Fishery Data Series No. 12-79

Southeast Alaska Steelhead Snorkel Surveys of Regional Index Streams, 2010 and 2011

by

Carol L. Coyle

December 2012

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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SOUTHEAST ALASKA STEELHEAD SNORKEL SURVEYS OF REGIONAL INDEX STREAMS, 2010 AND 2011

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ABSTRACT

Snorkel surveys have been conducted annually since 1997 to monitor the spawning abundance of steelhead *Oncorhynchus mykiss* in 10 index streams in Southeast Alaska, and were conducted again during 2010 and 2011. These index streams were surveyed by a two- or three-person team using snorkel gear between mid-April and early June. Snorkel surveyors observed peak counts (counts bracketed by lower counts) in nine of the index streams during 2010 and six during 2011. The peak survey counts in index streams during 2010 and 2011 were generally lower, as observers reported average to below average peak counts in most index streams. No "record high" peak counts were recorded in either 2010 or 2011.

Key words: steelhead, *Oncorhynchus mykiss*, emigration, abundance, Eagle Creek, Harris River, Humpback Creek, Ketchikan Creek, McDonald Lake Creek, White River, Slippery Creek, Petersburg Creek, Sitkoh Creek, Ford Arm Creek, Peterson Creek, Pleasant Bay Creek, weir, sex, length, abundance indices, snorkel survey, index stream.

INTRODUCTION

Southeast Alaska has 271 uniquely identified steelhead *Oncorhynchus mykiss* producing systems into which flow an additional 60 steelhead supporting tributaries, for a total of 331 known steelhead supporting water bodies (ADF&G 1985). Most populations are believed to contain 200 or fewer spawning adults. Major sport fisheries occur on several of the larger systems such as the Thorne River (Prince of Wales Island) , which may support up to 1,000 spawning steelhead, and the Situk River, which has had annual returns of over 10,000 steelhead. Steelhead harvests in Southeast Alaska generally increased from the late 1970s through 1989, but then began to decline (Mills 1993). As fishery managers and anglers began reporting lower escapements, an emergency order (EO) prohibiting steelhead harvest in the Situk River was enacted in 1991. In 1992, harvests were prohibited by EO in 24 popular systems, and in 1993 steelhead harvest was again prohibited in the Situk River, along with 47 other systems. In 1994, the Alaska Board of Fisheries enacted conservative regulations for steelhead in Southeast Alaska, thereby limiting anglers regionwide to a harvest of 2 steelhead per year with a minimum size limit of 36 inches (914 mm) total length (TL). In 2009, the Alaska Board of Fisheries further restricted streams on the Juneau road system to nonretention of steelhead. (5 AAC 47.023).

Intensive research on steelhead stocks in Southeast Alaska has largely been limited to Petersburg Creek (Jones 1972–1976), Situk River (Johnson 1990, 1991, 1996; Didier and Marshall 1991; Johnson and Marshall 1991; Glynn 1992; Glynn and Elliott 1993; Bain et al. 2003; Johnson and Jones 1998–2001, 2003, Marston et al. 2012, *in prep*), and Sitkoh Creek (Love and Harding 2008, 2009, Love et al. 2012; Love et al. *in prep*). Estimates of migratory timing, abundance, and age composition have been made for a few other systems (Karta River, Jones 1983; Peterson Creek; Harding and Jones 1990–1992; and Sitkoh Creek, Jones et al. 1991, Yanusz 1997). Creel surveys of steelhead sport fisheries have also been conducted (Klawock River, Freeman and Hoffman 1989–1991; Ward Creek, Hubartt 1989, 1990; Karta River, Hoffman et al. 1990; Peterson Creek, Harding and Jones 1991, 1993, 1994; Sitkoh Creek, Schmidt 1992), and run enhancement has been studied in 1 system (Ward Creek; Freeman 1992, 1995).

Although counts of adult steelhead have been conducted in a few select systems for many years, consistent foot surveys to monitor peak abundance were not initiated until 1994. Since then, survey methodology has evolved, and the streams and reaches selected for survey have changed as observers gained experience in each system (Johnson and Jones 1998–2001; 2003; Harding 2005; Harding and Love 2008; Harding 2009).

Substantial changes in survey methods were also instituted in 1997 to increase the proportion of steelhead observed in index streams and to better identify dates of peak instream abundance (Johnson and Jones 1998). Beginning in 1998, snorkeling became the standard method for conducting steelhead index surveys in alignment with the findings of Shardlow et al. (1987) that experienced snorkel surveyors generally observe the highest proportion of inriver steelhead among all common survey methods.

OBJECTIVES

The research objective in 2010 and 2011 was:

1. Directly count the number of inriver steelhead once a week from late April through mid May in 10 previously established Southeast Alaska index streams using standard snorkel techniques until a peak is detected, where a peak count is defined as a count having a lower count before and after a higher count.

Associated tasks:

1. Calculate an expansion factor for converting past and future snorkel survey counts in Peterson Creek to estimates of total steelhead escapement above the weir.
2. Monitor stream temperatures in each of the index streams.

METHODS

SOUTHEAST ALASKA SNORKEL SURVEYS

Snorkel surveys were scheduled to provide indices of peak steelhead abundance for 10 streams in Southeast Alaska in 2010 and 2011 (Figure 1). All index streams have been surveyed for steelhead since 1997 (Johnson and Jones 1998–2001, 2003; Harding 2005; Harding and Love 2008; Harding 2009) with the exception of Slippery Creek, which has been surveyed 11 times since 2000 (Slippery Creek was not surveyed in 2005). The percentage of available stream area surveyed (feet surveyed per feet of anadromous stream) annually averages 62% and ranges from 24.2% in Ford Arm Creek to 100% in McDonald Lake Creek (Appendix A1).

As in prior years, surveys of index streams were conducted weekly, up to 5 times (depending on the stream), from late April through the end of May when instream abundance was expected to peak. A peak count is successfully achieved if it is bracketed by lower counts. If the highest count occurred during the last survey, an additional survey was attempted to obtain a peak count. In many cases a final survey was not performed, thus a final lower count was not obtained and the count was considered a "high" count.

Surveys were conducted by at least 2 observers wearing dry suits and snorkel gear. One trained senior observer was always present. Data from each survey in each stream were recorded for discrete sections (reaches) of the river (Appendix A1). When a shore-based (third) crewmember was available, counts were verbally conveyed to that person, whom tabulated and recorded the counts by reach as the survey progressed. When a shore-based crewmember was not available, one or both snorkelers recorded the counts by stream reach with a waterproof (wax-based) marker on a small plastic diver's slate or something similar for later transcription onto conventional data forms.

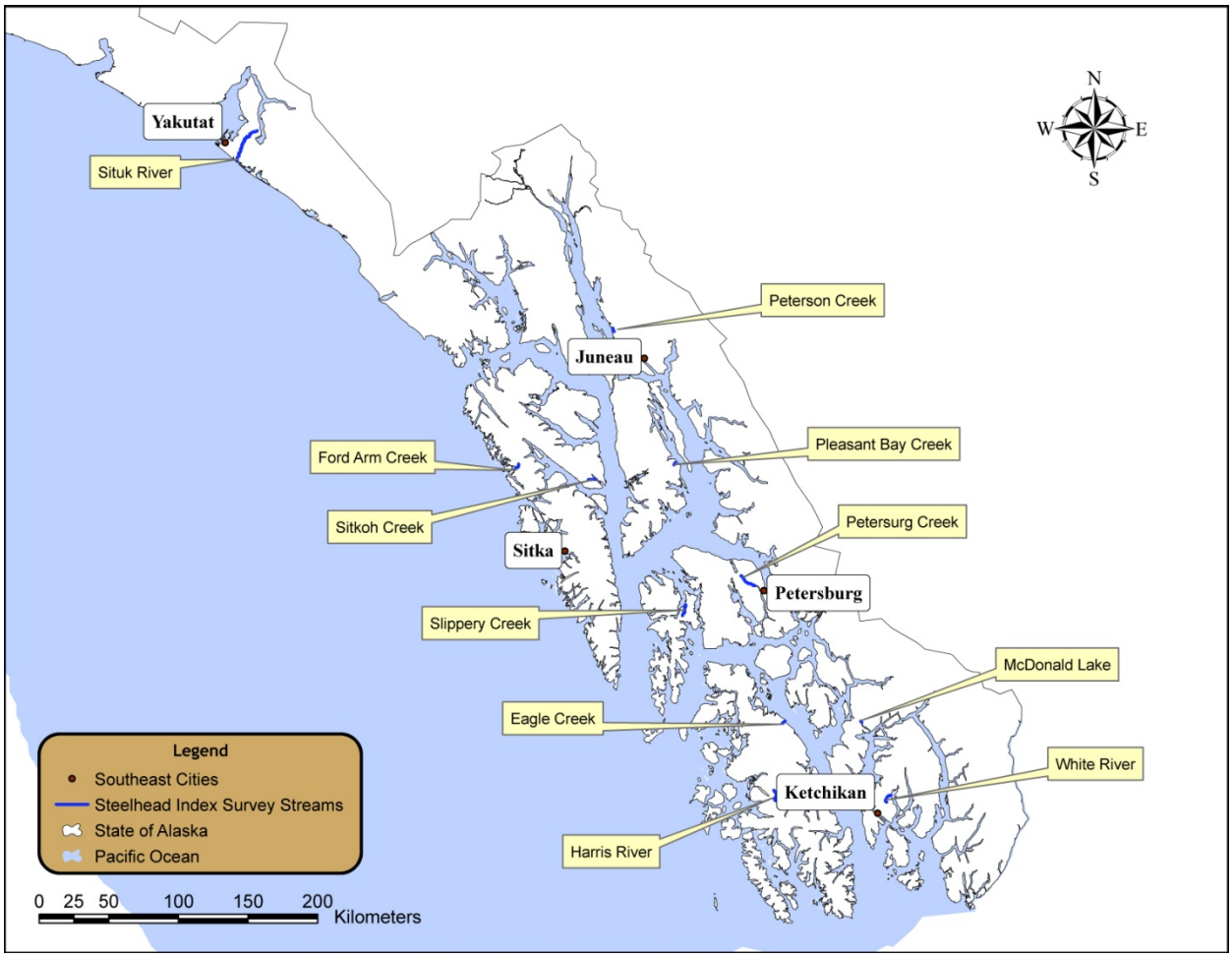


Figure 1.–Locations of the Situk River and the steelhead index systems in Southeast Alaska surveyed in 2010 and 2011.

Observers, as a team, counted all adult steelhead seen during the survey. The observers attempted to stay abreast of one another in the stream in order to coordinate their observations and obtain maximum coverage. When passing through high concentrations of steelhead, both observers counted the number of steelhead in their area of responsibility before consulting with each other and agreeing upon a final count.

If either or both surveyors felt that a questionable count was made in a particular stretch of river, the area was recounted. Typically, steelhead are minimally disturbed on the first pass, so accurate second counts of a pool or run are usually possible.

Several habitat and climactic variables were recorded at each survey site (Appendix A2 [2010] and A3 [2011]). Surface water temperature (°C), and weather conditions (cloud cover, wind, and precipitation) were recorded at the beginning of each survey. In each index system, water levels were recorded at a permanent benchmark established in 1997. This benchmark was either a permanent mark on a bridge abutment, a U.S. Geological Survey (USGS) gauging station, or a mark carved in bedrock. Water clarity was measured using a Secchi disk; the Secchi disk was held underwater by 1 observer approximately 20 cm below the water surface while the second

snorkel observer would back away underwater, keeping visual contact with the disk, while feeding out the line. The point at which the Secchi disk disappeared was the distance that was recorded. Some observers also recorded the distance in which the disk reappeared when pulled towards them following the first measurement.

