Comments pertaining to use of SJB salmon population models to modify flow standards for the purpose of doubling natural production of Chinook salmon

State Water Resources Control Board

October 13, 2012

San Joaquin Tributaries Authority

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Outline

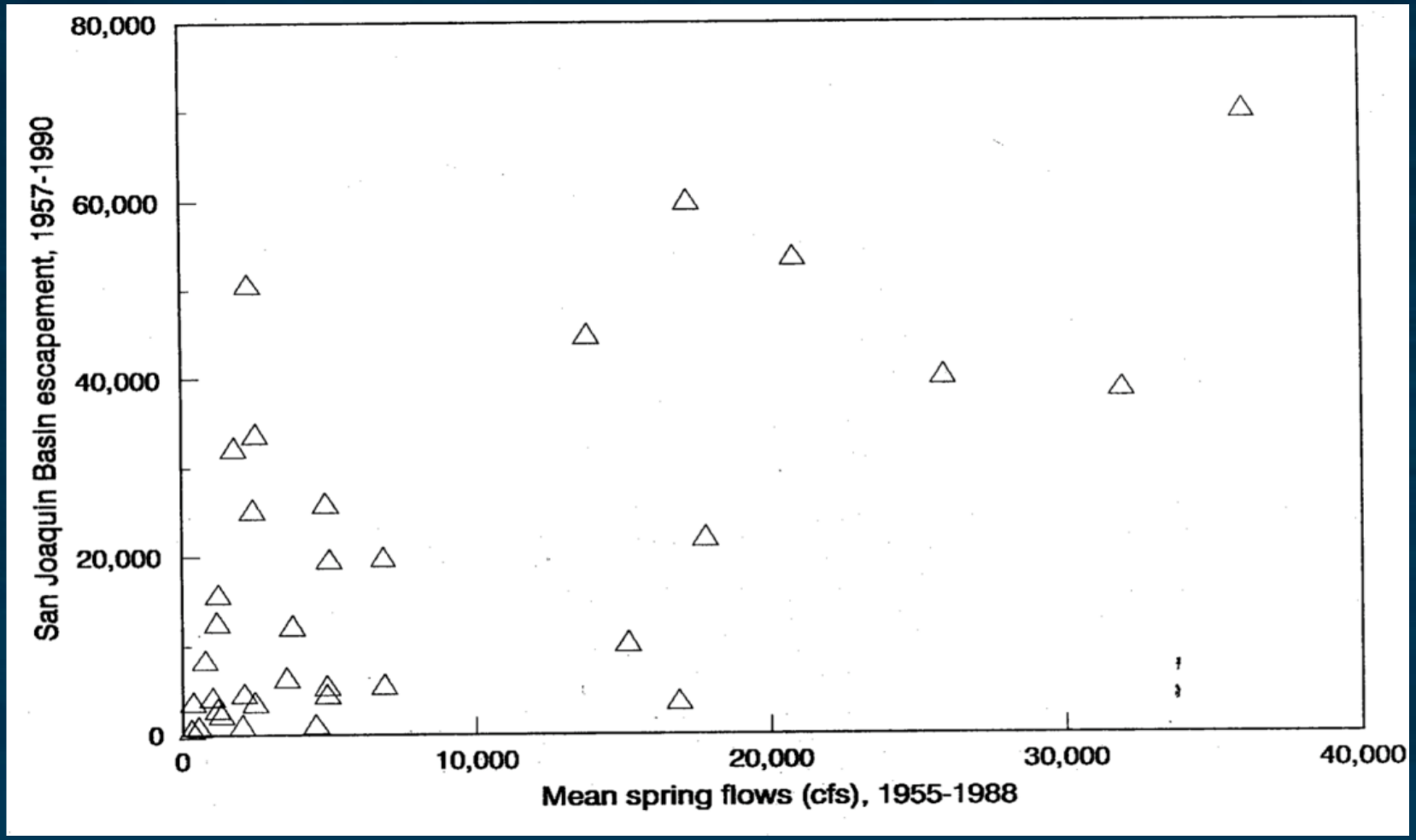
- Introductions and Background
- 1991 “More Flow = More Fish” Linear Regression
- CDFG SJB 2005 Population Model
- Impacts and Issues
- Questions

SWRCB and the "More Flow = More Fish" Paradigm

"Studies that examine the relationship between fall-run Chinook salmon population abundance and flow in the SJR basin generally indicate that: 1) additional flow is needed to significantly improve production (abundance) of fall-run Chinook salmon; and 2) the primary influence on adult abundance is flow 2.5 years earlier during the juvenile rearing and outmigration life phase."

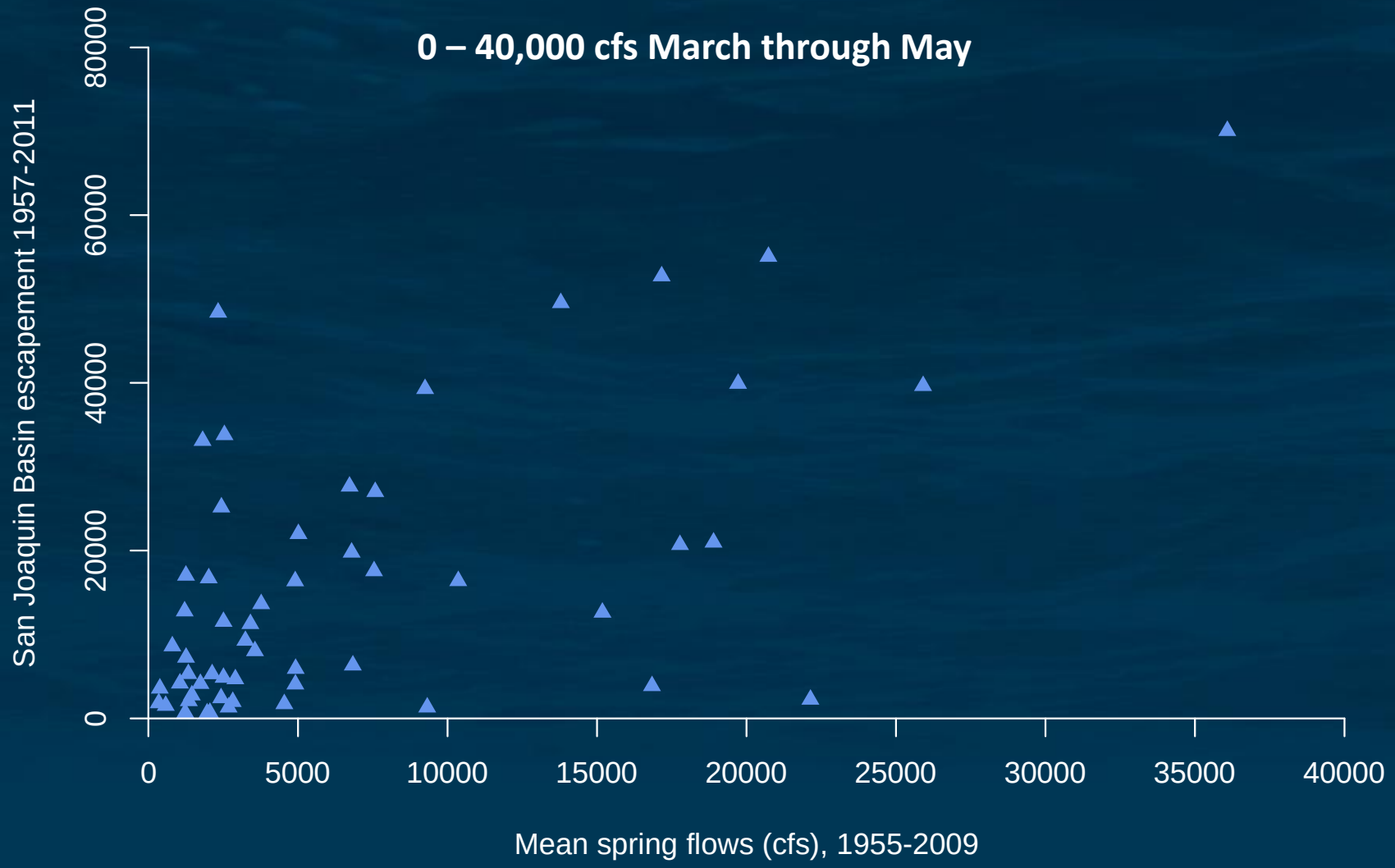
SWRCB *Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives, February 2012, at 3-29 – 3-30, citing AFRP 2005; DFG 2005a; Mesick 2008; DFG 2010a; USDOI 2010.*

