

**Stephan Lake
Sockeye Salmon Smolt
Data Report
2010**

**Prepared by:
CIAA Staff
2013**

The Stephan Lake Project was made possible through an Alaska Sustainable Salmon Fund grant received from the Alaska Department of Fish and Game and the National Oceanic and Atmospheric Administration, and a State of Alaska Designated Legislative Grant.

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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 Stephan Lake. This Stephan Lake Data Report encompasses data collected from the 2010 sockeye salmon smolt migration.

The purpose of the data report is to provide a vehicle to distribute the information produced by the monitoring and evaluation studies. 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 Stephan 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

Many individuals and agencies contributed to the success of the Stephan Lake Project. Appreciation is extended to Cook Inlet Aquaculture Association interns, seasonal assistants, and full-time staff who invested many hours in planning and executing this project. Special thanks are also extended to the Alaska Department of Fish and Game for the support they provided during this project.

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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 (CIAA) and the Alaska Department of Fish and Game (ADF&G) agreed to monitor sockeye salmon smolt migrations from Stephan Lake. Stephan Lake was not known to have a population of northern pike.

During the 2010 smolt migration, staff monitored environmental conditions at 5:00 PM from 18 May through 25 June. Water levels fluctuated 0.70 feet during that time period. Water temperatures averaged 10.0°C (± 2.6) [mean \pm standard deviation] and ranged from 4.0 to 15.0°C. Air temperatures averaged 18.0°C (± 5.1) and ranged from 9.0 to 29.0°C. None of the days were clear, 62% were partly cloudy, 13% were overcast and 26% had measured rainfall.

The smolt migration was enumerated from 17 May through 24 June. During that time, 36,657 sockeye salmon smolt and 15,409 coho salmon smolt were captured while migrating from Stephan Lake.

Throughout the migration, staff collected 1,501 sockeye salmon smolt, and took scale samples, weight and measurements for fork length. Based on the samples read, there were 3 age classes. Within the sample, age-1 was the most abundant age class (61.9%), followed by age-2 (32.7%), and age-3 (5.4%). The average length of the sampled age-1 sockeye salmon smolt was 106.0 mm (± 1.7) and the average weight was 11.9 g (± 0.2). The average length of the age-2 sockeye salmon smolt was 117.4 mm (± 1.1) and the average weight was 16.9 g (± 0.5). The average length of the age-3 sockeye salmon smolt was 147.2 mm (± 4.1) and the weight was 32.9 g (± 2.6).

During the same time period, staff also collected 600 coho salmon, 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. Based on the samples read, there were 4 age classes. Within the sample, age-2 was the most abundant age class (48.6%), followed by age-3 (29.6%), age-1 (19.7%), and age-0 (2.1%). The average length of the sampled age-2 coho salmon smolt was 126.8 mm (± 0.7) and the average weight was 20.4 g (± 0.4). The average length of the sampled age-3 coho salmon was 142.8 mm (± 1.5) and the average weight was 30.3 g (± 3.6). The average length of the sampled age-1 coho salmon was 108.5 mm (± 1.4) and the average weight was 14.1 g (± 1.9). The average length of the age-0 coho salmon was 79.0 mm (± 3.4) and the weight was 5.9 g (± 0.8).

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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 invasive 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 Stephan Lake was completed during 2010 to as part of a larger effort to assess juvenile sockeye salmon migrations from the Susitna River drainage. Stephan Lake was chosen for enumeration because northern pike presence had not been documented.

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PROJECT AREA

Stephan Lake is located at 62°42' W latitude and 148°54' N longitude in the Talkeetna Mountains of the Susitna River drainage, approximately 73 kilometers northwest of Talkeetna, Alaska (Figure 1). The lake has an elevation of 568 meters, surface area of $4.0 \times 10^6 \text{ m}^2$, mean depth of 7 m, maximum depth of 27.7 m, and a volume of $33.7 \times 10^6 \text{ m}^3$ (Figure 2) (Spafard and Edmundson, 2000). There are seven small unnamed tributaries of Stephan Lake. The lake's discharge forms Prairie Creek, which flows into the Talkeetna River.

