JUVENILE SAN JOAQUIN STEELHEAD MIGRATION AND SURVIVAL THROUGH THE SOUTH DELTA, 2011 AND 2012

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OBJECTIVES

- Background on study
  - Tagging and Release
  - Analysis Methods
- Compare results: 2011 vs. 2012
  - Route selection at Head of Old River, Turner Cut
  - Survival through Delta
    - Route-specific
    - Reach-specifc
    - Overall

6-YEAR STEELHEAD STUDY

- NMFS OCAP RPA IV.2.2
  - Proportional causes of mortality on steelhead smolts outmigrating from SJR Basin, through southern Delta
    - Flow
    - Exports
    - Project and non-project adverse effects
- 2011 – 2016
- Target release period: March 1 – June 15
- Acoustic-tagged steelhead from Mokelumne River Hatchery
- Coordinated with South Delta Temporary Barriers Study and Chinook tagging studies (VAMP)

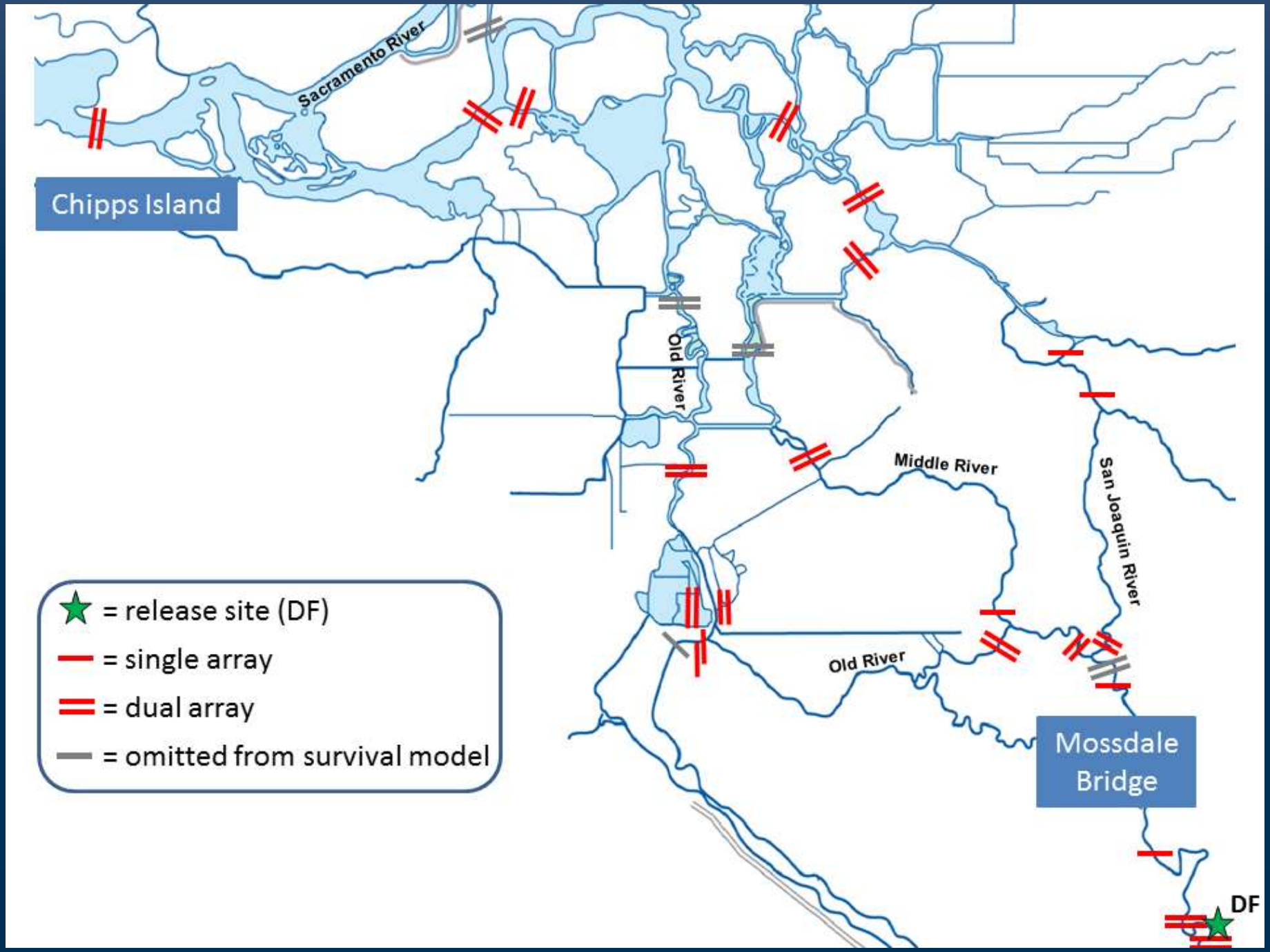
TAGGING AND RELEASE

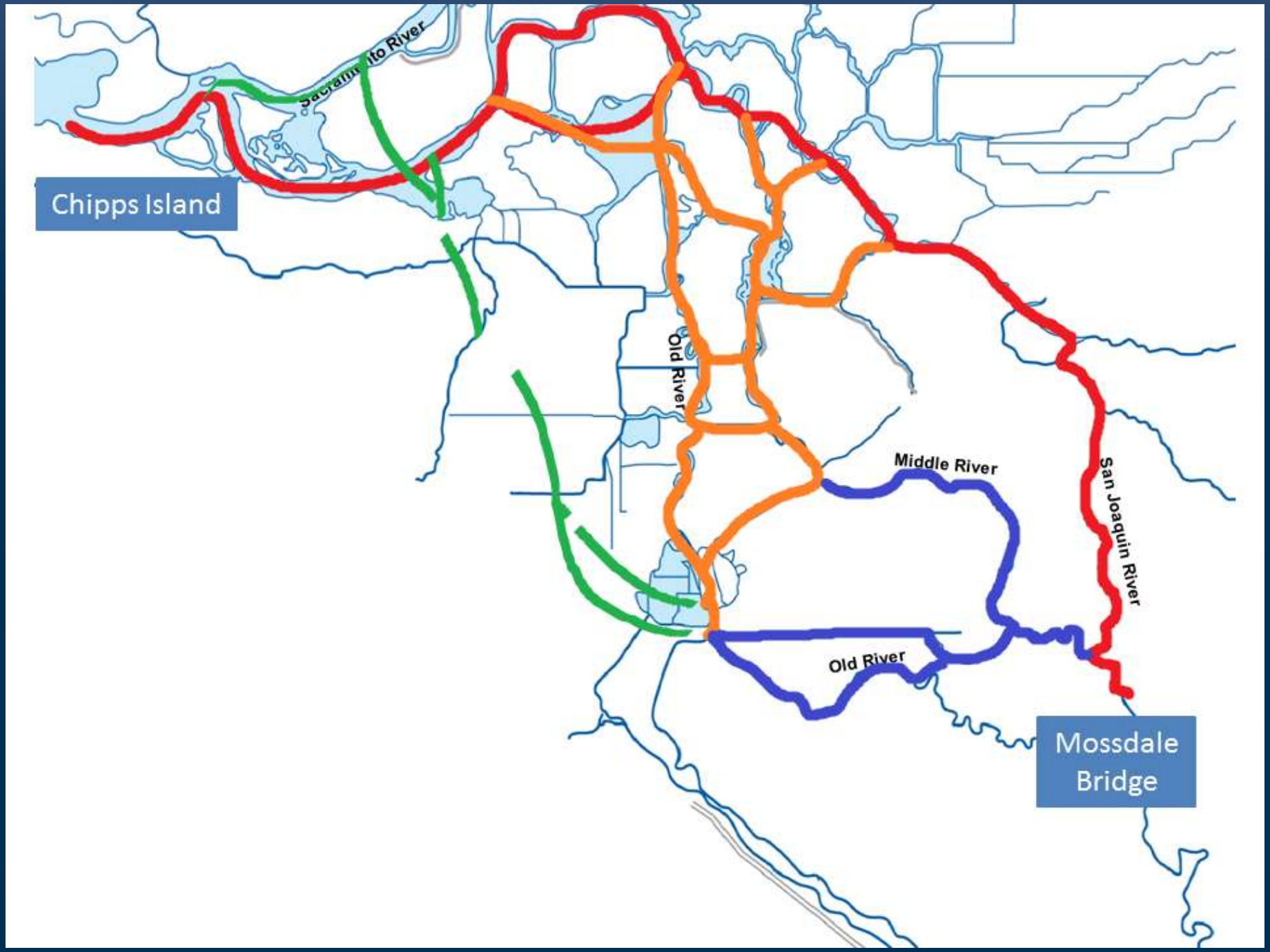
Year	Release Dates	Number Released	Fish Length (avg, mm)
2011 (HTI)	March 22 – 25	479	259
	May 3 – 7	474	274
	May 17 – 21	478	281
	May 22 – 26	480	290
	June 15 – 18	285	282
2012 (VEMCO)	April 4 – 7	477	220
	May 2 – 6	478	230
	May 18 – 23	480	251

