University of Washington
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THE WATER BUDGET A STEP TOWARDS BALANCING FISH AND POWER IN THE COLUMBIA RIVER BASIN

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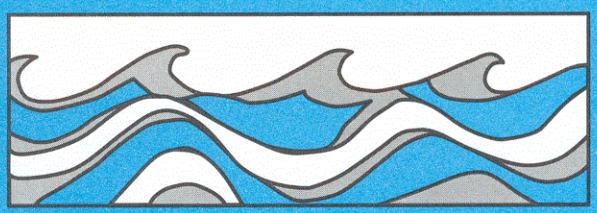

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Report Summary

In November 1982 the Northwest Power Planning Council adopted the water budget, a measure designed to ensure adequate flows for migrating juvenile salmon and steelhead on the Columbia and Snake Rivers. The water budget was unusual because it had the support of power and fish interests which had a long history of conflict regarding the allocation of water resources. This report is a study of the development of the water budget and an analysis of technical decision-making within a heated political climate.

The Water Budget

The Columbia River along with its largest tributary, the Snake, has been a prime source of electrical energy generation since the 1930s when Federal dam construction began. Today the Federal Columbia River Power System produces 13,000 megawatts (MW) of firm energy annually and provides Northwest consumers with some of the cheapest electrical energy in the nation. This cheap power, however, has come at a price. During the time that dams were constructed, Northwest salmon and steelhead runs have declined precipitously, threatening Indian treaty rights to fish and public enjoyment of one of the Northwest's unique natural resources. The commercial Columbia salmon catch has been reduced by two thirds. In recent years, the conflicts over management of the river system for fish and power have intensified.

The water budget, adopted by the Power Council in November 1982, was designed to address one of the fisheries interests' main concerns: the management of river flows to accommodate the downstream migration of juvenile salmon and steelhead. Salmon and steelhead, which hatch in the tributaries and streams, journey downstream each spring to the ocean where they live before returning upstream to spawn. Although considerable attention has been paid to the upstream migration needs of anadromous fish, the effect of dams and reservoirs on their downstream migration has been neglected.

Historically the fisheries agencies and tribes had requested minimum and optimum average daily flows for 12 months of the year, with emphasis on the juvenile migation period between April 15 and June 15. The fisheries interests, however, had no real authority over how the river was managed and had to

make their requests to Bonneville Power Administration (BPA) and the Army Corps of Engineers. Particularly in low flow years, when water was needed to meet firm energy needs, their requests were often rejected. In drought years, such as 1977, water was finally released from reservoirs for fish only after emergency measures were taken that involved the governors of four states, the treaty tribes, the Corps, BPA and the fish and wildlife agencies. The experience highlighted the need for better integration of fish needs into river planning and operations.

The Power Council accomplished this integration in two main ways: (1) it identified a specific volume of water, the water budget, to be assigned to fish during the April 15 to June 15 migration period and (2) it created two water budget manager positions to be filled by the tribes and the fish and wildlife agencies. These water budget managers would have control over the timing and shaping of the assigned volume of water. The water budget concept provided a way for fisheries interests to have real authority within the river planning system.

The initial estimate of the impact of the water budget on firm energy generation was 550 average megawatts, resulting in a per kWh cost to the electrical consumer of about .12 cents.

The Power Council's Decision-making Process

The formation of the Power Council was mandated by the Pacific Northwest Electric Power Planning and Conservation Act, which was passed by Congress in 1980. The Act assigned the Council two tasks. The first was to develop a Fish and Wildlife Program for the Columbia River Basin. The second was to develop an energy plan for the region. The water budget, which was adopted as the centerpiece of the Fish and Wildlife Program, was the first test of the Council's effectiveness as a regional planning body.

In taking on this task, the Council had two important assets: (1) a definitive law that provided detailed instructions on the objectives of the program, including providing "flows of sufficient quality and quantity . . . to improve the production, migration, and survival of [anadromous] fish," and (2) its members had considerable stature and were, for the most part, well-known to the public. Nevertheless, the Council stepped into an arena of highly contentious interest groups. As planners and decision-makers, they had to create a structure of incentives that would lead traditional opponents to act jointly. The following highlights aspects of the Council's planning and decision-making process.

(1) The Council steered clear of abstract issues, such as equitable treatment and the value of fish versus power, and focused instead on creating an environment that was conducive to learning and problem-solving on a scientific and technical level. The Council relied heavily on the work of the Instream Flow Work Group, a modeling work group established by the Corps that included representatives from the different interest groups.

(2) The Council's work reflected independence and neutrality and ensured equal power among all participants. This equality not only was conveyed during the development process, but also incorporated into the water budget solution by integrating representatives of the tribes and fish and wildlife agencies into river planning.

(3) The Council circumscribed its task such that significant steps towards solving the problem could be made without threatening the basic operating assumptions of the existing agencies. Although this limited the range of solutions, it made it politically more feasible for the Council to achieve a first step quickly.

(4) In keeping with the spirit of the Act, the Council adhered to an open process and fostered public debate of river management and allocation issues.

An important future agenda item for the Power Council is the coordination of research documenting the relationship of flows to fish survival. Existing data are scarce, making the water budget concept susceptible to challenge by nonfish interests. As the current surplus of regional energy supplies dwindles and pressures for increased power generation increase, fisheries interests and programs such as the water budget will become more vulnerable. A well-designed research program demonstrating the relationship of flows to survival will be essential when public debate once again heats up.

CHAPTER ONE

Introduction

In November 1982 the Northwest Power Planning Council (Power Council) adopted a Fish and Wildlife Program for the Columbia River Basin to "protect, mitigate, and enhance fish and wildlife, including related spawning grounds and habitat, on the Columbia River and its tributaries." [1] A key element of that program was the "water budget," a concept that provides Indian tribes and fisheries agencies with a specified amount of water above and beyond water for firm power generation. According to the plan, water budget managers assigned by these entities are allowed use the water budget to shape river flows to accommodate the yearly downstream migration of salmon and steelhead juveniles.

The water budget is unusual in that it has drawn the support of a number of traditionally contentious interest groups. Indeed the long history of political strife among the dam operators, the power managers, the fishery agencies, and the Columbia River Indian tribes would have left the most optimistic observer somewhat skeptical of the Power Council's ability to develop a viable solution. The

[1] Pacific Northwest Electric Power Planning and Conservation Act, Public Law 96-501, Section 4(h) known in this report as the Regional Act or the Act.

evolution of the water budget is a good example of scientific and technical decision-making in a heated political climate.

The fisheries "problem" developed because the Columbia River, once a seemingly inexhaustible resource, had reached its limits. It appeared to many that the river could no longer support the increasing demands for electrical power generation, flood control, irrigation, and recreation, without irreparable damage to a unique and irreplaceable resource -- runs of salmon and steelhead trout. Indeed several species of Columbia River anadromous fish were under consideration for the endangered species list. Fisheries advocates believed that one of the main reasons for the demise of the fish runs was that the natural, seasonal variability of the river flows had been altered to accommodate electric power generating needs. To rectify this, tribes and fisheries agencies wanted to ensure that adequate water remained in the river during the months that juvenile salmon migrate downstream.

Until the passage of the Regional Power Act which created the Power Council, attempts to allocate resources and to reconcile differences among the institutional groups had been confrontational and unproductive. The tribes and fisheries agencies lacked official authority to implement measures they considered necessary to protect the fish. For

this and other reasons, the fate of the fish continued to languish in a political and legal quagmire.

The passage of the Power Act, however, portended change. The tribes, in alliance with federal and state fisheries agencies, aggressively took advantage of the opportunity the Act provided for improving their position in river politics. According to the Act, the fish and wildlife program was to be based on the recommendations of the federal and state fish and wildlife agencies and appropriate Indian tribes. The newly formed Power Council would be the organizational mechanism for ensuring the program achieved the objectives of the fisheries agencies and the tribes. Federal and local power interests, recognizing the strengthened position of the fishery interests, waited anxiously on the sidelines. A long history of court decisions upholding Indian rights not only to fish but also to the environment that allows those fish to survive loomed in the background. Much was at stake.

Despite the history of the conflict, the issues were not purely legal and political. Major technical questions had to be answered. How much water did the migrating fish need? To what extent did flow levels affect survival? If you provide flows for fish, what will be the effect on power generation? On flood control? On reservoir-related recreation? For decades the conflicting interest groups had

come up with different answers to these questions. To create a viable solution to the problem it was clear that not only must there be a modicum of political agreement on policy but there must also be a general consensus on the scientific and technical conclusions upon which implementation of that policy is based.

This study of the Power Council's solution to the problem of fish flows, the water budget, includes an analysis of the relationship of policy making and resource management to scientific and technical analysis. In searching for a solution, the Power Council had to develop ways of evaluating and incorporating scientific and technical advice into the decision framework. Institutional biases had to be identified and common languages had to be developed among technical staffs. This was vitally important because it was clear that the solutions upon which the ultimate policy would rest could only result from creative problem solving on the part of the scientific and technical analysts.

In addition, the Council had to make its plans executable within the existing institutional framework. The water budget concept required delicate negotiations with numerous well-established management institutions in the basin. These institutions, created to manage the river for hydroelectric generation, flood control, irrigation, and

other legislated uses, have accrued great influence and power within the region. The history of their dealings with the tribes and fisheries agencies was laced with conflict. Clearly the water budget solution would succeed only if the institutions responsible for execution of the plan recognized and accepted the shift in balance that the water budget represented.

This study begins by examining, in the next two chapters, the history of the conflict and the major underlying issues that the Act tried to address. Chapter Four looks at the evolution of the Power Council and its role as negotiations and analysis of the problem progressed as well as other actors and their stakes in the outcome of the Council's work. Chapters Five and Six look at the technical evolution of the water budget and Chapter Seven attempts to analyze the progress made by the Power Council in bringing together these contentious interest groups and what the implications are for scientific and technical policy making in other similarly charged political environments.

This study deals only with one small portion of the Fish and Wildlife Program -- the water budget. Other parts of the program required resolution of different problems, with slightly different actors and interests. The water budget was selected as the focus of this study because it

provides a manageable microcosm of the controversial issues that have historically been tied to fish and wildlife management on the Columbia. Strategies applied to this particular problem have been applied elsewhere in the Council's work and provide important insight into the successes and failures of their negotiating strategies in general.

CHAPTER 2

Roots of the Conflict:
An Abundant Resource Becomes Scarce

In the Beginning

In its pristine state the Columbia River was a wild and often unpredictable home for millions of salmon and steelhead that spawned in its gravelly headwaters and tributaries. To the Indians who first knew them and the fish biologists who study them, they are in many ways a mystery. Hatched along the shady banks of tributaries and streams, these fry and smolts commence a journey to the sea that is often seven or eight hundred miles long. For two to three years these fish inhabit the oceans. Certain species have been known to wander thousands of miles before they return, negotiating rapids and waterfalls to the same tributary or stream where their journey began.

The 1,200-mile-long river, however, was not always an idyllic haven. Snow melt in the mountains each spring swelled the river to three to five times its winter flow. The extremes were readily apparent at Celilo Falls where the river flowing through a canyon only 400 yards wide would rise up to 50 feet. These spring floods sometimes became destructive, wiping out settlements and homes as the waters swept towards the sea.

At the beginning of the Eighteenth Century, 39 tribes totalling fifty to eighty thousand Indians, inhabited the Columbia River Basin. Their main source of nourishment was the salmon. It has been estimated that the per capita consumption averaged close to a pound a day during the entire year, an annual Indian catch of 18 million pounds per year. These fish were eaten fresh or dried and made into pemmican so they could be traded to tribes situated further from the river. [1]

Each year the fish returned, swimming upriver to the streams and tributaries, where ultimately they died. Why did the fish come upriver to die? Indian legend explained:

> What was more logical than the concept that the salmon ascended the streams to benefit mankind, died and then returned to life?... the salmon were a race of supernatural beings who dwelt in a great house under the sea. There they went about in human form, feasting and dancing like people. When the time came for the 'run' the salmon-people dressed in garments of salmon flesh, that is, assumed the form of fish to sacrifice themselves. Once dead, the spirit of each fish returned to the house beneath the sea. If the bones were returned

[1] Leo, Harris, Indian water rights in the Columbia Basin, IN Water Rights for Fish and Wildlife, Conference Proceedings, edited by Polly Dyer, Institute for Environmental Studies, University of Washington (March 4, 1978) pp. 105-110.

> to the water, the being resumed his form with no discomfort and could repeat the trip the next season. [2]

The lives and culture of the tribes revolved around the salmon and the river. Celilo Falls, later submerged by the construction of the Dalles Dam, was a major fishing area. Indians would perch on rocks and wooden platforms with spears and nets catching sometimes 20 fish per day. Chinook, known as Tyee to the Indians and the largest of the species, often reached 50 pounds. [3]

White men and women who began moving into the area in the early 1800s also were drawn to the great abundance of the river fisheries. The first salmon cannery was built on the Columbia in 1866. Within 20 years, there were 55 canneries located near or on the river packing 630,000 cases of one-pound cans of Chinook, valued at $13 million. Spurred by the high demand in New York and other eastern cities where one-pound cans of salmon sold for as much as 50 cents, as well as lucrative markets in the British Isles, commercial fishing on the river continued to increase. The white fishermen now competed vigorously with the Indians for

[2] Quote by Philip Drucker from Anthony Netboy's, The Columbia River Salmon and Steelhead Trout: Their Fight for Survival, Seattle: University of Washington Press (1980) p. 16.

[3] The source for the following discussion on early Columbia River fisheries is Anthony Netboy's book (see previous footnote) pp. 10-36.

the fish, and the spear and net gave way to less artful, but more efficient means of harvesting. Gillnets, purse seines, traps, wheels, dipnets, set nets, and troll lines choked the Columbia from Astoria to the Dalles, the lower reaches of the Snake River and other smaller rivers in the basin. Fish wheels, anywhere from 9 to 32 feet in diameter, scooped up thousands of migrating Chinook and deposited them in large bins on the shore of the river.

According to Francis A. Seufert, the last president of the Seufert Canning Company, in the flood year of 1894, when the river was higher than it had been in a century, the cannery's Phelps wheel caught 227,000 pounds of salmon between May 17 and July 31st, peaking at 42,000 pounds on July 2nd. Seufert and other entrepreneurs continued to harvest, can, and ship this seemingly undiminishable resource for many years. In the years 1916-1920, the commercial fishing catch reached an all time high of 41.2 million pounds per year. From then on it declined. By 1946 the average annual commercial salmon and steelhead landings totaled 17.3 million pounds, down 23.9 million pounds from the 1920s.

Meanwhile the Indians and their traditional ways of life were beginning to change. In the mid 1850s, four Columbia Basin Tribes -- the Umatilla, the Warm Springs, the Yakima Nation, and the Nez Perce -- signed 14 different

treaties known as the Stevens treaties, with the United States. By signing these treaties, the Indians ceded title to 64 million acres of land to the new Washington Territory. In signing these treaties, however, the Indians reserved certain rights, including the "right to continue fishing as an economic and cultural way of life."

Much has changed since those treaties were signed. Now more than 79 dams dot the rivers and tributaries of the basin. The once unpredictable Columbia is now carefully controlled by a series of giant dams which have transformed its rushing waters to a series of long, quiet reservoirs that are filled and emptied in anticipation of floods and power and irrigation needs. The riverside towns and villages are safe, but the entire upper half of the Columbia has been effectively closed off to salmon. The river is no longer regarded primarily as a source of fish production but rather of electrical energy.

Despite this, the rights of the Indians have been upheld time and time again in the courts. These rights include (1) the right to fish in their usual and accustomed places and to receive a fair share of the harvestable catch (2) the right to an adequate supply of water and (3) a trust relationship with the U.S. government whereby the government acts as the guardian in the best interests of the tribes. In recent years these legal rights have emerged as

a key lever for change in the Columbia River Basin. Today, however, the Indian's main competitor on the river is no longer the white fisherman. Indeed on the river, the white fisherman and the Indian have become hesitant allies. Together they are challenging what they see as a formidable obstacle to the preservation of the Columbia River salmon--the public and private power managers.

The Federal Vision

There were several motivations for taming the Columbia. The earliest was the desire to make it more suitable for navigation. The river was a natural transportation corridor for explorers, adventurers and other skilled boatsmen, but to be a viable trading corridor, precipitous water falls and rapids had to be eliminated. Another early motivation for controlling the Columbia was the frequent flooding as well as the desire to provide water for irrigation to the farmers in eastern Washington.

The year 1933 was momentous for the Columbia River Basin. President Roosevelt authorized an expenditure of $60 million for the construction of Grand Coulee dam, the largest in the world. That same year $20 million was authorized for Bonneville Dam. These were the first projects in a much larger scheme proposed by the Army Corps of Engineers to build a series of dams on the Columbia between the Canadian border and the Pacific Ocean. The main

impetus for construction of Bonneville was to eliminate the navigational barrier created by the Cascade Rapids and was the first step towards enabling barges to navigate north into Washington and Idaho wheat country.

The main impetus for Grand Coulee was providing irrigation. At its completion in 1942, it had an impoundment capacity of 5.32 million acre-feet, enough storage to irrigate 500,000 acres of semi-arid land. An important byproduct of dam construction was the generation of electricity, something that elicited much personal interest and enthusiasm on the part of President Roosevelt. At the dedication of Bonneville dam he articulated a vision.

> In developing electricity from this Bonneville Dam, from the Grand Coulee Dam and from other dams to be built on the Columbia and its tributaries, the policy of the widest use ought to prevail. The transmission of electricity is making such scientific strides today that we can well visualize a date, not far distant, when every community in this great area will be wholly electrified. [4]

In fact the two dams generated 2.5 million kilowatts of electric power. To administer the marketing and transmission of power, Congress passed the Bonneville Project Act which created the Bonneville Power

[4] Bonneville Power Administration, Columbia River Power for the People: A History of Policies of the Bonneville Power Administration, DOE-BP-7, US Government Printing Office, 1981-796-874, p. 21.

Administration. With the responsibility for the actual operation of the dams in the hands of the Corps of Engineers, the new Bonneville Power Administration constructed a complex network of transmission lines to transport the power throughout the region. In many ways the economic vitality of the region became tied to the cheap electricity of the big dams.

The construction of dams continued in the Columbia and the Snake, the Columbia's largest tributary. McNary Dam was completed in 1953, Chief Joseph in 1955, the Dalles Dam in 1957, Ice Harbor Dam in 1961, Lower Monumental Dam in 1969, Little Goose in 1970, and Lower Granite in 1973. The location of these dams and others in the Columbia River system are shown in Figure 2.1.

