Annual Progress Report

Columbia River Fishery Development Program

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ABSTRACT

The cooperative program between the National Marine Fisheries Service and Oregon Department of Fish and Wildlife to develop natural runs of fall salmon in the Willamette River system has been divided into implementation and evaluation phases which can be accomplished simultaneously. Results with early spawning Columbia River coho initially appeared promising. However, since 1970, when 17,900 adults returned, coho runs have steadily declined despite supplementation with 1.25 million smolts for each of 5 years. We concluded that flows are too low and temperatures too high for these fish when they return to the Willamette. In 1976 (1974 brood) we began experimenting with Cowlitz River (Washington) late spawning coho. The first return of these adults is expected in the fall of 1977.

We have introduced early (September-October) and late (November-December) spawning races of fall chinook. Most of these fish have been reared in ponds in the Willamette Valley. Early spawning fall chinook runs generally increased since 1966 when 1,000 returned to over 30,000 in each of 1974-76. We first introduced late spawning Cowlitz River (Washington) fall chinook in 1972 when 2.3 million were released into Row River. Additional releases were made in 1973, 1975, and 1976. No fish were available for planting in 1974 and 1977. We estimated approximately 500 late spawning fish returned in each of 1974 and 1976, and 1,000 in 1975. *Myxobolus insidiosis* and low flows in spring 1973 may have affected the adult runs in 1975 and 1976.

Beginning in 1978 we plan to change from development to evaluation studies with coho and fall chinook. We want to determine the capability of both species to maintain self-sustained runs and to significantly contribute to the fisheries, and describe the freshwater life history that evolves for these fish if they are successful. We believe that if the right fall salmon stocks or combination of stocks can be utilized, there is a potential in the Willamette to produce self-sustained runs of both species that will benefit Oregon.

Stock Assessment and Enhancement of Fall Salmon Species in the Willamette River System

INTRODUCTION

The cooperative program to develop the natural potential of the Willamette River to produce salmon and steelhead has been in effect since FY 1971. However, an informal program to accomplish that end existed for several years prior to 1971. From FY 1971 to 1977, approximately one-third of the funding for the fall salmon program was contributed by the National Marine Fisheries Service and two-thirds by the Oregon Department of Fish and Wildlife[1]. This program has primarily concentrated on developing natural runs of fall chinook and coho salmon above Willamette Falls, historically a barrier to these fish

[1] *Management and Research Division of the Fish Commission of Oregon prior to July 1, 1975.*

but now passable due to construction of a new fishway. Effort has also been devoted to development of winter and summer steelhead in the system. Steelhead are considered a separate activity of the program and are reported on by Buchanan (1977). The rationale behind the development program and methods employed were described in detail by Sams (1973).

In FY 1977, the return of 30,200 fall chinook to the Willamette River was 3,572 fish fewer than that in FY 1976. The return of early spawning coho in FY '77 was again low with only 2,333 adults counted. However, this stock may not be well suited to the Willamette system, and we have begun experimenting with a later spawning stock from the Cowlitz River (Washington).

PROGRAM IMPLEMENTATION--FY 1977

Coho

In 1965 we began efforts to increase the run of coho in the Willamette River system. Initial results appeared promising, but recent returns have been disappointing. We first stocked unfed fry, fingerlings, and adults surplus to our hatchery needs. In 1970, a run of 17,902 adults passed above Willamette Falls as a result of these plants. During 1971 we expected 9,000-12,000 adults to return from a 1.25 million smolt plant, a 1:1 return from the progeny of 12,400 adults that returned in 1968, and returns from releases of 7,090 adults and 5.7 million fry. However, only 17,410 adults returned in 1971. Returns have steadily decreased since 1971 despite continued releases of approximately 1.25 million smolts for 4 additional years (1969-72 broods). Adults were due to return from these releases each year from 1972 through 1975. Only 1,501 adults were counted in 1974; 5,922 in 1975; and 2,333 in 1976. We concluded from these low returns that early spawning coho were not well suited to the Willamette watershed.

We then began looking for a later spawning stock, which involved marking studies, first with Alsea River (coastal) stock and then later with Sandy Hatchery (November egg take) stock, with little success. In 1976 (1974 brood) we began experimenting with Cowlitz River (Washington) late spawning coho. This stock primarily returns from November to early December and spawns in December and January. Additional attributes of this stock are discussed by Hansen (1976). During the spring of 1976, we released 40,479 ad-cwt marked juvenile coho of the late spawning stock below Scoggins Dam in the Tualatin River system. Additionally, we released 497,521 unmarked late spawning coho in 10 other Willamette River subsystems above the falls. We did not observe any ad-cwt jacks returning to Scoggins Dam in the fall of 1976. However, their small size at release (18.2 g/fish), unseasonably low stream flow, and an improperly designed weir in the ladder at Scoggins Dam which may have harmed juvenile emigrants, may have resulted in low survival. We expect few adults to return in 1977.

In the spring of 1977, we released 100,916 ad-cwt juvenile coho and 99,317 ad-cwt juvenile coho of the late and early spawning stocks, respectively, into Scoggins Creek below the dam (Table 1). The primary purpose of this release was to determine the fishery contribution and comparative survival of each stock. However, both groups were released in April and it is possible they were not fully smolted; this will probably result in few adult returns. Cowlitz (late spawning) coho were significantly smaller at release than Columbia River (early spawning) coho (15.6 vs 21.6 g/fish).

Table 1. Releases of juvenile coho of early and late spawning stocks into the Willamette River system, March-June 1977.

River system	Stream	Number	Brood year	Month stocked	Size g/fish
		Early Spawning (Columbia River)			
Tualatin	Scoggins Cr.	99,317[a]	1975	April	21.6
Willamette	Wil. Falls forebay	7,830[b]	"	"	28.3
"	" " "	8,750[b]	"	May	32.4
Subtotal		115,897			
Tualatin	Lee Cr.	78,501	1976	March	0.3
"	Sunday Cr.	125,602	"	"	"
Rickreall Cr.	Reservoir	161,250	"	"	"
Silver Cr.	"	270,389	"	"	"
Abernethy Cr.	Beaver Lake	100,419	"	June	2.4
Tryon Cr.	Main stem	25,283	"	"	"
Subtotal		761,444[c]			
Total		877,341			
		Late Spawning (Cowlitz River)			
Tualatin	Scoggins Cr.	100,916[a]	1975	April	15.6
"	" "	193,861	"	"	16.8
Total		294,777			

[a] *Marked ad-cwt.*
[b] *Experimental fish for testing the Sullivan plant downstream migrant bypass.*
[c] *Surplus hatchery fry and fingerlings.*

We also released 193,861 unmarked juvenile coho of the late spawning stock below Scoggins Dam in 1977. These fish were released to establish an egg bank of late spawning coho at the Scoggins Dam holding facility. However, the Washington Department of Fisheries has since agreed to annually supply late spawning coho for our use. Therefore, we will discontinue development of an egg bank for this stock. We will not complete the 2nd and 3rd years of the full-cycle release initiated with Cowlitz coho in 1976 in 10 subsystems of the Willamette River. This production program will be resumed later if the results of the fishery contribution study, to be completed in 1981, indicates the Cowlitz stock contributes well to Oregon fisheries, and we show that the stock can develop and perpetuate a significant natural run in the Tualatin system.

