

# HOMING BEHAVIOR AND CONTRIBUTION TO COLUMBIA RIVER FISHERIES OF MARKED COHO SALMON RELEASED AT TWO LOCATIONS

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## ABSTRACT

This study was initiated to determine the feasibility of creating or enhancing fisheries in specific areas by releasing salmon smolts into those areas. In 1970, two groups each of approximately 100,000 1968-brood coho salmon, *Oncorhynchus kisutch*, were marked with a right ventral (RV) or a left ventral (LV) finclip at Little White Salmon National Fish Hatchery near Cooks, Wash. The LV-marked group was transported by truck to Youngs Bay, 19 km (12 miles) from the mouth of the Columbia River near Astoria, Oreg., and released in April 1970. The RV-marked group was released in May 1970 at Little White Salmon Hatchery, 242 km (150 miles) from the mouth of the Columbia River. The Youngs Bay and Columbia River gill-net fisheries were sampled for these marks in the fall of 1970 and 1971. The two groups homed to their respective areas of release with very little straying. The LV-marked group contributed 7.7 fish to the fisheries sampled for each 1,000 fish released, and the RV-marked group contributed 11.7 fish to the fisheries sampled per 1,000 fish released. However, a fair comparison of the contribution of the two groups is inhibited by 1) incomplete sampling for these marks in the ocean fisheries, 2) the difference in time and size of release of the groups, 3) the unknown effect of delayed mortality due to hauling the LV-marked group, and 4) duplication of these marks in the ocean fisheries.

The Pacific salmon, *Oncorhynchus* spp., hatchery program has undergone considerable evolution in the past 10 yr. The escapement of adult fish to hatcheries is often more than sufficient to supply egg needs. In many cases, hatcheries receive sizable excesses of returning adults. These fish must be disposed of either by releases into streams, burial, donations, or sales. The sale of salmon carcasses has caused considerable friction between commercial fishermen and fishery agencies. Salmon returning to hatcheries often arrive in a condition which makes them unsuitable for donation or release into streams. Burial of the excess salmon is an obvious waste of a valuable resource.

Taft and Shapovalov (1938) found the homing instinct of coho salmon, *O. kisutch*, to the parent stream to be fairly exact. Hasler and Wisby (1951), Wisby and Hasler (1954), and Groves et al. (1968) reported the importance of olfaction in homing of adult salmon. Hasler (1966) and Wagner (1969) felt that the organic odor of the parent stream was imprinted rapidly in juvenile salmon, possibly at the time of downstream migration. We felt that if

the homing instinct was exact and the home-stream imprint was acquired quickly during parr-smolt transformation, then the homing site could be altered by transportation and release of coho salmon smolts.

The purpose of this study was to determine the feasibility of creating or enhancing fisheries in specific areas by releasing salmon smolts in those areas. If salmon returned to the area of release, the problem of excess hatchery returns could be reduced. This homing behavior would provide local fisheries with larger catches of salmon and a longer fishing season.

Youngs Bay was the site picked for testing the homing behavior of salmon. It is about 19 km (12 miles) upstream from the mouth of the Columbia River near Astoria, Oreg. The Lewis and Clark, Walluski, Youngs, and Klaskanine rivers empty into Youngs Bay (Figure 1). All are small rivers with low summer flows and greatly fluctuating winter flows. The Klaskanine Salmon Hatchery, operated by the Fish Commission of Oregon, is located on the North Fork of the Klaskanine River (Weiss 1966).

