Reclamation Point of Contact: Joshua Israel, Science Division, Bay Delta Office, Sacramento, CA

6-Year Steelhead Telemetry Study Analysis and Reporting

Fact Sheet Number

FY18_020

Project Description

The study was designed to use the results from the Six-year steelhead telemetry study during 2011-2016 to evaluate juvenile steelhead route selection at channel divergences in the south Delta and along the mainstem San Joaquin River, and how these behaviors influence survival in specific reaches and through the Delta to Chipps Island. This is the second year in a three-year agreement to achieve a full examination of 2011-2016 results by the end of FY19.

Project Need

The NOAA National Marine Fisheries Service's (NMFS) Biological Opinion (BiOp) on Long-term Operations of the Central Valley Project and State Water Project (OCAP) included Reasonable and Prudent Alternative (RPA) Action IV.2.2 to undertake experiments utilizing acoustically-tagged salmonids to confirm proportional causes of mortality due to flows, exports, and other project and non- project adverse effects on steelhead smelt out-migrating from the San Joaquin Basin and through the southern Delta. This study coincided with different periods of operations and focus on clipped hatchery steelhead (*Oncorhynchus mykiss*) between 2011 and 2016. This period included changes in CVP/SWP operations, droughts/flood conditions, and D-1641 San Joaquin River pulse flows to assess the influence of flow and exports on juvenile steelhead survival.

Project Objectives

- Complete release-recapture modeling from 2014-2016 South Delta steelhead telemetry study.
- Perform multiyear analysis on survival and route selection for 2011 – 2013 studies.

Schedule of Project Milestones (When Will Data Collection, Analyses, and Reporting Elements be Completed?)

Date	Milestone
11/30/2017	Predator filter completed for 2014, 2015, 2016
12/31/2017	Mark-recapture analysis for 2014 study
01/31/2018	Reporting for 2014
05/31/2018	Mark-recapture analysis for 2015, 2016 studies
06/30/2018	Reporting for 2015, 2016
12/31/2018	Draft manuscript for 2011-2013

Expected FY 2018 Project Cost

$171,356

Is this Project for a CVP/SWP Biological Opinion or Water Right Decision Compliance? If so, Which Specific Requirement?

No.

Investigator

Rebecca Buchanan
School of Aquatic and Fishery Sciences
University of Washington
Seattle, WA

Reclamation Point of Contact: John Hannon, USBR

Evaluation of Juvenile Salmon Colonization in Tributaries to Shasta Reservoir, California

Fact Sheet Number

FY18_021

Project Description

The goal of the proposed work is to provide information to inform the Shasta Dam Fish Passage Evaluation (SDFPE) and reintroduction of Chinook salmon above Shasta Dam. The proposed work is directly related to and described within the existing SDFPE, but is restricted to tasks that can be accomplished prior to installation and operation of the in-river and head-of-reservoir traps.

Project Need

The U.S. Bureau of Reclamation (Reclamation) is responsible for many dams of the CVP such as storage dams including Shasta Dam on the Sacramento River, Folsom Dam on the American River, and New Melones Dam on the Stanislaus River. In 2009 the National Marine Fisheries Service (NMFS) determined through a Biological Opinion that these three dams, among others, were likely to jeopardize the continued existence of four federally-listed anadromous fish species: Sacramento River winter-run Chinook Salmon (*Oncorhynchus tshawytscha*), Central Valley spring-run Chinook Salmon (*O. tshawytscha*), California Central Valley steelhead (O. mykiss), and the Southern distinct population segment of the North American green sturgeon (*Acipenser medirostris*). The Biological Opinion set forth a series of Reasonable and Prudent Alternatives (RPAs) that allows continued operation of the CVP and SWP in compliance with the Federal Endangered Species Act.

The RPAs include a Fish Passage Program (Action V) to evaluate the reintroduction of winter-run and spring-run Chinook salmon and steelhead into their historical habitats blocked by Shasta, Folsom, and New Melones dams. The near-term goal for Action V is to increase the geographic distribution and abundance of the target species. The long-term goal is to increase the abundance, productivity, and spatial distribution of the target species, and to improve their life history, health, and genetic diversity. As part of Reclamation's response to Action V of the Biological Opinion, they created the Shasta Dam Fish Passage Evaluation (SDFPE) to determine the feasibility of reintroducing winter-run and spring-run Chinook salmon and steelhead to tributaries above Shasta Dam. The SDFPE outlines reintroduction of Chinook salmon above Shasta Dam in a multi-year phased approach. One of the proposed reintroduction efforts focuses on moving salmon to the McCloud River due to its inherently colder water than the Sacramento and PIT rivers. However, reintroduction efforts may be focused in the Sacramento River instead. The work collected under this project will provide information to inform the SDFPE and reintroduction of Chinook salmon above Shasta Dam.

