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JOINT BASE ELMENDORF-RICHARDSON
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ENVIRONMENTAL CONSERVATION PROGRAM

ABUNDANCE AND RUN TIMING OF SMOLT AND ADULT SALMON IN THE SIXMILE CREEK DRAINAGE, JOINT BASE ELMENDORF-RICHARDSON, ALASKA, 2016

Final February 2017

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Prepared for:

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Symbols and Abbreviations

Alaska Department of Fish and Game	ADF&G
Air Force Base	AFB
Celsius	°C
Center for Environmental Management of Military Lands	CEMML
Civil Engineers Installation Environmental Conservation	CEIEC
Cook Inlet Beluga Whale	CIBW
Department of Defense	DoD
Feet	‘ or ft
Height	H
Joint Base Elmendorf-Richardson	JBER
Kilometers	km
Length	L
Meters	m
National Marine Fisheries Service	NMFS
National Oceanic & Atmospheric Administration	NOAA
United States Army Corp of Engineers	USACE
Width	w

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Abstract

In 2008, the National Marine Fisheries Service (NMFS) listed the Cook Inlet beluga whale (*Delphinapterus leucas*) as endangered (NMFS 2008). Beluga whales are predatory in nature and follow eulachon (*Thaleichtys pacificus*) into the Upper Cook Inlet during the spring, then switch to consuming salmon (*Oncorhynchus* spp.) as the eulachon numbers decline (NMFS 2009). In 2011, critical habitat was established within Cook Inlet, including Knik Arm, into which Sixmile Creek empties (76 FR 20180, April 11, 2011). The Sixmile drainage, located on Joint Base Elmendorf-Richardson (JBER), produces sockeye (*O. nerka*), coho (*O. kisutch*), chum (*O. keta*) and pink (*O. gorbuscha*) salmon. These salmon are likely food sources for the beluga whales and part of a small sport fishery. Thus, monitoring these populations is a necessity for JBER.

A fyke weir was used to enumerate out-migrating smolt, and a weir was used to enumerate adult salmon at the outlet of Lower Sixmile Lake, using the same methodology that was used in 2015 (CEIEC 2015). The estimated smolt out-migration for 2016 for sockeye was 1,245, and 862 for coho. The 2016 sockeye smolt out-migration counts were the lowest recorded in the 11 years smolt have been enumerated. However, this was the second largest coho out-migration count recorded. A total of 1,228 adult sockeye and 67 adult coho were enumerated using the weir in 2016. The adult sockeye counts were considerably lower than the previous 18-year cumulative average of 3,203 salmon. The adult coho cumulative escapement was also lower compared to the 13-year cumulative average of 85. Current management recommendations for this system are: (1) continue to monitor the out-migrating smolt salmon and the returning adult salmon, (2) extend the adult salmon sampling period to ensure a more representative count of coho occurs, and (3) continue monitoring water quality parameters.

Introduction

In 2008, the National Marine Fisheries Service (NMFS) listed the Cook Inlet beluga whale (*Delphinapterus leucas*) as endangered (NMFS 2008). Beluga whales are predatory in nature and follow eulachon (*Thaleichtys pacificus*) into the Upper Cook Inlet during the spring, then switch to consuming salmon (*Oncorhynchus* spp.) as the eulachon numbers decline (NMFS 2009). In 2011, critical habitat was established within Cook Inlet, including Knik Arm in front of the mouth of Sixmile Creek (76 FR 20180, April 11, 2011). Included in the designation was a list of factors that the NMFS deemed essential to the survival and recovery of the Cook Inlet beluga. These factors or Primary Constituent Elements (PCEs) include all of the Pacific salmon species with the exception of pink salmon (*O. grobuscha*). The Sixmile drainage, located on Joint Base Elmendorf-Richardson (JBER), produces sockeye (*O. nerka*), coho (*O. kisutch*), chum (*O. keta*) and pink salmon. Belugas are commonly seen milling at the mouth of Sixmile during the fall, and it is assumed that they are foraging for salmon returning to the creek. Monitoring productivity of this population is important in terms of the beluga (i.e., PCE) as well as for management of the small sport fishery at the mouth.

Background

The Sixmile Creek drainage (Figure 1), located in south-central Alaska, consists of Upper and Lower Sixmile lakes and Sixmile Creek on JBER. The lakes were created in 1951 when Sixmile Creek was dammed in two locations (Abbott and Allgair n.d.) to create a floatplane base. The first records of sockeye salmon (*Oncorhynchus nerka*) in the Sixmile Creek drainage occurred in 1975 (Rothe et al. 1983). These sockeye have been genetically linked to stocks in Big Lake and Fish Creek (Habicht et al. 2007).

In 1988, the Conservation and Planning Element of the Environmental Flight, 3rd Civil Engineering Squadron began monitoring the returning adult salmon using a weir and continued to monitor through 2008. In 2003, Tracey Gotthardt, with the Alaska Natural Heritage Program, conducted a field study, "Limnological and Fishery Investigations Concerning Sockeye Salmon Production in Sixmile Lakes, Elmendorf Air Force Base, Alaska" (Gotthardt 2006). This was the first time that the out-migrating smolt had been enumerated from the Sixmile lakes. In 2009 and 2010, the Alaska Department of Fish and Game (ADF&G) was contracted to conduct data collection and daily operations of the weir. In 2011, JBER's Civil Engineers Installation Environmental Conservation Section (CEIEC) once again operated the weir and collected salmon escapement data. From 2003 to 2010, enumeration of the out-migrating smolt was sporadic. Since 2012, enumerating the out-migrating smolt has become an annual project.

Out-migrating smolt have been counted from Lower Sixmile Lake beginning mid-May through June. Sixmile smolt out-migration includes sockeye and coho salmon. Sockeye salmon smolt are the most abundant species, with annual counts ranging from 4,037 to 23,644, while counts of coho salmon smolt have ranged from 23 to 3,996 fish.

The Sixmile Creek adult weir is operable by mid-July, with biologists, technicians, and volunteers counting and releasing salmon until mid-September. Four out of the five North American Pacific salmon species can be found spawning in the Sixmile Creek drainage. Sockeye, coho, and a small fraction of the pink salmon can be enumerated at the weir. Sockeye salmon are the most abundant species, with annual counts ranging between 317 and 4,768, while counts of coho salmon have ranged between 1 and 527 fish.

Objective

The primary objective of this project was to continue the enumeration of the Sixmile drainage out-migrating smolt and spawning adult sockeye salmon. The secondary objective was to maintain the historical database and to evaluate long-term salmon population trends within the Sixmile drainage.

Study Site

The Sixmile Creek drainage covers approximately 2,033 acres on JBER (Figure 1). The drainage includes Sixmile Creek, Lower Sixmile Lake, and Upper Sixmile Lake. The lakes and creek occupy a valley created by an old channel of Eagle River (U.S. Department of Defense 2012). The system is recharged primarily by groundwater entering the south side of Upper Sixmile Lake. The lakes are approximately 3.4 kilometers (km) in length. Sixmile Creek flows approximately 1.5 km from Lower Sixmile Lake, draining into the Knik Arm of Cook Inlet.

During 1975, when sockeye were first recorded in Sixmile Creek drainage, a fish ladder was installed at the outflow of Lower Sixmile Lake (Gotthardt 2006). During the summer of 1996, a new fish friendly culvert with splash pool was placed between Upper and Lower Sixmile lakes. The culvert was revamped in 2004 to add a beaver baffler to prevent beavers from clogging the culvert and preventing fish passage.

From 1988 until 1997, the adult weir was located in a meadow halfway between Lower Sixmile Lake and Cook Inlet (61.29209 -149.82277). In 1998, the adult weir was relocated at the outflow of Lower Sixmile Lake under the Fairchild Avenue Bridge. This site is where both the adult weir and smolt weir are currently located.

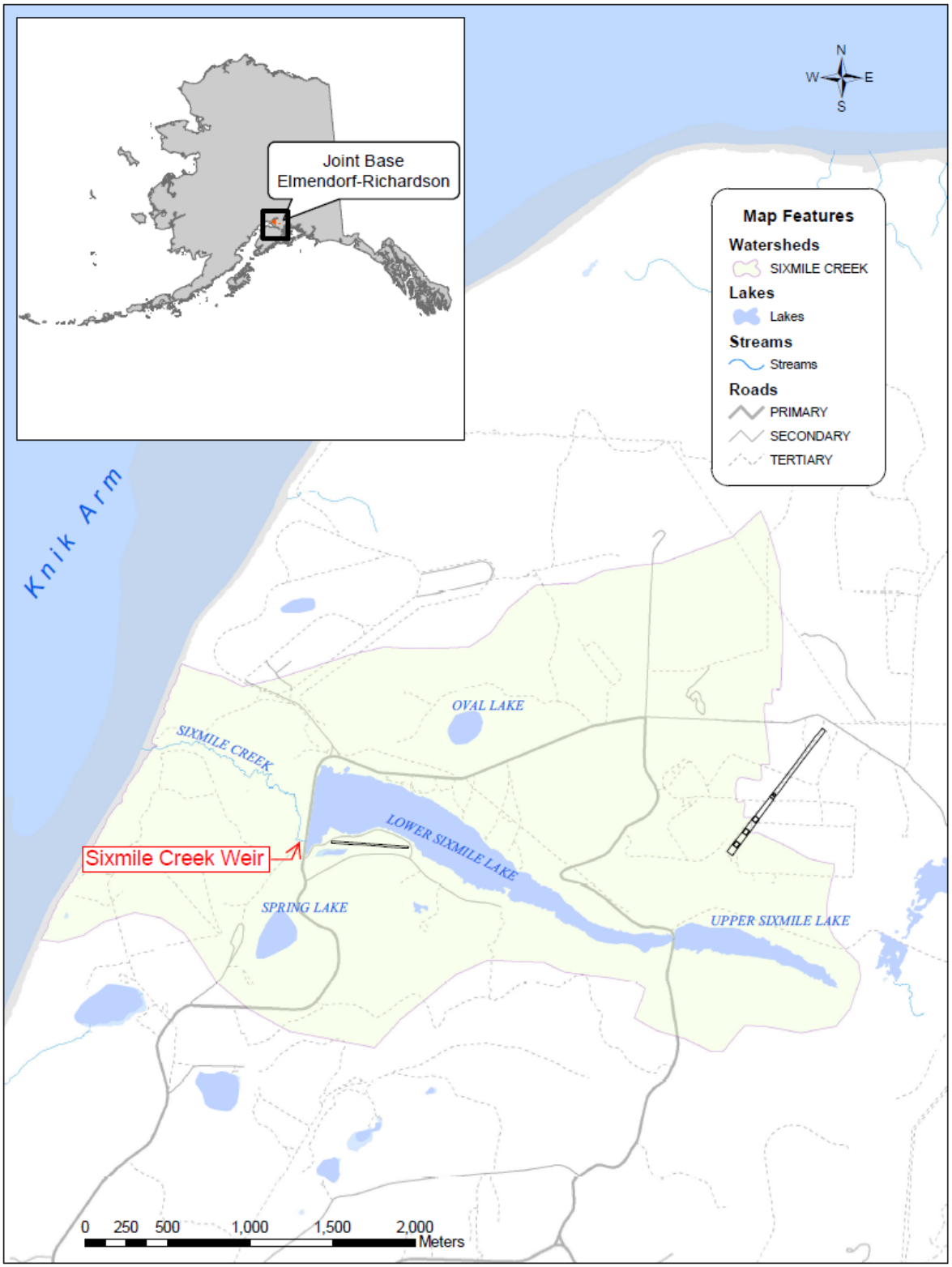

Figure 1. The Sixmile Creek drainage on JBER, AK (Gumpert 2011).