CALIBRATION OF SNORKEL COUNTS TO WEIR COUNTS

2010 and 2011

The "peak" survey counts for a given year on streams with known or estimated weir escapement counts, may be used to produce a survey count-to-escapement expansion factor for that year. The averages of several yearly estimates of these expansion factors under differing snorkeling conditions may eventually be used to estimate total run strength when weir counts are unavailable. Detailed methods for the development of this expansion factor are described in Appendix A3 of Weller et al. (2007).

Snorkel counts were used for calculating snorkel team-specific count-to-abundance expansion factors (π_i) for Peterson Creek steelhead in 2010 and 2011. Snorkel survey expansion factors were calculated as the weir count N_i on the survey day (immigrants upstream less any adults already passed downstream and any known mortalities at the time), divided by the snorkel survey count C_i for an observer team i, as per the following equation:

$$\pi_i = N_i / C_i \tag{1}$$

An average ($\hat{\pi}$) of k available expansion factor estimates could then be estimated for observer teams on Peterson Creek using:

$$\hat{\pi} = \sum_{i=1}^{k} \pi_i / k , \tag{2}$$

and the sample variance is calculated:

$$var(\hat{\pi}) = \sum_{t=1}^{k} (\pi_i - \hat{\pi})^2 / (k-1) . \tag{3}$$

The sample standard deviation is calculated as the square root of the sample variance.

Estimates across time (multiple survey days) for individual teams were calculated using these equations with appropriate substitutions for i.

STREAM TEMPERATURE MONITORING

Temperature data loggers (HOBO® temp logger model U22 Pro v2)[1] were installed in 9 of the 10 snorkel index streams to provide information on temperature versus peak abundance (no temperature logger was installed in McDonald Lake Creek). The temperature loggers were scheduled to be retrieved each year during the first survey, at which time replacement loggers were installed. The temperature loggers were programmed to record and store temperatures every 2 hours.

[1] Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

RESULTS

SOUTHEAST ALASKA SNORKEL SURVEYS, 2010

Thirty-four snorkel surveys were conducted in the 10 steelhead index streams between April 23 and May 18, 2010. (Table 1, Appendix A2). Observers obtained a peak count in 9 of the index streams. Only in Sitkoh Creek was a peak count not obtained during 2010. The peak 2010 steelhead counts ranged from 35 on May 23 in Peterson Creek to 221 on May 11 in Ford Arm Creek. An additional snorkel survey was performed in Humpback Creek (a nonindex stream) in the Ketchikan area due to management concerns, and only 18 adult steelhead were reported. Although the Humpback Creek count was a single count and peak counts vary in time from year to year, this number was well below the peak historic count of 105 during 2003 and the high count of 112 recorded during 2006 (Appendix A2).

Table 1.–Steelhead index streams surveyed in 2010 along with dates of peak (P; bracketed) or high (H; unbracketed) counts.

Stream name	No. of surveys	Peak/high count date	Peak/high count of steelhead		General location
Eagle Creek	3	May 6	69	(P)	Prince of Wales Island
Harris River	3	May 5	95	(P)	Prince of Wales Island
White River	3	April 30	42	(P)	Revillagigedo Island
McDonald Lake Creek	3	May 7	88	(P)	Southern mainland
Slippery Creek	4	May 6	66	(P)	Kuiu Island
Petersburg Creek	4	May 11	221	(P)	Kupreanof Island
Pleasant Bay Creek	3	May 7	51	(P)	Admiralty Island
Ford Arm Creek	4	May 17	99	(P)	Chichagof Island
Sitkoh Creek	2	May 6	71	(H)	Chichagof Island
Peterson Creek	5	May 10	35	(P)	Northern mainland

SOUTHEAST ALASKA SNORKEL SURVEYS, 2011

Thirty-three snorkel surveys were conducted on 9 of the 10 steelhead index streams between April 19, and June 1, 2011 (Table 2, Appendix A3). McDonald Lake Creek in the Ketchikan area was not surveyed during 2011 due to staffing constraints. Observers obtained a peak count in 7 of the index streams. The peak or high 2011 steelhead counts ranged from 27 on May 24 in Peterson Creek to 169 on May 12 in Ford Arm Creek.

Table 2.–Steelhead index streams surveyed in 2011 along with dates of peak (P; bracketed) or high (H; unbracketed) counts.

Stream name	No. of surveys	Peak/high count date	Peak/high count of steelhead		General location
Eagle Creek	3	May 25	54	(H)	Prince of Wales Island
Harris River	3	April 19	58	(H)	Prince of Wales Island
White River	3	May 9	47	(P)	Revillagigedo Island
McDonald Lake Creek	0	ND	ND	ND	Southern mainland
Slippery Creek	4	May 19	52	(P)	Kuiu Island
Petersburg Creek	3	May 12	131	(P)	Kupreanof Island
Pleasant Bay Creek	4	May 19	94	(P)	Admiralty Island
Ford Arm Creek	4	May 12	169	(P)	Chichagof Island
Sitkoh Creek	4	May 6	68	(P)	Chichagof Island
Peterson Creek	5	May 24	27	(P)	Northern mainland

CALIBRATION OF SNORKEL COUNTS TO WEIR COUNT

2010 and 2011

Division of Sport Fish staff from the Juneau area office conducted snorkel surveys in 2010 and 2011 during weir operations at Peterson Creek. A total of 8 surveys (4 each year) were conducted during 2010 and 2011, which allowed for calibration of snorkel counts. The Juneau team saw an average of 32.2% (SD = 0.44) of the upstream weir count in 2010 and 20.3% (SD = 2.12) in 2011 (Table 3).

Table 3.–Calibration of steelhead snorkel survey counts to Peterson Creek weir escapements, 2010 and 2011.

Date	Snorkel team	Snorkel count	Net weir count [a]	% Observed	π_t	Snorkel conditions
2010						
4/8	T Research	0	0	ND[b]	ND[b]	Normal visibility and water level
5/3	Juneau	5	19	26.3	3.80	Normal visibility and low water level
5/10	Juneau	35	100	35.0	2.86	Excellent visibility and low water level
5/13	Juneau	29	88	31.8	3.03	Normal visibility and low water level
5/17	Juneau	28	81	35.8	2.89	Normal visibility and low water level
Average	Juneau			32.2	3.15	
					0.20	variance
					0.44	SD
					0.94	range
2011						
4/12	TResearch	0	0	ND[b]	ND[b]	Normal visibility and water level
5/10	Juneau	3	7	42.9	2.33	Normal visibility and water level
5/18	Juneau	22	89	24.7	4.05	Poor visibility and normal water level
5/24	Juneau	27	81	33.3	3.00	Normal visibility and water level
6/1	Juneau	7	50	14.0	7.14	Excellent visibility and low water level
Average	Juneau			20.3	4.13	
					4.53	variance
					2.12	SD
					4.81	range

Note: Snorkel surveys conducted on 4/8/2010 and 4/12/2011 were not index counts, but were conducted to establish a count when the weir was installed.

[a] Weir count of known adult steelhead above weir (i.e., net count) when snorkel team finished survey at weir.

[b] No data, could not be calculated.

Peak survey to total escapement

Escapement (total upstream weir count) and peak survey counts from 2010 and 2011 were used to calculate an expansion factor for estimating total escapement from peak survey counts. In Peterson Creek, the estimated expansion factor was 4.09 (Table 4).

Table 4.–Peak survey count to total escapement expansion factor data and calculations for Peterson Creek steelhead.

Year	Peak count	Escapement, N_y		Expansion factor, $\hat{\pi}_y$
2010	35	114		3.26
2011	27	133		4.93
			$\overline{\pi}$ =	4.09

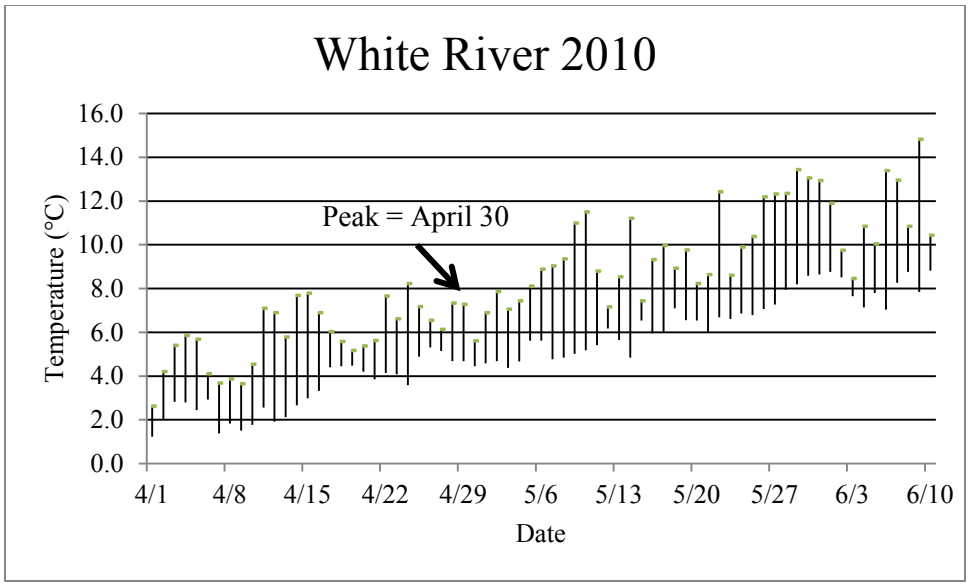
STREAM TEMPERATURE MONITORING

Complete water temperature records during the 2010 surveys are available for White River, Slippery Creek, Ford Arm Creek, Petersburg Creek, Pleasant Bay Creek and Peterson Creek (Figure 2). No records are available for Sitkoh Creek or McDonald Lake Creek, and partial records are available for the remaining index streams. Complete water temperature records during the 2011 surveys are available only for White River and Peterson Creek (these streams are on road systems). In 2010, peak and high snorkel counts were recorded in index streams when the daily average water temperatures ranged from 5.1 °C in White River to 11.0°C in Slippery Creek. In 2011, peak and high snorkel counts were recorded in index streams when the daily average water temperatures ranged from 5.4 °C in White River to 14.4°C in Petersburg Creek. The peak count at Peterson Creek (calibration stream) in 2010 occurred on May 20 when the daily average water temperature was 7.2°C. In 2011 the peak count at Peterson Creek occurred on May 24 when the daily average water temperature was 6.5°C.

DISCUSSION

We have consistent snorkel survey data for 7 index streams from 1997 through 2011 (Table 5). Reviewing the peak and high survey counts for index streams in all years reveals that the 2010 and 2011 counts were generally lower, and observers reported median to below median peak counts in most index streams (Figure 3). The number of steelhead observed during the 2010 and 2011 snorkel counts was consistent with anecdotal angler reports made to Division of Sport Fish area management biologists that indicated steelhead abundance was down from recent years. Peak counts were obtained for 9 of the 10 index systems in 2010, but only 6 in 2011. This change is likely due to poorer visibility and high water conditions in the southern streams during 2011. As in the 2008 and 2009 reporting period, no "record high" peak counts were recorded in either 2010 or 2011.

Steelhead snorkel survey counts in Southeast Alaska have been made since 1997 to monitor trends in steelhead abundance (Johnson and Jones 1998–2001, 2003; Harding 2005, 2008, 2009, 2012). The 2010 installation of a traditional picket weir in Peterson Creek provided an effective opportunity to compare snorkel survey counts to weir counts, as neither the resistivity counter, operated during 2008, nor the Dual Frequency Identification Sonar (DIDSON) used in 2009 provided enough resolution to calibrate immigrant counts with snorkel counts (Coyle and Reed 2012a-b). A standard picket weir was used in 2010 and 2011. With the exception of 2007, snorkel calibrations were made for Sitkoh Creek data from 2003 to 2009 (Harding and Love 2008; Harding 2009, 2012). The average percent of steelhead observed in Sitkoh Creek varied from 40.2% to 60.0 % (Appendix A4). The average percent of steelhead observed in Peterson Creek was 8% lower in 2010 and 20% lower in 2011 than the minimum observed in Sitkoh Creek. The reduced percent observed is likely due to the difference in visibility between these two streams. Peterson Creek is a brownwater stream whereas Sitkoh Creek is a clearwater stream. At Peterson Creek, snorkel team members did not vary during 2010, but did vary in 2011. At Peterson Creek the percent observed is below the overall management objective that a peak snorkel survey should observe approximately 40 to 60% of the actual escapement; this management objective would be difficult to achieve at Peterson Creek due to poor visibility relative to other streams. A better management objective would be year-to-year consistency within each survey stream, as each stream is unique.



