Jun	1,000	202	20.3%	8,751	42,151	7,109,472	2,666	5,226
5	3-Jun	7-Jun	1,000	217	21.8%	8,613	38,549	5,446,482	2,334	4,574
6	8-Jun	10-Jun	1,000	202	20.3%	8,115	39,015	6,102,361	2,470	4,842
7	11-Jun	13-Jun	1,000	695	69.5%	42,351	59,910	1,595,270	1,263	2,476
8	14-Jun	26-Jun	0	0	100.0%	34,350	34,350	0	-	0
		Total	**6,591**	**1,787**	**27.1%**	**138,033**	**280,547**	**106,747,856**	**10,332**	**20,250**

* - 100% trap efficiency indicates that total fish counts were occuring during that time period, and no dye tests were performed.

Throughout the migration, staff collected 1,100 sockeye salmon smolt, took scale samples, weight, and measurements for fork length. Four samples were unreadable for age, so a total of 1,096 samples were used for analysis. Based on the samples read, there were 2 age classes. Within the sample, age-1 was the most abundant age class (50.4%), followed by age-2 (49.6%). The average length of the sampled age-1 sockeye salmon smolt was 58.8 mm (±0.4) and the average weight was 1.9 g (±0.1). The average length of the age-2 sockeye salmon smolt was 76.2 mm (±1.2) and the average weight was 4.8 g (±0.35) (Table 3).

During the same time period, staff also collected 638 coho salmon smolt, took scale samples, weight, and measurements for fork length. Nineteen samples were unreadable for age, so a total of 619 samples were used for analysis. Based on the samples read, there were 4 age classes. Within the sample, age-2 was the most abundant age class (59.3%), followed by age-3 (35.2%), age-1 (5.3%), and age-4 (0.2%). The average length of the sampled age-2 coho salmon smolt was 119.0 mm (±1.5) and the average weight was 18.2 g (±0.7). The average length of the age-3 coho salmon smolt was 129.0 mm (±1.6) and the average weight was 21.9 g (±0.9). The average length of the age-1 coho salmon smolt was 84.0 mm (±6.2) and the average weight was 7.0 g (±1.9). The age-4 coho salmon smolt was 155.0 mm long and weighed 34.8 g (Table 4).

2012

The smolt migration was enumerated from 19 May through 25 June. During that time, 45,838 sockeye salmon smolt were captured while migrating from Judd Lake. Trap efficiency data were collected on 12 occasions. However, only 4 mark-recapture tests met the goal of 1,000 smolt released. Total counts were possible from 15 June through 17 June. With a 95% confidence, the estimated number of sockeye smolt migrating from Judd Lake was 234,113 (±16,451) (Table 6). Other fish captured during that time were 1,974 coho salmon smolt, 9 Chinook salmon smolt, and 164 Arctic char.

Table 6: Estimate of the total Judd smolt migration for 2012

Estimate of the Total Judd Smolt Migration for 2012										
Sample Periods			Total Dyed Smolts Released	Total Dyed Smolts Recovered	Trap Efficiency* (%)	Total Unmarked Captures	Migration Estimate of Unmarked Smolts	Variance Estimate		
No.	begin	end	M_h	m_h	e_n	u_h	U_h	$v(U_h)$	$SE(U_h)$	95% C.L.
1	19-May	21-May	1,000	145	14.6%	8,193	55,173	18,011,964	4,244	8,318
2	22-May	23-May	1,000	125	12.6%	3,426	26,218	4,914,247	2,217	4,345
3	24-May	27-May	800	142	17.9%	4,322	23,409	3,234,338	1,798	3,525
4	28-May	29-May	339	74	22.1%	2,152	9,417	942,927	971	1,903
5	30-May	2-Jun	403	40	10.1%	3,768	36,726	29,185,896	5,402	10,589
6	3-Jun	7-Jun	500	97	19.6%	7,501	37,847	11,795,026	3,434	6,731
7	8-Jun	12-Jun	1,025	347	33.9%	9,027	25,589	1,289,747	1,136	2,226
8	13-Jun	13-Jun	1,031	283	27.5%	712	1,556	10,272	101	199
9	14-Jun	14-Jun	331	147	44.6%	828	1,526	10,567	103	201
10	15-Jun	17-Jun	0	0	100.0%	2,515	2,515	0	-	0
11	18-Jun	21-Jun	413	95	23.2%	2,582	10,722	946,049	973	1,906
12	22-Jun	23-Jun	414	77	18.8%	590	2,725	88,220	297	582
13	24-Jun	25-Jun	71	20	29.2%	222	690	17,049	131	256
		Total	**7,327**	**1,592**	**21.7%**	**45,838**	**234,113**	**70,446,300**	**8,393**	16,451

* - 100% trap efficiency indicates that total fish counts were occuring during that time period, and no dye tests were performed.

Throughout the migration, staff collected 840 sockeye salmon smolt, took scale samples, weight, and measurements for fork length. One sample was unreadable for age, so a total of 839 samples were used for analysis. Based on the samples read, there were 4 age classes. Within the sample, age-1 was the most abundant age class (91.5%), followed by age-2 (7.9%), age-0 (0.5%), and age-3 (0.1%). The average length of the sampled age-1 sockeye salmon smolt was 62.6 mm (±0.4) and the average weight was 2.0 g (±0.1). The average length of the age-2 sockeye salmon smolt was 75.3 mm (±1.4) and the average weight was 3.5 g (±0.2). The average length of the age-0 sockeye salmon smolt was 50.3 mm (±3.7) and the average weight was 0.8 g (±0.1). The length of the age-3 sockeye salmon smolt was 101 mm and the weight was 9.5 g (Table 3).

During the same time period, staff collected 609 coho salmon smolt, took scale samples, weight, and measurements for fork length. Forty samples were unreadable for age so 569 were used for analysis. Based on the samples read, there were 3 age classes. Within the sample, age-2 was the most abundant age class (61.0%), followed by age-3 (30.9%), and age-1 (8.1%). The average length of the sampled age-2 coho smolt was 116.0 mm (±1.7) and the average weight was 16.1 g (±0.9). The average length of the age-3 coho smolt was 134.0 mm (±2.2) and the average weight was 25.3 g (±2.9). The average length of the age-1 coho salmon smolt was 83.0 mm (±2.7) and the average weight was 5.6 g (±0.6) (Table 4).

RECOMMENDATIONS

Judd Lake is one of the three main sockeye salmon producing lakes in the Susitna River Valley and is one of the few lakes remaining without the presence of invasive northern pike. It is important that this lake continue to be monitored for healthy smolt production at least once every five years. The data are important for comparisons between lakes with and without the presence of northern pike. It is also important that Judd Lake be periodically monitored for the presence of invasive northern pike, as it could prove detrimental to the salmon population and other native species should northern pike colonize the lake.

