Fishery Data Series No. 09-14

Assessment of Adult Steelhead Populations on Prince of Wales Island, Alaska: Eagle Creek and Cable Creek, 2006

by

By Kelly S. Piazza

March 2009

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

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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 Department of Fish and Game	ADF&G
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)

Measures (fisheries)

fork length	FL
mid eye to fork	MEF
mid eye to tail fork	METF
standard length	SL
total length	TL

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

FISHERY DATA SERIES NO. 09–14

ASSESSMENT OF ADULT STEELHEAD POPULATIONS ON PRINCE OF WALES ISLAND, ALASKA: EAGLE CREEK AND CABLE CREEK, 2006

by
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ABSTRACT

Weirs were installed in Cable Creek and Eagle Creek on Prince of Wales Island, Southeast Alaska, in 2006 to capture, enumerate and sample immigrant steelhead. Information was collected on the escapement, run timing, composition, and the relationship between snorkel surveys and weir counts for the development of expansion factors. This report will summarize the information gathered from Cable Creek and Eagle Creek during the second year of a 3-year cooperative project.

The minimum spawning escapement at Eagle Creek was 299 steelhead. Females made up the majority of the total immigrant run at 53% (157 fish), while males represented 47% (138 fish). Age classes 4.2 and 4.3 dominated among spawning fish in Eagle Creek. The average total length of steelhead from Eagle Creek was 779 mm (SE = 5.3) for females and 785mm (SE = 7.1) for males. Of the 294 fish sampled, three (1.0%) were ≥36 inches (914 mm) TL; two were male and one was female. Nine snorkel surveys were conducted during the season; on average, 51.9% (SD = 62.0%; n = 6) of the weir count was observed.

The minimum spawning escapement at Cable Creek was 134 steelhead. Females made up the majority of the total immigrant run at 54% (75 fish), while males represented 46% (64 fish). Age classes 3.3 and 3.2 dominated among spawning fish in Cable Creek. The average total length of female steelhead from Cable Creek was 763 mm (SD = 74.0) and the average total length of males was 766 mm (SD = 84.4). Of the 139 fish sampled, five steelhead (3.6%) were ≥36 in (914 mm) TL; three were females and two were males. Eight snorkel surveys were conducted during the season; on average 43.0% (SD = 38.1%) of the weir count count was observed.

Keywords: steelhead, *Oncorhynchus mykiss*, escapement, snorkel survey, weir, age-sex-length composition, expansion factor, Prince of Wales Island, Southeast Alaska

INTRODUCTION

Steelhead *Oncorhynchus mykiss* are an important subsistence resource for rural residents of Prince of Wales Island (PWI). Subsistence users have traditionally harvested steelhead from the island's streams during fall through spring. Nearly all of these streams are located within the Federal Conservation Unit boundaries of the Tongass National Forest. Explicit regulations for subsistence fishing for steelhead on PWI have only existed under the Federal Subsistence Program since 2003.

Annual escapements of steelhead are known to occur in at least 309 watersheds in Southeast Alaska and there are 74 drainages known to contain steelhead on PWI, a few of which are shown in Figure 1. However, the amount of information on PWI steelhead populations is limited and estimates of adult abundance are largely unavailable. Prior to this project, assessment of PWI steelhead consisted of sporadic use of weirs (Jones 1984; Hoffman et al. 1990; Harding and Jones 1993; Hoffman 2007, 2008) and snorkel surveys (Tables 1 and 2) in select systems. These data, along with casual observations by Alaska Department of Fish and Game (ADF&G) and U.S. Forest Service (USFS) staff during the 1980s–1990s, were used to categorize *a priori* each steelhead system as "small" (less than 150 fish) or "large" (greater than 150 fish).

In the early 1990s, ADF&G fishery managers interpreted increasing sportfishing effort, coupled with decreasing harvest and total catch (all fish landed including both harvested and released fish), as strong indications of declining abundance throughout Southeast Alaska (Harding and Jones 2004). By the mid-1990s, harvest opportunities under sportfishing regulations were significantly restricted to the current regulations that only allow sport harvest of steelhead greater than 36 in TL. Under these regulations, sport harvests dramatically declined, while sport effort and catch stabilized or increased throughout the region. However, stable or even increasing angler catch of steelhead may disguise or mislead the true abundance of steelhead in streams (Hooten 2001); as anglers become more efficient their catches may increase, but steelhead abundance may be lower. ADF&G does believe however, that the current conservative regulations provide for sustainability of steelhead stocks while allowing for a limited harvest opportunity.

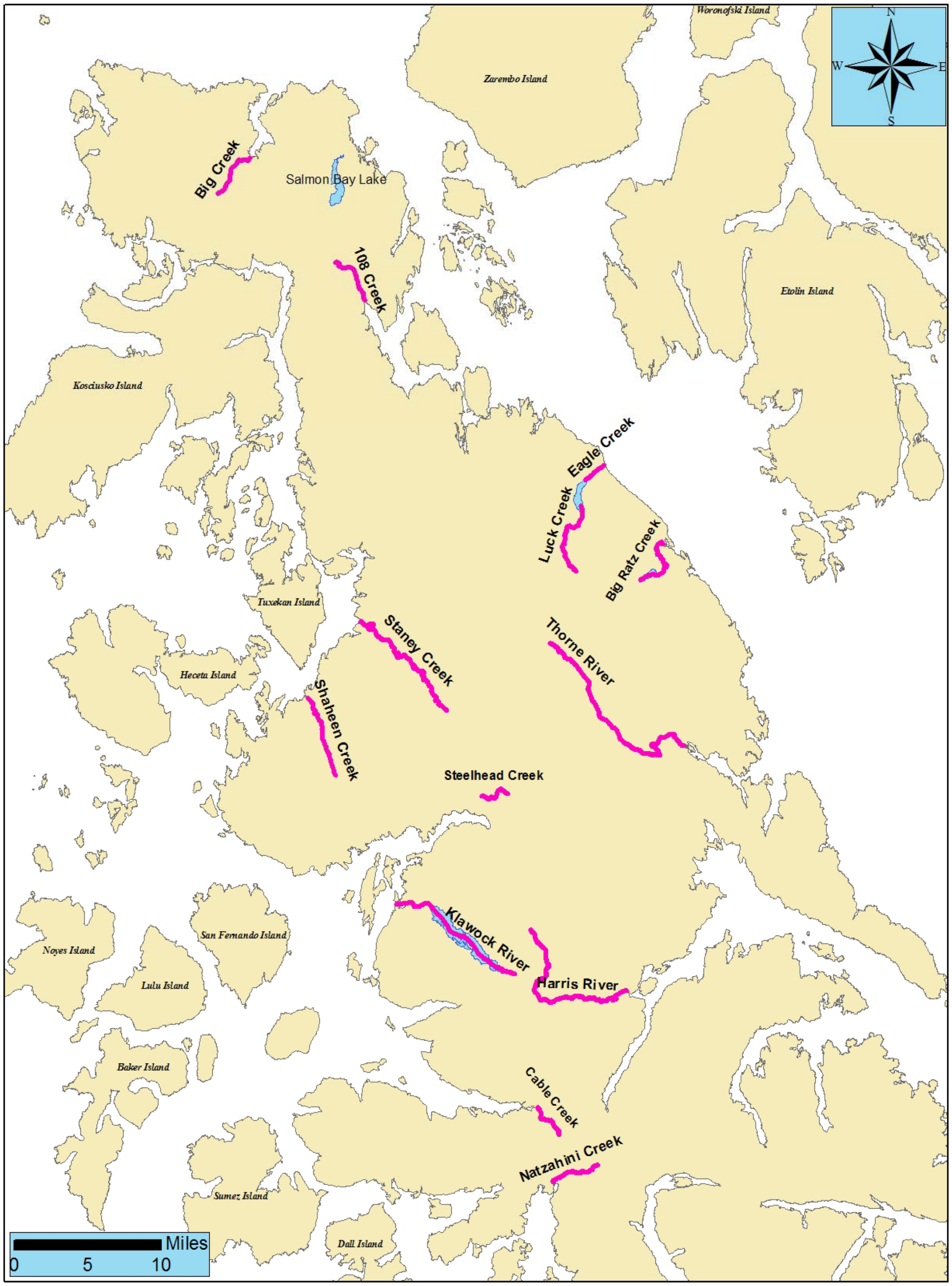

Figure 1.–Prince of Wales Island, Southeast Alaska: locations of “small” and “large” steelhead streams that support subsistence harvest, nominated for inclusion in this study.

Table 1.–Steelhead peak index counts for selected streams on Prince of Wales Island. A peak count is defined as a bracketed count having a lower count before and after the high or peak count. (USFS 2002; USFS *Unpublished*).

Year sampled	Harris River[a]	Trocadero Creek	Cable Creek	Maybeso Creek	Dog Salmon Creek	12-Mile Creek	Nutkwa Creek	Black Bear Creek	Big Ratz Creek	Shaheen Creek	Sal Creek
1994	94	18	34	6	50						
1995	151	30	52	19	13	40					
1996	127	21	24	17	6	33					
1997	99	18	26	6	15	28	32				
1998	140	4	10	19	14	20	42				
1999	192	28	31	13	17	42		51			
2000	80	22	7	1	14	5		24		33	3
2001	100	9	8	13	16	23			17	34	4
2002	188	43	30	6		47		18	19	32	21
2003	196	21	37	14	36	52					
2004				2		57					
2005		8	13	6	19	33					
2006			110			32					

[a] Harris River counts presented in Table 1 were conducted by USFS staff and differ from the counts presented in Table 2, which were conducted by ADF&G staff.

Table 2.–Steelhead snorkel surveys conducted in Eagle Creek and Harris River, 1997–2006. Peak count (P) is defined as a bracketed count having a lower count before and after the high or "peak" count; high count (H) is defined as an unbracketed count and is the highest count for that year (Harding 2005, *In prep;* Harding and Love 2008).

