IN REPLY
REFER TO:

CVO-100
ENV-7.00

United States Department of the Interior

BUREAU OF RECLAMATION
Central Valley Operations Office
3310 El Camino Avenue, Suite 300
Sacramento, California 95821

APR 24 2009

Ms. Maria Rea
Sacramento Area Office
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento, CA 95814-4706

Subject: Additional comments on the NMFS draft Biological Opinion

Dear Ms. Rea:

In coordination with the Department of Water Resources (DWR), we are transmitting additional comments from DWR on the National Marine Fisheries Service (NMFS) draft Biological Opinion regarding the effects of the Central Valley Project and State Water Project on salmonids and green sturgeon to supplement the comments provided to NMFS on January 13, 2009, February 2, 2009, and March 20, 2009 (see Enclosure).

If you have any questions, please feel free to contact me at (916) 979-2199.

Sincerely,

Ronald Milligan
Operations Manager

Enclosures - 2

cc: Mr. Donald Glaser
Regional Director
Bureau of Reclamation
2800 Cottage Way
Sacramento, CA 95825

Mr. Michael Chotkowski
Regional Environmental Officer
Bureau of Reclamation
2800 Cottage Way
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Continued on next page.

Continued from previous page.

Mr. Russ Strach
Sacramento Area Office
National Marine Fisheries Services
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Service Office
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(w/encl to each)

Attachment 1

Additional Comments Action IV.2.2; 4:1 SJR to Exports ratio

Action IV.2.2 imposes a limitation of combined exports to ¼ of the flow in the San Joaquin River from March 15 through June 15 in all but dry and critical water year types, and ½ in dry and critical years. The purpose of the action is to protect emigrating juvenile San Joaquin steelhead. NMFS proposes to use Particle Tracking Model (PTM) results to determine the flows necessary to allow 50% of the particles to reach Chipps Island as a surrogate for steelhead emigration.

DWR requests that NMFS modify Action IV.2.2 to use real-time monitoring to determine the timing of San Joaquin steelhead emigration through the south Delta and base the duration of project restrictions on the historical CWT Chinook experiment results. As described below, DWR compared PTM results with coded wire tag (CWT) experiments conducted by USFWS for the VAMP from 1995 to 2006. The result of the comparison shows that there is no correlation between the timing and magnitude of CWT Chinook recoveries and PTM particles passing Chipps Island.

DWR argues against the use of PTM results to simulate salmonid behavior because particles are most similar to "packets of water" moving in the system, whereas juvenile salmonids are actively swimming organisms with behavioral characteristics that PTM does not simulate. To determine the efficacy of PTM results simulating salmonid behavior, DWR compared 24 juvenile Chinook experimental releases in the lower San Joaquin River to associated PTM results. The 24 experimental releases were conducted for the VAMP from 1995 to 2006. These experimental releases were conducted using coded wire tagged (CWT) hatchery origin juvenile Chinook released at Mossdale and Durham Ferry, upstream of the export facilities, and recaptured at Chipps Island, downstream, at the western boundary of the Delta. The purpose of the VAMP experiments was to try to determine the effects of flow and exports on juvenile Chinook. Since there are no such juvenile steelhead experiments on the lower San Joaquin River, we use Chinook as the closest surrogate for juvenile steelhead.

The following 24 figures are a comparison of the daily passage at Chipps Island of CWT juvenile Chinook and particles from associated PTM results for individual experimental releases. All the releases occur during the months of April and May. The fish releases were made at Mossdale from 1995 through 2004, and then at Durham Ferry, just upstream, from 2005 through 2006. There are usually 2 experimental releases each year, but there were 3 in 1995 and 1998, and only 1 in 1997 and 2004. All the PTM studies used the same release dates and hydrology as the fish studies and used a constant 5,000 particles in each of the PTM studies. There are no figures past 2006, because after 2006, FWS started using radio tagging instead of CWT tagging. Both the CWT and PTM data are presented in terms of percentages of CWT recoveries and particle passage at Chipps to standardize and evaluate the results from year to year. The left y axes are the percentage of CWT Chinook recovered at Chipps, and the right Y axes are the percentage of particles passing Chipps Island on a daily time step.

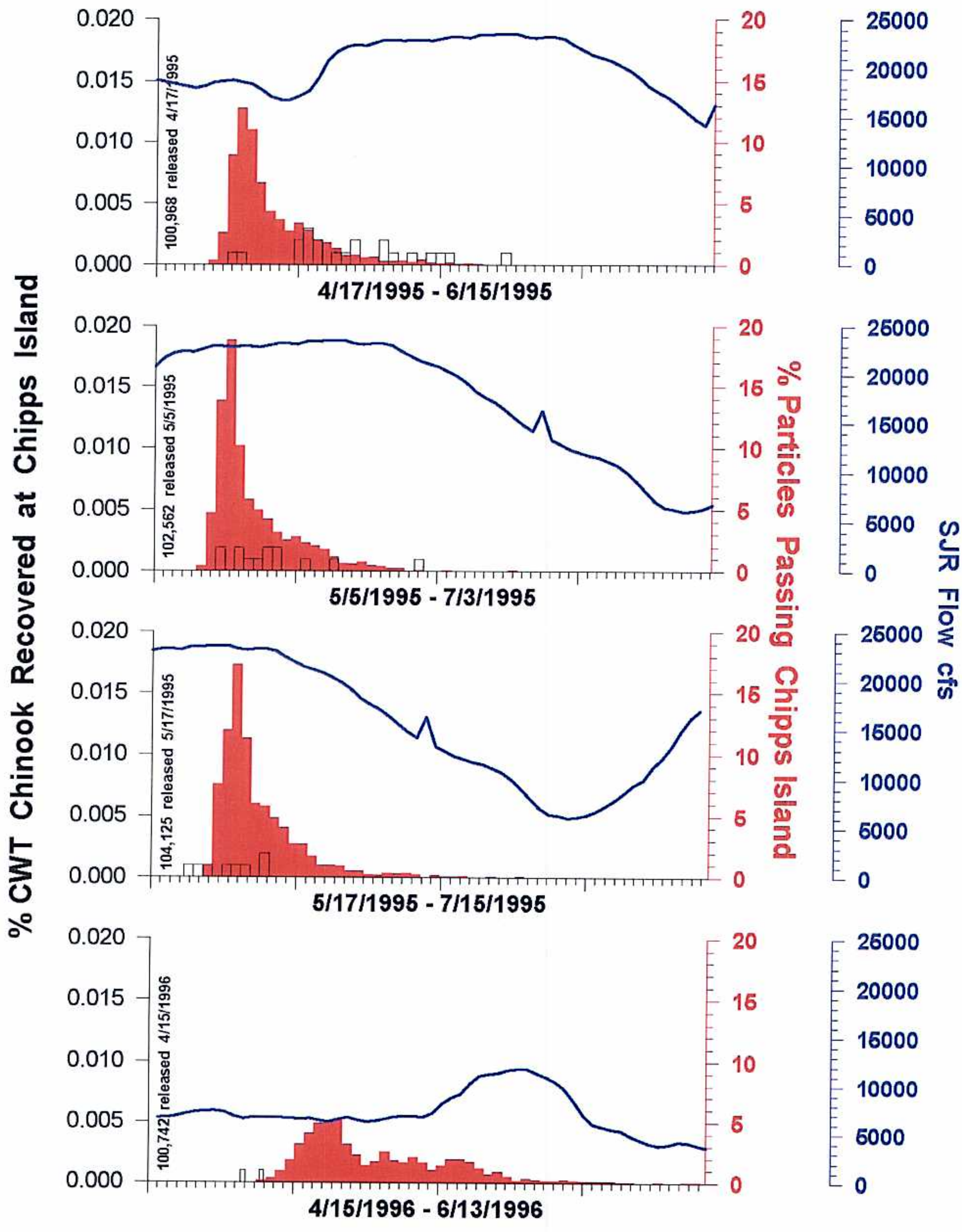
Two characteristics are apparent from the 24 graphs: the trend of the timing of CWT Chinook recoveries at Chipps Island compared to PTM results, and the trend of the magnitude of CWT Chinook recoveries at Chipps Island compared to PTM results.

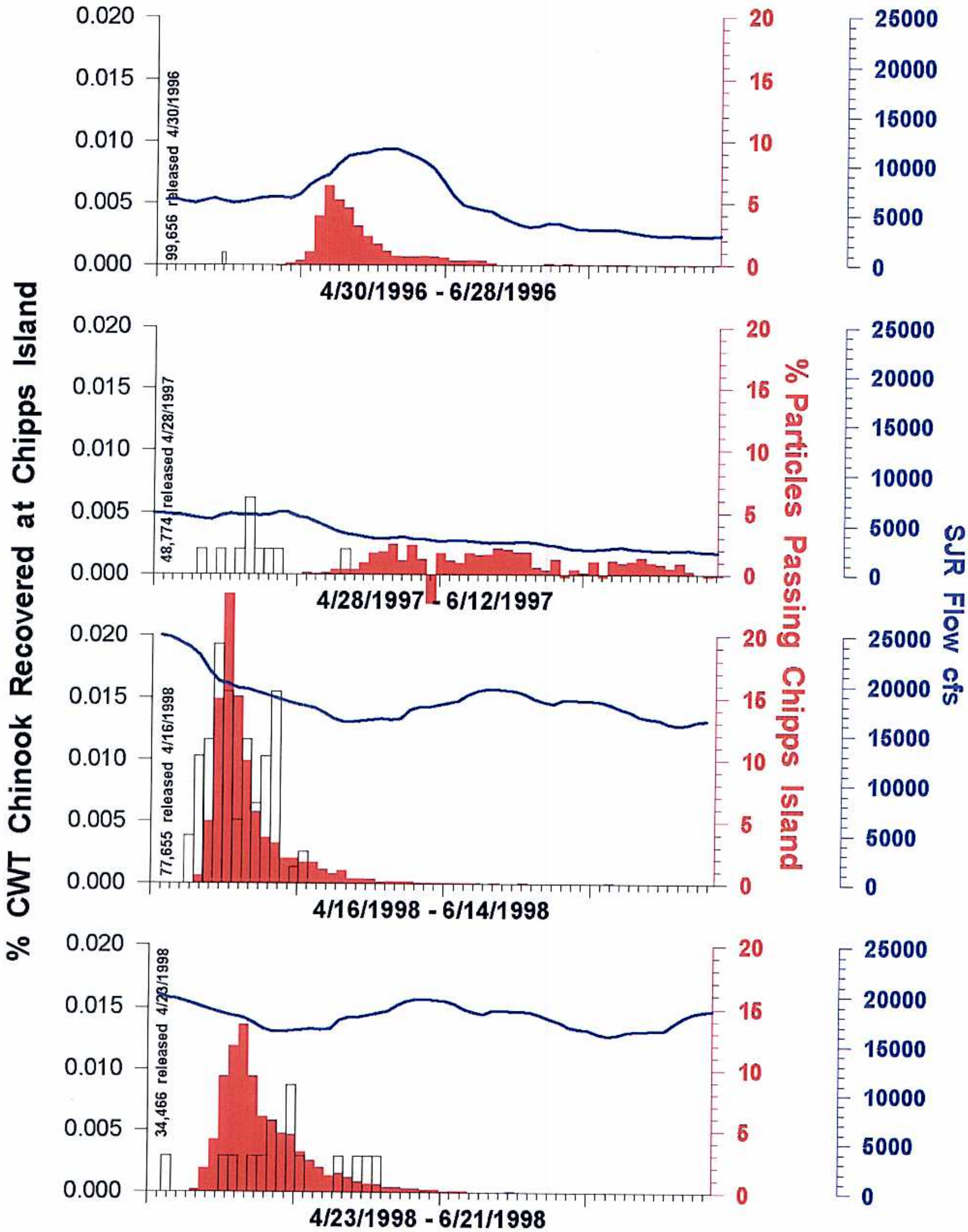
The only years for which the timing of the CWT recoveries at Chipps were associated with the timing of the particles past Chipps were 1995, 1998 and 2006. Those were the three very high San Joaquin River flow years; flows greater than 20,000 cfs. The rest of the years, the CWT timing of recoveries at Chipps was much earlier than the particle timing past Chipps. Most years, there was little overlap between the CWT recoveries and particles passing Chipps. In the lowest flow years, 2000 through 2004, there was no overlap between the timing of the CWT recoveries at Chipps and the passing of particles past Chipps. In those lowest flow years, the CWT Chinook pass Chipps Island within about two weeks, regardless of the PTM results. The CWT Chinook are actively swimming downstream when compared to the neutrally buoyant particles.

