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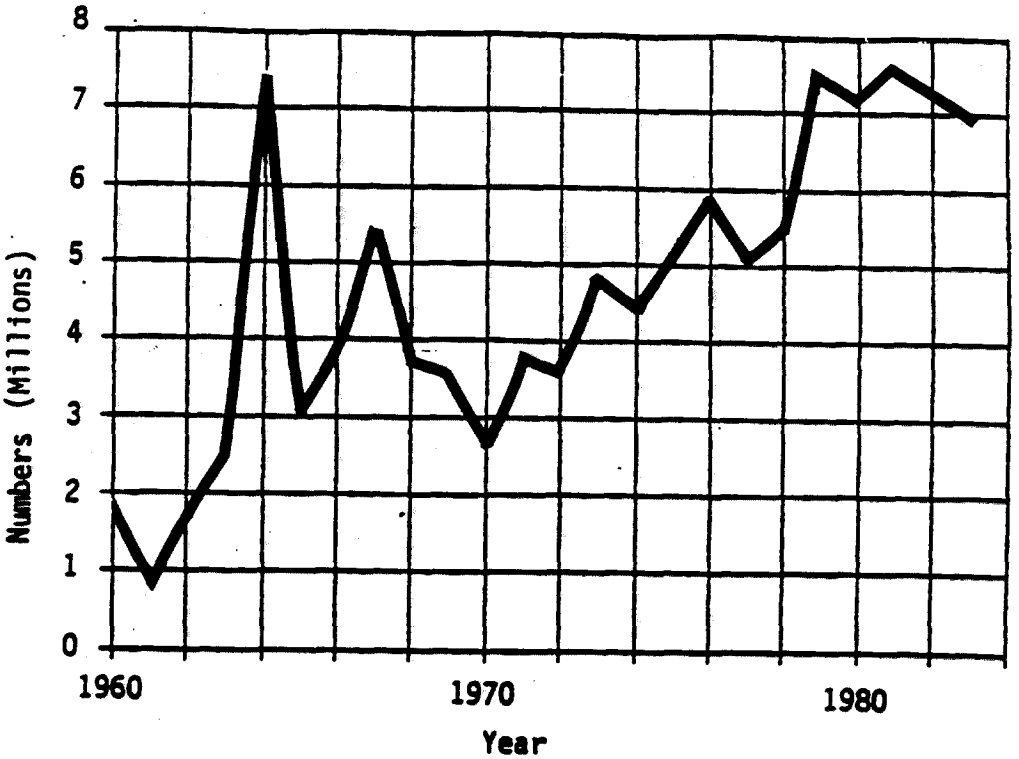

Figure 53. Columbia River Fisheries Developments Program spring chinook salmon releases (Delarm and Wold 1984).