All released at Durham Ferry on San Joaquin River

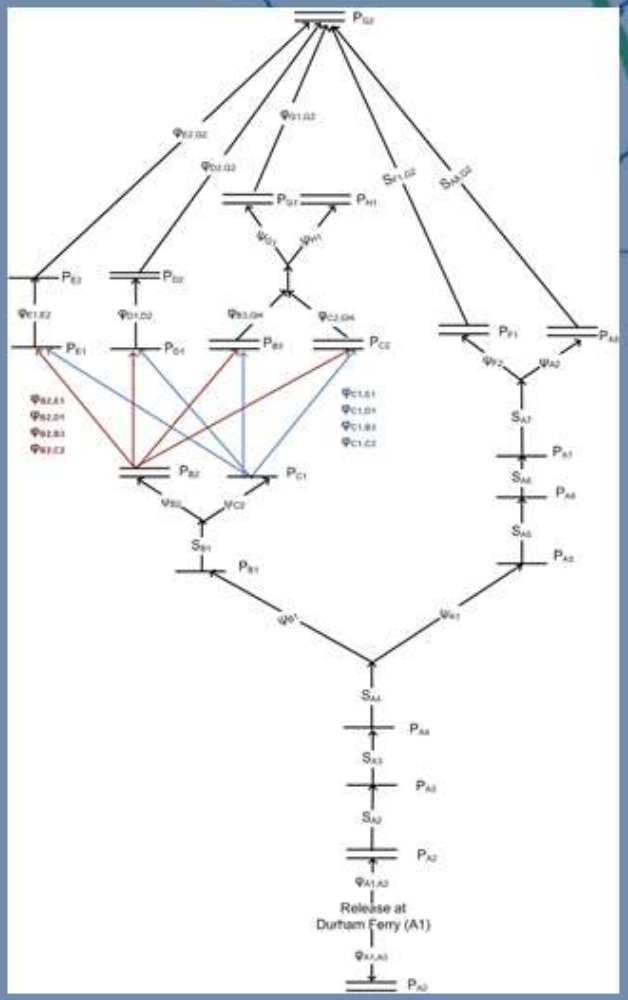
HTI 795LD

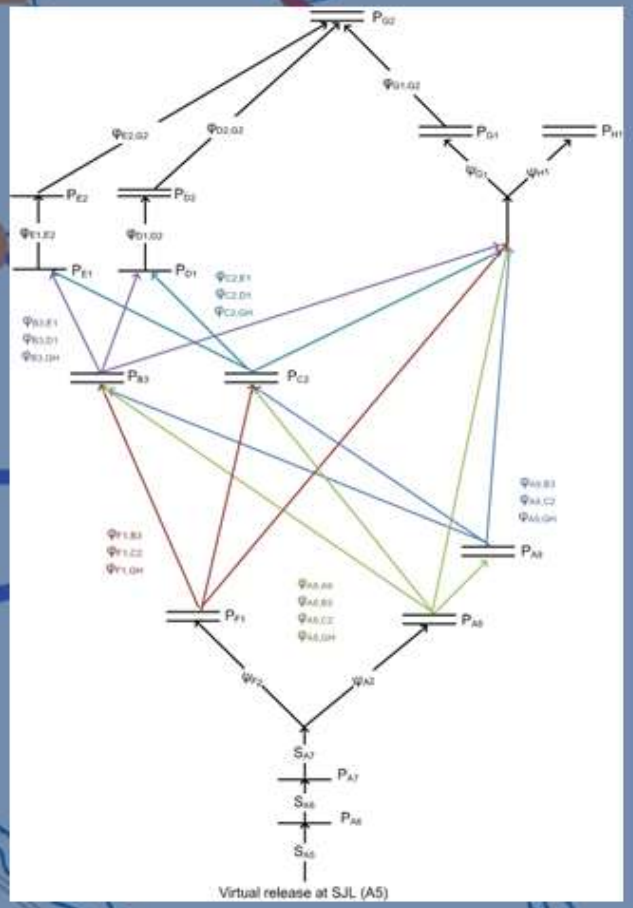
VEMCO V6


Sacramento River
Chipps Island
Old River
Middle River
San Joaquin River
Old River
Mossdale Bridge
DF
= release site (DF)
= single array
= dual array
= omitted from survival model


Chipps Island
Old River
Middle River
San Joaquin River
Old River
Mossdale Bridge

- Release-recapture model
- Predator filter (behavior-based)
- Tag-life data, fish health study
- Tagger effects