A commercial salmon fishery began on Youngs Bay in the early 1900's. The bay was closed to commercial fishing from 1931 to 1962, but has remained open from 1962 to present. From 1962 to

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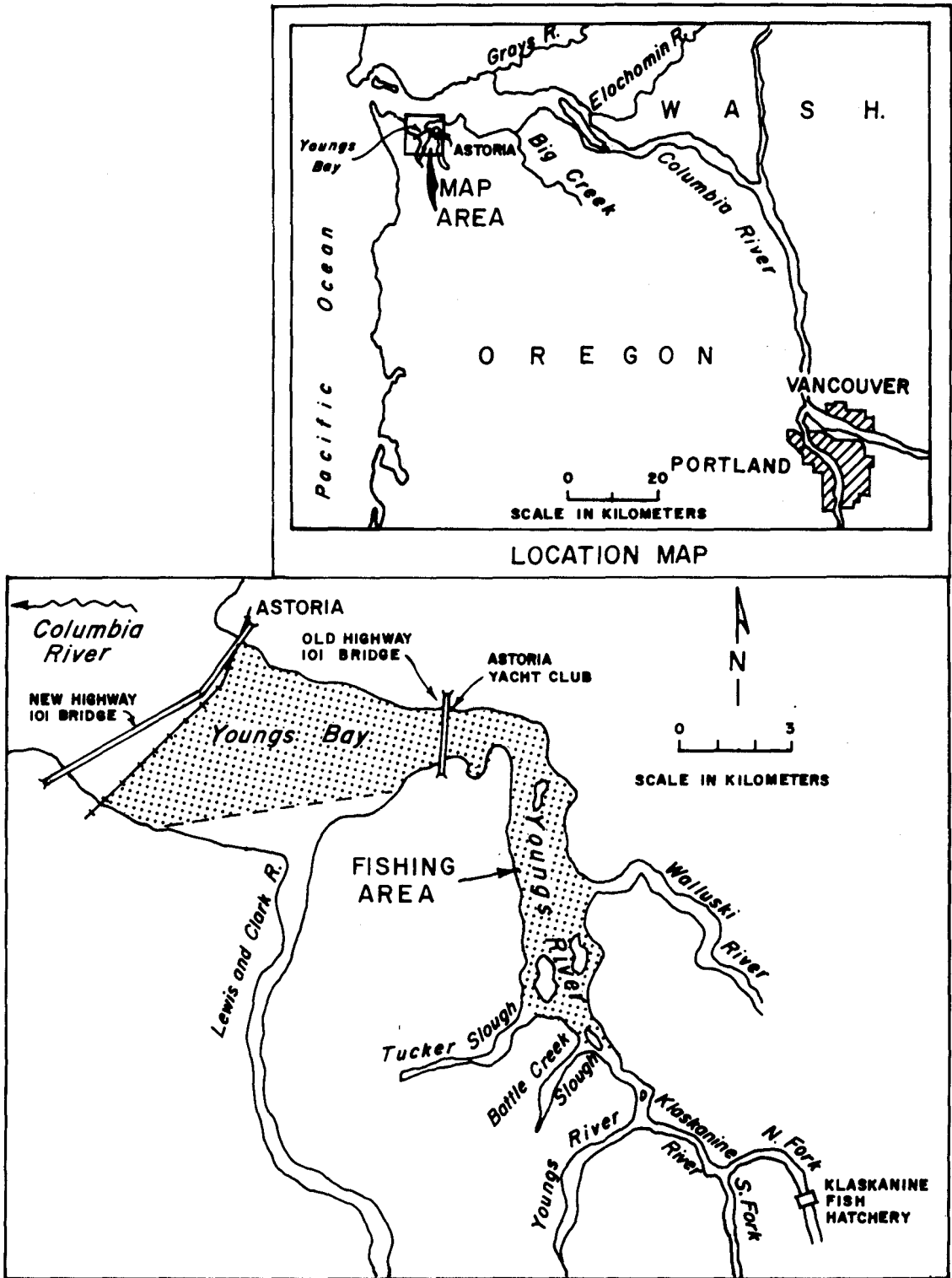


FIGURE 1.—Youngs Bay, Oreg.