In 1977, we also released 100,419 early spawning coho fingerlings into Beaver Lake (Abernethy Creek) and 25,283 into Tryon Creek. Additionally, 635,742 early spawning unfed fry of the 1976 brood were released into Lee, Rickreall, Silver, and Sunday creeks. These fingerling and fry plants were surplus to Fish Division needs.

Fall Chinook

We have introduced both early (September-October) and late (November-December) spawning races of fall chinook into the Willamette River. The first releases of the early spawning stock in 1963 were from surplus eggs taken at Columbia River hatcheries. However, most of the fish released to date have been reared in Willamette Valley ponds. From 1970-77, we annually released 5.5 to 11.3 million early spawning fall chinook averaging 4.6-7.0 g/fish (Table 2). In 1977 we released 11,251,455 early spawning fish of the 1976 brood into the Willamette system. Of this total, 10,610,581 were released below Willamette Falls at George Rogers State Park near the city of Lake Oswego (Table 3) because critical low river flows were forecast for the Willamette River during the downstream migration. The remainder emigrated into the Willamette from Aumsville and Stayton ponds or were marked and released at Willamette Falls.

We first introduced late spawning fall chinook juveniles in 1972 with a release in the upper Willamette River of 2 million 1971-brood Cowlitz Hatchery (Washington) stock. Approximately 0.5, 2.5, and 2.3 million were released in 1973, 1974, and 1976, respectively. However, this stock was not available for planting in 1975 and 1977. We plan to continue evaluating the natural production potential of this stock in the Willamette system.

PROGRAM EVALUATION--FY 1977

Generally our evaluation will determine the species and races of fall salmon to be developed in each stream studied and the numbers of adult fish expected from natural reproduction. The objectives for fiscal years 1972-77 and the work accomplished in fiscal 1977 are:

Table 2. Numbers of early spawning fall chinook salmon released into the Willamette River from valley rearing ponds, 1968-77.

Year	Brood year	Number released	Size (grams/fish)
1968[a]	1967	1,741,300	5.4
1969[b]	1968	1,341,000	4.6
1970[c]	1969	10,709,800	5.9
1971[c]	1970	10,565,600	7.2
1972[c]	1971	11,036,900	5.2
1973[d]	1972	12,647,800[e]	6.3
1974[d]	1973	11,896,441[e]	5.7
1975[d]	1974	5,543,100	6.0
1976[d]	1975	6,006,800	5.7
1977[d]	1976	11,251,400[f]	5.1

[a] *Salem pond.*

[b] *Salem and Stayton ponds.*

[c] *Aumsville, Salem, and Stayton ponds.*

[d] *Aumsville and Stayton ponds.*

[e] *Includes an estimated number fish left in the ponds when trapping was terminated. Volitional emigration of these residuals was not monitored.*

[f] *Includes an estimated 344,000 fish left in the ponds when trapping was terminated. Volitional emigration of these residuals was not monitored.*

Table 3. Early spawning 1976-brood juvenile fall chinook (Columbia River stock) released into the Willamette River system, April 23-June 1, 1977.

Release site	Number released	Release date	Rearing site
George Rogers Park at Lake Oswego	10,610,581[a]	4/23-5/13	Aumsville-Stayton ponds
Mill Creek (Aumsville pond outlet)	259,075	5/10-23	Aumsville pond
North Santiam River (Stayton pond outlet)	186,000	4/29-5/23	Stayton pond
Willamette Falls (Sullivan Plant tailrace)	90,012[b]	5/2-4	South Santiam Hatchery
Willamette Falls (Sullivan plant forebay)	87,712[b]	5/2-4	South Santiam Hatchery
Canby ferry	18,075[c]	6/1	Sandy Hatchery
Total	11,251,455[d]		

[a]*Includes 92,006 ad-clipped fish which were seined from Aumsville pond and marked at South Santiam Hatchery.*

[b]*Ad-clipped with separate codes. Moved from Aumsville pond to South Santiam Hatchery for marking.*

[c]*Experimental fish marked with a partial fin clip to determine migration timing from Canby ferry to Willamette Falls.*

[d]*Included in total is 158,000 fish from Aumsville pond and 186,000 from Stayton pond as the estimated number of juveniles remaining in each pond by Fish Culture personnel when trapping was terminated. The number of volitional emigrants is unknown.*

Objective 1: Determine if the Runs of Fall Chinook and Coho Salmon are Increasing in the Willamette River system

Results

The counts of fall chinook have generally increased annually since 1965 with the exception of 1971 (Table 4). However, the return of 30,200 fall chinook in 1976 was not as high as the runs of 34,189 in 1974 and 33,772 in 1975. From 1970 through 1974 3-year-old adults averaged 58.9% of the run. In 1975 only 16.0% were 3-year-old fish and 4-year-old fish constituted 81.4% of the run. As anticipated, in 1976 only 14.6% of the run was 4-year-old fish and 3-year-old fish constituted 78.8%[2]. The runs of 1975 and 1976 probably

[2]*Above Willamette Falls.*

Table 4. Calculated escapement of fall chinook adults and jacks over Willamette Falls, 1965-76.

Year	Adults	Jacks	Total
1965	77	2	79
1966	771	255	1,026
1967	1,901	111	2,012
1968	4,043	203	4,246
1969	6,817	140	6,957
1970	7,457	101	7,558
1971	4,880	210	5,090
1972	11,614	212	11,826
1973	21,861	376	22,237
1974	33,924	265	34,189
1975	32,877	895	33,772
1976	29,269	931	30,200

would have been considerably higher if a normal two-brood run had returned in each of these years. We believe the low warm flows in 1973 delayed the emigration of juveniles, aggravated fish diseases, required essentially all downstream migrants to pass through the industry generating plants at Willamette Falls, and were responsible for the subsequent low return of 3-year-old fish in 1975 and 4-year-old fish in 1976.

Coho returns reached a high at Willamette Falls of approximately 17,000 adults in each of 1970 and 1971 (Table 5). They have since decreased, and only 2,333 adults returned in 1976. However, as previously mentioned, we believe the early spawning stock is probably not best suited for the Willamette system.

A fall salmon recreational fishery is slowly developing in the Willamette River below and above Willamette Falls. In the river below the falls, several hundred coho jacks are taken annually. In recent years a fishery for fall chinook has developed in the Salem area and on the South and main-stem Santiam rivers. Based on interviews with sport fishermen, we believe several hundred fish have been caught annually the past 4 years. We believe the sport fishery will become more intensive if we can establish a population of late spawning fall chinook. These fish enter the river the same time as the early spawning fish but are brighter in appearance. They do not spawn until November or December and would be exposed to the fishery longer.

Objective 2: Determine if Adult Fall Chinook That Have Returned to Date From Pond-Reared Juveniles Have Adequately Seeded the Willamette River to Develop a Self-Perpetuating Natural Run

Results

Fall chinook adults returned to the Willamette system in 1976 for the 7th consecutive year as the result of juveniles being reared, fed, and released from the ponds. The trend of counts at Willamette Falls has steadily increased

Table 5. Calculated escapement of coho adults and jacks over Willamette Falls, 1954-60 and 1965-76.

