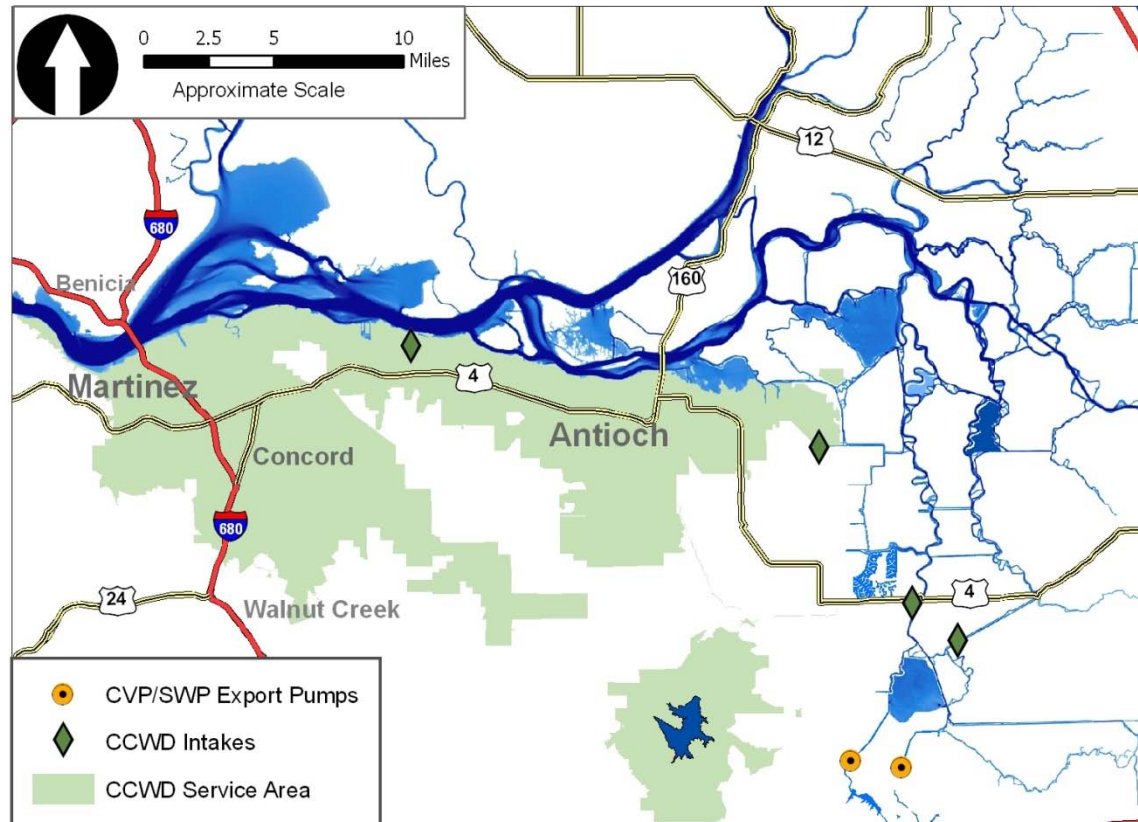# Use of an Index for Old and Middle River Flow Objectives

State Water Resources Control Board
Comprehensive (Phase 2) Review and Update to the Bay-Delta Plan
Workshop 2: Bay-Delta Fishery Resources

CONTRA COSTA
WATER DISTRICT

October 2, 2012

Contra Costa Water District

- Location: In-Delta diverter, serving Bay area

- Beneficial Use: primarily M&I; 500,000 customers

- Water rights: CCWD and CVP contract

Recommendation for State Board

If the State Board chooses to implement flow objectives for Old and Middle River (OMR), use a flow index rather than USGS OMR.

Why use an index for OMR?

- Motivation
  - Current method has implementation problems
  - During March 2010 Delta Flow workshops, State Board asked stakeholders to recommend a solution.

- Objectives of flow index approach:
  - Resolve current implementation issues
  - Provide fish protection equivalent to the current method that uses USGS OMR

Current Implementation Issues

- ## Daily values are not available in real-time
  - ### Artifact of the calculation

Daily average tidally filtered USGS values for today depends on flows that occur in the future.

