

Defining Juvenile Salmon Habitat Criteria in the Delta to Inform Habitat Restoration Opportunities

1. BACKGROUND/PURPOSE

Restoring aquatic habitats in the Delta to improve rearing conditions for juvenile salmonids has been identified as a common goal in numerous programs and plans including the Delta Plan, EcoRestore, the Central Valley Project Improvement Act, the Delta Conservation Framework, the Sacramento Salmonid Resiliency Strategy and the 2008 Biological Opinions for operation of the State Water Project and Central Valley Project.

Under current conditions, relatively few juvenile salmonids that enter the Delta survive (generally <10%). As a consequence, investments to improve growth and survival in upstream areas are often lost in the Delta.

The purpose of this proposal is to define suitable salmon rearing habitat in the Delta, use these criteria to develop an initial, science-based habitat suitability index to rank potential habitat restoration areas, and host a scientific workshop to review and refine the habitat criteria and resulting habitat mapping to be used both in restoration site selection but also as design criteria for restoration planning. This effort will help to identify near-term priority efforts that could be funded by Proposition 1 and other funding sources.

Project objectives include:

1. Meta-analysis of existing information regarding criteria for juvenile salmon rearing habitat and defining Delta rearing habitat criteria
2. Establish habitat selection criteria for salmon rearing in the Delta; and
3. Identify near-term and long-term priorities for aquatic habitat restoration in the Delta that can be funded by Prop. 1 and other funding sources.

The project would be guided by the Collaborative Adaptive Management Team (CAMT) (see Attachment A) working closely with the San Francisco Estuary Institute, the Delta Conservancy and its partners in a collaborative team effort. The project would include cost sharing and in-kind technical support through CAMT's member organizations, including engagement of resource agency and NGO scientists with expertise in salmonid biology and restoration. The project would be designed to dovetail with other ongoing initiatives including the Delta Stewardship Council's Delta Landscape Scenario Planning. Details regarding the proposed team are provided in Section 3 below.

An Advisory Panel would be established to help guide the study. The panel would include scientists with expertise in salmonid biology as well as an agriculture representative and a County representative to be self-identified.

2. SCOPE OF WORK AND BUDGET

Task 1. Meta-analysis of Existing Information Regarding Salmon Rearing Habitat in the Delta and Defining Delta Rearing Habitat Criteria

The purpose of this task is to define what suitable salmon rearing habitat is in the Delta based on existing information for the Delta and other systems, and to understand the scale of restoration necessary to see a population level effect. The task will include:

1. Reviewing available data from existing restoration projects in the Delta.
2. Performing meta-analysis on existing information on habitat suitability from the literature and other sources including, but not limited to:
 - a. Ecosystem Diagnosis & Treatment (EDT) modeling done for the Bay Delta Conservation Plan Habitat Plan;
 - b. IEP Technical Report on “Effects of Tidal Wetland Restoration on Fish”;
 - c. NMFS and USBR efforts (including the winter-run lifecycle model and CVPIA Science Integration Team models) to review habitat preferences and predation on juvenile Chinook salmon within the Delta; and
 - d. Existing restoration opportunity area mapping from previous evaluations.
3. Confirming existing environmental objectives relevant to salmon rearing habitat in the Delta.
4. Using compiled information to define what salmon rearing habitat is in the Delta;
5. Developing an estimate of habitat need based on the expectation of fish size classes and numbers expected to arrive from upstream using available life cycle models for winter and fall run chinook salmon.
6. Hosting a workshop with the Advisory Panel to review and discuss items #1-5 above.

Habitat features considered may include riverine and tidal velocity, water depth, submerged and emergent vegetation, proximity to a main channel and water export facilities, residence time, potential turbulence and vulnerability to predation (e.g., at a levee breach), salinity, and water temperature.

Ecological potential visioning based on the concepts in the Delta Renewed publication will be used to assess existing habitat (e.g., patch sizes, proximity to islands and channels, habitat type and function) and proximity among habitat parcels. These efforts may support refinement of primary constituent element definitions useful in future ESA consultations.

Expectations of fish size classes and numbers arriving will be generated from existing models and objectives developed from the watershed.

Deliverable: Synthesis of what is currently known about salmon rearing habitat in the Delta, recommendations on how salmon rearing habitat should be defined in the Delta, maps of areas meeting criteria for rearing habitat, the scale of restoration needed, and key gaps in knowledge.

Timeline: Task to be complete within 3 months of contract execution.