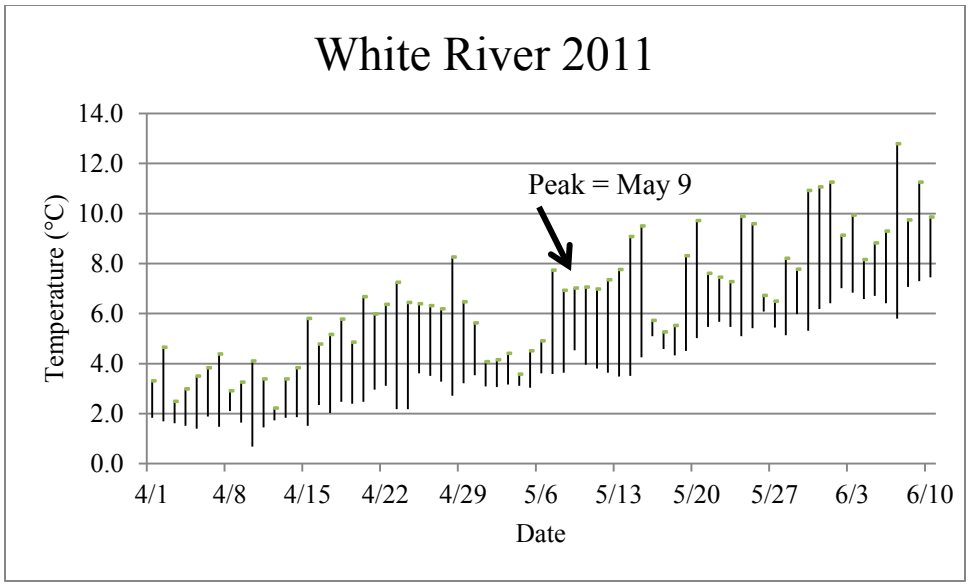


Figure 2.–The daily high, low, and average water temperatures recorded at steelhead index streams and the dates of "high" or "peak" snorkel counts during the 2010 and 2011 Southeast Alaska steelhead snorkel surveys. No temperature graphs exist for McDonald Lake Creek 2010 and 2011, Harris River 2011, and Sitkoh Creek 2010 and 2011.

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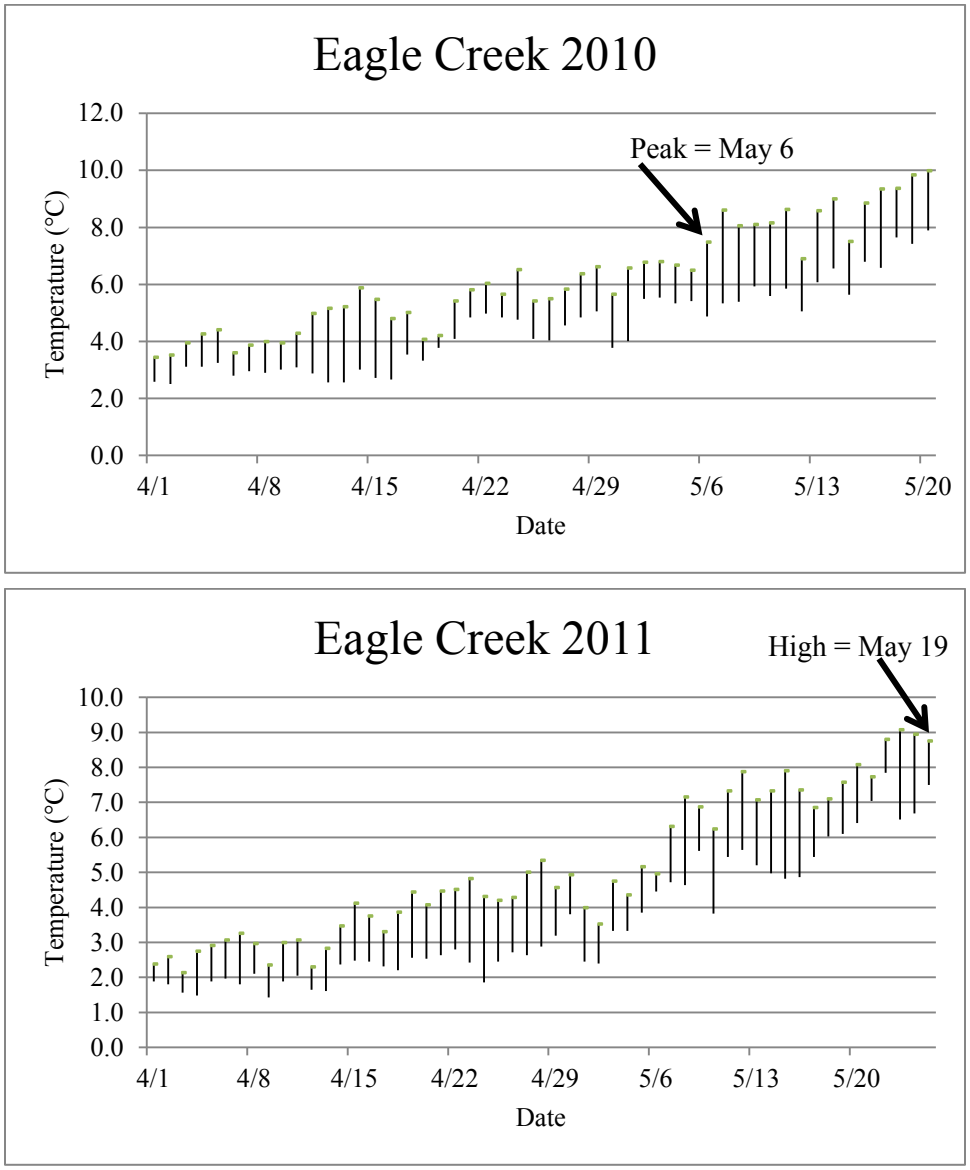

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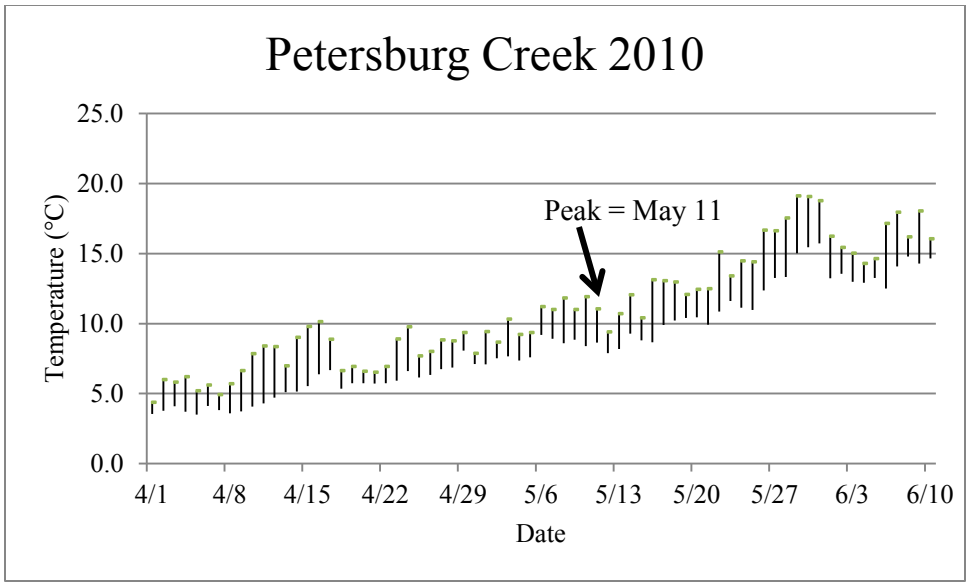

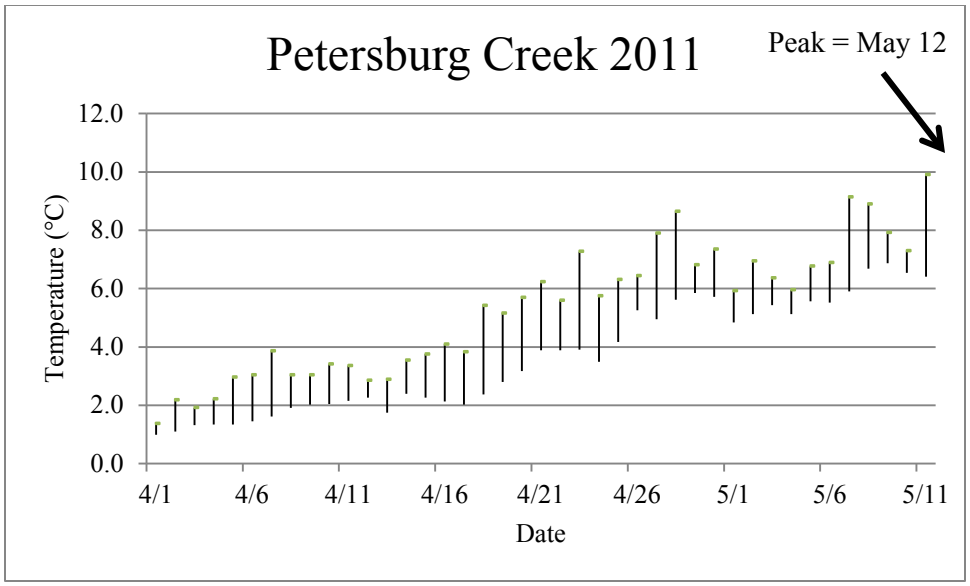

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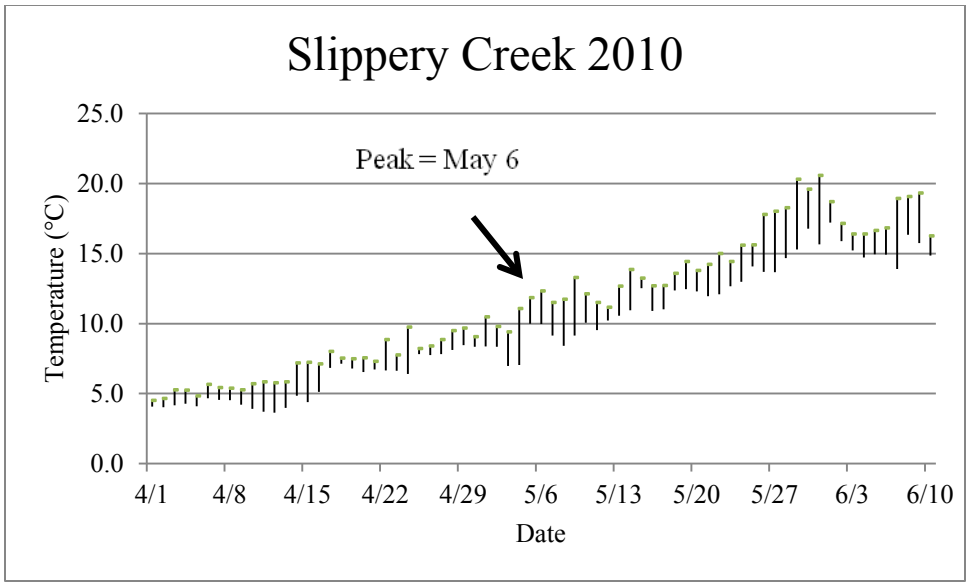

