State Water Resources Control Board Workshop 2
Bay-Delta Fishery Resources

October 1-2, 2012

California Department of Fish & Game

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

October 1, 2012

Kevin Shaffer and Pat Coulston

FISH SPECIES ARE AT RISK (listing status)

- Delta smelt (State and federally listed)
- Longfin smelt (State listed; Bay-Delta Distinct Population Segment warrants listing federally)
- Green sturgeon (federally listed)
- Spring-run Chinook salmon (State and federally listed)
- Winter-run Chinook salmon (State and federally listed)
- Central Valley steelhead (federally listed)
- Fall and late-fall run Chinook salmon
- White sturgeon

KEY POINTS – CENTRAL VALLEY SALMONIDS

- Salmon Narrative Objective:
  - Several actions and monitoring implemented since 2006
  - Population doubling goals still not being met
- DCC Gate Operation Objective
  - Adopt NMFS criteria with DFG participation in decision-making
- Upstream flow management issues
- Adaptive management/climate change

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Salmonid Plans/Programs Implemented Since 2006

- Constant Fractional Marking Program
- Chinook Salmon Escapement and Steelhead Monitoring plans
- CA Hatchery Scientific Review Report
- NOAA Fisheries CV Recovery Plan

Salmon Narrative Goals
fall-run Chinook Salmon

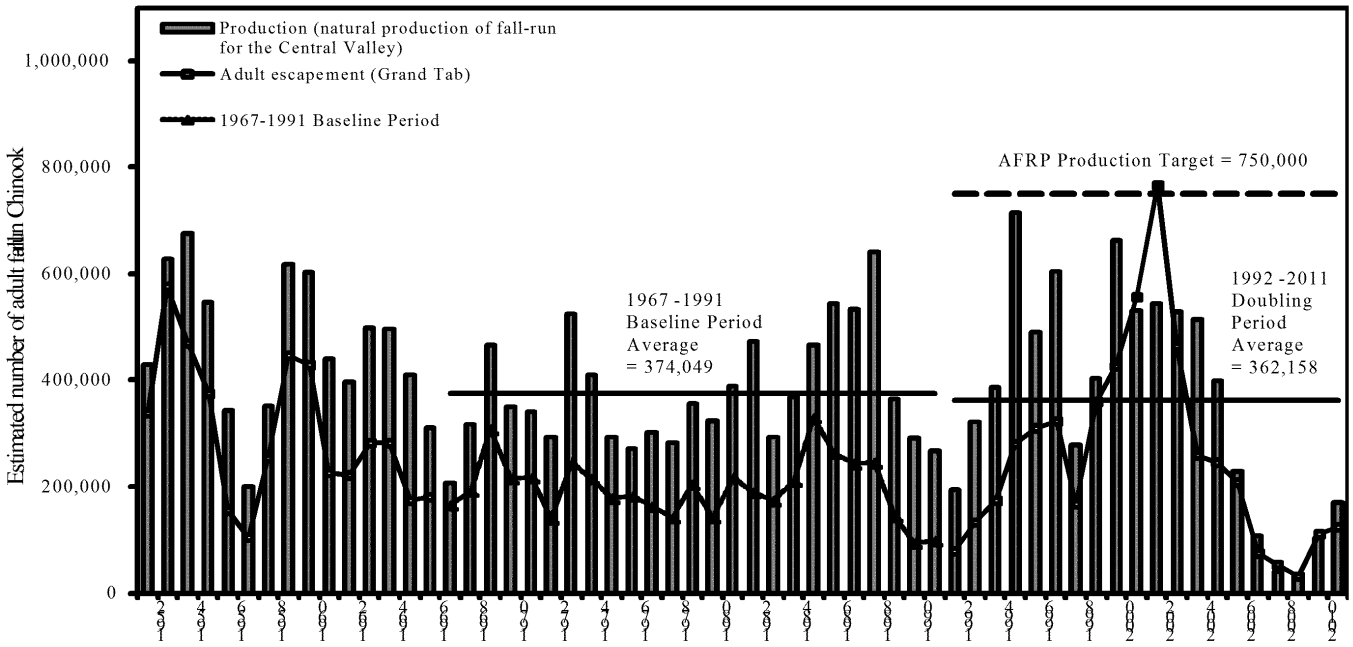

Figure 1. Estimated yearly natural production and in-river escapement of adult fall-run Chinook salmon in the Central Valley rivers and streams. 1952 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

Salmon Narrative Goals
winter-run Chinook Salmon

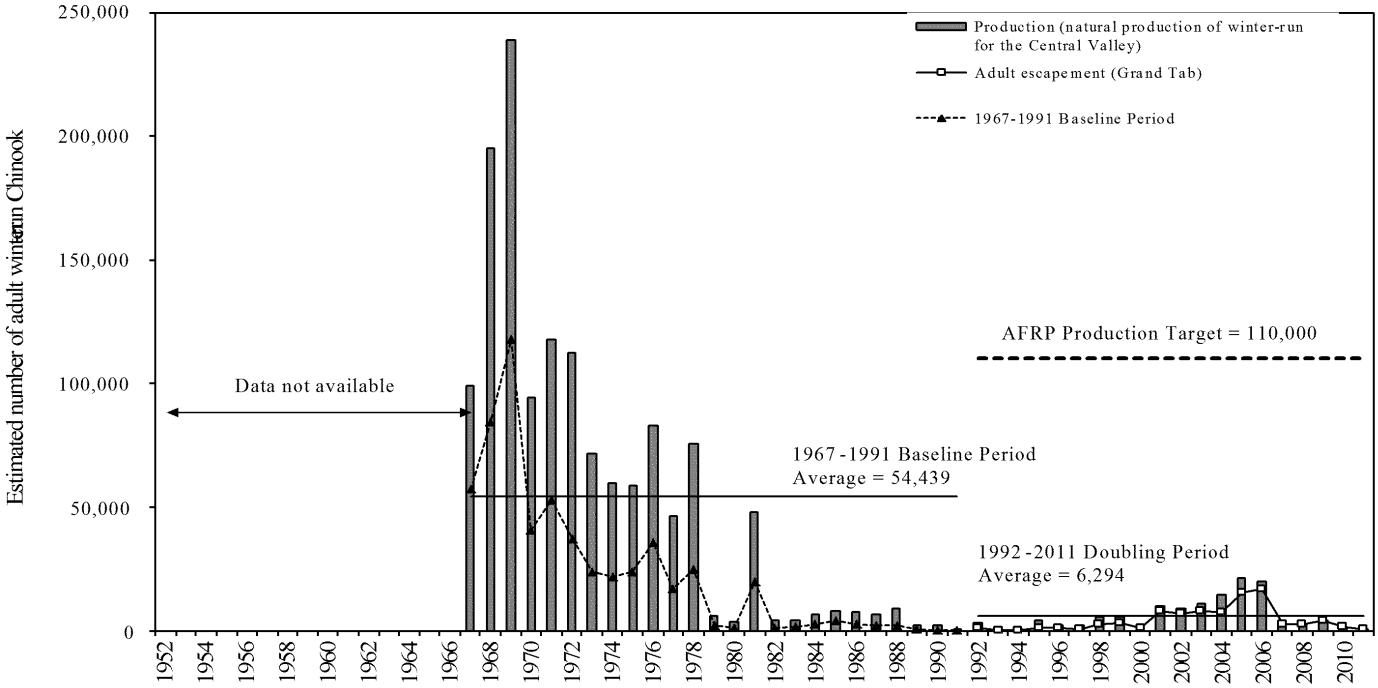

Figure 3. Estimated yearly adult natural production, and in river adult escapements of winter-run Chinook salmon in the Central Valley rivers and streams. 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967-1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

Delta Cross Channel Gate Operations

- Recommend amending the Water Quality Control Plan criteria with current operating criteria in NOAA Fisheries' OCAP Biological Opinion (2009, 2011)
- Add criteria for optional gate closures in October to allow pulse flow experiment in lower Mokelumne River

Upstream Flow Management Issues for Salmonid Protection

- Redd dewatering

  More stable flow management from September to March

- Restoration of floodplain habitat

  Inundation and variation for ecosystem function

- Riparian processes and regeneration

  Encouraging regeneration and recruitment

Redd dewatering in winter 2012

Sacramento River below Keswick Dam

Central Valley sturgeon

- Important ecological and angling values in the Central Valley
- Due to many unknowns, water management should take a precautionary approach
- Current emphases on regulations and monitoring to protect both species
- Remediation of stranding and migration barriers
- Improving upstream spawning grounds are priorities
- The federal recovery team for green sturgeon

WHAT'S NEXT

Adaptive Management

- Flow and the fish community is a complex system
- Essential nature of monitoring and special studies, timely reporting and use of data

Climate Change

- Temperature challenges for aquatic systems
- Changes in habitat suitability for fishes

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CVP/SWP Smelt Entrainment Impacts/Protection:

Key Points

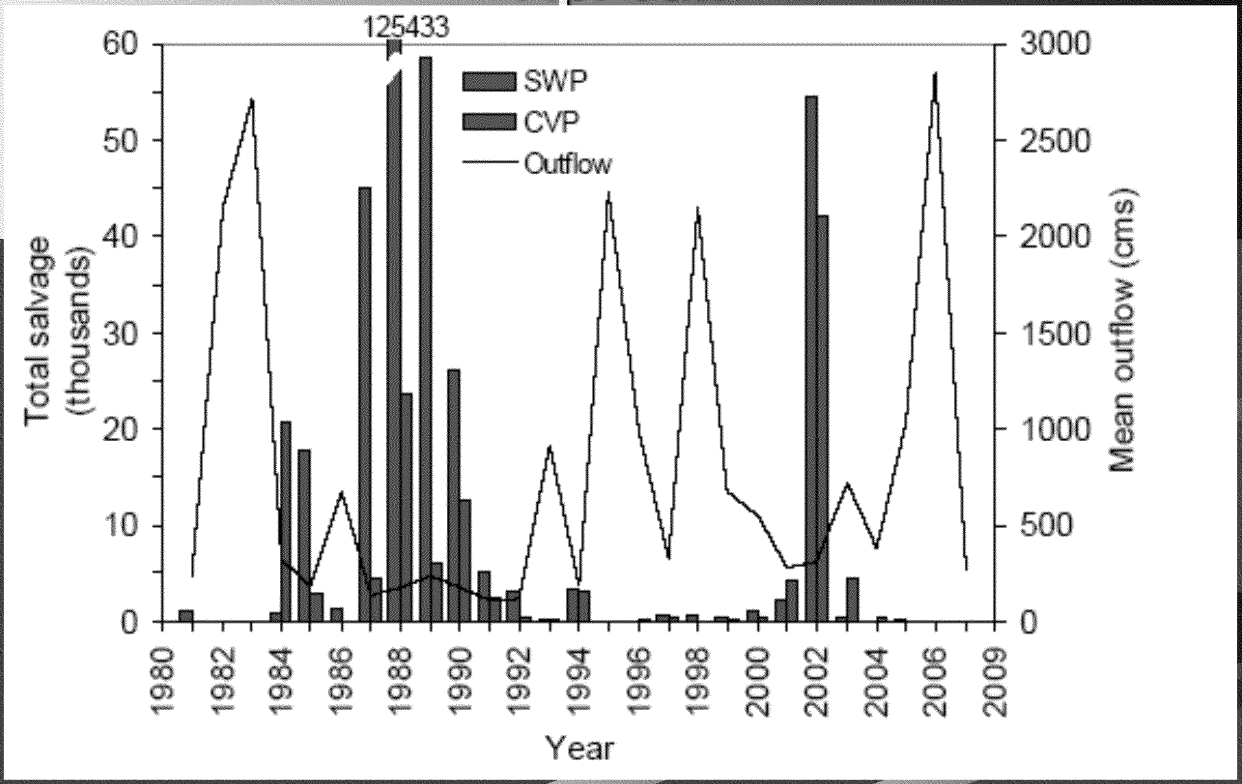
- Both smelt species have substantial vulnerabilities
- Longfin smelt (LFS) entrainment vulnerability is highest when recruitment is lowest
- X2 and OMR flows influence entrainment
- Consult DFG's 2009 SWP Incidental Take Permit (ITP) Effects Analysis
- Consult 2008 delta smelt Biological Opinion (BO)
- Estuary changes modify perspective on entrainment
- Entrainment losses can be consequential
- 2006 Bay-Delta Plan insufficiently protective

