MokeWISE Program Scope of Work:
Project 1a: Re-Introduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir

April 2015

Problem Statement and MokeWISE Stakeholder Interests

Many West-slope Sierra rivers have lost connectivity with the ocean due to the construction of large rim dams. As a result, upper watersheds have lost important influxes of marine derived nutrients, and salmon populations that once utilized the upper watersheds to spawn have declined with the loss of accessible habitat. On rivers where dam removal is generally not an option, trap and haul programs have shown to be effective at increasing production of salmon in river systems and at returning essential marine nutrients to upper watersheds.

The Reintroduction of Fall-Run Chinook Salmon Upstream of Pardee Reservoir Project will conduct a study to determine the feasibility of transporting adult fall-run Chinook salmon upstream of Pardee reservoir and transporting the juvenile salmon back downstream of Camanche Dam. The study will evaluate the benefits of and clarify the short and long-term operations and any mitigation required to support the proposed project. The study will also seek to identify any potential impacts and constraints of proposed actions on domestic water supply, river flows, technical, political, environmental, economic, legal, and recreational issues. The project includes data collection and analysis, capture and transport system design, as well as an alternatives analysis. Based on the alternatives analysis, a final design will be selected. Implementation of the project includes environmental documentation and permitting, stakeholder outreach and coordination, construction, and monitoring. Costs for this project are estimated to be $180,000, with $80,000 for planning and $100,000 for implementation.

Proponents of this project are interested in restoring the ecological values and sustainability of the upper Mokelumne River and its fishery. They view this project as contributing to restoration of beneficial ecological services in the watershed, strengthening the available gene pool in returning Mokelumne River salmon, and as a method to increase production of a key social, economic, cultural and ecological resource.

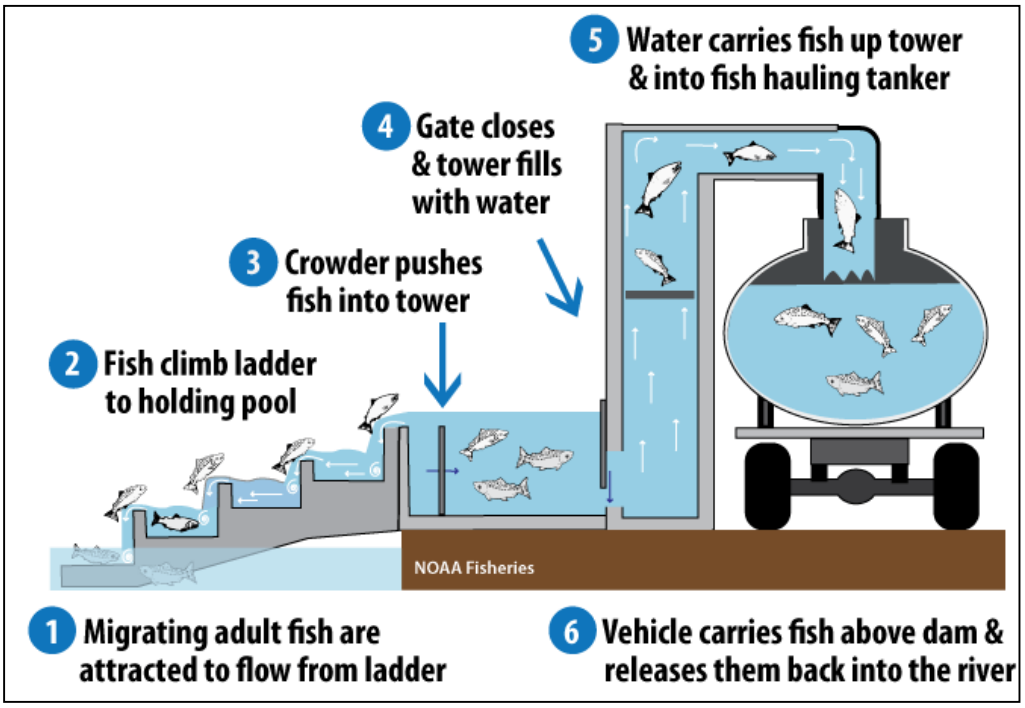
Water agencies are concerned that reintroduction of salmon into the upper Mokelumne watershed could increase their regulatory exposure. They are also concerned that such reintroduction might require changes in temperature or flow requirements that may reduce the availability of water for consumptive use, particularly in times of extended drought and climate change. Consistent with the decision to address climate change in MokeWISE programmatically, the final MokeWISE report will include a table that identifies vulnerabilities associated with this project under climate change and that identifies potential management strategies to address these vulnerabilities.

