Background and Technical Basis for the Biological Opinions

Delta Smelt Biological Opinion

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Disclosures

- Recent and Current Projects
  - *DWR*
    - *Georgiana Slough Non-physical Barrier Experiment*
    - *Fish Screen Evaluations (NBA, Suisun RRDS, Sherman Island)*
    - *Head of Old River Barrier and Temporary Barriers Program*
    - *Franks Tract Project*
    - *Dutch Slough Restoration Project*
    - *Lower San Joaquin River Erosion Repairs PBA*
  - *SFCWA*
    - *Salmon Recovery Group*
  - *CCWD*
    - *Alternative Intake Project*

Presentation Agenda

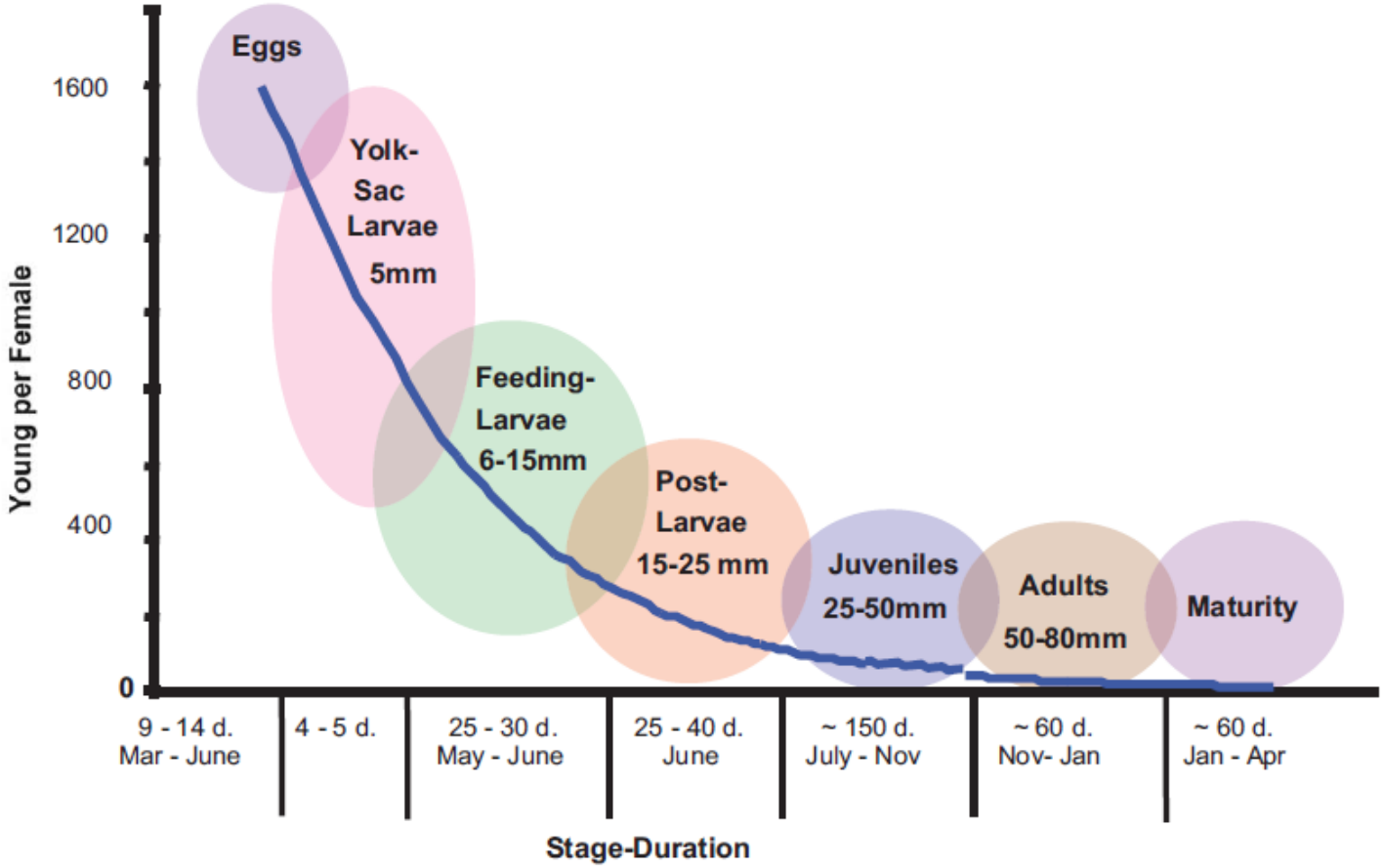
- Summary Overview of Delta Smelt Biology and Status
- Summary of Effects of the Proposed Action
- Reasonable and Prudent Alternative Actions
- Updates and Rulings
- Questions and Answers

