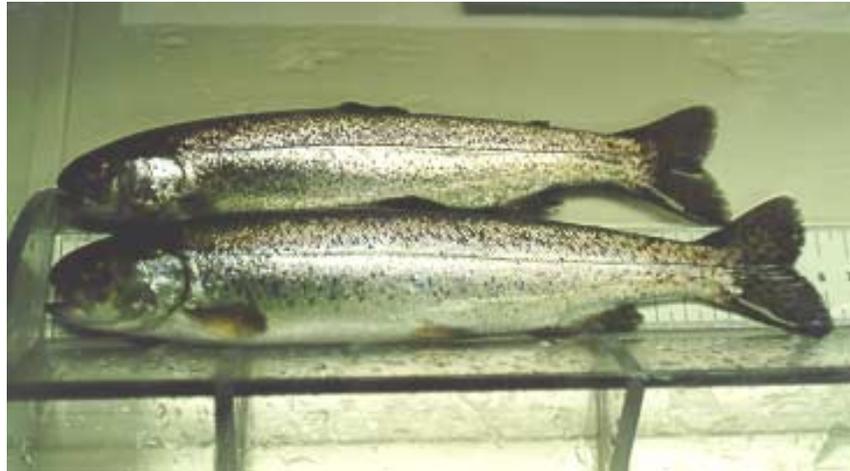




STEELHEAD ACCLIMATION STUDY AT SAWTOOTH FISH HATCHERY, IDAHO

Project Progress Report



By

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**Steelhead Acclimation Study at
Sawtooth Fish Hatchery, Idaho**

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To

**U.S. Fish and Wildlife Service
Lower Snake River Compensation Plan Office
1387 S. Vinnell Way, Suite 343
Boise, ID 83709**

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ABSTRACT

Juvenile emigration and adult recovery rates were used to test the effects of a two week acclimation period on steelhead *Oncorhynchus mykiss* smolts reared at Hagerman National Fish Hatchery and subsequently transported and released into the Salmon River at Sawtooth Fish Hatchery. Acclimated steelhead were reared at Sawtooth Fish Hatchery for two to three weeks prior to being released, whereas non-acclimated steelhead were transported from Hagerman National Fish Hatchery and released directly into the Salmon River. Between 1992 and 1997, 370,908 acclimated and 356,881 non-acclimated steelhead were released with coded wire tags. A total of 2,579 of the acclimated and 2,000 of the non-acclimated steelhead were released with passive integrated transponder (PIT) tags.

Interrogation rates at downstream dams for PIT tagged acclimated steelhead ranged from 33.9% in 1994 (brood year 1993) to 62.7% in 1993 (brood year 1992). Interrogation rates for steelhead from the non-acclimated groups ranged from 42.7% in 1994 (brood year 1993) to 69.6% in 1997 (brood year 1996). Non-acclimated steelhead from the 1991, 1993, and 1996 broods were interrogated at significantly ($P < 0.05$) higher rates than acclimated fish. For the 1992 brood, acclimated steelhead were interrogated at a significantly ($P < 0.05$) higher rate. For the 1994 and 1995 broods, PIT tag interrogation rates were not significantly different. Non-acclimated steelhead from the 1991, 1994, 1995, and 1996 broods had significantly ($P < 0.05$) shorter travel time to Lower Granite Dam than fish from the acclimated group. For the 1992 and 1993 broods, travel time to Lower Granite Dam was not significantly different between groups.

Adult steelhead return data are complete for only the 1991 and 1992 broods. For brood year 1991, 13 adults from the acclimated group and 15 adults from the non-acclimated group were recovered in Idaho. Recovery rates were not significantly different ($\chi^2 = 0.51$, $P = 0.475$) between groups. Sex and age composition of the adults recovered did not differ significantly between the acclimated and non-acclimated groups ($\chi^2 < 0.001$, $P = 1.000$ and $\chi^2 = 0.57$, $P = 0.449$, respectively). For brood year 1992, 80 adults from the acclimated group and 46 adults from the non-acclimated group were recovered in Idaho. Acclimated steelhead smolts returned as adults at a significantly higher rate than non-acclimated smolts ($\chi^2 = 5.79$, $P = 0.016$). Sex and age composition of the adults recovered did not differ significantly between the acclimated and non-acclimated groups ($\chi^2 = 0.24$, $P = 0.626$ and $\chi^2 = 1.04$, $P = 0.309$, respectively)