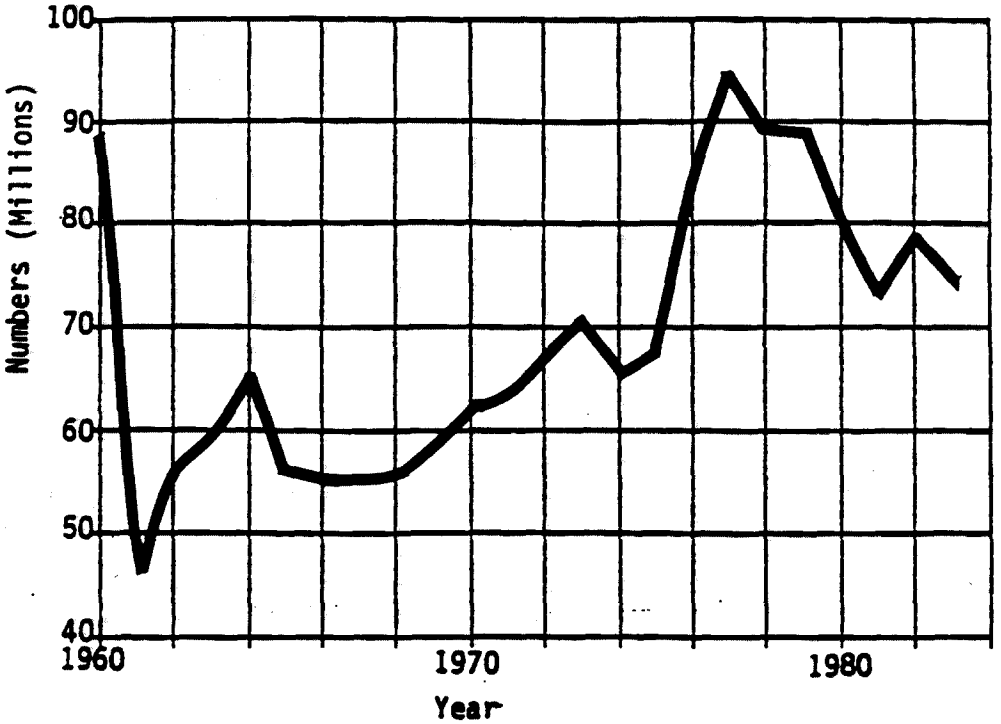

Figure 54. Columbia River Fisheries Development Program fall chinook salmon releases (Delarm and Wold 1984).

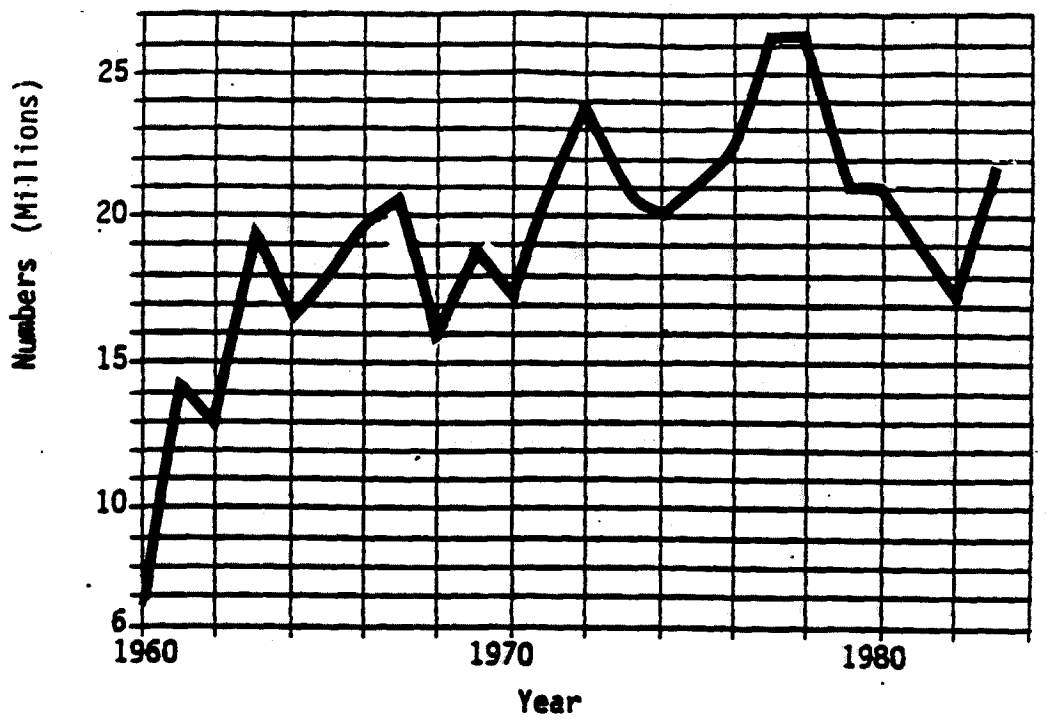

Figure 55. Columbia River Fisheries Development Program coho salmon releases (Delarm and Wold 1984).

