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Assessment of Adult Steelhead Populations on Prince of Wales Island, Alaska: Harris River and Big Ratz Creek, 2005

by

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and

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October 2008

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

Symbols and Abbreviations

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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
mideye to fork	MEF
mideye 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. 08–46

ASSESSMENT OF ADULT STEELHEAD POPULATIONS ON PRINCE OF WALES ISLAND, ALASKA: HARRIS RIVER AND BIG RATZ CREEK, 2005

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

In 2005, weirs were installed in the Harris River and Big Ratz Creek on Prince of Wales Island, Southeast Alaska to collect information on the escapement, run timing, composition, and the relationship between snorkel surveys and weir counts for the development of expansion factors. The minimum spawning escapement at the Harris River was 172 steelhead. Females made up the majority of the immigrants (59.1%, SE = 3.7), and ages 3.2 (56.8%, SE = 3.7) and 3.3 (23.9%, SE = 3.2) were the predominant age classes. The total length of immigrant female steelhead averaged 789 mm and had SD = 82.7, and the total length of males averaged 757 mm and had SD = 93.7. Of the 171 fish measured, 4 (2.3%) were ≥36 in (914 mm) TL; 3 were male and 1 was female. Ten snorkel surveys were conducted during the season; on average 68.8% (SD = 18.0%) of the weir count count was observed. The minimum spawning escapement at Big Ratz Creek was 399 steelhead. Females made up the majority of the immigrants (63.6%, SE = 2.0), and ages 3.2 (31.4%, SE = 1.9) and 4.2 (36.4%, SE = 2.0) were the predominant age classes. The total lengths of immigrant female and male steelhead averaged 759 mm (SE = 4.9) and 737 mm (SE = 7.4), respectively. Of the 355 fish sampled for length, 6 (1.7%) were ≥36 in TL; 3 were males and 3 were females. Eleven snorkel surveys were conducted during the season; on average, 30.8% (SD= 13.8%) 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 have only existed under the Federal Subsistence Program since 2003.

Steelhead occur in over 330 streams in Southeast Alaska and there are 74 drainages known to contain steelhead on PWI (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) 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 and 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 sport fishing 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. By the mid-1990s, harvest opportunities under sport fishing 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. These results were interpreted by ADF&G managers as effectively stabilizing steelhead abundance (D. Vincent-Lang, ADF&G, Anchorage; *personal communication*). Unfortunately, system-specific sport fishery data for PWI steelhead are limited. 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; -1991). 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.

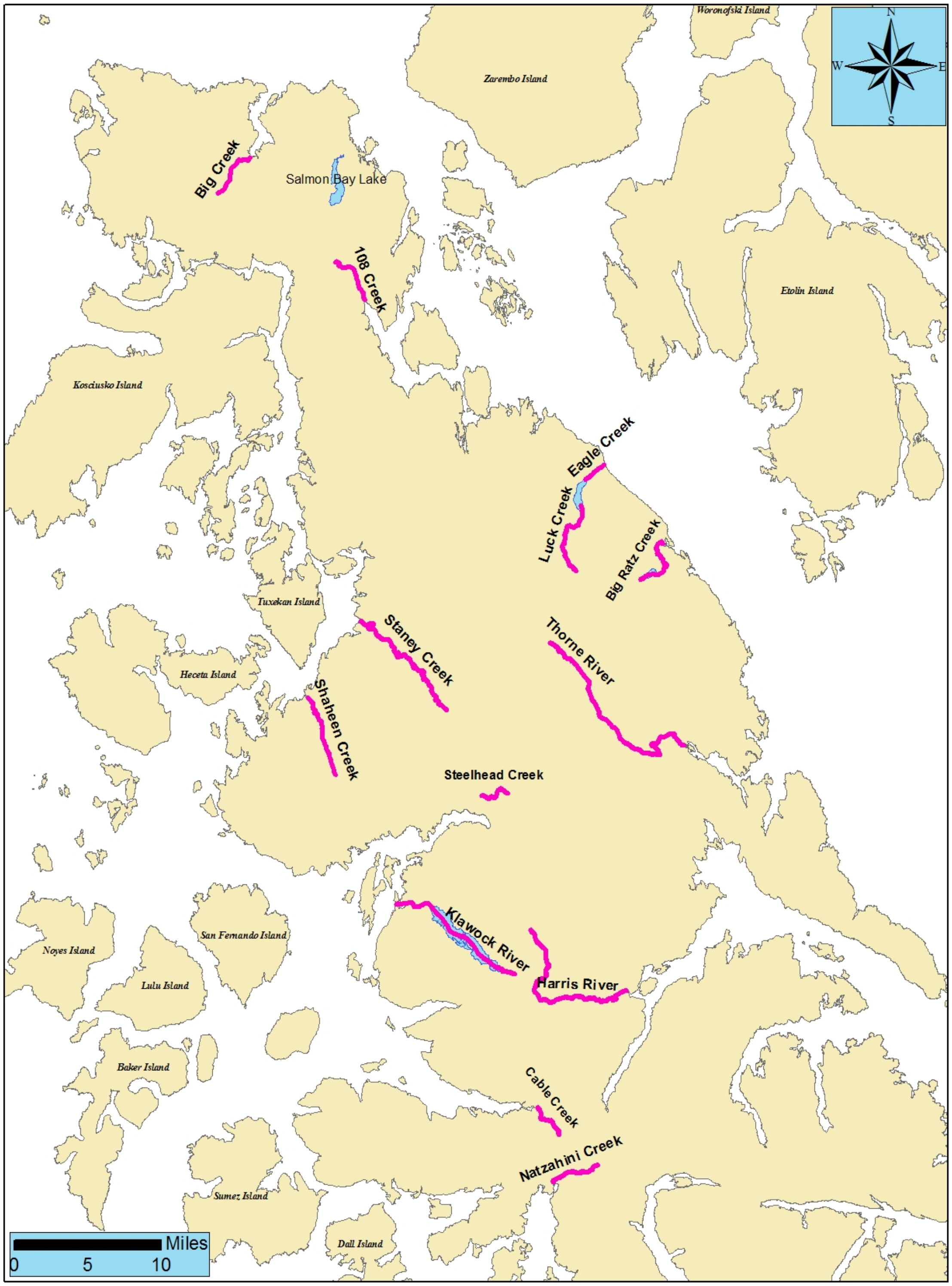

Figure 1.–Prince of Wales Island, Southeast Alaska: locations of "small" and "large" steelhead streams that support subsistence harvest. Each was nominated for inclusion in this study.

Table 1.–Steelhead peak index counts for selected streams on Prince of Wales Island (USFS 20021; USFS Craig Ranger District unpublished data).

Year sampled	Harris River	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					

Although not provided for in regulation at the time, subsistence harvest of steelhead by PWI residents was estimated from household surveys in 1997 and 1998 (ADF&G 2000)[1]. During these years, estimated harvest across all 12 PWI communities was 770 fish. Most of this harvest was taken with rod and reel, primarily by residents of Craig, Klawock, and Hydaburg. Analysis of these data suggests that a total annual harvest of about 600 steelhead occurred in freshwater fisheries on PWI (USFS 2002, *Unpublished*).[2]

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 25 fish annually in 2003–2005 (J. Reeves, USFS, *personal communication*). 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.

Table 2.–Steelhead snorkel surveys conducted in Eagle Creek and Harris River, 1997–2005. 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.).

	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)

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 assessment 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. Knowledge about the

1 ADF&G. *Unpublished* 2000 Division of Subsistence Community profile database (CPDB) microcomputer database, Internet: www.state.ak.us/adfg/subsist/geninfo/publctns/cpdb.htm. Alaska Department of Fish and Game, Division of Subsistence, Anchorage, AK.

2 USFS. 2002. 2002 Federal Subsistence Program fisheries proposals – Federal Subsistence Board book. Office of Subsistence Management, Anchorage, AK.

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 Harris River and Big Ratz Creek in 2005, the first year of a 3-year project.

The objectives of the 2005 study were to:

1) count all immigrant and emigrant steelhead in Harris River and Big Ratz 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; and
4) estimate system-specific expansion factors for converting snorkel survey counts to total escapement.

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

METHODS

SELECTION OF STREAMS FOR STUDY

Six freshwater streams will be 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 returned 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, therefore most remote systems will not be included for study.

Harris River and Big Ratz Creek were chosen to be studied during the first year of the project. Turek (2005) indicated that the local residents of PWI utilize Harris River and Big Ratz Creek for subsistence steelhead fishing. In addition, local PWI fish biologists and representatives of the PWI Native organizations also emphasized that these systems 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, Harris River and Big Ratz Creek were found to be ideal choices.

