# PROTECTING SALMON AND STEELHEAD

## Endangered Species Act
## Federal Columbia River Power System
## 2010 Progress Report - Section 1

SEPTEMBER 2011

**Throughout the Columbia River Basin**, tribal, state, local, and federal parties are working in partnership to protect and restore stocks of salmon and steelhead. Thirteen stocks of these fish are listed as threatened or endangered under the Endangered Species Act (ESA). Many parties in the region are working together to protect and enhance important habitats, improve hatchery and harvest practices, and enhance river conditions for migrating fish. This report summarizes the actions implemented by the Action Agencies in 2010 to protect ESA-listed salmon and steelhead affected by the operation of the FCRPS[1]. It describes the status of Reasonable and Prudent Alternative (RPA) actions being implemented across the fish life cycle for calendar year

*continued on page 2*

In May 2008, National Oceanic and Atmospheric Administration (NOAA) Fisheries issued a Biological Opinion (BiOp) on the operation of 14 of the projects that make up the Federal Columbia River Power System (FCRPS). The FCRPS projects are operated for multiple purposes including flood control, fish and wildlife, power generation, navigation, irrigation, and recreation. The FCRPS BiOp considered a suite of Reasonable and Prudent Alternative (RPA) actions proposed by the Bonneville Power Administration (BPA), Bureau of Reclamation (Reclamation), and U.S. Army Corps of Engineers (Corps), together referred to as the Action Agencies. These actions, developed through a collaborative process with regional states and Tribes to protect salmon and steelhead across their life cycle, were supported by a biological analysis that NOAA Fisheries concluded would avoid jeopardy to the fish and would not adversely modify their critical habitat.

On May 20, 2010, NOAA Fisheries completed the 2010 Supplemental BiOp, incorporating the Adaptive Management Implementation Plan (AMIP) into the 2008 BiOp. In 2009 the Obama Administration directed the development of the AMIP which takes a more precautionary approach in implementation of the RPA, providing contingency and rapid response actions in case of unanticipated, significant fish declines.

The Action Agencies committed to implementing the RPA actions, including the use of spill and surface passage structures at dams, management of water releases from

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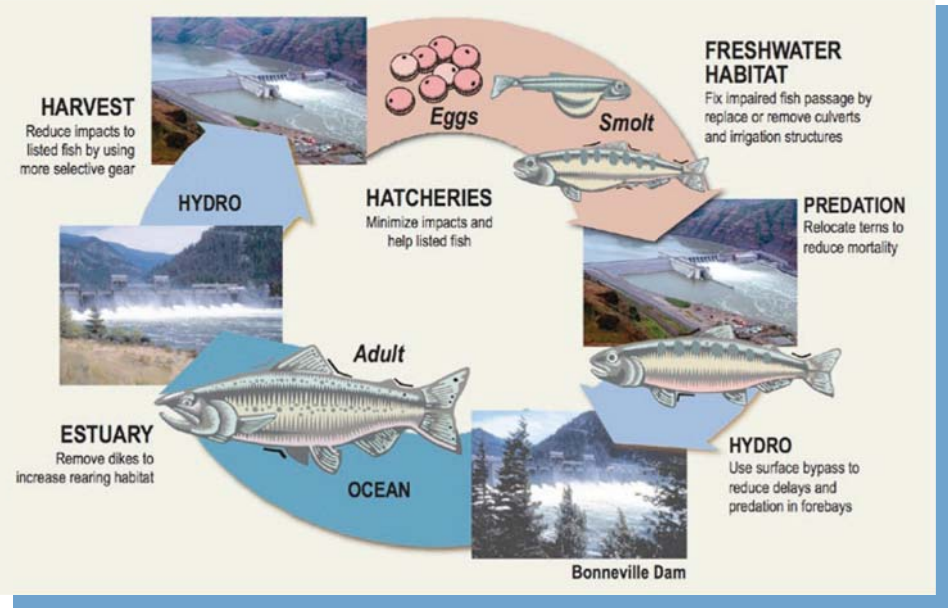


**All-H Problems: All-H Solutions** *Samples from the 2010 FCRPS BiOp*

## Contents



This report is produced by the "Action Agencies"—the U.S. Army Corps of Engineers Northwestern Division, Bureau of Reclamation Pacific Northwest Region, and Bonneville Power Administration.

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2010. The actions described in this annual report are focused on achieving biological performance standards, achieving programmatic performance targets, and addressing factors that limit certain life stages for specific evolutionarily significant units (ESUs) or distinct population segments (DPSs) of salmon and steelhead. Adaptive management is the process the agencies use to make adjustments to actions based on new scientific information and to meet biological performance objectives effectively and efficiently.

The full FCRPS 2010 Annual Progress Report, which includes the Detailed Description of RPA Action Implementation and Project Tables for RPA Action Implementation, is available online at: *http://www.salmonrecovery.gov*. Previous FCRPS progress reports and information on other salmon and steelhead protection efforts are available on websites listed at the end of this document.

[1]*The FCRPS includes 14 major dams and power plants on the Columbia and Snake rivers. These dams and power plants are operated as a coordinated system (including with Canada) to meet multiple purposes as authorized by Congress.*

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storage reservoirs, expanded control of predators that prey on young salmon, improvement of tributary and estuary habitat, and implementation of hatchery reforms. To support BiOp implementation certainty and promote regional collaboration, the Action Agencies also entered into the Columbia Basin Fish Accords with three states and five tribes.

The Action Agencies are responsible for providing annual progress reports detailing the implementation and progress of the RPA. This report meets the requirements of RPA Action 2 and reports RPA implementation progress during the period January 1, 2010, through December 31, 2010.

This annual report is organized into three sections. RPA implementation highlights are presented in Section 1, discussing findings that will inform future RPA implementation. This section also presents information in formats requested by the federal-state-tribal Regional Implementation Oversight Group (RIOG). Section 2 addresses progress on RPA implementation by action. Section 3 lists projects implemented during 2010 and includes habitat metrics completed the same year.

To review the 2010 Supplemental FCRPS BiOp in its entirety, please visit: *http://www.salmonrecovery.gov/BiologicalOpinions/FCRPS/2010SupplementalFCRPSBiOp.aspx*.

The 2008 BiOp can be found at: *http://www.salmonrecovery.gov/BiologicalOpinions/FCRPS/2008Biop.aspx*

and the AMIP can be found at: *http://www.salmonrecovery.gov/Files/BiologicalOpinions/AMIP_09%2010%2009.pdf*.


**Figure 1. Map Of The Columbia River Basin Showing Action Areas, Dams, And Listed Species.**

# 2010 Fish Status and Environmental Conditions

## Adult Fish Returns and Trends

One way the Pacific Northwest tracks how well salmon and steelhead are doing is by comparing the number of fish that return each year to spawn. Many dams have fish counting stations where annual index tallies are made of the various species as they swim up the fish ladders. In 2010, more than 1.8 million adult and jack salmon and steelhead were counted as they passed Bonneville Dam (jack salmon are young males that mature and return to spawning grounds earlier than others in their age class). This number exceeds historical averages (i.e., for 2000 and earlier) and is above the 10-year average (Figure 2). Specific adult return and trend information for the species addressed in the BiOp are presented beginning on page 31.

As shown in Table 1, counts in 2010 of adult steelhead, Chinook, and sockeye passing Bonneville Dam exceeded the 10-year average; the counts of spring and fall Chinook were substantially above the 10-year average, and the count of sockeye was more than three times the 10-year average. The count of adult coho was slightly below the 10-year average. In a typical year, about 80 percent of all returning adult salmon are of hatchery origin, though the actual percentage varies by species.

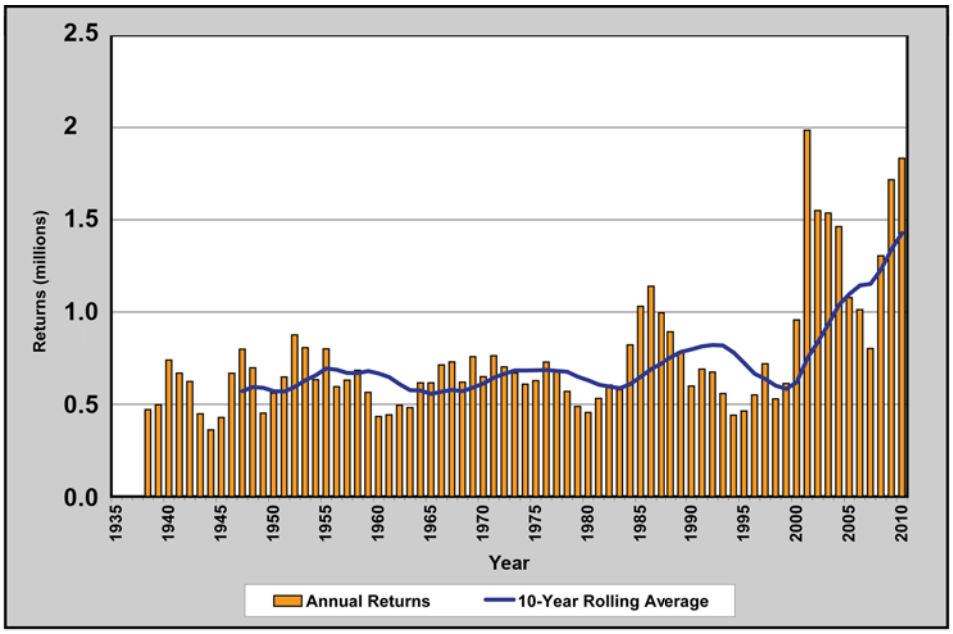



**Figure 2. Adult and Jack Salmon/Steelhead Returns at Bonneville Dam, 1938 to 2010 (includes hatchery and natural-origin fish).**

**Table 1. Adult Salmon and Steelhead Returns at Bonneville Dam – 2010 and 10-year average (includes hatchery and natural origin fish).**

| Species | 2010 | 10-year average |
|---|---|---|
| Chinook – Total [1/] | 902,439 | 747,446 |
| Spring Chinook [2/] | 257,035 | 191,236 |
| Summer Chinook | 113,207 | 102,906 |
| Fall Chinook | 532,197 | 453,295 |
| Steelhead | 416,603 | 415,238 |
| Sockeye | 386,524 | 123,949 |
| Coho [3/] | 127,644 | 142,288 |
| Chum and Pinks | 128 | 220 |
| TOTALS of all species for period | 1,833,338 | 1,429,141 |

*Period of 10-year average 2001-2010. Data are for daytime counts – 0400 to 2000 PST. All data from U.S. Army Corps of Engineers Fish Passage Report 2010, Table 18b, except as noted below:*

*[1/] Chinook data are from monthly values in Fish Passage Report 2010, Table 19, except values for 2000-2002 are from monthly values in Fish Passage Report 2002, Table 18. Values include jacks.*

*[2/] Assumed Chinook run dates are: Spring = Jan 1–May 31; Summer = June 1–July 31; Fall = Aug 1–Dec 31*

*[3/] Includes jacks.*

### Adult Fish Survival

The 2008 FCRPS BiOp established methodology to annually estimate system survival rates of listed adult salmonids through defined hydrosystem reaches based on Passive Integrated Transponder (PIT) tagged fish detections at Bonneville, McNary, and Lower Granite dams with corrections for harvest and straying. In 2010, system survival estimates for both upper Columbia River ESUs were among the highest measured since 2002 and well above recent year estimates.

Long term system survival performance is evaluated for 5 stocks using a 5-year rolling average of annual system survival estimates. Snake River stocks are used as surrogates for Snake River sockeye and mid-Columbia steelhead. In 2010 Snake River fall Chinook and upper Columbia River steelhead surpassed the performance standard while the Snake River spring/summer Chinook salmon ESU, the Snake River steelhead DPS, and the upper Columbia River spring Chinook ESU were below adult performance standards (Figure 3). Several factors are being addressed that likely affect the attainment of adult performance standards: modifications to operations and structures at dams designed to increase juvenile survival that may increase fallback and delay of adults, losses due to sea lion predation, and additional levels of straying and harvest-related mortality not addressed using current methodology. Each of these potential factors is being assessed through BiOp Research, Monitoring & Evaluation (RME) actions. The Action Agencies are investigating adding PIT tag detection capabilities to adult passage facilities at The Dalles and John Day dams and adding PIT tag interrogation capability in fisheries above

Bonneville Dam to better understand and quantify unexplained and higher than anticipated losses within those reaches.

### Juvenile Fish Survival

Hatchery and wild juvenile salmon and steelhead that migrate to the ocean through the Snake and Columbia rivers can either be left "in river" to migrate past the dams or transported by barge or truck to below Bonneville Dam. Total system survival is a combination of transportation and in-river survival.

In 2010, less than 40 percent of the Snake River steelhead and Chinook were transported. Ninety-eight percent of the transported juveniles were assumed to have survived to the point of release below Bonneville Dam. Total system survival to the Bonneville tailrace (survival of in-river and transported groups combined) was about 57 percent for wild Chinook and 69 percent for combined wild and hatchery Chinook, 71 percent for wild steelhead, and 74 percent for wild and hatchery steelhead. These total system survival estimates are around 5 to 10 percent lower than in 2009, in part because fewer fish were transported. Because significant proportions of juvenile upper Columbia spring Chinook and steelhead are not transported, in-river survival rates are equivalent to total system survival rates for these species. Research is being carried out under the BiOp to better understand any delayed effects of transport.

The BiOp established an in-river survival performance metric for Snake River and upper Columbia River Chinook and steelhead; this metric is intended to provide important information for both the annual adaptive management process and the comprehensive evaluations in 2013 and 2016. The Action Agencies empirically measured in-river survival for 2010 (Lower Granite to Bonneville and McNary to Bonneville) and compared that with the survival estimates derived by running Comprehensive Fish Passage (COMPASS) modeling (with prospective survival estimates for the actions implemented at the start of the 2010 migration season using 2010 river conditions, fish migration patterns, and dam and transport operations). Figure 4 shows the results of these comparisons. Results indicate that the benefits from the RPA actions implemented to date are likely accruing as expected.

In-river survival estimates for wild Snake River steelhead, and combined hatchery and wild upper Columbia River steelhead and spring Chinook were higher than mean estimates developed using the COMPASS model. Wild

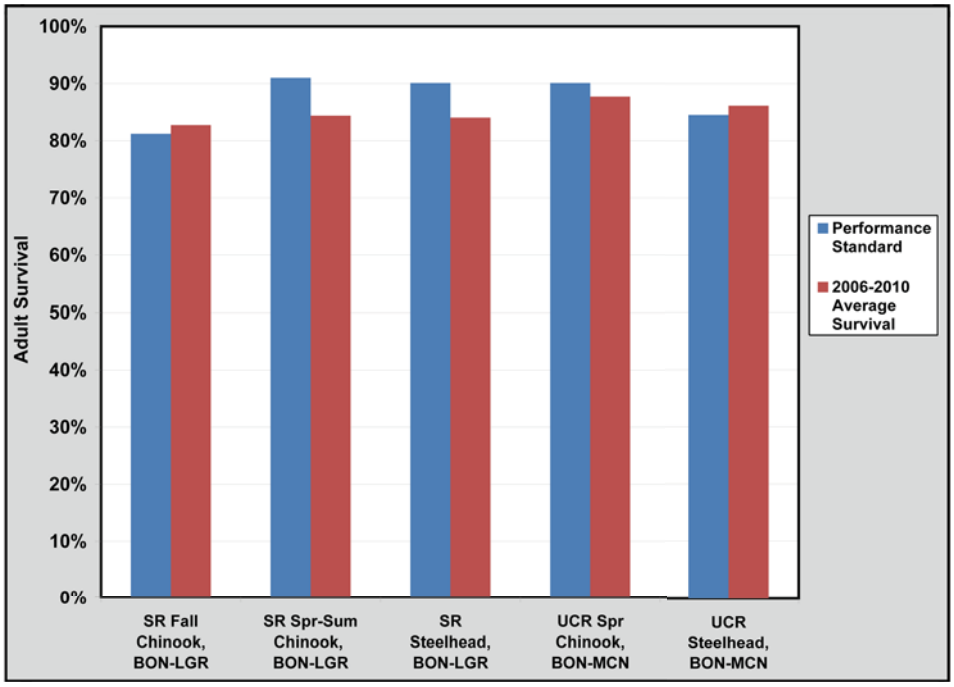



**Figure 3. 2008 FCRPS BiOp Adult Survival Standard and Five-Year Rolling Average Survival of Adults that Migrated In-River as Juveniles, Based on PIT Tag Conversion Rates of Snake River (SR) and Upper Columbia River (UCR) ESUs.** (BON = Bonneville, MCN = McNary, LGR = Lower Granite)

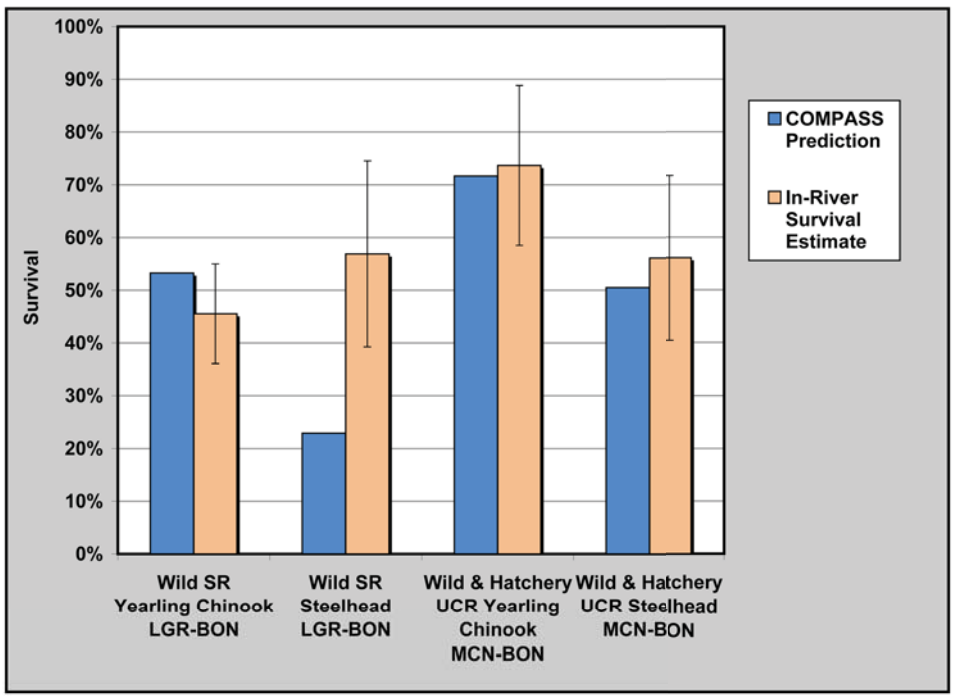



**Figure 4. COMPASS Model Predictions and PIT Tag Estimated In-River Survival for Juvenile Snake River (SR) Wild Spring/Summer Chinook and Steelhead and for Upper Columbia River (UCR) Wild/Hatchery Spring Chinook and Steelhead. Error whiskers indicate 95 percent confidence intervals.** (BON = Bonneville, MCN = McNary, LGR = Lower Granite)

Snake River yearling Chinook in-river survival estimates were lower than mean COMPASS estimates (see Figure 4). These results suggest that steelhead are generally deriving more benefits from recently installed surface flow weirs than Chinook. Improvements planned to deter predation near dams (avian wires and egress improvements) are expected to result in additional benefits to all species.

Estimated in-river survival (wild and hatchery combined) for Snake River yearling Chinook salmon and steelhead through the entire hydropower system (Snake River smolt trap above Lower Granite Dam to the tailrace of Bonneville Dam) in 2010 was relatively high compared to recent years (Figure 5). Estimated survival for yearling Chinook was 55.1 percent, which was higher than the 1999-2010 average of 49.3 percent, and higher than the 2009 estimate of 53.1 percent. However, the difference between 2009 and 2010 was not statistically significant ($P = 0.67$). For Snake River steelhead, estimated 2010 in-river survival was 61.8 percent, which was higher than the average of 40.4 percent for 1997-2010, but lower than the 2009 estimate of 67.8 percent. Again, the difference between 2009 and 2010 survival was not statistically significant ($P = 0.38$).

Yearling Chinook salmon and steelhead migration rates through the hydropower system were near average in 2010. Travel times were shorter than those observed in years with similar levels of flow. Relatively high spill proportions and the use of surface collectors at most projects likely shortened travel times and helped compensate for the lower water velocities associated with lower flow levels.

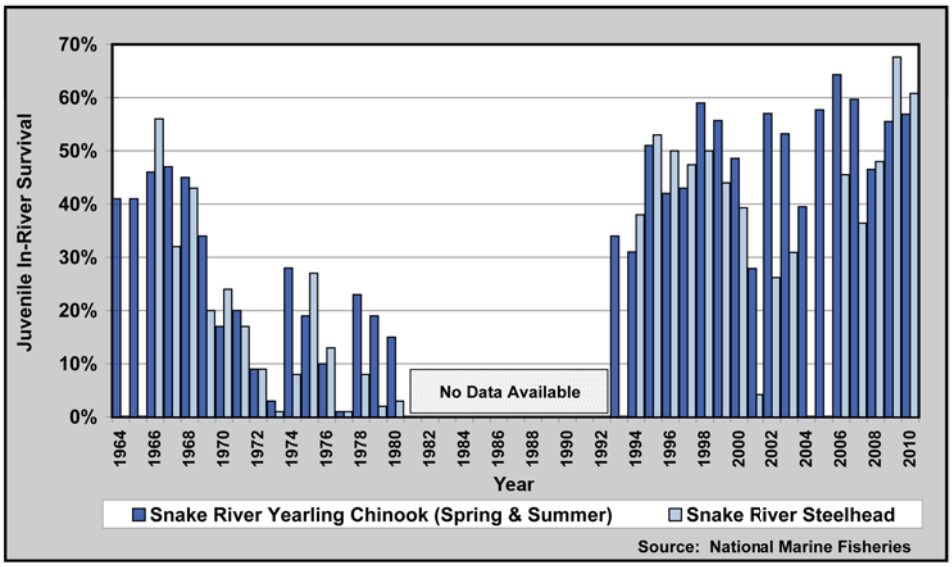



**Figure 5. In-River Survival Estimates (Hatchery and Wild Combined) for Snake River Chinook and Steelhead.** Steelhead estimates for 2004 and 2005 are unavailable due to lower PIT tag detection efficiency at Bonneville Dam. Survival estimates are not available for 1981 through 1992.