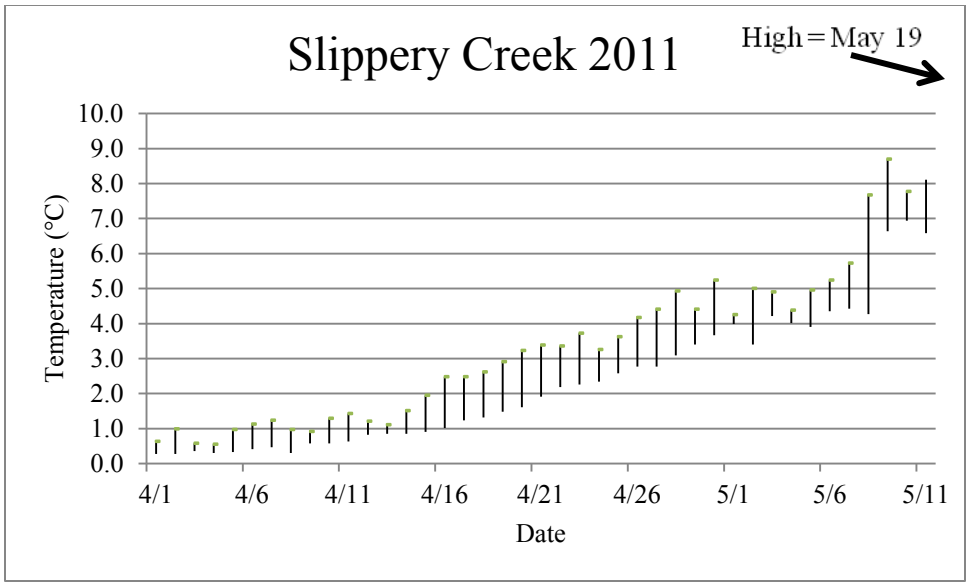

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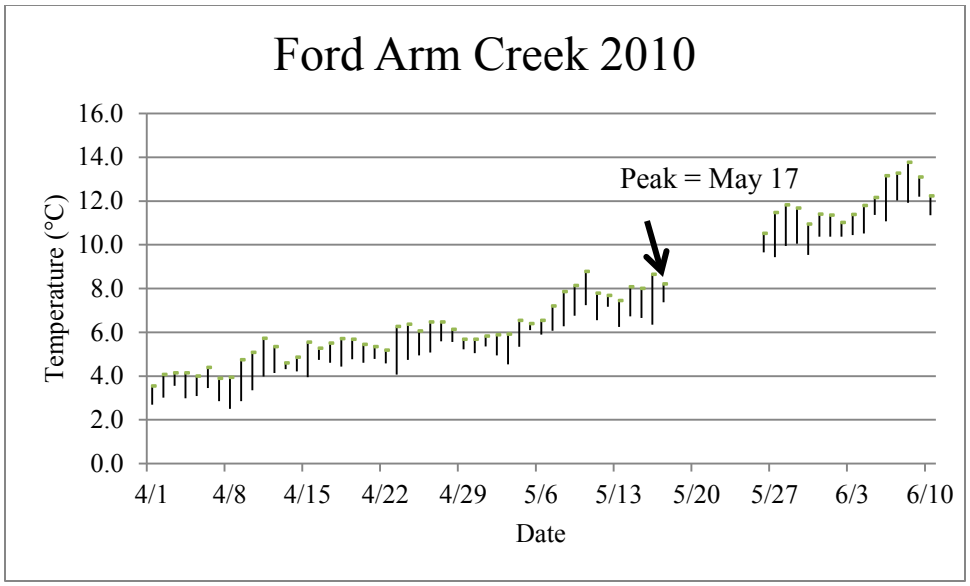

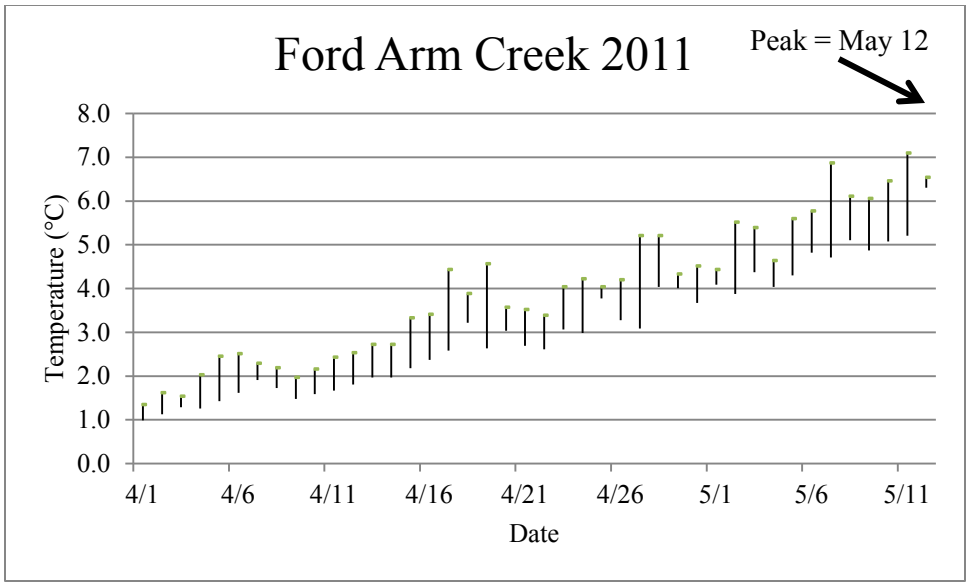

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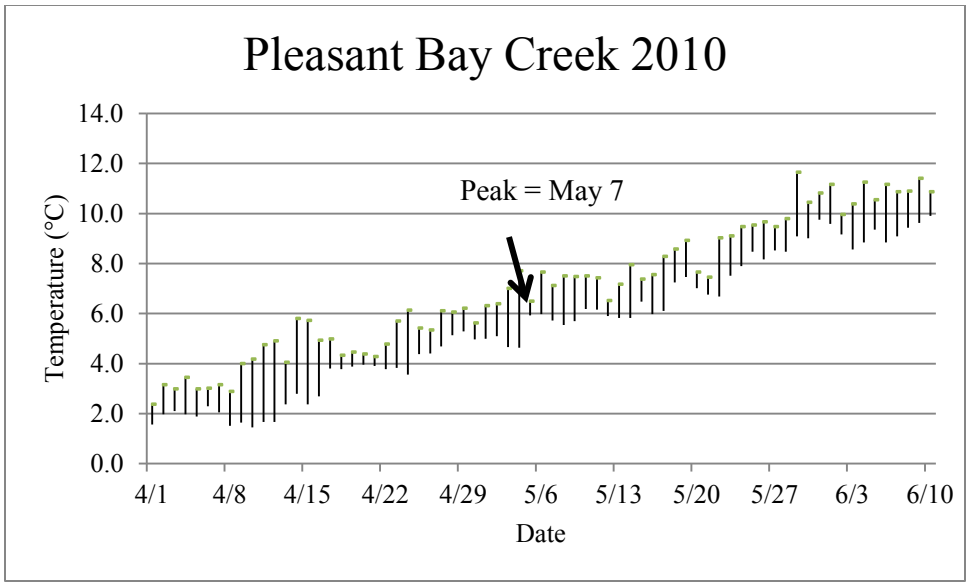

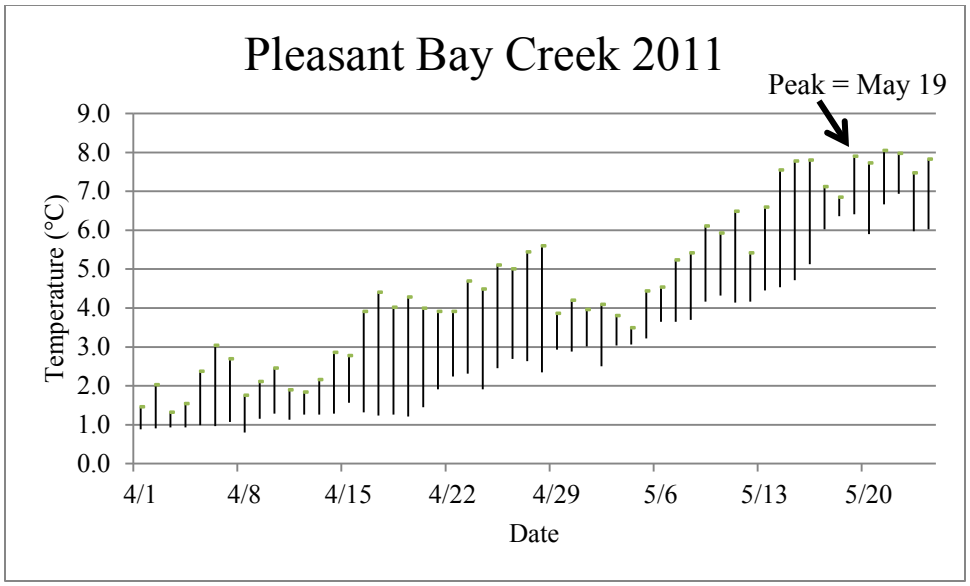

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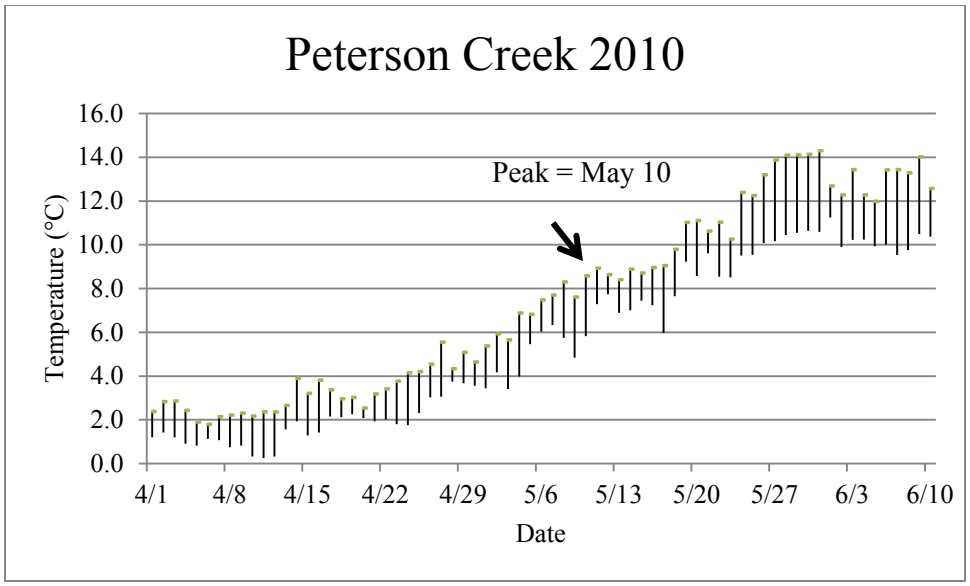