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
		*Natzuhini 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

The Harris River is a "large" system located on the southeastern side of Prince of Wales Island (Figure 2). It empties into Clarence Straight via Harris Bay. Harris River (ADF&G Anadromous Stream Catalog No. 102-60-10820) is about 12.5 miles long, has one main tributary (Fubar Creek)

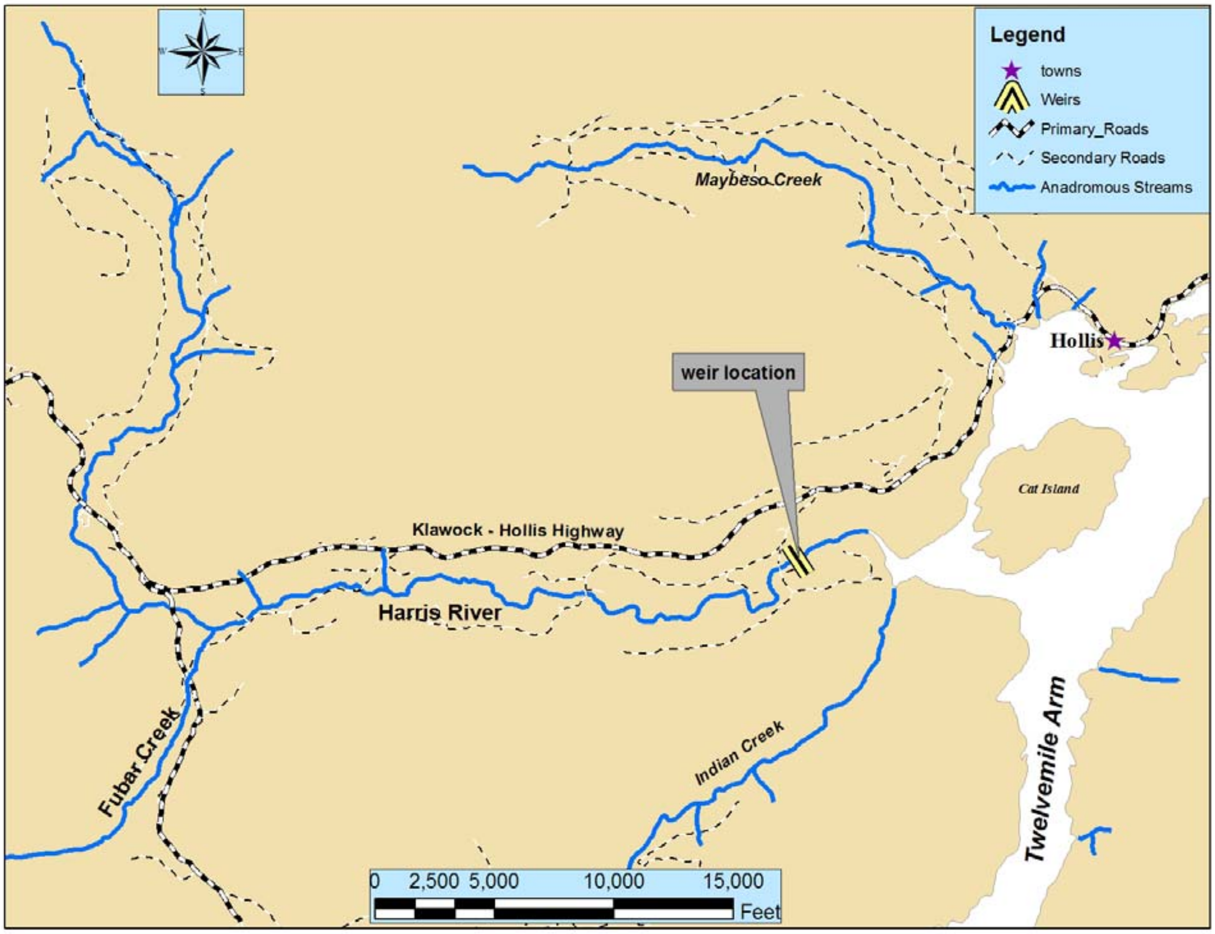

Figure 2.–Location of weir on Harris River, Prince of Wales Island.

and numerous small unnamed tributaries. Big Ratz Creek is a "small" system located on the eastern side of central Prince of Wales Island, which flows into Clarence Straight via Ratz Harbor (Figure 3). Big Ratz Creek (ADF&G Anadromous Stream Catalog No. 106-10-10100) is about 4.0 miles long and drains Trumpeter, Little and Big lakes. A USFS fish ladder is located immediately downstream from the Big Lake outlet.

WEIRS

Aluminum bipod weirs were installed in each stream approximately 400m 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 fish in each trap were processed whenever necessary to avoid crowding. 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. Scales samples were collected from all immigrating steelhead for age estimation. Each steelhead had 4

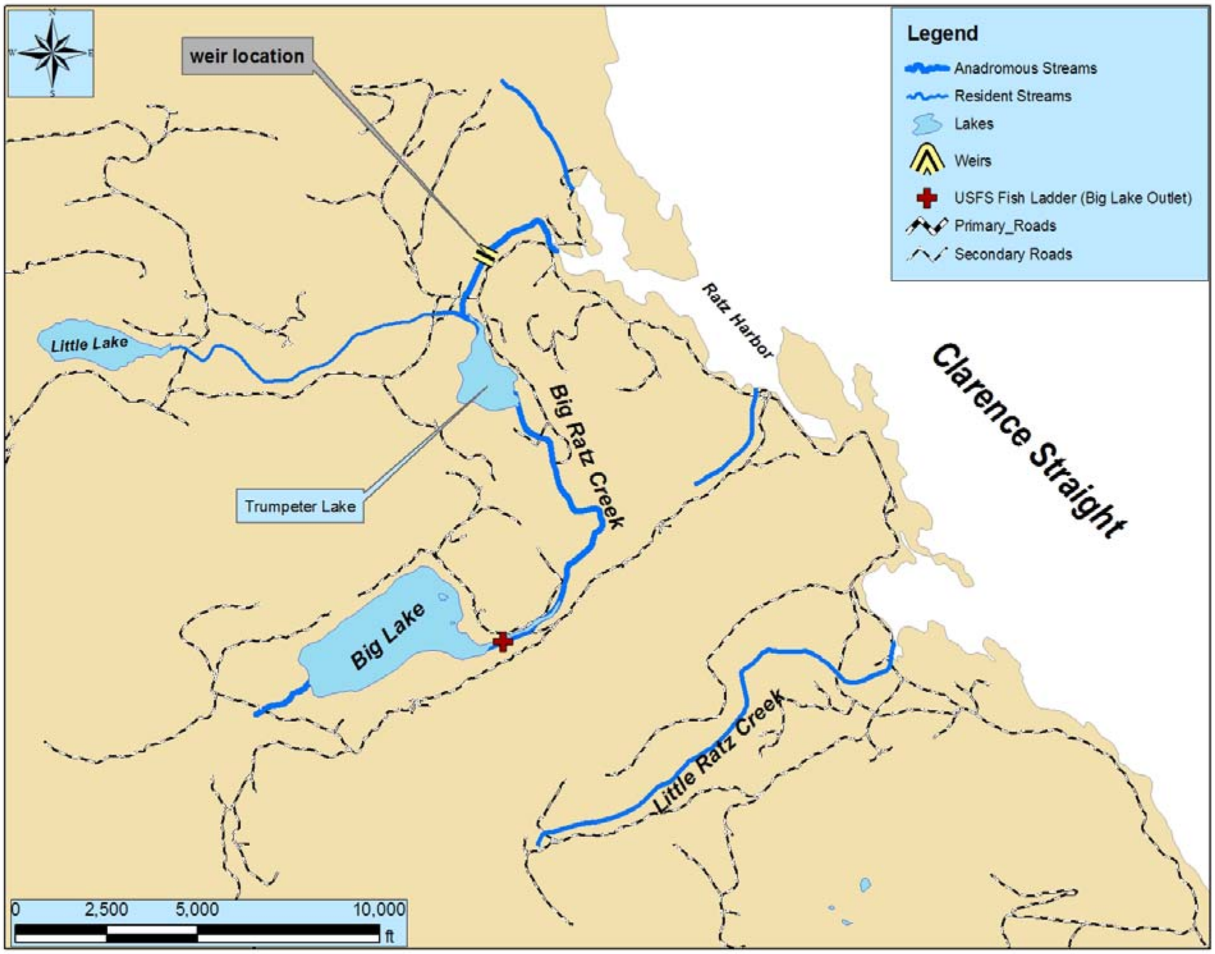

Figure 3.–Location of weir on Big Ratz Creek, Prince of Wales Island.

scales collected from the left side. 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 (Alword 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 determining length and sex, each fish was marked 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 (USF&WS) Genetics Laboratory in Anchorage. All emigrating adult steelhead kelts 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 two 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:

$$\hat{p}_a = \frac{n_a}{n} \quad (1)$$

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

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 presence of weirs to calibrate these counts allowed the calculation of escapement expansion factors (π) for each stream. 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 2005. Survey crews were not apprised of cumulative weir counts prior to sampling (to minimize potential observer bias). Ambient conditions were recorded (i.e., light conditions, water level, water clarity). In Harris River, each survey began at a location two pools above the Hydaburg bridge and continued downstream to the weir site, 400m above tidewater. In Big Ratz Creek, each survey began at the outflow of Trumpeter Lake and continued downstream to the weir site, 400m above tidewater.