1965, the fishing area extended from Battle Creek slough to the old Highway 101 bridge (Figure 1). The open area was extended to the new Highway 101 bridge in 1965. Coho salmon is the main species caught, but some chum salmon, *O. keta*, chinook salmon, *O. tshawytscha*, and steelhead trout, *Salmo gairdneri*, are also taken (Weiss 1966). The coho fishery has fluctuated from a low of 2,100 adults in 1962 to a high of 31,600 adults in 1967.<sup>3</sup>

The sport fishery in Youngs Bay itself is very limited. A majority of the sport fishing occurs from the confluence of the North and South forks of the Klaskanine River upstream to the Klaskanine Salmon Hatchery. A minor sport fishery for coho salmon exists on the Youngs River. It is limited by an impassable falls a short distance upstream from the river's confluence with Youngs Bay. There is little or no sport fishing for salmon on the Lewis and Clark or Walluski rivers. Sport fishing for coho in Youngs Bay and its tributaries starts after the first fall rains, from mid-September to the first of October.<sup>4</sup>

## METHODS AND MATERIALS

### Source of Fish

Coho salmon were selected as the test species for this study because of the success of hatchery coho culture exhibited by large hatchery returns. The coho for this experiment were obtained from Little White Salmon National Fish Hatchery. The eggs were taken in 1968 at Klaskanine Salmon Hatchery, and 926,300 were shipped to Little White Salmon Hatchery for hatching and rearing. Eggs from coho returning to Little White Salmon Hatchery were not reared at the station because the stock was considered undesirable. This stock had inadvertently been selected to commingle with the hatcheries fall chinook returns. This made it difficult to retain coho in good condition until spawning time. The Klaskanine coho were a later returning stock and would presumably eliminate the conflict with fall chinook.

Little White Salmon Hatchery is located near Cooks, Wash. on the Little White Salmon River approximately 1.5 km (1 mile) upstream from its confluence with the Columbia River and is about

242 km (150 river miles) from the Pacific Ocean. The hatchery is operated by the U.S. Fish and Wildlife Service and is funded primarily by the National Marine Fisheries Service.

### Marking

The marking portion of the study took place in March 1970. A total of 201,700 1968-brood coho salmon were marked with a finclip at Little White Salmon Hatchery. The right ventral (RV) fin was removed from 100,809 coho which were to be released in the Little White Salmon River. The left ventral (LV) fin was removed from 100,914 fish which were to be released into Youngs Bay. Fish were 55-62/kg (25-28/pound) at time of marking.

### Release Procedures

Youngs Bay was selected as a release site for three reasons. First, the bay is within the Columbia River system and yet a great enough distance from the Little White Salmon Hatchery to examine homing characteristics of coho salmon. Second, the bay provides a specific area separate from the Columbia River to which the salmon could home. Finally, the intensive commercial fishery in the bay was somewhat separate from the Columbia River fishery and would be relatively easy to sample.

A total of 100,662 LV-marked coho salmon weighing 2,019 kg (4,451 pounds) or 49.8 fish/kg (22.6/pound) were transported from the Little White Salmon Hatchery to Youngs Bay on 23, 27, and 29 April 1970. This was the normal historical coho release time at the hatchery. Two hatchery tank trucks, each making one trip per day, were used to transport the fish. On the first trip the water in the trucks was iced to maintain a constant temperature during transportation. The weather was rainy and cold, and the result was 2°C lower water temperature in the trucks than in the bay. Bay water was added to the tanks to equalize the two temperatures. The weather was the same on ensuing trips so icing was discontinued. The dates and water temperatures at the time of release are as follows:

Date	Time	Temperature (°C)	
		Bay	Truck
23 April	1930	11.1	10.6
27 April	2000	10.0	10.6
30 April	2000	11.1	10.6

<sup>3</sup>James L. Galbreath. 1968. Youngs Bay commercial coho fishery in 1967. Fish Comm. Oreg., Fish Comm. Res. Lab., Clackamas, Oreg. (Unpubl. manuscr., 10 p.)

<sup>4</sup>Franklin R. Young. Fish Comm. Manage. Res. Hdqrs., Clackamas, Oreg. (Pers. commun.).

The Astoria Yacht Club boat launching ramp (Figure 1) was chosen as the release site in Youngs Bay. It provided easy access and no spawning gravel or stream mouths occurred near the site. We hoped that returning adult coho salmon would mill around the bay in search of a stream. This would provide ample opportunity for commercial fishermen to harvest the fish.

