

NMFS – Reclamation  
Shasta RPA Draft Proposed Amendment Workshop #1  
Science/Modeling Workplans Stakeholders Meeting  
March 24, 2017

Introductions

1. Todd Manley (NCWA)	17. Jeff Rieker (Reclamation)	33. Carl Wilcox (CDFW)
2. Craig Addley (Cardno Inc.)	18. Garwin Yip (NMFS)	34. Jeff Sutton (TCCA)
3. Steven Handy (Redding Electric Utility)	19. Christina Durham (NMFS)	35. Max Zakato
4. Liz Kiteck (Reclamation)	20. Pablo Arroyave (Reclamation)	36. Jason Peltier (San Luis & Delta- Mendota Water Authority)
5. Thuy Washburn (Reclamation)	21. Michelle Banonis (Reclamation)	37. John Rubin
6. Tom Boardman (San Luis & Delta- Mendota Water Authority)	22. Francis Brewster (Santa Clara Valley Water District)	38. Margarite petiel (CCWD)
7. Randi Field (Reclamation)	23. Sheila Greene (Westlands Water District)	39. Andrew Fecko (PCWA)
8. Don Bader (Reclamation)	24. Josh Israel (Reclamation)	40. Bruce McLaughlin
9. Chuck Hanson (Hanson Environmental Inc.)	25. Ron Milligan (Reclamation)	41. James Takahara
10. Dave Moooney (Reclamation)	26. Danielson (WAPA)	42. Ansel Weber (?) SMUD
11. Luis Bair (RD 108)	27. Mike Krowalski (WAPA)	43. Doug Obegi (NRDC)
12. Thad Bettner (GCID)	28. Travis Yonts (Reclamation)	44. Lee Burteau
13. Brycen Swart (NOAA Fisheries)	29. Eric Danner (NMFS- SWFSC)	45. John McClain
14. Jim Piper (City of Sacramento Department of Utilities)	30. Miles Daniels (NMFS-SWFSC)	46. Mike Deas (Watercourse Engineering Inc.)
15. Federico Barajas (Reclamation)	31. Mike Ford (DWR)	
16. Shelly Stratimore	32. Jason Roberts (CDFW)	

1. Overview of meeting purpose (TPs)
2. Presentation--Reclamation Draft Workplan for Shasta and Trinity Division Seasonal Operational Water Temperature Modeling (Jeff Rieker)

- Technical work group will convene in a month or so
- Future: Need to consider:
  - Transition from current to future model application
  - Ongoing revisions once completed

### 3. Presentation--NMFS Southwest Fisheries Science Center Science/Modeling Efforts and Workplans (Eric Danner)

- RAFT output Sacramento River modeling of temperature over space and time is based on Reclamation's input data. The SWFSC is not ready to utilize their reservoir model as input to RAFT/CVTEMP
- Future:
  - How do we best use these physical models moving forward?
  - What studies are needed?

#### Questions for Eric:

- Shelia: Are we working on a bioenergetics model? Eric's presentation made it sound like that was in process, but that has not been reviewed. Are we working on this model?
  - **GETBACK.** Garwin/Josh—We are assessing predation to be able to work toward building a model in the future. Also working on an individual based model.

Yes, see pages 4-5 of enclosure 4 in NMFS June 19, 2017 letter to Reclamation on the Shasta RPA proposed amendment<sup>1</sup> for more detail on the adaptation of InSALMO, an individual based model of freshwater life stages of salmon, to the Sacramento River for winter-run Chinook salmon and the need for continued research to understand juvenile winter-run Chinook salmon drift feeding, growth, and survival in order to develop a bioenergetics model.

- Frances: On reservoir modeling slides with profiles, it looked like there was a big change between observations and predictions where the reservoir appeared to warm up significantly—why such a big jump? What are we doing to resolve that?
  - Miles: It was a model spinup effect—we think it is a spurious artifact. We put this graph together quickly. We need to work out in the code so that you don't have the huge gradient. **UPDATE**-- this artifact has since been corrected.
- Sheila: With RAFT predictions of temp-dependent egg mortality—do you go back and validate predictions vs. observed? How well does it validate? I thought NMFS had overseen a program to measure temperature in the redds within the last few years. At least the temperature from the model could be validated with those data.

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<sup>1</sup>[http://www.westcoast.fisheries.noaa.gov/publications/Central\\_Valley/Water%20Operations/nmfs\\_s\\_draft\\_proposed\\_2017\\_rpa\\_amendment\\_-\\_january\\_19\\_2017.pdf](http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/nmfs_s_draft_proposed_2017_rpa_amendment_-_january_19_2017.pdf)

- **GETBACK.** Miles: Speaking as an end user, Eric has graphs of temperature-dependent mortality model results vs. actual at RBDD. However it is difficult to validate the model, especially with field measurements.