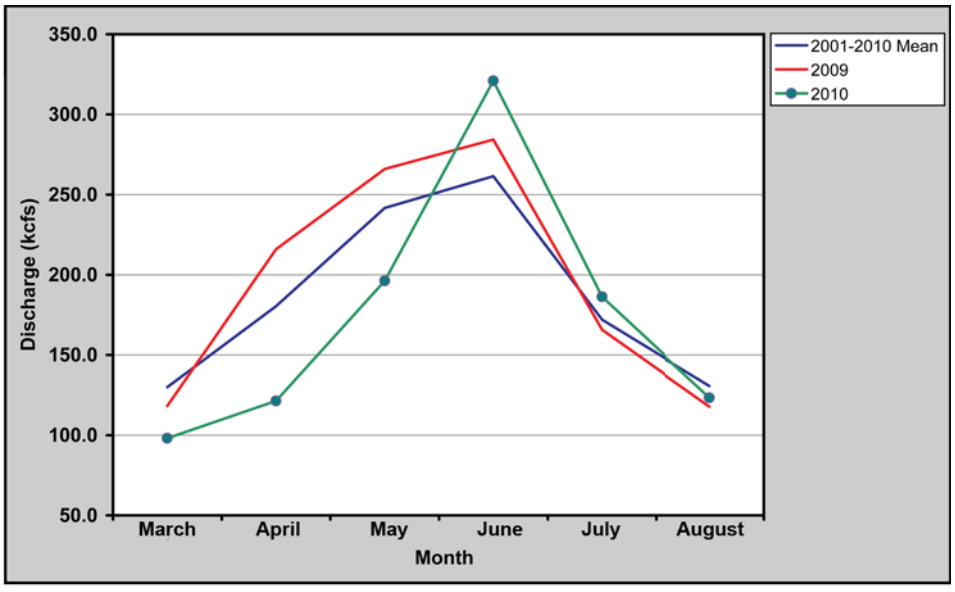



**Figure 6. Mean Daily Flow by Month at McNary Dam, 2009 and 2010, with average values for the 2001-2010 period.**

## Water Year and Streamflow Summary

In 2010, Columbia River Basin flows during April and May were substantially below average, but increased to somewhat above average during June and July (Figure 6). The Columbia River had a below average water year, with the January through September volume as measured at The Dalles Dam at 80 percent of average. May and June precipitation across the basin contributed significantly to higher June flows and a rising water supply, reversing a trend toward an extremely dry year rather than one just moderately below average. On the Columbia River mainstem, a preliminary flow spike occurred about mid-May. Early June rains, combined with additional snow melt, caused a rise in flows as measured at The Dalles Dam during the first week of June. Flows then steadily receded for the rest of the summer season.

### Ocean and Climate Conditions

RPA Action 2 of the FCRPS BiOp calls for this report to include annual review of forecasts and climate change information and research, which is summarized in this section. Columbia River Basin salmon and steelhead abundance is strongly correlated with periods of relatively warm or cold off-coast ocean conditions. In general, warmer conditions are less favorable for salmon and colder conditions are more favorable. Pronounced warm and cold cycles have occurred over most of the past century, lasting approximately 20 to 30 years each (Figure 7). This climate

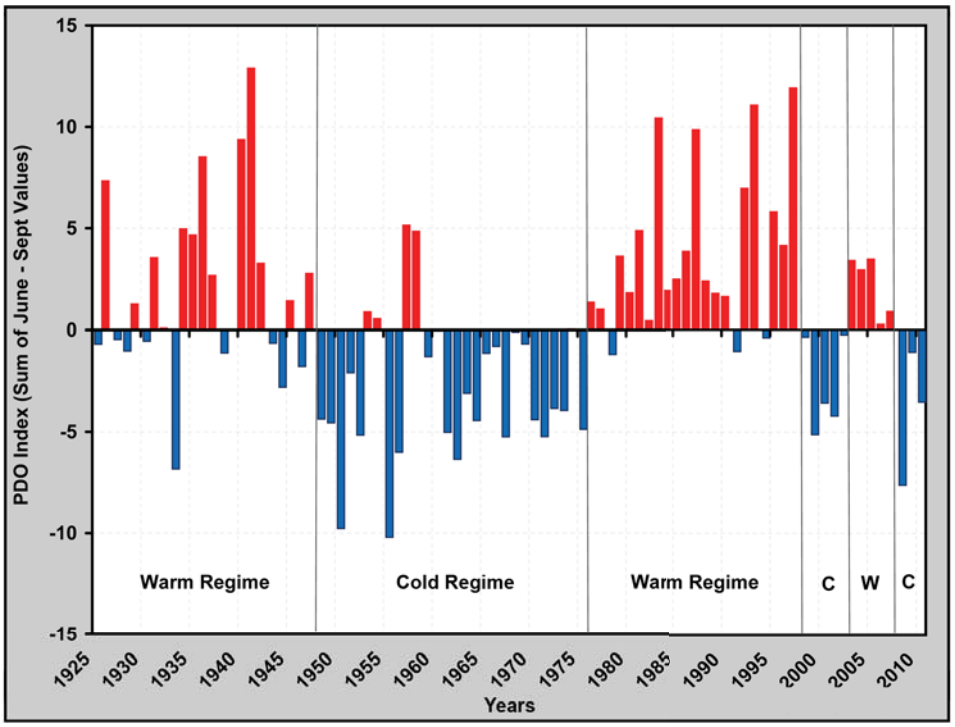



**Figure 7. Time Series of Shifts in Sign of the Pacific Decadal Oscillation (PDO), 1925 to 2010.** Values are averaged over the months of May through September. Red bars indicate positive (warm) years; blue bars negative (cool) years. Note that 2008 was the most negative since 1956.

| | Juvenile migration year | | | | Forecast of adult returns | |
|---|---|---|---|---|---|---|
| | 2007 | 2008 | 2009 | 2010 | Coho 2011 | Chinook 2012 |
| **Large–scale ocean and atmospheric indicators** | | | | | | |
| PDO (May–Sep) | ■ | ■ | ■ | ■ | ● | ● |
| MEI (annual) | ■ | ■ | ■ | ■ | ● | ● |
| **Local and regional physical indicators** | | | | | | |
| Sea surface temperature anomalies | ■ | ■ | ■ | ■ | ● | ● |
| Coastal upwelling | ■ | ■ | ■ | ■ | ● | ● |
| Physical spring transition | ■ | ■ | ■ | ■ | ● | ● |
| Deep water temperature and salinity | ■ | ■ | ■ | ■ | ● | ● |
| **Local biological indicators** | | | | | | |
| Copepod biodiversity | ■ | ■ | ■ | ■ | ● | ● |
| Northern copepod anomalies | ■ | ■ | ■ | ■ | ● | ● |
| Biological spring transition | ■ | ■ | ■ | ■ | ● | ● |
| June spring Chinook | ■ | ■ | ■ | ■ | — | ● |
| September Coho | ■ | ■ | ■ | ■ | ● | — |

Key
■ good conditions for salmon
■ intermediate conditions for salmon
■ poor conditions for salmon
● good returns expected
— no data
● poor returns expected

**Figure 8. Ocean Ecosystem Indicators of the Northern California Current.** Colored squares indicate positive (green), neutral (yellow), or negative (red) conditions for salmon entering the ocean each year. In the two columns to the far right, colored dots indicate the forecast of adult returns based on ocean conditions in 2009.

pattern is known as the Pacific Decadal Oscillation (PDO).

A cool PDO regime in place from about 1947 to 1976 was characterized by abundant salmon returns to the Columbia River Basin. The PDO shifted to a warm phase in about 1977, which coincided with a significant decline in Columbia River Basin salmon runs. Although it is not clear yet whether another longer-term shift has taken place or what effects might be associated with climate change, ocean conditions have been variable since about 1999, with relatively brief cool and warm periods.[2]

NOAA Fisheries Northwest Fisheries Science Center (NWFSC) oversees the Ocean Ecosystem Indicators Project to track specific climatic and biological indicators believed to influence the growth and survival of juvenile salmon once they reach the ocean. The NWFSC forecasts coho and Chinook salmon returns based on a survey of a range of ecosystem indicators. Ocean indicators during juvenile migration year 2008 were the best overall since 1999-2000. However, during the second half of 2009 the trend of cool ocean conditions shifted to a warmer regime, likely leading to higher mortality of juvenile salmonids. The warming trend that began in late 2009 continued through April 2010 and, by May 2010, cooling resumed. According to the NWFSC, the mixed signals from the ocean made it difficult to predict 2011 coho and 2012 Chinook salmon returns (Figure 8).[3]

### Ocean and Plume Monitoring and Research Findings

- Ocean conditions and circulation appear to affect salmon growth and survival indirectly by changing prey community composition and quality, rather than by a direct effect of temperature on salmon growth or prey quantity. To date, research indicates that different populations of Columbia River salmon move to different locations along the coastal

[2] *For more information see the Pacific Northwest Climate Impacts Group website at http://cses.washington.edu/cig/.*

[3] *See the Northwest Fisheries Science Center's Ocean Ecosystems Indicators website at http://www.nwfsc.noaa.gov/research/divisions/fed/oeip/a-ecinhome.cfm.*

zone where they establish their ocean feeding grounds and overwinter.

- Parasite species richness may be useful as a metric of trophic success and/or prey availability for juvenile salmon. Limited data suggest that salmonid marine growth and condition metrics were higher in coho salmon with high parasite species richness, reflecting a more diverse diet. Macroparasite community composition in juvenile Chinook and coho shifted significantly in the transitions between "cold" and "warm" PDO cycles in 1999-2005. These changes are thought to be attributed to changes in the marine zooplankton community that serve as intermediate hosts.
- Reduced peak freshet flow volumes have been influenced more by flow regulation and irrigation diversion than climate change, but earlier spring freshets may be more associated with climate change than flow regulation and diversion.
- The plume will likely be relatively unresponsive to sea level rises comparable to the ranges anticipated in the 2007 Intergovernmental Panel on Climate Change report, but the estuary is anticipated to respond very strongly, in particular with regard to salinity intrusion length.

### New Climate Change Information

The 2010 Supplemental BiOp contained a thorough review of new climate science. The Supplemental BiOp concluded that "new observations and predictions regarding physical effects of climate change are within the range of assumptions considered in the 2008 BiOp and the AMIP." The Supplemental BiOp went on to state: "New studies of biological effects of climate change on salmon and steelhead provide additional details on effects previously considered and suggest that adult migration conditions in the mainstem lower Columbia may need particular attention through monitoring and proactive actions." The BiOp also included additional RPA requirements to address this concern.

More recently, the NWFSC conducted a scientific literature review of recent climate change studies. This review is included as an attachment to Section 2 of this 2010 progress report. The review concluded that new analyses were generally consistent with previously reported historical trends of climate change.

# Implementation Overview

The Action Agencies have established implementation strategies and actions using the "All-H" approach—hydropower, habitat, hatchery, and harvest, plus predator management—to work toward salmon and steelhead recovery in the Columbia River Basin. Work performed is summarized below. Detailed descriptions can be found in Section 2, the RPA action implementation portion of this 2010 progress report.

## Hydropower

Under the hydropower strategy, the Action Agencies implemented juvenile and adult dam passage modifications, operational improvements for spill and transport of juvenile fish, water management operations, and operational and maintenance activities aimed at improving juvenile passage survival and adult returns. These actions are focused on achieving higher juvenile dam survival performance standards, which in turn improve overall system survival and in-river survival.

### Improvements for Fish at the Dams

Most salmon and steelhead in the Columbia River Basin encounter one or more hydropower dams as they migrate to and from the ocean. Fish passage systems provide various routes of passage to help salmon and steelhead get past the dams. Over the past several decades, juvenile fish survival past the dams has improved dramatically.

Juvenile fish pass dams by many routes: through the turbines, through juvenile bypass systems, through spillways, or by collection and transport in barges or trucks. Turbine passage is often considered to be the least desirable juvenile route of passage. As a result, juvenile bypass systems, spill, and other surface passage routes are used to divert the vast majority of migrating fish away from the turbines. Depending on location, time of year, and species, about 76 percent to 99 percent of the juvenile fish use these non-turbine routes. Juvenile dam survival estimates of 86 percent to 99 percent have been demonstrated at Snake and Columbia river dams, with survival rates at most of the dams in the upper 90 percent range. The BiOp includes dam survival performance standards (through all passage routes) of 96 percent for spring migrating fish and 93 percent for summer migrating fish. Preliminary testing has indicated that many of the projects are well on their way to meeting juvenile dam passage performance standards (Table 2), with significant additional improvements planned over the next few years. Key accomplishments are noted below.

### Surface Passage and Spill

The Action Agencies' hydro operations include spring and summer spill to help juvenile salmon and steelhead pass the lower Columbia and Snake river dams. In 2010, consistent with the court-ordered 2010 Spring and Summer Fish Operations Plans, spill operations from 2009 were continued with only those modifications necessary to conduct essential research.

Surface passage structures are used in addition to conventional spillways to provide more natural river passage conditions, improve juvenile fish survival, reduce juvenile fish passage delay, improve water quality, and make more efficient use of spill. Most juvenile salmon tend to travel in the upper 10 to 20 feet of the water column as they migrate downstream to the ocean. When approaching the dams, juvenile fish need to dive to depths of 50 to 60 feet to access passage routes such as a spillbay opening or a guidance screen that

will guide them into a juvenile bypass channel. Surface passage structures such as spillway weirs and the Bonneville corner collector provide downstream migrating fish with more surface-oriented routes of dam passage, thereby reducing passage delay and improving survival.

In 2010, construction of The Dalles Dam spillwall was completed. The spillwall was installed between spillbays 8 and 9 to help guide juvenile fish that pass the dam via the spillway away from shallow water predator habitat to the deeper main river channel for conveyance downstream, thereby improving overall dam survival to achieve the juvenile dam survival performance standards specified in the BiOp.

Following spillwall construction at The Dalles Dam, a juvenile dam passage performance standard evaluation for both spring and summer juvenile salmonids was completed in 2010. Results from the first year of full performance standard testing indicated a marked improvement over the pre-spillwall configuration in dam survival of both spring and summer migrants (see Figure 9 and Table 3). Dam survival of yearling Chinook salmon exceeded the spring migrant performance standard of 96.0 percent at 96.4 percent. Dam survival of juvenile steelhead was slightly below the spring juvenile migrant performance standard of 96.0 percent at 95.3 percent. Finally, dam survival of subyearling Chinook salmon exceeded the summer juvenile migrant performance standard of 93.0 percent at 94.0 percent. A second year of performance standard testing will occur in 2011.

**Table 2. Status of Juvenile Fish Bypass Improvements and Testing at Columbia and Snake River Dams.**

| Dam | Status of dam passage improvements | Testing Status |
|---|---|---|
| Bonneville | Complete & Ready For Performance Standard Testing | Preliminary test conducted in 2010. Results indicate performance standards can be met with current configuration. This will be confirmed with future performance standard tests. |
| The Dalles | Complete & Ready For Performance Standard Testing | A juvenile dam passage performance standard test was conducted in 2010. Estimated dam passage survival exceeded the performance standards for yearling and sub-yearling Chinook. Steelhead estimate slightly under standard. |
| John Day | Complete & Ready For Performance Standard Testing | Preliminary test conducted in 2010. Results indicate performance standards are expected to be met with current configuration. This will be confirmed with future performance standard tests. |
| McNary | In Progess | Testing will occur following outfall relocation planned to be completed in 2012 |
| Ice Harbor | Complete & Ready For Performance Standard Testing | Preliminary testing conducted in prior years indicates performance standards can be met with current configuration. This will be confirmed with future performance standard tests. |
| Lower Monumental | In Progress | Preliminary testing conducted in prior years indicate performance standards can be met for spring migrants and are expected to be met for summer migrants with outfall relocation planned to be completed in 2012. This will be confirmed for spring migrants with future performance standard tests. |
| Little Goose | Complete & Ready For Performance Standard Testing | Preliminary testing conducted in prior years indicate performance standards can be met with current configuration. This will be confirmed with future performance standard tests. |
| Lower Granite | In Progress | Testing will occur following planned configuration changes. |

**Table 3. Pre and Post-Spillwall Dam Survival of Juvenile Spring and Summer Migrants at The Dalles Dam.**

| | Yearling Chinook Salmon | | Steelhead | | Subyearling Chinook Salmon | |
|---|---|---|---|---|---|---|
| | Pre-spillwall 2005 | Post-spillwall 2010 | Pre-spillwall 2005 | Post-spillwall 2010 | Pre-spillwall 2005 | Post-spillwall 2010 |
| Dam Passage Survival (%) (95% CI) | 93.9 (±2.1) | 96.4 (±1.9) | na | 95.3 (±1.9) | 90.0 (±1.9) | 94.0 (±1.8) |

## Juvenile Bypass Systems

Juvenile fish screened bypass systems are in place at seven of the eight lower Columbia and Snake river dams. These bypass systems guide fish away from turbines by means of submerged screens installed in the turbine intakes. As fish travel with flow into the turbine intakes, the guidance screens guide the fish up through channels in the dam, routing them away from turbines. The fish are then either passed back to the river below the dam (bypassed) or loaded into barges or trucks for transport downstream past the remaining dams.

## Fish Transportation and Barging

Juvenile fish transportation is an ongoing program that collects fish from juvenile bypass facilities at Lower Granite, Little Goose, Lower Monumental, and McNary dams and transports them by either barge or truck to release sites below Bonneville Dam.

The 2010 BiOp recommended fish transport operations be adaptively managed on an annual basis. The timing and conditions for fish transportation are based on annual research comparing adult returns to Lower Granite Dam of transported fish versus fish that migrated in-river. In general, Chinook survive better when migrating in-river in early April, but survive better when transported beginning in late April or early May. Also, steelhead generally exhibit higher survival when transported during the spring migration.

In 2010, through coordination with the Technical Management Team (TMT), smolt transportation began on April

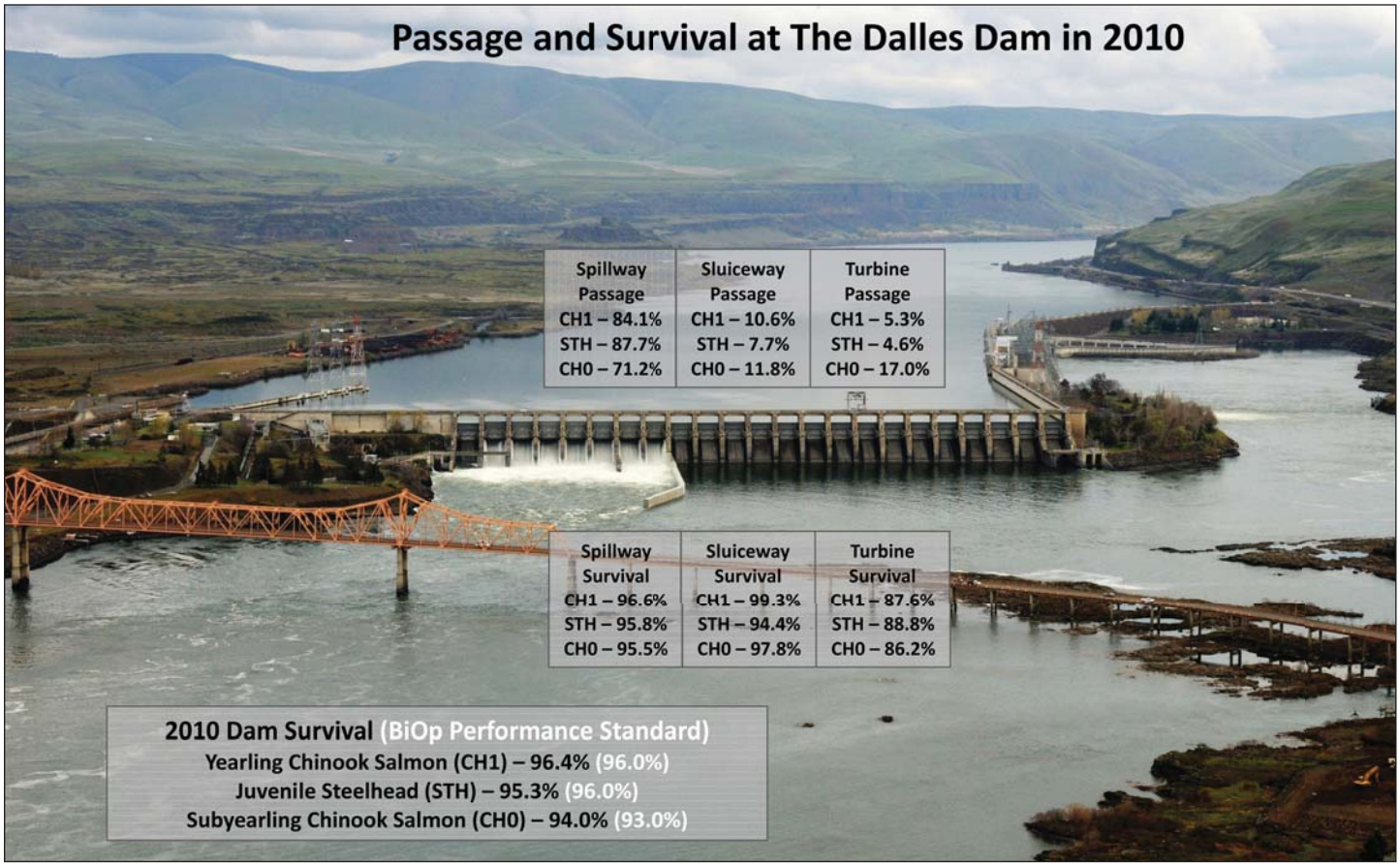



**Figure 9. The Dalles Dam – 2010 Route-Specific Passage and Survival Estimates for Yearling and Subyearling Chinook and Juvenile Steelhead.** CH0 = subyearling Chinook. CH1 = yearling Chinook. ST = steelhead. BiOp performance standards are 96 percent overall survival for yearling Chinook and steelhead and 93 percent for subyearling Chinook.