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INTRODUCTION

Steelhead *Oncorhynchus mykiss* juveniles are released annually into the upper Salmon River at Sawtooth Fish Hatchery as part of the Lower Snake River Compensation Plan program (LSRCP). The juvenile steelhead were reared at Hagerman National Fish Hatchery and until 1992 were transported to Sawtooth Fish Hatchery for direct release into the Salmon River. Beginning in 1992, a portion of the release group was transported to Sawtooth Fish Hatchery two to three weeks prior to release for short-term acclimation. Transporting fish at an earlier date is an operational procedure used to ease the transportation schedule at Hagerman National Fish Hatchery and allows personnel to identify and correct any problems associated with annual fish transportation procedures. In addition to increasing the operational efficiency, the early transport and short-term acclimation may provide fisheries management benefits. The homing efficiency of adults might be increased, thereby minimizing the rate of straying of hatchery-reared steelhead into natural spawning areas. Secondly, short-term rearing at Sawtooth Fish Hatchery enhances Hagerman National Fish Hatchery's ability to not exceed the 4.5 fish per pound (210 mm, fork length) target release size. Steelhead that are full-term reared at Hagerman National Fish Hatchery (15°C water temperature) typically are deprived of food in the spring to retard growth. Feed deprivation can be avoided when acclimating steelhead in the cooler water at Sawtooth Fish Hatchery (7°C).

The purpose of this study is to monitor acclimated and non-acclimated releases at Sawtooth Fish Hatchery, beginning with brood year 1991 Pahsimeroi A and Sawtooth A steelhead stocks. Bjornn et al. (1979) conducted a similar study at Pahsimeroi Fish Hatchery using steelhead raised at Hagerman National Fish Hatchery. The authors reported that a larger percentage of acclimated steelhead (acclimated in 4°C to 10°C water for 10 to 12 weeks) migrated to Lower Granite Dam, Washington, as compared to non-acclimated steelhead released directly from Hagerman National Fish Hatchery. Specific objectives of this study are to:

1. Determine if acclimation affects adult return rate,
2. Determine if acclimation affects the adult age at return,
3. Determine if acclimation affects the sex ratio of returning adults, and
4. Determine if acclimation affects juvenile migration timing and migration success.

In this report, we document study results for brood years' 1991 to 1996 juvenile releases and brood years' 1991 and 1992 adult returns. All adult returns from juvenile releases pertaining to this study will be complete in the year 2000.

METHODS

Brood years 1991-1996 steelhead, Pahsimeroi A and Sawtooth A stocks, were used for the study. For each brood year, juvenile steelhead were categorized into one of two groups, acclimated or non-acclimated. The first group consisted of juvenile steelhead that were acclimated to river water at Sawtooth Fish Hatchery for a period of two to three weeks prior to being released from the raceways into the Salmon River. Steelhead placed in the non-acclimated group were released directly into the Salmon River at Sawtooth Fish Hatchery. Both groups of steelhead were reared at, and transported from, Hagerman National Fish Hatchery.

For each brood year, the acclimated and non-acclimated groups were released no more than four days apart.

In 1995 (brood year 1994) and 1996 (brood year 1995), an additional group of Pahsimeroi A-stock steelhead were acclimated and released. Data from these groups are reported but not used in the analyses.

Passive Integrated Transponder (PIT) tags were used to evaluate the performance of juvenile steelhead emigrating from the upper Salmon River drainage. Fork length (mm), weight (g), tag code, and comments (e.g., fin clips, body damage, additional tags) were recorded for each steelhead that was PIT-tagged. The PIT Tag Identification System sites are located at Lower Granite, Little Goose, and Lower Monumental dams on the lower Snake River and at McNary Dam on the Columbia River. The PIT tag information was downloaded from the Columbia River Basin PIT Tag Information System (PTAGIS) (Pacific States Marine Fisheries Commission 1997). The PIT tagging information, by brood year, group, and tag file, is summarized in Appendix A.

Returns of coded-wire-tagged fish were used to calculate return rates, sex composition, and age composition of adult steelhead returning to the upper Salmon River drainage. These data include Idaho sport fishery harvest, hatchery rack returns, and tributary escapement. Coded-wire tag information was downloaded from the Regional Mark Information System Coded-wire Tag Database (Pacific States Marine Fisheries Commission 1997). Coded-wire tag release information is summarized by brood year, group, and coded-wire tag code (Appendix B).

Data were analyzed using SYSTAT statistical software (SYSTAT 1992). All data were analyzed by brood year. The PIT tag interrogation data (unique interrogations for all dams), which represented replicate raceways within a group (acclimated and non-acclimated), were tested (chi-square - $\alpha=0.05$) by raceway to determine if data could be pooled. Chi-square tests of independence with the Yates correction for continuity ($\alpha=0.05$, Zar 1984) were used to determine if PIT tag interrogation rates differed between groups. Travel time data of PIT-tagged steelhead to Lower Granite Dam were pooled by group and tested using the Mann-Whitney test ($\alpha=0.05$). Chi-square tests of independence with the Yates correction for continuity ($\alpha=0.05$, Zar 1984) were used to test for differences between groups in adult return rates, sex ratios, and age composition of adult steelhead that returned to Idaho waters.

