

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

**Prepared by:  
Nathan Weber, Biologist  
June 2013**

**The Byers Lake Project was made possible through enhancement taxes paid by the commercial fishermen in Area H Cook Inlet and associated waters, 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 Byers Lake. This report encompasses data collected from the 2010 sockeye salmon smolt migration as it falls under the Alaska Sustainable Salmon Fund grant.

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 later data reports.

The Byers Lake Data Report was prepared by Cook Inlet Aquaculture Association 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. The statements, findings, conclusions, and recommendations are those of the author and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration, the U.S. Department of Commerce, or the Alaska Department of Fish and Game.

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## **ACKNOWLEDGEMENTS**

Many individuals and agencies contributed to the success of the Byers Lake Project. Appreciation is extended to Cook Inlet Aquaculture Association Interns Will Horner and Jake Novitsky, Seasonal Assistant Matt Smukall, and all full-time staff who aided in the field. 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 (*Oncorhynchus nerka*) abundance in key salmon producing lakes with and without invasive 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 Byers Lake. The project also documented other migrating fish species during this time and where applicable collected samples from coho smolt. In addition, CIAA found no presence of northern pike during this time.

The 2010 smolt migration was enumerated from 22 May and continued daily until 26 June. During this time, 17,317 sockeye salmon (*O. nerka*) and 10,852 coho salmon (*O. kisutch*) smolts migrated from the lake.

Based on the readable sockeye samples collected (n=1,203), an estimated 97% ( $\pm 0.002\%$ ) were age-1 and 3% ( $\pm 0.5\%$ ) were age-2. The average length and weight of age-1 sockeye smolt were 96 mm ( $\pm 1$  mm) and 8.8g ( $\pm 0.2$  g). The average length and weight of age-2 sockeye smolt were 118 mm ( $\pm 2$  mm) and 17.4 g ( $\pm 1.0$  g).

Based on the readable coho samples collected (n=602), an estimated 0.9% ( $\pm 2.3\%$ ) were age-0, 67.5% ( $\pm 0.1\%$ ) were age-1, 31.2% ( $\pm 0.2\%$ ) were age-2, and 0.5% ( $\pm 3.6\%$ ) were age-3. The average length and weight of age-0 smolt were 43 mm ( $\pm 19.2$  mm) and 1.8 g ( $\pm 0.4$  g). The average length and weight of age-1 smolt were 85 mm ( $\pm 1.1$  mm) and 6.9 g ( $\pm 0.5$  g). The average length and weight of age-2 smolt were 115 mm ( $\pm 1.2$  mm) and 16.4 g ( $\pm 0.5$  g). The average length and weight of age-3 smolt were 160 mm ( $\pm 24.5$  mm) and 44.1 g ( $\pm 21.4$  g).

Simple environmental conditions were also measured during this time—personnel recorded 82 mm accumulated rainfall, water level in Byers Creek fluctuated +0.58 feet, water temperature averaged 11°C, and air temperature averaged 16°C.

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## **INTRODUCTION AND PURPOSE**

To better understand the recent low adult sockeye salmon (*Oncorhynchus nerka*) returns to the Susitna River drainage system, the Cook Inlet Aquaculture Association (CIAA), in cooperation with the Alaska Department of Fish and Game (ADF&G), assessed 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 was to enumerate the smolt and adult returns and assess the characteristics of these populations in terms of age composition, sex and size. Additionally, for some lake systems, environmental conditions and water quality measurements were collected as well as the collection of genetic samples, and the performance of mark-recapture studies and hydroacoustic surveys. The goal was 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.

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## PROJECT AREA

Byers Lake is located in Denali State Park approximately 50 km north of Talkeetna, Alaska (Figure 1). Significant vegetation along the lake is alder (*Alnus* spp.), birch (*Betula* spp.) and cottonwood (*Populus* spp.). The lake covers 131.5 ha, has a maximum depth of 54.0 m, a mean depth of 20.0 m, a 6.4 km shoreline, and is located at an elevation of 248.8 m above sea level (Figure 2) (Sparfard and Edmundson, 2000). Byers Lake has a discharge via Byers Creek, which flows southwest into the Chulitna River. Monitoring activities took place in Byers Creek.

