HRCM 12:
Sutter and Steamboat Sloughs

Scientific Evaluation Worksheet

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Action: HRCM12: Channel margin habitat in Sutter and Steamboat Sloughs.

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Action Description and Clarifying Assumptions

Enhance channel margin habitats along between 12 and 36 miles of Steamboat and Sutter Sloughs to improve habitat conditions for covered fish species.

Option #1: 12 miles = 6 miles of channel, each side

Option #2: 36 miles = 18 miles of channel, each side

Approach

1. Modify channel geometry in Steamboat and Sutter Sloughs to improve hydrodynamic and structural complexity.
2. Allow for establishment of native emergent vegetation in intertidal elevations.
3. Establish woody riparian vegetation along banks that do not already support woody riparian vegetation.

Intended Outcomes as Stated in Conservation Measure

1. Increase the extent of shaded riverine aquatic cover and increasing instream structural complexity through contributions of instream large woody material.
2. Provide inputs of organic material (e.g., leave and twig drop) in support of aquatic foodweb processes.
3. Increase production and export of terrestrial invertebrates into the aquatic ecosystem.
4. Improve connectivity with upstream habitat areas, including existing and future restored habitats.
5. Reduce the risk for predation on covered fish species by non-native fish predators.
6. Reduce the risk for entrainment of juvenile salmonids by providing a migration corridor that bypasses the intakes of a new north Delta diversion point, the Delta Cross Channel, and Georgiana Slough.

Positive

P1. Increased establishment of instream structure through export of LWD to benefit covered species.

P2. Additional splittail spawning habitat on narrow floodplain margin.

P3. Additional rearing habitat for splittail, green and white sturgeon, Chinook salmon and steelhead (consider loss to entrainment).

P4. Increased production and export of terrestrial invertebrates into the aquatic ecosystem for rearing splittail, green and white sturgeon, Chinook salmon and steelhead

Negative

N1. Increased habitat for non-native predators/competitors to Chinook salmon, steelhead, green and white sturgeon, and splittail, if flows through sloughs are not sufficient to prevent colonization by non natives (by creating more predator habitat)

N2. Increased mortality of covered species due to increased exposure risk to contaminants due to longer residence time in this area

Conceptual Model Information Regarding Intended Outcomes

The basic drivers and outcomes are described in the DRERIP conceptual models, specifically, the salmonid model.

Assumptions

Provided in BDCP Conservation Measure
Not provided.

Added by Evaluation Team
Not Provided.

Problem(s) with Action as Written:

Not provided.

Scale of Action:

Large

Rationale: Not provided.

Evaluation Summary Tables

Summary tables listing magnitude and certainty scores for each outcome, by species, are provided in Appendix A. Details regarding each of the listed scores and the rationales for the scores are provided in the discussion of positive and negative outcomes on the following pages.

Positive Outcomes Identified, Not Separately Evaluated

Below is an outcome that was identified, but not listed in the worksheet, because it was merged with another outcome for full evaluation.

- OP1: Increased establishment of woody riparian and emergent vegetation to provide high quality rearing habitat for covered species. This outcome was merged with P2 and P3.

Relation to Existing Conditions:

Would the action result in a change to system dynamics (either within the Delta or as inputs to the Delta) such that the current understanding of how the system works may no longer hold?

YES

Nature of Change:

Not provided.

Potential Positive Ecological Outcome(s)

Outcome P1: Increased establishment of instream structure through export of LWD to benefit covered species.

The text and scores provided here are applicable to all covered fish species (i.e. species were not evaluated separately). The approach and assumptions for HRCM12 indicates that the channel will be reconfigured to increase HD and structural complexity; however, it does not include any levee setbacks and will not allow for the channel to evolve. No changes to the currently impaired flood hydrology are included in the action. Thus, the ability for natural channel processes (DRERIP Floodplain Model, Figure 2) to erode banks and recruit & export the increased riparian vegetation as LWD will be minimal. Note: score for salmonids maybe splittail. Good evidence that woody debris is important for upstream areas, less for Delta.