RESULTS

Brood Year 1991

A total of 989 PIT-tagged and 101,278 coded-wire-tagged Pahsimeroi A-stock steelhead were released into the Salmon River on April 10, 1992 at the Sawtooth Fish Hatchery. Of those steelhead that were PIT-tagged, 491 were acclimated and 498 were non-acclimated (Table 1). Of those steelhead possessing coded-wire tags, 55,632 were acclimated and 45,646 were non-acclimated (Table 2).

A total of 28 adult steelhead were recovered in Idaho with coded-wire tags from the 1991 brood. Of those, 13 were from the acclimated group (0.023% of the total acclimated release),

and 15 were from the non-acclimated group (0.033% of the total non-acclimated release) (Appendix C). Appendix D summarizes sex composition, by age, of acclimated and non-acclimated steelhead recovered with coded-wire tags. Return rate ($\chi^2 = 0.51$, $P = 0.475$), age structure ($\chi^2 = 0.57$, $P = 0.449$), and sex ratio ($\chi^2 < 0.001$, $P = 1.00$) of adult steelhead that were acclimated were not significantly different than steelhead that were non-acclimated (Table 2).

Of those steelhead from the acclimated ($n = 491$) and non-acclimated ($n = 498$) groups which were PIT-tagged, 176 (35.8%) and 242 (48.6%), respectively, were interrogated at either Lower Granite, Little Goose, or McNary dams (Appendix B). Juvenile steelhead from the non-acclimated group were interrogated at a significantly ($\chi^2 = 15.95$, $P < 0.001$) higher rate than steelhead from the acclimated group (Table 1). Median travel times to Lower Granite Dam for steelhead that were acclimated and non-acclimated were 35.1 days and 24.9 days, respectively. The PIT-tagged steelhead that were non-acclimated had significantly ($P < 0.001$) shorter travel times to Lower Granite Dam than steelhead that were acclimated.

Table 1. Summary of release and PIT tag interrogation data and chi-square statistics for steelhead smolts (brood years 1991 to 1996) used in the acclimation experiments at Sawtooth Fish Hatchery. Acclimated (ACC) and non-acclimated (NON-ACC) steelhead were studied.

Brood Year	Group	# Released	# Interrogated	% Interrogated	χ^2	P
1991	ACC	491	176	35.8	15.95	<0.001
	NON-ACC*	498	242	48.6		
1992	ACC*	300	188	62.7	4.63	0.031
	NON-ACC	300	161	53.7		
1993	ACC	298	101	33.9	4.23	0.040
	NON-ACC*	302	129	42.7		
1994	ACC	300	177	59.0	0.17	0.677
	NON-ACC	300	183	61.0		
1995	ACC	301	149	49.5	0.80	0.370
	NON-ACC	301	157	52.2		
1996	ACC	889	528	59.4	9.40	0.002

NON-ACC*	299	208	69.6
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* indicates group was interrogated at significantly ($P \leq 0.05$) higher rate

Table 2. Summary of adult return attributes and chi-square statistics for coded-wire-tagged steelhead (brood years 1991 to 1992) used in the acclimation experiments at Sawtooth Fish Hatchery. Acclimated (ACC) and non-acclimated (NON-ACC) steelhead were studied.

NUMBER					
Brood Year	Group	# Released	# Returned	χ^2	P
1991	ACC	55,632	13	0.51	0.475
	NON-ACC	45,646	15		
1992	ACC*	65,865	80	5.79	0.016
	NON-ACC	59,846	46		

SEX RATIO					
Brood Year	Group	# Males	# Females	χ^2	P
1991	ACC	8	5	<0.001	1.000
	NON-ACC	9	6		
1992	ACC	42	38	0.24	0.626
	NON-ACC	27	19		

AGE					
Brood Year	Group	1-Ocean	2-Ocean	χ^2	P
1991	ACC	8	5	0.57	0.449
	NON-ACC	6	9		
1992	ACC	47	33	1.04	0.309
	NON-ACC	32	14		

* indicates group returned at a significantly ($P \leq 0.05$) higher rate

Brood Year 1992

A total of 600 PIT-tagged and 125,711 coded-wire-tagged Pahsimeroi A-stock steelhead were released into the Salmon River on April 9, 1993 at the Sawtooth Fish Hatchery. Of those

steelhead that were PIT-tagged, 300 were acclimated and 300 were non-acclimated (Table 1). Of those steelhead possessing coded-wire tags, 65,865 were acclimated and 59,846 were non-acclimated (Table 2).

A total of 126 adult steelhead were recovered in Idaho with coded-wire tags from the 1992 brood. Of those, 80 were from the acclimated group (0.121% of the total acclimated release) and 46 were from the non-acclimated group (0.077% of the total non-acclimated release) (Appendix C). Steelhead from the acclimated group returned at a significantly ($\chi^2 = 5.79$, $P = 0.016$) higher rate than those steelhead that were non-acclimated (Table 2). Appendix D summarizes sex composition, by age, of acclimated and non-acclimated steelhead recovered with coded-wire tags. The age structure and sex ratio of adult steelhead which were acclimated were not significantly different ($\chi^2 = 1.04$, $P = 0.309$ and $\chi^2 = 0.24$, $P = 0.626$, respectively) than steelhead that were non-acclimated (Table 2).

