

Results of the Upper Sustut River Steelhead Fence 2005

Dean Peard¹



British Columbia
Ministry of Environment
Fisheries Branch
Skeena Region
PO Box 5000
Smithers, B.C.
V0J 2N0

Skeena Fisheries Report SK 147

November, 2005

¹ Ministry of Environment - Fish, Wildlife, Science and Allocation Branch - Skeena Region

Abstract

A floating PVC fish fence was installed into the upper Sustut River on July 28, 2005 and removed on October 2, 2005. The fish fence has been used in conjunction with a trap box, since 1992, as an indicator of annual upper Sustut River adult steelhead (*Oncorhynchus mykiss*) abundance.

In 2005, 271 adult steelhead were enumerated between July 29 and October 2. When the fence was removed on October 2, approximately 170 steelhead were counted in the first pool below the fence resulting in an overall upper Sustut River steelhead escapement estimate of 440. Presence of net marks, sex and general condition was recorded for all steelhead handled during the project. Fork length, scales and genetic samples were collected from 19% (n = 52) of the steelhead captured in the trap box. After capture, all species were released upstream of the fence. Other species enumerated in 2005 included: rainbow trout (n =4), bull trout (*Salvelinus confluentus*) (n =17), Rocky Mountain whitefish (*Prosopium williamsoni*) (n =43), Chinook (*O. tshawytscha*) (n =383), sockeye (*O. nerka*) (n =1175) and coho (*O. kisutch*) (n =88). The first steelhead was captured on July 31, and the last steelhead was captured on October 2. The 2005 steelhead count was the second lowest steelhead count since 1993 (208) and below the mean abundance estimate of 684.

A total of 5.2% of all steelhead handled during the project were observed with gillnet marks. The ratio of female to male steelhead was 2.01:1. Overall, males were significantly larger than females (Students t-test =12.50 p<0.001). Length comparisons between sex and ocean residency could not be calculated because there was no representation of two ocean male steelhead in the sample (♂=0)(♀=21). A small representation of female steelhead in the three ocean sample (♀=5) (♂=16) precluded any further sex-length analysis. Repeat spawners represented 19% (n=10) of the sample and all repeat spawners sampled had similar age structure 4.2S1+. The predominant freshwater age in the sample was 4 (80%) followed by 5 (20%). The marine age observed in the sample was evenly distributed between 2+ (50%) and 3+ (50%).

Water level was recorded twice a day during site visits by the contractor. Measurements were taken from an instream staff gauge located immediately upstream of the fence. Water levels ranged from 0.24 m to 0.50 m with a mean level of 0.31 m. Onset temperature data loggers were deployed on land and in the river to monitor water and air temperatures respectively. Water temperature was recorded hourly. Water temperatures ranged from 3.54°C to 13.17°C with a mean of 8.74°C.

Table of Contents

Abstract.....	ii
List of Tables	iv
List of Figures	v
List of Appendices.....	vi
1.0 Introduction	1
2.0 Study Area	1
3.0 Methods	2
3.1 Steelhead Enumeration	2
3.2 Steelhead Migration and Physical Data.....	6
3.3 Steelhead Gillnet Marks	6
3.4 Male and Female Steelhead Run Timing	6
4.0 Results.....	6
4.1 Steelhead Results	6
4.2 Steelhead Migration and Physical Data.....	9
4.3 Steelhead Length Distributions by Sex.....	11
4.4 Steelhead Gillnet Marks	11
4.5 Male and Female Steelhead Run Timing	12
4.6. Steelhead Ages	12
5.0 Discussion.....	13
5.1 The Importance of Continued Monitoring.	15
6.0 Recommendations	15
7.0 Acknowledgments	16
8.0 Literature Cited	18
Appendix Figures	20
Appendix Tables	21

List of Tables

Table 1. Dates when 50% of the steelhead migrated through the fence and the total count to September 30, for the years 1994 to 2005.	7
Table 2. History of Tag 14270 (White) recaptured at the upper Sustut River fence 2002- 2004.	9
Table 3. Historical upper Sustut River steelhead data for the years 1994 to 2005.	14

List of Figures

Figure 1. Sustut River	3
Figure 2. Map of Susut River and Tributaries	4
Figure 3. Photograph of the steelhead enumeration fence, trap box and sampling station (a) and of the fence and downstream holding pool (b), 2004.....	5
Figure 4. Daily cumulative percentage of upper Sustut River steelhead migrating past the fence for the years 1994 to 2005.....	8
Figure 5. Photo of female steelhead captured at Sustut Fence 2000, 2002 and 2004.....	9
Figure 6. Water temperatures and steelhead migration stratified by hour August 1- October 1, 2005.....	10
Figure 7. Daily staff gauge height and the number of steelhead migrating past the upper Sustut River fence in 2005.....	11
Figure 8. Daily cumulative percent of male and female steelhead migrating past the fence 2005.....	12

List of Appendices

Appendix Figure 1. Daily minimum and maximum water temperatures at the upper Sustut River fence, August 1 to October 1, 2005.....	19
Appendix Table 1. Daily and cumulative totals of steelhead, rainbow trout, bull trout and Rocky Mountain whitefish migrating past the upper Sustut River fence, 2005.....	21
Appendix Table 2. Steelhead sampling data from the upper Sustut River fence, 2005.....	23
Appendix Table 3. Daily and cumulative total of chinook, sockeye and coho salmon migrating past the upper Sustut River fence, 2005.....	29
Appendix Table 4. Daily staff gauge height, air and water temperature and weather conditions for the upper Sustut River, 2005.	32
Appendix Table 5. Statistical week definitions for 2005.	35
Appendix Table 6. Age data from scale analysis for steelhead sampled at the upper Sustut River 2005.	36
Appendix Table 7. Scale condition code definitions.	37
Appendix Table 8. Summary, by sex and freshwater age, of all steelhead sampled at the Sustut River fence, 2005.	38
Appendix Table 9. Summary, by sex and marine age, of all steelhead sampled at the upper Sustut River fence, 2005.....	39
Appendix Table 10. Historical review of the repeat spawner rate for the upper Sustut River steelhead population, based on scale sample analysis. .	40
Appendix Table 11. Number of steelhead past the fence and the number and percent of steelhead sampled, by sex, for statistical weeks 7-5 to 10-1 2005.....	40

1.0 Introduction

Since 1992, the upper Sustut River adult summer run steelhead (*Oncorhynchus mykiss*) population has been used as an annual index of all early run Skeena River summer steelhead. The early run Skeena River steelhead stocks are susceptible to intense commercial fisheries for sockeye (*O. nerka*) and pink (*O. gorbuscha*) salmon where they are susceptible to capture in a mixed stock fishery (Ward *et al.* 1993; Cox-Rogers 1994). Sustut River summer run steelhead also support a significant recreational fishery on the Skeena River and lower Sustut River.

The objectives of the Sustut River enumeration program are:

1. to enumerate the upper Sustut River summer-run steelhead population,
2. to examine the sex ratio of steelhead throughout the run,
3. to examine the effect of water height and temperature on steelhead migration
4. to examine the number of gillnet marked steelhead and the distribution of gillnet marked fish throughout the run,
5. to examine the relative run timing of male and female steelhead

2.0 Study Area

The Sustut River is located in north central British Columbia and is a tributary to the upper Skeena River (Figure 1). Originating in the Omineca Mountains approximately 220 km north of Smithers, B.C. the Sustut River flows for 8 km northwest from Sustut and Mud lakes where it joins Johanson Creek near the main spawning area for upper Sustut steelhead (Bustard 1993). The river then flows 3 km west to its confluence with Moosevale Creek before turning southwest for approximately 100 km and flowing into the Skeena River. The Sustut River drains approximately 3,574 km² and has seven main tributaries: Birdflat Creek, Bear River, Asitka River, Red Creek, Two Lake Creek, Moosevale Creek and Johanson Creek. Fish species known to inhabit the upper Sustut River include steelhead, chinook salmon (*O. tshawytscha*), sockeye salmon (*O. nerka*), coho salmon (*O. kisutch*), bull trout (*Salvelinus confluentus*), Dolly Varden char (*S. malma*), Rocky Mountain whitefish (*Prosopium williamsoni*), and burbot (*Lota lota*)² (Bustard 1993). The physical area that defines the upper Sustut River steelhead population is the Sustut River upstream of the Moosevale Creek confluence including Johanson Creek and Sustut and Johanson lakes (Spence *et al.* 1990) (Figure 2). The physical area that defines the lower Sustut

² In August, 1999 a single juvenile burbot (<10 cm fork-length) was found in a beaver impoundment by Ministry Staff on the Sustut River approximately 800 meters upstream of its confluence with Johanson Creek.

River steelhead population is the Sustut River downstream of the Bear River confluence, including Bear River and Bear Lake (Spence *et al.* 1990) (Figure 2).

3.0 Methods

3.1 Steelhead Enumeration

A floating fish counting fence constructed from 3.8 cm PVC pipe was placed in the Sustut River, 500 m upstream of the confluence with Moosevale Creek and 70 km upstream of the confluence with the Bear River (Figure 2). The fence was operated between July 28 and October 2. Fish were directed into an aluminum trap box where they remained until a gate was opened allowing continued upstream migration.

The total number of steelhead counted at the fence to September 30 is used to indicate the abundance of the adult upper Sustut River steelhead population and is the value used for annual comparisons. The Sustut River count is hypothesized to be reflective of steelhead abundances for other upper Skeena tributaries. Fish holding downstream of the fence were counted visually on October 2, immediately after fence removal.

The fence was inspected twice a day, and debris was removed and repairs made as necessary. The fence trap box was checked in the morning and evening during low levels of fish migration and was checked more frequently during heavier migration. Anecdotal information indicates that human activity around the fence often halts or delays migration. Therefore, periods of fish handling and the removal of debris and carcasses from the fence were limited to avoid affecting fish migration.

Sex and fork length data plus scale and genetic material was collected from approximately 20% of the fish handled during the project. Although the fence monitors tried to sample fish on a random basis, sampling biases more than likely occurred during periods of peak migration (pers. comm. Ron Steffey).

