Salmon and Endangered Species

Chapter Four
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National Audubon Society, 1999

“No one will escape, unaffected, by any meaningful process to recover salmon.”
Brian Gorman, National Marine Fisheries Service, 1999

“The Endangered Species Act has altered the way the Corps does business.”
Tom Davis, former Chief of Planning, North Pacific Division, 2001

Spawning Sockeye salmon.

New Legislation and New Values

Salmon have long been important to the identity of this region, but attitudes toward these fish and the natural world in general have evolved considerably over the last 150 years. If the Euroamericans who arrived on the Columbia and Snake rivers during the mid-19th century could witness the debates regarding Pacific salmon in the late 20th century, they might be astonished at the contrast in priorities and values. The first white settlers viewed salmon as an inexhaustible resource, and they devoted their energies to increasing the efficiency of harvest methods and transportation systems, not to protecting the region’s fisheries. At the same time, the federal government encouraged the perception that the nation could enjoy the fruits of development and continue to have fish, too – and conservationists advocated using the region’s water, timber, and fisheries resources to the fullest extent. By the late 19th century, far-sighted individuals had warned that some salmon species were headed for extinction; in the late 1880s Congress directed the Corps to investigate the alarming reduction in the numbers of Columbia River salmon.[1] Not until the environmental era of the 1960s and 1970s, however, did the region recognize the limitations of its resources, prompting dramatic changes in fisheries policy and management, as well as changes in the operations and management of the Portland District’s dams.

Salmon decline was a highly visible, politicized issue that reflected a larger historical trend: the realization that the Pacific Northwest’s natural resources were finite. No longer did the rivers run thick with the inconceivable quantities of salmon encountered by Lewis and Clark. By the end of the 20th century, a number of salmon species that passed through Columbia and Snake river dams were listed as threatened and endangered. The perception of the Pacific Northwest as a place offering nature’s bounty in unlimited quantities had come to an end – and scientists, economists, and policy makers faced the monumental task of managing the resource in this new reality. “Our time of having it all is over,” explained a reporter in 1991. “The choices must be made.”[2]

Extended length traveling screens are installed to help juvenile fish safely pass the dams.

Salmon raised by hatcheries are trucked and barged past the dams and released in the rivers.

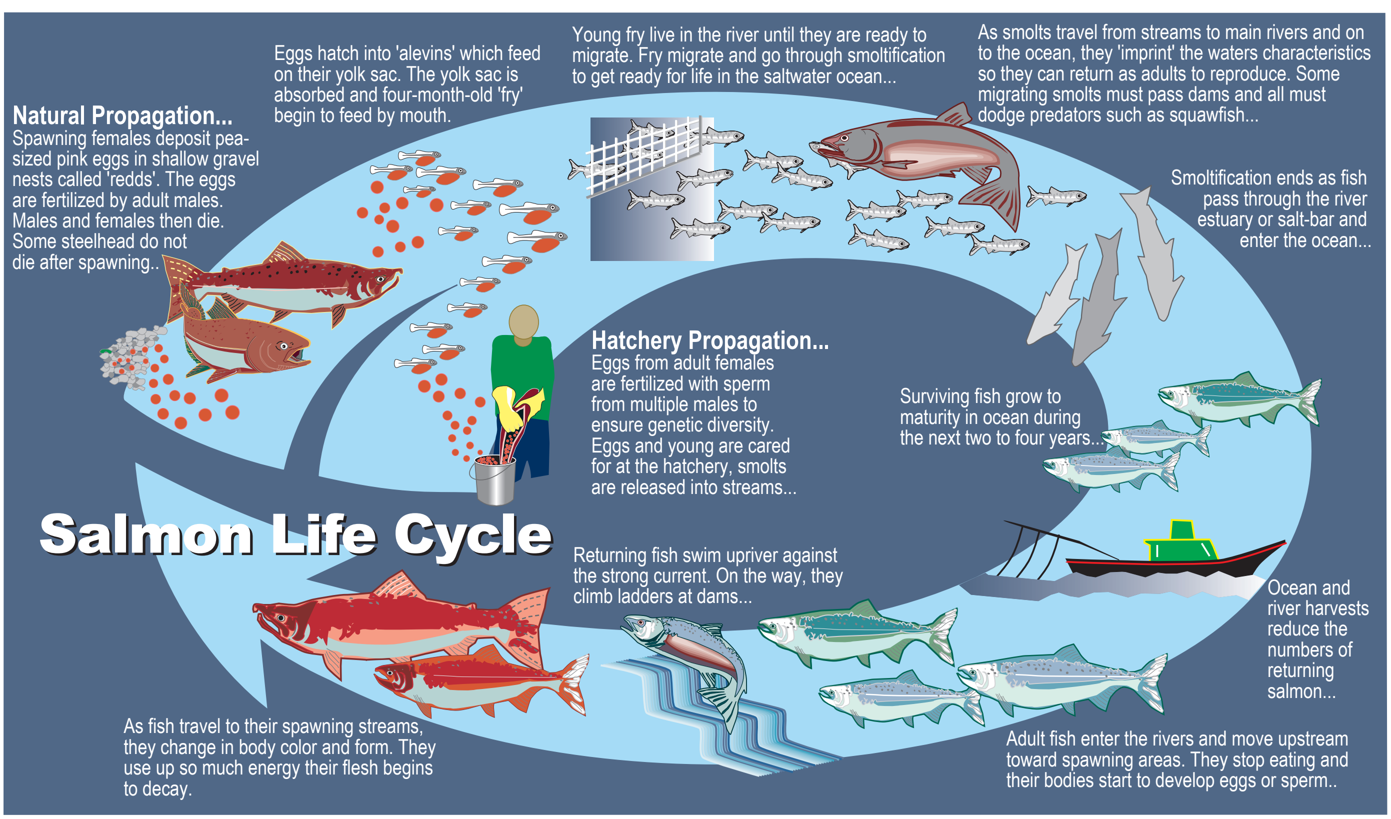
Dams in particular came under scrutiny. When they were originally constructed many Americans applauded them for turning desert into orchards, providing jobs during the Depression, and supplying inexpensive electricity. By the 1960s, though, many no longer viewed dams as humans harnessing nature for the public good, but as attempts to engineer nature. Turbines were viewed as blenders, and bypass flumes became tunnels of death.[3]

The Endangered Species Act (ESA) reflected this shift in attitudes toward the environment in general, and dams in particular. Although Congress passed endangered species legislation in 1966 and 1969, these earlier acts were weak and ineffective, while the amended statute of 1973 proved to be one of the nation's strongest environmental measures. Called the "pit bull of environmental law," this landmark legislation established a set of rules that provided special protection to threatened and endangered species. Because salmon are anadromous fish, the ESA granted the National Marine Fisheries Service (NMFS) regulatory authority over the fish; the U.S. Fish and Wildlife Service (USFWS) held responsibility for freshwater, resident species. Under the ESA, NMFS designated the Corps, Bonneville Power Administration (BPA), and the Bureau of Reclamation as Action Agencies responsible for implementing listing recommendations in cooperation with NMFS. Specifically, NMFS directed these Action Agencies to conduct studies, alter operations, modify structures, provide supplemental water to assist migrating fish, and participate in recovery activities. The statute required NMFS to write a recovery prescription – known as a 4(d) rule – which could be applied to each salmon run listed.[4]

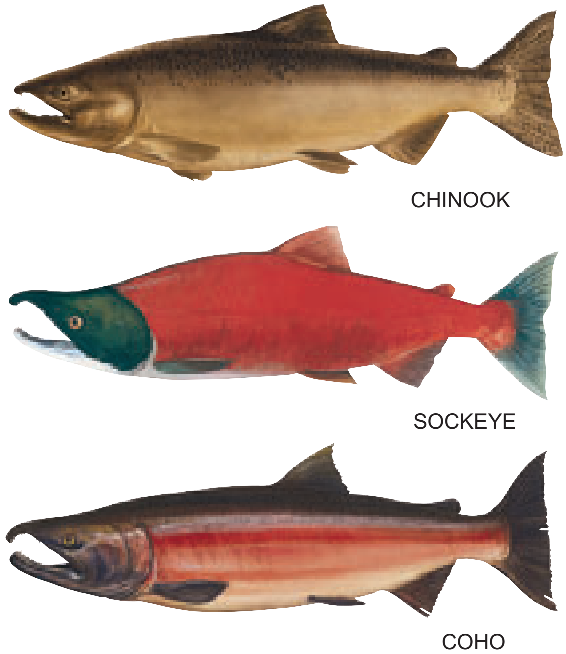
In the early 1990s, NMFS had received petitions to list five salmon populations under the ESA. The five populations included Snake River spring, summer, and fall chinook, Snake River sockeye, and

PACIFIC SALMON

Salmon are anadromous fish that hatch in freshwater, swim to the ocean, and then return as adults to freshwater to spawn. The Greek term "anadromous," which means "running upward," refers to this migratory behavior. Salmon start out as pea-sized eggs buried in the gravel of cold, swiftly running water. After hatching, juvenile salmon undergo smoltification – a process that enables them to adapt to saltwater. As they move downriver, smolts imprint on the sequence of odors they encounter. After maturing in the ocean, they find their way back to the waters of their birth, where they spawn, by following the reverse sequence. Once they enter freshwater, they do not feed extensively. Salmon generally die after spawning, while steelhead can live to repeat the spawning cycle.
The five species of Pacific Salmon include Chinook, sockeye, coho, chum, and pink.



lower Columbia River coho. In December 1991, the agency listed the Snake River sockeye as endangered; the following spring NMFS listed Snake River chinook populations as threatened. Regional observers understood that the impact would be significant – particularly to the Pacific Northwest's economy. ESA listings threatened a wide range of economic activities, including hydroelectric generation, agriculture, commercial and recreational fisheries, and Native American treaty fisheries. "Every man, woman and child in the Northwest will be shaken as if by an earthquake," predicted Oregon Senator Mark Hatfield in 1991.[5]



Endangered salmon species.

In March of 1999, in a bold application of the act, NMFS named nine additional species of salmon as threatened or endangered. This ruling affected 72,000 square miles of watersheds in Oregon and Washington, including the urban areas of Portland and Seattle. As predicted in the early 1990s, the impact of the listing on the economy was felt almost immediately. This federal action restricted a number of projects, ranging from highway construction to building new housing developments. These listings also curtailed logging, grazing, and farming in salmon habitat. Never before had the ESA resulted in such far-reaching impacts in a heavily urbanized area. "As far as the impact of ESA listings on the human population, this was simply unprecedented," observed Curt Smith, salmon advisor to Washington Governor Gary Locke.[6] Similarly, in 1999, representatives of the National Audubon Society commented that the salmon listings "may be the biggest hammer ever brought down in the 26 years of the Endangered Species Act."[7] That year, Brian Gorman, NMFS spokesman, warned, "No one will escape, unaffected, by any meaningful process to recover salmon."[8]

The region had experienced endangered species listings before – most notably the spotted owl that pitted the timber industry against environmentalists – but the reverberations were not nearly as widespread. "The consequences [of the listings] could far surpass those that followed similar action to safeguard the northern spotted owl," observed *The Seattle Times/Post-Intelligencer*.[9] While spotted owls ranged for thousands of acres, salmon ranged for thousands of miles, swimming through a number of borders and jurisdictions. Listings of salmon stocks created considerable alarm among the region's residents and policy makers.

