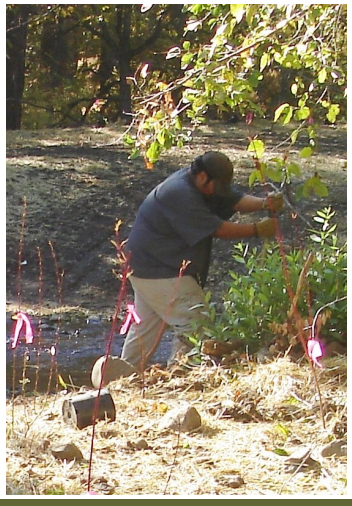
Yakama Nation Fisheries

2014/15

With updated status and trends

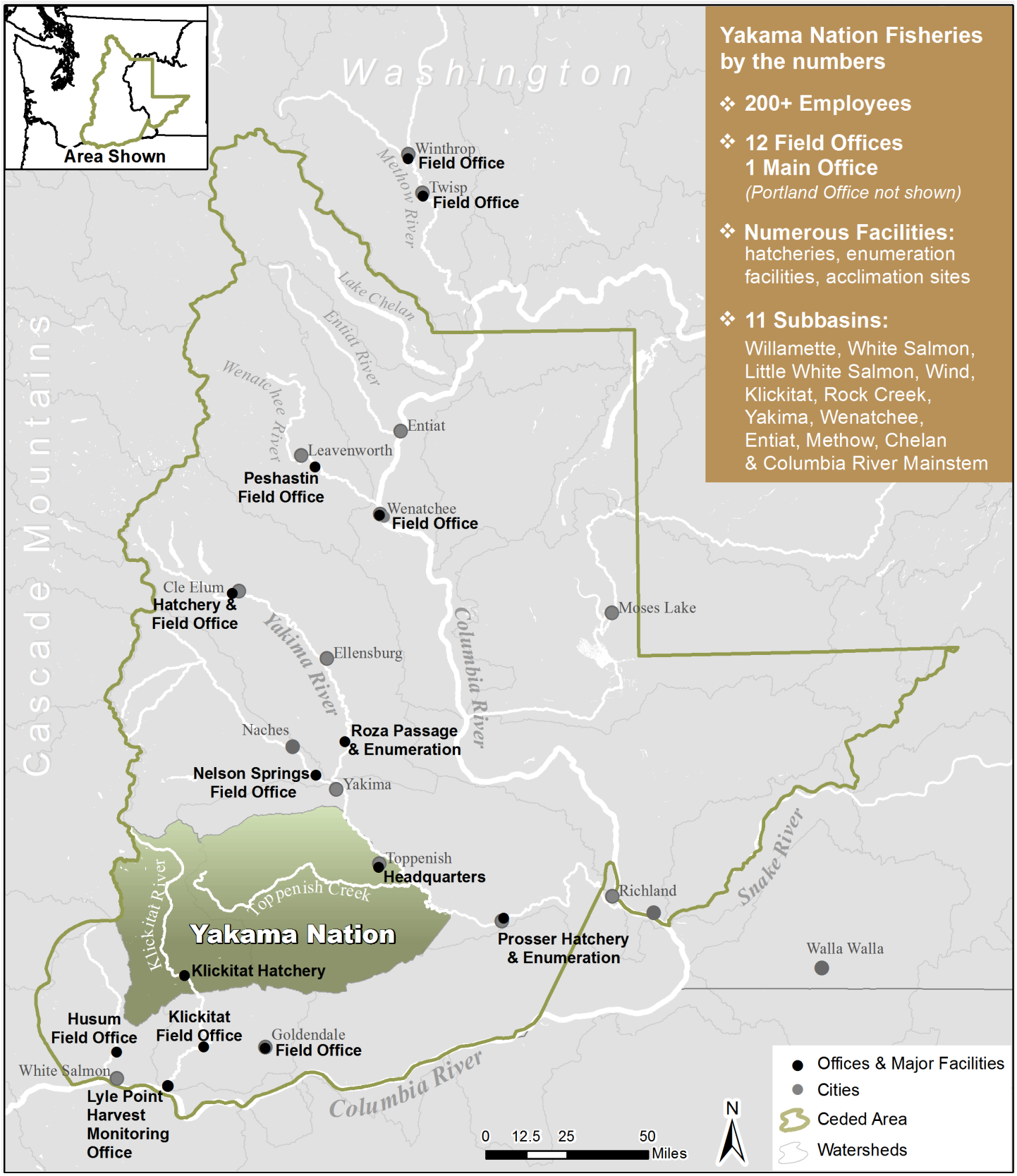
Yakama Nation Fisheries Program

Status and Trends Report



2008 Columbia River Fish Accords Implementation

Yakama Nation Fisheries Offices & Facilities



Pictured on front cover: Hancock Spring Restoration Project (Methow), Sockeye Trap and /haul (Cle Elum Hatchery), Satus Creek Riparian Restoration, Lamprey Restoration (Prosser Hatchery), Kelt Tagging (Prosser Fish Monitoring Facility) (YN)

HONOR. PROTECT. RESTORE.

Contents

Celilo Falls, Historic

Yakama Nation Fisheries Status and Trends Report Project

The Yakama Nation's Status and Trends Annual Reports (STAR) summarize progress toward achieving recovery goals described in the 2008 Columbia Basin Fish Accords Memorandum of Agreement (Accord). The Accord is intended, in part, to support the implementation of projects and management actions considered necessary to improve the survival of salmon and steelhead listed under the Endangered Species Act (ESA) to the levels described in the National Oceanic and Atmospheric Administration's 2008 Biological Opinion for Federal Columbia River Power System operations. It also provides funding for white sturgeon and Pacific lamprey recovery actions and benefits other species not listed under the ESA.

The purpose of STAR is to: 1) track the implementation of the projects and management actions described in the Accord, 2) report on the biological effectiveness of implemented projects and actions by monitoring trends in the status of salmon and steelhead populations and other species of priority to the Yakama Nation such as white sturgeon and Pacific lamprey, and 3) provide information to tribal leadership to aid in the development of policy direction.

The STAR report consists of four chapters, three of which document progress in implementing restoration work and improvements to management actions, and one that tracks the status and trends of priority species. This comprehensive report is comprised of the four chapters that have been released individually over the previous year. To ensure the reports reflect current and relevant information, each chapter will be updated periodically.

To learn more about the Yakama Nation Fisheries Status and Trends project and to download this report, please visit: www.yakamafish-nsn.gov/restore/projects/star

2008 Columbia River Fish Accord

On May 2, 2008, the Yakama Nation, along with several other agencies and Tribes, signed the Columbia Basin Fish Accords Memorandum of Agreement [March 26, 2008 Yakama Nation Tribal Council Resolution T-118-08]. As opposed to ongoing hydro-system litigation, and the uncertainty of Bonneville Power Administration (BPA) funding through the Northwest Power Act mitigation program, the Accord provides stable funding to implement fish and wildlife restoration projects throughout Yakama Nation's Ceded Lands, as well as other areas utilized by all aquatic treaty-trust* species within the Columbia River Basin. The Accord provides for large scale restoration actions and long term planning towards restoration goals, as well as a better ability to address the Yakama Nation's priorities.

Benefits to the Yakama Nation to date include:

1) Expansion of the **Yakama Nation's zone of influence** for species and habitat restoration on the ground and through increased presence in management forums (see map on page 2, hydrosystem foreword page 58).

2) Expansion of **production and reintroduction programs**, including existing programs and the creation of new programs that likely would not have been developed without an Accord (see Chapter 3).

3) **Secure and stable funding** for 10 years (2008-2018) has allowed project managers to develop and implement long term plans for better integrated projects, the larger of which have required several years of planning and implementation. This process is more efficient, as tribal managers spend less time applying for grants and more time completing work on-the-ground (see Chapters 1 and 3).

4) Increased ability to direct funding towards the **Yakama Nation's values,** such as restoration of lamprey and sturgeon and the reintroduction of coho and sockeye (see Chapters 1, 2 and 3).

5) **Increased spill** at Federal Columbia River Basin mainstem dams. This is known to be vital to improving migratory fish survival. The hydro-system operational benefits obtained through previous litigation efforts have also been locked in for the duration of the Accord (see Chapter 4). Potential impacts to non-salmonid species such as **lamprey and sturgeon**, when addressing dam passage issues, are now included in every discussion. Previously they were not.

6) Improved coordination of restoration and reintroduction efforts funded by BPA with US v. OR harvest management to improve **harvest opportunities** for all species. (see Chapters 1 through 4).

7) Increased focus on habitat restoration needed for **species-level benefits**. ESA-listed species are the primary constraint on Treaty fishing opportunities; habitat restoration is currently our best opportunity to restore wild fish abundance and remove those limitations. The Accord has enabled the Yakama Nation to more than double habitat restoration efforts in number, size, and scope (see Chapters 1 and 2).

8) Greater **Tribal representation** and collaboration in hydrosystem improvement discussions with an increased opportunity to advocate for the natural resources most significant to the Yakama Nation (see Chapter 4).

**Yakama Nation Treaty of 1855 (12 stat. 951) with the United States of America.*

CHAPTER 1

HABITAT

"The balance for all of our survival, that depends on the balance between these fish, this forest, the water and one is not without the other."

-Yakama Nation Councilwoman Stella Washines

Background: Celilo Falls (Oregon Historical Society), Above: Klickitat Meadows Restoration (YN)

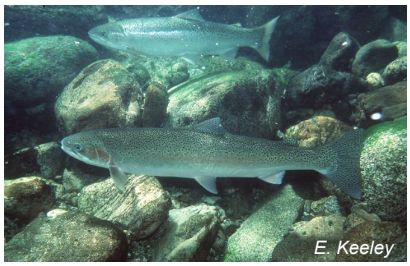
Background and Focal Species

This habitat chapter summarizes the Yakama Nation's progress, since 2008, towards achieving Columbia Basin Fish Accords habitat restoration goals. Habitat restoration is of benefit to all aquatic treaty-trust* species of the Yakama Nation, and benefits wildlife and other natural resources as well.

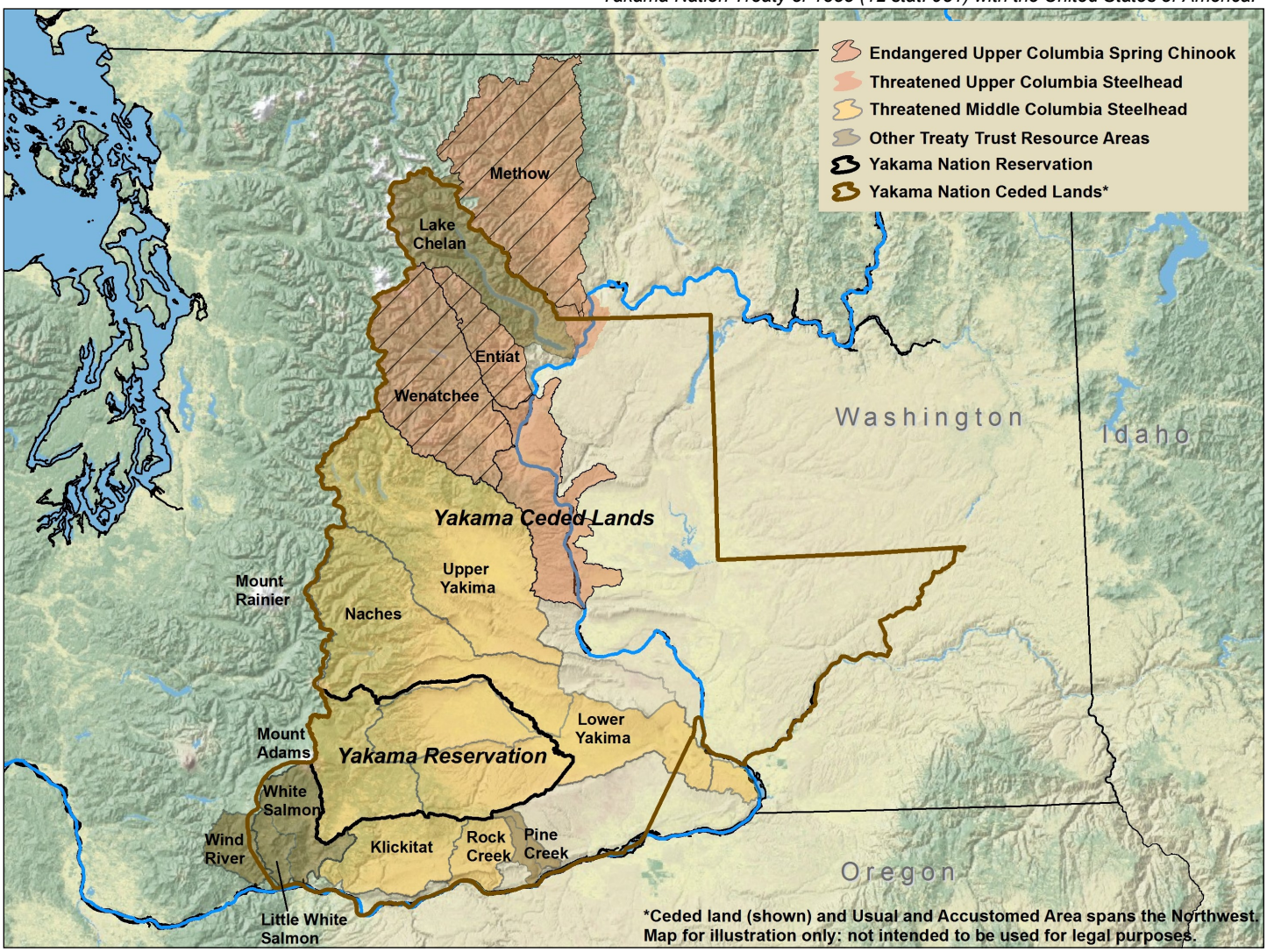

E. Keeley

Restoring the natural habitats needed by wild salmon, steelhead, and Pacific lamprey is among the highest priorities for Accord funding. The Yakama Nation is utilizing Accord dollars to implement a broad set of actions to restore natural stream function. Endangered Species Act listed species must be able to sustain themselves in their natural habitats, thus their habitats must be healthy, accessible, and abundant to reach delisting goals. The goals of the Yakama Nation are even higher: sustainable fisheries of all species. Therefore, the status and trends of additional species important to the Yakama Nation are described in following chapters of this report.


YN/ ODFW


E. Keeley

*Yakama Nation Treaty of 1855 (12 stat. 951) with the United States of America.



Major Habitat Ecological Concerns for Chinook Salmon, Steelhead, and Pacific Lamprey in the Yakama Nation's Treaty Trust Resource Areas

Ecological Concern: Reduced channel complexity

Major Causes: Agriculture and forestry practices

Effects: Loss of in-stream habitat such as wood and substrates. Decline of essential depth and pool variability.

Ecological Concern: Loss of riparian vegetation

Major Causes: Agriculture and forestry practices

Effects: Loss of natural shade and in-stream cover, bank erosion, and decreased ability to filter sediment.

Ecological Concern: Streambed channelization

Major Causes: Road construction

Effects: Loss of natural stream form, flow patterns altered, loss of suitable substrates due to increased flow velocities.

Ecological Concern: Low productivity/high competition

Major Causes: Loss of nutrients and increased non-native fish

Effects: Reduction in availability of food for native fish.

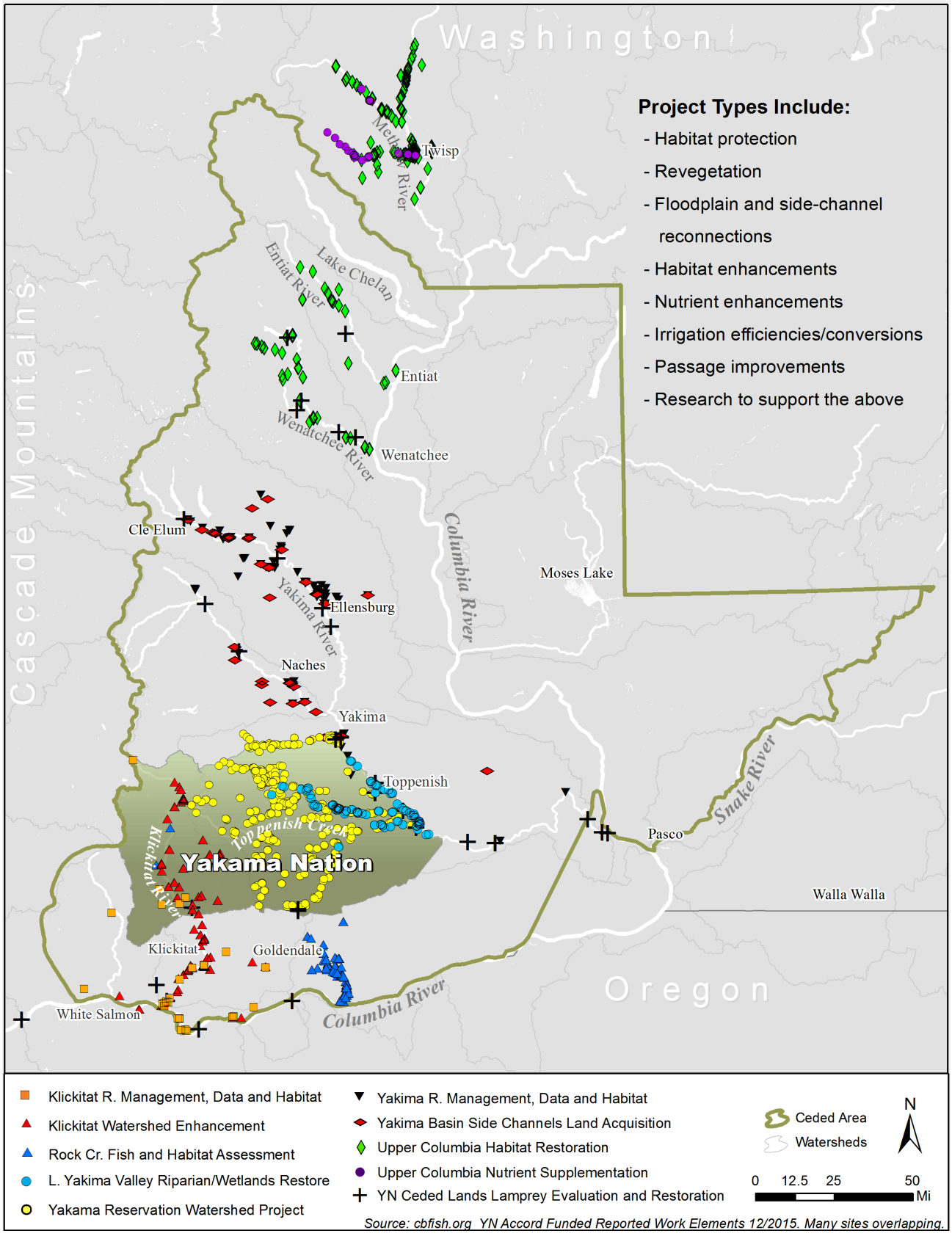
Ecological Concern: Altered hydrology and water quantity

Major Causes: Hydro-operations and agriculture practices

Effects: Loss of access to habitats. Natural flows and the timing of those flows are altered causing spawning, rearing, and migration challenges for native fish.

Clockwise above: Toppenish Creek (Yakima), Tepee Creek (Klickitat), Peshastin Creek (Wenatchee), Twisp River, Little Rattlesnake Creek (Naches) (YN)

Yakama Nation Accord-Funded Habitat Restoration Projects



Source: cbfish.org YN Accord Funded Reported Work Elements 12/2015. Many sites overlapping.

Yakama Nation Accord-Funded Habitat Restoration Actions Addressing Ecological Concerns (2008 – Present)*

Ecological Concern:

Loss of riparian vegetation

Actions: Plantings, maintenance, fencing, and weed removal

Project Actions: 412

Benefits: Increased shading, reduced erosion, increased food sources, habitat complexity

Ecological Concern:

Streambed channelization

Actions: Decommission/ remove roads, realign/ connect/create side channels, create/ restore/enhance wetlands and flood-plain

Project Actions: 52

Benefits: Increased habitat complexity, increased sinuosity, reduced erosion

Project Actions: 223

Benefits: Increased habitat quantity/ quality, water quantity/ quality

Ecological Concern:

Reduced channel complexity

Actions: Install in-stream structures, create new channels, wetland/ floodplain reconnection, habitat protection

Ecological Concern:

Low productivity/ high competition

Actions: Carcass plantings, invasive species control, and research

Project Actions: 56

Benefits: Improved quality and quantity of available food

Project Actions: 118

Benefits: Improved flow, habitat quantity, water quality

Ecological Concern:

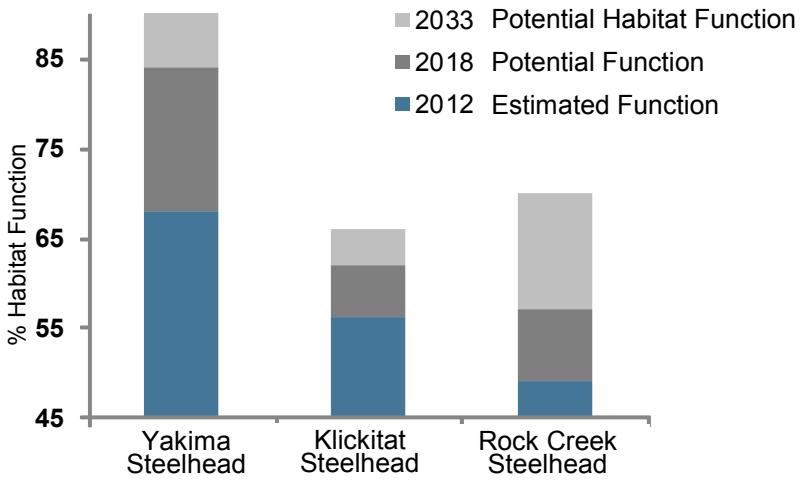
Altered hydrology and water quantity

Actions: Install fish passage structures, screening, remove barriers, acquire water rights, improve irrigation

**Count of individual work elements as reported in cbfish.org through 12/2015. Does not include planning actions. Some actions may apply to multiple categories, some may repeat annually.*

Clockwise above: Panther Creek (Yakima), Klickitat floodplain, Yakima River, Toppenish Creek (Yakima), Hancock Springs (Methow)(YN)

Yakima/ Klickitat — Percent Improvement in Habitat Quality

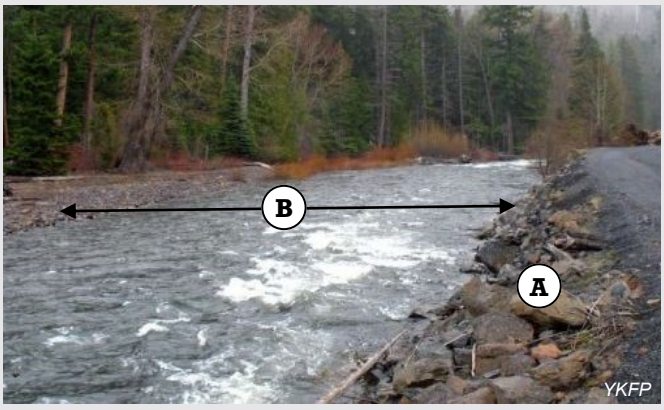


Yakama Nation Fisheries Program staff and other experts estimated the current health of habitat for fish, as well as future conditions following completion of the 2008 Accords restoration projects.

Habitat function is estimated based on the degree to which habitat conditions affect the health of fish populations. Restoration actions are intended to reverse the impact of past land use practices that have impaired habitat function.

The following examples are projects that the Yakama Nation has implemented to improve habitat conditions for fish.

PROJECT SPOTLIGHT: Upper Klickitat River In-Channel and Floodplain Enhancement Project



Started April 24, 2010 | Completed November 2, 2010; Accord-funded

Problem

Road development resulted in changes to the river that negatively affected steelhead and spring Chinook. When the road was built, rocks (**A**) were installed along its edge to prevent damage by the river. The road and rock combination caused the river to become “channelized” (**B**) which resulted in the loss of its the natural meandering pattern. In addition, large wood that provided places for fish to feed and live throughout their lives was altered or removed.

Restoration Actions

To improve habitat complexity, water quality, and reduce channelization, the Yakama Nation replaced the uniform rock structure with 65 log jams (**C**), strategically placed boulders, reconnected or created 0.5 miles of side-channel, stabilized 0.5 miles of streambank, planted riparian vegetation, and created numerous pools.

Benefits

Returning 1.68 miles of the river to a more complex configuration, the Yakama Nation restored productive spawning, rearing, and holding habitat for salmon, steelhead, and other fish and wildlife species. Additional benefits to the Yakama Nation are reduced road maintenance costs.

Project Spotlight—Klickitat Subbasin

PROJECT SPOTLIGHT: Klickitat River Floodplain Restoration Project ("Haul Road Removal")

Started 2001 | Phase 4 In-Progress 2013; Multiple Funding Sources and Partners (Including the Salmon Recovery Funding Board and YN-Accord)

Problem

Eighty years ago, a railroad grade was built along the Klickitat River to haul timber to the mill downstream. Converted to asphalt in the 1950s (**A**), the road became unnecessary when the mill closed in the early 1990s. Located in the active floodplain, parts of the deteriorating road washed out in 1996. The road impeded the natural river function, restricting fish habitat development, simplifying the river, and impacting overall river health.

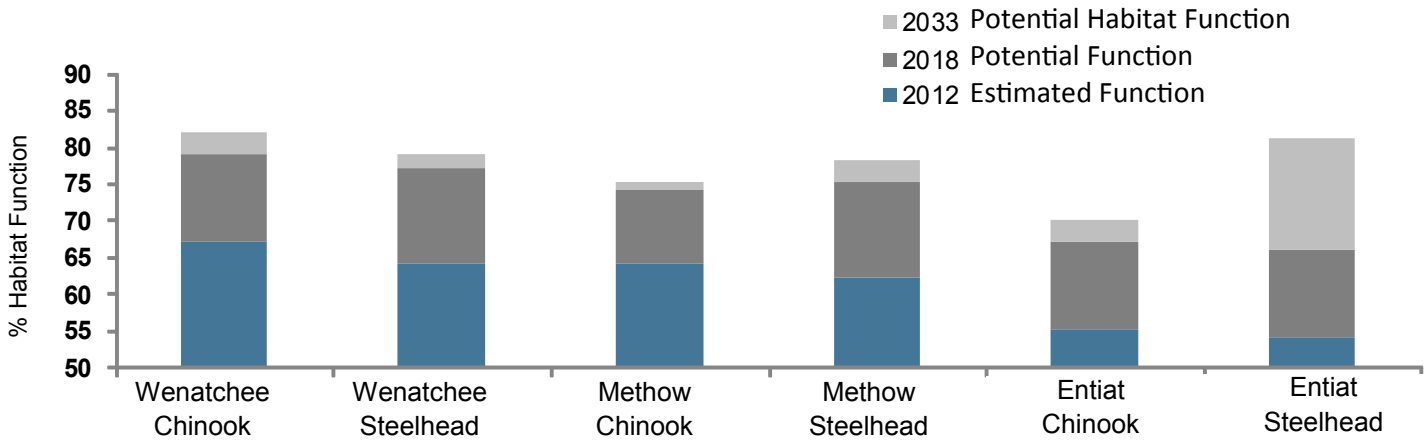
Restoration Actions

To restore natural river processes and healthy fish habitat, 4.35 miles of the road, fill, and rip-rap were removed (**B**), river banks re-sloped, and riparian areas revegetated. Asphalt was also removed along 8 miles of road. Floodplains, tributaries, and side channels were reconnected, culverts removed, and roughness elements installed.

