2003 Goldsborough Creek Post-Dam Removal Smolt Trapping Study:

2003 Smolt Trapping Project Summary and Data Compilation for the

United States Army Corps of Engineers
Seattle District
Seattle, Washington

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2003 Goldsborough Creek Post-Dam Removal Smolt Trapping Study

Project Summary

Goldsborough Creek is located in Mason County, Washington, in the Hammersley Inlet-Oakland Bay Watershed, and is the largest stream system within WRIA 14. The U.S. Army Corps of Engineers, Simpson Timber Company, Squaxin Island Tribe, and other parties worked together in the removal the Goldsborough Dam in September 2001. Removal of the dam and associated restoration should improve salmon habitat and increase of salmonid production in the 25 miles of mainstream and tributaries above the dam site.

Prior to the dam removal and channel reconstruction by the U.S. Army Corps of Engineers, a monitoring plan was put in place for pre- dam removal. Squaxin Island Tribe and US Fish and Wildlife Service (USFWS) conducted smolt trapping on Goldsborough Creek in 1999-2001 to monitor and assess the smolt production preceding the dam removal. For results and information regarding pre-dam removal see: Squaxin Island Tribe 1999, Bernard et al. (1999), USFW 2000, Celedonia et al. (2001), and 2001, Missildine (2001).

In the spring of 2002, the Squaxin Island Tribe implemented post-dam monitoring by conducting a smolt trap project within the Goldsborough restoration site. Now that the dam has been removed all adult spawning *Oncorhynchus spp.* in Goldsborough Creek will have access to the twenty plus miles of mainstream, tributaries, and wetlands above the dam site, prime rearing habitat for juvenile salmonids, which is hypothesized to result in increased production above the dam site.

The Squaxin Island Tribe continued its study of post-dam monitoring by conducting a smolt trap project within the Goldsborough site in the spring of 2003. Squaxin Island Tribe installed two rotary-screw traps, one located above the dam removal site and one below the project area near the mouth of Goldsborough Creek. In the attempt to ensure that all outmigrating juvenile *Oncorhynchus spp.* were counted, the screw traps were scheduled to be installed by the 4th week of March. Due to high and swift river flows the installation of the traps was delayed to March 31st, 2003. The upper and lower screw traps were in operation from March 31, 2003 to July 2, 2003. Both Traps were checked twice daily, once in the morning hours of 8 to 9 AM and once in the late afternoon hours of 3 to 4 PM. Each salmonid species (*Oncorhynchus spp.*) was identified, counted, fork length measured, and recorded on data collection sheets. In addition, all other fish species and organisms were identified and counted.

Using Peterson's Mark/Recapture Methodology we were able to calculate lower and upper trap catch efficiencies four separate times throughout the smolt trapping season. For the upper trap our marking consisted of clipping the upper lobe of the caudal fin of wild coho

smolts captured in the upper trap, and at times using coho captured in the lower trap, and releasing them 100 meters upstream from the upper trap. Lower lobe caudal fin clips were used to mark coho for the lower trap efficiency and were released just below the upper trap site. The upper trap yielded a mean efficiency of 15.31%, while the lower trap produced a mean efficiency of 21.10%.

2003 numbers indicate that there was an increase in natural coho production compared to 2002 data with an estimated coho outmigration of 61,844 coho smolts (21.10% lower trap efficiency) in the Goldsborough watershed, of these an estimated 40,840 coho smolts outmigrated from above the dam site. In 2002, no more than an estimated 6,090 (11.92 % trap efficiency) pre-dam coho outmigrated from the Goldsborough watershed. The vast increase of outmigrating coho in Goldsborough Creek can be attributed to improved stream conditions and the increase of adult coho escapement into the upper watershed above the dam site.

Prior to dam removal studies showed zero chum salmon fry. Once again, chum salmon were seen above the dam site in 2003, but not in as prolific numbers in as 2002. The upper trap captured a total of 4,010 chum fry compared the 15,921 chum fry captured in 2002. One factor that may be influencing the lower chum fry numbers is predation by the increased number of coho smolts in the area this year. It can be concluded that adult chinook migrated above the dam site. Pre-dam removal smolt trap studies above the dam in 2000 and 2001 encountered zero chinook smolt. In the two years of the dam removal the upper trap has show and increase of chinook above the dam site, with 1 chinook in 2002 and 180 chinook trapped in 2003.

