SCIENCE WORK PLAN

Shasta RPA Adjustment

VERSION

August 7, 2017 - Initial drafting for coordination with NMFS and others prior to a Sept. 21 workshop rollout.

PURPOSE

1. This draft is to solicit feedback from stakeholders and other interested parties.
2. Reduce uncertainties for compliance with the 2009 Biological Opinion RPA Action Suite I.2.
3. Identify near-term monitoring, modeling, and analysis and synthesis needs to improve fish and water management decisionmaking regarding Action Suite I.2.
4. Improve likelihood of achieving desired fish and water management goals

BACKGROUND

In 2015 and 2016, Reclamation and NMFS utilized Action I.2.3.C to manage Shasta Division operations due to drought conditions. During this period, drought conditions across the Centralk Valley impacted ESA-listed species in the Sacramento and San Joaquin river basins and Bay-Delta. Additional information documented the poor performance of ESA-listed species, which was not expected based on the actions taken as part of Action I.2.3.C. Based on new information related to multiple years of drought, recent data demonstrating extremely low listed-salmonid population levels for the endangered winter-run Chinook salmon, and new information available and expected to become available as a result of ongoing work through collaborative science processes Reclamation requested reinitiation of consultation on the long-term operation of the Central Valley Project and State Water Project towards the end of water year 2016.

In 2017, NMFS provided Reclamation with a draft amendment to the 2011 amended RPA related to Action Suite I.2 in the biological and conference opinion on the long-term operations of the CVP and SWP. NMFS cited work including drought operation of Shasta and Keswick reservoirs, drought conditions, and new science and temperature survival models. Reclamation reviewed the draft amendment and hydrologic indicators suggesting 2017 would be well suited for conducting a study to evaluate if the CVP could be operated to meet a temperature target of 53.0 daily average temperature near the Clear Creek Confluence as a surroage for a target of 55.0 seven-day averae daily maximum at the most downstream winter-run redd during the 2017 temperature management season. The study would assess the efficacy of the DAT and temperature thresshold

and consider potential factors, other than temperature, that may impact survival of juvenile salmonid rearing and migrating through the Sacramento River. Additionally, the 2017 pilot effort would

1. Analysis of the effects for NEPA
2. Science work plan to address uncertainties and areas of potential controversy.

Also agreed upon a transparent and inclusive process that includes water users and other interested parties.
Series of workshops.
This document provides initial thoughts for the purpose of collaborating on subsequent drafts for work in FY 2018
Results will be provided in a final draft with specific studies to be developed under Reclamation Fact Sheets.
Annual assessment as Shasta RPA or ROC on LTO

MANAGEMENT QUESTIONS

Management questions are intended to provide a tiered approach to identify areas and interest and direct the work to the most relevant issues for decision making.

Conceptual Models and Frameworks

A combination of two approaches.
Australia Model, Maintain in drier years, rebuild in wetter
Columbia River Model

- Maintain: sustain populations
- Restore: rebuild with juvenile productivity
- Protect: off the shelf contingency

We also think about the H's

- Hydrology
- Habitat
- Hatcheries
- Harvest

Life-Stage/Spatial Structure based on management units, data collection, and potential actions

- Temperature-Dependent Egg Mortality
- Non-Temp. Egg to Migration Past Red Bluff
- Red Bluff to Verona
- Verona to Sacramento
- Sacramento to Chipps
- Ocean to Spawner

This Science Work Plan will focus on Shasta cold water pool management and the context of the greater life-cyle.

Tiered Questions

General assumption that in most years, temperature dependent mortality is not a driving factor, but in drier years cold water pool management plays a crucial role.