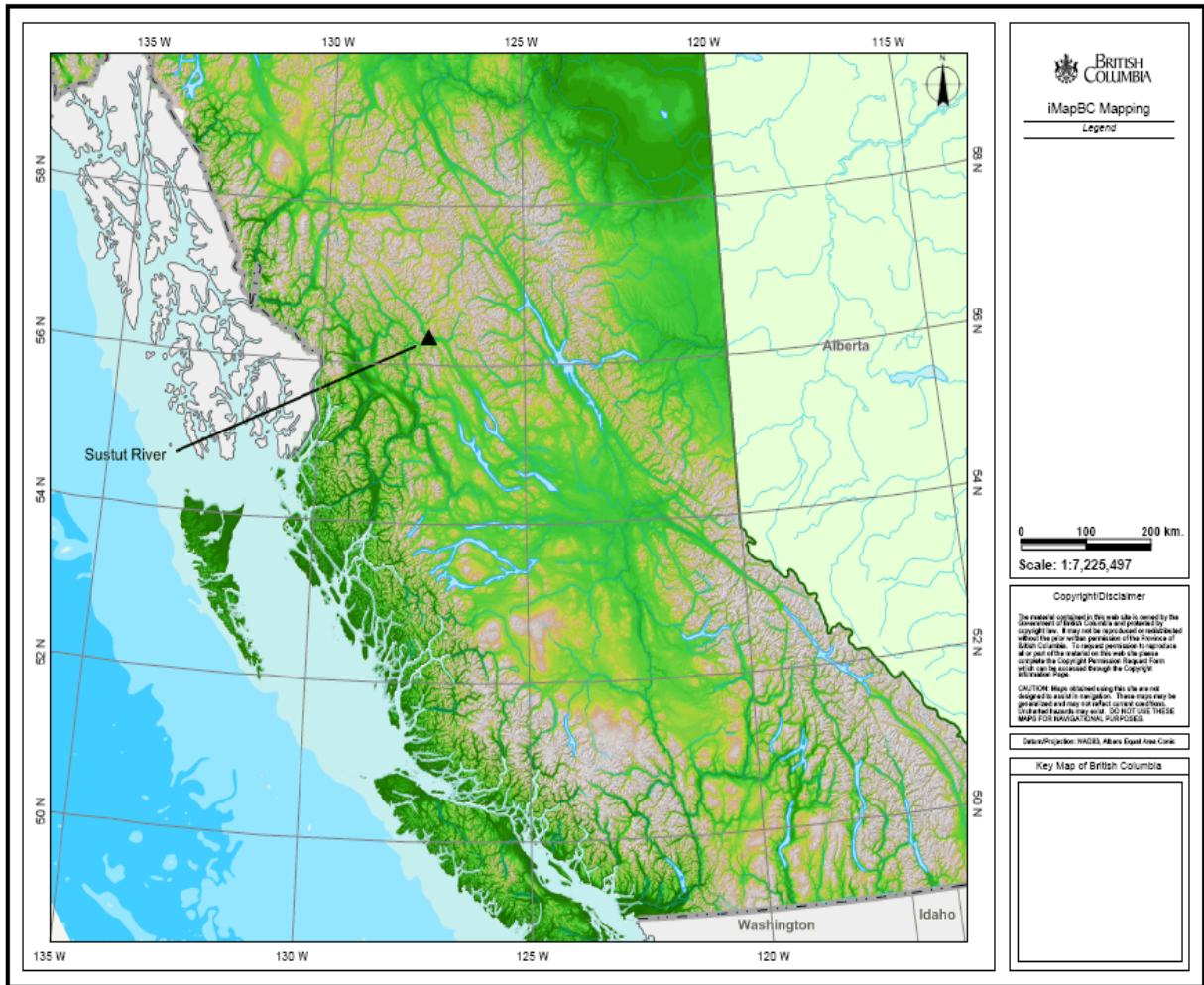


Figure 1. Sustut River

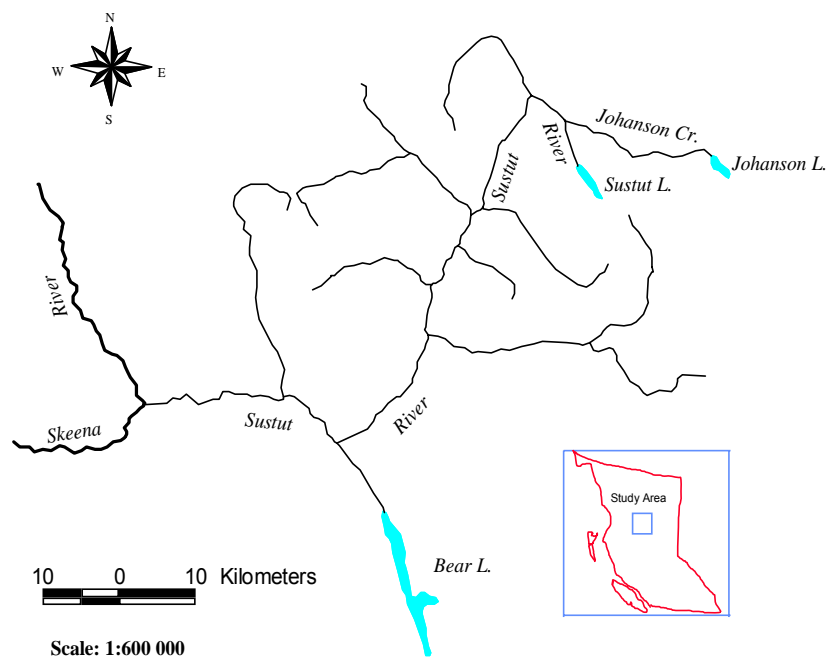


Figure 2. Map of Susut River and Tributaries

a



b



Figure 3. Photograph of the steelhead enumeration fence, trap box and sampling station (a) and of the fence and downstream holding pool (b), 2004.

The fence monitors used the visual characteristics described in Scott and Crossman (1973) and McPhail and Carveth (1994), to identify the species of all fish captured during the project. For data collection purposes, a plexiglass viewing box was used to identify fish by species, sex and to observe scars, wounds and general condition.

3.2 Steelhead Migration and Physical Data

Manual stream temperatures were recorded daily using a minimum-maximum thermometer (Brannon Ltd). Also, temperature data loggers (Onset Computer Corporation, Pocasset, MA) were deployed in the river and in the air near the fence site to record hourly temperatures. Water levels were recorded in the morning and the evening using a metric instream staff-gauge. Air temperature and weather conditions were also recorded daily. Maximum daily water temperature and level were examined against steelhead migration by graphical and statistical methods to determine if these physical factors influenced migration patterns.

3.3 Steelhead Gillnet Marks

The presence or absence of gillnet marks was noted for all steelhead as they migrated past the fence.

3.4 Male and Female Steelhead Run Timing

The run timing of male and female steelhead was examined by plotting cumulative percent male and female steelhead by date over the duration of fence operation. The date of first arrival and median migration date past the fence for male and female steelhead was also compared. Finally, daily numbers of male and female steelhead migrating past the fence were plotted and compared using a Students t-test for distribution comparisons.

4.0 Results

4.1 Steelhead Results

Between July 28 and September 30, 2005, 268 steelhead migrated upstream through the upper Sustut River fence (Table 1; Appendix Table 1). An additional three steelhead migrated past the fence between October 1 and October 2. Approximately 170 steelhead were counted in the pool immediately downstream

of the fence prior to its removal making the estimated spawning escapement to the upper Sustut River 441 steelhead.

The first steelhead migrated through the fence on July 31 and by September 3, 50% of the steelhead enumerated in 2005 had passed the fence (n=134) (Figure 4). For purposes of annual comparison, the previous dates by which 50% of the migration had occurred along with the corresponding total fence counts to September 30 are recorded in Table 1 for the years 1994 to 2005. Information prior to 1994 was not included due to the variability in fence design and location.

By annual comparison, the 50% migration date has been relatively consistent since 2002. September 3 was the reported 50% migration date for 2004 and 2005, and September 2 was the reported 50% migration date for 2002 and 2003 (Table 1). In the last 12 years, the mean date at which 50% of the steelhead run had passed the fence was September 7 (SD=5.88).

Table 1. Dates when 50% of the steelhead migrated through the fence and the total count to September 30, for the years 1994 to 2005.

Year	Date of 50% Migration	50% Fence Count	Aggregate Fence Count
1994	Aug-29	292	584
1995	Sep-08	234	467
1996	Sep-07	233	466
1997	Sep-13	325	649
1998	Sep-07	532	1064
1999	Sep-17	366	731
2000	Sep-07	186	377
2001	Sep-16	378	756
2002	Sep-02	406	812
2003	Sep-02	558	1115
2004	Sep-03	521	1042
2005	Sep-03	134	268
Earliest 50% Migration Date	Aug-29	Minimum Count	268
Latest 50% Migration Date	Sep-17	Maximum Count	1115
		Mean Count	694

Graphical analysis of the cumulative proportional distribution of steelhead over time indicates that, in 2005, steelhead migration past the fence was more gradual than in 2004 (Figure 4). In 2004, 49.8% (n=520) of the steelhead migration was accounted for on three dates: August 26 (n=110), September 3 (n=290) and September 24 (n=120) (Diewert 2004). During the 2004 study, the mean daily upstream count was 15.8 (SD=40.6) and the maximum daily count was 290. In comparison, in 2005, the mean daily count was 4.1 (SD=6.83) and the maximum count was 37.

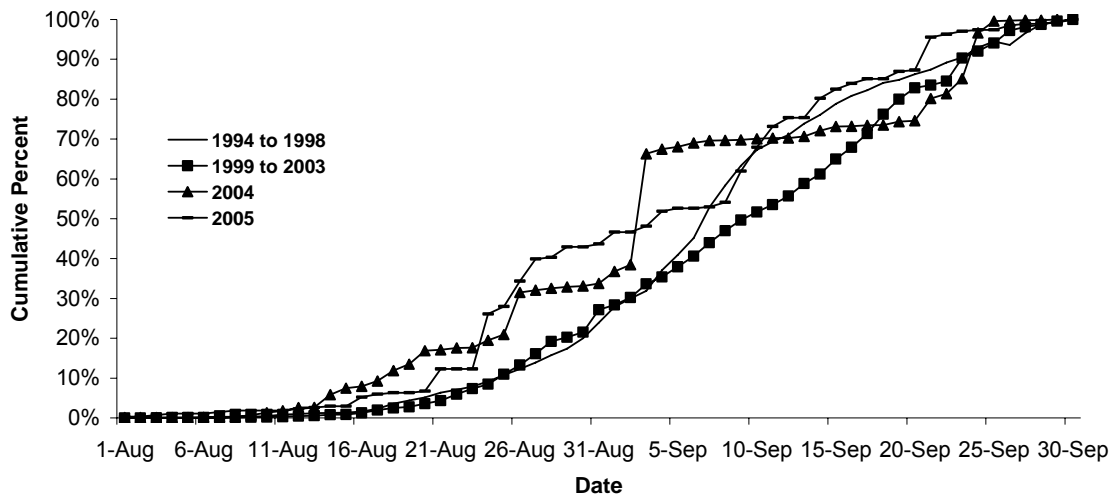


Figure 4. Daily cumulative percentage of upper Sustut River steelhead migrating past the fence for the years 1994 to 2005.

