Delta Action 8

What have we learned?

EWA Conference
November 28, 2006
Pat Brandes and Ken Newman
USFWS

Delta Action 8
What have we learned?

- Interior Delta < Mainstem survival
- Relative interior Delta survival weakly correlated to combined SWP and CVP exports
- Need to understand what proportion of juvenile salmon are diverted into the interior Delta

Delta Action 8 Experiment (CVPIA-AFRP)

Purpose: evaluate benefit of reducing E/I ratio from 65 to 35% between Nov - Jan.

to benefit juvenile salmon
from all Sacramento basin salmon runs

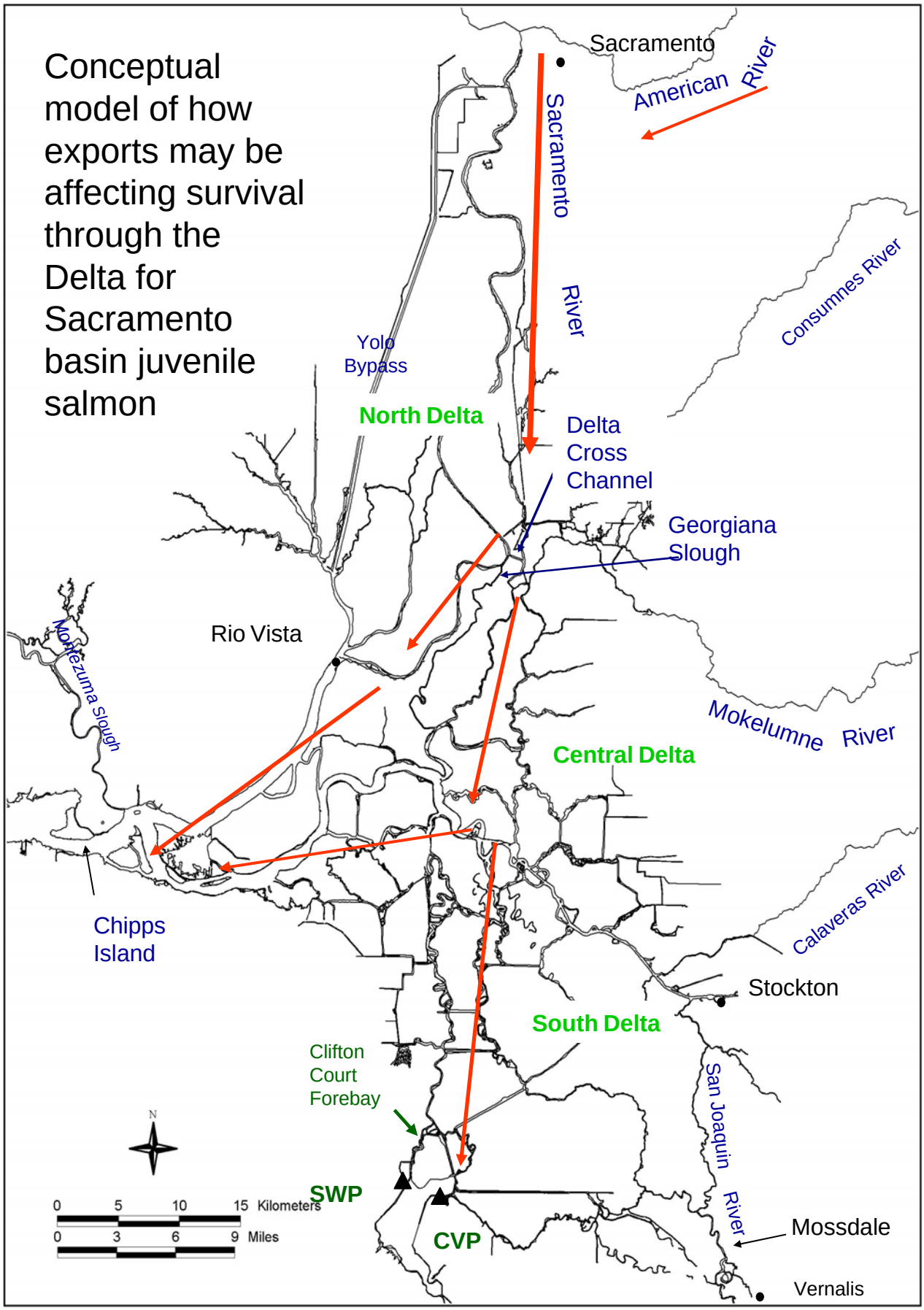
Why?

To determine if Delta Action 9 should be implemented

Delta Action 8

- No EWA was used in 2006.
- EWA was requested
  - Provide stability in exports
    - in 1999 exports changed significantly during the period
      - 3 vs 17 day average:

        3870 vs 8368


Conceptual model of how exports may be affecting survival through the Delta for Sacramento basin juvenile salmon
Sacramento
American River
Sacramento River
Consumnes River
Yolo Bypass
North Delta
Delta Cross Channel
Georgiana Slough
Rio Vista
Montezuma Slough
Mokelumne River
Central Delta
Chipps Island
Calaveras River
Stockton
South Delta
Clifton Court Forebay
San Joaquin River
SWP
CVP
Mossdale
Vernalis
N
0 5 10 15 Kilometers
0 3 6 9 Miles

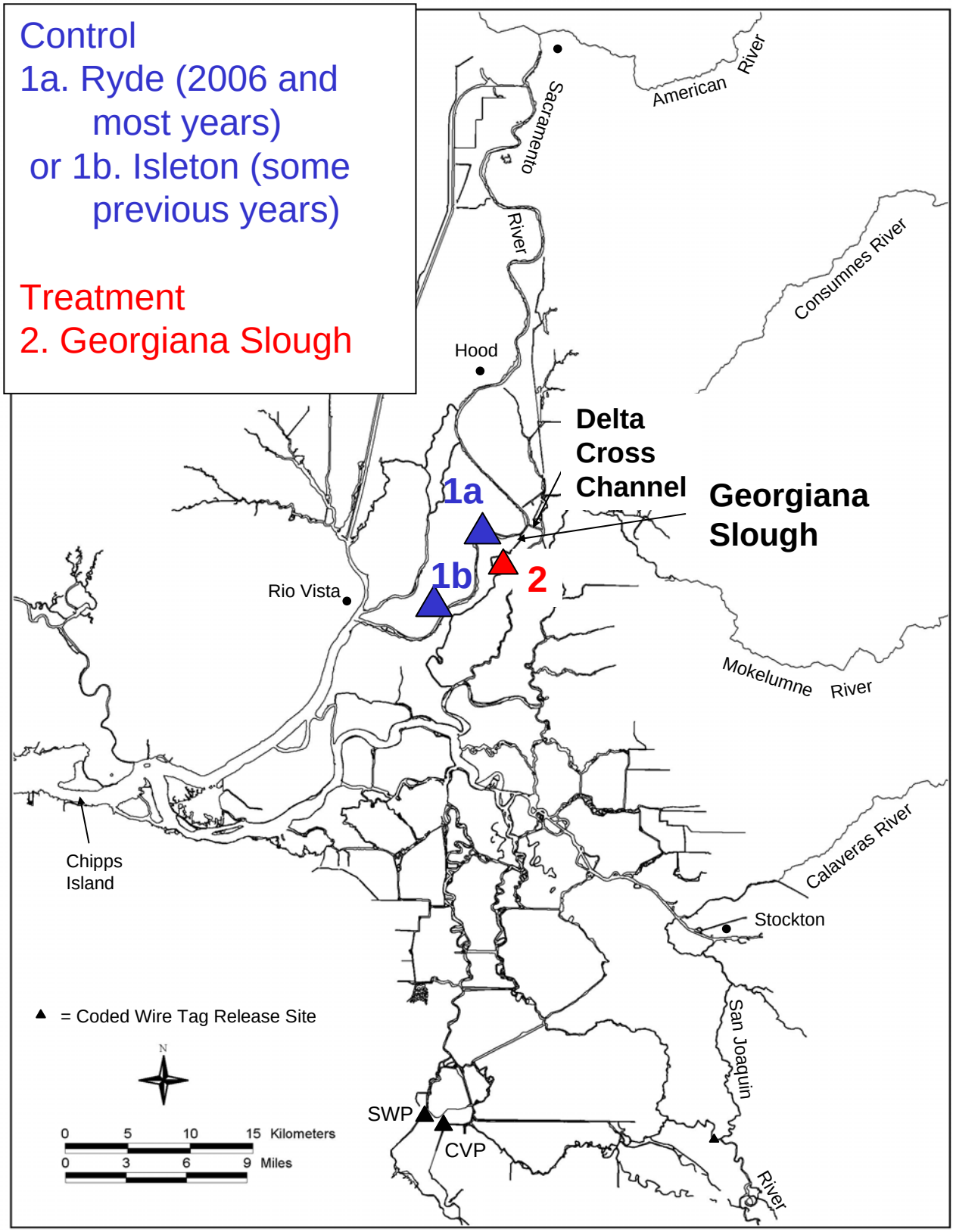


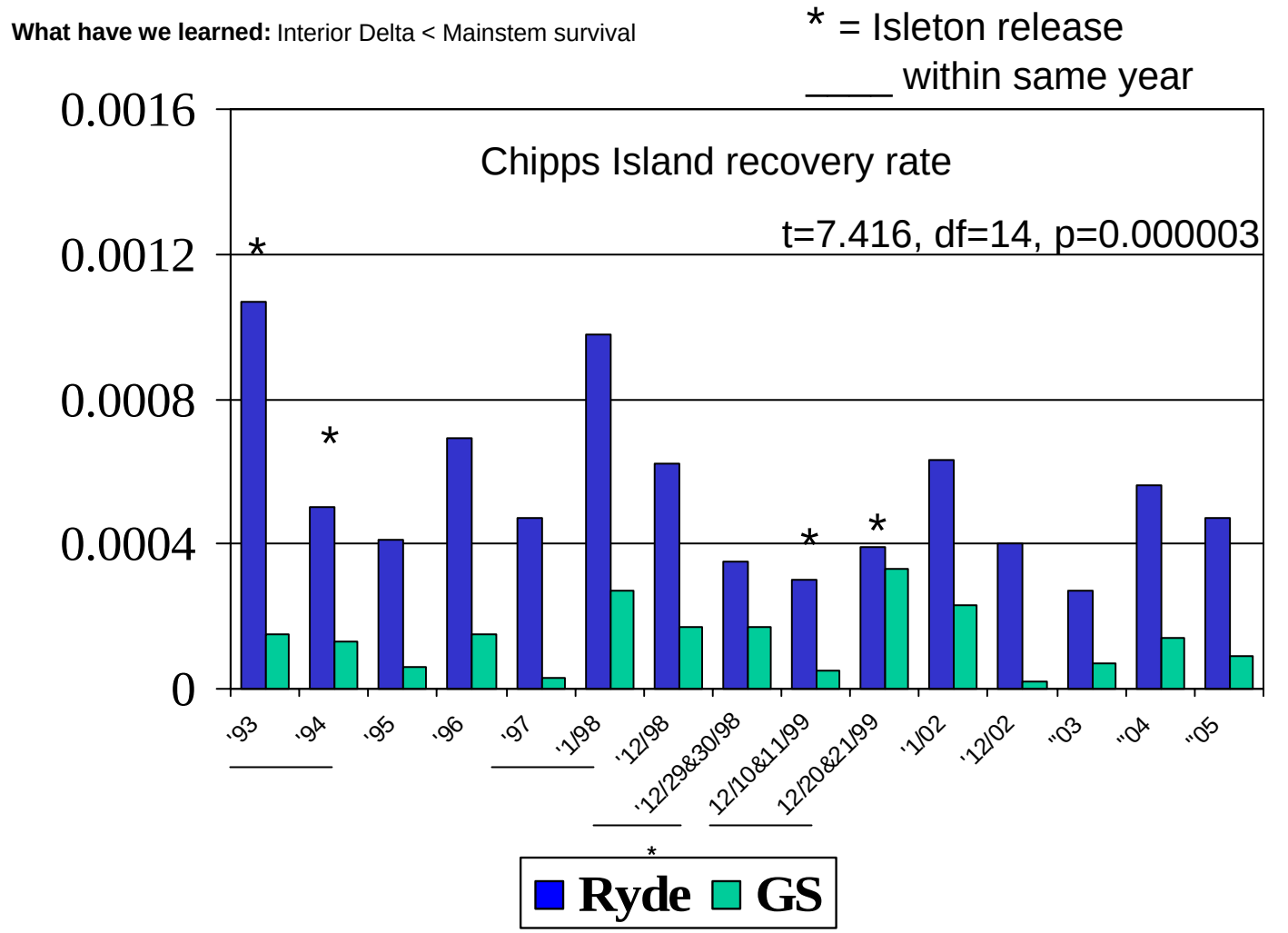
Figure 1: Experimental design for Delta Action 8