23 at Lower Granite Dam, May 1 at Little Goose Dam, May 4 at Lower Monumental Dam, and on July 15 at McNary Dam. Until these dates, smolts collected at Snake River dams were bypassed back to the river. Estimated percentages of non-tagged spring/summer Chinook salmon smolts that were transported during the entire 2010 season were 38.2 percent for wild fish and 22.6 percent for hatchery fish. For non-tagged steelhead, estimated percentages transported were 36.8 percent and 34.8 percent for wild and hatchery smolts, respectively (Figure 10). Of the fish transported, 97.7 percent were barged, and the balance transported by truck.

These estimates represent the percentage of smolts that arrived at Lower Granite Dam that were subsequently transported from either Lower Granite or one of the downstream Snake River collector dams. The 2010 estimated number of fish transported was the lowest observed for the period between 1995-2010, with the exception of wild Chinook salmon which had a lower estimate in 2007. The drop in percentage of fish collected and transported is likely related to the installation of the surface passage structures and increased proportion of spill relative to total river flow.

## Water Management and Flow Operations

In addition to fish passage at the dams, operators manage storage reservoirs to enhance fish survival. River flows are augmented with water released from upstream storage dams to help juvenile migration and adult spawning, and to cool water temperatures.

Water managers recognize that available storage—water that actually can be managed—is limited relative to total annual runoff in the Columbia River Basin. Specific operating plans are used at individual reservoirs to provide salmon flows, protect resident fish, manage flood risks, and serve other authorized purposes.

In late 2009, the Action Agencies updated the annual Water Management Plan in coordination with the TMT for use in 2010 to incorporate any changes to the operating plans from the previous year. Both the storage projects and the run-of-river mainstem lower Columbia River and Snake River projects were operated under the plan, in part, to aid juvenile fish passage. Storage projects are: Libby, Hungry Horse, Albeni Falls, Grand Coulee, and Dworshak, while run-of-river projects are Bonneville, The Dalles, John Day, McNary, Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams.

The annual Columbia River Treaty Operating Committee Agreement on Operation of Treaty Storage for Non-Power Uses was executed on December 3, 2009. Under this agreement, 1 million acre feet (maf) of flow augmentation water was stored in Mica Reservoir

from late December through February, and was released for fish benefits by July 31, 2010. Treaty operations were coordinated through regular state and tribal briefings. A new Non-Power Uses Agreement for 2011 was executed on November 3, 2010, which provides for 1 maf of flow augmentation water storage under the same terms as the prior agreement.

In 2010, the Bureau of Reclamation (Reclamation) provided 487 thousand acre feet (kaf) of flow augmentation water from the upper Snake River above Brownlee Reservoir in accordance with the NOAA Fisheries 2008 Upper Snake River Irrigation Projects BiOp. For more information see the December 1, 2010, Annual Progress Report for Reclamation's 2010 Salmon Flow Augmentation Program at: *http://www.usbr.gov/pn/programs/fcrps/uppersnake/index.html*.

### Water Quality

Fish passage spill operations may result in the generation of total dissolved gas (TDG) supersaturation in the Columbia and lower Snake rivers at levels above 110 percent, the current state and federal water quality standards. The states of Washington and Oregon provide limited exceptions to these standards for juvenile fish passage spill. The Corps monitors TDG levels in the river and adjusts spill patterns and spill rates consistent with applicable standards.

To help manage water temperatures in the lower Snake River in the summer, cold water is released from Dworshak Dam on the North Fork Clearwater River from early July through mid-September. The tailwater temperature at Lower Granite Dam did not exceed 68°F at any time during this augmentation season. For a more thorough discussion of how the system was operated in 2010, see the "2010 Dissolved Gas and Water Temperature Report: Columbia River Basin" at: *http://www.nwd-wc.usace.army.mil/tmt/wqnew/tdg_and_temp/2010*.

### Adult Passage Improvements

The vast majority of fish ladders at Columbia and Snake river dams continue to perform well for adult salmon and steelhead. However, John Day Dam ladders were cited in RPA action 28 as a concern with regard to historic problems with fish passage. These problems include adult fish dropping back out into the tailrace after entering the ladders, long passage times, fish jumping out of the ladder in the exit sections, and difficulties with fish counting related to fish delaying just above the count stations. At the John Day north ladder, the main cause of these problems has been attributed to hydraulic issues at two separate locations: the count station exit section area and the lowest section of the ladder from the entrance to the transition pool.

Applying lessons learned from the South Fish Ladder improvements, the Corps completed structural improvements to the upper section (including count station) at the John Day North Fish Ladder in spring 2010. Passage evaluations in 2010 suggest that the upper ladder modifications successfully resolved the chronic delay, jumping, and turn-around problems observed in that section and plans are underway to complete improvements to the lower fishway by 2013.

## Kelt Management

BPA and Corps completed the 2010 Kelt Management Plan (KMP) and released it for comment in December. The goal of kelt management actions is to improve survival and productivity of listed steelhead by allowing kelts to successfully survive and spawn in a subsequent year. The 2010 version of the KMP built upon the framework of the 2009 plan. It includes a review and synthesis of previous research on kelt migration studies through the hydrosystem as well as kelt reconditioning efforts. Beginning with the 2011 KMP, updates and research results will be reported in Columbia River Inter-Tribal Fish Commission's (CRITFC) annual reports, and the focus will shift

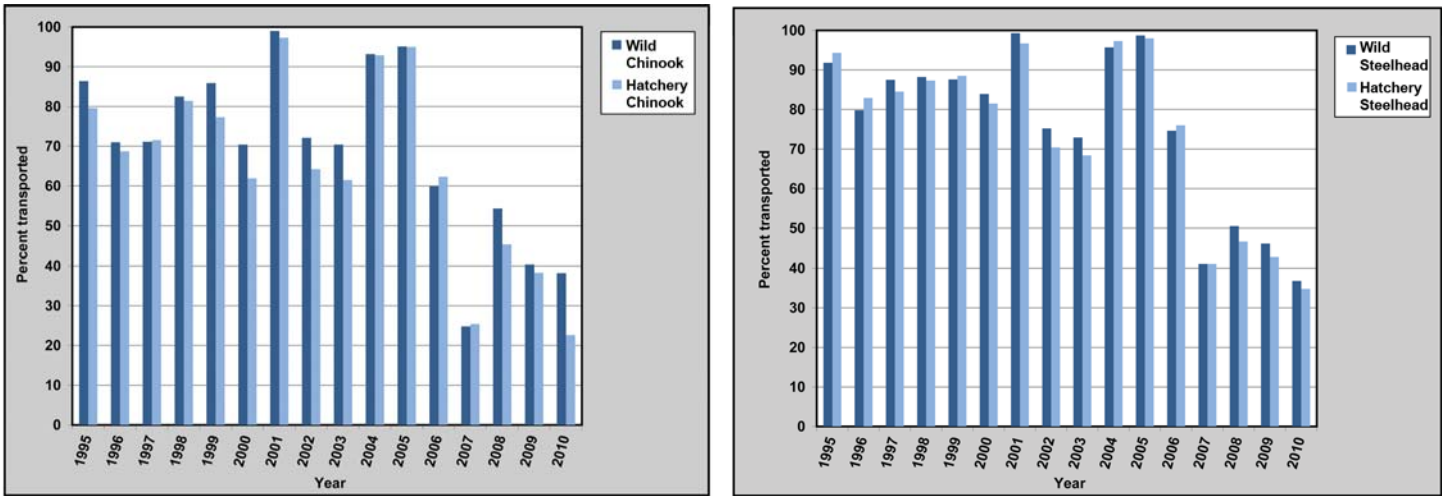



**Figure 10. Estimated Percent of Yearling Chinook Salmon and Steelhead Transported to Below Bonneville Dam by Year (1995-2010)[4].**

[4]*Faulkner, J. R., S. G. Smith, W. D. Muir, D. M. Marsh, J. G. Williams. 2010. Survival Estimates for the Passage of Spring-Migrating Juvenile Salmonids through Snake and Columbia River Dams and Reservoirs, 2010. Report by National Marine Fisheries Service to the U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife, Seattle, Washington, Contract 40735, Project No. 199302900, 100 p.*

**Double-crested cormorant**

from planning to progress and adaptive management actions.

The 2010 KMP discussed research efforts that would continue in 2011 as well as a continued focus on kelt-specific operations at Bonneville and The Dalles dams. As part of the overall package to increase the number of adult B-run Snake River steelhead above Lower Granite Dam, the Action Agencies, along with NOAA Fisheries, developed a benefit analysis based on the 2008-2010 research at The Dalles Dam. Results from those studies allowed the Action Agencies to conclude that by extending the operating season of the ice and trash sluiceway to include December 1-15 and March 1-April 9, a 0.9 percent increase in adult returns would be realized. NOAA Fisheries concurred in benefits to B-run Snake River steelhead, and the operation was implemented. In addition to The Dalles operation, the Bonneville Dam second powerhouse corner collector was opened nearly one month early (March 14) in an effort to provide a safer route of passage for early migrating (primarily lower Columbia River) steelhead kelts.

BPA continued to fund CRITFC to prepare a Master Plan for kelts, and CRITFC has subcontracted portions of this project to the University of Idaho. The Master Plan, which will apply to reconditioning Snake River kelts, is part of a three-step technical review process required by the Northwest Power and Conservation Council's (NPCC) for artificial propagation projects, particularly those that affect natural populations and involve construction of capital facilities. In addition, the Master Plan will focus on kelt collection and reconditioning at various locations, designed to hold fish over so they can spawn in a subsequent year.

## Predator Management

Four main predator species are a major cause of mortality of ESA-listed fish in the Columbia River system. Populations of Caspian terns and double-crested cormorants, which eat large numbers of migrating juvenile fish, have increased over the last two decades in the Columbia River Estuary. These two species are also present in the mid-Columbia region, but at lower numbers. Both Caspian terns and double-crested cormorants are protected under the Migratory Bird Treaty Act of 1918; this complicates Action Agency ability to reduce the impact of these birds on the ESA-listed salmon and steelhead. Among fish, northern pikeminnow are voracious consumers of juvenile salmon and steelhead. California sea lions are known to consume substantial numbers of adult spring Chinook salmon and winter steelhead below Bonneville Dam, and injure many fish that pass upstream. Predation by introduced fish species such as smallmouth bass and walleye is also a concern.

Federal and state agencies are cooperating in efforts to manage and reduce predation on listed species. Programs to redistribute Caspian terns currently nesting in the estuary, deter and block sea lions from Bonneville Dam fish ladders, and reduce the northern pikeminnow population through a sport-reward program have been successful in decreasing the loss of adult and juvenile salmon to predation. In 2010, the Action Agencies continued efforts to control specific predators and improve survival of juvenile fish. Under the RPA, the Action Agencies efforts to manage predation by sea lions are limited to non-lethal deterrent actions at Bonneville Dam.

### Caspian Terns and Double-Crested Cormorants

Caspian terns and double-crested cormorants consumed an estimated 24.3 million, or about 16 percent of the estimated 150 million juvenile Chinook and steelhead to reach the estuary during the 2010 outmigration. The federal agencies have been addressing growing populations of Caspian terns and double-crested cormorants nesting in the estuary as well as those in the mid-Columbia River that prey on juvenile salmon.

Recent efforts to redistribute Caspian terns from Rice Island, in the Columbia River Estuary, to East Sand Island, nearer to the ocean, were successful in reducing predation rates. As intended, the relocation shifted the terns' diet away from juvenile salmon toward a more diverse diet of predominantly marine fish species. (At Rice Island, juvenile salmon previously made up 75 percent to 90 percent of the terns' diet.)

In 2010, the Caspian tern colony on East Sand Island consisted of about 8,283 breeding pairs, significantly smaller than in 2009 and the smallest the colony has been since it became fully established in 2001 (Figure 11). Caspian terns nesting at the East Sand Island colony consumed about 5.3 million juvenile salmonids (95 percent c.i. = 4.5 – 6.1 million) in 2010, lower but not significantly different than the smolt consumption estimates from the previous two years. Since 2000, the average number of smolts consumed by Caspian terns nesting on East Sand Island was 5.3 million smolts per year, less than half the annual consumption of juvenile salmonids by Caspian terns in the Columbia River Estuary prior to 2000, when the breeding colony was located on Rice Island.

Implementation of the Caspian Tern Management Plan for the Columbia River Estuary continued in 2010, with the construction of one new nesting island prior to the nesting season. This, together with the construction of three islands in 2009 after the nesting season, allowed a reduction in available tern nesting acreage on East Sand Island to 3.1 acres in 2010.

In 2010, East Sand Island was also home to the largest double-crested cormorant colony in western North America, consisting of about 13,596 breeding pairs (Figure 11). This was the second consecutive year in which colony numbers grew by more than 10 percent. By comparison, the cormorant colony on East Sand Island totaled only about 100 pairs in 1989.

Juvenile salmonids represented about 16.4 percent of the diet of double-crested cormorants nesting on East Sand Island in 2010, compared with 9.2 percent in 2009, resulting in a total consumption of approximately 19.2 million juvenile salmonids (95 percent c.i. = 14.6 – 23.8 million) in 2010, the highest smolt consumption estimate ever recorded at the East Sand Island cormorant colony.

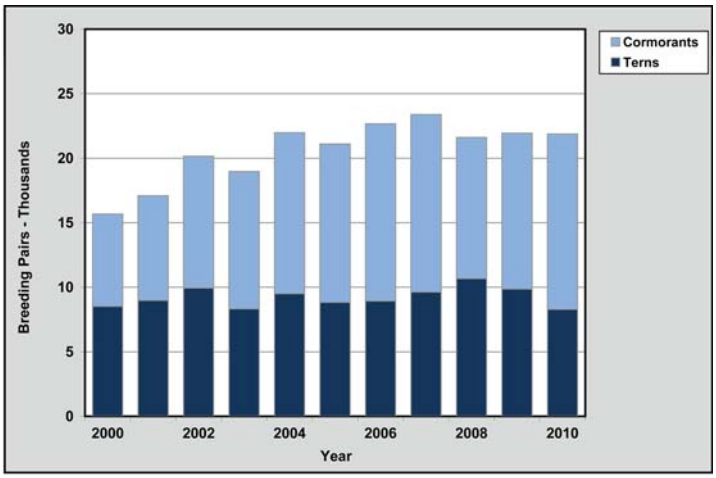
Management options to reduce or limit smolt losses to the double-crested cormorant colony on East Sand Island are under consideration. To reduce predation on juvenile salmonids by double-crested cormorants in the Columbia River Estuary, it may be necessary to reduce the size of the cormorant colony on East Sand Island. Non-lethal management approaches, such as relocating a portion of the colony to alternative colony sites along the Pacific coast, seem more appropriate in the context of the cormorant colony on East Sand Island, whose growth appears to be at the expense of other colonies in the region.

Further up-river in the Columbia Plateau region, Caspian terns and double-crested cormorants are also responsible for most of the smolt losses to avian predators. In 2010, the largest breeding colonies of Caspian terns in the Columbia Plateau region were on Crescent Island (in McNary Pool) and Goose Island (Potholes Reservoir, in Washington), where 375 and 416 pairs nested, respectively. Caspian tern nesting success at Crescent Island averaged 0.52 young raised per nesting pair, higher than it has been in recent years, while the Goose Island tern colony experienced almost complete nesting failure in 2010. Three other smaller Caspian tern colonies in the Columbia Plateau region also failed or nearly failed to produce any young. In 2010, salmonid smolts represented 71 percent of tern prey items at the Crescent Island colony and 21 percent of tern prey items at the Goose Island colony; estimated smolt consumption was 420,000 and 122,000 smolts, respectively. The largest colony of double-crested cormorants on the mid-Columbia River was on Foundation Island (in McNary Pool), where 308 pairs nested in 2010. Sampling during 2005-2010 indicated that about 50 percent (by mass) of the diet of Foundation Island cormorants was juvenile salmonids during May (the peak of smolt out-migration), while less than 10 percent of the diet was salmonids in early April, June, and July.

In the reach from John Day to Bonneville dams, new avian predation deterrent wires over John Day tailrace and the completion of a spillway wall at The Dalles Dam both appeared to contribute to improved smolt survival. At John Day Dam, the new wire array and boat hazing in the tailrace resulted in a 76 percent reduction of smolt consumption by California gulls from 2009 to 2010 (Zorich et al. in prep)[5]. Preliminary estimates of survival from the upstream face through the tailrace of John Day Dam were 94.7 percent and 96.1 percent for acoustic-tagged yearling Chinook salmon and steelhead, respectively (Weiland et al. 2010). Preliminary estimates of yearling Chinook salmon and steelhead survival were 96.4 percent and 95.3 percent through The Dalles Dam (Skalski et al. 2010) and 96.3 percent and 95.6 percent through Bonneville Dam (Ploskey et al. 2010).

### Northern Pikeminnow

Large northern pikeminnow are voracious consumers of juvenile salmon. Since 1990, BPA has funded the Northern Pikeminnow Management Program (NPMP) to reduce the numbers of larger pikeminnow and improve survival of juvenile salmon. The NPMP relies on private-sector fishing efforts to provide the majority of the catch of northern pikeminnow. In 2010, the BPA reward for the catch of this predator was sustained at a higher-tiered monetary level than initiated in 2005. This reward structure helps sustain the higher catches and, in 2009, resulted in the highest harvest rate of pikeminnow



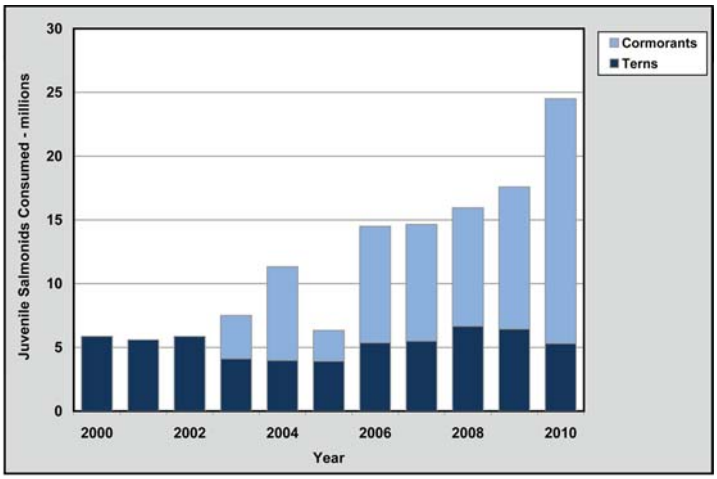




**Figure 11. Abundance of Colonial Birds and Consumption of Juvenile Salmon in the Columbia River Estuary.** Estimates of consumption by cormorants not available for 2000 – 2002.

**Table 4. Consumption of Salmonids by California Sea Lions, Steller Sea Lions, and Harbor Seals at Bonneville Dam, From Surface Observations Conducted Between 2002 and 2010. Total salmonid passage counts include all adult salmonids that passed Bonneville Dam from Jan**uary 1 through May 31. "Expanded" estimates correct for the fact that observers are not present at all times. "Adjusted" estimates further correct to account for catch events where the prey species could not be identified. Source: Evaluation of Pinniped Predation on Adult Salmonids and Other Fish in the Bonneville Dam Tailrace, 2008-2010, *http://www.nwd-wc.usace.army.mil/tmt/documents/fish/2010/2008-2010_Pinniped_Report.pdf*

| Year | Bonneville Dam salmonid passage (Jan. 1-May 31) | Expanded salmonid consumption estimate | | Adjusted salmonid consumption estimate | |
|---|---|---|---|---|---|
| | | Estimated consumption | % of run (Jan. 1 to May 31) | Estimated consumption | % of run (Jan. 1 to May 31) |
| 2002 | 284,733 | 1,010 | 0.4 % | - | - |
| 2003 | 217,185 | 2,329 | 1.1 % | - | - |
| 2004 | 186,804 | 3,533 | 1.9 % | - | - |
| 2005 | 82,006 | 2,920 | 3.4 % | - | - |
| 2006 | 105,063 | 3,023 | 2.8 % | 3,401 | 3.1 % |
| 2007 | 88,474 | 3,859 | 4.2 % | 4,355 | 4.7 % |
| 2008 | 147,543 | 4,466 | 2.9 % | 4,927 | 3.2 % |
| 2009 | 186,060 | 4,489 | 2.4 % | 4,960 | 2.7 % |
| 2010 | 267,194 | 6,081 | 2.2 % | 6,321 | 2.4 % |

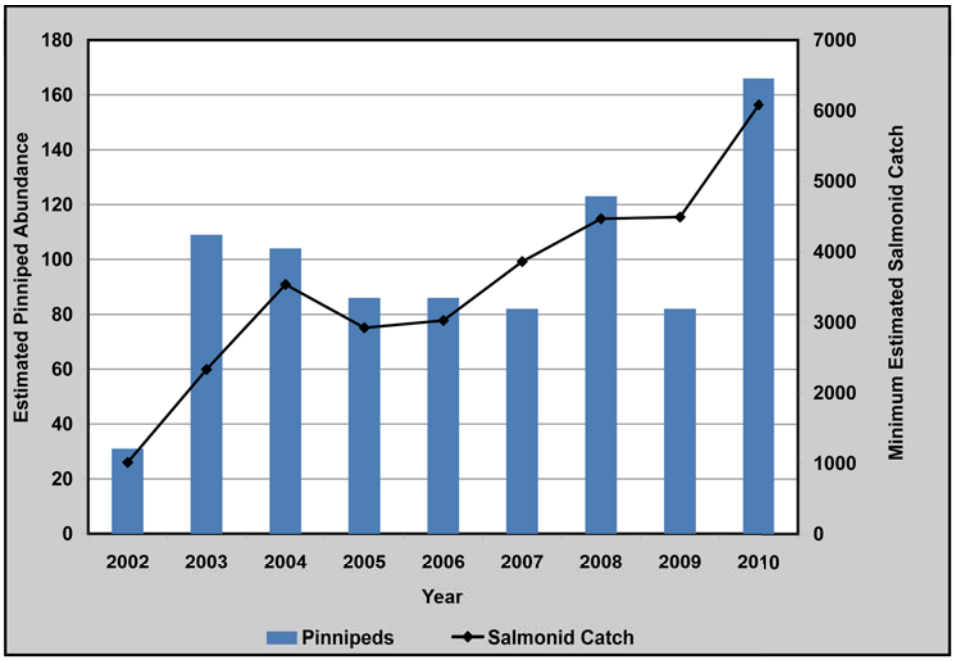



**Figure 12. Estimated Minimum Number of Adult Salmonids Consumed by Pinnipeds and Estimated Total Number of Pinnipeds Seen at Bonneville Dam January 1–May 31, from 2002 to 2010.** In 2005, regular observations did not start until March 18. Pinnipeds observed included California sea lions, Steller sea lions, and harbor seals. Source: Evaluation of Pinniped Predation on Adult Salmonids and Other Fish in the Bonneville Dam Tailrace, 2008-2010, *http://www.nwd-wc.usace.army.mil/tmt/documents/fish/2010/2008-2010_Pinniped_Report.pdf*

since program inception. In addition, program managers continued the dam-angling program component initiated in 2009. This program provided two fishing crews that focused on the forebay and tailrace sections of The Dalles and John Day dams—areas not accessible to the general fishing public. A total of 3,964 northern pikeminnow were caught at those locations in 2010.