Aerial Imagery: Google Earth

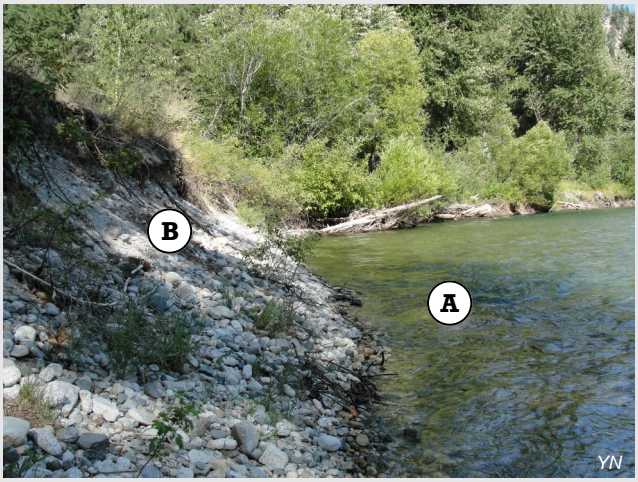
Aerial photos (at left) reveal a change in the landscape after the haul road was removed. In 1996, the straight roadbed is clearly visible (1). In 2013, the roadbed has been removed, a side-channel has developed and stream-side vegetation has become established (2).

Upper Columbia — Percent Improvement in Habitat Quality*



*Please see explanation on page 12

PROJECT SPOTLIGHT: Entiat River "3-D" Habitat Enhancement Project



Started July 16, 2011 | Completed October 31, 2012; Accord-funded

Problem

Past land use practices reduced the amount of large wood in a section of the Entiat River. The reduction of wood resulted in the loss of fish habitat quantity and complexity (**A**), as well as greater river movement and bank erosion (**B**) compared to similar river reaches that were not impacted. The prior land use practices also reduced off-channel rearing habitat.

Restoration Actions

To improve habitat complexity and quantity, improve floodplain connection and reduce erosion rates, seven log structures (**C**) were constructed. In addition, 0.75 miles of off-channel habitats were created at 5 locations, and 9 acres of streamside (*riparian*) area were planted with native vegetation.

Benefits

The engineered log structures have helped to create pools for fish habitat, provide refuges during high flows and capture additional wood that helps to stabilize the migrating channel as well as increase habitat complexity. The addition of off–channel rearing habitats has benefited juvenile fish in numerous ways. As the native vegetation plantings age, they will help to increase fish habitat complexity and stability.

Project Spotlight—Methow Subbasin

PROJECT SPOTLIGHT: Chewuch (Methow) River Mile 10 Fish Habitat Enhancement Project

Started September 12, 2011 | Completed October 19, 2012; Accord-funded

Problem

Due to past land use practices, as well as riprap along the streambank, River Mile 10 of the Chewuch River was lacking instream habitat complexity and off-channel habitats. These conditions provided little opportunity for the recruitment of woody material. In addition, the channel had become unstable and disconnected from the floodplain. To compound the habitat deficiencies, an undersized culvert was also present. Since the location is considered a critical area for threatened and endangered fish, addressing the limiting factors was a priority.

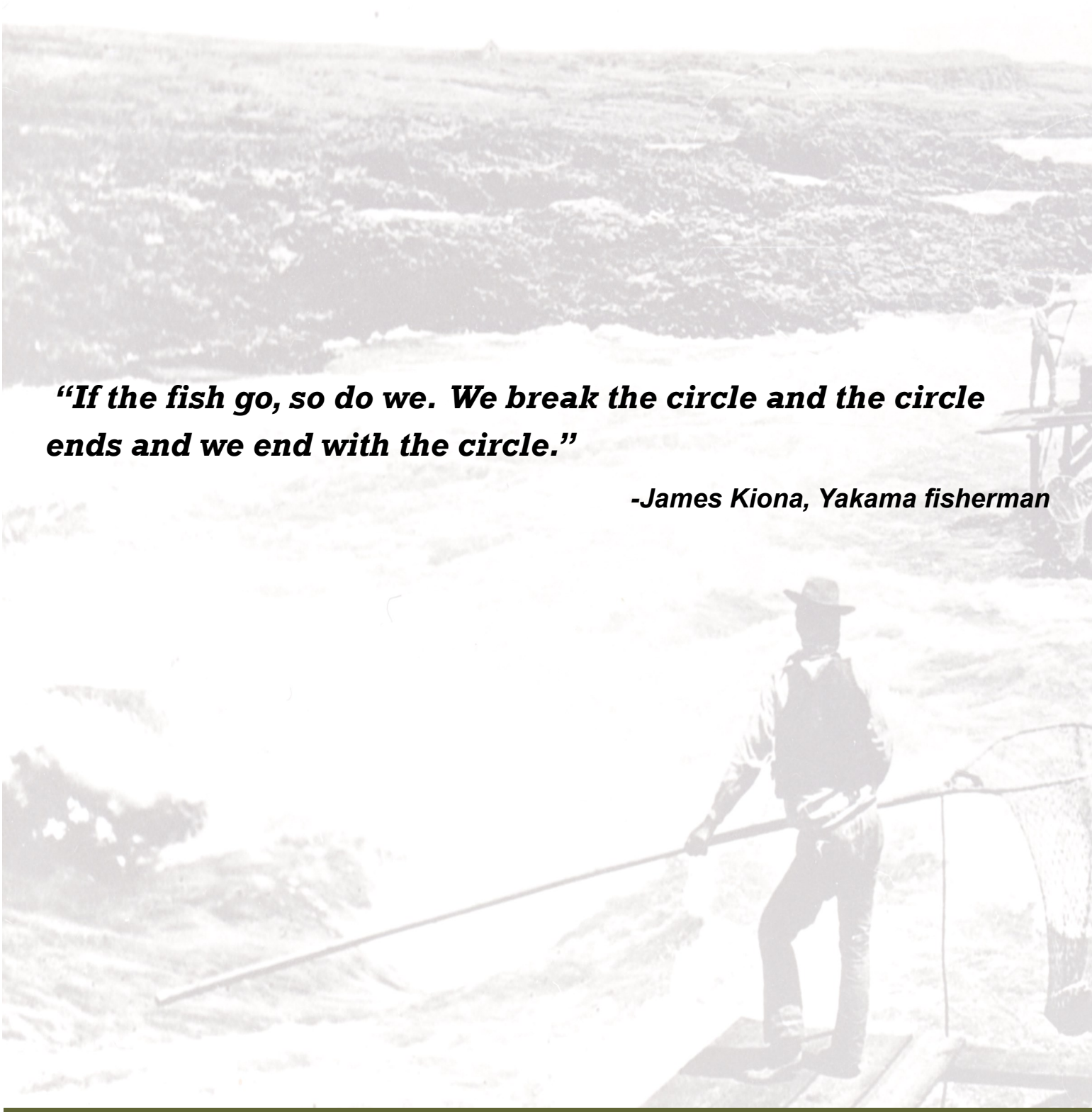
Restoration Actions

To restore River Mile 10, 0.25 miles of off-channel habitat was created (**A**), 1.64 acres of stream-side (riparian) area were planted with native vegetation (**B**), the undersized culvert was removed, and 8 engineered log structures were installed (**C**) totaling 0.85 miles of restored river. To further enhance fish populations in the Chewuch River, the Yakama Nation is implementing similar actions at River Mile 8 and has proposed work from River Mile 11.75 to River Mile 13.

Benefits

By creating off-channel habitat and improving stream-side habitat complexity, rearing and holding habitat was provided for juvenile and adult fish. Benefits from the work were realized almost immediately as steelhead were observed in the side-channel five days after construction (**D**). Stabilizing streambanks, reconnecting the floodplain, and planting riparian vegetation has helped the river function in a natural and healthy manner which will help create and maintain fish habitat into the future. Primary fish species benefiting from these efforts include spring Chinook, steelhead, bull trout, and other resident fish.

CHAPTER 2



"If the fish go, so do we. We break the circle and the circle ends and we end with the circle."

-James Kiona, Yakama fisherman

SPECIES

Background: Celilo Falls, Historic

Yakama Nation Focal Species*

Focal Species: Chinook (Tkwínat; Núsux)

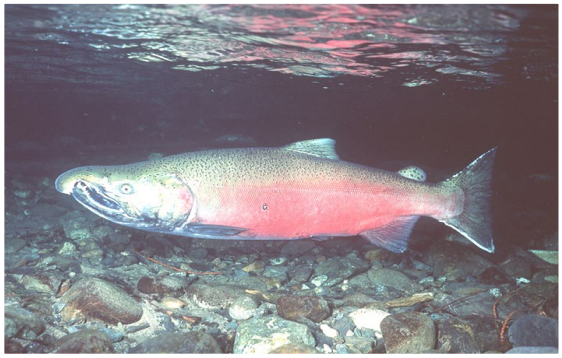
Status: Endangered (Spring Chinook, Upper Columbia)

Trend: Slight increase

Focal Species: Steelhead (Shushάynsh)

Status: Threatened (Upper Columbia and Middle Columbia)

Trend: Increasing



Focal Species: Coho (Sinux)

Status: Reintroduced

Trend: Increasing

Focal Species: Sockeye (Kálux)

Status: Reintroduced

Trend: Increasing

Focal Species: Pacific lamprey (Asúm; K'súyas)

Status: Depressed

Trend: Severely declining

Focal Species: White sturgeon (Wílaps)

Status: Depressed

Trend: Stable

*See page 8 of this report for distribution map of salmon and steelhead.

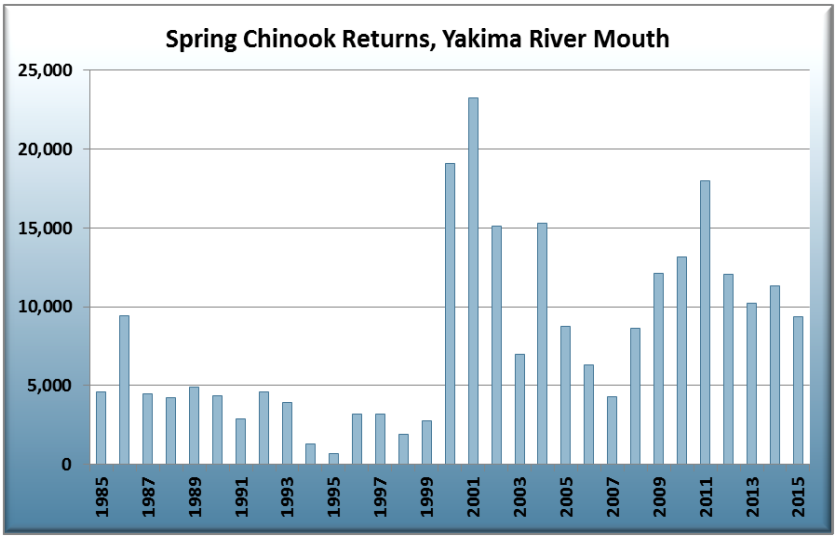
Clockwise above: E. Keeley, E. Keeley, Peter Essick, Yakima Herald Republic, YN/ODFW, E. Keeley

Yakima Subbasin Chinook

Marion Drain broodstock collection (YN)

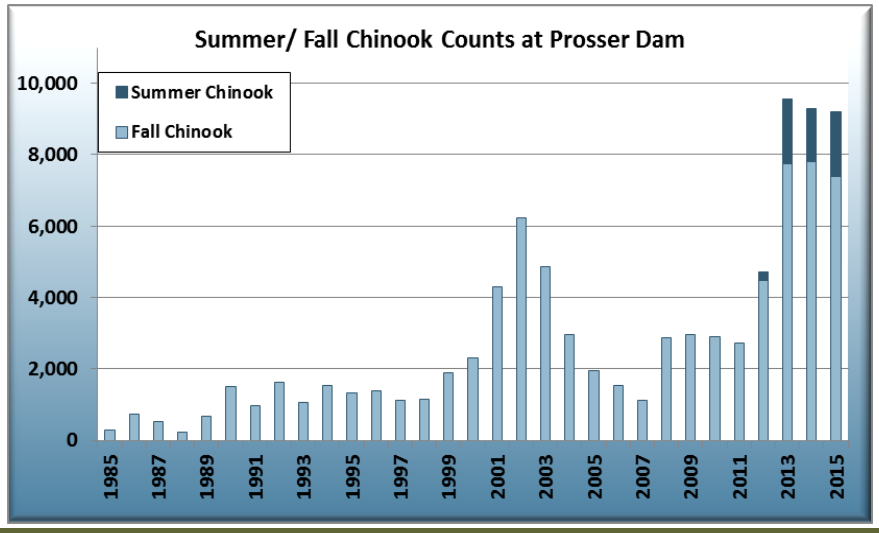
Spring Chinook

- At the time of the 1855 Treaty, 200,000 adult spring Chinook returned annually to the Yakima Subbasin. In the 1980s and 1990s, returns were less than 3,500.
- **Goal:** Restoration of the fishery through supplementation and habitat protection and enhancement.
- Since 1997, the Yakama Nation has been supplementing spring Chinook in the Upper Yakima using a new hatchery and acclimation complex in the Cle Elum area.
- Because Yakima spring Chinook appear to be habitat limited, the Yakama Nation is addressing habitat limiting factors to benefit all species. Environmental conditions led to lower returns in 2015.



Summer/Fall Chinook

- By 1970, summer-run Chinook were extirpated and the fall-run was maintained with out-of-basin hatchery stock.
- The purpose of the summer/fall Chinook hatchery program is to provide for sustainable harvest, maintain population health, and contribute to regional research and education.



- **Goal:** Average 7,000 natural-origin adults past Prosser Dam each year, and a total contribution of at least 18,000 summer/fall Chinook to all fisheries per year.
- The summer/fall Chinook program has both mitigation and conservation components. The goal is to meet or exceed viable salmon population guidelines and Treaty harvest obligations on a sustainable basis.

Data source: Yakama Nation Fisheries/ DART

Sockeye Restoration in the Yakima Subbasin*

Treaty era: 200,000 adult sockeye returned to these lakes annually to spawn. Sockeye were extirpated when their nursery lakes were dammed for irrigation.

July 10, 2013, First Return Celebration: Adult offspring from the 2009 transplants released into Cle Elum Lake returned back to the nursery lakes to spawn.

October 17, 2013: 701 sockeye return to the Yakima River Basin to spawn.

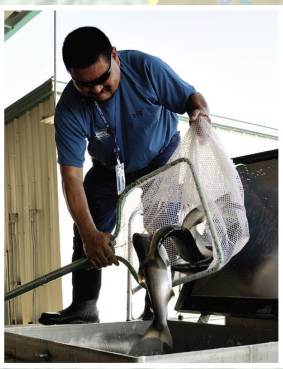
2014/15 Counts at Prosser Dam: 2,676 sockeye return in 2014, but only 341 returned in 2015 due to severe drought.

Kachess

Keechelus

Cle Elum

Upper Yakima



2009 - 2012: 21,000 adults collected at Priest Rapids Dam and released into Cle Elum Lake.

2011: 100,000 juvenile sockeye, offspring from the adults transplanted in 2009, were trapped at Roza and Prosser dams. These fish were from the first sockeye to spawn in the Yakima Basin in over 100 years.

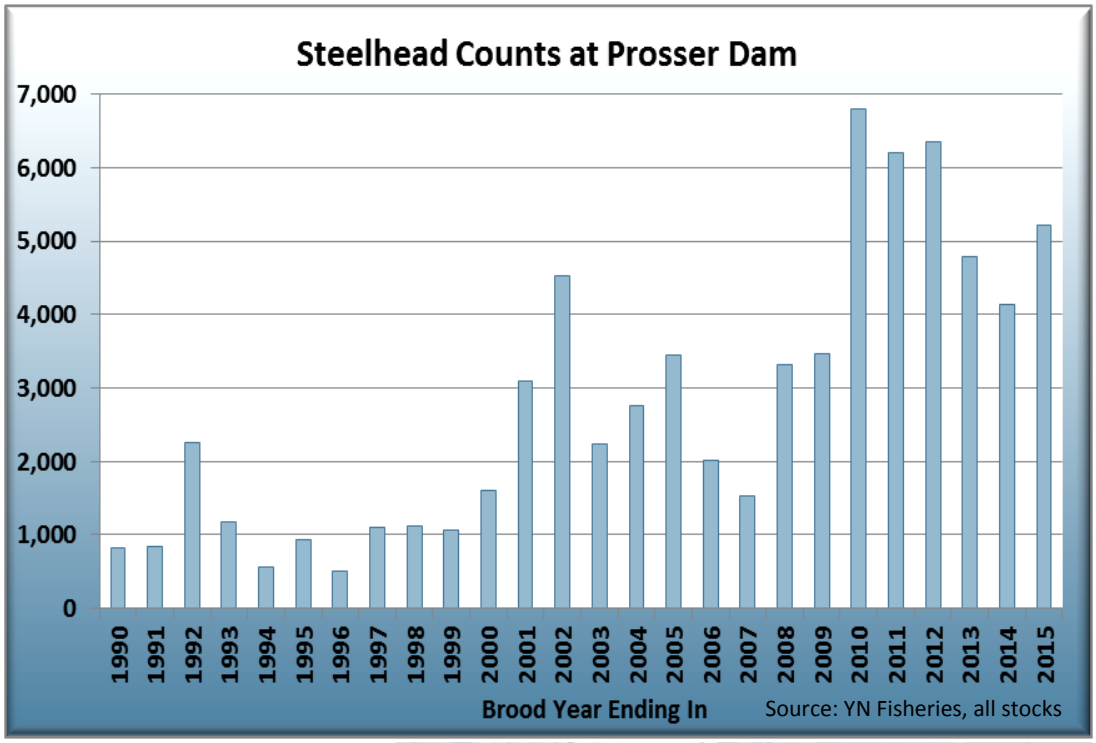
*Efforts described on this page are supported by Pacific Coastal Salmon Recovery Funds from the National Oceanographic and Atmospheric Administration and the U.S. Bureau of Reclamation. The Washington Department of Fish and Wildlife is also a partner.

Clockwise above: Sockeye in Cle Elum River (YBEEP); Sockeye reintroduction, tagging, transport (Cle Elum Hatchery) (YN)

Yakima Subbasin Steelhead

At the time of the 1855 Treaty, approximately 20,000-40,000 steelhead returned annually to the Yakima Subbasin. By the 1990s the average number of returning adults was less than 1,000. Improvements in hydrosystem operations and water management decisions, together with sustained efforts by the Yakama Nation to improve steelhead habitat on the Yakama Reservation and throughout the Yakima River Basin, are producing significant increases in steelhead survival and abundance.

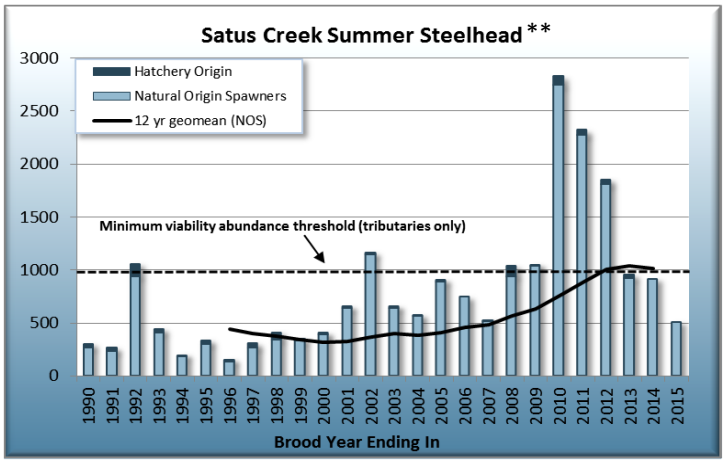
By actively reconditioning fish at Prosser Hatchery, as well as restoring habitat and stream flows, Yakama Nation Fisheries is helping to improve steelhead survival and productivity.

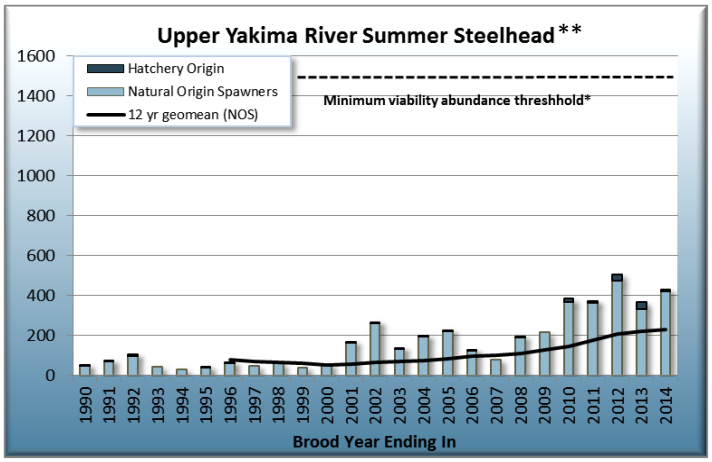


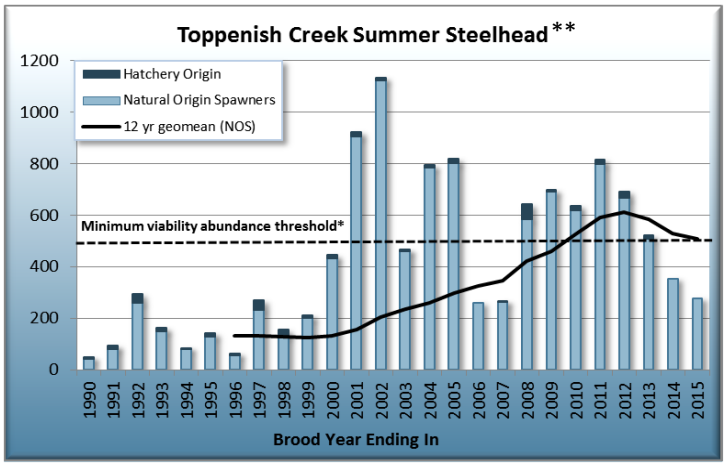
Clockwise above: Kelt in Prosser Hatchery feeding tanks, steelhead tagging (Prosser), smolt monitoring (Chandler juvenile facility) (YN)

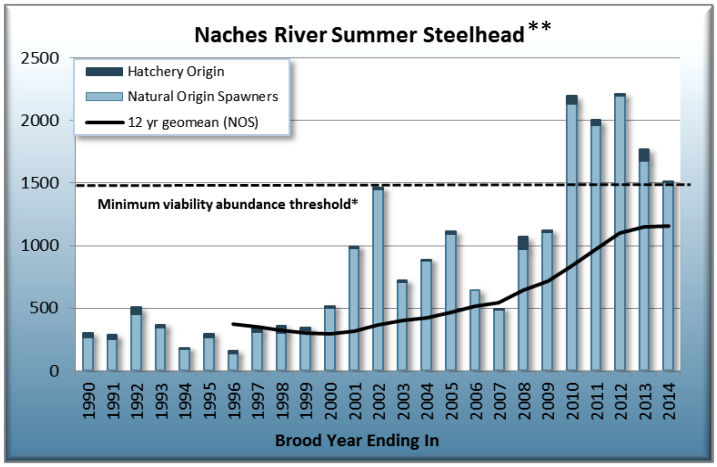
Yakima Subbasin Steelhead, Continued

- Abundance estimates are generally increasing for all Yakima steelhead populations.
- Highest population estimates in the last 20 years for the Naches, Toppenish, and Satus populations, approaching minimum viability thresholds.









*See footnote on page 30.

**Abundance estimated as 2.5 x redd count. Data source: Tim Resseguie, YN .

PROJECT SPOTLIGHT: Yakima Basin Steelhead Population Monitoring

Smolt monitoring (Chandler juvenile facility)

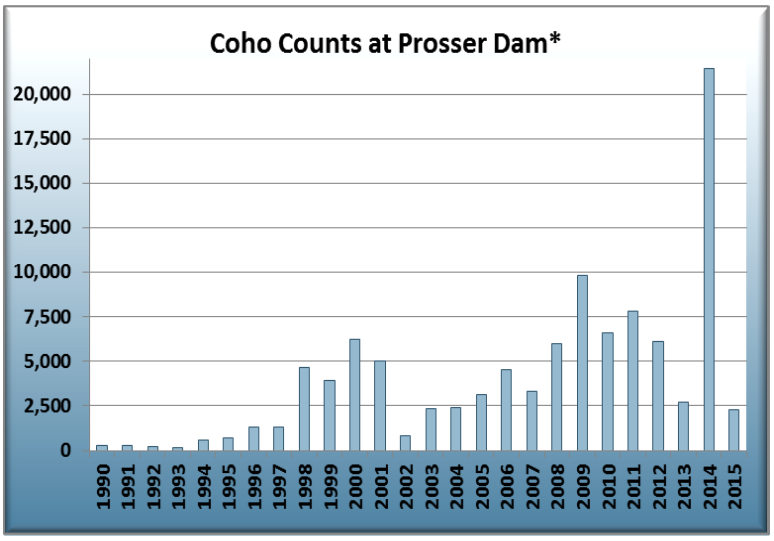
Since 2010, the Yakama Nation has been conducting intensive studies of steelhead in the Yakima Basin to better manage populations.

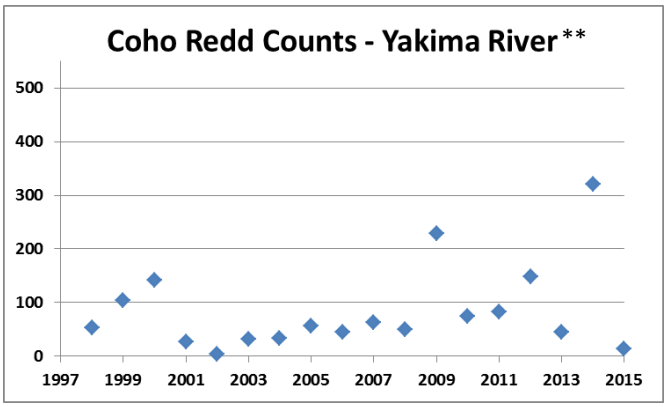
Activities include:

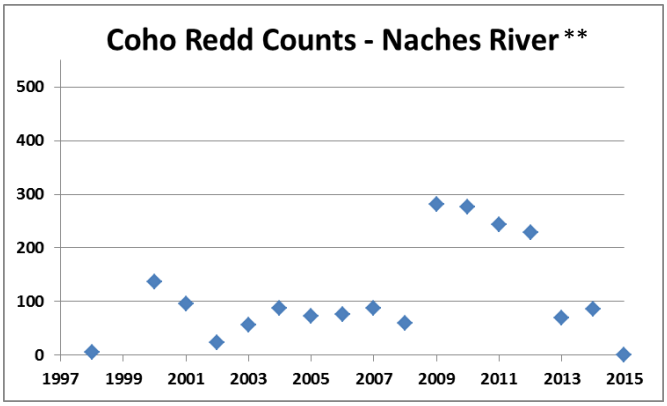
- DNA sampling at Chandler, Prosser, and Roza facilities to improve abundance and productivity estimates for individual populations.
- Radio-tracking adult steelhead and expanded spawning surveys to better define spawning areas, abundance, productivity, and population structure.
- Investigating effects of Yakima Basin dams on steelhead movements.
- Evaluating interactions between rainbow trout and steelhead.
- Most of this work is Accord funded.

