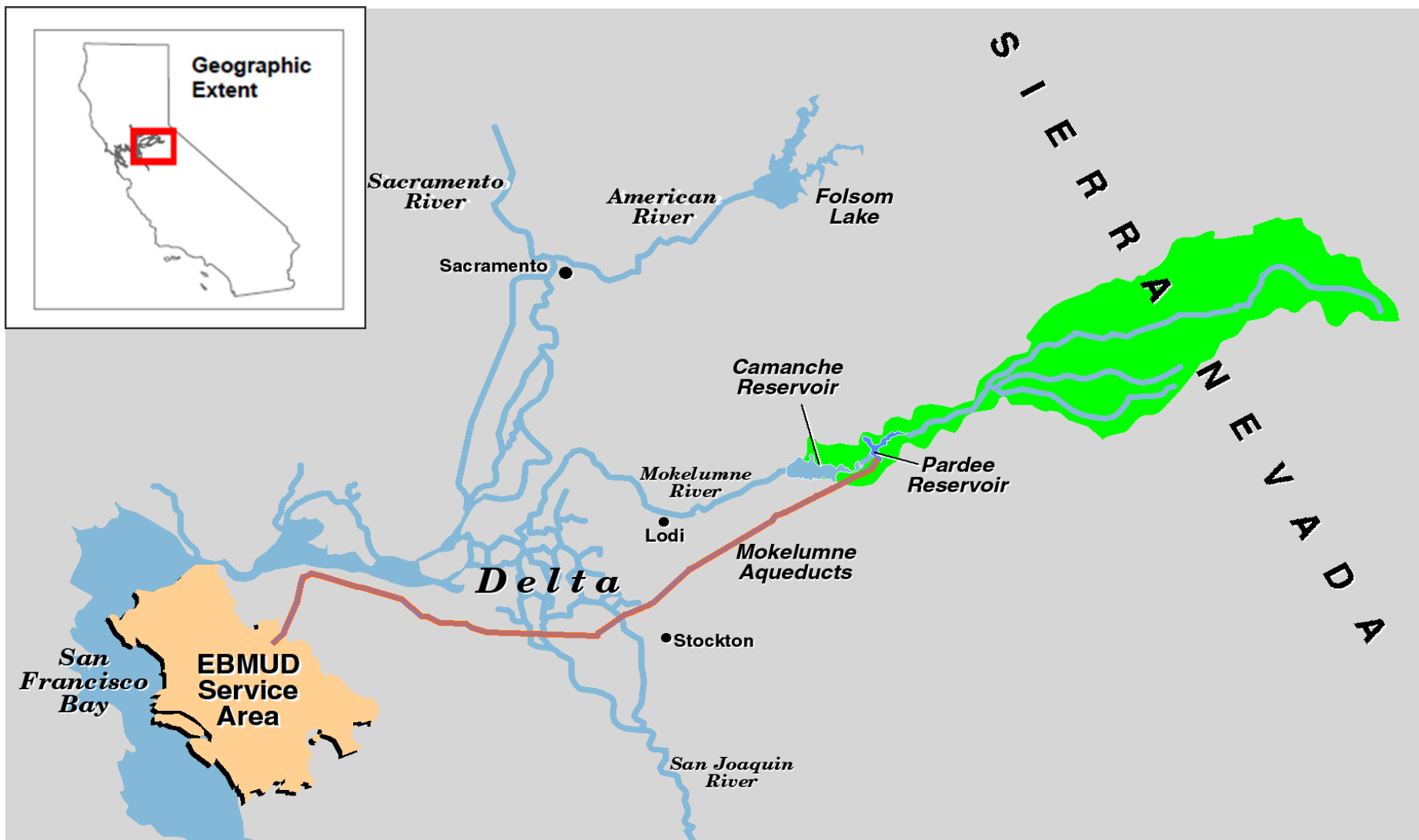


Maintaining anadromous fish populations through fish passage and other management strategies on the Lower Mokelumne River, Ca.