In 2010, the exploitation rate on northern pikeminnow was 15.2 percent. This rate was based on a numerical catch of 178,981 from the sport reward and dam angling fisheries.

The NPMP has removed close to 3.5 million pikeminnow from the Columbia River since 1990. Evaluation indicates that, as a result, pikeminnow predation on juvenile salmon has declined 38 percent in that time, saving 4 to 6 million juvenile salmon annually that otherwise would have been eaten by this predator.

## California Sea Lions at Bonneville Dam

In recent years, California sea lions, which are protected under the Marine Mammal Protection Act (MMPA), have been observed swimming more than 140 miles up the Columbia River to Bonneville Dam to prey in increasing numbers on adult spring Chinook salmon, winter steelhead, and white sturgeon. Generally arriving from mid to late February and leaving by the first week in June, these male sea lions are gaining weight in preparation for the summer mating season.

Corps biologists began gathering data on sea lion presence and predation at the dam in 2001, when six California sea lions were documented. In 2002—the first full season of monitoring—30 sea lions were counted. In 2004, 101 sea lions were counted, and in 2005 the number was estimated at 87 or more. From 2006 to 2008, the number went from 72 to 84. Not all sea lions counted were at the dam at the same time; usually about 30 were present on any one day. The number of fish eaten by sea lions has increased every year from 2006 to 2010 (Table 4). In 2002, the expanded consumption estimate was 1,010 adult salmon and steelhead that

would otherwise have passed Bonneville Dam from January 1 through May 31. The 2010 expanded adult salmonid catch estimate for the Bonneville Dam tailrace observation area was 6,081 (Figure 12), or about 2.2 percent of the adult salmonid run at Bonneville Dam from January 1 through May 31, 2010. This is the lowest percentage since 2004. California sea lions were the primary salmonid predator, accounting for 84 percent of the observed salmonid catches. Catch by Steller sea lions increased, from 0.3 percent in 2007 to 16 percent of total salmonid take in 2010.

The Corps has implemented a variety of sea lion deterrents, from physical barriers to non-lethal harassment. Sea lion exclusion devices were installed at Bonneville Dam to prevent sea lions from entering the fish ladders through the 12 primary fishway entrances. Corps biologists also coordinated with U.S. Department of Agriculture personnel and boat-based crews from the Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife (WDFW), and CRITFC on all sea lion harassment activities at Bonneville Dam. In addition, the Action Agencies supported CRITFC in conducting monitoring and non-lethal harassment efforts to deter marine mammal predation downstream of the dam.

In 2010, under the MMPA nuisance sea lion removal authority, the states trapped 22 California sea lions. Fourteen were on the list for removal and were euthanized. In addition, two California sea lions on the list for removal were trapped in Astoria, Oregon, in September 2010 and euthanized. The others were tagged and released.

## Habitat Protection and Improvement Actions

Columbia River habitat, both estuary and tributary, is important to salmon in their complex life cycle. Each year, the Action Agencies spend tens of millions of dollars under the RPA and the Columbia Basin Fish Accords to implement actions that improve the quantity and quality of habitat used by salmon in the estuary and tributaries. In coordination and partnership with tribes and federal, state, and local parties, the Action Agencies are increasing the volume of water in streams, installing or retrofitting fish screens at water diversions to keep fish safely out of irrigation canals, reconnecting side channels and floodplains to add complex and diverse habitats, removing barriers to expand access to blocked habitat, and acquiring easements or other protective interests for riparian areas along tributaries.

### Tributary Habitat

In 2010, the Action Agencies continued to expand an already significant tributary habitat program and targeted key factors known to limit the survival of specific salmon and steelhead populations. The expanded program uses up-to-date biological information to target habitat actions proposed by local watershed groups to support fish populations with the greatest biological need. The program also uses local expert panels to estimate improvements from proposed and implemented actions. In addition to these population-focused efforts, the Action Agencies maintained or expanded efforts for other anadromous fish populations.

Projects to protect, improve, or restore critical fish habitat employ different approaches, depending on location, targeted to the specific limiting factors found in the individual watershed. The following sections summarize Action Agency accomplishments from 2005 to 2010 and provide examples of the work completed in 2010.

#### Increasing Water Quantity and Quality through Water Transactions

Fish survival can suffer from the combined effect of naturally low summer flows and water withdrawals for human uses. One of the most effective and immediate steps the Action Agencies take to improve fish habitat is to lease or purchase water rights or install water efficiency improvements to increase the amount of water in streams. This in turn provides immediate improvements to salmon and steelhead survival by reducing thermal stress and providing higher quality habitat for spawning and juvenile rearing. Since 2005, the Action Agencies protected approximately 255,800 acre-feet of instream water in the Columbia River Basin (Figure 13).

In 2010, BPA worked with the National Fish and Wildlife Foundation, state water agencies, local water trusts, and others to implement over 35 water transactions

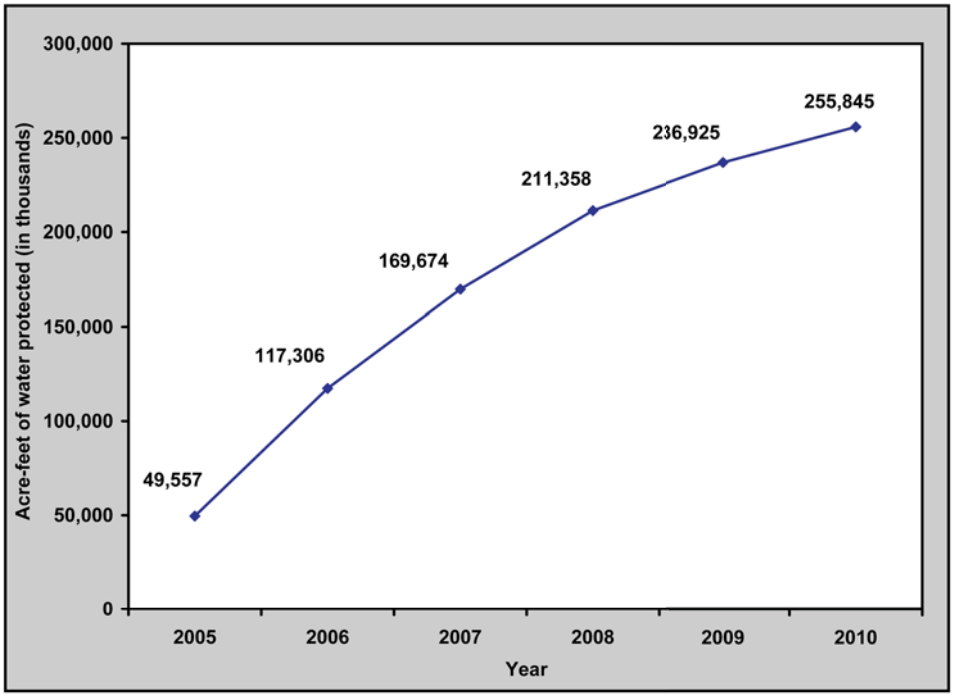



**Figure 13. Water Protected, in Acre-Feet of Instream Flow, 2005-2010.** Cumulative acre-feet/year can include annually renewed leases.

**Before: Big Timber Creek de-watered during irrigation season.**

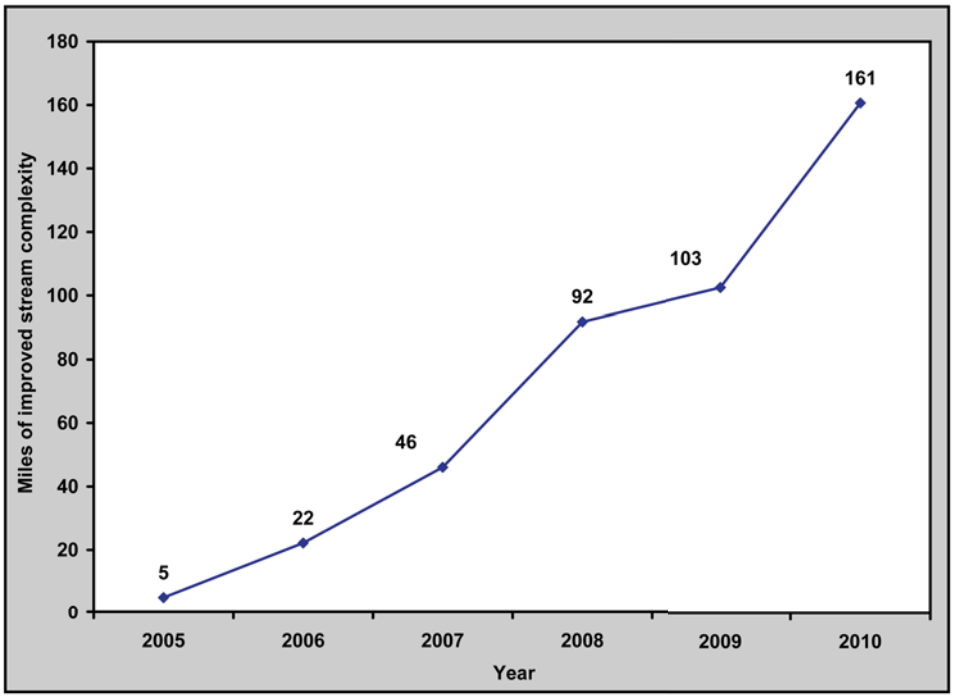



**Figure 14. Miles of Improved Stream Complexity, 2005-2010**

**After: Big Timber Creek with 4.5 cfs instream flow restored from water transaction provides continuous access to approximately 15 miles of steelhead and Chinook habitat.**

in streams as part of the Columbia Basin Water Transactions Program (CBWTP), as well as through associated water transaction projects under the Idaho Accord and the Umatilla Accord. These efforts resulted in approximately 18,920 acre-feet/year of instream water to enhance flows throughout the Columbia River Basin.

One of the highlights from 2010 was a water transaction on Big Timber Creek, a tributary to the upper Lemhi River near Leadore, Idaho. The creek has high-quality steelhead and Chinook salmon habitat in the upper reaches. However, the lower two miles of the creek are dewatered during the irrigation season (March-November). In collaboration with Idaho Department of Water Resources (IDWR) and the irrigator, 4.5 cubic feet per second (cfs) of flows were restored to the lower end of Big Timber Creek. This water transaction work, combined with other fish passage efforts along the creek, will help provide access to 15 miles of habitat for steelhead and Chinook.

**Before: Spring Creek Channel choked with reed canary grass.**

**After: Spring Creek Reed canary grass replaced with large wood.**

### Improving Habitat Complexity

Salmon evolved in streams that meandered, with multiple channels, and flooded seasonally. The complex habitats these processes created provided important rearing areas for juvenile salmon and steelhead, as well as cool-water refuges during the heat of summer. Human development has changed the nature of most of the Columbia River Basin's river systems, depriving salmon of some of these habitat attributes.

An important component of the Action Agencies' habitat program involves funding actions and providing technical assistance to improve channel complexity by reconnecting side channels and, where feasible, increasing floodplain function to improve instream habitat conditions. The Action Agencies have improved 161 miles of stream since 2005, with 58 miles completed in 2010 (Figure 14).

One example of this type of work involved the removal of reed canary grass and the placement of large wood

within Russell Springs (Spring Creek) on the Tucannon River. This project, implemented by the Confederated Tribe of the Umatilla Indian Reservation, enhanced a stream channel that provides spawning and rearing habitat for adult steelhead and holding habitat for juvenile Chinook. Since completion of this project, adult steelhead have been observed upstream of the pictured culvert.

**Improving and Protecting Riparian Areas to Improve Water Quality**

Riparian habitat—the streamside environment—makes a major contribution to water quality and long-term salmon survival. While only the short-term anticipated impacts of actions to improve and restore degraded riparian habitat are credited toward achieving the BiOp targets, many of those actions will continue to accrue benefits beyond 2018. In addition, because these actions can help moderate stream temperatures, they are an important hedge against the longer-term effects of climate change, which are expected to cause stream temperatures to increase seasonally throughout the Columbia River Basin.

Riparian habitat can be protected through land purchases or conservation easements, which aim to reduce adverse land use impacts. In many instances, plantings or natural revegetation can reestablish a viable riparian zone by providing shade and other benefits for the stream. Since 2005, the Action Agencies have improved approximately 5,700 acres and protected almost 49,000 acres. These improvements provide habitat benefits that will help keep water cool and clean for ESA-listed populations (Figure 15).

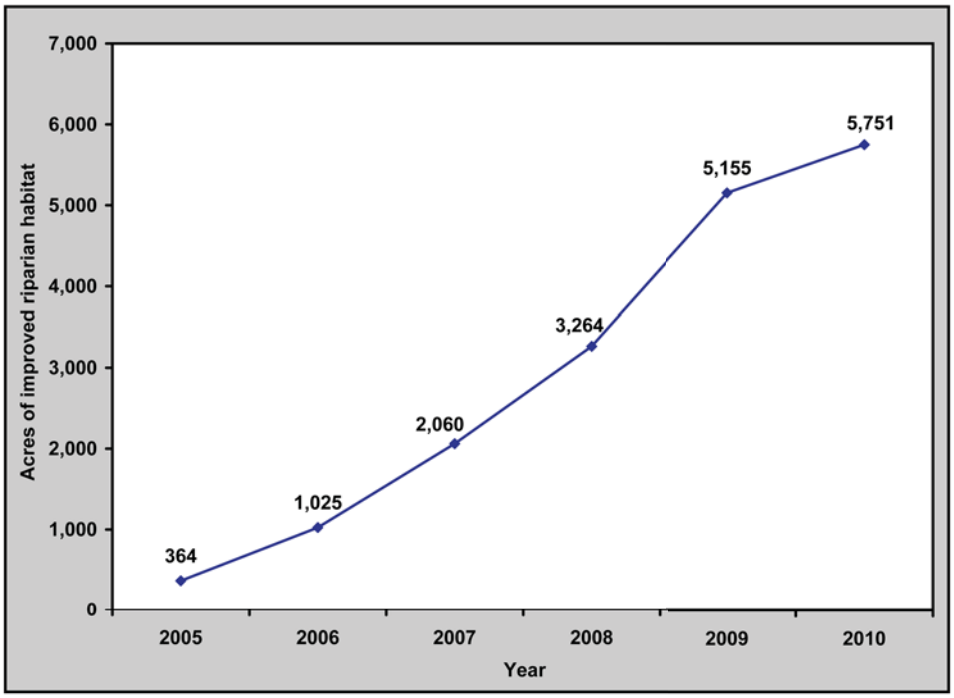



**Figure 15. Acres of Riparian Habitat Improved, 2005-2010.** Note: Improvement measures include creating, connecting, or realigning channels; conducting controlled burns; planting; practicing no-till farming; removing mine tailings and invasive plant species; enhancing floodplains; or restoring wetlands.

**Reducing Fish Entrainment at Irrigation Diversions**

The Action Agencies have been funding projects to replace, improve, and install fish screens at irrigation diversions to prevent fish from becoming trapped, or entrained, in irrigation ditches. The fish screens, which are designed according to state and federal criteria, keep fish in the streams—out of irrigated fields—and thus provide immediate improvements to juvenile fish survival. Diversion consolidation projects combine two or more surface diversions into one-reducing the number of diversion and screen facilities fish must navigate. Some fish screen projects entirely eliminate the need for screens- and associated surface water diversions- by replacing surface diversions with groundwater wells. The latter type of screen elimination project also results in more instream flow for fish while maintaining the original off-stream water use. Screens also are installed where irrigation canals rejoin the main river. Adults returning to spawn can be attracted by irrigation "return flows". Adults or their eggs can perish in the irrigation canal when flow in the canal is stopped at the end of the irrigation season. In 2010, the Action Agencies addressed fish entrainment with installation of 41 fish screens (Figure 16).

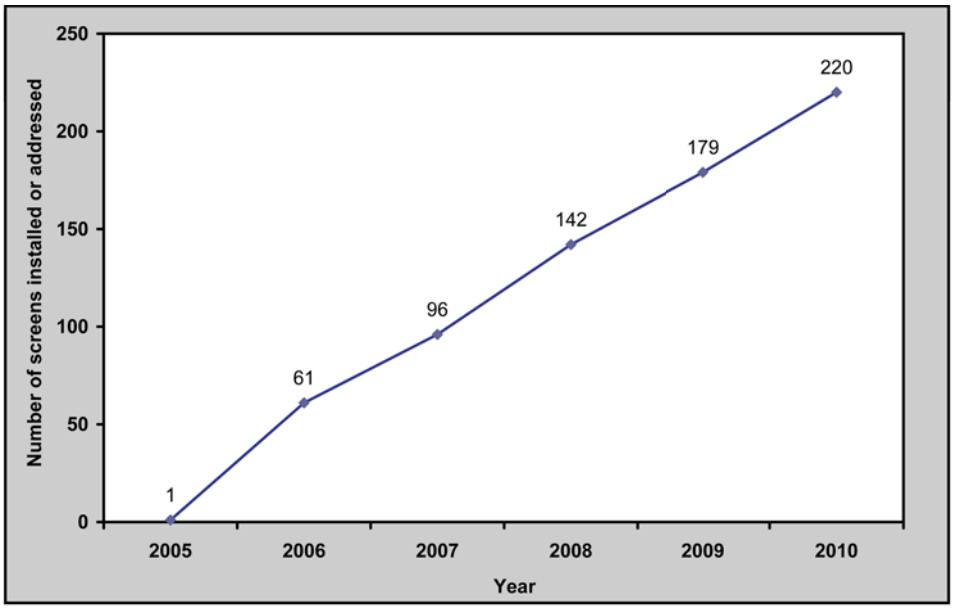



**Figure 16. Number of Fish Screens Addressed, 2005-2010.**

**Before: Bridge Creek unscreened irrigation diversion.**

**After: Bridge Creek irrigation diversion screen.**

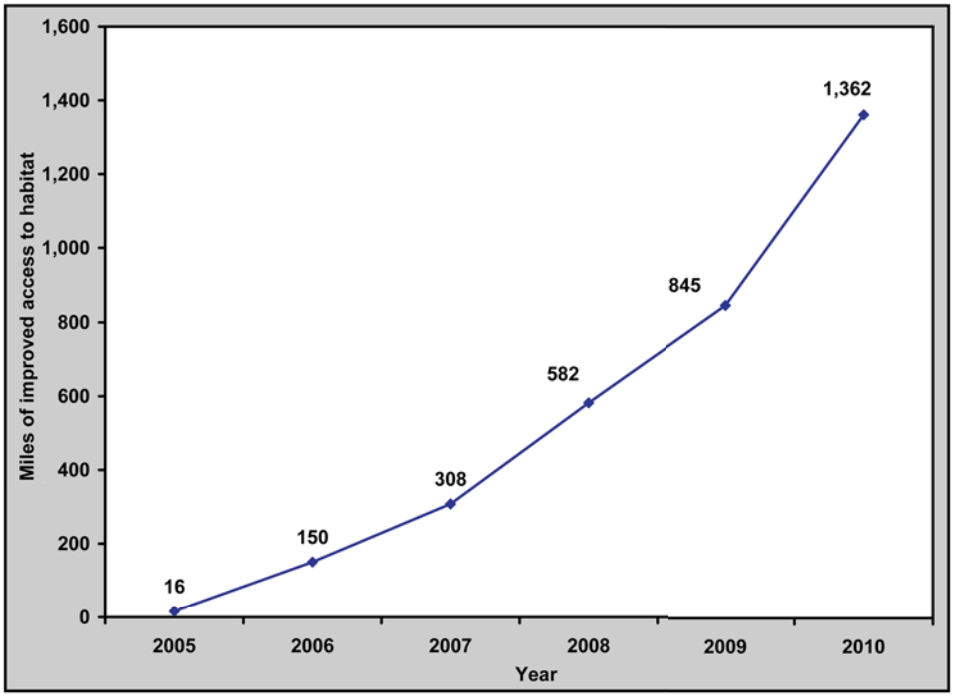



**Figure 17. Miles of Habitat Made Accessible, 2005-2010.**

**Before: Culvert on Iron Creek prevented juvenile access to upstream habitat.**

**After: Bridge over Iron Creek provides unrestricted access for juveniles and adults.**

One example of this type of work involved the installation of a screen on a Bridge Creek irrigation diversion in the John Day River Basin. Approximately 1.1 cfs of irrigation water flows through this diversion. The screen prevents entrainment of mid-Columbia steelhead, mid-Columbia spring Chinook salmon, and redband trout.

#### Improving Access to Spawning and Rearing Habitat

High quality spawning and rearing habitat generally is associated with higher fish survival from the egg to smolt stage and provides better food sources and protection from predators. Human development has restricted access to significant portions of the historical range of Columbia River Basin salmon and steelhead in many Columbia River tributaries. Many of these blockages can be fixed without adversely affecting agricultural activities. Since 2005, the Action Agencies have improved access to approximately 1,300 miles of instream habitat for anadromous fish (Figure 17).

In 2010, the Action Agencies funded projects that opened or enhanced access to 500 miles of fish habitat. One example of this type in Iron Creek, a tributary to the Salmon River in Idaho, involved the replacement of a culvert with a bridge. Iron Creek provides habitat for salmon, steelhead, and bull trout. The culvert prevented juvenile passage to upstream habitat. The new bridge provides unrestricted access for juveniles and adults.

### Estuary Habitat Actions

Fish from throughout the Columbia River Basin use the Columbia River Estuary for varying amounts of time during all months of the year. The estuary's diverse habitats provide food and refuge for juvenile salmon for rearing and migrating as they make their critical transition from fresh water to salt water. Adult salmon returning to the Columbia River also pass through the estuary as they migrate to their spawning grounds.

