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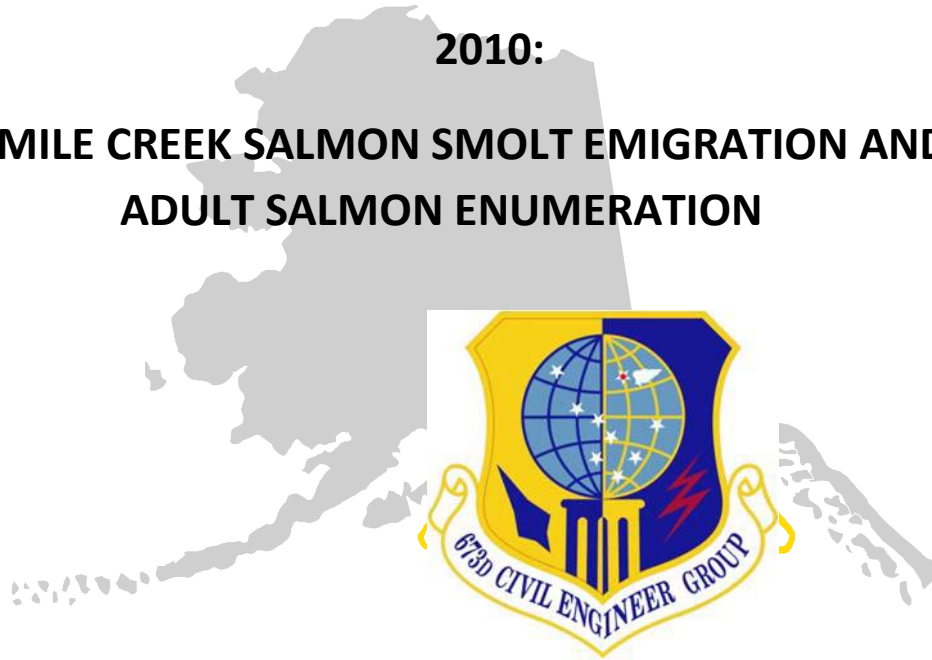
JOINT BASE ELMENDORF RICHARDSON

COOK INLET BELUGA WHALE HABITAT MONITORING

2010:

SIXMILE CREEK SALMON SMOLT EMIGRATION AND

ADULT SALMON ENUMERATION



Prepared for:

673^d Civil Engineer Squadron
Cultural and Natural Resource Conservation
673 CES/CEANC
6326 Arctic Warrior Drive
JBER-Elmendorf, AK
99506-3204

Prepared by:

Dan Bosch
Fisheries Biologist III
Colton Lipka
Fisheries Technician III
Alaska Department of Fish and Game
Division of Sport Fish
333 Raspberry Rd.
Anchorage, AK 99518

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Sixmile Creek Salmon Smolt Emigration and Adult Salmon Enumeration**

PRINCIPAL INVESTIGATOR: Dan Bosch

Alaska Department of Fish and Game

Division of Sport Fish

333 Raspberry Rd.

Anchorage, AK 99518

CONTRACTING ORGANIZATION: **673^d Civil Engineer Squadron,
Cultural and Natural Resource Conservation,
6326 Arctic Warrior Drive
JBER-Elmendorf, AK 99506-3204**

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14. ABSTRACT Alaska Department of Fish and Game Sport Fish Division enumerated adult salmon escapement and smolt emigration for Sixmile Drainage on Joint Base Elmendorf-Richardson during May through September 2010. Sockeye salmon (<i>Oncorhynchus nerka</i>) smolt emigration totaled 4,037. The dominant freshwater age class for sockeye salmon smolts was age-1 (73 %, SE=3.3%) followed by age-2 (27%). Mean weight and length of age-1 smolts was 7.5 g (SE=0.2g) and 88.5 mm (SE=0.8mm) while age-2 smolts were 12.3 g (SE=0.3g) and 104.4 mm (SE=0.9 mm). Only 42 coho salmon (<i>O. kisutch</i>) smolts were counted. Peak daily emigration was 639 smolts on June 5 and the date of 50% emigration was June 10. The total drainage adult salmon escapement estimate for 2010 was 2,533 sockeye, 22 coho, 5 chum (<i>O. keta</i>) and 492 pink (<i>O. gorbuscha</i>). The 2010 adult sockeye salmon weir count was greater than the historical average of 2,005 and the seventh largest escapement of record. The date of 50% completion of the escapement was 31 July, one day earlier than the historic date (1988-2009). Recommendations include: 1) continued adult monitoring; 2) replace fish ladder; 3) consider smolt mortality caused by weir; and 4) increase enforcement/monitoring of salmon sport fishery at creek mouth.					
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EXECUTIVE SUMMARY

The Cook Inlet population of beluga whales (*Delphinapterus leucas*), designated endangered by NOAA National Marine Fisheries Service, feeds on salmon in Upper Cook Inlet. Sixmile drainage on Joint Base Elmendorf-Richardson (JBER) produces sockeye (*Oncorhynchus nerka*), coho (*O. kisutch*), chum (*O. keta*) and pink (*O. gorbuscha*) salmon that are likely a food source for this population of whales; a sport fishery for salmon also exists at the mouth of Sixmile Creek. Both uses warrant monitoring of these populations. Alaska Department of Fish and Game Sport Fish Division (ADF&G) was contracted by JBER Cultural and Natural Resources Conservation office to count and describe the smolt emigration and adult salmon escapement of the Sixmile Drainage during May-September 2010.

ADF&G used a fyke weir to enumerate smolt and an adult salmon weir at the outlet of Lower Sixmile Lake, the same methodology used since 2001 and 1996, respectively. Two stream surveys were conducted below the weir to index pink salmon during peak run timing (mid August) and to index any remaining salmonids below the weir when the project concluded (15 September).

The estimated sockeye salmon smolt emigration in 2010 was 4,037. The dominant freshwater age class for sockeye salmon smolts was age-1 (73 %) followed by age-2 (27%). The mean weight and length of sockeye salmon age-1 smolts was 7.5 g (range 2.1-11.9 g) and 88.5 mm (range 60-105 mm) while for age-2 smolts the estimates were 12.3 g (range 8.7-17.1 g) and 104.4 mm (range 95-115 mm). Only 42 coho salmon smolts were counted and these were not sampled for age or size.

The total drainage adult salmon escapement estimate for 2010 was 2,533 sockeye, 22 coho, 5 chum, and 492 pink salmon. The 2010 adult sockeye salmon weir count was greater than the historical average of 2,005 and the seventh largest escapement of record. The date of 50% completion of the escapement was 31 July, which is one day earlier than the historic date (1988-2009).

ADF&G recommends a) continued monitoring of adult salmon, b) replacing the aging fish ladder because it is a barrier to smolt movement, c) increasing enforcement of fishing regulations at the mouth of Sixmile Creek, and d) consider the effects of the smolt weir on predation of salmon juveniles by rainbow trout.

Herman Griesse, GS-12
Wildlife Biologist
673 CES/CEANC

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INTRODUCTION

The Cook Inlet beluga whale (*Delphinapterus leucas*) is a distinct stock and an opportunistic feeder that primarily targets eulachon (*Thaleichthys pacificus*) during its seasonal migration to upper Cook Inlet. Belugas' predatory focus switches to salmon as eulachon spawning runs decline (National Marine Fisheries Service, 2008). The Cook Inlet beluga whale was designated endangered 22 December 2008 by NOAA National Marine Fisheries Service. It is believed that the salmon population of Sixmile Creek drainage on Joint Base Elmendorf-Richardson (JBER) (Figure 1) may contribute to the prey base of the whale's critical habitat in Cook Inlet and Knik Arm.