1991 Linear Regression – Spring Flow vs Escapement

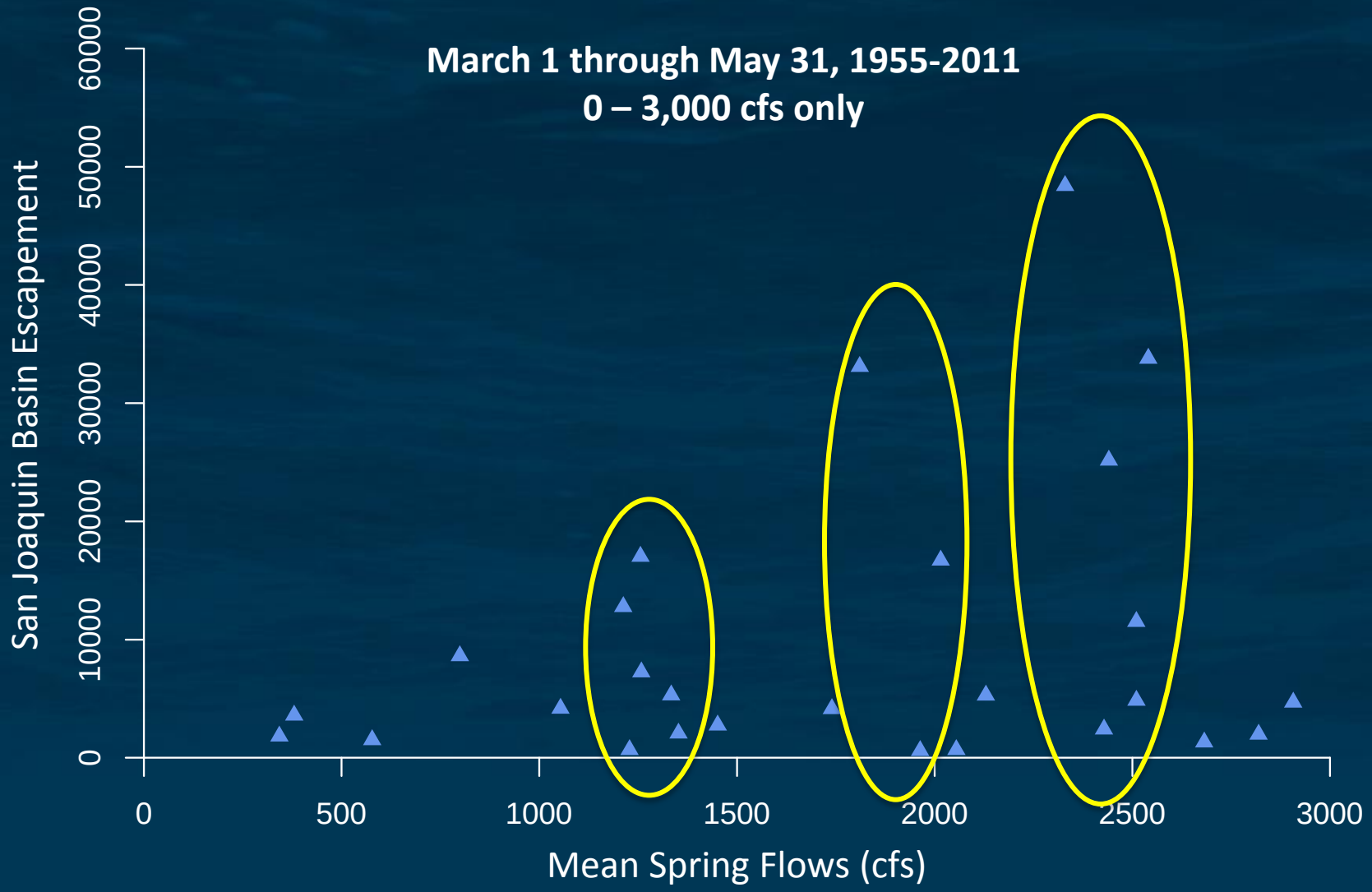


From 1991 SWRCB Water Quality Control Plan for Salinity

SJR Flow vs Escapement Relationship (1955-2009)



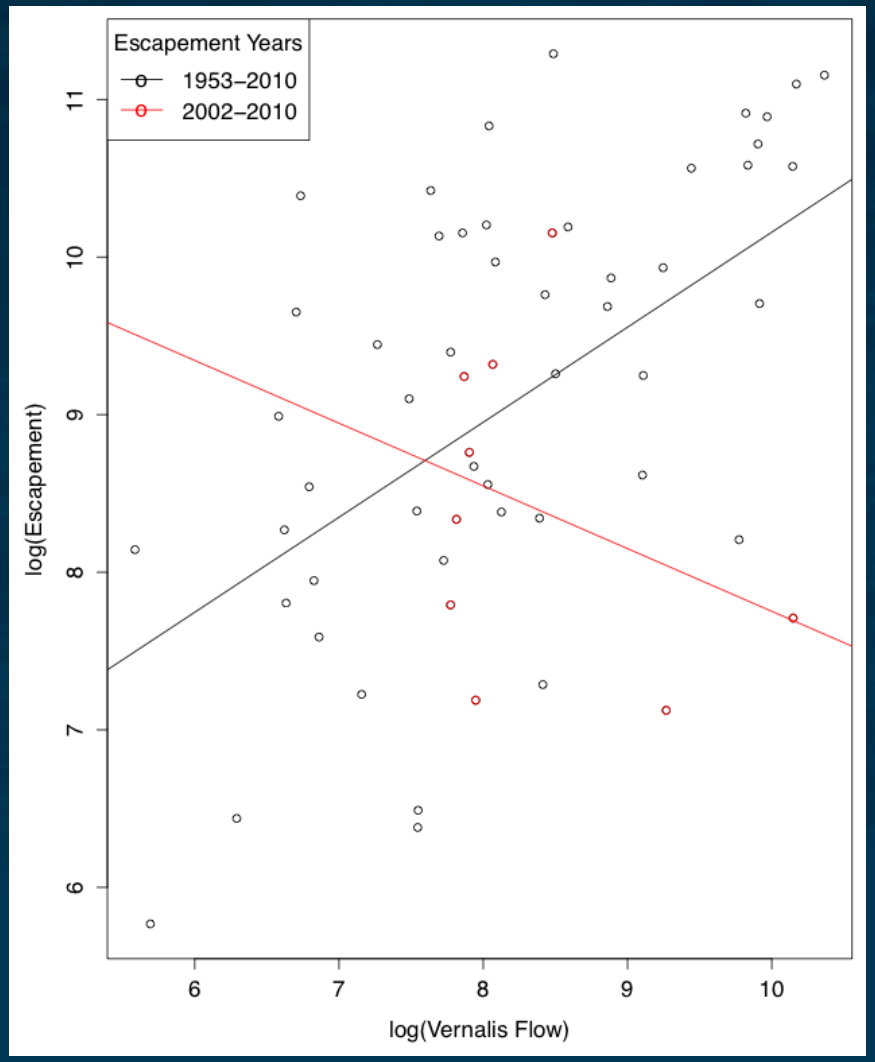
SJR Flow-Escapement Relationships (Managed Flow Range)



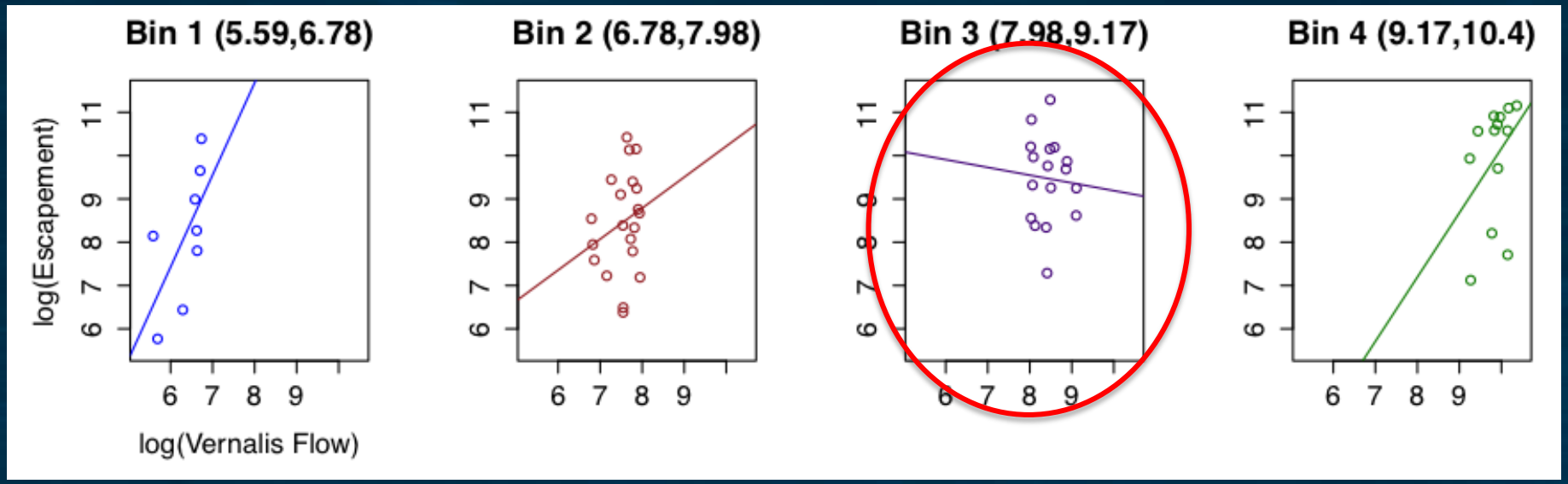
Simple Regression - Not Appropriate for Data