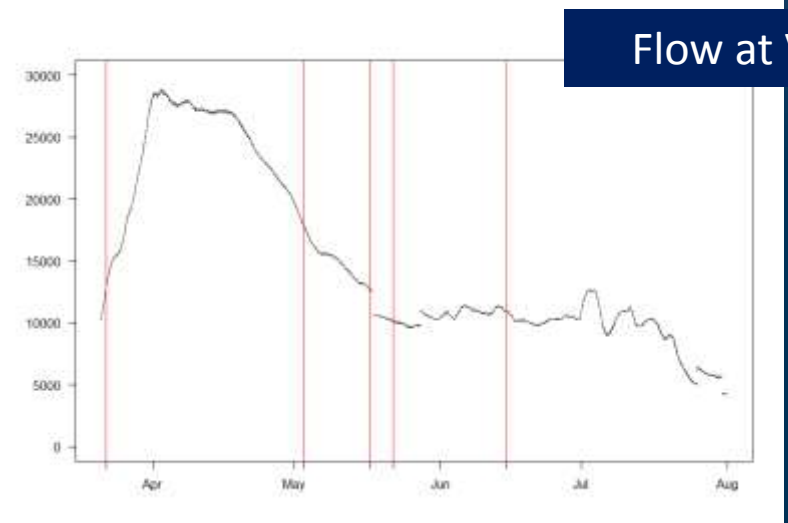


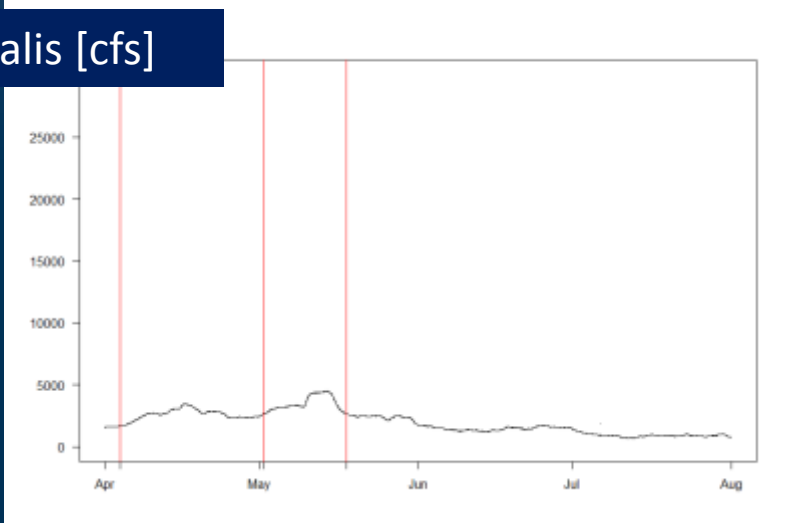
CONDITIONS

2011: No barrier at Head of Old River

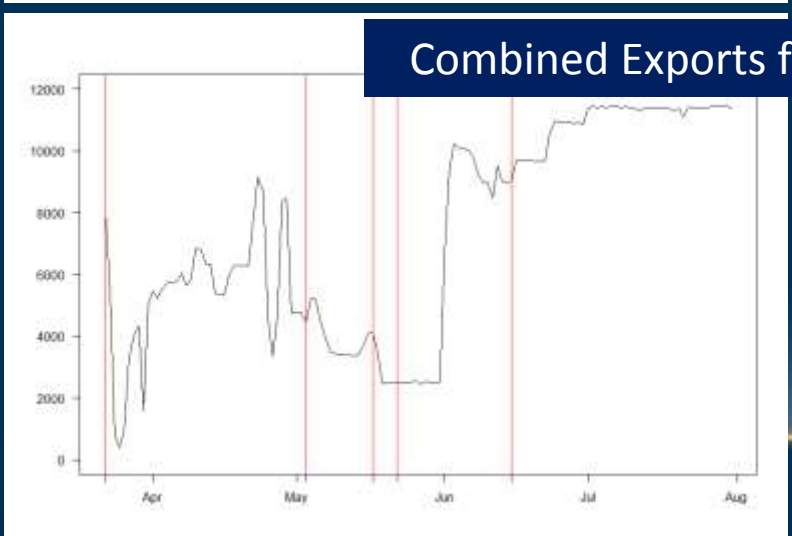
2012: Physical barrier at HOR

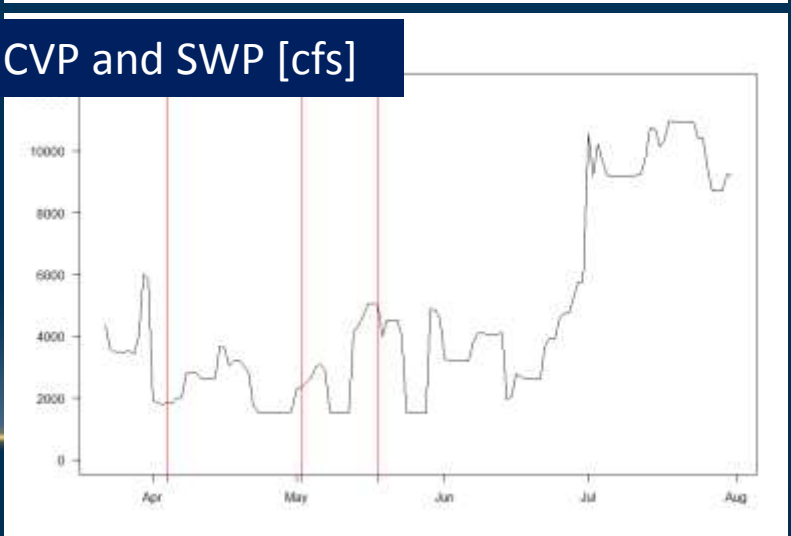
Flow at Vernalis [cfs]



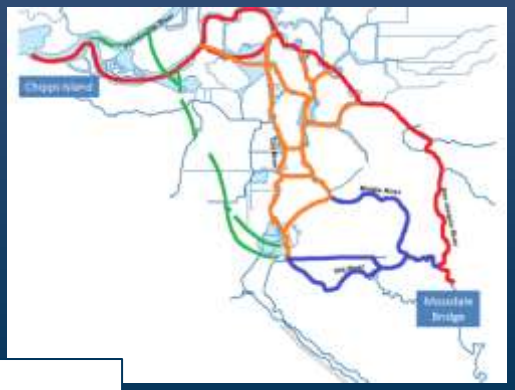


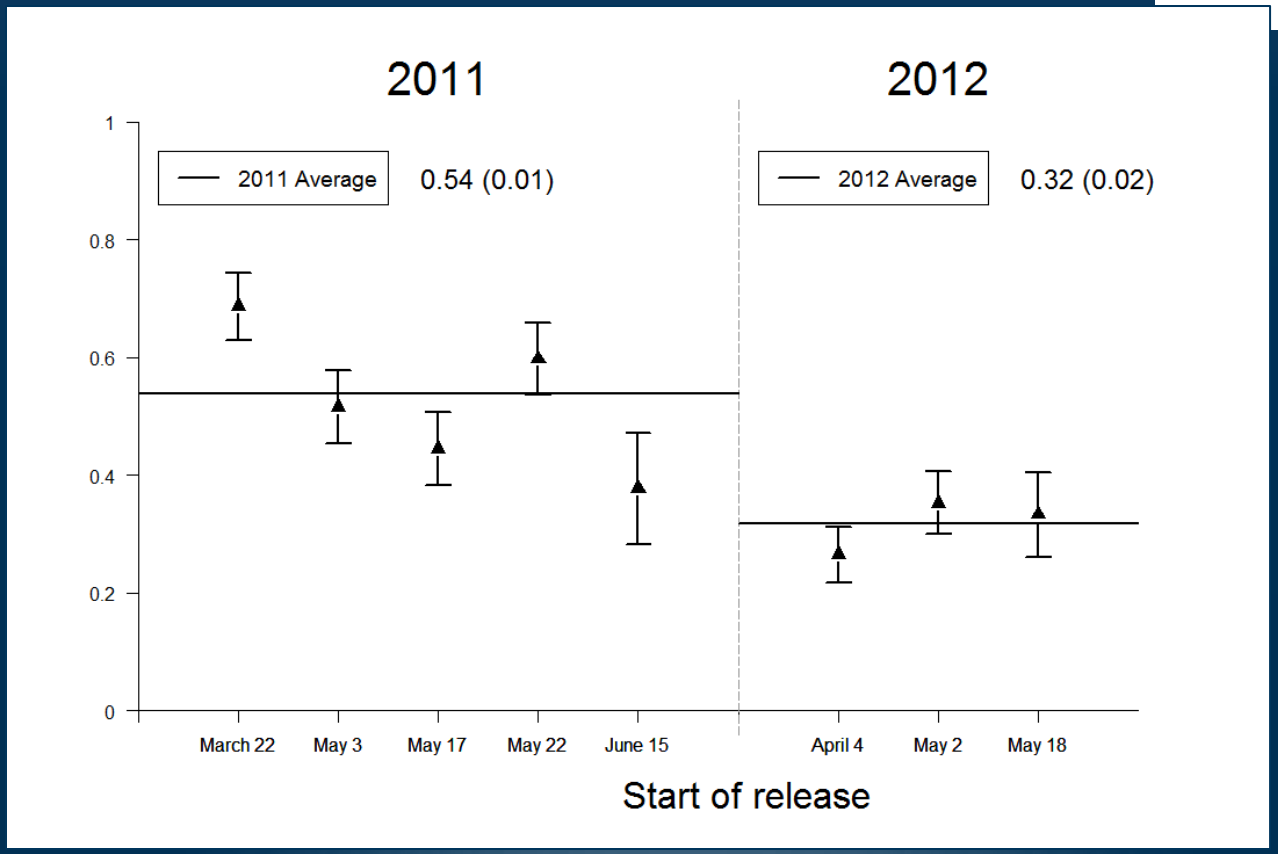
Combined Exports from CVP and SWP [cfs]