Year	Adults	Jacks	Total[a]
1954	315	160	475
1955	340	1,810	2,150
1956	2,600	6,035	8,635
1957	2,950	1,200	4,150
1958	394	976	1,370
1959	2,065	840	2,905
1960	512	458	970
1965	7,080	2,184	9,264
1966	4,071	2,247	6,318
1967	7,084	1,614	8,698
1968	12,400	5,300	17,700
1969	3,260	14,032	17,292
1970	17,902	19,453	37,355
1971	17,410	6,670	24,080
1972	9,483	7,157	17,140
1973	5,174	1,583	6,757
1974	1,501	3,941	5,442
1975	5,922	6,927	12,849
1976	2,333	2,217	4,550

[a]*Totals through 1960 are corrected for 8-hour daytime passage. They are expanded to include 24-hour passage since 1965.*

since 1966 when only 1,026 were observed. Over 30,000 adults passed Willamette Falls in each of 1974-76. The returns in 1975 and 1976 might have been up to two times higher if the 1972 brood had not encountered low, warm flows on their downstream migration.

We released 10.6 million pond-reared juveniles in 1970 contributing to the return of 11,826 adults in 1972. In 1971 (1970 brood), we released an additional 10.6 million fish. Therefore, 21.3 million pond-reared fish contributed to the return of 22,237 adults in 1973, which was approximately double the return of 1972. We believe the returns in 1972 and 1973 were directly attributable to pond-reared fish. The return of 34,189 fall chinook in 1974 was 11,952 fish higher than the return in 1973. However, the numbers of juveniles in the 1970 and 1971 broods contributing to the 1974 run were comparable (21.6 million) to released fish contributing to the 1973 run. We therefore believe natural production was partly responsible for the 1974 run. As a result of the above, we believe the pond rearing technique is a useful tool in stocking a stream with adults for natural reproduction.

We intend to determine the numbers and distribution of naturally spawned fall chinook in the Willamette system. Beginning with the 1977 brood that is to be released in 1978 and continuing through releases in 1982, we intend to stock all production from the Willamette Valley rearing ponds into the Columbia River near the mouth of the Sandy River. This will permit evaluation of production from hatchery and wild fish above Willamette Falls whose naturally spawned progeny will return as adults in 1980-83, and evaluate the production from wild adults only whose progeny will return in 1983-85.

Objective 3: Determine Whether Fall Chinook Returning to the Willamette System Are Spawning

Results

Since 1969 we have surveyed the Willamette River system annually, mainly by fixed-wing aircraft, to determine the distribution of early spawning fall chinook. Boats were used only in Mill Creek (Salem) which is a relatively narrow, brush-covered stream. We counted 6,642 fall chinook redds during airplane and boat surveys covering 555 km of stream above the falls from September 23 to October 1, 1976 (Table 6). Visibility was good to very good during the aerial surveys in all systems except the Row River where visibility was fair. It appeared the aerial surveys were made at the peak of spawning, but silt may have obscured some redds during boat surveys in Mill Creek. Some overlap of fall and spring chinook redds is possible in the McKenzie River above Interstate 5 bridge, upper areas surveyed in the Clackamas and North and South Santiam rivers, and below Dexter Dam on the Middle Fork of the Willamette River.

The redd count was 1,900 less than in 1975, but 3,500 fewer adults returned in 1976 than in 1975. Additionally, females were only 36% of the population in 1976 compared to 50% in 1975. The highest redd count obtained in 1976 was on a 12.2 km section of the South Santiam River where 76.2 redds/km were observed. Of the 4,986 redds counted above Willamette Falls during the surveys by air, 73% were in the Santiam system (main stem, North and South Santiam), 10% in the main-stem Willamette River, and 13% in the Molalla River. The most apparent changes of redd distribution from 1975 to 1976 were: (1) in 1976, less than half as many redds were observed in the main-stem Willamette and the North Santiam River than were seen in 1975 (474 vs 1,134 in the main Willamette and 510 vs 1,491 in the North Santiam); and (2) almost two times as many redds were observed in the Molalla and South Santiam rivers in 1976 than in 1975 (655 vs 340 in the Molalla River and 1,881 vs 1,054 in the South Santiam River). We counted 1,656 redds in Mill Creek during boating surveys and determined a spawning population of 7,530 by using the fish to redd factor of 4.54 obtained by dividing the total redd count above Willamette Falls (6,642) into the total adult escapement above the falls (30,200).

The total redds observed by both boat and air surveys (6,642) expressed as a percentage of females present above Willamette Falls was 61%. This is based on 36% of the adults passing the falls being females (Table 7). Therefore, nearly 40% of the estimated females passing the falls were not accounted for in terms of redds. In similar surveys in 1974 and 1975, 59% and 50% of the females, respectively, were unaccounted for in terms of redds.

Table 6. Summary of tule fall chinook spawning ground surveys in the Willamette River system, 1976[a].

Stream	Km[b] surveyed	Number redds	Redds/km
Willamette River	220.4	474	2.15
M.F. Willamette	27.0	21	0.78
C.F. Willamette	47.8	1	0.02
Row River	12.2	2	0.16
McKenzie River	33.8	182	5.38
Calapooia River	13.2	0	0.00
Santiam River	18.8	1,260	67.02
North Santiam	43.0	510	11.86
South Santiam	60.7	1,881	30.99
Molalla River	42.6	655	15.38
Mill Creek (Salem)	35.4	1,656	46.78
Grand total above Willamette Falls	554.9	6,642	11.97
Clackamas River	36.7	274	7.47

[a]*All surveys were conducted by plane except Mill Creek survey which was made from boats. Surveys were made during September 23-October 1, 1976.*

[b]*Survey areas extend from the mouth upstream the specified distance, except for the main-stem Willamette River which is from Newberg upstream to the junction of the Coast and Middle forks of the Willamette River.*

Table 7. Sex ratios of fall chinook salmon determined from carcasses recovered on the Willamette River and tributaries, September-October 1976.

Stream	Males		Females		Number sampled
	No.	%	No.	%	
Willamette River	42	74	15	26	57
Molalla River	161	67	79	33	240
Santiam River	106	62	64	38	170
South Santiam R.	123	67	61	33	184
North Santiam R.	123	55	99	45	222
McKenzie River	59	69	27	31	86
Mill Creek (Salem)	202	63	118	37	320
Total	816	63.8	463	36.2	1,279
Clackamas River	51	66	26	34	77
Grand Total	867	63.9	489	36.1	1,356

We estimated approximately 500 late spawning chinook returned to the Willamette system in 1974 and 1,000 in 1975. In 1976[3] we made maximum unduplicated counts of 94 redds in the Coast Fork of the Willamette (main stem, Row River and Mosby Creek) and 24 redds in the Luckiamute system (Table 8). Utilizing the fish to redd factor of 4.54, determined for tule chinook, we calculated a spawning population of 536.

Table 8. Number of redds observed of late spawning fall chinook, Willamette River system, 1974-76.