- Too Simplistic –ignores all other available data (e.g., harvest)
- Does not represent best or widely-accepted statistical practices
- Most recent data actually has a negative correlation

Escapement vs. Vernalis Flow

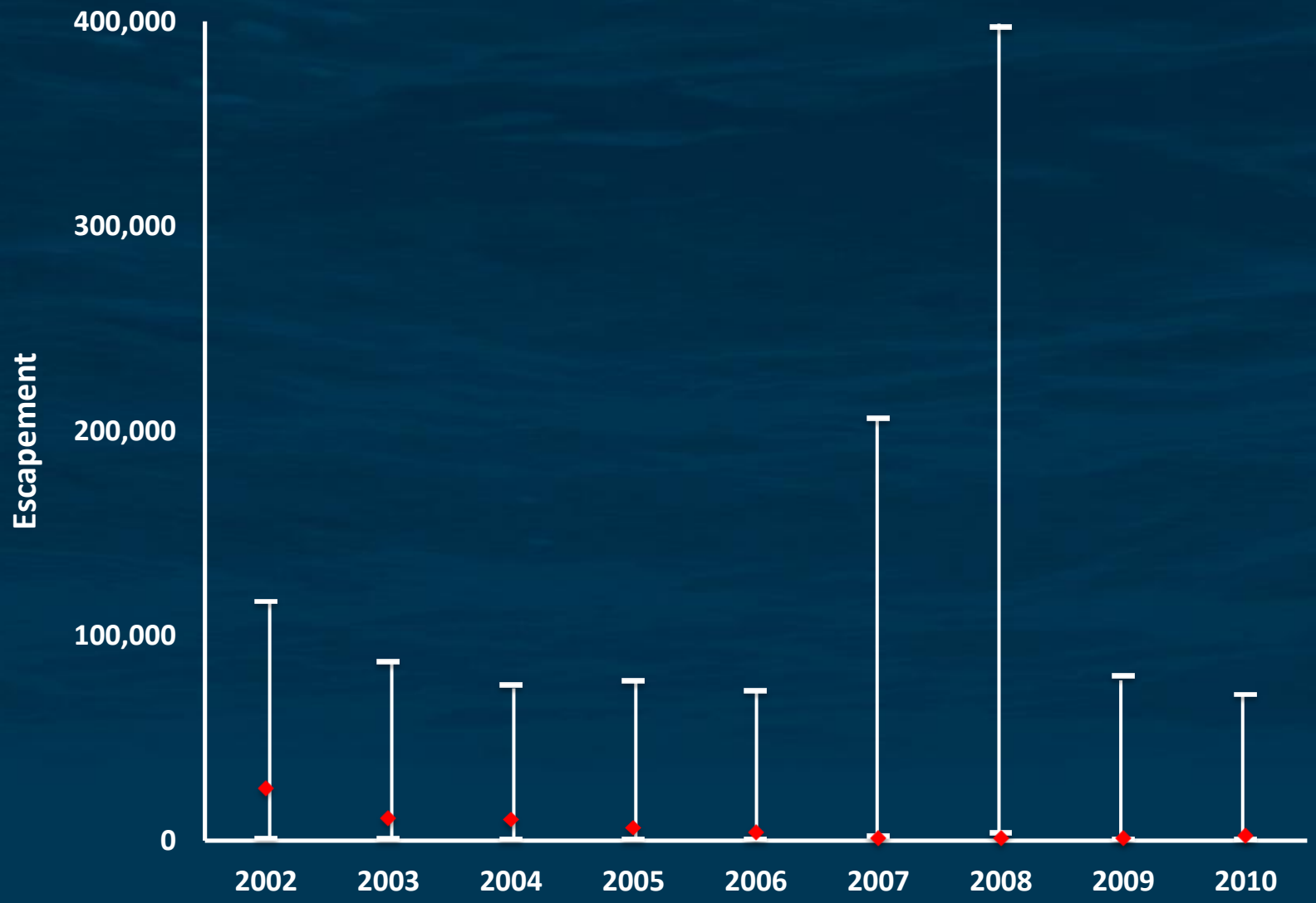


Simple Regression - Not Appropriate for Data



- Breaking data into equal subsets results in highly variable correlation estimates
- Indicates there is not a linear relationship that holds over entire range of flow values

Simple Regression Has No Predictive Power



Simple Regression Statistical Summary

- Linear regression does not represent best or widely-accepted statistical practices for this data set
- The type of model used is not appropriate for the data
- Most recent 2002-2010 data suggests a negative correlation between these variables
- There is no simple linear relationship between escapement and flow; no causal relationship between escapement and flow