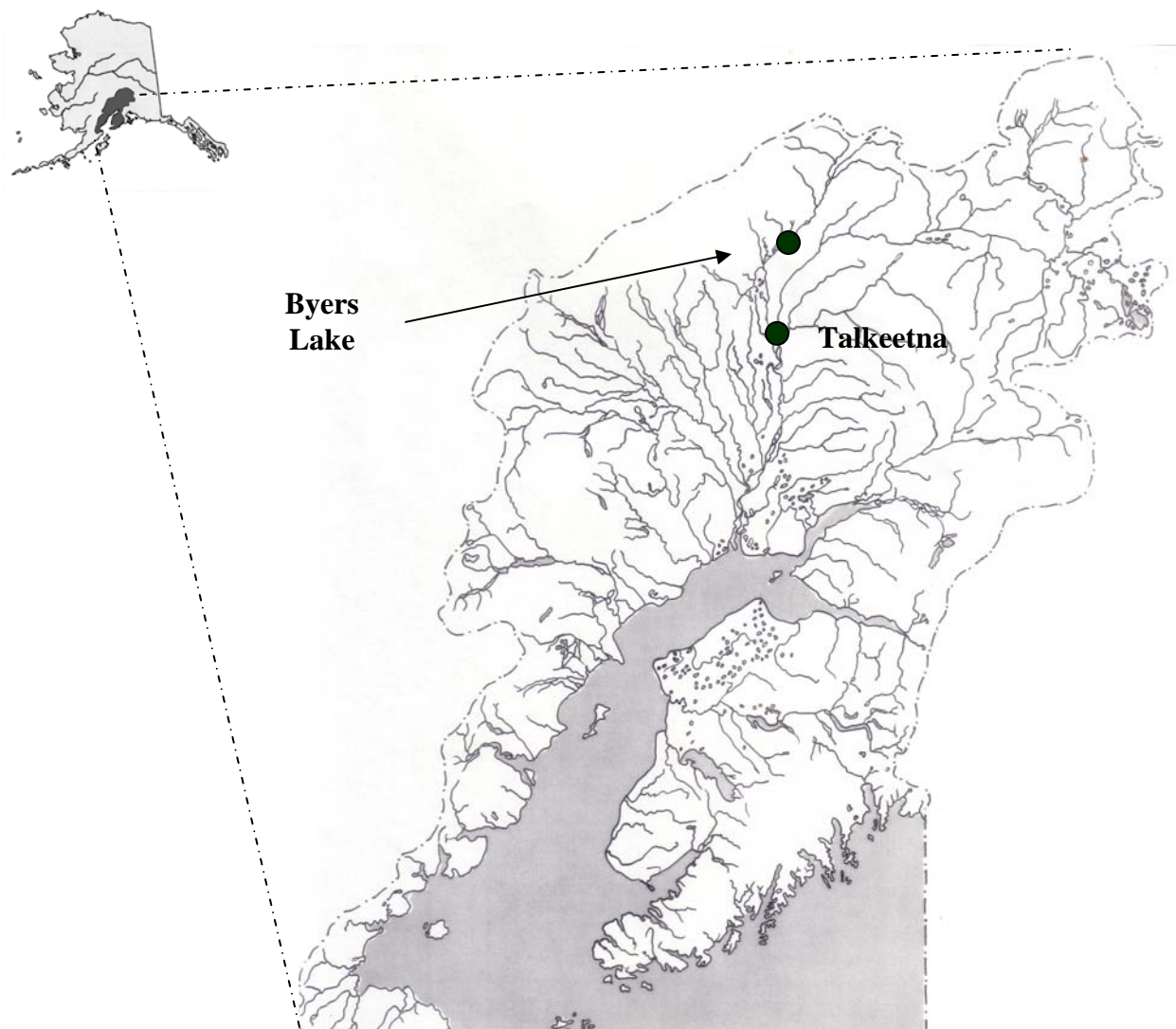


Figure 1. Byers Lake in Relation to Cook Inlet and Alaska

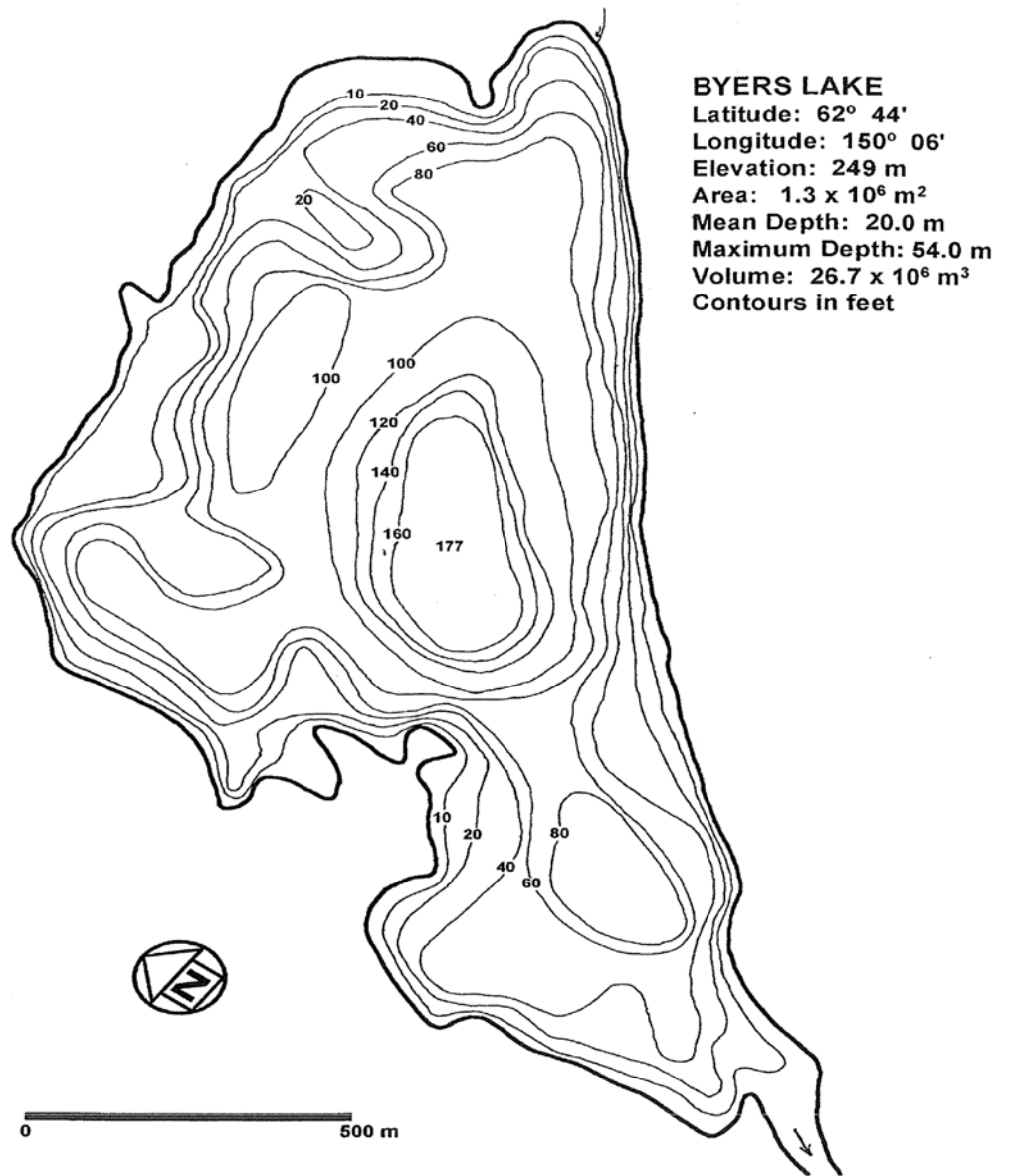


Figure 2. Bathymetric map of Byers Lake

# METHODS

## Environmental Conditions

To assess the environmental conditions during the salmon smolt migration to Byers Lake, percent cloud cover was visually estimated, water level fluctuations were measured to the nearest tenth of a foot, precipitation measured to the nearest millimeter, and water and air temperatures measured to the nearest degree centigrade. All measurements were all recorded at 5:00 PM each day (CIAA Staff, 2010).

## Smolt Enumeration

To enumerate the smolt migration, a smolt trap was temporarily placed in Byers Creek. The smolt trap consisted of a modified fyke net with Vexar® netting leads and a double compartment live-box. The leads were anchored bank to bank and fyke net funneled migrating smolt into the live-box. A swing gate remotely controlled by the trap operators directed smolt into one of two live-box compartments where they were enumerated and a smolt sample was collected. The fish were then released downstream of the trap. A total count was used during the smolt migration.