While 2003 smolt trapping data is the second year of post-dam removal data, at this time only preliminary conclusions can be made on the success of the Goldsborough Restoration Project. 2003 is the first year that we would expect to see coho smolts that directly benefited from the dam removal. The Squaxin Island Tribe believes that continued smolt monitoring within the Goldsborough restoration site is essential for at least 2 more years to continue building a reliable post-dam database of smolt production. Provided that this post-dam database can show a consecutive yearly increase of smolt production above the dam site in relation to the natural fluctuations the dam removal and restoration project can be concluded as a success.

A summary of the 2003 Squaxin Island Tribe Goldsborough Creek Post-Dam Removal Smolt Trapping Study data is represented in the following tables: Upper and lower trap efficiencies, upper and lower trap daily catches, and species overview of catch.

Table 1.
2003 Upper Goldsborough Screw Trap Daily Catch of Oncorhynchus spp. and other non-salmonid species.

	Oncorhynchus spp.						Non- salmonids	
Date	Coho	< 1 Coho	Chinook	Chum	Cutthroat	< 1 Cutthroat	Lamprey	Stickelback
4/1/2003	0	0	0	0	0	0		0
4/2/2003	5	2	0	0	2	0		0
4/3/2003	5	0	0	0	1	0		0
4/4/2003	2	1	0	33	1	0		0
4/5/2003	2	0	1	52	0	0		0
4/6/2003	4	0	1	50	1	0		0
4/7/2003	11	0	0	117	2	0		0
4/8/2003	17	0	0	185	1	0		0
4/9/2003	12	1	0	151	5	0		0
4/10/2003	29	0	1	75	3	0		0
4/11/2003	7	0	0	58	3	0		0
4/12/2003	17	3	0	75	4	0		0
4/13/2003	0	0	0	0	0	0		0
4/14/2003	0	0	0	0	0	0		0
4/15/2003	20	0	1	13	5	0		0
4/16/2003	8	0	1	104	3	0		0
4/17/2003	18	3	2	207	4	0		0
4/18/2003	9	1	2	281	1	0		0
4/19/2003	10	0	0	301	0	1		0
4/20/2003	20	0	1	350	0	0		0
4/21/2003	30	0	2	0	1	0		0
4/22/2003	37	0	2	320	3	0		0
4/23/2003	48	0	2	219	8	0		1
4/24/2003	135	0	0	129	4	0		1
4/25/2003	283	0	1	6	5	0		0
4/26/2003	157	1	2	104	4	0		1
4/27/2003	225	0	0	29	4	0		0
4/28/2003	269	2	0	12	3	0		0

Table 1. Con't.

2003 Upper Goldsborough Screw Trap Daily Catch of Oncorhynchus spp. and other non-salmonid species.

	Oncorhynchus spp.						Non- salmonids		
Date	Coho	< 1 Coho	Chinook	Chum	Cutthroat	< 1 Cutthroat	Lamprey	Sculpin	Stickelback
4/29/2003	267	0	7	14	10	0	3	0	0
4/30/2003	238	0	2	4	8	0	1	0	0
5/1/2003	299	2	7	0	9	0	8	0	1
5/2/2003	356	0	1	19	3	0	4	1	0
5/3/2003	220	0	2	1	6	0	3	0	0
5/4/2003	177	0	0	9	3	0	4	1	0
5/5/2003	373	0	3	0	3	0	4	0	1
5/6/2003	519	0	4	0	2	0	4	1	1
5/7/2003	194	0	3	12	2	0	5	0	1
5/8/2003	178	0	1	48	1	0	2	1	0
5/9/2003	229	0	3	22	1	0	5	0	0
5/10/2003	203	0	2	13	0	0	4	0	0
5/11/2003	317	0	10	16	5	0	2	1	0
5/12/2003	211	0	5	72	3	0	4	0	2
5/13/2003	161	0	7	218	0	0	2	0	1
5/14/2003	122	0	5	134	2	0	5	0	0
5/15/2003	73	0	3	296	0	0	2	0	0
5/16/2003	58	0	4	109	1	0	5	5	0
5/17/2003	67	0	1	69	0	0	2	3	0
5/18/2003	60	0	2	48	1	0	4	1	0
5/19/2003	72	0	4	12	0	1	5	6	0
5/20/2003	60	0	6	0	0	1	2	0	0
5/21/2003	30	0	6	14	1	2	5	0	0
5/22/2003	68	0	17	0	5	0	0	0	1
5/23/2003	76	1	8	0	4	1	3	5	0
5/24/2003	65	0	11	5	4	0	7	1	1
5/25/2003	29	0	5	9	4	2	0	2	0

