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UPSTREAM AQUATIC RESOURCES



OVERVIEW OF TESTIMONY

- **Introduction**
- **Opinions**
- **Analytical methods**
- **Conclusions**



INTRODUCTION

- **Upstream Aquatic Resources**
 - Dr. Greenwood covers in Delta Aquatic Resources
- **Organized by species or species group**
 - 9 covered species and 7 non-covered species of special concern
- **Reservoir operations are the only upstream CWF influence**
 - Flow and water temperature



Corrected Slide

OPINIONS

- CWF H3+ will result in minor changes to upstream flows and habitat suitability for upstream life stages of winter-run, spring-run, and fall-/late fall-run Chinook Salmon, and CCV steelhead; operational criteria and real-time operational adjustments will reasonably protect these salmonids.
- CWF H3+ will result in minor changes to upstream water temperature conditions for spawning, rearing, and migration habitat of winter-run, spring-run, and fall-/late fall-run Chinook Salmon, and CCV steelhead; operational criteria and real-time operational adjustments will reasonably protect these salmonids.
- CWF H3+ related changes in upstream flow and water temperatures are unlikely to have a population level effect on winter-run, spring-run and fall-/late fall-run Chinook Salmon, and CCV steelhead.
- CWF H3+ will result in minor changes to upstream flows and habitat suitability for upstream life stages of Green and White Sturgeon; operational criteria and real-time operational adjustments will reasonably protect sturgeon.



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OPINIONS

- CWF H3+ will result in minor changes to upstream water temperature conditions for spawning, rearing, and migration habitat of Green and White Sturgeon; operational criteria and real-time operational adjustments will reasonably protect sturgeon.
- CWF H3+ will maintain reasonably protective upstream flow and water temperature conditions for upstream spawning, rearing, and migration of Sacramento Splittail.
- CWF H3+ will maintain reasonably protective upstream flow and water temperature conditions for upstream spawning, rearing, and migration of Pacific and River Lamprey.
- CWF H3+ is reasonably protective of non-covered species of primary management concern upstream spawning and egg incubation, juvenile rearing, adult occurrence and adult migration.
- CWF H3+ is reasonably protective of cold water reservoir species in upstream reservoirs.



SALMONIDS

- **Life Stage**

- Two species- Chinook and California Central Valley Steelhead evaluated

Table 1. General Timing of Upstream Salmonid Presence by Life Stage.

Species	Adult Immigration	Adult Holding	Spawning, Egg Incubation, Alevins	Upstream Juvenile Rearing	Juvenile Emigration
Winter-Run Chinook Salmon	Dec-Aug	Jan-Aug	Apr-Oct	Jun-Nov	Jul-Mar
Spring-Run Chinook Salmon	Mar-Sep	Apr-Sep	Aug-Dec	Year-round	Oct-May
Fall-Run Chinook Salmon	Jul-Dec	--	Sep-Jan	Dec-Jun	Dec-Jun
Late Fall-Run Chinook Salmon	Nov-Apr	--	Dec-Jun	Mar-Jul	Year-round
Steelhead	Aug-Mar	Sep-Nov	Nov-Apr	Year-round	Nov-Jun



SALMONIDS

- **Life Stage Analyzed**
 - Spawning and egg incubation
 - Fry and juvenile rearing
 - Migration



ANALYTICAL APPROACH

- **Reservoir Storage**
- **Flow**
- **Water Temperature**
- **Life Cycle Models**



RESERVOIR STORAGE

- **Used CalSim II to look at storage changes**
- **End of May (EOM) and end of September (EOS) reservoir storage used to evaluate potential impacts**
- **EOM and EOS modeled results indicate that storage volumes in the Sacramento, Feather and American Rivers are similar between NAA and H3+ NOD**



SALMONIDS - FLOW

- **The primary upstream flow-related biological parameters are:**
 - Spawning and egg incubation, spawning habitat availability, redd dewatering, and redd scour;
 - Fry and juvenile rearing, rearing habitat availability, and juvenile stranding; and
 - Migration of juveniles, adults, and steelhead kelts.



SALMONIDS - FLOW

- **Analytical approach**

- Three tools used to evaluate flow related effects

- 1) Modeled mean flow rate comparisons

- CalSim II used to model mean monthly flow rates

- 2) Sacramento Ecological Flow Tool (SacEFT)

- Models the effects of changing water operations on the physical habitat components of salmonids and green sturgeon in the Sac River

- 3) SALMOD

- Evaluates flow and temperature related mortality of early life stages in the Sac River to Red Bluff



SALMONIDS – FLOW CONCLUSIONS

- **Flow rates comparison generally found that any changes to flow rates in all rivers would not be of sufficient magnitude or frequency to cause biologically meaningful effects.**
- **Reductions in mean flows were generally less than or equal to 5%.**



SALMONIDS – SALMOD CONCLUSION

- **Model predicts that there would be negligible differences in flow-related mortality, translating to a 7% reduction in flow related mortality.**



SALMONIDS- ADDITIONAL FLOW ANALYSIS

- **Additional analysis was conducted for the BiOp/ITP:**
 - Minimal effects to flow overall, even where there were some flow-related effects.
 - Real time operations will help minimize flow related effects.



