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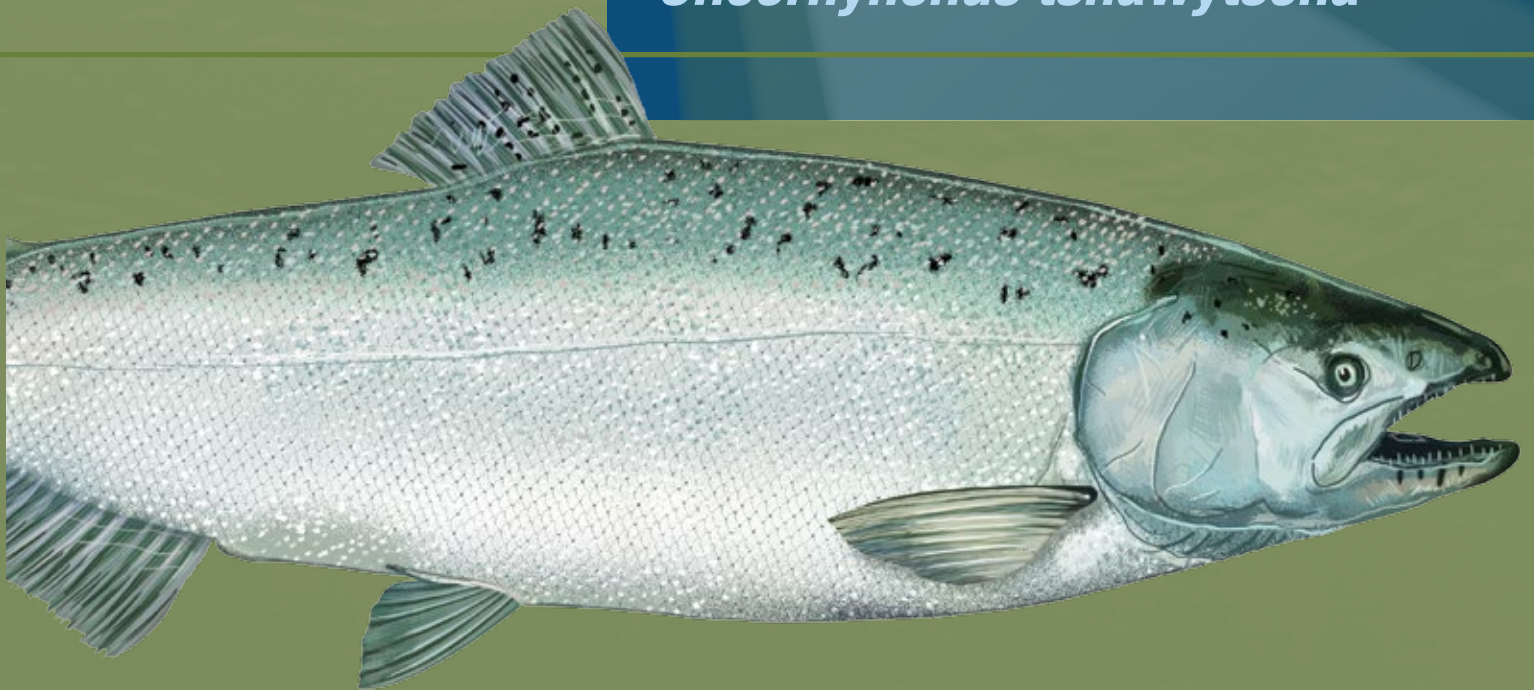
SPECIES *in the* SPOTLIGHT

Priority Actions: 2016-2020

Sacramento River

Winter-run Chinook Salmon

Oncorhynchus tshawytscha



SPECIES SPOTLIGHT BACKGROUND

The 5-year action plan is part of a strategy to marshal resources on species listed under the Endangered Species Act of 1973 (ESA) for which immediate, targeted efforts are vital for stabilizing their populations and preventing their extinction. Eight species were identified by the National Marine Fisheries Service (NMFS) as among the most at-risk of extinction:

- Atlantic Salmon Gulf of Maine Distinct Population Segment (DPS)
- Central California Coast Coho Evolutionarily Significant Unit (ESU)
- Cook Inlet Beluga Whale DPS
- Hawaiian Monk Seal
- Pacific Leatherback Sea Turtle
- Sacramento River Winter-run Chinook ESU
- Southern Resident Killer Whale DPS
- White Abalone

These species were identified as among the most at-risk of extinction based on three criteria (1) endangered listing, (2) declining populations, and (3) are considered a recovery priority #1¹. We know the threats facing these species and understand the management actions we can take that will have a high probability of success. The 5-year action plan builds upon existing recovery or conservation plans and details the focused efforts needed over the next 5 years to reduce threats and stabilize population declines. We will engage our partners in the public and private sectors in actions they can take to support this important effort. We will report on our progress through the Biennial Report to Congress and post updates on our website: <http://www.nmfs.noaa.gov/pr/>.

