Freshwater Flow:
The missing element in the Bay Delta Conservation Plan

JONATHAN ROSENFIELD, PH.D.
CONSERVATION BIOLOGIST

The Bay Institute
The Bay-Delta’s Imperiled Public Trust Fisheries

Species at or near all-time low abundances:

- Four unique Chinook salmon populations
- Central Valley steelhead
- Green sturgeon
- Delta smelt
- Longfin smelt
- Striped bass (YOY)
- Steelhead
- Shrimp and other prey species
Bay-Delta’s Public Trust Fisheries:
Parallel, Long-Term, Catastrophic Declines

LONGFIN SMELT
1967-2011

Delta Smelt
1967-2011

Winter-Run Chinook
1970-2010

Striped Bass Age 0
1967 - 2011
Decline of San Joaquin River Fall Run Chinook salmon

San Joaquin River Estimated Natural Production

'Doubling goal 78,000

'SJF Production

'52-'66
45,190

'67-'91
38,130

'92-'10
19,365


Production (x1000)

0 20 40 60 80 100 120
Bay-Delta Conservation Plan (BDCP)

Water exporter initiative to address:

- **Entrainment**: Build new water diversion w/ improved fish screening technology
- **Shallow Habitat**: Restore thousands of acres of tidal wetlands

In return for:
- 50 year ESA take permit
Bay-Delta Conservation Plan

Must

• Contribute to recovery of:
  • 12 fish species,
  • 23 terrestrial vertebrates,
  • 19 plant species, &
  • 7 invertebrates

• Improve *reliability* of water supply

Assumes:

• New diversion eliminates “entainment” problems

• Habitat restoration *more than compensates* for increased diversions
Restore Shallow Water Habitats
Only ~5% of historical wetlands and riparian habitat remains
Resolve Entrainment Problems

Location and Operation of South Delta Water Export Facilities are Problematic

- Abundance Effects
- Life History Diversity Erosion
- Habitat Destruction
- Loss of Productivity
Entrainment as a Multi-faceted Problem

Abundance Impacts

Measured fish “salvage” \(>9 \times 10^6\) fish/yr at South Delta exports facilities

Actual mortality may be \(>100x\) measured
Entrainment as a Multi-faceted Problem

Habitat Destruction
Entrainment as a Multi-faceted Problem

Productivity Impacts

~three 50’ boxcars worth of water (& food) exported every second

“Water export from the Sacramento-San Joaquin Delta is a direct source of mortality to fish... and export plus within-Delta depletion alters system energetics of an already low-productivity ecosystem by removing phytoplankton biomass equivalent to 30% of Delta primary production.” [Cloern and Jassby 2012].
Changing Location of Diversion + Habitat Restoration do not Address the Bay-Delta’s Biggest Problem

Declining Freshwater Flow
Bay-Delta Subjected to Persistent, Severe Drought
Dramatic Change in Frequency of Wet vs. Catastrophically Dry Years

**Hydrology Since 1967**

<table>
<thead>
<tr>
<th>Yr Type</th>
<th>Unimpaired</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Super-Critical</td>
<td>1</td>
<td>17</td>
</tr>
</tbody>
</table>

**Water Year Type Classifications**

- ~20% exceedence categories
- “Super Critical” (SC) = 97.5% exceedence
Delta outflows drive species abundance & ecosystem processes
Delta outflows drive species abundance & ecosystem processes

**Starry Flounder Abundance vs. Delta Outflow**

- Log (Abundance); Bay Study Index + 10
- Log (Spring Delta Outflow); Mar - Jun, Mlm³

- Blue circles: Abundance 1980 - 1987
- Red triangles: Abundance 1988-2011
Delta outflows drive species abundance & ecosystem processes

**LONGFIN SMELT VS. DELTA OUTFLOW**

- Log (Abundance) vs. FMWT Index
- Abundance 1967-1987
- Abundance 1988-2011

Log (Net Delta Spring Outflow); Mar-May, TAF
San Joaquin Salmon and Flows
A shared history of decline

San Joaquin River Natural Chinook Salmon Production vs. Vernalis Flow

Doubling goal 78,000

'67-'91 38,130

'92-'10 19,365

A shared history of decline
What do these declining Delta species have in common?

