National Research Council Committee on

Sustainable Water and Environmental Management in the California Bay-Delta

Christina Swanson, Ph.D.

Executive Director and Chief Scientist

The Bay Institute

January 26, 2010

Davis, California

Sacramento-San Joaquin Watershed

- 9 of 10 largest rivers are dammed
- 5 dams controlled by CVP or SWP

Delta

- CVP and SWP pumps seasonally export up to 65% of inflow

San Francisco Estuary

- In 10 of last 20 years, more than 50% of total freshwater inflow diverted from tributary rivers or from the Delta

From: From the Sierra to the Sea (TBI 1998)

Water Year 2003

Hydrology: >median

Sacramento Basin

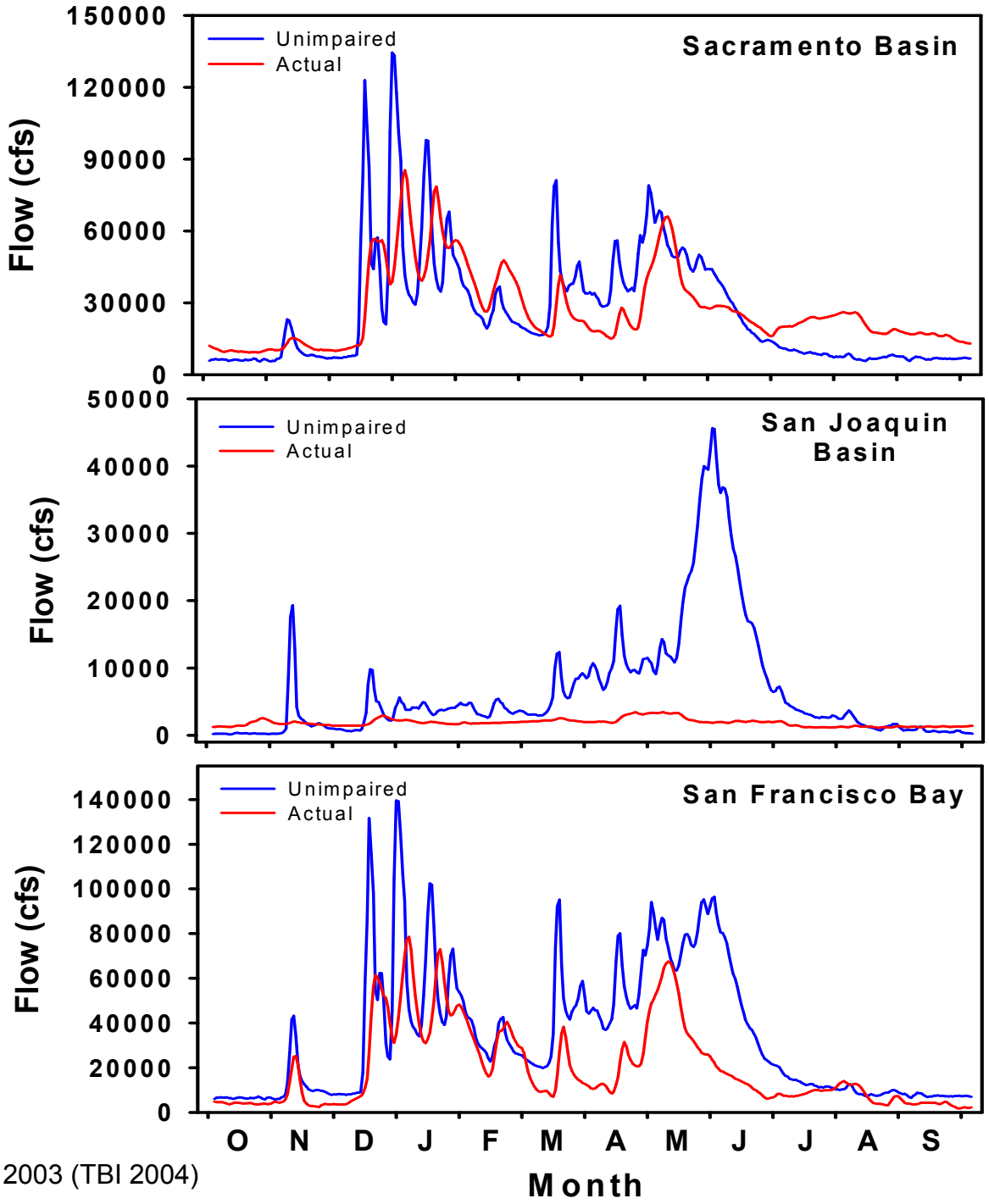
- Annual inflow to Delta reduced by 22%
- Summer inflow increased by 155%

