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From the Archives

The efforts of the United States in reference to the introduction of useful food fishes should not be limited to the salmonidae already mentioned (to which the various species of trout, salmon, white-fish and smelts belong) and to the shad, as many other kinds yet remain for consideration. The land-locked salmon, the European char and the smelt, will be available for all ponds or lakes of a certain extent and temperature. In these they will pass the greater part of their time, running up into the tributaries or outlets to spawn. The great Danube salmon, which sometimes reaches the weight of 100 pounds, would find a perfectly suitable residence in the Mississippi river and its tributaries, feeding on the worthless chubs, suckers and cat fish so abundant therein. The alewife can be propagated to a much greater extent than at present. The sterlet, a kind of small sturgeon found in the Volga and in Russia, is esteemed far beyond the turbot, will thrive in the Mississippi valley and in the lakes. The gourami, an East India fish, can be placed to great advantage in the mill-dams, ponds, etc., of the south, thriving as it does in very warm water and feeding entirely on vegetable matter. It attains a weight of twenty pounds or more, grows with great rapidity, and is unsurpassed in the excellence of its flesh.

Spencer F. Baird (1873): National Fish Culture, Transactions of the American Fisheries Society, 2:1, 25-32.

Extirpation and Tribal Reintroduction of Coho Salmon to the Interior Columbia River Basin

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ABSTRACT: *Harvest of anadromous salmonids in the Columbia River basin has been fundamental to the nutrition, economy, and cultural and religious beliefs of the regional Native American tribes. Agricultural development, dam construction, urbanization, and overharvest following colonization by European-origin settlers, however, resulted in dramatic reductions in salmon runs and negative impacts to the well-being of tribal peoples. Federal and state fishery agencies attempted to mitigate for the loss and to rebuild some salmonid populations but deemed Coho Salmon of lesser importance for upriver fisheries and allowed them to go functionally extinct. In the mid-1990s, fishery agencies of the Columbia River Treaty tribes spearheaded efforts to reestablish the extirpated Coho Salmon, beginning in the Yakima, Wenatchee, Methow, and Clearwater rivers. The programs were initiated with juveniles from composite lower Columbia River hatchery stocks, acclimated or direct released near potential spawning habitat, then were transitioned to producing juveniles with broodstock collected in-basin. Increasing numbers of fish are now returning to these rivers, a portion of which is the product of natural spawning. Results suggest that the Coho Salmon are adapting to their new environments and founding local naturalized populations.*

Extirpación y reintroducción de salmón plateado por tribus autóctonas en la cuenca del Río Columbia

RESUMEN: *la captura de salmónidos anádromos en la cuenca del Río Columbia ha sido fundamental para la nutrición, economía, cultura y creencias religiosas de las tribus nativas de Norte América. El desarrollo de la agricultura, la construcción de presas, urbanización y sobre pesca que siguieron a la llegada de los colonizadores europeos, dieron como resultado reducciones dramáticas de las corridas de salmón y causaron un impacto negativo en el bienestar de la gente tribal. Las agencias pesqueras federales y estatales trataron de mitigar estas pérdidas y de reconstruir algunas poblaciones de salmónidos, sin embargo clasificaron al salmón plateado como de menor importancia para las pesquerías, permitiendo así que llegara a la extinción funcional. A mediados de la década de 1990, tanto las agencias pesqueras como las tribus oriundas del Río Columbia encabezaron esfuerzos para restablecer el extirpado salmón plateado, comenzando con los ríos Yakima, Wenatchee, Methow y Clearwater. Los programas se iniciaron utilizando individuos juveniles de los stocks cultivados en la parte baja del Río Columbia, mismos que se aclimataban o se liberaban directamente cerca de hábitats potenciales para el desove. Posteriormente, en una etapa transitoria, se produjeron juveniles a partir de reproductores recolectados en las cuencas. En la actualidad, cada vez más peces están regresando a estos ríos, una parte de los cuales es el producto de desoves naturales. Los resultados sugieren que el salmón plateado se está adaptando a sus nuevos ambientes y está creando poblaciones locales naturales.*

INTRODUCTION

Before European settlement, the Columbia River Basin in the Pacific Northwest supported runs of anadromous salmonids averaging 7 to 16 million fish annually (Chapman 1986; Schalk 1986). These salmonids included five species (estimated proportion of total return): Chinook Salmon (*Oncorhynchus tshawytscha*; spring, summer, and fall runs; 50%), Sockeye Salmon (*O. nerka*; 30%), Coho Salmon (*O. kisutch; 8%*), steelhead (*O. mykiss; 6%*), and Chum Salmon (*O. keta*; 6%). While Chum Salmon were unable to pass Celilo Falls at river kilometer (rkm) 320, the other four species were widely distributed through the middle and upper Columbia River and Snake River basins (Figure 1; Chapman 1986).

Native American Indian tribes long occupied the interior Columbia Basin, and harvest of the abundant salmon was fundamental to their nutrition, economy, and cultural and religious beliefs (Craig and Hacker 1940; Netboy 1980; DeVoto 1997; Johnsen 2009). Tribal creation stories recount how salmon offered themselves up as food for the newly arrived humans, and fishing is viewed as an integral part of the natural life cycle of both the tribal peoples and the salmon (Landeen and Pinkham 1999). In counterpart, the tribes recognized their responsibility toward the salmon and traditionally managed their fishing practices to assure sufficient escapement to the spawning grounds. While the Indians harvested large numbers of fish annually, they did so in a sustainable manner for over 10,000 years (Johnsen 2009).

