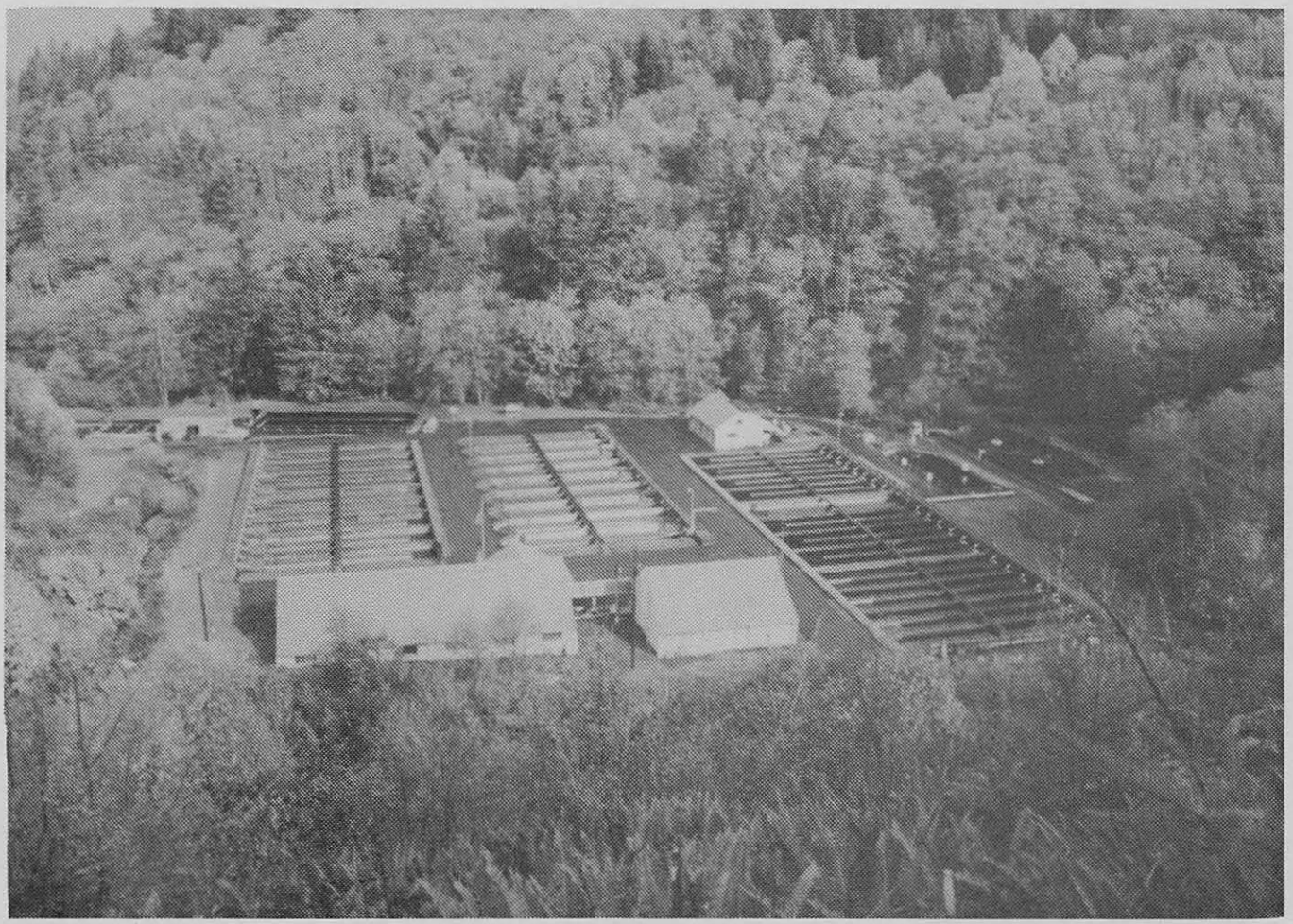
NOAA Technical Memorandum NMFS F/NWR-17

COLUMBIA RIVER FISHERIES DEVELOPMENT PROGRAM
ANNUAL REPORT FOR F.Y. 1985

MICHAEL R. DELARM AND EINAR WOLD

JULY 1986



TM NMFS/NWR-17, DeLarm & Wold

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Mitchell Act

To provide for the conservation of the fishery resources of the Columbia River, establishment, operation, and maintenance of one or more stations in Oregon, Washington, and Idaho, and for the conduct of necessary investigations, surveys, stream improvements, and stocking operations for these purposes.

Be it enacted by the Senate and House of Representatives of the United States of American in Congress assembled, That the Secretary of the Interior is authorized and directed to establish one or more salmon-cultural stations in the Columbia River Basin in each of the States of Oregon, Washington, and Idaho. Any sums appropriated for the purpose of establishment of such stations may be expended, and such stations shall be established, operated, and maintained, in accordance with the provisions of the Act entitled "An Act to provide for a five-year construction and maintenance program for the United States Bureau of Fisheries," approved May 21, 1930, insofar as the provisions of such Act are not inconsistent with the provisions of this Act.

Sec. 2. The Secretary of the Interior is further authorized and directed (1) to conduct such investigations, and such engineering and biological surveys and experiments, as may be necessary to direct and facilitate conservation of the fishery resources of the Columbia River and its tributaries; (2) to construct and install devices in the Columbia River Basin for the improvement of feeding and spawning conditions for fish, for the protection of migratory fish from irrigation projects, and for facilitating free migration of fish over obstructions; and (3) to perform all other activities necessary for the conservation of fish in the Columbia River Basin in accordance with law.

Sec. 3. In carrying out the authorizations and duties imposed by section 2 of this Act, the secretary of the Interior is authorized to utilize the facilities and services of the agencies of the States of Oregon, Washington, and Idaho responsible for the conservation of the fish and wildlife resources in such States, under the terms of agreements entered into between the United States and these States, without regard to the provisions of section 3709 of the Revised Statutes, and funds appropriated to carry out the purposes of this Act may be expended for the construction of facilities on and the improvement of lands now owned or controlled by the United States: Provided, That the appropriate agency of the State wherein such construction or improvement is to be carried on first shall have obtained without cost to the United States the necessary title to, interest therein, right-of-way over, or licenses covering the use of such lands.

Approved May 11, 1938, amended August 8, 1946
(52 Stat. 345) (60 Stat. 932)

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This TM series is used for documentation and timely communication of preliminary results, interim reports, or special purpose information; and has not received complete formal review, editorial control, or detailed editing.

COLUMBIA RIVER FISHERIES DEVELOPMENT PROGRAM ANNUAL REPORT FOR F.Y. 1985

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COVER PHOTO: THE OREGON DEPARTMENT OF FISH AND WILDLIFE BIG CREEK HATCHERY. THE FACILITY IS LOCATED CLOSE TO THE TOWN OF ASTORIA, NEAR THE COLUMBIA RIVER MOUTH.

U.S. DEPARTMENT OF COMMERCE
MALCOLM BALDRIGE
National Oceanic and Atmospheric Administration
ANTHONY J. CALIO
National Marine Fisheries Service
WILLIAM G. GORDON

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INTRODUCTION

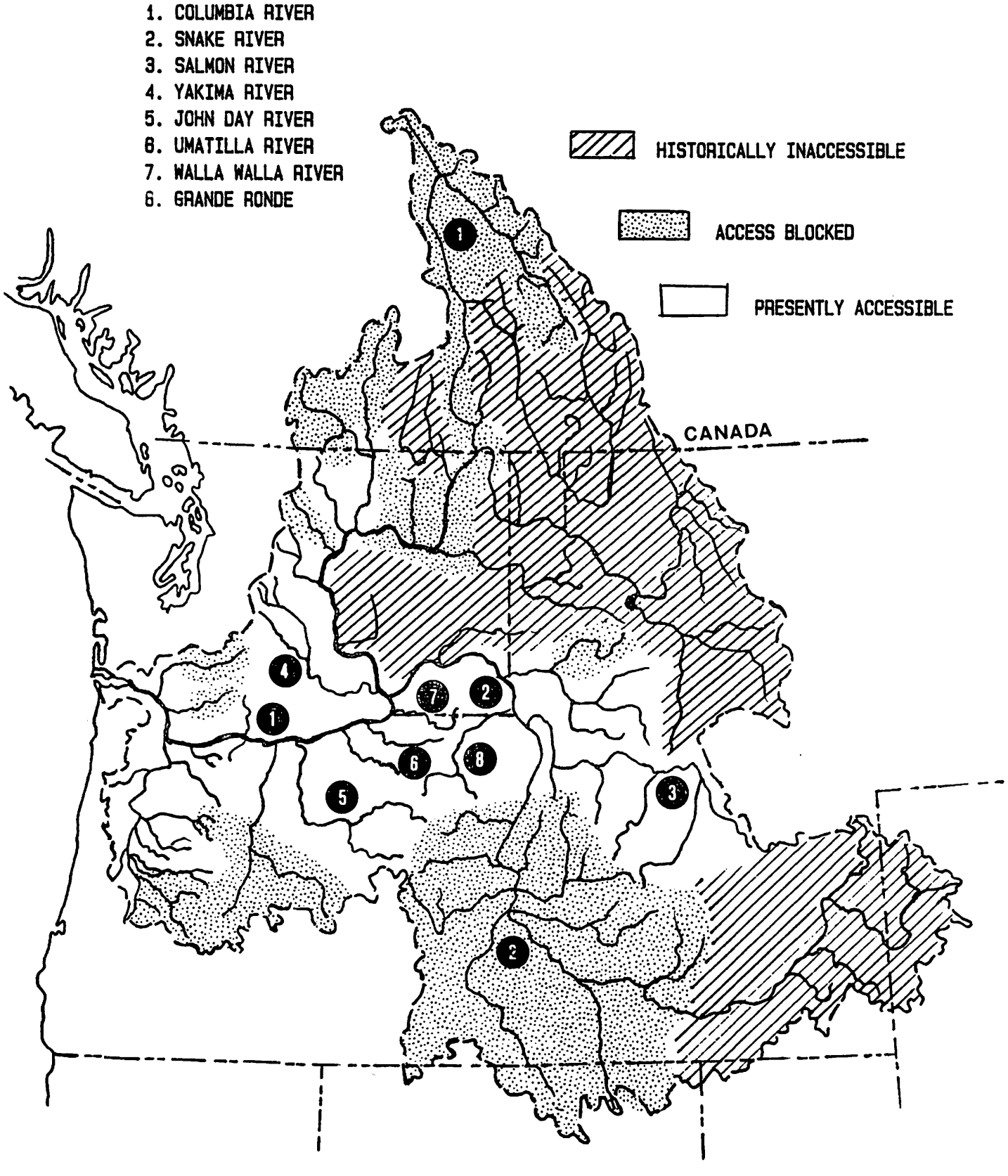
Congress passed the Mitchell Act in 1938 authorizing the appropriation of $500,000 for surveys and improvements in the Columbia River watershed for the benefit and conservation of salmon (Oncorhynchus sp.) and steelhead (Salmo gairdneri). The Act recognized that the salmonid resource was in serious and progressive decline due to destruction of favorable environmental conditions by hydroelectric projects, deforestation, pollution, and water diversions. The purpose of the initial appropriation was to reinvest funds the Government had received from fishermen for leases of seining grounds on the Federally owned Sand Island and Peacock Spit in the mouth of the Columbia River.

Stream census and surveys were initiated and by 1942 most tributary streams in the Columbia Basin had been surveyed. Data on various populations of salmon and steelhead were accumulated and information regarding unscreened irrigation diversions, impassable waterfalls, log and debris jams, splash dams, and sources of pollution were cataloged for future use. These surveys indicated a detrimental degradation of the original pristine habitat had occurred. Hydroelectric projects had reduced the area available to anadromous fish (Figure 1). Mining and lumber operations and unscreened irrigation diversions were adversely affecting salmon and steelhead in the remaining habitat.

The Mitchell Act was amended in 1946 to remove the limitations on subsequent appropriations from Congress for development of anadromous fish in the Columbia Basin. The Act authorized the utilization of facilities and services from the State conservation agencies of Idaho, Washington, and Oregon in developing the salmonid resources of the region. The Act also permitted closer cooperation between Federal and State governments and for the first time allowed transfer of monies to the States for specific work.

In 1947, State and Federal agencies recommended the formation of the Lower Columbia River Fisheries Development Program (CRFDP) as a way of maintaining salmon and steelhead resources in the Columbia Basin. This recommendation was endorsed by the Federal River Basin Inter-Agency Committee, U.S. Army Corps of

FIGURE 1. - THE HISTORICAL AND PRESENT AREA AVAILABLE TO ANADROMOUS FISH IN THE COLUMBIA RIVER



Engineers, and U.S. Bureau of Reclamation. The resultant CRFDP was administered under the U.S. Department of the Interior. The U.S. Corps of Engineers submitted, and Congress approved for FY 1949, an initial appropriation of $1 million to be utilized by the CRFDP.

Prior to 1956, the CRFDP involved only the States of Oregon and Washington and included that part of the Columbia Basin located below McNary Dam. In 1956, Congress instructed the CRFDP to develop the fishery resources above McNary Dam, and Idaho became a participant in 1957. At this time the word "Lower" was dropped from the CRFDP name.

Since its creation, the CRFDP's goal has been to develop maximum salmon and steelhead runs into the Columbia Basin and increase adult contribution to the various fisheries and escapement. To work towards that goal, the CRFDP has concentrated on three areas; hatchery construction and operation, stream improvement and the screening of irrigation diversions, and quality improvement studies.

In 1970, with the reorganization of Federal fisheries responsibilities, the CRFDP was transferred from the Department of the Interior to the Department of Commerce. It is currently administered as part of the Environmental and Technical Services Division (ETSD) of the National Marine Fisheries Service (NMFS) in Portland, Oregon in cooperation with the U.S. Fish and Wildlife Service (USFWS), Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fisheries (WDF), Washington Department of Game (WDG), and Idaho Department of Fish and Game (IDFG) (Figures 2 and 3).

In FY 1985 approximately $9,562,400 was appropriated, the majority of which went to the USFWS and State agencies (Figure 4) with approximately 8.5 percent of funds used in-house. The majority of expenditures (79.6 percent) was used for hatchery operation and maintenance (Figure 5). Through FY 1985 approximately $157 million has been provided by the CRFDP for production and enhancement of salmonids (Table 1).

Figure 2. - Organizational chart showing location of the Columbia River Fisheries Development Program in the Federal Government.

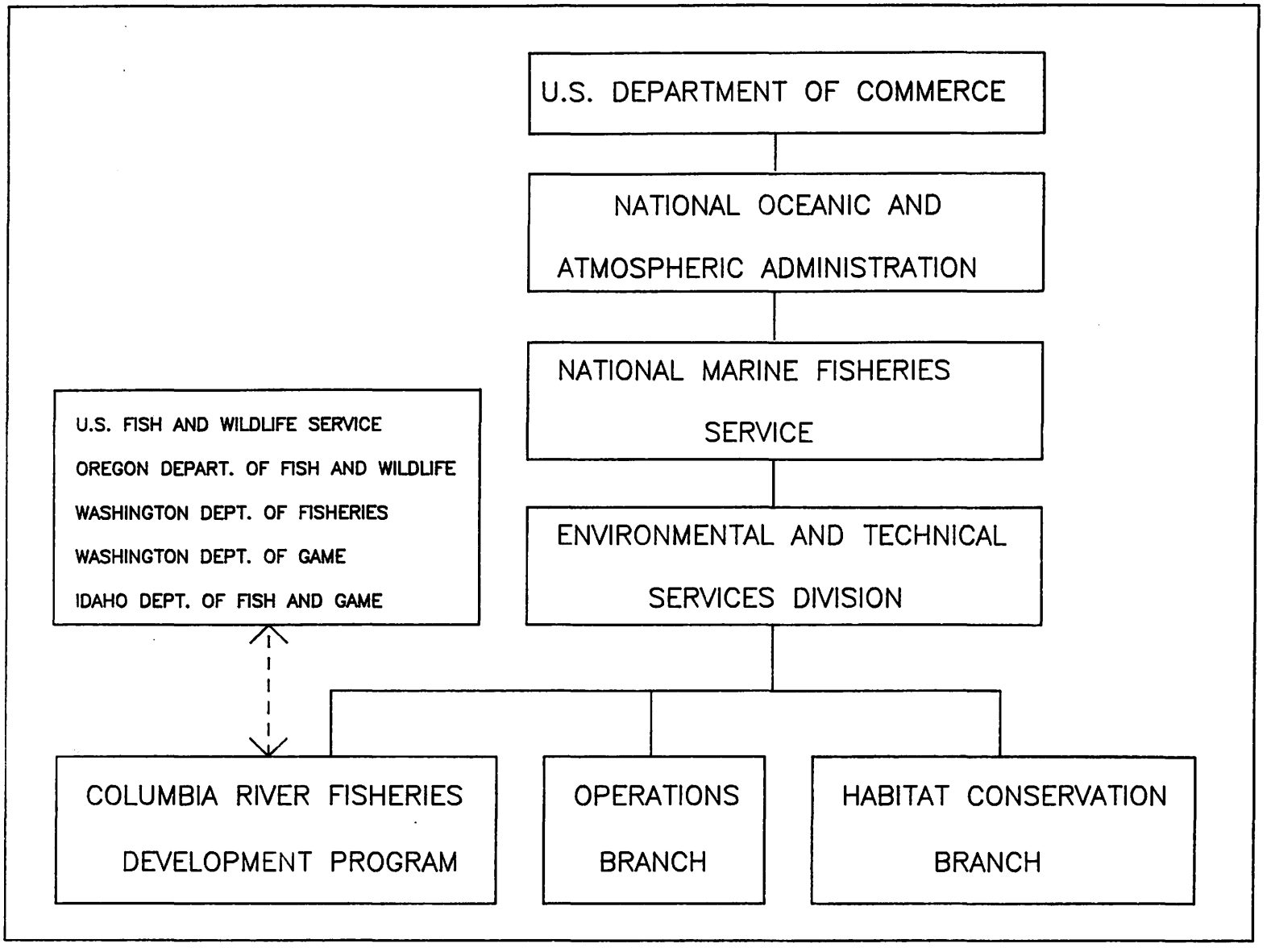


Figure 3. -- Organizational Structure of the Environmental and Technical Services Division.