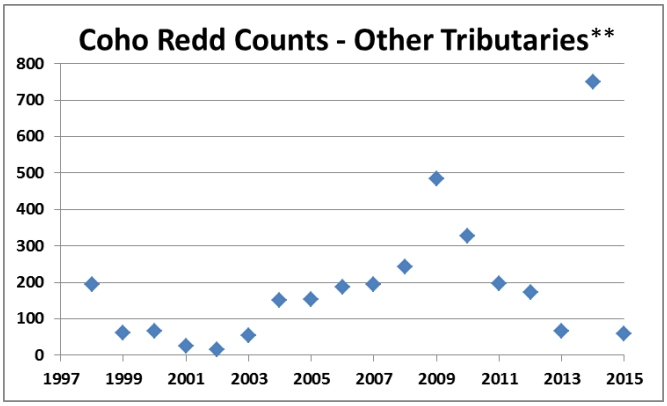
Yakima Subbasin Coho

- **Goal:** Develop a sustainable, naturally spawning coho population with a total annual harvest of at least 20,000 fish.
- **Near-Term Goal:** Restore annual returns of coho populations to biologically sustainable levels (15,000 adults, eventually including at least 3,500 of natural-origin) that provide harvest opportunities for tribal members.
- Approximate Treaty era run size: 110,000 adults
- 1980s average run size: 200 adults
- Average annual returns for the past decade have been over 7,000 fish (over 20,000 total in 2014).







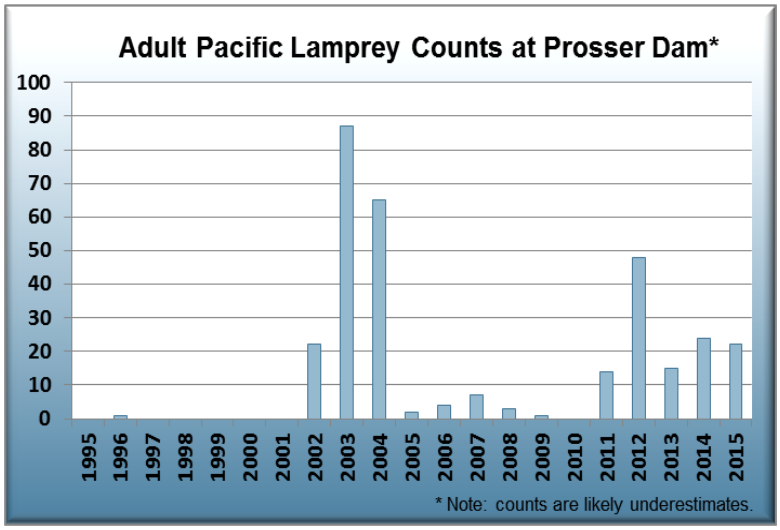


*Abundance estimate based on all counts at Prosser Dam, before broodstock collection (includes hatchery and wild adults).
**2015 redd counts underestimate due to very poor survey conditions.
Data source: Yakama Nation Fisheries

Pacific Lamprey Restoration*

Overall Goal for the Columbia River Basin:

To increase naturally sustainable Pacific lamprey populations to levels that support tribal harvest opportunities by 2025.



Source: Columbia River DART

2009-2010: Refined survey protocols and conducted distribution surveys, developed cooperative relationships with regional entities, and developed objectives and future work elements.

2011-2012: Identified threats and limiting factors, and initiated restoration action plan.

2012-2013: Successfully completed artificial propagation of Pacific lamprey with the production of several thousand larvae.

2012-2013: Translocated 137 adult Pacific lamprey from the Lower Columbia River into Satus, Toppenish, and Ahtanum creeks.

2012-2013: Documented distribution of larvae/juveniles in Yakima, Wenatchee, Entiat, and White Salmon subbasins.

2014-2017: Focus on restoration throughout the Ceded Lands, document progress, and reassess abundance and distribution estimates.

The Interesting Life of a Pacific Lamprey

Eggs and larvae

- Eggs hatch and larvae drift downstream to slow velocity areas.
- Larvae live in sand/silt filter feeding for 3-7 years.

Juveniles

- Larvae transform to juveniles and migrate to the ocean.

Adults

- Adults live in the ocean for 1-3 years and feed on fish.

Spawning

- Adults return to fresh-water to live for a year before spawning.
- Die 3 to 36 days after spawn.

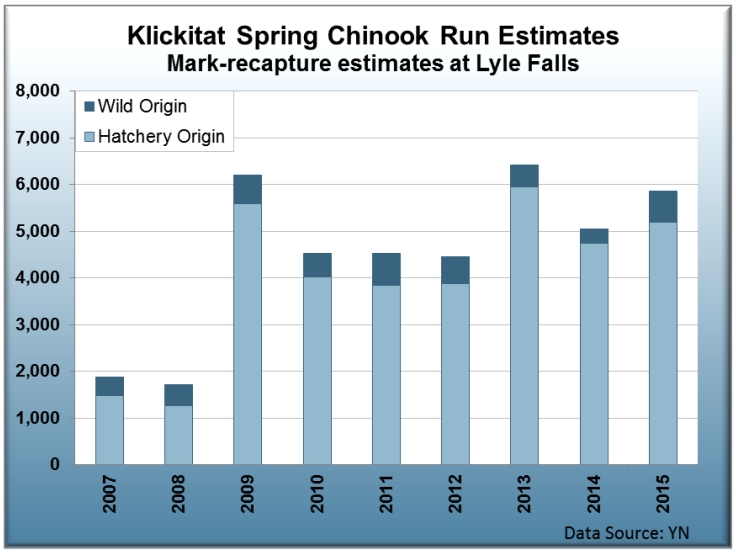
**Translocation and survey efforts described on this page are funded through the 2008 Columbia Basin Fish Accord, other work is supported by the Bureau of Reclamation and Public Utility Districts.*

Above: Lamprey release, Ahtanum Creek, lamprey spawning and juveniles at Prosser Hatchery (YN), lamprey underwater (USFWS)

Klickitat Subbasin Chinook

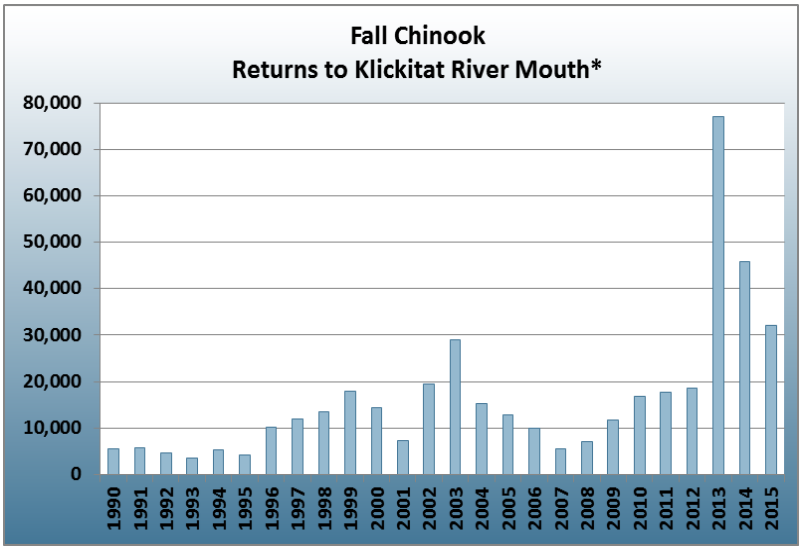
Spring Chinook

- Despite a low abundance, the population is not Federally listed. Hatchery supplementation is in place to mitigate for fish loses due to Columbia River Basin development.
- **Goal:** Increase population viability and local adaptation, while fulfilling Treaty harvest obligations sustainably.
- **Objective:** Reach harvest goals of 1,000 for all mainstem fisheries (majority in Zone 6 Tribal fisheries) and 3,000 in the Klickitat.
- **Strategies:** Transition the program to a conservation/harvest program by incorporating an increasing number of natural origin broodstock.



Fall Chinook

- Introduced into the Klickitat Subbasin in 1952 to meet harvest obligations for Tribal fisheries.
- **Goal:** Provide increased harvest opportunities to fulfill Treaty obligations by establishing a locally adapted population.
- **Objective:** Production of 18,000 fall Chinook for harvest in all fisheries, majority in Zone 6 Tribal fisheries and the Klickitat River.
- **Strategies:** Transition the out-of-basin program so pre-smolts from Little White Salmon National Fish Hatchery are reared and released from acclimation site(s) in the lower Klickitat River, as well as develop a local broodstock.

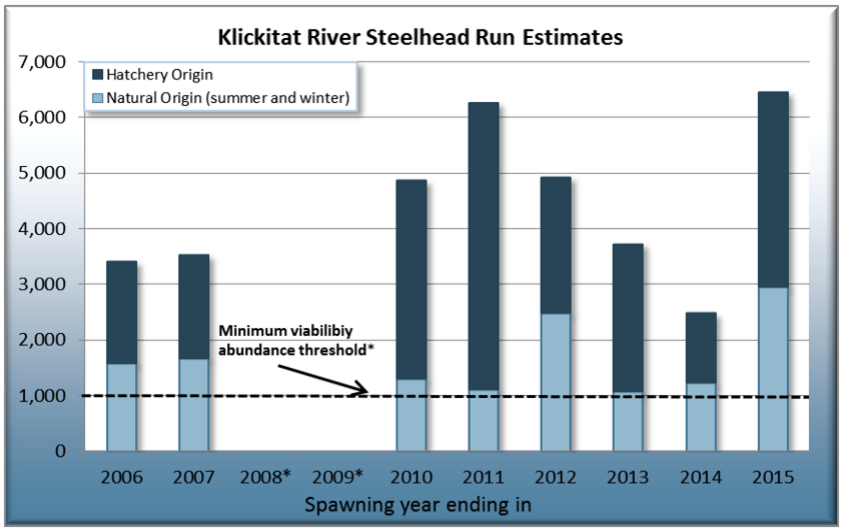


*Data source: Through 2010, run reconstruction in HGMP report, YN.; 2011-2015 population estimate based on mark-recapture to Lyle Falls.

Above: Chinook jumping at Lyle Falls, Klickitat platform fishing (CRITFC)

Klickitat Steelhead

- In the Treaty era, 3,000 - 6,000 steelhead spawned in the Klickitat River annually. During the mid- to late-1990s, adult steelhead returns were estimated as low as about 1,000 fish.
- The graph below illustrates the trend in population abundance of Klickitat steelhead since 2006, when results from the mark-recapture enumeration method became available. In recent years, abundance has increased to reach or exceed the Minimum Viability Abundance Threshold.*



*See footnote on page 30. Source: YN, based on mark-recapture. No estimates 2008/9

PROJECT SPOTLIGHT: Klickitat Population Monitoring

Juvenile Monitoring

- Smolt traps operated in the upper and lower Klickitat River reveal outmigration timing and abundance for salmon and steelhead.
- Migration patterns and survival are monitored using in-stream PIT tag (passive integrated transponder) detectors in tributaries.

Adult Monitoring

- Spawner abundance, distribution, and biological data are collected using redd surveys.
- Mark-recapture population estimates are calculated for a more accurate estimate of population size.
- Adult passage monitoring occurs at Lyle and Castile fishways.

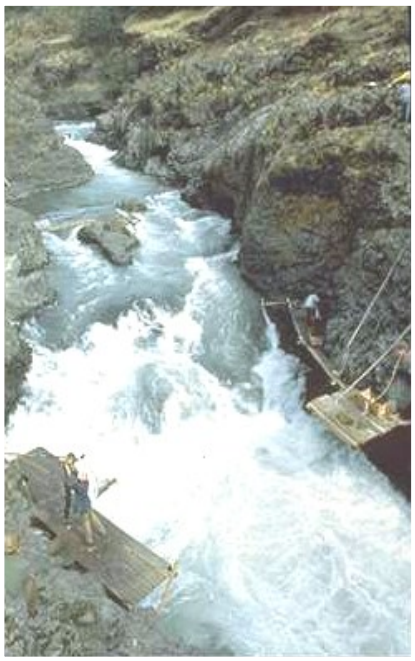
Genetic Testing

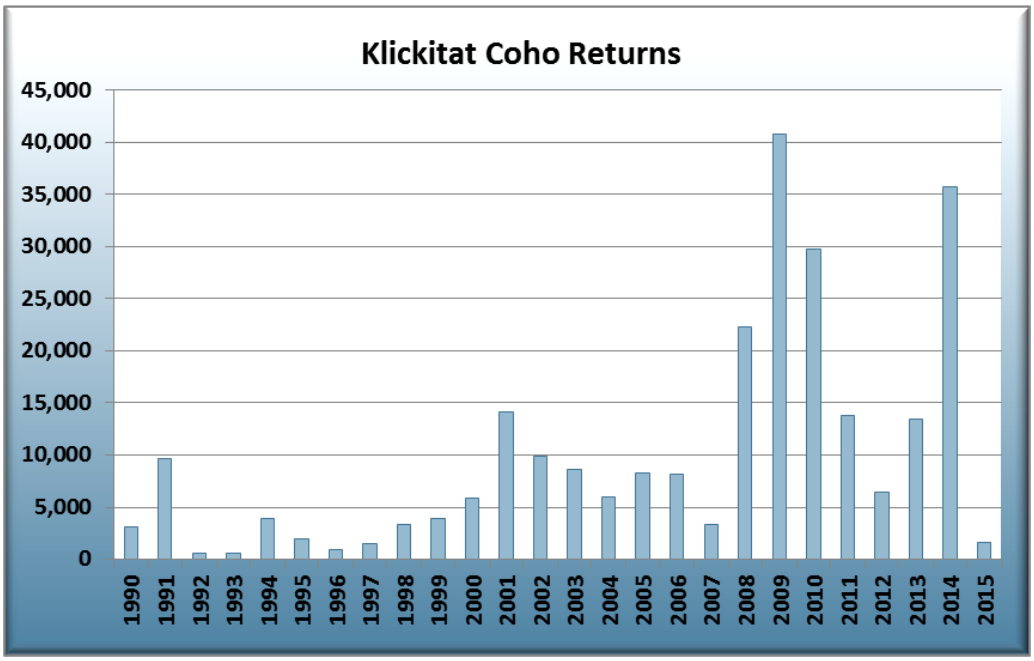
- Research is conducted to determine steelhead subpopulation composition, distribution, and interactions with each other and rainbow trout and to determine spring Chinook hatchery/wild interactions, effects, and to inform future broodstock strategies.

Above: Steelhead, screwtrap, Klickitat gorge survey (YKFP)

Klickitat Subbasin Coho

- Coho were introduced into the Klickitat Subbasin in 1952 to meet harvest obligations for Tribal fisheries.
- **Goal:** Provide increased harvest opportunities to fulfill Treaty obligations by establishing a locally adapted population.
- **Objective:** Produce 14,000 coho for harvest, mostly in Zone 6 Tribal fisheries and the Klickitat River.
- **Strategies:** Release out-of-basin pre-smolts from acclimation sites in the lower Klickitat River and develop a local broodstock program.

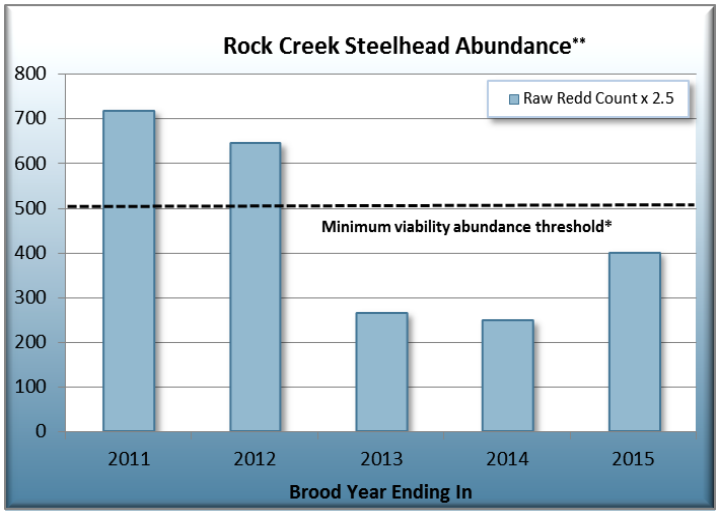




Above: Mid-Columbia coho, Klickitat platform fishing, Klickitat hatchery (YKFP). Data source: Yakama Nation Fisheries

Rock Creek Steelhead

- Oral histories indicate that there used to be significant steelhead runs and year-round flows in Rock Creek. During the mid- to late-1990s, adult steelhead populations were extremely low in the nearby Klickitat River, and likely were also very low in Rock Creek.



- The Yakama Nation has been monitoring Rock Creek steelhead abundance and distribution since 2008. Although the timeline is not long, recent population estimates for Rock Creek steelhead (assuming about 2.5 spawners per redd observed) have been greater than or equal to the 12-year geomean and Minimum Viability Abundance Threshold.*

- Surveys of the Rock Creek population distribution, abundance, movement, relatedness with other populations, and habitat conditions will help biologists to target the most effective restoration strategies. A geomorphic assessment, completed in 2015, will assist in locating key sites for restoration.

- Research in Rock Creek is in part cooperative between the United States Geological Survey and the Yakama Nation, and receives Accord funding.

*See footnote on page 30.

**Due to high flows and poor visibility, 2013 values are an underestimate. Abundance estimate assumes approximately 2.5 spawners per redd, which has been used for other steelhead populations in the region (E. Harvey, J. Zendt, YN).

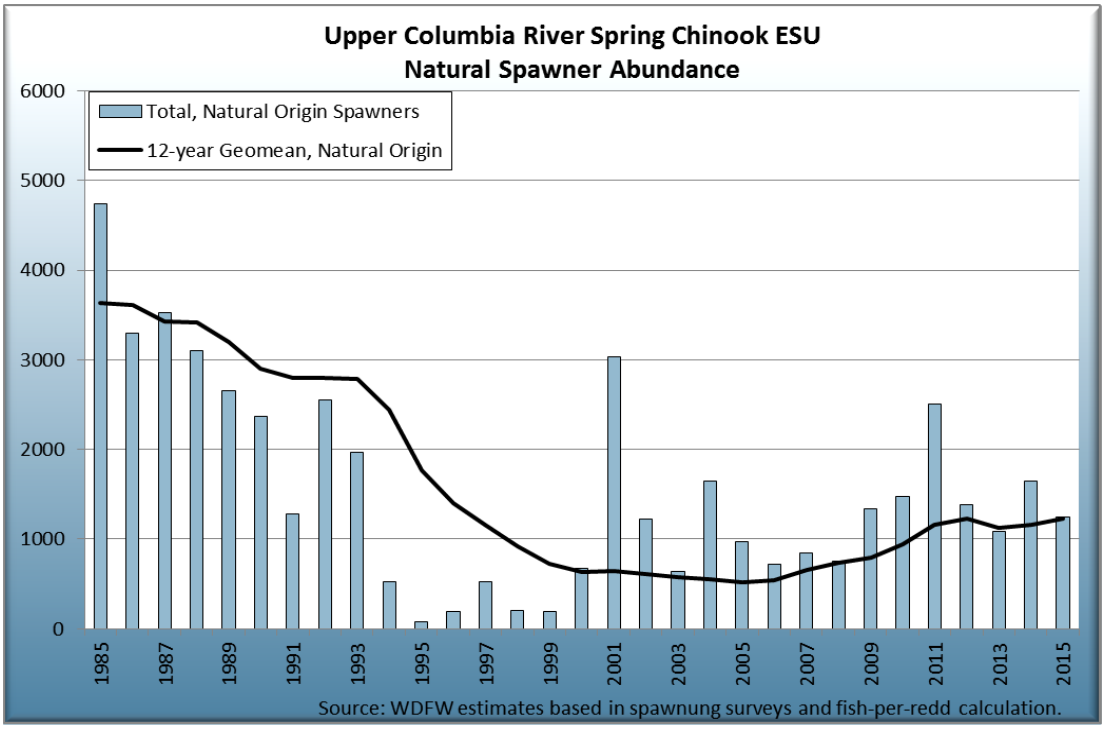
Above: Rock Creek steelhead, genetic sampling, fish survey (YN)

Upper Columbia River Spring Chinook

At the time of the 1855 Treaty, it is estimated that about 68,000 wild spring Chinook returned to the Wenatchee, Entiat, and Methow River basins. In the mid- to late-1990s, adult spring Chinook populations in the region were at record lows, leading to their listing as Endangered under the ESA. Since then, the status of adult spring Chinook populations has improved slightly; however, all of the populations continue to remain significantly below Treaty-era levels.

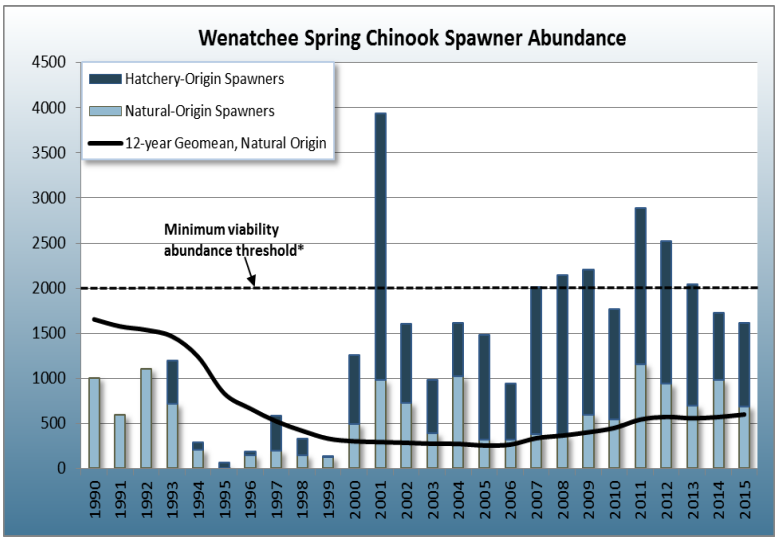
By restoring and protecting key habitats, appropriately regulating harvest, and advocating for the appropriate use of hatchery supplementation to increase natural spawner abundance, the Yakama Nation is helping to restore this species.

Chinook, American River (YBEEP)



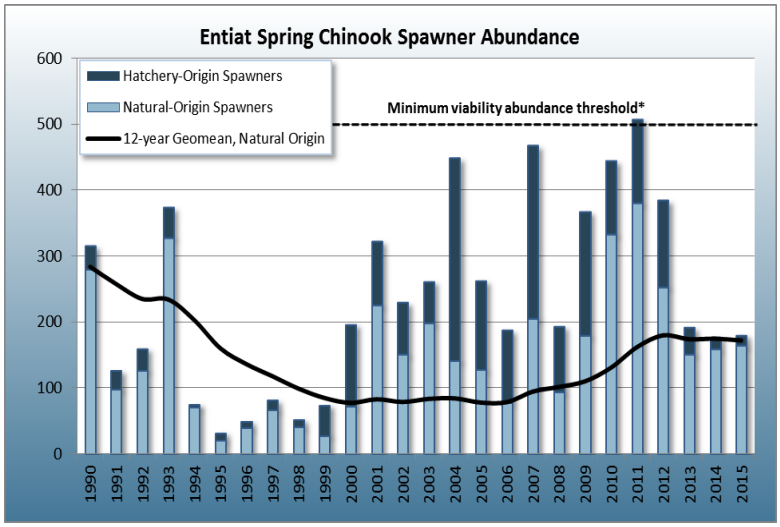
Above: Hancock Springs fish survey (USFWS/ YN); broodstock at Prosser Hatchery (Yakima Herald-Republic)

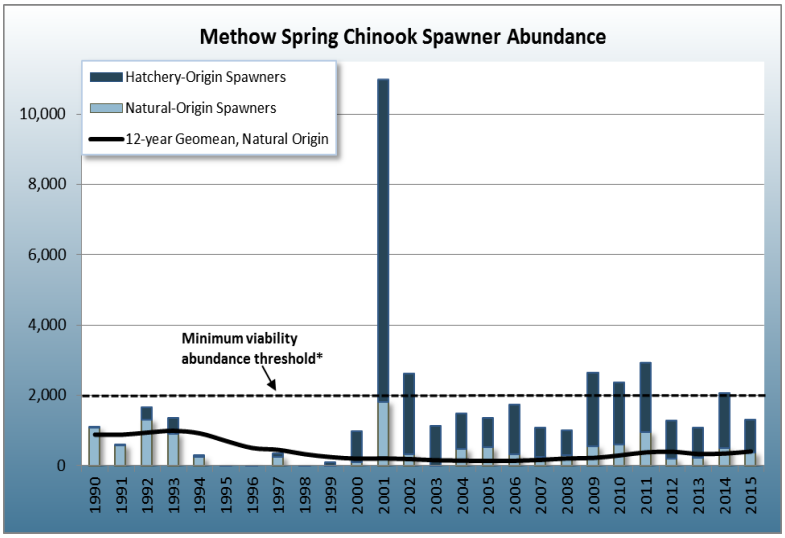
Upper Columbia River Spring Chinook, Continued



- Adult abundances are increasing for natural origin spring Chinook in the Wenatchee and Entiat rivers, but have recently decreased in the Methow River.

- Although the number of returning adult spring Chinook has increased since the record low returns of the mid-1990s, the populations must continue to grow before they are no longer considered at significant risk for extinction.*





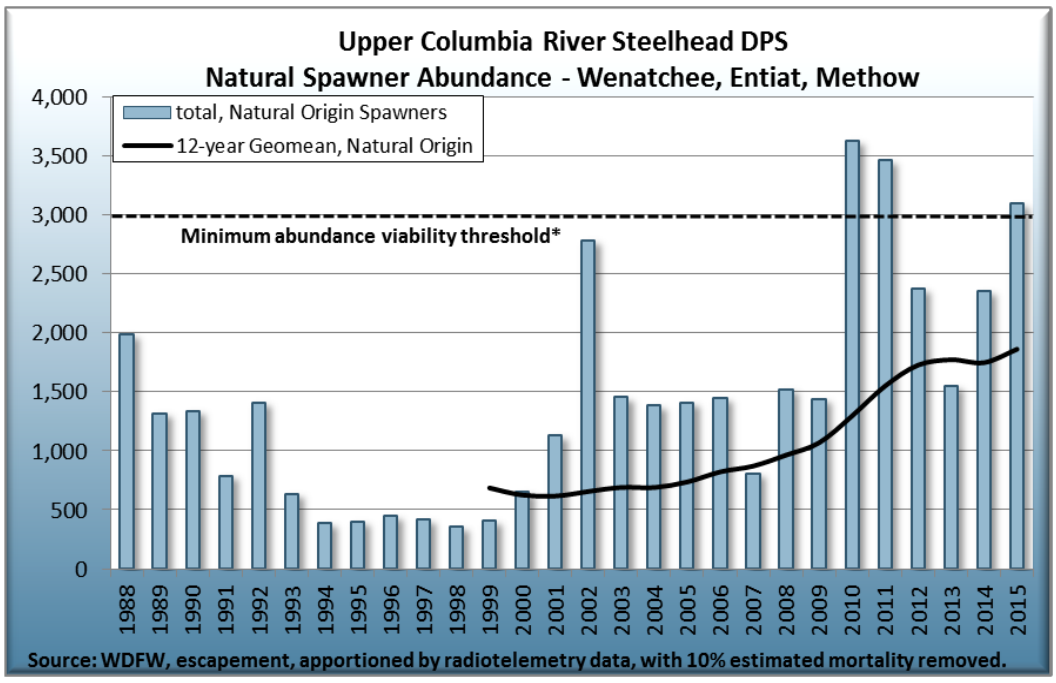
** For ESA delisting, the standard set by the National Oceanic and Atmospheric Administration is a 12-year geomean which must exceed the "minimum viability abundance threshold" for numbers of natural-origin adults. Before the extinction risk can be lowered there are additional population structure and distribution requirements that also must be met. The goal of the Yakama Nation is more robust however: naturally reproducing populations that can provide sustainable harvest benefits.*

Data source: WDFW (SASI) estimates based on spawning surveys and fish-per redd calculation.