Colonization of the region by European-origin settlers, however, had devastating effects on the ecosystem and on tribal

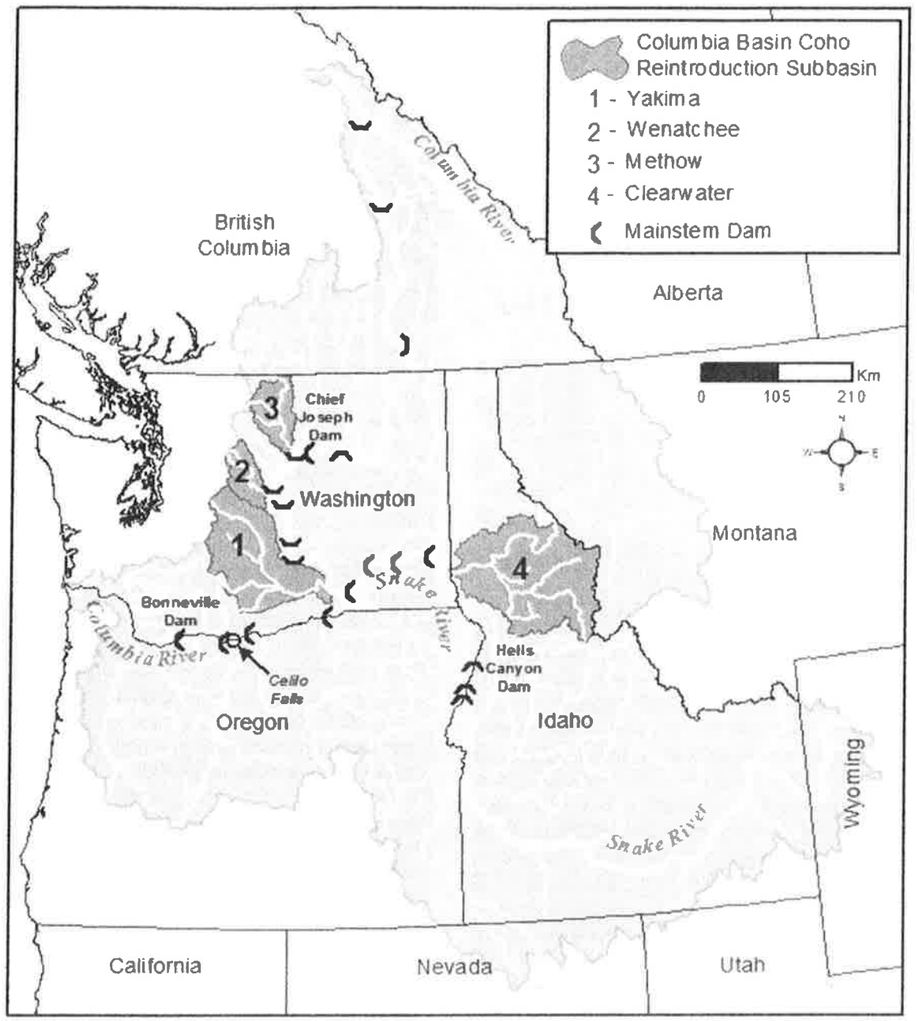


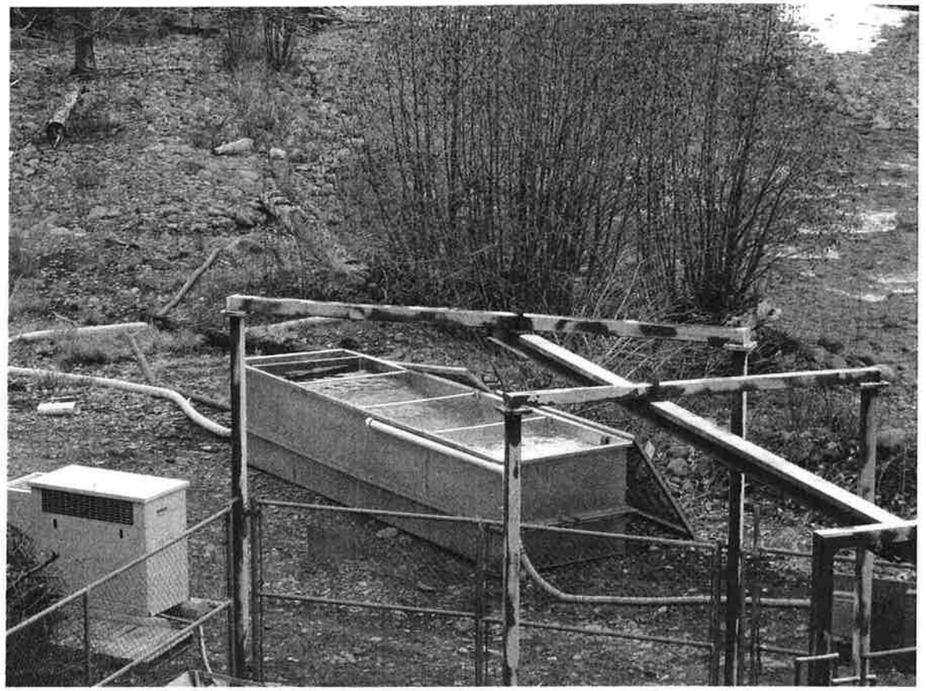
Figure 1. Map of the Columbia Basin showing the location of Celilo Falls, Columbia River, and Snake River main-stem dam and subbasins in which the tribes have enacted programs to reintroduce Coho Salmon.

well-being. Large-scale agriculture, urbanization, overfishing, and construction of dams for hydroelectric power and irrigation severely diminished the salmon runs and, in turn, tribal fishing opportunities. Among the main-stem hydroelectric dams, Chief Joseph Dam (Columbia River rkm 878) and Hell's Canyon Dam (Snake River rkm 398) were impassable and excluded salmon from over 55% (2740 rkm) of previously accessible habitat (Figure 1; Craig and Hacker 1940; Netboy 1980; Cone and Ridlington 1996; Lichatowich 1999).

In 1938, the U.S. Congress passed the Mitchell Act to provide federal and state fishery management agencies with resources to mitigate loss of salmon associated with construction of the main-stem hydroelectric dams (Mitchell Act 1938; Cone and Ridlington 1996). The primary mitigation activity funded by the Act was construction and operation of hatcheries. However, these facilities were essentially all located along the main-stem Columbia in proximity to or below Bonneville Dam (rkm 235; the lowest of the main-stem dams), to support coastal and lower river nontribal commercial and sport fisheries. The Act did little to rebuild depressed interior populations or support upstream tribal fisheries, despite promises made to the tribes (Dompier 2005).

