January 19, 2017

For Discussion with Reclamation and DWR

NMFS proposed changes to CWF to address adverse effects in Initial Draft Biological Opinion (BiOp)

NMFS generated this proposed summary of potential changes to the proposed action that can reduce its adverse effects for purposes of discussion with Reclamation and DWR. This is a discussion draft that is intended to provide a constructive platform for continued dialog and collaboration at both a technical and policy level. NMFS recognizes that the underlying technical analyses may change as a result of peer review and continued analysis, as the BiOp is being finalized. NMFS is requesting technical assistance from Reclamation and DWR to evaluate the effects of these potential changes on the overall design and performance of the CWF project, in order to better understand their feasibility.

1. *Construction*
   - All pile-driving work must occur in a shortened work window (e.g. June 1-Aug 30), and revisit this once project approaches 100% design.
     - To address acoustic stress for large segments of steelhead and green sturgeon populations
   - Maximize the use of overland material transport in certain times and areas and only use barging when absolutely necessary and revisit this once project approaches 100% design
     - To address acoustic stress and propeller strikes for green sturgeon and juvenile salmonids
2. *North Delta DCC Operations:*
   - Close the DCC for October and November and/or ensure that new criteria are developed such that closures occur at least as frequently as NAA
     - To address increased entrainment into Delta Cross Channel in Oct/November due to DCC gate being open more under PA vs NAA
3. *Upstream:*
   - Condition approval of CWF on resolving upstream temperature issues through Shasta RPA adjustment process, and long-term ops reinitiation, including specific end of April storage criteria.
     - To address the increase in temperature related mortality for winter-run
4. *Cumulative North Delta Survival Reductions:*
   - Develop an adaptive management plan and initial operations for limiting and fully mitigating North Delta survival reductions (see below Conceptual Framework)
     - To address the following factors:
       i. 1-2% loss at each fish screen due to impingement (up to 7% cumulative at all 3 screens); predation losses at screens in addition to these impingement losses.
       ii. NDD bypass rules currently don't meet the proposed action's criteria of not increasing the frequency, duration or magnitude of reverse flows.
       iii. Reduced river velocity and increased effect of tides increases travel distance and time for juvenile salmonids, resulting in a reduction in survival for at

least 75% of the years during winter-run migratory months. 25% of years could experience up to 10-11% survival reduction during key migratory months of February and March and >20% in October and November. (See figure 1 below).

iv. Modeling results predict these findings are robust and biologically meaningful, when viewed in life-cycle context

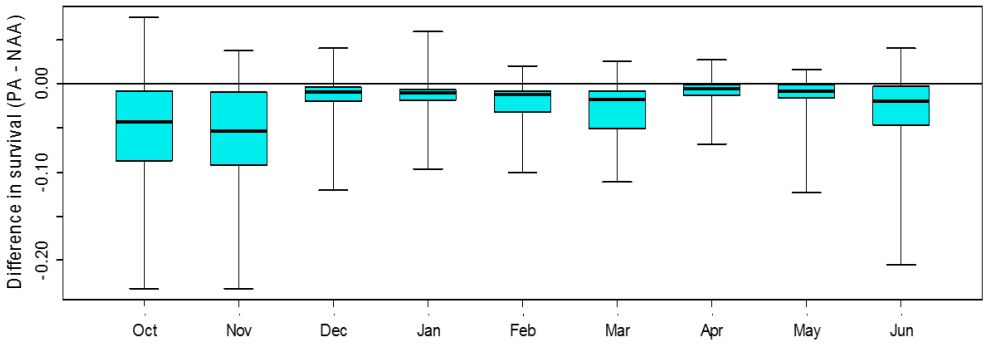

Figure 1. USGS Flow-Survival Analysis (Perry analysis of NDD Bypass Rules). Reduced survival in all months of migration period (shown for all WYT). Note: Modeled survival results shown do not include the predicted and constrained 5% loss in the screening reach criteria from the BA.

