

**Columbia River Basin Fish and Wildlife Program  
Projects currently funded by the Bonneville Power Administration in the  
Columbia Estuary/Lower Columbia River**

**Project summaries**

**Title: Evaluate Sturgeon Populations in the Lower Columbia River**

**Project Number: 1986-050-00**

**Sponsor:** Oregon Department of Fish and Wildlife (ODFW).

Summary: This project includes a series of closely coordinated and complementary activities being implemented in an orderly progression from initial problem scoping to full-scale restoration and mitigation in the Columbia River downstream from Lake Roosevelt, and in the Snake River downstream from Lower Granite Dam. The project has evolved from conducting research on white sturgeon in the Columbia River Basin to implementing mitigation activities based on research results, and monitoring the effects of mitigation activities.

**Title: Select Area Fisheries Enhancement**

**Number: 1993-060-00**

**Sponsor: Oregon Department of Fish and Wildlife (ODFW).**

Summary: As part of the 1993 Strategy for Salmon, the Northwest Power and Conservation Council recommended terminal-fishing sites be developed to allow harvest of known hatchery production while minimizing incidental harvest of weak stocks. Beginning in 1991, listing of various ESU's under the federal ESA complicated harvest management and severely limited execution of mixed-stock fisheries in the mainstem Columbia River. The Select Area Fisheries Evaluation (SAFE) Project was subsequently initiated by Bonneville Power Administration (BPA) in 1993 to mitigate fisheries by providing the opportunity to harvest locally-produced salmon stocks in off-channel areas of the Columbia River. Based on evaluations and given available funding, five Select Area fishing areas were established and four currently exist including Youngs Bay, Tongue Point/South Channel, and Blind Slough/Knappa Slough in Oregon and Deep River in Washington. Approximately 4,000,000 coho, spring, and fall chinook hatchery smolts are currently reared and released from SAFE net pens and associated hatcheries. Commercial and recreational fisheries have expanded substantially due to improved rearing strategies and increased releases as the project has progressed from research to implementation. Potential for additional expansion of the SAFE Project exists with the current infrastructure and is primarily constrained by available funding.

**Title: Ocean Survival of Salmonids**

**Number: 1998-014-00**

**Sponsor: National Oceanic and Atmospheric Administration (NOAA)**

Summary: The project's recent work in the plume and adjacent coastal zone has shown that the northern California Current may have experienced another regime shift, beginning in late 1998. Due in large part to increases in the length of the upwelling season in 1999, zooplankton biomass has doubled in the coastal waters off Oregon, community composition has shifted to a dominance of cold water species, and salmon survival has increased five-fold. Therefore, it is important to keep in mind that the plume and plume dynamics are modulated by climate

influences at decadal scales as well as inter-annual, seasonal and daily scales depending upon the strength of the upwelling process. Thus, plume-ocean interactions are a key component of the research program.

**Title: Evaluate Spawning of Fall Chinook and Chum Salmon Just Below the Four Lowermost Mainstem Dams**

**Number: 1999-003-01**

**Sponsor: Oregon Department of Fish and Wildlife (ODFW).**

Summary: This project determines what conditions must exist to provide successful spawning and rearing below lower Columbia River mainstem dams and what measures must be taken to protect those fish. Specifically, this project describes the abundance, spatial and temporal distributions, and stock origins of spawning chum and fall Chinook salmon, as well as the emergence timing and emigration from local rearing areas. In addition, it identifies operational and physical habitat factors affecting spawning.

**Title: Sandy River Delta Habitat**

**Number: 1999-025-00**

**Sponsor: US Forest Service (USFS).**

Summary: Sandy River Delta was historically a wooded, riparian wetland with components of ponds, sloughs, bottomland woodland, oak woodland, prairie, and low and high elevation floodplain. It has been greatly altered by past agricultural practices and the Columbia River hydropower system. The original channel of the Sandy River was diked in the 1930's, and diverted into the "Little Sandy River". The original Sandy River channel has subsequently filled in and largely become a slough. Restoration of historic landscape components is a primary goal for this land, with current focus on restoration of riparian forest and wetlands. The Forest Service proposes to remove the 1930's dike across the Sandy River to restore the hydrologic pattern and improve estuary habitat for anadromous fish. Restoration of open upland areas (meadow/prairie) would follow substantial completion of the riparian and wetland restoration.