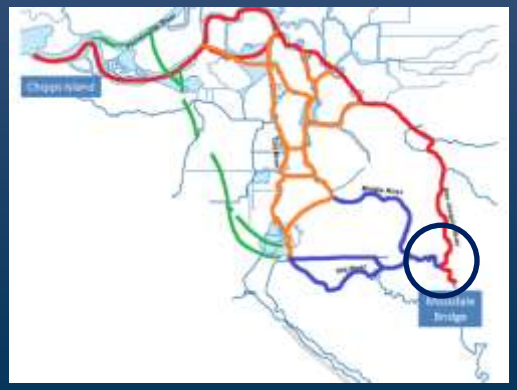


TOTAL SURVIVAL THROUGH DELTA

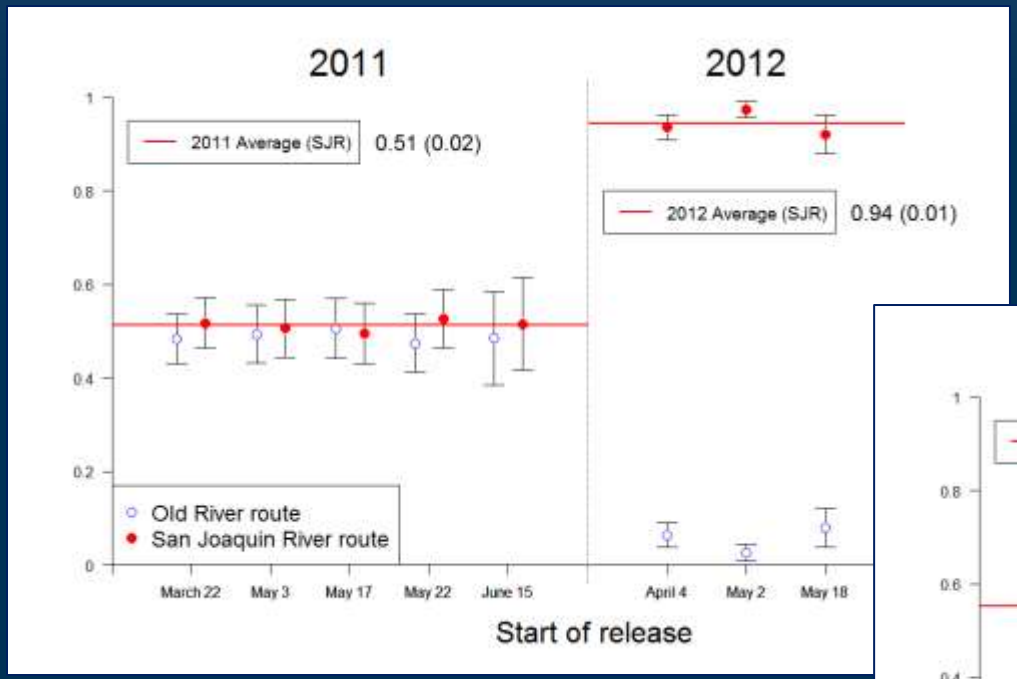




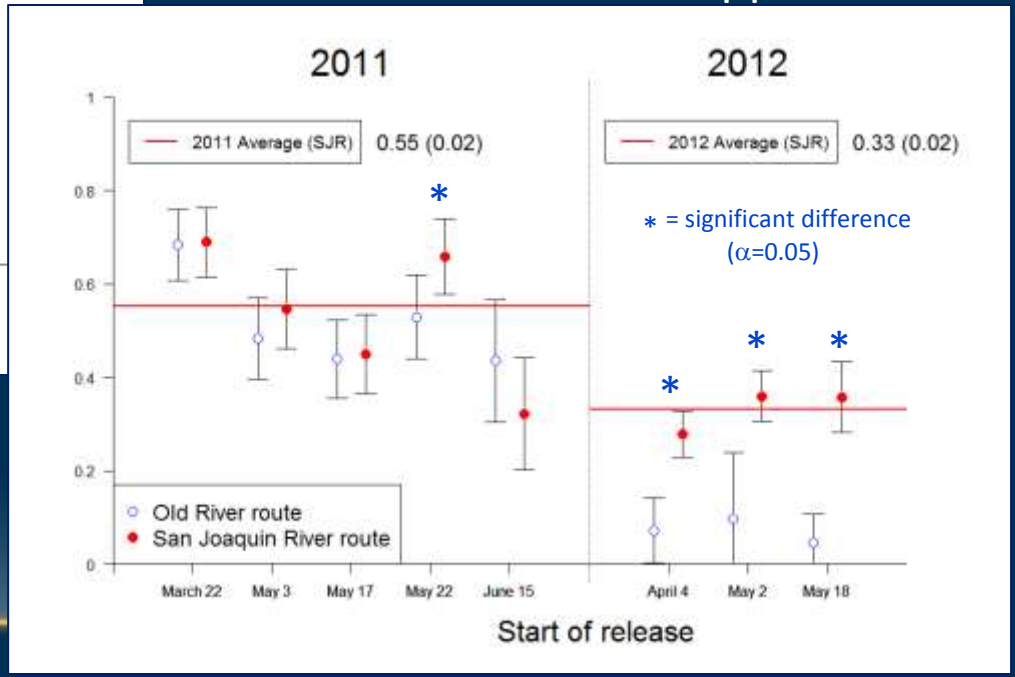
HEAD OF OLD RIVER



Route Selection

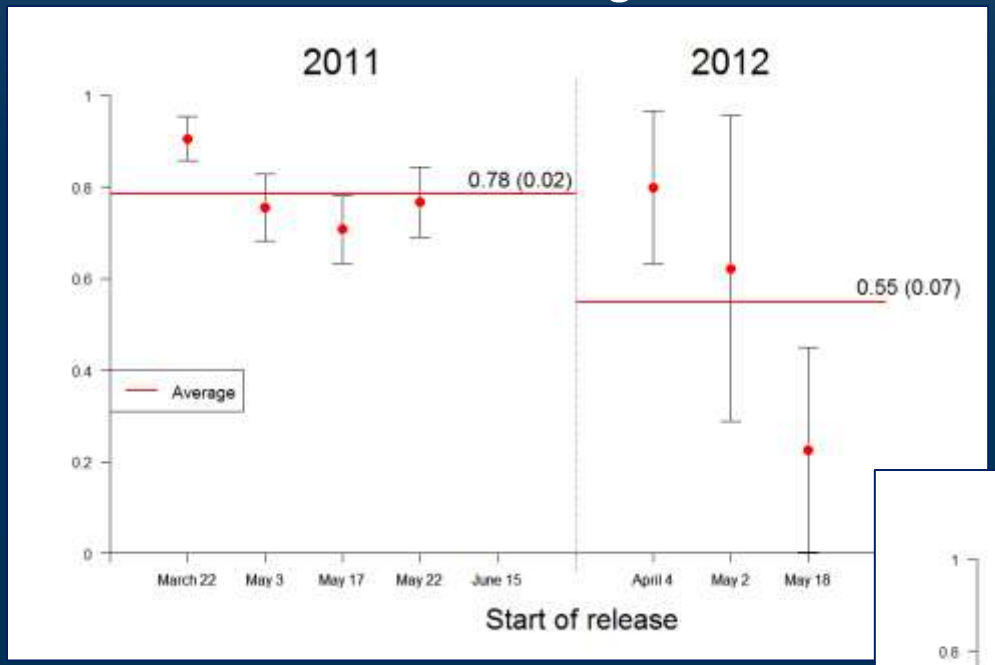


Survival: Mossdale - Chipps Island

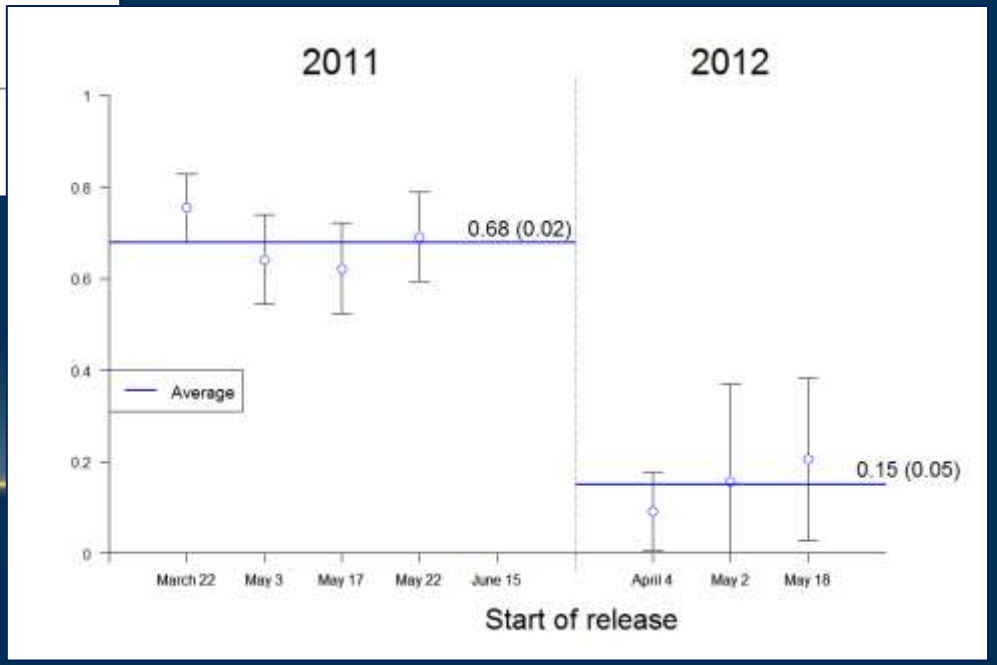


OLD RIVER ROUTE

Survival: Mossdale through South Delta

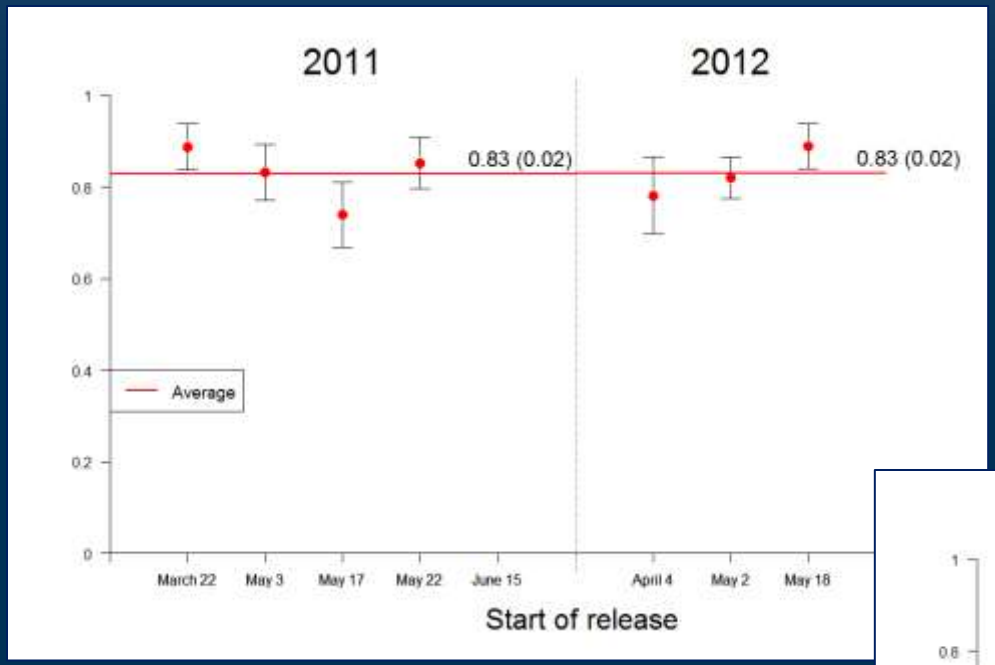


Survival: South Delta - Chipps Island

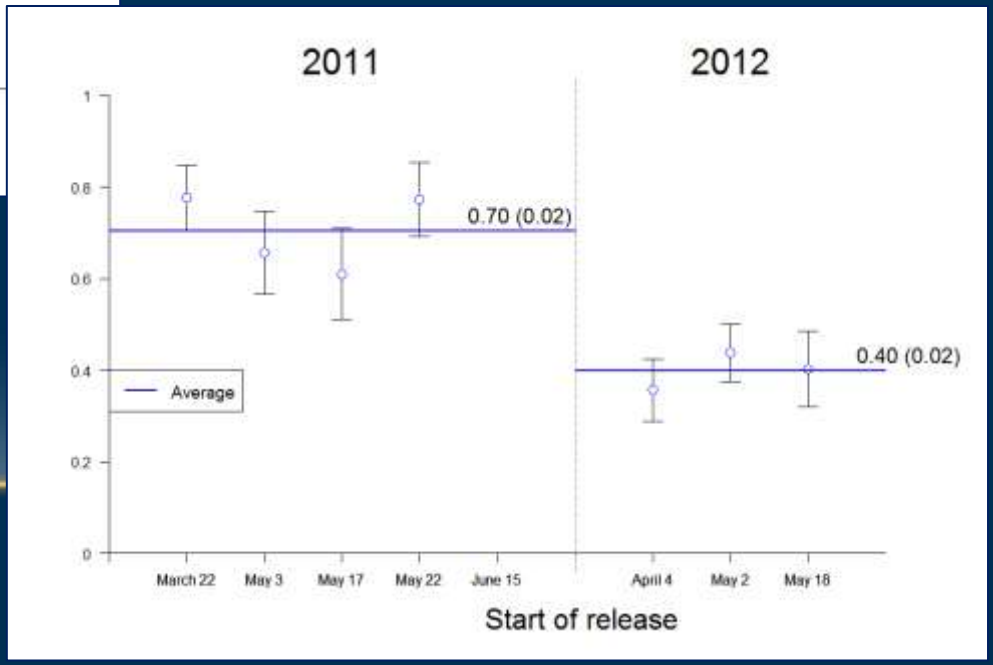


SAN JOAQUIN RIVER ROUTE

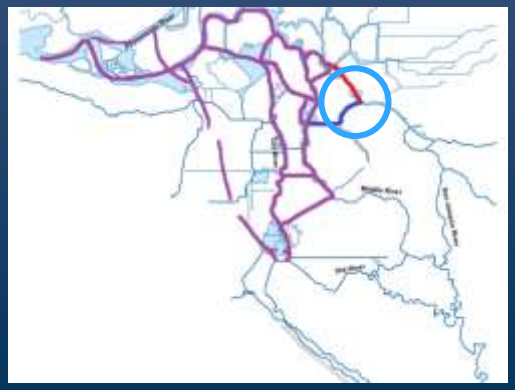
Survival: Mossdale - Turner Cut Junction



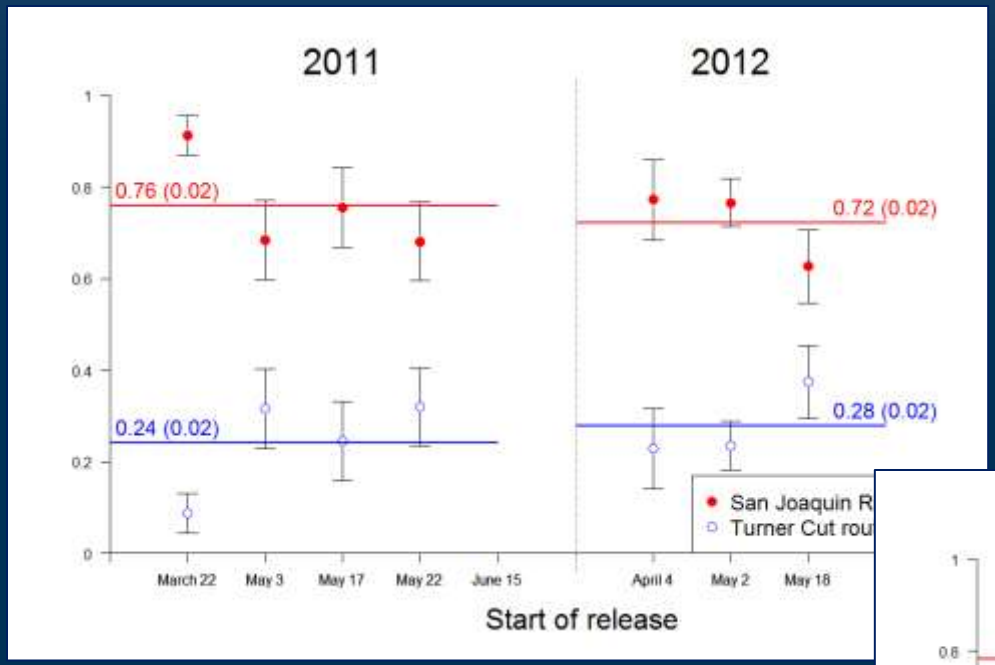
Survival: Turner Cut - Chipps Island



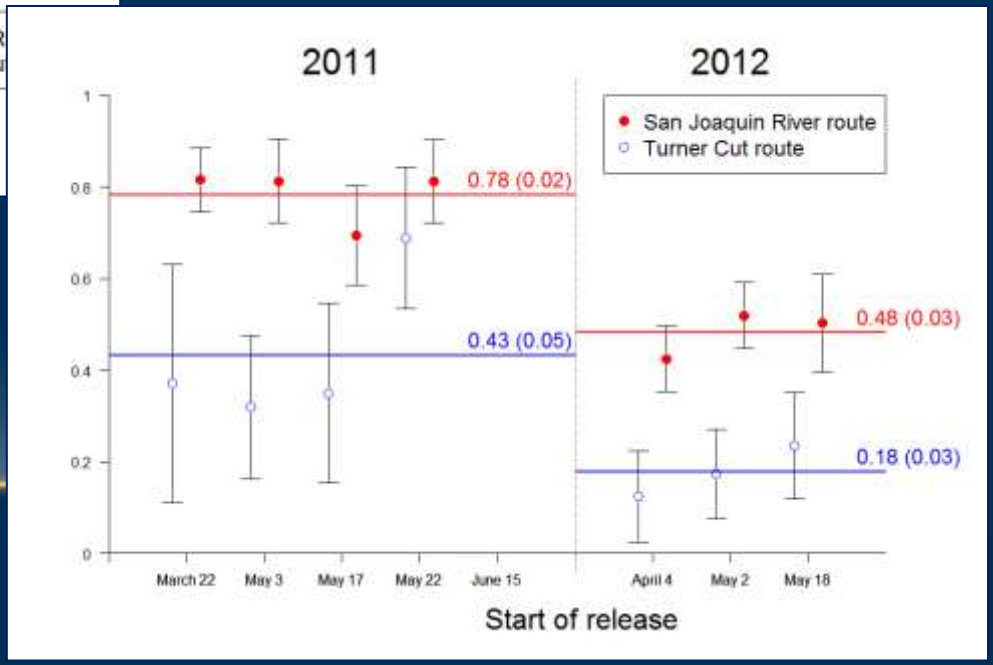