Project Objectives

- Objective 1. Project planning, study design development and coordination.
- Objective 2. Spatial and temporal distribution of resident fish
- Objective 3. Evaluate dispersal, growth, and survival of juvenile salmon released into tributaries upstream of Shasta Dam
- Objective 4. Evaluate the efficacy and performance of Juvenile Collection Structure(s) (hereafter referred to as the JCS).

Schedule of Project Milestones (When Will Data Collection, Analyses, and Reporting Elements be Completed?)

Date	Milestone
02/02/2018	Field work initiated
03/30/2019	Field work for first year completed
08/31/2019	Draft 2018 report to BOR
10/31/2019	Review comments from BOR
12/31/2019	Final 2018 report to BOR

Expected FY 2018 Project Cost

$1,162,125

Is this Project for a CVP/SWP Biological Opinion or Water Right Decision Compliance? If so, Which Specific Requirement?

The Biological Opinion set forth a series of Reasonable and Prudent Alternatives (RPAs) that allows continued operation of the CVP and SWP in compliance with the Federal Endangered Species Act. The RPAs include a Fish Passage Program (Action V) to evaluate the reintroduction of winter-run and spring- run Chinook salmon and steelhead into their historical habitats blocked by Shasta, Folsom, and New Melones dams.

Investigator

Noah Adams
USGS

Operation of Segregation Weir in Clear Creek

This is Activity 3 of contract “Fisheries Monitoring Activities in Sacramento River, Clear Creek and Battle Creek required by NMFS OCAP Biological Opinion.”

Fact Sheet Number

FY18_022

Project Description

Install and maintain a temporary picket weir to prevent fall-run Chinook from accessing spring-run Chinook spawning grounds, thereby reducing the potential for hybridization of the runs and negative impacts from redd super-imposition and other forms of competition.

Project Need

Whiskeytown Dam blocks passage for spring Chinook resulting in their spawning downstream in areas accessible to fall Chinook. Hybridization and competition with fall Chinook will decrease the fitness and number of spring Chinook. Without the weir, the small number of spring Chinook would probably be overwhelmed by the fall Chinook population which is 100 times larger. Increasing the population of spring Chinook so that it can survive independently of other populations is required for recovery and de- listing of spring Chinook in the Central Valley ESU. This activity is required in the NMFS Recovery Plan. Data collected at the weir is used to meet other BiOp requirements which are used to manage water releases and habitat restoration.

Project Objectives

Install and monitor temporary picket weir from late August to early November to spatially separate spring and fall Chinook. Improve adult spring Chinook population estimates by collecting carcasses on the weir to determine population age structure, genetic determination of run, stream of natal origin of adults, and juvenile life history based on adult otoliths. Allow estimates of juvenile spring Chinook production using an upstream rotary screw trap, which are otherwise unavailable.

Schedule of Project Milestones

Date	Milestone
10/01/2017	Field work continues from previous FY
11/01/2017	Weir removed from Clear Creek
08/23/2018	Install and maintain weir and collect carcasses and other data
09/30/2018	Annual Report

Expected FY 2018 Project Cost

$27,992 – FY18 Agreement amount = $36,035 - $8,763 (Received in FY17)

Is this Project for a CVP/SWP Biological Opinion or Water Right Decision Compliance? If so, Which Specific Requirement?

This project is used to develop adult escapement and juvenile production estimates required in Sections 11.2.1.3.7 and 11.2.1.3.8.a of the CVP/SWP BiOp. The project is described in the Biological Assessment for the BiOp as a part of the CVP.

Investigator

Matt Brown & James G. Smith
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R15PG0006 Genetic Analyses of California Salmonid Populations

Task 2: Genetic analysis for salmonid reintroduction efforts and other RPA actions

Fact Sheet Number

FY18_023

Project Description

The purpose of this task is to provide the genetic analyses and interpretation necessary to evaluate variation among salmonid populations to ascertain their prospective adaptive potential for reintroduction. NMFS and Reclamation will use this information to determine the most genetically appropriate source population(s) for reintroduction efforts in targeted locations (e.g. Shasta and Folsom Dams).

Project Need

In order to maximize the potential for success in salmonids reintroduction efforts above major dams in California, the genetic composition of the source stock populations must be evaluated, and continued genetic monitoring of fish passed above barriers dams is needed once projects are initiated. This evaluation may include a variety of genetic and genomic approaches, including establishment of genomic diversity baselines and assessment of both neutral and adaptive variation based on the best available and newly collected data. Genetic analysis and monitoring is a core component in all recovery planning documents and RPAs related to reintroduction of ESA listed stocks of Central Valley DPS steelhead, and Sacramento River spring-run and winter-run Chinook salmon.