**Title: Reintroduction of Chum in Duncan Creek**

**Number: 2001-053-00**

**Sponsor: Pacific States Marine Fisheries Commission (PSMFC).**

Summary: Duncan Creek was a historically important spawning area for chum salmon, estimated returns of 500 adults annually. A three-pronged approach is being used to reestablish a self-sustaining chum salmon population in Duncan Creek. First, the original dam structure (built in 1963) was replaced in 2000 to provide dual usage of the area, a lake from June 1 through October 15 and a pre-impoundment configuration providing access to and from salmonid spawning grounds (creek and spawning channels) from October 16 to May 31. Second, spawning channels were constructed in fall of 2001. Channels are located in historical chum salmon spawning areas with natural springs/seeps providing the water. Third, beginning fall of 2001, and occurring annually since, chum salmon brood stock have been collected from nearby spawning areas and used in supplementation programs at Duncan Creek. Three methods of reintroduction are being evaluated: natural straying from adjacent spawning populations, direct adult supplementation into the spawning channels above monitoring weirs, and fed-fry supplementation releases via artificial propagation. An intensive and comprehensive monitoring and evaluation program is associated with the supplementation program. Fry resulting from

supplementation methods are marked allowing statistical comparison of adult returns and fry-to-adult survival rates between the two artificial reintroduction methods. The success of this habitat as a spawning refugia is evaluated by egg-to-fry and fry-to-adult survival rates and monitoring a variety of physical parameters in the channels. This proposal seeks to continue brood stock collection for supplementation, and if deemed necessary a salvage operation, and the monitoring and evaluation associated with these activities. Results from this project will provide the background and framework to successfully implement other chum salmon reintroduction projects in the Lower Columbia River domain.

**Title: Estuary/Ocean Research, Monitoring and Evaluation (RM&E) Support**

**Number: 2002-077-00**

**Sponsor: Pacific Northwest National Laboratory (PNNL)**

Summary: The goal of this project is to facilitate the estuary/ocean subgroup (EOS) and related activities for federal research, monitoring, and evaluation (RME) in the lower Columbia River, estuary, and ocean and to aid the action agencies in certain aspects of implementation of the 2008 Biological Opinion (BiOp) on Operation of the Federal Columbia River Power System. Comprehensive RME by the Action Agencies was mandated in the 2008 BiOp. The federal RME process is ongoing and includes the EOS, whose members include the Action Agencies, the Estuary Partnership, NMFS, and PNNL. A major milestone for the EOS was completion of the Estuary RME Program document in January 2008. The framework and many of the elements from the Estuary RME Program were built into the BiOp and vice versa.

This scope of work covers five estuary/ocean RME topics during FY09. First, the EOS will facilitate and document the federal estuary RME effort. . Second, address the BiOp's RPA 37 (NMFS 2008) by working cooperatively with the Action Agencies to establish a regional technical group and convene periodic meetings to assess survival benefits from estuarine habitat restoration. Third, convene and annual coordination of estuary/ocean RME participants to assure efficiency, avoid redundancy, and share results for their common good,. Fourth, support for federal RME efforts regionally coordinated through the Pacific Northwest Aquatic Monitoring Partnership (PNAMP), an assemblage of federal, state, and tribal agencies whose goal is "...to coordinate important scientific information at the appropriate scales needed to inform public policy and resource management decisions." And, fifth, EOS input into federal basin-wide RME through the Technical/Policy Oversight Group

**Title: Lower Columbia River Estuary Ecosystem Monitoring**

**Number: 2003-007-00**

**Sponsor: Lower Columbia River Estuary Partnership (LCREP).**

Summary: This project creates a consistent approach to protocol development and status and trends monitoring of estuarine habitats. The goal is to develop an ecosystem based monitoring program focused on increasing the survival of juvenile salmonids The Estuary Partnership in conjunction with USGS will provide dissolved oxygen, temperature, and conductivity data at habitat and fish monitoring locations. USGS will develop a summary report documenting the results of the sampling that will be included in the Estuary Partnership's Year 5 annual report.

**Title: Historic Habitat Food Web Link**

**Number: 2003-010-00**

**Sponsor: National Oceanic and Atmospheric Administration (NOAA).**

Summary: This proposal addresses specific information needs identified in a recent interdisciplinary assessment of the hydroelectric system's impacts on estuarine habitat conditions for juvenile salmon. The goal of this research is to reconstruct historic changes in estuarine rearing opportunities and food web linkages of Columbia River salmon and to evaluate their implications for managing river flows and restoring estuarine habitats.

**Title: Columbia River Estuary Habitat Restoration**

**Number: 2003-011-00**

**Sponsor:** Lower Columbia River Estuary Partnership (LCREP).

Summary: The mission of the Lower Columbia River Estuary Partnership's Habitat Restoration Program is to implement and monitor strategic, well-coordinated, scientifically sound projects designed to rehabilitate, enhance, protect, conserve, create, and restore 16,000 acres tidal wetlands and other key habitats to support native species using the Lower Columbia River estuary from the river's mouth to Bonneville Dam, with a special emphasis on ESA listed species, and other focal species described in the Comprehensive Conservation Management Plan and the sub-basin plan.

