Progress Report on the Howard Hanson Project Adult Return Rate Study for CWT Coho and Chinook Salmon, 1994-1996

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October 1997

PREFACE

The purpose of this report is to provide an annual summary of the coded-wire-tagged (CWT) coho and chinook salmon adult return portion of the Howard Hanson Project Adult Return Rate Study. Companion evaluations of the adult returns of fin-clipped steelhead and otolith-marked coho salmon are the responsibility of the Washington Department of Fish and Wildlife.

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INTRODUCTION

In 1911, 225 square miles of the Green River's 440 square mile drainage were blocked to anadromous fish passage with the construction of a diversion dam at river mile (RM) 61.0 to supply public water to the City of Tacoma. A second anadromous fish barrier, Howard Hanson Dam, was constructed at RM 64.5 in 1961 for water storage and flood control, also with no consideration for anadromous fish passage (Seiler and Neuhauser 1985).

A 1982 court decision permitted the first outplanting of juvenile anadromous salmonids upstream of Howard Hanson Dam since the barriers were constructed. The first outplanting of juvenile anadromous salmonids above the dam began with steelhead in 1982, then coho salmon in 1983, and chinook salmon in 1987 (Seiler and Neuhauser 1985; Wunderlich and Toal 1992); all species continue to be planted to date. In 1992, the passing of adult steelhead above Howard Hanson Reservoir marked the first time adult anadromous salmonids had been upstream of the diversion dam since its construction.

Juvenile anadromous salmonid outmigration from the reservoir was first studied in 1984 by the Washington Department of Fisheries (WDF) (Seiler and Neuhauser 1985). Results suggested that outflow passing through the main discharge gates had little effect on downstream fish migration at low pool. Discharge is transferred to the bypass pipe as the pool level increases, and use of this outlet was found to inhibit downstream migration of juvenile fish.

Studies, funded by the U.S. Army Corps of Engineers (USACE) and Tacoma Public Utilities (TPU), were initiated in 1989 to examine the feasabililty of raising Howard Hanson Reservoir in order to increase storage capacity of the project.

Environmental impact studies were also initiated to aid in the mitigation process. The potential effects of the dam and increased reservoir capacity on anadromous salmonids were also studied, including: effects on habitat (Wunderlich and Toal 1992); effects of the dam on outmigrating juvenile anadromous salmonids (Dilley and Wunderlich 1992, 1993); the vertical and horizontal distribution of juvenile salmonids in Howard Hanson Reservoir (Dilley 1993, 1994); and the effects of the reservoir on smolt passage rates (Aitkin et al. 1996).

In 1993, a cooperative study was undertaken to look at adult return rates of coho salmon (*Oncorhynchus kisutch*), chinook salmon (*O. tshawytscha*) and steelhead (*O. mykiss*) planted above Howard Hanson Reservoir. Steelhead fingerlings and smolts were fin-clipped and released above and below the dam. Coho salmon fry were otolith-marked and released above the dam. Juvenile coho and chinook salmon were coded-wire tagged (CWT); CWT coho salmon smolts were released above and below the dam and all CWT chinook salmon were released above the dam. This multifaceted long-term study will not be completed until the year 2001.

To assess adult return rates and whether outplanting of juvenile salmonids above Howard Hanson Reservoir is effective, the USACE and TPU are funding an ongoing cooperative study with the Washington Department of Fish and Wildlife (WDFW), the Muckleshoot Indian Tribe (MIT), and the Western Washington Office (WWO) of the U.S. Fish and Wildlife Service (USFWS).

The objective of this CWT study is to evaluate the salmon outplanting effort above the dam and provide baseline adult return rate data for pre- and post-

project (pool raising) comparisons. The effect of the dam and the reservoir on survival of coho salmon from smolt to adult will also be evaluated. An effort will also be made to determine the effect of the dam and the reservoir on fall chinook salmon. The USFWS is responsible for annual CWT data collection and reporting, plus retrieval of tags from marked adults captured at TPU's fish trap at the diversion dam.

METHODS

Experimental Design

Four groups of approximately 20,000 coho salmon smolts each were tagged with different CWT codes. The four groups formed two test/control pairs. In each test/control pair, test and control groups were released above and below the project, respectively, on or within a day of each other. The first test/control pair was released during reservoir refill and the second pair was released approximately two weeks later at a higher pool level. Approximately 80,000 CWT coho salmon smolts were released per year from 1993 to 1995. The CWT coho salmon portion of the adult return rate study was designed and implemented by Gary Sprague (WDFW). Detailed information on the tagging and releases of the CWT coho salmon is found in Appendix A.

Approximately 400,000 CWT juvenile fall chinook salmon were outplanted each year in the upper watershed above the reservoir in 1994, 1995, and 1996. These fish were tagged to evaluate the outplanting efforts by the Muckleshoot Tribe. The effects of the dam and reservoir may be looked at using the U.S./Canada harvest rate indicator stock from the lower Green River, as a pseudo-control. Detailed information on the tagging and releases of the CWT fall chinook salmon is found in Appendix A.