Prior to the 2002, all steelhead captured in the trap box were marked with an anchor tag before being released upstream of the fence. Annual handling mortality rates were estimated by comparing fish handled to the number of mortalities recovered from the upstream side of the fence. Although measured mortality may include death by natural processes, it is assumed that all observed mortality is a byproduct of handling. Since 2002, the anchor tagging component of the program has been discontinued. The fence monitors now collect genetic material, scales and length data from a sub sample of the upper Sustut River steelhead (~20%) captured at the site. 4,510 steelhead were enumerated at the site between 1995 and 2001. A total of 68 steelhead mortalities were recovered resulting in a handling mortality rate of 1.5%. In comparison, 2,969 steelhead were enumerated between 2002 and 2004 and 11 mortalities were recovered resulting in a handling mortality rate of 0.36%. There was not any steelhead mortality observed in 2005.

Steelhead that had been previously anchor tagged in the Tye test fishery or at the Sustut fence are subject to recapture during the study period. Since the Sustut tagging component was discontinued in 2001, it is unlikely that any further tags applied at the Sustut fence will be recovered. In 2005, there was one steelhead observed with an anchor tag. A comprehensive search of the tag database revealed that tag number 37190 (yellow) had been issued to Fisheries and Oceans Canada in 2001. Specific information about the tag application was unavailable. However, based on the tag number series, tag 37190 was more than likely applied in the 2003 Tye Test Fishery. Diewert 2004 reported that a female steelhead tagged at the fence in 2000 was recaptured as a mortality in 2004. (Table 2). An examination of historical tagging data revealed that tag 14270 (white) had also been recaptured at the fence in 2002 (Table 2). Measured growth from the date of initial capture to the date of first recapture and second recapture was 60mm and 50mm respectively.

Table 2. History of Tag 14270 (White) recaptured at the upper Sustut River fence 2002- 2004.

Initial Capture				
Date	NF Length (mm)	Tag Number	Tag Colour	Comments
Sept 17,2000	700	14270	White	Bright; clean
1 st Recapture				
Date	NF Length (mm)	Tag Number	Tag Colour	Comments
August 24,2002	760	14270	White	None
2 nd Recapture				
Date	NF Length (mm)	Tag Number	Tag Colour	Comments
August 19,2004	810	14270	White	Mort



Figure 5. Photo of female steelhead captured at Sustut Fence 2000, 2002 and 2004.

4.2 Steelhead Migration and Physical Data

Environmental data recorded by the fence monitors daily are presented in Appendix Table 4. For purposes of analysis, water temperatures collected via Stowaway data loggers will be utilized. The data logger recorded water temperatures from August 1 to October 1, 2005. Water temperature was recorded hourly providing 1,464 data points for analysis. Overall, the highest temperature was recorded on August 12 (15.83°C) and the lowest was recorded on September 27 (1.82°C). The mean temperature during this time period was 8.74°C. Daily minimum and maximum water temperatures are shown graphically

in Appendix Figure 1. Water levels, measured by staff gauge, ranged from 0.2475 m to 0.505 m and averaged 0.316 m. Stratified by hour, the warmest water temperatures were recorded between 5:00 PM and 6:00PM (Figure 6). Based on 2005 records, 73.8% (n=200) of the steelhead entering the trap box did so between 3:00 PM and 8:00PM. The remainder, 26.2% (n=71), were captured outside of that period. Figure 6 shows a high number of steelhead captured between 8:00 AM and 10:00AM. Since fence staff is not present after dusk, steelhead could have entered the trap box at any time after dusk. As a result, this number does not reflect the specific hour migration into the trap box may have occurred.

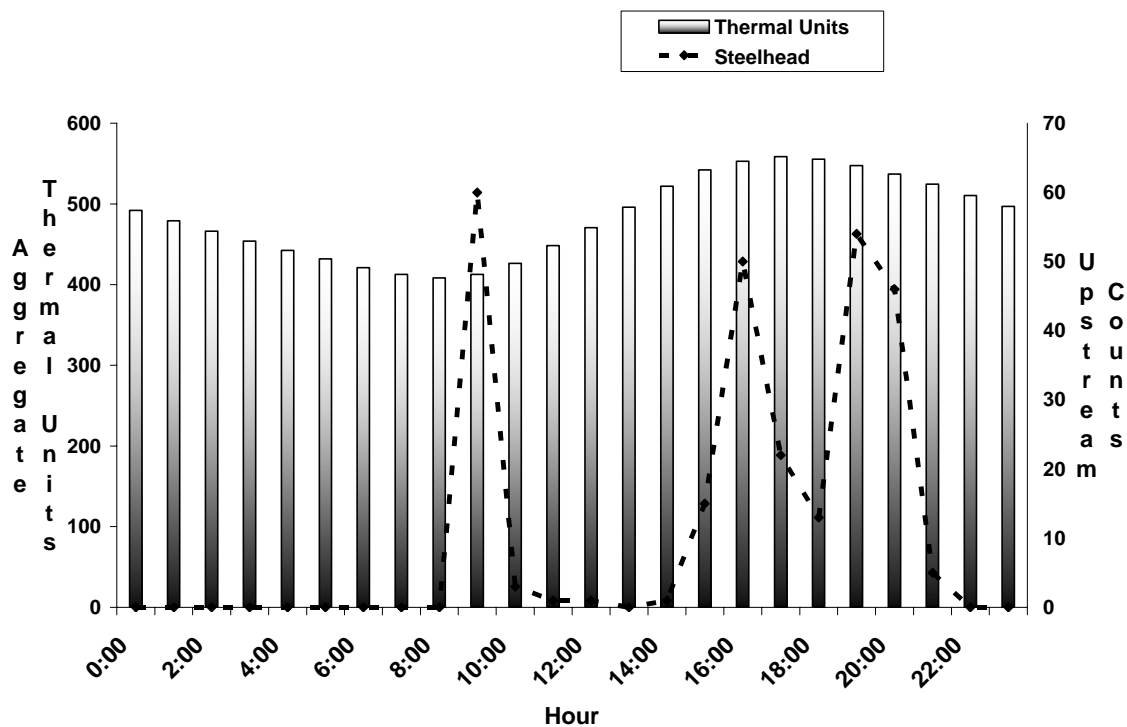


Figure 6. Water temperatures and steelhead migration stratified by hour August 1- October 1, 2005.

Water levels were recorded by fence staff twice daily. The two daily measurements were averaged to determine a daily level (Figure.7). Measurements were recorded from a metric staff gauge located immediately upstream of the fence. In 2005, water levels ranged between 0.245 m and 0.505 m. The mean level was 0.312 m and the standard deviation was 0.048. The highest daily water level was 0.505 m measured on August 2, 2005 and the lowest level was 0.2475 m measured on September 27, 2005. A Petersen correlation coefficient test was performed to determine if there was a significant linear relationship between water level and steelhead migration past the fence. The result was ($r=0.03$) and indicated no significant relationship between steelhead migration and water level.

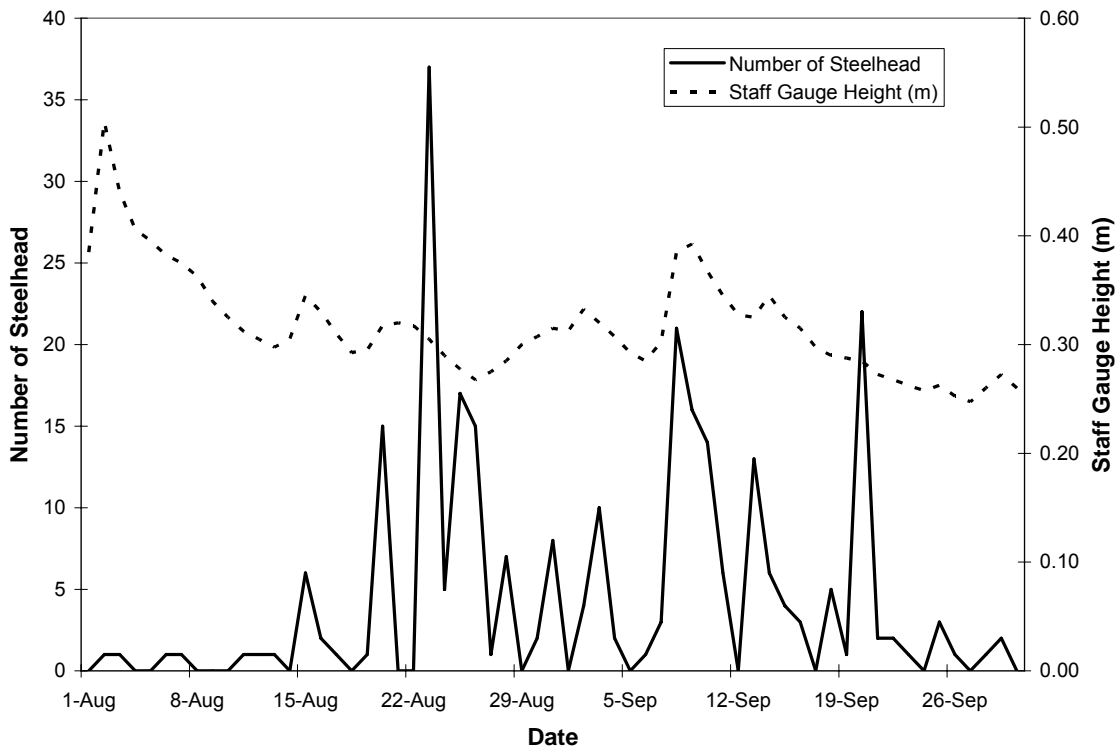


Figure 7. Daily staff gauge height and the number of steelhead migrating past the upper Sustut River fence in 2005.