All releases were made at dusk to reduce predation by gulls, grebes, ducks, and resident fish. The smolts dispersed rapidly upon release, most of them swimming toward deeper water. Movements could be seen as far as 100 m from shore shortly after releases. Only one instance of predation by birds was observed, and initial transportation losses were negligible. All the fish appeared health and active upon release.

The RV-marked coho salmon were released directly from the Little White Salmon Hatchery rearing ponds into the Little White Salmon River on the evening of 12 May 1970. A total of 100,367 fish weighing 2,504 kg (5,520 pounds) or 40.1 fish/kg (18.2/pound) were liberated. The RV-marked group was released 2 wk later than the Youngs Bay group. The reason for this difference in release dates is unknown.

### Sampling

In the fall of 1970, we sampled the Youngs Bay commercial fishery for marked 2-yr-old coho salmon. The sampling was concentrated at The New England Fish Company. A fish buyer, Lawrence Peterson, was contracted by New England Fish Company to purchase fish from Youngs Bay commercial fishermen and deliver them to the processing plant. We also did some sampling of the Youngs and Klaskanine rivers sport fisheries. The Columbia River commercial fishery was sampled by the Fish Commission of Oregon. The California ocean fisheries were not sampled for single fin marks and the British Columbia and Alaska ocean fisheries and Columbia River sport fisheries were not sampled for marked fish.

Returns to hatcheries near Youngs Bay were examined for stray LV- or RV-marked coho salmon. The major effort was concentrated at the Klaskanine Salmon Hatchery since it is the only hatchery on a tributary of Youngs Bay. Returns to Big Creek Salmon Hatchery on Big Creek near Knappa, Ore., the Elokom Salmon Hatchery on the Elochomin River near Cathlamet, Wash., and the Grays River Salmon Hatchery on the Grays

River near Grays River, Wash., were examined for LV- and RV-marked coho (Figure 1). The coho returning to Little White Salmon National Fish Hatchery were also checked for marks.

The sampling in the fall of 1971 was similar to that done in 1970. The only differences being that the sampling effort was concentrated at Barbey Packing Corporation in Astoria, and there was no sampling of the Youngs and Klaskanine River sport fisheries.

## RESULTS

### 1970 Sampling Season

The Youngs Bay gill-net season began on 13 September 1970 and ended on 31 October 1970, a total season of 49 days. Sampling for marked 1968-brood coho jack salmon at the New England Fish Company took place on 13 of the 49 days (jack salmon are predominately males that mature early and that on the average are considerably smaller than the normal adult fish). The entire catch of coho jacks was examined on the days sampled. The total catch of jacks was estimated at 2,300 in the Youngs Bay fishery in 1970.<sup>5</sup> Of these, 952 were examined for marks for a 41.4% sample. Only two LV-marked and no RV-marked coho were found. This is to be expected since most fishermen use nets of 15.9-cm (6¼-inch) stretched mesh size for adult coho because of the higher price paid for adults. Table 1 shows the days sampled, the total weight and number of coho examined by day, and the marks found.

The Klaskanine River sport fishery was sampled on 23, 24, 25, 26, and 30 September. No marks were found on 18 coho jacks examined.

The Fish Commission of Oregon sampled the Columbia River commercial fishery in 1970. Only two marked coho jacks were found, one LV and one RV. This was again due to the use of 15.9-cm or larger mesh size gill nets for adult chinook and coho.

There was no concentrated sampling effort for the LV- and RV-marked coho salmon in the Columbia River sport fishery or the California, British Columbia, or Alaska ocean commercial and sport fisheries. Also, duplication of these marks in the ocean fisheries precluded their assignment to specific experiments. Table 2 lists the number of

<sup>5</sup>James L. Galbreath. Fish Comm. Manage. Res. Hdqrs., Clackamas, Ore. (Pers. commun.).