Upper and Lower Sixmile Lakes were created in the early 1950's after Sixmile Creek was dammed. Sockeye salmon were first reported colonizing the Sixmile Drainage in the mid 1970's and were pioneers from the Big Lake/Fish Creek Drainage. These sockeye salmon are genetically similar to Big Lake/Fish Creek populations (Habicht et. al. 2007). Big Lake drainage sockeye salmon return primarily as age-1.2 adults, similar to the return of sockeye salmon to the Sixmile Creek Drainage. Gotthardt (2006) found that age-1 smolts constituted 88% of the 2003 emigration from the Sixmile Drainage, the remainder being age-2.

Monitoring of the Sixmile Drainage salmon populations was conducted from 1988 to 2008 by staff from 673 CES/CEANC (formerly 3 CES/CEANC). In 2009 and continuing into 2010, this project was awarded to the Alaska Department of Fish and Game with U.S. Air Force funding through U. S. Army Medical Research and Acquisition Activity, Ft. Detrick, Maryland.

An adult fish weir was first operated approximately 0.5 km downstream of the current fish ladder beginning in 1988. In 1996 the weir was moved to the current site under the bridge across the outlet of Lower Sixmile Lake (Figure 2). Sockeye and coho smolt out-migration during 2003-2006, and 2009 was also measured under the bridge. In addition to documenting fish entering or departing Lower Sixmile Lake, stream walks were conducted during late August to early September to provide an estimate of salmon that spawned below the lake.

Adult salmon enter the Sixmile system to spawn from July through September. Both sockeye and coho salmon spawn in or above Sixmile Lake, while pink salmon generally spawn downstream of the fish ladder at the outlet of Lower Sixmile Lake. Historical annual returns of sockeye salmon adults (1988-2009) averaged 2,005 (range 663 – 4,282) fish (Appendix 5). The adult pink salmon annual return has been estimated to range 447 – 2,500 fish since 2001, while 22 – 102 coho salmon have returned during the same period. Chum salmon are relatively rare in the stream.

Salmon smolts have been counted emigrating from Lower Sixmile Lake from mid-May through June. Sixmile smolt out-migration includes sockeye and coho salmon (pink salmon spawn below the lake and chum salmon are very rare). Sockeye salmon smolts are the most abundant species. From 2003 through 2009 they have ranged from 4,037 – 20,113, while coho salmon smolts have ranged from 23 – 393 fish.

The purpose of this study was to count the outmigration of sockeye and coho salmon smolts, the escapement of all adult salmon, and estimate the age, sex and length compositions of smolt and adults at the Sixmile Creek Drainage in 2010.



Figure 1.- Sixmile Drainage on Joint Base Elmendorf-Richardson near Anchorage, Alaska.

OBJECTIVES

The objectives for the Sixmile Creek weir project were:

1. Count the number of sockeye and coho salmon smolts emigrating from Sixmile Creek from 15 May through June.
2. Estimate the fresh-water age composition of the smolt emigration of sockeye salmon such that the estimates are within 10 percentage points of the true value 95% of the time.
3. Count the number of adult salmon (all species) migrating into Sixmile Creek from 1 July through 15 September.
4. Estimate the age and sex composition of the adult escapement of sockeye salmon such that the estimates are within 10 percentage points of the true value 95% of the time.
5. Census the sex composition of the adult coho salmon escapement.

6. Count adult salmon spawning below the weir (stream surveys).

TASKS

1. Estimate mean length and weight-at-age for the Sixmile Creek sockeye salmon smolt outmigration.
2. Estimate mean length-at-age for the Sixmile Creek adult sockeye salmon escapement.
3. Collect water temperature and water clarity data on a daily basis at the weir site.
4. Interview anglers encountered during stream survey for harvest information (effort and harvest).

METHODS

STUDY SITE

The Sixmile Creek Drainage is located in Southcentral Alaska on JBER (Figure 1) and flows approximately 1.5 kilometers into the Knik Arm of Cook Inlet (Figure 2).

The Sixmile Creek 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. The system is charged primarily by springs entering the south side of Upper Sixmile Lake. The creek is now flooded for most of its length by the waters of Upper and Lower Sixmile Lakes, which were created by damming Sixmile Creek in 1951. Improvements to the Talley Avenue crossing the upper portion of the system in 1996 included the addition of a fish ladder-culvert easing fish access into Upper Sixmile Lake. Much of the historic creek channel is still visible in the lakes.

SMOLTS

Smolt-Counts (Objective 1)

Sockeye and coho salmon smolts emigrating from Sixmile Lake are typically counted from mid-May through the end of June. In 2010 smolts were counted emigrating from Lower Sixmile Lake from 15 May through 30 June.

Sockeye and coho smolts emigrating from Lower Sixmile Lake were captured daily in a fyke trap, identified by species, and counted by hand and released below the weir. The fyke trap was a 1.5-m² tunnel that narrows 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. Meshed wings were attached to the fyke trap and extended from each side of the tunnel entrance to the bridge abutment, so that it effectively fished the entire stream width. The trap was contained entirely under the bridge and protected from vandalism by locked gates on both ends.

The sampling crew monitored the fyke net daily to pass fish in a timely fashion and minimize impeding the downstream migration. The fyke trap was also inspected daily by the sampling crew for gaps that could allow smolts to pass through undetected.

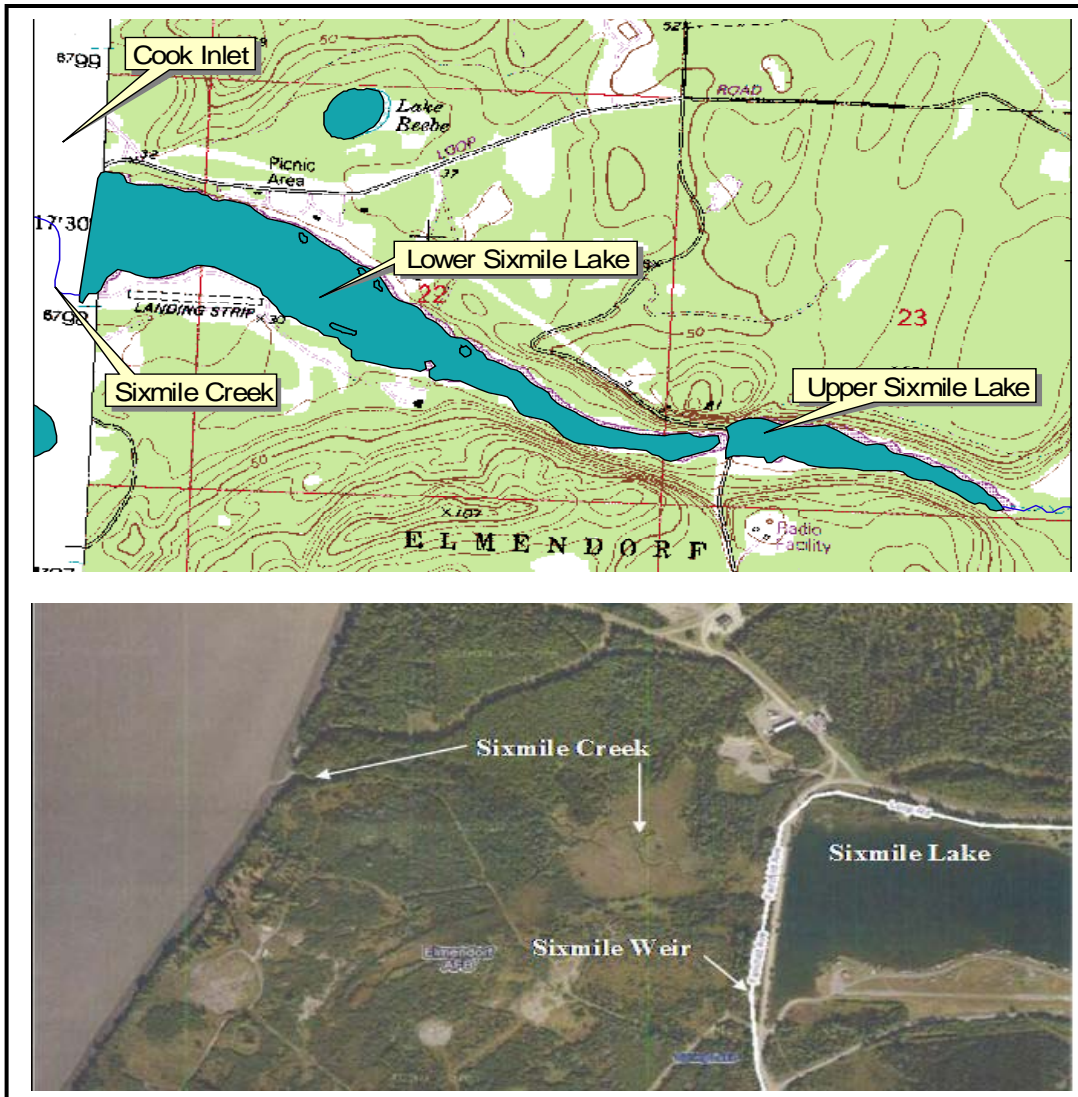


Figure 2.- Sixmile Creek, Lower and Upper Sixmile Lakes, and weir location, JBER, Alaska.

