The Capture and Tagging of Naturally Produced Pre-Smolt Upriver Bright Fall Chinook on the Hanford Reach of the Columbia River, 1989

Columbia River Laboratory Progress Report 90-15

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May 1990

ACKNOWLEDGEMENTS

Dan Thompson and Paul Graham (WDF) directed the tagging trailer. Joe Hymer, Rich Pettit, Hugh Fiscus, Guy Norman, Dave Geist and John DeVore (WDF) and Joe Jay Pinkham, Bill Fiander, Matt Goudy Jr., Paul Wahpat and Stephen Thompson (YIN) were the field personnel on the project. Batelle Northwest allowed use of their buildings at the tagging site for equipment storage. The U.S. Dept. of Energy allowed right of trespass onto the Hanford Nuclear Reservation. The U.S. Fish and Wildlife Service provided a portable generator and Columbia River Intertribal Fish Commission administered the funds for this project. It is with expressed sorrow that the unfortunate passing of Matt Goudy Jr. is acknowledged. We will miss his participation and companionship.

Introduction

The Columbia River Upriver Bright (URB) fall chinook stock originates primarily from natural and hatchery spawning escapement above McNary Dam on the Columbia River. Smaller populations exist in the Deshutes River and in the Snake River. URB fall chinook migrate to ocean waters off the coast of Washington to Alaska and back providing a significant interception (harvest) opportunity. The significant utilization of the URB fall chinook stock by so many user groups across international boundaries has made the URBs a key harvest indicator stock for the Pacific Salmon Treaty (PST). Coded wire tag (CWT) representation of this stock is essential to effectively monitor interception rates by both foreign and domestic fisheries.

Since the PST implemention in 1985, URB exploitation has been measured by CWT recoveries from releases of URB fall chinook from the Priest Rapids Hatchery. The feasibility of capturing and tagging 200,000 pre-smolts from natural (wild) spawning URBs on the Hanford Reach was researched in the spring of 1985 (Norman, 1985). This research was initiated in recognition of the significant natural spawning that occurs in the Hanford Reach area (Table 1), and its potential effect on total production of this stock. In 1987 the capturing, marking and tagging of wild pre-smolt URBs on the Hanford Reach of the Columbia River was initiated. The effort to CWT wild URBs has now been completed three consecutive years (Table 2). The additional tag recoveries should further improve run predictions, PST allocations and accountability of wild URB production.

URB fall chinook run sizes have recently increased, reaching a recent historical record of 419,400 adults returning to the mouth of the Columbia River in 1987. In the Hanford Reach area natural spawning population escapement for 1987 also reached a record level with 86,200 adult fall chinook returning to the spawning grounds between McNary Dam and Priest Rapids Dam (Table 1).

With two-thirds of the average returns (escapment) of URB fall chinook freely spawning on the Hanford Reach accountability (Table 1) through CWT programs should provide not only better fisheries interception data but may also provide key wild production base line data. This base line data will provide insight, as well as a reference, to monitor future effects of changing hatchery releases and their effect on natural production. These effects may include sympatric competition, genetic consequences and other unknowns. Similar insight about habitat and habitat degradations, out-migration through hydroelectric projects, effect of chemical pollution (flouride, pesticides, PCBs etc.), critical habitat loss due to dredging or low water (result of heavy agricultural useage), and their impact on URB fall chinook production may be obtained. Coded wire tagging of naturally spawned pre-smolt URBs, will then provide the means to comparatively evaluate hatchery and natural productivity. Specific information about URB natural spawning escapement and its relationship to the ranges of productivity (run size) and how this would relate to harvest management and McNary

Dam escapement goals are expected results from this project. The Hanford Tagging Project to date has coincided with the largest spawning escapements in recent history.

Organization and implementation of the Hanford tagging project is a multi-agency cooperative effort. The Department of Energy grants right of trespass to the tagging site. Batelle Northwest allows use of the two buildings that are used for equipment storage on the site. The US Fish and Wildlife Service loans a portable generator to power the tagging trailer, the Yakima Indian Nation provides manpower for capture and tagging operations and the Washington Department of Fisheries provides the tagging trailer and associated equipment for tagging operations as well as manpower for capture and tagging operations and data analysis. The project is entirely funded with federally allocated PST funds administered by the Columbia River InterTribal Fish Commission.