The magnitude of recoveries of CWT Chinook at Chipps Island compared to the magnitude of particles passing Chipps Island were also not well associated. The only year for which the magnitude of CWT Chinook recovered at Chipps was relatively similar to the magnitude of particles passing Chipps Island was 1998. For the other two high flow years, 1995 and 2006, the recoveries of CWT Chinook at Chipps Island was relatively low. For the low flow years 1999 through 2001, the recoveries of CWT Chinook was relatively high compared to particles passing Chipps Island.

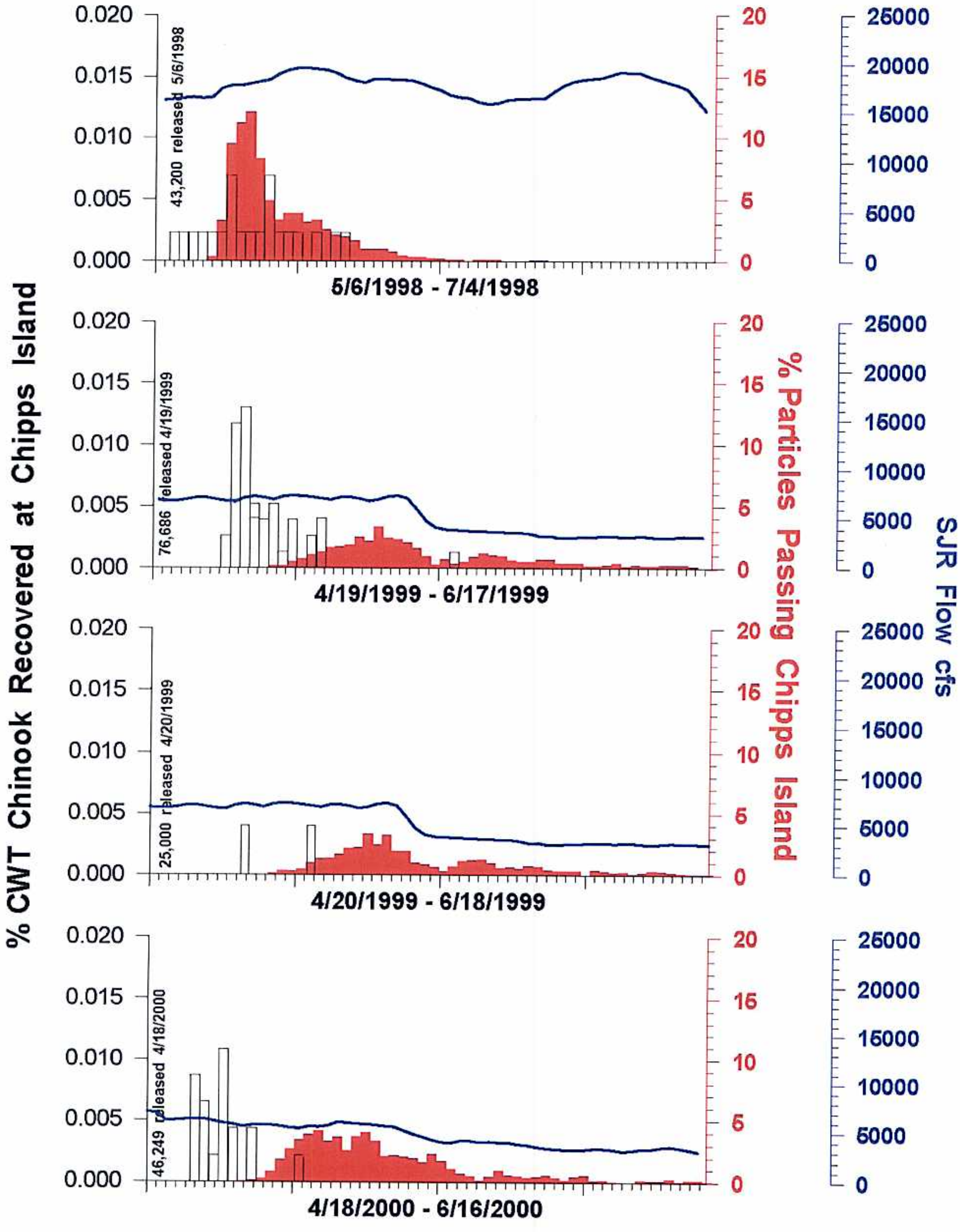
The result of the comparison of timing and magnitude of CWT Chinook recoveries and PTM particles passing Chipps Island shows that there is no correlation. This is shown in the last two figures in this attachment. There are factors other than hydrodynamics affecting juvenile Chinook emigration through the south Delta not accounted for in the PTM. Based on the 24 experiments graphed in this evaluation, the PTM results are an adequate surrogate for "timing" of salmonid emigration in only very high flow years like 1995, 1998 and 2006. But for the rest of the years, intermediate and low flow years, the PTM results would result in significant project regulation 3 to 6 weeks beyond emigration timing.

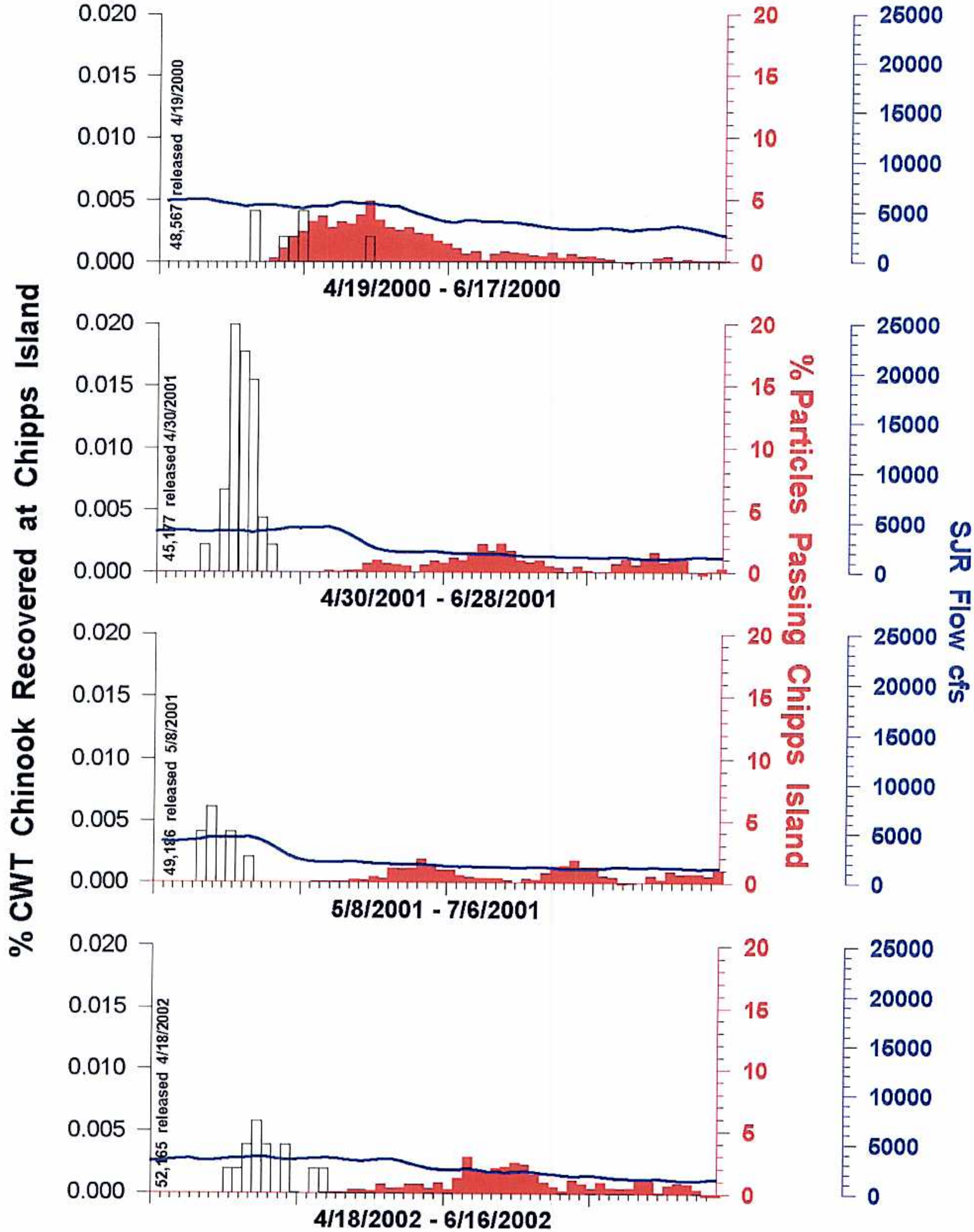
Therefore, DWR requests that NMFS adopt an alternative action to IV.2.2. to use real-time monitoring to determine the timing of San Joaquin steelhead emigration through the south Delta and base the duration of project restrictions on the historical CWT Chinook experiments.

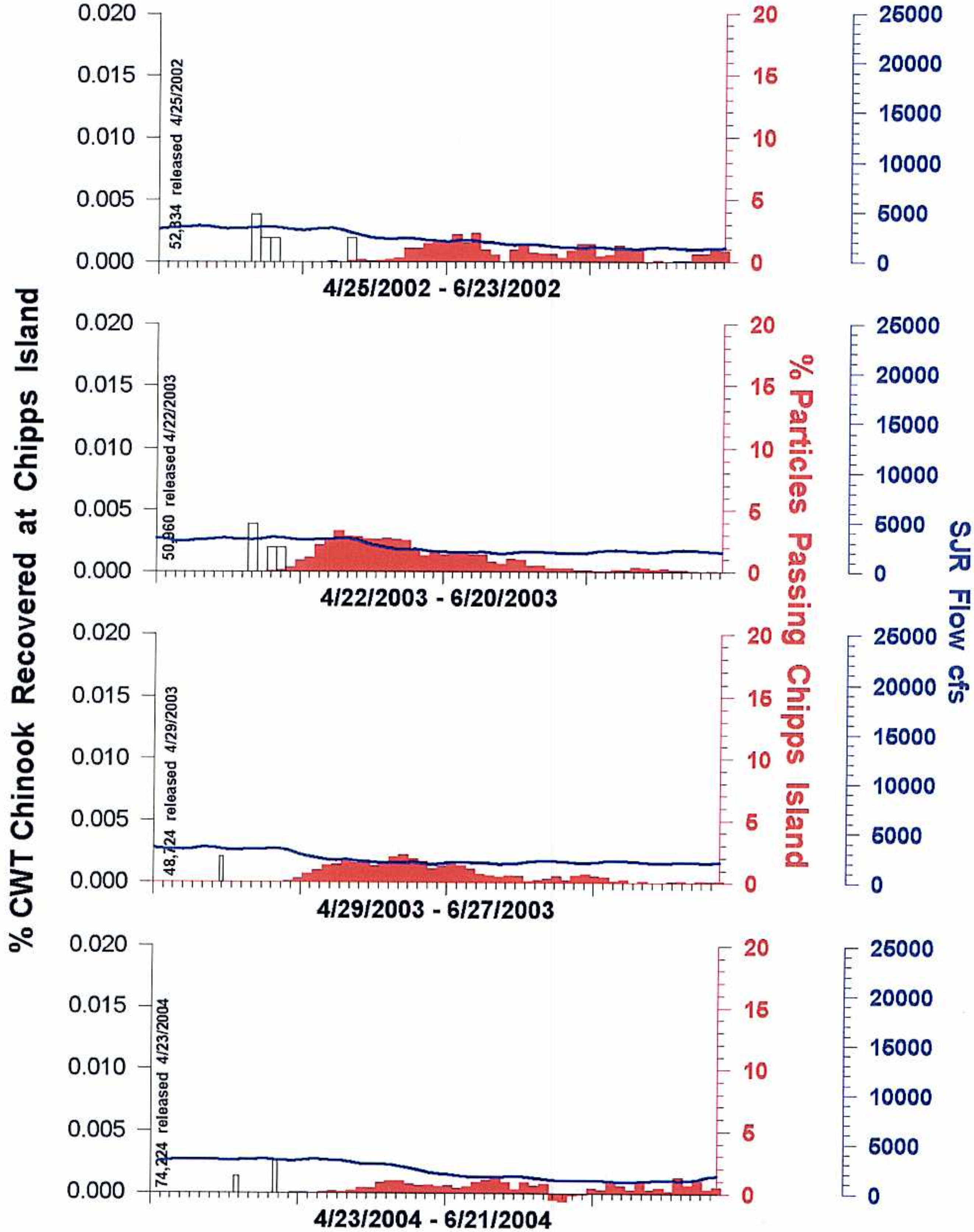

% CWT Chinook Recovered at Chipps Island
% Particles Passing Chipps Island
SJR Flow cfs
100,968 released 4/17/1995
4/17/1995 - 6/15/1995
102,562 released 5/5/1995
5/5/1995 - 7/3/1995
104,125 released 5/17/1995
5/17/1995 - 7/15/1995
100,742 released 4/15/1996
4/15/1996 - 6/13/1996
0.020
0.015
0.010
0.005
0.000
20
15
10
5
0
25000
20000
15000
10000
5000
0