SALMONIDS – WATER TEMPERATURE

- **Analytical Approach**

- 1) Mean monthly water temperature comparison
- 2) “Level of Concern” analysis in Sac River
- 3) “Percentage of months exceeding 56 degree threshold”
- 4) “Degree-Day/Degree-Month analysis in Sac, Feather, and American Rivers



SALMONIDS – WATER TEMPERATURE CONCLUSION

- **The results from the four analysis conducted consistently indicate that temperature related effects to the Chinook Salmon ESUs an CCV Steelhead spawning and egg incubation and rearing would be minimal**
- **My opinion is that the CWF is reasonable protective of the egg, larval, and juvenile life stages.**



SALMONIDS- ADDITIONAL WATER TEMPERATURE ANALYSIS

- **Additional analysis conducted in the BiOp/ITP:**
 - While small differences were observed in model outputs, real-time operations and current modifications to the OCAP RPA are reasonably protective of the salmonids' egg, larval and juvenile life stages.



GREEN AND WHITE STURGEON

- **Spawning and Egg Incubation Flows**
- **Spawning and Egg Incubation Water Temperatures**
- **Rearing Water Temperatures**



GREEN AND WHITE STURGEON – SPAWNING AND EGG INCUBATION FLOWS

- **Used mean monthly flows modeled in CalSim II and modeled water temperatures in SRWQM**
- **These analysis indicate:**
 - Flows during spawning period would generally be similar between NAA and H3 and H4
 - Flows would generally be similar NAA and H3 and H4 or substantially higher (up to 548%) under H3 and H4 in the Feather River between Thermalito Afterbay and the confluence of the Sac River
 - H3+ compared to NAA shows no flow reductions greater than 5% in the Sacramento River in any spawning period month; The same is true for the Feather except for in critical years in July.



GREEN AND WHITE STURGEON - FLOW CONCLUSION

- **Given the single reduction of 9% in the Feather River in critical years, this reduction does not change my opinion that the CWF H3+ is reasonably protective of sturgeon spawning**



GREEN AND WHITE STURGEON – SPAWNING AND EGG INCUBATION WATER TEMPERATURES

- **Analytical approach:**

- 1) Mean Monthly water temperature comparison
- 2) Level of concern analysis in the Sac River
- 3) Percent exceedance analysis for Green Sturgeon in Feather River
- 4) Degree-Day/Degree/Month analysis in the Sac and Feather Rivers



GREEN AND WHITE STURGEON – SPAWNING AND EGG INCUBATION WATER TEMPERATURES - CONCLUSION

- **The results from the four analyses indicate that temperature- related effects to Green and White Sturgeon spawning and egg incubation would be minimal.**



GREEN AND WHITE STURGEON – REARING WATER TEMPERATURES

- **Analytical Approach**
 - 1) **Mean monthly temperature comparison**
 - 2) **Percent exceedance**
 - 3) **Degree Day/Degree Month**



GREEN AND WHITE STURGEON – REARING WATER TEMPERATURES – CONCLUSION

- **There were small differences observed in model outputs but considering real-time operations and current modifications to the OCAP RPA , it is my opinion that the CWF H3+ is reasonably protective of Green sturgeon rearing.**



GREEN AND WHITE STURGEON – CONCLUSION

- **CWF H3+ is reasonably protective of Green and White Sturgeon in upstream waterways.**
- **Minimal effects in the preponderance of months and water year types.**



SACRAMENTO SPLITTAIL

- **CWF is reasonably protective to Sacramento Splittail because there are generally no negative effects.**
- **Flows under H3, H4 and CWF H3+ are similar to or greater than flows under the NAA in a preponderance of the months and water temperatures under H3 and H4 remain within optimal splittail range at a similar frequency to those under NAA**



PACIFIC AND RIVER LAMPREY

- **The results indicate a mix of small to moderate increases and decreases in flows, and , although they have the potential to have positive and negative effects on River Lamprey migration, my opinion is that CWF H3+ is reasonably protective of Lamprey.**



NON COVERED SPECIES OF PRIMARY MANAGEMENT CONCERN

- **CWF H3+ is reasonably protective of the non-covered species.**