Background Information

Reference Programs

The National Oceanic and Atmospheric Administration (NOAA) has information about reintroducing and moving fish in instances where fish ladders are not present; this type of operation, referred to as a "trap and haul" operation, is the type of operation being proposed to move adult fall-run Chinook salmon upstream of Camanche Dam and Pardee Dam and move juvenile salmon back downstream of Camanche Dam. A schematic of one type of system that can be used to move adult salmon for trap and haul operations is provided in **Figure 1**.

Figure 1: Schematic of an Adult Fish Trap and Haul Set-Up



Source: NOAA 2015

Trap and haul operations have been implemented in several riverine systems in California, including the San Joaquin and Sacramento Rivers, with efforts on the San Joaquin River dating back to the 1940's (San Joaquin River Restoration Program 2013).

Information from other similar programs in California demonstrate that careful planning and analysis is required to ensure successful implementation of these types of projects. For example, one trap and haul program on the San Joaquin River found increased success with a fish elevator similar to the one shown in **Figure 1** to transport fish, because other options such

as moving fish from the river into trucks using dip nets required the fish to be removed from water for a period of time, potentially causing physical stress to the fish (San Joaquin River Restoration Program 2013). Efforts on the San Joaquin River have also shown that it is important to sustain suitable salmon habitat in areas where salmon are being introduced. As such, in addition to trapping and hauling, channel modification projects, projects to reduce impacts caused by gravel mining, flood abatement, and other efforts have been implemented to improve habitat (San Joaquin River Restoration Program 2013).

On the Blue River in Oregon, a salmon restoration project implemented by the United States Army Corps of Engineers (USACE) that involved trap and haul activities was initially unsuccessful due to the fact that trapping infrastructure was placed too close to the dam (the Cougar Dam). For this effort, the USACE found that cold water spilling over the dam was an impediment to restoration as the salmon would not swim up to traps that were located in the cold water. As a result, the USACE constructed a $55 million temperature control tower on the Cougar Dam, after which time salmon were found migrating up the river and into traps (Palmer 2010).

The United States Bureau of Reclamation (USBR) has done additional studies on trap and haul efforts for juvenile vs. adult salmon, and has found that trap and haul programs vary for fish based upon their developmental stage (USBR 2014). Thorough these efforts, USBR found that critical factors to support salmon survival include: suitable water temperatures, adequate and timely flow, and passable watercourses (USBR 2014).

Project Information

Project Description

The purpose of this project would be to conduct a pilot study to determine the feasibility of transporting adult fall-run Chinook salmon upstream of Camanche and Pardee dams and transporting the juvenile salmon back downstream of Camanche Dam. The study would evaluate the benefits of the proposed project and clarify the operations required to support it. The study would also seek to identify any potential impacts and constraints on the following:

- Domestic water supply
- River flows
- Considerations of the following constraints:
    - Technical
    - Political
    - Environmental