Conceptual Framework to Resolve Cumulative Survival Reductions in North Delta

Develop an adaptive management program of actions to address these modeled results, with following components:

1. Establish an objective for improving winter-run survival throughout the system, and tier a specific NDD-associated survival reduction objective to that.
    a. There are BDCP objectives for improving survivals that could be used. Ideally these would be improvements in survival over baseline for each water year type. This approach should keep the focus on recovery overall, and include actions upstream, for example, as part of a larger "salmon resiliency strategy.".
    b. Include a specific target cap on a metric such as 1) predicted annual survival reductions cannot be more than 3% mean and 5% worst-case through the Delta, or 2) cohort replacement above threshold level as attributable to the new NDD. This would have to include the cumulative survival losses in the screening reach and downstream due to flow survival relationships.
    c. Set up a range of experiments and conditions to further reduce uncertainties and identify operational criteria that would meet this survival or CRR objective. Describe adaptive management process per the existing framework document; utilize CSAMP process.

2. Establish initial interim operating criteria that meet this NDD objective, subject to results of operational phasing period, adaptive management, and further refinement in the long-term Ops consultation.
    a. Use operational phasing approach and testing period already in the proposed action to limit impingement losses to 1% or less, and ensure that NMFS seeping velocities are attained
    b. Implement the 2013 Fish Facilities Technical team work plan between the time CWF is permitted and dual conveyance becomes operational
    c. Reduce the loss in the screening reach criteria from 5% (currently in the proposed action) to 1 or 2%, or other values as appropriate to meet the objectives
    d. Use the flow-survival analysis to back-calculate what bypass flows are required to meet objectives, and initially condition operations using this rule curve at 1 or 2%. (See figures with draft rule curves below for further discussion)
    e. Or use the life-cycle model and DPM to identify operations that produce a positive cohort replacement rate.
    f. Allow flexibility to operate to different criteria if necessary to learn as part of NMFS-approved adaptive management experiment.
    g. Ensure that operating criteria meet stated objective of not increasing reverse flows at Georgiana Slough

3. Establish mainstem Sacramento River habitat mitigation program to at least offset the NDD-associated survival reduction.
    a. For example, if capped annual survival reduction is 3%, then buy credits (through established 3rd-party conservation banks or put out an RFP) to off-set those losses at a ratio that we can rely on. This is consistent with past practices on levee consultations.
    b. Ensure that Yolo Bypass action is fully operational and effective prior to NDD operations, and test approaches for November/December pulses to improve winter-run access to bypass as compared to NAA.
    c. Use SWFSC LCM to identify other mitigation opportunities.
    d. Create relationship between habitat and operations whereby if habitat is more effective than anticipated, then diversions can increase, as long as objectives are met.

Figures illustrating effect of NDD bypass rules on through-Delta survival

Draft. Please do not distribute without author's permission.