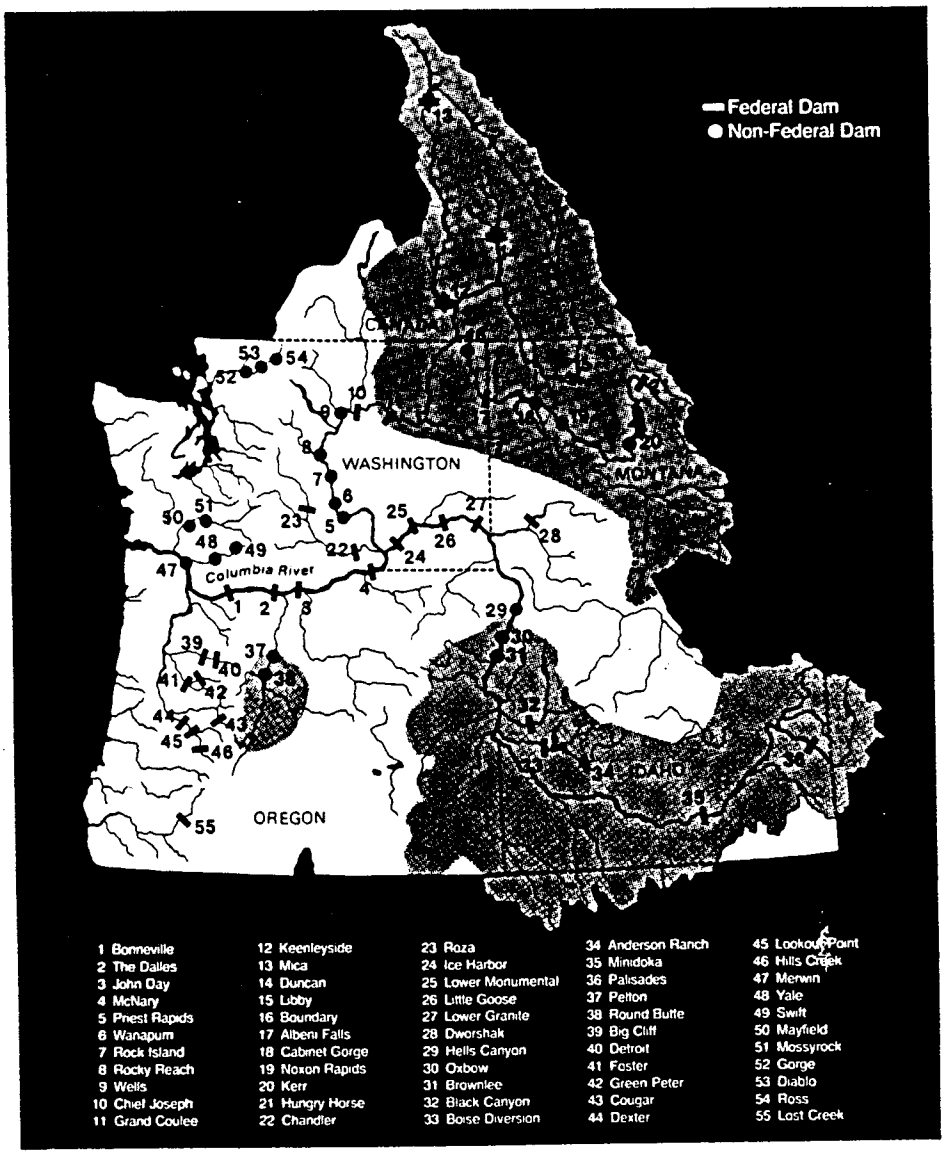
In 1964, Canada consented to the construction of Libby Dam in Washington state, which flooded vast amounts of land in Canada, adding 5 million acre-feet of storage capacity to the Columbia Basin. When this project and others required by the treaty were completed in the mid-1970s, 15.5 million acre-feet of storage was added to the basin, substantially increasing the ability of BPA and the Corps to manipulate river flows to accommodate needs for peak power.

Today the firm energy capability of the 28 federal dams totals 13,000 average Megawatts (MW). BPA's main power grid now provides 80 percent of the region's bulk power

FIGURE 2.1

Federal and Nonfederal Dams
in the Columbia River System

Shading indicates area lost to fish migration and spawning as a result of hydroelectric projects.



(Adapted from Northwest Energy News (September/October 1982) p. 17.)

transmission capacity and the transmission systems of 15 major utilities in the Pacific Northwest and British Columbia. Individual systems are connected to the main power grid and then to each other at 215 points. In addition, these grids are connected to nine California systems via the Pacific Northwest/Pacific Southwest Intertie. This pooling capability greatly aids the efficient use electricity. [5]

In many respects, BPA has done its job well. Roosevelt's dream is a reality. Average residential consumption of electricity in the Northwest area served by the dams is about 20,000 kWh per year at a cost of about 2.5 cents a kWh, while average national consumption is only about 6,000 kWh at 6 cents per kWh. [6] Industries, attracted by the plentiful, cheap power, moved into the area. In 1976 the Aluminum industry consumed 16.6 billion kilowatt-hours (kWh) of electricity, about 24% of the total electrical usage in the Northwest. [7]

[5] Larry Hittle, et al., Pacific Northwest power generation, multipurpose use of the Columbia River and regional energy legislation: an overview, Environmental Law 10:2 (Winter 1980) p. 266.

[6] POWER, The People's Power Guide: A Manual of Electric Utility Policies for Consumer Activists, Olympia: POWER (1982) p. 5.

[7] Larry Hittle et al., Ibid., p. 268.

Irrigation also has brought benefits to the region. The Bureau of Reclamation maintains nine dams in upstream locations in the basin and 7.5 million acres of land are now under irrigation. Direct benefits to farmers resulting from these projects equals $80 million in increased income annually. In addition, secondary benefits are realized by the thousands of employers and employees who are involved in farm-related industry. The irrigation projects are also major consumers of electricity, using 800 million kWh to lift and relift water to canals and lateral systems that carry water to the farmers while each farmer uses about 730 kWh per acre per season to sprinkle crops. [8]

The Eisenhower Era

The Eisenhower era of the 1950s brought a new philosophy and new dams to the river. The harnessing of the Columbia was no longer to be solely a federal effort. This new "partnership policy" was an attempt to replace federal sponsorship by getting private and and public utilities actively involved in power development on the Columbia River. As part of this policy, Congress cancelled federal

[8] Larry Vinsonhaler, A reclamationist discusses hydropower/irrigation/ fish interactions, IN Water Rights for Fish and Wildlife, Conference Proceedings, Polly Dyer, editor, Institute for Environmental Studies, University of Washington (March 4, 1978) p. 47-49.

plans to build a dam at Priest Rapids in order to allow Grant County PUD to take over the project. Subsequently licenses were granted to Grant County PUD for Wanapum Dam, to Chelan County PUD for Rocky Reach Dam and to Douglas County for Wells Dam. These Mid-Columbia dams were financed with bonds secured with long-term sales contracts with utilities throughout the region including Seattle City Light, Puget Sound Power and Light, Portland General Electric, Pacific Power and Light, Washington Water Power, Tacoma City Light, and with Alcoa Aluminum Company.

The Snake River also continued to be harnessed for electricity during this partnership era. In 1953 the Middle Snake was turned over to the Idaho Power Company when the private utility requested a license for three power projects: Hells Canyon, Oxbow, and Brownlee. These dams were approved by the Federal Power Commission and the utility completed them in the late 1950s and 1960s.

The Fate of the Fish

The proliferation of dams along the Columbia continued unabated into the 1970s. But a hidden cost of these dams became increasingly evident as the Columbia River salmon and steelhead runs declined precipitously. The events surrounding the completion of Grand Coulee portended the potentially catastrophic effects these dams could have on anadromous fish. When the unladdered dam was completed, it

closed off 1000 miles of upriver salmon and steelhead spawning areas, locking out 17,000 Chinooks, 8,000 bluebacks, and 3,000 steelhead trout that normally traveled 600 miles up from the ocean. [9]

In 1939, two years before the completion of Grand Coulee Dam, it was recognized that the great dam would have a significant effect on Chinook migrating to upstream spawning areas. In an effort to save the runs, fish arriving at the dam were trapped and transplanted to the Methow, Entiat, and Wenatchee Rivers. Today many of the fish in those rivers are the remnants of the upper Columbia salmon and steelhead runs.

The original design for Bonneville Dam also had no provision for fish. When queried about this, the Chief of the Corps of Engineers allegedly responded, "We do not intend to play nursemaid to the fish!" [10] The public apparently felt otherwise, however, and the Corps was eventually pressured into redesigning the dam to include an elaborate system of fish locks and ladders, at a cost of $7 million. The ladders, which proved the most successful, were a series of stepped up pools, with a vertical drop of one foot between them. Water pours down the pools inducing

[9] Anthony Netboy, Ibid., p. 73.

[10] Ibid., p. 75.

the fish to swim or jump from one to another.

No one knew in 1938 when the dam was officially put into operation whether in fact these fish ladders would work, yet the survival of the fish runs above Bonneville dam depended on their success. It was with great anticipation that the public waited for the salmon to make their upriver journey. More than one million fish scaled the 65-foot dam in 1938 of which 470,000 were salmonids. It was with great relief that the dam developers announced to the world that indeed the dams and the fish could coexist. [11]

Despite this attention to the structural needs of adult salmon migrating upstream, the salmon's battle for survival was not won so easily. The dams destroyed more than one-half the available spawning grounds. Chief Joseph Dam, constructed in 1955 below Grand Coulee, contains no fish passage facilities and cuts off the upper reaches of the Columbia to the migrating fish (see Figure 2.1). Hells Canyon Dam completed in 1967 by the Idaho Power Company, cuts off the upper reaches of the Snake River.

In addition to elminating spawning grounds, the dams radically changed the natural variability of the river. Before the dams, the natural runoff peaked each spring, coinciding with the downstream migration of juvenile salmon.

[11] Ibid., p. 77.

Now, however, spring flows are stored in reservoirs in anticipation of the following winter's peak electrical energy needs. As a result, particularly in low flow years, there is no spring swell of water to carry the salmon and steelhead to the sea. Figure 2.2 shows the generalized effect of managing the river system for power generation.

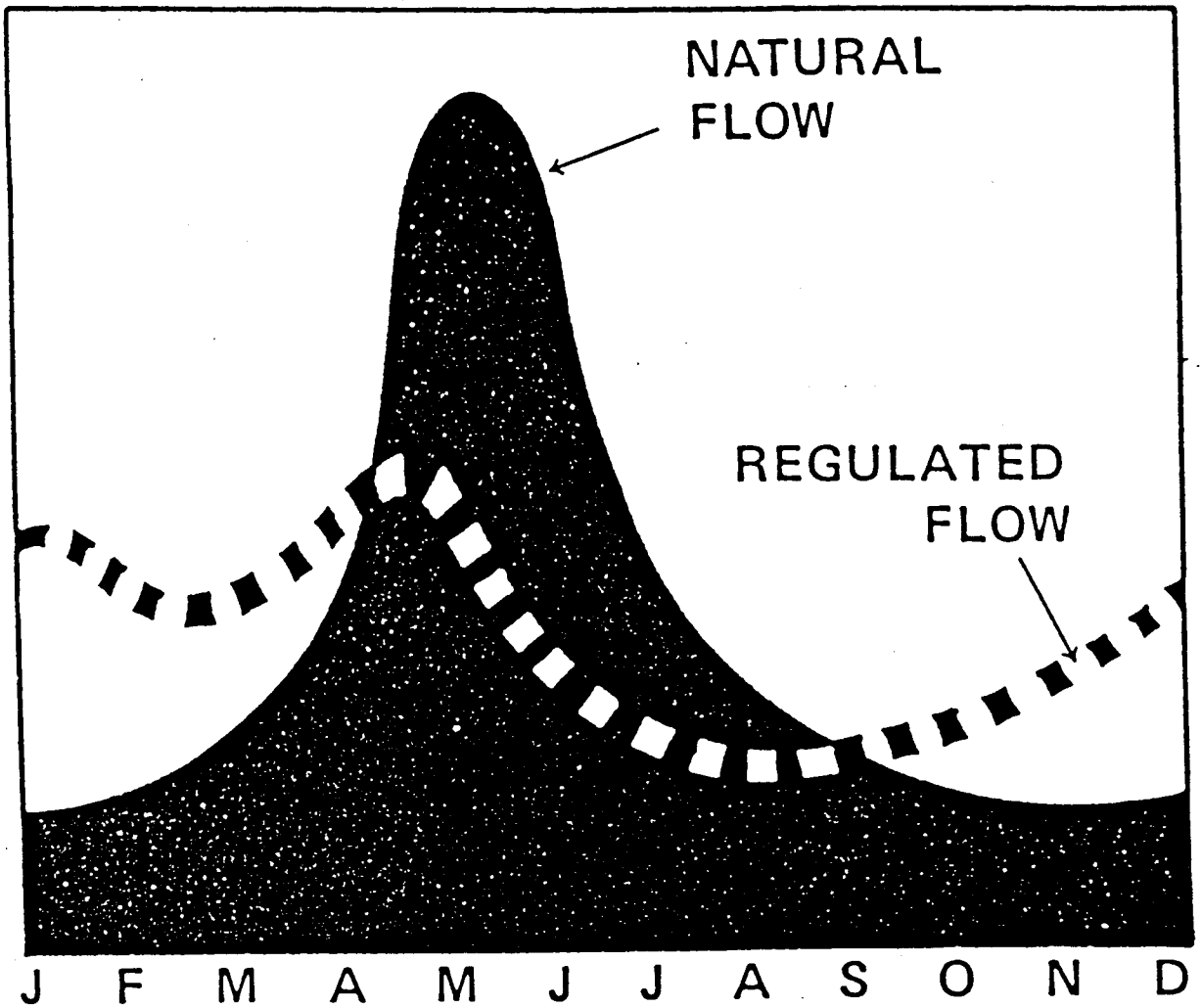
The level and pace of flows during the spring months are important because it has been shown that juvenile salmon and steelhead migrating to the ocean must adhere to a strict time schedule. If their journey is delayed, their chances of survival are significantly decreased. Smoltification, a physiological process which produces the urge to migrate in young salmon, appears to take place between 42 degrees farenheit and 53 degrees farenheit. Below 42 degrees, the young fish are sedentary, above 53 degrees, the fish rapidly revert to a preadolescent state called "parr." Survival levels for adolescent fish that have reverted to this state can drop as much as 80 percent. [12]

During the spring months, the Columbia River system varies in the amount of time it maintains the temperature window. But the time period is particularly short in low flow years, and temperatures above 54 degrees are regularly

[12] Columbia River Fisheries Council, Rationale for Instream Flows for Fisheries in the Columbia and Snake Rivers (February 1979) p. 5.

FIGURE 2.2

Generalized Effect of Reservoir Operations on Main-stem Columbia River Flows near the Dalles, Oregon



(Adapted from Ed Chaney, A Question of Balance: Water/Energy -- Salmon and Steelhead Production in the Upper Columbia River Basin, Northwest Resource Information Center, Inc. (November 1978) p. 6.)

reached inthe Columbia by mid May. Because major downstream migrations usually begin in mid-April, the fish have only 30 days to make their journey if the effects of temperature are to be minimized. This time limit is also supported by research on coastal coho smolts which shows that elevated levels of thyroxin, the chemical indicative of smoltification, are only maintained in the migrating fish for 30 days regardless of the temperature of the water. [13] Therefore, fisheries biologists argue that it is critical that salmon and steelhead complete their seaward migration in less than 30 days.

Evidence shows, however, that the dams and reservoirs have significantly retarded the salmon's spring travel schedule. Riding the rushing waters of the spring thaw, migrating smolts took 22 days to travel from the Salmon River to the Lower Columbia during low flow years; it now takes more than twice as long to negotiate the series of regulated reservoirs. [14] The Columbia River Inter-tribal Fish Commission (CRITFC) estimates are even higher. They

[13] For a discussion of the travel time rationale, see the CRFC report, Rationale for Instream Flows for Fisheries in the Columbia and Snake Rivers (February 1979) and Mal Karr's paper, Evaluation of Fish Flow Options: Biological/Hydrological Considerations, (July 1982).

[14] Wesley Ebel et al., Status-Report 1978; the Snake River Salmon and Steelhead Crisis; Its Relation to the Energy Shortage, NMFS (September 1979) p.14.

claim that the existing system of six reservoirs in the 240 miles from Lower Granite Dam to the Dalles Dam has increased travel time over free flowing stream conditions 15 times when flows are at 50,000 cubic feet (cfs) per second and six times when flows are at 300,000 cfs. [15]

In addition to a lack of water in the spring, the dams themselves present significant hazards. Smolts in the sluggish regulated waters behind the dams become listless and disoriented and more susceptible to predators. Many fish that are sucked into the hydraulic turbines die; others are bruised and often disoriented when disgorged on the downstream side of the river, easy prey for predators. It has been estimated that turbine related mortalities are as high as 30 percent at some dams when indirect mortality from predation is included. [16]

In high flow years, water is spilled over the dam, creating another potential hazard, nitrogen supersaturation. Although many of the fish are spared the turbines in these years and swept instead over the dams, if flows are too high, the water crashing over the dams becomes saturated with atmospheric gases that are lethal to fish.

[15] Mal Karr, Analysis of Columbia River System Water Supply vs. Streamflows for Fish During Low Runoff Periods, CRITFC, (August 1982) p. vi.

[16] Wesley Ebel et al., Ibid., p. 9.

In 1978 a General Accounting Office (GAO) report listed four main reasons for the decline of salmon fisheries in the Columbia basin, including (1) logging and other watershed development that removes groundcover and increases sediments, (2) irrigation withdrawals that reduce streamflows, and (3) overfishing in fresh and ocean waters. However the main cause, according to the report, was the construction and operation of the series of dams on the mainstem Columbia, the Snake River and their tributaries. [17] Indeed when there were only two big dams on the Columbia, 60 to 80 percent of juveniles survived the journey to the sea. [18] Now cumulative mortalities of downstream migrants are estimated to be as high as 95 percent in low flow years and 40 to 65 percent in moderate flow years. [19]

The decline of Columbia Basin upriver salmon and steelhead is shown in Table 2.1 and Figures 2.2 to 2.5. Basically, there are four upriver species: chinook, sockeye,

[17] Michael C. Blumm, Hydropower vs. the Salmon: the struggle of the Pacific NW's anadromous fish resources for peaceful coexistence with the Federal Columbia River Power System, Reprinted from Environmental Law 11(211):212-300 1981 by Oregon State University Sea Grant College Program, Pub. No. ORESU-R-80-025, p.216

[18] Anthony Netboy, Ibid., p. 99.