So momentous was the impact of this legislation that the Portland District's history could best be understood as constituting two eras: before and after the ESA. The legislation's full effect wasn't immediately felt by the agency, but the listings of Pacific salmon species changed that. "The Corps' awareness and sensitivity to environmental issues … hit hard with the listing of endangered species on the Columbia River," explained Jerry Weaver, former Chief of Plan Formulation for the North Pacific Division, in 2001.[10] Tom Davis, former Chief of Planning for the North Pacific Division, agreed. "Since the early 1990s the Endangered Species Act has altered the way the Corps does business," he declared in 2001, "and today it's the most significant thing we deal with."[11]

With its diverse missions of flood control, navigation, hydropower, and environmental activities, the Corps often found itself embroiled in the salmon controversy. For example, calls to increase spill because of salmon and water temperature concerns meant a decrease in power output and an increase in the likelihood of fish suffering from gas bubble disease. Decreasing spill resulted in another trade-off: more power but also more salmon going through turbine passage routes. "You can't have an agency with such a widespread mission that touches so many people that is not going to get criticism," commented Colonel Eric T. Mogren, Deputy Commander, Northwestern Division.[12]

Managing salmon, however, was not a simple task. The large number of agencies and tribes operating on the Columbia River system presented an enormous challenge, and salmon migrations further complicated management. Salmon swim through a maze of federal jurisdictions: BPA, NMFS, Corps of Engineers, USFWS, Bureau of Land Management, Bureau of Reclamation, USDA Forest Service, and the Environmental Protection Agency (EPA).[13] Additional interests include state agencies, tribes, and environmental, economic, and recreational groups, reflecting an increasing level of public involvement at the end of the 20th century. "The level of institutional cooperation between state agencies, tribes, federal agencies, and private landowners needed to achieve salmon recovery in the Columbia River Basin is unprecedented," explained a report produced by the Northwest Power Planning Council.[14] Ultimately, the fight for salmon is a fight over control of the river, explained Colonel Mogren in 2001: "It's about whether it's going to be state controlled, tribal controlled, local controlled, or federal controlled. Whether you're going to give the use to agriculture or business or navigation or flood control or hydropower or tribal, environmental protection. That's what this is fundamentally about; it's about who gets to control the water."[15]

The District increasingly found itself having to balance often opposing interests, and it was required to consult and coordinate with state and federal fisheries agencies, as well as with the tribes. The Nez Perce, Umatilla, Warm Springs, and Yakama reserved the rights to harvest salmon in perpetuity in exchange for ceding millions of acres of lands to the United States in 1855, and the tribal perspective was sometimes different from that of other interests operating along the region's rivers. "The ESA must do more than merely prevent extinction of fish, wildlife, and plants," explained one tribal publication in 2000. "The ESA must restore these populations to healthy levels that may again support harvest."[16] As Colonel Mogren explained, salmon were a crucial focal point in consultation with the tribes. "You can't talk fish without talking hydropower," he observed, "and you can't talk hydropower without talking fish, and you can't talk about either one without talking about Indians." He viewed coordination with the tribes as being an essential component of the Northwestern Division's and the Portland District's operations. "It's important to meet their elders and go to their ceremonies and listen," Colonel Mogren recalled. "They don't care about the Corps of Engineers; they care about the character of the people that they are dealing with. They want to know as a person who you are, and what your beliefs and values are. If you get that rapport going, you can make headway."[17]

While establishing personal relationships may have fostered rapport, responding to environmental concerns proved to be a continuing challenge for the Corps. The agency adapted its focus, evolving from massive engineering projects to responding to new environmental requirements, but the need to balance a diversity of interests continued to create conflict. "Anything we've done in the last three years, there's been an issue associated with it," said Douglas Arndt, a fisheries biologist with the Northwestern Division, in 1999.[18] Furthermore, the Corps' new environmental role met with some skepticism. As one participant at a public hearing complained, "You're the Corps of Engineers, not the Corps of Biologists."[19] The following sections describe the causes of fish loss, as well as how the District responded to the salmon crisis, completing research and updating fish-passage facilities.

The Five "H"s

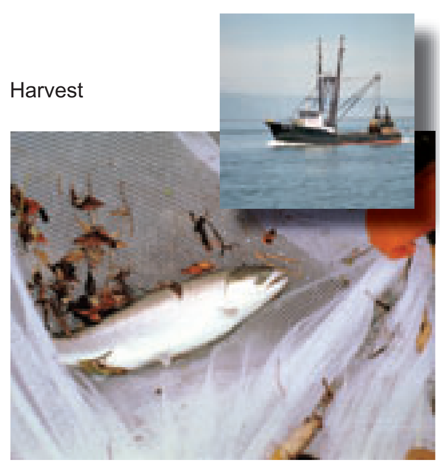
In the search for the causes of diminishing salmon runs, dams provide an easy target. They are enormous, highly visible structures and have a history of disrupting the migrations of anadromous fish. But the dams on the Columbia and Snake rivers were only one piece in the complex puzzle of salmon decline. The listing of Pacific Northwest salmon species in the 1990s rekindled a serious investigation into human-made and natural causes of salmon decline. Toward the end of the 20th century, scientists generally attributed human-caused fish loss to four primary areas, dubbed the four "H's": habitat, harvest, hatcheries, and hydropower. Some suggested that a fifth "H," high seas, had a significant – but largely unknown – impact on salmon populations.

As a cause of salmon decline, habitat is especially complex in terms of historical attitudes and practices. "Habitat" is a modern concept – newspapers and other popular publications rarely used the term until the 1960s and 1970s. During the 19th century, settlers in the Columbia River Basin did not view their surroundings as a habitat or as an ecosystem. Moreover, changes to habitat were sometimes incremental and difficult to detect. When advocates for salmon searched for causes for the decline of the region's fisheries, they tended to focus on visible, easily identified causes such

The Five "H"s

Habitat

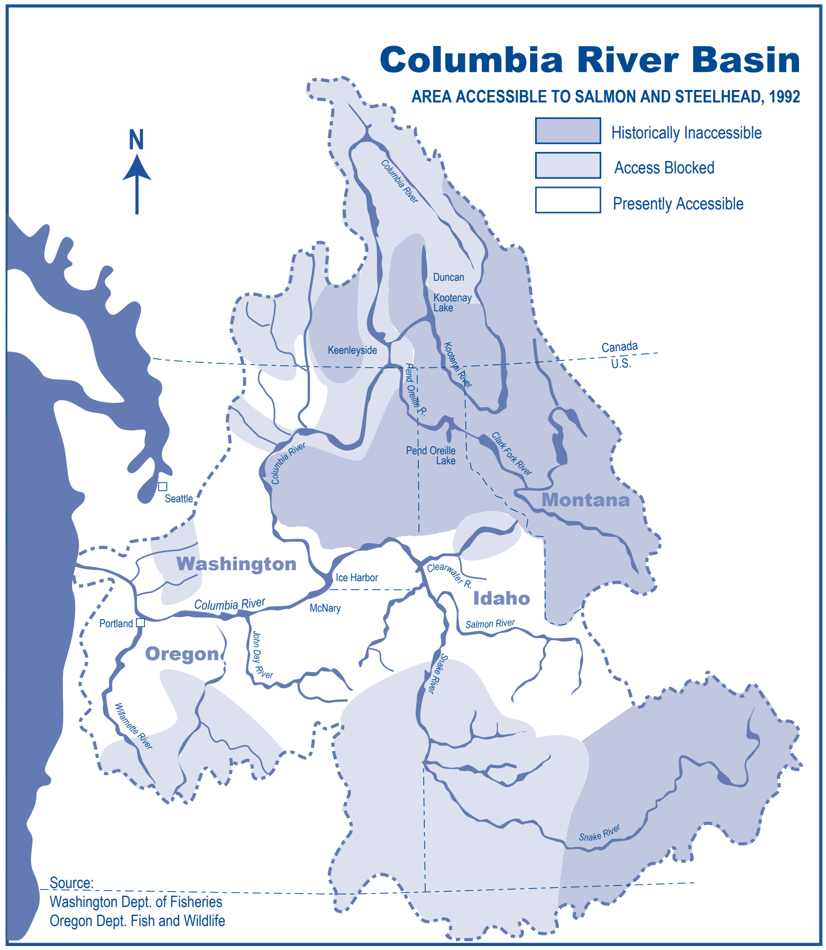
Harvest



as harvest and dams. Incorporating habitat concerns into research and policies is a recent practice, part of the bigger picture of biodiversity and ecosystems that emerged during the environmental movement.

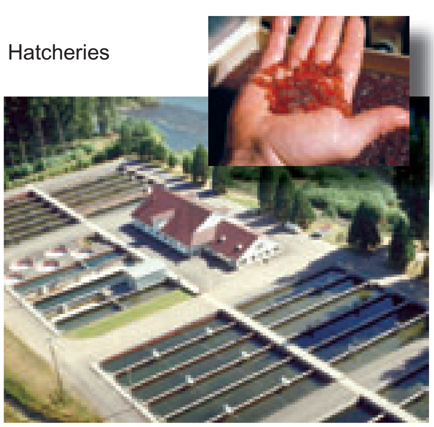
By the end of the 20th century, threats to salmon habitat were better understood. Logging, agriculture, mining, development, and recreation dramatically altered water quality and temperature, while reduced food supply, introduced animal waste, pesticides, and industrial pollution further harmed anadromous fish.[20] NMFS, in listing the Puget Sound Chinook salmon as threatened under the ESA in 1999, identified widespread habitat modification as one factor contributing to its decline.[21]

Hatcheries are another cause of salmon decline. In addition to regulating seasons and methods of harvest, early state and federal authorities turned to hatcheries and fish culture as a means to perpetuate salmon and steelhead populations. During the early 1870s, cannery interests in the Pacific Northwest experimented with artificial propagation, and for the next century the Oregon Fish Commission, Washington Department of Fisheries and Game, the U.S. Fish Commission, and their successor agencies constructed hatcheries throughout the Columbia River Basin and Puget Sound. Some fisheries authorities placed substantial faith in hatcheries. The U.S. Bureau of Fisheries, for example, claimed in 1913 that "the possibilities for fish-cultural work are practically unlimited," particularly "with reference to the Pacific Coast salmon."[22] Similarly, fisheries expert John N. Cobb noted in 1917 that "the consensus of opinion is that artificial culture does considerable good."[23]



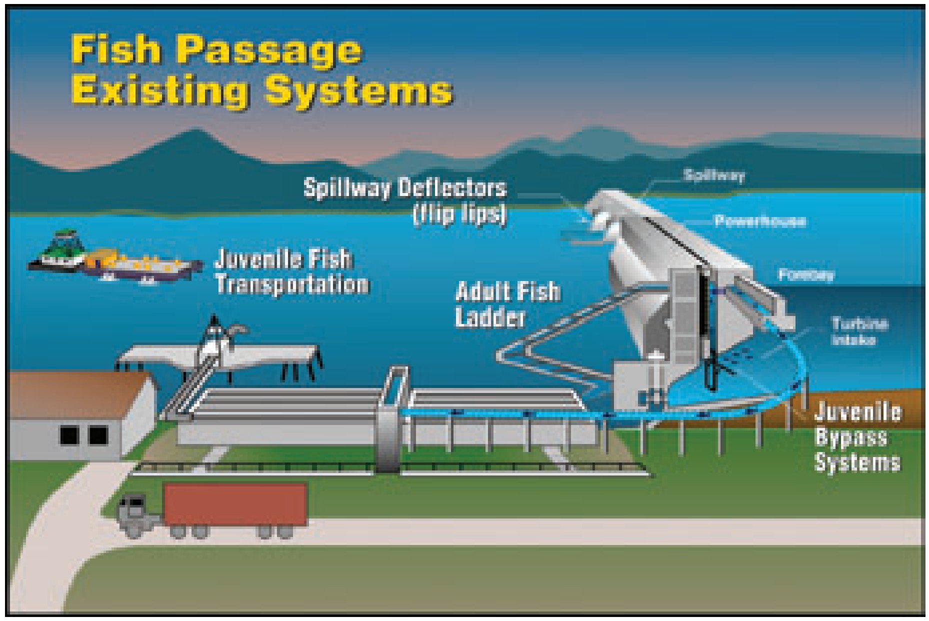
This faith in hatcheries reflects an early 20th century belief that science and technology combined could sustain a critical resource, allowing continued use and harvests.[24] Modest successes in artificial propagation replaced initial failures and led biologists to believe that anadromous fish populations could be sustained with this method, which became "the only recognized tool of fishery management."[25] Increasingly, hatcheries were seen as the solution to declining salmon runs. The region's earlier reliance on hatcheries, however, came under scrutiny during the environmental era. By the 1980s, an increasing number of fisheries biologists had pointed out that reliance on hatcheries had weakened wild stocks.

Hatcheries



Hydropower

High Seas



Concerns included competition for food, space, and cover, and vulnerability to disease. Hatchery fish can infect wild ones with bacterial kidney disease, weakening them during the smoltification process, the demanding physiological transition from fresh to salt water.[26]

Harvesting also affected salmon populations on the rivers and the ocean. During the 20th century, commercial catches of salmon and steelhead on the Columbia River varied. In the late 1930s, they averaged about 18 million pounds annually, which was a substantial drop from the 40 million pounds averaged during World War I and a decline of 50 percent from their 1911 peak. Catches dropped steadily in the post World War II era.[27] During the 1940s, ocean trollers hauled a large percentage of the catch, and advances in technology improved navigational aids, netting materials, and fish-hauling equipment.

The 1940s also saw an increase in regulations. The Pacific Marine Fisheries Commission, for example, was established in 1947 to oversee ocean fisheries along the West Coast. This interstate commission reviewed fisheries research data and tried to develop unified positions on regional fisheries issues. In later decades, fishing seasons were shortened, and the number of fishing fleets was restricted.[28]

After World War II, population growth as well as increased affluence and leisure time considerably augmented the number of recreational anglers. The interest in sports fishing grew rapidly in the 1960s and 1970s. Almost a million anglers fished for salmon and steelhead in the rivers in 1976 and 1977 in Oregon, Washington, and Idaho. In 1976, their coho catch was 1.7 million, and in 1977, a drought year, it was 900,000. Sport fishers' chinook harvest totaled 631,000 in 1976 and 553,000 in 1977, while the steelhead catch increased from 210,000 to 258,000.[29]

Better technology and equipment and a record number of river users led to increased pressure on the salmon resource. Together with widespread habitat degradation and other causes mentioned in this section, salmon populations plummeted and by the early 1990s, several species had been listed as threatened or endangered. Salmon forecasts in 1994 were so bleak that for the first time in history fisheries agencies shut down all offshore coho and most chinook salmon fishing in Oregon and Washington.[30] Along the Columbia River, controversy remains over Indian gillnets, while up north Canadians claim U.S. fishers continue to intercept millions of Canadian salmon – fish that don't have to negotiate mainstem dams like their American counterparts.