Year	Coast Fork	Row River	Mosby Creek	Luckiamute River	Total
1974	*a*	47	43	--	90
1975	44	55	48	--	147
1976	18[b]	35	41	24[c]	118

[a]*No survey.*
[b]*Lower 6 miles surveyed on January 17, 1977.*
[c]*First year adults were due to return.*

We obtained scales from early spawning fall chinook carcasses on the Willamette, McKenzie, Santiam, South Santiam, North Santiam, Molalla, Clackamas, and Mill Creek (Salem). In examining 1,313 assignable scales, we determined the run was composed of 79.1% 3-year-old fish and 14.6% 4-year-old fish (Table 9). We found 12 late spawning fall chinook carcasses during surveys on the Coast Fork of the Willamette. Scales from these fish indicated six were 3 years old and six were 4 years old.

Objective 4: Determine the Stock of Late Spawning Fall Chinook Best Suited for the Willamette System.

Results

We analyzed and evaluated various races of fall chinook in Oregon and Washington and decided to work with the Cowlitz River stock in our development program. Reasons for this selection were detailed by Sams (1973).

We estimated 500 adults of this stock returned to Row River in 1974 from the release of 2.3 million juveniles of the 1971 brood. The eggs of this brood

[3]*Row River, Mosby Creek, and upper Coast Fork surveys completed in November-December 1976; however, lower 6 miles of Coast Fork surveyed on January 17, 1977.*

Table 9. Age composition of fall chinook determined from carcasses recovered on the Willamette River and tributaries, September-October 1976.

Stream	Total scale samples	Number of samples regenerated	Number of spring chinook	Number by age 2	3	4	5
Willamette River	57	4	--	1	34	15	3
Molalla River	239	9	--	2	199	27	2
Santiam River	170	4	2	1	130	29	4
South Santiam River	187	1	--	10	146	22	8
North Santiam River	219	3	--	3	175	22	16
McKenzie River	86	2	11	4	58	11	0
Mill Creek (Salem)	330	13	--	7	234	56	20
Total	1,288	36	13	28	976	182	53
Percentage				2.3	78.8	14.7	4.2
Clackamas River	90	3	13	1	62	10	1
Grand Total	1,378	39	26	29	1,038	192	54
Percentage				2.2	79.1	14.6	4.1

were incubated at Oxbow Hatchery and shipped to Elk River Hatchery for rearing. We noted considerable size variation at release and estimated 10% were "pinheads" and also suspect that long-distance hauling of juveniles may have affected survival to adults.

Cowlitz stock fall chinook of the 1972 and 1973 broods were incubated at Oxbow Hatchery and shipped to Aumsville starter ponds for rearing. We released 496,000 juveniles in 1973 and 2.2 million in 1974 into Row River after short-term starter pond rearing. We suspect *Myxobolus insidiosus* may have affected juvenile survival to adults of both broods (Richard A. Holt, ODFW Fish Pathologist, personal communication, 1976). During the fall of 1975 spring chinook juveniles of the 1974 brood which were started and reared for a short period in the Aumsville dirt starter ponds were infected with *Myxobolus insidiosus*. It is likely *Myxobolus* also affected juvenile late spawning fall chinook survival. Early spawning fall chinook reared at Aumsville starter ponds apparently do not contact this protozoan because they are removed from the ponds in early February prior to the onset of warm water temperatures at which *Myxobolus* becomes infectious. In the future, we believe that Cowlitz late spawning fall chinook should be initially reared in a hatchery.

The production capabilities of the late spawning fall chinook will be monitored in the Row River when naturally spawned adults begin returning in 1977. Estimates of natural production will be determined by counts of bright fish at Willamette Falls and by spawning ground surveys. To fully determine the production capabilities of this stock, we plan the following: (1) in 1978 and 1979, we will release 200,000 ad-cwt each of early spawning Columbia River and late spawning Cowlitz River fall chinook into Mill Creek (Salem). We will compare fishery contribution rates, freshwater life history patterns, and returns to the Willamette; and (2) we will release 200,000 ad-cwt Cowlitz stock sub-yearlings (fall release) into the Luckiamute system for one cycle beginning with the 1977 brood to establish a run for continued production by natural spawning. The capability of 1977-79-brood returning adults to produce adequate returns will be evaluated at the Willamette Falls viewing window (separation from tules by color) and by spawning ground surveys. Ocean and freshwater fishery contribution rates will be estimated. We also plan to study freshwater life history patterns and work with Fish Culture personnel in planning time-of-release studies.

If the Cowlitz River stock fall chinook is unsuited to our needs in the Willamette system, we may eventually experiment with upper Columbia or Snake River stocks. However, development of surplus numbers of these stocks is probably several generations away.

Objective 5: Determine the Contribution and Return to the Willamette River System of the Cowlitz River Late Spawning Stock of Coho

Results

We expect the first adult Cowlitz coho to return to the Willamette system in 1977 from the 1974-brood release of 538,000, including 40,000 ad-cwt, into Scoggins Creek of the Tualatin system. However, as previously mentioned, we do not expect a large return because of the small size of these fish at release.

We released 295,000 fish of this stock (1975 brood) into Scoggins Creek in the spring of 1977. It also appeared these fish were not fully smolted at release (15.6 g/fish) and a low return is anticipated.

We plan to release larger smolts in 1978 (1976 brood) and 1979 (1977 brood). Early (Columbia River) and late (Cowlitz River) spawning stocks of coho will be ad-cwt and released immediately below Scoggins Dam to determine downstream fishery contribution rates for each stock. The release of both stocks will be of a comparable size and on a comparable date (30 g/fish about May 1). Adults will be collected at Scoggins Dam to establish the return rate for each marked group.

We will not determine the capability of late spawning coho to maintain adequate returns from natural production until the results of the fishery contribution study are completed. Adults from this experiment are expected to return in 1979 (1976 brood) and 1980 (1977 brood). If the late spawning coho prove advantageous to Oregon fisheries, we will begin releasing smolts into the Yamhill and Luckiamute systems for 3 years beginning in 1981.

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APPENDIX

The text does not refer to the tables and figures included in this appendix. Data in the appendix will provide some background relating to fall salmon runs in the Willamette River.

Appendix Table 1. Cowlitz River stock juvenile fall chinook released into the Willamette River system, 1972-76.

