

**EFFECTS OF ACCLIMATION ON THE  
SURVIVAL OF SPRING CHINOOK SALMON**

**ANNUAL REPORT 1993  
(June 1, 1993-May 31, 1994)**

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#### INTRODUCTION:

Many hatcheries, particularly those raising spring and summer chinook yearlings, are supplied with groundwater from wells or springs. Generally the smolts are released from rearing ponds supplied with groundwater directly into a tributary of ambient temperature surface water. Often the groundwater supply is relatively constant in temperature while the receiving water displays significant temperature variation. It is speculated that pre-release exposure to the varying temperature regime and the chemical characteristics of the ambient receiving water could enhance post-release survival, possibly through improved smoltification.

In one experiment with yearling coho salmon (Hopley, et.al., 1978), fish exposed to ambient river water for 6 weeks prior to release survived at a significantly higher rate than those released at a comparable size and time without acclimation. In an informal field application, emigration of chum salmon from egg boxes was stimulated by a change from well water to surface water, even though the temperature of each supply was equal. In field applications spring chinook yearlings have been stimulated to migratory behavior by adding ambient creek water to the spring water-supplied rearing pond (personal observation).

Thus, the potential for improved survival of smolts exposed to ambient river water before release has been shown experimentally and, circumstantially, through field application. No definitive research has been done for spring or summer chinook or steelhead. This project was designed to conduct acclimation experiments using spring chinook yearlings to determine if the experimental treatment will result in increased survival.

This report covers work conducted from June 1, 1993 to May 31, 1994. The reader is directed to the first through fourth annual reports for information on work performed during proceeding years.

#### Project Goal:

"To determine if acclimation of spring chinook smolts in ambient temperature surface water prior to release will increase survival (smolt-to-adult) compared to smolts raised only in constant temperature spring water."

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This project is being conducted at the Klickitat State Salmon Hatchery near Glenwood, Washington. The hatchery is funded through the Columbia River Fisheries Development Program and is operated by the Washington Department of Fisheries.

This project was divided into two sections:

Section 1) To provide rearing ponds and adequate Klickitat River acclimation water at the Klickitat Hatchery site to conduct the study. This section had one objective (Objective 1) and was completed in January of 1991.

Section 2) To compare the smolt-to-adult survival of spring chinook raised in and released directly from a groundwater supplied hatchery to smolts released from the same hatchery following acclimation to ambient temperature surface water for a period of time before release. This section is made up of 4 objectives (2-5) and is partially complete (Objective 2 was completed in 1992, Objective 3 was completed in 1994). Releases of uniquely marked (coded-wire tagged) experimental and control groups of fish over four consecutive years are involved in the study (1991-1994). As of May 1st 1994, all four brood years of fish will have been released. Recoveries of coded-wire tagged fish from all years will be used for analysis. Recoveries of marked fish began in 1992 and will continue until 1997.

**DESCRIPTION OF PROJECT AREA:**

The project is being conducted at the Klickitat State Salmon Hatchery near Glenwood, Washington (Figure 1). The hatchery is funded by the Federal government through the Columbia River Fisheries Development Program administered by the National Marine Fisheries Service (NMFS), Award Number NA-88-ABH-00024. The hatchery is operated by the Washington Department of Fisheries (WDF). Research fish for the project are being provided from normal production levels available on site. Research fish will be identified through WDF annual production programming activities.

Research activities are being coordinated with other projects including: 86-13-Augmented Fish Health Monitoring in Washington; 89-46-Evaluation of Fish Quality Indices. Engineering, construction and research activities are being fully coordinated with the NMFS' Columbia River Fisheries Development Program and the Yakima/Klickitat Production Project Experimental Design Work Group (EDWG).

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#### METHODS AND MATERIALS:

Completion of one objective (3) and continuation of two objectives (4,5) were to be achieved during 1993-1994:

**OBJECTIVE 3:** Application of coded-wire tags to juveniles.

**OBJECTIVE 4:** Recovery of Coded-Wire Tags.

**OBJECTIVE 5:** Data Analysis and Reports.

A more detailed discussion of each objective follows;

**OBJECTIVE 3:** Application of coded-wire tags to juveniles.

**Task 3.1:** Apply Coded-Wire Tags to Juveniles.

Subtask 3.1.4: All fish from each pond will be wire-tagged with a unique tag code (1992 brood).

**Task 3.2:** Enumeration of Tagged Fish.

Subtask 3.2.4: During the tagging process, all tagged fish will be enumerated so a precise number of fish per tag code will be available (1992 brood).