% CWT Chinook Recovered at Chipps Island
% Particles Passing Chipps Island
SJR Flow cfs
99,656 released 4/30/1996
4/30/1996 - 6/28/1996
48,774 released 4/28/1997
4/28/1997 - 6/12/1997
77,655 released 4/16/1998
4/16/1998 - 6/14/1998
34,466 released 4/23/1998
4/23/1998 - 6/21/1998
0.000
0.005
0.010
0.015
0.020
0
5
10
15
20
0
5000
10000
15000
20000
25000


% CWT Chinook Recovered at Chipps Island
% Particles Passing Chipps Island
SJR Flow cfs
43,200 released 5/6/1998
5/6/1998 - 7/4/1998
76,686 released 4/19/1999
4/19/1999 - 6/17/1999
25,000 released 4/20/1999
4/20/1999 - 6/18/1999
46,249 released 4/18/2000
4/18/2000 - 6/16/2000
0.000
0.005
0.010
0.015
0.020
0
5
10
15
20
0
5000
10000
15000
20000
25000


% CWT Chinook Recovered at Chipps Island
% Particles Passing Chipps Island
SJR Flow cfs
48,567 released 4/19/2000
4/19/2000 - 6/17/2000
45,177 released 4/30/2001
4/30/2001 - 6/28/2001
49,186 released 5/8/2001
5/8/2001 - 7/6/2001
52,165 released 4/18/2002
4/18/2002 - 6/16/2002
0.020
0.015
0.010
0.005
0.000
20
15
10
5
0
25000
20000
15000
10000
5000
0


% CWT Chinook Recovered at Chipps Island
% Particles Passing Chipps Island
SJR Flow cfs
52,334 released 4/25/2002
4/25/2002 - 6/23/2002
50,360 released 4/22/2003
4/22/2003 - 6/20/2003
48,724 released 4/29/2003
4/29/2003 - 6/27/2003
74,224 released 4/23/2004
4/23/2004 - 6/21/2004
0.020
0.015
0.010
0.005
0.000
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15
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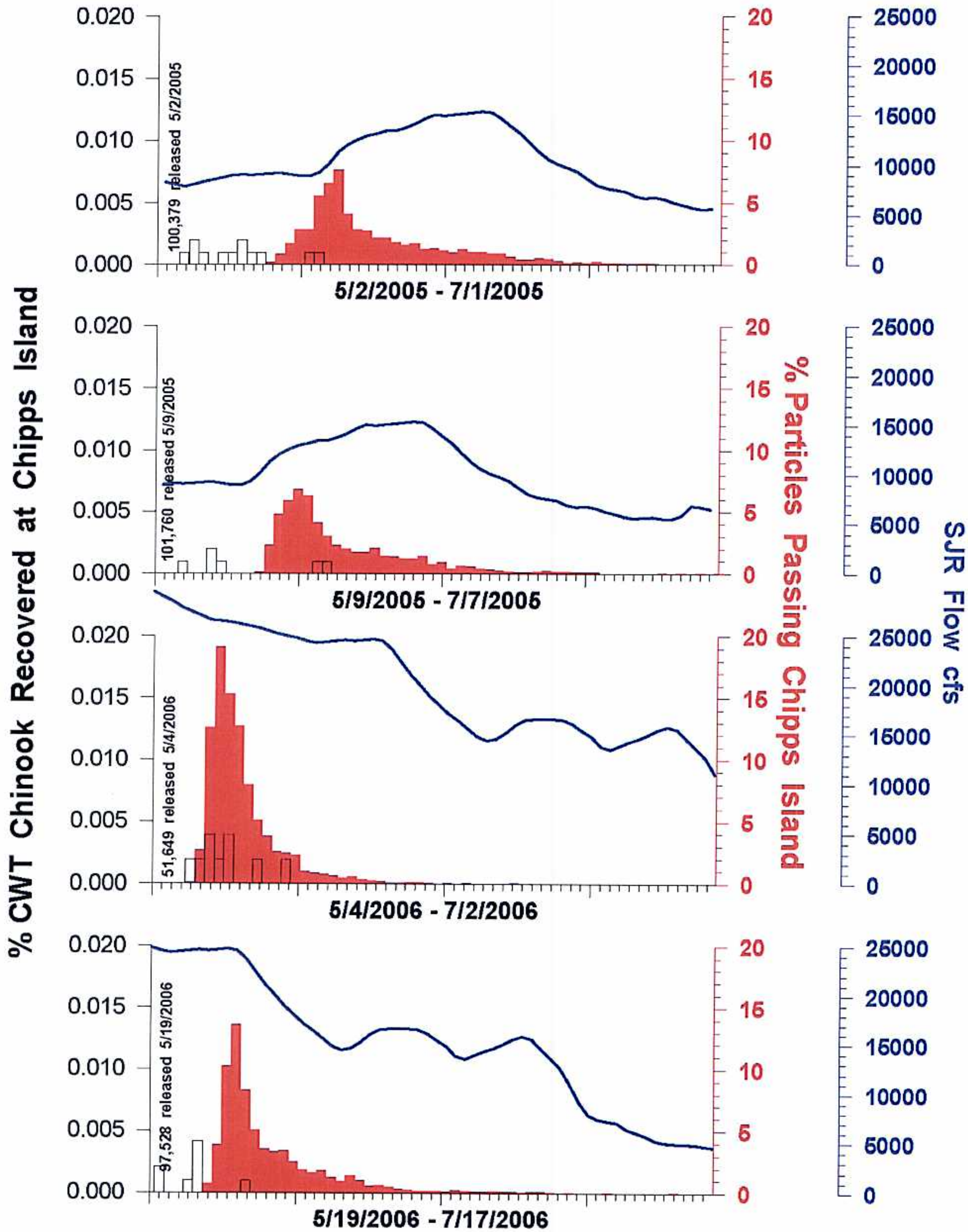
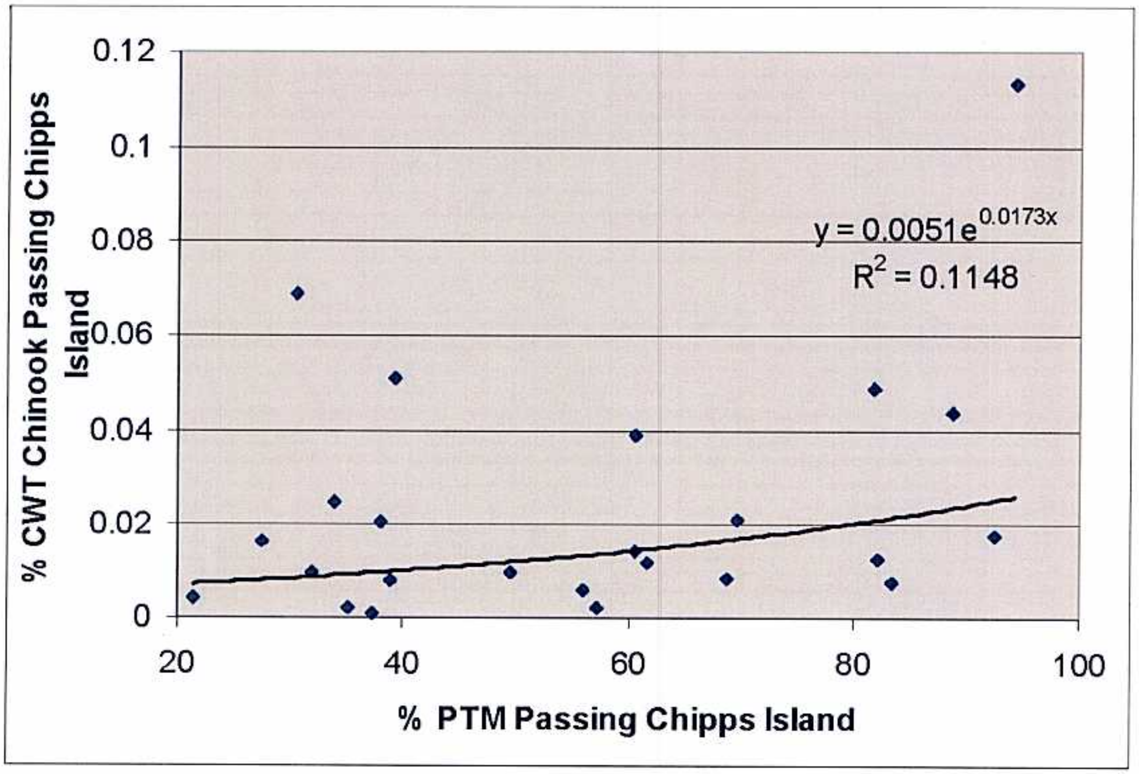
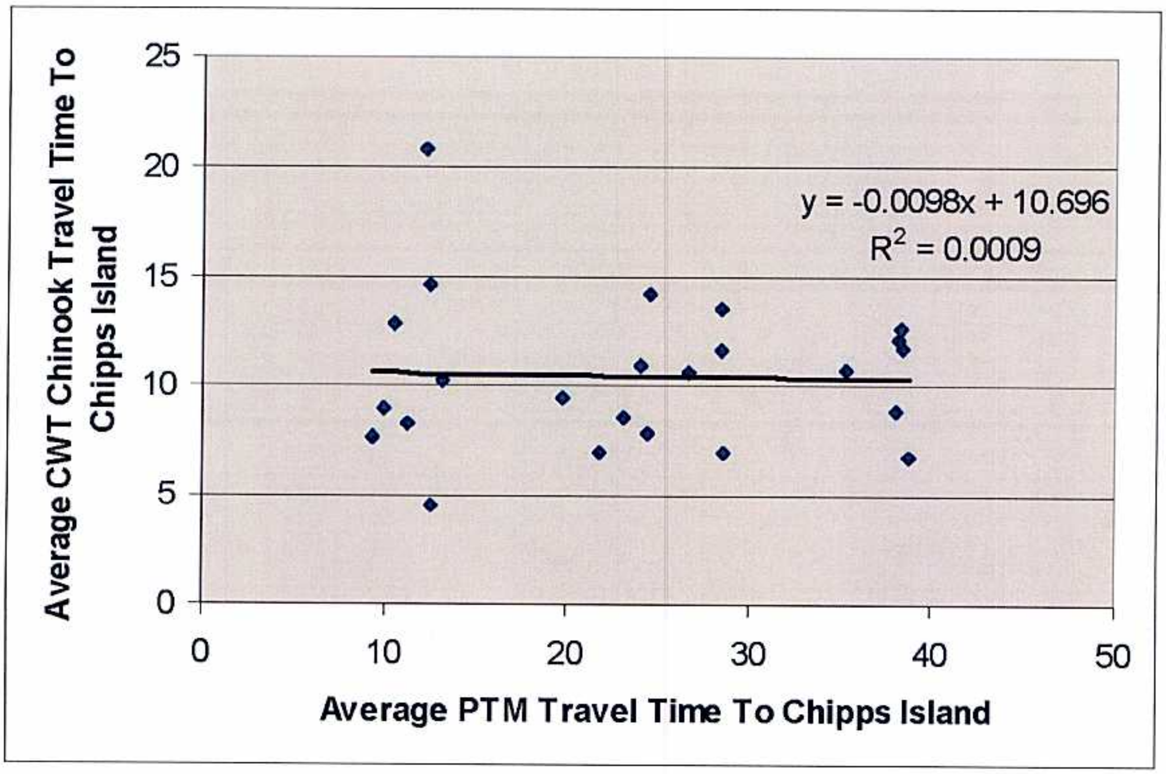
25000
20000
15000
10000
5000
0