Summary Overview of Delta Smelt Biology and Status

- Distribution and Range
  - Delta smelt are endemic to the Bay-Delta
  - Range extends from San Pablo Bay upstream to Verona on the Sacramento River and Mossdale on the San Joaquin River
  - Formerly considered to be one of the most common pelagic fish in the Bay-Delta

Summary Overview of Delta Smelt Biology and Status

- Conceptual model of delta smelt life history



Source: Bennett 2005

Summary Overview of Delta Smelt Biology and Status

- Biology and Life History
  - Adult Migration and Spawning
    - In LSZ prior to spawning
    - Adults undergo a spawning migration from brackish water to freshwater annually – triggered by changes in flow and turbidity associated with the “first flush”
    - Adults spawn during the late winter and spring, with most occurring during April through mid-May
    - Spawning occurs primarily in sloughs and shallow edge areas in the Delta; also recorded in Suisun Marsh and the Napa River

Summary Overview of Delta Smelt Biology and Status

- Biology and Life History
  - Larval Development
    - Eggs attach to substrate and hatch in 8 to 13 days
    - Most larvae move downstream toward the low salinity zone (LSZ)
    - At all life stages, delta smelt are found in greatest abundance in the water column and usually not in close association with the shoreline
    - Successful feeding seems to depend on a high density of food organisms and turbidity

Summary Overview of Delta Smelt Biology and Status

- Biology and Life History
  - Juveniles
    - Young-of-the-year rear in the LSZ from late spring through fall and early winter
    - The LSZ historically had the highest primary productivity
    - Juveniles are sight feeders that prey upon copepods, cladocerans, amphipods, and insect larvae
    - Data indicate that they seem to prefer water with high turbidity (feeding and defense mechanisms)