Smolt-Age, Weight, and Length-Sockeye Salmon Only (Objective 2)

To meet objective criteria, a sample size of 106 sockeye salmon smolts (Thompson, 1987) was needed, assuming two age classes, an unreadable scale rate of 10%, and a migration of 12,300 sockeye salmon smolts (average from 2003-2006 and 2009, and used in the finite population correction factor).

To ensure a representative sample of smolts was taken, the crew attempted to sample a fixed proportion of the previous 2 days' emigration every 2 days for age and length data. The

proportion of fish sampled was determined pre-season and was based on historical information. Fish were sampled en masse to ensure no size selectivity occurred.

Smolts were anesthetized with Alka-Seltzer® prior to collecting size information and scale samples. Scale samples were taken from the preferred area (Clutter and Whitesel 1956), mounted on microscope slides and labeled. Scale-age was determined using a microfiche reader and a dissecting microscope. Weight was measured to the nearest tenth of a gram using an electronic scale. Fork length was measured from the tip of the snout to the fork of the tail to the nearest 1mm.

The information detailed above was recorded in a Rite-In-the-Rain® notebook and entered in a Microsoft Excel™ file.

ADULTS

Adults-Weir Counts (Objective 3)

All adult salmon passing into Lower Sixmile Lake were enumerated from 13 July through 15 September, 2010. Two separate foot surveys counted fish downstream of the weir (see below).

The weir was cleaned and inspected daily for gaps that would allow salmon to pass through undetected and more frequently if conditions warranted. The weir was monitored daily during daylight hours, to pass fish in a timely fashion in order to minimize impeding the upstream migration.

The following information was collected:

1. The number of salmon by species counted through the live trap (daily);
2. The number of salmon by species sampled for age, sex, and length (every two days);
3. The number of other fish, by species, that passed through the live trap (daily);
4. Environmental observations (daily-water temperatures and water clarity);
5. The number of salmon by species that were recorded harvested by anglers below the weir (twice weekly);
6. Any comments regarding the ability to accurately count salmon through the live trap.

The information detailed above was recorded daily in a Rite-In-the-Rain® notebook and entered in a Microsoft Excel™ file daily.

Adults-Age, Sex, and Length (Objectives 4 and 5)

To meet objective criteria, a sample size of 131 sockeye salmon was needed (Thompson, 1987), assuming unreadable scale rate of 10% and an escapement of 1,647 sockeye salmon (5-year average and used in the finite population correction factor).

To ensure a representative sample of adults was taken, the crew attempted to sample a fixed proportion of the previous two days' weir count every other day for ASL data. The proportion of fish to be sampled was determined pre-season and was based on historical information. Fish were sampled en masse to ensure no size selectivity occurred.

Sampled fish were measured from the mid-eye to the fork-of-tail to the nearest 0.5 cm. Sex was determined by external physical characteristics, such as kype development or a protruding ovipositor. Length and sex were recorded in Rite-In-the Rain® notebooks while sampling, and later entered into a Microsoft Excel™ file, and transferred to standard age, weight, and length (AWL) version 1.2 mark-sense forms (Heineman unpublished; Appendix A1).

One scale was collected from sockeye salmon from the preferred location (Clutter and Whitesel 1956). If the preferred scales couldn't be obtained, another scale was taken from as close to the preferred scale as possible, and always from the first or second row above the lateral line, in order to capture the early life history portion of the age. If no scales were available in the preferred area on the left side of the fish, scales were collected from the preferred area on the right side of the fish. If scales were not obtainable from a given fish, that fish was not sampled at all and sampling continued with the next available fish. Scales were mounted on gum cards, which were then covered with wax paper after drying, and placed in a press to keep them from curling. Impressions were made in cellulose acetate as described in Clutter and Whitesel (1956). The corresponding litho-code and line numbers from the mark-sense form were recorded on the gum card along with the date, collector name, and location. The impressions were magnified and viewed on a microfiche reader and the ages were determined from the growth patterns of the circuli. Ages were reported in European notation (Jearld Jr. 1983) and recorded on AWL forms and into a Microsoft Excel™ file.

Adults-Foot and Angler Surveys (Objective 6)

Foot surveys were conducted downstream of the weir to count salmon spawning below the weir during the third week of August, the peak of the pink salmon return, and on the day that the weir was dismantled (Objective 6). Angler Surveys were not conducted and Task 4 was not met.

DATA ANALYSIS

Smolt -Counts

Total sockeye and coho salmon smolt counts were added to the historic database. Cumulative and daily run timing plots were made for each species to allow comparison to previous years.

Smolt -Age and Length -Sockeye Salmon Only

The proportion of sockeye salmon smolts of age category g migrating downstream was estimated as:

$$\hat{p}_g = \frac{n_g}{n} \quad 1)$$

where:

n_g = the number of sockeye salmon sampled belonging to age category g , and
 n = the total number of sockeye salmon sampled for age.

The number of salmon smolts of age category g passing downstream was estimated by:

$$\hat{N}_g = N\hat{p}_g \quad 2)$$

where:

N = the total number of sockeye salmon smolts enumerated during the migration.

The variance of \hat{N}_g was estimated as:

$$\text{var}[\hat{N}_g] = N^2 \text{var}[\hat{p}_g] \quad 3)$$

Where

$$\text{var}[\hat{p}_g] = \left(\frac{N-n}{N} \right) \left(\frac{\hat{p}_g(1-\hat{p}_g)}{n-1} \right) \quad 4)$$

Mean length at age was estimated using standard sample summary statistics.

Adults -Counts

Total sockeye and coho salmon escapement counts were added to the historic database. Cumulative and daily timing plots were made for each species to allow comparison to previous years.

Sockeye and coho salmon counted below the weir after it was removed (9/15/2010 survey) were added to the respective weir counts for these species to obtain final escapement counts. The majority of pink salmon spawn below the weir and the escapement for this species was calculated as the sum of the peak run-timing survey count and pink salmon counted through the weir.

Adults-Age, Sex and Length

The proportion, total number, and their variances, pertaining to adult sockeye salmon of age or sex category *g* migrating upstream through the weir will be estimated using equations 1-4. Mean length at age was estimated using standard sample summary statistics.

RESULTS

Environmental Observations

Water temperature averaged 17.5 degrees Celsius during the smolt emigration and 14.2 degrees Celsius during the adult escapement and water clarity was good to excellent during the duration of the project (Task 3).

SMOLTS

Smolt -Counts

From 15 May to 30 June 2010 a total of 4,037 sockeye and 42 coho salmon smolts were counted emigrating from Lower Sixmile Lake.

Smolt -Age, Weight, and Length

Sockeye salmon smolt age, composition and weight (g) and length (mm)-at-age were estimated based on 169 readable scales from 173 fish sampled during the smolt emigration (Table 1). The dominant freshwater age class for sockeye salmon smolts was age-1 smolt (73%, SE=3.3%) followed by age-2 (27%, SE=3.3%). The mean weight and length of age-1 sockeye salmon smolts were 7.5 g (SE=0.2g and range 2.1-11.9g) and 89 mm (SE=0.8mm and range 60-105 mm), respectively while age-2 smolt were 12.3 g (SE=0.3 and range 8.7-17.1g) and 104 mm (SE=0.9 and range 95-115mm), respectfully.