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APPENDICES

Appendix 1: Judd Lake 2010 environmental conditions

Date	Sky	Precip. (mm)	Stage * (ft)	Water Temp. (^{o}C)	Air Temp. (^{o}C)
17-May	2	0	ND	ND	ND
18-May	2	0	ND	3	7
19-May	3	0	ND	3	7
20-May	1	0	ND	2	8
21-May	4	0	ND	3	8
22-May	1	0	ND	3	10
23-May	2	0	ND	ND	ND
24-May	3	0	ND	ND	ND
25-May	2	0	ND	ND	ND
26-May	2	0	ND	ND	ND
27-May	1	0	ND	ND	ND
28-May	3	0	ND	ND	ND
29-May	4	0	0.0	ND	ND
30-May	2	3	0.3	5	19
31-May	4	0	0.4	4	22
1-Jun	3	0	0.1	5	20
2-Jun	4	1	0.2	5	18
3-Jun	4	3	0.2	4	9
4-Jun	4	3	0.0	4	9
5-Jun	2	3	-0.3	4	17
6-Jun	3	0	-0.4	6	19
7-Jun	4	3	-0.5	6	21
8-Jun	4	0	-0.4	6	18
9-Jun	4	0	-0.5	7	16
10-Jun	4	0	-0.6	6	20
11-Jun	4	2	-0.6	6	22
12-Jun	4	3	-0.7	7	15
13-Jun	2	0	-0.8	7	18
14-Jun	5	25	-0.7	7	11
15-Jun	5	23	-0.4	5	9
16-Jun	5	14	-0.3	5	8
17-Jun	5	7	-0.5	7	16
18-Jun	5	1	-0.6	6	18
19-Jun	5	3	-0.6	7	15
20-Jun	3	1	-0.8	8	17
21-Jun	1	0	-0.9	8	18
22-Jun	4	1	-0.9	9	12
23-Jun	1	0	-0.9	10	19
24-Jun	4	0	-1.0	9	15
25-Jun	4	1	-1.0	10	20
26-Jun	3	0	-1.1	11	18
27-Jun	4	3	-1.1	11	14
Total		95			
Avg.		2	-0.5	6	16
Min.		0	-1.1	2	8
Max.		25	0.4	11	22

* - Does not reflect actual depth, only water level fluctuation

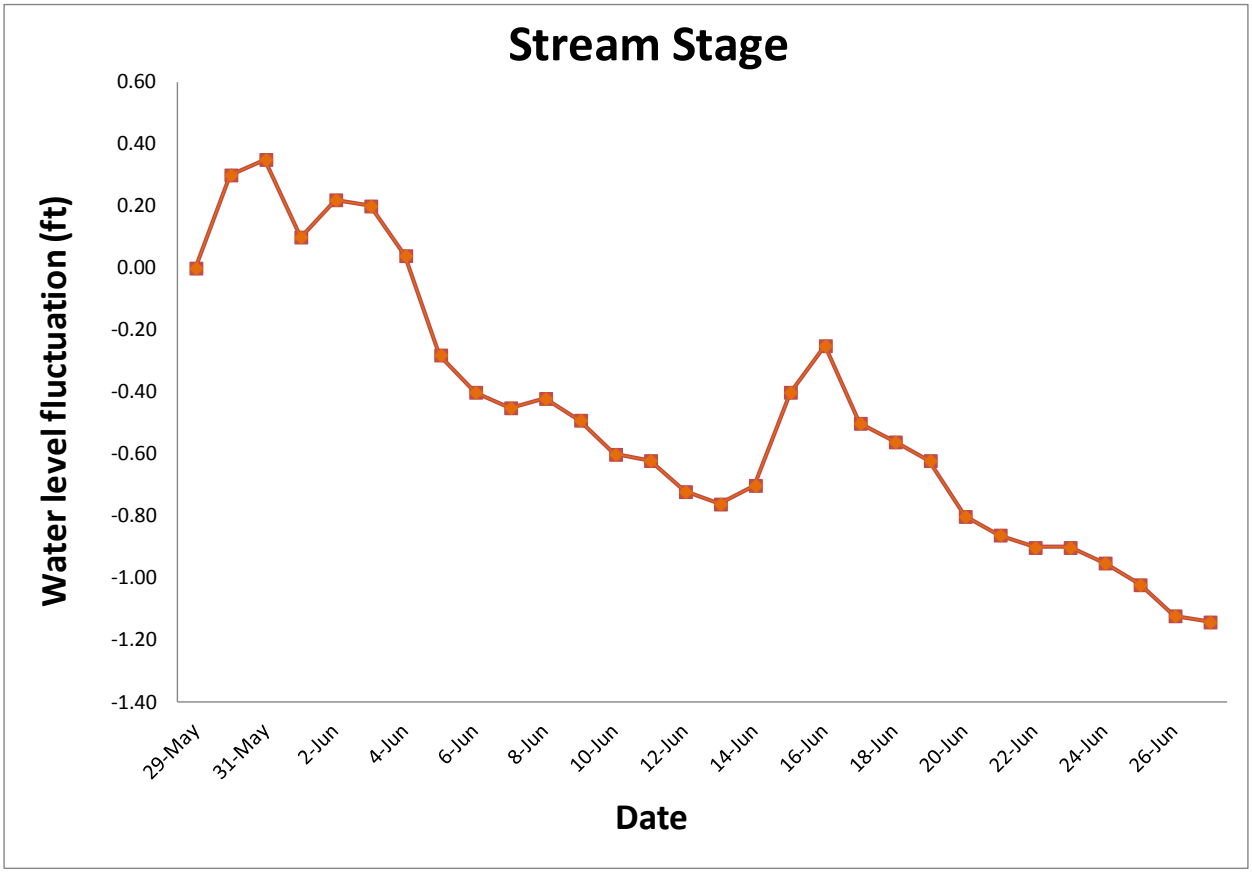
Summary of Cloud Cover - Percent of Days

	No. Days	Overcast	Partly Cloudy	Clear	Rain
Smolt	42	38%	36%	12%	14%

ND = No Data

1 = Clear
2 = Cloud Cover <50%
3 = Cloud Cover >50%
4 = Overcast
5 = Rain

Appendix 2: Judd Lake 2010 water level fluctuation



Appendix 3: Judd Lake 2011 environmental conditions

Smolt Migration

Date	Sky	Precip. (mm)	Stage * (ft)	Water Temp. (^{o}C)	Air Temp. (^{o}C)
17-May	4	0	0.0	2	2
18-May	4	0	0.1	3	2
19-May	4	15	0.4	2	2
20-May	2	10	0.5	2	3
21-May	3	0	0.5	2	3
22-May	3	5	0.6	2	0
23-May	1	0	0.6	2	0
24-May	1	0	0.7	3	0
25-May	1	0	0.7	2	0
26-May	2	0	0.8	2	0
27-May	1	0	1.1	3	5
28-May	1	0	1.3	3	8
29-May	1	0	1.4	3	12
30-May	1	0	1.4	3	10
31-May	5	4	1.5	3	7
1-Jun	4	3	1.3	3	6
2-Jun	5	5	1.3	4	5
3-Jun	5	2	1.2	4	4
4-Jun	5	3	1.2	4	9
5-Jun	2	0	1.1	4	12
6-Jun	2	0	1.0	4	10
7-Jun	5	4	0.9	4	9
8-Jun	2	0	0.9	4	11
9-Jun	2	0	0.8	5	11
10-Jun	3	1	0.8	6	11
11-Jun	3	0	0.7	6	10
12-Jun	3	0	0.7	6	10
13-Jun	3	0	0.7	6	15
14-Jun	4	0	0.8	7	12
15-Jun	3	0	0.8	7	15
16-Jun	1	0	0.8	7	17
17-Jun	1	0	0.8	9	17
18-Jun	2	0	0.8	9	18
19-Jun	5	1	0.8	9	17
20-Jun	3	0	0.8	9	14
21-Jun	2	0	0.7	9	15
22-Jun	3	0	0.7	9	10
23-Jun	2	0	0.7	9	16
24-Jun	1	0	0.7	9	18
25-Jun	4	3	0.6	9	16
26-Jun	3	0	0.6	9	15
Total		55			
Avg.		1	0.82	5	9
Min.		0	0.00	2	0
Max.		15	1.50	9	18