San Joaquin Basin

- Annual inflow reduced by 73%

Delta

- Annual freshwater outflow reduced by 48%
- Spring outflow reduced by 60%

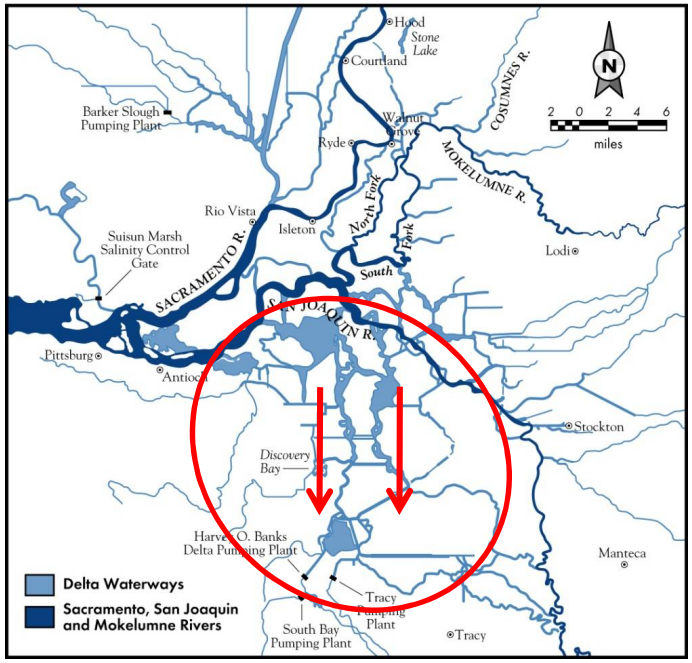


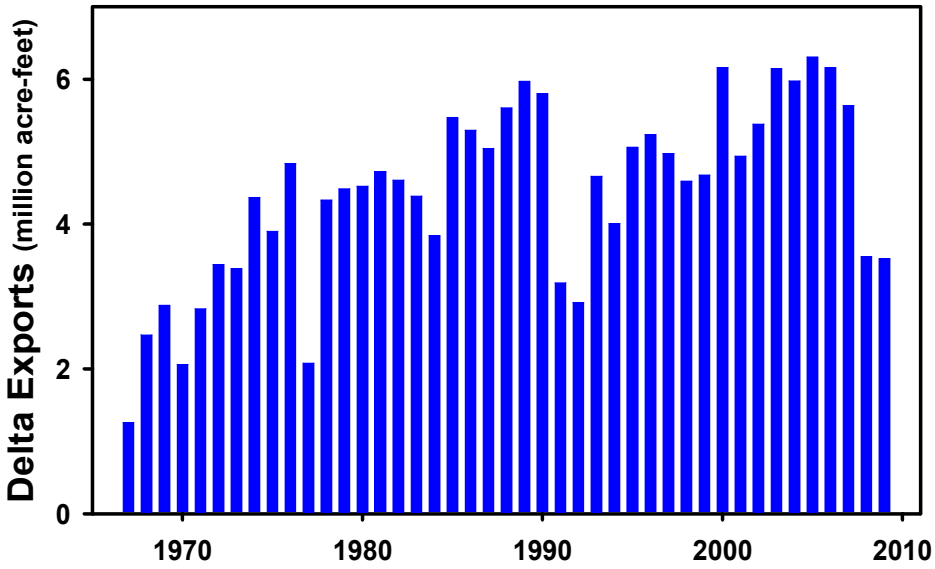
From: The Year in Water 2003 (TBI 2004)