Project Objectives

- Genotyping and data analysis and/or analysis and interpretation of existing data.
- Review and preparation of documents related to ongoing reintroduction projects for Central Valley listed salmonids.
- Participation in meetings and other communication with agency and other partners and stakeholders in reintroduction planning.

Schedule of Project Milestones

Date	Milestone
09/30/2018	FY17-18 Progress Report
FY15-19, ongoing	Review documents for reintroduction work
FY15-19, ongoing	Genetic analysis for reintroduction projects

Expected FY 2018 Project Cost

FY18 as budgeted: $77,864.13

Modified FY18-FY19 request: $208,064.18

Is this Project for a CVP/SWP Biological Opinion or Water Right Decision Compliance? If so, Which Specific Requirement?

Yes. RPA actions for the CVP/SWP BiOp for reintroduction of Sacramento River winter-run and spring-run Chinook salmon and steelhead re-introductions above Shasta and Nimbus Dams.

Investigator

Dr. Devon Pearse
NMFS/SWFSC/FED
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Reclamation Point of Contact: Towns Burgess Ph.D., Fish Biologist, Bureau of Reclamation, Bay-Delta Office

Drivers of Delta Smelt Health Condition and Reproduction

Fact Sheet Number

FY18_024

Project Description

The purpose of this project is to retain Delta Smelt collected from existing monitoring programs to evaluate fish health and condition. This will be accomplished by determining how fish health indices (e.g., biomarkers of exposure and effects, nutritional status) relate to Delta Smelt health and reproductive condition, by conducting a regional comparison of juvenile Delta Smelt condition using archived Delta Smelt, by quantifying the foraging and metabolic consequences of semi-anadromy for Delta Smelt, and by determining the sensitivity of the biomarkers through the use of starvation experiments with captive-bred Delta Smelt. This data will be used to establish a conceptual framework that investigates relationships among stressor effects, ecosystem variables, and the health indices of Delta Smelt to improve our understanding of the species and its decline.

Project Need

Under Component 3 (‘Improve Habitat for Delta Smelt Growth and Rearing’) of the 2008 U.S. and Wildlife Service Biological Opinion on the long term operation of the CVP, Reclamation is required to increase net Delta outflow during fall (September-November) to increase the amount and quality of Delta Smelt habitat during above normal and wetter years. To evaluate the effect of these flow actions on the Delta Smelt population, Reclamation will provide funding to the University of California-Davis (UCD) for two years to perform measures and analyses of the health, growth, diet, movement, and reproductive and habitat history of captured (wild) and cultured Delta Smelt.

Project Objectives

The principal objectives of this project are to:

1. Determine how Delta Smelt health indices (e.g., biomarkers of contaminant exposure and nutritional status) vary with condition, fecundity and oocyte quality;

2. Compare juvenile Delta Smelt health condition among regions and water years;

3. Quantify the foraging and metabolic consequences of semi-anadromy for Delta Smelt;

4. Determine the sensitivity of applied biomarkers to Delta Smelt starvation; and

5. Evaluate growth rates in association with salinity history of Delta Smelt.

Status

Reclamation has completed and executed this agreement (R17AC00129).

Schedule of Project Milestones (When Will Data Collection, Analyses, and Reporting Elements be Completed?)

Date	Milestone
May 2017–November 2018	Collect and cryogenically preserve Delta Smelt from CDFW and USFWS fish surveys.
May 2017–April 2019	Necropsy and process Delta Smelt
May 2017–April 2019	Evaluate condition factor, organo-somatic indices (hepatosomatic index and gonadosomatic index), RNA/DNA and TAG analysis to determine nutritional status, gross and histological staging and measurement of oocyte size (egg quality) and number (fecundity) for reproductive output analysis, and histopathological analysis of gill, liver and gonad for health analysis necropsied for fish
May 2017–April 2019	Three enzymatic biomarkers will be measured: Na/K ATPase activity in gills, ethoxyresorufin-O-deethylase (EROD) activity in liver, and acetylcholinesterase activity in the brain for the fish necropsied
July 2017–April 2019	Perform starvation experiments at the UCD Fish Conservation and Culture Lab (FCCL). The cultured fish will be flash frozen and processed for biomarkers and histopathology following the identical procedures used for wild fish.