Table 1. Con't.
2003 Upper Goldsborough Screw Trap Daily Catch of Oncorhynchus spp. and other non-salmonid species.

	Oncorhynchus spp.						Non- salmonids		
Date	Coho	< 1 Coho	Chinook	Chum	Cutthroat	< 1 Cutthroat	Lamprey	Sculpin	Stickelback
5/26/2003	48	0	6	1	0	2	4	1	0
5/27/2003	17	0	4	12	1	4	7	1	0
5/28/2003	37	0	6	0	2	1	4	0	0
5/29/2003	27	0	2	0	1	1	4	4	0
5/30/2003	14	0	0	0	0	1	3	2	2
5/31/2003	15	0	2	0	0	6	4	3	0
6/1/2003	5	0	2	0	5	0	5	1	1
6/2/2003	12	0	2	0	4	0	5	4	0
6/3/2003	6	0	2	0	1	3	2	2	0
6/4/2003	3	0	2	0	1	2	0	5	0
6/5/2003	4	0	1	1	1	6	3	0	1
6/6/2003	7	0	0	0	3	5	2	1	0
6/7/2003	5	0	0	0	1	6	2	0	0
6/8/2003	3	0	0	0	1	5	1	7	0
6/9/2003	0	0	2	2	0	7	2	2	0
6/10/2003	1	0	0	1	2	0	1	0	0
6/11/2003	0	0	0	0	1	2	1	0	0
6/12/2003	1	0	0	0	0	5	0	0	0
6/13/2003	0	0	0	0	0	3	1	1	1
6/14/2003	0	0	1	1	0	7	0	0	0
6/15/2003	0	0	0	0	1	0	1	2	0
6/16/2003	0	0	0	0	2	3	3	0	0
6/17/2003	0	0	0	1	0	5	5	1	0
6/18/2003	0	0	0	0	0	2	4	0	0
6/19/2003	0	0	0	0	0	3	0	2	0
6/20/2003	0	0	0	0	0	0	0	0	0
6/21/2003	0	0	0	0	0	3	2	0	0
6/22/2003	0	0	0	0	1	0	2	0	0

Table 1. Con't.

2003 Upper Goldsborough Screw Trap Daily Catch of Oncorhynchus spp. and other non-salmonid species.

	Oncorhynchus spp.						Non- salmonids		
Date	Coho	< 1 Coho	Chinook	Chum	Cutthroat	< 1 Cutthroat	Lamprey	Sculpin	Stickelback
6/23/2003	0	0	0	0	0	2	2	0	0
6/24/2003	0	0	0	0	0	3	2	0	0
6/25/2003	0	0	0	0	1	2	1	0	1
6/26/2003	1	0	0	0	1	5	0	0	0
6/27/2003	1	0	0	0	3	7	2	2	0
6/28/2003	0	0	0	0	0	0	0	0	0
6/29/2003	0	0	0	0	1	5	0	0	0
6/30/2003	0	0	0	0	0	0	0	0	0
7/1/2003	0	0	0	0	0	0	0	0	0
7/2/2003	0	0	0	0	1	6	4	2	0

1. Daily coho count reflects total fish caught at upper trap including recaptured clipped fish.

Table 2.
2003 Lower Goldsborough Screw Trap Daily Catch of Oncorhynchus spp. and other non-salmonid species.