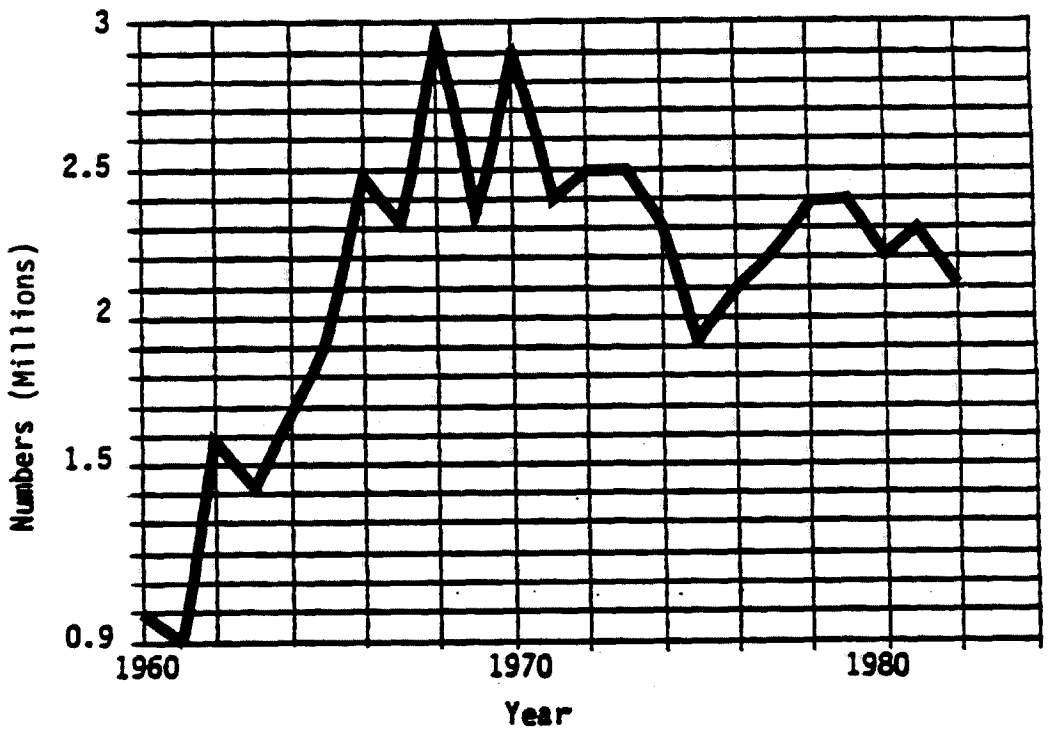

Figure 56. Columbia River Fisheries Development Program steelhead trout releases (Delarm and Wold 1984).

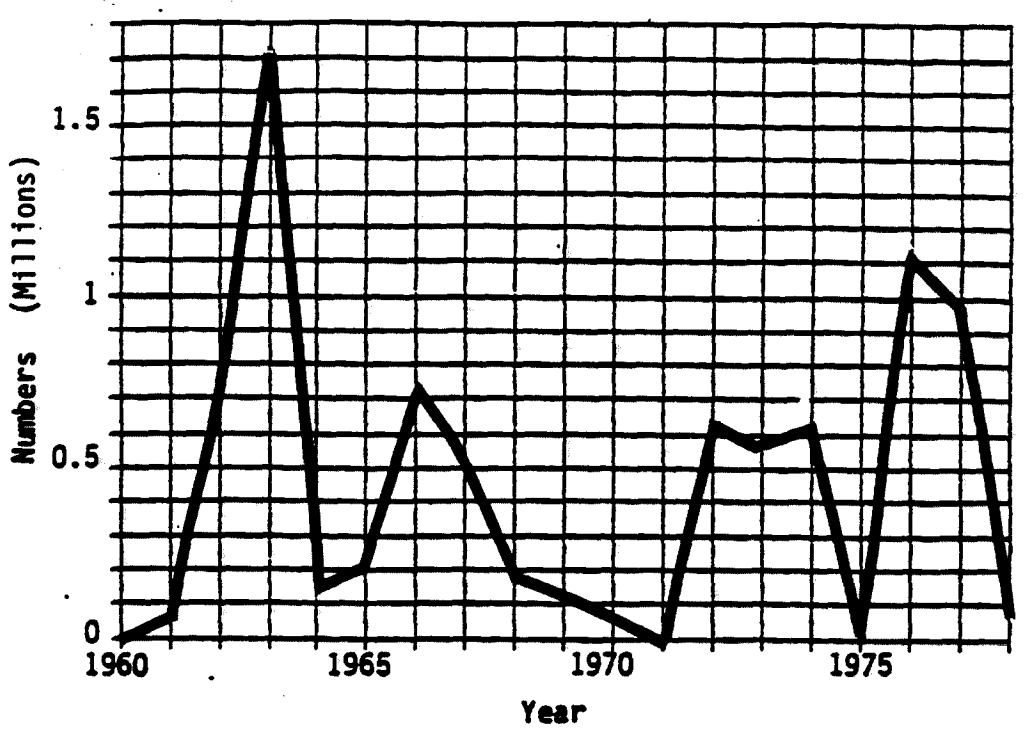

Figure 57. Columbia River Fisheries Development Program chum salmon releases (Delarm and Wold 1984).

million in 1960, to 26.3 million in 1977 and 1978. Although their numbers have fluctuated from year to year, coho releases have exceeded 20 million in most years since 1971. The number of steelhead trout smolt releases has been relatively uniform since 1961, ranging from 1.4 million in 1963, to 2.9 million in 1970. Chum salmon smolt releases have fluctuated considerably, ranging from no releases in 1960, 1971, and 1975, to 1.7 million in 1963.