Methods

Peak emergence from the gravel occurs in April with smolt out-migation, from the Hanford Reach, peaking in July. Therefore, the target time for capturing and tagging wild pre-smolt URB fall chinook is in late May and early June when the fingerlings have attained a suitable size for application of coded wire tags (>= 47 mm fork length) and prior to the June releases of fall chinook from Priest Rapids Hatchery.

The highest abundance of rearing pre-smolt wild URB fall chinook has been found in the White Bluffs area of the Hanford Reach of the Columbia River (RM 360-370) (Figure 1). Capture and tagging operations have therefore concentrated in this area. In 1989, as in 1987 and 1988, tagging operations were situated at the old Hanford Townsite (RM 362) within the Hanford Nuclear Reservation. This site was chosen because of its proximity to the White Bluffs area; an important factor for minimizing handling and stress of captured pre-smolts. A five station tagging trailer was set up on the boat ramp, powered by a diesel generator loaned from the U.S. Fish and Wildlife Service. A floating wharf was anchored adjacent to the boat ramp to secure floating pens for unprocessed catch, tagged chinook, culled non-taggable chinook, and incidental catch. A screened submersible pump provided a constant flow of water through the tagging trailer during tagging operations.

The specific onset of the tagging operation was determined by initial test seining in mid May. Capture of pre-smolt chinook in key index areas on the Hanford Reach provided abundance and average size information. Random subsamples of stick seine hauls were taken. Individual fork lengths were recorded for each fish in these subsamples. Average growth rates for May (as determined from 1987 and 1988 seine catches on the Hanford Reach) were applied to the average fork length of juveniles captured during test seining to interpolate the optimun time to initiate tagging operations. The optimal start-up time for tagging was determined to be when the majority of pre-smolts available for capture were 47 mm fork length or greater. This is considered the minimum size for safely implanting full-length coded wire tags in chinook without causing undue damage or mortality.

Stick seines of 34-36 feet in length with six foot bags constructed of 3/16 inch bobbinet were used in the capture of wild chinook pre-smolts. Seines were fished in the direction of the current parallel to stream margins. Efforts were concentrated in habitat likely to contain an abundance of chinook fingerlings. In general, shallow areas with aquatic floral cover are best in the early morning and late afternoon hours when chinook are actively feeding and seeking protection from predators. When the sun was full on the water, deeper areas were sought by chinook pre-smolts, ostensibly to escape detection by avian predators. Samplers wore polarized glasses to detect fingerling chinook for effective capture. The seine was pursed towards shore when the probability of capturing more fish diminished, the probability of escape of the fish in the bag of the net increased greatly or the abundance of fish in the bag was large enough to cause concern over handling stress to the captured chinook. Seine hauls were also cut short if rocks or debris were caught in the net. This was done to minimize physical harm to the captured chinook. Efficient capture techniques varied with the habitat fished. At times it was desirable to fish two nets side by side to capture escapees from one net with the other. At other times, the best method was to have one or more samplers beat the water adjacent to the net to scare fish out of cover and into the net.

Captured chinook were transported to jet sleds in 5 gallon plastic buckets and poured into 32 gallon plastic garbage cans on the jet sled. Care was taken to watch the captured chinook for signs of stress. The water was changed as necessary to replenish the oxygen supply. When the garbage cans were full (3,000 fish per can was considered maximum capacity), the fish were transported to the tagging site and placed in floating net pens to await the tagging process.

