San Joaquin River Salmon Survival and the 2009 NMFS Biological Opinion

1/26/10

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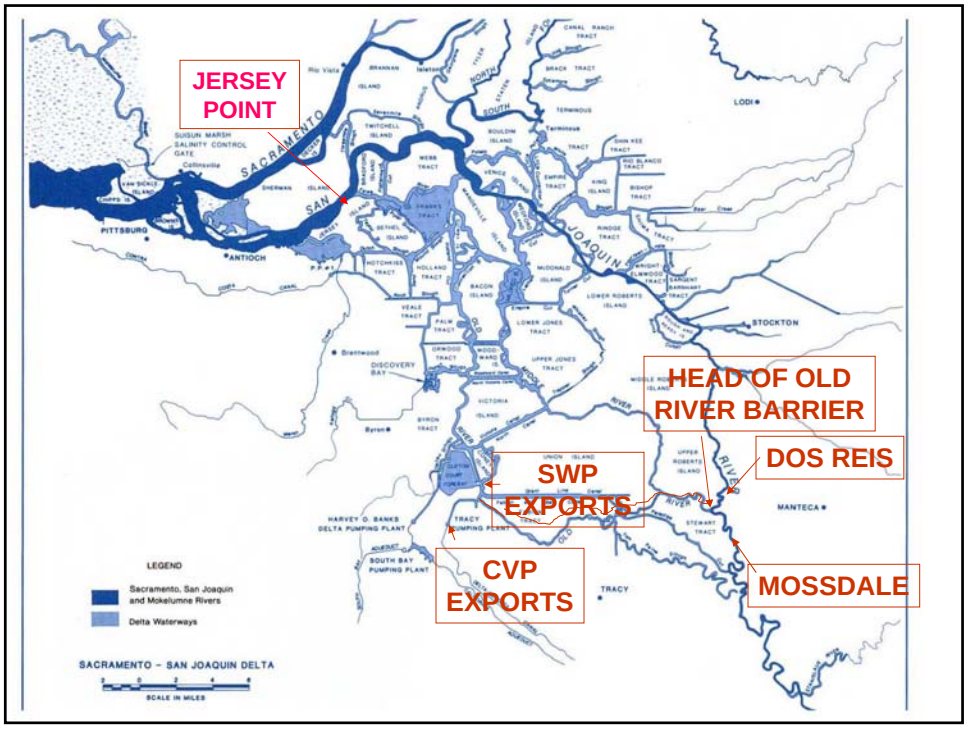
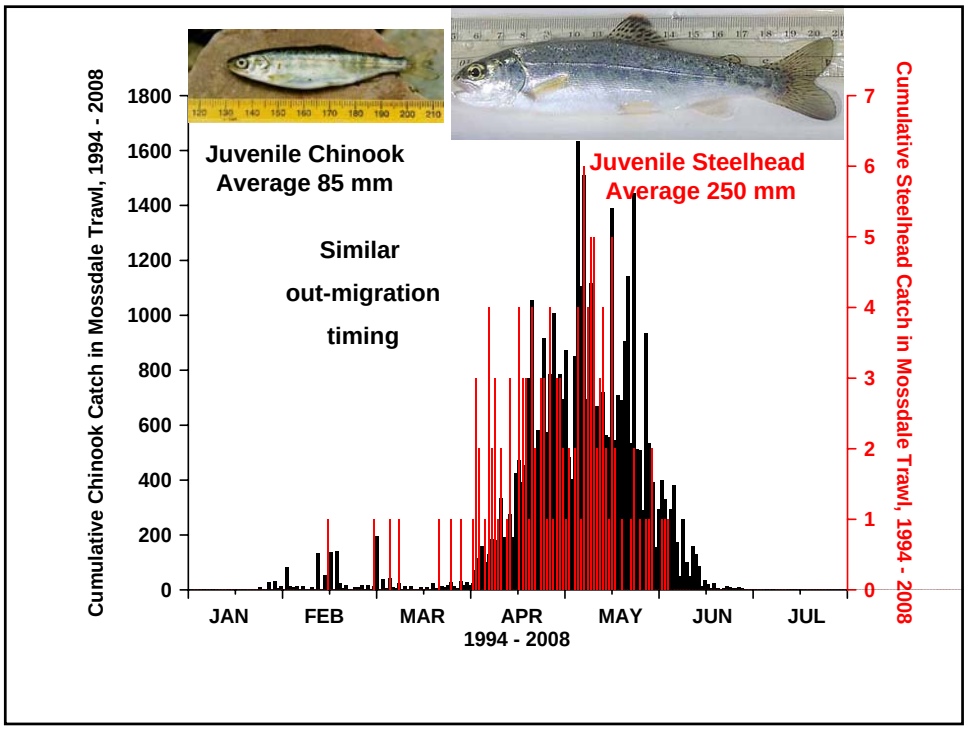
Overview

- Steelhead and salmon movements
- Description of the NMFS RPA and its rationale
- Water Supply impacts of the RPA
- Review of other studies on the effect of flow and exports on San Joaquin Salmon
- Non-physical Barrier to keep salmon in the main stem of the San Joaquin River

2


JERSEY POINT
HEAD OF OLD RIVER BARRIER
DOS REIS
SWP EXPORTS
CVP EXPORTS
MOSSDALE
SACRAMENTO
SAN JOAQUIN
PITTSBURG
ANTIOCH
STOCKTON
LODI
MANTECA
TRACY
LEGEND
Sacramento, San Joaquin and Mokelumne Rivers
Delta Waterways
SACRAMENTO – SAN JOAQUIN DELTA


Juvenile Chinook
Average 85 mm
Juvenile Steelhead
Average 250 mm
Similar
out-migration
timing
Cumulative Chinook Catch in Mossdale Trawl, 1994 - 2008
Cumulative Steelhead Catch in Mossdale Trawl, 1994 - 2008
0
200
400
600
800
1000
1200
1400
1600
1800
0
1
2
3
4
5
6
7
JAN
FEB
MAR
APR
MAY
JUN
JUL
1994 - 2008