EXTIRPATION OF COHO SALMON FROM THE INTERIOR COLUMBIA RIVER BASIN

While returns for all Columbia River salmonids diminished throughout the 20th century, interior Coho Salmon runs were particularly hard hit. From precolonial returns of hundreds of



Photograph 1. Mobile Coho Salmon acclimation tank installed along Rattlesnake Creek, tributary to the Naches River in the Yakima River subbasin. Photo credit: Todd Newsome.

thousands, the first Coho Salmon count at the newly constructed Bonneville Dam in 1938 was already only 15,000. By the mid-1900s, escapement to the interior Columbia had diminished to 2,000 to 3,000 fish (Fish Passage Center 2013), most of which were strays from lower river hatcheries (Mullan 1983).

In the mid-1900s a program was enacted to rebuild Coho Salmon returns to the interior basin. The program involved transfers of fertilized eggs of lower Columbia River (LCR) stocks from Mitchell Act hatcheries for incubation and rearing at five federal and state hatcheries located in the Mid-Columbia region, upstream of the confluence with the Snake River. Intensive stocking began in the 1960s, and substantial increases in adult returns were quickly observed (Wahle and Pearson 1984). However, juveniles were released directly from the hatcheries or into the main-stem Columbia, and little natural spawning of the returning adults resulted (Fulton 1970; Horner and Bjornn 1981). In this same period, sportfishing for steelhead and spring Chinook Salmon became increasingly popular. To provide additional hatchery resources for these species, the Coho Salmon program was phased out, beginning in 1969 and ending by 1981 (Horner and Bjornn 1981; Wahle and Pearson 1984; Dompier 2005). Main-stem dam counts rapidly diminished, and natural populations of Coho Salmon in the region were soon deemed functionally extinct (Nehlsen et al. 1991).

Two smaller Coho Salmon programs were initiated in the 1960s in the Snake River basin, by the Idaho Fish and Game Department (IDFG) in the Clearwater River and by the Oregon Department of Fish and Wildlife in the Grande Ronde River. Both programs involved out-planting of fertilized LCR eggs from Mitchell Act hatcheries. Adult returns, however, were poor and the programs were terminated within 6–7 years. Subsequently, as in the Mid-Columbia, Coho Salmon populations in the Snake River were determined to be extinct.

By the 1990s, natural populations of other salmonid stocks in the interior Columbia had fallen to such highly depressed levels that the National Marine Fisheries Service proposed them for listing under the Endangered Species Act (ESA; National Oceanic and Atmospheric Administration [NOAA] 2004). With their new threatened or endangered status, regulatory protections and funds for rebuilding became available. In contrast, interior Coho Salmon had already been extirpated and were not petitioned for listing; thus, there were no ESA-related legal obligations to enact restoration measures. The tribes, however, viewed extinction of any member of the Columbia River salmon family as unacceptable.

POLICY ISSUES AND TRIBAL RESPONSE

Disputes generated by attempts of tribal members to continue traditional fishing activities in the Columbia basin resulted in several court cases through the 1900s, culminating in decisions in the tribes' favor under the ongoing *U.S. v. Oregon* proceedings. An initial decision (*U.S. v. Oregon* 1969)

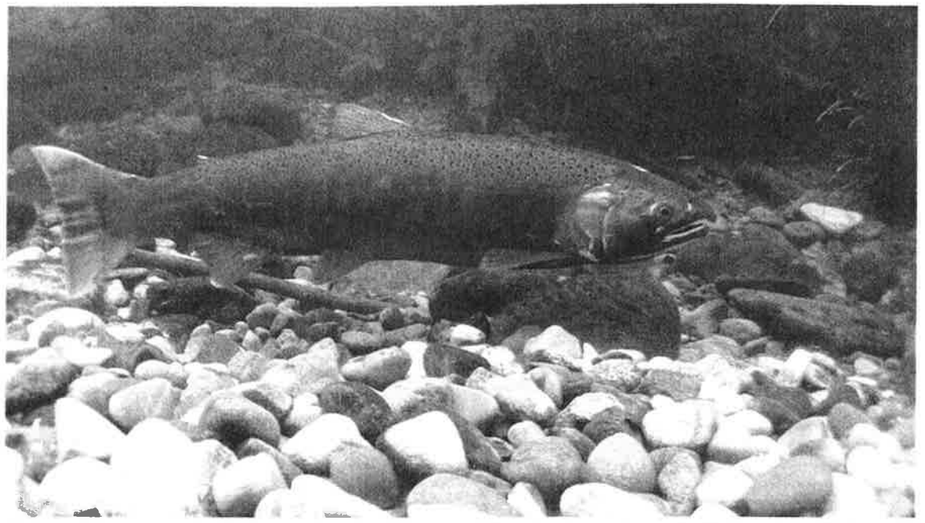
Photograph 2. Coulter Pond—a beaver pond located on Coulter Creek in the Wenatchee subbasin, used for acclimation of Coho Salmon juveniles. Photo credit: Cory Kamphaus.

recognized the reserved "right of taking fish" at all "usual and accustomed" fishing locations of the four Columbia River treaty tribes—the Confederated Tribes of the Warm Springs Reservation of Oregon, the Confederated Tribes of the Umatilla Indian Reservation, the Yakama Nation (YN), and the Nez Perce Tribe (NPT)—as written in their 1855 treaties with the U.S. Government. In 1975, a decision in a related case (*U.S. v. Washington* 1974) clarified the tribal share to be 50% of the harvestable portion of the run destined for tribal usual and accustomed fishing locations, and this percentage was applied to the portion of Columbia River run destined for areas upstream of Bonneville Dam. In 1977, the court requested creation of a forum in which the tribes would participate as co-managers alongside state and federal agencies for negotiating fishery policies, harvest sharing, and hatchery production levels, and the first interagency harvest management agreement was established (Straub et al. 1977). The same year the Columbia River Inter-Tribal Fish Commission (CRITFC) was created by resolution of the four tribes to provide technical, policy, and legal support. Subsequently, each of the tribes developed their own fisheries agencies to facilitate management of programs within their ceded territories (Dompier 2005).