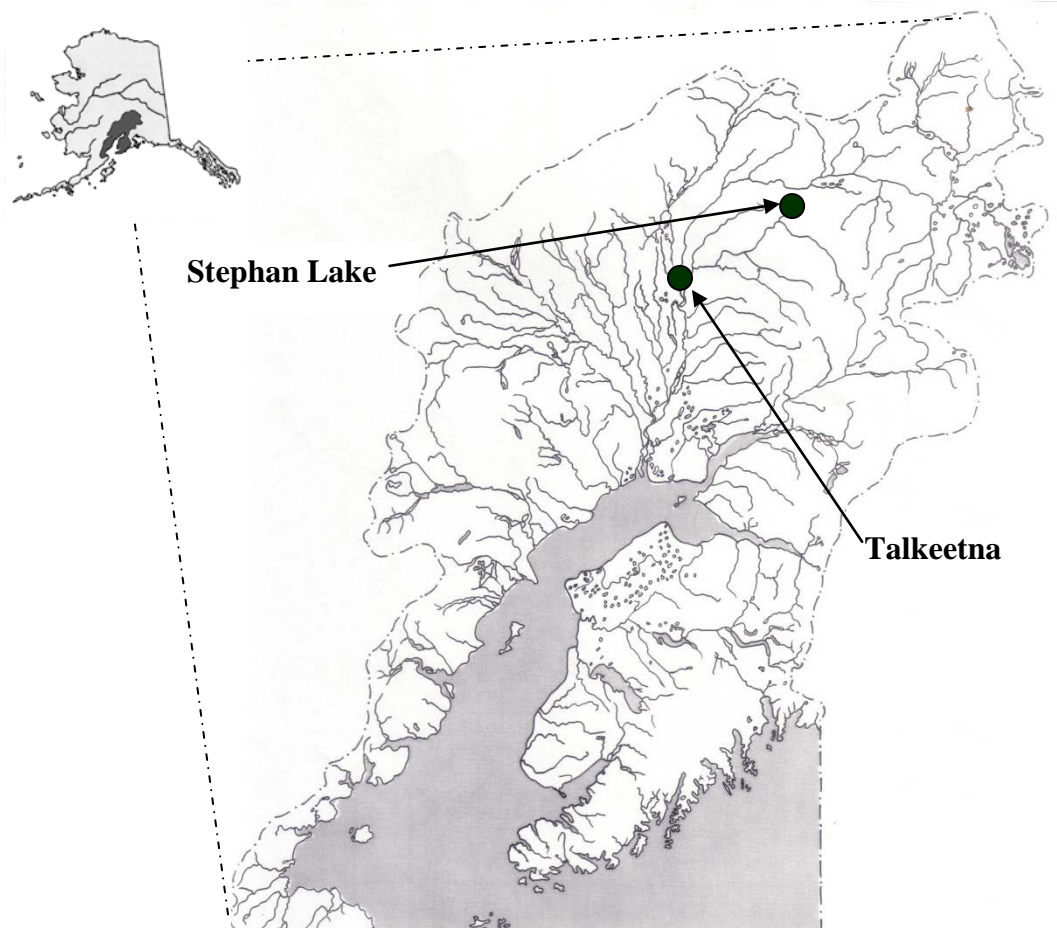


Figure 1: Stephan Lake in relation to Cook Inlet and Alaska

STEPHAN LAKE

Latitude: 62° 42'
Longitude: 148° 54'
Elevation: 568 m
Area: 4.0 x 10⁶ m²
Mean Depth: 7.0 m
Maximum Depth: 27.7 m
Volume: 33.7 x 10⁶ m³
Contours in feet