— Measurements
— Tidally Filtered
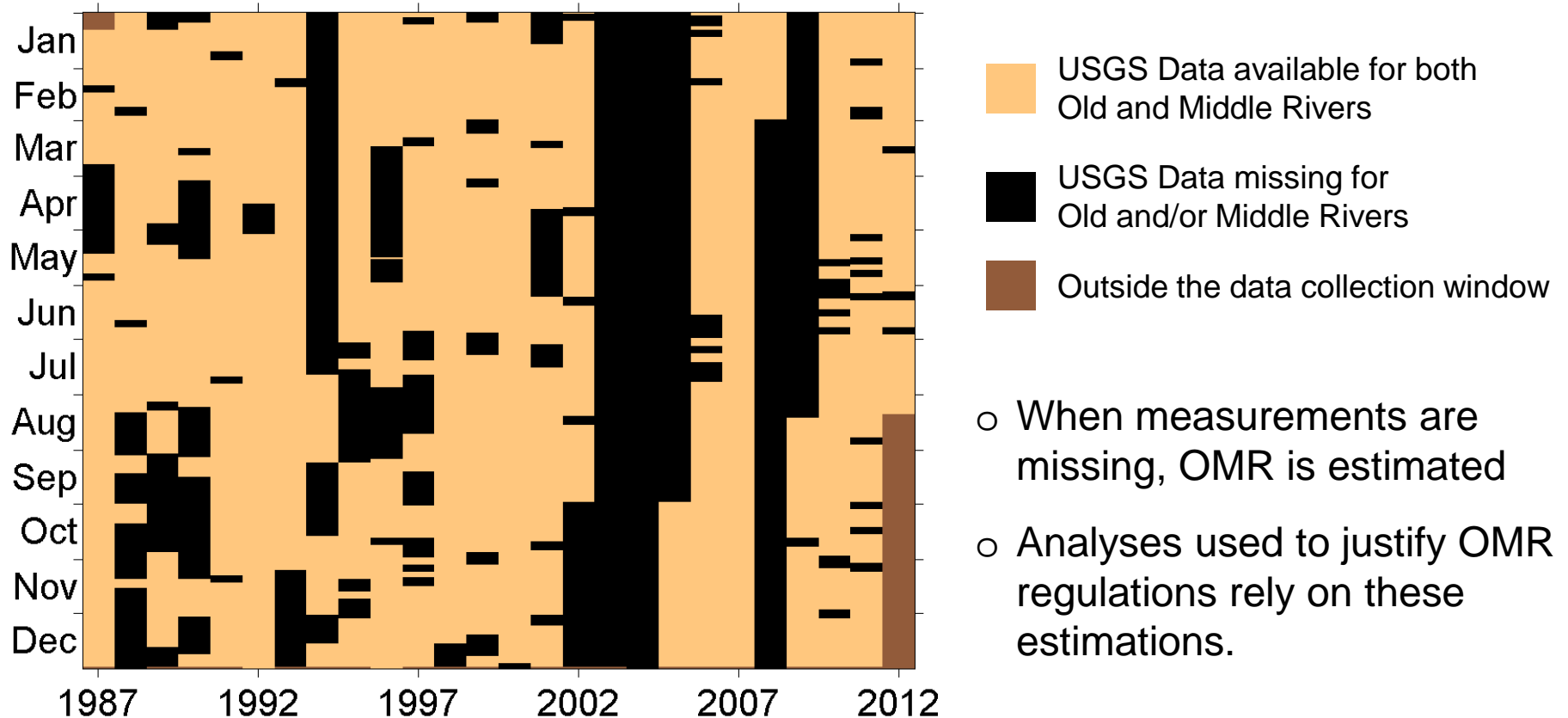■ Daily Average Tidally Filtered

~3 day lag
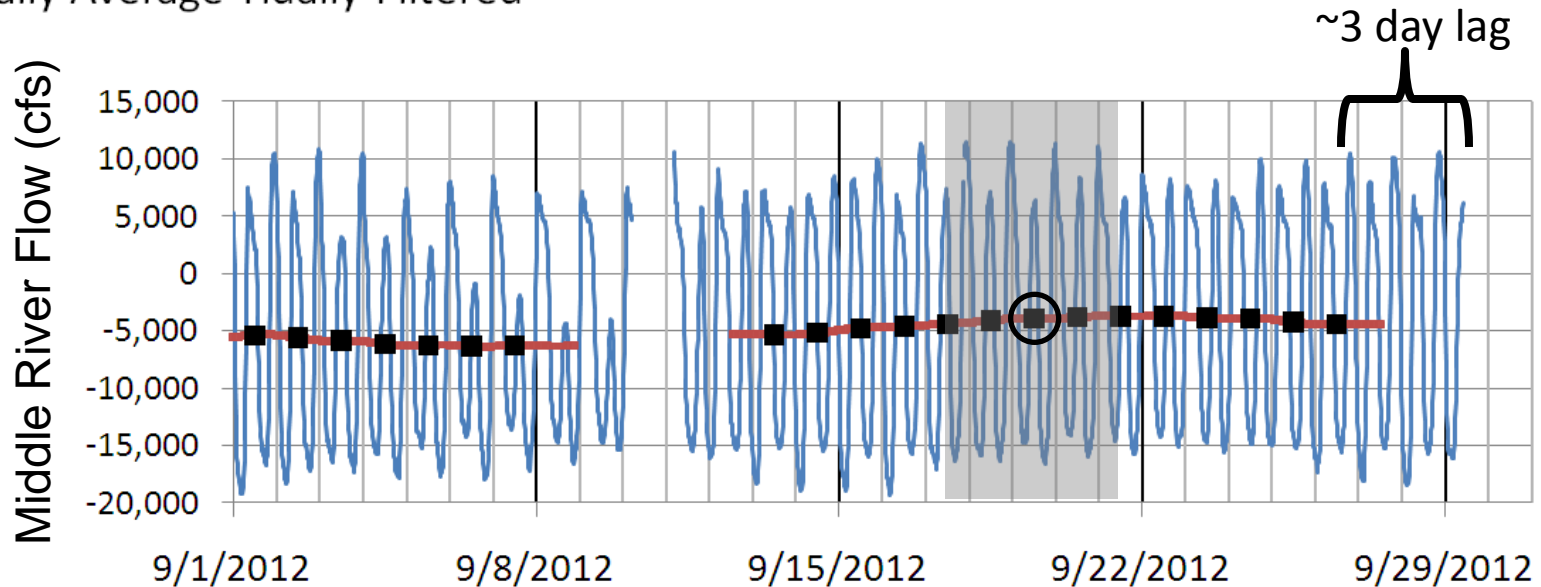
Data source: USGS station 11312676 downloaded from USGS NWIS September 29, 2012.

Current Implementation Issues

- Daily values are not available in real-time
  - Artifact of the calculation:

    Daily average tidally filtered USGS values for today depends on flows that occur in the future.