The percentage contribution of smolt releases from CRDFP-funded facilities represents a large portion of all smolts released in the Columbia River Basin. During the period 1960 through 1976, the total CRFDP-funded releases comprised 74 percent of the total numbers and 57 percent of the total weight of all Columbia River Basin hatchery releases (National Marine Fisheries Service 1981).

The CRFDP also has funded the construction of fishways and removal or modification of both natural and manmade barriers affecting fish migration.

With the exception of several projects in Idaho, all construction was completed by 1970 (National Marine Fisheries Service 1981). Accumulated debris, log jams, and splash dams were removed on the Calapooia and Clatskanie rivers, as well as Big, Tide, Goble, Eagle, Deep, Clear, Abernathy, and Delph creeks (Wahle and Smith 1979).

A total of 87 fishway projects have been funded by CRFDP in the Columbia River Basin (National Marine Fisheries Services 1981). The fishways have varied in size from small, rock-cut fish passageways such as Wiley Creek in Oregon, to large, complex ladders such as those located on the Wind and Klickitat rivers in Washington and Willamette Falls in Oregon. Thirty-six fish ladders or ladder complexes were constructed under the CRFDP, which includes 18 in Washington, 16 in Oregon, and two in Idaho (National Marine Fisheries Service 1984; Armstrong 1985; Korn 1985) (Table 32). Oregon Department of Fish and Wildlife (ODFW) also operates rock-cut passes on the Yamhill, Willamina, Molalla, Santiam, and Mohawk rivers, while WDF operates several ladders on the Klickitat and Kalama rivers.

Another area of stream improvement under the CRFDP is the construction and maintenance of fish screens on irrigation diversions. Fish screen projects were initiated in Oregon in 1953, and in the early 1960s in Washington. There were 19 screens funded by CRFDP in Washington (Delarm and Wold 1984). Of these, 16 are currently operating. They are located on the Entiat, Methow, Twisp, Touchet, Tucannon rivers, and Rattlesnake Creek (National Marine Fisheries Service 1984).

Few screens were in operation in Idaho and Oregon when CRFDP projects began. There are 813 screens constructed under the CRFDP on inventory in Oregon, Washington, and Idaho. The average number of screens operating each year is 382, 12, and 196 in the three states respectively (Delarm and Wold 1984). The number of screening diversions used each year has varied, depending upon available funding and changes in irrigation withdrawal methods. Oregon and Idaho operated and maintained approximately 380 and 200 screens, respectively, during 1984 (Delarm and Wold 1984). The Oregon screens are located mainly on the John Day and Wallowa rivers; Idaho

Table 32 - Fish ladders or ladder complexes operated under the Columbia River fishery development program.[1]

Agency	Ladder	Location
Oregon Department of Fish and Wildlife	Barth Falls	North Fork Klaskanine River
	Bonnie Falls	North Fork Scappoose Creek
	City of Lostine Dam	Lostine River
	Clatskanie Falls	Clatskanie River
	Eagle Creek Falls	Eagle Creek
	Elkhorn Falls	Little North Santiam River
	Fifteenmile Creek Falls	Fifteenmile Creek
	Goble Creek Falls	Goble Creek
	Minam River Falls	Minam River
	Oregon Iron and Steel Dam	Tualatin River
	Pegleg Falls	Callawash River
	Punchbowl Falls	West Fork Hood River
	Sheepridge Dam	Lostine River
	Sherars Falls	Deschutes River
	Threemile Dam	Umatilla River
	Wiley Creek Falls	Sanitam River
	Willamette Falls	Willamette River
Washington Department of Fisheries	Cameron	Abernathy Creek
	Casteel	Klickitat River
	Cedar Creek	Lewis River
	Delimeter	Cowlitz River
	Johnson	Lewis River
	Klama Falls	Kalama River
	Klickitat #2	Klickitat River
	Klickitat #5	Klickitat River
	Little Kalama (3 ladders)	Kalama River
	Ostrander (2 ladders)	Cowlitz
	Shippard Falls	Wind River
	Trout	Wind River
	Washougal	Washougal River
	Winkler	Washougal River
	Pioneer	Wenatchee River
	Methow Valley	Methow River
	Fulton and Chewack	Chewack River
Idaho Department of Fish and Game	Middle Fork	Middle Fork Salmon River
	Selway	Selway River

[1]Sources: National Marine Fisheries Service (1981); Armstrong (1985); Korn (1985).

screens are in the Salmon River drainage. It is estimated that the screening program in Idaho has reduced mortalities by over one million juvenile chinook salmon and steelhead trout annually (Mallet 1970).