## Smolt Characteristics

The Byers Lake smolt characteristics were assessed by collecting a sample of the migrating smolts and measured for age, weight, and length. Throughout each day, field personnel randomly collected sockeye (up to 40 per day) and coho samples (up to 20 per day). Each smolt collected for evaluation was first measured to the nearest millimeter for fork length<sup>1</sup> and then weighed to the nearest 0.1 g. Several scales were also removed from the primary growth area<sup>2</sup> and mounted on a glass slide for subsequent age determination. Scale samples were read by CIAA full-time staff at headquarters in Kenai.

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<sup>1</sup> Standard fork length was measured from the tip of the snout to the fork of the tail.

<sup>2</sup> The 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 AND DISCUSSION

### Environmental Conditions

During the 2010 smolt migration, environmental conditions were monitored from 22 May to 24 June. Water level in Byers Creek fluctuated +0.58 during this time. Stream temperatures averaged 11°C and ranged from 5 to 16°C. Air temperatures averaged 16°C and ranged from 9 to 22°C. Nine percent of the days were clear, 53% were partly cloudy, and 38% were completely overcast. Measurable rain was recorded on 16 days during the smolt migration. A total of 82 mm of rain fell during this period.

### Smolt Enumeration

The 2010 smolt migration was enumerated from 22 May and continued daily until 24 June. During this time, 17,317 sockeye (*O. nerka*) and 10,852 coho (*O. kisutch*) smolts migrated from the Byers Lake (Figure 3). Other fish counted during this time were 12 Chinook salmon smolt (*O. tshawytscha*), 23 adult rainbow trout (*O. mykiss*), 33 adult longnose sucker (*Catostomus catostomus*), and 1 Arctic grayling (*Thymallus arcticus*).

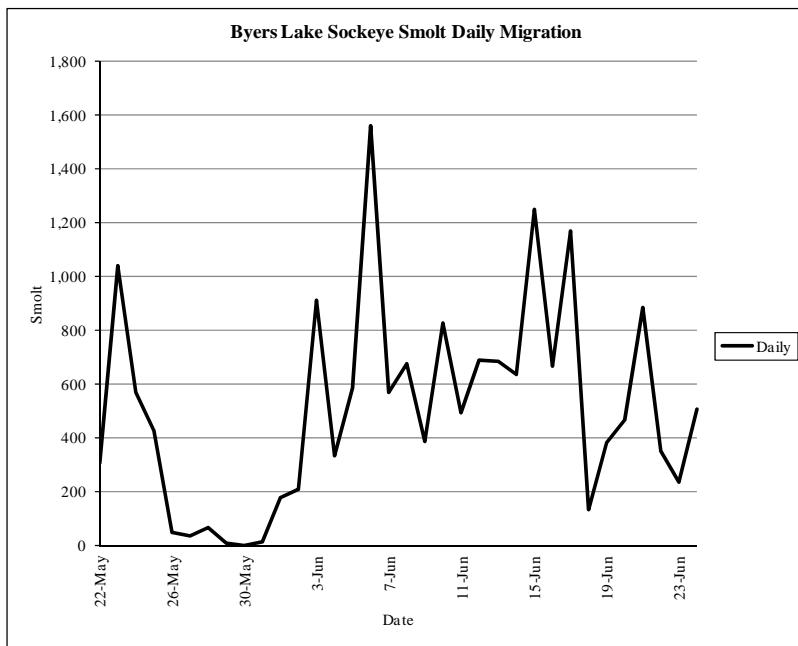


Figure 3. Sockeye Smolt Daily Migration

## Smolt Characteristics

Based on 1,203 readable sockeye samples, an estimated 97% ( $\pm 0.002\%$ ) were age-1 and 3% ( $\pm 0.5\%$ ) were age-2 (Table 1). The average length and weight of age-1 sockeye smolt were 96 mm ( $\pm 1$  mm) and 8.8g ( $\pm 0.2$  g). The average length and weight of age-2 sockeye smolt were 118 mm ( $\pm 2$  mm) and 17.4 g ( $\pm 1.0$  g).