Methods

Smolt Weir Design and Operation

Sockeye and coho salmon smolt out-migrating from the Sixmile lakes are typically counted from mid-May through the end of June. In 2016, the smolts were enumerated beginning on 5 May through 23 June.

Smolts were captured by use of a weir with a live box, which was checked at least twice daily. The weir consisted of four 1.22 m x 2.44 m panels that spanned from the bridge abutment; this ensured that the entire stream width was effectively fished. These panels were made out of aluminum frame covered in poly vinyl mesh netting. The panels narrowed to a cylindrical entrance into a rectangular aluminum box with 1.0 m x 0.85 m x 0.80 m (L x W x H) dimensions. The smolts were then captured in the aluminum box using small dip nets. It is at this point, identification of the smolt occurred using Pollard et al. (1997) Field Identification of Costal Juvenile Salmonids book.

The panels were inspected daily by the sampling crew for gaps that could allow smolt to pass through undetected. Water temperature, in Celsius (°C), was recorded on a daily basis.

Adult Weir Design and Operation

Adult sockeye, coho, and a few pink salmon were counted and released into Lower Sixmile Lake. The adult salmon counts typically occur between mid-July and mid-September. In 2016, adults were counted beginning on 5 July through 30 September. A custom mobile picket weir with a gate that can be lifted to allow controlled fish passage was used to enumerate salmon. The weir was visually inspected daily to ensure that there were no gaps that would allow salmon to pass through undetected, and it was also cleaned of debris. Before the gate was opened to pass fish, the exit of the fish ladder was blocked so that fish were unable to escape downstream. A beach seine net was used to school the fish through the open gate where they were identified using ADF&G's identification pdf and then released into the lake. Water temperature, in °C, was recorded at the site each day.

Genetics Collection

As part of the ADF&G Fish Resource Permit, genetic samples were collected from a maximum of 100 adult coho before being counted and released into the lake. Using dog nail clippers, the axillary process was clipped and placed into a labeled bottle of ethanol for preservation. A count for the amount of fin clips collected was recorded. The preserved fin clips were given to ADF&G for analysis.

Data Analysis

CEIEC maintains two historical databases, one for the enumeration of the out-migrating smolt and the other for the enumeration of returning adults. The total number of smolt and adult sockeye and coho were added to their representative database. Cumulative and daily counts for 2016, for both the

smolt and adults, were compared to previous years' average counts. Water temperature was graphed alongside the daily smolt and adult counts for 2016 and the daily average smolt and adult counts for previous years, in order to illustrate any correlations.

Results

Smolt Weir

The smolt weir was installed on May 5, 2016, and was in place for a total of 57 days until removal on June 23, 2016. The weir was removed a week earlier than normal due to high numbers of mortalities and to prevent adding any further stress or additional mortalities on the smolt or fry. During the smolt weir operation, water temperature measured between 9.0° C and 20.5°C, with an average of 16.7° C.

A total of 1,245 sockeye and 862 coho were counted during the weir operation. The first smolts were documented on May 11, 2016, and May 14, 2016, with one coho and nine sockeye smolt, respectively. The last documented smolt, both coho and sockeye, were recorded on June 18, 2016.

Table 1. Smolt daily and cumulative counts of sockeye and coho salmon at the Sixmile Creek weir, JBER 2016.

		Sockeye		**Coho**	
Date	Temp (°C)	Daily	Cumulative	Daily	Cumulative
5-May	9.0	0	0	0	0
6-May	9.5	0	0	0	0
7-May	10.0	0	0	0	0
8-May	10.0	0	0	0	0
9-May	10.	0	0	0	0
10-May	11.3	0	0	0	0
11-May	12.5	0	0	1	1
12-May	13.4	0	0	0	1
13-May	14.8	0	0	1	2
14-May	15.0	9	9	4	6
15-May	16.0	2	11	1	7
16-May	16.3	19	30	36	43
17-May	16.3	18	48	8	51
18-May	16.3	2	50	3	54
19-May	16.5	59	109	44	98
20-May	15.3	31	140	30	128
21-May	15.3	3	143	4	132
22-May	15.5	19	162	12	144
23-May	15.3	6	168	2	146
24-May	15.5	21	189	17	163

25-May	15.3	76	265	52	215
		Sockeye		**Coho**	
Date	Temp (°C)	Daily	Cumulative	Daily	Cumulative
26-May	17.3	14	279	14	229
27-May	17.5	12	291	12	241
28-May	18.0	81	372	111	352
29-May	18.5	41	413	38	390
30-May	18.8	71	484	32	422
31-May	19.0	84	568	7	429
1-Jun	19.0	37	605	26	455
2-Jun	19.3	26	631	19	474
3-Jun	19.0	14	645	8	482
4-Jun	19.0	10	655	6	488
5-Jun	18.8	38	693	55	543
6-Jun	17.5	17	710	19	562
7-Jun	17.5	271	981	127	689
8-Jun	18.0	117	1098	44	733
9-Jun	18.0	76	1174	79	812
10-Jun	18.5	27	1201	2	814
11-Jun	18.3	7	1208	7	821
12-Jun	17.8	9	1217	5	826
13-Jun	18.8	16	1233	32	858
14-Jun	20.0	8	1241	3	861
15-Jun	19.8	0	1241	0	861
16-Jun	20.4	0	1241	0	861
17-Jun	20.5	0	1241	0	861
18-Jun	20.0	4	1245	1	862
19-Jun	19.5	0	1245	0	862
20-Jun	18.5	0	1245	0	862
21-Jun	20.0	0	1245	0	862
22-Jun	20.5	0	1245	0	862
23-Jun	20.5	0	1245	0	862
TOTALS	**16.7 Average**		**1245**		**862**

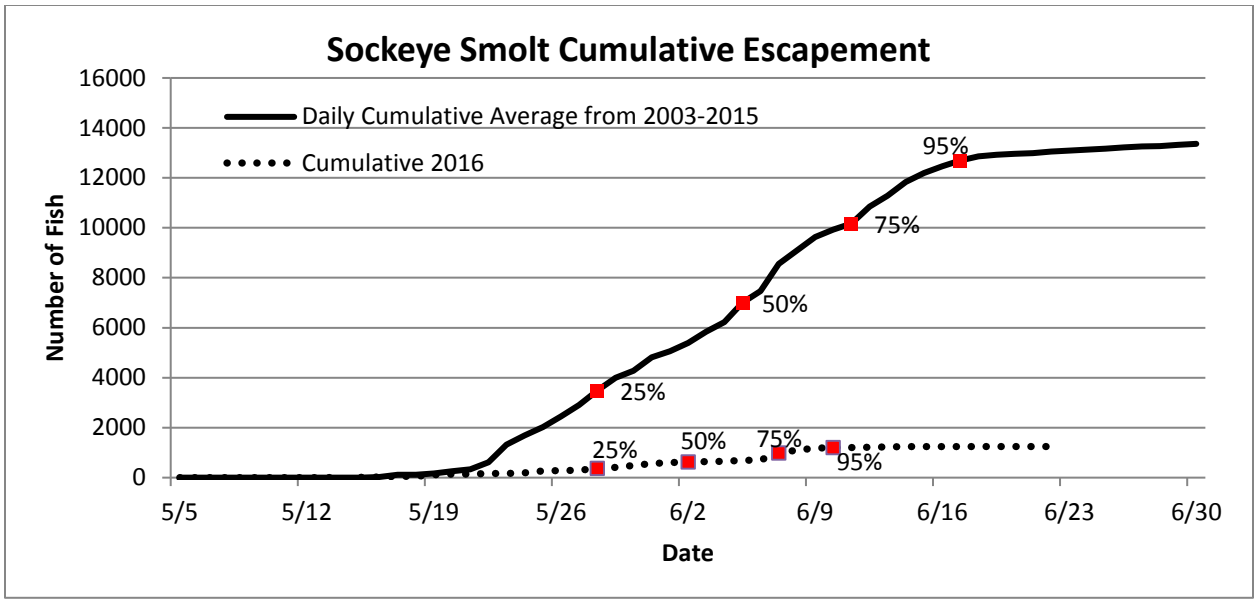

Figure 2. Daily cumulative comparison of 2016 sockeye out-migration and the average from 2003-2015.

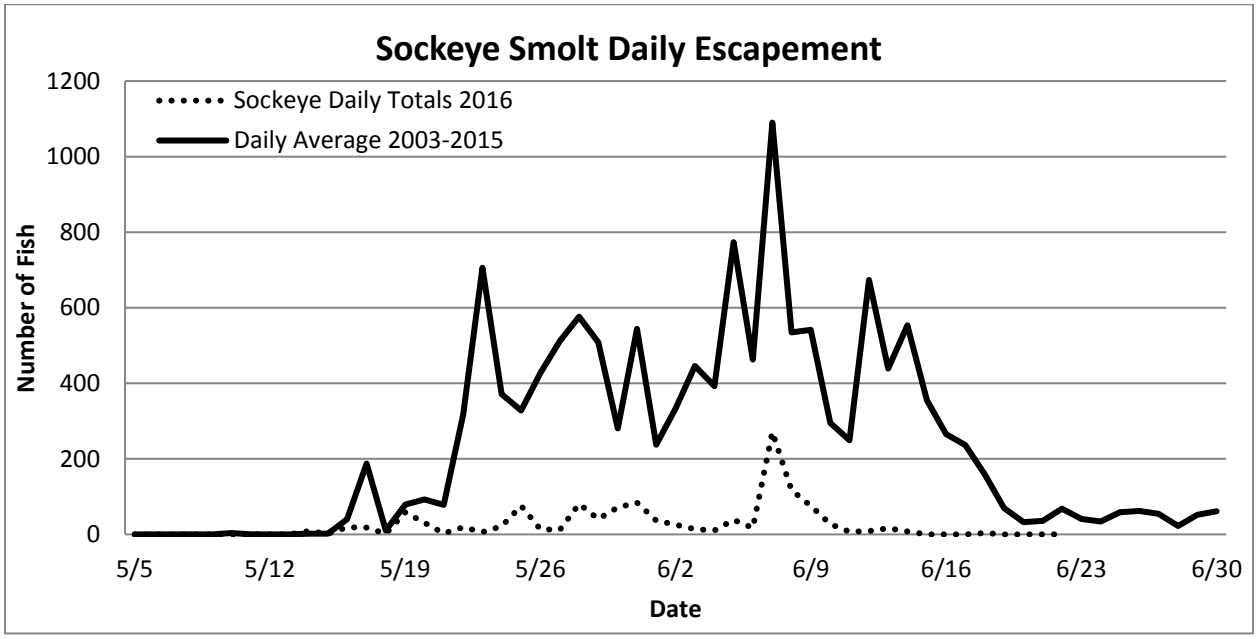

Figure 3. Daily comparison of 2016 sockeye out-migration and the average from 2003-2015.