* - Does not reflect actual water depth, only water level fluctuation

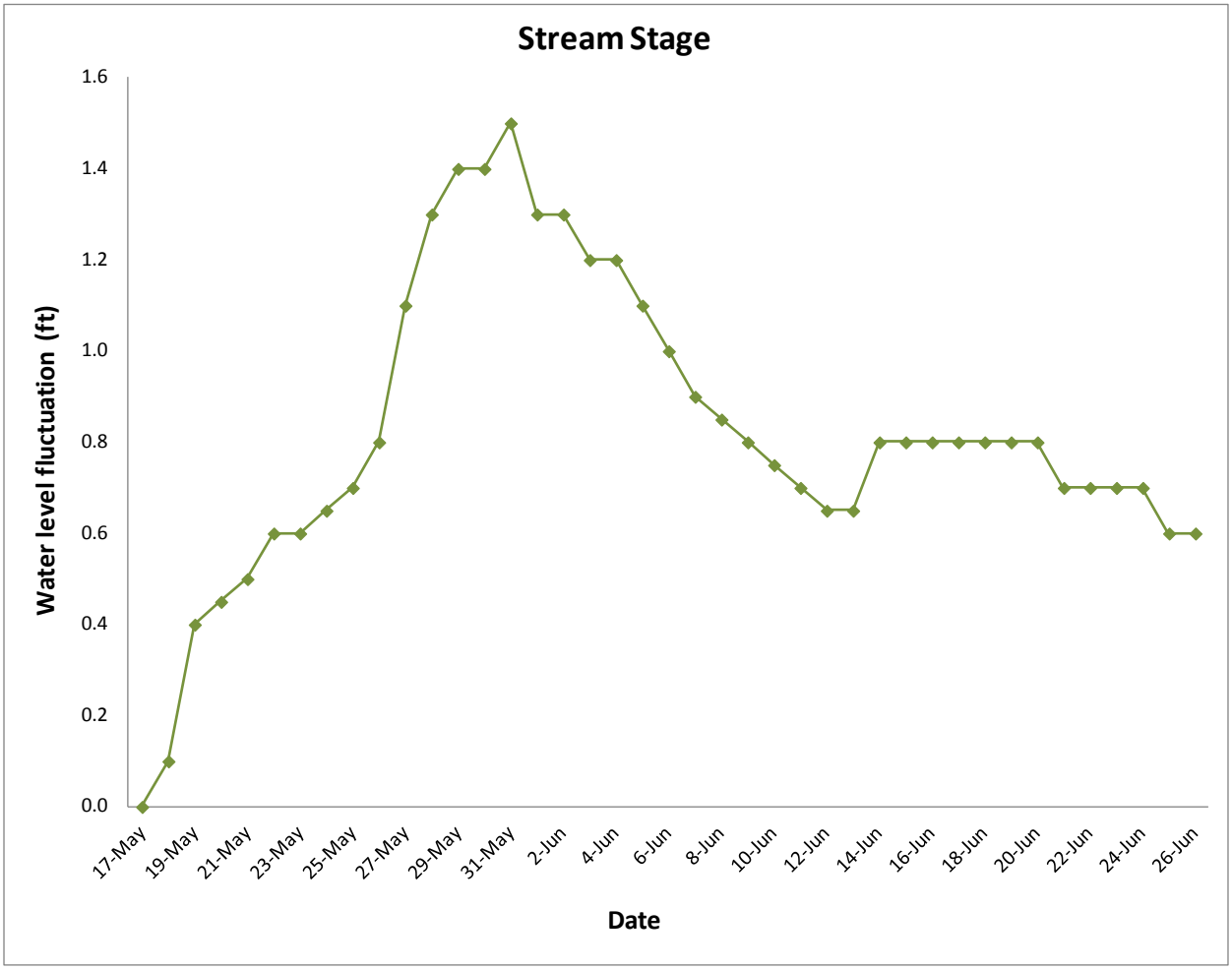
Summary of Cloud Cover - Percent of Days

	No. Days	Overcast	Partly Cloudy	Clear	Rain
Smolt	41	15%	46%	24%	15%

ND = No Data

1 = Clear
2 = Cloud Cover <50%
3 = Cloud Cover>50%
4 = Overcast
5 = Rain

Appendix 4: Judd Lake 2011 water level fluctuation



Appendix 5: Judd Lake 2012 environmental conditions

Date	Sky	Precip. (mm)	Stage * (ft)	Water Temp. (^{o}C)	Air Temp. (^{o}C)
20-May	2	0	0.0	3	6
21-May	2	0	0.0	4	13
22-May	2	ND	0.4	4	13
23-May	2	0	0.4	4	14
24-May	5	ND	0.6	3	7
25-May	4	ND	0.7	3	8
26-May	2	ND	0.8	3	11
27-May	4	ND	0.9	3	9
28-May	3	ND	0.9	2	12
29-May	3	ND	0.9	3	9
30-May	4	ND	0.8	3	11
31-May	5	ND	0.8	3	8
1-Jun	3	ND	0.8	4	12
2-Jun	3	ND	0.8	4	14
3-Jun	4	ND	0.9	4	13
4-Jun	3	ND	1.0	4	9
5-Jun	2	ND	1.0	4	12
6-Jun	4	ND	1.0	4	10
7-Jun	2	0	1.1	5	14
8-Jun	4	1	1.3	5	10
9-Jun	3	2	1.4	6	14
10-Jun	4	0	1.2	5	15
11-Jun	3	0	1.0	5	17
12-Jun	5	5	1.1	5	7
13-Jun	5	14	1.0	5	6
14-Jun	3	4	0.9	5	10
15-Jun	3	0	0.7	5	11
16-Jun	3	0	1.0	6	17
17-Jun	3	9	1.2	7	17
18-Jun	2	0	1.3	7	17
19-Jun	2	8	1.1	6	17
20-Jun	2	0	1.1	7	17
21-Jun	2	0	1.0	7	22
22-Jun	2	0	1.0	8	20
23-Jun	2	0	0.9	8	21
24-Jun	4	5	0.9	8	12
25-Jun	5	6	0.8	8	9
26-Jun	3	10	0.5	8	12
Total		60			
Avg.		3	0.9	5	13
Min.		0	0.0	2	6
Max.		14	1.4	8	22

* - Does not reflect actual water depth, only water level fluctuation

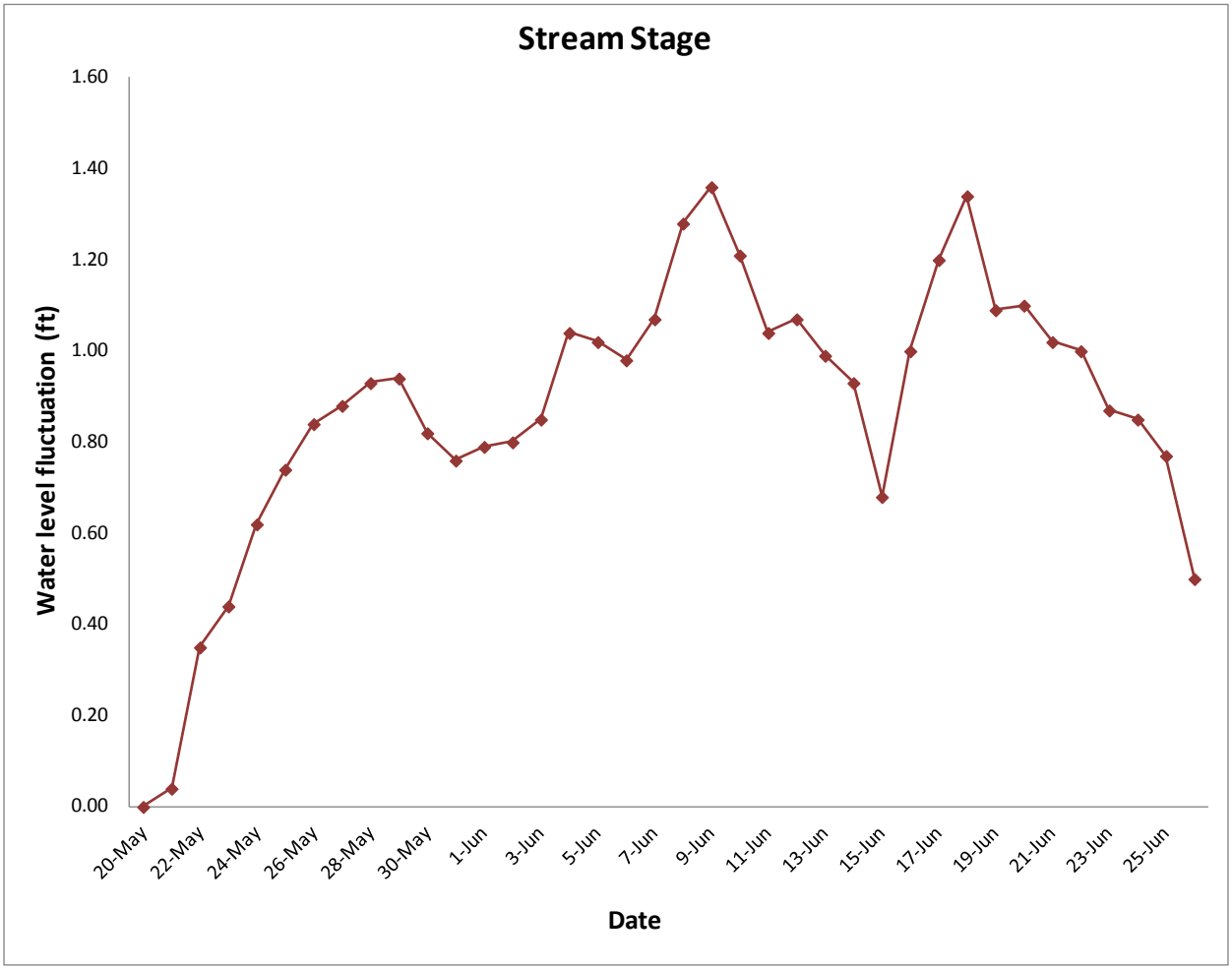
Summary of Cloud Cover - Percent of Days

