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Introduction

About this Update

This is an update of the 1995 Wy-Kan-Ush-Mi Wa-Kish-Wit (Spirit of the Salmon): The Columbia River Anadromous Fish Restoration Plan of the Nez Perce, Umatilla, Warm Springs, and Yakama Tribes. It supplements the original plan using an adaptive management framework to describe progress and needed modifications to the original recommendations. It also identifies and addresses new challenges with new science and policy.

The 1995 Spirit of the Salmon Plan and the 2014 Update cover the anadromous fish species of the Columbia River basin: salmon, steelhead, Pacific lamprey, and white sturgeon. Anadromous fish migrate as juveniles from freshwater to saltwater and return to freshwater as adults to spawn. Salmonids and lamprey continue this lifecycle, however since the massive dams were built on the Columbia River, white sturgeon populations above Bonneville Dam have been landlocked and are managed as resident fish. For more information about Columbia River salmon, lamprey, and white sturgeon, see Biological Perspective 260 in the 1995 Spirit of the Salmon Plan.

The geographic scope of the Plan corresponds to the migratory range of the upriver anadromous fish covered in this Plan. That range includes the Columbia Basin above Bonneville Dam, the entire mainstem of the Columbia River, and the Pacific Ocean as far north as Southeast Alaska and along Oregon's northern coast.

In the Introduction to this Update, The Need for a Plan recaps the reasons the tribes developed their own fish restoration plan. The 1995 Plan's goals and objectives are stated in the Spirit of the Salmon Goals and Objectives.

Spirit of the Salmon Basic Principles articulates how traditional values have blended with science to guide our restoration efforts. The Tribes' Treaty Reserved Fishing Rights and Sovereignty and Consultation summarize the legal principles that guide the Plan and this Update. Sovereignty and Consultation provides background on tribal sovereignty and government-to-government relations and describes new developments since 1995. Traditional Ecological

Dipnetting on the Columbia

So powerful was the connection to the salmon that these sacred fish shaped the culture and very religion of the tribes.

Online Resources

Quick codes are found throughout this publication to provide an easy way to access additional resources online. The codes look like this: 25. Enter the number in the Quick Link field found at the top of each page of the plan website **plan.critfc.org.**

Knowledge, emerging terminology in 1995, elaborates on this basic principle.

Progress toward the protection and restoration of salmon, lamprey, and sturgeon since release of the 1995 Spirit of the Salmon Plan is depicted in Summary of Accomplishments, We Have Halted the Salmon Decline, and The Accords, Pacific Salmon Treaty, and *U.S. v. Oregon* Agreements. The Plan's updated institutional and technical recommendations also discuss accomplishments.

First Foods

Salmon is foremost among our First Foods. The First Foods—water, salmon, deer, cous (or roots) and huckleberry—are served in that order in our longhouses. According to our creation story, the salmon was the first to agree to care for the Indian people followed by the other animals and plants. Each First Food consists of ecologically related foods. The salmon grouping includes the various salmon species, including steelhead, and also lamprey, freshwater mussels, trout and other fishes. The deer grouping includes mule deer, white-tailed deer and elk, among other four-legged, hoofed animals. The roots are cous, celery, camas and bitterroot. The berries are huckleberry and chokecherry. All First Foods, all life, depends on water and is always served first in our longhouse ceremonies. Our relationship to salmon and the First Foods is a reciprocal one. The First Foods nourish the native people, while the native people must protect them and the habitats that support them.

The condition of anadromous fisheries a decade and a half after the Spirit of the Salmon Plan was published and how these populations are now trending is shown in a series of figures in Looking Forward—Abundance Trends.

Remaining Problems and Gaps and New Challenges and Opportunities summarize what else needs to be accomplished.

The outstanding actions are discussed further in updates of the 1995 Plan's original 11 institutional recommendations and 13 technical recommendations. In these sections, the Update examines each recommendation, reporting on the problem or issue as it currently stands; assessing the results of actions taken; identifying remaining problems and gaps; and proposing modified and new actions.

The new challenges, those not identified in the 1995 Spirit of the Salmon Plan, are the basis for new institutional and technical recommendations and a new section of community development recommendations. Issues and opportunities are summarized; actions to resolve or manage the issues are proposed; and desired outcomes identified.

For the new technical recommendations, an initial hypothesis about the problem and the needed solutions are presented and the anticipated results of the proposed actions are stated. This is an abbreviated version of the hypothesis/solution structure employed in the original 1995 Wy-Kan-Ush-Mi Wa-Kish-Wit technical recommendations. Note: The technical recommendations are presented in order of the salmon lifecycle 301.

Wy-Kan-Ush-Mi Wa-Kish-Wit

(Spirit of the Salmon)

Wy-Kan-Ush-Mi Wa-Kish-Wit, the salmon's spirit, is sacred life. The salmon was provided a perfect world in which to thrive. For thousands of years the salmon unselfishly gave of itself for the physical and spiritual sustenance of humans. The salmon's spirit has not changed; what has is the environment that once sustained that powerful spirit.

This Spirit of the Salmon Update reports what appears to be a halt in the steep decline in total salmon runs. The Update records other accomplishments on the journey to recover salmon and the culture centered on them C426. Just as importantly the Update describes our native vision of what remains to be done.

In the years since the release of Wy-Kan-Ush-Mi Wa-Kish-Wit or Spirit of the Salmon Plan, we have buried many of our elders who once fished Celilo Falls and drank from the waters of the Columbia. With redoubled commitment we produce this Update to convey to our

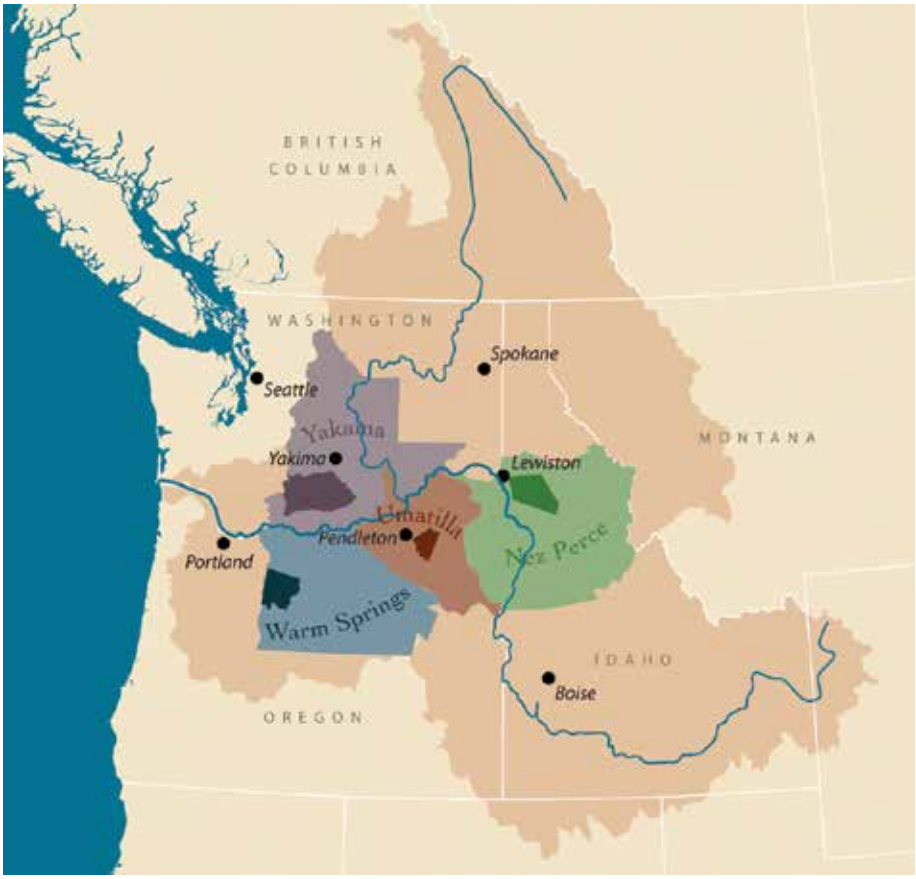
Creation Story

Salmon is a main dish at almost every meal, reflecting its central place in the cultures of Plateau tribal life in the Columbia River Basin. Each year Plateau peoples hold feasts to celebrate the return of the salmon. The salmon's homecoming is a promise of plentiful food to help people grow healthy and strong. Salmon are also a part of the tribes' religions. One creation legend teaches how important salmon is:

When the Creator was preparing to bring humans onto the earth, He called a grand council of all the animal people, plant people, and everything else. In those days, the animals and plants were more like people because they could talk. He asked each one to give a gift to the humans—a gift to help them survive, since the humans were pitiful and would die without help. The first to come forward was Salmon. He gave the humans his body for food. The second to give a gift was Water. She promised to be the home to the salmon. After that, everyone else gave the humans a gift, but it was special that the first to give their gifts were Salmon and Water. When the humans finally arrived, the Creator took away the animals' power of speech and gave it to the humans. He then told the humans that since the animals could no longer speak for themselves, it was the humans' responsibility to speak for the animals. To this day, salmon and water are always served first at tribal feasts in remembrance of this story and to honor the First Foods.

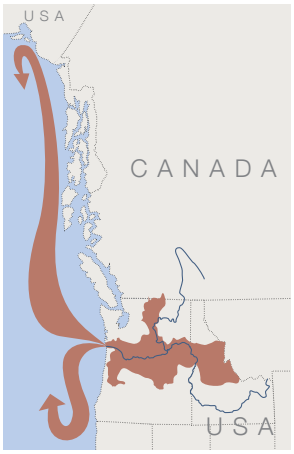
Most modern Indians don't eat as much salmon as their ancestors, but they still eat more than other people. Salmon continue to help feed the tribes, and many Indians still practice their culture by fishing for salmon and observing First Foods traditions. The tribes still value the ancient promise that was made to honor the gifts of the animal and plant people and to speak for them. If we don't honor that promise, these foods will go away.

Columbia Basin Treaty Tribes



The ceded lands of the four treaty tribes make up a large portion of the central Columbia River Basin (darker tan). These ceded lands were transferred to the United States at treaty signing. Each tribe's ceded area is labeled, with the present-day reservation shown in a darker shade.

Salmon Migratory Range



The geographic scope of the Plan corresponds to the migratory range of the upriver anadromous fish covered in this Plan. That range includes the Columbia Basin above Bonneville Dam, the entire mainstem of the Columbia River, and the Pacific Ocean as far north as Southeast Alaska and along Oregon's coast.

partners—to the states and federal government, and to all involved—that it is our Creator-given responsibility to honor, respect, and protect our fish, our Big River, our collective home. If salmon—and lamprey and sturgeon that are also part of this Update—are to survive in the Columbia Basin, we must face the challenges before us with our goals clearly in mind, in heart, and in spirit. As we said 18 years ago when we released the Spirit of the Salmon Plan, we must respect, reestablish, and restore the balances that once enabled this watershed to perform so magnificently.

The Need for a Plan

When we published the original Wy-Kan-Ush-Mi Wa-Kish-Wit or Spirit of the Salmon Plan in the last decade of the 20th century, we found ourselves in a dire situation in which our First Foods, our salmon and our Big River were threatened and, in some places, gone.

Nearly unceasing and uncompromising industrial development typified by construction of large Columbia and Snake river hydroelectric and flood storage dams, large-scale floodplain development and alterations, and severely exploititive commercial fisheries, caused the crash of what had been since time immemorial some of the world's most productive salmon runs.

During this period of exploitation, many assumed that technology would fix the problems—dams with fish ladders, barges for moving juvenile salmon around the dams, and industrial-style hatcheries are a few examples. As the tribes witnessed, technology alone did not prevent the crash of Columbia Basin fish populations. Recognizing this, the tribes built their *Spirit of the Salmon Plan* on the natural structure and functions of the multiple ecosystems where salmon, lamprey, and sturgeon live combined with the wise use of technology.

The tribes also examined the human structures charged with the management and protection of the basin's anadromous fisheries. What we saw in 1995 were five major institutions governing anadromous fish restoration. These institutions, as detailed in the Legal and Institutional Context 13 of the Spirit of the Salmon Plan, were unable or unwilling to rebuild fish populations, particularly the upriver runs above Bonneville Dam that the tribes depend on. The *U.S. v. Oregon* Columbia River Fish Management Plan, the U.S.-Canada Pacific Salmon Treaty, the Columbia River Basin Fish and Wildlife Program, and the Federal Energy Regulatory Commission were, for various reasons, limited in scope or authority. The Endangered Species Act (ESA), on the other hand, provided the legal means to conduct comprehensive recovery of the basin's salmon runs; yet, under the leadership of the National Marine Fisheries Service, the ESA had not fulfilled this promise.

In 1995 the biological circumstances of Columbia Basin salmon, lamprey, and sturgeon populations were extreme: the fish continued to decline, moving ever closer to extinction. Dams blocked more than half of the historical anadromous fish habitat. Other water and land uses had also eliminated habitat, including critical floodplain and estuarine habitats. Elevated water temperatures, increased sediments, and toxic pollutants degraded the river system's water—the "air that salmon must breathe."

The operation of Columbia River dams and storage reservoirs had profound ecological impacts. Among them, the dramatic losses of juvenile salmon, estimated as high as 96% cumulative mortality through the nine passable mainstem Columbia dams (NMFS 1995). Numerous alternatives to juvenile salmon migrating through these hydropower dams and their generating turbines were tried but with very limited success. For adult migrating salmon, fish ladder design caused "fall back" over dam spillways and through turbines. Pacific lamprey were also falling victim to passage problems at the dams. White sturgeon were trapped between the dams and virtually unable to migrate through or around these structures.

Hatcheries, used in the Columbia River Basin primarily to compensate for losses caused by water development projects, were operated without regard for sustaining the historical geographic distribution of salmon. Most of this hatchery mitigation was not taking place where the damage had occurred. The mitigation supplied hatchery-produced fish to support lower river fisheries in lieu of helping to restore the natural populations in the upstream tributaries. Yet prior to non-Indian settlement, salmon persisted throughout the basin.

Major US Dams of the Columbia/Snake Rivers

The primary large mainstem dams that affect salmon passage in the United States portion of the Columbia River Basin. On the Columbia, fish can pass nine dams from Wells to Bonneville; on the Snake, fish can pass four dams from Lower Granite to Ice Harbor.

The Spirit of the Salmon Plan responded to the environmental and institutional crisis described above, proposing a series of hypotheses, referred to as technical recommendations, designed to lessen human-caused mortality of the species in question and a series of related institutional recommendations to manage the implementation of these hypotheses.

This Update examines where the Plan has taken us—the accomplishments, the remaining problems, and what lies ahead.

Spirit of the Salmon Plan Goals and Objectives

The four tribes are not amending the original 1995 goals and objectives as part of the Update. But as the Plan's "expiration date" of 2020 nears, the tribes will consider how many of these goals and objectives to carry forward unchanged, which ones need modification, and what new goals and objectives are appropriate. CRITFC notes, however, that the doubling goal of 4 million salmon by 2020 is ambitious and, given the challenges of our times, may be difficult to achieve.

These are the current goals and objectives as developed in 1995.

Goals

- Restore anadromous fishes to the rivers and streams that support the historical, cultural and economic practices of the tribes. (These are generally areas above Bonneville Dam.)
- Emphasize strategies that rely on natural production and healthy river systems to achieve this goal.
- Protect tribal sovereignty and treaty rights.
- Reclaim the anadromous fish resource and the environment on which it depends for future generations.

Objectives

- Within **7 years**, halt the declining trends in salmon, sturgeon and lamprey populations originating upstream of Bonneville Dam.
- Within **25 years**, increase the total adult salmon returns above Bonneville Dam to 4 million annually and in a manner that sustains natural production to support tribal commercial as well as ceremonial and subsistence harvests.

Legendary Salmon Runs

Tribal elders recount stories of salmon runs so large you could almost walk across streams on their backs and of so many salmon they literally changed the sound of the river.

- Within **25 years**, increase sturgeon and lamprey populations to naturally sustainable levels that also support tribal harvest opportunities.
- Restore anadromous fishes to historical abundance **in perpetuity**.

The salmon is important to us because we depended on salmon for our very survival. The salmon was put here by the Creator for our use as part of the cycle of life. It gave to us, and we, in turn, gave back to it through our ceremonies in recognizing the first salmon feast. Their returning meant our continuance was assured because the salmon gave up their lives for us. In turn, when we die and go back to the earth, we are providing that nourishment and those nutrients back to the soil, back to the riverbeds, and back into that cycle of life.

Carla Higheagle,
Nez Perce

Spirit of the Salmon Plan Basic Principles

The following principles expand on the 1995 descriptions of our values and principles, reflecting a deeper understanding of our traditional values and how they can be adapted to address changing circumstances.

Honor tribal culture and values. Since time immemorial, the salmon have faithfully returned to the river to serve human and other needs. For native cultures in the Columbia Basin, the continuation of human life depends on the return of the salmon. The interdependence of salmon and the people is the foremost example of what traditional native thinkers call the connectedness, or connection, of all life. In the basin's native cultures, water and food were never taken for granted. Tribal society recognized that the earth's water and food are always matters of survival and spiritual nourishment. This knowledge is the foundation of the tribes' recommendations for Wy-Kan-Ush-Mi Wa-Kish-Wit Spirit of the Salmon Plan.

Fulfill tribal sovereignty, treaty rights, and trust responsibility. The tribes are co-managers of fish resources pursuant to their inherent sovereignty and their 1855 treaty rights as interpreted by federal court decisions including *U.S. v. Oregon* and *U.S. v. Washington*. The Plan establishes a foundation for the United States government and its citizens to honor their treaty and trust responsibilities to the four tribes. Returning fish to the tribes' usual and accustomed fishing places as guaranteed in 1855 treaties would begin to meet the ceremonial, subsistence, and commercial needs of tribal members. Meeting these obligations benefits the non-Indian public, allowing people to enjoy their legal allotment of harvestable fish and share in a healthier, more natural river system.

Integrate the best science with traditional ecological knowledge. An integrated approach provides a range of tools to understand and evaluate efforts to protect and restore the Columbia Basin's natural resources, particularly its riverine resources. The *Umatilla River Vision* 1296 exemplifies this blending of Western science and traditional knowledge. It supports the natural production and use of salmon and other fish by tribal members while describing the attributes of an ecologically functional river system in terms of hydrology,

geomorphology, habitat connectivity, riparian vegetation, and aquatic biota.

Restore ecosystems that are holistic, sustainable, and resilient. Salmon and salmon cultures coexisted in balance for millennia. In the last 200 years, population growth, economic development, and climate change have disrupted the formerly balanced systems. Climate change will exacerbate and accelerate change in unexpected ways C342 and C624. Maintaining and restoring salmon, lamprey, and sturgeon populations under these conditions requires management practices and tools that are broadly multidisciplinary; account for social and ecological influences at multiple temporal and spatial scales; protect biodiversity, functional processes, and interrelationships that sustain salmon ecosystems; incorporate continuous change; allow for uncertainty; and avoid thresholds that will tip ecosystems into a state unfavorable to anadromous fish.

Put fish back in the rivers. The tribes' longstanding commitment to reestablishing wild fish runs is based on traditional values. To achieve this central goal, the Plan includes a propagation strategy the tribes call supplementation. Rather than perpetuating the dominant hatchery rearing and release paradigm, which focuses on hatchery returns for harvest, supplementation uses hatchery technology to rebuild naturally spawning fish stocks while also providing harvest. Supplementation is essential because, in so many situations, needed remedial actions are not being implemented and those that are cannot be implemented quickly enough or on a scale that is large enough to halt further population losses.

Protect watersheds where fish live now and historically. To support anadromous fish, Columbia Basin riverine and aquatic habitats must be returned to natural conditions closer to those that existed prior to dam construction, irrigation withdrawals, forest clearcuts, cattle grazing, metal mining, urbanization, and other consumptive uses. Salmon and lamprey need connected migratory habitat that supports biological functioning throughout their lifecycle, not just fragments of good habitat here and there. The Plan describes how the basin's watersheds can be protected and how degraded areas can be rehabilitated and identifies where fish need to be reintroduced or supplemented. To return the basin to health and productivity, the tribes seek to engage their watershed neighbors in local, collaborative efforts.

Manage gravel-to-gravel. The Plan's technical recommendations are aimed at increasing survival at each stage of the anadromous lifecycle from spawning gravel to spawning gravel—from eggs hatching in the streambed gravel to juveniles migrating downstream thorough

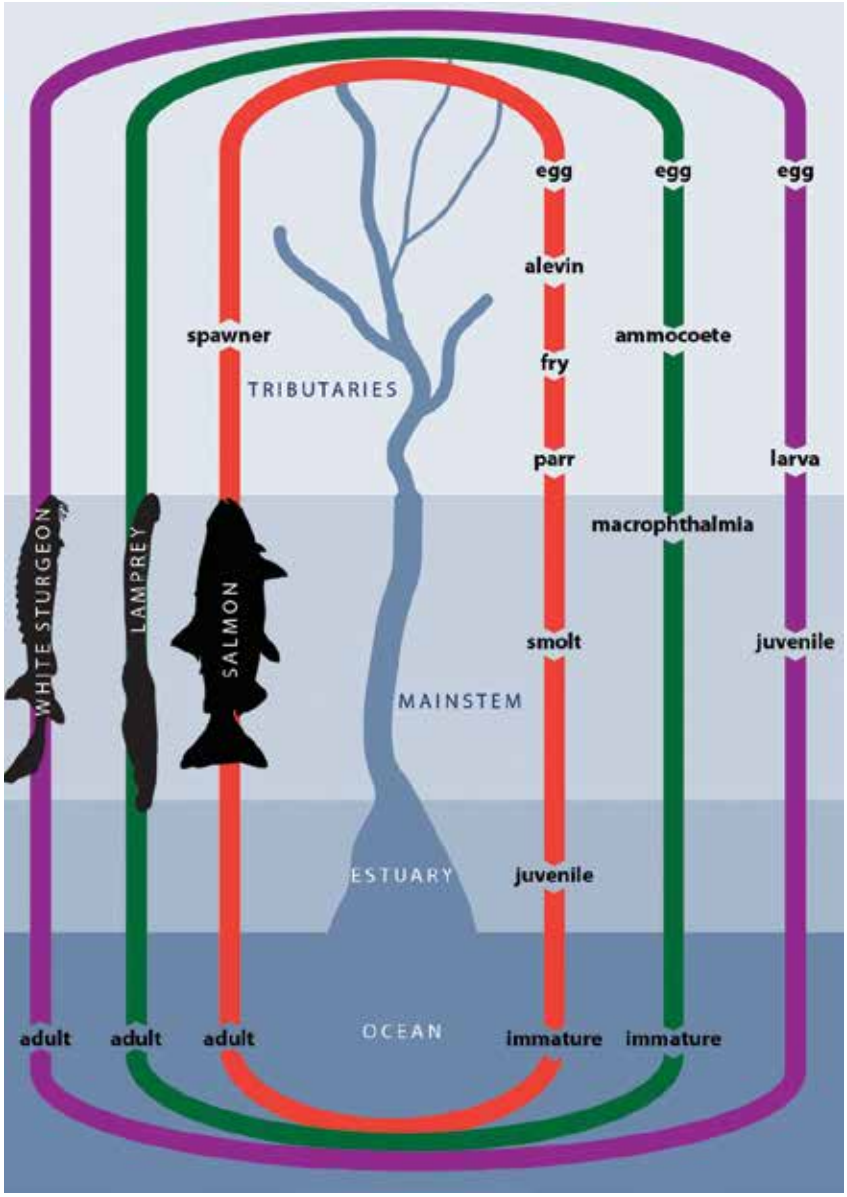
My strength is from the fish; my blood is from the fish, from the roots and berries. The fish and game are the essence of my life. I was not brought from a foreign country and did not come here. I was put here by the Creator.

Chief Meninock, Yakama (1915)

dams and reservoirs to saltwater homes where they feed and grow to adult fish and then return to spawn in freshwater gravel to begin the process again.

Use adaptive management. Adaptive principles allow resource managers to take immediate on-the-ground actions to reverse anadromous fish decline even in the face of scientific uncertainty. The tribes' technical recommendations are designed as testable hypotheses: they define problems, propose remedial actions, set objectives, and describe means to evaluate the actions. Using this adaptive management framework, restoration actions can be modified as indicated by scientific evaluation.

Gravel-to-Gravel Lifecycle



The anadromous lifecycle extends from spawning gravel to spawning gravel—from eggs hatching in the streambed gravel to juveniles migrating downstream through dams and reservoirs to saltwater homes where they feed and grow to adult fish and then return to spawn in freshwater gravel to begin the process again.

The Tribes' Treaty Reserved Fishing Rights

The treaties of 1855 between the United States and individual tribal governments provide the legal basis for the four tribes' fishing rights. While there are other tribes in the Columbia River Basin with ties to the salmon, the four Columbia River treaty tribes are the only tribes in the basin that have reserved rights to anadromous fish in treaties with the United States. The Nez Perce, Umatilla, Warm Springs, and Yakama tribes negotiated treaties in 1855, reserving the right to maintain the natural resources on which their culture depended, including rights to water, land, fish, and other natural foods and medicines.

> *Let them do as they have promised. That is all I have to say.*
>
> *Yakama Chief Kamiakin*
> *Walla Walla Treaty Council*
> *(1855)*

Retaining the right to continue their fishing practices was a primary objective of these four tribes during treaty negotiations. Each treaty contained a substantially identical provision securing to the tribes the right to take "fish at all usual and accustomed fishing places in common with citizens of the United States." The four tribes each reserved the right to harvest fish within their respective reservations and at "all usual and accustomed fishing places" outside the reservations and ceded areas.

Tribal rights to fish, unimpeded, at all of usual and accustomed places secured in the 1855 treaties were enforced in the 1969 federal court litigation that became known as *United States v. Oregon* 1285. In this case, Judge Robert Belloni found that the tribes have an absolute right to a fair share of the fish produced by the Columbia River system. Judge Belloni also found that the states have limited power in the regulation of the tribes' treaty rights to fish and that managing Columbia Basin fish such that few return to the tribes usual and accustomed fishing places is patently unfair. He further found that the protection of the treaty Indian fishery must be co-equal with the management of other fisheries.

United States v. Oregon provides the framework for implementing the tribal treaty fishing right and a foundation for Wy-Kan-Ush-Mi Wa-Kish-Wit Spirit of the Salmon Plan.

The United States Supreme Court has affirmed the "usual and accustomed" treaty fishing clause in no fewer than seven written opinions. Federal district court opinions *Sohappy v. Smith/United States v. Oregon* (1969) and *United States v. Washington* (1974) have confirmed that the tribes are entitled to 50% of the harvestable number of fish destined to pass usual and accustomed fishing places. Interpreting these 1855 treaties, federal courts established a large body of case law setting forth certain fundamental principles strictly limiting the circumstances and conditions under which state and

federal governments can regulate treaty Indian fishing and establishing the tribes as co-managers of the fisheries resource.

The tribes' right to govern their members and manage their territories and resources flows from tribal sovereignty as recognized by treaties. The fact that treaties were made with Indian tribes reflects the United States' recognition of tribal sovereignty. The U.S. Supreme Court has described tribal governmental powers as "inherent powers of limited sovereignty which has never been extinguished."

Because of Indian tribes' unique history and political status, the federal government and its agencies have a trust responsibility to use their expertise and authority, in meaningful consultation with the tribes, to safeguard treaty-reserved natural resources.

Celilo Falls

Columbia River Indian fishery at Celilo Falls before the 1957 inundation by The Dalles Dam. Photo courtesy the Matheny Collection.

Sovereignty and Consultation

Sovereignty and consultation are among the basic principles that guide this Plan. They are also foundational to the relationship between federally recognized Indian nations and the United States. They define certain aspects of the legal relationship between tribes and states and tribal people and non-Indian people.

While these principles are not new, the federal government's understanding of and prescriptions for sovereignty and consultation have changed since the Spirit of the Salmon Plan was published. These developments and some of the legal and historical background are presented in this section.

Tribal people lived on this land, with these waters, long before there was a United States of America. The tribes' independent governments were and are self-governing and autonomous. In signing treaties with the federal government, the tribes and bands that now compose the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, the Yakama Indian Nation, and the Nez Perce Tribe retained their inherent authority to govern themselves.

> *Indian tribes are governments, not Elks Clubs.*
>
> *Professor Charles Wilkinson*

Treaties did not, as is frequently assumed, grant rights to Indians from the United States; rather, the tribes ceded certain rights to the United States government and reserved the rights they never gave away. Tribal governments use these treaties today to affirm and retain rights such as the sovereign right of self-government, fishing and hunting rights, and jurisdictional rights over their lands.

The trust responsibility is a legal doctrine that has grown out of treaties, statutes, court decisions, and other dealings between the United States and Indian tribes. The United States is obligated to represent the best interest of the tribes, protect the safety and well-being of tribal members, and fulfill treaty obligations. This is why the federal government and its implementing agencies owe a duty to recognize the impacts of their activities on the tribes, as well as a duty to safeguard natural resources, which are fundamental to tribal self-government and prosperity.

Government-to-government consultation is a key means to preserve sovereignty, Indian self-determination, self-governance, and treaty rights. "Consultation" means the meaningful and timely process of seeking, discussing, and carefully considering the views of another sovereign in a manner that is cognizant of all parties' cultural values and, when feasible, seeking agreement. It means that there is direct dialogue between tribes and the U.S. government on issues of

relevance and import to tribes. Consultation provides mechanisms by which tribes can have a voice in federal management of their interests.

The mechanism of consultation has its legal bases in treaties, statutes, executive orders, and the ethical foundations in the unique relationship between the United States and Indian tribes. Consultation, a formal process for communication with the tribes, should occur whenever it appears that tribes may have an interest in the outcome of an agency's action, whether the tribal interest is direct or indirect.

Recent U.S. presidents have issued executive orders supporting consultation with Indian tribes. In 2000 President Clinton issued Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, mandating all executive agencies to engage in meaningful consultation to ensure respect for tribal rights. He directed all federal agencies to "have an effective process to permit elected officials and other representatives of Indian tribal governments to provide meaningful and timely input in the development of regulatory policies on matters that significantly or uniquely affect their communities."

Sovereignty on Display

A color guard of many Columbia Basin and Pacific Northwest tribes present their nations' flags along with the stars and stripes at an annual meeting of the National Congress of American Indians.

In 2004 President Bush issued an Executive Memorandum recommitting to work with tribes on a government-to-government basis. In 2009 President Obama issued a Memorandum on Tribal Consultation announcing his administration's commitment to carry out Executive Order 13175 and to conduct "regular and meaningful consultation and collaboration with tribal officials in policy decisions that have tribal implications…."

While most federal departments and major federal agencies now have consultation policies as mandated by three presidents, the U.S. Department of State does not. The State Department conducts relations with the government of Canada over matters of great importance to the four tribes, including the Pacific Salmon Treaty, a bilateral fish harvest and rebuilding agreement, and the Columbia River Treaty, a

U.S.-Canada arrangement to optimize the river's hydroelectric power production that is currently in pre-negotiations. The challenges the tribes face in the potential remaking of the Columbia River Treaty are discussed in institutional recommendation COLUMBIA RIVER TREATY.

The U.S. State Department's position is all the more puzzling in light of the Obama Administration's 2010 endorsement of the United Nations Declaration on the Rights of Indigenous Peoples. The declaration's emerging principles of international law cover government-to-government consultation, notably in Articles 19 and 32. Article 32 includes this provision:

> *Good words do not last long until they amount to something.*
>
> *Chief Joseph*
> *Nez Perce*

> *States [i.e., countries] shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free and informed consent prior to the approval of any project affecting their lands or territories and other resources, particularly in connection with the development, utilization or exploitation of mineral, water or other resources.*

Passed by the United Nations in 2007, the declaration will likely affect the United States in coming years as the world becomes increasing internationalized.

The unique and distinctive political relationship between the United States and Indian tribes is defined by treaties, statutes, executive orders, judicial decisions, and agreements and differentiates tribes from other entities that deal with, or are affected by, the federal government. This relationship has given rise to a special federal trust responsibility, involving the legal responsibilities and obligations of the United States toward tribes and the application of fiduciary standards of due care with respect to Indian lands, tribal trust resources, and the exercise of tribal rights.

Indian tribes are governmental sovereigns; inherent in this sovereign authority is the power to make and enforce laws, administer justice, manage and control Indian lands, exercise tribal rights, and protect tribal trust resources.

The following conservation standards limit federal and state restrictions of tribal activities exercising the treaty fishing right: 1) the restriction is reasonable and necessary for conservation of the species at issue; 2) the conservation purpose of the restriction cannot be achieved by reasonable regulation of non-Indian activities; 3) the measure is the least restrictive alternative available to achieve the

required conservation purpose; 4) the restriction does not discriminate against Indian activities, either as stated or applied; and, 5) voluntary tribal measures are not adequate to achieve the necessary conservation purpose.

Traditional Ecological Knowledge and Science

Integrating traditional ecological knowledge with science is one of the basic principles of Wy-Kan-Ush-Mi Wa-Kish-Wit. In this Update, we examine the role of traditional knowledge more explicitly, even if briefly, than we did in the 1995 Spirit of the Salmon Plan.

Traditional ecological knowledge, often referred to as TEK, is the evolving knowledge, practice, and belief about the relationships that exist between humans and the natural environment. Rooted in a familial relationship with the plants, animals, and the environment, traditional ecological knowledge is passed down the generations through oral traditions, such as storytelling, songs, and ceremonies. For tribes in the Columbia River Plateau, traditional ecological knowledge imparts cultural values and worldviews as well as specific practical knowledge such as techniques and stewardship principles for fishing and hunting, gathering plants, roots and berries, and cultivating the land.

While traditional ecological knowledge has guided the tribes since time immemorial—and integrating it with science is one of the basic principles of the Spirit of the Salmon Plan—Western scientific tradition only recently began recognizing tribal perspectives for understanding and managing natural systems. Contrary to popular understanding, traditional ecological knowledge and Western science share several fundamental traits, including the need to make sense of a seemingly chaotic world, the desire to conduct both practical and curiosity-driven investigations, a non-static view of facts based on continuously updated information, and the use of experiments and quantitative thinking. Unlike Western science, which strives for a value-neutral perspective, traditional ecological knowledge incorporates an explicit moral and ethical content—a recognition that social, spiritual, cultural, and natural systems are intertwined and inseparable. Also unlike Western science, traditional ecological knowledge emphasizes a local, place-based perspective rather than a comprehensive, global view and values concrete knowledge more than theoretical knowledge. However, the two viewpoints are regarded as a difference of degrees rather than type and are increasingly seen as complementary.

Indigenous people from all corners of the globe view traditional ecological knowledge not as a symbolic concept frozen in time, but as living wellspring of practical knowledge that can help protect and restore natural and cultural legacies. Principles of traditional ecological knowledge have been successfully employed in diverse ecotypes: tropical forests and fisheries, grasslands, mountainous regions, and traditional irrigation systems in deserts, for example. Closer to home, examples have also been well-documented: the ritual management of salmon by tribes in northern California relying on a complex social system, including communicating allowed catch sizes among river villages; the use of a traditional calendar of natural events by the Nez Perce to document the phenology of natural systems; and the application of the First Foods concept (described on the following page) by the Confederated Tribes of the Umatilla Indian Reservation in managing river systems from an ecosystem perspective.

An Holistic Approach

Combining traditional wisdom with cutting-edge science, the tribes efforts offer a holistic solution to restoring salmon and other fish species to their historical ecological range throughout the Columbia River Basin.

The four CRITFC member tribes have a deep history of being connected to the land, as reflected in their culture, spirituality, and everyday lives. Their spiritual and cultural values and practices are grounded in *tamánwit*, the natural law or philosophy of the traditional Plateau peoples. *Tamánwit* describes the responsibilities humans have to give back to the earth that provides for them. *Tamánwit* requires an intimate familiarity with seasonal patterns in nature, including the flowering of plants, migrations of fish and birds, and changing weather. These and other seasonal patterns are closely linked to cultural practices such as gathering, processing and storing food or other materials for shelters and tool-making, and even prescribing the time for storytelling.

For example, we are crafting this restoration plan in autumn, the season that Nez Perce call *sexni'm*—the time for hunting, food preparations, and moving to winter lodges. In the paradigm of Western science, the study of seasonal patterns is called phenology; the intersection between traditional calendars and phenological research holds promise for understanding the impacts of climate change. For instance, the Swinomish Tribe of Puget Sound consider its calendar of 13 moons to provide an early warning system for climate change, where departures from the expected timing of events are a red flag indicating disharmony in natural cycles.

Our religious leaders told us that if we don't take care of the land, the water, the fish, the game, the roots, and the berries we will not be around here long. We must have our salmon forever!

Delbert Frank
Warm Springs

TEK in Practice: A First Foods Perspective for Managing Riverine Ecosystems

In 2008 the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) published their *Umatilla River Vision* 1296, an outline for managing rivers from an ecosystem perspective focusing on the minimum ecological products required to sustain their culture. The *River Vision* documents the serving order and importance of First Foods:

> *In the tribal creation belief, the Creator asked the foods "who will take care of the Indian people?" Salmon was the first to promise, then other fish lined up behind salmon. Next was deer, then cous, then huckleberry. Each "First Food" represents groupings of ecologically related foods. The First Food serving ritual in the longhouse is based on this order and reminds people of the promise the foods made and the people's reciprocal responsibility to respectfully use and take care of the foods. The longevity and constancy of these foods and serving rituals across many generations and their recognition through First Food ceremonies demonstrate the cultural and nutritional value of First Foods to the CTUIR community...*

Managing from a First Foods perspective calls for a change from management practices employed in recent decades, which were often single-species approaches narrow in scope and with limited spatial and temporal extents. In contrast, a First Foods perspective for river management means integrating the entire ecosystem, a broader range of biodiversity, and broad spatial scales—from ridgetop to ridgetop. The *River Vision* highlights several processes in need of restoration and protection that extend beyond the immediate focus of anadromous fish: water quantity and quality (both groundwater and surface water), geomorphic diversity of the river channel (side channels, off-channel habitats, tributary junctions, etc.), connectivity across habitats and across the river network, and the community structure and health of the entire riverine biota and riparian communities. While the *River Vision* outlines a farsighted approach for a particular river, a First Foods perspective can be applied across the treaty tribes' ceded lands and beyond, along with the principles from other sources of traditional ecological knowledge.

Principles of Traditional Ecological Knowledge for Wy-Kan-Ush-Mi Wa-Kish-Wit

The principles that can inform Wy-Kan-Ush-Mi Wa-Kish-Wit may be grouped into four broad categories.

The following table shows the practical applications and examples of real-world use of these principles:

1. Documentation of natural conditions prior to Euro-American settlement, including knowledge about indicators of ecosystem change.
2. A framework for holistic management of anadromous fishes based on existing relationships between tribal members and natural resources.
3. An adaptive management framework, a result of the tribes' unique ability to accommodate environmental change in their social systems.
4. Recognition of the importance of place and the relationship between that place and the community it supports.

CRITFC member tribes combine traditional ecological knowledge (TEK) and Western science to manage natural resources and implement the Spirit of Salmon Plan

TEK Principle	Practical Application	Examples
Documentation of conditions prior to Euro-American settlement	Quantitative descriptions of the historical distribution and abundance of plants and animals	Knowledge of the traditional distribution of fishing places for lamprey based on ethnographic interview of Yakama or other tribes' elders
	Qualitative descriptions of relationships among humans and plants, animals, and their environment	Relationships described in Coyote and other stories, songs, rituals, and ceremonies, and from ethnographic interviews
	Indicators of changes in phenology due to climate change	Timing of animal migrations and behavior, flowering, flooding, and other seasonal variations, such as those described by the Nez Perce calendar

TEK Principle	Practical Application	Examples
Framework for holistic management of anadromous fishes	Perspective that human and natural systems are intertwined—that ethical and moral principles cannot be divorced from natural resource management	The Yakama Nation's use of Interdisciplinary Science Protocol, a procedure for approvals and check-ins with other Yakama programs and leaders during each phase of a project
	Incorporation of the concept of resilience (the ability of ecosystems to absorb disturbance, self-organize, and adapt) into management plans	The *Umatilla River Vision* emphasizes restoring the self-organizing components of river systems—including spatial and temporal diversity of riverine processes such as natural flow regimes and floodplain functions—rather than restoring to a determined state
	Incorporation of a broad spatial extent or whole watershed perspective	First Foods serving order is from water in the river to huckleberries on the ridgeline and includes everything in between
	Recognition of a broad view of the biological community	First Foods concept implies a holistic perspective of the biota and biological processes. This perspective might include attention to invasive species and bio-indicator species (macroinvertebrates, freshwater mussels, etc.)

TEK Principle	Practical Application	Examples
Framework for holistic management of anadromous fishes (continued)	Application of a gravel-to-gravel approach to restoring anadromous fish	Wy-Kan-Ush-Mi Wa-Kish-Wit recognizes impacts from human activities and bottlenecks to growth and survival at all life history stages—from spawning adults to developing eggs, emergence of fry, rearing of juveniles, migration to the ocean, and returning to freshwater to spawn
	Consider the impact of today's actions on future conditions and society	The tribes have successfully maintained their cultural practices and the resources supporting them in large part because they view the impacts of present actions for generations in the future

TEK Principle	Practical Application	Examples
Framework for adaptive management	Tribal culture as flexible and open to change, learning from and building upon direct observation and experience and rapidly accumulating social knowledge	Tribal hatchery programs in the Columbia River Basin are becoming more ecologically integrated in contrast to hatcheries that are production-oriented
	The direct application of adaptive management principles by tribes	
	Multiple species management, resource rotation, vegetation succession management, landscape patchiness management, and other ways of responding to and managing pulses and ecological surprises, including climate change	

TEK Principle	Practical Application	Examples
Importance of place	The long history of knowledge in specific locations	For thousands of years at Wy-am (Celilo Falls), indigenous peoples caught, processed, traded, and performed ceremonies surrounding salmon. This history is preserved in stories, in modern ceremonies at Celilo longhouse, and in archeological evidence
	The importance of geography in stories	In traditional stories, places were often main characters, objects, and subjects of the stories. Thus, sacred places are not interchangeable and cannot be bought and sold as such
	Acknowledgment that restoration must employ landscape context—focusing connectivity and incorporating the role of non-interchangeable places in the larger picture	The *Umatilla River Vision* states, "Key river characteristics are variable throughout the river network. Therefore, while some management goals can be set for the basin, different river reaches require different management and restoration targets depending on the context and structure of the reach."
	Recognition of the importance of evolutionary adaptations of organisms to their local environment	The Nez Perce use of wild, 100% local-origin brood stock for supportive breeding

A Summary of Accomplishments

After more than a decade of implementation of the Spirit of the Salmon, the tribes, the region, and the nation have made significant accomplishments. These achievements are summarized below and also discussed in Salmon Decline Halted; The Accords, Pacific Salmon Treaty, and *U.S. v. Oregon* Agreements; and in the updated institutional and technical recommendations.

- The precipitous decline of some salmon populations was halted so recovery may now be possible and achievable.
- Through hundreds of small and large efforts—from replacing culverts where roads cross streams to reducing the inequitably large ocean catches of upriver chinook to releasing millions of young fish into natural habitats to successfully litigating to require more spill at hydroelectric dams—the tribes and their CRITFC can rightfully take some of the credit for the increased abundance.
- The Spirit of the Salmon Plan became one of the primary recovery plans and frameworks for the basin. It helped to coordinate tribal work and policy priorities. It influenced public thought and perception. It provided guidance for state and federal agencies and policy makers and influenced the content and direction of Endangered Species Act recovery planning.
- Tribal treaty rights to fish on the mainstem Columbia River and its tributaries and to habitat conditions conducive to productive and sustainable native fish runs were respected and honored more than ever before.
- Columbia Basin Fish Accords, signed in 2008, represent major policy and legal commitments to implement $600 million of remedial hydrosystem actions and on-the-ground restoration

Spill Now Required

Spilling water and surface bypass systems to pass juvenile salmon by deadly dam turbines are now required at most hydroelectric projects on the Columbia and Snake rivers. Above, night-time spill at Ice Harbor Dam on the Snake River.