TABLE 1.—Weight, number, and marks of 1968-brood coho salmon examined by sample day during the 1970 Youngs Bay gill-net season.<sup>1</sup>

Date 1970	Weight (kg)	Number	Marks			
			LV	Ad-LV	Ad-RV	Ad
9/17	—	14	—	1	—	—
18	—	7	—	—	—	—
22	147	125	—	—	—	—
23	82	77	—	—	—	—
24	147	126	1	—	—	—
25	186	137	—	—	—	—
26	108	90	—	—	—	—
27	87	70	—	—	—	—
28	—	68	—	—	—	—
30	104	118	1	—	1	—
10/ 6	—	12	—	—	—	—
7	69	58	—	—	—	1
8	—	50	—	—	—	—
Total	930	952	2	1	1	1

<sup>1</sup>The sampling was done at New England Fish Co. unloading dock.

1968-brood LV- and RV-marked coho recovered by year, area, and fishery.

The returns of Klaskanine, Big Creek, Grays River, Elokomín, and Little White Salmon hatcheries were examined for LV- and RV-marked 1968-brood coho salmon. A total of 9,039 jacks returned to Klaskanine Hatchery and 8,705 were examined for marks. Only three LV and no RV marks were observed. No LV or RV marks were found in the returns to the other three hatcheries. At Little White Salmon Hatchery, 1 LV-marked and 55 RV-marked coho were observed. Table 3 lists the number of marked 1968-brood coho returning to the five previously mentioned hatcheries by hatchery, year, and mark.

### 1971 Sampling Season

In 1971 the sampling for marks was done at Barbey Packing Corporation, Astoria, Oreg. The entire catch of coho salmon was examined on 27 days of the 49-day season. The catch of 1968-brood coho was estimated to be 8,110 fish. Of these, 5,477 were examined for marks for a 67.5% sample. Table 4 shows the days sampled, the weight and numbers of coho sampled, and the marks found. A total of 355 marked coho were observed, of which 336 were LV marked and 8 were RV marked (Table 4). Length and weight data were collected from 320 of the marked 1968-brood coho examined. These data are presented in Table 5.

The sport fisheries of Youngs Bay and its tributaries were not sampled in 1971, but the Fish Commission of Oregon again sampled the Columbia River gill-net fishery for marks. A total of 17

TABLE 2.—Number of 1968-brood LV- and RV-marked coho salmon recovered by year, area, and fishery, 1970 and 1971.<sup>1</sup>

Area and fishery	1970		1971	
	LV	RV	LV	RV
Youngs Bay gill net	2	0	336	8
Youngs Bay sport	0	0	—	—
Columbia River gill net	1	1	17	74
Total	3	1	353	82

<sup>1</sup>Columbia River and ocean sport and ocean commercial fisheries were not sampled for these marks.

TABLE 3.—Number of 1968-brood LV- and RV-marked coho salmon recovered at five Columbia River hatcheries by year, 1970 and 1971.

Hatchery	1970		1971	
	LV	RV	LV	RV
Klaskanine	3	0	1	0
Big Creek	0	0	1	0
Grays River	0	0	0	1
Elokomín	0	0	0	0
Little White Salmon	1	55	3	300
Total	4	55	5	301

LV-marked and 74 RV-marked 1968-brood coho salmon were recovered. As in 1970, the Columbia River sport, California, British Columbia, and Alaska ocean sport, and ocean commercial fisheries were not sampled for LV- or RV-marked coho.

Hatchery returns examined in 1970 were again examined in 1971. Klaskanine Hatchery had an adult coho return of 5,476 fish. Only one LV-marked and no RV-marked fish were found. No RV- or LV-marked adults were seen at Big Creek or Elokomín hatcheries, and only one RV mark was recovered at Grays River Hatchery. At Little White Salmon Hatchery, 300 RV-marked and only 3 LV-marked 1968-brood coho were recovered. (See Table 3.)

The estimated catches of marked 1968-brood coho salmon by fishery, year, and mark are presented in Table 6. These values were obtained by multiplying the total 1968-brood coho catch for a fishery by the rate of occurrence of a mark in that fishery. Columbia River gill-net estimates were calculated for weekly periods and summed for the season. The Youngs Bay marked fish estimates were made for the entire fall season. For example, it was estimated that 8,110 1968-brood coho were caught in Youngs Bay in 1971 (Table 4). Of these fish 5,477 were sampled for marks and 336 LV marks were observed. Thus the estimated catch of LV marks was  $8,110 \times 336/5,477 = 498$ .