Fish Tagging and Release Procedures

The tagging of juvenile coho salmon and chinook salmon with a binary-coded-wire tag and their subsequent recovery and reporting followed standard CWT protocol (Johnson 1989; Nielsen 1992). The CWT is implanted into the nasal cartilage of the juvenile fish and the fish is marked externally with an adipose fin clip. The adult fish is identified by the fin clip, sacrificed, and the tag is extracted and read.

Coho salmon used in this study were Big Soos Creek stock spawned and reared at Soos Creek Hatchery (WDFW), transferred to Crisp Creek Rearing Pond (MIT and WDFW) in August of the following year, and coded-wire tagged with full-length tags (0.25 x 1.1 mm) on-site as smolts.

Fall chinook salmon used in this study were Big Soos Creek stock spawned at Soos Creek Hatchery (WDFW), transferred to Keta Creek Hatchery (MIT) in November of that year as eyed eggs, and coded-wire tagged with half-length tags (0.25 x 0.5 mm) on-site as fingerlings.

Coho control groups were released directly below Howard Hanson Dam and coho test groups were released immediately above the reservoir in the Green River mainstem (approximately 4 RM upstream of the dam). Chinook were released throughout 56 possible sites in the Green River tributaries and mainstem above the reservoir.

Tag Recoveries

The Green River fish trap at the TPU diversion dam is operated by TPU, and MIT is responsible for sampling the trap for CWT fish. In 1994, the trap was operated from September 2 to November 29. In 1995, it was operated from October 6 to November 28, but was pulled due to high water during October 25-27. In 1996, the trap was operated from September 6 to December 20.

The Pacific States Marine Fisheries Commission (PSMFC) online database is the clearinghouse for all CWT recovery data on the West Coast. This is a very dynamic database and a period of at least two years from date of adult return is needed for verification of marine tag recoveries and final reporting; any data used before that time are preliminary. The observed data are expanded using a recovery estimation equation (Johnson 1989) to estimate the total marked catch. Data used in this report are found in Appendix B and were obtained on August 25, 1997 (PSMFC 1997).

Data Analysis

Sufficient recovery data are presently available to conduct a preliminary analysis of BY 1991, 1992, and 1993 coho salmon recoveries. Expanded recovery data were used to compare the test and control survivals and distribution.

Absolute survival rates were computed by dividing total expanded recoveries by the total number of tagged fish released. To compare survival rates of tests and controls we used a chi-square test at $\alpha = 0.05$.

Poisson, a contribution rate testing program employing a Poisson distribution (Newman and Comstock 1991), was used to test for homogeneity of contribution patterns of test and control pairs among the fisheries. However, due to lack of expanded recovery information, we deleted the following from the data set: the 1995 WDFW hatchery and ocean sport recoveries of tag codes 05-35-38 and 05-35-39, the 1996 WDFW estuary sport recoveries of tag codes 05-35-40, 05-35-41, 05-35-42, and 05-35-43, and the 1996 WDFW ocean sport recoveries of tag codes 05-35-42 and 05-35-43.

RESULTS

The following preliminary results suggest that Howard Hanson Project affects not only coho salmon smolt emigration (Seiler and Neuhauser 1985; Dilley and Wunderlich 1992, 1993) but, as expected, the project also affects adult coho salmon survival.

Coho BY 1991

The CWT recoveries (Appendix B) indicated survival rates for the first pair, released during reservoir refill (1110 ft), were 5.5% for the test and 6.1% for the control. Survival rates for the second pair, released at full pool (1141 ft), were 1.8% for the test and 7.8% for the control. A chi-square test showed that both test groups survived at significantly lower rates than their respective controls ($p < 0.02$ for the first, $p < 0.001$ for the second) (Table 1).

Fishery contribution patterns for the first and second test/control pairs differed. The first pair was not significantly different ($p = 0.151$), while

the second pair was significantly different ($p = 0.004$). This suggests a difference in contribution patterns among the fisheries based on project conditions.

Coho BY 1992

The CWT recoveries of BY 1992 coho salmon (Appendix B) show a trend similar to the CWT recoveries of BY 1991 coho salmon. Survival rates for the first pair, released during reservoir refill (1122 ft), were 0.1% for the test and 1.1% for the control. The survival rates for the second pair, also released during reservoir refill (1132 ft), were 0.03% for the test and 0.66% for the control. A chi-square test showed that both test groups survived at significantly lower rates than their respective controls ($p < 0.001$ for both test/controls pairs) (Table 2).

Fishery contribution patterns for the first and second test/control pairs were not significantly different ($p = 0.695$ and $p = 0.590$, respectively). It may be important to note that only a ten-foot difference in pool level occurred between the first and second test/control releases. The statistical power of this test may be low due to very few CWT recoveries.

Coho BY 1993

The CWT recoveries of BY 1993 coho salmon (Appendix B) follow the trends observed for the BY 1991 and BY 1992 coho salmon. Survival rates for the first pair, released during low pool (1085 ft), were 0.5% for the test and 1.5% for the control. The survival rates for the second pair, released during reservoir refill (1123 ft), were 0.1% for the test and 1.4% for the control. A chi-square test showed that both test groups survived at significantly lower rates than their respective controls ($p < 0.001$ for both test/controls pairs) (Table 3).