Table 1. Summary of sockeye salmon smolt characteristics, 2007–2010

Smolt Year	Migration	Age Class (%)				Mean length (mm)				Mean weight (g)			
		Age 1	95% C.I.	Age 2	95% C.I.	Age 1	95% C.I.	Age 2	95% C.I.	Age 1	95% C.I.	Age 2	95% C.I.
2007	15,530	99%	( $\pm 0.001$ )	1%	( $\pm 3.5$ )	99	( $\pm 0.4$ )	102	( $\pm 3.5$ )	8.5	( $\pm 0.2$ )	9.9	( $\pm 3.5$ )
2008	6,470	99%	( $\pm 0.002$ )	1%	( $\pm 3.2$ )	90	( $\pm 0.8$ )	127	( $\pm 13$ )	7.1	( $\pm 1.9$ )	18.7	( $\pm 6.5$ )
2009	14,841	99%	( $\pm 0.001$ )	1%	( $\pm 1.7$ )	93	( $\pm 0.4$ )	101	( $\pm 13.5$ )	8.2	( $\pm 0.1$ )	10.5	( $\pm 4.3$ )
2010	17,317	97%	( $\pm 0.002$ )	3%	( $\pm 0.5$ )	96	( $\pm 0.5$ )	118	( $\pm 2.2$ )	8.8	( $\pm 0.2$ )	17.4	( $\pm 1.0$ )
Mean	13,540	99%		1%		94		112		8.2		14.1	

Based on 602 readable coho samples, an estimated 0.9% ( $\pm 2.3\%$ ) were age-0, 67.5% ( $\pm 0.1\%$ ) were age-1, 31.2% ( $\pm 0.2\%$ ) were age-2, and 0.5% ( $\pm 3.6\%$ ) were age-3 (Table 2). The average length and weight of age-0 smolt were 43 mm ( $\pm 19.2$  mm) and 1.8 g ( $\pm 0.4$  g). The average length and weight of age-1 smolt were 85 mm ( $\pm 1.1$  mm) and 6.9 g ( $\pm 0.5$  g). The average length and weight of age-2 smolt were 115 mm ( $\pm 1.2$  mm) and 16.4 g ( $\pm 0.5$  g). The average length and weight of age-3 smolt were 160 mm ( $\pm 24.5$  mm) and 44.1 g ( $\pm 21.4$  g).

Table 2. Summary of coho salmon smolt characteristics, 2007–2010

Smolt Year	Migration	Age Class (%)									Mean length (mm)									Mean weight (g)								
		Age 0	Age 1	95% C.I.	Age 2	95% C.I.	Age 3	95% C.I.	Age 0	95% C.I.	Age 1	95% C.I.	Age 2	95% C.I.	Age 3	95% C.I.	Age 0	95% C.I.	Age 1	95% C.I.	Age 2	95% C.I.	Age 3	95% C.I.				
2007	982	100%	0%	ND	0%	ND	0%	ND	72	( $\pm 2.6$ )	ND	ND	ND	ND	ND	ND	2.7	( $\pm 0.4$ )	ND	ND	ND	ND	ND	ND				
2008	24,287	0%	31.2%	( $\pm 0.3$ )	66.7%	( $\pm 0.1$ )	2.2%	( $\pm 2.1$ )	ND	ND	110	( $\pm 13.2$ )	117	( $\pm 1.2$ )	141	( $\pm 2.05$ )	ND	ND	11.2	( $\pm 1.0$ )	15.6	( $\pm 0.6$ )	25.3	( $\pm 8.7$ )				
2009	17,675	0%	10.9%	( $\pm 0.6$ )	87.5%	( $\pm 0.03$ )	0.2%	ND	ND	ND	104	( $\pm 2.2$ )	115	( $\pm 0.7$ )	144	ND	ND	ND	11.7	( $\pm 0.7$ )	15.8	( $\pm 0.3$ )	35.8	ND				
2010	10,852	0.9%	67.5%	( $\pm 0.1$ )	31.2%	( $\pm 0.2$ )	0.5%	( $\pm 4$ )	ND	ND	85	( $\pm 1.1$ )	115	( $\pm 1.2$ )	160	( $\pm 24.5$ )	ND	ND	6.9	( $\pm 0.3$ )	16.4	( $\pm 0.5$ )	44.1	( $\pm 21.4$ )				
Mean	13,449	25%	27%		46%		1%		72		100		116		148		2.7		9.9		15.9		35.1					

ND = No Data

2009 - There was only 1 coho salmon sample collected from the age-3 class, therefore there was insufficient data to analyze.

2010 - There were 0.9% ( $\pm 2.3\%$ ) coho salmon that were age-0.