NMFS Justification for SJR Inflow to Export ratio

- Action IV.2.1 San Joaquin River Inflow to Export ratio (April and May)
  - Ranges from 1:1 to 4:1 depending on year types
- Based on the 2006 VAMP report review of the Salmon Escapement data (1953 – 2005)
- Review of Salmon Escapement and SJR Flows and I/E ratio 2 ½ years previous
  - SJR Flows on Escapement R2 = 0.40 40%
  - SJR Flows/Exports ratio (ln) on Escapement R2 = 0.56 56%
  - Ratio R-squared better
  - "As you increase flows and decrease exports relative to flows there should be corresponding increases in smolt survival and adult escapement 2 ½ years later" (2006 annual VAMP report)

5

Water Supply Impacts of SJR I/E

- SWP/CVP Average Water Supply Impacts
  - 135 TAF
  - Smaller in dry years
  - Larger in wetter years

6

Overview of Most Recent Information Exports vs. SJR Salmon Survival

- Newman USFWS (2008) from VAMP studies
- Department of Fish and Game (2005) –
- DWR Analysis 2009

7

VAMP Studies Review by USFWS

- Vernalis Adaptive Management Program (VAMP) – Evaluating actual SJR Salmon survival through the Delta
  - Designed to Separate the effects of inflow, exports and Head of Old River Barrier placement on SJR Salmon Survival
- Newman (2008) (USFWS Statistician)
  - Most recent peer reviewed analysis
  - Coded wire tag experiments 1985 – 2006 – up to 20 experiments
  - Major Conclusions
    - Positive effects of SJR Inflows on SJR Salmon Survival through the Delta
    - Head of Old River Barrier (HOR) beneficial effect on SJR Salmon Survival
    - **Exports** have a "**weak to negligible"** effect on SJR Salmon Survival

8

Dept. of Fish and Game Analysis

- March 2005 report to the SWRCB
- DFG development of SJR salmon population model
- Major findings
  - **Spring-time San Joaquin River Inflow is the primary factor influencing fall-run Chinook Salmon populations in the SJR**
  - **SJR Inflow/Export ratio does not influence salmon survival**
  - **Some positive relationships with exports**
  - **"Delta exports are not having the negative influence upon salmon production they once were thought to have"**

9

DWR review of the Salmon Escapement data

- Reviewed salmon Escapement data from 1952 through 2008
- Found similar results to salmon Escapement as the VAMP report
  - San Joaquin Inflow - R2 - 0.31 31% (s)
  - SJR I/E ratio (ln) - R2 - 0.43 43% (s)
  - Exports - R2 - 0.18 18% (s)
- However export data has time trend
  - flow does not
  - results are driven by early 1950's extremely low exports as the CVP came on line

10

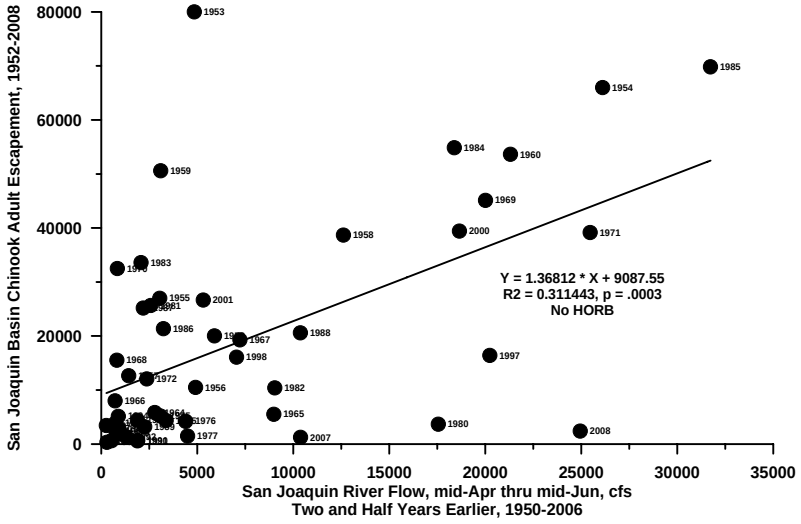


Figure 3. San Joaquin basin Chinook adult escapement from 1952 through 2008, and San Joaquin River flow, mid-April through mid-June, when they emigrated as juveniles through the Delta two and a half years earlier from 1950 through 2006. No Head of Old River Barrier years only.

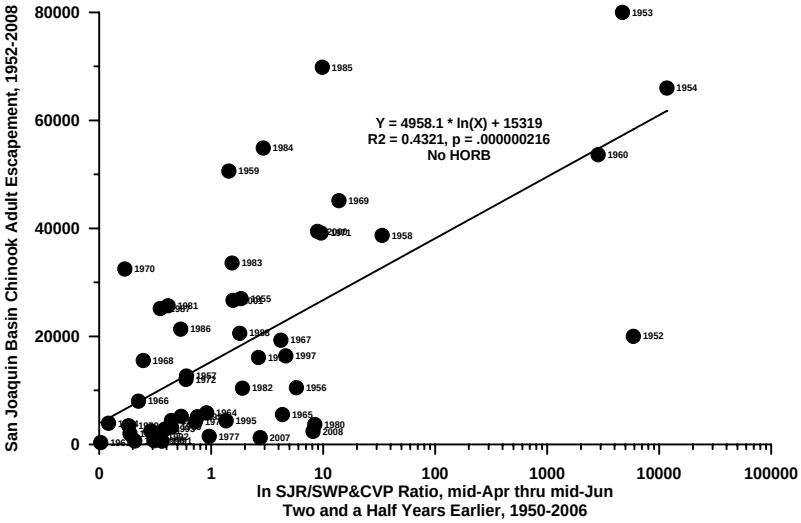


Figure 6. San Joaquin basin Chinook adult escapement from 1952 through 2008, and the natural log of the ratio of San Joaquin River flow to SWP and CVP south Delta exports from mid-April through mid-June when they emigrated through the Delta as juveniles two and half years earlier from 1950 through 2006. No Head of Old River Barrier years only.