**Title: Grays River Watershed Assessment**

**Number: 2003-013-00**

**Sponsor: Pacific Northwest National Laboratory (PNNL).**

Summary: The Pacific Northwest National Laboratory (PNNL) is collaborating with the Columbia River Estuary Task Force (CREST) on implementation of the Grays River Restoration Project (BPA Project 200301300). The Grays River is vitally important to the recovery of Lower Columbia River (LCR) chum salmon because it currently has the most viable population remaining in the LCR region. The Grays River watershed is also important to the recovery of salmon and steelhead in the LCR ecosystem. Today, numbers of naturally spawning salmon and steelhead have declined to levels far below historical numbers because of habitat limiting factors that include but are not limited to the lack of habitat connectivity, diversity, channel stability, riparian function and altered stream flow conditions. The long-term objective of this project is to restore habitat-forming processes to enhance salmon and steelhead populations in the Grays River, following recommendations developed during the FY04-06 BPA-sponsored Grays River Watershed Assessment (BPA Project # 2003-013-00). Specifically, this project will be the first step in restoring channel structure and function that will increase instream habitat diversity, channel stability, and riparian integrity in the critical response reach upstream and adjacent to critical salmon spawning areas of the Grays River.

**Title: Tidal Freshwater Monitoring**

**Number: 2005-001-00**

**Sponsor: Pacific Northwest National Laboratory (PNNL).**

Summary: This study will 1) provide basic data on the migration characteristics and ecology of yearling and subyearling salmonids in tidal freshwater habitats in the vicinity of the Sandy River delta in the lower Columbia River; and 2) assess feasibility to apply acoustic telemetry technology for action effectiveness research and quantify residence times and migration pathways in shallow, tidal freshwater habitats. The Sandy River delta and vicinity was chosen as the study area because it is in the tidal freshwater area of interest (RM 110-146), there is a major habitat restoration project ongoing there with potential for significant restoration of shallow

water habitat for juvenile salmonids, the area was mandated in the Action Agencies' Implementation Plan for the Updated Proposed Action, and because of relatively high mortality rates below Bonneville Dam. Research on juvenile salmonid ecology in tidal freshwater is also called for in the Northwest Power and Conservation Council's Lower Columbia Subbasin Plan and draft Research Plan. The project proposes to use a shallow (0-2 m) beach seine to sample fish within three of the most common shallow tidal freshwater habitats: river confluence floodplain, shallows, and mainstem islands. This is not a pilot study for an estuary-wide research, monitoring, and evaluation program. The study will perform status and trends monitoring and uncertainties research on yearling and subyearling salmonids in tidal freshwater and develop protocols for action effectiveness research.

**Title: Impact of American Shad in the Columbia River**

**Number: 2007-275-00**

**Sponsor: US Geological Survey (USGS)**

Summary: American shad (*Alosa sapidissima*) are non-native anadromous clupeids that have become extremely abundant in the Columbia River during the last 70 years, with adult counts at Bonneville Dam being as high as 5 million fish during recent years. American shad adults, perhaps over 20 million, enter the lower Columbia River during April-June for spawning. Juveniles outmigrate in vast numbers primarily during July through early winter, and evidence suggests that many overwinter in the estuary. However, there is very little known about their potential positive or negative impacts on the aquatic community.

The goal of this project is to provide credible lines of argument regarding whether shad provide positive benefits or are detrimental to efforts to restore Columbia River fisheries. This project will provide information on the role that juvenile and adult shad play as competitors for forage, as forage themselves, and as potential vectors of disease that may influence the productivity of salmonid populations. While little is known about American shad in the Columbia River, this project will build upon extensive research from the east coast of North America where efforts to restore American shad runs to rivers have been underway for decades. The project includes coordinated activities to address three objectives; 1) shad as potential competitors of juvenile salmon for forage, 2) the role that shad play as prey for juvenile salmon (a potential positive effect) and as prey supporting growth of native and introduced predators of juvenile salmon (a potential negative effect), and 3) the role that shad may play as vectors of disease that poses a potential threat to the restoration of salmonid populations. Field, laboratory, and modeling tasks will begin in 2007 and will continue through 2009.

**Title: Removal of Sea Lions at Bonneville Dam**

**Number: 2008-003-00**

**Sponsors: Oregon Department Of Fish and Wildlife (ODFW)**

**Idaho Department of Fish and Game (IDFG)**

**Pacific States Marine Fisheries Commission (PSMFC)**

**Washington Department of Fish and Wildlife (WDFW)**

Summary: The sponsors, PSMFC, ODFW, WDFW, and IDFG propose to construct and operate California sea lion trapping equipment to mark, monitor, haze, and facilitate the removal of California sea lions preying on fishes at Bonneville Dam.

