Topic: Fall X2

Region: Delta Type of Idea: Operations/Adaptive Management

Timeframe: September through November; Following Above Normal and Wet Years

Species and Life stage: Delta Smelt

Current Requirement

2008 FWS BO – RPA Component 3 – Action 4: Estuarine Habitat During Fall

Objective: Improve fall habitat for delta smelt by managing of X2 through increasing Delta outflow during fall when the preceding water year was wetter than normal. This will help return ecological conditions of the estuary to that which occurred in the late 1990s when smelt populations were much larger. Flows provided by this action are expected to provide direct and indirect benefits to delta smelt. Both the direct and indirect benefits to delta smelt are considered equally important to minimize adverse effects.

Action: Subject to adaptive management as described below, provide sufficient Delta outflow to maintain average X2 for September and October no greater (more eastward) than 74 km in the fall following wet years and 81km in the fall following above normal years. The monthly average X2 must be maintained at or seaward of these values for each individual month and not averaged over the two month period. In November, the inflow to CVP/SWP reservoirs in the Sacramento Basin will be added to reservoir releases to provide an added increment of Delta inflow and to augment Delta outflow up to the fall target. The action will be evaluated and may be modified or as determined by the Service.

Background

Action 4 expressly requires that the Fall X2 action be adaptively managed, to ensure that the implementation of the action addresses the uncertainties of its effectiveness and water-efficiency. The action also states that as new information is developed and as circumstances warrant, changes to the Fall X2 action itself may be necessary. In 2011 Reclamation provided the Service with an updated Adaptive Management Plan that provided a framework to implement Fall X2. The AMP includes a review of Action 4 and evaluates habitat, X2 as a surrogate, evidence for the link between habitat and abundance, hydrology, and specifics of action. The key questions identified in the AMP that remain unanswered include ecological mechanisms that link outflow to abundance, other drivers of abundance, and if there are more water-efficient ways to provide the necessary benefits.

New scientific information has been developed since the 2008 BO. In 2011, the Interagency Ecological Program (IEP) Management, Analysis, and Synthesis Team (MAST) released the Fall Low Salinity Habitat (FLaSH) report to suggest studies to explore the importance of fall low-salinity habitat for Delta Smelt (Brown et al. 2014). The IEP MAST also developed the Final MAST Report in 2015, which included an updated Delta Smelt conceptual model.

As part of Action 4, FWS will be conducting a comprehensive 10-year review of the outcomes and effectiveness, including an independent peer review. This is anticipated to be completed in early 2019.

Ideas

1) Flexible Operation of Fall X2
    a. Modify averaging period to two months to allow for more flexible operations.
    b. Allow for 1-3 km variations based on hydrologic conditions, air temperatures, other factors
    c. Define future Adaptive Management actions for different scenarios
2) Suisun Marsh Salinity Control Gates (SMSCG) Re-operation
    a. Use SMSCG and Roaring River Distribution System (RRDS) in September and October to achieve habitat in Grizzly and Honker Bays following Above Normal and Wet Years
3) Remove December requirement

Any flexibility in operation gained from this proposal would need to be implemented in accordance with CDFW's Consistency Determination on the 2008 and 2009 BOs. Due to coordination in operation of the CVP and SWP, DWR would also need approval to implement an Adaptive Management flexibility in Fall X2.

Past Implementation

Since 2008 only two years have been classified as Above Normal or Wet Water Year types. In 2011, X2 for the months of September and October was at approximately 74 km. In 2017, the X2 location for September was 74 km. In October 2017, through coordination with FWS, Reclamation operated to 80 km (Delta Smelt Fall Outflow in 2017 Environmental Assessment [EA]). The two-month average for X2 in 2017 was planned as approximately 77 km. CDFW Consistency Determination

Current Science

Spawning Habitat – PCE 4 Salinity (2008 BO)
The LSZ expands and moves downstream when river flows are high. By capturing river flows, reservoirs can contribute to upstream movement of the LSZ which reduces habitat quality and quantity. Banks and Jones pumping likewise can result in upstream movement of the LSZ. Model results in the biological assessment show that in the future the location of the LSZ will generally be further upstream than occurred historically. This will result in a reduction in the amount and quality of spawning habitat available to delta smelt. These changes are primarily due to proposed future increases in upstream depletions and changes to reservoir operations and export pumping from the CVP/SWP.

Using lookup tables from the FLaSH Report (Table 2-1 in Brown et al. 2014) an X2 of 74 km would give a low salinity zone (LSZ) area of approximately 8,408 hectares (20,777 acres) and an X2 location of 81 km would give a LSZ area of approximately 5,313 hectares (13,129 acres) (Table A). In the lookup table, the largest increase in habitat between X2 kilometers is from 81 km (5313 hectares) to 80 km (6653 hectares). This represents an approximately 25.5% increase in habitat from a km difference in X2. This is seen as an inflection point that reaches habitat in

Grizzly Bay and Honker Bay, two key areas for delta smelt habitat. Figure 1 shows the same data in a plot. The line between 80 km and 81 km has the greatest slope, showing the greatest increase in habitat for a 1km difference in X2 location.