**Task 3.3:** Adipose Fin Check.

Subtask 3.3.4: Fish with naturally missing adipose fins will be counted during the tagging process (1992 brood).

**Task 3.4:** Tag loss Assessment.

Subtask 3.4.4: After a minimum of 30 days, a random sample of 2,000 fish will be examined to assess long-term coded-wire tag loss and adipose mark quality (1992 brood).

**OBJECTIVE 4:** Recovery of Coded-Wire Tags.

**Task 4.1:** Recovery of coded-wire tags at the hatchery rack.

Subtask 4.1.2: Snouts will be recovered from all adipose fin-clipped fish returning to the hatchery and their wire tags removed and recorded. Data will be reported in the following quarterly report.

**OBJECTIVE 5:** Data Analysis and Reports.

**Task 5.1:** Quarterly and Yearly Progress Reports are to be provided each year.

Subtask 5.1.4: Quarterly and yearly reports for 1993-94.

Reports are due within 15 days of the end of each quarter. The draft annual report is due 3/31/94, the final annual report is due 5/31/94.

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## RESULTS AND DISCUSSION:

### GENERAL DISCUSSION: 1992 BROOD RELEASE;

The fourth year's test and control groups (1992 brood) were released on April 29th, 1994. All study parameters were intact. The six week test group began receiving river water on March 18, 1994. The three week test groups began receiving river water on April 8, 1994. Detailed release information is contain in Appendix A.

Water temperature profiles for the treatment groups are contained in Appendix B. Gill ATP-ase levels are being analyzed by Wally Zaugg (NMFS retired). The results of the 1989 brood samples showed a significant difference in gill ATP-ase levels for the 6 week acclimation group when compared to either the control or the 3 week test group. However, there were no significant differences between the 1990 or 1991 brood experimental groups.

Bacterial Kidney Disease (BKD) screening was conducted on all groups. Sixty fish from each group were sacrificed and kidney smears will be examined using florescent antibody technique analysis (FAT). The samples will also be analyzed using ELISA. This comparison will allow comparisons between the techniques as well as continue base line data collection of BKD levels for final data analysis. Results of the BKD sampling of the 1991 brood (released April 30, 1993) are presented in Appendix C. Results of the BKD sampling of the 1992 brood (released April 29, 1994) will be presented in future reports. **OBJECTIVE 3 Task 3.5**

Additional work completed this year included:

- 1) Andy Appleby (project leader) complete an informational request made by BPA. Called a Project Review Form, it was completed and returned to BPA in January of 1994.
- 2) Contract modification 008 was submitted during the year. This was for the addition of O&M funds for FY95.
- 3) Randomization of the 12 study ponds (1992 brood) into various treatment and control groups.
- 4) Monitor the growth of the 1992 brood fish.

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DETAILED DISCUSSION BY OBJECTIVE:

**OBJECTIVE 3:** Application of coded-wire tags to juveniles.

**Task 3.1:** Apply Coded-Wire Tags to Juveniles.

Subtask 3.1.4 All fish from each pond will be wire-tagged with a unique tag code (1992 brood). Tagging was conducted between 6/30/92 and 7/12/92. Fish were healthy at the time of tagging and appeared to handle well. No unusual difficulties were noted. Size at tagging was 53 fish per pound.

**Task 3.2:** Enumeration of Tagged Fish.

Subtask 3.2.4: During the tagging process, all tagged fish will be enumerated so a precise number of fish per tag code will be available (1992 brood). The number of tagged fish placed into each pond are as follows:

1992 Brood Klickitat Spring Chinook

POND	TAGCODE	NUMBER	TREATMENT
1A	635309	20,754	3 week acc.
2A	635308	20,416	3 week acc.
3A	635307	20,569	3 week acc.
4A	635306	20,494	3 week acc.
5A	635305	20,477	control
6A	635114	20,476	control
7A	635113	20,499	control
8A	635112	20,530	control
9A	635111	20,053	6 week acc.
10A	635110	20,958	6 week acc.
11A	634831	20,052	6 week acc.
12A	634830	20,180	6 week acc.