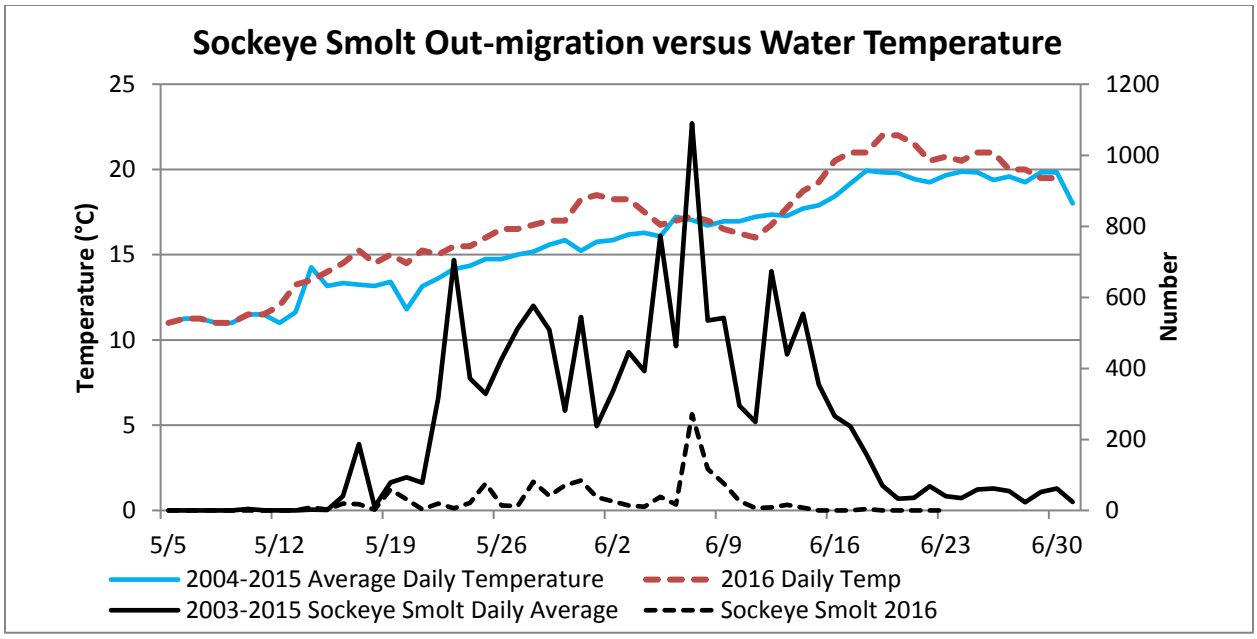

Figure 4. A comparison of 2016 and daily average 2003-2015 sockeye smolt counts to the water temperature.

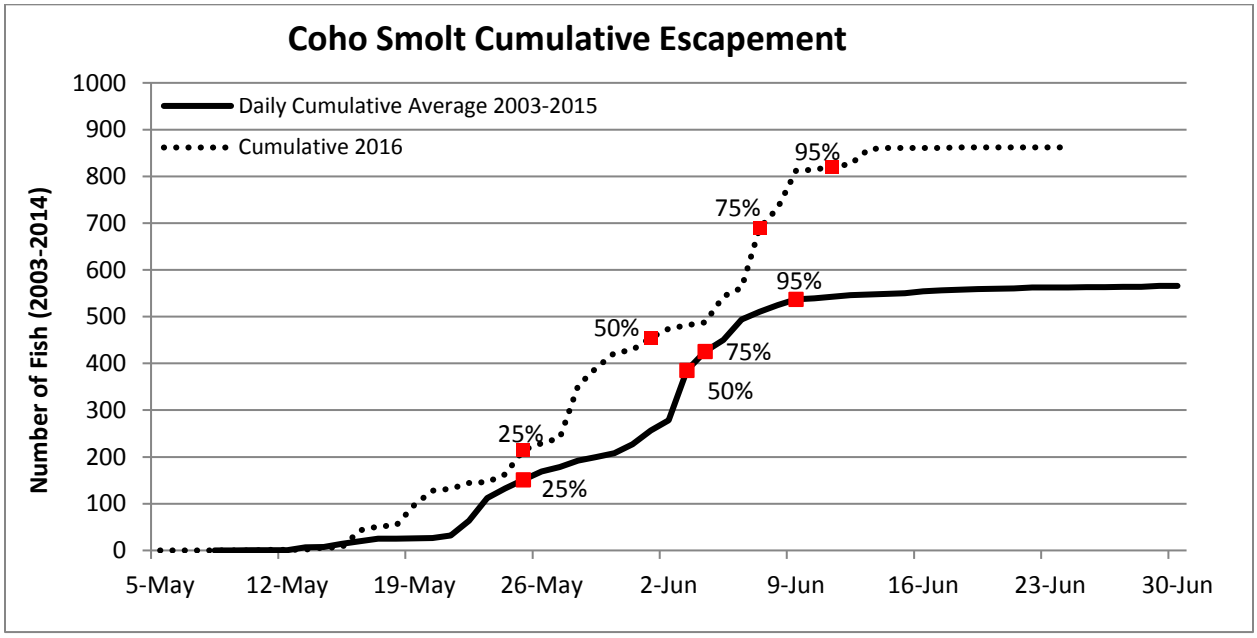

Figure 5. Daily cumulative comparison of 2016 coho out-migration and the average from 2003-2015.[1,2]

[1] Note: Not all years from 2003-2014 were sampled for smolt. See Appendix 1A and 1B for years sampled.
[2] Note: Coho salmon have not always been counted and recorded.

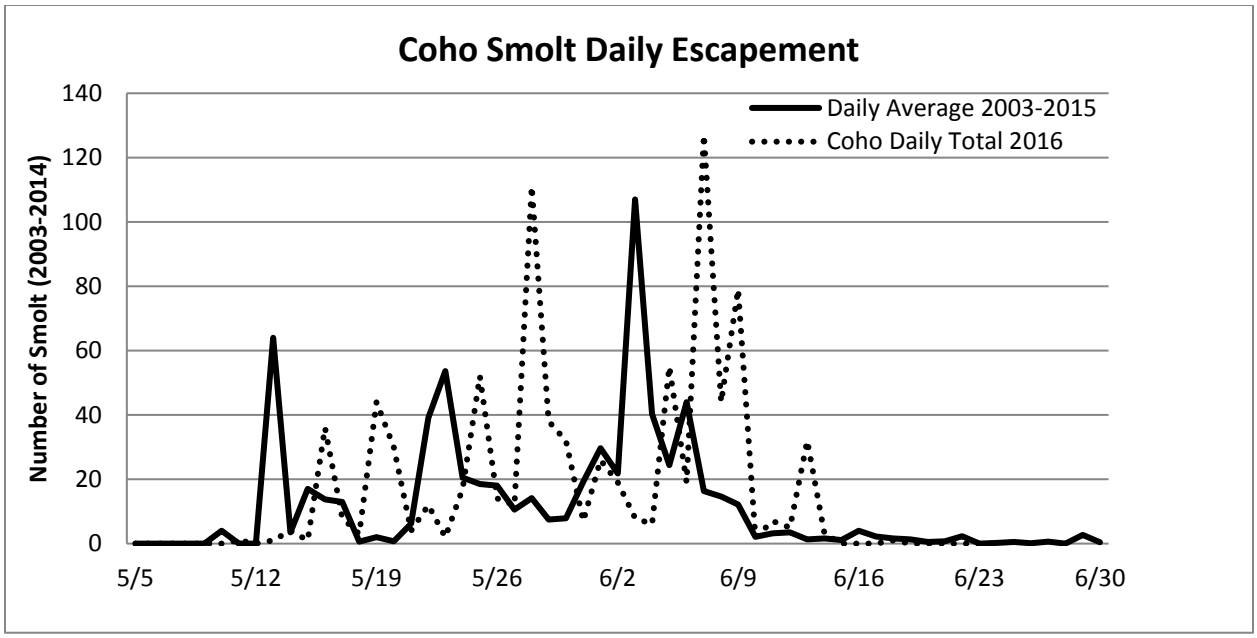

Figure 6. Daily comparison of 2016 coho out-migration and the average from 2003-2015.

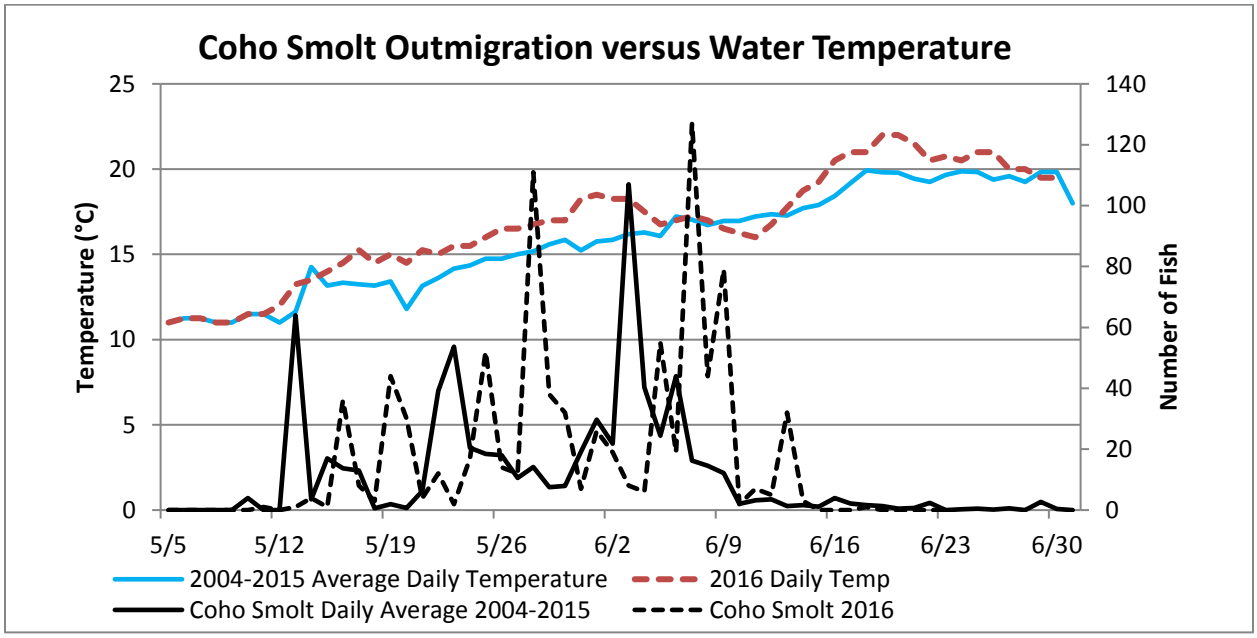

Figure 7. A comparison of 2016 and daily average 2003-2015 coho smolt counts to the water temperature.

Since the water temperatures were high during the 2016 sampling period at the sample location (under the bridge) it was suggested that an YSI be used to see what the temperature and dissolved oxygen (DO) was at the end of the lake. On 23 June, water temperature and DO was taken in Lower Sixmile Lake where smolt could potentially be holding. See Appendix 2 for more information regarding the temperature and DO readings. The highest temperature recorded occurred under the bridge (Site Smolt 9) with a temperature of 21.8°C (Table 2). The lowest DO was measured at Site 4 at a depth of 0.94 m with a DO of 27 (Table 2). No

smolt, parr or fry were observed during the assessment, except for those schooling near the trap by the bridge.

Table 2. Water temperatures and dissolved oxygen readings.

GPS Point	Depth (m)	DO%	Temperature in °C
Smolt 1	4.75	97	20
	Surface	128	21.15
Smolt 2	5.25	116	20.76
	Surface	138	20.9
Smolt 3	0.3	118	21.1
Smolt 4	3.1	27	18.8
	Surface	126	21.05
Smolt 5	3	108.6	20.57
	Surface	137	21.05
Smolt 6	2	155	20.57
	Surface	120.4	21.26
Smolt 7	.75	128	20.85
	Surface	124.5	21.28
Smolt 8	2.75	100	20.5
	Surface	131	21.2
Smolt 9	0.3	145.5	21.44

Adult Weir

The adult salmon weir was in place on July 5, 2016, through September 30, 2016, for a total of 88 sampling days. No major issues or problems occurred during weir operation. Water temperature documented during the project ranged between 23.5°C (July 17) and 9.1°C (September 30), with an average of 17.2°C.

A total of 1,228 sockeye and 67 coho were counted passing through the weir. The first adult salmon, both sockeye and coho, were recorded on July 23, 2016. The last documented sockeye and coho to pass through the weir occurred on September 30 and September 27, respectively.

Table 3. Adult daily and cumulative counts of sockeye and coho salmon at the Sixmile Creek weir, JBER 2016.