	No. Days	Overcast	Partly Cloudy	Clear	Rain
Smolt	38	21%	66%	0%	13%

ND = No Data

1 = Clear
2 = Cloud Cover <50%
3 = Cloud Cover>50%
4 = Overcast
5 = Rain

Appendix 6: Judd Lake 2012 water level fluctuation



Appendix 7: 2010 Judd Lake daily smolt migration

	Sockeye			Coho		King		Pink		Chum		Rainbow		Arctic Char	
Date	Daily	Total	Trap	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total
17-May	5,151	5,151	50%	36	36	0	0	0	0	0	0	0	0	5	5
18-May	4,514	9,665	50%	13	49	0	0	0	0	0	0	0	0	1	6
19-May	3,153	12,818	50%	30	79	0	0	0	0	0	0	0	0	5	11
20-May	3,244	16,062	50%	25	104	0	0	0	0	0	0	1	1	2	13
21-May	1,428	17,490	50%	23	127	0	0	0	0	0	0	0	1	0	13
22-May	ND	17,490	ND	ND	127	ND	0	0	0	ND	0	ND	1	ND	13
23-May	ND	17,490	ND	ND	127	ND	0	0	0	ND	0	ND	1	ND	13
24-May	ND	17,490	ND	ND	127	ND	0	0	0	ND	0	ND	1	ND	13
25-May	ND	17,490	ND	ND	127	ND	0	0	0	ND	0	ND	1	ND	13
26-May	ND	17,490	ND	ND	127	ND	0	0	0	ND	0	ND	1	ND	13
27-May	ND	17,490	ND	ND	127	ND	0	0	0	ND	0	ND	1	ND	13
28-May	ND	17,490	ND	ND	127	ND	0	0	0	ND	0	ND	1	ND	13
29-May	ND	17,490	ND	ND	127	ND	0	0	0	ND	0	ND	1	ND	13
30-May	ND	17,490	ND	ND	127	ND	0	0	0	ND	0	ND	1	ND	13
31-May	ND	17,490	ND	ND	127	ND	0	0	0	ND	0	ND	1	ND	13
1-Jun	ND	17,490	ND	ND	127	ND	0	0	0	ND	0	ND	1	ND	13
2-Jun	ND	17,490	ND	ND	127	ND	0	0	0	ND	0	ND	1	ND	13
3-Jun	ND	17,490	ND	ND	127	ND	0	0	0	ND	0	ND	1	ND	13
4-Jun	ND	17,490	ND	ND	127	ND	0	0	0	ND	0	ND	1	ND	13
5-Jun	71	17,561	100%	382	509	0	0	0	0	0	0	1	2	10	23
6-Jun	2,429	19,990	100%	342	851	0	0	0	0	0	0	1	3	35	58
7-Jun	250	20,240	100%	257	1,108	0	0	0	0	0	0	0	3	23	81
8-Jun	5,469	25,709	100%	390	1,498	0	0	0	0	0	0	2	5	9	90
9-Jun	13,505	39,214	100%	231	1,729	0	0	0	0	0	0	4	9	7	97
10-Jun	18,354	57,568	100%	347	2,076	0	0	0	0	0	0	1	10	2	99
11-Jun	3,098	60,666	100%	204	2,280	0	0	0	0	0	0	0	10	5	104
12-Jun	2,109	62,775	100%	312	2,592	0	0	0	0	0	0	1	11	2	106
13-Jun	869	63,644	100%	292	2,884	0	0	0	0	0	0	0	11	4	110
14-Jun	185	63,829	100%	107	2,991	0	0	0	0	0	0	0	11	0	110
15-Jun	59	63,888	100%	134	3,125	0	0	0	0	0	0	0	11	2	112
16-Jun	208	64,096	100%	329	3,454	0	0	0	0	0	0	0	11	2	114
17-Jun	168	64,264	100%	447	3,901	0	0	0	0	0	0	0	11	0	114
18-Jun	0	64,264	100%	79	3,980	0	0	0	0	0	0	0	11	0	114
19-Jun	40	64,304	100%	175	4,155	0	0	0	0	0	0	0	11	0	114
20-Jun	0	64,304	100%	15	4,170	0	0	0	0	0	0	0	11	0	114
21-Jun	17	64,321	100%	18	4,188	0	0	0	0	0	0	0	11	0	114
22-Jun	0	64,321	100%	3	4,191	0	0	0	0	0	0	0	11	0	114
23-Jun	0	64,321	100%	0	4,191	0	0	0	0	0	0	0	11	0	114
24-Jun	8	64,329	100%	0	4,191	0	0	0	0	0	0	0	11	0	114
25-Jun	0	64,329	100%	0	4,191	0	0	0	0	0	0	0	11	0	114
26-Jun	0	64,329	100%	0	4,191	0	0	0	0	0	0	0	11	0	114
Total		64,329			4,191		0		0		0		11		114

Appendix 8: Judd Lake 2010 smolt hourly log

Hourly Log - Sockeye Enumeration

	AM						PM												AM					
	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00
5/17/2010																		1385		2220		1546		
5/18/2010								1613						40						2461				
5/19/2010							1064									1077				755		257		
5/20/2010							714									387				843		1300		
5/21/2010							83									209			177			959		
5/22/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5/23/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5/24/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5/25/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5/26/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5/27/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5/28/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5/29/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5/30/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5/31/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6/1/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6/2/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6/3/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6/4/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6/5/2010																	14			20	19		18	
6/6/2010												2				10			14	38	850	1515		
6/7/2010									10								24			123	25		68	
6/8/2010											27						208				785		4459	
6/9/2010											650						5850			1907				5108
6/10/2010													694				13333		3049			1378		
6/11/2010											64						65			1978		991		
6/12/2010												248					39			635		1187		
6/13/2010												225					242						402	
6/14/2010													42							69		74		
6/15/2010													37						22					
6/16/2010																			119			89		
6/17/2010																0			109			59		
6/18/2010															0							0		
6/19/2010													30											10
6/20/2010													0											0
6/21/2010												3												14
6/22/2010												0												0
6/23/2010												0												0
6/24/2010												5												3
6/25/2010												0												0
6/26/2010												0												0