Entrainment Basics

- Entrainment is largely under-observed
  - Pre-screen loss
  - Screen efficiency
  - Larvae not counted in salvage
- Entrainment ≠ Salvage (index)
- Entrainment & Salvage both estimated

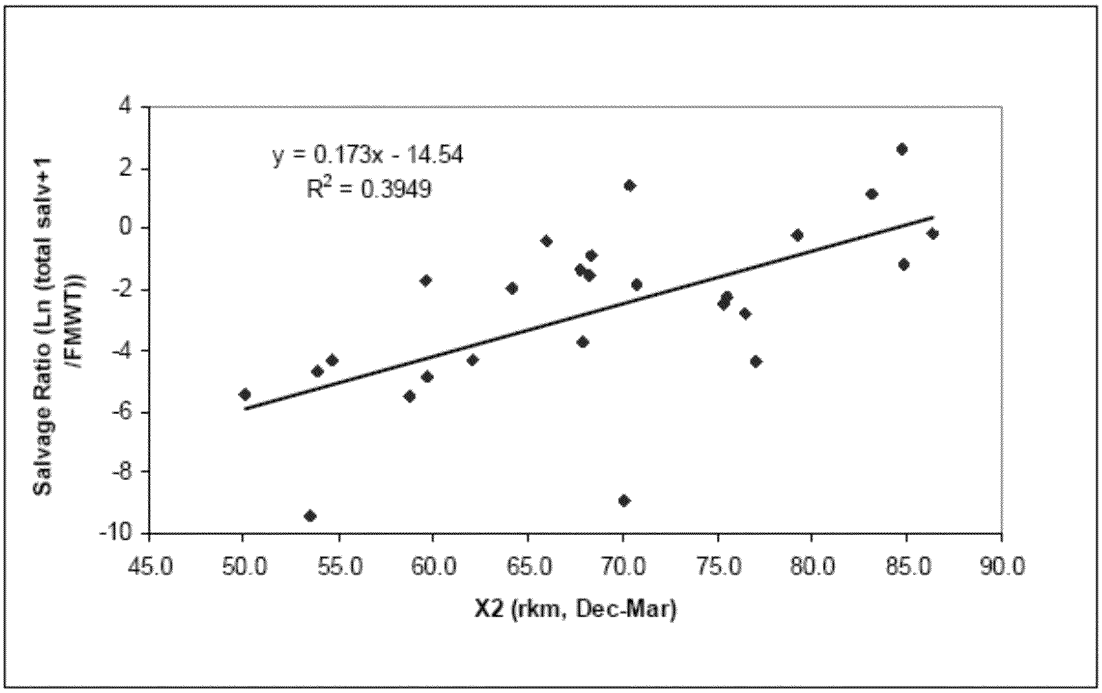
Longfin Smelt (juv.) Entrainment

Apr-Jun



Longfin smelt entrainment is highest in drier years

Longfin Smelt (adult) Entrainment

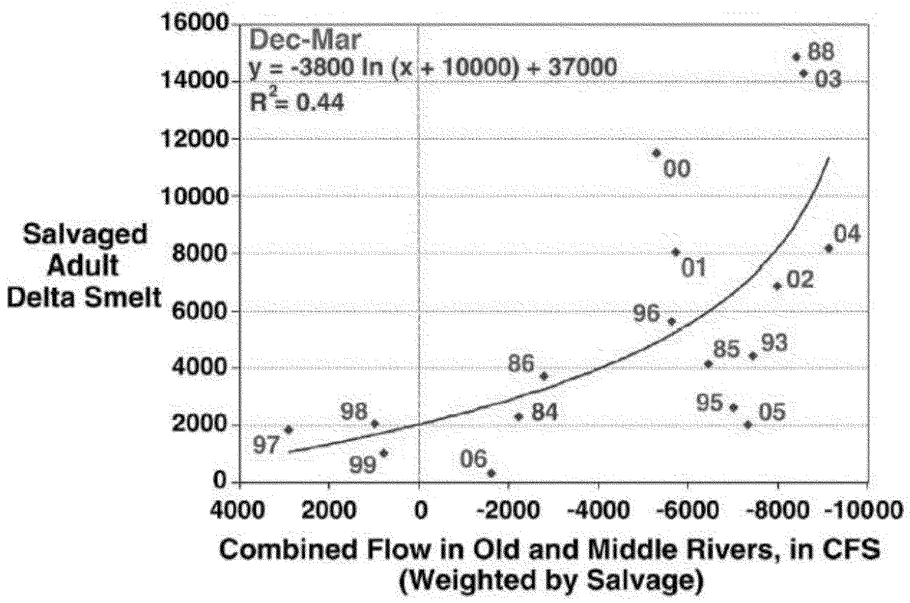


Higher X2 position = greater LFS entrainment

Delta Smelt Entrainment

- Spawning adults, larvae, and early juveniles all vulnerable
- Drier winter/spring conditions increase vulnerability
- X2 & Old/Middle River (OMR) flows predictive of DS entrainment (Kimmerer 2008)
- Turbidity plays a role in adult DS entrainment

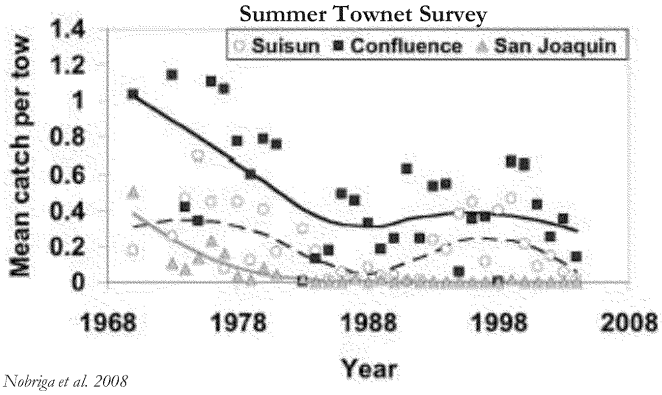
Delta Smelt Entrainment



Note: Data shown are for the period 1984-2007, excluding years 1987, 1989-92, 1994, and 2007 that had low (<12ntu) average water turbidity during Jan-Feb at Clifton Court Forebay.

More negative OMR flows increase relative delta smelt entrainment

Has our perspective on delta smelt entrainment impact changed?



Nobriga et al. 2008

← Extirpation of juv. delta smelt from San Joaquin

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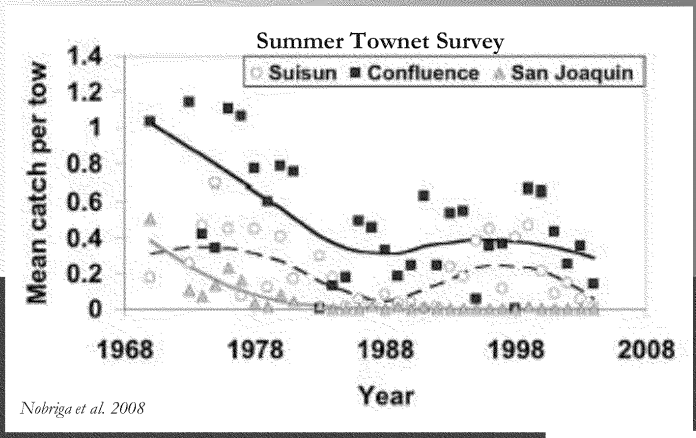
Has our perspective on delta smelt entrainment impact changed?



Nobriga et al. 2008

← Extirpation of juv. delta smelt from San Joaquin

OMR Trend →

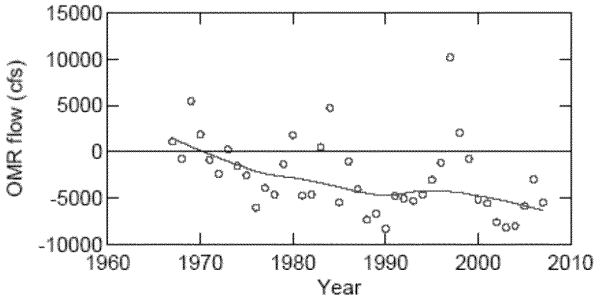


Figure 4. Trend in average winter (Dec-Mar) Old and Middle River (combined) flows, 1967-2007, based on estimated (1967-1992) and measured (1993-2007) flows. See text for data sources. A LOWESS line was plotted through points to show general trend.

2009 DFG SWPITPEA

Population Importance of Entrainment?

- 2012 delayed longfin smelt entrainment experience
- Early 1970s south-central Delta (SJR) delta smelt extirpation
- Statistical challenges to entrainment impact detection
  - "Swamping" population responses to other variables
  - Shifting trends in smelt distribution and abundance
  - Episodic nature of entrainment
  - Problems in entrainment estimation
- The role of assumptions about density dependence
- Direct losses of rare (listed) species seems fundamentally problematic
- Informative recent Kimmerer/Miller/Kimmerer published delta smelt proportional entrainment debate

Smelt Entrainment: Existing Protection Schemes

	OMR Objective Adults	OMR objective Larvae/Juvenile	Decision Making Inputs	Decision Making Process
2008 USFWS Delta Smelt Biological Opinion	✓ Turbidity & salvage-based OMR constraints	✓ Temperature-based OMR constraints	✓ Monitoring ↓ Action	✓ SWG ↓ WOMT ↓ FWS ↓ CVP/SWP
2009 DFG Longfin Smelt Incidental Take Permit	✓ Dec-Feb, river flow-based OMR constraints	✓ Jan-Jun, survey-based, OMR range = -1,250 to -5,000	✓ Monitoring ↓ Action	✓ SWG ↓ WOMT ↓ Director ↓ DWR
2006 Bay-Delta Plan	✗ No explicit OMR objectives to protect adult smelt	✗ No explicit OMR objectives to protect larvae/juvenile	✗ No inputs to prompt action	✗ No "real-time" process

DFG summary

- Water flow management in the Delta should focus on key migration, spawning, and rearing functions of all fish species.
- Adjusted Delta cross-channel gate operations will benefit anadromous species
- Several monitoring programs are underway to gather information to advise and revise water management
- Upstream water management will be key to conserving anadromous species.
- Climate change challenges to aquatic species and ecosystems- the delta; Sacramento River basin

SWRCB Salmonids and Pelagic Organisms workshop

Pat Brandes

U.S. Fish and Wildlife Service

October 1, 2012

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Outline

- What additional scientific information should be considered to inform potential changes to the Bay-Delta plan?

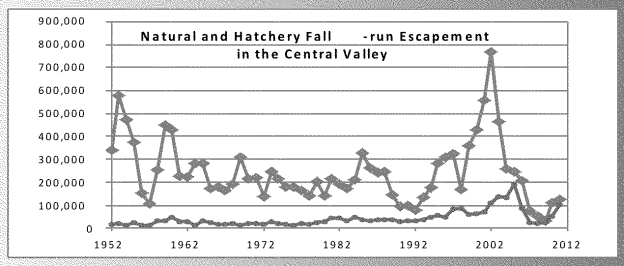
- How should the State Board address scientific uncertainty and changing circumstances?