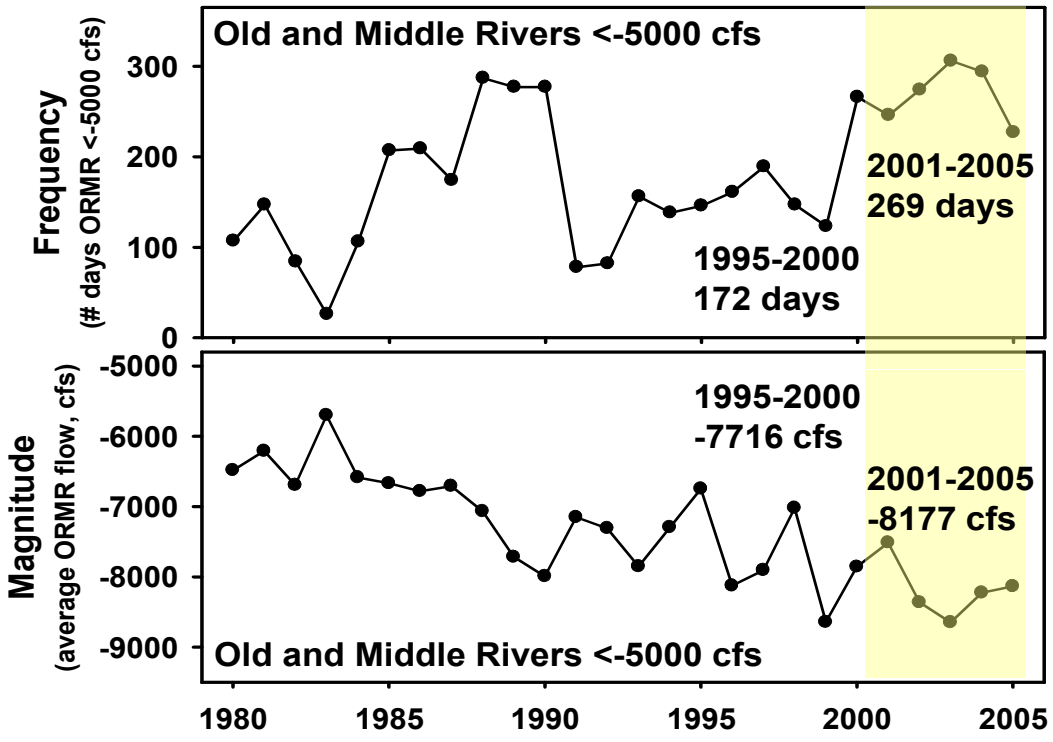
Delta Water Project Operations

From the 1990s to the 2000s

- Annual CVP+SWP exports increased by 29%
- Reverse OMR flows <-5000 cfs in 74% of the year (56% increase)







Entrainment Loss

Particle tracking model (PTM) indicates that at moderate Export:Inflow ratios (or moderate negative OMR flows) most particles in south Delta are lost to the pumps.

(Kimmerer & Nobriga 2008)

Cohort analysis for delta smelt indicates that only fish hatched during VAMP export reduction (~April15-May15, average OMR flow = -1500 cfs) survive to summer.

Unpublished research; W. Bennett & J. Hobbs

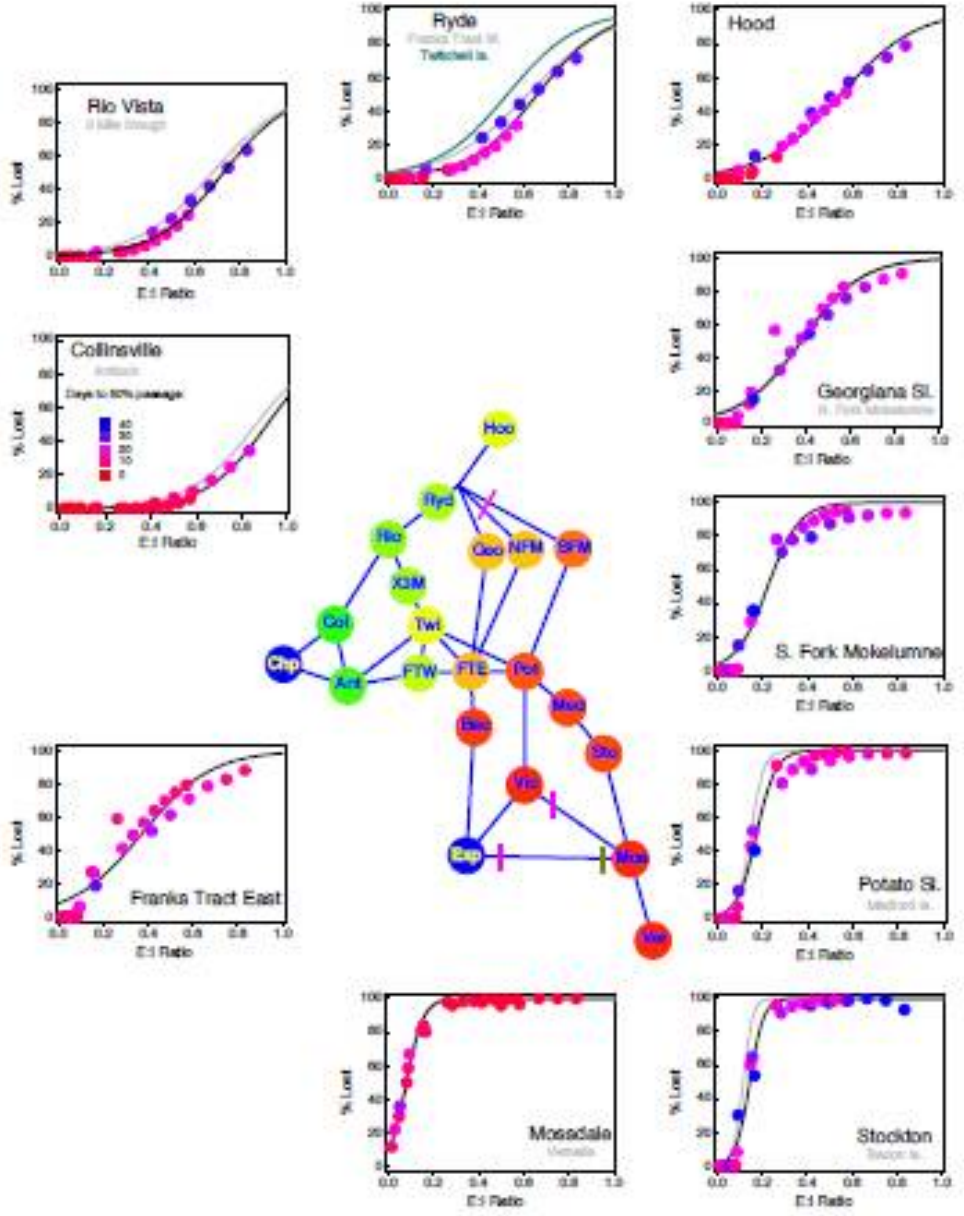
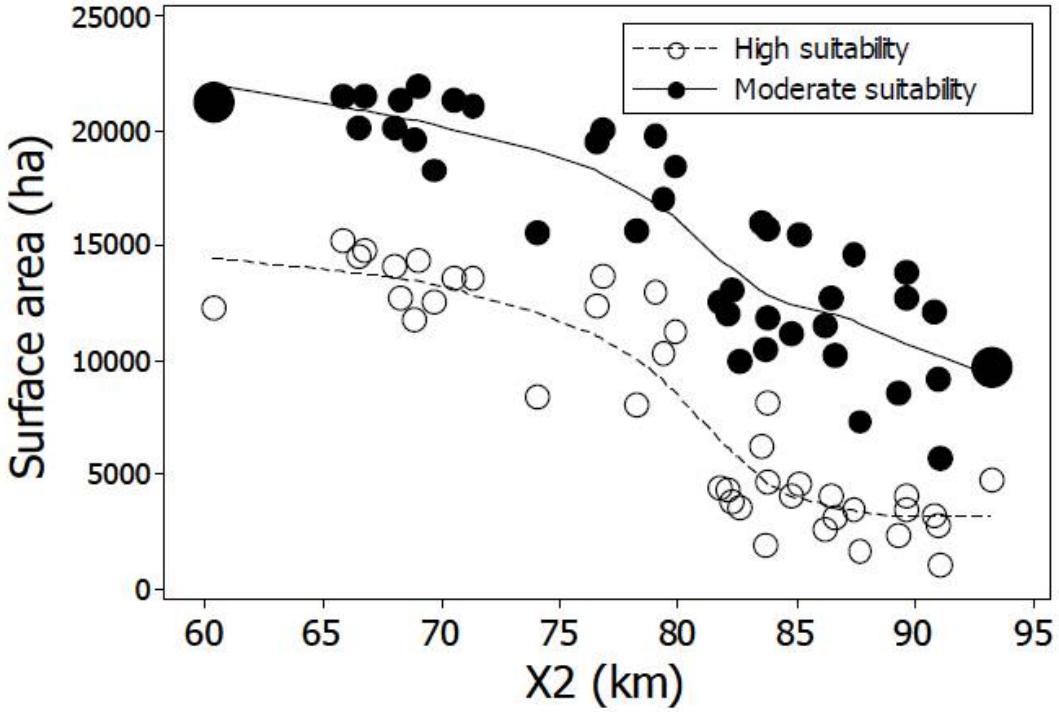