Unprocessed fish were loaded from the floating pens into flow-through basins in the tagging trailer. Fish were then anesthetized with tricaine methanesulfonate (MS-222) in small basins on the sorting table. Incidental non-target species, chinook less than 47 mm fork length, chinook greater than 80 mm fork length and injured chinook were culled and piped into the sort pen for recovery, length frequency sampling and eventual release. Chinook greater than 80 mm were culled to avoid any possibility of tagging a small sized spring or summer chinook. The adipose fins on taggable chinook pre-smolts (47-80 mm fork length) were clipped. Small "taggers" (47-60 mm) were routed to CWT tagging machines with small head molds for tag application. Larger fish (>60 mm) were routed to CWT tagging machines with larger head molds. All tagged fish were automatically checked for tags and counted by the tagging machines before they were piped to the recovery pen. Subsamples of the tagged and sorted chinook (sample size target = 100 each group) were sampled for fork lengths and tagged chinook were also sampled for tag retention prior to release. Chinook releases were conducted twice daily. All fish were released in shallow water near the boat launch where aquatic vegetation provided cover and protection from predators (mainly squawfish and smallmouth bass). Every evening, 100-300 tagged chinook were transferred to a floating

pen to ascertain the degree of overnight mortality. A subsample of the tagged chinook were kept in a floating pen for the duration of the project to ascertain tag retention.

Results

Preliminary test seinings were conducted on May 10 and 24 to determine the average size of pre-smolt chinook which governs the proper commencement of tagging operations. On May 10, the grand average fork length for seven stick seine catches of chinook fingerlings was 43.0 mm (weighted by catch per set) (Table 3). By May 24, the grand average fork length for eight sets had increased to 44.1 mm. Chinook fingerlings caught during the same test seining time period (May 5 and 6, 1988 and May 7, 1987) had comparable grand average fork lengths of 45.8 and 41.4, respectively. The percent of taggable size chinook in 1989 test seining catches was 12.7 (May 10) and 23.5 (May 24) (Table 3). This compared to 31.1% taggable size chinook in 1988 and 4.0% taggable size chinook in 1987. From this data, May 30 was chosen for the initiation of tagging operations in 1989.

A total of 355,542 pre-smolt wild URB chinook were processed during 1989 tagging operations at Hanford (Table 7). Relative to the 1987 and 1988 seining, catch per unit effort and overall abundance of pre-smolt wild URB fall chinook rearing on the Hanford Reach was lower in 1989. The catch per set averaged 1,517 in 1987, 1,101 in 1988 and 600 in 1989 (Table 4, DeVore, 1988 and Norman, 1987). The 1989 catchability of pre-smolt chinook did not limit the speed of the tagging operations. As in previous years sorting and tagging procedures usually dictated tagging efficiency. Estimated and actual catches by day and area are presented in Tables 4 and 5. It is interesting to note that some recaptures of marked chinook were made about 1 mile upstream of the tagging and release area (Reactor Run, RM 363) (Figure 1).

For the course of the 1989 operations, 60.9% of chinook processed were tagged (Table 4), down from the 76.5% of the catch tagged in 1987 (Norman,1987) and up from 58.8% tagged in 1988 (DeVore, 1989). The grand mean average fork length for all URB pre-smolts processed was 46.8 mm (1989), noticably smaller than 48.9 mm (1988) and 53.8 mm (1987) (Table 6b). The decline in relative size of the URB pre-smolts was probably a phenomenon related to colder air and water temperatures experienced between emergence and seining in 1989 and not related to the seining operation itself.

The total number of pre-smolt wild URB chinook tagged in eleven days in 1989 was 208,592 with 146,950 sorted due to small size or injury. The effective tag output after mortality (immediate and delayed) and immediate tag shed was 200,205 (Table 7). The goal is 200,000 tagged natural URB fall chinook. The delayed mortality figure of 1,245, in table 7, represents the total number of tagged chinook mortalities after release and is based on the percentage of cumulative mortalities of tagged chinook subsamples held overnight in a live pen after every day of tagging. A tag shed rate of 0.7% was extrapolated from twice daily quality control checks of subsamples of the tagged groups. Expanding the tag shed rate to the number of live tagged chinook released results in an estimated

1,446 chinook that lost tags during processing.