Table A – Lookup Table (Table 2-1) from Brown et al. 2014

X2 (km)	Area of LSZ (hectares)
73	8,585
74	8,408
75	8,231
76	8,380
77	8,162
78	7,959
79	7,369
80	6,653
81	5,313
82	5,051
83	5,075
84	4,753
85	4,483
86	4,492
87	4,456
88	4,463

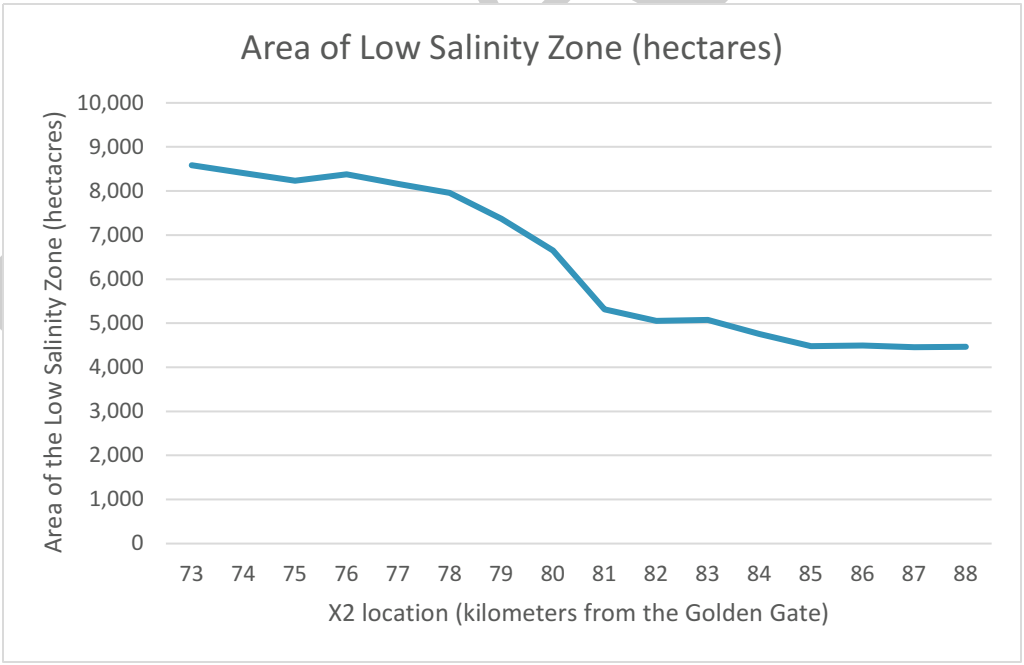


Figure 1: X2 location versus Area of the Low Salinity Zone

Justification

Idea 1: Flexible Operation of Fall X2

The UnTRIM Bay-Delta model, along with the lookup table, show effects from the location of X2 are not linear. The UnTRIM model shows a change in salinity between 80 and 81 km (Figures 2 and 3). As described in Bever et al (2016), Grizzly Bay and Honker Bay are key regions for Delta Smelt.