Smolt -Run Timing

Peak smolt emigration in 2010 occurred on June 5 when 639 fish emigrated. Fifty percent of the total emigration (2,420) had occurred by June 10 (Figure 3).

Table 1.- Age, weight (g), and length (mm) composition of the sockeye salmon smolt emigration, Sixmile Creek Drainage, 2010

Sockeye Smolt	<u>Freshwater Age Group</u>		Total
	1	2	
Sample size	124	45	169
Percent	73.4	26.6	
SE	3.3	3.3	
Number of Fish	2,962	1,075	4,037
SE	134.8	134.8	
Mean Weight(g)	7.5	12.3	8.8
SE	0.2	0.3	0.2
Min Weight	2.1	8.7	2.1
Max Weight	11.9	17.1	17.1
Mean Length (mm)	88.5	104.4	93
SE	0.8	0.9	0.8
Min Length	60	95	60
Max Length	105	115	115

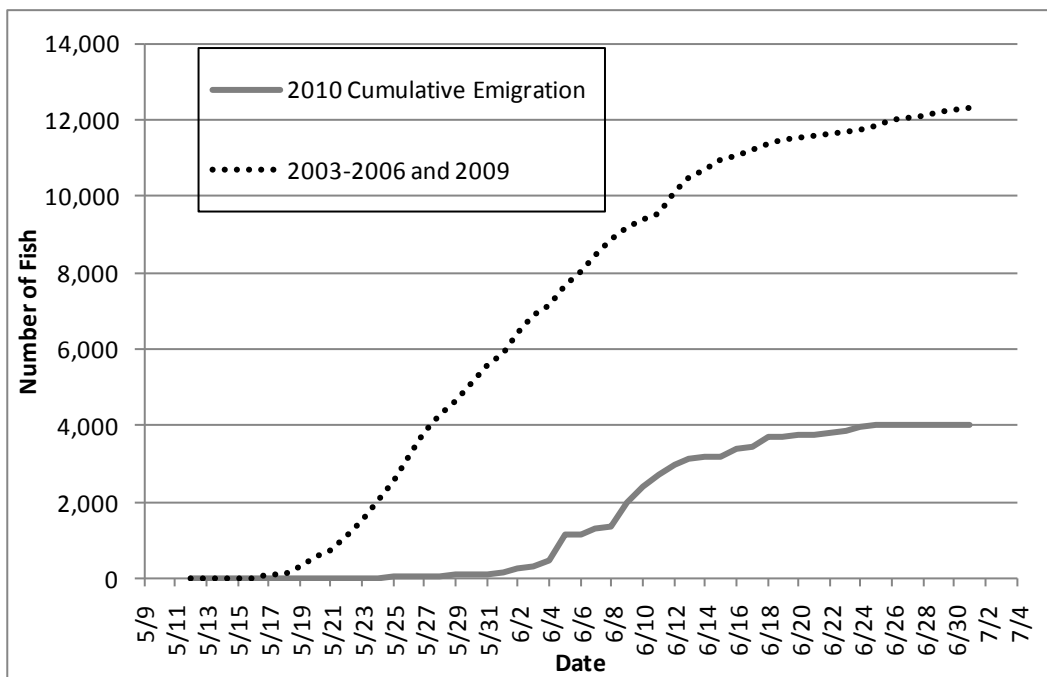
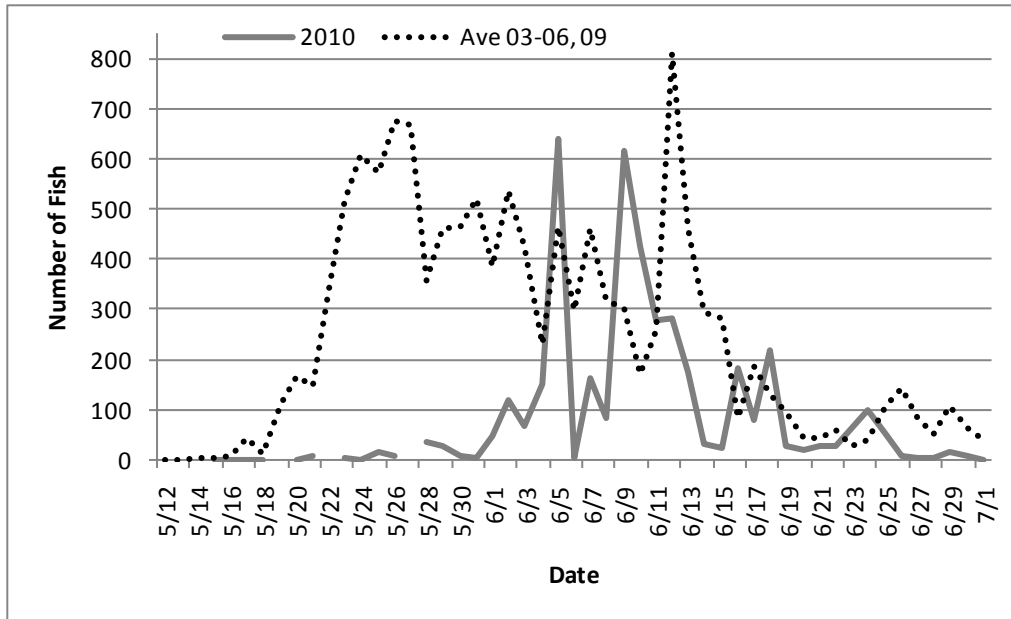


Figure 3.- Average daily (top) and cumulative (bottom) emigration timing for sockeye salmon smolts, Sixmile Creek Drainage, 2010 compared to the 2003-2006 and 2009 average (12,305).

ADULTS

Adults-Counts and Surveys

A total of 2,533 sockeye, 18 coho, and 15 pink salmon were counted passing through the weir into Lower Sixmile Lake in 2010. Two stream surveys were conducted to count fish spawning below the weir, primarily pink salmon. The first stream survey was conducted under good conditions on 16 August and 477 pink, 7 sockeye, and 5 chum salmon were counted. The final stream survey was conducted on 15 September under good conditions and 4 coho salmon were counted below the weir. Counts of sockeye, coho and pink salmon from the final stream survey were added to the final weir counts to yield total escapement to the Sixmile Drainage. It is understood that the salmon escapement estimates are biased low due to a) salmon missed during the survey and b) salmon that spawned and disappeared between surveys; this bias is most severe for pink salmon and minimal for sockeye salmon.

Adults-Age, Sex, and Size Estimates

A total of 274 sockeye salmon were sampled for age, sex, and length information producing 219 readable scales (Table 2). The dominant age class for sockeye salmon was age-1.2 (83%, SE=2.4%), followed by age-1.3 (11%, SE=2.0, Table 2). The sex ratio of adult sockeye salmon was 39% male (SE=2.8%) and 61% female (SE=2.8%, Table 2). The mean length of male sockeye salmon was 465 mm (SE=4.4, range 320-605 mm) while females averaged 497 mm (SE=2.3, range 430-575 mm) (Table 2). The mean length of all sockeye salmon was 484 mm (SE=2.8, range 320-605 mm)

Adults-Run Timing

Peak sockeye salmon escapement occurred on July 23. Fifty percent of the weir count had occurred by July 31, when 1,349 fish passed through the weir (Figure 4). The date at which 50% of the total weir count was reached in 2010 was two days later than the average mid-point (50%) of the return from 2000-2009.

Adults-Comparison

Annual escapement estimates for Sixmile and two Upper Cook Inlet salmon streams, Fish Creek and Campbell Creek, were compared (Figure 5). Fish Creek is operated by the Alaska Department of Fish and Game Commercial Fisheries Division in Palmer, and escapement estimates are monitored via a weir at the outlet of Big Lake. Campbell Creek is monitored by the Division of Sport Fish in Anchorage and estimates are obtained via foot and float surveys.