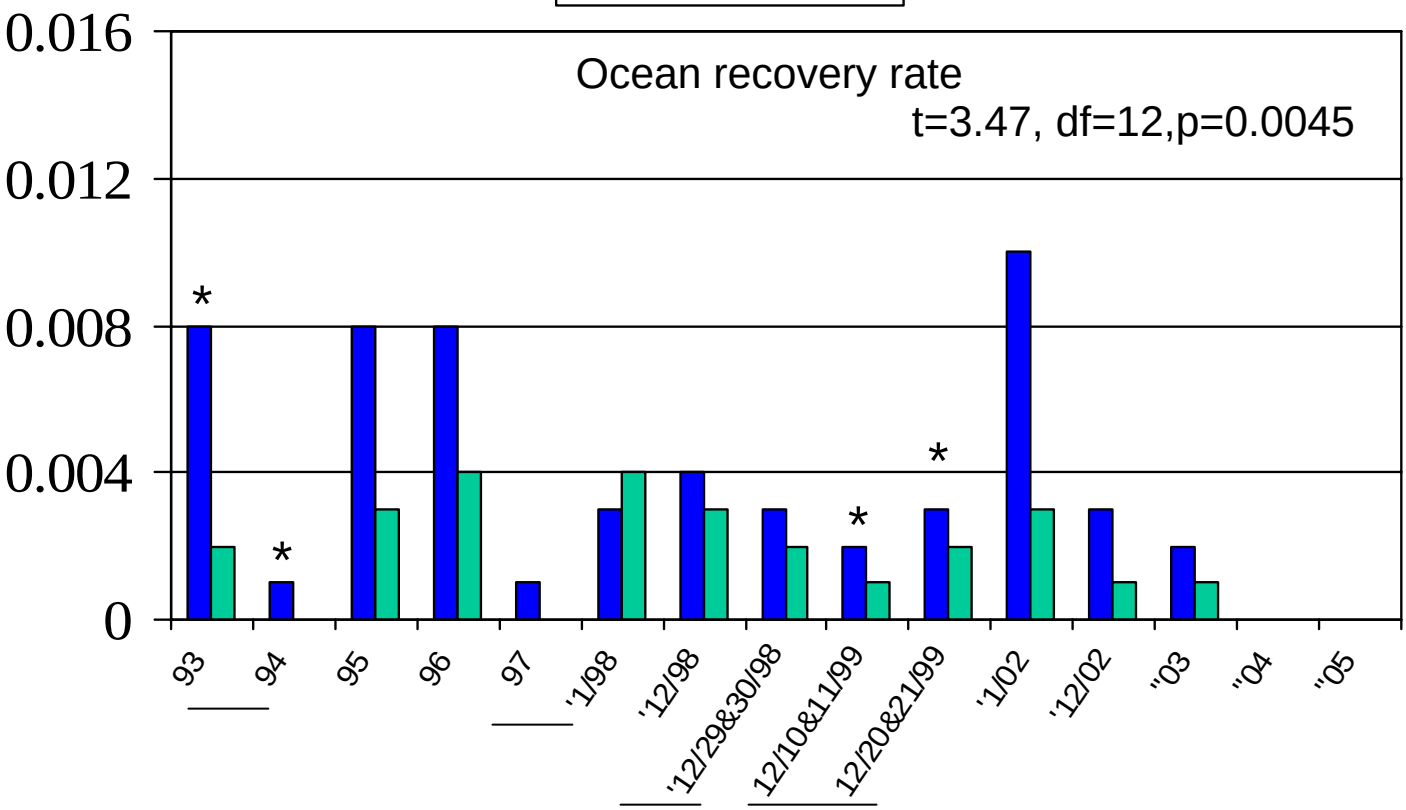
Methods:

- Estimate recovery rate at Chipps Island or in the ocean fishery
  - Recovery Rate = $\frac{\text{\# recovered}}{\text{\# released}}$

Ocean fishery would have an expanded # recovered

What have we learned: Interior Delta < Mainstem survival





Recovery rates of marked fish released at Ryde or Isleton and Georgiana Slough between 1993 and 2005

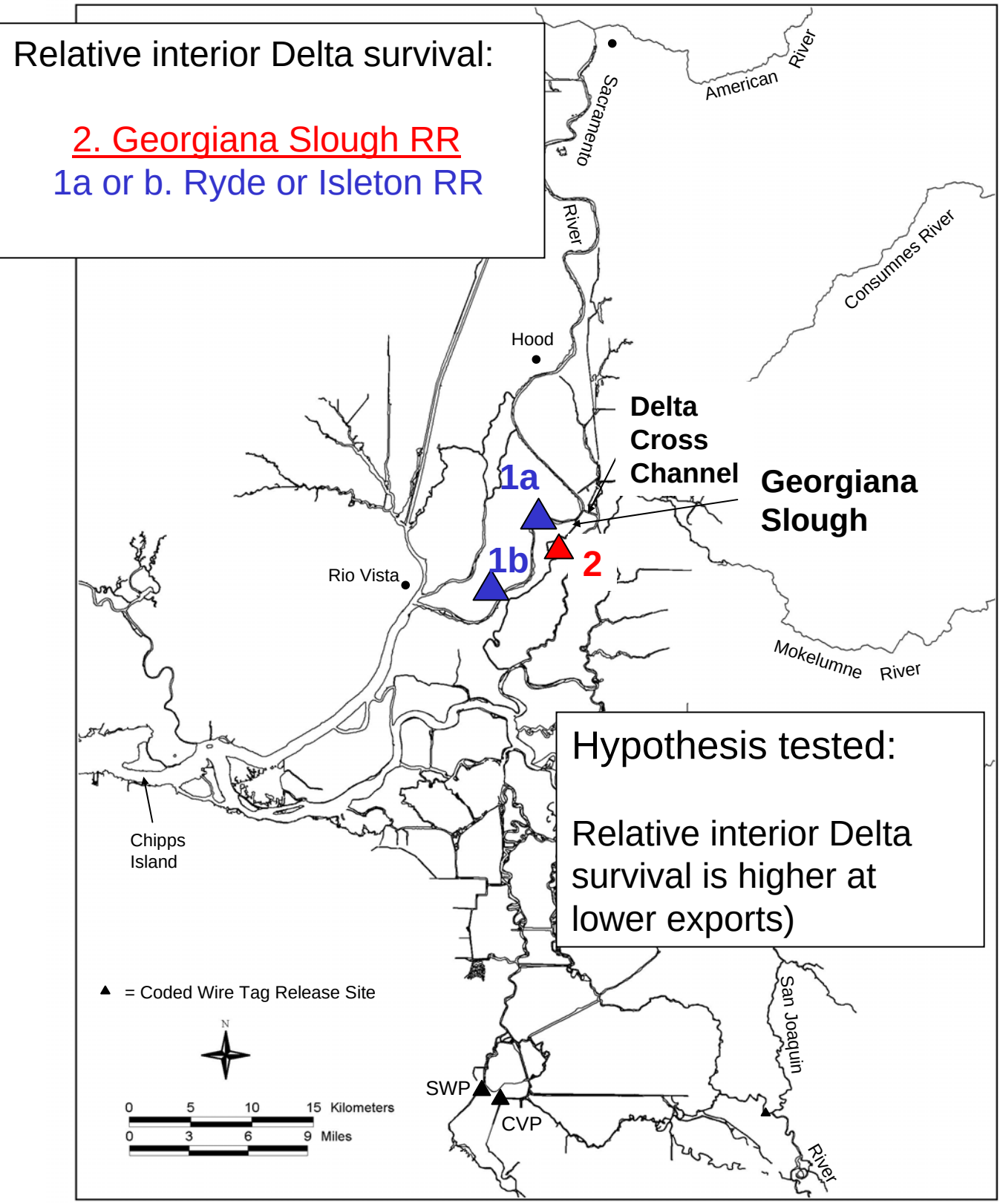
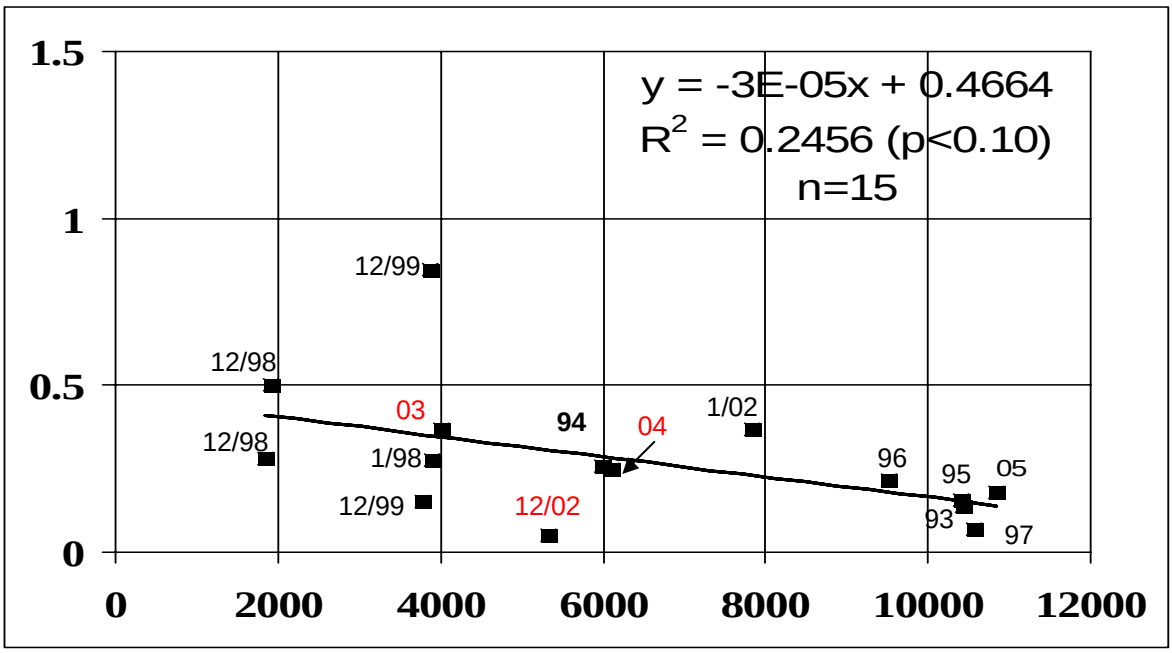


Figure 1: Experimental design for Delta Action 8

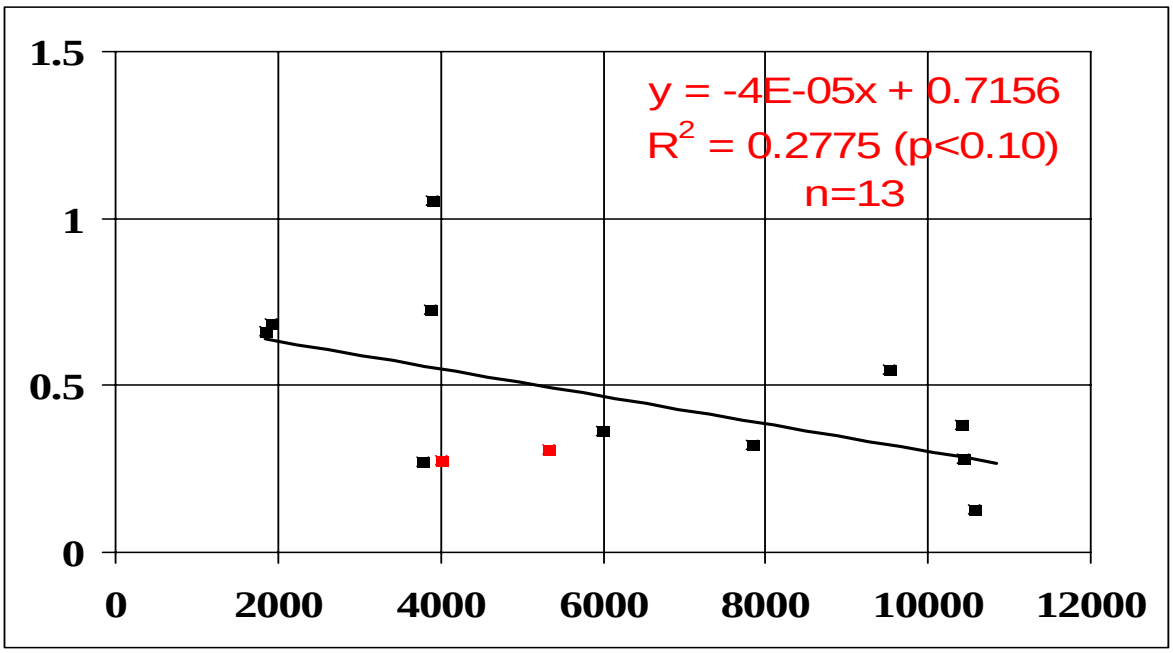
Chipps Island differential recovery rates



Combined SWP (CCFI, Banks in 2005) +CVP Exports

Differential Recovery Rates

Ocean differential recovery rates



Combined SWP (CCFI) +CVP Exports

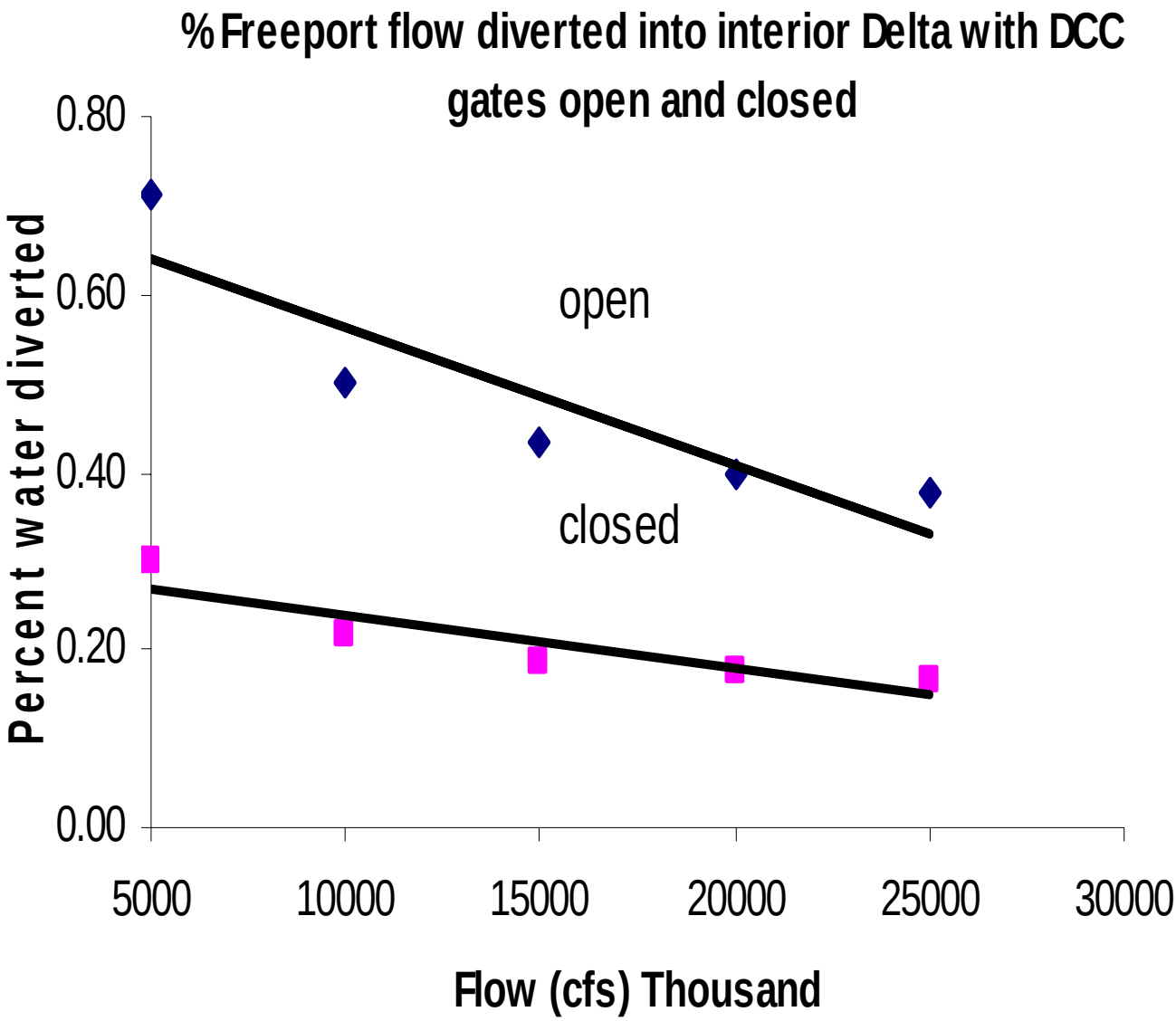
What have we learned: Relative interior Delta Survival weakly correlated to exports