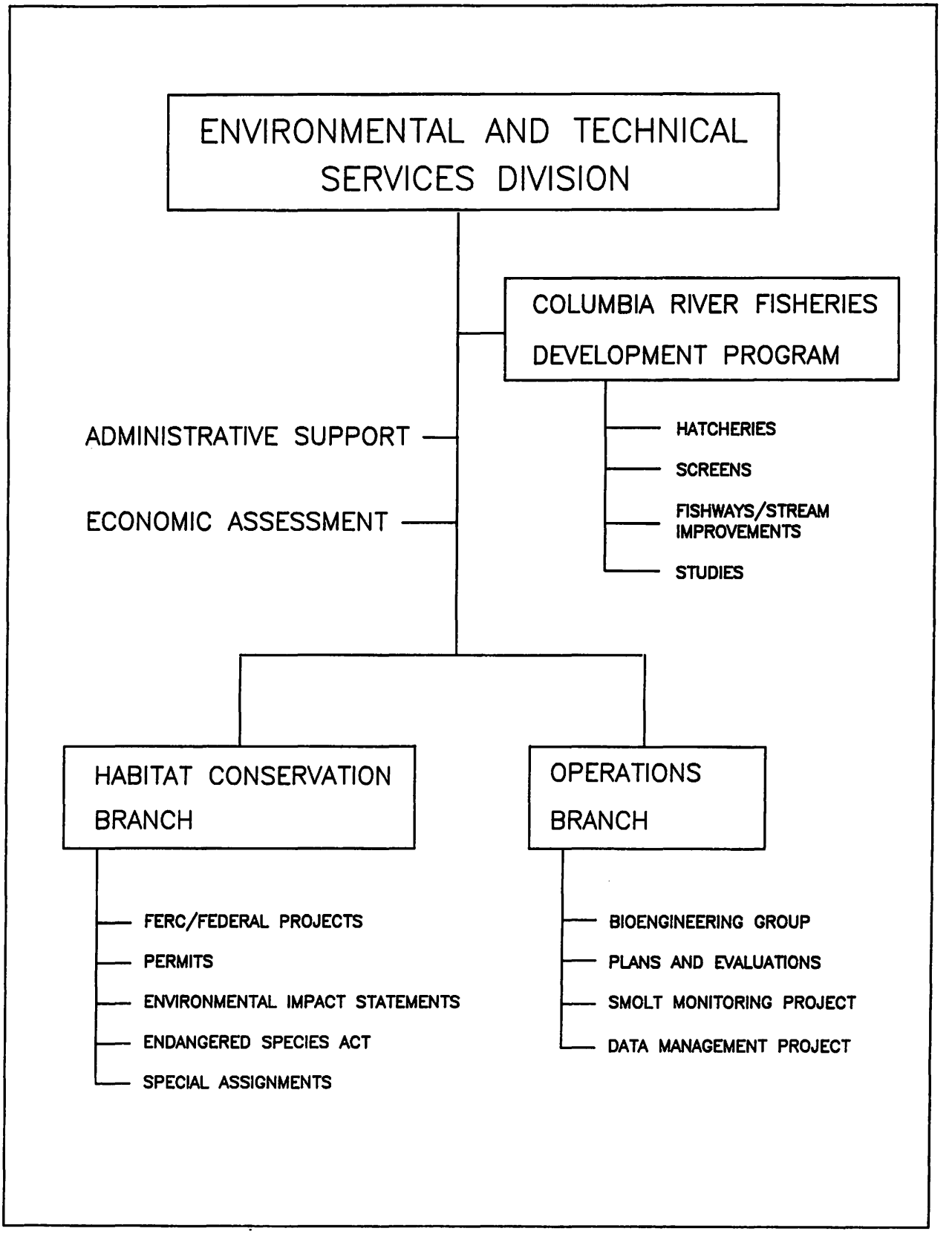


FIGURE 4.-- DIVISION OF FY1985 COLUMBIA RIVER FISHERIES DEVELOPMENT PROGRAM FUNDS

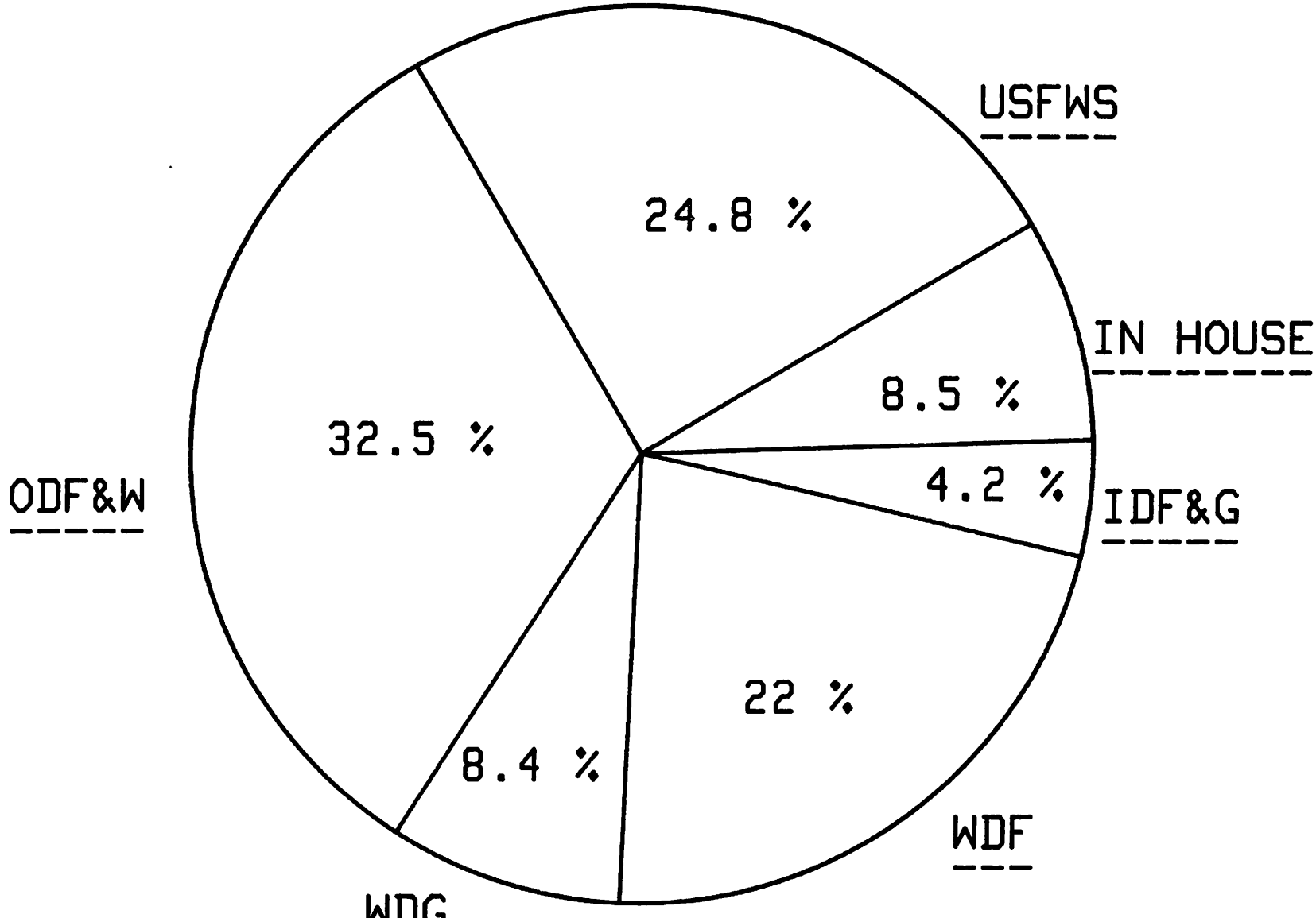


FIGURE 5. FY 1985 C.R.F.D.P. APPROPRIATED FUNDS.

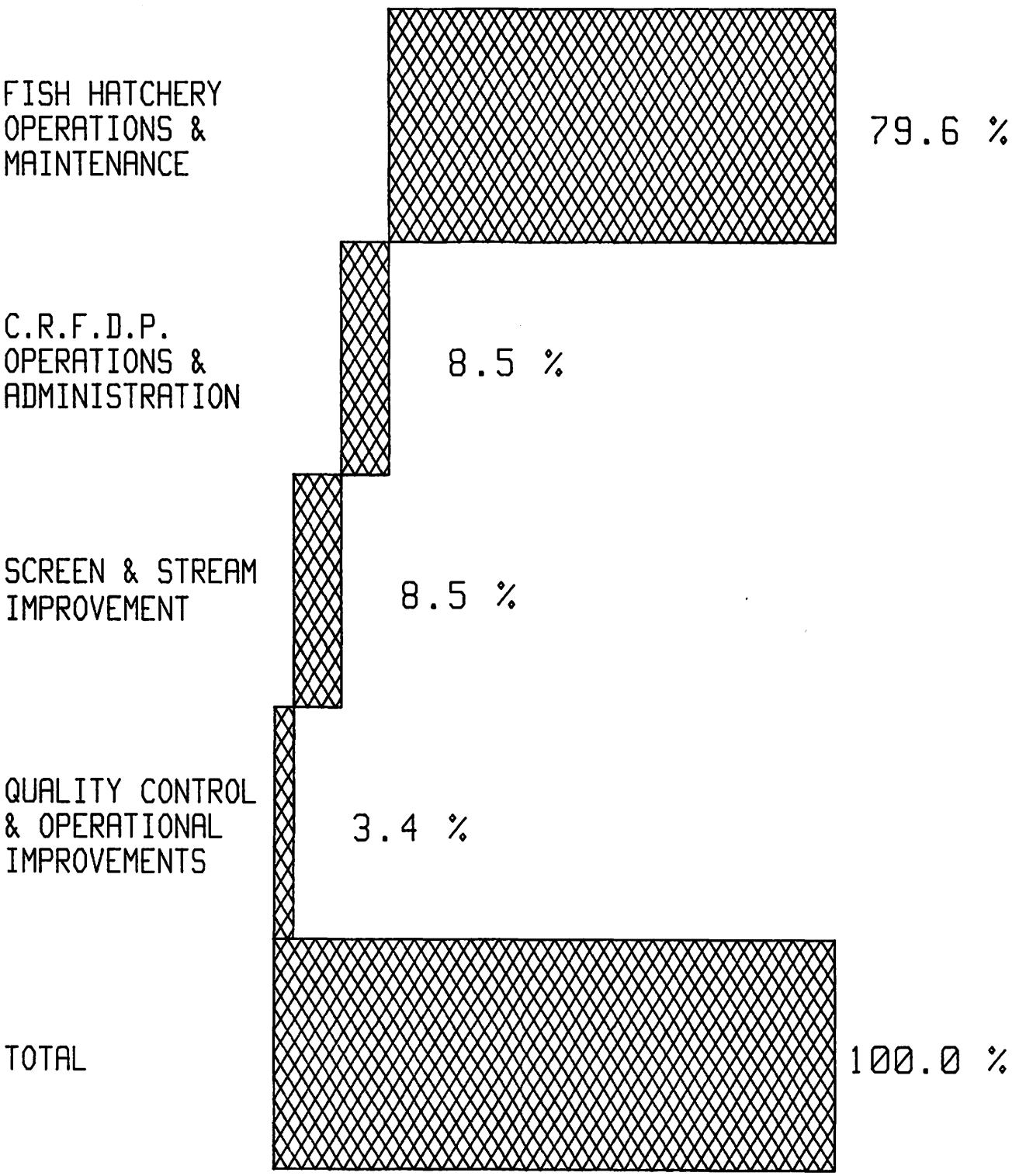


Table 1.-- FUNDS EXPENDED BY THE COLUMBIA RIVER FISHERIES DEVELOPMENT PROGRAM 1949-1985

FISCAL YEAR	CONSTRUCTION	O&M AND STUDIES	POLLUTION ABATEMENT	TOTAL
1949	$1,000,000	0	0	$1,000,000
1950	1,192,500	7,500	0	1,200,000
1951	2,118,813	94,130	0	2,212,943
1952	1,525,451	149,983	0	1,675,434
1953	2,935,000	476,885	0	3,411,885
1954	1,750,000	634,814	0	2,384,814
1955	1,000,000	1,080,305	0	2,080,305
1956	900,000	972,527	0	1,872,527
1957	1,400,000	1,274,133	0	2,674,133
1958	1,600,000	1,215,091	0	2,815,091
1959	1,600,000	1,404,498	0	3,004,498
1960	1,200,000	1,625,157	0	2,825,157
1961	1,400,000	1,964,429	0	3,364,429
1962	1,431,000	1,934,060	0	3,365,060
1963	1,608,200	2,056,563	0	3,664,763
1964	965,700	2,049,416	0	3,015,116
1965	588,000	2,273,900	0	2,861,900
1966	968,700	2,382,800	0	3,351,500
1967	1,050,000	2,429,000	0	3,479,000
1968	0	2,599,200	0	2,599,200
1969	420,000	2,571,800	0	2,991,800
1970	1,048,000	2,886,000	0	3,934,000
1971	0	2,939,400	0	2,939,400
1972	0	3,020,400	0	3,020,400
1973	0	3,314,000	0	3,314,000
1974	63,400	3,301,300	394,500	3,759,200
1975	1,095,000	3,799,800	495,700	5,390,500
1976	781,800	4,439,100	500,000	5,720,900
T.Q. 1/	0	1,179,900	9,400	1,189,300
1977	445,100	5,007,300	500,000	5,952,400
1978	217,000	5,646,600	500,000	6,363,600
1979	33,500	6,111,400	2,797,000	8,941,900
1980	9,100	6,385,100	500,000	6,894,200
1981	0	6,821,300	386,800	7,208,100
1982	0	7,801,900	0	7,801,900
1983	0	9,583,600	0	9,583,600
1984	190,434	9,580,400	0	9,580,400
1985	980,000	8,582,400	0	9,562,400
TOTALS	$31,516,698	$119,409,157	$6,083,400	$157,009,255

1/ T.Q. refers to the three month Transition Quarter from July to September necessitated by a change in Federal fiscal year reporting dates.

Information concerning CRFDP and other ETSD activities are published periodically under the NOAA Technical Memorandum NMFS F/NWR series and other publications. The series is subjected to peer review and editing and may be cited as a publication.

FISH CULTURE

The original plan for artificial propagation under the CRFDP envisioned construction, enlargement or renovation of 31 hatcheries over a ten-year period. In 1949, part of the initial $1 million was used to initiate construction of Klickitat and expand Spring Creek National Fish Hatchery. Clackamas (not one of the original 31) was the last hatchery constructed and was jointly funded by Portland General Electric Company and the CRFDP in 1979. Due to changes in the initial plan, a total of 22 hatcheries and 3 major rearing ponds have been constructed (Figure 6, Appendix 1, 2, 3, 4). All except for the Toutle Hatchery continue to produce salmon, steelhead trout, or sea-run cutthroat. Toutle hatchery was destroyed during the May 18, 1980 eruption of Mt. St. Helens.

The CRFDP rearing facilities are concentrated in the lower Columbia Basin below The Dalles Dam with only the two Ringold facilities located above that point (Tables 2 and 3). In addition to the main rearing facilities many hatcheries operate satellite rearing ponds (Table 4). These satellite facilities serve to extend production through outplants to surrounding areas.

Since 1949, the CRFDP has utilized the majority of funds on fish culture, including construction, operation, and maintenance of hatcheries. In FY 1985 79.6 percent of appropriated funds were provided for hatchery operations (Figure 5). Stream improvement (8.5 percent), quality improvement studies (3.4 percent), and various in-house functions (8.5 percent) account for the remaining appropriated funds.

Production from CRFDP facilities totaled approximately 99.3 million fish during the year (Table 5, Appendix Tables 5, 6, 7, 8). Species such as spring chinook salmon, coho salmon, steelhead trout, and sea-run cutthroat are usually

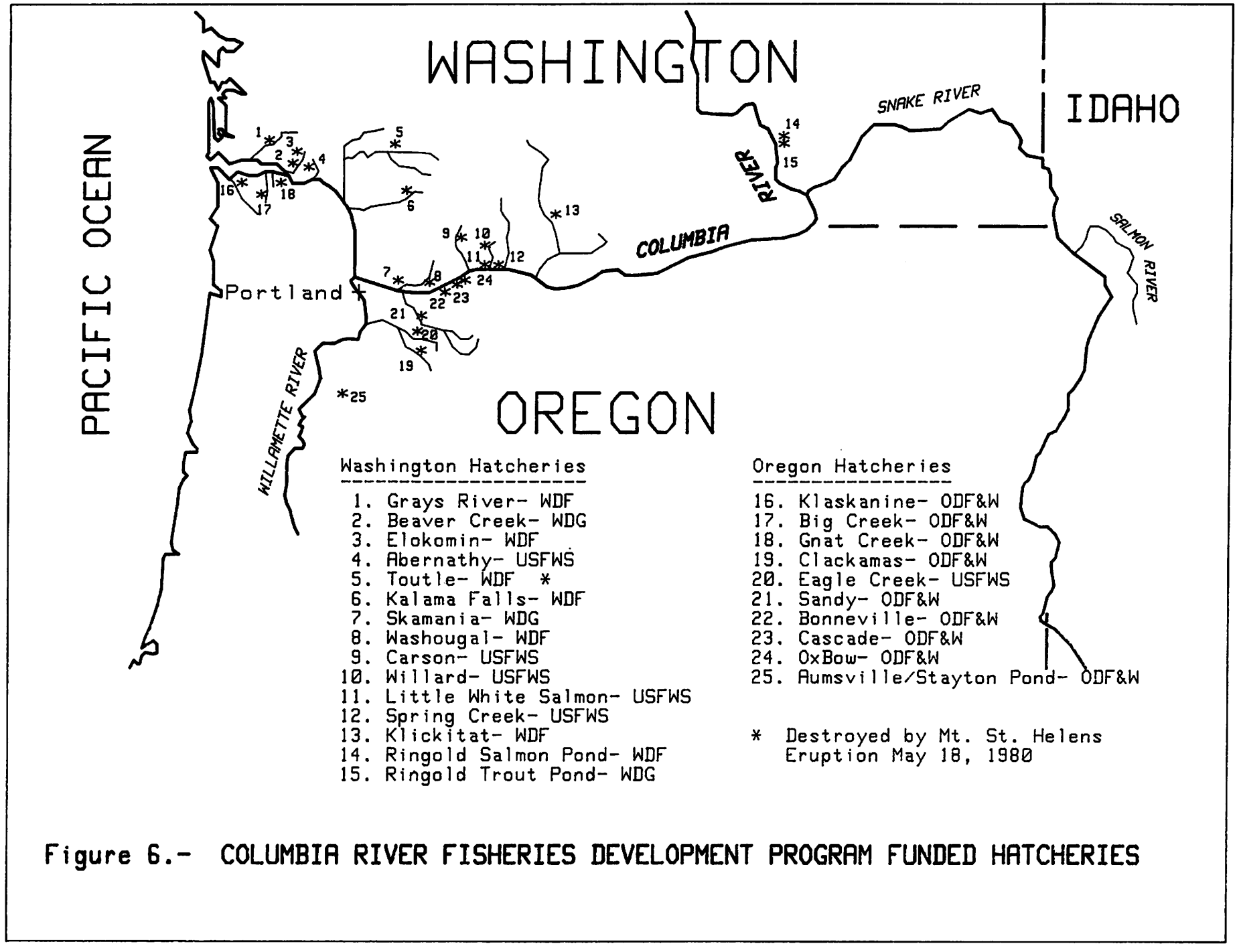


Figure 6.- COLUMBIA RIVER FISHERIES DEVELOPMENT PROGRAM FUNDED HATCHERIES

Table 2.--Columbia River Fisheries Development Program Facilities - Columbia Basin --Washington