**Title: Sea Lion Non-Lethal Hazing**

**Number: 2008-004-00**

**Sponsor: Columbia River Inter-Tribal Fish Commission (CRITFC)**

Summary: Sea lion presence below Bonneville Dam was rare and their consumption of salmonids was not a major concern prior to the 2000 Biological Opinion for Operation of the Federal Columbia River Power System (FCRPS) (NMFS 2000). Since 2001, the ACOE have been documenting sea lion abundance and estimating predation rates using visual observations within a quarter mile of the dam. Currently, the only quantitative measure of sea lion predation in the Columbia River is the ACOE limited observation area below Bonneville Dam, however, the amount of predation in the lower 150 miles is unknown and estimated through modeling at 13,000 in 2007 ([http://wdfw.wa.gov/wlm/sealions/sec\\_120\\_appl.pdf](http://wdfw.wa.gov/wlm/sealions/sec_120_appl.pdf)). Boat-based hazing activities in 2007, reported that approximately one-quarter of all hazing events involved a predation observation (Brown et al. 2007). Boat hazers reported a total of 1,494 hazing events and salmonid predation was observed in every site within the study area (Navigation Marker 85 to Bonneville Dam approximately 6 miles). This confirmed that substantial sea lion predation is occurring beyond of the observation limit (area viewable from the tailrace deck of the Dam) of the ACOE's enumeration program and necessitates the need for a technique to estimate sea lion predation. The Pinniped Fisheries Interaction Task Force expressed the desire for more data on sea lion abundance, distribution, and predation in the Columbia River (NOAA 2007b) and this project seeks to gather that data. .

**Title: Development of an integrated strategy for Chum salmon restoration in the tributaries below Bonneville Dam.**

**Number: 2008-710-00**

**Sponsor: Washington Department of Fish and Wildlife (WDFW)**

Summary: Chum Salmon Restoration in the Lower Columbia River – Development of an Integrated Strategy to Implement Habitat Restoration, Reintroduction and Hatchery Supplementation in the Tributaries below Bonneville Dam. (WDFW)

WDFW's proposed chum restoration approach for LCR chum salmon is as follows:

Step 1. Determine if remnant populations of chum salmon exist in LCR tributaries.

Step 2. if such populations exist, develop stock-specific recovery plans involving habitat restoration that include the creation of spawning refugias, supplementation where necessary, and a habitat and fish monitoring and evaluation plan. Step 3. if chum salmon have been extirpated from previously utilized streams, develop reintroduction plans that utilize appropriate genetic donor stock(s) of LCR chum salmon, and integrate habitat improvement and fry-to-adult survival evaluations.

**Innovative projects - limited performance period:**

**Title: Eelgrass Enhancement and Restoration**

**Number: 2007-513-00**

**Sponsor: Pacific Northwest National Laboratory (PNNL)**

Summary: Strong flows in the Columbia River likely limit the success of eelgrass seed dispersal and new plant establishment. This project will use innovative site selection techniques to identify 5-10 areas suitable for eelgrass enhancement, plant eelgrass and monitor success.

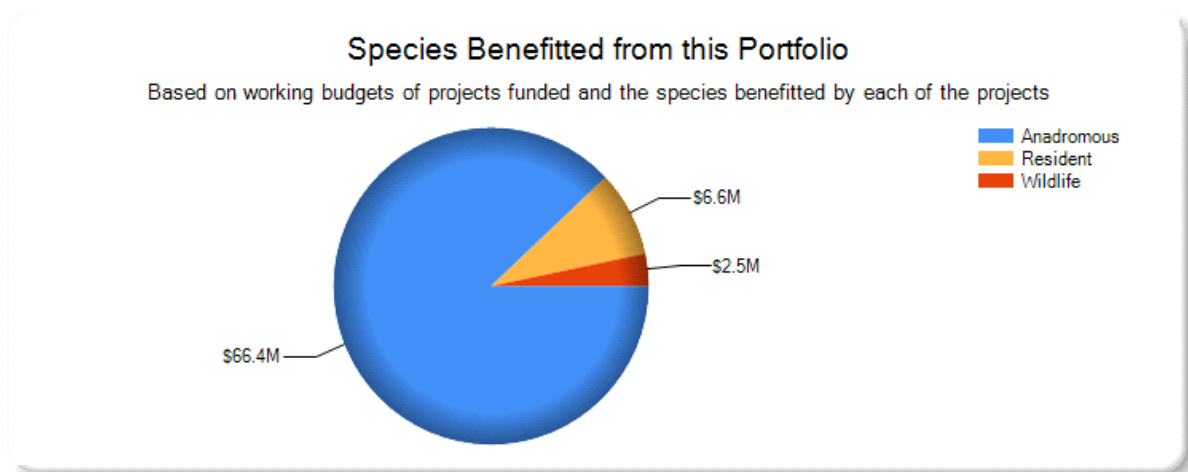
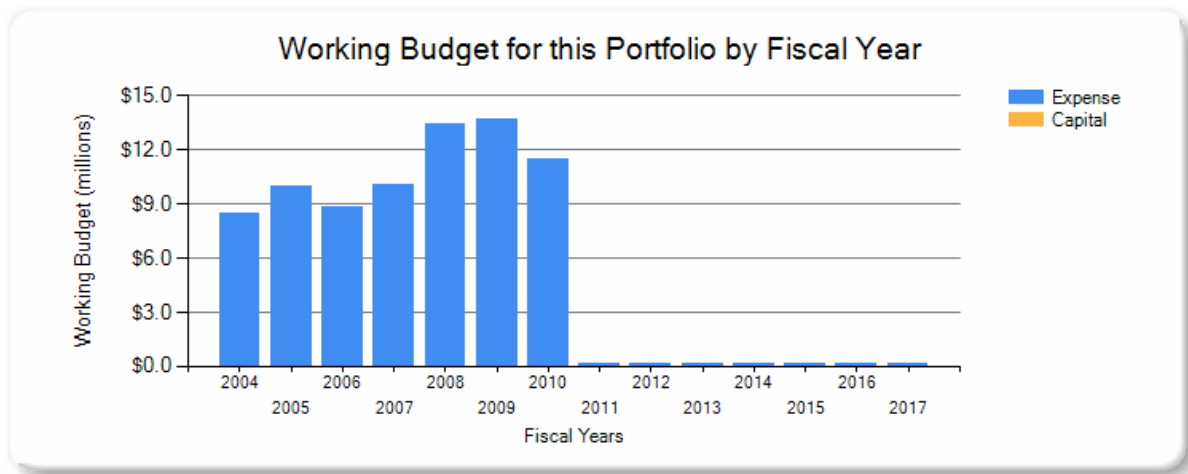
**Title: Integrated Non-Lethal Electric Barrier Sea Lion Abatement**