This strategy will guide agency actions where we have the discretion to make critical investments to safeguard these most endangered species. The strategy will not divert resources away from the important and continued efforts to support all ESA-listed species under our authority. Many of our species have long-standing conservation programs supported by multiple partners. We remain committed to those programs. This action plan is designed to highlight the actions that can be taken by us, other federal and state resource agencies, environmental organizations, Native American Tribes and other partners to turn the trend around for this species from a declining trajectory to a trajectory towards recovery.

¹ Priority #1 is defined as a species whose extinction is almost certain in the immediate future because of a rapid population decline or habitat destruction, whose limiting factors and threats are well understood and the needed management actions are known and have a high probability of success, and is a species that is in conflict with construction or other developmental projects or other forms of economic activity. NMFS Endangered and Threatened Listing Recovery Guidelines (55 FR 24296, June 15, 1990).

SACRAMENTO RIVER WINTER-RUN CHINOOK SALMON STATUS

The Sacramento River winter-run Chinook salmon ESU was chosen as one of the eight most at-risk species because it is composed of just one small population that is currently under severe stress caused by one of California's worst droughts on record. Over the last 10 years of available data (2003-2013), the abundance of spawning winter-run Chinook adults ranged from a low of 738 in 2011 to a high of 17,197 in 2007, with an average of 6,298. The population subsists in large part due to agency-managed cold water releases from Shasta Reservoir during the summer and artificial propagation from Livingston Stone National Fish Hatchery's winter-run Chinook salmon conservation program. Winter-run Chinook salmon are dependent on sufficient cold water storage in Shasta Reservoir, and it has long been recognized that a prolonged drought could have devastating impacts, possibly leading to the species' extinction.

California's current drought began in 2012, and winter-run Chinook salmon are experiencing the consequences of low water storage and a limited volume of cold water in Shasta Reservoir. Monitoring data indicated that approximately 5.6% of winter-run Chinook salmon eggs spawned in the Sacramento River in 2014 survived to the fry life stage. Under varying hydrologic conditions from 2002 to 2013, winter-run Chinook salmon egg-to-fry survival ranged from three to nearly 10 times higher than it was in 2014. Smolts in 2014 suffered additional mortality migrating to and through the Delta. The extremely limited production in 2014 is hypothesized to be the result of warm water temperatures that caused egg and newly hatched fry mortality and low flows that led to increased predation. Unfortunately, the ongoing drought has made 2015 another challenging year for winter-run Chinook salmon. Without marshalling our resources and heightening our engagement with vital partners, Sacramento River winter-run Chinook salmon may be lost to future generations.

SACRAMENTO RIVER WINTER-RUN CHINOOK SALMON KEY CONSERVATION EFFORTS/CHALLENGES

Working in close coordination, the five agencies [United States Department of the Interior Bureau of Reclamation and Fish and Wildlife Service (USFWS), NOAA's National Marine Fisheries Service (NMFS), the California Department of Water Resources (DWR), and the California Department of Fish and Wildlife (CDFW)] primarily involved in the coordinated operation and regulation of the federal Central Valley Project and State Water Project, of which Shasta Reservoir is a major component, developed and implemented an [Interagency 2015 Drought Strategy](#) in order to rapidly and equitably balance between all of the competing needs for limited water across the state. Focused planning efforts have been directed toward Shasta Reservoir, because, in addition to serving as a source of cold water to protect winter-run Chinook salmon eggs and fry during the summer, the reservoir also supports other beneficial uses,

including agricultural and urban water deliveries and Delta salinity management. Given the continued dry conditions, the five agencies, along with the California State Water Resources Control Board (SWRCB), are in the midst of developing an interagency 2016 drought strategy

The ongoing drought has intensified California's water management challenges and accentuated the urgent and critical need to reintroduce winter-run Chinook salmon populations into their historical habitat, an area which is not dependent on Shasta Reservoir storage and is somewhat buffered from drought by the influence of cold water springs. The survival and recovery of winter-run Chinook salmon cannot be achieved without establishing additional populations.