Factors Affecting Delta Smelt

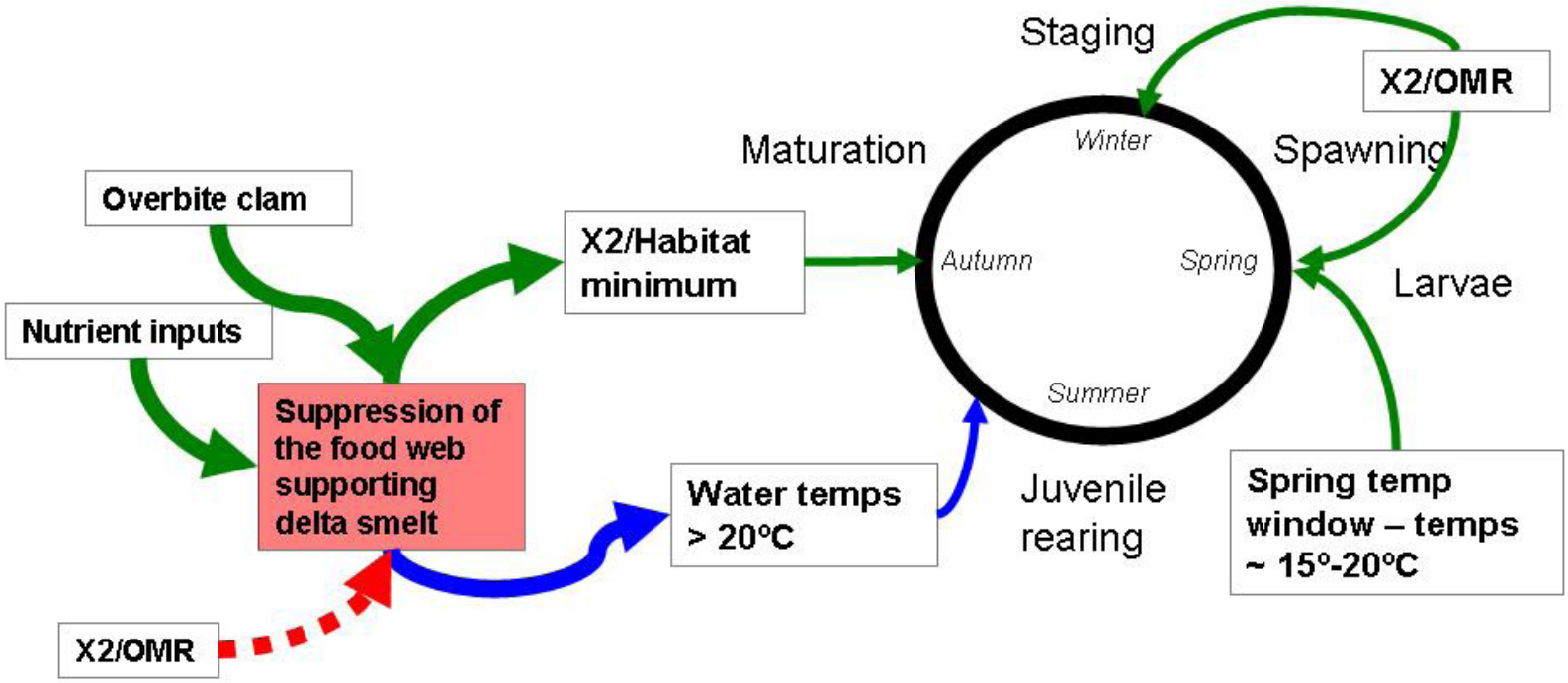
- Land use conversion (direct loss/modification of habitat)
- Reservoir operations and diversions
  - Entrainment
  - Habitat modification
    - Decreased spring flows, increased summer and fall inflows
    - Changes in salinity, water temperatures, turbidity
- Other important stressors
  - Aquatic macrophytes, predators, competition, food web and forage dynamics, contaminants, toxic blue-green algae

Past, Present, and Ongoing Effects

- Past and present diversions of water from the Delta have resulted in numerous adverse effects:
  - a reduction in rearing and foraging habitat
  - net negative flows in the south and central Delta
  - increased entrainment of all life stages
  - altered the LSZ by moving it eastward, resulting in:
    - decreased habitat area
    - movement of adults closer to the central Delta where vulnerabilities are increased