		Sockeye		**Coho**	
Date	Temp (°C)	Daily	Cumulative	Daily	Cumulative
5-Jul	20	0	0	0	0
6-Jul	19.5	0	0	0	0
7-Jul	20	0	0	0	0
8-Jul	19	0	0	0	0

		Sockeye		Coho	
Date	Temp (°C)	Daily	Cumulative	Daily	Cumulative
9-Jul	20	0	0	0	0
10-Jul	20	0	0	0	0
11-Jul	20.5	0	0	0	0
12-Jul	21.75	0	0	0	0
13-Jul	21.5	0	0	0	0
14-Jul	22.25	0	0	0	0
15-Jul	22.3	0	0	0	0
16-Jul	22.25	0	0	0	0
17-Jul	23.5	0	0	0	0
18-Jul	23	0	0	0	0
19-Jul	23	0	0	0	0
20-Jul	23	0	0	0	0
21-Jul	22.75	0	0	0	0
22-Jul	21.25	0	0	0	0
23-Jul	21	39	39	1	1
24-Jul	20.5	2	41	0	1
25-Jul	19.5	52	93	0	1
26-Jul	19.75	11	104	0	1
27-Jul	19.5	1	105	0	1
28-Jul	20.25	0	105	1	2
29-Jul	19.75	29	134	0	2
30-Jul	19	3	137	0	2
31-Jul	19.25	13	150	0	2
1-Aug	18.25	1	151	0	2
2-Aug	18.5	2	153	0	2
3-Aug	19.5	40	193	0	2
4-Aug	18.75	13	206	0	2
5-Aug	18.75	2	208	0	2
6-Aug	19.25	1	209	1	3
7-Aug	18.5	3	212	0	3
8-Aug	18.75	6	218	2	5
9-Aug	18.25	1	219	0	5
10-Aug	17.5	1	220	0	5
11-Aug	17.75	8	228	0	5
12-Aug	17.25	113	341	0	5
13-Aug	17.25	111	452	0	5
14-Aug	17	68	520	0	5
15-Aug	17.5	40	560	0	5
16-Aug	18	67	627	0	5
17-Aug	17.75	73	700	1	6

		Sockeye		Coho	
Date	Temp (°C)	Daily	Cumulative	Daily	Cumulative
18-Aug	18	44	744	0	6
19-Aug	17.75	56	800	2	8
20-Aug	17.5	19	819	14	22
21-Aug	17.5	33	852	8	30
22-Aug	16.75	27	879	0	30
23-Aug	16.5	8	887	0	30
24-Aug	17	32	919	0	30
25-Aug	16.75	23	942	0	30
26-Aug	17.25	20	962	2	32
27-Aug	17.75	22	984	0	32
28-Aug	17.625	19	1003	0	32
29-Aug	17.75	15	1018	3	35
30-Aug	17.25	17	1035	1	36
31-Aug	17.25	10	1045	1	37
1-Sep	17	3	1048	0	37
2-Sep	17.25	5	1053	0	37
3-Sep	16.75	10	1063	0	37
4-Sep	16.5	1	1064	0	37
5-Sep	16.25	4	1068	0	37
6-Sep	16.125	9	1077	0	37
7-Sep	15.75	10	1087	0	37
8-Sep	15.25	7	1094	0	37
9-Sep	15	4	1098	0	37
10-Sep	14.25	0	1098	0	37
11-Sep	14.5	5	1103	0	37
12-Sep	14.25	7	1110	6	43
13-Sep	14.25	10	1120	2	45
14-Sep	13.25	4	1124	2	47
15-Sep	13	12	1136	0	47
16-Sep	12.625	10	1146	0	47
17-Sep	12.75	10	1156	4	51
18-Sep	12.5	6	1162	2	53
19-Sep	12.25	8	1170	0	53
20-Sep	12	1	1171	2	55
21-Sep	11.75	10	1181	0	55
22-Sep	11.25	9	1190	1	56
23-Sep	11	5	1195	3	59
24-Sep	10.25	6	1201	2	61
25-Sep	11	10	1211	1	62
26-Sep	10.125	1	1212	3	65

		Sockeye		Coho	
Date	Temp (°C)	Daily	Cumulative	Daily	Cumulative
27-Sep	10.5	6	1218	2	67
28-Sep	9.625	3	1221	0	67
29-Sep	9.375	5	1226	0	67
30-Sep	9.125	2	1228	0	67
TOTALS	**17.2 Average**		**1228**		**67**

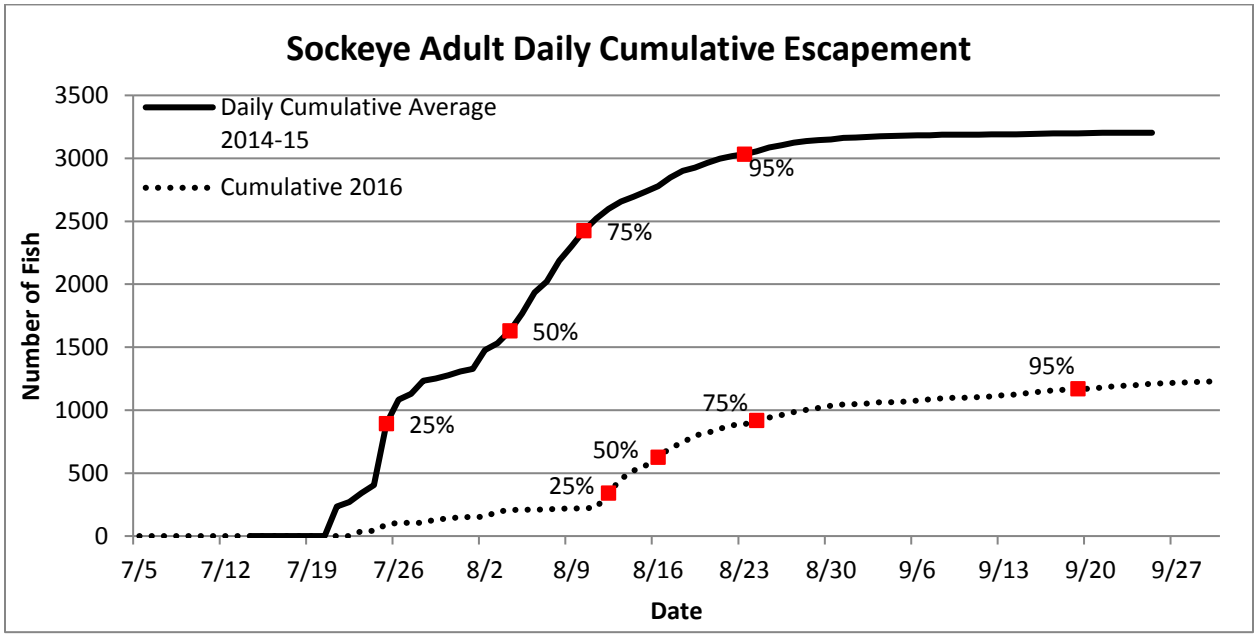

Figure 8. Cumulative daily comparison for the 2016 sockeye run and average cumulative from 2014-2015.

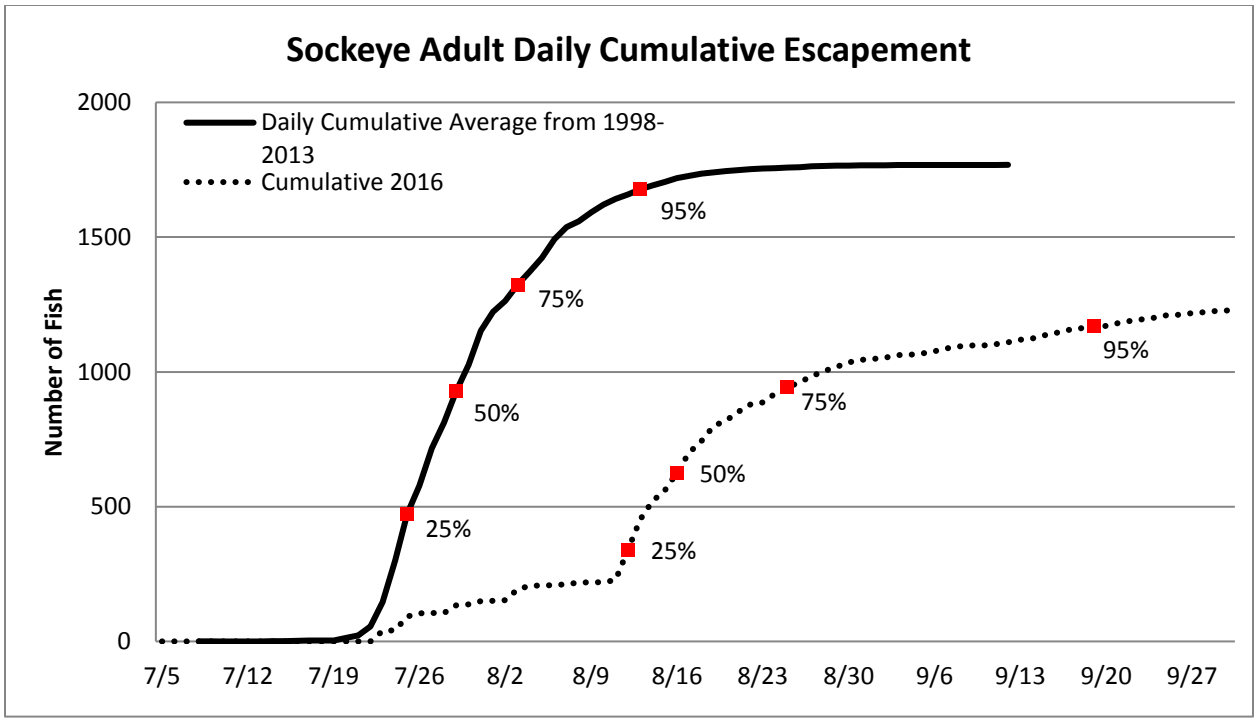

Figure 9. Cumulative daily comparison for the 2016 sockeye run and average cumulative from 1998-2013

Two different graphs (Figure 8 and 9) are used to illustrate the cumulative daily comparison of adult sockeye. These graphs were used to show that the cumulative average of returning sockeye from 1998-2013 was much lower than cumulative average of returning sockeye from 2014 and 2015. Also, in the 2014 and 2015 the field season was extended so that more of the run was captured.

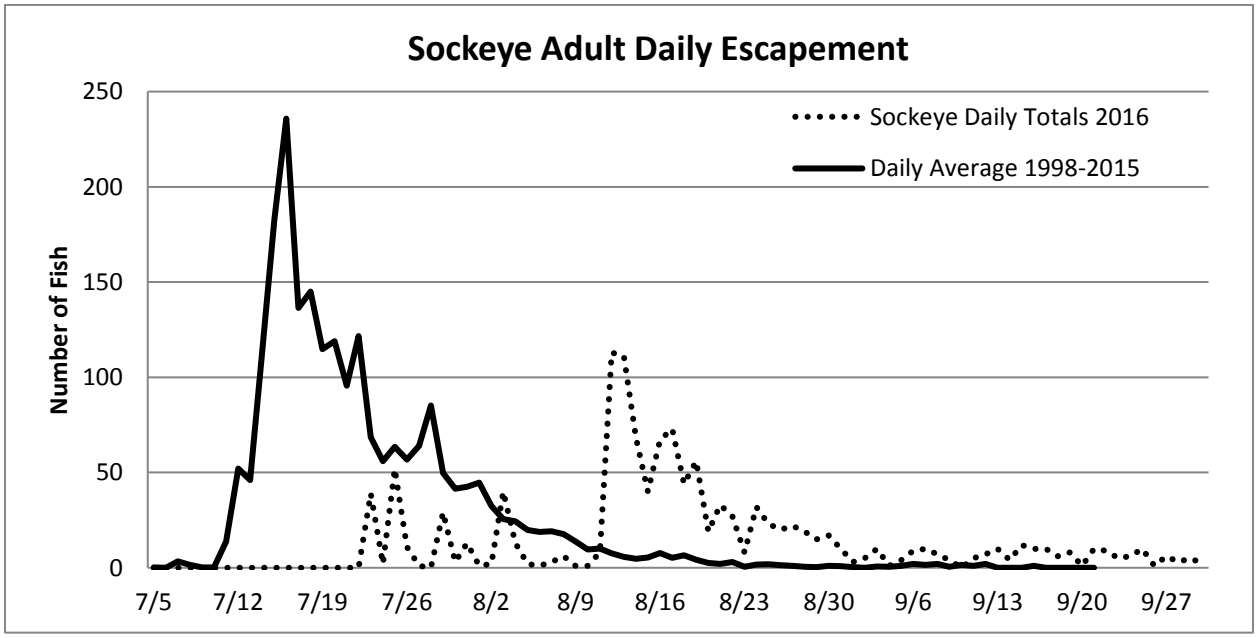

Figure 10. Comparison of daily totals from the 2016 sockeye run and the average daily totals from 1998-2015.