RESULTS

HARRIS RIVER

Abundance at the Weir

A total of 170 immigrant adult steelhead, one of which died, were passed upstream through the Harris River weir from 17 March to 25 May. The day after the weir was fish-tight, a snorkel survey counted 5 steelhead that had likely arrived prior to weir installation. The first adult steelhead was caught in the weir trap on 19 March, and the last on 25 May, and the peak of run occurred on 15 April when 12 fish were passed (Figure 4, Appendix B1). Twenty-four post-spawned kelts, two of which were unmarked (and assumed to be

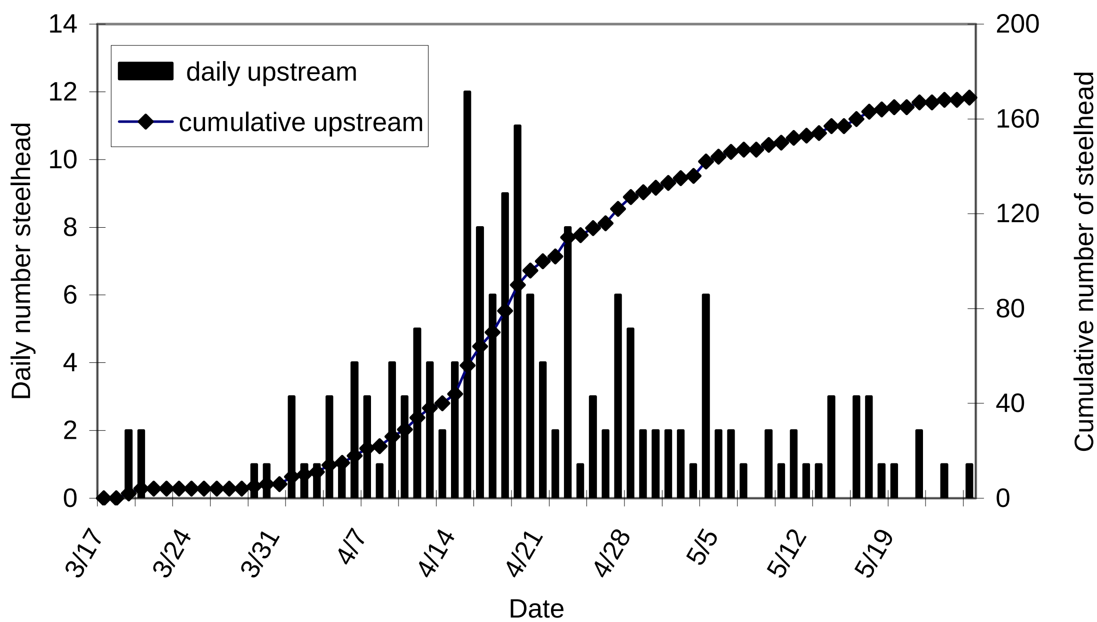

Figure 4.–Daily and cumulative counts of immigrant steelhead at Harris River, 2005.

from among the 5 fish seen above the weir after it was fish-tight), were passed downstream from 6 May through 22 May, and any remaining emigrating steelhead left the drainage after the weir was pulled (Figure 5, Appendix C1). The minimum spawning escapement in the Harris River was 172 steelhead ([170 immigrants–1 mortality] + [5 seen above the weir–2 unmarked emigrants]).

Water temperatures ranged from approximately –1°C on 19 March to 9°C during mid-May. Temperatures were between 2–4°C during the peak escapement in April (Figure 6, Appendix A1). Water levels taken at the weir gaging station varied from 92 cm during late March to 256 cm during the period of peak immigration (Figure 6, Appendix A1).

Age, Sex and Length

A total of 171 immigrating steelhead were measured, and 170 were sexed and sampled for scales prior to being released upstream to spawn in the Harris River.

The total length of all immigrant steelhead averaged 774 mm and had a SD = 89.0, and the range was 595 mm to 950 mm. The total length of females averaged 789 mm and had SD = 82.7, and the total length of males averaged 757 mm and had a SD = 93.7. Four fish, or 2.3%, of the total immigrant steelhead run met the minimum length requirements for sport fish retention (≥914 mm TL, or ≥36 in TL; Table 4). Although more of the fish in this population were females, proportionately more males (3 fish) were of legal size.

Of the 170 steelhead sampled for scales, 88 were successfully aged; the freshwater age could not be determined for 70 of the samples and 12 were not readable. Females made up the majority of the immigrants (59.1%, SE = 3.7), and ages 3.2 (56.8%, SE = 3.7) and 3.3 (23.9%, SE = 3.2) were the predominant age classes. (Table 5). Initial spawners composed 47% (SE = 1.1) of the Harris River spring immigrant run (Table 6).

Snorkel Surveys

During the operation of the Harris River weir, 10 snorkel surveys were conducted from 18 March to 25 May. Visibility conditions were normal to excellent throughout the entire season. On average, 68.8 % (SD = 18.0%) of the cumulative weir count was observed (Table 7). From these results a snorkel survey expansion factor of 1.61 was generated. Using this expansion factor, steelhead population estimates for the Harris River based on peak/high snorkel counts from 1997 to 2005 range from 85 to 322 and average 219 steelhead (Table 8).

Table 4.–Length composition of spring immigrant steelhead in Harris River, 2005.

Length *l*, mm TL	n_l	P_l
595–614	4	0.023
615–634	7	0.041
635–654	7	0.041
655–674	8	0.047
675–694	18	0.105
695–714	6	0.035
715–734	11	0.064
735–754	9	0.053
755–774	6	0.035
775–794	15	0.088
795–814	15	0.088
815–834	14	0.082
835–854	9	0.053
855–874	19	0.111
875–894	9	0.053
895–914	10	0.058
≥915	4	0.023
	n = 171	

BIG RATZ CREEK

Abundance at the Weir

A total of 375 adult immigrant steelhead, two of which died, were passed through the Big Ratz Creek weir from 11 March to 31 May. The day after the weir was fish-tight, a snorkel survey was conducted (under poor visibility conditions) and no steelhead were observed in the system above the weir. The first adult steelhead was caught on 15 March, the last on 31 May, and the peak of the run occurred on 26 April when 23 fish were passed upstream (Figure 7, Appendix B2). A total of 122 post-spawned kelts were passed downstream from 3 May through 31 May and any remaining emigrating steelhead left the drainage after the weir was pulled (Figure 8, Appendix C2). Thirty-four kelts were unmarked, however 8 immigrant steelhead were passed upstream without a mark. The minimum spawning

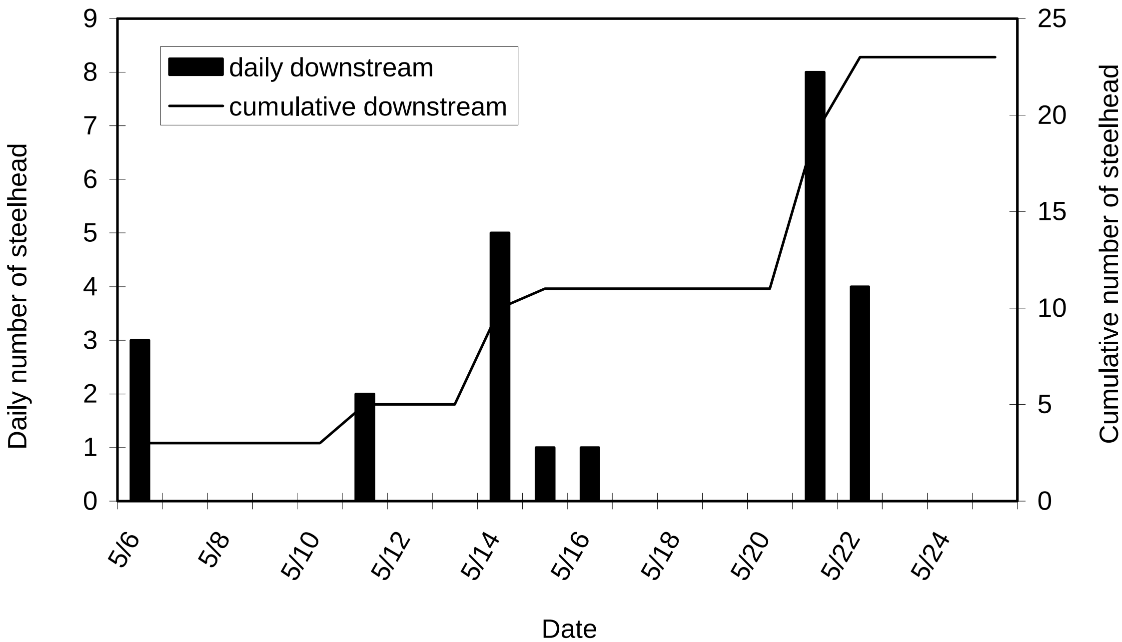

Figure 5.–Daily and cumulative counts of emigrant steelhead at Harris River, 2005.