Escapements to all three systems are highly variable over years. There was, however, a significant (positive) correlation (r) between the escapement to Fish Creek and Sixmile Creek ($r=0.56$; $p<0.005$; one tailed test). The relationship between Campbell Creek and Fish and Sixmile creeks was less pronounced (Fish Creek: $r=0.32$; $p<0.1$; one tailed test; Campbell Creek:

r=0.11; p>0.1; one tailed test). These weaker relationships may be due to the Campbell Creek data originating from stream surveys (vs. weir).

Run timing comparison between Six Mile Creek and Fish Creek in 2009 shows similar timing with the majority of fish passage having taken place between 22 July and 2 August for both systems (Figure 6).

Table 2.- Age-Sex composition and length-at age of the sockeye salmon escapement, Sixmile Creek drainage, 2010 .

Male		1.1	1.2	1.3	2.1	2.2	2.3	Total-Sex only*
Sample Size		3	72	5	2		1	108
	%	1.4	32.9	2.3	0.9	0.0	0.5	39
	SE	0.75	3.04	0.97	0.62	0.00	0.44	3
Number of Fish		35	833	58	23	0	12	998
	SE	19	77	24	16	0	11	71
	Ave Length (mm)	432	462	543	345		605	465
	SE	56.30	4.25	11.06	4.78	0.00	0.00	4.41
	Min Length (mm)	320	400	520	340		605	320
	Max Length (mm)	520	570	585	350		605	605
Female								
Sample Size			110	19		7		166
	%	0.0	50.2	8.7	0.0	3.2	0.0	61
	SE	0.00	3.24	1.82	0.00	1.14	0.00	3
Number of Fish		0	1272	220	0	81	0	1,535
	SE	0	82	46	0	29	0	71
	Ave Length (mm)		490	524		514		497
	SE	0.00	2.73	6.15	0.00	13.37	0.00	2.33
	Min Length (mm)		430	445		465		430
	Max Length (mm)		560	570		575		575
All Fish								274
All Fish								Total-Age only**
Sample Size		3	182	24	2	7	1	219
	%	1.4	83.1	11.0	0.9	3.2	0.5	
	SE	0.75	2.43	2.02	0.62	1.14	0.44	
Number of Fish		35	2105	278	23	81	12	2533
	SE	19	61	51	16	29	11	
	Ave Length (mm)	432	479	528	345	514	605	484
	SE	56.30	2.54	5.50	4.78	35.74	0.00	2.73
	Min Length (mm)	320	400	445	340	465	605	320
	Max Length (mm)	520	570	585	350	575	605	605

*Total for all sex Identified fish used in var calculation, n=274

**Total for all aged fish used in var calculation, n=219

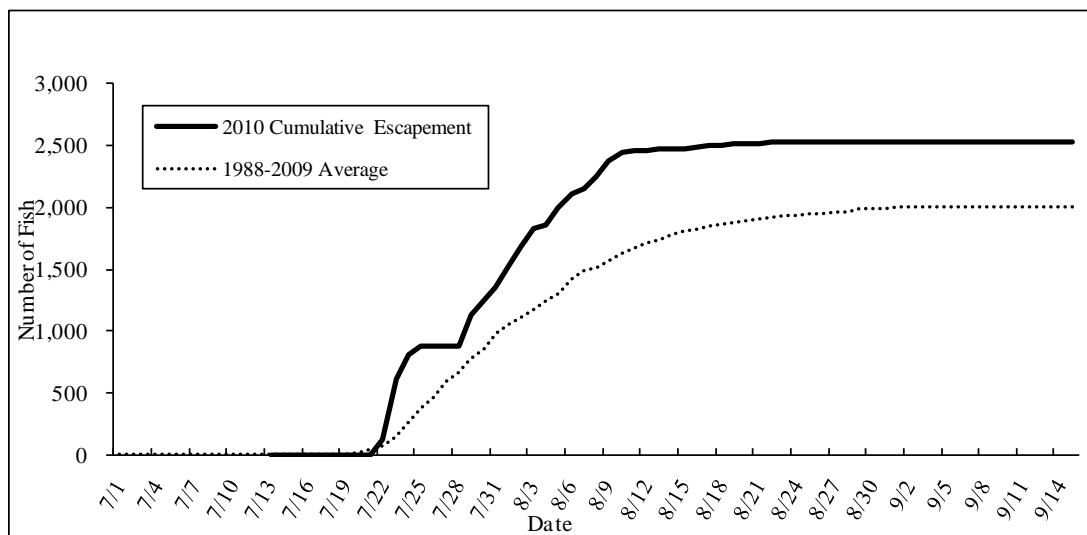
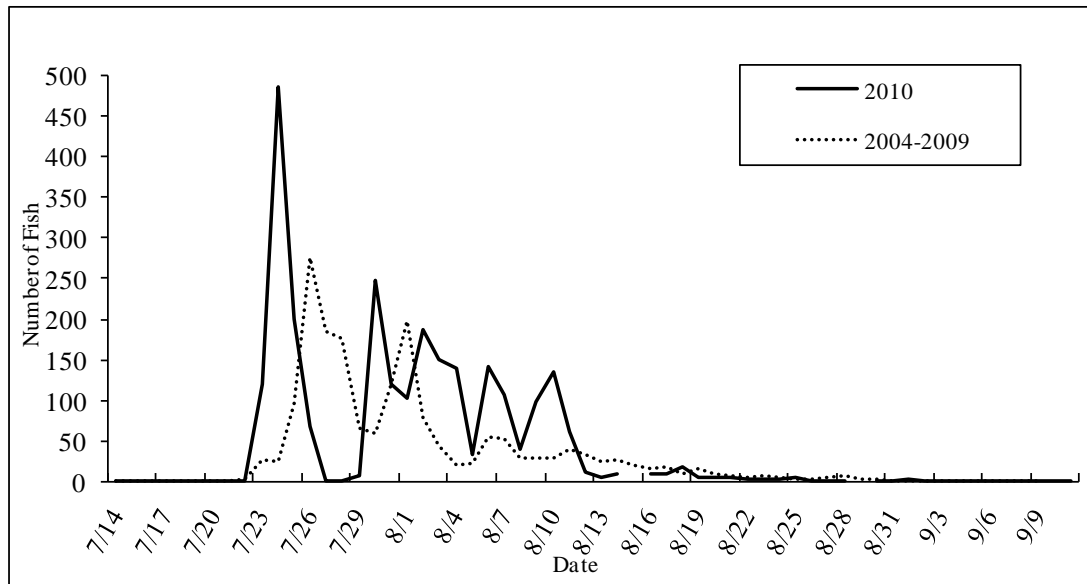


Figure 4.- Average daily (top) and cumulative (bottom) escapement timing for adult sockeye salmon, Sixmile Creek Drainage, 2010.