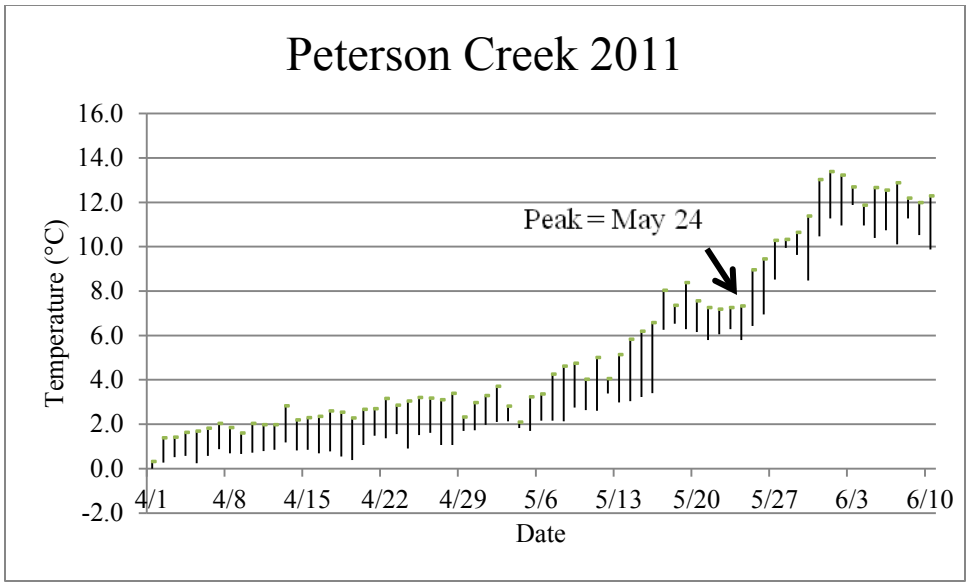

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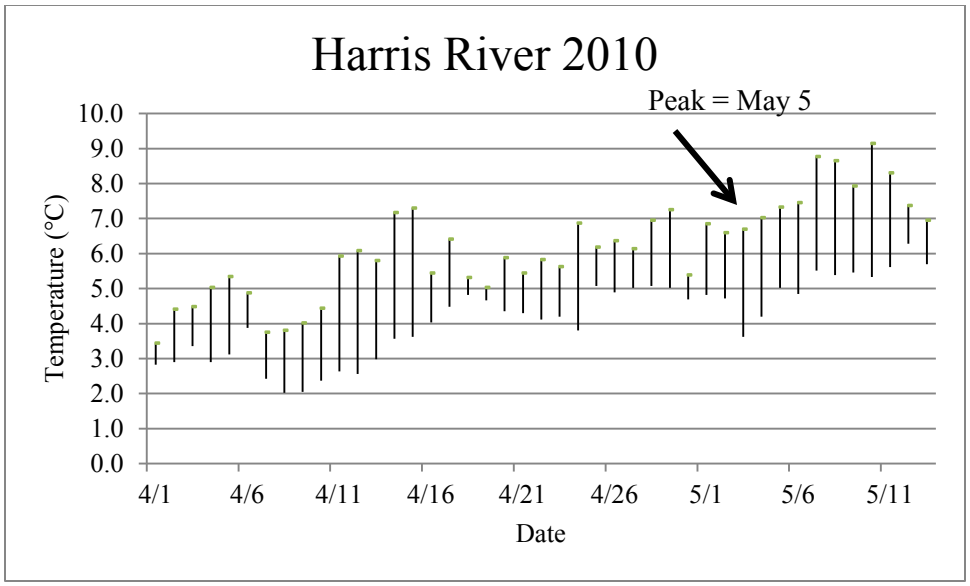

Figure 2.–Page 8 of 8.

Table 5.–Steelhead snorkel survey counts collected on index streams in Southeast Alaska, 1997–2011.

Management area	Stream name	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Juneau	Peterson Cr.	**26**	*29*	*38*	***27***	**41**	**13**	**36**	***39***	**22**	**36**	**26**	**26**	**22**	**34**	**27**
	Pleasant Bay	*155*	**81**	*132*	**48**	*48*	**36**	**50**	**51**	*47*	*59*	**94**	**53**	**64**	**51**	**94**
Ketckikan	Humpback Cr.	**91**	*24*	*4*	*7*	*101*	*94*	**105**	*65*	**38**	*112*	*18*	ND	*23*	**19**	ND
	Ketchikan Cr.	*48*	*47*	*19*	**15**	***24***	*5*	**60**	***53***	*94*	ND	ND	ND	*14*	ND	ND
	McDonald Lk.Cr	**145**	**86**	*100*	**47**	*74*	*14*	**79**	***76***	**134**	**100**	*25*[b]	*45*	ND	**88**	ND
	White River	*84*	**93**	*60*	**38**	**48**	**37**	*77*	*35*	*67*	**41**	**85**	**45**	**45**	**42**	**47**
Petersburg	Petersburg Cr.	*123*	**152**	**115**	*68*	*64*	*41*	**146**	**330**	**369**	**241**	**289**	**251**	**198**	**221**	**131**
	Bear (Big) Cr.	ND	ND	ND	ND	ND	ND	ND	ND	**132**	ND	ND	ND	ND	ND	ND
	Marten Cr.	*14*	*17*	*18*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Slippery Cr.[a]	ND	ND	ND	ND	*41*	*31*	*76*	*92*	ND	*79*	**68**	**46**	**86**	**66**	**52**
Prince of Wales	Eagle/Luck Cr.	*90*	**56**	*118*	**82**	ND	**36**	*95*	*67*	*102*	**154**	*134*	*8*	**137**	**69**	*54*
	Harris River	*104*	**156**	*192*	**79**	*53*	*200*	*195*	**124**	**122**	**92**	**128**	*122*	**90**	**95**	*58*
	Ford Arm Cr.	*296*	*103*	*89*	**134**	*28*	*122*	**181**	**379**	**459**	**428**	**673**	**266**	**194**	**99**	**169**
	Sitkoh Cr.	*329*	*154*	*120*	*112*	*115*	*65*	**296**	**354**	**259**	**213**	*70*	**167**	**201**	*35*	**68**

[a] Slippery Creek not surveyed in 1997–1999 and 2005.

[b] Based on only one survey count.

Note: Peak count (bold) is defined as a bracketed count or a count having a lower count before and after the high or "peak" count; high count (italicized) is defined as an unbracketed count and is the highest count for that year/system. ND represents no data.

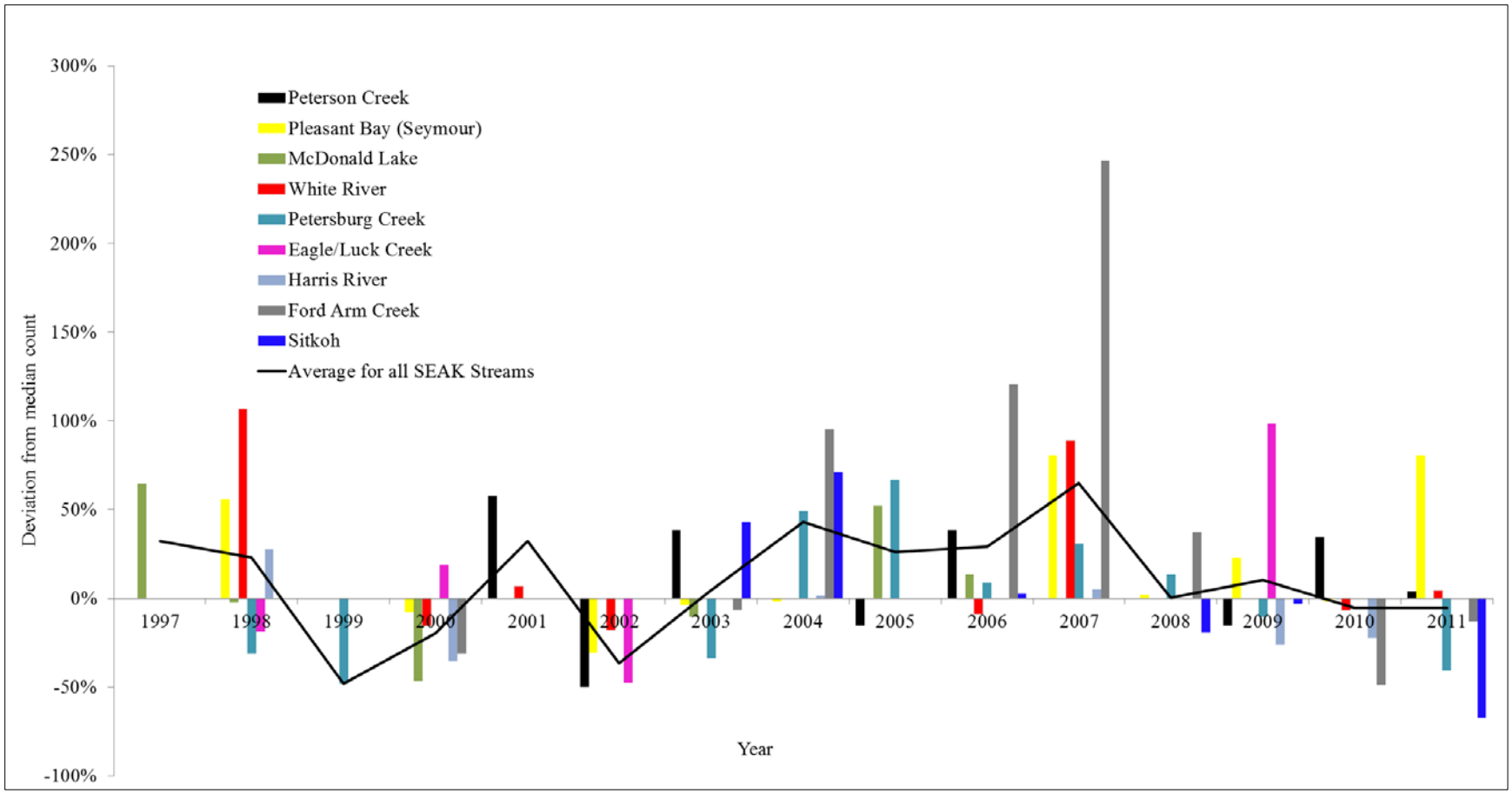

Figure 3.–Annual deviations from the median peak snorkel survey count (bars) and the average annual deviation (line) for Southeast Alaska steelhead snorkel surveys, 1997–2011. Only peak counts were used and only for systems surveyed since 1997, (Slippery Creek is not included).

Between-year variability is evident when looking at the sample standard deviations and ranges for surveys conducted by the Juneau team in Peterson Creek (Table 3). During 2010 the Juneau team was identical for all 4 index snorkel surveys, but due to injuries the Juneau team had a different substitute for each of the last 2 surveys during 2011. In 2010 the Juneau team tended to provide data that were 5 times more consistent than the multiple crews used in 2011. The difference in variance between 2010 and 2011 is statistically significant ($P = 0.028$) when using a F-test for equal variances (Zar 1984). Still, a standard deviation of 2 fish is very low in terms of how it affects escapement estimates. Using the average π (4.09) for Peterson Creek (Table 4), a difference of 2 fish observed in the peak snorkel survey equates to about 8 fish in the escapement estimate which, using the 2011 peak snorkel count (27), means that the estimated total escapement would be skewed by about 7%.

Developing a complete temperature record for each index stream improved from the 2008–2009 reporting period. Only 2 of the temperature data loggers were lost. The limited number of snorkel surveys can also contribute to incomplete records as the logger is often either set or retrieved only during the snorkel season; this involves bringing the logger to the office, and subsequently returning it to the stream. Steps have been taken to improve the consistency of data collection either by using the data retrieval shuttle that allows for *in situ* retrieval, or by replacing the temperature logger in the field rather than retrieving it. Regardless, temperature records for any given year will not be complete until all postseason data are retrieved and incorporated during the following season. The average daily water temperatures during peak snorkel counts for the two year reporting period ranged from 5.1°C (White River) during 2010 to 14.3°C (Petersburg Creek) during 2011. Although inferences from these temperature data cannot be made because this is not a rigorous temperature study, it does provide some baseline water temperature data for steelhead streams in Southeast Alaska. Such data may become important if significant climate changes alter the timing of peak spawning activity.

Steelhead peak immigration was, in general, slightly later in 2011 than 2010, with the exception of the Harris River in southern Southeast Alaska where increased water level and low visibility prevented any such determination. Trends for 2010 and 2011 were mixed. Peak immigration in the Petersburg area was later in Slippery Creek during 2011 than 2010, and earlier in Petersburg Creek during 2011 than 2010. Ford Arm Creek in the Sitka area had peak counts only 5 days apart, with 2011 being earlier than 2010. In northern Southeast Alaska (Pleasant Bay Creek and Peterson Creek), peak immigration occurred approximately 2 weeks later in 2011 than 2010.