Brood year	Release date	Number released	Release site	Size (grams/fish)
1971	6/72	2,314,665	Row River	3.3
1972	5/73	495,675	Row River	4.0
1973	5/74	2,178,829	Row River	4.0
"	"	131,250	L. Lucklamute R.	3.5
"	"	78,000	Lucklamute R.	"
"	"	109,153[a]	Green Peter Res.	3.9
1974		(No fish available)		
1975	5/76	262,340	L. Lucklamute R.	3.5
"	"	2,040,328	Lucklamute R.	3.7

[a]*Experimental release to determine if this stock would migrate from reservoir.*

Appendix Table 2. Number of redds observed, by location, of early spawning fall chinook, Willamette River system, 1969-76.[a]

Stream	Km[b] surveyed	1969	1970	1971	1972	1973	1974	1975	1976
Willamette River	220.4	26	101	27	391	1,326	1,041	1,134	474
M.F. Willamette	27.0	7	30	27	24	74	82	80	21
C.F. Willamette	47.8	8	92	8	30	17	11	10	1
Row River	12.2	1	0	3	0	20	5	3	2
McKenzie River	33.8	5	64	71	138	361	216	200	182
Calapooia River	13.2	1	5	1	0	22	1	0	0
Santiam River	18.8	225	229	224	293	60	2,175	1,393	1,260
North Santiam	43.0	165	100	36	110	685	720	1,491	510
South Santiam	60.7	382	559	348	269	780	2,578	1,054	1,881
Molalla River	42.6	162	207	37	614	1,171	778	340	655
Mill Creek (Salem)	35.4	--[c]	961	600	1,354	1,992	1,990	2,819	1,656
Total above Willamette Falls	554.9	982	2,348	1,382	3,223	6,508	9,597	8,524	6,642
Clackamas River	36.7	89	59	89	110	426	554	436	274

[a] *All surveys were conducted by plane except Mill Creek survey which was made from boats. Surveys were made from September 23-October 4.*

[b] *Km shown extend from the mouth upstream the specified distance, except for the main-stem Willamette River which is from Newberg upstream to the junction of the Coast and Middle forks of the Willamette.*

[c] *Survey not made, no fish were due to return until 1970.*

Appendix Table 3. A summary of fall chinook spawning ground surveys in the Willamette River system, September 23-October 1976.[a]

River	River section: Reference points	River section: River km	Km surveyed	Redds	Avg. number of redds/km	Date	Visibility
Willamette R.	Newberg to Wheatland Ferry	80.5-115.7	35.2	10	0.28	9/30/76	Very good
	Wheatland Ferry to Salem	115.7-135.2	19.5	55	2.82	"	" "
	Salem to Independence	135.2-154.6	19.4	12	0.62	"	" "
	Independence to Albany	154.6-192.0	37.4	36	0.96	"	" "
	Albany to Marys R.	192.0-212.6	20.6	5	0.42	"	" "
	Marys R. to American Can Intake	212.6-237.2	24.6	58	2.36	"	Good
	American Can Intake to Harrisburg	237.2-259.4	22.2	139	6.26	"	"
	Harrisburg to McKenzie R.	259.4-281.3	21.9	117	5.34	"	"
	McKenzie R. to Jct. Coast and Middle Forks	281.3-300.9	19.6	42	2.14	"	"
Total			220.4	474	2.15		
Middle Fork Willamette R.	Mouth to Fall Cr.	0.0- 18.2	18.2	10	0.55	9/30/76	Good
	Fall Cr. to Dexter Dam	18.2- 27.0	8.8	11	1.25	"	Very good
Total			27.0	21	0.78	"	
Coast Fork Willamette R.	Mouth to Row R.	0.0- 33.3	33.3	1	0.03	9/30/76	Very good
	Row R. to Cottage Grove Res.	33.3- 47.8	14.5	0	0.00	"	Fair
Total			47.8	1	0.02	"	
Row River	Mouth to Dorena Dam	0.0- 12.2	12.2	2	0.16	9/30/76	Very good
Total			12.2	2	0.16	"	
Mill Cr. (Boat Survey)	Mouth to Jct. of Stayton Ditch	0.0- 35.4	35.4	1,656	46.78	9/23/76-9/29/76	Fair
Total			35.4	1,656	46.78	"	
McKenzie R.	Mouth to Interstate 5 Br.	0.0- 7.1	7.1	51	7.18	9/30/76	Very good
	Interstate 5 Br. to Mohawk R.	7.1- 17.2	10.1	84	8.32	"	" "
	Mohawk R. to Hendricks Br.	17.2- 33.8	16.6	47	2.83	"	" "
Total			33.8	182	5.38		

[a] *All surveys made by airplane except Mill Creek (Salem) where boats were used.*

Appendix Table 3. (Continued)

River	River section: Reference points	River km	Km surveyed	Redds	Avg. number of redds/km	Date	Visibility
Calapooia R.	Mouth to Corvallis Hwy. Br.	0.0- 13.2	13.2	0	0.00	9/30/76	Good
	Corvallis Hwy. Br. to SPRR Br.	13.2- 27.5	--	--			
	SPRR Br. to Brownsville	27.5- 52.0	--	--			
Total			13.2	0	0.00	"	
Santiam R.	Mouth to OERR Br.	0.0- 5.1	5.1	320	62.75	10/1/76	Very good
	OERR Br. to Interstate 5 Br.	5.1- 10.3	5.2	350	67.31	"	"
	Interstate 5 Br. to Jefferson Br.	10.3- 15.4	5.1	340	66.67	"	"
	Jefferson Br. to Jct. of N. & S. Santiam R.	15.4- 18.8	3.4	250	73.53	"	"
Total			18.8	1,260	67.02	"	
North Santiam R.	Mouth to First Hwy. Br.	0.0- 4.7	4.7	150	31.91	10/1/76	Very good
	Hwy. Br. to SPRR Br.	4.7- 17.9	13.2	310	23.48	"	"
	SPRR Br. to Stayton Br.	17.9- 26.9	9.0	39	4.33	"	"
	Stayton Br. to L. N. Fork	26.9- 43.0	17.0	11	0.65	"	"
Total			43.0	510	11.86	"	
South Santiam R.	Mouth to Crabtree Hwy. Br.	0.0- 12.2	12.2	930	76.23	10/1/76	Very good
	Crabtree Hwy. Br. to Lebanon Br.	12.2- 29.4	17.2	875	50.87	"	"
	Lebanon Br. to Lebanon Dam	29.4- 33.5	4.1	53	12.93	"	"
	Lebanon Dam to Foster Dam	33.5- 60.7	27.2	23	0.85	"	"
Total			60.7	1,881	30.99	"	
Thomas Cr.	Mouth to County Road Br.	0.0- 3.5	--	--	--	--	--
	County Rd. Br. to Covered Br. above Scio	3.5- 19.3	--	--	--	--	--
Total			--	--	--		

Appendix Table 3. (Continued)

River	River section: Reference points	River km	Km surveyed	Redds	Avg. number of redds/km	Date	Visibility
Crabtree Cr.	Mouth to SPRR Br.	0.0- 6.0	--	--	--	--	--
	SPRR Br. to Transmission Lines	6.0- 15.9	--	--	--	--	--
Total			--	--	--		
Molalla R.	Mouth to Hwy. 99E Br.	0.0- 5.8	5.8	37	6.38	10/1/76	Good
	Hwy. 99E to Goods Br.	5.8- 9.7	3.9	100	25.64	"	"
	Goods Br. to SPRR Br.	9.7- 16.3	6.6	234	35.45	"	"
	SPRR Br. to Hwy. 213 Br.	16.3- 23.2	6.9	146	21.16	"	"
	Hwy. 213 Br. to Feyrer Pk.	23.2- 29.9	6.7	89	13.28	"	"
	Feyrer Pk to Robbins Rd.	29.9- 33.3	3.4	12	3.53	"	"
	Robbins Rd. to N. Fk.	33.3- 42.6	9.3	37	3.98	"	"
Total			42.6	655	15.38	"	
GRAND TOTAL ABOVE WILLAMETTE FALLS			554.9	6,642	11.97		
Clackamas R.	Mouth to 82nd Ave. Br.	0.0- 1.9	1.9	4	2.11	10/1/76	Good
	82nd Ave. Br. to Carver Br.	1.9- 12.7	10.8	148	13.70	"	"
	Carver Br. to Barton Br.	12.7- 21.4	8.7	54	6.21	"	"
	Barton Br. to Eagle Cr.	21.4- 26.9	5.5	57	10.36	"	"
	Eagle Cr. to River Mill Dam	26.9- 36.7	9.8	11	1.12	"	"
Total			36.7	274	7.47	"	
Clear Cr.	Mouth to Fishers Mill	0.0- 9.0	--	--	--	--	--
Total			--	--	--		
GRAND TOTAL WILLAMETTE SYSTEM			591.6	6,916	11.69		