6.2.2.2 Lower Snake River Compensation Plan

In 1976, Congress authorized funding of a Corps of Engineers program to mitigate for fish losses caused by construction and operation of the four lower Snake River hydroelectric projects: Lower Granite, Little Goose, Lower Monumental, and Ice Harbor dams. This program has involved the construction of major hatcheries, the expansion and modernization of existing hatcheries, and the construction of acclimation ponds.

Above Lower Granite Dam, the program has modernized and expanded the McCall (summer chinook), Hagerman (steelhead), Crystal Springs (steelhead), and Dworshak hatcheries (spring chinook and steelhead), and constructed the Sawtooth Hatchery (Table 33). In addition, a major new facility is being constructed on the Clearwater River (Clearwater Anadromous or Dworshak II Hatchery) to rear spring chinook and steelhead.

Between Lower Monumental and Little Goose dams, the program funding was used to build the Lyons Ferry Hatchery. This facility primarily produces steelhead, but considerable fall chinook production is scheduled for the future. Steelhead from Lyons Ferry are outplanted in several tributaries in the lower Snake drainage and in the Walla Walla River. The Tucannon Hatchery also has been acquired under this program. In addition, the program included funding for the construction of Lookingglass Hatchery in Oregon for spring chinook production, and Irrigon/Wallowa Hatchery, for steelhead production.

Mitigation required to compensate for losses from construction and operation of the lower Snake River dams was computed by Salo (1974) (Table 34, columns 1 through 5). Salo estimates annual losses as 134,500 salmon and steelhead. Losses for these dams has also been calculated by Junge (1980) (Table 34, column 6). Junge estimates annual losses as 262,400 salmon and steelhead for the Lower Snake River dams.

Table 33 - Hatchery Release Program under the Lower Snake River Compensation Plan.

	Species	Number
Idaho		
McCall	Summer chinook	1,000,000
Hagerman	Steelhead	
Magic Valley (Crystal Springs)	Steelhead	4,400,000
Sawtooth	Spring chinook	2,350,000
Clearwater	Spring chinook/	1,700,000
	Steelhead	2,500,000
Dworshak	Spring chinook	750,000
Washington		
Lyons Ferry	Spring chinook/	132,000
	Fall chinook	9,162,000
	Steelhead	1,640,000
Tucannon	Steelhead	
	Spring chinook	
Oregon		
Lookingglass	Spring chinook	1,390,000
Irrigon/Wallowa	Steelhead	1,677,600
TOTAL ALL SPECIES		26,701,600

Table 34 - Estimated annual losses of salmon and steelhead due to the Lower Snake River Dams.

Species	McNary Dam Average Counts (1957-63)	Percent of Run Entering the Snake River	Snake River Run	Operational Loss Due to Lower Snake River Dams	Loss Due to Lower Snake River Dams (Salo 1977)	Loss Due to Lower Snake River Dams (Junge 1980)
Fall chinook	97,500	33	32,700	48	20,700	33,800
Spring/summer chinook	222,100	55	122,000	48	58,700	123,600
Steelhead	172,600	67	114,000	48	55,100	105,000
				TOTAL	134,500	262,400

6.2.2.3 Grand Coulee Dam

The U.S. Bureau of Reclamation constructed Grand Coulee Dam in 1941 thereby blocking the migration of salmon and steelhead above this point in the river (see Chapters 4 and 5). Mitigation for this project relied on included collection of fish from the Rock Island Dam fish ladders from 1939 to 1943. Fish were used to establish natural spawning runs in the Wenatchee, Entiat, and Okanogan rivers, as well as to supply brood stock to the Leavenworth Hatchery. Three hatcheries (Leavenworth, Entiat, and Winthrop) are currently part of this program. Present production includes 3 million spring chinook and 0.15 million steelhead at Leavenworth, 1.5 million spring chinook at Entiat, and 0.89 to 1.0 million spring chinook at Winthrop.

