

Adult Return of Fingerling Coho Salmon Outplanted in the Upper Elwha River

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Abstract

Fingerling Elwha coho salmon were coded-wire-tagged and outplanted above the Elwha dams to evaluate adult return. This work was undertaken to evaluate outplanting strategies for restoring coho to the upper Elwha River. Adult survival was compared to Elwha hatchery production and to pre-smolt outplanting conducted elsewhere. In these comparisons, survival data from previous Elwha fish studies were used to estimate the outplant's passage loss through the Elwha dams and its smolt-to-adult survival. Estimated fingerling-to-adult survival of the outplant ranged from 0.71% to 0.87%, which is higher than values reported from Washington coast, but lower than values reported from Puget Sound. Estimated smolt-to-adult survival of the outplant ranged from 2.16% to 2.61%, which compared favorably to Elwha hatchery smolt-to-adult survival from the same brood (2.40%) and nine other broods (mean = 1.36%, range = 0.17% to 3.23%). Several factors suggested that adult survival of the outplant was underestimated, however. Catch distribution of the outplant was not significantly different than that of tagged hatchery production of the same brood, but 29% fewer rack recoveries were observed (compared to tagged hatchery production of the same brood). Adult lengths of the outplant were similar to Elwha River hatchery production.

Introduction

This is an analysis of the adult survival of one coded-wire-tagged group of juvenile coho salmon outplanted in the upper Elwha River. Outplanting was intended to continue for one complete cycle and determine freshwater, dam-passage, and marine survival, but it was interrupted after the first year because of other activities related to federal licensing of the Elwha dams.

This report describes adult return from fingerling and smolt stages of this outplant (with allowance for dam passage loss) and compares it to survival of Elwha hatchery coho smolt releases and regional outplants in other systems.

Information on survival of outplants will assist in Elwha fishery restoration planning. This information is expected to help shape outplanting strategies for coho salmon, as juvenile outplants are one facet of Elwha River fishery restoration.

Tagging and outplanting was a joint effort of Olympic National Park, U.S. Fish and Wildlife Service, and Lower Elwha S'Klallam Tribe (LET). In all, 152,525 juvenile Elwha coho (2.8 gm mean weight; 160 fish per pound) were tagged on June 22-26, 1987 at the LET Hatchery and outplanted on July 31, 1987, in equal numbers at three upper Elwha River sites within Olympic National Park. Fish were moved by truck to a staging site at Sweets Field, then flown upriver by helicopter and scattered-planted by hand into side channel habitat (Figure 1). Total cost for personnel, tags, and helicopter service in this effort exceeded \$15,000. Additional details of the tagging and outplanting are reported elsewhere (Wunderlich and Hager 1988).

Methods

Survival

Fingerling-to-adult survival was computed by dividing total adult return by total tag release (after adjustment for tag retention and smolt survival at the Elwha dams). Total adult return of the outplant group (tag code 051908) was obtained from Pacific States Marine Fisheries Commission (PSMFC). Total tag release was obtained by applying an estimated tag-retention rate (86.9%) and dam-survival rate (77.7% to 93.8%) to the total outplant.

Smolt-to-adult survival was computed by applying a fingerling-to-smolt survival value of 32.9% to the outplant group (Wunderlich et al. 1989), and the same tag-retention and dam-passage factors as for fingerlings.

Estimated tag retention was based on a 358-fish sample of the outplant group taken twelve days after tagging.

Dam survival was based on a coded-wire-tag study of smolt survival initiated in 1984 when test and control pairs of smolts were released above and below the dams (Wunderlich 1988). Assumptions involved in using the 1984 results to estimate passage loss of the outplant group were:

- The outplants passed the dams as smolts. That is, juveniles were not displaced from outplant sites and did not pass the dams at a pre-smolt stage with different survival than estimated for smolts in 1984. This possibility was minimized by scatter planting fish at sites at least 5 river kilometers above Lake Mills.
- Smolt survival through the dams in 1988 (emigration year for the outplant group) was the same as during the 1984 passage study. Examination of streamflow and exit operation at each dam during the

spring of both years suggests that survival for coho smolts was comparable in 1988 and 1984.

- Tagged and non-tagged fish in the outplant group experienced the same fingerling-to-smolt and dam-passage survival.

The outplant group's survival was compared to other Elwha smolt releases by accessing PSMFC recovery data. In this comparison, only complete return data (brood years 1978 to 1988) were used. Further, Elwha hatchery tag groups in brood years 1981 and 1982 were aggregated (by brood) because of their small size and variability in release dates (Table 1).

Recovery distribution

Recoveries of the outplant group and that of a hatchery smolt release of the same brood (tag code 212256; Table 1) were examined to see if naturally-reared and hatchery-reared Elwha coho differed in catch distribution and rack recovery. Observed catches in major reporting areas (mixed net and seine, estuary sport, and ocean troll from U.S. and British Columbia agencies) were compared by contingency table analysis (Snedecor and Cochran 1980). The proportions of observed recoveries of these two groups at the hatchery rack were qualitatively examined.

