



## U.S. Fish & Wildlife Service

### *Arcata Fish and Wildlife Office Fisheries Program's Drought Response 2016 Providing Technical Support to Water Managers*

#### ***Klamath Basin Anadromous Fish and Aquatic Habitat Monitoring and Assessments***

The U. S. Fish and Wildlife Service's Fisheries Program is responsible for: 1) facilitating the restoration of nationally significant fishery resources, 2) seeking and providing mitigation of fishery resources adversely impacted by federal water development projects, 3) providing technical assistance with regard to management of interjurisdictional fisheries and aquatic habitats, and 4) maintaining a federal leadership role in scientifically-based management of national fishery resources. Consistent with this direction, the Service has an established history of working collaboratively on salmon and lamprey issues in the Klamath Basin, with its involvement dating back over 30 years ago with the creation of the Arcata Office to help fulfill the U. S. Government's trust responsibilities to Native American peoples to restore depleted interjurisdictional salmon resources.

In FY16, the Service's Arcata Fish and Wildlife Office Fisheries Program, working in collaboration with tribal and agency partners, contributed over 2.4 million dollars in support of monitoring studies, applied research, and to provide technical support needed to better inform management and guide restoration of anadromous fish populations and associated aquatic habitats Northern California. The primary focus of the Program's activities was within the Klamath Basin and included efforts to support the Trinity River Restoration Program. Activities supported by the Service's Arcata Office are extensive and either directly or indirectly contribute to assessing the impacts of the on-going drought, including:

- collection of adult salmon escapement and stock assessment data used by Pacific Fishery Management Council to develop harvest management recommendations,
- monitoring juvenile fish abundance, size, growth, and health in relation to environmental conditions,
- assessing the prevalence and distribution of fish diseases and associated intermediate hosts,
- monitoring and modeling water temperatures in the Klamath and Trinity rivers,
- developing fish habitat/flow relationship models on both the Klamath and Trinity rivers to inform water management decisions, assess effectiveness of restoration actions, and guide the design of future restoration projects through an adaptive management process,
- developing, validating and calibrating the S3 (Stream Salmonid Simulator) Chinook Salmon production model, integrating data from the studies mentioned above into a decision support system,
- running predictive models such as S3 and the Klamath Basin Water Temperature Model to compare and contrast the effects of water management alternatives on aquatic resource,
- responding to requests for technical assistance regarding juvenile and adult fish health concerns, aquatic habitat availability and quality, and supplemental flow releases from Reclamation as directed under the Fish and Wildlife Coordination Act,
- providing technical assistance to Tribes in the Klamath/Trinity, Smith, Mad, Eel river basins, etc, and
- developing and overseeing the implementation of the geographically-specific Pacific Lamprey Conservation Initiative Implementation Plans, which directly assess drought-related risk to populations.

Below are a collection of brief highlights from selected activities conducted by the Arcata Fish and Wildlife Office Fisheries Program in FY16 that directly assess or minimize impacts of the on-going drought. Stated "Conservation Goals" relate to the *Strategic Plan for the U.S. Fish and Wildlife Service Fish and Aquatic Conservation Program: FY2016-2020*.

**Feature Project: Fall Chinook Salmon Spawning Escapement on the Mainstem Klamath River**  
**Conservation Goal: Fulfill Tribal Trust and Subsistence Responsibilities**

This collaborative project involving the Service's Arcata and Yreka Field office's, Native American Tribes, and California Department of Fish and Wildlife monitors the spawning distribution and estimates age composition, spawning escapement, and prespawn mortality of Fall Chinook Salmon within an 80-mile reach of the Klamath River annually. Data generated by this collaborative study are used by the Pacific Fishery Management Council to develop run size forecasts, harvest strategies, and to set quotas for tribal, commercial, and sport fisheries and to assess spawning success in relation to environmental conditions, flow and fish diseases. In-season updates and annual and multiyear trend analysis reports for this project are available from the Arcata Fish and Wildlife Office website at <http://www.fws.gov/arcata/>. Results of this monitoring effort were used to assess the effects of low flows resulting from the on-going drought on pre-spawn mortality in the Klamath Basin.