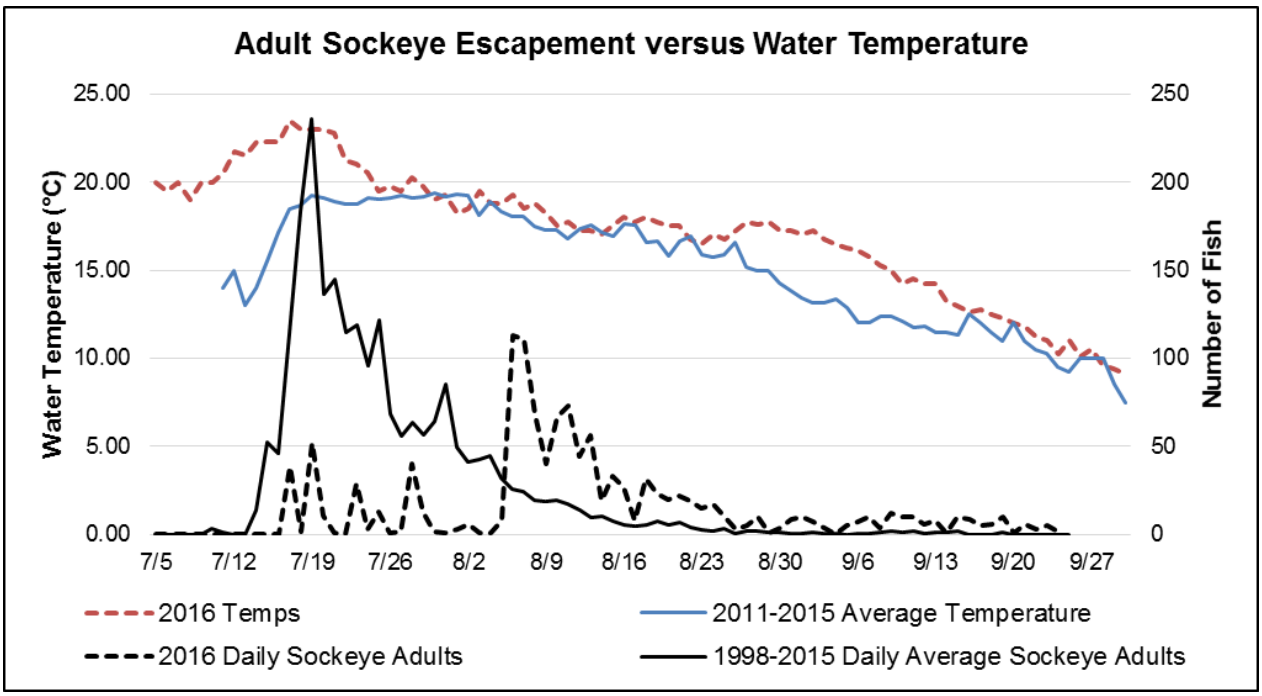

Figure 11. A comparison of 2016 and daily average 2003-2015 sockeye adult counts to the water temperature.

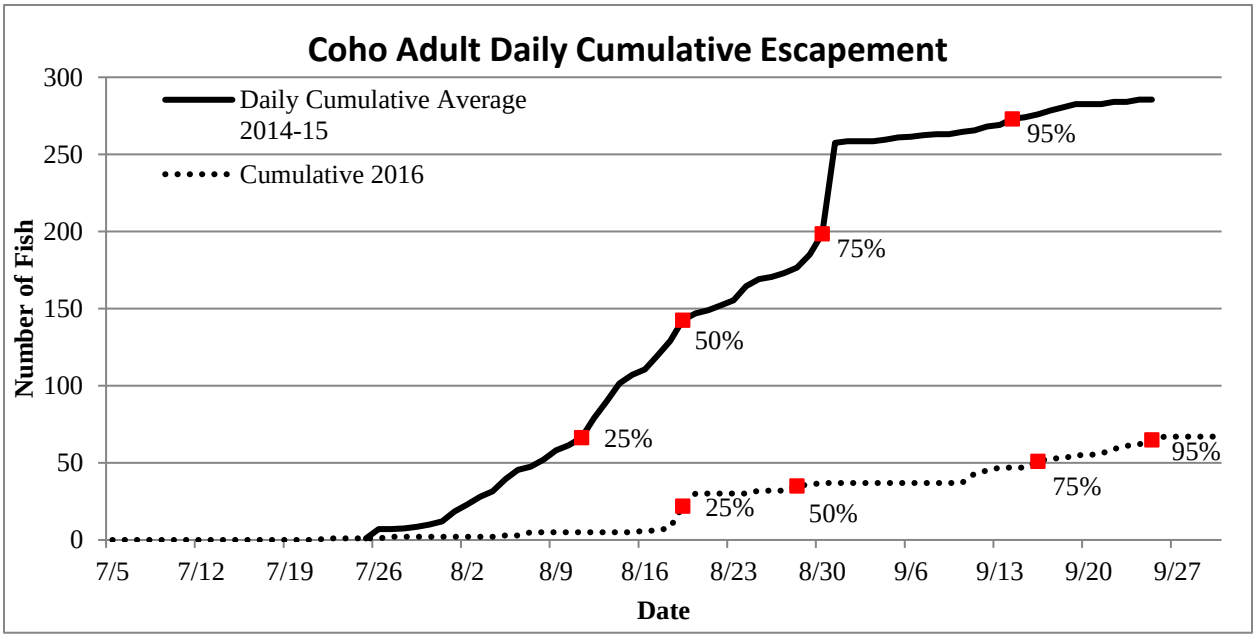

Figure 12. Comparison of daily cumulative for the 2016 coho run and the average daily cumulative from 2014-15.

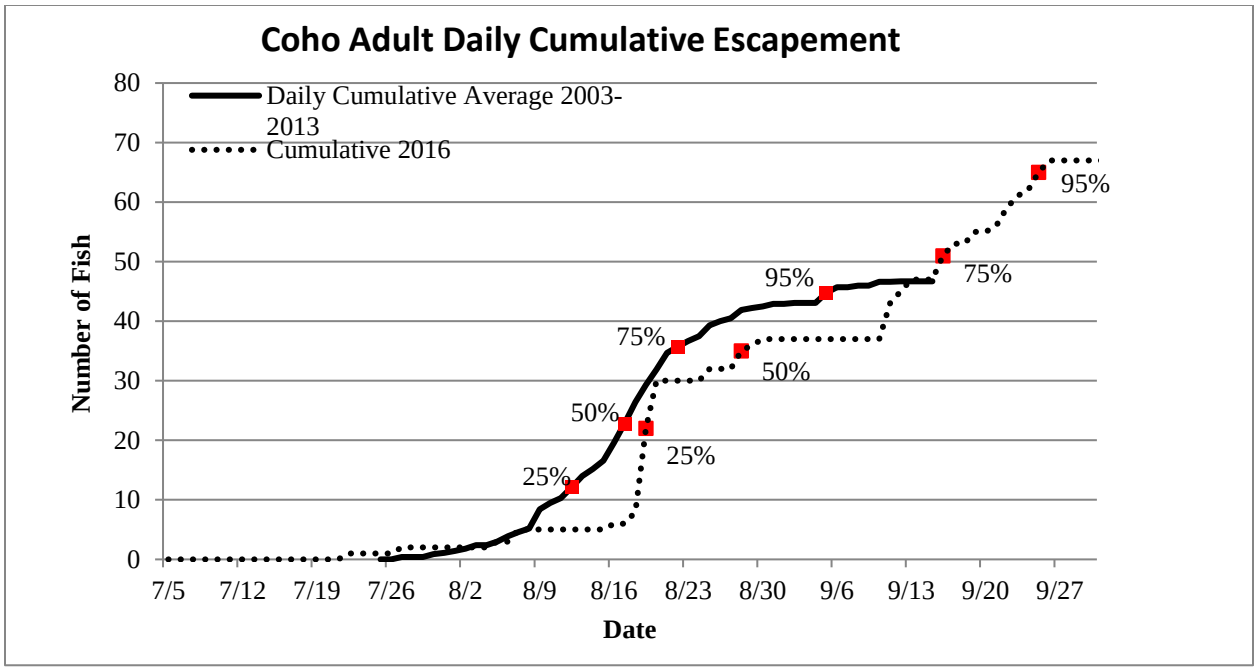

Figure 13. Comparison of daily totals from the 2016 coho run and the average from 2004-2013.

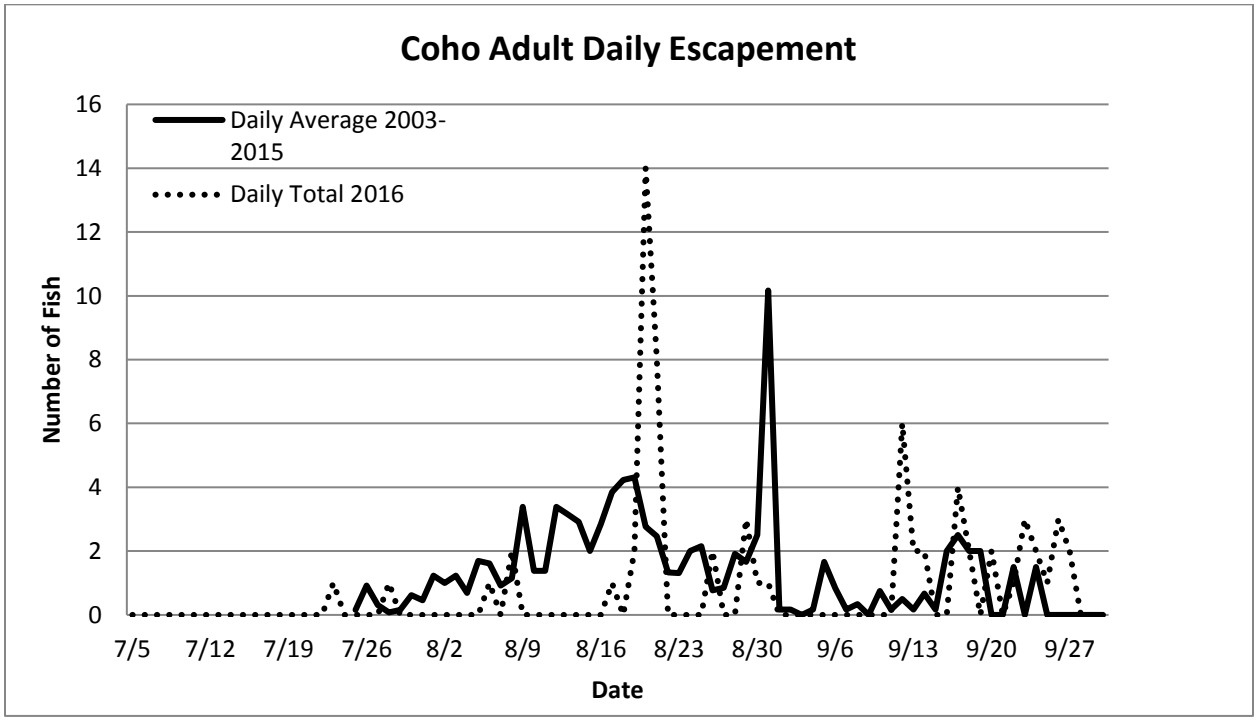

Figure 14. Comparison of the daily totals from the 2016 coho run and the average daily totals from 2003-15.