With their strengthening technical and management capabilities, the tribes increased pressure for rebuilding interior Columbia Basin salmon and steelhead, including restoration of Coho Salmon. In 1988, a new agreement was established, the Columbia River Fish Management Plan (Goldschmidt et al. 1988), in which the tribes negotiated an annual program to transport 1,000,000 early run LCR Coho Salmon juveniles for release in the Umatilla River and another 700,000 in the Yakima River. However, the states insisted that the objective of these programs be limited to tributary harvest and maintained language from the prior agreement that the tribes forego claims to a 50% allocation on Coho Salmon. The agreement also set restrictions on gill-net mesh size in main-stem fisheries to protect migrating steelhead (Straub et al. 1977) that preclude effective harvest of the similarly sized Coho Salmon (Dompier 2005).

Eight years later, however, the YN redesigned their program to also facilitate establishment of a natural Coho Salmon population within the Yakima River. Between 1996 and 1999, the tribe shifted from direct release of LCR smolts in the lower river to acclimation and release from upriver facilities in closer proximity to natural spawning habitats. Additionally, returning adults were collected for use as broodstock, to develop a localized stock for continued supplementation. During this same period, the YN began a similar reintroduction program in the Mid-Columbia Methow and Wenatchee rivers, as did the NPT in the Clearwater River (Figure 1).

There have been differences in approach among the three programs, largely related to availability of rearing, acclimation, and monitoring facilities. However, common to each was initiation with acclimation and release of out-of-basin LCR smolts, followed by transition to production of smolts from



Photograph 3. A mature female Coho Salmon that has returned for natural spawning in the Methow River. Photo credit: Robert Farley.

adults returning in-basin to create a new localized stock. In the 15+ years since initiation, annual counts of returning adults and the number and distribution of redds have risen dramatically. A brief description of the design and results for each program is provided below, followed by a discussion on use of an out-of-basin hatchery stock to reintroduce an extirpated population.

TRIBAL PROGRAMS TO RESTORE COHO SALMON

Restoration of Coho in the Yakima River

The Yakima River (Figure 2A) once supported runs of Coho Salmon between 44,000 (Kreeger and McNeil 1993) and 150,000 (Yakama Indian Nation et al. 1990), though the fish were extinct by the mid-1990s. In 1988, the YN and Washington Department of Fish and Wildlife developed the Yakima/Klickitat Fisheries Project—a comprehensive project to restore healthy populations of anadromous and resident salmonids to the Yakima and Klickitat rivers funded by the Bonneville Power Administration (BPA). Though the project focused on spring Chinook Salmon and steelhead, the YN also incorporated the Columbia River Fish Management Plan Yakima River Coho Salmon program under the Yakima/Klickitat Fisheries Project. Beginning in 1997, the release locations of the LCR smolts were moved further upstream near better spawning and juvenile rearing habitat, with the objective of reestablishing a natural population. The initial two phases of this three-phase program are complete. Over this period, hatchery origin adults that returned in-basin were increasingly used as broodstock to create a local strain of Coho Salmon. Returning adults are captured at Prosser Dam and spawned at Prosser Hatchery (Figure 2A). The hatchery facilities are limited, so a portion of the eggs is transferred out-of-basin for incubation and rearing but returned to the Yakima River for acclimation and release as smolts. As of 2010, the transition was complete and stocking of LCR juveniles was eliminated.

In Phase I (1997–2006), release sites for the LCR smolts were primarily earthen or concrete ponds located adjacent to the main-stem upper Yakima and Naches rivers (Figure 2A), where the fish were held 4–6 weeks prior to release. Mature adults from the initial releases successfully returned and were observed spawning in both subbasins, generally near the acclimation ponds (Bosch et al. 2007). Returns estimated from counts at Prosser Dam have increased from a few hundred strictly hatchery origin fish in the 1980s and 1990s to several thousand currently of both hatchery and natural origin. Additionally, hundreds of redds are now observed annually and a portion of the return is naturally spawned fish (Figure 3A; YN 2011).

Tagging data indicate that out-migration survival from site of release to McNary Dam for progeny of adults collected in-basin ranged from similar to substantially higher than their LCR counterparts (Bosch et al. 2007). Estimates of smolt-to-adult return rates (SARs) for natural origin fish were consistently higher than for hatchery origin (LCR and in-basin combined) fish (Table 1; Bosch et al. 2007; YN 2011).

To address concerns regarding possible negative effects of reintroduced Coho Salmon on ESA-listed spring Chinook Salmon, marked Coho Salmon smolts were released in areas with known high densities of newly emergent spring Chinook Salmon fry. Over 2,000 smolts were recaptured downstream in a rotary screw trap and stomach contents were examined. Only two contained fish remains identified as *Oncorhynchus* spp., and postrelease predation was deemed insignificant (Dunnigan 1999).