	Eagle Creek		Harris River	
Year completed	Peak/high count of steelhead		Peak/high count of steelhead	
1997	90	(H)	104	(H)
1998	56	(P)	156	(P)
1999	118	(H)	192	(H)
2000	82	(P)	79	(P)
2001	NA		53	(H)
2002	36	(P)	200	(H)
2003	95	(H)	195	(H)
2004	67	(H)	124	(P)
2005	102	(H)	122	(P)
2006	154	(P)	92	(P)

Unfortunately, system-specific sport fishery data for PWI steelhead are limited. On-site creel surveys were conducted by ADF&G on the Karta River (1983, 1989, and 1992), the Thorne River (1988–1990), and the Klawock River (1987–1988) (Jones 1984; Hoffman et al. 1990; Harding and Jones 1993; Freeman and Hoffman 1989-91). Sport catch and harvest for all species are annually estimated throughout Alaska from postal surveys of sport fishing license holders (Didier et al. 1990). However, sample sizes from these postal surveys are usually insufficient to accurately estimate system-specific sport harvest and catch of steelhead from these small sport fisheries. These results indicate that most of the sport fishing effort is directed at systems with spring run steelhead.

However, some site-specific angler information is available from anglers reserving and utilizing USFS recreational cabins to access steelhead streams (e.g., Harding et al. 2005). During 2006, a postal survey was sent to party heads utilizing USFS recreational cabins on 5 PWI systems (Karta, Kegan, Red Bay Lake, Staney and Sweetwater) Anglers fishing from these cabins caught an estimated 461 steelhead; most of this catch and harvest came from the 3 cabins on the Karta system: 444 caught and 24 harvested (Harding et al. *In prep*).

Although not provided for in regulation at the time, subsistence harvest of steelhead by PWI residents was estimated from household surveys in 1997, 1998 and 1999. During these years, the total estimated harvest across all 12 PWI communities was 770 fish. This harvest estimate included harvest taken by commercial gear, non-commercial gear and rod and reel. Most of the harvest (636 fish) was taken using rod and reel, primarily by residents of Craig, Klawock, and Hydaburg (ADF&G 2000).

The federal subsistence fishery for steelhead is managed under different regulations for small and large systems, as well as spring and fall runs, and road-accessible and remote systems. Since inception of the federal subsistence fishery in 2003, subsistence harvest is required to be reported on permits. Annual subsistence harvest of steelhead on PWI tallied from permit returns has totaled approximately 39 fish annually in 2003–2006 (USFS *Unpublished*). Turek (2005) recently completed a study of subsistence harvest use patterns for steelhead on PWI. Although subsistence harvest was not rigorously estimated as part of this study, results from key respondent interviews suggest that actual subsistence harvest of steelhead by PWI residents in 2004 was in the hundreds of fish, similar to the results of household surveys from the 1990s. The large discrepancy in subsistence harvest estimates remains a conundrum and major source of uncertainty for federal subsistence fishery managers.

Low to high levels of steelhead harvest under the current Federal subsistence steelhead fishery, coupled with a popular sport fishery and the lack of accurate contemporary data on PWI steelhead stocks, prompted the formation of a cooperative steelhead stock asessment project between ADF&G, the Organized Village of Kasaan (OVK), the Bureau of Indian Affairs (BIA), and the USFS in 2005. The purpose of this project is to gather baseline stock assessment data on a subset of PWI streams that support subsistence harvest of steelhead. We will collect information on the escapement, run timing, age-sex-length composition, and relationship between snorkel surveys and weir counts for development of expansion factors. Knowledge about the strength and timing of these runs will assist biologists and regulators to manage for sustainability and take necessary action to conserve stocks if needed. This report will summarize the information gathered from Cable Creek and Eagle Creek in 2006, the second year of this 3-year project; results from the first year of this project are presented in Piazza et al. (2008).

The objectives of the 2006 study were to:

1) count all immigrant and emigrant steelhead in Cable Creek and Eagle Creek;
2) determine or estimate the length composition of immigrant steelhead in each stream;
3) estimate the age composition of immigrant steelhead steel in each stream such that each multinomial proportion is within ±10 percentage points of the true value 95% of the time; and
4) estimate system-specific mean expansion factors for converting snorkel survey counts to concurrent weir counts such that each of this year's abundance estimates (one for each survey) obtained using this mean expansion factor are within ±50% of the true value 90% of the time.

An additional task included collection of tissue samples from immigrant steelhead for genetic stock identification.

METHODS

SELECTION OF STREAMS FOR STUDY

Six freshwater stream systems were selected from a list of systems that support spring steelhead runs (Table 3) for study during the 3-year duration of this project. Streams were selected based on a combination of criteria:

1) importance to the subsistence fishery. Streams to be studied must support subsistence fishing effort, as determined by 2003–2004 USFS subsistence permits, results of the 2003–2004 ADF&G Subsistence Division household surveys, discussions between state and federal biologists, and consultation with PWI Native organizations.
2) abundance of the adult steelhead populations. Systems from each *a priori* category ("small system" = less than 150 returning adult fish, or "large system" = greater than 150 returning adult fish) will be studied.
3) accessibility. Streams were categorized as either road accessible or remote. Road-accessible streams support most of the subsistence effort, and therefore most remote systems will not be included for study.

Table 3.–Prince of Wales Island stream systems proposed for steelhead population studies *("*" denotes systems with a high priority for inclusion*).

Population size management category	Access management category	Stream names
Small populations ($N_{estimated}$ < 150)	Road-accessible system	*Cable Creek *Natzhini Creek Naukati Creek *Big Ratz Creek Hatchery Creek *Shaheen Creek
	Remote system	*Salmon Bay Creek Lake Creek Hunter Creek Cabin Creek Old Franks Creek Trout Creek (Kosciusko Island)
Large populations ($N_{estimated}$ >150)	Road-accessible system	*Harris River *Eagle Creek *Thorne River *Hydaburg River *Klawock River
	Remote system	*Karta River

Eagle Creek and Cable Creek were chosen to be studied during the second year of the project. Turek (2005) indicated that the local residents of PWI utilize Cable Creek and Eagle Creek for subsistence steelhead fishing. In addition, local PWI fish biologists and representatives of the PWI Native organizations have also emphasized that these streams are targeted by both sport and subsistence users (R. Peterson, Organized Village of Kasaan, personal communication; S. McCurdy, ADF&G, personal communication; A. Cross, USFS, personal communication). Given such subsistence harvest records, popularity with local anglers, and their road accessibility, Cable Creek and Eagle Creek were found to be ideal choices.

Eagle Creek is a "large" system located on the northeastern side of Prince of Wales Island (Figure 2). Eagle Creek (ADF&G Anadromous Stream Catalog No. 107-40-10055), the outlet stream for Luck Lake, is located on the north end of the lake, is about 2.8 km long, and empties into Clarence Straight about 3.0 km south of the community of Coffman Cove in a steep, rocky intertidal zone. The Luck Lake drainage has been extensively logged and roads cross the main inlet and the outlet stream.

Cable Creek is a "small" system located on the western side of central Prince of Wales Island, northwest of the community of Hydaburg (Figure 3). Cable Creek (ADF&G Anadromous Stream Catalog No. 103-60-10770) is) along with its 2 tributaries, Beaver Creek and Snipe Creek, is about 6.4 km long, flows in a westerly direction, and drains into Trocadero Bay. Cable Creek is readily accessible via the Hollis and Hydaburg roads. A USFS fish ladder is found in the headwaters, adjacent to the Hydaburg road.

WEIRS

Aluminum bipod weirs were installed in each stream approximately 400 m above saltwater (Figures 2 and 3). The weirs were comprised of 18 mm diameter aluminum pickets spaced 31 mm apart. Two separate emigrant and immigrant adult steelhead traps (2.5 m^2 each) were placed on the upstream and downstream sides of the weirs. Weir integrity was checked daily, and the trap was checked every few hours for the presence of fish. Fish were processed as soon as possible after entering the trap. If debris became a problem, the weirs were brushed clean and cleared. Water temperature and depth were recorded at about 0800–0900 each day, and only after the weir surfaces were cleaned.

WEIR COUNTS AND AGE, SEX, AND LENGTH SAMPLING

All immigrating adult steelhead were counted, measured to the nearest 5 mm FL and TL, and sexed using secondary sexual characteristics. (current sport fishing regulations are based on total length, and additional comparisons between fork length and total length were desired). Spawning escapement was calculated as the sum of all immigrants and unmarked emigrants. Scale samples were collected from all immigrating steelhead for age estimation. Four scales were collected from the left side of each fish. Scales were taken from the area 2 rows above the lateral line and along a line from the posterior end of the dorsal fin to the anterior end of the anal fin (Alvord 1954). These were then placed on labeled gum cards and pressed flat in sequential order for storage until aging and electronic imaging could be performed in the laboratory. After measuring length and determining sex, each fish was marked