Although salmon spend most of their lives in salt water, most habitat, hatchery, and harvest remedies have focused on threats in fresh water. However, in addition to the impact of the fourth "H," hydropower, described below, there is increasing consensus that the causes of fish loss – and the need for additional knowledge – extend well into the open ocean. This fifth "H," high seas, adds a host of variables to an already complex puzzle. "The ocean is the big black box that's really the determining factor in run size," explained John Kranda, Portland District project manager.[31] Conditions that might play a very significant role include climatic shifts over decades that impact ocean productivity, and ocean currents and temperatures in the North Pacific, particularly El Niño and La Niña events. An ocean dynamic adds even more uncertainty to a system fraught with uncertainty, and makes mitigation efforts all the more difficult, admitted Brigadier General Robert H. Griffin, Northwestern Division Commander. "The truth is there's a lot going on out there in the

THE CORPS AND COLUMBIA RIVER SALMON

The Corps' interest in Columbia River salmon is longstanding. As early as 1887, Major William A. Jones, Portland Engineer Officer, investigated salmon catch methods, artificial propagation, life cycle, and the depletion of runs. The Corps' responsibilities for navigation prompted this report, which examined the danger posed to vessel traffic by dams and fish traps. By the 1930s, Congress had recognized the importance of providing fish passage over dams and included "fishways" (ladders) in dam cost estimates, noting, "the salmon industry is of great importance to the states of Oregon and Washington, and should not be endangered."

Northern pike minnow caught with several juvenile salmon in its belly. Photo courtesy of National Marine Fisheries Service, Seattle, WA.

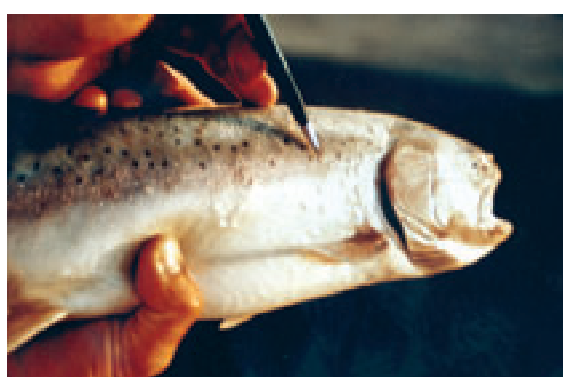
ocean that isn't being blamed simply because if you blame the ocean there's nobody who can be held accountable."[32]

Hydropower, the most visible of the "H's," became the focus of blame when salmon populations were in jeopardy. Dams introduced a number of threats to migrating salmon, including delays caused by the blocking of the migratory journey. Juvenile salmon evolved under seasonal flooding; spring freshets rushed young salmon to the sea. Water slowed by dams – and the time spent navigating over, around, and through them – added as much as one month to the migration. Other hydropower-related threats included increased predation, mainly by northern pike minnow (formerly "squawfish"), and the stresses of tagging and bypass collection and transportation by barge, truck, or flume. The biggest hazards, however, were from turbines, Total Dissolved Gas (TDG), and temperature.

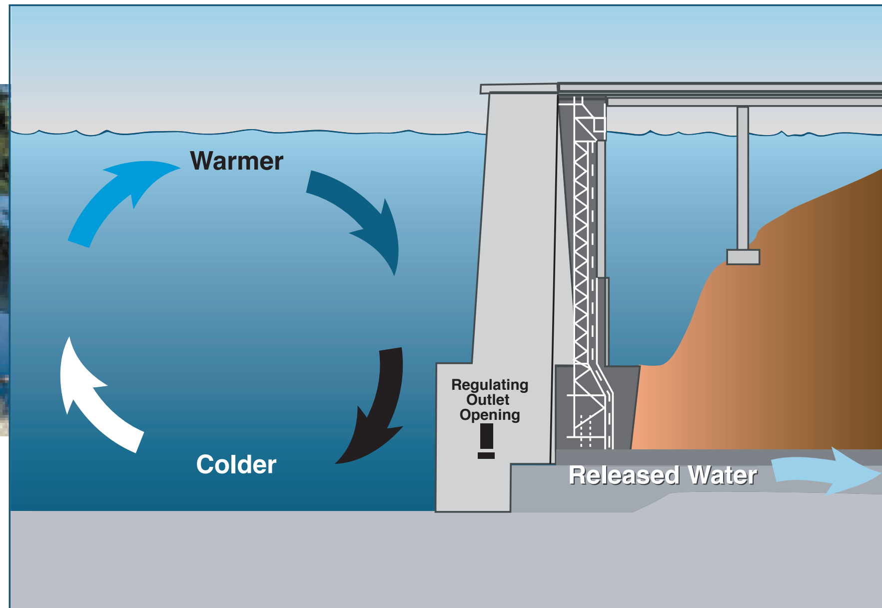
The turbine intake system is probably the most dangerous path a young salmon can take through a dam. While this is the prevailing view, over the years it has not been shared by all. In 1941, the assistant chief of engineers for the Corps, Thomas Robins, testified before Congress that dam turbines were "absolutely incapable of hurting the fish. If you could put a mule through there, and keep him from drowning, he would go through without being hurt. Before we put the wheels in, we carried on experiments with fish, and proved conclusively that the pressure of the turbines will not injure fish."[33] While this statement is exaggerated and inaccurate, recent claims that turbines are large blenders, dicing young salmon on their journey to the sea, are also misleading. Because the force of rushing water drives the turbine blades they rotate 70 to 90 times per minute, not the thousands per minute found in a blender. Still, the turbine intake system subjects young salmon to a number of dangers that can cause injury or death: pressure from diving to low depths (juveniles prefer to stay in the upper water column), striking (hitting solid parts of the turbine machinery), gill tearing (from jets of water streaming at different velocities), cavitation (sudden changes in pressure, low to high, from the blade action), and predation (disorientation or injury from transiting the system makes them more susceptible to feeding by opportunistic fish or birds).[34]

High levels of Total Dissolved Gas, or TDG, can lead to gas bubble disease, one of the most serious threats to migrating smolts. Water plunging down the spillway injects air bubbles, composed of oxygen and nitrogen, into the water. While the bubbles disappear, the gas is incorporated into the water – and fish absorb the extra oxygen and nitrogen when they pass the gas-saturated water over their gills to breathe. As fish return to shallower water, the pressure lessens and the gasses bubble out of solution inside the fish. Gas bubble trauma in fish is akin to the nitrogen narcosis – better known as caisson disease or the "bends" – experienced by scuba divers who ascend too quickly. Symptoms include tiny blisters on fins or scales, and swollen or ruptured eyes.[35] "By the time you see bubbles on the outside of a fish," said one fish farm operator, "it's toast."[36]

Even with reduced spillway flow it was difficult to keep TDG levels at or below the 110 percent threshold required by state water quality standards in Washington and Oregon. These states sometimes gave the NMFS permission to allow levels to reach 120 percent because of spring runoff and calls for increased spill.[37] In 1996, 4.2 percent of nearly 40,000 smolts examined near dams showed signs of gas bubble disease; of those, 37 were severe cases with possible lethal concentrations of nitrogen. And like the young salmon that emerged from the turbines, smolts that lingered at the bottom of the spillway could become disoriented by the churning water or disabled by high levels of TDG which increased their vulnerability to predation and disease.[38]



High levels of Total Dissolved Gas in the water can result in gas bubble disease in salmon. Photos courtesy of National Marine Fisheries Service, Seattle, WA.



Cougar Dam reservoir water temperatures will be regulated through a temperature control tower.

Columbia River water temperatures also presented problems for salmon. Temperatures were raised in a number of ways: farm runoff, logging that removed cooling shade, pumping water from wells for homes, farms, industry, and hydropower structures. Dams raised water temperatures by slowing and pooling water that was then warmed by the summer sun. Dams also disrupted seasonal flows, making the river warmer than usual in autumn and cooler than usual in spring. The risk posed to salmon by temperature fluctuations was very real but largely unstudied. "We've spent a lot of energy on helping fish get past dams, on barges and other things but we haven't looked much at temperature," said Charles C. Coutant, a research ecologist with the Independent Scientific Advisory Board. "Maybe we've made a mistake."[39]

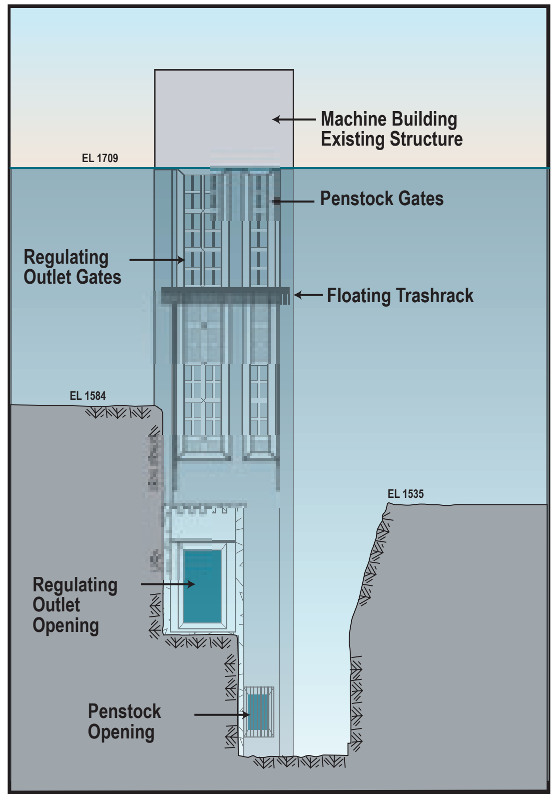
Scientists found that temperature change greatly impacts a salmon's ability to survive. Salmon are cold-blooded creatures and unusually warm water speeds up their system, forcing them to consume the fat reserves that are needed to make the long journey to their spawning grounds; because of raised metabolic rates some salmon are too exhausted to spawn. Higher temperatures also drive smolts from the edges of the river to the main reservoir where there is less to eat and a greater chance of being eaten.[40] And because warmer water holds less gas, including oxygen, respiratory problems can develop as fish struggle to breathe.[41]

State and federal agencies maintained that river temperature levels above 68 degrees could be harmful to fish; summer temperatures in the Columbia River occasionally climbed as high as 80 degrees. In July of 1998, abnormally warm waters were blamed for the deaths of more than 40,000 smolts at McNary Dam.[42] The EPA recommended increased spills to stay within the levels required by the Clean Water Act, but this action entrained more air and pushed TDG levels beyond the 110 percent level required by the ESA. This recommendation put the EPA at odds with the Portland District and complicated salmon recovery efforts.[43]

It was not just the Columbia River dams that posed a temperature threat to anadromous fish. In the 1960s, the Corps erected dams on the Willamette River system to control floods, generate power, and to supply water for irrigation and domestic use, low flow augmentation, and recreation.[44] The Corps incorporated fish facilities in these dams. However, toward the end of the 20th century, unnatural temperatures became the primary concern, particularly at Cougar Dam on the South Fork of the McKenzie River and the Blue River Dam on the Blue River. The Corps launched the Willamette Temperature Control Project to address this hazard.

The impact of hydropower facilities on Willamette River temperatures was not a new consideration. A report by USFWS in 1952 noted that development of water-use and flood-control projects on the Willamette River System changed the ecology of many of the Willamette streams. Changes in temperature and chemical composition of the water affected fish populations in the system. The report further recommended planning a fishery-management program.[45] When the Cougar and Blue River dams were constructed, however, upstream habitat loss was the focus of salmon runs, and a hatchery sited at Leaburg was intended to compensate for the degradation. Biologists and engineers failed to anticipate the temperature problem.[46]

By the 1990s, scientists had identified temperature as the major cause of salmon decline on the Willamette. In the fall, water as much as 10 degrees higher than normal was flushed from a single outlet near the top of the reservoir, triggering eggs to hatch off schedule in December or January – months ahead of time – when food supplies are low. The smolts that did survive often couldn't find their way out of the reservoir and through the specially designed "fish horn" – a system that never worked properly. Temperature also disrupted the crucial timing of salmon migrating upriver. Originally, returning adults were to be trapped near the base of the dam and trucked above. In the spring and summer, however, only a few adults congregated near the base of the dams because the water released was too cold.[47] "The water's just too cold sometimes and too warm other times. It's just the opposite of what the natural river temperatures should be," explained Nancy MacHugh, Oregon Department of Fish and Wildlife (ODFW) interagency coordinator.[48] By 1998, native chinook runs numbered 1,000 to 2,000 fish, less than one percent of their historic size, and on March 24, 1999, NMFS listed the Upper Willamette River Chinook Evolutionary Significant Unit (ESU) as threatened.