Of those steelhead from the acclimated ($n = 300$) and non-acclimated ($n = 300$) groups which were PIT-tagged, 188 (62.7%) and 161 (53.7%), respectively, were interrogated at either Lower Granite, Little Goose, Lower Monumental, or McNary dams (Appendix B). Juvenile steelhead from the acclimated group were interrogated at a significantly ($\chi^2 = 4.63$, $P = 0.031$) higher rate than steelhead from the non-acclimated group (Table 1). Median travel time to Lower Granite Dam for steelhead that were acclimated and non-acclimated were 35.7 days and 34.7 days, respectively. No significant ($P = 0.182$) differences were detected between the travel time of acclimated and non-acclimated groups to Lower Granite Dam.

Brood Year 1993

A total of 600 PIT-tagged and 122,016 coded-wire-tagged Sawtooth A-stock steelhead were released into the Salmon River on April 29, 1994 at the Sawtooth Fish Hatchery. Of those that were PIT-tagged, 298 were acclimated and 302 were non-acclimated (Table 1). Of those steelhead possessing coded-wire tags, 60,695 were acclimated and 61,321 were non-acclimated (Appendix B).

The 2-ocean component of the 1993 brood returned in the spring of 1997. The coded-wire tag data for 2-ocean steelhead have not been analyzed at this time. Adult return data from the 1-ocean adults are summarized below.

To date, 30 adult (1-ocean) steelhead were recovered in Idaho with coded-wire tags from the 1993 brood. Of those, 17 were from the acclimated group (0.028% of the total acclimated release) and 13 were from the non-acclimated group (0.021% of the total non-acclimated release) (Appendix C). Appendix D summarizes sex composition, by age, of acclimated and non-acclimated steelhead (1-ocean) recovered with coded-wire tags.

Of those steelhead from the acclimated ($n = 298$) and non-acclimated ($n = 302$) groups which were PIT-tagged, 101 (33.9%) and 129 (42.7%), respectively, were interrogated at either Lower Granite, Little Goose, Lower Monumental, or McNary dams (Appendix B). Juvenile steelhead from the non-acclimated group were interrogated at a significantly ($\chi^2 = 4.23$, $P = 0.04$) higher rate than steelhead from the acclimated group (Table 1). Median travel time to Lower Granite Dam for steelhead that were acclimated and non-acclimated was 14.8 days and 12.3 days, respectively. No significant ($P = 0.08$) differences were detected between the travel time of acclimated and non-acclimated groups to Lower Granite Dam.

Brood Year 1994

A total of 600 PIT-tagged and 120,755 coded-wire-tagged Sawtooth A-stock steelhead were released into the Salmon River at the Sawtooth Fish Hatchery. Steelhead from the acclimated and non-acclimated groups were released on April 17 and April 21, 1995, respectively. For this reason, interrogation rate and travel time data presented below may not be comparable due to changing water conditions. Of those steelhead that were PIT-tagged, 300 were acclimated and 300 were non-acclimated (Table 1). Of those steelhead possessing coded-wire tags, 61,243 were acclimated and 59,512 were non-acclimated (Appendix B).

Of those Sawtooth A-stock steelhead from the acclimated (n = 300) and non-acclimated (n = 300) groups which were PIT-tagged, 177 (59.0%) and 183 (61.0%), respectively, were interrogated at either Lower Granite, Little Goose, Lower Monumental, or McNary dams (Appendix B). No significant ($\chi^2 = 0.17$, $P = 0.677$) differences were detected between interrogation rates of acclimated and non-acclimated steelhead (Table 1). Median travel time to Lower Granite Dam for the Sawtooth A-stock steelhead that were acclimated and non-acclimated was 22.4 days and 17.7 days, respectively. The PIT-tagged steelhead which were non-acclimated had significantly ($P = 0.01$) shorter travel times to Lower Granite Dam than those steelhead which were acclimated.

Adults from brood year 1994 will return in 1997 and 1998. Adult return information will be presented in a project final report.

Brood Year 1995

A total of 602 PIT-tagged and 133,383 coded-wire-tagged Sawtooth A-stock steelhead were released into the Salmon River at the Sawtooth Fish Hatchery. Problems relating to the release dates of brood year 1994 acclimated and non-acclimated groups were addressed at the Hagerman National Fish Hatchery Coordination Meeting in 1996. However, brood year 1995 steelhead from the non-acclimated group were released three days earlier than steelhead from the acclimated group. Steelhead from the acclimated and non-acclimated groups were released on April 19, 1996 and April 16, 1996, respectively. For this reason, interrogation rate and travel time data presented below may not be comparable due to changing water conditions. Of those that were PIT-tagged, 301 were acclimated and 301 were non-acclimated (Table 1). Of those steelhead possessing coded-wire tags, 65,042 were acclimated and 68,341 were non-acclimated (Appendix B).