*Chinook Salmon carcass on the banks of the Klamath River. (USFWS photo).*

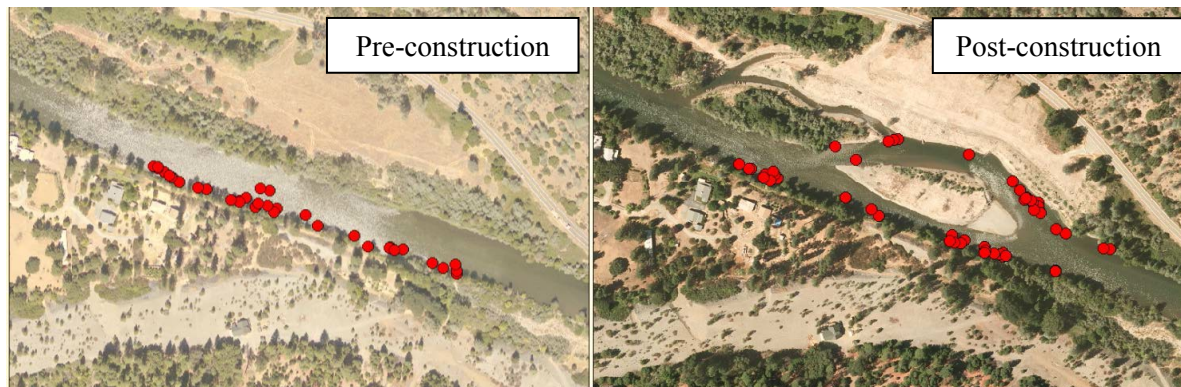


*Spawning Chinook Salmon in the Mainstem Klamath River (USFWS photo).*

**Feature Project: Trinity River Fall Chinook Salmon Spawning Distribution**

**Conservation Goal: Conserve, Restore, and Enhance Aquatic Habitats**

This project is being implemented through a unique partnership between the Service's Arcata Fish and Wildlife Office and the Bureau of Reclamation, Hoopa Valley Tribe, Yurok Tribe, U.S. Forest Service, and California State Department of Fish and Wildlife. The objective of this multi-year study is to quantify changes in the spawning distribution and abundance, potential redd dewatering, and prespawn mortality of Chinook Salmon within a 113-mile reach of the Trinity River in relation to habitat restoration efforts, environmental conditions, flow and fish diseases. Data generated by this study are used by the TRRP through an adaptive management framework to guide restoration actions aimed at altering the river's physical morphology. In addition, results of this on-going monitoring effort were instrumental in disproving claims made by plaintiffs that the release of supplemental fall flows designed to minimize the risk of an adult fish kill on the lower Klamath River would result in dewatering of redds, and was included in written declarations submitted to the Federal District Court in 2013 and again in 2015. Annual and a multiyear trend analysis reports for this study are available from the Arcata Fish and Wildlife Office website at <http://www.fws.gov/arcata/>.



*Distribution of salmon redds (spawning beds) before and after construction at the Wheel Gulch Fish Habitat Rehabilitation Site (USFWS graphic).*

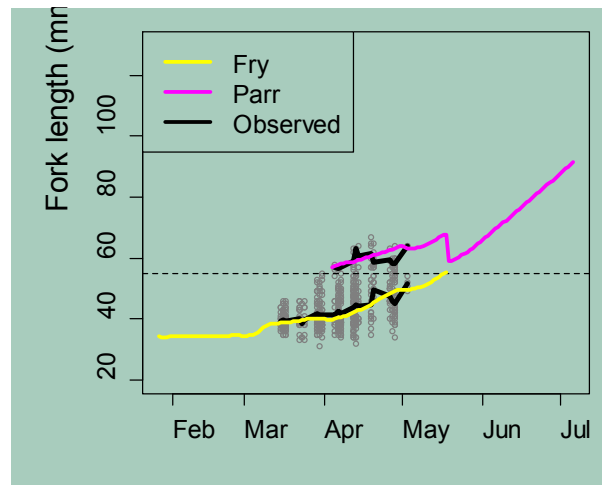
**Feature Project: The S3 Model – A Decision Support Tool for Klamath River Water Management**