Facility	General Location	Congressional District	Operating Agency 1/	Species Reared 1960-81	Anadromous Releases 1981	Year Anadromous Operation Began	Funding Agency 1/
Hatcheries							
Abernathy	Longview	3rd	USFWS	fc(sc,co,sh)	Yes	1959	NMFS, USFWS
Beaver Creek	Cathlamet	3rd	WDG	sh, src	Yes	1958	NMFS
Carson	Carson	4th	USFWS	sc, co(fc,sh)	Yes	1932	NMFS, USFWS
Elokomin	Cathlamet	3rd	WDF	fc, co (ch)	Yes	1954	NMFS
Grays River	Grays River	3rd	WDF	fc, co, ch	Yes	1961	NMFS
Kalama Falls	Kalama	3rd	WDF	fc, sc, co	Yes	1959	NMFS
Klickitat	Glenwood	4th	WDF	fc, sc, co	Yes	1950	NMFS
Little White Salmon	Cook	4th	USFWS	fc, sc, co(ch)	Yes	1898	NMFS, USFWS
Willard	Cook	4th	USFWS	co (fc, sc)	Yes	1951	NMFS, USFWS
Skamania	Washougal	4th	WDG	sh (fc)	Yes	1956	NMFS
Spring Creek	Underwood	4th	USFWS	fc (co)	Yes	1901	NMFS, CE, USFWS
Toutle	Toutle	3rd	WDF	fc, sc, co	No	1952	NMFS
Washougal	Washougal	4th	WDF	fc, co (ce)	Yes	1958	NMFS
Rearing Ponds							
Ringold Salmon	Ringold	5th	WDF	fc, sc, co	Yes	1962	NMFS
Ringold Trout	Ringold	5th	WDG	sh	Yes	1962	NMFS

1/ USFWS-U.S. Fish and Wildlife Service, NMFS-National Marine Fisheries Service, WDF-Washington Department of Fisheries, WDG-Washington Department of Game, CE-U.S. Army Corps of Engineers

2/ fc-fall chinook salmon, sc-spring chinook salmon, co-coho salmon, ch-chum salmon, ce-cherry (masu) salmon, sh-steelhead trout, src-sea run cutthroat

Table 3.--Columbia River Fisheries Development Program - Columbia Basin -- Oregon

Facility	General Location	Congressional District	Operating Agency 1/	Species Reared 1960-81	Anadromous Releases 1981	Year Anadromous Operation Began	Funding Agency 1/
Hatcheries							
Big Creek	Knappa	1st	ODFW	fc, co, sh(ch)	Yes	1938	NMFS
Bonneville	Bonneville	3rd	ODFW	fc, co (sh)	Yes	1909	NMFS, CE
Cascade	Cascade Locks	3rd	ODFW	fc,co (sc,ch)	Yes	1958	NMFS
Clackamas	Estacada	2nd	ODFW	sc	Yes	1979	ODFW, NMFS, PGE
Eagle Creek	Estacada	2nd	USFWS	sc,co,sh(fc)	Yes	1957	NMFS
Gnat Creek	Westport	1st	ODFW	sh (fc,sc,sh)	Yes	1960	NMFS
Klaskanine	Astoria	1st	ODFW	fc, co, sh	Yes	1911	NMFS
OxBow	Cascade Locks	2nd	ODFW	fc, sc (co)	Yes	1938	NMFS
Sandy	Sandy	2nd	ODFW	fc,co (sc,sh)	Yes	1950	NMFS

1/ ODFW-Oregon Department of Fish and Wildlife, USFWS-U.S. Fish and Wildlife Service, CE-U.S. Army Corps of Engineers, PGE-Portland General Electric

2/ fc-fall chinook salmon, sc-spring chinook salmon, smc-summer chinook salmon, co-coho salmon, sh-steelhead trout

Table 4. -- Satellite Rearing and Acclimation Facilities Operated by Each Agency

Agency	Hatchery	Satellite
USFWS	Spring Creek	Big White Salmon Pond
ODFW	Gnat Creek	Trojan Ponds
	Oxbow	Wahkeena Pond
		Herman Creek Ponds
WDG	Skamania	Vancouver Pond
		Gobar Pond
	Beaver Creek	Alder Creek Pond
		Coweeman River Net Pen
		Toutle River Trap
		Coal Creek Cooperative
WDF	Kalama Falls	Lower Kalama Hatchery
		Gobar Pond
	Grays River	Weyco Pond

Table 5. -- Releases of Salmonids in Numbers and Pounds from Columbia River Development Program Funded Rearing Facilities, 1960-85. Releases do not include chum salmon or cutthroat trout.

Year	Fall Chinook[1]		Spring Chinook		Coho		Steelhead		Totals	
	Numbers (millions)	Pounds (10,000s)	Numbers (millions)	Pounds (10,000s)	Numbers (millions)	Pounds (10,000s)	Numbers (millions)	Pounds (10,000s)	Numbers (millions)	Pounds (10,000s)
1960	89.1	33.0	1.8	6.0	6.4	21.7	1.0	13.6	98.3	74.3
1961	46.6	30.6	0.8	3.0	14.2	50.7	0.9	10.8	62.5	95.1
1962	55.8	28.3	1.7	5.8	12.9	57.2	1.6	13.9	72.0	105.2
1963	58.8	32.6	2.4	8.5	19.6	75.7	1.4	13.8	82.2	130.6
1964	65.5	40.7	7.6	22.1	16.5	77.5	1.7	23.3	91.3	163.6
1965	56.2	37.0	3.0	10.2	17.9	85.4	1.9	24.8	79.0	175.4
1966	54.9	48.9	3.8	11.2	19.7	103.2	2.5	30.8	80.9	194.1
1967	55.1	49.8	5.5	17.8	20.2	100.0	2.3	28.8	83.1	196.4
1968	55.5	59.5	3.8	16.7	15.7	86.7	3.0	32.5	78.0	195.4
1969	57.9	57.4	3.5	16.5	18.6	110.4	2.3	26.9	82.3	211.2
1970	62.2	69.0	2.6	14.8	17.4	99.7	2.9	45.5	85.1	229.0
1971	63.3	48.3	3.8	23.9	21.3	120.7	2.4	30.8	90.8	223.7
1972	67.1	72.2	3.6	25.3	23.9	152.1	2.5	37.1	97.1	286.7
1973	70.4	83.2	4.8	40.1	20.9	119.7	2.5	41.3	98.6	284.3
1974	65.5	88.8	4.4	26.9	20.2	117.7	2.3	33.2	92.4	266.6
1975	67.3	87.8	5.2	32.7	21.1	138.3	1.9	29.4	95.5	288.2
1976	84.0	114.9	5.9	48.0	22.2	132.6	2.1	33.0	114.2	328.5
1977	95.0	103.4	5.1	37.2	26.3	155.6	2.2	35.4	128.6	331.6
1978	89.3	116.2	5.5[2]	40.9	26.3	165.8	2.4	39.9	123.5	362.8
1979	89.1	119.1	7.5[2]	60.6	21.1	113.3	2.4	38.6	120.1	331.6
1980	80.1	113.3	7.2[2]	51.2	20.8	124.0	2.2	33.0	110.3	321.5
1981	73.3	106.3	7.6	52.1	19.2	112.2	2.3	38.0	102.4	308.6
1982	78.6	110.7	7.3	62.4	17.4	97.8	2.1	35.2	105.4	306.1
1983	74.5	116.9	6.9	46.6	21.7	107.5	2.1	33.1	105.2	304.1
1984	72.4	112.8	8.7	62.3	22.3	128.3	3.3	41.4	106.7	344.8
1985	57.5	94.5	7.7	51.5	30.7	119.9	2.4	37.6	98.3	303.5

1/ From 1972 on, part of the funds to operate the fall chinook program was supplied by outside sources such as the U.S. Army Corps of Engineers.

2/ Includes a small number of summer chinook reared at Program facilities.

reared more than one year and are released the second spring after hatching. Fall chinook and chum salmon are usually released the first spring after they are hatched. Appendix Table 9 lists potential egg incubation capacity and 1986 production goal for each CRFDP facility.

The 1985 release is estimated to cost an average of $1.81, $2.27, $3.10, and $4.34 per pound for WDF, ODFW, WDG, and USFWS hatcheries, respectively. The pounds produced per full-time equivalent (FTE) employment averaged 32,800, 25,200, 16,950, and 14,550 pounds for WDF, ODFW, WDG, and USFWS facilities, respectively. These figures are based on operation and maintenance costs and do not include any capital spending. Also, costs were assumed to equal money provided in the FY 1985 contracts for each facility. Production figures used are actual released for 1985 and do not take into account major fish losses experienced this year. Appendix tables 10, 11, 12, and 13 detail the costs for each facility and agency.

Juvenile releases were reduced from 1984. The major factor accounting for the reduction was that adult fall chinook escapement during 1984 was insufficient to supply needed eggs for the 1985 releases.

Three major fish losses at the rearing facilities also reduced juvenile numbers. The first loss occurred at the USFWS's Spring Creek hatchery when an outbreak of Bacterial Gill Disease resulted in loss of approximately two million fall chinook and early release of an additional 14 million which were in questionable health. At release these fish were suffering large daily mortalities.

The second loss took place at WDG's Skamania hatchery when a power outage combined with human error caused a loss of water to the rearing ponds. Two water level alarms malfunctioned resulting in a loss of 470,000 steelhead.

The third loss occurred at ODFW's Klaskanine hatchery where 150,000 coho salmon smolts perished. Low flows and warmer than usual water temperatures caused depletion of the oxygen supply in a portion of a holding pond. An additional 1.3 million coho smolts were released early when the problem was

discovered. Steps have been taken to minimize and hopefully eliminate future fish losses by reviewing pond loading densities and upgrading alarm equipment.

Adult and jack returns to CRFDP facilities totaled 162,336 fish (Table 6, Appendix Tables 14, 15, 16, 17). Spring chinook, fall chinook, coho, steelhead, sea-run cutthroat, and chum recoveries were 8,109, 47,921, 97,781, 7,467, 994, and 64, respectively. In cases where surplus adults are recovered, they may be sold and the procedes credited to the CRFDP. Biological sampling for various bacterial and viral diseases commonly occurs during spawning operations (Figures 7 and 8). Program-funded facilities also attract increased numbers of the public during spawning season. Tours from nearby schools provide opportunities to educate youngsters on the value of this natural resource (Figure 9).

Table 6. Adult and Jack Returns to Columbia River Fisheries Development Program Funded Hatcheries in 1985.

	Fall Chinook		Spring Chinook	Coho	Chum	Steelhead	Cutthroat	Total
	URB	Tule						
ODFW	2,930	19,912	944	58,357	64	1,230	194	83,631
WDF	954	15,294	348	22,467				39,063
WDG						4,949	800	5,749
USFWS	853	7,978	6,817	16,957		1,288		33,893
TOTAL	4,737	43,184	8,109	97,781	64	7,467	994	162,336

Funds were provided to initiate major rehabilitation and construction at WDF's Klickitat Hatchery late in the fiscal year. New raceways, water dissipation building, and a freezer storage unit were built this year (Figure 10). The facilities existing prior to improvement were crumbling beyond repair. All improvements are to be completed early in 1986.

Figure 7. - Spawning coho salmon at the Washington Department of Fisheries Washougal Hatchery.

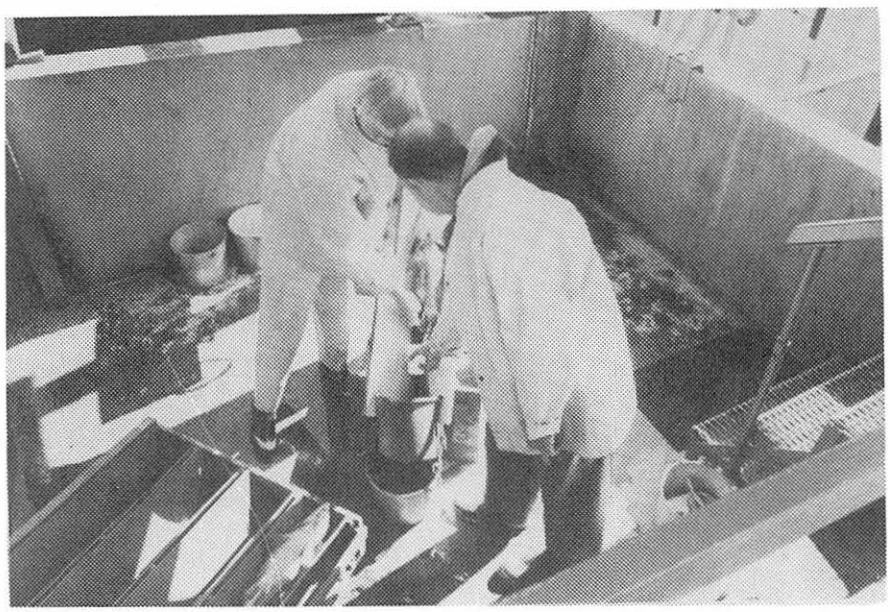


Figure 8. - Collecting ovarian fluid for various bacterial and viral tests.

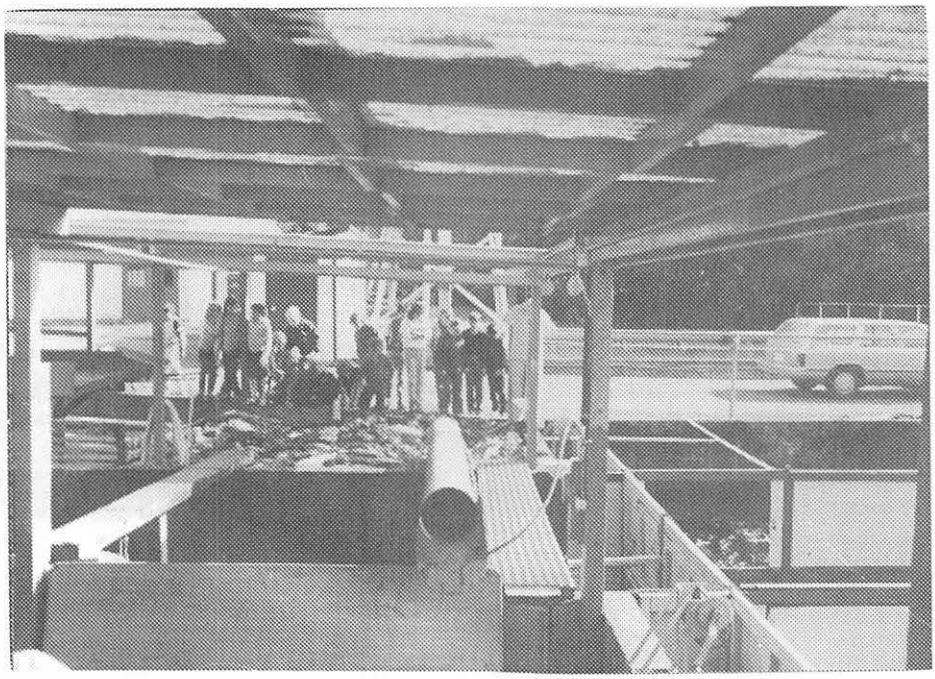
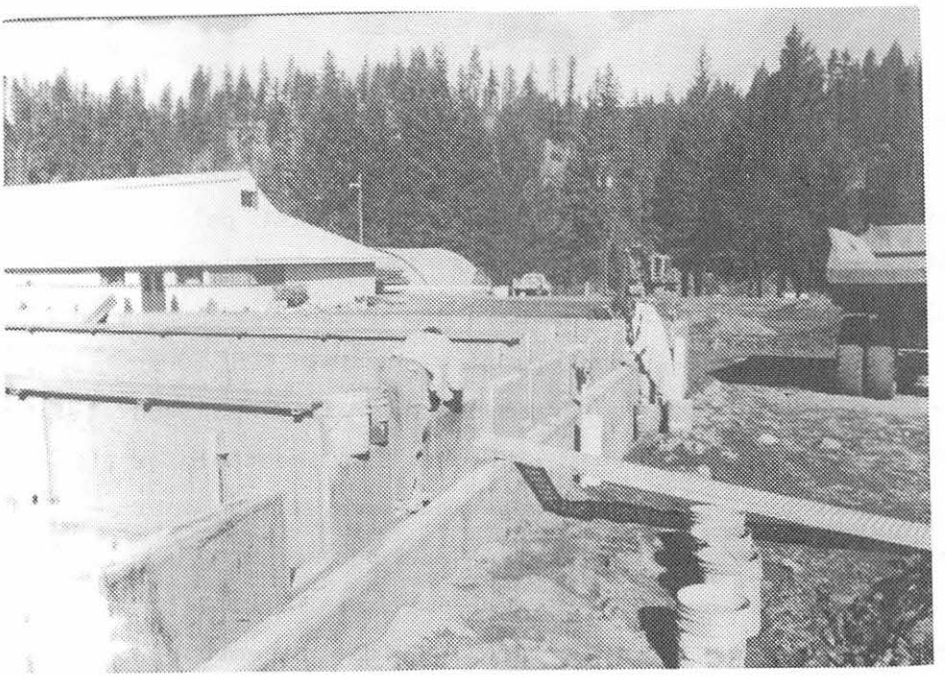


Figure 9. - Tour from nearby school viewing spawning operations at the U.S. Fish and Wildlife Service's Abernathy Salmon Cultural Development Center.



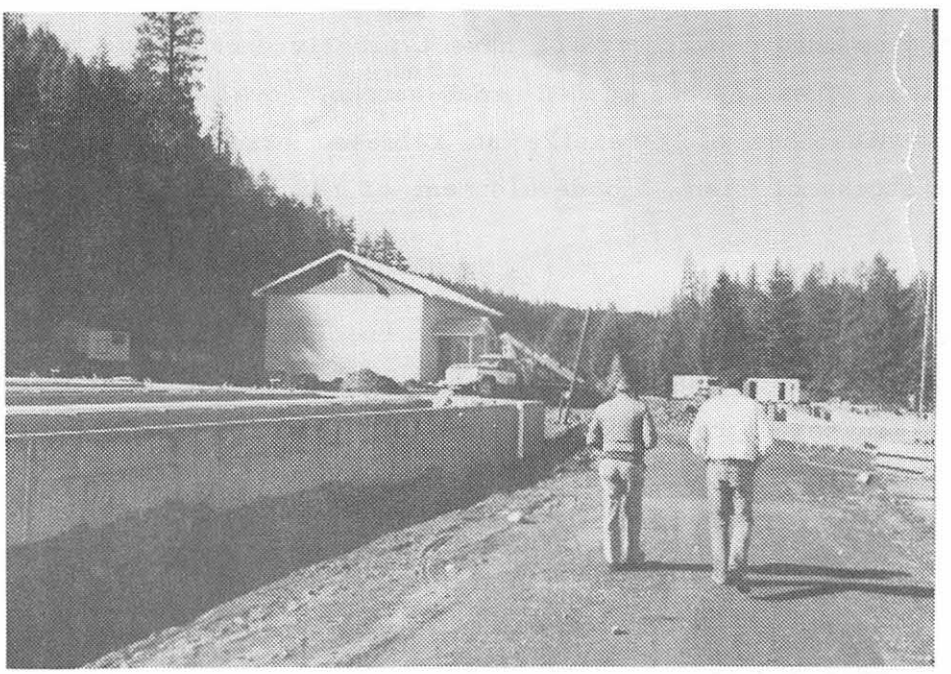


Figure 10. - Construction of new raceways (top photo) and energy dissipation building (bottom photo) at the Washington Department of Fisheries Klickitat Hatchery.