  - Complicates operational decisions
  - Impossible to determine compliance in real-time

Current Implementation Issues

- Daily values are not available in real-time

- Measurements are missing over 30% of the time

USGS Data available for both Old and Middle Rivers

USGS Data missing for Old and/or Middle Rivers

Outside the data collection window

o When measurements are missing, OMR is estimated

o Analyses used to justify OMR regulations rely on these estimations.

Current Implementation Issues

- Daily values are not available in real-time
- Measurements are missing over 30% of the time
- Forecasting project operations is complicated by other factors that affect OMR
  - Noise in the measurements
  - Changes in flow due to wind, atmospheric pressure, precipitation, channel barriers and local in-Delta diversions and return flows.

Proposed Solution

- Objectives should be based on a flow index, rather than the USGS OMR

- Benefits of a flow index
  - Based on readily available information
    - Improves operations forecasting
    - Allows determination of compliance
  - Remains representative of regional hydrodynamics
  - Remains protective of fish

Flow Index based on readily available information

- If HORB is not installed:

$$Flow\ Index = 0.42 * \overline{Q_{SJR}} - 0.87 * Q_{Exports}$$

- If HORB is installed:

$$Flow\ Index = -0.79 * Q_{Exports}$$

Flow Index remains representative of regional hydrodynamics

- USGS OMR is itself an index
  - USGS OMR is an index of flow at two locations
  - USGS OMR is estimated over 30% of the time (incorporates another index)
- Particle Tracking Model (PTM) provides a more comprehensive representation of regional hydrodynamics, so we examine PTM results under different OMR values.

Particle Tracking Simulations
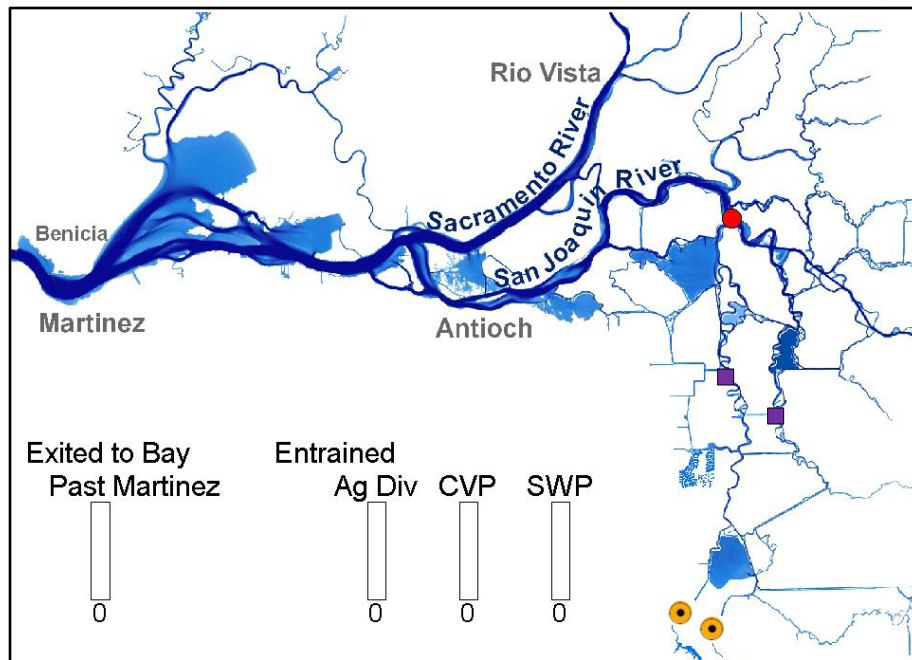
USGS OMR = -4,600 cfs　　　　　　　　USGS OMR = -4,850 cfs
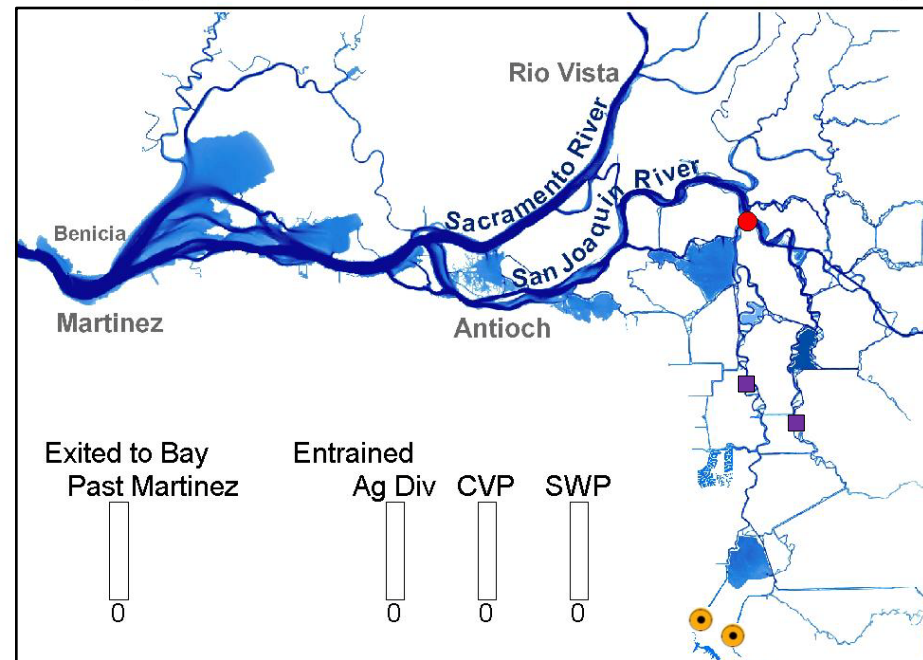
Model assumptions:
- historical inflows and tides
- release 1000 particles over 25 hour period (2 tidal cycles)
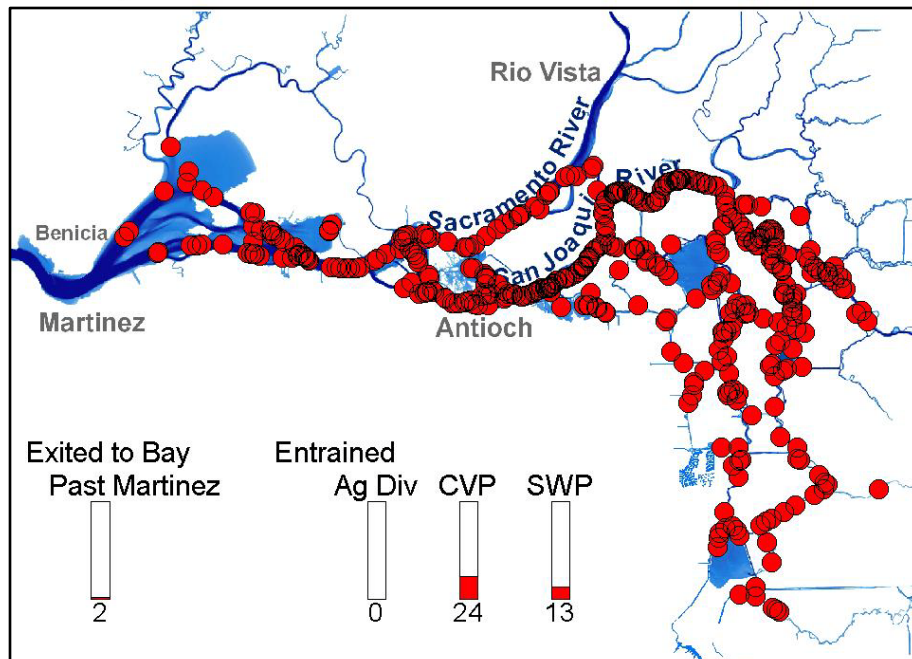
Particle Tracking Simulations
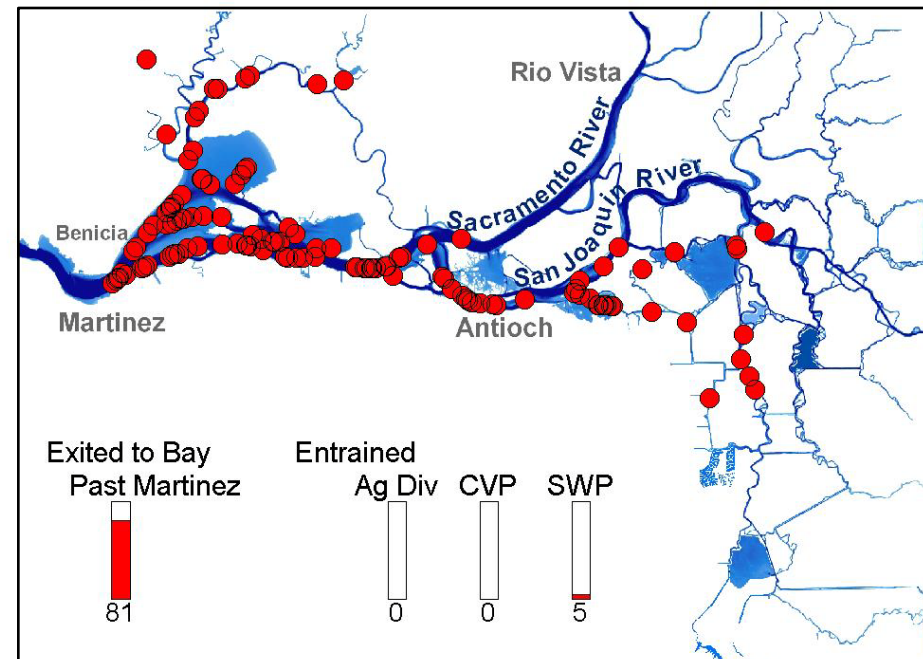
Two time periods with very similar OMR values show very different particle transport.