Most Columbia River Basin juvenile salmon stay in the upper 10 to 20 feet of the water column as they migrate downstream to the ocean. To prevent juvenile fish from diving to depths of 50 to 60 feet to find passage routes—including spillways— engineers and biologists have developed and installed bypass structures that keep migrating juveniles closer to the surface. The eight dams on the lower Columbia and Snake rivers now have surface bypass structures. Photo courtesy Scott Butner.

projects. Although the Nez Perce Tribe was not a signatory to the agreement, it too has an aggressive portfolio of projects aimed at rebuilding fish runs consistent with those of the other tribes and CRITFC.

- Although the hydrosystem and its operations still cause significant fish mortality, improvements have been carefully made. Spilling water and screen bypass systems to pass juvenile salmon by deadly dam turbines are now required at most hydroelectric projects on the Columbia and Snake rivers. Structural changes for both migrating adult and juvenile fish appear to be saving salmon and lamprey from previous levels of death and injury.
- Tribal habitat projects have recovered hundreds of stream miles to support salmon. This work is increasingly focused on projects—such as reconnecting floodplains, restoring streamflow, and reestablishing habitat complexity—projects that are most likely to contribute to salmon abundance, diversity, and species resilience over time.
- Oregon industry, municipalities, and the U.S. Environmental Protection Agency worked closely with tribes to revise Clean Water Act standards for toxic chemicals so that the amount of fish people eat (tribal people have some of the highest documented fish consumption rates) is accurately reflected in the regulations restricting allowed discharges of toxic chemicals.
- Scientific research capacity has expanded. Individual tribal programs and activities address the full range of freshwater life stages. A genetics research laboratory is fully operational, providing services and advice to improve tribal programs, including the study of supplementation and its effects on naturally producing populations. CRITFC operates the full-service regional StreamNet Library (*www.streamnet.org*), which specializes in scientific and technical collections on Northwest fish and wildlife.

Salmon Reintroduced

Returning sockeye in Lake Cle Elum in the Yakima subbasin.

Tribal hatchery reintroduction projects are successfully reestablishing natural populations of previously extirpated stocks of coho and sockeye in the Hood, Umatilla, Walla Walla, Yakima, Wenatchee, Methow, Clearwater, and Grande Ronde rivers

- Use of supplementation, to support both naturally spawning fish runs and tribal harvest, has had notable success in subbasins throughout the interior Columbia, including the Klickitat, Yakima, Wenatchee, Methow, Okanagan, Umatilla, Walla Walla, Snake Clearwater, Salmon, Grande Ronde, and Imnaha.
- Tribal hatchery reintroduction projects are successfully reestablishing natural populations of previously extirpated stocks of coho and sockeye and in the Hood, Umatilla, Walla Walla Yakima, Wenatchee, Methow, Clearwater, and Grande Ronde rivers.
- The 2011 *Tribal Pacific Lamprey Restoration Plan* C3562 is the most comprehensive strategy to date for rebuilding the basin's lamprey population and marks the start of a concerted effort by the region's governments and agencies on behalf of this species.
- Litigation and, in more recent years, negotiations have brought about ocean and in-river harvest regulations for Columbia River salmon that are more rational and lawful. The regulations are now based on abundance rather than catch ceilings. They have also supported more equitable harvest sharing between Indian and non-Indian fisheries, as called for in tribal treaties.
- Treaty Indian and non-Indian sport and commercial fisheries were cautiously and gradually reestablished as some of the fish populations turned toward recovery and as carefully implemented hatchery programs were implemented.
- With increases in salmon runs in many years, tribal members harvested more salmon, from a more diverse mix of species, at a variety of times during the year. More tribal members, including younger generations, found employment and income from fishing.

Tribal Fishing and River Culture Improvements

As salmon dependent people, our religion, culture, and economy rely on the return of the salmon. Although not appearing in the 1995 Plan explicitly as recommendations, the development and revitalization of tribal communities goes hand in hand with fish restoration. We celebrate these important achievements in connecting salmon restoration with the needs of our salmon way of life.

- Tribal members are using their skills, training, and expertise in virtually all aspects of anadromous fish restoration and protection.
- The tribes made great strides in recovering their salmon cultures and economies. Some 30 fishing access sites C373, destroyed when hydroelectric dams were built on the Columbia, have been replaced.
- Tribal members have improved fish handling, safety, and marketing, positioning themselves to take advantage of the increased fish runs and better fishing access. Their salmon are commanding higher prices in the marketplace. Once a vital part of tribal livelihood, fishing may regain its rightful place in tribal life.
- Celilo Village, one of the longest continually occupied sites in North America and a symbol of tribal salmon culture, was renovated with a new water supply and distribution system, a new sewer system, paved streets, and a refurbished longhouse.
- The Confederated Tribes of the Umatilla Indian Reservation moved its First Foods mission from concept to application. The seminal *Umatilla River Vision*, a framework for managing riverine ecosystems, is based on traditional knowledge preserved in tribal religious and cultural practices.

Fishing Sites Constructed

The Dallesport Treaty Fishing Access Site was opened and dedicated with a ribbon cutting ceremony and honor songs in April 2012.

The 31st in-lieu and treaty fishing access site constructed by the U.S. Army Corps of Engineers under Public Law 100-581, Title IV: Columbia River Treaty Fishing Access Sites was completed in 2012. The Dallesport access site represents the end of the construction phase of the Columbia River Treaty Fishing Access Site program. The sites constructed are mitigation for usual and accustomed fishing areas lost by the tribes when the lower Columbia River dams were constructed, beginning with Bonneville Dam in 1937.

The Accords, Pacific Salmon Treaty, and U.S. v. Oregon Agreements

These three 2008 agreements expanded efforts to address numerous institutional and technical problems identified in the 1995 Spirit of the Salmon Plan. These landmark agreements made improvements in the fragmented and process-laden management of Columbia River Basin salmon. The agreements helped to streamline and coordinate decision-making and in ways that encourage cooperation among the tribes and federal and state governments. Together the three—the Columbia Basin Fish Accords, the Pacific Salmon Treaty, and the *U.S. v. Oregon* Agreements—provide an institutional framework for implementing the Spirit of the Salmon Plan during most of the remainder of its planned duration.

Columbia Basin Fish Accords

The Columbia Basin Fish Accords C294 were signed by the Umatilla, Warm Springs, and Yakama tribes, the Columbia River Inter-Tribal Fish Commission, and the United States represented by the Bureau of Reclamation, the Army Corps of Engineers, and the Bonneville Power Administration. Stemming from nearly a decade of federal courts litigation, the Accords are a series of binding policy and legal agreements that represent a pivotal decision and milestone in the tribes' decades-long commitment to put fish back in the rivers and restore the watersheds where they live. The three tribal governments and CRITFC agreed not to litigate against hydropower and river operations conditions for a decade. In return, the federal government committed over $600 million to fund highest priority tribal fish recovery and habitat restoration projects.

As a result of the 2008 Accords, efforts directed toward federal court litigation are now dedicated to the restoration of fish runs and improvement of habitat conditions. Though the Nez Perce Tribe chose to not sign the Accords, the tribe continues to implement important fish and habitat projects in the Snake River Basin. The Nez Perce Tribe is also litigating to assure that breaching the Snake River dams is a viable response for Endangered Species Act (ESA) listings.

Columbia Basin Fish Accords Signing

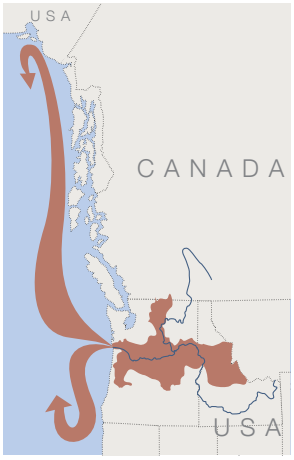
The Accords were signed in May 2008 during a ceremony at Columbia Falls State Park, site of the ancient petroglyph She Who Watches, representing a female tribal chief who watches over the people and the river. Pictured displaying the hide they signed May 8, 2008 to commemorate the historic agreement are from left to right: Colonel Steven Miles, Northwest Division Commander, U.S. Army Corps of Engineers; Antone Minthorn, Chairman, Confederated Tribes of the Umatilla Indian Reservation; Mike Marchand, Chairman, Confederated Tribes of the Colville Indian Reservation; Ralph Sampson, Chairman, Confederated Tribes and Bands of the Yakama Nation; Tim Personius, Deputy Regional Director, Bureau of Reclamation; Steve Wright, Administrator, Bonneville Power Administration; Ron Suppah, Chairman, Confederated Tribes of the Warm Springs Reservation of Oregon; and Fidelia Andy, Chairwoman, Columbia River Inter-Tribal Fish Commission and Yakama Nation Fish and Wildlife Committee.

Pacific Salmon Treaty

The governments of Canada and the United States signed a new bilateral agreement for the conservation and harvest sharing of Pacific salmon. The product of nearly 18 months of negotiations, the 2008 agreement represents a major step forward in science-based conservation and sustainable harvest sharing of the salmon resource between Canada and the United States.

Interception of Pacific salmon bound for rivers of one country in fisheries of the other has been the subject of discussion and frequent conflict between the governments and citizens of Canada and the United States since the early part of the last century. In 1985, after many years of negotiation, the Pacific Salmon Treaty was signed. After an impasse in negotiations resulted in ocean harvest agreements

Columbia River Chinook Migrate As Far North As Southeast Alaska



Ocean fisheries in Canada and Alaska harvest significant numbers of Hanford Reach bright fall chinook and upper Columbia River summer chinook.

expiring in 1992, the treaty was renewed seven years later in 1999; and most recently in 2008.

In the 1999 agreement, the United States and Canada agreed to regulations that account for annual variations in stock abundance rather than fishery regulations based on negotiated catch ceilings. The new 2008 treaty, in force from 2009 through 2018, will reduce chinook harvest off the west coast of Vancouver Island by 30% and Southeast Alaska by 15%. The changes send an estimated one million more chinook to Puget Sound and the Columbia River. While chinook are the target species, the agreement also covers coho, chum, pink, and sockeye salmon. For nearly 25 years, these consecutive agreements have resulted in more chinook returning to the Columbia River.

The U.S. Pacific Salmon Treaty delegation is made up of representatives from Alaska, Washington/Oregon, 24 treaty tribes, including the four CRITFC member tribes, and the federal government.

U.S. v. Oregon Agreements

Since the mid-1990s, the parties to *United States v. Oregon* struggled to reach agreement on fisheries and production actions. In many years, litigation occurred and annual or interim agreements were only reached through court-ordered negotiation, settlement orders, or rulings of the court. The parties to *United States v. Oregon* negotiated a successor agreement to the 1988 Columbia River Fish Management Plan from 1997-2008. The 2008-2017 *United States v. Oregon* Management Agreement was concluded in May 2008, after many years of negotiation. The management agreement, a stipulated court order in *United States v. Oregon*, will guide management decisions for mainstem Columbia River fisheries and Columbia Basin hatchery programs until 2017.

The 2008 Agreement addresses the fundamental issues the tribes identified at the start of the negotiations. Fishery opportunity is enhanced as compared to previous agreements and treaty harvest will again be protected by federal court order. Hatchery programs crucial to treaty fisheries and tribal fishery programs are part of the agreement. Under the auspices of the federal court, the tribes have the opportunity to engage the states on regulatory issues. The parties formalized commitments to rebuild specific populations to specific levels and agreed to performance measures. In addition the agreement provides a co-management structure and is enforceable in federal court.

The 2008 Agreement also contains significant hatchery fish production commitments. It maintains important hatchery programs,

such as the Snake River fall chinook program and various tribal coho programs, and provides for increased hatchery supplementation of other important stocks of spring chinook and Group B steelhead. Juvenile release numbers and sites for each interior hatchery program are detailed in Appendix D, 2008-2017 *U.S. v. Oregon* Management Agreement Production Tables B.1-B.7 (revised May 31, 2012) 1278.

The 2008 agreement contains a detailed description of a dispute resolution process. These elements provide the parties with a variety of ways to address technical, legal, and policy disputes that may arise over the next 10-year period. Prosecution referral agreements are included in a section on judicial review of disputes.

Finally, the agreement contains a new section on performance measures, commitments, and assurances. This section describes the parties' expectations that the harvest and hatchery production measures will assist upriver stocks to rebuild over time. Performance measures are provided to assist in monitoring progress toward population restoration. If any of the indicator fish populations—those used to measure progress—do not improve as expected, then the Policy Committee could suggest modifying the agreement or make recommendations to other entities regarding additional (non-harvest or hatchery production) actions that could be taken to help rebuild stocks of concern.

The 1990s ESA listings of Columbia and Snake River salmon brought additional legal and bureaucratic processes into Columbia River fisheries management issues. Most notably, the federal government, through the National Marine Fisheries Service (NMFS), gained

A Tradition of Sound Fisheries Management

The Indian fishery at Celilo Falls prior to inundation in 1957.

The tribal tradition of sound fisheries management included rules and regulations, management areas, law enforcement and more 807.

significant regulatory authority over activities that "take"—harm or kill—ESA-listed fish. These activities include ocean and in-river fisheries and hatchery management. If NMFS decides changes are needed in hatchery production programs in the future, the tribes may be forced to again seek judicial relief should the modifications affect the number of fish returning to usual and accustomed fishing areas.

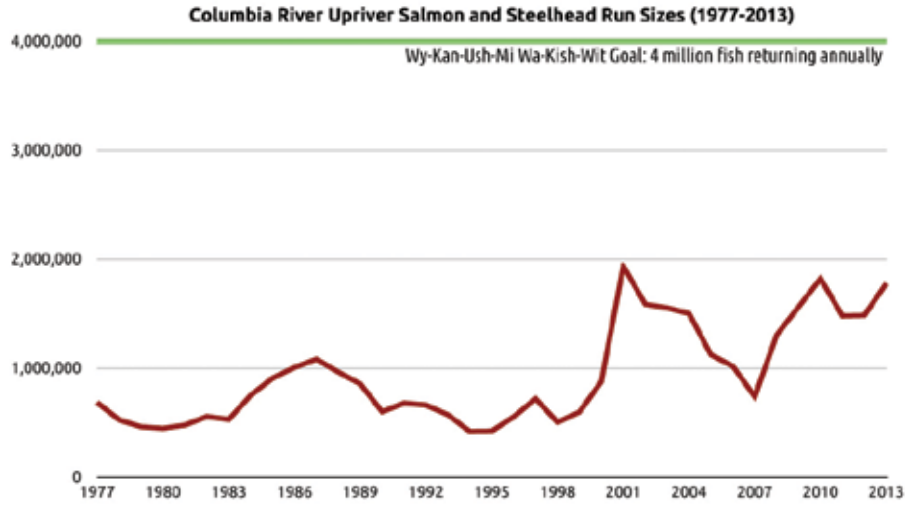
The new hatchery production actions provided for in the agreement will not be implemented without securing new funding. In the current state and federal budget and political climate, acquiring the necessary new funding will be difficult, even with the support of *United States v. Oregon* parties. The 2008 agreement expires in 2017. For the remaining period of the agreement, key outcomes, which the tribes will monitor closely for achievement, include tribal mainstem fisheries that reach the agreement's harvest, conservation and allocation commitments, implementation of the agreement's hatchery production programs, and development of regulatory coordination that provides for tribal enforcement.

(For more discussion, see institutional recommendations Tribal Hatchery Management and Hatchery Management and technical recommendations Supplementation and Reintroduction.)

Salmon Decline Halted

Since the Spirit of the Salmon Plan was formulated, the tribes, the region, and our country's and Canada's leaders have worked together to halt the general trend of declines in total upriver salmon (and steelhead), particularly after some very low years in the mid-1990s. The figure below shows the turnaround beginning in 2001.

Upriver spring chinook had record returns in 2001; upper Columbia summer chinook in 2002; sockeye in 2012; and fall chinook in 2013. While this is a real improvement, overall upriver salmon runs remain less than 2 million and far short of the 4 million Spirit of the Salmon goal.



Run sizes of Columbia upriver salmon and steelhead

For individual salmon populations, the picture is varied and indicates that some stocks may still be declining. A discussion of population trends for the Columbia's upriver stocks is presented in Looking Ahead—Abundance Trends.

Pacific lamprey and Columbia River white sturgeon—the other anadromous species covered in the Spirit of the Salmon Plan—have not reached the Plan's goal of increasing "to naturally sustainable levels that also support tribal harvest opportunities."

Looking Ahead—Abundance Trends

Actions taken under the Spirit of the Salmon Plan have contributed to a more optimistic outlook for the Columbia River Basin's anadromous fish. Generally the trends indicate some large stocks of salmon and sturgeon have stabilized or increased over the last decade (Figures 2, 13, 18, 19, and the figure on the previous page).

While full analyses of individual fish stocks are beyond the scope of this Update, mainstem data do indicate mostly positive prospects for our ability to recover salmon, lamprey, and sturgeon.

Mainstem data on large units of fish (as shown, for example, on the previous page) are collected for a variety of management purposes, including harvest regulation and monitoring fish passage through the hydrosystem. Mainstem data are not necessarily collected to assess trends in specific wild stocks. But they can be useful to gain an understanding of the status of larger management units and can provide insight into the status of finer level groups of fish.

Figures 7, 8, and 14-18 show data specific to natural-origin stocks that indicate a general uptick in rebuilding natural spawners since their lowest run sizes in the 1990s. Figure 9 shows an uptick for Snake River wild A steelhead, but not wild B steelhead.

Our ability to evaluate trends for specific stocks using mainstem data is limited in large part to reconstructing run sizes of different salmon populations. Changes in abundance are difficult to correlate with specific actions taken to recover fish because of the numerous factors that affect their survival.

However, most natural-origin stocks, including Pacific lamprey and white sturgeon, remain well below historical levels. The lamprey population has yet to move toward recovery (Figure 14). The decline of Columbia River white sturgeon between Bonneville and McNary dams has generally stabilized, but populations levels overall are still not at restoration levels (Appendix D: Sturgeon Abundance 1287). The numbers of most natural-origin fish caution us that much more work lies ahead.

Note: Data in Figures 1-21 are either Columbia River mouth estimates or Bonneville Dam estimates, depending on availability. Data are from the *U.S. v. Oregon* Technical Advisory Committee run reconstructions and U.S. Army Corps of Engineers dam counts. Not all stock run sizes are reconstructed to the river mouth. Some stock specific data in Figures 1-21 are not available back to 1977. Different data sets are available for different time periods. The data shown are the data available for that specific stock.

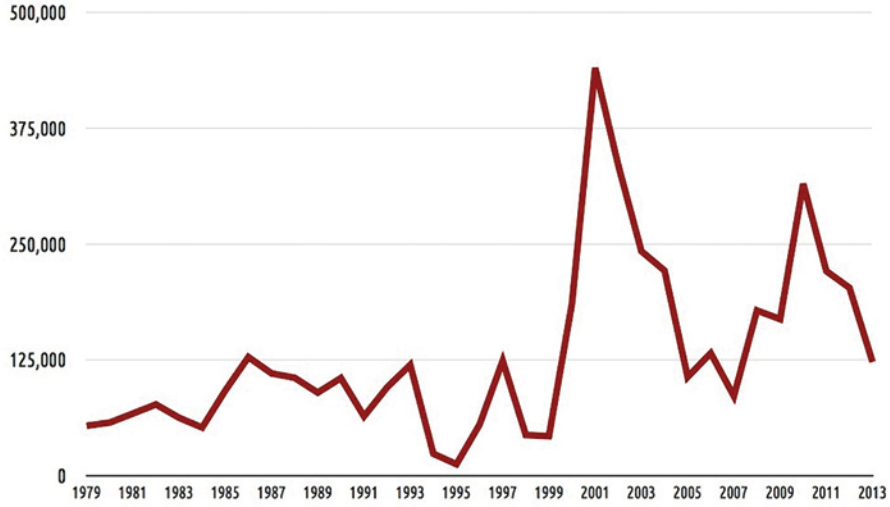
2014 Forecasts Continue Upward Trend

Chinook passing the Bonneville Dam counting window.

Biologists predict a record return of fall chinook—1.6 million!—to the Columbia River mouth this summer and fall. That would be the most fall chinook since Bonneville Dam was built in 1938. The bulk of returning fall chinook are upriver-destined fish.

The river's 2014 spring chinook and sockeye returns are also expected to be robust. Some 200,00 upriver spring chinook are anticipated, making the return modestly higher than those observed over the past decade. The 2014 prediction for returning sockeye is estimated at 340,000, larger than the 10-year average.

Figure 1. Columbia River mouth run size of upriver spring chinook and Snake River spring/summer chinook



Some increase in the overall return of upriver spring chinook to the Columbia River has occurred since 1979. Most of the spring chinook, however, are of hatchery origin.

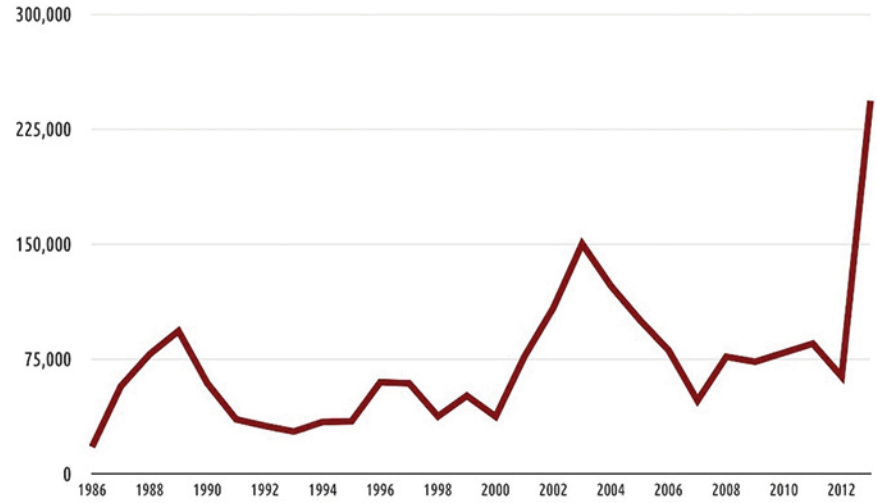
Figure 2. River mouth run size of upper Columbia summer chinook

Run sizes of upper Columbia summer chinook have increased since 1979, but the trend has been relatively flat since 2001.

Figure 3. River mouth run size of Bonneville Pool tule fall chinook (Spring Creek Hatchery)

Almost all of the Bonneville Pool tule fall chinook are hatchery-origin fish returning to Spring Creek Hatchery. With the exception of 2006 and 2007, run sizes of Spring Creek tules have generally increased since 1986. There are no data on the river mouth returns of any natural-origin tules from Zone 6 tributaries (the are between Bonneville and McNary dams).

Figure 4. River mouth run size of mid-Columbia bright stock fall chinook

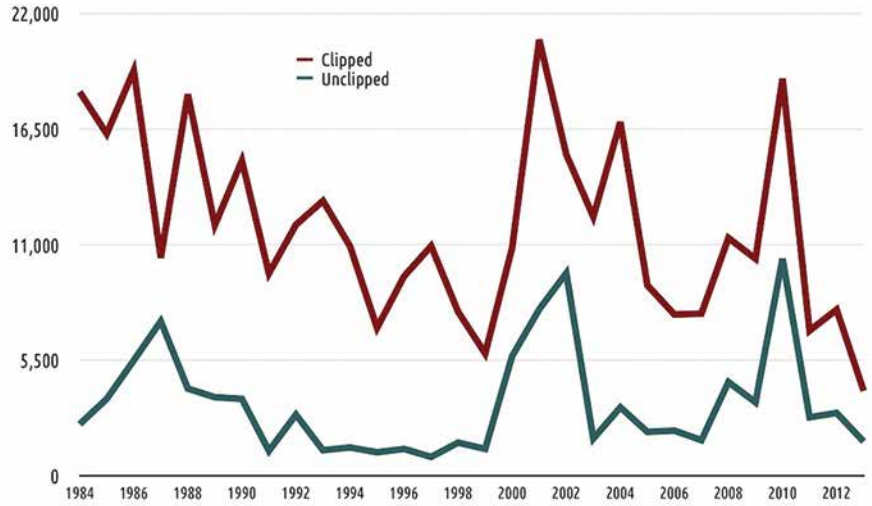


The mid-Columbia bright stock fall chinook are primarily hatchery-origin fish returning to Little White Salmon, Klickitat, and Umatilla hatcheries. This group also includes small numbers of naturally spawning fish in Zone 6 tributaries outside the Deschutes River. There have been some increases in the run sizes for this group since the 1990s. Significant increases might not be expected since hatchery production has remained relatively stable. There are no data on the river mouth run sizes of any natural-origin fish in this group.

Figure 5. River mouth run size of upriver bright stock fall chinook

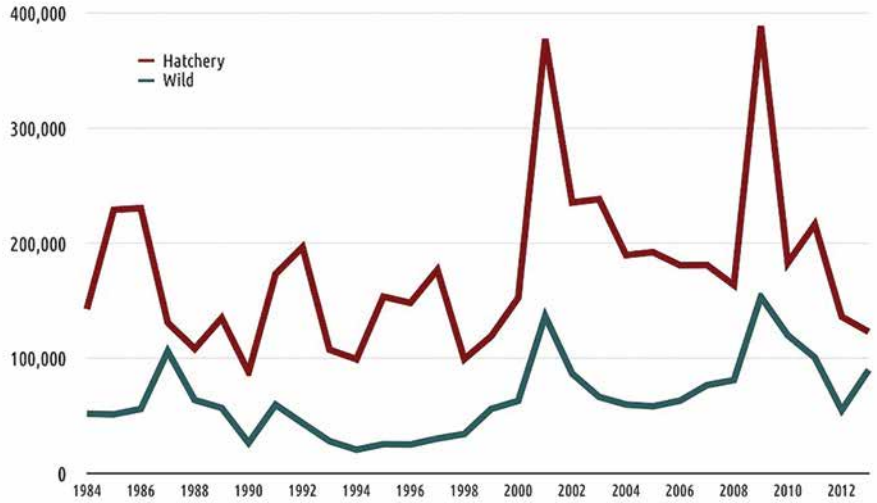
This group of upriver bright stock fall chinook is comprised of natural-origin fish from the Deschutes River and all hatchery and natural-origin fish from areas upstream of McNary Dam including the Snake and Yakima rivers. A significant portion of this group is natural-origin fish from the Hanford Reach. With the exception of 2007, run sizes have generally increased relative to the 1990s.

Figure 6. Bonneville Dam counts of Skamania stock steelhead



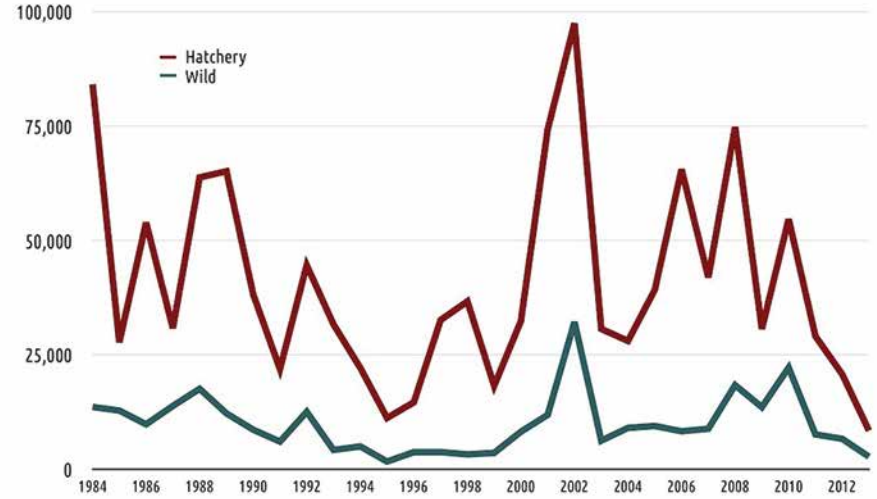
Most unclipped steelhead are presumed to be natural-origin fish. (Biologists consider unclipped fish to be a reasonable index of wild run sizes and have a long history of clipped and unclipped dam counts for steelhead but not for other stocks.) These summer run steelhead pass Bonneville Dam from April 1 through June 30. They may be primarily destined for tributaries downstream of McNary Dam. While a couple years have had strong returns, no real increasing trend is apparent. (It is not possible to reconstruct upriver steelhead runs at the river mouth.)

Figure 7. Bonneville Dam counts of Group A Index steelhead



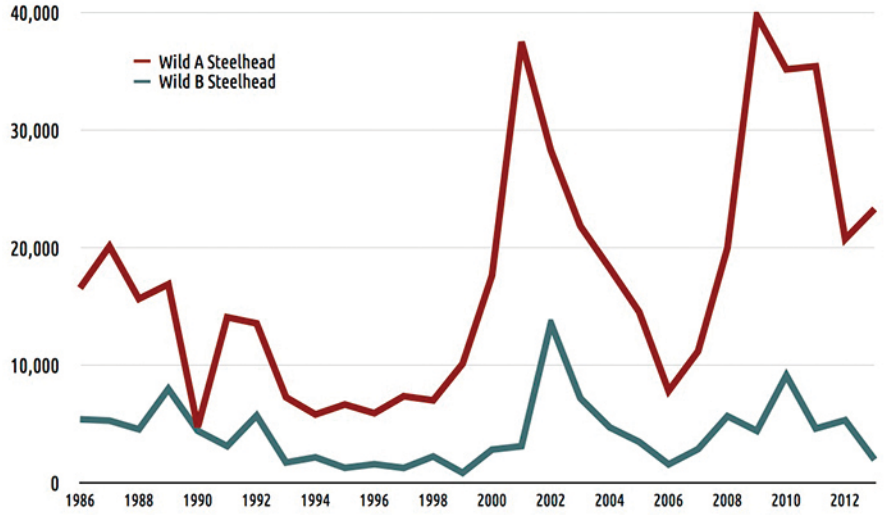
Group A Index steelhead are steelhead measuring less than 78 cm fork length that pass Bonneville Dam from July 1 through October 31. These fish can be destined for anywhere in the basin. The majority of the unclipped fish are presumed to be natural-origin fish. There has been a slight increasing trend since the 1980s and 1990s.

Figure 8. Bonneville Dam counts of Group B Index steelhead



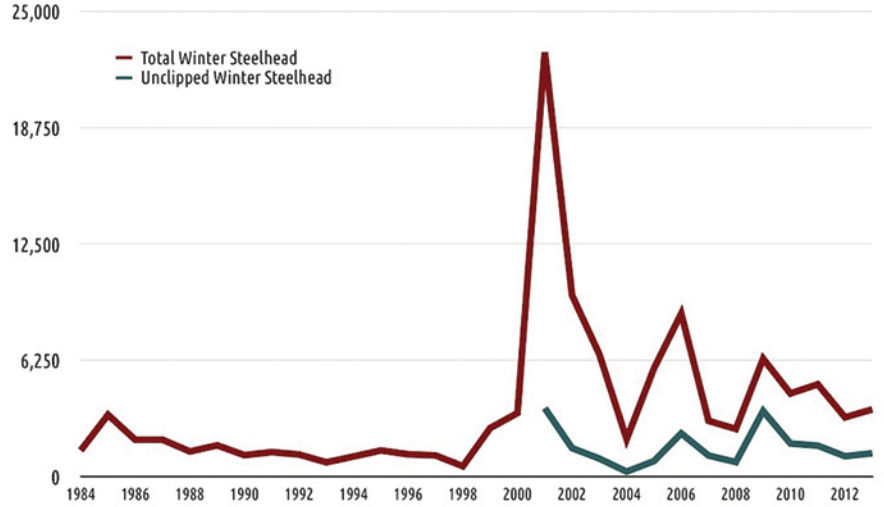
Group B Index steelhead are steelhead that measure 78 cm or greater and pass Bonneville between July 1 and October 31. They are presumed to be primarily destined for areas in the upper Clearwater basin and in the Middle Fork Salmon River. Around 20-25% of the unclipped fish in recent years may be hatchery-origin fish from supplementation programs in the Clearwater Basin. There has been no increasing trend in unclipped Group B Index steelhead since the 1980s.

Figure 9. Lower Granite Dam counts of wild steelhead



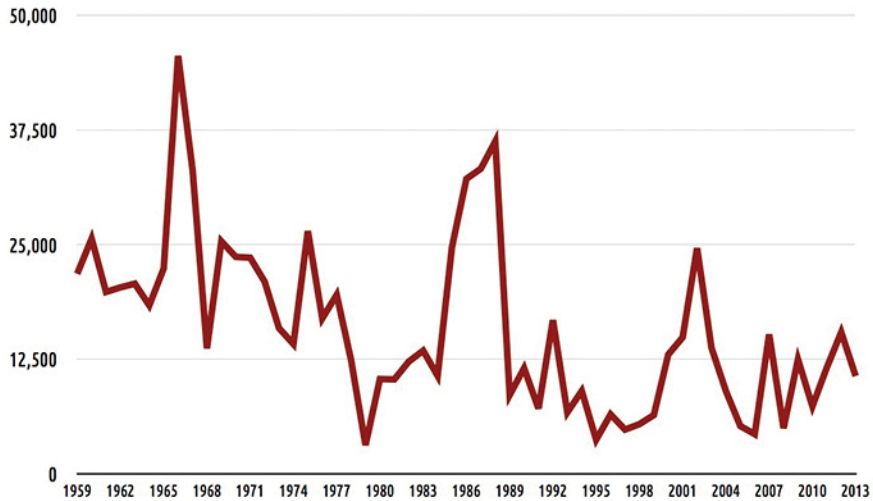
Wild steelhead returns to Lower Granite Dam show a general increase in abundance compared to the lowest return years in the 1990s. The pattern is similar to the pattern of wild steelhead data at Bonneville even after mainstem fisheries have occurred.

Figure 10. Bonneville Dam counts of winter steelhead (Nov 1-Mar 31)



Winter steelhead are destined for tributaries between Bonneville and The Dalles dams. Almost all unclipped fish are presumed to be natural-origin fish. Because of inconsistent counts in the winter, it is difficult to be certain of trends; but it appears there has been a slight increasing trend for winter steelhead compared to the 1990s.

Figure 11. Spawner estimates of John Day River steelhead from redd counts



While overall returns of unclipped steelhead are stable or increasing, some individual stocks may not be doing as well. Figure 11 shows data on spawner estimates for John Day River steelhead based on redd counts. These data indicate a continued decreasing trend for this stock. Data for other individual stocks are not always readily available

Figures 6 through 10 show some limited progress toward recovering the total wild numbers of steelhead, although Figure 11 suggests there may be continued concerns with individual stocks. Because data are not available on the trends or status of individual ESA-listed Distinct Population Segments (DPSs) at Bonneville Dam, it is difficult to assess progress toward delisting.

Figure 12. Columbia River mouth run size for sockeye

Most Columbia River sockeye are destined for the Okanagan River. In recent years, trends show increasing strength in river mouth run sizes of sockeye. Sockeye runs are a mix of hatchery and natural-origin fish. There are no river mouth estimates of total natural-origin fish.

Figure 13. Bonneville Dam counts of coho

Since 2000, counts of upriver coho have generally been larger than counts prior to 2000 except for 1986. However, the 2012 count was the lowest since 2000. There are no estimates of total natural-origin upriver coho, so it is not possible to determine any trend in natural-origin coho run sizes. Upriver coho are not reconstructed to the river mouth.

Figure 14. Daytime counts of adult Pacific lamprey at Bonneville and McNary dams

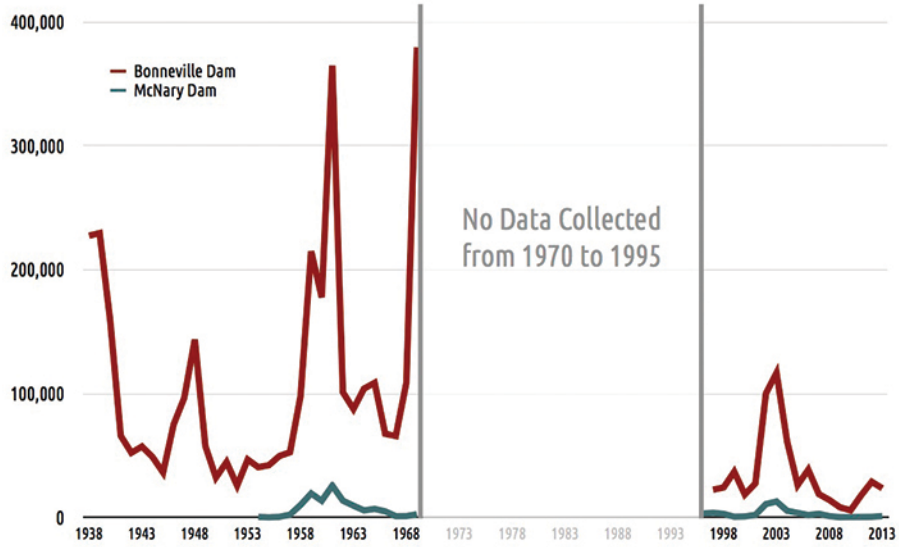


Figure 14 shows just how far the numbers of Pacific lamprey, an important subsistence and cultural resource, have fallen in recent years. Once returning to the Columbia River and its tributaries by the millions, lamprey returns were at an all-time daytime low of 6,234 in 2010.

For information about white sturgeon population abundance trends, see Appendix D 1287.

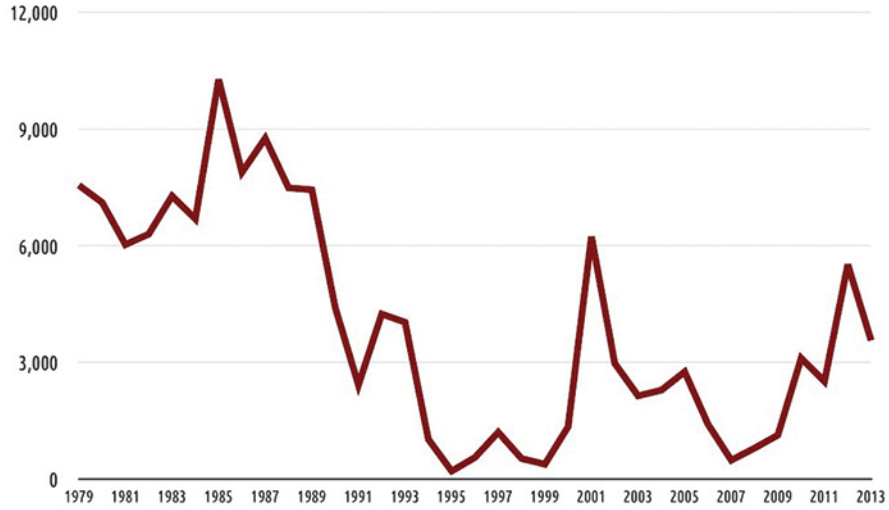
Figure 15. Columbia River mouth run size of natural origin Snake River spring/summer chinook

With the exception of three years in the early 2000s, natural-origin Snake River spring/summer chinook has made little improvement since the 1980s. These data include Clearwater Basin natural-origin fish, which are not ESA-listed.

Figure 16. Lower Granite Dam counts of wild Snake River spring/summer chinook

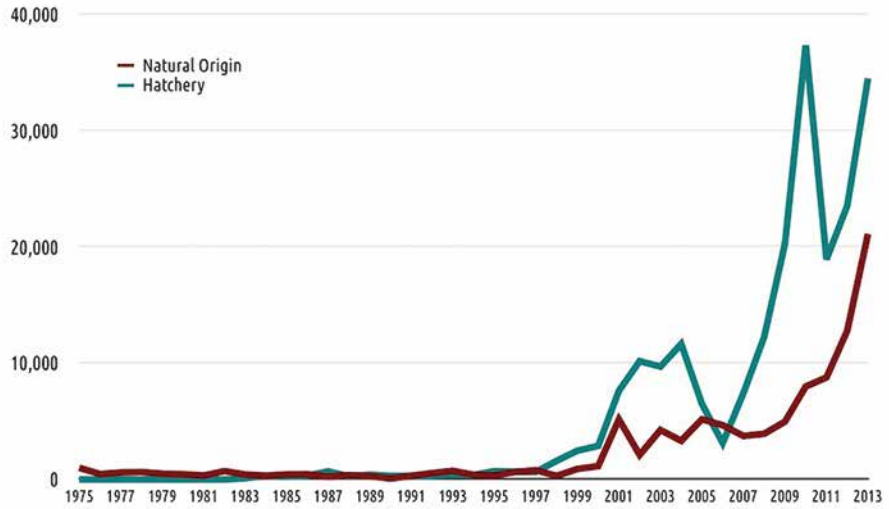
The data on wild Snake River spring/summer chinook indicate that as with the river mouth run sizes, an increase in run sizes has occurred since the lowest return years in the mid-1990s. The pattern at Lower Granite is unchanged compared to the pattern at the river mouth even after mainstem fisheries have occurred.

Figure 17. Columbia River mouth run size of natural origin upper Columbia spring chinook



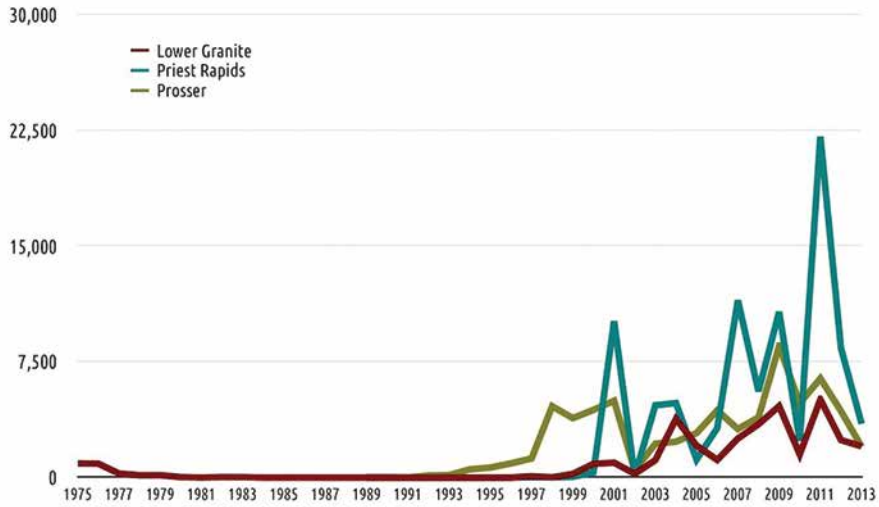
The natural-origin upper Columbia spring chinook are destined for areas upstream of Priest Rapids Dam. The number of these fish has decreased since the 1980s; and thus no progress has been made towards recovering them. They are listed as endangered under the ESA.

Figure 18. Natural and hatchery returns of Snake River fall chinook to Lower Granite Dam



The data on Snake River fall chinook indicate considerable progress in restoring their abundance. Hatchery and natural-origin fish are collected for hatchery broodstock. As a result, the escapement to spawning areas upstream is less than the numbers of fish arriving at Lower Granite Dam. However, quality and quantity of habitat continue to constrain natural production. To meet ongoing mitigation needs, maintenance of the supplementation program is required.