Of those Sawtooth A-stock steelhead from the acclimated (n = 301) and non-acclimated (n = 301) groups which were PIT-tagged, 149 (49.5%) and 157 (52.2%), respectively, were interrogated at either Lower Granite, Little Goose, Lower Monumental, or McNary dams (Appendix B). No significant ($\chi^2 = 0.80$, $P = 0.37$) differences were detected between interrogation rates of acclimated and non-acclimated steelhead (Table 1). Median travel time to Lower Granite Dam for the Sawtooth A-stock steelhead that were acclimated and non-acclimated was 27.1 days and 16.6 days, respectively. PIT-tagged steelhead which were non-acclimated had significantly ($P = 0.005$) shorter travel time to Lower Granite Dam than those steelhead which were acclimated.

Adults from brood year 1995 will return in 1998 and 1999. Adult return information will be presented in a project final report.

Brood Year 1996

A total of 1,189 PIT-tagged and 124,646 coded-wire-tagged Sawtooth A-stock steelhead were released into the Salmon River on April 25, 1997 at the Sawtooth Fish Hatchery. Of those that were PIT-tagged, 889 were acclimated and 299 were non-acclimated (Table 1). Of those steelhead possessing coded-wire tags, 62,431 were acclimated and 62,215 were non-acclimated (Appendix B).

Of those steelhead from the acclimated (n = 889) and non-acclimated (n = 300) groups which were PIT-tagged, 528 (59.4%) and 208 (69.6%), respectively, were interrogated at either Lower Granite, Little Goose, Lower Monumental, or McNary dams (Appendix B). Juvenile steelhead from the non-acclimated group were interrogated at a significantly ($\chi^2 = 9.40$, $P = 0.002$) higher rate than steelhead from the acclimated group (Table 1). Median travel time to Lower Granite Dam for steelhead that were acclimated and non-acclimated was 16.7 days and 12.1 days, respectively. PIT-tagged steelhead which were non-acclimated had significantly ($P < 0.001$) shorter travel time to Lower Granite Dam than those steelhead which were acclimated.

Adults from brood year 1996 will return in 1999 and 2000. Adult return information will be presented in a project final report.

SUMMARY

Smolt Migration

Differences in PIT tag interrogation rates between acclimated and non-acclimated steelhead smolts were detected in four of the six years that the experiments were conducted. Non-acclimated steelhead from the 1991, 1993, and 1996 broods were interrogated at significantly higher rates than steelhead that were acclimated (Table 1). Only one acclimated group of steelhead, brood year 1992, was interrogated at a higher rate than their non-acclimated counterpart. No differences were detected between interrogation rates of acclimated and non-acclimated steelhead from the 1994 and 1995 broods.

The PIT-tagged steelhead which were non-acclimated had significantly shorter travel time to Lower Granite Dam than the acclimated steelhead in four of the six years (brood years 1991, 1994, 1995, and 1996) that the experiments were conducted. No differences were detected between the travel times of acclimated and non-acclimated steelhead from the 1992 and 1993 broods.

It should be reiterated that, because the acclimated and non-acclimated steelhead from brood years 1994 and 1995 were not released at the same time, the PIT tag interrogation data between groups within a year may not be comparable due to changes in water conditions.

Adult Return

Adult steelhead data are complete for only the 1991 and 1992 brood years. A total of 28 brood year 1991 and 126 brood year 1992 coded-wire-tagged steelhead returned to Idaho waters. Acclimated steelhead from the 1992 brood returned at a significantly higher rate than steelhead that were non-acclimated. For brood year 1991, return rate of acclimated and non-

acclimated steelhead was not significantly different. Sex ratio and age composition of brood year 1991 and 1992 steelhead did not differ between groups (acclimated, non-acclimated).

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APPENDICES

Appendix A. PIT tag interrogation data for Sawtooth Fish Hatchery acclimation experiments, brood years 1991 to 1996. The PIT tag interrogation data are summarized by brood year, group (acclimated, non-acclimated), and tagging file. Interrogation sites are Lower Granite (LGR), Little Goose (LGO), Lower Monumental (LMN), and McNary (MCN) dams. Pahsimeroi A (PAH A) and Sawtooth A (SAW A) stocks were studied. Median travel time was calculated to Lower Granite Dam only.