Points in red updated

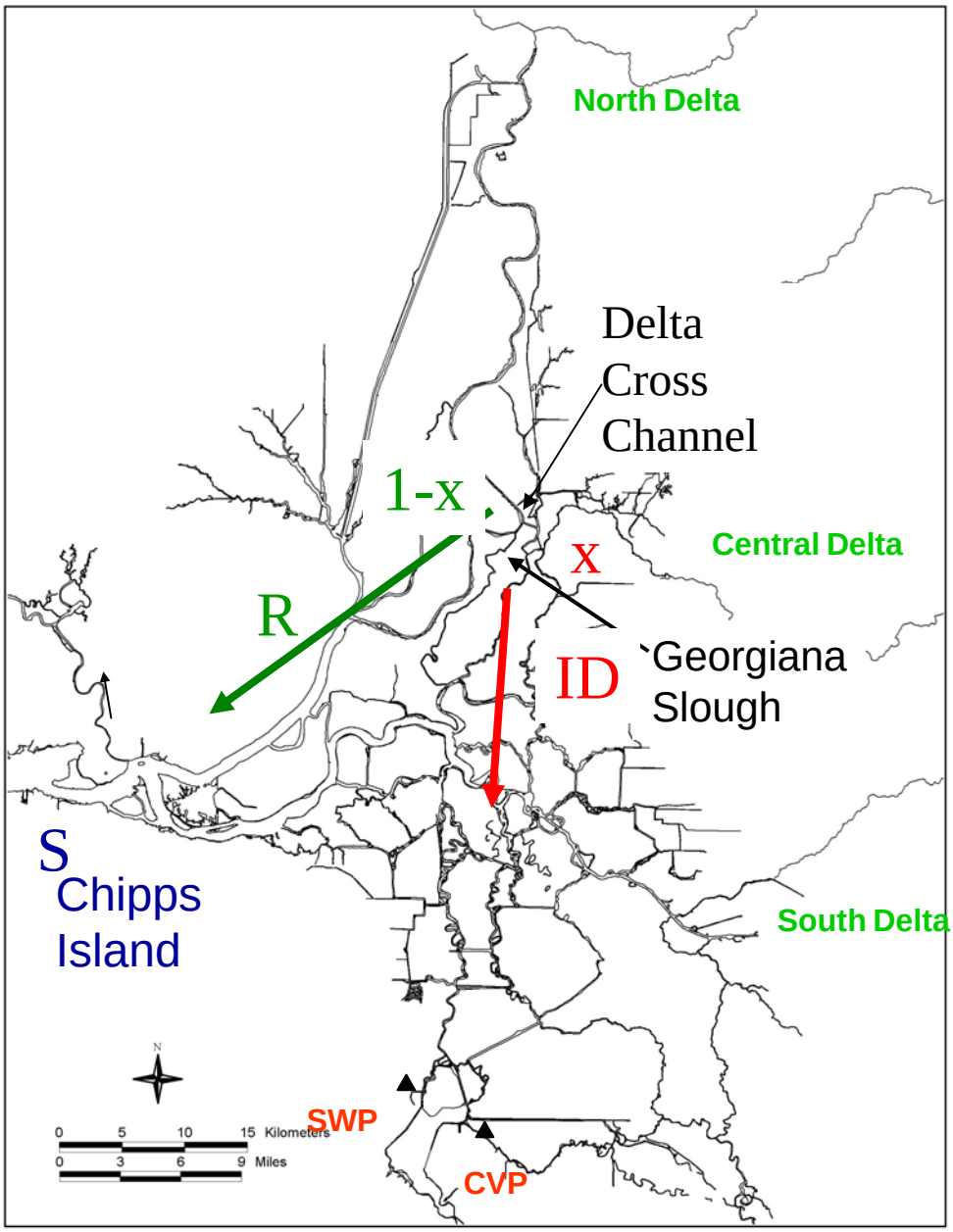
CALFED Science has funded a statistical review that includes this relationship/study

Delta Action 8

- Key ?
  - How important is this relationship to the entire population?
    - How many juvenile salmon are diverted into the interior Delta ?
      - Approaches/assumptions have evolved


% Freeport flow diverted into interior Delta with DCC gates open and closed
0.80
0.60
0.40
0.20
0.00
Percent water diverted
open
closed
5000
10000
15000
20000
25000
30000
Flow (cfs) Thousand

Model survival with and without EWA export curtailments to estimate change in Delta survival



Daily Delta survival (S) = ((1-x) * R) + (x * ID)

Where :

x = % water diverted into Interior Delta

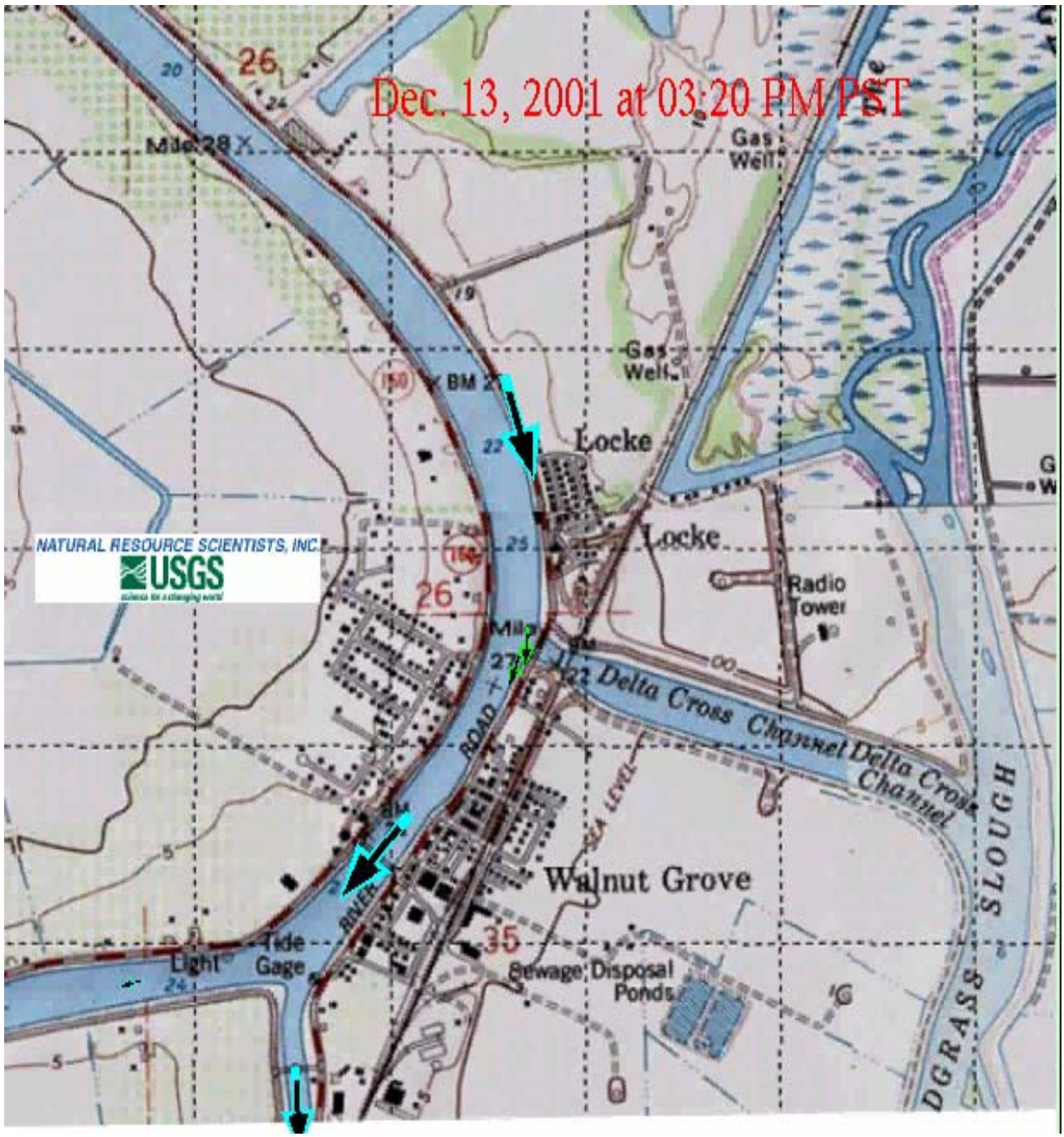
R = Ryde survival = (0.8)

ID= ((GS/Ryde survival ratio *(Ryde survival))

and GS/Ryde survival = 0.52 - 0.00003*exports

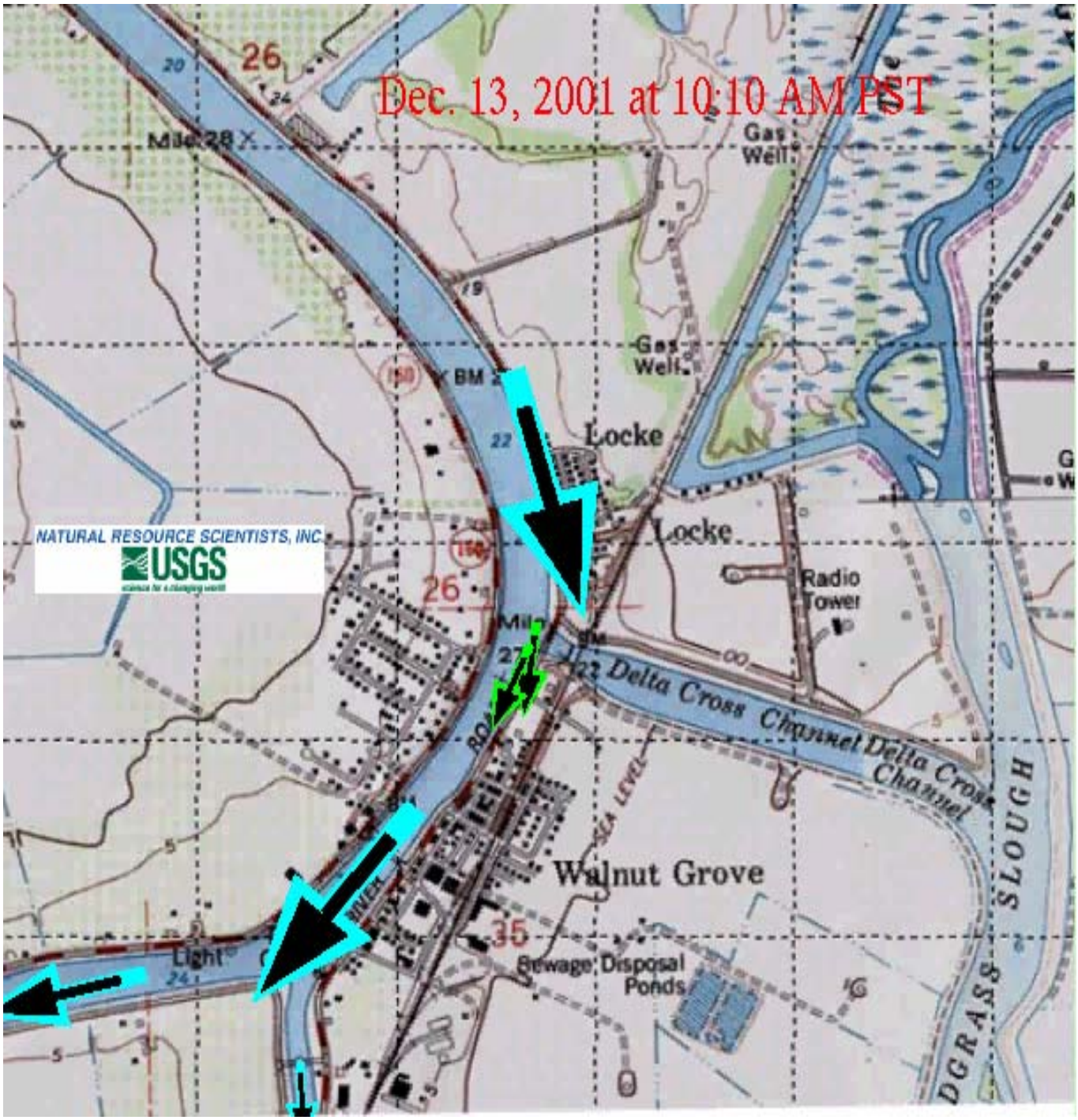
Population S = Sum of (Daily survival * % of population migrating on that day)