**Number: 2007-524-00**

**Sponsor: Smith-Root, Inc.**

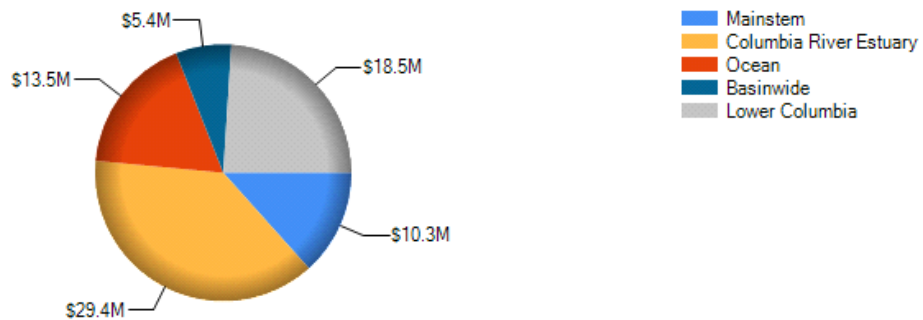
Summary: The scope of this contract is to develop and implement a demonstration project to assess the potential to deter upstream movement and predation by marine mammals on Columbia Basin fish resources. The objective is to deploy and evaluate a passive, integrated electric barrier and sonar array that selectively inhibits upstream marine mammal movements and predation, without injuring pinnipeds or affecting anadromous fish migrations. A combined split-beam, broadband sonar system will be integrated with a electric grid using protocols that detect, classify and track marine mammals, and activate an electrical field only when pinnipeds are present.

Summary of projects listed above:



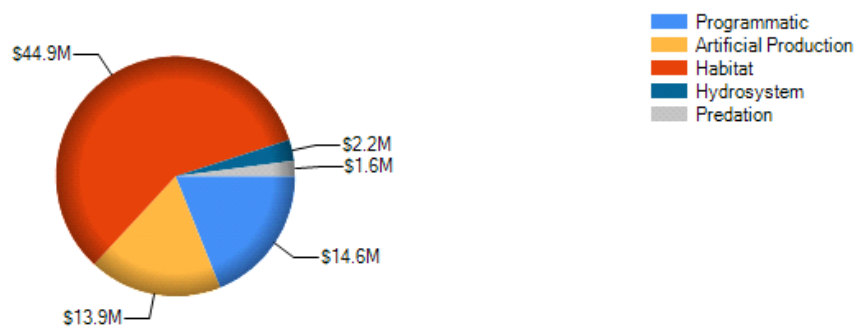
### Areas/Provinces Affected by this Portfolio

Based on working budgets of projects funded and the defined areas of each of the projects



### Purpose of Projects in this Portfolio

Based on budgets of projects funded and the Purpose designated for each of the projects



\*Project summary information and charts provided by Taurus and Pisces (Bonneville Power Administration).

### Related projects (not included in summary charts above):

**Number: 2003-114-00**

**Title: Pacific Ocean Survey Tracking (POST)**

**Sponsor: Kintama Research**

Summary: Kintama Research is working to construct an ocean tracking array for measuring the movements and survival of fish as small as salmon smolts along the west coast of North America & establish the relevance of such a tool for addressing important resource management issues, in particular, to develop the assessment of early marine survival and ocean movements for Columbia River salmon stocks. In 2006, the project began direct measurements of the survival of Snake & Yakima River run-of-river (ROR) spring chinook smolts, and also compared the relative survival and performance of transported vs ROR Snake R smolts.