**Conservation Goal: Conserve, Restore, and Enhance Aquatic Habitats**

The U. S. Fish and Wildlife Service's Arcata Office has partnered with the U.S. Geological Survey Columbia River Research Laboratory and Texas State University to develop a fish population dynamics model for the Klamath River named the Stream Salmonid Simulator (S3) Model. This decision support tool consists of an integrated set of sub-models that will be used to predict and compare the effects of water management alternatives on the production of juvenile Chinook Salmon in the Klamath Basin. The model tracks Chinook Salmon spawning abundance and distribution and tracks subsequent causes of mortality throughout the cohorts freshwater life history (redd scour, habitat limitations, disease, water temperatures, etc.) over time within the 233-mile section of the mainstem Klamath River that spans from Keno Dam in Oregon to its confluence with the Pacific Ocean in California. Development of the S3 model includes the construction of a water temperature model that was relied on extensively this past fall to help guide the development and support the selected fall flow augmentation water management alternative that was implemented by BOR to reduce the risk of a fish kill on the Klamath River.

Another critical component of the S3 Model is its juvenile fish disease module, which was developed through an on-going partnership between the model developers and the Service's California-Nevada Fish Health Center and the Salmon Disease Laboratory at Oregon State University. The disease sub model simulates the infection prevalence and resulting fish mortality via the fish parasite *Ceratomyxa nova* in relation to biological and physical factors experienced by juvenile salmon in the Klamath River. Calibration and validation of the S3 Model to historical abundance estimates of juvenile Chinook Salmon

is currently underway. Next steps include extending the S3 Model into the Trinity Basin, and the addition of an ocean component and an upstream adult migration sub module. These improvements will transform S3 into a full life cycle model that can be used to evaluate the effectiveness of channel rehabilitation projects, gravel injections, large wood augmentation, differing flow regimes, etc. on both the Klamath and Trinity rivers by isolating ocean versus in-river influences on fish production. In 2015, the S3 Model was used to model water temperatures to help inform supplemental fall flow releases intended to reduce the risk of an adult fish kill in the lower Klamath River and to inform spring pulse flows and hatchery fish releases based on survival predictions influenced by S3's juvenile disease sub model.



Example output from S3 showing average predicted size of juvenile Chinook Salmon compared to observed size data collected at juvenile traps in the Klamath River. The dashed horizontal line at 55 mm represents the breakpoint between fry and parr. (USFWS and USGS graphic).

### **Feature Project: Pacific Lamprey Conservation Initiative**

#### **Conservation Goal: Fulfill Tribal Trust and Subsistence Responsibilities**

Pacific Lamprey are a native anadromous fish integral to the ecology and culture of the Pacific Coast. In Northern California, the Smith, Klamath and Eel basins serve as a stronghold for Pacific Lamprey populations in California and support important subsistence fisheries by Native American Tribes. The current range of the species has declined triggering a series of efforts coordinated by the Service to help protect and restore populations. Central to this approach was a clear definition of issues facing the species, which are summarized in a threats assessment recently completed by the Service and Federal, State, Tribal, and NGO partners titled *Pacific Lamprey (Entosphenus tridentatus) Assessment and Template for Conservation Measures in California*. Efforts have now shifted to working collaboratively to develop geographically-specific implementation plans that identify, prioritize, and guide implementation of future conservation and restoration actions in the state, including how to buffer the species from impacts due to climate change and the on-going drought. Staff recently released final implementation plans for the South Central Coast and South Coast Regional Management Units.



Pacific Lamprey migrating upstream to spawn. (USFWS photo).

**Feature Project: Development and Implementation of Flow Management Triggers to Reduce Risk of an Adult Salmon Fish-kill in the Klamath River**

**Conservation Goal: Educate and Engage the Public and our Partners to Advance Our Conservation Mission**

A fish kill of national significance occurred in the lower Klamath River in September 2002. Though estimates vary, the US Fish and Wildlife Service's Arcata Office estimated that a minimum of 34,000 adult fish, primarily fall Chinook Salmon, died in the event. Causative factors included low flow, warm water temperatures, and high densities and extended residence time of salmon in the lower river. These factors, in combination, created optimal conditions for Ich and columnaris to proliferate and resulted in the disease epizootic. In subsequent years having similar hydrology and large projected in-river salmon runs, the Bureau of Reclamation (BOR) released additional flows down the Trinity River to improve conditions for adult salmon in the lower Klamath River and thereby reduce the risk of another fish kill event. These additional flow releases, which averaged about 34,000 acre-feet per year, occurred in 2003, 2004, 2012, 2013, and 2014 and no significant salmon mortality event occurred during any of those years.