Efforts to reintroduce winter-run Chinook salmon to the McCloud River and Battle Creek are underway. On the McCloud River, a pilot reintroduction feasibility plan is being developed by Bureau of Reclamation in collaboration with the USFWS, NMFS, CDFW, and DWR. This pilot plan will inform decision making for a long-term reintroduction upstream of Shasta Dam to the McCloud River. On Battle Creek, a major salmon and steelhead [habitat restoration project](#) is underway, which when completed will restore suitable winter-run Chinook salmon habitat and set the stage for reintroduction. The restoration project is a collaborative effort between the Pacific Gas and Electric Company (PG&E), Bureau of Reclamation, USFWS, NMFS, the Federal Energy Regulatory Commission, the SWRCB, and CDFW, with valuable participation from the public, including the [Greater Battle Creek Watershed Working Group](#) and the [Battle Creek Watershed Conservancy](#). In order to efficiently begin utilizing the restored habitat, CDFW is proactively developing a Battle Creek winter-run Chinook salmon reintroduction implementation plan with technical guidance from NMFS and USFWS.

In addition to the drought, another important threat to winter-run Chinook salmon is a lack of suitable rearing habitat in the Sacramento River and Delta to allow for sufficient juvenile growth and survival.



KEY ACTIONS NEEDED 2016-2020

The key actions that follow represent a small subset of the recovery actions identified in the July 2014 recovery plan, and represent actions NMFS and partners can take in the next five years to promote recovery of the species. The partners identified below have indicated their interest in helping achieve the action, but are not committed to a specific activity or commitment of resources. This list is not comprehensive of all potential partners, and we welcome partnering with others not identified within this plan.

Improve Management of Shasta Reservoir Coldwater Storage

Description and Background: The California drought has made it extremely challenging to make water releases from Shasta Reservoir that are sufficiently cold to protect winter-run Chinook salmon throughout their spawning, egg incubation, and fry rearing life stages. Insufficient cold water in 2014 led to the mortality of approximately 95% of winter-run Chinook salmon eggs and fry. The ability to measure and model the thermal profile in Shasta Reservoir must be improved in order to most efficiently manage the reservoir’s limited amount of cold water. To improve the management of Shasta Reservoir’s coldwater storage, this action suite calls for physical modeling to refine the reservoir water temperature model and couple it with the Southwest Fisheries Science Center’s (SWFSC) water temperature model for the Sacramento River, installing a real-time reservoir water temperature profiler in Keswick Reservoir, replacing

the damaged Oak Bottom water temperature curtain with a new curtain, and developing biological models to inform reservoir managers so they can make sound decisions about storage and release of coldwater.

Expected Benefits to the Species: Improved management of Shasta Reservoir’s cold water should significantly increase winter-run Chinook salmon survival, especially during drought conditions.

Source: This effort will contribute to Recovery Plan Action SAR-1.4, page 151 (NMFS 2014).

Location: Shasta Reservoir

NMFS Point of Contact: Garwin Yip, California Central Valley Area Office, Garwin.Yip@noaa.gov, 916-930-3611.

Lead Partners: Bureau of Reclamation, NMFS West Coast Region, NMFS SWFSC

Partners: CDFW, USFWS, SWRCB, Northern California Water Association, Sacramento River Settlement Contractors

Updates: Updated annually end of each fiscal year

Resources:

Funding:

Activity	Current Status	Expected Completion Date	Lead Partner(s)	Estimated Funding Needed
Physical modeling improvements	Ongoing	2017	NMFS SWFSC and Bureau of Reclamation	\$200,000
Installing Keswick Reservoir thermal profiler	Not initiated, needs funding	1 year from start	NMFS SWFSC and Bureau of Reclamation	\$35,000
Replacing Oak Bottom curtain	Planning phase	April 2016	Bureau of Reclamation	\$1.5 million
Biological model development	Not initiated, needs funding	2 years from start	NMFS SWFSC	\$485,000

Opportunities for Partners:

- We encourage sustained partnerships with Bureau of Reclamation, CDFW, USFWS, SWRCB, Northern California Water Association, and Sacramento River Settlement

Contractors and seek additional partners to support improved management of the Shasta Reservoir coldwater storage.