2005 CDFG SJB Population Model

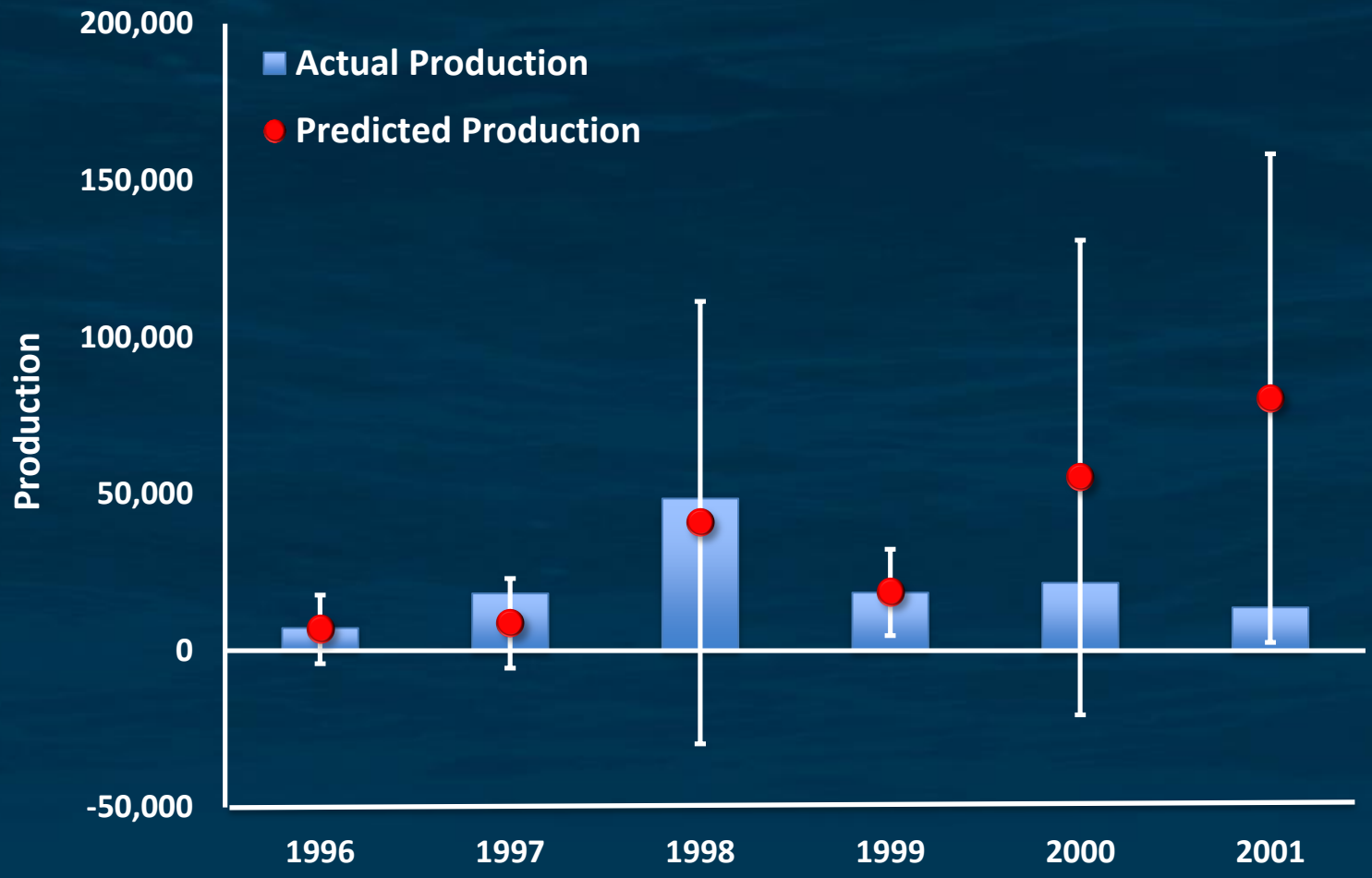
Combination of other models

- **Mossdale Smolt Production Model**
  - Predicts # smolts that arrive at Mossdale
  - Function of spawners and spring flows at Vernalis
- **Delta Survival Model**
  - Predicts # of migrants that survive through Delta to Chipps Is
  - Function of # of smolts predicted to arrive at Mossdale, spring flow at Vernalis and HORB
- **Cohort Production Model**
  - Predicts adult production
  - Function of # of smolts at Chipps Is

CDFG SJB Population Model Statistical Summary

- Each component model has major violations of its distributional assumptions, making their behavior unpredictable
- Chaining-together approach amplifies errors and increases uncertainty in model output, which is unaddressed
- Model authors neither validated its predictions using real data, nor attempted to quantify the uncertainty inherent in their modeling process
- Predictions highly unreliable because variability is typically larger than the prediction itself, making the prediction of no practical use
- The model neglects available data on factors much more likely to affect Salmon population than those it uses (water temperature, ocean conditions, ocean survival, ocean predation, harvest, etc)

Model Prediction



The New CDFG Model – SalSim 2.0

"This life cycle model (V.1.0) began as a fairly simple spreadsheet…"

"…new questions arose as to the relative importance of other, non-flow factors on Chinook salmon populations."

"Due to peer review comments received, SalSim has evolved into version 2.0, a substantially more complex model, containing greater resolution in the inland, delta, and ocean ecosystems comprising salmon life history to provide insight into the effects of changes not only in flow, but also water temperature, water quality, predator abundance, ocean condition, harvest and superimposition of redds on Chinook salmon populations."

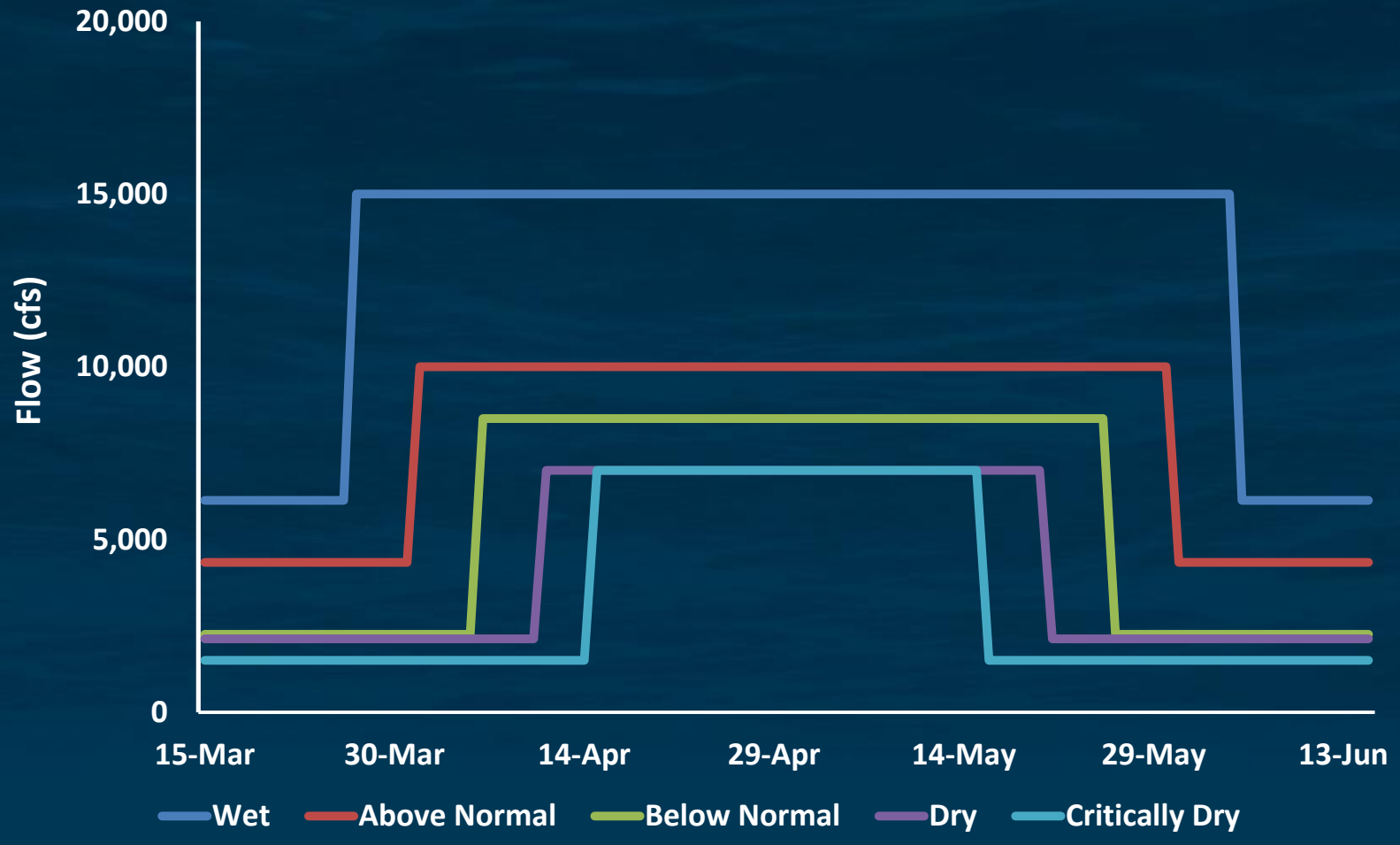
CDFG 2012. Letter from Scott Cantrell to SWRCB. Written Information Responsive to the Workshop Questions for the Bay- Delta Workshop 3 - Analytical Tools for Evaluating Water Supply, Hydrodynamic and Hydropower Effects