% CWT Chinook Recovered at Chipps Island
% Particles Passing Chipps Island
SJR Flow cfs
100,379 released 5/2/2005
5/2/2005 - 7/1/2005
101,760 released 5/9/2005
5/9/2005 - 7/7/2005
51,649 released 5/4/2006
5/4/2006 - 7/2/2006
97,528 released 5/19/2006
5/19/2006 - 7/17/2006



0.12
0.1
0.08
0.06
0.04
0.02
0
20
40
60
80
100
% CWT Chinook Passing Chipps Island
% PTM Passing Chipps Island
y = 0.0051e^0.0173x
R^2 = 0.1148



25
20
15
10
5
0
0
10
20
30
40
50
Average CWT Chinook Travel Time To Chipps Island
Average PTM Travel Time To Chipps Island
y = -0.0098x + 10.696
R^2 = 0.0009

Attachment 2

Cramer Fish Sciences

Technical Memorandum

CRAMER FISH SCIENCES®
Oregon • California • Washington • Idaho • Alaska

Technical Memorandum

TO: **California Department of Water Resources**
FROM: Brad Cavallo (lead), Joe Merz, Cameron Turner, and Paul Bergman
SUBJECT: Analyses of Reasonable and Prudent Alternatives of the draft OCAP Biological Opinion
DATE: April 1st, 2009

Our review and critique of the draft OCAP Biological Opinion's (BiOp) Reasonable and Prudent Alternatives (RPA) focuses on two major technical issues: 1) an assessment of steelhead Delta passage timing, 2) a model based assessment of proposed Delta winter run Chinook and steelhead actions.

1. Steelhead smolt outmigration through the Sacramento-San Joaquin Delta

The OCAP RPA recommends several actions with the expressed intent of improving through Delta survival for outmigrating Central Valley steelhead smolts. Specifically, action Suite IV.1 recommends modified operations of the Delta Cross Channel from October through January primarily for the benefit of winter run Chinook and steelhead. The RPA further indicates that, "about 8 percent of the annual CV steelhead emigration from the Sacramento River Basin occurs [between November and January]". While this statement is true, it ignores available, pertinent data related to the unique emigration timing of natural origin Central Valley steelhead. Since all hatchery produced steelhead are released in-river and all receive an adipose fin clip, it is important to examine differences in emigration timing between hatchery and natural origin steelhead. Such an analysis of trawling data from the Sacramento River and Chipps Island, and from south Delta export facilities suggests significant differences in emigration timing between hatchery and natural origin steelhead.

Examining the proportion of unclipped steelhead smolts (natural origin fish) from Sacramento and Chipps Island trawls by month from 1999 to 2007 illustrates that most natural origin steelhead emigrate after March, with a peak occurring in June (Figure 1). Similarly, data from State and Federal south Delta export facilities indicate that December through January represent the lowest period of natural origin steelhead smolt emigration, with peak natural origin steelhead smolt emigration occurring after March (Figure 2, Figure 3). Given that hatchery origin steelhead from Mokelumne River, Nimbus, and Feather River Hatcheries are not considered part of the Central Valley steelhead ESU, NMFS should tailor RPAs to specifically target known timing of natural origin steelhead.

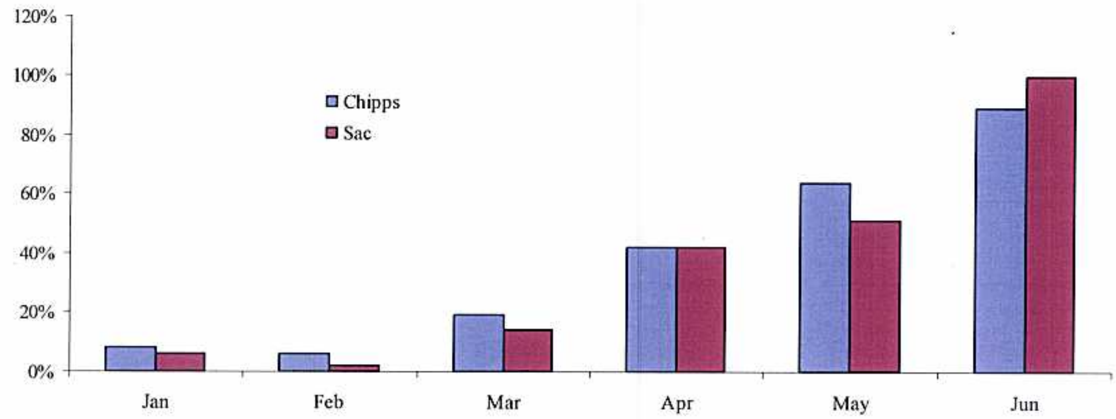


Figure 1. The percentage of *O. mykiss* captured each month in the Sacramento River and Chipps Island trawls that were unclipped (1998 through 2007).

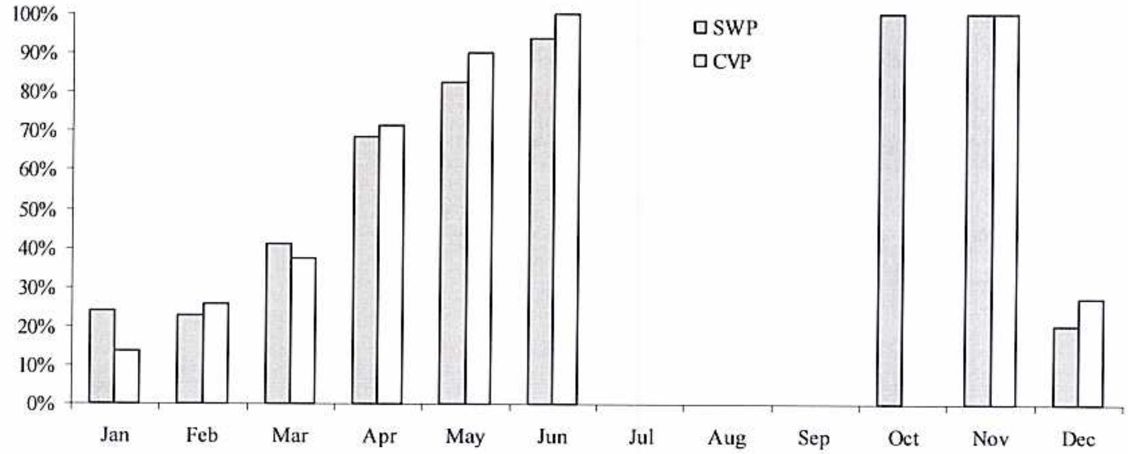


Figure 2. The proportion of salvaged steelhead at the State Water Project and Central Valley Project that were not adipose fin clipped. These are monthly averages between 1998 and 2007.

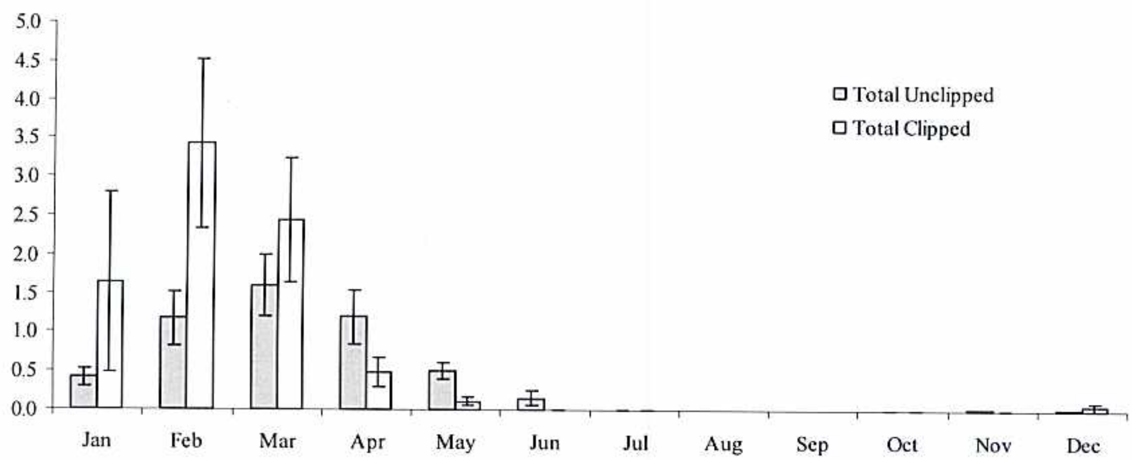


Figure 3. The average monthly CPUE of unclipped and clipped steelhead observed at the state and federal salvage facilities, 1998 through 2007. Bars indicate standard error. CPUE = number of fish/total acre feet diverted.

2. Modeling assessment of proposed actions to benefit winter run Chinook and early emigrating steelhead smolts

The objective of our quantitative assessment was to compare simulated survival of juvenile salmonids migrating through the Delta between alternative water management scenarios proposed as RPAs in the OCAP BiOp. Analyses of the proposed NMFS actions (in conjunction with previous USFWS requirements) were conducted using CalSim II and Delta Simulation Model II (DSM2-HYDRO). The base model used in this analysis originated from the modeling conducted for the 2008 OCAP Biological Assessment (BA) (Reclamation 2008). The BA includes the details on the CalSim II assumptions and modeling in Chapter 9 and Appendix D. Daily flow values for the alternative water management scenarios were obtained from DSM2-HYDRO model runs performed by the California Department of Water Resources. The data spanned water years 1976-1991.

A total of four scenarios (Table 1) were examined to assess delivery reductions due to the Delta actions specified in the NMFS draft RPA and the USFWS BO. All four studies include a specific level of Old and Middle River (OMR) restriction that bound the RPA specified in the USFWS BiOp. Two of the scenarios then layered on the proposed NMFS Delta related RPAs allowing the incremental impacts to be estimated.

Study Name	Base Study	NMFS Action IV.2.1	NMFS Action IV.2.2	NMFS Action IV.2.3	USFWS Action 1	USFWS Action 2	USFWS Action 3 (Pre-VAMP)	USFWS Action 3 (Post-VAMP)
Scenario 0: FWS/NMFS Low	OCAP 7.0	35% EI in Jan	Mar 15 to Jun 15: 2:1 in D, C Wys; 4:1 in W, AN, BN Wys	Feb 1 to Jun 30: OMR>-5000 cfs	Dec 18 to Dec 31: OMR>-2400 cfs	Jan 1 to Feb 28: OMR>-5000 cfs	Mar 1 to May 15: OMR>-5000 cfs	May 16 to Jun 30: OMR>-5000 cfs
Scenario 1: FWS/NMFS High	OCAP 7.0	35% EI in Jan	Mar 15 to Jun 15: 2:1 in D, C Wys; 4:1 in W, AN, BN Wys	Feb 1 to Jun 30: OMR>-2500 cfs	Dec 18 to Dec 31: OMR>-2000 cfs	Jan 1 to Feb 28: OMR>-1250 cfs	Mar 1 to May 15: OMR>-1250 cfs	May 16 to Jun 30: OMR>-1250 cfs
Scenario 2: FWS Low	OCAP 7.0	None	None	Feb 1 to Jun 30: OMR>-5000 cfs	Dec 18 to Dec 31: OMR>-2400 cfs	Jan 1 to Feb 28: OMR>-5000 cfs	Mar 1 to May 15: OMR>-5000 cfs	May 16 to Jun 30: OMR>-5000 cfs
Scenario 3: FWS High	OCAP 7.0	None	None	Feb 1 to Jun 30: OMR>-2500 cfs	Dec 18 to Dec 31: OMR>-2000 cfs	Jan 1 to Feb 28: OMR>-1250 cfs	Mar 1 to May 15: OMR>-1250 cfs	May 16 to Jun 30: OMR>-1250 cfs

Table 1. Descriptions of scenarios used to assess probable survival benefits for outmigrating smolts (winter run Chinook or steelhead) through the Sacramento-San Joaquin Delta.