Fishery contribution patterns for the first and second test/control pairs were not significantly different ($p = 0.390$ and $p = 0.361$, respectively), as was observed for BY 1992 coho salmon. This suggests that project conditions had no effect on contribution patterns for either brood year. The statistical power of this test may be low due to very few CWT recoveries.

Chinook BY 1993

Data are very preliminary at this date. Only 27 expanded recoveries of tag code 5-1-1-8-6 are reported as of August 25, 1997. These consisted of recoveries from the following fisheries: the 1995 USFWS Green River trap and the Canadian Department of Fisheries and Oceans (CDFO) mixed net and seine; the 1996 WDFW estuary sport, mixed net and seine, and treaty troll; the 1996 CDFO mixed net and seine and ocean sport; and the 1996 USFWS Green River trap (Appendix B).

ACKNOWLEDGMENTS

I would like to thank the Seattle District of the U.S. Army Corps of Engineers and Tacoma Public Utilities for funding this study. I would also like to thank the Muckleshoot Indian Tribe, Washington Department of Fish and Wildlife, and the Northwest Indian Fish Commission for their cooperation in this study.

I thank Rich Comstock (WWO) for his statistical assistance in completing this report.

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Table 1. The CWT recoveries of coho salmon (BY 1991) as of August 25, 1997.

	Release Group			
	First[A] test	First[B] control	Second test	Second control
Tag code	5-32-22	5-32-20	5-32-23	5-32-21
Number of CWT fish released	20,187	20,307	19,978	20,266
Observed recoveries	566	617	202	747
Expanded recoveries	1118	1242	355	1575
Survival based on expanded recoveries (%)	5.5	6.1	1.8	7.8
	χ^2 Test			
Test/control survival	$\chi^2 = 6.2$ $P < 0.02$		$\chi^2 = 791.8$ $P < 0.001$	
	Poisson Test			
Test/control recovery distribution	$p = 0.151$		$p = 0.004$	

[A] Test group fish are those released upstream of Howard Hanson Reservoir.
[B] Control group fish are those released downstream of Howard Hanson Dam.

Table 2. The CWT recoveries of coho salmon (BY 1992) as of August 25, 1997.

	Release Group			
	First[A] test	First[B] control	Second test	Second control
Tag code	5-35-36	5-35-37	5-35-38	5-35-39
Number of CWT fish released	20,284	20,433	19,937	20,296
Observed recoveries	8	77	2	45
Expanded recoveries	27	232	6	134
Survival based on expanded recoveries (%)	0.1	1.1	0.03	0.66
	χ^2 Test			
Test/control survival	$\chi^2 = 161.8$ $P < 0.001$		$\chi^2 = 115.2$ $P < 0.001$	
	Poisson Test			
Test/control recovery distribution	$p = 0.695$		$p = 0.590$	

[A] Test group fish are those released upstream of Howard Hanson Reservoir.
[B] Control group fish are those released downstream of Howard Hanson Dam.

Table 3. The CWT recoveries of coho salmon (BY 1993) as of August 25, 1997.

	Release Group			
	First[A] test	First[B] control	Second test	Second control
Tag code	5-35-40	5-35-41	5-35-42	5-35-43
Number of CWT fish released	20,210	20,318	20,098	20,039
Observed recoveries	43	117	6	122
Expanded recoveries	107	313	17	281
Survival based on expanded recoveries (%)	0.5	1.5	0.1	1.4
	χ^2 Test			
Test/control survival	$\chi^2 = 101.0$ $P < 0.001$		$\chi^2 = 236.4$ $P < 0.001$	
	Poisson Test			
Test/control recovery distribution	$p = 0.390$		$p = 0.361$	

[A] Test group fish are those released upstream of Howard Hanson Reservoir.
[B] Control group fish are those released downstream of Howard Hanson Dam.

Appendix A. Tagging and release information for CWT coho and fall chinook salmon used in the adult return rate study at Howard Hanson Project.

Table A. General information on the Big Soos Creek stock of coho salmon used in the CWT adult return rate study at Howard Hanson Project.

	Brood year		
	1991	1992	1993
Tag and release year[A]	1993	1994	1995
Tag codes	5-32-20, 5-32-21, 5-32-22, 5-32-23	5-35-36, 5-35-37, 5-35-38, 5-35-39	5-35-40, 5-35-41, 5-35-42, 5-35-43
Spawned and raised at Soos Creek Hatchery	1991	1992	1993
Transferred to Crisp Creek Rearing Pond (during August)	1992	1993	1994
Agency in charge of spawning fish	WDFW	WDFW	WDFW
Agency in charge of raising fish	WDFW/MIT	WDFW/MIT	WDFW/MIT
Agency in charge of tagging fish	USFWS	USFWS	USFWS
Agency in charge of tag retentions	USFWS	USFWS	USFWS
Agency in charge of releasing fish	WDFW	WDFW	WDFW
	Years of adult returns to the Green River		
as 2 year old	1993	1994	1995
as 3 year old	1994	1995	1996
as 4 year old	1995	1996	1997

[A] Fish were tagged and released during early spring of each year.

Table B. General information on the Big Soos Creek stock of fall chinook salmon used in the CWT adult return rate study at Howard Hanson Project.