4.3 Steelhead Length Distributions by Sex

Of the 271 steelhead counted migrating through the fence, 90 (33.3%) were male and 181 (66.6%) were female resulting in a female to male ratio of 2.01:1. A total of 16 male and 36 female steelhead were measured for nose-fork length. Male lengths ranged from 790 to 930 mm and averaged 850 mm while female lengths ranged from 665 to 835 mm and averaged 740 mm. Overall, males were significantly larger than females (Students t-test =12.50 $p < 0.001$).

4.4 Steelhead Gillnet Marks

Fence observers recorded the presence of gillnet marks on steelhead that were handled during the project. Gillnet marks were present on 5.1% ($n=14$) of all steelhead that migrated past the fence. In total, 11 of the steelhead observed with net marks were female and three were male. Length was determined for only four of the net marked steelhead observed in the 2005 sample. The small sample size precluded any comparisons with data collected in previous years.

4.5 Male and Female Steelhead Run Timing

The first female steelhead passed through the fence on July 28 while the first male steelhead migrated upstream on August 9 (Appendix Table 2). The median migration date was September 3 for both sexes. The plot of daily cumulative percentage of male and female steelhead arriving at the fence revealed a similar migration pattern for both sexes (Figure 8). When the daily numbers of male and female steelhead migrating past the fence were plotted and compared, the student's t-test revealed no significant difference between the arrival time of females and males Student's t-test ($t=1.29$) ($p>0.1$).

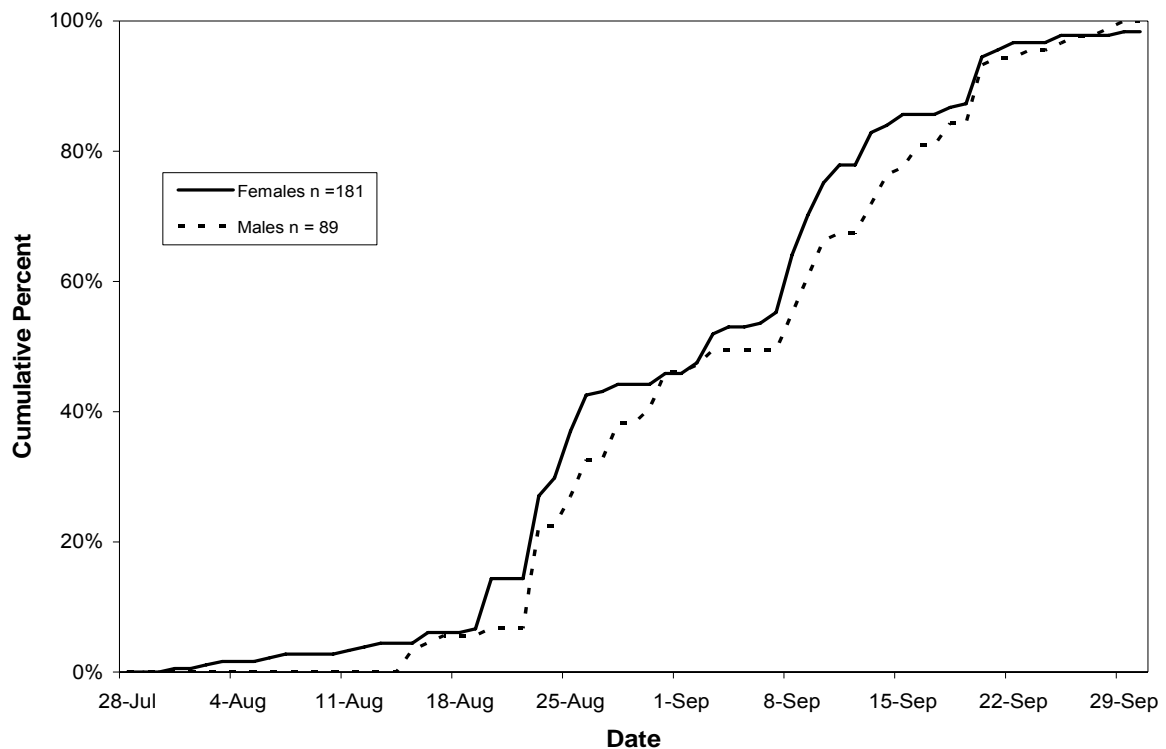


Figure 8. Daily cumulative percent of male and female steelhead migrating past the fence 2005.

4.6. Steelhead Ages

In 2005, scales were removed from 52 steelhead at the upper Sustut River fence. These scales were analyzed to determine freshwater and ocean residency age and repeat spawning rates. 80% of the scales ($n=42$) were classified as being in good condition (code 1) (Appendix Table 11) while 2% ($n=1$) were in poor

condition (code 2) (Appendix Table 7). The remaining scale samples 17.25% (n=9) were showing evidence of regeneration. Regeneration may have affected the accuracy of the ageing of these nine samples. (Appendix Table 11, 12). Freshwater residency ranged from four to five winters. Four was the predominant freshwater age and represented 80% (n=36) of the scales collected and freshwater age five represented 20% (n=9) of the sample. Freshwater age could not be determined for seven of the scale samples collected (Appendix Table 6). In the 2005 sample marine residency ranged from two to three winters. Maiden spawners represented 80.7% (n=42) of the sample, and 19% (n=10) of the scales examined showed evidence of repeat spawning.

5.0 Discussion

The 2005 upper Sustut River steelhead fence count to September 30 was 269. This value is the lowest recorded count since methods were standardized in 1994 (Table 3). An unusually high number of steelhead (~170) were observed downstream of the fence prior to its removal. The sum of the 2005 fence count and steelhead observed downstream of the fence prior to removal, results in an abundance estimate of 441. Since 1994, annual fence counts have ranged from a high of 1,115 in 2003 to a low of 269 in 2005 (Table 30). Recent trends in ocean productivity have negatively affected adult steelhead recruitment in southern British Columbia (Ward et al 2006). Unfortunately, ocean survival of Skeena summer run steelhead stocks can not be measured like it is on the south coast. 2005 data collected from steelhead sampled from the upper Sustut River seemed to indicate a change in the proportional representation of marine age. Age data collected over time indicates that two ocean steelhead represent a significant portion of the annual upper Sustut river escapement (Diewert 2001,2002,2003,2004). In 2005, excluding repeat spawners, the proportional representation of two ocean steelhead in the sample declined. A similar comparison of Nass summer run steelhead stocks indicated a similar general shift in marine age composition. This may indicate that a shift in ocean survival rates may have affected adult recruitment in 2005.

Table 3. Historical upper Sustut River steelhead data for the years 1994 to 2005.

Year	Date of First Steelhead	Date of 50% Migration	Index	Average Length (cm)		Repeat Spawner	% Handling Mortalities	% Gillnet Marked			
				M	F			M	F	Total	
1994	8-Aug	29-Aug	584	82	73						2.0
1995	8-Aug	8-Sep	467	82	74	1.2	4.0				6.0
1996	17-Aug	7-Sep	466	82	73	1.3	2.8				14.0
1997	9-Aug	13-Sep	649	81	73	0.6	1.5	9.2	17.8		15.4
1998	3-Aug	7-Sep	1064	82	74		0.8	13.4	13.8		13.7
1999	17-Aug	17-Sep	731	84	75	2.5	0.3	6.1	9.9		8.5
2000	8-Aug	7-Sep	377	82	74	0.4	0.5	10.6	16.2		14.1
2001	15-Aug	16-Sep	756	86	77	2.5	1.9	10.1	14.5		12.8
2002	9-Aug	2-Sep	812			1.9	0.5	3.6	8.4		6.3
2003	3-Aug	2-Sep	1115	78	73	1.2	0.3	8.3	14.2		11.8
2004	28-Jul	3-Sep	1042	81	74		0.3	6.0	8.8		7.7
2005	31-Jul	3-Sep	269	85	74	19	0	3.3	5.5		4.8
Minimum			269	78	73	0.4	0.0	3.3	5.5		2.0
Maximum			1115	86	77	19.0	4.0	13.4	17.8		15.4
Average			694	82	74		1.05				

The mortality rate for steelhead migrating past the fence in 2005 was 0%, which is below the overall mean of average of 1.05% (Table 3). The reduction in observed steelhead mortality can probably be attributed to changes in handling procedures at the site. Rather than handling and sampling all steelhead captured at the site, site monitors now sample only 20% of the steelhead captured annually

In 2005, 67% of the steelhead migrating past the fence were female and 33% were male. These results suggested a sex ratio of 2.05:1 females to males. The

sex ratio in favor of females is similar to that found in previous years (Parken *et al.* 1997; Williamson 1998, 1999a, 2000; Diewert 2001, 2002, 2003, 2004). In 2005, 4.8% of all steelhead migrating past the fence exhibited gillnet marks. This falls in the lower end of previously recorded values which have ranged from 2.0 to 15.4% (Table 3). Female steelhead tended to exhibit a higher gillnet mark rate than males (5.5% and 3.3%, respectively). Past studies have found that gillnet marked males and females were significantly smaller than unmarked fish (e.g. Diewert 2002).

5.1 The Importance of Continued Monitoring.

The upper Sustut River fence is one of two long term indexes used to estimate summer run steelhead abundance in the Skeena River watershed. It is also the only index available to monitor the abundance of upper Skeena River steelhead stocks. The long term data set collected at the site allows fisheries managers to compare annual abundance, run timing, sex ratios and age composition of adult steelhead in the upper Sustut. The ability of fisheries managers to monitor steelhead stock abundance and other important biological parameters would be severely affected if this project were to discontinue. The social, economic and ecological benefits created by the Skeena summer run steelhead stocks make this project both cost efficient and an important component for monitoring the long term viability of these stocks.

6.0 Recommendations

1. Enumeration of the upper Sustut River steelhead population should continue to be carried out annually. We recommend a small raft be used to assist in counting steelhead downstream to the Moosevale Creek confluence. This count should coincide with the fence removal in the fall. The valuable time series of data that results from this project provides fisheries managers with information on abundance trends for all early run Skeena steelhead populations and provides feedback on the impact of fisheries on these important stocks.
2. Efforts to visually enumerate steelhead below the fence prior to fence removal should continue. These counts provide the basis for estimating total steelhead spawning escapement to the upper Sustut River allowing for an evaluation of stock status relative to carrying capacity. Surveys should take place throughout the latter portion of the project to ensure that a count of steelhead below the fence is always available. A final count should be carried out as close to the date of fence removal as possible. How the count occurs should be standardized to maintain the long term consistency of the data.