Figure 7. Percent of particles lost to export pumps for spring tide runs with no agricultural diversions and 24 combinations of inflow and export flow. Data are shown for selected release sites, color-coded by the time needed for 75% of particles to leave the Delta. Lines are logistic functions fit to the data, and are dark for selected sites and light gray for other sites with similar responses. Central diagram is a schematic arrangement of the sites in Figure 1, with principal links between sites. Short lines represent barriers including the DCC in the northern Delta, the Head of Old River barrier in the south Delta (dark yellow), and south Delta agricultural barriers (pink).

Changes in Estuarine Habitat

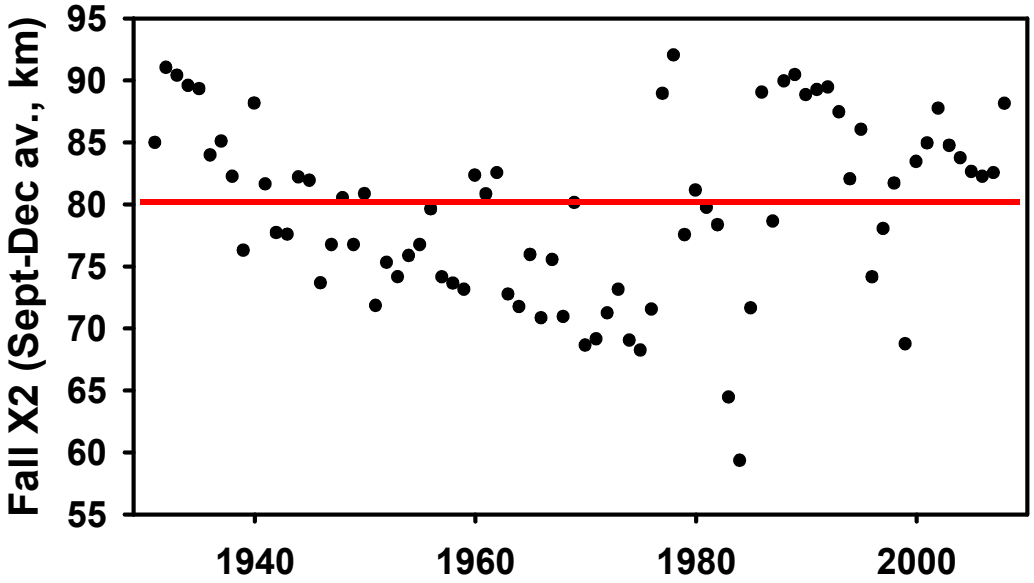
- **Low freshwater outflow in fall decreases habitat quality and quantity for delta smelt**

