Study 32

Salmon Simulator (SalSim) for the SJRRP

Public Draft
2014 Monitoring and Analysis Plan

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San Joaquin River Restoration Program
2014 Monitoring and Analysis Plan
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1. Statement of Need:

The management of flow, water temperatures, hatchery fish releases, and fish losses at diversions and false pathways are critical issues for the San Joaquin River Restoration Program. For example, flow management will have to balance limited water supplies between the needs of juvenile and adult salmon as well as spring-run salmon and fall-run salmon. The survival of hatchery reared fish released in the Restoration Area and their impact on naturally produced juvenile salmon will depend on many factors, including the location and timing of the release and the number released. The importance of losses of salmon at diversions and false pathways (e.g., Mud and Salt sloughs) will depend on the percentage lost from the entire population. It would be best to address these issues with a salmon population model.

2. Background:

The California Department of Fish and Wildlife has developed a full life-cycle salmon population model, called SalSim (Version 2), for the San Joaquin River Basin that estimates fall-run Chinook salmon escapements relative to flow management, water temperatures, hatchery management, irrigation diversions, Head of Old River Barrier (HORB) operations, Delta exports and ocean sport and commercial harvest effort, along with other environmental factors. Instream flows, irrigation diversions, HORB operations, Delta exports and Merced River Hatchery operations are user-modifiable variables. SalSim is comprised of three sub-models that include a water operations model, a water temperature model, and a salmon production model. For the Restoration Area, the model would simulate flows between Friant Dam and the confluence with the Merced River, water temperatures throughout the Restoration Area based on the San Joaquin Basin HEC-5Q calibration results for data from 1980 to 2010, and simulate salmon abundance from the egg throughout their entire life cycle to adults returning inland to spawn two to four years later. The salmon production sub-model was calibrated based on rotary screw trap data from the Stanislaus and Tuolumne rivers, survival rates of coded-wire-tag hatchery fish in the Delta and Bay, with an emphasis on escapements to the Stanislaus, Tuolumne, and Merced rivers. SalSim can use external data generated by other operational models such as CALSIM II, Riverware, and the HEC-5Q water temperature model. It has a Graphical User Interface (GUI) that allows any user to (1) run alternative flow scenarios for the Restoration Area as well as the Stanislaus, Tuolumne, and Merced rivers; (2) evaluate different export rates at the CVP and SWP Delta pumping facilities; (3) evaluate different diversion rates at the dams; (4) installation of the Head of the Old River Barrier; and (5) releases of fall-run juveniles from the Merced River Hatchery at different locations and timing.

SalSim, which was released to the public on June 11, 2013, does not currently have a functional salmon production sub-model for the SJRRP Restoration Area. The model includes the San Joaquin River from Friant Dam to the Merced River confluence and divides this portion into seven sub-reaches the same as the Stanislaus, Tuolumne and Merced rivers, with the upper four reaches containing suitable spawning habitat. This layout will need to be reconciled with the location of available spawning habitat in the

Restoration Area. SalSim currently does not allow changes to fisheries growth, survival, timing, movement or spawning distributions, which would be added as a result of the proposed work.

3. Anticipated Outcomes:

SalSim would be modified to develop a salmon production model with modifiable salmon production parameters for the Restoration Area. SalSim would inform flow scheduling, and could be used to evaluate reintroduction scenarios and some restoration or population management actions. A particular advantage of the rapid response (2-4 minutes per simulation) of SalSim is that the Flow Scheduling Subgroup could use it to evaluate the effects of flow changes on the salmon populations in real-time. SalSim could be used to evaluate restoration actions (e.g., revegetation and channel narrowing) to reduce stream temperatures (using input from external HEC-5Q model results), hatchery release strategiespercent passage at Hills Ferry Barrier, and potential interactions (i.e., competition for suitable habitat and food) between spring-run and fall-run salmon fry on relative escapements of spring-run and fall-run salmon in the Restoration Area. With the proposed updates to the salmon production model, input data on salmon biology, such as adult migration timing, spawning distribution, juvenile migration timing, and loss rates at unscreened channels, could be modified in the future as empirical data are obtained from field studies in the Restoration Area.

SalSim offers the long-term advantage that it can be readily adapted to future SJRRP needs and conditions, because it is under the control of the California Department of Fish and Wildlife.

4. Methods:

There are seven primary tasks for the model development team:

1. Add a SJR Conservation Facility module similar to the Merced River fish hatchery one including timing and location of releases of fall-run and spring-run salmon.

2. Develop the means for the user to revise juvenile survival, growth, and movement parameters to reflect conditions in the Restoration Area (Inland Module).

3. Develop the means for the user to revise input data relative to salmon biology (e.g., adult salmon migration timing and spawning distribution).

4. Develop the means to track “research model” version results. For example, if the user changed flow operations or salmon survival parameters, the results would indicate those changes so that model runs could be replicated.

5. Add model components reflecting Restoration Area operations.

    a. Install adult migration barriers at Hills Ferry to allow modeling of percent passage

    b. Provide flow diversions at Mendota Pool (Pre-2B Project) and Arroyo Canal

    c. Include flow routing and associated water temperature response through the Chowchilla and Eastside bypasses and Reach 4B alternatives

6. Update the Delta module to relate survival to Vernalis Flow, HORB, and Export.
7. Develop the means to concurrently model spring-run and fall-run salmon and their interactions (e.g., juvenile density dependence and adult redd superimposition).
8. Develop a Restoration Area specific user's manual for adjustments to the survival, growth, movement, timing and spawning distribution parameters as well as the model flow and temperature input.
9. Add the ability to upload daily flow schedules into reservoir operations module using CSV or similar format

5. Schedule

This project would require approximately six months to complete. The current CDFW contract with the model development team expired June 30, 2013. In order to efficiently modify and enhance SalSim with these modifications, additional funding should be swiftly procured to enable this work to promptly begin and be completed before the end of 2014.

6. Budget

Total estimated budget is $113,500.

7. Deliverables: User-manual and operational SalSim model

8. Point of Contact/ Agency: PI: Erica Meyers, CDFW; Carl Mesick, USFWS

9. References

California Department of Fish and Wildlife. 2013. Salmon Simulator as implemented for the San Joaquin River System, User's Manual. June 2013, Fresno California. Available: http://www.salsim.com/