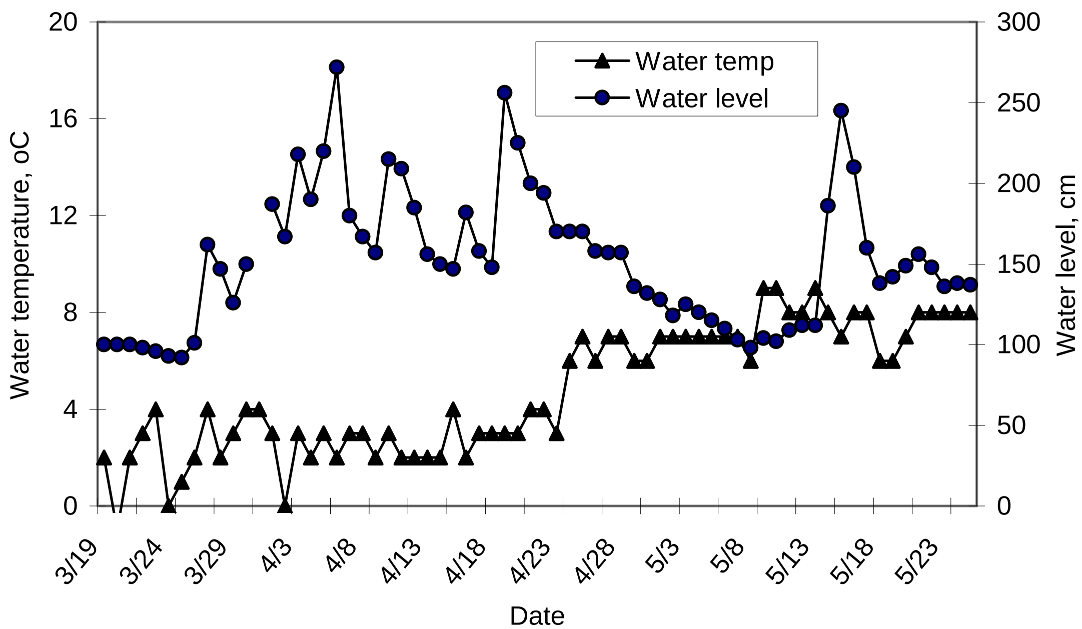

Figure 6.–Daily measurements of water level, and water temperature at Harris River, 2005.

escapement in Big Ratz Creek was 399 steelhead ([375 immigrants –2 mortalities] +34 unmarked emigrants –8 immigrants passed upstream without marks).

Water temperatures in Big Ratz Creek ranged from approximately 3°C on 21 March to 15°C on 7 May and were between 8 and 12°C during the peak upstream migration in late April (Figure 9,

Table 5.–Age and sex composition of spring immigrant steelhead at the weir in the Harris River, 2005.

		Brood year and age class						
		2001	2000	2000	1999	1999	1998	
		2.2	2.3	3.2	3.3	4.2	4.3	Total
Females	n_a	3	1	30	14	2	2	52
	$\hat{p}_a$, %	5.8	1.9	57.7	26.9	3.8	3.8	59.1
	SE, %	2.7	1.6	5.8	5.2	2.2	2.2	3.7
Males	n_a	5	2	20	7	2		36
	$\hat{p}_a$, %	13.9	5.6	55.6	19.4	5.6		40.9
	SE, %	5.2	3.4	7.5	5.9	3.4		3.7
Combined	n_a	8	3	50	21	4	2	88
	$\hat{p}_a$, %	9.1	3.4	56.8	23.9	4.5	2.3	
	SE, %	2.2	1.4	3.7	3.2	1.6	1.1	

Appendix A2). Water levels taken at the weir gaging station varied from 51 cm (during the period of peak steelhead escapement), to 30 cm on 11 May.

Age, Sex and Length

A total of 364 immigrating steelhead in Big Ratz Creek were sexed and sampled for scales prior to being released upstream to spawn; of these, 355 were measured.

The total length of immigrant steelhead averaged 751 mm (SE = 4.1) and ranged from 600 mm to 950 mm. The total length of females averaged 759 mm (SE = 4.9), and males averaged 737 mm (SE = 7.4). Six fish, or 1.7%, of the total run met the minimum length requirements for sport fish retention (≥914 mm TL, or ≥36 in TL; Table 9). An equal number of males and females were of legal size.

Of the 364 immigrants sampled for scales, 236 were successfully aged; the freshwater age could not be determined for 116 samples and 12 were not readable. Females made up the majority of the immigrants (63.6%, SE = 2.0), and ages 3.2 (31.4%, SE = 1.9) and 4.2 (36.4%, SE = 2.0) were the predominant age classes. (Table 10). Initial spawners composed 75% (SE = 0.8) of the Ratz Creek spring run (Table 11).

Snorkel Surveys

Ten snorkel surveys were conducted during operation of the Big Ratz Creek weir between 21 March and 31 May. An additional snorkel survey was conducted on 1 June after the weir was removed. At times, the snorkel crews experienced poor visibility conditions due to the tannic nature of this system and the number of deep holding pools. On average, 30.8% (SD = 13.8%; n = 10) of the cumulative weir count was observed (Table 12).

DISCUSSION

Results obtained from the first year of this study provide a number of key insights important for the management of steelhead on PWI.

The 2005 steelhead escapements into the Harris River and Ratz Creek were 172 and 399, respectively. Only a few immigrant steelhead (~5) in the Harris River were missed, as observed during our first snorkel survey, despite a relatively early weir installation (17 March). One significant flood event occurred on the Harris River early in the season (30 March), which scoured a 1.0 m x 1.3 m pit along the upstream base of the weir, creating a hole approximately 0.4 m x 1.0 m in size. Upon discovery by the crew, the hole was promptly filled with sandbags. We believe that no fish passed upstream unaccounted for during this time because water flows were very high and few steelhead were passed prior to and after this event.

The Ratz Creek weir was fish tight during the entire season (11 March–31 May). Some immigrant steelhead were not counted in 2005 despite the early installation of the weir. Because the number of unmarked emigrants (n = 34) exceeded the number of immigrants passed upstream without a mark (n = 8), it is assumed that some of the steelhead emigrants moved into

Table 6.–Age classes of spring immigrant steelhead in Harris River, 2005.

Age class	Number of steelhead	Number of females	Number of males	$\hat{p}_a$, %	SE, %
2.2	3	1	2	1.9	0.31
2.3	2	1	1	1.3	0.25
3.2	22	14	8	13.9	0.79
3.3	12	6	6	7.6	0.60
x.2[a]	22	8	14	13.9	0.79
x.3[a]	13	6	7	8.2	0.63
2.2s1	2	2	2	1.3	0.25
2.2s1s1	3	2	1	1.9	0.31
2.3s1	1	1	1	0.6	0.18
3.2s1	21	11	10	13.3	0.77
3.2s1s1	4	3	1	2.5	0.36
3.2s1s1s1	3	2	1	1.9	0.31
3.3s1	6	5	1	3.8	0.44
3.3s1s1	3	3	0	1.9	0.31
4.2s1	3	1	2	1.9	0.31
4.2s1s1	1	1	1	0.6	0.18
4.3s1	1	1	1	0.6	0.18
4.3s1s1	1	1	1	0.6	0.18
x.2s1[a]	17	8	9	10.8	0.71
x.2s1s1[a]	7	3	4	4.4	0.47
x.2s1s1s1[a]	1	0	1	0.6	0.18
x.3s1[a]	5	5	0	3.2	0.40
x.3s1s1[a]	5	5	0	3.2	0.40
Initial spawners	74	36	38	46.8	1.1
Repeat spawners	84	54	36	53.2	1.1
Total	158	90	74	100	

[a] x = freshwater age undetermined.

the system prior to weir installation, either as spring or fall immigrants. Although we did not study fall immigration during this project, it is likely that Ratz Creek supports a fall-run of steelhead given that there are two lakes on the system that could serve as overwintering habitat.