6.2.2.4 Corps of Engineers' Willamette River Project

The Corps of Engineers operates four hydroelectric complexes in the Willamette Basin for which salmon and steelhead mitigation, in the form of

artificial production, is provided. These are Cougar, Detroit-Big Cliff, Green Peter-Foster, and Lookout Point-Dexter dams (Corps of Engineers 1981).

Mitigation for the Cougar Dam is provided by McKenzie Hatchery. This hatchery was constructed to produce 80,800 pounds or 606,000 spring chinook salmon and steelhead smolts annually to replace estimated losses of 4,060 spring chinook salmon formerly using the South Fork above Cougar Dam (Corps of Engineers 1981).

Detroit-Big Cliff Complex mitigation replaces losses of fish formerly migrating above these projects. The Minto Barrier Dam downstream from Big Cliff Dam on the North Fork Santiam deflects adult fish into holding ponds from which they are transported to Marion Forks Hatchery. Propagation facilities at Marion Forks produce 86,141 pounds or 795,000 spring chinook salmon and steelhead smolts annually (Corps of Engineers 1981).

Mitigation for the Green Peter-Foster complex is provided by the South Santiam Hatchery below Foster Dam. This hatchery produces 56,121 pounds or 322,000 spring chinook salmon and steelhead smolts annually to replace project-inundated spawning grounds (Corps of Engineers 1981).

Adult fish collection and holding facilities are provided at the base of Dexter Dam to provide for compensation of the Lookout Point-Dexter Complex. Facilities also are sited at this location for egg taking and fertilizing. Fertilized eggs are taken to Oakridge Hatchery for hatching and rearing. Propagation facilities at Oakridge Hatchery produce 181,800 pounds or 2.39 million smolts annually to replace those spring chinook salmon and steelhead formerly migrating above these projects (Corps of Engineers 1981).

6.2.2.5 Lower Columbia River Corps of Engineers Dams

There are four Corps of Engineers dams on the Lower Columbia River; Bonneville, The Dalles, John Day, and McNary dams. The mitigation required to compensate for losses caused by these dams has been computed by Junge (1980) (Table 35). Losses are computed as 539,000 salmon and steelhead annually.

Table 35 - Annual losses of salmon and steelhead due to Lower Columbia River dams (Junge 1980).

Species	Loss from Lower Columbia River Dams
Spring chinook	108,000
Summer chinook	73,000
Fall chinook	143,000
Sockeye	72,000
Steelhead	143,000
	539,000

6.2.3 Pacific Northwest Electric Power Planning and Conservation Act of 1980

The other major program underway to restore salmon and steelhead resources in the Columbia River Basin is under the auspices of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Northwest Power Act). The Northwest Power Act required the Northwest Power Planning Council to develop a Columbia River Basin Fish and Wildlife Program consisting of measures to protect, mitigate and enhance fish and wildlife affected by the development, operation and management of hydroelectric facilities in the Columbia River Basin. The Council's fish and wildlife program includes measures to improve downstream passage; upstream passage; and wild, natural, and hatchery propagation. Various federal agencies are currently implementing the program.

6.2.4 Non-Federally Funded Mitigation

This section includes a listing of mitigation programs that are either entirely or partially non-federally funded. These program descriptions include major species reared and released at artificial production facilities. These programs may differ from year to year depending on egg availability, disease, and agreed-to program changes.

6.2.4.1 Idaho Power Company

The Federal Power Commission issued a license to the Idaho Power Company (IPCo) in 1955 for a three-dam complex in the middle Snake River consisting of Brownlee, Oxbow, and Hells Canyon dams. One provision of this license required IPCo to "construct, maintain, and operate facilities for the purpose of conserving the fishery resource of the Middle Snake River" (Idaho Power Co. 1982).

Initially these efforts consisted of measures to enhance and protect the salmon and steelhead production above Hells Canyon Dam. A program was initiated to transport adult and juvenile salmonids around the three projects. However, an evaluation of the transportation program, begun in 1961, indicated that while spawning of transported adults was apparently successful, total numbers of downstream migrating juveniles were declining. Juvenile fish were apparently not successfully migrating through the reservoirs, and were displaying a high rate of residualism (Ebel, personal communication).