* Key Points from previous submittals

The Board should consider UPDATED, RECENT and past information on:

1. the status of the stocks
2. juvenile abundance indices at Chipps Island relative to flow
3. genetic information at Sacramento, Chipps Island and at the fish facilities
4. survival information from the San Joaquin Delta/Basin - including HORB and importance of continued survival monitoring
5. and increasing DCC gate closures

1. The status of the stocks



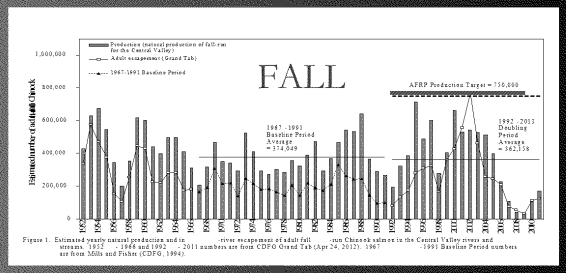


Figure 1. Estimated yearly natural production and in -river escapement of adult fall -run Chinook salmon in the Central Valley rivers and streams. 1952 - 1966 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967 -1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

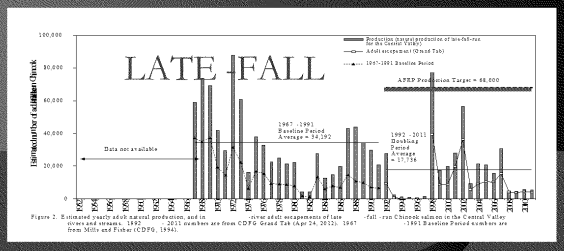


Figure 2. Estimated yearly adult natural production, and in -river adult escapements of late -fall -run Chinook salmon in the Central Valley rivers and streams. 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967 -1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

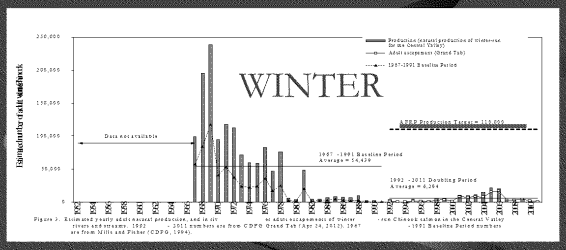


Figure 3. Estimated yearly adult natural production, and in -river adult escapements of winter -run Chinook salmon in the Central Valley rivers and streams. 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967 -1991 Baseline Period numbers are from Mills and Fisher (CDFG, 1994).

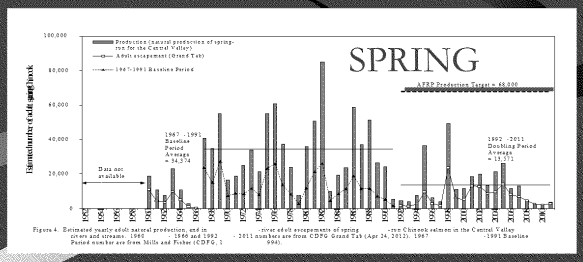


Figure 4. Estimated yearly adult natural production, and in -river adult escapements of spring -run Chinook salmon in the Central Valley rivers and streams. 1966 - 1986 and 1992 - 2011 numbers are from CDFG Grand Tab (Apr 24, 2012). 1967 -1991 Baseline Period number are from Mills and Fisher (CDFG, 1994).

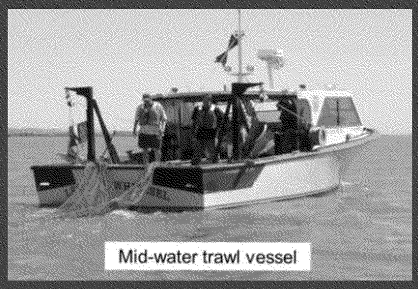
Indicators demonstrate

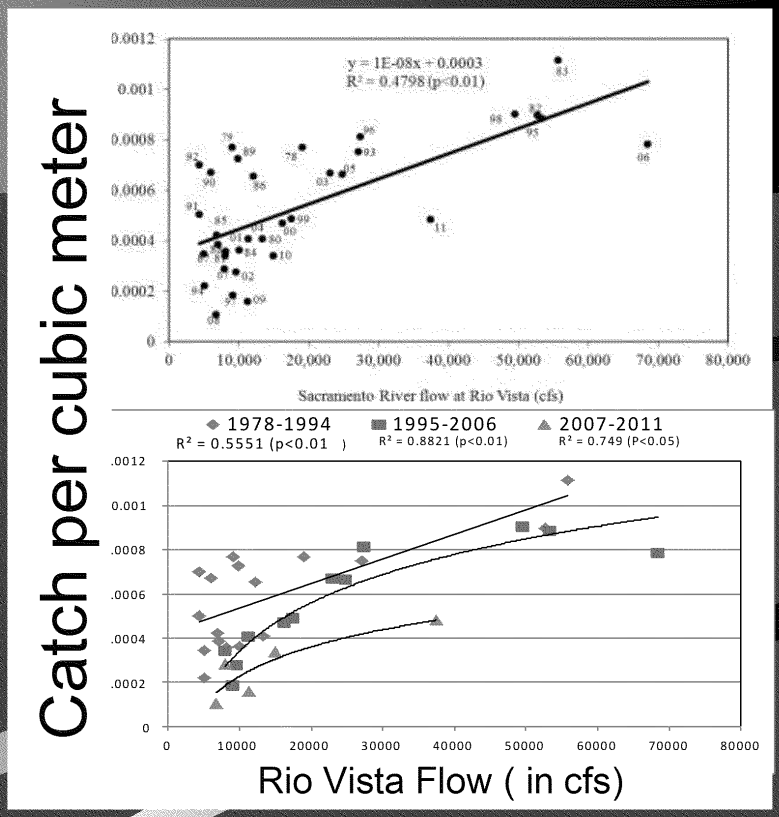
- continued decline of salmonid populations

- more protection is needed to meet WQCP's narrative salmon doubling goal

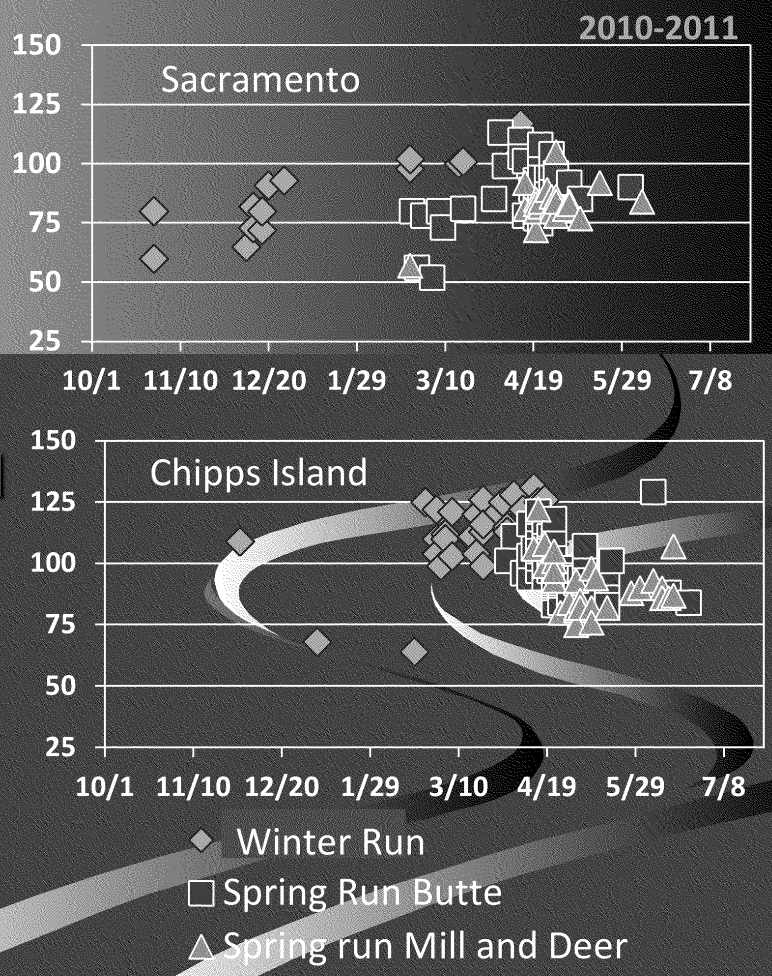
2. Juvenile salmon abundance indices at Chipps Island relative to flow

Juvenile salmon abundance leaving the Delta is still higher at higher flows





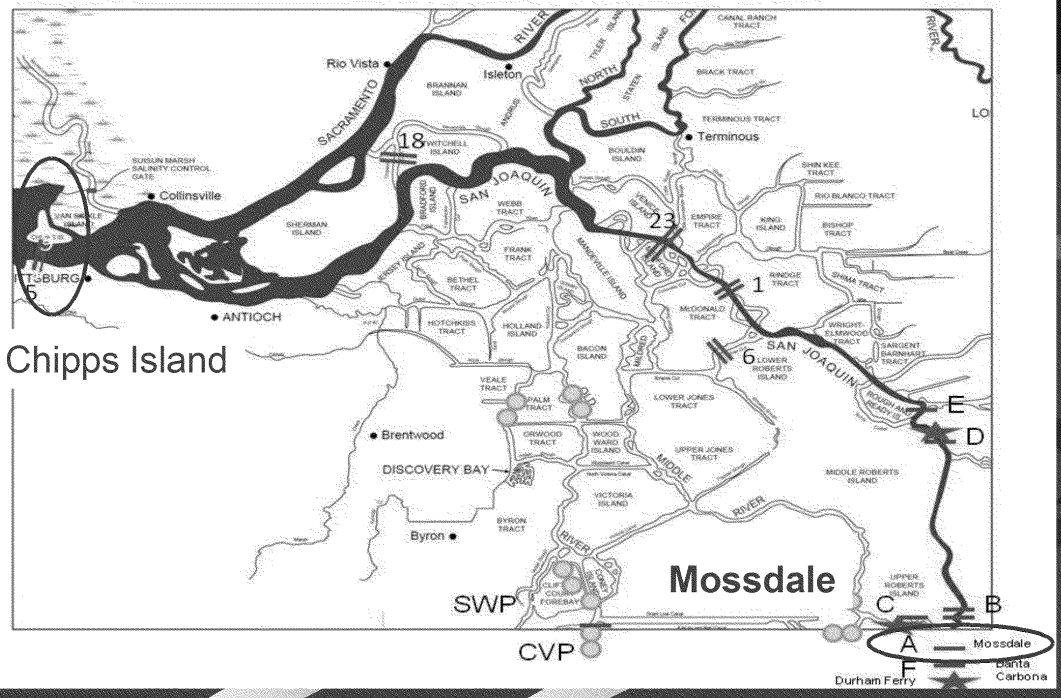
3. the temporal distribution of winter and spring- run Chinook salmon in the Delta based on genetic analyses.