Tag File	Release Site	Rel. Date	#Tag	#Rel	Mean Tag Length (mm)	S.D.	S.E.	INTERROGATION INFORMATION										Median Travel Time (days)
								LGR		LGO		LMN		MCN		TOTAL		
								n	%	n	%	n	%	n	%	n	%	
BROOD YEAR																		
1991																		
ACCLIMATED																		
PAH A-STOCK																		
DAC92066.H91	SAWTP	4/10/92	100	98	207	16.75	1.67	33	33.7	6	6.1	*	*	1	1.0	40	40.8	30.9
DAC92066.H92	SAWTP	4/10/92	100	98	210	20.68	2.07	30	30.6	5	5.1	*	*	0	0.0	35	35.7	34.3
DAC92066.H93	SAWTP	4/10/92	100	100	202	18.05	1.81	37	37.0	2	2.0	*	*	0	0.0	39	39.0	34.5
DAC92066.H94	SAWTP	4/10/92	100	98	199	21.43	2.14	22	22.4	3	3.1	*	*	0	0.0	25	25.5	35.0
DAC92066.H95	SAWTP	4/10/92	100	97	196	19.89	1.99	34	35.1	2	2.1	*	*	1	1.0	37 ^a	38.1	45.0
					TOTAL											TOTAL	176	
NON-ACCLIMATED																		
PAH A-STOCK																		
DAC92065.79H	SAWTP	4/10/92	47	46	201	15.96	2.33	26	56.5	2	4.3	*	*	0	0.0	28	60.9	24.6
DAC92065.80H	SAWTP	4/10/92	33	33	205	15.75	2.74	10	30.3	2	6.1	*	*	1	3.0	13	39.4	25.0
DAC92065.H78	SAWTP	4/10/92	167	166	196	22.62	1.75	68	41.0	7	4.2	*	*	0	0.0	75	45.2	24.7
DAC92065.H79	SAWTP	4/10/92	120	119	190	19.72	1.80	51	42.9	6	5.0	*	*	2	1.7	59	49.6	25.1
DAC92065.H80	SAWTP	4/10/92	134	134	192	19.07	1.65	60	44.8	5	3.7	*	*	2	1.5	67	50.0	25.3
					TOTAL											TOTAL	242	
BROOD YEAR																		
1992																		
ACCLIMATED																		
PAH A-STOCK																		
DAC93051.H69	SAWTP	4/09/93	100	100	192	21.54	2.15	49	49.0	8	8.0	3	3.0	0	0.0	60	60.0	36.7
DAC93051.H70	SAWTP	4/09/93	100	100	191	19.48	1.95	45	45.0	16	16.0	1	1.0	3	3.0	65	65.0	35.6
DAC93051.H71	SAWTP	4/09/93	100	100	197	19.53	1.95	50	50.0	10	10.0	2	2.0	1	1.0	63	63.0	34.0

TOTAL 300

TOTAL 188

Appendix A. (Continued).

Tag File	Release Site	Rel. Date	#Tag	#Rel	Mean Tag Length (mm)	S.D.	S.E.	INTERROGATION INFORMATION										Median Travel Time (days)
								LGR		LGO		LMN		MCN		TOTAL		
								n	%	n	%	n	%	n	%	n	%	
BROOD YEAR																		
1992 (continued)																		
NON-ACCLIMATED																		
PAH A-STOCK																		
DAC93051.H72	SAWTP	4/09/93	100	100	185	18.41	1.84	37	37.0	10	10.0	2	2.0	2	2.0	51	51.0	32.9
DAC93051.H73	SAWTP	4/09/93	100	100	188	16.88	1.69	43	43.0	4	4.0	4	4.0	1	1.0	52	52.0	36.3
DAC93051.H74	SAWTP	4/09/93	100	100	190	16.45	1.65	45	45.0	7	7.0	4	4.0	2	2.0	58	58.0	31.3
		TOTAL		300											TOTAL	161		
BROOD YEAR																		
1993																		
ACCLIMATED																		
SAW A-STOCK																		
DAC94047.H54	SAWTP	4/29/94	100	100	185	19.14	1.91	26	26.0	8	8.0	2	2.0	2	2.0	38 ^b	38.0	17.8
DAC94048.H55	SAWTP	4/29/94	98	98	185	17.94	1.81	24	24.5	4	4.1	3	3.1	2	2.0	33	33.7	13.7
DAC94048.H56	SAWTP	4/29/94	100	100	186	17.34	1.73	20	20.0	7	7.0	1	1.0	2	2.0	30 ^c	30.0	11.6
		TOTAL		298											TOTAL	101		
NON-ACCLIMATED																		
SAW A-STOCK																		
DAC94047.H51	SAWTP	4/29/94	102	102	179	16.46	1.63	30	29.4	10	9.8	3	2.9	1	1.0	44	43.1	11.8
DAC94047.H52	SAWTP	4/29/94	100	100	176	17.64	1.76	30	30.0	9	9.0	6	6.0	2	2.0	47 ^d	47.0	12.6
DAC94047.H53	SAWTP	4/29/94	100	100	181	19.81	1.98	25	25.0	3	3.0	5	5.0	5	5.0	38	38.0	13.3
		TOTAL		302											TOTAL	129		
BROOD YEAR																		
1994																		
ACCLIMATED																		
SAW A-STOCK																		
DAC95064.H51	SAWTP	4/21/95	300	300	188	20.65	1.19	123	41.0	34	11.3	18	6.0	2	0.7	177	59.0	22.4
		TOTAL		300											TOTAL	177		
PAH A-STOCK																		
DAC95065.H66	SAWTP	4/21/95	300	300	188	23.78	1.37	131	43.7	35	11.7	19	6.3	1	0.3	186	62.0	23.0

Appendix A. (Continued).