Appendix Table 4. Sex ratios of early spawning fall chinook, Willamette River system, 1970-76.[a]

Year	Males		Females		Total
	No.	%	No.	%	
1970[b]	300	46.3	348	53.7	648
1971	164	43.2	216	56.8	380
1972	481	58.4	342	41.6	823
1973	1,930	61.0	1,234	39.0	3,164
1974	760	47.4	842	52.6	1,602
1975	825	50.1	821	49.9	1,646
1976	867	63.9	489	36.1	1,356

[a]*Includes Clackamas River.*
[b]*Sex ratios taken on Mill Creek tag and recovery carcass survey.*

Table 5. Releases of adults, fry-fingerlings, and smolts contributing to returning coho adults, Willamette River system, 1965-76.

Year	Willamette Falls counts		Releases contributing to adult run		
	Adults	Jacks	Adults	Fry-Fing.	Smolts
1954	315	160			
1955	340	1,810			
1956	2,600	6,035			
1957	2,950	1,200			
1958	394	976			
1959	2,065	840			
1960	512	458			
1961-64	(Fall counts discontinued)				
1965	7,080	2,184	--	5,272,700	61,800
1966	4,071	2,247	--	--	178,600
1967	7,084	1,614	7,715	8,084,300	296,300
1968	12,400	5,300	1,846	9,465,400	--
1969	3,260	14,032	4,205	10,615,700	--
1970	17,902	19,453	9,208	7,894,500	--
1971	17,410	6,670	7,090	5,747,100	1,253,800
1972	9,903	7,157	5,216	5,565,100	1,345,400
1973	5,174	1,583	830	883,200	1,217,000
1974	1,501	3,941	1,450	1,364,100	1,253,000
1975	5,922	6,927	1,316	2,070,300	1,266,200
1976	2,333	2,217	1,139	631,400	189,800

Appendix Table 6. Releases of fry, fingerlings, and pond-reared fall chinook contributing to returning adults, Willamette River system, 1965-76.

Year	Adults[a] returning	Number of returns by age class		Releases contributing to 3's (millions)			Releases contributing to 4's (millions)		
		3's	4's	Fry	Fing.	Pond	Fry	Fing.	Pond
1965	79	--	--	0	0	0	0	0	0
1966	1,026	--	--	4.8	7.2	0	0	0	0
1967	2,012	--	--	0	2.9	0	4.8	7.2	0
1968	4,246	--	--	10.8	3.2	0	0	2.9	0
1969	6,957	--	--	9.7	7.9	0	10.8	3.2	0
1970	7,558	4,989	2,320	0	4.0	1.7	9.7	7.9	0
1971	5,090	1,675	3,272	0	3.5	1.3	0	4.0	1.7
1972	11,826	10,289	1,242	0	10.5	10.7	0	3.5	1.3
1973	22,237	13,609	8,317	0	0	10.6	0	10.5	10.7
1974	34,189	16,684	16,855	0	0	11.0	0	0	10.6
1975	33,772	5,302	27,592	0	0	12.6[b]	0	0	11.0
1976	30,200	23,888	4,409	0	0	5.7	0	0	12.6[b]

[a]*Jacks included in total.*

[b]*Total is subjective because Fish Culture personnel report of estimated fish released after trucking terminated was too high.*

Appendix Table 7. Age composition of early spawning fall chinook, Willamette River system, 1970-76.[a]

Year		Number by age 2	3	4	5	Total
1970	No.	2	60	28	0	90
	%	2.2	66.7	31.1	0	100
1971	No.	4	47	92	0	143
	%	2.8	32.9	64.3	0	100
1972	No.	13	504	61	2	580
	%	2.2	86.9	10.5	0.4	100
1973	No.	15	713	385	8	1,121
	%	1.3	63.7	34.3	0.7	100
1974	No.	11	757	811	21	1,600
	%	0.7	47.3	50.7	1.3	100
1975	No.	24	255	1,294	18	1,591
	%	1.5	16.0	81.4	1.1	100
1976	No.	29	1,038	192	54	1,313
	%	2.2	79.1	14.6	4.1	100

[a]*Includes Clackamas River.*

Appendix Table 8. Releases of coho adults, fry, and smolts into the Willamette River system above Willamette Falls by brood year, 1962-76.[a]

System	1962 brood			1963 brood			1964 brood		
	Adults	Fry	Smolts	Adults	Fry	Smolts	Adults	Fry	Smolts
Tualatin R.		195.0	--			--	635	--	--
Molalla R.		686.1	61.8			19.7	1,500	400.0	--
Pudding R.		--	--			--	523	281.7	14.1
N. Yamhill R.		291.9	--			10.1	300	100.0	29.3
S. Yamhill R.		462.9	--			69.8	900	1,891.4	14.3
Mill Cr. (Salem)		--	--			--	457	--	--
Rickreall Cr.		--	--			--	--	304.9	--
Luckiamute R.		400.0	--			--	--	393.6	--
N. Santiam R.		384.4	--			--	--	--	--
S. Santiam R.		850.0	--			69.0	1,400	1,117.9	74.8
Calapooia R.		502.4	--			--	--	494.7	28.9
Marys R.		350.0	--			--	250	1,178.6	30.0
Long Tom R.		--	--			--	--	300.2	--
McKenzie R.		--	--			--	--	--	74.6
Mohawk R.		500.0	--			10.0	1,350	500.0	--
Fall Cr.		350.0	--			--	--	410.0	--
Coast Fk.		300.0	--			--	400	511.3	--
Middle Fk.		--	--			--	--	200.0	30.3
Total		5,272.7	61.8			178.6	7,715	8,084.3	296.3

[a]*Adults listed are actual numbers released, fry and smolts are listed in 1,000's. Some fed fingerlings are included with fry listings. Cowlitz River (Washington) stock coho are not included.*

Appendix Table 8. (Continued)