STUDIES

Since its creation, the CRFDP has assumed a lead role in protecting the anadromous resource and enhancing fish culture. CRFDP studies have resulted in major advancements in fish culture. Oregon moist pellets (OMP) and Abernathy dry diets were developed with CRFDP funding and support. Both diets are currently in wide use and represented a tremendous improvement over prior diets. A second major development included two methods of mass marking juvenile fish. The first, a terramycin mark, is deposited on fishes bones when fed food coated with this drug. The drug is detectable as a fluorescent yellow ring when bones are viewed in a special wave length fluorescent light under a microscope. This method is limited in its use to studies that are based on returns to hatcheries. The second method included the development of a prototype of the coded-wire tag (CWT). This research served as a foundation for the development of the tags which are currently in use world-wide. The tag itself is only 0.042 inch long and contains information on its surface in the form of binary notches.

Studies funded by the CRFDP have typically encompassed a wide spectrum of activities. These have included broad hatchery evaluations using fin-marks and CWT's, evaluations of time/size at release, assessments of performance for various stocks of fish, and development of new techniques for use in salmonid culture.

Several studies were supported by the CRFDP this year, the majority of which are conducted by the cooperating agencies. The objective of these studies is to improve the quality of juvenile fish and improve adult contribution to the various fisheries.

Washington Department of Fisheries (WDF)

The WDF investigated three areas of salmon culture this year. The first study dealt with quantification and evaluation of volitional release strategies for yearling coho. 1985 was the first year of a three-year study using electronic counters to enumerate and obtain migration timing for volitional

releases. This study allows the fish to determine their readiness to migrate as opposed to forced releases. Four hatcheries participated; Grays River, Kalama Falls, Elokomin, and Klickitat. Grays River and Kalama Falls were used because coho are normally released from several identical ponds, thus providing control and experimental tagged releases. Elokomin and Klickitat hatcheries were chosen because they release large numbers of coho from a single pond and could release fish for an extended period of time (8-12 weeks). Preliminary information showed that average size of actively migrating fish was larger than the average size remaining in volitional release ponds. Periods of peak migration seem to be cyclic and are similar between hatcheries that are many miles from each other (Klickitat and Elokomin). Tag returns from adult fish should become available in 1987 or 1988.

The second investigation included ongoing incubation studies and focused on improving fry quality. An experimental egg grader was used to separate eggs from a common spawning at Grays River Hatchery into two distinct size groups, large and small. Fry originating from large eggs were significantly larger at ponding than fry from small eggs. The size difference was maintained for approximately 25 days of rearing. After 25 days fry from small eggs attained the same size as fry from larger eggs.

The third study investigated alternative release strategies for fall chinook at Grays River and Washougal hatcheries. This was the third of four years of marking. At Washougal, fall releases of CWT fall chinook were made in September, October, and November and at Grays River a September release was made. A CWT control was released in June (normal release time) at both hatcheries. An additional group of Grays River fall chinook were tagged and then transferred to Washougal Hatchery for subsequent rearing and release in June. This tagged group was part of a transport study to determine if Grays River fall chinook survival could be increased by releasing them into a non-natal stream. Preliminary results should become available in 1987 or 1988.

Marked returns from the 1980-1983 brood coho density study are being summarized. Preliminary information seems to indicate that the heaviest loaded ponds produced the most fish. Evidence also seems to indicate that reduced

pond loading increases survival although the relationship is not linear and survival is not increased significantly. Further results should become available in 1986-87.

Washington Department of Game (WDG)

The WDG conducted two studies this year, one an ongoing study of Kalama River Steelhead and the other a hatchery stock characteristics study.

A comprehensive computer-assisted analysis and summarization of Kalama River steelhead data took place this year. Reports are expected shortly summarizing this large body of information collected over the years. A successful method has been developed under this investigation which utilizes a genetic mark to identify different groups of fish. This was accomplished by selectively breeding fish at Skamania Hatchery that had certain genotypes which do not occur or which occur in small numbers in native fish in the Kalama River system. By examining genotypes of wild steelhead in the Kalama River, it has been possible to distinguish hatchery-reared steelhead from wild steelhead. This technique, involving electrophoresis has shown to be an effective identification tool and is in use in other areas with other studies.

The hatchery stock characteristics study is a new investigation began this year. Present and historical stock characteristics at Skamania and Beaver Creek hatcheries were evaluated. Factors evaluated were age composition, run timing, smolt-to-adult survival, genetic variability, smolt quality, and disease history. Skamania summer-run steelhead adults returning to the hatchery were found to have trends of increasing mean length, older age structure, decreased proportion of males, and earlier spawn timing. Size at release was found to be the most important variable in predicting percent return to the hatchery. The "high grade" three-salt returning adults were found to have a lower overall percent return. Early returning and regular returning adults had similar stock characteristics. The Beaver Creek winter steelhead adult return and spawn timing were found to have moved earlier with respect to time. Releasing juveniles greater than six fish per pound had little influence on percent return of adults to the hatchery.

Based on the above summarized information, future investigations will be recommended to attempt to increase adult contribution to the various fisheries. For more information refer to Randolph (1986).

Idaho Department of Fish and Game (IDFG)

Idaho conducted two ongoing studies this year. The first is titled Clearwater River Development of Spring Chinook and Steelhead Stocks. The objective is to restore the Clearwater drainage chinook and steelhead runs to self-sustaining and fishable populations. This program has been in existence since 1961. The old Washington Water Power Dam located near Lewiston, Idaho was a primary factor in the depressed runs and in 1972 this dam was removed. Adult fish are collected, eggs taken, and eyed eggs and smolts planted in hatching channels or rearing ponds in the Selway and South Fork Clearwater rivers.

The second investigation involves attempting to bolster the remnant population of sockeye salmon returning to several lakes in the upper Salmon River drainage with stocks obtained from Fulton River, British Columbia. Historically, Idaho's Salmon River drainage had large runs of sockeye. The Payette River system alone had a run in excess of 100,000 fish and Redfish Lake was named for its sockeye runs. Sunbeam Dam on the Salmon River and Black Canyon Dam on the Payette River blocked these runs during the early 1900's. Sunbeam Dam was later removed but was in place long enough to reduce the sockeye runs to a few pair since that time. Beginning in 1980, sockeye eggs have been obtained from the Government of Canada, transported to Idaho for rearing, and released. In 1985, no eggs were available from Canada. Two female sockeye were trapped and 13,000 eggs obtained from native Idaho stock. Approximately 1,000 fingerlings were produced and released into Stanley Lake from those eggs.

Oregon Department of Fish and Wildlife (ODFW)

The ODFW has experimented with different diets in recent years. This

season, Sandy and Bonneville hatcheries field tested a closed formula moist diet. Preliminary results indicated adult survival may be higher for coho with this diet but more information is needed. ODFW also conducted unannounced quality control inspections of the feed manufacturing plant. Ingredients were sampled, formulations checked, conditions examined, and samples taken to ensure feed quality is maintained.

The ODFW is continuing work on a final report of the Columbia River coho salmon time of release experiment. In that study, yearling coho salmon were released in early May, June, and July of 1979, 1980, and 1981. Preliminary results have been reported (Westgate 1979, 1980, 1981, 1982, 1983). Those results indicated a substantial increase in adult coho salmon survival occurred when yearlings were released in June and July as compared to May each year the study was conducted.

A primary need of fish culturists continues to be the establishment of optimum population levels of fish reared within hatcheries. The goal is to formulate rearing programs specific to the species and rearing conditions found at each hatchery. Water flow, temperature, and fish size are major factors that limit allowable loads of rearing ponds.

Fish health at the various hatcheries were routinely monitored throughout the rearing cycle. Results from 170 examinations of juvenile salmonids indicate low temperature disease (LTD), bacterial kidney disease (BKD), and external fungus were the most prevalent diseases encountered. Examinations in 1983 and 1984 were the same. Treatments with various drugs were used to control these diseases.

U.S. Fish and Wildlife Service (USFWS)

The USFWS continued two density studies, one for spring chinook at Carson NFH and one for Willard coho. The Carson NFH study is designed to rear spring chinook in raceways at three densities (fish per cubic foot of water) and three levels of loading (pounds of fish per gallon per minute). The 1985 release (1983 brood) was the second year of a planned four years of tagged releases.

Although all information is preliminary, several observations have been made: (1) BKD-related mortality was significantly higher in high density-low inflow raceways, (2) gill NA, K-ATPase (enzyme indicator of smolting) at time of release was reduced in fish reared at highest density and lowest water inflow rate, and (3) fish reared in lowest density/highest water inflow were better able to control their blood sodium concentrations when challenged to 27 ppt saltwater for 24 hours (Abernathy 1985). Effects on overall survival will be evaluated when tagged adults are recovered from sport and commercial fisheries and hatchery rack beginning in 1986.

The Willard coho density investigation was limited to recovering and analyzing tagged adults in the various fisheries and at the Little White Salmon NFH. A summary of the 1984 tagged hatchery returns can be found in Abernathy (1984).

Additional studies conducted by the Abernathy Salmon Culture Technology Center staff and supported by the CRFDP include:

1. Investigating causative agents responsible for egg mortality at Spring Creek NFH.

2. Investigating the relationship of nutrition vs. osmoregulation and parr/smolt transformation in salmon.

3. Investigating the relationship of microtagging on fish quality.

STREAM IMPROVEMENTS

A major emphasis in the early years of the program to increase the abundance of salmonids was the construction of fishways and the removal or modification of both natural and man-made barriers affecting fish migration. These activities were authorized and directed by Section 2 of the amended Mitchell Act. To date, approximately two thousand miles of prime rearing and spawning habitat formerly inaccessible to returning adult fish have been opened

Table 7. -Fish Ladders or Ladder Complexes Operated Under the Columbia River Fishery Development Program.

Agency	Ladder	Location
ODFW *	Barth Falls	NF Klaskanine River
	Bonnie Falls	NF Scappoose Creek
	City of Lostine Dam	Lostine River
	Clatskanie Falls	Clatskanie River
	Elkhorn Falls	Little North Santiam River
	Fifteenmile Creek Falls	Fifteenmile Creek
	Goble Creek Falls	Goble Creek
	Minam River Falls	Minam River
	Oregon Iron & Steel Dam	Tualatin River
	Pegleg Falls	Callawash River
	Punchbowl Falls	WF Hood River
	Sheepridge Dam	Lostine River
	Threemile Dam	Umatilla River
	Wiley Creek Falls	Santiam River
	Willamette Falls	Willamette River
WDF **	Cameron	Abernathy Creek
	Casteel	Klickitat River
	Cedar Creek	Lewis River
	Delimeter	Cowlitz River
	Johnson	Lewis River
	Kalama Falls	Kalama River
	Klickitat #2	Klickitat River
	Klickitat #5	Klickitat River
	Little Kalama	Kalama River
	Ostrander	Cowlitz
	Shippard Falls	Wind River
	Trout	Wind River
	Washougal	Washougal River
	Winkler	Washougal River
IDFG	Middle Fork	Middle Fork Salmon River
	Selway	Selway River

* Also operates "rock cut fish passes" on the Yamhill, Willamina, Molalla, Santiam, and Mohawk rivers.

** Also operates several informal ladders on lower Columbia River tributaries.

up. Current stream clearance work consists primarily of yearly surveys by state fish and wildlife departments. These surveys detect and allow removal of obstructions before they cause major fish passage problems. In addition, fish ladders are maintained to assure proper operation.

The three state agencies, ODFW, WDF, and IDFG, currently operate 31 fish ladders or fish ladder complexes in the basin. The ODFW, WDF, and IDFG operate 15, 14, and 2 ladders, respectively (Table 7). In addition, Oregon has rock cut fish passes that require no formal operation but only periodic inspection (Table 8). The WDF also operates several informal ladders in the lower Columbia River tributaries. The size and complexity of fishways and ladders vary from simple rock cut passes a few feet in height to the large and complex Willamette Falls fish ladder which opened up the entire Willamette River above Oregon City to anadromous salmonids (Figures 11 and 12).

Table 8. - Rock Cut Fish Passes Operated Under the Columbia River Fishery Development Program by Oregon Department of Fish and Wildlife

Name	Location	Year Completed
Agency Creek No. 1	Yamhill River	1962
Agency Creek No. 2	Yamhill River	1962
Agency Creek No. 3	Yamhill River	1962
Butte Falls No. 3	Pudding Creek	1963
Butte Falls No. 4	Pudding Creek	1963
Coast Creek	Luckiamute River	1962
Nate Creek	Milk Creek (Willamette R.)	1961
Wiley Creek No. 3	Santiam River	1958
Wiley Creek No. 5	Santiam River	1967
Hard Rock Falls	Santiam River	1963
Mohawk Falls	Mohawk River	1962

IRRIGATION SCREENS

The CRFDP involvement in screening irrigation diversions began in the early to mid-1950's. The initial task in developing a screen program was to identify and describe the need for one. To define the problem, the CRFDP

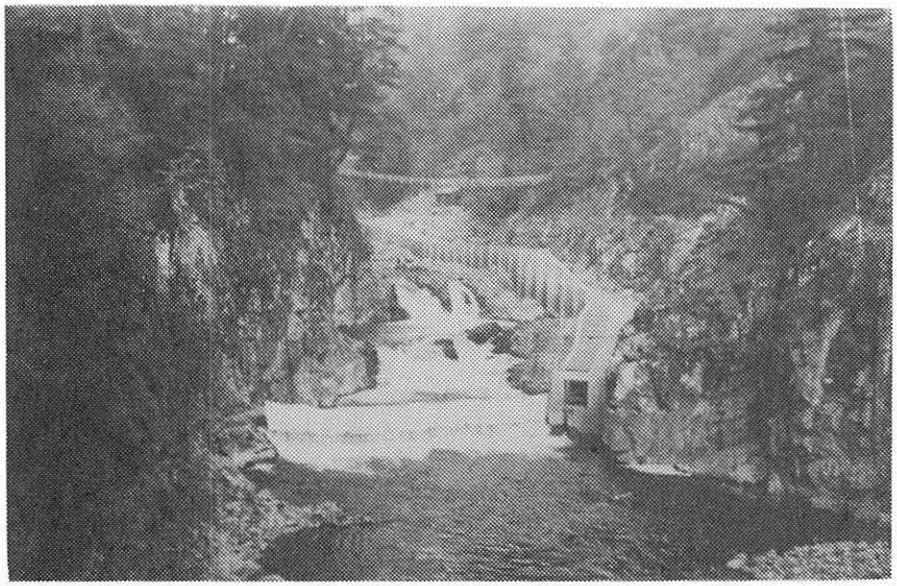


Figure 11. - Shipperd Falls fishway constructed under the Columbia River Fisheries Development Program is located on the Wind River in Washington.

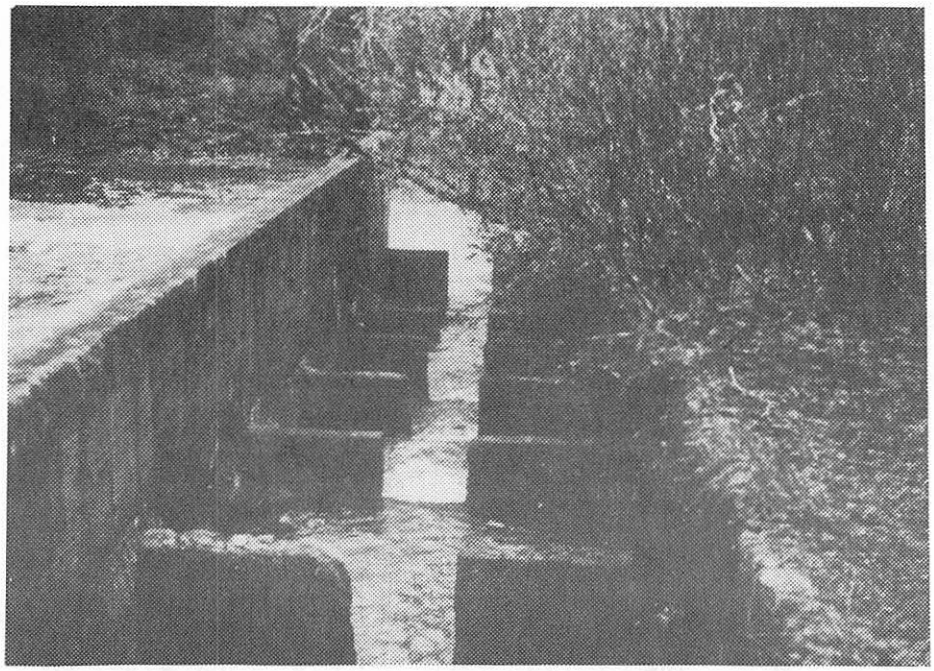


Figure 12. - Clatskanie Falls fishway constructed under the Columbia River Fisheries Development Program is located in Oregon.

initiated watershed surveys of the mid-Columbia and Snake rivers and their tributaries in the 1950's. The resulting sub-basin reports located and enumerated most unscreened irrigation diversions in the target watersheds. The reports described serious problems needing corrective action. Construction began in the mid-1950's and has continued to some extent into the 1980's.

Since the CRFDP began, over 700 screens have been constructed in Oregon, Idaho, and Washington. Oregon and Idaho have constructed 500+ and 236 screens, respectively. Due to variations in the number of diversions used each year, Oregon and Idaho operate approximately 380 and 200 screens, respectively. Washington currently operates 16 screens with program funding.

Due to varying ditch sizes, orientations, and capacities, the screens can vary from simple fixed plate to multi-drum screens (Figures 13 and 14). Oregon and Washington operate primarily drum screens. Idaho originally installed perforated plate wiper blade screens but are in the process of converting to drum screens. They have the manpower to convert 4-5 screens to drums per year.

A typical irrigation diversion consists of a temporary rock-log wing dam extending upstream and across the river, although permanent concrete structures requiring adult fish passage facilities are also used. The angle at which the diversion leaves the river can vary from a few degrees to 90 degrees. The diverted water in many cases passes through a headgate structure used to regulate flow. The water and fish move down the canal, through a trash rack and water passes through the screen; the fish are deflected by the screen into a bypass pipe which transports them back to the river downstream of the wing dam. Diversion flows range in size from less than one cubic feet per second (cfs) to well over 100 cfs. In general, Oregon has much smaller diversions than Idaho or Washington. In some cases, diversions totally dewater a stream, causing migration problems to both juvenile and adult migrants. Without adequate screening and bypass facilities, juvenile fish would end up in ranchers' fields or be left stranded in the irrigation canal at the end of the season.