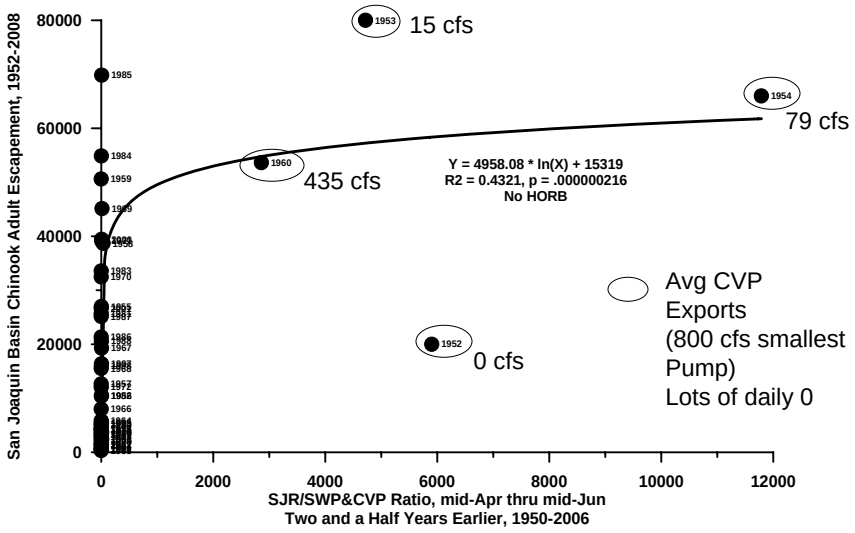


Figure 5. San Joaquin basin Chinook adult escapement from 1952 through 2008, and the ratio of San Joaquin River flow to SWP and CVP south Delta exports from mid-April through mid-June when they emigrated through the Delta as juveniles two and half years earlier from 1950 through 2006. No Head of Old River Barrier years only.

DWR review of the Salmon Escapement data (cont.)

- De-trended Data results
  - San Joaquin Inflow - R2 - 0.39 39% (s)
  - SJR I/E ratio (ln) - R2 - 0.39 39% (s)
  - Exports - R2 - 0.08 8% (s)
  - SJR + Exports - R2 - 0.39 Exports (NS)
- Difference between SJR Inflow and SJR Inflow/Export ratio r squared values does not exist
- Export effects “small to negligible” (same as found by Newman 2008)
- **Once SJR flows accounted for, Exports add no further value in explaining changes in SJR Salmon escapement**

14

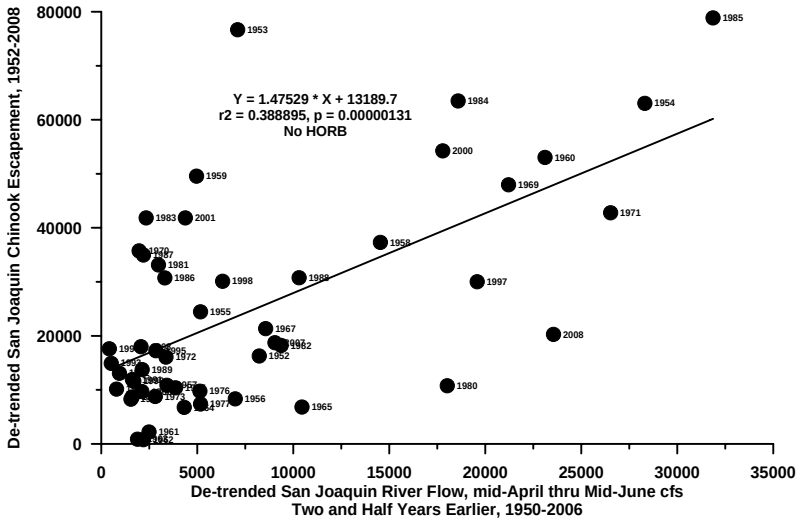


Figure 7. De-trended San Joaquin basin Chinook adult escapement from 1952 through 2008, and de-trended San Joaquin River flow from mid-April through mid-June when the juveniles emigrated through the Delta two and half years earlier, 1950 through 2006.

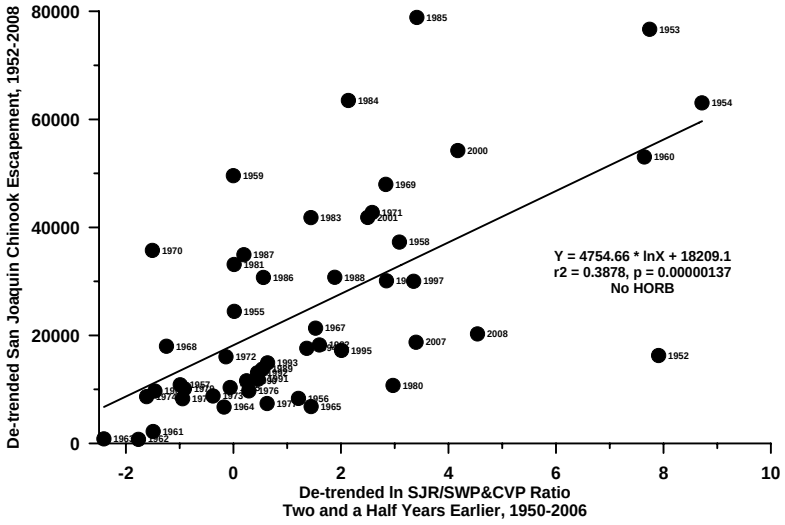
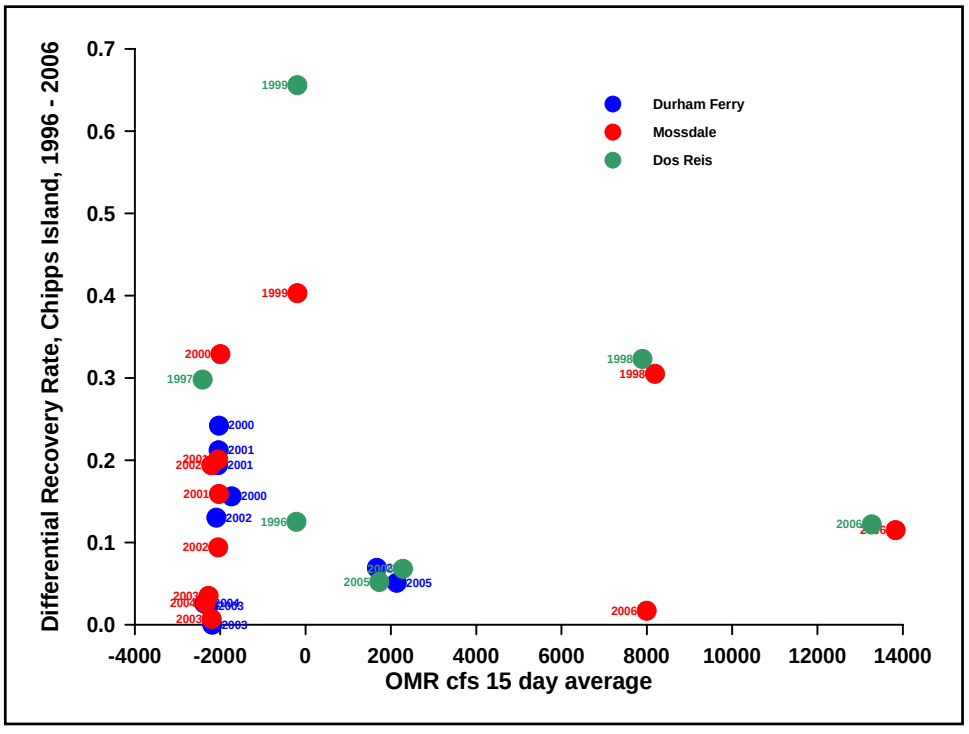