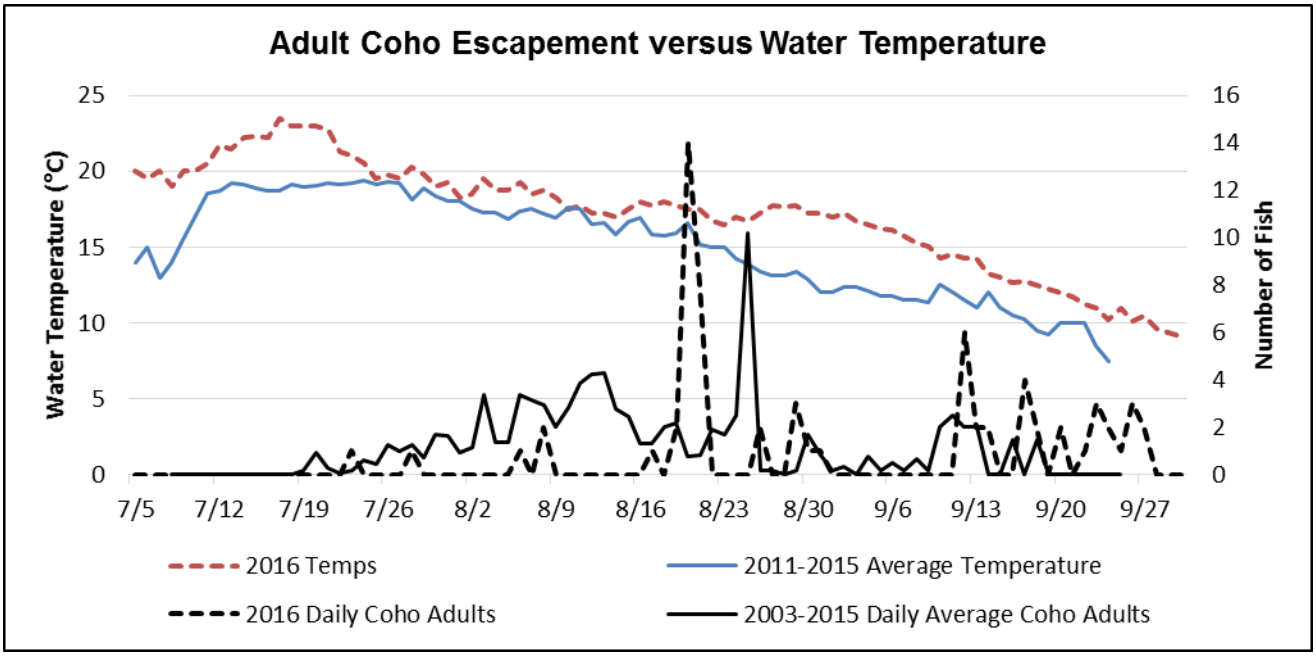

Figure 15. A comparison of 2016 and daily average 2003-2015 coho adult counts to the water temperature.

Discussion and Conclusion

The objective of this project was to identify and count the out-migration of smolt salmon and the returning adult salmon for the Sixmile Creek drainage. By using these counts, we expect to identify inter-annual trends by comparing historical data to the current year's data. We were also trying to identify any environmental factors that might cause a negative effect on the salmon stock. As of 2016, there are 10 years of data on out-migrating salmon smolt, 18 years of data on the returning adult sockeye salmon at the bridge location, and 14 years for returning adult coho salmon.

Smolt Weir

During the 2016 season, Sixmile Creek reached the lowest recorded annual count of out-migrating sockeye smolt (Appendix 1A). The 2003-2015 average of 13,362 fish compared to this year's count of 2,107 fish shows an extreme disparity in smolt numbers throughout the years. During 2016, the major pushes of out-migrating sockeye smolt occurred at similar timeframes compared to historical averages, as seen in Figures 2 and 4 found on pages 8 and 9. Many sockeye fry and smolt were collected on the weir frames in a stunned state; or they were found lifeless. The trap was removed, but the weir was left up until June 19, 2016, in order to reduce stress on the smolt, parr and fry and allow them to course downstream naturally. The trap was replaced the following day on June 20, after informing ADF&G area manager of the mortalities occurring.

The 2016 coho smolt count of 862, was the second highest recorded in ten sampling years, but significantly lower than 2014 (3,996) and just slightly higher than 2015 (540). The first 50th percentile of the 2016 coho smolt out-migrated on June 1, two days earlier than the previous years' average of 3 June

(Figure 5). However, the 95th percentile of coho was reached on 11 June, two days later than the cumulative historic average (Figure 5). Compared to the 2003-2015 average initial daily out-migration peak on May 13 of an average of 64 fish, the 2016 daily out-migration peak was about three days later, occurring on May 16 with just 36 fish (Figure 6). When the data is compared to water temperatures there are more peaks in out-migrating coho and they are larger, over a shorter time frame (Figure 7). This could suggest that lake warmed quicker than years past, causing the smolt to feel stressed. Groot and Margolis (1991) suggest that with low flow and high ambient air temperatures that water temperatures can reach lethal limits of 25° C for juveniles. This could be the reason why the coho smolt out-migrated quicker with higher numbers. This has the potential to cause there to be less prey for species that are dependent on aquatic food chains.

It should be noted that the smolt, as compared to previous years, were more difficult to identify to species due to comparable size and reduction of parr marks. The coho smolt did not have the standard identifying marker of a white leading edge on the anal fin. Most years, the coho are also noticeably larger than the sockeye smolt. This year, however, their sizes were quite similar, making the identification process longer, more tedious, and difficult. This could account for some bias in field identification of coho.

During the sampling time for smolts, there were 36 days of ambient temperature that were warmer than average, with many days reaching record highs, especially during the month of June (National Weather Service 2016). On 23 June, water temperature and DO was taken in Lower Sixmile Lake where smolt could potentially be holding in cooler temperature refuges due to water temperature within the lake (Appendix 2). Temperature, DO and depth were measured at each site, and the GPS point for each site was taken and later mapped. The highest temperature recorded occurred under the bridge (Site Smolt 9) with a temperature of 21.8°C. Again the lethal limit proposed by Groot and Margolis (1991) is around 25° C for juveniles. The lowest DO was measured at Site 4 at a depth of 0.94 m with a DO of 27% (Table 2). Normal DO levels for salmon in 20° C water is 46 – 85% Ruggerone (1999). Epmark et al. (2010) conducted a study on juvenile Atlantic salmon (*Salmo salar*) where their control DO levels were around 80-90%, low oxygen exposure was 110 – 190%, and high oxygen exposure was 130 – 216% all water temperatures were at 12° C. Most of the DO readings that were taken in the lake were well above the normal level. However, there could be some bias related to these readings because the field crew was having trouble with the YSI reader.

Adult Weir

The adult sockeye salmon had a total return of 1,228 fish for 2016. This year was well below the average annual return. However, the average rose from 1,761 to 3,203 after last year's count (Figure 8). The largest and main return peak occurred on 12 August, with a total of 113 sockeye passing through the

weir. During 2016, 95% of the sockeye counted had passed through the weir by September 19 (Figure 8), 36 days later than the historical average 1998-2013. Figure 8 appears skewed due to the recorded high returning adult sockeye in 2015 and only having two years (2014 and 2015) of data beyond September 12. Due to this issue, the data was split to display the cumulative average of 2016 against the historical cumulative average for 1998-2013 (ending on September 12), and against the 2014 and 2015 cumulative average (Extending past September 12). When the peak of the sockeye run for all years sampled is examined, the week of July 23 to July 29 has the highest average returning sockeye counts (Figure 9 and Appendix 1C) except for 2016 season.

The 2016 adult coho cumulative escapement was similar to the average of previous years' (Figure 13), with the exception of 2014 and 2015 seasons (Figure 12). The historical average cumulative total of 47 from 2003-2013, was surpassed on September 13, 2016, when 47 coho passed into the lake. By September 10, a total of 37 coho passed through the weir. The temperature on this day was 14.3°C, which demonstrated a 2 degree decrease from just five days prior on 5 September with a temperature of 16.3°C. This decrease, and continued decrease in water temperature, could have been a facilitator in the increase of coho passing through the weir in the month of September. Between September 10 and September 26, the temperature fell from 14.3°C to 10.1°C, and about 50% of the adult coho run passed through the weir on those dates. Therefore, it may be prudent to continue collecting future water temperatures to statistically evaluate any possible correlations between fish run timing and water temperature.

The average water temperature for the 2016 adult enumeration was 17.2 °C. This year showed a higher than average ambient air temperature, causing the water temperature to stay high until gradually dropping in the fall (National Weather Service 2016). Ambient air temperature was above average for 75 days out of the 88 days sampled (National Weather Service 2016). Water temperature can be a factor in whether the salmon choose to migrate up-river to spawn or not. Ideal migration temperatures for adult salmon range from 6.0 °C to 12.0°C (Wilson and Kelly 1984). The average water temperature was above this range until 20 September when it measured as 12.0°C.

The collection of genetics required thorough and careful identification of adult spawning salmon. Each salmon was identified by using ADF&G's standard identification method found on ADF&G Sport Fishing website and in the 2016 Southcentral Fishing Regulations, before clipping genetics or releasing into the lake. This detailed evaluation of each species helped increase the accuracy in identification and in final adult salmon counts. The use of the custom picket weir also allowed for a more organized release and thus improved identification of fish species.

Recommendations

Based on the 2016 field season, the following recommendations are proposed for consideration of future sampling:

1. Water temperature monitoring should continue because as it is one factor for determining when smolts and adults migrate.
2. Suggest monitoring dissolved oxygen in the lake when water temperatures start nearing the lethal range.
3. Possibly install the smolt trap and weir at an earlier date due to earlier ice melt and warming temperatures. This will ensure the capture of any fish that may be out-migrating at an earlier date.
4. Due to coho numbers increasing toward the end of the season (end of September), it may be wise to continue counting fish at the Sixmile weir later into the season in order to better assess the coho run.
5. There is now 18 complete years of adult sockeye salmon monitoring. Suggest looking into population trends.

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Appendices

Appendix 1A. Smolt sockeye escapement counts by date, Sixmile Creek drainage, 2003-2016.