Appendix 9: 2011 Judd Lake daily smolt migration

	Sockeye			Coho		King		Pink		Chum		Rainbow		Arctic Char	
Date	Daily	Total	Trap	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total
17-May	5,009	5,009	24%	41	41	0	0	0	0	0	0	2	2	0	0
18-May	4,119	9,128	24%	18	59	0	0	0	0	0	0	3	5	0	0
19-May	5,146	14,274	24%	20	79	0	0	0	0	0	0	0	5	0	0
20-May	3,543	17,817	24%	21	100	0	0	0	0	0	0	0	5	0	0
21-May	2,193	20,010	13%	12	112	0	0	0	0	0	0	0	5	0	0
22-May	3,144	23,154	13%	18	130	0	0	0	0	0	0	0	5	0	0
23-May	2,236	25,390	13%	23	153	0	0	0	0	0	0	0	5	0	0
24-May	2,111	27,501	13%	31	184	0	0	0	0	0	0	1	6	0	0
25-May	2,660	30,161	13%	17	201	0	0	0	0	0	0	0	6	0	0
26-May	1,537	31,698	18%	54	255	0	0	0	0	0	0	1	7	0	0
27-May	892	32,590	18%	20	275	0	0	0	0	0	0	0	7	0	0
28-May	493	33,083	18%	12	287	0	0	0	0	0	0	0	7	0	0
29-May	2,115	35,198	18%	29	316	1	1	0	0	0	0	0	7	0	0
30-May	655	35,853	18%	24	340	0	1	0	0	0	0	0	7	0	0
31-May	3,093	38,946	21%	76	416	0	1	0	0	0	0	0	7	0	0
1-Jun	3,417	42,363	21%	49	465	0	1	0	0	0	0	0	7	0	0
2-Jun	2,241	44,604	21%	101	566	0	1	0	0	0	0	0	7	0	0
3-Jun	1,692	46,296	22%	80	646	0	1	0	0	0	0	0	7	0	0
4-Jun	2,296	48,592	22%	62	708	0	1	0	0	0	0	0	7	0	0
5-Jun	2,077	50,669	22%	79	787	0	1	0	0	0	0	0	7	0	0
6-Jun	1,575	52,244	22%	120	907	0	1	0	0	0	0	0	7	0	0
7-Jun	973	53,217	22%	100	1,007	0	1	0	0	0	0	0	7	0	0
8-Jun	3,633	56,850	20%	135	1,142	0	1	0	0	0	0	0	7	0	0
9-Jun	1,811	58,661	20%	61	1,203	0	1	0	0	0	0	0	7	0	0
10-Jun	2,671	61,332	20%	37	1,240	0	1	0	0	0	0	0	7	0	0
11-Jun	20,653	81,985	70%	214	1,454	0	1	0	0	0	0	0	7	0	0
12-Jun	9,969	91,954	70%	156	1,610	0	1	0	0	0	0	0	7	0	0
13-Jun	11,729	103,683	70%	321	1,931	0	1	0	0	0	0	0	7	0	0
14-Jun	4,348	108,031	100%	160	2,091	0	1	0	0	0	0	2	9	0	0
15-Jun	6,913	114,944	100%	422	2,513	14	15	0	0	0	0	0	9	0	0
16-Jun	2,612	117,556	100%	270	2,783	0	15	0	0	0	0	0	9	0	0
17-Jun	2,919	120,475	100%	121	2,904	0	15	0	0	0	0	0	9	0	0
18-Jun	1,724	122,199	100%	79	2,983	0	15	0	0	0	0	0	9	0	0
19-Jun	846	123,045	100%	52	3,035	0	15	0	0	0	0	0	9	0	0
20-Jun	1,252	124,297	100%	202	3,237	0	15	0	0	0	0	0	9	0	0
21-Jun	2,956	127,253	100%	131	3,368	0	15	0	0	0	0	0	9	0	0
22-Jun	2,252	129,505	100%	32	3,400	0	15	0	0	0	0	0	9	0	0
23-Jun	3,660	133,165	100%	44	3,444	0	15	0	0	0	0	0	9	0	0
24-Jun	1,634	134,799	100%	16	3,460	0	15	0	0	0	0	0	9	0	0
25-Jun	1,097	135,896	100%	75	3,535	0	15	0	0	0	0	0	9	0	0
26-Jun	2,137	138,033	100%	31	3,566	0	15	0	0	0	0	0	9	0	0
Total		138,033			0		15		0		0		9		0

Appendix 10: Judd Lake 2011 smolt hourly log

Hourly Log - Sockeye Enumeration

	AM						PM												AM					
	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00
5/17/2011							0	0	0	0	0	0	0	0	0	0	0	46	226	3259	1135	293	0	0
5/18/2011					273	0	0	0	14	0	0	0	0	0	0	24	0	0	0	3049	842			
5/19/2011							1116	0	0	0	0	0	0	0	0	0	349	0	1338	1301	738	292	0	0
5/20/2011						1152	13													1081	635	395	260	
5/21/2011							409													749	257	362	416	
5/22/2011							427			69										1728	592	328		
5/23/2011							461													1273	331	171		
5/24/2011							396														1141	397	177	
5/25/2011							416												1347	412	360	125		
5/26/2011								559												705	160	92	21	
5/27/2011								209												452	106	69	56	
5/28/2011															493									
5/29/2011			143						69				266							1318	168	127	24	
5/30/2011			364				0												216	75	0	0	0	
5/31/2011																		114			2375	566	38	
6/1/2011																				608	1189	1287	333	
6/2/2011							210														1704	271	56	
6/3/2011							81														1468		143	
6/4/2011								45												415	1321	515		
6/5/2011					565															337	115	1060		
6/6/2011							516													775	267	17		
6/7/2011								35												531	366	41		
6/8/2011							23													3336	215	59		
6/9/2011							19														887	824	81	
6/10/2011							51													1777		843		
6/11/2011								125							27			2282		3254	1326			
6/12/2011				1345													273			7473	289	487	102	
6/13/2011					1538												6342	958	988	649	804	358		
6/14/2011							1015										501		736	389	1334	373		
6/15/2011							188									170		2363	476	2813	883	20		
6/16/2011							521											42	1420		185	444		
6/17/2011							754										318			944	308	595		
6/18/2011							468									48			322	293	516	77		
6/19/2011						107											122		118	68	72	12		
6/20/2011							77													759		416		
6/21/2011							157														2556		243	
6/22/2011								160								464	104			1018	127	319		
6/23/2011					149														1666	1045		800		
6/24/2011							168										439			874		153		
6/25/2011						137										220	259	304	190	610	98			
6/26/2011						1021														1030		94		