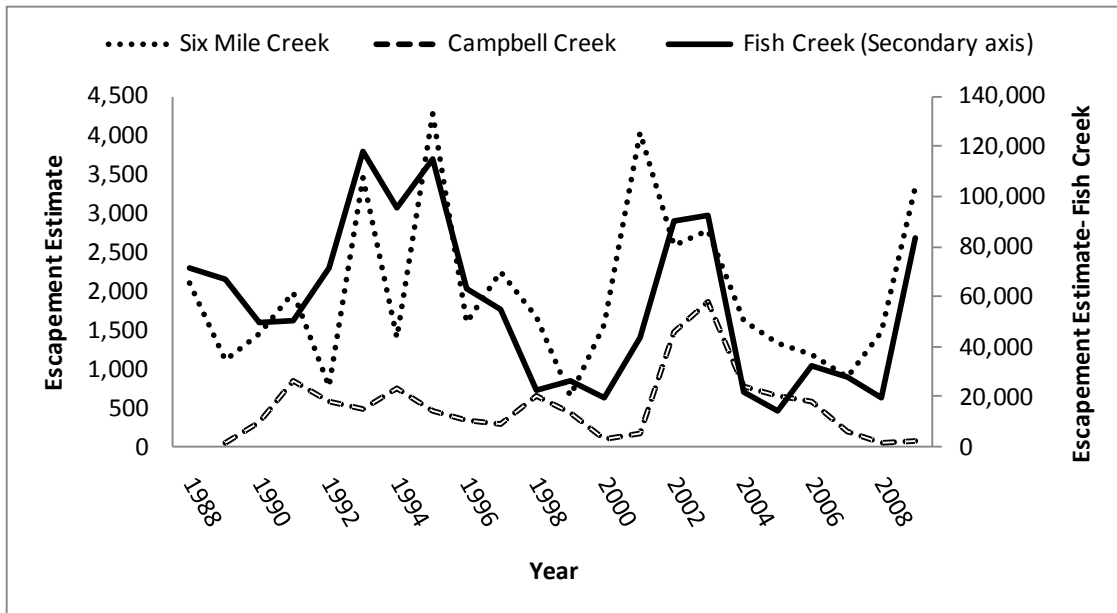


Figure 5.- Inter-annual comparison of trends for Sockeye Salmon escapement in selected Upper Cook Inlet streams (Campbell Creek escapements are derived from stream surveys and are therefore minima).

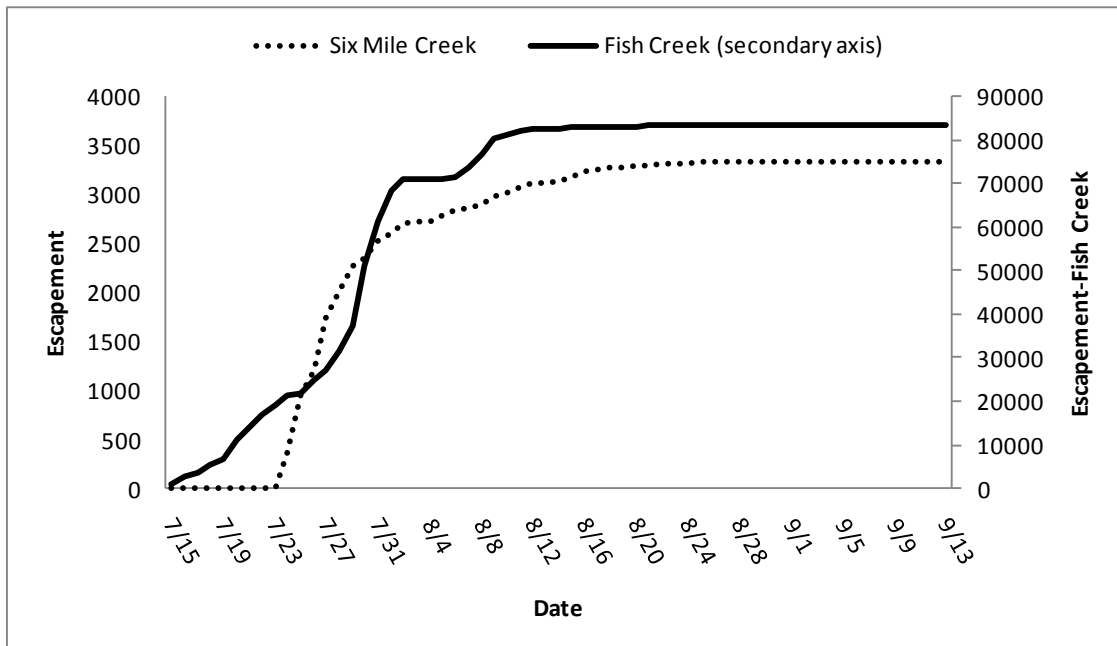


Figure 6.- Cumulative run timing comparison of Sixmile Creek (JBER) and Fish Creek Sockeye salmon escapements 2009.

DISCUSSION

The purpose of this study was to count the number of salmon smolts emigrating, and number of adult salmon escaping into the Sixmile Creek Drainage in anticipation of future requirements to monitor essential components of the critical habitat for the endangered Cook Inlet beluga whale.

Sockeye and coho salmon smolts were counted from 19 May through 30 June 2010, meeting Objective 1. The date at which 50% of the emigration had occurred in 2010 (June 10) was 9 days later than the historical average mid-point (June 1); the total emigration (4,037) was also well below the 2003-2006, and 2009 average emigration of 12,305. The 2010 emigration of sockeye smolts was the smallest on record. Sampling efforts to estimate age composition were sufficient to meet Objective 2 for emigrating sockeye salmon smolts. A sample goal size of 106 fish was set for sockeye salmon smolts, with 173 fish being sampled producing 169 readable scales. Mean length at age data was also collected to satisfy Task 1.

Adult sockeye, coho, chum, and pink salmon were counted escaping into the Sixmile Creek Drainage, meeting Objective 3. The project concluded on 15 September. The escapement of 2,533 adult sockeye salmon in 2010 was greater than the historical 1988-2009 average of 2,005. The date July 31, when 50% of the sockeye immigration had occurred in 2010, was consistent with the historic 1988-2009 run timing. Coho (22), chum (5), and pink salmon (492) were also counted in 2010.

Sampling efforts were sufficient to estimate the major age classes of adult sockeye salmon (Objective 4). A sample size goal of 131 fish was set for adult sockeye salmon and 274 scales were collected producing 219 readable scales. Mean length-at-age data, task two, was also collected from sampled adult sockeye passing the weir; lengths ranged from 320 mm to 605 mm.

A sex census of coho salmon was not conducted in 2010 and Objective 5 was not met.

Two stream surveys (16 August and 15 September) were conducted to meet Objective 6. The first was during the peak of the pink salmon return to count pink salmon (477) spawning below the weir and the second after the weir was dismantled, to count any adult salmon that were below the weir. The pink salmon return (477) in 2010 was the second smallest since counts were recorded in 2001.

The historical peak daily smolt emigration typically occurred when the water temperature was between 16-17 degrees Celsius and the 2010 emigration peak occurred when water temperature increased from 16 to 20 degrees Celsius in three days (7 June-9 June). Likewise the adult escapement began when lake outlet temperatures dropped to 18 degrees Celsius.

Angler effort at the mouth of Sixmile Creek during the adult escapement was monitored; however the data were not recorded daily during the season, thus Task 4 was not met. From

personal observations the angler impact on the Sixmile Creek sockeye salmon escapement is minimal, while the average Statewide Harvest estimate over the last 5 years is 127. Effort, catch and harvest at the mouth of Sixmile creek varies annually with no clear trend (appendix 6). Effort, catch and harvest estimates for Sixmile Creek from the Statewide Harvest Survey (SWHA) for 2000-2009 can be found in Appendix 2.

RECOMMENDATIONS

1. Sixmile Drainage has a long term adult sockeye salmon escapement data set that should be continued. The Sixmile sockeye salmon population is small and supports a small sport fishery. This population of salmon is most likely spawning and rearing-habitat-limited, and is not likely to support a much larger population. Additionally, the sport fish harvest and escapements of coho salmon should be monitored. The coho salmon escapement averaged 72 fish from 2001-2009 with a return of 22 in 2010.
2. The current fish ladder should be replaced because it is perched and is a velocity barrier to juvenile salmonids trying to move into the lake to rear. Smolt released above the ladder have been observed being preyed upon by rainbow trout congregating below the ladder. Their vulnerability was likely increased by the effects of the perched fish ladder.
3. Sport fish harvest at the mouth of Sixmile Creek should precipitate improved enforcement coverage. The fishery is predominantly on State lands below mean-high-tide emphasizing the need for improved enforcement plan between JBER conservation staff and Alaska Wildlife Troopers.

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The content and information contained in this report does not necessarily reflect the position or the policy of the U.S. Government, and no official endorsements should be inferred.