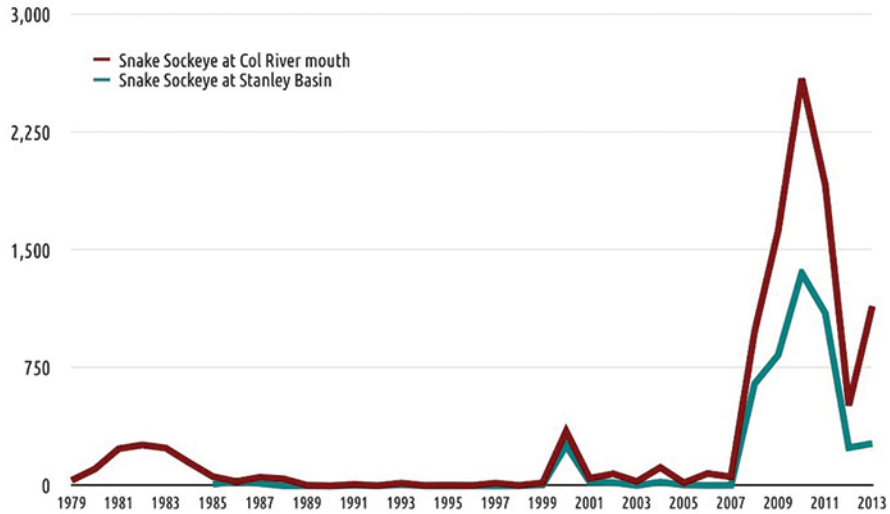
Figure 19. Upriver dam counts for coho



Progress has been made in coho reintroduction efforts in the upper basin. The data include both hatchery- and natural-origin fish.

Coho upstream of the Hood River Bridge are not ESA-listed, and upstream groups are products of tribal reintroduction efforts. Data on natural-origin coho in the Hood River, which are part of the Lower Columbia ESU, are not readily available.

Figure 20. Columbia River mouth run size and Stanley Basin return of Snake River sockeye



In some years, no sockeye spawned naturally in the Stanley Basin, and a captive brood program supported the entire run. The majority of the run are hatchery-origin fish. In recent years, the total Snake River sockeye return, including a few natural-origin fish, has shown an increase, probably reducing the short-term threat of extinction at least to some degree. However, with total returns of sockeye to the Stanley Basin remaining at less than 1,500, these fish clearly remain in dire condition. Snake River sockeye have been listed as endangered under the ESA since 1991.

Figure 21. Tributary returns of reintroduced spring chinook in the Umatilla and Walla Walla rivers

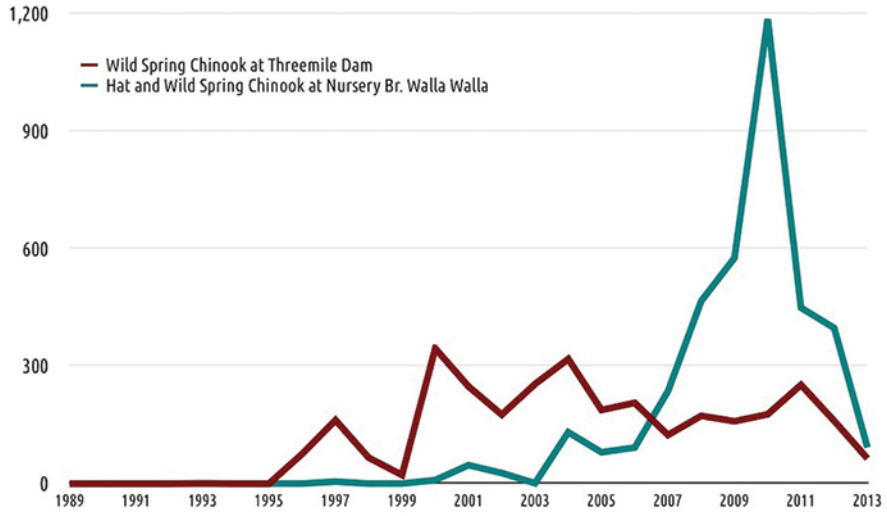


Figure 21 depicts progress in reintroducing spring chinook to the Umatilla and Walla Walla rivers. The trend for natural-origin spring chinook in the Umatilla River, however, does not show continued increases. Data specific to natural-origin fish in the Walla Walla were not available for this report.

In conclusion, some progress has been made in reintroducing extirpated salmon stocks, yet very limited headway has been made in the overall restoration of upriver salmon and lamprey populations, which would help fulfill treaty-reserved rights to take fish at all usual and accustomed fishing places.

Remaining Problems and Gaps

While acknowledging the many positive achievements made in recent decades, we also need to identify the actions recommended in the 1995 Spirit of the Salmon Plan that have yet to be fully implemented by the tribes, CRITFC, and the region.

The gaps and problems remaining from the 1995 Plan are summarized here and in the individual institutional and technical updates. Other problems and opportunities have emerged since 1995; they are summarized in New Challenges and Opportunities.

More than ever before, the institutions that manage anadromous fish in the Columbia Basin are using their authorities and structures to work constructively with tribes on the tasks of fish restoration. The three 2008 agreements, *U.S. v. Oregon* Management Agreement, Pacific Salmon Treaty, and Columbia Basin Fish Accords, represent the increasing acceptance and institutionalization of treaty rights and tribal sovereignty. As history indicates, however, recent successes cannot allow us to rest. All three agreements expire in 2017-18.

Significant institutional and technical changes are still necessary to achieve sustainable restoration of salmon, lamprey, and sturgeon. The 1.5 million salmon now returning to the Columbia River annually is short of the Spirit of the Salmon Plan's annual return goal of 4 million salmon and far short of the historical estimate of 16 million annually prior to non-Indian settlement. One of the many causes is certainly the persistent human degradation of the habitat where fish live.

The tribes pointed out habitat problems in 1995 that remain problems today: State standards and enforcement are not protecting riparian habitats. Consumptive water uses continue to expand, while

N'chi Wana—The Big River

instream flows remain inadequate. Damage to wetlands, upland and riparian soils, and riparian vegetation endures.

Water quality as well as water quantity problems persist. While water quality regulations were strengthened in Oregon and are likely to be in Washington and Idaho, little progress has been made to reduce the actual input of pollutants into the Columbia River watershed. Known sources of toxic pollutants are not yet prohibited.

Many habitat restoration actions have been opportunistic rather than systemically integrated actions that reconnect fragmented habitat and reestablish watershed-wide stream system integrity.

After three decades of focusing on fish habitat rehabilitation, baseline surveys of watershed and in-channel conditions must be coordinated and completed. These essential data will allow the effectiveness of habitat restoration activities to be gauged.

In addition to baseline surveys, the 1995 Spirit of the Salmon Plan called for monitoring and research information gathered by individual projects at the reach and watershed levels to also be aggregated to measure progress at larger spatial and temporal scales.

Fish management entities need to develop consistent data collection and monitoring across projects and agencies, which would allow them to move to more objective, quantitative measures when determining the effectiveness of restoration strategies and actions.

The 2008 *U.S. v. Oregon* Management Agreement and the Columbia Basin Fish Accords have proven to be useful vehicles for implementing the more auspicious, but sometimes contentious, fish restoration projects. Supplementation and reintroduction programs have helped bring back salmon production to upriver areas where water development and the taking of broodstock for lower river hatcheries caused huge salmon losses during the 20th century.

However, numerous other declining and extirpated populations identified in 1995 have yet to benefit from supplementation and reintroduction. Among the areas where the tribes are currently proposing salmon supplementation facilities are the Klickitat, South Fork Walla Walla, Yakima, and Wenatchee rivers. Among those at the top of the list for reintroductions are coho and sockeye in the Grande Ronde River basin and sockeye and summer/fall chinook in the Deschutes.

Reprogramming existing John Day mitigation production to upstream areas is moving forward, but, as of 2013, fish have yet to be released. This hatchery production will be partial compensation for The Dalles and John Day dams.

Our cultural teachings tell us we must honor and protect the resources on which we depend. The resources don't belong to us, we belong to the resources.

Johnson Meninick, Yakama

The original 1995 Spirit of the Salmon recommendations for Pacific lamprey stressed research and actions on dam passage. For the first time, the 2008 Accords secured a plan and funded actions at mainstem federal dams to improve lamprey migration. More improvements are still in the works, including research on artificial propagation strategies and lamprey migratory and dam passage behavior and survival.

To revive Pacific white sturgeon populations, the 1995 Plan called for artificial propagation actions, including research. Now that the studies on white sturgeon are largely complete, the tribes and CRITFC need to accelerate their efforts if sturgeon production is to shift from planning to implementation.

While improvement has occurred since 1995, both harvest and hatchery provisions of the 2008-2017 *U.S. v. Oregon* Management Agreement fall short of meeting tribal needs for subsistence spring chinook. The fall fishery, tribal members' most significant commercial fishery, continues to be constrained by steelhead stocks listed under the Endangered Species Act (ESA).

The Pacific Salmon Treaty management process needs to find alternatives to the current aggregate abundance-based approach, which is not responsive enough to protect some weak stocks. The 1995 Plan called for stock-specific concerns to be addressed in harvest management consistently with both treaty rights and escapement objectives.

The tribes continue to work toward the 1980 Northwest Power Act's promise: management of fish and power on an equitable basis. The Spirit of the Salmon Plan called for a cooperative approach between tribes, fish agencies, and federal dam operators to move hydrosystem management in that direction. Cooperation is much more in play now than it was in 1995, and numerous measures described in the 1995 Plan, such as spill, transportation, turbine efficiency, and passage modifications, have improved fish survival.

The Spirit of the Salmon flow targets for federal dams were not achieved, however, and none of the Columbia or Snake River dams—John Day, Wanapum, Rocky Reach, Lower Granite, Little Goose, Lower Monumental, and Ice Harbor—were drawn down.

The cooperative approaches thought to be in place with nonfederal dam owners in 1995, have led to few tangible improvements in fish survival. Unfortunately, the public utility districts that own mid-Columbia River dams have reduced spill volumes over the past decade. Decreases in smolt-to-adult returns (SARs) have been observed for this region's salmon populations, as noted in recent Comparative Survival Studies (2012). This is in contrast to increased SARs and spill volumes in the Snake River. Reach survivals have also suffered at

these nonfederal projects, especially when compared to reach survivals in the Snake River. The National Marine Fisheries Service has not required mid-Columbia dam owners to meet the same level of project survival that are required at the federal hydroelectric projects set under the ESA.

Fish passage was not achieved at the three Hells Canyon dams on the upper Snake River as called for in 1995.

To fully realize the benefits of the 1995 Spirit of the Salmon Plan recommendations, the Update identifies various funding needs for tribal hatcheries, fisheries monitoring, harvest and production data integration, and toxics reduction to name a few. Many of the projects are necessary for ESA compliance, such as supplementation of Snake River fall chinook and habitat measures affecting B-run steelhead. The federal entities implementing fish mitigation activities in partnership with the tribes will be most effective when they provide durable funding.

New Challenges and Opportunities

Driven primarily by population growth and climate change, future pressures will challenge environments in new ways. We have already seen increases in the size and number of predacious arctic tern and cormorant colonies in the Columbia Basin. Rising air temperatures appear to be resulting in decreased snowfall and increased rainfall during the winter months, leading to shifts in the timing and quantity of runoff.

Climate change combined with increased demand for consumptive use of water from surface, shallow, and deep groundwater will adversely affect fish habitat. Particularly threatening would be the increased use of Columbia River water and tributary winter/spring flow to meet seasonal agricultural needs.

Water quality will also be affected by climate change, including additional sediment delivery from winter storms and higher summer water temperatures. Salmon and Pacific lamprey will be particularly susceptible to these changes to water quantity and quality because they rely on freshwater rivers and streams as spawning and rearing habitat and as migration corridors.

Warm water fish and invertebrates communities will tend to expand their range. The distribution of cold-water communities, including anadromous fishes, will tend to contract. An increased human population will use more water, land, and other natural resources, placing greater pressure on ecosystems.

The net result of these changes may often be to create new, hybrid communities and ecosystems that exhibit properties of both warm water and cold water systems. The challenge fish managers face will not be so much to restore former ecosystems; rather we will be challenged to manage these new hybrid systems in ways that sustain salmon production without triggering "threshold" changes that are hostile to coldwater species.

Our Future

Warm Springs children returning from sampling macro invertebrates on Shitike Creek during a science camp.

See the community development recommendation Workforce Development.

The rise of globalization—the movement of people, resources, and goods across continents and oceans—is contributing to a dangerous increase in aquatic and terrestrial invasive species. Without natural predators and with environmental shifts wrought by climate changes, invasive species such as zebra and quagga mussels are likely to affect the river system's food web and alter habitats. In the basin, changes in aquatic habitat and introduction of exotic species have already tipped the predator/prey balance to the point that active management is

required to control piscivorous predator populations to reduce salmon and lamprey losses.

In assessing climate impacts and developing adaptive responses, we will need to incorporate resilience concepts. In this context, resilience is the ability of socio-ecological systems to absorb disturbance, self-organize and adapt, a necessity for any lasting solutions. Resilience also incorporates the concept of "thresholds" that separate one system state from another. When a system crosses a threshold, returning it to its previous state is difficult if not impossible. For example, if climate change forces a subbasin across a threshold it may not be able to sustain salmon or lamprey in its new state. Such an analysis needs to be added to our restoration, monitoring, and evaluations in the near future. A new lifecycle analysis that incorporates these new ecological realities would be useful to inform managers about the range of options that might achieve recovery and other management goals.

On a more affirmative note, opportunities to restore fish passage are becoming ever more feasible. Recent developments in juvenile fish passage technology could potentially provide passage opportunities at dams such as Chief Joseph, Grand Coulee, Dworshak, and the Hells Canyon Complex.

Discussions between the United States and Canada over the renewal process and terms of the Columbia River Treaty represent a major opportunity to modernize the treaty to address ecosystem-based functions and climate change impacts, such as shifts in snow pack and precipitation distribution. Terms of the treaty's renewal could also include restoring fish passage at Chief Joseph and Grand Coulee dams, which would return more salmon to both countries. The Columbia River Treaty coordinates the river system's management and operation of hydroelectric production, reservoir storage, and flood control between the two countries.

Our elders always told us that we have to protect the natural resources for the seven generations to come. That is and has been our direction.

Jay Minthorn, Umatilla

As the regional population and economy grows, more pressure is likely to be placed on the river's hydroelectric resources. The *Tribal Energy Vision* recommends energy conservation and supply measures to address these demands.

Current discussions about hatchery management practices represent an opportunity for decision makers to endorse the dual purpose of tribal supplementation programs, which is to address the legal and socio-ecological requirements of both harvest and conservation.

Monitoring and data evaluation are needed to determine if mark selective fisheries are reducing the number of harvestable fish available to tribal fishers or having adverse impacts on natural-origin fish. Mark selective fisheries target adipose fin-clipped hatchery fish,

requiring fishers to release any natural-origin fish they catch. Federal and state fish agencies developed the current fin-clipping program over recent decades. Research is needed to analyze the program impact on the salmon destined for Columbia River treaty Indian fisheries.

The original 1995 Plan did not incorporate the social and economic needs of our tribal fishing community and culture. Our vision of restoration is a revitalized salmon culture and economy as well as recovered fish resources. Having always embraced a holistic approach, we now have the opportunity in this Update to offer recommendations that integrate the social and economic aspects of salmon restoration. The New Community Development Recommendations address these components.

The challenges for our tribal members who fish are often economic. Through higher prices paid for tribally caught fish, some tribal members now have increased income for boats, repairs, fuel, nets, and basic living expenses. They have been able to teach younger generations how to fish and the importance of fishing to tribal culture and communities. But for many the income generated is still not sufficient.

This Update identifies several opportunities the tribes have to help maintain and increase the value of tribally caught fish. Tribal FishCo LLC, a tribally owned company whose primary purpose is to operate the East White Salmon Fish Processing Facility, aims to access new markets for tribally caught salmon and salmon products. The intertribal company could potentially help open new markets for sturgeon. Fish plant operations, which to date have provided some limited tribal employment, are still in the formative stages.

Additional employment opportunities for our tribal members will be in fisheries management and the many related fields. The Update recommends a workforce development program to establish sustainable pathways for Native American students to successfully pursue careers in fisheries and natural resources.

Maintaining our traditional tribal fishing culture continues to demand our attention in new ways. Affordable housing along the Columbia River is an increasing problem for tribal fishing families. Most tribal housing along the river was destroyed to make way for Columbia River dams. This issue will call on the creative and cooperative leadership of the four tribal governments. Meeting tribal member housing needs along the river will help sustain the tribes' fishing way of life and take pressure off treaty access fishing sites, allowing the sites to return to their primary purpose of providing access for fishing and fishing-related activities.

Another challenge we are newly addressing in this Update is the need for public education and outreach. Each successive generation needs to know about the merits of salmon recovery and the linkage to job creation and ecosystem health. Local Columbia Basin communities will prosper as fish runs and our treaty fisheries are restored.

An informed and involved public can effect positive change and contribute significantly to fish protection and restoration. An informed public is also more likely to successfully address the future challenges of climate change, invasive species, toxic pollution, and other factors yet unknown.

These are some of the major challenges and opportunities that have emerged since 1995 when we wrote the Spirit of the Salmon Plan (or issues we did not address in the 1995 Plan). They are discussed in more detail in new institutional, technical, and community development recommendations and throughout the Update.

Institutional Recommendations

Restoration of Columbia Basin anadromous fish requires procedures that are authoritative, efficient, goal-oriented, and effectively resolve disputes. Where existing processes meet these standards, their most useful aspects should be retained. Where they fail, they should be modified, replaced, or eliminated. Wy-Kan-Ush-Mi Wa-Kish-Wit has 16 recommendations—11 original and 5 new recommendations— to improve the established institutions responsible for managing the restoration of anadromous fish in the Columbia Basin and structures used for managing fisheries.

The tribal recommendations for institutional change reflect the need to manage activities affecting anadromous fish in a manner that implements restoration and recovery through adaptive management, or "learning by doing." In general, these recommendations utilize existing structures but modify them to provide increased accountability for the parties with direct responsibilities for increasing survival and meaningful participation for the tribes whose very existence is dependent upon restoration and recovery.

What are Institutional Recommendations?

During the past 40 years, the region has established institutions to manage restoration of anadromous fish in the Columbia Basin as well as to manage fisheries. Using the authorities of their participating governments, these structures are intended to focus personnel and resources on the tasks of restoration in an efficient and effective manner.

This Plan proposes a series of biological and technical hypotheses that are designed to lessen human-caused mortality at all stages of the lifecycle of the species in question. The institutional recommendations are aimed at managing the implementation of the technical hypotheses, evaluating outcomes, and modifying the hypotheses to reflect knowledge obtained. A brief discussion of adaptive management and the hypotheses is at 301.

The first 11 Insitutional Recommendations were updated in 2013 and are listed, along with the new recommendations in the table at 50 along with new recommendations. Each updated

recommendation cosists of a summary of the problem or issue as of 2013 (Current Status); an evaluation of how the recommendation was affressed (Assessment); and what changes are currently proposed (New and Modified Actions). For each updated recommendation, a link to the original institutal recommendation is provided. The original recommendations are available at 302.

In each of the five new Institutional Recommendations, an institutional problem or challenge is summarize (Issue); recommendations to manage or resolve the issue are made (Actions Needed); and the expected result is identified (Desired Outcome).

Insitutional Recommendation 1

Existing Mechanisms

Modify the existing basinwide mechanisms of the Columbia River Fish Management Plan, the Columbia River Basin Fish and Wildlife Program, and orders of the Federal Energy Regulatory Commission (FERC), and the Endangered Species Act (ESA) to fully implement treaty rights to natural resources.

Online

The complete 1995 recommendation 518.

Current Status

A trio of 10-year agreements was signed in 2008 that culminated 40 years of a complex history. A new harvest agreement under the *U.S. v. Oregon* Columbia River Fish Management Plan, a newly negotiated Chinook Annex (Chapter 3) under the Pacific Salmon Treaty between the United States and Canada, and the historic Columbia Basin Fish Accords are each milestones in their own right, but together they are an important step in shaping salmon policy—one that institutionalizes, at the federal, state, and tribal levels, a coordinated system designed to protect and restore salmon, lamprey, and sturgeon throughout their lifecycles and all their habitats. In other words, together the three agreements institutionalize "gravel-to-gravel" management.

Assessment

The Accords agreement specifically recognized and supported the importance of the *U.S. v. Oregon* parties' commitments,

Columbia Basin Fish Accords (2008-2017)

The Accords were signed in May 2008 during a ceremony in the Columbia River Gorge near the site of the ancient She Who Watches *petroglyph. Oral tradition views the carving as a tribal chief who was turned to stone to allow her to watch over her people and the river forever. Photo: Angie Moore.*

The Columbia Basin Fish Accords were signed by the Umatilla, Warm Springs and Yakama tribes, the Columbia River Inter-Tribal Fish Commission, and the United States represented by the Bureau of Reclamation, the Army Corps of Engineers, and the Bonneville Power Administration. Stemming from nearly a decade of federal courts litigation, the Accords are a series of binding policy and legal agreements that represent a pivotal decision and milestone in the tribes' decades-long commitment to put fish back in the rivers and restore the watersheds where they live. Though the Nez Perce Tribe chose to not sign the Accords, the tribe continues to implement important fish and habitat projects in the Snake River Basin.

including the commitments of the National Marine Fisheries Service (NMFS) pursuant to the ESA.

State, federal, and tribal parties do not always coordinate their management actions in a manner that implements all legal responsibilities, including treaty and trust responsibilities. Unfortunately, issues are sometimes isolated to a single section or branch within a larger agency, where that section does not have the broader perspective of the agency as a whole. Often technical branches do not understand the government's trust obligations to the tribes or the tribes' treaty fishing rights. As a result, decisions are made on a single-species basis, ignoring broader ecosystem effects or important legal agreements such as treaty-reserved rights.

The 1995 recommended action regarding Existing Mechanisms remains relevant and applicable.

New and Modified Actions

- The Columbia River Basin Fish and Wildlife Program must continue to protect and enhance fish (and wildlife) as affected by the basin's hydroelectric system whether or not they are listed under the ESA.
- Make tribal public education and outreach efforts an integral part of fish and wildlife project implementation. See the Public Education and Outreach institutional recommendation.
- Include tribal perspectives in workshops and symposia on natural resource management.
- Expand the tribes' publication of research in peer-reviewed journals.
- Federal government agencies assist tribes in implementing culturally appropriate workforce training and development.
- Future agreements among state, federal, and tribal parties recognize the importance of gravel-to-gravel management and the interdependence of decisions affecting individual salmon life stages.

Also see in this Update, the Accords, Pacific Salmon Treaty, and *U.S. v. Oregon* Agreements and the Regulatory Coordination and Improvement institutional recommendation.

Institutional Recommendation 2

Columbia River Fish Management Plan

Plan and implement the fish production called for in the U.S. v. Oregon *Columbia River Fish Management Plan.*

Online

The complete 1995 recommendation 520.

Current Status

Since the mid-1990s, the parties to *U.S. v. Oregon* struggled to reach agreement production actions. In many years, litigation occurred and annual or interim agreements were only reached through court-ordered negotiation, settlement orders or rulings of the court. The parties to *U.S. v. Oregon* negotiated a successor agreement to the 1988 Columbia River Fish Management Plan, which extended from 1997 to 2008. After many years of negotiation, the 2008-2017 *U.S. v. Oregon* Management Agreement was concluded in May 2008. The 2008-2017 agreement is a stipulated court order in *U.S. v. Oregon* and will guide management decisions for mainstem Columbia Basin production programs until 2017, but will not be used to set precedent or prejudice future allocation or production actions.

Federal Courts

Pioneer Courthouse, Portland, Oregon, ca. 1877, about 20 years after the United States signed treaties with the Warm Springs, Yakama, Nez Perce, and Umatilla tribes. During the 20th century, federal courts heard and decided many fishing rights disputes. These days tribal, state, and federal fish managers are caring for Columbia River fisheries with fewer trips to the courthouse. Photo courtesy of GSA.

Assessment

The 2008-2017 *U.S. v. Oregon* Management Agreement contains the fundamental elements the tribes identified at the start of negotiations. Production programs crucial to treaty fisheries and tribal fishery programs will continue as part of the court-ordered agreement. The tribes have the opportunity to engage the states on regulatory issues under the auspices of a federal court. The parties formalized rebuilding commitments and agreed to performance measures. The agreement provides co-management structure and is enforceable in federal court.

The 2008 agreement expires by its terms in 2017. For the remaining period of the agreement, a key outcome is implementation of the

agreement's production programs (without too many additional processes).

New and Modified Actions

- Review escapement goals for each species.
- Review performance of allocation agreements and adjust as appropriate.
- Improve tribes' ability to meet their First Foods ceremonial needs for salmon, particularly for spring chinook, through appropriate production programs and non-Indian harvest regulations, as required by *U.S. v. Oregon* agreements.

Institutional Recommendation 3

Dispute Resolution

For public lands and water project management, implement a dispute resolution process similar to the Columbia River Fish Management Plan and Federal Energy Regulatory Commission (FERC) processes.

Online

The complete 1995 recommendation 521.

Current Status

The dispute resolution process in the current *U.S. v. Oregon* Columbia River Fish Management Agreement (see I. C. 6. Dispute Resolution Procedure in the agreement 1288) provides the tribes with recourse should the provisions of the court-ordered agreement not be met. Formal dispute resolution processes associated with agreements in the FERC process also provide the tribes a method to address disagreements. The existence of a dispute resolution mechanism makes parties evaluate their actions from a different perspective. Many land use and water use decisions are made at the state and local level and do not have formal dispute resolution processes that recognize the tribes as co-managers.

Assessment

The Umatilla, Warm Springs, and Yakama tribes negotiated the Columbia Basin Fish Accords as a settlement agreement with the operating agencies of the Federal Columbia River Power

The Tribes Prefer Cooperation to Other Forms of Conflict Resolution

Confederated Tribes of the Umatilla Indian Reservation Board of Trustees Chair Antone Minthorn and Umatilla County farmer Bud Schmidtgall.

The Nez Perce, Umatilla, Warm Springs, and Yakama tribes and the federal, state, and private entities involved in the management and protection of Columbia Basin fish, water, and habitat resources have found that resolving their differences outside formal dispute resolution processes is usually more productive. Read other stories of cooperative efforts and negotiated agreements at 917.

System (FCRPS). A dispute resolution mechanism is included as part of the settlement agreement (see IV. F. Dispute Resolution), which provides opportunity for greater tribal input in the operation of the FCRPS. Formal dispute resolution mechanisms for federal, state, and local land use decisions have not been developed. Tribes have entered collaborative processes with local entities to protect tribal interests. A good example is the Umatilla tribe working with local landowners to retain instream flows for fish, while providing alternative sources for irrigation water. Another is a collaborative process between tribal, federal, and state interests employed to raise the Oregon water quality standards based on tribal fish consumption. Although formal dispute resolution processes provide good recourse to protect tribal interests, a well-designed collaborative process can also produce positive results that protect tribal interests.

New and Modified Actions

- Encourage the use of collaborative processes in fish restoration and protection efforts, as appropriate.
- Continue to develop timely dispute resolution processes, similar to those in the Columbia Basin Accords and the *U.S. v. Oregon* Management Agreements, in any new agreements or entities as means of supporting the restoration of the tribes' fish resources.
- Implement timely dispute resolution processes in land and water use decisions as a means to support the restoration of the tribes' fish resources, as recommended in the 1995 Spirit of the Salmon Plan.

Institutional Recommendation 4

Fish and Wildlife Program Funding

Establish a new state and tribal fish and wildlife entity using Bonneville Power Administration (BPA) funding.

Current Status

The mechanisms for funding fish and wildlife mitigation in the Columbia River Basin evolved significantly since the Spirit of the Salmon Plan was drafted in 1995. Since then:

- Congress passed legislation mandating creation of an Independent Scientific Review Panel to appraise fish and wildlife expenditures under the Pacific Northwest Electric Power Planning and Conservation Act (Northwest Power Act), which authorized the development of a fish and wildlife program.
- The Northwest Power and Conservation Council (NPCC), National Marine Fisheries Service (NMFS), and Columbia Basin tribes entered into a Memorandum of Understanding guiding the operations and their mutual oversight of an Independent Science Advisory Board. (The Columbia River Basin Fish and Wildlife Program is developed under the auspices of NPCC, while Endangered Species Act recovery is administered by NMFS.)
- The federal courts clarified BPA's obligations to adopt rates sufficient to fund implementation of the Fish and Wildlife Program adopted by the Northwest Power and Conservation Council and to act consistently with the program in its funding decisions.
- BPA adopted Cost Recovery Adjustment Clauses in its rate proceedings to guarantee that ratepayer funding would be available to implement its legal responsibilities and commitments.
- A number of tribal, federal, and state parties adopted the Columbia Basin Fish Accords agreements setting forth 10-year project funding commitments to implement the Northwest Power Act, Endangered Species Act, and other legal requirements.

Online

The complete 1995 recommendation 522.

Columbia Basin Fish Accords

Fidelia Andy, Columbia River Inter-Tribal Fish Commission Chairwoman, signs the Columbia Basin Fish Accords.

Federal, state, and tribal parties signed the Accords—funding commitments to implement the Northwest Power Act, the Endangered Species Act, and other legal requirements—in May 2008 during a ceremony along the Columbia River.

Assessment

As part of the 2008 Columbia Basin Fish Accords, BPA and the tribes are still seeking improved certainty and stability regarding BPA commitments to implement fish and wildlife mitigation activities in partnership with the tribes, including additional and expanded actions to further address the needs of ESA-listed anadromous fish. The Accords brought significant certainty to the entities that entered into these agreements. However, BPA made several incorrect assumptions in developing its FY 2012 and FY 2013 fish and wildlife budgets. As a result, BPA has asked a number of regional parties to reduce fish and wildlife expenditures not secured by Accords commitments, threatening project implementation.

It's a very small thing to ask for our people to have fish for future generations.

Rebecca Miles, Nez Perce

While the tribes welcome scientific review, repeated review of long-established projects or programs with proven track records that are mandated by legal agreements and federal mitigation obligations has reached the point of diminishing returns. Furthermore, since the vast majority of production programs under the Northwest Power Act are tribal programs, and since the scientific review of these programs largely focuses on conservation concerns, these reviews may be inconsistent with the five conservation principles established in *U.S. v. Oregon*. (For the conservation principles, see the final paragraph of Sovereignty and Consultation).

New and Modified Actions

- The entities mentioned above must continue to work closely together to coordinate their funding and project implementation responsibilities.
- Fish (and wildlife) resources should not bear the burden of government entities' limitations to forecast funding needs or to make commitments to provide those funds in a durable manner.
- The region must continue to plan for and implement its commitments to non-listed fish (and wildlife) species.
- Scientific review of projects must be holistic in nature and not unfairly focus on tribal production programs.
- Scientific review of long-established, mandated programs must be restructured as partnerships that lead to more successful programs.

Institutional Recommendation 5

Watersheds

Support ongoing and implement new subbasin planning through a Columbia Basin watershed program.

Online

The complete 1995 recommendation 523.

Current Status

In the Columbia River Basin, more emphasis has been placed over the last decade on implementing a watershed/landscape approach towards natural resource management. This has resulted in collaborative decision-making processes by virtually all stakeholders in each subbasin. In many subbasins, tribes are taking the lead. Many funding opportunities now require evidence that a landscape approach has been implemented and projects prioritized. As the number and complexity of watershed-related activities continues to increase, meaningful engagement and partnerships with the tribes become mandatory.

Assessment

In 2000 the Northwest Power and Conservation Council (NPCC) adopted a new Columbia River Basin Fish and Wildlife Program that established goals and objectives for all the basin's fish and wildlife populations. The program also required subbasin plans for all tributaries and sections of the main Columbia and Snake rivers (in the United States) be locally developed. Each subbasin plan included information on all the existing fish and wildlife programs, activities, and

Grande Ronde Restoration

Grande Ronde River. Photo courtesy U.S. Forest Service.

The Grande Ronde Model Watershed operates throughout the Grande Ronde Basin implementing projects on salmon-bearing streams and watersheds funded by BPA and Oregon Watershed Enhancement Board. Multiple entities, including the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and the Nez Perce Tribe, are engaged in the basin's restoration. The Grande Ronde Basin is located in northeastern Oregon and southeastern Washington.

CTUIR has revitalized significant tributary and mainstem segments, including McCoy Creek, Rock Creek, and the upper Grande Ronde, where the tribe and the U.S. Forest Service removed mine tailings above Clear Creek. The dredge spoils piled in the streamside zone were leveled to allow the river to migrate and overspill its banks in floods. The Forest Service added woody debris to the mainstem in 2011 and 2102, continuing work begun two decades ago. The result: showpiece restoration sites.

management plans (Inventory); a biological analysis of the potential for fish and wildlife survival improvement (Assessment); and a plan with a vision, biological objectives to measure and quantify fish and wildlife populations and environmental conditions, strategies needed to achieve the biological objectives, and a research, monitoring, and evaluation plan for the actions and results (Management Plan) 30.

By 2005, 58 subbasin plans were developed collaboratively by state and federal fish and wildlife agencies, tribes, local planning groups, fish recovery boards, and Canadian entities where the plans addressed transboundary rivers. Historical, current, and future fish and wildlife recovery actions needed in each subbasin were documented.

The subbasin plans were adopted as new amendments to the Fish and Wildlife Program. Subbasin plans, which will be updated every 10-15 years, integrate strategies and projects funded (not just by Bonneville Power Administration) so that each plan serves the NPCC's purposes under the Northwest Power Act and also accounts for Endangered Species Act and Clean Water Act requirements and other laws governing natural resource management as much as possible. The 23 subbasins of direct concern to the four tribes can be viewed at 30.

The NPCC and the Bonneville Power Administration (BPA) now use the subbasin plans as one of the sources that guide implementation of projects funded under the Columbia River Basin Fish and Wildlife Program, which directs more than $140 million per year of BPA electricity revenues to protect, mitigate, and enhance fish and wildlife affected by hydropower dams.

Is Watershed Degradation Outpacing Restoration?

At a national level, the Clean Water Act resulted in improvement in water quality after its inception, but the nation's rivers have been trending toward increased degradation in recent years (Palmer and Allan 2006). Freshwater fish taxa nationwide have also become increasingly imperiled (Jelks et al. 2008), with habitat degradation and invasive species as the principal cause.

Given that restoration efforts nationwide are extensive (Palmer and Allan 2006), these national assessments are likely indicative of the kinds of continuing threats to restoration progress experienced in the Columbia River Basin.

Within the Columbia Basin, large expanses of land bordering the mainstem Columbia, Snake, and Willamette rivers were rated as having a very high risk of habitat degradation given the human uses present (National Fish Habitat Board 2010). In the western mountain region of Oregon, Washington, and Idaho, about 68% of streams are rated as having fair to poor conditions related to riparian disturbance (EPA 2013). Because the rating methodology used did not highlight non-point sources, it is likely that the threat is worse than portrayed: Non-point-source impacts to aquatic habitats are the current major source of impairment in the Columbia Basin and the legal ability to control them is poor and essentially voluntary.

Because of the inadequacy of national and regional habitat condition trend databases, it is difficult to make assessments of the ability to achieve a net improvement in habitat condition (Bernhardt et al. 2007).

Monitoring now being done in the Columbia Basin is attempting to apply advanced statistical procedures and robust habitat and fish monitoring protocols to establish trends in aquatic habitat condition. In the future, these monitoring data may tell us if we are indeed making the headway needed to restore the watershed habitat that fish and people alike depend on.

Also see the technical recommendation Climate Change.

In 2008 the Umatilla, Warm Springs, and Yakama tribes and CRITFC signed the Columbia Basin Fish Accords with the BPA, the U.S. Army Corps of Engineers, and the Bureau of Reclamation. This agreement guarantees the availability of $600 million for salmon restoration projects throughout the Columbia Basin through 2018. In return, the tribes agreed to not litigate for additional fish passage at the dams or the breaching of Snake River dams during this time period. Although the Nez Perce Tribe did not sign these agreements, the tribe continues to get BPA funding for priority projects.

Another key tribal salmon recovery funding source for watershed projects is the Pacific Coastal Salmon Recovery Fund administered by National Marine Fisheries Service. Since 2000 the CRITFC tribes and CRITFC itself have completed 248 projects and currently have 43 ongoing ones in the basin under the Pacific Coastal Salmon Recovery Fund, having received a total of $24.7 million through a competitive process.

Recent findings indicate watershed restoration can revitalize local communities where the work occurs (Ecotrust 2012). For example, every $1 million invested in restoration by the Oregon Watershed Enhancement Board supports 16 full-time equivalent jobs, along with $589,000 in wages and $2.3 million in overall economic activity. The study was not specifically focused on tribes.

New and Modified Actions

Continued government-to-government relationships with the tribes are crucial for overall subbasin planning efforts and implementation. The tribes can assist in prioritizing future projects that fulfill each subbasin's conservation and research goals, along with leveraging limited funding resources. Specific recommended actions include the following:

- In the next NPCC amendment process, the tribes should be the lead entity in the updating and implementation of the subbasin plans that encompass the ceded territories.
- Promote tribal success stories and advocate for continued funding under the Columbia River Basin Fish and Wildlife Program, the Pacific Coastal Salmon Recovery Fund, and other sources.
- Continue or realize tribal participation in community-based watershed councils to coordinate and implement watershed restoration actions. Organize community-based watershed councils where appropriate.
- Explore the economic—as well as cultural—benefits of watershed restoration to the tribes.

- Promote all agency efforts to conduct habitat restoration projects and seek means to encourage private entities to participate in these efforts on private land.
- Promote public education on the merits of salmon habitat recovery and the linkage to job creation and on the benefits from ecosystem health.
- Promote programs that provide incentives for private landowners to create or improve riparian zones and keep streamside areas free of continuing impacts from agricultural activities, grazing, mining, and unnecessary human disturbance that reduce vegetation recovery. See Oregon DEQ (2007), Wu (2008), Abdalla (2008).
- Strengthen regulatory mechanisms that would hold industry and governments accountable for land use practices detrimental to fish. For example, two related cases are currently in the Supreme Court regarding whether runoff from logging roads can be regulated under the Clean Water Act (*Decker v. Northwest Environmental Defense Center*, No. 11-338, and *Georgia-Pacific West v. Northwest Environmental Defense Center*, No. 11-347).

Also see technical recommendation Watershed Restoration.

Institutional Recommendation 6

Evolutionarily Significant Unit (ESU)

Reconsider the ESU interim policy on the use of propagation.

Online

The complete 1995 recommendation 524.

Current Status

The application of the Endangered Species Act (ESA) to salmon management was a nascent issue in 1995, and many of its ramifications were in dispute or not fully developed. The recommendation to "reconsider the ESU interim policy on the use of propagation" in the original Spirit of the Salmon Plan does not address the multifaceted issue of ESA implementation that has materialized since then. See a discussion of ESA issues in the technical recommendation ESA Delisting.

Online

The complete 1995 recommendation 525.

Institutional Recommendation 7

Tribal Hatchery Management

Transfer certain federally funded hatcheries to tribal control.

Current Status

Hatchery programs produce fish for a number of purposes: harvest augmentation, supplementation, conservation/recovery, and fish reintroduction. In 1995 when the initial the Spirit of the Salmon Plan was published, all hatcheries in the Columbia Basin were managed by state or federal agencies, with the four tribes having little or no influence on decisions regarding program operations. While the situation has not changed for the hatchery programs operated below Bonneville Dam, of the 42 hatcheries that produce anadromous fish in the interior basin, the tribes are now primary managers of 6 of them (Table 1), and 2 other hatcheries operate with a combination of tribal and federal management staff (Table 2). The remaining 34 hatcheries continue to be operated by state or federal agencies, although operational plans (broodstock management and production and release methodologies) for each facility are developed with significant input from the tribes (Table 3). For details, see Appendix C 2008-2017 *U.S. v. Oregon* Management Agreement Production Tables, revised May 31, 2012 1278.

Table 1. Tribally Managed Fish Hatcheries.

Fish Hatchery	Subbasin	Management Agency
Parkdale	Hood R	Warm Springs Tribe
Levi George (Cle Elum)	Yakima R	Yakama Nation
Prosser	Yakima R	Yakama Nation
Klickitat	Klickitat R	Yakama Nation
Nez Perce Tribal	Clearwater R	Nez Perce Tribe
Kooskia†	Clearwater R	Nez Perce Tribe

†National Fish Hatchery

Note: The Chief Joseph Hatchery (Columbia River mainstem) was recently completed and is operated by the Confederated Tribes of the Colville Reservation. The Crystal Springs Hatchery to be operated by the Shoshone-Bannock Tribes for supplementation of the upper Salmon River is currently under construction.

Table 2. Shared Management Hatcheries.

Fish Hatchery	Subbasin	Management Agency
Warm Springs†	Deschutes R	Warm Springs & USFWS
Dworshak†	Clearwater R	Nez Perce & USFWS

†National Fish Hatchery

Table 3: Hatcheries with Tribal Advisory Input.

Fish Hatchery	Subbasin	Mgmnt Agency
Eagle Creek†	Clackamas R	USFWS
Carson†	Wind R	USFWS
Willard†	Little White Salmon R	USFWS
Little White Salmon†	Deschutes R	USFWS
Spring Creek†	Columbia mainstem	USFWS
Leavenworth†	Yakima R	USFWS
Entiat†	Entiat R	USFWS
Winthrop†	Methow R	USFWS
Hagerman†	Snake R mainstem	USFWS
Bonneville	Columbia mainstem	ODFW
Cascade	Columbia mainstem	ODFW
Irrigon	Columbia mainstem	ODFW
Oxbow	Columbia mainstem	ODFW
Umatilla	Columbia mainstem	ODFW
Oak Springs	Deschutes R	ODFW
Round Butte	Deschutes R	ODFW
Wallowa	Grande Ronde	ODFW
Lookingglass	Grande Ronde R	ODFW
Skamania	Washougal R	WDFW
Washougal	Washougal R	WDFW
Priest Rapids	Columbia mainstem	WDFW
Ringold	Columbia mainstem	WDFW
Eastbank	Columbia mainstem	WDFW
Wells	Columbia mainstem	WDFW
Methow	Methow R	WDFW
Lyons Ferry	Columbia mainstem	WDFW
Tucannon	Tucannon R	WDFW
Clearwater	Clearwater R	IDFG
Rapid River	Salmon R	IDFG
Pahsimeroi	Salmon R	IDFG
Sawtooth	Salmon R	IDFG
McCall	Payette R	IDFG

Walla Walla Hatchery

Unloading juvenile spring chinook at the Umatilla Hatchery Satellite Facilities. The Umatilla tribe plans to add capacity for Walla Walla fish production to the existing facilities at its Umatilla Hatchery Satellite.

The Umatilla tribe is moving ahead with spring chinook hatchery facilities for the Walla Walla River basin. After more than two decades of planning and seeking authorization, the Umatilla tribe won approval in December 2013 from the Northwest Power and Conservation Council.

Habitat alterations and stream dewatering related to agricultural practices extirpated spring chinook in the Walla Walla Basin about 75 years ago. Construction and operation of the Columbia River hydrosystem changed migratory conditions for fish in the mainstem, also contributing to the demise of Walla Walla spring chinook.

Over the past 20 years, the tribe and irrigated agriculture made agreements to leave water in the river for fish and provide water for crops.