- We encourage the public to conserve water. Water is a critical part of California's way of life. The state's economy, environment, and people need water to flourish. Unfortunately, there is limited water to meet these needs – especially during this historic drought. Californians are acting now to make water conservation a way of life. Please visit saveourwater.com to find out what you can do to make conservation a part of your daily life.

Restore and Provide Access to Battle Creek Habitat

Description and Background: Reintroducing winter-run Chinook salmon to the cold water spring-fed habitat in Battle Creek is critical to preventing the species' extinction. Currently, with only one population, the Sacramento River winter-run Chinook salmon ESU is at high risk of extinction. Establishing a second population will contribute to the species' viability by increasing its abundance and productivity, and improving its spatial structure and diversity. The Battle Creek Salmon and Steelhead Restoration Project (BCRP) located near the town of Manton, California in Shasta and Tehama Counties will restore and provide access to approximately 42 miles of prime salmon and steelhead habitat on Battle Creek, plus an additional 6 miles in its tributaries. Restoring Battle Creek is being accomplished by the modification of hydroelectric project facilities and operations, including instream flow releases. The BCRP will restore suitable winter-run Chinook salmon habitat and set the stage for reintroduction. The restoration project is a collaborative effort between PG&E, Bureau of Reclamation, USFWS, NMFS, Federal Energy Regulatory Commission, SWRCB, and CDFW, with valuable participation from the public, including the Greater Battle Creek Watershed Working Group and the Battle Creek Watershed Conservancy.

Expected Benefits to the Species: The restoration of a drought-resistant, spring-fed system like Battle Creek is especially important to species such as winter-run and spring-run Chinook salmon and steelhead, which are dependent on cold water stream habitats. Winter-run Chinook salmon are particularly dependent upon habitats like Battle Creek that have stream reaches that are kept cold year-round by natural springs. Historically, winter-run Chinook salmon populations occurred in Battle Creek, but at present, the only population of winter-run Chinook salmon occurs in the mainstem of the Sacramento River below Shasta Dam (Yoshiyama et al. 1998). This section is typically kept cold enough for winter-run Chinook salmon by releases from Shasta Reservoir. However, periods of extended drought, like the one California is currently facing, can exhaust the reservoir's cold water reserve, leaving winter-run Chinook salmon susceptible to reproductive failure. Restoring habitat and reestablishing a winter-run Chinook

salmon population in Battle Creek will greatly increase the species' viability and put it on a path towards recovery.

Source: This effort will contribute to Recovery Plan action BAC-1.1 (Restoration), BAC-1.2 (Reintroduction), page 199 (NMFS 2014)) as well as Action I.2.6 in the Central Valley Project and State Water Project (CVP/SWP) 2009 Biological Opinion's Reasonable and Prudent Alternative (NMFS 2009).

Location: Battle Creek is located in Shasta and Tehama Counties, near Anderson, California

NMFS Point of Contact: Naseem Alston, California Central Valley Area Office, Naseem.alston@noaa.gov, 916-930-3655

Lead Partners: Memorandum of Understanding for implementation of BCRP includes NMFS, USFWS, CDFW, Bureau of Reclamation, and PG&E. DWR has provided supplemental funding. A lead agency for the reintroduction project has not yet been identified.

Partners: Battle Creek Watershed Conservancy and Greater Battle Creek Watershed Working Group

Proposed Start Date: Ground Breaking Ceremony for BCRP occurred in September 2010. A Reintroduction Plan is currently being written and is scheduled to be completed in August 2016. Implementation of the Plan will begin soon after, when a lead agency is identified and funding has been secured.

Expected Completion Date: The entirety of the BCRP is expected to be completed in 2020, provided funding can be obtained to complete the project. The date of completion for the reintroduction is dependent on the rate of successful colonization.

Current Status: BCRP is near its final implementation phase. The reintroduction component is being planned.

Updates: Updated annually end of each fiscal year

Resources:

Funding:

\$121 million has been obligated for the BCRP so far, and \$18 million more is needed to complete it. Estimated cost of reintroduction will be available upon completion of the Reintroduction Plan. Funding sources have not yet been identified.

Opportunities for Partners:

- We encourage sustained partnerships with Bureau of Reclamation, CDFW, DWR, USFWS, PG&E, Battle Creek Watershed Conservancy, and Greater Battle Creek Watershed Working Group, and seek additional partners to restore Battle Creek habitat.