	Brood year		
	1993	1994	1995
Tag and release year (during spring)	1994	1995	1996
Tag codes (half-length tag)	5-1-1-8-6	5-1-1-7-15, 5-1-1-10-1, 5-1-1-12-14, 5-1-1-12-15	5-1-1-15-7, 5-1-1-15-8, 5-1-1-15-9, 5-1-1-15-10
Spawned at Soos Creek Hatchery (during fall)	1993	1994	1995
Transferred to Keta Creek Hatchery as eyed eggs (during November)	1993	1994	1995
Agency in charge of spawning fish	WDFW	WDFW	WDFW
Agency in charge of raising fish	MIT	MIT	MIT
Agency in charge of tagging fish	USFWS	NWIFC	NWIFC
Agency in charge of tag retentions	USFWS	NWIFC	NWIFC
Agency in charge of releasing fish	MIT	MIT	MIT
	Years of adult returns to the Green River		
as 2 year old	1995	1996	1997
as 3 year old	1996	1997	1998
as 4 year old	1997	1998	1999
as 5 year old	1998	1999	2000
as 6 year old	1999	2000	2001

Table C. Tag and release information for CWT coho salmon (BY 1991), tagged and released in 1993.

	Release Group			
	First test	First control	Second test	Second control
	Tag Data			
Tag code	5-32-22	5-32-20	5-32-23	5-32-21
Raceway	3	1	4	2
Group	1	2	3	4
Date(s) tagged	14 April	13 April	15 April	14-15 April
Number tagged	20,373	20,599	20,233	20,484
Size at tagging (#fish/lb)	20	20	20	20
Date of tag retention test	19 April	19 April	10 May	10 May
Number sampled	446	532	431	425
Tag retention (%)	99.55	99.44	99.54	99.76
	Release Data			
Date released	26 April	26 April	11 May	12 May
Number of fish released	20,268	20,430	20,078	20,307
Number of fish with CWT and adipose clip	20,187	20,307	19,978	20,266
Ad only	81	123	100	41
Size at release (#fish/lb)	21	21	19	19
	Howard Hanson Reservoir Physical Data at Release			
Pool elevation (ft)	1110.0	1110.0	1141.4	1141.0
Inflow (cfs)	1500	1500	2130	2100
Discharge (cfs)[A]	758	758	1839	2197

[A] Discharge switched from main radial gates to bypass gate on July 8, 1993 at 1140.4 ft pool elevation.

Table D. Tag and release information for CWT coho salmon (BY 1992), tagged and released in 1994.

	Release Group			
	First test	First control	Second test	Second control
	Tag Data			
Tag code	5-35-36	5-35-37	5-35-38	5-35-39
Raceway	1	3	4	5
Group	1	2	3	4
Date(s) tagged	19 April	19-20 April	20 April	21 April
Number tagged	20,504	20,505	20,428	20,544
Size at tagging (#fish/lb)	26	26	26	26
Date of tag retention test	25 April	25 April	25 April	25 April
Number sampled	500	500	500	500
Tag retention (%)	99.4	99.8	98.0	99.8
	Release Data			
Date released	26 April	27 April	10 May	11 May
Number of fish released	20,406	20,474	20,344	20,337
Number of fish with CWT and adipose clip	20,284	20,433	19,937	20,296
Ad only	122	41	407	41
Size at release (#fish/lb)	26.0	26.0	24.7	25.7
	Howard Hanson Reservoir Physical Data at Release			
Pool elevation (ft)	1122.0	1122.7	1132.3	1132.8
Inflow (cfs)	1000	970	850	800
Discharge (cfs)[A]	941	789	653	653

[A] Discharge switched from main radial gates to bypass gate on May 12, 1994 at 1133.6 ft pool elevation.

Table E. Tag and release information for CWT coho salmon (BY 1993), tagged and released in 1995.

	Release Group			
	First test	First control	Second test	Second control
	Tag Data			
Tag code	5-35-40	5-35-41	5-35-42	5-35-43
Raceway	1	2	3	4
Group	1	2	3	4
Date(s) tagged	17 April	18 April	18-19 April	19-20 April
Number tagged	20,451	20,531	20,313	20,570
Size at tagging (#fish/lb)	20	20	20	20
Date of tag retention test	19 April	20 April	24 April	25 April
Number sampled	505	505	503	504
Tag retention (%)	99.01	99.01	99.40	97.82
	Release Data			
Date released	24 April	25 April	9 May	10 May
Number of fish released	20,412	20,521	20,219	20,485
Number of fish with CWT and adipose clip	20,210	20,318	20,098	20,039
Ad only	202	203	80	446
Unmarked fish	0	0	41	0
Size at release (#fish/lb)	23	23	19	19
	Howard Hanson Reservoir Physical Data at Release			
Pool elev. (ft)	1085.2	1086.9	1122.8	1124.7
Inflow (cfs)	650	740	1110	1230
Discharge (cfs)[A]	538	546	716	725

[A] Discharge switched from main radial gates to bypass gate on May 25, 1995 at 1137.4 ft pool elevation.

Table F. Tag and release information for CWT fall chinook salmon (BY 1993), tagged with half-length tags and released in 1994.