—continued on next page—

Fish Hatchery	Subbasin	Mgmnt Agency
Oxbow FH	Snake R mainstem	IDFG
Magic Valley FH	Snake R mainstem	IDFG
Niagara Springs FH	Snake R mainstem	IDFG

†National Fish Hatchery

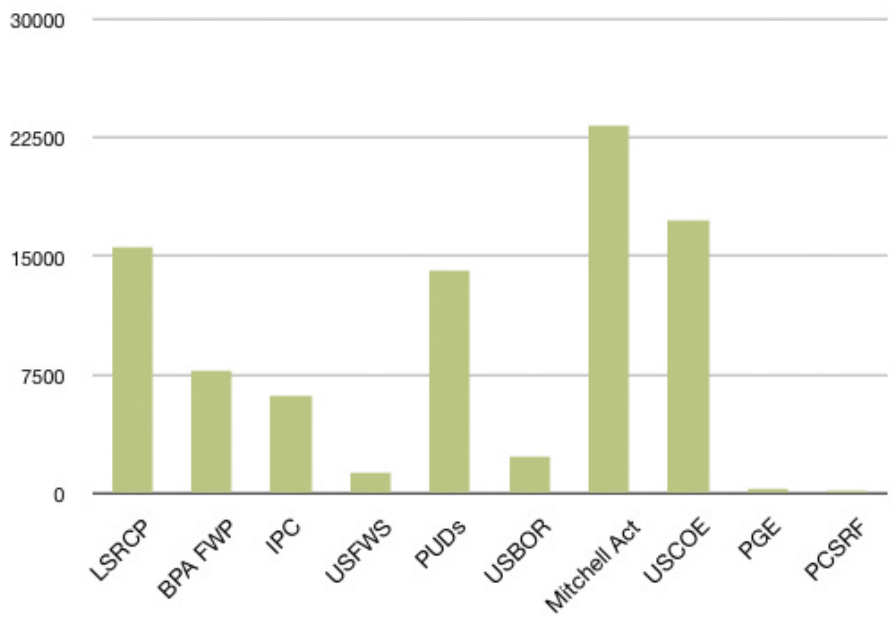
Note: The Springfield FH to be operated by IDFG to supplement the Red Fish Lake sockeye population is currently under construction.

Mitchell Act funding is responsible for approximately one-third of the fish produced in hatcheries for release above Bonneville Dam (see graph on next page). However, funding for the Act has remained stagnant, compromising production levels and operation and maintenance needs. The U.S. Army Corps of Engineers and various hydroelectric power companies are responsible for the bulk of the remainder. The Army Corps of Engineers is planning to meet John Day Mitigation Project obligations, including construction of new facilities. The 2008 Columbia Basin Fish Accords included a tribal project to reprogram existing John Day mitigation production to upstream areas. New tribal hatcheries have also been proposed to support tribal coho reintroduction programs in the Yakima and Wenatchee rivers; spring chinook supplementation programs in the Walla Walla, Grande Ronde, and Imnaha rivers; and coho and fall chinook mitigation programs in the Klickitat River. The tribes await funding for these facilities.

Walla Walla Hatchery (continued)

The tribe's long-term goal for the Walla Walla River is to have both Indian and non-Indian harvests and natural spawning spring chinook. Since 1997 the tribe has been leading way to those goals: Passage improvements include removing two decommissioned diversion structures, constructing and improving juvenile screen and bypass facilities and fish ladders. Numerous habitat restoration projects have also been completed in the basin.

With subsequent approvals, construction will begin in late 2014, the first fish will be released in 2017, and the first adult fish will return in the spring of 2019. The new facilities will produce 500,000 spring chinook smolts annually for release into the Walla Walla River Basin—400,000 into the South Fork and 100,000 into the Touchet River.



Production (in millions) of salmon and steelhead juveniles for stocking above Bonneville Dam by funding agency. See Glossary for acronyms. Source: Appendix C. 2008-2017 *U.S. v. Oregon* Management Agreement Production Tables, revised May 31, 2012.

Assessment

Appropriate management of hatchery production is a key component to realizing conservation and mitigation objectives, including sustainable tribal harvest. While debate continues on the role of hatchery production in the future sustainability of fish runs, judicious integration of hatchery and naturally spawning populations remains an integral part of the tribal approach to restoring fish runs. Direct tribal management of facilities provides greater opportunity to achieve this integration consistent with the overall vision of restoration.

New or Modified Actions

- Identify additional hatchery facilities to transfer to the tribes.
- Ensure adequate funding for existing hatchery programs operated consistent with tribal vision.
- Secure funding for construction and operation of the new tribal hatcheries that have been proposed.
- Develop regional strategy to increase Mitchell Act funding.
- Work with U.S.Army Corps of Engineers to ensure appropriate implementation of the John Day Mitigation Project.
- Complete John Day mitigation reprogramming.

Online

The complete 1995 recommendation 526.

Institutional Recommendation 8

Research, Monitoring, and Evaluation

State, tribal, and federal agencies coordinate and set priorities for research, monitoring, and evaluation programs.

Current Status

In times of shrinking funding, it is even more important that managers show accountability for the expenditure of public money. Until fisheries managers can determine whether the changes from specific restoration strategies and actions are positive or negative, and by how much, fish agencies and tribes cannot realistically claim that our actions are effective. In part, this requires that research and monitoring information gathered at the reach and watershed scales by individual projects must also be aggregated to measure progress at larger spatial and temporal scales. Typically, managers must address change at the following larger scales.

Spatial scales:

- Populations (across reaches and, sometimes, watersheds)
- Evolutionarily Significant Units (ESUs) (for multiple populations and meta-populations)
- Basinwide (to address larger questions of mitigation for total hydropower caused losses)

Temporal scales:

- Brood years (to measure productivity and abundance)
- Long-term trends (to measure sustainability of progress)

Addressing management needs at these larger spatial and temporal scales will require two fundamental changes in the way research and monitoring is typically conducted today. First, managers will have to develop more consistency of monitoring across projects and agencies to allow data from multiple sources to be aggregated at the appropriate scales. Second, the present practice of using expert panels and professional judgment to evaluate change subjectively and qualitatively will have to give way to quantitative baselines against which change can be measured in objective and quantitative terms.

Because the level of natural variation in habitat conditions and salmon populations is high, both over time and between areas, it is difficult to distinguish change due to restoration actions from change due to natural variability in these ecosystems. No single agency has the resources required to make this determination alone.

The fastest way to use available research and monitoring resources more effectively is to increase the coordination of efforts between member tribes and with other agencies. Rather than pursuing a number of separate research and monitoring programs, managers should cooperate in fewer, but better designed and coordinated programs. Coordination should include the design of research and monitoring programs, the areas to be monitored, the way data are collected and analyzed, and consistent reporting on the status and trends of both habitat condition and the response of fish populations.

Fortunately, there is general recognition of this problem and efforts to address it at several levels are proceeding. Our member tribes are each developing more consistency in sampling and data analysis within their ceded areas. Research and monitoring results are regularly shared with other managers and stakeholders during workshops and conferences. Tribal scientists regularly publish articles in peer-reviewed professional journals and conferences. Each tribe also hosts local science workshops and conferences (e.g., Yakima/Klickitat Fisheries Project Science Review, Future of Our Salmon) to explore local issues in more depth.

Hagerman Genetics Lab

Lab Director Shawn Narum showing one of the newest pieces of lab equipment. This machine can automatically evaluate nearly 800 samples of genetic material per load.

CRITFC's genetics program began in 1999 after member tribes began seeing the role of genetics in fisheries research and management increase. It was in 1999 that CRITFC and the University of Idaho entered into an agreement that established a working relationship and collaborative research program for the research and training in production, supplementation, and the life history and recovery of salmon, steelhead, and native fishes of the Columbia Basin. Also out of this partnership was born a state-of-the-art genetics lab built with funds from the University of Idaho and CRITFC.

The Pacific Northwest Aquatic Monitoring Partnership (PNAMP) is sponsoring similar discussions and development of tools to

accomplish much the same thing among resource managers at the regional level.

Assessment

More effective monitoring efforts will support better decisions about allocation of limited restoration resources and, potentially, faster rebuilding of salmon populations. As more salmon populations increase in numbers and become self-sustaining, fishing regulations can be liberalized and catches will increase. This will also support more tribal fisheries in usual and accustomed fishing locations.

The growing awareness by resource managers that the monitoring and reporting of restoration successes and failures can best be addressed by coordinated action provides substantial opportunities to do a better job collectively than could be achieved by individual actions.

Habitat Effectiveness Monitoring

Umatilla tribal technicians conducting habitat effectiveness monitoring on Meacham Creek, a Umatilla River tributary, where the tribe recently completed extensive restoration.

There are three major problems with achieving a well coordinated monitoring and reporting effort in the Columbia Basin. First, the technical issues are complex; thus it will take some time to address and implement effective coordinated actions. Second, an appropriate forum and infrastructure to support inter-agency discussions and projects must be maintained. The PNAMP project may be an appropriate forum to address this need. Finally, a regular and effective dialog between researchers and managers is needed to incorporate the results of research and monitoring into management and restoration decisions.

A coordinated monitoring program that can effectively detect change in the conditions of freshwater ecosystems and salmon populations will be a keystone for improving salmon restoration efforts in the future. Present tribal and regional discussions on these efforts are converging and providing noticeable progress. The discussions should continue and provide a basis for improved research, monitoring, and data-sharing actions. The information generated from these efforts should be used to guide restoration actions in an adaptive manner until the objectives of this Plan are achieved.

New or Modified Actions

- Continue collaborative efforts, such as the Anadromous Salmonid Monitoring Strategy, to improve the coordination of research, monitoring, and data-sharing efforts.
- Build tribal capacity to implement regional best research, monitoring, and data management procedures.
- Replace the use of expert panels and professional opinion to evaluate restoration by establishing quantitative baselines against which to measure the rate and amount of progress in restoring anadromous fish populations.
- Increase collaborative efforts to analyze and interpret research and monitoring data within a lifecycle context.
- Continue present series of tribal-sponsored science conferences. Develop additional methods to effectively communicate research and monitoring results to managers and stakeholders.

Habitat Status and Trend Monitoring

CRITFC is currently conducting a long-term habitat status and trends monitoring project in the upper Grande Ronde River and Catherine Creek using Columbia Habitat Monitoring Program (CHaMP 2012) protocol. These watersheds support two populations considered to be currently non-viable, but essential to the future restoration of the Grande Ronde major population group (MPG). This monitoring effort represents an assessment of the rate of recovery occurring due to aggregate (combined) restoration actions that have been or are being taken. Restoration is being assessed using a spatially balanced GRTS sampling design supported by National Marine Fisheries Service, Bonneville Power Administration, and the Independent Scientific Review Panel.

Monitoring efforts in the upper Grande Ronde and other Columbia Habitat Monitoring Program sites will serve as a model for future monitoring. This effort will act as a prototype for effective analysis of habitat conditions and trends that are highly linked to fish survival and abundance, demonstration of linkages between habitat condition and biotic response (fish, macroinvertebrates), and ability to model population trends associated with trends in habitat condition. This program is also a model for streamlining collection, management, quality assurance, and analysis of large habitat data sets.

Online

The complete 1995 recommendation 526.

Institutional Recommendation 9

Coordinated Information Management

Make research and monitoring data available through a coordinated information system.

Current Status

An information system was part of the Research, Monitoring and Evaluation section of the original 1995 Plan. The Plan called for the continuation and expansion of the project then referred to as the Coordinated Information System. The project has continued; and the data management goals described in 1995 are now much closer to realization. Today a very open and collaborative approach is improving data management and sharing among agencies.

At this time, however, the tribes do not receive any funding from the StreamNet project for data management or data sharing. To address this need, the Tribal Data Network (TDN) project began under the Columbia Basin Fish Accords agreement. The project is being expanded to provide partial support for staff positions at each tribe in addition to the original intent of delivering high-level database and data system design and application development.

The primary goal of the TDN project, funded by the Accords, is to assist CRITFC member tribes with monitoring data management by building tools and capacity within each tribe. The TDN has built infrastructure and initiated pilot programs, which implement tools and develop capacity for monitoring data management within member tribes.

The TND project plans to expand these pilot programs across all four-member tribes as opportunities arise. Currently the project is developing new pilot programs and is adapting the juvenile migrant data exchange system developed by the Northwest Indian Fisheries Commission for use in the Columbia Basin.

Despite encouraging progress to date, only limited and inadequate support for basic tribal data management capacity exists. Unlike state agencies, the tribes have not received regular annual funding under the StreamNet project. Only temporary funding has been obtained to

partially meet tribal Tier 1 data management needs identified under the Coordinated Assessment project.

Near-term priorities for the project are to assist the tribes in developing better data management tools for juvenile and adult abundance, improved harvest estimates, and improved PIT- and coded-wire tag data.

Long-term priorities for the project are seeking additional funding to build capacity within member tribes through development of data management tools, provision of one-time infrastructure purchases, acquisition of data processing expertise and coordination, and funding assistance for staff positions with each of the four tribes.

Assessment

Good progress is being made and present plans should be continued.

New and Modified Actions

- Seek full support to implement tribal data management programs and strategies.
- Continue to develop and implement improved data management practices in coordination with other regional natural resource managers.

Data Collection and Management

CRITFC fish technician Donette Miranda sampling a salmon at Bonneville Dam. CRITFC samples sockeye, chinook, and steelhead at Bonneville, Wells, and Tumwater dams for biological, age, and migration data. Making such information useful depends on our ability to manage this growing database and others.

Online

The complete 1995 recommendation 528.

Institutional Recommendation 10

Harvest Management

Update provisions of the Pacific Salmon Treaty and the Columbia River Fish Management Plan based on the latest survival rate and catch level information.

Current Status

The two harvest management processes affecting Columbia River treaty Indian fisheries occur under the *U.S. v. Oregon* Columbia River Management Plans and the Pacific Salmon Treaty between the governments of Canada and the United States.

United States v. Oregon

Since the mid-1990s, the parties to *U.S. v. Oregon* struggled to reach agreement on fisheries and production actions. In many years, litigation occurred and annual or interim agreements were only reached through court-ordered negotiation, settlement orders, or court rulings. The parties to *U.S. v. Oregon* negotiated a successor agreement to the 1988 Columbia River Fish Management Plan from 1997-2008. After many years of negotiation, the 2008-2017 *U.S. v. Oregon* Management Agreement 1288 was concluded in May 2008. The 2008-2017 agreement is a stipulated court order in *U.S. v. Oregon* and will guide management decisions for mainstem Columbia River fisheries and Columbia Basin production programs until 2017 but will not be used to set precedent or prejudice future allocation or production actions.

Each tribe is responsible for planning, coordinating, and managing tributary fisheries on those fish species that return to areas within their respective treaty territories. Thus, some runs and stocks of fish are subjected to treaty harvest in the mainstem Columbia River and again in local tributary fisheries as fish are migrating to their rivers of origin to spawn. Other tributary fisheries are not covered under the current management agreement. Tributary fisheries in places like the Snake River Basin are managed consistent with tribal harvest plans and harvest management frameworks for salmon (including steelhead) in that basin.

Pacific Salmon Treaty

In May 2008, the Pacific Salmon Commission recommended a new bilateral agreement (in particular, see Chapter 3 of the updated treaty 1289) for the conservation and harvest sharing of Pacific salmon to the governments of Canada and the United States. The product of nearly 18 months of negotiations, the agreement represents a major step forward in science-based conservation and sustainable harvest sharing of the salmon resource between Canada and the United States. Approved in December 2008 by the respective governments, the new fishing regimes are in force from the beginning of 2009 through the end of 2018.

The new 2008 treaty agreement calls for reducing the catch off Southeast Alaska by 15% and Canada cutting its harvest off the West Coast by 30%. The changes send an estimated one million more chinook to Puget Sound and the Columbia River. Chinook are the target, but the 10-year agreement also covers coho, chum, pink, and sockeye salmon. The agreement's aim is to achieve one of the original goals of the treaty: halt the decline and rebuild chinook stocks coast-wide.

One of Our Young Fishers

Reggie Grace (Yakama) and a chinook salmon he harvested from the Columbia River.

We are fortunate to have a growing number of young tribal members. Many of them want to make salmon fishing part of their livelihood. One of the goals of the Spirit of the Salmon Plan is to reclaim anadromous fish resources for future generations. We must have our fish!

Assessment

United States v. Oregon

The 2008-2017 *U.S. v. Oregon* Management Agreement contains the fundamental elements the tribes identified at the start of the negotiations. Fishery opportunity is enhanced as compared to previous agreements; and treaty harvest will again be protected by federal court order.

Many of the harvest provisions of the 2008 agreement build on the harvest rate schedules as described in previous agreements (notably, the 2001 and 2005-2007 Interim Agreements), and for others the parties agreed to new abundance-based harvest rate schedules. The abundance-based harvest regime addresses conservation concerns and provides greater flexibility in shaping mainstem fisheries and enabling access to harvestable fish. Mainstem and certain tributary treaty fisheries are to be managed according to these harvest guidelines.

The 2008 agreement expires by its terms in 2017. For the remaining period of the agreement, key outcomes include: mainstem fisheries

that comport with its conservation and allocation commitments; adherence to framework commitments and procedures; implementation of the agreement's production programs; and development of regulatory coordination mechanisms that provide for tribal enforcement. Also see the updated Columbia River Fish Management Plan recommendation.

Pacific Salmon Treaty

Interception of Pacific salmon bound for rivers of one country in fisheries of the other has been the subject of discussion between the governments of Canada and the United States since the early part of the last century. In 1985, after many years of negotiation, the Pacific Salmon Treaty was signed, setting long-term goals for the benefit of the salmon and the two countries.

The treaty embodies the commitment made by Canada and the United States to carry out their salmon fisheries and enhancement programs to:

- Prevent over-fishing and provide for optimum production.
- Ensure that both countries receive benefits equal to the production of salmon originating in their waters.

In fulfilling these obligations, both countries agreed to take into account:

- The desirability in most cases of reducing interceptions.
- The desirability in most cases of avoiding undue disruption of existing fisheries.
- Annual variations in abundance of the stocks.

Since the Spirit of the Salmon Plan was released, significant revisions to the Pacific Salmon Treaty have been made: The arrangements and institutions established in 1985 proved effective in the early years of the salmon treaty but became outmoded after 1992, when the original fishing arrangements expired. From 1992 to 1998, the two countries were not able to reach agreement on comprehensive, coastwide fisheries arrangements. In 1999 government-to-government negotiations culminated in the successful renewal of long-term fishing arrangements under the Pacific Salmon Treaty.

Some of the key elements introduced with the 1999 agreement include the creation of the Transboundary Panel and the Committee on Scientific Cooperation; the inclusion of habitat provisions in the Treaty; a move from fisheries based on negotiated catch ceilings to abundance-based management fisheries; and the establishment of the Northern and Southern Restoration and Enhancement funds.

In December 2008, the governments of Canada and the United States approved the new fishing regimes, described above and in force from the beginning of 2009 through the end of 2018. The agreement represents a major step forward in science-based conservation and sustainable harvest sharing of the salmon resource between the two countries.

New and Modified Actions

United States v. Oregon

- Improve tribes' ability to meet their First Foods ceremonial needs for salmon and clean water.
- Continue to see that all tribal members have opportunities to fish for subsistence in the mainstem and tributaries.
- Gain full access for tribal fisheries to harvestable hatchery and wild fish.
- Appropriately allocate harvest among different (tribal and non-tribal) fisheries.
- Continue improving technical information and tools. See the updated Harvest Management (In-river) recommendation.
- Expand funding for harvest monitoring.

Pacific Salmon Treaty

- Integrate new technical results into harvest management decisions.
- Continue to implement abundance-based management provisions of the treaty for ocean fisheries and move away from aggregate abundance-based management.
- Address mark-selective fishing proposals of the United States and Canada. See the new technical recommendation Mark Selective Fisheries.
- Administer the enhancement funds established in the 1999 agreement to increase returns of naturally spawning chinook.
- Meet annually with Canadian First Nations.
- Implement recommendations from the performance review, as appropriate.
- Advocate for funding to implement fishing regimes and maintain information base.
- Review and implement recommendations of habitat technical committee, as appropriate.

Online

The complete 1995 recommendation 529.

Institutional Recommendation 11

Law Enforcement

Continue coordinated harvest enforcement and develop habitat protection enforcement.

Current Status

CRITFC Enforcement has commissions from all four member tribes, directing CRITFC officers to enforce tribal laws and regulations. The Bureau of Indian Affairs (BIA) assigned the responsibility for enforcing federal laws on in-lieu and treaty fishing access sites to CRITFC Enforcement in 2010. Officers also were trained by BIA and received Special Law Enforcement Commissions from BIA to enforce federal law, including its regulations for the fishing access sites. A new BIA 638 contract provides for two officers needed to handle increased demands.

CRITFC Enforcement maintains a 24-hour effort to enforce all fishing regulations and protect tribal fishing rights in a 150-mile stretch of the Columbia River from four miles below Bonneville Dam to McNary Dam (Zone 6). Officers also assist Indian fishers during times of need, protect archeological sites, protect tribal fishing sites from encroachment by non-Indians who come to use or even vandalize sites, and police the 31 tribal in-lieu and treaty fishing access sites along Zone 6 of the Columbia River.

All CRITFC officers serve as an extension of tribal law enforcement. The officers hold commissions from all four CRITFC member tribes, the BIA and are commissioned in Klickitat, Skamania, Wasco, Hood River, Umatilla, Sherman, and Gilliam counties. Under Oregon Senate Bill 412, CRITFC officers are commissioned to enforce Oregon laws.

Assessment

Columbia Basin fisheries law enforcement agencies become more effective in protecting the fishery resource by continuing to enforce harvest and conservation regulations of the entities in a coordinated manner. Under the authority of *U.S. v. Oregon* and other various federal, state, and tribal court rulings, the implementation of treaty fishing rights in the region requires recognition of the tribes' desire to maintain jurisdiction of treaty fishing activities by members of the four treaty tribes.

This includes other public safety concerns directly related to treaty fishing activities, such as law and order at all usual and accustomed areas, including the in-lieu and treaty fishing access sites. In addition to archaeological resource protection for culturally sensitive areas in the basin, law enforcement must also be diligent in monitoring and reporting any environmental and habitat law violations that threaten the basin's fishery resources.

New or Modified Action

Continue coordinated enforcement of harvest and conservation regulations as adopted by the federal, state, and tribal entities of the region. The coordinated effort to protect fishery resources will also include an enforcement response to violations of environmental, habitat, and archaeological laws.

Safety Training

CRITFC Enforcement officers Christine Tegner and Larry Risley practice life saving techniques during cold water survival training.

While the CRITFC enforcement team is at its core a resource protection division that enforces tribal regulations, thanks to its public safety work, the communities and sites along the river where the tribes have their Zone 6 fisheries are a safer place.

NEW
Recommendation

Institutional Recommendation 12

Public Education and Outreach

Develop public education and outreach strategies for each Spirit of the Salmon Plan recommendation or cluster of related recommendations.

Issue

The tribes and their staffs cannot implement the Spirit of the Salmon Plan alone. Other groups, institutions, and individuals need to be educated and persuaded to act. Increasing knowledge, influencing attitudes and motivating action requires the tribes and CRITFC to develop a robust communication strategy that extends current public education and outreach efforts.

Such a communication strategy needs to recognize the limited resources the tribes and CRITFC are able to allocate to public education and outreach. Using these resources wisely, developing partnerships, and training leadership and staff can expand organizational capacity to communicate strategically.

Public education and outreach products and activities are most effective when integrated into a communication strategy that defines upfront the purpose, the audience, and the messages most likely to translate information into action.

Crucially, a communication strategy identifies key actors—those who have a direct interest or assert power in matters affecting anadromous fish protection and restoration—and intermediaries who assist in reaching the key actors.

Strategic communication can provide the missing link between the Spirit of the Salmon recommendations and the socio-political processes of policy making and public and private participation that result in actions vital to the restoration of anadromous fish resources.

Knowing both what needs to be changed and how change might be brought about are powerful management tools embraced by the Spirit of the Salmon Plan.

Actions Needed

To help implement the Spirit of the Salmon Plan, develop public education and outreach strategies for each recommendation or cluster of related recommendations by taking the following actions:

- Define public education and outreach objectives, personnel and resources, key messages, target audiences, and means of communication.
- Train additional leaders and key staff to increase effectiveness in public education and outreach activities.
- Use available research and data on public and key actor awareness and perceptions; preferences regarding information sources; and other communication trends.
- Identify and work with key partners to undertake public education and outreach actions.
- Seek funding seek to implement public education and outreach strategies.
- Monitor and evaluate public education and outreach efforts.

Desired Outcome

The individuals, groups, and institutions that have an interest or assert power in matters affecting fish protection and restoration, including elected and government officials, landowners, and businesses, act in ways that are consistent with the protection and restoration of Columbia Basin anadromous fisheries and fish habitat. Present and future generations in the region and the nation are aware of and support the four Columbia River treaty tribes' initiatives as well as regional initiatives to rebuild these fisheries and the cultural and natural environments upon which they depend.

Learning by Doing

Salvaging fish in the John Day Basin.

Nearly 100 people representing landowners and 10 different agencies and organizations salvaged some 10,000 fish, including lamprey and freshwater mussels, before beginning a habitat restoration project in the John Day Basin's Granite Boulder Creek area. The Warm Springs tribe lead this effort.

For more information, contact the John Day Basin Office of the Confederated Tribes of Warm Springs Reservation of Oregon.

NEW Recommendation

Institutional Recommendation 13

Columbia River Treaty

Modernize the Columbia River Treaty to include ecosystem-based functions as a management obligation, an updated coordinated flood risk management plan, provisions that allow for adaptive management, particularly to implement goals and objectives for ecosystem-based functions and address the effects of climate change; restoration of fish passage throughout the basin, specifically at Chief Joseph and Grand Coulee dams and the Hells Canyon Complex; and enlargement of the U.S. Entity membership to include tribal representatives.

Issue

Canada and the United States signed the Columbia River Treaty in 1961 to develop and manage the international river system. The treaty came into force in September 1964. The treaty has no set end date, though either party can terminate the agreement beginning in September 2024 with at least a 10-year notice.

Under the treaty, the United States and Canada manage the river for optimized hydropower generation and coordinated flood risk management. Bilateral management of fish and other natural and cultural resources were not considered relevant or necessary under the treaty by either country. Columbia Basin tribes and First Nations were not consulted regarding the impact to their lands, resources, and cultures. Canada agreed to build three storage dams and coordinate the operation of these new storage facilities with the U.S. hydroelectric power supply system to optimize hydroelectric power production and to provide coordinated flood risk management. In exchange, Canada receives 50% of the additional power, or downstream benefits, generated in the United States as a result of the new Canadian storage. This is referred to as the Canadian Entitlement.

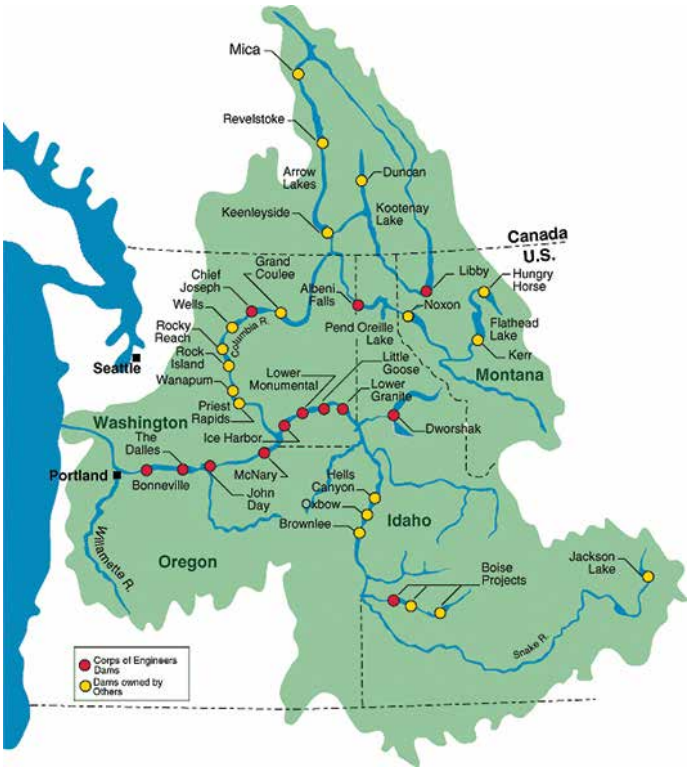
Canada sold the first 30 years of their share of the downstream benefits, or entitlement, to a U.S. consortium for almost $254 million. The United States now delivers an average of about 483 megawatts of power annually to Canada (estimated annualized capital cost of replacing this power with new generation plants is approximately $300 million). In addition, the United States paid Canada almost $65 million for the benefits of a coordinated flood-control operating plan. This

payment represented 50% of the estimated value of the flood loses averted in the United States through September 2024 as a result of this new storage. The United States was allowed to build Libby Dam in Montana, with each country keeping the downstream flood and power benefits realized within its boundaries.

After 2024 the United States loses the assured flood storage provided by Canada. Though the United States can still "call upon" Canada to provide flood storage when it is needed to prevent flooding in the United States, the United States must first put all of its system flood control reservoirs to full "effective use" for flood risk management purposes. The potential effect of this substantial change in flood risk management, coupled with poor forecasting capabilities for basin snowpack, is to drain U.S. reservoirs in anticipation of high run-offs. If these anticipated high run-offs do not materialize as the season progresses, the potential exists for the entire spring freshet to be captured to refill reservoirs for power production and to restore some ecosystem-based functions. The result would be substantially reduced river flows for outmigrating juvenile salmon.

In developing this coordinated river system operations approach under the treaty with Canada, the United States did not consult with the tribes nor consider the effect of this treaty on the tribes' treaties with the United States nor the effect on the tribes' cultural and natural resources. The tribes were also excluded from the governance and implementation of the U.S.-Canada Columbia River Treaty.

Columbia River Basin Dams

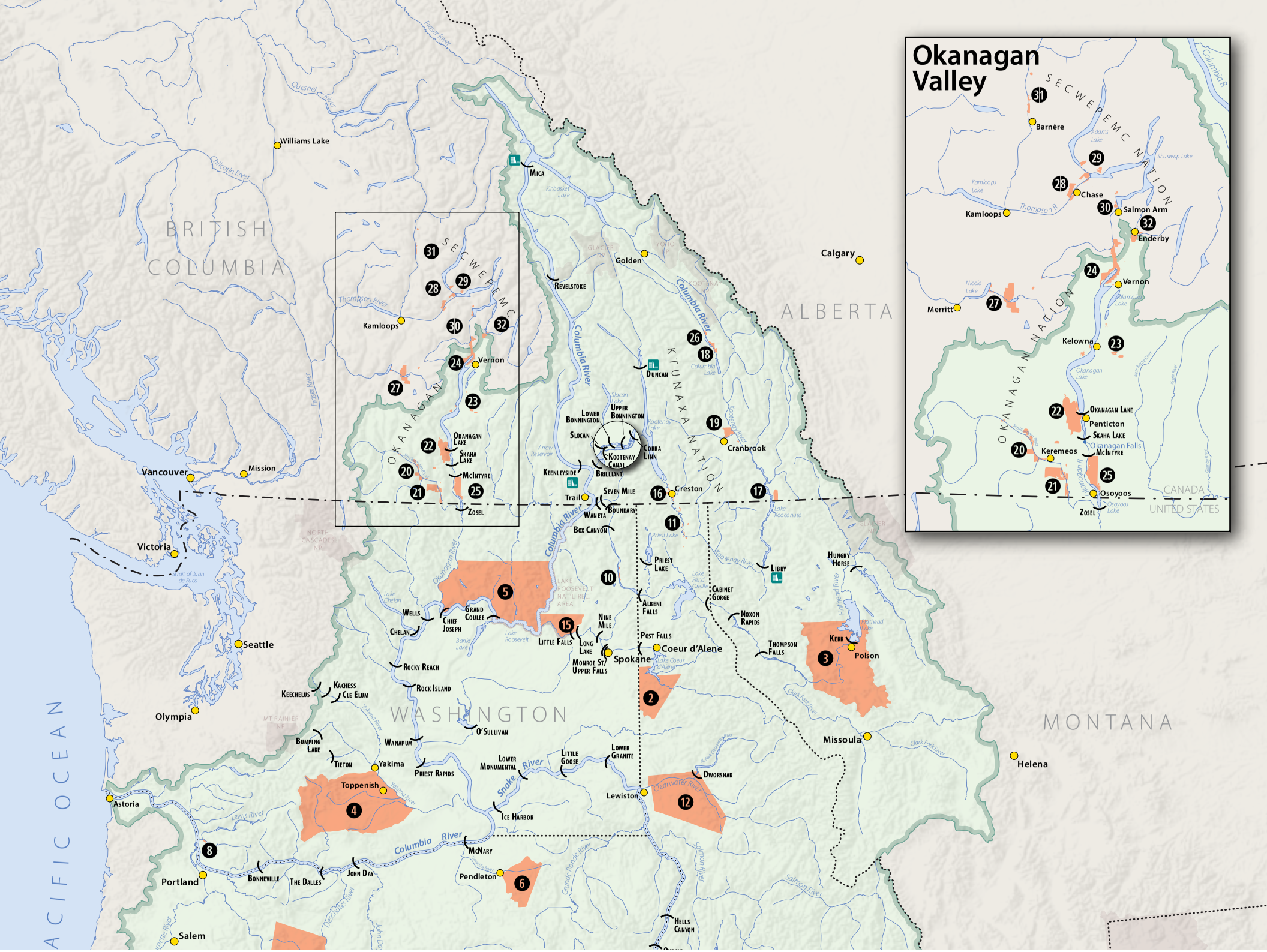


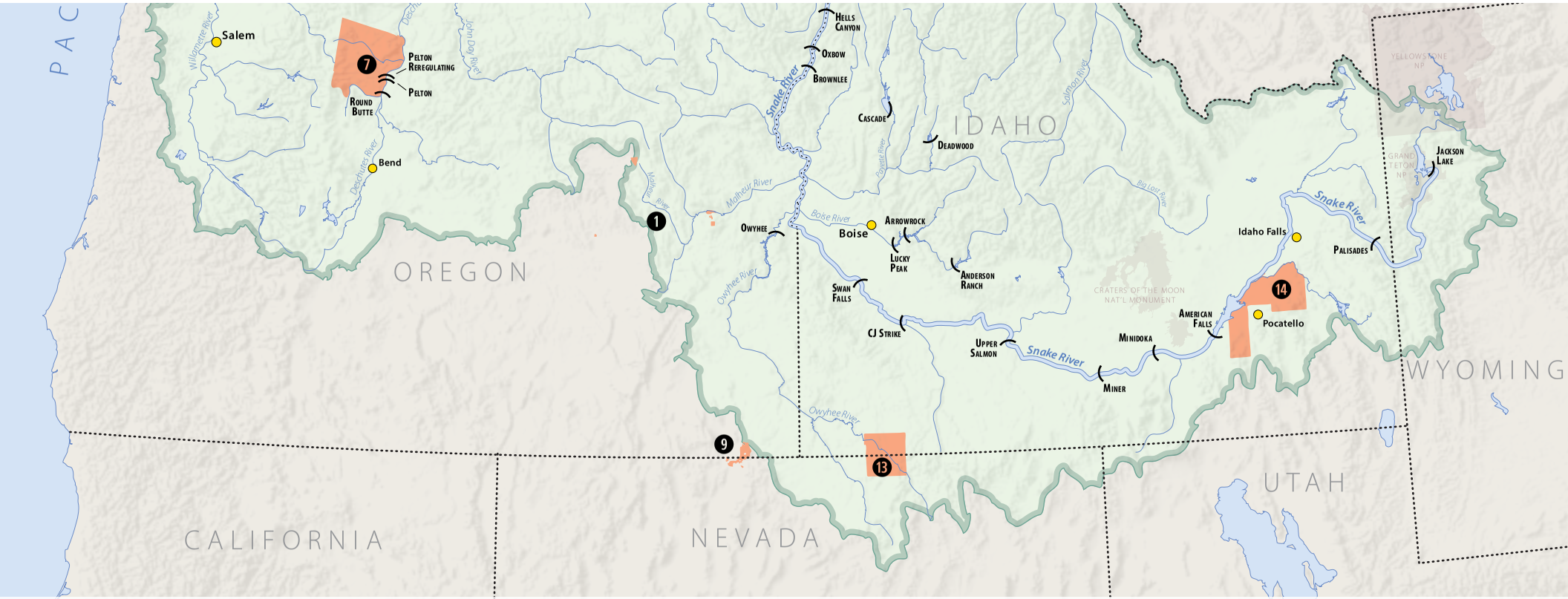
The Columbia River is the largest river in the Pacific Northwest. Its system of hydroelectric dams is a reliable source of energy and a tremendous challenge to anadromous fish.

Fifteen tribal nations in the United States and seventeen first nations in Canada have come together to participate in the Columbia River Treaty review. The tribal and First Nations want to broaden the current treaty to include ecosystem function and the possibility of restoring fish passage to historical spawning grounds. See map on next page.

Actions Needed

- Modernize the treaty to include ecosystem-based functions as a management obligation under the treaty equal to hydropower production and coordinated flood risk management.
- Develop an updated coordinated flood risk management plan with Canada that is built upon some level of assured flood storage in Canadian


Okanagan Valley
SECWEPEMC NATION
Barnère
Chase
Kamloops
Salmon Arm
Enderby
Vernon
Merritt
Kelowna
OKANAGAN NATION
Okanagan Lake
Penticton
Skaha Lake
Okanagan Falls
McIntyre
Keremeos
Osoyoos
Zosel
CANADA
UNITED STATES
BRITISH COLUMBIA
ALBERTA
WASHINGTON
MONTANA
PACIFIC OCEAN
Williams Lake
Mica
Golden
Calgary
Revelstoke
Columbia River
KTUNAXA NATION
Duncan
Cranbrook
Upper Bonnington
Lower Bonnington
Slocan
Kootenay Canal
Brilliant
Corra Linn
Keenleyside
Trail
Seven Mile
Creston
Boundary
Waneta
Box Canyon
Priest Lake
Libby
Hungry Horse
Cabinet Gorge
Albeni Falls
Noxon Rapids
Post Falls
Coeur d'Alene
Spokane
Nine Mile
Long Lake
Little Falls
Monroe St
Upper Falls
Thompson Falls
Kerr
Polson
Missoula
Helena
Dworshak
Lewiston
Clearwater River
Lower Granite
Little Goose
Lower Monumental
Snake River
Ice Harbor
McNary
Pendleton
Hells Canyon
Columbia River
Wells
Chelan
Chief Joseph
Grand Coulee
Rocky Reach
Rock Island
Keechelus
Kachess
Cle Elum
O'Sullivan
Wanapum
Priest Rapids
Bumping Lake
Tieton
Yakima
Toppenish
Vancouver
Mission
Victoria
Seattle
Olympia
Astoria
Portland
Salem
Bonneville
The Dalles
John Day
Okanagan River
Okanagan Lake
Okanagan Valley
Thompson River
Kamloops
Vernon
Okanagan Lake
Skaha Lake
McIntyre
Zosel
Fraser River
Quesnel River
Chilcotin River
Kootenay River
Pend Oreille River
Clark Fork River
Flathead River
Salmon River
Grande Ronde River
Deschutes River
Lewis River
Yakima River
Columbia River
Kootenay Lake
Slocan Lake
Arrow Reservoir
Lake Roosevelt
Banks Lake
Lake Chelan
Lake Pend Oreille
Flathead Lake
Priest Lake
Lake Koocanusa
Columbia Lake
Kinbasket Lake
Kamloops Lake
Shuswap Lake
Adams Lake
Nicola Lake
Okanagan Falls
Osoyoos Lake
Trait of Juan de Fuca
NORTH CASCADES NP
MT RAINIER NP
GLACIER NP
YOHO NP
LAKE ROOSEVELT NAT'L REC AREA



This map was produced by the Columbia River Inter-Tribal Fish Commission. It is meant for informational and display purposes only and was created with the best data available at the time of production. It does not represent any legal boundaries or information.
Map date: March 2013

North

0 25 50 100 200 Kilometers

0 25 50 100 200 Miles

Columbia Basin Boundary

Reservation or Reserve

Dam authorized by Columbia River Treaty

Tribal Nations in the United States*

1. Burns Paiute Tribe
2. Coeur d'Alene Tribe
3. Conf. Salish and Kootenai Tribes of the Flathead Nation
4. Conf. Tribes and Bands of the Yakama Nation
5. Conf. Tribes of the Colville Reservation
6. Conf. Tribes of the Umatilla Indian Res.
7. Conf. Tribes of the Warm Springs Res. of Oregon
8. Cowlitz Indian Tribe
9. Ft. McDermitt Paiute Shoshone Tribes
10. Kalispel Tribe of Indians
11. Kootenai Tribe of Idaho
12. Nez Perce Tribe
13. Shoshone Paiute Tribe of the Duck Valley Indian Res.
14. Shoshone-Bannock Tribes of the Ft. Hall Res.
15. Spokane Tribe of Indians

** management authorities and responsibilities affected by the Columbia River treaty; does not include all tribes in the Columbia Basin*

First Nations in Canada

Inside the Columbia Basin

KTUNAXA NATION

16. Yaqan nuʔkiy *(Lower Kootenay Indian Band)*
17. ʔakink̓umtasnuqtiʔit *(Tobacco Plains Indian Band)*
18. ʔakisq̓nuk *(Columbia Lake Indian Band)*
19. ʔaq̓am *(St. Mary's Indian Band)*

OKANAGAN NATION

20. c'əc'əwixaʔ *(Upper Similkameen Indian Band)*
21. kɬk'ər'míws *(Lower Similkameen Indian Band)*
22. snpíntktn *(Penticton Indian Band)*
23. stqaʔtkʷəɬwt *(Westbank First Nation)*
24. suknaqínx *(Okanagan Indian Band)*
25. swíws *(Osoyoos Indian Band)*

SECWEPEMC NATION

26. Kenpés̓qt *(Shuswap Indian Band)*

Outside the Columbia Basin with Asserted Interests

OKANAGAN NATION

27. spaxomən *(Upper Nicola Band)*

SECWEPEMC NATION

29. Qwʔewt *(Little Shuswap Indian Band)*
28. Sexqeltqín *(Adams Lake Indian Band)*
31. Simpcw *(Simpcw First Nation)*
30. Sk̓emtsin *(Neskonlith Indian Band)*
32. Splatsín *(Splatsín First Nation)*

Columbia River Treaty

reservoirs, consistent with meeting goals and objectives for ecosystem-based functions.

- Identify and integrate goals and objectives for ecosystem-based functions into river and reservoir operation plans developed pursuant to the treaty.
- Include provisions in the modernized treaty that allow for adaptive management, particularly to implement goals and objectives for ecosystem-based functions, and to address changes in snowpack and precipitation distribution brought on by climate change.
- Restore fish passage throughout the basin, specifically at Chief Joseph and Grand Coulee dams and the Hells Canyon Complex.
- Enlarge the membership of the U.S. Entity to include tribal representatives.

Who Owns the Water?

The following statement of Chief Joseph of the Nez Perce Tribe illustrates the chicanery that has befallen the tribes with regard to ownership of natural resources. "If we ever owned the land we own it still, for we never sold it. In the treaty councils the commissioners have claimed that our country had been sold to the Government. Suppose a white man should come to me and say, 'Joseph, I like your horses, and I want to buy them.' I say to him, "No, my horses suit me. I will not sell them.' Then he goes to my neighbor and says to him: 'Joseph has some good horses. I want to buy them, but he refuses to sell.' My neighbor answers, 'Pay me the money, and I will sell you Joseph's horses.' The white man returns to me, and says, 'Joseph, I have bought your horses, and you must let me have them.' If we sold ours to the Government, this the way they were bought." Just like the neighbor did not own the horses to sell, neither does BPA (or other agency or entity) own the water of the Columbia River Basin to generate power.

—As quoted in the 1995 Spirit of the Salmon Plan

Desired Outcome

The U.S. government and the tribes work together in the Columbia River Treaty 2014/2024 Review. Using the tribes' expertise, cultural and natural resource restoration and protection is integrated into coordinated river and reservoir operations and management plans. Ecological processes are also promoted through the treaty in such a way that the tribes receive equitable benefits relative to other interested parties. Each tribe has a voice in the treaty's governance and implementation.

NEW Recommendation

Institutional Recommendation 14

Hatchery Management

Properly manage hatchery supplementation programs and enact reforms to other associated programs in order to strike a balance between effects on population abundance, diversity, distribution, and productivity, and the maintenance of or increase in populations while other restoration actions are implemented.