Flow Index reflects regional hydrodynamics

Release location:
San Joaquin River near
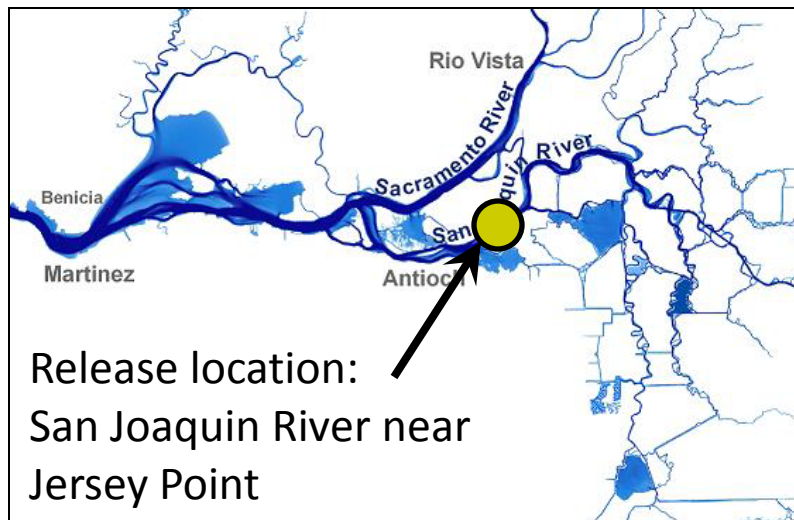mouth of Old River
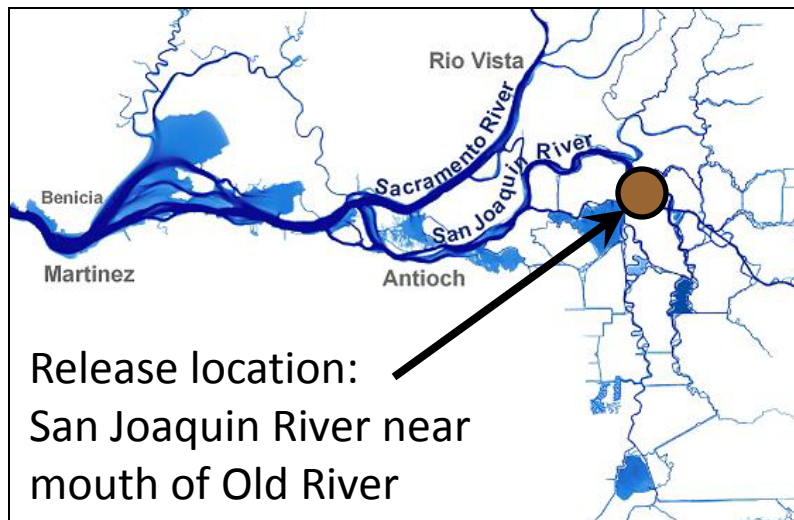
- Entrainment increases as USGS OMR and Flow Index become more negative