	Tag Code		
	5-1-1-8-6		
	Tag Data		
Dates tagged	7 March - 14 April		
Number tagged	416,582		
Sizes at tagging[A] (#fish/pound)	550/389/350/323/253		
Dates of tag retention tests	30 March & 12 April		
Number sampled	919		
Tag retention (%)	89.77		
	Release Data		
Date released	30 March	12 April	19 April
Number of fish released	187,872	106,195	121,705
Total number of fish released	415,772		
Number of fish with CWT and adipose clip	373,362		
Ad only	42,409		
Size at release (#fish/pound)	368	253	230
	Howard Hanson Reservoir Physical Data at Release		
Pool elevation (ft)	1076.1	1075.2	1094.8
Inflow (cfs)	1380	1500	1930
Discharge (cfs)[B]	1457	1523	956

[A] Multiple numbers indicate growth of fish over tagging period.
[B] Discharge switched from main radial gates to bypass gate on May 12, 1994 at 1133.6 ft pool elevation.

Table G. Tag and release information for CWT fall chinook salmon (BY 1994), tagged with half-length tags and released in 1995.

	Tag Codes			
	5-1-1-7-15	5-1-1-10-1	5-1-1-12-14	5-1-1-12-15
	Tag Data			
Dates tagged	7-13 March	14-17 March	20-23 March	23-28 March
Number tagged	104,363	109,160	104,966	101,394
Sizes at tagging (#fish/pound)	320	310	300	300
Date of tag retention test	25 April		25 April[A]	
Number sampled	1021		943	
Tag retention (%)	93.8		96.8	
	Release Data			
Date released	29 March	30 March	20 March	24 March
Number of fish released	104,064	108,855	104,778	101,186
Number of fish with CWT and adipose clip	97,612	105,372	101,425	97,948
Ad only	6,452	3,483	3,353	3,238
Size at release (#fish/pound)	233	204	226	226
	Howard Hanson Reservoir Physical Data at Release			
Pool elevation (ft)	1073.7	1073.2	1077.5	1072.9
Inflow (cfs)	690	680	1320	940
Discharge (cfs)[B]	770	716	1229	928

[A] Tag codes 5-1-1-10-1, 5-1-1-12-14, and 5-1-1-12-15 were combined for the tag retention test.

[B] Discharge switched from main radial gates to bypass gate on May 25, 1995 at 1137.4 ft pool elevation.

Table H. Tag and release information for CWT fall chinook salmon (BY 1995), tagged with half-length tags and released in 1996.

	Tag Codes			
	5-1-1-15-7	5-1-1-15-8	5-1-1-15-9	5-1-1-15-10
	Tag Data			
Dates tagged	5-12 March	12-18 March	18-21 March	22-27 March
Number tagged	102,477	101,850	103,190	102,174
Size at tagging (#fish/lb)	317	300	300	168
Date of tag retention	28 March	22 April[A]		
Number sampled	458	1070		
Tag retention (%)	84.0	88.1		

	Release Data							
Date released	15 March	18 March	29 March	26 April	22 March	26 April	29 March	26 April
Number of fish released	102,477	87,597	13,819	434	102,574	434	101,740	434

Table H. (continued)

	5-1-1-15-7	5-1-1-15-8			5-1-1-15-9		5-1-1-15-10	
Release Data (continued)								
Total Number of fish released	102,477		101,850		103,008		102,174	
Number of fish with CWT and adipose clip	86,081		89,730		90,750		90,015	
Ad only	14,603		12,120		12,258		12,159	
Unmarked fish	1,793		0		0		0	
Size at release (#fish/lb)	247	241	168	148	240	148	168	148
Howard Hanson Reservoir Physical Data at Release								
Pool elev. (ft)	1069.8	1068.7	1078.5	1135.5	1072.8	1135.5	1078.5	1135.5
Inflow (cfs)	1160	940	640	2430	880	2430	640	2430
Discharge (cfs)[B]	1045	1028	592	1248	654	1248	592	1248

[A] Tag codes 5-1-1-15-8, 5-1-1-15-9, and 5-1-1-15-10 were combined for the tag retention test.
[B] Discharge switched from main radial gates to bypass gate on June 12, 1996 at 1140.3 ft pool elevation.

Appendix B. A listing of the Howard Hanson Reservoir CWT adult return recovery data for both coho and fall chinook salmon as of August 25, 1997, from the Pacific States Marine Fisheries Commission database.

09:03:00 25-aug-1997 ANNUAL RECOVERIES BY RECOVERY YEAR PAGE 1
QUERY: hhanson TAGCODE: 0501010806
RELEASING AGENCY: MUCK RELEASE TYPE: B
1993 Fall Chinook TAGGED: 373362 HATCHERY: KETA CREEK HATCHERY
RELEASED: 04/12/94 AD-ONLY: 42409 SITE: GREEN R 09.0001
LENGTH: 60 UNMARKED: 87050 STOCK: BIG SOOS CR 09.0072

YEAR	FISHERY - <Recovery Agency>.....		OBS'D	EST'D	MEAS'D	AVG MM
1995	Fish Trap (freshwater)	- FWS	1	1	1	126
	Mixed Net and Seine	- CDFO	1	1	1	401
1995 TOTALS:			2	2	2	264
1996	Estuary Sport	- WDFW	4		2	575
	Mixed Net and Seine	- CDFO	1	2	1	540
	Mixed Net and Seine	- WDFW	5	7	5	690
	Ocean Sport	- CDFO	1	10		
	Treaty Troll	- WDFW	2	2	2	560
	Fish Trap (Freshwater)[1]	- FWS	(4)	(4)		
1996 TOTALS:			13	21	10	626
			(17)	(25)		
TOTALS FOR TAGCODE 0501010806			15	23	12	566
			(19)	(27)		

[1] Data collected at TPU trap and entered by author using an expansion rate of 1.