Issue

Hatchery programs were instituted in the Columbia Basin to mitigate for losses to fisheries associated with hydrosystem development and habitat loss and degradation. Artificially produced juvenile salmon were released from the programs as a substitute for the juveniles previously produced by natural reproduction in the tributary streams throughout the basin. More recently, some hatchery programs have been instituted with a conservation role—to rebuild return numbers of wild populations and conserve their natural productivity and genetic diversity levels. The need for conservation efforts was made more apparent with the recent listing of many of the basin's salmon populations as threatened or endangered under the Endangered Species Act (ESA). However, evidence has accrued that hatchery programs can impart negative effects on the genetic resources of wild populations, highlighting the need for a comprehensive assessment of hatchery management practices.

The Hatchery Scientific Review Group (HSRG), which was established and funded through the Congressional appropriations process, was the most recent of a series of groups formed over the past two decades to study management of Columbia Basin hatcheries (federal, state, and tribal). "The challenge before the HSRG was to determine whether or not conservation and harvest goals could be met by fishery managers and, if so, how" (HSRG 2009).

The HSRG produced a report that described general principles for management. These included quantified standards for the proportion of natural-origin fish to incorporate into the hatchery broodstock and the proportion of hatchery-origin fish allowed to escape to spawning grounds. The report then provided recommendations for management of each individual hatchery program, categorized as either a

segregated harvest augmentation program or an integrated conservation/supplementation program.

The tribes' perspective on the HSRG recommendations is captured in the Policy Statement that prefaced the 2009 HSRG report to Congress:

> The HSRG's recommendations are not the only possible alternatives for managing hatchery programs to meet conservation and harvest goals. As such, the managers may develop other solutions which better meet their program principles and goals. Success over time will be defined by the managers' ability to take actions in the future to adjust hatchery programs based on good science to meet their conservation and harvest goals.

The HSRG recommendations are technical and scientific in nature. They are not intended to be policy decisions, but rather their function is to inform policy decisions. They also are not mandates that carry

Hatchery Technology Can Be Used to Rebuild Wild Fish Runs

the force of law or policy, and the intent is not for them to be a litmus test or the exclusive basis for deciding HGMPs (Hatchery and Genetic Management Plans) or funding decisions. As such, any changes to hatchery programs in response to the recommendations must also be informed by and consistent with existing legal and policy mandates. These mandates include, but are not limited to, the following items.

- Legislatively authorized and mandated mitigation obligations of the Federal Columbia River Power System (FCRPS) and other dams to provide fish. The mitigation obligations associated with the FCRPS and other dams are substantial and continuing into the future.
- Legally mandated harvest agreements in (*U.S. v. Oregon*, Pacific Salmon Treaty) and tribal treaty trust reserved fishing rights.
- Logistical challenges and facility constraints.
- Funding needs for new infrastructure and operating budgets (which have been stagnant or decreasing) necessary for implementation and appropriate monitoring and evaluation.

The tribal view is that proper management of supplementation programs and reforms to other programs balance the effects on population abundance, diversity, distribution, and productivity on the one hand, and the maintenance of or increase in populations while other restoration actions are implemented on the other hand.

Actions Needed

- Seek flexibility in implementation of hatchery reform policies through the development of a regional hatchery policy.
- Examine hatchery reform on a case-by-case basis.
- End federal requirement for mass marking hatchery fish. (See the technical recommendation MARK SELECTIVE FISHERIES.)

Desired Outcome

Flexibility is required for appropriate implementation of hatchery reform policies, particularly for programs that have both harvest mitigation and conservation objectives. Examining hatchery reform on a case-by-case basis recognizes the unique characteristics and challenges of each program. The consequence of failing to manage hatchery programs in concert with natural populations will be continued declines in natural populations, which will constrain the ability to exercise the tribes' treaty fishing right.

NEW Recommendation

Institutional Recommendation 15

Tribal Energy Vision

To prevent the Northwest's energy supply system from placing undue reliance on the Columbia River's ability to generate electricity or placing undue burdens on its ecosystem functions.

Issue

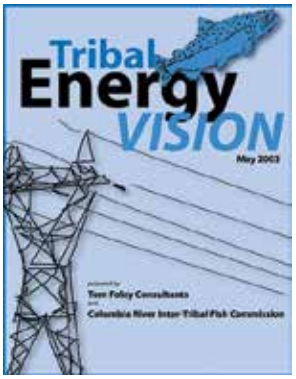
In 2003 CRITFC published an energy vision for the Columbia River. The publication followed on the heels of the energy crisis of 2001 and decisions by the federal government to forego salmon protection measures (spill and flow) at Federal Columbia River Power System dams. The juvenile salmon migration in 2001 experienced very high mortality rates. The underlying theme of the *Tribal Energy Vision* is that the Northwest's energy supply system must not place undue reliance on the Columbia River's ability to generate electricity nor place undue burdens on its ecosystem functions. The 1995 Plan recommended energy conservation and supply measures to address this vision.

Actions Needed

CRITFC is now in the process of updating that vision. Its update will include an assessment of the region's progress since 2003 and recommendations to address the new challenges facing the region, including:

- Continued aggressive acquisition of energy efficiency measures.
- Utilizing "smart" energy technologies to conserve energy resources and reduce peak energy demands.
- Integration of wind and other renewable energy sources with the region's existing hydro and thermal generation in a manner that is beneficial to salmon and the river's other ecosystem functions.
- Anticipating and responding to climate changes as they affect water energy demand and production as well as water supply.

Energy Vision



The complete Tribal Energy Vision is available online at C3105.

Desired Outcome

Implementing the *Tribal Energy Vision* by emphasizing a diverse and reliable energy resource mix saves Northwest ratepayers more than $1.3 billion per year, reduces damage to salmon and other fish and wildlife in the Columbia Basin, and reduces emissions that cause climate change.

Coal Is Not an Alternative

CRITFC Executive Director Paul Lumley speaks out against transport of coal along the Columbia River.

Coal is the dirtiest of energy sources: Coal-fired power plants are the largest producers of carbon dioxide, which is the leading culprit in global warming. Coal mining, coal transport, and coal burning all generate toxic pollutants. The *Tribal Energy Vision* discusses coal-free, energy-efficient alternatives to coal.

NEW Recommendation

Institutional Recommendation 16

Regulatory Improvement and Coordination

Ensure activities affecting anadromous fish are managed in a timely manner that implements restoration and recovery through adaptive management, or "learning by doing," and using existing institutional structures and modifying them as necessary to provide sufficient accountability to ensure timely increases in survival and meaningful participation for the tribes.

Issue

Restoration of Columbia Basin salmon, sturgeon, and lamprey depends upon institutional structures that efficiently coordinate the actions, goals, and resources of relevant government agencies and enlist the support and energy of individuals and non-governmental agencies. Because of the limits of scientific knowledge about these species in specific ecosystems, an effective monitoring and evaluation program is indispensable for charting restoration progress and indicating the need for mid-course correction. For more on this, see the updated institutional recommendation Monitoring, Research, and Evaluation. Finally, when policy-makers, technical experts, or implementers differ on the means for restoration, timely dispute resolution processes must be available at functional levels to address issues in a manner that does not stall the effort. Also see the institutional recommendation Dispute Resolution.

The right of the tribes to govern their members and manage their territories and resources flows from tribal sovereignty as recognized by treaty. In general, tribal governmental powers are described as "inherent powers of a limited sovereignty which has never been extinguished." The tribes' status as one of three sovereigns is recognized in the Constitution and has been upheld by the courts since the early years of the Republic. Treaties made with Indian tribes, indeed the fact that treaties were made, reflects the federal government's recognition of tribal sovereignty.

In the realm of treaty fishing rights, the tribes, states, and federal government share the responsibility to protect and enhance fish

habitat as co-tenants. In addition to the concept of a co-tenancy regarding the fishery resource, the United States stands in a trust or fiduciary relationship to Indian tribes. The trust relationship is a legal doctrine, embodying the many political promises made by the federal government to tribes. The trust doctrine governs all aspects of federal government actions that affect Indian tribes.

The treaty promises of the United States to protect the aboriginal right of our tribes to take fish at all of our usual and accustomed fishing places precedes all other laws affecting the Columbia Basin and were not diminished by those laws.

For the last 30 years, treaty fishing rights cases and the federal trust responsibility toward Indian tribes have been major factors in the evolution of institutional structures for the management and protection of Columbia Basin salmon fisheries. From a tribal perspective, the development of management institutions in the basin reflects and must continue to reflect the implementation of treaty promises through the development of joint or co-management strategies by the tribes, the states, and the federal government.

Now the primary goals of the tribes, the states, and the federal government are to rebuild weak runs to full productivity and fairly share the harvest of upper river runs between Indian treaty fisheries and non-Indian fisheries in the ocean and Columbia River Basin. As a means to accomplish this purpose, these parties intend to use habitat protection authorities, enhancement efforts, and artificial production techniques as well as harvest management to ensure that Columbia River fish runs continue to provide a broad range of benefits in perpetuity.

Protect Floodplains—FEMA Could Help

Building in floodplains is not good for fish or people. The home pictured above was on Mill Creek, a Walla Walla River tributary, before a 1996 flood destroyed it and damaged roads and bridges. Photo courtesy of Charlie Woodruff.

Floodplains are crucial habitat for salmon, influencing their health, growth and survival. Over-developed floodplains, characterized by stream channelization and lack of floodplain connectivity, have been identified as common limiting factors for fish survival and recovery.

The responsible regulatory agencies are working on policies that may preclude certain floodplain development. Actions could include increased areas for riparian easements, condemnation and relocation of critical value floodplain developments, and relocation of flood-damaged development rather than redevelopment in floodplain.

The Federal Emergency Management Agency (FEMA) has been slow to embrace habitat protection standards as part of its National Flood Insurance Program (NFIP). In fact, the NFIP has actually encouraged development within floodplains by promoting fill of floodplains to remove an area from the zone of the NFIP and encouraging community levee development to map areas out of the NFIP regulatory zone.

Actions Needed

- Regulatory entities need to manage activities affecting anadromous fish in a timely manner that implements restoration and recovery through adaptive management, or "learning by doing."
- Use existing institutional structures and modifying them as necessary to provide sufficient accountability for the parties with direct responsibilities to ensure timely increases in survival and meaningful participation for the tribes whose very existence is dependent upon restoration and recovery.

Desired Outcome

Tribes, states, and the federal government need to establish accountable processes to meet defined goals and objectives for salmon restoration in a time specific manner.

Technical Recommendations

Given the history of abundant salmon populations above Bonneville Dam and the complexity of jurisdictions and interest groups whose activities have contributed to their demise, the tribes conclude that significant actions must continue to be undertaken if we are to preserve our cultural heritage and treaty-guaranteed property rights. These actions are summarized in the technical recommendations that follow.

The preferred approach for managing these required activities is adaptive management. This approach combines the objective approach of scientific methodology with social and political decision making processes.

Adaptive management is a process consisting of identifying a problem, taking actions to address the problem, observing the results, and modifying the assessment of the problem and needed remedies. Adaptive management requires taking actions of a magnitude large enough to be likely to demonstrate measurable results in the face of inherent biological variability. It is a flexible process that does not require perfect knowledge to begin. It is self-correcting as new information is obtained.

An adaptive management approach to restoring salmon production in the Columbia River Basin above Bonneville Dam includes:

1. Initial assessment of the problem;
2. Formulation of goals, hypotheses about the nature of the problem(s), and needed solutions;
3. Identification of the expected results of the proposed actions;
4. Implementation of the proposed actions;
5. A monitoring program to observe the actual result of actions;
6. Communication of results among interested parties; and
7. Reevaluation of the problem definition and modification of management actions.

The technical recommendations made in the 1995 plan addressed steps 1 through 3 of this process. Between 1995 and 2013, numerous of the recommended actions were implemented—step 4, and to varying degrees, results were monitored and communicated—steps 5

and 6. The Update reassesses the problems and the actions taken and offers new and modified actions—step 7.

The Update's new technical recommendations address steps 1 through 3.

What Are Technical Recommendations?

The 13 original and 7 new technical recommendations are designed to accomplish the Spirit of the Salmon Plan's goals and objectives established in 1995 (listed on pages 7-8).

Measures that we believe are needed and appropriate to achieve the Plan's objectives are set forth in the hypotheses that are the foundation of the 20 original and new technical recommendations.

The first 13 original technical recommendations are updated. Each consists of a summary of the problem or issue as of 2013 (Current Status); an evaluation of how the original recommendation was addressed (Assessment); and what new changes are proposed (New and Modified Actions). Preceding each update is also a summary of the 1995 recommended actions. To see the original hypotheses and the recommendations in full, go to 301.

The last 7 Technical Recommendations are new. For each new recommendation, the problem is summarized (Issue); an hypothesis about the problem and the needed solutions is presented (Hypothesis and Needed Actions); and the anticipated results of the proposed actions are described (Expected Outcome).

Together the 20 technical hypotheses summarize the tribes' perception of the problems and their proposed responses. The hypotheses are organized within the lifecycle stages of the salmon beginning with the hypotheses affecting early life history stages (e.g., egg to juvenile survival). No prioritization of the importance of the hypotheses is implied by the sequence in which they are presented.

There may be actions other those recommended by the Spirit of the Salmon Plan that would achieve the Plan's objectives. The tribes are flexible on the details of specific actions as long as the end result, as measured by overall survival rates and fish abundance, is consistent with the objectives of this plan.

Technical Recommendation 1

Land Use

Begin improving in-channel stream conditions for anadromous fish by improving or eliminating land-use practices that degrade watershed quality.

Online

The complete 1995 recommendation 310.

Habitats Involved

Tributary

Life Stages Involved

Adult, egg, parr

Current Status

Some land-use practices have been altered to improve in-channel stream conditions in tributary watersheds in recent years. For example, forestry actions on federal lands have emphasized reduction of forest fragmentation; support of ecosystems as well as Endangered Species Act-listed species; culvert replacement with structures that promote natural stream bottoms; large-woody-debris movement; fish passage; recognition of connections of forest productivity with marine productivity; recognition of geomorphic processes producing high-quality fish habitat; and better treatment of roads to reduce landslides and sediment delivery. However, numerous land use practices that degrade watershed quality have not been sufficiently controlled. An important example is the continuing impact from agricultural practices that result in significant soil erosion and loss of riparian cover and livestock grazing damage to streambanks.

Assessment

Past land use recommendations made by CRITFC relied heavily on an extensive review of literature available to land management effects on streams and fish habitat (Rhodes, McCullough, and Espinosa 1994). Rhodes et al. developed the Coarse Screening Process in 1994. (Tables at 1117 and 1115) The Coarse Screening Process has been a significant reference in the Pacific Northwest used by land and fish managers (e.g., Muck 2010, Elliott et al. 2010, NMFS 1996, 1999)

Science & Tribal Knowledge

PLATEAU TRIBES FACING CLIMATE CHANGE
Tribal populations dependent on natural resources are among the most climate-sensitive communities. Efforts to protect and restore Columbia Basin populations of salmon, Pacific lamprey, and other imperiled coldwater fish have generally not addressed climate change. Climate change is expected to significantly alter the ecology and economy of the Pacific Northwest during the 21st century. Rising air temperatures are likely to decrease snowfall and increase rainfall during the winter months, leading to shifts in the timing and quantity of runoff, including increased flooding during the winter when water is already in ample supply and decreased flows during the summer when water demands are high.

and in environmental appeals of federal actions having likely impacts to anadromous fish resources (e.g., ONRC/NEDC 2004).

Useful land management recommendations were similarly proposed by Henjum et al. (1994), USFS (1994), and Spence et al. (1995). The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) have proposed very useful guides for evaluating the proper functioning of salmon and bull trout habitats and highlight the need to improve conditions before permitting habitat-disturbing actions (NMFS 1996, USFWS and NMFS 2000).

In all Northwest states, the standards established for protecting riparian habitat are routinely weak: Different standards are applied to fish- and non-fishing bearing streams, even though non-fish-bearing streams transport sediment, large woody debris, and thermal loads downstream to fish-bearing streams. Standards are inadequately monitored and enforced and do not reflect the latest scientific findings, among numerous other shortcomings.

Currently, Best Management Practices in agricultural management programs designed to meet the states' water quality standards under the Clean Water Act non-point-source provisions are only weakly linked to instream performance criteria; are not sufficiently responsive to needed rates of habitat and water quality recovery; and are essentially voluntary (see McCullough 2010).

Improving land use activities will have the added benefit of making terrestrial/aquatic systems more resilient to perturbation caused by climate change (ISAB 2007a) and helping to

Culverts Block Fish Passage

Throughout the Columbia Basin, thousands of culverts route streamflow underneath roads, railroads and other obstructions. Above, the entrance to a submerged culvert is clogged, creating a barrier to fish.

The old design of culverts resulted in many of them lowering the stream level on their downstream side over time. This elevated culvert on Goat Creek Springs on the upper Methow River blocks fish passage. Landowners have agreed to replace the culvert and reconnect the springs to the river's side channel so the area can support ESA-listed chinook, steelhead, and other fish. While progress has been made replacing culverts, more work is needed.

prevent introduction and spread of exotic plant and animal species into watersheds of the Columbia River Basin. (See the new technical recommendation Invasive Species.)

New and Modified Actions

- Maintain and improve integrity of riparian buffers and upland forests. Apply riparian buffers equal in width to those recommended by the Northwest Forest Plan (see Rhodes et al. 1994) and for both fish-bearing and non-fish-bearing streams to fully promote natural stream process restoration. Refrain from harmful salvage logging, especially in riparian buffers but also in upland forests to the degree possible (Beschta et al. 1995, 2004, USFS and BLM 1994). Protect structures against wildfire in the wildland-urban interface by clearing buffers surrounding the structures rather than thinning entire forests. Allow fire to assume a natural role in ecosystem modification to the extent feasible. Decrease fragmentation and increase connectivity among tracts of old growth and mature forest.
- Protect and restore natural processes (such as succession and disturbance) that allow aquatic ecosystems to restore and maintain themselves (see Mac et al. 1998a, 1998b, Ripple and Beschta 2004, ISAB 2011). (Also see Traditional Ecological Knowledge and Science .)
- Promote land use practices that will be sustainable under climate change impacts. Manage land use from a gravel-to-gravel or lifecycle approach. Protect and restore habitats for all life stages of fish and the lateral and longitudinal migration corridors necessary for fish to move between them (see Fausch et al. 2002, Allen 2004, White et al. 2012).
- Continue to engage in selected reach- and watershed-level habitat monitoring programs that detect signals from climate change and land use and help understand how to restore and maintain sustainable and resilient ecosystems. The sites and monitoring methods should be coordinated at larger spatial and temporal scales as discussed in the institutional update Research, Monitoring, and Evaluation.
- Monitor habitat conditions in representative watersheds using parameters described in McCullough and Espinosa (1996) and in the Columbia Habitat Monitoring Program (CHaMP) monitoring protocols. Habitat monitoring parameters are designed to follow trends in the habitat characteristics essential for abundance, productivity, genetic diversity, and spatial diversity

of listed species (i.e., VSP parameters, McElhany et al. 2000). Improvement in habitat quality and quantity as revealed by a monitoring program such as CHaMP can imply the potential for species recovery by removal of limiting factors. Also needed are more comprehensive monitoring projects like the Integrated Status and Effectiveness Monitoring Program (ISEMP) that couples habitat and fish population monitoring.

- Use data on habitat quality trends in a full lifecycle model for each listed species to project population response to habitat trends and land restoration scenarios. A data-driven and formal model-based approach is urgently needed as a replacement to the qualitative, "expert-opinion" approach to habitat evaluation.
- Create a system of watershed reserves to act as anchor habitats to increase the stability of the habitat systems supporting aquatic resources.

Modified institutional actions:

- Implement and improve existing land use regulations. Implementing and enforcing land use regulations to provide full protection of fish habitat was an emphasis of the 1995 Spirit of the Salmon Plan; it remains a critical need that demands new strategies. These include land use practices cited in the *Umatilla River Vision* (Jones et al. 2008a) and Oregon Department of Forestry and Oregon Department of Environmental Quality (2002); recommendations for protecting and restoring aquatic and terrestrial resources to sustainable levels in Rhodes et al. (1994), Spence et al. (1995), and Washington Coast Sustainable Salmon Partnership (2012); and actions known to improve and maintain water temperature regimes of streams cited in Rhodes et al. (1994), McCullough (1999), Independent Scientific Advisory Board (2007), and Beechie et al. (2012). (Also see the technical recommendation CLIMATE CHANGE and learn about using General Land Office township survey data to document land use changes C6055.)
- Improve existing regulations that are weak. Substantial improvement in Best Management Practices is needed in agricultural management programs designed to meet the states' water quality standards under the Clean Water Act non-point-source provisions in TMDL (Total Maximum Daily Load is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards).

Technical Recommendation 2

Tributary Water Quantity

Protect and increase instream flows by limiting consumptive water withdrawals, using the most efficient irrigation methods, preventing soil compaction and riparian vegetation removal, and wetland destruction; and, where necessary, restore soil and riparian vegetation and recreate wetlands.

Online

The complete 1995 recommendation 311.

Habitats Involved

Tributary

Life Stages Involved

Adult, egg, parr

Current Status

Current levels of watershed development and land uses continue to have major impacts that routinely reduce streamflows as described in the 1995 Plan. The same conflicts between in-stream and out-of-stream uses still exist, as does the antiquated legal means of dealing with water availability detailed extensively by Wilkinson (1992). The science of instream flow evaluation for aquatic uses was developed prior to the 1995 Plan, but instream flows are still frequently not designated for anadromous fish. The ability of the Endangered Species Act (ESA) to achieve its goal of restoring the viability of listed anadromous fish populations depends heavily upon there being water in streams.

As long as instream flows sufficient for fish are without a protective legal framework and are provided at the discretion of the landowners through whose property a stream flows salmon viability will be increasingly threatened. The best in-channel habitat restoration efforts will be useless without sufficient water. A lack of water in the fall season when the salmon typically spawn results in limited spawning area and reduced quality of the habitat available. Currently, these impacts are arising from the combination of increased human use and effects of climate change.

Climate change has also been shown to result in earlier spring snowmelt and, consequently, earlier and more extreme summer low flows (Mayer and Naman 2011), especially in snowmelt-dominated streams (Wu et al. 2012), leading to higher summer water temperatures. Actions that slow the flow of water through watersheds and

promote more efficient use of water will be essential to ameliorate these changes.

Also see Biological Perspective: Habitat of Anadromous Fish in the Columbia River in the 1995 Plan 279.

Assessment

In the period since the 1995 Plan was released, a significant increase in the understanding of the surface water-groundwater interaction has arisen (e.g. see EPA 2000, Kondolf et al. 2006; Jones et al. 2008b; CTIC 2008; Goodrich 2008). Groundwater linked to surface streamflow in a floodplain is termed hyporheic flow (EPA 2000). This surface water-groundwater interaction has implications for both water quantity and quality.

Floodplain Restoration Improves Instream Water Conditions

A floodplain created when the Confederated Tribes of the Umatilla Indian Reservation made improvements to Russell Spring Creek, prime steelhead and spring chinook spawning and rearing habitat in the Tucannon subbasin.

Recent research shows that channel restoration and reconnection with the floodplain is a means to reestablish surface and subsurface water exchange (hyporheic exchange), which can reduce summer surface water temperatures. Water runs into the floodplain, is absorbed into floodplain soil and gravels, and returns to the stream as cool water. In addition to cooling stream water temperatures, hyporheic exchange recharges groundwater supplies, which leads to more sustained instream flows.

Streams can be classified as ephemeral, intermittent, or perennial, depending upon the relationship between bed elevations and groundwater elevations on a seasonal basis (Goodrich 2008). Many streams support salmonid rearing on a periodic or a seasonal basis. Groundwater pumping can alter the availability of surface water. Streams that are intermittent and support salmonid rearing in certain years or parts of the year can be dewatered by groundwater pumping, thereby reducing the availability of rearing habitat in a drainage. The same effect can result in impaired stream passage for juveniles and adults by converting a stream reach to a "losing" reach when it is dewatered (Goodrich 2008).

Conflicts over water availability increasingly occur today among the agriculture community due to irrigation with a common resource (groundwater and surface water that are fully linked hydrologically). Assumptions still remain that if surface water becomes unavailable, irrigation can still draw upon groundwater. Among groundwater users,

the user who can dig the deeper well can be the one who commands water availability. Despite the method used to access water, aquatic resources suffer when sufficient water is not left in the stream.

Yet to be developed are new legal mechanisms that provide greater protection for instream flows while safeguarding user interests. Existing tools, such as water leasing, are not always workable, e.g., in orchard agriculture. Existing water law not only fails to give deference to instream flows, but it also fails to provide the flexibility to implement creative solutions, such as user rotations. Watershed partnerships based on the premise that all resources can be safeguarded by planned and efficient use of water availability are necessary to sustain the basin's combined terrestrial and aquatic resources (CTIC 2008).

New and Modified Actions

The tributary water quantity recommendations made in the 1995 Spirit of the Salmon Plan remain relevant and applicable.

Protect and restore groundwater and surface water quantity

- Monitor status and trend of water quantity (and quality) in selected watersheds as a means to know whether sufficient actions are being taken to protect and restore aquatic resources; provide sufficient funding for watermasters to regulate water consumption to no more than legally permitted; monitoring and flow regulation should take into account interactions among flow and other environmental variables, such as temperature and biotic interactions (e.g., Wenger et al. 2011); land use actions such as floodplain management, allowing stream and floodplain interconnection, road network reduction, and wetland protection are important water quantity protective mechanisms; and focus efforts on instream flow needs for aquatic resources, channel, and floodplain maintenance as data needs for water adjudication procedures. See the new and updated monitoring actions in the technical recommendation Watershed Restoration and the institutional recommendation Research, Monitoring, and Evaluation.
- Implement and adequately fund programs such as the Columbia Basin Water Transactions Program (MacDonnell 2011) that promote innovative local solutions for maintaining and restoring instream flows for fish; promote revisions to water law provisions to facilitate long-term maintenance of instream flows for fish (MacDonnell 2011); and recognize the dependence of streamflow in fish-bearing reaches on the streamflows in

non-fish-bearing reaches, thus protecting connectivity among all river reaches to allow for critical fish migration.

- Ensure water saved to protect fish remains instream and is not simply removed by activating rights of junior water users; and protect instream flows for fish on a stream-system basis that cuts across water control jurisdictions and does not allow benefits gained in one river reach to be undone by uncontrolled regulation downstream.
- Recognize the tight linkage between groundwater and surface water flow quantity in permitted water consumption: groundwater usage must not be allowed to deplete surface water, while surface return flows from irrigation and other runoff should be used to recharge groundwater.

Engage in land management actions known to confer resistance to climate change impacts on water quantity/quality
(ISAB 2007a, Furniss et al. 2010, Peterson et al. 2011)

- Protect and restore floodplains, wetlands, riparian and upland soils, and upland vegetation that control water quantity and timing of release.
- Restore natural biota that help maintain floodplains and wetlands directly through ecosystem engineering, e.g., beavers (see Pollock et al. 2004, White and Rahel 2008) or indirectly through trophic cascades (see Ripple and Beschta 2004).
- Encourage cooperation between landowners, state and federal agencies, and tribes that seek protection of fish, wildlife, and ecosystem health in achieving a balance among all land uses that depend upon water availability.
- Encourage the recognition among landowners that groundwater and surface water users draw their water supply from a common source.

Technical Recommendation 3

Watershed Restoration

Actively restore watersheds where salmon populations are in imminent danger of extinction. Use Coarse Screening Process to develop demonstration projects.

Online

The complete 1995 recommendation 312.

Habitats Involved

Tributary

Life Stages Involved

Adult, egg, parr

Current Status

The four tribes, along with agencies and local groups, are engaged in significant efforts to restore Columbia Basin watersheds and their stream systems. The tribal aim is watershed-wide habitat restoration to increase egg-to-smolt survival of Endangered Species Act-listed and depressed populations and to help restore these populations to levels where both ESA viability criteria and the Spirit of the Salmon Plan goals and objectives are met. Active habitat restoration applied at the watershed, riparian zone, and stream channel scales is underway in areas where habitat is most damaged, including many portions of the Yakima, Clearwater, Grande Ronde, Umatilla, Salmon, Tucannon, Deschutes, Entiat, Wenatchee, Methow, and John Day rivers. Specific habitat restoration actions identified by subbasin in Volume II of the 1995 Spirit of the Salmon Plan were incorporated into 2004 subbasin plans 30 and further developed in many subbasins in National Marine Fisheries Service (NMFS) recovery plans under the ESA. "Expert" subbasin panels familiar with site-specific limiting factors have highlighted current key restoration actions, although CRITFC suggests this qualitative approach be replaced by quantitative modeling based on monitoring data on fish and habitat condition.

After 150 years of human development and land use impacts, watershed restoration in the Columbia River Basin is still a giant work-in-progress. Substantial funds from the Bonneville Power Administration, the Pacific Coast Salmon Recovery Fund, and numerous other federal, state, tribal, public utility districts, and private sources are being expended for watershed restoration every year. Yet CRITFC and others estimate that hundreds of millions more dollars are needed annually for Columbia Basin watershed restoration, land protections, elimination of passage barriers, instream flows, water

quality, program operations, monitoring, outreach and education, and regulatory actions (State of Washington 2011). Additional restoration funding is needed now otherwise rapidly occurring impacts from both climate change and continuing human development may undo gains already made. See the sidebar "Is Watershed Degradation Outpacing Restoration?" in the update of the institutional recommendation, Watersheds.

Assessment

Active habitat restoration has sometimes occurred as opportunistic actions rather than as part of a comprehensive watershed-based program that addresses cumulative impacts to habitat conditions throughout salmon-bearing stream systems. The purpose of a comprehensive restoration program is to address all key limiting factors impairing the processes that create a sustainable fish production system. Restoration is most effective when conducted systemically and strategically.

Systemic action often involves reconnecting fragmented habitat to allow stream systems to support salmon and lamprey at different life history stages. This enables instream migration and occupation of multiple habitat types in multiple life history stages. Restoration principles that employ a holistic, ecosystem approach are more likely to be successful than fragmented, opportunistic, and single-species approaches. These principles are emphasized in the tribes' use of the First Foods concept (see the Update's Traditional Ecological Knowledge and Science and Jones et al. 2008a).

In addition to active restoration, passive restoration is vital to success. While the benefits of passive restoration sometimes require a longer time horizon to become effective, the passive restoration approach is often far less expensive and avoids the risks of heavy machinery use in sensitive areas. Some examples of passive restoration include enforcing laws that restrict impacts and establishing riparian reserves, fencing, new land acquisitions, and

Upper Columbia Basin Restoration: Hancock Springs: *Before*

Decades of uncontrolled livestock use at Hancock Springs created trampled banks and a sprawling channel with very little sinuosity or complexity. No salmonids were able to use the creek, which is a tributary of the Methow River in the upper Columbia basin.

See the same stretch of creek four years later ▶

easements. Often, removing—or in the case of culverts, replacing—a continuing, spatially extensive source of impact is all that is needed to initiate recovery.

Due to the massive geographic scale of streams needing restoration, enforcement of effective laws that deal with forest and agricultural practices and non-point source impacts is essential to stream restoration. The most extensive land uses impairing streams are in the non-point source category. Basin management plans that implement passive restoration and reduce or remove key stressors to streams can limit the severity of negative impacts from climate change and current and future land uses. The 2013 Washington Supreme Court decision in *Lemire v. State of Washington* supporting the ability of Washington Department of Ecology to regulate non-point source pollution of streams subject to direct livestock impacts reveals that non-point source impacts may be controlled by the states, despite the weak regulatory language in the federal Clean Water Act.

Although a wide range of agencies collect a wide range of habitat data, intensive, coordinated monitoring and trend analysis is still in a rudimentary phase. Furthermore, monitoring in many watersheds is lagging or not being done comprehensively. The newer and still formative efforts include the Columbia Habitat Monitoring Program (CHaMP) run by NMFS and the Bonneville Power Administration; the Intensively Monitored Watershed (IMW) programs initiated by various consortia of agencies and tribes; the U.S. Forest Service's effectiveness monitoring programs, PACFISH/INFISH Biological Opinion or PIBO and the Aquatic and Riparian Effectiveness Monitoring Plan (AREMP); and the Integrated Status and Effectiveness Monitoring Program (ISEMP), which examines status and trends and multi-scale actions.

Upper Columbia Basin Restoration: Hancock Springs: *After*

The same stretch of Hancock Springs in September 2011. Chinook salmon were seen using the pool (foreground) within 24 hours of completing reconstruction. Note the abundance of wood placed below the water surface and new wetland sod along the banks.

During the first years of restoration, hydraulic permitting issues restricted work to activities that could be done by hand. Despite the limitations, Yakama Nation fisheries staff and their partners made improvements that increased channel complexity. The fish responded and began using the improved habitat. Permitting agencies relaxed their control and allowed more aggressive channel reconstruction to fix hydraulic problems. After nearly five years of work, including major channel repair and much more, spring chinook have returned to Hancock Springs.

By monitoring representative stream reaches, entire stream systems, riparian areas, and salmon-bearing watersheds, information is gained to assess the extent to which various restoration actions are addressing specific limiting factors or to assess the combined cumulative actions of all current and historic restoration projects. These factors control improvement in productivity, abundance, spatial distribution, and genetic diversity (i.e., viability criteria) for entire salmon populations. These data can be used to develop models that land managers can then employ to predict potential habitat condition and population viability improvements from restoration actions. Because these intensive, comprehensive monitoring programs assess progress in representative damaged habitat for listed populations, they suggest progress in restoration of entire Evolutionarily Significant Units (ESUs) or the scale of restoration that would be needed in the watersheds supporting other populations in the ESU. However, this emphasizes the need to also conduct targeted implementation and effectiveness monitoring to local scale projects in other basins that are not part of intensive monitoring programs. Coordinated funding, management, and data reporting from this type of monitoring program are needed.

Multispecies Approach Includes Freshwater Mussels

Historically abundant in the Columbia Basin, native freshwater mussels (not to be confused with invasive, non-native mussels) provide ecosystem services that benefit other aquatic species, including salmonids. Recent studies suggest that freshwater mussels also benefit Pacific lamprey populations, in part by retaining organic matter in the system. The mussels have been harvested for food and shell material by Native Americans for over 10,000 years and are considered an important cultural resource. Today the Nez Perce, Umatilla, Warm Springs, and Yakama tribes are working to reestablish freshwater mussel populations.

Ecosystem services and other interesting facts:

- Some freshwater mussels species can live to be 100 years old.
- Because they are long-lived, they can shed information on climatic conditions and aquatic pollutants. Their shell rings record information much like tree rings do.
- As they feed, freshwater mussels filter material from the water column.
- One mussel can filter 20-70 liters of water a day. A dense bed of mussels can filter an amount of water that's about the same as the stream's daily discharge (Xerces Society 2011).
- By filtrating water they may serve as bioremediators, extracting metals, and other toxics (Xerces Society 2011).
- Freshwater mussels are a food source for mammals, waterfowl, and fish and other aquatic species.

New and Modified Actions

Restore watersheds using active and passive restoration throughout the anadromous fish range and in watersheds contributing to anadromous fish habitat; when funding is limited, focus restoration where salmon and other native species are in imminent danger of extirpation. (Use

Coarse Screening Process to develop demonstration projects. See Coarse Screening Tables 5B.2 1117 and 5B.3 1115.)

- Prioritize strategies for restoration of freshwater habitats supporting salmon populations or subpopulations and other anadromous species in the following order: 1) protect key watersheds or stream reaches with intact processes and high-quality habitat (potentially through the creation of reserves), 2) reconnect isolated high-quality habitat, 3) restore hydrologic, geologic (sediment delivery and routing), and riparian processes, and 4) conduct instream habitat enhancements. See Roni et al. (2002) and Beechie et al. (2010).
- Improve land use regulations to protect and restoration floodplains and wetlands, remove dikes and channel hardening and allow active channel migration.
- Incorporate a multispecies approach in setting restoration targets. For example, even restoration specifically targeted towards salmon should account for the biotic integrity of macroinvertebrates and non-game fishes that make up the food base and provide dependable indicators of watershed health. See Independent Scientific Advisory Board (2011), Beechie et al. (2008), and Hubler (2009).
- Apply watershed and stream restoration actions at an intensity matching the needed rates of recovery. This may involve application of models linking land use, habitat response, and habitat monitoring as well as decreases in restoration funding gaps.
- Restore watershed-wide stream system integrity, including expanding the extent of restoration to more of the stream network and applying greater intensity to restoring upland watershed conditions. See Allen (2004) and Roni et al. (2010).
- Adapt research and monitoring programs to identify key land use and salmon production interactions and reveal effective ways to improve watershed conditions. Promote measures known to be effective in instream habitat recovery. Provide quantitative evaluation of the magnitude of improvement and the rate of recovery of habitat quality and quantity and of associated benefits to salmon and lamprey survival and production. This will be essential in showing that cumulative habitat restoration actions are lessening the limiting factors impairing fish abundance, productivity, genetic diversity and spatial diversity, which are all expectations in Columbia Basin Fish Accords agreements. (Also see the updated institutional recommendation Research, Monitoring and Evaluation.)

- Use McCullough and Espinosa (1996) and CHaMP (2012) in developing and refining necessary forms of monitoring.
- Develop and use more efficient processes to select the best restoration projects capable of producing the greatest benefits in the short and long terms, based on best available fish and habitat monitoring and lifecycle productivity data plus comprehensive engineering analysis.
- Use emerging technologies, such as TIR evaluation of water temperature, LIDAR evaluation of riparian cover, hyperspectral analysis of terrestrial vegetation cover (vitality, species composition), real-time satellite-based reporting of water quality from monitoring stations, and GIS mapping technology, to create shared understanding and evaluation measures across jurisdictions.

Technical Recommendation 4

Supplementation

Use supplementation to help rebuild salmon populations at high risk of extinction.

Online

The complete 1995 recommendation 313.

Habitats Involved

Tributary

Life Stages Involved

Egg, parr

Current Status

Hatchery production in the Columbia Basin comes primarily from conventional harvest augmentation programs, operated to mitigate for lost production associated with development of the hydrosystem. Most hatcheries upstream of Bonneville Dam continue to fulfill this role and support the tribal Zone 6 tribal fishery located between Bonneville and McNary dams. As outlined in the 1995 Spirit of the Salmon Plan, however, the tribes propose using additional supplementation to help rebuild natural populations. Abundance levels of natural populations throughout the interior basin are too depressed to provide significant tribal harvest and, in many cases, are so low that the long-term sustainability of the populations is threatened. Unlike conventional programs, supplementation hatcheries use adults captured in-river as broodstock, including a portion that are of natural origin, rear their progeny in a hatchery, and release them adjacent to natural spawning areas to which they are allowed to return as adults and augment the spawning population.

The tribes now manage or co-manage, with federal and state partners, several supplementation hatchery programs in the interior basin. Appendix C, 2008-2017 *U.S. v. Oregon* Management Agreement Production Tables 1278, lists all hatchery programs in operation above Bonneville Dam. The May 31, 2012 revision of the tables indicates the current co-managers

Restoration Success: Johnson Creek Summer Chinook

Johnson Creek during the spring runoff.

Researchers found hatchery-reared salmon that spawned with wild salmon had the same reproductive success as salmon left to spawn in the wild, according to a study of the Nez Perce Tribe's Johnson Creek Artificial Propagation Enhancement Project. The study focused on a population of summer chinook whose natal stream is located in central Idaho, almost 700 miles upstream of the Pacific Ocean.

Read more about this and other supplementation successes at C302.

agreed to juvenile production targets and release sites and identified the primary program purpose for each as conservation, supplementation, fishery, reintroduction, and/or research.

Assessment

Results from the supplementation programs suggest that with judicial management, they can provide the sought after demographic benefits while sufficiently controlling for effects on other viable salmonid parameters (McElhany et al. 2000) that might be associated with artificial spawning and rearing (Hedrick et al. 2000, Sharma et al. 2006, Berejikian et al. 2009, Eldridge and Killibrew 2008, Knudsen et al. 2008, Schroder et al. 2008, Schroder et al. 2010, Hess et al. 2012). Declines in natural population abundance have been reversed in response to some of these supplementation programs, though reduced habitat productivity and hydrosystem mortality continue to constrain natural growth.

Importantly, returns have been sufficient in several of these streams and rivers to reestablish terminal tribal fisheries at usual and accustomed locations. In other populations, the habitat and hydrosystem effects continue to depress population productivity, though supplementation has at least served to maintain abundance. The programs are monitored at varying levels of intensity to provide information to assess trends in abundance, productivity, spatial structure, and diversity and help guide (adaptive) management.

The tribes proposed that the supplementation programs be managed based on guidelines described in detail by Cuenco et al. (1993) including:

- Supplementation hatchery programs must necessarily be enacted in concert with efforts to restore habitat, improve hydrosystem survival, and manage harvest.
- Program scale should be appropriate to both mitigation needs and match the potential natural productivity of the stream.
- Use of natural-origin broodstock as feasible to increase integration with the natural population and promote local adaptation.
- Adopt spawning and rearing practices to maintain genetic diversity and to produce behavioral and physical phenotypes of hatchery-origin fish that are (more) similar to those of natural-origin fish.
- Acclimate and release hatchery-origin juveniles in locations within spawning areas to promote adult homing for natural reproduction.

While gains have been achieved and the threat of extirpation has been substantially reduced, essentially none of the natural populations in the interior Columbia Basin can be deemed naturally abundant and self-sustaining. Reduced habitat productivity and hydrosystem mortality continue to constrain natural growth of these populations. As a result, these populations remain in need of further support from hatchery supplementation. Additionally, the supplementation recommendations made in 1995 have been only partially implemented, and often program management does not yet adequately conform to the Cuenco et al. (1993) guidelines. For many programs:

- Funding for program infrastructure is insufficient.
- Current hatchery facilities cannot rear fish at desired low densities and under semi-natural conditions.
- Acclimation facilities are too few and often located lower in the basin (downstream of much of the natural spawning area) than is preferable.
- Program scale is sometimes reduced relative to tribal proposals.
- Limitations are sometimes imposed on the number of natural-origin fish that can be used for broodstock and the number of hatchery-origin adults permitted to escape for natural spawning.

New and Modified Actions

The tribes will continue to seek additional funding for infrastructure, operation, and monitoring activities for each of the various programs as needed and continue to promote adherence to supplementation management guidelines. The tribes will also continue efforts to obtain funding for construction and operation of the following proposed hatcheries.

- Northeast Oregon Hatchery
- Wahkiakus Hatchery (Klickitat R)
- S Fork Walla Walla R Hatchery
- Yakima R fall chinook hatchery

Restoration Success: Snake River Fall Chinook Supplementation

A record number of Snake River fall chinook spawned in the Snake River basin in 2013. Pictured above, fall chinook and other salmon at a dam's fishing counting window. Photo courtesy of the Northwest Power and Conservation Council.

In 2013 the Nez Perce Tribe's Snake River recovery program resulted in the highest number of wild fall chinook to return to the Snake River since 1960. When these chinook spawned, the results were a record-setting 63,000 redds, the rocky nests were fish lay and fertilize their eggs, in the Snake and Clearwater river basins. The increase in Snake River returns and the increased distribution in redds were aided by the tribal program that supplements existing Snake River fall chinook populations. C2519

Online

The complete 1995 recommendation 314.

Technical Recommendation 5

Reintroduction

Use supplementation to reintroduce salmon to watersheds from which they have been eliminated.

Habitats Involved

Tributary

Life Stages Involved

Egg, parr

Current Status

As recommended, several programs to reintroduce extirpated stocks have been enacted within the interior Columbia Basin, primarily through initiatives of the tribes. Examples of tribally managed reintroduction programs are shown below.