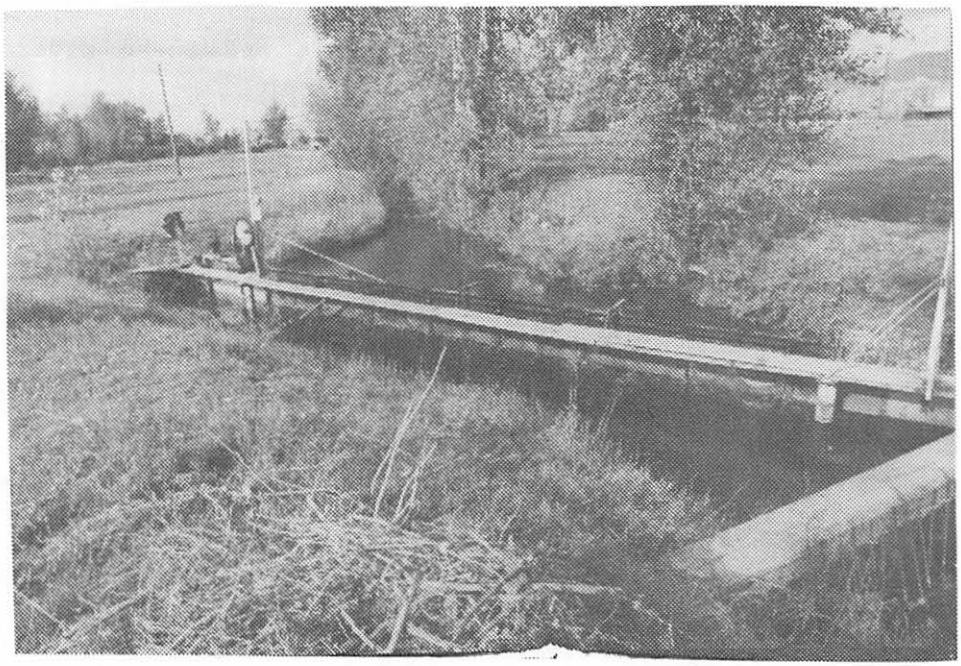


Figure 13. - Typical fixed plate irrigation diversion screen constructed under the Columbia River Fisheries Development Program in Idaho.

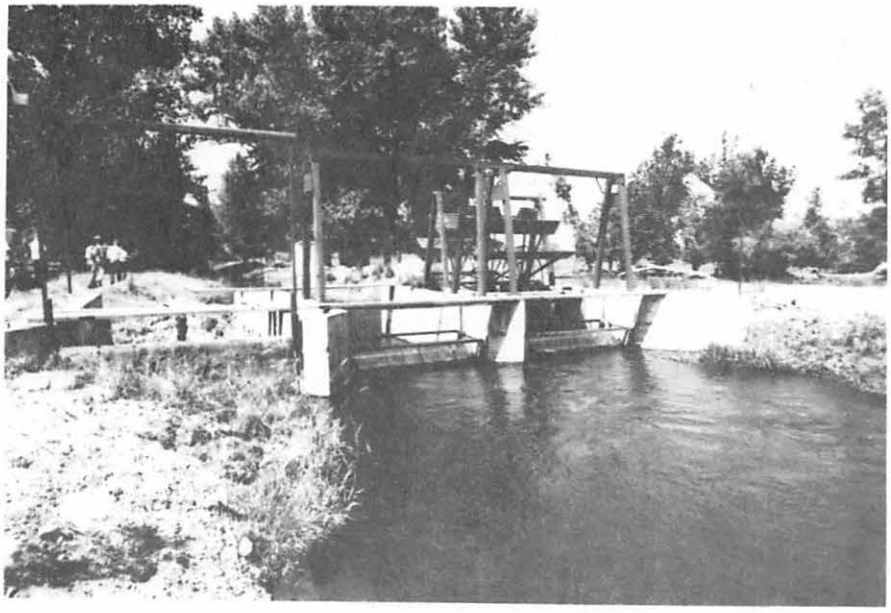


Figure 14. - Typical paddle-wheel driven drum screen constructed under the Columbia River Fisheries Development Program in Oregon and Idaho.

Over 700 diversions in the basin have been screened with CRFDP funds. There remain significant numbers of ditches unscreened in certain watersheds. The Walla Walla River in Oregon may have over 30 unscreened diversions. The Imnaha, Wallowa, Grande Ronde, and Umatilla rivers, all in Oregon, have unscreened ditches. Recognizing a potential problem, the CRFDP sponsored an ODFW study to identify and inventory all irrigation screen problems and requirements for correction in northeastern Oregon in 1985. Beginning in 1986, those unscreened diversions identified will have screens installed. It is expected to take 5 to 7 years with available resources before all identified diversions are screened.

There also remain several unscreened diversions in the Sawtooth National Recreation Area on the upper Salmon River in Idaho. The Idaho diversions have been identified and will be screened in the future. To obtain additional information concerning the screen program, refer to Delarm et al. (1985).

OPERATIONS BRANCH

Early in 1984 the ETSD was reorganized (Figure 3). Prior to that time the ETSD was divided into three sub-divisions; the CRFDP, the Fish Facilities Branch (engineering), and the Environmental Assessment Branch. The ETSD is currently divided into two branches - Operations and Habitat Conservation with the CRFDP continuing to be managed separately by the ETSD, but is closely associated with the Operations Branch.

Fall Chinook Hatchery Evaluation

The Bonneville Power Administration (BPA) began funding an 8-year study in 1979 to determine distribution, contribution, and value of fall chinook salmon reared at Columbia River hatcheries. FY 1985 was the seventh year of the study. Information from this tagging study will provide data to determine the effectiveness of hatcheries constructed as mitigation for hydroelectric developments. In addition, these data will aid fishery agencies in planning further measures to protect, mitigate, and enhance salmon runs on the Columbia River. This information is important to regulating bodies, such as the Pacific

Fishery Management Council, charged with negotiating, setting, and adjusting fishing seasons, locations, and limits. Current regulations are based on data from a fin-marking study completed over ten years ago. Since completion of that study, new rearing facilities have been built, existing facilities renovated, alterations in sport and commercial fisheries have occurred, and hatchery practices have changed.

The objectives of the study are to (1) determine the contribution of hatchery fall chinook from Columbia River hatcheries to individual Pacific salmon fisheries by age class of fish and (2) determine the distribution, contribution, and value of each hatchery's production of fall chinook to Pacific coast salmon fisheries.

The desired goal to achieve objective 1 was to tag a constant percentage of fish at each rearing facility. A goal of tagging at least 150,000 fish at each facility was set to achieve objective 2. Attempts were made to meet both goals at each hatchery. This required additional tag codes at some hatcheries because the number of fish tagged for the constant percentage was insufficient to meet the 150,000 goal.

Nearly 14 million tagged fall chinook were released from the participating facilities during the four brood years. Releases were 4,035,100, 2,864,700, 3,466,400, and 3,475,500 for the 1978-through-1981 brood years, respectively. The percentage of the releases tagged each year was 4.4, 3.5, 3.9, and 4.1 for the four broods, respectively. Total yearly releases ranged from 81 million to 92 million from the participating facilities.

Sport and commercial fisheries from Alaska through California are being sampled for wire-tagged salmonids (Figure 15). Recoveries of the 1978 brood began in 1980. Fishery recoveries of the 1981 brood will not be complete until 1986.

Final estimated catch data are not yet available for any complete brood of fall chinook marked for this study. Values are available through 1983 for Alaska, British Columbia, Washington, Oregon, and California fisheries. Fall

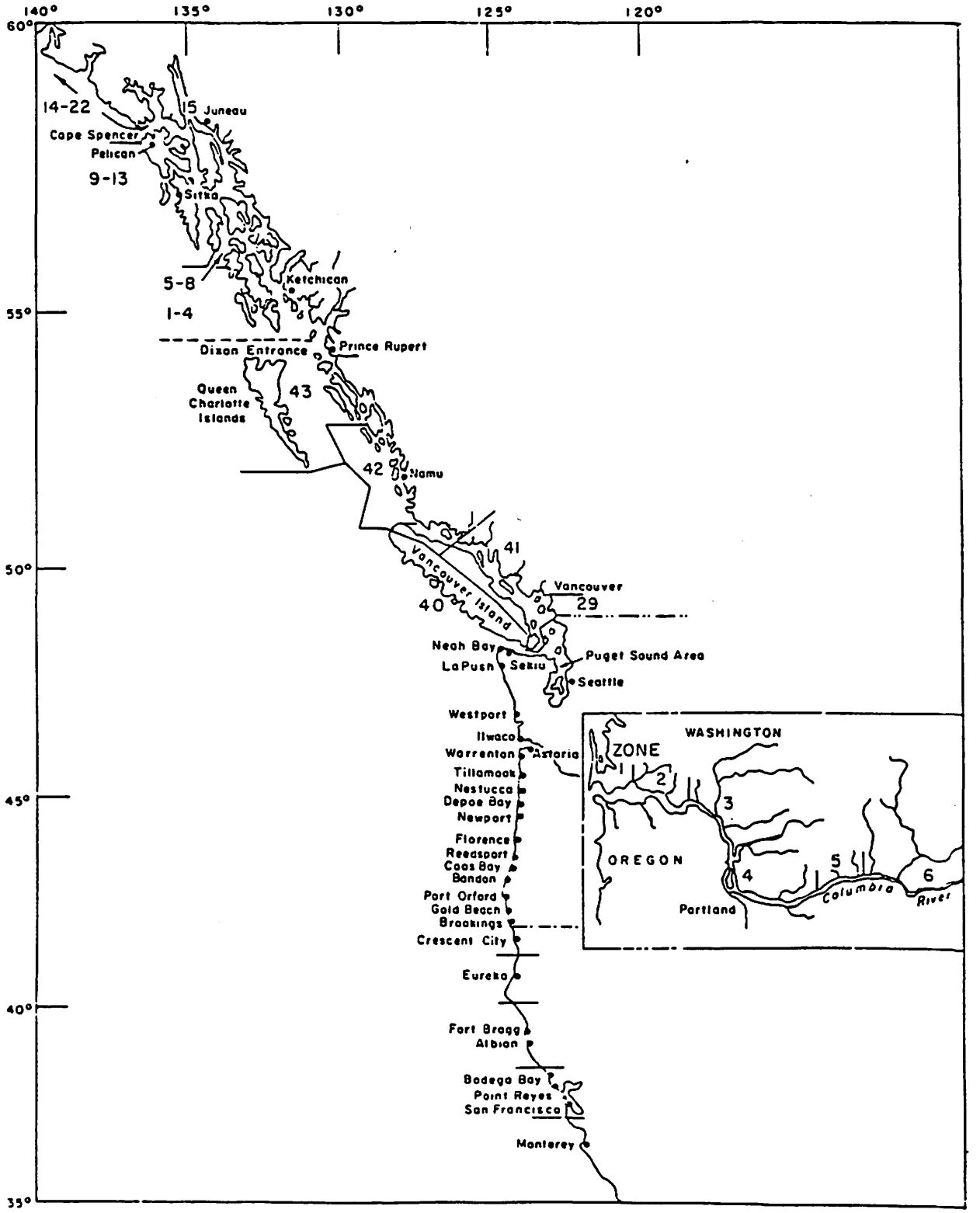


Figure 15. Ports and zones sampled for tagged fall chinook of Columbia River origin.

chinook from Columbia River hatcheries are predominantly recovered in these fisheries. Appendix Tables 18 and 19 show tagged releases and tag recovery statistics for the 1978 and 1979 broods. For more indepth information, see Vreeland (1985).

Transport Operations on the Snake and Columbia Rivers - 1985

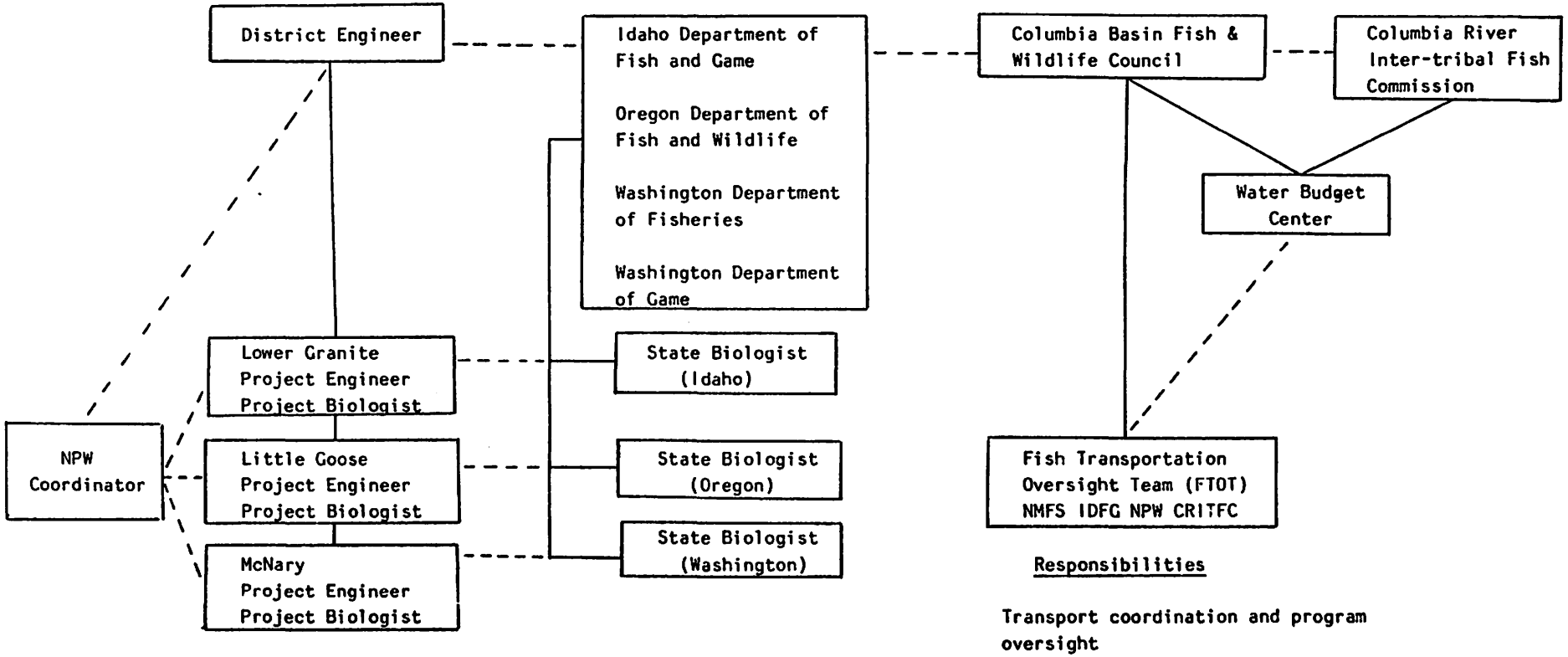
The Fish Transportation Oversight Team (FTOT) continued to manage the transport program and provided coordination between Walla Walla District, Corps of Engineers (NPW), fishery agencies, and tribes. The FTOT is composed of biologists from the National Marine Fisheries Service (NMFS), Idaho Department of Fish and Game (IDFG), Columbia River Inter-Tribal Fish Commission (CRITFC), and NPW. The IDFG member was chairman for the team. Line of authority and responsibilities for transporting salmonids is given in Figure 16.

The FTOT's goal is to maximize survival of Snake and Columbia River salmonids by improving collection, transport, and bypass conditions for juvenile migrants. Responsibilities include providing coordination; biological and program oversight, developing an annual work plan; conducting on-site inspections of collection and transport facilities prior to, during, and after the season; and producing an annual report summarizing transport activities. A meeting is hosted by FTOT each summer for program participants and other interested individuals to discuss current season's operation and recommend program and facility modifications for the following year.

Additional biological oversight is provided by cooperative agreements between NPW and the States of Idaho, Oregon, and Washington. Under these cooperative agreements NPW funds State fishery biologists at each transport project. Idaho's representatives were assigned to Lower Granite, Oregon's to Little Goose, and Washington's to McNary. Work loads were shared by NPW's project biologists and State biologists.

Juvenile salmonids were collected and transported from the Snake River at Lower Granite (River Mile (RM) 107.5) and Little Goose (RM 70.3) dams, and from the Columbia River at McNary Dam (RM 292). The Snake River, a major tributary

Figure 16 Line of authority and responsibilities for trapping and transportation of juvenile salmon and steelhead trout from collection points at Lower Granite, Little Goose, and McNary Lock and Dam projects to release sites below Bonneville Lock and Dam. Dotted line denotes line of communication and solid line is supervision.



Responsibilities

Maintenance of transportation, collection, bypass, and holding facilities and equipment

Operate and monitor collection and transportation equipment and facilities

Contract tug and tractor rental

Administer cooperative agreements and task orders for State biologists

Responsibilities

Inspection and quality control of collection and transportation equipment and facilities

Monitor fish sampling and handling

Monitor water quality and fish condition

Compile data and write progress reports

Responsibilities

Transport coordination and program oversight

Prepare annual work plan

Inspection and oversight of collection and transportation facilities and quality control

Identify and recommend changes needed in facilities and equipment or their operation

Assimilate data and write annual report

of the Columbia River, joins at RM 324.3. Collected smolts were transported below Bonneville Dam (RM 146.1) via truck or barge and released into the river. Transported smolts bypass 4 to 8 dams and 145 to 280 miles of impounded river (Figure 17).

The 1985 transport season commenced March 28 and ended on September 26. A total of 18,210,309 smolts were collected including 4,482,333 at Lower Granite, 2,270,618 at Little Goose, and 11,457,358 at McNary. Total collection included 3,107,164, 13,245, and 247,780, smolts bypassed at McNary, Lower Granite and Little Goose, respectively. Bypass operations began the first day of operation and ended on July 12, May 8, and June 6 at Little Goose, Lower Granite, and McNary, respectively.

A total of 14,787,592 juvenile salmonids were transported to below Bonneville, with Lower Granite accounting for 4,459,438, Little Goose 2,008,980, and McNary 8,319,174 (Table 9). Barge transport accounted for 14,238,382 and trucking for 549,175. Tables 10 and 11 compare number of fish transported for the years 1978 through 1984. For an indepth description of the 1985 transport operations, see Koski et al. (1986).

Bioengineering Group

The Bioengineering Group of the Operations Branch functions in those areas where application of engineering capability and behavioral expertise is necessary to protect or develop the fisheries resource. The primary areas include 1) the development and implementation of instream flow requirements for fish in concert with streamflow regulation resulting from flood control, irrigation and hydro power system operation; 2) the design and operation of fish passage, protection, and production facilities; and 3) review of proposed activities in habitat areas which require Federal permit or license. Efforts are directed toward protecting and improving passage conditions along migration routes and toward minimizing adverse effects of water resource development on natural spawning and rearing areas. Effort is also directed toward providing effective hatchery facilities for salmon and steelhead production.