In 2005, 1.7% of the steelhead in Ratz Creek and 2.3% in the Harris River met minimum length requirements for sport fish retention (≥914 mm TL, or ≥36 in TL). Less than 1% of the steelhead run in the Karta were documented as 36 inches or greater in 1989 and 1992, and no fish over 36 inches were encountered during creel surveys conducted at the Karta in 1989 and 1991 (Freeman and Hoffman 1989; Harding and Jones 1993; Hoffman et al. 1990). Similarly, no fish greater than 36 inches were encountered at the 12-Mile weir in 2004 (Hoffman 2007). It has been estimated that less than 5% of adult steelhead in Southeast Alaska are greater than 36 inches in total length. The current sport fish regulations, established in 1994, protect 95% of adult steelhead returning to systems in southeast Alaska (Harding et al. 2006).

Steelhead returning to the Harris River were dominated by fish that spent three years in freshwater, while steelhead returning to Ratz Creek were dominated by fish that spent three to four years in freshwater before smolting. In both systems steelhead spent two to three years in saltwater prior to returning to spawn as adults. 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). Similar age patterns have been documented in the Thorne River (Freeman and Hoffman 1989) and in Ward Creek (Hubartt 1989).

The importance of using weirs to enumerate steelhead returns on PWI is highlighted by the results obtained from both the Harris River and Big Ratz Creek. Initially, these two streams were categorized by managers as "large" (total annual $N > 150$ adult fish) and "small" (total annual $N < 150$ fish) systems. The Harris River was thought to support an adult steelhead population of 400 fish or greater, while the steelhead population at Big Ratz Creek was estimated as 100 or less. The minimum escapement numbers obtained for Big Ratz Creek (N = 399) greatly exceeded the original estimate, suggesting that it should be reclassified as a "large" system. The actual counts obtained for the Harris River (N = 172) did not change the management classification for this system, however the escapement was substantially lower than anticipated. While weir data collected in 2005 led to changes in management classification, a weir count of 87 fish on 12-Mile Creek in 2004 confirmed its original classification as a "small system" (Hoffman 2007).

This project also provided the opportunity to further examine 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

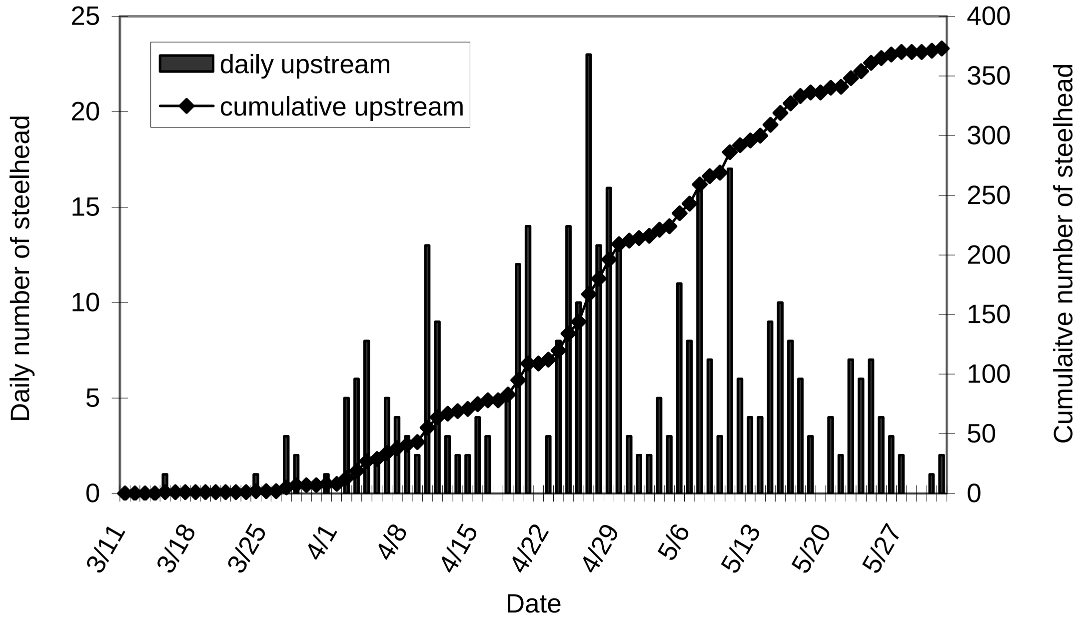

Figure 7.–Daily and cumulative counts of immigrant steelhead at Big Ratz Creek, 2005.

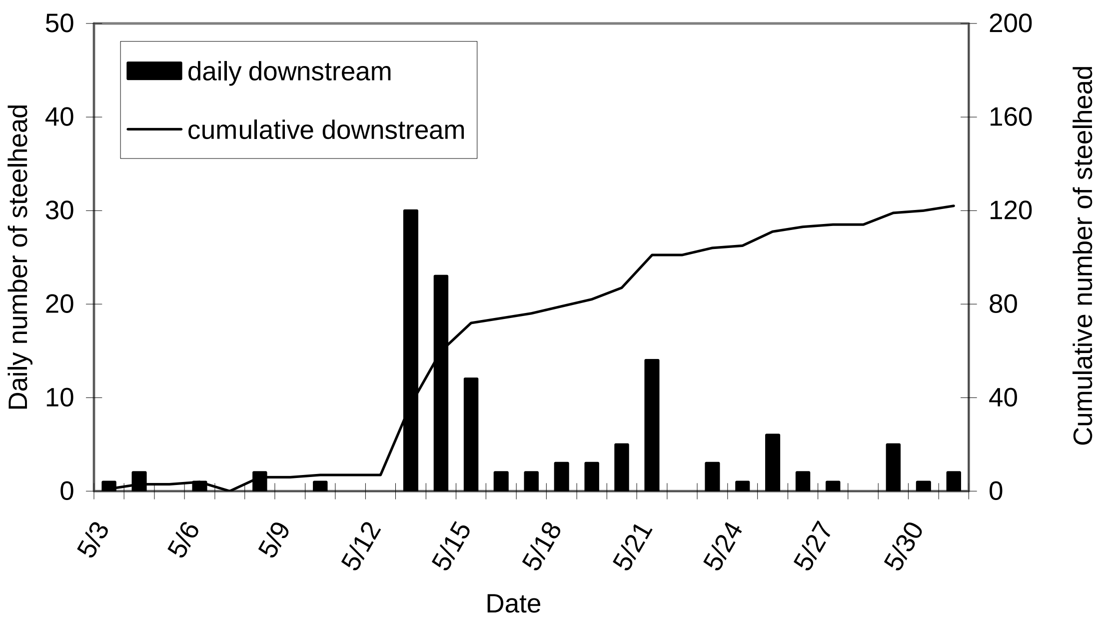

Figure 8.–Daily and cumulative counts of emigrant steelhead at Big Ratz Creek, 2005.

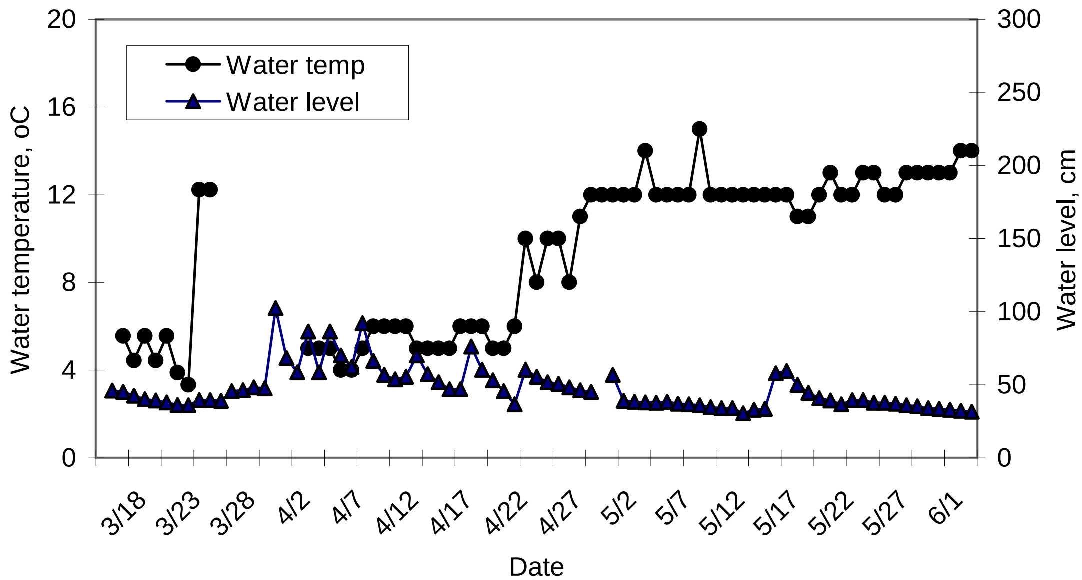

Figure 9.–Daily measurements of water level, and water temperature at Big Ratz Creek, 2005.