Cost: Est. \$ 88,000

Task 2. Identify Habitat Selection Criteria and Map Potential Habitat Areas

Information on habitat suitability compiled as part of Task 1 will be used to develop an initial, science-based habitat suitability index to rank potential habitat areas and assist in identifying where protection and restoration strategies could be pursued. A GIS-based or other BPJ best available science evaluation (with transparency) habitat assessment will be conducted to identify priority areas where current conditions suggest habitat for a given target species and life stage is suitable, and where habitat restoration could serve to increase the quantity and/or quality of habitat. The initial habitat suitability work will be done in consultation with the Advisory Panel with the intent of facilitating broader discussion and feedback through the science workshop described in Task 3 below.

Deliverable: Preliminary habitat opportunity mapping.

Timeline: Task to be completed within 4 months of contract execution.

Cost: Est. \$ 42,000

Task 3. Organize Science Workshop and Identify Priority Restoration Areas

After preliminary criteria have been developed (Task 2), the project team will host a scientific workshop to review and refine the habitat criteria and resulting habitat mapping to be used both in restoration site selection but also as design criteria for restoration planning. After the habitat criteria and mapping have been discussed, the team will engage in a planning exercise to prioritize restoration which would include reviewing land owner information (public vs private), levee planning, proximity to other sites, and other criteria to help prioritize projects for implementation. The selection and evaluation process will be performed for a number of potential restoration project sites to identify a list of high-priority projects that are compatible and complementary, and together, meet the goals and objectives of Delta habitat restoration to benefit target fish species and life stages. CVPIA decision support models will be used to test the potential affects of habitat restoration in the Delta.

Deliverable: Final selection criteria and priority areas for aquatic restoration for salmonids in the Delta.

Timeline: Task to be completed within 6 months of contract execution.

Cost: Est. \$ 27,000

Task 4. Prepare Technical Report

Prepare a draft and final technical report documenting the process used and outcomes of the project, including maps showing priority restoration locations for aquatic habitat designed to benefit juvenile salmonids. The target audience for the report will be future Prop 1 applicants and others seeking to restore aquatic habitat in the Delta. The contractor will provide a two-week comment period for participants and will incorporate edits based on comments to prepare a final report.

Deliverable: Draft and final technical reports

Timeline: Task to be completed within 9 months of contract execution.

Cost: Est. \$ 44,000

Task 5. Project Management and Travel

Oversee and manage project team and activity, including progress reports and invoices, budgets and planning, communication and coordination.

Deliverable: Progress reports and CAMT and Delta Conservancy update presentations. A final presentation will also be provided to the Delta Stewardship Council.

Timeline: Ongoing.

Cost: Est. \$ 34,000

Total Project Budget: \$ 235,000

Cost Sharing Summary

Cost sharing would be provided by CAMT member agencies including National Marine Fisheries Service, Delta Science Program, Department of Water Resources and State Water Contractors and Northern California Water Agency (NCWA). CAMT would also arrange for additional expertise in salmonid biology through in-kind contributions of agency staff. CAMT funding would be directed toward the Advisory Panel (including an agricultural and county representative) and assistance with facilitation and management of the team and project workshops. The table below shows proposed cost sharing by task.

Task	Conservancy Funds	CAMT Funds	In-Kind Contribution
1. Meta-analysis of Existing Information Regarding Salmon Rearing Habitat in the Delta	\$ 4,000	\$ 84,000	40 hours
2. Identify Habitat Selection Criteria and Map Potential Habitat Areas	\$ 36,000	\$ 6,000	20 hours
3. Organize Science Workshop and Identify Priority Restoration Areas	\$ 3,000	\$ 24,000	20 hours
4. Prepare Technical Report	\$ 29,000	\$ 15,000	10 hours
5. Project Management and Travel	\$ 21,000	\$ 13,000	
Total	\$ 93,000	\$ 142,000	90 hours

3. PROJECT TEAM

The project team will be led by SFEI and supported by an Advisory Panel. Key project personnel and their experience are briefly described below.

3.1 SFEI Staff

The project team will be led by **Letitia Grenier** at SFEI. Dr. Grenier will be supported by Robin Grossinger, Sam Safran, April Robinson, Micha Salomon and Ruth Askevold.

Letitia Grenier, Senior Scientist and Program Director. Dr. Grenier co-directs SFEI's Resilient Landscapes Program. Letitia holds a PhD in Conservation Biology from the University of California at Berkeley and has previously worked on investigating bioaccumulation of contaminants in estuarine food webs, the condition of California's wetlands, and other ecological questions about the Bay and Delta. Her focus now is to work with partners to conserve California's living resources by developing landscape-scale, collaborative, science based visions and solutions.