Today, the Oxbow, Rapid River, Niagara Springs and Pahsimeroi hatchery complexes constitute the IPCo mitigation program. Oxbow is used primarily as an adult holding facility, although provision exists to update the facility for fall chinook production. Rapid River Hatchery is designed to produce about three million spring/summer chinook smolts; two million are released on-station, while the remaining third are released into Hells Canyon. Adults are collected at the hatchery and at an adult trapping facility in Hells Canyon.

Steelhead production at the Niagara Springs and Pahsimeroi facilities follows two paths. The first involves adults collected at the Hells Canyon

adult trap, held and spawned at Oxbow Hatchery, reared at Niagara Springs and released back into Hells Canyon. In the second path, adults are collected at the Pahsimeroi facility, the juveniles are reared at Niagara Springs, and then released into the Pahsimeroi. These two programs are intended to produce about 3.2 million steelhead smolts annually.

In addition to the steelhead program at Pahsimeroi, the facility is also programmed to produce about one million spring/summer chinook smolts for release into the Pahsimeroi River. Presently, this program uses Rapid River as an egg source, although the facility is intended to be self-sustaining in the future.

One commentor has reported the number of salmon and steelhead returning above Hells Canyon Dam immediately prior to 1961 when passage above this point was blocked (Table 36). Table 36 also shows the average number of fish IPCo trapped at Brownlee and Oxbow dams from 1957 to 1963 to provide brood stock for their mitigation program and the number of smolts originally required of IPCo annually to mitigate for the Hells Canyon Complex.

Table 36 - Hells Canyon mitigation.

Species	Average Returns Above Hells Canyon Dam Site Before Passage Blocked[1]	IPCo Broodstock Trapping Program at Brownlee and Oxbow Dams from 1957 to 1963 (annual average)	IPCo Mitigation Requirement for Hells Canyon Complex (pound of smolts)
Fall chinook	25,000	7,500	1,000,000
Spring/summer chinook	6,800	4,300	4,000,000
Steelhead	9,800	2,600	400,00

[1]PNRC 1976 (Report F - Compensation).

6.2.4.2 Douglas County Public Utility District

When Wells Dam was constructed in 1967, Douglas County PUD was required to construct two fishways, a spawning channel, and fish culture facilities. The hatchery and rearing pond originally produced 325,000 steelhead smolts. The channel was converted to a hatchery which presently produces 1.5 million summer chinook. As part of the 1984 Mid-Columbia PUD Settlement Agreement signed by Douglas, Chelan, and Grant County PUDs; Washington Department of Fisheries and Department of Game; Oregon Department of Fish and Wildlife; National Marine Fisheries Service; and the Yakima, Umatilla, and Colville tribes, Grant County PUD was required to supplement the Wells Hatchery with 25,000 pounds of steelhead. The Bureau of Reclamation also was allowed to use the Wells facility to produce 150,000 steelhead for release into the Okanogan drainage (Columbia River Inter-Tribal Fish Commission 1982).

In addition, the 1984 Mid-Columbia PUD Settlement Agreement requires Douglas County PUD to install and test spillbay bypass units by 1988 and to provide spill for 50 percent fish passage efficiency (up to 20 percent daily average flow over 30 days) at Wells Dam.

6.2.4.3 Chelan County Public Utility District

With the construction of Rocky Reach Dam in 1962, Chelan County PUD was required to construct a fishway to attract and collect adult migrants. Additionally, in 1968, Chelan County PUD was required to construct a spawning channel on Turtle Island to accommodate 300 pairs of fall chinook salmon. The channel was converted to a hatchery in the period 1970 to 1977. As part of the 1984 Mid-Columbia Settlement Agreement (see 6.2.4.2 for signatories), Chelan County PUD was required to continue funding for the Rocky Reach and the Turtle Rock facilities. Production goals are a total of 35,000 pounds of coho, 25,000 pounds of yearling chinook, and 30,000 pounds of steelhead at these facilities. Chelan County PUD also funds the Chelan Hatchery which produces steelhead (Columbia River Inter-Tribal Fish Commission 1982).

In addition, the 1984 Mid-Columbia PUD Settlement Agreement requires Chelan County PUD to install a mechanical bypass system by the spring of 1987 and to provide spill for 30 percent fish passage efficiency (up to 10 percent daily average flow over 30 days) at Rocky Reach Dam.