Post tag sampling of subyearling chinook in 1989 occurred on the 18th and 19th of July. Out of a sample of 1,317 juvenile chinook ten were adipose clipped (marked). All ten tag codes were from the 1988 Hanford wild chinook tagged during the 1989 Hanford Tagging Project. The daily subsamples were 468 juveniles sampled with nine marks on July 18th and 849 juveniles sampled with one mark on July 19th. In 1989, none of the smolt mortalities at the juvenile bypass at McNary Dam were sampled for CWTs as had previously been done (DeVore, 1989).

Discussion

From the capture and tagging operation on the Hanford Reach a general abundance of subyearling chinook can be determined. In 1989, the average catch per set again indicates that juvenile abundance may be down from previous tagging years (Table 4, DeVore, 1989). As in the previous two years capture methods were adapted to maximize the pre-smolt catch per unit of effort (optimal habitat of shallow runs with floral cover and adequate flow were sought). McNary Dam passage total indices (Table 8) also concurs with the general abundance indicated by seining. Different flow regimens occurred, for each of the Hanford Tagging Project years (Table 4, DeVore, 1989, Norman, 1987) that might have affected subyearling chinook catchability (catch per effort) and the variable efficiency of the Juvenile Bypass System at McNary Dam. One could conclude from the above observations that the 1988 brood year recruitment to smolts was lower than one might expect in light of the good escapement of natural spawners (Table 1).

Flows did not constrain capture efficiency at any time in 1989. The efficiency of operations was good overall even though the sizes of the pre-smolts were smaller and sorting was more scrutinized to obtain the goal of 200,000 taggers.

CWT recoveries from the Hanford Tagging Project are begining to be documented (Table 2). From this data will come better accountability of the URB fall chinook stock. This improved accountability may provide data that not only determines exploitation rates on wild URB chinook by The United States and Canadian fisheries, but in addition provide insight about comparative hatchery and wild stock interactions, wild stock and flow regime interactions, outmigration and passage interactions of subyearlings, and a general determination of optimal escapement of the naturally spawning URB fall chinook stock.

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Table 1. Upper Columbia River adult fall chinook counts for 1980-1989.

Year	McNary Dam Count	Hanford Reach Natural Spawn	Hatchery Escapement*
1980	29,900	21,900	2,200
1981	21,100	15,200	1,600
1982	31,100	20,700	2,800
1983	48,700	37,000	3,200
1984	61,000	45,400	7,100
1985	93,300	63,800	12,600
1986	113,300	73,900	16,800
1987	157,000	86,200	22,600
1988	114,700	72,100 **	11,500
1989	96,500	64,400	8,900
Ten year ave.:	76,700	50,100	8,900

* Includes Priest Rapids, Ringold and Lyons Ferry hatcheries. Adult escapement based on biological age composition.
** The parent escapement for pre-smolts tagged in 1989.

Table 2. Yearly tagging and recovery effort of naturally spawned URB fall chinook.

Tag Year	Number of Pre-smolts Captured	Tagged	Output*	Columbia River Tag Recoveries to Date by Age ** 2	3	4	5
1987	263,909	201,369	188,916	-	-	-	-
1988	355,786	209,172	205,074	12	-	-	-
1989	355,542	208,592	200,630	3	9	-	-

* Effective tag output equals number pre-smolts tagged minus tag loss.
** This tag recovery data is for actual unexpanded recoveries from the Columbia River. No ocean recovery data available at present.

Table 3. Hanford Reach test seining data, 1987-1989.

Year	Date	Estimated Chinook Catch	Fork Length Sample Statistics (in mm) n	Mean*	Min.	Max.	Percent of Catch ** (>= 47 mm)
1987	May 07	21,675	203	41.8	37	62	4.0%
	May 20	24,658	427	46.9	37	75	46.1%
1988	May 5-6	15,100	668	45.8	36	65	31.1%
1989	May 10	21,675	878	43.0	35	65	12.7%
	May 24	12,600	861	44.1	35	67	23.5%

Data was obtained by sub-sampling seining catches from the Hanford Reach area of the Columbia River.

* Mean and percent of catch by min. size are weighted by catch per set.

** Min. fork length for CWT placement = 47 mm.

Table 4. Daily catch of smolts (in thousands) during the Hanford Reach wild fall chinook tagging project, 1989.