Table 7.–Weekly snorkel surveys of adult steelhead, percentage of steelhead observed based on cumulative weir counts, and visibility conditions in the Harris River (18 March–25 May, 2005).

Date	Survey no.	No. observed during snorkel	Cumulative upstream weir count	Downstream weir count	Percent of weir count observed[a]	Visibility conditions
3/18/2005	1	5	0	0		normal
3/25/2005	2	6	4	0	66.7%	excellent
4/8/2005	3	20	22	0	74.1%	normal
4/14/2005	4	32	44	0	65.3%	normal
4/22/2005	5	85	102	0	79.4%	normal-below normal
4/29/2005	6	118	129	0	88.1%	excellent
5/5/2005	7	122	144	0	81.9%	excellent
5/13/2005	8	123	154	5	79.9%	excellent
5/19/2005	9	87	165	11	54.7%	poor
5/25/2005	10	44	169	23	29.1%	normal
				Average % observed	68.8%	
				SD	18.0%	

[a] Five fish were observed during the first snorkel survey on 3/18, prior to any fish passage through the weir. These five fish have been factored into the percent of the weir count observed.

steelhead populations. 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 average percent of the weir count observed during snorkel surveys varied substantially between the two streams studied in 2005. In Big Ratz Creek, observers were only able to observe an average of 31% of the adult fish that had migrated upstream of the weir, whereas in the Harris River, observers were able to account for an average of 69%.

Several factors may have contributed to these differences. Big Ratz Creek is a tannic-stained system in which underwater visibility is limited to

Table 8.–Harris River steelhead population estimates based on snorkel survey expansion factor of 1.61.

Year completed	Peak/high count of steelhead	Expanded steelhead population estimate
1997	104(H)	167
1998	156(P)	251
1999	192(H)	309
2000	79(P)	127
2001	53(H)	85
2002	200(H)	322
2003	195(H)	314
2004	124(P)	200
2005	122(P)	196
	Mean	219

Table 9.–Length composition of spring immigrant steelhead in Ratz Creek, 2005.

Length *l*, mm TL	n_l	$\hat{p}_l$	SE [$\hat{p}_l$]
595–614	7	0.020	0.002
615–634	13	0.037	0.003
635–654	17	0.048	0.004
655–674	29	0.082	0.005
675–694	32	0.090	0.005
695–714	27	0.076	0.005
715–734	42	0.118	0.006
735–754	30	0.085	0.005
755–774	16	0.045	0.004
775–794	22	0.062	0.004
795–814	37	0.104	0.005
815–834	18	0.051	0.004
835–854	27	0.076	0.005
855–874	23	0.065	0.004
875–894	6	0.017	0.002
895–914	3	0.008	0.002
≥915	6	0.017	0.002
	$n = 355$		

an average of 2 m or less. Ratz Creek has a number of deep, dark pools (up to 4.5 m deep) with moderate to high levels of turbidity that further obstruct visibility. When steelhead stacked up in these pools, observers, on most occasions, were only able to accurately count steelhead milling closer to the surface. Counting under these conditions was challenging and required a number of snorkel passes to ensure that the majority of fish were counted and that each fish was counted only once. Resulting counts were usually averaged and likely under-represented the actual number of fish present. In addition, the Ratz Creek system contains 2 upstream lakes that serve as holding areas for steelhead prior to spawning. Counting of adult steelhead in the lakes was restricted by water depth so they were not included in the survey area. A combination of these factors likely contributed to less accurate snorkel counts on this system. Based on the inaccuracy of snorkel counts at Ratz Creek, and the likelihood of a fall run of unknown size, we are unable to generate a snorkel survey expansion for this system with confidence.

In contrast, the Harris River is extremely clear, and (due to previous logging activities), has little habitat complexity in the form of large wood debris (and no lakes). Observers were thus able to effectively view the entire aquatic habitat and conduct visual counts with greater efficiency and accuracy. The final snorkel survey on Harris River revealed a surprisingly small number of steelhead (44 or 29.1% of the weir count) when 146 had been passed through the weir. We cannot explain why so few were seen, though Harris River steelhead are readily visible and at times concentrated in a few main holes, making them more vulnerable to harvest and predation. It is possible some steelhead succumbed to natural mortality or were harvested by subsistence or sport anglers, however there were no steelhead harvest reported on subsistence permits for the Harris River in 2005 (Jeff Reeves, USFS, *personal communication*).

Substantial variability exists between the snorkel results obtained at the three systems studied to date (68.8% in Harris River, 30.8% in Ratz Creek, and 79.0% in 12-Mile Creek [see Hoffman 2007]). 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 derived from this year's study and that of the pilot study on 12 Mile Creek in 2004 indicate that snorkel survey calibrations (generated from weir counts) are site-specific and cannot be compared across systems. Each system is unique in its habitat complexity, clarity, and presence of lakes. We have found that these variables limit the scope in which snorkel survey calibrations can be applied.

It is possible that snorkel surveys are not a good indicator of abundance. Other methods that may

Table 10.–Age and sex composition of spring immigrant sampled at the weir in Ratz Creek, 2005.

		Brood year and age class						
		2000	1999	1999	1998	1998	1997	
		3.2	3.3	4.2	4.3	5.2	5.3	Total
Females	n_a	44	20	56	27	3		150
	$\hat{p}_a$, %	29.3	13.3	37.3	18.0	2.0		63.6
	SE, %	2.9	2.2	3.1	2.5	0.9		2.0
Males	n_a	30	9	30	14	2	1	86
	$\hat{p}_a$, %	34.9	10.5	34.9	16.3	2.3	1.2	36.4
	SE, %	4.6	2.9	4.6	3.5	1.4	1.0	2.0
Combined	n_a	74	29	86	41	5	1	236
	$\hat{p}_a$, %	31.4	12.3	36.4	17.4	2.1	0.4	
	SE, %	1.9	1.4	2.0	1.6	0.6	0.3	

Table 11.–Age classes of spring immigrant steelhead in Ratz Creek, 2005.

Age class	Number of steelhead	Number of females	Number of males	$\hat{p}_a$,%	SE, %
3.2	58	34	24	16.5	0.7
3.3	21	14	7	6.0	0.4
4.2	54	34	20	15.3	0.7
4.3	37	24	13	10.5	0.6
5.2	4	3	1	1.1	0.2
5.3	1	0	1	0.3	0.1
x.2[a]	48	27	21	13.6	0.6
x.3[a]	40	29	11	11.4	0.6
3.2s1	11	5	6	3.1	0.3
3.2s1s1	5	5	0	1.4	0.2
3.3s1	7	6	1	2.0	0.3
3.3s1s1	1	0	1	0.3	0.1
4.2s1	24	15	9	6.8	0.5
4.2s1s1	7	6	1	2.0	0.3
4.2s1s1s1	1	1	0	0.3	0.1
4.3s1	4	3	1	1.1	0.2
5.2s1	1	0	1	0.3	0.1
x.2s1[a]	20	11	9	5.7	0.4
x.2s1s1[a]	1	1	0	0.3	0.1
x.3s1[a]	6	6	0	1.7	0.2
x.3s1s1[a]	1	1	0	0.3	0.1
Initial spawners	263	165	98	74.7	0.8
Repeat spawners	89	60	29	25.3	0.8
Total	352	225	127	100.0	

[a] x = freshwater age undetermined.

warrant further exploration include the use of video counters, resistivity weirs, and radiotelemetry. The USFS Craig Ranger District has employed a resistivity weir on Harris River concurrently with our weir as a means of comparison and also at 12-Mile Creek in 2006. Though results from either project are not available at this time, a few hurdles need to be overcome before this approach is adopted for widespread use. Challenges encountered include: difficulties maintaining a power source during operation, and limitations on stream gradient and substrate. Resistivity weirs can be operated at a lower cost, with less environmental impact, and minimal disturbance to fish migration in comparison to standard bipod weirs. Multiple-year studies may also be considered in the future to determine how much interannual variation exists within a system and to obtain broader scope of knowledge about a particular steelhead stock.