In 2010, the Action Agencies completed on-the-ground projects in the estuary and continued planning and development of additional projects for future implementation. Table 5

summarizes the estuary habitat metrics accomplished in 2010 with Action Agency funding assistance. Figures 18 and 19 show cumulative improvements since 2002.

One of the estuary habitat projects implemented by the Action Agencies in 2010 was the Haven Island Restoration Project (*photos page 20*). This project restored much of the natural hydrologic connectivity to 80 acres of disconnected tidal floodplain islands within the Youngs River Estuary. The project also reconnected 700 feet of historical tidal channels to the estuary by removing 500 feet of an existing levee, opened up 800 feet of historical tidal channels by removing a tidegate, removed and controlled invasive plants, and planted approximately three acres with Sitka spruce and other on-site native shrubs/trees. This project resulted in the restoration and enhancement of 80 acres of tidally-influenced emergent wetlands within the Columbia River Estuary, including providing diverse off-channel habitat for juvenile salmonids. In 2009, baseline data were collected and in 2010, project-level effectiveness monitoring efforts began.

In 2010, the Corps contracted for a structural, hydraulic, and environmental analysis of Columbia River pile dikes to identify which pile dike structures are needed to support the Corps' navigation responsibilities, provide a preliminary analysis of habitat associated with each pile dike, and inventory "essential" and "non-essential" piling for maintaining the navigation channel. Non-essential pilings are considered candidates for removal or modification to improve habitat access for juvenile salmon as well as reduce avian predation. Essential pilings are candidates for "capping" to reduce avian predation. Field observations were completed in 2010. The final report, including findings and recommendations, is scheduled for completion in 2011.

As part of an overall adaptive management strategy that assists the Action Agencies in identifying and responding to new information arising during implementation, the Action Agencies addressed the delays in

**Table 5. Summary of Estuary Habitat Restoration Metrics, 2010.**

| Action | Metric |
|---|---|
| Improve and restore streams/channels | 2 linear miles |
| Plant/maintain native vegetation and remove invasive species in riparian or wetlands | 796 acres |
| Levee removal: reconnect historic tidal channels | 700 feet |
| Tide gate removal: open up historic tide channels | 800 feet |

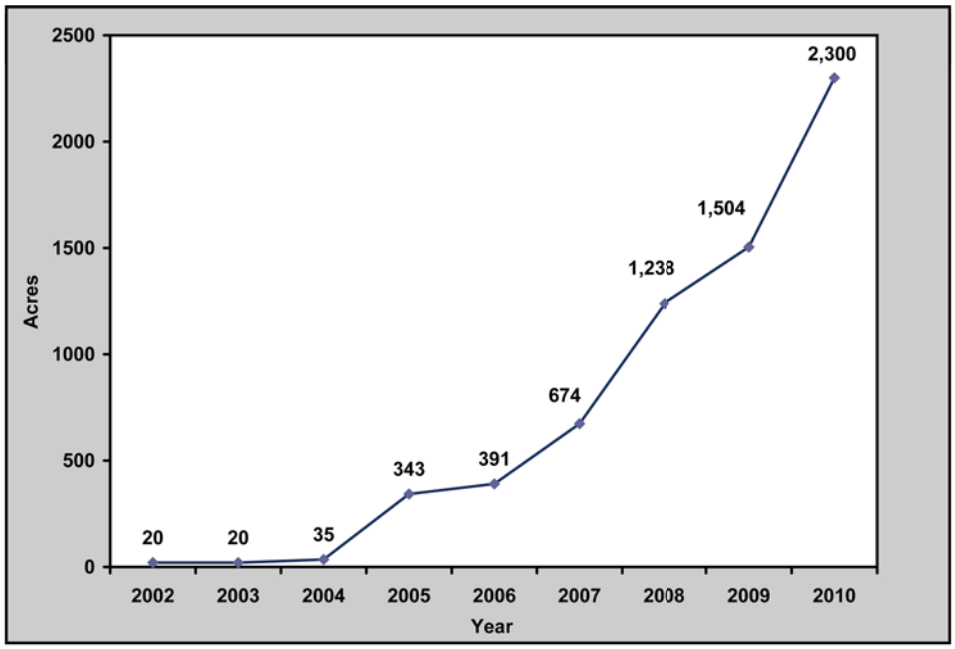



**Figure 18. Estuary Floodplain Access Improved, 2002-2010.** Improved access includes breaching or lowering dikes and levees and enhancing floodplains for salmon benefit.

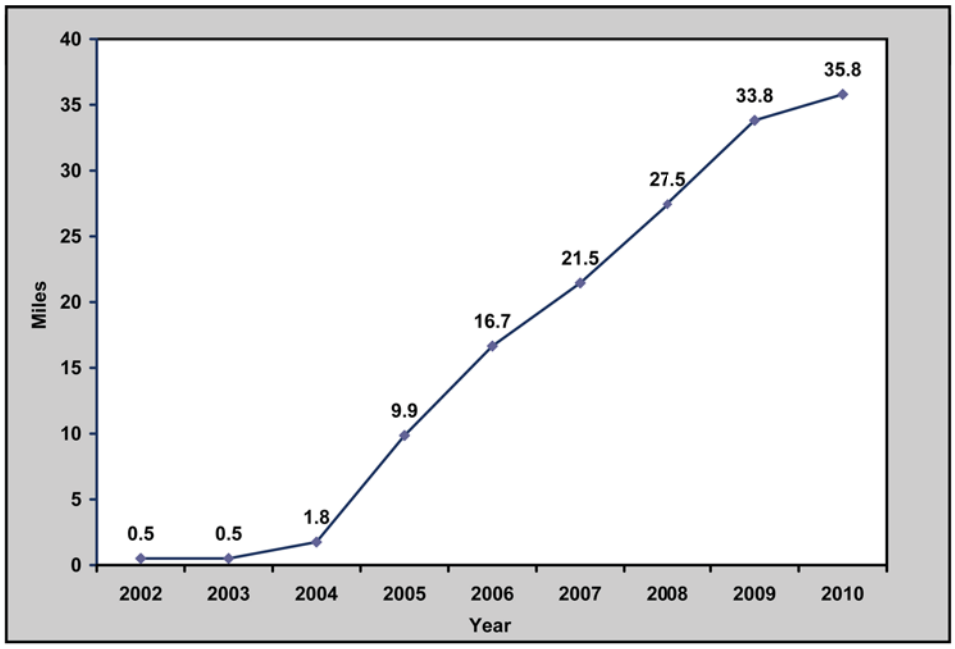



**Figure 19. Estuary Riparian Area Improved, 2002-2010.** Improvement measures include native riparian plantings, removal of invasives, and increasing complexity by adding large woody debris.

**Before: BPA partnered with Columbia Land Trust on Haven Island restoration efforts. Pictured is a levee on Haven Island before it was breached.**

**After: The same levee on Haven Island from a different angle after the levee was breached. Breaching this levee helps provide important habitat for juvenile salmonids in the estuary.**

project implementation in the estuary by significantly increasing project development efforts to increase on-the-ground projects and accelerate the pace of implementation.

In order to better assess benefits from habitat improvements in the estuary, the Expert Regional Technical Group (ERTG) addressed improvements to the quantitative methodology for scoring ecosystem restoration projects for Survival Benefit Units (SBUs). This enhanced scientific rigor for restoration planning and development in the estuary. Additionally, the ERTG produced the following products that the Action Agencies and their partners are utilizing for habitat project development:

- Scoring Criteria that ERTG uses in evaluating each project.
- "ERTG Template" that describes each project, provides a problem statement for the site, then develops the actions that will be taken at each site for use in scoring the SBUs.
- A SBU Calculator to score each individual project. This improvement to the scoring process ensured the integrity of the scoring process but also made it transparent and repeatable.

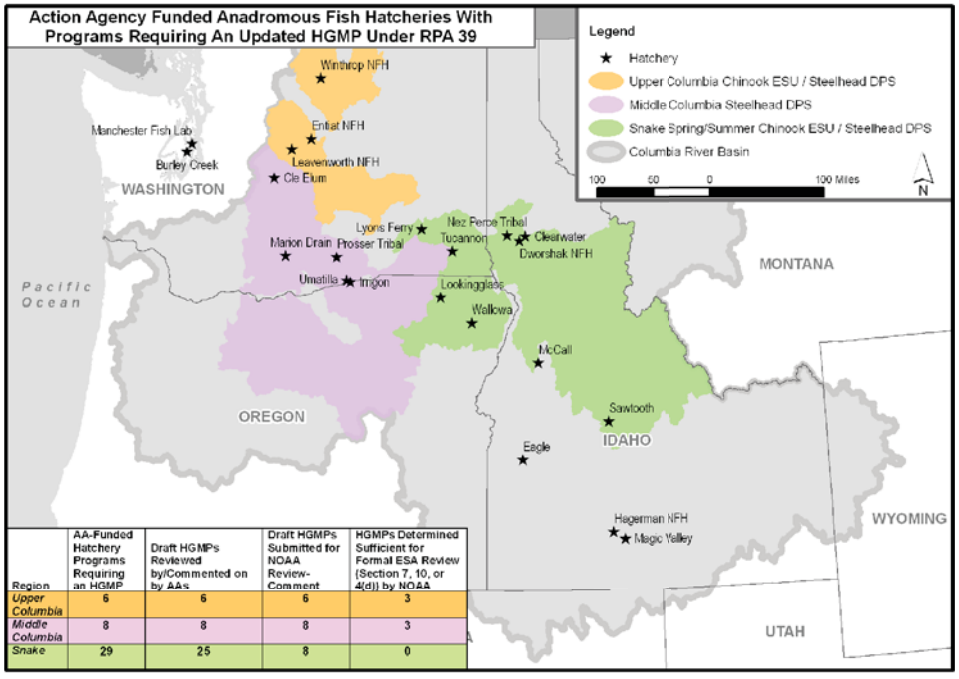
The Action Agencies have used these products to improve development of estuary projects. The Action Agencies also developed a Program Management Plan (PGMP) for the Estuary Habitat Restoration Action Plan. The PGMP provided definition to how the Action Agencies would enhance restoration project development. An outcome of these actions is an increased capability for project development in conjunction with partners leading to a significant increase of projects being brought to the Action Agencies for evaluation and determination for future actions.

Projects for future implementation are continuing to be identified using other emerging tools such as the Columbia River Estuary Ecosystem Classification System (CREEC). CREEC is being developed by scientists from the University of Washington and the United States Geological Survey, and is scheduled for completion in 2012. The objective of the classification system is to provide a framework to map and aid understanding of the highly variable and dynamic estuary ecosystem, so that the enhancement projects with the highest biological benefits can be identified and prioritized for implementation. In this way, CREEC supports planning, preservation, restoration, and management activities as well as research and monitoring.

In 2010, the Action Agencies hosted a scientific workshop to begin application of sections of the CREEC that have been completed. The workshop engaged a science panel, local experts, planners, and project managers to identify areas and projects in the estuary that will provide the highest benefits for the 13 listed ESUs in the Columbia River.

## Hatchery Actions

The Action Agencies continue to fund an extensive existing hatchery program as off-site mitigation for the federal dams, including conservation hatcheries for listed fish, while preparing for scientifically based hatchery reforms throughout the Columbia River Basin. BiOp RPA action 39 requires updated Hatchery and Genetic Management Plans (HGMPs) for 43 Action Agency-funded anadromous hatchery programs




| Region | AA-Funded Hatchery Programs Requiring an HGMP | Draft HGMPs Reviewed by/Commented on by AAs | Draft HGMPs Submitted for NOAA Review-Comment | HGMPs Determined Sufficient for Formal ESA Review (Section 7, 10, or 4(d)) by NOAA |
|---|---|---|---|---|
| *Upper Columbia* | 6 | 6 | 6 | 3 |
| *Middle Columbia* | 8 | 8 | 8 | 3 |
| *Snake* | 29 | 25 | 8 | 0 |

**Figure 20. Action Agency-Funded Anadromous Fish Hatcheries with Hatchery Programs Requiring an Updated HGMP and ESAConsultation under Biop Rpa Action.**

in the upper Columbia, mid-Columbia, and Snake river regions of the basin (Figure 20). The updated and complete HGMPs will be submitted to NOAA Fisheries for analysis of hatchery impacts on listed species as part of NOAA's ESA consultation process for all hatchery programs in the three regions.

In 2010, the Action Agencies facilitated HGMP development to assist the operators in completing their ESA compliance. The Action Agencies worked with hatchery operators to revise 39 draft HGMPs which were submitted to NOAA for ESA consultation. The HGMPs identify operations to meet production requirements and to reduce or eliminate detrimental genetic and ecological effects on listed species. The Action Agencies' strategy is to ensure that FCRPS mitigation hatchery programs are aiding conservation and not impeding recovery of salmon ESUs or steelhead DPSs.

The Lower Snake River Compensation Plan and WDFW staff continued planning for specific hatchery reform actions to transition the Tucannon River and Touchet River steelhead hatchery programs from Lyons Ferry Hatchery broodstock to local broodstock. In 2010, WDFW developed revised HGMPs for both of these hatchery programs.

The Action Agencies also continued to fund safety-net programs to reduce the extinction risk of at-risk populations of ESA-listed Snake River sockeye salmon and Snake River spring/summer Chinook. One of those programs, the Snake River Sockeye Salmon Captive Broodstock Program, preserves this critically imperiled species. The program has produced hundreds of thousands of progeny from remnants of the wild stock. The progeny are raised in carefully managed hatcheries and released into their natural habitats as mature adults to spawn or as juveniles to migrate downstream. Since 1999, 3,193 adults from the program have returned to Idaho's Redfish Lake or the Sawtooth Hatchery weir on the upper Salmon River. In 2010, 1,355 adults returned to these two locations, eclipsing the 2009 return of 833 adults. The 2010 return was the largest recorded annual return since 1956.

The BiOp calls for the Action Agencies to expand the program to produce between 500,000 and 1 million smolts annually. For several years, BPA worked with the state of Idaho and Idaho Department of Fish and Game (IDFG) to identify and begin the acquisition process for a hatchery property with adequate water quantity and quality to achieve the expanded production level. In July 2010, the Springfield Hatchery property in southeastern Idaho was acquired to help meet this BiOp action.

The Action Agencies continued to fund hatchery conservation programs for salmon and steelhead to preserve and rebuild genetic resources and assist in promoting recovery of listed ESUs and DPSs. During 2010, BPA continued funding two projects to recondition upper and mid-Columbia River steelhead kelts and increase spawner abundance of these threatened DPSs. BPA also continued funding of conservation programs for upper Columbia spring Chinook, Snake River steelhead, and Snake River sockeye, as well as a project aimed at reintroducing Columbia River chum salmon in lower Columbia River tributaries below Bonneville Dam and increasing the abundance of this threatened ESU.

## Harvest

Harvest impacts on ESA-listed fish species in the Columbia River Basin are managed primarily through states, tribes, and federal agencies other than the Action Agencies, and are addressed in separate BiOps. The Action Agencies have supported the identification and implementation of approaches or conservation measures to reduce the effects of harvest on ESA-listed species. In 2010, the Action Agencies continued funding the initial evaluation of several types of live-capture fishing gear that can be used to selectively harvest marked hatchery fish while allowing ESA-listed wild fish to escape unharmed. As the testing of gear has narrowed the last few years, the main gear type tested in 2010 was the purse-seine in the upper Columbia River below the mouth of the Okanogan River. Purse seines take advantage of the temperature differential between the mainstem Columbia River and Okanogan where fish concentrate in mass.

## Research, Monitoring, Evaluation, and Adaptive Management

The FCRPS BiOp is premised on adaptive management and accountability for results. The Action Agencies use the best available scientific information to achieve performance standards and make needed adjustments to ensure actions meet the BiOp goals.

The Action Agencies participated in a regional coordination process to support the Anadromous Salmonid Monitoring Strategy (ASMS). This process resulted in adoption of a regional strategy for fish status Viable Salmonid Population monitoring, habitat action effectiveness, and hatchery action effectiveness. It also initiated the development of a data management strategy to support a data exchange that will, in turn, support the BiOp and recovery of salmon and steelhead.

RPA action 2 of the FCRPS BiOp calls for an annual status report to "describe the status of physical or biological metrics monitoring." This section includes that report by reviewing the status of RME actions. The Action Agencies implemented an extensive RME program that focuses on management actions and supports adaptive management within the BiOp's performance requirements. The RME program is implemented through the NPCC Fish and Wildlife Program, the Corps' Anadromous Fish Evaluation Program, and Reclamation's technical assistance activities, and it is coordinated with RME activities of other regional agencies. The Action Agencies work closely with state, federal, and tribal aquatic habitat and ESA-listed salmon and steelhead monitoring programs, the Columbia Basin Fish and Wildlife Authority, and the state and tribal constituents through a forum called the Pacific Northwest Aquatic Monitoring Partnership (PNAMP). The objective is to collaboratively advance a regionally

coordinated approach to fish and habitat status monitoring, action effectiveness research, critical uncertainty research, and data management. In addition, input on RME needs and priorities for fish population monitoring and for hatchery and habitat effectiveness monitoring have been provided by state and tribal fish management agencies through development of the Columbia River Basin ASMS. In May 2010, the Action Agencies, NOAA Fisheries, and the NPCC published a RME RPA Gap Assessment and Recommendation Report, which was based on revision of the ASMS, available at: *http://www.salmonrecovery.gov/Files/RM&E%20Recommendations%20Report%20w%20revised%20Appendix.pdf*.

In June 2010, the NPCC initiated the RME and Artificial Production Categorical Review of the NPCC Fish and Wildlife Program to support comprehensive evaluation of the RME needs and to find program efficiencies. BPA, the NPCC, and the Independent Scientific Review Panel (ISRP) evaluated the RME projects, specifically their ability to support BiOp commitments finding opportunities to standardize RME methods and designs.

The RME program is focused on a performance framework of various RME strategies and objectives designed to inform key management questions and implementation action impacts on various salmonid life cycle stages. In 2010, programmatic performance was tracked through project implementation and compliance monitoring, while biological and environmental performance was tracked and evaluated through status monitoring, action effectiveness research, and critical uncertainty research. Performance standards were monitored to ensure accountability and adherence to proposed actions.

The 2010 FCRPS AMIP outlines specific biological "triggers" that, if exceeded, will activate a range of near- and long-term responses to address significant fish declines. For instance, very low returns of a species could trigger increased hydro actions, stepped-up predator control and hatchery measures, and possible modifications to existing harvest agreements.

Taken as a whole, the Action Agencies' RME actions are focused on answering five key management questions:

1. Are we meeting biological and programmatic performance objectives established within the Columbia Basin Fish and Wildlife Program, FCRPS BiOp, and ESA Recovery Plans?
2. Where objectives are not being met, what factors are limiting our ability to achieve performance standards or objectives?
3. What is the effectiveness of different hydro and off-site mitigation actions in addressing factors limiting achievement of performance standards and objectives?
4. Is research and monitoring information accessible to the region and compatible with regional standards and protocols for monitoring, data collection, and access?
5. Are actions being implemented and accomplished as proposed?

The Action Agencies implemented RME projects within nine strategic focus areas to support the implementation of the all-H action strategy. These strategic focus areas are:

- Fish Population Status Monitoring: (RPAs 50-51)
- Hydro RME (RPAs 52-55)
- Tributary Habitat RME (RPAs 56-57)
- Estuary and Ocean RME (RPAs 58-61)
- Harvest RME (RPAs 62)
- Hatchery RME (RPAs 63-65)
- Predation and Invasive Species Management RME (RPAs 66-70)
- Coordination and Data Management (RPAs 71-72)
- Project Implementation and Compliance Monitoring (RPA 73)

## Fish Population Status Monitoring

The fish population status and trend monitoring program supports monitoring of population and ESU spawner abundance as well as juvenile freshwater productivity and survival that indicate responses to tributary restoration actions, hatchery management actions, and hydropower actions. In addition, this information provides an important foundation for program performance relative to baseline conditions or AMIP contingency triggers.

### What Was Achieved In 2010

- For fish population status monitoring, the Action Agencies continued to monitor the status of ESA-listed fish and enhance the existing status monitoring performed by regional fish management agencies.
- The ASMS was completed and the BiOp components were fully implemented to provide a comprehensive strategy for high-precision adult spawner and juvenile productivity and survival monitoring programs for a minimum of one population per each Major Population Group (MPG) for each listed ESU or DPS. This monitoring program was significantly enhanced through further expansion of a regional PIT tag array network in tributaries to support spawner abundance surveys. In addition, an expansion of juvenile trapping and surveys was implemented for key populations to support the ASMS strategy and to inform habitat action effectiveness studies and improve survival benefit assessments.

### What Was Learned from 2010 Project Results

- The 2010 fish status and trend monitoring program provided new population assessments for listed B-Run steelhead in the Snake River Basin.
- The highest numbers of adult returns were observed for listed middle Columbia steelhead, upper Columbia Chinook and steelhead, and Snake River Chinook sockeye and steelhead.
- Significant increases in natural-origin adult spawners and reduction of

hatchery-origin spawners for many populations across the basin improved viability attributes of productivity and diversity for these species.

- Over 140 data collection and analysis methods were identified to assess fish abundance for various life stages. Additional work is needed to support standardization of data collection and analysis methods for fish abundance metrics across the basin to improve timely reporting of the assessment results.

**What Was Modified to More Effectively Accomplish BiOp Strategies**

- BPA is continuing to improve and expand additional tributary PIT tag arrays to fully implement the BiOp actions of the ASMS.
- BPA is requiring full documentation of protocols, designs, and methods as a contract requirement to identify opportunities to standardize data collection and analysis methods and to improve study designs.

**Related Observations and Modifications to Achieve BiOp Strategies**

- Neither the AMIP Early Warning Indicator nor the Significant Decline trigger were tripped for any ESU in 2010.
- Total adult fish returns in 2010 were more than 1.83 million salmonids counted passing Bonneville Dam, the second highest number since counting began in 1938. Counts of spring, summer, and fall adult and jack Chinook and steelhead were all above the 10-year average. The count for sockeye (including unlisted fish from the Upper Columbia River ESU) was more than 386,000, more than three times the 10-year average. Of those, 2,201 were counted at Lower Granite Dam, compared to 1,219 adults counted in 2009.
- The high 2010 adult returns are likely a result of both the operations and passage configuration improvements made in recent years and favorable ocean conditions. Future variability in adult returns is expected. Action Agencies will be looking for overall trends that are stable or increasing at the species level.