TABLE 4.—Weight, number, and marks of 1968-brood coho salmon caught each day during the 1971 Youngs Bay gill-net season.<sup>1</sup>

Date 1971	Weight (kg)	Number	Marks						
			LV	RV	Ad	Ad-LV	Ad-RV	Ad-LM	Ad-RM
9/17	1,007	236	—	—	—	—	—	—	—
18	1,204	282	—	—	—	—	—	—	—
19	1,427	334	—	—	—	—	—	—	—
20	929	217	—	—	—	—	—	—	—
21*	1,457	305	12	—	—	—	—	—	—
22*	1,132	260	12	—	—	—	—	—	—
23*	910	210	9	1	1	—	—	—	—
24	835	195	—	—	—	—	—	—	—
25*	1,084	240	14	—	—	—	—	—	—
26*	1,289	296	17	—	—	—	—	—	—
27*	434	98	4	—	—	—	—	—	—
28*	408	99	3	1	—	—	—	—	—
29	650	152	—	—	—	—	—	—	—
30*	978	225	6	—	—	—	—	—	—
10/ 1*	1,341	305	8	—	—	—	—	—	—
2*	1,135	265	14	—	—	—	—	—	—
3*	1,289	307	17	1	—	—	—	—	—
4*	552	128	7	—	—	—	—	—	—
5*	2,085	503	31	1	—	—	—	—	—
6*	1,084	271	18	—	—	1	—	—	—
7*	980	222	29	1	—	—	—	3	—
8*	627	144	14	1	—	—	2	—	1
9*	766	185	6	1	—	—	—	—	—
10*	725	173	12	—	1	—	1	—	—
11*	688	152	14	—	1	—	—	—	—
12*	563	137	5	—	—	—	—	—	—
13	477	112	—	—	—	—	—	—	—
14	901	211	—	—	—	—	—	—	—
15*	716	172	12	—	—	—	—	—	—
16*	615	147	8	—	—	—	—	—	—
17*	660	161	13	—	—	—	—	—	—
18	689	115	—	—	—	—	—	—	—
19	494	116	—	—	—	—	—	—	—
20	811	190	—	—	—	—	—	—	—
21	1,070	250	—	—	—	—	—	—	—
22*	786	186	18	1	—	—	—	—	—
23*	528	132	21	—	—	—	—	—	—
24*	353	91	10	—	—	—	—	—	—
25*	252	62	2	—	—	—	—	—	—
26	57	13	—	—	—	—	—	—	—
27	312	73	—	—	—	—	—	—	—
28	245	57	—	—	—	—	—	—	—
29	83	20	—	—	—	—	—	—	—
30	31	7	—	—	—	—	—	—	—
31	33	8	—	—	—	—	—	—	—
Total	34,672	8,110	336	8	3	1	3	3	1

<sup>1</sup>The sampling was done at Barbey Packing Corp. unloading dock. The days sampled are denoted by an asterisk. The entire catch was sampled for those days. The number of fish landed at Barbey on the days not sampled was estimated by using an average weight of 4.28 kg/fish which was calculated by dividing 23,417 kg sampled by 5,477 fish sampled.

TABLE 5.—Sex composition and average size of LV- and RV-marked 1968-brood coho salmon sampled during the 1971 Youngs Bay gill-net season.

Mark	Number of fish	Average size		Sex of fish	
		Length (cm)	Weight (kg)	Male	Female
LV	303	67	3.9	120	183
RV	7	70	4.2	5	2
Total	310	67	3.9	125	185

TABLE 6.—Estimated catch of 1968-brood LV- and RV-marked coho salmon by year, area, and fishery, 1970 and 1971.<sup>1</sup>

Area and fishery	1970		1971	
	LV	RV	LV	RV
Youngs Bay gill net	5	0	498	12
Youngs Bay sport	0	0	—	—
Columbia River gill net	8	2	267	1,162
Total	13	2	765	1,174

<sup>1</sup>Columbia River and ocean sport and ocean commercial fisheries were not sampled for these marks.