Table 12.–Weekly snorkel surveys of adult steelhead, percentage of steelhead observed based on cumulative weir counts and visibility conditions in Big Ratz Creek (21 March–1 June, 2005).

Date	Survey no.	No. observed during snorkel	Cumulative upstream weir count	Downstream weir count	Percent of weir count observed	Visibility conditions
3/21/2005	1	0	0	0		poor
4/1/2005	2	0	8	0	0.0%	poor
4/7/2005	3	13	36	0	36.1%	poor
4/12/2005	4	24	67	0	35.8%	normal
4/22/2005	5	19	112	0	17.0%	normal
4/26/2005	6	50	167	0	29.9%	normal
5/2/2005	7	85	216	0	39.4%	normal
5/10/2005	8	140	286	7	50.2%	normal
5/17/2005	9	99	333	76	38.5%	normal
5/24/2005	10	77	361	105	30.1%	normal
6/1/2005	11	78	373	122	31.1%	normal
				Average % observed[a]	30.8%	
				SD	13.8%	

[a] The June 1, 2007 snorkel survey was not used to calculate the overall average % observed. This survey was conducted after the weir was removed.

The results obtained during 2005 suggest that Federal staff may need to consider changes to the management of some PWI streams for the subsistence harvest of steelhead. Previously, managers were directing the harvest efforts of subsistence users to “large” systems that included the Harris River. If the current guideline allowing for a 10% harvest rate is applied to the previous Harris River estimate of 400+ adult steelhead, the allowable harvest is 40 fish. This amount would have been equivalent to nearly a third (23.0%) of the total return (172 fish) enumerated by our weir. However, application of the 10% harvest guideline using the actual weir count would result in a maximum harvest that is considerably lower (17 steelhead). Thus, conservation concerns could arise if the allowable harvest levels were based on historical estimates of steelhead abundance instead of current weir counts.

During 2006 and 2007, 4 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 when other enumeration methods are unavailable. 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

STREAM GAGE AND TEMPERATURE DATA

Appendix A1.—Harris River water temperature and level, 2005.

Date	Time	Water temperature (°C)	Water level (cm)	Comments: weather, debris, etc.
19-Mar	8:00	2	100	clear, cold , windy
20-Mar	7:30	-1	100	clear cold, ice on river
21-Mar	7:45	2	100	light snow, cloudy
22-Mar	8:00	3	98	clear
23-Mar	8:00	4	96	clear
24-Mar	7:49	0	93	clear cold, ice on river
25-Mar	7:20	1	92	cloudy light rain last night
26-Mar	7:45	2	101	rained overnight, cloudy
27-Mar	7:53	4	162	rain all night, still raining
28-Mar	8:00	2	147	lots of debris, high turbidity
29-Mar	6:45	3	126	scattered showers
30-Mar	6:30	4	150	rain
31-Mar	8:00	4	n/a	High water above gage
1-Apr	7:45	3	187	water levels dropped, low visibility, snowing
2-Apr	8:00	0	167	lots of snow mixed with rain, water levels rising
3-Apr	7:30	3	218	high water last night, dropped
4-Apr	7:55	2	190	high water going down
5-Apr	8:00	3	220	continuous rain and very windy
6-Apr	8:00	2	272	snow, light showers
7-Apr	8:00	3	180	partly cloudy, rain subsided, water dropping
8-Apr	7:35	3	167	sunny, water less turbid
9-Apr	7:45	2	157	light rain in a.m., some debris
10-Apr	8:00	3	215	lots of rain last night, turbid water
11-Apr	8:00	2	209	lots of rain last night, turbid water
12-Apr	7:25	2	185	no rain, partly cloudy
13-Apr	7:48	2	156	no rain, clear, stars last night
14-Apr	8:00	2	150	foggy, light rain yesterday afternoon
15-Apr	7:00	4	147	lots of rain last night, turbid water
16-Apr	8:20	2	182	no rain last evening or this morning
17-Apr	7:48	3	158	clear sunny morning and afternoon
18-Apr	8:00	3	148	rain
19-Apr	8:00	3	256	rain, high water over gage in afternoon
20-Apr	8:00	3	225	light rain, water dropping, poor visibility
21-Apr	8:10	4	200	no rain, still dropping
22-Apr	7:45	4	194	sunny
23-Apr	8:05	3	170	sunny
24-Apr	8:00	6	170	sunny
25-Apr	7:15	7	170	sunny
26-Apr	6:00	6	158	sunny
27-Apr	8:05	7	157	sunny
28-Apr	7:56	7	157	sunny
29-Apr	8:00	6	136	sunny
30-Apr	7:45	6	132	overcast
1-May	8:10	7	128	cloudy light rain
2-May	6:30	7	118	showers
3-May	7:00	7	125	cloudy
4-May	8:10	7	120	sunny
5-May	8:00	7	115	sunny
6-May	8:05	7	110	sunny
7-May	8:30	7	103	sunny

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Appendix A1.–Page 2 of 2.

Date	Time	Water temperature (°C)	Water level (cm)	Comments: weather, debris, etc.
8-May	7:30	6	98	sunny
9-May	7:00	9	104	sunny
10-May	6:30	9	102	sunny
11-May	8:00	8	109	overcast, light rain
12-May	7:48	8	112	light rain
13-May	8:00	9	112	light rain
14-May	7:30	8	186	heavy rain
15-May	8:00	7	245	rain
16-May	8:00	8	210	overcast
17-May	7:00	8	160	overcast
18-May	6:40	6	138	sunny
19-May	8:00	6	142	overcast
20-May	7:37	7	149	rain
21-May	7:49	8	156	rain
22-May	6:45	8	148	light rain, cloudy
23-May	6:30	8	136	light rain, cloudy
24-May	7:00	8	138	cloudy
25-May	8:00	8	137	sunny

Appendix A2.–Ratz Creek water temperatures and levels, 2005.

Date	Time	Water temperature (°C)	Water level (cm)	Comments: weather, debris, etc.
14-Mar	14:30	n/a	46	n/a
15-Mar	8:00	6	45	sunny, partly cloudy
16-Mar	9:00	4	43	sunny, partly cloudy
17-Mar	9:00	6	40	sunny, clear
18-Mar	9:00	4	39	sunny, clear
19-Mar	9:00	6	38	sunny, clear
20-Mar	9:00	4	36	sunny, partly cloudy
21-Mar	9:00	3	36	overcast, snowing
22-Mar	9:00	12	40	overcast, calm, mixed rain and snow
23-Mar	9:00	12	40	sunny, clear
24-Mar	9:00	n/a	39	sunny, clear
25-Mar	9:00	n/a	46	overcast, calm
26-Mar	9:00	n/a	46	rain
27-Mar	9:00	n/a	48	rain
28-Mar	9:00	n/a	48	rain
29-Mar	7:30	n/a	102	rain
30-Mar	9:00	n/a	68	rain overnight, overcast day
31-Mar	8:00	n/a	59	high wind overnight, rain
1-Apr	9:00	5	87	overcast, calm
2-Apr	9:00	5	59	n/a
3-Apr	9:00	5	87	all night rain, rain
4-Apr	9:00	4	70	n/a
5-Apr	9:00	4	62	rainy
6-Apr	9:00	5	92	sunny, clear
7-Apr	9:00	6	66	sunny, clear
8-Apr	9:00	6	57	sunny, clear
9-Apr	9:00	6	54	overcast
10-Apr	9:00	6	55	overcast
11-Apr	9:00	5	70	sunny, showers
12-Apr	9:00	5	57	sunny, showers
13-Apr	9:00	5	52	sunny
14-Apr	9:00	5	47	sunny
15-Apr	9:00	6	47	rain
16-Apr	9:00	6	76	cloudy
17-Apr	9:00	6	60	clear
18-Apr	9:00	5	53	overcast
19-Apr	9:00	5	46	rain
20-Apr	9:00	6	37	rain
21-Apr	9:00	10	60	rain
22-Apr	9:00	8	55	clear
23-Apr	9:00	10	52	sunny
24-Apr	9:00	10	51	sunny
25-Apr	9:00	8	48	overcast
26-Apr	9:00	11	46	a.m. fog
27-Apr	9:00	12	45	sunny
28-Apr	9:00	12	n/a	n/a
29-Apr	9:00	12	57	sunny
30-Apr	9:00	12	39	overcast

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Appendix A2.–Page 2 of 2.