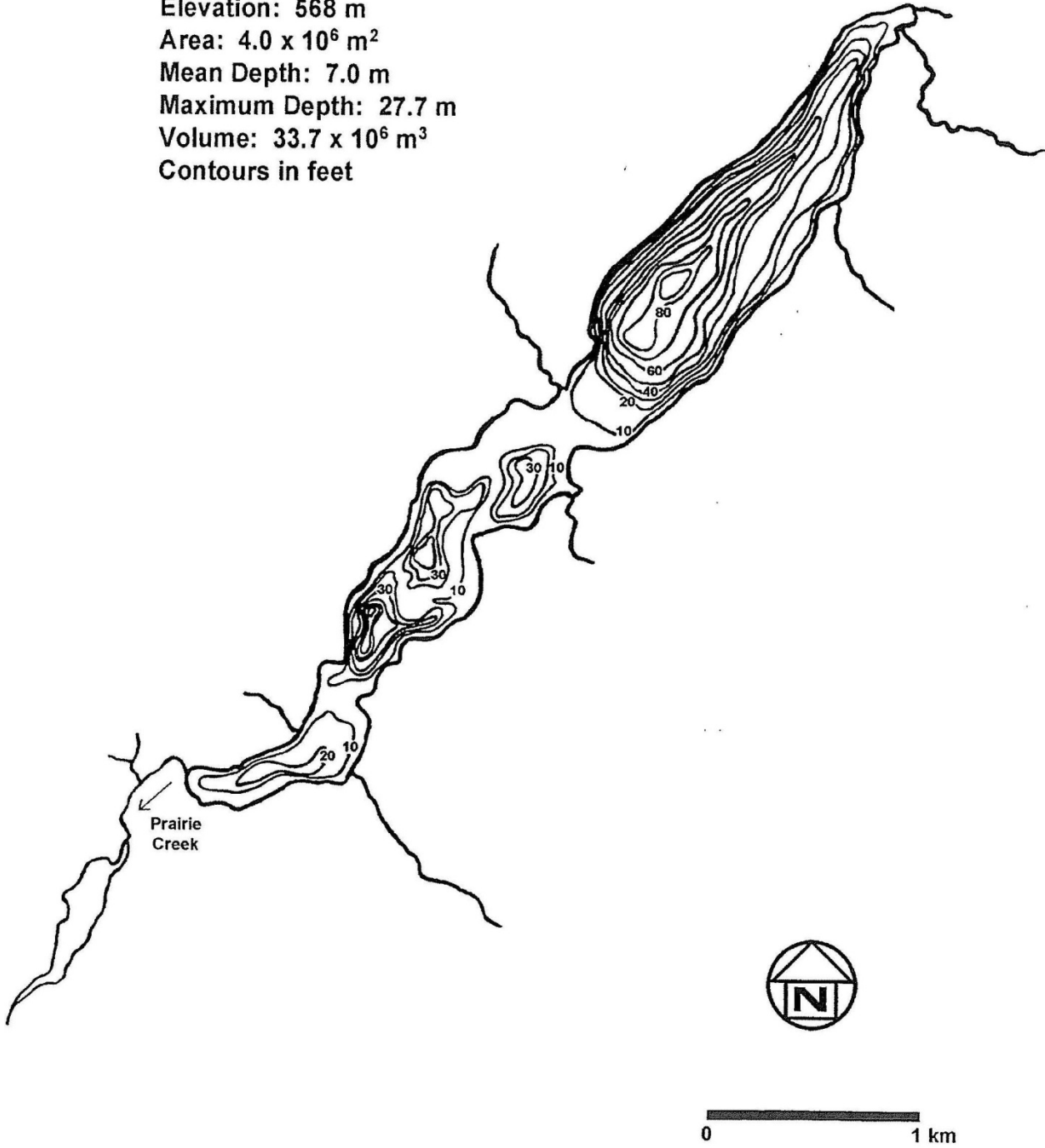


Figure 2: Bathymetric map of Stephan Lake

METHODS

Environmental Conditions

To assess the environmental conditions during the sockeye salmon smolt migration at Stephan Lake percent cloud cover was visually estimated, water level fluctuation recorded to the nearest 0.1 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).