6.2.4.4 Grant County Public Utility District

Grant County PUD provides mitigation for construction and operation of Priest Rapids and Wanapum dams, constructed in 1961 and 1964 respectively. Mitigation includes a spawning channel built to accommodate 5,000 spawners completed in 1963. The channel was converted to a hatchery in 1972. The hatchery goal is 75,000 pounds of fall chinook (or equivalent numbers of other races). Up to four sections of the channel are made available to Chelan and Douglas PUDs for rearing 25,000 pounds of fall chinook. As part of the 1984 Mid-Columbia Settlement Agreement (see 6.2.4.2 for signatories), Grand County PUD was required to maintain the existing 100,000 pound capacity of yearling fall chinook at the Priest Rapids Hatchery (Columbia River Inter-Tribal Fish Commission 1982).

In addition, the 1984 Mid-Columbia PUD Settlement Agreement requires Grant County PUD to conduct spill effectiveness tests from 1985 to 1987, to install the selected bypass alternative by 1988, and to provide spill for 50 percent fish passage efficiency (13 to 27 percent daily average flow over 30 days) at Wanapum Dam. They must also install a mechanical bypass system by the spring of 1988 and annually provide spill equaling 10 to 19 percent of flow over 30 days at Priest Rapids Dam.

6.2.4.5 Portland General Electric Company

Portland General Electric Company (PGE) operates the Bull Run Project on the Sandy River, the North Fork Project on the Clackamas River, and the Pelton and Round Butte projects on the Deschutes River (Kindley 1982). A mitigation program for the Bull Run and North Fork projects provides coho and spring chinook salmon, and winter steelhead trout. This program is operated at the Clackamas Hatchery on the Clackamas River (Kindley 1982). Funding for this facility includes some Columbia River Fisheries Development Program and Oregon Department of Fish and Wildlife contributions.

The Pelton Project includes hatchery facilities with a capacity of one million spring chinook salmon eggs. The production levels of the hatchery are to maintain returns of 1,800 steelhead trout and 1,200 spring chinook salmon annually. This predicates annual production of 145,000 chinook and 180,000 steelhead trout of migrant size (Kindley 1982).

6.2.4.6 City of Tacoma

The Mayfield and Mossyrock projects on the Cowlitz River are operated by the City of Tacoma. Fish facilities at these projects include two hatcheries and a 240-acre rearing pond (Kindley 1982).

The two hatcheries (one for salmon production and the other for trout production) were constructed to compensate for losses of spring and fall chinook and coho salmon, and steelhead trout that migrated upstream of the dam sites. The salmon hatchery has a capacity of 550,000-600,000 pounds, whereas the trout hatchery's productive capacity is about 250,000 pounds (Kindley 1982).

Production levels at the salmon hatchery have been established to maintain annual adult runs of 17,300 spring chinook salmon, 8,300 fall chinook salmon, and 25,500 coho salmon. This results in annual releases of approximately 5 to 6 million fall chinook fingerlings, 3.5 to 4 million coho yearlings, and 2 to 4 million spring chinook fingerlings and/or yearlings (Kindley 1982).

At the trout hatchery, production levels are established to sustain runs of winter steelhead at about 12,000 adults. This predicates annual releases of approximately 500,000 winter run and 200,000 summer run steelhead smolts (Kindley 1982).

6.2.4.7 Eugene Water and Electric Board

Eugene Water and Electric Board (EWEB) owns and operates the Carmen Smith, Leaburg, and Walterville Projects. The Carmen Smith complex compensates for losses with an artificial spawning channel for steelhead. Mitigation for the other EWEB projects is accomplished with operational shutdown during outmigrant timing and flow releases for migrants (Kindley 1982).

6.2.4.8 Pacific Power and Light Company

Pacific Power and Light operates the Merwin, Yale, and Swift projects on the Lewis River. Fishery facilities include two hatcheries that produce coho and fall chinook salmon, and steelhead trout (Kindley 1982).

They also operate Condit Dam on the White Salmon River. Passage was originally provided at this project with a wooden ladder that was washed out and rebuilt and subsequently washed out. No artificial production mitigation was provided for the project.

6.2.4.9 City of Portland

The Bull Run Dam in the Sandy Basin provides for Portland's municipal water supply. In order to mitigate for fish losses caused by this dam, Portland has agreed to fund expansion of the Clackamas Hatchery that will provide annual production of 30,000 pounds of spring chinook salmon and 20,000 pounds of summer steelhead. Placement (release location) of this production is up to the discretion of the Oregon Department of Fish and Wildlife.

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