- What cold water pool management is necessary to maintain winter-run populations in drier years?
    - What is a reasonable biological objective for temperature dependent mortality to maintain populations (percentage and year-to-year frequency)?
        - How might additional populations above Shasta and in Battle Creek change requirements for populations below Shasta?
    - What is the relationship between water operations, physical habitat, and temperature dependent mortality in maintaining years?
        - What are the appropriate egg to fry survival biological mechanisms to model?
        - How does peaking operations influence the temperature of releases from Whiskeytown and Keswick?
        - What level of storage is required from a prior year to maintain a reasonable level of protection for a subsequent year?
    - What are the non-temperature dependent factors that may relieve pressures on cold water management?
        - Disease
        - Predation
        - ~~Habitat~~
- What cold water pool management is necessary to provide for sufficient rebuilding of winter-run populations?
    - What is a reasonable biological objective for temperature dependent mortality to restore populations (percentage and year-to-year frequency)?
    - What is the relationship between water operations, physical habitat, and temperature dependent mortality for restoration years?
        - Gravel Condition (Improve survival at higher temperatures)
        - Rearing Habitat (Improve survival)
        - Migration Cues (Improve Survival)
    - What are the other non-temperature dependent factors that may relieve pressures on cold water management?
        - Predation
        - Habitat (bio-energetic models)

- What are the near real time indicators of a risk to winter-run populations and what measures can be taken in response?
    - What Modeling Tools?
        - Forecasts Reservoir Stratification
        - Forecasts of Temperature Dependent Mortality Models
        - Other drivers of survival to Red Bluff
        - Where is the sensitivity
    - What Monitoring?
        - Weaknesses in spatial and temporal resolution
        - Redd Location
    - The H's
        - Hydrology
            - Risk Levels for Fish in Different Life Stages
            - Pulse versus Temperature Survival
        - Habitat
        - Harvest
        - Hatcheries: Increase brood stock collection

What level of survival is needed to protect, restore, and maintain winter run Chinook salmon
What are the effects of managing too hot based on location of redds?
    What is effect of managing some redds too hot?
    Can some proportion of redds be effectively targeted?
What are the potential risks of managing too cool early in the season under different levels of spring storage and allocation?
Can tradeoffs be quantified? What are the interaction of these effects?
Use the LCM to understand the temperature dependent mortality objectives?
Can a cohort replacement rate support high rates of temp dependent mortality?
Is managing by water year type a good idea? Pull ensembles of years. - Have different rules for second set of
What other actions may target making up for this?- hatcheries,

Physical
What monitoring can be improved to manage cold water management and reservoir stratification?
How does peaking influence Spring Creek and Keswick temperatures?
What modeling can be improved to manage cold water?
What we learn would inform water operations approaches.
Bioenergetic model for food in the upper river. NMFS has a model and needs the UCD developed data collection.

STATUS

This section describes what is thought to be known. There is broad agreement on several aspects of temperature management and the relationship to temperature dependent mortality of Winter-Run Chinook salmon.
Field survival temperatures are different than hatcheries
There is high certainty in the critical temperature at which material temperature dependent mortality begins to occur.
Temperature dependent mortality is about managing O2 and controlling the respiration of the embryos to a level within the available dissolved oxygen flux.

HYPOTHESES

Hypotheses provide specific testable questions that, if proven or refuted, would answer a management question. Hypotheses guide the near-term approaches to addressing management questions.

1. Thresholds for O2 respiration and flux are different in the Central Valley than scientific basis behind the 7DADM.
    a. Prediction
    b. Test
2. Background mortality and carrying capacity may explain variability
3. Alternative Strategy to Redd Protection may Improve Survival
4. Prespawning Temperature Effects

TECHNICAL APPROACH AND COORDINATION STRATEGY

The technical approaches and coordination strategy describes the different initiatives, resources, and forums that may assist in addressing the management questions to identify the potential deficiencies.