System	1965 brood			1966 brood			1967 brood		
	Adults	Fry	Smolts	Adults	Fry	Smolts	Adults	Fry	Smolts
Tualatin R.	--	349.7		150	195.3			685.7	
Molalla R.	--	846.0		656	431.1		722	1,640.0	
Pudding R.	--	910.7		551	535.7		664	430.1	
N. Yamhill R.	817	291.5		--	336.2		706	--	
S. Yamhill R.	220	797.0		150	712.0		967	306.0	
Mill Cr. (Salem)	363	--		--	--		299	--	
Rickreall Cr.	--	250.6		300	--		--	152.5	
Luckiamute R.	200	389.4		350	208.7		659	224.7	
N. Santiam R.	--	260.7		--	391.6		--	310.9	
S. Santiam R.	--	1,340.7		905	3,273.4		1,808	2,366.1	
Calapooia R.	--	221.2		--	271.3		320	422.6	
Marys R.	246	608.7		200	836.6		1,126	80.0	
Long Tom R.	--	--		--	157.0		--	--	
McKenzie R.	--	696.0		--	--		--	--	
Mohawk R.	--	--		450	397.6		607	279.4	
Fall Cr.	--	--		493	500.0		340	--	
Coast Fk.	--	1,744.8		--	2,014.6		840	893.6	
Middle Fk.	--	859.4		--	354.6		150	102.9	
Total	1,846	9,465.4[b]		4,205	10,615.7		9,208	7,894.5	

[b] *Does not include 102,994 fry introduced into Corral Creek of the main Willamette.*

Appendix Table 8. (Continued)

System	1968 brood			1969 brood			1970 brood		
	Adults	Fry	Smolts	Adults	Fry	Smolts	Adults	Fry	Smolts
Tualatin R.	506	--		500	740.1	--	320	--	--
Molalla R.	912	825.3		891	--	--	360	--	--
Pudding R.	632	829.1	120.6	900	222.5	113.0	--	307.6	93.3
N. Yamhill R.	179	--	86.2	429	--	--	--	--	86.3
S. Yamhill R.	1,123	--		300	828.5	85.3	--	--	--
Mill Cr. (Salem)	120	41.9	28.4	--	--	46.1	--	--	26.2
Rickreall Cr.	150	--		200	--	--	150	--	--
Luckiamute R.	780	518.2	185.8	600	476.5	252.7	--	223.0	165.3
N. Santiam R.	--	--		--	442.8	--	--	--	--
S. Santiam R.	1,622	1,159.9	206.2	740	803.5	218.3	--	--	193.4
Calapooia R.	566	456.8	119.7	--	780.1	123.3	--	--	118.6
Marys R.	--	357.1	153.0	--	437.4	160.4	--	--	179.7
Long Tom R.	--	--	16.3	--	--	17.6	--	--	14.6
McKenzie R.	--	383.0	28.8	--	--	30.0	--	--	31.1
Mohawk R.	500	--	195.7	350	--	203.2	--	--	211.0
Fall Cr.	--	346.8	48.6	306	--	47.5	--	352.6	27.1
Coast Fk.	--	421.0	64.6	--	406.0	48.2	--	--	70.5
Middle Fk.	--	408.0		--	427.7	--	--	--	--
Total	7,090	5,747.1	1,253.9	5,216	5,565.1	1,345.6	830	883.2	1,217.1

Appendix Table 8. (Continued)

System	1971 brood			1972 brood			1973 brood		
	Adults	Fry	Smolts	Adults	Fry	Smolts	Adults	Fry	Smolts
Tualatin R.	150	454.4	--	159	182.3	--	--	373.0	94.9
Molalla R.	--	--	288.6	--	480.6	275.4	--	--	--
Pudding R.	450	512.5	--	308	785.1	41.1	171	--	--
N. Yamhill R.	--	--	--	--	--	--	--	--	--
S. Yamhill R.	--	397.2	435.2	208	196.1	483.8	239	--	--
Mill Cr. (Salem)	--	--	--	--	--	--	--	--	--
Rickreall Cr.	150	--	--	164	--	--	152	--	--
Luckiamute R.	150	--	--	160	327.1	20.3	214	--	--
N. Santiam R.	--	--	40.4	--	--	38.4	--	--	--
S. Santiam R.	150	--	338.3	159	99.1	231.8	363	--	--
Calapooia R.	--	--	--	--	--	--	--	--	--
Marys R.	--	--	19.8	--	--	20.3	--	--	--
Long Tom R.	--	--	--	--	--	--	--	--	--
McKenzie R.	--	--	--	--	--	--	--	--	--
Mohawk R.	--	--	21.3	--	--	25.2	--	--	94.9
Fall Cr.	400	--	--	158	--	--	--	258.4	--
Coast Fk.	--	--	20.4	--	--	24.9	--		--
Middle Fk.	--	--	89.8	--	--	105.1	--	--	--
Total	1,450	1,364.1	1,253.8	1,316	2,070.3	1,266.3	1,139	631.4	189.8

Appendix Table 8. (Continued)

System	1974 brood			1975 brood			1976 brood		
	Adults	Fry	Smolts	Adults	Fry	Smolts	Adults	Fry	Smolts
Tualatin R.	--	183.1	59.9			99.3		204.1	
Molalla R.	--	--	--			--		--	
Pudding R.	--	345.4	--			--		270.4	
N. Yamhill R.	--	--	--			--		--	
S. Yamhill R.	--	--	--			--		--	
Mill Cr. (Salem)	--	--	--			--		--	
Rickreall Cr.	--	--	--			--		--	
Luckiamute R.	204	158.5	--			--		161.3	
N. Santiam R.	--	--	--			--		--	
S. Santiam R.	--	--	--			--		--	
Calapooia R.	--	--	--			--		--	
Marys R.	--	--	--			--		--	
Long Tom R.	--	--	--			--		--	
McKenzie R.	--	--	--			--		--	
Mohawk R.	--	--	--			--		--	
Fall Cr.	--	--	--			--		--	
Coast Fk.	--	--	--			--		--	
Middle Fk.	--	--	--			--		--	
Total	204	687.0	59.9			99.3		635.8	

Appendix Table 9. Early spawning juvenile fall chinook (Columbia River stock) released into the Willamette River system from Willamette basin ponds, 1967-76 broods.

Brood	Molalla River	Mill Creek	North Santiam R.	South Santiam R.	Willamette R.[d]	Total
1967[a]	--	1,741,317	--	--	--	1,741,317
1968[a]	--	1,248,796	--	--	--	1,248,796
1969[b]	646,803	400,135	4,120,074	4,880,090	662,615	10,709,717
1970[b]	478,743	474,773	3,423,923	5,301,202	551,101	10,229,742[e]
1971[b]	513,583	974,086	3,831,618	3,758,318	1,959,288	11,036,893
1972[b]	1,383,990	2,867,125	3,954,693	3,391,307	1,050,682	12,647,797[f]
1973[c]	1,109,676	180,880	--	2,989,542	1,390,762	5,670,860[g]
1974[c]	1,077,025	--	--	2,032,832	2,434,147	5,544,104[h]
1975[c]	471,924	216,202	117,507	2,153,301	3,047,839	6,006,773
1976[c]	--	259,075	186,000	--	10,788,305	11,233,380

[a] *Salem Pond.*

[b] *Aumsville, Salem, and Stayton ponds.*

[c] *Aumsville and Stayton ponds.*

[d] *Main Willamette releases at Eugene and Harrisburg except 1976 brood release which was below Willamette Falls.*

[e] *Total does not include 313,373 fish released into the Clackamas River.*

[f] *Total is subjective because estimated fish released by Fish Culture personnel after trucking terminated was high.*

[g] *Additional releases of 2,205,955 into Mill Creek and 4,019,625 into the North Santiam River were estimated to have been made from Aumsville and Stayton ponds, respectively, by Fish Culture personnel after trucking terminated. We believe most of the fish were pond mortality.*

[h] *Fish culture personnel subjectively estimated 5,380,000 additional fish migrated from the ponds after trucking terminated. We believe most of the fish were pond mortality.*

Appendix Table 10. The occurrence of fingerling coho in the Willamette River system as determined by survey of index streams, 1972-77.