## Hydro RME

Hydro RME studies were conducted on the juvenile fish transportation program, turbine survival, and juvenile and adult dam passage. Many of these studies and what we have learned from them are covered in earlier subsections.

**What Was Achieved In 2010**

Action Effectiveness Monitoring and Research

- At Bonneville Dam, a dam passage survival evaluation was conducted for spring migrants, and an evaluation of two spill treatments was conducted for summer migrants (24-h 95 kcfs and 85 kcfs daytime/TDG nighttime spill).
- A second year of evaluation of the effectiveness of the juvenile fish behavioral guidance device in the forebay of Bonneville Dam second powerhouse was conducted.
- The first year of juvenile salmon dam passage performance standard testing was conducted at The Dalles Dam after completing the installation of the tailrace spillwall designed to improve tailrace egress.
- The effects of the new spillwall and juvenile spill program at The Dalles Dam on adult passage, including use of the north ladder, were evaluated.
- A second year of evaluation of downstream passage via The Dalles Dam ice and trash sluiceway by overwintering summer steelhead was conducted from late 2009 into early 2010.
- At John Day Dam, a comparison of juvenile passage route-specific survival between 30 percent and 40 percent spill treatments was conducted with spillway weirs moved to bays 18 and 19, a new extended-length flow deflector in Bay 20, and completion of the avian predation deterrent wire array over the tailrace.
- The effectiveness of the avian predation deterrent efforts at John Day Dam (wire arrays and boat hazing) were evaluated.
- The effects on adult salmonid passage related to lamprey orifices installed in the weirs at the exit section of the Oregon shore ladder at McNary Dam were evaluated using video cameras.

Critical Uncertainty Research

- Juvenile sockeye salmon from Idaho were PIT tagged and used for an evaluation of the feasibility of transport from Lower Granite Dam.
- A study to evaluate the effects of bypass on adult return rates of Snake River Basin hatchery fish was funded by the Corps in 2010 and an associated regional workshop was held in September 2010.
- A PIT tag study to evaluate weekly smolt-to-adult returns (SAR) for natural spring Chinook and steelhead transported from Lower Granite Dam continued in 2010.
- Design and installation criteria were developed as a part of the evaluation of the feasibility of installing spillway PIT detectors at FCRPS dams.
- Juvenile fish descaling rates at two different turbine operating levels at McNary Dam were evaluated to help optimize turbine operations to improve fish survival.

**What Was Learned from 2010 Project Results**

Action Effectiveness Monitoring and Research

- Survival estimates at Bonneville, The Dalles, and John Day dams suggest these dams have reached high enough dam survival levels to attain performance standards.
- The Behavioral Guidance System (BGS) at Bonneville Dam provided inadequate survival benefits to justify permanent installation. The prototype BGS will be removed.
- Juvenile fish survival improved significantly (3-4 percent) at The Dalles Dam after installation of the spill wall.
- Radio tag study results and adult fish counts indicated that while adult salmon may have difficulty accessing The Dalles Dam north ladder during

high flow conditions (spill >100 kcfs), the new spill configuration did not impede the ability of tagged salmon to find alternative passage routes via the East Fish Ladder.

- Results from two years of evaluations of downstream passage via The Dalles Dam ice and trash sluiceway by overwintering summer steelhead and outmigrating steelhead kelts provided large enough benefits (0.9 percent of a 6 percent target for Snake River steelhead) to justify opening this route early and to keep this surface route open later (March 1 until December 15).
- No significant differences were found at John Day Dam during a preseason evaluation of direct injury rates or 48-hour survival rates between new extended-length deflectors and a standard deflector.
- At John Day Dam, the new wire array and boat hazing in the tailrace resulted in a 76 percent reduction of smolt consumption by California gulls from 2009 to 2010.
- Lamprey orifices installed in the weir walls at the exit section of the McNary Dam south ladder exit section did not deter or delay migrating stocks of adult salmon, steelhead, and shad.

Critical Uncertainty Research

- Survival probability of juvenile sockeye salmon from release sites upstream to Lower Granite Dam suggest that substantial mortality occurs upstream from the Snake and Clearwater river confluence prior to entering the FCRPS.
- Initial results from PIT-tagged juvenile Snake River sockeye provided preliminary data to estimate in-river survival estimates but too few fish were diverted into barges to obtain useful data for the transport group in 2010.
- Spillway feasibility prototype testing at Ice Harbor Dam was delayed, allowing time to evaluate the potential benefits and best location to undertake prototype testing.
- Evaluations of juvenile fish descaling rates related to different turbine operations at McNary Dam found some improvements at the higher flow operation, but debris on the turbine intake trash racks seems to be a more important factor for fish condition.
- NOAA Fisheries evaluations of SARs from wild fish transported and left in-river in the spring continued to indicate benefits from spring transport compared with inriver migration, especially for steelhead smolts.
- Results from a study to evaluate the effects of bypass on adult return rates of Snake River Basin hatchery fish found that while there was a general correlation between increased bypass events and reduced adult return rates, the mechanism of reduced adult return rates remains poorly understood. It is unclear whether the bypass systems themselves result in reduced SARs or if there is selectivity in the bypass systems.

**Related Observations and Modifications to Achieve BiOp Strategies**

- Dam modifications and spill/surface passage improvements appear to be on track to achieve the hydrosystem performance standards of 96 percent and 93 percent average dam survival for spring and summer migrating fish, respectively.
  - Increased coverage of wire arrays to deter avian predators at John Day Dam, along with surface weir modifications in the spillway, increased juvenile project survival to near performance standard levels. With the addition of these configuration actions, we are planning to move forward with performance standard testing in 2011.
  - Installation and operation of the spillwall at The Dalles Dam provided substantial improvements to all smolts passing the dam, resulting in at or near performance standard level survival of Chinook and steelhead. Expanding the avian predation deterrent wire array in the tailrace should ensure passage reaches performance standard levels. We plan to continue performance standard testing in 2011.
- Even with low spring flows in 2010, PIT tag in-river juvenile survival estimates for upper Columbia River steelhead and Snake River steelhead were higher than mean COMPASS estimates. Snake River Chinook PIT tag estimates were the only estimates lower than mean COMPASS estimates, but were within the 95 percent confidence interval (i.e, the difference was not statistically significant). These results suggest that steelhead may be deriving more benefits from recently installed surface flow weirs compared to Chinook. Improvements planned to deter predation near dams (avian wires and egress improvements) are expected to result in additional benefits to all species.
- Survival rates of ESA-listed adult Snake River spring/summer Chinook and steelhead through the FCRPS remained below adult passage performance standards in 2010. In contrast, 2010 Snake River fall Chinook, upper Columbia River spring Chinook, and upper Columbia River steelhead system survival rates were among the highest ever. Adult system survival reductions may be related to dam modifications to improve juvenile outmigration, injuries, and mortalities related to sea lion predation, unquantifiable levels of mortality related to fisheries, and unaccounted levels of straying. The addition of adult PIT tag detectors at The Dalles and John Day dams and in tributaries may help pinpoint the section of the river where these fish are being lost. Adult return data continue to confirm that smolt transportation during May is correlated with higher adult steelhead returns than are in-river migration and somewhat higher returns for Chinook. Nevertheless, under adaptive management (as discussed with RIOG), the Action Agencies are continuing to spill during this time period (May 7-20) and monitoring the adult return data to see whether this relationship changes based on improved in-river conditions.

## Tributary Habitat RME

Tributary habitat conditions and limiting factors were evaluated through state-of-the-art "Intensively Monitored Watersheds" (IMW), which quantify the relationships between habitat conditions and fish productivity. The expansion of habitat status and trend monitoring to support the habitat evaluations for fish habitat condition and climate change for one population per MPG was integrated into the ASMS and was reviewed by the ISRP before implementation in 2010.

### What Was Achieved in 2010

- Habitat status and trend monitoring was expanded.
- To improve regional habitat status and trend monitoring the *Scientific Protocol for Salmonid Habitat Surveys within the Columbia Habitat Monitoring Program (CHaMP)* protocol (*http://www.monitoringmethods.org/Protocol/Details/416*) was developed by the Integrated Status and Effectiveness Monitoring Project (ISEMP) and supported regionally by BPA, NOAA, and regional partners for systematic implementation across the Columbia River Basin for one population per MPG under the RME A/P Categorical Review. Successful testing of the draft protocol was implemented in the John Day Basin in 2010, but it was agreed that further testing of the approach in more diverse environments is needed before full implementation can occur. Pending 2011 results and ISRP review, this protocol, as modified based on experience, will be implemented in the Entiat, Imnaha, John Day, Klickitat, Lemhi, Methow, Minam, Okanogan, Pahsimeroi, South Fork Salmon, Tucannon, upper Grande Ronde, Umatilla, Wenatchee, and Wind rivers, as well as Asotin, Big, Catherine, Lolo, and Toppenish creek populations to support systematic tributary habitat monitoring to support evaluation of fish response to restoration actions and quantitative updates to the status of salmonid limiting factors.
- Ongoing habitat action effectiveness studies were implemented through IMW and individual project assessments. The coordination of large-scale implementation of habitat restoration actions occurred in the IMWs to evaluate the effectiveness of restoration treatments relative to fish population response. In addition to ISEMP, Reclamation implemented a comprehensive pre-project evaluation of fish production and fish food webs in a large mainstem reach of the Methow River.
- Reclamation and its monitoring partner, the U.S. Geological Survey (USGS), are developing a new study design to evaluate a proposed large woody debris treatment plan for the reach. To support additional data assessments, BPA supported the standardization of data collection and transfer methods for habitat metrics collected under the CHaMP protocol.
- To support action effectiveness assessments and help prioritize restoration treatments, further advances were made in the selection and development of the NOAA NWFSC Shiraz Model to be used for assessments of fish response to tributary habitat restoration actions across the Columbia Basin to support RPA action 57.

### What Was Learned from 2010 Project Results

- Reclamation conducted an analysis of fish food webs in a large reach of the mainstem Methow River. The work identified potential food competition that may be limiting production of ESA-listed fish.
- Preliminary findings from BPA projects in the John Day IMW validate the effectiveness of treatment activities in addressing ecological impairments resulting from channel incision.

### Related Observations and Modifications to Achieve BiOp Strategies

- The habitat program structure, which consists of biologically targeted projects, assessment of habitat quality improvements, use of expert panels, and independent scientific review, is under way and functioning well overall.
- Hundreds of on-the-ground actions were completed throughout the Columbia River Basin in 2010 to improve tributary spawning and rearing habitat for numerous populations of salmon and steelhead. New projects continue to be identified and scheduled for future implementation. As evidenced by Figures 13-17 and Section 3 in the 2010 Annual Progress Report, there is a continuing supply of habitat improvement projects available to the Action Agencies and partners for implementation.
- The Fish Accord partnerships, and other partnerships, are effectively supporting tributary habitat project implementation.
- BPA is implementing a pilot project to test the feasibility of implementation of the data collection analysis and management of the CHaMP protocol. Based on the 2011 field season results and further independent science review, the Action Agencies will decide whether or not to expand and include additional partners and populations.
- BPA is preparing to implement a programmatic review and approach to project-level habitat action effectiveness to restructure the NPCC Fish and Wildlife Program to align with the PNAMP habitat action effectiveness monitoring strategy and revised RME strategy to support RPA action 56.

## Estuary and Ocean RME

Estuary and ocean studies were conducted to report on the status and condition of estuarine and ocean habitat to support the evaluation of fish performance and life history diversity from key environmental attributes relative to actions in various habitat areas.

### What Was Learned from 2010 Project Results

We advanced our knowledge of juvenile salmon ecology in the estuary and, as a result, can better understand the complexities surrounding key management questions:

*Are the estuary habitat actions achieving the expected biological and environmental performance?*

The Salmon Benefits Study advanced the techniques and methods for assessing (or indexing) changes to habitat connectivity, early life history, diversity, and salmon survival benefit. 2010 findings concluded that site-scale passage barriers, dike breaches, and wetted area can be extracted using remote-sensing and modeling techniques for passage barrier change assessment. In addition, standard nearest-neighbor distance methods can be used to approximate juvenile salmon migration pathways using hydrologic routing and directional thresholds.

Site-scale action effectiveness research generally showed positive ecological responses. Hydraulically efficient tide gates improved water quality, prey production, and juvenile salmon access at the Julia Butler Hanson National Wildlife Refuge. Excavation produced new channel habitat, diverse habitat forms, increased prey production, and increased juvenile salmon use at Crims Island (Haskell and Tiffan 2011). Levee breaches and culvert replacement reconnected floodplain wetland habitat and increased juvenile salmon use at Kandoll Farm (Roegner et al. 2009) and Fort Columbia.

*Are the habitat actions in the estuary improving juvenile salmonid performance and which actions are most effective at addressing the limiting factors preventing achievement of habitat, fish, or wildlife performance?*

Status and Trends Monitoring and Tidal Freshwater Monitoring studies showed that juvenile salmon use shallow, tidal freshwater habitats to feed and grow year-round. Habitat use varied by season, stock of origin, life-history stage, and other factors. The Tidal Freshwater Monitoring study found that unmarked Chinook salmon are the most common salmon species in estuary tidal freshwater. The next most common species are chum and coho salmon. Multiple life history strategies were evident based on fish length frequency distributions through time. Study findings suggest that estuary habitat actions targeted at improving the quality of and access to a variety of shallow tidal freshwater habitats will benefit juvenile salmon.

*What are the limiting factors/threats in the estuary and ocean that prevent achieving the desired fish or habitat performance?*

Genetic survey results showed that stock compositions of Chinook salmon juveniles are highly variable spatially and seasonally during juvenile migration. Interior Columbia River stocks were present later in the summer and were more prevalent above St. Helens, Oregon, (river mile 86) than at sites closer to the estuary mouth. Findings suggest that estuary habitat actions that target a variety of shallow tidal freshwater habitats will benefit juvenile salmon at different times of the year. Future critical uncertainties research will continue to investigate these species, population, life history strategy, and habitat relationships.

Critical uncertainties research also estimated juvenile salmon migration timing and survival through the estuary, with particular focus on those areas with high avian predation. Key findings include:

- For steelhead, mortality from Bonneville Dam to river kilometer 50 was 12 percent. However, from river kilometer 50 to river kilometer 8 it was 33 percent. For yearling Chinook salmon, the mortality rates were 7 percent and 13 percent, respectively. For subyearling Chinook salmon, the mortality rates were 11 percent and 8 percent, respectively.
- Data collected with the pair-trawl PIT tag detection system were used to calculate the reach survival estimates from upstream dams to below Bonneville Dam. The mean estimated survival rates (S.E.) for non-transported yearling Chinook salmon and steelhead from the tailrace of Lower Granite Dam to the tailrace of Bonneville Dam in 2010 were 57 percent (3.1 percent) and 61 percent (2.9 percent), respectively.
- Data indicate that ocean temperatures, forage fish abundance, and, possibly, predator abundance strongly influence SARs. The movement of forage fish to the mouth of the Columbia River appears to happen suddenly and is strongly controlled by ocean conditions.

**Related Observations and Modifications to Achieve BiOp Strategies**

- The Action Effectiveness research has consistently shown, as floodplain habitats and wetlands are restored, juvenile salmon begin using these restored habitats almost immediately. Additionally, the structure and function that develop these habitats also are being restored to the extent possible given the present hydrograph. Plant species are developing that support both prey production for juvenile salmonids and for export of macro-detritus to support the entire lower river and estuarine habitats. Actions for the improvement of tide gates with more hydraulically efficient tide gates, replacement of culverts, and habitat development through engineered efforts (channel formation etc.) to levee breach have all shown improvements to the lower river and estuarine habitats and to ESA-listed salmonid species.
- Estuary and ocean research will prioritize studies that support science-based decision making and Columbia Estuary Ecosystem Restoration Program (CEERP) goals. To this end, estuary and ocean RME will continue to support 1) Status and trends monitoring to provide ecological context from which to assess action effectiveness results ( i.e., are estuary ecosystems degrading irrespective of CEERP restoration?); 2) Action effectiveness monitoring and research to determine the success of the restoration effort (i.e., what are the most effective restoration actions?); and 3) Critical uncertainties research to build the state-of-the-science in the estuary (i.e., what are the key limiting factors preventing the achievement of desired habitat or fish performance?).

- The CEERP program will modify and expand specific topics of research. Status and trends monitoring will be expanded temporally to cover additional fish species presence and expanded spatially to better understand how salmon use different tidal habitats. Salmon benefits study will produce methods to index changes in early life history diversity, habitat connectivity, and juvenile salmon survival benefits. Action effectiveness monitoring and research will assess juvenile salmon density (number per square meter) to support comparative analysis thru time and location. Critical uncertainties research will investigate species, population, life history strategy, and habitat relationships such that restoration efforts strategically address those factors and threats that most prominently influence juvenile salmon survival and productivity. In addition, estuary and ocean research will better synthesize key research findings; results will be reported and disseminated to regional managers and stakeholders, including the ERTG to inform restoration project assignment of survival benefit units. At a program level, the CEERP will begin the operation of a regional adaptive management framework to best understand, conserve, and restore ecosystems in the lower Columbia River and estuary.

## Harvest RME

Harvest investigations linked to FCRPS interests included feasibility studies for Zone 6 harvest PIT tag recoveries to help refine upstream adult survival rates. Selective fishing methods and gear were evaluated. Support was continued for coded-wire tagging and recovery operations needed to assess the survival, straying, and harvest rates of specific hatchery fish stocks. Further work was advanced on genetic stock identification techniques.

### What Was Achieved in 2010

- The Action Agencies continued to fund the development of selective fishing gear for harvesting anadromous salmonids in the Columbia and Okanogan rivers. In 2010, the Colville Confederated Tribe nearly exclusively used purse seine methods, yielding a total of 19,512 salmonids, which is a 16 percent increase in total catch from 2009.

### What Was Learned from 2010 Project Results

Status and Trends

- Techniques for the genetic monitoring of stocks have made considerable headway toward identifying markers associated with adaptive traits such as anadromy as well as distinguishing hatchery from wild stock. These improved techniques will allow for more effective monitoring of hatchery and wild fish.

Action Effectiveness

- Purse seines are an effective management tool for harvest with very minimal immediate mortality due to handling and release techniques in the upper Columbia and Okanagan rivers.
- The transfer of fishing and gear technology is feasible to other fishing areas within the Columbia River Basin.
- Harvest managers were able to collect PIT tag data from commercial catch in 2010, thus improving interrogation techniques and better informing harvest managers of stock composition of catch and impacts by gear.

Critical Uncertainty

- Uncertainty exists regarding whether high observed survival from immediate release techniques equates to high long-term survival and spawning success resulting from the use of selective fishing techniques.

### Related Observations and Modifications to Achieve BiOp Strategies

- In the Colville selective fisheries study, the immediate release survival of summer/fall Chinook and steelhead was assessed for three gear types. Mortality was lowest for fish captured in the purse and beach seines (100 percent and 99 percent immediate release survival, respectively), compared to traditional hoop, dip, and tangle nets, which had only an 80 percent immediate release survival. Pursuit of purse-seining for longer-term post research is currently planned for the Confederated Colville Tribe. This method also serves as a tool for broodstock collection and managing hatchery fish on spawning grounds.

## Hatchery RME

BPA continued to fund monitoring and evaluation of BiOp hatchery actions throughout the Columbia River Basin and continued relative reproductive success (RRS) studies for several ESA-listed salmon and steelhead populations. These RRS studies compare reproductive success of hatchery-origin fish to reproductive success of natural-origin fish. Hatchery studies also continue to assess the effects that specific implemented reform actions have on native populations.

### What Was Achieved in 2010

- The RRS studies of hatchery-origin fish compared to natural-origin fish continue to be assessed for Grande Ronde Chinook salmon and Hood River steelhead populations. The Wenatchee spring Chinook RRS study has completed data collection and is nearing completion. Additional RRS studies for steelhead were implemented in the Methow River in 2010 and, after receiving technical assistance from NOAA Fisheries and other Action Agencies, the Snake River fall Chinook RRS is anticipated to commence in late 2011. Several more hatchery studies continue to assess the effects that hatchery programs and implemented reform actions have on native populations.
- Five new projects were implemented in 2010 to address identified gaps in hatchery RME. Newly initiated 2010 projects include expanded PIT tagging on spring Chinook in the Tucannon River as well as an evaluation of the Tucannon endemic program, RRS studies on steelhead in the Methow River, Imnaha River steelhead monitoring, and a project researching the effectiveness of supplementation on B-run steelhead.

**What Was Learned from 2010 Project Results**

Status and Trends

- Research on hatchery emergence techniques for Chinook salmon suggests that the practice of altering emergence timing can dramatically affect later life history events. In particular, fish raised in high growth conditions had the greatest variation in seasonal timing and had the highest rates of early maturation, with most males maturing at age 1. These findings have strong implications for broodstock management of Chinook salmon.
- RRS studies of steelhead in the Hood River have shown that resident trout have significant genetic contribution to anadromous steelhead populations. However, residualized hatchery fish have only a minimal genetic contribution to steelhead, likely due to the high proportion of hatchery fish that leave the river within one month of release. These results suggest that although resident trout are important to the steelhead populations, residualized hatchery fish have minimal effect on anadromous steelhead.
- A spring Chinook hatchery supplementation program was implemented on the Lostine River to help prevent the extirpation of this population of the Snake River spring Chinook ESU, and it has been determined that the use of captive broodstock to support the hatchery production of spring Chinook for the Lostine Basin is feasible. A sufficient number of hatchery Chinook have returned in recent years; transition to a conventional-type hatchery program has been possible and is now fully implemented. Supplementation has substantially increased the total number of fish spawning in the wild compared to the 1997-2000 period when the project was initiated. However, with the exception 2009, which saw a very large return, the number of natural-origin fish has remained relatively unchanged since 2001.