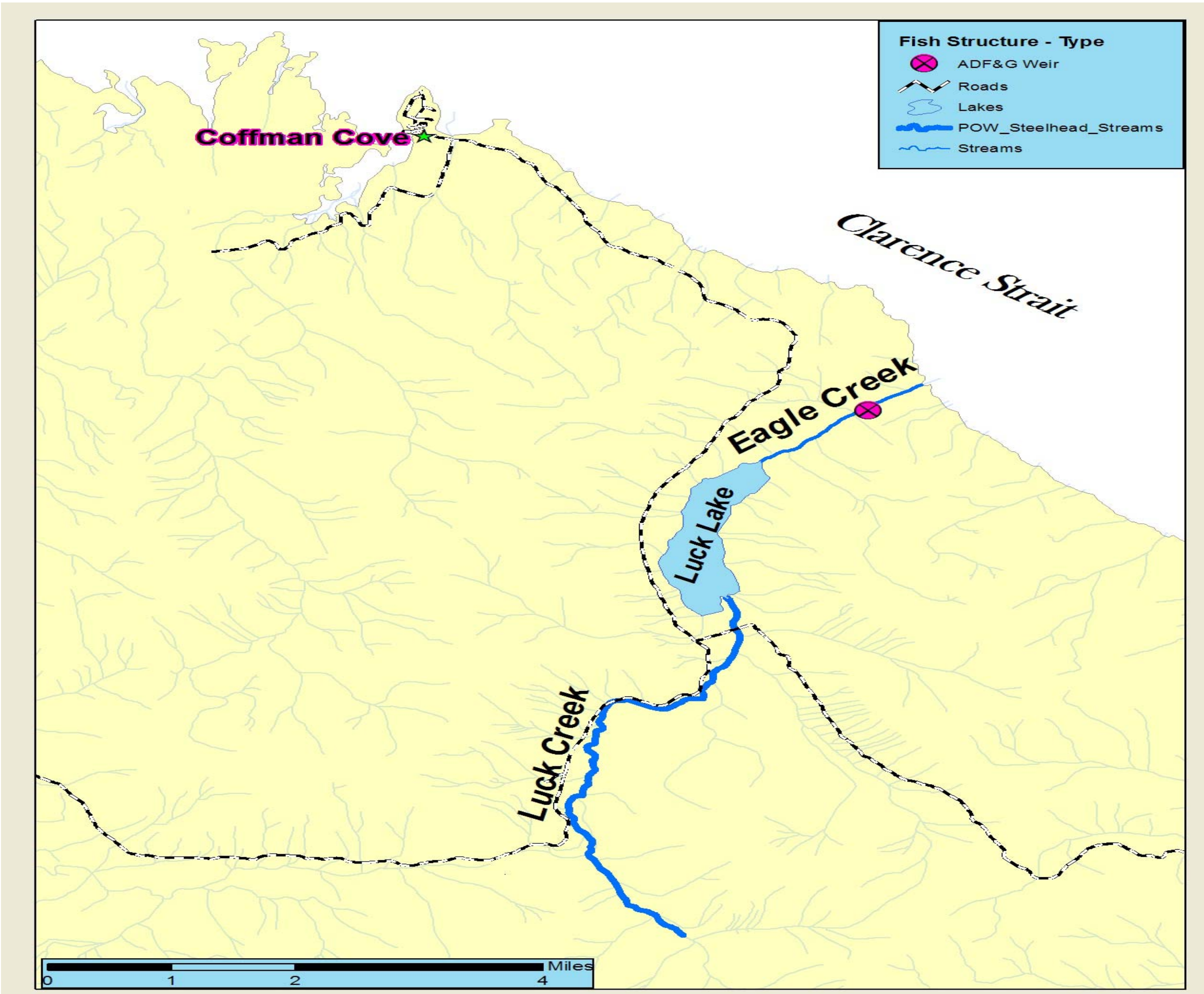

Figure 2.–Location of weir on Eagle Creek, Prince of Wales Island.

with a top caudal lobe finclip to indicate that it had been previously sampled. A small portion of the detached top caudal fin lobe was collected from 100 steelhead from each stream and placed into 70% ethanol for later genetic analysis by U.S. Fish and Wildlife Service (USFWS) Genetics Laboratory in Anchorage. All emigrating adult steelhead kelts (post-spawned emigrant steelhead) were counted and checked for the presence of a caudal finclip.

Scale samples removed from adult steelhead were removed from the gum cards, placed on glass slides, and analyzed with electronic imaging software. Images were aged using methods described by Jones (*Undated/Unpublished*). Two technicians made 2 independent readings to estimate the age of each fish. Prior to each reading, the scale images were then "shuffled" (or other measures were taken) to ensure that no information from previous readings was available (to minimize observer bias). Disagreements between the replicate readings were tallied following the second reading, and those scales not in agreement were read a third time (after again being randomized). The modal age of the readings was taken as the correct age, thereby minimizing observer-related measurement error. If no correspondence occurred from any pair-wise combination among the three readings, the scale sample was rejected.

Age composition of immigrant steelhead was estimated by:

$$\hat{p}_a = \frac{n_a}{n} \tag{1}$$

$$var[\hat{p}_a] = \left(1 - \frac{n}{N}\right)\frac{\hat{p}_a(1 - \hat{p}_a)}{n - 1} \tag{2}$$

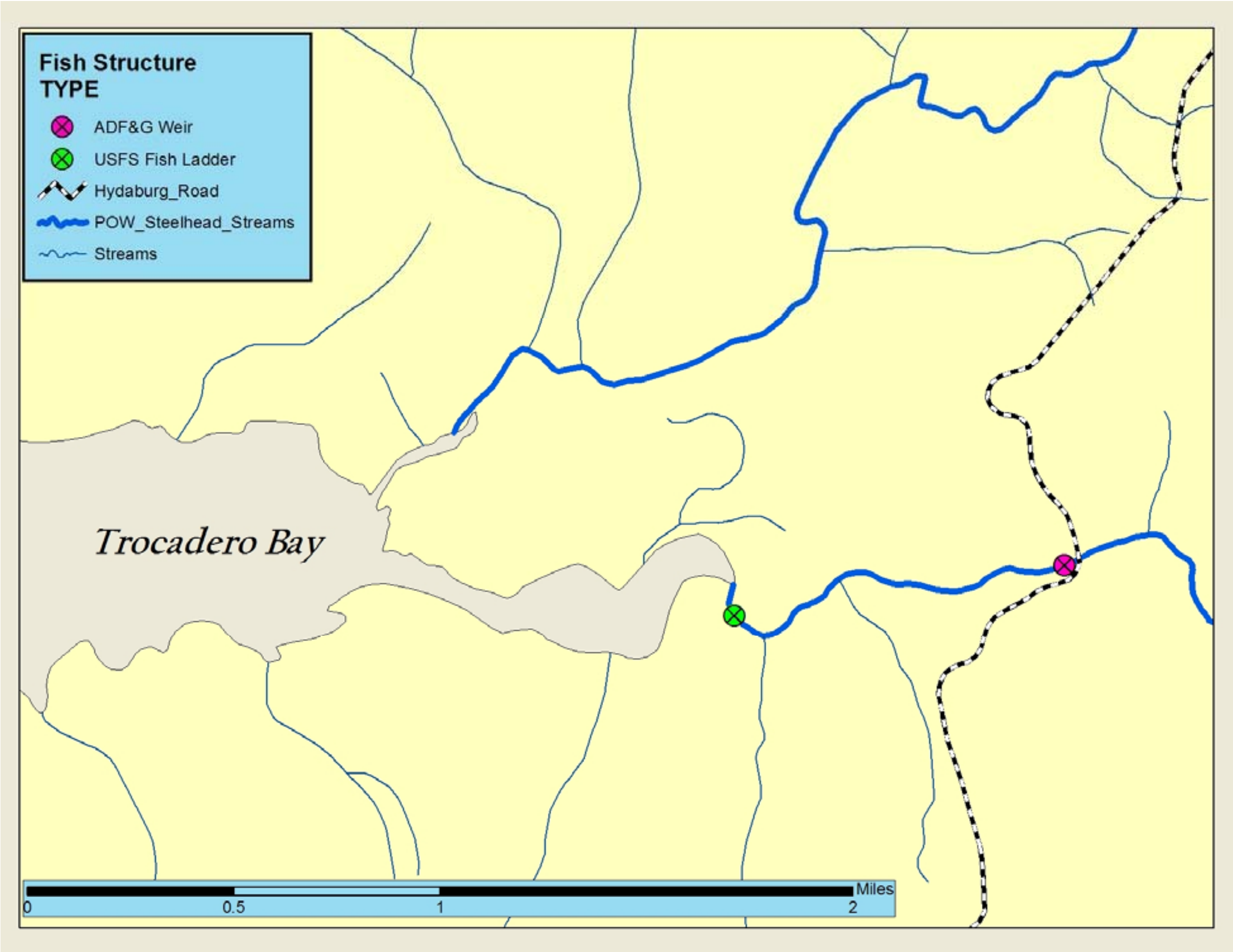

Figure 3.–Location of weir on Cable Creek, Prince of Wales Island.

where n is the number of fish successfully aged, n_a is the subset of n that belong to age group a, and N is the population size. In the event that a census was not achieved, length composition was also estimated by these equations for length group l.

Average length was determined or estimated using standard summary statistics (Cochran 1977).

SNORKEL SURVEYS

Snorkel surveys of steelhead were conducted each week on both streams. The percent of the weir count observed P was calculated for each trip. The percent of the weir count is based on the snorkel survey count C, divided by the total weir count N at the time of the snorkel survey (less any adults passed downstream and any known mortalities at the time plus the number of fish observed in the system prior to fish passage). i.e., $P_t = C_t / N_t$.

The presence of weirs to calibrate the snorkel counts also allows the calculation of escapement expansion factors (π) for each stream if variability among survey trips is low. Expansion factors are based on the total weir count N at the time of the snorkel survey (less any adults already passed downstream and any known mortalities at the time), divided by the snorkel survey count C (i.e., $\pi_t = N_t / C_t$) obtained from each survey trip.

Two teams comprised of ADF&G and USFS personnel conducted surveys in spring 2006. Ambient conditions were recorded (i.e., light conditions, water level, water clarity). In Eagle Creek, each survey began at upper Luck Creek 0.8 km upstream from the crossing of USFS road 30334 and continued downstream to the lake followed by a survey of the lake outlet to the weir site, 0.4 km above tidewater. In Cable Creek, each survey began about 60 m downstream of the fish ladder and continued downstream to the weir site approximately 0.8 km upstream of saltwater. A second snorkel crew surveyed the tributaries Beaver Creek and Snipe Creek.

RESULTS

EAGLE CREEK

Abundance at the Weir

A total of 295 immigrant adult steelhead were passed upstream through the Eagle Creek weir from 15 March to 29 May. Three days after the weir was fish-tight, a snorkel survey counted 3 additional steelhead that had likely arrived prior to weir installation. The first adult steelhead was caught in the weir trap on 15 March, and the last upstream migrant was captured on 27 May, with the peak of run occurring 10 May when 17 fish were passed (Figure 4, Appendix A1).

A total of 61 post-spawned emigrant steelhead kelts were passed downstream from 18 April through 29 May. An unknown number of kelts were passed downstream from early May through 29 May and any remaining emigrating steelhead left the drainage after the weir was removed (Figure 5, Appendix B1). Thirty-seven post-spawned steelhead were unmarked; however 36 steelhead were inadvertently passed upstream without a mark. The minimum spawning escapement in Eagle Creek was 299 steelhead (295 immigrants + [3 seen above the weir + 37 unmarked emigrants - 36 immigrants passed upstream without marks]).