Impacts and Issues

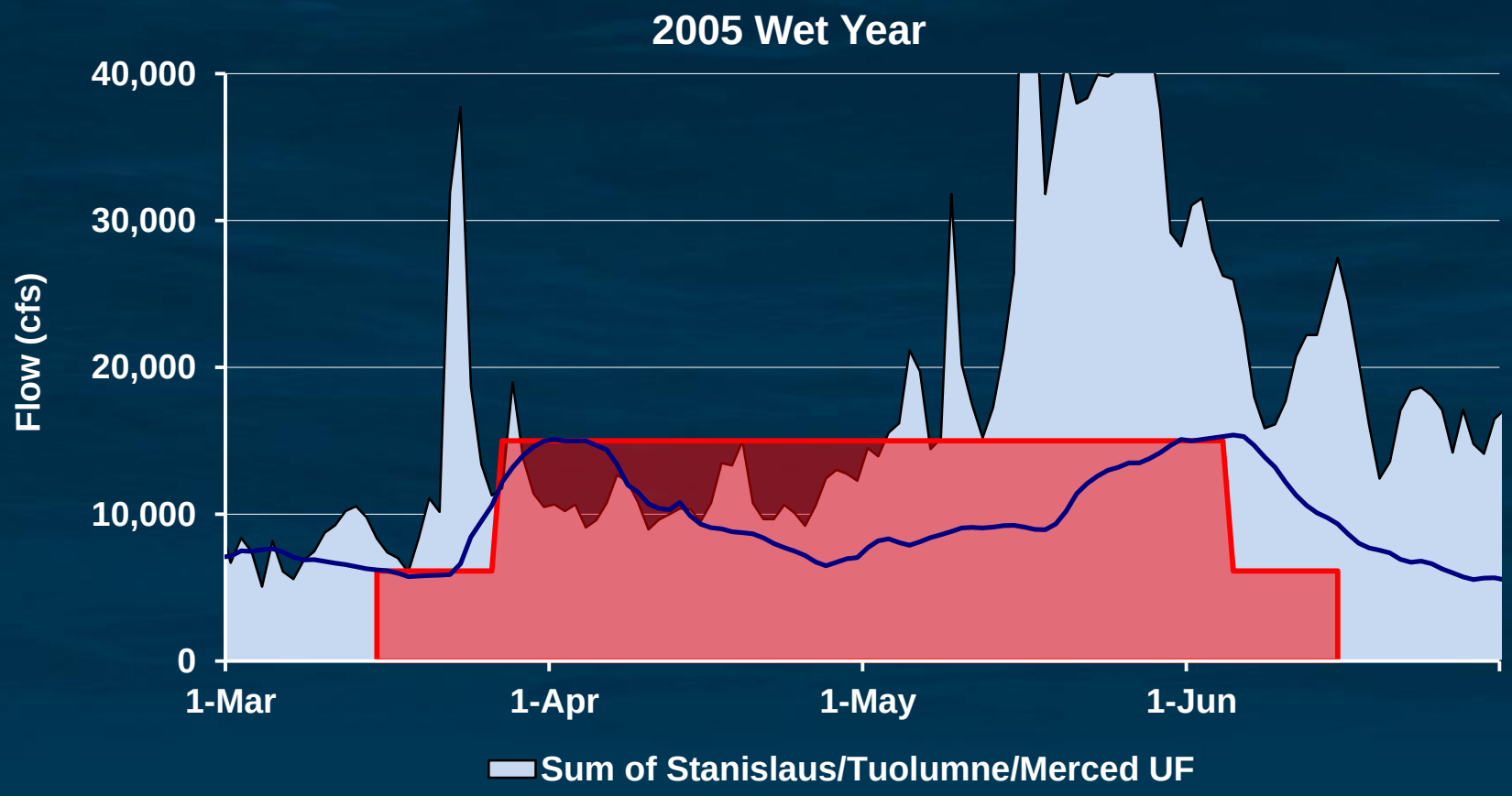
Anadromous Fish Restoration Program Doubling Goal

	Production
Stanislaus River	22,000
Tuolumne River	38,000
Merced River	18,000
Total	**78,000**

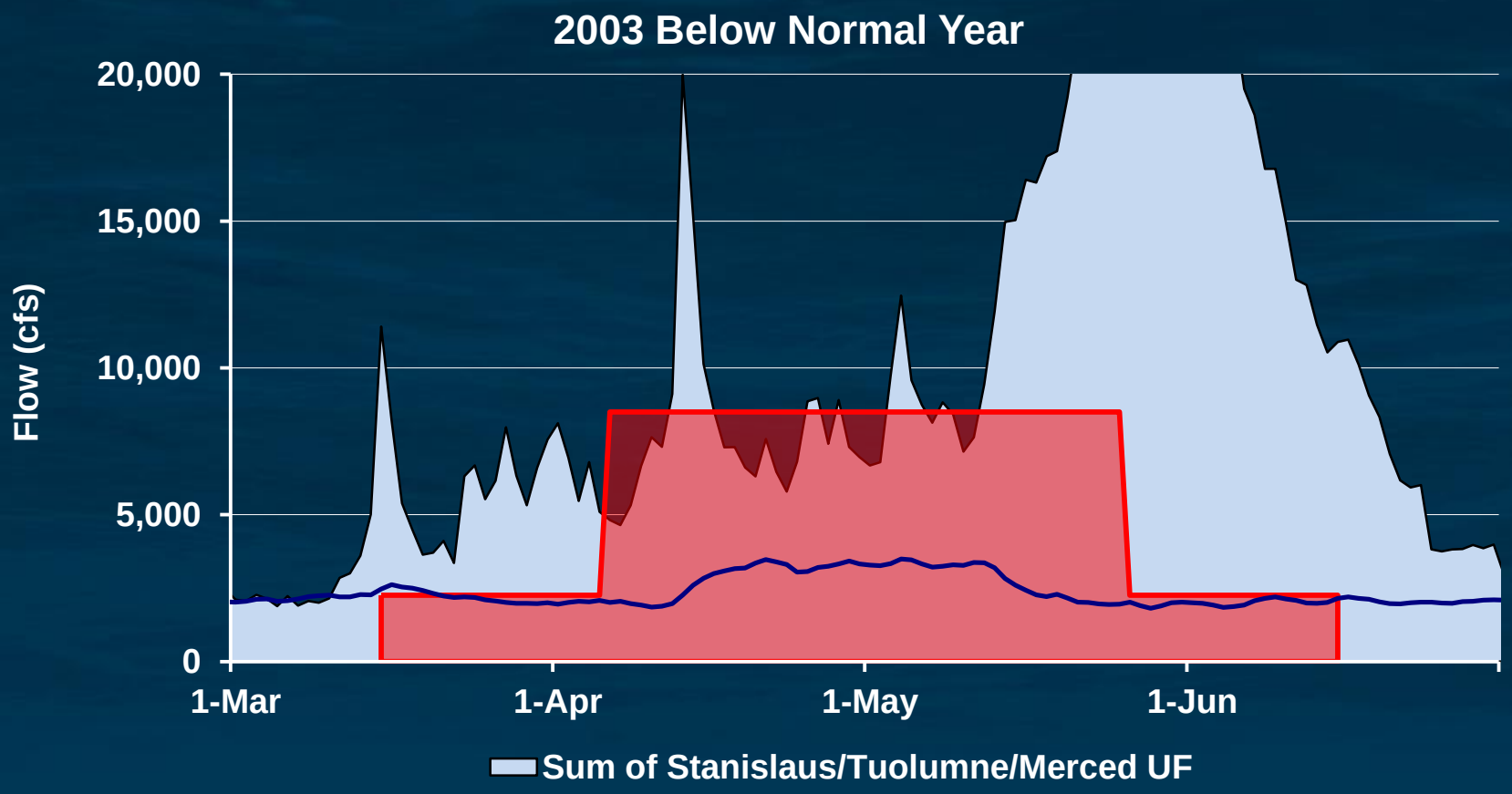
Minimum Flow Schedule to Double Population