Effectiveness Monitoring

- Recent findings from hatchery effectiveness studies found that the frequency of adult male Chinooks relative to jacks affected reproductive success. As the number of adult males (or conversely jacks) decreased, their access to females, participation in spawning events, and adult-to-fry reproductive success all increased. The same negative correlation between frequency and success was also observed in jacks. These findings demonstrate a genetic basis for the two distinct life history types and have implications for the management of both hatchery and natural populations.
- Research on sockeye salmon suggests that there are multiple critical periods for imprinting, and these developmental periods correspond to several types of current release strategies employed by the captive broodstock program, including strategies such as planting eyed eggs, as well as fall and smolt releases. The results of this research have contributed to the development and prioritization of future rearing and release plans to minimize straying in sockeye salmon at Redfish Lake.
- Projects monitoring and evaluating the effectiveness of supplementation on recovering spring Chinook salmon populations in the upper Grande Ronde River have found that the survival probability of upper Grande Ronde River hatchery-origin juveniles was similar to that of natural-origin.

Critical Uncertainty

- Feasibility studies investigating RRS of fall Chinook in the Snake River, using a mixed-stock analysis approach, were unable to accurately estimate hatchery and wild reproductive contributions due to genetic similarity between hatchery and natural-origin fish. However, findings from the feasibility study did provide other information to assess and improve techniques for recovery status of the fall Chinook.
- Findings from RRS studies in the Wenatchee River reveal that both male and female hatchery-origin fish produced far fewer juvenile progeny per parent when spawning naturally than did natural-origin fish, and spawning location seemed to have the most significant effect on fitness for both males and females. For females this explained most of the reduced fitness observed for hatchery fish. How spawning location affects reproductive success and the implications of these findings on population management of both hatchery and natural-origin fish needs further investigation.

**Related Observations and Modifications to Achieve BiOp Strategies**

- The Snake River sockeye captive broodstock and conservation/ supplementation program again returned high numbers of adult fish in 2010. This indicates that conditions have potentially moved from handfuls of adult fish on the brink of extinction to a more stable base for this program, which will be expanded in future years under the BiOp.
- Feasibility studies on the RRS of fall Chinook in the Snake River have found little to no genetic differences between hatchery and natural-origin fish. However, recent developments in identifying single nucleotide polymorphism (SNP) markers have significantly improved diagnostic capabilities, not only between hatchery and natural-origin fish, but also among a variety of selective traits within populations, such as thermal adaptation and anadromy.
- To support the effective monitoring of hatchery-origin fish, a 100 percent marking strategy of all hatchery fish was implemented in 2010. Marking of hatchery fish techniques include Coded Wire Tag and/or adipose fin clipping. One hundred percent marking of hatchery fish helps support estimating pHOS (proportion hatchery-origin spawners), pNOB (proportion natural-origin broodstock), escapement of NOF (natural-origin fish), and stray rates

(out of population and MPG). Information learned from determining pHOS, escapement, and stray rates will contribute to the assessment of the status of wild populations as well as future population management of both hatchery and natural-origin populations.

## Predation and Invasive Species Management RME

Predation RME studies were conducted to evaluate and monitor the NPMP, avian predation rates on juvenile salmon in the lower Columbia River and on the Columbia Plateau, and predation rates of California sea lions on adult salmon below Bonneville Dam. Completion of the stock assessment for double-crested cormorants occurred in 2010, and management plans for avian predation and other predation on juvenile salmonids were further advanced. Continued monitoring on the effectiveness of predation management actions were implemented as a component of most predator management projects.

### What Was Achieved in 2010

- Finished the stock assessment for double-crested cormorants and initiated the process for development of a double-crested cormorant management plan in collaboration with states, tribes, and constituent groups.
- Initiated research and monitoring on shad interactions with non-indigenous predators (small mouth bass and walleye) to understand impacts on predator over-wintering survival.

### What Was Learned from 2010 Project Results

- Acreage size for Caspian tern nesting habitat was successfully decreased for East Sand Island, with belief that biological effects are at a tipping point to meet biological reduction goals.
- The Corps and other federal, state, and tribal agencies implemented a variety of sea lion deterrents at Bonneville Dam in 2010. Physical barriers called sea lion exclusion devices (SLEDs), installed at all primary fishway entrances, and floating orifice gate (FOG) barriers continue to be effective in preventing sea lions from entering fishways.
- Non-lethal deterrence efforts have been unsuccessful at reducing the numbers of sea lions or the amount of predation. Lethal removals over the past three years may have slowed the growth in numbers of salmonids consumed, but pinniped numbers and the numbers of salmonids consumed have continued to grow.
- Other non-native fish predators on juvenile salmon (smallmouth bass, walleye) are not compensating for the removals of northern pikeminnow by either consuming more juvenile salmon or increasing reproductive success.

### Related Observations and Modifications to Achieve BiOp Strategies

- Predation continues to be a serious issue for the survival of both juvenile and adult salmon and steelhead. Future management actions will focus on controlling predation by native and non-native species.
- After reducing available nesting habitat on East Sand Island from 3.5 to 3.1 acres, Caspian tern smolt consumption dropped from 2008-2009 record levels, but still remained near the 10-year average. Additional island building expected in 2011-2012 would allow reductions in available nesting habitat to two acres and is expected to decrease smolt consumption even further.
- The increases in numbers of double-crested cormorant nesting pairs and smolt consumption in 2010 are of heightened concern. Development of cormorant management plans is moving forward in 2010 that will include methods for reducing consumption of juvenile salmon.
- Very high levels (>10 percent) of predation of PIT-tagged upper Columbia steelhead released at Rock Island Dam by Caspian terns nesting on Goose Island in Potholes Reservoir are of particular concern for this ESU. Development of an inland avian predation management plan has begun to address potential methods for reducing this high level of predation.
- Predation by northern pikeminnow is being successfully controlled, with significant survival benefits. Examination of predation by non-native species, such as shad, walleye, and bass, is under way with projects initiated in 2010. Management of non-native species predation may conflict with state management of exotic warm-water game species (walleye, largemouth and smallmouth bass, northern pike, catfish, etc.) for sport fisheries. Action Agencies must proceed with sensitivity to other management jurisdictions through well-designed basic research within this topic area.
- The amount of fish eaten by sea lions continued to increase in 2010, with an expanded catch estimate of 6,081 adult salmon and steelhead. Increases in Steller sea lion abundance and salmon predation in 2010 may be countering some of the expected reductions from efforts by the states to remove sea lions.

# 2010 Accomplishments

| WHAT ARE OUR GOALS AND STRATEGIES? | WHAT ARE OUR KEY ACCOMPLISHMENTS? |
|---|---|
| **HYDROSYSTEM** | |
| Increase the survival rates of fish passing through mainstem dams:<br>• Manage water to improve juvenile and adult fish survival.<br>• Configure dam facilities to improve juvenile and adult fish passage survival.<br>• Operate and maintain fish passage facilities to improve fish survival. | • Completed construction at The Dalles Dam of extended spillwall to improve juvenile survival in the tailrace, along with first year of performance standard testing. Estimates of dam passage survival for spring and fall Chinook exceeded the performance standard while the estimate for steelhead was slightly below (95.3 percent).<br>• Increased coverage of wire arrays to deter avian predators at John Day Dam, along with surface weir modifications in the spillway, increased juvenile project survival to near performance standard levels.<br>• Rebuilt John Day north ladder exit section and count station to reduce adult delay, counting problems, and fish jumping behavior.<br>• Extended operation of The Dalles Dam sluiceway (March 1 to December 15) to benefit adult survival and escapement of wild B-run Snake River and other steelhead overwintering in the hydrosystem. |
| **PREDATOR MANAGEMENT** | |
| Reduce the number of juvenile fish consumed by predators:<br>• Redistribute avian predators.<br>• Reduce fish predation.<br>• Manage sea lion predation. | • Created a 0.8-acre island in Lower Klamath NWR for alternative habitat for Caspian tern nesting before the nesting season to encourage tern redistribution.<br>• Reduced habitat for Caspian tern nesting on East Sand Island to 3.1 acres to encourage tern redistribution as creation of alternative habitat was completed.<br>• Initiated human disturbance methods, including installation of barriers, to prevent double-crested cormorants from nesting on East Sand Island.<br>• Removed more than 178,000 northern pikeminnow from the Columbia River in 2010; reduced their predation of juvenile salmon by about 40 percent since 1990. |
| **HABITAT** | |
| Improve tributary and/or estuary habitat used by salmon for spawning or rearing:<br>• Protect and improve tributary habitat based on biological needs and prioritized actions.<br>• Improve juvenile and adult fish survival in estuary habitat. | • Increased streamflows by protecting 18,920 acre-feet of water in tributaries throughout the Columbia River Basin.<br>• Addressed fish entrainment with installation of 41 fish screens in tributaries.<br>• Improved or opened access to 516 miles of tributary spawning and rearing habitat.<br>• Improved 595 acres of riparian habitat in tributaries and increased the complexity of 58 miles of streams used by anadromous fish.<br>• Leased or purchased 2,302 acres of riparian habitat in tributaries.<br>• Improved and restored 2 linear miles of stream/channels in the estuary.<br>• Removed tide gate to open up 800 feet of historic tide channels in the estuary.<br>• Removed 700 feet of levee to reconnect historic estuary tidal channels.<br>• Removed invasive plant species and planted and maintained native vegetation in riparian wetlands on 796 acres in the estuary. |
| **HATCHERIES** | |
| Use hatcheries to address the biological priorities of ESA-listed salmon and steelhead:<br>• Implement safety-net programs to avoid extinction.<br>• Implement conservation hatchery programs to build genetic resources and assist with promoting recovery.<br>• Reduce potentially harmful effects of artificial production. | • Worked with hatchery operators to revise 39 draft Hatchery Genetic Management Plans (HGMPs) to initiate ESA consultation and to identify operations to reduce or eliminate (where appropriate) detrimental genetic and ecological effects on listed species. |

The following summaries primarily describe abundance and abundance trends at the species or ESU level as of December 2010. Species-level status is determined based on a review of population-level status and includes consideration not just of abundance, but also productivity, spatial structure, and diversity. These are the attributes of a viable salmonid population. The following section includes a brief review of some of the population-level information in the 2008 FCRPS BiOp and the 2010 Supplemental BiOp, which contain a much more thorough review of the status of independent populations within each ESU. In addition, in late 2009, the AMIP was completed and in 2010 the AMIP was incorporated into the 2010 Supplemental BiOp. The AMIP includes abundance and trend-based indicators intended to signal significant declines at the ESU/DPS level. Such declines – in the unlikely event they occur – would trigger contingency actions.

Figures 21 through 27 display natural spawners only (with the exception of sockeye populations, which are sustained through a captive broodstock program).[6]

## Snake River Fall Chinook Salmon

The Snake River fall Chinook salmon ESU was listed under the ESA as a threatened species in 1992. This ESU is composed of only one extant population, which spawns and rears in the mainstem Snake River and in the lower reaches of its major tributaries below Hells Canyon Dam. It is estimated that 85 percent of the ESU's historical spawning habitat was lost as a result of construction of the privately owned Hells Canyon Dam complex, which blocks all fish passage.

The most recent 10-year average return of natural-origin fish (through 2010) is estimated to be 3,475 adults. The most recent four-year average return is 3,911 adults (Figure 21). An analysis of adult returns from 1990-2010 indicates that the ESU-level trend in abundance was positive during this period. Neither the AMIP Early Warning Indicator nor the Significant Decline trigger for this ESU were tripped in 2010.

Returns of natural-origin Snake River fall Chinook salmon have trended upward since 1990. The FCRPS BiOp considered trends of natural-origin adults based on two time periods with differing management actions and climate: 1977-2004 and 1990-2004. Although abundance trends were positive for both periods, productivity measured as returns-per-spawner (R/S – a measure of productivity) were positive only for 1990-2004. These estimates represent average survivals during the periods in question and do not fully reflect survival improvements resulting from more recent hydrosystem improvements and other management changes.

The Supplemental BiOp analysis added three years of additional data to the base period estimates for this ESU. With the addition of the new data, average abundance for the most recent 10 years increased compared to the 2008 BiOp. The 24-year extinction risk estimate increased slightly with the addition of the new data. The extended base period estimate for recruit-per-spawner productivity and median annual population growth rate for the period beginning in 1990 declined. The extended base period estimate for abundance trend increased slightly. NOAA Fisheries analyzed the new data and concluded the RPA avoided jeopardizing this ESU and did not adversely modify its critical habitat.

## Snake River Spring/Summer Chinook

The Snake River spring/summer Chinook salmon ESU was listed under the ESA as a threatened species in 1992. The ESU comprises 28 extant populations in five MPGs. The populations in this ESU spawn and rear in the tributaries of the Snake River between its confluence with the Columbia River and the Hells Canyon Dam.

The most recent 10-year average return of natural-origin Snake River spring/summer Chinook salmon was

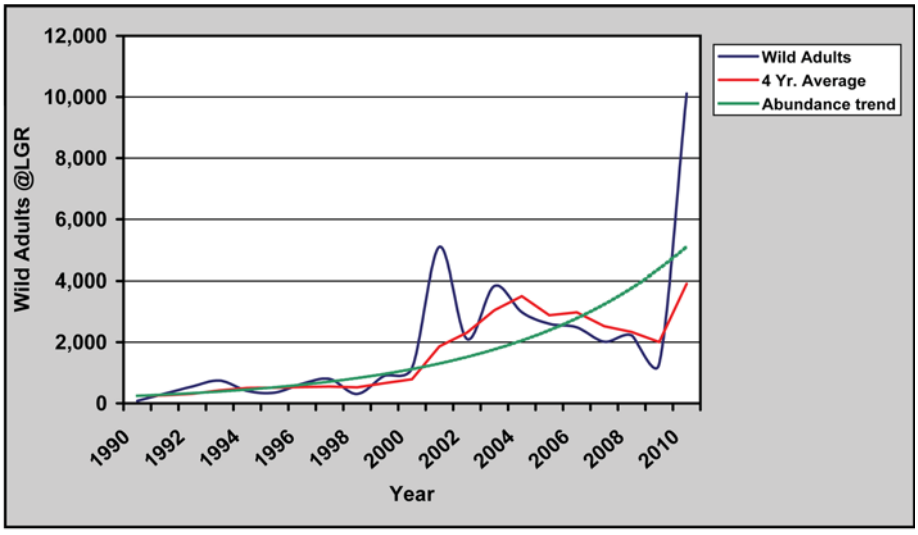



**Figure 21. Returns of Naturally Produced Adult Snake River Fall Chinook Salmon at Lower Granite Dam, 1990-2010.**

[6] *Abundance charts in this report show ESU-level abundance from 1990 until the most recent available observation, consistent with the 2008 BiOp's "short-term" trend estimation period. The exception is the middle Columbia Steelhead DPS, which is represented by the Yakima River Major Population Group. Estimates are of naturally produced adult returns and are taken from the US v. OR TAC Joint Staff Reports at http://wdfw.wa.gov/fishing/crc/staff_reports.html, with the exception of the Yakima River MPG returns, which are taken from Columbia River DART (Data Access in Real Time) at http://www.cbr.washington.edu/dart/, and upper Columbia Steelhead numbers, which were supplied by NOAA Fisheries. Trend lines are shown where the 1990-present trend is statistically significant ($p<.05$). The trend estimation method is taken from Good et al. (2005).*

21,503 adults. The most recent four-year average return was 16,563 adults (Figure 22). An analysis of adult returns from 1990-2010 indicates that the ESU-level trend in abundance was positive during this period. Neither the AMIP Early Warning Indicator nor the Significant Decline trigger for this ESU were tripped in 2010.

The FCRPS BiOp considered population-level information based on adult returns from 1984-1986 through 2003-2005. Population-level abundance trends of natural-origin adults during this time period were generally positive. However, recruit-per-spawner productivity estimates were generally negative. These estimates represent average survivals during the periods in question and do not fully reflect survival improvements resulting from more recent hydrosystem improvements and other management changes.

The 2010 Supplemental BiOp analysis added three-five years of data for 12 of the 22 populations analyzed in the 2008 BiOp. With the addition of the new data, average abundance for all 12 populations for the most recent 10 years increased compared to the 2008 BiOp. The base period extinction risk estimates increased for six of the nine populations for which new extinction risk estimates were available, though the increases were not significant. The extended base period estimates for recruit-per-spawner productivity and median annual population growth rate for the period beginning in 1990 generally declined. The extended base period estimates for abundance trend changed only slightly, with most populations continuing to show stable or slightly increasing trends. NOAA Fisheries analyzed the new data and concluded the RPA avoided jeopardizing this ESU and did not adversely modify its critical habitat.

Table 6 summarizes the tributary habitat metrics completed since 2005 with Action Agency support in areas used by Snake River spring/summer Chinook.

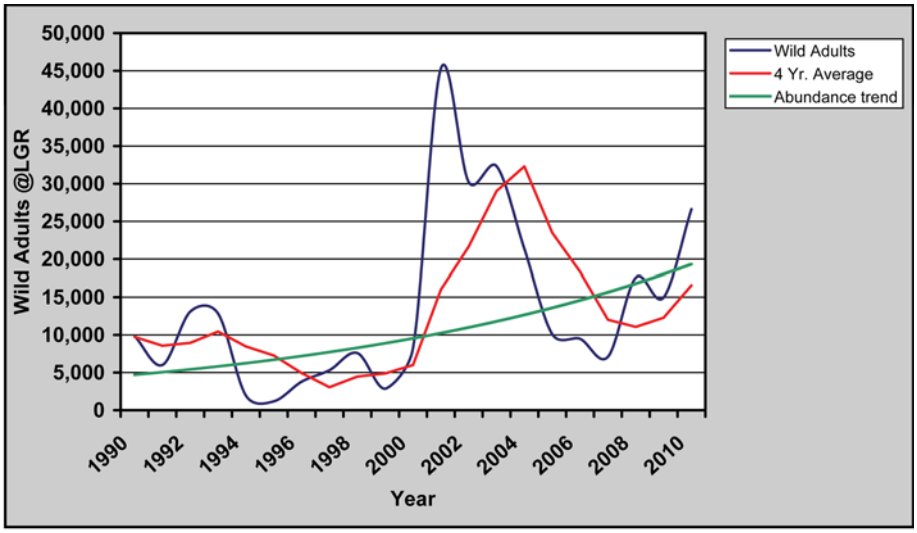



**Figure 22. Returns of Naturally Produced Adult Snake River Spring/Summer Chinook Salmon at Lower Granite Dam, 1990-2010.** The ESU-level trend in abundance was positive during this period.

**Table 6. Snake River Spring/Summer Chinook Tributary Habitat Improvement Metrics, 2005-2010**

| Metric | 2010 | 2005-2010 |
|---|---|---|
| Acre-feet/year of water protected | 3,945 | 51,952 |
| Acres protected | 497 | 2,241 |
| Acres treated | 61 | 1,128 |
| Miles of enhanced or newly accessible habitat | 71 | 349 |
| Miles of improved stream complexity | 41 | 54 |
| Miles protected | 3 | 46 |
| Screens installed or addressed | 2 | 41 |

## Snake River Sockeye Salmon ESU

The Snake River sockeye salmon ESU was listed under the ESA as endangered in 1991. The ESU includes all anadromous and residual sockeye in the Snake River Basin, as well as the artificially propagated fish from the Redfish Lake Captive Broodstock Program. This species was thought by some to be functionally extinct at the time of its listing. It had suffered from significant long-term harvest pressures, a state-sponsored fish eradication program that eliminated it from three of its natal lakes, private dams with little or no fish passage, construction of the federal dams on the lower Snake River, and a major detrimental ocean/climate shift in the mid 1970s. An experimental captive broodstock program was initiated at the time of listing in an effort to forestall complete extinction in the near term and to preserve the species' remaining genetic diversity. The program has achieved its original purpose and is now being expanded to help support recovery.

The average annual adult return from the captive broodstock program between 1991 and 1999 was 11 fish. The average return from 2004 to 2007 was 50 fish. The years 2008-2010 saw extraordinary returns of 907, 1,219, and 2,406 fish, respectively, as counted at Lower Granite Dam (Figure 23). These were the largest sockeye returns since fish counts began at Lower Granite Dam in 1975. The NWFSC attributed the increased numbers in 2008 to favorable ocean conditions and an increase in smolt

releases from the captive broodstock program (Factors Affecting Sockeye Salmon Returns to the Columbia River in 2008, by NOAA-NWFSC 2009).

## Snake River Steelhead DPS

The Snake River steelhead DPS was listed as threatened in 1997. The DPS comprises 24 individual populations in five MPGs. Steelhead of the interior Columbia River Basin, and especially the Snake River DPS, are commonly referred to as either A-run or B-run. These designations are based on migration timing, age, and size at return. There is only marginal information regarding the status of most individual populations of Snake River steelhead, but it is believed that B-run steelhead spawn almost entirely in the Clearwater and Salmon rivers, while A-run steelhead occur throughout the Snake River Basin.

The most recent 10-year average return of natural-origin Snake River steelhead was 26,522 adults (2000-2009). The most recent four-year average return was 22,986 adults (Figure 24). An analysis of adult returns from 1990-2009 indicates that the DPS-level trend in abundance was positive during this period. Neither the AMIP Early Warning Indicator nor the Significant Decline trigger for this ESU were tripped in 2010.

For most populations in this DPS, the 2008 FCRPS BiOp applied "average" A-run and B-run population profiles, based on counts of returning adults at Lower Granite Dam. Based on these profiles, the BiOp concluded that most individual A-run populations in the DPS have trended upward since 1990, while B-run populations have not. Recruit-per-spawner productivity estimates have been positive for A-run populations generally over the 20-year period, but not for most B-run populations. These estimates represent average survivals during the periods in question and do not fully reflect survival improvements resulting from more recent hydrosystem improvements and other management changes. No updated data were available for the 2010 Supplemental BiOp's review.