Expected FY 2018 Project Cost

$500,000

Investigator

Swee Teh Ph.D.
Director of the UC Davis Aquatic Health Program

Reclamation Point of Contact: Dr. Erwin Van Nieuwenhuyse, Bureau of Reclamation

Investigating the Role of Nutrients (N & P) in Food Resource Dynamics of the Sacramento-San Joaquin Delta

Fact Sheet Number

FY18_025

Project Description

This project will evaluate nutrient-phytoplankton-zooplankton dynamics in the Sacramento-San Joaquin Delta with a particular focus on increasing Delta smelt food resources to enhance their abundance and survival in the Delta. A critical goal is to determine whether nutrient additions to the Sacramento Deep Water Ship Channel timed to occur when ambient nutrient concentrations are at a minimum can increase primary (phytoplankton) and secondary (zooplankton) productivity to positively affect food resource availability for the entire aquatic food web.

Project Need

Ecosystem-based management (EBM) has gained international popularity in recent years as an effective management strategy for aquatic ecosystems. An ecosystem approach to aquatic resource management is viewed as a desirable goal for fisheries management, but there is little consensus on what strategies or measures are needed to achieve success. Water quality is certainly an important component of EBM and is strongly impacted by anthropogenic activities. Historically, management of water quality was primarily focused on human health; however, the basis for aquatic ecosystem management requires a much larger view: protection of the water resource base as a whole in order to support broad ecosystem health. The timing and availability of food resources, in particular, are critical for the overall productivity, diversity and resilience of aquatic ecosystems. Such ecosystem wide structural dependence on resources makes understanding when and why primary production is limited a critical step for developing new tools for managing overall ecosystem health.

The Sacramento-San Joaquin Delta has experienced a long-term decline in all measures of aquatic ecosystem health. Yet, given the multitude of research activities, no clear mechanism(s) has been identified to explain this precipitous decline. Conceptual models for the pelagic organism decline in the Sacramento-San Joaquin Delta suggest the potential for both “top-down” and “bottom-up” drivers of fish abundance. As in many estuaries, higher trophic level production in the open waters of the Delta region is fueled by phytoplankton production. However, the Delta has notably low phytoplankton production and biomass resulting in low overall aquatic

ecosystem productivity compared to other systems. With respect to the Delta, increasing high quality food resources (i.e., phytoplankton & zooplankton) would be expected to have a beneficial effect for the entire aquatic ecosystem, especially for endangered native species such as the Delta smelt whose reproduction and survival are critically linked to the availability of food at the larval growth stage. Therefore, increasing food resources, especially at critical times of the year, has the potential to enhance the entire Delta aquatic ecosystem; especially native fish species that are often out-competed for food resources by introduced species.

Project Objectives and Methodological Approaches

To address the potential effects of nutrients on food resources in Delta aquatic habitats, this project will:

1. Evaluate nutrient-phytoplankton-zooplankton dynamics across several environmental gradients in the Sacramento-San Joaquin Delta. Delta habitats will be sampled to determine nutrient dynamics associated with phytoplankton and zooplankton community composition and abundances.

2. A nutrient addition study in the Sacramento Deep Water Ship Channel (SSC) will examine the effects of nutrient enrichment on phytoplankton-zooplankton dynamics. We hypothesize that nutrient enrichment will result in increased primary (phytoplankton) and secondary (zooplankton) productivity that will positively affect food resource availability for the entire aquatic food web.

   Nitrogen in the form of calcium nitrate, which is the dominant form of N contributing to DIN in the upper SSC, will be applied to a ~300 m length of the SSC by a crop duster to achieve a target nitrogen concentrations of 0.5 mg/L. The nutrient enrichment response will be monitored for a period of 4-6 weeks following nitrogen application. We will characterize the ecosystem response to nutrient enrichment using a number of different approaches of quantifying metabolic rates. First, integrated rates of gross primary production (GPP) and respiration (R) will be quantified using the δ18O-DO mass balance approach to provide a spatially and temporally integrated estimate of GPP, R and net ecosystem production (NEP = GPP-R). The δ18O technique characterizes an integrated ecosystem response at the time scale of weeks, and consequently, samples will be collected during the week prior to enrichment and one month post enrichment. Second, the response to nutrient additions at shorter time scales, we will model metabolic rates made over 24 h periods using a combination of in situ measurements of dissolved oxygen and laboratory incubations of water and sediments.

Schedule of Project Milestones (When Will Data Collection, Analyses, and Reporting Elements be Completed?)

Date	Milestone
10/01/2017 to 09/30/20	Continuous and synoptic examinations of nutrient-phytoplankton-zooplankton dynamics across environmental gradients
07/01/2018 to 09/30/18 07/01/2019 to 09/30/19 07/01/2019 to 09/30/20	Nutrient addition experiments and monitoring response on phytoplankton-zooplankton productivity
Annually	Presentation of research results at the Biennial Bay-Delta Science Conference and related conferences
Annually	Reporting of research results to various state and federal agencies at cooperator meetings
Semi-annually	Submission of semi-annual reports

Expected FY 2018 Project Cost

FY 2018: $282,167
FY 2019: $301,417
FY 2020: $300,439
Total project cost: $884,023

Investigator

Drs. Steven Sadro and Randy Dahlgren
University of California – Davis

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Reclamation Point of Contact: Dr. Erwin Van Nieuwenhuyse, Ph.D.

Single-Platform Integrated Aquatic Species and Habitat Sampling System

Fact Sheet Number

FY18_026

Project Description

Over the last 36 months, a prototype of the Single-Platform Integrated Aquatic Species and Habitat Sampling System (Sampling Platform), was designed, constructed and field tested. This innovative push net system guides fish through a live well outfitted with video and water quality equipment facilitating instantaneous sampling of aquatic organisms and associated environmental data. Results from initial field trials in a reservoir where no listed species were present demonstrate that the Sampling Platform allows for relatively non-invasive sampling of fish populations and zooplankton and associated environmental parameters in critical habitat areas; shoals, intertidal, and sub-tidal zones that are now under sampled or not presently sampled. This new system would greatly improve the effectiveness of ESA-listed and non-listed fish and aquatic habitat monitoring and research in the San Francisco Estuary including the Sacramento San Joaquin Delta and tributaries. Results of these investigations will also be available for operational and management decisions affecting the Central Valley Project, implementation of the delta smelt and salmon biological opinions and the design and assessment of fish habitat restoration efforts.

Project Need

Operation of the Central Valley Project has been identified as a potential cause of a substantial reduction in the quantity and quality of habitat for resident and anadromous fish populations dependent on the Sacramento-San Joaquin Delta-San Francisco Bay estuary (Bay-Delta). Monitoring activities are designed to document the status and trends of fish populations and their habitat (hydraulic conditions, water quality, food supply), in order to provide baseline data for adaptive management experiments and to document the effect of Reclamation actions to benefit delta smelt and other listed fish populations. These activities rely on trawling, seining and other methods that harass or kill captured fish, some of which are listed as threatened or endangered under federal and state Endangered Species Acts. This project furthers the development and deployment of more effective and benign fish sampling methods by supporting the refinement and field testing of a new and innovative approach to fish sampling which minimizes harm to individual fish. Initial, field trials in a reservoir where no listed species are present were successful. This next phase will facilitate continued refinement of equipment and allow sampling in areas where listed fish are known to occur but are not routinely sampled, e.g. shallow littoral habitat, tidal and intertidal habitats. The sampling approach to be developed by

this project will likely greatly improve the effectiveness of fish monitoring, revealing habitat associations, thereby contributing to efforts to reverse the decline in Bay-Delta fish populations and improve their habitats.

Project Objectives

The objectives of the project are to:

- Improving Sampling Platform prototype including safety, fish sampling and video storage, sampling chamber function, and recording of water velocities and net angle to better estimate water volume sampled;
- Continue developing image acquisition, live-trapping and genetic identification to allow expanded cost-effective sampling that minimizes impacts to sensitive fish species;
- Advancing technology associated with video recording and image recognition of aquatic species;
- Continue algorithm development to identify individual fish species;
- Continue development of uninterrupted (rather than at discrete stations) recorded biological data, yielding time- and location (lat-long)-stamped observations;
- Continue improving sampling efficacy and reduced fish handling;
- Expanding fish community sampling to the Delta;
- Testing hypotheses related to Delta fish species and habitat associations;
- Linking fisheries observations to simultaneously recorded water quality and physical data;
- Conduct a series of field tests on the sampling platform and analyze its performance against other sampling methods (e.g., Kodiak trawl, otter trawl, mid-water trawl, etc.)

Schedule of Project Milestones (When Will Data Collection, Analyses, and Reporting Elements be Completed?)

Date	Milestone
03/01/2018	Permitting and IEP Coordination
12/31/2018	Vessel Modification
05/31/2018	Field Tests and Analysis
11/30/2018	Draft Manuscript
12/31/2018	Final Manuscript
09/30/2019	Presentations and Briefings

Expected FY 2018 Project Cost

$460,000

Is this Project for a CVP/SWP Biological Opinion or Water Right Decision Compliance? If so, Which Specific Requirement?

No.

Investigator

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