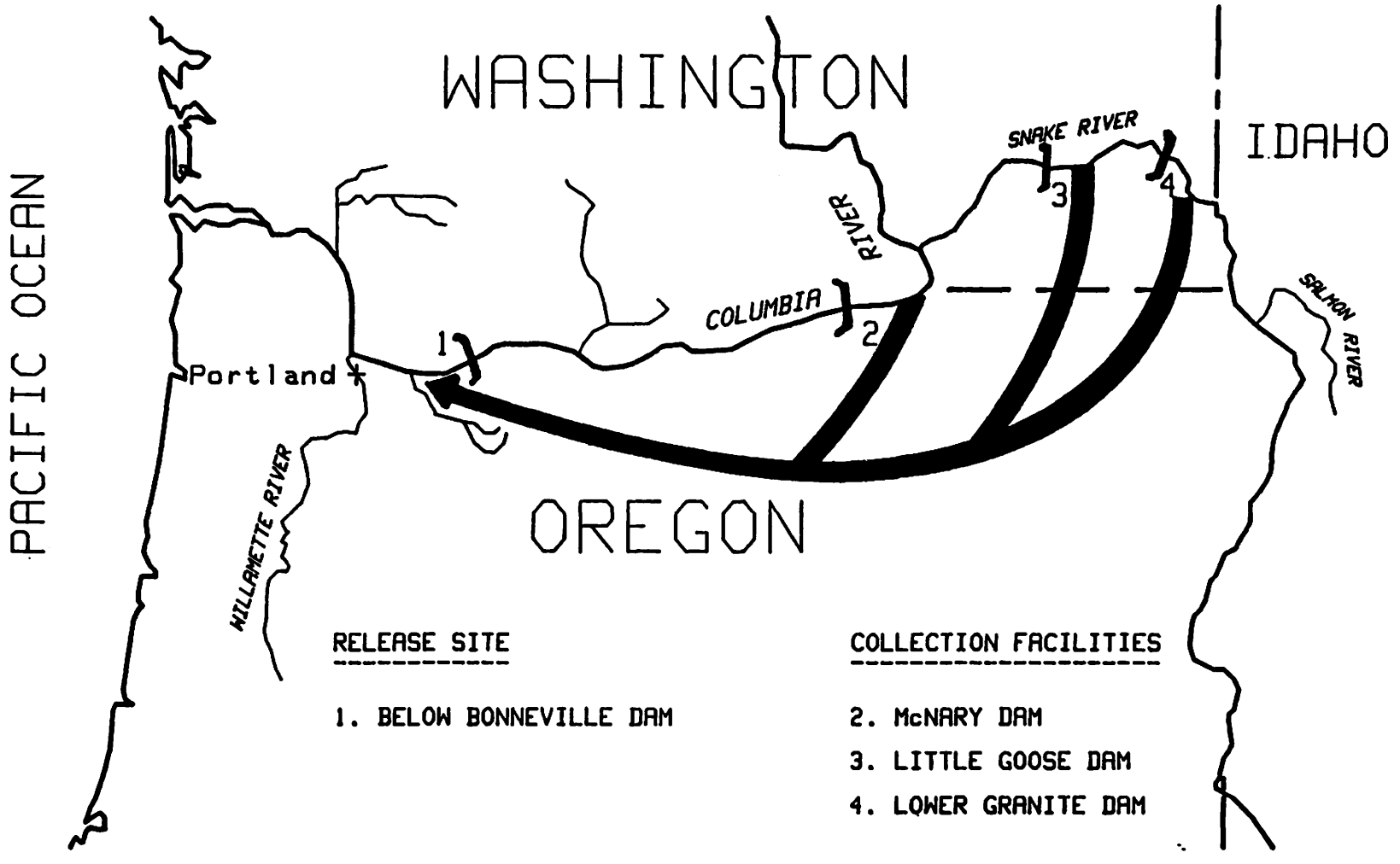


Figure 17 -- LOCATIONS OF FISH COLLECTION FACILITIES, TRANSPORTATION ROUTE, AND RELEASE SITE.

Table 9. Juvenile transport summary and dates of operation.

	Trucked	Barged	Total
Lower Granite			
March 28-July 23			
Yearling chinook	39,400	1,690,780	1,730,180
Subyearling chinook	34,562	8,255	42,817
Wild steelhead	2,946	450,590	453,536
Hatchery steelhead	25,351	2,201,103	2,226,454
Sockeye	1,057	5,359	6,416
Coho	0	35	35
TOTAL	103,316	4,356,122	4,459,438
Little Goose			
March 30-July 23			
Yearling chinook	9,609	895,663	905,272
Subyearling chinook	25,237	1,857	27,094
Wild steelhead	783	147,351	148,134
Hatchery steelhead	7,106	918,569	925,675
Sockeye	500	2,305	2,805
Coho	0	0	0
TOTAL	43,235	1,965,745	2,008,980
McNary			
April 6-September 26			
Yearling chinook	188,849	713,274	902,123
Subyearling chinook	199,796	6,211,697	6,411,493
Steelhead	12,206	535,504	547,710
Sockeye	1,694	392,281	393,975
Coho	79	63,794	63,873
TOTAL	402,624	7,916,550	8,319,174
Grand Total	549,175	14,238,382	14,787,592

Table 10. Summary by dam of all juvenile fish transported from 1978 through 1985.

	Lower Granite	Little Goose	McNary	Total
1978	1,980,600	996,285	82,211	3,059,906
1979	2,367,446	1,453,615	1,247,120	5,068,181
1980	3,830,747	2,282,987	1,740,545	7,854,279
1981	2,730,866	1,464,991	4,112,993	8,308,850
1982	1,851,616	1,234,110	3,003,853	6,089,579
1983	2,368,049	868,937	4,326,013	7,562,999
1984	2,046,020	2,274,307	4,708,632	9,028,959
1985	4,459,438	2,008,980	8,319,074	14,787,592

Table 11. Summary of juvenile fish trucked or barged from Lower Granite, Little Goose, and McNary Dams from 1978 through 1985.

	Trucked	Barged	Total
1978	1,580,724	1,478,372	3,059,096
1979	2,031,212	3,036,969	5,068,181
1980	3,019,232	4,835,047	7,854,279
1981	3,145,980	5,162,860	8,308,850
1982	2,152,901	3,936,678	6,089,579
1983	2,780,487	4,782,512	7,562,999
1984	1,030,026	7,998,933	9,028,959
1985	549,175	14,238,417	14,787,592

The Bioengineering Group provides biological and engineering expertise for the design and operation of fish passage and fish protective facilities for adult and juvenile anadromous fish at dams and water diversion structures. Although the primary objective of the Bioengineering Group is to develop methods of providing anadromous fish safe upstream and downstream passage at projects in the Northwest Region, it is also involved in fish protective activities throughout the country. Primary recipients of the services provided by the Section are Federal agencies, such as the Corps of Engineers, U. S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and Federal Energy Regulatory Commission; private and public power companies; and various state fishery agencies. Activities of the Bioengineering Group fall into the following six categories:

1. Review and establishment of functional fish facility design for Federal, Federally-funded, Federal Energy Regulatory Commission, and Nuclear Regulatory Commission licensed projects.

2. Review of fish facility project construction and operation.

3. Development of instream flow requirements and methods for fisheries agencies' participation in regional hydropower system operation to obtain river flows for anadromous fish.

4. Assistance in design review for Columbia River Fisheries Development Program activities.

5. Participation in interagency committees for design and review of fish protective facilities.

6. Responses to requests from other Regions or agencies for assistance in designing fish protective facilities.

Recent Activities:

The types of projects the Bioengineering Group has been involved with have remained quite similar over many years. New hydroelectric projects being developed in the Region continue to require the development of general and site specific fish passage criteria and the planning and design of the appropriate facilities to satisfy these criteria. Existing projects continue to require structural and operational improvements to existing fish facilities based upon on-site experience and continuing fish passage research.

As examples of recent work, in 1985, the Bioengineering Group continued to participate in planning, design and operation of fish passage facilities at the nine lower and mid-Columbia River dams, the four lower Snake River dams, and numerous smaller tributary dams in the Columbia Basin and other Northwest Region river basins. A large portion of staff time was spent on the planning, design review, and construction monitoring related to new fish passage facilities in the Yakima River Basin which are being developed as part of the Northwest Power Planning Council's Fish and Wildlife Program.

The design of juvenile passage facilities for Little Goose Dam powerhouse and construction of juvenile facilities for John Day Dam powerhouse continued in 1985. These facilities, structurally designed by the Corps, incorporate functional design criteria provided by fisheries agencies through a subcommittee on fish passage. The Bioengineering Group plays a prominent role on these types of committees.

The Bioengineering Group continues to work with other fisheries agencies in obtaining improvements in operation of adult fish passage facilities at the five Public Utility District (PUD) dams on the mid-Columbia. Review of past and current adult passage conditions at these PUD projects by Bioengineering personnel has resulted in development, in conjunction with other fisheries agencies, of more stringent passage criteria which the agencies are now requesting be carried out by the PUD's.

The numerous smaller hydroelectric projects provide a large segment of the Bioengineering Group's workload. The engineers participated in the planning and design of fish passage and protective facilities for these projects. While

adult passage facilities are needed at many of these projects, frequently the most difficult problem is to work with the developer to provide a juvenile fish protection system which will be effective and reliable yet not unnecessarily expensive.

The Group provides engineering review of hatchery facilities to be constructed under the CRFDP. This requires working with hatchery operating agencies' designers.

The Group receives several requests each year for assistance from agencies outside of the Northwest Region. In 1985, significant amounts of time were spent on review of fish passage plans at several dams in Michigan and Indiana. The Bioengineering Group's assistance on all of these projects was requested by the U. S. Fish and Wildlife Service. The group also provided assistance to the Southwest Region of NMFS concerning design and operation of several fish passage facilities in California. A more complete list of FY 1985 activities is included as Appendix 20.

Research continues to be conducted at juvenile fish collector dams which is designed to measure areas of stress in the system and evaluate Submersible Traveling Screen efficiencies. Additional proposed facility modifications being developed and changes already incorporated, such as reduced holding and transportation densities, should further improve the transportation process. When flows such as recommended by Section 4(h) of the Northwest Power Act are implemented, fish will be moved through the reservoirs with less delay than in the past. Fish survival will be improved as the bypass systems and stream flows are perfected.

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Appendix 1 -- A brief description and history of Oregon Department of Fish and Wildlife Salmonid Rearing Facilities Funded by the Columbia River Fisheries Development Program.

Big Creek Hatchery
Route 4, Box 594
Astoria, Oregon 97103

Dave Rieben, Manager - Telephone (503) 458-6512

Species	Pounds Reared Annually	Numbers Released Annually
Coho	49,335	740,000
Fall Chinook	71,250	5,800,000
Steelhead	15,000	90,000
Sea Run Cutthroat	3,335	10,000

History

Big Creek Hatchery is located near Knappa, Oregon, approximately 20 miles upstream from Astoria.

Big Creek Hatchery is one of the four Oregon hatcheries that were remodeled and enlarged under the Columbia River Fishery Development Program. The refurbishing took place in 1957 at a cost of $437,000.

The hatchery was remodeled to rear fall chinook and coho salmon. NMFS pays the main operation and maintenance costs. However, the Bureau of Reclamation contributes approximately $20,600 each year for coho production in addition to the above.

Bonneville Hatchery
P.O. Box 262
Bonneville, Oregon 97008

Trent Stickle, Manager - Telephone (503) 374-8393

Species	Pounds Reared Annually	Numbers Released Annually
Coho	133,335	1,000,000
Fall Chinook	87,500	7,000,000

History

Bonneville Hatchery is located downstream from Bonneville Dam.

The hatchery was remodeled and enlarged in 1957 at a cost of $413,000. Prior to the enlargement, the hatchery was operated solely by the State of Oregon. In 1974 the station was once more enlarged by the Corps of Engineers to mitigate fish losses occasioned by construction of John Day Dam.

Total facilities now include 8 residences and 58 rearing ponds. Under present arrangements, the Corps finances 45 percent of the operations costs and the NMFS funds the remaining 55 percent.

The hatchery receives its rearing water from three sources: Tanner Creek, Mitchell Creek, and a series of wells that were drilled by the Corps of Engineers. The station presently rears coho and up-river bright and "tule" fall chinook salmon.

Cascade Hatchery
Star Route, Box 526
Bonneville, Oregon 97008

Wayne Stedronsky, Manager - Telephone (503) 374-8381

	Expected Releases in 1985	
Species	Pounds	Numbers
Coho	94,444	1,700,000

History

Cascade Salmon Hatchery is located on the Oregon shore approximately 1 mile upstream from Bonneville Dam.

The hatchery was constructed by the Federal Government in 1959 with funds provided by the Columbia River Fishery Development Program at a cost of $683,000. The hatchery was constructed on U.S. Forest Service land under a Forest Service use permit.

The station has a gravity flow water supply from Eagle Creek.

The station was originally built with two residences and in 1963 a third one was added at a cost of $30,000. Cascade Hatchery rears principally coho in 30 ponds and a 16' x 80' raceway.

The O&M is funded totally by NMFS under a Cooperative Agreement with the Oregon Department of Fish and Wildlife.

Clackamas Hatchery
24500 S. Entrance Road
Estacada, Oregon 97023

Dick Harrison, Manager - Telephone (503) 630-7210

Species	Pounds Reared Annually	Numbers Released Annually
Spring Chinook	37,500	300,000

History

Clackamas Hatchery was constructed in 1976 and is located near Estacada, Oregon. It is presently funded by three organizations. The Portland General Electric Company provides 25 percent of O&M funding for the production of 25,000 pounds of spring chinook for partial mitigation for its projects on the Clackamas River. The Oregon Department of Fish and Wildlife and NMFS share in the remainder of the funding obligations.

Gnat Creek Hatchery
Route 2, Box 2198
Clatskanie, Oregon 97016

R. L. Warren, Manager - Telephone (503) 455-2234

Species	Pounds Reared Annually	Numbers Released Annually
Steelhead	107,500	645,000

History

Gnat Creek Hatchery is located near the town of Westport, Oregon, approximately 22 miles upstream from Astoria.

The station was constructed in 1960 under the Columbia River Fishery Development Program at a cost of $566,000. It was constructed to rear steelhead trout, but since the merging of Oregon Fish and Game Commissions, some salmon have been included in its program.

The hatchery has four residences and fifteen large rearing ponds, 16' x 100'.

The station has two water sources, Gnat Creek and an artesian well.

The O&M is funded totally by NMFS under a Cooperative Agreement with the Oregon Department of Fish and Wildlife.

The Trojan ponds are operated as a satellite installation to Gnat Creek Hatchery and are used primarily as acclimation ponds.

Klaskanine Hatchery
Route 2, Box 764
Astoria, Oregon 97103

Quentin Smith, Manager - Telephone (503) 325-3653

Species	Pounds Reared Annually	Numbers Released Annually
Coho	82,350	1,400,000
Fall Chinook	50,000	4,000,000
Steelhead	10,800	65,000

History

Klaskanine Hatchery is located about 8 miles southeast of Astoria.

The hatchery was enlarged in 1959 under the Columbia River Fishery Development Program at a cost of $511,000. The original hatchery was operated by the Oregon Fish Commission.

The outside rearing facilities consist of sixteen 20' x 80' raceways, five concrete series raceways, and a 1½-acre rearing pond. The hatchery was originally constructed to rear steelhead and coho salmon but in recent years fall chinook have been added to the program. Very few fall chinook are able to return to the hatchery as at the time of entrance into the Klaskanine River, the water is too low for easy migration upstream.

The water supply for the hatchery comes from 3 intakes located on the North Fork of the Klaskanine and the Little North North Fork.

There are currently five residences at the hatchery.

The O&M is funded totally by NMFS under a Cooperative Agreement with the Oregon Department of Fish and Wildlife.

Oxbow Hatchery
Star Route, Box 750
Cascade Locks, Oregon 97014
Larry E. Dimmick
Manager - Telephone 374-8540

Species	Pounds Reared Annually	Numbers Released Annually
Coho	130,770	1,700,000

History

Oxbow Hatchery is located 1 mile east of Cascade Locks.

The hatchery was remodeled with Columbia River Fishery Development Program funds in 1952 at a cost of $310,000. It is relatively a small station with four residences and twelve ponds operating in tandem, utilizing a spring water supply. The spring water runs approximately 45° and the station is used to start fish for both Bonneville and Cascade whose water temperatures sometimes are lower.

In 1977, two large rearing ponds were constructed under the Columbia River Fishery Development Program utilizing Herman Creek water at a cost of $300,000.

Wahkeena Pond is located on the Columbia River, twenty miles east of Portland near Multnomah Falls. It was constructed in 1963 under the Columbia River Fishery Development Program at a cost of $51,000. The pond is presently being operated as a satellite facility to Oxbow Hatchery.

The O&M is funded totally by NMFS under a Cooperative Agreement with the Oregon Department of Fish and Wildlife.

Sandy Hatchery
39800 S.E. Fish Hatchery Road
Sandy, Oregon 97055

Dick Whitlatch, Manager - Telephone (503) 668-4222

Species	Pounds Reared Annually	Numbers Reared Annually
Coho	55,555	1,000,000

History

The Sandy River Hatchery is located approximately two miles northeast of the town of Sandy on Cedar Creek, a tributary to the Sandy River.

The station was constructed in 1959 under the Columbia River Fishery Development Program at a cost of $333,000. It has twenty circulating ponds and four residences. The upstairs of the hatchery building has been converted into a laboratory and the Oregon Department of Fish and Wildlife utilize this space as a nutrition research station.

The water supply for the station comes from Cedar Creek and its quantity in the summer at times is critical. Sandy Hatchery is primarily a coho station. However, it has intermittently reared some fall chinook.

The O&M is funded totally by NMFS under a Cooperative Agreement with Oregon Department of Fish and Wildlife.

Aumsville/Stayton Pond
43182 North River Drive
Sweethome, Oregon 97386

Gene Middaugh, Manager - Telephone (503) 367-3437

Species	Pounds Reared Annually	Numbers Reared Annually
Fall chinook	87,500	7,000,000

History

The Aumsville Pond was developed to provide a rearing facility for the Willamette River fall chinook program.

The O&M is funded totally by NMFS under a Cooperative Agreement with Oregon Department of Fish and Wildlife.

Appendix 2 -- A brief description of Washington Department of Game Salmonid Rearing Facilities funded by the Columbia River Fisheries Development Program.

Beaver Creek Hatchery
28 Beaver Creek Road
Cathlamet, Washington 98612

Stanley Woody, Manager - Telephone 206-795-3620

Species	Pounds Reared Annually	Numbers Released Annually
Steelhead	80,000	457,000
Cutthroat	9,000	33,000

History

Beaver Creek Hatchery is located on the Elokomin River approximately 2 miles from its confluence with the Columbia River at Cathlamet, Washington. It is primarily a winter steelhead and searun cutthroat rearing station constructed in 1958 by the Columbia River Fishery Development Program at a cost of $663,000.

The hatchery is composed of 10-4' x 30' raceways, 20-80' x 10' raceways, 2 100' x 12' raceways, and rearing pond. The hatchery receives its water from three sources, the Elokomin River, Beaver Creek, and it also utilizes well water for incubation of eggs within the hatchery building

There are four residences at the hatchery.

The O&M is funded totally by NMFS under a Cooperative Agreement with the Washington Department of Game.

Ringold Springs Rearing Pond
Star Route, Box 188
Meda, Washington 99343

Bruce Walters, Manager - Telephone 509-269-4327

Species	Pounds Reared Annually	Numbers Released Annually
Steelhead	25,000	146,000

History

The Ringold Springs Rearing Pond is located on the Columbia River 20 miles upstream from Pasco, Washington. It was constructed as experimental facilities in 1963 under the Columbia River Fishery Development Program at a cost of $80,000.

The facility (5-acre pond) is operated by the Washington Department of Game. There is one residence at the facility.

The pond receives water from springs that emerge from the adjacent hillside. These springs are irrigation return water that appeared following the creation of Banks Lake irrigation system.