## Discussion

The 2010 smolt migration was the 4<sup>th</sup> consecutive year CIAA monitored sockeye and coho smolts leaving Byers Lake. Personnel arrived to the lake on 15 May in anticipation of



monitoring the beginning of the migration but were delayed 7 days by remaining lake ice. The first 2 days were spent constructing the field camp and the following 5 days were spent transporting and installing the sampling gear in the creek. Lake ice prevented personnel from accessing the lake by watercraft, which was the most efficient method to haul sampling gear from the lake to the creek. Personnel were limited to transporting the sampling gear by hand via an established trail that lead near the lake outlet, and then carried the gear through heavy brush to the sampling site. Breaking lake ice and strong water flow further delayed personnel in completing the installation until the trap was considered fish-tight by 8:00 PM on 22 May. Typically, monitoring should begin before any significant smolt are enumerated leaving the lake to accurately record the smolt migration in its entirety. Due to the delayed start of the enumeration it was suspected smolt began migrating before 22 May.

The 2010 sockeye smolt migration was similar to previous enumerations in that age-1 smolt (97%) dominated the age composition followed by age-2 smolt (3%). The 2007–2010 average sockeye smolt were comprised of 99% of the age-1 class and 1% of the age-2 class. The coho smolt age composition in comparison was comprised of 46% age-2, 27% age-1, 25% age-0, and 1% age-3 from 2007–2010.

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## **RECOMMENDATIONS**

In future salmon smolt monitoring activities at Byers Lake, the smolt enumeration should begin prior to May 15 in order to record data before any significant numbers of smolt migrate from the lake.

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## **LITERATURE CITED**

CIAA, 2010. Byers Lake 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, Commercial Fisheries Division, Regional Information Report No. 2A00-23:21.

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## **APPENDICES**

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## Appendix 1. Byers Lake 2010 – Environmental Conditions

Date	Sky	Water			Water Temp. (°C)	Air Temp. (°C)
		Precip. (mm)	Fluctuation (ft)	Flow		
22-May	2	0.0	ND	ND	ND	ND
23-May	1	0.0	ND	ND	6	18
24-May	1	0.0	ND	ND	6	20
25-May	3	22.9	ND	ND	5	11
26-May	2	0.0	ND	ND	9	16
27-May	1	0.0	ND	ND	7	14
28-May	4	0.0	ND	ND	10	20
29-May	3	0.0	ND	ND	10	21
30-May	2	1.3	2.20	ND	11	22
31-May	5	0.0	2.20	ND	13	15
1-Jun	5	1.3	2.00	ND	10	17
2-Jun	3	0.0	2.00	ND	14	17
3-Jun	5	7.6	2.00	ND	8	10
4-Jun	5	7.6	2.00	ND	9	9
5-Jun	3	3.6	1.90	ND	13	19
6-Jun	2	0.0	1.90	ND	13	16
7-Jun	2	0.0	1.80	ND	13	21
8-Jun	5	1.3	1.80	ND	10	12
9-Jun	3	0.5	1.80	ND	13	11
10-Jun	3	7.6	1.75	ND	13	19
11-Jun	3	0.0	1.76	ND	12	16
12-Jun	5	2.5	1.76	ND	11	11
13-Jun	4	1.3	1.76	ND	13	14
14-Jun	5	5.1	1.72	ND	13	15
15-Jun	5	10.2	1.74	ND	11	13
16-Jun	5	2.5	1.76	ND	10	11
17-Jun	4	3.8	1.76	ND	12	12
18-Jun	3	2.5	1.72	ND	13	20
19-Jun	4	0.0	1.70	ND	13	15
20-Jun	2	0.0	1.70	ND	14	22
21-Jun	2	0.0	1.68	ND	15	21
22-Jun	3	0.0	1.62	ND	15	20
23-Jun	2	0.0	1.62	ND	12	15
24-Jun	2	0.0	1.64	ND	16	22
Total		82				
Avg.		2.4		ND	11	16
Min.		0.0	1.62	ND	5	9
Max.		22.9	2.20	ND	16	22
Ice out = 22 May						
Summary of Cloud Cover - Percent of Days						
	No. Days	Meas. Rain	Overcast	Partly Cloudy	Clear	
Smolts	34	47%	38%	53%	9%	
1 = Clear						
2 = Cloud Cover <50%						
3 = Cloud Cover >50%						
4 = Overcast						
5 = Rain						
ND = No Data						