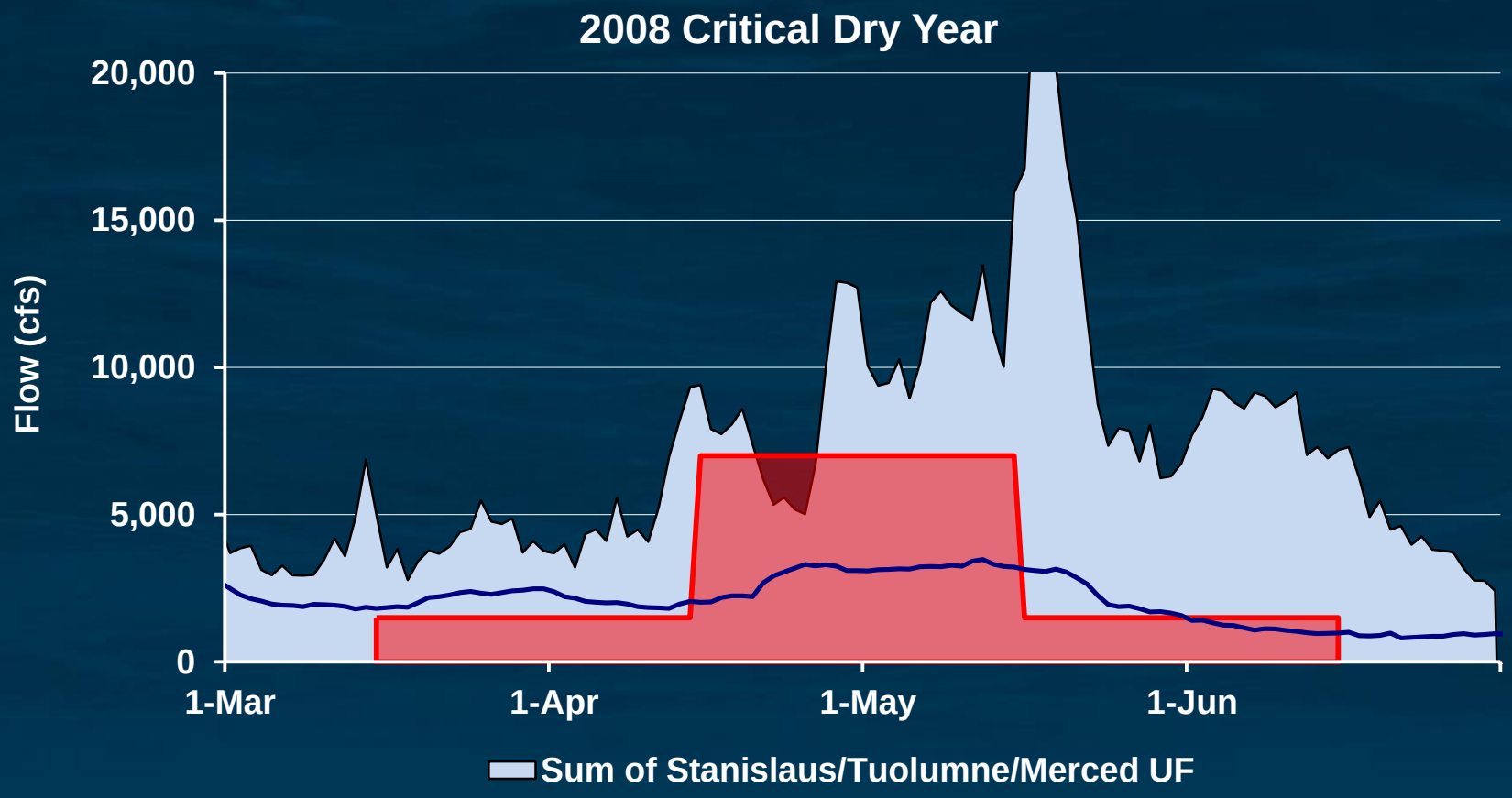
Water Impact in Wet Year



Water Impact in Normal Year



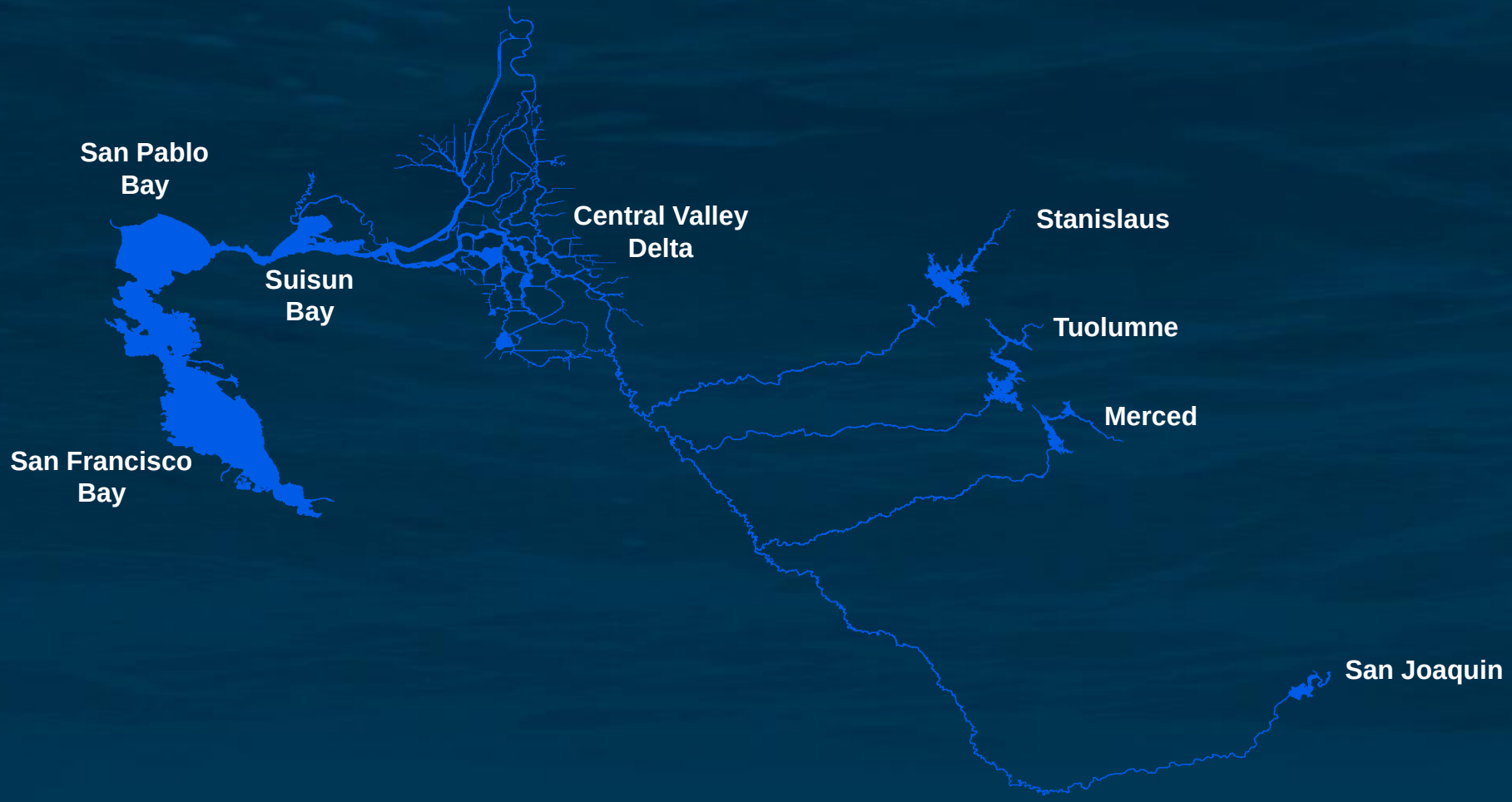
Water Impact in Critical Dry Year



Example Models

- Ecosystem Diagnosis and Treatment Model (EDT)
- SALMOD
- Interactive Object-oriented Salmonid Simulation (IOS)
- Oncorhynchus Bayesian Analysis (OBAN)
- Oak Ridge Chinook Model (ORCM)