Figure 2. Percentage of time with salinity <6 for X2 = 80 km

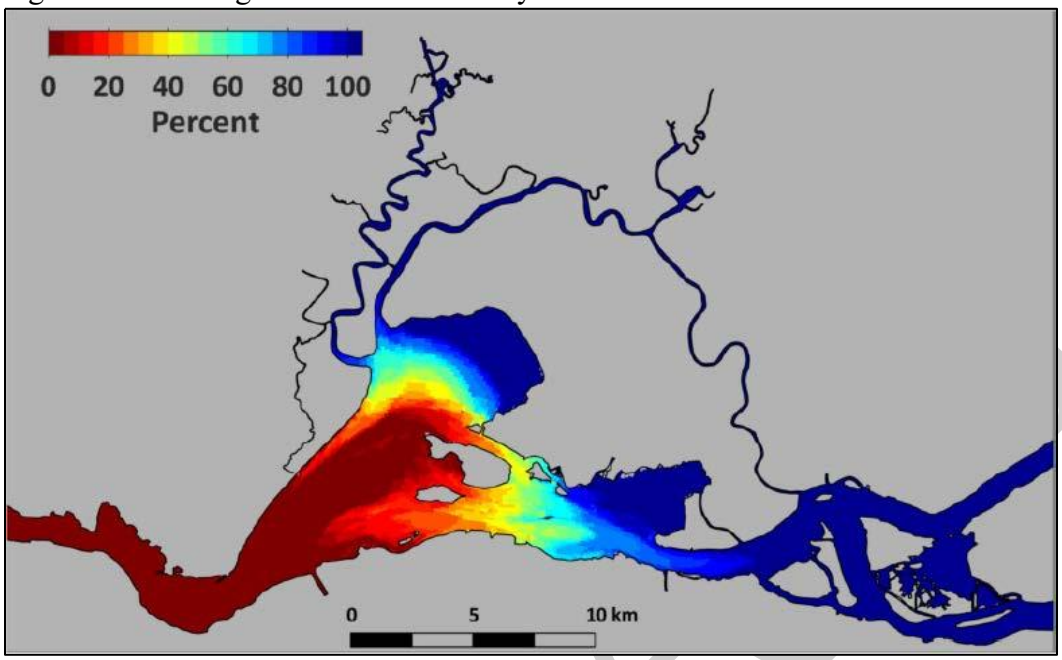
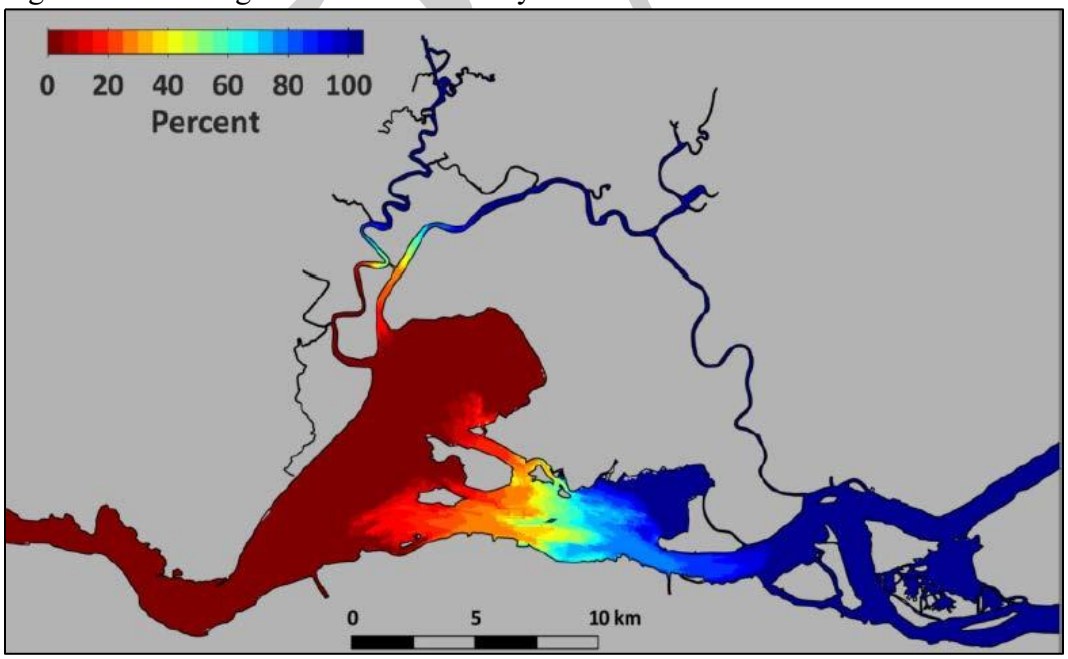


Figure 3. Percentage of time with salinity <6 for X2 = 81 km



The 2015 Environmental Impact Statement (EIS) on the Coordinated Long-term Operation of the Central Valley Project (CVP) and State Water Project (SWP) (LTO) found the X2 position ranged from 85.6 km to 92.3 km, depending on the water year type, with a long term average X2

position of 88.1 km (page 9-343). Using the lookup table, an X2 position of 88 km provides for approximately 4,463 hectares of LSZ.

Changing the AN Year (81 km) to two-month average may result in an increase of approximately 10-20% total hectares of LSZ compared to 81 km alone (Table B). Using the lookup table and a two-month average of 80 km (with up to 3 km variation) may result in an increase of approximately 20-25% total hectares of LSZ. A two-month average could also allow for more flexibility in operation. A similar exercise for W years (74 km) yielded less meaningful differences in LSZ.