<u>Salmonid Migration Survival Model Description</u>

In order to assess how winter run Chinook and steelhead smolt survival to Chipps Island might be influenced by the proposed RPAs, we conducted a model-based assessment using the Delta Passage Model developed by Cramer Fish Sciences and available DSM2-HYDRO data. The Delta Passage Model was completed in Fall 2008 and was presented at the CALFED Science Conference in October. The model has not been peer reviewed, but is built using the most current and best available published studies related to the salmonid migratory behavior and reach specific mortality rates. The Delta Passage Model represents a system dynamics approach to integrating, understanding, and exploring salmon migration through the hydrodynamically complex Sacramento-San Joaquin Delta. Habitat, predators and flow conditions in the Delta are known to profoundly influence salmonid populations by impairing survival among outmigrating juveniles. Attempts to understand and quantify Delta salmonid mortality have been conducted for more than thirty years and have culminated in numerous reports (Kjelson and Brandes 1989, Baker et al. 1995, Brandes and McLain 2001, Newman and Rice 2002 , Newman 2003, Newman 2008, Kimmerer 2008, Vogel 2008, Perry and Skalski 2008). The core purpose of the Delta Passage model is to provide a common, transparent framework upon which knowledge may be integrated and displayed.

The Delta Passage model…

- Simulates migration and mortality of juvenile Chinook salmon from the Sacramento River and San Joaquin River through the Delta.
- The model operates on a daily time step, using simulated flow through Delta channels.
- Tidal influences on hydrodynamics and fish behavior are not addressed as the model seeks to represent average fish response over days, not hours.
- The model is composed of 10 reaches and five reach junctions (Figure 4).
- Fish behavior at reach junctions and mortality within reaches is modeled probabilistically using empirical estimates of variance.
- For each selected scenario, 100 Monte Carlo simulations are generated, providing estimates of salmon survival to Chipps Island and confidence intervals.

With the exception of flow into the Tracy and Banks pumping plants, water movement though the Delta is modeled in the Delta Passage Model using daily flow output from the hydrology module of the Delta Simulation Model II (DSM2-HYDRO). Flow into the Tracy and Banks pumping plants is modeled using daily flow output from the CALSIM II model. The nodes in the DSM2-HYDRO and CALSIM II models that were used to provide flow for specific reaches in the Delta Passage Model are shown in Table 2.

Delta Passage Model reach	DSM2-HYDRO node	CALSIM II node
Sac1	RSAC155	--
SS	SLSBT011	--
Sac2	RSAC128	--
DCC	DCC	--
Geo	Georgiana_SL	
Mok	RSMKL008	--
Sac3	RSAC123	--
Sac4	RSAC101	--
SJ1	RSAN112	--
Old	ROLD074	--
SJ2	RSAN063	--
Tracy Exports	--	D418_TD
Banks Exports	--	D419_TD
SJ3	RSAN014	

Table 2. Correspondence between reaches in the Delta Passage Model and nodes in the DSM2-HYDRO and CALSIM II models.

Smolt migration speed in the *Delta Passage* model is reach-specific as informed by acoustic tagging studies. For North Delta reaches **Sac1**, **Sac2**, **Sac3**, **SS**, **Geo**, and **Mok** mean migration speed is predicted as a linear function of flow (Figure 5). Observed flows and migration speeds from acoustic studies for reach **Sac1** were used to create a best-fit linear relationship (Figure 5). Because migration speed data is unavailable for all other North Delta reaches, this linear function is applied North Delta-wide. Due to strong tidal influences in reach **Sac4** (between Rio Vista and Chipps Island) we chose to have mean migration speed independent of reach inflow. For reach **Sac4,** mean migration speed is set constant at 22.634 km/day, the average speed of smolts in the **Sac1** reach from the acoustic study data. Average migration speeds observed in acoustic studies are used to set mean migration speed for San Joaquin River reaches **SJ1** and **SJ2**. For **SJ3**, mean migration speed is set the same as **SJ2** because no migration speed data is available. Stochasticity/uncertainty for migration rate is modeled using error estimates from acoustic tracking experiments. Migration speed variance from acoustic study data is used along with mean migration speed to define a normal probability distribution that is sampled from each day to determine the daily migration speed in each reach (Table 3).

Migration pathways at reach junctions **A**, **B**, **C**, and **E** smolts are diverted into reaches proportional to the flow diverted. Perry and Skalski (2008) found that acoustically tagged Chinook smolts moved proportionally with flow for North Delta releases (see figure 4 from Perry and Skalski 2008). Stochasticity/uncertainty is modeled using the largest error estimates for all acoustic tracking experiments at a given reach junction. Movement of fish toward the state and federal pumps at junction **D** is informed by Kimmerer (2008) analysis of releases of coded wire tagged Chinook smolts in the Delta. Kimmerer (2008) found that percent salvage of Coleman National Fish Hatchery smolts increased non-linearly with export flow (see figure 9 from Kimmerer 2008). In our model, the percentage of fish moving towards the pumps is predicted from total Delta exports using Kimmerer's nonlinear function. The status of two migration barriers, the Delta Cross Channel (DCC) and the Head of Old River Barrier (HORB), is determined by user inputs.

Daily smolt survival is predicted as a logarithmic function of flow (Figure 6). The choice of a logarithmic relationship between flow and survival was made based on the flow/survival relationship developed by Newman (2003) from CWT Chinook smolt releases in the North Delta. To obtain flow measurements for association with the survival estimates from acoustic tag experiments we used a mean of daily flows from the 10 days following the release for each experiment (10 days including the day of release). Daily flow data was obtained from USGS or CDEC flow gauges. A flow-survival relationship for each reach was created by fitting a logarithmic curve to the available reach-specific acoustic tag and flow data. The constraints of slope ≥ 0 and y-intercept ≥ 0 were used. Curve-fitting was performed using the Solver tool in Microsoft Excel. Stochasticity/uncertainty is modeled using error estimates from acoustic study data. The mean daily survival is used along with the reach-specific standard deviation to define a normal probability distribution that is sampled from each day to determine the daily survival rate at each reach. The entrainment rate of fish at the pumps is 70%, with 30%

of fish being salvaged. In our model, salvaged (saved) fish are monitored but do not re-enter the Delta system.

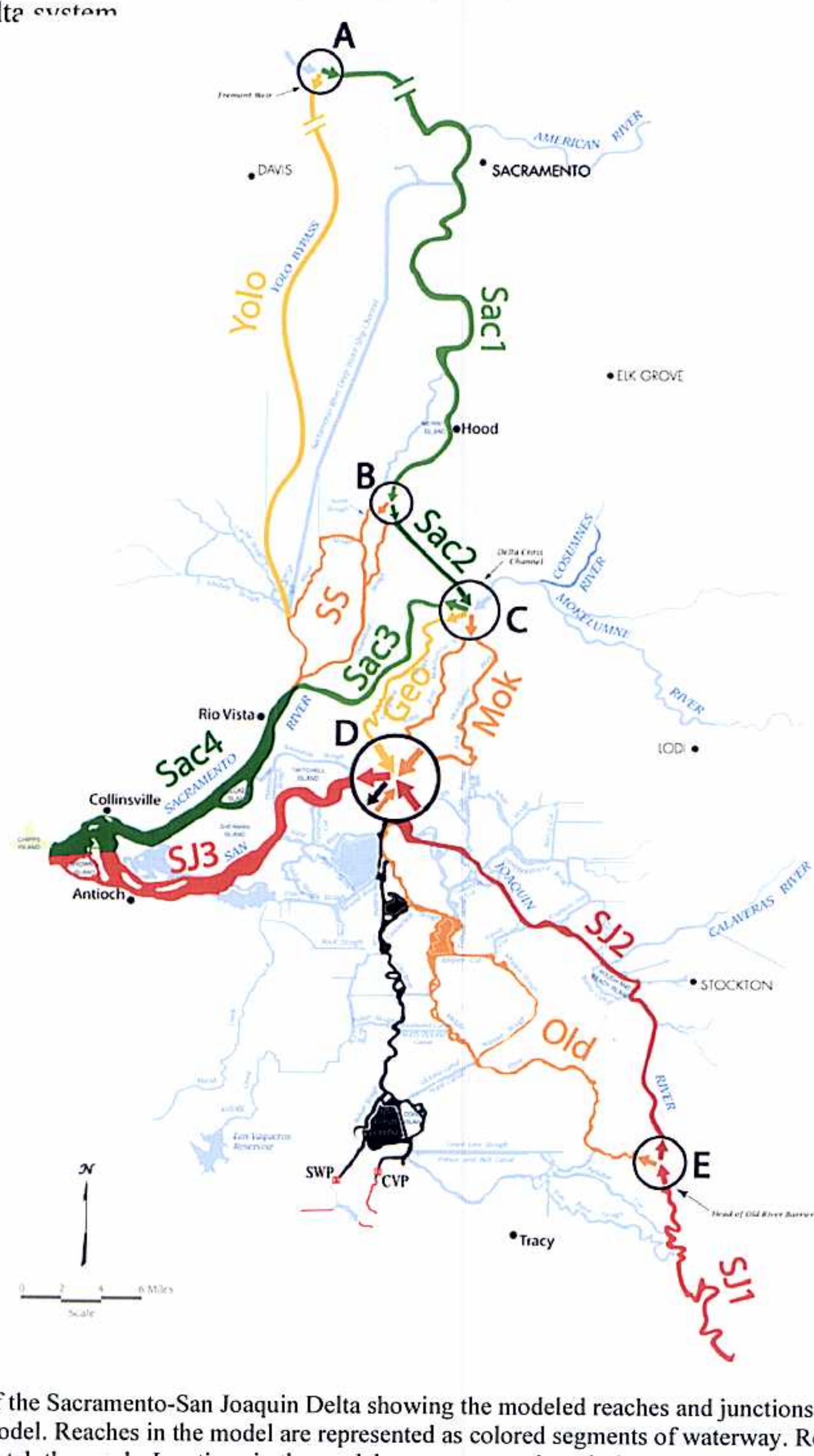


Figure 4. Map of the Sacramento-San Joaquin Delta showing the modeled reaches and junctions of the Delta Passage model. Reaches in the model are represented as colored segments of waterway. Reach labels are colored to match the reach. Junctions in the model are represented as circles containing arrows that correspond to the various flows entering and exiting each junction. Junctions are labeled by black letters, A-E.

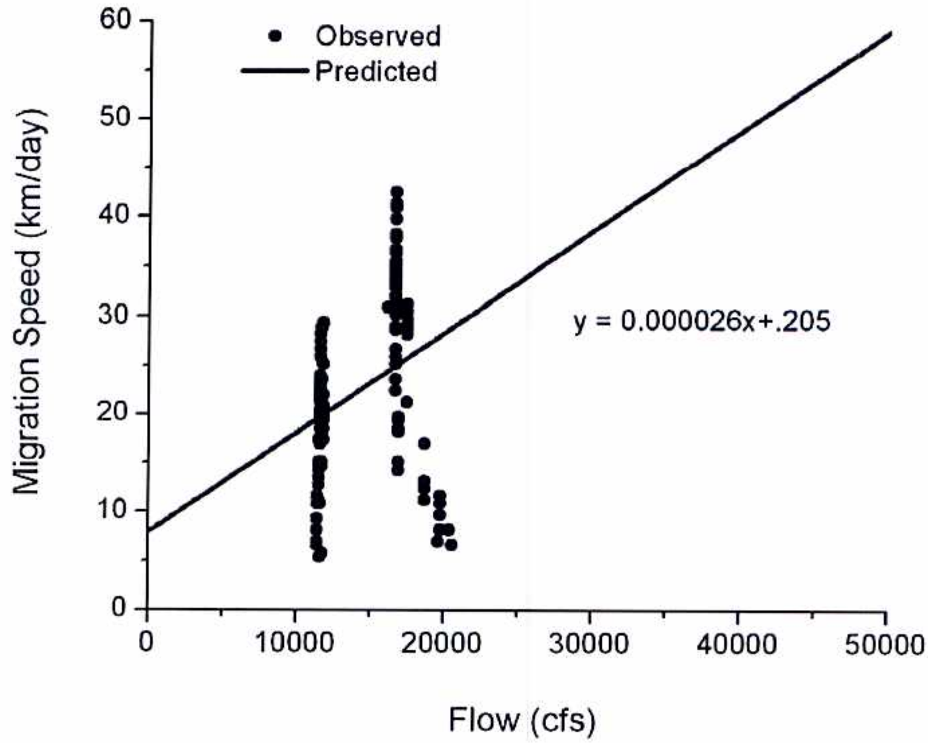


Figure 5. Linear function used to predict migration speed from flow for reaches in the North Delta. Observed data is from acoustic study data for the Sac1 reach between West Sacramento and the entrance of Sutter Slough.