	Year											Average
Date	2003	2004	2005	2006	2009	2010	2012	2013	2014	2015	2016	2003-2006, 2009-2010,2012-2015
5-May										0	0	0
6-May										0	0	0
7-May										0	0	0
8-May										0	0	0
9-May										0	0	0
10-May										0	0	4
11-May										1	0	1
12-May				0				0		0	0	0
13-May				0						0	0	0
14-May	0			4						0	9	2
15-May	0	4		1		0				1	2	2
16-May	21	2		2		0				177	19	40
17-May	1	126		1		0				807	18	187
18-May	21	7		0		0				34	2	10
19-May	8	402		13	26					25	59	79
20-May	165	407	92	44	114	0		0		14	31	93
21-May	220	185	121	118	86	8		-	3	39	3	78
22-May	815	464	30	181	192			0	1086	91	19	318
23-May	1,383	146	15	637	402	5		0	3987	479	6	705
24-May	740	325	155	1,725	87	1	0	0	641	38	21	371
25-May	864	319	312	986	375	14	70	0	162	182	76	328
26-May	460	616	309	1,919	83	7	234	0	309	333	14	427
27-May	731	266	229	1,897	209		69	1	121	1086	12	512
28-May	445	714	365	229	38	34	2,404	0	196	1335	81	576
29-May	673	63	125	1,424	28	26	2,134	0	368	243	41	508
30-May	275	693	20	1,316	23	6	430	40	2	3	71	281
31-May	1,047	172	595	781	8	5	562	104	2095	74	84	544
1-Jun	506	74	447	836	64	47	12	320	56	14	37	238
2-Jun	688	41	961	882	117	117	20	386	49	81	26	334
3-Jun	521	394	660	418	123	67	23	881	448	924	14	446
4-Jun	128	92	600	90	238	150	636	615	810	562	10	392
5-Jun	384	13	608	254	1,071	639	2,049	2,227	155	336	38	774
6-Jun	243	140	265	350	483	5	891	963	38	1245	17	462
7-Jun	1,104	37	96	107	963	162	2,677	2,376	2782	596	271	1090
8-Jun	111	25	234	114	1,103	84	1,017	2,255	58	349	117	535
9-Jun	478	47	274	65	636	616	1,029	1,349	358	567	76	542
10-Jun	173	22	129	174	357	427	813	779	0	80	27	295
11-Jun	1,076	0	143	29	44	277	195	352	10	364	7	249
12-Jun	3,660	58	144	62	123	281	505	1,757	1	146	9	674
13-Jun	1,536	7	134	148	488	176	1,129	771	0	0	16	439
14-Jun	779	26	132	223	303	30	2,603	1,395	1	43	8	554
15-Jun	573	18	344	230	237	23	1,075	1,049	0	0	0	355
16-Jun	96	11	190	113	10	181	799	1,256	0	0	0	266
17-Jun	134	2	161	596	42	80	612	737	0	0	0	236
18-Jun	20	12	118	188	318	220	546	159	1	3	4	159

	Year											
Date	2003	2004	2005	2006	2009	2010	2012	2013	2014	2015	2016	Average 2003-2006, 2009-2010,2012-2015
19-Jun	14	17	366	30	47	28	146	50	0	1	0	70
20-Jun	6	16	88	72	38	20	34	49	0	4	0	33
21-Jun	3	5	122	53	35	26	97	14	0	1	0	36
22-Jun	9	1	213	14		26	60	291	0	0	0	68
23-Jun	2	35	62	12	29	61	101	93	6	4	0	41
24-Jun			27	73	12	99	15	44	5	1		35
25-Jun			308	16	0	51	51	45	0	0		59
26-Jun			218	188	18	9	41	18	2	0		62
27-Jun			88	80		2	203	7	0	0		54
28-Jun			20	129	3	3	23	1	1	1		23
29-Jun			27	297	1	16	60	12	5	0		52
30-Jun			28	100		8	279	11	4	0		61
1-Jul					40	0		56	0			24
2-Jul									0			
Totals	20,113	6,004	9,575	17,221	8,614	4,037	23,644	20,463	13,760	10,280	1,245	13,722
Totals	20,113	6,004	9,575	17,221	8,614	4,037	23,644	20,463	13,760	10,280	1,245	12,269

The first total in the average column (13,722) is the sum of those averages. The second total in the average column (12,269) is the average from all of the yearly totals (2003-2016).

Appendix 1B. Smolt coho escapement counts by date, Sixmile Creek drainage, 2003-2016.

	Year											Average
Date	2003	2004	2005	2006	2009	2010	2012	2013	2014	2015	2016	2003-2006, 2009-2010,2012-2015
5-May										0	0	0
6-May										0	0	0
7-May										0	0	0
8-May										0	0	0
9-May										0	0	0
10-May										4	0	4
11-May										0	1	0
12-May										0	0	0
13-May										64	1	64
14-May	1									6	4	4
15-May	2	0				0				66	1	17
16-May	2	0				0				53	36	14
17-May	0	0				0				52	8	13
18-May	0	0			0	0				3	3	1
19-May	0	0			0					8	44	2
20-May	0	0	1		0	0		0		4	30	1
21-May	24	0	3	1	0	0		0	19	9	4	6
22-May	13	4	5	9	7			0	263	12	12	39
23-May	0	0	0	24	3	0		0	447	9	2	54
24-May	0	0	47	24	1	0	25	0	103	5	17	21
25-May	0	0	39	19	11	2	0	0	88	26	52	19
26-May	0	0	16	48	3	4	0	0	73	36	14	18
27-May	0	0	7	19	1		15	0	28	25	12	11
28-May	0	0	5	7	0	2	20	0	82	25	111	14
29-May	0	1	0	9	0	0	10	0	51	4	38	8
30-May	1	14	7	9	1	2	2	0	41	2	32	8
31-May	0	1	17	3	0	0	1	15	153	2	7	19
1-Jun	0	0	51	1	2	1	0	12	230	0	26	30
2-Jun	0	0	59	3	0	1	1	9	145	0	19	22
3-Jun	0	0	1	1	0	1	0	54	1004	9	8	107
4-Jun	0	0	16	0	0	0	0	13	363	11	6	40
5-Jun	1	0	7	2	4	0	9	17	202	2	55	24
6-Jun	3	0	15	2	0	0	1	16	390	13	19	44
7-Jun	0	0	6	1	1	4	1	26	123	1	127	16
8-Jun	0	0	4	0	3	1	4	17	53	64	44	15
9-Jun	0	1	5	0	2	1	1	21	76	15	79	12
10-Jun	0	0	4	0	0	3	0	11	1	2	2	2
11-Jun	0	0	8	1	0	6	0	2	12	3	7	3
12-Jun	0	0	3	5	0	1	2	12	4	8	5	4
13-Jun	0	1	2	0	0	5	0	5	0	0	32	1
14-Jun	0	0	5	1	3	1	3	3	0	0	3	2
15-Jun	0	0	4	0	0	0	0	7	0	0	0	1
16-Jun	0	0	28	1	0	2	4	4	1	0	0	4
17-Jun	0	0	3	13	0	0	2	3	0	1	0	2

	Year											Average
Date	2003	2004	2005	2006	2009	2010	2012	2013	2014	2015	2016	2003-2006, 2009-2010,2012-2015
18-Jun	0	0	6	1	4	4	0	1	0	0	1	2
19-Jun	2	0	8	0	1	0	2	0	0	0	0	1
20-Jun	0	0	2	0	2	0	0	0	1	0	0	1
21-Jun	0	1	4	0	0	0	1	0	1	0	0	1
22-Jun	0	0	1	0		0	1	1	18	0	0	2
23-Jun	0	0	0	0	0	0	0	0	0	0	0	0
24-Jun			1	0	0	1	0	0	0	0		0
25-Jun			1	0	1	0	0	0	2	0		1
26-Jun			1	0	0	0	0	0	0	0		0
27-Jun			1	0		0	2	1	0	0		1
28-Jun			0	0		0	0	0	0	0		0
29-Jun			0	0		0	0	0	19	0		3
30-Jun			0	0		0	0	0	3	0		0
1-Jul								0				0
2-Jul												
Totals	49	23	393	204	50	42	107	250	3,996	540	862	674
Totals	49	23	393	204	50	42	107	250	3,996	540	862	592

The first total in the average column (674) is the sum of those averages. The second total in the average column (592) is the average from all of the yearly totals (2003-2016).

Appendix 1C. Adult sockeye escapement counts by date, Sixmile Creek drainage, 1998-2016.

	Year																			Average
Date	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	1998-2015
1-Jul											0								0	
2-Jul											0								0	
3-Jul											0								0	
4-Jul																			0	
5-Jul																			0	
6-Jul																			0	
7-Jul																			0	
8-Jul				4							1								0	3
9-Jul											0								0	0
10-Jul				1							0								0	1
11-Jul											0			0					0	0
12-Jul											0			0					0	0
13-Jul											0		0	0					0	0
14-Jul							1				0	0	0	0			0	0	0	0
15-Jul											0	0	0	0			0	0	0	0
16-Jul	2										0	0	0	2	0	27	0	0	0	3
17-Jul	3										0	0	0	0	0	10	0	0	0	1
18-Jul	1				0						0	0	0	0	0	0	0	0	0	0
19-Jul					0						1	0	0	0	0	0	0	0	39	0
20-Jul	3			149	0						0	0	0	0	0	0	0	0	2	14
21-Jul	17			133	0		5				1	0	0	1	0	0	469	0	52	52
22-Jul	17			285	0		107			1	0	0	119	0	0	1	69	0	11	46
23-Jul	43		518	300	0		100			1	0	0	487	0	0	0	142	4	1	114
24-Jul	487		178	1,188	0		18			1	8	358	200	0	0	0	122	5	0	183
25-Jul	184		78	405	328	158	0	276		4	516	582	67	198	1	3	111	862	0	236
26-Jul	56		21	26	173	251	2	124			344	268	0	241	4	152	48	337	0	136
27-Jul	48		3	130	476	364	2	22		219	100	537	0	18	1	309	30	61	0	145
28-Jul	4			286	300	394	13	2		14	32	264	7	0	4	197	61	144	0	115
29-Jul	154		200	297	363	279	24	2		1	9	260	247	2	1	27	27	11	29	119
30-Jul	20		180	91	162	132	321	31	205	3	67	86	119	1	141	14	51	1	3	96
31-Jul	20		133	305	59	176	301	160	359	80	112	181	103	0	22	0	49	8	13	122
1-Aug	21		44	151	91	95	43	92	50	171	46	70	187	0	57	3	16	28	1	69
2-Aug	0		38	59	40	44	26	72	2	34	31	100	151	2	28	27	9	288	2	56
3-Aug	138		24	45	86	88	41	40	3	13	17	12	140	115	10	196	10	101	40	63
4-Aug	48		5	70	76	86	59	35	3	7	21	14	34	57	0	255	15	182	13	57
5-Aug	0		33	26	65	128	30	50	154	36	20	44	141	5	0	83	38	234	2	64
6-Aug	115	386		11	49	70	9	21	84	125	2	76	107	0	10	45	25	313	1	85
7-Aug	56	206	48	16	67	83	17	51	39	37	9	21	40	0	5	29	26	146	3	50
8-Aug	0	1	17			34	62	14	41	1	14	37	98	0	0	13	66	266	6	42