Smolt collection

To enumerate the smolt migration, a collection facility was temporarily placed in Prairie Creek, approximately 700 meters downstream from the outlet of Stephan Lake. An inclined plane trap installed in mid-to-late May that was comprised of an inclined plane, double compartment live box, and an adjustment support. The adjustment supports were an A-frame which rested on the substrate and sampled shallow reaches (up to 4 ft deep) of Prairie Creek, where the inclined plane trap was stationed in the main flow and used for the duration of the smolt migration. There were two leads composed of vexar paneling, which were anchored upstream to each bank and functioned by directing fish into the trap. The use of the vexar paneling enabled staff to sample the entire width of the creek to ensure a total smolt count.

Smolt enumeration and characteristics

Typically, staff checked the trap at least 4 times daily and all smolts were enumerated. Age (scales), weight, and length (AWL) data were collected 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 length¹ measured to the nearest millimeter and weighed to the nearest 0.1 gram. Approximately 10 scales were removed from the primary growth area² and mounted on a glass slide for subsequent age determination. The procedures for AWL are described in the Stephan Lake Smolt Procedures Manual (CIAA, 2010).

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.

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RESULTS

Environmental Conditions

During the 2010 smolt migration, staff monitored environmental conditions at 5:00 PM from 18 May through 25 June. Water levels fluctuated 0.7 ft during that time period. Stream temperatures averaged 10°C (± 2.6) [mean \pm standard deviation] and ranged from 4 to 15°C. Air temperatures averaged 18°C (± 5.1) and ranged from 9 to 29°C. None of the days were clear, 62% were partly cloudy, 13% were overcast and 26% had measured rainfall. A total of 80 mm of rain fell during that period.

Smolt Enumeration and Characteristics

The smolt migration was enumerated from 17 May through 24 June. During that time, 36,657 sockeye salmon smolt were captured while migrating from Stephan Lake. Other fish captured during that time were 15,409 coho salmon smolt (*O. kisutch*), and 5 rainbow trout (*O. mykiss*).

Throughout the migration, staff collected 1,501 sockeye salmon smolt, and took scale samples, weight, and measurements for fork length. Fourteen samples were unreadable for age, so a total of 1,487 samples were used for analysis. Based on the samples read, there were 3 age classes. Within the sample, age-1 was the most abundant age class (61.9%), followed by age-2 (32.7%), and age-3 (5.4%). The average length of the sampled age-1 sockeye salmon smolt was 106.0 mm (± 1.7) and the average weight was 11.9 g (± 0.2). The average length of the age-2 sockeye salmon smolt was 117.4 mm (± 1.1) and the average weight of was 16.9 g (± 0.5). The average length of the age-3 sockeye salmon smolt was 147.2 mm (± 4.1) and the weight was 32.9 g (± 2.6) (Table 1).

During the same time period, staff also collected 600 coho salmon, took scale samples, weight, and measurements for fork length. Sixteen samples were unreadable for age, so a total of 584 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 (48.6%), followed by age-3 (29.6%), age-1 (19.7%), and age-0 (2.1%). The average length of the sampled age-2 coho salmon smolt was 126.8 mm (± 0.7) and the average weight was 20.4 g (± 0.4). The average length of the sampled age-3 coho salmon was 142.8 mm (± 1.5) and the average weight was 30.3 g (± 3.6). The average length of the sampled age-1 coho salmon smolt was 108.5 mm (± 1.4) and the average weight was 14.1 g (± 1.9). The average length of the age-0 coho salmon smolt was 79.0 mm (± 3.4) and the weight was 5.9 g (± 0.8) (Table 1).

Table 1: Stephan Lake 2010 sockeye and coho salmon smolt AWL summary

	Age Class (%)								Mean length (mm)								Mean weight (g)							
	Age 0	95% C.I.	Age 1	95% C.I.	Age 2	95% C.I.	Age 3	95% C.I.	Age 0	SD	Age 1	SD	Age 2	SD	Age 3	SD	Age 0	SD	Age 1	SD	Age 2	SD	Age 3	SD
Sockeye	NS	NS	61.9%	0.0%	32.7%	0.1%	5.4%	0.3%	NS	NS	106.0	1.7	117.4	1.1	147.2	4.1	NS	NS	11.9	0.2	16.9	0.5	32.9	2.6
Coho	2.1%	1.28%	19.7%	0.3%	48.6%	0.1%	29.6%	0.2%	79.0	3.4	108.5	1.4	126.8	0.7	142.8	1.5	5.9	0.8	14.1	1.9	20.4	0.4	30.3	3.6

NS = No Sample

RECOMMENDATIONS

Stephan Lake is an important sockeye salmon producing lake in the Susitna River Valley and is one of the few lakes remaining without the presence of 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 invasive northern pike.