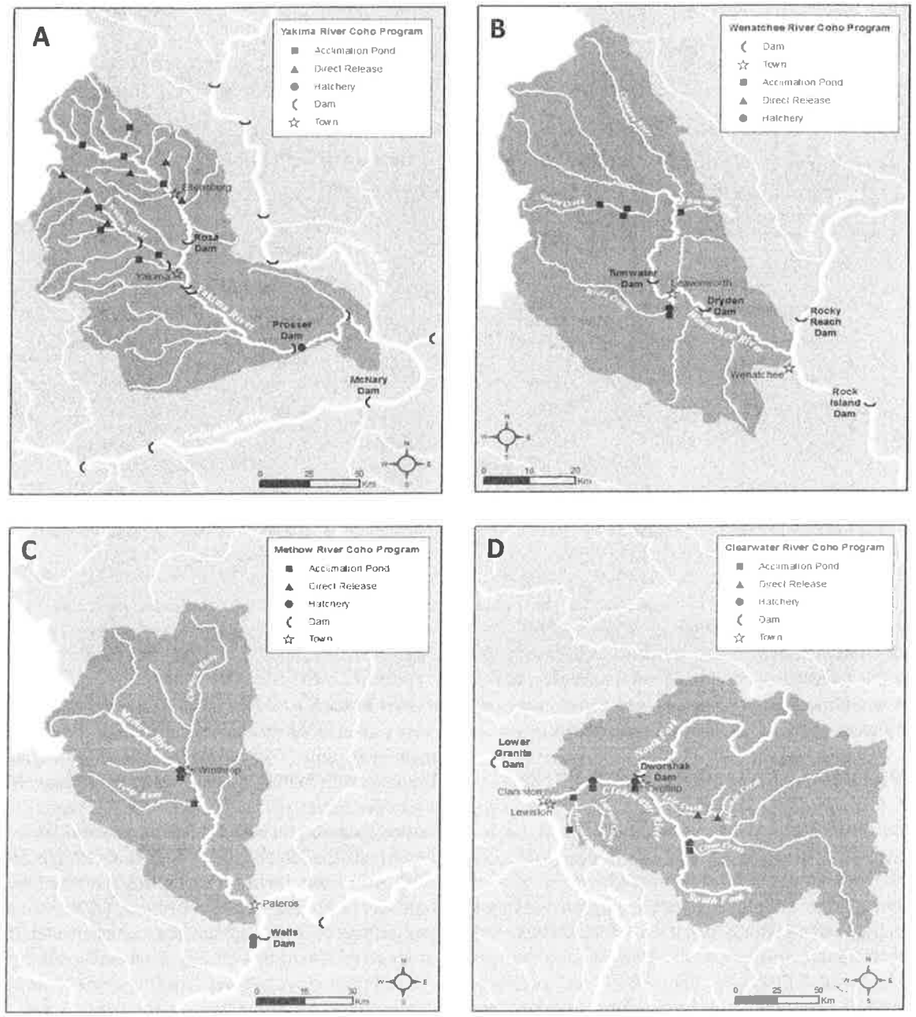


Figure 2. Maps of the tribal Coho reintroduction programs in the (A) Yakima River subbasin, (B) Wenatchee River subbasin, (C) Methow River subbasin, and (D) Clearwater River subbasin.

In Phase II (2007–2102), alternative approaches that would expand the area into which Coho Salmon might establish themselves were investigated. Some smolts were released from temporary mobile acclimation facilities operated in upstream locations in tributary streams of the Naches and upper Yakima rivers. The mobile acclimation units are portable aluminum raceways that hold up to 10,000 smolts. Data from tagged fish over four consecutive years indicated that juvenile survival and subsequent adult return rates to McNary Dam were similar within years to rates for smolts released from the main-stem acclimation ponds (YN 2011). In other streams where acclimation facilities do not exist or would be logistically difficult to establish, juveniles were released as parr and allowed to overwinter within the streams before out-migration. Parr releases have the additional advantage of substantially reducing hatchery rearing costs. Data for the direct released parr indicated that out-migration survival was generally similar to that for fish delivered to the acclimation ponds and also suggested that returning adults demonstrated high homing fidelity to their release streams (YN 2011).

At the end of Phase II the tribe submitted the Yakima Basin Coho Salmon Master Plan for final review by the Northwest Power and Conservation Council (NPCC). Activities described in the plan for Phase III include construction of a conservation hatchery in the upper Yakima River near Ellensburg, Washington (Figure 2A); increasing the proportion of natural origin adults in the broodstock; and phasing out use of the main-stem acclimation sites in favor of releases in tributary streams. Supplemented streams will be monitored to assess juvenile survival

Table 1. Prosser Dam estimates of Yakima River Coho Salmon smolt out-migrants, adult returns, and smolt-to-adult return (SAR) rates for fish of hatchery origin (a mix of lower Columbia River and in-basin stocks) and in-basin natural origin (figures updated from those reported in Bosch et al. [2007]; na = not available/applicable). SAR values are estimated from time of out-migration passage at Prosser Dam to adult return to Prosser Dam; the estimates do not account for survival from time of release to arrival at Prosser Dam, which can vary widely between release locations

Juvenile release year	Hatchery origin			Natural origin			Total smolts	Total adults
	Smolts	Adults	SAR (%)	Smolts	Adults	SAR (%)		
2000	331,503	3,546	1.07	37,359	1,432	3.83	368,862	4,978
2001	134,574	166	0.12	40,605	309	0.76	175,179	475
2002	155,814	669	0.43	19,859	1,523	7.67	175,673	2,192
2003	139,135	505	0.36	9,092	1,820	20.0	148,227	2,325
2004	148,810	2,405	1.62	18,787	472	2.51	167,597	2,877
2005	204,728	2,646	1.29	31,631	1,562	4.94	236,359	4,208
2006	204,602	2,203	1.08	8,298	1,049	12.6	212,900	3,252
2007	260,455	4,132	1.59	20,131	459.1	2.28	280,586	4,591
2008	416,708	8,835	2.12	8,046	982	2.28	539,640	9,817
2009	496,594	5,153	1.04	25,108	573	2.28	366,253	5,726
2010	341,145	7,216	2.12	35,158	802	2.28	369,049	8,018
2011	333,891	4,948	1.5	24,108	550	2.28	268,611	5,498