	Escapement goal		Recent 5-year average	
Program	Total	Nat. origin	Total	Nat. origin
Hood River spring chinook	not available	205	not available	206
Yakima River coho	5,000	3,500	6,978	1,840
Yakima River summer chinook			not available	not available
Cle Elum Lake/ River sockeye			not available	not available
Wenatchee River coho		1,500	10,914	502
Methow River coho		1,500	2,647	64
Umatilla River spring chinook	8,000	2,000	2,900	200 (?)
Walla Walla River spring chinook	5,500	2,500	539	216
Clearwater River coho			3,946	not available
Lookingglass Creek (Grande Ronde River) spring chinook	2,000	1,000	431	115

The programs were each initiated by importing juveniles from non-endemic hatchery stocks. Many of the fish were released from hatcheries or other locations in-basin to facilitate the recapture of returning adults for use as broodfish to help create a new localized stock. Over time, release of the non-endemic juveniles has diminished as the programs transition to production of local fish. In several programs, this transition is complete. Over this same period, an increasing proportion of the juveniles have been released at sites in proximity to natural spawning areas to further promote naturalized populations. When feasible, the juveniles are held in acclimation facilities prior to release, typically for 4-6 weeks, to encourage homing to these new spawning areas.

Each of the reintroduction programs has seen growth in both adult escapement, annual redd counts, and production of naturally spawned juveniles, which suggests that new localized natural populations are being established. Additionally, returns have been sufficiently high in many cases to reinstate limited tribal fisheries at usual and accustomed places.

Assessment

These programs are progressing toward their goal of reestablishing viable natural populations, despite the highly domesticated nature of some of the non-endemic hatchery stocks used to initiate the reintroductions. ("Highly domesticated" refers to those stocks in segregated rearing for 10 to 20 generations.) Recently, hatchery programs to supplement natural populations have come under substantial criticism, because of a belief that rearing within a hatchery

First Time in 100 Years Sockeye Return to Lake Cle Elum—Fish Passage Next

Sockeye spawning in Lake Cle Elum.

The Yakama Nation held a "Return of the Sockeye" ceremony in July 2013 to celebrate the first Cle Elum sockeye in over 100 years. (A video of the event is linked on 375)

In 2009 the tribe released 1,000 adult sockeye into Lake Cle Elum,a tributary of the Yakima River. (The sockeye were trapped at Priest Rapids Dam on the Columbia and were from either the Wenatchee or Okanagan river systems.)

After being released into Lake Cle Elum, these sockeye spawned in tributaries above the lake, producing juveniles that in the spring of 2011 migrated downstream through the Yakima and Columbia rivers on their way to the Pacific Ocean.

In 2013 some of these sockeye returned to freshwater to complete their lifecycle, migrating upstream to the Yakima River, where they were captured and hauled around Roza and Cle Elum dams, and released back into Lake Cle Elum.

With strong sockeye returns to the Columbia River, the tribe was able to trap adult sockeye at Priest Rapids Dam and release them in Lake Cle Elum in 2010, 2011, and 2012. The sockeye spawned successfully in all three years.

This supplementation effort is likely to be necessary until the sockeye can return without a truck ride past Roza and Cle Elum dams. Fish passage at these dams is part of the recently approved Yakima Basin Integrated Water Resource Management Plan.

environment, purportedly even for as little as one generation, will have a substantial negative effect on fitness of the natural population with which they interbreed (Araki et al. 2008, Christie et al. 2011). However, the apparent rapid readaptation of the reintroduced fish to the natural environment observed in these programs suggests that fitness changes that may accrue in a hatchery stock are susceptible to reversal in the face of natural selective processes and judicious management of broodstock and hatchery rearing.

Fraser (2008) reviewed reports for 31 salmonid reintroduction programs. He cautiously stated that evidence was insufficient to definitively conclude whether the programs had been successful or not in establishing new self-sustaining natural populations. The reasons given, however, were that the programs had not been in place for sufficient numbers of generations and/or that the environmental factors responsible for extirpation of the stocks had not been sufficiently mitigated for. The tribal programs in the Columbia Basin are relatively new, and habitat and hydrosystem problems continue to constrain rebuilding. For the short-term at least, supplementation of reintroduced stocks is required. Also, infrastructure, operation, and monitoring activities for these programs have generally been underfunded. Nonetheless, the dramatic increases in escapement and natural spawning are highly encouraging.

New and Modified Actions

- With the evidence of progress achieved by current reintroduction programs, the tribes will advocate for additional financial support for program infrastructure, operation, and monitoring.
- The tribes will continue to seek funding for establishment of the following new reintroduction programs:
  - Grande Ronde River coho
  - Wallowa Lake/River (Grande Ronde River) sockeye
  - Keechelus Lake, Kachess Lake, and Bumping Lake (Yakima River) sockeye
- The tribes, in appropriate coordination with other Columbia River Basin tribes and First Nations, will investigate options for reintroducing salmon and lamprey above Grand Coulee, Dworshak, and the Hells Canyon Complex dams. See the recommendations Restoring Fish Passage and Columbia River Treaty.

Technical Recommendation 6 (formerly Juvenile Salmon Passage)

Juvenile Fish Migration

Use flow, spill, drawdowns, peak efficiency turbine operation, new turbine technology, and predator control projects to improve in-river juvenile salmon survival; avoid fluctuations caused by power peaking operations.

Online

The complete 1995 recommendation 315.

Habitats Involved

Mainstem

Life Stages Involved

Smolt

Current Status

The dams on the Columbia and Snake rivers continue to adversely impact juvenile anadromous salmonids and lamprey during their migration to the ocean. In fact, downstream juvenile migration is the life history stage where most of the human-caused salmonid mortality occurs. In 2013, for example, chinook and steelhead passing passed through the eight-dam mainstem system, mortality was 47.7% and 56.4%, respectively (NMFS 2013).

Construction of the dams created a series of reservoirs, destroying mainstem habitat, increasing juvenile travel time, and facilitating predation by making invasive and natural predators more effective. Operation of the hydrosystem alters the natural hydrograph of the river system, reducing flow in the spring migration season and adding again to juvenile migration times. The dams themselves impair passage and pose one of the largest single sources of mortality for juvenile salmon migrants. Transportation of fish around dams by tanker trucks and barges is ongoing: juvenile fish continue to suffer from both direct and delayed mortality effects.

The 1995 Spirit of the Salmon Plan called for the implementation of a program of short-term and long-term juvenile passage and mainstem habitat restoration measures at both the federal and non-federal Columbia and Snake River dams. These measures addressed flow, spill, transportation, turbine efficiency, and structural changes. While numerous improvements have been made to the Federal Columbia River Power System (FCRPS) over the last 15 years, significant mortality still occurs. The juvenile dam survival standards in the 2008 Biological Opinion (BiOp) (93-96% at each dam), still allow for up to 28% mortality at the dams for spring migrants and 44% mortality for summer migrants (for those fish passing eight federal dams). This does

not include any mortality that may occur in the reservoirs, which vary widely based on yearly water conditions. The National Marine Fisheries Service (NMFS) has not determined what standards will be included in the 2018 BiOp.

The mid-Columbia Public Utility District (PUD) dams that impact upper Columbia stocks are to meet a dam passage survival standard of 93% for juveniles that pass the projects. Similar to the FCRPS, this standard does not take into account any mortality that may occur in the reservoirs. The Federal Energy Regulatory Commission (FERC) licenses govern the PUD dams. Habitat Conservation Plans (required under Endangered Species Act implementation) and Memoranda of Agreement. The NMFS biological opinions associated with these FERC licenses do not require measurement to see if the survival standard is being met.

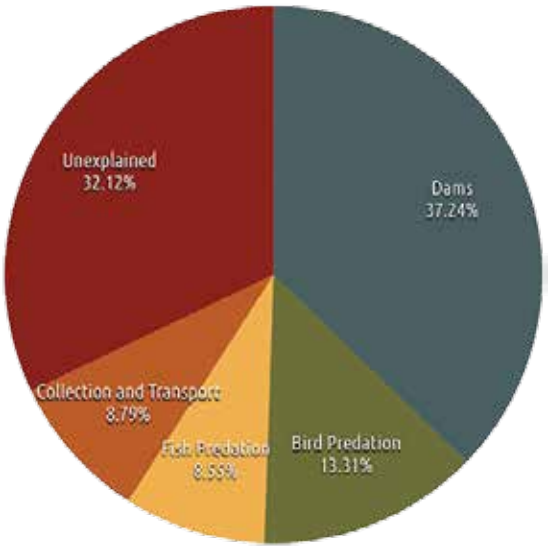
Assessment

The environment encountered by juvenile salmon during their migration through the mainstem Columbia and Snake rivers has changed significantly over the last 15 years. These changes include both structural improvements and operational changes, in the case of FCRPS projects, and stem primarily from revised Biological Opinions for the FCRPS (2004 and 2008) and court-ordered spill operations resulting from litigation over those BiOps. In the litigation, the tribes were critical to winning concessions that improved conditions for fish migration. The subsequent agreements under the Columbia Basin Fish Accords cemented these benefits.

While structural changes have been made at mid-Columbia PUD projects, their benefits have been used to reduce spill operations, leaving no net benefit (and potentially a negative) for juvenile migrating fish.

Operations: Significantly, a 2005 federal court order called for operations to move to 24-hour spill at all FCRPS projects in both the spring and summer. Prior to 2005, John Day, McNary, Little Goose, Lower Monumental, and Lower Granite dams had no daytime spill during the spring season and in the Snake River no spill during the summer. (Instead juvenile summer migrants from the Snake River were transported below the dams.) The order also allowed for earlier spring spill and increased spill volumes at many projects, most notably at Bonneville and Lower Monumental

Chinook Migration Mortality



Sources of mortality for juvenile Snake River hatchery spring/summer chinook outmigrating 2006-2011.

Dams are the single largest source of human-caused mortality for Snake River hatchery spring chinook and other salmonids.

dams. For more details, tables, FCRPS Spring Spill, and FCRPS Summer Spill, go to 376.

The court order did not address mid-Columbia PUD dams. These dams have actually reduced spill over the years as structural changes have been implemented, as shown in the table Mid-Columbia Spill Comparison 2000 and 2011 that is found online at 376.

Transportation: In conjunction with the spill changes, the order solidified the "spread the risk" approach reducing the number of juveniles transported by tanker trucks and barges below the FCRPS dams. The percent of fish transported has decreased from 63%-97% before the order (2003 and 2004, depending on species) to 36%-48% after (2011, depending on species).

PROPORTION OF SALMON TRANSPORTED, 1999-2011. Hatchery (H); Wild (W).

	Yearling Chinook	Steelhead	Subyearling Chinook	Sockeye
1999	77.7% (H) 86% (W)	82.5%	87.0%	
2000	71%	81%	93%	
2001	98.0%	98.6%	96.2%	
2002	68.3%	67.7%	92.9%	
2003	62.9%	67.0%	89.5%	
2004	87.0%	96.4%	97.2%	
2005	92%	94%	80.9%	
2006	61.1% (H) 57.9% (W)	76% (H) 79.3% (W)	52.1% (H) 56.2% (W)	59.2%
2007	24.2% (H) 16.8% (W)	47% (H) 43.7% (W)	35.7% (H) 35.8% (W)	53.2%
2008	49.3% (H) 48.8% (W)	41% (H) 44.7% (W)	58.1% (H) 46.3% (W)	62%
2009	36% (H) 40% (W)	46% (H) 48% (W)	51.1% (H) 44.8% (W)	65.4%
2010	24% (H) 40% (W)	39% (H) 42% (W)	56% (H) 49% (W)	33%
2011	42% (H) 40% (W)	36% (H) 48% (W)	46% (H) 42% (W)	39.5%

*Fish transported from Lower Granite, Little Goose, Lower Monumental, and McNary dams prior to 2006. After 2006 only subyearlings transported from McNary Dam.

Total Dissolved Gas: The 1995 FCRPS BiOp endorsed a Total Dissolved Gas (TDG) standard of 115% as measured by forebay monitors and 120% as measured by tailrace monitors instead of the 125% TDG level that was identified in the 1995 risk assessment as supported by the tribes in the Spirit of the Salmon Plan. This more conservative level was chosen since no voluntary spill program existed before this time and its effects were uncertain. Oregon and Washington both adopted the 115%/120% standards; however, Oregon has since dropped the forebay requirement. Data collected from 1995 to the present still supports the original 1995 risk assessment that levels of TDG up to 125% pose little risk to aquatic species. The higher standard allows for more spill and associated passage survival benefits; the tribes continue to advocate for the higher levels of TDG up to 125% in the tailrace.

Structurally, the hydroelectric dams have gone through extensive retrofits on the spillways and tailraces to greatly reduce the production of TDG and still provide adequate spill for safe fish passage.

Turbine Efficiency: The 2008/2010 FCRPS BiOp calls for turbine operations to be in the 1% operating band through the entire fish passage season. A 1% operating band provides the best turbine passage conditions for fish that use that route.

Spill Passage Efficiency: The 2008 Accords identified minimum for spill passage efficiency (passage efficiency through spillways) per project, which the U.S. Army Corps of Engineers has committed to maintain. These range from 36% to over 90%.

Reach Survival: No specific reach survival metrics were included in the 2008/2010 FCRPS BiOp. However, operational and structural changes that have aided survival through the hydrosystem have also improved reach survival for in-river migrants. Smolt-to-adult return rates (SARs) for in-river migrants are now similar to SARs for transported migrants. As a result, transportation benefits have diminished for all salmonid species; and, depending on migration time and species, transportation may add no benefit at all.

Despite the improvement at the federal dams, SARs are still short of what is needed for recovery (ISAB 2012). In addition, recent comparative survival study results indicate a difference in the SARs between Snake River migrants and upper Columbia stocks outmigrating in the same year (Comparative Survival Study Oversight Committee and Fish Passage Center 2012). The study shows that since 2004 the smolt-to-adult survival ratio is smaller for upper Columbia River stocks.

A likely, though not a conclusive, explanation is that over the past decade spill volumes at mid-Columbia projects have decreased while

spill in the Snake River has increased (Comparative Survival Study Oversight Committee and Fish Passage Center 2012). The data show poorer reach survival between Rock Island to McNary (for upper Columbia River stocks) than between Lower Granite to McNary (for Snake River stocks).

Structural Improvements: Starting in 2001, new surface passage structures (removable, top, adjustable spillway weirs, and the Bonneville corner collector) have been added to the FCRPS dams. Surface passage structures allow downstream migrating fish to pass the dam at the surface. This reduces juvenile fish passage delay, improves water quality, makes more efficient use of spill, improves juvenile fish survival, and helps direct more fish over the spillway instead of through the bypass. When downstream migrating fish pass dams at the surface, the result is fewer fish transported downstream by barges and trucks. All FCRPS dams on the Snake and

Major Dam Structural and Operational Changes Since 2000

BONNEVILLE DAM

- Corner collector installation (2004) and using Powerhouse II as primary powerhouse
- New flow deflectors and new spring and summer spill patterns and volumes
- Modifications to the Powerhouse I sluiceway to improve efficiency

THE DALLES DAM

- Spill wall construction (2010) and modified spill pattern
- Improved avian wires to reduce predation in the tailrace of the dam

JOHN DAY DAM

- Construction of two top spill weirs (2008)
- 24-hour spill program; testing 30 or 40% spill for both spring and summer
- Much improved avian wires to reduce predation in the dam's tailrace

MCNARY DAM

- Construction of two top spill weirs (2007)
- 24-hour spill program, 40% for spring and evaluating both 40 and 60% in the summer
- Juvenile outfall bypass was relocated in 2012 to improve tailrace egress and survival

ICE HARBOR

- Installed one removal spillway weir and tested new 24-hour spill program comparing 45 kcfs/spill to the gas cap at night versus 30% spill
- Relocated juvenile outfall bypass to improve tailrace egress for bypass

LOWER MONUMENTAL

- Installed one removal spillway weir (2008) and tested new 24-hour spill program with spill levels set to the total dissolved gas standard
- Juvenile outfall bypass was relocated in 2012 to improve tailrace egress and survival

LITTLE GOOSE DAM

- Installed new top spill weir (2009) and tested new 24-hour spill program of 30% spill

LOWER GRANITE DAM

- Installed one RSW (2001) and implemented 24-hr spill program of 21 kcfs spill

PRIEST RAPIDS DAM

- Installed specific spill pathways in 2010

WANAPUM DAM

- Installed the Wanapum Future Unit Bypass in 2009

ROCKY REACH DAM

- Installed a juvenile bypass in 2003, with final configuration occurring in 2007 (beginning no-spill operations)

Columbia rivers now have at least one surface passage structure. In the mid-Columbia, Rocky Reach and Wanapum dams have surface pass structures. Additional structural changes have also been made to improve juvenile fish passage, such as installation of spill deflectors, restructuring of spill walls, relocation of juvenile outfalls to improve tailrace egress, and improved avian wire systems to lower predation in the tailrace.

Through implementation of increased spill levels and structural changes, the FCRPS is aiming to reach an average, per dam, passage survival standard of 96% for spring migrants and 93% for summer migrants. These standards are currently being tested. System survival appears to have increased under these operations. With spill and surface spill structures, chinook survival from the Snake River Trap at the Lewiston Bridge to McNary Dam was 75.3% and 74.3% in 2009 and 2010, respectively, in contrast to 53.1% in 2001 when no spill was provided. This compares to an average survival from the Salmon River to Ice Harbor Dam of just 33% following the completion of Lower Monumental and Little Goose dams in 1970, but an 89% survival in the same reach prior to the construction of those dams (1966-68).

Flow: Flow targets called for in the 1995 Spirit of the Salmon Plan have not been achieved. The 2008 BiOp includes flow objectives that are not mandatory.

Drawdown: Drawdown of the reservoirs called for in the 1995 Plan have not been achieved. Litigation on the FCRPS BiOp led to the development of a Plan of Study for John Day Reservoir drawdown, which serves to accelerate drawdown of that reservoir should certain biological decline triggers be met.

New and Modified Actions

If the FCRPS or mid-Columbia PUD projects do not meet performance measures (96% and 93% for FCRPS and 95% for mid-Columbia) and/or SARs decline precipitously, this could force the region to look at additional or alternate solutions. This could include actions to:

- Further alter spill programs through increased spill or changes in spill timing to improve juvenile passage past the dams.
- Install additional passage structures (i.e., Wanapum Dam-style surface routes or similar surface bypass structures).
- Further alter project operations to better accommodate juvenile fish passage past the dams by, for instance, changing the turbine operating range.
- Investigate altered flood control (to create a more normative hydrograph).
- Further study of dam removal options.

Online

The complete 1995 recommendation 316.

Technical Recommendation 7

Estuary Protection and Restoration

Protect and restore critical estuary habitat.

Habitats Involved

Estuary

Life Stages Involved

Smolt, adult

Current Status

The Columbia River estuary, the tidally influenced area that forms the border between Oregon and Washington, extends from the river's plume upstream 146 miles to Bonneville Dam. The 1995 Plan describes the biological function of the Columbia River estuary and the degradation and diminishment that began with accelerated human development in the decades following the treaties of 1855.

A U.S. Environmental Protection Agency study in 2007 (Hayslip et al.) concluded that the lower Columbia River estuary's overall ecological condition was only fair, while conditions in particular estuarine areas were poor. More recently the National Marine Fisheries Service (NMFS) declared estuary degradation a "key limiting factor" to the recovery of salmonids (2011).

A 2013 analysis compared the land cover data for 2010 to GIS interpretations of the late-1800s pre-development survey maps; the comparison showed a 70% loss of vegetated tidal wetlands and 55% of forest uplands (Corbett 2013 and cited in NMFS 2013).

Recent studies (Bottom et al. 2008) confirmed that the estuary is essential habitat for salmon and that salmon select for shallow wetland habitats in the estuary to feed and avoid predators as they prepare to enter the ocean. Similarly, Pacific lamprey depend on the estuary during juvenile rearing and migration life stages (CRITFC 2011).

Between 2005 and 2010, the U.S. Army Corps of Engineers dredged over 130 miles of riverbed to create a 43-foot-deep shipping channel from the mouth to the ports of Portland, Oregon and Vancouver, Washington. This, together with many previous dredging projects, created sandy islands that support unnaturally large flocks of predatory birds, such as Caspian terns and double-crested cormorants.

These birds feed on outmigrating smolts and represent a threat to salmon recovery in the estuary (Evans et al. 2012).

Assessment

Regional scientists have developed new predictive methods, data and other scientific tools that are yielding improved an understanding of the estuarine and nearshore marine areas (Columbia River Estuary Conference 2012).

Emerging research on toxic contamination describes toxic pollutants in the estuary and their lethal and sublethal effects on salmonids (Sethajintanin 2004, Sloan 2009, Yanagida 2011, Johnson 2013).

Another new and pressing concern for the estuary involves potential impacts from climate change. Effects of climate change, such as changes in flow, spring freshet, and water temperatures, have the potential to deplete available rearing habitat. Other changes include rising tidal influences, increased salinity, and more invasive species.

In addition, changes to river flow stemming from negotiations within the Columbia River Treaty process could have huge impacts on habitat. Reestablishing sustained peak flows could aid river and estuarine processes that would stimulate similar sediment transport in the rivers and sediment plumes in the estuary that occurred historically.

The proliferation and impact of non-native species (aquatic and avian) and continued maintenance dredging are threats that require more attention in terms of both research and preventive and remedial action than is currently being given to them. See the new technical recommendation Invasive Species.

With the 2009 establishment of the Lower Columbia River Estuary Program and the 2011 NMFS Columbia River Estuary Endangered Species Act Recovery Plan, the institutional framework for protecting and restoring the estuary is coming into place. The Federal Emergency

Columbia River Estuary

The Columbia River estuary is a critical intersection between freshwater and saltwater. Juvenile salmon and lamprey spend days or weeks gradually acclimatizing themselves to increasing concentrations of salts. The adult fish use estuary areas to readjust body chemistry to the freshwater environment. Tidally influenced changes in the Columbia River are observed as far upstream as Bonneville Dam at river mile 146.

Management Administration's recent policy on national flood insurance could limit additional damage from floodplain development (FEMA 2012). Funding for estuary work, as described in the updated Water Quality (Toxic Contamination) recommendation, continues to be an outstanding problem.

New and Modified Actions

- Use a larger, more comprehensive ecosystem approach.
- Increase land acquisition to achieve the goal of habitat restoration.
- Implement moratoriums on floodplain development.
- Take actions that create and support diversity and longer periods of use by salmon.
- Incorporate new scientific tools and findings.
- Address the connectivity and cumulative effects of upriver activities, e.g., hydropower operations and estuary conditions.
- Integrate climate change considerations.

Technical Recommendation 8

Ocean Harvest

Establish Alaskan and Canadian ocean fisheries based on chinook abundance.

Online

The complete 1995 recommendation 317.

Habitats Involved

Ocean

Life Stages Involved

Adult

Current Status

In 1999 the Pacific Salmon Commission (PSC) adopted an abundance-based approach for chinook fisheries in Canada and Alaska to replace the ceiling-based approach in the 1985 Chinook Chapter to the Pacific Salmon Treaty 1289. The abundance-based approach is based on the estimated aggregate abundance of chinook stocks contributing to the fishery.

Assessment

One of the original purposes of the Pacific Salmon Treaty was to rebuild chinook stocks coastwide by 1998. Many stocks remained below rebuilding levels at the end of the original rebuilding period due to decreased survival rates attributed to poor environmental conditions. The ceiling-based approach did not produce the intended results of rebuilding stocks. An approach more responsive to changes in abundance was adopted instead.

Some chinook stocks responded positively to the abundance-based approach as measured by increases in terminal area returns. Other chinook stocks, particularly in British Columbia and Puget Sound, did not respond. The largest stocks drive the estimated aggregate abundance in a

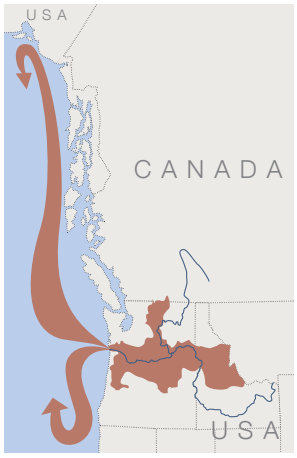
Ocean Fisheries

Columbia River chinook are caught in ocean fisheries. Three types of ocean-going vessels, purse seiners, trollers, and gill netters, commercially harvest salmon. Above is a troller. Photo courtesy Apalachicola National Estuary Research Reserve site.

fishery. Changes in abundances of small stocks may not correspond to the changes in abundances of large stocks. The consequence is the implemented fishing regimes are not as responsive to the needs of small stocks.

The current Chinook Chapter runs through 2018, with a review after the 2013 fishing season. The Chinook Chapter outlines a number of assignments to the PSC Chinook Technical Committee (CTC) designed to better inform policy makers on the management of the fisheries. Implementation of a total mortality approach, which accounts for landed catch and incidental fishing mortalities, is one assignment. Investigation into precautionary management approaches, which incorporate additional information, such as environmental data to better evaluate trends in abundance, is another assignment. Resolution on the assignments to the CTC has been slow due to policy differences and lack of resources. State and federal agencies have reduced capabilities because of budget constraints.

Salmon Range



The Columbia's upriver salmon populations migrate to the Pacific Ocean as far north as Southeast Alaska and along Oregon's coast.

New and Modified Actions

- Complete CTC assignments by committing the necessary resources.
- Maintain and enhance the indicator stock program.
- Evaluate exploitation rates in the current management approach for effects on coastwide rebuilding of all stocks.
- Investigate options to modify the abundance-based approach to be more responsive to variations in small stocks.
- Evaluate effects of expanding mark selective fisheries on rebuilding. Also see the new technical recommendation Mark Selective Fisheries.

Technical Recommendation 9 (formerly Adult Salmon Passage)

Adult Fish Migration

Use stored cold water, additional ladders, ladder improvements, and ladder maintenance to enhance mainstem adult passage; incorporate 24-hour video fish counting.

Online

The complete 1995 recommendation 318.

Habitats Involved

Mainstem

Life Stages Involved

Adult

Current Status

The construction and operation of mainstem hydroelectric dams continue to impair adult salmonid and lamprey migration to spawning locations in the Columbia River Basin. The dams have resulted in higher water temperatures unsuitable for salmon; hazardous passage through dams via fish ladders; fallback at fish ladder exits; and increased opportunities for salmon predators.

Recent survival rates indicate an improvement over those reported in the 1995 Plan. From 2009 through 2011, the survival of adult fish passing eight Federal Columbia River Power System (FCRPS) dams in the Columbia River Basin (Bonneville–Lower Granite dams) ranged as shown below. The FCRPS Biological Opinion (BiOp) targets, issued in compliance with Endangered Species Act, are shown in parentheses. These targets are to be met each year and are not averages. The rates do not account for increased predation on adults, particularly below Bonneville Dam.

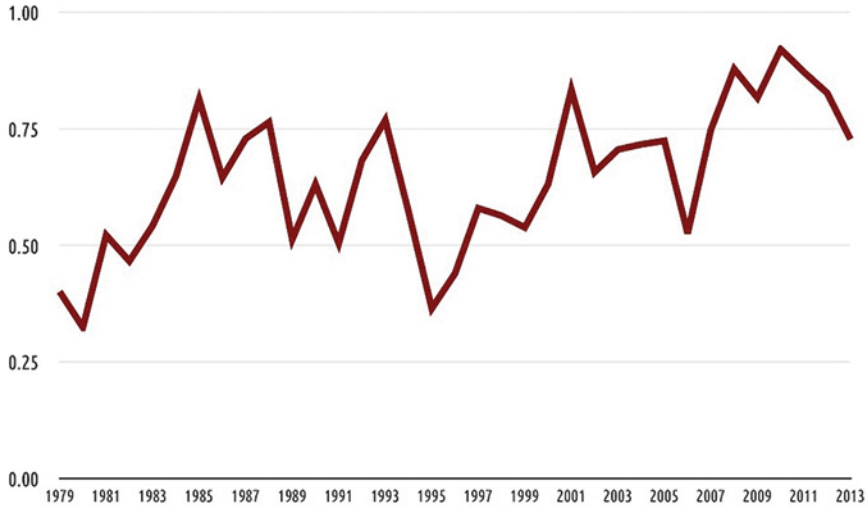
- Snake River spring chinook – 88 to 92% (BiOp target 91%) 1986-2012 figure
- Upper Columbia spring chinook – 88 to 97% (BiOp target 90.1% only for Bonneville–McNary)
- Snake River sockeye – 67 to 83% (BiOp target 81.1%)
- Snake River steelhead – 75 to 83% (BiOp target 90.1%)
- Snake River fall chinook – 85 to 88% (BiOp target 81%) 1986-2012 figure

Also, upstream survival for some salmon stocks appears to be increasing slightly over time. The figures on the next page for Snake River spring/summer chinook and Snake River fall chinook show upstream survival based on conversion rates.

Conversion Rate Change Over Time

Conversion rates for Snake River spring/summer chinook from Bonneville to Lower Granite dams

Conversion rates for Snake River fall chinook from Bonneville to Lower Granite dams



Conversion rates are an upstream survival estimate corrected for harvest. The Technical Advisory Committee, composed of tribal, federal, and state biologists, estimates conversion rates as part of run reconstructions. Conversion loss includes other sources of mortality, such as passage loss, natural mortality or unaccounted for harvest. Conversion rates are not corrected for lock passage, fallback, and re-ascension nor are they adjusted for errors caused by fish passing outside of standard seasonal count dates.

The mid-Columbia dams (Wells, Rocky-Reach, Rock Island, Wanapum, and Priest Rapids) are not included in the FCRPS BiOp; rather they are regulated by the FERC licensing process. The National

Marine Fisheries Service (NMFS) biological opinions associated with these FERC licenses assumes no more that 2% adult passage mortality across the concrete of each dam. However, NMFS does not require these assumptions to be measured.

More information about adult fish passage and migration is provided in the technical recommendations Adult Salmon Passage and Predation.

Assessment

Operators of the FCRPS took actions related to recommendations in the 1995 Spirit of the Salmon Plan for cold-water flow augmentations from Dworshak Dam during the summer, fishway modifications to improve the upstream migration habitat for adult salmonids, and 24-hour fish counts to provide for more precise management data. They are briefly evaluated below, and several newer issues are described.

Water temperature: In the early 2000s, the region formalized a process which uses technical personnel from tribal, state and federal agencies—called the Technical Management Team (TMT)—to regulate the release of cold water at Dworshak to help assure that state water quality standards are met (i.e., to stay below 68°F). Through regional processes, salmon managers and agencies annually manage the reservoir between elevations 1,600' and 1,535' (65' range) for release in July and August for flow augmentation and temperature control. In the 2004 Snake River Basin Adjudication, the Nez Perce Tribe reserved an additional 15 feet of drawdown (to as low as 1520), previously used in July/August, for release in September (or earlier if the tribe deems necessary).

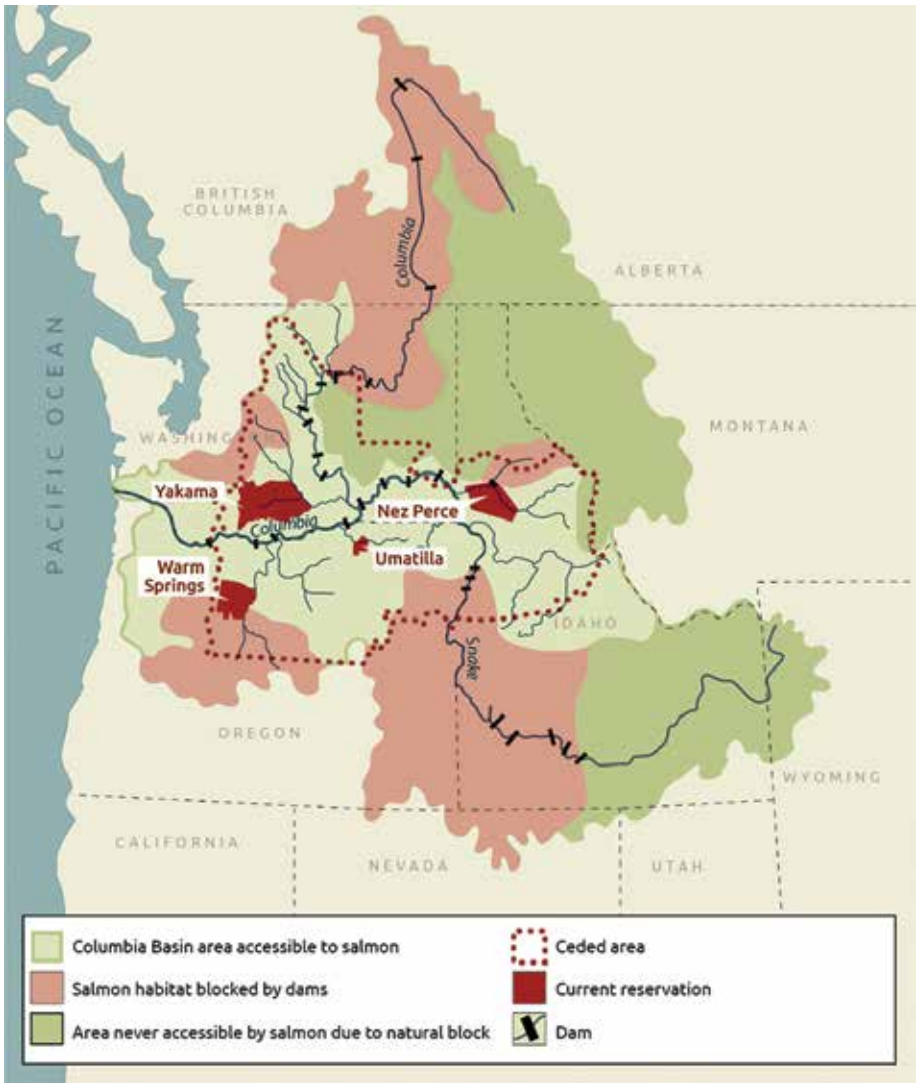
Fishway modifications: Multiple fishway modifications have been added to FCRPS dams since 1995, improving adult passage. Adult attraction flows through fishways were increased at Ice Harbor, McNary, and John Day dams. New serpentine sections were added to John Day Dam in 2004 to reduce adult leaping and injury in the upper sections of the ladder. Sea lion exclusion devices were added to the ladder entrances at Bonneville Dam. (Sea lion predation is also addressed through hazing and other management actions.)

Fish counting: To improve fish counting, the hydraulics at count stations at John Day, Bonneville, and The Dalles dams were improved reducing delay and milling of fish. In addition, PIT (passive integrated transponder) tag detectors are now at Bonneville, McNary, Lower Granite, and Ice Harbor dams to allow for counting 24 hours a day. PIT tag counting allows for calculations on the effects of juvenile

outmigration on adult returns (by route) and reservoir survivals for individual fish.

Fallback: Adult fallback has been reduced by changing project procedures at Bonneville Dam to give priority to operating Powerhouse II, which moves downstream generation flow away from adult fish passage exits. At The Dalles Dam, the addition of a spill wall and changed spill patterns has decreased adult fall back (although this was a beneficial side effect of other efforts). McNary Dam still has large issues with fallback with winter steelhead because no safe fallback route is available during the non-spill season when these adults are present. Regional managers are trying to find a safer downstream route of passage to address this issue.

Habitat Blocked by Columbia and Snake River Dams



Columbia and Snake river dams and blocked habitat in relation to tribal ceded lands.

Kelt downstream passage: Currently, there is no regional strategy for downstream passage of Snake River and mid-Columbia kelts. The safest passage occurs through open surface routes, sluiceways, and spillways during their outmigration, which usually starts in late February. Due to costs, many of these passageways are closed during parts of the season. The 2008 BiOp, which relies on kelt survival improvements, has allowed regional negotiations on improving and securing kelt passage at certain projects. CRITFC negotiated improved passage for kelts at Bonneville and The Dalles dams and is currently reviewing other critical locations.

Independent inspection and monitoring: After September 11, 2001, security measures have limited the ability for independent tribal monitoring at the dams.

Lamprey structural improvement: Lamprey structural improvements are being installed at many ladders. Ladder improvements to benefit salmon have been co-designed to assist lamprey during their upstream passage as well. Lamprey-focused improvements are being tested to assure they are not detrimental to adult salmon passage. See the updated technical recommendation LAMPREY.

Mid-Columbia passage: No significant adult passage improvements have been made since 2001 at the mid-Columbia PUD projects. Neither dam passage nor reach survival are monitored at these projects.

New and Modified Actions

While the actions implemented since 1995 incrementally improved adult salmon passage survival rates, they did not meet the BiOps' annual targets. Additional actions need to be implemented to meet BiOp targets:

- Fish facilities should have full components of spare parts and backup systems.
- Additional ladders should be added at Lower Granite and Little Goose dams to give them two each, ensuring adequate passage should one ladder fail and cause adult blockage, as occurred in 2013 at Lower Granite Dam.
- Additional adult PIT tag monitoring locations should be added at John Day, The Dalles, Lower Monumental, and Little Goose dams to better identify losses in the FCRPS system. Similarly, additional PIT tag monitoring locations should be investigated for the mid-Columbia PUD dams that do not have them so that losses can be identified in that reach.
- Increase PIT tagging in the upper Columbia River, in accordance with consensus regional technical recommendations, to allow for comparisons of smolt-to-adult returns (SARS) for Snake River and upper Columbia populations.
- Monitoring systems for the adult fish facilities should be fully automated and not require operators to make manual adjustments.
- Install an adequate adult fishway trash rake system at Bonneville Powerhouse II; the system should protect lamprey and be easily maintained.

- Ensure adequate auxiliary water supply systems at critical fish ladders, i.e., the Dalles, Little Goose, and Lower Granite dams to ensure ladder functionality in instances where the primary water supply system fails.
- Add shade cloth to adult ladders where needed to aid in reducing temperature difference within ladders and at exits, which can impede adult migration.
- Review mid-Columbia project licenses to determine if improvements similar to those at FCRPS dams can be made at mid-Columbia dams.

Other actions:

- Integrate adult lamprey passage assessment and needs into a new anadromous fish migration and passage recommendation in a new Spirit of the Salmon Plan. Until then, see updated technical recommendation LAMPREY.
- Continue improving and installing lamprey dam passage structures.

Technical Recommendation 10

Water Quality

Improve mainstem and tributary water quality by eliminating sources of toxic pollution that accumulates in fish tissue and by reducing discharges of other contaminants to meet water quality criteria for anadromous fish.

Online

The complete 1995 recommendation 319.

Habitats Involved

Mainstem, tributary

Life Stages Involved

Smolt, adult

Current Status

Toxic contaminants in the Columbia River watershed can negatively impact the health and vitality of our fish. The results of an U.S. Environmental Protection Agency (EPA) fish contaminant survey, completed in cooperation with CRITFC, showed that 92 priority pollutants were detected in resident and anadromous fish tissue collected from 24 different tribal fishing sites on the Columbia River (2002). Contaminants measured in these fish included PCBs, dioxins, furans, arsenic, mercury, and DDE, a toxic breakdown product of the pesticide dichlorodiphenyltrichloroethane (DDT).

In January 2009, the EPA released the *Columbia River Basin: State of the River Report for Toxics* 1292, a look at toxic contaminants in the basin. The report focused on persistent toxic chemicals, which remain in the environment for a long time, contaminate food sources, and accumulate in fish and birds. The report identified four contaminants of primary concern because they are "found throughout the Basin at levels that could adversely impact people, fish, and wildlife." These four are mercury, DDT and breakdown products, polychlorinated biphenyls (PCBs), and polybrominated biphenyl ethers (PBDEs).

More is now known about the presence and effects of the toxic contaminants identified in the 1995 Spirit of the Salmon Plan and about other contaminants.

PBDEs, linked to impaired endocrine and thyroid functions, were found to be increasing in whitefish in the upper Columbia River (Rayne et al. 2003). Endocrine-disrupting compounds thought to be the cause of intersex characteristics and elevated female egg yolk protein levels in male juvenile chinook salmon were at 22 of the 23 sites sampled by Nilsen et al. (2007). Morace (2012) consistently found

human-health pharmaceuticals and PBDEs in wastewater treatment plant effluents in cities along the Columbia and measured estrogenicity levels that were well above those shown to cause effect in aquatic biota.

Currently used pesticides, herbicides, and insecticides contain chemicals that have sublethal effects on salmon, including problems with olfaction, homing, and predator avoidance (Sandahl et. al. 2007). Mixtures of pesticides can have an additive or synergistic effect. Laetz et. al. (2009) determined that mixtures of diazinon, chlorpyrifos, malathion, carbaryl, and carbofuran—the most extensively used pesticides in California and the Pacific Northwest—significantly inhibit the ability of salmon to react to essential stimuli, and therefore the presence of these mixtures may be affecting salmon recovery more than expected. Studies have directly correlated prespawn mortality to chemical pollutants in non-point-source urban runoff (Spromberg and Scholz 2011).

The tribes always treated water as a medicine because it nourished the life of the earth, flushing poisons out of humans, other creatures and the land. We knew that to be productive, water must be kept pure. When is kept cold and clean, it takes of the salmon.

Levi Holt, Nez Perce

Oregon and Washington (2013) recently documented that mercury concentrations in fish in the Columbia River Basin exceed those considered safe for ecosystem and human health. What is still not known is which factors are most important in controlling the production of the bio-accumulative and toxic organic form, methylmercury. Scientists do know that the formation of methylmercury can be linked to parameters associated with water management activities in reservoirs, such as water inundation and wetting and drying cycles, organic carbon and nutrient cycling, and inputs from upland terrestrial habitats. Needed is a better understanding of the linkage between reservoir management and the risk of mercury methylation. Operational approaches to minimize the risks associated with mercury contamination can and should be developed while still meeting the critical water needs.

As mentioned in the 1995 technical recommendation ADULT SALMON PASSAGE 318, sediment sorption is one of the mechanisms that allows contaminants to persist in the environment, degrade habitat, and present an exposure risk to fish and other organisms. In the Yakima basin, organochlorine pesticides, nutrients, dissolved oxygen, and bacteria problems are associated with suspended sediment loading and transport from agricultural activities into the river (Morace et al. 1999). Implementation of best management practices in the area is showing a broad range of water quality and aquatic habitat improvements (Joy 2002).

Water quality is a priority concern for tribal people who consume fish that may be tainted with toxic contaminants. CRITFC tribal members that were surveyed in the fall and winter of 1991-1992 ate

six to eleven times more fish than EPA's estimated national average, at that time, 6.5 grams per day (CRITFC 1994). If tribal members had access to resume ancestral cultural diets, the quantity of fish in the diet would be even greater. In 2011 Oregon adopted water quality standards based on the tribal fish consumption rate of 175 grams per day that was documented in the CRITFC survey. Washington is revising its water quality standards, and EPA recently disapproved Idaho's request to use a fish consumption rate of 17.5 grams per day because it was not protective of tribal consumers.

While elevated water temperature is a major factor negatively affecting fish at all life stages, as of 2013, no temperature Total Maximum Daily Load is required for the Lower Columbia system. Some progress has been made, however, in reducing temperature by release of cool water from behind dams with high head reservoirs. See the updated technical recommendation Adult Fish Migration.

Water Quality Monitoring

Nez Perce Water Resources staff taking water samples on Big Canyon Creek, a Clearwater River tributary.

Nez Perce Water Resources Division collects water quality data for streams, ponds, reservoirs, groundwater, springs and other water bodies on the tribe's 770,000-acre reservation. The water resources division tracks trends in water quality, evaluates the effectiveness of management practices and targets areas for restoration.

Assessment

Growing evidence supports the alarming fact that Columbia Basin fish are exposed to a wide range of dangerous toxins. Exposure can cause abnormalities including tumors, lesions, and endocrine imbalances that affect fish reproduction and cellular development. Mortalities can also result from diseases and changes in behavior associated with toxic exposure and bioaccumulation of pollutants.

In 2005 CRITFC tribes joined EPA Region 10 and numerous other federal, state, and local agencies, and others to form the Columbia River Toxics Reduction Working Group. To date, implementation of its goal to reduce human and ecosystem exposure to toxics has been greatly restricted by a lack of realistic and sustainable funds. In 2011, based largely on CRITFC's Fish Consumption Survey, EPA approved Oregon's water quality standards. Oregon became the first state in the nation to adopt water quality standards based on human health criteria that recognize tribal

customs and culture. The enforcement of Oregon's strict water quality rules will make it safe to eat 175 grams per day or about 23 servings of 8 oz. of fish per month. While adoption of standards represents progress in controlling toxics, the standards must be enforced for water quality to improve. Washington and Idaho need to update their water quality standards to provide a similar level of protection for high fish-consuming tribal members and others.