	Year																			Average
Date	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	1998-2015
9-Aug	56	7	3	13	62	58	39	28	18	5	15	74	135	0	0	19	54	180	1	43
10-Aug	40		30		28	18	147	37	12	9	5	32	61	0	8	46	27	215	1	45
11-Aug	29			9	30	11	38	14	33	22	22	64	11	2	0	39	17	177	8	32
12-Aug	25	4	4	2		82	22	16	15	48	9	31	4	0	3	17	20	132	113	26
13-Aug	24	14	3		42	22	31	16	70	6	21	13	9	0	0	27	33	83	111	24
14-Aug	17	3	1			40	12	65	7	10	18	13		0	3	32	11	65	68	20
15-Aug	13	3			36	41	21	18	5	11	3	37	9	5	2	12	9	75	40	19
16-Aug	9	3		23		44	9	18	16	5	3	61	10	0	4	20	17	66	67	19
17-Aug	12		3			32	14	7	8	4	0	17	17	0	10	3	9	130	73	18
18-Aug	0	3	5	4	11	15	6	41	11	10	9	16	4	0	1	8	11	94	44	14
19-Aug	0			5		9	1	17	16		2	14	6	3	0	7	10	44	56	10
20-Aug	0				19	3	7	9	9	4	1	15	5	1	0	4	12	62	19	10
21-Aug	0	1					7	7	6	2	1	8	3	0	0	5	7	60	33	8
22-Aug	0	2	1		15	2	0	9	10	8	2	9	2	0	0	0	6	32	27	6
23-Aug	0	4	1				1	12	3	8	0	4	2	0	0	2	1	34	8	5
24-Aug					1		7	3	1	1	0	5	5	2	0	1	3	41	32	5
25-Aug						10	0	10	3		0	5	0	0	0	3	0	62	23	8
26-Aug		7					13	6	1		0	1	0	0	0	0	2	32	20	5
27-Aug		2				9	28	5	1		1	1	0	0	0	0	0	39	22	7
28-Aug		6			1		15	0	4	2	0	0		0	0	0	1	25	19	4
29-Aug							3	4	0		0	4	0	1	0	0	0	15	15	2
30-Aug							4	2	3		0	0	0	0	0	0	1	12	17	2
31-Aug							0	5	0		0	0	2	0	0	3	0	24	10	3
1-Sep							1		0		0		0	0	0	0	0	5	3	1
2-Sep							0		0		0		0	2	1	3	0	9	5	2
3-Sep	3						3		0		0		0	0	0	3	0	9	10	2
4-Sep	7						1		0		0		0	0	0	1	0	5	1	1
5-Sep							0		0		0		0	0	0	0	0	9	4	1
6-Sep	1						0		0		0		0	0	0	2	0	2	9	1
7-Sep							0		0		0		0	0	0	0	1	2	10	0
8-Sep							0		0		0		0	0	1	1	1	6	7	1
9-Sep													0	0	0	2	0	3	4	1
10-Sep													1	0	0	0	1	0	0	0
11-Sep														0	0	0	0	0	5	0
12-Sep														0	0	1	0	2	7	1
13-Sep														0			0	1	10	1
14-Sep														0			0	2	4	1
15-Sep														0			0	4	12	2
16-Sep																	0	3	10	2
17-Sep																	0	4	10	2
18-Sep																	0	1	6	1

	Year																			Average
Date	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	1998-2015
19-Sep																	0	3	8	2
20-Sep																	0	2	1	1
21-Sep																	0	4	10	2
22-Sep																	0	0	9	0
23-Sep																	0	0	5	0
24-Sep																	0	0	6	0
25-Sep																	0	2	10	1
26-Sep																	0		1	0
27-Sep																	0		6	0
28-Sep																	0		3	0
29-Sep																	0		5	0
30-Sep																	0		2	0
1-Oct																	0			0
Totals	1,662	663	1,571	4,034	2,580	2,778	1,611	1,341	1,192	903	1,463	3,334	2,533	658	317	1,652	1,638	4,768	1,245	2,228
Totals	1,662	663	1,571	4,034	2,580	2,778	1,611	1,341	1,192	903	1,463	3,334	2,533	658	317	1,652	1,638	4,768	1,245	1,892

The first total in the average column (2,228) is the sum of those averages. The second total in the average column (1,892) is the average from all of the yearly totals (1998-2016)

Appendix 1D. Adult coho escapement counts by date, Sixmile Creek drainage, 2003-2016.

	Year														Average
Date	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2003-2015
14-Jul	0												0	0	
15-Jul	0												0	0	
16-Jul	0												0	0	
17-Jul	0												0	0	
18-Jul	0												0	0	
19-Jul	0												0	0	
20-Jul	0												0	0	
21-Jul	0												0	0	
22-Jul	0												0	0	
23-Jul	0												0	1	
24-Jul	0												0	0	
25-Jul	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
26-Jul	0	0	0	0	0	0	0	0	0	0	0	0	12	0	1
27-Jul	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0
28-Jul	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
29-Jul	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
30-Jul	0	0	5	0	0	0	0	0	0	0	0	0	3	0	1
31-Jul	0	0	0	1	0	1	0	0	0	0	0	0	4	0	0
1-Aug	0	0	0	0	0	3	0	0	0	0	0	0	13	0	1
2-Aug	0	0	0	0	0	0	4	0	0	0	0	1	8	0	1
3-Aug	0	0	0	0	0	2	0	0	0	4	0	0	10	0	1
4-Aug	2	0	0	0	0	0	0	0	0	0	0	0	7	0	1
5-Aug	0	0	0	1	0	1	1	0	0	3	0	0	16	0	2
6-Aug	0	0	4	0	0	0	1	2	0	2	0	0	12	1	2
7-Aug	1	0	0	0	1	0	2	0	0	4	0	0	4	0	1
8-Aug	0	0	0	0	0	0	6	0	0	0	0	0	9	2	1
9-Aug	0	0	1	0	1	5	21	3	0	1	0	2	10	0	3
10-Aug	0	0	0	1	0	1	5	2	0	2	0	0	7	0	1
11-Aug	1	0	0	2	0	0	6	1	0	6	3	1	9	0	1
12-Aug	0	0	0	11	2	0	3	2	0	0	1	0	24	0	3
13-Aug	0	0	0	7	1	0	0		0	3	1	1	22	0	3
14-Aug	1	0	0	0	2	5	2	1	0	3	1	0	22	0	3
15-Aug	0	0	0	4	0	4	3	1	0	15	3	2	11	0	2
16-Aug	0	0	0	2	2	0	7	0	0	17	4	1	5	0	3
17-Aug	0	0	0	4	4	1	20	0	0	6	1	1	17	1	4
18-Aug	0	0	0	3	0	2	21	0	3	0	0	0	18	0	4
19-Aug	1	0	0	5	0	0	20	1	0	0	0	1	27	2	4
20-Aug	0	0	0	1	0	1	18	0	1	7	0	0	8	14	3
21-Aug	0	0	0	3	2	0	4	0		0	1	1	4	8	2

	Year														
Date	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Average 2003-2015
22-Aug	0	0	0	6	1	0	3	0	0	0	0	1	5	0	1
23-Aug	0	0	1	0	0	0	2	0	2	0	3	1	6	0	1
24-Aug	1	0	2	4	0	0	11	0	0	0	1	0	17	0	2
25-Aug	0	0	1	6	0	0	0	0	0	0	0	0	9	0	2
26-Aug	1	0	0	4	0	1	0	0	0	0	0	1	3	2	1
27-Aug		0	0	4	1	0	5	0	0	4	0	2	4	0	1
28-Aug		0	0	0	0	0	2		1	0	0	3	5	0	2
29-Aug		1	0	0	0	0	0	0	0	1	1	0	14	3	2
30-Aug		0	1	0	0	0	1	0	0	1	1	0	27	1	3
31-Aug		0	0	0	0	0	0	0	0	0	0	2	118	1	10
1-Sep		0	0	0	0	0	0	0	1	0	1	0	0	0	0
2-Sep		0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-Sep		0	0	0	0	0	0	0	0	0	0	0	0	0	0
4-Sep		0	0	0	0	0	0	0	0	0	17	1	2	0	0
5-Sep		0	0	0	0	0	0	1	0	0	8	0	2	0	2
6-Sep		0	0	0	0	0	0	0	0	0	0	1	1	0	1
7-Sep		0	0	0	0	0	0	0	0	0	3	0	1	0	0
8-Sep		0	0	0	0	0	0	0	0	0	0	0	1	0	0
9-Sep		0	0	0	0	0	0	0	0	0	0	1	1	0	0
10-Sep		0	0	0	0	0	0	0	0	0	1	4	3	0	1
11-Sep		0	0	0	0	0	0	0	0	0	0	2	1	0	0
12-Sep	0	0	0	0	0	0	0	0	0	0	6	1	6	1	
13-Sep	0	0	0	0	0	0	0	0	0	0	0	0	2	0	
14-Sep											0	2	2	1	
15-Sep											3	2	0	0	
16-Sep											1	4	0	2	
17-Sep											0	2	4	3	
18-Sep											0	3	2	2	
19-Sep											0	4	0	2	
20-Sep											1	0	2	0	
21-Sep											0	0	0	0	
22-Sep											1	2	1	2	
23-Sep											0	0	3	0	
24-Sep											0	2	2	2	
25-Sep											0	0	1	0	
26-Sep											0		3	0	
27-Sep											0		2	0	
28-Sep											0		0	0	
29-Sep											0		0	0	
30-Sep											0			0	
1-Oct											0			0	

	Year														Average
Date	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2003-2015
Totals	8	1	16	69	17	27	178	18	8	79	54	44	527	67	92
Totals	8	1	16	69	17	27	178	18	8	79	54	44	527	67	79.5

The first total in the average column (92) is the sum of those averages. The second total in the average column (79.5) is the average from all of the yearly totals (2003-2016).

Appendix 2: Sixmile Parr Mortality Assessment

Sixmile Parr Mortalities

The Sixmile smolt trap was presenting multiple sockeye parr mortalities beginning on June 14, 2016, with a water temperature of 20 degrees Celsius. There were 54 sockeye parr mortalities, which were found against the panels, 6 sockeye parr mortalities found within the trap box, and 3 coho parr mortalities found against the panels. There was mild debris loads due to cottonwood cotton, which may have contributed to a quarter of these mortalities. Visual observation of parr swimming on their sides was made during these peak temperature days. From June 19 at 0938 until June 20 at 1115, the trap box was pulled from the panels to allow free motion downstream to allow any parr and debris into the creek. This was done to prevent any trap-caused mortalities from continuing. The temperature decreased to 18.5°C, and it was decided that the trap could be reinstalled. From June 14, when the first mortality occurred, until the trap was pulled on June 23 at 1040, the average temperature was 20.04°C.

GPS Points of Potential Smolt Holding Areas

On June 23, using depth, temperature, and dissolved oxygen (DO), data was retrieved from various points within the lower areas of lower Sixmile Lake. This was completed to verify if certain parts of the lake could be used as holding areas for out-migrating smolts, due to higher water temperatures in the area leading to the creek. Nine sites were chosen based water depth, amount of shade coverage and one site was under the bridge where the trap is located.

GPS Point	Depth (m)	DO%	Temperature in °C
Smolt 1	4.75	97	20
	Surface	128	21.15
Smolt 2	5.25	116	20.76
	Surface	138	20.9
Smolt 3	0.3	118	21.1
Smolt 4	3.1	27	18.8
	Surface	126	21.05
Smolt 5	3	108.6	20.57
	Surface	137	21.05
Smolt 6	2	155	20.57
	Surface	120.4	21.26
Smolt 7	.75	128	20.85
	Surface	124.5	21.28
Smolt 8	2.75	100	20.5
	Surface	131	21.2
Smolt 9	0.3	145.5	21.44

Sixmile Lake Parr Mortalities: Potential Smolt Holding Areas

Appendix 3: Sixmile Project Inventory & Maintenance Log

Sixmile Project Inventory & Maintenance Log				
Smolt Salmon Project				
Item	**Quantity**	**Maintenance**	**Replacement Frequency**	**Year of Last Replacement**
Small Dipnets	2	Annually	Biannually	2017
8ft x 3ft Weir Panels	4	Annually	As needed	2017
Smolt Trap Box	1	Annually	As needed	Unknown
Smolt Trap Funnel	1	Annually	3-4 years	2017
Zip Ties	1 bag	--	Annually	2017
Brush (Long Handle)	2	--	As needed	2018
Brush (short handle)	2	--	As needed	2017
Rubber Gloves	2 pair	--	Annually	2017
Thermometer	1	--	Annually	2017
Adult Salmon Project				
Item	**Quantity**	**Maintenance**	**Replacement Frequency**	**Year of Last Replacement**
Beach Seine Net	1	Annually	4-5 years	2017
Picket Weir w/Gate	1 (4 pieces)	Annually	As needed	2015
Dipnet	2	Annually	Biannually	2017
Fish Counter (multi)	1	--	As needed	2011
Thermometer	1	--	Annually	2017