Date	Oncorhynchus spp.						Non- salmonids		
	Coho	< 1 Coho	Chinook	Chum	Cutthroat	Steelhead/RB	Lamprey	Sculpin	Stickelback
	0	0	0	5	0	0	0	2	2
	21	0	0	1	3	0	2	5	0
	12	0	0	95	2	0	0	1	1
	13	0	0	126	3	0	1	0	0
	10	0	1	60	2	0	0	2	1
	20	0	1	256	5	0	1	2	1
	16	0	0	255	1	0	0	3	0
	31	0	0	210	10	0	6	0	0
	37	0	0	49	5	0	2	1	0
	38	1	0	29	17	0	2	2	0
	35	0	0	28	8	0	1	2	0
	26	2	1	68	9	0	3	4	0
	34	0	0	137	9	0	1	1	0
	100	0	0	34	9	0	0	3	0
	31	0	0	33	3	0	0	0	0
	43	0	2	22	5	0	0	8	0
	55	0	0	72	7	0	0	4	0
	51	2	0	81	4	0	0	4	0
	61	0	1	79	5	0	0	3	0
	60	0	4	55	8	0	0	8	0
	80	0	1	45	5	0	1	8	0
	120	0	1	82	6	0	0	4	0
	169	0	0	48	9	0	0	6	0
	299	0	0	19	8	0	0	8	0
	454	0	0	14	0	0	0	3	0
	345	1	2	12	9	0	0	2	0
	439	0	1	2	6	1	0	4	0
	552	1	0	0	6	0	0	5	0
	402	0	0	9	14	0	0	11	0

Table 2 Con't.

2003 Lower Goldsborough Screw Trap Daily Catch of Oncorhynchus spp. and other non-salmonid species.

Date	Oncorhynchus spp.						Non- salmonids	
	Coho	< 1 Coho	Chinook	Chum	Cutthroat	Steelhead/RB	Lamprey	Stickelback
	773	0	3	3	23	0		0
	641	2	5	7	18	1		0
	577	0	0	19	9	1		0
	461	0	1	14	10	0		0
	306	0	1	13	9	0		0
	1089	0	3	58	3	0		0
	803	0	1	10	0	0		0
	524	0	2	15	1	0		0
	483	0	4	0	0	0		0
	471	0	1	8	3	0		1
	402	0	4	7	1	0		0
	462	0	4	8	4	0		0
	452	0	5	19	6	0		0
	459	0	4	0	16	0		0
	220	0	3	0	8	0		0
	326	0	2	10	3	0		1
	218	0	5	17	3	0		0
	135	0	9	4	2	0		0
	87	0	6	5	0	0		0
	182	0	3	8	1	0		0
	147	0	4	2	2	0		0
	195	0	2	9	1	0		0
	0	0	0	10	0	0		0
	31	0	4	0	6	0		0
	14	1	4	4	6	0		0
	13	0	5	0	9	0		0
	32	0	4	0	2	0		0
	6	0	2	2	5	0		0
	12	0	7	5	2	0		0

Table 2 Con't.

2003 Lower Goldsborough Screw Trap Daily Catch of Oncorhynchus spp. and other non-salmonid species.

	Oncorhyncnus spp.						Non- salmonids	
Date	Coho	< 1 Coho	Chinook	Chum	Cutthroat	Steelhead/RB	Lamprey	Stickelback
						0		
						0		
						0		
						0		
						0		
						0		
						0		
						0		
						0		
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						0		
						0		
						0		
						0		

Table 2 Con't.

2003 Lower Goldsborough Screw Trap Daily Catch of Oncorhynchus spp. and other non-salmonid species.

Date	Oncorhynchus spp.						Non- salmonids		
	Coho	< 1 Coho	Chinook	Chum	Cutthroat	Steelhead/RB	Lamprey	Sculpin	Stickelback
	0	0	3	0	0	0			0
	0	0	0	0	0	0			0
	1	0	0	0	4	0			0
	0	0	0	0	0	0			0
	0	0	0	0	0	0			0
	0	0	2	0	4	0			0
TOTALS									

1. Daily coho count reflects total fish caught at lower trap including recaptured clipped fish.

Table 3.
Mark-recapture results for Upper and Lower Screw Trap efficiency estimates.