In 2013 the 15 treaty tribes of the Columbia River Basin agreed to form a coalition that would focus on water quality challenges that face the Columbia River. The coalition intends to unite on efforts to establish regional water quality standards and management standards that are protective of the health of high fish-consuming tribal members.

Currently no sustained funds are directed to the Columbia River Basin for toxic reduction activities and monitoring programs—as called for the 1995 Spirit of the Salmon Plan—or for research. Major federal investments in such programs are now critical and can help offset impacts from the Federal Columbia River Power System. In 2008 the Columbia River Basin was designated a Large Aquatic Ecosystem by the EPA but receives the least amount of funding for water quality research and monitoring of all the great river and water bodies in the United States. The lower Columbia River estuary receives $600,000 a year in federal funding whereas Puget Sound, Chesapeake Bay, and the Great Lakes each receive well over $50 million.

Pollution prevention and green chemistry strategies that hold the most promise for toxic reduction in the Columbia River are limited by the lack of progress on reform of the Toxic Substances Control Act (TSCA). Current TSCA rules impose burdens on government to prove actual harm to control or replace a chemical, which stifles the development of safer chemical and product designs.

New and Modified Actions

- A unified tribal approach is needed to establish regional water quality standards, regional aquatic life criteria, and regional best management practices that are protective of the health of high fish-consuming tribal members and the quality of tribal First Foods. Tribes throughout the Columbia River Basin, in coordination with CRITFC, are interested in establishing a regional approach to water quality standards and best management practices and advocating for the implementation of the reasonable and prudent alternative measures that the National Marine Fisheries Service Biological Opinions have recommended limiting the impact of 37 active ingredients in current use pesticides and herbicides.
- TSCA reform promises to improve the effectiveness of reducing toxic chemicals at their source instead of having to deal with them once they enter the environment. CRITFC will work to support TSCA reform and promote green chemistry and pollution prevention strategies that limit the release of toxic chemicals into the environment.
- Advocate for a renewed Columbia River Restoration Act that would provide the financial support needed for a large-scale ecosystem protection program to conduct the monitoring and remediation programs necessary to protect the watershed on a basinwide scale.
- Dam system managers should conduct a programmatic review and assessment of how hydropower projects impact the uptake of mercury and other toxic substances in the mainstem Snake and Columbia rivers and identify opportunities for operational changes or other actions to help mitigate these impacts and reduce toxic contamination. Evaluate how environmental toxicants impact the reproductive fitness of fish impounded behind dams.
- Implement restoration actions through subbasin plans and third-party eco-certification programs that promote best management practices to agricultural runoff, municipal and industrial stormwater, and other non-point-sources of pollution.

Online

The complete 1995 recommendation 320.

Technical Recommendation 11 (formerly Stock-Specific Harvest)

Harvest Management (In-river)

Closely monitor tributary salmon production and escapement to improve management.

Habitats Involved

Mainstem, tributary

Life Stages Involved

Adult

Current Status

While many of the populations of upriver salmon (including steelhead) are listed for protection under the Endangered Species Act, returns of upriver runs have increased from the 1990s and provided harvest opportunities. The harvest schedules for each run are set under the court-adopted 2008-2017 *United States v. Oregon* Management Agreement 1288. Most hatchery production is also covered in the management agreement.

Spring chinook returns provide for tribal ceremonial and subsistence fisheries and, in some years, commercial fisheries. The return timing of spring chinook to Bonneville Dam has been consistently later in recent years compared to years prior to 2000. The cause is not readily apparent. The spring chinook return has often been less than pre-season forecasts in recent years with no obvious cause.

Summer chinook and sockeye provide fishing opportunities during the summer. Recent sockeye enhancement efforts in Canada resulted in substantially increased returns. Sockeye harvest in the mainstem is limited, however, to protect the Snake River population. Upper Columbia summer chinook run sizes have supported regular and stable summer fisheries since 2004.

Fall chinook, steelhead, and coho are harvested in the fall. The return of fall chinook to the Hanford Reach remains strong. The return of Snake River fall chinook has increased due to tribal hatchery supplementation programs. Fall fishing is often constrained to protect Group B steelhead (fish greater than 78 cm in length).

Treaty tribes also annually harvest salmon, including steelhead, in tributary fisheries. Tributary fisheries are subject to agreement of local managers. For some species and areas, fishing opportunities

have increased as a result of improved fish returns, reductions in prior intercepting fisheries, and increases in survival.

Sturgeon fisheries fluctuate based on current stock assessments for each of the Zone 6 pools. Overall sturgeon abundance and productivity is less than desired. Also see the updated technical recommendation STURGEON.

Assessment

The management objectives for mainstem fisheries balance harvest opportunities on strong abundant stocks with increased escapement of weaker stocks to their rivers of origin. The desire to evaluate harvest and escapement information in finer detail requires additional monitoring. Traditional sources of information such as fish tickets, coded wire tag recoveries, net flights, spawning ground surveys, hatchery returns, and dam counts provide baseline information. Additional sources of information are being incorporated into the management process. Tribal harvest monitors provide data for total catch estimation; they also collect some biological data. PIT (passive integrated transponder) tag detections provide information on the migration patterns of individual fish. Genetic data and analysis provide information on population structure. The *U.S. v. Oregon* Technical Advisory Committee and Production Advisory Committee provide a forum where scientists from tribal, state, and federal agencies can exchange and analyze information.

Restoring Historical Tributary Fisheries

Tribal members harvested spring chinook at Punch Bowl Falls on the West Fork Hood River in 2011. The fishery was re-established as a result of work in the basin by the Warm Springs tribe using hatchery methods and protecting habitat for natural production.

New and Modified Actions

- Investigate potential causes for the delay in the migration of adult spring chinook.
- Investigate ways to improve spring chinook return forecasts.
- Improve capabilities in monitoring and analyzing the effects of mark selective fishing on allocation and escapement. (See the new technical recommendation MARK SELECTIVE FISHERIES.)

- Investigate ways to improve the return of naturally spawning Group B steelhead in the Clearwater and Middle Fork Salmon rivers.
- Investigate alternate steelhead management strategies for fall season fisheries that could replace current fish length-based management and still meet conservation and harvest objectives.
- Develop new harvest rate schedule for sockeye that provides additional harvest opportunity on upper Columbia stocks while maintaining improvements in the escapement of Snake River stocks.
- Explore methods to incorporate additional information, such as PIT tag and genetic information, into forecasting and monitoring.
- Integrate harvest and production information.
- Maintain the viability of the coded wire tag system to estimate harvest impacts by stock; and support efforts to increase tagging rates and sampling rates as necessary.
- Continue developing tributary fishery opportunities and management frameworks for salmon (including steelhead) in tribal treaty territories and usual and accustomed places.

Technical Recommendation 12

Lamprey

Conduct research on Pacific lamprey and design artificial propagation strategies to supplement natural production.

Online

The complete 1995 recommendation 321.

Habitats Involved

Mainstem

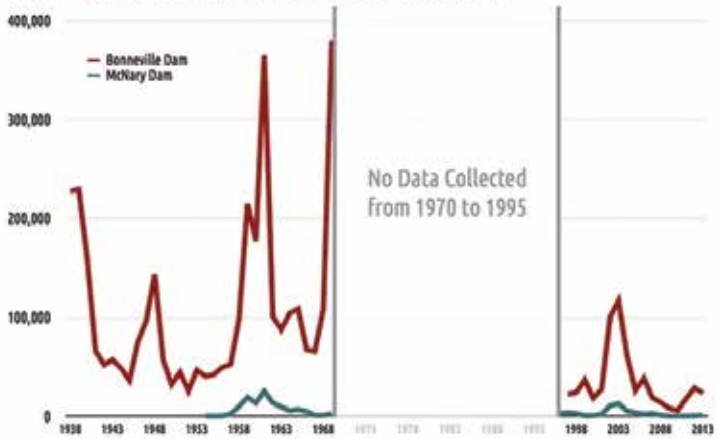
Life Stages Involved

Adult lamprey

Current Status

Pacific lamprey populations continue to decline. Returning adult Pacific lamprey at Bonneville Dam have dropped from an estimated 1 million in the 1950s and 1960s to less than 100,000 over the past decade, including a likely historical low of 6,234 in 2010. The figure below shows the counts of adult Pacific lamprey at Bonneville and McNary dams from 1938-2012. Lamprey declines are even more drastic in the upper Columbia and Snake rivers, where annual adult returns are estimated to be less than 8,000 adults. Despite diminished populations, lamprey remain indispensable to tribal culture—they are essential in First Foods ceremonies and appreciated as a medicinal and nourishing food. Pacific lamprey are vital as well to the biodiversity and ecological services of Columbia River watersheds.

Figure 14. Daytime counts of adult Pacific lamprey at Bonneville and McNary dams



Assessment

The original 1995 Spirit of the Salmon hypothesis and recommendations focused on research and follow-up actions on dam passage and related mitigation, including artificial propagation strategies. The tribes continue to believe that although actions need to be taken concurrently to address the many problems facing Columbia Basin lamprey, the single most urgent problem is poor passage for adults and juveniles.

Annual counts of adult Pacific lamprey at Bonneville Dam resumed in 1998 indicating a progressive shift in recognizing these culturally

important fish as a management priority. Nonetheless, until the 2008 Columbia Basin Fish Accords, lamprey passage improvements were largely overshadowed by regional emphasis on improving salmon passage to the extent that some improvements for salmon were detrimental to lamprey. In the Accords, the U.S. Army Corps of Engineers committed to spend $5 million annually for lamprey specific passage improvements at its projects. Since the Accords, a variety of operational and structural changes at mainstem hydroelectric dams were made to improve passage for adult lamprey, including the use of multiple lamprey passage structures and extensive modification of entrances and ladders at Bonneville and John Day dams.

In the Accords, the Bureau of Reclamation committed to identifying and developing a plan for its Columbia Basin projects that affect lamprey. Also, the Bonneville Power Administration provided funding for tribally led lamprey projects, including development of a basinwide lamprey restoration plan.

In December 2011 the tribes released the *Tribal Pacific Lamprey Restoration Plan* C3262 for the Columbia River Basin (CRITFC 2011). The Confederated Tribes of the Umatilla Indian Reservation and the Yakama Nation have developed lamprey restoration approaches for the Umatilla and Yakima rivers, respectively (CRITFC 2011 and Yakama Nation and GeoEngineers 2012).

The current goal of the *Tribal Pacific Lamprey Restoration Plan* is to immediately halt population declines and prevent further extirpation in tributaries. By 2020 the goal is have annual returns of 200,000 adult lamprey at Bonneville Dam and distribution throughout tribal ceded areas. By 2035 the goal is to have annual returns of 1 million at Bonneville Dam, distribution throughout tribal ceded areas, and ample opportunities for tribal harvests to meet ceremonial, medicinal, and subsistence needs.

How Lamprey Lost His Bones

Pacific Lamprey. Photo by U.S. Fish and Wildlife Service

One day Sucker and Eel were having a gambling game. Sucker was very lucky at gambling that day, and Eel was very unlucky. The two of them played their game until night. When they decided to stop, Sucker had won all of Eel's fin furs, all of his shell wampum and all of his best baskets. Sucker had even won Eel's house. Eel was very sad. Eel sat thinking for a long tme. Finally he said, "Sucker, I'm going to play one more game and bet my bones. I'm going to win this game?" So they played and as usual Sucker won! That is why today, the sucker has many, many bones, and the eel has only one.

—Columbia Plateau Tribal Story

New and Modified Actions

The tribal lamprey restoration plan calls for these key actions:

- Improve lamprey mainstem passage, survival and habitat (Lamprey Plan Objective 1).
- Improve tributary passage and identify, protect, and restore tributary habitat (Lamprey Plan Objective 2).
- Supplement and/or augment interior lamprey populations by reintroduction and translocation of adults and juveniles into areas where they are severely depressed or extirpated (Lamprey Plan Objective 3).
- Evaluate and reduce contaminant accumulation and improve water quality for lamprey in all life stages (Lamprey Plan Objective 4).
- Conduct research, monitoring, and evaluation of lamprey at all life history stages (Lamprey Plan Objective 6).
- Begin implementing components of the *Framework for Pacific Lamprey Supplementation Research in the Columbia River*.

New institutional actions:

- Establish and implement a coordinated regional lamprey outreach and education program within the region (Lamprey Plan Objective 5).
- Include Pacific lamprey in existing Columbia Basin management and restoration forums and processes established for salmon.
- Increase technical capacity of all federal and state agencies and Federal Energy Regulatory Commission license holders to handle lamprey issues.

Technical Recommendation 13

Sturgeon

Develop artificial propagation and management strategies for white sturgeon populations above Bonneville Dam.

Online

The complete 1995 recommendation 322.

Habitats Involved

Mainstem

Life Stages Involved

All

Current Status

White sturgeon populations upstream of Bonneville Dam are reservoir-based populations, with the exception of sturgeon that occupy the Hanford Reach. Sturgeon in Hanford Reach are bounded by Priest Rapids, McNary, and Ice Harbor dams. Tribal subsistence and commercial fisheries currently occur in Bonneville, The Dalles, and John Day reservoirs, with harvest guidelines for each reservoir of 1,100, 1,000, and 1,000 sturgeon, respectively. Population abundances (i.e., estimates of all sturgeon greater than two feet in length) are highest in Bonneville reservoir, which has approximately 300,000 sturgeon. The Dalles reservoir population is estimated at 85,000, while the John Day reservoir population is estimated at 42,000. Harvests are currently stable, although fishers will experience some downturns in harvestable numbers over the next decade, particularly in the John Day reservoir. In the longer term, fishers' catches will vary with river flows as recruitment is positively related to spring flows. Such variation will continue until spring flows are adjusted for sturgeon spawning or more likely until a hatchery program begins releasing sturgeon into reservoirs with poor recruitment.

Assessment

Most of the study recommendations in the 1995 Spirit of the Salmon Plan have been conducted. The findings will be incorporated into a Sturgeon Master Plan, in development via the Columbia Basin Fish Accords process. The white sturgeon decline that was apparent in 1995 has generally reversed, but Columbia River sturgeon above Bonneville Dam are still at risk. The survival of young sturgeon (i.e., recruitment) varies depending on annual flows. Studies have verified that spring flows with greater than average discharge and longer than average duration are beneficial for sturgeon. Flow requirements for listed salmon juvenile outmigrants overlap with sturgeon spawning

periods and may benefit sturgeon, but modifying flows to specifically benefit sturgeon spawning is unlikely in the near future.

Periodic or regular releases of juvenile hatchery sturgeon could be used to offset similar periods of poor or marginal natural recruitment. Such a hatchery has the potential to stabilize sturgeon populations, which in turn could increase and stabilize tribal harvests over the long term.

Beginning in the late 1990s, CRITFC staff began a multi-year project, funded by the Bonneville Power Administration, to determine the feasibility of collecting, holding, and spawning white sturgeon upstream of Bonneville Dam. The efforts included detailed release strategies for juvenile sturgeon of various ages to determine growth, entrainment, and survival over time. These investigations were to provide information for hatchery release strategies.

Tribal Sturgeon Research Crew

Funding cuts precluded completion of these efforts, although an estimated 20,000 yearling white sturgeon were released in Rock Island reservoir in 2003. Since 2003 researchers have caught hundreds of hatchery sturgeon downstream of Rock Island reservoir. Nearly 50% of the released hatchery yearlings have survived and are growing an average of 4 inches per year; many of these fish are now 4 feet long.

In 2008, under the *U.S. v. Oregon* Fish Management Agreement and the Accords, federal and state agencies committed to resuming studies to estimate present and optimum population levels, life history characteristics, recruitment, spawning potential, and appropriate sturgeon fishing sanctuaries. The *U.S. v. Oregon* entities also agreed to consider artificial propagation, transplantation and flow augmentation, which were key recommended actions in the 1995 Spirit of the Salmon plan.

As part of the Sturgeon Master Plan, the Accords have funded a project to determine if a sturgeon hatchery can be used to prevent declines in sturgeon populations upstream of McNary Dam and in Zone 6, particularly in the John Day reservoir. Although the largest by area, John Day reservoir has the smallest sturgeon population of the three Zone 6 reservoirs. (Zone 6 is the stretch of Columbia River encompassing Bonneville, The Dalles, John Day, and McNary dams. The three reservoirs, or pools, are Bonneville, The Dalles, and John Day.)

As the Accords' Sturgeon Master Plan progresses, regional co-managers (i.e., states and tribes) will employ data from the 2003 release to complete plans for hatchery sturgeon releases in Zone 6 reservoirs and impoundments upstream of McNary Dam.

My mother told me stories of when they used to go down to the Snake River to hunt and fish. One day they were out playing and swimming in the river and saw several sturgeons swimming by. Her dad told her just to stand there and not move and not to disturb them. She can remember those large fish just swimming by amongst them as they were out in the river.

Tonia Garcia, Nez Perce

New and Modified Actions

- Complete and submit a plan for a sturgeon hatchery, including draft construction designs and identification of potential locations, as well as the justification and rationale for construction of a facility. (Step 1 of the 3-step Sturgeon Master Plan)
- Complete an evaluation of the hatchery design and production goals before construction begins. (Steps 2 and 3 of the Sturgeon Master Plan.)
- Work to decrease toxic contamination in the mainstem so the fish health advisory can be lifted. (Also see the technical recommendation Water Quality.)

NEW Recommendation

Technical Recommendation 14

Predation

Habitats Involved

Mainstem, tributary, estuary

Life Stages Involved

Smolt, adult

Issue

Along with competition, migration, and immigration, predation is a keystone agent that controls fish population dynamics. Although predation is a naturally occurring population control agent, management becomes necessary in a highly modified environment such as the Columbia River Basin. Since the publication of the Spirit of the Salmon Plan in 1995, an alarming increase in predation of salmon, lamprey, and juvenile sturgeon by birds, marine mammals, and other fish has occurred (Rieman et al. 1991; Collis et al. 2002; Evans et al. 2012; Stansell et al. 2010). In the basin, newly created habitat from dredge spoils increased predacious bird populations; a lack of historical primary food sources brought more hungry sea lions upriver; and changes in the flow regime and the introduction of exotic species gradually expanded predacious fish populations. These negative changes in avian, mammalian, and fish species population dynamics have tipped the predator/prey balance to the point that active management is required to rebalance predator populations and reduce salmon, lamprey, and sturgeon losses.

Avian predation refers to predation by piscivorous (i.e., fish eating) birds on salmonids. Key avian predator species in the Columbia Basin include double-crested cormorants (*Phalacrocorax auritus*), Caspian terns (*Hydroprogne caspia*), California gulls (*Larus californicus*), and ring-billed gulls (*Larus delawarensis*). The abundance and distribution of double-crested cormorants and Caspian terns has increased dramatically in recent years, from a few hundred to tens of thousands in a less than 20 years (Roby 2012). In 2011 the combined loss was approximately 23 million smolts (BRNW 2012). Smolts may also be subject to predation by

The Columbia River Caspian Tern Colony

A Caspian tern with a salmon smolt in its mouth. Photo: Julie Carter

marine seabirds off the Pacific coast. Estimates of these oceanic predators are upwards of a hundred thousand birds or more (Fredricks personal communication 2013).

Marine Mammal predation is a growing problem in the lower Columbia River. A California sea lion (*Zalophus californianus*) population and its impacts on listed salmonids (*Oncorhynchus* spp.) have increased dramatically at Bonneville Dam over the last decade. So much so that in 2008 National Marine Fisheries Service granted the states of Oregon, Washington, and Idaho authority to lethally remove nuisance California sea lions under section 120 of the Marine Mammal Protection Act. CRITFC estimates that over 33,000 Endangered Species Act-listed spring chinook have been taken by California sea lions over the last decade. Since 2009 the Steller sea lion (*Eumetopias jubatus*) population in the Columbia River has also increased. In 2012 Steller sea lion predation at Bonneville Dam exceeded that of California sea lions. California sea lion abundance is estimated at 296,750 animals (Carretta et al. 2011), which indicates a robust and expanding population. California sea lions are present year round in Bonneville pool.

A Growing Problem

A California sea lion with an adult chinook.

Over 33,000 Endangered Species Act-listed adult spring chinook have been taken by California sea lions over the last decade.

Fish predation (i.e., fish on fish predation) is well studied or barely studied, depending on the species of predator. Baseline research efforts in the John Day reservoir on the Columbia River in the 1980s identified the northern pikeminnow (*Ptychocheilus oregonensis*), a native fish, as a significant predator of salmonid smolts, along with non-native walleye, smallmouth bass, and channel catfish (Vigg et al. 1991). Estimates of smolt predation were in the millions, with most eaten by northern pikeminnows, which are not protected as a game fish by the states of Oregon and Washington. An intensive government-sponsored public control program on northern pikeminnows was initiated in 1990 and continues in 2013. The program has removed nearly 4 million pikeminnow from the Columbia and Snake rivers. Management action to remove non-native piscivorous fishes has not been taken, although sufficient information confirms their direct and indirect impacts on salmon (ISAB 2008). In 2013 Washington State,

however, removed the catch size and daily limits on catfish, walleye, and smallmouth bass on selected areas of the Columbia and Snake rivers and their tributaries upstream of McNary Dam.

Hypothesis and Needed Actions

Active management will keep predators at a level that is more in balance with the environment and reduce losses of Columbia River salmon and other native fish populations. To achieve this, the following actions must be taken.

- Develop a common metric for fish, bird, and marine mammal predation (i.e., adult equivalents) so that comparisons and impacts can be properly assessed.
- Investigate, monitor, evaluate, and propose solutions to habitat changes at Columbia River tributary confluences where hydrologic modifications have resulted in increased sediment deposition and potentially attracted predator responses.
- Investigate indirect food web effects of predation.
- Apply active, adaptive management practices to predation sources.
- Pursue legislative solutions to barriers preventing active management.
- Persuade co-managers to prioritize salmon management in anadromous waters and remove barriers to harvest non-native fish species.
- Focus public outreach on benefits of native fish communities and balanced ecosystems.
- Develop greater cross-agency cooperation and investigation opportunities.

Expected Outcome

Fewer Columbia River salmon, lamprey, and sturgeon will be lost to predators.

NEW Recommendation

Technical Recommendation 15

Mark Selective Fisheries

Habitats Involved

Mainstem

Life Stages Involved

Smolt

Issue

In the case of Columbia River salmon (including steelhead), mark selective fisheries are any fisheries that allow the retention of fish with a clipped adipose fin (hatchery fish) and require the release of unclipped fish (generally wild fish). Mark selective fisheries result in differentially higher harvest impacts on clipped fish. Mark selective fisheries became a popular harvest management tool after the listing of salmon populations for protection under the Endangered Species Act and the mass fin clipping of hatchery fish. The costs of implementing and monitoring mark selective fisheries are considerable. For example, a mass-marking trailer costs around $1 million. Yet the benefits to wild populations remain unknown.

Proponents of mark selective fisheries claim that by maintaining low harvest impacts on wild stocks and removing additional hatchery fish that may stray and spawn in the wild, conservation benefits accrue to wild populations. While mark selective fisheries may reduce harvest impacts on wild populations, the benefits to wild stocks have not actually been quantified. In fact, no agency is evaluating the assumed benefits and fisheries managers have not agreed on an evaluation framework.

The tribes believe that implementation of mark selective fisheries has allowed non-treaty fisheries the opportunity to access a larger share of hatchery fish while maintaining the same allowable impacts on wild fish as would occur without mark selective fisheries.

For example, implementation of mark selective fisheries in 2008-2009 allowed non-treaty fisheries to harvest a greater allocation of Columbia River spring chinook than the treaty fisheries. Subsequently, the tribes and the states negotiated a modification to the *U.S. v. Oregon* Management Agreement, which provides for an equal sharing of the allocation.

The states now propose new chinook mark selective fisheries for the fall season Buoy 10 sport fishery and the fall season in-river sport and commercial fisheries. The states also propose mark selective in-river commercial coho fisheries. The tribes anticipate larger mark selective sport fisheries in the rest of Ocean Area 1-4 (north of Cape

Falcon to Canada border) and in ocean commercial troll fisheries within the next few years. In addition, Canada is considering implementing mark selective fisheries in ocean fisheries known to impact Columbia River populations. These proposals raise a number of issues.

One issue concerns mortality rates on the released wild (non-marked or non-clipped) fish. Although release mortality rates vary greatly by fishery, significant losses are occurring in some fisheries. Yet no technical consensus exists on the release mortality rates that would be acceptable in any new mark selective fishery.

A second issue concerns current assessment models that do not adequately account for impacts of mark selective fisheries. There is no technical agreement on how to modify harvest models to appropriately account for impacts in mark selective fisheries.

A third issue concerns the poorly understood consequences of sequential mark selective fisheries on allocation and conservation objectives. Prior interceptions of mark selective fisheries change the mark rate of fish available to subsequent fisheries. This alteration in stock composition complicates management decisions made to achieve allocation and conservation goals.

Marking Hatchery Fish

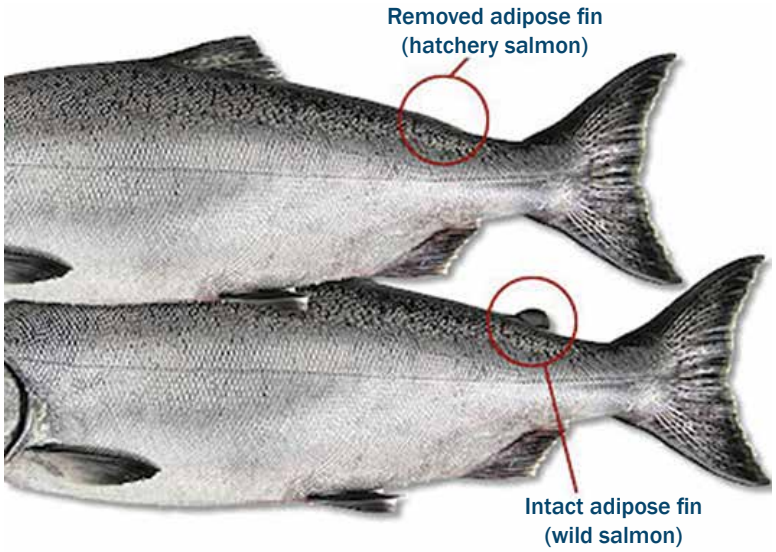


Photo courtesy Washington Department of Fish and Wildlife.

During mark selective fisheries, wild salmon must be released. But there are no good data on how many wild fish die as a result of being caught and then released.

Hypothesis and Needed Actions

Mark selective fishing is an allocation tool that allows access to more abundant hatchery (marked) fish. The abundance of naturally spawning populations will remain the same after implementation of mark selective fisheries and the allocation to non-Indian fisheries will continue increasing under mark select fisheries. We recommend the following actions.

- Determine actual release mortality in Columbia River fisheries instead of simply extrapolating from previous studies and studies in other areas. The proponents of mark selective fisheries should use their resources for new studies.

- Research potential impacts from multiple encounters. As mark selective fisheries expand, the probability of multiple recaptures of unmarked fish increases.
- Assess the impacts of mark selective fisheries on wild fish by adequately monitoring fisheries to determine the extent to which unmarked (wild) fish are being handled. Although direct observations provide the best information, they are not employed because of cost. Indirect observations, such as angler interviews, provide less accuracy in assessing impacts.
- Incorporate the effects of mark selective fishing in fishery planning models by using a range of estimates for release mortalities. The range of estimates needs to be adjusted annually based on observations from previous years. Fishery planning models should consider the gauntlet effect of subsequent mark selective fisheries because the mark rate will change and release mortality may increase as a result of the multiple encounters.

Expected Outcome

The research and monitoring of mark selective fisheries described above will determine the impacts on the restoration of wild stocks and harvest allocations. Once research and monitoring results are known, fisheries managers will adapt their conservation and allocation methods.

NEW Recommendation

Technical Recommendation 16

Restoring Fish Passage

Habitats Involved

Mainstem, tributary

Life Stages Involved

Smolt, adult

Issue

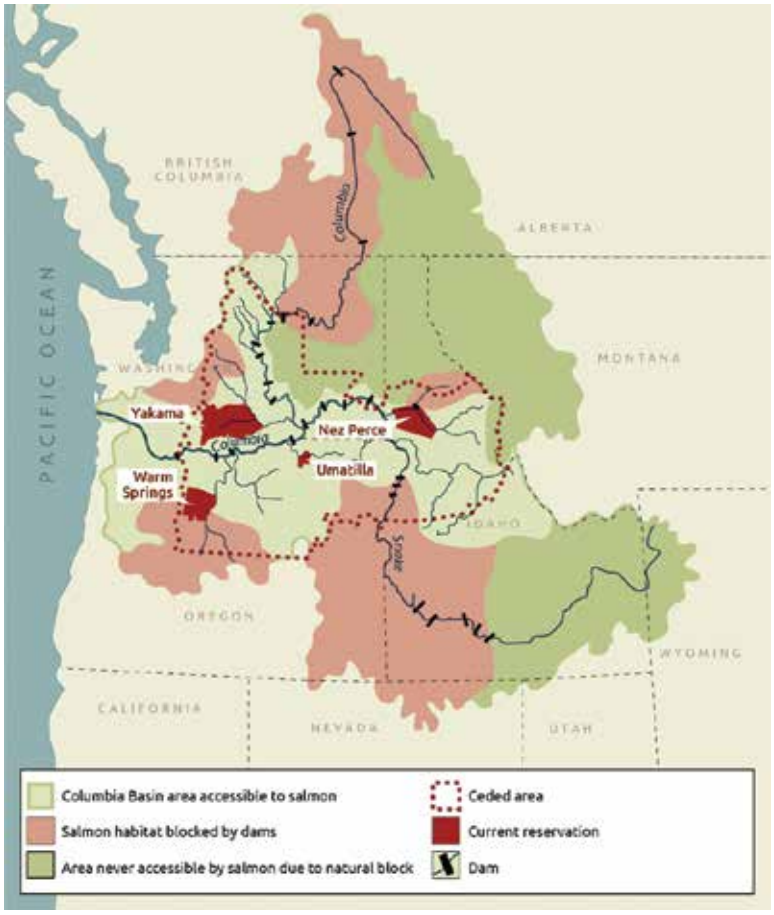
Since the late 1800s, over 1,000 dams have been constructed in the more than 160,000 square miles of the Columbia River Basin that were historically accessible to anadromous fish. Many Columbia Basin dams completely block fish passage into the watershed's upper reaches. Dams obstruct passage of salmon and other anadromous fish between spawning and rearing habitat and the Pacific Ocean. Where fish passage was not provided, extirpation of the upstream population was the result. Dams and other water resource developments made more than 55%, or nearly 100,000 square miles, of the historical spawning and rearing habitat unavailable to salmon, lamprey, and sturgeon.

Extensive work throughout tributary watersheds has restored passage to over 15,000 square miles of this habitat. The remainder, about 80,000 square miles, is still blocked. (Over the decades, fish agencies, tribes, and others have also opened up some 800 square miles of historically inaccessible habitat by providing passage over natural barriers.)

The largest blockages occur in the upper Columbia at Grand Coulee Dam and in the Snake River at the Hells Canyon Complex. Grand Coulee eliminated approximately 1,100 miles of spawning habitat and extirpated the largest number of known anadromous populations relative to other projects (NPCC n.d.).

On the Snake River, the construction of the three-dam Hells Canyon Complex in the 1950s and 1960s

Blocked and Accessible Areas for Salmon



blocked nearly 2,000 miles of anadromous fish habitat. Additional spawning habitat was lost following construction of other mainstem and tributary dams. In total over 30% of the habitat originally available to salmon in the Snake River Basin has been lost. The extent of fishing by native peoples also measures the magnitude of damage: Above the four lower Snake River dams, for example, tribes are presently harvesting salmon at less than 1% of pre-contact levels, while no Pacific lamprey are harvested due to extremely low adult returns.

Downstream of Grand Coulee and Hells Canyon dams, salmon and lamprey habitat is also blocked in virtually all the tributaries. Small hydroelectric dams and irrigation diversion dams dot the landscape, excluding or impeding passage to spawning and rearing habitat above. Forestry practices and poorly designed roads and culverts create additional blockages to an undeterminable number of tributary streams and habitat miles.

White Salmon River Recolonization

The blast at the base of Condit Dam that initiated the breaching of this 100-year-old structure on the White Salmon River.

Condit Dam at river mile three on the White Salmon River blocked salmon passage for almost a century. After years of discussion between the dam's owner, PacifiCorp, and the tribes and fish agencies, the dam was intentionally breached on October 26, 2011. The dam's removal reopened the some 26 miles of mainstem and tributary fish habitat.

In anticipation of the breach, the U.S. Fish and Wildlife Service translocated 679 returning adult tule fall chinook from downstream of the project to locations upstream. As a result a total of 191 redds were observed during subsequent spawning surveys. The following year, spawning of naturally returning adults resulted in counts of 194 redds of tule fall chinook and 257 redds of bright fall chinook (Engle, Skalicky, and Poirier 2013). Carcass samples indicated a high percentage of tule chinook were natural origin based on the presence of an adipose fin clip. In 2012 escapement estimates totaled 755 tule fall chinook and 1,061 bright fall chinook (Engle, Skalicky, and Poirier 2013).

In addition to fall chinook, the White Salmon is being recolonized by steelhead. In 2013 Yakama Nation biologists documented live steelhead and spawning activity in both Rattlesnake and Buck creeks, tributaries upstream of the former Condit Dam (Zendt 2013).

Hypothesis and Needed Actions

Opportunities to restore fish passage are becoming more feasible. Recent developments in juvenile fish passage technology could potentially provide passage opportunities at dams such as Chief Joseph, Grand Coulee, Dworshak, and the Hells Canyon Complex.

New passage technology is currently operational and being tested at Round Butte Dam on Oregon's Deschutes River. In 2012 the U.S. Army Corps of Engineers embarked on passage studies at three high-head dams in Oregon's Willamette basin and at Howard Hanson Dam in Washington. A new juvenile fish collector is being installed and tested at Swift Reservoir, Washington, and

a juvenile sockeye passage facility is now operating successfully at a high-head dam on the Skagit River, Washington. Additionally, the U.S. Geological Survey, U.S. Army Corps of Engineers, and U.S. Bureau of Reclamation are investigating and testing new technologies to pass anadromous and resident species more effectively past dams.

The 2011 removal of Condit Dam on the White Salmon River is a significant example of reopening a Columbia Basin river to salmon. See the White Salmon River Recolonization sidebar on the previous page.

We recommend the following actions to restore fish passage.

- Continue investigating fish passage technologies and opportunities. Include investigation of fish passage at Chief Joseph, Grand Coulee, Dworshak, and Hells Canyon Complex dams as a goal for the Columbia River Treaty 2014/2024 Review process.
- Assess the feasibility and potential benefits of removing aged and/or unprofitable tributary dams to reopen tributary habitat to anadromous fish.
- Continue replacing inferior culverts that block or impede salmonid and lamprey passage.
- Assess habitat quality and reintroduction options in blocked-area passage restoration proposals. Investigate potential donor stocks and evaluate the role and use of supplementation hatcheries.
- Include above measures to restore passage for lamprey and sturgeon, as applicable.

Future of Our Salmon

The 2014 Future of Our Salmon Conference focused on restoring fish passage to all the salmon's historical range C2396.

Expected Outcome

Anadromous fish will return to reopened habitat areas; and eventually tribal members will again be able to harvest these fish at traditional locations that have been blocked for more than a generation.

NEW Recommendation

Technical Recommendation 17

Invasive Species

Habitats Involved

Mainstem, tributary, esturary

Life Stages Involved

All

Issue

The most serious threats to the Columbia Basin's native fishes and water resources include the following aquatic invasive species: zebra and quagga mussels (*Dreissena polymorpha* and *Dreissena rostriformis bugensis*, respectively); Asian carp (*Hypophthalmichthys* spp.); hydrilla (an aquatic plant); spiny water flea (a planktonic animal); and viral hemorrhagic septicemia (VHS), a deadly fish virus, represent the most serious threats to the Columbia Basin's native fishes and water resources.

Not native to the basin, aquatic invasive species negatively impact the region's natural resources, ecology, and/or economy. Because water provides a barrier to detection, unlike terrestrial invasive plants, managers cannot quickly identify and eliminate aquatic invasive species. Many states have enacted taxes on specific user groups to fund invasive species prevention programs. The federal budget for invasive species is very limited, with less than $5 million available for all states that have control and eradication plans.

The most urgent threat to the Columbia River system is from zebra and quagga mussels. These short lived (<4 years) mussels are very prolific and often present for years before being documented because of their small size and benthic (i.e., bottom dwelling) nature. In the Great Lakes, invasive mussels carpet most areas of the lake bottom and have greatly affected the food web and altered the habitats of numerous native species of fish and invertebrates. The mussels have crossed the Mississippi River and now are spreading westward. In January 2008, quagga mussels were discovered in Lake Mead, Nevada. This has vastly increased the probability of these invasive mussels getting into the Columbia River drainage.

Tribal resources in the Columbia River Basin are very vulnerable and will remain so until prevention (and eventually control) options for aquatic invasive species are developed and proven in the field.

Hypothesis and Needed Actions

The zebra and quagga mussels have the potential to permanently alter the Columbia River ecosystem, likely resulting in greater impacts to salmon recovery. No salmon-safe toxins, pathogens, or chemicals are presently available to control or eradicate these mussels if they become established in the Columbia River system. As prevention is the only option that exists at this time, the following actions are necessary to address this issue.

- Pursue through legislation greater levels of funding for prevention, monitoring, and outreach.
- Work with the tribes' Columbia Basin partners for appropriate regulation and taxation in all western states to address invasive species and transport pathways.
- Exert greater political pressure on the National Park Service to reduce unauthorized exits from Lake Mead National Recreation Area for uninspected boats.
- Explore additional funding opportunities to maintain and increase CRITFC capacity to monitor and act on aquatic invasive species issues, including participation in regional and national forums for invasive species management.

Expected Outcome

Taking swift action may result in the delay or prevent the introduction and establishment of new invasive species, particularly those like zebra or quagga mussels. Timeliness is critical as the mussels, along with many other invasive species, are firmly established in most of the United States and can easily spread to the rest of the nation.

A Contaminated Boat

Non-native zebra mussels attached to a boat rudder. Zebra mussels can clog fish ladders, irrigation systems, spillways, and other aquatic structures. Photo courtesy of the National Park Service.

NEW Recommendation

Technical Recommendation 18

Climate Change

Habitats Involved

All

Life Stages Involved

All

Issue

Climate change is expected to significantly alter the ecology and economy of the Pacific Northwest during the 21st century. The CRITFC tribes are among the most climate-sensitive communities. (See a video on how the tribes are facing climate change at C392.)Their economies and culture rely on natural resources. Tribal economies heavily depend on forest productions, agriculture, and tourism, while their cultures are deeply connected to tribal First Foods, with water and salmon foremost among them. Climate change will impact tribal economies and First Foods in a number of ways.

Increased insect outbreaks, wildfires, and changing species composition in forest and upland areas will pose challenges for adequate ecosystem health. Declining springtime snowpack will also lead to reduced summer streamflows, which will strain water supplies and require alterations in hydropower operations. Coldwater fisheries such as salmon, Pacific lamprey, and sturgeon will experience additional stresses as water temperatures rise and summer streamflows decline.

Salmon and lamprey are particularly susceptible to these changes in water quantity and quality not only because they rely on freshwater rivers and streams as spawning and rearing habitat and as migration corridors, but also because their survival is already imperiled by an accumulation of other detrimental synergistic factors.

The resulting alteration of salmon migration patterns, degradation of salmon spawning and rearing grounds, and the increase of predators and aquatic contaminants, if not addressed, could lead to salmon, lamprey, and other fish extinctions.

Hypothesis and Needed Actions

Developing technical and policy strategies to address changes in Columbia Basin water and fish resources will assist our member tribes in mitigating and adapting to climate change.

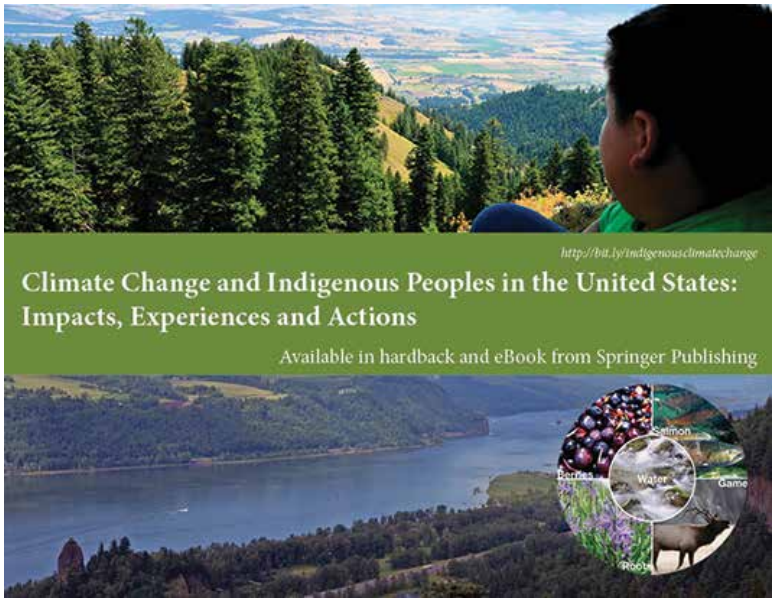
To prepare, the following actions need to be taken.

- Collect historical stream temperature, stream discharge, and weather data from the Grande Ronde and the Clearwater River

basins to calibrate climate models and to project stream discharge and effects on stream temperatures under future climate change scenarios.

- Produce a technical analysis of alterations in Columbia River mainstem hydrology and water quality caused by climate change and the potential mitigation and adaptation tools and processes to address these changes. Include databases and analyses of tributary temperatures and mainstem flows as well as water depletions necessary for future water resource planning needed to maintain anadromous fish populations under the next Columbia River Treaty.
- Once tribal assessments on current climate change activities are drafted, develop Strategic Climate Change Adaptation Plans in collaboration with tribal staff.
- Update the *Tribal Energy Vision* C3105 to reflect current and projected climate change knowledge and identify revised regional energy goals and objectives for CRITFC and its member tribes. See the new institutional recommendation *Tribal Energy Vision*.
- Track legislation related to climate change and energy policy and potential revenue streams to address these issues and update tribes frequently.

Analysis of Columbia Basin Water and Fish Resources



CRITFC has been studying the impacts of climate change on tribal lands for over a decade, and recently some of that research was selected for a special peer-reviewed issue of Climatic Change Journal.

The issue has been released as a stand-alone hardback book. For ordering information, visit *http://bit.ly/indigenousclimatechange*

- Make information available to the tribes and others on the latest global and regionally downscaled climate models.
- Provide estimates of changes in runoff, temperature and precipitation patterns, and changes at the subbasin level.
- Analyze activities of other local, regional, national, and international entities to address climate change impacts.
- Develop decision support tools to allow co-managers to examine alternate management strategies in the negotiations for the

renewal of the Columbia River Treaty.

- Conduct outreach activities regarding findings and recommendations to our tribes and others using a variety of means, including digital and web-based media.
- Use CRITFC research and analysis, literature review, and participation in regional and national forums to complement tribal/CRITFC climate change projects.
- Incorporate the concepts of resilience, ecological thresholds, and alternative system states into climate impact assessments, analytical tools, and adaptation plans.
- Assist our member tribes in developing strategies, coordinating policy, and mitigating and adapting to climate change (i.e., adopting specific response measures to address water resource changes within specific tribal watersheds).
- Produce a climate change technical and policy framework document for CRITFC and member tribes that identifies key elements of concern and develop strategies to address these elements.
- Track the activities and outcomes of important technical climate change forums, such as the Western Climate Initiative, and, if appropriate, participate in such forums.