Lengths at adult recovery were qualitatively examined for size-related differences of the outplant versus hatchery releases from the same and different Elwha broods.

Results and Discussion

Employing the assumptions outlined above, the outplant group's total survival was estimated at 0.71% to 0.87% from fingerling-to-adult, and 2.16% to 2.61% from smolt-to-adult (Table 2).

The outplant's fingerling-to-adult survival appeared to be within or above the expected range, but few empirical measures were found for comparison. Springtime fry plants (400 per pound) in Gray's Harbor survived at 0.2% to adult, based on measured fry-to-smolt survival of 7% and smolt-to-adult survival of 3% (Dave Seiler, WDF, personal communication). A summer fingerling plant (7.8 gm) in the Raft River survived at 0.41% to adult, based on PSMFC data (tag code 050524). Puget Sound fry plants often exhibit high survival (compared to Strait of Juan de Fuca stocks) with approximately 10% fry-to-smolt and 20% smolt-to-adult (2% fry-to-adult) (Chuck Baranski and Dave Seiler, WDF, personal communications).

The outplant's smolt-to-adult survival compared favorably to Elwha hatchery smolts, especially in recent years (Table 1). Hatchery smolts of the same brood (1986) survived at 2.40%, while hatchery smolts of all broods (Table 1) survived at a mean rate of only 1.36% (range of 0.17% to 3.23%). However, in this comparison, it should be noted that the lowest hatchery smolt survival

(0.17% for brood year 1988) may not be representative because flooding in 1991-1992 reduced coho recoveries in the terminal catch and hatchery racks (Pat Crain, LET, personal communication).

Although the outplant group's survival compared favorably to that of Elwha hatchery smolts, these factors suggest it was underestimated:

- Passage loss through Lake Mills was not included in the dam survival estimate. Test groups in the 1984 smolt survival study were released in Lake Mills forebay (rather than at the head of the reservoir), so mortality in passing Lake Mills was not part of the survival test.
- Terminal area return of the outplant group was likely underestimated compared to hatchery smolts of the same brood. Rack return of the outplant group was 29% less (of total observed recoveries) than that of the same brood year's smolt release from LET hatchery (tag code 212256), probably because the outplant group imprinted on the upper river.
- The outplant's tag retention may have been underestimated. Tag-loss was measured at 13 days (Table 1) instead of 30 days, which is customary. Tag loss does not stabilize until approximately 30 days after tagging; however, additional tag loss from 12 to 30 days was likely less than 1% (Blankenship 1981). If 1% added tag loss occurred, true survival of the outplant group would have been slightly better.

Catch distribution of the outplant group mirrored that of the hatchery's smolt release of the same brood (tag code 212256). No significant difference was found ($\chi^2 = 31.1$, $P < 0.001$).

The outplant group's overall mean length at recovery (62.8 cm) was similar to Elwha hatchery smolts from the same brood (66.1 cm) and other broods (range of 54.3 to 67.4 cm) (Table 1).

References

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Table 1. Coded-wire-tag data for Elwha coho salmon (source: PSMFC).

Tag code	Brood year	Release date	Tagged release	Tag-loss days	Weight (gm)	Release stage	Release type ¹	Adult length (cm)	Total est. rec.	Total surv. (%)	Release site
050556	78	5/6/80	27,868	156	30.3	Smolt	P	57.1	468	1.68	Hatchery
050738	79	4/30/81	28,370	24	28.4	Smolt	P	63.1	142	0.50	Hatchery
050853	80	5/10/82	28,410	26	28.4	Smolt	P	67.4	92	0.32	Hatchery
051127	81	4/20/83	8,849	46	23.9	Smolt	P	61.3	163	1.84	Hatchery
051128	81	5/16/83	9,430	46	30.3	Smolt	P	58.4	359	3.81	Hatchery
051129	81	6/3/83	8,808	45	32.4	Smolt	P	54.3	352	4.00	Hatchery
051430	82	6/4/84	8,145	42	34.9	Smolt	P	60.1	270	3.31	Hatchery
051431	82	5/15/84	7,782	41	28.4	Smolt	P	61.3	202	2.60	Hatchery
051432	82	4/20/84	7,720	41	22.7	Smolt	P	64.7	196	2.54	Hatchery
051517	82	5/30/84	4,235	44	-30.0	Smolt	E	61.2	226	5.34	RKm 6
051520	82	4/25/84	3,489	43	-30.0	Smolt	E	65.9	26	0.75	RKm 6
051522	82	5/15/84	3,275	42	-30.0	Smolt	E	62.1	152	4.64	RKm 6
051523	82	5/8/84	3,770	42	-30.0	Smolt	E	64.7	112	2.97	RKm 6
211941	85	4/22/87	72,340	32	22.7	Smolt	K	60.3	178	0.25	Hatchery
051908	86	7/31/87	131,740	13	2.8	Finlg	E	62.8	879	0.67	Upper river
212256	86	5/4-5/23/88	71,404	34	30.3	Smolt	K	66.1	1,713	2.40	Hatchery
212532	87	5/1-6/4/89	60,809	46	34.9	Smolt	K	59.1	394	0.65	Hatchery
213159	88	4/5-5/20/90	70,405	91	32.4	Smolt	K	57.4	122	0.17	Hatchery

¹P = production; E = experimental; K = Pacific Salmon Treaty indicator.