Reach	Mean (km/day)	Standard Deviation
Sac1	Linear function of flow	9.105
SS	Linear function of flow	9.105
Sac2	Linear function of flow	9.105
Sac3	Linear function of flow	9.105
Sac4	22.634	9.105
Geo	Linear function of flow	9.105
Mok	Linear function of flow	9.105
SJ1	30.938	0.266
SJ2	21.630	0.411
SJ3	21.630	0.411

Table 3. Mean and standard deviations used to define a normal probability distribution that is sampled from each day to determine the daily migration speed in each reach.

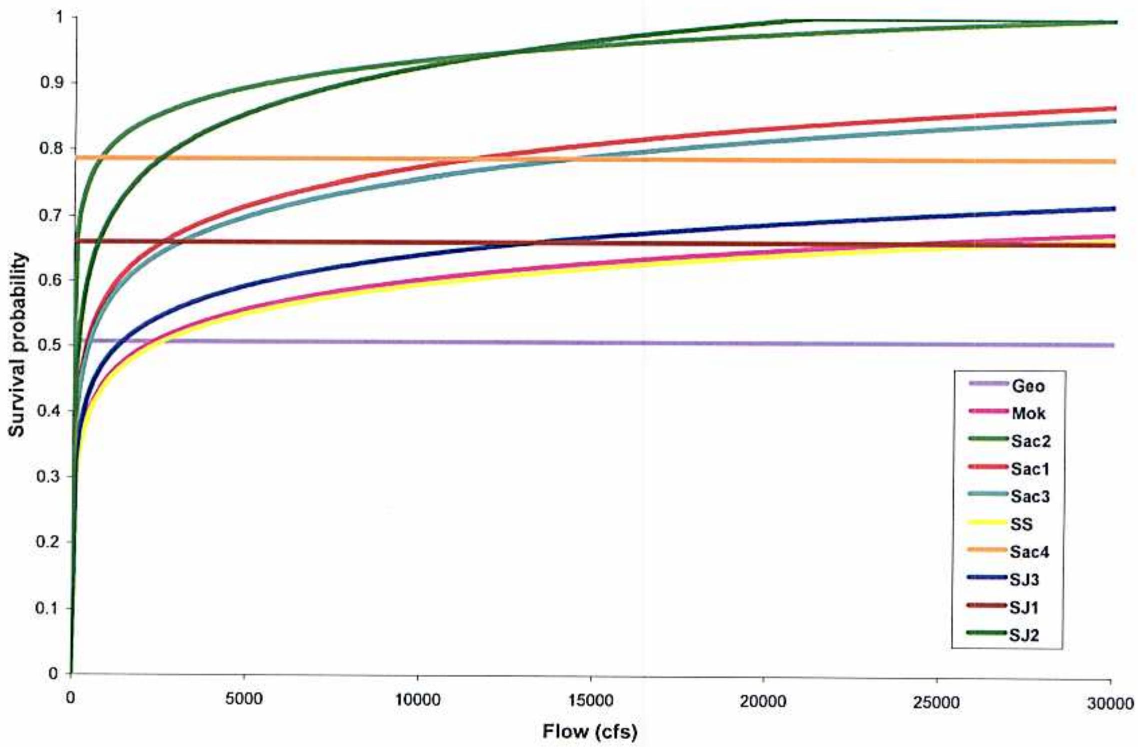


Figure 6. Reach-specific survival proportion as a logarithmic function of flow for all reaches. The mean daily survival is used along with the reach-specific standard deviation to define a normal probability distribution that is sampled from each day to determine the daily survival rate at each reach

<u>Delta Passage Model Settings</u>

In the Delta Passage Model, one million simulated smolts were released each year into both the Sacramento River and the San Joaquin River, respectively. The simulated release locations were West Sacramento on the Sacramento River and Durham Ferry on the San Joaquin River. At West Sacramento, the timing of release each year was modified from the passage distribution of juvenile Winter-Run Chinook salmon at the Red Bluff Diversion Dam (RBDD). The average RBDD timing distribution from brood years 1997-2006 was shifted by three months to approximate the natural timing of arrival at the Delta by Winter-Run Chinook salmon. At Durham Ferry, the timing of release each year was a normal distribution approximating the natural timing of arrival at the Delta by steelhead as indicated by Chipps Island trawls. Timing of smolt inputs to the model are shown in Figure 7. For each year the total proportion of fish surviving to Chipps Island was calculated independently for releases in the Sacramento River and releases in the San Joaquin River. In addition, Monte Carlo simulations were used to produce one-hundred separate realizations for each of the four scenarios.

<u>Delta Passage Model Results</u>

Monte Carlo simulations along with the probabilistic functions built into the Delta Passage Model make it possible to estimate means and variance for predicted survival outcomes. For example, Figure 8 depicts observed outcomes from one-hundred realizations of Scenario 2 for fish entering the Delta from the San Joaquin River.

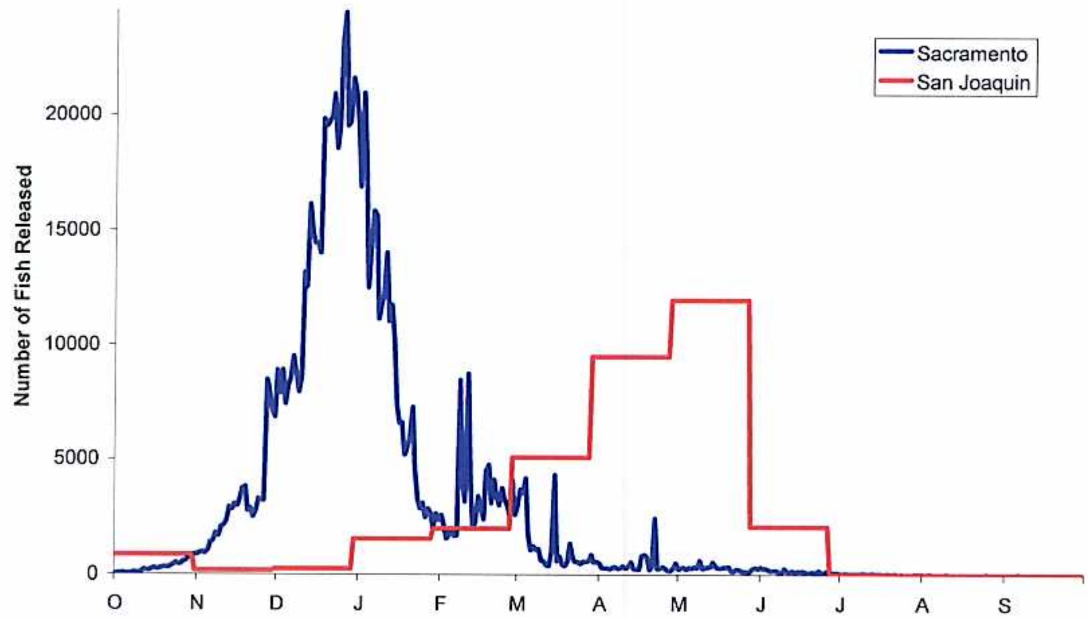


Figure 7. Annual timing distribution of simulated fish release at West Sacramento in the Sacramento River and Durham Ferry in the San Joaquin River.

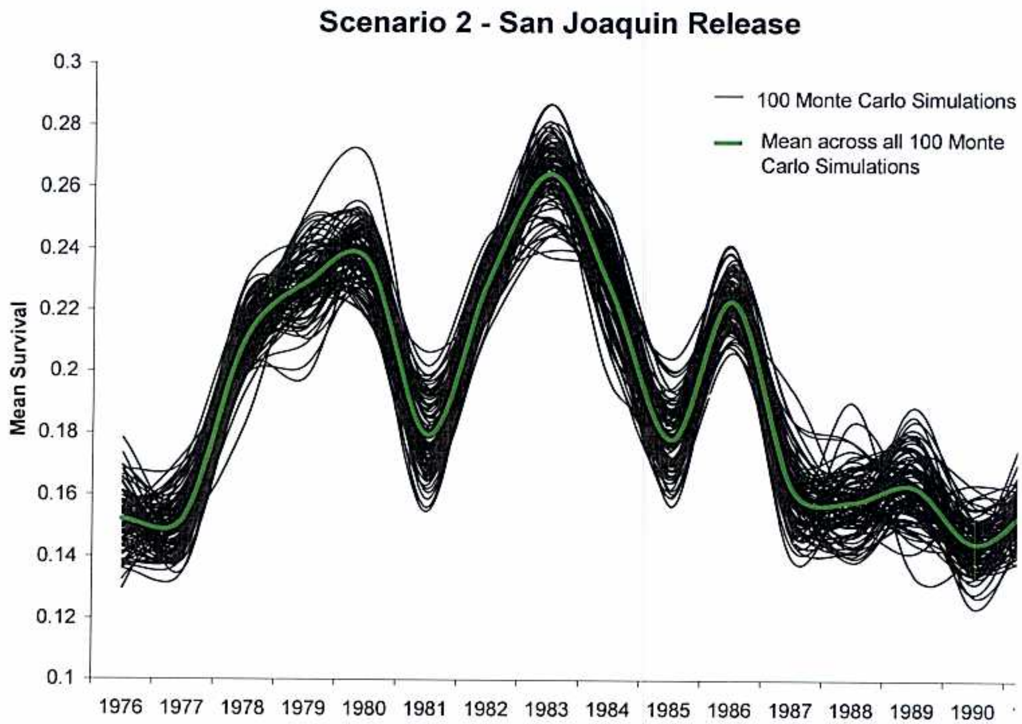


Figure 8. Mean survival from release at Durham Ferry to Chipps Island for each simulated Water Year showing results of all 100 Monte Carlo simulations for Scenario 2 and the San Joaquin release. Note that lines have been smoothed in Microsoft Excel.

While descriptive statistics for modeled survival estimates are useful for comparing scenario outcomes, the results should be interpreted cautiously. The functional relationships included in the model are based upon a handful of acoustic tagging studies and do not represent the full breadth of possible outcomes which might occur if environmental stochasticity were better understood or if behavior differences between tagged hatchery fish and wild untagged fish were addressed . Despite these limitations, the Delta Passage Model is a useful tool which effectively integrates complex relationships otherwise difficult to visualize or understand.

These results of model simulations are summarized by year and scenario with means and standard deviations as shown in Figure 9 and Figure 10. Detailed results from each modeled scenario are provided in Table 4.