- Considerable scatter such that a given OMR or Flow Index does not precisely predict entrainment

# Flow Index reflects regional hydrodynamics

Release location:
San Joaquin River near
Jersey Point
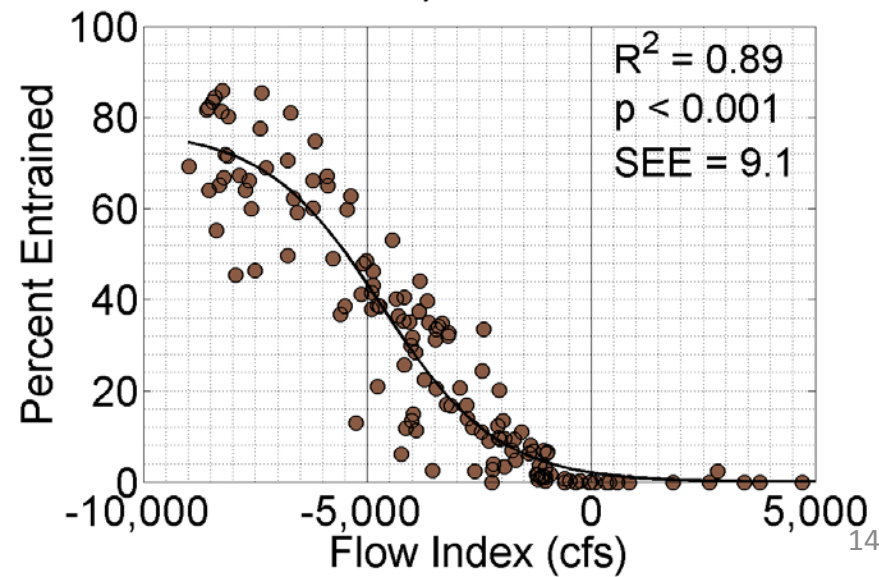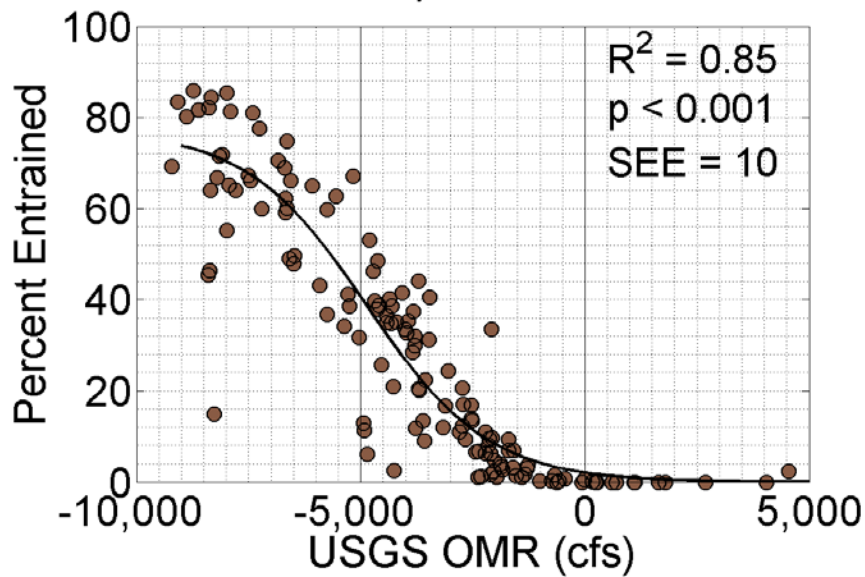
- As the particle release point gets further away, entrainment is less likely and OMR accounts for less variability.