Michelle Workman
Supervising Fisheries/Wildlife Biologist
EBMUD Fisheries & Wildlife Division

Mokelumne River and Water Supply System Overview

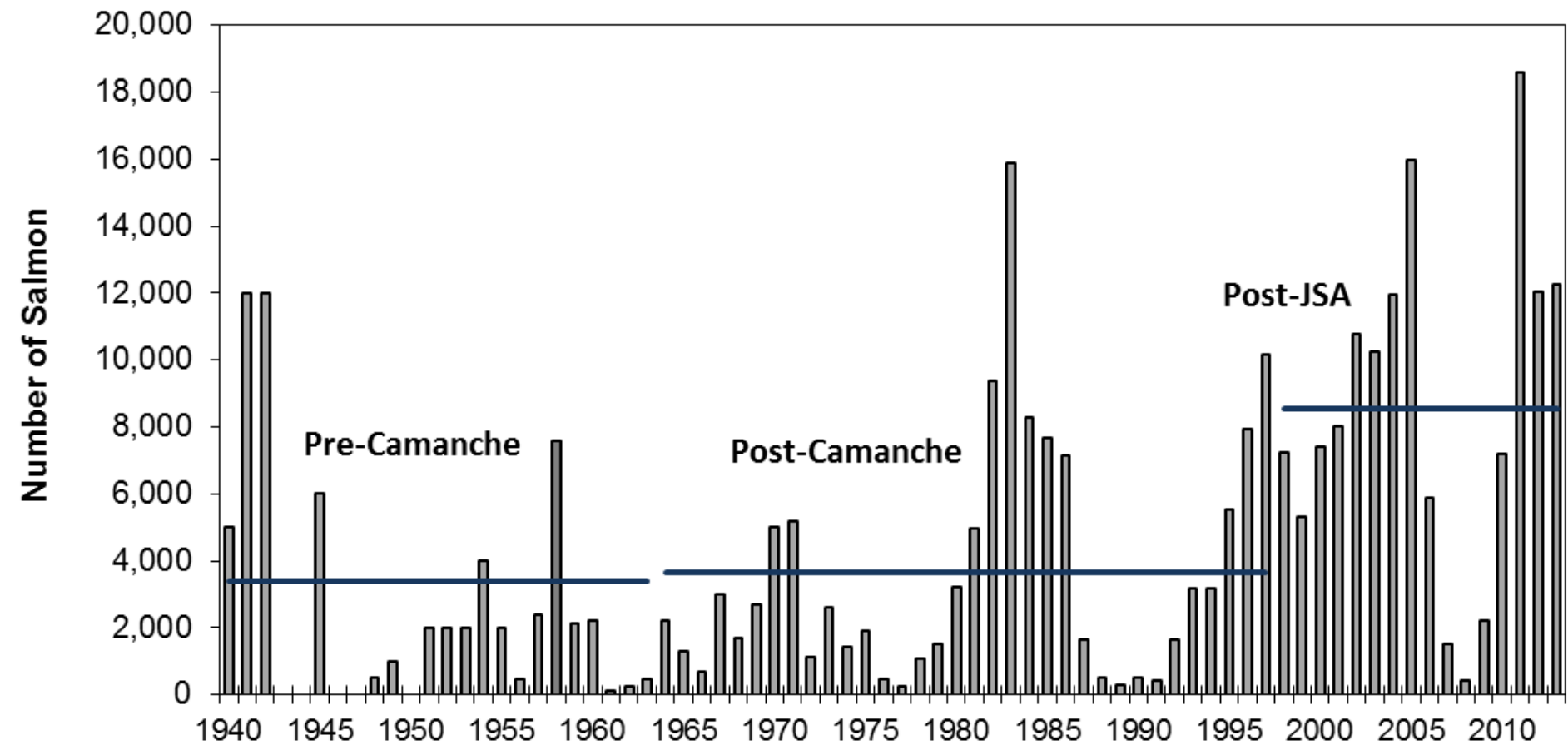


1998 Joint Settlement Agreement



- Result of FERC relicensing
- Developed a Partnership with EBMUD, CDFW and USFWS (NMFS added later)
- Developed a Water Quality and Resource Management Plan
- Provided a 10-fold increase in dry-year flows from early 1990s
- A portion of any newly acquired supplies provided for fisheries flows
- \$2 million Endowment for habitat improvements
- \$12.5 million in improvements to upgrade hatchery

Historic Fish Numbers

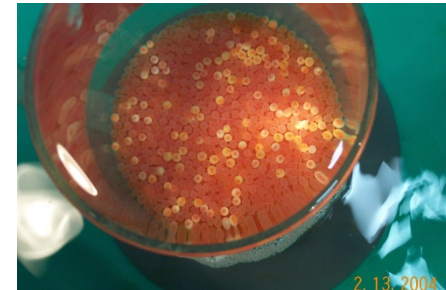


Horizontal lines indicate pre-Camanche, post-Camanche, and post-JSA periods, respectively.