09:03:00 25-aug-1997 ANNUAL RECOVERIES BY RECOVERY YEAR PAGE 2
QUERY: hhanson TAGCODE: 053220
RELEASING AGENCY: WDFW RELEASE TYPE: B
1991 Coho TAGGED: 20307 HATCHERY: CRISP CR HATCHERY
RELEASED: 04/26/93 AD-ONLY: 123 SITE: GREEN R 09.0001
LENGTH: UNMARKED: STOCK: BIG SOOS CR 09.0072

YEAR	FISHERY - <Recovery Agency>.....		OBS'D	EST'D	MEAS'D	AVG MM
1994	Estuary Sport	- WDFW	4	15	2	545
	Fish Trap (freshwater)	- FWS	46	(46)[1]	46	540
	Hatchery	- WDFW	310	329	310	539
	Mixed Net and Seine	- CDFO	15	66	15	530
	Mixed Net and Seine	- WDFW	134	341	134	558
	Ocean Sport	- CDFO	6	65		
	Ocean Troll (non-treaty)	- CDFO	94	373	94	530
	Test Fishery Seine	- WDFW	8	8	8	516
1994 TOTALS:			617	1196	609	541
TOTALS FOR TAGCODE 053220			617	1196 (1242)	609	541

[1] An expansion rate of 1 was used by the author.

09:03:00 25-aug-1997 ANNUAL RECOVERIES BY RECOVERY YEAR PAGE 3
QUERY: hhanson TAGCODE: 053221
RELEASING AGENCY: WDFW RELEASE TYPE: B
1991 Coho TAGGED: 20266 HATCHERY: CRISP CR HATCHERY
RELEASED: 05/12/93 AD-ONLY: 41 SITE: GREEN R 09.0001
LENGTH: UNMARKED: STOCK: BIG SOOS CR 09.0072

YEAR	FISHERY - <Recovery Agency>.....		OBS'D	EST'D	MEAS'D	AVG MM
1994	Estuary Sport	- WDFW	9	35	3	553
	Fish Trap (freshwater)	- FWS	43	(43)[1]	43	528
	Freshwater Sport	- WDFW	1	4		
	Hatchery	- WDFW	341	361	341	532
	Mixed Net and Seine	- CDFO	20	70	20	505
	Mixed Net and Seine	- WDFW	196	491	196	559
	Ocean Sport	- CDFO	5	33		
	Ocean Troll (non-treaty)	- CDFO	125	524	122	522
	Test Fishery Seine	- WDFW	6	6	6	540
1994 TOTALS:			746	1526 (1569)	731	537
1995	Estuary Sport	- WDFW	1	7		
1995 TOTALS:			1	7		
TOTALS FOR TAGCODE 053221			747	1532 (1575)	731	537

[1] An expansion rate of 1 was used by the author.

09:03:00 25-aug-1997 ANNUAL RECOVERIES BY RECOVERY YEAR PAGE 4
QUERY: hhanson TAGCODE: 053222
RELEASING AGENCY: WDFW RELEASE TYPE: B
1991 Coho TAGGED: 20187 HATCHERY: CRISP CR HATCHERY
RELEASED: 04/26/93 AD-ONLY: 81 SITE: GREEN R 09.0001
LENGTH: UNMARKED: STOCK: BIG SOOS CR 09.0072

YEAR	FISHERY - <Recovery Agency>		OBS'D	EST'D	MEAS'D	AVG MM
1994	Estuary Sport	- WDFW	6	23	2	535
	Fish Trap (freshwater)	- FWS	15	(15)[1]	15	523
	Hatchery	- WDFW	319	338	319	539
	Mixed Net and Seine	- CDFO	11	42	10	538
	Mixed Net and Seine	- WDFW	114	295	114	557
	Ocean Sport	- CDFO	3	10		
	Ocean Troll (non-treaty)	- CDFO	91	388	91	534
	Test Fishery Seine	- WDFW	7	7	7	549
1994 TOTALS:			566	1103	558	542
TOTALS FOR TAGCODE 053222			566	1103 (1118)	558	542

[1] An expansion rate of 1 was used by the author.