Reintroduce Winter-Run Chinook Salmon into the McCloud River

Description and Background: The ongoing drought has intensified California's water management challenges and accentuated the urgent and critical need to reintroduce winter-run Chinook salmon populations into their historical habitat, an area which is not dependent on Shasta Reservoir storage and is somewhat buffered from drought by the influence of cold water springs. The survival and recovery of winter-run Chinook salmon cannot be achieved without establishing additional populations.

Expected Benefits to the Species: Reintroducing winter-run Chinook salmon to the McCloud River would increase the species abundance, spatial structure, and diversity, and ultimately its chances of long-term survival and recovery. Ensuring there are greater numbers of winter-run Chinook salmon widely distributed across a variety of habitats will greatly reduce the species' risk of extinction. Reintroducing winter-run Chinook salmon to higher elevation, spring-fed habitat upstream of Shasta Dam would reduce the ESU's vulnerability to droughts, climate change, and other catastrophic events. Re-establishing winter-run Chinook salmon in their historical habitat would promote the ecological and evolutionary processes responsible for the local adaptation and diversity that allowed the species to persist for thousands of years (Anderson et al. 2014).

Sources: This effort will contribute to Recovery Plan action SAR-1.1 (page 150, NMFS 2014) as well as Action V in the Central Valley Project/State Water Project (CVP/SWP) 2009 Biological Opinion's Reasonable and Prudent Alternative (NMFS 2009).

Location: McCloud River

NMFS Points of Contact: Jonathan Ambrose, California Central Valley Area Office, Jonathan.Ambrose@noaa.gov, 916-930-3717. Alice Berg, California Central Valley Area Office, Alice.Berg@noaa.gov, 916-930-3716

Lead Partners: Bureau of Reclamation, NMFS, USFWS, CDFW, DWR

Proposed Start Date: Reintroduction planning was initiated in 2013.

Expected Completion Date: Implementation of the pilot plan is scheduled to be completed in 2019. Reintroduction is expected to be a long-term program with no specific completion date.

Current Status: A pilot implementation plan is in development and is scheduled to be completed in early 2016 with implementation beginning in late 2016 or 2017. NMFS regulatory work, including having an experimental population designation rule in place, is scheduled to be completed by the fall of 2016.

Updates: Updated annually end of each fiscal year

Resources:*Funding:*

Bureau of Reclamation has spent \$1.4 million on the overall project as of July 2015 and expects to spend \$300,000 more to finalize the pilot plan. Cost of implementing the pilot plan is roughly estimated at \$15 million. Costs for the long-term program are dependent on the results of the pilot study and are not available at this time. Funding for implementation of the pilot plan has not yet been identified.

Opportunities for Partners:

- We encourage sustained partnerships with Bureau of Reclamation, CDFW, DWR, and USFWS, PG&E, and seek additional partners to support the McCloud River reintroduction plan.

Improve Yolo Bypass Fish Habitat and Passage

Description and Background: Significant modifications have been made to the historic floodplain of California’s Central Valley for water supply and flood damage reduction purposes, resulting in losses of rearing habitat, migration corridors, and food web production for juvenile winter-run Chinook salmon. The Yolo Bypass, a 59,000-acre leveed floodplain engineered to convey floodwaters of the greater Sacramento Valley, still retains many biologically valuable characteristics of the historic floodplain habitat that are favorable to salmon. However, the value of this habitat is compromised in below-normal to critically dry years, when there is little or no floodplain inundation and poor connectivity between the Yolo Bypass and the Sacramento River. In addition adult winter-run Chinook salmon stray into the Yolo Bypass during their upstream migration. Existing flood and agricultural structures within the Bypass are inadequate to allow passage back into the Sacramento River at most flow levels leading to significant migratory delays, illegal harvesting, and fish unable to reach their spawning grounds. Actions include improving three weirs and four road crossings within the Bypass to allow better fish passage for adults and modifications to Fremont Weir to provide increased frequency, magnitude, duration, and access to seasonal floodplain habitat in the Bypass for juveniles.

Expected Benefits to the Species: Restoration of floodplain rearing habitat for juvenile Sacramento River winter-run Chinook salmon in the Yolo Bypass will provide floodplain connectivity, physical and biological habitat rearing conditions to promote food web productivity, and protection from predators that will in turn support juvenile winter-run development, growth, and survival. Improvement of flood and agricultural structures in the Yolo Bypass will reduce adult migratory delays, strandings, illegal harvesting, and losses to the population.