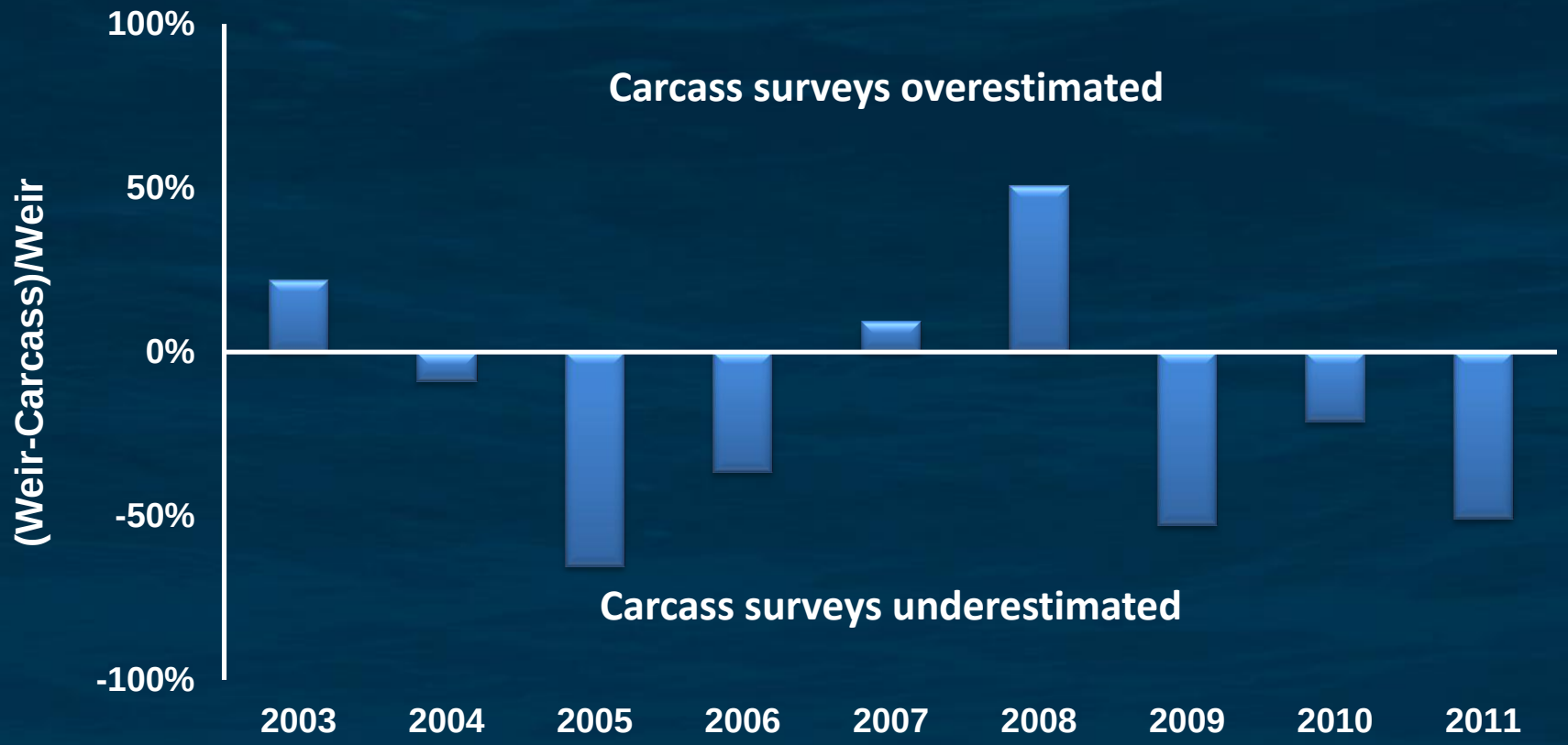
San Joaquin Basin



Typical Life Cycle Model Inputs

Inputs
Spawning Number of individuals, area of suitable spawning gravel (particle size, depth, velocity) relative to flow/temperature; habitat capacity; geographic and temporal distribution of spawning; fecundity; pre-spawn mortality; gender ratio; redd dimensions; water temperatures; river flow; temperature model; flow/water operations model
Incubation Rate of superimposition; geographic and temporal distribution of redds; intragravel DO, intragravel temperature; intragravel flow; survival to emergence; mortality due to factors such as de-watering, water temperature, DO, and sedimentation; water temperatures; river flow; rate of egg development; temperature model; flow/water operations model
Juvenile Rearing Number of juveniles produced; area of suitable habitat relative to flow; habitat capacity; hatchery augmentation; growth rate; food supply; mortality rates due to factors such as predation, disease, water temperature, and DO; flow; water temperature; DO; turbidity, levels of contaminants; temperature model; flow/water operations model
Juvenile Migration Baseline mortality; loss rates due to factors such as predation, disease, water temperature, flow, DO, and entrainment; migration timing; migration rate; route selection; hatchery augmentation; water temperature; flow; dissolved oxygen; turbidity; water diversions; barrier operations; levels of contaminants; temperature model; flow/water operations model
Ocean Timing of ocean entry; size at ocean entry; harvest; by-catch mortality; migratory pathways; food supply; growth rate; water temperatures; losses to predation
Adult Migration Harvest (legal and illegal); migration timing; migration rate; fish origin; migratory pathways; mortality rates due to factors such as disease, water temperature, DO, and stranding; water temperatures, DO, and flow throughout the migration corridor from the Bay to the spawning grounds; temperature model; flow/water operations model.

Annual Weir and Carcass Count Comparison



Expert Panel

"Developing clear statements of desired states for a management objective are essential in selecting appropriate models defining the modeling analysis." (p.5)

"The use of biological and ecological models for the Bay-Delta is in its scientific infancy, and has often been abused when employed for policy purposes." (p. 10)

***Lund J. et al. 2012**. Analytical Tools for Evaluating the Water Supply, Hydrodynamic, and Hydropower Effects of the Bay-Delta Plan.*

Thank You

San Joaquin Tributaries Authority

(Additional slides)

Where We Agree / Disagree

Alternative	SJTA	USFWS	NMFS	CDFG	TBI TU NRDC	GCID SVWU NCWA	American Rivers
Increase Spring Flows	Disagree	Agree	Agree	Agree	Agree	Disagree (Pulse Concept)	Agree
Predator Suppression	Agree	Somewhat Agree	Not Addressed	Not Addressed	Somewhat Agree	Agree	Not Addressed
Habitat Improvement	Agree	Somewhat Agree	Not Addressed	Unclear	Unclear	Somewhat Agree	Disagree
Install HORB	Agree	Agree	Not Addressed	Not Addressed	Not Addressed	Not Addressed	Not Addressed
Reduce hatchery impacts on natural stocks	Agree	Not Addressed	Not Addressed	Somewhat Agree	Not Addressed	Not Addressed	Not Addressed
Improve Harvest Management	Agree	Not Addressed	Not Addressed	Not Addressed	Not Addressed	Not Addressed	Not Addressed

Increase Spring Flows

Who	Position
SJTA	**Dissagree:** No Evidence more flow would make more smolts; No increase in ocean abundance; Without changes in harvest management, would not increase freshwater adult abundance.
USFWS	**Agree**: "There is evidence to suggest that if spring flows originating from the San Joaquin River are increased, predation will decrease and survival of juvenile salmon migrating through south Delta will improve."
NMFS	**Agree**: "Although there is uncertainty, we do believe increased flows will benefit native fishes, including salmonid survival through the Delta and an adaptive management program is needed to further define and refine how to achieve the stated biological goals and objectives in the SWRCB's 2010 flow criteria report."
CDFG	**Agree**: "Flow criteria should reflect the frequency, duration, timing, and rate of change of flows, and not just volumes or magnitudes. In addition, Delta inflows should generally be provided from tributaries to the Bay-Delta estuary in proportion to their contribution to unimpaired flow unless otherwise necessary."
TBI TU NRDC	**Agree**: "In addition to survival being higher with higher flows, Chinook salmon abundance has also been found to be higher with greater San Joaquin River flow", and "the scientific literature strongly suggests that [...] restoring flow regimes [...] are the restoration actions most likely to result in direct benefits to salmon."
GCID SVWU NCWA	**Somewhat Disagree:** "uniform application of a very high % of unimpaired flow each month from January through June... would not have any practical application for management actions to benefit salmon survival", but "The benefits to fish survival from pulse flows… could be considerable."
American Rivers	**Agree:** "Require increased flows during the late winter and early spring on upstream rivers (particularly the Feather and San Joaquin) to increase the frequency of floodplain inundation. "Request that the Bay Delta Conservation Plan EIR/EIS evaluate alternatives that employ a proportionate unimpaired flow approach or otherwise mimic natural flow patterns for the purpose of increasing the frequency of floodplain inundation."

Predator Suppression

Who	Position
SJTA	**Agree:** Would lead to high smolt survival through the tribs and Delta; increased ocean abundance; but without harvest management would not increase freshwater adult abundance.
USFWS	**Somewhat Agree:** The FWS states that "one mechanism for the high mortality in the Delta, especially in the south Delta, is predation", but suggests that predation will decrease if spring flows are increased.
NMFS	**Not Addressed**
CDFG	**Not Addressed**
TBI TU NRDC	**Somewhat agree:** They maintain that alien species compete with and prey upon juvenile salmonids, but state that competition/predation could be reduced by providing floodplain connectivity through increased flows, providing habitat for juvenile salmonids that alien species are not capable to capitalize on.
GCID SVWU NCWA	**Agree:** "An aggressive predator removal program at the CCF and TFF should be designed and implemented"; "Avoid creating predation problems at future Delta structures"
American Rivers	**Not Addressed**

Habitat Improvement

Who	Position
SJTA	**Agree:** Habitat cannot be created through increased flows; Not clear on habitat improvements unrelated to flow.
USFWS	**Somewhat agree:** If the south Delta were returned to more riverine/estuarine habitat, as it was historically, […], it would likely reduce the production of warm water predators.
NMFS	**Not Addressed**
CDFG	**Unclear:** "Manmade structures make habitat restoration and species recovery efforts extremely difficult, and sometimes impossible. Levee systems and stream bank armoring inhibit a number of processes including stream channel meander, bank erosion and sediment deposition that contribute to floodplain creation, which results in altering the character of floodplain habitats."
TBI TU NRDC	**Unclear:** "restoring floodplain connectivity" will benefit salmon by improving habitat; however, authors state that connectivity can be established by flow increases
GCID SVWU NCWA	**Somewhat Agree:** "Significant actions should be implemented to re-create shallow-water rearing habitats for anadromous fish in the primary migratory corridors of the Delta"
American Rivers	**Disagree:** "Scientific certainty regarding the benefits of increased outflows in the absence of floodplain inundation may not be as high as certainty associated with floodplain inundation, but there is a very strong body of evidence that suggests it would benefit numerous species (TBI et al. 2010 and 2012)." "The Board should take actions that will increase the area of frequently inundated floodplain habitat in the Delta."