3. It is recommended that approximately 20% of the male and female steelhead migrating past the fence continue to be sampled for age and length. This compromise ensures that the valuable time series of biological data will continue while handling mortality remains at a low level. It is also recommended that steelhead captured with anchor tags be sampled for age and length for comparative reasons.

7.0 Acknowledgments

Ron, Wanda, Clayton, Hillary, Heather, Leaf, Brome and Hawk Steffey repaired, installed and maintained the enumeration weir. Their dedication to the project was above and beyond what was asked of them; both fish and fisheries managers benefited from their hard work and thoughtful approach.

Mark Beere assisted with the installation of the enumeration weir.

Mark Beere directed this study and provided editorial reviews and valuable comments for the final draft.

BC Conservation Foundation, Kamloops, BC provided general contracting services.



This project was funded by BC Environment's Habitat Conservation Trust Fund and was developed by personnel of BC Environment. The Habitat Conservation Trust Fund was created by an act of the legislature to preserve, restore and enhance key areas of habitat for fish and wildlife throughout British Columbia. Hunters, anglers, trappers and guides contribute to HCTF enhancement projects

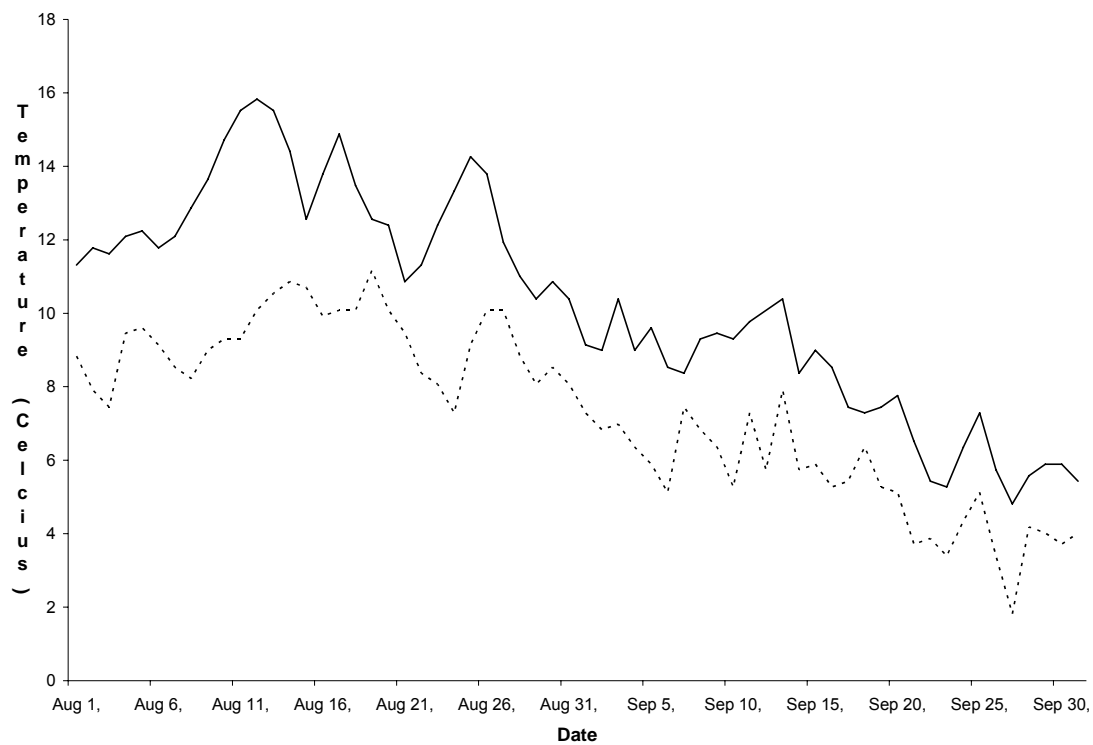
through license surcharges. Tax deductible donations to assist in the work of HCTF are welcome.

8.0 Literature Cited

- Cox-Rogers, S. 1994. Description of daily simulation model for the Area 4 (Skeena) commercial gillnet fishery. Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2256.
- Bustard, D. 1993. Adult steelhead studies in the upper Sustut River 1992. Unpublished manuscript prepared for British Columbia Ministry of Environment, Lands and Parks, Smithers, B.C.
- Diewert, R.E. 2001. Enumeration of adult steelhead in the upper Sustut River 2000. British Columbia Ministry of Water, Land and Air Protection. Fisheries Branch. Skeena Fisheries Report SK#128.
- Diewert, R.E. 2002. Enumeration of adult steelhead in the upper Sustut River 2001. British Columbia Ministry of Water, Land and Air Protection. Fisheries Branch. Skeena Fisheries Report SK#130.
- Diewert, R.E. 2003. Enumeration of adult steelhead in the upper Sustut River 2002. British Columbia Ministry of Water, Land and Air Protection. Fisheries Branch. Skeena Fisheries Report SK#134.
- Diewert, R.E. 2004. Enumeration of adult steelhead in the upper Sustut River 2003. British Columbia Ministry of Water, Land and Air Protection. Fisheries Branch. Skeena Fisheries Report SK#138.
- McPhail, J.D. and R. Carveth. 1994. Field key the freshwater fishes of British Columbia. British Columbia Resource Inventory Committee Publication #44.
- Parken, C.K., K.L. Morten, and D.Y. Atagi. 1997. Review of the escapement of adult steelhead to the upper Sustut River 1986, 1992-1996. British Columbia Ministry of Environment, Lands and Parks. Fisheries Branch. Skeena Fisheries Report SK#107.
- Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada, Bulletin No. 184, Ottawa, Ontario.
- Spence, C.R., M.C. Beere and M.J. Lough. 1990. Sustut River steelhead investigations 1986. British Columbia Ministry of Environment, Lands and Parks. Smithers, B.C., Skeena Fisheries Report SK#64.
- Steffey, Ron. Personal communication. January 10, 2006

- Ward, B.R., A.F. Tautz, S. Cox-Rogers and R.S. Hooton. 1993. Migration timing and harvest rates of the steelhead trout populations of the Skeena River system. PSARC Working Paper S93-06.
- Ward, B.R. et al. Watershed Restoration to Reconcile Fisheries and Habitat Impacts at the Keogh River in Coastal British Columbia. American Fisheries Society Symposium 2006. pgs 587-602.
- Williamson, C.J. 1998. Enumeration of Adult Steelhead in the Upper Sustut River 1997. British Columbia Ministry of Environment, Lands and Parks. Fisheries Branch. Skeena Fisheries Report SK #112.
- Williamson, C.J. 1999a. Enumeration of Adult Steelhead in the Upper Sustut River 1998. British Columbia Ministry of Environment, Lands and Parks. Fisheries Branch. Skeena Fisheries Report SK #120.
- Williamson, C.J. 2000. Enumeration of Adult Steelhead in the Upper Sustut River 1999. British Columbia Ministry of Environment, Lands and Parks. Fisheries Branch. Skeena Fisheries Report SK #126

Appendix Figures



Appendix Figure 1. Daily minimum and maximum water temperatures at the upper Sustut River fence, August 1 to October 1, 2005.

Appendix Tables

Appendix Table 1. Daily and cumulative totals of steelhead, rainbow trout, bull trout and Rocky Mountain whitefish migrating past the upper Sustut River fence, 2005.

Date	Steelhead		Rainbow Trout		Bull Trout		Whitefish	
	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.
29-Jul	0	0	0	0	0	0	0	0
30-Jul	0	0	0	0	0	0	2	2
31-Jul	1	1	0	0	0	0	2	4
1-Aug	0	1	1	1	1	1	2	6
2-Aug	1	2	0	1	0	1	1	7
3-Aug	1	3	0	1	0	1	0	7
4-Aug	0	3	0	1	1	2	0	7
5-Aug	0	3	0	1	1	3	0	7
6-Aug	1	4	0	1	0	3	0	7
7-Aug	1	5	0	1	0	3	0	7
8-Aug	0	5	0	1	0	3	0	7
9-Aug	0	5	1	2	0	3	0	7
10-Aug	0	5	1	3	0	3	0	7
11-Aug	1	6	0	3	0	3	0	7
12-Aug	1	7	0	3	0	3	1	8
13-Aug	1	8	0	3	0	3	0	8
14-Aug	0	8	0	3	0	3	0	8
15-Aug	6	14	0	3	0	3	2	10
16-Aug	2	16	0	3	0	3	1	11
17-Aug	1	17	0	3	0	3	1	12
18-Aug	0	17	0	3	1	4	1	13
19-Aug	1	18	0	3	0	4	2	15
20-Aug	15	33	0	3	0	4	0	15
21-Aug	0	33	0	3	0	4	1	16
22-Aug	0	33	0	3	1	5	1	17
23-Aug	37	70	0	3	0	5	3	20
24-Aug	5	75	0	3	1	6	1	21
25-Aug	17	92	0	3	1	7	1	22
26-Aug	15	107	0	3	0	7	1	23
27-Aug	1	108	0	3	0	7	2	25
28-Aug	7	115	0	3	1	8	4	29
29-Aug	0	115	0	3	1	9	0	29
30-Aug	2	117	0	3	0	9	2	31
31-Aug	8	125	0	3	0	9	0	31
1-Sep	0	125	0	3	0	9	0	31
2-Sep	4	129	0	3	0	9	0	31
3-Sep	10	139	0	3	0	9	1	32
4-Sep	2	141	0	3	0	9	0	32
5-Sep	0	141	0	3	0	9	1	33
6-Sep	1	142	0	3	0	9	1	34
7-Sep	3	145	0	3	1	10	1	35

Continued Date	Steelhead		Rainbow Trout		Bull Trout		Whitefish	
	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.
8-Sep	21	166	0	3	2	12	3	38
9-Sep	16	182	0	3	1	13	1	39
10-Sep	14	196	0	3	1	14	1	40
11-Sep	6	202	0	3	0	14	0	40
12-Sep	0	202	0	3	2	16	0	40
13-Sep	13	215	0	3	1	17	0	40
14-Sep	6	221	0	3	0	17	0	40
15-Sep	4	225	0	3	0	17	0	40
16-Sep	3	228	0	3	0	17	1	41
17-Sep	0	228	0	3	0	17	0	41
18-Sep	5	233	0	3	0	17	0	41
19-Sep	1	234	0	3	0	17	0	41
20-Sep	22	256	0	3	0	17	0	41
21-Sep	2	258	0	3	0	17	0	41
22-Sep	2	260	0	3	0	17	0	41
23-Sep	1	261	0	3	0	17	0	41
24-Sep	0	261	0	3	0	17	0	41
25-Sep	3	264	0	3	0	17	0	41
26-Sep	1	265	0	3	0	17	0	41
27-Sep	0	265	0	3	0	17	0	41
28-Sep	1	266	0	3	0	17	0	41
29-Sep	2	268	0	3	0	17	1	42
30-Sep	0	268	0	3	0	17	0	42
1-Oct	0	268	0	3	0	17	1	43
2-Oct	3	271	1	4	0	17	0	43