From: Feyrer et al., 2010, in final review (1967-2008 data)



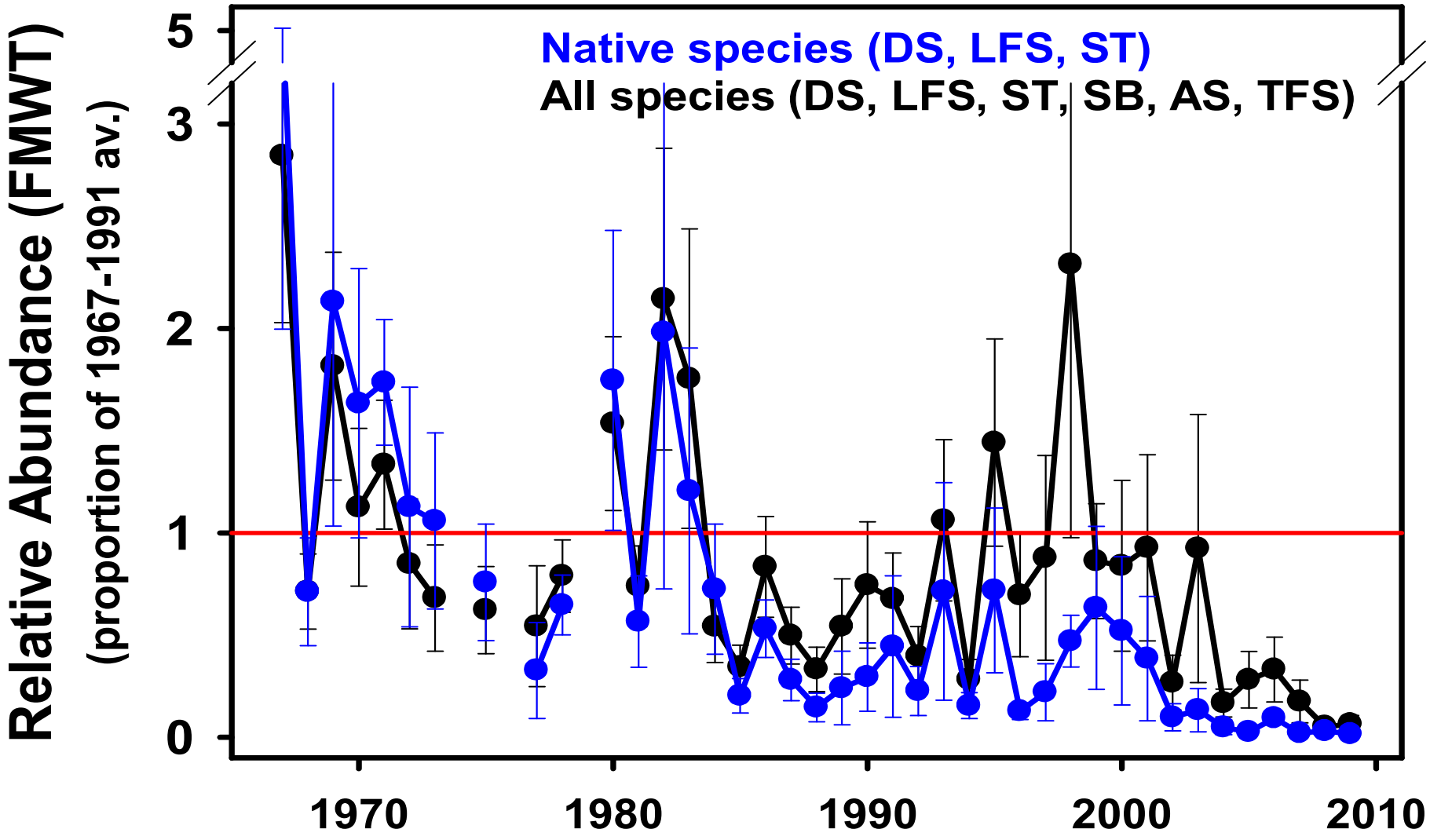
- **In 17 of past 20 years, fall X2>80 km**