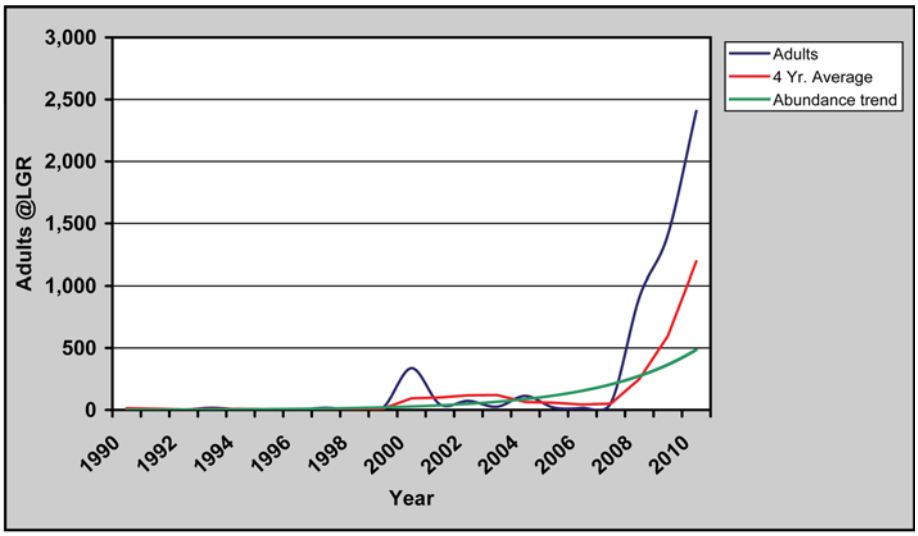



**Figure 23. Returns of All Snake River Sockeye Salmon at Lower Granite Dam, 1990-2010.** The ESU-level trend in abundance was positive during this period.

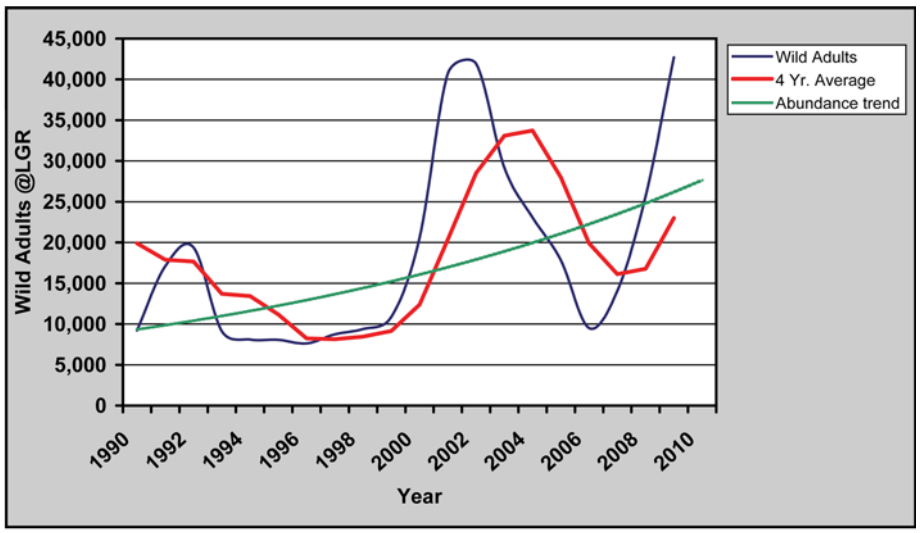



**Figure 24. Returns of Naturally Produced Adult Snake River Steelhead at Lower Granite Dam, 1990-2009.** DPS-level trend in abundance was positive during this period.

**Table 7. Snake River Steelhead Tributary Habitat Metrics, 2005-2010**

| Metric | 2010 | 2005-2010 |
|---|---|---|
| Acre-feet/year of water protected | 3,945 | 51,952 |
| Acres protected | 497 | 2,811 |
| Acres treated | 71 | 1,139 |
| Miles of enhanced or newly accessible habitat | 98 | 402 |
| Miles of improved stream complexity | 41 | 84 |
| Miles protected | 3 | 46 |
| Screens installed or addressed | 2 | 41 |

Table 7 summarizes the tributary habitat metrics completed since 2005 with Action Agency support in areas used by Snake River steelhead.

## Upper Columbia River Spring Chinook Salmon

The upper Columbia spring Chinook salmon ESU was listed as endangered in 1999. The ESU consists of three extant populations in one MPG. These populations spawn and rear in the mainstem Columbia River and its tributaries between Rock Island Dam and Chief Joseph Dam (a barrier to upstream migration).

The most recent 10-year average return of natural-origin upper Columbia River spring Chinook salmon was 1,870 adults at Rock Island Dam (2000-2010). The most recent four-year average return was 1,428 adults (Figure 25). An analysis of adult returns from 1990-2010 indicates that the ESU-level trend in abundance was stable during this period. Neither the AMIP Early Warning Indicator nor the Significant Decline trigger for this ESU were tripped in 2010. In a January 22, 2010, letter from S. Wright to B. Thom, the Action Agencies described their analysis that concluded it was unlikely that the ESU would drop below the Significant Decline threshold in 2010 or 2011.

The FCRPS BiOp considered population-level information based on adult returns from 1984 through 2003. The BiOp concluded that 1990–2003 abundance trends for the Wenatchee River and Entiat River populations were generally stable, while the Methow River population saw a slight decline over that period. During the 1984-2003 base period analyzed in the BiOp, these populations failed to replace themselves. These estimates represented average survivals during the periods in question and do not fully reflect survival improvements resulting from more recent hydrosystem improvements and other management changes.

The 2010 Supplemental BiOp analysis added five years of data for all three extant populations. With the addition of the new data, average abundance for all three populations for the most recent 10 years increased compared to the 2008 BiOp. The base period extinction risk estimates increased for the two populations for which valid estimates were found in the BiOp. The extended base period estimates for recruit-per-spawner productivity and median annual population growth rate declined for all populations. The extended base period estimates for abundance trend improved slightly for all populations. NOAA Fisheries analyzed the new data and concluded the RPA avoided jeopardizing this ESU and did not adversely modify its critical habitat.

Table 8 summarizes the tributary habitat metrics completed since 2005 with Action Agency support in areas used by upper Columbia River spring Chinook.

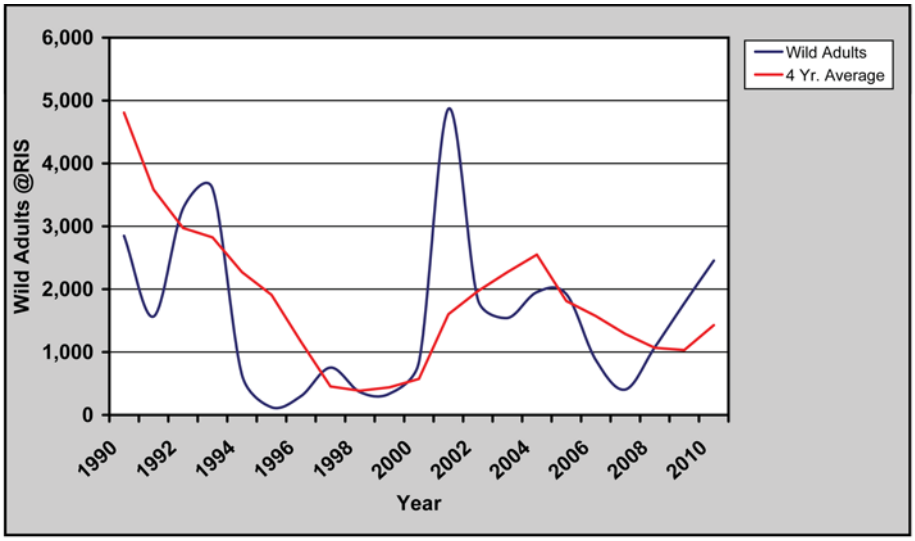



**Figure 25. Returns of Naturally Produced Adult Upper Columbia River Spring Chinook Salmon at Rock Island Dam, 1990-2010.** ESU-level trend in abundance was generally stable during this period.

**Table 8. Upper Columbia River Spring Chinook Tributary Habitat Metrics, 2005-2010**

| Metric | 2010 | 2005-2010 |
|---|---|---|
| Acre-feet/year of water protected | 586 | 9879 |
| Acres protected | 0 | 37 |
| Acres treated | 2 | 235 |
| Miles of enhanced or newly accessible habitat | 65 | 69 |
| Miles of improved stream complexity | 1 | 3 |
| Miles protected | 0 | 3 |
| Screens installed or addressed | 2 | 3 |

## Upper Columbia River Steelhead

The upper Columbia River steelhead DPS was listed as endangered in 1997 but was recently relisted as threatened. The DPS consists of four populations in one MPG. These populations spawn and rear in the rivers and tributaries draining the eastern slope of the Cascade Mountains upstream of Rock Island Dam.

The most recent 10-year average return of natural-origin upper Columbia River steelhead was 2,669 adults (1998-2007). These data were obtained from NOAA Fisheries and have not been recently updated. The most recent four-year average return was 2,628 adults (Figure 26). An

analysis of adult returns from 1990-2007 indicates that the ESU-level trend in abundance was positive during this period.

The FCRPS BiOp considered population-level information based on adult returns through 2006. Hatchery returns have dominated natural spawning in all populations in this DPS. Historical broodstock protocols included the use of out-of-basin broodstock and extensive mixing of stocks from different populations within the DPS. This may be a major contributor to the poor productivity seen in these populations.

The BiOp concluded that short- and long-term abundance trends for all populations were positive. During the 20-year base period analyzed in the BiOp, these populations failed to replace themselves. The estimates represent average survivals during the periods in question and do not fully reflect survival improvements resulting from more recent hydrosystem improvements and other management changes.

The 2010 Supplemental BiOp analysis added three years of data for all four extant populations. With the addition of the new data, average abundance for all populations for the most recent 10 years increased compared to the 2008 BiOp. The base period extinction risk estimates decreased slightly for two populations, increased for one, and remained the same for the fourth. The extended base period estimates for recruit-per-spawner productivity decreased slightly for two populations, while median annual population growth rate estimates decreased slightly for three populations. The extended base period estimates for abundance trend changed only slightly, with all populations continuing to show stable or slightly increasing trends. NOAA analyzed the new data and concluded the RPA avoided jeopardizing this ESU and did not adversely modify its critical habitat.

Table 9 summarizes the tributary habitat metrics completed since 2005 with Action Agency support in areas used by upper Columbia River steelhead.

## Middle Columbia River Steelhead

The middle Columbia River steelhead DPS was listed as threatened in 1999. The DPS comprises 17 individual populations in four MPGs. These populations spawn in Oregon and Washington drainages upstream of the Hood River and Wind River systems up to and including the Yakima River Basin. Almost all populations within this DPS are summer-run steelhead; the exceptions are the winter-run populations returning to the Klickitat Creek and Fifteen Mile Creek watersheds.

The most recent 10-year average return of natural-origin middle Columbia River steelhead was 17,201 adults for the period for which a DPS-level aggregate number is available (1996-2005). The most recent four-year average return was 21,985 adults. An analysis of adult returns from 1990-2005 indicates that the ESU-level trend in abundance was positive during this period. Due to the difficulty in obtaining timely estimates of DPS-level abundance for middle Columbia River steelhead, the AMIP relies on abundance estimates based on dam counts for the Yakima River MPG of this DPS. Based on preliminary estimates, the most recent 10-year average return from this MPG was 3,467 natural-origin adults (2000-2010). The most recent four-year average return was 4,333 natural-origin adults (Figure 27). The abundance trend for this MPG between 1990 and 2010 was positive. Neither the AMIP Early Warning Indicator nor

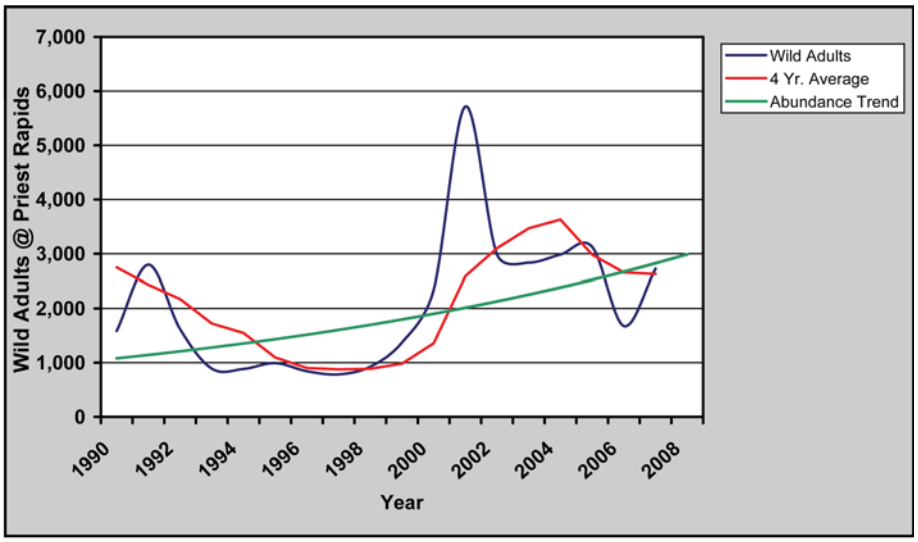



**Figure 26. Returns of Naturally Produced Adult Upper Columbia River Steelhead at Priest Rapids Dam, 1990-2007.**

**Table 9. Upper Columbia River Steelhead Tributary Habitat Metrics, 2005-2010**

| Metric | 2010 | 2005-2010 |
|---|---|---|
| Acre-feet/year of water protected | 1,786 | 13,202 |
| Acres protected | 7 | 80 |
| Acres treated | 2 | 339 |
| Miles of enhanced or newly accessible habitat | 69 | 86 |
| Miles of improved stream complexity | 4 | 6 |
| Miles protected | 0.4 | 4 |
| Screens installed or addressed | 2 | 3 |

the Significant Decline trigger for this MPG were tripped in 2010.

The 2008 FCRPS BiOp considered population-level abundance estimates of natural-origin middle Columbia River steelhead based on adult returns through 2004 or 2005. Eleven of the 13 populations for which adequate information is available had a positive trend in abundance since 1990. Over the most recent 10 years, the average abundance of three populations has been more than the minimum level needed for recovery, as identified by the Interior Columbia Technical Recovery Team. However, over the 20 years considered in the BiOp (concluding with the adult returns for 2004 or 2005), only eight of those 13 populations had positive recruit-per-spawner productivity.

The 2010 Supplemental BiOp analysis added five years of data for the four populations in the Yakima River MPG. With the addition of the new data, average abundance for all four of these populations for the most recent 10 years increased compared to the 2008 BiOp. The base period extinction risk estimates decreased slightly for two populations, increased for one, and remained the same for the fourth. The extended base period estimates for recruit-per-spawner productivity increased for two populations and decreased for the other two. Median annual population growth rate estimates decreased slightly for two populations, increased for one, and remained unchanged for the fourth. The extended base period estimates for abundance trend changed only slightly, with all populations continuing to show stable or slightly increasing trends. NOAA analyzed the new data and concluded the RPA avoided jeopardizing this ESU and did not adversely modify its critical habitat.

Table 10 summarizes the tributary habitat metrics completed since 2005 with Action Agency support in areas used by middle Columbia River steelhead.

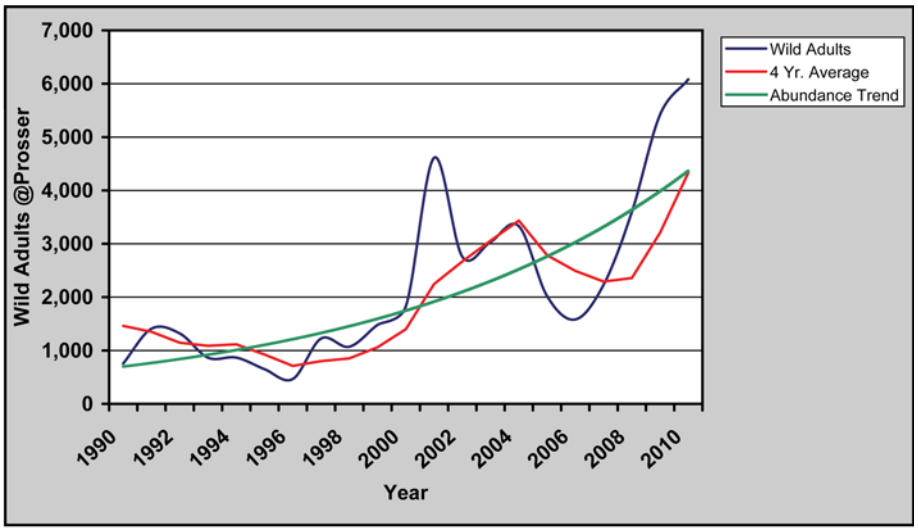



**Figure 27. Returns of Naturally Produced Adult Middle Columbia River Steelhead (Yakima River Major Population Group) at Prosser Dam, 1990-2010.**

**Table 10. Middle Columbia River Steelhead Tributary Habitat Metrics, 2005-2010**

| Metric | 2010 | 2005-2010 |
|---|---|---|
| Acre-feet/year of water protected | 13,189 | 37,403 |
| Acres protected | 1797 | 5,410 |
| Acres treated | 522 | 13,425 |
| Miles of enhanced or newly accessible habitat | 350 | 864 |
| Miles of improved stream complexity | 13 | 68 |
| Miles protected | 74 | 655 |
| Screens installed or addressed | 37 | 173 |

## Lower Columbia and Willamette River ESUs

A total of six ESUs in the Willamette and Lower Columbia Rivers are presently listed under the ESA. The two listed ESUs in the Willamette River are also covered by a separate BiOp for the Willamette Project. Quantitative status information is lacking for many of the populations in these ESUs. For those populations for which data are available, the information indicates that abundance, while well below historic levels, is stable or increasing.[7]

These ESUs are currently threatened by a broad array of habitat and other environmental factors. Because they largely do not migrate through the federal dams on the Columbia and lower Snake rivers, the proposed operation of the Columbia/Snake projects of the FCRPS has a limited impact on these populations, with the exception of certain populations located in the Upper Columbia River gorge. However, the Action Agencies' estuary habitat program will provide survival benefits for all populations in these ESUs, including those that spawn below Bonneville Dam.

[7] *Information taken from 2010 Pacific Coast Salmon Recovery Fund report to Congress.http://www.nwr.noaa.gov/Salmon-Recovery-Planning/PCSRF/PCSRF-Documents.cfm*

# Working with the Region

The Action Agencies work with regional interests to improve regional coordination and collaboration, and to implement actions to strengthen Columbia River Basin salmon and steelhead stocks. Tribal, state, and federal agency representatives are jointly looking at options for a better way to stabilize salmon and steelhead populations in the Columbia River Basin and bring these fish back to sustainable levels. The Action Agencies work closely with the region through the RIOG, the Columbia Basin Fish Accords, and NPCC's Fish and Wildlife Program.

## Regional Implementation Oversight Group

The RIOG was established in 2008 to provide high-level policy review for the Columbia River Basin—to discuss and coordinate implementation of the FCRPS BiOp. The RIOG involves federal, state, and tribal agencies actively engaged in salmon recovery efforts. The group reviews the Action Agencies' progress reports under the BiOp, considers adaptive management decisions based on emerging scientific information, evaluates contingency plans, and helps to resolve policy and technical disputes. The group encourages collaboration, accountability, and transparency for BiOp implementation. The RIOG structure includes technical subgroups (e.g., the TMT) to support regional review. In 2010 the RIOG met five times to discuss, review, and coordinate on a variety of topics including spring and summer hydrosystem operations, the 2010 Supplemental FCRPS BiOp, the 2009 Annual Progress Report and 2010-2013 Implementation Plan, emerging scientific information, and analyses called for in the Adaptive Management Implementation Plan.

## Columbia Basin Fish Accords

In 2008, the Action Agencies entered into the Columbia Basin Fish Accords with the Confederated Tribes of the Warm Springs Reservation of Oregon, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes and Bands of the Yakama Nation, the CRITFC, the Confederated Tribes of the Colville Indian Reservation, the Shoshone-Bannock Tribes of Fort Hall, and the states of Idaho and Montana. In addition, in 2009, the Action Agencies entered into an Estuary Habitat Memorandum of Agreement with the state of Washington. These historical, long-term agreements are intended to support and strengthen RPA implementation, foster cooperation and partnership, and advance fish recovery for all. These partnerships help accomplish "on-the-ground" implementation of actions that are beneficial to listed fish.

In 2010, tribal, state, and federal partners implemented new projects and expanded existing projects under the Columbia Basin Fish Accords. Many projects are under way to protect and restore fish habitat in the tributaries and estuary. Examples of work completed in 2010 include the protection of instream water in the Lemhi River; the protection of land through purchase or easements in the Okanogan Basin; the addition of woody debris in the upper Tucannon River watershed to improve instream habitat complexity; the removal of fish passage barriers in the North Fork John Day River to improve access to instream habitat; and the planting of riparian vegetation along streams in the Klickitat, Naches, and Rock Creek watersheds. Funding through the Accords continues to support hatchery supplementation programs in the Umatilla, Hood, Yakima, and upper Columbia river areas, the Snake River sockeye captive broodstock program, and various important RME programs throughout the basin.

## Northwest Power and Conservation Council Fish and Wildlife Program

Under the Northwest Power Act, the NPCC works to protect, mitigate, and enhance Columbia River Basin fish and wildlife and their related spawning grounds and habitat that have been affected by hydropower development. The NPCC's Columbia Basin Fish and Wildlife Program guides BPA's funding and must be taken into account by all federal agencies that manage, operate, or regulate hydropower dams in the basin. The NPCC's amended program (finalized in 2009) can be found at: *http://www.nwcouncil.org/library/2009/2009-09/Default.asp*.

# Conclusion

In 2010, as the result of a multi-year collaboration process, the Action Agencies continued the third year of implementing the 2008 FCRPS BiOps. This progress report summarizes this third year of implementation. Major dam improvements occurred, acres of habitat were improved, predators were controlled, and fish status overall was good. Working with our regional partners, the Action Agencies will build on these accomplishments in the years ahead.

### For More Information on Regional Efforts:

- Pacific Coastal Salmon Recovery Fund: *http://www.nwr.noaa.gov/Salmon-Recovery-Planning/PCSRF/*
- Columbia River Inter-Tribal Fish Commission: *http://www.critfc.org*
- Upper Columbia United Tribes: *http://www.ucut.org*
- Columbia Basin Fish and Wildlife Authority: *http://www.cbfwa.org*
- Northwest Power and Conservation Council: *http://www.nwcouncil.org*
- Oregon Watershed Enhancement Board: *http://www.oregon.gov/OWEB/index.shtml*
- Washington Salmon Recovery Office: *http://www.rco.wa.gov/salmon_recovery/gsro.shtml*
- Idaho Office of Species Conservation: *http://www.species.idaho.gov*
- Federal Columbia River Power System 2009 Annual Report, website links, and more information on federal agency efforts for salmon and steelhead: *http://www.salmonrecovery.gov*