The NMFS-SWFSC temperature-dependent mortality model is based on and validated by the Red Bluff Diversion Dam (RBDD) rotary screw trap egg to fry survival data with the assumption that most of the temperature dependent mortality is in the egg stage. There is no field measurement data of winter-run Chinook salmon egg mortality per se. It is extremely difficult to validate actual egg survival in the field, especially with an ESA listed species. Page 6, table 3 of enclosure 3 in NMFS June 19, 2017 letter to Reclamation includes the modeled temperature dependent mortality, modeled total egg to fry survival, and actual egg to fry survival for 1996 to 2016, as a comparison of predicted vs. observed survivals. Predicted vs. observed survival and temperature dependent mortality are also on page 4, figure 2 of Martin et al. (2017).

CDFW has been monitoring water temperature in the upper Sacramento River 2014 to 2016. Water temperature and dissolved oxygen probes were placed in the gravel adjacent to winter-run and fall-run redds. The water quality monitoring reports can be found at:

<http://www.calfish.org/ProgramsData/ConservationandManagement/CDFWUpperSacRiverBasinSalmonidMonitoring.aspx>

- Jeff Sutton: Comment from CSAMP presentation--modeling doesn't take into account the improvements to the system, for example, TCD installation and retirement of RBDD gates, if data shut off at 2011. That is a concern regarding model inputs. How are these assumed operational improvements being incorporated?
  - **GETBACK.**

The SRWQM and RAFT model does take into account TCD gate changes. While retirement of RBDD gates make affect juvenile survival downstream of the RBDD, it does not affect upper Sacramento River temperatures where winter-run redds occur and therefore has an insignificant effect on temperature-dependent mortality rates.

- Lewis Bair: Jump from temperature to survival at RBDD has a lot of other stressors that add additional uncertainty (disease, etc) in addition to temperature. We should spend time talking about red bluff and NMFS change from observed temperature over the eggs to survival percentages. This is a big change and everyone should understand the differential.
  - **REQUEST** that we consider the distance and stressors between temperature down to survival at RBDD

Flow conditions, water temperature, loss of natural morphologic function, spawning habitat availability, loss of riparian habitat and instream cover, and predation are all identified as very high threats to the winter-run Chinook salmon population in the Upper Sacramento River (NMFS 2014). In addition to elevated water temperatures, a combination of factors, some of which are temperature-related, likely contribute to reduced survival including: 1) unfertilized eggs; 2) redd superimposition; 3) gravel movement; 4) low dissolved oxygen; 5) pollution and/or

sedimentation; 6) disease; 7) predation; 8) poor habitat conditions; and 9) lack of adequate food or space. NMFS supports future actions to reduce the threat of these stressors and they are included in our recovery plan (NMFS 2014).

- ????: In predation/tethering study from last slide-- would this device give any sort of population abundances/predator density abundances or would it just identify species? Is this project currently funded? If it is not funded, is it just a science fair project or a tool in development for use?
  - **GETBACK**

Specifically this study would be implemented to quantify relative predation, identify predators, and determine environmental conditions (e.g. water velocity, depth, temperature, chemistry, habitat types, etc.) and locations that influence salmon smolt predation. The NMFS-SWFSC has been conducting these predation event recorder studies on the lower Sacramento River and lower San Joaquin River since 2014. Their methods and results have been presented at science conferences and have been published in peer-reviewed scientific journals (e.g., Demetras et al. 2016, Smith et al. 2016, etc.). Currently there is no funding for this proposed project in the upper Sacramento River.

The Sacramento Valley Recovery Program is funding additional predation studies in the upper Sacramento River, including projects that quantify rainbow trout abundance and predation rates and ones that facilitate predator identification as well as identification of predation hot spots.

#### 4. Discussion--Reclamation science planning concepts (Michelle/Josh)

- Gaps in science?
  - Lots of things we're talking about go beyond the shelf life of the RPA adjustment, and is more appropriate for the ROC on LTO effort.
  - Should look holistically across the whole system and species
- Science workplan should be general, but focus and prioritize Shasta and the Sac.
  - Collaborative planning
  - Structured decision-making
  - Expertise shared across the agencies
  - Open data
  - External review

#### 5. Open questions and comments:

- Thad: Interest in forming technical committee, participation will be important to create a trusted tool. On biological workplan, will there be another technical committee or will discussions go through CSAMP? There are a lot of different forums on science, we should try to consolidate into the best forum.
  - Michelle: CSAMP is a good forum, but it depends on our objectives. CSAMP allows for vetting of certain topics, but might not make for a good technical forum. We will have to think about what works best. There is limited capacity in CSAMP and we need to be mindful of how much to tack on. We need to think strategically about the best way to do this.