Upper Trap Efficiency*				Lower Trap Efficiency*			
Release Date	Marked Sample[1] (*m*)	Recaptures (R)	Efficiency ( )	Release Date	Marked Sample[1] (*m*)	( )	Efficiency ($\hat{E}$)
04/22;4/24[2]	116	7	0.0603	4/23;4/24[3]	143		0.2587
5/2	102	29	0.2843	5/3	101		0.3861
5/12	102	6	0.0588	5/13	108		0.1667
5/22	67	14	0.2090	5/23	31		0.0323
		56				95	
	Mean Efficiency =		**0.1531**		Mean Efficiency=		**0.2110**

[1]All randomly sampled Coho smolts.
[2]This sample is a combination of two releases with the same mark and location occuring 2 days apart.
[3]This sample is a combination of two releases with the same mark and location occuring 1 day apart.

Estimated Outmigrating Coho Smolts $(n = C/\hat{E})_j$

n = is the estimated number of outmigrating Coho Sm(C= is the total catch for trap j $\hat{E}$= Trap effieciency

For the purpose of calculating the Estimated Outmigrating coho smolts:
Upper Trap total catch only consists of unmarked fish only, since marked fish were included in the catch when they were first caught and marked.
Lower Trap total catch consists of all unmarked fish and upper caudal clip fish.

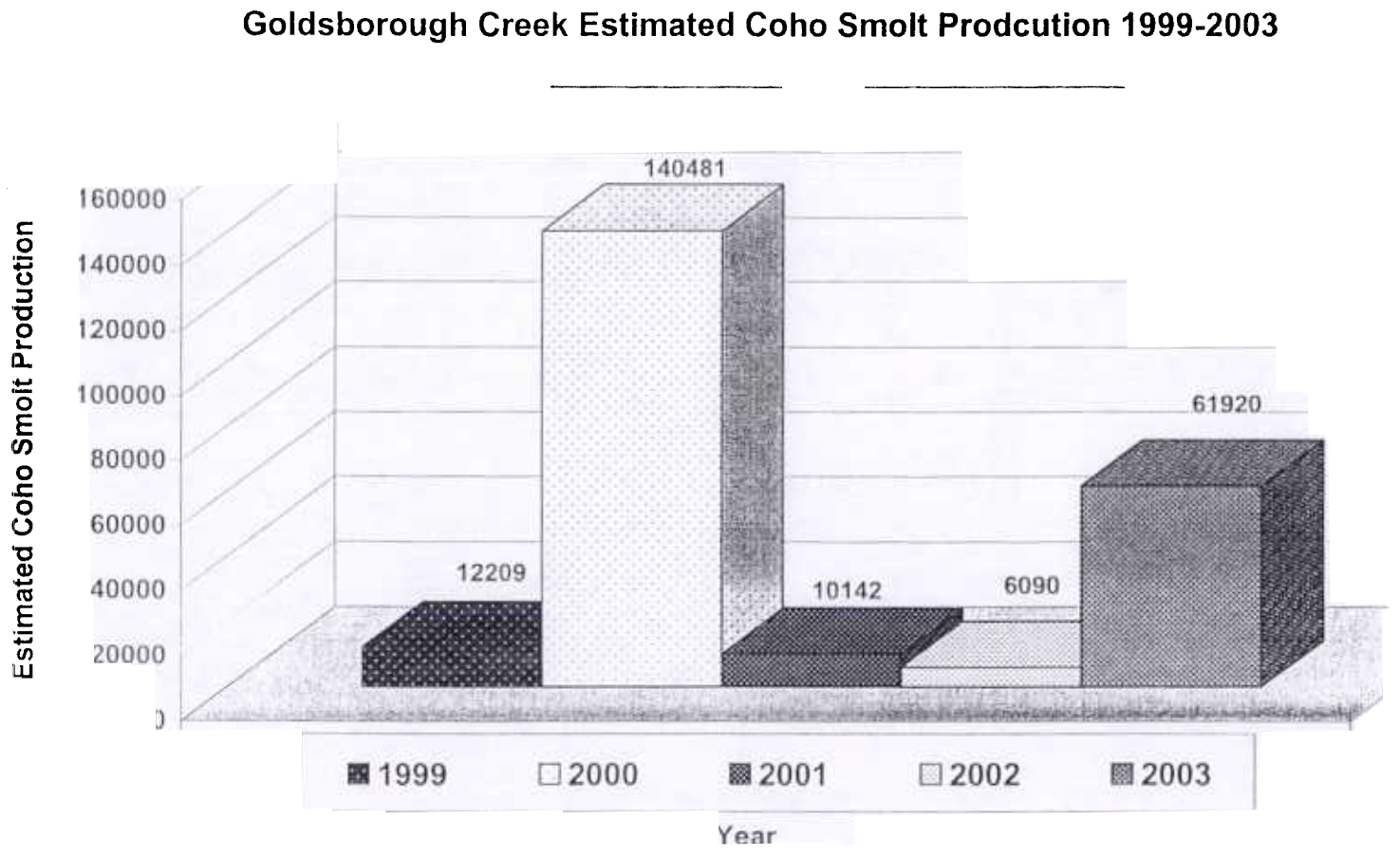
Estimated Outmigrating coho smolts	**Upper Trap =**	**40840**
	Lower Trap=	**61844**