Summary Overview of Delta Smelt Biology and Status

- Lifecycle Conceptual Model For Delta Smelt



Source: USFWS OCAP BO

Effects of the Proposed Action

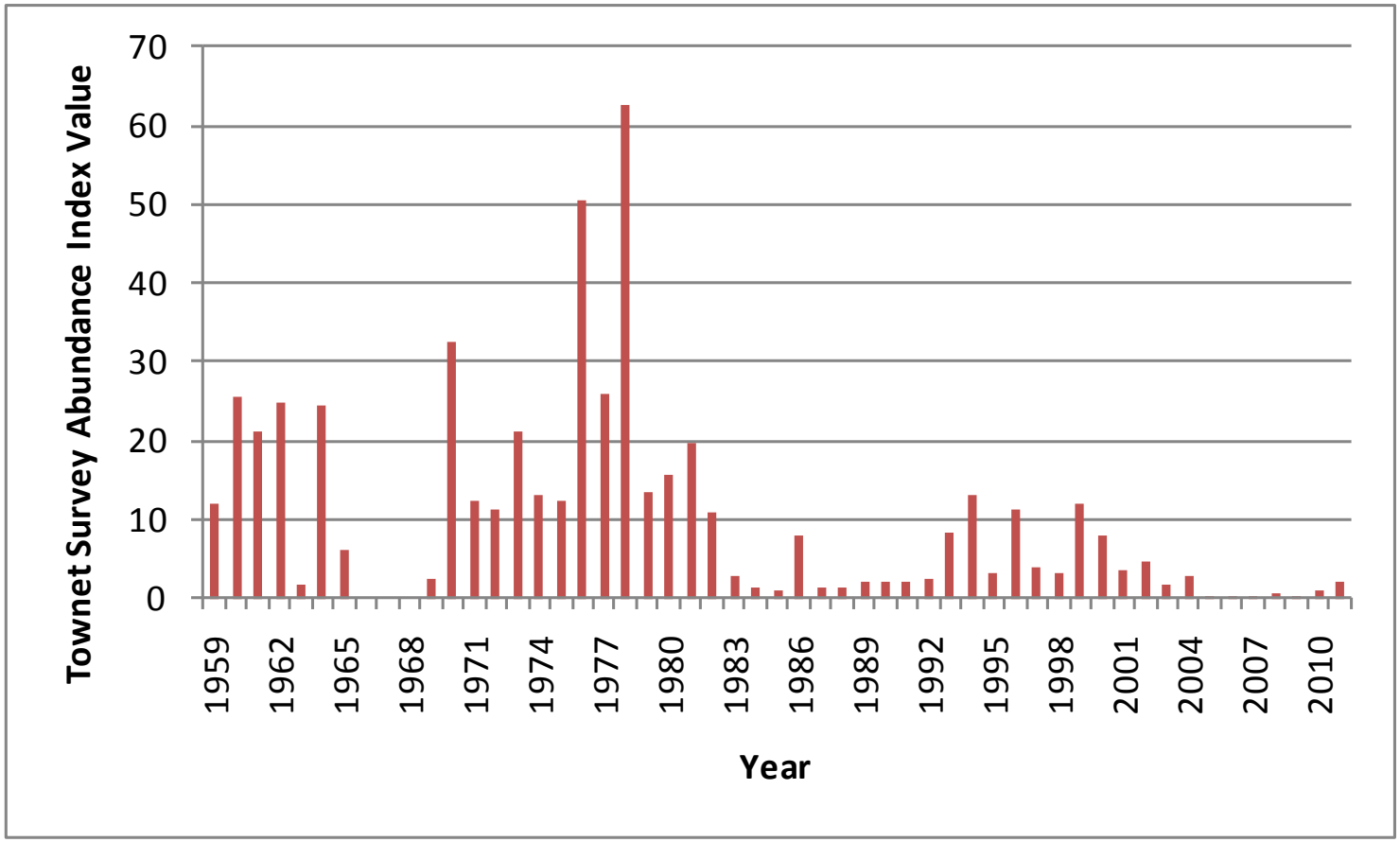
- Under the proposed operations inflows to the Delta are likely to be further reduced:
  - increased relative entrainment
  - OMR flows are expected to become more negative, resulting in higher entrainment
  - reduced Delta outflows, further altering the LSZ and resulting in reduced habitat and shifts in position where there are increased vulnerabilities

Effects of the Proposed Action

- Other baseline stressors will continue to adversely affect the species
- Increased pumping at the export facilities corresponds to the decline of the delta smelt population
- Resilience of the delta smelt population is currently at or near its lowest level