Source: FWS preliminary, unpublished data

4. juvenile salmon survival estimates from the 2010 VAMP

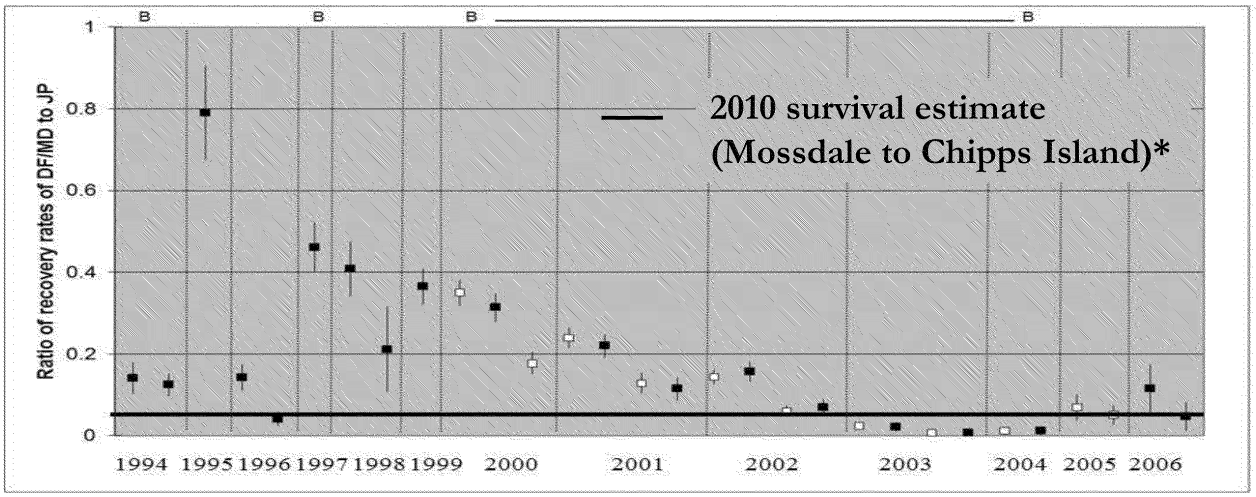
(and other recent survival studies)



venile salmon survival was low (0.05) in 2010

relative to mean of past estimates ($\bar{X}$ = 0.16)

Salmon smolt survival from Mossdale (black) or Durham Ferry (white) to Jersey Point



*Additional mortality between Jersey Point and Chipps Island is assumed to be low.

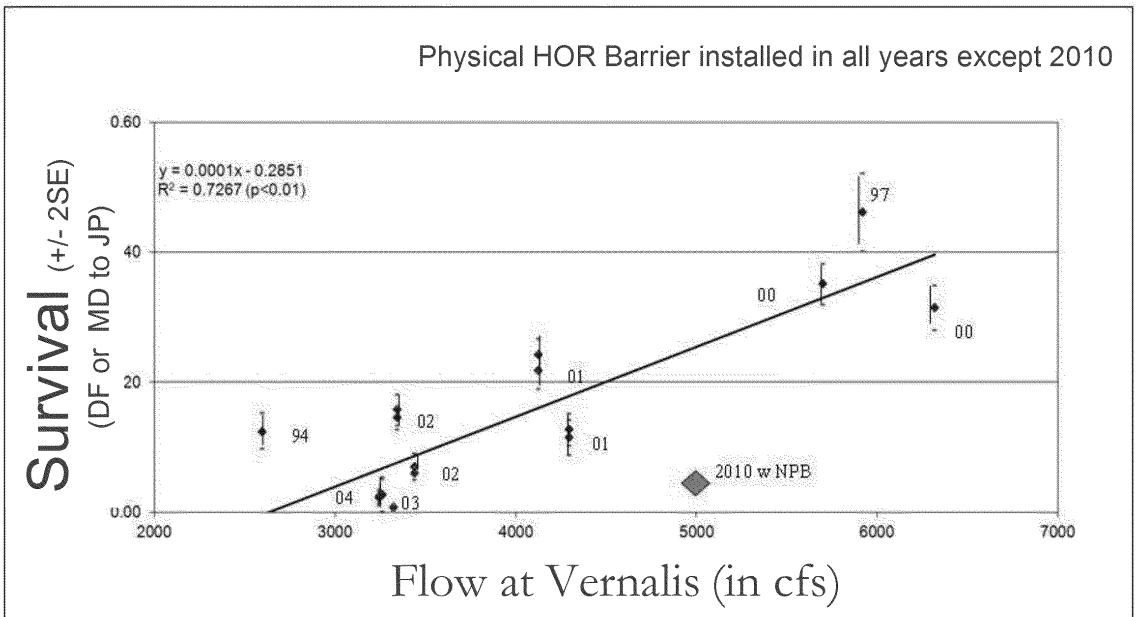
B = Years with physical Head of Old River installed
Non-physical barrier installed in 2010.

Source Brandes et al., 2008. and SJRG, 2010

The Board should also consider information on:

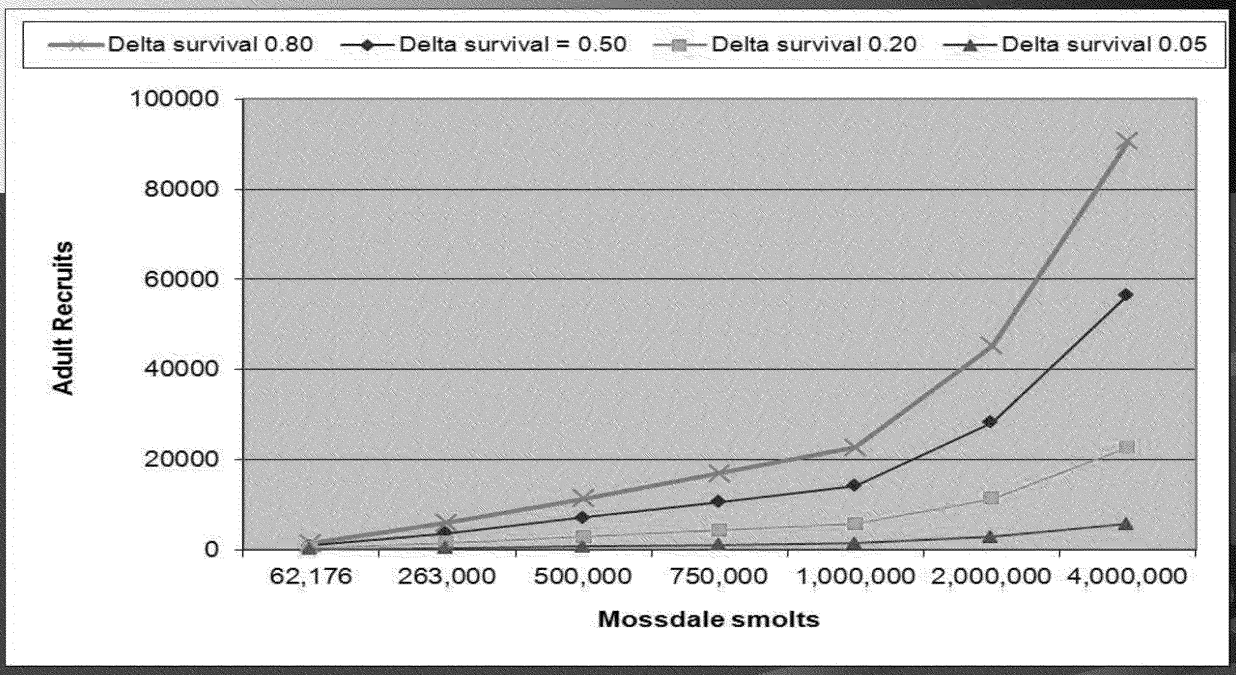
the benefits to salmon of a physical barrier at the head of Old River – while still being protective of delta smelt

Salmon survival with a physical HORB is related to flow and higher than with the non-physical barrier in 2010



Source: SJRG, 2007 and SJRG, 2011

Adult recruitment is very sensitive to juvenile survival in simulations



* Simulations also indicate a 0.50 survival rate through the Delta could meet the doubling goal in the San Joaquin basin in [illegible] years.

Source: DOI, 2011

*

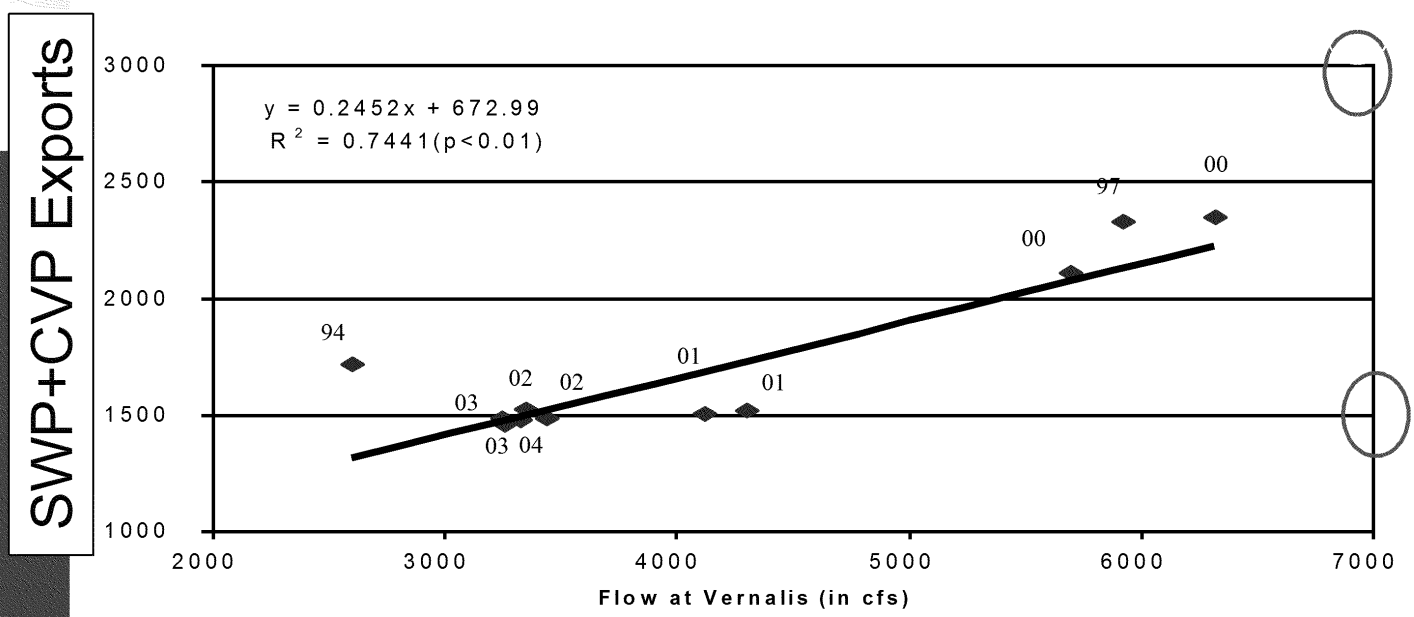
The Board should also consider:

the importance of continued survival monitoring: upstream and in the Delta

- No consistent survival monitoring occurring in Sacramento River through the Delta or upstream

- VAMP monitoring is no longer occurring (need additional data to assess export mortality on survival)

The relationship between flow and exports during VAMP tests with the physical HORB in place



The Board should also consider new and previous information on:

5. Increasing the frequency and duration of DCC gate closures

*(and flow conditions that achieve no bidirectional flow to minimize the proportion of juvenile salmon entering Georgiana Slough)

(DOI, 2010 and DOI,2012)

The Board should address scientific uncertainty and changing circumstances

- With an adaptive management plan (AMP) but consider a more protective approach while AMP development proceeds.

* Although there is uncertainty, there is evidence that increased flows will benefit native fishes, including salmonids (DOI, 2010).