The Ringold Springs water is not suitable for the incubation of eggs. Water temperatures are around 50 degrees the year around but even when water is chilled there is a low survival rate. The reasons for the high mortalities are attributed to phosphate introduced by fertilizers.

The O&M is funded totally by NMFS under a Cooperative Agreement with the Washington Department of Game.

Skamania Hatchery
MPO 39L
Washougal, Washington 98671

Vince Janson, Manager - Telephone 206-837-3131

Species	Pounds Reared Annually	Numbers Released Annually
Steelhead	98,000	588,000

History

The Skamania Hatchery is located on the North Fork of the Washougal River, approximately 12 miles northeast of the town of Washougal, Washington. The station rears spring summer and winter-run steelhead and was constructed in 1957 by the Columbia River Fishery Development Program at a cost of $458,000.

The station has 32 80' x 10' raceways and 10 4' x 30' raceways. The main water supply for the station is from the North Fork of the Washougal River. The five residences receive their domestic water from a well. Because of the cold water temperatures in the winter, eggs are usually transferred from the station after stripping in January and February to the Vancouver Hatchery. The fry are returned to the station when the water is warming in June and the fish are reared to smolt size for release. There are five residences at the facility.

The O&M is funded totally by NMFS under a Cooperative Agreement with the Washington Department of Game.

Appendix 3 -- A brief description and history of Washington Department of Fisheries salmonid rearing facilities funded by the Columbia River Fisheries Development Program

Elokomin Hatchery
1318 State Highway 407
Cathlamet, Washington 98612

Ed Jouper, Manager - Telephone 206-795-3608

Species	Pounds Reared Annually	Numbers Released Annually
Coho	106,000	1,700,000
Fall Chinook	32,000	2,500,000

History

Elokomin Hatchery is located approximately 6 miles northeast of Cathlamet, Washington, on the Elokomin River. The station was constructed in 1954 under the Columbia River Fishery Development Program at a cost of $566,000.

In 1958 the first dirt pond was constructed at a cost of $10,000 and in 1976 the second horseshoe-shaped dirt pond was placed in operation at a cost of $160,000.

The hatchery has four residences with a domestic water supply from a well. The hatchery receives its water from three separate sources: Elokomin River, Clear Creek, and an un-named intermittent spring.

The hatchery has 20 concrete raceways, 20' x 80', and two large dirt rearing ponds. The station rears principally coho and fall chinook.

The O&M is funded totally by NMFS under a Cooperative Agreement with the Washington Department of Fisheries.

Grays River Hatchery
P.O. Box 768
Grays River, Washington 98621

Dick Aksamit, Manager - Telephone 206-465-2446

Species	Pounds Reared Annually	Numbers Released Annually
Fall Chinook	17,500	1,750,000
Coho	20,000	400,000

History

Grays River Hatchery is located approximately three miles northeast of the town of Grays River on the West Fork of the Grays River, about 20 miles upstream from the mouth of the Columbia River. This station was the last formal hatchery constructed under the Columbia River Fishery Development Program and was completed in 1961 at a cost of $666,000.

It has three residences, ten formal concrete rearing ponds, 20' x 78' and one large earth rearing pond, 60' x 200'. The two adult holding ponds, 40' x 60', are also used for rearing.

The hatchery receives the majority of its water from the West Fork of the Grays River. However, some hatchery water is obtained from infiltration pump systems located on the hatchery grounds.

Weyco Pond is a 5-acre pond constructed by the Weyerhaeuser Lumber Company and is operated as a satellite rearing facility to the Grays River Hatchery. It is located on the upper watershed of Grays River. Columbia River Fishery Development Program funds are used to help pay for food.

The principal species reared in this pond has been fall chinook, as water flows and temperatures preclude the rearing of yearling coho. Washington Department of Fisheries Enhancement Program includes an additional water supply for this pond.

The O&M is funded totally by NMFS under a Cooperative Agreement with the Washington Department of Fisheries.

Kalama Falls Hatchery
Box 3900, Kalama River Road
Kalama, Washington 98625

Bob Ready, Manager - Telephone 206-673-4825

Species	Pounds Reared Annually	Numbers Released Annually
Coho	71,250	1,425,000
Spring Chinook	50,000	500,000
Fall Chinook	75,000	7,500,000

History

Kalama Falls Hatchery is approximately ten miles upstream from the mouth of the Kalama River. The station was constructed in 1959 at a cost of $928,000.

The station has five residences, twelve concrete ponds, 20' x 77', and six dual-purpose adult juvenile ponds, 40' x 50'.

The station rears spring chinook, fall chinook, and coho salmon.

The station's water supply is totally by pump from the Kalama River. Standby generation is provided in case of a power failure.

Lower Kalama Hatchery is presently operated as a satellite to Kalama Falls Hatchery.

The O&M is funded totally by NMFS under a Cooperative Agreement with the Washington Department of Fisheries.

Klickitat Hatchery
Route 2, Box 90
Glenwood, Washington 98619-9607

Doug Loucks, Manager - Telephone 509-364-3310

Species	Pounds Reared Annually	Numbers Released Annually
Coho	87,500	1,400,000
Spring Chinook	112,500	900,000
Fall Chinook	40,000	4,000,000

History

Klickitat Hatchery is located approximately 35 miles upstream from the mouth of the Klickitat River, east of the town of Glenwood, Washington. The station was the first hatchery constructed under the Columbia River Fishery Development Program at a cost of $650,000.

The hatchery consists of five residences, thirty 20' x 80' concrete ponds, two earthen ponds, and two lined ponds.

The Klickitat station rears fall and spring chinook and coho salmon. Some difficulty has been experienced in obtaining enough adult fish to supply the hatchery with an adequate number of eggs to fulfill rearing schedules. A major falls was laddered under the Columbia River Fishery Development Program to provide access to the hatchery. Native runs of fish in the Klickitat consisted of spring chinook and steelhead as other species were blocked by the falls. The hatchery is one of the most remote stations in the Columbia system.

The O&M is funded totally by NMFS under a Cooperative Agreement with the Washington Department of Fisheries.

Washougal Hatchery
Route 2, Box 443
Washougal, Washington 98671

Richard Johnson, Manager - Telephone 206-837-3311

Species	Pounds Reared Annually	Numbers Released Annually
Fall Chinook	60,000	6,000,000
Coho	200,000	3,000,000

History

Washougal Hatchery is located 14 miles northeast of Washougal, Washington. The station was constructed in 1958 with funds provided by the Columbia River Fishery Development Program at a cost of $1,025,000.

The station has four residences, 24 concrete ponds of various sizes, two dirt ponds, and one large rearing lagoon. The hatchery receives its rearing water from four separate sources: Bob's Creek, Boyles Creek, C Creek, and the Washougal River. The station uses a unique pumping system to take water from the river. It employs the Bob's Creek water with approximately 100 feet of head to drive turbine pumps with intakes in the river.

The O&M is funded totally by NMFS under a Cooperative Agreement with the Washington Department of Fisheries.

Ringold Springs Rearing Pond
HC-01, Box 189
Meda, Washington 99343

Frank Anderson, Manager - Telephone 509-269-4448

Species	Pounds Released Annually	Numbers Released Annually
Spring Chinook	125,000	1,000,000

History

The Ringold Springs Rearing Pond is located on the Columbia River 20 miles upstream from Pasco, Washington. It was constructed as experimental facilities in 1963 under the Columbia River Fishery Development Program at a cost of $80,000.

The facility (a 9-acre pond and 14 rearing ponds) is operated by the Washington Department of Fisheries.

The pond receives water from springs that emerge from the adjacent hillside. These springs are irrigation return water that appeared following the creation of Banks Lake irrigation system.

The Ringold Springs water is not suitable for the incubation of eggs. Water temperatures are around 50 degrees the year round but even when water is chilled there is a low survival rate. The reasons for the high mortalities are attributed to phosphate introduced by fertilizers.

The O&M is funded totally by NMFS under a Cooperative Agreement with the Washington Department of Fisheries.

Appendix 4 -- A brief description and history of U.S. Fish and Wildlife Service salmonid rearing facilities funded by the Columbia River Fisheries Development Program.

Abernathy Hatchery
Abernathy Salmon Cultural Techniques Center
1440 Abernathy Road
Longview, Washington 98632

Dave Leith, Director - Telephone (206) 425-6072

Species	Pounds Reared Annually	Numbers Released Annually
Fall Chinook	42,000	1,500,000

History

Abernathy Hatchery is located 14 miles downriver from Longview and is approximately five miles from the confluence of Abernathy Creek and the Columbia River. It was constructed in 1960 at a cost of $389,000. All construction was funded by NMFS. NMFS funds only about 40 percent of the operational costs, FWS 60 percent.

The Abernathy Hatchery is principally a research and development center for hatchery practices, including nutritional studies. Only about half of the station is dedicated to standard fish production. Most of the research and development has been confined to fall chinook although some coho investigations have been undertaken.

The station consists of three residences and 12 rearing ponds, 6 of which utilize reuse water systems. The 6 ponds not on the reuse system utilize Abernathy Creek water. The reuse system is operated utilizing well water.

The Abernathy research lab contains numerous rearing tanks which also utilize well water. The hatchery employs a unique electric weir to guide the adult fish to the spawning pond.

The Fish and Wildlife Service and NMFS share in the funding of studies and fish production.

Carson Hatchery
Carson, Washington 98610

Don Zirjacks, Manager - Telephone (509) 427-5905

Species	Pounds Reared Annually	Numbers Released Annually
Spring Chinook	133,500	2,670,000

History

Carson Hatchery is located about 13 miles northwest of Carson, Washington, on the Wind River. It was remodeled and changed from trout to a salmon hatchery in 1956 at a cost of $477,000. NMFS funded the remodeling.

The station consists of 46 8' x 80' concrete raceways and two large dirt rearing ponds. These dirt ponds were added in 1977 with funds provided by NMFS.

The water supply for the hatchery is principally the Tyee Springs which has a constant temperature of about 46 degrees. River water is mixed with Tyee Springs water to obtain higher temperatures during the summer period. This warmer water is used effectively to ripen adult spring chinook which are spawned usually in late August.

The funds for operating Carson are supplied by NMFS, with cyclic maintenance funds provided by the Fish and Wildlife Service.

Eagle Creek Hatchery
Route 1, Box 610
Estacada, Oregon 97023

Jamieson E. Holway, Manager - Telephone (503) 630-6270

Species	Pounds Reared Annually	Numbers Released Annually
Spring Chinook	35,000	400,000
Coho	72,000	1,000,000
Steelhead	15,500	100,000

History

Eagle Creek Hatchery is located approximately 7 miles from Estacada, Oregon on Eagle Creek which is a tributary to the Clackamas River. The station was constructed under the Columbia River Fishery Development Program in 1956 at a cost of $474,000. In 1963, 36 additional ponds were added with CRFDP funds.

The station has three duplex residences, housing six families. The station rears spring chinook, coho and steelhead.

The station's water supply comes from Eagle Creek and is inadequate to run all of the ponds during the low flow period in the summer and early fall. Both banks of raceways are located in tandem and reuse the water three times.

The funds for operating Eagle Creek Hatchery are supplied by NMFS, with cyclic maintenance funds provided by the Fish and Wildlife Service.

Little White Salmon Hatchery (Willard National Fish Hatchery)
P.O. Box 17
Cook, Washington 98605

Jack E. Bodle, Manager - Telephone (509) 538-2755

Species	Pounds Reared Annually	Numbers Released Annually
Fall Chinook	176,000	8,700,000
Spring Chinook	35,000	1,200,000

History

Little White Salmon Hatchery is located at the mouth of the Little White Salmon River approximately 20 miles upstream from Bonneville Dam. This station is one of the oldest hatcheries on the river, and has been remodeled several times. The latest rehabilitation occurred in 1958 under the Columbia River Fishery Development Program at a cost of $612,000.

In addition to being one of the oldest hatcheries on the river, it is also one of the largest. The hatchery is composed of a series of 49 rearing ponds. These ponds vary in size and shape depending on the topography of the land.

The station receives its primary water from the Little White Salmon River and Bailey Springs. The station also utilizes water from a series of intermittent springs during the winter rearing period when Little White Salmon River water is quite cold.

There are four residences at the Little White Salmon Station.

The funds for operating Little White Salmon Hatchery are supplied by NMFS, with cyclic maintenance funds provided by the Fish and Wildlife Service.

Willard National Fish Hatchery
Star Route
Cook, Washington 98605

Ron Wong, Asst. Manager - Telephone (509) 538-2305

Species	Pounds Reared Annually	Numbers Released Annually
Coho	166,000	2,500,000

History

The Willard National Fish Hatchery is located on the Little White Salmon River at Willard, Washington. Willard is supervised by the management of Little White Salmon Hatchery. It is a coho rearing station constructed in 1954 with funds from the Columbia River Fishery Development Program at a cost of $640,000.

The station was originally constructed to rear both fall chinook and coho; however, cold water temperatures prohibit effective rearing of zero-year migrant fall chinook.

The station receives its main rearing water from the Little White Salmon River and a groundwater well. Willard takes no eggs as a natural barrier blocks all fish downstream from the station. Returning adults are collected at Little White Salmon Hatchery and the eggs are taken to Willard for incubation and rearing.

The station has 50 8' x 80' raceways and 12 residences.

The funds for operating Willard Hatchery are supplied by NMFS, with cyclic maintenance funds provided by the Fish and Wildlife Service.

Spring Creek Hatchery
Underwood, Washington 98651

Ed LaMotte, Manager - Telephone (509) 493-1730

Species	Pounds Reared Annually	Numbers Released Annually
Fall Chinook	162,000	15,000,000

History

Spring Creek Hatchery is located approximately 30 miles above Bonneville Dam at Underwood, Washington. The original station was one of the older hatcheries on the river. However, it was remodeled in 1955 by the Columbia River Fishery Development Program at a cost of $492,000. It was nearly completely razed and remodeled again by the Corps of Engineers in 1970 at a cost of approximately $8,000,000.

The station features a 90 percent reuse system with 44 circulating rectangular Abernathy ponds with rock and oyster shell filters as an integral part of the reuse facilities. The water source is a series of springs that emerge from the base of the cliff adjacent to the hatchery.

Two satellite ponds on the Big White Salmon River are operated by the Spring Creek staff.

Funding is approximately 50 percent NMFS and 50 percent Corps of Engineers. The Corps funding is for the mitigation of losses occurred at John Day Dam. This station is probably the most successful fall chinook station on the Columbia River.

Appendix Table 5. - Numbers and Pounds of Juvenile Salmonids Released from Columbia River Fisheries Development Program Funded Hatcheries Operated by Oregon Department of Fish and Wildlife in 1985

	URB Fall Chinook		Tule Fall Chinook		Spring Chinook		Coho		Steelhead		Cutthroat/Chum		Total	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
Aumsville/Stayton			4,534,193	86,799	69,768	7,548							4,603,961	94,347
Big Creek	102,563	[1]6,130	5,899,211	68,596			856,540	63,852	62,916	[2]12,742	10,238	[3]2,582	6,931,468	153,902
Bonneville														
Yearling	303,098	39,037					2,072,986	141,813						
Fingerling	6,357,225	189,074	1,042,214	15,726			1,818,836	14,804						
Total	6,660,323	228,111	1,042,214	15,726			3,891,822	156,617					11,594,359	400,454
Cascade							1,787,783	100,699					1,787,783	100,699
Clackamas					923,563	111,459							923,563	111,459
Gnat Creek														
Yearling									735,551	[4]142,484	24,882	[3]9,200		
Fingerling									39,172	[5]1,925				
Total									774,723	144,409	24,882	9,200	799,605	153,609
Klaskanine														
Yearling							1,358,852	123,532						
Fingerling							976,388	6,259						
Total			1,595,440	8,140			2,335,240	129,791	61,282	[2]11,785	924,630	[6]2,499	4,916,592	152,215
Oxbow														
Yearling							2,111,085	110,528						
Fingerling							2,025,914	8,375						
Total					130,707	927	4,136,999	118,903					4,267,706	119,830
Sandy														
Yearling							896,604	64,172						
Fingerling							160,226	1,067						
Total							1,056,830	65,239					1,056,830	65,239
Total	6,762,886	234,341	13,071,058	179,261	1,124,038	119,934	14,065,214	635,101	898,921	168,936	959,750	14,281	36,881,867	1,351,854

[1] Rogue River stock.
[2] Winter Steelhead.
[3] Cutthroat
[4] Winter Steelhead are 522,132 at 104,793 pounds. Summer Steelhead are 213,419 at 37,691 pounds.
[5] Winter Steelhead are 25,426 at 1,205 pounds. Summer Steelhead are 13,746 at 720 pounds.
[6] Chum Salmon.

Appendix Table 6. - Numbers and Pounds of Juvenile Salmonids Released from Columbia River Fisheries Development Program Funded Hatcheries Operated by the Washington Department of Game in 1985

	Winter Steelhead		Summer Steelhead		Cutthroat		Total	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
Beaver Creek	352,891	69,054	50,990	7,800	72,665	14,606	476,546	91,460
Skamania								
Fingerlings	89,557	1,103	22,487	364				
Yearling	64,988	8,361	382,843	45,270				
Total	154,545	9,464	405,330	45,634	38,765	3,198	598,640	58,296
Gobar Pond	60,560	10,468	59,352	10,261			119,912	20,729
Vancouver Pond			116,094	24,462			116,094	24,462
Ringold			112,001	17,500			112,001	17,500
Total	567,996	88,986	743,767	105,657	111,430	17,804	1,423,193	212,447

Appendix Table 7. - Numbers and Pounds of Juvenile Salmonids Released from Columbia River Fisheries Development Program Funded Hatcheries Operated by Washington Department of Fisheries in 1985

	URB Fall Chinook		Tule Fall Chinook		Spring Chinook		Coho		Total	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
Elokomin										
Yearling							1,703,000	92,455		
Fry							1,205,300	2,108		
Total			2,562,000	24,820			2,908,300	94,563	5,470,300	119,383
Grays River										
Yearling							264,797	16,550		
Fry							2,825,200	5,967		
Total			845,100	14,189			3,089,997	22,517	3,935,097	36,706
Lower Kalama										
Yearling							533,500	35,000		
Fry										
Total			3,445,210	40,000			533,500	35,000	3,978,710	75,000
Kalama Falls										
Yearling					569,296	43,792	831,300	50,106		
Fry							50,000	62		
Total			4,001,300	44,696	569,296	43,792	881,300	50,168	5,451,896	138,656
Klickitat										
Yearling					614,500	61,450	1,163,488	92,794		
Fry					258,100	2,260	1,351,900	5,140		
Total			123,100	2,003	872,600	63,710	2,515,388	97,934	3,511,088	163,647
Washougal										
Yearling							3,183,660	174,902		
Fry							1,477,700	3,636		
Total			6,061,750	74,104			4,661,360	178,538	10,723,110	252,642
Ringold										
Yearling	1,200,000	171,429							1,200,000	171,429
Total	1,200,000	171,429	17,038,460	199,812	1,441,896	107,502	14,589,845	478,720	34,270,201	957,463

Appendix Table 8. - Numbers and Pounds of Juvenile Salmonids Released from Columbia River Fisheries Development Program Funded Hatcheries Operated by U.S. Fish and Wildlife Service in 1985

	URB Fall Chinook		Tule Fall Chinook		Spring Chinook		Coho		Steelhead		Total	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
Abernathy			628,978	25,038							628,978	25,038
Carson												
Yearlings					2,491,301	121,210					2,491,301	121,210
Eagle Creek												
Yearlings					612,503	59,404	241,163	16,295	153,749	12,696		
Fry					32,384	230	521,819	3,012				
Total					644,887	59,634	762,982	19,307	153,749	12,696	1,561,618	91,637
Little White/Willard												
Yearlings	95,364	5,958			1,354,959	94,138	999,358	64,061				
Fry	1,045,758	12,022			665,949	[1]12,171	244,914	2,264				
Total	1,141,122	17,980	1,600,008	14,510	2,020,908	106,309	1,244,272	66,325			6,006,310	205,124
Spring Creek	2,120,774	17,747	[2]13,905,417	84,532							16,026,161	102,279
Total	3,261,896	35,727	16,134,403	124,080	5,157,096	287,153	2,007,254	85,632	153,749	12,696	26,714,368	545,288

[1]Zero-age accelerated smolts released in October.