## Appendix 2. Byers Lake 2010 – Smolt Migration

Date	Sockeye			Coho			Chinook		Rainbow		Longnose Sucker		Arctic Grayling	
	Daily	Mort.	Total	Daily	Mort.	Total	Daily	Total	Daily	Total	Daily	Total	Daily	Total
22-May	307	0	307	52	0	52	0	0	3	0	0	0	0	0
23-May	1,040	0	1,347	77	0	129	0	0	7	0	1	0	0	0
24-May	571	0	1,918	84	0	213	0	0	2	0	0	0	0	0
25-May	426	0	2,344	53	0	266	0	0	0	0	0	0	0	0
26-May	51	0	2,395	36	0	302	0	0	2	0	4	0	0	0
27-May	35	0	2,430	6	0	308	0	0	0	0	6	0	0	0
28-May	66	0	2,496	35	0	343	0	0	1	0	0	0	0	0
29-May	11	0	2,507	54	0	397	0	0	0	0	0	0	0	0
30-May	1	0	2,508	5	0	402	0	0	0	0	0	0	0	0
31-May	12	0	2,520	17	0	419	1	1	0	0	3	0	0	0
1-Jun	177	0	2,697	313	0	732	0	1	2	0	0	0	0	0
2-Jun	208	0	2,905	19	0	751	0	1	0	0	4	0	0	0
3-Jun	913	0	3,818	53	0	804	0	1	0	0	0	0	0	0
4-Jun	333	0	4,151	57	0	861	0	1	0	0	5	0	0	0
5-Jun	586	0	4,737	93	0	954	0	1	0	0	0	0	0	0
6-Jun	1,563	0	6,300	268	0	1,222	1	2	0	0	3	0	0	0
7-Jun	570	0	6,870	360	0	1,582	0	2	0	0	0	0	0	0
8-Jun	677	0	7,547	279	0	1,861	0	2	1	0	1	0	0	0
9-Jun	387	0	7,934	544	0	2,405	2	4	1	0	0	0	0	0
10-Jun	825	0	8,759	1,157	0	3,562	2	6	0	0	0	0	0	0
11-Jun	495	0	9,254	694	0	4,256	1	7	0	0	1	0	0	0
12-Jun	691	0	9,945	354	0	4,610	0	7	1	0	0	0	0	0
13-Jun	684	0	10,629	358	0	4,968	0	7	0	0	0	0	0	0
14-Jun	638	0	11,267	536	0	5,504	0	7	0	0	0	0	0	0
15-Jun	1,248	0	12,515	1,160	0	6,664	0	7	0	0	0	0	0	0
16-Jun	668	0	13,183	714	0	7,378	0	7	0	0	0	0	0	0
17-Jun	1,168	0	14,351	946	0	8,324	2	9	0	0	0	0	0	0
18-Jun	134	0	14,485	174	0	8,498	0	9	0	0	1	0	0	0
19-Jun	382	0	14,867	461	0	8,959	0	9	0	0	2	0	0	0
20-Jun	468	0	15,335	108	0	9,067	0	9	2	0	0	0	0	0
21-Jun	884	0	16,219	306	0	9,373	0	9	0	0	2	0	0	0
22-Jun	352	0	16,571	807	0	10,180	1	10	0	0	0	0	1	0
23-Jun	238	0	16,809	277	0	10,457	1	11	0	0	0	0	0	0
24-Jun	508	0	17,317	395	0	10,852	1	12	1	0	0	0	0	0
Total	17,317	0	17,317	10,852	0	10,852		12		23		33		1

### Appendix 3. Byers Lake 2010 – Update

Misc. Activities	
Ice-out:	22-May
Smolt Crew On-site:	15-May
Smolt Crew Off-site:	26-Jun

Smolt Migration			
Dates:	22-May to 24-Jun		
	No.	%	
Sockeyes:	17,317	100%	
Mortalities:	0	0.0%	
Age 1:	16,828	97%	
Age 2:	461	3%	
Coho:	10,852	100%	
Age 0:	92	0.9%	
Age 1:	7,321	67.5%	
Age 2:	3,383	31.2%	
Age 3:	55	0.5%	
Chinook smolt:	12		
Rainbow Trout:	23		
Longnose Sucker:	33		
Arctic Grayling:	1		