23-Aug-05		F						
Continued								
Date	Time	Sex	NF	Scale s	Book #	GN	Tag	Comments
23-Aug-05		F						
23-Aug-05		F						
23-Aug-05		F						
23-Aug-05		M						
23-Aug-05		M						
23-Aug-05		M						
23-Aug-05		M						
23-Aug-05		M						
23-Aug-05		M						
23-Aug-05		M						
23-Aug-05		M						
23-Aug-05		M						
23-Aug-05		M						
23-Aug-05	19:15	F	72	9~49	44195			
23-Aug-05		F	69	10~50	44195			
23-Aug-05		F						
23-Aug-05		F						
23-Aug-05		F						
23-Aug-05		F						
23-Aug-05		F						
23-Aug-05		M						
23-Aug-05		M						
23-Aug-05		M						
24-Aug-05	8:30	F						
24-Aug-05	18:30	F	68	1~41	44196			
24-Aug-05		F						
24-Aug-05		F				yes		
24-Aug-05		F						
25-Aug-05	8:30	F	81	2~42	44196			
25-Aug-05		M	84	3~43	44196			
25-Aug-05		F				yes		Poor condition
25-Aug-05		F						
25-Aug-05		F						
25-Aug-05	15:15	M	84	4~44	44196			
25-Aug-05		M						
25-Aug-05		F						
25-Aug-05		F						
25-Aug-05		F						
25-Aug-05		F						
25-Aug-05		F						
25-Aug-05		F						
25-Aug-05		F						
25-Aug-05	18:00	M	83.5	5~45	44196			
25-Aug-05		F	83.5	6~46	44196	yes		
25-Aug-05		F	78.5	7~47	44196			
26-Aug-05	9:00	F						

26-Aug-05		F						
26-Aug-05		F						
Continued								
Date	Time	Sex	NF	Scale s	Book #	GN	Tag	Comments
26-Aug-05		M						wound on top of head
26-Aug-05	15:00	M						very large
26-Aug-05		M						very large
26-Aug-05		F						
26-Aug-05		F						
26-Aug-05		F						
26-Aug-05	16:00	M						
26-Aug-05		M						
26-Aug-05		F				yes		
26-Aug-05		F						
26-Aug-05		F						
26-Aug-05		F						
27-Aug-05	8:45	F						
28-Aug-05	9:00	F	70.5	8~48	44196			
28-Aug-05		M	93	9~49	44196			
28-Aug-05		F	82	10~50	44196			
28-Aug-05		M	90	1~41	44197			
28-Aug-05		M						
28-Aug-05		M						
28-Aug-05	15:30	M						
30-Aug-05	8:45	M						
30-Aug-05		M						
31-Aug-05	8:15	F	77	2~42	44197			
31-Aug-05		M	91	3~43	44197			
31-Aug-05		M	90.5	4~44	44197			
31-Aug-05		F						
31-Aug-05		F						
31-Aug-05		M						
31-Aug-05		M						
31-Aug-05		M						
2-Sep-05	15:30	F	68.5	5~45	44197			
2-Sep-05		F	69.5	6~46	44197			
2-Sep-05	17:45	M						
2-Sep-05		F						
3-Sep-05	15:00	F						
3-Sep-05	16:00	M						
3-Sep-05		F						
3-Sep-05		F						
3-Sep-05		F						
3-Sep-05		F						
3-Sep-05	17:00	M						
3-Sep-05		F	73.5	7~47	44197			
3-Sep-05	17:15	F	81	8~48	44197			
3-Sep-05	18:15	F						
4-Sep-05	16:30	F						
4-Sep-05	17:30	F						

6-Sep-05	9:00	F				yes		
7-Sep-05	15:00	F						
7-Sep-05		F						
Continued								
Date	Time	Sex	NF	Scale s	Book #	GN	Tag	Comments
7-Sep-05	16:15	F						
8-Sep-05	15:15	F	70	9~49	44197	no		
8-Sep-05		F	77	10~50	44197	no		
8-Sep-05		F						
8-Sep-05		F						
8-Sep-05		F						
8-Sep-05		F						
8-Sep-05		F						
8-Sep-05		F				yes		
8-Sep-05		M	82.5	1~41	44198	no		
8-Sep-05		M						
8-Sep-05		M						
8-Sep-05		M						
8-Sep-05	16:30	F						
8-Sep-05		F						
8-Sep-05		M						
8-Sep-05	17:00	F	67	2~42	44198	no		
8-Sep-05		F						
8-Sep-05	19:00	F						
8-Sep-05		F						
8-Sep-05		F						
9-Sep-05	8:15	F						
9-Sep-05		F						
9-Sep-05	16:00	F						
9-Sep-05		F						
9-Sep-05		F						
9-Sep-05		F						
9-Sep-05		F						
9-Sep-05		F						
9-Sep-05		F				yes		
9-Sep-05		M						
9-Sep-05		M						
9-Sep-05		M						
9-Sep-05	19:15	F						
9-Sep-05		M						
9-Sep-05		M						
10-Sep-05	16:15	F	69	4~44	44198	no		Ventral wound
10-Sep-05		F						
10-Sep-05		F						
10-Sep-05		F						
10-Sep-05		M	88	5~45	44198	no		
10-Sep-05		M	79	6~46	44198	no		
10-Sep-05		M						

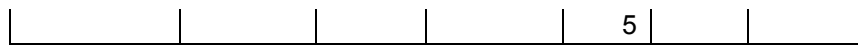
10-Sep-05		M						
10-Sep-05		F	81	7~47	44198	no		
10-Sep-05		F	73	8~48	44198	no		
10-Sep-05	20:30	F						
Continued								
Date	Time	Sex	NF	Scale s	Book #	GN	Tag	Comments
10-Sep-05		F						
10-Sep-05		F						
10-Sep-05		M						
11-Sep-05	9:00	F						
11-Sep-05	13:45	F						
11-Sep-05	19:00	F						
11-Sep-05		F						
11-Sep-05		F						
11-Sep-05		M						
13-Sep-05	9:15	M				yes		
13-Sep-05	14:00	F						
13-Sep-05		F	71.5	9~49	44198	no		
13-Sep-05	14:30	F						
13-Sep-05	15:30	F						
13-Sep-05		F						
13-Sep-05		M						
13-Sep-05	19:00	F						
13-Sep-05		F						
13-Sep-05		F						
13-Sep-05		M						
13-Sep-05		M						
14-Sep-05	9:00	M						
14-Sep-05		M						
14-Sep-05		M						
14-Sep-05		F						
14-Sep-05	10:15	M	89.5	10~50	44198	yes		
14-Sep-05	14:00	F	69	1~41	44199			
15-Sep-05	9:00	F	82	2~42	44199	yes		
15-Sep-05		M	86.5	3~43	44199			
15-Sep-05		F	66.5	4~44	44199			
15-Sep-05		F	77	5~45	44199			
16-Sep-05	9:15	M						
16-Sep-05	19:15	M						
16-Sep-05		M						
18-Sep-05	8:45	M						
18-Sep-05		M						
18-Sep-05		M						
18-Sep-05		F						
18-Sep-05		F						
19-Sep-05	16:15	F	67	6~46	44199	no	no	
20-Sep-05	9:30	F						
20-Sep-05	19:45	M						
20-Sep-05		M						

20-Sep-05		M						
20-Sep-05		M						
20-Sep-05		M						
20-Sep-05		M						
20-Sep-05		M						
Continued								
Date	Time	Sex	NF	Scale s	Book #	GN	Tag	Comments
20-Sep-05		M						
20-Sep-05		F						
20-Sep-05		F						
20-Sep-05		F						
20-Sep-05		F						
20-Sep-05		F						
20-Sep-05		F						
20-Sep-05		F						
20-Sep-05		F						
20-Sep-05		F						
20-Sep-05		F						
20-Sep-05		F						
20-Sep-05		F						
21-Sep-05		F						
21-Sep-05	19:15	F	73	7~47	44199	no		
21-Sep-05		M	82.5	8~48	44199	no		
22-Sep-05	19:30	F						
22-Sep-05		F						
23-Sep-05	8:30	M						
25-Sep-05	8:30	M						
25-Sep-05	14:00	F						
25-Sep-05	14:30	F						
26-Sep-05	11:30	M						
28-Sep-05	19:45	M				yes		
29-Sep-05	19:30	M	82.5	9~49	44199	no		
29-Sep-05		F	77	10~50	44199	no		
2-Oct-05	18:45	F	83	1~41	44200	no		
2-Oct-05		F	69	2~42	44200	no		
2-Oct-05		F	72.5	3~43	44200	no		

Appendix Table 3. Daily and cumulative total of chinook, sockeye and coho salmon migrating past the upper Sustut River fence, 2005.