Sources: This effort will contribute to Recovery Plan actions SAR-1.12 and SAR-1.13 (pages 158 and 159, NMFS 2014) as well as Actions 1.61 and 1.7 in the CVP/SWP 2009 Biological Opinion’s Reasonable and Prudent Alternative (NMFS 2009).

Location: Yolo County, CA

NMFS Point of Contact: Brycen Swart, California Central Valley Office, Brycen.Swart@noaa.gov, 916-930-3712

Partners: DWR, CDFW, Bureau of Reclamation, NMFS West Coast Region, NMFS SWFSC, Cal Trout, Cal Marsh and Farms, Metropolitan Water District, State and Federal Contractors Water Agency, Yolo Basin Foundation, Yolo County, Bureau of Reclamation District (RD) 108, RD 2068, Conaway Ranch, Sacramento Area Flood Control Agency.

Proposed Start Date: Planning for Yolo Bypass restoration and fish passage efforts began in 2011.

Expected Completion Date: Near-term fish passage actions are expected to be completed by 2021 and floodplain restoration actions are to be completed by 2023.

Current Status: Lead agencies and partners are undergoing alternative formulation and analysis for environmental planning and permitting pursuant to the National Environmental Policy Act and the California Environmental Quality Act.

Updates: Updated annually end of each fiscal year.

Resources:

Funding:

DWR has allocated \$18 million for planning through 2017. Construction cost needs are preliminarily estimated at \$32 million. [Note that this construction estimate is subject to change as it was prepared based on limited information, where the preliminary engineering was from 1 to 5% complete.] Funding for construction has not yet been identified.

Opportunities for Partners:

- We encourage sustained partnerships with DWR, CDFW, Bureau of Reclamation, Cal Trout, Cal Marsh and Farms, Metropolitan Water District, State and Federal Contractors Water Agency, Yolo Basin Foundation, Yolo County, Bureau of Reclamation District (RD) 108, RD 2068, Conaway Ranch, Sacramento Area Flood Control Agency, and seek additional partners to support restoration of the Yolo Bypass floodplain and improved fish passage.
- We encourage the public to conserve water. Water is a critical part of California’s way of life. The state’s economy, environment, and people need water to flourish. Unfortunately, there is limited water to meet these needs – especially during this historic drought. Californians are acting now to make water conservation a way of life. Please visit saveourwater.com to find out what you can do to make conservation a part of your daily life.

Manage Winter and Early Spring Delta Conditions to Improve Juvenile Survival

Description and Background: This is a suite of four related activities intended to understand, manage, and reduce the exposure of juvenile winter-run Chinook salmon to negative flows and increased predation in the central and south Delta: (A) continued partnership and support of the Collaborative Adaptive Management Team (CAMT) and the Salmon Scoping Team; (B) installation of barriers at Georgiana Slough and other key junctions; (C) improved enhanced particle tracking modeling; and (D) real-time salmon monitoring and water export management in the Delta. Adaptive management is widely considered a useful tool as a structured method for addressing uncertainty and it has become a key part of ESA planning (Zabel et al. 2002; Daily and Olympia 2006). The CAMT partnership and process is essential to achieve a better understanding of Delta conditions and impacts to ESA species in the Delta. Previous studies have shown that fish using the interior Delta have decreased survival relative to fish that migrate through the Sacramento River mainstem or north Delta pathways (Perry et al. 2010). Recent testing has determined that a non-physical barrier at Georgiana Slough was an effective juvenile salmon deterrent that will help keep winter-run Chinook salmon from entering the Delta interior. Improved particle tracking modeling is needed to better understand how hydrologic conditions (e.g., inflows, tides, and export levels) affect the distribution juvenile winter-run Chinook salmon in the Delta.

The proportion of the population entering the interior Delta each year is not known. Water management actions have previously focused on closing the Delta Cross Channel gates when ESA-listed salmon smolts may be migrating past (NMFS 2009). Knowing when fish may be present is based on historical distribution data and current monitoring data from rotary screw traps, beach seines, and Sacramento River trawl surveys. Data from active collections can be used to inform timely management decisions if the data are compiled quickly and relayed to managers through communication like the weekly Delta Operations for Salmonids and Sturgeon meeting.