09:03:00 25-aug-1997 ANNUAL RECOVERIES BY RECOVERY YEAR PAGE 5
QUERY: hhanson TAGCODE: 053223
RELEASING AGENCY: WDFW RELEASE TYPE: B
1991 Coho TAGGED: 19978 HATCHERY: CRISP CR HATCHERY
RELEASED: 05/11/93 AD-ONLY: 100 SITE: GREEN R 09.0001
LENGTH: UNMARKED: STOCK: BIG SOOS CR 09.0072

YEAR	FISHERY - <Recovery Agency>.....		OBS'D	EST'D	MEAS'D	AVG MM
1994	Estuary Sport	- WDFW	4	17	2	575
	Fish Trap (freshwater)	- FWS	5	(5)[1]	5	494
	Hatchery	- WDFW	127	135	127	530
	Mixed Net and Seine	- CDFO	3	12	3	513
	Mixed Net and Seine	- WDFW	37	95	37	554
	Ocean Troll (non-treaty)	- CDFO	20	86	20	523
	Test Fishery Seine	- WDFW	6	6	6	550
1994 TOTALS:			202	350	200	533
TOTALS FOR TAGCODE 053223			202	350 (355)	200	533

[1] An expansion rate of 1 was used by the author.

QUERY: hhanson TAGCODE: 053536

RELEASING AGENCY: WDFW RELEASE TYPE: B

1992 Coho TAGGED: 20284 HATCHERY: CRISP CR HATCHERY

RELEASED: 04/26/94 AD-ONLY: 122 SITE: GREEN R 09.0001

LENGTH: UNMARKED: STOCK: BIG SOOS CR 09.0072

YEAR	FISHERY - <Recovery Agency>.....		OBS'D	EST'D	MEAS'D	AVG MM
1995	Estuary Sport	- WDFW	1	6		
	Hatchery	- WDFW	1	1	1	570
	Mixed Net and Seine	- CDFO	1	4	1	513
	Mixed Net and Seine	- WDFW	4	10	4	522
	Ocean Troll (non-treaty)	- CDFO	1	6	1	459
1995 TOTALS:			8	27	7	519
TOTALS FOR TAGCODE 053536			8	27	7	519

QUERY: hhanson TAGCODE: 053537

RELEASING AGENCY: WDFW RELEASE TYPE: B

1992 Coho TAGGED: 20433 HATCHERY: CRISP CR HATCHERY

RELEASED: 04/27/94 AD-ONLY: 41 SITE: GREEN R 09.0001

LENGTH: UNMARKED: STOCK: BIG SOOS CR 09.0072

YEAR	FISHERY - <Recovery Agency>.....		OBS'D	EST'D	MEAS'D	AVG MM
1995	Estuary Sport	- WDFW	4	35	1	550
	Fish Trap (freshwater)	- FWS	4	4	2	509
	Hatchery	- WDFW	15	20	15	536
	Mixed Net and Seine	- CDFO	1	4	1	480
	Mixed Net and Seine	- WDFW	30	64	30	554
	Ocean Troll (non-treaty)	- CDFO	18	94	18	521
	Ocean Troll (non-treaty)	- WDFW	2	4	2	530
	Sport (private)	- WDFW	1	1	1	510
	Test Fishery Seine	- WDFW	1	1	1	560
	Treaty Troll	- WDFW	1	5	1	550
1995 TOTALS:			77	232	72	538
TOTALS FOR TAGCODE 053537			77	232	72	538

QUERY: hhanson TAGCODE: 053538

RELEASING AGENCY: WDFW RELEASE TYPE: B

1992 Coho TAGGED: 19937 HATCHERY: CRISP CR HATCHERY

RELEASED: 05/10/94 AD-ONLY: 407 SITE: GREEN R 09.0001

LENGTH: UNMARKED: STOCK: BIG SOOS CR 09.0072

YEAR	FISHERY - <Recovery Agency>.....		OBS'D	EST'D	MEAS'D	AVG MM
1995	Hatchery	- WDFW	1		1	490
	Ocean Troll (non-treaty)	- CDFO	1	6	1	468
1995 TOTALS:			2	6	2	479
TOTALS FOR TAGCODE 053538			2	6	2	479

QUERY: hhanson TAGCODE: 053539

RELEASING AGENCY: WDFW RELEASE TYPE: B

1992 Coho TAGGED: 20296 HATCHERY: CRISP CR HATCHERY

RELEASED: 05/11/94 AD-ONLY: 41 SITE: GREEN R 09.0001

LENGTH: UNMARKED: STOCK: BIG SOOS CR 09.0072

YEAR	FISHERY - <Recovery Agency>		OBS'D	EST'D	MEAS'D	AVG MM
1995	Estuary Sport	- WDFW	1	5		
	Hatchery	- WDFW	7	9	7	553
	Mixed Net and Seine	- CDFO	1	4	1	417
	Mixed Net and Seine	- WDFW	18	42	18	551
	Ocean Sport	- CDFO	1	7		
	Ocean Sport	- WDFW	1			
	Ocean Troll (non-treaty)	- CDFO	10	54	10	511
	Ocean Troll (non-treaty)	- WDFW	1	2	1	490
	Sport (charter)	- WDFW	1	1	1	520
	Sport (private)	- WDFW	1	2	1	440
	Test Fishery Seine	- WDFW	1	1	1	320
	Treaty Troll	- WDFW	2	7	2	500
1995 TOTALS:			45	134	42	526
TOTALS FOR TAGCODE 053539			45	134	42	526