Upper Columbia River Steelhead

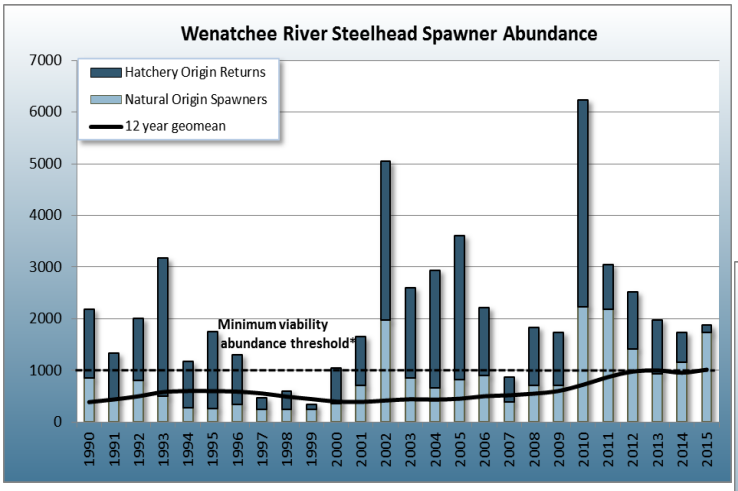
In the Treaty era, about 12,000 wild steelhead spawned in the Wenatchee, Entiat and Methow rivers annually. During the late-1970s to early-1980s, as well as the 1990s, populations were extremely low throughout the Yakama Nation's Ceded Lands. Major causes for these declines include man-made barriers and deterioration of watershed and in-stream habitat conditions due to land use practices. In recent years, in part through concerted efforts to address these issues, steelhead populations have increased throughout the region.

Unlike salmon, steelhead may spawn multiple times. By actively reconditioning spent spawners (kelts) and restoring their habitats throughout the region, Yakama Nation Fisheries is helping to improve wild steelhead survival and productivity.

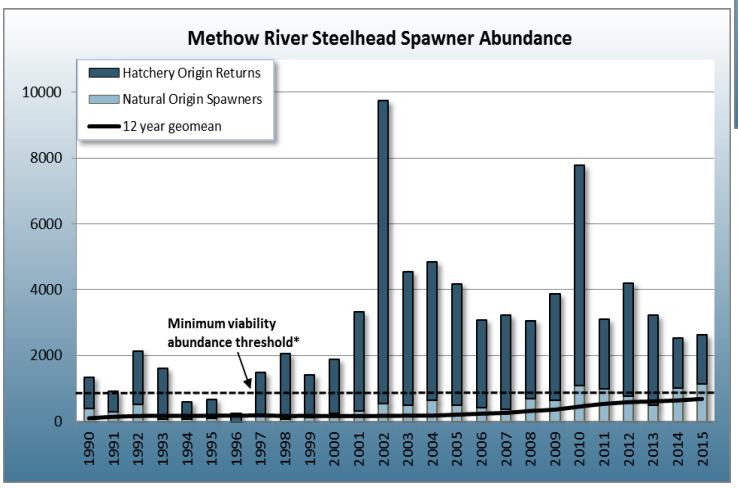


Above: steelhead, kelt reconditioning, Prosser Hatchery (CRITFC/ YN)

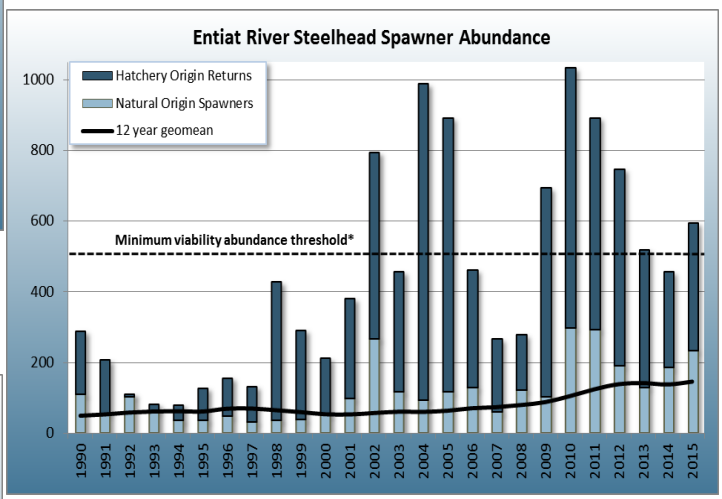
Upper Columbia River Steelhead, Continued



- Recent population estimates for steelhead in the Wenatchee, Entiat, and Methow are at their highest level for the last 20 years.



- After record lows in the 1970s and 1990s, adult abundance estimates for steelhead have increased for the Wenatchee, Entiat, and Methow populations.



- Methow and Wenatchee natural origin populations have exceeded the Minimum Viability Abundance Threshold* in recent years.

*See footnote on page 30

Data sources: WDFW (SASI) estimates. (NOAA (SPS) data incorporated prior-1987 for geomean prior to 2000). Data is escapement, apportioned by radiotelemetry data minus 10% estimated mortality.

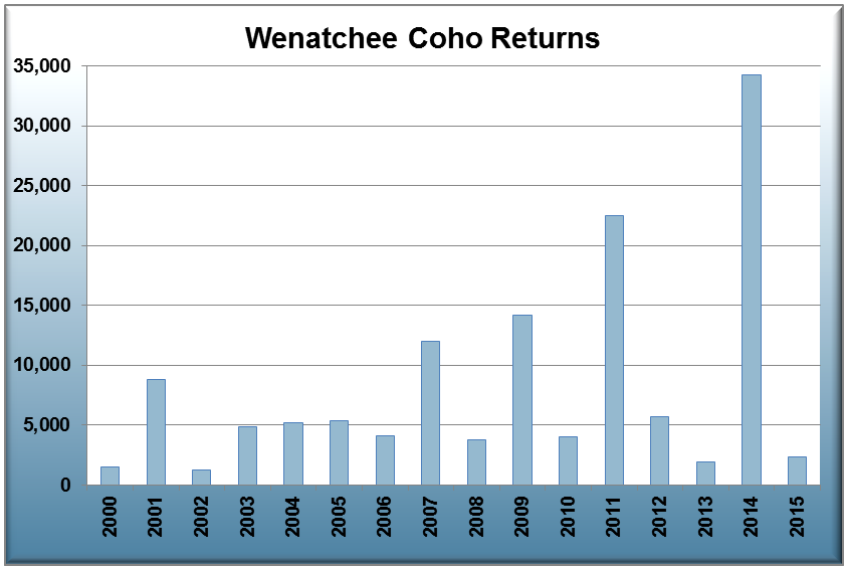
PROJECT SPOTLIGHT: Steelhead Kelt Reconditioning in the Upper Columbia River

The Yakama Nation's Accord-funded steelhead kelt reconditioning project, which uses methods developed by Yakama Nation Fisheries and the Columbia River Inter-Tribal Fish Commission in the Yakima Subbasin, is expanding into the Upper Columbia River. Kelts are steelhead that have already spawned and appear to have the potential to spawn again during the upcoming year. After spawning in the spring, kelts are held in captivity for 6-9 months to recover from the weight loss and stress that occur during their return from the ocean. In the fall these kelts are returned to the same area where they were captured to reproduce once again. The Yakama Nation is developing reconditioning facilities at the Winthrop National Fish Hatchery in the Methow Subbasin. (Photo: Methow Grist)

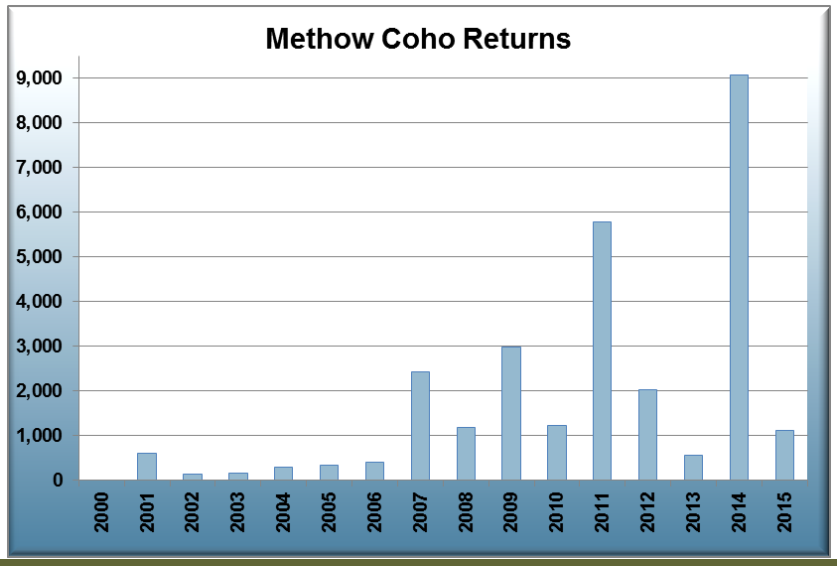
Upper Columbia Coho

Methow coho 1910 (Mullan 1992)

- **Estimated Treaty era returns:** Wenatchee River 7,000-8,000; Methow River 23,000-31,000 annually.
- By the mid-1980s, coho were extinct in the Wenatchee, Entiat, and Methow rivers.



- **Goal:** By 2028, develop a locally adapted, naturally spawning coho stock in the Wenatchee River and Methow River subbasins with an escapement of at least 1,500 adults in each subbasin (current numbers are supported by hatchery production) that provide harvest opportunities.
- The Yakama Nation began to reintroduce coho to the Methow River in 1997 and the Wenatchee River in 1999.



Data source: Fish Passage Center, adults only
Photo: juvenile coho, Butcher Creek Acclimation Site (CRITFC)

White Sturgeon Restoration in the Mid-Columbia*

2007-2008 and 2010-2012: Successfully spawned white sturgeon at the Yakama Nation's Marion Drain Hatchery.

Overall Goal for the Columbia Basin: To increase white sturgeon populations to naturally sustainable levels that support tribal harvest opportunities by 2025.

Rocky Reach

2011 Releases—6,500

2010-2011: Yakama Nation's Marion Drain Hatchery produced 13,000 juvenile white sturgeon for the Chelan and Grant PUDs.

2011: 13,000 hatchery-raised juvenile white sturgeon released.

2012: Improvements to the hatchery facility included a new production well, completion of an additional aeration tower, new incubation room, and a broodstock holding/rearing area.

Wanapum

2011 Releases—5,000

2015: Successfully spawned 19 wild white sturgeon collected from the Columbia River.

2012-2016: Continue to rear juvenile sturgeon for release in Priest Rapids, Wanapum, and Rocky Reach reservoirs.

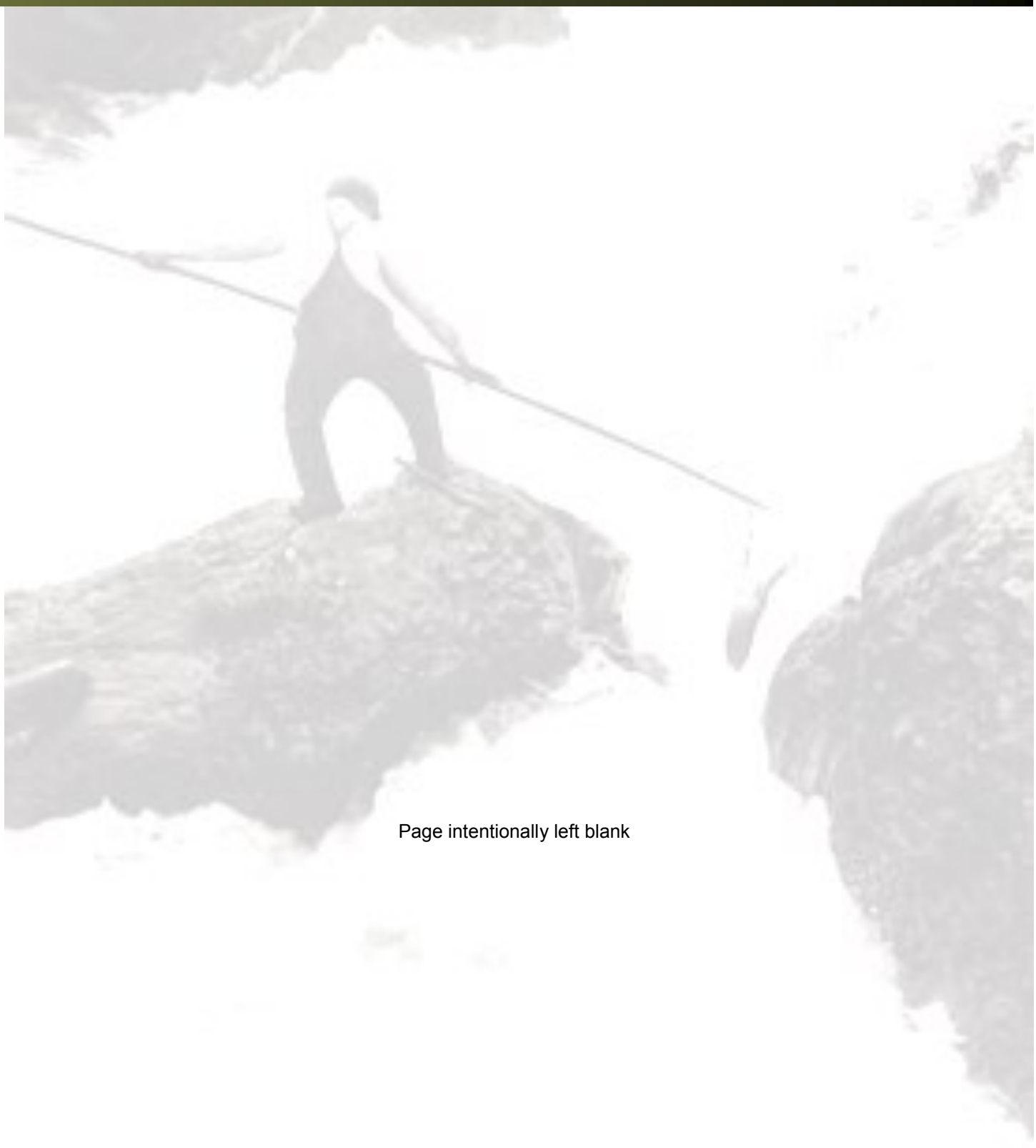
Priest Rapids

2011 Releases—1,500

2014-2017: Expansion of Marion Drain program. Working collaboratively with other agencies, plan to move from research to implementing restoration actions using research results to guide restoration priorities and methods.

**While the development of methods and staff resources described on this page are funded through the Columbia Basin Fish Accord Agreement of 2008, production efforts are supported by Grant, Douglas, and Chelan public utility districts.*

Photos: Pond at Prosser Hatchery, Marion Drain Hatchery (YN)



Page intentionally left blank

Photo: Celilo Falls ca .1950 (WA State Historical Society)

CHAPTER 3

HATCHERY

"For the Yakama people, fishing for salmon is not much less necessary to the Indians than the atmosphere they breathed."

-U.S. Supreme Court Justice Joseph McKenna

Landmark 1905 US v Winans Supreme Court decision

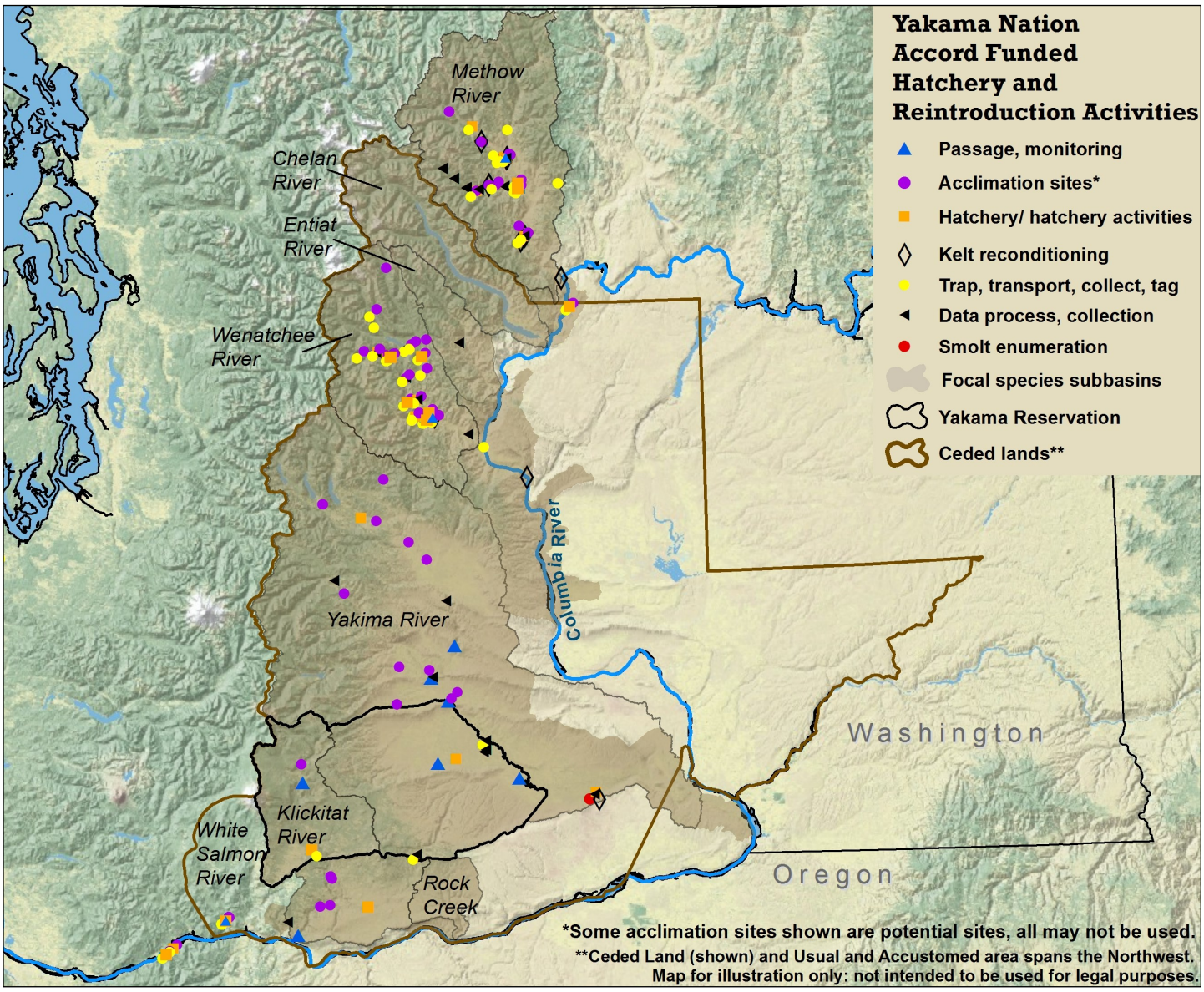
Background: Celilo Falls, historic

Fish passage monitoring, Roza Dam (YN)

Accord Agreement Background

This chapter is an overview of the Yakama Nation's hatchery and reintroduction programs supported by the 2008 Columbia River Fish Accords Agreement. These activities occur throughout the Yakama Nation's Reservation and Ceded Lands and other treaty trust natural resource use areas, and covers some priority production work supported by other funding sources as well.

One of the main areas in which the Accord provides funds to the Yakama Nation is the development of new hatchery and acclimation facilities, but it also provides support for the planning and expansion of current production facilities.



The Yakama Nation Fisheries Background

Mandate of Fisheries Restoration

In its Treaty with the United States,* the Yakama Nation reserved a variety of rights, including the right to fish at all usual and accustomed places, which includes the right to have fish present to harvest. Since 1855, human population growth and development have substantially altered flows and habitats resulting in reduced productivity for fish populations. As a result, releases of hatchery fish are required to: 1) augment harvest, 2) re-establish fish to areas where they were extirpated, and 3) supplement naturally spawning populations. The Yakama Nation's vision for fisheries restoration combines traditional knowledge with modern science, utilizing a variety of approaches for maximum benefit.

Monitoring natural production, Upper Yakima (YKFP)

Gravel-to-Gravel Management

The gravel-to-gravel management concept is our holistic approach to fishery restoration that recognizes the need to protect our salmon and steelhead throughout their lifecycles, from eggs maturing in the gravel to adults spawning on the gravel. The concept emphasizes reconnecting fish with their natural habitats. Unfortunately, natural habitats have become degraded and often do not support self-sustaining natural populations. The Yakama Nation is working with various partners to implement habitat restoration and water resource management projects designed to address all factors limiting abundance and productivity.

Traditional platform fishing, Klickitat Gorge (YKFP)

Hatchery Production Approaches

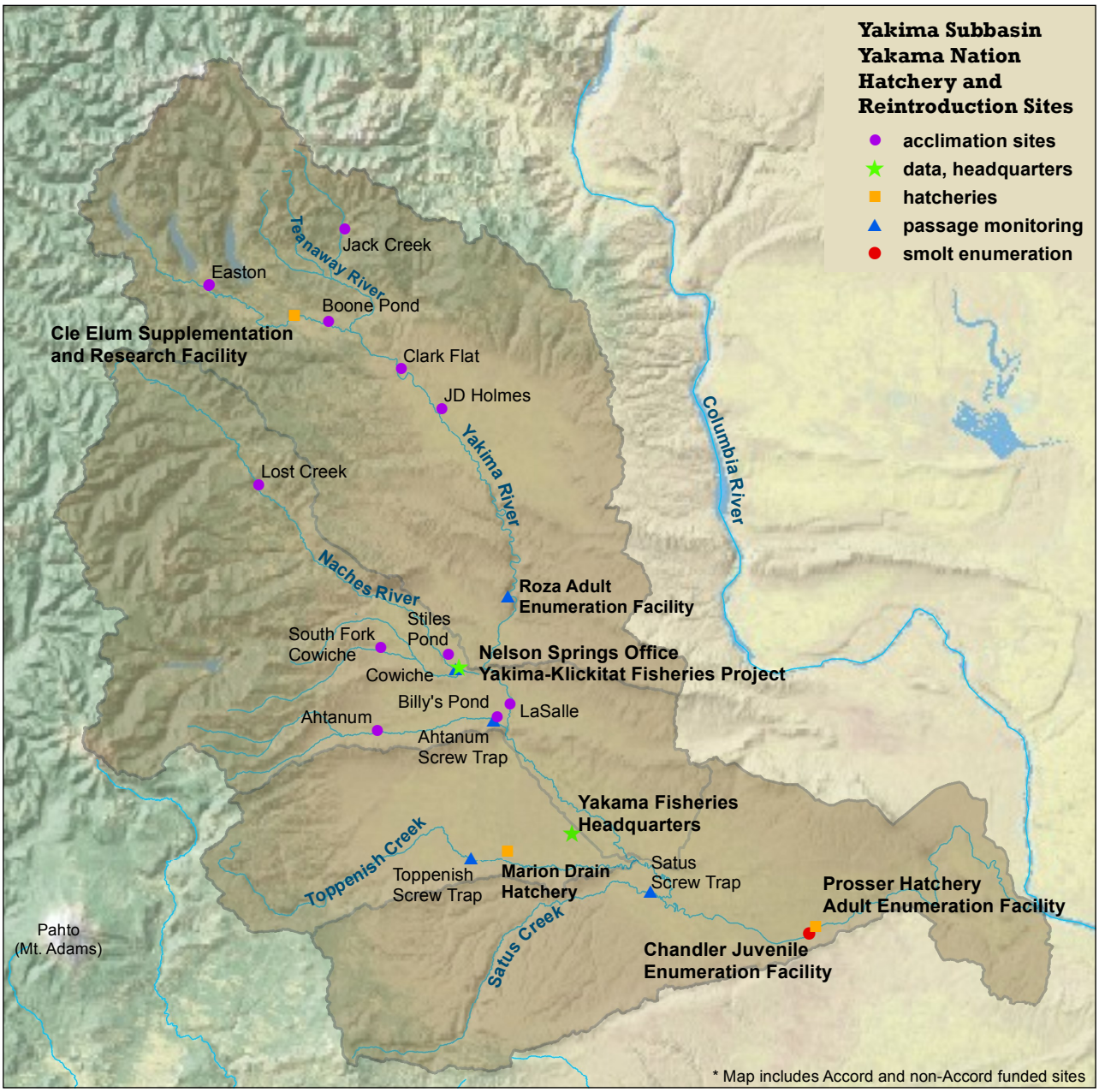
One hatchery tool that the Yakama Nation is using is "supplementation." Columbia River Treaty tribes have generally referred to its purpose as increasing the abundance of naturally spawning populations (usually through integrated hatchery programs) or reintroducing historically present species to their native habitats. An integrated program is where broodstock (usually native) are managed as an artificially propagated component of a naturally spawning population, with the goal to increase the size and productivity of the population (some returning hatchery-origin fish allowed to spawn naturally).

In some cases, we support a "segregated" program, where broodstock are managed as a discrete, separate population from naturally spawning, wild populations, with the goal to increase harvest opportunity to mitigate for those that have been lost.

Family Fishing Day, Yakama Nation

**Yakama Nation Treaty of 1855 (12 stat. 951) with the U.S.A.*

Yakima Subbasin



Yakima Subbasin:
Yakama Nation's Accord Funded Hatchery and Reintroduction Activities

- Master plan development
- Yakima/Naches coho mobile acclimation units
- Steelhead kelt reconditioning and evaluation
- Facilities operations and maintenance for coho and spring Chinook restoration
- Monitoring and evaluation to track program effectiveness
- Yakima fall Chinook restoration facilities
- *Implemented through other funding sources:* Sockeye reintroduction, Pacific lamprey restoration research, and white sturgeon restoration research

Cle Elum Supplementation and Research Facility - Upper Yakima River Spring Chinook (Tkwínat, Núsux)

At the time of the 1855 Treaty, about 200,000 spring Chinook returned annually to the Yakima River. By the 1980s and 1990s, annual returns of adults declined to less than 3,500 fish, providing minimal tribal subsistence harvest.