Delta Cross Channel CLOSED
EBB TIDE



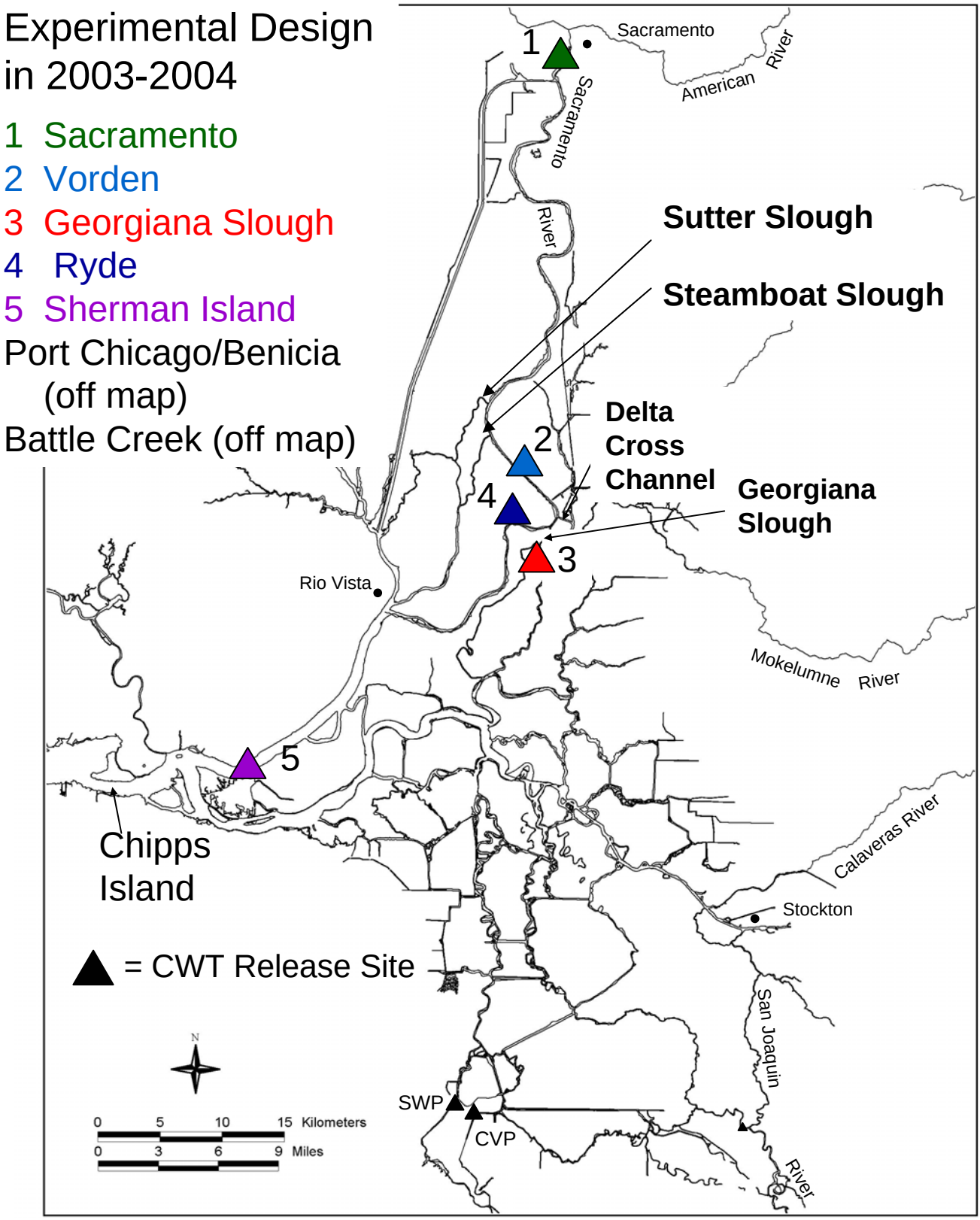
Source: Dave Vogel, Asilomar presentation 2002

Attachment 5:
Delta Cross Channel Closed
EBB TO FLOOD TIDE

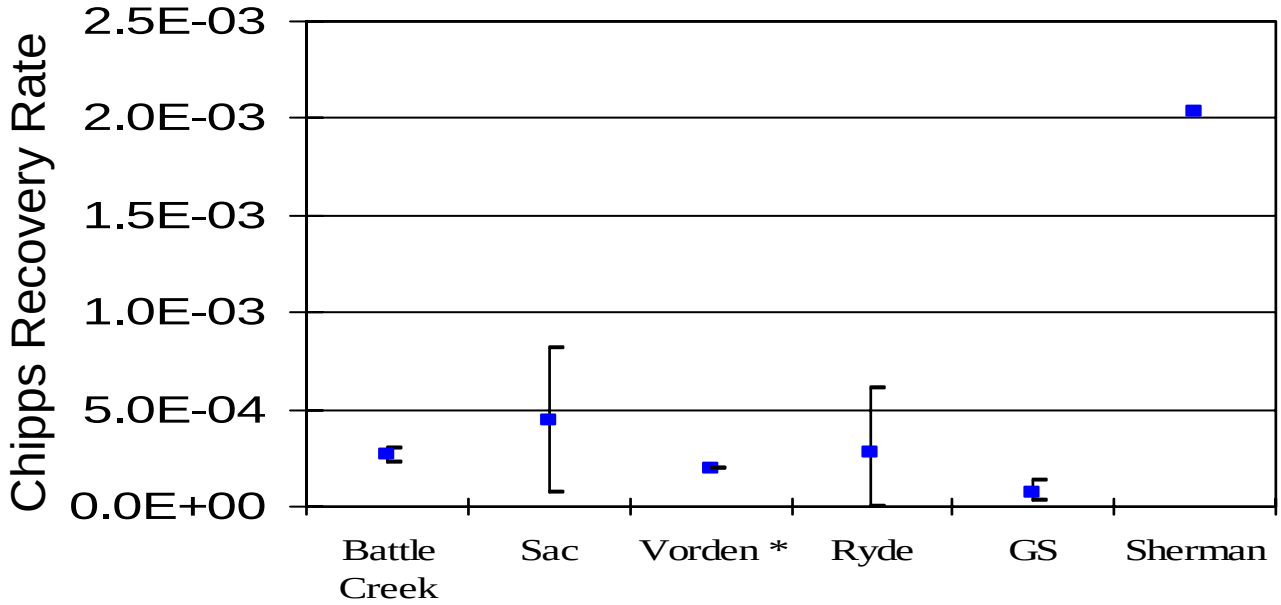


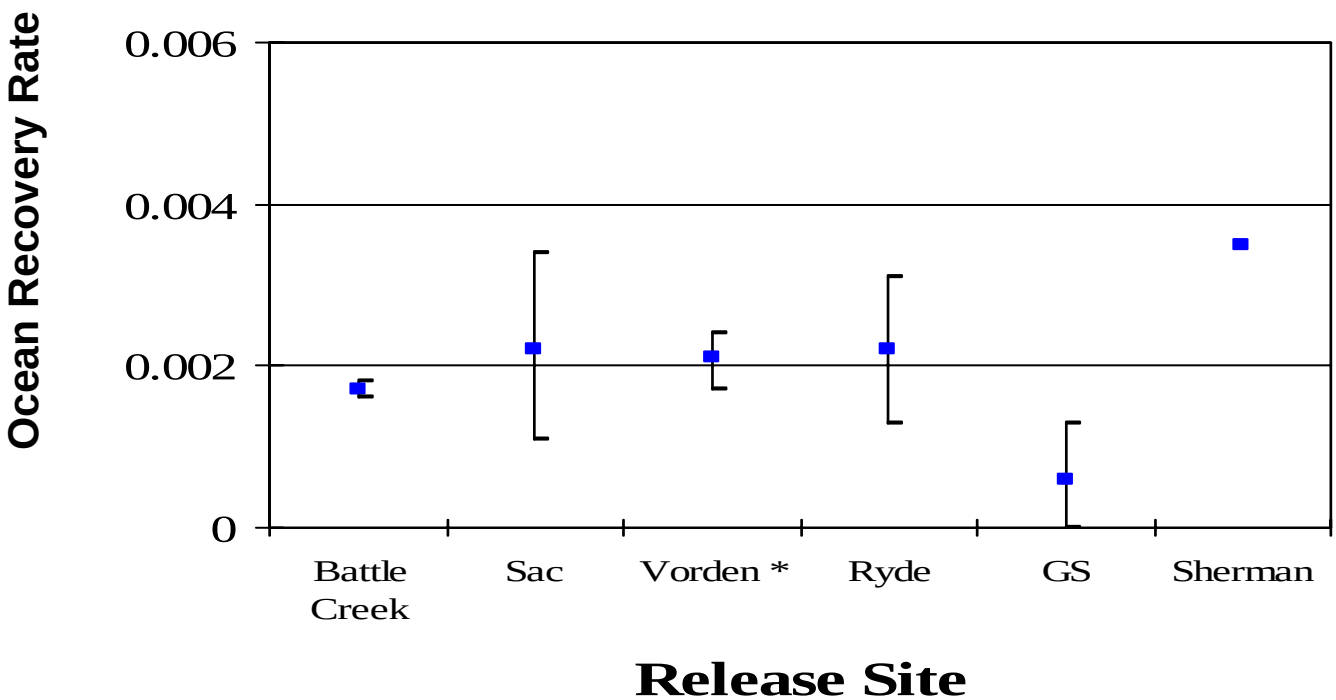
Source: Dave Vogel, Asilomar presentation 2002

What have we learned: Need to understand what proportion of juvenile salmon are diverted into the interior Delta



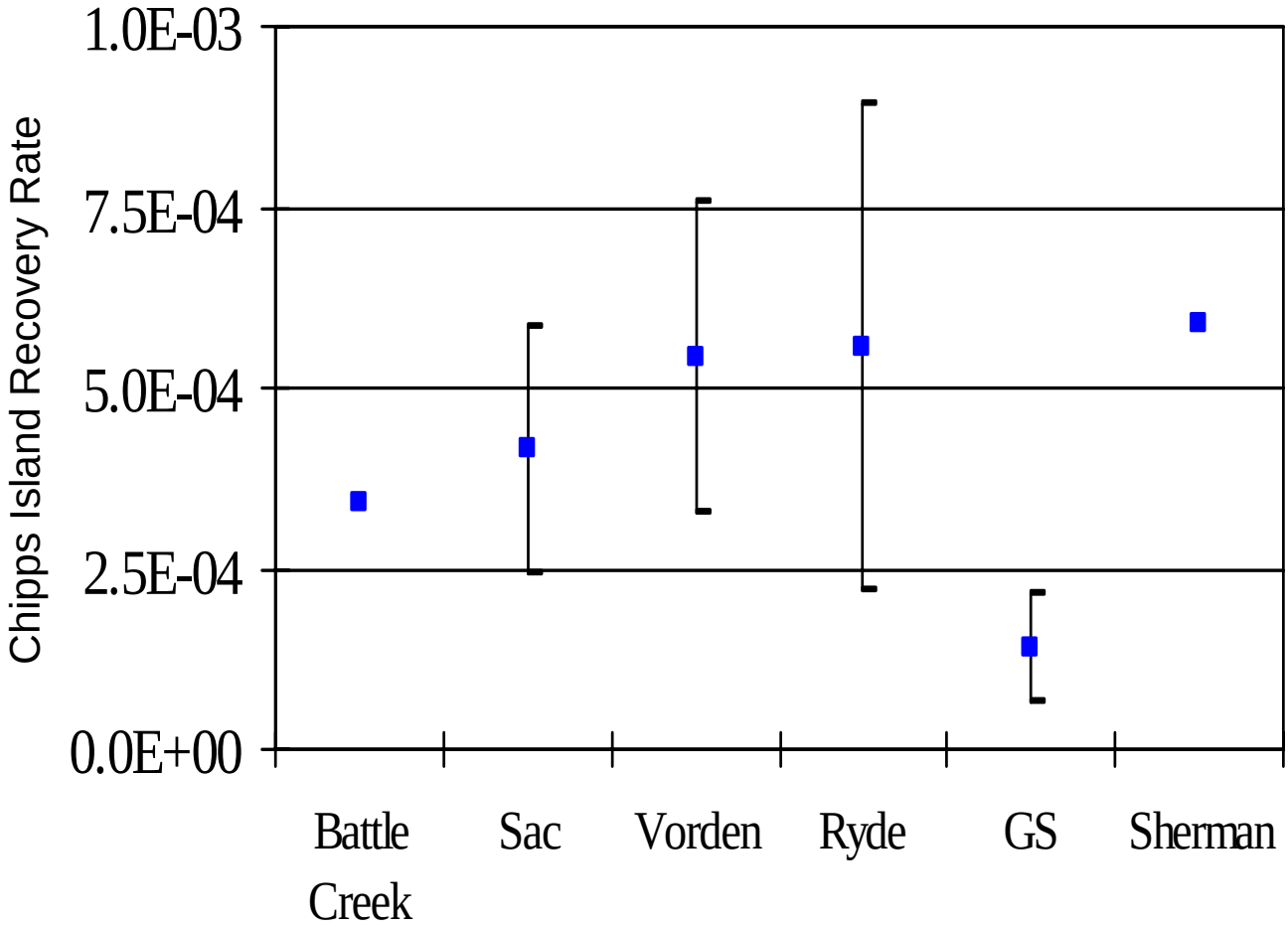
Detailed map of the Sacramento-San Joaquin Delta indicating coded wire tag release locations used in December of 2003 and 2004 (triangles).





Mean (+/- 2 SD) Chipps Island and expanded ocean recovery rates generated for releases made in December of 2003.

* Vorden release was made 15 days after the Sacramento release.



Mean (+/- 2 SD) recovery rates for releases made in December of 2004.

Where do we go from here?

- Better estimate fish split into interior Delta
- Estimate survival by reach to put GS/Ryde ratios into context

  (Compare between methods)
- Reduce uncertainty in GS/Ryde survival versus export relationship – establish mechanisms

Vernalis Adaptive Management Plan (VAMP)

What have we learned?

Pat Brandes
USFWS

Vernalis Adaptive Management Plan (VAMP)

What have we learned?