- *Continued operation likely to jeopardize existence of the species*

Delta Smelt Abundance Trends



Source: http://www.dfg.ca.gov/delta/data/townet/indices.asp?species=3

Reasonable and Prudent Alternative

- Regulations implementing Section 7 of the ESA define reasonable and prudent alternatives as alternative actions that:
  - can be implemented in a manner consistent with the intended purpose of the action;
  - can be implemented consistent with the scope of the action agency's legal authority and jurisdiction;
  - are economically and technologically feasible; and
  - would avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

Reasonable and Prudent Alternative

Action 1: Adult Migration and Entrainment (First Flush)

Objective -	Protect pre-spawning adults from entrainment
Action –	Limit OMR to ≥ -2,000 cfs for 14 days
Timing –	A) Dec 1 to Dec 20 – examine turbidity, position of X2, fish distribution, river flows – SWG recommends start date to USFWS
	B) After Dec 20 – 3 day average turbidity at Prisoners Point, Holland Cut, and Victoria Canal – SWG recommends start date
Triggers –	Turbidity – 3 day average of 12 NTU or greater
	Salvage – 3 days of smelt salvage above risk threshold
Off-ramps –	Temperature reaches daily mean of 12°C at Mossdale, Antioch, and Rio Vista
	Onset of spawning

Reasonable and Prudent Alternative

Action 1: Adult Migration and Entrainment (First Flush)

Background- Adult entrainment characterized by pulse of pre-spawning migrants entering central and south Delta following "first flush"

Result is increased vulnerability to entrainment

Justification- *Turbidity*: turbidity is indicator of smelt migration; timing is variable, thus, initiation is based on conditions

Salvage: During some years, smelt have been salvaged prior to turbidity increases; salvage trigger allows for protection and flexibility

OMR flows: correlation between OMR reverse flows and salvage

Off-ramp: Temp of 12°C used as surrogate for timing of spawning

Reasonable and Prudent Alternative

Action 2: Adult Migration and Entrainment

Objective -	Adaptive: to follow Action 1 and tailor protection to protect pre-spawning adults from entrainment
Action –	Adaptive: limit OMR to ≥ -1,250 to -5,000; specific criteria dependent on other conditions (i.e., turbidity, salvage, and judgment)
Timing –	Immediately after Action 1 (if Action 1 not implemented, then SWG may recommend a start date)
Suspension –	3 day flows ≥ 90,000 cfs in Sac R at Rio Vista *and* ≥ 10,000 cfs in SJ R at Vernalis
Off-ramps –	Temperature reaches daily mean of 12°C at Mossdale, Antioch, and Rio Vista
	Onset of spawning

Reasonable and Prudent Alternative

Action 2: Adult Migration and Entrainment

Background- Extends protection when warranted (adaptive) based on variable conditions

Justification- *Salvage*: Salvage trends trigger variable OMR flow criteria and allows for protection and flexibility

OMR flows: correlation between OMR reverse flows and salvage

Off-ramp: Temp of 12°C used as surrogate for timing of spawning; Sac and SJ R flows are protective

Reasonable and Prudent Alternative

Action 3: Entrainment Protection of Larval Smelt

Objective -	Adaptive: minimize larval smelt from entrainment by managing hydrodynamics in central Delta
Action –	Adaptive: limit OMR to ≥ -1,250 to -5,000; specific criteria dependent on other conditions (i.e., sampling data, flow, turbidity, salvage, modeling, and judgment) – SWG makes recommendations to USFWS
Timing –	Based on triggers (generally March – June 30)
Triggers –	Temperature reaches daily mean of 12°C at Mossdale, Antioch, and Rio Vista
	Onset of spawning (presence of spent females)
Off-ramps –	June 30
	Temperature reaches daily mean of 25°C for 3 consecutive days at Clifton Court Forebay

Reasonable and Prudent Alternative

Action 3: Entrainment Protection of Larval Smelt

Background- Adaptive: protects larval smelt by limiting reverse OMR flows at variable levels depending on smelt distributions throughout Delta