In 1997 the Yakama Nation, with BPA support, opened the Levi George Supplementation and Research Facility in Cle Elum to enhance spring Chinook returns and provide additional fishing opportunities. Since 2001, an average of 12,000 spring Chinook have returned annually providing for an average harvest of 2,090 fish.

Cle Elum Facility

Cle Elum marking crew (YKFP)

Research: One of the main purposes of the Cle Elum program is to provide information to regional decision-makers regarding hatchery production and management practices. The program includes extensive monitoring and evaluation in the following areas:

- Physiology and morphology
- Homing and spatial distribution
- Reproductive traits and success
- Redd and natural-origin abundance
- Gene flow and genetic divergence
- Ecological interactions and harvest

Project success: Results from our extended study demonstrate that a well-designed and carefully managed supplementation program can produce fish for harvest and increase the number of fish returning to spawning grounds. Through restoration work, collaboration has increased in the basin. In 2000, the recreational fishery was re-opened after a 40-year closure.

Cle Elum Hatchery: Spring Chinook Production

Incubation

- Local natural-origin broodstock are collected at Roza Dam
- Eggs are thermally regulated using well water and chilled water

Raceways

- Fry moved to raceways in early March, reared at low densities
- Overhead cover and underwater feeders encourage natural behavior
- Active disease monitoring
- Juveniles remain in raceways until January

Smolt Acclimation

- Juveniles moved to one of three acclimation sites located in natural spawning areas (Easton, Clark Flat, and Jack creeks) in January/February
- Fish allowed to imprint for at least three weeks before volitional release

Prosser Tribal Hatchery - Yakima River Fall Chinook (Tkwínat, Núsux)

During the pre-Treaty era, up to 100,000 adult fall Chinook returned to the Yakima Subbasin annually. With the completion of hydroelectric dams, there has been a loss of natural production, in part due to the inundation of spawning habitat. Reduced production led to the loss of Tribal harvest opportunities. To offset the lost productivity, and as a result of the *US v. Oregon Columbia River Management Plan,* the Yakama Nation released the first hatchery-reared fall Chinook in 1983. The plan established a short-term production goal for the Yakima Subbasin, requiring the annual release of 1.7 million sub-yearling fall Chinook for harvest augmentation.

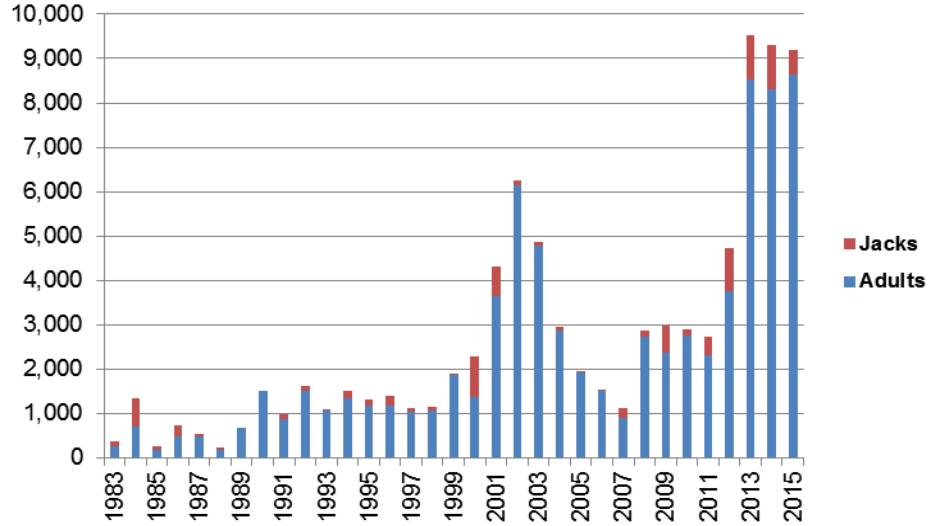
Prosser Hatchery, staff caring for young Chinook in raceways

Yakima fall Chinook broodstock collection

The Yakama Nation is in the process of implementing a summer- and fall-run Chinook program in the Yakima Basin to increase harvest levels, natural spawning abundance, and distribution. The goals of the program are to:

- Improve survival of juvenile fall Chinook by using a local brood source and constructing an acclimation facility in the Lower Yakima River for the release of these fish.
- Improve the survival and productivity of fall Chinook juveniles released above Prosser Dam by upgrading facilities and increasing the use of local, natural-origin returns as the brood source.
- Reintroduce summer-run Chinook to the Yakima Subbasin ***(see page 46 for more about summer Chinook)***

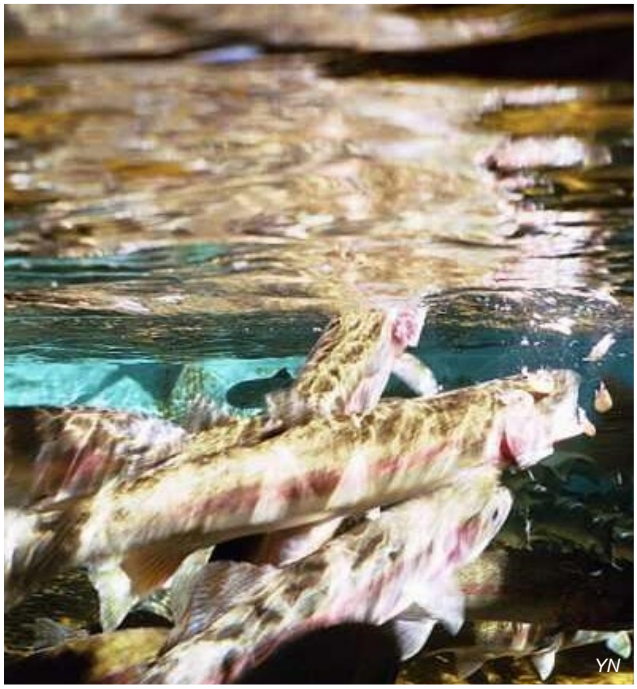
Counts of Summer and Fall-run Chinook at Prosser Dam



Releases of hatchery-origin fish, improvements in hatchery practices, habitat protection and restoration, and increases in freshwater and marine survival have contributed to increases in the number of summer- and fall-run Chinook counted at Prosser Dam since 1983.

Source: Yakama Nation Fisheries. Adult and jack, hatchery and wild combined.

Prosser Tribal Hatchery - Yakima River Steelhead (Shusháynsh) Kelt Reconditioning



Prosser Hatchery, kelts feeding

Steelhead are capable of spawning more than once; however, their physical condition after spawning combined with having to pass several dams and survive other dangers limit survival as they migrate to the ocean and back to spawn. To improve the potential for steelhead to be repeat spawners, the Yakama Nation and CRITFC have developed a process to recondition kelts after spawning. A "kelt" is a post-spawn steelhead, and "reconditioning" is the process of improving the health and fitness of the kelt to increase its potential to spawn a second time. We believe that through increased productivity and survival, this process will aid in improving steelhead abundance and diversity.

Prior to the 1855 Treaty, up to 40,000 steelhead returned annually to the Yakima Subbasin. That number declined to around 1,000 in the 1990s. Since 1999, the Yakama Nation has been a leader in the development of strategies to recondition kelts. We are conducting research to refine the process and discover which methods work best to reduce post-spawn mortality and increase reproductive success.

To help enable repeat spawning, we recondition kelts by capturing, holding, and feeding post-spawned steelhead in an artificial environment. We collect steelhead kelts at Prosser Dam and the Chandler Canal, after which they receive care at the Prosser Hatchery for up to 9 months before they are released. On average, the Yakama Nation annually releases about 200 reconditioned kelts.

Prosser Hatchery: Steelhead Kelt Reconditioning

Collection of Kelts

- Out-migrating kelts are collected during the spring at Prosser Dam and Chandler Canal

Kelt Reconditioning

- Kelts held at Prosser Hatchery
- Feeding regimes allow kelts to rebuild their energy reserves
- Fish are treated with antibiotics to avoid infections and strengthen the immune system

Release of Kelts

- Reconditioned kelts are released below Prosser Dam during the peak of the upstream steelhead migration

Prosser Tribal Hatchery - Yakima River Coho (Sinux)

In the Treaty-era, coho were found in virtually every creek and river in the Yakima Subbasin. During this time, annual returns of adult coho to the Yakima Subbasin were between 45,000 and 100,000. By the early 1980s, coho were extirpated from the area. To reestablish the coho population and the Tribal fishery, the Yakama Nation initiated a reintroduction program in 1985.

Prosser Hatchery staff caring for young coho in raceways

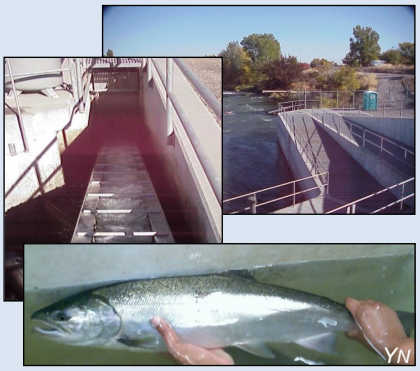
Mid-Columbia coho

Since the Yakama Nation's first hatchery releases of coho in 1985, the number of returning adults has steadily increased (see graphs on p. 23). We are developing a local, natural-origin brood source for a supplementation program that is intended to establish a wild, self-sustaining natural population.

Project success: Annual adult coho returns to Prosser Dam have averaged about 7,000 fish (2006-2015), including returns of nearly 4,000 wild/natural fish annually.

Prosser Hatchery: Coho Production

Collection of Adults



- Local natural-origin broodstock are collected at Prosser Dam and Chandler by-pass
- Adults are maintained at the Prosser Hatchery until spawning

Incubation and Early-rearing

- Incubation and early-rearing occurs at Prosser and Eagle Creek National Fish hatcheries
- Coho are reared at Prosser Hatchery for their first year
- Coho are transferred to Eagle Creek Hatchery, and back to Prosser in early-February

Smolt Acclimation

- Pre-smolts from Eagle Creek Hatchery are reared at the Stiles, Holmes, Lost Creek, Boone, and Easton acclimation sites in the spring
- Mobile acclimation units are also used
- Volitional release begins in April

Upper Yakima Sockeye (Kálux) Restoration

In the early 20th century, sockeye nursery lakes in the Upper Yakima Subbasin were impounded by the Yakima Basin Irrigation Project, which lacked fish passage facilities. Prior to the irrigation project, the lakes supported an annual run of 200,000 sockeye. In 2009, Yakama Nation Fisheries, with support from several partners, reintroduced adult sockeye into Lake Cle Elum to spawn naturally. After adults are captured at Priest Rapids Dam and/or Roza Dam, we transport them to Lake Cle Elum for release, a process that will continue until upstream passage is provided at Cle Elum Dam. A temporary out-migrant chute has been constructed so that juveniles can migrate downstream on their own, while a permanent one is in design.

Sockeye reintroduced by the Yakama Nation, Lake Cle Elum (photo: YBEEP)

The number of adult sockeye returning to Priest Rapids and Roza dams determines the number of fish the Yakama Nation can transplant. Number of fish transported has ranged from 1,000 in 2009 to 10,000 in 2012 and 2014. In 2013, around 140,000 juvenile sockeye, offspring from the adults transplanted in 2011, were estimated to migrate downstream past Roza and Prosser dams.

Cle Elum Dam juvenile passage structure

Brood-year 2009 sockeye out-migrant, 2011 (photo: Yakima Herald-Republic)

Mel Sampson, reintroducing sockeye at Cle Elum, 2009

Yakama Nation adult sockeye trap and haul

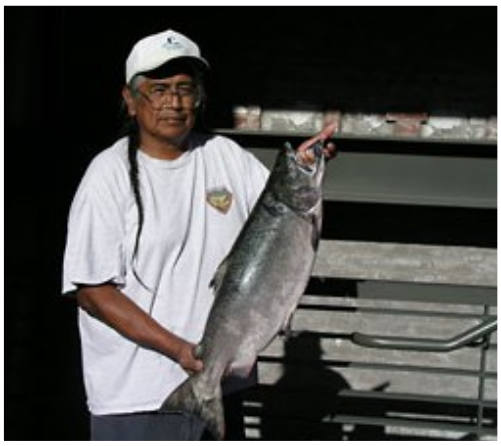
Project Success: In 2013, 701 adults, offspring from the 2009 transplants that were released into Lake Cle Elum, returned to the Yakima Basin and were trucked to the nursery lakes to spawn. These fish were the first naturally produced Yakima River sockeye to return and spawn in the basin in over 100 years. In 2014 2,676 fish returned, but only 341 returned in 2015 due to severe drought.

Note: The Yakama Nation's sockeye reintroduction efforts are supported by Pacific Coastal Salmon Recovery Funds from the National Oceanographic and Atmospheric Administration, the U.S. Bureau of Reclamation, and Grant County PUD.

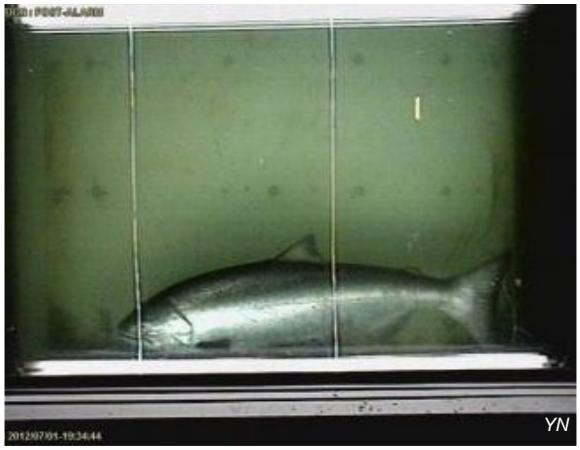
Marion Drain Tribal Hatchery - Yakima River Summer Chinook (Tkwínat, Núsux)

Yakima River Summer Chinook (Tkwínat; Núsux)

By 1970, summer Chinook were extirpated from the Yakima Subbasin. Beginning in 2009, the Yakama Nation developed production facilities to reestablish the lost summer run. We use summer Chinook eggs from the Wells Hatchery/Wells Dam, incubate and rear their offspring at Marion Drain Hatchery, and acclimate them at sites throughout the subbasin. The Tribe's goal is to eventually use a local, natural-origin broodstock.



Tony Washines, Yakama Nation, Chinook for sale in Portland (photo: Ecotrust)



First summer Chinook to return past Prosser Dam, 2012

The summer Chinook hatchery program has two phases. In the initial phase, we plan to re-colonize habitat with summer Chinook and provide fish for harvest. In this phase, we plan to annually release 500,000 summer Chinook (1/2 sub-yearlings and 1/2 yearlings) at locations above Prosser Dam. Improved habitat quality, through on-going restoration work, will allow us to reach our long-term goal which is a self-sustaining and locally-adapted population. To reach harvest goals, we may have to continue some hatchery supplementation.

Project success: Annually, over 1,700 summer-run Chinook passed Prosser Dam 2013-15. These are among the first adults to return to the Yakima Basin in over 40 years. *(See graph on page 19)*

Marion Drain Hatchery: Summer Chinook Production

Collection of Adults

- Wells Hatchery broodstock are spawned in October at Wells
- Goal is to move to natural and local broodstock produced by the program and collected locally

Incubation and Early-rearing

- Eggs are transferred to the Marion Drain Hatchery where they are hatched and reared

Smolt Acclimation

- Pre-smolts moved to Mid-Yakima locations (such as Nelson Springs), Prosser Hatchery, or potentially kept at Marion Drain Hatchery for final acclimation and volitional release in late-April and into May

Marion Drain Tribal Hatchery
Mid-Columbia White Sturgeon (Wílaps)

Since the 1990s, Yakama Nation Fisheries has been researching how to culture white sturgeon by rearing small numbers in Tribal hatchery facilities. We obtained fish from various sources, including Pelfrey Sturgeon Hatchery, CRITFC's mid-Columbia Research Program, and the U.S. Fish and Wildlife Service. In 2015, 19 wild adult white sturgeon were collected from the Columbia River. After spawning, they were returned to the river.

Visitors at the Marion Drain Hatchery

Extracting eggs from white sturgeon

Working collaboratively with other agencies, the Yakama Nation intends to move from the research phase of the project to the implementation of restoration actions. Results from our research will be used to guide the implementation of effective and efficient restoration activities.

The long-term goal of the Yakama Sturgeon Management Project is to restore healthy white sturgeon populations that provide harvest opportunities in the mid-Columbia River and Lower Snake River reservoirs.


Juvenile white sturgeon at the Marion Drain (photo: Yakima Herald-Republic)

Project Success: Since 2007, the Yakama Nation has spawned and reared white sturgeon at our Marion Drain Hatchery to assist with the restoration of mid-Columbia River populations. Survival is very high. Since 2010, juvenile white sturgeon have been released into Priest Rapids, Wanapum, and Rocky Reach reservoirs.

Placing white sturgeon eggs in hatching containers

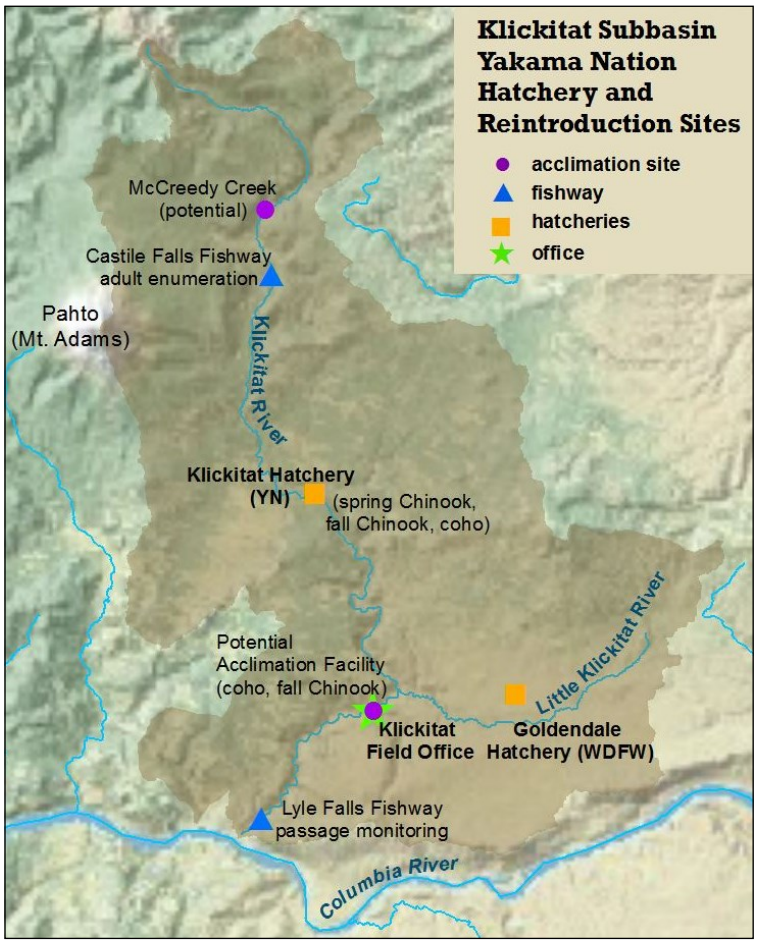
Note: While the development of methods and staff resources described on this page are funded through the Columbia Basin Fish Accord Agreement of 2008, production efforts are supported by Grant, Douglas, and Chelan Public Utility Districts.


White sturgeon broodstock collection (Photo: CRITFC)

Klickitat Subbasin

The Tribal fishery at Lyle Falls (Klickitat River) is important for ceremonial, subsistence, and commercial harvest. Klickitat Hatchery production of fall Chinook and coho helps to sustain the commercial fishery that contributes significantly to tribal members' income. Traditional dip nets, set nets, and jump nets are the preferred fishing method. Lyle Falls is one of the last places where Yakama tribal members can harvest fish using traditional methods and pass these ancient technique on to the next generation, ensuring the survival of our way of life.

Klickitat Gorge, traditional platform fishing (Photo: CRITFC)



Species of Interest: Background

- **Spring Chinook (Tkwínat, Núsux)** - Native to the Klickitat Subbasin, spring Chinook were once harvested in significant numbers. Since 1977, annual returns of natural spring Chinook averaged 300 fish. Reforms to the spring Chinook hatchery have included introducing wild spring Chinook into the hatchery population to increase natural influence. Spring Chinook are the only species that swim-in to the hatchery for broodstock collection and spawning purposes. (see graph p. 25)

Yakama Nation staff collecting biological samples with the USFWS staff, Klickitat Hatchery

- **Fall Chinook (Tkwínat, Núsux)** - Fall Chinook, which were introduced into the Klickitat Subbasin in 1952 to meet harvest obligations, usually are unable to pass Lyle Falls. (see graph p. 25)
- **Coho (Sinux)** - Coho were introduced in 1952 to meet harvest obligations. The Yakama Nation's goal is to produce approximately 14,000 coho for harvest, mostly in the Zone 6 Columbia River Tribal fisheries and Klickitat River. (see graph p. 27)

Klickitat Hatchery

Klickitat Hatchery

Built in 1949, the Klickitat Hatchery was operated by the state of Washington through 2006. At that time the Yakama Nation took over hatchery operations; however, the WDFW still participates as a co-manager through the YKFP. The Klickitat Hatchery is one of the few Mitchell Act hatcheries above Bonneville Dam. Hatchery operations are federally-funded as mitigation for lost fisheries.

Species we incubate, rear, acclimate and release at the hatchery include Klickitat spring Chinook (600,000 yearling smolts), Little White Salmon upriver bright fall Chinook (4 million sub-yearling smolts), and Lewis River late-coho (1 million yearling smolts). These species are managed for harvest augmentation, separate from wild stocks.

Klickitat Hatchery

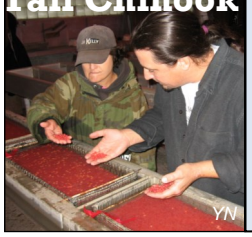
Project Success: Since 2009, annual spring Chinook returns to Lyle Falls have averaged 5,200 fish. Annual adult fall Chinook and coho returns to the river mouth have averaged over 31,000 and 20,000, respectively. (see graphs p. 25-27)

Wahkiacus Field Office (photo: Google Maps)

Proposed Lower Klickitat River Acclimation Facility

The Yakama Nation is currently investigating the development of a fall Chinook and coho acclimation site on the lower Klickitat River. The proposal would free-up water and space at the Klickitat Hatchery. In addition, shifting a portion of the fall Chinook and coho releases downstream would reduce potential overlap with spring Chinook and steelhead spawning and rearing areas, reducing potential impacts on wild stocks while maintaining harvest opportunities.

Fall Chinook



- Upriver bright fall Chinook obtained from Lower White Salmon Hatchery as green eggs
- Future: transition to pre-smolts and local broodstock obtained from the Lyle Fishway/Trap

- Fall Chinook are reared at Klickitat Hatchery by YKFP
- Approximately 4 million released annually
- Strategy to release half of the fish into the lower river, but may modify plan in the future

Coho

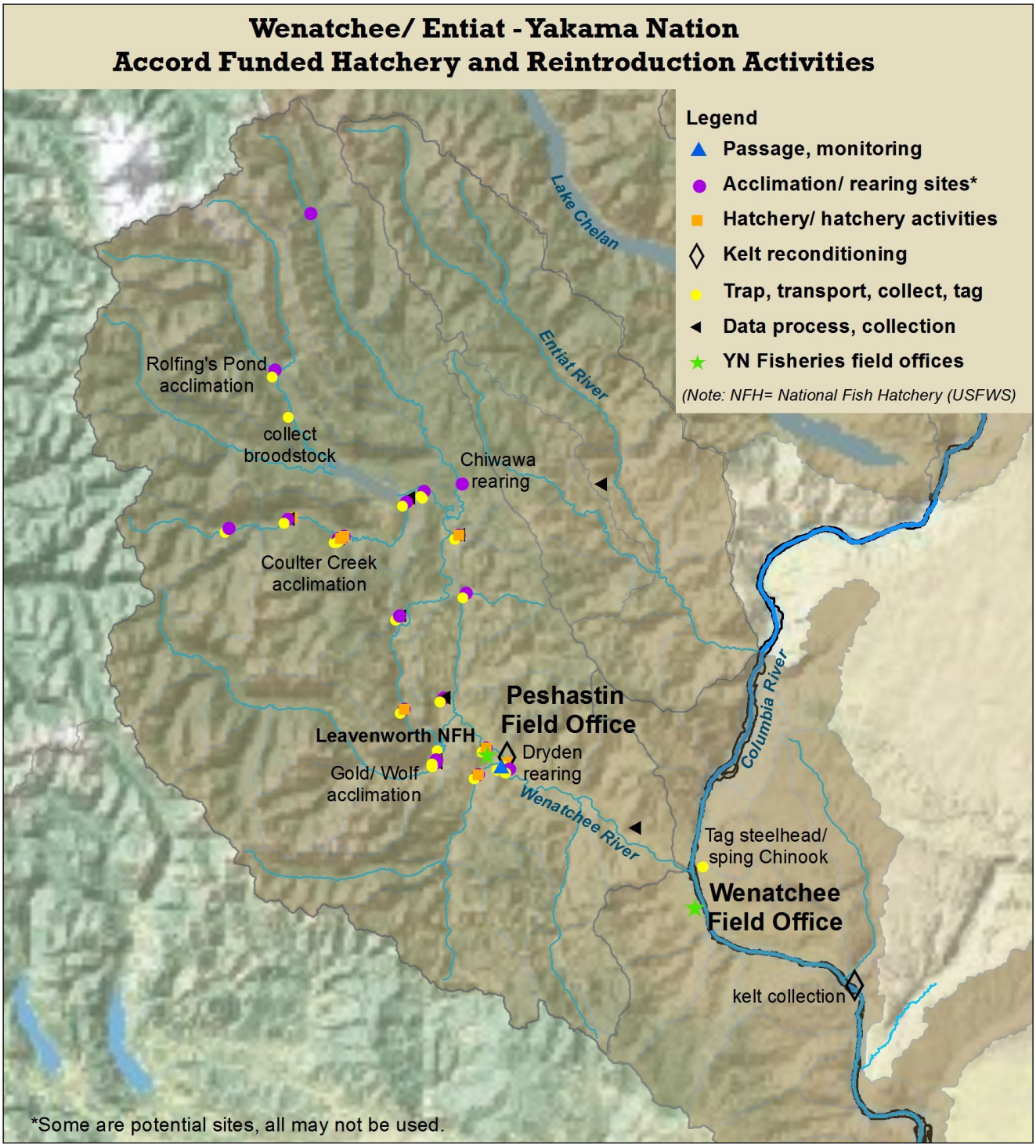
- Green eggs obtained from Lewis and Washougal hatcheries
- Strategy to transition a portion of program to local broodstock collected from the Lyle Fishway/Trap

- A third of the coho are acclimated at Klickitat Hatchery by YKFP
- Approximately 1 million released annually
- Strategy to release all fish in the lower river