Date	Time	Water temperature (°C)	Water level (cm)	Comments: weather, debris, etc.
1-May	9:00	12	38	overcast
2-May	9:00	14	38	overcast
3-May	9:00	12	38	overcast
4-May	9:00	12	38	overcast
5-May	9:00	12	37	sunny, clear
6-May	9:00	12	37	sunny, clear
7-May	9:00	15	36	sunny
8-May	9:00	12	35	sunny
9-May	9:00	12	34	sunny
10-May	9:00	12	34	sunny
11-May	9:00	12	30	overcast
12-May	9:00	12	33	overcast
13-May	9:00	12	34	rain
14-May	9:00	12	58	rain, wind
15-May	9:00	12	59	rain
16-May	9:00	11	50	rain
17-May	9:00	11	45	clear, sunny
18-May	9:00	12	41	sunny
19-May	9:00	13	39	sunny
20-May	9:00	12	37	overcast
21-May	9:00	12	40	overcast
22-May	9:00	13	40	cloudy
23-May	9:00	13	38	cloudy
24-May	9:00	12	38	clear
25-May	9:00	12	37	clear
26-May	9:00	13	36	clear
27-May	9:00	13	35	clear
28-May	9:00	13	34	clear
29-May	9:00	13	34	rain
30-May	9:00	13	33	sunny, clear
31-May	9:00	14	32	sunny, clear

APPENDIX B

DAILY AND CUMULATIVE WEIR COUNTS FOR IMMIGRATING STEELHEAD

Appendix B1.–Daily and cumulative weir counts for immigration steelhead at Harris River, 2005.

Date	No. of steelhead daily	Cumulative	Morts	Comments
17-Mar	0	0		
18-Mar	0	0		
19-Mar	2	2		
20-Mar	2	4		
21-Mar	0	4		
22-Mar	0	4		
23-Mar	0	4		
24-Mar	0	4		
25-Mar	0	4		
26-Mar	0	4		
27-Mar	0	4		
28-Mar	0	4		
29-Mar	1	5		
30-Mar	1	6		flood scoured hole in weir
31-Mar	0	6		weir fish tight
1-Apr	3	9		
2-Apr	1	10		
3-Apr	1	11		
4-Apr	3	14		
5-Apr	1	15		
6-Apr	4	18	1	
7-Apr	3	21		
8-Apr	1	22		
9-Apr	4	26		
10-Apr	3	29		
11-Apr	5	34		
12-Apr	4	38		
13-Apr	2	40		
14-Apr	4	44		
15-Apr	12	56		
16-Apr	8	64		
17-Apr	6	70		
18-Apr	9	79		
19-Apr	11	90		
20-Apr	6	96		
21-Apr	4	100		
22-Apr	2	102		
23-Apr	8	110		
24-Apr	1	111		
25-Apr	3	114		
26-Apr	2	116		
27-Apr	6	122		
28-Apr	5	127		
29-Apr	2	129		
30-Apr	2	131		

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Appendix B1.–Page 2 of 2.

Date	No. of steelhead daily	Cumulative	Morts	Comments
1-May	2	133		
2-May	2	135		
3-May	1	136		
4-May	6	142		
5-May	2	144		
6-May	2	146		
7-May	1	147		
8-May	0	147		
9-May	2	149		
10-May	1	150		
11-May	2	152		
12-May	1	153		
13-May	1	154		
14-May	3	157		
15-May	0	157		
16-May	3	160		
17-May	3	163		
18-May	1	164		
19-May	1	165		
20-May	0	165		
21-May	2	167		
22-May	0	167		
23-May	1	168		
24-May	0	168		
25-May	1	169		
Totals		169	1	

Appendix B2.–Daily and cumulative weir counts for immigrating steelhead at Ratz Creek, 2005.

Date	No. of steelhead daily	Cumulative	Morts
11-Mar	0	0	
12-Mar	0	0	
13-Mar	0	0	
14-Mar	0	0	
15-Mar	1	1	
16-Mar	0	1	
17-Mar	0	1	
18-Mar	0	1	
19-Mar	0	1	
20-Mar	0	1	
21-Mar	0	1	
22-Mar	0	1	
23-Mar	0	1	
24-Mar	1	2	
25-Mar	0	2	
26-Mar	0	2	
27-Mar	3	5	
28-Mar	2	7	
29-Mar	0	7	
30-Mar	0	7	
31-Mar	1	8	
1-Apr	0	8	
2-Apr	5	13	
3-Apr	6	19	
4-Apr	8	27	
5-Apr	2	29	
6-Apr	5	34	
7-Apr	4	38	
8-Apr	3	41	
9-Apr	2	43	
10-Apr	13	56	
11-Apr	9	64	1
12-Apr	3	67	
13-Apr	2	69	
14-Apr	2	71	
15-Apr	4	75	
16-Apr	3	78	
17-Apr	0	78	
18-Apr	5	83	
19-Apr	12	95	
20-Apr	14	109	
21-Apr	0	109	
22-Apr	3	112	
23-Apr	8	120	
24-Apr	14	134	
25-Apr	10	144	
26-Apr	23	167	
27-Apr	13	180	
28-Apr	16	196	
29-Apr	13	209	
30-Apr	3	212	

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Appendix B2.–Page 2 of 2.

Date	No. of steelhead daily	Cumulative	Morts
1-May	2	214	
2-May	2	216	
3-May	5	221	
4-May	3	224	
5-May	11	235	
6-May	8	243	
7-May	16	259	
8-May	7	266	
9-May	3	269	
10-May	17	286	
11-May	6	292	
12-May	4	296	
13-May	4	300	
14-May	9	309	
15-May	10	319	
16-May	8	327	
17-May	6	333	
18-May	3	336	
19-May	0	336	
20-May	4	340	
21-May	2	341	1
22-May	7	348	
23-May	6	354	
24-May	7	361	
25-May	4	365	
26-May	3	368	
27-May	2	370	
28-May	0	370	
29-May	0	370	
30-May	1	371	
31-May	2	373	
Totals		373	2

APPENDIX C

DAILY AND CUMULATIVE WEIR COUNTS FOR EMIGRATING STEELHEAD

Appendix C1.–Daily and cumulative weir counts for emigrating steelhead at Harris River, 2005.

Date	No of steelhead daily	Cumulative	Morts	Marked	No Mark	Comments
5/6/05	3	3		3		
5/7/05	0	3				
5/8/05	0	3				
5/9/05	0	3				
5/10/05	0	3				
5/11/05	2	5		1	1	unmarked fish was sampled
5/12/05	0	5				
5/13/05	0	5				
5/14/05	5	10		5		
5/15/05	1	11	1	1		mortality, half eaten
5/16/05	1	12		1		
5/17/05	0	12				
5/18/05	0	12				
5/19/05	0	12				
5/20/05	0	12				
5/21/05	8	20		7	1	unmarked not sampled, visibly unhealthy
5/22/05	4	24		4		
5/23/05	0	24				
5/24/05	0	24				
5/25/05	0	24				
Totals		24	1	22	2	

Appendix C2.–Daily and cumulative weir counts for emigrating steelhead at Ratz Creek, 2005.

Date	No of steelhead daily	Cumulative	Morts	Marked	No mark	Comments
5/3/05	1	1			1	unsure if clipped, poor shape, not sampled
5/4/05	2	3			2	
5/5/05	0	3				
5/6/05	1	4			1	
5/7/05	0	0				
5/8/05	2	6			2	
5/9/05	0	6				
5/10/05	1	7			1	
5/11/05	0	7				
5/12/05	0	7				
5/13/05	30	37		23	7	
5/14/05	23	60		17	6	
5/15/05	12	72		10	2	
5/16/05	2	74		2		
5/17/05	2	76		1	1	
5/18/05	3	79		3		
5/19/05	3	82		3		
5/20/05	5	87		4	1	
5/21/05	14	101		8	6	
5/22/05	0	101				
5/23/05	3	104		3		
5/24/05	1	105			1	
5/25/05	6	111		5	1	unsure if clipped, sampled
5/26/05	2	113		2		
5/27/05	1	114			1	
5/28/05	0	114				
5/29/05	5	119		5		
5/30/05	1	120		1		
5/31/05	2	122		1	1	
Totals		122	0	88	34	

APPENDIX D

COMPUTER FILES

Appendix D1.–Computer files used containing data, statistics, and interim calculations used to assess steelhead stocks in the Harris River and Big Ratz Creek, 2005.

Computer file	Description
Harris River steelhead_05	Excel file containing physical data, weir counts, snorkel survey counts, sex-length estimates, charts and appendices.
Ratz Creek steelhead_05	Excel file containing physical data, weir counts, snorkel survey counts, sex-length estimates, charts and appendices.