Climate Change Strategies

The tribes have developed some strategies to protect and restore populations of salmon, Pacific lamprey, and other imperiled fish in an ecosystem altered by the effects of climate change.

Expected Outcome

CRITFC will continue to understand, address, and communicate the effects of climate change on the resources of the member tribes and will coordinate, develop and implement policies and strategies to address these effects. Member tribes and CRITFC will prepare a tribal strategic plan to address the changes to tributary biotic and abiotic factors in tribal ceded lands that would likely limit future anadromous fish production.

With strategic climate change/adaptation plan(s), the members tribes will have funding to take mitigation and adaptation actions to protect their natural resources.

NEW Recommendation

Technical Recommendation 19

Update Lifecycle Model

Habitats Involved

All

Life Stages Involved

All

Issue

The tribes have steadfastly insisted that all salmon management and recovery programs and actions be viewed from two perspectives. First, salmon management programs should be designed with a gravel-to-gravel perspective. That is, both positive and negative impacts on salmon production must be evaluated within the context of the entire salmon lifecycle. Second, restoration responsibility should be based upon a fair allocation of the conservation burden. In other words, the responsibility for restoring salmon populations should be proportional to the magnitude of mortality caused by different types of human activities. These concepts were incorporated in the original Spirit of the Salmon Plan through the use of a quantitative lifecycle model that normalized mortality at each life stage in terms of "adult-equivalent" returns to the spawning grounds. This was the first plan that addressed issues at every part of the salmon's lifecycle.

The approach is still valid, but the original model needs to be updated to incorporate new information gained since 1995 (e.g., additional data on harvest rates and migration mortality through the hydropower system) and additional impacts that were not included in the original model (e.g., climate change, invasive species). This will require a complete restructuring and recoding of the model to incorporate new technology and greater complexity in how we represent each life history stage.

Whereas the tribes were the only group to put all the pieces together in 1995, most agencies are open to this perspective today, and several of them are developing quantitative assessments of one or

A Spring Chinook Lifecycle Model

Catherine Creek in the Umatilla's ceded area.

CRITFC is developing a lifecycle model for the two spring chinook populations in Catherine Creek (above) and the upper Grande Ronde watersheds, incorporating basinwide water temperature modeling, streamflows, and fine sediment concentrations in spawning gravels, all key limiting factors identified in the Columbia Basin Fish Accords evaluation of streams supporting Endangered Species Act-listed populations. This monitoring project will provide information on whether aggregate efforts applied in habitat restoration are improving key limiting factors and whether models used to express fish-habitat relationships are able to predict fish population response and identify priority restoration actions.

more of the salmon's life history stages. Depending on how the various modeling groups cooperate in their efforts, this could lead either to greater consensus about the important factors affecting salmon or to a series of model wars if the groups do not discuss shared concerns.

Hypothesis and Needed Actions

A lifecycle analysis is useful to inform managers about the range of options that might achieve stated management goals. Such an analysis will be more useful if all management agencies have trust in its outputs. Fortunately, managers are more willing to share data and cooperate in addressing common problems than they were in 1995.

The next-generation model (or series of models) will also be most useful if it can be applied in a variety of management arenas (e.g., harvest management, habitat restoration, flow and spill management). To incorporate new ecological realities and be useful in a range of forums, the new lifecycle analyses will have to be multidisciplinary and more complex.

The following actions will increase the likelihood of developing a robust and widely useful update of the first lifecycle model.

- Contact possible collaborators in other agencies. Form a working group of willing participants.
- Identify common objectives and agency-specific objectives.
- Identify available data and other information. Develop a data management strategy to manage needed data.
- Develop model structure and software and coding standards.
- Develop a common and agency-specific work plan and draft schedule.
- Complete updated lifecycle model according to schedule.

Expected Outcome

Future lifecycle analyses will support evaluation and development of restoration strategies that are more likely to successfully address the impacts of climate change, invasive species, toxic pollution, and other factors that were not incorporated in the original model. Lifecycle analyses will also serve as an educational tool that stakeholders can use to explore their own restoration options.

NEW Recommendation

Technical Recommendation 20

ESA Delisting

Habitats Involved

All

Life Stages Involved

All

Issue

Listing of salmon populations in the Columbia River and elsewhere has a complex and contentious history. The National Marine Fisheries Service (NMFS) has the administrative responsibility for overseeing the application of the Endangered Species Act (ESA) to anadromous salmon. Beginning in 1991, NMFS determined that Snake River sockeye qualified to be listed as "endangered" under the ESA. Subsequently, 12 additional salmon stocks were listed as either threatened or endangered.

NMFS also determined in the early 1990s that the appropriate unit for listing was the Evolutionarily Significant Unit (ESU), composed of variable numbers of individual salmon populations that were determined to share an evolutionary history that was more similar among those populations than with adjacent or other salmon populations. The tribes were critical of the ESU policy because it appeared to elevate concerns for the maintenance of reproductive isolation of individual salmon populations over the condition of the listed species as a whole in its environment. In 2000 NMFS published a technical paper clarifying viable salmonid population conditions in recovery of ESUs. In 2005 NMFS further clarified the roles that hatcheries can play in listing and delisting salmon populations.

In a short ten generations, one broad sweep of the geological second hand, America has reduced its life forms to struggling endangered species.

Ted Strong, Yakama

Delisting an ESU involves passing a two-part test. First, a specified list of populations in an ESU must achieve a biological status that no longer warrants the protections of the ESA. NMFS defines this status in terms of spawner abundance, productivity, distribution, and diversity—referred to as the four Viable Salmonid Population (VSP) parameters. Second, NMFS must show that the factors that led to listing of the populations in the first place have been addressed.

In a July 21, 1998 letter, Department of Commerce Assistant Secretary Terry Garcia wrote to CRITFC about the relationship of the ESA and the tribes' treaty fishing rights. In the letter, Mr. Garcia announced that "the recovery of salmon populations must achieve two goals: 1) the recovery and delisting of salmonids listed under the provisions of the ESA; 2) the restoration of salmonid populations, over time, to a level to provide sustainable harvest sufficient to allow for

the meaningful exercise of tribal fishing rights." The letter further discussed the trust responsibilities of the federal government to the tribes and recognized:

> …the importance of the federal government's efforts to allocate the conservation burden for salmonids listed under the ESA in such a way that, among other things, it does not discriminate against tribal fishing rights and is implemented in a least restrictive manner. Accordingly, the tribes may reasonably expect, as a matter of policy, that tribal fishing rights will be given priority over the interests of other entities, federal and non-federal, that do not stand in a trust relationship with the United States.

ESA Timeline

1991/92: Federal government lists Snake River sockeye as an endangered species, others as threatened.

1992: First biological opinion by National Oceanic and Atmospheric Administration (NOAA) says dams will not jeopardize endangered or threatened fish; plan immediately challenged in court.

1994: U.S. District Judge Malcolm Marsh strikes down plan.

1995: New biological opinion says dams jeopardize salmon and steelhead; standards proposed for spill, flow, reservoir levels and barging juvenile fish downstream.

1996: Environmental, fishing groups and Oregon sue, saying jeopardy standard is not enough; Oregon argues for greater river flows.

1997: Marsh okays 1995 plan; ruling appealed.

1998: Upper Columbia steelhead listed as endangered; Snake River and lower Columbia steelhead listed as threatened.

1999: Appeals court upholds Marsh's ruling and 1995 plan; six more Columbia Basin salmon and steelhead listed as endangered or threatened.

2000: With a nine-agency federal caucus, NOAA releases plan focused on hydropower, habitat, hatcheries and harvests for 10 years.

2001: National Wildlife Federation and fishing and conservation groups challenge 2000 plan; Oregon and four tribes join.

2003: Judge James A. Redden takes case; he rejects NOAA's plan, saying it does not protect salmon harmed by dams.

2004: New NOAA plan adjusts spill, says dams do not threaten salmon survival.

2005: Redden overturns plan for violating the ESA and orders summer spill at three Snake dams and one Columbia dam.

2008: NOAA issues another biological opinion; Redden finds that actions slated for years 5-10 of the opinion were not reasonably certain to occur and the biological benefits estimated for some specific actions, e.g. the estuary improvements, were uncertain.

2008: Federal agencies, five tribes and two states sign separate 10-year agreements identifying specific fish and habitat projects—the Columbia Basin Fish Accords—funded by the Bonneville Power Administration.

2010: NOAA's supplemental opinion incorporates 2008 plan; supporters and plaintiffs file briefs through February 2011.

2010-2013: A supplemental biological opinion, revised implementation plan and draft 2014 FCRPS Biological Opinion are prepared. Briefing continues on challenges to the plans.

—List compiled by The Oregonian

Hypothesis and Needed Actions

Progress on rebuilding salmon populations is often held up by regulatory processes as much as by correcting or remediating for biological and environmental problems. Developing more efficient administrative systems will increase the effective use of available resources and faster rebuilding of salmon populations. The following actions will increase the likelihood of protecting the exercise of tribal treaty rights and delisting of salmon populations.

- Ensure that all parties understand the tribes' treaty rights and the need to fairly allocate the burden of conservation in a manner that is consistent with those rights and the federal government's trust responsibilities to the tribes.
- Implement the Secretarial Order 3206, which requires proper allocation of the conservation burden proportional to the causes of decline.
- Identify specific actions that are reasonably certain to occur and produce anticipated biological benefits.
- Support and implement the 2005 NMFS hatchery policy.
- Plan and evaluate the use of hatchery technology within the context of all risks and impacts to salmon throughout their lifecycle rather than as a single issue.
- Establish monitoring and evaluation efforts sufficient to determine whether anticipated benefits are being achieved.
- Complete and submit Hatchery and Genetic Management Plans (HGMPs) for each salmon population.
- NMFS should reduce the time required to review and accept HGMPs to no more than nine months.

Expected Outcome

Implementing the above actions provides the best likelihood for the tribes to exercise their reserved fishing rights while also delisting populations under the ESA. This strategy will also make better use of available resources and provide the flexibility necessary to address local conditions and buffer against new challenges posed by climate change, toxics, and invasive species.

Community Development Recommendations

We are salmon people. The well-being of our communities is tied not only to natural resources and the ecological services they provide, but also to the use and development of salmon as the center of culture and livelihood. Since long before the treaties with the United States and its citizens, we lived and derived our economic sustenance from Nch'i-Wana, the Big River, and other rivers in the Columbia Basin. From our homes and fishing stations along the Columbia, we harvested salmon and lamprey, processing and trading the fish through extensive networks.

We have come along way since Celilo Falls and other important villages and fishing areas were encroached upon and then drowned behind the waters of Columbia River dams. The dams challenged our rights to access fish and fishing sites. In exchange for ceding millions of acres to the United States in the treaties of 1855, we reserved for ourselves and succeeding generations the right to take fish at all our usual and accustomed fishing places. Our intent has always been to retain our fish and salmon way of life.

Working with the U.S. Congress and Army Corps of Engineers, we have established new access fishing sites and fishing stations along the river. We now market our salmon and get better prices than at any time in recent history. The historic Celilo Village has been renovated. More and more of our people are making a living again in fisheries as fisher men and women, fish technicians, biologists, hatchery managers, and research scientists, and using other skills needed in

restoration. Our spiritual connection with the salmon and our other First Foods continues to be celebrated in longhouses throughout the basin.

What Are Community Development Recommendations?

While our native fishing community is coming back to life, the Wy-Kan-Ush-Mi Wa-Kish-Wit Update acknowledges that more work is required to sustain and broaden this resurgence. The well-being of our communities is tied to the use and development of salmon as the center of culture and livelihood as well as to the natural resources and ecological services they provide. The Community Development recommendations are intended to describe some of the key economic and social infrastructure solutions the tribes are implementing or planning to implement. In the recommendations that follow, the community development issue or opportunity is stated (Issue); actions to address the issue are listed (Actions Needed); and expected results are identified (Desired Outcome). These new community development recommendations are offered as part of the tribes' holistic vision of salmon restoration.

Fishers Memorial

Children singing the final blessing of the food before the salmon dinner is served.

On April 4, some 250 people gathered at Columbia Hills State Park in Dallesport, Washington for a blessing of the river and dedication of the proposed Fishers Memorial the tribes plan to build there. The memorial will honor tribal fishers who have lost their lives to the hazards of the mighty Columbia River.

At the blessing and dedication, drummers sang the traditional three sets of seven songs. Those assembled talked about the memorial and remembered their lost loved ones. The CRITFC Enforcement Department was given a beaded staff to honor their dedication to search, rescue, and recovery efforts on the Columbia.

In his remarks, event organizer River Chief Wilbur Slockish, Jr. encouraged respect for the powerful river that both gives life and takes it away. The event concluded with a salmon dinner.

For more information about the Fishers Memorial, visit C5606.

Community Development Recommendation 1

Salmon Marketing

NEW Recommendation

Issue

Helping the tribal fishing community increase the economic value of its commercial treaty fisheries is an important goal of CRITFC's member tribes.

CRITFC's Salmon Marketing Program has had a big impact. Prices paid to tribal fishers for fresh fish have risen from $1.00 or less per pound two decades ago to as much as $10.00 or more per pound for fresh fillets, depending on the species and time of year. Both direct-to-the-public and wholesaler buyer prices have increased. Still much more can be done.

Currently, most of the fishers are limited to selling whole fish, keeping them at the lower end of the marketing channel. With new generations of tribal members entering the fishery every year, an effective program of on-going training and the development of value-added products are essential to continued success. These are but a couple of the challenges ahead.

More information about salmon marketing, its cultural roots, and about opportunities to benefit from direct sales to the public is available on the CRITFC website C521.

Making Happy Customers

A buyer inspecting a freshly caught salmon.

Actions Needed

- Integrate the CRITFC marketing program with Tribal FishCo, LLC, the newly created fish processing plant at East White Salmon, Washington. (See community development recommendation Tribal FishCo, LLC.)

- Promote a local, regional, national, and international "branding" campaign for Columbia River Indian-caught Salmon.
- Research economic multiplier effect to determine the tribal fishing community's contribution to local economies.
- Assist fishers in modernizing the fishery with access to newer and safer boats, engines, and other equipment.
- Help establish a boat and engine maintenance facility staffed by tribal specialist and mechanics.
- Expand current initiatives for fisher and consumer education, marketing, product safety and diversification, fisher safety on the river, and other projects.

Desired Outcome

Through higher prices paid for tribally caught fish, tribal fishers have increased income for boats, repairs, fuel, nets, and basic living expenses (e.g., rent, food, and gas) that allows them to carry on their traditional livelihood. By having the necessary capital to continue fishing, the fishers are able to teach the younger generations how to fish and about the importance of fishing to tribal culture and communities.

Tribal fishing on the Columbia River is safer because of enhanced fisher education, better fishing safety practices, and safer boats and other equipment.

Local communities understand the important economic contribution of the treaty fishery and restored fish runs.

Community Development Recommendation 2

Tribal FishCo, LLC

NEW Recommendation

Issue

In 2010 CRITFC's four member tribes formed Tribal FishCo, LLC (FishCo) to operate and maintain a fish processing center located in White Salmon, Washington, which was built by the U.S. Army Corps of Engineers under Public Law 100-581 Title IV Columbia River Treaty Fishing Sites legislation. Once the tribes have a federally compliant food processing facility, they can take greater control of their fisheries resources by processing and marketing fish and accessing new markets.

To date, a number of important activities to assist FishCo to begin operations at the plant have been completed:

Each of the four member tribes appointed two representatives to the Board of Advisors (Board), which provides policy oversight to FishCo.

CRITFC secured funding from the U.S. Department of Agriculture to complete a feasibility study planning document and a business plan. These were developed by the McDowell Group not only to determine feasibility, but also to provide guidance for start-up and future operations. The Board, the plant manager, and CRITFC staff provided input for the business plan's development. The plan noted that for the tribes to move forward with operations, they would require an additional capital contribution or a partnership with an experienced seafood processor to provide equipment or capital (i.e., cash or a line of credit to purchase fish).

CRITFC also funded an engineering report on FishCo's processing

Fisher Services

Tribal fishers Wilson and Roxanne Begay buying ice at the White Salmon Fish Processing Center operated by FishCo.

plant discharges and the city's wastewater treatment system, which will be used in the negotiation process for a user agreement with the City of Bingen to authorize discharges into its wastewater treatment system.

FishCo hired a manager to conduct a pilot test for plant operations and also contracted with an experienced seafood processor for limited operations in 2011 and 2012. For the fall 2012 fishing season, FishCo hired 16 employees to process fish and to provide bookkeeping functions. These limited operations also provided information on the makeup of discharges (e.g., fats, oils, grease), which will assist the negotiation process for an agreement with the City of Bingen to use its wastewater treatment plant.

Fish Processing at the Plant

Tribal FishCo's White Salmon processing facility includes an ice machine, freezer, refrigerator, blast freezer, and loading dock.

CRITFC contracted with FishCo to provide ice to the tribal fishers in 2011 and 2012. In total, FishCo provided approximately one million pounds of ice to the fishers, which helped generate $98,000 in ice-contracting revenues.

For the summer and fall 2013 fishing seasons, FishCo provided ice to the tribal fishers at near cost. The ice helped maintain the quality of the tribal catch, while charging a minimal fee preserved FishCo's capital.

CRITFC continues to assist FishCo with the payment of invoices for plant utilities and operations.

Actions Needed

For FishCo to operate in the near term, these issues to be need addressed.

- The user agreement with the City of Bingen must be finalized prior to full-scale operations to reserve capacity at the city's wastewater treatment system. The agreement will set a monthly fee for using the city's wastewater treatment plant; a higher fee will be charged during peak operating periods.
- The Board needs support from the member tribes' economic development personnel to help with start-up and operational activities. Tribes have expertise in business planning and project capitalization. The business plan should be updated to incorporate financial and market information.
- The Board needs to review capitalization needs for FishCo's operations (e.g., cash, labor, equipment) and whether it will utilize a contractor to assist with operations.
- The Board's review of capitalization needs also must include an evaluation of the funds necessary to ensure that basic management and accounting functions are budgeted.

Desired Outcome

- A user agreement is finalized between Tribal FishCo and the City of Bingen authorizing the use of the city's wastewater treatment system for FishCo's operational discharges.
- FishCo operates as a federally compliant food processing facility, allowing access to new markets.
- FishCo is operated by the four tribes as a self-sustaining entity, capable of meeting cash flow needs and the needs of the markets.
- The fish plant provides tribal employment opportunities for fish processing.

NEW Recommendation

Community Development Recommendation 3

White Sturgeon Marketing

It was not uncommon at Celilo to catch sturgeon. My father used to keep these sturgeon and cut them up into large pieces and give them to a lot of the people he knew that lived nearby. We would keep enough to eat for ourselves too, and I always thought that they were delicious.

Richard Powaukee, Nez Perce

Issue

White sturgeon are sold to wholesale buyers and directly to the public. Sturgeon are required to be sold in the round (uncleaned) to ensure compliance with length limits and to provide detailed growth information.

In 2009 the Salmon Marketing Program looked at ways to increase the value of tribally caught salmon and other fish and the factors that affect prices. It found that 2009 sturgeon prices were generally between $1.50 and $2.00 per pound in the round. By 2011-12, the price increased to $2.50 per pound, sometimes reaching as high $3.00 per pound. The increase is due in part to competition, market dynamics, reduced catch rates from non-tribal fisheries, and a more positive image of tribally caught fish in the marketplace.

Even though most sturgeon entering markets are farm raised, wild sturgeon from the Columbia River command significant interest, which is often reflected in a higher price per pound than the price paid for farm-raised fish. This higher price and awareness that the fish are sustainably harvested are key elements in the development of a marketing plan.

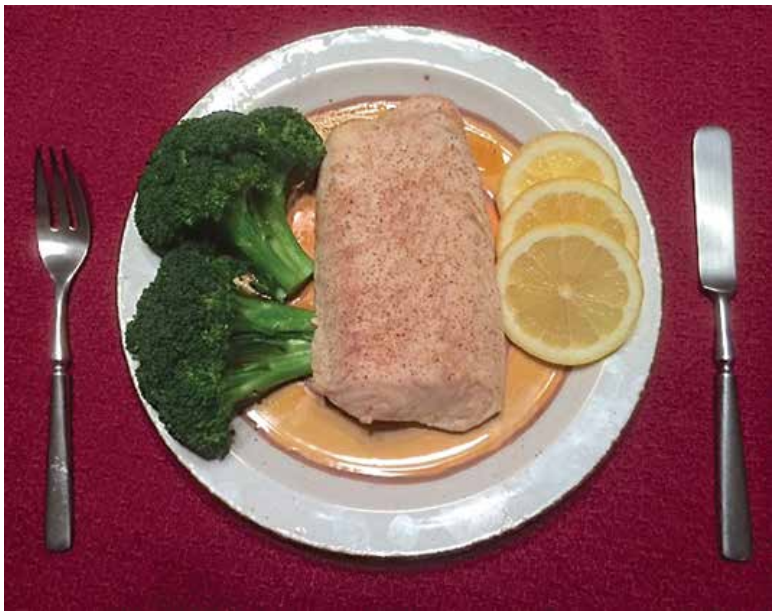
Several factors, however, complicate sturgeon marketing efforts. First is a fish health advisory to limit consumption of sturgeon caught in Zone 6 (Bonneville to McNary dams). This new health advisory will have unknown effects on the ability to market tribally caught sturgeon. Second is the likely termination of the non-tribal lower river sturgeon fishery after 2013. The end of this commercial fishery may reduce the number of processors interested in handling sturgeon. Third is the requirement to sell sturgeon in the round that limits the number of buyers. Not all processors are set up to process whole sturgeon; yet there are buyers and distributors who would purchase headed and gutted sturgeon.

Actions Needed

The following actions are needed to strengthen sturgeon marketing efforts.

- Incorporate best handling practices in the tribal sturgeon harvest.
- Continue to promote the purchase of tribally caught fish, including wild sturgeon, in the commercial marketplace and to the public.
- Maintain positive market visibility for tribally caught salmon, sturgeon, and other fish.
- With Tribal FishCo, explore processing sturgeon for secondary markets.
- Investigate using hatchery sturgeon reared to market size to maintain and expand fresh markets for wild sturgeon.
- Work to decrease toxic contamination in the mainstem so the fish health advisory can be lifted. (See the update of the technical recommendation Water Quality.)

Baked Sturgeon



Desired Outcome

These actions will increase the value and maintain the market pricing of tribally caught sturgeon.

NEW
Recommendation

Community Development Recommendation 4

Housing Near Tribal Fishing Access Sites

Issue

The U.S. Army Corps of Engineers built four dams on the mainstem Columbia River that inundated the four treaty tribes' usual and accustomed fishing places and fishing villages along that stretch of river. Under Public Laws 79-14 and 100-581, Title IV, Congress designated federal lands and directed the Army Corps of Engineers to acquire private lands to provide for tribal member access to usual and accustomed fishing areas and to provide infrastructure for camping, fishing access, and ancillary fishing facilities.

River Housing Options Studied

Yakama Nation Housing Authority Chairwoman Elena Bassett and CRITFC Enforcement Chief Davis Washines on location with U.S. Corps of Engineers and tribal officials studying tribal housing needs along the Columbia River.

While the Army Corps of Engineers completed construction of the treaty fishing access sites in 2011, the federal agency has an on-going obligation to analyze and undertake remediation and mitigation projects, including infrastructure development for the cultural, social, environmental, religious, and traditional practices lost to the tribes because of federal hydroelectric development of the river. Federal development of the Columbia River has resulted in persistent poverty and unhealthy and unsafe living conditions for the tribes' members living along the river. Currently the most urgent need is for housing and housing infrastructure.

While CRITFC is a fish organization and has no expertise in housing, the problem of affordable and safe housing is affecting fishing access sites. Tribal members without other alternatives are using the access sites either for temporary or year-round residency. This is causing numerous problems, such as overcrowding, over-burdened utilities, and an unanticipated level of maintenance and wear.

Actions Needed

We can address these challenges by taking the following actions.

- Assist the U.S. Army Corps of Engineers in completing study on housing needs of tribal members living along the Columbia River.
- Assist the four tribes by developing recommendations for a strategic plan that addresses tribal member housing needs along the river. Elements of a strategic plan may include:
  - Defining roles and responsibilities of tribal governments, tribal housing, and other programs, CRITFC and local tribal communities.
  - Describing options for establishment of a tribal entity to coordinate with the U.S. Army Corps of Engineers.
  - Researching and outlining steps needed to create a Community Housing Development Organization to take advantage of non-Indian Housing and Urban Development funds.
  - Helping pursue federal appropriations in support of U.S. Army Corps of Engineers housing development opportunities.
  - Establishing a timeline or schedule.

Desired Outcome

A key outcome of such a strategic planning effort would be the formation of a permanent entity that would lead and coordinate the tribes' efforts to address tribal member housing needs along the Columbia River. Meeting the housing needs of tribal members would take pressure off the treaty access fishing sites and allow them to return to their primary purpose, which is providing access for fishing and fishing-related activities.

NEW
Recommendation

Community Development Recommendation 5

Workforce Development

Issue

The Columbia River treaty tribes play a major role in salmon management and mitigation and provide benefits to all citizens of the Pacific Northwest. Together the natural resource departments of CRITFC and its member tribes dedicate approximately 600 professional and technical staff to natural resource programs and jobs. Yet the region lacks the resources and focus to bring increasing numbers of skilled Native American employees into its fisheries and natural resource programs.

Native Americans are greatly underrepresented amongst students of postsecondary education, especially in science, technology, engineering, and math (STEM) subjects. Fewer than half of tribal youth in the Pacific and Northwestern regions of the United States graduate from high school. Although Native Americans comprise 1.5% of the U.S. population, they account for only 0.7% of students graduating with bachelor's degrees in science. The low numbers of Native American students earning advanced degrees in the sciences directly correlate to too few students successfully pursuing careers in natural resource management. At present, few programs exist to address this disparity.

Advancing Native American students into science-related careers in natural resources and fisheries programs is a critical factor in maintaining tribes' independence and sovereignty. "Adding more Native people to the natural resources field will demonstrate the effectiveness of using traditional knowledge in conjunction with Western science, thereby helping to discover ways to solve problems through a combination of these approaches" (Martinez 2004).

The CRITFC Tribal Workforce Development Program seeks to establish and sustain a tribal workforce pool of respected and skilled Native American scientists and technicians that serves the tribes' salmon and natural resource management program needs. The mission of the program is to build and foster pathways for Native American students from elementary school through postgraduate levels to achieve the skills, education, and training necessary to succeed in the tribe's fisheries and natural resource positions. The program, a multifaceted of blending traditional ecological knowledge with Western science, consists of many approaches, including internship

opportunities, summer programming, and increasing salmon awareness among students of all ages.

The Tribal Workforce Development Program is part of CRITFC's Watershed Department. The program's goal is to increase employment of tribal members in professional careers protecting tribal resources (CRITFC 2012).

A New Generation of River Caretakers

These young people from the Warm Springs tribe examine invertebrates on Shitike Creek, a Deschutes River tributary, during a science field trip conducted by the Warm Spring Fisheries Department. Cheyenne Wahneta, on the left, is now a department employee. On the right is Allen LeClair.

Actions Needed

The program's goal can be achieved by taking the following actions.

- Collect data from the CRITFC member tribes' education, workforce, and natural resources departments to identify needs and pathways for collaboration.
- Identify factors limiting tribal workforce development.
- Identify successful existing models and analysis of the bases for their successes as well as steps required to implement and/or merge such models in the context of salmon and natural resource management.
- Mobilize tribal resources and infrastructure to oversee and assure the transferability and sustainability of the programs efforts.
- Partner with institutions of higher education that provide financial and cultural support to undergraduate and graduate tribal students in STEM fields.
- Partner with organizations to provide internship opportunities to high school and college student in STEM fields.

Desired Outcome

On behalf of the Columbia River treaty tribes, we seek:

- Establishment of a sustainable tribal workforce of respected Native American scientists and technicians that serves the tribes' salmon management programs.
- Emergence of nationally recognized leadership of Native American faculty in areas of science and technology to support fisheries and coastal-margin ecosystem management.
- Preservation of tribal salmon culture and understanding and sustained transfer of this to future generations of tribal members.
- Non-tribal understanding of tribal salmon management and a commitment to bilateral consultation, respect, and learning.
- Increased numbers of tribal students pursuing degrees in fisheries and natural resource management.
- More internship opportunities for tribal high school and college students in fisheries and natural resource management.

Appendices

- References
- Glossary

The plan appendices listed below are only available online:

- APPENDIX A: Subbasin Descriptions 16
- APPENDIX B: Hatcheries and Rearing Facilities 1298
- APPENDIX C: 2008-2017 US v. Oregon Production Tables 1278
- APPENDIX D: Sturgeon Abundance 1287

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Glossary

anadromous fish. Fish, such as salmon and lamprey, that hatch in freshwater, migrate to the ocean, where they grow, and then return to freshwater as mature fish to spawn.

anthropogenic. Produced or caused by humans.

artificial propagation. Using a human-controlled system to spawn, incubate, hatch and/or raise fish.

basin. See WATERSHED.

batholith. See IDAHO BATHOLITH.

B-run steelhead. Summer steelhead that are greater than 78 cm in length.

BA. Biological assessment

baseline monitoring. In the context of restoration, baseline monitoring is done before implementation to establish historical and/or current conditions against which progress or lack of progress can be measured.

BCF. Bureau of Commercial Fisheries

Best Management Practices (BMPs). An action or combination of actions that are the most effective and practical means (including technological, economic, and institutional) of preventing or reducing non-specific sources of water pollution. The term is also used in other fields of natural resource management.

BIA. Bureau of Indian Affairs

BLM. Bureau of Land Management

BO or BiOp. Biological Opinion

Bonneville Power Administration (BPA). Created in 1937, the agency markets and distributes power generated by the Federal Columbia River Hydroelectric System and provides funding for salmon recovery projects under the Northwest Power Act.

BPA. See BONNEVILLE POWER ADMINISTRATION.

broodstock. Adult fish that produce the next generation of fish.

CBFWA. Columbia Basin Fish and Wildlife Authority

CCT. Confederated Colville Tribes

ceded area. Territory transferred from one government to another.

CFF. Commission of Fish and Fisheries

Clean Water Act. A federal statute with the primary goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. The act delegates the authority to develop and implement water quality standards to the U.S. Environmental Protection Agency (EPA). The EPA also acts to ensure that each state's water quality standards and pollution control programs are consistent with the act's purposes.

COE or USCOE. U.S. Army Corps of Engineers

Columbia Basin Fish Accords (Accords). Ten-year agreements between federal agencies, tribes, and states to work together to protect and restore Columbia Basin fish and wildlife resources. The agreement with the Umatilla, Warm Springs, and Yakama tribes and the Bonneville Power Administration, U.S. Army Corps of Engineers, and Bureau of Reclamation focuses on improving fish passage at federal dams, restoring habitat, and using hatcheries to rebuild anadromous fish populations. The agreement extends through September 2018.

Columbia River Fish Management Plan (CRFMP). A consent decree approved by and entered as an order of the district court in *U.S. v. Oregon*, in which the parties to *U.S. v. Oregon* may exercise their sovereign power in a coordinated and systematic manner to protect and rebuild upper Columbia River fish runs and allocate their harvest between Indian and non-Indian fisheries.

Columbia River Inter-Tribal Fish Commission (CRITFC). A coordinating fisheries agency, founded in 1977 by the Nez Perce, Umatilla, Warm Springs, and Yakama tribes—the four Columbia River tribes that reserved fishing rights in 1855 treaties with the United States government. CRITFC, through its staff of biologists, policy analysts, law enforcement officers, and other specialists, strives to protect the tribes' fishing rights and works to restore the fish resources upon which tribal religion, culture and livelihood depend.

Columbia River Treaty (CRT). A 1964 agreement between the United States and Canada.

COLTEMP (Columbia Temperature Model). A simulation model describing salmon passage through the Columbia and Snake River hydropower system.

co-managers. The tribes, federal fish agencies and Idaho, Oregon and Washington state fish agencies. See COLUMBIA RIVER TREATY.

cotenancy. An interest and possession in real property by several distinct titles but by unity of possession, or any joint ownership or common interest with its grantor.

CRFMP. See Columbia River Fish Management Plan.

CRiSP. Columbia River Salmon Passage Model

CRITFC. See Columbia River Inter-Tribal Fish Commission

CTUIR. Confederated Tribes of the Umatilla Indian Reservation

CTWSIR. Confederated Tribes of the Warm Springs Reservation of Oregon

DFOP. Detailed Fisheries Operating Plan

DOE. Washington Department of Energy

downstream migration. The journey of young salmon or lamprey from streams and rivers to the ocean.

DPS. Discrete Population Segment

ecosystem services. The functions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life.

Endangered Species Act (ESA). A federal statute with a primary goal of protecting threatened and endangered species and the ecosystems on which they depend. Under the act, the U.S. Fish and Wildlife Service (USFWS) has the authority to designate species for protection and the responsibility to develop recovery plans. The National Marine Fisheries Service (NMFS), under an agreement with the USFWS, administers the ESA for Pacific salmon.

EPA. U.S. Environmental Protection Agency

ESA. See Endangered Species Act.

escapement. The number of salmon surviving to return to a specified point of measurement. Spawning escapement consists of those fish that survive to spawn.

ESU. Evolutionarily Significant Unit

FCRPS. Federal Columbia River Power System

FELCC. Firm Energy Load Carrying Capacity

FERC. Federal Energy Regulatory Commission

fiduciary. A person or institution that manages money or property for another and that must exercise a standard of care in such management activity imposed by law or contract.

First Foods. The traditional foods of the indigenous peoples of North America. For the Nez Perce, Umatilla, Warm Spring and Yakama tribes, these foods—water, salmon, deer, roots and berries—are celebrated for the vital sustenance they provide and for their religious, cultural, economic and medicinal importance. See First Foods.

fish ladder. (also known as fishway) A series of ascending pools of water, constructed to enable salmon or other fish to swim upstream around or over a dam. Resembles a stairway.

fish screen. A meshlike structure placed across a water intake, pipe or passageway to divert fish from the intake.

flow. The rate at which water passes a given point on a stream or river; often expressed as cubic feet per second (cfs).

FLUSH. (Fish Leaving Under Several Hypotheses) A simulation model describing salmon passage through the Columbia and Snake River hydropower system.

FPC. Fish Passage Center

FPE. Fish Passage Efficiency

FTE. Full-Time equivalent employees

FWP. Columbia River Basin Fish and Wildlife Program

genetics. The study of heredity and variation in organisms of the same or related kinds.

genotypic. Pertaining to the genetic make-up of an organism.

GRTS. Generalized Random Tessellation Stratified. A form of spatially-balanced sampling that is a true probability design. No points in the target population are too far from a sampled point and few sampled points are close together.

habitat. The place where a plant or animal lives and grows.

HCP. Habitat Conservation Plan

HGMP. Hatchery and Genetic Management Plan. The Endangered Species Act (ESA) requires salmon hatchery programs in areas with ESA-listed populations to complete a HGMP and submit it to the federal government for approval. The plan describes the composition and operation of individual hatchery programs.

hydrograph. A representation of water levels over time.

hypothesis. An unproved logically consistent theory tentatively accepted to explain certain facts or to provide a basis for further investigation, argument, etc.

ICFRU. Idaho Cooperative Fish and Wildlife Research Unit

Idaho batholith. The mountainous area in north-central Idaho composed primarily of granitic parent rock. Soils weathered from this parent rock are generally non-cohesive and prone to erosion.

IDFG. Idaho Department of Fish and Game

inbreeding depression. A reduction in fitness resulting from mating between close relatives.

infectious hematapoietic necrosis. (IHN) A virus that can kill salmonids including chinook, sockeye and steelhead; the most severe outbreaks occur when fish are young (i.e., fry or fingerlings).

IPC. Idaho Power Company

ISP. Integrated System Plan

juvenile. Young fish, usually two years of age or less and not able to spawn..

LIDAR. A remote sensing method that uses lasers to measure variable distances to the earth. Combined with other data, this technology produces accurate, three-dimensional information. LIDAR stands for light detection and ranging.

LLC. Limited Liability Company

LRMP. Land Resource Management Plan

LSRCP. Lower Snake River Compensation Plan

mainstem. The main channel of a river as opposed to tributary streams and smaller rivers that feed into it.

MCPUD. Mid-Columbia Public Utilities Districts

Mitchell Act. A federal statute passed in 1938 to mitigate for fishery damage caused by Bonneville Dam and subsequent federal water projects; and implemented by state and federal agencies primarily through hatchery programs that resulted in the taking of upper Columbia and Snake river salmon as broodstock for downriver hatcheries.

mitigation Actions. taken to help compensate for damage, such as human-caused damage to fish and wildlife resources. Mitigation for fish losses often takes the form of hatchery production.

mortality. The death of fish from natural or human causes.

natural production. Fish that are raised and return to spawn in streams, either by natural spawning or by outplanting hatchery fish.

NCASI. National Council of the Paper Industry for Air and Stream Improvement, Inc.

NMFS. National Marine Fisheries Service, National Oceanic and Atmospheric Administration

Northwest Power Act. The Pacific Northwest Electric Power Planning and Conservation Act of 1980 (also known as the Regional Power Act), authorized the Northwest Power and Conservation Council and called for the development of a Columbia Basin fish and wildlife mitigation program to be funded by the Bonneville Power Administration. See Northwest Power and Conservation Council.

Northwest Power and Conservation Council (NPCC). The NPPC, authorized by the Northwest Power Act, consists of eight members appointed by the governors of Idaho, Montana, Oregon, and Washington. Under the federal act, NPCC is charged with the development of a fish and wildlife program to protect, mitigate, and restore Columbia Basin fish and wildlife (including related spawning grounds and habitat) harmed by hydroelectric dams.

Northwest Power Planning Council (NPPC). now the Northwest Power and Conservation Council. See above.

NPT. Nez Perce Tribe

NPTEC. Nez Perce Tribal Executive Committee

NRC. National Research Council

ODEQ. Oregon Department of Environmental Quality

ODFW. Oregon Department of Fish and Wildlife

outbreeding depression. A reduction in fitness resulting from mating distant relatives potentially causing problems in adaptation.

outplanting. See supplementation.

PAC. Production Advisory Committees

passage. The movement of migratory fish through a river system.

PBDEs. Polybrominated diphenyl ethers.

PCSRF. Pacific Coastal Salmon Recovery Fund

PGE. Pacific General Electric

PIT-tags. Passive Integrated Transponder tags are used to identify salmon for monitoring and research purposes. These microchips are inserted in the body cavity of the fish and decoded at select monitoring sites.

phenology. A branch of science dealing with the relationships between climate and periodic biological phenomena, such as plant flowering or fish migration.

phenotypic. Pertaining to the visible or otherwise measurable physical characteristics of an organism.

PNL. Pacific Northwest Laboratories

population. A group of organisms of a species living in a certain area.

PRP. Project Review Process

PSC. Pacific Salmon Commission

PSMFC. Pacific States Marine Fisheries Commission

PST. Pacific Salmon Treaty

PUD. Public Utilities District

RASP. Regional Assessment of Supplementation Projects

rearing. The juvenile life stage of anadromous fish that is spent in freshwater rivers, streams, and lakes before migrating to the ocean.

recruit. A fish of sufficient size to be subject to harvest and/or a mature fish arriving at a spawning area.

redd. A spawning nest dug into gravel in a stream bed by an adult salmon.

riparian. The region adjacent to bodies of water, such as streams, springs, rivers, ponds, and lakes.

run. A population of fish of the same species consisting of one or more stocks migrating at a discrete time.

salmonid. A fish of the Salmonidae family, which includes salmon and trout.

SAP. Scientific Advisory Panel

SBT. Shoshone Bannock Tribes of Fort Hall

sedimentation. The settling of silt or any matter in bodies of water.

smolt. A juvenile salmon migrating to the ocean and undergoing physiological changes (smoltification) to adapt its body from a freshwater to a saltwater environment.

smolt-to-adult returns. Survival rate of a salmon population from the smolt to adult life stages, calculated by estimating the number adults returning to either Bonneville or Lower Granite dams divided by the initial number of smolts released and/or migrating from rearing areas.

spawner. A mature fish that produces eggs or sperm.

species. Basic category of biological classification. In sexually reproducing organisms, a group of interbreeding individuals not normally able to interbreed with other groups. Under the ESA, a species can be either a biological species, biological sub-species, or distinct population segment of a biological species.

SRIT. Snake River Implementation Plan

SRSRT. Snake River Salmon Recovery Team

STFA. State and Tribal Fish Agency Analytical Team

stock. A group of fish that spawn together in a particular stream during a particular season that generally do not interbreed with any other group of their species that spawns at a different time.

straying. The tendency of some anadromous fish to return and spawn in streams other than those in which they were born.

subbasin. A designated watershed with a single entry river into either the Snake or Columbia River basins.

supplementation. The act of releasing young, artificially propagated fish into natural spawning and rearing habitat. As adults, these fish will return to spawn naturally in the stream where they were released rather than returning to the propagation facility. (Also called outplanting.)

TAC. Technical Advisory Committee

tailrace. The canal or channel immediately downstream of a dam's powerhouse and spillway that carries water away from the dam.

TEK. Traditional Ecological Knowledge

TIR. Technology used to measure and depict stream temperature patterns over multiple spatial scales. TIR stands for thermal infrared radiometer.

total maximum daily load (TMDL). Under the Clean Water Act, the total amounts of different pollutants allowable for a particular watershed.

tributary. A stream of lower order than the stream or river it joins. For example, the Clearwater River is a tributary of the Snake River, which is a tributary of the Columbia River.

US v Oregon. The federal court case that upheld the treaty fishing rights of the Columbia River treaty tribes in a 1969 decision. The case remains under the court's jurisdiction. Federal District Judge Robert Belloni recognized the rights of tribes to fish at all usual and accustomed fishing places and rules that the tribes are entitled to a "fair share" of the fish runs. The decision holds that the state is prohibited from discriminating against treaty fishing and that state power is limited in regulating treaty Indian fisheries, i.e., the state can regulate only when "reasonable and necessary for conservation."

US v Washington. A 1974 federal court case that reaffirmed Puget SoundWestern Washington tribes' reserved rights to 50% of harvestable salmon. Subsequent proceedings ruled that the treaty right included the right to harvest hatchery fish and imposed a duty on the state to protect salmon habitat. The Yakama Nation is a party in the case, which like *U.S. v. Oregon* continues under the jurisdiction of the federal district court.

United States-Canada Pacific Salmon Interception Treaty. (also called the Pacific Salmon Treaty or PST) Signed in 1985, the United States-Canada Pacific Salmon Treaty limits each country's interception of the other's salmon

to promote the ability of stocks to rebuild in both nations. The two countries' governments made new treaty agreements in 1999 and most recently in 2008.

upstream migration. The return of adult salmon from the ocean to inriver areas where they were born and where they will spawn the next generation.

USBOR or BOR. U.S. Bureau of Reclamation

USCOE or COE. U.S. Army Corps of Engineers

USDA. U.S. Department of Agriculture

USFS U.S. Forest Service

USFWS U.S. Fish and Wildlife Service

watershed. The drainage area contributing water, organic matter, dissolved nutrients and sediments to a river or lake. Used interchangeably with basin or subbasin.

waterspreading. The illegal or unauthorized use of federally subsidized water for irrigation.

WDOE. Washington Department of Ecology

WDF. Washington Department of Fisheries

WDFW. Washington Department of Fish and Wildlife

WDW. Washington Department of Wildlife

WPPSS. Washington Public Power Supply System

YIN. Confederated Tribes and Bands of the Yakama Indian Nation

YN. Yakama Nation; Confederation Tribes and Bands of the Yakama Indian Nation

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Definitions are provided for additional clarification; they have no legal significance.