Install HORB

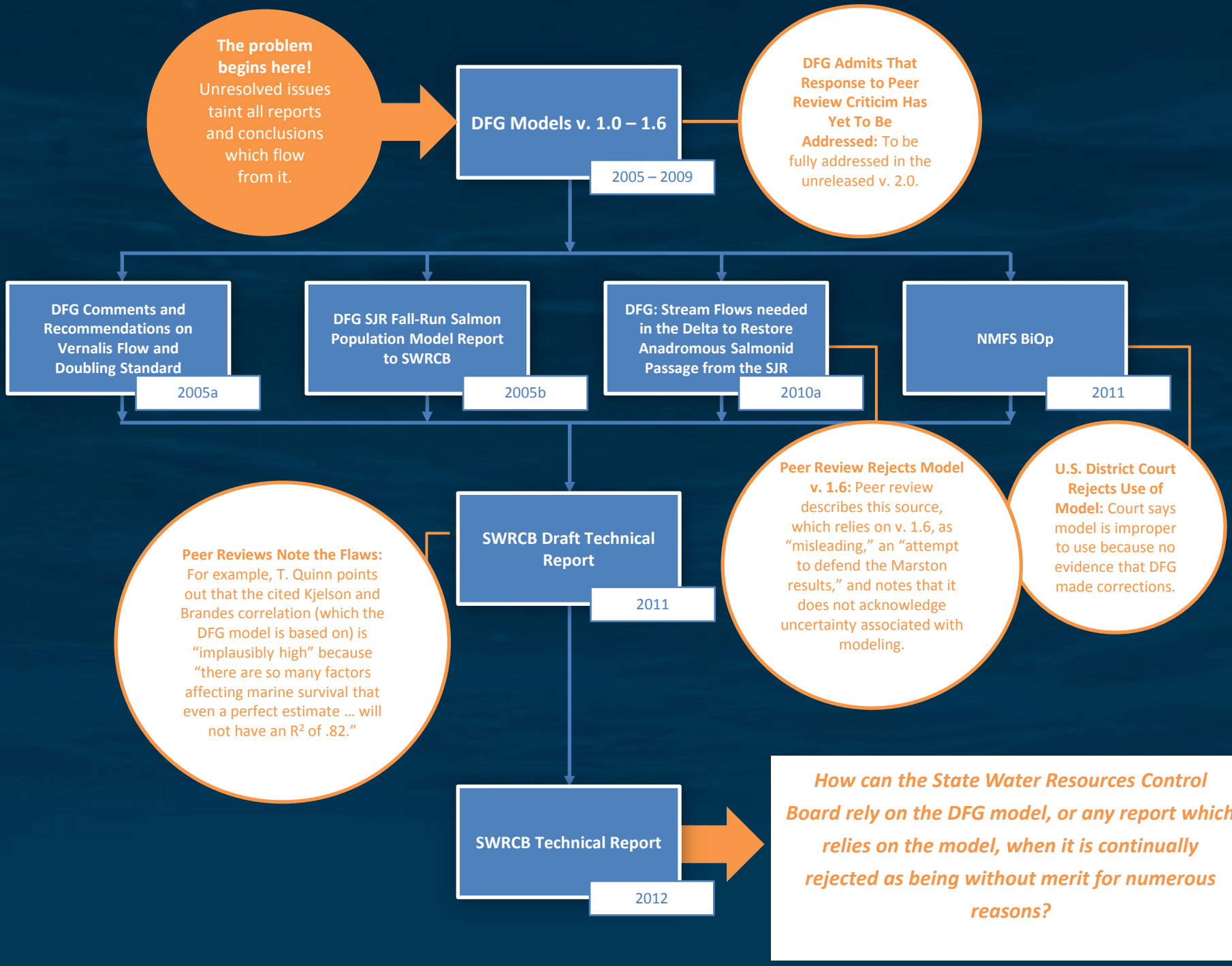
Who	Position
SJTA	**Agree:** Increase in survival through tribs and ocean; Increase ocean abundance; without changes in harvest management would not increase freshwater adult abundance.
USFWS	**Agree:** Board should consider evaluating a physical barrier at the head of Old River to increase juvenile salmon survival through the Delta at Vernalis flows of up to 7,000 cfs
NMFS	**Not Addressed**
CDFG	**Not Addressed**
TBI TU NRDC	**Not Addressed**
GCID SVWU NCWA	**Not Addressed**
American Rivers	**Not Addressed**

Reduce Hatchery Impacts on Natural Stocks

Who	Position
SJTA	**Agree:** Increased population resilience to environmental fluctuations; but without changes in harvest management would not increase freshwater adult abundance.
USFWS	**Not Addressed**
NMFS	**Not Addressed**
CDFG	**Somewhat agree:** Recommend on site releases of all hatchery fish to reduce impacts of strays.
TBI TU NRDC	**Not Addressed**
GCID SVWU NCWA	**Not Addressed**
American Rivers	**Not Addressed**

Improve Harvest Management

Who	Position
SJTA	**Agree:** Only alternative that would increase survival of fish between ocean entry and adulthood, thereby directly increasing escapement
USFWS	**Not Addressed**
NMFS	**Not Addressed**
CDFG	**Not Addressed**
TBI TU NRDC	**Not Addressed**
GCID SVWU NCWA	**Not Addressed**
American Rivers	**Not Addressed**


The problem begins here! Unresolved issues taint all reports and conclusions which flow from it.
DFG Models v. 1.0 – 1.6
2005 – 2009
DFG Admits That Response to Peer Review Criticim Has Yet To Be Addressed: To be fully addressed in the unreleased v. 2.0.
DFG Comments and Recommendations on Vernalis Flow and Doubling Standard
2005a
DFG SJR Fall-Run Salmon Population Model Report to SWRCB
2005b
DFG: Stream Flows needed in the Delta to Restore Anadromous Salmonid Passage from the SJR
2010a
NMFS BiOp
2011
Peer Reviews Note the Flaws: For example, T. Quinn points out that the cited Kjelson and Brandes correlation (which the DFG model is based on) is "implausibly high" because "there are so many factors affecting marine survival that even a perfect estimate … will not have an R^2 of .82."
SWRCB Draft Technical Report
2011
Peer Review Rejects Model v. 1.6: Peer review describes this source, which relies on v. 1.6, as "misleading," an "attempt to defend the Marston results," and notes that it does not acknowledge uncertainty associated with modeling.
U.S. District Court Rejects Use of Model: Court says model is improper to use because no evidence that DFG made corrections.
SWRCB Technical Report
2012
How can the State Water Resources Control Board rely on the DFG model, or any report which relies on the model, when it is continually rejected as being without merit for numerous reasons?

<u>Note Where the DFG Model is *NOT* Used</u>: The DFG Salmon Population Model v. 1.0 was completed in 2005. It was revised to model 1.5 in 2008, and v. 1.6 in 2009. Peer review of the model reveals flaws fatal to its adequacy. Consistently rejected as inadequate, the model is not found in any significant ongoing project since the development of the DFG model. Rather, projects most often use the 2006 SWRCB Basin Plan and D-1641 as a baseline for flow.

2006 Water Quality Control Plan

D-1641

Bay Delta Conservation Plan

Ongoing

"The operational assumptions include continued deliver of water to SWP and CVP contractors up to the adopted water contract amounts based on water availability and operational constraints, and continued operations under …SWRCB Decision 1641 … [and] SWRCB Water Quality Control Plan adopted in 2006."♦

NMFS BiOp for Salmonid Species

2009

NMFS initially used DFG model v. 1.0 to calculate flows needed for the protection of CV Steelhead despite DFG warning that results were subject to peer review. The Eastern District Court for California thus held that it was unreasonable and unlawful to rely on that version of the DFG Model.▪

The peer review which the DFG indicated to NMFS regarding its version 1.0 pointed out several inadequacies which render the model insufficient for reliable results. Changes to address the inadequacies are expected in version 2.0, which has yet to be released. Version 1.6 is the latest version and does not address the fatal flaws of the DFG Model.

USFWS BiOp for Delta Smelt

2008

Assumptions for base and future models do *not* include or discuss the DFG model for any study or run.

San Joaquin River Restoration Program

2011/12

The SJRRP environmental documents do not use the DFG model in any respect. Rather, "CalSim simulations informs the evaluation of effects to fisheries due to changes in river flows."◊ Unlike the DFG model, CalSim modeling is a peer-reviewed and widely accepted modeling method.