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LITERATURE CITED

CIAA, 2010. Stephan Lake Smolt Procedures Manual. Cook Inlet Aquaculture Association.

Spafard, M.A., and J.A. Edmundson. 2000. A Morphometric Atlas of Alaskan Lakes: Cook Inlet, Prince William Sound, and Bristol Bay Areas. Alaska Department of Fish and Game Regional Information Report. 2A00-23: 24.

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APPENDICES

Appendix 1: Stephan Lake 2010 environmental conditions

Date	Sky	Precip. (mm)	Stage* (ft)	Water Temp. (°C)	Air Temp. (°C)
18-May	2	0	0	5	ND
19-May	4	0	0.1	7	21
20-May	2	22	0.5	4	21
21-May	2	0	0.5	5	22
22-May	3	0	0.4	6	20
23-May	2	0	0.3	7	20
24-May	2	0	0.2	8	29
25-May	3	0	0.1	9	15
26-May	5	0	0.2	9	20
27-May	3	0	0.0	9	20
28-May	5	1	0.0	10	18
29-May	3	0	0.0	11	18
30-May	2	0	0.0	12	22
31-May	2	1	0.0	10	19
1-Jun	5	1	-0.1	11	15
2-Jun	2	0	-0.1	12	26
3-Jun	5	0	-0.2	9	10
4-Jun	5	10	-0.2	11	9
5-Jun	2	3	-0.1	11	13
6-Jun	3	0	-0.1	11	17
7-Jun	3	1	-0.1	10	15
8-Jun	4	6	0.0	11	11
9-Jun	4	4	0.0	11	17
10-Jun	5	1	-0.1	10	14
11-Jun	3	0	0.0	12	17
12-Jun	5	4	-0.1	11	9
13-Jun	4	4	-0.1	10	14
14-Jun	3	0	-0.1	11	14
15-Jun	5	6	-0.1	11	10
16-Jun	5	5	0.1	12	11
17-Jun	4	4	0.1	12	14
18-Jun	3	1	0.1	11	20
19-Jun	5	1	0.1	11	16
20-Jun	3	6	0.1	13	21
21-Jun	3	1	0.1	14	22
22-Jun	3	0	0.1	14	19
23-Jun	3	0	0.1	13	28
24-Jun	2	0	0.2	15	24
25-Jun	2	2	0.3	14	23
Total		80			
Avg.		2	0.1	10	18
Min.		0	-0.2	4	9
Max.		22	0.5	15	29