[19] Michael Blumm, Anadromous Fish and Federal Water projects in the Columbia Basin, Anadromous Fish Law Memo, Issue 1 (June 1979), p. 3.

TABLE 2.1

Decline of Salmon and Steelhead Runs

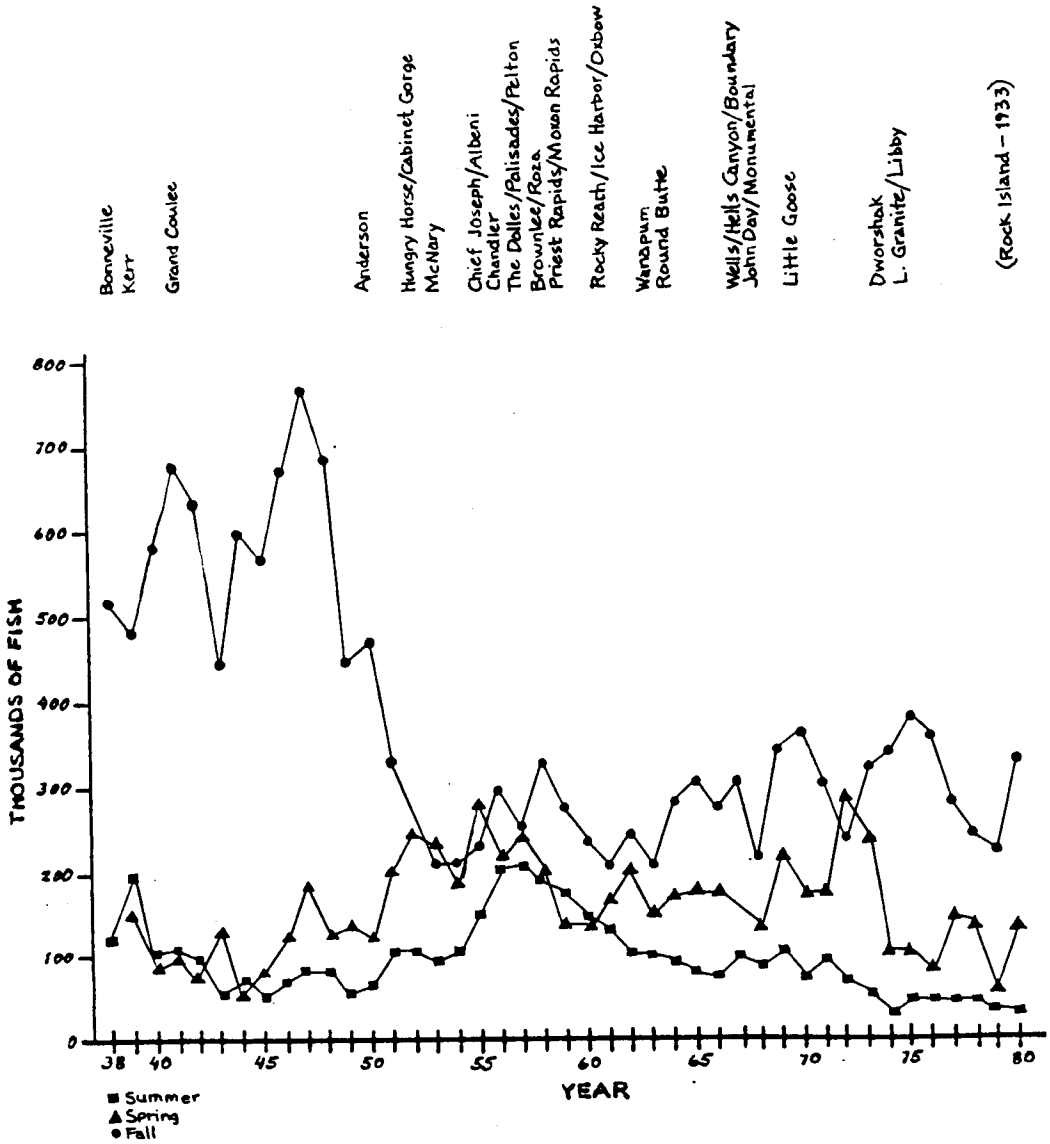
This table shows the estimated numbers (in thousands) of upriver salmon and steelhead entering the Columbia River. (Note: upriver is defined as destined above Bonneville Dam; coho count is at Bonneville Dam.)

Year	Spring Chinook	Summer Chinook	Fall Chinook	Sockeye	Summer Steelhead	Coho
1938	--	123	516	168	250	15
1939	152	192	480	125	232	14
1940	90	113	558	196	423	12
1941	108	106	678	174	337	18
1942	77	95	627	94	297	12
1943	131	57	447	73	216	6
1944	56	67	596	25	232	4
1945	83	53	566	11	268	1
1946	124	72	670	101	268	4
1947	186	86	761	335	262	11
1948	126	87	682	143	240	4
1949	138	58	446	53	162	1
1950	120	69	469	113	179	10
1951	206	116	333	204	244	5
1952	246	114	242	319	383	8
1953	229	95	213	260	361	13
1954	189	115	192	180	290	4
1955	281	148	232	245	299	4
1956	217	195	298	202	201	6
1957	253	207	252	147	230	5
1958	198	187	328	313	211	4
1959	138	170	274	271	232	3
1960	134	143	230	179	200	3
1961	162	129	206	58	228	4
1962	200	108	245	39	252	15
1963	147	100	207	65	229	13
1964	169	97	280	105	179	54
1965	176	82	304	55	227	76
1966	175	75	268	169	209	72
1967	151	101	308	165	167	96
1968	134	89	210	135	162	63
1969	216	106	341	76	172	49
1970	171	73	359	85	138	80
1971	168	90	296	150	225	76
1972	281	77	235	123	226	66
1973	233	49	318	61	188	55
1974	108	34	238	44	145	61
1975	104	44	374	58	84	58
1976	78	42	359	44	122	53
1977	144	41	275	100	196	19
1978	129	43	240	18	105	53
1979	51	34	220	53	114	45

(Adapted from Ad Hoc Committee, Initial Recommendations for the Protection, Mitigation, and Enhancement of Anadromous Fish in the Columbia River Basin (December 1981) p. 98.)

FIGURE 2.3

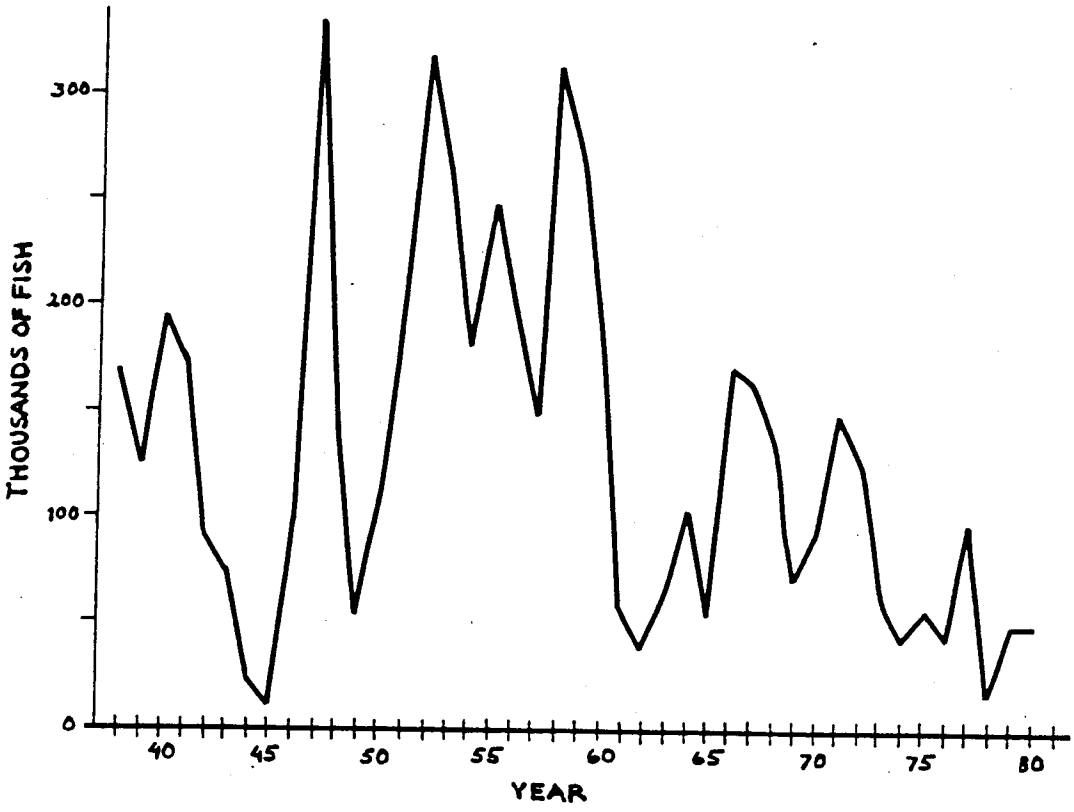
Estimated Numbers of Chinook Salmon Entering the Columbia River 1930-1980 and Major Dams by Year of Completion



(Adapted from Ad Hoc Committee, Initial Recommendations for the Protection, Mitigation, and Enhancement of Anadrmous Fish in the Columbia River Basin (December 1981) p. 99.)

FIGURE 2.4

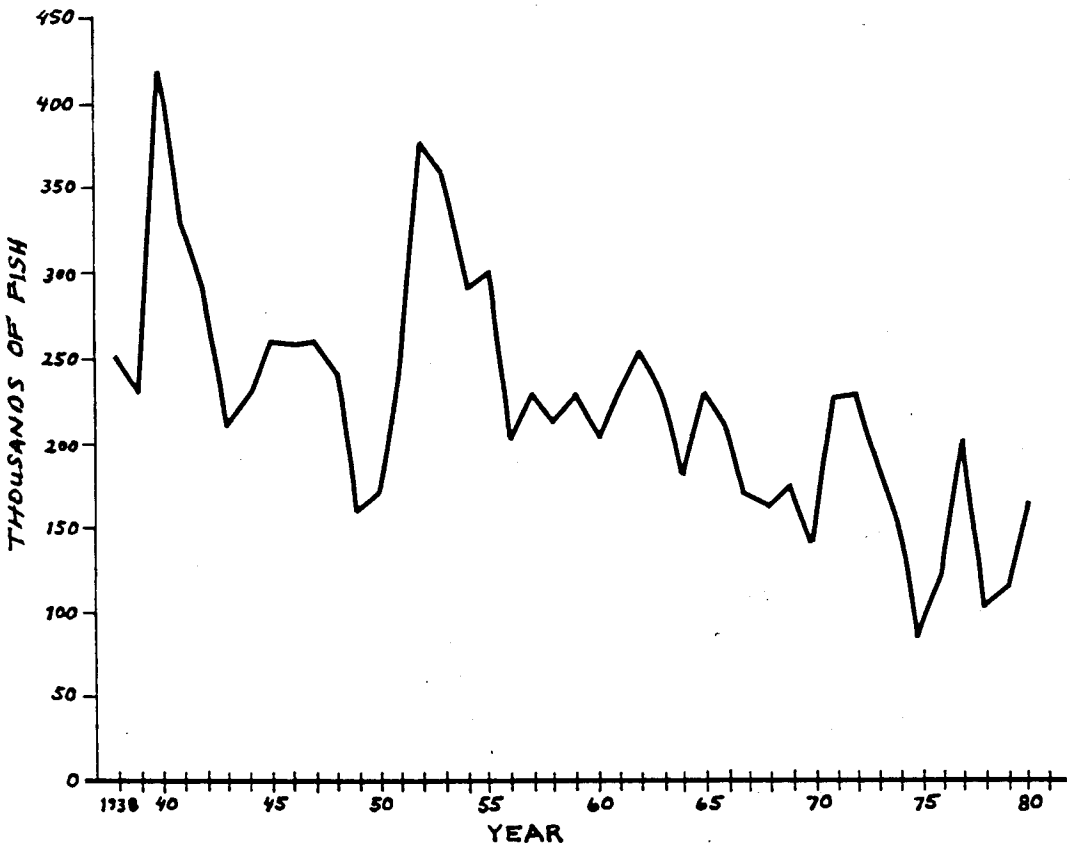
Estimated Numbers of Sockeye Salmon Entering the Columbia River 1938-1980



(Adapted from Ad Hoc Committee, Initial Recommendations for the Protection, Mitigation, and Enhancement of Anadromous Fish in the Columbia River Basin (December 1981) p. 100.)

FIGURE 2.5

Estimated Number of Upriver Summer Steelhead Entering the Columbia River 1938-1980



(Adapted from Ad Hoc Committee, Initial Recommendations for the Protection, Mitigation, and Enhancement of Anadromous Fish in the Columbia River Basin (December 1981) p. 101.)

summer steelhead, and coho. Listed below are descriptions of the species and their status according to the fisheries agencies and the tribes. [20]

Chinook (Oncorhynchus tshawytscha)

Also known as king salmon or tyee, this is the largest species, averaging 15-25 pounds. Since 1957 commercial fishing of chinook has been prohibited above Bonneville Dam except for Indian set net fishing. Chinook on the Columbia consist of the fall, summer, and spring runs. Fall chinook have continued to be the most abundant resource in the river system. Because most of the production has been from hatcheries in the lower Columbia, the lower river stocks have been less severely impacted by the dams. The sharp decline in the 1940s is due to increased harvest by ocean fisheries. Summer chinook have shown a steady downward trend since 1957 and are the most depressed of all runs. By 1980, the run dropped to 35,000 fish from a high of 200,000 in 1957, a decrease of 83 percent (see Figure 2.3). Runs of spring chinook have fluctuated as new hatcheries caused increases and new dams caused

[20] Figures on the status of these species are from the Initial Recommendations for the Protection, Mitigation, and Enhancement of Anadromous Fish in the Columbia River Basin submitted by the Ad Hoc Committee to the Power Council and published in December, 1981.

decreases. In 1979 returns reached an all time low of 51,000 fish.

Sockeye salmon (Oncorhynchus nerka)

Also known as the blueback of the Columbia River, this fish weighs on the average, 3-5 pounds at maturity. Generally sockeye hatch in streams adjoining lake where they spend a year or more before they begin their long migration to the sea. The last commercial sockeye season was in 1972. The 1980 runs of 50,000 fish represent only 19 percent of the 1953 run and is only 38 percent of the 43-year average.

Coho salmon (Oncorhynchus kisutch)

Also known as silvers, these fish weigh an average of 7 to 9 pounds. Coho have managed to increase due to the use of hatcheries to augment natural runs. Hatchery production, however, has been directed to releasing smolts below Bonneville Dam, thus maintaining the lower river runs. Commercial fishing of coho above Bonneville is no longer allowed.

Steelhead trout (Salmo gairdneri)

This fish weighs an average of 9-10 pounds and has many of the characteristics of salmon, including the habit of spending several years in the ocean before returning upstream to spawn. Between 1940 and 1979, estimated

runs decreased by 276,000 fish or 73 percent.

By the late 1970s, the situation, in the eyes of the fisheries advocates, had reached crisis proportions. Dams constructed by Idaho Power Company along the mid-Snake had proved disastrous to fish. At Brownlee an elaborate and expensive fish skimmer system which was supposed to scoop the fish over the dam proved a total failure. All attempts to mitigate the effects on downstream migration of anadromous fish proved futile. Fish migration through the middle Snake was completely blocked. The utility gave up and constructed a hatchery in compensation. The subsequent decline of the Snake River runs was so dramatic that in 1978 the Department of Interior filed for these species to be considered for protection under The Endangered Species Act.

While the resources of the basin remained abundant, the environmental costs of irrigation and electric power development remained hidden. But now it was clear that the waters of the Columbia had reached their limits. It was in this context that in 1980, the Regional Power Act was passed with its provisions for fisheries mitigation on the Columbia.

CHAPTER THREE

A Resource in Transition

The Law and the Issues

The New Law

The Pacific Northwest Electric Power Planning and Conservation Act was one of the last bills President James E. Carter signed into law in 1980. At the time of its passage the Bonneville Power Administration had projected an electricity shortage for the region and a notice of insufficiency had been sent to affected utilities. One of the purposes of the Act was to alleviate this power planning crisis by developing an energy plan for the region. As described by the Act, this plan was to be revolutionary in many ways. It was to be developed by a new regional entity, called the Pacific Northwest Conservation and Electric Power Planning Council, composed of representatives from each of the four Northwest states. The Power Act placed conservation and renewable resources as the priority resources and allowed BPA to regionalize the cost of new resources, authorizing acquisition of new resources by BPA and providing billing credits for conservation and acquisition of new resources by local utilities.

Energy planning, however, was not the only novel aspect of this law. Embedded in the Act was an important provision for shifting the traditional balance between fish and wildlife on the one hand and power on the other. The Act explicitly stated that one of its main purposes was:

> (6) to protect, mitigate and enhance the fish and wildlife, including related spawning grounds and habitat, of the Columbia River and its tributaries, particularly anadromous fish which are of significant importance to the social and economic well-being of the Pacific Northwest and the Nation and which are dependent on suitable environmental conditions substantially obtainable from the management and operation of the Federal Columbia River Power System and other power generating facilities on the Columbia River and its tributaries. [1]

The law further expanded on this notion in Section 4(h) which outlines a program to be developed that is to protect, mitigate and enhance fish and wildlife within the Columbia River Basin.