R. Perry 03 January 2017

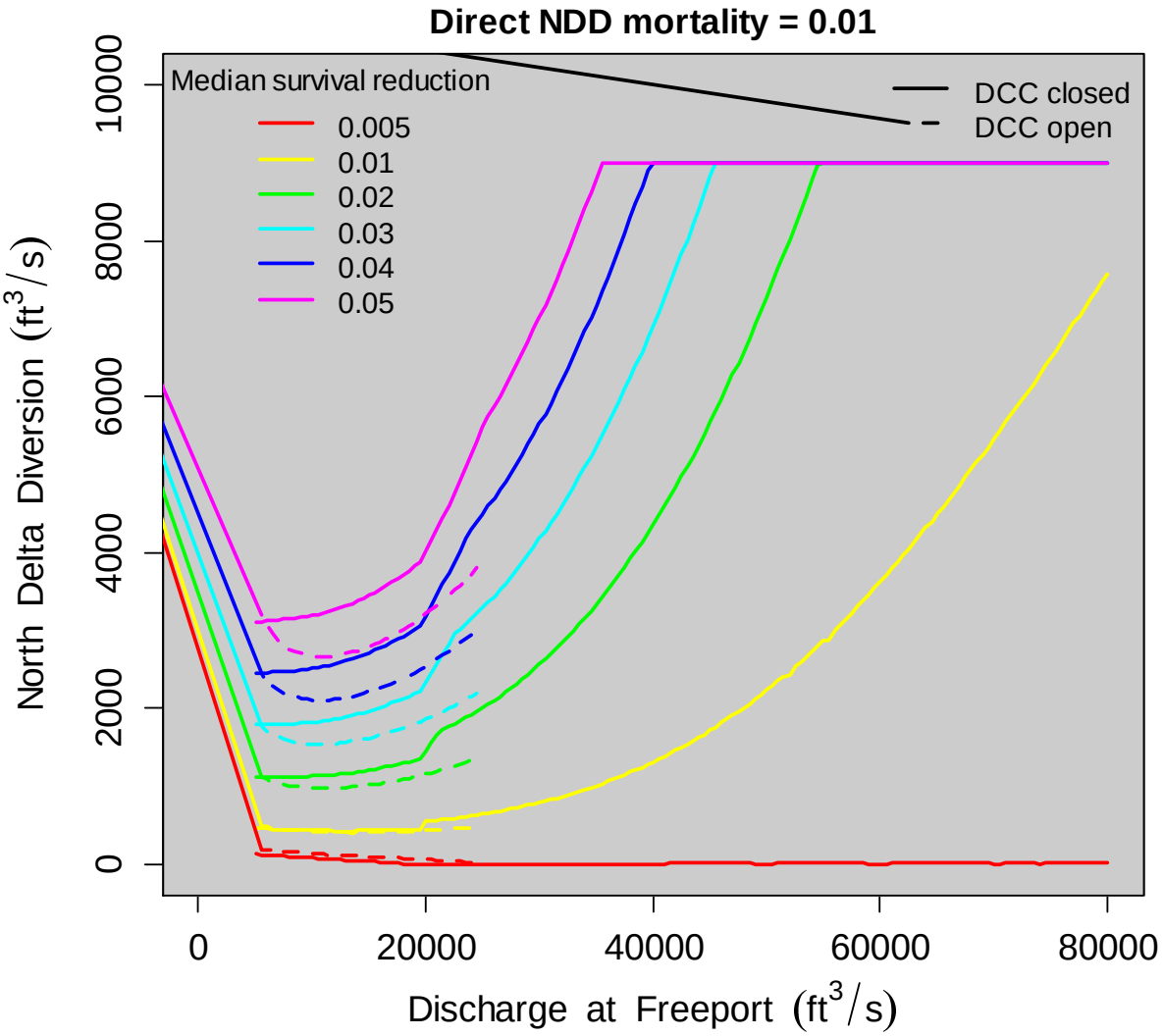

Figure 2. North Delta Diversion (NDD) outflow that yields a given absolute reduction in median through-Delta survival (ranging from 0.005 to 0.05 percentage points) as a function of discharge of the Sacramento River at Freeport under the assumption of 1% additional direct mortality caused by the NDD. Direct NDD mortality is defined as all additional mortality caused by the NDD over and above the effect of reduced Sacramento River discharge (e.g., losses caused by impingement of fish on intake screens).