- ???: Anyone else doing science besides Eric? To develop robust approaches needs variety. Is there funding for others to examine issues related to winter run?
  - Josh—the modeling plan you heard about addresses many of the issues the science center has been working on. NCWA salmon recovery program call today to discuss other stressors in the system—predation, disease, pathogens, improved temp modeling---that has been a stakeholder-led effort that has been a good collaboration that has helped prioritize different topics.

Yes, there are numerous other partners, collaborators, and funders doing research, monitoring, and restoration related to Sacramento River winter-run Chinook salmon including the Bureau of Reclamation, USFWS, DWR, DFW, the Northern California Water Agencies, Sacramento River Settlement Contractors, Anderson-Colusa Irrigation District, Glen Colusa Irrigation District, Reclamation District 108, Sutter Municipal Water Company, River Garden Farms, Cal Marsh and Farm, CalTrout, Golden Gate Salmon Association, and CSU Chico.

- Todd-the idea is to develop near term actions and projects that can be completed to move the needle on species.
- Question really on fundamental science---issues with egg and juvenile survivorship. If you don't understand what is happening you cannot fix it. What Eric has been doing with egg mortality model needs validation from field data. You would want to tag fish and track mortality. Maybe some of that is happening, but it seems important to make progress.

Yes, the NMFS-SWFSC temperature-dependent mortality model does include validation from data. Since 2013 the NMFS-SWFSC has been tagging juvenile hatchery winter-run Chinook salmon with acoustic telemetry transmitters in order to understand movement patterns and emigration survival.

- ???: In looking to prioritize projects, sometimes we don't get a measure of our investment return. Many times we focus on investment dollars and not what information we have gained from the effort.
  - Pablo--Reclamation agrees that the basis of our funding has to be focused on most urgent need to fill the gaps that will help us continue to operate the projects. We've been getting a lot of drought funding, but that's going away, so we need to identify the most urgent priorities for funding
- Sheila: There are other egg mortality and life cycle models used in the previous BO--- will there be an effort to compare and contrast the more recent NMFS models to the existing models for the purpose of comparing and contrasting them to explain why there are differences? The other models are the Interactive Object-oriented Simulation (IOS) model, the OBAN winter run model, the USBR egg mortality model and the Cramer Fish Sciences egg mortality models. There is also a population model named SalMod. And there is an egg mortality model used on the American River.
  - **GETBACK.** Josh: We'll use a set of tools, not just a single tool
  - Eric: Mid-April – will host a technical workshop to get into the weeds of the temperature-dependent mortality model and CVTEMP website.

NMFS-SWFSC developed the temperature-dependent mortality model (Martin Model) because the observed survival rates in the field were significantly lower than what was predicted in the existing models. The existing models used in the 2008 CVP/SWP long-term water operations biological assessment, such as IOS and OBAN, are based on laboratory studies in controlled environments. The Martin model is based on field data in the Sacramento River, delivering much more accurate results. In addition, a 2011 Independent Science Panel concluded that none of the existing models used in 2008 biological assessment were sufficiently well suited to examining the water management and RPA questions to justify their selection as the model to use (Rose et al. 2011). The panel recommended that NMFS develop their own life cycle model.

- Doug: Will we apply the egg mortality model to other rivers and species?
  - Eric: Looking at this on Clear Creek. Ben Martin coordinating with USFWS and we are open to expansions. You need the right level of data to apply. Most other runs aren't subject to the same constraints as winter run. A bit different incubation in that winter-run are challenged by warmer water temperatures at the back end of incubation, vs. spring-run that are challenged by warmer water temperatures at the front end of incubation. WR model is parametrized with increasing temperatures at end of egg development. A spring run model would need the reverse construct, but we think the fundamental biology and physics would be the same.
- Doug: Would encourage you to think about scaling up to include non-listed fall run as well as part of a larger CVPIA context.
  - Eric: concern that these are hatchery fish as opposed to wild fish.

6. Other comments mentioned for the next workshop:

- Will there be modeling greenhouse gases and how it would affect everything?

The 2008 CVP/SWP long-term water operations biological assessment included climate change model predictions for future CVP/SWP water operations. Specifically, four regional climate change scenarios were defined to represent a range of possibilities from available climate projection information out to 2030 that vary from less warming to more warming from historical; and, drier to wetter than historical. In addition, based on contemporary projections of sea level rise by 2030, a 1-foot sea level rise coupled with a 10% increase in tidal range assumption was defined for joint consideration with the four regional climate changes. The consultation reinitiation beginning in 2017 will continue to use the most up to date climate change prediction models.

- Will there be an economics impacts analysis?

In 2016 a socioeconomic impact analysis was completed as part of the Coordinated Long-Term Operation of the Central Valley Project and State Water Project National Environmental Policy Act (NEPA) analysis<sup>2</sup>. The reinitiation of consultation will also include a socioeconomic impact analysis as part of its NEPA process.