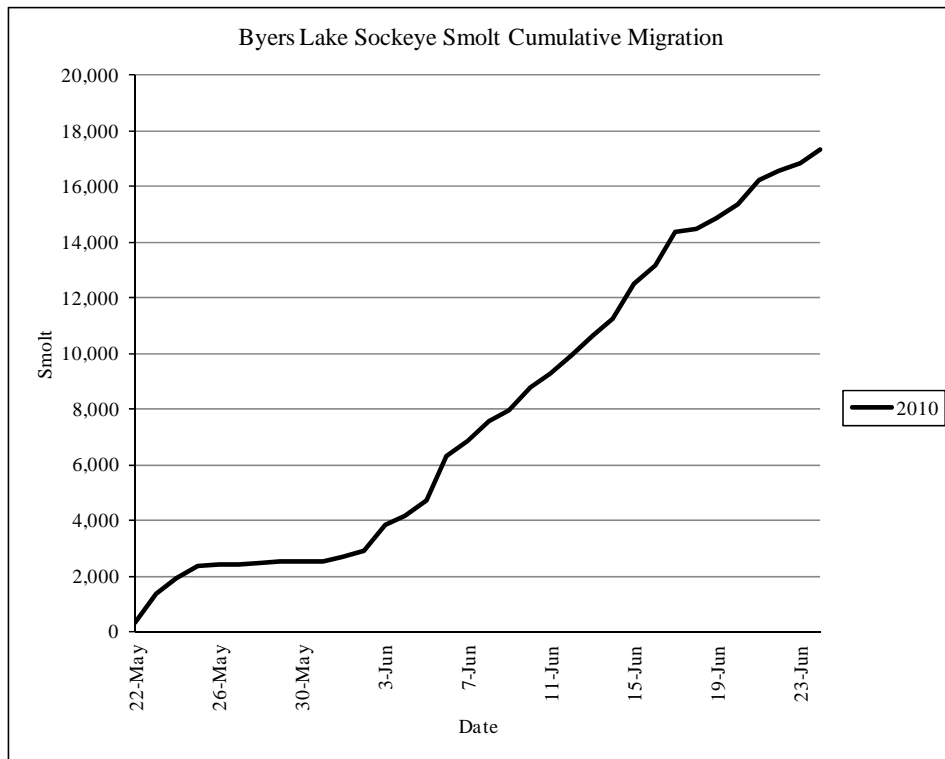


Figure 4. 2010 Byers Lake Sockeye Smolt Cumulative Migration

Appendix 4. Byers Lake – Historical Sockeye Smolt Migrations

Date	2007	2008	2009	2010
22-May	ND	ND	ND	307
23-May	ND	ND	ND	1,347
24-May	ND	ND	ND	1,918
25-May	632	ND	ND	2,344
26-May	1,353	ND	ND	2,395
27-May	1,476	ND	ND	2,430
28-May	1,476	ND	105	2,496
29-May	1,476	ND	108	2,507
30-May	1,476	1,048	109	2,508
31-May	1,872	1,916	110	2,520
1-Jun	1,872	2,168	112	2,697
2-Jun	1,872	2,380	447	2,905
3-Jun	2,005	2,438	631	3,818
4-Jun	3,513	2,471	957	4,151
5-Jun	4,642	2,655	1,135	4,737
6-Jun	4,680	2,869	1,349	6,300
7-Jun	4,680	2,919	1,576	6,870
8-Jun	4,684	2,945	1,980	7,547
9-Jun	7,128	2,990	2,828	7,934
10-Jun	8,408	3,060	3,457	8,759
11-Jun	9,837	3,099	4,427	9,254
12-Jun	11,388	3,130	4,650	9,945
13-Jun	13,119	3,167	4,765	10,629
14-Jun	14,478	3,332	6,192	11,267
15-Jun	14,592	3,482	8,484	12,515
16-Jun	14,660	3,642	8,866	13,183
17-Jun	15,074	3,765	9,858	14,351
18-Jun	15,221	3,885	10,636	14,485
19-Jun	15,495	3,928	11,183	14,867
20-Jun	15,495	3,954	11,668	15,335
21-Jun	15,526	4,174	12,120	16,219
22-Jun	15,526	5,751	12,584	16,571
23-Jun	15,526	6,187	13,188	16,809
24-Jun	15,530	6,470	13,940	17,317
25-Jun	ND	ND	14,469	ND
26-Jun	ND	ND	14,595	ND
27-Jun	ND	ND	14,643	ND
28-Jun	ND	ND	14,659	ND
29-Jun	ND	ND	14,841	ND

ND = No Data