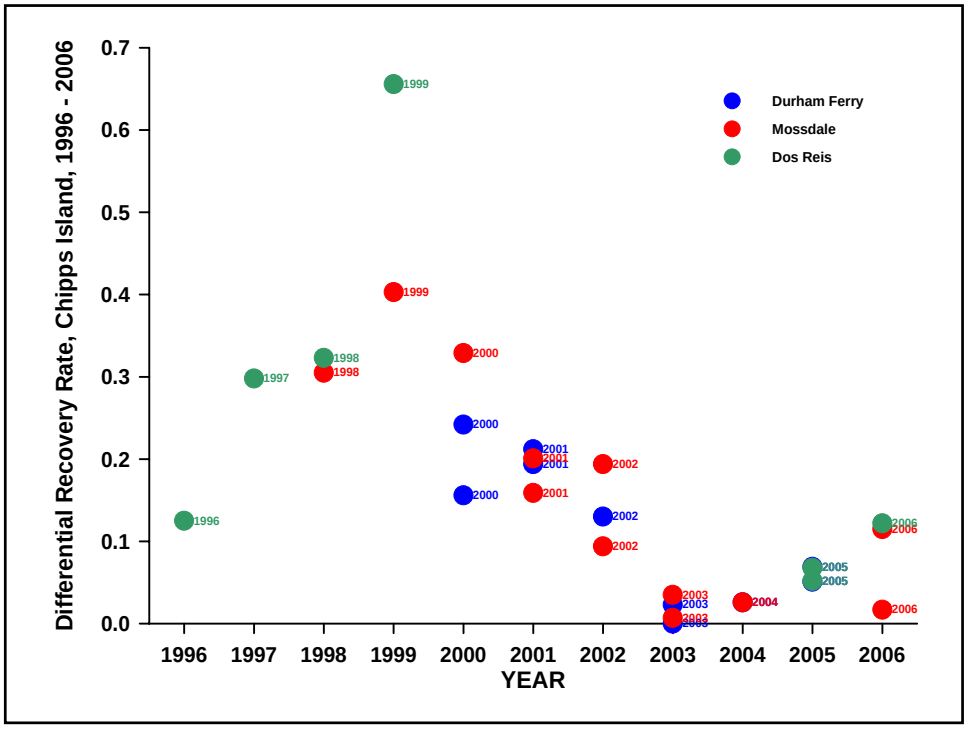
Figure 9. De-trended San Joaquin basin Chinook adult escapement from 1952 through 2008, and de-trended ln San Joaquin River flow from mid-April through mid-June when the juveniles emigrated through the Delta, two and a half years earlier, 1950 through 2006.

Salmon Survival issues

- SJR Salmon Travel time through the Delta not related to export rates
  - Coded wire tag studies of actual VAMP experiments show no relationship between actual travel times and those predicted by Particle tracking studies.
  - Two to three weeks regardless of PTM
- SJR Salmon Survival through the Delta not affected by OMR flows (see next slide)
- Note time trend in SJR salmon survival from 1999

17





Conclusions

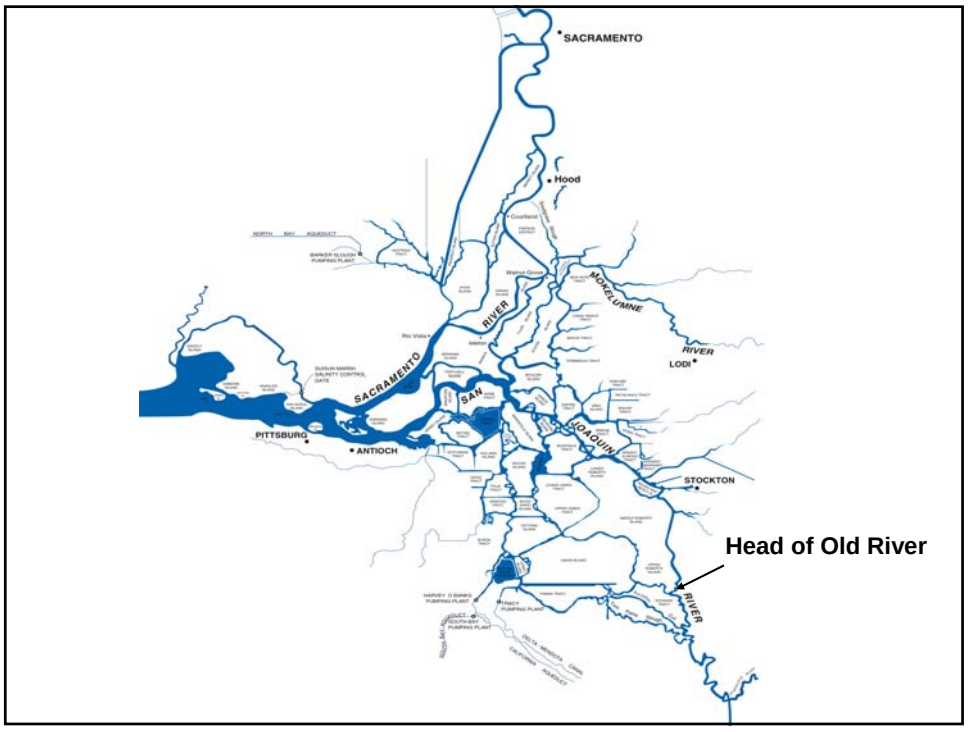
- Export constraints will not effectively improve salmon survival
- Three separate reviews do not support SJR I/E
- Need to use Better Action
  - Keep D1641 export constraints
  - Non-Physical Barrier at HOR