- **Low fall outflow results from increased upstream diversions and increased Delta exports**

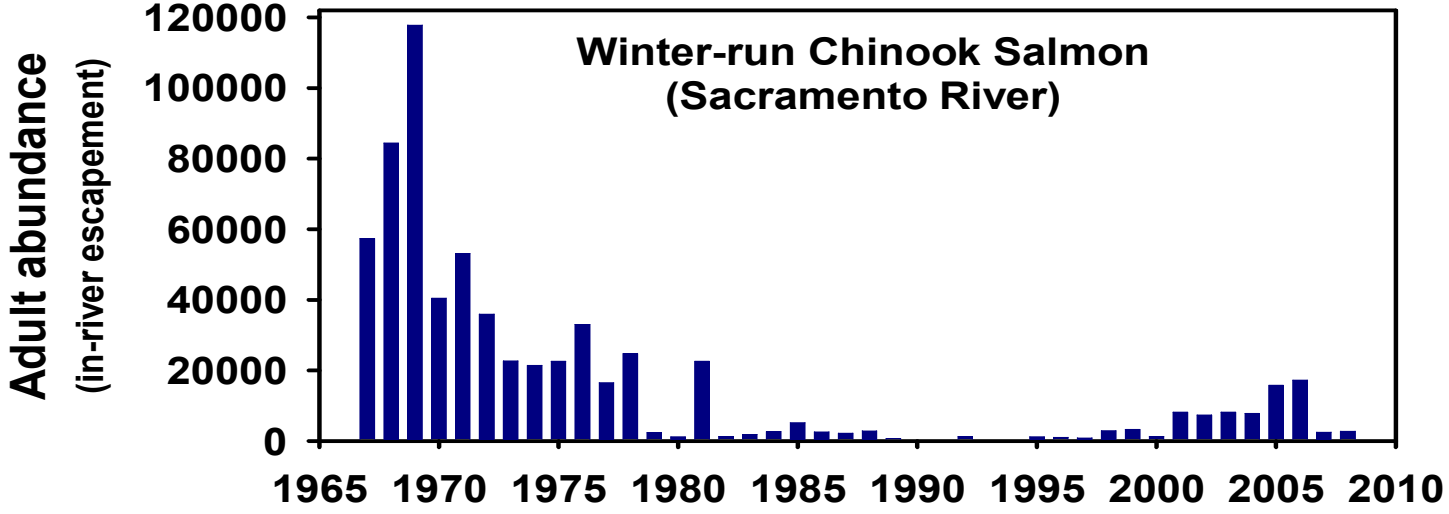


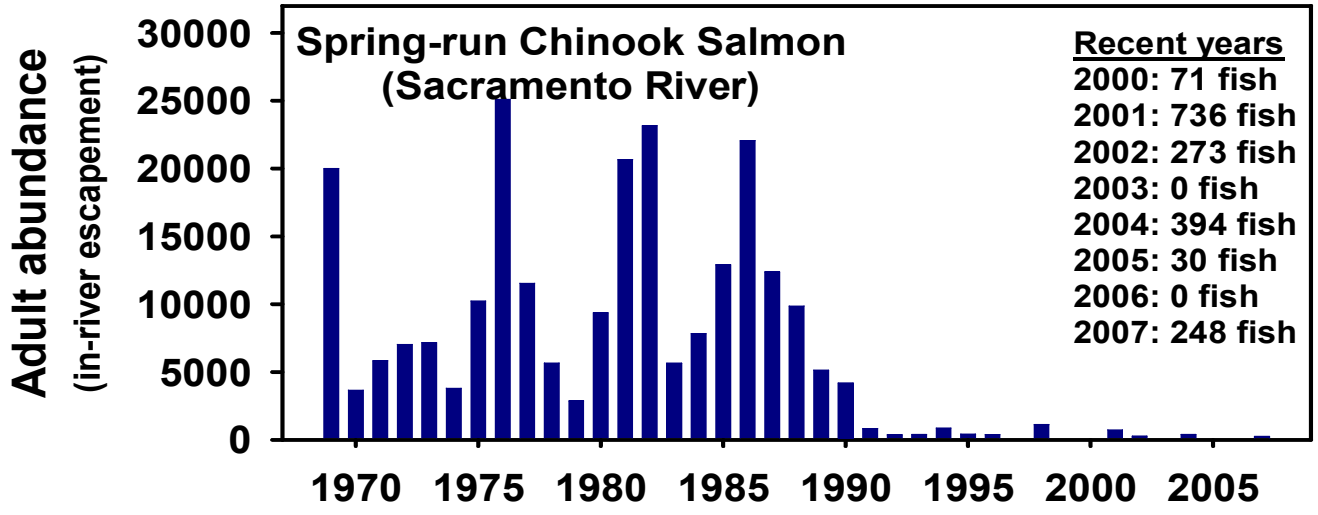
Pelagic Delta fish populations have collapsed