Water temperatures ranged from approximately 0°C on 17 March to 12°C during late May. Temperatures were between 5°–6.5°C during the peak escapement in late April and early May (Figures 4 and 6, Appendix C1). Water levels taken at the weir gaging station varied from 280 cm during mid-March to 1,800 cm during the period of peak immigration (Figure 6, Appendix C1).

Age, Sex and Length

A total of 294 immigrating steelhead were measured, sexed, and sampled for scales prior to being released upstream to spawn in Eagle Creek. One additional fish was sampled for scales and sexed, but not measured.

Females made up the majority of the total immigrant run at 53% (157 fish), while males represented 47% (138 fish). The length of immigrant steelhead averaged 782 mm TL (SE = 4.4) and ranged from 530 mm to 930 mm. The length of immigrant males averaged 785 mm TL (SE = 7.1), while the average length of immigrant females was 779 mm TL (SE = 5.3). Three fish, or 1.0% of the total immigrant steelhead run, met the minimum length requirements for sport fish retention (≥914 mm TL, or ≥36 in TL; Table 4). Two males and one female were of legal size.

Of the 294 immigrant steelhead sampled for scales, 164 were successfully aged; the freshwater age could not be determined for 80 of the samples, 5 were not readable, no match could be determined for 27 and 14 scale samples were missing from the scale card. Of the initial spawners that were successfully aged (84 fish), females made up the majority (51.2%, SE = 5.5), and ages 4.2 (34.5%, SE = 5.2) and 4.3 (22.6%, SE = 4.6) were the predominant age classes (Table 5). Initial spawners composed 51.4% (SE = 1.35) of the Eagle Creek spring immigrant run (Table 6).

Snorkel Surveys

During the operation of the Eagle Creek weir, 9 snorkel surveys were conducted from 20 March to 29 May. Visibility conditions varied from poor to excellent and varied between the inlet and outlet streams. Because of an incomplete emigrant count, snorkel to weir conversions could not be calculated for the last 3 surveys. On average, 51.9% (SD = 62.0; n = 6) of the cumulative weir count was observed (Table 7).

CABLE CREEK

Abundance at the Weir

A total of 139 adult immigrant steelhead were passed through the Cable Creek weir from 25 March to 24 May. The day after the weir was fish-tight, a snorkel survey (conducted under poor visibility conditions) observed 6 steelhead in the system that had likely arrived prior to weir

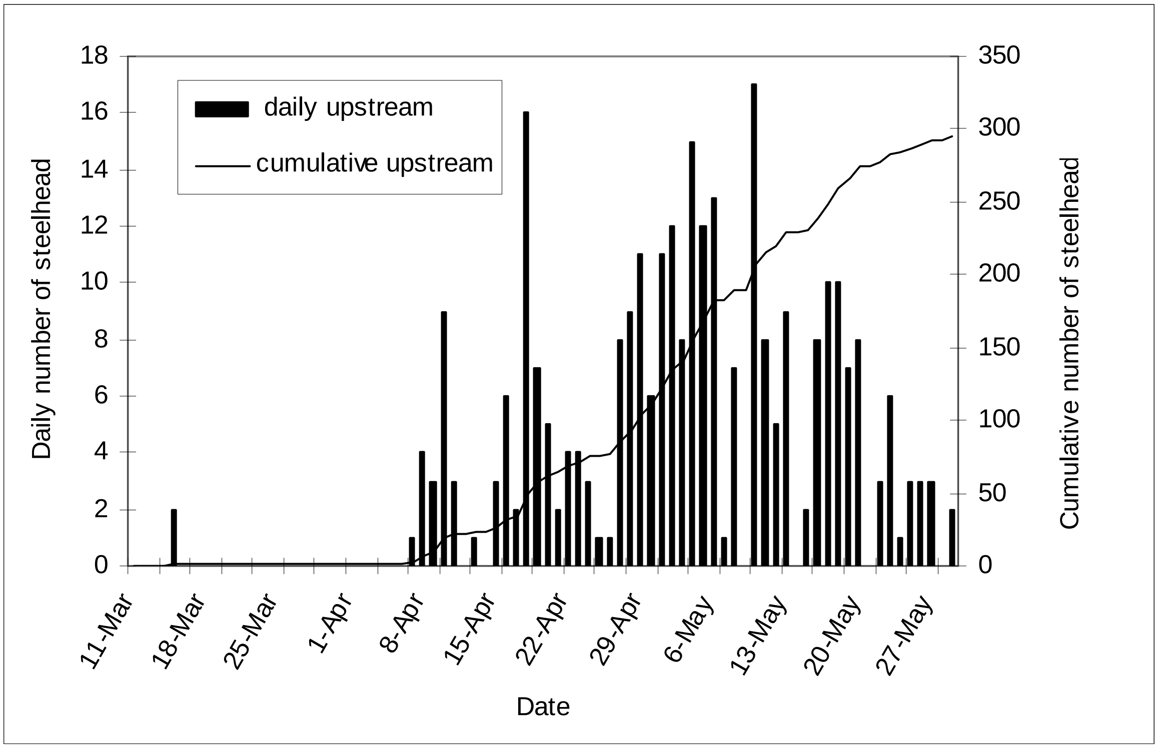

Figure 4.–Daily and cumulative counts of immigrant steelhead at Eagle Creek, 2006.

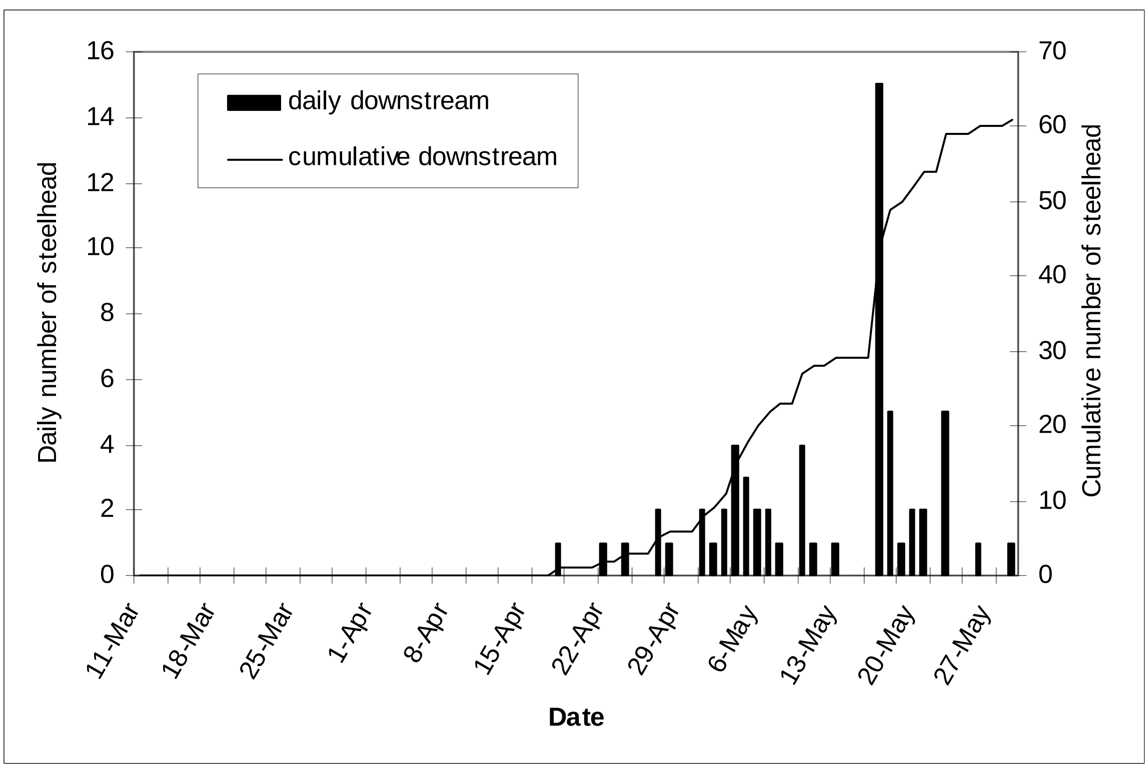

Figure 5.–Daily and cumulative counts of emigrant steelhead at Eagle Creek, 2006.

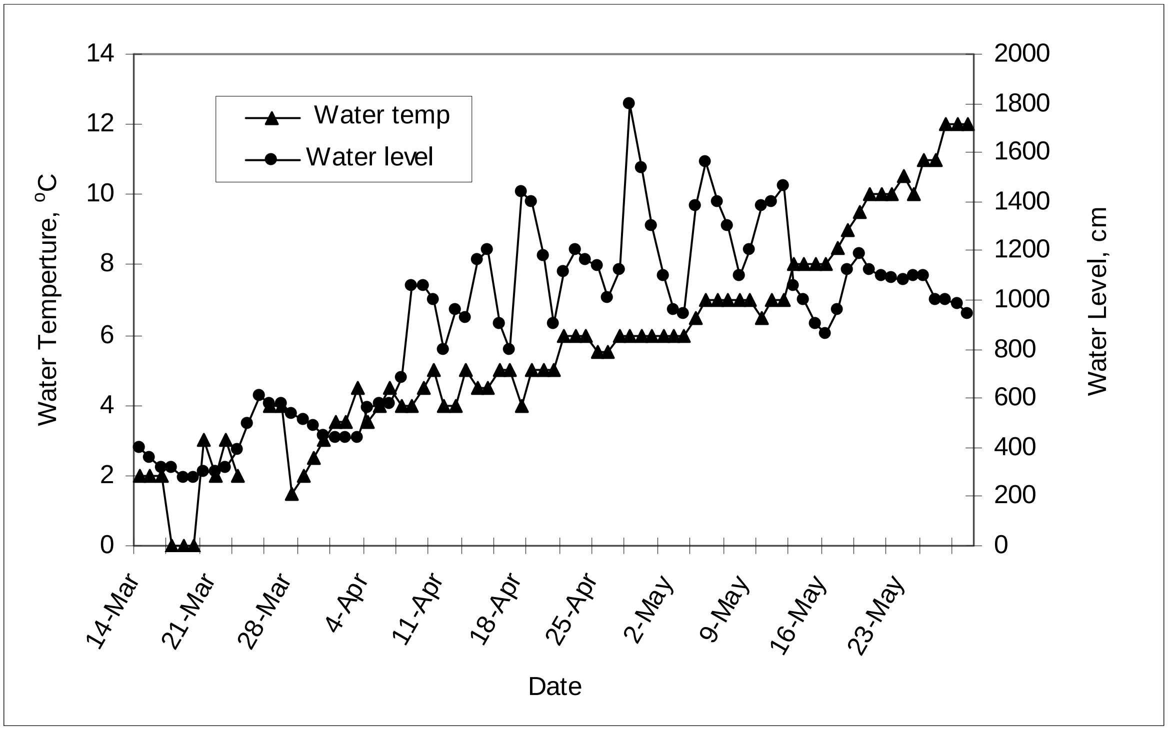

Figure 6.–Daily measurements of water level (cm) and water temperature (°C) at Eagle Creek, 2006.