The Endangered Species does not require an economic impact analysis, however when developing a Reasonable and Prudent Alternative (RPA) action to avoid jeopardy and adverse

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<sup>2</sup>[https://www.usbr.gov/mp/nepa/nepa\\_projdetails.cfm?Project\\_ID=21883](https://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=21883)

modification, NMFS is required by regulation to devise an RPA that is “economically and technologically feasible”. Page 718 of the 2009 CVP/SWP long-term water operations biological opinion describes the economic and technological feasibility of the current RPA<sup>3</sup>.

Side comment/recommendation:

Would’ve been helpful to open it up to other scientific presentations.  
Needed a facilitator.

Additional email questions from Shelia for Eric (received 03/28/17):

In the temperature-related egg mortality model, they use the egg to fry survival to Red Bluff for calibration. For a long time around here we have discussed the limitation of the rotary screw traps during times of high flows and debris. They pull the traps when the flows get very high because the associated debris damages the traps or the flow dis-lodges them. We also know that fish tend to move under high flow conditions because the turbidity tends to go up too. The method the USFWS used to interpolate when the traps are out is to take an average before and after which misses the time period when the fish density is usually high. This results in an underestimate of the egg to fry survival. How has NFMS dealt with this? There are other circumstances when the traps are raised, hatchery steelhead release and exceedance of take limits.

**GETBACK**

The juvenile monitoring at Red Bluff has been ongoing for over 20 years and is considered by the fishery agencies to be the best available scientific information regarding the abundance of winter-run Chinook salmon in the upper Sacramento River. Over the years, the program has been reviewed by multiple statisticians as well as many fish biologists experienced in fish biology and the program has been adjusted as a result of those reviews (*e.g.*, McDonald and Howlin 2000, Skalski 2000, etc.).

Even though RBDD fish traps may not be in operation due to increased river flows, heavy debris loads, safety, or take issues, they are randomly sub-sampled during portions of storm events (day/night) to capture the general magnitude of fish passage. The result balances estimating fish passage while minimizing damage to equipment and maximizing crew safety when attempting to sample throughout storm events that can (and do) easily overwhelm traps.

Lack of sampling all days within a week can result in negative or positive bias, depending on sample effort before and after elevated fish passage events. For example, if sample days are missed prior to a storm/runoff event, and sampling resumes following the event and observes elevated fish passage, you will incorporate positive bias in your data set if you insert interpolated values on missed days earlier in the week based solely on your after-event elevated observations. The opposite can be true when missed days occur following elevated passage events.

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<sup>3</sup>[http://www.westcoast.fisheries.noaa.gov/publications/Central\\_Valley/Water%20Operations/Operations,%20Criteria%20and%20Plan/nmfs\\_biological\\_and\\_conference\\_opinion\\_on\\_the\\_long-term\\_operations\\_of\\_the\\_cvp\\_and\\_swp.pdf](http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Operations,%20Criteria%20and%20Plan/nmfs_biological_and_conference_opinion_on_the_long-term_operations_of_the_cvp_and_swp.pdf)

Missed sampling days occur in most years during the winter-run emigration period. Since this is after the fry emergency period, we do not expect these events to impact egg-to-fry survival rates in any single year, and thus do not impact our comparison of egg-to-fry survival rates across multiple years.

## **References**

- Demetras, N.J., D.D. Huff, C.J. Michel, J.M. Smith, G.R. Cutter, S.A. Hayes, and S.T. Lindley. 2016. Development of underwater recorders to quantify predation of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in a river environment. *Fishery Bulletin* 114(2):179-185.
- Martin, B.T., A. Pike, S.N. John, N. Hamda, J. Roberts, S.T. Lindley, and E.M. Danner. 2017. Phenomenological vs. biophysical models of thermal stress in aquatic eggs. *Ecology Letters* 20:50-59.
- McDonald, L.L. and S. Howlin. 2000. Review of quantitative procedures used for estimating abundance of juvenile Chinook salmon passing the Red Bluff Diversion Dam, Sacramento River. Western EcoSystems Technology. Cheyenne, WY. April 28, 2000.
- NMFS (National Marine Fisheries Service). 2014. Recovery Plan for the Evolutionary Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead. California Central Valley Area Office. July 2014.
- Rose, K., J. Anderson, M. McClure, and G. Ruggerone. 2011. Salmonid Integrated Life Cycle Models Workshop. Report of the Independent Workshop Panel. Delta Science Program. Sacramento, CA. June 14, 2011.
- Smith, J.M., D. Huff, C. Michel, D. Demer, G. Cutter, S. Manugian, T. Quinn, and S. Hayes. 2016. Quantifying the Abundance, Distribution, and Predation of Salmon by Non-Native Fish Predators in the San Joaquin River. 9th Biennial Bay-Delta Science Conference November 17, 2016.