River system	Stream	Spring observations					
		1972	1973	1974	1975	1976	1977
Molalla	Main stem	Present	Present	Present	0	Present	Present
	M.F. Molalla R.	--	--	0	--	--	--
	N.F. Molalla R.	0	Present	0	--	--	--
	Copper Cr.	--	--	0	--	--	--
	Dickey Cr.	--	--	0	--	--	--
	Luckens Cr.	0	--	0	--	--	--
	Milk Cr.	--	--	--	--	Present	--
Pudding	Abiqua Cr.	--	--	Present	--	Present	0
	Butte Cr.	--	--	"	0	--	0
	Silver Cr.	--	--	0	--	--	--
	W.F. Drift Cr.	--	--	--	--	--	--
	Powers Cr.	--	--	--	--	--	--
	N.F. Silver Cr.	--	--	--	--	--	--
S. Yamhill R.	Main stem	Present	Present	Present	0	Present	0
	Agency Cr.	"	"	"	0	"	0
	Gold Cr.	"	0	0	0	--	--
	Deer Cr.	"	Present	Present	0	--	0
	Rowell Cr.	"	0	0	0	--	--
	Rock Cr.	"	Present	Present	0	Present	--
	Rogue R.	"	0	"	0	"	--
	Mill Cr.	"	Present	--	Present	"	Present
	Coast Cr.	"	"	Present	--	0	--
	E.F. Willamina Cr.	0	--	0	--	Present	--
	Willamina Cr.	Present	Present	--	--	--	--
	Gooseneck Cr.	"		--	--	--	--
	Pierce Cr.	--	--	0	--	--	--
	Kitten Cr.	--	--	0	--	--	--
	Hanchet Cr.	--	--	Present	--	--	--
	Gilber Cr.	--	--	0	--	--	--

Appendix Table 10. (Continued)

River system	Stream	Spring observations					
		1972	1973	1974	1975	1976	1977
N. Yamhill R.	Main stem	Present	Present	0	--	Present	0
	Fairchild Cr.	"	0	0	--	0	--
	Haskins Cr.	"	Present	Present	0	0	--
	Turner Cr.	"	"	"	Present	--	--
	Ceder Cr.	"	0	--	--	--	--
	Panther Cr.	"	Present	--	--	0	--
	Baker Cr.	"	--	--	--	--	--
Tualatin	Main stem	--	Present	--	--	--	--
	Scoggins Cr.	--	--	Present	Present	--	--
	Gales Cr.	--	--	"	--	Present	Present
	Lee Cr.	--	--	--	--	--	--
	McKay Cr.	--	--	Present	0	Present	--
	E.F. Dairy Cr.	--	Present	"	0	"	0
	W.F. Dairy Cr.	--	0	0	0	0	0
	Whitcher Cr.	--	--	0	--	--	--
	Mendenhall Cr.	--	--	Present	--	--	--
Mill Cr.	Main stem (Salem)	Present	0	0	0	Present	0
N. Santiam R.	Mad Cr.	--	0	0	--	--	--
	Rock Cr.	--	Present	0	0	0	0
	Stout Cr.	Present	"	Present	0	Present	Present
	Vatentine	--	--	--	--	--	--
S. Santiam R.	Main stem	--	--	--	--	--	--
	Mook Cr.	--	--	--	--	--	--
	Canyon Cr.	--	--	--	--	--	--
	Crabtree Cr.	--	--	0	--	--	--
	Thomas Cr.	--	Present	0	--	--	Present
	Neal Cr.	Present	"	--	0	Present	--
	Jordon Cr.	--	--	0	--	--	--
	Hamilton Cr.	--	Present	--	--	Present	--

Appendix Table 10. (Continued)

River system	Stream	Spring observations 1972	1973	1974	1975	1976	1977
	Wiley Cr.	Present	--	--	--	--	--
	McDowell Cr.	--	Present	--	--	--	--
	Beaver Cr.	0	--	--	--	--	--
Luckiamute R.	Main stem	Present	--	--	--	Present	--
	Ritner Cr.	"	Present	0	0	0	Present
	Pedee Cr.	"	"	Present	--	--	"
	Teal Cr.	"	--	"	--	--	--
	Little Luckiamute R.	"	--	--	--	--	Present
	Soap Cr.	0	0	--	--	--	--
	Price Cr.	0	0	0	--	--	--
	Maxfield Cr.	0	0	0	--	--	--
Calapooia	Main stem	Present	Present	Present	0	0	0
	Brush Cr.	0	--	--	--	--	--
Rickreall Cr.	Main stem	--	--	--	0	--	--
Marys	W. Fork	0	--	Present	--	0	--
	Oliver Cr.	Present	0	"	--	--	--
	Beaver Cr.	"	0	--	--	--	--
	Greasy Cr.	"	0	Present	0	0	0
	Rock Cr.	"	Present	"	0	0	0
	Woods Cr.	0	0	"	0	0	--
	Oleman Cr.	Present	--	--	--	--	--
	Shotpouch Cr.	"	0	Present	0	--	--
	Blakesley Cr.	0	--	Present	0	--	--
	Mulkey Cr.	--	--	--	--	--	--
	Squaw Cr.	--	--	--	--	--	--
	Gellatley Cr.	--	--	--	--	--	--
	Reese Cr.	--	0	--	--	--	--
	Hammer Cr.	Present	0	0	--	--	--

Appendix Table 10. (Continued)

River system	Stream	Spring observations					
		1972	1973	1974	1975	1976	1977
McKenzie	Camp Cr.	--	0	0	0	0	--
Mohawk	Main stem	Present	--	Present	--	--	--
	Mill Cr.	"	Present	"	0	Present	Present
	Drury Cr.	0	--	0	0	--	--
	Shotgun Cr.	Present	Present	0	0	--	--
	Cartright Cr.	--	"	Present	0	0	0
	McGowen Cr.	Present	"	0	--	0	0
	Parsons Cr.	"	"	Present	--	0	--
	Cash Cr.	"	"	"	--	--	--
C.F. Willamette	Bear Cr.	Present	Present	Present	--	--	--
	Mosby Cr.	--	0	0	0	Present	0
	Gettings Cr.	--	--	--	--	--	--
M.F. Willamette	Little Fall Cr.	--	--	Present	--	--	--
	Hills Cr.	--	Present	0	--	--	--
	Lost Cr.	Present	"	--	0	0	--
	Sturdy Cr.	--	--	--	--	--	--