## DISCUSSION

Hatchery returns (see Table 3) indicate that there is little straying of the LV-marked coho salmon released in Youngs Bay to hatcheries in the area or back to the parent hatchery (Little White Salmon). Only five LV-marked fish were recovered at the four hatcheries near Youngs Bay. Only 4 LV-marked coho returned to Little White Salmon Hatchery in 1970 and 1971, while 355 RV-marked fish returned to the hatchery.

Catches of marked coho also suggest that they home to the area of release (Table 6). An estimated 504 LV-marked coho were caught in the Youngs Bay gill-net fishery in 1970 and 1971. Only 12 RV-marked fish were estimated to have been caught in the bay. For 1970 and 1971 combined, the estimated Columbia River gill-net catch of LV- and RV-marked coho was 267 and 1,162, respectively. Of the 267 LV coho caught, about 45% were taken in Zone 1; 30% in Zone 2; and 25% in Zones 3 through 5. This means that about 75% of the LV-marked coho caught in the Columbia River were caught in waters adjacent to Youngs Bay. Since few LV-marked fish returned to Little White Salmon Hatchery or hatcheries in the area, it is reasonable to assume that these fish were bound or searching for the area of release.

These catches and hatchery returns gave an indication that the coho homed to the area of release with little straying. With few exceptions, the LV-marked coho released in Youngs Bay returned to the Youngs Bay area, and the RV-marked coho released at Little White Salmon Hatchery were bound for or returned to the hatchery.

Other investigators have reported various degrees of straying and homing tendencies of transported fish. Ellis and Noble (1960) reported returning fall chinook salmon from Klickitat Salmon Hatchery released in the lower Columbia River showed a greater tendency to stray than chinook released at the hatchery. Few of the transported chinook returned to the hatchery.

Wagner (1969) found that steelhead trout smolts trapped on the Alsea River and transported downstream returned as adults to an upstream trap in fewer numbers than untransported steelhead trout. This was probably due to the transported steelhead straying into tributaries as they moved upstream. From this and other studies (Wagner 1967), he concluded that the homing imprint in definitely influenced by stocking site and that capturing and transferring smolts during

their downstream migration may cause gaps in imprinting. These gaps could result in delayed adult upstream migration. The duration of the delay probably depends on the strength of upstream stimuli.

Experiments conducted at hatcheries in Oregon, Washington, and California have shown that a majority of the chinook salmon, coho salmon, or steelhead trout released as smolts in an area with no downstream migration prior to hauling return to the area of release as adults. Studies at Ice Harbor Dam on the Snake River, 538 km above the Columbia River mouth (334 miles), indicated that chinook transported from Ice Harbor to below Bonneville Dam, a distance of 304 km (189 miles), returned as adults to Ice Harbor with little straying (Ebel et al. 1972).

These studies and our data suggest that coho salmon released in an area to create or enhance a fishery would home back to that area.

When examining the contribution of the RV- and LV-marked coho salmon to the fisheries sampled, it appears that the RV group released at Little White Salmon Hatchery had better survival than the LV group released at Youngs Bay. The total catch of RV-marked 1968-brood coho in 1970 and 1971 was 1,176 or 11.7 per 1,000 released compared to 778 LV coho caught or 7.7 per 1,000 released. However, a good comparison between the recoveries of the two groups cannot be made because of incomplete sampling. The ocean fisheries and Columbia River sport fishery were not sampled for LV- or RV-marked coho, and the Youngs Bay sport fishery was sampled only sparsely in 1970. Catches of LV- and RV-marked fish in these fisheries could alter the contribution of either or both groups significantly.