Delta smelt and longfin smelt at high risk of extinction



Sacramento River
Only extant winter-run Chinook salmon population
Spring-run Chinook salmon nearly extirpated





Science in the San Francisco Estuary

- Intensively monitored for nearly 50 years
- One of best studied estuaries in the world
- Pelagic Organism Decline (POD) in early 2000s prompted intensive and multi-disciplinary research effort to determine causes (2005-present)
- **Results – "causes" of POD**
  - Water project operations – direct and indirect effects on **species** and **habitat**
  - Contaminants
  - Invasive species (and food web effects)
  - Low population size

Development of OCAP and Biological Opinions

2007: 2005 BiOp for delta smelt invalidated by federal court
Interim protections for delta smelt identified and ordered

2008: 2004 BiOp for salmon and steelhead invalidated

2008: OCAP description of proposed CVP and SWP operations conveyed to USFWS and NMFS
- Identified impacts to species
- Proposed action: continue and intensify past operations
- No specific protections identified

2008: "Jeopardy" BiOp for delta smelt issued
- Identified RPAs for protection of species and habitat from impacts of CVP and SWP operations

2009: "Jeopardy" BiOp for salmon, steelhead, sturgeon and Orca
- Identified RPAs for protection of species and habitat from impacts of CVP and SWP operations

Jeopardy BiOps required UFSW and NMFS to identify RPAs to avoid

- jeopardy to continued existence of species, and
- adverse modification of habitat

resulting from CVP and SWP operations.

BiOps incorporated information and analyses on:

- Status of species
- Biology (life history, ecology, behavior, physiology, habitat use)
- Viability criteria (abundance, productivity, diversity, spatial structure)
- Hydrology (wet v dry conditions)
- Water project operations, and
- Season, timing and location of project impacts.

RPAs were designed

- based on best available, multi-disciplinary science
- targeted to affected life stage, project operation, and impact
- to be flexible and responsive to real-time environmental, monitoring and biological conditions, and
- to minimize impacts on water deliveries.

Alternative RPAs

Criteria:

- **Scientific basis**
- **Equal or greater protection**
- **Less impact on water supply and/or deliveries**
- **Impacts on habitat**
- **Impacts on other species**
- **Impacts on other stressors**
- **Flexible and responsive to environmental and biological conditions**

Example Evaluation of Alternative RPA

RPA Component 2

Objective: Prevent transport of DS into S. Delta and entrainment

Input data:
Population status
Salvage (current and cumulative)
Distribution (20 mm survey)
X2 location
Temperature
Turbidity
Current hydrology and operations
PTM results

Frequency:
Weekly evaluation to adjust OMR flows

Use of PEI

Objective: Limit entrainment loss to predetermined target

Input data: Distribution (20 mm survey), hydrology and operations

Frequency:
~ 2 weeks or whenever 20 mm survey results available to adjust OMR flows

No consideration of: salvage, limited detection ability of 20 mm survey, model not validated or tested

"Conflicts" and "Incompatibilities" between the two BiOps

Example: RPA 3 (fall habitat protection for delta smelt)
Carryover storage (temperature protection for WR and SR Chinook salmon)

- **RPA 3 only implemented in fall after wet and above normal years; storage can be conserved to meet both protections**
- **RPA 3 requires ~7000 cfs outflow (81 km) to ~12,000 cfs (74 km)**
- **Current WQCP standards already require minimum 3000-4500 cfs outflow; difference = 2500-9000 cfs**
- **CVP and SWP control 5 reservoirs; Shasta is not only option**
- **CVP and SWP can adjust exports to meet increased outflow requirement; fall exports have averaged ~7000-11,000 cfs**
- **Entire outflow enhancement could be accomplished with reduced exports and no impacts on upstream storage.**

Other Stressors

Other stressors that are not the result of CVP and SWP operations also adversely affect species and habitat.

They are not subject to regulation by BiOps for CVP and SWP operations.

Other stressors can be addressed in consultations for other activities with a federal nexus.