Table 4.–Length composition of spring immigrant steelhead in Eagle Creek, 2006.

Length l, mm TL	n_l	$\hat{p}_l$	SE [$\hat{p}_l$]
515–534	1	0.003	0.000
535–554	0	0.000	0.000
555–574	0	0.000	0.000
575–594	0	0.000	0.000
595–614	0	0.000	0.000
615–634	5	0.017	0.001
635–654	6	0.020	0.001
655–674	15	0.051	0.002
675–694	23	0.078	0.002
695–714	11	0.038	0.002
715–734	20	0.068	0.002
735–754	17	0.058	0.002
755–774	22	0.075	0.002
775–794	33	0.113	0.003
795–814	34	0.116	0.003
815–834	27	0.092	0.003
835–854	29	0.099	0.003
855–874	15	0.051	0.002
875–894	18	0.061	0.002
895–914	14	0.048	0.002
≥915	4	0.014	0.001
	n = 294		

installation. The first adult steelhead was caught on 26 March, the last on 24 May, and the peak of the run occurred on 26 April when 9 immigrants were counted (Figure 7, Appendix A2). Five kelts were passed downstream from 29 April through 23 May, and any kelts remaining in the system presumable left after the weir was removed (Figure 8, Appendix B2); all 5 steelhead kelts passed downstream were marked, therefore were previously counted when passed upstream through the weir. The minimum spawning escapement in Cable Creek was 134 steelhead (139 immigrants + 6 observed above the weir - 11 observed as harvest).

Water temperatures in Cable Creek ranged from approximately 3°C on 25 March to 10°C on 16 May and were between 5–7°C during the peak upstream migration in late April (Figures 7 and 9, Appendix C2). Water levels taken at the weir gaging station varied from 170 cm during late March to 315 cm on 18 April near the period of peak steelhead escapement (Figure 9, Appendix C2).

Table 5.–Age and sex composition of spring immigrant steelhead sampled at the weir in Eagle Creek, 2006.

		Brood year and age class						
		2001	2000	2000	1999	1999	1997	
		3.2	3.3	4.2	4.3	5.2	6.3	Total
Female	n_a	9	12	13	8	1	0	43
	$\hat{p}_a$, %	20.9	27.9	30.2	18.6	2.3	0.0	51.2
	SE, %	4.5	4.9	5.0	4.3	1.7	0.0	5.5
Male	n_a	6	4	16	11	3	1	41
	$\hat{p}_a$, %	14.6	9.8	39.0	26.8	7.3	2.4	48.8
	SE, %	3.9	3.3	5.4	4.9	2.9	1.7	5.5
Combined	n_a	15	16	29	19	4	1	84
	$\hat{p}_a$, %	17.9	19.0	34.5	22.6	4.8	1.2	
	SE, %	4.2	4.3	5.2	4.6	2.3	1.2	

Table 6.–Age classes of immigrant Eagle Creek steelhead, 2006.

Age Class	Number of steelhead	Number of Females	Number of Males	p-hat_a,%	SE, %
3.2	15	9	6	6.1	0.64
3.3	16	12	4	6.6	0.66
4.2	28	13	15	11.5	0.85
4.3	19	8	11	7.8	0.71
5.2	4	1	3	1.6	0.34
6.3	1	0	1	0.4	0.17
x.2[a]	20	9	11	8.2	0.73
x.3[a]	21	14	7	8.6	0.75
3.1s1s1	1	1	0	0.4	0.17
3.2s1	30	13	17	12.3	0.88
3.2s1s1	8	5	3	3.3	0.47
3.2s1s1s1	1	1	0	0.4	0.17
3.3s1	1	1	0	0.4	0.17
3.3s1s1	1	1	0	0.4	0.17
4.1s1	1	1	0	0.4	0.17
4.2s1	28	16	12	11.5	0.85
4.2s1s1	4	0	4	1.6	0.34
4.3s1	2	2	0	0.8	0.24
5.2s1	3	2	1	1.2	0.29
5.2s1s1	1	1	0	0.4	0.17
x.2s1[a]	23	11	12	9.4	0.78
x.2s1s1[a]	10	5	5	4.1	0.53
x.2s1s1s1[a]	2	1	1	0.8	0.24
x.3s1[a]	4	4	0	1.6	0.34
Initial Spawners	124	66	58	50.8	1.33
Repeat Spawners	120	65	55	49.2	1.33
Total	244	131	113	100	

[a] x = freshwater age undetermined.

Age, Sex and Length

One hundred thirty-nine immigrating steelhead were measured, sexed, sampled for scales, and caudal fin-clipped prior to being released upstream to spawn in Cable Creek.

Females comprised 54% (75 fish) of the total immigrant run while males represented 46% (64 fish). The length of all immigrating steelhead averaged 765 mm TL (SD = 78.7), and ranged from 580 mm to 1000 mm. The length of males averaged 766 mm TL (SD = 84.4), and the length

Table 7.–Weekly snorkel surveys of adult steelhead, percentage of steelhead observed based on cumulative weir counts, and visibility conditions in Eagle Creek (20 March–29 May, 2006).

Date	Survey no.	No. observed during snorkel	Cumulative upstream weir count	Downstream weir count[a]	Percent of weir count observed[b]	Visibility conditions
20 Mar	1	3	2	0	60.0%	poor-normal
28 Mar	2	0	2	0	0.0%	excellent
4 Apr	3	1	2	0	20.0%	excellent-normal
11 Apr	4	43	22	0	172.0%	excellent-normal
20 Apr	5	22	62	1	34.4%	poor
2 May	6	32	134	9	25.0%	excellent-normal
9 May	7	63	190	23	n/a	normal-poor
17 May	8	77	249	44	n/a	normal
29 May	9	124	295	61	n/a	normal
				Average % observed	51.9%	
				SD	62.0%	

[a] An unknown number of steelhead were passed downstream without being counted after 8 May. The percent of the weir count observed cannot be calculated with accuracy for the last three snorkel surveys.

b Three fish were observed during the first snorkel survey on 20 March, prior to any fish passage through the weir. These fish have been factored into the percent of the weir count observed.

of females averaged 763 mm FL (SD = 74.0). Five fish, or 3.6%, of the total immigrant steelhead run met the minimum length requirements for sport fish retention (≥ 914 mm TL, or ≥ 36 in TL; Table 8). Three females and 2 males were of legal size.

Of the 139 steelhead sampled for scales, 64 were successfully aged; the freshwater age could not be determined for 70 of the samples and 5 were not readable. Of the initial spawners that were successfully aged (33 fish), males made up the majority (51.5%, SE = 8.8), and ages 3.3 (42.4%, SE = 8.7) and 3.2 (39.4%, SE = 8.6) were the predominant age classes (Table 9). Initial spawners composed 52% (SE = 0.82) of the Cable Creek spring immigrant run (Table 10).

Snorkel Surveys

During the operation of the Cable Creek weir, 8 snorkel surveys were conducted from 30 March and 24 May. Visibility conditions were very poor to excellent throughout the season. On average, 43.0% (SD = 38.1%) of the cumulative weir count was observed (Table 11).

DISCUSSION

Results obtained from the second year of this study continue to provide key insights important for the management of steelhead on Prince of Wales Island.

The steelhead escapements into Eagle Creek and Cable Creek were 299 and 134, respectively. The Eagle Creek weir was fish tight during the entire season (15 March–29 May). During the first snorkel survey conducted 3 days after the weir was fish tight, 3 steelhead were observed in Eagle Creek. It is assumed that these fish moved into the system prior to weir installation, either as spring immigrants or fall-run immigrants. Although we did not study fall immigration during this project, it is likely that Eagle Creek supports a fall-run of steelhead, given that there is a lake in the system that could serve as prime overwintering habitat. Spawning fish (10) were observed in a small area (approximately 15 m) of gravel flats located just downstream from the weir from 7 April to early May. Because these fish did not pass through the weir and the exact number of steelhead that spawned below the weir is not known, the escapement count of 299 steelhead should be considered a minimum count.