Justification- *Timing*: window for smelt spawning is variable based on seasonal conditions – need for adaptive timing

Salvage: salvage trends trigger variable OMR flow criteria and allows for protection and flexibility

OMR flows: correlation between OMR reverse flows and salvage

Off-ramp: temp of >25°C, conditions are no longer suitable for smelt

Reasonable and Prudent Alternative

Action 4: Estuarine Habitat During Fall

Objective - Adaptive: improve fall habitat by managing X2 through increasing Delta outflow during fall when proceeding water year is wetter than normal; will provide direct and indirect benefits

Action – Adaptive: provide sufficient Delta outflow to maintain average X2 position for Sept and Oct no greater (more eastward) than 74 km in fall following wet years and 81 km in fall following above normal years; in Nov, inflow to CVP/SWP reservoirs in Sac Basin will be added to reservoir releases to provide added incremental releases, Delta inflow, and augment Delta outflow up to fall target– Action will be evaluated and could be modified or terminated by USFWS

Reasonable and Prudent Alternative

Action 4: Estuarine Habitat During Fall

Timing – Sept 1 to Nov 30

Triggers – Wet and above normal water year types

Adaptive – Adaptive management of this action include the following:

1) Delta smelt habitat study group
2) Conceptual model review and prep of study design
3) Performance evaluation of the Action
4) Studies to understand relationship between smelt habitat qualities and smelt production
5) Peer review
6) USFWS review and adjustment

Reasonable and Prudent Alternative

Action 4: Estuarine Habitat During Fall

Background- Higher Delta outflows formerly occurred in fall months of all but drought water years; currently, fall outflows are similar to droughts regardless of water year type

Fall habitat area is a significant covariate in delta smelt stock-recruitment relationship

Westward and variable locations of fall habitat provide increased habitat area and moves population away from future entrainment risks

Justification- Proposed Action would have adverse effects on fall habitat associated with position of X2; this Action would address those effects

Reasonable and Prudent Alternative

Action 5: Temporary Spring Head of Old River Barrier (HORB) and the Temporary Barrier Project (TBP)

Objective -	Minimize entrainment of larval and juvenile smelt or from being transported into the south and central Delta, where they could be entrained
Action –	Adaptive: Do not install HORB if smelt entrainment is a concern; if HORB is not installed, ag. barriers would be installed
Timing –	Timing based on conditions; normal installation of HORB and TBP is April
Triggers –	Installation of HORB would only occur when PTM shows that entrainment will not increase beyond 1% at station 815
Off-ramps –	If Action 3 ends or May 15, whichever is first

Reasonable and Prudent Alternative

Action 5: Temporary Spring HORB and the TBP

Justification- Installation of the HORB and TBP changes hydrodynamics and can increase reverse flows in central and south Delta, which can increase entrainment risk

OMR flow criteria provided in Action 3 would reduce the potential affects of HORB and TBP

Reasonable and Prudent Alternative

Action 6: Habitat Restoration

Objective - Improve habitat conditions for smelt by enhancing food production and availability

Action – Program to create or restore a minimum of 8,000 acres of intertidal and subtidal habitat in Delta and Suisun Marsh; monitoring program shall be developed to focus effectiveness of restoration program

Timing – Restoration efforts shall begin within 12 months (of signed BO) and completed within 10 year period

Reasonable and Prudent Alternative

Action 6: Habitat Restoration

Justification- Almost all of the historic wetlands have been lost due to land use conversion

Pelagic productivity has been declining in the Delta

The base on the food web is dependent on wetlands for carbon inputs, primary and secondary productivity

Evaluations have provided evidence that smelt have been food-limited during summer months

Tidal marsh may benefit delta smelt even if they do not occur within the marsh itself

Updates

- Draft BO by October 1, 2011
- Final BO and RPA , as well as required NEPA analysis by December 1, 2013

Questions and Answers