TURNER CUT JUNCTION



Route Selection at Turner Cut



Survival: Turner Cut - Chipps Island



SUMMARY

2011: high flow, no barrier

- Half entered Old River
- Similar survival in OR and SJR routes
- Higher survival than in 2012, especially:
  - From Turner Cut junction
  - From salvage, Interior Delta

2012: low flow, physical barrier

- Most remained in SJR
- Higher survival in SJR

Both years

- Survival to Chipps Island higher for SJR fish than for Turner Cut fish

THANKS

- U.S. Bureau of Reclamation – funding for analysis

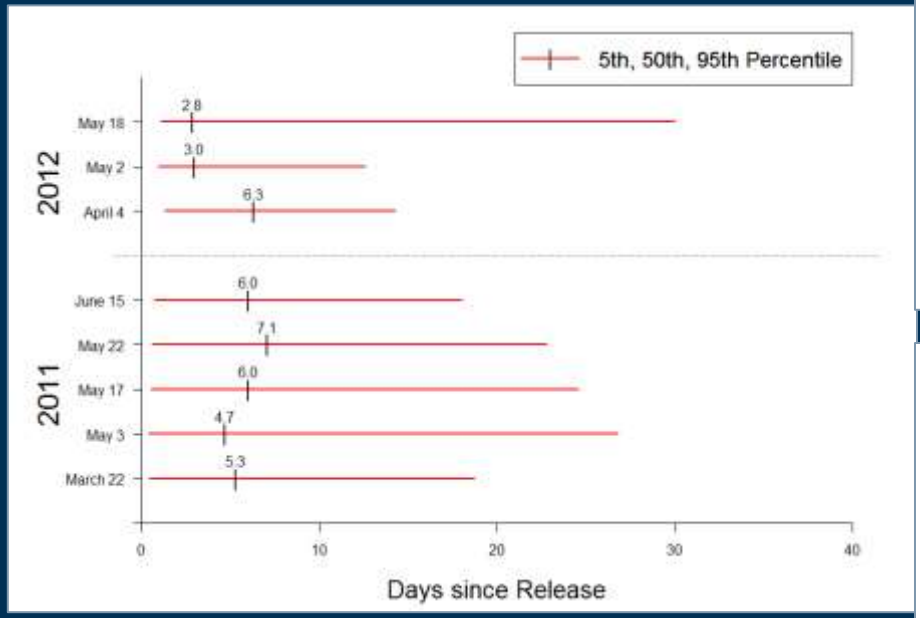
- Design and implementation of study
  - U.S. Bureau of Reclamation
  - U.S. Fish and Wildlife Service
  - U.S. Geological Survey
  - California Department of Water Resources