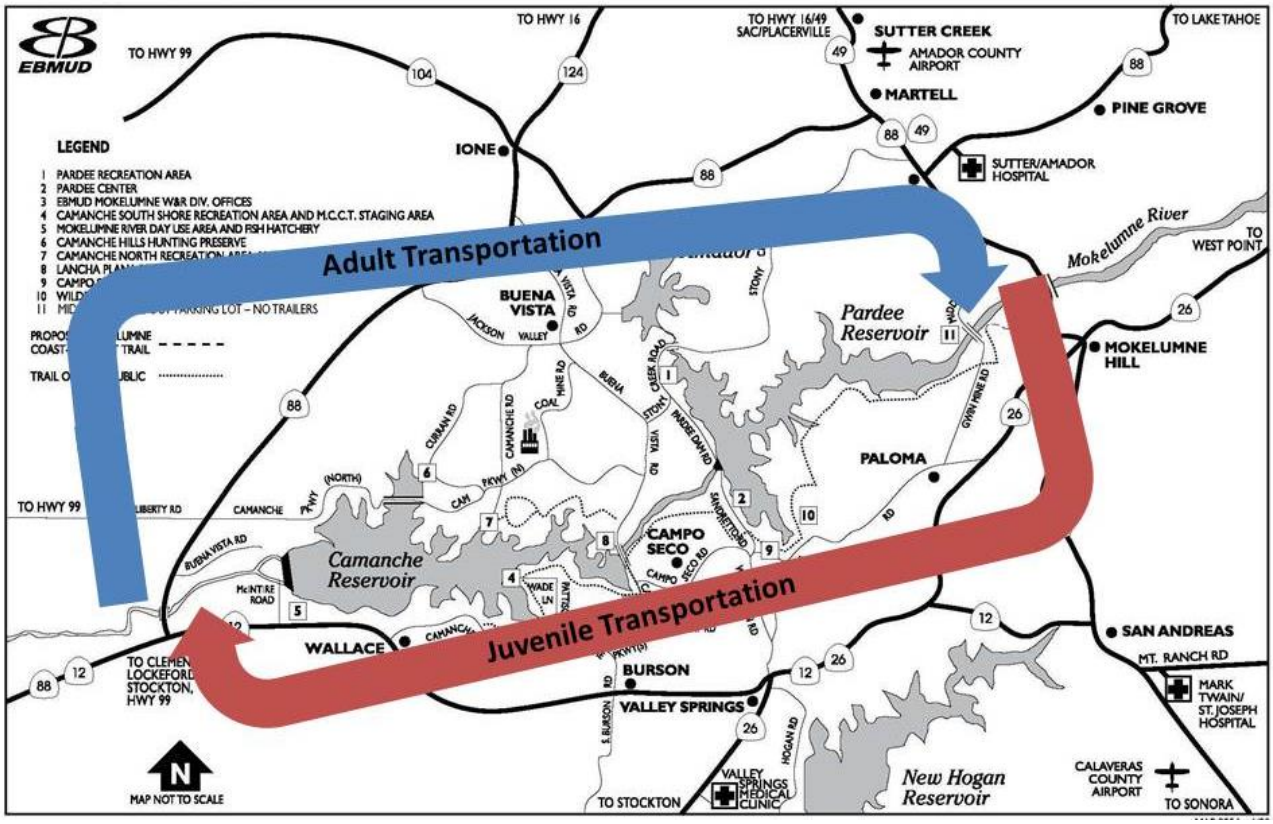
- Economic
- Legal
- Recreation

Prior to implementation, the project will require environmental review under the California Environmental Quality Act (CEQA) and perhaps under the National Environmental Policy Act (NEPA), and will also need to comply with other applicable laws. The study will include coordination with any interested parties. Expected results of expanding current fall-run Chinook salmon habitat include improved resilience of the Mokelumne River population to climate change, enhanced upper watershed ecosystems, and expanded recreational opportunities.

Project Location

The project concept would generally be located immediately upstream of Pardee Dam and immediately downstream of Camanche Dam. Fish and/or eggs would be transported past the approximately 20-mile stretch between the lower part of the Camanche Reservoir and above Pardee Dam, within the upper Mokelumne River. **Figure 2** shows the general area within which the project would be located.

Figure 2: Project Location Map



Project Sponsor

Foothill Conservancy would serve as the lead. The California Sportfishing Protection Alliance (CSPA) would be a co-sponsor.

Scope of Work

Task 1. Data Collection and Analysis

The first step in this project is to conduct data collection and analysis to understand existing conditions that will affect the final re-introduction program. As noted previously, other trap and haul programs in the western United States have found that understanding existing habitat and physical conditions of applicable water bodies is critical to maintaining salmon survival and ultimately to program success.

