

# Delta Operations and Hydrology: The Winter Salvage Hypothesis

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## Background

- Delta hydrology is complex
  - Inflow: Seasonal and annual variation
  - Tidal effects.
- How operations affects hydrology.
  - Upstream dam operations.
  - Water diversions.
  - South Delta barriers.

## Recent Changes in Delta Operations and Hydrology

- The period since 2000 has had relatively high Sacramento River flow and low San Joaquin River flow (Figure 1).
- SWP and CVP exports have generally increased since 2000 (Figure 2).
- The seasonal pattern of exports has changed in recent years (Figure 3).
  - Increased winter exports.
  - Reduced spring exports.
  - More summer exports.
- South Delta barriers have been operated for longer periods.

## Trends in Fish Salvage

- Fish are salvaged at SWP and CVP fish screens.
- The number of fish collected is used as a crude measure of project effects (“entrainment”).
- Patterns in delta smelt salvage since 2000 (Figure 4).
  - Winter salvage of adult delta smelt (the spawning stock) has increased substantially.
  - Winter salvage was relatively high even after “correcting” for higher pumping rates.
  - Winter salvage was especially high considering the low smelt population in the delta.
- The other pelagic fishes (striped bass, longfin smelt, threadfin shad) showed a similar pattern of increased winter salvage.

## **The Winter Salvage Hypothesis**

- Have increased winter exports adversely affected pelagic fishes?

## **Follow-Up Studies**

- Are the salvage results a result of data error?
- If not, what are the mechanisms responsible for increased winter salvage?
  - Hydrodynamic effects?
  - Fish health?
  - Habitat changes?
- Is the recent pattern similar to that occurring in the late 1980s and early 1990s?
- Could winter fish losses at the pumps have population level effects on pelagic fishes?