- Many people involved in planning and implementing tagging study
  - Scott Brewer, Mike Simpson – USGS (data processing)
  - Predator filter discussion:
    - Jon Burau, Chris Vallee, Jason Romine – USGS
    - Ryan Reeves, Mike Cane – DWR
    - Phil Sandstrom – UC Davis

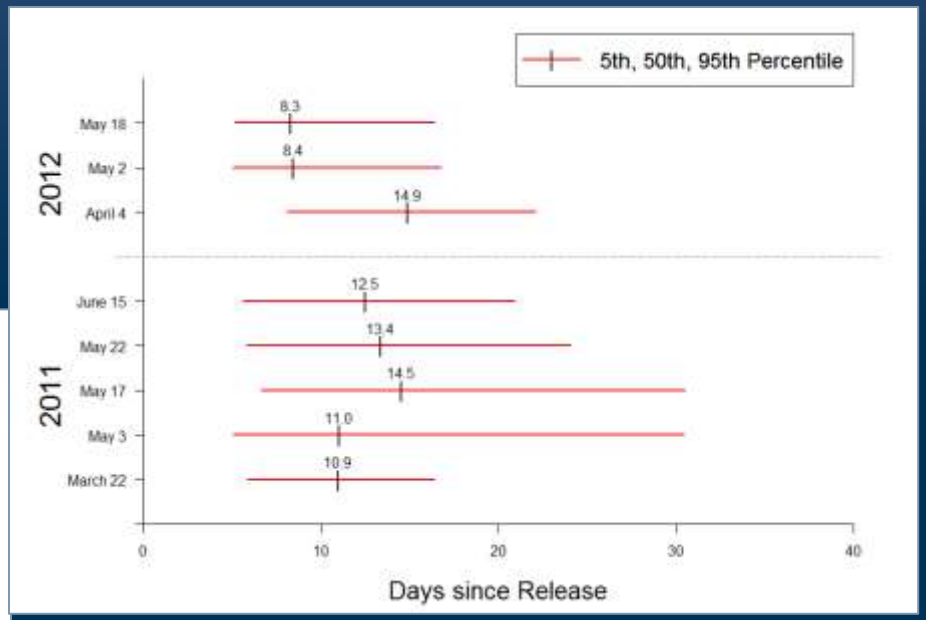
EXTRAS

TRAVEL TIME (DAYS)