- Survival in 2006 appears to have been higher with lower exports
- No clear relationship between F/E ratio and smolt survival in range tested w/o barrier
- Survival has been low since 2003
- Need to measure survival at exports of 1500 with flows of 7000 and HORB
- Need to continue measuring survival with and without HORB
- Need to identify sources/locations of mortality

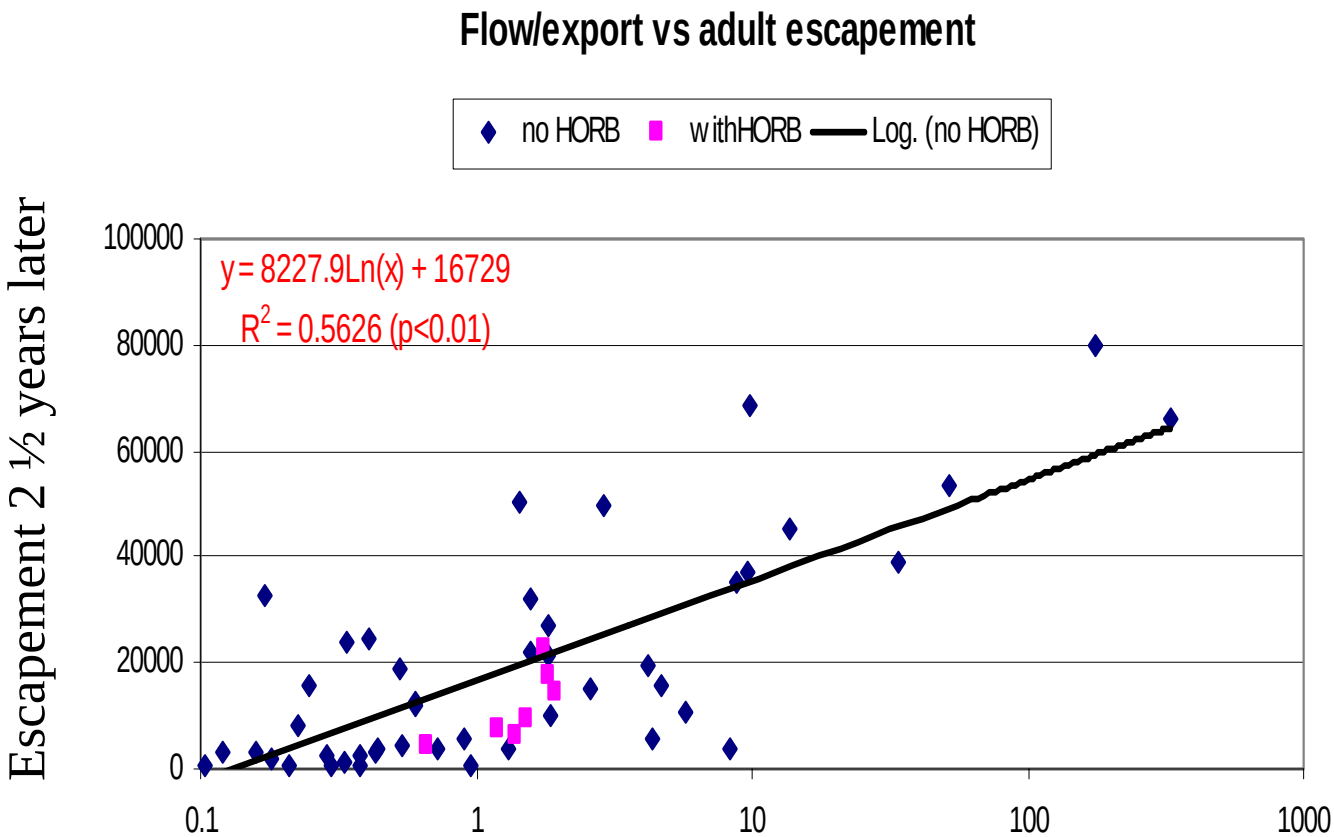
Vernalis Adaptive Management Plan (VAMP)

EWA and B2 assets were used in 2006
to reduce exports
for high and low export experiment

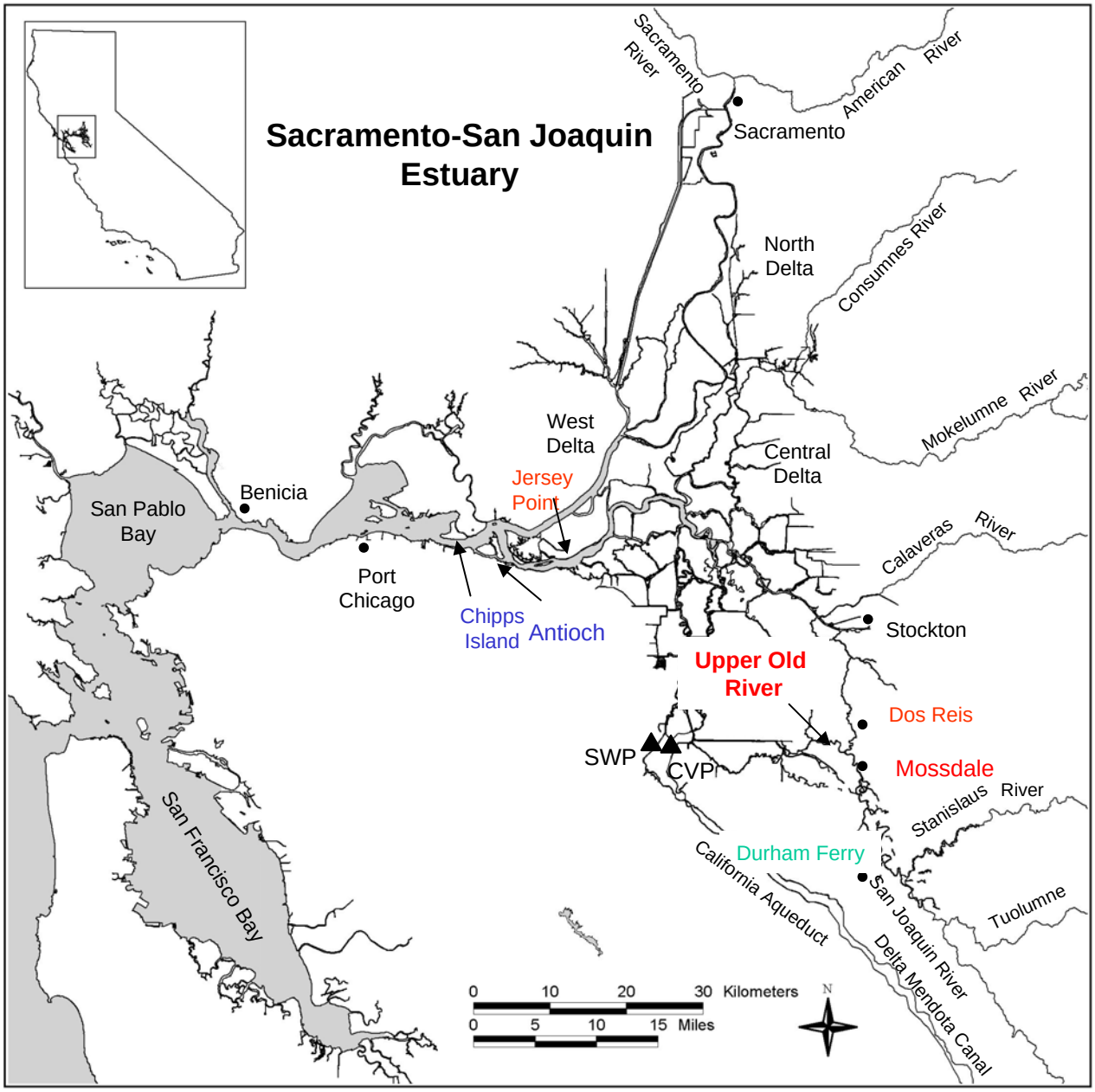
WHY VAMP?

To better understand how flow/exports affect juvenile salmon survival through the Delta for salmon originating from the SJ tributaries with and without the HORB in place

Conceptual model of how smolt survival may vary with flow/exports



Mean Flow/Export Ratio between April 15 and June 15 (1951 to 2003) and escapement 2 ½ years later



VAMP release sites in the Sacramento-San Joaquin Estuary, California.

Methods:

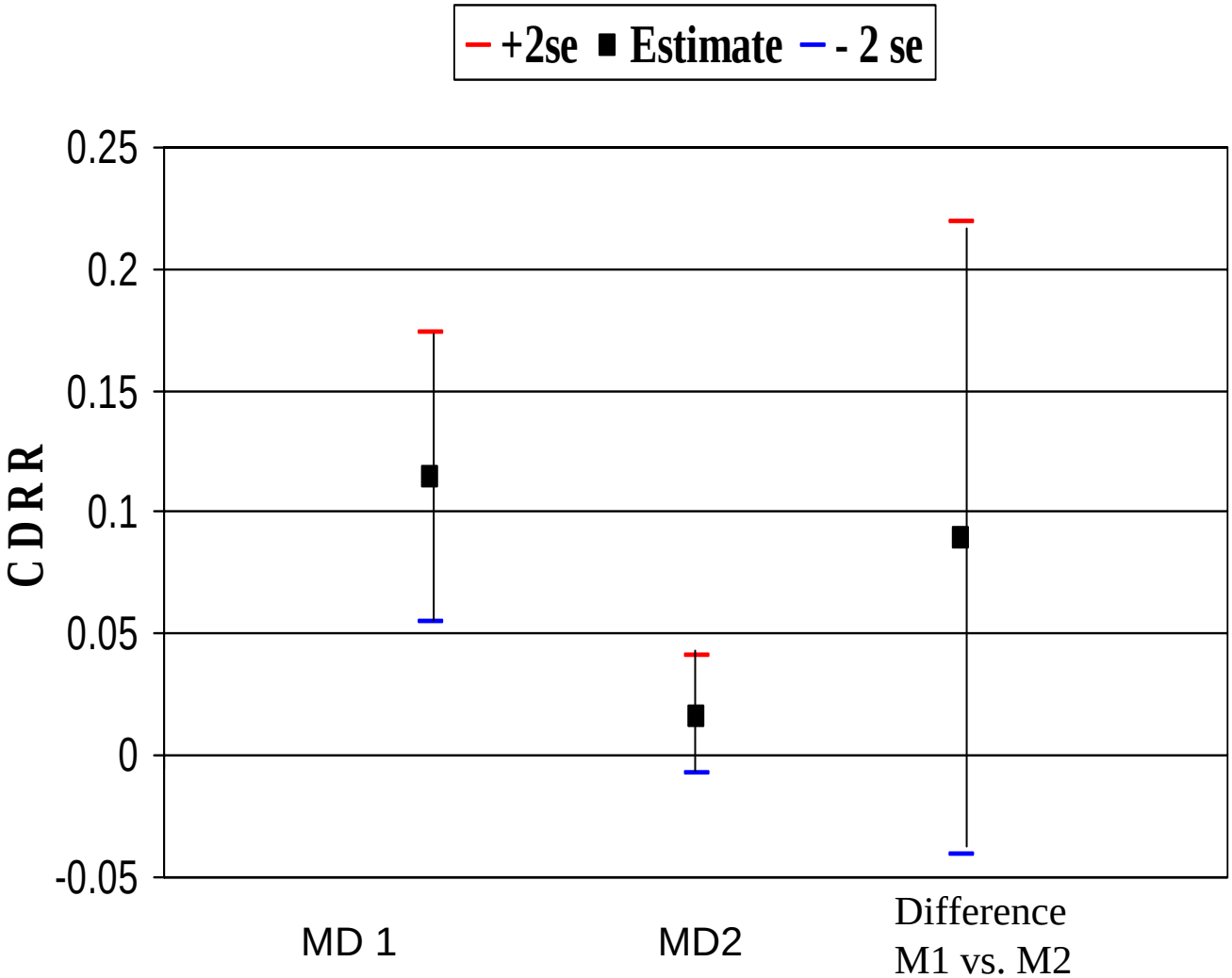
- Estimate combined recovery rate
  - from recoveries at Antioch, Chipps Island and in the ocean fishery (as available)

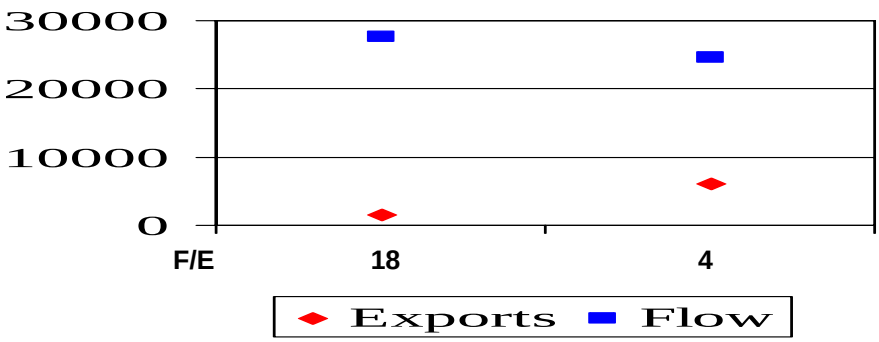
    (no ocean recoveries in 2004-2006)

$$\text{Recovery Rate} = \frac{\text{sum \# recovered}}{\text{\# released}}$$

- Estimate ratio of recovery rates
  (combined differential recovery rate -CDRR)