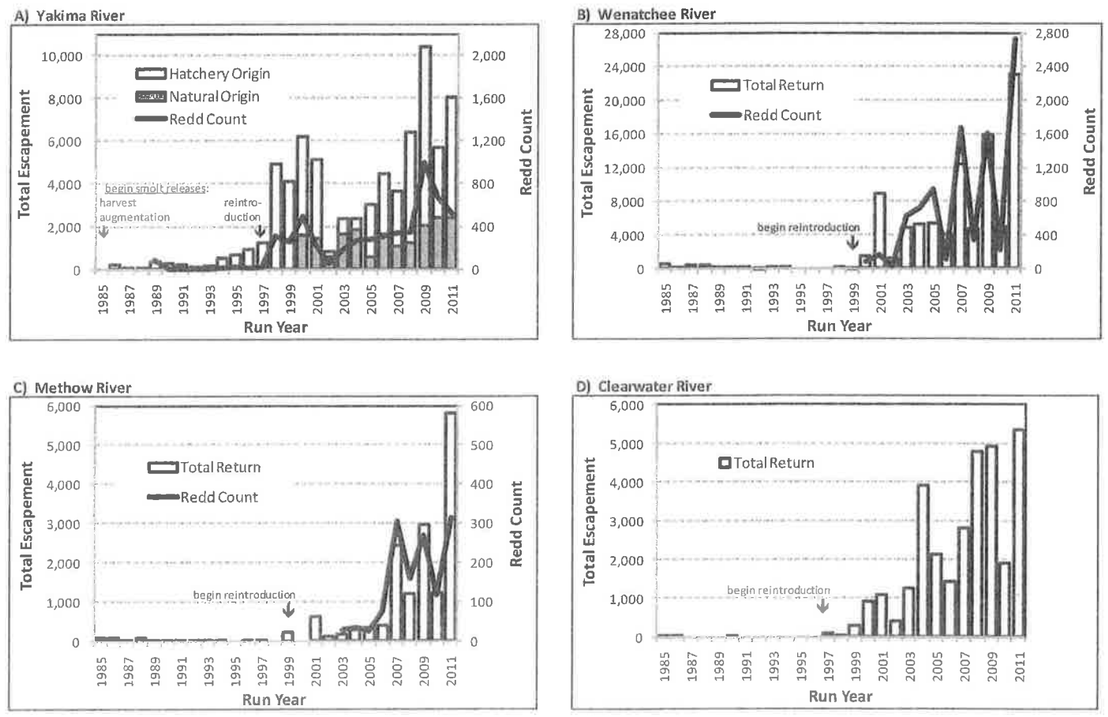


Figure 3. Annual adult returns of reintroduced Coho Salmon (differentiated between hatchery origin and natural origin when data available) and annual redd counts in the (A) Yakima River subbasin, (B) Wenatchee River subbasin, (C) Methow River subbasin, and (D) Clearwater River subbasin.

and relative natural productivity of hatchery versus natural origin adults. The plan sets an intermediate goal for a 3-year average annual return (hatchery and natural origin combined) of 5,000 fish. Once the conservation hatchery is operational, the plan sets an annual escapement goal of 3,500 natural origin fish to the upper Yakima Basin, which, if consistently achieved, will permit eventual phasing out of the supplementation program.

Restoration of Coho in the Wenatchee and Methow Rivers

Estimated historical returns of Coho Salmon to the Methow and Wenatchee subbasins in the mid-Columbia region (Figures 2B and 2C) ranged between 23,000 to 31,000 and 6,000 to 7,000, respectively (Mullan 1983). In 1995 the YN launched a program, also funded by the BPA through the NPCC Fish and Wildlife Program, to test the feasibility of reestablishing natural Coho Salmon runs in this region. The program began in the Methow River with transfers of LCR smolts for rearing and release from Winthrop National Fish Hatchery (NFH; rkm 81; Figure 2C). However, initial returns were insufficient to create a localized Mid-Columbia River (MCR) broodstock. Although releases continued in the Methow River, the tribe shifted focus in 1999 to supplementing the Wenatchee River, with Leavenworth NFH located on Icicle Creek (confluence at rkm 35) as the primary release site. Higher return rates were expected due to a shorter main-stem migration distance and fewer hydroelectric facilities to navigate, and multiple collection facilities within the watershed provided greater likelihood of capturing adults for broodstock. The feasibility study was also designed to initiate natural reproduction in areas of low risk to ESA-listed spring Chinook Salmon and steelhead while studying potential interactions between reintroduced Coho Salmon and these endangered species.

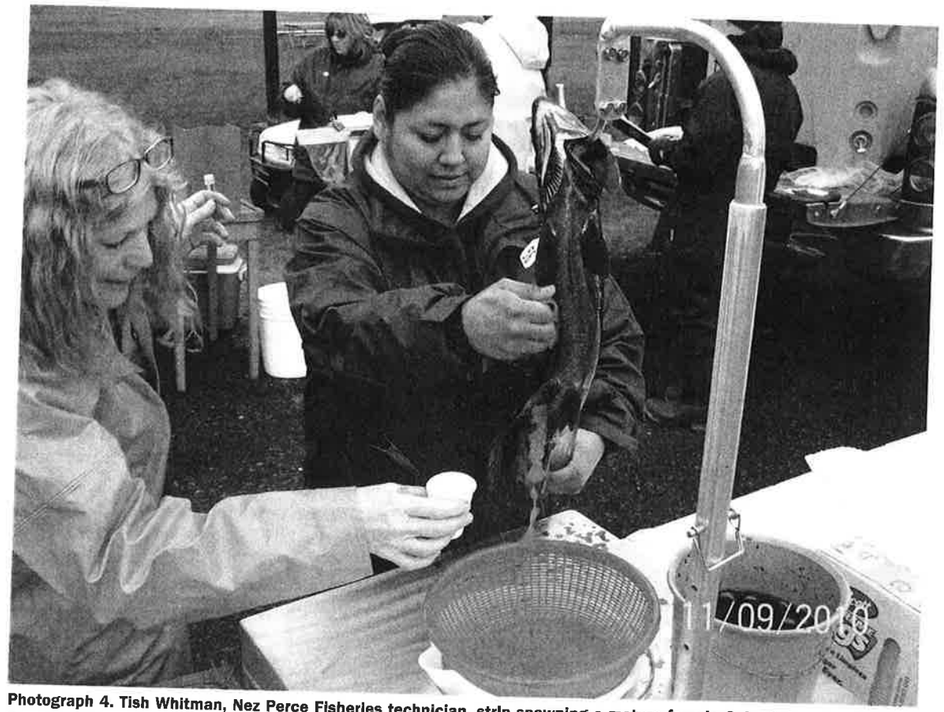
Without facilities for direct counting of fish in-river, adult Coho Salmon escapement has been estimated using passage counts at main-stem Columbia River dams. Return to the Wenatchee River is calculated as the difference between passage at Rock Island Dam and Rocky Reach Dam—the main-stem Columbia River dams located immediately downstream and upstream of the Wenatchee River confluence, respectively (Figure 2B). Methow River escapement is estimated as the passage count above Wells Dam, located just downstream of the Methow River confluence (Figure 2C).