This project seeks to provide objective information as to where Columbia River Chinook salmon smolts migrate to in the sea, and key information on the rates of marine mortality during the initial phase of the marine life cycle. These data will be used in an explicit test of the PATH hypothesis that delayed mortality due to the hydrosystem is the cause of the problem, and secondly will be used to assess the efficacy of transport to boost salmon returns. Successful demonstration of the application of the array to Columbia River salmon recovery issues would address a number of key RPAs which existing approaches cannot adequately address. Given the record salmon returns to the Columbia River in several years since the ocean climate changes of 1999, a critical issue for successful salmon management is to distinguish the true effects on salmon returns caused by the operation of the hydrosystem from those due to ocean climate change. The POST (Pacific Ocean Shelf Tracking) array is designed to be able to separate marine from freshwater impacts on salmon, and to localize the regions of the coast where mortality is high.

**Number: 2003-009-00**

**Title: Canada-USA Shelf Salmon Survival Study**

**Sponsor: Canada Department of Fisheries and Oceans**

Summary: The primary objective of this research is to assess the effects of ocean conditions on the production of Columbia River Basin salmon. The information generated in this study is intended to map the ocean conditions that determine the growth and survival of Pacific salmon along the west coast of North America from southern British Columbia to southeast Alaska, and to identify which stocks of Columbia River salmon forage in these areas. Documenting the extent of changes in growth, along with changes in physical features of the ocean will help to improve our understanding of how climatic events in the ocean can impact important fish resources. More specifically, the samples collected in this study will provide an assessment of whether different stock groups (including ESA listed stocks) predominate in regions of poor growth and survival. This research will also provide baseline data that can be used to forecast the size of Columbia River salmon runs.

**Projects currently funded by the Corps of Engineers in the Columbia Estuary/Lower Columbia River**

**Project summaries**

**Title: A Study of Salmonid Survival and Behavior through the Columbia River Estuary Using Acoustic Tags**

**Sponsor: NMFS/ PNNL**

Summary: Recent evidence suggests that improvement in survival of the estuarine and early ocean life history phase of Columbia River salmon may be critical to the recovery of endangered stocks. Survival success of Columbia River salmon hinges on the complex interaction of smolt quality and the abiotic and biotic ocean conditions at the time of entry and during their first year of ocean residence. Factors that potentially affect age-class recruitment during the first months of ocean residency include fish size and health status at the time of entry, entry timing, and ocean conditions during the first months. These factors are influenced or controlled by several aspects of the Columbia River estuary: differences in life history strategies, river flow (hydropower system management), and estuarine habitat availability and quality. Therefore, it is important to understand how salmonids use the estuary, both spatially and temporally, and how different ESU's, life history types, and various rearing, passage, and condition histories use and benefit from the estuary, and how these conditions affect ocean entry timing and survival. The development of micro-acoustic transmitters enables their use in the lower Columbia River and estuary environment for both ocean- and stream-type salmon.

Objectives:

1. Estimate survival from Bonneville Dam through at least five river reaches to the mouth of the Columbia River for yearling and subyearling Chinook salmon, and possibly steelhead.
2. Quantify the effects of FCRPS passage history on mortality of emigrant juvenile yearling and subyearling Chinook downstream of Bonneville Dam; compare survival for spill, RSW, JBS, and turbine passage. For each release replicate calculate and compare mortality rates between treatment groups.
3. Monitor and map estuary migration pathway and habitat associations and behaviors relative to these pathways to support estuary habitat restoration activities.
4. Determine the fate of subyearling Chinook salmon that ceases migration in the Columbia River downstream of Bonneville Dam.
5. Determine over-winter survival of subyearling Chinook who cease migration in the lower river and estuary.
6. Estimate survival probabilities for yearling and subyearling Chinook salmon within the plume.
7. Competitively procure prototypes of "rearing Chinook" acoustic micro-transmitters for function and biocompatibility evaluation.

**Title: Estuarine Habitat and Juvenile Salmon – Current and Historic Linkages in the Lower Columbia River and Estuary**

**Sponsor: NMFS**

Summary: Studies completed to date reveal that the Columbia River estuary 1) is used by juvenile salmonids all year long, 2) is used by juvenile salmon representative of all ESU's, 3) that shallow water habitats associated with marsh and forested wetlands are used by smaller

juvenile salmon of each ESU whereas larger juveniles use the larger order channels, 4) residence time for juveniles salmon averages 21 days in wetland habitats that contribute to their growth and survival, 5) that insects represent a major food source and source of energy for juvenile salmon, and 6) insects are associated with vegetated wetland sites. The focus of the information is generated from the mouth of the Columbia River to RM 40. Although Chinook salmon stocks from the lower Columbia River dominate this reach, it is hypothesized that tidally influenced habitat from RM 40 to Bonneville Dam will be used to a greater extent by mid and upper Columbia basin salmon stocks in a similar manner. However, this is unknown and needs to be verified.

Objectives:

1. Evaluate the diversity and importance of life history strategies used by juvenile salmonids from RM 40 to Bonneville Dam
2. Evaluate salmon prey resources and performance (e.g., growth, foraging success) at representative locations in the tidally influenced portion of the lower Columbia River
3. Determine habitat-specific rearing patterns among different source populations (ESU's) in the Columbia River estuary from RM 40 to Bonneville Dam.