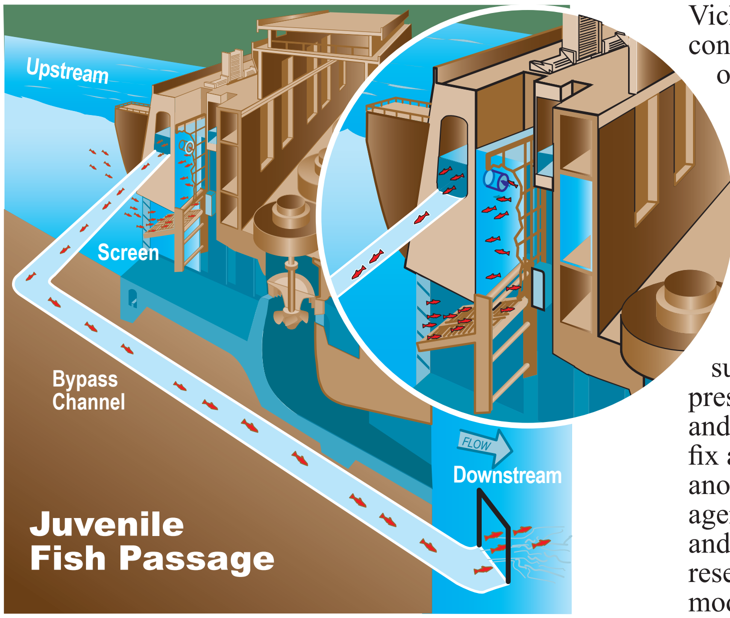
Modifications to the Cougar Dam temperature control tower began in 2002 with the drawdown of the reservoir. New outlet gates will be added to the tower to allow better water temperature regulation of water released from the reservoir.

To mitigate the harmful temperature fluctuations, the District proposed large control towers at Blue River (257 feet) and Cougar (302 feet) dams in 1995. Through a series of ports on each tower water could be released from varying depths in the reservoir, depending on downstream temperature needs. "We're trying to restore the temperature to what it was before the dams were built," said Doug Clarke, project manager. And unlike other Corps salmon recovery efforts, the towers had broad support from fishing groups, environmentalists, and state and federal officials. "Temperature regulation is going to be very beneficial, especially to spring chinook," remarked Bob Bumstead, conservation chairman for the McKenzie Flyfishers.[49]

The District estimated that temperature control modifications to the Cougar and Blue River dams would take eight years and cost $42 million. While interested parties agreed the project needed to move forward, concerns about the impact of construction on water quality, recreation, hydropower losses, and fish populations remained. Plans called for draining the Blue River reservoir, but a pool was needed at Cougar reservoir for bull trout, a threatened species under the ESA. An ODFW fisheries biologist worried that the proposed 80-acre pool wouldn't be enough to sustain a bull trout population "hanging on by its toenails." In the early 21st century, the District worked with USFWS and ODFW to develop a plan to collect adult bull trout below the dam and transport them to release sites above the reservoir in the South Fork McKenzie River.[50]

Although the District released a final EIS for the construction of the project in 1995, fisheries biologists modified its design to include a larger temporary pool, an unscreened opening for the diversion tunnel, and placement of two cofferdams to manage water flows during construction. The Cougar reservoir is to be lowered each summer for up to five years beginning in April of 2002, while workers complete the temperature control structure; construction will render unusable the reservoir's three boat ramps. The Corps will begin work at the Blue River Dam when the Cougar


Bull trout



Dam intake tower is completed.[51] Fisheries biologists predicted that improved salmon conditions in the lower McKenzie could rebuild the chinook run by 16,700 a year.[52] A fish passage report at the close of the 20th century recommended that an upstream adult trap be built immediately. For downstream migrants, it concluded, the only practical solution is trapping and hauling the fish, and more research is required about reservoir hydraulics and fish behavior.[53]

In addition to the perils of turbines, TDG, and temperature, hydropower raised the issue of techno-fixes versus more natural ways of routing juvenile salmon through dams. "If you understand how a bypass system works it's not the most natural thing," said John Kranda. "With the fish having to sound into a turbine intake and get screened up into a gate well and shoot through an orifice and into a channel that runs the length of the dam; it's dewatered while they're doing that, eight hundred CFS (cubic feet per second) down to thirty, and into a pipe and then back out to the river. Pressure changes and all these mechanical systems – even the average person would think that's not very natural."[54] Other fish passage techniques had drawbacks as well. Barging and trucking smolts stressed and crowded them, and more passive methods like water slide flumes deposited dazed fish into the waiting jaws of northern pike minnows, an over-sized minnow that consumed millions of young salmon and steelhead every year.[55]

Finding Solutions

"We are extremely interested in providing safe fish passage," Corps biologist Gary Johnson explained in 1989. "But we also feel a strong obligation to the region's ratepayers to operate our projects in a way that will balance all of our resources."[56] For much of the 20th century Americans believed they could have dams and salmon, too – a perception that Congress encouraged. Later in the century, with the emergence of the environmental movement, that balance became harder to maintain as salmon moved to the forefront. This shift prompted changes in fisheries management as well. While the early focus had been on adult fish, juveniles received an increasing amount of attention during the period 1980-2000.

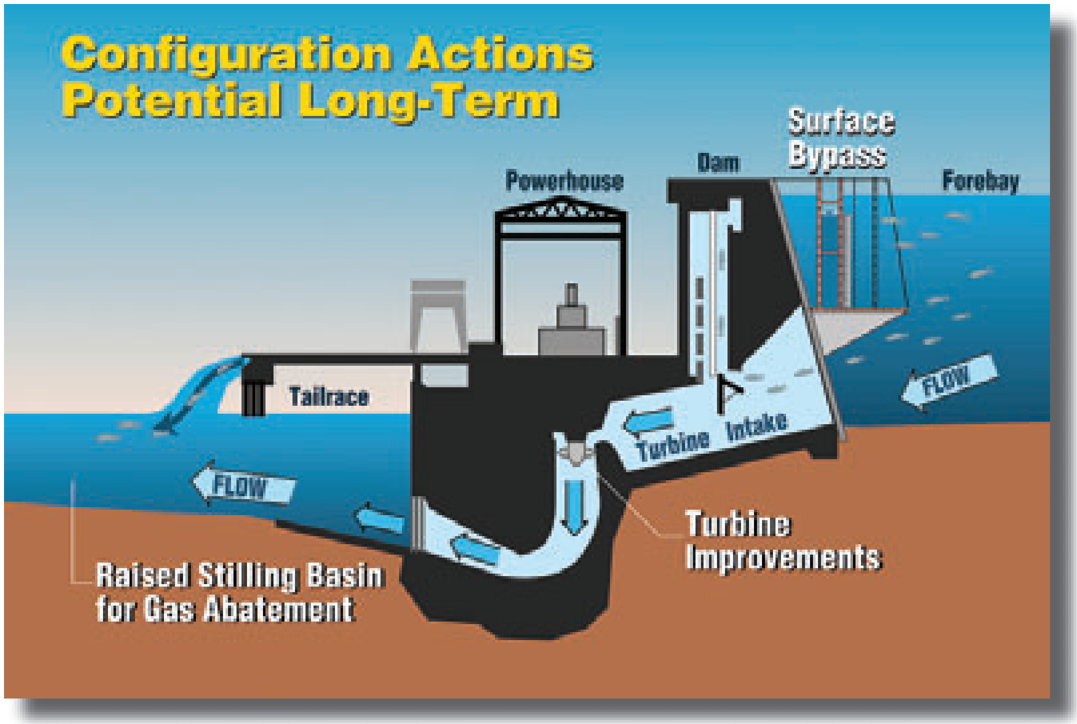
Although Pacific salmon have been probed, tagged, and monitored for decades, many uncertainties remained. During the environmental era, research projects replaced construction as the District's primary mission on the Columbia. In 1980, the District lost the Fisheries Engineering Research Laboratory at Bonneville Dam when a heavy snowfall collapsed the building. While the laboratory's functions were transferred to the Corps' Waterways Experiment Station (WES) in Vicksburg, Mississippi, the District continued to initiate a large number of new research and monitoring efforts in the Pacific Northwest.[57] In the early 1990s alone, its Fish Passage Development and Evaluation Program conducted approximately 50 studies of fish passage issues including transportation, spill effect, bypass effectiveness, adult migration, and gas supersaturation.[58] Each dam presented a different challenge, and the Corps soon realized that a fix at one dam might not work on another. This section examines the agency's response to new regulations and new realities, and its extensive research and monitoring and facility modifications.

The Pacific Northwest Electric Power Planning and Conservation Act, signed into law in 1980, significantly influenced the Corps' research and construction efforts to improve salmon passage. The act created the Northwest Power Planning Council (NWPPC), which had two objectives: to assure the region of adequate, reliable, economical power supply, and to "protect, mitigate, and enhance fish and wildlife" and their habitats in the Columbia Basin. Governors from four states – Idaho, Montana, Oregon, and Washington – appointed two members to sit on the Council. The Power Act contained three principal mandates for the Council:

- ❖ Develop a 20-year electric power plan to guarantee adequate and reliable energy at the lowest economic and environmental cost;
- ❖ Develop a program to protect and rebuild fish and wildlife populations affected by hydropower development; and
- ❖ Educate and involve the public in the Council's decision-making process.[59]

Hydroelectric dams greatly altered natural flows, regulating the river to produce more electricity in the fall and winter, in turn, reducing river flows in the spring when juvenile salmon and steelhead migrate.[60] To increase spring flows, the NWPPC established a "water budget" in 1982 to be used between

April 15th and June 15th, the period when most young salmonids journey downriver. The water budget, which replaced the Committee on Fisheries Operations, represented a volume of water earmarked to improve smolt survival. The Council's goal was to simulate the effects of a spring freshet, augmenting the flow and flushing the fish to the open ocean and thereby reducing their exposure to predation and other hazards. By the 1980s the NWPPC, under its Columbia River Basin Fish & Wildlife Program, had called for spill at dams without adequate bypass systems.[61]



Potential long-term actions at the dams to benefit juvenile fish passage

NWPPC encouraged the preparation of interim juvenile passage plans while developing permanent solutions to passage problems at John Day, The Dalles, Bonneville, and other dams that lacked mechanical juvenile bypass systems. Interim fish passage plans called for spilling water at these dams when significant numbers of juvenile migrants were present. Fisheries agencies and tribes determined what constituted a significant number, which varied from a few hundred to tens of thousands, depending on the dam and the season.[62] The NWPPC Program created a Fish Passage Center (FPC), located in Portland, which provided fish passage management recommendations regarding spill, flow, and fish facilities operations.[63] In large part the FPC was formed to monitor the effectiveness of programs undertaken in response to the 1980 Power Act.[64]

Biological Opinions issued by the NMFS added a new dynamic to the Corps' short and long-term planning. In its 1995 Opinion, for example, the NMFS called for significant changes in the way federal dams were operated on the Columbia River system. Among the options considered by the Corps – ranging from the status quo to partial breaching – were major system improvements, including surface bypass systems, fish friendly turbine blades, and increased spill.[65] The 1995 Opinion called for increased river flows from April to September to simulate more natural river conditions during the time when endangered smolts are migrating downriver. It required the unscreened Dalles Dam to spill nearly two-thirds of the total volume or river flow, leaving only 36 percent available for power generation.[66]

The Corps' emphasis on research reflected the need for more knowledge about riverine systems and human impacts. "We're still in our infancy in terms of understanding," explained Johnson.[67] In the Columbia River Basin, the magnitude of scientific research undertaken remained staggering throughout the period 1980-2000.[68] Even so, there was a significant gap in information on juvenile salmon – how they migrated, why they migrated, and why their numbers were declining. Adding to this was a hydropower system comprised of non-uniform structures. "Fish need to be evaluated system-wide to give us a better feel for where the system is working best and where improvements should be made. Each project on the Columbia River is different. Differing site conditions, plus structural or placement variations make them unique," said Stuart Stanger, Corps project manager. "This means there is no 'one-size-fits-all' solution to the fisheries issue, making finding answers that much more complex."[69]

A noteworthy indication of the District's development during the environmental era was the sizeable increase in the number of biologists employed. As Johnson put it, "It's an exciting time to be a fish biologist."[70] Engineers had to adapt to the new emphasis. "I'm not a biologist myself, I'm an engineer," explained Kranda. "It gets kind of frustrating to me because as engineers we're kind of black and white, concrete and steel, yes or no. You can take a research study and, given all the variables that you can imagine for why a fish survives or doesn't survive as it passes through a complex system, if you want to you can shoot holes in [the study]."[71] To improve fish passage, the District undertook four innovative areas of research including surface bypass, fish friendly turbines, passive integrated transponder (PIT) tags, and the Project Improvements for Endangered Species (PIES).