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QUERY: hhanson TAGCODE: 053540
RELEASING AGENCY: WDFW RELEASE TYPE:
1993 Coho TAGGED: 20210 HATCHERY: CRISP CR HATCHERY
RELEASED: 04/24/95 AD-ONLY: 202 SITE: GREEN R 09.0001
LENGTH: UNMARKED: STOCK: BIG SOOS CR 09.0072

YEAR	FISHERY - <Recovery Agency>.....		OBS'D	EST'D	MEAS'D	AVG MM
1996	Estuary Sport	- WDFW	6		2	470
	Mixed Net and Seine	- CDFO	1	2	1	472
	Mixed Net and Seine	- WDFW	12	15	12	527
	Ocean Sport	- CDFO	1	15		
	Ocean Troll (non-treaty)	- CDFO	19	69	19	506
	Sport (private)	- WDFW	1	2		
	Test Fishery Seine	- WDFW	2	2	2	530
	Fish Trap (Freshwater)[1]	- FWS	(1)	(1)		
1996 TOTALS:			42	106	36	511
			(43)	(107)		
TOTALS FOR TAGCODE 053540			42	106	36	511
			(43)	(107)		

[1] Data collected at TPU trap and entered by author using an expansion rate of 1.

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QUERY: hhanson TAGCODE: 053541
RELEASING AGENCY: WDFW RELEASE TYPE:
1993 Coho TAGGED: 20318 HATCHERY: CRISP CR HATCHERY
RELEASED: 04/25/95 AD-ONLY: 203 SITE: GREEN R 09.0001
LENGTH: UNMARKED: STOCK: BIG SOOS CR 09.0072

YEAR	FISHERY - <Recovery Agency>.....		OBS'D	EST'D	MEAS'D	AVG MM
1995	Estuary Sport	- WDFW	1	4		
1995 TOTALS:			1	4		
1996	Estuary Sport	- WDFW	12		10	471
	Mixed Net and Seine	- WDFW	39	59	39	536
	Ocean Sport	- CDFO	6	64		
	Ocean Sport	- ODFW	1	2	1	510
	Ocean Troll (non-treaty)	- CDFO	39	144	38	502
	Ocean Troll (non-treaty)	- WDFW	1	16	1	460
	Sport (charter)	- WDFW	5	7	5	510
	Sport (private)	- WDFW	3	6	3	490
	Test Fishery Seine	- WDFW	4	4	4	478
	Fish Trap (Freshwater)[1]	- FWS	(6)	(6)		
1996 TOTALS:			110 (116)	303 (309)	101	511
TOTALS FOR TAGCODE 053541			111 (117)	307 (313)	101	511

[1] Data collected at TPU trap and entered by author using an expansion rate of 1.

QUERY: hhanson TAGCODE: 053542

RELEASING AGENCY: WDFW RELEASE TYPE:

1993 Coho TAGGED: 20098 HATCHERY: CRISP CR HATCHERY

RELEASED: 05/09/95 AD-ONLY: 80 SITE: GREEN R 09.0001

LENGTH: UNMARKED: 41 STOCK: BIG SOOS CR 09.0072

YEAR	FISHERY - <Recovery Agency>.....		OBS'D	EST'D	MEAS'D	AVG MM
1995	Hatchery	- WDFW	1	1	1	200
1995 TOTALS:			1	1	1	200
1996	Mixed Net and Seine	- WDFW	1	1	1	400
	Ocean Troll (non-treaty)	- CDFO	4	15	4	490
1996 TOTALS:			5	16	5	472
TOTALS FOR TAGCODE 053542			6	17	6	427

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QUERY: hhanson TAGCODE: 053543
RELEASING AGENCY: WDFW RELEASE TYPE:
1993 Coho TAGGED: 20039 HATCHERY: CRISP CR HATCHERY
RELEASED: 05/10/95 AD-ONLY: 446 SITE: GREEN R 09.0001
LENGTH: UNMARKED: STOCK: BIG SOOS CR 09.0072

YEAR	FISHERY - <Recovery Agency>.....		OBS'D	EST'D	MEAS'D	AVG MM
1995	Mixed Net and Seine	- WDFW	1	2	1	350
	Test Fishery Seine	- WDFW	1	1	1	300
1995 TOTALS:			2	3	2	325
1996	Estuary Sport	- WDFW	19		11	501
	Mixed Net and Seine	- CDFO	1	2	1	464
	Mixed Net and Seine	- WDFW	42	57	42	533
	Ocean Sport	- CDFO	2	31		
	Ocean Sport	- WDFW	1			
	Ocean Troll (non-treaty)	- CDFO	42	165	42	496
	Ocean Troll (non-treaty)	- WDFW	1	6	1	440
	Sport (charter)	- WDFW	3	5	3	533
	Sport (private)	- WDFW	3	7	3	463
	Test Fishery Seine	- WDFW	1	1	1	520
	Treaty Troll	- WDFW	2	2	2	520
	Fish Trap (Freshwater)[1]	- FWS	(3)	(3)		
1996 TOTALS:			117 (120)	275 (278)	106	511
TOTALS FOR TAGCODE 053543			119 (122)	278 (281)	108	508

[1] Data collected at TPU trap and entered by author using an expansion rate of 1.