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**Task 3.3: Adipose Fin Check.**

Subtask 3.3.4 Fish with naturally missing adipose fins will be counted during the tagging process (1992 brood). The number of fish with naturally missing adipose fins in each pond are as follows:

POND	NUMBER OF FISH
1A	3
2A	0
3A	2
4A	4
5A	0
6A	2
7A	0
8A	1
9A	4
10A	2
11A	1
12A	3

**Task 3.4: Tag loss Assessment.**

Subtask 3.4.4 After a minimum of 30 days, a random sample of 2,000 fish will be examined to assess long-term coded-wire tag loss and adipose mark quality (1992 brood).

POND	INITIAL TAG LOSS (%)	INTERMEDIATE TAG LOSS (%)
1A	0.0	.99
2A	0.5	1.2
3A	0.5	.59
4A	0.8	.99
5A	0.2	.99
6A	0.4	.40
7A	0.9	1.57
8A	0.0	.19
9A	0.4	.59
10A	0.2	1.18
11A	0.2	.59
12A	0.4	1.18

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**OBJECTIVE 4:** Recovery of Coded-Wire Tags.

**Task 4.1:** Recovery of coded-wire tags at the hatchery rack.

Sub-task 4.1.3 Snouts will be recovered from all adipose fin-clipped fish returning to the hatchery and their wire tags removed and recorded. Two hundred seventy eight (278) adults from the 1989 brood, 4 maxi-jacks from the 1990 brood and 193 "mini-jacks" or two year old fish from the 1991 brood were recovered during the 1993 spawning operations. The results are presented below. Fishery recoveries for 1993 include 1992 catch.

1989 Brood:

Tagcode	Pond	Group	RECOVERIES				Catch 1993	Total	Group Total
			Rack		Catch				
			1991	1992	1993	1993			
635602	a1	6wk.	4	0	15	4	23		
635604	a2	6wk.	1	1	29	5	36		
635607	a3	6wk.	2	1	17	2	22		
635608	a4	6wk.	4	2	21	5	32	113	
635611	a5	3wk.	3	2	22	2	29		
635601	a6	3wk.	0	2	35	2	39		
635562	a7	3wk.	3	1	17	1	22		
635561	a8	3wk.	2	5	23	1	31	121	
635559	a9	cont.	1	0	27	5	33		
635556	a10	cont.	2	1	27	3	33		
635555	a11	cont.	2	2	19	0	22		
635552	a12	cont.	3	4	26	7	40	128	

1990 Brood:

Tagcode	Pond	Group	RECOVERIES				Catch 1993 1994	Total	Group Total
			Rack		Catch				
			1992	1993	1993	1994			
635922	a1	cont.	7	0	0	0	7		
634312	a2	cont.	3	2	0	0	5		
635925	a3	cont.	2	0	0	0	2		
634313	a4	cont.	2	0	0	0	2	16	
635926	a5	6wk.	9	0	0	0	9		
634314	a6	6wk.	13	0	0	0	13		
635928	a7	6wk.	11	0	0	0	11		
634315	a8	6wk.	10	1	0	0	11	44	
635931	a9	3wk.	5	0	0	0	5		
635932	a10	3wk.	9	0	0	0	9		
635935	a11	3wk.	10	0	0	0	10		
635937	a12	3wk.	9	1	0	0	10	34	

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1991 Brood:

Tagcode	Pond	Group	Rack Recoveries		
			1993	Group Total	
634546	a1	cont.	0	0	
634507	a2	cont.	14	14	
634506	a3	cont.	9	9	
634505	a4	cont.	16	16	39
634504	a5	3wk.	15	15	
634503	a6	3wk.	18	18	
634502	a7	3wk.	17	17	
634406	a8	3wk.	15	15	65
634405	a9	6wk.	17	17	
634403	a10	6wk.	18	18	
634363	a11	6wk.	20	20	
634362	a12	6wk.	34	34	89

**OBJECTIVE 5: Data Analysis and Reports.**  
**Task 5.1: Quarterly and Yearly Progress Reports.**

Subtask 5.1.4: Quarterly and yearly 1992.

At the end of each quarter. Draft annual due 3/31/94, final annual due 5/31/94. Three quarterly reports have been submitted during this year. Reports were submitted 8/31/93; 11/30/93; and 2/28/94. A draft and final annual report will be submitted at the required time (3/31/94 and 5/31/94) and will substitute for the fourth quarterly report.