Magnitude = 3
Based on the approach and assumptions for HRCM12, there will be an increase in riparian vegetation on the channel margin. While flood hydrology will not be changed by HRCM12, the channel morphology will be changed, ostensibly such that high water events will be able to recruit LWD and export it to downstream areas (DRERIP Floodplain Model Figure 2). This will result in an effect on a large area/multiple patches.

Certainty = 2
Understanding is high, but nature of outcome would be dependent on the uncertain timing of flooding events.

Outcome P2: Additional splittail spawning habitat on narrow floodplain margin.

P2a1: Splittail 12 mile

DLO Relationship and General Observations:
Floodplain model page 25 and Splittail model pages 9 and 12 describe how additional floodplain habitat supports splittail spawning; Assume that there will be floodplain habitat available, but action as described does not indicate that there will be seasonally-inundated FP habitat. Splittail will spawn on flooded vegetation (Moyle et al. 2004) if FP is not accessible.

Increased establishment of woody riparian and emergent vegetation to provide high quality rearing habitat for covered species is an intermediate outcome.

Magnitude = 2
See general observations above.

Certainty = 3
See general observations above.

P2a2: Splittail - 36 mile

Floodplain model page 25 and Splittail model pages 9 and 12 describe how additional floodplain habitat supports splittail spawning; Assume that there will be floodplain habitat available, but action as described does not indicate that there will be seasonally-inundated FP habitat. Splittail will spawn on flooded vegetation (Moyle et al. 2004) if FP is not accessible.

Increased establishment of woody riparian and emergent vegetation to provide high quality rearing habitat for covered species is an intermediate outcome.

Magnitude = 3
See general observations above.

Certainty = 3
See general observations above.

Outcome P3: Additional rearing habitat for splittail, green and white sturgeon, Chinook salmon and steelhead (consider loss to entrainment).

P3a1: Splittail - 12 mile

Greatest importance is in dry years when floodplains are not available.

Increased establishment of woody riparian and emergent vegetation to provide high quality rearing habitat for covered species is an intermediate outcome.

Magnitude = 2
See general observations above.

Certainty = 3
See general observations above.

P3a2: Splittail - 36 mile

Greatest importance is in dry years when floodplains are not available.

Magnitude = 3
See general observations above.

Certainty = 3
See general observations above.

P3b. Green Sturgeon (12 and 36 mile the same)

Juvenile sturgeon are benthic feeders so creation of additional benthic habitat would be beneficial (Sturgeon model page 8). Channelization of the estuary has reduced foraging habitat for Green Sturgeon (Green Sturgeon Model page 20). Juveniles use intertidal

habitats along the Sacramento River and many areas in the Delta (Green Sturgeon Model page 4).

Magnitude = 2
Small spatial extent

Certainty = 1
Limited data on rearing preferences

P3c. White Sturgeon (12 and 36 mile the same)

Juvenile sturgeon are benthic feeders so creation of additional benthic habitat would be beneficial (Sturgeon model page 8). Although it is unknown whether white sturgeon will utilize habitats this shallow. They were never captured in Yolo Bypass studies (Sommer and Harrell, unpublished data). Although it's not mentioned in the White Sturgeon model, it is likely that white sturgeon will utilize the same habitats for foraging as described for green sturgeon. Shallow water habitats and low tidal areas are likely nursery habitat (White Sturgeon Model page 15).

Magnitude = 2
Small spatial extent

Certainty = 1
Limited data on rearing preferences

P3d. Steelhead (12 and 36 mile the same)

Tidal marshes can provide rearing habitat and foraging opportunities to fishes that enter marsh channels (Fish Habitat Linkages Model). The primary food organisms of juvenile salmonids are drifting aquatic insects and the larval stages of terrestrial insects (Quinn 2005).

Riparian vegetation is important to salmonids (inc steelhead) by contributing terrestrial insects into the stream and logs and branches that shape channel morphology, retaining organic matter, providing essential cover, stabilizing banks, maintaining undercut banks, and modifying water temperatures through shading (Murphy and Meehan 1991). .

Allochthonous inputs from streamside vegetation are important to salmonids because they provide food for the aquatic invertebrate food base (Murphy and Meehan 1991). Given their similarities in life history, it can be assumed that they are utilizing the same habitats as juvenile salmon, and many of the references below for Chinook salmon would apply to steelhead as well.