According to the Act, the program developed for the Columbia Basin was to contain (1) measures to be implemented by Bonneville Power Administration and other Federal agencies to mitigate harm done to fish and wildlife as a result of development of hydroelectric projects in the basin, (2) objectives for the development and operation of new projects, and (3) fish and wildlife management

[1] Pacific Northwest Electric Power Planning and Conservation Act, Public Law 96-501, Sec. 2, known in this report as the Regional Power Act or the Act.

coordination and research and development to assist in the protection, mitigation and enhancement of anadromous fish at and between the dams. Specifically, the Act required that the Council include program measures that

> (A) complement the existing and future activities of the Federal and region's State fish and wildlife agencies and appropriate Indian tribes:
> (B) be based on, and supported by, the best available scientific knowledge;
> (C) utilize where equally effective alternative means of achieving the same sound biological objective exist, the alternative with the minimum cost;
> (D) be consistent with the legal rights of appropriate Indian tribes in the region; and
> (E) in the case of anadromous fish--
>
> (i) provide for improved survival of such fish at hydroelectric facilities located on the Columbia River system; and
> (ii) provide flows of sufficient quality and quantity between such facilities to improve production, migration, and survival of such fish as necessary to meet sound biological objectives. [2]

This study focuses primarily on the aspects of the Fish and Wildlife Program dealing with the provision of adequate flows, especially during smolt migration. However, the complexity of this issue cannot be completely appreciated without an understanding of the social and economic context of the decision-making. The requirements of the Act address many issues that have been hotly debated throughout the region. These issues and relevant sections of the law are examined in the remainder of this chapter.

[2] Ibid., Sec. 4(h)(6).

A Question of Equity -- The Institutional Framework

In section 4(h) the scope of the program and the responsibilities of the relevant agencies, such as the Corps of Engineers, the Bureau of Reclamation, and the Federal Energy Regulatory Commission, are addressed. Specifically the Act states

> (11)(A) The Administrator and other Federal agencies responsible for managing, operating, or regulating Federal or non-Federal hydroelectric facilities located on the Columbia River or its tributaries shall--
>
> (i) exercise such responsibilities consistent with the purposes of this Act and other applicable laws, to adequately protect, mitigate, and enhance fish and wildlife, including related spawning grounds and habitat, affected by such projects or facilities in a manner that provides equitable treatment for such fish and wildlife with the other purposes for which such system and facilities are managed and operated.
>
> (ii) exercise such responsibilities, taking into account at each relevant stage of decisionmaking processes to the fullest extent practicable, the program adopted by the Council . . . [3]

The word "equitable" had been the focus of much attention both by fisheries advocates and power managers before the bill was signed into law. Exactly what did the word mean? How did one treat such different resources equally? BPA and other federal operating agencies had been managing planning and river flows to maximize the purposes they represented --

[3] Ibid., Sec. 4(h) [emphasis added].

power, irrigation, recreation, and flood control. The wording of this law had significant implications. The existing management institutions on the Columbia now had to make room for yet another purpose -- the adequate protection of fisheries. In a system where allocation of water was delicately balanced among several competing uses, the addition of another as a firm constraint portended a significant shifting of the institutional balance.

Interestingly, the passage of the Power Act was not the first time that Congress had requested equitable consideration of fish and wildlife on the Columbia. The Wildlife Coordination Act, passed in 1934 and amended in 1946 and 1958, had as one of its objectives "to provide that wildlife conservation shall receive equal consideration and be coordinated with other features of water resource development programs." [4] This Act, which applied to impoundments, diversions, or modifications of waters which involved surface areas of more than 10 acres, was implemented through consultations with the Fish and Wildlife Service, National Marine Fisheries Service, and other state fish and wildlife agencies. The law requires these agencies to submit recommendations to the federal development agency

[4] Michael Blumm, Fish and wildlife program approval issues: a legal perspective on scientific proof, economic cost, and Indian treaty rights, Anadrmous Fish Law Memo 17(April 1982) p. 4-5.

which must then include all justifiable means and measures for wildlife in the project such that "maximum overall project benefits" are obtained.

This consultation process, however, was generally considered by fisheries advocates to be a failure. Three reasons for this were (1) recommended actions to benefit fish could be rejected if they were "unjustifiable" in the eyes of the river planning agencies, (2) the burden was on fish and wildlife agencies to prove fish losses would occur, a task difficult to accomplish until the dam was constructed and (3) mitigation measures implemented as a result of the Act were disproportionately located in the lower part of the river. [5] In fact, in responding to National Marine Fisheries Services' comments on a 1981 environmental impact

[5] Michael Blumm, Hydropower vs. salmon: the struggle of the Pacific Northwest's anadromous fish resources for peaceful coexistence with the Federal Columbia River Power System. Reprinted from Environmental Law 11(211):212-300, 1981 by Oregon State University Sea Grant College Program, Pub No. ORESU-R-80-025, p. 260.

statement prepared on the Role of BPA in the Pacific Northwest Power Supply System, BPA stated that the Fish and Wildlife Coordination Act did not apply to BPA's power planning and coordination functions. [6]

A precedent of a different sort was set in a suit brought by Umatilla Reservation which challenged proposals to increase peaking capacity on the river. As a result of the suit, BPA signed a memorandum of understanding (MOU) with the tribes that stated

> Operation of [Federal Columbia River Power System] may be subject to restraints on peaking and rates of flow for the protection of the fishery resource, even though such restraints may reduce power generation. [7]

However, despite statute and case law, participation by fisheries agencies in the river planning process remained from their perspective inadequate. In March 1975, the Corps established the Committee on Fisheries Operations (COFO) which advised the dam operators on policies and operating plans that would protect the fishery resources. Funding for

[6] Ad Hoc Committee, Initial recommendations for the protection, mitigation, and enhancement of anadromous fish in the Columbia River Basin, IN: Recommendations for Fish and Wildlife Program under the Pacific NW Electric Power Planning and Conservation Act; Volume I and II. Portland: Northwest Power Planning Council (December 1981), p. 14.

[7] Memorandum of Understanding Between the Bonneville Power Administration and Columbia Basin Indian Tribes (November 29, 1976).

a full time "smolt coordinator" on this committee was provided by BPA. Although the fisheries agencies and tribes found COFO useful because it allowed them to get better acquainted with the technical aspects of river operation and power management, many saw the group as only advisory and therefore largely ineffective. According to Janet McLennan, Assistant Power Manager at BPA, COFO convened each November or December to develop plans for dealing with spill as well as flow requirements for fish. When it came to actual decision-making meetings, however, only BPA and the Corps were involved -- the fisheries agencies were not invited. "It was not a very democratic process," she said, "and was the source of much tension." [8]

In summary, attempts to obtain consideration for fish were often frustrated. Annual requests for fish flows during spring smolt migration were often turned down. An MOU between the Corps and BPA states that the Corps will override BPA power schedules to avoid harmful effects on fish only so far as practicable. Indeed the secondary nature of the status of fish in dam operation is reflected in the comments of Mr. L.W. Lloyd, regional director of the Bureau of Reclamation, in comments during Power Council hearings when he admitted that when fish flows are provided

[8] Interview with Janet McLennan, Portland, Oregon (May 26, 1983).

on a water-availability basis, fish usually take a secondary position. [9]

Section 4(h) of the new law threatened to disrupt the delicate balance of power between BPA, the Corps, the Bureau of Reclamation and the public and private utilities. If fisheries interests were to be incorporated into river planning equally, they would have to be accorded equal institutional status in the planning process.

A Question of Equity--the Economic Perspective

Clearly implementation of any fisheries program that shifted away from the institutional status quo was going to carry with it significant financial implications for the power industry. For this reason the power interests referred to the section of the Act which states that "the program shall consist of measures to protect, mitigate, and enhance fish and wildlife affected by the development, operation, and management of such facilities while assuring the Pacific Northwest an adequate, efficient, economical, and reliable power supply." [10] The Act does not define "economical" or how to achieve both an economical supply of power and a viable fisheries program. The determination of

[9] L.W. Lloyd during Power Council Hearings on Fish and Wildlife Recommendations, (March 23, 1982) Boise, Idaho.

[10] Regional Power Act, Ibid. [emphasis added]

this balance was left to the Power Council.

For some time fisheries advocates had been arguing that the cost/benefit analyses performed by BPA and the Corps over the years had been biased against fish. The reason for this, they argued, was that economic analyses were based on the goal of maximizing power production. The real goal, it was argued, should be to maximize the value of both resources. According to Ed Chaney, project director of the Northwest Resource Information Center, Inc.:

> Maximization of net social benefits is the only valid economic goal for the allocation of upper Columbia Basin river flows between salmon and steelhead and production of hydroelectric energy . . . Two things are essential to properly evaluate the marginal net social benefits to the region of incremental changes in hydroelectric operations to restore fisheries (1) the opportunity costs of each incremental change must accurately and equitably reflect the effects on each resource; (2) values assigned to each resource must accurately reflect its true value to society." [11]

Traditionally, according to fisheries advocates, evaluations of dam projects have not accurately reflected the true cost of power because these costs, while they have included materials and labor, have not included the foregone value of reduction in fish yields and other opportunity costs.

[11] Ed Chaney, Cogeneration of Electrical Energy and Anadromous Salmon and Steelhead in the Upper Columbia River Basin: an Economic Perspective on the Question of Balance, Eagle, Idaho: Northwest Resources Information Center, Inc., p. 11.

One reason that fish are at a significant disadvantage in traditional cost/benefit evaluations is that their value is much more difficult to quantify than the value of electricity. The cost of electricity can be calculated fairly accurately (except for the external environmental impacts), and in fact electricity users are charged rates that are based on recovering the cost of operation. With fish the problem is much more complex. The market value of fish, for example, only reflects the cost of catching the fish. The cost of production is borne by society as a whole through fish hatcheries or maintenance of the natural environment. [12] Other values are not quantifiable, such as their cultural significance or their intrinsic worth as wildlife. As a result, fish tend to be undervalued in the economic sense not only by power managers but by society as a whole.

In addition, cost/benefit analyses can be biased by the selection of alternative energy sources. For example, a 1982 assessment of the cost of providing fish flows during spring smolt migration was estimated based on the cost of replacing 490 megawatts (MW) of firm energy. According to the report, "Nuclear was assumed to be the least cost

[12] Ed Whitelaw and Ernie Niemi, Balancing the Production of Fish and Power in the Columbia River Basin: an Economic Analysis, Oregon: Economic Consultants Oregon, Ltd. (March 1982), p. 10-11.

alternative for providing this base load energy." [13] The firm energy value of the nuclear alternative was estimated to be 50 mills per kilowatt-hour (kWh). The Corps' estimate of $150 million for fish flows would have been different had they used conservation as the replacement resource which the Council has recently estimated to cost 18 mills/kWh. This reluctance to select conservation as the alternative energy resource significantly increased the cost of providing fish flows.

Fisheries advocates insisted that this history of bias was rectified by the Act. They claimed that the Act addressed the issue of benefits by making economic considerations secondary to biological considerations. They believed the overriding objective of the program was to restore, protect, and enhance fish runs. [14] Indeed the Act states that the measures contained in the program shall "utilize, where equally effective alternative means of achieving the same sound biological objective exist, the

[13] U.S. Army Corps of Engineers, Main Stem Columbia River and Snake River Instream Fish Flow Report, Interagency Study (March 1982) p. 69.

[14] Michael Blumm, Fish and wildlife program approval issues: a legal perspective on scientific proof, economic cost and Indian treaty rights, Anadromous Fish Law Memo 17 (April 1982) p. 15.

alternative with the minimum economic cost." [15]

A Question of Equity--Sharing the Water and Reevaluating Risk

One of the primary technical goals of the Act and the goal on which this study focuses is to "provide flows of sufficient quality and quantity between such facilities [dams] to improve production, migration, and survival of such fish as necessary to meet sound biological objectives." [16] Because the current method of operation on the river attempts to maximize power generation, while meeting flood control and recreation constraints, it was recognized that the effect of providing such flows was to reduce the amount of energy available from the system.

The rate of change in elevation from the Columbia's headwaters to its mouth is one of the largest of any major river in the country. It drops about two feet per mile as it winds its 1,200 miles from Columbia Lake in Canada to the Pacific Ocean. This gradient plus the large volume of water, an average of 140 million acre-feet per year, has made it an attractive energy source. Unlike a thermal generating plant where, barring shortages of gas, oil or uranium, the amount of fuel for the plant is totally within

[15] Regional Power Act, Sec. 4(h)(6)(c) [emphasis added].
[16] Ibid., Sec. 4(h)(6)(E)(ii).

the control of the operators, the amount of "fuel," i.e., the water, is unpredictable, ranging from a lows of about 53 million acre-feet to about 160 million acre-feet in recent years. Each incremental one-million acre-feet of flow has an associated energy value of about 1.1 billion kWh, about one-fifth the annual energy capability of a large nuclear plant. [17]

The 42 million-acre feet of reservoir storage available in the basin makes it possible to shape flows within a year but nearly impossible to move excess flows from one year to another. [18] Low water conditions become critical for power production, therefore when sequential dry years occur.

Energy planners only rely on the hydropower system to supply electricity equivalent to what could be generated using the current system of reservoirs during the worst drought within forty years of streamflow history. This critical planning period is the 42-month period of drought conditions that occurred between 1928 and 1932. The amount of energy that can be produced during these conditions is

[17] Merrill S. Schultz, Managing low water year emergencies: concerns of power managers, unpublished paper, p. 5.

[18] Merrill Schultz, Ibid.

called the Firm Energy Load Carrying Capability (FELCC) of the river system. [19] Flows in excess of firm energy requirements can be used to generate what is called "secondary energy."

Management of the river is in accordance with the Pacific Northwest Coordination Agreement which was signed by BPA, the Corps, and 14 public and private utilities in 1964. The underlying principle of the agreement is that various project operators manage the river as one utility, maximizing coordination and the efficient generation of power. The annual operating plan for the river is adopted in July, before the river managers know the level of the coming winter's snowpack. To accommodate this uncertainty, they develop two guides for each river facility. The first, called "critical rule curves," shows how full reservoirs should be at the end of each month in order to meet firm power loads during the critical planning period. The

[19] Basing water resource decisions on historical streamflows is not the only method for evaluating risks of droughts and floods. Many hydrologists point out that the pattern of flows during an historical period is extremely unlikely to recur and that the sample provided by a 40-year historical record is far too small to determine the expected frequency of droughts over the real life of a system. As an alternative to basing planning on the worst period on record, they propose using statistical methods to generate "synthetic" streamflow records which are neither actual records nor predictions, but rather flow sequences that are equally likely to occur during the life of the structure(s).

second, called an "energy content curve," is the lowest a reservoir can be and still have a 95% probability of refilling by July 31st. The latter is used to determine how much nonfirm energy is available to sell. These curves serve as guides for operating dams and manipulating flows on the river for the coming year.

By January of each year, however, the amount of snowpack in the mountains is an excellent indication of the level of runoff to be expected in the spring. When spring arrives, the primary concern of the dam operators and power managers is refilling the reservoirs. In average and good water years, there is plenty of water. The Corps refills its reservoirss and BPA meets its firm energy needs and there is water left over that is spilled over the dams or used for the generation of secondary power. As a result, during these years, there is surplus water in the river when the juvenile salmon need it to carry them towards the sea.

It is a different story when natural runoff is low and water becomes a precious commodity. BPA needs it to meet firm power needs, the Bureau of Reclamation needs it for irrigation, the Corps needs it for maintaining reservoir levels for recreational purposes, and the fish need it for their migration to the sea. In very low water years, the situation can become critical as occurred in 1977.

In 1977 a record low snowpack alerted regional managers of an impending crisis and prompted intensive activity on the part of all involved to protect their interests. For power managers this meant meeting customer contracts; for the fisheries advocates it meant ensuring enough water was spilled over the dams to avert a catastrophic fish kill. In response, the governors of the four Northwest states -- Washington, Oregon, Montana, and Idaho -- called on the public to conserve electricity voluntarily. The public responded and more than 4.5 million megawatt-hours (mWh) of electricity was saved throughout the region during the six-month period. [20]

To ensure enough water for the fish, the Columbia River Treaty Tribes, the Corps, BPA, and the fish and wildlife agencies initiated Operation Fish Flow. Water was released from the reservoirs for the fish. Excess electricity that was generated as a result of these flows was "stored" with British Columbia Hydro and Power Authority, Portland General Electric, and several California utilities. When the stored energy was returned, the energy loss was estimated to be 260,090 mWh of electricity or about .002 of the system's annual load. [21] Although juvenile survival during 1977 was

[20] Ed Chaney, A Question of Balance: Water/Energy--Salmon and Steelhead--Production in the Columbia River Basin Summary Report. Eagle Idaho: Northwest Resources Information Center (1978) p. 14.

estimated to be less than 1 percent [22] and adult returns in subsequent years were extremely depressed, a total catastrophe was averted.

The year 1977 was an example of extreme conditions, but it is estimated that one out of every four years, flows in the Columbia are low, creating the potential for harmful stress on the fish runs. In addition, BPA's inclination to shape flows not only to the seasonal demand for electricity but also to the daily fluctuations in electricity use also conflicted with fishery needs. One of the Power Council's major tasks then was to decide how the water should be allocated between these competing uses. How does one share the water equitably without totally disrupting the region's main source of power? How much firm energy would have to be foregone to shift the balance? For years these questions had been debated in the policy arena with little satisfactory progress made either in coordination of fish needs or in agreement as to what those needs were. It was into this arena that the newly formed Power Council stepped.

[21] Ibid, p. 16.

[22] Wesley J. Ebel et al., Status Report -- 1978; the Snake River Salmon and Steelhead Crisis: Its Relation to Dams and the National Energy Shortage, Seattle: NMFS (September 1978) p. 5.