**Title: Evaluation of the Relationship among Time of Ocean Entry, Physical, and Biological Characteristics of the Estuary and Plume Environment and Adult Return Rates**

**Sponsor: NMFS**

Summary: The goal of this study will be to examine the relationship among time of salmonid ocean entry, physical and biological characteristics of the Columbia River estuary and near shore plume environment, and smolt-to adult return rates (SARs) for yearling chinook and/or coho salmon. The last release of juvenile emigrants occurred in 2006, this work will focus on adult return rates and the analysis of physical and biological features measured when juveniles were released. While this program has potential management purposes more suited to the hatchery, harvest, and transportation programs than specific estuarine studies, the Portland District feels this data coupled with outside funding (BPA and NMFS) of estuary and near shore/plume habitats biological and physical characteristics is too valuable and important NOT to continue for the cost.

**Title: Evaluating Cumulative Ecosystem Response to Habitat Restoration Projects in the Lower Columbia River and Estuary**

**Sponsor: PNNL/ NMFS/ CREST/UW**

Summary: The types of estuarine restoration being implemented in the LCRE by the Corps and others include activities to: (1) reconnect backwater channels, sloughs and oxbows and recover estuarine wetlands through dike removal and tide gate replacement; (2) reconnect upland drainages and freshwater inflow through removal of armored channels, culverts, diversions, and other channelizing structures; (3) remove intertidal fills and piling fields; (4) allow natural accumulation of large woody debris; (5) place dredged material; and, (6) remove armor from shorelines. Such ecological restoration requires that detrimental changes be reversed to a measurable degree. However, existing data collection and analytical methods are insufficient to evaluate the cumulative benefits to the ecosystem or salmon populations.

Objectives:

1. Support the cumulative effects assessment at a pilot and estuary wide scales through field work to document the selected higher-order metrics, develop time-series, and expand the spatial and temporal diversity of sites for cumulative effects analysis:

At Kandoll, Crims Island, and Vera restoration and reference sites sample all the core metrics (Roegner et al., 2008) plus material flux.

At Julia Butler Hanson, sample hydrology, vegetation, and flux and use HEC-RAS to model wetted-area for the Cumulative Effects Study.

At selected natural breach sites, sample hydrology, morphology, vegetation, and fish abundance.

2. Test estuary wide the cumulative effects analysis methodology developed in previous years, including GIS assessments, discrete hydrologic modeling, and meta-analyses.

3. Support the Corps to implement an adaptive management framework developed in FY08 to support decisions by the Corps and others regarding LCRE habitat restoration activities.

**Title: Evaluation of Life History Diversity, Habitat Connectivity, and Survival Benefits Associated with Habitat Restoration Actions in the Lower Columbia River and Estuary**  
**Sponsor: PNNL/UW**

Summary: Although existing projects within the Anadromous Fish Evaluation Program and the Columbia Basin Fish and Wildlife Program address many of the FCRPS BiOp RPA actions, there are gaps in coverage of RPA Actions 58, 59, and 60: life history diversity index, habitat connectivity index, and estuary restoration-associated survival benefits. One of the goals of habitat restoration in the lower Columbia River and estuary (LCRE) is to increase salmonid life history diversity. Therefore, as called for in Action 58, a quantitative method is needed to index and periodically monitor life history diversity in the LCRE. Another goal of the LCRE habitat restoration effort is to increase habitat connectivity thereby improving the opportunity for juvenile salmonids to access shallow-water, off-channel habitats where they can forage and find refuge from predators during their migration to the ocean. A method to quantify and periodically monitor habitat connectivity, however, has not been developed and applied for the LCRE, as required by Action 59.

The 2008 Biological Opinion included an assessment of the survival benefits of habitat restoration actions in the LCRE proposed in the Biological Assessment. The assessment was necessarily based on professional judgment using the best available knowledge because data on incremental benefits to juvenile salmonid survival associated with specific restoration projects do not exist for the LCRE. This research need regarding survival benefits pertains to Action 60, calling for evaluation of habitat restoration actions. It is not certain that increased survival as an outcome of restoration can be measured and/or indexed in terms of life history diversity or habitat connectivity, but an evaluation of the potential is necessary given the requirements of the BiOp.

1. Develop and test with existing data quantitative methods to apply in the lower Columbia River to index:

a. Life history diversity for salmonids at representative locations;

b. Habitat connectivity by reach estuary wide

2. Assess feasibility and, if feasible, develop a technical approach to estimate the survival benefits associated with specific habitat restoration actions in the lower Columbia River and estuary.

**Title: Pile Structure Evaluation Coal Ck**

**Sponsor: PNNL/USGS**

Summary: This is the pilot study for monitoring action effectiveness of a pile removal.

Includes water quality and habitat monitoring, occurring once before project implementation  
Effectiveness: Water quality and habitat monitoring occurring during implementation and/or post-implementation.