Subtask 1.1 Determine Habitat Suitability

The project will conduct a habitat suitability assessment. Habitat conditions such as temperature, flow, presence of suitable spawning gravels, cover, and water quality are important factors in successful salmon reproduction.

The purpose of this analysis will be to determine if the existing setting in the Mokelumne River under current operations provides suitable habitat for both juvenile and adult salmon. If habitat is found to be unsuitable, the analysis will include recommendations (e.g. habitat restoration) for additional projects necessary to improve habitat suitability.

Subtask 1.2 Analyze Hydrologic Conditions

Information about the actual instream flows in relevant reaches of the Mokelumne River is abundant. The Joint Settlement Agreement (JSA) specifies in-river flow requirements for the Mokelumne River downstream of Camanche Dam, and the PG&E Project 137 FERC license specifies flows between Salt Springs Dam and Electra Powerhouse. USGS gauges with long records are present below Camanche Dam and upstream of Pardee Reservoir.

The purpose of this task is to analyze hydrologic conditions (base flows and peaking flows) for the stretches of the Mokelumne River within which fish would be introduced. As such, streamflow data from applicable United States Geological Survey (USGS) gages, Pacific Gas and Electric stream ecology monitoring program sites, East Bay Municipal Utility District (EBMUD) monitoring points, and other applicable data sources will be processed to develop monthly and daily hydrographs to the extent practical. Further, streamflow data will also be analyzed for water quality data to the extent feasible.

The purpose of this analysis will be to determine if current flows and operations are conducive to salmon survival in the Mokelumne River for both juvenile and adult salmon. If flows are found to be unsuitable and potentially detrimental to salmon survival, the analysis should include recommendations to address this issue. It is possible that flow constraints could be factored into final design of the project; for instance, salmon could be trucked and hauled to various points of the Mokelumne River at specific times to coincide with suitable flow conditions.

Task 2. Design

Subtask 2.1 Design of the Transport System

The project would capture and truck both juvenile and adult salmon for distances of approximately 20 miles, from below Camanche Dam to above Pardee Reservoir. The design of the transport system should consider the type of vehicles used, routes on which vehicles

would move for transportation, back-up fail-safe plans in case vehicles break down, and operational and staffing considerations.

Subtask 2.2 Design of Redd Capping System

The project currently envisions release of up to 100 fall-run Chinook per year upstream of Pardee Reservoir. Dedicated staff will catalogue redds that the transported fish produce and select a limited number for redd-capping. These personnel may also build artificial redds adjacent to selected natural redds and seed the artificial redds with excess eggs transported from the Mokelumne River Fish Hatchery. This subtask involves logistical planning. It also involves designing the capping system that will allow staff to capture the alevins immediately post-emergence and transport them downstream to the Camanche Hatchery. Once the alevins are delivered to the hatchery, hatchery personnel would rear them separately from hatchery-produced juveniles, mark them, and ultimately release them into the lower Mokelumne River.

Subtask 2.3 Alternatives Analysis

The stakeholders participating in the project will review and comment on potential design alternatives for hauling and for the redd-capping systems.

Subtask 2.4 Final Design

The stakeholders will select final designs for the various elements necessary to implement the hauling and redd-capping program. The final design will take into consideration the various habitat parameters analyzed as part of Task 1.

Task 3. Environmental and Permitting

Environmental review will be necessary for the project. The project will definitely require CEQA review. The project will likely also require NEPA review, conditional on several factors, including need for federal permitting, any federal funding that may support that project, or project facilities on federal (likely BLM) land.

Task 4. Implementation of Pilot Study

Subtask 4.1 Stakeholder Outreach and Coordination

In order to ensure success of the project, the on-going pilot project workgroup will invite interested parties and stakeholders, including interested former members of the MCG to review and comment on the efforts of the pilot workgroup as work progresses. The workgroup will address stakeholder concerns in designing the pilot project and will review the results with stakeholders as these results become known.