APPENDICIES

DESCRIPTION:		ALASKA DEPARTMENT OF FISH & GAME STANDARD AGE WEIGHT LENGTH FORM VERSION 1.2									
DATE: YEAR											
MONTH/DAY											
SPECIES											
TYPE OF MEASUREMENT:											
LENGTH											
WEIGHT											
FISHERY											
GEAR											
CODE:											
MESH INCHES EIGHTH'S											
SIZE											
LOCATION OF SAMPLE:											
SUBLOCATION OF SAMPLE:											
PROJECT NUMBER											
PAGE NUMBER											

#	SEX	MATURITY INDEX	LENGTH OF FISH			WEIGHT OF FISH							
			100's	10's	1's	1000's	100's	10's	1's				
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Appendix 2. Daily and cumulative smolt emigration counts by salmon species, Sixmile Creek Drainage, 2010.

DATE	Sockeye		Coho		Rainbow		Water Temp °C
	Daily	Cum	Daily	Cum	Daily	Cum	
5/15	0	0	0	0	0	0	
5/16	0	0	0	0	1	1	7.8
5/17	0	0	0	0	0	1	8.9
5/18	0	0	0	0	0	1	10.0
5/19		0		0		1	
5/20	0	0	0	0	0	1	12.2
5/21	8	8	0	0	1	2	13.3
5/22	0	8		0		2	
5/23	5	13	0	0	0	2	14.4
5/24	1	14	0	0	0	2	14.4
5/25	14	28	2	2	0	2	15.0
5/26	7	35	4	6	1	3	15.0
5/27		35		6		3	
5/28	34	69	2	8	0	3	16.7
5/29	26	95	0	8	0	3	16.7
5/30	6	101	2	10	0	3	16.7
5/31	5	106	0	10	0	3	16.7
6/1	47	153	1	11	0	3	16.7
6/2	117	270	1	12	0	3	16.7
6/3	67	337	1	13	0	3	16.7
6/4	150	487	0	13	0	3	16.1
6/5	639	1,126	0	13	0	3	15.0
6/6	5	1,131	0	13	0	3	15.0
6/7	162	1,293	4	17	0	3	16.7
6/8	84	1,377	1	18	0	3	19.0
6/9	616	1,993	1	19	0	3	20.0
6/10	427	2,420	3	22	0	3	20.0
6/11	277	2,697	6	28	0	3	20.0
6/12	281	2,978	1	29	0	3	20.0
6/13	176	3,154	5	34	0	3	20.0
6/14	30	3,184	1	35	0	3	20.0
6/15	23	3,207	0	35	0	3	19.5
6/16	181	3,388	2	37	0	3	19.0
6/17	80	3,468	0	37	0	3	19.0
6/18	220	3,688	4	41	0	3	19.0
6/19	28	3,716	0	41	0	3	19.0
6/20	20	3,736	0	41	0	3	20.0
6/21	26	3,762	0	41	0	3	20.0
6/22	26	3,788	0	41	0	3	20.0
6/23	61	3,849	0	41	0	3	20.5
6/24	99	3,948	1	42	0	3	20.5
6/25	51	3,999	0	42	0	3	20.5
6/26	9	4,008	0	42	0	3	21.0
6/27	2	4,010	0	42	0	3	21.0
6/28	3	4,013	0	42	0	3	20.5
6/29	16	4,029	0	42	0	3	20.5
6/30	8	4,037	0	42	0	3	21.0
Totals		4,037		42		3	

Appendix 3. Historical daily and cumulative sockeye salmon smolt emigration counts, Sixmile Creek Drainage, 2003-2006 and 2009, 2010.

Date	Daily Outmigration						Ave 03-06, 09
	2003	2004	2005	2006	2009	2010	
5/12				0			0
5/13				0			0
5/14	0			4			2
5/15	0	4		1		0	2
5/16	21	2		2		0	8
5/17	1	126		1		0	43
5/18	21	7		0		0	9
5/19	8	402		13	26		112
5/20	165	407	92	44	114	0	164
5/21	220	185	121	118	86	8	146
5/22	815	464	30	181	192		336
5/23	1,383	146	15	637	402	5	517
5/24	740	325	155	1,725	87	1	606
5/25	864	319	312	986	375	14	571
5/26	460	616	309	1,919	83	7	677
5/27	731	266	229	1,897	209		666
5/28	445	714	365	229	38	34	358
5/29	673	63	125	1,424	28	26	463
5/30	275	693	20	1,316	23	6	465
5/31	1,047	172	595	781	8	5	521
6/1	506	74	447	836	64	47	385
6/2	688	41	961	882	117	117	538
6/3	521	394	660	418	123	67	423
6/4	128	92	600	90	238	150	230
6/5	384	13	608	254	1,071	639	466
6/6	243	140	265	350	483	5	296
6/7	1,104	37	96	107	963	162	461
6/8	111	25	234	114	1,103	84	317
6/9	478	47	274	65	636	616	300
6/10	173	22	129	174	357	427	171
6/11	1,076	0	143	29	44	277	258
6/12	3,660	58	144	62	123	281	809
6/13	1,536	7	134	148	488	176	463
6/14	779	26	132	223	303	30	293
6/15	573	18	344	230	237	23	280
6/16	96	11	190	113	10	181	84
6/17	134	2	161	596	42	80	187
6/18	20	12	118	188	318	220	131
6/19	14	17	366	30	47	28	95
6/20	6	16	88	72	38	20	44
6/21	3	5	122	53	35	26	44
6/22	9	1	213	14		26	59
6/23	2	35	62	12	29	61	28
6/24			27	73	12	99	37
6/25			308	16	0	51	108
6/26			218	188	18	9	141
6/27			88	80		2	84
6/28			20	129	3	3	51
6/29			27	297	1	16	108
6/30			28	100		8	64
7/1					40	0	40
Total	20,113	6,004	9,575	17,221	8,614	4,037	12,305

Appendix 4. Daily and cumulative weir counts by salmon species, Sixmile Creek Drainage, 2010.

Date	Total Sockeye	Total Sockeye	Coho	Total Coho	Pinks	Total Pinks	Temp C
7/12							
7/13	0	0	0	0	0	0	
7/14	0	0	0	0	0	0	
7/15	0	0	0	0	0	0	
7/16	0	0	0	0	0	0	
7/17	0	0	0	0	0	0	
7/18	0	0	0	0	0	0	
7/19	0	0	0	0	0	0	
7/20	0	0	0	0	0	0	
7/21	0	0	0	0	0	0	
7/22	119	119	0	0	0	0	19.5
7/23	487	606	0	0	0	0	19.5
7/24	200	806	0	0	0	0	19.0
7/25	67	873	0	0	0	0	19.0
7/26	0	873	0	0	0	0	18.0
7/27	0	873	0	0	0	0	18.0
7/28	7	880	0	0	0	0	18.0
7/29	247	1,127	0	0	0	0	18.0
7/30	119	1,246	0	0	0	0	18.0
7/31	103	1,349	0	0	0	0	18.0
8/1	187	1,536	0	0	0	0	18.0
8/2	151	1,687	0	0	0	0	18.0
8/3	140	1,827	0	0	0	0	18.0
8/4	34	1,861	0	0	0	0	18.0
8/5	141	2,002	0	0	0	0	18.0
8/6	107	2,109	2	2	0	0	18.0
8/7	40	2,149	0	2	0	0	18.0
8/8	98	2,247	0	2	2	2	18.0
8/9	135	2,382	3	5	0	2	17.5
8/10	61	2,443	2	7	3	5	17.5
8/11	11	2,454	1	8	10	15	12.0
8/12	4	2,458	1	9	0	15	12.0
8/13	9	2,467	2	11	0	15	12.0
8/14		2,467		11		15	
8/15	9	2,476	1	12	0	15	12.0