Robin Grossinger, Senior Scientist and Program Director. For over twenty years, Robin Grossinger has analyzed how California landscapes have changed since European contact, using these data to guide landscape-scale restoration strategies. Robin leads efforts throughout the state to reintegrate natural processes within our highly modified landscapes, creating healthier and more adaptive neighborhoods, cities, and surrounding landscapes. He has advised restoration strategies for San Francisco Bay, the Sacramento-San Joaquin Delta, urban landscapes such as the Google campus, and rivers throughout California.

Sam Safran- Associate Environmental Scientist. Sam Safran's work focuses on understanding how ecosystems functioned in the past and how best to use this knowledge to inform present-day landscape-scale restoration and management. At SFEI he has helped lead the development strategies and guide-lines for process-based restoration in the Delta (published in "A Delta Renewed") and developed GIS-based landscape metrics to assess the provision of Delta ecosystem functions (published in "A Delta Transformed"). He is also skilled at cartography and other forms of data visualization.

April Robinson, Environmental Scientist. April Robinson has a background in wetland ecology and more than ten years' experience monitoring and studying the wetlands of the San Francisco Estuary and its watershed. Her work with SFEI includes co-authoring the Delta Landscapes reports. April has a Master's Degree in Ecology and Conservation Biology from San Francisco State University.

Micha Salomon, GIS specialist. Micha Salmon has over a decade of experience using geographic information systems (GIS) for environmental research. Micha's expertise includes cartography, mapping historical and contemporary wetlands, development and testing of GIS and mapping and analysis methodologies, and the acquisition, QAQC, publication and stewardship of geodata. He has extensive knowledge of the historical and contemporary geography of the Bay Area and California.

Ruth Askevold, Program Manager and Senior Designer. Ruth Askevold is responsible for designing SFEI publications and educational and outreach materials. She is experienced in using historical maps and photo-graphs to assist in visualizing the past. She has over twenty years of experience in geographic information systems, design, and cartography. Her experience includes project management, spatial analysis, and information design. She received her master's degree from San Francisco State University in Geography and Human Environmental Studies, where she specialized in geographic information systems and historical geography and studied design and visualization at the City College of San Francisco.

3.2 Advisory Panel

The project will be supported by a standing Advisory Panel consisting of experts in salmonid biology, restoration, and agriculture. The Advisory Panel will consist of the experts listed below, as well as one representative from the Counties and one representative from the agricultural community (to be self-identified):

1. Dr. Rene Henery – California Science Director, Trout Unlimited (TU) - Dr. Henery is an Ecologist and Ecogeographer who holds a joint position as the California Science Director for Trout Unlimited (TU), and Assistant Research Professor at the University of Nevada, Reno (UNR). Rene completed his B.A. at Reed College in Portland Oregon and his PhD at the University of California, Davis. His dissertation investigated opportunities to recover Pacific salmon through the restoration of connectivity, with an emphasis on Central Valley Chinook salmon and floodplain restoration.
2. Dr. John Ferguson – Principal Fisheries Biologist, Anchor QEA - Dr. Ferguson has 40 years of experience evaluating the behavior and survival of salmon in large river systems and applying this information to water management decisions. He is recognized internationally as a fish passage expert and has authored or coauthored more than 45 peer-reviewed publications, Technical Memoranda, and contract reports. From 2003 to 2011, Dr. Ferguson directed the Fish Ecology Division of the National Oceanic and Atmospheric Administration's (NOAA's) Northwest Fisheries Science Center and oversaw Riverine Survival, Migration Behavior, Estuary and Ocean Ecology, Fish Passage Engineering, and Watershed programs.
3. Dr. Chuck Hanson – Hanson Environmental - Dr. Hanson has more than 30 years of experience in freshwater, estuarine, and marine biological studies. Dr. Hanson has contributed to the study design, analysis, and interpretation of fisheries, stream habitat, and stream flow (hydraulic) data used to develop habitat restoration strategies, Habitat Conservation Plans, Endangered Species Act consultations, and environmental analyses. He has directed numerous investigations and environmental impact analyses for projects sited in freshwater, estuarine, and marine environments of the San Francisco Bay/Delta, the central and northern California Coast, Puget Sound, Hudson River, and Chesapeake Bay. Dr. Hanson served as a member of the USFWS Native Delta Fish Recovery Team, numerous technical advisory committees, and as science advisor to settlement negotiations. Dr. Hanson has also participated in the development of adaptive management programs including real-time monitoring, management of power plant cooling water and other diversion operations, and the San Joaquin River Vernalis Adaptive Management Plan (VAMP).