CHAPTER FOUR

Setting the Stage

The Power Council and Other Actors

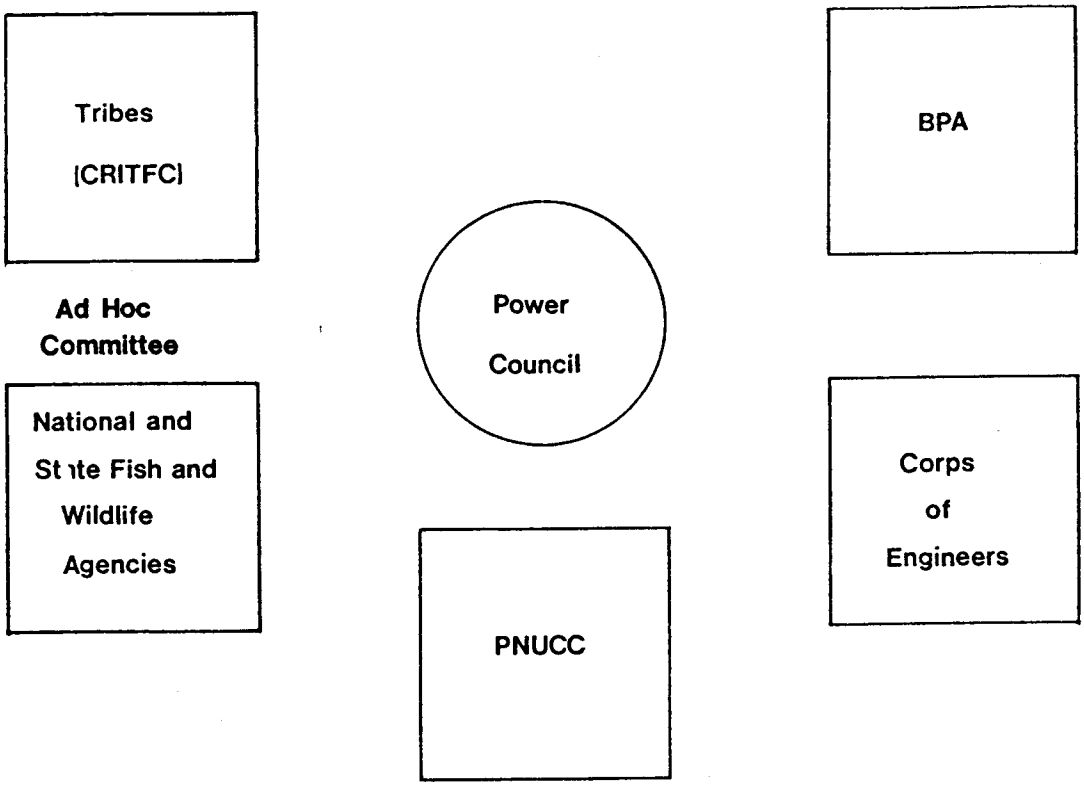
To understand the dynamics of the Power Council's process, it is useful to survey the principle actors. This chapter describes not only who they were and what stakes they had in the outcome, but also their perception of the Power Council's role. The principle actors described in this chapter are shown in Figure 4.1.

The Northwest Power Planning Council

The Power Council, officially formed on April 28, 1981, was an unusual governmental body in many ways. Created by federal legislation, it was neither a federal nor a state agency, but rather a regional planning body. Appointed by the governors of each of the four Northwest states -- Montana, Idaho, Oregon, and Washington -- the eight members were selected to represent the interests of the region and their states in energy planning and Columbia River fish and wildlife program development. Their plans and recommendations, however, were not subject to legislative approval.

FIGURE 4.1

The Principle Actors



The Council had little explicit authority, yet the program developed by the Council depended on the cooperation of numerous federal, state, and private entities that had a long and bitter history of disputes and conflicts. To be effective, the Council had to demonstrate an ability to develop reasonable solutions that had the support of the agencies required to carry them out. In a sense, the Council was the "new kid on the block" in a neighborhood where established interests had long ago staked out their territories and had developed a complex and delicately balanced system of operation and decision-making. The Council's task required not only an acute sense of diplomacy, but also a working understanding of highly technical issues relating (in the case of the fish and wildlife plan) to river hydrology, dam operation, energy planning, and fish biology.

When the eight members met for the first time in April 1981, they were strangers, with a wide range of backgrounds in law, engineering, utility management, and politics. The chairman, Dan Evans, former governor of the State of Washington, believed that the role of the Council would be defined as the process itself evolved, but that a great deal depended on the chemistry of the people. The Council members were employed full time (except for the Evans who was also President of Evergreen College) and therefore had

the opportunity to immerse themselves in a set of relatively narrowly defined issues -- fish and power planning. According to Evans, the usual distinction between the official and his or her analytic staff became blurred; although the Council had a staff, members also felt it their responsibility to be informed on the technical aspects of the issues. As a result, the members had an unusually deep understanding of the issues. [1]

The Council Chairman also believed that because the Council was not an elected body, the Council had to be perceived as a neutral problem solver to stay viable. He believed the key to being successful depended on: (1) being independent and (2) being analytical rather than political. He also was convinced that although it was clear the results of the process would have political implications, decisions had to be based on a sound analytical framework. It was his hope that the Council would adhere to this approach throughout the development of the fish and wildlife program. [2]

In addition to the personalities and skills of the individual Council members and their unique regional charter, the rolle of the Council was further shaped by the

[1] Interview with Dan Evans, Chairman, Northwest Power Planning Council (April 25, 1983) Olympia, Washington.

[2] Ibid.

nature of the Regional Power Act itself which required a public process. After requesting recommendations for the fish and wildlife program from federal and regional fish and wildlife agencies and appropriate Indian tribes, the Council was required to make these recommendations available not only to the relevant federal and state agencies, but also to the public. The Act required that the Council "provide for public participation and comment regarding the recommendations and supporting documents, including an opportunity for written and oral comments." [3]

The Council addressed this requirement in several ways. First it held town meetings throughout the region. About 1,000 citizens attended these meetings held in six different locations. The purpose of the meetings was to educate the public regarding the Power Council's role and to receive public input on a series of issues, including how to both protect fish and produce power. Second, it made its twice-monthly business meetings open to the public and provided time at the end of each meeting for public comment. Chairman Evans, reminiscing about early brainstorming meetings regarding fish flows, remarked that the meeting could have been like any other working meeting except that there were 150 to 200 people watching. In fact the Council

[3] Regional Power Act, Public Law 96-501, Sec. 4(h)(B).

withdrew into executive session only two or three times during the development of the program, to deal with personnel matters or contract negotiations. [4]

Finally, the Council provided for public input through public hearings. Hearings on the draft Fish and Wildlife Program were held on the Yakima Indian Reservation to symbolize the importance the Council placed on tribal participation and the critical plight of the Yakima River Basin where irrigation has made the river nearly uninhabitable for fish.

In addition to educating the public about some highly technical issues, the public nature of the process used to develop the Fish and Wildlife Program served two other important purposes: (1) it reinforced the perception of the Council as neutral and fair and (2) the publicity helped establish legitimacy in the eyes of the public. By holding public meetings and deliberations, the Council provided little opportunity for the development of suspicion often associated with decision-making in such a contentious political environment. Instead the Council came across as analytical and forthright, more interested in viable technical solutions that would serve the public interest than in political deal-making. This perception was valuable

[4] Interview with Dan Evans, Ibid.

in giving the Council public credibility. Ironically, this shunning of political deal-making, ultimately provided the Council with their most powerful lever in terms of influencing river operations -- political clout.

As well as soliciting and reviewing recommendations for the program and soliticing public input, the Council had two other arenas for debating the technical issues. The first were called consultations and for the most part, they were held after the initial draft of the Program was released in order to obtain feedback. The Council members would invite in pertinent "actors" relating to a particularly sticky and contentious issue. For example, after the draft fish and wildlife plan was published, a consultation was held to discuss the proposed water budget. These meetings brought different interest groups together to air potential problems or conflicts. These were working meetings in the sense that the Council members actively questioned the participants. The general consensus on the part of these participants was that the Council members had prepared themselves well for the meetings, asked searching questions and were uniformily tough. One member of the Inter-Tribal Fish Commission, for example, noted that it was with amazement that they realized

the Council members "had actually read" their reports. [5]

The consultations were important in another respect. According to the Act, the Fish and Wildlife Program was to be based primarily on the recommendations of the fisheries agencies and the tribes. The consultations provided an opportunity for nonfish interests to "get in the door on a one-to-one basis with Council members to state their case." They found it a valuable arena for making themselves heard. [6]

The second arena used by Council members to debate technical solutions was the Scientific and Statistical Advisory Committee. This committee was composed of 60 people with a wide variety of interests. The Council divided the main committee into six subcommittees relating to different aspects of the Council's work. The Fish and Wildlife Advisory Committee was composed of 10 people, with representatives from the tribes, the federal and state agencies and the general public. Council members regarded this committee as a source of feedback on proposed measures

[5] Interviews with participants, particularly technical staff of various agencies, revealed a common theme -- that the Council was tough with everybody and impatient when presented with poorly supported or inconsistent data.

[6] Interview with Al Wright, Chairman of the Fish and Wildlife Committee, Pacific Northwest Utilities Conference Committee (PNUCC). (March 31, 1983) Bellevue, Washington.

for the Fish and Wildlife Program. At least some members of the Advisory committee, however, had severe reservations about the committee's effectiveness. For example, Michael Blumm, attorney and editor of the Anadromous Fish Law Memo, noted that some of the members, particularly those associated with federal or state agencies, had access to the Council not only through the Advisory Committee but also through the special consultations held with Council members. This was frustrating to "citizen" members who did not have a niche within the institutional framework. Some members were also frustrated because they believed the Committee was relegated to being a sounding board rather than a source of constructive problem solving.

According to the Act the fish and wildlife program had to be developed "within one year after the time provided for receipt of the recommendations" so that it could be included in the energy plan for the region. The program was important therefore because it was the first test of the Council's effectiveness. If it failed in its efforts to resolve the fish and wildlife problems associated with the Columbia River Basin, its credibility would be severely damaged when it came to proposing a region-wide solution to energy planning.

The Ad Hoc Committee

In anticipation of the the Council's request for recommendations for the Fish and Wildlife Program for the Columbia River Basin, the federal and state fisheries agencies and the tribes formed the Ad Hoc Executive Committee in April 1981. This committee was necessary because the Power Council had made it clear that it wanted the various fisheries interests to speak with one voice. Members of the Ad Hoc Committee included the Washington Departments of Fisheries and Game, Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, Montana Department of Fish, Game, and Parks, Bureau of Indian Affairs, National Marine Fisheries Service, Fish and Wildlife Service, and the Columbia River Inter-tribal Fish Commission which represents the Umatilla, Nez Perce, Yakima, and Warm Springs tribes. It was chaired by Bill Wilkerson of the Washington Department of Fisheries. [7]

The Ad Hoc Committee reflected an unusual shift in traditional alliances. In Washington the state agencies and the tribes had been at odds since the early 1960's when the state sought to limit Indian fishing for conservation

[7] The Ad Hoc Committee essentially contained the same members as the defunct Columbia River Fisheries Council which conducted some of the early research on fish flows, as well as new members included by virtue of the regional nature of the Act, such as the Montana Fish and Wildlife agencies.

purposes. After sporadic eruptions of violence, the federal government entered the controversy in 1970 on behalf of the Indians by filing suit against the state.

In 1974 US District Court Judge George Boldt upheld the treaty rights claimed by the tribes and ruled that the Indians were entitled to 50 percent of the harvestable catch. This decision (called Phase I) and Judge Orrick's subsequent decision that an adequate environment must be maintained for the survival of the species (called Phase II) have been a major source of controversy between state agencies and the tribes and treaty rights have also become a determining factor in river and ocean management. The conflicts addressed in the Northwest Regional Power Act therefore represented a reversal in fish politics. Suddenly the tribes were allied with the state agencies. Together they had to come up with proposed changes for protecting fish and wildlife threatened by federal priorities and operating procedures on the Columbia River.

The Power Council published the Ad Hoc Committee's recommendations along with the comments of other agencies in four volumes containing more than 2000 pages. These recommendations became the subject of public comment in hearings held throughout the region. The major concern was the level of activity the Power Council should assume in modifying the proposals to make them acceptable to all

concerned. While some argued that the Act required the Council to accept and implement the Ad Hoc Committee's proposals, others believed the practicalities imposed by river politics required negotiation and compromise.

The Bonneville Power Administration

The relationship between the Power Council and the Bonneville Power Administration has been from the beginning strained. Peter Johnson, current Administrator, called the Power Council an "experiment in Political Science," praised its function as a forum, but questioned the viability of having a planning function that is separate from the implementing agency. [8] Dan Evans acknowledged this underlying friction during an interview in March 1982.

> . . . the Council is the one new agency involved in this picture, where Bonneville is a continuing body although with some very large new responsibilities. Various utilities (public and private), the direct service industries, the other elements mentioned in the Act are essentially all existing. So, suddenly we're fitting a new body into this picture and it has changed relationships. I guess the most important continuing one is with Bonneville. Someone suggested that the Council is really a board of directors of Bonneville, but that's not an accurate perception. Bonneville has operating responsibilities, the Council has planning responsibilities. The intertie, of course, is where the Council's planning responsibilities have an effect on the operation of Bonneville, the

[8] Speech delivered during the Regional Power Act Conference at Lewis and Clark College in Portland, Oregon, February 1983.

> various utilities, and the direct service industries. There are numerous places where that occurs. There is little wonder that in the initial stages of this we are finding some frictions, some misunderstandings as we attempt to find these appropriate relationships and roles. [9]

With regard to fisheries, BPA has publicly announced its perception of the Council as advisory but has agreed to implement the Power Council's plan only "so far as practicable." [10] It appears this agency like others affected by the planning of the Power Council was jockeying for position, taking a cautiously cooperative but not overly enthusiastic role as the Council proceeded with its business.

Since its inception in 1937, with the passage of the Bonneville Project Act, the BPA's primary responsibility was the marketing of electricity produced at federal projects. Over the years BPA has sought to maximize and shape power output to meet demand for electrical energy. These policies however have met increasing resistance from environmentalists and fisheries interests. In response to these pressures the agency initiated in fiscal year 1978 a

[9] Interview with Dan Evans in Northwest Energy News, Northwest Power Planning Council: Portland 1:1 (March 1982) p. 13.

[10] Remarks of Peter Johnson, Administrator, BPA, before the Northwest Power Planning Council, Missoula, MA (October 10, 1982).

fisheries restoration program and by 1981 their fisheries research and development program had reached $2.94 million.

Regarding adequate fish flows for smolt migration, Larry Dean, Director of Power Supply, stated that BPA provided the fish flows that fisheries agencies requested in good years, but that in years of low runoff, he didn't believe BPA had the authority to take the actions fisheries agencies requested. The effect of providing flows for fish in such years would have cost thousands of dollars in power losses and he had no way to evaluate the request. The Power Act, he stated, gave the Council the opportunity to determine that balance. [11]

In its initial recommendations to the Council regarding fish flows, BPA expressed two major concerns that have continued to be a recurring theme throughout the development of the program: (1) whether there was sufficient study and data to identify the range of desirable flows for different circumstances and (2) how these flows can be implemented while assuring an "adequate, efficient, economical, and reliable power supply."

[11] Interview with Lawrence Dean, Director, Division of Power Supply, BPA (April 4, 1983) Vancouver, Washington.

The Army Corps of Engineers

Although BPA and the fisheries agencies had the most to gain and lose in the process of developing the Fish and Wildlife Program, the Army Corps of Engineers played a pivotal role. The Corps controls operation of the downstream dams and sets operating limits for the reservoir system that allows regulation of the flows. Its primary consideration in developing these limits is flood control but they are also concerned with numerous other purposes including navigation, recreation, power generation, and fisheries protection. The Power Act only directly addresses two of these purposes -- power generation and fisheries protection, but the implementation of the water budget affects operations relating to all of them. According to General James Van Loben Sels, head of the North Pacific Division, his challenge was to integrate the requirements of the fish flows recommended by the Council into his other responsibilities. [12]

Historically the Corps has been associated with structural controls to decrease variability. Fish survival and other environmental concerns however have slowly been integrated into its responsibilities and work. According to

[12] Interview with General James W. Van Loben Sels, Division Engineer, North Pacific Division, U.S. Army Corps of Engineers (April 11, 1983) Portland, Oregon.

Van Loben Sels, the Corps "takes its responsibilities towards fish seriously," but even he admits that commitment to equal consideration of fish flows has required significant changes to institutional thinking within the Corps itself. [13]

From the Corps point of view the Power Council represents a unique regional body whose purpose was to bring together diverse interest groups in order to define the "premier expression of the public interest." However, despite assurances by staff that the Corps is attempting to shift its traditional perception of river management and to be relatively cooperative in implementing fish flow recommendations by the Council, the Corps seems to guard carefully what it sees as its institutional and legal role in river management. As Van Loben Sels stated emphatically during an interview, "Notwithstanding the water budget plan and all [the Council's] planning, I am still the decision-maker. I don't work for the Council and I don't work for the water budget managers. Their plan is not law." [14]

[13] Ibid.

[14] Ibid.

The Pacific Northwest Utilities Conference Committee (PNUCC)

The PNUCC is composed of publicly owned utilities and cooperatives, investor-owned utilities (IOUs), and direct service industries (DSIs). The Corps and BPA sit on the PNUCC but are not voting members. In the Fish and Wildlife Program development, therefore, the PNUCC represented the views of the nonfederal project managers and wholesale customers. According to McLennan, the utilities were caught somewhat by surprise by the content of the Regional Power Act relating to fisheries and did not realize until late into the process how specific the Act was in its requirements. "The utilities thought that the status quo would be maintained with a few changes. When the recommendations of the fisheries agencies were published, there was great uneasiness." [15]

To respond to the Power Council's activities relating to fish and wildlife, the PNUCC established its own Fish and Wildlife Committee in early 1981. Al Wright, Chair of the Committee, stated that the PNUCC believed the Council's role was to analyze the hydroelectric development in the Columbia and to determine what effects on fish and wildlife remained to be mitigated. The PNUCC believed that the decline of the

[15] Interview with Janet McLennan, Assistant Power Manager for Environmental Affairs, (May 26, 1983) Portland, Oregon.

fish runs could not be attributed totally to the hydroelectric system. It also believed that many of the effects attributable to the hydroelectric system had already been mitigated. Al Wright admitted that, given this perspective, the PNUCC's approach to the fish related requirements of the Act "was not totally positive." [16]

Nevertheless, the PNUCC recognized that something had to be done and therefore requested the Council to formulate a program that would be sure to have positive results and that would include measures whose costs bore some relation to the amount they would accomplish. The PNUCC expressed its concerns in detailed oral and written comments on the initial recommendations of the Ad Hoc Committee and on the draft program, as well as through consultations.

This concludes the overview of the major actors involved in the development of the water budget. Although most of these actors had a long history of interaction, there were great gaps in communication, particularly at the technical level. There was no common language relating either to the engineering aspects of river management or to the complexities of fish biology, and the tribes and the fisheries agencies had to rely on the expertise of the more

[16] Interview with Al Wright, Ibid.,

established institutions, BPA and the Corps, for technical assessments of their requests. Given the priorities of BPA and the Corps, it is easy to understand how mistrust and conflicts arose. To break this pattern, the Council searched for solutions to the problem of spring fish flows analytically on the technical as well as the policy level. The next chapter describes the technical issues involved in addressing the problem of spring fish flows, as well as the story of how the concept of the water budget evolved.