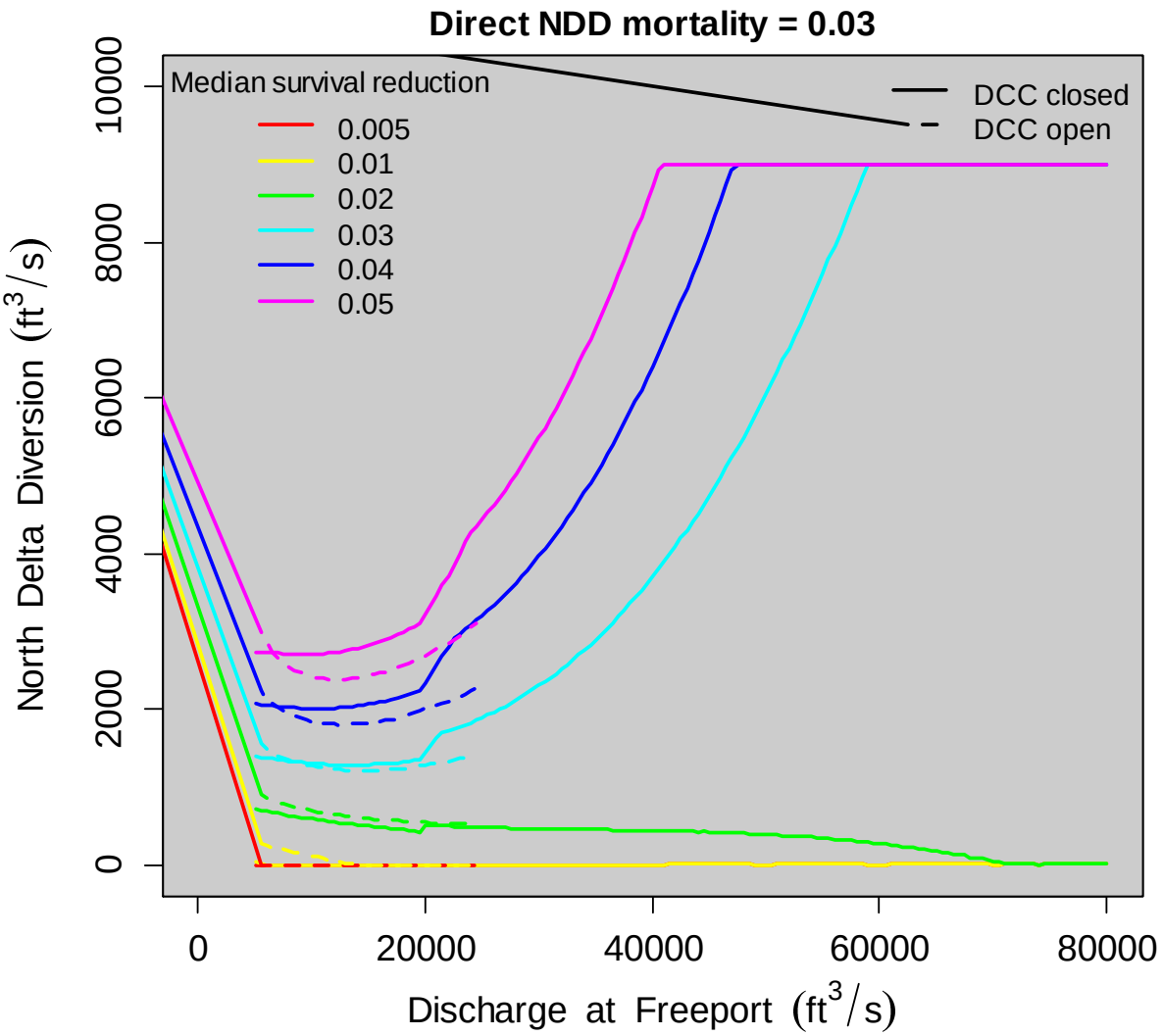

Figure 3. North Delta Diversion (NDD) outflow that yields a given absolute reduction in median through-Delta survival (ranging from 0.005 to 0.05 percentage points) as a function of discharge of the Sacramento River at Freeport under the assumption of 3% additional direct mortality caused by the NDD. Direct NDD mortality is defined as all additional mortality caused by the NDD over and above the effect of reduced Sacramento River discharge (e.g., losses caused by impingement of fish on intake screens).