Tag File	Release Site	Rel. Date	#Tag	#Rel	Mean Tag Length (mm)	S.D.	S.E.	INTERROGATION INFORMATION										Median Travel Time (days)	
								LGR		LGO		LMN		MCN		TOTAL			
								n	%	n	%	n	%	n	%	n	%		
BROOD YEAR 1994 (continued) NON-ACCLIMATED SAW A-STOCK																			
DAC95064.H48	SAWTP	4/17/95	300	300	187	20.66	1.19	135	45.0	21	7.0	24	8.0	3	1.0	183	61.0	17.7	
		TOTAL		300											1.0	TOTAL	183		
BROOD YEAR 1995 ACCLIMATED SAW A-STOCK																			
TDR96073.H55	SAWTP	4/19/96	301	301	181	21.41	1.24	104	34.6	24	8.0	18	6.0	3	1.0	149	49.5	27.1	
		TOTAL		301											1.0	TOTAL	149		
PAH A-STOCK																			
TDR96074.H74	SAWTP	4/19/96	302	302	195	23.39	1.35	119	39.4	39	12.9	22	7.3	3	1.0	183 ^e	60.6	15.8	
NON-ACCLIMATED SAW A-STOCK																			
TDR96073.H61	SAWTP	4/16/96	301	301	179	23.75	1.37	101	33.6	29	9.6	24	8.0	3	1.0	157 ^f	52.2	16.6	
		TOTAL		301											1.0	TOTAL	157		
BROOD YEAR 1996 ACCLIMATED SAW A-STOCK																			
TDR97057.H11	SAWTP	4/25/97	300	299	169	17.97	1.04	100	33.4	46	15.4	26	8.7	2	0.7	174	58.2	15.5	
TDR97057.H21	SAWTP	4/25/97	300	291	172	20.15	1.16	109	37.5	44	15.1	31	10.7	0	0.0	184	63.2	18.1	
TDR97057.H22	SAWTP	4/25/97	300	299	168	19.83	1.15	102	34.1	44	14.7	22	7.4	2	0.7	170	56.9	17.1	
		TOTAL		889											0.7	TOTAL	528		

Appendix A. (Continued).

Tag File	Release Site	Rel. Date	#Tag	#Rel	Mean Tag Length (mm)	S.D.	S.E.	INTERROGATION INFORMATION								Median Travel Time (days)		
								LGR		LGO		LMN		MCN			TOTAL	
								n	%	n	%	n	%	n	%		n	%
BROOD YEAR																		
1996 (continued)																		
NON-ACCLIMATED																		
SAW A-STOCK																		
TDR97057.H12	SAWTP	4/25/97	300	299	173	19.10	1.10	140	46.8	44	14.7	23	7.7	1	0.3	208	69.6	12.1
			TOTAL	299											TOTAL	208		

- * The PIT Tag Identification System at Lower Monumental Dam (LMN) was not operational until 1993, thus no data were available for brood year 1991
- ^a Includes 1 fish which had a travel time greater than 280 days (March-November)
- ^b Includes 1 fish which had a travel time greater than 280 days (March-November)
- ^c Includes 1 fish which had a travel time greater than 280 days (March-November)
- ^d Includes 2 fish which had travel times greater than 280 days (March-November)
- ^e Includes 2 fish which had travel times greater than 280 days (March-November)
- ^f Includes 1 fish which had a travel time greater than 280 days (March-November)

Appendix B. Coded-wire tag (CWT) release and passive integrated transponder (PIT) tag interrogation data for acclimated (ACC) and non-acclimated (NON-ACC) steelhead, brood years 1991 to 1996, that were released into the Salmon River to test acclimation at Sawtooth Fish Hatchery.

GROUP	STOCK	CWT RELEASE DATA		PIT TAG FILE	PIT TAG DATA PIT NUM	TOTAL INTERROGATIONS	
		CWT CODE	NUMBER			NUMBER	PERCENT
BROOD YEAR 1991							
ACC	PAH A	104421	17,955	DAC92065.H91-95	491	176	35.8
ACC	PAH A	104422	18,336				
ACC	PAH A	104423	19,341				
		TOTAL	55,632				
NON-ACC	PAH A	104007	45,646	DAC92065.H78-80, 79-80H	498	242	48.6
		TOTAL	45,646				
BROOD YEAR 1992							
ACC	PAH A	105010	8,161	DAC93051.H69-71	300	188	62.7
ACC	PAH A	105020	20,508				
ACC	PAH A	105021	18,890				
ACC	PAH A	105022	18,306				
		TOTAL	65,865				
NON-ACC	PAH A	104949	19,196	DAC93051.H72-74	300	161	53.7
NON-ACC	PAH A	104950	18,219				
NON-ACC	PAH A	104951	17,868				
NON-ACC	PAH A	105034	4,563				
		TOTAL	59,846				
BROOD YEAR 1993							
ACC	SAW A	104629	60,695	DAC94047.H54-56	298	101	33.9
		TOTAL	60,695				
NON-ACC	SAW A	104628	61,321	DAC94047.H51-53	302	129	42.7
		TOTAL	61,321				

Appendix B. (Continued.)