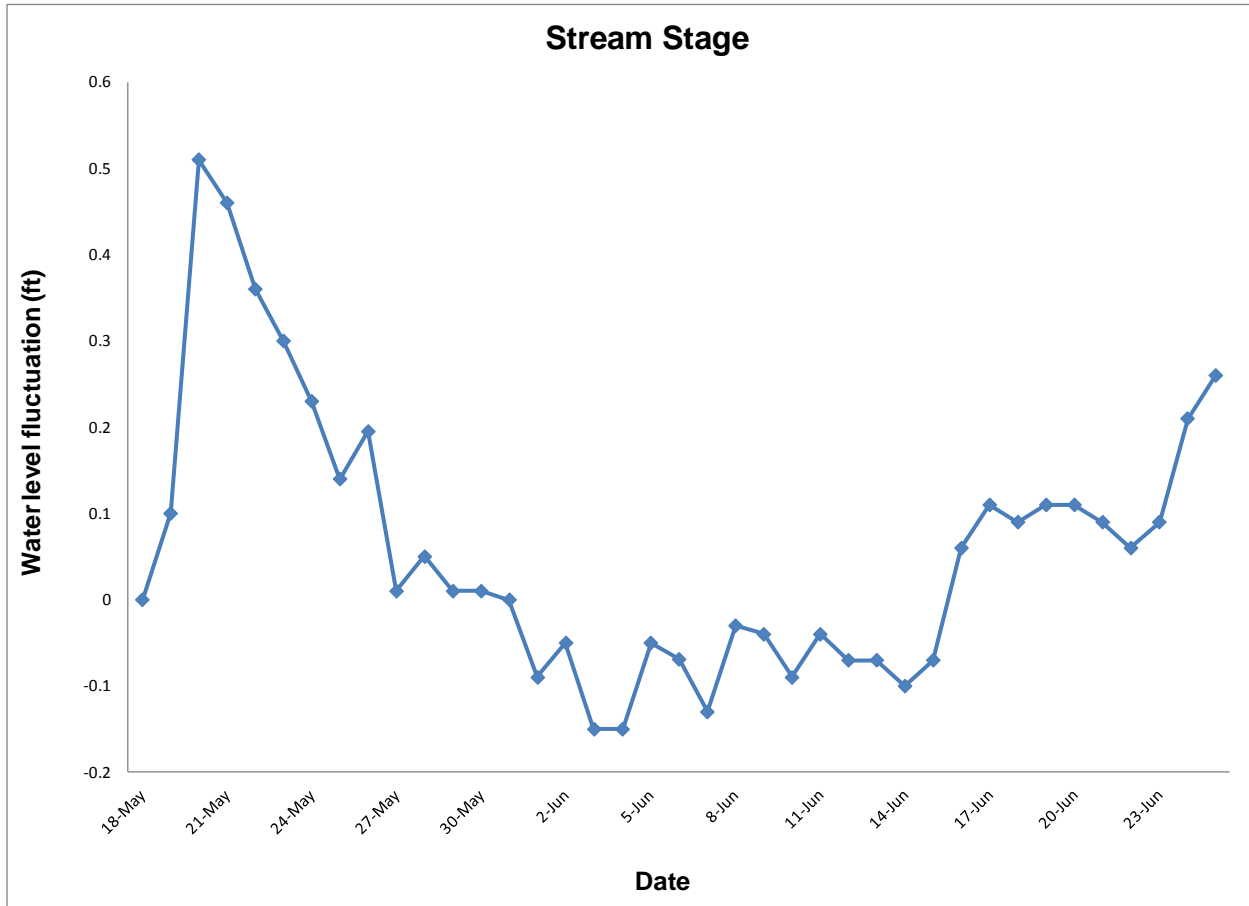
* - Does not reflect actual water depth, only water level fluctuation

Summary of Cloud Cover - Percent of Days					
	No.	Clear	Partly	Overcast	Rain
	Days		Cloudy		
Smolt	39	0%	62%	13%	26%