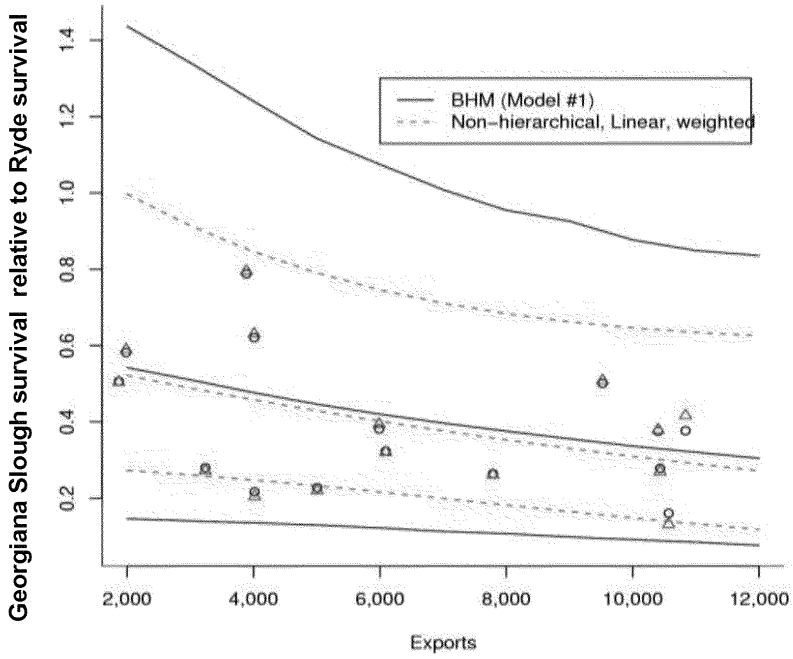
and evidence suggests that exports may decrease salmon survival in the interior Delta

Uncertainty associated with

-Low sample size (15) – need 100

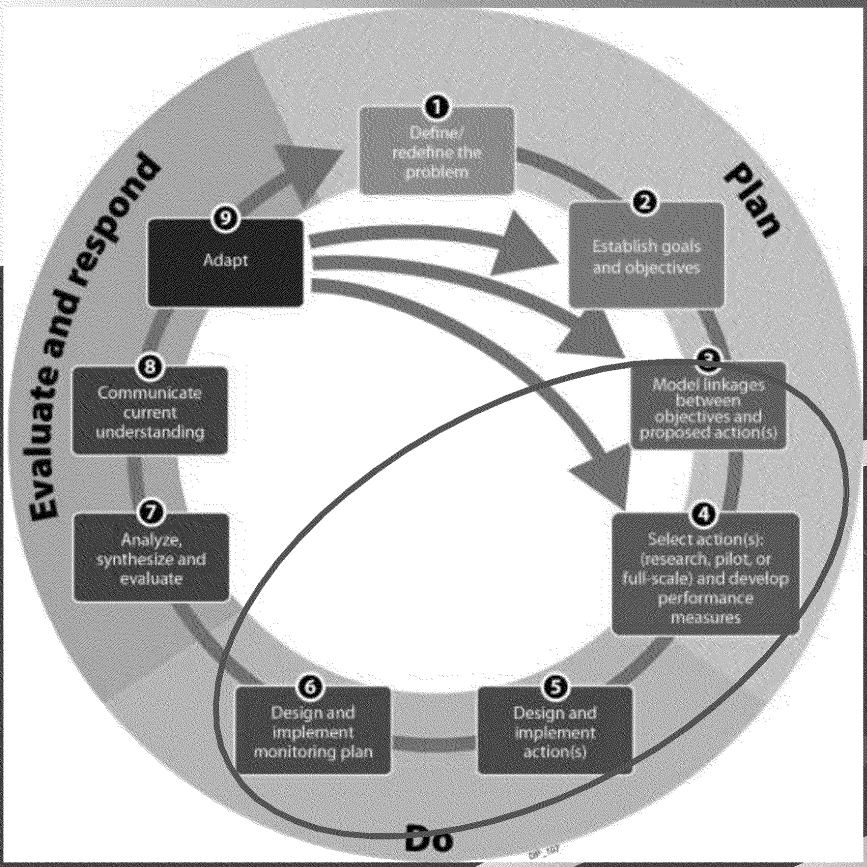
-Lots of noise relative to the signal

Proportion entering interior Delta estimated by Perry (2010) - a function of flow entering GS



Source : Newman and Brandes, 2010

Adaptive Management



Needs:
Specific biological and physical indicators

A range of flow criteria alternatives

DOI Technical and Application Guides may be helpful

Source: Delta Stewardship Council. 2012. Final Staff Draft of the Delta Plan. Available online: http://deltacouncil.ca.gov/delta-plan. Accessed 8/10/12.

Key Points from Previous submittals

* Flow is one of the most important components of ecosystem function (DOI, 2012).
* Changes in Delta flows and flow variability have contributed to declines of multiple native species, including salmonids (DOI, 2010)
* Delta inflow and outflow are important for salmon migration cues, and juvenile survival and abundance (DOI, 2010)

Key Points from Previous submittals

* Multiple mechanisms are hypothesized for increased survival at higher flows:

- reduced water temperatures,
- lower proportion of flow diverted,
- reduced entrainment,
- lower predation and disease,
- elimination of reverse flows,
- increased floodplain habitat

DOI (2010)

Key points from previous submittals

* The Board should consider flow objectives based upon a similar percent of unimpaired flow from each of the San Joaquin tributaries to meet the Vernalis objective. (DOI, 2011)

*Increased flows that mimic the general seasonality, variability, magnitude and duration of the natural hydrograph will benefit native fishes including salmonids. (DOI, 2011)

SWRCB Workshop 2:

Bay-Delta Fishery Resources

NOAA Fisheries

Garwin Yip and Ryan Wulff

October 1, 2012

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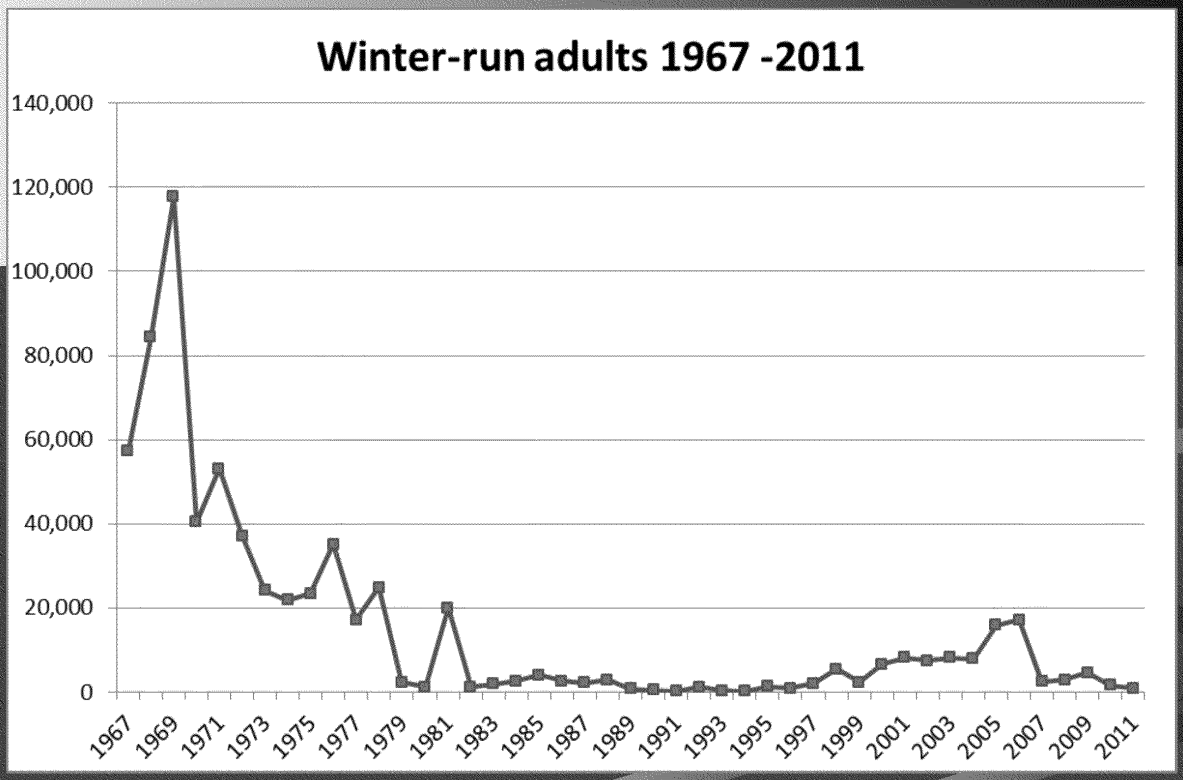
Key points

1. Low numbers for winter-run Chinook
2. NMFS 2009 Biological Opinion (BiOp)
3. The SWRCB should model a range of outflow objectives
4. Increased flows will benefit native fishes, including salmonid survival through the Delta
5. New or soon-to-be completed information is relevant

Winter-Run Decline



NMFS 2009 BiOp and RPA Actions

Scope of BiOp

a) CVP/SWP controlled streams on the Sacramento and San Joaquin Rivers and their tributaries

b) Winter-run, Spring-run and Steelhead

Additional areas under State Water Board jurisdiction:

a) San Joaquin Tributaries Operations

b) Sacramento River Tributaries

c) Fall-run and Late fall-run

Post NMFS 2009 BiOp Information

New information since 2009/2010:

a) Annual Reviews

b) 2011 RPA amendments

c) Joint Stipulation and associated sentinel steelhead study

Post NMFS 2009 BiOp Information

New information since 2009/2010:

d) NAS study (2010)

i. Overall RPA: **"The assortment of actions among the three habitat realms (watersheds, mainstem rivers, and delta) is designed to improve survival and to enhance connectivity throughout this system. This approach is consistent with the contemporary scientific consensus on improving ecosystem functioning…"**

ii. OMR: **"The committee concludes that the strategy of limiting net tidal flows toward the pump facilities is sound, but…this action alone will [not] benefit the San Joaquin salmon, unless it is combined with an increase in San Joaquin River flows."**

Dams and Cold Water Pool Management

- Reservoir releases are vital for salmon and steelhead survival.
- The process for establishing new outflow objectives should be accompanied by CalSim modeling/evaluation.
- This could include potentially modifying SWRCB or DFG 2010 springtime outflow criteria to protect reservoir releases

Dealing with Uncertainty

- Precautionary approach
- Monitoring and adaptive management processes
- Substantial commitments of resources

Forthcoming Information

1. NMFS Final Recovery Plan (Winter 2012/2013)
2. Winter-Run Life Cycle Model (first stages: Dec. 2013)
3. Scientific paper on migration patterns of juvenile winter-run Chinook salmon through the Delta (In review)
4. Report - Potential causes of 2011 winter-run decline
5. Technical memorandum for BDCP - Delta Salmonid Survival Objectives (early 2013)

Suggestions for the SWRCB

1. Upstream reservoir releases/ cold water pool management
2. Alternative methods to protect beneficial uses of salmonids
3. Increased outflow in the San Joaquin
4. Use the precautionary approach
5. Support modifications to the DCC Gates objectives

In conclusion

- Adequate flows are an essential component of habitat for all life stages of listed and non-listed anadromous fish

- There continues to be strong support, even with new information, for the goals and biological objectives identified in the DFG and SWRCB 2010 flow criteria reports.