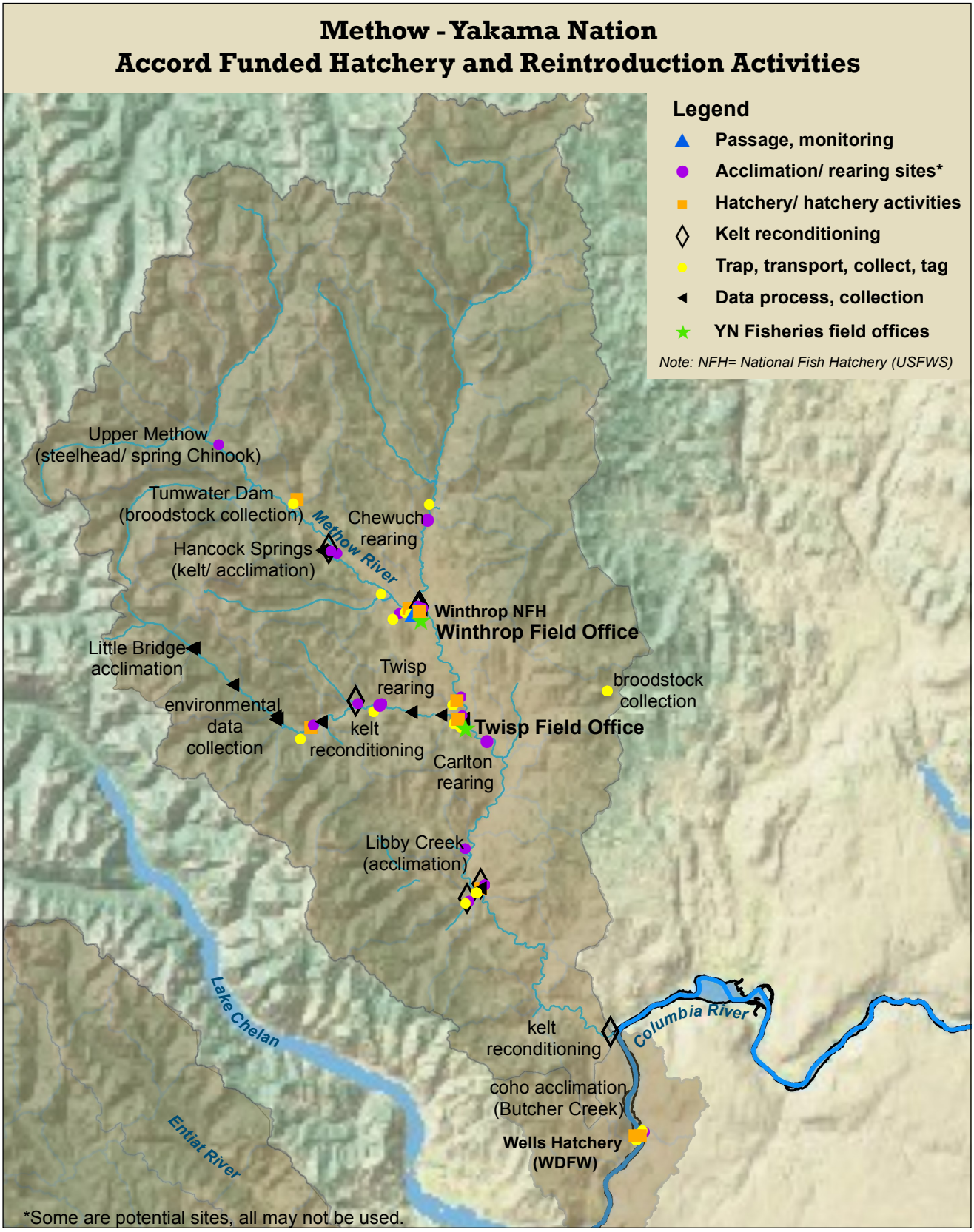
Upper Columbia

Collaborating with state and county agencies (Chelan, Douglas and Grant County PUDs) in the Upper Columbia, the Yakama Nation's Accord-funded hatchery and reintroduction activities include:

- Steelhead kelt reconditioning
- Proposed Wenatchee/Methow coho restoration facility
- Wenatchee/Methow steelhead and spring Chinook acclimation facilities
- Wenatchee spring Chinook rearing facilities



Upper Columbia



Wenatchee and Methow Subbasins: Coho (Sinux) Reintroduction

At the time of the 1855 Treaty, 40,000-50,000 coho returned annually to the Wenatchee, Entiat, and Methow subbasins. By the early 1990s, coho were extinct in all of these subbasins. Supported by funds from the Accord and the Grant and Chelan County PUDs, the Yakama Nation is restoring coho salmon to the Wenatchee and Methow subbasins. Besides the economic and cultural values associated with restoring these coho populations, other benefits include providing the local ecosystem with marine-derived nutrients, increasing the abundance of other species that rely on healthy salmon runs, and the opportunity to study the process of local adaptation as coho are reintroduced.

Adult male coho

Adult female coho

The Yakama Nation incubates and rears coho at the Leavenworth, Peshastin, and Winthrop hatcheries; however, these facilities have limited space, so we are exploring the possibility of a new coho hatchery in the Upper Columbia. In preparation, we are developing broodstocks at the Leavenworth and Winthrop hatcheries using fish collected at the Dryden and Tumwater dams, swim-ins to the Winthrop National Fish Hatchery, and fish collected from the Wenatchee and Methow subbasins. (see graphs, page 33).

Goal: While the first broodstock in this reintroduction effort came from the Lower Columbia, we have the goal of developing a locally-adapted, harvestable, and self-sustaining coho population in the Upper Columbia. We plan to add acclimation sites including semi-natural locations throughout the Wenatchee and Methow subbasins, use local broodstock, and focus on areas where naturally produced and locally adapted coho are the most successful. Using results from ongoing monitoring studies, we will be able to focus our efforts in areas where risks are low for negative interactions with sensitive species.



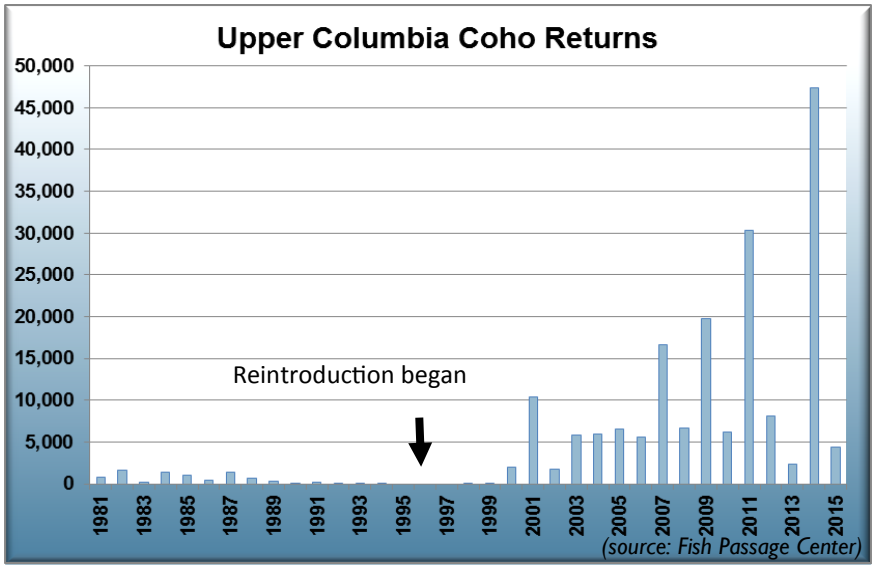

Leavenworth National Fish Hatchery and various potential semi-natural acclimation sites (YN)

Wenatchee and Methow Subbasins: Coho (Sinux) Reintroduction

Project success: Since 1996, we have conducted research to evaluate the feasibility of reintroducing coho into the Wenatchee and Methow subbasins. Currently, 1.5 million smolts are acclimated and released annually into the subbasins by Yakama Nation. Over the last ten years, the average annual return of adult coho has been 14,700 adults. Record returns in 2009 allowed for the opening of a limited fishery in Icicle Creek, and the return of over 30,000 fish in 2011 allowed for harvest in the lower Wenatchee and Methow subbasins.

Adult coho

Juvenile coho



Proposed Upper Columbia Coho Hatchery

With the opening of the coho fishery, the Yakama Nation's Upper Columbia Coho Reintroduction Program is now considered a success. In transitioning to full implementation, a new coho hatchery has been proposed for the Upper Columbia. By 2028, it is the Yakama Nation's goal to have developed self-sustaining, naturally reproducing populations of coho in the Wenatchee and Methow subbasin. With the addition of a new hatchery, which is currently in the planning phase, we anticipate annual releases of 2 million smolts that are acclimated throughout the Wenatchee and Methow subbasins.

Wenatchee and Methow Subbasins: Steelhead (Shusháynsh) and Spring Chinook (Tkwínat, Núsux) Acclimation

Using what has been learned from the successful Mid-Columbia Coho Restoration Project, the Yakama Nation is implementing a similar approach in the Upper Columbia to restore steelhead and spring Chinook. Yakama Nation Fisheries is developing localized acclimation and rearing facilities at semi-natural sites throughout the region to increase the effectiveness of conservation production programs.

Icicle Creek Chinook fishery, Max Corpuz, mid-1990's

Utilizing existing Grant, Chelan, and Douglas County PUD mitigation production, this project is converting from direct-stream and/or single-point smolt releases to an approach of more naturalized and widely distributed acclimation and rearing. With these short-term sites, the Yakama Nation hopes to improve spawning distribution of adult returns and homing ability, while improving productivity and survival. At some locations, we plan to co -rear multiple species, a method that we have tested and demonstrated to be viable.

Vision: With the potential of supplementation numbers being reduced in the future, it is essential that conservation hatchery programs are operated in an efficient and effective manner. With improved productivity and survival, as well as better spawner distribution and homing, increased efficiency and effectiveness are goals that we believe the Methow/ Wenatchee steelhead and spring Chinook project can achieve. (see graphs, p. 29-32)

Yakama Nation fisheries working with Chinook, early in the program



Semi-natural acclimation sites in the Wenatchee and Methow subbasins (YN)


Winthrop National Fish Hatchery back channel acclimation site

Upper Columbia Steelhead (Shushάynsh) Kelt Reconditioning

Yakama Nation Fisheries, along with partner CRITFC, is expanding their successful Yakima Subbasin Kelt Reconditioning Program into the Upper Columbia. Kelt reconditioning is a process whereby post-spawn steelhead are taken into captivity and cared for so that they will be more likely to spawn again (see page 32). With funding from BPA and in cooperation with the U.S. Fish and Wildlife Service, we have developed facilities at the Winthrop National Fish Hatchery to recondition post-spawn kelts prior to their release.

Kelts in conditioning tank

Kelt weir on Little Bridge Creek, Twisp Subbasin

Research: With a steelhead reproductive success study being conducted by WDFW in the Twisp Subbasin, it is the ideal location to monitor the effectiveness of kelt reconditioning. Coordinating with WDFW's monitoring project will better enable the Yakama Nation Upper Columbia Kelt Reconditioning Program to: 1) recondition kelts using long-term methods at existing facilities, 2) evaluate kelt survival and the effectiveness of reconditioning methods, and 3) collaborate with ongoing monitoring studies to document the reproductive success of kelts released from the program.

Strategy: The overall goal for the Upper Columbia Steelhead Kelt Reconditioning Program is to help restore steelhead through increased productivity and reduced mortality. Reconditioning improves the health of kelts and removes dangers encountered during post-spawn migrations to the ocean and back. The Yakama Nation will be collecting kelts for reconditioning at several sources, including live-spawned broodstock from the Twisp River program at Methow Fish Hatchery and Winthrop National Fish Hatchery, Chelan PUD's Rock Island bypass facility, and tributary weirs in the Methow Subbasin. By 2015, we expect to have an average of 100 kelts available annually for reconditioning.

Kelt Reconditioning—Before

Kelt Reconditioning—After

CHAPTER 4

"Since Time Immemorial…The sacred relationship of the Yakama people, the Salmon, and the mighty Columbia River is based on an understanding that all life is intertwined and interdependent."

-Russell Jim, Yakama Nation elder

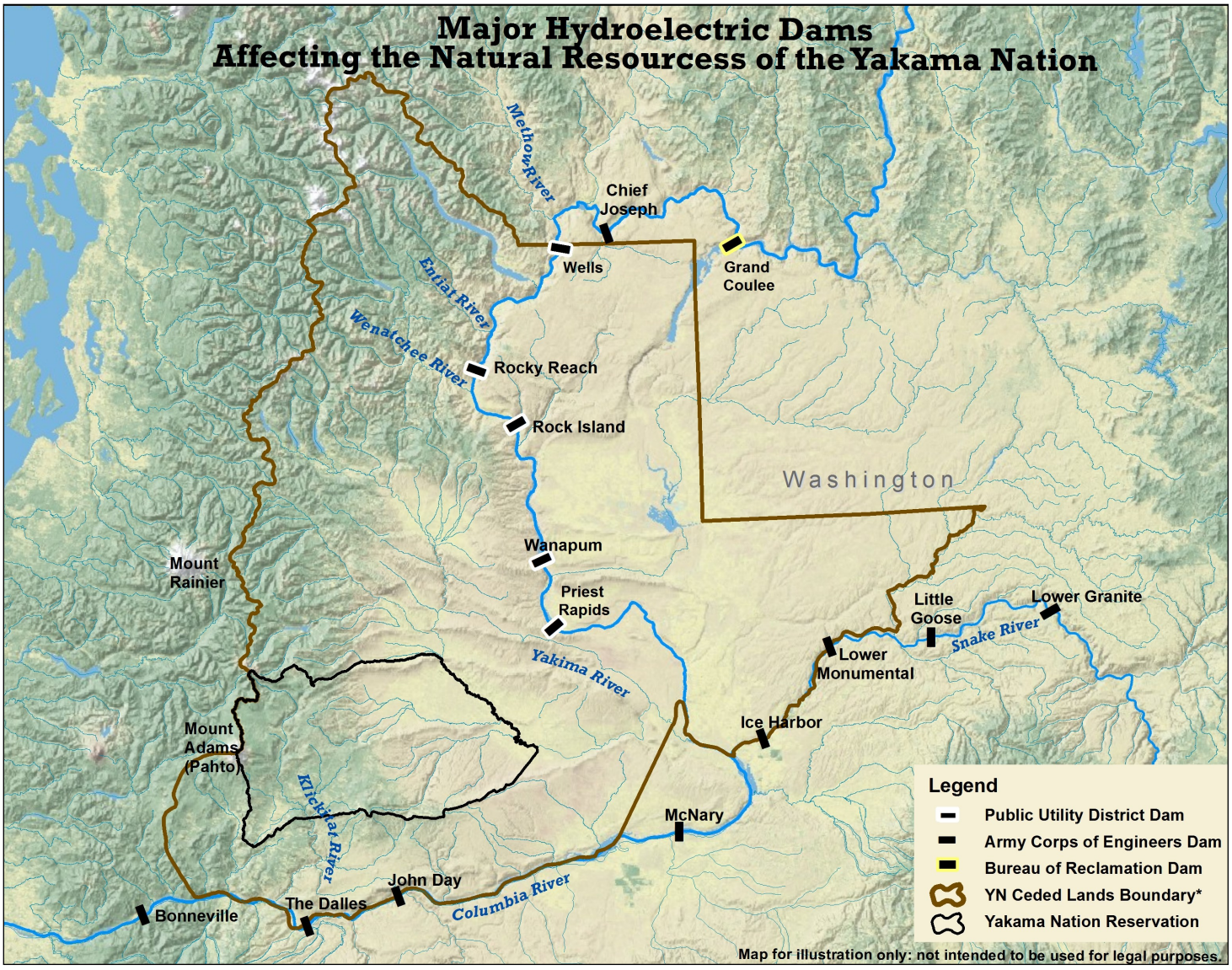
HYDRO

Background photo: Celilo falls, Oregon Historical Society

Background

This chapter summarizes fish passage and operational modifications (e.g., spill and flow) to the federally operated dams located on the lower mainstem Columbia and Snake rivers. Many of the improvements have been implemented as a result of the 2008 Columbia River Fish Accords, and many of them were fought for by the Yakama Nation and others to be included in the agreement.

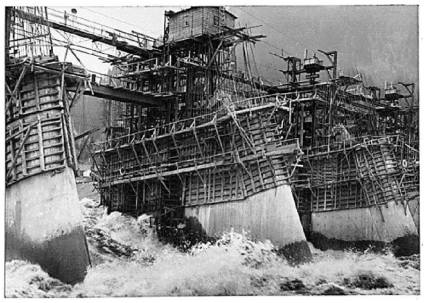
Platform fishing at Celilo Falls (historic)



**Yakama Nation Treaty of 1855 (12 stat. 951) with the United States of America, Ceded land (shown) and Usual and Accustomed Area span the Northwest.*

Dam Operation and Impacts on Natural Resources

The construction and operation of hydroelectric dams in the Columbia River Basin have significantly impacted fish and wildlife populations important to the Yakama Nation and forever changed the Columbia River ecosystem. Without mitigation for loses, the dams would jeopardize the existence of the Yakama Nation's treaty trust natural resources. As a result, the Bonneville Power Administration, U.S. Army Corps of Engineers, and U.S. Bureau of Reclamation are funding actions to: 1) improve dam facilities for fish passage, 2) increase spawning and rearing habitat, 3) offset hydrosystem-related fish mortality with production programs, and 4) monitor and evaluate actions to ensure the desired benefits are achieved.



Bonneville Dam under construction (Roosevelt Library)

Adequate support for the operation and maintenance of passage improvements is critical. The U.S. Army Corps of Engineers' Fish Passage Plan, developed annually through a regional forum that includes the Yakama Nation, describes year-round project operations to protect and enhance fish species. Annual hydrosystem improvements are funded through the U.S. Army Corps of Engineers' Columbia River mitigation budget.

Chinook salmon navigating a fish ladder

Chinook Salmon (Tkwínat; Núsux) and Steelhead (Shusháynsh)

The operation of hydroelectric dams on the lower mainstem Columbia and Snake rivers leads to slower migrations through the reservoirs and provides favorable conditions for predators to prey on out-migrating juvenile chinook and steelhead. Under the current operations plan, combined impacts to out-migrating juvenile salmon and steelhead can result in mortality rates of 50%. Without operation plans and improvements, the survival rates would be much lower. For example, record low run-off combined with a power emergency in 2001 led to reduced spill at Bonneville and The Dalles dams and no spill at the other projects. Consequently, Snake River Chinook and steelhead survival (Snake River to Bonneville Dam) was 26.6% and 3.8%, respectively.

Pacific Lamprey (Asúm; K'súyas)

The operation of hydroelectric dams affects adult and juvenile lamprey migration. When adult fish ladders and downstream bypass systems were designed for salmon and steelhead, the needs of lamprey were not considered. Because adult fish ladders were designed around the needs of salmon and steelhead, successful passage of adult lampreys has been limited due to high velocities, turbulence, unnatural surfaces, and predators. Since migrating juvenile lamprey are weak swimmers, relative to juvenile salmon and steelhead, the fish are susceptible to injury and mortality when passing through the bypasses. The design of these structures is a major contributing factor in the decline of lamprey.

Experimental lamprey ramp (University of Idaho)

White sturgeon

White Sturgeon (Wílaps)

Construction of hydroelectric dams has isolated white sturgeon populations by blocking their upstream migration. The fishway openings are often too small and the turns too tight for them to navigate. The existence and operation of dams has changed and/or reduced sturgeon spawning and rearing habitats. Isolation and altered habitats have led to the need for artificial production to support declining sturgeon populations.

Juvenile Fish Passage

River flows, along with configurations and operations at dams, are critical elements that influence how quickly juvenile fish migrate to the ocean. Reducing travel time with more flow improves survival by reducing exposure to predators, warm water, and other stressors. NOAA Fisheries conducts annual evaluations of smolt survival passing through the hydropower system. In addition to the survival studies, the U.S. Army Corps of Engineers estimates project and route-specific survival rates, fish passage distribution (e.g., fish passage efficiency and spill passage efficiency), forebay behavior, travel time, and tailrace exit for juvenile fish, to evaluate the success of fish passage improvements.

The Federal Columbia River Power System Biological Opinion includes passage survival standards for fish passing through each dam of 96% and 93% for spring and summer migrating fish, respectively. Juvenile survival estimates of 86% to 99% have been observed at all Snake River and Columbia River dams; however, uncertainty exists regarding how well these tests represent the range of environmental variation. Passing survival standards in one high-flow year does not necessarily ensure that standards are being met in normal or lower-flow years. Note that these standards are for dam passage only and do not account for potential reservoir or delayed mortality. Performance testing is ongoing at most of the projects.

Major improvements to passage structures at hydroelectric dams in the Columbia River Basin have led to improved survival of juvenile salmon and steelhead. Since 2001, the U.S. Army Corps of Engineers has spent over $1.8 billion to study and improve juvenile fish passage and survival through federal Columbia River hydroelectric dams.

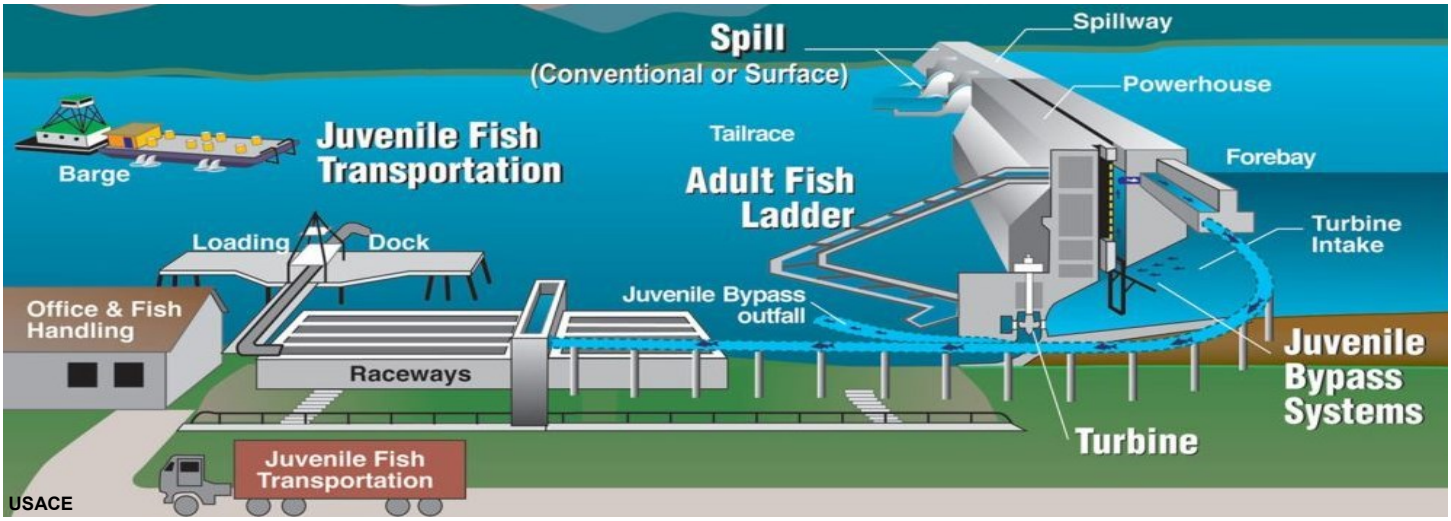
Examples of these efforts include:

- Surface passage structures and modified spill operations to improve survival of juveniles at the dams
- Screens that divert fish away from turbines
- Improved turbines that reduce harm to fish
- Predator control management
- Flow augmentation (spring-summer operations including spill to speed downstream migrations and improve survival of juveniles)
- Barges and trucks to transport fish past the dams

Although significant progress has been made, opportunities for additional improvements remain.

Juvenile Columbia River Fish Passage: Annual Estimated Whole-System Survival		
Species	**Pre-BiOp***	**Post-BiOp**
Chinook	49%	52%
Steelhead	34%	58%
Sockeye	34%	51% **

**BiOp (Biological Opinion) is issued and reported by NOAA Fisheries addressing hydrosystem impacts and goals for protections. Survival rates as reported by NOAA.*
***Number much lower in 2014/15*



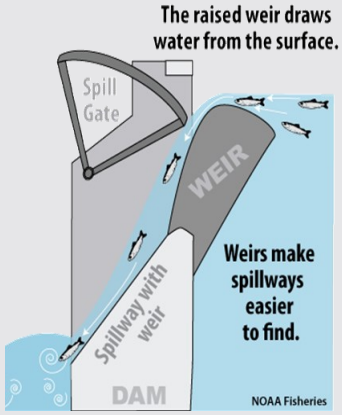
Improving Juvenile Fish Passage Survival

There are three main passage routes for juvenile salmonids migrating downstream past Columbia River and Snake River dams: 1) surface fish passage, 2) through turbines, and 3) through bypass routes. The best survival is typically through the spillway, while passage through turbines results in the lowest survival. Transport is also used during certain times of the year and under low flow conditions (see page 76).

1) Surface Fish Passage

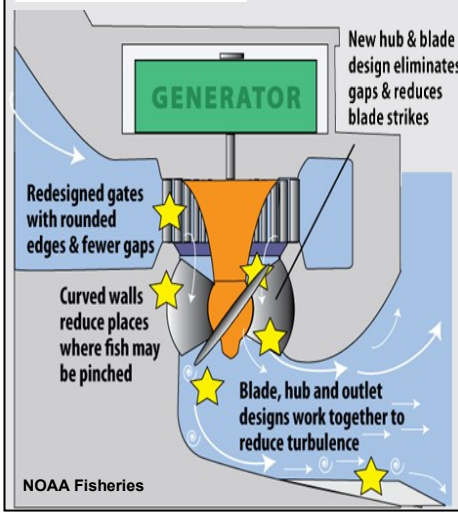
Concerns: Conventional spill gates force juvenile salmon and steelhead, that prefer to travel near the surface, to dive 50-60 feet to pass through the dam.

Solution: Spillway weirs allow fish to pass near the surface. By 2009, surface passage was installed at all dams on the Lower Columbia and Snake rivers. Surface passage is not limited to spillways. Similar benefits are observed at The Dalles and Bonneville dams' powerhouses, where surface passage exists.



2) Turbine Passage

Concerns: Passage through turbines cannot be completely avoided by migrating juvenile fish. Conventional turbines can result in injuries or death to young fish when they hit the blades or turbine walls. Research shows that an average of 13% and 30% of the spring and summer migrants, respectively, pass through the turbines.

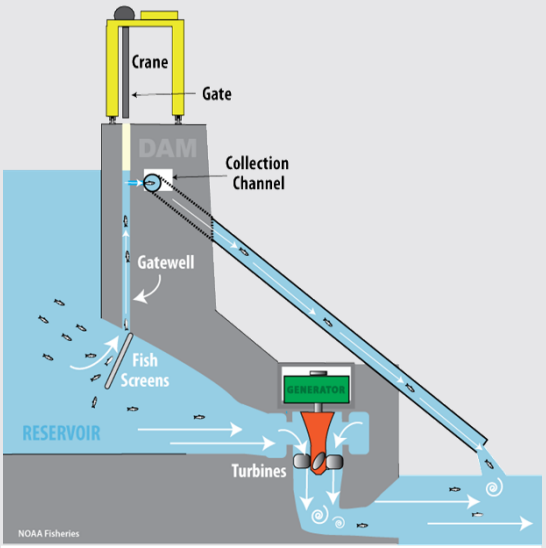


Solution: The U.S. Army Corps of Engineers' Turbine Survival Program evaluates the effects of turbine passage on fish and recommends potential improvements. Studies at dams with new turbines have shown reduced injury rates. New turbines will be installed at Ice Harbor dam in 2016 that may improve lamprey survival as well.