**Title: Julia Butler Hanson Tide Gate Replacement**

**Sponsor: USFWS/PNNL**

Summary: Baseline monitoring of tide gate replacement and installation project sites at the Julia Butler Hansen (JBH) National Wildlife Refuge was carried out in 2007. The refuge is located near Skamokawa, Washington at about river kilometer (rkm) 55. The U.S. Corps of Engineers (USACE) is constructing multiple tide gates on this U.S. Fish and Wildlife Service site in phases, beginning in 2008. Therefore, 2007 baseline monitoring was conducted on Ellison Slough and Duck Lake Slough, both slated for 2008 construction, as well as an unnamed channel with a previously replaced tide gate. Baseline monitoring of 2009 construction sites is planned for 2008. Monitored indicators included landscape features and vegetation. Water properties flux monitoring was initiated in 2007 as well on a four-season sampling plan.

**Title: Crims Island Restoration Monitoring**

**Sponsor: USGS**

Summary: In 2005, the Corps' Portland District implemented a restoration project at Crims Island located at river kilometer 88 in the lower Columbia River. The restoration action included breaching a dike in two locations, removing material to the correct elevation for tidal wetland development, and the excavation of tidal channels. Monitoring of this project provides an opportunity to assess habitat improvement at the site and, in conjunction with other restoration project evaluation, to assess the cumulative ecosystem response to habitat restoration. The monitoring objectives were to:

1. Assess fish community composition and fish passage at the restored areas.
2. Collect post-restoration monitoring data on vegetation, elevation, and channel development during 2006 and 2007.
3. Collect data on the flux of ecosystem components in and out of the restored site.

**Title: Tenasillahe Island Restoration Monitoring**

**Implementer: USFWS**

The Corps will improve tidegate outlets at existing locations in the flood control levee surrounding Tenasillahe Island and construct inlet structures and channels at two locations to improve fisheries access and egress and improve water circulation in interior channels. Monitoring actions for the interim feature will cover 3 years in the estimated 10-year life of this feature and then be discontinued with implementation of the long-term restoration feature for Tenasillahe Island.

**Title: Juvenile Salmonid Stranding**

**Sponsor: PNNL/UW**

The overall goal of study is to address the impact of the deepening project on juvenile salmon stranding, specifically, to assess the consequence of dredging to deepen the navigational channel on the risk of fish stranding by commercial vessels.

The two objectives of the study are to:

Assess the effect of channel deepening on the risk of juvenile fish stranding with a before and after comparison, and

Determine the magnitude of wake and the resulting wave run-up generated by passing vessels before and after channel deepening and relate the wake to ship characteristics and shoreline physical factors with factors analysis.

**Other related work:**

**Title: USGS - Water quality monitoring**

Summary: Objective: To provide an ongoing characterization of the concentrations and mass flux of sediment and chemicals - 3 sites in LCRE (Warrendale, Beaver, and Willamette River at Portland). Metric: Water-soluble pesticides, suspended and dissolved trace elements, major ions, nutrients, carbon, and suspended sediment

Metrics: Ammonia, nitrate & nitrite, total phosphorus, specific conductance, total nitrogen, suspended solids, fecal coliform bacteria, oxygen, temperature, flow, pH, turbidity, metals, soluble reactive phosphorus

**Title: Ramsey Lake Project Monitoring**

**Sponsor: City of Portland, Bureau of Environmental Services**

**Project Funder: NOAA Coastal Restoration Program**

Summary: The primary reason for funding this project is NOT the FCRPS BiOp. The project is included anyway because it provides data that can be used to inform estuary/ocean RME. Data may be useful to others for meta-analysis of action effectiveness research data.

**Proposed new work**

**Draft Columbia River Accord (Washington - under review)**

**Proposed projects:**

- 1a WDFW Umbrella Project - WDFW Component
- 1b Lower Columbia Fish Recovery Board (LCFRB) Component
- 2 Abernathy Tidal Restoration
- 3 Germany Tidal Restoration
- 4 Lower Kalama Tidal Restoration
- 5 Acquisition of Chaney Parcel at Wood's Landing and Restoration of Chum Salmon Spawning Tributary
- 6 Ft. Columbia Tidal Reconnection
- 7 Fish- Hump Island Restoration
- 8 Paradise Point Wetland Enhancement
- 9 Austin Point LWD Complexing
- 10 Elochoman Tidal Restoration
- 11 Willow Grove Tidal Restoration
- 12 Shillapoo Wildlife Area/Post Office Lake Setback Levees
- 13 Duncan Creek Fish Passage Restoration
- 14 Pile Dike Removal
- 15 Burke Island Hydrology Improvements
- 16 Lower Washougal Delta Habitat Complexing
- 17 Lower Kalama Delta Habitat Complexing
- 18 Chinook River Estuary Restoration
- 19 Lower Cowlitz Tidal Restoration
- 20 Lewis River Acquisition
- 21 Port of Kalama Off-channel Wetland Enhancement
- 22 Cottonwood/Howard Island Tidal Channel Connections
- 23 Barlowe Point Beach Nourishment