The Cable Creek weir was fish tight during the entire season (20 March–29 May). Only a few immigrant steelhead (6) in Cable Creek were missed, as observed during our first snorkel survey. One major flood event occurred on Cable Creek (18 April) that threatened the integrity of the weir. High flows moved a large amount of woody debris and logs onto the upstream face of the weir. This blockage resulted in a scoured pit

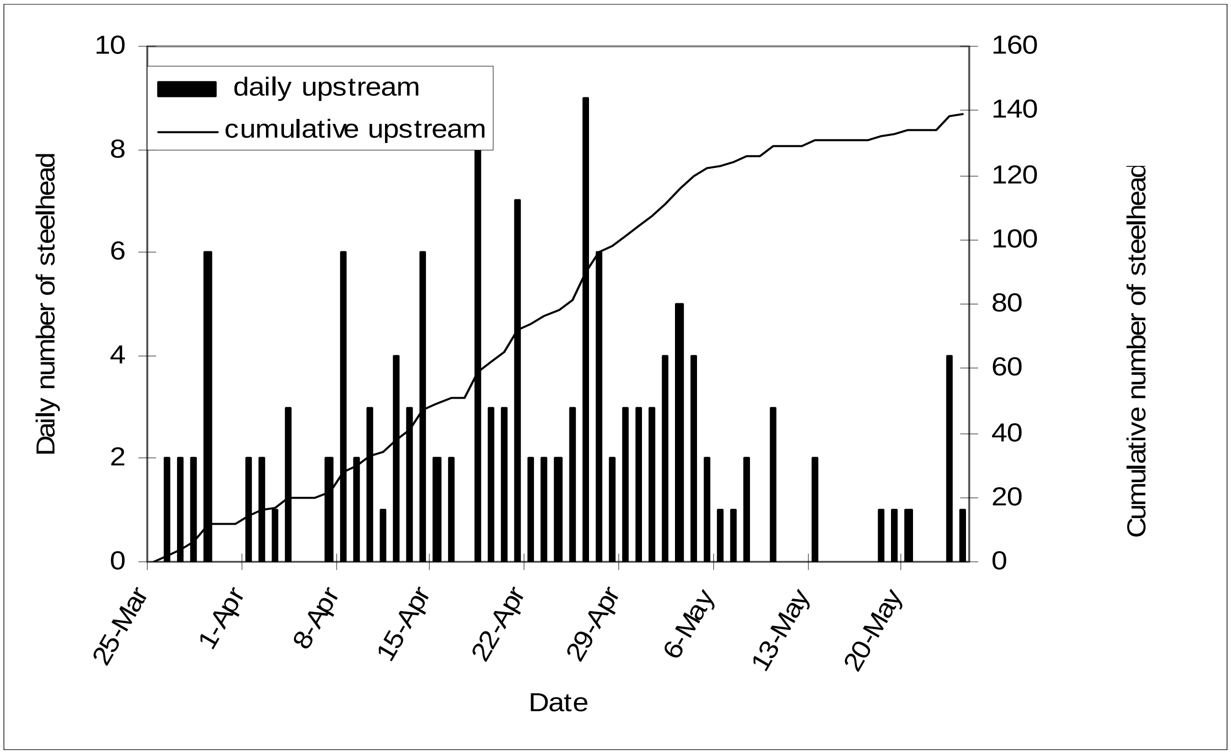

Figure 7.–Daily and cumulative counts of immigrant steelhead at Cable Creek, 2006.

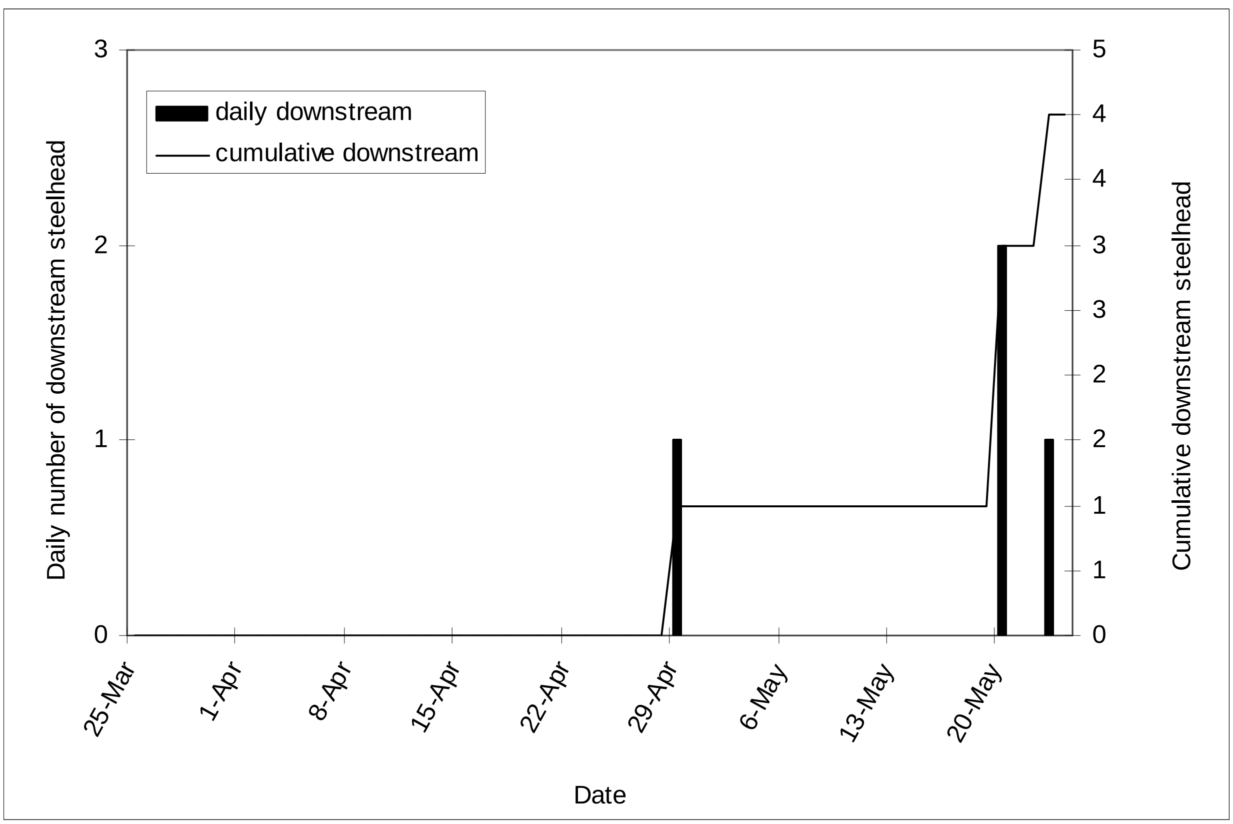

Figure 8.–Daily and cumulative counts of emigrant steelhead at Cable Creek, 2006.

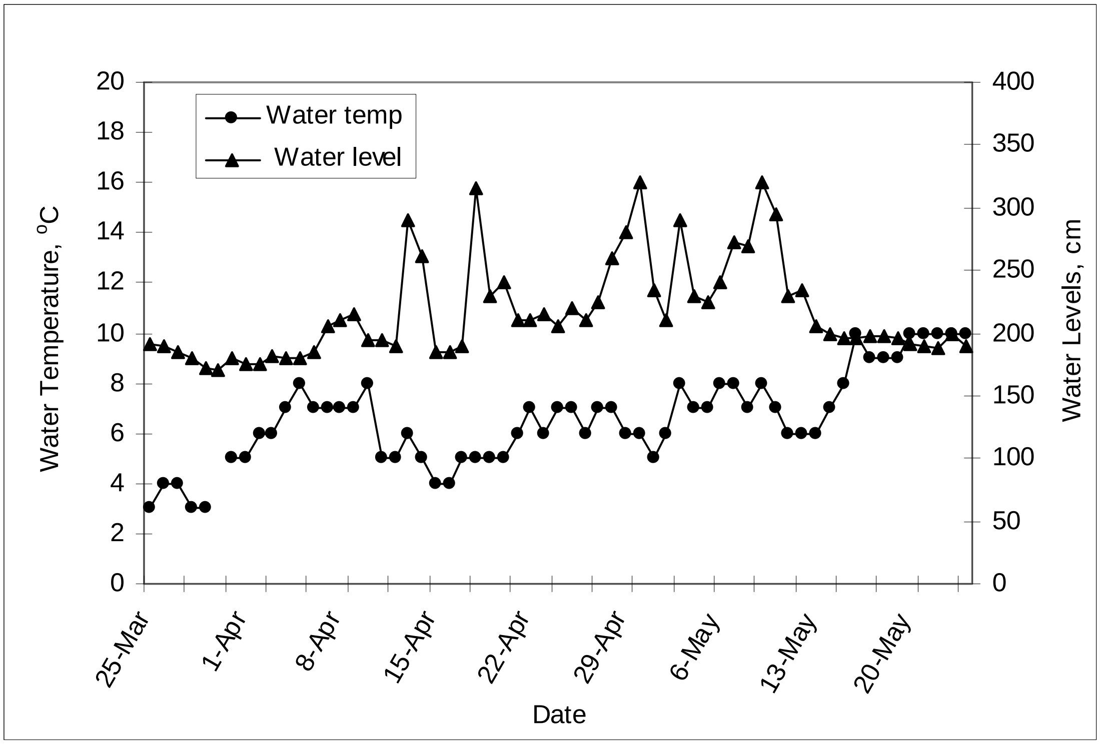

Figure 9.–Daily measurements of water level (cm), and water temperature (°C) at Cable Creek, 2006.

Table 8.–Length composition of spring immigrant steelhead in Cable Creek, 2006.

Length *l*, mm TL	n_l	P_l
575–594	1	0.007
595–614	1	0.007
615–634	3	0.022
635–654	8	0.058
655–674	10	0.072
675–694	6	0.043
695–714	6	0.043
715–734	12	0.086
735–754	13	0.094
755–774	7	0.050
775–794	22	0.158
795–814	10	0.072
815–834	16	0.115
835–854	7	0.050
855–874	6	0.043
875–894	3	0.022
895–914	3	0.022
≥915	5	0.036
	n = 139	

approximately 3 m x 0.6 m along the upstream base of the weir, 0.6 m–0.9 m in front of the weir structure; however, the weir structure was not breached. As soon as conditions were safe, crews cleared debris, checked for holes, reinforced the weir structure and filled the pit with sandbags. We believe that no fish passed upstream unaccounted for during this time because no holes were detected and the integrity of the creek banks remained intact.

Two regulatory closures were implemented in Cable Creek in 2006. ADF&G Division of Sport Fish issued an emergency order closing the Cable Creek drainage to all sport fishing from 12 April to 31 May. A federal fishing closure was issued on 13 April closing Cable Creek to subsistence fishing until 31 May. State and federal managers estimated that 11 or more steelhead were harvested from Cable Creek, during which time very few steelhead were observed during snorkel surveys, prompting the closure and concern for the spring spawning population. The upstream weir count at the time the harvest occurred was 38 steelhead. The Federal Subsistence Management Rationale for spring run steelhead in "small" road accessible systems on PWI requires that inseason action be taken when the total harvest reaches 5 or more steelhead (USFS *Unpublished*).

Table 9.–Age and sex composition of spring immigrant steelhead sampled at the weir in Cable Creek, 2006.