CHAPTER FIVE

Searching for the Solution

Laying the Technical Groundwork

Four major proposals for providing adequate flows during the spring migration of juvenile salmon were evaluated formally by the river management community and the public. The first was proposed after the 1977 drought by the Columbia River Fisheries Council (CRFC). The second was recommended to the Power Council by the Ad Hoc Committee, a loose coalition of fisheries agencies and the tribes. The last two proposals were the draft and final water budget recommendations of the Power Council. Table 5.1 summarizes the four proposals.

Each of these proposals, as well as hundreds of alternatives, were evaluated by the Instream Flow Work Group. This group was established in October 1979 by the federal resource and water management agencies to coordinate development of a database to use in making water resource management decisions regarding flows for fish. Initially the group included CRFC, National Marine Fisheries Service (NMFS), the U.S. Bureau of Reclamation, Bonneville Power Administration (BPA) and the Army Corps of Engineers (Corps). Later, once the Power Council was established, the group was expanded to include representatives from the

TABLE 5.1

Summary of Fish Flow Proposals

1. CRFC
   Requested instantaneous and daily average flows for 12 months of year.

MINIMUM FLOWS	Lower Snake* (kcfs)	Mid-Col** (kcfs)
Apr 15-30	85	110
May	85	130
June 1-15	85	110

FELCC Deficit: 3600 MW

OPTIMUM FLOWS (May)	140	140***

FELCC Deficit: 6300 MW

2. AD HOC COMMITTEE
   Requested MINIMUM flows unless volume of water dropped below 65 MAF in which case shortage would be shared.

	Lower Snake*	Mid-Col**
Apr 15-30	85	110
May	85	130
June 1-15	85	110

FELCC Deficit: 490 MW

3. POWER COUNCIL'S DRAFT WATER BUDGET

   Proposed water budget that would be equivalent to 58 kcfs-months at Priest Rapids Dam and 20 kcfs-months at Lower Granite Dam.

   Management of this block of water is by water budget managers during Apr 15--Jun15 period
   No firm power flows are specified.

4. POWER COUNCIL'S FINAL WATER BUDGET

   Modified draft proposal to specify firm power flows. When combined with water budget, flows resulted that were the equivalent**** of:

	Lower Snake* (kcfs)	Mid-Col** (kcfs)
Apr 15-30	70	134
May	85	134
Jun 1-15	80	134

FELCC Deficit 550 MW

* As measured at Lower Granite Dam.
** As measured at Priest Rapids Dam.
*** Optimum flows were also requested for April and June but are not shown here.
**** These average flows are only for comparison's sake. The concept of the water budget implies a volume of water to be shaped by the water budget managers to coincide with the movement of the fish.

Regional Power Council staff, the Columbia River Inter-Tribal Fish Commission (CRITFC), the Pacific Northwest Utilities Conference Committee (PNUCC), and the water resource departments of the State of Oregon, Washington, Idaho, and Montana. The group was chaired by the Corps.

The group modeled the river system using the Corps' Hydro System Seasonal Regulation (HYSSR) Program. This program determines the amount of water that should be put into or released from each storage reservoir during each month in order to meet desired levels of instream flow for fish or power generation within constraints placed on the system by other uses, such as flood control, irrigation, and navigation. The firm energy generating capability for the base case entailed routing 40 years of streamflows through the Columbia River Basin system so generation from the simulated hydroelectric projects conformed to the estimated hydroelectric load shape. As explained in Chapter Three, the critical period is defined as that portion of the historical 40-year streamflow record which, when combined with reservoir storage, produces the least amount of energy. For all case studies other than the base case, the HYSSR program was used to meet different fish flow requirements at Priest Rapids, Lower Granite and the Dalles. The firm power generated as a result of meeting the fish flow targets were then compared to the Firm Energy Load Carrying Capability

(FELCC) of the base case. [1]

Active members of the group were concerned with technical rather than political issues, and, according to Mark Maher, engineer for NMFS, politics was set aside so they could be purely a data gathering and appraisal group. Any member could try out any flow experiments they wanted. No one challenged the scenarios or required justification for trying out a particular flow regime. [2] The group provided a valuable forum for technical representatives from the various agencies to learn the complexities of river operation.

The remainder of this chapter examines the main fish flow schemes proposed by the tribes and the fish and wildlife agencies; the next chapter describes the Council's water budget proposals. As the story of the water budget unfolds, it becomes clear that the concept of the water budget was not the isolated idea of one person but rather the synthesis of numerous ideas generated during this period of intensive study.

[1] U.S. Army Corps of Engineers, Mainstem Columbia River and Snake River Instream Fish Flow Report (March 1982) p. 8-13.

[2] Interview with Mark Maher, Engineer, NMFS (March 7, 1983) Portland, Oregon.

Minimum and Optimum Fish Flows

The droughts of 1973 and 1977 stimulated interest and controversy regarding the relationship between smolt survival and the level of flows in the Snake and the Columbia during their migration period. During those dry years, large numbers of juvenile migrants perished and the number of of adults returning several years later was drastically reduced. As a result of the droughts, fisheries biologists tried to quantify the effects of flow levels on smolt survival in order to identify the minimum instream flows required to maintain the anadromous fish runs. This research was funded mainly by NMFS and the Corps.

In February 1979 the Columbia River Fisheries Council (CRFC) published a Rationale for Instream Flows for Fisheries in the Columbia and Snake Rivers. The CRFC was a precursor to the the Ad Hoc Committee (see Chapter Four) and was composed of the Oregon Department of Fish and Wildlife, the Washington Department of Fisheries, Washington Department of Game, Idaho Department of Fish and Game, NMFS, the U.S. Fish and Wildlife Service, and the CRITFC. The Rationale was an attempt by fisheries agencies and the tribes to formalize and quantify their instream flow requests. It was based on the work of a Subcommittee on River Flows which was composed of three biologists, a biometrician, and an hydraulics engineer from various

national and state fisheries agencies.

The Rationale presented provisional recommendations for instantaneous and daily average minimum flows for each month. These were considered essential to maintaining fish runs at an acceptable levvel. In addition, optimum flows were requested for the peak smolt migration period, April to June. These flow requests became known within the river management community as "minimum" and "optimum" flows. They are summarized in Table 5.2.

Although it was clear that a relationship existed between level of flows and juvenile mortalities, data specifically relating the two was scarce. Scientific data on which the requests were based came from studies which estimated mortalities of migrants at each dam. Using this data and other studies estimating direct turbine mortalities, spillway mortalities, and predation losses, in conjunction with historical flow levels, CRFC attempted to distinguish flow related mortalities from turbine and other types of mortalities. A graph of the regression equation showing the relationship of flows to survival is shown in Figure 5.1. [3]

[3] CRFC, Rationale for Instream Flows for Fisheries in the Columbia and Snake Rivers (February 1979) p. 6-7.

TABLE 5.2

Minimum and Optimum Average Daily Flow Requests for Fish
(Thousands of Cubic Feet per Second)

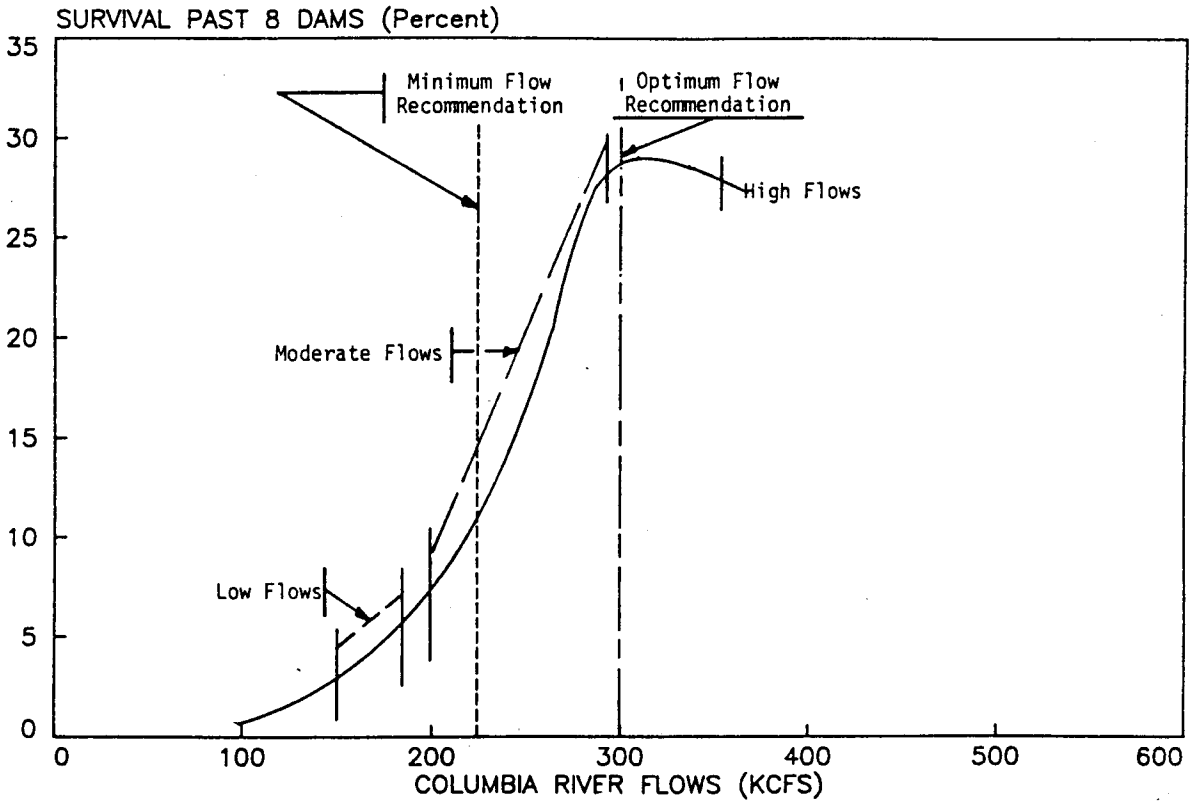
Month	Lower Granite		Priest Rapids		Bonneville	
	Minimum	Optimum	Minimum	Optimum	Minimum	Optimum
January	20	20	70	---	60	110
February	20	20	70	---	60	110
March	20	20	70	---	60	110
April 1 - 15	40	100	70	---	120	190
April 16 - 25	85	110	70	100	160	225
April 26 - 30	85	120	110	120	200	250
May	85	140	130	140	220	300
June 1 - 15	85	120	110	120	200	250
June 16 - 30	30	90	80	90	120	200
July 1 - 15	30	---	80	---	120	---
July 16 - 31	20	---	110	---	140	---
August	20	---	95	---	120	---
September	20	---	40	---	90	---
October 1 - 15	20	---	40	---	90	---
October 16 - 31	20	---	70	---	90	---
November	20	---	70	---	60	---
December	20	20	70	---	60	110

(from U.S. Army Corps of Engineers, Main Stem Columbia River and Snake River Instream Fish Flow Report (March 1982) p. 14.)

FIGURE 5.1

Relationship of Flows to Survival

Based on flows measured at the Dalles Dam and on survival data from 1966 to 1975.



(from Ad Hoc Committee's Recommendations IN Recommendations for Fish and Wildlife Program under the Pacific Northwest Electric Power Planning and Conservation Act, Portland:NPPC (December 1981) p. 201.)

Although the CRFC requests were for 12 months of the year, they were greatest during the the height of juvenile migration. At Priest Rapids on the Mid-Columbia, CRCF asked for 110,000 cubic feet per second (cfs) during the latter part of April and June and for 130,000 cfs during May. At Lower Granite on the Lower Snake River, the requests were for 85,000 cfs during April, May, and June.

To test the effect of these flow requests on FELCC, NMFS supplied the minimum and optimum flow figures to the Instream Flow Work Group for analysis. They also wanted to determine whether the river, if not regulated for hydropower generation, could meet the minimum and optimum flow requests.

The group began by selecting four years they believed were representative of various river conditions. The amount of runoff and the percent of the average for each selected year is shown in Table 5.5. Figures 5.2 and 5.3 show the results of their work. In low water years (1973 and 1977), neither minimum nor optimum flows would have been met on either the Columbia or the Snake, even if the system had not been regulated for hydropower. In average and good water years (1978 and 1974), the minimum flow requests were mostly met on the Columbia, even when the river was regulated for hydropower, but the minimum flows were not met on the Snake and could not have been unless the river was unregulated.

TABLE 5.5

Simulated Years

Year	Jan-July Volume-of-runoff (MAF)	Percent of Average	Rank 1929-1978
1973	70.7	69	43
1974	156.7	154	1
1977	53.4	52	50
1978	105.0	103	25

(From Army Corps of Engineers, Main Stem Columbia River and Snake River Fish Flow Report (March, 1982) p . 3.)

The reduction in FELCC if minimum flows were met was 3600 MW. The loss when optimum flows were provided during May was 6300 MW.

The Recommendations of the Ad Hoc Committee

In November 1981, the Ad Hoc Committee submitted its recommendations for incorporation into the Columbia River Fish and Wildlife Program. To achieve the objective of improving juvenile migrant survival, the Committee proposed measures that would reduce migration time, turbine-related mortality, and predation. To reduce migration delays, the Committee recommended a "share-the-shortage" flow regime which was based on the CRFC minimum flow recommendations but which provided a way to share the shortage with other interests during very low water years.

FIGURE 5.2

Unregulated and Observed Flows
on the Snake and Columbia Rivers
1973 and 1977

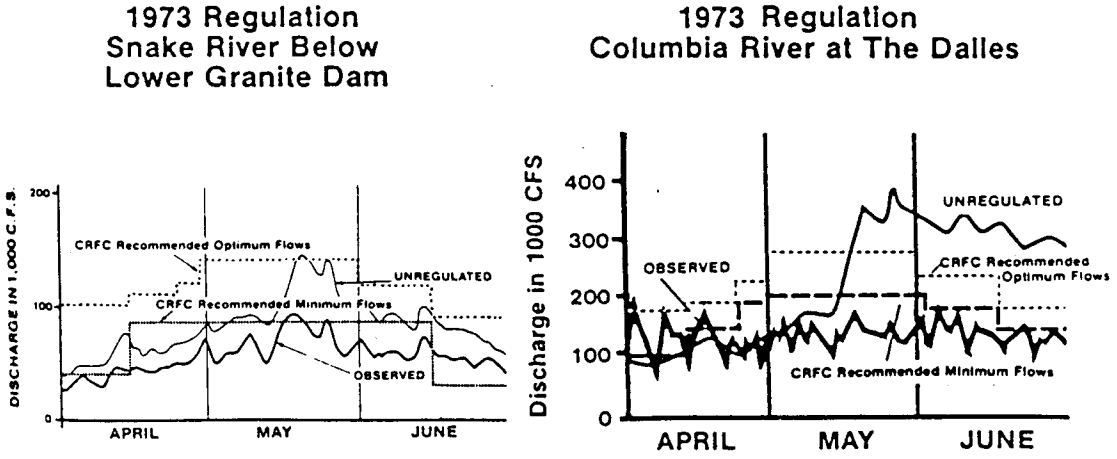
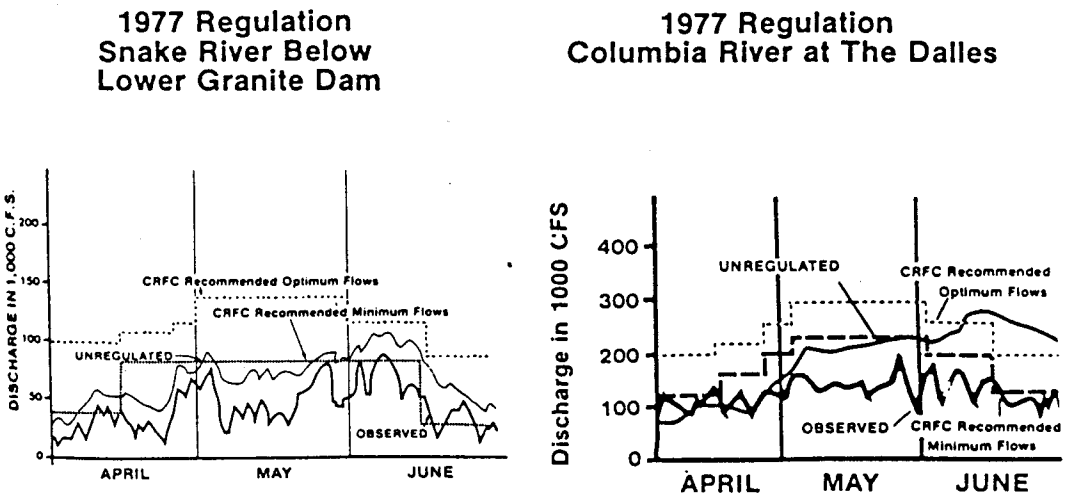


Figure 1



(from U.S. Army Corps of Engineers, Main Stem Columbia River and Snake River Instream Fish Flow Report (March 1982) p. 5.)