Though with substantial year-to-year variability, adult returns to both subbasins have increased dramatically (Figures 3B and 3C; Yakama Nation Fisheries Resource Management 2012). Within a few years after reintroduction, enough adults were collected to fully meet broodstock needs. As of brood year 2003 in the Wenatchee River and 2006 in the Methow River, import of LCR smolts was eliminated, and all releases have since been of MCR origin. Of significance, the 2009 returns were sufficient to open a limited tribal and nontribal fishery in Icicle Creek—the first such fishery in over half a century. This was followed by another record return in 2011, and a fishery was opened in Icicle Creek, the lower Wenatchee River, and the Methow River.

Natural spawning of returning adults within both subbasins has generally increased, as assessed by redd counts conducted during annual spawning ground surveys (Figures 3B and 3C; Yakama Nation Fisheries Resource Management 2012). Monitoring data suggest that SARs in both the Wenatchee River (Table 2) and Methow River for fish produced from MCR broodstock have been comparable to those for other salmon species from hatchery programs in their respective basins during the last 10 years (M. Tonseth, Washington Department of Fish and Wildlife, personal communication) and that SARs for natural origin smolts tend to be greater than their MCR hatchery counterparts. Results from studies to assess interactions with ESA-listed spring Chinook Salmon and steelhead indicate that the reintroduced Coho Salmon had little or no negative impact. These included evaluations of predation on fry of spring Chinook Salmon, superimposition by spawning Coho Salmon

Table 2. Smolt-to-adult return (SAR) rates of Wenatchee River Coho Salmon produced from lower Columbia River (LCR) or Mid-Columbia River (MCR) origin broodstock or fish of in-basin natural origin (NO) for brood years 1997 to 2005 (na = not available/applicable). SAR values are estimated from time of release for hatchery smolts or time of capture for natural origin smolts to adult return. SAR values for subbasin are calculated for smolts from all release sites averaged together.

Brood year	Release year	Release site	SAR		
			LCR (%)	MCR (%)	NO (%)
1997	1999	Icicle Creek	0.23	na	na
1998	2000	Icicle and Nason creeks	0.18	na	na
1999	2001	Icicle and Nason creeks	0.08	na	na
2000	2002	Icicle Creek	0.30	0.54	na
		Nason and Beaver creeks	na	0.41	na
		Subbasin	0.30	0.49	0.38
2001	2003	Icicle Creek	0.45	0.44	na
		Nason and Beaver creeks	na	0.32	na
		Subbasin	0.45	0.38	0.43
2002	2004	Icicle Creek	0.36	0.27	na
		Nason and Beaver creeks	0.40	0.42	na
		Subbasin	0.37	0.31	0.90
2003	2005	Icicle Creek	na	0.20	na
		Nason and Beaver creeks	na	0.10	na
		Subbasin	na	0.18	0.15
2004	2006	Icicle Creek	na	0.53	na
		Nason and Beaver creeks	na	0.39	na
		Subbasin	na	0.49	1.64
2005	2007	Icicle Creek	na	0.15	na
		Nason and Beaver creeks	na	0.12	na
		Subbasin	na	0.14	0.15
2006	2008	Icicle Creek	na	0.52	na
		Nason and Beaver creeks	na	0.45	na
		Subbasin	na	0.50	1.36
2007	2009	Icicle Creek	na	0.20	na
		Nason and Beaver creeks	na	0.10	na
		Subbasin	na	0.32	0.36
2008	2010	Icicle Creek	na	0.69	na
		Nason and Beaver creeks	na	0.77	na
		Subbasin	na	0.72	0.79



Photograph 4. Tish Whitman, Nez Perce Fisheries technician, strip spawning a mature female Coho Salmon captured at Dworshak NFH. Photo credit: Michael Bisbee.

on spring Chinook Salmon redds, and competition for habitat between juvenile Coho Salmon, spring Chinook Salmon, and steelhead (Murdoch et al. 2005).

With positive results observed during the feasibility phase, the YN recently finalized a master plan for the Mid-Columbia reintroduction program and submitted it to the NPCC Fish and Wildlife Program (Yakama Nation Fisheries Resource Management 2012). The plan calls for renovation of current acclimation sites and construction of additional facilities in locations in the upper watershed and in major tributary streams. Habitat models were used to identify locations suitable for spawning and rearing and established release numbers based on estimated carrying capacities. Construction of a new broodstock holding and spawning facility in the Wenatchee basin that will operate with increasing proportions of natural origin fish into the broodstock was proposed. The plan set target goals for 3-year mean escapement to both subbasins of 1,500 natural origin Coho Salmon. It is hoped that in as few as five generations the goal may be reached, though this will be contingent on the success of continued actions to improve in-basin habitat, as well as estuarine habitat and hydrosystem survival.

Restoration of Coho in the Clearwater River

Though no quantified estimates of historic Coho Salmon returns to the Snake River Basin have been reported, it is known that substantial spawning occurred, primarily in the Tucannon, Clearwater, and Grande Ronde rivers. Through an agreement under *U.S. v. Oregon*, the NPT secured an allotment of LCR Coho Salmon eggs in 1994, which they transported to their Sweetwater Springs facility near Lapwai, Idaho, for incubation and rearing. The following year they direct released 622,000 parr among five streams in the Clearwater subbasin (Figure 2D; Everett et al. 2006). The IDFG opposed the reintroduction effort and was successful in blocking delivery of a second egg allotment in 1996 (Dompier 2005). However, the tribe prevailed in this dispute; by the next year IDFG dropped their objections and juvenile releases recommenced in 1998 (Everett et al. 2006).