SWRCB Bay-Delta Fishery Resources workshop

U.S. Environmental Protection Agency

Bruce Herbold and Erin Foresman

October 1, 2012

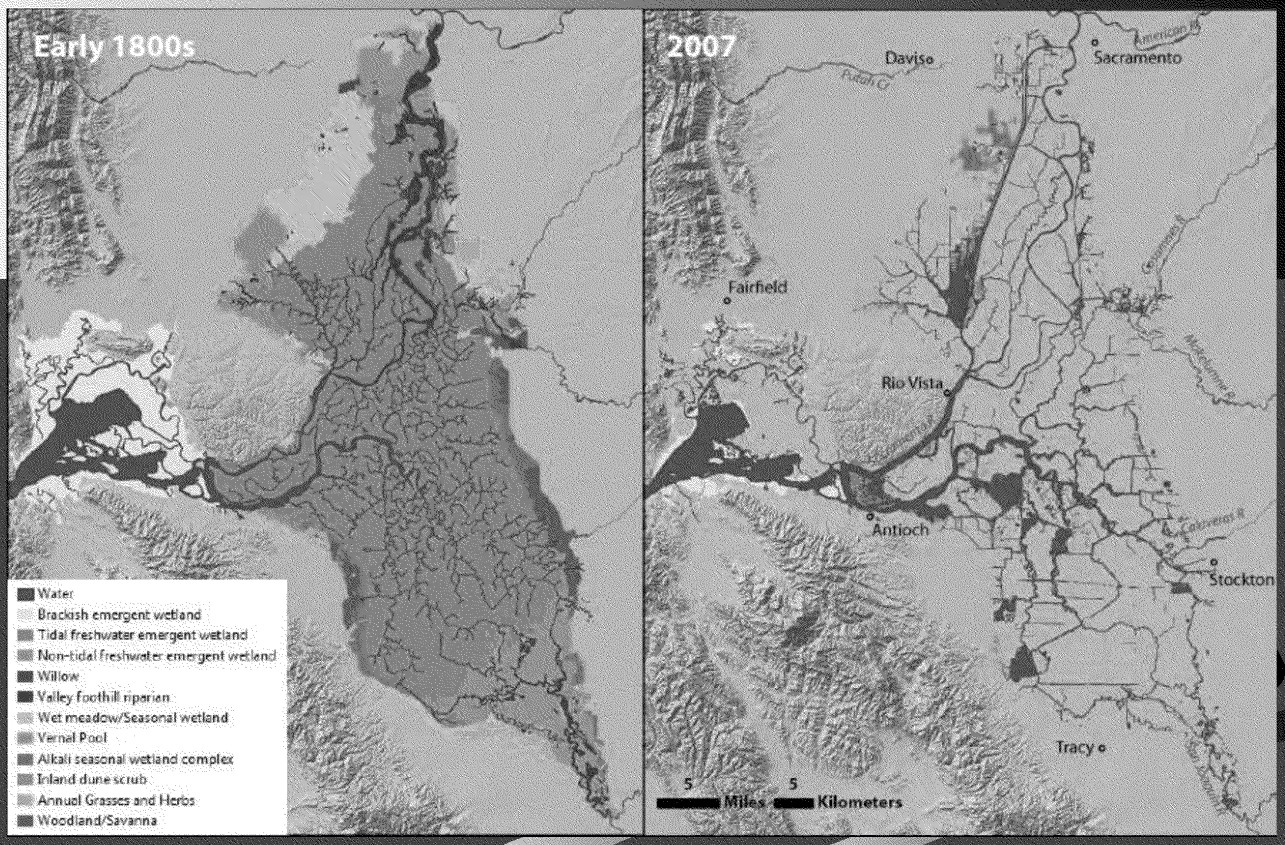
Outline

- EPA recommendations
- New Analyses
- Concepts for water quality objectives
- Adaptive management
- Recommendations

EPA Recommendations

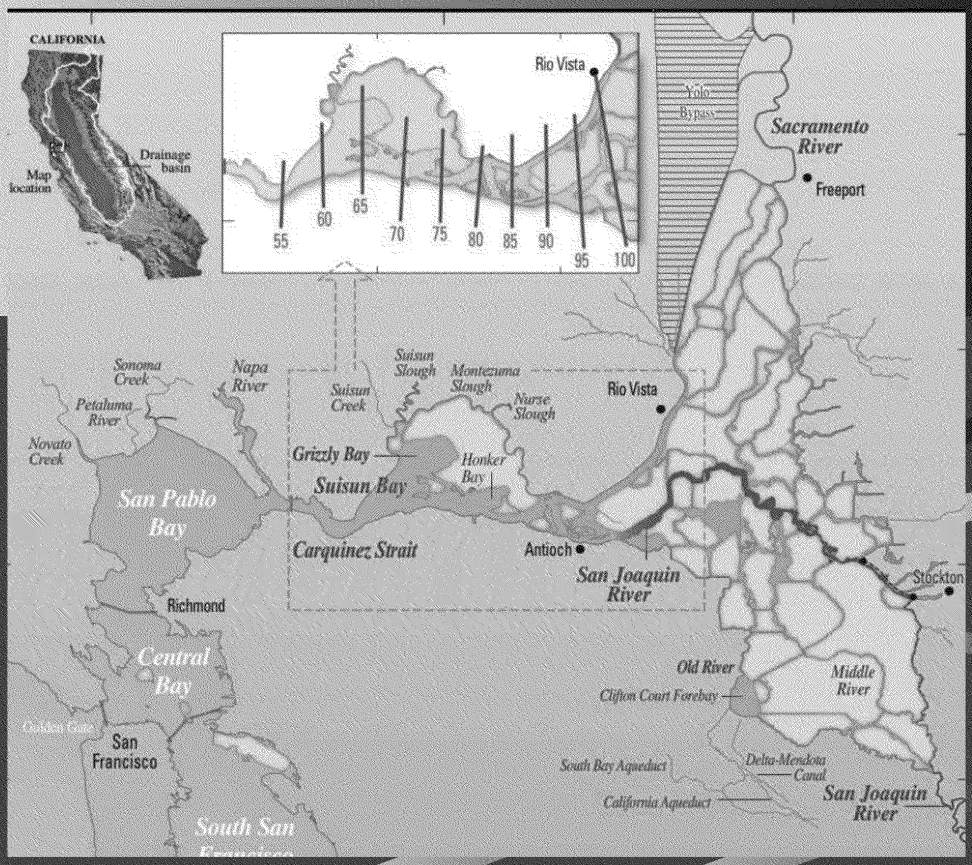
Objective	Recommendation
Springtime Delta outflow	• Begin in January or activate based on flow or turbidity measure from first storm • Remove Roe Island trigger but require Roe Island standard • Operate reservoirs to maintain coldwater pool for salmonids
Fall Delta outflow	• Activate and quantify objective based on better estimate of real hydrologic conditions such as 8-river index or end of June reservoir storage • Identify a range of X2 values with 2010 flow criteria and reference conditions
San Joaquin Migratory Corridor	• Provide a spring and fall downstream flow connection between Vernalis and the Bay

Geometry , habitat, and flows have changed



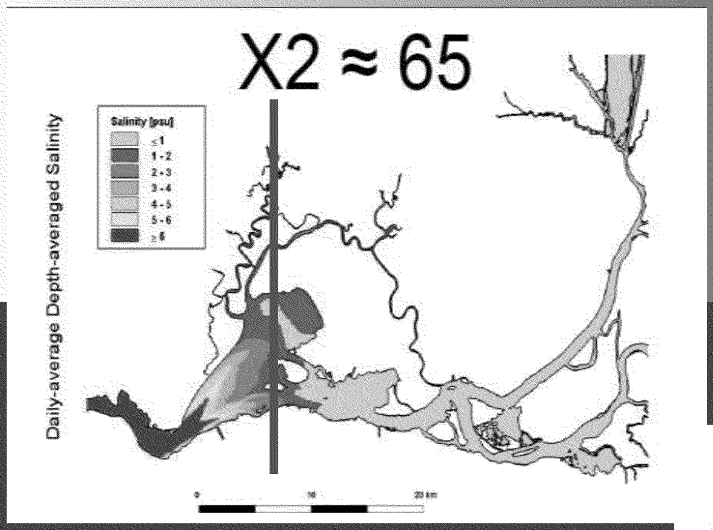
Source: SFEI 3/27/12 Presentation at LSZ Workshop available at http://www.epa.gov/sfbay-delta/pdfs/hist-estuarine-gradient-epa-grossinger.pdf

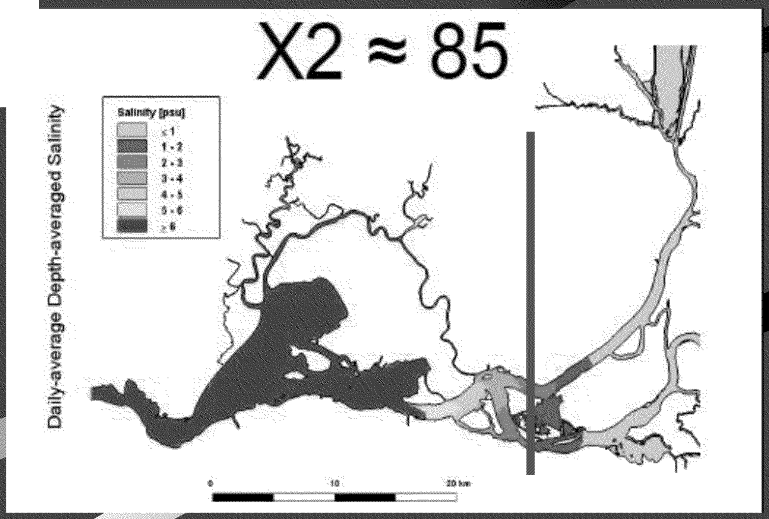
X2 and the SF Bay Delta Estuary



DeLio (2011) adapted from Jassby et al. (1995)