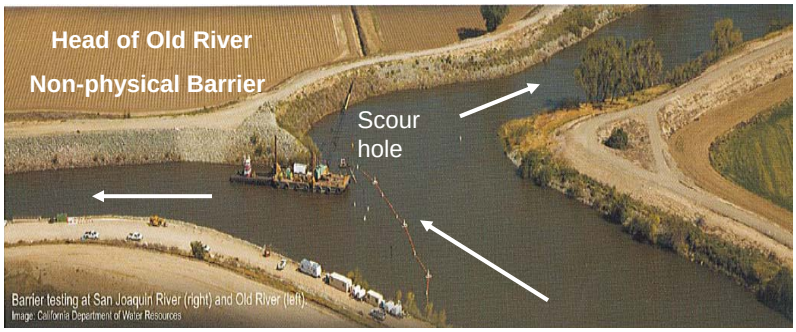
20

Non-Physical Barriers Instead of Export Constraints

- Exports constraints will not benefit San Joaquin salmon survival
- VAMP studies show that keeping salmon in the main-stem of the San Joaquin River does provide benefits to salmon Survival
- Historic Physical Barrier at the Head of Old River (HOR)
  - Spring barrier - Salmon- 1992 to 2007 (most years)
  - Fall Barrier - DO improvement - 1968 to today as needed for DO improvement near Stockton

21





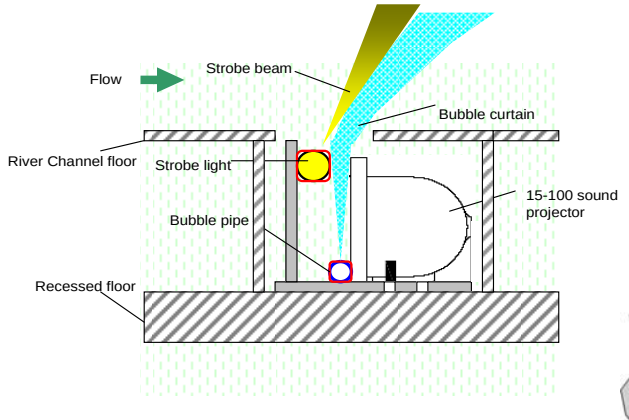
Use of HOR Physical Barrier no longer possible

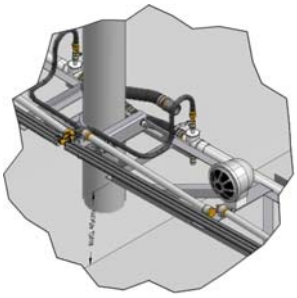
- Judge Wanger Decision on Dec 2007
  - Disallowed the Physical Spring Salmon Barrier due to hydrologic concerns related to Delta Smelt
  - About half the SRJ flows split at HOR and head down Old River
  - With no other changes, the HOR physical barrier results in higher reverse flows in Old and Middle River
- USFWS 2008 BiOp
  - Makes installation of the HOR Physical Barrier all but impossible

24

Non-Physical Barrier

Three factors - Lights - Sound - Air Bubble Curtain





Why does the NPB Work

- Air Bubble Curtain contains the sounds
- Strobe lights allow the fish to identify the source of the sounds
- Fish sense the risk of passing through the barrier to an uncertain future was greater than the risk of swimming away

26

Laboratory and Field Tests

- USBR Denver Lab evaluations looking at the Georgiana Slough area on The Sacramento River
  - Mixed results but promising
- HOR NPB Field installation in 2009
  - Concept in early January 2009
  - Installation by early April 2009
  - Light speed in today's permitting environment
  - Largest installation of this technology