**WORK SCHEDULE AND PRODUCTS: OBJECTIVES 3, 4 and 5**

SUBTASK	PRODUCT	STATUS
OBJECTIVE 3	Tag application	Complete
Subtask 3.1.4	Tag 1992 brood	Complete
Subtask 3.2.4	Enumerate 1992 brood	Complete
Subtask 3.3.4	Adipose Fin Check	Complete
Subtask 3.4.4	Tag Loss Assessment	Complete
OBJECTIVE 4	Recovery of CWT's	
Subtask 4.1.2	Recovery CWT at rack during 1993	Complete
OBJECTIVE 5	Analysis and reports	
Subtask 5.1.4	Analysis and Reports for FY-94	5/31/94

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**COSTS:**

Funds totalling \$68,925.00 (\$58,925 + 10,000 carry over) were approved for FY94 O&M. A request for FY95 O&M funding totalling \$36,802.00 (\$22,728 + \$14,074 carry over) was made during this reporting time (see Appendix D).

**PERSONNEL:**

In addition to the temporary staff at the hatchery site, the following personnel from the Olympia office have been involved in this project during the reporting period.

NAME	POSITION	TIME
Andrew Appleby	Fisheries Biologist 3	44 days
* Patty Michak	Fisheries Biologist 3	1 day
* Bob Rogers	Fish Health Specialist 3	1 day

\*= involved in kidney sampling for FAT and ELISA analysis.

**LITERATURE CITED:**

Hopley, C., P.R.Seidel, H.G.Senn, and R.C. Hager. 1978.  
Results of 1970 and 1972 brood Columbia River Coho studies.  
Prog. Rept. 46. Washington State Department of Fisheries.  
pp.18-25.

FOR MORE INFORMATION OR CLARIFICATION CONTACT:

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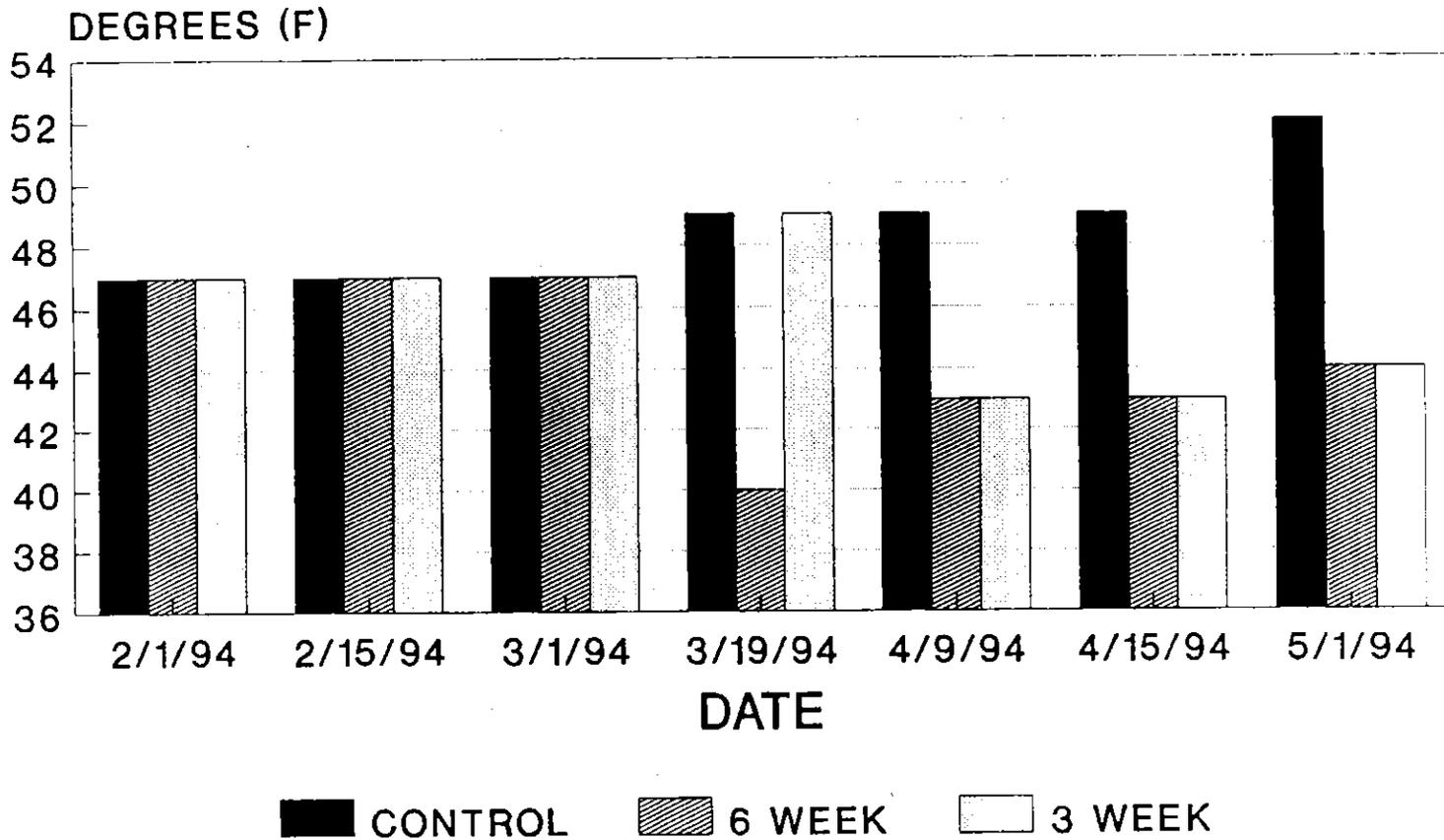
RELEASE INFORMATION FOR 1992 BROOD SPRING CHINOOK  
 ACCLIMATION STUDY  
 RELEASED FROM KLICKITAT HATCHERY APRIL 29, 1994