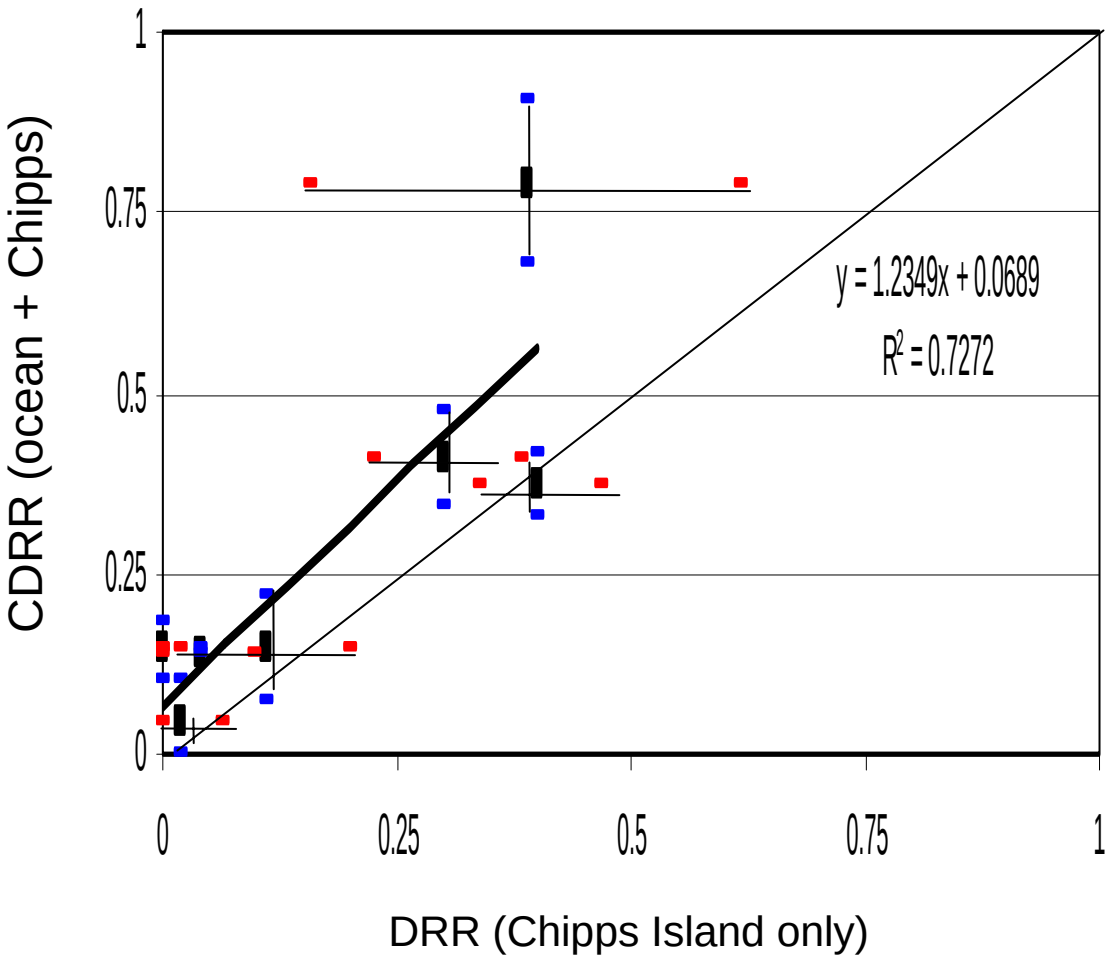
$$\text{Ratio:} \quad \frac{\text{Recovery Rate of upstream group}}{\text{Recovery Rate of downstream group}}$$



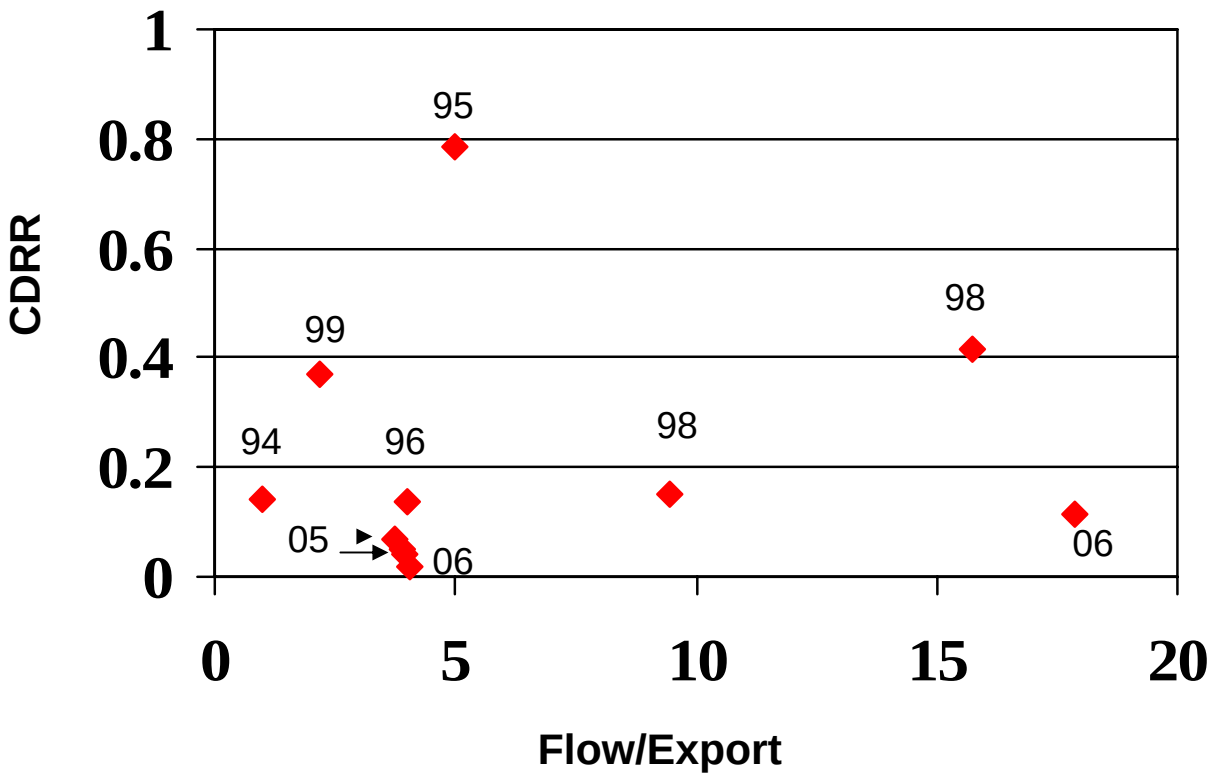


CDRR (+/- 2 SE) using Chipps Island and Antioch recoveries of smolts released at Mossdale (MD) relative to those released at Jersey Point for the first (1), second (2) release groups and their difference in 2006.

What have we learned: Survival in 2006 appears to have been higher with lower exports



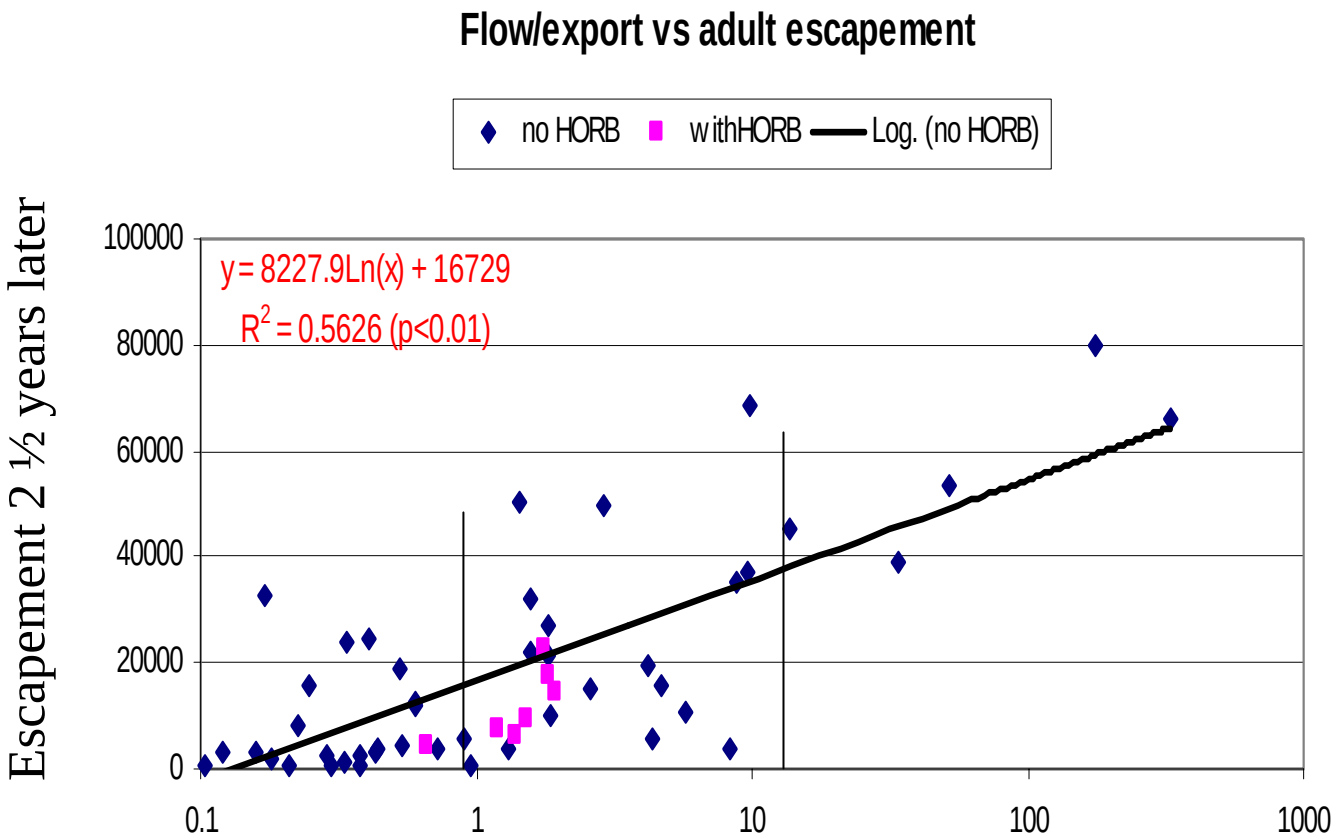
CDRR using ocean and Chipps Island recoveries versus just using Chipps Island recoveries (DRR) of the Mossdale or Durham Ferry and Jersey Point releases without the HORB in place.



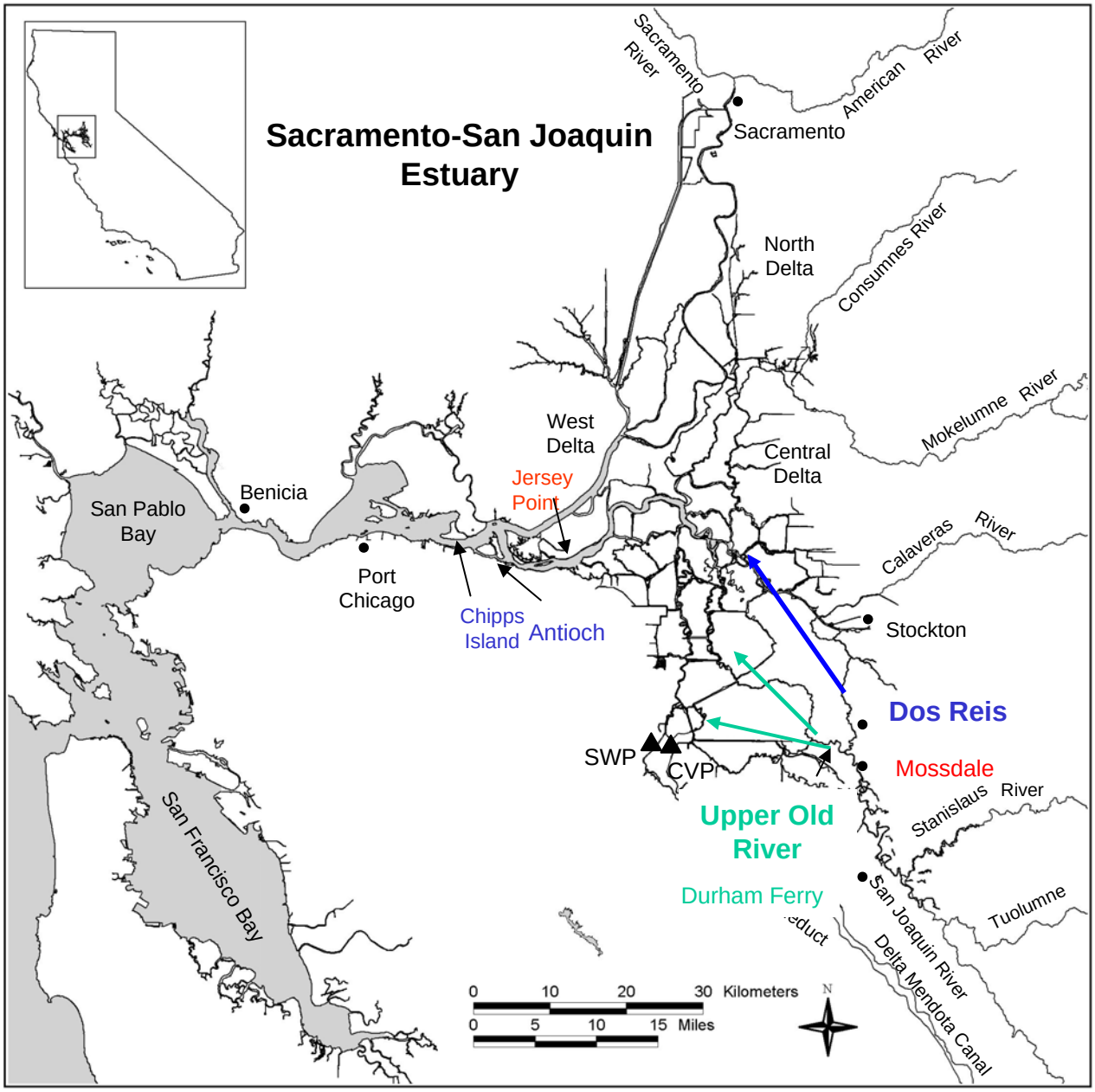
No clear relationship between CDRR (DF/MD-JP survival) and flow/exports in years without a HORB.