Date	Chinook		Sockeye		Coho	
	Daily	Cum	Daily	Cum	Daily	Cum
29-Jul-05	23	23	0	0	0	0
30-Jul-05	23	46	0	0	0	0
31-Jul-05	19	65	0	0	0	0
1-Aug-05	6	71	0	0	0	0
2-Aug-05	75	146	0	0	0	0
3-Aug-05	8	154	0	0	0	0
4-Aug-05	23	177	0	0	0	0
5-Aug-05	25	202	0	0	0	0
6-Aug-05	27	229	1	1	0	0
7-Aug-05	18	247	0	1	0	0
8-Aug-05	22	269	0	1	0	0
9-Aug-05	3	272	0	1	0	0
10-Aug-05	5	277	7	8	0	0
11-Aug-05	24	301	5	13	5	5
12-Aug-05	6	307	1	14	0	5
13-Aug-05	20	327	1	15	1	6
14-Aug-05	12	339	0	15	0	6
15-Aug-05	10	349	0	15	0	6
16-Aug-05	5	354	22	37	1	7
17-Aug-05	3	357	138	175	3	10
18-Aug-05	9	366	46	221	0	10
19-Aug-05	6	372	29	250	0	10
20-Aug-05	5	377	175	425	3	13
21-Aug-05	2	379	23	448	1	14
22-Aug-05	2	381	49	497	5	19
23-Aug-05	1	382	99	596	0	19
24-Aug-05	0	382	30	626	3	22
25-Aug-05	0	382	100	726	1	23
26-Aug-05	0	382	17	743	1	24
27-Aug-05	0	382	1	744	1	25
28-Aug-05	0	382	105	849	2	27
29-Aug-05	0	382	3	852	2	29
30-Aug-05	0	382	12	864	1	30
31-Aug-05	0	382	1	865	1	31
1-Sep-05	0	382	2	867	0	31
2-Sep-05	0	382	91	958	3	34
3-Sep-05	0	382	109	1067	4	38
4-Sep-05	0	382	6	1073	3	41
5-Sep-05	0	382	3	1076	0	41
6-Sep-05	0	382	0	1076	0	41

				6		
7-Sep-05	0	382	10	108 6	2	43
8-Sep-05	0	382	19	110 5	4	47
9-Sep-05	0	382	13	111 8	1	48
Continued						
Date	Chinook		Sockeye		Coho	
	Daily	Cum	Daily	Cum	Daily	Cum
10-Sep-05	0	382	4	112 2	1	49
11-Sep-05	0	382	7	112 9	6	55
12-Sep-05	0	382	6	113 5	2	57
13-Sep-05	0	382	9	114 4	5	62
14-Sep-05	0	382	2	114 6	2	64
15-Sep-05	0	382	11	115 7	3	67
16-Sep-05	0	382	5	116 2	1	68
17-Sep-05	0	382	2	116 4	3	71
18-Sep-05	1	383	2	116 6	1	72
19-Sep-05	0	383	1	116 7	3	75
20-Sep-05	0	383	0	116 7	1	76
21-Sep-05	0	383	0	116 7	0	76
22-Sep-05	0	383	0	116 7	0	76
23-Sep-05	0	383	0	116 7	0	76
24-Sep-05	0	383	0	116 7	1	77
25-Sep-05	0	383	5	117 2	4	81
26-Sep-05	0	383	1	117 3	0	81
27-Sep-05	0	383	0	117 3	0	81
28-Sep-05	0	383	1	117 4	1	82
29-Sep-05	0	383	0	117 4	2	84
30-Sep-05	0	383	1	117 5	0	84
1-Oct-05	0	383	0	117 5	0	84
2-Oct-05	0	383	0	117	3	87



Appendix Table 4. Daily staff gauge height, air and water temperature and weather conditions for the upper Sustut River, 2005.

Date	Time	Staff Gauge (m)	Water Temp °C Max	Min	Air Temp °C Max	Min	Weather
28-Jul-05	15:00	0.36					mix of sun and cloud
29-Jul-05	9:00	0.365					mostly cloudy
29-Jul-05	20:00	0.35		9			partly clear
30-Jul-05	8:00	0.34					mostly clear
30-Jul-05	20:00	0.33	13	8	18	-2	mostly cloudy
31-Jul-05	8:45	0.33					mostly cloudy
31-Jul-05	19:45	0.33	13	9.5	18	6.5	high overcast
1-Aug-05	8:15	0.335					cloudy, raining
1-Aug-05	19:45	0.435	13	8.5	12.5	6	cloudy, drizzling rain
2-Aug-05	8:00	0.53					mix of sun and clouds
2-Aug-05	20:00	0.48	12	8	16.2	2.2	mostly clear
3-Aug-05	8:30	0.45					sunny, thin overcast
3-Aug-05	20:00	0.43	12	7	18.5	-2.8	cloudy, sprinkle earlier
4-Aug-05	8:15	0.41					overcast with drizzle
4-Aug-05	20:00	0.405	12	9	19.3	7.7	partly clear, rain earlier
5-Aug-05	8:25	0.4					cloudy, some clear patches
5-Aug-05	20:00	0.39	12	9	15.7	6.8	mostly cloudy, light rain
6-Aug-05	8:30	0.38					cloudy, some light rain
6-Aug-05	20:00	0.385	12	9	13	4.9	partly sunny, some rain
7-Aug-05	8:20	0.375					mostly cloudy some rain
7-Aug-05	20:00	0.375	12	10.5	17.5	3.9	partly sunny, scattered showers
8-Aug-05	8:10	0.37					clear, smoky
8-Aug-05	20:00	0.355	12.5	8.5	19.5	-2	high, broken clouds
9-Aug-05	8:30	0.345					mostly clear
9-Aug-05	20:00	0.335	14	9	18.5	1.5	clear
10-Aug-05	8:15	0.33					completely clear
10-Aug-05	19:30	0.325	14.5	9	23	0.5	clear
11-Aug-05	8:15	0.315					completely clear
11-Aug-05	20:30	0.31	15	9	28	1.5	clear, some wispy clouds
12-Aug-05	8:15	0.305					completely clear
12-Aug-05	20:00	0.305	16	9.5	27.5	1	clear, scattered cloud
13-Aug-05	8:30	0.3					clear, scattered cloud
13-Aug-05	19:30	0.295	16	10	27	1.5	partly cloudy, thundershower
14-Aug-05	8:15	0.295					completely clear, smoky
14-Aug-05	19:30	0.315	15.5	10	23	3	cloudy, thundershower w/ hard rain@18:00
15-Aug-05	8:45	0.355					overcast
15-Aug-05	19:45	0.335	14.5	10	11	7	overcast, light rain
16-Aug-05	8:30	0.33					overcast, some rain last night
16-Aug-05	19:30	0.33	14	9	20	7	mix of sun and cloud, light rain
17-Aug-05	8:30	0.315					partly clear
17-Aug-05	19:45	0.305	15	9.5	21	4	mostly clear
18-Aug-05	8:30	0.295					high thin cloud cover

18-Aug-05	20:00	0.29	14.5	9.5	19	2	mostly cloudy, light rain
Continued							
Date	Time	Staff Gauge (m)	Water Temp °C		Air Temp °C		Weather
			Max	Min	Max	Min	
19-Aug-05	8:15	0.29					high thin overcast
19-Aug-05	20:00	0.3	14	9.5	15	9	cloudy, rain earlier
20-Aug-05	8:15	0.32					mostly cloudy
20-Aug-05	20:30	0.315	13	9.5	15	6	mostly cloudy, showers earlier
21-Aug-05	8:30	0.315					mostly cloudy
21-Aug-05	20:00	0.325	12.5	9	11	5	partly clear, some light rain earlier
22-Aug-05	8:15	0.32					mostly cloudy
22-Aug-05	19:30	0.315	11.5	8	13	5	some clearing
23-Aug-05	8:30	0.31					mostly clear
23-Aug-05	19:45	0.3	12.5	8.5	16	1	mostly clear, cloudy earlier
24-Aug-05	8:30	0.295					completely clear
24-Aug-05	19:45	0.285	14	6.5	22	-3	completely clear
25-Aug-05	8:30	0.28					completely clear
25-Aug-05	20:00	0.275	14.5	8.5	26	0	clear, starting to cloud up
26-Aug-05	9:00	0.27					mostly cloudy
26-Aug-05	19:15	0.265	14	9.5	22	4.5	scattered clouds, sunny most of the day
27-Aug-05	8:45	0.27					overcast, light rain
27-Aug-05	19:15	0.28	13.5	9.5	13.5	6.5	overcast, rain on and off all day
28-Aug-05	9:00	0.28					partly clear
28-Aug-05	19:45	0.29	12	8.5	13.5	4	overcast, starting to break up, rain earlier
29-Aug-05	8:45	0.305					mostly clear
29-Aug-05	19:45	0.295	11	8	12	0.5	overcast, light rain
30-Aug-05	8:45	0.295					mostly cloudy
30-Aug-05	20:15	0.32	11	8	12.5	4.5	mostly cloudy
31-Aug-05	8:15	0.315					mostly cloudy
31-Aug-05	19:45	0.315	11	8	13	4	partly clear, some rain earlier
1-Sep-05	8:45	0.31					overcast, light rain
1-Sep-05	19:45	0.315	10	6.5	11	1	mostly cloudy, mix of sun/rain earlier
2-Sep-05	8:45	0.335					clearing, some rain last night
2-Sep-05	19:15	0.33	9.5	6	10	1	mostly cloudy, some clear breaks
3-Sep-05	8:30	0.325					overcast
3-Sep-05	20:00	0.315	10	6	12.5	2.5	partly clear some rain earlier
4-Sep-05	9:00	0.31					overcast
4-Sep-05	19:30	0.305	10	5.5	12	-0.5	mostly clear
5-Sep-05	8:45	0.295					high, broken cloud cover
5-Sep-05	19:15	0.29	9.5	5	14	-3	completely clear
6-Sep-05	9:00	0.285					partly clear
6-Sep-05	19:00	0.285	8	4.5	13	-5.5	overcast, drizzling rain
7-Sep-05	9:15	0.295					overcast
7-Sep-05	19:00	0.31	9	6.5	8	5.5	overcast, light rain
8-Sep-05	8:45	0.375					mostly clear, rain last night
8-Sep-05	19:30	0.395	9.5	6	14	3	mostly cloudy
9-Sep-05	8:15	0.395					mostly clear
9-Sep-05	19:30	0.39	9.5	5	14	2	mostly clear