		Brood year and age class					
		2001 2.3	2001 3.2	2000 3.3	2000 4.2	1999 4.3	Total
Female	n_a	0	7	7	2	0	16
	$\hat{p}_a$, %	0.0	43.8	43.8	12.5	0.0	48.5
	SE, %	0.0	8.8	8.8	5.8	0.0	8.8
Male	n_a	1	6	7	1	2	17
	$\hat{p}_a$, %	5.9	35.3	41.2	5.9	11.8	51.5
	SE, %	4.2	8.4	8.7	4.2	5.7	8.8
Combined	n_a	1	13	14	3	2	33
	$\hat{p}_a$, %	3.0	39.4	42.4	9.1	6.1	100.0
	SE, %	3.0	8.6	8.7	5.1	4.2	0.0

Table 10.–Age classes of immigrant Cable Creek steelhead, 2006.

Age Class	Number of steelhead	Number of Females	Number of Males	p-hat_a,%	SE, %
2.3	1	0	1	0.8	0.16
3.2	13	7	6	9.8	0.54
3.3	14	7	7	10.5	0.55
4.2	3	2	1	2.3	0.27
4.3	2	0	2	1.5	0.22
x.2[a]	13	4	9	9.8	0.54
x.3[a]	23	15	8	17.3	0.68
3.1s1	1	1	0	0.8	0.16
3.2s1	19	14	5	14.3	0.63
3.2s1s1	2	0	2	1.5	0.22
3.3s1	2	1	1	1.5	0.22
3.3s1s1	1	1	0	0.8	0.16
4.2s1	3	1	2	2.3	0.27
4.2s1s1	1	1	0	0.8	0.16
4.3s1	1	1	0	0.8	0.16
x.2s1[a]	23	12	11	17.3	0.68
x.2s1s1[a]	6	2	4	4.5	0.38
x.3s1[a]	4	2	2	3.0	0.31
x.3s1s1[a]	1	0	1	0.8	0.16
Initial Spawners	69	35	34	51.9	0.90
Repeat Spawners	64	36	28	48.1	0.90
Total	133	71	62	100	

[a] x = freshwater age undetermined.

In 2006, 3.6% of the steelhead in Cable Creek and 1.0% of the steelhead in Eagle Creek met minimum length requirements for sport fish retention (≥914 mm TL, or ≥36 in TL). Results from the previous year indicated that 1.7% and 2.3% of the steelhead in Big Ratz Creek and the Harris River, respectively, were greater than 36 inches in length (Piazza et al. 2008). In 2004, no fish greater than 36 inches were encountered at the 12-Mile weir (Hoffman 2007). Similarly, less than 1% of the steelhead run in the Karta River were larger that 36 inches in 1989 and 1992, and no fish over 36 inches were encountered during creel surveys conducted at the Karta River in 1989 and 1991 (Freeman and Hoffman 1989; Harding and Jones 1993; Hoffman et al. 1990). Biologists estimate that less than 5% of adult steelhead in Southeast Alaska are greater than 36 inches in total length so that current sport fish regulations, established in 1994, protect 95% of fish returning to systems in the region (Harding et al. 2006).

Table 11.–Weekly snorkel survey of adult steelhead, percentage of steelhead observed based on cumulative weir counts, and visibility conditions in Cable Creek (30 Mar–24 May, 2006).

Date	Survey no.	No. observed during snorkel	Cumulative upstream weir count[a]	Cumulative downstream weir count	Percent of weir count observed[b]	Visibility conditions
30 Mar	1	18	12	0	100.0%	excellent
7 Apr	2	0	22	0	0.0%	poor
12 Apr	3	4	38	0	9.1%	normal
26 Apr	4	15	90	1	15.8%	normal
5 May	5	44	122	1	34.6%	normal
10 May	6	6	129	1	4.5%	very poor; high water
19 May	7	87	133	1	63.0%	excellent
24 May	8	110	138	4	78.6%	excellent
				Average % observed[c]	43.0%	
				SD	38.1%	

[a] A minimum of 11 steelhead were harvested from the Snipe Creek hole around 10 April, as observed by ADF&G staff. These fish have not been removed from the cumulative upstream weir count.

[b] Six fish were observed during the first snorkel survey on 30 March, prior to any fish passage through the weir. These 6 fish have been factored onto the percent of the weir count observed.

[c] Due to very poor survey conditions, the values from the sixth snorkel survey have been excluded from the average percent of the weir count observed.

Steelhead returning to Eagle Creek were dominated by fish that spent 4 years in freshwater before smolting, while steelhead returning to Cable Creek were dominated by fish that spent 3 years. In both systems steelhead spent 2 to 3 years in saltwater prior to returning to spawn as adults. Similar age patterns were documented in Big Ratz Creek and the Harris River (Piazza et al. 2008), the Thorne River (Freeman and Hoffman 1989) and in Ward Creek (Hubartt 1989). These age patterns were also observed in 1983, 1989, 1992 and 2005 in the Karta River (Harding and Jones 1993; Hoffman et al. 1990; Hoffman 2008; Jones 1984).

The importance of using weirs to enumerate steelhead returns on Prince of Wales continues to be highlighted by the additional results obtained from both the Eagle Creek and Cable Creek systems. Initially, these 2 streams were categorized by managers as "large" (total annual N > 150 adult fish) and "small" (total annual N < 150 fish) systems, respectively. Eagle Creek was thought to support an adult steelhead population of 500 fish or greater, while steelhead populations at Cable Creek were estimated as 100 or less. The actual counts obtained for Eagle Creek (N = 299) did not change the management classification for this system, however the escapement was substantially lower than anticipated. In contrast, the minimum escapement numbers obtained for Cable Creek (N= 139), while exceeding the original estimate (100 adults or less), confirmed its classification as a "small" system. While the results collected in 2006 did not lead to changes in management classification, a weir count of 399 fish on Big Ratz Creek in 2005 resulted in a change from a "small" to a "large" system (Piazza et al. 2008).

In 2006 we further examined the feasibility of using snorkel survey calibration methods as a management tool to estimate steelhead abundance. Snorkel survey methods are used extensively throughout Southeast Alaska to develop indices of adult steelhead populations in freshwater streams. Typically, such data have been interpreted as an indicator of peak abundance. However, our study design enabled us to calibrate the snorkel survey estimates using weir censuses as actual abundance.

The percent of the weir count observed during snorkel surveys varied greatly between snorkel survey counts in the 2 streams studied in 2006. Several factors may have contributed to the high variability between surveys in the percent of fish seen. Eagle Creek is a tannic-stained system with limited underwater visibility of approximately 2 m or less. Eagle Creek has a few deep, dark pools (up to 15' deep) with moderate to high levels of turbidity that obstructs visibility under normal conditions and worsens during high flows. These pools are substantial holding areas for steelhead prior the fish moving into Luck Lake. Steelhead tend to stack up in these pools, and on most occasions, observers were only able to accurately count steelhead milling closer to the surface. Multiple passes through these pools were usually required and resulting counts were averaged and likely under-represented the actual number of fish present. Counting of adult steelhead in Luck Lake was restricted by water depth and was thus not included in the survey area. It is also believed that fall fish were present in the system prior to spring immigration as evidenced by observations made during 2 snorkel surveys when more fish were observed upstream than were passed through the weir. On 11 April, 43 fish were observed during a snorkel survey when the known weir count was only 25 (22 passed via weir + 3 observed prior to fish passage). Eagle Creek is a well-known fall steelhead system and it is assumed that fall fish overwintering in Luck Lake moved into the creek to spawn, thus were present to be observed during the snorkel surveys. A combination of these factors likely contributed to less accurate snorkel counts in the Eagle Creek system. Based on the high variability in the accuracy of snorkel counts at Eagle Creek, an uncertain emigrant count, and the likelihood of a fall run of unknown size, we did not generate a snorkel survey expansion for this system.

Cable Creek also proved to be a challenging system to achieve reliable snorkel counts. The proportion of the weir count observed during the snorkel surveys varied greatly throughout the season (0%–100%). The upper reach of Cable Creek and the 2 tributaries are shallow, relatively clear with little habitat complexity and no lakes in this system. However, the lower reach of Cable Creek has numerous deep holes and large wood complexes. During 2006 numerous heavy rainfall events stirred up the sediment, creating high levels of turbidity that hindered the observation of fish, especially in the deeper holes such as the "Snipe Creek hole" where a majority of steelhead hold prior to entering the tributaries and moving upstream to spawn. Like Eagle Creek, counting steelhead in these holes proved very difficult, requiring numerous passes to obtain a confident steelhead count. These challenging conditions were considered normal for Cable Creek. It is believed that the best snorkel counts in Cable Creek occurred during low water conditions when snorkelers were able to see the bottom of the deeper holes, especially the Snipe Creek hole. During these counts, 63%–100% of the weir count was observed. Based on high variability in the accuracy of snorkel counts at Cable Creek, we did not generate a snorkel survey expansion for this system. The variability between surveys was higher than expected for Cable Creek. It is believed that the variability of expansion factors between years and between systems will be better understood after future weir studies are completed.

Substantial variability exists between the snorkel results obtained at the 5 systems studied to date (51.9% in Eagle Creek, 43.0% in Cable Creek, 82.5% in Harris River, 32.1% in Ratz Creek, and 74% in 12-Mile Creek). The intent of generating snorkel calibration factors based on weir counts is to have a management tool for estimating steelhead abundance when weirs or other means of enumeration are unavailable. Data collected during 2005 and 2006 and that of the pilot study on 12 Mile Creek in 2004 suggest that snorkel survey calibrations (generated from weir counts) are site specific and may not be comparable across systems (Hoffman 2008; Piazza et al. 2008). Each system is unique in its habitat complexity (including presence of lakes), and water clarity. Information collected in 2006 further indicates that such variables limit the scope in which snorkel survey calibrations can be applied. However, as more snorkel/weir comparisons are made, snorkel counts may contribute information that will assist managers in more accurately categorizing the PWI systems, i.e., small or large.

After 2 years of study, our results indicate that that snorkel surveys may not be a good indicator of abundance. Multiple-year studies should be considered in the future to determine how much inter annual variation exists within a system and to obtain broader scope of knowledge about a particular steelhead stock. Other methods that may warrant further exploration include the use of redd surveys, video counters, sonar, and radiotelemetry.

During 2007, two additional PWI steelhead streams that support subsistence harvest will be chosen to continue our monitoring efforts. We will further explore whether snorkel survey calibrations are a feasible tool for managers to estimate steelhead abundance. Such information will assist biologists and regulators from tribal, state, and federal agencies to manage for sustainability and take the necessary action to conserve stocks if needed.