$R^2 = 0.52$
$p < 0.001$
SEE = 5.2

$R^2 = 0.44$
$p < 0.001$
SEE = 5.6
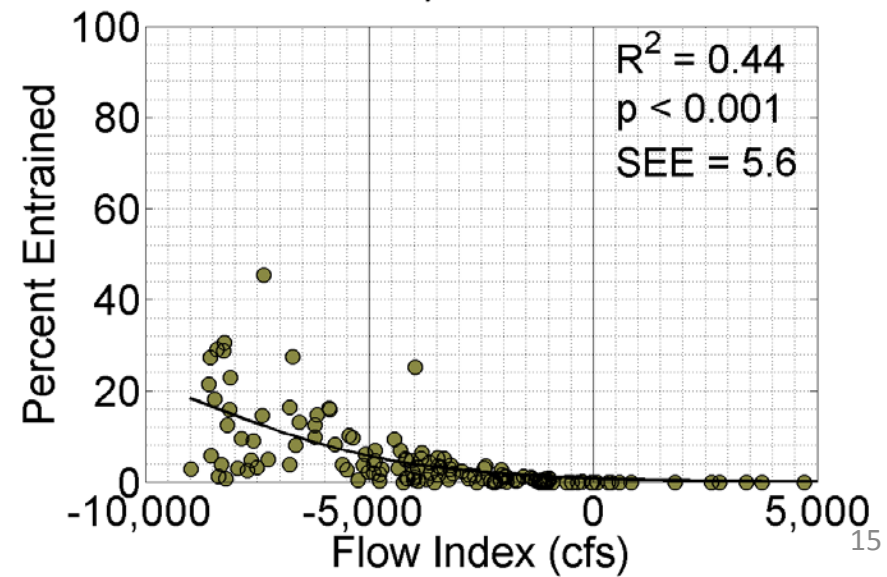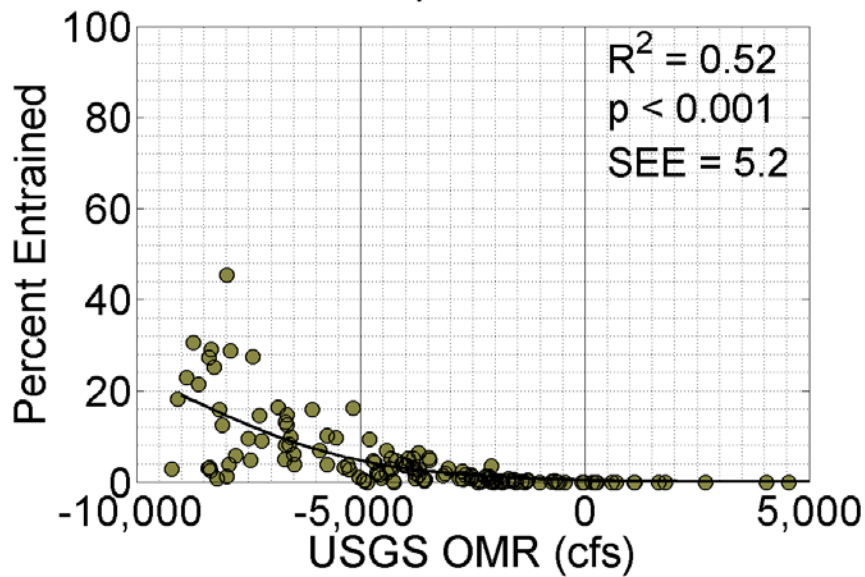
Flow Index remains protective of adult delta smelt