Surface bypass was a strategy that sought to pass young salmon safely around a dam powerhouse by taking advantage of specific migrational behaviors of salmonids. Juvenile salmon naturally swim in the top 20 to 30 feet of the river, and they follow attraction flows – water volumes they're pre-programmed to follow – as they travel. Turbine flows draw them down into the bypass systems. Because smolts prefer to swim in the upper part of the water column, researchers argued, surface bypass would guide more fish with less delay and stress than screened bypass systems. Corps engineer Patty Etzel compared surface bypass design to a box of tissue: "There is a narrow slot we call a 'vertical slot' that fish move into. Then it opens up like the inside of a Kleenex box, and the fish spread out and travel through the project with the flow."[72]

The 1995-98 NMFS biological opinion stressed bypass studies; Congress also asked the Corps to test surface bypass or "skimming" at The Dalles by 1996. The Corps responded quickly to the interest in surface bypass with a study of all eight dams on the Columbia-Snake river system. A collaborative effort involving the Portland District, Walla Walla District, and the WES sped modeling, design, and construction of test vertical slots.[73]

The NMFS and other regional interests still considered spill to be the best method to pass fish by dams, and surface collection worked in conjunction with spill.[74] Corps projects have powerhouses and spillways in a side-by-side design. However, water that flows to the turbines attracts fish to the turbine bays and directs them down the turbine intakes, not the spillways. The challenge was to find the best surface bypass system for the Corps' dams.

Since no two dams were the same, this was a tough, but essential task. "Because each dam is different, it's important we understand how the migrating juvenile salmon respond to the varying hydraulic conditions that we create around these structures, " said Mark Lindgren, Corps engineer.[75] Accordingly, research began with what was known. "At The Dalles is a base level of knowledge of hydraulic characteristics and fish behavior because of the extensive research already done for screen systems and on design of a new juvenile bypass system with a mile-long bypass channel," described Corps biologist John Ferguson. "Those studies have taught us how fish behave as they approach and move through the project. For instance, the fish tend to concentrate at the west end of the powerhouse before they pass through the structure. Because we know a lot about The Dalles, we'll start testing there."[76] The Dalles Dam research demonstrated that approximately 43 percent of the fish used the sluiceway to bypass the dam and the sluiceway used only three percent of the water flow. "This is a highly efficient rate of fish passage for the volume of water used," remarked Ferguson.[77]

Hydroacoustic monitoring and radio tagging measured the effectiveness of surface bypass at The Dalles. Using that data, the Corps could better design facilities that fit the behavior of the fish. "The key to all our work on the river is adaptive management," said Ferguson. "Our plans for surface bypass, for instance, are not set in concrete. Two years from now things may change as we learn and adapt to what we've learned. The fisheries program is not meant to be rigid. We have to be flexible and design the program in such a way that it adjusts with our growing knowledge base."[78]

Turbines presented another challenge. Although these devices are not the blenders described by some river users, they can injure

Bonneville Surface Bypass

First Powerhouse 4 - Unit Prototype

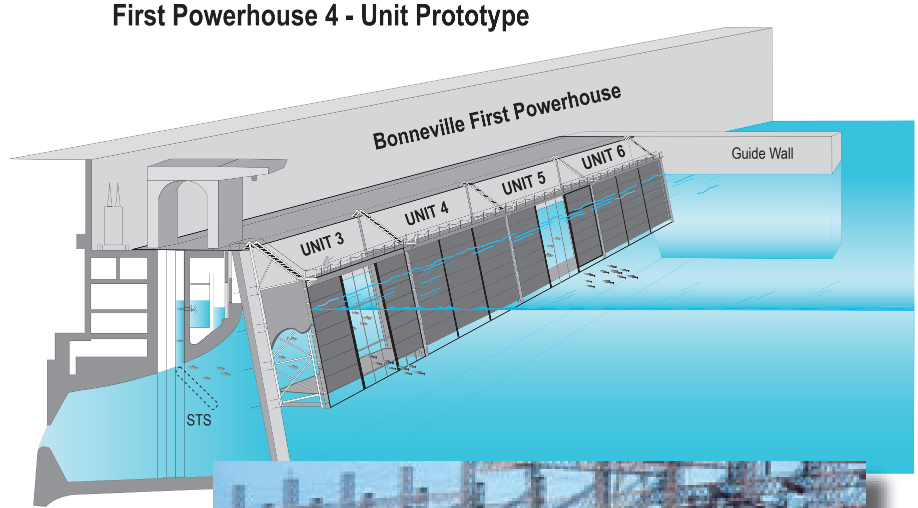
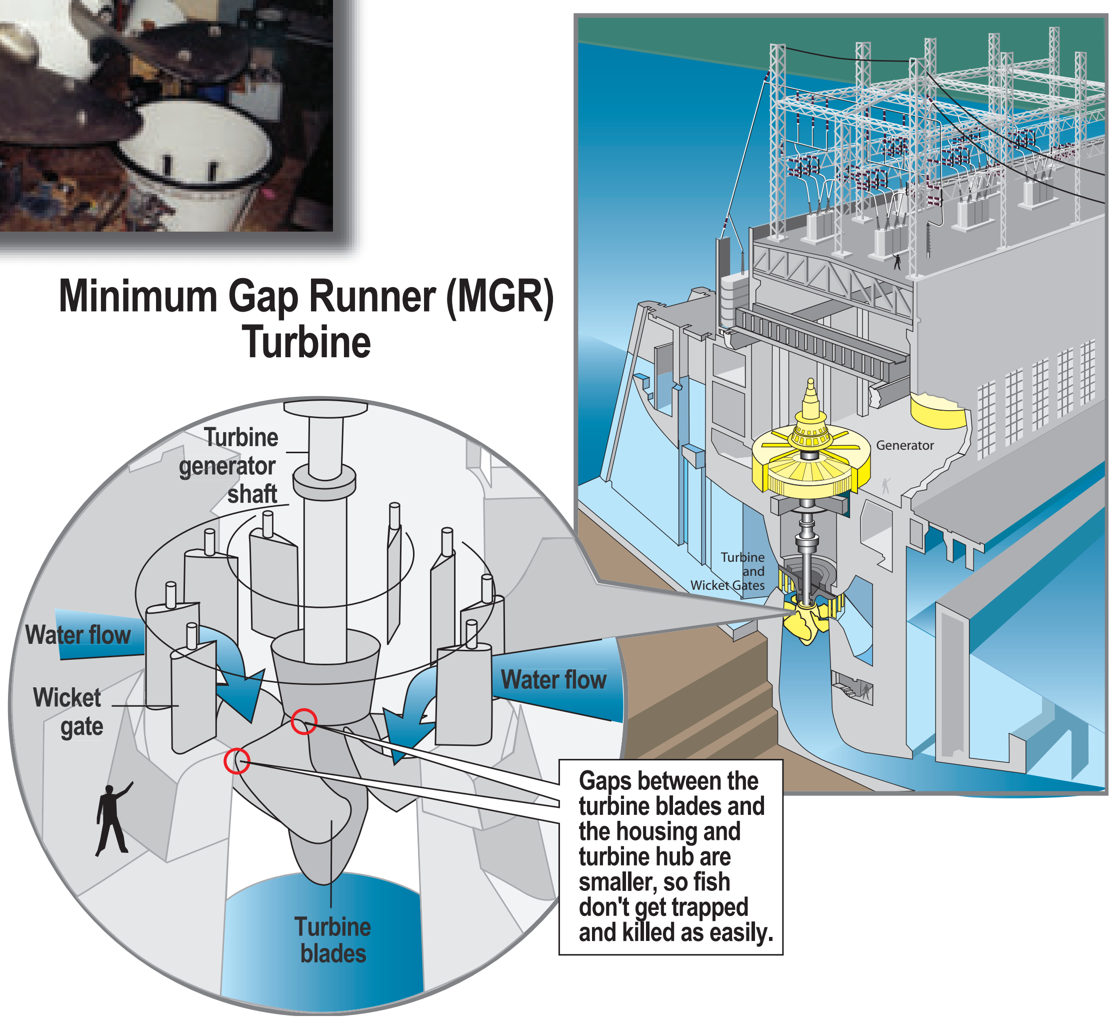


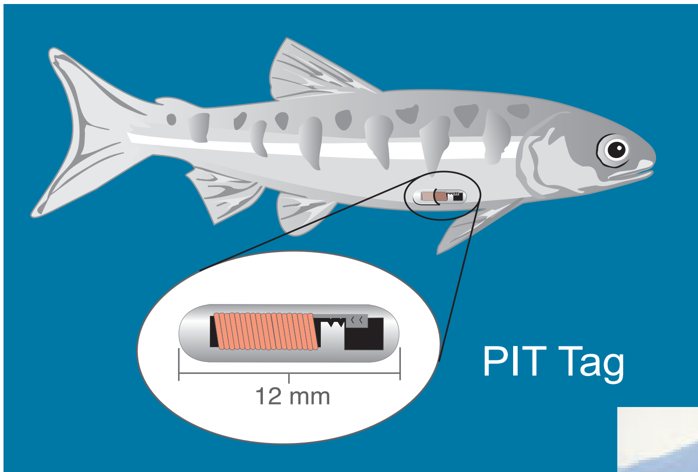
Diagram of the surface bypass system with vertical slots for juvenile salmon and the working system at Bonneville Dam or kill fish. To get a better idea of what a fish undergoes when passing through the turbine intake system, the Corps conducted extensive safer turbine trials at the WES in Vicksburg, Mississippi. A scale model of a McNary turbine behind Plexiglas allowed researchers to get a fish-eye view. "The big picture from our initial work," explained Ferguson, "is that if you think rotating turbine blades are a problem – they aren't…. We have been so focused on the blades being the problem. But it looks to us now that the fixed members are more of a problem than the blades. We never would have thought that."[79]

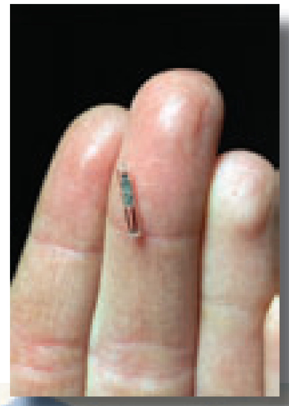
Armed with this information, researchers tested a new design called Minimum Gap Runner, or MGR. As a turbine blade changes operational angles, gaps form between the hub and blade, and between the blades and the outer casing of the turbine. One study indicated a two to three percent injury rate from fish getting caught in those gaps. An MGR would eliminate the gaps by making the corner of the blades longer and by milling out notches in the hub to accommodate the longer corners when the blades are tilted at a steep angle. In addition to being biologically favorable, research showed that power generation might be increased. Each new MGR, researchers estimated, would produce enough additional power to fuel about 15,000 homes in an average year.[80]

Bonneville's first powerhouse, built in 1938 and undergoing rehabilitation in the late 1990s, was a candidate for this pioneering design. MGR technology could be beneficial at Bonneville because there were fish distributed lower in the turbine intake systems, particularly at night and particularly in the summer, so more fish went under the bypass screens and through the turbines. Due to funding issues, the Corps could replace only one original powerhouse turbine per year, with full powerhouse conversion anticipated by 2007.[81]

Minimum Gap Runner (MGR) Turbine







Juvenile Pit Tag and radio monitor

A 16-member Turbine Working Group (TWG) was assembled to study turbine passage problems. In its ranks were biologists and engineers from NMFS, Corps, Department of Energy, BPA, public utility districts, Idaho National Engineering Laboratory and the Electric Power Research Institute. The Corps also developed a Turbine Passage Survival Program in coordination with the TWG. This four-year program, with a projected cost of $8.72 million, investigated short-term improvements to juvenile passage via the turbine route.[82]

One of the best data collection devices developed during this time period was the PIT tag, or passive integrated transponder. Scientists implanted these small coils of wire, comparable in size to a grain of rice, in smolts. PIT tags were inactive until the fish passed through detectors located at monitoring facilities along the Columbia and Snake rivers. The detectors triggered each tag to send a coded message to a 24 hour-a-day computer database maintained by the Pacific Marine Fisheries Commission.[83]

This remarkable electronic capsule enabled biologists to track a fish during its journey to the ocean and back, providing important information for in-season and long-term management decisions. A benefit to this monitoring method is that each PIT tag is unique, like a fingerprint, and once it's inserted, it's truly passive. "All the information on the fish can be read as the fish passes a detector," said Stanger, "much like a clerk can determine the cost or category of a grocery item as it passes a barcode reader."[84]

In a direct response to the listing of Columbia River salmon, the Portland District developed the Project Improvements for Endangered Species program or "PIES." From 1991 to 1996, a series of 19 items were addressed at Bonneville, The Dalles, and John Day dams. "Individual PIES projects range in cost from $40,000 to $4 million for engineering, design and construction," said Steven Wabnitz, PIES project manager. "There's a wide range, but whatever the cost, they are all being done for the same reason: to make passage conditions better for the salmon."[85]

Projects included placing netting over the adult fish ladder at John Day to prevent fish from jumping out of the ladder; a sonar inspection of the Bradford Island fish ladder at Bonneville that detected obstructions in the outlet; fishway water quality improvements at all three dams to ensure contaminated water did not discharge into the fish passage facilities; a spill modification study at Bonneville; installation of a camera monitoring system at Bonneville and John Day that simplified monthly inspections of submerged traveling screens, vertical barrier screens, and juvenile bypass system orifices; and adding an electronic device at all three dams that adjusted turbine blades to river conditions (this maintained optimum efficiency and reduced harmful pressure to the smolts). The PIES program represented a serious commitment by the Corps to incorporate the ESA into its operations. "What we are doing is the best we can do for the survival of the fish," said Wabnitz. "It's a balancing act."[86]

The Corps received considerable criticism for its handling – or too much handling – of fish passage through its hydroelectric facilities. However, the agency has a long history of fish management. "The Corps has gotten a lot of flack lately about the harm our projects do to the region's migratory fish runs," noted Colonel Charles A.W. Hines, District Commander, in 1992. "But what many people don't know is that the Corps of Engineers has been concerned about fish runs for more than 100 years."[87] The early dams indeed were outfitted – ladders for adult salmon passage – but little attention was given to juvenile bypass. As the "H's" of fish loss became more visible, the District's salmon work shifted in focus from adult passage to juvenile passage.