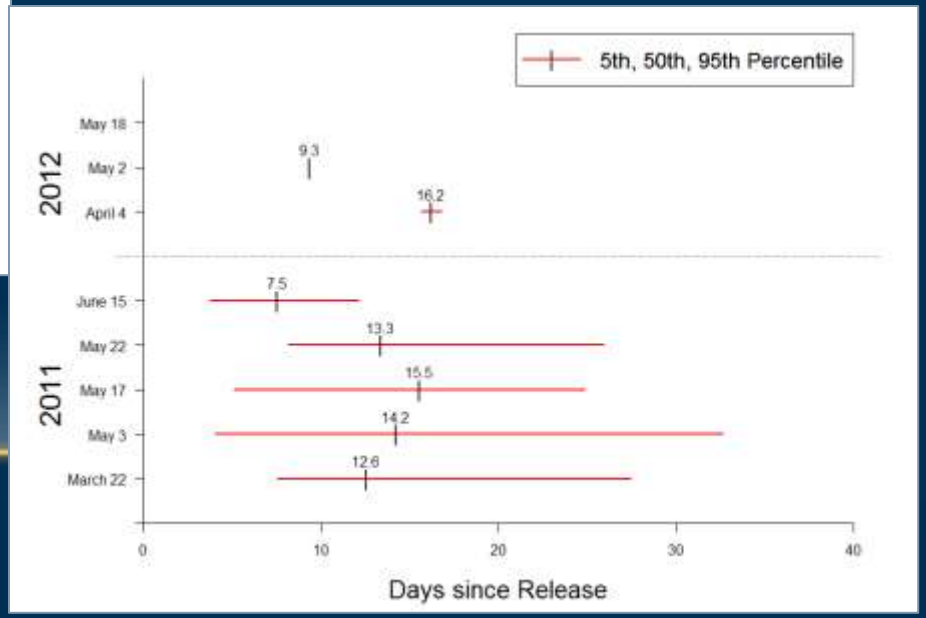
To Head of Old River



To Chipps Island via San Joaquin River



To Chipps Island via Old River

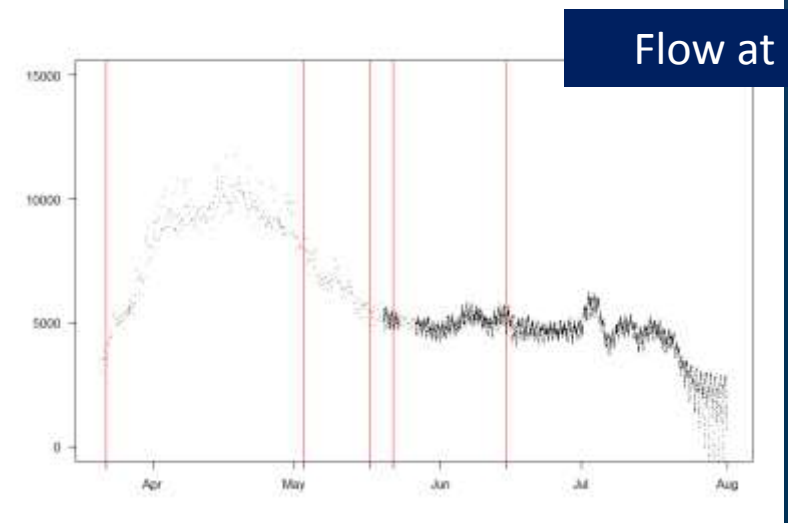


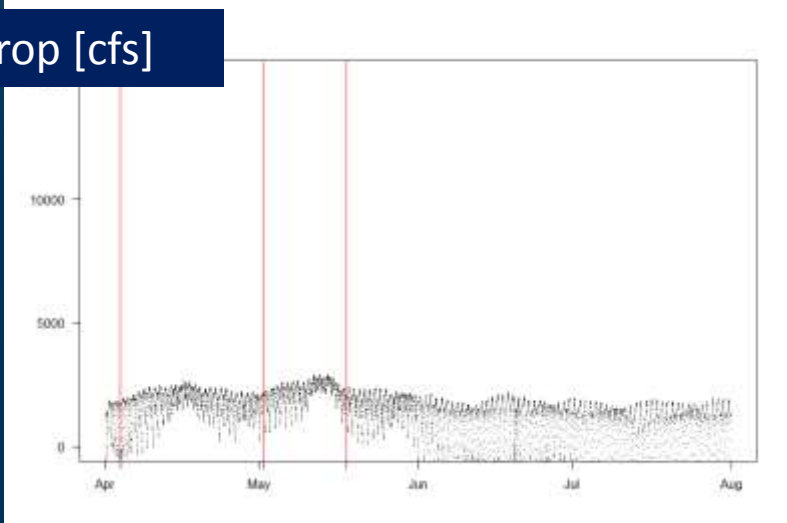
CONDITIONS

2011: No barrier at Head of Old River

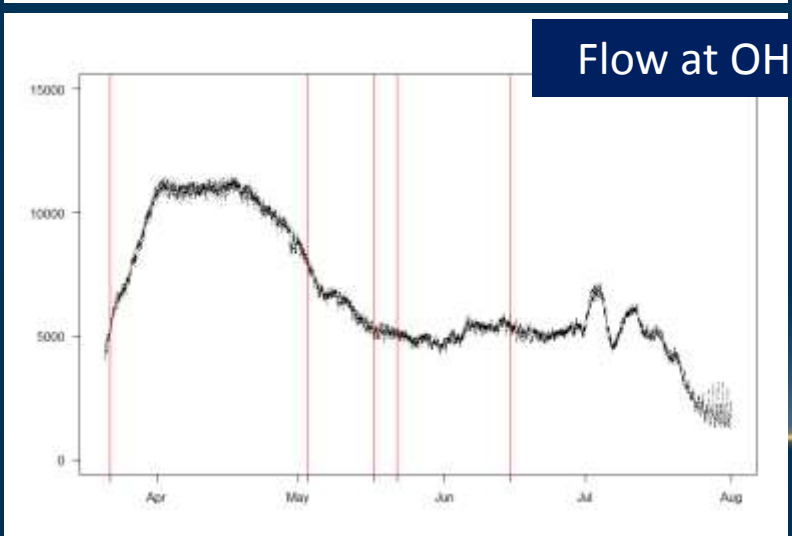
2012: Physical barrier at HOR

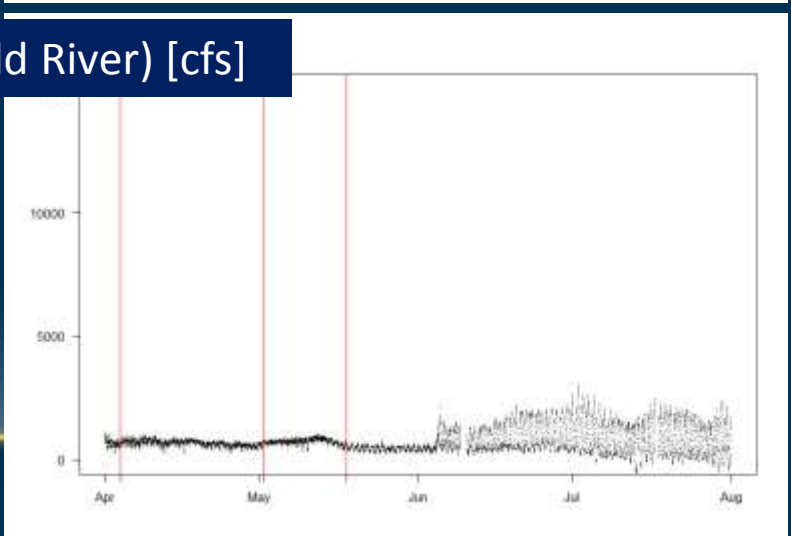
Flow at Lathrop [cfs]





Flow at OH1 (Old River) [cfs]





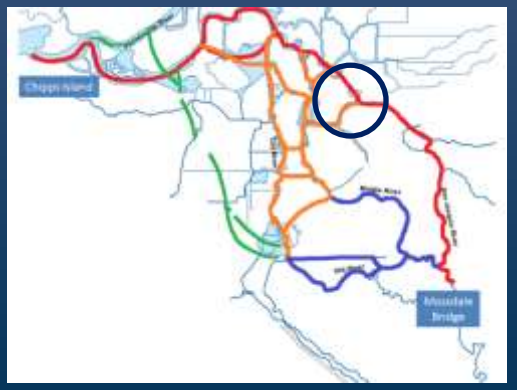
PREDATORS

- Problem: Predatory fish eat tagged study fish, then move past receivers
- Result: Biased survival estimates
- Solution: Identify and remove detections from predators
- Predator filter
  - Behavior differences
  - Residence time
  - Migration rate
  - Movements between receivers
  - Total travel time
  - Discharge, water velocity, tidal cycle (movements against flow)
- Spatially explicit rule

PREDATOR FILTER: BEHAVIORAL ASSUMPTIONS

- Juvenile steelhead
  - May rear in Delta for extended time
  - Are unlikely to move against flow
  - May linger or move upriver temporarily with reverse flow, but will eventually move downstream
- Predatory fish (e.g., Striped Bass)
  - May move against flow
  - May linger in a given area
  - May move either very quickly or very slowly between detection sites
- Criteria
  - Partially based on trajectories of tags assumed to have been transported from SWP (CVP)
  - Discussions with steelhead biologists familiar with Delta

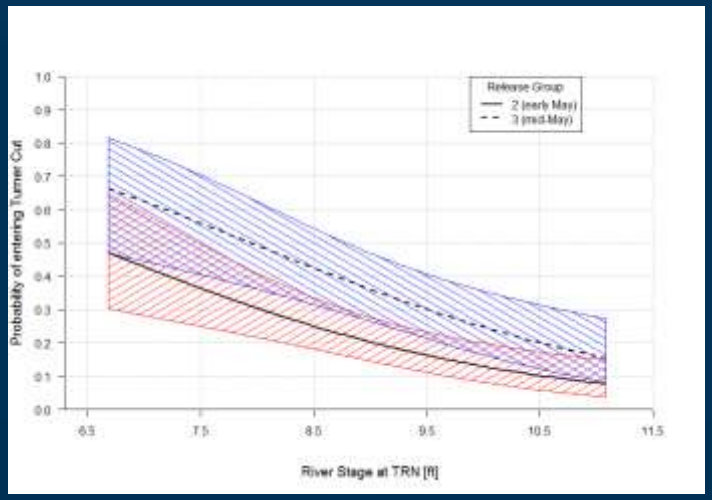
ROUTE SELECTION: TURNER CUT (2012)

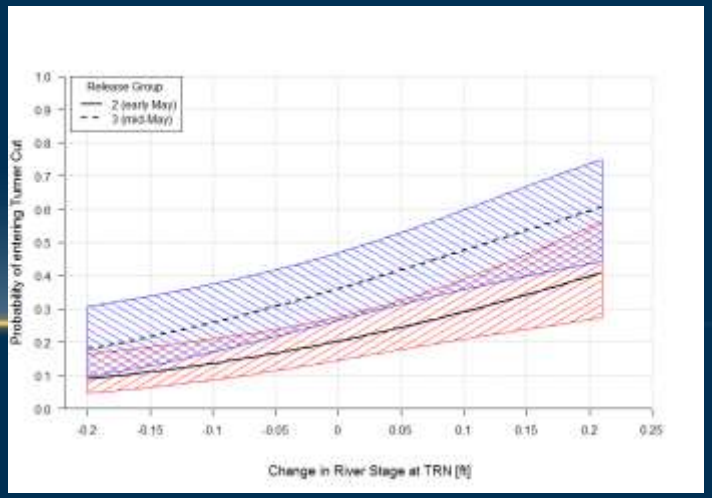


- Regressed probability of entering Turner Cut against:
  - River discharge (TRN, SJG)
  - River stage (TRN)
  - Exports (CVP, SWP)
- Omitted first release group: poor detection probability in Turner Cut

- Significant (α=0.05):
  - River stage at TRN*
  - Change in stage at TRN*
  - Change in flow at TRN
  - CVP exports
  - Release Group*

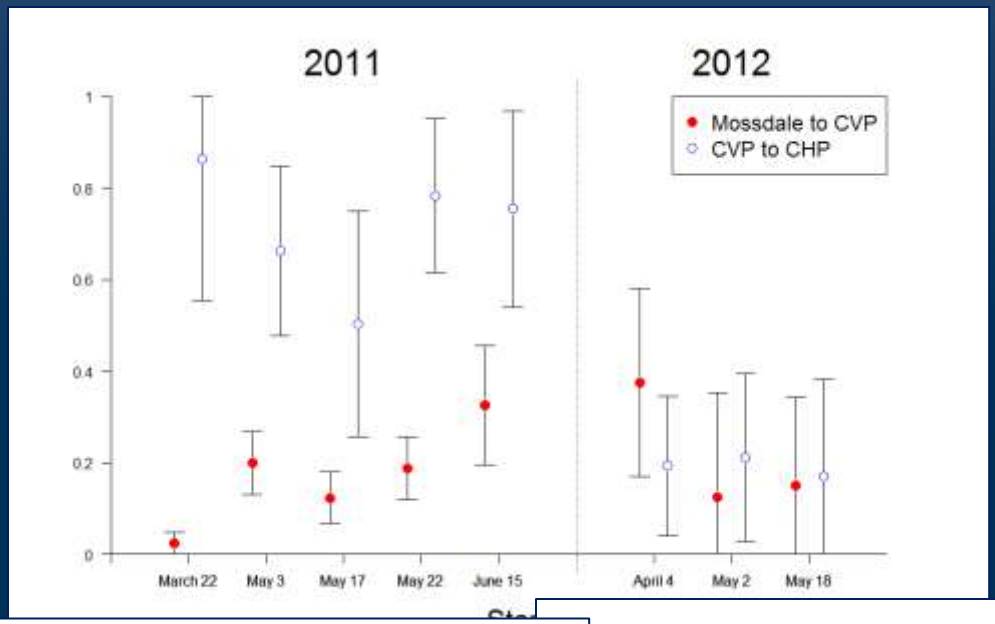
* in best model (AIC)