Expected Benefits to the Species: Survival of juvenile winter-run Chinook salmon is expected to increase by: (1) expanding our knowledge of, and managing to Delta conditions and impacts to ESA species; (2) minimizing the distribution of juveniles from the Sacramento River into the interior Delta; and (3) minimizing their exposure to reverse flows and predation if they do enter the interior Delta due to better real-time spatial distribution and movement information.

Sources: This effort will contribute to Recovery Plan actions DEL-1.18 (minimize reverse flows), DEL-1.20 (minimize access to Delta interior), and DEL-1.22 (curtail exports when winter-run are present) (NMFS 2014). It was also mentioned in the [CAMT 2014 Progress](#)

[Report to the Collaborative Science Policy Group](#) and will contribute to Action IV.1.3 in the CVP/SWP 2009 Biological Opinion's Reasonable and Prudent Alternative (NMFS 2009).

Location: Sacramento-San Joaquin Delta

NMFS Point of Contact: Garwin Yip, California Central Valley Area Office, Garwin.Yip@noaa.gov, 916-930-3611

A. Partnership and support of the Collaborative Adaptive Management Team and the Salmon Scoping Team

Lead Partners: DWR, CDFW, Reclamation, USFWS, and NMFS

Partners: Delta Stewardship Council

Proposed Start Date: Collaborative Science and Adaptive Management Program June, 2013

Expected Completion Date: The Salmon Scoping Team Gap Analysis is scheduled for completion in early 2016

Current Status: The Collaborative Science and Adaptive Management Program was launched following a decision made on April 9, 2013 by the United States District Court for the Eastern District of California to extend a court-ordered remand schedule for completing revisions to the salmon (NMFS 2009) and Delta Smelt (USFWS 2008) Biological Opinions. Following the issuance of the Court Order, a two-tiered organizational structure was established to implement the Collaborative Science and Adaptive Management Program comprised of: (1) a Policy Group made up of agency directors and top-level executives from the entities involved in the litigation, and (2) the CAMT including designated managers and scientists representing state and federal agencies, water contractors and non-governmental organizations to serve as a working group functioning under the direction of the Policy Group. Per the signed final judgment on May 5, 2015, NMFS is no longer under the Court's jurisdiction and the Collaborative Science and Adaptive Management Program is no longer required under remand, but the effort continues given the need for strong science to guide Delta management. The CAMT Salmon Scoping Team is currently in the process of reviewing its *Work Plan Element 1: Identification of gaps in the current understanding of water project-linked effects on juvenile salmonid survival in the south delta* (Gap Analysis), which is expected to provide direction for Delta research.

Updates: Updated annually end of each fiscal year

Resources: Significant investment in long term research related to the Gap Analysis is needed, as well as ongoing funding to support the Policy Group, CAMT, and the Salmon Scoping Team.

B. Installation of barriers at Georgiana Slough and other key junctions

Lead Partners: DWR, Reclamation, US Geological Survey

Partners: USFWS, NMFS

Proposed Start Date: RPA Action IV.1.3-related activities:

- Studies already completed listed under "Expected Completion Date"

- Proposed 5-year implementation of a seasonal bio-acoustic fish fence barrier at Georgiana Slough to start winter of 2017.
- Additional studies of an Infra-sound Fish Fence (IFF) barrier at either Sutter or Steamboat sloughs for 2 years between 2017 and 2022.

Expected Completion Date: RPA Action IV.1.3-related activities:

- Non-physical barrier studies 2 years at Georgiana Slough (completed in 2011 and 2012) and 2 years at the Head of Old River (completed in 2009 and 2010).
- Physical barrier (Floating Fish Guidance Structure) 1 year at Georgiana Slough (completed in 2014).
- 5-year Adaptive Management Study of the bio-acoustic fish fence at Georgiana Slough (2022)
- 2-year IFF study at either Sutter Slough or Steamboat Slough by (2022)

Current Status: Final RPA Action IV.1.3 Recommendation Report delivered to NMFS on 3/27/15. Discussions are underway to implement recommendations of the report by winter of 2017.

Resources: Listed here are order of magnitude costs needed to build and operate the bio-acoustic fish fence and IFF barrier technologies, taken from the final recommendation report. Conducting a study with acoustic-tagged fish will be additional to the cost of construction, but would not necessarily incur long term operations and maintenance costs.

- Georgiana Slough bio-acoustic fish fence: \$12.8 million needed to build and install; annual operations and maintenance \$510,000.
- Sutter or Steamboat Slough IFF²: \$7.6 million needed to build and install; annual operations and maintenance \$390,000.