What have we learned: No clear relationship between F/E ratio and smolt survival in range tested w/o barrier

Conceptual model of how smolt survival may vary with flow/exports

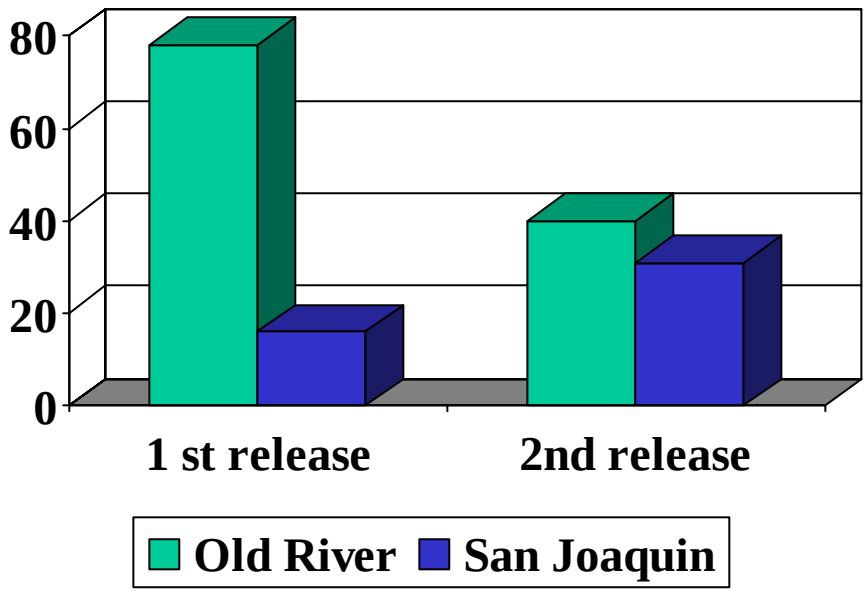


Mean Flow/Export Ratio between April 15 and June 15 (1951 to 2003) and escapement 2 ½ years later

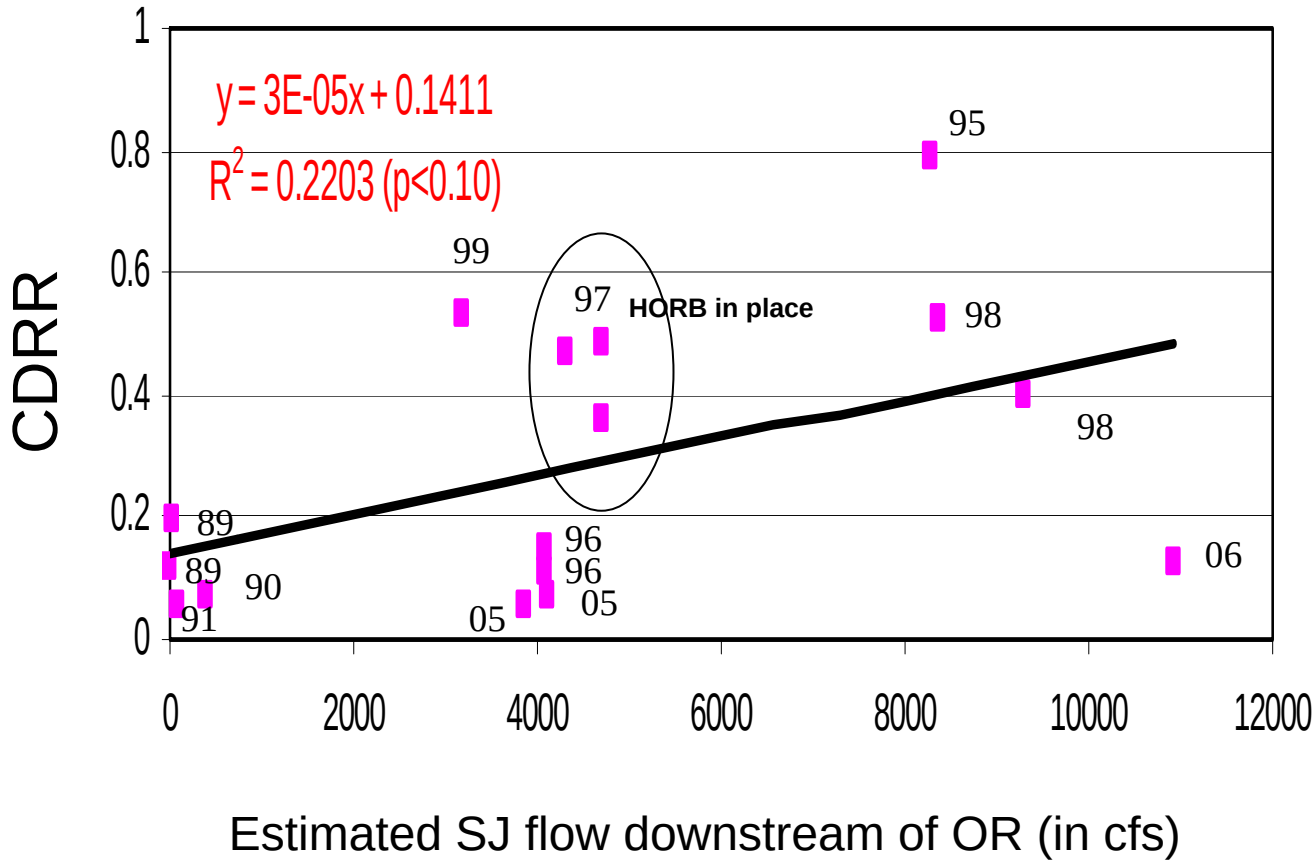


VAMP release sites in the Sacramento-San Joaquin Estuary, California.

Based on Vogel's work in 2006



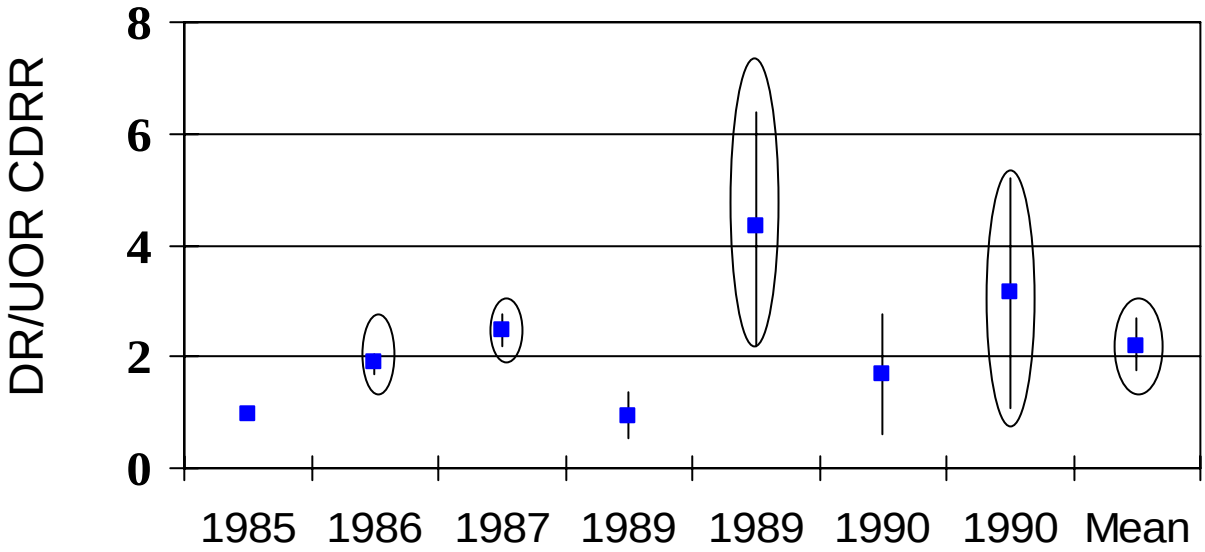
Results of ultrasonic tag detection (%) in upper Old River versus the San Joaquin River downstream of UOR during VAMP in 2006



Survival between Dos Reis and Jersey Point versus San Joaquin River flows downstream of Old River *.

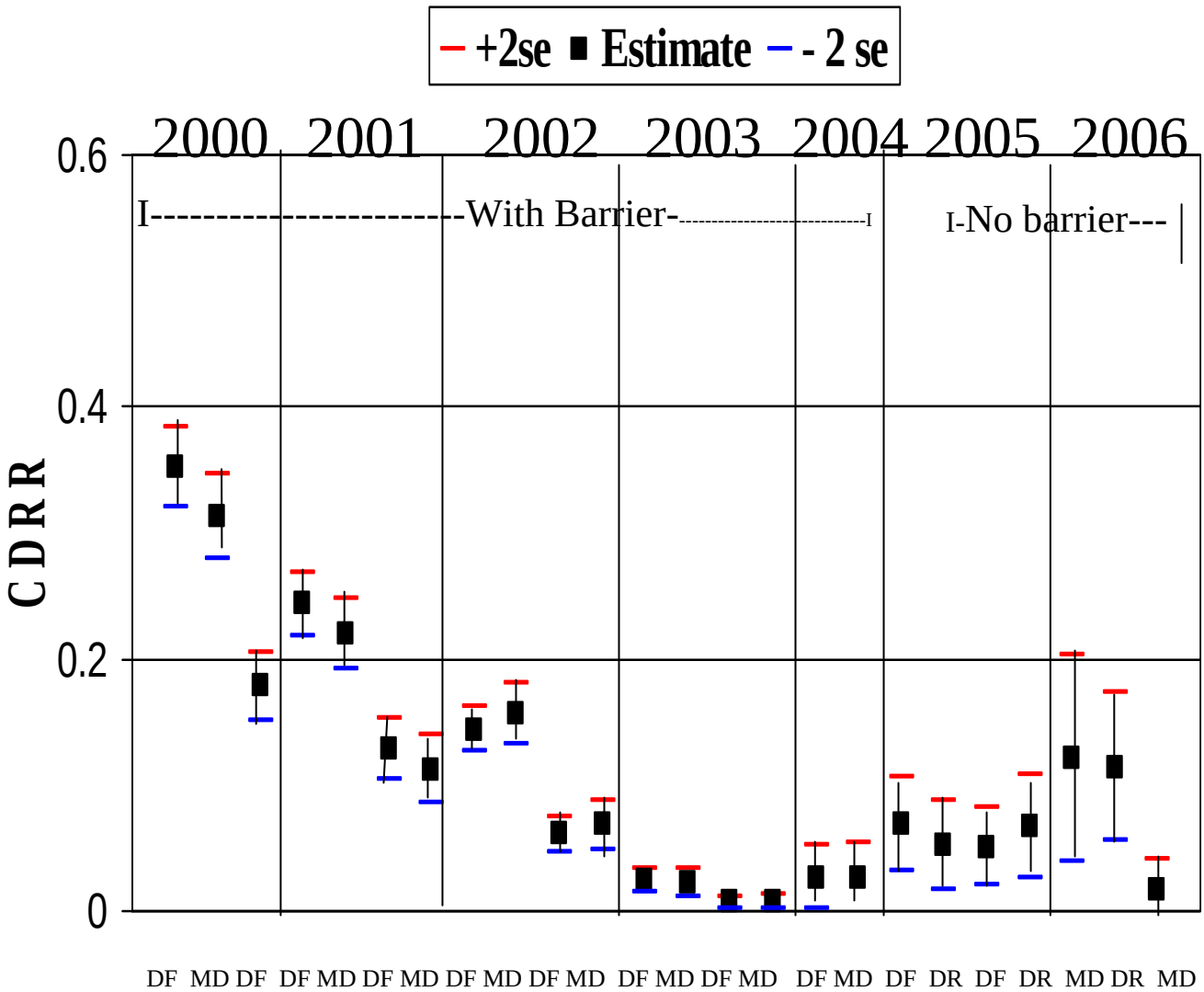
Survival on the San Joaquin River generally higher with higher flows

* Modeled DSM2 flows in 1990-2004, other estimate in 1989 and measured flows in 2005 and 2006



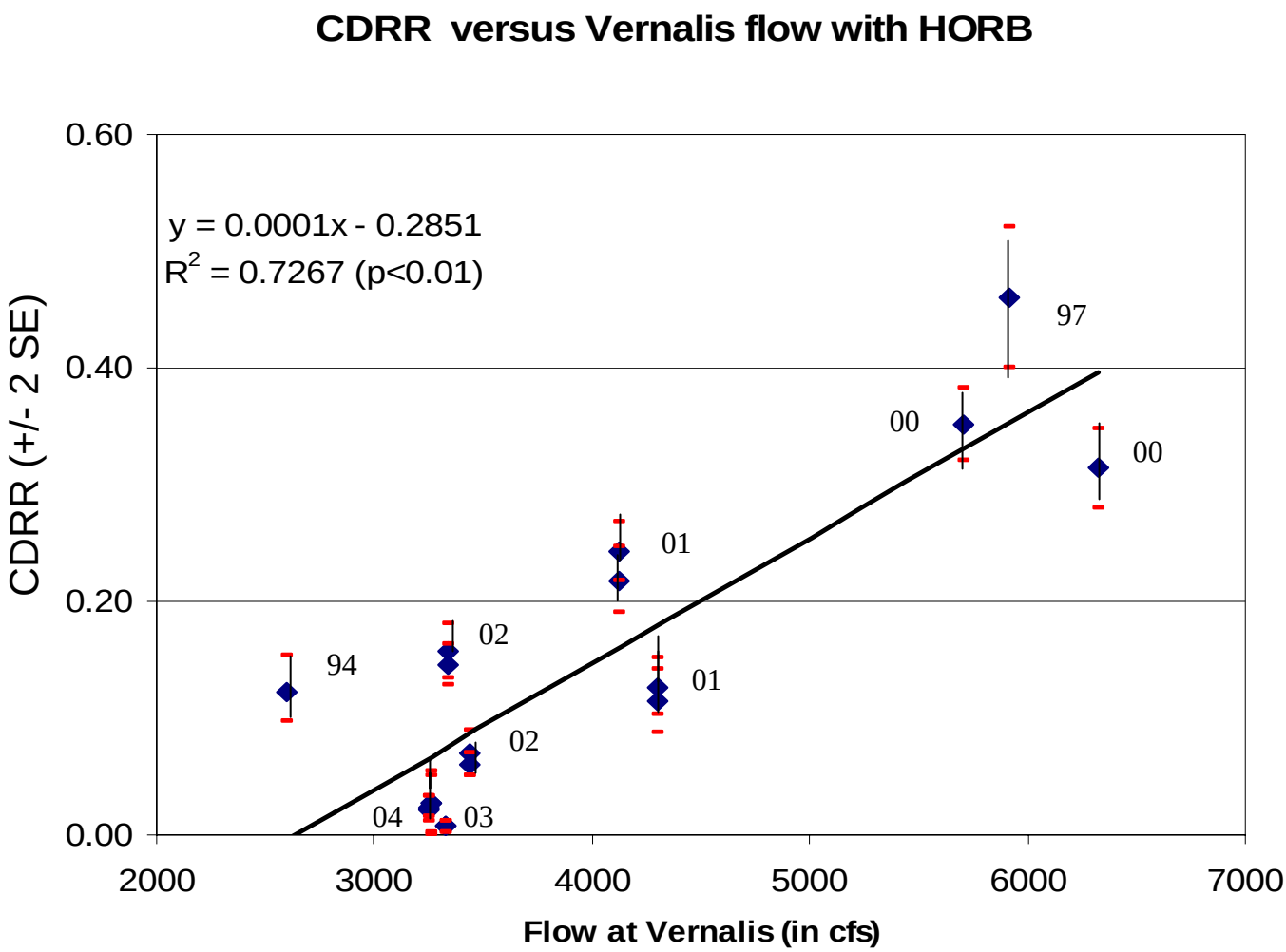
The CDRR for the Dos Reis group relative to the UOR group
Those circled are significantly different than 1.0 at 95% CI