Subtask 4.2 Operation

Each year, the technical team will determine the number of adult fish that can be obtained from the Mokelumne River Fish Hatchery through communication with hatchery personnel. It is possible that the technical team will track some, or all, adult fish with radio telemetry. Natural redds formed by these fish will be identified and capped to capture emerging alevins. The program has potential to construct artificial redds adjacent to natural redds and plant eggs in the substrate, contributing to the data that is generated from the project on reproduction success and limitations in the system.

Hatchery personnel will determine the number of excess eggs available for transport. The project technical team will transport available eggs from the hatchery to the man-made redds upstream of Pardee Reservoir. Once eggs are placed in the redds, the redds will be capped. The technical team will capture alevins soon after emergence and transport them back downstream to the hatchery.

After the project is designed, personnel needs will be determined. Volunteer labor may help reduce project cost. Work performed by the crew will include tracking adult salmon, identifying natural redds, building man-made redds, depositing eggs in the redds, capping the redds, monitoring capped redds for alevins, removing caps and alevins, and transporting eggs, alevins, and adult salmon. Transportation will likely be via a tanker truck with one trip upstream and one trip downstream each day, seven days a week. Distance trucked would be roughly 20 miles, from below Camanche Reservoir to above Pardee Reservoir.

Potential staff needed:

- Two person crews would be needed for any fish transport activities. Estimated at 1 trip per week for 10 weeks = 160 staff hours.
- For redd surveys, 2-3 person crews, one day per week, for 12 weeks = 288 staff hours.
- Redd capping, emergence trapping: 3 person crews daily for 3 weeks = 504 staff hours

- Juvenile transport – 2 staff needed 1 day per week for 3 weeks = 40

Subtask 4.3 Monitoring Program and Adaptive Management

A monitoring and adaptive management program is necessary to ensure that the program is implemented in a manner that allows for continual achievement of established goals and objectives. The adaptive management program will require monitoring to assess physical characteristics (temperature, habitat, flows, etc.) and also to assess salmon success and mortality rates for both adults and juveniles. Additionally, adaptive management will need to assess potential or actual impacts on domestic water supply resulting from implementation of the pilot study. If program participants decide to consider a longer-term program, they will first assess potential political, economic, legal, and recreational impacts. The adaptive management program, with agreement by the stakeholder group, will set performance measures and will also set thresholds that indicate when adaptive management actions should be taken. The plan should define specific actions to be taken in the event that thresholds are not being met. The stakeholder group should maintain flexibility to modify this plan as necessary to meet established goals and objectives throughout program implementation.

Budget

The total cost of this project is anticipated to be $180,000. Costs associated with the project are broken down as follows:

- Planning Costs: $80,000
  - $10,000 for project definition
  - $50,000 for project evaluation
  - $20,000 for consultation
- Operations Costs: $100,000
  - Fish transporting activities at one staff person once a week for 10 weeks
  - Redd surveys at 2-3 staff persons once a week for 12 weeks
  - Redd-capping and emergence trapping activities at 3 staff persons daily for 3 weeks
  - Juvenile transport activities at 2 staff persons once a week for 3 weeks
- **Total Project Costs: $180,000**

References

National Oceanic and Atmospheric Administration (NOAA). 2015. About Dams & Fish – Trap and Haul. Available at:

http://www.westcoast.fisheries.noaa.gov/fish_passage/about_dams_and_fish/trap_and_haul.html

Palmer, Susan. 2010. "Helping Fish Find Their Way – New System Helps Move Salmon Past Cougar Dam." *The Register-Guard.* Available at: http://special.registerguard.com/csp/cms/sites/web/news/cityregion/25199471-41/fish-salmon-dam-river-chinook.csp

San Joaquin River Restoration Program. 2013. Final 2014 Monitoring and Analysis Plan – Study 6, Trap and Haul of Adult Fall Run Chinook. Available at: http://restoresjr.net/flows/MAP/2014_MAP/6-ZJ_StudyWorkplan-Trap&HaulMap8513.pdf

United States Bureau of Reclamation (USBR). 2014. Final Environmental Assessment for the 2014 San Joaquin River Restoration Program Juvenile Fall-Run Chinook salmon Trap and Haul Study. Available at: http://www.usbr.gov/mp/nepa/documentShow.cfm?Doc_ID=16547