C. Enhanced particle tracking modeling

Lead Partners: NMFS SWFSC, Bureau of Reclamation

Partners: DWR, US Geological Survey, Delta Operations for Salmonids and Sturgeon

Proposed Start Date: Development of the enhanced particle tracking modeling, as part of the winter-run life-cycle model, began in 2013. Implementation of a pilot application of the enhanced particle tracking modeling as a support tool began in February of 2015. Model validation and calibration to the South Delta is proposed for 2016.

Current Status: The model is complete and running; parameter estimation (i.e., calibration) continues. Future work may include explicit accounting for effects of 2-D channel junction geometry on flow splits and route selection, and inclusion of additional tagging data in the calibration and model performance assessment (sometimes called validation).

Expected Completion Date: Initial final version in late 2015, with improved versions in 2016-17.

² Cost of IFF at Steamboat or Sutter is based on the estimated cost of an IFF barrier at Georgiana Slough reported in the Final RPA IV.1.3 Recommendation Report.

Updates: Updated annually end of each fiscal year

Resources: Roughly \$350,000 has been spent to date on model development. An additional \$133,000 is needed to analyze existing fish tagging and monitoring data to improve the accuracy of enhanced particle tracking modeling predictions.

D. Real time monitoring and export management in the Delta to reduce exposure to negative flows and increased predation in the central and south Delta

NMFS uses enhanced monitoring information (such as catch data from trawls, seines, and rotary screw traps) to assess real-time fish distribution in the context of export management and implementation of the 2009 NMFS Biological Opinion on Long-term Operations of the CVP/SWP. In water year 2015 a number of additional monitoring actions were considered as part of the [Interagency 2015 Drought Strategy](#) in an attempt to achieve greater water operational flexibility. These monitoring actions included enhanced monitoring from trawls, seines, and rotary screw traps as well as real-time information on the movements of acoustic-tagged winter-run Chinook salmon.

Lead Partners:

- Enhanced Monitoring: CDFW, USFWS, DWR, Reclamation
- Real Time telemetry receivers: NMFS SWFSC, UC Davis, USFWS, Bureau of Reclamation, DWR.
- CVP and SWP Operations: Bureau of Reclamation and DWR

Partners: Contra Costa Water District, East Bay Municipal Water District, SWRCB

Proposed Start Date: Enhanced monitoring has been implemented during drought years and is being discussed for future years. Real-time tracking of acoustic-tagged winter-run Chinook salmon started in 2015.

Expected Completion Date:

- Enhanced monitoring: No completion date. This information is needed annually to protect winter-run Chinook salmon.
- Real-time tracking of acoustic-tagged winter-run Chinook salmon: 2015.

Current Status: Ongoing.

Updates: Updated annually end of each fiscal year

Resources:

Funding:

- Monitoring Improvement Costs: In 2015 the trawling and beach seining enhanced monitoring and the additional multiple-haul sampling at Jersey Point and Prisoner's Point cost the Delta Juvenile Fish Monitoring Program approximately \$985,000. Additional funding is needed to continue this sampling effort in future years.
- Expanding the Acoustic Receiver Array Costs: Funds are needed to purchase 16 new real time acoustic telemetry system receivers (including shore box, solar panels,

cable, hardware, cellular network plan, server fees, beacon transmitters), costing \$244,800. Hiring two technicians for 12 months (at a total cost of \$340,424) is needed to procure the equipment, perform setup and troubleshooting, permitting, installation, maintenance, website management and data management. Additional sums (\$24,441) are needed to support existing staff salaries for one month to perform data analysis and dissemination as well as report writing. Travel funds (\$48,260) are needed for technicians to deploy, maintain, and trouble-shoot real time receivers. Total funding need is approximately \$657,925.

Opportunities for Partners:

- We encourage DWR, CDFW, Bureau of Reclamation, USFWS, US Geological Survey, and UC Davis, CVP and SWP Operations, Delta Stewardship Council, Delta Operations for Salmonids and Sturgeon, Contra Costa Water District, East Bay Municipal Water District, SWRCB to continue to collaborate on managing conditions in the central and south Delta.
- We encourage the public to conserve water. Water is a critical part of California's way of life. The state's economy, environment, and people need water to flourish. Unfortunately, there is limited water to meet these needs – especially during this historic drought. Californians are acting now to make water conservation a way of life. Please visit saveourwater.com to find out what you can do to make conservation a part of your daily life.

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