Over 15 years have elapsed since the implementation of stricter regulations in 1994, and the response of steelhead stocks has been mixed. With the exception of 2001, snorkel index counts were, on average, lower between 1999 and 2003, than those previous or since (Figure 3). Beginning in 2004 and continuing through 2007, snorkel counts trended upwards, but declined to at or below average during 2008 and 2009 and continued to decline slightly more in 2010 and 2011. Collectively these counts suggest that the steelhead stocks surveyed during 2010 and 2011 were closer to historic averages and generally had lower escapements compared to 2004–2007. Even though index stocks appear stable and near average levels, it remains unclear whether these stocks have rebounded from the depressed levels observed in the late 1980s and early 1990s leading to the department's decision to issue emergency orders closing many streams to the retention of steelhead in 1992 and again in 1993.

In 2009, the Alaska Board of Fisheries approved the proposal submitted by the Juneau Chapter of Trout Unlimited that prohibited retention of steelhead along the Juneau road system. Thus,

sport anglers are prohibited from harvesting steelhead from Peterson Creek. Steelhead counts at the Peterson Creek weir, from 1989 to 1991, averaged 205 fish. Two decades later the counts at the Peterson Creek weir were 114 in 2010 and 133 in 2011. Because snorkel surveys in 2010 and 2011 were close to average, and because steelhead snorkel surveys were not conducted in Southeast Alaska until 1996, it remains unclear whether this reduction in escapement is primarily due to a loss or degradation of holding pools or other habitat change, or a natural variation in steelhead numbers. It is recommended that a weir be used to evaluate steelhead escapement into Peterson Creek if steelhead trends remain depressed or decline further. Closing part or all of Peterson Creek may be an effective tool when water levels are low. It is also recommended that: 1) refinement of expansion factors continue; 2) a literature review be conducted for estimating minimum spawning populations for steelhead in small streams in Southeast Alaska; and 3) managers and researchers develop protocols and criteria for implementing management actions based upon snorkel counts.

The estimation of an expansion factor for Peterson Creek snorkel surveys based on weir counts (Appendices A5, A6) was an objective of this project. The expansion factor will allow us to estimate steelhead escapement in Peterson Creek in future years when a peak snorkel count has been obtained. Estimates of escapement based on the current expansion factor, using only 2 observations (2010 and 2011), will have 60% confidence intervals that are ±49% of the point estimate based on a Student's t-distribution with 1 df. Prediction precision will be improved with additional paired observations of weir escapement counts and peak snorkel counts. For example, 3 additional years of data are projected to provide estimates of escapement with 60% confidence intervals that are ±33% of the point estimate based on a Student's t-distribution with 4 df. Efforts to develop "expansion factors" comparing snorkel counts with weir counts should continue in the future as this procedure continues to be refined. Ideally, more of the snorkel index streams will be "calibrated" using this method as opportunities become available.

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APPENDIX A

Appendix A1.–Steelhead index stream name, anadromous stream number, management area, length and percent of stream surveyed, number of survey reaches, and approximate dates for start of weekly surveys for steelhead in 2010 and 2011.

Index stream	Anadromous stream number	Area	Survey length/stream length (m[a])	Percent of stream surveyed (%)	Number of reaches	Target survey date[b]
Eagle Creek	107-40-10055	POW	8,722.62/14,976.65	58.24	4	23-Apr
Harris River	102-60-10820	POW	11,780.47/29,402.84	40.07	5	24-Apr
White River	101-44-10024	Ketchikan	6,002.84/10,896.60	55.09	3	25-Apr
McDonald Lake Creek[c]	101-80-10068	Ketchikan	3,395.70/3,431.74	98.95	4	26-Apr
Humpback Creek[c]	101-30-10830	Ketchikan	3,218.70/3,218.70	100.00	4	30-Apr
Petersburg Creek	106-44-10600	Petersburg	8,529.50/22,245.22	38.34	3	30-Apr
Slippery Creek	109-43-10030	Petersburg	2,446.20/3,502.46	69.84	2[d]	30-Apr
Ford Arm Creek	113-73-10030	Sitka	1,770.28/7,315.81	24.20	2	30-Apr
Sitkoh	113-59-10004	Sitka	5,552.23/6,137.45	90.46	3	30-Apr
Pleasant Bay Creek	111-12-10005	Juneau	2,027.76/3,781.04	53.63	2[e]	30-Apr
Peterson Creek	111-50-10010	Juneau	1,116.48/2,302.5	48.50	1	30-Apr

[a] Meters to be surveyed/meters of anadromous stream.

[b] Additional surveys are required if highest counts occur during last of three surveys.

[c] Snorkel surveys performed at Humpback Creek and McDonald Lake Creek in 2010 only.

[d] Stream reach 3 was dropped in 2000 due to safety concerns and because <10% of steelhead were ever observed in this section of river.

[e] Stream reach 3 was dropped in 2007 due to safety concerns.

Appendix A2.–Counts of steelhead from 2010 surveys by stream, date, and reach of stream along with measured environmental variables.

Stream	Survey date	Survey reach	Observers[a]	Survey type[b]	Distance surveyed (m)	Tide code[c]	Remark code[d]	Water level code	Weather codes[f]	Staff gauge level/depth (cm)	Secchi disk (m)	Surface temp.	Number of live steelhead
Eagle/Luck	04/24	1	SM DL	S	4,168.2	ND	22	33	C	ND	ND	ND	2
Eagle/Luck	04/24	2	SM DL	S	1,899.0	ND	22	33	C	ND	ND	ND	11
Eagle/Luck	04/24	3	SM DL	S	1,528.9	ND	22	33	C	ND	ND	ND	25
Eagle/Luck	04/24	4	SM DL	S	1,126.5	ND	22	33	C	ND	ND	ND	4
Eagle/Luck	05/06	1	SM M	S	4,168.2	ND	22	33	O	ND	ND	ND	1
Eagle/Luck	05/06	2	SM M	S	1,899.0	ND	22	33	O	ND	ND	ND	9
Eagle/Luck	05/06	3	SM M	S	1,528.9	ND	22	33	O	ND	ND	ND	39
Eagle/Luck	05/06	4	SM M	S	1,126.5	ND	22	33	O	ND	ND	ND	20
Eagle/Luck	05/20	1	SM KP MW	S	4,168.2	ND	22	32	O	ND	ND	ND	9
Eagle/Luck	05/20	2	SM KP MW	S	1,899.0	ND	22	32	O	ND	ND	ND	13
Eagle/Luck	05/20	3	SM KP MW	S	1,528.9	ND	23	32	O	ND	ND	ND	14
Eagle/Luck	05/20	4	SM KP MW	S	1,126.5	ND	23	32	O	ND	ND	ND	0
Ford Arm	04/28	1	TT PF S	S	643.7	43	22	32	O,R	16.00	19/21	5.5	15
Ford Arm	04/28	2	TT PF S	S	1,126.5	41	22	32	O,R	16.00	19/21	5.5	44
Ford Arm	05/10	1	TT KF	S	643.7	43	22	33	O	23.00	15/20	8.0	9
Ford Arm	05/10	2	TT KF	S	1,126.5	43	22	32	O	23.00	15/20	8.0	80
Ford Arm	05/17	1	PF MM H	S	643.7	43	21	33	C	21.00	14.0	7.0	14
Ford Arm	05/17	2	PF MM H	S	1,126.5	42	21	33	C	21.00	85.0	7.0	85
Ford Arm	05/26[1]	1	PF MM GH	S	643.7	43	22	33	C	22.00	14/19	8.5	23
Ford Arm	05/26	2	PF MM GH	S	1,126.5	43	22	33	C	22.00	14/19	8.5	51
Harris	04/23	1	SM KP MW TJ	S	1,207.1	ND	21	33	C	ND	ND	ND	9
Harris	04/23	2	SM KP MW TJ	S	3,363.5	ND	21	33	C	ND	ND	ND	27
Harris	04/23	3	SM KP MW TJ	S	3,089.9	ND	21	33	C	ND	ND	ND	15
Harris	04/23	4	SM KP MW TJ	S	2,864.6	ND	21	33	C	ND	ND	ND	2
Harris	04/23	5	SM KP MW TJ	S	1,255.3	ND	21	33	C	ND	ND	ND	0
Harris	05/05	1	SM KP MW KM	S	1,207.1	ND	21	33	O	ND	ND	ND	2
Harris	05/05	2	SM KP MW KM	S	3,363.5	ND	21	33	O	ND	ND	ND	74
Harris	05/05	3	SM KP MW M	S	3,089.9	ND	21	33	O	ND	ND	ND	14
Harris	05/05	4	SM KP MW KM	S	2,864.6	ND	21	33	O	ND	ND	ND	5
Harris	05/05	5	SM KP MW KM	S	1,255.3	ND	21	33	O	ND	ND	ND	0
Harris	05/21	1	SM KP MW M	S	1,207.1	ND	21	33	C	ND	ND	ND	0
Harris	05/21	2	SM KP MW KM	S	3,363.5	ND	21	33	C	ND	ND	ND	29
Harris	05/21	3	SM KP MW KM	S	3,089.9	ND	21	33	C	ND	ND	ND	7
Harris	05/21	4	SM KP MW M	S	2,864.6	ND	21	33	C	ND	ND	ND	3
Harris	05/21	5	SM KP MW KM	S	1,255.3	ND	21	33	C	ND	ND	ND	0

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Stream	Survey date	Survey reach	Observers[a]	Survey type[b]	Distance surveyed (m)	Tide code[c]	Remark code[d]	Water level code[e]	Weather codes[f]	Staff gauge level/depth (cm)	Secchi disk (m)	Surface temp.	Number of live steelhead
Humpback	04/29	1	KP MW TJ MB	S	ND	ND	22	32	C	ND	ND	ND	0
Humpback	04/29	2	KP MW TJ MB	S	ND	ND	22	32	C	ND	ND	ND	10
Humpback	04/29	3	KP MW TJ MB	S	ND	ND	22	32	C	ND	ND	ND	8
Humpback	04/29	4	KP MW TJ MB	S	ND	ND	22	32	C	ND	ND	ND	1
McDonald	04/27	1	KP MW TJ	S	708.1	ND	22	32	O	ND	ND	ND	9
McDonald	04/27	2	KP MW TJ	S	820.8	ND	22	32	O	ND	ND	ND	13
McDonald	04/27	3	KP MW TJ	S	772.5	ND	22	32	O	ND	ND	ND	25
McDonald	04/27	4	KP MW TJ	S	1,094.4	ND	22	32	O	ND	ND	ND	2
McDonald	05/07	1	KP KM TJ	S	708.1	ND	21	33	C	ND	ND	8.0	13
McDonald	05/07	2	KP KM TJ	S	820.8	ND	21	33	C	ND	ND	8.0	31
McDonald	05/07	3	KP KM TJ	S	772.5	ND	21	33	C	ND	ND	8.0	34
McDonald	05/07	4	KP KM TJ	S	1,094.4	ND	21	33	C	ND	ND	8.0	10
McDonald	05/18	1	MW KM MB	S	708.1	ND	22	31	O	ND	6.5	10.0	15
McDonald	05/18	2	MW KM MB	S	820.8	ND	22	31	O	ND	6.5	10.0	5
McDonald	05/18	3	MW KM MB	S	772.5	ND	22	31	O	ND	6.5	10.0	2
McDonald	05/18	4	MW KM MB	S	1,094.4	ND	22	31	O	ND	6.5	10.0	1
Petersburg	04/27	1	DF VG	S	3,379.6	43	21	33	O	-86.00	7.4	7.5	64
Petersburg	04/27	2	DF VG	S	2,253.1	43	21	33	O	-86.00	7.4	7.5	46
Petersburg	04/27	3	DF VG	S	2,896.8	43	22	33	O,R	-86.00	7.4	7.5	20
Petersburg	05/04	1	DF VG	S	3,379.6	ND	22	33	O/C	91.00	5.2	7.5	39
Petersburg	05/04	2	DF VG	S	2,253.1	ND	22	33	O	91.00	5.2	7.5	49
Petersburg	05/04	3	DF VG	S	2,896.8	ND	22	33	O	91.00	5.2	7.5	81
Petersburg	05/11	1	DF VG	S	3,379.6	42	21	33	O	91.00	6.4	8.5	42
Petersburg	05/11	2	DF VG	S	2,253.1	42	21	33	O	91.00	6.4	8.5	45
Petersburg	05/11	3	DF VG	S	2,896.8	42	21	33	O	91.00	6.4	8.5	134
Peterson	04/08	1	DL KK NN	S	110.4	ND	22	32	O	ND	ND	2.0	0
Peterson	05/03	1	BG DT JL	S	110.4	ND	22	33	O	12.50	2.0	4.9	5
Peterson	05/10	1	BG DT JL	S	110.4	ND	21	35	C	6.80	3.5	7.8	35
Peterson	05/13	1	BG DT JL	S	110.4	ND	22	33	C	1.90	4.0	7.7	29
Peterson	05/17	1	BG DT JL	S	110.4	ND	22	33	C	6.80	3.0	8.2	28
Pleasant Bay	04/28	1	BG BF JL	S	1,158.7	ND	21	32	O	31.75	8.0	5.2	23
Pleasant Bay	04/28	1	BG BF JL	S	1,158.7	ND	21	32	O	31.75	8.0	5.2	23
Pleasant Bay	04/28	2	BG BF JL	S	869.0	ND	21	32	O	31.75	8.0	5.2	18
Pleasant Bay	05/07	1	ND	S	1,158.7	ND	ND	33	ND	34.00	7.0	ND	ND
Pleasant Bay	05/07	2	ND	S	869.0	ND	ND	33	ND	34.00	7.0	ND	51
Pleasant Bay	05/14	1	BG DT JL	S	1,158.7	ND	22	33	C	34.00	7.0	6.8	23
Pleasant Bay	05/14	2	BG DT JL	S	869.0	ND	22	33	C	34.00	7.0	6.8	18