Normalized salvage (shown as size of bubble) as a function of flow and turbidity
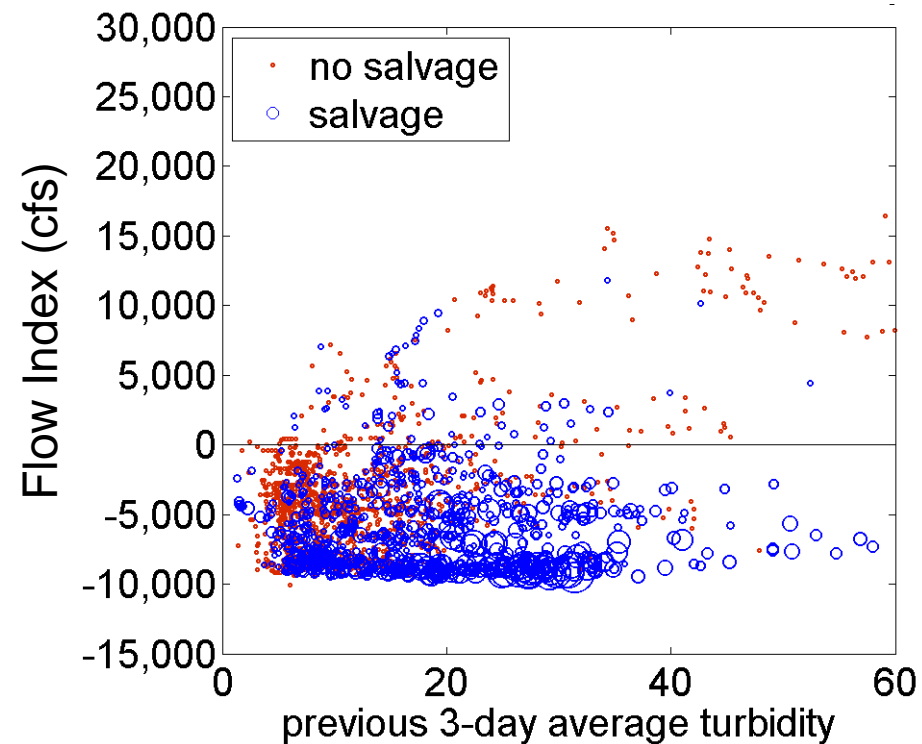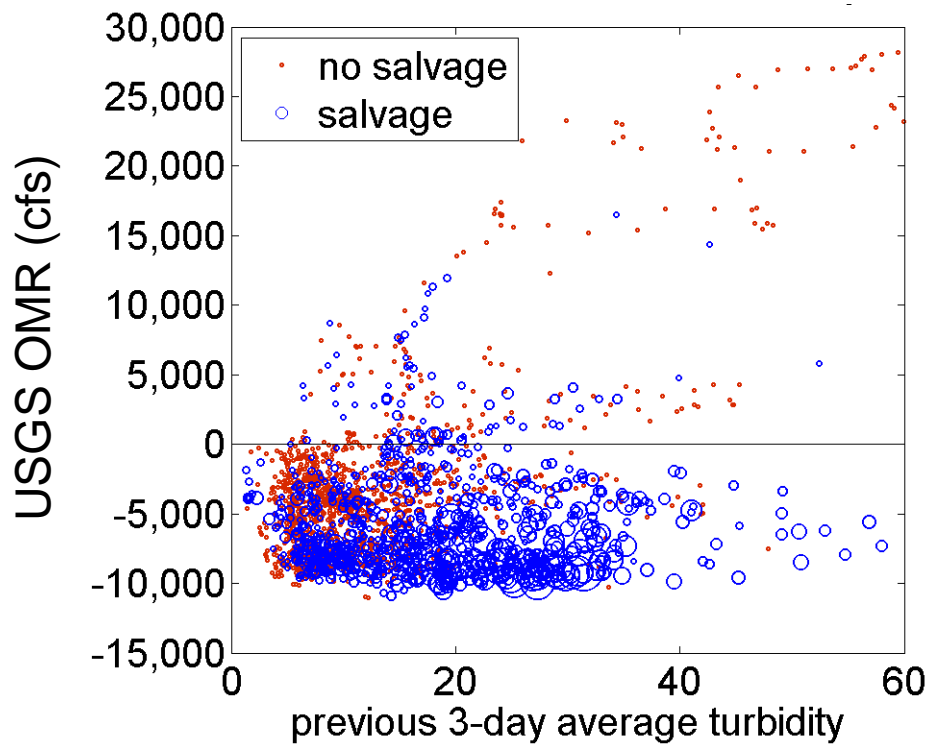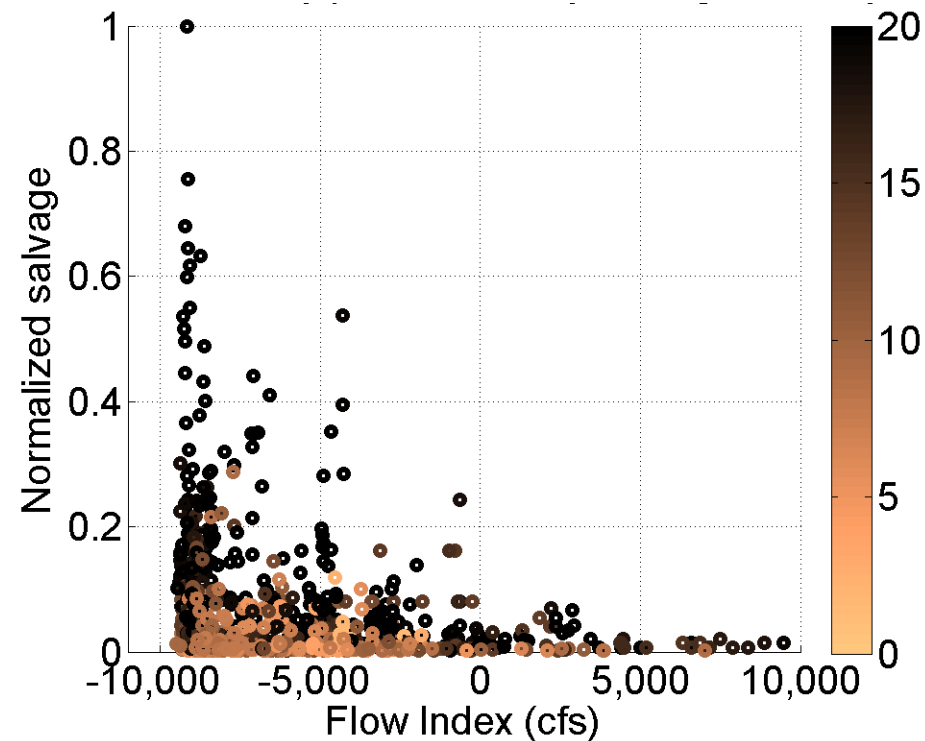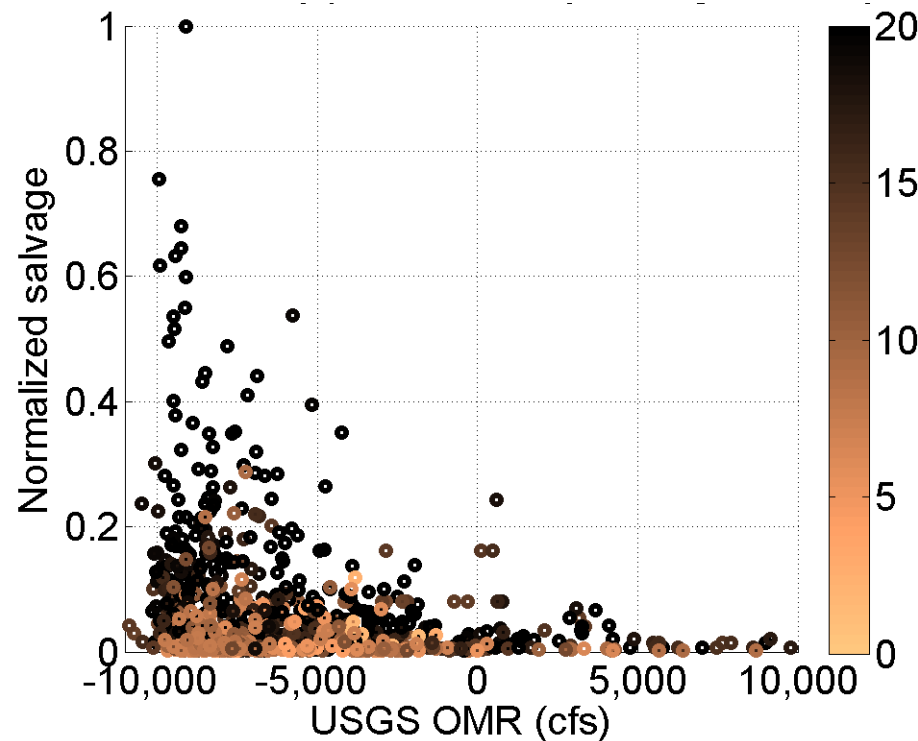