Magnitude = 2
Rearing habitat in the delta is reduced. This could have a sustained minor population effect.

Certainty = 2
Not much in the literature regarding steelhead use of estuaries for rearing.

P3e. Chinook Salmon (12 and 36 mile the same)

Greatest importance is in dry years when floodplains are not available.

Magnitude = 3
Sutter and Steamboat are one of several emigration routes juvenile salmon can choose, and are among the few that provide rearing habitat. Habitat improvements would improve rearing success in these corridors. Limited spatial or temporal habitat effects.

Certainty = 3
Numerous studies have indicated that shallow riparian habitat benefits fry Chinook (Sommer 2005, Quinones 2005, Kjelson 1982). Loss of this habitat has been indicated as a major source of decline in CV Chinook.(NMFS 1997, CDFG 2004). Shallow water habitats including river floodplains and riparian margin provide rearing habitat. Growth rates for juvenile Salmon are higher and emigration rates are slower when in shallow water rearing habitats (Kjelson 1982, Sommer et al 2005).

Outcome P4: Increased production and export of terrestrial invertebrates into the aquatic ecosystem for rearing splittail, green and white sturgeon, Chinook salmon and steelhead.

P4a1: Splittail - 12 mile

Adult consumption of earthworms is common (Moyle et al. 2004). Consumption of other invertebrates is common in all life stages (Feyrer et al. 2003).

Magnitude = 2
See general observations.

Certainty = 3
See general observations.

P4a2: Splittail - 36 mile

Adult consumption of earthworms is common (Moyle et al. 2004). Consumption of other invertebrates is common in all life stages (Feyrer et al. 2003).

Magnitude = 3
See general observations.

Certainty = 3
See general observations.

P4b. Green Sturgeon (12 and 36 mile the same)

Invertebrates are common food items for small sturgeon, but it's unclear how much they use terrestrial prey (White Sturgeon Model page 8).

Magnitude = 1
See general observations.

Certainty = 2
Sturgeon are benthic feeders and it is unknown how much they will feed on surface drift. More than 1 because there is diet data for sturgeon

P4c. White Sturgeon (12 and 36 mile the same)

DLO Relationship and General Observations:
Invertebrates are common food items for small sturgeon, but it's unclear how much they use terrestrial prey (White Sturgeon Model page 8).

Magnitude = 1
See general observations.

Certainty = 2
Sturgeon are benthic feeders and it is unknown how much they will feed on surface drift. More than 1 because there is diet data for sturgeon.

P4d. Steelhead

Moyle et al. 2004, page 277 states that stream-dwelling O. mykiss feed mostly on drifting aquatic organisms and terrestrial insects.

Magnitude = 2
See general observations.

Certainty = 2
See general observations.

P4e.1 Chinook Salmon 12 Mile

Consumption of terrestrial invertebrates in drift is very common (Sommer et al. 2001). Diet has a large effect on growth and survival.

Magnitude = 2
See general observations.

Certainty = 3-4
See general observations.

P4e2: Chinook Salmon - 36 Mile

Consumption of terrestrial invertebrates in drift is very common (Sommer et al. 2001). Diet has a large effect on growth and survival.

Magnitude = 3
See general observations.

Certainty = 3-4
See general observations.

Potential Negative Ecological Outcome(s)

Outcome N1: Increased habitat for non-native predators/competitors to Chinook salmon, steelhead, green and white sturgeon, and splittail, if flows through sloughs are not sufficient to prevent colonization by non natives (by creating more predator habitat).

Note: Scored under current operations/flows. If flows were to increase then predator risk would decrease. Longfin are unlikely to be in this area so magnitude was scored lower. Predation could have negative affect, but not certain what balance is between non-native/native abundance shifts. Many migration studies in this area are assuming predation is the cause of mortality. Concern is that we are increasing predation rate in these areas by routing fish (up to 50% of the population) in an area that predators exist in. However, we do not know if this will be a population level affect.