3) Turbine Bypass

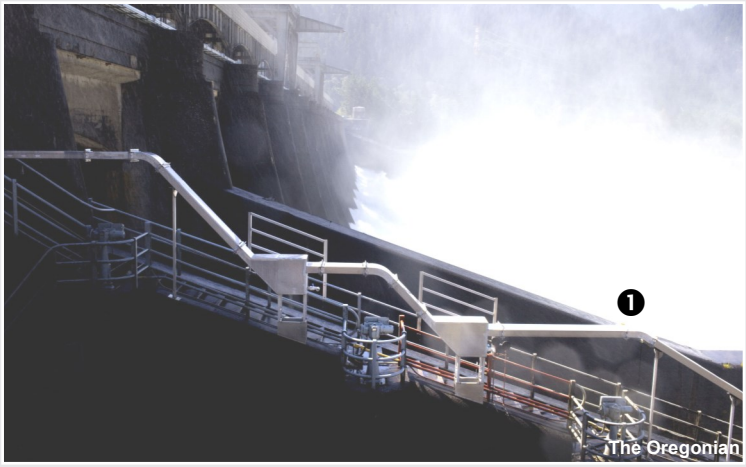
Concerns: Preventing juvenile passage through turbines, where survival is lower.

Solution: By using submersible screens, juvenile fish are diverted away from turbines and into a bypass route that either releases fish downstream or into a fish collection facility. Collection facilities allow for fish to be sampled and returned to the river or transported via truck and/or barge at Lower Granite, Little Goose, and Lower Monumental dams. Data supports the premise that there is a delayed impact on the survival of bypassed fish when compared to returning adults that used other routes, however, additional research is needed.



Bonneville Dam

Project Spotlight: Pacific Lamprey Passage Improvements



Lamprey ladder at Bonneville Dam

Significant differences in swimming style and behavior exist among lamprey, salmon, and steelhead. Unfortunately, the fact that lamprey are less capable swimmers in high velocity flows was not considered when fish passage facilities were built years ago. Velocities associated with fish ladders are often too high for lamprey to navigate without repeated burst swimming, reattaching, and resting. In addition, their swimming behavior makes it difficult to migrate up fish ladders that have sharp corners and turns. Poor passage can also be attributed to turbulence, poor attraction, unnatural flows, and predators. Challenges associated with passing dams is considered a primary reason for the decline of lamprey.

Lamprey impinged at John Day Dam

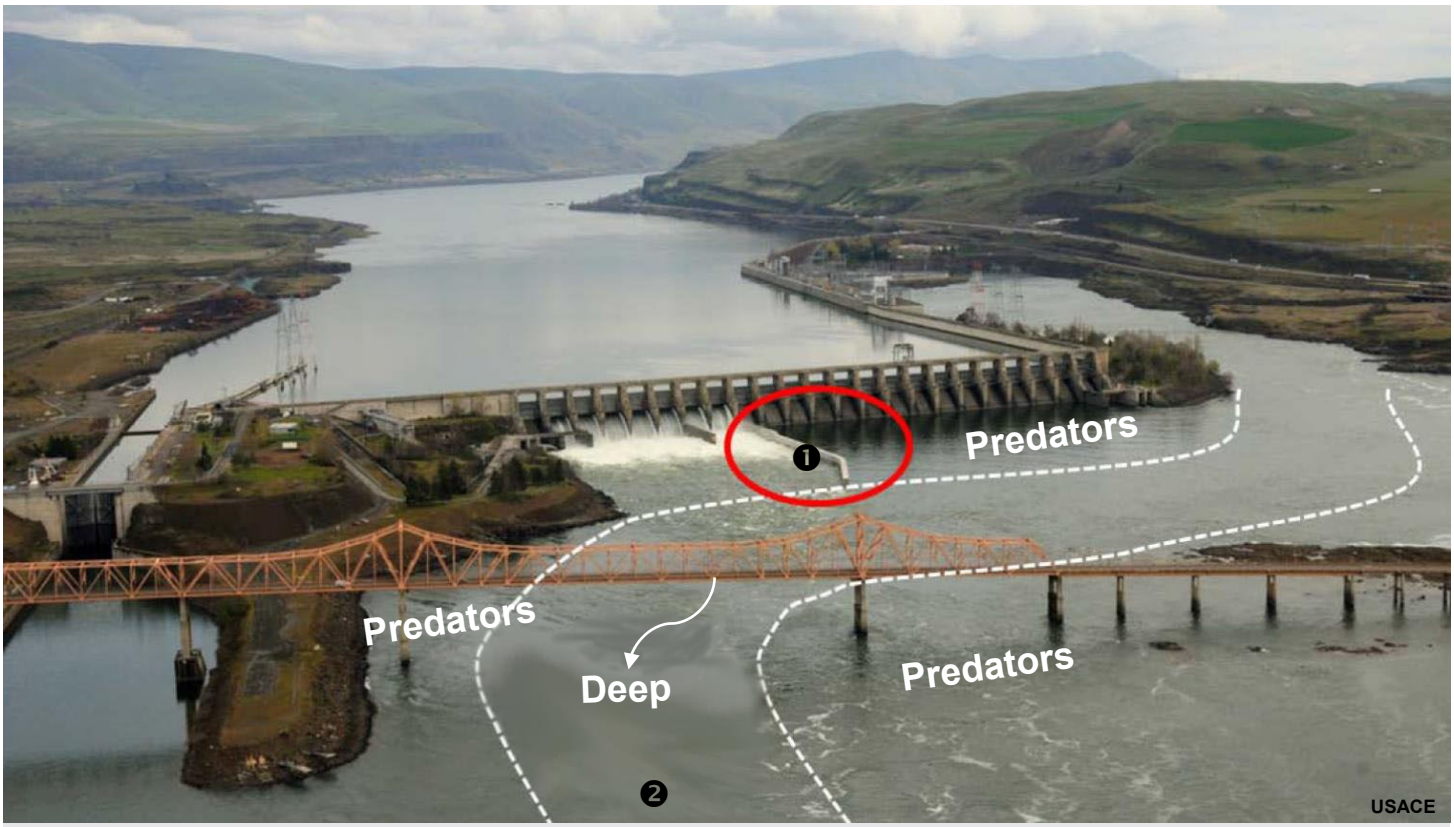
To improve adult upriver passage, facilities at Bonneville Dam have been modified to address the needs of lamprey. This has been made possible through modifications to the ladder entrances, the installation of lamprey passage systems at passage problem areas, and adding velocity reducing structures that lead to a collection ramp at the Cascade Island ladder (**1**).

Bonneville Dam Improvements

Action	Species	Project Status	Intended Benefit
Juveniles			
Spring spill: April 10 - June 15 (on-going)	Salmon and Steelhead	⊙	Improves survival and reduces travel time
Summer spill: June 16 - August 31 (on-going)	Salmon and Steelhead	⊙	Improves survival and reduces travel time
Modify sluiceway to improve surface flow at Powerhouse 1 (2009)	Salmon and Steelhead	●	Improved fish passage efficiency and reduced forebay delay
Reduce gaps around Powerhouse 1 turbines (minimum gap turbine runner) (2009)	Salmon and Steelhead	●	Improved survival of fish passing through turbines
Modify screened bypass system at Powerhouse 2 (2008)	Salmon and Steelhead	●	Improved fish guidance efficiency and reduced gatewell residence time
Install shallow water guidance screen at Powerhouse 2 (2008)	Salmon and Steelhead	●	Increased corner collector efficiency and reduced forebay delay
Complete corner collector (2004)	Salmon and Steelhead	●	Improved surface passage for juveniles
Improve second powerhouse juvenile bypass	Salmon and Steelhead	⊙	Improves passage for juveniles
Test BiOp goal performance	Salmon and Steelhead	⊙	Confirmed if modifications reduced impacts of dams enough to reach goals
Adults			
Chum spawning flows - Maintain tailwater elevation below Bonneville Dam at 11.5 feet beginning the first week of November (when chum arrive) and ending by December 31 (on-going)	Chum	⊙	Provides adequate conditions for chum spawning in the mainstem Columbia River in the area of the Ives Island complex and access to Hamilton and Hardy creeks for spawning
Haze sea lions (on-going)	Salmon and Steelhead	⊙	Reduces predation by sea lions on salmon, steelhead, white sturgeon, and other species
Improve Bradford Island ladder system (2013)	Salmon and Steelhead	⊙	Improves reliability of upstream adult passage
Install Washington shore lamprey flume system (2013)	Lamprey	⊙	Provides an alternate route around the fishway entrance during upstream migrations
Install sea lion exclusion gates at all adult fish ladder entrances (2006)	Salmon and Steelhead	●	Prevents sea lions from entering the fish ladders and/or passing into Bonneville Reservoir
Improve Cascades Island ladder entrance (2009)	Lamprey	⊙	Guides lamprey out of the main fish ladder and into alternative routes, also improves lamprey passage conditions at the ladder entrance
Install lamprey passage structures	Lamprey	⊙	Provides more successful adult lamprey passage
Concerns			
➔ Because the Powerhouse 1 sluiceway outfall is not in an ideal location for tailrace exit, there is a need to review survival data, under a range of flows, to determine if the location of the sluiceway affects survival.			
➔ Spillway survival, under the current spill program, is not as high as it could be. The lower than desired survival may be related to stilling, tailrace erosion, and debris.			
➔ Powerhouse 2 bypass survival/descaling issues due to debris and poor hydraulic conditions affect passage for all species.			
➔ Performance testing was successful during a high-flow, high-spill year. Additional testing is ongoing and further improvements may be needed depending on test results.			

○ **Not Started** ⊙ **In Progress** ● **Completed**

The Dalles Dam

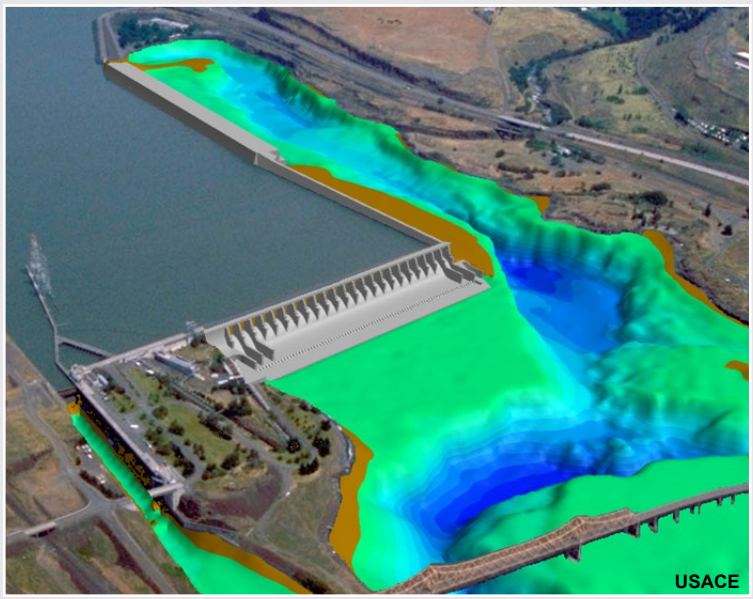


Project Spotlight: Improved Spillway Wall

Approximately 80% of the juvenile salmon and steelhead that migrate past The Dalles Dam pass through the spillway. Concentrations of predators in the tailrace limits juvenile survival. In recent years, two approaches (i.e., juvenile bypass system and guidance wall) were evaluated to improve juvenile survival through the tailrace.

Although the juvenile bypass system was similar to those built at other facilities, studies showed that The Dalles Dam juvenile bypass system was plagued with technical challenges and extraordinary expense associated with construction and operation.

In 2010, the U.S. Army Corps of Engineers built a guidance wall (**1**) extending 850 feet downstream from the spillway. This structure guides juvenile fish away from areas where predators concentrate and keeps the fish in the deepest and fastest water, considered the safest section of the river for them, directly downstream from the tailrace (**2**).



Imagery below The Dalles Dam, showing structure of deep channel contours (in blue).

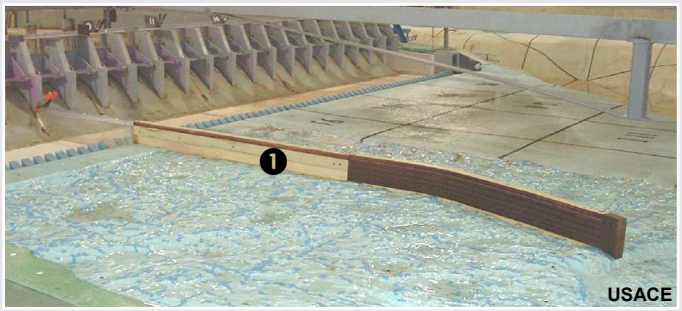
The Dalles Dam Improvements

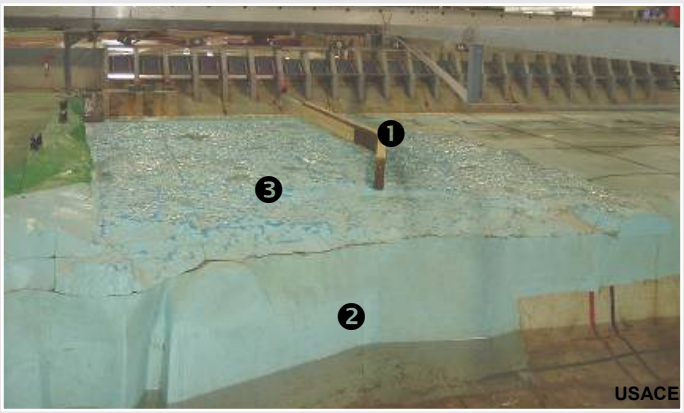
Action	Species	Project Status	Intended Benefit
Juveniles			
Spring spill: April 10 - June 15 (on-going)	Salmon and Steelhead	⊙	Improves survival and travel time
Summer spill: June 16 - August 31 (on-going)	Salmon and Steelhead	⊙	Improves survival and travel time
Improve turbine operation (2011)	Salmon and Steelhead	●	Improved survival through turbines
Complete spillway wall (2010)	Salmon and Steelhead	●	Increased direct and indirect juvenile survival through surface fish passage
Install improved avian wire array (2011)	Salmon, Steelhead, Lamprey	●	Improved avian predation deterrent program
Test BiOp goal performance	Salmon and Steelhead	●	Confirms if modifications reduce impacts of dams enough to reach goals
Adults			
Fix east ladder back-up water supply system (2013)	Salmon and Steelhead	⊙	Returns adult salmon and steelhead use of north ladder to pre-spillwall conditions, improves reliability of upstream adult passage
East fish ladder diffuser plating and ramps installed	Lamprey	●	Provides more successful adult lamprey passage
Improve lamprey passage	Lamprey	⊙	Provides more successful adult lamprey passage
Concerns			
➔ To improve adult passage reliability, the east ladder needs a supplemental water supply. Efforts to address this issue are in progress.			
➔ To ensure project operation and configuration do not change, three spillway gates need to be repaired. Without the repairs, it may not be possible to maintain the survival benefits.			
➔ Bird wires and mobile hazing, via boats, are essential at the project to control avian predators.			
➔ To ensure the east ladder does not become too crowded during peak adult returns, evaluate modifying project operations by shifting some of the passage to the north ladder via spill.			

○ **Not Started** ⊙ **In Progress** ● **Completed**

Project Spotlight: Improved Spillway Wall, Continued

With the spillway wall in place, studies in 2011 showed that 96% of tagged yearling Chinook successfully passed The Dalles Dam, a 4% increase compared to the 2004 and 2005 test results. Also in 2011, 99.5% of the downstream migrating juvenile steelhead survived. Note that variable environmental conditions can affect results from one year to the next, however, and 2011 was a high flow year which likely improved survival.





*Photos from a 1:80 physical model of The Dalles Dam and guidance wall (**1**). The wall directs smolts to the deep drop-off (**2**) and fast-moving water to avoid predators. The stilling basin rock floor (**3**) is contoured to actual bottom contours of the site.*

John Day Dam

Project Spotlight:
North Ladder Improvements

The John Day Dam north fish ladder count station has consistently had a high percentage of downstream movement (fallback), that increases passage times through the ladder, adding stress to the fish. In 2009, the U.S. Army Corps of Engineers started a project to improve passage, decrease downward movement, and reduce/eliminate the jumping that was occurring in the north fish ladder. To address the problems, a flow pattern was created (**1**) that forced adult fish migrating upstream to swim through a continuous series of turns. Also, direct upstream passage routes (**2**) were built to eliminate jumping and holding by salmon and steelhead. Monitoring confirmed that jumping was eliminated and that downstream movement was significantly reduced.

Modifications to the north ladder were completed to improve conditions for migrating lamprey. Since lamprey are unable to attach to the 90 degree corners that are often found in fishways, the north ladder was built with rounded corners (**3**) to help lamprey pass potential problem areas.

John Day Dam Improvements

Action	Species	Project Status	Intended Benefit
Juveniles			
Spring spill: April 10 - June 15 (on-going)	Salmon and Steelhead	⊙	Improves survival and reduces travel time with spill
Summer spill: June 16 - August 31(on-going)	Salmon and Steelhead	⊙	Improves survival and reduces travel time with spill
Improve turbine operation (2011)	Salmon and Steelhead	●	Improved survival through turbines
Two spillway weirs installed (2008) and improved (2013)	Salmon and Steelhead	●	Improved juvenile fish survival through surface flow outlet modifications- Reduced forebay delay and improved tailrace exit to improve fish passage efficiency
Install improved avian wire array (2010)	Salmon and Steelhead	●	Improved avian predation deterrent program
Test BiOp goal performance	Salmon and Steelhead	⊙	Confirms if modifications reduce impacts of dams enough to reach goals
Adults			
Modify John Day Dam northern ladder entrance (2009)	Lamprey	⊙	Improves entrance to fish ladder and provides alternate route for lamprey passage via a lamprey passage structure
Modify upper sections of north ladder (2011)	Salmon, Steelhead, Lamprey	●	Improved upstream adult passage conditions
Install lamprey trapping system and diffuser plating at south fish ladder (2012-2014)	Lamprey	⊙	Provides more efficient collection of lamprey at the dam for translocation and research
Concerns			
➔ Low turbine survival			
➔ Currently, 30% and 40% spill are being tested; however, it remains unknown which approach will be selected. More fish were observed using the spillways during the 40% spill test. Studies have shown that the return rates for fish that used the bypass as compared to spill can be classified as poor.			
➔ The ability of fish to successfully exit from the bypass outfall area may be limited.			
➔ Long-term maintenance of bird-deterrent wires is essential to protect against avian predation.			

○ **Not Started** ⊙ **In Progress** ● **Completed**

Project Spotlight: Keyhole Entrance and Lower Ladder Modification

In 2011, the entrance and lower section of the John Day Dam north fish ladder were modified to improve its performance for salmonid and lamprey upstream passage. The ladder, with its deeper keyhole-shaped entrance (**1**), includes 3/4 inch lamprey-specific diffuser grating to prevent entrapment at a dead end. The edges of the entrance were rounded (**2**) for the lamprey who have trouble navigating sharp corners. Structures (bollards) on the bottom (**3**) and the wide entrance reduce velocities and provide the lamprey with places to rest as they migrate through the new lamprey passage system.

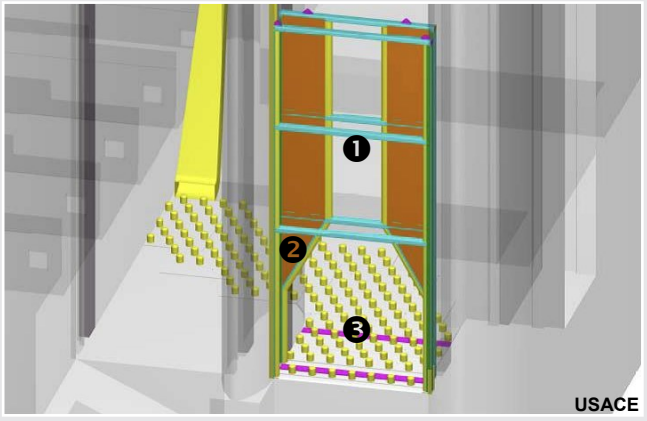
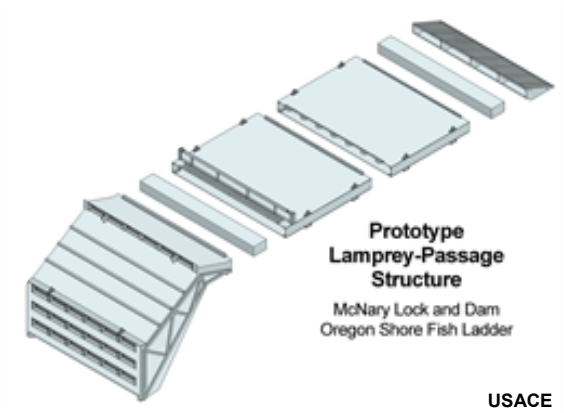


Illustration of the keyhole entrance weir and velocity reducing structures leading to the ramp.

McNary Dam

Project Spotlight: Adult Pacific Lamprey Passage Improvements

Studies have shown that it is difficult for lamprey to enter the fish ladder at McNary Dam. Because the ladder was built for salmon and steelhead, the entrance is located in the upper portion of the water column where the water velocity is high. Unlike salmon and steelhead, lamprey move along the bottom of the river. Ideally, lamprey passage routes should be located lower in the water column.



Passage modifications are critical to improve conditions for lamprey migrating up rivers to their spawning areas. With a better understanding of the migratory behavior and passage needs of lamprey, the U.S. Army Corps of Engineers installed a prototype fish passage system 30 feet below the surface of the river. To create more favorable conditions for lamprey passage, the structure contains baffling that reduces the velocity of the water where lamprey enter the structure.

Lamprey ramp design and installation at McNary Dam

To better monitor lamprey, the fish passage facility is fitted with PIT-tag detection equipment, video cameras, and sonar imaging (DIDSON) equipment to track the migrations of lamprey and learn more about their passage behavior.

McNary Dam Improvements

Action	Species	Project Status	Intended Benefit
Juveniles			
Improve turbine operation (2013)	Salmon and Steelhead	●	Improved survival through turbines
Relocate juvenile bypass outfall (2012)	Salmon and Steelhead	●	Improved fish passage and successful exit, improved survival of bypassed fish
Improve debris management system (2011)	Salmon and Steelhead	⊙	Reduces injury of bypass and turbine passed fish
Install surface flow outlet/ spillway weir (2007-09)	Salmon and Steelhead	⊙	Improved juvenile fish passage efficiency and reduced forebay delay
Test BiOp goal performance	Salmon and Steelhead	⊙	Confirm if modifications reduce impacts of dams enough to reach goals
Adults			
Install lamprey openings in fish ladders (2010)	Lamprey	●	Provided alternative upstream passage route through the fish ladder with resting spots.
Build customized deep water entrance to Oregon shore fish ladder (2013)	Lamprey	●	Improved ability for lamprey to migrate upstream
Improve lamprey passage	Lamprey	⊙	Improves adult lamprey passage success
Concerns			
➔ Actions need to be taken to address avian predation. In recent years, there have been problems with fish survival in the tailrace area.			
➔ Successful fish passage has been impaired by debris.			
➔ Steelhead fallback has been problematic during periods of no spill. Efforts are ongoing to evaluate this issue.			
➔ Because targets for performance testing were not met, action agencies must decide whether to retest or accept the higher spill levels as the new spill target.			

○ **Not Started** ⊙ **In Progress** ● **Completed**


USFWS

Pacific Lamprey Passage

Information collected from monitoring efforts will help the region develop and manage passage facilities to improve conditions for upstream lamprey migrations. If the design used at McNary Dam proves successful, the entrances of other dams in the Columbia River Basin may be fitted with similar structures.

This project was completed through a collaborative approach among tribes (including the Yakama Nation), states, government, and other interested entities.

Ice Harbor Dam

Project Spotlight: Modifications to Spillway Chute and Spill Deflectors

The removable spillway weir in spillway bay 2 (**1**) is the primary passage route for downstream migrating juvenile salmon and steelhead. Tests and hydraulic models have shown that there is potential for injury to juvenile fish passing over the spillway due to its steep slope and abrupt transition to the surface of the existing spill deflector. To resolve this condition, the U.S. Army Corps of Engineers intends to modify the spillway chute and the spill deflector in spillway bay 2, as well as add a new, permanent extension to the downstream end of the spillway pier between bays 1 and 2 (**2**). The work is expected to be completed by February 2015.

Ice Harbor Dam Improvements

Action	Species	Project Status	Intended Benefit
Juveniles			
Spring spill: April 3 - May 30 (on-going)	Salmon and Steelhead	⊙	Improves fish passage efficiency and reduces forebay delay (reducing passage time)
Summer spill: June 1 - August 31(on-going)	Salmon and Steelhead	⊙	Improves fish passage efficiency and reduces forebay delay (reducing passage time)
Modify spillway chute and deflectors (2014)	Salmon and Steelhead	⊙	Reduced injury and improved survival of spillway-passed fish
Replace turbine unit 2 (2012)	Salmon and Steelhead	⊙	Improved the survival of fish passing through turbines and reduced oil spill potential
Improve turbine operation (2011)	Salmon and Steelhead	⊙	Improved survival through turbines
Modify guidance screen (2010)	Salmon and Steelhead	⊙	Dam safety requirements related to the bypass system
Install spillway weir (2005)	Salmon and Steelhead	●	Improved juvenile fish passage success and reduced forebay delay by improving the bypass system
Improve removable spillway weir chute and deflector	Salmon and Steelhead	●	Reduces injury and improves survival of spillway passed fish
Improve turbine design	Salmon and Steelhead	⊙	Improved survival for fish passing through turbines
Test BiOp goal performance	Salmon and Steelhead	○	Confirms if modifications to reduce the impacts of dams are enough to meet goals
Adults			
Install lamprey openings in fish ladders (2012)	Lamprey	●	Provided lamprey with an alternative passage route with resting spots
Repair or replace north shore fishway back-up water supply	Salmon and Steelhead	●	Improves reliability of upstream passage for adults
Concerns			
➔ A potential problem may exist relative to the long-term survival of fish that have used the bypass.			
➔ Performance testing needs to be conducted. There are some concerns with forebay delay and spill levels.			