<table>
<thead>
<tr>
<th>Species</th>
<th>Native?</th>
<th>Life span (years)</th>
<th>Resident/Migratory?</th>
<th>Spawns Where?</th>
<th>Abundance correlated w/ Delta in-, thru-, out-flow?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinook salmon</td>
<td>Yes</td>
<td>3-5</td>
<td>Anadromous</td>
<td>River</td>
<td>Yes</td>
</tr>
<tr>
<td>Striped bass</td>
<td>No</td>
<td>4-10</td>
<td>Anadromous</td>
<td>River</td>
<td>Yes</td>
</tr>
<tr>
<td>Green sturgeon</td>
<td>Yes</td>
<td>Decades</td>
<td>Anadromous</td>
<td>River</td>
<td>Yes</td>
</tr>
<tr>
<td>Delta smelt* (Fall X₂)</td>
<td>Yes</td>
<td>1</td>
<td>Resident</td>
<td>Delta</td>
<td>Yes</td>
</tr>
<tr>
<td>Longfin smelt</td>
<td>Yes</td>
<td>1-3</td>
<td>Both</td>
<td>Delta/Suisun</td>
<td>Yes</td>
</tr>
<tr>
<td>Starry flounder</td>
<td>Yes</td>
<td>7-8</td>
<td>Catadromous</td>
<td>Ocean</td>
<td>Yes</td>
</tr>
<tr>
<td>Sac. Splittail</td>
<td>Yes</td>
<td>5-7</td>
<td>Resident</td>
<td>Shallow FW</td>
<td>Yes</td>
</tr>
<tr>
<td>Am. Shad</td>
<td>No</td>
<td>5-7</td>
<td>Migratory</td>
<td>River</td>
<td>Yes</td>
</tr>
<tr>
<td>Bay shrimp</td>
<td>Yes</td>
<td>1.5-2.5</td>
<td>Catadromous</td>
<td>Ocean</td>
<td>Yes</td>
</tr>
<tr>
<td>Calanoid Copepods</td>
<td>Yes/No</td>
<td>&lt;1</td>
<td>Resident</td>
<td>Varies</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Best Available Science Strongly Supports Restoration of Freshwater Flow Patterns as a Necessary for Ecosystem Restoration:

**State Water Resources Control Board (2010)**  “The best available science suggests that current flows are insufficient to protect public trust resources. [p.2]

**US Fish and Wildlife Service (2010)**  “...flow in the Delta is one of the primary determinants of habitat availability and one of the most important components of ecosystem function”

**California Department of Fish and Game (2010)**  “Recent Delta flows are insufficient to support native Delta fishes in habitats that now exist in the Delta”.[p. 94]

And

“... restoration for both salmon and steelhead in the SJR primarily hinges on obtaining sufficient magnitude, duration and frequency of spring time flows...”

**San Francisco Estuary Project (2011)**  “Scientists now consider poor freshwater inflow conditions to be one of the major causes for the ongoing declines of fish populations observed in the upper Estuary [p.23].

**National Research Council (2012)**  “... if the goal is to sustain an ecosystem that resembles the one that appeared to be functional up to the 1986-93 drought, exports of all types will necessarily need to be limited in dry years, to some fraction of unimpaired flows that remains to be determined...” [p. 105]
Problems for the BDCP

- Delta inflow and outflow are unchanged or reduced under most circumstance
  - Negative impacts to flow dependent species, particularly those that rely on Delta outflow

Operations may not be permitable
Problems for the BDCP

• Entrainment mortality is not significantly reduced for most species
  – Entrainment is not a problem under status quo conditions (???)

Conservation Measure #1 (New North Delta Conveyance) may not be a conservation measure
Problems for the BDCP

• Effects of Shallow Water Habitat Restorations:
  – Uncertain,
  – Unequally Distributed,
  – Occur in the Distant Future, and
  – Unlikely to Benefit Species that Do Not Use Shallow Water Habitats

Habitat restoration and improvements to flow are both necessary – neither is sufficient alone and their effects are not interchangeable
Problems for the BDCP

- Shifting Baselines
  - Incorporates existing Biological Opinions selectively
  - Defines current export baseline differently when evaluating economic v. biological effects
  - Assumes existing infrastructure and operations will not be altered (e.g. in response to regional climate change)
  - Applies threshold of significant impacts in a systematically biased fashion

Administrative Draft Environmental Documents
Not Credible
Available at: www.bay.org/publications

The Bay Institute