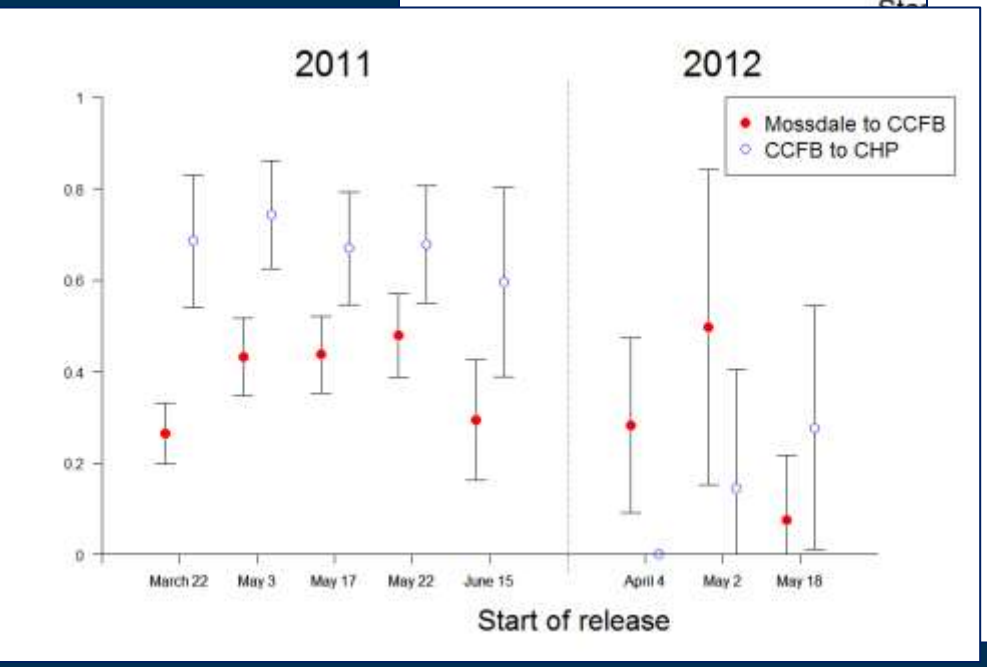


OLD RIVER ROUTE

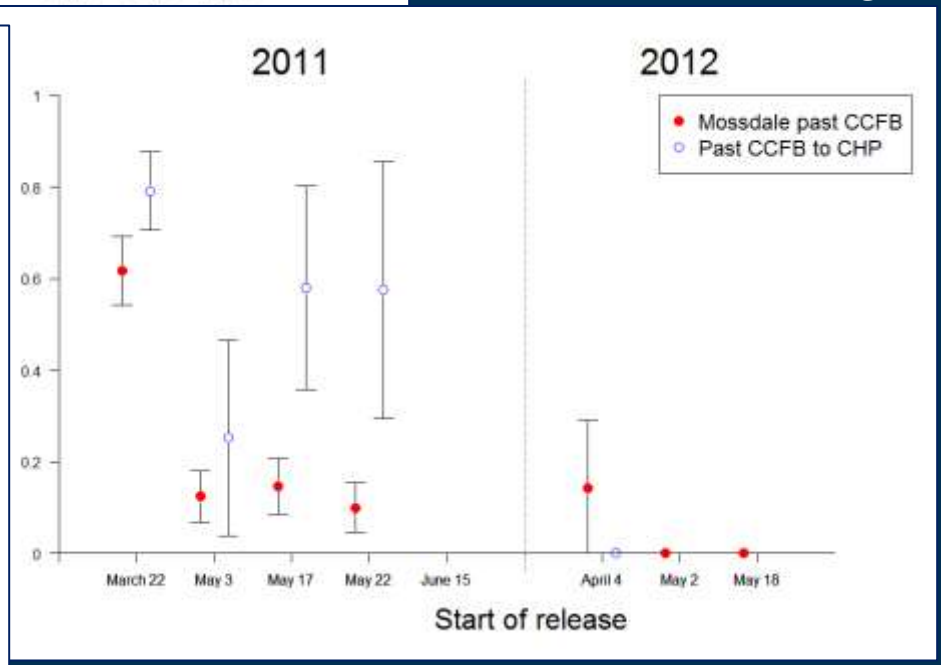
Central Valley Project



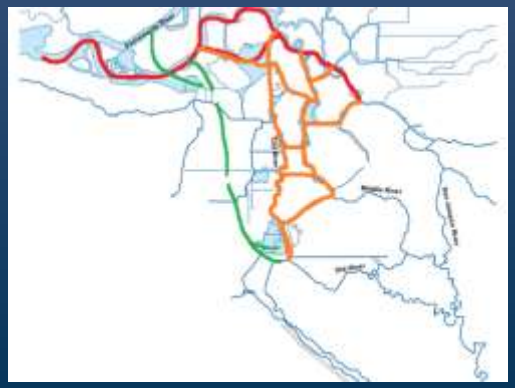
Clifton Court Forebay



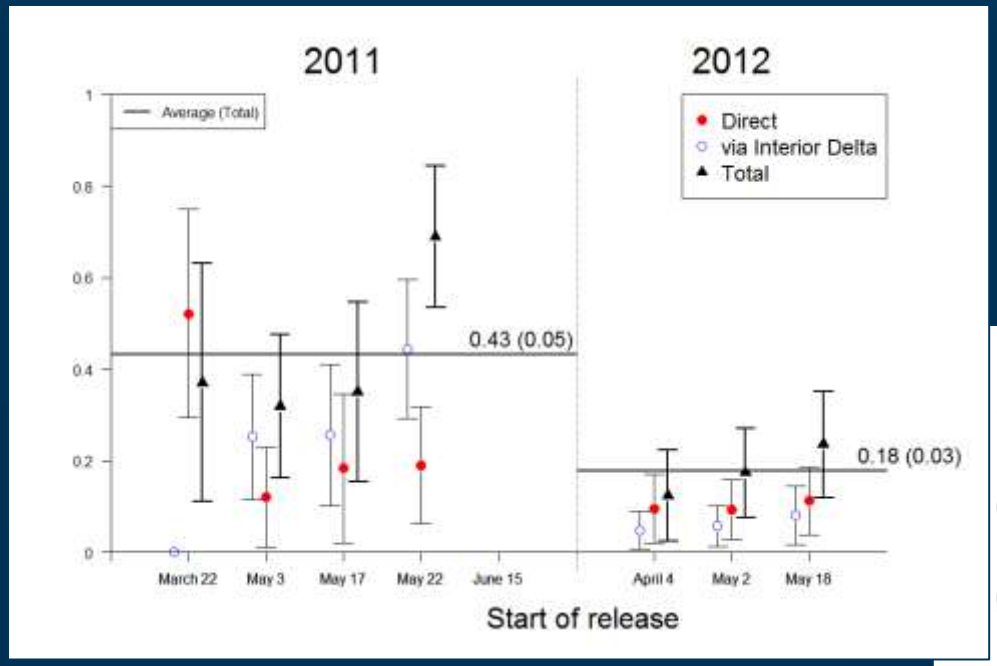
In-River



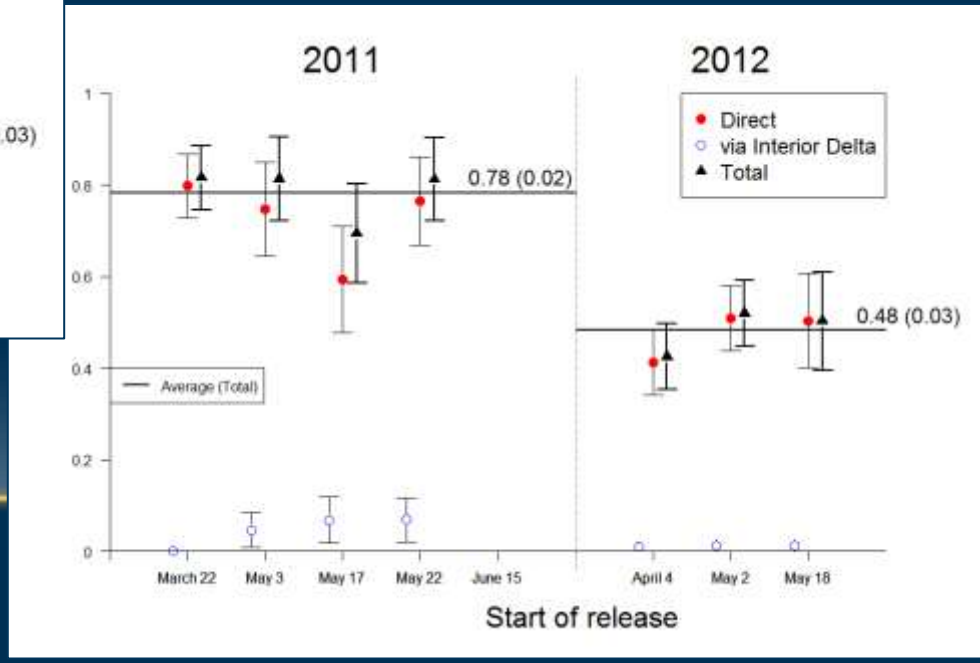
TRANSITION: TURNER CUT JUNCTION TO CHIPPS ISLAND



Via Turner Cut



Via San Joaquin River



UPSTREAM OF MOSSDALE