On average better survival for those that stay on San Joaquin River rather than migrate via UOR

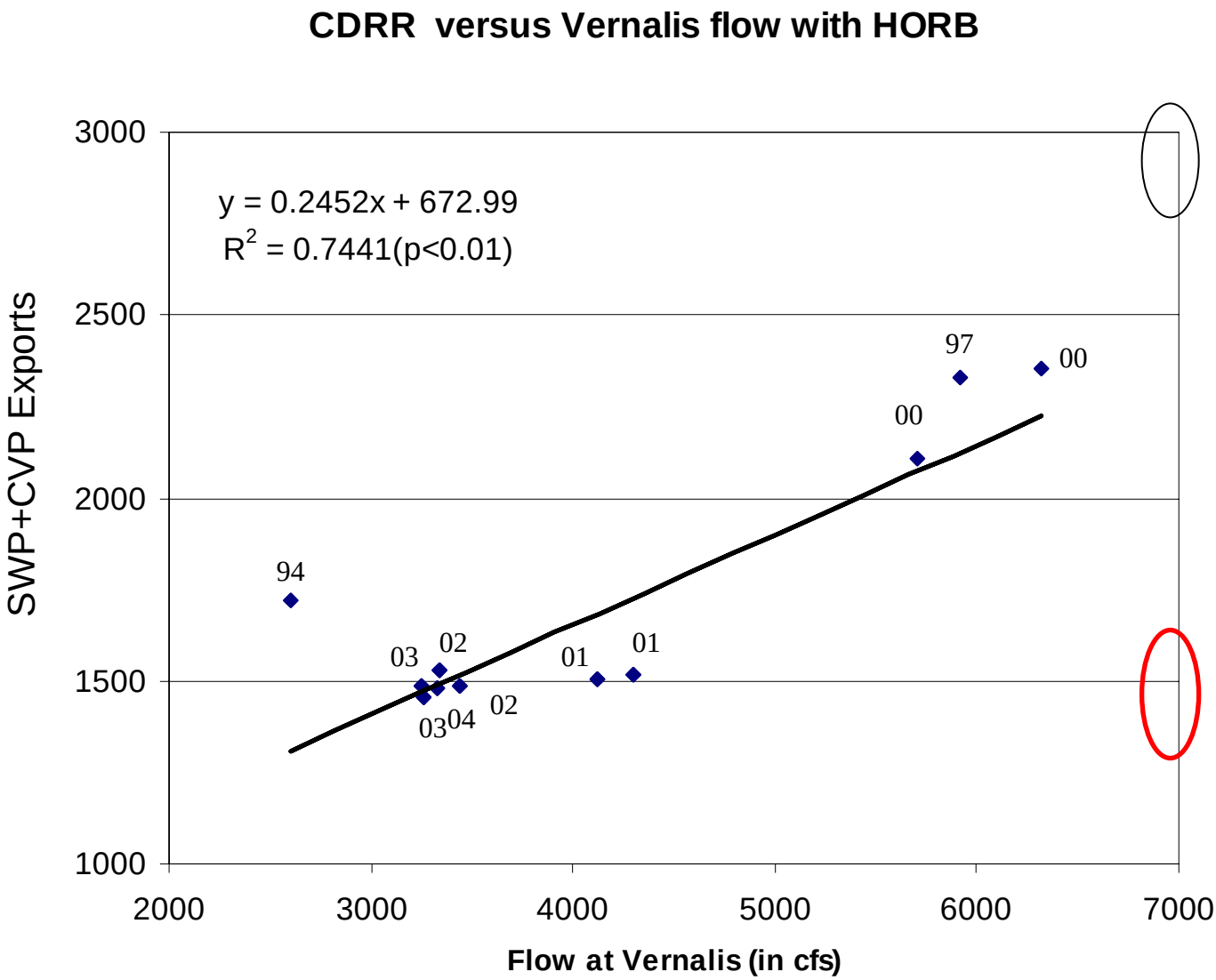


Combined Differential Recovery Rates (CDRR) (+ / - 2 SE) of CWT smolts released at Durham Ferry (DF), Mossdale (MD) and Dos Reis (DR) relative to those released at Jersey Point in 2000 – 2006.

What have we learned: Survival has been low since 2003



Survival for groups released at Mossdale and/or Durham Ferry relative to those released at Jersey Point and average flow at Vernalis in cfs



Relationship between flow and exports during VAMP tests with the HORB in place

What have we learned: Need to measure survival at exports of 1500 with a HORB in place

Vernalis Adaptive Management Plan (VAMP)

What should we do next ?

- Measure exports of 1500 with 7000 flow with HORB
- Continue testing with and without HORB
- Identify sources/locations of mortality (Additional ultrasonic tagging work in south Delta proposed)

Collaborative Ultrasonic tagging experiments in 2006

Pat Brandes
USFWS
Jon Burau
USGS

Collaborative Ultrasonic tagging experiments in 2006

- CWT/Vemco ultrasonic study in the Delta – Brandes and others
- Vemco ultrasonic study in the Sacramento basin - Klimley, MacFarlane and Ammann
- HTI Ultrasonic study in the Delta at Clarksburg – Burau and Vogel

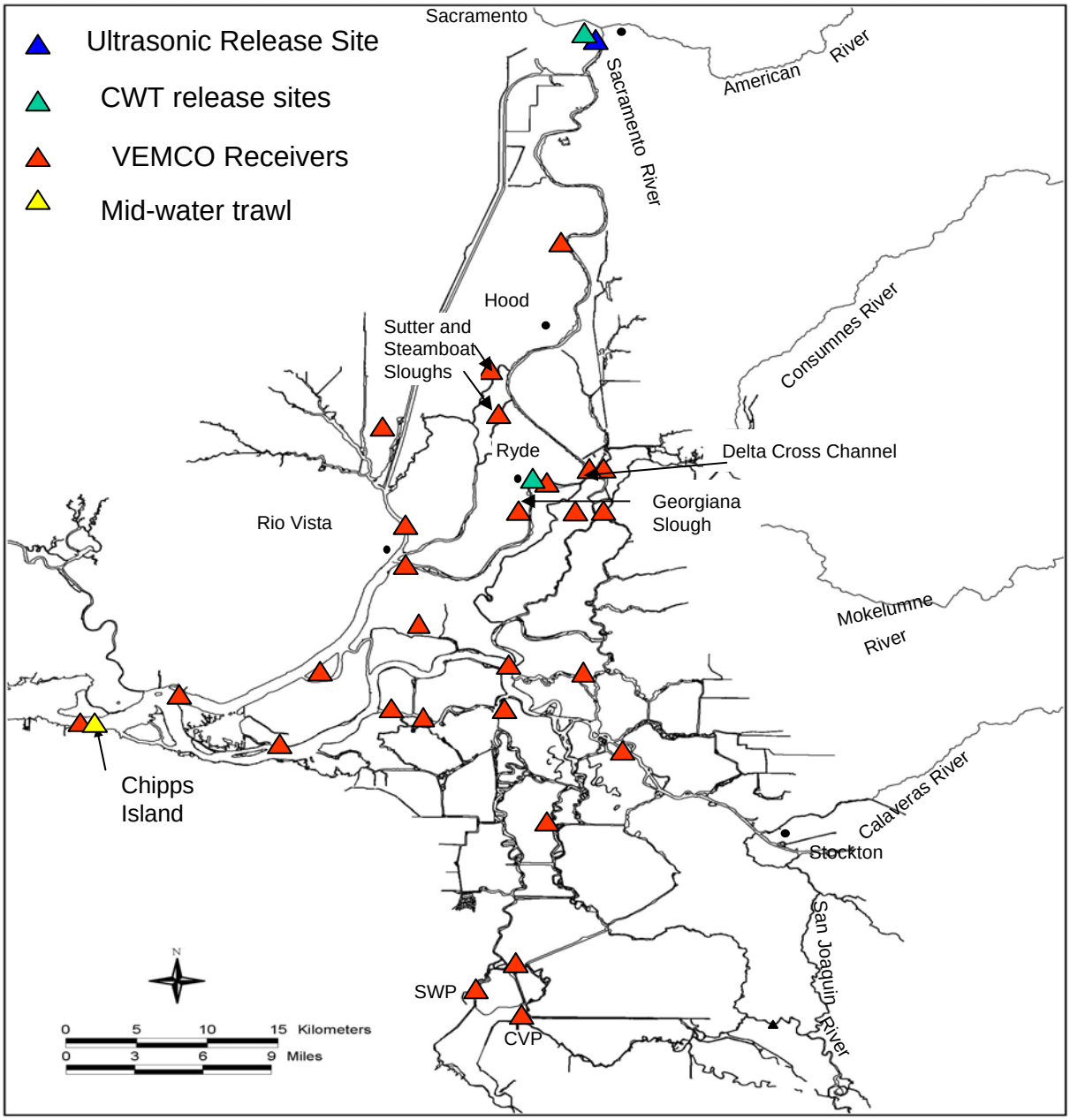
Ultrasonic tagging experiment to complement CWT DA 8 studies in 2006 -2007

- CWT Release site changed from Georgiana Slough to Sacramento to estimate survival through the Delta

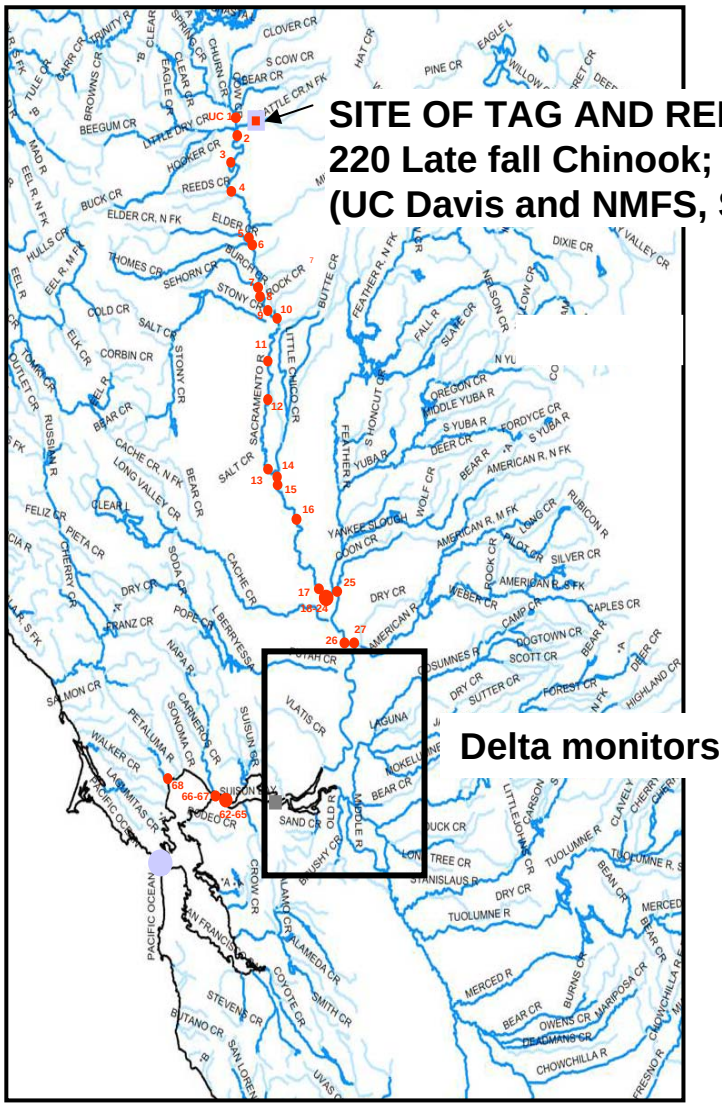
- Ultrasonic tagged fish will be released concurrently with CWT group at Sacramento

Goals of the project

- Determine proportion of ultrasonically tagged fish in various channels
  - Determine “average condition”
- Estimate survival through the Delta (and compare between methods)



Detailed map of the Sacramento-San Joaquin Delta showing proposed release sites and locations of ultrasonic receivers and the Chipps Island trawl. CWT release site for Benicia not shown.



Receivers associated with the larger CALFED salmonid VEMCO ultrasonic tagging project
Klimley (UCD), MacFarlane, Ammann (NMFS)

2006 -2007 Study Conditions

- December 2006
  - DCC gates open
  - Lower flows
- January 2007
  - DCC gates closed
  - Higher river flows

Sacramento releases

- Ultrasonic tags (72 per release)
  - V7-1L tags
    - 1.4 grams
    - 17.5 mm length
    - 44 day battery life
      - 140 mm/ 4.8% of body weight
      - battery turned off after tagging for 5 days
      - Surgically implanted

- CWT tags (70,000 per release)
  - decimal full tags

    - adipose clip with tag inserted into snout

    1 mm in length

Sacramento releases

CWT and Ultrasonic tags

- Truck in 4 discrete groups

-Hold in net pens until release

-Release over time to get “average condition”

Day/ebb (17,500 CWT, 18 Sonic)
Day/flood (17,500 CWT, 18 Sonic)
Night/ebb (17,500 CWT, 18 Sonic)
Night/flood (17,500 CWT, 18 Sonic)

Estimate and compare survival

- Between Sacramento and Ryde, and Sacramento to Chipps Island/Benicia
  - CWT (from Chipps Island and ocean recoveries as they become available)
  - Ultrasonic tags (detect fish released at Sacramento passing Ryde and Benicia - model survival probabilities (Russ Perry, CALFED fellow))

Estimate proportion moving into various channels

Ultrasonic tags

- Identify direction of movement at major junctions (S &S, GS, DCC)

- under different conditions
  with DCC gates open/closed

- for individuals released on:
  - Day/Night
  - Flood/Ebb

Model distribution probabilities (Russ Perry, CALFED fellow)

- We will also be collaborating with Jon Burau (USGS) in conducting his HTI ultrasonic study on how salmon behave at the Clarksburg bend.