X2 and the Low Salinity Zone

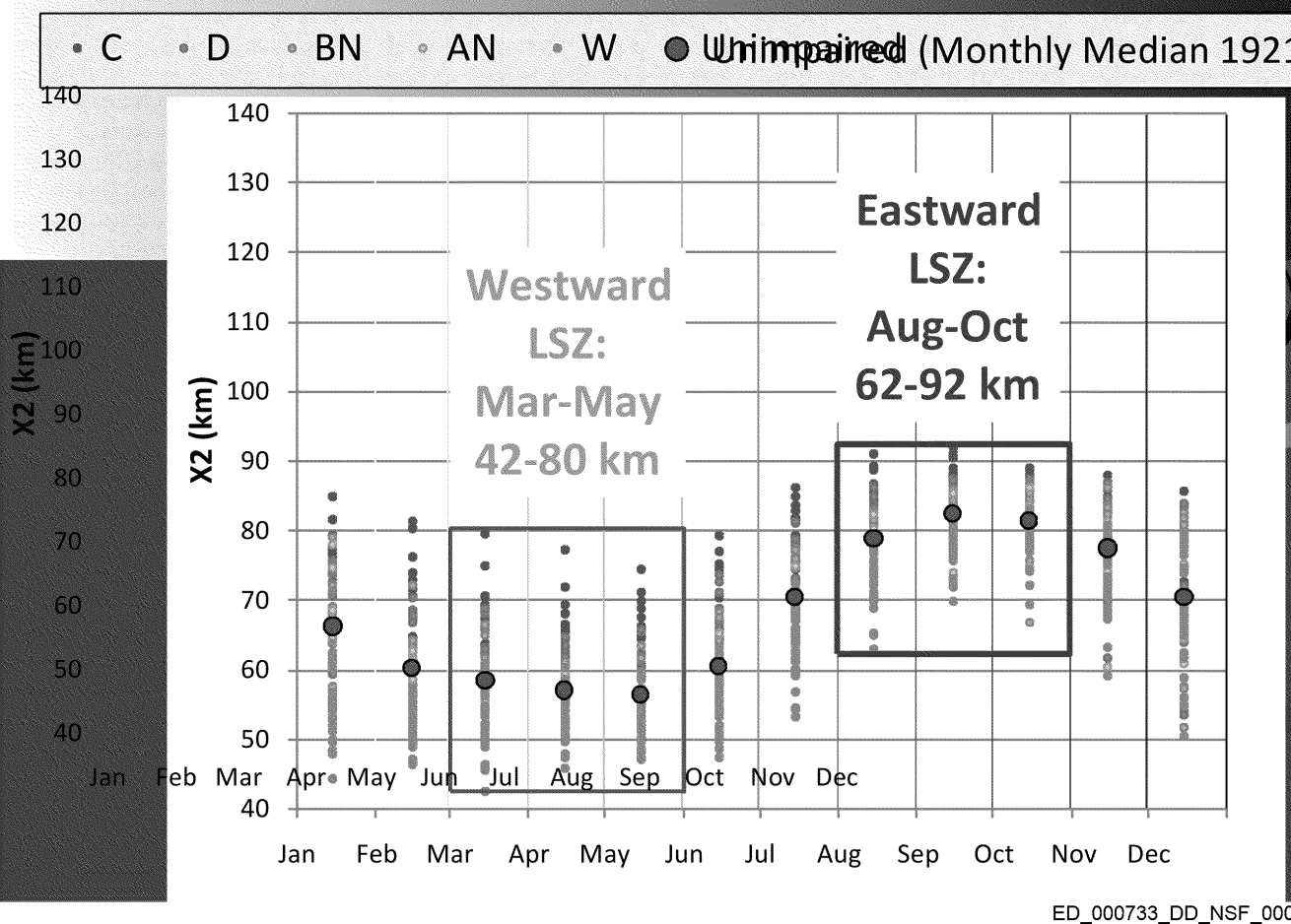




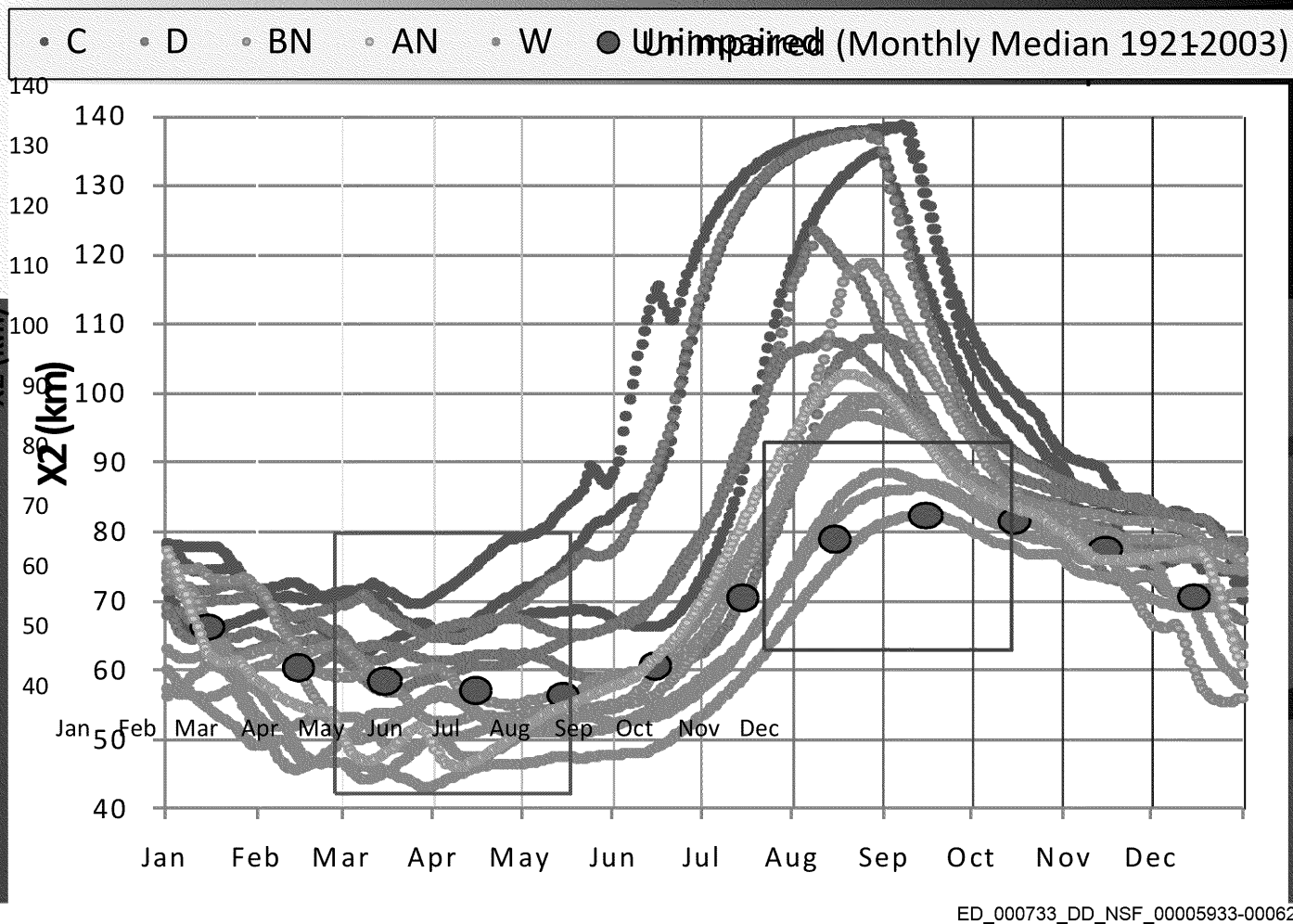
Source of X2 maps is Delta Modeling Associates Low Salinity Flip Book. June 15, 2012. Version 0.9

Monthly Unimpaired X2 (km)

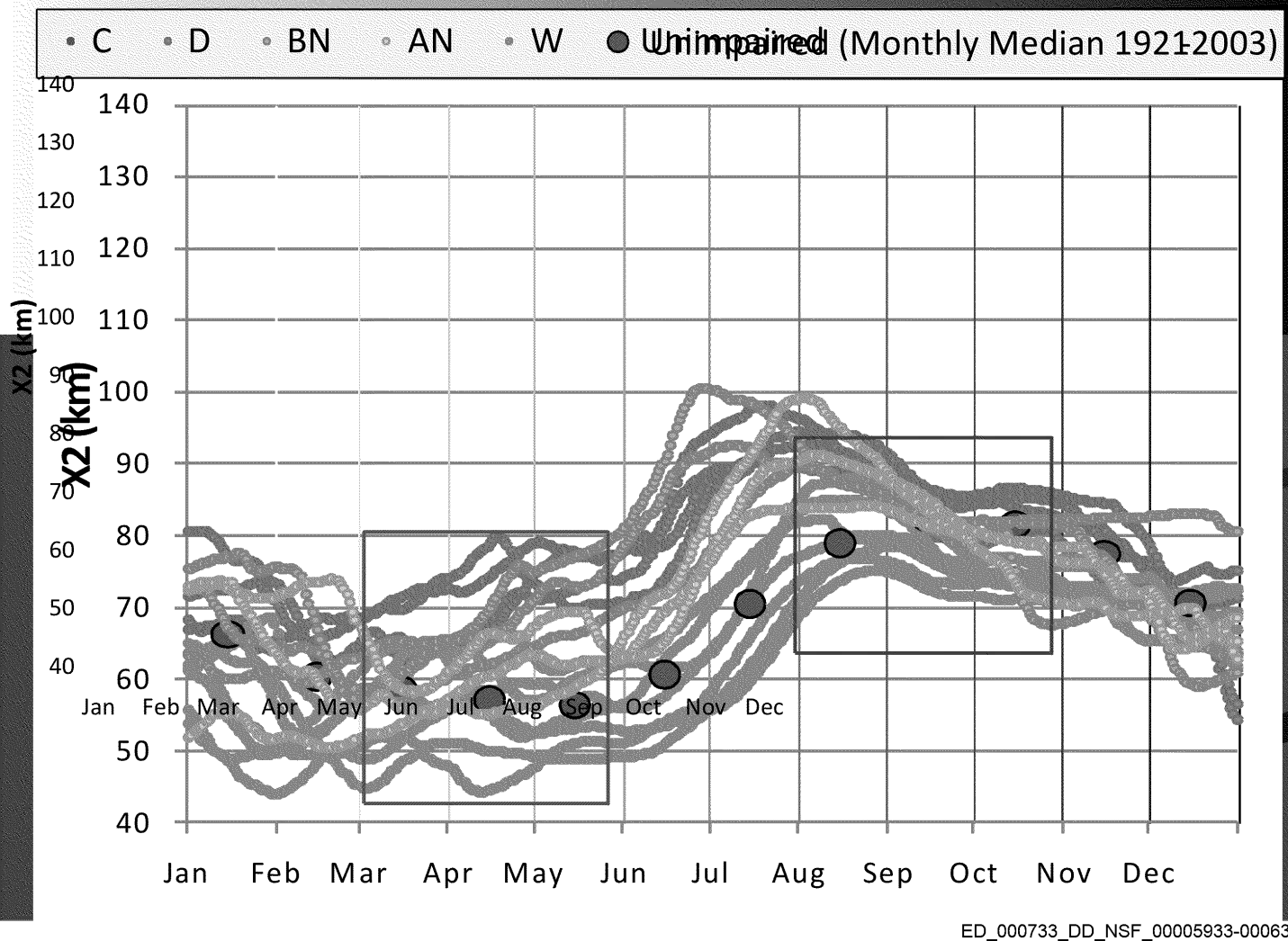
Courtesy of Dr. Anke Mueller-Solger, Using Jassby et al. 1995 Monthly Equation)



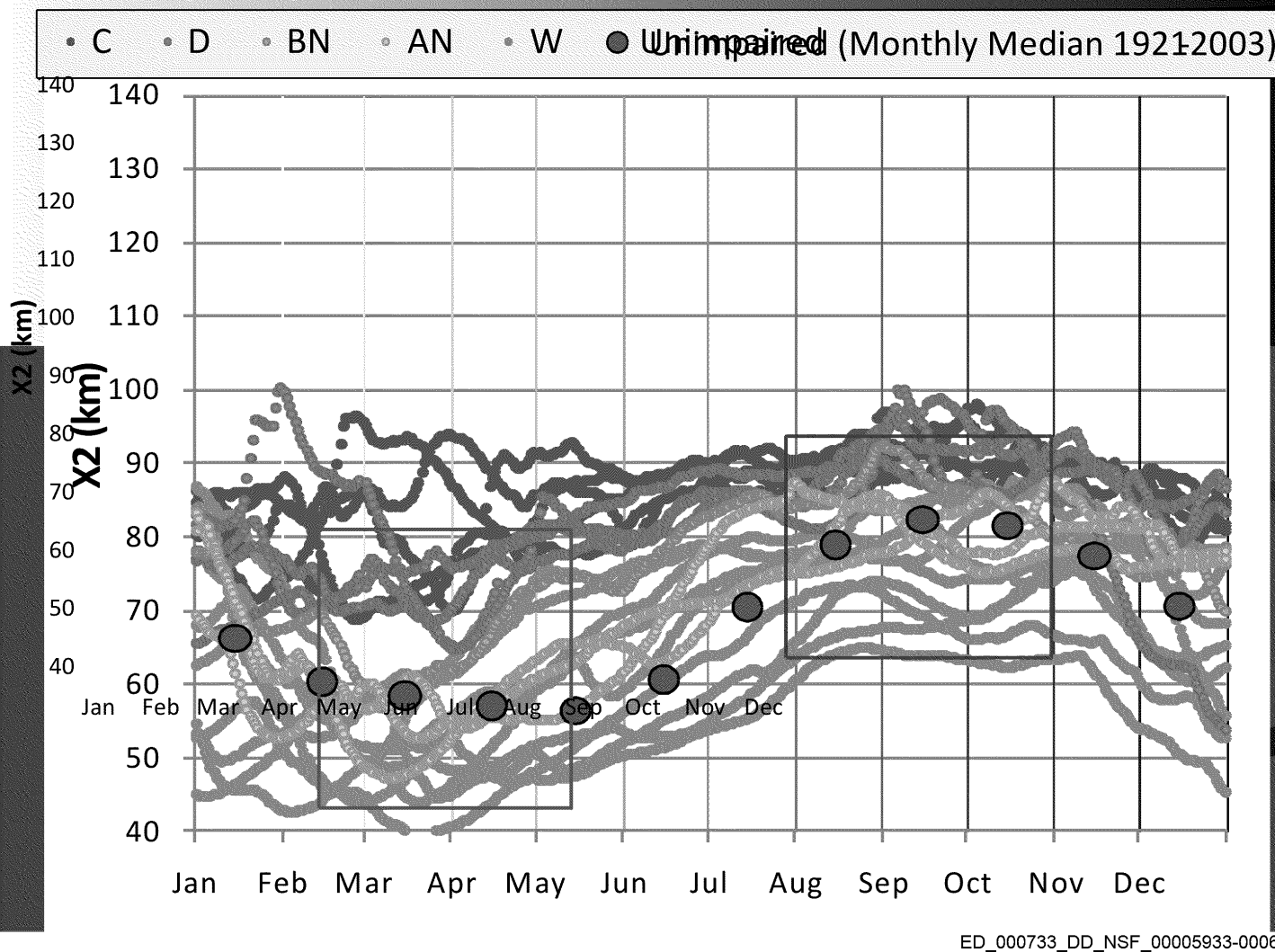
Daily X2 (km) After Channelization 1930-1944