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Stream	Survey date	Survey reach	Observers[a]	Survey type[b]	Distance surveyed (m)	Tide code[c]	Remark code[d]	Water level code[e]	Weather codes[f]	Staff gauge level/depth (cm)	Secchi disk (m)	Surface temp.	Number of live steelhead
Sitkoh	05/06	1	TT PF H	S	1,207.0	42	22	32	O	ND	15/18	7.0	11
Sitkoh	05/06	2	TT PF H	S	1,931.2	42	22	32	O	ND	15/19	7.0	29
Sitkoh	05/06	3	TT PF H	S	2,414.0	42	22	32	O	ND	15/20	7.0	31
Sitkoh	05/19	1	PF MM S	S	1,207.0	42	22	31	C	245.00	22/16	8.0	12
Sitkoh	05/19	2	PF MM S	S	1,931.2	42	22	31	C	245.00	22/17	8.0	13
Sitkoh	05/19	3	PF MM S	S	2,414.0	42	22	31	C	245.00	22/18	8.0	21
Slippery	04/29	1	DF VG	S	1,046.1	43	22	33	O	14.00	5.5	9.5	13
Slippery	04/29	2	DF VG	S	1,400.1	43	22	33	O/C	14.00	5.5	9.5	35
Slippery	05/06	1	DF VG	S	1,046.1	ND	21	33	O/C	21.30	6.8	11.5	33
Slippery	05/06	2	DF VG	S	1,400.1	ND	21	33	O/C	21.30	6.8	11.5	33
Slippery	05/12	1	DL VG	S	1,046.1	ND	22	33	O,R	10.60	4.6	11.5	2
Slippery	05/12	2	DL VG	S	1,400.1	ND	22	33	O,R	10.60	4.6	11.5	5
White	04/20	1	KP,MW,TJ	S	2,381.8	ND	23	31	O	ND	ND	ND	3
White	04/20	2	KP,MW,TJ	S	2,317.5	ND	23	31	O	ND	ND	ND	0
White	04/20	3	KP,MW,TJ	S	1,303.6	ND	23	31	O	ND	ND	ND	4
White	04/30	1	KP, MW, KM	S	2,381.8	ND	22	32	O,R	ND	ND	ND	27
White	04/30	2	KP, MW, KM	S	2,317.5	ND	22	32	O,R	ND	ND	ND	5
White	04/30	3	KP, MW, KM	S	1,303.6	ND	22	32	O,R	ND	ND	ND	10
White	05/11	1	KP, TJ, KM	S	2,381.8	ND	21	32	O	ND	ND	8.0	24
White	05/11	2	KP, TJ, KM	S	2,317.5	ND	21	32	O	ND	ND	8.0	1
White	05/11	3	KP, TJ, KM	S	1,303.6	ND	21	32	O	ND	ND	8.0	8

Note: The point at which the Secchi disk disappeared was the distance that was recorded, but some observers also recorded the distance in which the disk reappeared when pulled towards them following the first measurement.ND represents no data.

[a] Observer: TT (Troy Tydingco), DF (Doug Fleming), VG (Vera Goudima), KP (Kelly Piazza), MW (Mike Wood), KK (Kurt Kondzela), BG (Brian Glynn), SM (Steve McCurdy), TJ (Todd Johnson), DL (David Love), NN (Nathaniel Nichols), BF (Brian Frenette), MM (Monica Matz), KH (Kyle Hert), GH (G. Hagerman), JS (Jason Sexton), KF (Kyle Ferguson), KM (Kris Maledy), MB (Malika Brunette), BN (Brendan Naples), ND (Neil Durco).

[b] S = snorkel, F = foot, R&R = rod and reel.

[c] 41 = high, 42 = low, 43 = intermediate.

[d] 21 = excellent visibility, 22 = normal visibility, 23 = poor visibility.

[e] 31 = high water, 32 = normal water, 33 = low water.

[f] C = clear, O = overcast, R = rain, W = wind on water surface, O/C = overcast with breaks.

Appendix A3.–Counts of steelhead snorkel surveys from 2011 by stream, date, and reach of stream along with measured environmental variables.

Stream	Survey date	Survey reach	Observers[a]	Survey type[b]	Distance surveyed (m)	Tide code[c]	Remark code[d]	Water level code	Weather codes[f]	Staff gauge level/depth (cm)	Secchi disk (m)	Surface temp.	Number of live steelhead
Eagle/Luck	4/28	1	SM DM RR	S	1,609.3	ND	22	32	C	ND	ND	ND	7
Eagle/Luck	4/28	2	SM DM RR	S	3,218.7	ND	22	32	C	ND	ND	ND	7
Eagle/Luck	4/28	3	SM DM RR	S	4,828.0	ND	22	32	C	ND	ND	ND	30
Eagle/Luck	4/28	4	SM DM RR	S	6,437.4	ND	22	32	C	ND	ND	ND	11
Eagle/Luck	5/11	1	SM MW	S	1,609.3	ND	22	31	C	ND	ND	ND	3
Eagle/Luck	5/11	2	SM MW	S	3,218.7	ND	22	31	C	ND	ND	ND	13
Eagle/Luck	5/11	3	SM MW	S	4,828.0	ND	23	31	C	ND	ND	ND	23
Eagle/Luck	5/11	4	SM MW	S	0.0	ND	ND	31	C	ND	ND	ND	ND
Eagle/Luck	5/25	1	SM MW	S	1,609.3	ND	22	31	C	ND	ND	5.5	3
Eagle/Luck	5/25	2	SM MW	S	3,218.7	ND	22	31	C	ND	ND	5.5	11
Eagle/Luck	5/25	3	SM MW	S	4,828.0	ND	22	31	C	ND	ND	5.5	40
Eagle/Luck	5/25	4	SM MW	S	0.00	ND	22	31	C	ND	ND	5.5	ND
Ford Arm	4/25	1	TT PF MM	S	1,609.3	43	22	33	O	23	12.5	4	1
Ford Arm	4/25	2	TT PF MM	S	3,218.7	43	22	33	O	23	12.6	4	12
Ford Arm	5/12	1	TT PF JS	S	1,609.3	43	22	32	C	22	19.5/15	6.5	89
Ford Arm	5/12	2	TT PF JS	S	3,218.7	42	22	32	C	22	19.5/15	6.5	80
Ford Arm	5/18	1	TT PF	S	1,609.3	42	22	33	O	21.5	13.5/15	7	32
Ford Arm	5/18	2	TT PF	S	3,218.7	42	22	33	O	21.5	13.5/15	7	84
Ford Arm	5/18	1	TT PF	S	1,609.3	42	22	33	O	21.5	13.5/15	7	32
Ford Arm	5/18	2	TT PF	S	3,218.7	42	22	33	O	21.5	13.5/15	7	84
Harris	4/19	1	SM SB	S	1,609.3	ND	22	32	O	ND	ND	ND	1
Harris	4/19	2	SM SB	S	3,218.7	ND	22	32	O	ND	ND	ND	48
Harris	4/19	3	SM SB	S	4,828.0	ND	22	32	O	ND	ND	ND	9
Harris	4/19	4	SM SB	S	6,437.4	ND	22	32	O	ND	ND	ND	0
Harris	4/19	5	SM SB	S	8,046.7	ND	22	32	O	ND	ND	ND	0
Harris	5/2	1	SM CC BN ND	S	1,609.3	ND	23	31	R	ND	ND	ND	0
Harris	5/2	2	SM CC BN ND	S	3,218.7	ND	23	31	R	ND	ND	ND	3
Harris	5/2	3	SM CC BN ND	S	4,828.0	ND	23	31	R	ND	ND	ND	8
Harris	5/2	4	SM CC BN ND	S	6,437.4	ND	23	31	R	ND	ND	ND	3
Harris	5/2	5	SM CC BN ND	S	8,046.7	ND	23	31	R	ND	ND	ND	0
Harris	5/10	1	SM MW BN	S	1,609.3	ND	23	31	O	ND	ND	ND	0
Harris	5/10	2	SM MW BN	S	3,218.7	ND	23	31	O	ND	ND	ND	13
Harris	5/10	3	SM MW BN	S	4,828.0	ND	23	31	O	ND	ND	ND	7
Harris	5/10	4	SM MW BN	S	6,437.4	ND	23	31	O	ND	ND	ND	0
Harris	5/10	5	SM MW BN	S	8,046.7	ND	23	31	O	ND	ND	ND	0
Petersburg	4/28	1	DF VG	S	11,088.0	42	22	33	C	-84	4.9	7	33