Appendix 11: 2012 Judd Lake daily smolt migration

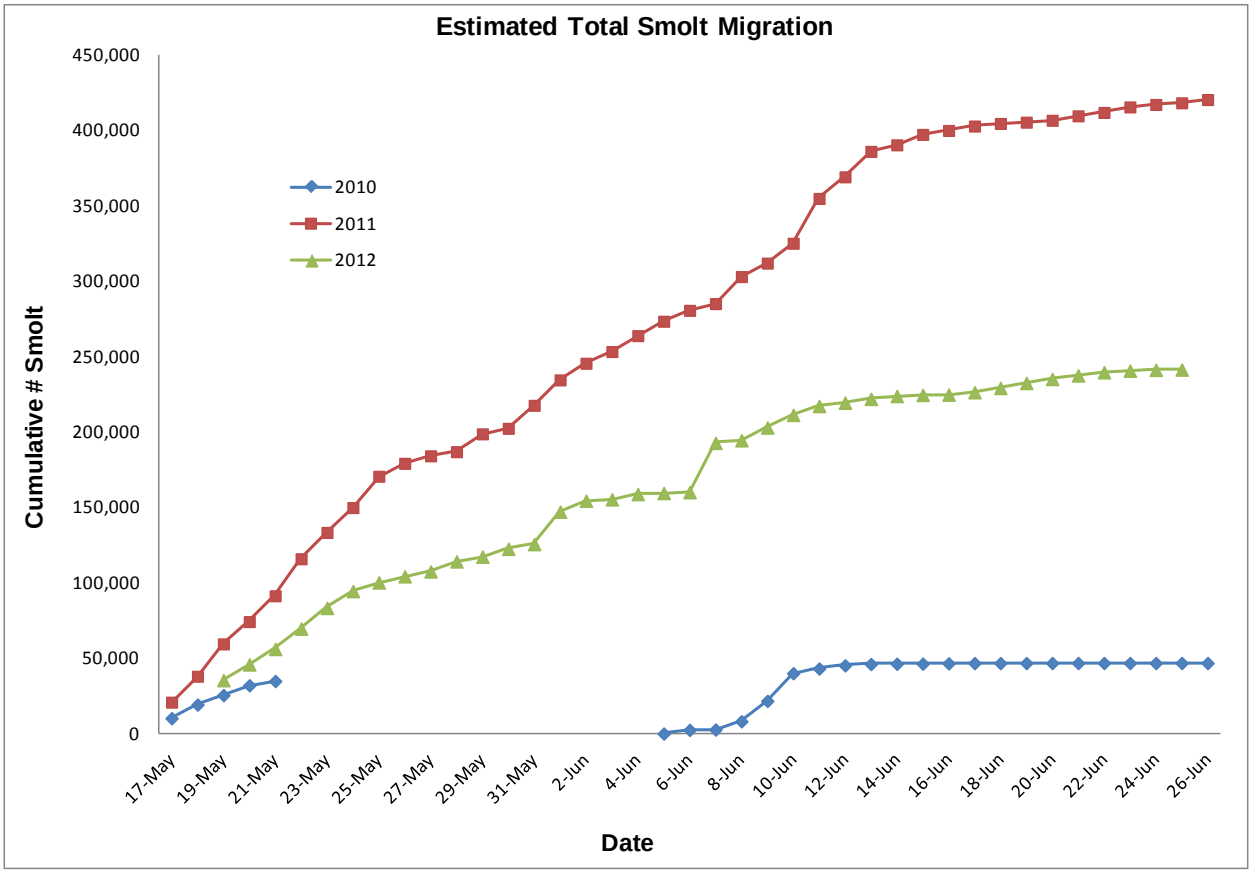
	Sockeye			Coho		Chinook		Pink		Chum		Rainbow		Arctic Char	
Date	Daily	Total	Trap	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total
19-May	5177	5,177	15%	19	19	0	0	0	0	0	0	0	0	6	6
20-May	1521	6,698	15%	13	32	0	0	0	0	0	0	0	0	2	8
21-May	1495	8,193	15%	5	37	0	0	0	0	0	0	0	0	4	12
22-May	1701	9,894	12%	6	43	0	0	0	0	0	0	1	1	6	18
23-May	1725	11,619	12%	7	50	0	0	0	0	0	0	0	1	1	19
24-May	1994	13,613	18%	10	60	0	0	0	0	0	0	0	1	4	23
25-May	1026	14,639	18%	5	65	0	0	0	0	0	0	0	1	4	27
26-May	721	15,360	18%	14	79	0	0	0	0	0	0	1	2	12	39
27-May	581	15,941	18%	14	93	0	0	0	0	0	0	0	2	2	41
28-May	1462	17,403	22%	30	123	0	0	0	0	0	0	0	2	7	48
29-May	690	18,093	22%	24	147	0	0	0	0	0	0	0	2	7	55
30-May	531	18,624	10%	9	156	1	1	0	0	0	0	0	2	3	58
31-May	318	18,942	10%	13	169	0	1	0	0	0	0	0	2	6	64
1-Jun	2182	21,124	10%	15	184	3	4	0	0	0	0	0	2	12	76
2-Jun	737	21,861	10%	10	194	0	4	0	0	0	0	0	2	2	78
3-Jun	173	22,034	19%	5	199	0	4	0	0	0	0	0	2	0	78
4-Jun	683	22,717	19%	10	209	0	4	0	0	0	0	0	2	23	101
5-Jun	140	22,857	19%	34	243	0	4	0	0	0	0	0	2	2	103
6-Jun	110	22,967	19%	29	272	1	5	0	0	0	0	0	2	1	104
7-Jun	6395	29,362	19%	140	412	0	5	0	0	0	0	0	2	2	106
8-Jun	577	29,939	34%	246	658	0	5	0	0	0	0	0	2	4	110
9-Jun	2881	32,820	34%	90	748	0	5	0	0	0	0	0	2	1	111
10-Jun	2832	35,652	34%	68	816	0	5	0	0	0	0	0	2	0	111
11-Jun	2002	37,654	34%	115	931	0	5	0	0	0	0	0	2	1	112
12-Jun	735	38,389	34%	93	1,024	0	5	0	0	0	0	0	2	0	112
13-Jun	712	39,101	28%	104	1,128	0	5	0	0	0	0	0	2	3	115
14-Jun	828	39,929	44%	106	1,234	0	5	0	0	0	0	0	2	2	117
15-Jun	732	40,661	100%	142	1,376	0	5	0	0	0	0	1	3	4	121
16-Jun	217	40,878	100%	83	1,459	0	5	0	0	0	0	2	5	8	129
17-Jun	1566	42,444	100%	101	1,560	0	5	0	0	0	0	0	5	8	137
18-Jun	655	43,099	23%	61	1,621	0	5	0	0	0	0	0	5	9	146
19-Jun	772	43,871	23%	84	1,705	0	5	0	0	0	0	0	5	1	147
20-Jun	612	44,483	23%	43	1,748	0	5	0	0	0	0	0	5	4	151
21-Jun	543	45,026	23%	38	1,786	0	5	0	0	0	0	0	5	4	155
22-Jun	395	45,421	23%	34	1,820	3	8	0	0	0	0	0	5	5	160
23-Jun	195	45,616	23%	43	1,863	1	9	0	0	0	0	0	5	3	163
24-Jun	159	45,775	28%	60	1,923	0	9	0	0	0	0	0	5	1	164
25-Jun	63	45,838	28%	51	1,974	0	9	0	0	0	0	0	5	0	164
Total		45,838			1,974		9		0		0		5		164

Appendix 12: Judd Lake 2012 smolt hourly log

Hourly Log - Sockeye Enumeration

	AM						PM												AM					
	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00
5/19/2012														103			32	463	1461	1349	1275	494		
5/20/2012					43					5							17	19	269	309	417	193	49	
5/21/2012					7							0					9	107	469	577	267	59		
5/22/2012					142							9						300	244	384	385	237		
5/23/2012					71							22							274	335	804	219		
5/24/2012					57							16							203	273	1289	156		
5/25/2012			9									21							251	271	379	95		
5/26/2012					73							44							163	134	203	104		
5/27/2012					75														228	102	73	103		
5/28/2012						1						0							357	449	330	306	19	
5/29/2012							5					2								134	339	210		
5/30/2012						23													66	271	116	50	5	
5/31/2012																			81	176	59	2		
6/1/2012			6									2							44	1659	381	90		
6/2/2012						32						3						5	60	311	290	36		
6/3/2012				10								0							51	76	36			
6/4/2012					6							0								325	319	33		
6/5/2012					4														32	65	21	18		
6/6/2012			1																10	31	50	8		
6/7/2012					61	20						0	1							1802	3220	1264	27	
6/8/2012							30		2			0				4	1	32	174	235	97	3		
6/9/2012				10															695	1095	603	448		
6/10/2012				63															395	1058	1036	280		
6/11/2012					24														1142	671	135	30		
6/12/2012					13														144	426	152			
6/13/2012				15															71	65	456	100		
6/14/2012					10															292	509	17		
6/15/2012				122													13	2	15	351	202	27		
6/16/2012							34					3									175	5		
6/17/2012					5															1177	334	50		
6/18/2012							12													371	184	88		
6/19/2012						38														253	445	36		
6/20/2012				53																250	276	33		
6/21/2012						18														365	148	12		
6/22/2012				35																217	108	35		
6/23/2012						14														135	26	20		
6/24/2012						18														113	11	17		
6/25/2012								10												43	8	2		