Facility redesign and improvements underscored the differences between the dams. "Back in our naïve days in the 1980's we just thought if that design worked there it would work here and so we put it on the second powerhouse and it didn't work for beans. We spent a lot of years after the second powerhouse was constructed trying to tweak it and make it work," observed Kranda.[88] It was difficult to remain flexible when confronted with changing conditions. "We've been relying on this spill as a primary passage route at The Dalles. However, we're now finding problems with high spill causing injury to fish and we are constantly chasing our tail on all this stuff."[89]

To be responsive, the District practiced adaptive management, requiring continual fixes as the information evolved – an approach that required more time and money spent on salmon recovery efforts. "If you're a taxpayer or ratepayer on the outside paying for all this stuff," commented Ken Casavant, NWPPC economist, "each new thing" looks very alarming. "But it's essential because what we know about salmon is in flux." [90] For the Portland District, this work included a number of project improvements: Bonneville second powerhouse Juvenile Bypass System, John Day Dam Juvenile Fish Sampling and Monitoring Facility, and the installation of traveling screens and spill deflectors (flip lips) to reduce turbine passage and gas supersaturation.

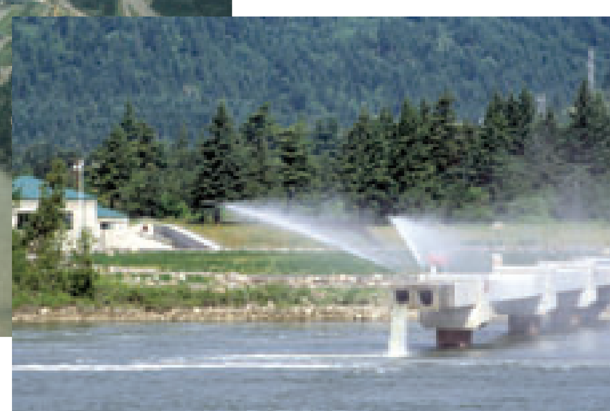
Improving fish passage for juveniles proved more difficult than for adults. Bonneville Dam, the last hydropower obstacle between smolts and the open sea, exemplified this point. Like Lower Granite Dam, the Corps designed the Bonneville second powerhouse with a juvenile bypass facility. During construction of the second powerhouse, the Corps modified the first powerhouse to include a juvenile bypass system.[91]

Bonneville's second powerhouse included the following components: submersible traveling screens that guided fish out of the turbine intakes and into the gatewells; vertical barrier screens that prevented juveniles from returning to the turbine intakes; orifices that allowed fish to travel from gatewells into the bypass area; a bypass downwell; a sampler that automatically collected up to 10 percent of juvenile migrants passing through the system; a dry separator connected to a wet separator in the migrant observation room; and four raceways to hold fish from the wet separator. The Corps modified the first powerhouse by drilling orifices in the bulkhead slots to permit passage from the gatewell slots, constructed a bypass and juvenile sampler, and installed submersible traveling screens to divert migrants from turbine intakes.[92]

Evaluating the downstream migrant systems began in 1982, the first year of operation of the second powerhouse. Researchers limited their observation to the migrant facility in the second powerhouse because construction was in progress and traveling screens were not yet installed. Fish guidance tests in 1983 yielded disappointing results – less than 30 percent of the fish entering the turbine intakes were guided into the gatewells.[93]

Though an improvement, this system still posed a number of stresses to migrating salmon. Juveniles were required to sound 70 feet or more before being guided by the submerged screens back up into the bypass channel (because they preferred not to sound they lingered and were more vulnerable to predation); some smolts continued to dive and entered the turbine intake system; submerged screens caused high water velocities and significant pressure changes; and disoriented fish were released into relatively calm water – easy targets for pike minnows and other predators.[94]

To address these shortcomings, the Corps designed and constructed improvements to the second powerhouse. This was a major undertaking; its signature feature was a two-mile long, 48-inch high-



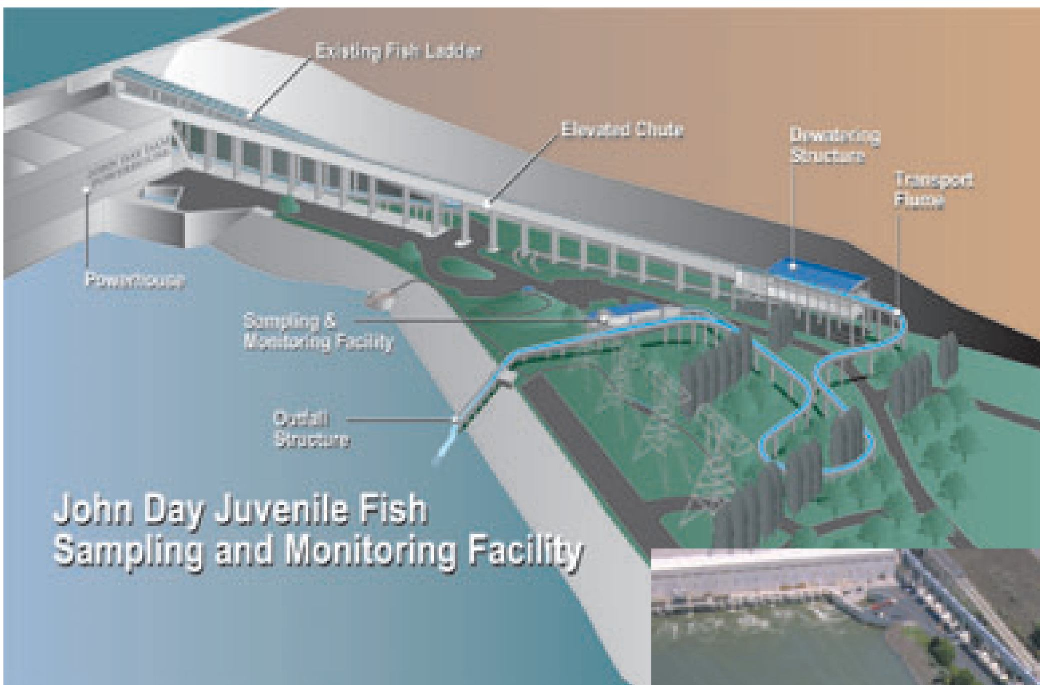
Bonneville Juvenile Transport System and monitoring facility. The outfalls have spray jets of water to deter gulls, terns, and other birds from feeding on the salmonids.

density polyethylene pipe running along the Washington shore. "This cost something on the order of $60 million," said Douglas Arndt. "It was a major engineering feat to build that, particularly in the conditions and the flows that it had to be put in."[95] To minimize maintenance and visual impacts, and to maintain river water temperatures in all seasons, the flume was buried for much of its length.[96] "I don't know of any other place where we have any bypass quite like this," said Heidi Helwig, of Portland District's Public Affairs Office.[97]

Other elements of Bonneville's second powerhouse bypass included a sample flume that directs the flow toward the monitoring facility where PIT tag monitors record fish data. Fish lifts then carry them up to an examination lab where they are anesthetized with a mild relaxant (Tricaine), identified (hatchery or wild origin), and inspected (for disease or injury). The outfalls are located in swift water to give smolts an edge over fish predators. Hydro cannons, located on each outfall, can spray jets of water 150 feet to deter gulls, terns, and other predatory birds from feeding on the salmonids. Samples from 1999 showed promise for fish condition and travel time. A projection for the improved system estimated a survival rate increase of juveniles by 6 percent to 13 percent.[98]

In June 1998, an independent scientific report to the NWPPC declared the new bypass system would be an improvement, but not a long-term solution. Mechanical bypass systems can be as lethal to young fish as passing through turbines, it stated, because they funnel large numbers of fish into a narrow space. The report recommended passage over spillways, a controversial position because more spill results in less water available to generate electricity (and a greater chance of gas entrainment). If fish are to be restored, the scientific panel said, dam operations on both rivers should be adjusted to better mimic natural river conditions.[99]

In August of 1997 the District unveiled a state-of-the-art fish sampling and monitoring facility at John Day Dam. It featured a 1,200 foot-long, 3-foot wide elevated transport flume – 50 feet above ground at its highest point – that carried fish from the upriver side of the dam to a dewatering facility and monitoring building and back into the river below the dam. The focus of its operations was twofold: (1) passive monitoring, described in the PIT tag technology above, and (2) physical monitoring, moving a sample number of migrating fish from the flume to inspect for injuries and disease. Through the monitoring process, scientists were able to collect data to help:



John Day juvenile fish monitoring and sampling facility.

- Assess the physical condition of the fish (disease, descaling)
- Determine travel times between dams
- Develop survival studies
- Determine run sizes and
- Evaluate the operation of the river system.[100]

The smolt monitoring project was a priority of the NWPPC and fisheries agencies as they sought to improve the survival rate of anadromous fish in the Columbia-Snake river system.

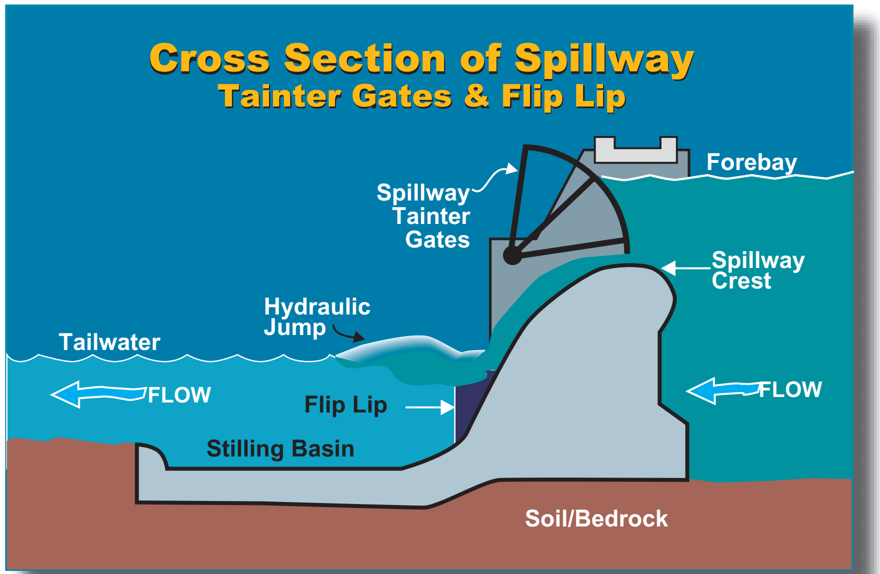
Submersible Traveling Screens (STS) were an important part of engineering solutions to steer migrating salmon into bypass systems and away from turbine intake systems. At Bonneville's second powerhouse, for example, these devices were extended into the gatewell slots on the intake deck of the powerhouse to guide the fish. Suspended at a 55-degree angle from the Vertical Barrier Screen, an STS was a 20-foot long frame with motorized screens that traveled along a track. Juveniles were guided by the flow of water along the face of the STS into the gatewell. Debris impinged on the STS traveled up to the top of the STS, then down the backside of it, where the water flowing through the STS washed the debris off. The debris then continued through the unit, with a small portion of it entering the intake and going into the gatewell.[101] The Dalles Dam remained the only major mainstem dam without fish screens over its turbines at the end of the 20th century. Nearly two-thirds of its flow from April through August was spilled rather than passed through generators.[102]