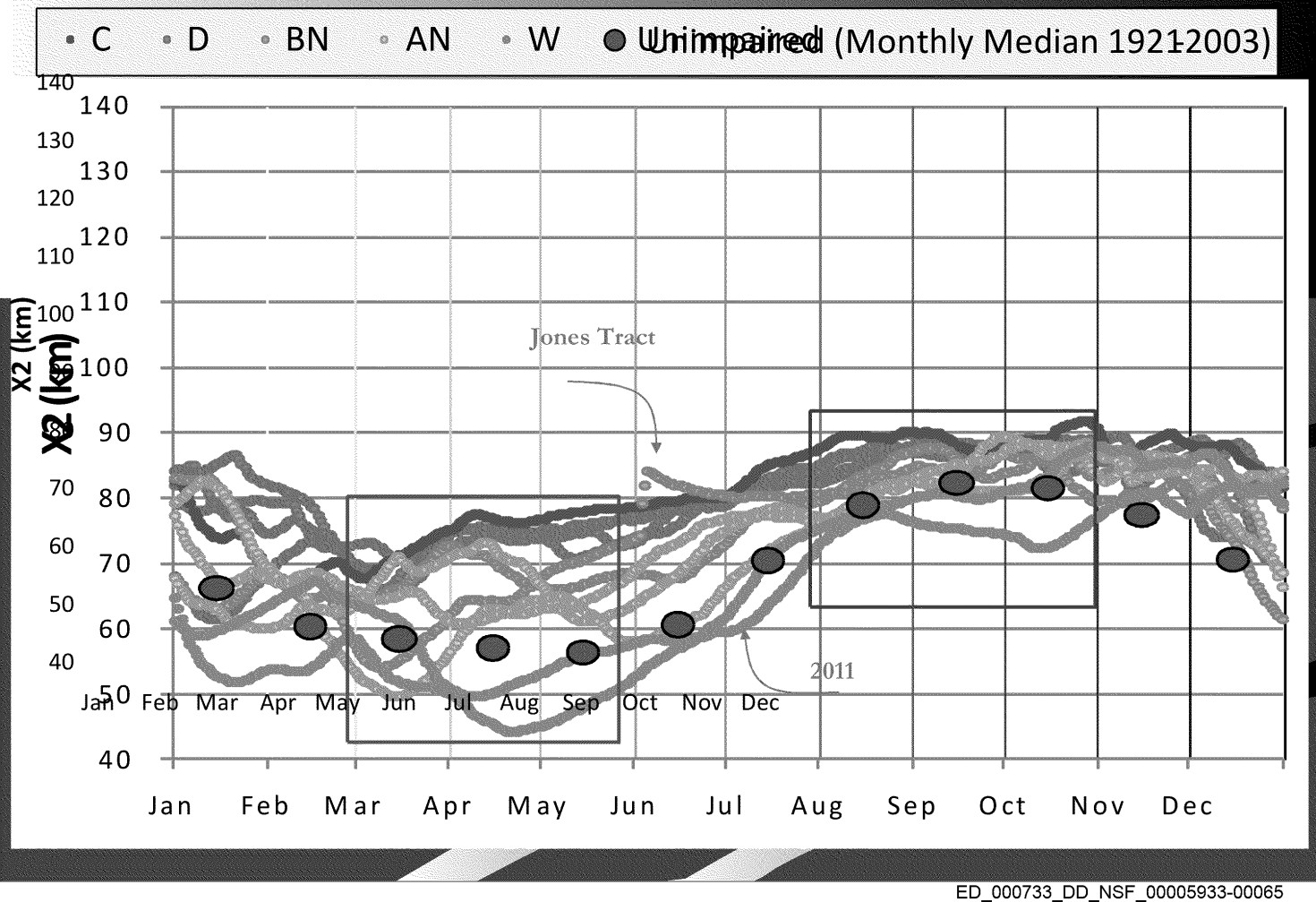
Daily **X2** (km) Before Exports 1951-1967



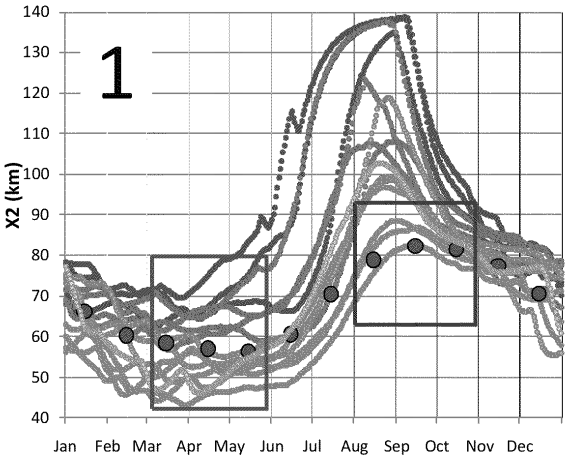
Daily X2 (km) Substantial Delta Diversions 1978-1999



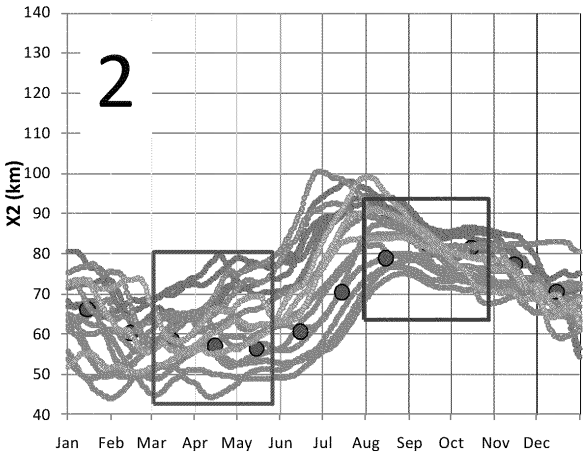
Daily X2 (km) After D-1641, 2000 and POD



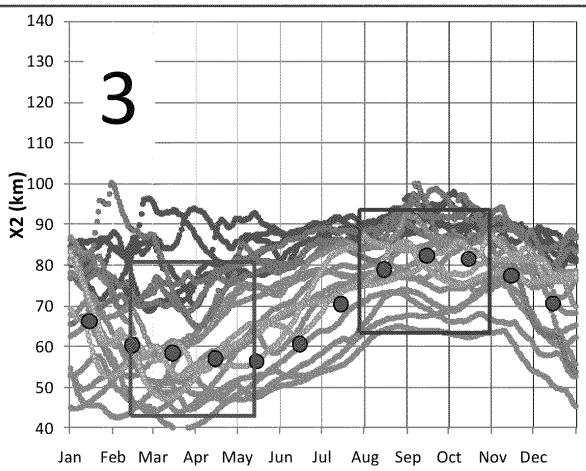
Before Shasta Dam (1930-1944)



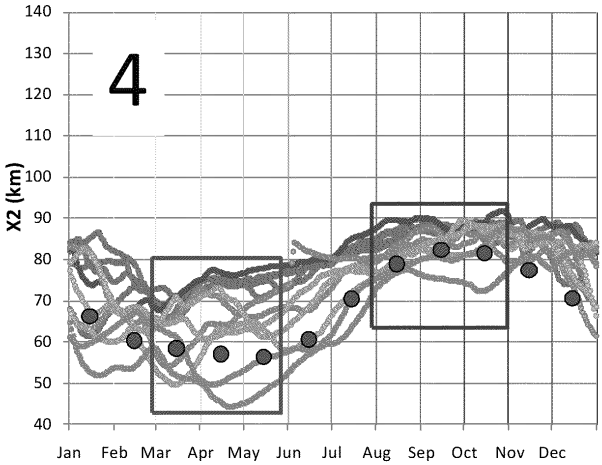
Before SWP Exports (1951-1967)



Substantial Delta Diversions (1978-1999)



After D-1641, 2000, & POD



Concepts for changes to water quality objectives

- Delta outflow
- Sacramento inflow
- Delta Cross Channel Gate
- San Joaquin inflow
- Old and Middle River flows
- Floodplain flows

Evaluate a range of water quality objectives

Less Aquatic Life Protection

More Aquatic Life Protection

Evaluate a range of water quality objectives

2006 WQCP
+ ESA BOs

Some of the
2010 Flow Criteria

Alternatives to evaluate

Alternative

Concepts for changes to water quality objectives

Springtime Delta Outflow Modifications

- Extend into January or a reliable measure of first storm
- Require the Roe Island standard, but remove the trigger
- Maintain cold water pool in reservoirs

Concepts for changes to water quality objectives

Fall Delta Outflow Modifications

Range of X2 values

- 2010 Flow Criteria Reports
- Reference condition

Activate and quantify

- 8-river index (April, May, June)
- End of June storage
- Experimental implementation

Concepts for changes to water quality objectives

San Joaquin Migratory Corridor

- Spring pulse flows – 2010 flows report
- Fall pulse flows 1 – 2 weeks
  range = 1:1 – 3:1 export to import ratio

Adaptive Management

- Triennial review
- Controlled experiments
- Monitoring and data assessment

Summary

- Fish benefit from flows that mimic the natural hydrograph pattern.
- The 1995 WQCP objectives restored some of the springtime hydrograph pattern.
- Modifications to objectives should build on this success to improve habitat in all seasons.
- Use controlled experiments and the triennial review process to adapt.

Objective	Recommendation
Springtime Delta outflow	• Begin in January or activate objective based on first storm • Remove Roe Island trigger but require Roe Island standard • Operate reservoirs to maintain coldwater pool forsalmonids • Specific X2 recommendations CDFG 2010 Flow Criteria Report and in Appendix 1 of comments for workshop 2 (p2-4).
Fall Delta outflow	• Activate and quantify objective based on better estimate of real hydrologic conditions such as 8-river index or end of June reservoir storage • Identify a range of X2 values with 2010 flow criteria and reference conditions • Specific X2 objectives recommended by CDFG in 2010 Flows Report and comments. • OCAP Biological Opinion RPAs designed to avoid jeopardy of operating CVP and SWP not necessarily sufficient to support beneficial uses (NMFS & FWS phase II scoping comments).
San Joaquin Migratory Corridor	• Provide a spring and fall downstream flow connection between Vernalis and the Bay
Delta Cross Channel	• Specific gate operation recommendations in Attachment 1 of CDFG workshop comments, Table 1, page 16.
Sacramento Inflows	• CDFG 2010 flow criteria recommendations at Wilkins Slough, Freeport, and Rio Vista
San Joaquin Inflows	• CDFG 2010 flow criteria recommendations
Old and Middle River Flows	• Specific OMR flow recommendations from CDFG • OCAP Biological Opinion RPAs designed to avoid jeopardy of operating CVP and SWP not necessarily sufficient to support beneficial uses (NMFS & FWS phase II scoping comments)
Floodplain flows	• CDFG 2010 flow criteria recommendations