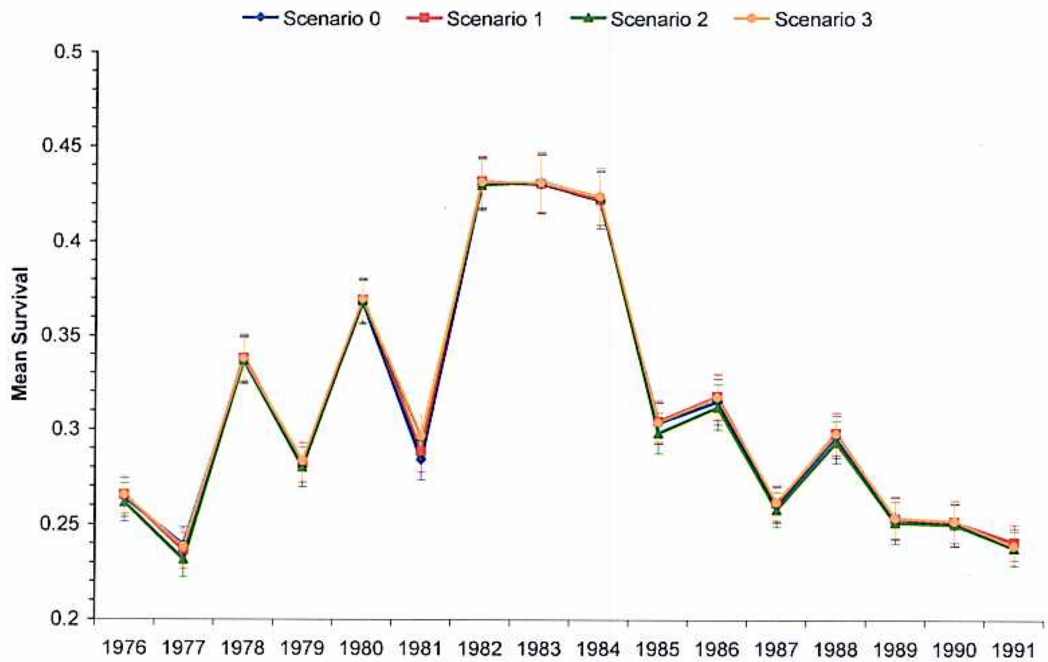


Figure 9. Mean survival from release at West Sacramento to Chipps Island for each simulated Water Year.

Results from fish released in the Sacramento River suggest no biologically significant or consistent difference in survival between the alternative scenarios in any water year (Figure 9). Close examination of data in Table 4 illustrates that predicted mean survival for Scenario 1 (seemingly most protective) was on average only 0.2% higher than that observed for Scenario 2 (seemingly least protective).

Simulated fish releases in the San Joaquin River found greater differences in predicted survival between scenarios. Specifically, survival in Scenarios 2 and 3 were substantially higher than survival in Scenarios 0 and 1 during most years (Figure 10). The exact cause of higher survival in Scenarios 2 and 3 is unclear, but are somewhat unexpected since these scenarios do not include the proposed and supposedly beneficial NMFS RPAs. Survival differences between scenarios in the San Joaquin River and the Sacramento River may be attributable to one or more of the following:

- Different release timing distributions between the San Joaquin and Sacramento Rivers in the Delta Passage Model.

- Lower daily flow values in the San Joaquin and Old River reaches of the Delta Passage Model could result in greater survival sensitivity to flow if those flow values are more consistently located on the portion of the flow-survival curves where the linear slope is larger.
- Differences between water management scenarios are larger for the San Joaquin River area of the Delta than for the Sacramento River area of the Delta.

While these results are preliminary, collectively our findings suggest that the benefits of proposed Delta juvenile salmonid RPAs may not yield the desired outcome in terms of magnitude or direction of survival benefits. Since flow and fish behavioral dynamics in the Delta are very complex and difficult to understand in a purely conceptual or qualitative setting, a tool like the Delta Passage Model would likely be extremely useful for evaluating the effectiveness of these and other alternative Delta operational scenarios.

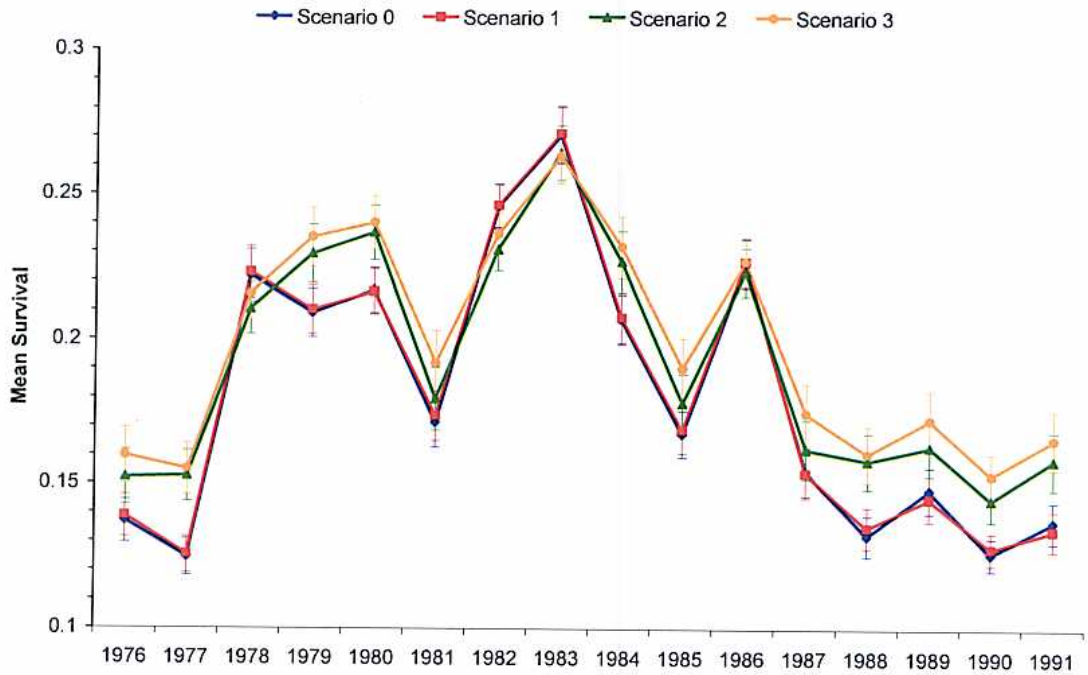


Figure 10. Mean survival from release at Durham Ferry to Chipps Island for each simulated Water Year.

Sacramento Release

Scenario	Stat	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	Mean	0.264	0.239	0.337	0.280	0.368	0.284	0.430	0.430	0.422	0.303	0.315	0.260	0.296	0.254	0.250	0.239
	SD	0.010	0.010	0.013	0.010	0.012	0.011	0.013	0.015	0.015	0.011	0.012	0.009	0.011	0.011	0.011	0.009
1	Mean	0.265	0.236	0.338	0.282	0.369	0.288	0.432	0.430	0.422	0.304	0.317	0.261	0.298	0.253	0.252	0.241
	SD	0.010	0.009	0.013	0.010	0.012	0.011	0.013	0.015	0.015	0.011	0.012	0.009	0.011	0.011	0.011	0.009
2	Mean	0.261	0.231	0.336	0.280	0.368	0.296	0.429	0.431	0.423	0.298	0.312	0.258	0.293	0.251	0.250	0.238
	SD	0.010	0.009	0.013	0.010	0.012	0.011	0.013	0.015	0.015	0.011	0.012	0.009	0.011	0.011	0.011	0.009
3	Mean	0.265	0.238	0.338	0.283	0.370	0.296	0.431	0.431	0.424	0.304	0.317	0.262	0.298	0.254	0.252	0.239
	SD	0.010	0.009	0.013	0.010	0.012	0.011	0.013	0.015	0.015	0.011	0.012	0.009	0.011	0.011	0.011	0.009

San Joaquin Release

Scenario	Stat	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	Mean	0.137	0.124	0.222	0.209	0.217	0.171	0.246	0.270	0.207	0.167	0.226	0.154	0.132	0.148	0.126	0.137
	SD	0.007	0.006	0.009	0.008	0.008	0.009	0.008	0.010	0.008	0.008	0.008	0.008	0.007	0.008	0.006	0.007
1	Mean	0.139	0.125	0.223	0.210	0.216	0.174	0.246	0.271	0.208	0.169	0.227	0.154	0.135	0.145	0.128	0.134
	SD	0.007	0.006	0.009	0.008	0.008	0.009	0.008	0.010	0.008	0.008	0.008	0.008	0.007	0.008	0.006	0.007
2	Mean	0.152	0.153	0.210	0.229	0.236	0.179	0.230	0.264	0.226	0.178	0.223	0.162	0.158	0.163	0.145	0.158
	SD	0.010	0.009	0.009	0.010	0.009	0.011	0.007	0.010	0.011	0.010	0.008	0.010	0.010	0.010	0.007	0.010
3	Mean	0.160	0.155	0.215	0.235	0.240	0.192	0.236	0.263	0.232	0.190	0.227	0.175	0.160	0.172	0.153	0.166
	SD	0.010	0.009	0.009	0.010	0.009	0.011	0.007	0.010	0.011	0.010	0.008	0.011	0.010	0.010	0.008	0.010

Table 4. Detailed results of the Delta Passage Modeling for proposed RPAs.

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Attachment 3

Revised Water Supply Impacts Analysis

DWR has changed the baseline for the purpose of analyzing potential water supply impacts associated with March draft Bi Op RPA actions. We believe a comparison with OCAP 7.0 of the Biological Assessment represents a better comparison than the previous baseline assumed and attached to our March 20, 2009 comments. The estimated water supply impacts, especially when combined with the actions in USFWS's Biological Opinion, are substantial.

The updated results indicate that when compared to OCAP Study 7.0, the average combined water supply impact to the SWP and the CVP of the NFMS draft RPA is roughly 900 taf to 1.1 Maf (or about 16% to 19%). By taking an alternative approach and layering the NFMS RPA on top of the terms of the USFWS 2008 Bi Op RPA that have been provisionally accepted by Reclamation, the average combined water supply impact of the NMFS draft RPA to the SWP and CVP is roughly 150 taf to 750 taf, or about 3% to 15% above the impact of the USFWS Bi Op RPA depending on the range of adaptive actions implemented by the USFWS under the terms on the Bi Op. When compared to OCAP Study 7.0, the average combined water supply impact of the collective USFWS RPA and NMFS draft RPA to the SWP and CVP is roughly 1.3 Maf to 1.6 Maf (or about 23% to 29%).

Again, it should be noted that these estimated impacts are incomplete, and we would expect them to be greater because they do not include reoperation of CVP reservoirs as specified in the draft RPA. A summary of the modeling assumptions for the CALSIM simulations is set forth below.

Modeling Assumptions

The initial analysis of the National Marine Fishery Service (NMFS) reasonable and prudent alternative (RPA) that would result in additional operational constraints in the Delta was completed with the CalSim II model. The base model used in this analysis originated from the modeling conducted for the 2008 OCAP Biological Assessment (BA) (Reclamation 2008). The BA includes the details on the CalSim II assumptions and modeling in Chapter 9 and Appendix D.

A total of six studies were conducted for this analysis. Two studies were used to estimate the reduction in SWP and CVP deliveries due only to the Delta actions specified in the NMFS draft RPA compared to OCAP Study 7.0. The other four studies were used to estimate the reduction in SWP and CVP deliveries due only to the Delta actions specified in the NMFS draft RPA compared to the Fish and Wildlife Service Biological Opinion (USFWS BO) RPA. All studies used Study 7.0 from the OCAP BA as a base model. Study 7.0 is the existing condition and represents the existing infrastructure and demands.

The modeling completed for USFWS RPA and NMFS draft RPA used only a D-1641 step. This is different from the modeling that was completed for the OCAP BA. The OCAP BA modeling included a Central Valley Project Improvement Act (CVPIA) 3406(b)(2) step, which estimated use of (b)(2) water, as well as an Environmental Water Account (EWA) step that modeled the current EWA and limited version of EWA. These steps were not modeled due to complexities in modeling new and proposed Delta actions and the uncertainty of how (b)(2) and EWA would be implemented.

OCAP Study 7.0 to NMFS draft RPA

A total of two studies were conducted to analyze the delivery reductions due to the Delta actions specified in the NMFS draft RPA compared to OCAP Study 7.0. These studies modified the base model to incorporate the logic needed to model the Delta portion of the RPA in the NMFS draft BO layered on top of D-1641.