Prototype tests of 40 foot-long screens at John Day showed that more migrating juvenile fish were guided into the bypass system (existing screens were 23 feet long). However, mortality rates were higher with the new screens in place. Mortality could result from increased turbulence – longer screens have a larger surface area and therefore higher velocities – or from debris caught on the screens. Even so, NMFS engineer Steve Rainey cautioned that it was premature to give up on them: "The screens need to be judged on their overall passage survival benefit and the jury is still out."[103]

The higher mortality rate troubled some river users, tribal members in particular. "The extended screens are more finicky than standard screens," said Tom Lorz, Columbia River Inter-Tribal Fish Commission (CRITFC) hydraulic engineer. "Due to the increased flow and debris diverted by these new screens, gatewell openings become clogged more often than with standard screens. And when they become clogged, the system doesn't operate very well. And when it doesn't operate very well, salmon pay the price." Tribal biologists also expressed concern about lamprey eels, which are not strong swimmers and were easily caught on screens. Cleaning brushes that scour the screens every four to six hours were killing eels, the biologists claimed.[104]

Another dam modification to improve fish passage was the introduction of spill deflectors, or "flip lips," to Corps' dams. These devices attached to the downstream face of the spillway and deflected water in a more horizontal pattern. The logic of this design was to keep water from plunging deeply and therefore reduce the effects of gas supersaturation. The Corps undertook a Dissolved Gas Abatement Study to identify ways to reduce TDG levels. A collateral goal was to meet state and federal water quality criteria: TDG should not exceed 110 percent, except when discharges surpass 475,000 cubic feet per second on the Columbia River. The District's primary goal here was

Extended fish screens



Flip Lip spill deflectors helped to move spill water in a more horizontal pattern to keep water from plunging deeply and to reduce the effects of gas supersaturation on fish.

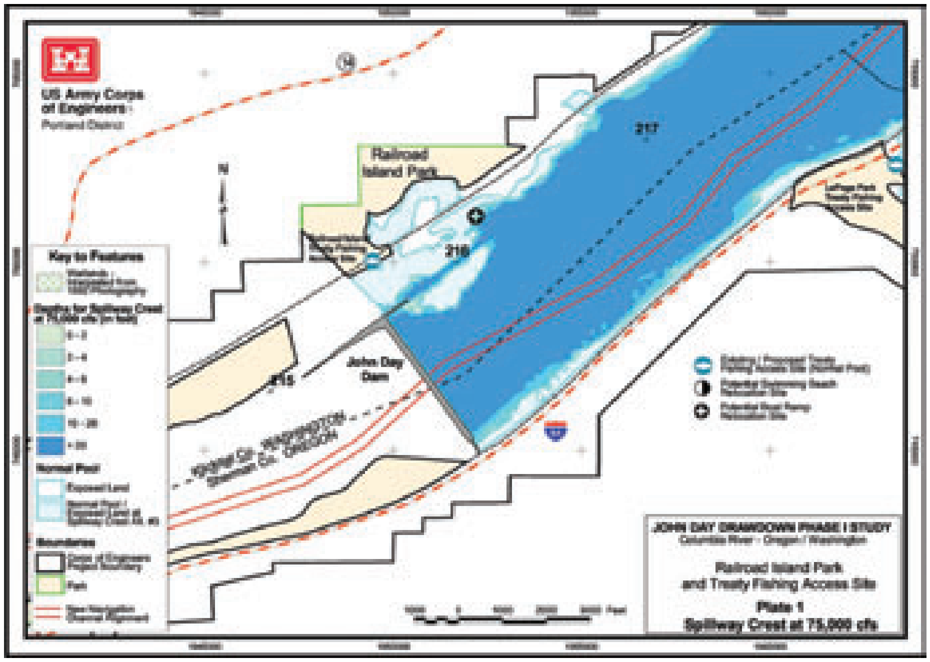
to "reduce gas levels as much as possible, to the extent economically, technically and biologically feasible." In addition to flip lips, Phase I of the study recommended four other alternatives to reduce TDG supersaturation: raised stilling basin, raised tailrace, flip bucket, and revised spillway shape. Physical model studies were underway to investigate hydraulic conditions, and biological concerns were to be addressed by an expert panel.[105]

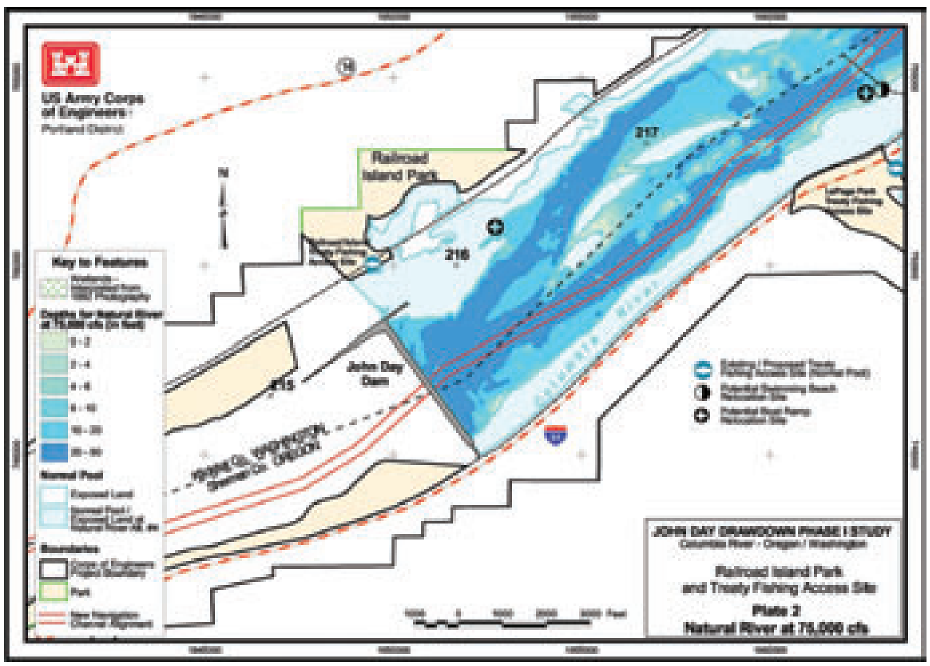
At John Day, juvenile fish used three methods to bypass the dam: through the turbines, through the juvenile bypass channel, or through the spillway. The spillway was considered safe – about 98 percent survived compared to 85 percent for turbines and 98 percent for bypass facilities. The threat of gas bubble disease from spill passage, however, prompted the installation of flip lips at John Day.[106]

Debating the John Day Drawdown

The ESA listings of Columbia and Snake river salmon stocks during the 1990s prompted a debate over whether the reservoir behind John Day Dam should be lowered or drawn down. In general, plans to restore migratory fish populations garnered attention, but the discussion surrounding the John Day drawdown was especially controversial due to its potential impact on a wide range of economic activities in the Columbia River Basin. The arguments that emerged – both for and against the drawdown – reflected the diversity of interests in the region, emphasizing the inherent challenges in crafting a solution to declining salmon populations.

The John Day Dam, which spans the Columbia River 215 miles upstream from the Pacific Ocean, creates a 76-mile long reservoir – Lake Umatilla. Historically, the area supported some of the most productive fall chinook spawning grounds on the Columbia. The deep waters of the John Day pool covered this habitat, slowing the flow of water down the Columbia.





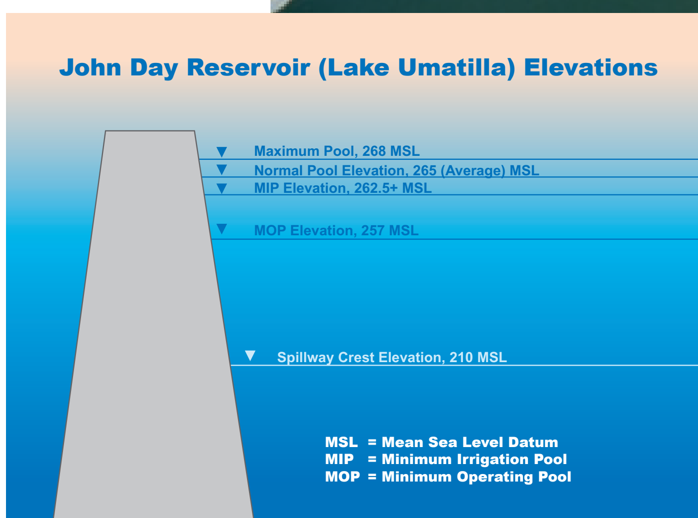
John Day reservoir maps for Phase I drawdown study based on 1994 hydrosurveys produced by GIS, Survey and Mapping Section of the US Army Corps of Engineers, Portland District.

The migration time of juvenile fish traveling to the ocean increased, leaving salmon more susceptible to disease, predators, and other problems. All reservoirs impede fish migration, but the problem at John Day – the slowest flowing of the river's pools – was particularly acute.[107]

One possible solution to increasing the flow on the Columbia involved lowering the reservoir behind John Day Dam below its normal operating range. Referred to as a "drawdown," this technique decreased the reservoir's width and depth, thereby increasing water velocity and creating a faster journey downriver for salmon. Additional

John Day Lock and Dam and Lake Umatilla

Proposed breaching of the dam would allow the natural river to flow and the river level to decrease.



goals of drawdowns included improving rearing conditions, reducing water temperature and dissolved gas, and restoring spawning habitat.[108]

A number of major salmon recovery plans emerged in the 1990s, many of them recommending drawdowns. In 1994, for example, the District prepared a draft study, which included an evaluation of lowering the John Day pool by six feet to an elevation of 257 feet. The District found that even at 257 feet, fish survival would not be enhanced significantly. After reviewing the study, Harza Engineering, an independent consulting group, recommended that the District consider a deep drawdown. The consultants determined that drawing down the elevation to 210 feet would be equivalent to four 33-foot Snake River reservoir drawdowns and would triple the fishery benefits compared to Snake River-only drawdowns.[109]

The NWPPC's salmon recovery plans also considered drawing down the reservoir. In 1994, for example, the agency proposed a modest drawdown of the John Day pool in its fish and wildlife program. Two years later the NWPPC appointed an Independent Science Group to analyze options for enhancing salmon recovery, including drawdowns. As part of its research, the group studied Hanford Reach, a free flowing stretch of the Columbia where chinook populations were thriving. After examining this area and reviewing more than 4,000 scientific studies, the group reached its primary conclusion – salmon need a river. Specifically, they argued that regulating the river's flow and draining reservoirs to establish a network of more natural river segments would increase salmon populations substantially.[110]

To achieve more natural river segments, the group proposed lowering the reservoirs behind John Day and McNary dams, both of which are located below the Hanford Reach. "Before flooding, the area behind John Day was a huge spawning area," explained Jack Stanford, a University of Montana ecologist and member of the team. Furthermore, Stanford explained a drawdown would allow the Hanford Reach riverbed to be flushed clean by the river and begin attracting salmon. "You give these fish half a chance and they'll take it," he said. The scientists also explained that it was important to recreate the river's natural flow patterns as closely as possible. Historically, the spring freshets that swept through the river sustained salmon habitat, replenishing gravel bars and boosting populations of insects that young salmon eat. During the rest of the year, stable flows maintained salmon eggs buried in gravel, as well as insects and plants at the base of the food chain. While the federal government changed the river's flow in response to the listing of Snake River salmon as endangered, unnatural fluctuations persisted.[111]

The scientific panel emphasized that drawing down reservoirs would create spawning grounds and salmon habitat, but objections to drawdown remained. Throughout the 1990s, a variety of arguments – mostly economic – emerged to counter proponents of drawdown. In particular, drawdown threatened farmers who relied on irrigation and barge and shipping operators who needed a deep river channel for navigation. Dixon Shaver, of Shaver Transportation Company, worried that water levels would become so low that modern barges would not be able to operate on the John Day stretch of the river. "We can't go back to pre-John Day equipment," he explained. "Today's vessels are too big and too long to be shooting the bends and rapids of the old river." Grain growers were also upset by the proposal to lower the reservoir. Jonathan Schlueter, the executive vice president of the Pacific Northwest Grain and Feed Association, said that shipping restrictions would have major impacts on the region. "Five hundred million bushels of wheat a year are exported out of the Columbia," he stated, "and 40 percent of that volume comes by barge." Opponents also expressed concerns about hydropower production and the elimination of recreational areas.[112]