Fish biologists and pathologists from the Service's Arcata Fish and Wildlife Office and California/Nevada Fish Health Center continue to respond to requests to provide technical assistance to managers from the Service's Pacific Southwest Regional Office, Reclamation's Mid-Pacific Regional Office and to the Department of Interior with regard to the real-time status of Klamath salmon runs, fish habitat conditions, prevalence of fish diseases, and risk of an adult fish-kill. Service efforts, working in close coordination with Federal, State and Tribal partners, have included developing technical guidance for implementing fall augmented flows presented in the 2013 and 2015 Fall Flow Technical Memorandums submitted to BOR in response to the agency's request for technical assistance, preparing and submitting written declarations to the United States District Court in 2013 and again in 2015, and serving as an expert witness in the hearing *SAN LUIS & DELTA-MENDOTA WATER AUTHORITY v. JEWELL* held in fall 2013. Judgments by the court in 2013 and 2015 were in favor of the Department of Interior, supplemental flow releases were released, and a fish kill did not occur.



*Service pathologists conducting Klamath River fall Chinook Salmon fish health survey in 2014 (USFWS photo).*

**Feature Project: Klamath Basin Juvenile Salmonid Production Monitoring.**

**Conservation Goal: Conserve Aquatic Species**

This multiyear study being conducted by the Service and its Tribal, State, and Federal partners produces annual estimates of juvenile abundance of Chinook Salmon and indices of abundance for Coho Salmon, steelhead and lamprey in the Klamath and Trinity rivers. Fish trapping sites are also used to collect information on incidence of infectious fish diseases and their relation to environmental variables such as water temperature, flow, etc. Data resulting from this study have proved valuable in assessing potential effects of water management alternatives, habitat restoration efforts, drought effects, and disease management actions.



*Rotary screw trap used to monitor the abundance of outmigrant juvenile salmonids on the Klamath River near Bogus Creek.*



*Diseased Chinook Salmon captured on the Klamath River.*

**Feature Project: Klamath Fish Health Assessment Team**

**Conservation Goal: Conserve Aquatic Species**

AFWO continues to be an active participant in the Klamath Fish Health Assessment Team (KFHAT), a technical workgroup which formed during the summer of 2003 with the purpose of providing early warning and a coordinated response effort to address, and if possible avoid, a non-hazardous materials related fish kill event in the anadromous portion of the Klamath River basin. To accomplish this goal, KFHAT has created a network through which current information about river and fish health conditions in the Klamath Basin can be quickly shared among participants, the general public, and resource managers. The severe drought throughout California has resulted in low flows, high water temperatures and high incidence of disease prevalence for salmon and steelhead in the Klamath River. Because of these conditions, the entities that comprise KFHAT, including the Service, are engaged in hands-on daily observations of river and fish conditions throughout the Klamath and Trinity River Basins. KFHAT provides a forum, through regular conference calls and an email distribution list, to exchange real-time information about river and fish health conditions throughout the Klamath and Trinity River basins. This allows the KFHAT team to provide water and fish managers with accurate and up-to-date information about the fish health conditions, as well as of environmental conditions that could contribute to or cause a fish kill. Members of KFHAT were also active in preparing to respond to a fish kill, in the event one occurs anywhere in the basin.



*Fish kill survey on the lower Klamath River, 2002.*

**Feature Project: Klamath Basin Environmental Water Account (EWA) Management**

**Conservation Goal: Educate and Engage the Public and our Partners to Advance Our Conservation Mission**

The Service's Arcata and Klamath Falls Fish and Wildlife offices are active participants on Reclamation's Flow Account Scheduling Technical Advisory (FASTA) Team, established under the Service and NOAA Fisheries 2013 Joint Biological Opinion. FASTA Team members provide technical information and real-time flow management recommendations to the Klamath Basin Area Office Area Manager with regard to managing EWA to best meet the needs of Coho Salmon in the Klamath River and needs of listed suckers in Upper Klamath Lake.