GROUP	STOCK	CWT RELEASE DATA		PIT TAG FILE	PIT TAG DATA PIT NUM	TOTAL INTERROGATIONS	
		CWT CODE	NUMBER			NUMBER	PERCENT
BROOD YEAR 1994							
ACC	SAW A	104510	20,321	DAC95064.H51	300	177	59.0
ACC	SAW A	104511	20,331				
ACC	SAW A	104512	20,591				
		TOTAL	61,243				
NON-ACC	SAW A	104507	19,923	DAC95064.H48	300	183	61.0
NON-ACC	SAW A	104508	19,689				
NON-ACC	SAW A	104509	19,900				
		TOTAL	59,512				
ACC	PAH A	104518	23,576	DAC95065.H66	300	186	62.0
ACC	PAH A	104519	21,995				
ACC	PAH A	104520	18,109				
		TOTAL	63,680				
BROOD YEAR 1995							
ACC	SAW A	104523	20,034	TDR96073.H55	301	149	49.5
ACC	SAW A	104524	21,351				
ACC	SAW A	104525	23,657				
		TOTAL	65,042				
NON-ACC	SAW A	104529	20,824	TDR96073.H61	301	157	52.2
NON-ACC	SAW A	104530	23,357				
NON-ACC	SAW A	104531	24,160				
		TOTAL	68,341				
ACC	PAH A	104532	21,690	TDR96074.H74	302	183	60.6
ACC	PAH A	104533	21,922				
ACC	PAH A	104534	20,067				
		TOTAL	63,679				

Appendix B. (Continued.)

GROUP	STOCK	CWT RELEASE DATA		PIT TAG FILE	PIT TAG DATA PIT NUM	TOTAL INTERROGATIONS	
		CWT CODE	NUMBER			NUMBER	PERCENT
BROOD YEAR 1996							
ACC	SAW A	105151	21,122	TDR97057.H11,21,22	889	528	59.4
ACC	SAW A	105152	20,629				
ACC	SAW A	105153	20,680				
		TOTAL	62,431				
NON-ACC	SAW A	105154	21,020	TDR97057.H12	299	208	69.6
NON-ACC	SAW A	105155	20,580				
NON-ACC	SAW A	105156	20,615				
		TOTAL	62,215				

ACC	PAH A	104534	<u>20,067</u>									
		TOTAL	<u>63,679</u>	1999	ND							

Appendix C. (Continued.)

RELEASE DATA				RETURN DATA								
GROUP	STOCK	CWT CODE	NUMBER CWT	YEAR COMPLETE	IDAHO FISHERY RECOVERIES		IDAHO HATCHERY RECOVERIES		TRIBUTARY STRAYS		TOTAL RETURN	PERCENT RETURN
					1-OCEAN	2-OCEAN	1-OCEAN	2-OCEAN	1-OCEAN	2-OCEAN		
BROOD YEAR 1996												
ACC	SAW A	105151	21,122									
ACC	SAW A	105152	20,629									
ACC	SAW A	105153	20,680									
		TOTAL	<u>62,431</u>	2000	ND	ND	ND	ND	ND	ND	ND	ND
NON-ACC	SAW A	105154	21,020									
NON-ACC	SAW A	105155	20,580									
NON-ACC	SAW A	105156	20,615									
		TOTAL	<u>62,215</u>	2000	ND	ND	ND	ND	ND	ND	ND	ND

* Based on returns of 1-ocean fish only

Appendix D. Sex composition, by age, of acclimated (ACC) and non-acclimated (NON-ACC) steelhead recovered in Idaho with coded-wire tags (CWT). Steelhead were released from Hagerman National Fish Hatchery in 1992 (brood year 1991), 1993 (brood year 1992), and 1994 (brood year 1993) into the Salmon River at Sawtooth Fish Hatchery.

GROUP	BROOD YEAR	NUMBER CWT	TOTAL 1-OCEAN	SEX—1-OCEAN		TOTAL 2-OCEAN	SEX—2-OCEAN	
				M	F		M	F
ACC	1991	55,632	8	8	0	5	0	5
NON-ACC	1991	45,646	6	4	2	9	5	4
ACC	1992	65,865	47	32	15	33	10	23
NON-ACC	1992	59,846	32	23	9	14	4	10
ACC	1993	60,695	17	11	6	ND	ND	ND
NON-ACC	1993	61,321	13	10	3	ND	ND	ND

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