VALUES ARE ESTIMATED FOR DRAFT REPORT

POND	TAGCODE	STUDY GROUP	DATE REL.	SIZE (MM)	SIZE (F/LB)	C.V. LENGTH	TAGS REL.	AD ONLY	UNTAGGED REL.	TOTAL REL.
1A	635309	3 week	4/29/94	162	9	9.61	19703	197	0	19900
2A	635308	3 week	4/29/94	166	8.1	11.41	19365	235	0	19600
3A	635307	3 week	4/29/94	170	7.7	8.98	19468	116	116	19700
4A	635306	3 week	4/29/94	169	7.8	11.91	19526	37	37	19600
5A	635305	control	4/29/94	170	7.5	11.04	19406	194	0	19600
6A	635114	control	4/29/94	172	7.3	10.39	16524	76	0	19600
7A	635113	control	4/29/94	163	8.8	8.93	19217	307	76	19600
8A	635112	control	4/29/94	164	8.7	9.28	19663	37	0	19700
9A	635111	6 week	4/29/94	167	7.9	11.68	19309	115	76	19500
10A	635110	6 week	4/29/94	162	8.9	10.55	19706	235	159	20100
11A	634831	6 week	4/29/94	162	8.8	9.84	19087	113	0	19200
12A	634830	6 week	4/29/94	161	9	10.93	19036	227	37	19300

BASED ON 100 FISH PER POND SAMPLED AT RELEASE.

# WATER TEMPERATURES FOR KLICKITAT FOR 1992 BROOD SPRING CHINOOK



AVERAGE OF MAXIMUM AND MINIMUM  
 Ponds a1-a4 3WK. Ponds a5-a8 control  
 Ponds a9-a12 6wk.

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Appendix B

**BACTERIAL KIDNEY DISEASE SCREENING RESULTS.  
 KLICKITAT HATCHERY 1991 BROOD SPRING CHINOOK.**

POND NUMBER	STUDY GROUP	PERCENT LEVEL OF INCIDENCE				AVERAGE PERCENT BY STUDY GROUP			
		BELOW DECT.	LOW	MOD.	HIGH	BELOW DECT.	LOW	MOD.	HIGH
A1	CONTROL	40	60	0	0	42.5	52.5	5.0	0.0
A2	CONTROL	30	70	0	0				
A3	CONTROL	50	40	10	0				
A4	CONTROL	50	40	10	0				
A5	3WK	50	40	10	0	62.5	30.0	7.5	0.0
A6	3WK	80	10	10	0				
A7	3WK	70	20	10	0				
A8	3WK	50	50	0	0				
A9	6WK	50	40	10	0	57.5	40.0	2.5	0.0
A10	6WK	60	40	0	0				
A11	6WK	60	40	0	0				
A12	6WK	60	40	0	0				

RESULTS BASED ON 10 FISH PER POND SAMPLES TAKEN ON DAY OF RELEASE.  
 ANALYSIS CONDUCTED USING ELISA.

**CRITERIA FOR DISCRIMINATION BETWEEN LEVELS OF INCIDENCE**

BELOW DECTATABLE	less than 0.1 O.D. VALUE
LOW	0.1---0.199 O.D. VALUE
MODERATE	0.2---0.449 O.D. VALUE
HIGH	0.45 OR HIGHER O.D. VALUE