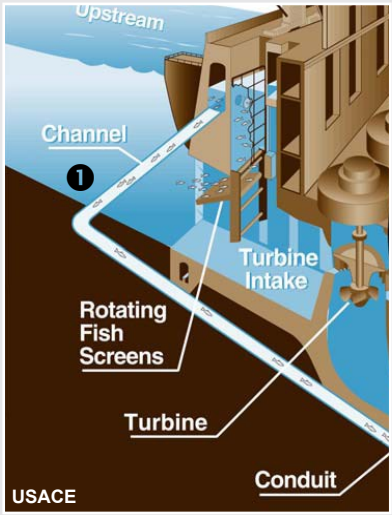
○ **Not Started** ⊙ **In Progress** ● **Completed**

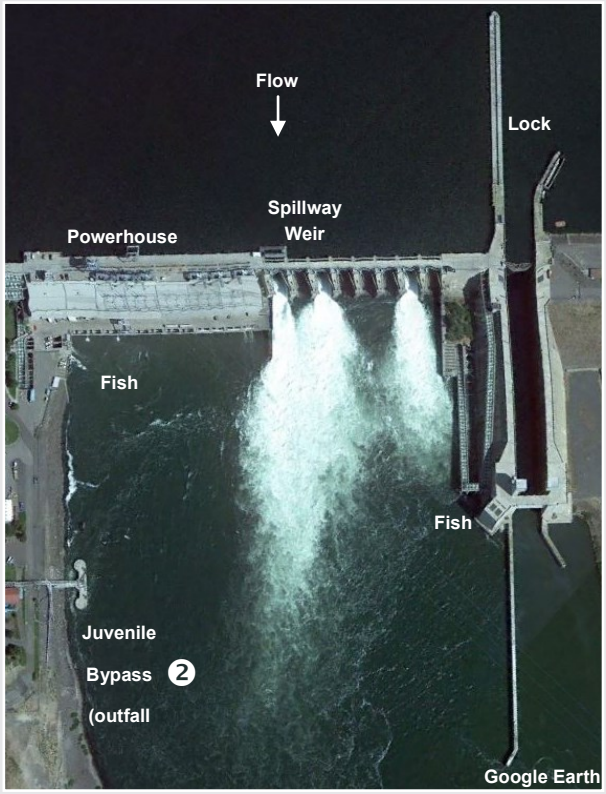
Juvenile bypass outfall at Ice Harbor Dam.

Lower Monumental Dam

Project Spotlight: Relocate Juvenile Bypass Outfall

To improve survival of by-passed juvenile fish, the juvenile outfall bypass pipes (**1**) were moved to a location with better flow conditions, reducing the opportunity for predation. The bypass outflow was moved from a location of 250 feet downstream from the dam to a new location of 2,100 feet downstream (**2**) and extending 500 feet from the bank (**3**).





Lower Monumental Dam Improvements

Action	Species	Project Status	Intended Benefit
Juveniles			
Spring spill: April 3 - May 31 (on-going)	Salmon and Steelhead	⊙	Improves survival and reduces travel time
Summer spill: June 1 - August 31 (on-going)	Salmon and Steelhead	⊙	Improves survival and reduces travel time
Transport fish based on flows and dates (on-going)	Salmon and Steelhead	⊙	Transport "spreads the risk" of decreased survival under certain river conditions (e.g., low-flow) when extra spill is not possible
Improve turbine operation (2013)	Salmon and Steelhead	⊙	Improved survival through turbines
Relocate juvenile bypass outfall (2012)	Salmon and Steelhead	●	Improved successful exit, and improved survival of bypassed fish
Install spillway weir (2008)	Salmon and Steelhead	●	Reduced forebay delay and improved direct and indirect juvenile fish survival with bypass improvements
Test BiOp goal performance	Salmon and Steelhead	⊙	Confirm if modifications reduce impacts of dams enough to reach goals
Adults			
Install lamprey openings in fish ladders (2012)	Lamprey	●	Provided alternative passage route with resting spots.
Concerns			
➔ A potential problem may exist with harmful levels of dissolved gasses in the water using the current spill pattern, which also results in fewer fish passed through the spillway. To ensure required spill passage efficiencies are met, alternative spill patterns should be explored.			
➔ The level of benefit from fish transport, as well as the continuation of the practice, are questionable at this project.			
➔ Performance tests were met during a high-flow year but not during a low-flow year. Action agencies must decide whether to retest or accept higher spill levels as the new target.			
➔ Due to damage, Unit 1 cannot be operated in full operating range and has to be locked into one position. As flows reduce, the unit is difficult to operate properly, compromising tailrace conditions.			

○ **Not Started** ⊙ **In Progress** ● **Completed**

Spotlight - Sockeye (Kálux)


Shutterstock

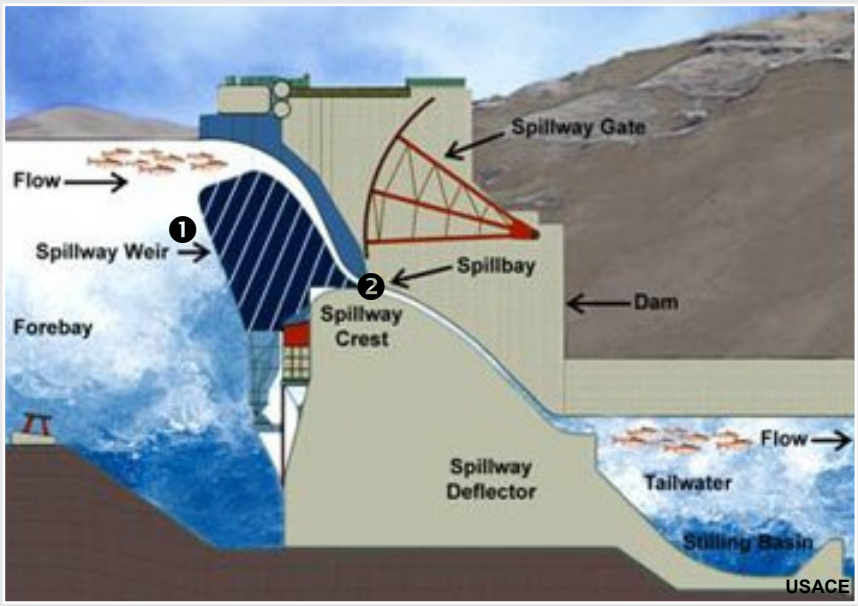
During the pre-treaty era, 150,000 sockeye returned annually to the Snake River Basin. Impassable dams, low flows, and deteriorated river conditions led to population declines resulting in the species being listed as federally endangered in 1991. By 1992, only one fish returned to spawn. To restore sockeye populations, tribal, state, and federal fish managers have relied on hatchery production, habitat improvements, and modifications to hydro-operations (e.g., Accord-mandated spill). With 2,392 adult sockeye passing Ice Harbor Dam in 2014, Snake River sockeye are slowly recovering, but the fragile state of the sockeye populations can affect other fisheries. Because incidental catch of sockeye must be minimized, other fisheries may experience closures to protect migrating adult sockeye. For sockeye to once again thrive in the Snake River Basin and elsewhere in the Columbia River Basin, efforts to improve flows and passage must continue.

Little Goose Dam

Project Spotlight: Surface Spillway Weir

To improve survival of juvenile salmon and steelhead migrating downstream past Little Goose Dam, the U.S. Army Corps of Engineers installed a spillway weir to provide fish passage near the water surface.

The spillway weir (**1**) fits inside the dam's spillway, raising the opening and allowing juvenile fish to pass near the surface, rather than having to dive 50 to 60 feet to pass through the deep spillway openings (**2**). Surface spill passage provides a more efficient and less stressful route for the young fish.



Since the completion of the weir, studies have shown that the structure has led to improved survival of migrating juvenile salmon and steelhead.

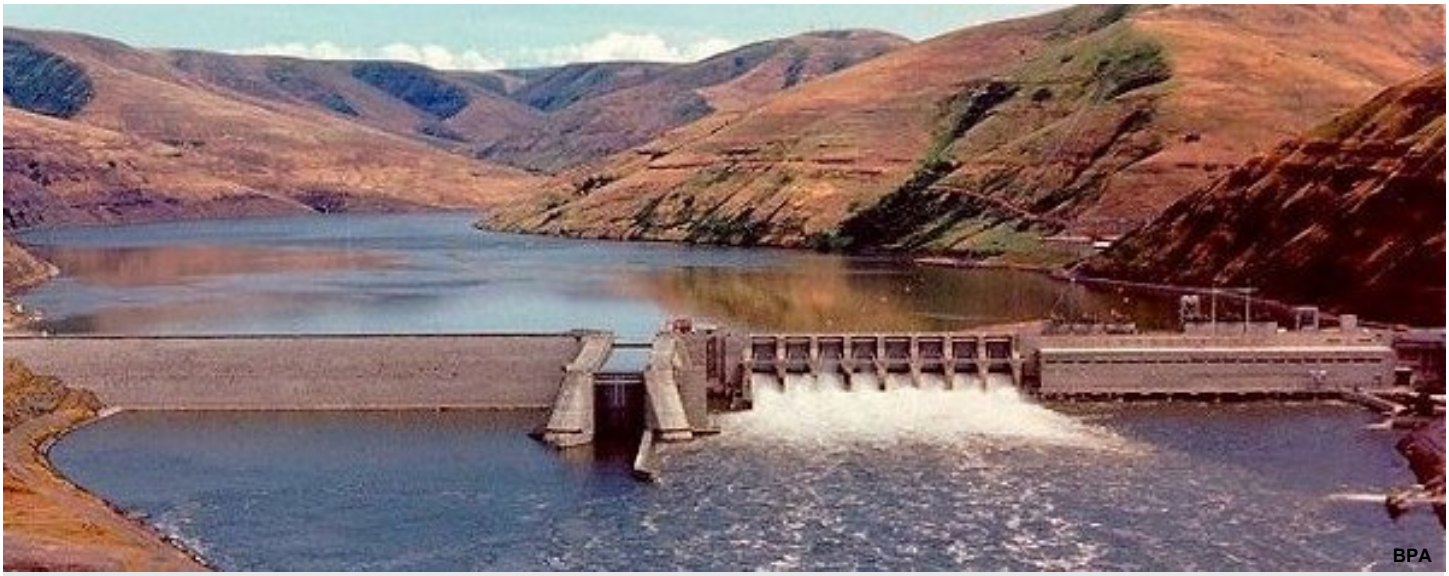
With the installation of the Little Goose Dam weir, surface fish passage facilities now exist at U.S. Army Corps of Engineers dams on the lower Snake River.

Little Goose Dam Improvements

Action	Species	Project Status	Intended Benefit
Juveniles			
Spring spill: April 3 - May 31 (on-going)	Salmon and Steelhead	⊙	Improves survival and reduces travel time
Summer spill: June 1 - August 31 (on-going)	Salmon and Steelhead	⊙	Improves survival and reduces travel time
Operate turbine Unit 1 to upper 25% of the 1% best efficiency range - provides disruption of eddy in front of powerhouse that delay migration (on-going)	Salmon and Steelhead	⊙	Improves successful exit of juvenile fish and migration of adult fish past dam
Transport fish based on flows and dates (on-going)	Salmon and Steelhead	⊙	Transport "spreads the risk" of decreased survival under certain river conditions (e.g., low-flow)
Improve turbine operation (2014)	Salmon and Steelhead	⊙	Improved survival through turbines
Install spillway weir and deflector (2009)	Salmon and Steelhead	●	Reduced forebay delay and improved survival of juvenile fish by bypass improvements
Relocate juvenile bypass outfall (2010)	Salmon and Steelhead	●	Improved successful exit, and improved survival on bypassed fish
Complete actions for permanent spillway weir	Salmon and Steelhead	⊙	Reduce forebay delay and improve direct and indirect survival of juvenile fish
Test BiOp goal performance	Salmon and Steelhead	⊙	Confirms if modifications reduce impacts of dams enough to reach goals
Adults			
Operate turbine Unit 1 to upper 25% of the 1% best efficiency range - provides disruption of eddy in front of powerhouse that delay migration	Salmon and Steelhead	⊙	Improves successful exit of juvenile fish and migration of adult fish past dam
Install lamprey openings in fish ladders (2013)	Lamprey	●	Provided alternative passage route with resting spots.
Investigate and reduce adult passage delays and blockages during spill	Salmon and Steelhead	⊙	Improves reliability of adult upstream passage
Concerns			
➔ During summer low-flow conditions (between 60-80kcfs), tailrace spill patterns that delay adult passage have been investigated. Implementation of improvements are under review.			
➔ The north adult ladder needs to be repaired.			
➔ Because there is concern about long-term survival for some species passing through this bypass, additional research is needed.			
➔ To ensure standards are met for all conditions, there is a need to continue improvements and performance testing The standards were not met the during summer low flows of 2013.			

○ **Not Started** ⊙ **In Progress** ● **Completed**

Lower Granite Dam



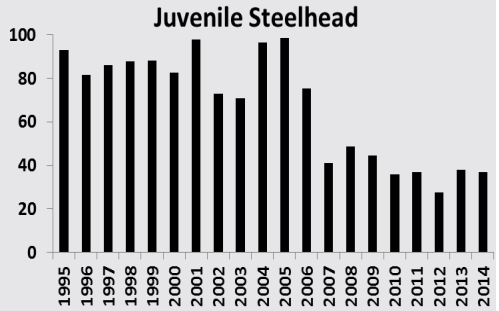
Project Spotlight: Spill and Juvenile Transport

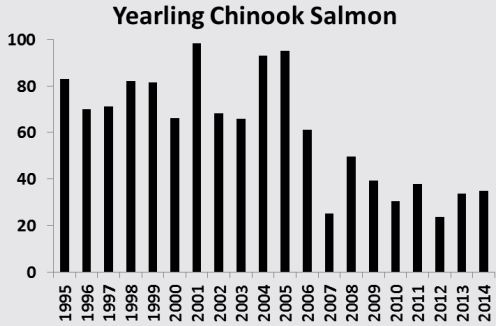
The most effective passage route for juvenile salmonids past dams is through spill. To increase survival, spill has been mandated by court order (through the Accord and required in the BiOP) to occur from April 10 through August 31 at most of the federal Columbia River Basin dams.

During low-flow conditions, sufficient spill may not be available. To reduce mortality as fish migrate past the lower Snake River dams, fish are diverted away from the dams, placed in barges/trucks, transported downstream and released below Bonneville Dam. Transportation helps to eliminate the additional mortality that could occur if these fish were to pass through the numerous dams and reservoirs during low flow and warm water conditions.

Studies have shown that transported fish may lose their homing instinct or fail to return for reasons that are not understood. Studies have shown that during some conditions, more transported fish have survived to the release locations below Bonneville Dam than fish that migrated downstream without assistance. However, under some conditions, fish that migrated without assistance returned in greater numbers as adults than the fish that were transported downstream in barges and trucks as juveniles. The “delayed mortality” of transported fish is a subject of ongoing research.

Juvenile fish are collected for barge transport at Little Goose, Lower Granite and Lower Monumental Dams, but are not collected at Ice Harbor Dam and are no longer collected from McNary Dam. Since 2006, changes in spill levels and dam improvements like surface weirs has led to a reduction of over 50% of the number of fish that have needed to be transported annually.





Percent of fish transported 1995-2014 (NOAA)

Lower Granite Dam Improvements

Action	Species	Project Status	Intended Benefit
Juveniles			
Spring spill: April 3 - May 31 (on-going)	Salmon and Steelhead	⊙	Improves survival and reduces travel time
Summer spill: June 1 - August 31 (on-going)	Salmon and Steelhead	⊙	Improves survival and reduces travel time
Transport based on flows and dates	Salmon and Steelhead	⊙	Transport "spreads the risk" of decreased survival under certain river conditions (e.g., low-flow) when extra spill may not occur
Improve turbine operation	Salmon and Steelhead	○	Improved survival through turbines
Install new juvenile fish facility and make improvements to opening (2012)	Salmon and Steelhead	⊙	Improved survival for all collected fish using a bypass system
Install prototype spillway PIT -tag monitoring system	Salmon and Steelhead	○	Improve monitoring of ESA-listed salmon and steelhead – confirms if modifications reduce impacts of dams enough to meet goals
Test BiOp goal performance	Salmon and Steelhead	○	Confirms if modifications reduce impacts of dams enough to meet goals
Adults			
Investigate and improve water supply for adult trap (2010)	Salmon and Steelhead	⊙	Improved performance to operate at full capacity without affecting fishway back-up water supply for adult passage
Modify fishway to improve passage conditions impaired by temperature ranges	Salmon and Steelhead	○	Improved passage conditions for adult fish
Investigate and reduce adult passage delays	Salmon and Steelhead	⊙	Improves reliability and reduces potential stress of adult upstream passage
Replaced valve and JFF upgrade may bring more reliable cool water to trap.	Salmon and Steelhead	⊙	Improve supply of cool water for adult trap to operate effectively at low flows
Concerns			
➔ After passing through the bypass, sub-yearlings tend to congregate in the tailrace area, delaying downstream migration.			
➔ To ensure the adult ladder operates effectively at low flows and increased river temperatures, work to improve water supply needs to continue.			
➔ During low flows, adults are delayed in the tailrace area. The delays negatively impact upstream migration.			
➔ Due to damage, Unit 1 cannot be operated in full operating range and has to be locked into one position. The unit is difficult to operate properly and creates poor tailrace conditions for adults and juveniles.			
➔ Facility improvements and performance testing must continue.			

○ **Not Started** ⊙ **In Progress** ● **Completed**

Spotlight: Adult Passage Issues at Lower Granite Fish Ladder

Due to its relatively high location in the water column, the water supply intake for the Lower Granite Dam fish ladder withdraws warm water during the summer. As a result, the water in the ladder tends to be warmer than the water in the tailrace and forebay. This temperature difference discourages adult salmon and steelhead from entering and exiting the fish ladder. The U.S. Army Corps of Engineers is modifying the water intakes to allow for the withdraw of water from deeper in the water column, providing cooler water throughout the ladder and to the adult fish trap. This is a high priority activity, as it is the only fish ladder at the dam. Contracting limitations and the need to close the fish ladder to perform the modifications have limited the implementation of corrective actions.

Efforts to Reduce Predation on Juvenile and Adult Fish


Lyn Topinka

In the Columbia River Basin, construction and operation of hydro-facilities have led to conditions that enhance opportunities for predators to consume a large number of juvenile and adult salmon, steelhead, and other fish species. To reduce predation, the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and Bonneville Power Administration fund efforts to control predators with the goal of improving the survival of juvenile and adult salmon and steelhead.


ODFW/ Anon.

Sea Lions

Columbia River salmon, steelhead, white sturgeon, and lamprey face threats from sea lions below Bonneville Dam. In recent years, the number of sea lions preying on salmon and steelhead, between February and June, has increased significantly. Sea lions annually consume thousands of returning adult fish. In addition, sea lions eat a significant number of adult white sturgeon and have been observed eating lamprey.


ODFW/ Anon.

- Efforts: Hazing techniques, exclusion devices, relocation, and lethal measures are used to reduce the presence of sea lions below Bonneville Dam.
- Each year since 2004, sea lions have consumed more than 3,000 salmon and steelhead immediately below the Bonneville Dam.
- Since peaking in 2011, observed sturgeon predation below Bonneville by sea lions has decreased 95%. This may, however, indicate that the sturgeon at that location have been depleted.
- Through 2015, 102 sea lions have been removed.

Northern Pikeminnow

Sport Reward Fishery Program

Northern pikeminnow are native to the Columbia River Basin. Construction of dams resulted in environmental changes that have led to increased predation on out-migrating juvenile fish.

- Goal: Reduce the average size and reduce the number of older fish that disproportionately prey on salmon and steelhead smolts. In the last 5 years, abundance of large fish has been reduced to one-tenth of those reported in 1990.
- Prior to the sport-reward, it is estimated that pikeminnow consumed 8% of all downstream juvenile salmonid migrants.
- From 1991 through 2011, 3.9 million pikeminnow removed.
- Pikeminnow harvested in 2013 resulted in an estimated 35% reduction in the number of salmon and steelhead hat would have been eaten by pikeminnow.


ODFW

THE SPORT REWARD FISHERY WILL ACCEPT

NORTHERN PIKEMINNOW

9 INCHES AND LONGER FOR PAYMENT

THE FIRST 100 PINKEMINNOW YOU CATCH PAYS

$4 PER FISH

PIKEMINNOW 101 TO 400 PAYS

$5 PER FISH

PIKEMINNOW 401 AND ABOVE PAYS

$8 PER FISH

Caspian Terns and Double-Crested Cormorants

Estuary

Tern and cormorant populations have increased significantly in the last 20 years. Between 2010-2013, the estimated annual smolt consumption by cormorants and terns was 19 million and 5 million, respectively.

- Goal: Redistribute 60% of the East Island tern colony to alternative sites in Oregon and California away from the Columbia River
- Goal: Reduce the cormorant population using privacy fences, nest destruction, hazing, and lethal take (when necessary) to reach the ~5,000 pair estuary BiOp goal

Inland Avian Predation Management (Columbia Plateau/Mid-Columbia Region)

Nesting colonies of terns are found on Goose, Crescent, and Blalock islands, whereas cormorants are nesting on Foundation Island. In 2012, terns consumed 730,000 juvenile steelhead.

- Goal: Reduce predation by hazing terns away from Goose and Crescent islands and attracting them to out-of-basin nesting sites
- Goose Island: Haze, potentially modify substrate, and take eggs
- Crescent Island: Haze, plant willows/vegetation, construct berms, and take eggs

Locations of Efforts to Reduce Predators

Note: Non-lethal hazing also conducted at all federal lower Columbia and Snake river dams, with limited lethal removal of gulls at McNary, Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams.

12-year geomean	Average over 12 years. Used to smooth out variation from one year to the next. (= geometric mean)
2008 Columbia River Fish Accords	Legal agreement signed between Yakama Nation and several other tribes and agencies to mitigate for the impacts of Federal dams on fishes.
BiOp	Biological Opinion. Issued by NOAA Fisheries, an opinion about the impacts of the federal hydrosystem, with goals for protecting salmon and steelhead listed under the Endangered Species Act.
BPA	Bonneville Power Administration, federal entity that markets and distributes energy produced by federal hydroelectric dams. It is part of the U.S. Department of Energy.
broodstock/ broodfish	Parent fish used as source of offspring for hatchery production.
bypass	A channel or conduit in a dam that provides a route for fish to move through or around the dam without going through the turbines.
CRITFC	Columbia River Intertribal Fish Commission, coordination and technical entity of which Yakama Nation is one of four member Tribes.
(corner) collector	A system at a dam that collects and holds the fish approaching the dam for later transportation or moves them through or around the dam without going through the turbines (e.g., at Bonneville Dam).
delisting	To remove from the endangered species list.
ESA	Endangered Species Act, a Federal law used to protect species at risk of going extinct.
escapement	Numbers of fish that make it back to a stream/river to spawn.
ESU, DPS	“Ecologically significant unit” “distinct population segment”: Ways to group closely related populations of a species from a certain region, used in defining and tracking management and recovery goals.
fallback	Fish that migrate partially or all the way up over a dam, and then go back downstream, expending extra time and energy in their attempt to reach spawning grounds.

GLOSSARY

fishway	Passage created to help fish get past a barrier.
flume	An open artificial channel or chute carrying a stream of water, as for furnishing power, conveying logs, or as a measuring device. (Also used for natural channels down a narrow gorge).
forebay	The area of a dam's reservoir that is immediately upstream from the powerhouse.
FPE	Fish passage efficiency: proportion of juvenile fish passing a dam through non-turbine routes.
gatewell	The slot on the upstream face of a concrete dam where hydraulic gates are stored when not used to close the turbine intakes. The gatewell typically houses the fish screening device.
geomorphic	Landforms and the processes that shape them.
hatchery origin spawner (HOS)	Hatchery origin spawner. A fish that was produced in a hatchery but returns to spawn in the wild.
hydroelectric	Electricity generated by hydropower systems by utilizing the force of falling water (e.g., from behind a dam to turn turbines).
hydrosystem	Series of dams that span rivers and affect migratory fishes and river conditions. In the Columbia River Basin, the term generally refers to the mainstem hydroelectric dams in the Columbia and Snake Rivers.
kelt	A steelhead that has already spawned once, but may be able to return to spawn again.
memorandum of agreement	A document written between parties to cooperate on an agreed upon project or meet an agreed objective.
minimum viability abundance threshold	The minimum number of fish (along with other population requirements) needed to reduce the risk of extinction, as is defined by the National Oceanic and Atmospheric Administration.
Mitchell Act	Act signed by Congress in 1938 to use seining fees to restore fish habitats. Amended in 1946 to screen irrigation ditches, build fish ladders, and establish hatchery supported fisheries, primarily downstream of Bonneville Dam.

Photo above: BPA

natural origin spawner (NOS)	Natural origin spawner. A fish that was spawned in the wild that returns as an adult to spawn in the wild.
NFH	National Fish Hatchery (operated by the U.S. Federal Government)
NOAA	National Oceanic and Atmospheric Administration. A federal agency that is part of the U.S. Department of Interior, involved with fisheries management on a federal level, as well as marine commerce, weather and coastal monitoring and warnings.
operation targets	Goals for how to operate dams for flow and spill, negotiated in order to balance the needs of natural resources and power generation. Achieving operation targets is dependent on annual flow conditions and in-season management.
PIT-tag	Passive integrated transponder. A tiny tag that is inserted in a fish that enables its presence and direction of movement to be recorded as it passes by a receiver antenna.
powerhouse	A primary part of a hydroelectric dam where the turbines and generators are housed and where power is produced by falling water rotating turbine blades.
PUD	Public utility district – local (county) governmental body that provides public utilities to the people of that district. They own and operate some hydroelectric dams in the Upper Columbia.
reconditioning	To improve the health/fitness of spawned out steelhead so that they are more likely to spawn again.
salmonid	Salmon and steelhead.
sluiceway	An artificial channel, that carries a portion of the current of a stream, canal, or other larger body of water.
smolt	Juvenile salmon that are migrating to the ocean.
SPE	Spillway passage efficiency: proportion of juvenile fish passing a dam through the spillway(s).
spillway	The channel or passageway around or over a dam through which excess water is released or "spilled" past the dam without going through the turbines. Spill gates control this flow.
subbasin	The land area that drains to a common point, usually into a medium-large size river. A “basin” consists of several smaller “subbasins”.

tailwater	The water surface immediately downstream from a dam or hydroelectric power plant.
translocation	To move an animal from one area to another, for example for reintroduction of an extinct population.
Treaty trust resources	Natural resources that occur in the usual and accustomed places for harvest, the rights to which are protected by the *Yakama Nation's Treaty of 1855 (12 stat. 951) with the United States of America.*
turbine	A mechanism in a dam that rotates with the force of water and produces electricity.
U.S. v Winans	1905 landmark U.S. Supreme Court case brought by the Yakama Nation, that held that Treaty tribal members had the right to cross non-tribal lands to access usual and accustomed places.
U.S. v. Oregon Columbia River Management Plan	Management agreement based on the federal U.S. v. Oregon court case, that establishes shared harvest rates between Tribal and non-Tribal fishers, upriver and downriver fishers, a means to protect and rebuild weak Columbia River fish populations, and resolve disputes.
USACE (or USCOE)	United States Army Corps of Engineers. A U.S. federal agency under the Department of Defense, responsible for the operating of 12 of the 14 Federal Columbia River Power System dams on the Columbia and Snake rivers and has responsibility over numerous other large-scale public works throughout the nation and world.
USBOR	United States Bureau of Reclamation. A federal agency in the Department of the Interior, responsible for water resource management, especially throughout the West for irrigation, water supply, and hydroelectric power generation.
watershed	The land area that drains to a common point, usually into a stream or other small water body.
WDFW	Washington Department of Fish and Wildlife– An agency providing fish and wildlife management for the state of Washington.
YKFP	Yakima-Klickitat Fisheries Project– a part of Yakama Nation Fisheries, YKFP collaborates and cooperates on fisheries issues with WDFW in the Yakima and Klickitat River subbasins.

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, under Project No. 200900200, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries.