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

6-Year Steelhead Telemetry Study Analysis and Reporting

Fact Sheet Number

2019_20

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 third year in a three-year agreement to achieve a full examination of 2011-2016 results by the end of FY19. We anticipate requesting a no-cost extension to end May 2022.

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.
- Perform multiyear analysis on survival and route selection for 2011–2016 studies

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

Date	Milestone
03/31/2018	Predator filter completed for 2014, 2015, 2016 (completed)
05/31/2018	Mark-recapture analysis for 2014 study (completed)
05/31/2018	Reporting for 2014 (completed)
07/31/2018	Mark-recapture analysis for 2015 study (completed)
07/31/2018	Reporting for 2015 (completed)
11/31/2018	Mark-recapture analysis for 2016 study
11/31/2018	Reporting for 2016
12/31/2019	Draft manuscript for 2011-2013
12/31/2021	Draft manuscript for 2011-2016 analysis

Expected FY 2019 Project Cost

$102,412

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 and Ian Smith

Assess Chinook Salmon Habitat Suitability and Production Potential in California Rivers

Fact Sheet Number

2019_37

Project Description

The USGS Western Fisheries Research Center, Columbia River Research Laboratory will assess the production potential and fish trap performance in the Sacramento River System in support of the recovery of fall and winter-run Chinook salmon populations. This study will adapt the stream salmonid simulator model (S3) for use in Central Valley Rivers of interest. The model will provide ability for end users to evaluate river management scenarios (i.e. flows, temperatures, habitat modifications) on Chinook salmon survival and production potential.

Project Need

The CVPIA Program is working to improve spawning and rearing habitat, as well as fish capture methods, in the main stem Sacramento River and its tributary rivers.

Project Objectives

This project is ongoing from FY 2017

- Apply the S3 model to assess habitat suitability and the production potential of juvenile Chinook salmon within a river of interest
- Quantify and assess the performance of a juvenile fish collector within a river of interest, if tested in 2019

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

Date	Milestone
January 2019	Task 1: Project sampling begins
March 2019	Task 2: Spring sampling begins
April 2019	Task 2: Spring sampling ends
November 2019	Task 2: Fall sampling begins
December 2019	Task 2: Fall sampling ends
June 2020	Task 1: Project sampling ends
December 2020	Final Report

Expected FY 2019 Project Cost

$614,315 in FY19 funds; $385,673 in FY20

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

This work is a step in evaluating the requirement in the 2009 NMFS Biological Opinion on the Long Term Operations of the CVP/SWP (BO) for fish passage upstream of Shasta Dam.

Investigator

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Reclamation Point of Contact: John Hannon

Constant Fractional Marking/Tagging Program for Coleman and Nimbus Fish Hatcheries Chinook Salmon (R14AP00125)

Fact Sheet Number

2019_21

Project Description

A constant fractional marking program for production releases of Coleman and Nimbus hatchery-reared fall-run Chinook salmon and marking of 100% of the steelhead (at Nimbus) and sample returning escapement adults in fisheries, hatcheries and rivers.

Project Need

The marking/tagging program is needed to (1) evaluate the contribution rates of hatchery fish to Central Valley Chinook salmon populations, (2) monitor and evaluate the hatchery programs' genetic and ecological effects on natural populations, (3) evaluate the success of restoration actions designed to increase natural production of Central Valley Chinook salmon, (4) estimate exploitation rates in ocean and inland fisheries, and (5) evaluate the impacts of straying on natural populations. Determination of the age structure of Central Valley Chinook salmon populations is also needed on an annual basis for run reconstruction of the salmon populations.

Project Objectives

Task 1: Project Management and Administration

Semi-annual and annual administrative reports, monthly invoices, and final invoice.

Task 2: Mark/tag Chinook Salmon Production Releases

Annually at Coleman and Nimbus Hatcheries, approximately 4,250,000 CWT/Ad-clipped juvenile fall-run Chinook salmon, spring 2014-2019. Count of total production of juvenile fall-run Chinook salmon and average size. Annual and final reports. Tagging data in electronic format (excel preferred) showing statistics on numbers tagged, tagging dates, tag retention, and fish size (mean, range, length frequency distribution).

Task 3: Ocean Harvest Sampling

Complete the recovery of CWTs in the private recreational skiff and recreational charter fisheries, from Crescent City to Avila Beach ports (Crescent City, Trinidad, Eureka, Shelter Cove, Fort Bragg, Bodega Bay, San Francisco, Sausalito, Princeton, Santa Cruz, Moss Landing,

Monterey, Morro Bay, and Avila Beach). In addition, recovery of CWTs from the commercial troll fishery, from Crescent City to Avila Beach ports. Assistance is also provided to inland Central Valley hatcheries in recovery of CWTs and scale samples.

Currently, PSMFC hires and supervises the existing field personnel sampling catches at the ocean ports. This project will continue staffing levels at each port checking for adipose fin clips, and removing, labeling, storing, and transporting CWT heads to the Santa Rosa laboratory. Sampling staff are hired and supervised by PSMFC, and receive technical guidance from the CDFW Ocean Salmon Project staff.

Ocean fishery effort and catch will be reported in the Pacific Fishery Management Council's annual preseason documents: Review of Ocean Salmon Fisheries and Preseason Report I: Stock Abundance Analysis and Environmental Assessment Part 1. All CWT data used in the analysis will be made available via the Regional Mark Processing Center for public and agency consumption.

Task 4: Coded-wire Tag Processing Laboratory

Assistance with staffing and providing a modernized coded-wire tag processing laboratory, which will meet the Central Valley CWT processing needs. This includes assistance with supervision of the laboratory and coordination of CWT data, managing the CWT database, processing CWTs. All Central Valley Chinook CWTs (60–80,000) can be processed each year in a timely manner. Automated equipment will be purchased to streamline the CWT processing.

CWT data will be entered, verified, and submitted on a timely basis to the RMIS system, consistent with standard requirements. Using data from the CWT and age determination program (Task 5), estimation of population parameters and cohort reconstructions will be developed on an annual basis.

Laboratory and data analysis staff will be hired and supervised by PSMFC, and will receive technical guidance from the CDFW Ocean Salmon Project staff.

Annual report that includes the following:

1. Estimate of hatchery contribution to ocean fishery by management zone, hatchery source, and juvenile release strategy.

2. Estimate of natural contribution to ocean fishery by management zone

3. Estimate of hatchery contribution to Central Valley rivers with sampling programs to include, at a minimum, the Sacramento River, Battle Creek, Clear Creek, Feather River, American River, and Stanislaus River. Include hatchery source, and juvenile release strategy.

4. Estimate of natural contribution to Central Valley rivers with sampling programs to include, at a minimum, the Sacramento River, Battle Creek, Clear Creek, Feather River, American River, and Stanislaus River.

5. CWT release and recovery data used to produce the annual report will be made available via the Regional Mark Processing Center for public and agency consumption.

Task 5: Age Determination

The age structure of Central Valley Chinook salmon populations will be determined by scale analysis. Approximately 550 scale samples will be collected and analyzed from each tributary stream, for each Chinook run. Scale preparation and reading will be conducted using optical scanners and computer-aided software to speed reading and allow for the collaboration of readers. Each scale will be read independently by two readers, and a third reader will be used to resolve any disagreement between the two primary readers. The validation of scale-based age determination will be accomplished by using scales of known-age CWT recoveries each year. Statistical methods (Kimura and Chikuni 1987, Cook and Lord 1978, Cook 1983) will then be used to correct for the potential of reader ageing-bias, by correlating known-age CWT scales with their corresponding scale-read age assignments.

Annual report detailing the age structure, of the Chinook populations in the sampled streams. Sample design, sample totals, and age totals will be reported. Estimates of age structure for Central Valley rivers and hatcheries with sampling programs will include, at a minimum, the Sacramento River, Battle Creek, Clear Creek, Feather River, American River, and Stanislaus River. Age structure for the corresponding hatcheries where applicable will be reported.

Schedule of Project Milestones

Date	Milestone
10/01/2018	Work initiated with hatchery contacts
11/01/2018	Tag order placed with Northwest Marine Tech
11/01/2018	Semi-Annual Progress Report
12/01/2018	Staff Hiring Process
02/2019 – 04/2019	Marking/Tagging at Coleman NFH
04/2019 – 06/2019	Marking/Tagging at Nimbus Hatchery
07/2019 – 08/2019	Trailer Maintenance and Report Writing
09/2019	Annual CFM Marking/Tagging Report
10/01/2018 – 09/30/2019	Tag Reading/Scale Ageing (Year-Around)
10/01/2018 – 09/30/2019	Head (Tag) and Scale Collection (All Runs)
04/01/2019 – 09/30/2019	Ocean/Inland Harvest Sampling
11/01/2018	Semi-Annual Progress Report
09/2019	Annual Report

Expected FY 2019 Project Cost

$1.7 Million; Program is done in cooperation with CDFW (marking trailers, office space, etc.) and additional funding partners (CDWR, EBMUD, USFWS, USBR, CDFW.)

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

Not specifically, but the California Fish and Game Commission Salmon Policy requires hatchery releases of Chinook salmon to be externally marked and coded wire tagged at the CDFW standard. The current Department standard is 25% of all production releases in anadromous waters.

Investigator

Stan Allen
PSMFC

Development of Pilot Juvenile Collectors for Use Above High Head Dams

Fact Sheet Number

2019_22

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. FY 2019 will be year two of a five-year effort to develop and test juvenile salmon collection systems that will be used above high head dams. DWR will test the collections systems, designed and built in 2018, under varying environmental conditions and with juvenile salmon to determine their efficiency.

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 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.

Project Objectives

- Test collection systems under varying reservoir temperature conditions to determine if the temperature curtain reduces water temperatures at the fish trap and also how far downstream in the reservoir we can move the collection system and still capture fish in cool water.

- Test collection systems under varying flows and debris conditions to determine methods for handling debris and cleaning guidance nets.

- Test collection systems with juvenile Chinook Salmon to determine collection efficiency

- Test collection systems to determine efficiency of passing resident fish species

- Visit juvenile collection projects in the Pacific Northwest to learn about the latest equipment and methods.

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

Date	Milestone
12/01/2018	Completion of fall testing of collection systems under varying environmental conditions
03/31/2019	Semi-annual report due
05/01/2019	Completion of testing of collection systems using fall-run Chinook Salmon
08/01/2019	Completion of testing of collection systems using late-fall-run Chinook Salmon
09/30/2019	Semi-annual report due

Expected FY 2017 Project Cost

$1,926,163 with $100,000 of the cost being provided by DWR

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

Randy Beckwith, CA Dept. of Water Resources

Reclamation Point of Contact: Towns Burgess, oburgess@usbr.gov

Assessing the Impacts of Different Contact Points on Predation-related Mortality of Juvenile Chinook Salmon in the Sacramento-San Joaquin Delta

Fact Sheet Number

2019_305

Project Description

NOAA-Fisheries Southwest Fisheries Science Center will employ a suite of methodologies to estimate juvenile Chinook Salmon survival associated with potential predator contact points. Subsequently, predator contact points will be removed or modified, and juvenile Chinook Salmon survival will be reevaluated following restoration.

Project Need

The Central Valley Project Improvement Act (CVPIA) has led to the implementation of a Decision Support Model (DSM) to assist in the prioritization of CVPIA restoration actions. The fall-run Chinook salmon DSM depends on a coarse-resolution salmon life-cycle model to predict the population benefits of different restoration actions and scenarios. One critical element of the life-cycle model is how to incorporate predation mortality during the juvenile rearing and outmigration portion of the salmon life-cycle. While estimates of overall mortality during this life stage are available, estimates of mortality specifically attributable to predation are not available, nor are estimates of predation mortality incurred over smaller spatial or temporal transitions within the life stage. Of particular importance to potential restoration activities, the predation mortality that occurs in proximity to, and as a result of, “contact points” is currently included in the DSM life-cycle model.

Currently, contact points in the life-cycle model are limited to only water diversion structures due to the limited information on other potential contact point types, and their frequency of occurrence within the watershed. Regardless, due to the large number of water diversions in the Central Valley, and the high levels of presumed predation-related mortality being associated to these diversions in the current model structure, water diversions are estimated to have a large influence on the life-cycle model results in comparison to other parameters. It is the opinion of the CVPIA Science Integration Team (the team working on the development of the DSM) that these results indicate that critical information gaps exist regarding predation and contact points, especially regarding other potential contact point types, and associated estimates of their

potential impacts on local predation rates. Bridging these data gaps would lead to a refinement of the model and likely more accurate and realistic restoration scenario predictions.

Project Objectives

The key objectives for this project are as follows:

- Determine what physical and hydrological features warrant the designation of being a "contact point" by performing a meta-analysis on existing literature regarding predation around contact points in the Central Valley and other similar watersheds

- If predator contact points exist, conduct field experiments to generate estimates and the overall range of local juvenile salmon mortality rates that can be confidently attributed to the different types of contact points

- Determine whether restoration actions can be taken that will increase juvenile salmonid survival

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

Date	Milestone
October–November 2018	USCS will perform meta-analysis on contact points
November 2018	Meta-analysis report provided to the PMT and Science Integration Team
December 2018	Project Management Team will meet and decide on contact points and study sites to focus on
January 2019	Optional secondary meeting with PMT if needed
January 2019	USCS will produce a Year 1 study plan, informed and approved by the Project Management Team
January–March 2019	Study preparation and acquisition of study equipment and supplies for Year 1
April–June 2019	Year 1 data collection and the study sites
July–November 2019	Data assimilation, post-processing and QAQC for Year 1
December 2019	Year 1 data collection report
January–October 2020	Data analysis and synthesis of Year 1 data
February 2020*	Meet with Project Management Team to discuss how and where to implement Year 2 data collection
April 2020*	USCS will produce a Year 2 study plan, informed and approved by the Project Management Team
May 2020*	Year 2 study plan
May–August 2020*	Study preparation and acquisition of study equipment and supplies for Year 2

Date	Milestone
September–November 2020*	Year 2 data collection at the study sites
October 2020	Meet with Project Management Team to discuss how and where to implement Year 3 data collection
December 2020–March 2021*	Data assimilation, post-processing and QAQC for Year 2
December 2020	Analysis and synthesis of Year 1 results will be put into a Year 1 Study Report and sent to PMT and SIT team
December 2020	USCS will produce a Year 3 study plan, informed and approved by the Project Management Team
January 2021	Year 3 study plan
January–March 2021	Study preparation and acquisition of study equipment and supplies for Year 3
April 2021*	Year 2 data collection report
April–June 2021	Year 3 data collection at the study sites
July–November 2021	Data assimilation, post-processing and QAQC for Year 3
December 2021	Year 3 data collection report
January 2022–September 2023	Final data analysis and synthesis
September 2023	Final analysis and synthesis report

Expected FY 2019 Project Cost and Financial Information

Fiscal Year 2019 costs = $249,912
Total cost for 5-year agreement through Fiscal Year 2023 = $553,461
Agreement number R18PG00077

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

N/A

Investigator

Cyril Michel
NOAA-Fisheries SWFSC
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Reclamation Point of Contact: Towns Burgess, oburgess@usbr.gov

Assessing the Impacts of Different Contact Points on Predation-related Mortality of Juvenile Chinook Salmon in the Sacramento-San Joaquin Delta

Fact Sheet Number

2019_307

Project Description

UC Santa Cruz will employ a suite of methodologies to estimate juvenile Chinook Salmon survival associated with potential predator contact points. Subsequently, predator contact points will be removed or modified, and juvenile Chinook Salmon survival will be reevaluated following restoration.

Project Need

The Central Valley Project Improvement Act (CVPIA) has led to the implementation of a Decision Support Model (DSM) to assist in the prioritization of CVPIA restoration actions. The fall-run Chinook salmon DSM depends on a coarse-resolution salmon life-cycle model to predict the population benefits of different restoration actions and scenarios. One critical element of the life-cycle model is how to incorporate predation mortality during the juvenile rearing and outmigration portion of the salmon life-cycle. While estimates of overall mortality during this life stage are available, estimates of mortality specifically attributable to predation are not available, nor are estimates of predation mortality incurred over smaller spatial or temporal transitions within the life stage. Of particular importance to potential restoration activities, the predation mortality that occurs in proximity to, and as a result of, “contact points” is currently included in the DSM life-cycle model.

Currently, contact points in the life-cycle model are limited to only water diversion structures due to the limited information on other potential contact point types, and their frequency of occurrence within the watershed. Regardless, due to the large number of water diversions in the Central Valley, and the high levels of presumed predation-related mortality being associated to these diversions in the current model structure, water diversions are estimated to have a large influence on the life-cycle model results in comparison to other parameters. It is the opinion of the CVPIA Science Integration Team (the team working on the development of the DSM) that these results indicate that critical information gaps exist regarding predation and contact points, especially regarding other potential contact point types, and associated estimates of their

potential impacts on local predation rates. Bridging these data gaps would lead to a refinement of the model and likely more accurate and realistic restoration scenario predictions.

Project Objectives

The key objectives for this project are as follows:

- Determine what physical and hydrological features warrant the designation of being a "contact point" by performing a meta-analysis on existing literature regarding predation around contact points in the Central Valley and other similar watersheds

- If predator contact points exist, conduct field experiments to generate estimates and the overall range of local juvenile salmon mortality rates that can be confidently attributed to the different types of contact points

- Determine whether restoration actions can be taken that will increase juvenile salmonid survival

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

Date	Milestone
October–November 2018	USCS will perform meta-analysis on contact points
November 2018	Meta-analysis report provided to the PMT and Science Integration Team
December 2018	Project Management Team will meet and decide on contact points and study sites to focus on
January 2019	Optional secondary meeting with PMT if needed
January 2019	USCS will produce a Year 1 study plan, informed and approved by the Project Management Team
January–March 2019	Study preparation and acquisition of study equipment and supplies for Year 1
April–June 2019	Year 1 data collection and the study sites
July–November 2019	Data assimilation, post-processing and QAQC for Year 1
December 2019	Year 1 data collection report
January–October 2020	Data analysis and synthesis of Year 1 data
February 2020*	Meet with Project Management Team to discuss how and where to implement Year 2 data collection
April 2020*	USCS will produce a Year 2 study plan, informed and approved by the Project Management Team
May 2020*	Year 2 study plan
May–August 2020*	Study preparation and acquisition of study equipment and supplies for Year 2

Date	Milestone
September–November 2020*	Year 2 data collection at the study sites
October 2020	Meet with Project Management Team to discuss how and where to implement Year 3 data collection
December 2020–March 2021*	Data assimilation, post-processing and QAQC for Year 2
December 2020	Analysis and synthesis of Year 1 results will be put into a Year 1 Study Report and sent to PMT and SIT team
December 2020	USCS will produce a Year 3 study plan, informed and approved by the Project Management Team
January 2021	Year 3 study plan
January–March 2021	Study preparation and acquisition of study equipment and supplies for Year 3
April 2021*	Year 2 data collection report
April–June 2021	Year 3 data collection at the study sites
July–November 2021	Data assimilation, post-processing and QAQC for Year 3
December 2021	Year 3 data collection report
January 2022–September 2023	Final data analysis and synthesis
September 2023	Final analysis and synthesis report

Expected FY 2019 Project Cost and Financial Information

Fiscal Year 2019 costs = $392,819
Total cost for 5-year agreement through Fiscal Year 2023 = $2,291,629
Agreement number R18AP00136

Investigator

Cyril Michel
Institute of Marine Sciences
University of California
Santa Cruz

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Reclamation Point of Contact: Mike Hendrick

Data Management and Modeling Associated with the Structured Decision Making (SDM) Process in the Delta

Fact Sheet Number

2019_38

Project Description

Structured decision making provides a formal, documented, and open source process to develop quantifiable and measurable objectives and determine the best decision alternatives to meet those objectives using quantitative models. In the development of the Implementation Plan and the initial SDM framework, the agencies focused efforts on a limited number of decision models to represent potential hypotheses for how actions addressing limiting factors would improve natural production for Chinook salmon (of all races), steelhead, and sturgeon. The models provided reasonable results and a logical method for prioritizing limited resources. Sensitivity studies identified uncertainty in both the parameters and models where refinement could potentially improve the ability to determine the best decisions to maximize natural production.

Project Need

The data will help support and refine Delta regional-level management actions. Establishing linkages between the data and actions will also foster knowledge transfer between projects and regions across the regions of the Delta.

Project Objectives

This Project will refine and further develop the quantitative modeling component of decision support tools through the SDM and DSM collaborative processes with agencies and stakeholders. The resulting products will assist to Reclamation prioritizing actions to fund and achieve the anadromous fish doubling goal of the CVPIA and management objectives of the BDO.

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

FY19 will be Base Year. The process as part of this contract will last through 9/20/23.

Expected FY 2019 Project Cost and Financial Information

From BDO Reclamation: $429,619
CVPIA funding at $689,610 for FY19

Reclamation Point of Contact: Andrew Schultz Ph.D., Fisheries Biologist, Bureau of Reclamation, Bay-Delta Office aschultz@usbr.gov, 916-414-2415

Delta Smelt Tag Development

Project Description

Current research on endangered Delta Smelt focuses on how management actions (e.g. habitat restoration, water project operations) affect the species' abundance and distribution. However, as the Delta Smelt population continues to decline (Moyle et al. 2016), it is increasingly difficult to discern the effects of management actions on the species. Frequent zero catches in recent field monitoring could reflect absence of fish in the water column; an increasingly spatially patchy distribution, making fish easier to miss during sampling; or that gear avoidance has increased over time as water transparency has increased (IEP MAST 2015; Latour 2016). Ideally, researchers would intensively sample for Delta Smelt at spatial and temporal scales that determine where fish are relative to the management questions of interest (e.g., Enhanced Delta Smelt Monitoring [IEP 2017]). Obtaining take permits for research studies has become increasingly difficult as a consequence of record-low abundance indices. Implementation of management actions and measuring their effectiveness will likely widen as a result unless new sampling techniques are applied (e.g., Feyrer et al. 2013, Schreier et al. 2016). In response to the Delta Water Quality and Ecosystem Restoration Grant Program's Proposal Solicitation Notice for conducting scientific studies to support implementation of the Delta Science Plan and the 2017-2021 Science Action Agenda, we propose to build upon our previous tagging research (Wilder et al. 2016) by applying a recent breakthrough in miniaturized acoustic transmitters. Working with cultured adult Delta Smelt, we will test whether this technology can be successfully applied. If successful, tagged cultured fish could be used as wild surrogates to gain information on survival, movement, and habitat use under various water operation scenarios, geographic locations, and habitats as has been done with salmonids in the estuary (Perry et al. 2010, Chapman et al. 2013, 2014). More importantly, successful implementation of miniaturized acoustic transmitters would allow field research to continue on Delta Smelt without impacting wild populations, particularly because concerns over genetic degradation of wild fish with cultured fish are generally low for Delta Smelt (Israel et al. 2011, Fisch et al. 2013, but see LaCava et al. 2015). There was wide support among CDFW and USFWS staff at the May 18, 2017 Delta Smelt Culture Program workshop to work through the permitting process for releasing cultured individuals under experimental conditions in the field. Wilder et al. (2016) evaluated mortality and tag retention in Delta Smelt fitted with PIT tags (8.4 mm [L] x 1.4 mm [D], 0.03 g) and Juvenile Salmon Acoustic Telemetry System (JSATS) PIN 615: State Water Contractors – Effects of the Smallest Available Acoustic Transmitter on Delta Smelt Survival, Physiology, and Behavior 3 acoustic transmitters (15 mm [L] x 3.4 mm [D], 0.22 g). Despite the JSATS transmitter being the smallest acoustic tag available at the time, we concluded that it was still too large for Delta Smelt, representing 4% to 8% of the body weight of the majority of adults used in the study. Survival of fish fitted with acoustic transmitters (50-60%) was lower, but was higher than previously reported for Delta Smelt (7-37%; Eder et al. 2012). Of the fish that survived, we observed many that exhibited sluggish swimming behavior in tanks. In

contrast, we found high survival in PIT-tagged fish after 28 days (95%) and swimming behavior did not appear to be compromised, though this was not evaluated experimentally. Given the success of the PIT tagging experiment, it is likely that sufficient miniaturization would yield similar results for acoustic transmitters. We estimated that a maximum tag burden of ~2% would be required (Wilder et al. 2016). Given the growing demand to determine responses of Delta Smelt to management actions and the increased utility of acoustic transmitters over PIT tags for field applications (Hockersmith et al. 2008), it is critically important to succeed in tagging Delta Smelt with acoustic transmitters. This study is needed to test the limitations of acoustic telemetry in Delta Smelt and demonstrate that acoustic telemetry can be successfully implemented in adults. In the time since our previous study was conducted, we (D. Deng, Pacific Northwest National Laboratory [PNNL]) have developed an even smaller JSATS transmitter (12.0 mm long x 2.0 mm in diameter, 0.08 g in air; Mueller et al. 2017) that has been successfully field tested with other small fishes (Figure 1). We propose to conduct a series of experiments to test application of this miniature acoustic transmitter in adult Delta Smelt. First, we propose to refine behavioral and physiological techniques for Delta Smelt that we have used primarily for other species (Hasenbein et al. 2013, 2016, Verhille et al. 2014, Fangue et al. 2015, Hansen et al. 2016, Hammock et al. 2017, Davis et al. in prep, Singer et al. in prep). Expanding the suite of response variables to include behavioral and physiological attributes will allow for a full evaluation of sublethal transmitter effects. Second, we propose to improve tagging techniques by evaluating transmitter insertion locations and determining an optimal water temperature for tagging. Third, we will evaluate the feasibility of using the new JSATS acoustic transmitter in Delta Smelt by assessing effects on survival, tag retention, morphometrics, gross pathology, behavior, and physiology.

Project Need

As the risk of Delta Smelt (*Hypomesus transpacificus*) extinction continues to grow, ongoing conservation, recovery, and management efforts have increasing urgency for the California Department of Fish and Wildlife (CDFW) and other natural resource management agencies (Collaborative and Adaptive Management Team 2014). With record low abundance estimates, understanding and predicting Delta Smelt response to management actions requires timely and defensible data. Research avoiding wild fish mortality is needed to evaluate effects of management and recovery actions. A promising non-lethal method is remote monitoring of movement and survival by telemetry: tracking Delta Smelt with acoustic transmitters or passive integrated transponder (PIT) tags. Delta Smelt are at such low numbers that it is challenging to evaluate their response to conservation, recovery, and other management actions using conventional monitoring techniques. The application of acoustic telemetry would provide resource managers key information on fine-scale behavior, survival, habitat use, and other biological and ecological attributes that have previously been limited to larger fish species (i.e., salmonids and sturgeon).

Project Objectives

The projects primary objectives are to: (1) develop an acoustic tag to insert into Delta Smelt that provides high survival and minimal sublethal effects, (2) develop techniques to assess sublethal

effects to tagged Delta Smelt, and (3) assess tag effects (lethal and sublethal) of tagged Delta Smelt.

Status

This study seeks to build upon previous work but remains unfunded.

Schedule of Project Milestones

Date	Milestone
Sep 2020	Refine physiological and behavioral techniques
Sep 2021	Refine and optimize tagging techniques using new JSATS tag
Oct 2021	Presentations at Delta Science Conference and National AFS meeting
Apr 2022	Manuscript submitted for publication
May 2022	Final Report

Project Manager (Reclamation Side Only):

Andrew Schultz Ph.D., Fisheries Biologist, Bureau of Reclamation, Bay-Delta Office

Principal Investigators

Rick Wilder, Senior Project Manager/Senior Fisheries Biologist, ICF

Co-investigator

Andrew Schultz Ph.D.
Fisheries Biologist
Bureau of Reclamation
Bay-Delta Office

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Reclamation Point of Contact: Andrew Schultz Ph.D., Fisheries Biologist, U.S. Bureau of Reclamation, Bay-Delta Office; Towns Burgess Ph.D., Fish Biologist, U.S. Bureau of Reclamation, Bay-Delta Office

Evaluation of Delta Smelt Health, Condition, Growth and Life History

Fact Sheet Number

2019_25

Project Title

(A) Drivers of Delta Smelt Health and Reproductive Condition

(B) Evaluation of Growth and Life History of Delta Smelt

Project Description

Project A and B are part of the same contract.

Project A

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) Delta Smelt from existing monitoring programs and cultured Delta Smelt. 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 mechanisms impacting the species, particularly across varying water years and outflow conditions.

Project B

The purpose of this project is to use otoliths to determine growth rates, and salinity and thermal history (habitat use) of Delta Smelt captured by existing monitoring programs. Growth rates will be determined by enumerating otolith increments and quantifying growth increment widths. Salinity history will be determined by using strontium isotope ratios (87 Sr: 86 Sr) by determining the mixture of freshwater strontium isotope ratios, which are associated with the volume of Sacramento and San Joaquin River, with the globally stable marine strontium isotope ratio. This technique will be used to reconstruct the salinity history using the strontium isotope

ratios and will be reported as the amount of time spent in different salinity habitats prior to and during the outflow augmentation period.

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. In Spring 2016 USFWS requested augmentation of summer outflow in the Sacramento River to benefit the Delta Smelt population. A short time later in 2016, Delta Smelt Resiliency Strategy recommended increasing outflow during summer periods to benefit Delta Smelt. There is a need to strengthen our understanding of the mechanisms and drivers impacting Delta Smelt population vital rates, behaviors and associated habitat features as relates to varying outflow and other environmental conditions.

Project Objectives

Project A

The principal objectives of this project are to:

- Determine how Delta Smelt health indices (e.g., biomarkers of contaminant exposure and nutritional status) vary with condition, fecundity and oocyte quality;
- Compare juvenile Delta Smelt health and reproductive condition among regions, water years and Delta outflow conditions;
- Quantify the foraging and metabolic consequences of semi-anadromy for Delta Smelt;
- Determine the sensitivity of applied biomarkers to Delta Smelt starvation
- Evaluate growth rates in association with salinity history of Delta Smelt.

Project B

The principal objectives of this project are to:

- Determine Delta Smelt growth rates using otoliths increments and widths;
- Determine salinity history using strontium isotope ratios;
- Determine thermal history using isotope techniques
- Use growth rates, and salinity and thermal history to evaluate hypothesized benefit of outflow augmentation on Delta Smelt habitat and health

Status

The current contract expires in April 2019. Current plans are to renew this contract for the next 3 years to match the current Directed Outflow Project contract.

Schedule of Project Milestones

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 2017 Project Cost

$750,000 per year

Investigator

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

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Reclamation Point of Contact: Andrew Schultz Ph.D., Fisheries Biologist, Bureau of Reclamation, Bay-Delta Office aschultz@usbr.gov, 916-414-2415

Effect of Outflow Alteration upon Delta Smelt Habitat, Condition and Survival

Directed Outflow Project

Fact Sheet Number

2019_26

Project Description

The Directed Outflow Project (DOP) is a continuing collaborative effort among a dozen state, federal and non-governmental groups. The DOP will employ a focused spatial and temporal approach to evaluate mechanistic hypotheses directly related to the rationales provided for the summer Delta outflow action and Yolo Bypass Toe Drain action to benefit Delta Smelt, with direct relevance to the fall outflow action. Paired data collections (same location and time) of abiotic and biotic habitat constituents to test specific hypotheses will assist in avoiding prior shortcomings of using data collected for different studies/hypotheses and/or across variable spatial/temporal scales (as discussed in MAST [2015] and elsewhere). Sampling will occur during the Delta Smelt juvenile rearing-stage, a period known to be associated with the location of the low salinity zone (LSZ). Results should strengthen our understanding of the mechanisms and drivers impacting Delta Smelt vital rates and associated habitat features with a focus on outflow conditions. Results should assist in evaluating the benefit and feasibility of future flow augmentation actions for managers and decision makers. Results from this and other related studies will inform evaluations on which particular outflow-related action or group of actions provides the most benefit for Delta Smelt.

Project Need

Requests and plans for water management actions related to augmentation of Delta outflow have proceeded and are expected to proceed in the future. However, there is uncertainty and disagreement regarding the mechanistic relationship of Delta outflow during the rearing period to Delta Smelt vital rates and habitat, and the hypothesized benefit of outflow alteration for Delta Smelt. Delta outflow has experienced reductions in recent years, coinciding with the collapse of the Delta Smelt. Reduced outflow has been linked to reductions in habitat suitability in Suisun Bay and Marsh and movement of the LSZ to the Confluence of the Sacramento-San Joaquin River where little connection to shallow open water habitats exists.

Project Objectives

The DOP's main objective will be to evaluate the hypothesized benefit of outflow alteration for Delta Smelt and its habitat in coordination with all stakeholder groups. The following process and product related sub-objectives will facilitate progression toward this evaluation objective.

- Test mechanistic hypotheses addressing the rationale behind outflow-based actions to benefit Delta Smelt.
- Concurrently sample fish and measure abiotic/biotic habitat conditions at each randomly selected location along the salinity and habitat gradient of the north to western Delta along the Sacramento River during the summer and fall.
- Compare collected fish and habitat measures in relation to research hypotheses.
- Produce a summary report with conclusions, recommendations on outflow management, and recommendations for future research.

Status

The DOP is currently in its 2018 field season which ends on November 30, 2018. Sampling for the 2019 season is planned to begin in April of 2019.

Schedule of Project Milestones (for 2019 Year)

Date	Milestone
Nov 2019	Sample and data collection completed
Mar 2020	Sample processing completed
Mar 2020	Oral or Poster Presentation at 2019 Annual IEP Conference
Fall 2020	Oral presentations on 2019 results
Winter 2021	Submit manuscript(s) for 2019 study year to peer-reviewed journal

Project Manager

Andrew Schultz Ph.D., Fisheries Biologist, Bureau of Reclamation, Bay-Delta Office

Principal Investigators

Andrew Schultz Ph.D., Fisheries Biologist, Bureau of Reclamation, Bay-Delta Office
Towns Burgess Ph.D., Fisheries Biologist, Bureau of Reclamation, Bay-Delta Office

Reclamation Point of Contact: Armin Halston, Natural Resource Specialist, Bureau of Reclamation, Bay-Delta Office, ahalston@usbr.gov, 916-414-2404

Evaluation of Factors Influencing Loss of Delta Smelt and Longfin Smelt During Dredging

Dredging and Smelt Loss

Project Description

The purpose of this project is to assist in evaluating the scope of Delta Smelt and Longfin Smelt loss, and mechanisms that influence the loss, during dredging activities conducted in the San Francisco Bay estuary and connecting Sacramento-San Joaquin Delta. Loss of Delta Smelt due to hydraulic suction dredging potentially has population level effects, as analyzed by the USACE. Currently, clamshell dredging is considered to have less adverse effects by federal resource agencies when compared to hydraulic suction dredging. Laboratory experiments will be conducted to test mechanisms impacting smelt behavior with respect to conditions related to dredging processes. Incidental fish catch data during past/present dredging will be compared to past/present fish surveys data in the area/region and known habitat features.

Project Need

Loss of the state and federally-listed Delta Smelt, and state-listed Longfin Smelt during the dredging process is a concern. Scope of loss, and mechanisms that influence the loss, during the process are unknown. There is a need to strengthen our understanding of the scope and processes involved in smelt loss during dredging processes and the effect of that loss on the smelt populations.

Project Objectives

TBD

Status

- Fish Conservation and Culture Laboratory has been contacted about this study and the feasibility of acquiring and transporting smelt for the study.
- Once a short concept proposal and fact sheet are completed, state and federal permitting personnel will be contacted.

Schedule of Project Milestones

Date	Milestone
Phase 1	
Summer 2019	Acquire necessary permits
Summer/Fall 2019	Test transportation techniques
Phase 2	
Fall-Winter 2019/20	Conduct pilot/initial laboratory experiments
Phase 3	
Summer-Winter 2020	Conduct laboratory experiments
February 2021	Summary Report

Investigators

David Smith, Ph.D.
Research Biologist
USACE, ERDC Cognitive Ecology & Ecohydraulics Team

Andrew Schultz Ph.D.
Fisheries Biologist
Bureau of Reclamation
Bay-Delta Office

Armin Halston
Natural Resource Specialist
Bureau of Reclamation
Bay-Delta Office

Reclamation Point of Contact: Erwin Van Nieuwenhuyse at USBR

DWR Interagency Ecological Program

Fact Sheet Number

2019_315

Project Description

Conduct the EMP monitoring, data analyses, and specific special studies to further the understanding of estuarine ecology and to provide information useful for the management and conservation of the upper San Francisco Estuary..

Project Need

This project contributes to managing water quality in the Delta and assists in the prevention of the extinction of a listed fish species by providing environmental and ecological data such as water quality, phytoplankton and zooplankton that are used to assess the status of the ecosystem and document trends. This data is also used for planning efforts and as system-level baseline data for adaptive management experiments and for restoration actions focused on recovery of fish populations listed under the Endangered Species Act. Results of the special studies will also be available for operational and management decisions affecting the Central Valley Project, implementation of the delta smelt and salmonid biological opinions.

Project Objectives

Conduct the EMP monitoring, data analyses, and specific special studies to further the understanding of estuarine ecology and to provide information useful for the management and conservation of the upper San Francisco Estuary.

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

EMP Implementation to be completed December 2019.
Special Studies and Quality Assurance Project to be completed December 2019.
IEP Workshop in March 2019. Manuscript for annual publications in November 2019.

Expected FY 2019 Project Cost

$2,100,306

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

FWS RPA Component 3

Reclamation Point(s) of Contact: Josh Israel and John Hannon

Ecohydraulics Analysis for Fish Movement

Fact Sheet Number

2019_319

Project Description

The USACE ERDC will provide technical and project management support to the USBR on the subject of ecohydraulics related to projects managed by the USBR Bay Delta Science Office.

Project Need

This work will include aspects development of project workflows and products to support ongoing projects related to: 1) Fremont weir notch and floodplain reconnection, 2) Fish movement evaluation through Shasta Reservoir, 3) Fish occupancy of newly constructed side channels and other habitats, and 4) Non–physical barrier evaluation and installation (coordinated with DWR)

Project Objectives

The USACE ERDC will provide technical and project management support to the USBR on the subject of ecohydraulics related to projects managed by the USBR Bay Delta Science Office. This work will include aspects development of project workflows and products to support ongoing projects including:

1. Fremont weir notch and floodplain reconnection. This project will involve participating in the Fisheries Engineering Technical Team and with the USBR Denver Technical Services Center to develop requirements for simulating fish entrainment at the Fremont Weir notch. Typical task include assisting with CFD model development, and running fish movement simulations (ELAM). The scope of the simulations and the types of behaviors simulated will be jointly decided with input from the FETT and others as directed by USBR. The aim of the work will be to help understand and refine the best notch design to maximize the notch benefits to fish.

2. Fish movement evaluation through Shasta Reservoir. This project will involve developing a hydrodynamics simulation of Shasta Reservoir with the USBR Technical Services Center and simulating juvenile salmon movement through the reservoir using a fish movement model (ELAM). Existing telemetry data will be used to calibrate and validate the movement model. The aim will be to assist with the reintroduction of salmon

above Lake Shasta. Upstream movement of adult fish as part of this project may also be included.

3. Fish occupancy of newly constructed side channels and other habitats. This project will involve using existing or developing new hydrodynamic simulations of the Sacramento River and some of the newly constructed or to be constructed side channels. The hydrodynamic models will be coupled to a habitat selection model developed on the Stanislaus River based on the ELAM. Existing fish habitat occupancy data will be used to guide calibration and validation of the model. The aim of the work will be to develop a rearing model for salmon in the Sacramento River that can be applied for the USBR, USACE and others.

4. Non–physical barrier evaluation and installation (coordinated with CA-DWR). This project will involve simulating the hydrodynamics and fish movement associated with nonphysical barriers in the lower Sacramento River. Significant leveraging with ongoing USACE and DWR work on this subject will occur.

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

An annual report will be generated at the end of each FY.

Expected FY 2019 Project Cost and Financial Information

FY19: $602,289
FY20: $256,804
FY21: $271,646
FY22: $276,315
FY23: $281,077
R19PG00018

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

- RPA Action lll.2.1: Increase and Improve Quality of Spawning Habitat with Addition of 50,000 Cubic Yards of Gravel by 2014 and with a Minimum Addition of 8,000 Cubic Yards per Year for the Duration of the Project Actions.

- RPA Action lll.2.2: Conduct Floodplain Restoration and Inundation Flows in winter or spring to Inundate Steelhead Juvenile Rearing Habitat on One- to Three-Year Schedule.

- RPA Action III.2.3: Restore Freshwater Migratory Habitat for Juvenile Steelhead by Implementing Projects to Increase Floodplain Connectivity and to Reduce Predation Risk During Migration.

- RPA Action 111.2.4: Evaluate Fish Passage at New Melones, Tulloch, and Goodwin Dams.

- RPA Action NF 4.1-4. 7: Implementation of Fish Passage Pilot Reintroduction Program.

- RPA Action I .6.1 : Restoration of Floodplain Rearing Habitat, through the increase of seasonal inundation within the lower Sacramento River basin; and

- RPA Action 1.7: Reduce Migratory Delays and Loss of Salmon, Steelhead, and Sturgeon, through the modification of Fremont Weir and other structures of the Yolo Bypass.

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Reclamation Point(s) of Contact: Mike Hendrick

Facilitation Services to Support the Collaborative Science and Adaptive Management Program (CSAMP)

Fact Sheet Number

2019_310

Project Description

These facilitation services will be used to support the CSAMP. Work would be conducted between September 1, 2018 and June 30, 2019. Kearns & West will subcontract with Bruce DiGennaro of the Essex Partnership to perform all technical tasks described in this Performance Work Statement. Kearns & West (K&W) will provide appropriate oversight and management services.

Project Need

The stated goal of the CSAMP is to "develop a robust science and adaptive management program, with collaboration of the scientists and experts from Public Water Agencies (PWAs) and the NGO community, that will inform the development and implementation of the BiOps, [the Bay Delta Conservation Program ("BDCP")], and other programs."

Project Objectives

Prepare agenda and background materials for quarterly CSAMP Policy Group meetings. Coordinate preparation of presentation materials for CSAMP Policy Group meetings.

Facilitate CSAMP Policy Group meetings (assume 4-hour meetings). Prepare meeting notes and track action items.

Schedule and facilitate monthly Policy Group Liaison calls. Schedule and facilitate monthly Policy Group calls.

In addition to the CSAMP Policy Group meetings, there will be facilitation of the CAMT Meetings, Delta Smelt Scoping Team meetings, and various related subcommittees.

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

The above will be completed by project end date, June 30, 2019.

Expected FY 2019 Project Cost and Financial Information

FY19 USBR: $161,650

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

NMFS 11.2.1.3 (1)

Reclamation Point(s) of Contact: Mike Hendrick

Facilitating Development of a Science Plan to Assess the Effects of Outflow and Flow Augmentation Actions on Delta Smelt

Fact Sheet Number

2019_309

Project Description

This process will work to develop a draft framework and objectives for the Science Plan to be completed at the end of June 2019. The scope of work focuses on leveraging the framework to facilitate the development of a monitoring and evaluation approach, an implementation plan, and a final Science Plan. Work would be conducted between September 1, 2018 and January 31, 2019.

Kearns & West will subcontract with Dr. Denise Reed to perform technical tasks described in this SOW. Dr. Reed would engage with important science groups such as IEP FLOAT (including FLOAT MAST), the Directed Outflow Project, the Delta Science Program (DSP), and the CAMT Delta Smelt Scoping Team (DSST), as well as decision makers and expected users of the SP, via CAMT and CSAMP. K&W will provide appropriate oversight and management services.

Project Need and Objectives

The focus will be on understanding the role of actions such as seasonal outflow management, Toe Drain flows, and Suisun water management, in the context of non-augmented conditions.

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

The schedule includes the development of an implementation plan for near-term and longer-term, including transition activities (e.g., technology testing, model development, laboratory studies), including role of existing entities and programs. Establish regular cycle (e.g., semi-annual, annual, biennial) for design of Science Plan activities based around flow variation, existing program planning, budget cycles, and decision-making.

Activities include to:

- Recognize, and become familiar with, existing annual/other patterns for science investments, reporting, and decision-making among entities
- Consider the necessary conditions underlying each flow action (e.g., water availability) and identify a set of scenarios that could be used to trigger the augmentation actions
- Identify roles and responsibilities within the scientific and management communities relative to the Science Plan implementation during augmented and non-augmented conditions
- Estimate resources (financial, personnel, logistical) to support the Science Plan and work with agency/program managers and others to identify potential sources
- Suggest appropriate mechanisms for future Science Plan updates

Expected FY 2019 Project Cost and Financial Information

FY19 USBR: $60,928

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

FWS RPA Component 5

Reclamation Point of Contact: Mike Hendrick

Facilitation Services to Support the Initial Phase of the Upper Sacramento River Science Collaboration

Fact Sheet Number

2019_312

Project Description

This project includes services that shall cover requirements needed to provide a facilitator that can work to prioritize science needs, prepare study plans and costs that address scientific data gaps and analysis. In this instance, the Facilitation BPA will be used to support the initial phase of the Upper Sacrament River Science Collaboration. Kearns & West (K&W) has been providing facilitation services on this topic through an existing NOAA Fisheries contract currently set to expire at the end of September 2018.

Project Need and Objectives

The tasks in this effort will include coordination and planning with a small group of “conveners” including Reclamation, NOAA Fisheries, and Sacramento River Settlement Contractors.

K&W’s team has included a Principal (Harty), and Associate (Alpaugh), and a Project Coordinator (Cullen), with Harty handling in-meeting facilitation and coordination with the conveners, and other K&W staff handling scheduling, graphics, document production, and similar tasks. K&W will submit a monthly progress report to the Reclamation Point of Contact via email.

Expected FY 2019 Project Cost and Financial Information

FY19 $80,000 USBR

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

NMFS 14.0 (2)

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Reclamation Point of Contact: Andrew Schultz, Ph.D. U.S. Bureau of Reclamation Bay-Delta Office

Delta Smelt Research and Refuge Population Development

UCD Fish Culture and Conservation Laboratory (FCCL): Refuge Population –

Fact Sheet Number

2019_27

Project Description

This project contributes to maintaining a genetically diverse population of Delta Smelt within a refuge setting which represents a population-bank for future rehabilitation of the species. The study results will assist in preventing the extinction of a listed fish species and provide scientific information for use in recovery efforts with which to train the next generation of scientists who will work to help improve scientific understanding and science-based management of public resources.

Project Need

The Fish Conservation and Culture Laboratory (FCCL) will manage every life stage of the Delta Smelt refuge population and make any necessary changes to improve survival and the well-being of the fish. Each year, the FCCL will rear approximately 200,000 larvae that are produced to ensure good prospects for recovering individuals from each genetically managed family of the 250 families made. Genetic management can minimize differentiation between the wild and refuge populations and mean kinship in the refuge population, increasing the potential for success of any reintroductions.

Besides the management of refuge population, the FCCL will put significant effort toward research including quantifying naturally occurring physical stimuli effects on Delta Smelt behavior, developing cryo-preservation of sperm and cells of Delta Smelt, comparing domestic and wild Delta Smelt offspring, and many more projects. The FCCL also will support many collaborative or off-site studies with fish and professional Delta Smelt handling skills.

Project Objectives

1. Continue the development of a Delta Smelt refugial population as a safeguard against species extinction in the wild

2. Create a genetically sound population of captive fish for research purposes

3. Conduct a series of experiments on smelt physiology, health, condition, and behavior

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

Date	Milestone
Oct 2018	Semi-annual report
Jan 2019	Fish tagging starts
Feb 2019	Spawning season of 12th generation starts
Apr 2019	Semi-annual report #4
May 2019	Fish tagging ends
May 2019	Spawning season of 12th generation ends
Oct 2019	Semi-annual report

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

No

Investigator

Dr. Tien-Chieh Hung
Biological and Agricultural Engineering Dept.
UC Davis

Reclamation Point(s) of Contact: Mike Hendrick

Fellows—Sea Grant Delta Science Program

Fact Sheet Number

2019_313

Project Description

The Delta Science Fellows Program is a project that brings together young scientists, agency scientists and senior research mentors on collaborative data analysis and research projects relevant to the Delta Stewardship Council's coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. Currently, the Science Fellows Program has a need for research on the priority topics identified in the Delta Plan and by a workgroup of interagency scientists and managers, as well as stakeholders. The Delta Plan and the DPIIC has established priorities for these fellowships, including collaborative research projects aimed at other topics relevant to the coequal goals.

Project Need

Reclamation participates in extensive coordinated research and monitoring programs (i.e. Interagency Ecological Program, Anadromous Fisheries Restoration Program) that supports the hydro-system, hatchery, and habitat management decisions related to the Bay-Delta system. The Delta Stewardship Council has convened the Delta Plan Interagency Implementing Committee (DPIIC) which identifies scientific research in support of management decisions related to the operation, health and status of the Bay-Delta systems which includes science fellowships. Reclamation has collaborated with Delta Science Program (DSP) for Science Fellows to address scientific research that reduces the adverse environmental impacts of the Central Valley Project and assist in supporting management decisions regarding these impacts.

Project Objectives

The objective of the project is to provide the administration of the Delta Science Program in which Science Fellows that will address high priority research topics of importance to the Bay-Delta system. The objectives include: 1) Assessing the effects of drought on the Delta, 2) Effectiveness and implications of habitat restoration actions, 3) Develop decision support tools for management of estuarine and migratory species, and 4) Science supporting the enhancement and protection of the cultural, recreational, natural resource, and agricultural values of the Delta.

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

Milestone	Date
Science Fellows Selection Process	Planned completion date March 2019
Contract Award to Science Fellows	Summer 2019
Science Fellows conduct reviews	Feb 2021
Annual Science Workshops	Winter 2020
Bay Delta Science Conference	Fall 2020
Annual Progress Report	October 2020

Expected FY 2019 Project Cost and Financial Information

$250,000

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

NMFS Conservation Recommendation 14.0

R15PG0006 Genetic Analyses of California Salmonid Populations

Task 2: Genetic analysis for salmonid recovery efforts and RPA actions

Fact Sheet Number

2019_28

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 recovery actions. NMFS and Reclamation will use this information to inform recovery efforts of ESA listed stocks.

Project Need

In order to maximize the potential for success of salmonid recovery efforts in California, the genetic composition of existing stocks must be evaluated, and continued genetic monitoring of fish populations is needed. This evaluation will use a variety of genetic and genomic approaches to establish genomic diversity baselines and assess both neutral and adaptive variation based on the best available existing and newly collected data. Genetic analysis and monitoring is a core component in all recovery planning documents and RPAs related to recovery of ESA listed stocks of Central Valley DPS steelhead, and Sacramento River spring-run and winter-run Chinook salmon.

Project Objectives

- Genomic sequencing and data analysis and/or analysis and interpretation of existing data for ESA listed stocks of Central Valley DPS steelhead, and Sacramento River spring-run and winter-run Chinook salmon, as well as comparison with targeted data collection to address specific recovery issues (e.g. Chinook salmon from New Zealand, coastal and Klamath basin Chinook and steelhead populations, adaptive genomic variation within and among salmonid species).

- Review and preparation of documents for recovery efforts for Central Valley listed salmonids.

- Participation in meetings and other communication with agency and other partners and stakeholders in recovery planning and implementation.

Schedule of Project Milestones:

Date	Milestone
09/30/2018	FY18 Annual Report
FY15–19, ongoing	Review documents for recovery work
FY15–19, ongoing	Genetic analysis for recovery projects

Expected FY 2019 Project Cost

$188,268.31

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 to support recovery of Sacramento River winter-run and spring-run Chinook salmon, and steelhead in the Sacramento-San Joaquin basin.

Investigator

Dr. Devon Pearse
NMFS/SWFSC/FED
devon.pearse@noaa.gov

R15PG0006 Genetic Analyses of California Salmonid Populations

Task 3: Parentage Based Tagging (PBT) of salmonids in California Hatchery Programs

Fact Sheet Number

2019_29

Project Description

The purpose of this task is to collect genotype data and conduct the genetic analyses necessary to evaluate the genetic pedigree relationships of California salmonid hatchery broodstock. NMFS and Reclamation will use this information to inform hatchery broodstock management, including supporting recovery actions for ESA listed Central Valley salmonids stocks.

Project Need

California hatcheries release a large number of juvenile salmonids every year, and genetic parentage based tagging (PBT) of adult spawners provides critical information about spawner age distribution, inbreeding, the distribution of reproductive success among spawners, migration among Central Valley hatcheries, and other population parameters. The California Hatchery Scientific Review Group recommended PBT a tool for the management of hatchery broodstock programs.

Project Objectives

- Genotyping and analysis of up to 6,000 samples per year, contingent on ongoing sampling at Central Valley hatcheries by NMFS, CDFW, and FWS staff. Continued broodstock PBT supports Central Valley salmon and steelhead monitoring programs and hatchery broodstock management by identifying hatchery-of-origin and brood year for field caught and hatchery return samples and monitoring inbreeding and migration among Central Valley salmon and steelhead hatcheries.

- Special hatchery broodstock projects to improve broodstock management:

    - Genotyping and analysis to improve our understanding of the genomic factors that affect the expression of anadromy in steelhead, minimize inbreeding, and support breeding experiments with steelhead at Nimbus and Mokelumne River Hatcheries.

    - Coordinated analysis of the four Central Valley steelhead hatchery programs (Coleman, Feather, Nimbus, Mokelumne) to evaluate breeding, rearing, and release strategies.

Schedule of Project Milestones

Date	Milestone
09/30/2018	FY18 Annual Report
FY15–19, ongoing	Ongoing PBT analysis
FY15–19, ongoing	Review and advise broodstock management

Expected FY 2019 Project Cost

$282,402.46

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

Yes. The BiOp on the CVP/SWP regarding RPA actions for hatchery broodstock management of steelhead and spring-run Chinook salmon, as well as other RPA recovery efforts.

Investigator

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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

2019_30

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 Objective

The principal objectives of this project are to:

- Determine how Delta Smelt health indices (e.g., biomarkers of contaminant exposure and nutritional status) vary with condition, fecundity, and oocyte quality;
- Compare juvenile Delta Smelt health condition among regions and water years;

- Quantify the foraging and metabolic consequences of semi-anadromy for Delta Smelt;
- Determine the sensitivity of applied biomarkers to Delta Smelt starvation; and
- 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

FY 2019 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

2019_31

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:

- 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.

- 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 $\delta^{18}O$-DO mass balance approach to provide a spatially and temporally integrated estimate of GPP, R and net ecosystem production (NEP = GPP-R). The $\delta^{18}O$ 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 9/30/20	Continuous and synoptic examinations of nutrient-phytoplankton-zooplankton dynamics across environmental gradients
7/1/2018 to 9/30/18 7/1/2019 to 9/30/19 7/1/2019 to 9/30/20	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 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

Agreement Budget Details: R18AC00040

Estimated Amount: $883,000
Agreement Expires 09/20/2020
Agreement is fully funded.

Obligated Amounts

FY18: $883,000

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

Single-Platform Integrated Aquatic Species and Habitat Sampling System

Fact Sheet Number

2019_314

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

$75,785

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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Agreement Budget Details: R18AP00053

Estimated Amount: $1,238,381
Agreement Expires 12/31/2020

Obligated Amounts: FY18: $491,686
FY19 Planned amount: $306,314 (Not funded as of 10/15/2018)

Invoiced Amounts: FY18: $0

Reclamation Point(s) of Contact: Mike Hendrick

Structured Decision Making (SDM) for the Sacramento-San Joaquin River Delta

Fact Sheet Number

2019_39

Project Description

Structured decision making provides a formal, documented, and open source process to develop quantifiable and measurable objectives and determine the best decision alternatives to meet those objectives using quantitative models. In the development of the Implementation Plan and the initial SDM framework, the agencies focused efforts on a limited number of decision models to represent potential hypotheses for how actions addressing limiting factors would improve natural production for Chinook salmon (of all races), steelhead, and sturgeon. The models provided reasonable results and a logical method for prioritizing limited resources. Sensitivity studies identified uncertainty in both the parameters and models where refinement could potentially improve the ability to determine the best decisions to maximize natural production.

Project Need

The data will help support and refine Delta regional-level management actions. Establishing linkages between the data and actions will also foster knowledge transfer between projects and regions across the regions of the Delta.

Project Objectives

The Bay-Delta system is the largest estuary on the Pacific Coast and supports more than 500 fish, wildlife and plant species, including several threatened and endangered species. It is also the home of more than a million people and the freshwater resources of the area support tens of millions of Californians. By its nature then, the management of resources in the Bay-Delta region involves the evaluation of potential tradeoffs between conservation objectives, such as restoring or conserving at-risk species, and other values, such as providing reliable water supply to the public. These decisions must be made under substantial uncertainty owing to high natural variability over time and space and unknown effects of natural and anthropogenic factors on the ecosystem. Thus, natural resource management in the Bay-Delta is fraught with the complexity and uncertainty associated with large-scale and cumulative effects and the consideration of multiple objectives. This interagency acquisition allows the Bureau of Reclamation to utilize a unique set of expertise to solve problems related to water delivery and natural resource management.

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

December 2018

1. Report or technical memo describing the results of rapid prototyping process, including stakeholder objectives, decision alternatives, a description of decision support model, the stakeholder guidelines and prioritization process.

2. Parameterized expert opinion derived decision support model.

3. Training of program personnel, in person or remotely, in decision modeling, computer coding, and conduction quantitative sensitivity analyses with R or similar software.

December 2019

1. Draft report describing the results of phase II, stakeholder objectives, decision alternatives, the prioritization process that was developed with the stakeholders, the revised model, sources of data and information used to parameterize the model, and an evaluation of model performance via sensitivity analysis. This report will be available for peer review.

2. Parameterized decision support model.

September 2020

Final revised report addressing the peer review comments and any revisions to the decision support model that were identified through the peer review.

Expected FY 2019 Project Cost and Financial Information

FY19 USBR: $153,221

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

No

Reclamation Point(s) of Contact: Mike Hendrick

Structured Decision Making (SDM) for the Scientific Management in the Sacramento-San Joaquin River Delta coordinated by the Delta Stewardship Council

Fact Sheet Number

2019_301

Project Description

Structured decision making provides a formal, documented, and open source process to develop quantifiable and measurable objectives and determine the best decision alternatives to meet those objectives using quantitative models. In the development of the Implementation Plan and the initial SDM framework, the agencies focused efforts on a limited number of decision models to represent potential hypotheses for how actions addressing limiting factors would improve natural production for Chinook salmon (of all races), steelhead, and sturgeon. The models provided reasonable results and a logical method for prioritizing limited resources. Sensitivity studies identified uncertainty in both the parameters and models where refinement could potentially improve the ability to determine the best decisions to maximize natural production.

The Delta Science Program (DSP) (acting under the administrative umbrella of the Delta Stewardship Council (Council)) will be the implementing entity of this agreement. The DSP, will further the purpose of this project through outreach and direct communication that will help improve transparency and collaboration between decision-makers, as well as other stakeholders in the Delta, who may contribute to and benefit from a decision-making framework. The DSP helps put science-based decision making as the focus of the SDM framework.

Project Need

This information will be used to inform prevention of the extinction of listed fish species and provide information for use in restoration and recovery efforts. Through processes like the Delta SDM, stakeholders and agencies will have a more comprehensive and transparent understanding for how water resource management and environmental factors (i.e. exports, habitat, tides, predators) affect ESA-listed species in the Delta. By incorporating a wide range of expert opinions, the pilot study will test how to best link various management action portfolios to actions and desired impacts to ESA listed species (examples are mentioned in the Background section). Additionally, it will be used by public agencies to evaluate and prioritize investments under various management scenarios.

Project Objectives

The Bay-Delta system is the largest estuary on the Pacific Coast and supports more than 500 fish, wildlife and plant species, including several threatened and endangered species. It is also the home of more than a million people and the freshwater resources of the area support tens of millions of Californians. By its nature then, the management of resources in the Bay-Delta region involves the evaluation of potential tradeoffs between conservation objectives, such as restoring or conserving at-risk species, and other values, such as providing reliable water supply to the public. These decisions must be made under substantial uncertainty owing to high natural variability over time and space and unknown effects of natural and anthropogenic factors on the ecosystem. Thus, natural resource management in the Bay-Delta is fraught with the complexity and uncertainty associated with large-scale and cumulative effects and the consideration of multiple objectives. This interagency acquisition allows the Bureau of Reclamation to utilize a unique set of expertise to solve problems related to water delivery and natural resource management.

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

Anticipated initiation date is February 1, 2019 and will run through September 30, 2021. This process will be worked in coordination with the SDM process with USGS and Oregon State.

Expected FY 2019 Project Cost and Financial Information

FY19 USBR: $160,000

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

No

Evaluating Contributions of Hatchery-origin Fish to the Conservation of Endangered Sacramento River Winter-run Chinook Salmon During a Drought

Fact Sheet Number

2019-32

Project Description

Using genetic methods, we will determine if hatchery-origin fish are contributing to conservation goals in the endangered winter-run Chinook salmon population.

Project Need

The Livingston Stone National Fish hatchery (LSNFH) releases captively-reared Chinook to supplement the endangered population winter-run in the Sacramento River, but the conservation impact of the hatchery program has yet to be systematically evaluated. It is unknown if hatchery fish from the LSNFH program successfully produce offspring when spawning in the river.

Pacific salmonids are known to adapt to captivity, but the traits driving fitness (reproductive success) are often not well understood. In this project we will evaluate if any traits measured by the United States Fish and Wildlife Service influence fitness of fish in the hatchery or in the river. This information will better inform managers about potential differences in selective pressures between the hatchery and river environments. If different traits are found to influence fitness in the two environments that could indicate genetic adaptation to captivity is occurring and provide ideas about how to modify the captive rearing process to reduce adaptation. In summary, this project improves ESA-species management by shedding new light on the LSNFH program impacts on the naturally-reproducing population of winter-run Chinook.

Project Objectives

- Assess genetic contribution of hatchery-origin fish to the natural population and determine if the genetic contribution is influenced by the 2011-2017 drought
- Compare standard genetics measures of population demographics to characterize hatchery operations under pre-drought and intra-drought protocols.
- Assess adaptation to captivity in light of changes to hatchery protocols due to the drought to inform hatchery managers on the impact of their decisions.

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

Date	Milestone
01 May 2019	Manuscript submission
07 May 2019	Project completion

Expected FY 2019 Project Cost

$65,650.00, but funds are already disbursed to University of California Santa Cruz.

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

N/A

Investigator

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Tidal Parr Study

Fact Sheet Number

2019_34

Project Description

To determine the growth benefits afforded to juvenile salmon by restored marsh habitat, juvenile salmon of hatchery origin will be reared in enclosures at predetermined sites of restored and soon-to-be-restored marsh habitat during March and April of 2019-2021.Enclosure-reared fish will be assessed at biweekly intervals for changes in fork length, weight, stomach fullness, diet based on gut contents, and energy reserve based on liver weight. To determine the timing and relative density of juvenile salmon occurrence at selected restored and soon-to-be-restored marsh locations, fish will be sampled with net gear at biweekly intervals, during the December through June salmon out-migration period, over three years, 2019-2021. The timing, relative density, and biometrics of juvenile salmon at these restoration locations will be compared to catches in other shallow water habitats. Since juvenile salmon are difficult to capture in shallow water and marsh habitats, water samples will be taken in parallel with net-gear sampling and analyzed for salmon environmental DNA (eDNA) as an indicator of salmon presence or absence. Detection ability of eDNA assays at distance from and time following salmon occurrence at a location will be tested using salmon in enclosures at sampling locations. Net-gear and eDNA sampling applied in concert will provide a more comprehensive and nuanced evaluation of juvenile salmon presence in these habitats, and will allow mutual validation of each technique.

Project Need

As a benefit to the public, the study contributes to the better understanding of juvenile salmonids utilization of habitats in the Sacramento-San Joaquin Delta. The study will address factors limiting fish populations in the lower Sacramento River basin, such as foodweb and diet dynamics. These results will aid in better future restoration efforts.

Project Objectives

- Compare growth and diet between caged juvenile salmon rearing near restored marsh habitat with caged juvenile salmon rearing near non-restored marsh habitat.

- Compare the timing, relative density, and biometrics of juvenile salmon caught at restored marsh habitat with juvenile salmon caught in other shallow water habitats.

- Utilize the new technology of eDNA to compare the assemblage and abundance of juvenile salmon in the Sacramento - San Joaquin River Delta at locations in various stages of restoration.

- Use the Study results for designing and adaptively managing higher functioning juvebile salmonid habitat restoration in the Sacramento – San Joaquin River Delta and associated regions.

Schedule of Project Milestones

Date	Milestone
5/2018–12/2019	Season 1: Data collection, analysis & reporting
12/2019–10/2020	Season 2: Data collection, analysis & reporting
3/2020	Presentation at 2020 IEP Workshop
10/2020	Presentation at 2020 Bay-Delta Conference
12/2020–10/2021	Season 3: Data collection, analysis & reporting
3/2021	Presentation at 2021 IEP Workshop
3/2022	Presentation at 2022 IEP Workshop
3/2022	Final data report and database submitted
10/2022	Presentation at 2022 Bay-Delta Conference

Expected FY 2019 Project Cost

The amount paid for FY 2019 is $250,000 by USBR. This contract will award that sum of money annually for three years. USBR will contribute $750,000 total at the end of this contract. The total project cost, with funding from DWR, is $831,686.

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

The National Marine Fisheries Service's (NMFS) 2009 Biological Opinion (BO) and Conference Opinion on the Long-term Operations of the Central Valley Project (CVP) and the State Water Project (SWP) Reasonable and Prudent Alternative (RPA) Action Suite I.6: Sacramento River Basin Salmonid Rearing Habitat Improvements requires restoration and monitoring of floodplain rearing habitat for juvenile winter-run Chinook salmon (*Oncorhynchus tshawytscha*); Central Valley spring-run Chinook salmon (*O. tshawytscha*); and California Central Valley steelhead (O. mykiss); in the lower Sacramento River basin, to compensate for unavoidable adverse effects of project operations.

The U.S. Fish and Wildlife Service (USFWS) 2008 on the Long-term Operations of the CVP and SWP BO includes an action to restore 8,000 acres of tidal habitat for the benefit of Delta smelt. If these 8,000 acres also provide suitable rearing habitat for salmonids, they may be used in partial satisfaction of the Reasonable and Prudent Alternative (RPA) Action I.6.1. To gain better biological understanding, RPA Action I.6.1 requires performance goals and associated monitoring, including habitat attributes, juvenile metrics, and inundation depth and duration criteria.

Investigator

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DWR
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Use of Artificial Light to Increase Movement of Fish into the Bypasses at Tracy Fish Collection Facility

Fact Sheet Number

2019_35

Project Description

Research at the TFCF has shown that populations of predatory Striped Bass (Morone saxatilis) have taken up residence in both the primary channel and upstream of the secondary channel, where they reside in the bypass pipes. The presence of these fish represents a predation threat to any smaller fishes entering the facility, which is of particular concern as several of the smaller species are threatened or endangered, and have the potential to impact operations based on take limits of listed species.

The use of artificial light on predator populations in aquatic systems has been used to effectively direct fish. A series of Delta Cross Channel studies lead by California Department of Water Resources, have employed the use of high intensity lights in combination with sound and air bubbles, in an effort to keep fish from being entrained into side channels off the Sacramento River. Light has also been used to attract out migrating salmonids to guidance structures at large dams on the Columbia River system.

Project Need

Populations of predatory Striped Bass are present, and reside on a permanent basis, in both the primary and secondary channels of the TFCF. Predation by these resident fish effectively reduces TFCF salvage efficiency of listed fishes by intercepting these fish prior to reaching the holding tanks. Reducing predation mortality has risen in importance as impacts to the continued operation of the facility have been realized.

Project Objectives

Determine whether or not the use of artificial light at, or in, the bypass entrances will result in increased movement of large predatory fishes out of the primary channel.

Determine whether lighting further acts to increase passage, or passage rates, of smaller, non-predatory fishes.

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

It is anticipated that a full report can be completed by the end of FY2019.

Expected FY 2019 Project Cost and Financial Information

FY19 Budget: $49,696

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

Action is related to NMFS BiOp RPA Action IV.4.1(1)(a)

Investigators

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Baselines: Establishing Passive Integrated Transponder Tagging Methods in Adult Delta Smelt

Fact Sheet Number

2019_36

Project Description

Delta Smelt have historically been difficult to tag because of their small size and delicate nature, so internal tags have not been used extensively. However, technological advances have allowed for both PIT tags and hydroacoustic tags to become smaller, potentially making them a more viable option for small fish. Very few studies have attempted to implant these tags into Delta Smelt and document their findings. Although acoustic tag implantation has yet to be successful in this species, PIT tag injection has shown some promising survival and tag retention results. The present study will allow us to refine Delta Smelt tagging techniques that will become very beneficial for future facility improvement studies by developing reference and baseline material.

Project Need

Delta Smelt tagging techniques have not been refined or extensively studied due to the relatively recent development of tags at the present size. Therefore, there is very little information about the process and impacts to these fish. Should this research be successful in developing methods for tagging Delta Smelt, the resulting knowledge could be a valuable asset for testing TFCF efficiency with this species.

Project Objectives

Determine the influence of tag implantation method (i.e., injection or surgical insertion) on survival and tag retention of adult Delta Smelt sourced from the UC Davis Fish Conservation and Culture Laboratory and held at the Tracy Aquaculture Facility.

Evaluate the influence of tag burden on survival and tag retention of the adult Delta Smelt using a variety of PIT tag sizes.

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

The tagging effect study will take place in FY 2019. Data analysis and results will be shared at a Tracy Technical Advisory Team (TTAT) meeting and a Tracy Series Report will be completed the following fiscal year after the study has been completed (FY 2020).

Expected FY 2019 Project Cost and Financial Information

FY19 Budget: $132,000

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

Action is related to NMFS BiOp RPA Action IV.4.1

Investigators

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Reclamation Point(s) of Contact: Erwin Van Nieuwenhuyse, Science Division, Bay Delta Office, Sacramento, CA

Upper Estuary Zooplankton Sampling

Fact Sheet Number

2019_316

Project Description

This project contributes to managing fisheries and aquatic resources in the Delta that are used to assess the status of the ecosystem and document trends. This data is also used for planning efforts and as system-level baseline data for adaptive management experiments and for restoration actions focused on recovery of fish populations listed under the Endangered Species Act. Results of the special studies will also be available for operational and management decisions affecting the Central Valley Project, implementation of the delta smelt and salmonid biological opinions.

Project Need

Conduct the fisheries and aquatic resources monitoring associated special studies called for in the water right permits and biological opinions governing long term operation of the CVP/SWP.

Project Objectives

Conduct monthly sampling for Neomysis shrimp and other zooplankton at 16 sites in San Pablo Bay, Suisun Bay, and the Sacramento-San Joaquin Delta as described under work plan element IEP-077 in the IEP Annual Work Plan.

Expected FY 2019 Project Cost

$312,000

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

FWS RPA Component 5

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Sacramento-San Joaquin Delta Coordinated Acoustic Telemetry Array

Fact Sheet Number

2019_302

Project Description

USGS California Water Science Center (CAWSC), Hydrodynamics Project, will coordinate the overall implementation and operations and maintenance (O&M) of the acoustic telemetry receiver array associated with the multi-agency Coordinated Acoustic Telemetry Array (CAT Array), and will take responsibility for implementing and O&M of the CAT Array in the Delta.

Project Need

There is a well-documented need for improved detection and associated modeling of salmon migration and survival in the Central Valley. These monitoring efforts can provide critical information on juvenile salmonid distribution and survival, which inform biologists and managers interpretations of the exposure and intensity of CVP and SWP water operation risks on tagged populations in Central Valley rivers and the Bay-Delta. Understanding salmon survival and migration dynamics in the Delta and its tributaries is critical to the operation of state and federal water projects, recovery of ESA-listed species, and sport and commercial fisheries management. Tracking the fate of individual tagged fish can be accomplished with acoustic telemetry, tracking groups of acoustic telemetered fish can be used to develop estimates of survival and movement for other non-tagged fish also part of that group, and population level sampling programs can use survival estimates generated by acoustic tagged fish and applied to other mass marked (e.g. coded wire tagging) groups to develop improved capture efficiency for these sampling programs. These capture efficiency estimates can then be used to estimate abundance of non-tagged populations.

Project Objectives

The key objectives of this study are as follows:

- Coordinate with participating agencies by attending and presenting at the Interagency Telemetry Advisory Group meetings
- Deploy, and provide operation and maintenance for the Coordinated Acoustic Telemetry Array in the Delta

- Develop, document, and disseminate standard deployment and operating procedures, performance standards metrics, QA/QC methodologies, and data transfer protocols

- Provide raw receiver data to database management team

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

Due to Reclamation	Task Deliverable
Varies; Complete by August 31, 2020	Task 1: Array Team Coordination
Ongoing; Complete by August 31, 2020	Task 2: Deploy and Maintain Delta Array
Annually; August 31, 2019 and August 31, 2020	Task 3: Develop, Document, Disseminate Array Standards
August 31, 2020	Task 4: Data Management
Ongoing; Complete by August 31, 2020	Task 5: Project Management

Expected FY 2019 Project Cost and Financial Information

This is a two-year interagency agreement beginning in Fiscal Year 2019 through Fiscal Year 2020. Fiscal Year 2019 costs $443,724 and total agreement costs approximately $850,363.

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

N/A

Investigator

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