Date	No. of sets	Est. Catch	Actual Catch	Tag Size*	Catch / Set	Flow range (KCFS)**
30-May	11	8.7	7.9	40.8% ^	0.7	135.5-140.0
31-May	41	18.8	17.1	40.8%	0.4	154.1-156.5
01-June	58	39.2	35.7	38.9%	0.6	140.8-170.2
02-June	47	42.3	38.5	47.7%	0.8	151.5-198.7
03-June	56	37.2	33.9	42.0%	0.6	155.3-197.3
04-June	48	20.4	18.6	47.4%	0.4	144.2-159.5
05-June	41	33.4	30.4	59.9%	0.7	134.1-152.5
06-June	57	47.1	42.9	66.6%	0.8	149.9-176.0
07-June	67	39.5	36.0	85.3%	0.5	153.5-171.3
08-June	56	44.0	40.0	75.7%	0.7	151.4-156.9
09-June	58	33.0	30.0	80.0%	0.5	133.7-156.6
10-June	50	27.0	24.6	85.9%	0.5	149.3-156.8
Totals	590	390.6	355.6	60.9%	0.6	133.7-198.7

Catch consisted primarily of wild pre-smolt URB fall chinook captured on the Hanford Reach of the Columbia River.

* Tagging size target was >= 47 mm.

** Range of river flows at the Hanford Reach of the Columbia River during seining hours, normally 0500-1400 hours.

^ Per-smolts for May 30 sized with May 31. No actual percent available for May 30.

Table 5. Pre-smolt wild fall chinook estimated catch (in thousands) by specific river area in the Columbia River at the Hanford Reach, May 31 - June 10, 1989.

Site No.*	Est. Total Catch	Total Sets	Est. Catch/ Set	May 30 Catch	May 30 Sets	May 31 Catch	May 31 Sets	June 1 Catch	June 1 Sets	June 2 Catch	June 2 Sets	June 3 Catch	June 3 Sets	June 4 Catch	June 4 Sets	June 5 Catch	June 5 Sets	June 6 Catch	June 6 Sets	June 7 Catch	June 7 Sets	June 8 Catch	June 8 Sets	June 9 Catch	June 9 Sets	June 10 Catch	June 10 Sets
8	100.3	137	0.7					3.7	5	15.0	16	15.9	13	1.6	7	9.0	13	13.4	14	6.6	12	13.4	17	8.7	16	13.0	24
22	60.1	94	0.6	3.5	3	10.6	24	5.2	11	11.2	14	5.3	9	2.2	7	6.8	8	7.9	8	6.4	8	1.0	2				
12	41.0	56	0.7					12.8	12	7.4	5	5.2	17	1.2	3	8.4	7	1.2	2	3.2	7	0.9	1	0.7	2		
2	30.2	42	0.7											0.1	1					6.8	8	9.1	11	8.0	10	6.2	12
13	27.9	47	0.6					2.2	3	6.7	8					5.3	9	6.8	11	3.8	7	2.7	6	0.4	3		
10	27.5	29	0.9									0.4	2	1.7	3			5.5	5	5.7	4	3.8	3	8.5	8	1.9	4
1	24.8	38	0.7									2.6	2	7.7	11			4.7	4	5.7	11	2.6	5	0.8	4	0.7	1
14	24.1	34	0.7					0.2	3	2.0	4	3.4	5	1.9	4	3.9	4	4.1	4	0.1	2	5.2	4	1.2	1	2.1	3
15	11.6	17	0.7					1.3	3									2.4	4			5.0	6	1.3	2	1.6	2
9	8.6	20	0.4	2.3	4	1.2	7	4.5	8					0.6	1												
17	8.6	16	0.5					2.8	2					3.1	7			0.8	2					1.6	3	0.3	2
23	7.9	11	0.7			5.7	6	2.2	5																		
20	6.7	13	0.5	2.9	4	1.3	4	2.5	5																		
6	5.3	17	0.3									4.4	8	0.2	1			0.3	3					0.4	5		
7	2.7	13	0.2											0	3					1	7			1	3		
11	1.8	1	1.8					1.8	1																		
18	1.2	2	0.6																							1.2	2
	0.3	1	0.3																			0	1				
3	0.0	2	0.0																	0.0	1			0.0	1		
Totals	390.6	590	0.6	8.7	11.0	18.8	41.0	39.2	58.0	42.3	47.0	37.2	56.0	20.4	48.0	33.4	41.0	47.1	57.0	39.5	67.0	44.0	56.0	33.0	58.0	27.0	50.0

List from greatest to least estimated catch.