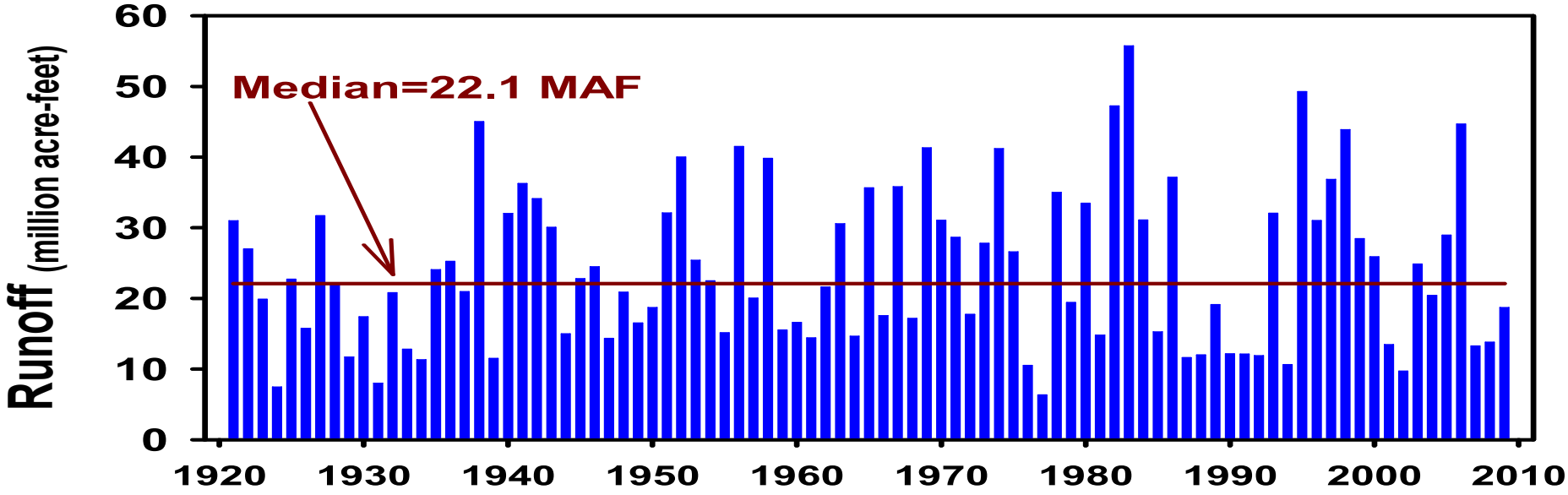
Other stressors can be addressed by federal (and state) resource management agencies in other processes:

- **Recovery Plans**
- **Habitat Conservation Plans (e.g., BDCP)**
- **Clean Water Act**
- **State and Regional Water Resources Control Boards**

Achieving an Environmentally Sustainable Bay-Delta and a Reliable Water Supply

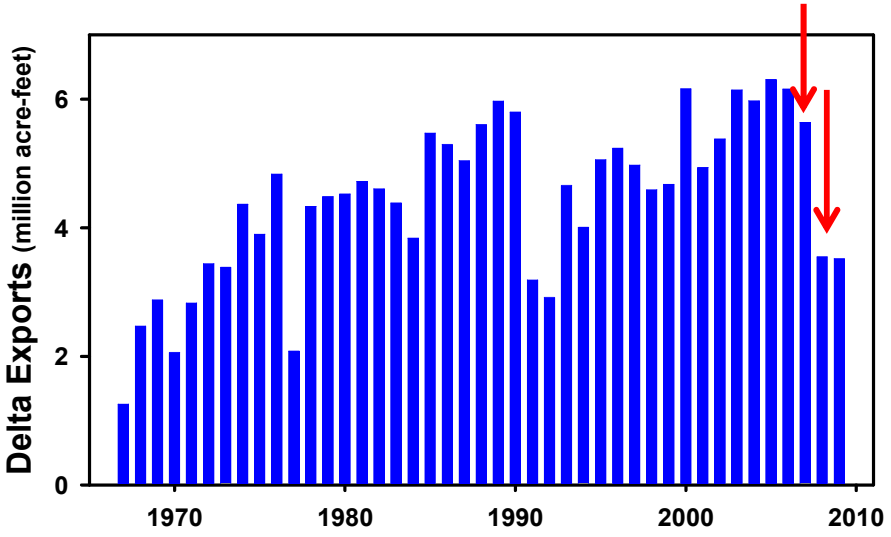
- Rigorous evaluation of fish agency's analysis of water project operations on endangered fishes and habitat. Fish agencies challenged to prove and defend their BiOps and RPAs as scientifically based, effective, efficient.
- Little attention given to evaluate how effectively the water projects are managing water resources and water project infrastructure to provide reliable water supply while meeting obligations to protect fish and wildlife.
- Ecosystem collapse, abrupt decreases in water deliveries, and intensified conflict are evidence that water resources not being managed sustainably.

Achieving an Environmentally Sustainable Bay-Delta and a Reliable Water Supply



Water Supply Management Objectives

Maximize annual deliveries
or
Ensure long-term reliability



Summary Conclusions

CVP and SWP operations have substantial adverse impacts on species and habitat.

Impacts are significant contributor to species declines and habitat degradation.

Impacts have increased in recent years and are predicted to increase in the future.

Affected species are in critical condition and at high risk of extinction. Habitats are severely degraded.

Even if USFWS and NMFS could require actions to address other stressors, they would still need to require changes in the proposed CVP and SWP OCAP operations to reduce project impacts on species and habitat.

Greater attention should be given to evaluate water project operations for efficiency, effectiveness and sustainability.