Table 2. Calculation of fingerling-to-adult and smolt-to-adult total survival for tag group 051908.

Component	Value
Outplant size	151,600
Tag-retention rate	0.869
Tag-group size	$151,600 \times 0.869 = 131,740$
Smolt-passage survival ¹	0.777 to 0.938
Tag-group size adjusted for smolt-passage survival	$131,740 \times 0.777 = 101,440$ to $131,740 \times 0.938 = 123,572$
Total estimated adult recoveries	879
Fingerling-to-adult total survival	$(879/123,572) \times 100 = \underline{0.71\%}$ to $(879/101,440) \times 100 = \underline{0.87\%}$
Pre-passage smolts ²	49,854
Pre-passage tagged smolts	$49,854 \times 0.869 = 43,323$
Post-passage tagged smolts	$43,323 \times 0.777 = 33,662$ to $43,323 \times 0.938 = 40,637$
Smolt-to-adult total survival	$(879/40,637) \times 100 = \underline{2.16\%}$ to $(879/33,662) \times 100 = \underline{2.61\%}$

¹Wunderlich (1988).

²Wunderlich et al.(1989).

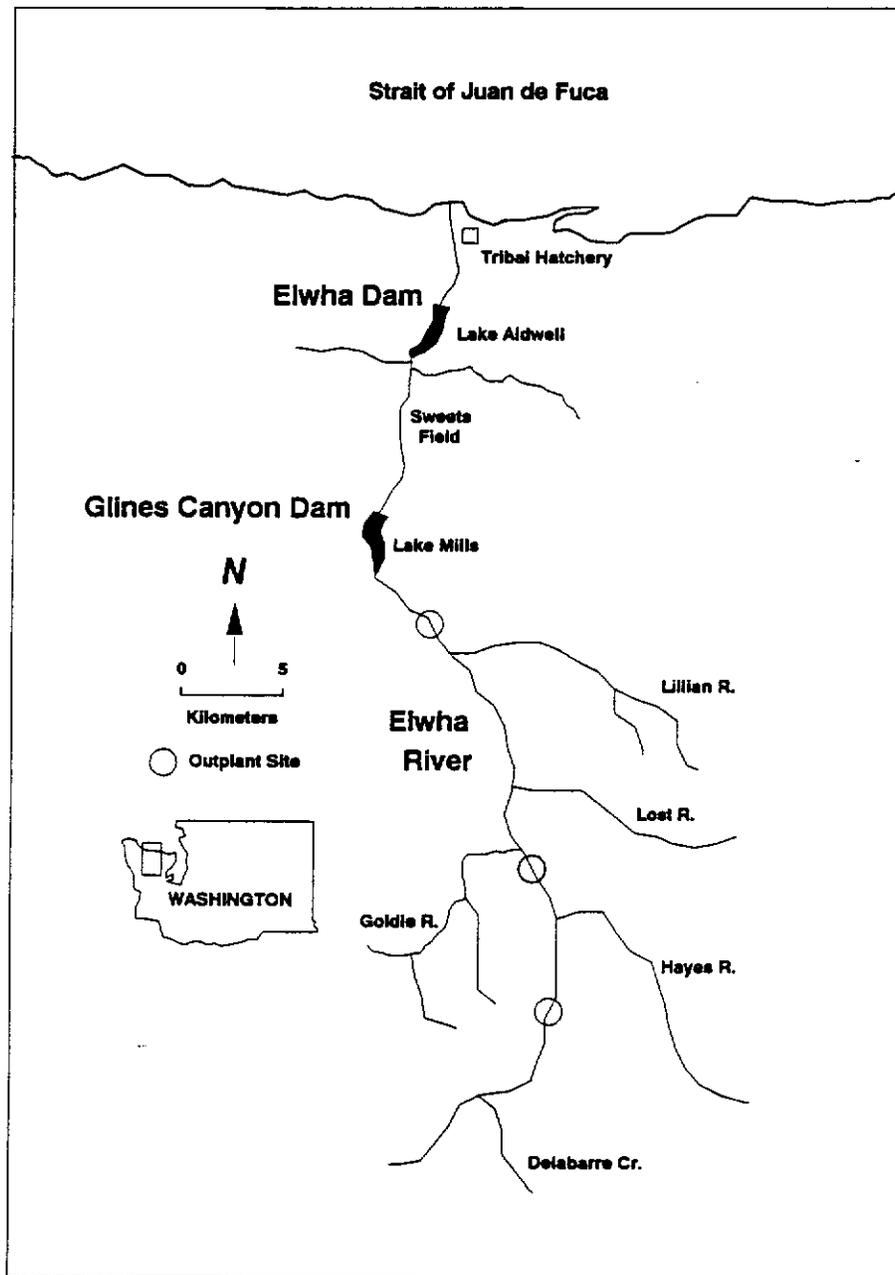


Figure 1. Outplant sites in the Elwha River.