A good comparison of the contribution of the two groups is also hampered by the difference in size and time of release of the groups. The LV-marked coho were released in Youngs Bay on 23, 27, and 29 April 1970, at 49.9 fish/kg (22.6/pound). The RV-marked coho were released at Little White Salmon Hatchery 2 wk later on 12 May and at a larger size, 40.1 fish/kg (18.2/pound). This later release of larger fish could have improved the survival of the RV-marked coho.

A third factor inhibiting comparisons of the contributions of the RV and LV groups is hauling mortality. Tests have indicated that post-transport mortality may have a noteworthy effect on transported fish (Ebel et al. 1972). It is not known if the procedures used in this study to transport

fish to Youngs Bay were more or less detrimental than the more natural migration pattern from the hatchery through Bonneville Dam and downstream to the ocean. If the employed transportation method caused significant mortalities and if changes in the method can be made to improve survival, then a better contribution from this type of release procedure could be obtained.

Other researchers have had similar difficulties in evaluating groups of fish released at different sites. Ellis and Noble (1960) had difficulty comparing the contribution and survival of groups of chinook salmon released at Klickitat Hatchery and Skamokawa, Wash., 354 km (220) and 53 km (33 miles), respectively, from the Columbia River mouth. Differences in the size of fish at release and marks used on each group as well as generally poor nutrition and survival during the hatchery rearing period influenced the results. However, the catch data indicate that contribution to the Columbia River fisheries was increased by release site manipulation. If straying could have been evaluated, total survival for the transported group may have been greater than the nontransported fish.

Wagner (1967, 1969) noted in studies with various release sites for steelhead on the Sandy, Alesia, and Wilson rivers that, in general, the contribution of hatchery reared steelhead to the sport fisheries was increased by releasing smolts in the lower stream areas. Here again, different mark types on the groups and variations in fishing effort on different stream sections may have influenced the results.

More recently Ebel et al. (1972) transported chinook salmon around Snake and Columbia River dams. They found that the contribution ratio of transported versus nontransported fish in the lower Columbia River sport and commercial fisheries was 1.4 to 1. Passage of chinook smolts through Snake and Columbia River dams certainly had an influence on survival differences between transported and nontransported groups.

## SUMMARY AND CONCLUSIONS

This study was initiated to determine the feasibility of creating or enhancing a fishery in a specific area by releasing hatchery salmon smolts into that area. The plan was to release hatchery coho salmon smolts into an area and sample the fisheries in the area to determine if the fish re-

turned in great enough numbers to warrant expansion of this practice.

Two groups of approximately 100,000 1968-brood coho at Little White Salmon National Fish Hatchery were marked—one with a right ventral finclip and the other with a left ventral finclip. Youngs Bay near Astoria, Oreg., was selected as the release site for the LV-marked group. The RV-marked coho were released at the hatchery. The releases were made in April and May of 1970.

The Youngs Bay and Columbia River gill-net fisheries were sampled for these marks in the fall of 1970 and 1971. A comparison of the catches and hatchery returns of the two groups showed that the two groups homed back to their respective areas of release with very little straying. The contribution of these two groups to the fisheries sampled was 7.7 fish per 1,000 released for the LV-marked Youngs Bay release and 11.7 fish per 1,000 released for the RV-marked Little White Salmon Hatchery release.

These statistics appear to favor the Little White Salmon Hatchery release, but there are several factors which prevent an accurate comparison of the two groups. First, the LV-marked coho were released in Youngs Bay 2 wk prior to and at a smaller size than the RV-marked coho released at the hatchery. Second, no evaluation was made of the possible effects of delayed mortalities of the LV coho due to hauling. Third, incomplete sampling for these marks was carried out in the ocean sport and commercial fisheries. Finally, duplication of single fin marks in the ocean fisheries prevented assignments to specific experiments. These four factors could have a significant influence on the contribution of either or both groups of coho.

Conclusions as to the practicality of transporting fish to an area to create or enhance local fisheries cannot be reached because of the four unknown factors influencing contribution. However, catches, hatchery returns, and the lack of straying indicate that this practice is biologically feasible. A study structured to evaluate the total contribution of two releases similar to those in this investigation and to eliminate the unknowns is presently underway.

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