-continued-

Date	Sockeye	Total Sockeye	Coho	Total Coho	Pinks	Total Pinks	Temp C
8/16	10	2,486	1	13	0	15	12.0
8/17	17	2,503	0	13	0	15	12.0
8/18	4	2,507	0	13	0	15	12.0
8/19	6	2,513	0	13	0	15	12.0
8/20	5	2,518	1	14	0	15	11.0
8/21	3	2,521	0	14	0	15	11.5
8/22	2	2,523	0	14	0	15	12.5
8/23	2	2,525	0	14	0	15	14.0
8/24	5	2,530	0	14	0	15	14.0
8/25	0	2,530	0	14	0	15	14.0
8/26	0	2,530	0	14	0	15	12.5
8/27	0	2,530	0	14	0	15	12.5
8/28		2,530		14		15	
8/29	0	2,530	0	14	0	15	12.0
8/30	0	2,530	0	14	0	15	12.0
8/31	2	2,532	0	14	0	15	12.0
9/1	0	2,532	0	14	0	15	12.0
9/2	0	2,532	0	14	0	15	12.0
9/3	0	2,532	0	14	0	15	12.0
9/4	0	2,532	0	14	0	15	12.0
9/5	0	2,532	0	14	0	15	12.0
9/6	0	2,532	1	15	0	15	11.5
9/7	0	2,532	0	15	0	15	11.5
9/8	0	2,532	0	15	0	15	11.0
9/9	0	2,532	0	15	0	15	11.0
9/10	1	2,533	3	18	0	15	11.0
9/11	0	2,533	0	18	0	15	11.0
9/12	0	2,533	0	18	0	15	10.5
9/13	0	2,533	0	18	0	15	10.5
9/14	0	2,533	0	18	0	15	10.5
9/15	0	2,533	0	18	0	15	10.5
Weir Totals		2,533		18		15	

Appendix 5.- Adult sockeye salmon escapement counts by date, Sixmile Creek Drainage, 2000 to 2010.

	Year																				Average		
Date	1988	1989	1990	1991	1992	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2004-2009
07/01																				0			0
07/02																				0			0
07/03																				0			0
07/04																							
07/05																							
07/06																							
07/07																							
07/08													4							1			1
07/09																				0			0
07/10													1							0			0
07/11																				0			0
07/12																				0			0
07/13																				0		0	0
07/14																1				0	0	0	0
07/15																				0	0	0	0
07/16										2										0	0	0	0
07/17										3										0	0	0	0
07/18										1				0						0	0	0	0
07/19														0						1	0	0	1
07/20					28					3			149	0						0	0	0	0
07/21					26					17			133	0		5				1	0	0	2
07/22		11				114				17			285	0		107			1	0	0	119	27
07/23	20		2		15	286				43		518	300	0		100			1	0	0	487	25
07/24	0	14	42		1	12			94	487		178	1,188	0		18			1	8	358	200	96
07/25	105	13	25	12	1	337			183	184		78	405	328	158	0	276		4	516	582	67	276
07/26	112		14		11	211		40		56		21	26	173	251	2	124			344	268	0	185
07/27	110	50		48	178	207	111	87		48		3	130	476	364	2	22		219	100	537	0	176
07/28	100	180		17	18	204	180	71	176	4			286	300	394	13	2		14	32	264	7	65
07/29	125	180		88		492	80	128	87	154		200	297	363	279	24	2		1	9	260	247	59
07/30	112	112	15	84		20	230		70	20		180	91	162	132	321	31	205	3	67	86	119	119
07/31				37		107	175		73	20		133	305	59	176	301	160	359	80	112	181	103	199

Date	Year																					Average	
	1988	1989	1990	1991	1992	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2004-2009
08/01	60		83	37		101	230	120	198	21		44	151	91	95	43	92	50	171	46	70	187	79
08/02	154	151	134	23		53	301		16	0		38	59	40	44	26	72	2	34	31	100	151	44
08/03	234	86	234		45		453			138		24	45	86	88	41	40	3	13	17	12	140	21
08/04	215	124	235	198	32	33	243	45	84	48		5	70	76	86	59	35	3	7	21	14	34	23
08/05	134		124	22			227	0	104	0		33	26	65	128	30	50	154	36	20	44	141	56
08/06	117	86	117	47	25	17	320			115	386		11	49	70	9	21	84	125	2	76	107	53
08/07	74	43	74	223	15	44	730	101	105	56	206	48	16	67	83	17	51	39	37	9	21	40	29
08/08	54		54	58	51		42			0	1	17			34	62	14	41	1	14	37	98	28
08/09	51		91	43		34	564	340		56	7	3	13	62	58	39	28	18	5	15	74	135	30
08/10	53	35	53	187	23		45	204		40		30		28	18	147	37	12	9	5	32	61	40
08/11	0			52	40	230	13		171	29			9	30	11	38	14	33	22	22	64	11	32
08/12	0			33	190	40	48	10		25	4	4	2		82	22	16	15	48	9	31	4	24
08/13	25		28	78		40	39		282	24	14	3		42	22	31	16	70	6	21	13	9	26
08/14	0	30	1	142	15		28	328		17	3	1			40	12	65	7	10	18	13		21
08/15	25		25	76					187	13	3			36	41	21	18	5	11	3	37	9	16
08/16	0			71		223	45			9	3		23		44	9	18	16	5	3	61	10	19
08/17	0		15	85	21	218	36			12		3			32	14	7	8	4	0	17	17	8
08/18	0		12			126	31		149	0	3	5	4	11	15	6	41	11	10	9	16	4	16
08/19	0			10		166				0			5		9	1	17	16		2	14	6	10
08/20	0		34		20	12			135	0				19	3	7	9	9	4	1	15	5	8
08/21	0		20	51	8		20			0	1					7	7	6	2	1	8	3	5
08/22	0		18					25	72	0	2	1		15	2	0	9	10	8	2	9	2	6
08/23	227			31	5		11			0	4	1				1	12	3	8	0	4	2	5
08/24	0			21		63								1		7	3	1	1	0	5	5	3
08/25	0					25			36						10	0	10	3		0	5	0	4
08/26	0			0		16				7						13	6	1		0	1	0	4
08/27	0					11			18	2					9	28	5	1		1	1	0	7
08/28	0							15		6				1		15	0	4	2	0	0		4
08/29	0			200				79								3	4	0		0	4	0	2
08/30	0						80									4	2	3		0	0	0	2
08/31	0															0	5	0		0	0	2	1

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	Year																				Average		
Date	1988	1989	1990	1991	1992	1993	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2004-2009
09/01																1		0		0		0	0
09/02																0		0		0		0	0
09/03											3					3		0		0		0	1
09/04											7					1		0		0		0	0
09/05																0		0		0		0	0
09/06											1					0		0		0		0	0
09/07																0		0		0		0	0
09/08																0		0		0		0	0
09/09																						0	
09/10																						1	
09/11																							
09/12																							
09/13																							
09/14																							
09/15																							
Total	2,107	1,115	1,450	1,974	768	3,442	4,282	1,593	2,240	1,662	663	1,571	4,034	2,580	2,778	1,611	1,341	1,192	903	1,463	3,334	2,533	1,641
Total	2,107	1,115	1,450	1,974	768	3,442	4,282	1,593	2,240	1,662	663	1,571	4,034	2,580	2,778	1,611	1,341	1,192	903	1,463	3,334	2,533	2,005

Appendix 6.- Effort, catch and harvest information by species, Sixmile Creek, 2000-2009 (SWHS, ADFG).

Year	Effort	Coho		Sockeye		Chum		Pink	
		Catch	Harvest	Catch	Harvest	Catch	Harvest	Catch	Harvest
2000	638	52	10	53	32	73	24	666	318
2001	535	166	58	213	58	168	0	321	64
2002	17	0	0	0	0	0	0	0	0
2003	1,135	548	238	641	428	544	0	900	121
2004	100	135	34	283	65	14	0	616	81
2005	258	0	0	34	34	0	0	35	12
2006	197	11	11	0	0	0	0	86	0
2007	1,361	591	591	16	16	112	7	1,181	637
2008	602	0	0	82	68	15	15	129	129
2009	221	0	0	0	0	0	0	0	0
5 Yr Avg	528	120	120	26	24	25	4	286	156