Related Programs and Projects

2009 BiOp
TCD
RST
SAIL
Life-Cycle Model
NCWA CE QUAL W2 (May be an initiative, may be separate?)

(b)(13)
Shasta Dam Fish Passage Improvement Project
NCWA Salmon Plan
Salmon Resiliency Strategy

Coordination Forums

Collegial Review
Synthesis
Stakeholder Involvement
ISB
SRTTG
WOMT
LOBO review in 2018

Methods and Study Design

Temperature Predictive Tools

- CEQUAL W2 Upgrade for Temperature Modeling (NCWA)
- Modeling Exploration of Stratification Predictions (Yong Lai U2RANS?)
- Desktop Analysis and Field Deployment of Monitoring Network Upgrades

Egg-Mortality Parameters

- Laboratory studies to refine and/or replace the 7DADM approach with relationships between temperature, oxygen demand, exposure duration and frequency, and sublethal effects.
- ?? Reach-specific carrying capacity analysis for background mortality
- Lit. review for FX of habitat quality, etc. on O2 flux

Population Level Effects

- LCM for population targets
- LCM for different survival strategies, e.g. sacrifice and pulse; removal of other stressors
- ?? Desktop analysis of prespawn effects and options on fish distribution.
- Mortality Model - Scenarios for temperature management, e.g. managing too early, too conservatively, not enough, falling back later in the season, etc.

Synthesis

- Real-Time Predictive Tools and Plans
    - Do we need super detailed space-time approaches or is Keswick sufficient?
- Independent Review

[Note: How does the bioenergetics fit with this?]
[Note: Is there something for other fish, basins, runs, etc.?]

PROPOSED ADDITIONAL ACTIVITIES

The following paragraphs describe additional activities necessary to augment the existing programs for the purpose of addressing management questions.

Eric Danner Lab Study for Interstitial Flow
Bio-Energetics Model
LCM Scenarios for Death by 1000 Cuts

1. Overview of CVP facilities and planning efforts (CVPIA, BiOp, ROC)

To manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public

A science workplan regarding facilities, operations, and environmental topics impacted by Shasta Division will accelerate development of supporting information for decisions related to amendments to the existing BiOps, projects related to the species being undertaken by stakeholders including the Sacramento Valley Salmon Recovery Program, and long-term adaptive management of the Central Valley Project.

Science Partnerships

Existing BiOps.
Reclamation envisions an approach that provides for Reclamation taking a lead role in the development of physical/operational modeling, with NMFS focusing more specifically on leading biological modeling. Both agencies should consider undertaking activities within a large, diverse, and collaborative science enterprise that incorporates other partner agencies, stakeholders, non-governmental organizations, and academia.

SVSRP
Sacramento River Salmon Recovery Group Settlement Contractor efforts.
Suite of action in the middle Sacramento River from Keswick to XXX
Yakima River example

State-led Efforts
CWF and EcoRestore, Salmon Resiliency Strategy, Smelt Resiliency Strategy
Suite of action in the Central Valley not exclusive to river.

CSAMP
Adaptive management fitting into operation and maintenance and mitigation for the project

Reclamation believes the need for such a workplan warrants an integrative approach that extends beyond independent processes to adjust BiOp RPAs, advance monitoring programs, and increase the use of adaptive resource management. Additional sections regarding the implementation of this science plan describe a path forward to support policy and decisionmaking.

Facility Science
- Temperature Control Device
- Temperature Curtains

Improving cold water stratigication
- Fish Passage

Operational Science
- Flow Management
- Temperature Management
- Ecosystem Management

Environmental Science
Biological
~~What level of survival is needed to protect, restore, and maintain winter run Chinook salmon¶~~
~~What are the effects of managing too hot based on location of redds? ¶~~
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~~¶~~
~~Physical¶~~
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~~How does peaking influence Spring Creek and Keswick temperatures?¶~~

~~What modeling can be improved to manage cold water? ¶~~

Methods
Facilities:

Operational: Calsim models have been undertaken….

Environmental Science
Biological
Adult condition and spawning success
Redd locations
Egg mortality
Interaction of these effects

Physical
Exceedance of Hec-5Q

REFERENCES