ND = No Data

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

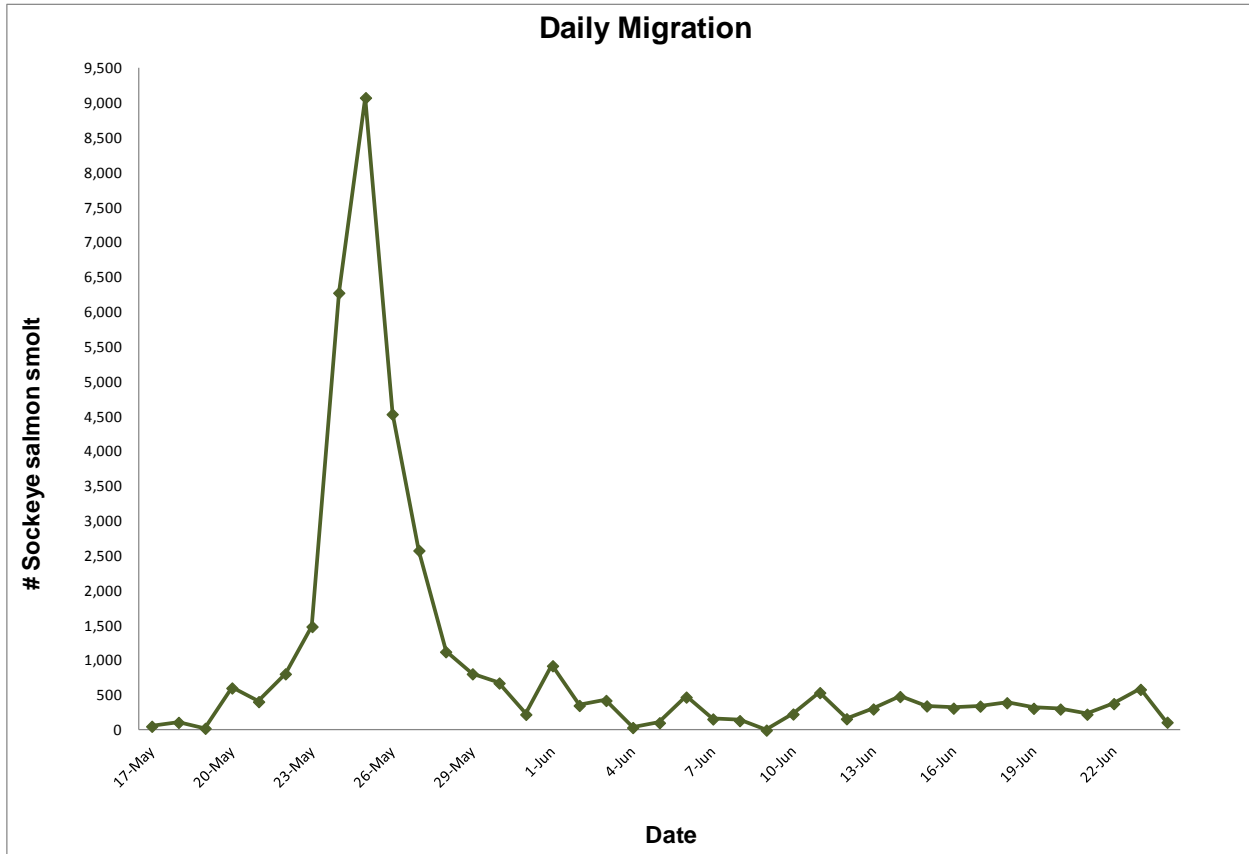
Appendix 2: Stephan Lake 2010 water level fluctuation