FIGURE 5.3

Unregulated and Observed Flows
on the Snake and Columbia Rivers
1974 and 1978

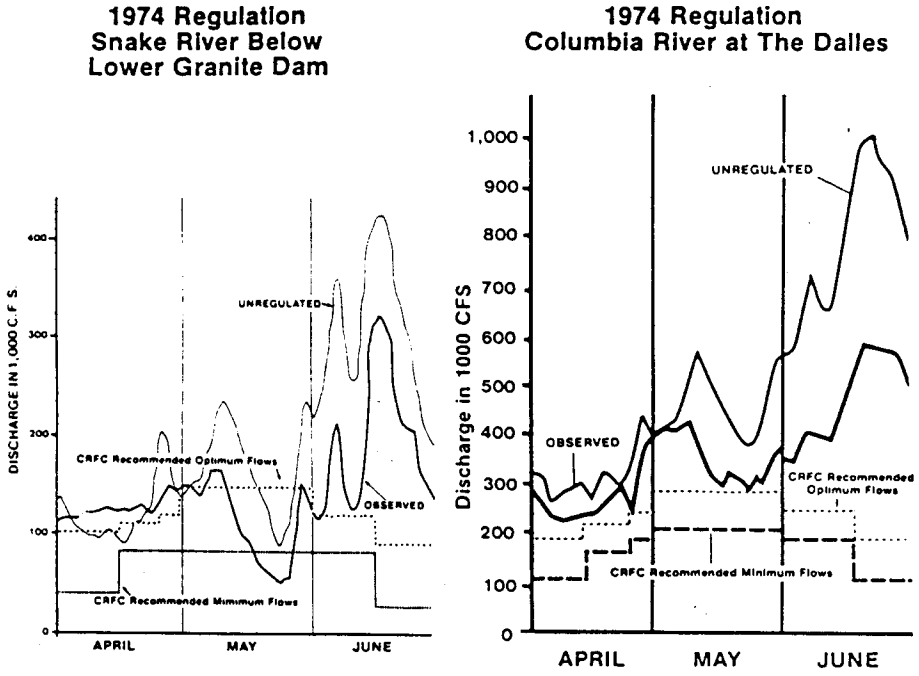
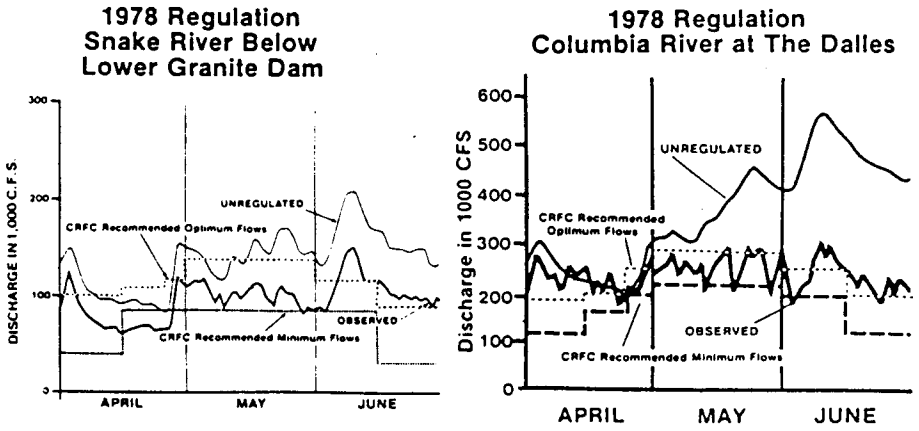


Figure 3



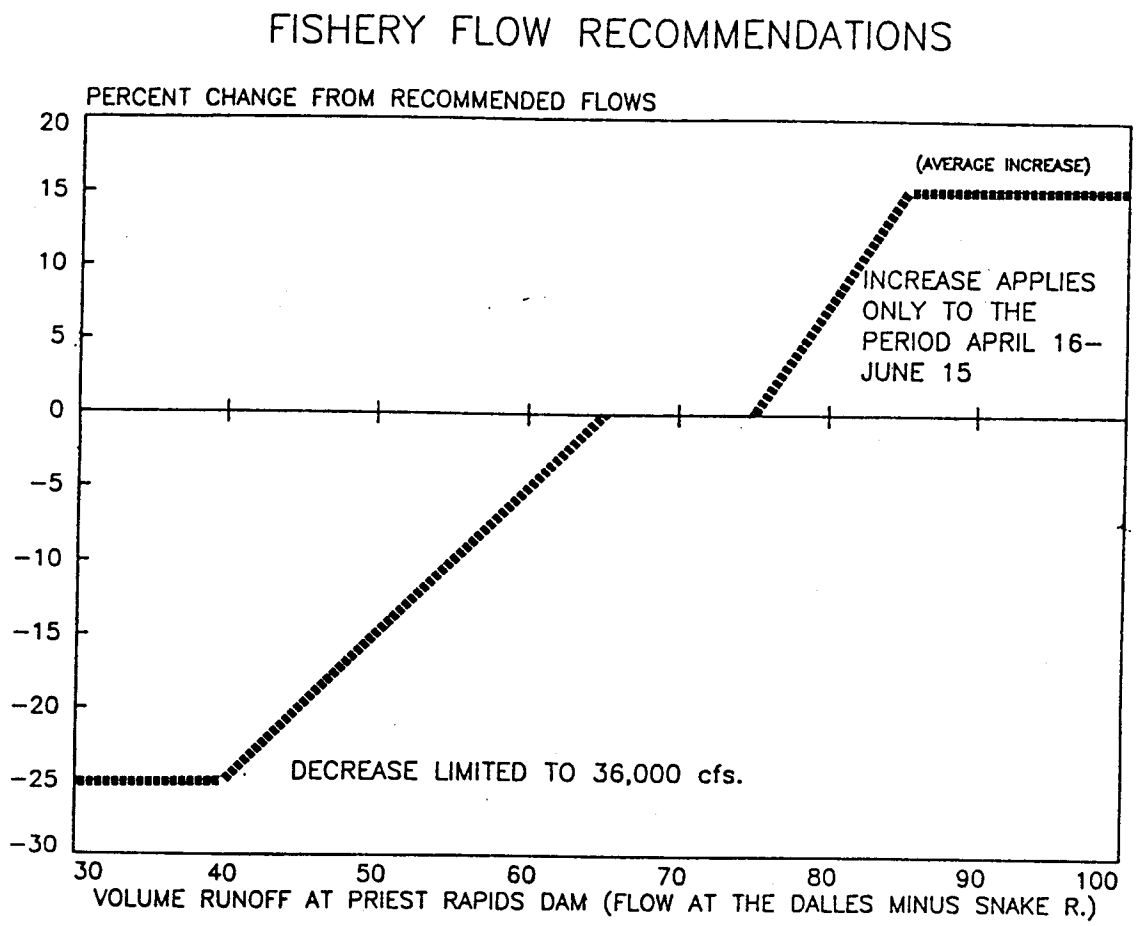
(from U.S. Army Corps of Engineers, Main Stem Columbia River and snake River Instream Flow Report (March 1982) p.6.)

According to the Committee, the minimum flow requirements still resulted in a mortality rate of 90 percent during low water years and that to achieve maximum migrant survival, optimum flow requests would have to be guaranteed. However, because of the severe impact on FELCC (6300 MW), these optimum flows were set aside temporarily in favor of minimum flows until further study could determine more precisely the added benefit of the increased flows.

The difference between the the Ad Hoc Committee's recommendation and previous proposals was that in years of low water, the shortage would be shared. Actual flows would be contingent upon the January-July volume of runoff forecast at Priest Rapids and Lower Granite Dams. In low water years, fish flows at Priest Rapids would be reduced at a rate of 1 percent for every 1 million acre feet (MAF) forecasted below 65 MAF. The maximum reduction permitted would be 25 percent or 36,000 cfs, whichever is greater for water years of 40 MAF and less. In better than average water years (more than 75 MAF) the recommended fishery flows would be increased at a rate of 1.5 percent for every 1 MAF forecasted above 75 MAF for the period April 16 through June 15. A similar sliding scale was proposed for Lower Granite Dam (see Figures 5.4 and 5.5).

FIGURE 5.4

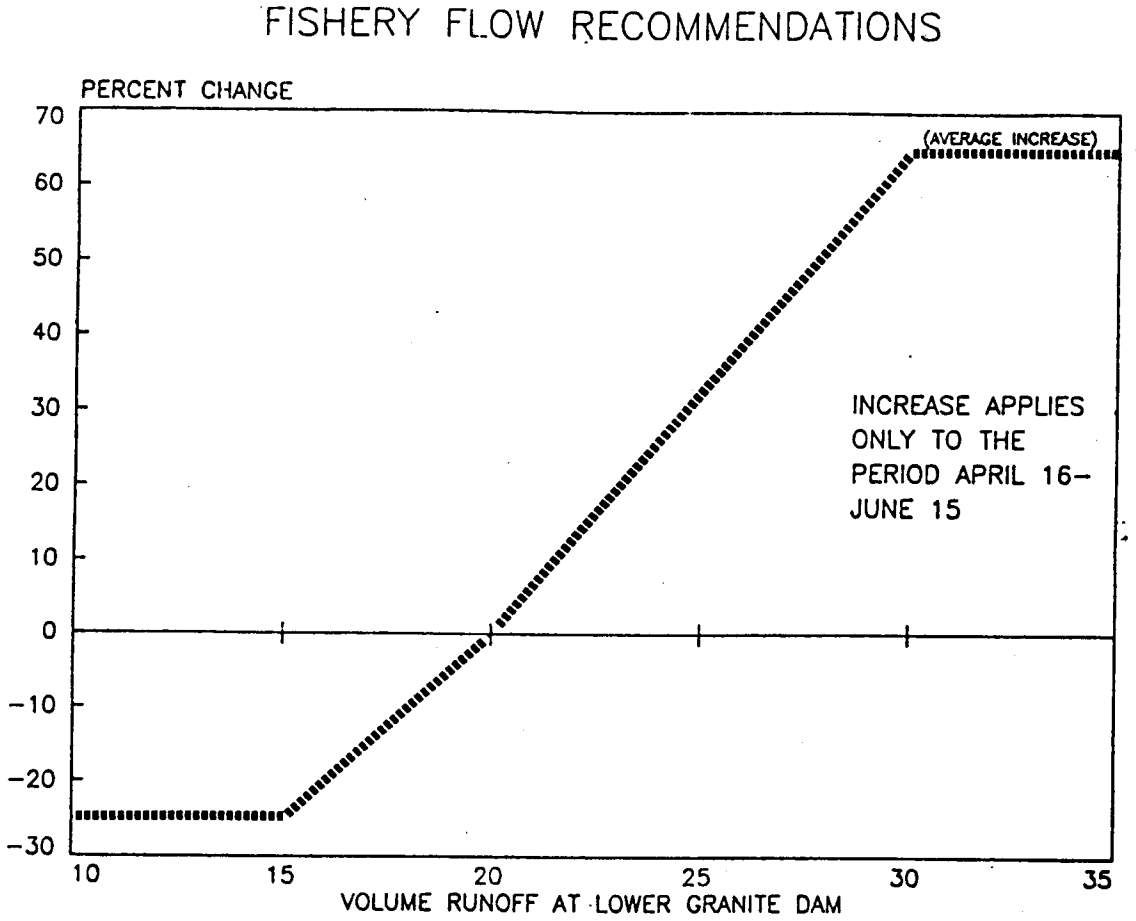
Sliding Scale Recommendation
for Priest Rapids Dam



(from: Ad Hoc Committee, Initial recommendations for the protection, mitigation, and enhancement of anadromous fish in the Columbia River Basin IN: Recommendations for Fish and Wildlife Program under the Pacific NW Electric Power Planning and Conservation Act; Volume I and II, Portland: Northwest Power Planning Council (December 1981) p. 182.)

FIGURE 5.5

Sliding Scale Recommendation
for Lower Granite Dam



(from: Ad Hoc Committee, Initial recommendations for the protection, mitigation, and enhancement of anadromous fish in the Columbia River Basin IN: Recommendations for Fish and Wildlife Program under the Pacific NW Electric Power Planning and Conservation Act; Volume I and II, Portland: Northwest Power Planning Council (December 1981) p. 183.)

Another provision of the recommendations allowed the fishery agencies the option of not reducing minimum flows in years below 65 MAF if they were willing to forego fish flows the following year. However, if the reservoirs refilled the year the agencies opted not to reduce flows, the level of flows the following year would be determined by volume of runoff. The recommendations also allowed the fisheries agencies to shape flows in low years such that they could provide minimum flows for a shorter duration. The sliding scale concept reduced the 3600-MW impact on FELCC of the CRFC minimum flow requests to 490 MW.

The recommendations regarding fish flows for downstream migrants were endorsed by all members of the Ad Hoc Committee, except for the tribes who felt that they had no obligation to compromise their treaty rights. The tribes therefore stuck with the demand for optimum flows and refused to endorse the "share-the shortage" concept proposed by the Ad Hoc Committee for low flow years.

Response to the Recommendations of the Ad Hoc Committee

The recommendations of the Ad Hoc Committee along with comments from many other agencies were published in December 1981 by the Power Council in a five-volume set entitled Recommendations for Fish and Wildlife Program under the Pacific Northwest Electric Power Planning and Conservation Act. Five hearings were held on these recommendations throughout the region. In reviewing the comments of the various agencies on the flow regimes proposed by the fisheries agencies and the tribes, it is interesting to note that the controversy appeared to center not on the amount of FELCC that would be debited as a result of the implementation of the fish flows but rather on how this energy would be made up, whether it would in fact result in higher survival rates, and whether a phased in program would allow better monitoring of results. The fact that there was little disagreement over the amount of firm energy that would be lost as a result of the sliding scale proposal can be attributed to the fact that the technical staffs of the different interest groups had been working together as part of the Instream Flow Work Group to model the proposed regimes. This data-sharing eliminated misunderstandings over the technical evaluation of the various proposals, however, the judgement as to whether the flow proposals themselves were justified or needed was still a matter for

dispute within the political and policy arenas.

BPA

BPA's position on the recommended flows was that they were "potentially workable" but requiring modifications and should be "phased in." [4] Mr. Larry Dean, Director of Power Supply for BPA, pointed out what had been learned through the work of the Instream Flow Work Group, that substantial releases of water from the major reservoirs during April through July, water which otherwise would be saved for energy releases in the winter, would reduce the FELCC by 450 MW. He also testified that he believed that fish flows should only be considered soft constraints. [5]

During this time period BPA submitted its own fish flow regime to the Instream Flow Work Group for evaluation. Called the "BPA Modified Sliding Scale Study," the regime had as an objective meeting minimum recommended fish flows during May in all years and attempting to meet optimum flows during May within the constraints of 95 percent confidence of refilling reservoirs (reservoir refill is an important

[4] Remarks of Janet W. McLennan, Assistant Power Manager for Natural Resources and Public Services, BPA, before the Northwest Power Planning Council (March 15, 1982) Portland, Oregon.

[5] Remarks of Lawrence A. Dean, Director, Division of Power Supply, BPA, before the Northwest Power Planning Council (March 15, 1982) Portland, Oregon.

criterion for both fish and power because it ensures that there is water available in case the following year is dry). Modeling showed that this proposal's impact on FELCC was a loss of 472 MW and that optimum flows were met at Priest Rapids in 27 of the 40 years. [6]

PNUCC

The PNUCC believed there was insufficient evidence to justify many of the measures proposed by the Ad Hoc Committee. They agreed that low flows on the Snake had created an extreme problem, but noted that drastic effects had not been measured in the Mid-Columbia. Although they agreed that higher mid-stream flows were one solution, they questioned whether there was a linear relationship between flows and survival, that is, whether higher flow levels meant equally higher survival.

The PNUCC also challenged travel time and survival assumptions on which many of the Ad Hoc Committee's recommendations were based, arguing that the agencies' predicted travel times through the impoundments did not coincide with actual observations. The PNUCC believed that except for very low flow years, smolts have adequate time to reach the ocean by late June. Therefore the PNUCC only

[6] U.S. Army Corps of Engineers, Mainstem Columbia River and Snake River Instream Fish Flow Report, Phase IV, 1985 Level Studies (June 1982) p. 16.

supported the adoption of the Ad Hoc Committee's recommendations for those years when providing flows would not impact FELCC.

In addition, PNUCC proposed that during the first five years of the sliding scale flow regime, research be conducted to determine the incremental benefits of various levels of instream flows. They argued there was no adequate scientific data to support any particular level of flow, including the "minimum" flows. They also proposed barging or trucking fish around the dam be considered as a long-term solution to low flows. [7]

CORPS

The Corps responded to the proposed recommendations by stating that evidence of beneficial effects did not justify implementing the sliding scale fish flow regime. General James Van Loben Sels proposed that a "framework program" be adopted only containing measures fully justified and that this program be refined over time.

[7] Testimony of Al Wright, Chairman, Fish and Wildlife Committee, PNUCC (March 16, 1982) Portland, Oregon. For detailed comments on the PNUCC position, see Response to Pacific NW Electric Power and Conservation Planning Council on Recommendations for Fish and Wildlife, Report No. 2, Volume II, (April 1982).

The Corps' major technical complaint with the "sliding scale" concept related to their existing planning processes and reservoir refill. The implementation of the "sliding scale" concept required knowledge in July of the volume-of-runoff forecast, information which is not available until January of the following year. The "floor level" instream flow concept, which the Corps advocated, would incorporate fish flows into the annual operating plan as a firm constraint, just as energy operation is currently. Although numerous variations on the "floor level" concept were modeled, the basic study called for 85,000 cfs at Lower Granite Dam and 130,000 cfs at Priest Rapids during the month of May. [8] The FELCC deficits resulting from the various "floor level" fish flow scenarios ranged from 400 to 800 MW.

Breakthrough -- Timing and Shaping the Flows

Of major concern to all parties was the position of the CRITFC which had adhered from the beginning to its request for optimum level flows, a regime that would have major impact on FELCC. According to the tribes, anything less than optimum flows would compromise their treaty rights. As Bill Wilkerson, at the time, Deputy Director of the

[8] See the description of the 85H study contained in U.S. Army Corps of Engineers, Main Stem Columbia River and Snake River Instream Fish Flow Report (June, 1982).

Washington State Department of Fisheries and also Chairman of the Ad Hoc Committee, reminded everyone during the hearings, the question of protection of Indian treaty rights could override all other considerations in the development of the fish and wildlife program.

A major challenge for the Council, therefore, was to prevent an impasse in the negotiation process by encouraging flexibility in the tribes' position. This the Council achieved successfully by adhering to the Chairman's initial goal of maintaining a neutral, but analytical approach to the problem. In the week to week technical negotiations, the Council regarded the CRITFC as an equal participant, thus creating an environment more conducive to finding technical solutions than to political posturing. This neutral, problem-solving approach on the part of the Council resulted eventually in the CRITFC analysts making major changes to their approach to the fish flow problem to achieve the same ends more efficiently.

The original CRFC rationale proposed in 1979 had asked for minimum and optimum average monthly flows for 12 months of the year, but the critical months were acknowledged to be April through June when the migration of juveniles was in progress. In early 1982 CRITFC hired its own hydrologist, Mal Karr, to evaluate the recommendations made by the Ad Hoc Committee. Because of the technical dialog established

among the various interest groups, Karr had access to information and the computer simulation packages necessary to carry out his analysis.

Karr's main concern was reducing the travel time of downstream migrants through the 8 lower Snake and Columbia dams to less than 30 days. To achieve that goal, he reasoned that the flows would be useful only when the fish were in the water and ready to migrate. Therefore, rather than providing storage releases on an average monthly basis, he proposed that they be timed and shaped to actual fish movement. In his report he states:

> Refining the storage operation could reduce the amount of storage release volumes needed to satisfy streamflows for fish which, in turn, would increase the system capability to meet optimum as well as minimum flows. This could be accomplished by timing storage releases for fish with downstream migrant fish movement on a daily or other short-term basis, rather than releasing on an average monthly basis. [9]

In keepinng with this philosophy, Karr submitted several proposals to the Instream Flow Work Group. By emphasizing providing optimum flows only during the peak period, the tribes reduced the FELCC deficit from 6300 MW for the original optimum flow request to 4310 MW and finally to 1855

[9] Malcolm H. Karr, "Analysis of Columbia River System Water Supply vs Streamflows for Fish During Low Runoff Periods," prepared for the Columbia River Inter-Tribal Fish Commission, August 1982.