27

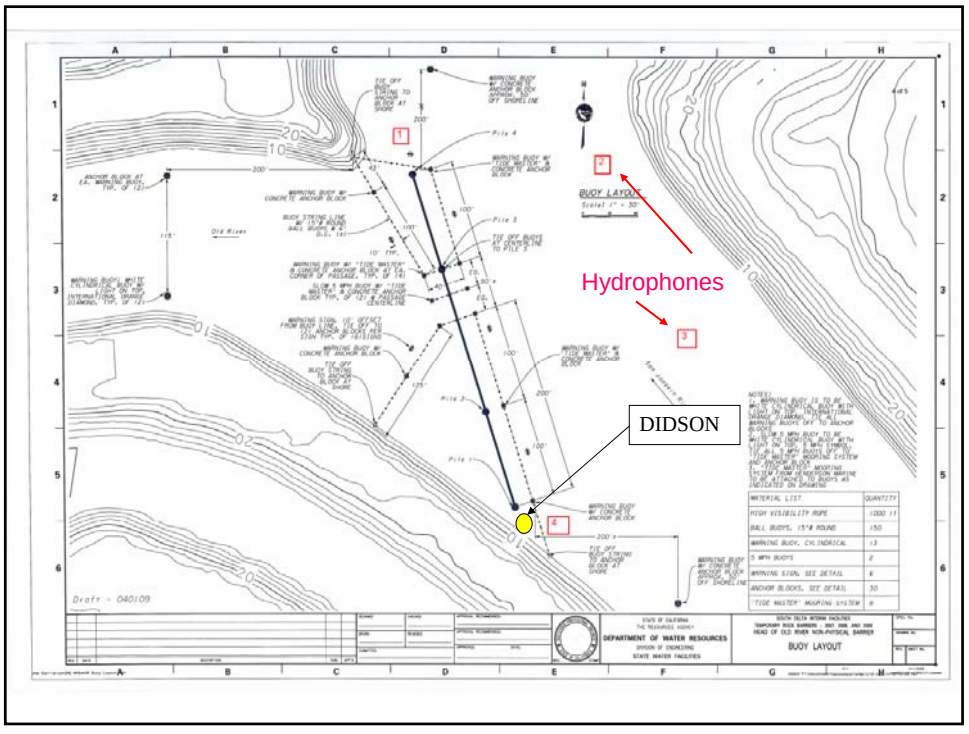
Installation Process

Operation

Evaluation of effectiveness

- Acoustic tagged salmon released at Durham Ferry 10 miles upstream
  - Part of the VAMP experiments
  - 4 hydrophones at the NPB
- A Dual-frequency Identification Sonar (DIDSON) camera - immediately upstream of the barrier
  - To observe the behavior of fishes in the vicinity of the barrier

29



- Insert animations here.

31

Results

- Extremely high degree of predation upstream and in the area of the NPB
  - Predation scour hole in the HOR area

Release	Number Released	Proportion Never Arrived at NPB	Proportion Consumed in NPB area	Total Dead Combined Proportion (before and in NPB area)
1	136	0.478	0.118	0.596
2	136	0.279	0.346	0.625
3	135	0.252	0.400	0.652
4	136	0.485	0.279	0.765
5	136	0.360	0.353	0.713
6	133	0.616	0.135	0.752
7	135	0.385	0.296	0.681

Results

- Non-Physical Barrier operation
  - **Deterrence rate of fish reaching the NPB was 81.4%**
  - However, many of the Smolts that stayed in the SJR were eaten before they left the area
- Smolts continuing downstream in the SJR
  - With NPB Off - 24.5% of smolts released
  - With NPB On - 30.8% of smolts released
    - 26% increase in survival
    - Need larger sample size to test statistical sig.
- While the NPB is effective – predation needs to be addressed in future installations

33

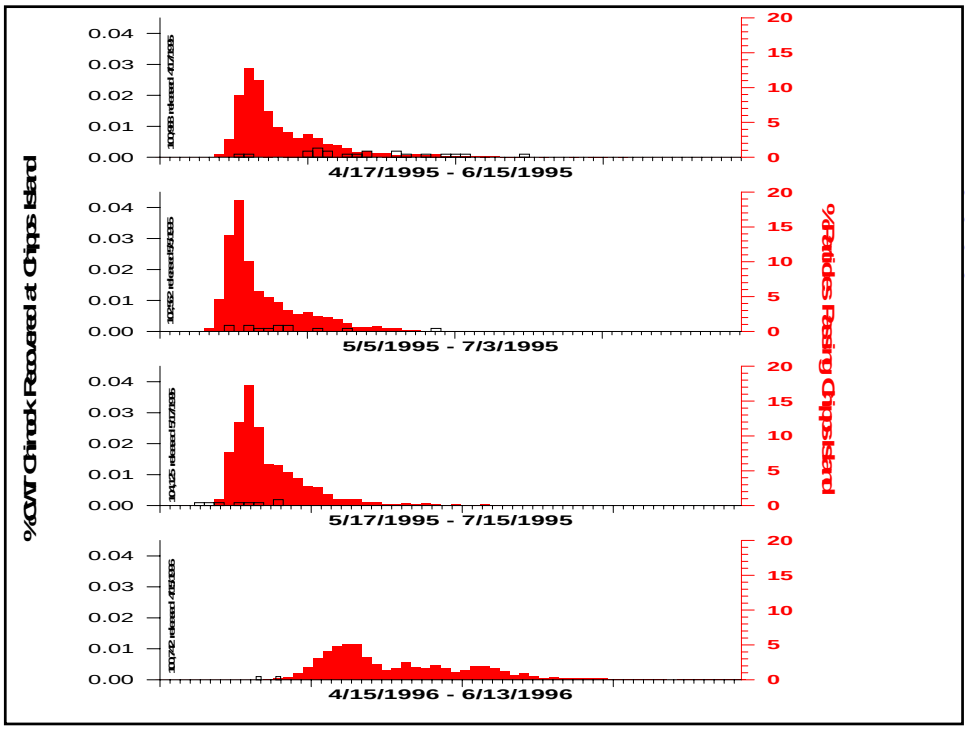
2010 NPB Planning

- Install NPB In 2010
- Keep Exports at previous VAMP Levels
- Add “Kicker” frame extension to help fish avoid the predation scour hole
- Evaluate use of concrete piers instead on steel piles
- Improvements to wiring harness design
- Add number of tagged fish
- More hydrophones
- Develop short-term predation control method