* Refer to Figure 1.

Table 6a. Fork length (in mm) of pre-smolt wild URB fall chinook captured in 1989.

	Tagged Chinook					Sorted Chinook				
Date	n	Mean	S.D.	Max.	Min.	n	Mean	S.D.	Max.	Min.
31-May	299	51.5	5.7	82	43	256	43.1	2.6	50	38
1-June	88	50.7	4.5	70	44	186	42.7	2.8	52	37
2-June	257	53.9	6.2	72	43	279	42.9	2.4	50	35
3-June	123	54.9	6.2	79	47	95	42.8	3.2	57	37
4-June	213	52.3	4.9	68	43	99	43.5	3.2	56	37
5-June	192	52.0	5.3	70	43	302	43.3	2.7	51	37
6-June	249	53.0	5.5	73	42	248	43.0	2.6	48	36
7-June	230	51.2	5.3	74	44	242	43.0	2.6	52	36
8-June	242	51.2	5.1	73	42	163	42.5	2.6	48	37
9-June	261	51.4	5.4	71	41	199	43.1	2.3	48	38
10-Jun	214	52.7	5.7	82	43	261	43.1	2.8	51	36

Table 6b. Yearly mean fork lengths of pre-smolt wild URB fall chinook sampled during the Hanford Tagging Project.

Year	Processed (mm)	Tagged (mm)	Sorted (mm)
1987	53.8	56.5	45.1
1988	48.9	53.9	43.2
1989	46.8	52.3	43.0

The capture and tagging of pre-smolts for the Hanford Tagging Project occurs on the Hanford Reach of the Columbia River.

Table 7. Daily numbers of pre-smolt URB "wild" fall chinook processed and effective tag output during the Hanford Tagging Project, 1989.

Date	Chinook Processed	Chinook Sorted	Chinook Tagged	Dead at Release	Delayed Mortality*	Tag Shed**	Tag Output
31-May	34,247	20,280	13,967	152	85	97	13,815
1-June	41,789	25,520	16,269	3,709 ***	77	112	12,560
2-June	46,037	24,060	21,977	245	133	152	21,732
3-June	28,396	16,460	11,936	747	69	82	11,189
4-June	31,741	16,710	15,031	15	92	104	15,016
5-June	33,514	13,450	20,064	81	123	139	19,983
6-June	31,763	10,610	21,153	84	129	146	21,069
7-June	27,473	4,050	23,423	193	143	162	23,230
8-June	28,969	7,030	21,939	168	134	152	21,771
9-June	25,580	5,120	20,460	216	124	141	20,244
10-June	26,033	3,660	22,373	91	137	155	22,282
Totals	355,542	146,950	208,592	5,701	1,245	1,441	200,205

Hanford Tagging Project takes place on the Hanford Reach of the Columbia River.

* Measured at 0.6% (7/1,141).
** Measured at 0.7%.
*** Interupted flow to the holding tank led to a higher number of mortalities.

Table 8. McNary Dam total passage indices (TPI), hatchery releases above McNary Dam and catches per set in thousands of subyearling chinook, 1985-1989.

Year	McNary Dam TPI *	Hatchery Releases Above McNary Dam *	Hanford Reach Catch per Set **
1985	6,569.3	11,602	--
1986	6,721.6	12,218	--
1987	7,044.2	9,112	1.5
1988	6,884.5	16,911	1.1
1989	5,034.8	11,770	0.6

* From DeHart et. al, 1990.
** Catches occured during Hanford Tagging Project.