Appendix 3: Stephan Lake 2010 daily smolt migration

Date	Sockeye		Coho		Chinook		Pink		Chum		Rainbow		Arctic char	
	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total
17-May	60	60	0	0	0	0	0	0	0	0	0	0	0	0
18-May	116	176	0	0	0	0	0	0	0	0	0	0	0	0
19-May	31	207	0	0	0	0	0	0	0	0	0	0	0	0
20-May	610	817	0	0	0	0	0	0	0	0	0	0	0	0
21-May	414	1,231	0	0	0	0	0	0	0	0	0	0	0	0
22-May	813	2,044	0	0	0	0	0	0	0	0	0	0	0	0
23-May	1,492	3,536	0	0	0	0	0	0	0	0	0	0	0	0
24-May	6,283	9,819	0	0	0	0	0	0	0	0	0	0	0	0
25-May	9,084	18,903	0	0	0	0	0	0	0	0	0	0	0	0
26-May	4,541	23,444	105	105	0	0	0	0	0	0	0	0	0	0
27-May	2,584	26,028	265	370	0	0	0	0	0	0	0	0	0	0
28-May	1,130	27,158	177	547	0	0	0	0	0	0	0	0	0	0
29-May	813	27,971	167	714	0	0	0	0	0	0	0	0	0	0
30-May	681	28,652	120	834	0	0	0	0	0	0	0	0	0	0
31-May	231	28,883	78	912	0	0	0	0	0	0	0	0	0	0
1-Jun	929	29,812	59	971	0	0	0	0	0	0	0	0	0	0
2-Jun	359	30,171	139	1,110	0	0	0	0	0	0	0	0	0	0
3-Jun	431	30,602	269	1,379	0	0	0	0	0	0	0	0	0	0
4-Jun	42	30,644	234	1,613	0	0	0	0	0	0	0	0	0	0
5-Jun	111	30,755	22	1,635	0	0	0	0	0	0	0	0	0	0
6-Jun	479	31,234	697	2,332	0	0	0	0	0	0	0	0	0	0
7-Jun	165	31,399	688	3,020	0	0	0	0	0	0	0	0	0	0
8-Jun	141	31,540	320	3,340	0	0	0	0	0	0	0	0	0	0
9-Jun	5	31,545	560	3,900	0	0	0	0	0	0	0	0	0	0
10-Jun	236	31,781	677	4,577	0	0	0	0	0	0	0	0	0	0
11-Jun	543	32,324	1351	5,928	0	0	0	0	0	0	1	1	0	0
12-Jun	168	32,492	813	6,741	0	0	0	0	0	0	2	3	0	0
13-Jun	308	32,800	1113	7,854	0	0	0	0	0	0	1	4	0	0
14-Jun	487	33,287	1011	8,865	0	0	0	0	0	0	0	4	0	0
15-Jun	352	33,639	1346	10,211	0	0	0	0	0	0	0	4	0	0
16-Jun	320	33,959	825	11,036	0	0	0	0	0	0	0	4	0	0
17-Jun	349	34,308	943	11,979	0	0	0	0	0	0	1	5	0	0
18-Jun	398	34,706	861	12,840	0	0	0	0	0	0	0	5	0	0
19-Jun	318	35,024	837	13,677	0	0	0	0	0	0	0	5	0	0
20-Jun	307	35,331	814	14,491	0	0	0	0	0	0	0	5	0	0
21-Jun	233	35,564	418	14,909	0	0	0	0	0	0	0	5	0	0
22-Jun	385	35,949	183	15,092	0	0	0	0	0	0	0	5	0	0
23-Jun	590	36,539	216	15,308	0	0	0	0	0	0	0	5	0	0
24-Jun	118	36,657	101	15,409	0	0	0	0	0	0	0	5	0	0
Total		36,657		15,409		0		0		0		5		0

Appendix 4: Stephan Lake 2010 daily smolt migration



Appendix 5: Stephan Lake 2010 hourly sockeye salmon smolt migration

	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		25																		35				
5/18/2010																				40	32	15		29
5/19/2010																						10	0	
5/20/2010	475						5													130				
5/21/2010																				40	218		156	
5/22/2010			114																	37	607	55		
5/23/2010			291																	140	89	894		78
5/24/2010			129																	3460		1458		614
5/25/2010															143	612	44				6939	764	377	817
5/26/2010			10																	1206	807		999	
5/27/2010																				254	1190	183	391	8
5/28/2010																				119	71	252	319	0
5/29/2010																				137	140	166	85	0
5/30/2010																				113	0	435	41	38
5/31/2010																				50	0	133	0	42
6/1/2010																				404	0	175	307	43
6/2/2010																				1	0	168	138	52
6/3/2010																				0	0	367	17	47
6/4/2010																				0	20	22	0	0
6/5/2010																				0	24	46	41	0
6/6/2010																				191	190	46	32	18
6/7/2010																				0	0	31	133	1
6/8/2010																				0	53	44	44	0
6/9/2010																				0	0	5	0	0
6/10/2010																				0	42	30	184	0
6/11/2010																				230	0	205	47	2
6/12/2010																				9	13	45	14	63
6/13/2010																				55	40	46	68	55
6/14/2010																				213	205	46	14	0
6/15/2010																				84	146	45	0	24
6/16/2010																				133	79	48	0	8
6/17/2010																				39	81	47	27	0
6/18/2010																				112	225	45	0	7
6/19/2010																				0	127	146	7	0
6/20/2010																				63	104	116	5	0
6/21/2010																				49	120	19	33	0
6/22/2010																				17	271	43	25	0
6/23/2010																				235	286	13	0	42
6/24/2010																				0	48	11	0	0

Appendix 6: Stephan Lake 2010 cumulative sockeye salmon smolt migration