The studies representing the NMFS RPA bound the range in the Old and Middle River (OMR) restriction described in Action IV.2.3. Each of these two models was modified to only include the following NMFS RPA:

- Action IV.2.1 – Maintain an export pumping rate to Delta E/I ratio of 35% or less in January.
- Action IV.2.2 – Maintain a San Joaquin River inflow to export ratio of 4:1 from March 15 through June 15 in all but dry and critically dry years, and a minimum 2:1 ration in dry and critically dry years.
- Action IV.2.3 – From February 1 through June 30, reduce exports, as necessary, to limit negative flows to -2500 to -5000 cfs in Old and Middle rivers, depending on presence of salmonids.

Table 1 summarizes these studies where the only changes between the two NMFS studies are the variation in OMR restriction described in Action IV.2.3.

Table 1 Applied Actions for each NMFS draft BO RPA.

Study Name	Base Study	Action IV.2.1	Action IV.2.2	Action IV.2.3
NMFS High Restriction	OCAP 7.0	35% EI in Jan	Mar 15 to Jun 15 2:1 in D, C WYs 4:1 in W, AN, BN WYs	Feb 1 to Jun 30 OMR>-2500 cfs
NMFS Low Restriction	OCAP 7.0	35% EI in Jan	Mar 15 to Jun 15 2:1 in D, C WYs 4:1 in W, AN, BN WYs	Feb 1 to Jun 30 OMR>-5000 cfs
OCAP Study 7.0	OCAP 7.0	None	None	None

Using the studies in Table 1, delivery reductions for the NMFS draft RPA were estimated by subtracting the total delivery of the OCAP Study 7.0 by the total delivery of the NMFS.

USFWS BO to NMFS draft RPA

A total of four studies were conducted to analyze the delivery reductions due to the Delta actions specified in the NMFS draft RPA compared to the USFWS BO. Each of these four studies was modified to incorporate the logic needed to model the Delta portion of the RPA in the USFWS BO. Two of these studies then layered on the proposed NMFS Delta related RPA.

All four studies include a specific level of Old and Middle River (OMR) restriction that bound the RPA specified in the USFWS BO. By layering the NMFS RPA onto the two USFWS studies, the incremental impacts were estimated.

USFWS BO

The D1641 step from each model was modified to operate to the USFWS RPA. Additional code was included in the model to restrict Banks and Jones pumping plants in order to meet the specified OMR target. The following is a summary of the ranges assumed in the modeling, and Table 2 summarizes the assumptions for each study.

- Action 1 – To protect upmigrating delta smelt. This action can start as early as December 1, based on the judgment of the USFWS, but after December 20 this action is based on turbidity and delta smelt salvage at the exports.

- Action 2 – To protect adult delta smelt that have migrated upstream and are residing in the Delta prior to spawning. This action would commence immediately after Action 1.

- Action 3 – To improve flow conditions in the Central and South Delta so that larval and juvenile delta smelt can successfully rear in the Central Delta and move downstream when appropriate. The initiation of this action is based on temperature and evidence of spawning.

Table 2 Applied Actions for each FWS BO RPA.

Study Name	Base Study	Action 1	Action 2	Action 3 (Pre-VAMP)	Action 3 (Post-VAMP)
FWS High Restriction (FWS-HR)	OCAP 7.0	Dec 18 to Dec 31 OMR>-2000 cfs	Jan 1 to Feb 28 OMR>-1250 cfs	Mar 1 to May 15 OMR>-1250 cfs	May 16 to Jun 30 OMR>-1250 cfs
FWS Low Restriction (FWS-LR)	OCAP 7.0	Dec 18 to Dec 31 OMR>-2400 cfs	Jan 1 to Feb 28 OMR>-5000 cfs	Mar 1 to May 15 OMR>-5000 cfs	May 16 to Jun 15 OMR>-5000 cfs

NMFS draft RPA

Each of the USFWS studies from Table 2 was modified to include the additional RPA from NMFS draft RPA. Additional code was included in the model to restrict Banks and Jones pumping plants in order to reduce levels down to 1/4 of the flow in the San Joaquin River in wet, above normal and below normal water years, and 1/2 of the flow in the San Joaquin River in dry and critical water years. The following is a summary of the RPA included in the modeling, with Table 3 summarizing the assumptions for each study.

- Action IV.2.1 – Maintain an export pumping rate to Delta E/I ratio of 35% or less in January.
- Action IV.2.2 – Maintain a San Joaquin River inflow to export ratio of 4:1 from March 15 through June 15 in all but dry and critically dry years, and a minimum 2:1 ration in dry and critically dry years.
- Action IV.2.3 – From February 1 through June 30, reduce exports, as necessary, to limit negative flows to -2500 to -5000 cfs in Old and Middle rivers, depending on presence of salmonids.

Table 3 Applied Actions for each NMFS draft BO RPA.

Study Name	Base Study	Action IV.2.1	Action IV.2.2	Action IV.2.3
NMFS / FWS High Restriction	FWS-HR	35% EI in Jan	Mar 15 to Jun 15 2:1 in D, C WYs 4:1 in W, AN, BN WYs	Feb 1 to Jun 30 OMR>-2500 cfs
NMFS / FWS Low Restriction	FWS-LR	35% EI in Jan	Mar 15 to Jun 15 2:1 in D, C WYs 4:1 in W, AN, BN WYs	Feb 1 to Jun 30 OMR>-2500 cfs

Using the studies in Table 3, delivery reductions for the NMFS draft RPA were estimated by subtracting the total delivery of the USFWS study by the total delivery of the NMFS.

Other Assumptions

For the NMFS studies it was assumed that a minimum health and safety pumping for Banks and Jones would be no less than 1500 cfs February through May, and 2000 cfs in June. The OMR restriction was assumed to be the minimum between the NMFS draft RPA and USFWS RPA.

It was assumed that San Joaquin River flows would remain the same as described by D-1641 and so the combined export of Banks and Jones would be decreased to meet the 4:1 in wet, above normal and below normal years, and 2:1 in dry and critical years. The splitting of available exports between the SWP and CVP under these new actions is not currently covered by formal agreement and so therefore only combined project deliveries were analyzed.

The CalSim II logic for operating to the NMFS Draft BO RPA is new and refinements are ongoing. However, this modeling effort does represent the best available at this time. The modeling did not attempt to model any other NMFS RPA action beyond the three listed above. Following is a list of potential improvements in order to better represent the NMFS as written.

- The San Joaquin River portion of the models was not modified in order to increase flows for pre-VAMP or post-VAMP. This would require taking water away from other prescribed uses. Implementing this in the model would likely only reduce the amount of time that SJR would be operating below the 4:1 or 2:1 criteria when the exports are operating at health and safety levels.
- The implementation of Shasta storage targets in September and April were not included in the models primarily because this would require adjusting rule curves and so under the allotted time this was not attempted. Implementing this would in effect reduce the flexibility of the reservoir for water storage in the model would likely reduce total deliveries.

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY
ARNOLD SCHWARZENEGGER, *Governor*

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April 20, 2009

Mr. Ronald Milligan, Operations Manager
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Section 7 Consultation DWR's Additional comments on draft NMFS' Salmonid Biological Opinion

Dear Mr. Milligan:

The Department of Water Resources (DWR) provides the following additional comments on the National Marine Fisheries Services' (NMFS) revised draft Biological Opinion for effects of CVP and SWP on salmonids and green sturgeon sent to DWR in March 2009 (March draft Bi Op). DWR provided comments on the draft Bi Op in letters sent to the U.S. Bureau of Reclamation (Reclamation) on January 13, 2009, February 2, 2009 and March 20, 2009.

Attachment 1 to this letter is an additional comment on Action IV.2.2 of the March draft Bi Op Reasonable and Prudent Alternative (RPA). This comment discusses results of a comparison DWR made between Particle Tracking Model (PTM) results and coded wire tag (CWT) experiments conducted by USFWS for the VAMP from 1995 to 2006. The result of the comparison shows that there is no correlation between the timing and magnitude of CWT Chinook recoveries and PTM particles passing Chipps Island. Therefore, there is no scientific justification for the use of the PTM results as a surrogate for salmon movement through the Delta. DWR recommends that NMFS modify Action IV.2.2 to use real-time monitoring to determine the timing of San Joaquin steelhead emigration through the south Delta and base the duration of project restrictions on the CWT Chinook emigration data obtained during the historic VAMP experiments. In addition, the USFWS currently conducts a Kodiak trawl at Mossdale three days per week from January through March, and June through December each year. In April and May, the California Department of Fish and Game (DFG) operates the Kodiak trawl and increases the effort to five days per week. Usually, ten tows are conducted per day. If NMFS agrees to use the monitoring data to implement this proposed RPA action, DWR would consider supporting a program to increase the Kodiak trawl sampling effort in the month of March from three days per week to five days per week, and increase the sampling effort from ten tows per day to twenty tows per day from March through June 15. This effort would be carried out in coordination with USFWS, DFG, and NMFS, with the costs shared by Reclamation.

Attachment 2 is a technical memorandum dated April 1 which was prepared by Cramer Fish Sciences at the request of DWR. It focuses on two major issues related to the RPA: 1) an assessment of steelhead Delta passage timing; and 2) a model-based assessment of the proposed Delta winter run Chinook and steelhead actions. This is a separate memorandum from the March 18 technical memorandum prepared by Cramer Fish Sciences and included in DWR's March 20, 2009 letter. With respect to steelhead passage timing, the analysis concludes that the peak emigration of natural origin steelhead occurs after March with a peak occurring in June. Given that hatchery origin steelhead from the Mokelumne River, Nimbus, and Feather River hatcheries are not considered part of the Central Valley steelhead ESU, NMFS should tailor the RPA action specifically to the known timing of natural origin steelhead. The results of the model-based analysis for the fish released in the Sacramento River suggest no biologically significant or consistent difference in survival under operation scenarios with both the USFWS December 2008 BO actions and the proposed NMFS RPA actions when compared to operation scenarios of the USFWS December 2008 BO action alone in any water year evaluated. For simulated fish releases in the San Joaquin River, greater differences in predicted survival between scenarios were found. However, the difference was not due to the proposed NMFS RPA actions but to the USFWS measures in their December 2008 BO. Although the results are preliminary, when taken collectively they suggest that the benefits of the proposed NMFS RPA actions for Delta juvenile salmonids may not yield the desired outcome in terms of magnitude or direction of survival benefits. This uncertainty, especially when viewed with the additional reduction caused to SWP and CVP water supply, indicates the proposed RPA actions included in the scenarios should be refined or removed.

Attachment 3 is a revision to the estimated water supply impacts that would result from the implementation of the proposed RPA, along with the revised modeling assumptions for the CALSIM simulations. In these studies, we used as a base the OCAP Study 7.0. The updated results indicate that when compared to OCAP Study 7.0, the average combined water supply impact to the SWP and the CVP of the NFMS proposed RPA is roughly 900 taf to 1.1 Maf (or about 16% to 19%). By taking an alternative approach and layering the NFMS proposed RPA on top of the terms of the USFWS 2008 Bi Op RPA that have been provisionally accepted by Reclamation, the average combined water supply impact of the NMFS draft RPA to the SWP and CVP is roughly 150 taf to 750 taf, or about 3% to 15% above the impact of the USFWS 2008 Bi Op RPA depending on the range of adaptive actions implemented by the USFWS under the terms of the Bi Op. When compared to OCAP Study 7.0, the average combined water supply impact of the collective USFWS RPA and NMFS draft RPA to the SWP and CVP is roughly 1.3 Maf to 1.6 Maf (or about 23% to 29%).

Again, it should be noted that these estimated impacts are incomplete, and we would expect them to be greater because they do not include reoperation of CVP reservoirs as specified in the draft NMFS RPA. In addition, these studies do not include any assessment of the USFWS Fall X2 measure which has not been accepted by Reclamation as reasonable or prudent.

DWR is analyzing the economic impacts of the draft Bi Op, and we expect to be able to provide you and NMFS with an analysis of both the near-term and long-term (year 2030) economic effects of the draft Bi Op as well as by the end of this week.

Sincerely,

Katherine F. Kelly
Chief, Bay-Delta Office
California Department of Water Resources

Enclosures:

Attachment 1 - Additional comment on Action IV.2.
Attachment 2 - April 1, 2009 Cramer Fish Sciences Technical Memorandum
Attachment 3 – Revised Estimate Water Supply Impacts and Modeling Assumptions

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