[2]Fish were released in February (early) because of severe disease problems caused by bacterial gill disease.

Appendix Table 9. - Approximate Egg Incubation Capacities and 1986 Production Goal for Columbia River Fisheries Development Program Facilities

			1986 Production Goal					
	Green Eggs	Eyed Eggs on Trays	Fall Chinook	Yearling Chinook	Coho Smolts	Steelhead	Cutthroat	Total
ODFW								
Big Creek	23,000,000	9,400,000	5,820,000		710,000	60,000	10,000	6,600,000
Bonneville	72,000,000	29,000,000	14,425,000		2,000,000			16,425,000
Cascade	8,150,000	6,175,000			1,700,000			1,700,000
Clackamas	2,500,000	2,500,000		1,260,000				1,260,000
Gnat Creek	2,350,000	1,683,000				645,000	25,000	670,000
Klaskanine	6,000,000	6,000,000	4,000,000		1,400,000	65,000		5,465,000
Oxbow	12,600,000	8,200,000			2,000,000			2,000,000
Sandy	4,900,000	3,200,000			895,000			895,000
Stayton Pond			5,500,000					5,500,000
WDC								
Beaver Creek	2,000,000	1,200,000				745,000	95,000	840,000
Skamania/Vancouver	7,000,000	5,000,000				785,000	35,000	820,000
Ringold						180,000		180,000
WDF								
Elokomin	9,000,000	9,000,000	2,500,000		1,700,000			4,200,000
Grays River	20,000,000	7,500,000	1,750,000		400,000			2,150,000
Kalama Falls Complex	5,000,000	5,000,000	7,500,000	500,000	1,425,000			9,425,000
Klickitat	10,700,000	7,740,000	4,000,000	900,000	1,400,000			6,300,000
Washougal	15,500,000	8,600,000	6,200,000		2,475,000			8,675,000
Ringold			1,100,000					1,100,000
USFWS								
Abernathy	2,400,000	2,400,000	1,600,000					1,600,000
Carson	6,700,000	4,300,000		2,400,000				2,400,000
Eagle Creek	2,500,000	800,000		600,000	1,000,000	150,000		1,750,000
Little White/Willard Complex	28,300,000	22,000,000	3,200,000	900,000	3,700,000			7,800,000
Spring Creek	30,000,000	20,000,000	14,750,000					14,750,000
Total	259,260,000	159,698,000	72,345,000	6,560,000	20,805,000	2,630,000	165,000	102,505,000

Appendix Table 10. - Cost of Production at Oregon Department of Fish & Wildlife Facilities During FY 1985. Costs are assumed to equal what was provided to each hatchery, including overhead, in the FY 1985 contract minus any capital spending.

	Cost	FTEs	Pounds Produced	Cost/ Pound	Pounds/ FTE
Aumsville/Stayton	$102,250	1.33	94,350	$1.08	70,950
Big Creek	[1]$351,650	6.31	153,900	$2.28	24,400
Bonneville[2]	$617,800	8.7	220,300	$2.80	25,300
Cascade	$283,100	6.5	100,700	$2.81	15,500
Clackamas[3]	$130,800	1.84	42,350	$3.09	23,000
Gnat Creek	$267,450	4.75	153,600	$1.74	32,350
Klaskanine	$268,600	4.67	152,200	$1.76	32,600
Oxbow	$244,100	4.75	119,850	$2.04	25,250
Sandy	$230,050	4.75	62,250	$3.54	13,100
Total	$2,495,800	43.60	1,099,500	$2.27	25,200

[1] $22K included for Bureau of Reclamation funding.

[2] NMFS provides funding for 55% of production, thus FTEs and pounds produced are 55% of total for the hatchery.

[3] NMFS provides funding for approximately 38% percent of production, thus FTEs and pounds produced are 38% of total for the hatchery.

Appendix Table 11. - Cost of Production at Washington Department of Game Facilities During FY 1985. Costs are assumed to equal what was provided to each hatchery, including overhead, in the FY 1985 contract minus any capital spending.

	Cost	FTEs	Pounds Produced	Cost/ Pound	Pounds/ FTE
Skamania/Gobar/Vancouver	$310,000	7.0	103,500	$3.00	14,800
Beaver Creek	$283,650	4.25	91,450	$3.10	21,500
Ringold	$ 63,500	1.3	17,500	$3.63	13,450
Total	$657,800	12.55	212,450	$3.10	16,950

Appendix Table 12. - Cost of Production at Washington Department of Fisheries Facilities During FY 1985. Costs are assumed to equal what was provided to each hatchery, including overhead, in the FY 1985 contract minus any capital spending.

	Cost	FTEs	Pounds Produced	Cost/ Pound	Pounds/ FTE
Elokomin	$250,900	4.67	119,400	$2.10	25,550
Grays River	$167,650	3.25	36,700	$4.57	11,300
Kalama Falls Complex	$418,000	8.17	213,650	$1.96	26,150
Klickitat	$372,950	5.67	163,650	$2.28	28,850
Ringold	$172,900	2	171,450	$1.01	85,750
Toutle					
Washougal	$348,900	5.42	252,650	$1.38	46,600
Total	$1,731,300	29.18	957,500	$1.81	32,800

Appendix Table 13. - Cost of Production at U.S. Fish and Wildlife Service Facilities During FY 1985. Costs are assumed to equal what was provided to each hatchery, including overhead, in the FY 1985 contract minus any capital spending.

	Cost	FTEs	Pounds Produced	Cost/ Pound	Pounds/ FTE
Abernathy [1]	$ 154,000	2.6	25,050	$6.15	9,650
Carson	$ 403,000	6.9	121,200	$3.33	17,550
Eagle Creek	$ 429,000	7.51	91,650	$4.68	12,203
Little White/ Willard	$ 800,800	12.7	205,100	$3.90	16,150
Spring Creek [2]	$ 358,800	4.21	51,150	$7.01	12,150
Total	$2,145,600	33.92	494,150	$4.34	14,550

[1] Includes only costs associated with fish production. Total facility funding from all sources was $592,100, not including administrative overhead.

[2] NMFS provides funding for 50 percent of production, thus pounds produced is 50 percent of total releases.

Appendix Table 14. - Adult and Jack Salmonids Returning to Columbia River Fisheries Development Program Funded Hatcheries Operated by Oregon Department of Fish and Wildlife in 1985

	Fall Chinook		Spring Chinook	Coho	Winter Steelhead	Chum	Cutthroat	Total
	URB	Tule						
Big Creek								
Males	218	6,510		4,912	375	19	114	
Females	117	4,080		4,212	320	45	80	
Jacks	12	316		761				
Total	[1]347	10,906		9,885	695	64	194	22,091
Bonneville								
Males	1,130	5,163		12,244				
Females	1,066	3,570		11,458				
Jacks	248	70		580				
Total	2,444	8,803		24,282				35,529
Cascade								
Males	41	57		449				
Females	56	39		479				
Jacks	27	81		192				
Total	124	177		1,120				1,421
Clackamas								
Males			412					
Females			484					
Jacks			48					
Total			944					944
Klaskanine								
Males	2	15		1,430	377			
Females	13	11		2,722	158			
Jacks				7,749				
Total	[1]15	26		11,901	535			12,477
Sandy								
Males				5,072				
Females				3,073				
Jack				3,024				
Total				11,169				11,169
Total	2,930	19,912	944	58,357	1,230	64	194	83,631

[1]Rogue River stock fall chinook.

Appendix Table 15. - Adult and Jack Salmonids Returning to Columbia River Fisheries Development Program Funded Hatcheries Operated by the Washington Department of Game in 1985

	Winter Steelhead	Summer Steelhead	Cutthroat	Total
Beaver Creek				
Males	631	54	440	
Females	583	58	310	
Total	1,214	112	750	2,076
Skamania				
Males	79	986		
Females	77	1,433		
Total	[1]604	2,419	50	3,073
Ringold				
Males		[2]200		
Females		[2]400		
Total		[2]600		600
Total	1,818	3,131	800	5,749

[1]448 adults were returned to the river unsexed.

[2]These numbers were estimates made by hatchery manager. No actual count was taken. Trap was shut down when enough adults were captured to obtain needed eggs.

Appendix Table 16. - Adult and Jack Salmonids Returning to Columbia River Fisheries Development Program Funded Hatcheries Operated by Washington Department of Fisheries in 1985

	Fall Chinook		Spring Chinook	Coho	Total
	URB	Tules			
Elokomin					
Males		[1] 1,006		[2] 3,506	
Females		[1] 803		[2] 2,557	
Jacks		23		892	
Total		1,832		6,955	8,787
Grays River					
Males		148		362	
Females		78		466	
Jacks		131		182	
Total		357		1,010	1,367
Kalama Falls					
Males	531	1,543	47	592	
Females	421	1,902	49	438	
Jacks	2	254	11	731	
Total	954	3,699	107	1,761	6,521
Lower Kalama					
Males		819		534	
Females		472		550	
Jacks		396		91	
Total		1,687		1,175	2,862
Klickitat					
Males		8	34		
Females			19		
Jacks		7	9		
Mini-Jacks			152		
Total		15	241		256
Washougal					
Males		1,365		4,274	
Females		914		4,893	
Jacks		5,425		2,399	
Total		7,704		11,566	19,270
Total	954	15,294	348	22,467	39,063

[1] Includes 182 males and 168 females transferred to Grays River for spawning.

[2] Includes 250 males and 250 females released into the Elokomin River above hatchery. Fish were surplus to hatchery egg needs.

Appendix Table 17. - Adult and Jack Salmonids Returning to Columbia River Fisheries Development Program Funded Hatcheries Operated by the U.S. Fish and Wildlife Service in 1985

	Fall Chinook		Spring Chinook	Coho	Steelhead	Total
	URB	Tules				
Abernathy						
Male		[1]1,278				
Female		943				
Jack						
Total		2,221				2,221
Carson						
Male			2,026			
Female			2,646			
Jack			62			
Total			4,734			4,734
Eagle Creek						
Male			324	2,264	698	
Female			346	2,197	590	
Jack			56	998		
Total			726	5,459	1,288	7,473
Little White Salmon/ Willard Complex						
Male	[2]412	112	[3]684	4,528		
Female		96	665	6,063		
Jacks	441	70	8	907		
Total	853	278	1,357	11,498		13,986
Spring Creek						
Male		2,137				
Female		3,258				
Jacks		84				
Total		5,479				5,479
Total	853	7,978	6,817	16,957	1,288	33,893

[1]Includes jacks. Scale samples were taken to determine the number of jacks but were not available at this time.
[2]Includes males and females.
[3]Includes 410 adults that were not sexed.

Appendix Table 18. - Release, Catch, and Return Statistics for the 1978-Brood Fall Chinook Hatchery Evaluation By Facility and Tag Code

	Tag Code	Number Released	Catch	Return	Catch/ 1,000 Releases	% Surv.
Big Creek	7-18-44	224,900	593	205	2.6	.4
Bonneville	7-18-42	287,900	823	307	2.9	.4
	7-18-43	15,100	4	4	0.3	.1
Klaskanine	7-18-45	244,100	298	14	1.2	.1
Stayton Pond	7-18-41	283,800	1,849	254	6.5	.7
Sea Resources	63-19-18	24,200	24	0	1.0	.1
Abernathy	5-4-50	63,400	293	80	4.6	.6
	5-4-51	48,900	178	54	3.6	.5
Big White Pond	5-4-43	141,400	268	108	1.9	.3
Little White Salmon	5-4-48	177,800	31	13	.2	.0
	5-4-49	264,800	36	10	.1	.0
Spring Creek	5-4-33	140,900	1,418	248	10.1	1.2
	5-4-44	135,500	2,175	363	16.1	1.9
	5-4-45	55,600	2	1	.0	.0
	5-4-46	246,000	1,194	191	4.9	.6
Cowlitz	63-19-42	143,600	236	118	1.6	.3
	63-19-51	11,100	67	26	6.0	.8
Elokomin	63-18-56	21,100	10	1	.5	.0
	63-19-56	117,800	10	1	.1	.0
Grays River	63-16-46	73,900	30	11	.4	.0
	63-18-33	7,600	4	2	.5	.1
	63-19-37	68,100	28	8	.4	.1
Kalama Falls	63-19-57	214,500	77	65	.4	.0
Klickitat	63-19-49	225,400	241	0	1.1	.1
Priest Rapids	63-18-21	48,100	144	168	3.0	.7
	63-18-57	17,500	9	11	.5	.1
	63-19-58	5,300	6	1	1.1	.1
	63-20-17	82,200	33	18	.4	.0
Speelyai	63-19-20	51,700	122	40	2.4	.3
	63-19-50	104,500	176	71	1.7	.2

Appendix Table 18. - Release, Catch, and Return Statistics for the 1978-Brood (contd.) Fall Chinook Hatchery Evaluation By Facility and Tag Code

	Tag Code	Number Released	Catch	Return	Catch/ 1,000 Releases	% Surv.
Toutle	63-18-54	12,000	8	3	.9	.1
	63-19-41	132,100	115	49	.8	.1
Washougal	63-19-38	97,400	69	26	.7	.1
	63-19-46	154,500	122	72	.8	.1
Weyco	63-19-39	92,400	61	9	.7	.1
TOTAL		4,035,100	10,754	2,552	2.7	.3

Appendix Table 19. - Release, Catch, and Return Statistics for the 1979-Brood Fall Chinook Hatchery Evaluation by Facility and Tag Code.

Rearing Facility	Tag Code	Number Released	Catch	Return	Catch/ 1,000 Release	% Surv
Big Creek	7-21-60	143,400	1,204	289	8.4	1.0
Bonneville	7-21-57	121,100	137	31	1.1	.1
Klaskanine	7-21-61	66,300	98	2	1.5	.2
OxBow	7-21-62	49,400	54	8	1.1	.1
	7-21-63	51,900	95	14	1.8	.2
Stayton Pond	7-20-55	282,200	1,891	187	6.7	.7
Sea Resources	63-20-61	18,400	40	23	2.2	.3
Abernathy	5-6-44	35,200	179	45	5.1	.6
	6-6-46	112,500	507	169	4.5	.6
Little White Salmon	5-6-43	162,600	46	2	.3	.0
Spring Creek	5-6-39	125,500	1,130	207	9.0	1.1
	5-6-40	75,200	1,230	200	16.4	1.9
	5-6-41	60,500	1,185	137	19.6	2.2
	5-6-42	23,100	94	15	4.1	.5
Cowlitz	63-21-37	20,700	158	64	7.6	1.1
	63-21-54	244,300	204	67	.8	.1
	63-21-59	70,500	53	26	.8	.1
Elokomin	63-20-5	98,400	61	13	.6	.1
Grays River	63-20-43	37,500	60	10	1.6	.2
Kalama Falls	63-21-5	100,400	165	89	1.6	.3
Klickitat	63-19-47	156,100	247	10	1.6	.2
Lewis River	63-21-60	103,700	280	68	2.7	.3
Lower Kalama	63-20-6	144,500	151	50	1.0	.1
Priest Rapids	63-19-48	147,200	384	232	2.6	.4
Washougal	63-21-53	314,600	619	262	2.0	.3
Weyco	H1-2-3	97,800	64	32	.7	.1
TOTAL		2,864,700	10,336	2,252	3.6	.4

Appendix 20

BIOENGINEERING ACTIVITIES
PARTIAL LISTING OF PROJECTS DURING F.Y. 1985

I. Review and Establishment of Fish Facility Design -

1. Bonneville Dam - adult and juvenile fish passage facilities
2. The Dalles Dam - adult passage and counting facilities
3. John Day Dam - juvenile passage facilities
4. McNary Dam - adult and juvenile passage facilities
5. Little Goose Dam - juvenile passage facilities
6. Winchester hydro project - adult and juvenile passage facilities
7. Yakima River Passage Projects - adult and juvenile passage facilities
8. Three Mile Dam - adult and juvenile passage facilities
9. Stayton Ditch hydro project - adult and juvenile passage facilities
10. Tumwater and Dryden dams - adult passage facilities
11. Salmon River Basin small hydro projects - adult and juvenile fish passage facilities
12. The Dalles North Fishway hydro project - juvenile fish passage facilities
13. Boyd proposed hydro project - adult and juvenile passage facilities
14. Valsetz hydro project - juvenile passage facilities
15. Rock Island Dam - juvenile bypass facilities
16. Rocky Reach Dam - juvenile bypass facilities
17. Horn Rapids Dam - adult and juvenile passage facilities
18. Marmot Dam - adult and juvenile passage facilities
19. Lower Snake River Compensation Plan - hatchery facilities
20. Leaburg hydro project - juvenile and adult passage facilities
21. Sullivan Plant - juvenile passage facilities
22. Priest Rapids Dam - juvenile passage studies facilities
23. Wanapum Dam - juvenile passage studies
24. White River (Washington) hydro project - juvenile and adult passage
25. Mill Creek hydro project - juvenile and adult passage facilities

II. Review of Fish Facility Construction and/or Operation

1. Bonneville Dam - adult and juvenile passage
2. Priest Rapids Dam - adult passage
3. Wanapum Dam - adult passage
4. Rock Island Dam - adult passage
5. Rocky Reach Dam - adult passage
6. Wells Dam - adult passage
7. Little Goose Dam - juvenile passage

III. Assistance in Design Review

1. Corps of Engineers Permits (numerous sites)
2. Corps of Engineers - Toutle River Single Purpose Retention Dam

IV. Responses to Requests from Other Regions and Agencies

1. U.S. Fish and Wildlife Service - review of Michigan State and Indiana State fishway designs (Bucannon Dam and South Bend Dam hydro project fish passage facilities)
2. U.S. Fish and Wildlife Service - review of passage problems at Tehama-Colusa Canal, California
3. NMFS Southwest Region - adult passage facilities at Cape Horn Dam
4. NMFS Southwest Region - review of fish facilities for the Don Clausen Fish Hatchery expansion and Coyote Valley Dam smolt release facility
5. U.S. Fish & Wildlife Service - adult facilities and the Potter Valley hydro project