Appendix 13: Judd Lake estimated total sockeye salmon smolt migration 2010–2012



Appendix 14: Judd Lake macrozooplankton summary 2010

Macrozooplankton Body Size (mm)

Date:	28-May	22-Jun	31-Jul	31-Aug	6-Sep	Seasonal Means: Mean Length (mm)	Weighted Length (mm)	Biomass (mg/m²)	Weighted Biomass (mg/m²)
Ergasilus									
Ovig Ergasilus									
Epischura									
Ovig Epischura									
Diaptomus									
Ovig Diaptomus									
Cyclops	0.83	1.03	1.02	0.73	0.73	0.87	0.96	12	15
Ovig. Cyclops		1.29	1.17			1.23	1.20	2	2
Bosmina	0.28	0.46	0.35	0.32	0.35	0.35	0.34	6	6
Ovig. Bosmina		0.41	0.36	0.36	0.36	0.37	0.36	1	1
Daphnia l.	0.62	0.68	0.69	0.55	0.58	0.62	0.59	29	26
Ovig. Daphnia l.		0.8	0.86	0.7	0.66	0.76	0.69	29	23
Daphnia g.									
Ovig Daphnia g.									
Holopedium	0.3	0.43	0.61	0.49		0.458	0.5716	7	13
Ovig Holopedium			0.83	0.56		0.695	0.8204	5	
Chydorinae		0.34				0.34	0.34	0.03	0.03
Ovig Chydorinae									
Copepod Nauplii									
							TOTAL:	92	86

Macrozooplankton Density (No/m²)

Date:	28-May	22-Jun	31-Jul	31-Aug	6-Sep	Seasonal Mean (No/m²)
Ergasilus						
Ovig Ergasilus						
Epischura						
Ovig Epischura						
Diaptomus						
Ovig Diaptomus						
Cyclops	3,376	11,943	4,299	1,875	955	4,490
Ovig. Cyclops		223	637			430
Bosmina	32	510	10,669	8,640	7,643	5,499
Ovig. Bosmina		159	478	815	637	522
Daphnia l.	255	860	17,516	25,593	44,427	17,730
Ovig Daphnia l.		287	3,503	10,922	31,210	11,481
Daphnia g.						
Ovig Daphnia g.						
Holopedium	32	3,471	13,535	245		4,321
Ovig Holopedium			2,229	82		1,156
Chydorinae		32				32
Ovig Chydorinae						
Copepod Nauplii						
					Total:	45,660

Judd Lake Site A 2010

Macrozooplankton Body Size (mm)

Date:	28-May	22-Jun	31-Jul	31-Aug	6-Sep	Seasonal Means: Mean Length (mm)	Weighted Length (mm)	Biomass (mg/m²)	Weighted Biomass (mg/m²)
Ergasilus									
Ovig Ergasilus									
Epischura									
Ovig Epischura									
Diaptomus									
Ovig Diaptomus									
Cyclops	0.8	1.07	1.02	0.65	0.73	0.85	1.00	15	21
Ovig. Cyclops		1.26	1.17			1.22	1.19	9	8
Bosmina	0.4	0.4	0.35	0.31	0.35	0.36	0.35	9	9
Ovig. Bosmina		0.43	0.29	0.34	0.34	0.35	0.31	1	1
Daphnia l.	0.59	0.6	0.68	0.53	0.59	0.60	0.60	40	40
Ovig Daphnia l.		0.74	0.83	0.71	0.65	0.73	0.67	42	34
Daphnia g.									
Ovig Daphnia g.									
Holopedium		0.48	0.63	0.47		0.527	0.6121	37	53
Ovig Holopedium			0.83			0.83	0.83	17	17
Chydorinae									
Ovig Chydorinae									
Copepod Nauplii									
							Total:	170	183

Macrozooplankton Density (No/m²)

Date:	28-May	22-Jun	31-Jul	31-Aug	6-Sep	Seasonal Mean (No/m²)
Ergasilus						
Ovig Ergasilus						
Epischura						
Ovig Epischura						
Diaptomus						
Ovig Diaptomus						
Cyclops	3,121	16,561	7,134	637	1,783	5,847
Ovig. Cyclops		828	2,293			1,561
Bosmina	32	318	19,363	2,878	16,306	7,779
Ovig Bosmina		159	3,057	229	1,911	1,339
Daphnia l.	255	414	20,382	9,730	100,382	26,233
Ovig. Daphnia l.		159	4,076	7,947	59,873	18,014
Daphnia g.						
Ovig Daphnia g.						
Holopedium		5,478	41,019	76		15,524
Ovig Holopedium			2,293			2,293
Chydorinae						
Ovig Chydorinae						
Copepod Nauplii						
					Total:	78,590

Judd Lake Site B 2010

Average Weighted Biomass: 135 (mg/m²)

Average Seasonal Density: 62,125 (No/m²)

Appendix 15: Judd Lake macrozooplankton summary 2011

Macrozooplankton Body Size (mm)

Date:	12-Jun	9-Jul	16-Aug	6-Sep	23-Sep	Seasonal Means: Mean Length (mm)	Weighted Length (mm)	Biomass (mg/m^2)	Weighted Biomass (mg/m^2)
Ergasilus									
Ovig Ergasilus									
Epischura									
Ovig Epischura									
Diaptomus									
Ovig Diaptomus									
Cyclops	0.94	1.12	1.18	0.85	0.53	0.92	0.86	297	256
Ovig. Cyclops	1.14	1.26	1.24			1.21	1.25	64	68
Bosmina	0.38	0.40	0.35	0.35	0.34	0.36	0.35	12	11
Ovig. Bosmina		0.44	0.43	0.42	0.42	0.43	0.43	1	1
Daphnia l.	0.72	0.73	0.73	0.61	0.53	0.66	0.63	66	59
Ovig. Daphnia l.	0.74	0.86	0.86	0.65	0.63	0.75	0.71	30	27
Daphnia g.									
Ovig Daphnia g.									
Holopedium	0.40	0.76	0.82			0.66	0.75	105	142
Ovig Holopedium		0.84	0.92			0.88	0.92		
Chydorinae				0.52		0.52	0.52	0.33	0.33
Ovig Chydorinae									
Copepod Nauplii									
						TOTAL:		576	565

Macrozooplankton Density (No/m^2)

Date:	12-Jun	9-Jul	16-Aug	6-Sep	23-Sep	Seasonal Mean (No/m^2)
Ergasilus						
Ovig Ergasilus						
Epischura						
Ovig Epischura						
Diaptomus						
Ovig Diaptomus						
Cyclops	270,191	69,745	14,522	3,822	130,209	97,698
Ovig. Cyclops	223	13,376	21,783			11,794
Bosmina	669	2,866	35,541	6,624	4,585	10,057
Ovig. Bosmina		1,592	382	255	611	710
Daphnia l.	1,783	4,459	63,822	45,223	59,144	34,886
Ovig. Daphnia l.	1,115	1,592	18,726	10,828	28,273	12,107
Daphnia g.						
Ovig Daphnia g.						
Holopedium	5,573	54,140	16,433			25,382
Ovig Holopedium		318	9,936			5,127
Chydorinae				127		127
Ovig Chydorinae						
Copepod Nauplii						
					Total:	197,888