Table 4.
Total catch and mean fork lengths of salmonids and other species caught in upper and lower traps.

Upper Trap			Lower Trap	
Species Caught	Number	Fork length (mm)	Species Caught	Fork length (mm)
Coho	6309	107.5	Coho	113.4
< 1 Coho	17	86.0	< 1 Coho	94.0
Chinook	180	69.5	Chinook	79.0
Chum	4034	36.9	Chum	35.8
Steelhead/RB	0	na	Cutthroat	164.4
< 1 Steelhead/RB	0	na	Steelhead/RB	199.0
Cutthroat	181	143.3	Catfish	na
< 1 Cutthroat	120	46.2	Lamprey	na
Sculpin	85	na	Sculpin	na
Stickleback	18	na	Stickleback	na
Lamprey	226	na		

Total coho catches include recaptured clipped coho.

Chart 1. **Goldsborough Creek Estimated Coho Smolt Production 1999-2003**



2000-Goldsborough Trapped by USFW. Catch is Egg tube and Natural Coho (2000 Celedonia)

2001- Goldsborough Trapped by USFW (2001 Missildine)

1999, 2002-2003 Goldsborough Creek Trapped by Squaxin Island Tribe

Table 5.
2003 Daily Goldsborough Creek Water Gauge Height

Date	Water Gauge Height (m)	Date	Water Gauge Height (m)	Date	Water Gauge Height (m)
4/6/2003	1.65	5/5/2003	1.3	6/4/2003	0.6
4/7/2003	1.6	5/6/2003	1.2	6/5/2003	0.91
4/8/2003	1.8	5/11/2003	1.15	6/6/2003	0.9
4/9/2003	1.7	5/13/2003	1	6/7/2003	0.9
4/11/2003	1.56	5/14/2003	1	6/8/2003	0.5
4/12/2003	1.6	5/18/2003	1.04	6/9/2003	0.5
4/14/2003	1.85	5/19/2003	0.95	6/10/2003	0.5
4/15/2003	1.7	5/20/2003	1	6/11/2003	0.89
4/16/2003	1.7	5/21/2003	1	6/12/2003	0.89
4/18/2003	1.62	5/22/2003	1	6/13/2003	0.9
4/19/2003	1.5	5/23/2003	1	6/14/2003	0.9
4/20/2003	1.4	5/24/2003	1	6/15/2003	0.9
4/21/2003	1.4	5/25/2003	1	6/17/2003	0.85
4/22/2003	1.4	5/26/2003	1	6/18/2003	0.85
4/23/2003	1.4	5/28/2003	0.9	6/19/2003	0.86
4/27/2003	1.4	5/29/2003	0.6	6/20/2003	0.86
4/28/2003	1.4	5/30/2003	0.6	6/21/2003	0.85
4/29/2003	1.3	5/31/2003	0.6	6/22/2003	0.85
4/30/2003	1.3	6/1/2003	0.6	6/24/2003	0.85
5/4/2003	1.3	6/3/2003	0.6	6/25/2003	0.85