Recreation of Figure 45 from 2011 USFWS BiOp

Flow Index appears to reduce scatter.
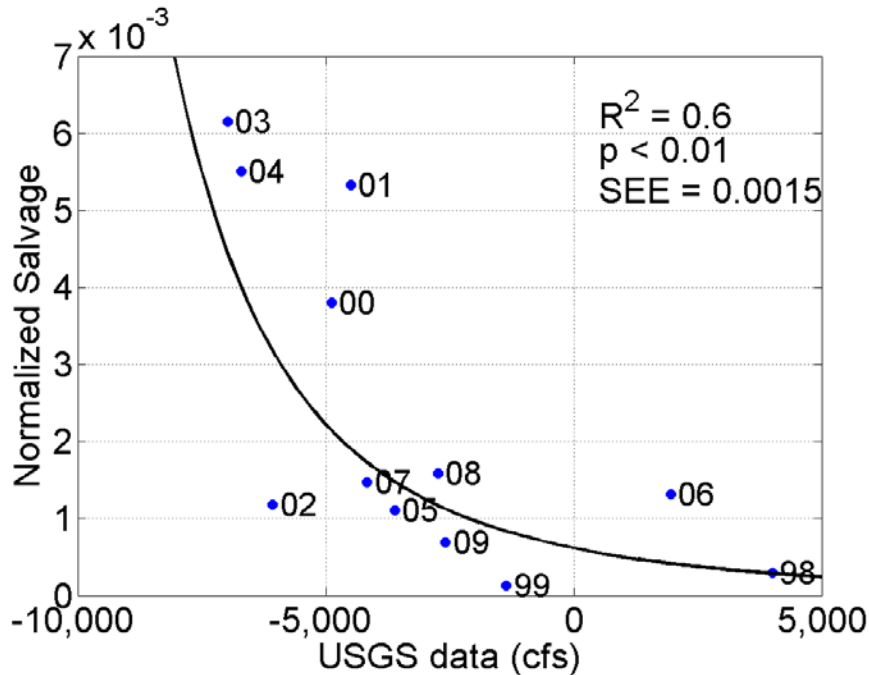
Flow Index remains protective of adult delta smelt

Normalized salvage as a function of flow and turbidity
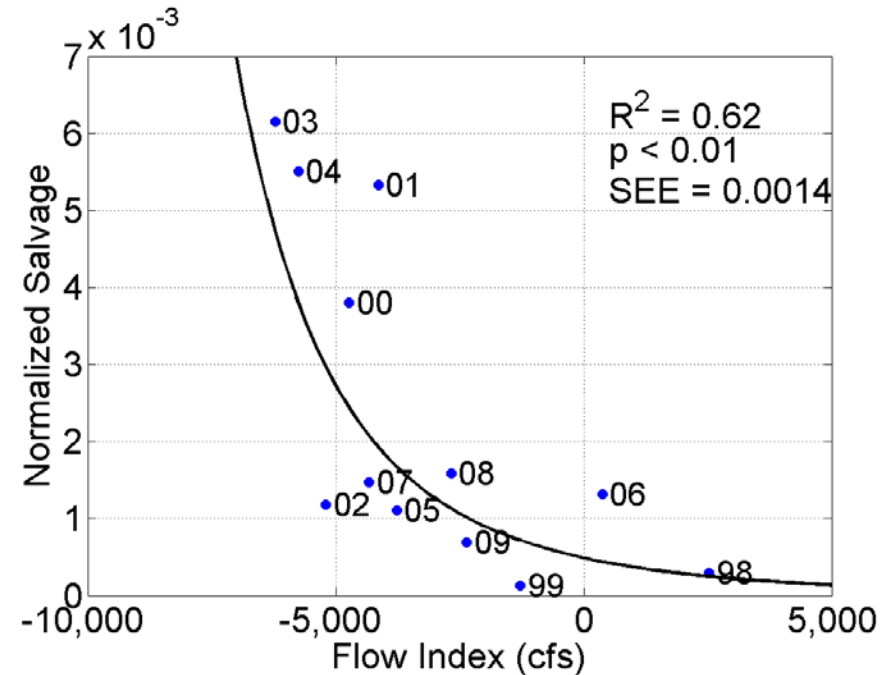Data colored by prior 3-day average turbidity (NTU)

Flow Index appears to reduce scatter.

Flow Index remains protective of steelhead

Seasonal aggregate of normalized hatchery steelhead salvage as a function of flows

Analysis based on Grimaldo (2012)

Flow Index is just as predictive as USGS OMR

Next Steps

- Conduct additional analyses and refine the flow index, as appropriate
  - Multivariate analysis (e.g. generalized additive model, GAM)
  - Evaluate flow index protection of other species (e.g. salmon)

- Conduct an experiment for WY 2013

Conclusions and Recommendation

Use of an index:

- solves operational and transparency issues
- provides a level of protection for listed fish species equal to that of the USGS OMR.

If the State Board chooses to implement flow objectives for Old and Middle River, use a flow index rather than USGS OMR.