Currently, approximately 800,000 age-1+ Coho Salmon smolts are released annually. Some of the fish are reared and released at Dworshak and Kooskia NFHs. The remaining individuals are reared out-of-basin and then brought back to Idaho as they approach the smoltification stage. Half of them are released directly into Lapwai Creek and Eldorado Creek (a tributary to Lolo Creek), and the other half are taken to Kooskia NFH for release following a 4- to 6-week acclimation period (Figure 2D).

In 1997, 94 Coho Salmon from the initial 1995 parr releases were observed at Lower Granite Dam (LGD; Snake River rkm 173). Returns have grown since then, and the average over the past 5 years was 4,000 fish (Figure 3D). In 2011 returns above LGD were sufficient for the tribe to open a small in-basin

fishery, offering their members the opportunity to harvest Coho Salmon locally for the first time since the mid-1900s.

In 1999 the tribe began use of returning adults for broodstock, to develop a local Clearwater stock (CLS). The adults are collected in ladders at Dworshak and Kooskia NFHs and at a temporary weir on Lapwai Creek (rkm 1) near Spalding, Idaho (Figure 2D). In 2009, managers were able to fully meet broodstock needs in-basin, and since then (with the exception of a shortfall in 2010) only CLS juveniles have been released.

The Clearwater program has been financed through an annual allocation to the tribe from the Pacific Coast Salmon Restoration Fund (PCSRF). Though the amount is adequate to cover basic hatchery expenses, few resources remain for monitoring and evaluation activities. The only monitoring data consistently available have been counts of returning adults at LGD, plus some qualitative information on Coho Salmon redd and carcass distribution opportunistically acquired during spawning surveys for fall Chinook Salmon.

The NPT submitted a master plan for the Coho Salmon reintroduction program (Everett et al. 2006) to the NPCC Fish and Wildlife Program for funding from the BPA. The plan proposed continued development of the localized stock through incorporation of natural origin fish, construction of additional in-basin juvenile rearing facilities at the Nez Perce Tribal Fish Hatchery (rkm 35), increase in the number of tributary streams into which smolts are released (using a rotating program for release for three generations followed by no supplementation for three generations), and tagging and monitoring to assess juvenile survival and adult return rates. Though in agreement with the objectives, the NPCC has yet to approve the program for funding. The tribe was successful, however, in procuring a recent allocation of Mitchell Act funds to finance construction of an acclimation facility on Lapwai Creek (rkm 1). This allocation will also finance a limited number of annual spawning surveys to better characterize the extent and distribution of natural spawning.

Despite the funding constraints, increases in adult escapement have been dramatic and the program has gained much favorable public attention. The relative success of the program led to its inclusion among the Example PCSRF Grantee Projects in the NOAA's Report to Congress on the PCSRF program for FY 2000–2008 (NOAA 2009).

SUMMARY

In each of the tribal programs to reintroduce Coho Salmon, annual adult escapement has increased from near zero to several thousands. The increase suggests that the programs are increasingly contributing to tribal and nontribal fisheries in the lower Columbia, and the tribes have recently been able to reopen fisheries within the subbasins. The number and distribution of redds have generally increased. Transition from importing LCR juveniles to releasing juveniles produced from adults collected in-basin is complete. Over the coming years, the localized nature of these new stocks will be enhanced through increased incorporation of natural origin fish into the hatchery broodstock. Available monitoring data indicate that juvenile survival rates and SARs for local stock smolts are generally greater than for LCR smolts and that SARs for natural origin smolts generally exceed those for hatchery origin smolts (Tables 1 and 2). Together, the results suggest that the out-of-basin hatchery stocks used to initiate the reintroductions are adapting to the local environment and creating new natural populations.

Fraser (2008) reviewed published manuscripts and agency reports for 31 salmonid reintroduction programs relative to their ability to establish self-sustaining natural populations. He cautiously concluded that long-term evidence is yet lacking, because in essentially all cases, programs have been in place for an insufficient number of generations and/or environmental perturbations continue to constrain natural productivity. Similarly, the tribal Coho Salmon programs are relatively new, and though harvest is now managed, effects from degradation of freshwater and estuarine habitat and elevated hydrosystem mortality persist. Continued supplementation and habitat restoration will therefore be necessary for some period before self-sustainability may be achieved.

Nonetheless, the rapidity with which the reintroduced hatchery Coho Salmon appear to be adapting to the new stream environments is notable. Concern has been expressed within the scientific and public communities regarding negative effects that hatchery rearing has on natural reproductive capabilities of fish and on long-term genetic fitness of natural populations supplemented with hatchery-reared fish (e.g., Independent Scientific Advisory Board 2003; Araki et al. 2008; Chilcote et al. 2011). The Coho Salmon available to the tribes for the reintroductions was an out-of-basin composite LCR hatchery stock that had undergone at least 20 successive generations of segregated rearing. One might presume these fish too highly domesticated to be of use for reintroduction. However, in each program a portion of the reintroduced Coho returned as mature adults, some spawned naturally, and within two generations are creating nascent natural populations. Genetic effects on natural fitness that may have accrued within the LCR stock are apparently susceptible to reversal in the face of natural selective processes, and judicious hatchery broodstock and rearing management.

The Columbia River Treaty tribes—the Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of the Warm Springs Reservation of Oregon, NPT, and YN—understand well that present circumstances will not permit Columbia Basin salmon and steelhead runs to return to precolonial levels. Nonetheless, they maintain a holistic vision as described in *Wy-Kan-Ish-Mi Wa-Kish-Wit*, Spirit of the Salmon (CRITFC 1995), for restoration of watersheds within their reservations and ceded territories to conditions that support abundant and productive populations. Through a combination of efforts to carefully manage harvest, to petition for continued improvements in hydrosystem survival and freshwater and estuarine habitat, and to appropriately manage hatchery programs, the tribes are progressing toward their goal to "put the fish back in the rivers" (CRITFC 1995, Executive Summary, p. v), including Coho Salmon and all other indigenous aquatic species.

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