Judd Lake Site A 2011

Macrozooplankton Body Size (mm)

Date:	12-Jun	9-Jul	16-Aug	6-Sep	23-Sep	Seasonal Means: Mean Length (mm)	Weighted Length (mm)	Biomass (mg/m^2)	Weighted Biomass (mg/m^2)
Ergasilus									
Ovig Ergasilus									
Epischura									
Ovig Epischura									
Diaptomus			1.58			1.58	1.58	6	6
Ovig Diaptomus									
Cyclops	0.87	1.12	1.01	0.87	0.56	0.89	0.68	84	48
Ovig. Cyclops		1.27	1.23			1.25	1.24	17	17
Bosmina	0.41	0.43	0.40	0.35	0.40	0.40	0.39	18	17
Ovig. Bosmina	0.42	0.50	0.40	0.39	0.36	0.41	0.39	1	1
Daphnia l.	0.49	0.76	0.70	0.63	0.52	0.62	0.60	61	57
Ovig. Daphnia l.	0.69	0.92	0.86	0.7	0.61	0.76	0.69	29	24
Daphnia g.									
Ovig Daphnia g.									
Harpacticoid					0.42		0.42		
Holopedium	0.38	0.58	0.85			0.60	0.78	13	24
Ovig Holopedium			0.94			0.94	0.94		
Chydorinae					0.6	0.6	0.6	0.53	0.53
Ovig Chydorinae									
Copepod Nauplii									
						Total:		229	194

Macrozooplankton Density (No/m^2)

Date:	12-Jun	9-Jul	16-Aug	6-Sep	23-Sep	Seasonal Mean (No/m^2)
Ergasilus						
Ovig Ergasilus						
Epischura						
Ovig Epischura						
Diaptomus			382			382
Ovig Diaptomus						
Cyclops	7,293	19,268	9,936	2,930	111,717	30,229
Ovig. Cyclops		2,006	3,822			2,914
Bosmina	96	255	47,771	12,994	1,375	12,498
Ovig. Bosmina	32	32	1,529	1,019	764	675
Daphnia l.	96	382	17,580	103,694	65,869	37,524
Ovig. Daphnia l.	287	32	8,408	30,446	18,492	11,533
Daphnia g.						
Ovig Daphnia g.						
Harpacticoid					153	153
Holopedium	1,561	318	9,554			3,811
Ovig Holopedium			3,439			3,439
Chydorinae					153	153
Ovig Chydorinae						
Copepod Nauplii						
					Total:	103,311

Judd Lake Site B 2011

Average Weighted Biomass: 380 (mg/m^2)

Average Seasonal Density: 150,600 (No/m^2)

Appendix 16: Judd Lake macrozooplankton summary 2012

Macrozooplankton Body Size (mm)

Date:	21-Jun	20-Jul	11-Aug	21-Aug	2-Sep	26-Sep	Mean Length (mm)	Weighted Length (mm)	Biomass (mg/m^2)	Weighted Biomass (mg/m^2)
Ergasilus										
Ovig Ergasilus										
Epischura										
Ovig Epischura										
Diaptomus										
Ovig Diaptomus										
Cyclops	0.88	0.93	0.61	0.53	0.55	0.69	0.70	0.86	94	148
Ovig. Cyclops	1.21	1.17					1.19	1.20	18	19
Bosmina	0.35	0.37	0.33	0.34	0.33	0.33	0.34	0.34	1	1
Ovig. Bosmina			0.34		0.33	0.35	0.34	0.33	0	0
Daphnia l.	0.64	0.64	0.61	0.54	0.50	0.55	0.58	0.56	16	15
Ovig. Daphnia l.	0.88	0.86	0.66	0.62	0.60	0.60	0.70	0.72	5	5
Daphnia g.										
Ovig Daphnia g.										
Holopedium	0.44	0.63	0.5			0.34	0.48	0.59	14	23
Ovig Holopedium		0.87					0.87	0.87		
Chydorinae						0.37	0.37	0.37	0.46	0.46
Ovig Chydorinae										
Copepod Nauplii										
								TOTAL:	151	212

Seasonal Means

Macrozooplankton Density (No/m^2)

Date:	21-Jun	20-Jul	11-Aug	21-Aug	2-Sep	26-Sep	Seasonal Mean (No/m^2)
Ergasilus							
Ovig Ergasilus							
Epischura							
Ovig Epischura							
Diaptomus							
Ovig Diaptomus							
Cyclops	285,287	29,045	8,121	7,643	5,732	1,482	56,218
Ovig. Cyclops	6,115	955					3,535
Bosmina	191	1,911	1,592	1,338	1,911	1,467	1,402
Ovig. Bosmina			159		955	107	407
Daphnia l.	1,720	10,892	13,376	15,669	21,497	5,288	11,407
Ovig. Daphnia l.	2,102	2,866	3,344	2,675	2,197	229	2,236
Daphnia g.							
Ovig Daphnia g.							
Holopedium	6,306	22,930	478			61	7,444
Ovig Holopedium		7,452					7,452
Chydorinae						367	367
Ovig Chydorinae							
Copepod Nauplii							
						Total:	90,467

Judd Lake Site A 2012

Macrozooplankton Body Size (mm)

Date:	21-Jun	20-Jul	11-Aug	21-Aug	2-Sep	26-Sep	Mean Length (mm)	Weighted Length (mm)	Biomass (mg/m^2)	Weighted Biomass (mg/m^2)
Ergasilus										
Ovig Ergasilus										
Epischura										
Ovig Epischura										
Diaptomus										
Ovig Diaptomus										
Cyclops	0.9	0.99	0.57	0.56	0.51	0.63	0.69	0.89	112	193
Ovig. Cyclops	1.19	1.17					1.18	1.19	9	9
Bosmina	0.43	0.43	0.33	0.34	0.33	0.34	0.37	0.36	2	1
Ovig. Bosmina		0.44	0.34	0.35	0.35	0.35	0.37	0.36	0.32	0.31
Daphnia l.	0.74	0.66	0.54	0.55	0.51	0.54	0.59	0.55	11	9
Ovig. Daphnia l.	0.84	0.86	0.64	0.66	0.58	0.63	0.70	0.69	4	4
Daphnia g.										
Ovig Daphnia g.										
Holopedium	0.61	0.43	0.53	0.38		0.32	0.45	0.47	9	9
Ovig Holopedium		0.92	0.7				0.81	0.88		
Chydorinae						0.33	0.33	0.33	0.29	0.29
Ovig Chydorinae						0.46	0.46	0.46	0.03	0.03
Copepod Nauplii										
								Total:	147	227

Seasonal Means

Macrozooplankton Density (No/m^2)

Date:	21-Jun	20-Jul	11-Aug	21-Aug	2-Sep	26-Sep	Seasonal Mean (No/m^2)
Ergasilus							
Ovig Ergasilus							
Epischura							
Ovig Epischura							
Diaptomus							
Ovig Diaptomus							
Cyclops	382,548	15,096	3,694	2,866	2,675	2,247	68,188
Ovig. Cyclops	3,248	382					1,815
Bosmina	382	1,529	1,911	764	1,815	993	1,232
Ovig. Bosmina		191	127	287	573	122	260
Daphnia l.	382	6,115	7,643	7,452	14,140	8,742	7,412
Ovig. Daphnia l.	1,146	1,720	3,822	1,433	1,529	672	1,720
Daphnia g.							
Ovig Daphnia g.							
Holopedium	4,395	19,873	2,038	96		92	5,299
Ovig Holopedium		573	127				350
Chydorinae						290	290
Ovig Chydorinae						15	15
Copepod Nauplii							
						Total:	86,581

Judd Lake Site B 2012

Average Weighted Biomass: 220 (mg/m^2)

Average Seasonal Density: 88,524 (No/m^2)