N1a. Longfin Smelt

Longfin model - Predation is a source of direct mortality to eggs and larvae. Some fish species (e.g., suckers, splittail, sturgeon) may feed on LFS eggs. Larval LFS are not strong swimmers (Wang 1986) and are thus highly vulnerable to predation. Striped bass and inland silverside are probably major predators on LFS larvae. Terns, gulls, and cormorants may also prey on this life stage. There appears to be a correlation between high flows and the abundance and distribution of LFS; high flows also decrease the success of LFS predators by increasing turbidity (Page 8.) There is little information in the model specific to competition with non-natives, competition for food resources is expected to have decreased with the recent decline in LFS (Page 14.), competition for spawning sites is unknown (Page 10.). Predation and competition are characterized as medium importance and medium understanding (Figure 5.); floodplain predation and competition are not specifically addressed.

Magnitude = 2

Certainty = 2

N1b. Splittail

The floodplain model does not address non native predation or competition on the floodplain. Evidence from Yolo and Cosumnes about non-natives taking advantage of floodplain (ref Sommer et al 2004, Moyle et al 2006). Floodplain Model: Page 10 talks about sources of invasive species. Foodweb Model is focused on estuarine systems.

Splittail model—Predation by non native fish is characterized as low with high understanding for juveniles and as medium with medium understanding for adults (Figures 5, 6 and 7.) Bird predation appears limited until water recedes and floodplains begin to isolate from main channels at which point fish are exposed to wading birds (Moyle 2004).

Magnitude = 2

Certainty = 3

N1c. Green/White Sturgeon

Models indicate probable distribution in the mainstem Sacramento River adjacent to these sloughs (Figure 7, white sturgeon model, Figure 2, green sturgeon model). There is no direct evidence of utilization of these sloughs by green sturgeon or white sturgeon.

Magnitude = 1

Certainty = 2

N1d. Steelhead/Chinook Salmon

The Chinook salmon and steelhead model indicates Non-native predation and competition with invasive species and hatchery produced salmonids is of medium importance in rearing and emigration estuarine habitats, including floodplain (Figure 2a).

Magnitude = 2-3

Certainty = 2

Outcome N2: Increased mortality of covered species due to increased exposure risk to contaminants due to longer residence time in this area.

The text and scores provided here are applicable to all covered fish species. The primary risk of this type of project at these locations is increased exposure to pesticides due to increased fish use and residence time in the enhanced habitat. The proposed habitat enhancements would not themselves result in significant changes in contaminant cycling or exposure. The habitat is being enhanced to facilitate spawning by splittail and rearing by splittail and other species. Surrounding lands are agricultural, including orchards and other crops. Pyrethroids, a class of pesticides used as dormant sprays on

orchards, can be toxic to fish, especially to early life stages (Pyrethroids model, page 16). Pyrethroid concentrations would be expected to peak during the winter/spring storm season and after peak agricultural application in the summer and fall (Pyrethroids model, page 2). Late-winter and spring are also the times splittail would use the enhanced floodplain habitat to spawn (Splittail model, page 1).

There are critical data gaps on pyrethroids and other pesticides that make it difficult to evaluate risk to covered fish (Pyrethroids model, page 32; Chemical stressors model, page 25). In general, little is known about the toxic effects of contaminants known to be present in the Delta on resident Delta species, and even less is known about the sublethal effects of contaminants (Chemical stressors model, page 25).

Magnitude = 1
See general observations.

Certainty = 3
See general observations.

Important Gaps in Information and/or Understanding

Research Needs

- Major gaps – rearing habitat for steelhead? Rearing habitat for juvenile sturgeon?
- Better diet information is needed for riparian and channel margin habitat use of SH, green and white sturgeon.
- More information is needed about relative importance of food to population level effects for all of the species.
- Transport studies are needed to evaluate the footprint of food transport.
- Timing duration of rearing for SH, green and white sturgeon.
- Better understanding of rearing habitat restoration while minimizing predatory fish abundance.

Assess Reversibility and Opportunity for Learning

Reversibility

Not provided

Opportunity for Learning

High: A spatial reach (linear in shape) offers space to conduct this type of study.

References Cited

CDFG 2004
Jackson 1992
Kjelson et al 1982
Lister and Genoe 1970
Newman 2008
NMFS 1997
Quinones 2005
Sommer 2005
Sommer 2005
Vogel 2008

Appendix A