MW.

Mal Karr's work showing that shorter travel times could be achieved by shaping flows to actual fish movement during migration periods had the important side effect of reducing impact on other uses of the river. His work, in effect, demonstrated a willingness on the part of the tribes to base their negotiating position on an examination of the technical issues. It paved the way for the Council to take a major step forward on the solution to the "fish flow" issue.

CHAPTER SIX

An Idea Coalesces

The Water Budget

For five years following the drought of 1977, the fish flow debate had centered on the concepts of minimum and optimum flows, terms that evoked bitter feelings and controversy within the river management community. With the publication of the Draft Fish and Wildlife Program in September of 1982, the Power Council, in a politically astute move, proposed a solution to the flow problem that effectively side-stepped the issue of minimum and optimum flows by making the focus of the solution not a predefined rate, but rather a volume of flow whose management was the perogative of the fisheries interests. This solution was a clever compromise. On the one hand, it kept Firm Energy Load Carrying Capacity (FELCC) impacts to a minimum, thereby satisfying the concerns of the power interests, while on the other hand, it provided the fisheries interests and the tribes a stronger and more integrated role in river management.

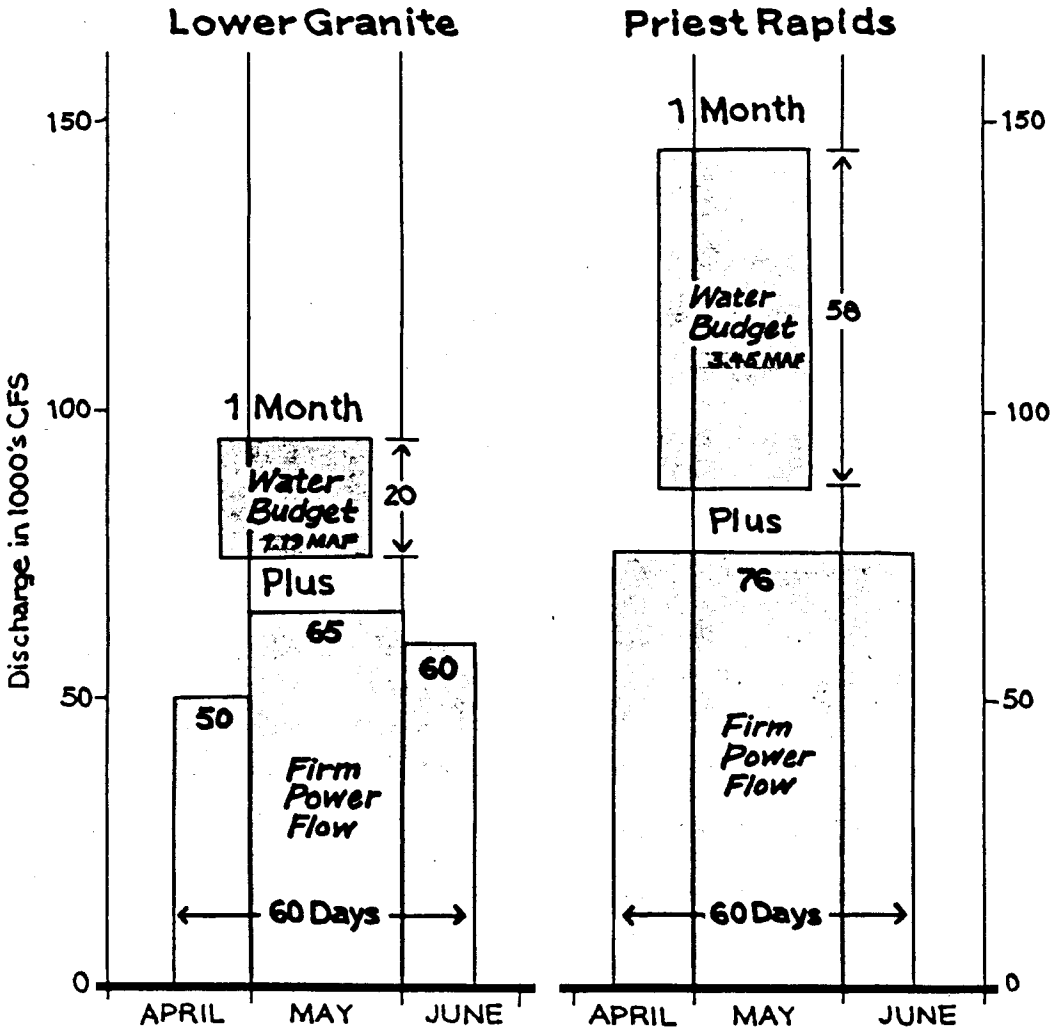
As described in the draft plan, the water budget allowed fish and wildlife agencies and the tribes to increase regulated flows during the period April 15 to June

15 as needed to enhance migration using a specified volume of water. The size of the water budget was derived from the flow recommendations submitted by the agencies and the tribes. The Council added the positive differences between the minimum flows recommended by the Ad Hoc Committee and the average monthly flows achieved during the 42-1/2-month critical period used for power requirements only. This resulted in 2.39 million acre feet (MAF) (40.2-kcfs months) at Priest Rapids Dam and 1.64 MAF (27.6 kcfs months) at Lower Granite Dam. A graphic description of the water budget is shown in Figure 6.1. Because simulations by the Instream Flow Work Group showed there was not enough water in the lower Snake to meet the recommended flows and refill the reservoir, the water budget was reduced at Lower Granite, but increased at Priest Rapids. In a special concession to the tribes, the total water budget was increased to improve the ability to meet optimum flows. The proposed water budget provided for a total of 4.64 MAF (78 kcfs-months) to be divided into 3.45 MAF (58-kcfs months) at Priest Rapids Dam and 1.19 MAF (20 kcfs-months) at Lower Granite Dam.

The effect of the water budget is to increase the level of flows in the river at a time when water is normally being retained in reservoirs. This "extra" water in the river can either be run through the turbines to generate power, or, if

FIGURE 6.1

The Water Budget



the demand for the electricity does not exist, can be spilled over the dams. Although "extra" electricity may be generated as a result of the water budget, it is generated at a time of year when demand is generally low. Power interests would prefer to keep this water in the system's reservoirs in anticipation of the coming winter, when natural river flows are low and the water could be released to meet peak winter electricity demand.

Because the water budget was a volume of water that was to be shaped during the migration period, the agencies and the tribes had to be integrated into dam operations to manage the water effectively. The Council therefore proposed that BPA provide the funds for three water budget managers--one to work for the agencies, one to work for the tribes, and one to work for the Council. According to the draft plan, the managers were responsible for informing the Corps when and to what extent the budgeted water was to released from storage.

The cost of the reduction in FELCC as a result of the water budget will be borne by the region's electrical ratepayers. Initial estimates showed the cost per kilowatt (kWh) to be 1.2 mills, translating to about $27 per year for the average residential customer. Since then estimates of FELCC impact and the cost of the measure have been revised downward.

Council's authority and the proposed water budget.

> The Council does not possess authority under the Act either to direct federal agencies to provide the water budget or to give to the fishery agencies and tribes control over river flows. Indeed, the federal agencies could not delegate that decision-making authority. The total water budget as proposed is not fully supported by the available data. Moreover, the proposed water budget is an inequitable use of water in dry water years and not manageable in its current form. [4]

Despite this public challenge to the Power Council's authority, BPA and the PNUCC appeared to accept the concept of the water budget. Johnson agreed to include the water budget as a firm power operating constraint and placed the 1984 and 1985 water budgets into the 1983 rate case. The PNUCC critiqued the program technically in an "effort to make the concept work."

Response to the Water Budget Proposal -- Technical Problem Solving

The water budget proposal grew out of the research and technical analysis of the fish and wildlife agencies, the tribes, and members of the Instream Flow Work Group. Many participants, even those close to the process, could not pinpoint where the idea changed from being a guaranteed flow

[4] Pacific Northwest Utilities Conference Committee, Comments on Pacific Northwest Electric Power and Conservation Planning Council Draft Fish and Wildlife Program, Report No. 3, Fish and Wildlife Committee (October 1982) p. C-2.

of water to a volume of water. Some observers noted that in deriving the concept, the Council merely put a name on ideas that had their genesis in the ongoing research of the CRITFC and the fisheries agencies. But there can be little doubt that the Council members, particularly Evans, and their staff managed to translate the existing research and technical proposals into a concept that addressed not only the biological needs of fish but also the need for an operational framework that would give fisheries interests enough authority to make them effective participants in river management.

The concept of the water budget was new enough to raise some major technical questions. To understand the operational and biological implications of the water budget, technical staff in all the interest groups generated their own versions of the water budget. BPA proposed a two-tiered "share-the-shortage; share-the-surplus" system. The PNUCC and the Intercompany Pool (the operating wing of the investor owned utilities and a subset of the members of the PNUCC) proposed a smaller water budget that was complemented by 90 percent of the January through July volume of runoff forecast above 50 MAF at Lower Granite Dam.

The CRITFC countered the Power Council's proposed water budget with one that was based on the fact that while the probability of one low water year occurring is 1 out of 4, a

sequence of dry years is much less probable. For example, the second year of a dry spell has a probability of recurring only 1 out of 50 years; and the third year of a dry spell has a probability of recurring only 1 in 250 years. Given these probabilities, the tribes proposed a water budget that distinguished between single dry years and a sequence of dry years. This budget calls for 2.1 MAF at Lower Granite Dam and 5.2 MAF at Priest Rapids Dam in single dry years. During the second year of a dry spell, the water budget would be reduced to 1.2 MAF at Lower Granite Dam and 3.5 MAF at Priest Rapids. During the third year, the water budget would be reduced to zero at Lower Granite and remain at 3.5 MAF at Priest Rapids. According to Mal Karr, the tribes were willing to take the risk that the sequential dry years would occur rarely. [5] Hydro regulation studies showed this proposal would cause an FELCC loss of 760 MW. It was rejected by the Council because it jeopardized reservoir refill and cost an additional 210 MW without, according to the Council, significantly reducing travel time. CRITFC disagrees with this assessment, however, and according to Karr, the Council has agreed to consider it again during the next review of the program.

[5] Interview with Mal Karr, Engineer for CRITFC (March 7, 1983) Portland, Oregon.

In addition to coming up with alternative water budget proposals, the interest groups raised major technical questions. Some of these questions were eventually addressed in the final water budget while others were not resolved and are being addressed during the process of implementation.

In the Power Council's draft proposal there were no provisions for firm power flows that would serve as the base to which the water budget would be added. Larry Dean of BPA questioned how operators were supposed to identify during the day-to-day operation of the dams which flows would have occurred without the water budget and which were assigned to the water budget. [6] PNUCC noted that the lack of specificity about firm power flows provided great "potential (and incentive) for manipulation." [7] These concerns were echoed by the fisheries agencies and the tribes.

BPA and the Corps also pointed out that despite the reduced budget for the lower Snake, flows would be difficult to achieve in low water years even with the use of Brownlee

[6] Remarks of Lawrence A. Dean, Director, Division of Power Supply, BPA, before the Northwest Power Planning Council (October 18, 1982) Missoula, Montana.

[7] Pacific Northwest Utilities Conference Committee, Comments on Pacific Northwest Electric Power and Conservation Planning Council Draft Fish and Wildlife Program, Report No. 3, Fish and Wildlife Committee (October 1982) p. C-2.

reservoir operated by Idaho Power Company and Dworshak reservoir operated by the Corps. The program did not specify any method of allocating flows between the two reservoirs. The Corps argued that if Idaho Power Company did not participate, the water budget at Lower Granite would have to be lowered even further. In response the utility argued that compensation had already been made as a result of Federal Energy Regulatory Commission (FERC) licensing procedures and it was under no obligation to contribute anything more.

The fisheries agencies were generally supportive of the water budget concept but were dissatisfied with the budget specified for Lower Granite Dam and asked for it to be increased by 7 kcfs months. They recognized, however, the water budget concept provided them with a role in river operations that would give more visibility to the needs of fisheries interests and would also give them a voice at the bargaining table during annual negotiations and planning processes.

The Final Water Budget Proposal

As a result of the official comments and formal and informal consultations regarding the water budget concept, the Council made two important changes in the final program. The first was to specify firm power flows to serve as the base from which to measure water budget usage. These flows

TABLE 6.1

FIRM POWER FLOWS WITHOUT THE WATER BUDGET

	Lower Granite (kcfs)	Priest Rapids (kcfs)
April 15-30	50	76
May	65	76
June 1-15	60	76

are shown in Table 6.1.

The second major change was to expand the section relating to the participation of Dworshak and Brownlee reservoirs in providing water budget flows. The Council included the following comment on Idaho's claim that it has no obligation to compensate for fish losses:

> The Council does not express an opinion on this question. Nevertheless, the Council believes that Idaho Power Company's participation in the water budget in the Snake River will help significantly in providing system wide flows for downstream migration If Idaho Power Company experiences a power loss as a result of participating in the water budget . . . Bonneville shall replace the loss in kind. [8]

A summary of the elements of the final water budget plan is shown in Table 6.2. [9]

[8] Northwest Power Planning Council, Columbia River Basin Fish and Wildlife Program, November 15, 1982, p. 3-5.

[9] Ibid.

TABLE 6.2

Summary of Final Water Budget Proposal

1. A block of water was assigned to fisheries agencies and the tribes which could be shaped to coincide with downstream migration of juvenile salmon during the period April 15 to June 15.

2. The total quantity of water was 4.03 MAF, comprised of 2.39 MAF at Priest Rapids Dam and 1.64 MAF at Lower Granite Dam.

3. The quantity of water was in addition to that required for firm power generation (see Table 6.1).

4. Federal operators and regulators were required to incorporate the water budget in all system planning.

5. FELCC was estimated to be reduced by 550 MW.

6. Brownlee Reservoir (operated by the Corps) and Dworshak (operated by Idaho Power) were both expected to be spilled to provide water budget flows. Power lost by Idaho Power was to be replaced in kind.

7. The water budget was not to conflict with nonpower constraints, and during better than critical water conditions, it was to be composed of a higher percentage of natural runoff.

8. The water budget would be coordinated by two Water Budget Managers, one appointed by the CRITFC and one by the fish and wildlife agencies.

9. BPA was required to fund a study to gather additional evidence on the relationship among flow, spills, travel time, and survival of smolts.

10. BPA was required to fund a program to be conducted by fish and wildlife agencies to monitor migrating characteristics and survival of various stocks of fish.

11. The Council made itself available to mediate disputes.

The final program did not attempt to resolve all water budget operating details. In recognition of this, the Council recommended that during daily operating routines, the following priorities be adopted. [10]

(1) Firm power to meet firm loads
(2) Water Budget
(3) Reservoir refill
(4) Secondary energy generation (beyond that provided in connection with the water budget)

These priorities and the vagueness of some of the program's language have haunted the water budget during implementation. In some respects, however, it was wise for the Council to shun details about complex technical matters and to encourage cooperative problem-solving during implementation. Whether this reliance on good faith and persuasion can survive the first few years of implementation where the details are "worked out" remains to be seen.

[10] Ibid., p.6.

Adoption of the Water Budget -- the Aftermath

A tense period of speculation followed the adoption of the final Columbia River Fish and Wildlife Program. In a political environment where adjudication had become the accepted norm for solving disputes, it seemed inconceivable that a program as far reaching and bold as the Fish and Wildlife Program would slide onto the books without a whisper of legal action.

In fact there were no suits brought as a result of the publication of the Fish and Wildlife Program. The measure of success goes beyond the acceptance of an agreement, however. The true test lies in the ability of the disputing parties to carry out the agreements and to achieve the established goals.

The concern of those following the debate is whether or not the water budget can be successfully implemented. Kai Lee has suggested that three elements attribute to such success: (1) the basic importance of joint action, (2) thinking through who will be involved in implementation, and (3) identifying mechanisms for responding to changes in external conditions. [11] The Council has successfully adhered to these criteria at least on the technical level by encouraging communication among the interest groups during

[11] Kai N. Lee, Defining success in environmental dispute resolution, Resolve (Spring, 1982) p. 3.

development of the proposal and by providing water budget manager positions to ensure that joint problem-solving continues through implementation. The Corps of Engineers has expanded this communication network by establishing an Implementation Work Group involving all key participants in the implementation of the Water Budget including Idaho Power Company, the Water Budget Managers, Power Council Staff, and others. The purpose of this group is to work out implementation details and negotiate settlements to problems such as the use of Dworshak and Brownlee Reservoirs on the Snake to meet water budget requirements during low flow years.

Officially the water budget could not be implemented the first spring after its adoption because the budget had not been incorporated into the 1982-1983 operating plan and because according to the Corps of Engineers (Corps), the National Environmental and Policy Act (NEPA) requirements were not complete. But, auspiciously, spring of the first year of the water budget brought with it better than average runoff conditions, allowing the Corps unofficially to test out the water budget.

During the first year of unofficial implementation, working relationships between the Corps and the water budget managers developed smoothly. The newly appointed water budget managers, Mal Karr and Mark Maher, found the Corps

cooperative and generally responsive to their requests for flows and spills on a "real time basis," that is, as they were needed to accommodate spring fish migration needs.

Other issues, however, critical to the success of the water budget stirred some controversy. These issues related to how the water budget was going to be integrated into other nonpower uses of the Columbia River such as recreation and flood control. The Corps jealously guards these responsibilities, which it claims are not subject to the balancing mandate of the Act which only applies to power and fish.

Conflicts with Flood Control and Recreation

Flood control requires delicate manipulation of the complex system of reservoirs. When snow packs portend a large runoff, the reservoirs are emptied so they can be used to regulate the rush of melting snow. As with energy planning, the Corps develops worst case scenarios; only rather than profiling drought conditions, these scenarios profile the worst potential flood that could occur and the reservoir space that would be needed to capture the water. Based on statistical studies of hydrological and weather records, flood control rule curves are developed above which the Corps cannot fill the reservoir during the flood season. These curves are modified during the year based on current river and weather conditions. In managing its system of