In addition to these general concerns, opponents of drawdown specifically critiqued the Independent Scientific Group's report. In January 1997, the Tri-Cities-Hermiston Group, composed of seven regional utilities and irrigators, had released a report responding to the science team's study. "We do want to support saving the salmon," explained Pamela Harrington, director of communications and marketing for Umatilla Electric Cooperative, "but we don't want to change our lifestyle to the degree that we don't have irrigated agriculture." Russell George, a former manager of the Corps' Reservoir Control Center and the author of the report, argued that a drawdown would decrease power generation and pose a threat to the electrical system's stability. He also discussed drawdown's adverse affects on irrigated agricultural lands, barge traffic, and flood control. "Returning the Columbia River … to the natural river level would have significant economic and environmental impacts on the people of the Pacific Northwest and beyond," George wrote. "[Drawdown] would be a major natural resource policy decision, and such action should be approached with great caution."[113]

Despite these objections, the drawdown debate continued. Following the listings of several species of Snake River fish in the early 1990s, the NMFS Biological Opinion called for a study evaluating the role of a John Day drawdown in salmon recovery. In response, in October 1998 Congress directed the Corps to examine the issue and appropriated $3.7 million for the first phase of the study. Congress ordered the agency to limit phase I to two options for lowering the reservoir: spillway crest level and natural river level. The purpose of the study was to evaluate the potential benefits for fish and wildlife of these two drawdown scenarios and to analyze the social and economic affects of these actions. Congress also told the Corps to recommend whether to proceed to phase II of the study. "As we began this study," explained Stuart Stanger, "our goal was to gather enough facts on effects, both biological and economic, to make a sound recommendation to Congress. We wanted to either be able to recommend dropping all further study of lowering the John Day reservoir off the regional agenda because of what we learned, or recommend further study of drawdown, which would include evaluating an expanded list of drawdown alternatives."[114]

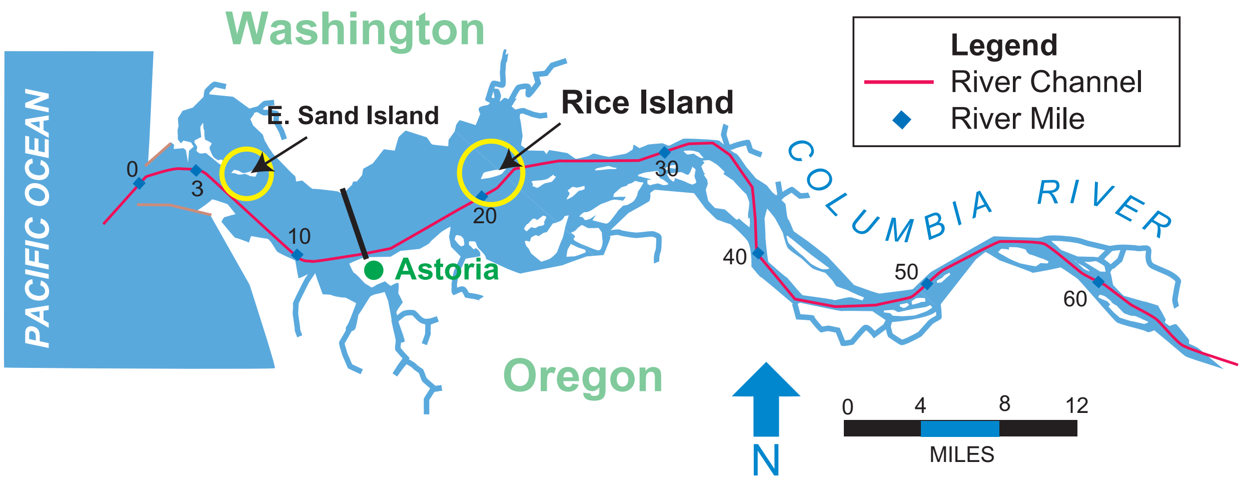
On September 18, 2000 the District released its John Day Drawdown Phase I Study Final Report. As directed, the agency's study evaluated spillway crest level and natural river level (breaching), each with and without flood control measures. After analyzing biological, economic, and social affects, the District's "biological studies show that drawdown would contribute little to the survival and recovery of listed Snake River fish." It therefore recommended to Congress that "no further study is necessary to allow Congress and the Region to make a decision regarding drawdown of the John Day reservoir, or removal of the John Day Dam." This recommendation eliminated John Day drawdown from further consideration.

While the Corps study recommended against drawdown as an option, the question remained of how to best revive salmon populations in the Columbia River Basin. Amidst the complexity of the salmon debate one thing remained clear – there would be no quick and easy answers. "All the tweaking and fixes in technology won't get us near the goals for salmon recovery we've set," observed Witt Anderson, the District's manager for salmon recovery plans. "So the decision is this: Do we do something dramatic or do we give up on significantly reversing the decline of salmon runs? We probably are running out of middle ground."[115]

The Trouble With Terns

While hydropower and salmon facilities dominated Portland District operations, the District was also active in other areas during the years 1980-2000, most notably its ongoing navigation mission on the Columbia River. As Chapter Two detailed, dredging was a large undertaking -- and one that attracted considerable controversy. Since the 1960s, dredge spoil has been deposited on Rice Island, a Corps-made sand spit located 21 miles upriver from the mouth of the Columbia. This barren island attracted Caspian Terns and became an example of an unintended consequence.

Caspian terns – seabirds that consume large numbers of salmon smolts – first arrived on Rice Island in 1986, drawn to the easy food supply, a lack of predators, and favorable nesting conditions



(terns prefer sandy areas free of vegetation). By the late 1990s, nearly 20,000 terns called the island home during the nesting season, making it the largest Caspian tern colony in the world.[116] Terns "jammed in there like cord wood" became a serious concern because their significant numbers required a large food supply of young salmon.[117] During the smoltification process, the transition from fresh to saltwater, young salmon prefer the upper water column. They are even more concentrated in estuaries where the lens of freshwater rides on top of the incoming saltwater.

This schooling behavior, together with thousands of birds looking for a meal, resulted in the consumption of staggering numbers of smolts. Researchers estimated that the colony used Rice Island as a staging area to consume 6 to 25 million young salmon annually, or as many as 25 percent of salmonids that reach the Columbia River estuary. The tern problem was first discovered by birders who noticed PIT tags strewn over the island. The tags had been implanted in juvenile hatchery salmon.[118]

A number of agencies and fishing groups, including the Corps, wanted to remove the salmon-decimating birds from Rice Island. The USFWS and the Audubon Society, however, defended the tern's presence in the area, citing the International Migratory Bird Treaty Act. Despite agency differences, in February 1999 an interagency team launched a compromise plan that tried, within the limits of environmental law, to make the island inhospitable to terns. It was an unprecedented seabird relocation effort. Decoys and recorded tern calls played over loudspeakers, attempting to lure returning terns to East Sand Island, their former nesting site located 17 miles downstream from Rice Island. District personnel hoped a colony situated nearer the ocean would expand the terns' diet to include perch and herring. The District tried a number of methods to dissuade terns from returning to Rice: erecting bald eagle scarecrows, sowing winter wheat to establish dense vegetation cover, plastic mesh fencing to discourage nesting, and simply running them off. It was "comparable

Nesting Caspian Terns

Terns consume large numbers of smolts.

Most terns did nest on East Sand Island in 2000, due to habitat modification conducted on Rice Island.

to chasing a chicken around in the old barn yard," recalled Geoff Dorsey of the Corps.[119]

Early relocation efforts were largely unsuccessful, and the controversy intensified. "Rice Island has been there since the early 1960s and will likely be there forever," said Al Clark, NMFS wildlife biologist. "Terns don't like vegetation where they nest and a dredge spoil island is perfect for that. If the Corps stopped dumping there, vegetation would grow and there'd be no more nest."[120] A commercial fisherman expressed a sentiment felt by many river users: "Get some raccoons, or possums, or anything, and put them right on the island, and that would take care of it, instead of spending all this money trying to move them from A to B." Accordingly, some frustrated members of the public released rodents on the island to encourage the terns to relocate.[121]

Some observers saw absurdity and humor in this unprecedented situation. "Feed the tern pellets of fish laced liberally with marijuana," suggested one letter to the editor, because "the terns would no longer be interested in work, which for a tern is catching fish. The road to salmon recovery is a rocky one but along that road we should leave no tern unstoned."[122] Another opinion piece suggested an alternate remedy: "If the Corps of Engineers can create an island, why can't they lower one a few feet? Let the terns nest under water for a few years. That should discourage them."[123]

Work on the tern issue continued. In 1998 the Caspian Tern Working Group (CTWG) had been formed to develop short and long-term goals for reducing predation. The CTWG included a host of agencies: Corps, NMFS, USFWS, BPA, Oregon State University, CRITFC, Oregon Fish and Wildlife, Washington Fish and Wildlife, and Idaho Fish and Game. In April of 1999, before the juvenile fish out-migration, the CTWG had implemented a pilot study, intended to increase juvenile salmonid survival and provide information for development of a long-term management plan. The study was partially successful – 1,400 pairs of Caspian terns nested on East Sand Island.[124]

On September 5, 1999, the NMFS issued a Biological Opinion requiring the Corps to prevent Caspian terns from nesting on Rice Island in 2000. The CTWG continued to meet and discuss the relocation of the Caspian tern colony in 1999 and 2000. The result of these discussions was the FY 2000 Tern Management Plan. The District prepared a draft Environmental Assessment (EA) on a proposed action to implement this plan. The Corps proposed preventing terns from nesting on Rice Island through active and passive discouragement, including the taking of up to 300 tern eggs and maintaining approximately four acres of Caspian tern nesting habitat at East Sand Island. After circulating the draft EA for public and agency review, a Finding of No Significant Impact was signed on March 17, 2000. Workers undertook plans on East Sand Island, and research activities, supported by the BPA, began on Rice Island.[125]

Meanwhile, the National Audubon Society and three other groups had sued the Corps and the USFWS on behalf of the terns, saying the United States was harassing the birds in violation of the Migratory Bird Act. A federal judge in Seattle first issued a temporary restraining order in April of 2000, forbidding any harassment of the birds. She then issued a permanent injunction in August of 2001, prohibiting both tern harassment and efforts to make East Sand Island tern-friendly.[126]

Most terns did nest on East Sand Island in 2000, apparently due to habitat modification conducted on Rice and East Sand islands prior to the injunction. An estimated 9,100 breeding pairs nested on East Sand; on Rice there were approximately 580 pairs. Preliminary research showed salmonids made up 44 percent of the diet of East Sand Island tern; salmonids composed 91 percent of the diet of Rice Island terns. Total consumption by terns was about 7.3 million smolts, or 6.4 percent of the estimated 115 million ocean-bound smolts that reached the estuary. Relocation of terns in FY 2000, therefore, resulted in six million fewer salmon being consumed than if all the terns had returned to Rice Island. The result of this effort was that Caspian terns could be moved successfully from Rice Island to East Sand Island without adverse impacts to the terns, while significantly reducing consumption of juvenile salmonids.[127]

The CTWG continued to meet periodically, urging the preparation of a long-term management plan for Caspian terns and other piscivorous birds in the Columbia River. No agency, however, stepped forward to prepare such a plan. In 2001, therefore, the Corps again prepared an EA for management of Caspian Terns in order to respond to the NMFS 1999 Biological Opinion. The Corps' proposed action covered two years in the hope that an appropriate agency would prepare a long-term plan, with required environmental documents, in the interim. The major actions proposed by the Corps included preparation of a minimum of four acres of Caspian tern nesting habitat on East Sand Island and passive and active harassment on the former tern nesting area on Rice Island. Because these types of activities had been described and commented on in previous EAs, the Corps did not issue a draft EA but proceeded to a Finding of No Significant Impact with 30-day notification. The Corps' EA acknowledged that unless the restraining order was rescinded, the agency could take no action on Rice Island.[128]

Conclusion

The controversy surrounding the terns demonstrated the complexities facing the District during the late 20th and early 21st centuries. This issue, along with the question of how to save declining runs of salmon, reflected the nation's changing values as well as the increasing number of interests involved in the region's rivers during the years 1980-2000.

Balancing these interests became one of the District's most consuming tasks, and its personnel devoted considerable resources to saving endangered salmon. Not everyone viewed this effort as successful. According to historian Joseph Taylor, "Since 1981, when Congress made the Bonneville Power Administration give salmon equal consideration when managing Columbia River dams, the region has invested three billion dollars to save these fish, and the only thing everyone can agree upon is that the effort has largely failed."[129] The Corps viewed the situation differently. "We spent over a billion dollars, or two billion dollars, and what do we have to show for it? Nothing. Well, that's bunk," said Brigadier General Griffin in 1999. "You know, we've doubled fish passage efficiency. We have more than cut in half the lethality of these dams that these fish go through. What's the cost benefit? Well, if this was a cost benefit business, we probably wouldn't be doing a lot of this, but that's not what recovering endangered species is about. I mean, it's something beyond just dollars and cents here."[130]

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