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APPENDIX A

DAILY AND CUMULATIVE WEIR COUNTS

FOR IMMIGRATING STEELHEAD

Appendix A1.–Daily and cumulative weir counts for immigrating steelhead at Eagle Creek, 2006.

Date	No. of steelhead daily	Cumulative	Date	No. of steelhead daily	Cumulative
11 Mar	0	0	20 Apr	5	62
12 Mar	0	0	21 Apr	2	64
13 Mar	0	0	22 Apr	4	68
14 Mar	0	0	23 Apr	4	72
15 Mar	2	2	24 Apr	3	75
16 Mar	0	2	25 Apr	1	76
17 Mar	0	2	26 Apr	1	77
18 Mar	0	2	27 Apr	8	85
19 Mar	0	2	28 Apr	9	94
20 Mar	0	2	29 Apr	11	105
21 Mar	0	2	30 Apr	6	111
22 Mar	0	2	1 May	11	122
23 Mar	0	2	2 May	12	134
24 Mar	0	2	3 May	8	142
25 Mar	0	2	4 May	15	157
26 Mar	0	2	5 May	12	169
27 Mar	0	2	6 May	13	182
28 Mar	0	2	7 May	1	183
29 Mar	0	2	8 May	7	190
30 Mar	0	2	9 May	0	190
31 Mar	0	2	10 May	17	207
1 Apr	0	2	11 May	8	215
2 Apr	0	2	12 May	5	220
3 Apr	0	2	13 May	9	229
4 Apr	0	2	14 May	0	229
5 Apr	0	2	15 May	2	231
6 Apr	0	2	16 May	8	239
7 Apr	1	3	17 May	10	249
8 Apr	4	7	18 May	10	259
9 Apr	3	10	19 May	7	266
10 Apr	9	19	20 May	8	274
11 Apr	3	22	21 May	0	274
12 Apr	0	22	22 May	3	277
13 Apr	1	23	23 May	6	283
14 Apr	0	23	24 May	1	284
15 Apr	3	26	25 May	3	287
16 Apr	6	32	26 May	3	290
17 Apr	2	34	27 May	3	293
18 Apr	16	50	28 May	0	293
19 Apr	7	57	29 May	2	295
			Totals		295

Appendix A2.–Daily and cumulative weir counts for immigrating steelhead at Cable Creek, 2006.

Date	No. of steelhead daily	Cumulative
25 Mar	0	0
26 Mar	2	2
27 Mar	2	4
28 Mar	2	6
29 Mar	6	12
30 Mar	0	12
31 Mar	0	12
1 Apr	2	14
2 Apr	2	16
3 Apr	1	17
4 Apr	3	20
5 Apr	0	20
6 Apr	0	20
7 Apr	2	22
8 Apr	6	28
9 Apr	2	30
10 Apr	3	33
11 Apr	1	34
12 Apr	4	38
13 Apr	3	41
14 Apr	6	47
15 Apr	2	49
16 Apr	2	51
17 Apr	0	51
18 Apr	8	59
19 Apr	3	62
20 Apr	3	65
21 Apr	7	72
22 Apr	2	74
23 Apr	2	76
24 Apr	2	78

Date	No. of steelhead daily	Cumulative
25 Apr	3	81
26 Apr	9	90
27 Apr	6	96
28 Apr	2	98
29 Apr	3	101
30 Apr	3	104
1 May	3	107
2 May	4	111
3 May	5	116
4 May	4	120
5 May	2	122
6 May	1	123
7 May	1	124
8 May	2	126
9 May	0	126
10 May	3	129
11 May	0	129
12 May	0	129
13 May	2	131
14 May	0	131
15 May	0	131
16 May	0	131
17 May	0	131
18 May	1	132
19 May	1	133
20 May	1	134
21 May	0	134
22 May	0	134
23 May	4	138
24 May	1	139
Totals		139

APPENDIX B
DAILY AND CUMULATIVE WEIR COUNTS FOR EMIGRATING STEELHEAD

Appendix B1.–Daily and cumulative weir counts for emigrating steelhead at Eagle Creek, 2006.

Date	No. of steelhead daily	Cumulative	Comments
17 Apr	0	0	
18 Apr	1	1	
19 Apr	0	1	
20 Apr	0	1	
21 Apr	0	1	
22 Apr	1	2	
23 Apr	0	2	
24 Apr	1	3	
25 Apr	0	3	
26 Apr	0	3	
27 Apr	2	5	
28 Apr	1	6	
29 Apr	0	6	
30 Apr	0	6	
1 May	2	8	
2 May	1	9	
3 May	2	11	
4 May	4	15	
5 May	3	18	
6 May	2	20	
7 May	2	22	
8 May	1	23	Crew stopped counting and examining each downstream fish for marks from May 8 through the end of the season.
9 May	0	23	
10 May	4	27	
11 May	1	28	
12 May	0	28	
13 May	1	29	
14 May	0	29	
15 May	0	29	
16 May	0	29	
17 May	15	44	
18 May	5	49	
19 May	1	50	
20 May	2	52	
21 May	2	54	
22 May	0	54	
23 May	5	59	
24 May	0	59	
25 May	0	59	
26 May	1	60	
27 May	0	60	
28 May	0	60	
29 May	1	61	
Total		61*	*considered a minimum count

Appendix B2.–Daily and cumulative weir counts for emigrating steelhead at Cable Creek, 2006.

Date	No of steelhead daily	Cumulative	Mortalities
28 Apr		0	
29 Apr	1	1	
30 Apr		1	
1 May		1	
2 May		1	
3 May		1	
4 May		1	
5 May		1	
6 May		1	
7 May		1	
8 May		1	
9 May		1	
10 May		1	
11 May		1	
12 May		1	
13 May		1	
14 May		1	
15 May		1	
16 May		1	
17 May		1	
18 May		1	
19 May		1	
20 May	2	3	
21 May		3	
22 May		3	
23 May	1	4	
24 May		4	1
Total		4	1

APPENDIX C
STREAM GAGE AND TEMPERATURE DATA

Appendix C1.–Eagle Creek water temperatures and levels, 2006.

Date	Water temperature (^{o}C)	Water level (cm)
14 Mar	2	400
15 Mar	2	360
16 Mar	2	320
17 Mar	0	320
18 Mar	0	280
19 Mar	0	280
20 Mar	3	300
21 Mar	2	300
22 Mar	3	320
23 Mar	2	390
24 Mar		500
25 Mar		610
26 Mar	4	580
27 Mar	4	580
28 Mar	1.5	540
29 Mar	2	510
30 Mar	2.5	490
31 Mar	3	450
1 Apr	3.5	440
2 Apr	3.5	440
3 Apr	4.5	440
4 Apr	3.5	560
5 Apr	4	580
6 Apr	4.5	580
7 Apr	4	680
8 Apr	4	1,060
9 Apr	4.5	1,060
10 Apr	5	1,000
11 Apr	4	800
12 Apr	4	960
13 Apr	5	930
14 Apr	4.5	1,160
15 Apr	4.5	1,200
16 Apr	5	900
17 Apr	5	800
18 Apr	4	1,440
19 Apr	5	1,400
20 Apr	5	1,180
21 Apr	5	900
22 Apr	6	1,110
23 Apr	6	1,200
24 Apr	6	1,160
25 Apr	5.5	1,140
26 Apr	5.5	1,010
27 Apr	6	1,120
28 Apr	6	1,800
29 Apr	6	1,540
30 Apr	6	1,300
1 May	6	1,100
2 May	6	960
3 May	6	940
4 May	6.5	1,380
5 May	7	1,560
6 May	7	1,400
7 May	7	1,300
8 May	7	1,100
9 May	7	1,200
10 May	6.5	1,380
11 May	7	1,400
12 May	7	1,460
13 May	8	1,060
14 May	8	1,000
15 May	8	900
16 May	8	860
17 May	8.5	960
18 May	9	1,120
19 May	9.5	1,190
20 May	10	1,120
21 May	10	1,100
22 May	10	1,090
23 May	10.5	1,080
24 May	10	1,100
25 May	11	1,100
26 May	11	1,000
27 May	12	1,000
28 May	12	980
29 May	12	940

Appendix C2.–Cable Creek water temperatures and levels, 2006.

Date	Water temperature (°C)	Water level (cm)
25 Mar	3	192
26 Mar	4	190
27 Mar	4	185
28 Mar	3	180
29 Mar	3	172
30 Mar		170
31 Mar	5	180
1 Apr	5	175
2 Apr	6	175
3 Apr	6	182
4 Apr	7	180
5 Apr	8	180
6 Apr	7	185
7 Apr	7	205
8 Apr	7	210
9 Apr	7	215
10 Apr	8	195
11 Apr	5	195
12 Apr	5	190
13 Apr	6	290
14 Apr	5	262
15 Apr	4	185
16 Apr	4	185
17 Apr	5	190
18 Apr	5	315
19 Apr	5	230
20 Apr	5	240
21 Apr	6	210
22 Apr	7	210
23 Apr	6	215
24 Apr	7	205

Date	Water temperature (°C)	Water level (cm)
25 Apr	7	220
26 Apr	6	210
27 Apr	7	225
28 Apr	7	260
29 Apr	6	280
30 Apr	6	320
1 May	5	235
2 May	6	210
3 May	8	290
4 May	7	230
5 May	7	225
6 May	8	240
7 May	8	273
8 May	7	270
9 May	8	320
10 May	7	295
11 May	6	230
12 May	6	235
13 May	6	205
14 May	7	200
15 May	8	196
16 May	10	196
17 May	9	198
18 May	9	198
19 May	9	196
20 May	10	192
21 May	10	190
22 May	10	188
23 May	10	200
24 May	10	190

APPENDIX D
COMPUTER FILES

Appendix D1.–Computer files used containing data, statistics, and interim calculations used to assess steelhead stocks in Eagle Creek and Cable Creek, 2006.

Computer file	Description
Eagle Creek steelhead_06	Excel file containing physical data, weir counts, snorkel survey counts, sex-length estimates, charts and appendices.
Cable Creek steelhead_06	Excel file containing physical data, weir counts, snorkel survey counts, sex-length estimates, charts and appendices.