Table B – Low Salinity Zone averages based on lookup table

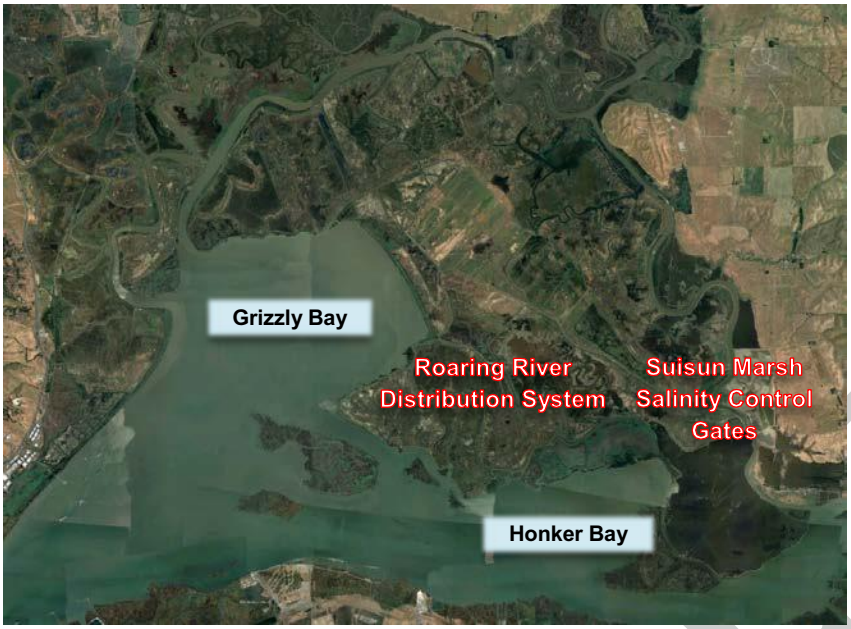
Above Normal Water Year					
September X2 (km)	October X2 (km)	Hectares of LSZ	Hectares of LSZ	Average (Hectares of LSZ)	Difference (Compared to 81 km)
80	82	6,653	5,051	5852	10.1%
79	83	7,369	5,075	6222	17.1%
78	84	7,959	4,753	6356	19.6%
81	81	5,313	5,313	5,313	N/A
82	80	5,051	6,653	5852	10.1%
83	79	5,075	7,369	6222	17.1%
84	78	4,753	7,959	6356	19.6%

The 2008 BO discusses that although habitat space may not be a limiting factor, habitat has become increasingly limited over time and has contributed to low population numbers. Action 4 of the RPA specifically states that 74 km and 81 km prescriptions are monthly averages and not to be averaged over the two months. This is presumably to avoid a large swing over the course of the each month. However, there could be another option: averaging the monthly averages. Taking the monthly averages and averaging them would be much less variable than taking the average of two months together.

Idea 2: Suisun Marsh Salinity Control Gates re-operation

Reclamation is looking at how water routed through Montezuma Slough by changing the operations of the SMSCG or different operations in the Roaring River Distribution System could help meet habitat objectives in Grizzly Bay and Honker Bay.

Flow management will be more effective in confined regions where existing flows are small, rather than broadly across the entire Delta (Brown et al. 2008).



Modeling Assumptions

Idea 1: Flexible Operation of Fall X2

Reclamation has completed some initial model runs looking at a two-month average. The CalSim II model runs looked at 82 years Q5E – September to end of May Mean "Annual" difference (TAF) from NAA – W or AN years (which occurred 38 times). The model runs looked at 1, 2, and 3 km variations in each direction for September and October for 74 km and 81 km. The initial model runs look like changing the Wet Year (74 km) to two-month average doesn't really change the amount of LSZ or provide much water supply benefit. Next steps for modeling may include looking average differences in acre-feet in Wet and Above Normal years separately.

Table C – Modeling Assumptions

September allowed extra 1km in, Pushed out 1 km in October
September allowed extra 2km in, Pushed out 2 km in October
September allowed extra 3km in, Pushed out 3 km in October
September pushed out 1km, allowed extra 1km in October
September pushed out 2km, allowed extra 2km in October
September pushed out 3km, allowed extra 3km in October

Idea 2: Suisun Marsh Salinity Control Gates re-operation

The modeling assumptions for Idea 2 would be to release 30 TAF over the months of September and October following AN and W years in place of Fall X2 requirements. SMSCG and RRDS would be operated to maximize the amount of the additional 30 TAF of water that moves into Grizzly and Honker Bays. Proposed modeling includes CalSim II and DSM2 with specific assumptions and scenarios still being discussed.

References

Bever, Aaron J.; MacWilliams, Michael L.; Herbold, Bruce; Brown, Larry R.; and Feyrer, Frederick V. (2016). Linking Hydrodynamic Complexity to Delta Smelt (Hypomesus transpacificus) Distribution in the San Francisco Estuary, USA. San Francisco Estuary and Watershed Science, 14(1).

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Interagency Ecological Program, Management, Analysis, and Synthesis Team (IEP MAST). 2015. An updated conceptual model of Delta Smelt biology: our evolving understanding of an estuarine fish. Technical Report 90. January. Interagency Ecological Program for the San Francisco Bay/Delta Estuary, Sacramento, CA.