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Stream	Survey date	Survey reach	Observersa	Survey typeb	Distance surveyed (m)	Tide codec	Remark coded	Water level code	Weather codesf	Staff gauge level/depth (cm)	Secchi disk (m)	Surface temp.	Number of live steelhead
Petersburg	4/28	2	DF VG	S	7,292.0	42	22	33	C	-84	4.9	7	46
Petersburg	4/28	3	DF VG	S	9,654.0	42	22	33	C	-84	4.9	7	49
Petersburg	5/12	1	VG CC	S	11,088.0	42	23	32to33	O/C	-81	7.1	6	29
Petersburg	5/12	2	VG CC	S	7,292.0	42	23	32to33	O/C	-81	7.1	6	42
Petersburg	5/12	3	VG CC	S	9,654.0	42	23	32to33	O/C	-81	7.1	6	60
Petersburg	5/18	1	VG DL	S	11,088.0	41	23	32to33	O	ND	4.6	5	28
Petersburg	5/18	2	VG DL	S	7,292.0	41	23	32to33	O	ND	4.6	5	24
Petersburg	5/18	3	VG DL	S	9,654.0	41	23	32to33	O	ND	4.6	5	39
Peterson	5/10	1	DT BG JL	S	11,10.4	ND	22	32	O, R	28	ND	3	3
Peterson	5/18	1	DT BG JL	S	11,10.4	ND	22	32	O	ND	ND	6.5	22
Peterson	5/24	1	DT CC JL	S	11,10.4	ND	22	32	O	31.5	3.5	3.5	27
Peterson	6/1	1	DT RH JL	S	11,10.4	ND	21	33	C	ND	4	11	7
Pleasant Bay	5/2	1	DT/BG/JL	S	1,609.3	ND	22	33	O	33	7	3.5	20
Pleasant Bay	5/2	2	DT/BG/JL	S	3,218.7	ND	22	33	O	33	7	3.5	32
Pleasant Bay	5/11	1	DT/JL	S	1,609.3	ND	21	32	C	32	ND	5	42
Pleasant Bay	5/11	2	DT/JL	S	3,218.7	ND	21	32	C	32	ND	5	35
Pleasant Bay	5/19	1	DT/JL	S	1,609.3	ND	21	32	C	32	7.5	3.5	50
Pleasant Bay	5/19	2	DT/JL	S	3,218.7	ND	21	32	C	32	7.5	3.5	44
Pleasant Bay	5/25	1	DT CC JL	S	1,609.3	ND	21	32	C	32	5.2	7.6	33
Pleasant Bay	5/25	2	DT CC JL	S	3,218.7	ND	21	32	C	32	5.2	7.6	20
Sitkoh	4/26	1	TT PF MM	S	1,609.3	43	22	33	O	ND	22/9	3	0
Sitkoh	4/26	2	TT PF MM	S	3,218.7	43	22	33	C	ND	22/9	3	0
Sitkoh	4/26	3	TT PF MM	S	4,828.0	42	22	33	C	ND	22/9	3	19
Sitkoh	5/6	1	TT PF MM	S	1,609.3	43	22	32to31	R	2.58	15/20	4.5	12
Sitkoh	5/6	2	TT PF MM	S	3,218.7	43	22	32to31	R	2.58	15/20	4.5	24
Sitkoh	5/6	3	TT PF MM	S	4,828.0	43	22	32to31	R	2.58	15/20	4.5	32
Sitkoh	5/13	1	TT/PF/JS	S	1,609.3	43	22	33	C	2.42	7/19	6.5	7
Sitkoh	5/13	2	TT/PF/JS	S	3,218.7	43	22	33	C	2.42	7/19	6.5	21
Sitkoh	5/13	3	TT/PF/JS	S	4,828.0	43	22	33	C	2.42	7/19	6.5	38
Sitkoh	5/25	1	TT PF	S	1,609.3	42	22	32	C	2.46	21/10.5	ND	8
Sitkoh	5/25	2	TT PF	S	3,218.7	42	22	32	C	2.46	21/10.5	ND	14
Sitkoh	5/25	3	TT PF	S	4,828.0	42	22	32	C	2.46	21/10.5	ND	28
Slippery	4/26	1	DF VG	S	1,609.3	42	22	32	O/C	37.00	6.1	4.5	1
Slippery	4/26	2	DF VG	S	3,218.7	42	22	32	C	37.00	6.1	4.5	6
Slippery	5/11	1	VG CC	S	1,609.3	42	22	32	O/C	35	5.8	8	3
Slippery	5/11	2	VG CC	S	3,218.7	42	22	32	O/C	35	5.8	8	31

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Stream	Survey date	Survey reach	Observers[a]	Survey type[b]	Distance surveyed (m)	Tide code[c]	Remark code[d]	Water level code	Weather codes[f]	Staff gauge level/depth (cm)	Secchi disk (m)	Surface temp.	Number of live steelhead
Slippery	5/19	1	VG DL	S	1,609.3	ND	23	33	C	20	2.8	9	9
Slippery	5/19	2	VG DL	S	3,218.7	ND	23	33	C	20	2.8	9	43
Slippery	6/1	1	DF VG	S	1,609.3	ND	21	33	C	14	7.4	15	4
Slippery	6/1	2	DF VG	S	3,218.7	ND	21	33	C	14	7.4	15	2
White River	4/26	1	MW SM KP	S	1,609.3	ND	22	33	O	ND	6.5	5.0	11
White River	4/26	2	MW SM KP	S	3,218.7	ND	22	33	O	ND	6.5	5.0	19
White River	4/26	3	MW SM KP	S	4,828.0	ND	22	33	O	ND	6.5	5.0	9
White River	5/9	1	MW SM TJ	S	1,609.3	ND	21	32	O	ND	7.5	6.0	33
White River	5/9	2	MW SM TJ	S	3,218.7	ND	21	32	O	ND	7.5	6.0	5
White River	5/9	3	MW SM TJ	S	4,828.0	ND	21	32	O	ND	7.5	6.0	9
White River	5/24	1	SM MW TJ	S	1,609.3	ND	21	33	C	ND	10	8.5	8
White River	5/24	2	SM MW TJ	S	3,218.7	ND	21	33	C	ND	10	8.5	10
White River	5/24	3	SM MW TJ	S	4,828.0	ND	21	33	C	ND	10	8.5	20

[a] Observer: TT (Troy Tydingco), DF (Doug Fleming), VG (Vera Goudima), KP (Kelly Piazza), MW (Mike Wood), KK (Kurt Kondzela), BG (Brian Glynn), SM (Steve McCurdy), TJ (Todd Johnson), DL (David Love), NN (Nathaniel Nichols), BF (Brian Frenette), MM (Monica Matz), KH (Kyle Hert), GH (G. Hagerman), JS (Jason Sexton), KF (Kyle Ferguson), KM (Kris Maledy), MB (Malika Brunette).

[b] S = snorkel, F = foot, R&R = rod and reel.

[c] 41 = high, 42 = low, 43 = intermediate.

[d] 21 = excellent visibility, 22 = normal visibility, 23 = poor visibility, 31 = high water, 32 = normal water, 33 = low water.

[e] 31 = high water, 32 = normal water, 33 = low water.

[f] C = clear, O = overcast, R = rain, W = wind on water surface, O/C = overcast with breaks.

Note: The point at which the Secchi disk disappeared was the distance that was recorded, but some observers also recorded the distance in which the disk reappeared when pulled towards them following the first measurement.ND represents no data.

Appendix A4.–Steelhead observed and reported during surveys at Sitkoh Creek from 2003–2009.

Year	Percent observed	Reference
2009	40.2	Harding (2012)
2008	45.1	Harding (2012
2007	ND	Harding (2009)
2006	60.0	Harding (2009)
2005	56.6	Harding and Love (2008)
2004	53.9	Harding and Love (2008)
2003	45.3	Harding and Love (2008)

Appendix A5.–Daily upstream, downstream, and cumulative counts of adult steelhead through Peterson Creek weir during 2010. The weir was operational from 4/5 to 5/28/2010, but fish were only passed from 4/27 to 5/27.

Date	Upstream count	Cumulative upstream count	Downstream count	Cumulative downstream count	Water temperature (°C)	Water level (cm)
4/27	2	2	0	0	5	57.9
4/28	1	3	0	0	4.4	62.8
4/29	0	3	0	0	4.9	61.0
4/30	2	5	0	0	4.7	68.3
5/1	1	6	0	0	5.0	56.7
5/2	9	15	0	0	6.3	56.1
5/3	4	19	0	0	5.7	55.5
5/4	12	31	0	0	6.4	51.8
5/5	30	61	0	0	6.4	54.9
5/6	32	93	0	0	7.5	57.3
5/7	3	96	0	0	7.5	54.9
5/8	4	100	0	0	8.0	48.8
5/9	0	100	3	3	7.2	49.4
5/10	3	103	0	3	8.2	47.5
5/11	6	109	2	5	9.1	48.2
5/12	2	111	15	20	9.1	53.3
5/13	1	112	4	24	8.6	56.4
5/14	0	112	1	25	9.2	51.2
5/15	0	112	6	31	8.6	51.2
5/16	0	112	1	32	9.6	59.7
5/17	2	114	1	33	9.1	51.2
5/18	0	114	2	35	9.5	48.2
5/19	0	114	5	40	9.6	54.3
5/20	1	115	0	40	11.1	49.4
5/21	0	115	4	44	10.6	46.9
5/22	0	115	0	44	10.7	45.1
5/23	0	115	14	58	10.3	43.9
5/24	0	115	8	66	12.6	42.7
5/25	0	115	1	67	12.8	42.7
5/26	0	115	2	69	14.0	41.5
5/27	0	115[a]	26	95[b]	13.6	39.6

[a] This count includes 1 fish that was confirmed by Floy™ tag to have subsequently moved back down through the weir; final upstream count = 114.

[b] This count includes 1 fish that was confirmed by Floy™tag to have subsequently moved back up and down through the weir; final downstream count = 94.

Appendix A6.–Daily upstream, downstream, and cumulative counts of adult steelhead through Peterson Creek weir during 2011. The weir was operational from 4/13 to 6/27/2011, but fish were only passed from 4/26 to 6/7/2011.

Date	Upstream count	Cumulative upstream count	Downstream count	Cumulative downstream count	Water temperature (°C)	Water level (cm)
4/26	1	1	0	0	2.0	74.7
4/27	0	1	0	0	1.6	101.2
4/28	0	1	0	0	1.8	65.8
4/29	0	1	0	0	2.0	60.4
4/30	0	1	0	0	2.0	59.7
5/1	0	1	0	0	2.2	61.0
5/2	0	1	0	0	2.0	66.4
5/3	0	1	0	0	2.2	76.2
5/4	0	1	0	0	2.0	121.9
5/5	1	2	0	0	2.0	78.6
5/6	2	4	0	0	2.5	86.3
5/7	1	5	0	0	2.6	83.5
5/8	1	6	0	0	2.5	76.2
5/9	1	7	0	0	3.0	70.1
5/10	23	30	0	0	3.0	67.1
5/11	1	31	0	0	2.8	66.4
5/12	2	33	0	0	3.5	66.4
5/13	4	37	0	0	3.6	88.4
5/14	28	65	3	3	3.4	72.5
5/15	2	67	0	3	3.3	68.3
5/17	12	87	0	3	5.6	66.4
5/16	8	75	0	3	3.6	64.0
5/18	5	92	0	3	6.7	69.5
5/19	2	94	5	8	6.5	61.0
5/20	11	105	4	12	6.5	70.1
5/21	2	107	2	14	6.5	66.4
5/22	3	110	12	26	6.5	64.0
5/23	4	114	4	30	6.5	69.5
5/24	6	120	3	33	6.0	65.8
5/25	0	120	1	34	7.0	61.6
5/26	0	120	2	36	7.5	62.2
5/27	0	120	10	46	8.8	59.7
5/28	1	121	0	46	10.5	59.4
5/29	2	123	3	49	11.0	56.1
5/30	1	124	8	57	8.8	53.6
5/31	3	127	12	69	10.8	53.0
6/1	4	131	8	77	11.5	53.0
6/2	0	131	8	85	11.2	51.8
6/3	0	131	0	85	11.2	50.0
6/4	0	131	2	87	11.0	49.4
6/5	3	134	7	94	11.0	50.0
6/6	3	137	0	94	11.0	48.8
6/7	0	137[a]	2	96[b]	10.0	46.9

[a] This count includes 4 fish that was confirmed by Floy™ tag to have subsequently moved up and down through the weir; final upstream count = 133.

[b] This count includes 4 fish that was confirmed by Floy™ tag to have subsequently moved back up and down through the weir; final upstream count = 92.

APPENDIX B

Appendix B1.–Computer data files used to prepare and generate estimates for this report. All files are organized on the Region 1-Douglas Sport fish Server under S:\Trout\REGIONSH\SURVEYS\2011 Report\2011 FDS report file archive.

File Name	Description
Temp_data_10_11_FDS.XLS	EXCEL spreadsheet with HOBO temperature data and graphs for 2010 and 2011.
Snorkel_97-11graphfor FDSreportmedian.xlsx	EXCEL spreadsheet containing normalized graph (Figure 3).
97-11SRV .xlsx	EXCEL spreadsheet with snorkel survey data for 1997–2011.
calibration of snorkel crews_2011_djr.xlsx	EXCEL spreadsheet containing descriptive statistics for calibration.
Snorkel_Calibrate_for10_11.xlsx	EXCEL spreadsheet with calibration tables (Table 3 and 4)