34

END

35


0.04
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0.01
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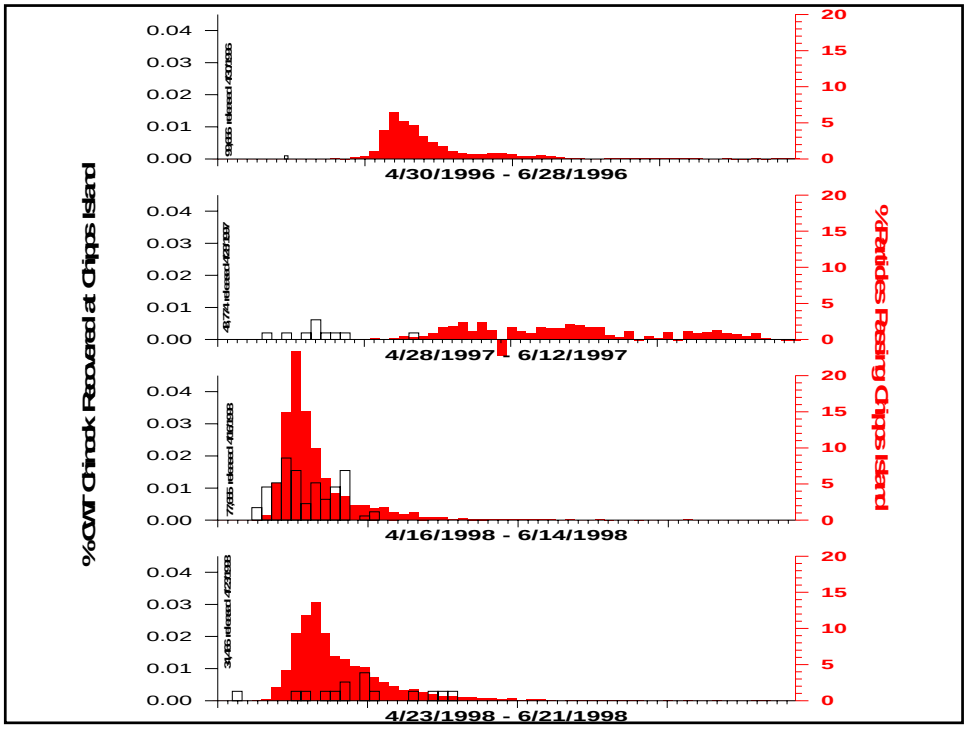
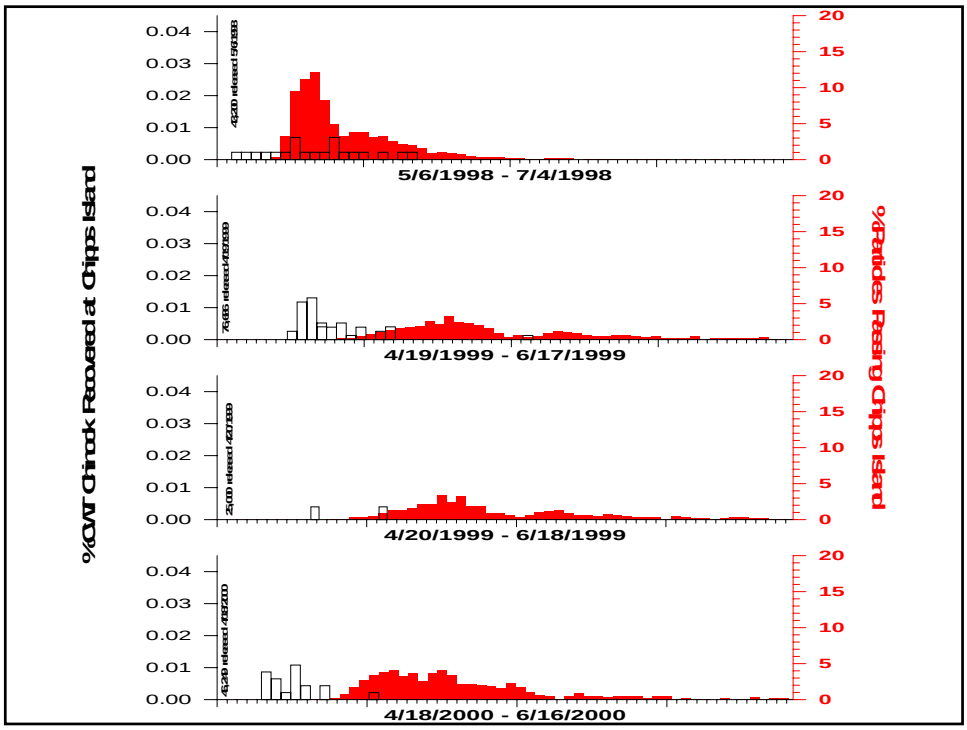
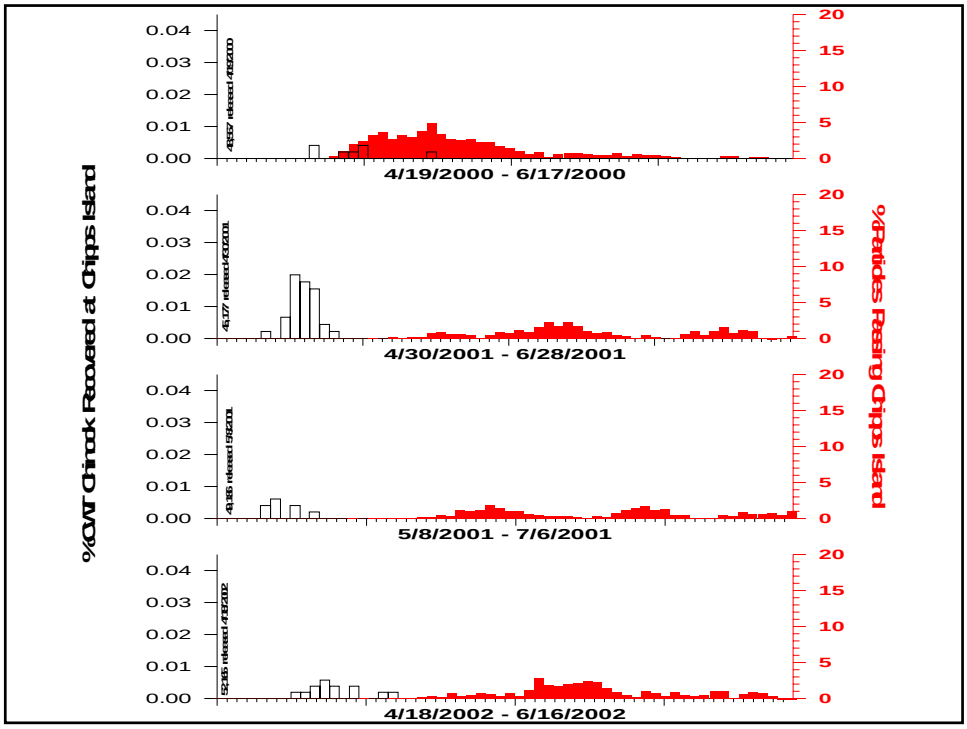
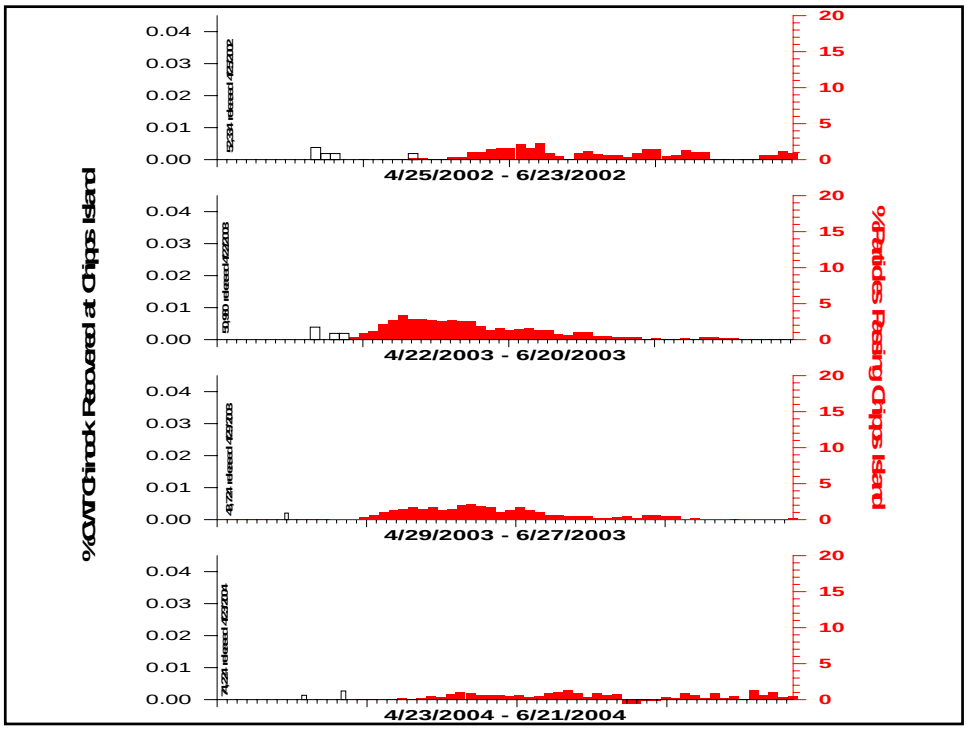
15
10
5
0
4/17/1995 - 6/15/1995
5/5/1995 - 7/3/1995
5/17/1995 - 7/15/1995
4/15/1996 - 6/13/1996