10-Sep-05	9:30	0.37					clear
10-Sep-05	20:45	0.365	9	4.5	16	-4.5	clear
Continued							
Date	Time	Staff Gauge	Water Temp °C		Air Temp °C		Weather
11-Sep-05	9:00	0.35					mostly cloudy
11-Sep-05	19:30	0.335	10	5	16	4	mix of sun and cloud
12-Sep-05	8:30	0.33					completely clear
12-Sep-05	19:45	0.325	10	5	18.5	-4	clear, high clouds
13-Sep-05	9:15	0.32					mostly cloudy, rain in night
13-Sep-05	19:15	0.33	10	6.5	15.5	4	mostly cloudy, windy, with showers
14-Sep-05	9:00	0.345					foggy, clear above
14-Sep-05	19:30	0.345	9	5.5	9	-1.5	mostly clear, cloudy earlier
15-Sep-05	9:00	0.335					mostly cloudy
15-Sep-05	20:00	0.33	9.5	5	13.5	-0.5	clearing
16-Sep-05	9:15	0.315					high clouds, some blue
16-Sep-05	19:45	0.315	9	4	13.5	-4	partly cloudy
17-Sep-05	8:45	0.3					mostly sunny
17-Sep-05	19:00	0.295	9	4.5	13.5	-4	mostly cloudy
18-Sep-05	8:45	0.29					mostly cloudy
18-Sep-05	19:00	0.29	8.5	5	8	4	partly clear
19-Sep-05	8:30	0.285					overcast
19-Sep-05	19:15	0.29	8	4	9	2	partly clear
20-Sep-05	9:30	0.285					mostly high cloud cover, some wind
20-Sep-05	19:45	0.285	8	4	11	2	partly cloudy
21-Sep-05	8:45	0.275					some small blue patches
21-Sep-05	19:15	0.27	8	3	10	-5	broken clouds
22-Sep-05	7:30	0.27					mostly cloudy
22-Sep-05	19:30	0.265	7	3	6	3.5	mostly cloudy
23-Sep-05	8:30	0.26					cloudy
23-Sep-05	19:15	0.265	5.5	2.5	6	-4.5	partly clear
24-Sep-05	8:30	0.255					overcast
24-Sep-05	19:15	0.26	6.5	3.5	10.5	1.5	partly clear
25-Sep-05	8:30	0.26					starting to clear
25-Sep-05	19:15	0.265	7	4	12	2	mostly clear
26-Sep-05	8:15	0.255					mostly clear
26-Sep-05	19:15	0.25	7	2.5	10.5	-5.5	mostly clear
27-Sep-05	9:00	0.25					clear high thin clouds
27-Sep-05	19:15	0.245	5.5	0.5	10.5	-10	cloudy
28-Sep-05	9:00	0.25					cloudy, misting
28-Sep-05	19:15	0.27	5	4	6	2	mostly cloudy
29-Sep-05	8:30	0.275					a few small clear patches, mostly overcast
29-Sep-05	19:30	0.27	6	3	10	1	partly clear
30-Sep-05	8:45	0.26					overcast, misting
30-Sep-05	19:00	0.26	5	4	10.5	-1.3	snow and rain
1-Oct-05	8:45	0.265					overcast
1-Oct-05	19:00	0.26	5	3	4.5	0	mostly cloudy
2-Oct-05	9:00	0.255					foggy

2-Oct-05	19:00	0.255	6	2.5	8.5	-2	clear
----------	-------	-------	---	-----	-----	----	-------

Appendix Table 5. Statistical week definitions for 2005.

Statistical Week	Calendar Week
7-5	July 29 to August 1
8-1	August 2 to 8
8-2	August 9 to 15
8-3	August 16 to 22
8-4	August 23 to 29
9-1	August 30 to September 5
9-2	September 6 to 12
9-3	September 13 to 19
9-4	September 20 to 26
10-1	September 27 to October 2

Appendix Table 6. Age data from scale analysis for steelhead sampled at the upper Sustut River 2005.

Date	Sex	NF(cm)	Scales	Book #	Cond. Code	Age
11-Aug-05	F	80	1~41	44195	1	4.2S1 +
16-Aug-05	M	87.5	2~42	44195	1	4.3+
17-Aug-05	M	81	3~43	44195	1	4.3+
20-Aug-05	F	78	4~44	44195	1	4.3+
20-Aug-05	F	71	5~45	44195	2	5.2+
20-Aug-05	F	79.5	6~46	44195	1	4.2S1 +
20-Aug-05	F	75	7~47	44195	1	4.2+
23-Aug-05	F	69	8~48	44195	1	5.2+
23-Aug-05	F	72	9~49	44195	1	4.2+
23-Aug-05	F	69	10~50	44195	5	4.2+
24-Aug-05	F	68	1~41	44196	1	4.2+
25-Aug-05	F	81	2~42	44196	1	4.2S1 +
25-Aug-05	M	84	3~43	44196	1	4.3+
25-Aug-05	M	84	4~44	44196	6	R.3+
25-Aug-05	M	83.5	5~45	44196	1	4.3+
25-Aug-05	F	83.5	6~46	44196	1	4.3+
25-Aug-05	F	78.5	7~47	44196	1	4.2S1 +
28-Aug-05	F	70.5	8~48	44196	1	4.2+
28-Aug-05	M	93	9~49	44196	1	4.3+
28-Aug-05	F	82	10~50	44196	1	4.3+
28-Aug-05	M	90	1~41	44197	1	4.3+
31-Aug-05	F	77	2~42	44197	1	4.2S1 +
31-Aug-05	M	91	3~43	44197	1	4.3+
31-Aug-05	M	90.5	4~44	44197	6	R.3+
2-Sep-05	F	68.5	5~45	44197	1	4.2+
2-Sep-05	F	69.5	6~46	44197	6	R.2+
3-Sep-05	F	73.5	7~47	44197	1	5.2+
3-Sep-05	F	81	8~48	44197	1	4.2S1 +
8-Sep-05	F	70	9~49	44197	6	R.2+
8-Sep-05	F	77	10~50	44197	1	4.2S1 +
8-Sep-05	M	82.5	1~41	44198	6	R.3+
8-Sep-05	F	67	2~42	44198	6	R.2+
10-Sep-05	F	69	4~44	44198	1	5.2+
10-Sep-05	M	88	5~45	44198	1	5.3+
10-Sep-05	M	79	6~46	44198	1	4.3+
10-Sep-05	F	81	7~47	44198	1	4.2S1 +
10-Sep-05	F	73	8~48	44198	1	4.2+
13-Sep-05	F	71.5	9~49	44198	1	5.2+
14-Sep-05	M	89.5	10~50	44198	6	R.3+
14-Sep-05	F	69	1~41	44199	1	4.2+

15-Sep-05	F	82	2~42	44199	1	4.2S1 +
15-Sep-05	M	86.5	3~43	44199	1	4.3+
15-Sep-05	F	66.5	4~44	44199	1	5.2+
15-Sep-05	F	77	5~45	44199	1	4.2S1 +
19-Sep-05	F	67	6~46	44199	1	4.2+
21-Sep-05	F	73	7~47	44199	1	5.2+
Continued						
Date	Sex	NF(cm)	Scale s	Book #	Cond. Code	Age
21-Sep-05	M	82.5	8~48	44199	1	4.3+
29-Sep-05	M	82.5	9~49	44199	1	4.3+
29-Sep-05	F	77	10~50	44199	1	4.3+
2-Oct-05	F	83	1~41	44200	5	4.3+
2-Oct-05	F	69	2~42	44200	1	5.2+
2-Oct-05	F	72.5	3~43	44200	1	4.2+

Appendix Table 7. Scale condition code definitions.

Condition Code	Definition
1	good condition
2	poor condition or questionable age (i.e. difficult to interpret due to poor quality)
3	freshwater age unreadable (e.g. U.2+)
4	unreadable (e.g. U.U+)
5	starting to regenerate (may underestimate freshwater age)
6	regenerated (e.g. R.2+)
7	missing
8	resorption at scale edge (e.g. Last marine annulus just visible on edge of scale)
9	first freshwater annulus very vague, but must be present due to high curculi count and spacing relative to other freshwater annuli.

Appendix Table 8. Summary, by sex and freshwater age, of all steelhead sampled at the Sustut River fence, 2005.

Age	Male		Female		Total	
	N	%	N	%	N	%
4.2+	0	0%	10	27.7%	10	19.2%
4.2S1+	0	0%	10	27.7%	10	19.2%
4.3+	11	68.75%	5	13.8%	16	30.76%
Total	11	68.75%	25	69.2%	36	
5.2+	0	0%	8	22.2%	8	15.3%
5.3+	1	6.25%	0	22.2%	1	1.9%
Total	1	6.25%	8	0%	9	
R.2+	0	0%	3	8.3%	3	5.76%
R.3+	4	25%	0	0%	4	7.69%
Total	4	25%	3	8.3%	7	
Grand Total	16	100.0%	36	100.0%	52	100.0%

Appendix Table 9. Summary, by sex and marine age, of all steelhead sampled at the upper Sustut River fence, 2005.

Age	Male		Female		Total	
	N	%	N	%	N	%
4.2+	0	0%	10	27.7%	10	19.2%
4.2S1+	0	0%	10	27.7%	10	19.2%
5.2+	0	0%	8	22.2%	8	15.3%
R.2+	0	0%	3	8.3%	3	5.76%
Total	0	0%	31	85.9%	31	59.46%
4.3+	11	68.75%	5	13.8%	16	30.76%
5.3+	1	6.25%	0	0%	1	1.9%
R.3+	4	25%	0	0%	4	7.6%
Total	16	100%	5	13.8%	21	40.26%
Grand Total	16	100.0%	36	100.0%	52	100.0%

Appendix Table 10. Historical review of the repeat spawner rate for the upper Sustut River steelhead population, based on scale sample analysis.

Year	Scales Read	Repeat Spawners		Source
		N	%	
1977 - 86	223	12	5.4%	Spence <i>et al.</i> 1990
1983	13	1	7.7%	Baxter 1997
1994	na	na	6.0%	Baxter 1997
1995	29	0	0.0%	Baxter 1997
1996	55	7	12.7%	Baxter 1997
2001	89	6	6.7%	Diewert 2002
2003	228	5	2.2%	Diewert 2003
2004	208	20	9.6%	Diewert 2004
2005	52	10	19%	Peard 2005

Appendix Table 11. Number of steelhead past the fence and the number and percent of steelhead sampled, by sex, for statistical weeks 7-5 to 10-1 2005.

Statistical Week	Steelhead Past the Fence			Steelhead Sampled					
				Male		Female		Total	
	M	F	Total	N	%	N	%	N	%
7-5	0	1	1	0	0%	0	0%	0	0%
8-1	0	4	4	0	0%	0	50%	0	0%
8-2	4	3	7	0	13%	1	14%	1	1.9%
8-3	3	18	24	2	24%	4	26%	6	11.6%
8-4	28	54	82	5	15%	9	23%	14	26.9%
9-1	10	16	26	2	10%	5	14%	7	13.4%
9-2	16	45	61	3	100%	6	81%	9	17.3%
9-3	15	17	31	2	27%	6	16%	8	15.3%
9-4	12	18	30	1	25%	1	23%	2	3.8%
10-1	2	4	6	1	0%	4	0%	5	9.6%
Total	90	181	271	16	30.8%	36	69.2%		100%