4. Alison Collins – Senior Resource Specialist, Metropolitan Water District (MWD) - For the past 10 years, she has worked in academia, as a private consultant, and with the federal National Marine Fisheries Service focusing her research on salmon, steelhead, and trout ecology along the west coast. Alison received her B.S. in Marine Biology from U.C. Santa Cruz and her M.S. from the University of British Columbia. Her research covers a range of topics, including isotope analysis to determine the contribution of marine subsidies to steelhead diet, acoustic tagging of salmonids to track migration, distribution, and mortality, population assessments of native fishes and aquatic communities to evaluate potential impacts of hydropower facilities on freshwater ecosystems, and the synthesis and evaluation of long term time-series status and trends of fish habitat across the California Current Ecosystem.
5. Merri Martz – Senior Scientist, Anchor QEA - Merri Martz has 25 years of biology, habitat restoration design, and project management experience, including expertise in wetland ecology; restoration planning and design for wetlands, floodplains, riparian zones, rivers, estuaries, and marine nearshore habitats; fish passage; and construction oversight of habitat restoration features. She has worked in major river systems and estuaries throughout the United States, including the Columbia, Willamette, Chehalis, Sacramento, Colorado, Platte, Missouri, and Mississippi rivers; the Rio Grande; Puget Sound; Neuse/Pamlico Sound; and Chesapeake Bay.
6. Brett Harvey – Senior Environmental Scientist, California Department of Water Resources (DWR) Division of Environmental Services - Brett Harvey develops and leads experimental studies and serves on interagency science synthesis teams supporting water and fisheries resource management decisions. He received his PhD in Ecology from UC Davis studying nutrient dynamics in coastal salmon-bearing streams, and before that worked at Center for Ecosystem Management and Restoration developing comprehensive reports on historical salmonid distributions in San Francisco Estuary streams. His current interests focus on developing research approaches to inform integration of juvenile salmon growth, survival and life history diversity response metrics into management decision frameworks. His service activities include the Salmon Scoping Team of the Collaborative Adaptive Management Team (2013-present), CVPIA Science Integration Team (2016-present), Salmon and Sturgeon Assessment of Indicators by Life Stage (2015-present), Integrated Modeling Steering Committee (2017-present), and Structured Decision Making for Scientific Management in the Bay-Delta (2017-present).

Collaborative Science and Adaptive Management Program

Policy Group

Thad Bettner	Glenn-Colusa Irrigation District
Tom Birmingham.....	San Luis Delta Mendota Water Authority
Gary Bobker	The Bay Institute
Charlton “Chuck” Bonham.....	CA Department of Fish and Wildlife
Curtis Creel	Kern County Water Agency
Jeff Kightlinger.....	Metropolitan Water District of Southern California
Felica Marcus.....	State Water Resources Control Board
David Murillo.....	U.S. Bureau of Reclamation
Karla Nemeth	CA Department of Water Resources
Noah Oppenheim	Pacific Coast Federation of Fishermen's Associations
Marguerite Patil	Contra Costa Water District
Bill Phillimore.....	Coalition for a Sustainable Delta
Jason Phillips	Friant Water Authority
Dick Pool.....	Water4Fish
Kate Poole.....	Natural Resources Defense Council
Paul Souza.....	U.S. Fish and Wildlife Service
Barry Thom	National Marine Fisheries Service
Jay Ziegler.....	The Nature Conservancy
Rachel Zwillinger	Defenders of Wildlife

Collaborative Adaptive Management Team (CAMT)

Kaylee Allen	U.S. Fish and Wildlife Service
Frances Brewster, Co-Chair.....	Public Water Agencies -Santa Clara Valley Water District
Steve Culberson.....	Interagency Ecological Program, Lead Scientist
Rene Henry	Trout Unlimited, representing The Nature Conservancy, Natural Resources Defense Council, The Bay Institute, and Water4Fish
Rainer Hoenicke.....	Delta Science Program
Steve Lindley.....	National Marine Fisheries Service
Sam Luoma, Co-Chair	UC Davis, representing The Nature Conservancy, Natural Resources Defense Council, The Bay Institute, and Water4Fish.
Dave Mooney	U.S. Bureau of Reclamation
Jennifer Pierre.....	Public Water Agencies - State Water Contractors
Maria Rea.....	National Marine Fisheries Service
Diane Riddle.....	State Water Resources Control Board
Deanna Sereno	Contra Costa Water District
Russel Stein.....	CA Department of Water Resources
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