%CVP Catch Recovered at Chipps Island
% Rates Passing Chipps Island
4/30/1996 - 6/28/1996
4/28/1997 - 6/12/1997
4/16/1998 - 6/14/1998
4/23/1998 - 6/21/1998


%CVP Catch Recovered at Chipps Island
% Rates Passing Chipps Island
5/6/1998 - 7/4/1998
4/19/1999 - 6/17/1999
4/20/1999 - 6/18/1999
4/18/2000 - 6/16/2000


%CWT Chinook Recovered at Chipps Island
%Ratides Rearing Chipps Island
4/19/2000 - 6/17/2000
4/30/2001 - 6/28/2001
5/8/2001 - 7/6/2001
4/18/2002 - 6/16/2002


%CWT Chinook Recovered at Chipps Island
%Ratides Rearing Chipps Island
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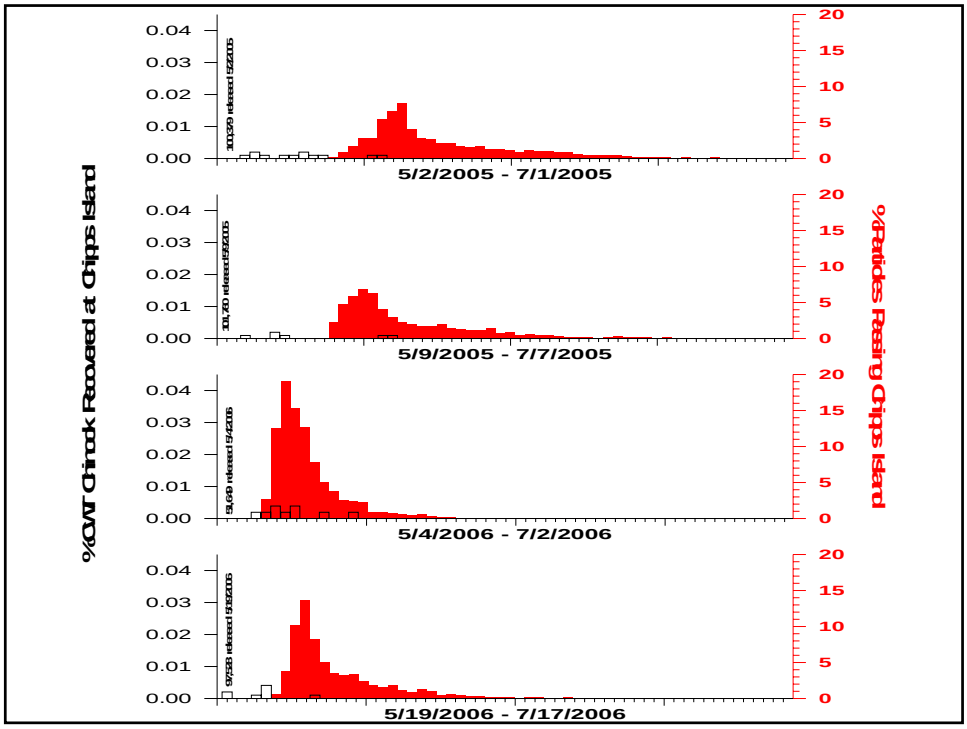
4/22/2003 - 6/20/2003
4/29/2003 - 6/27/2003
4/23/2004 - 6/21/2004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5/4/2006 - 7/2/2006
5/19/2006 - 7/17/2006