How did we get here?



- Physical and Operational Fixes
- Habitat Restoration
- Monitoring and Research Program
- Hatchery Practices



Physical and Operational Fixes



WIDD rebuild and screen diversion



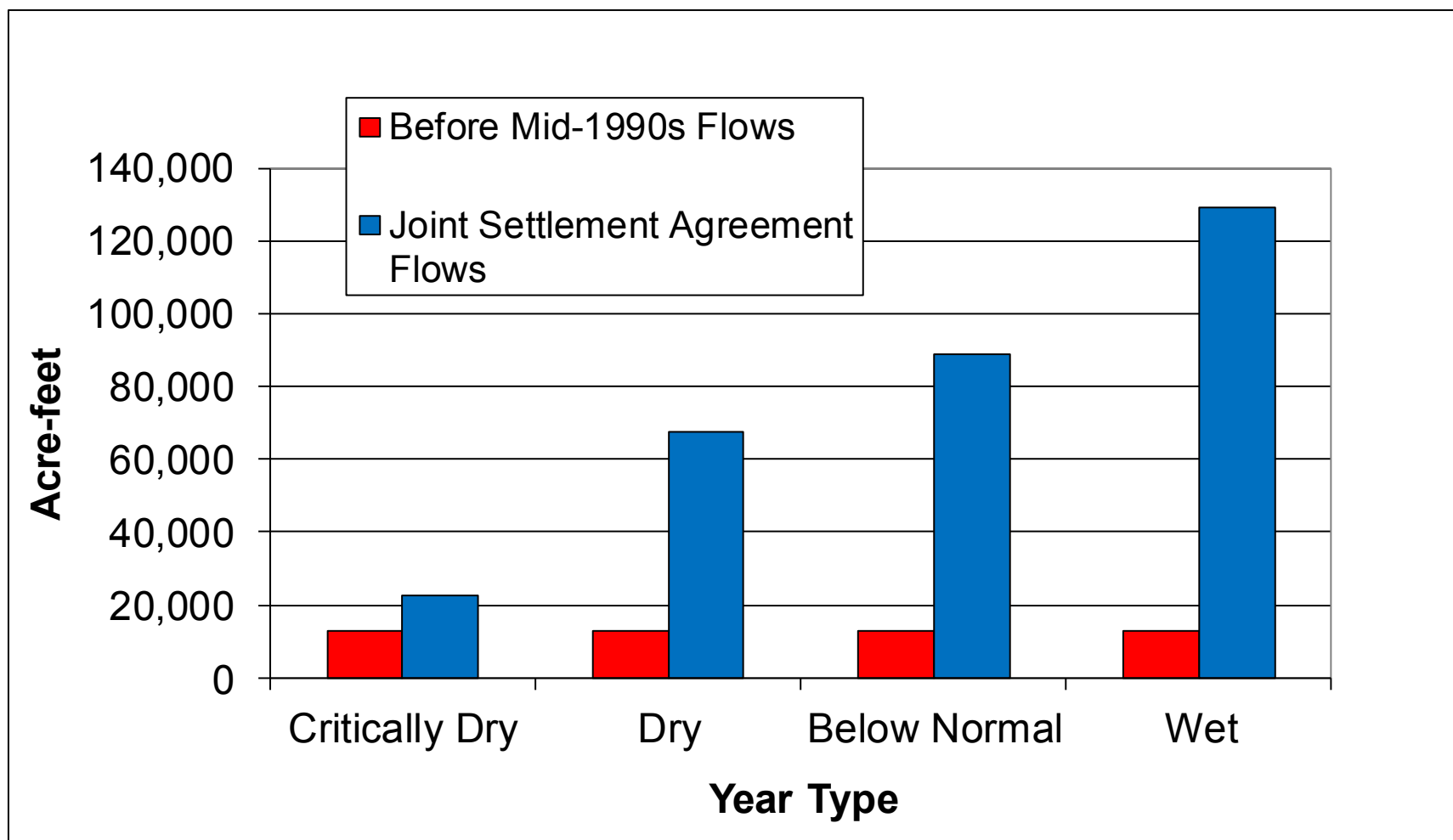
Before



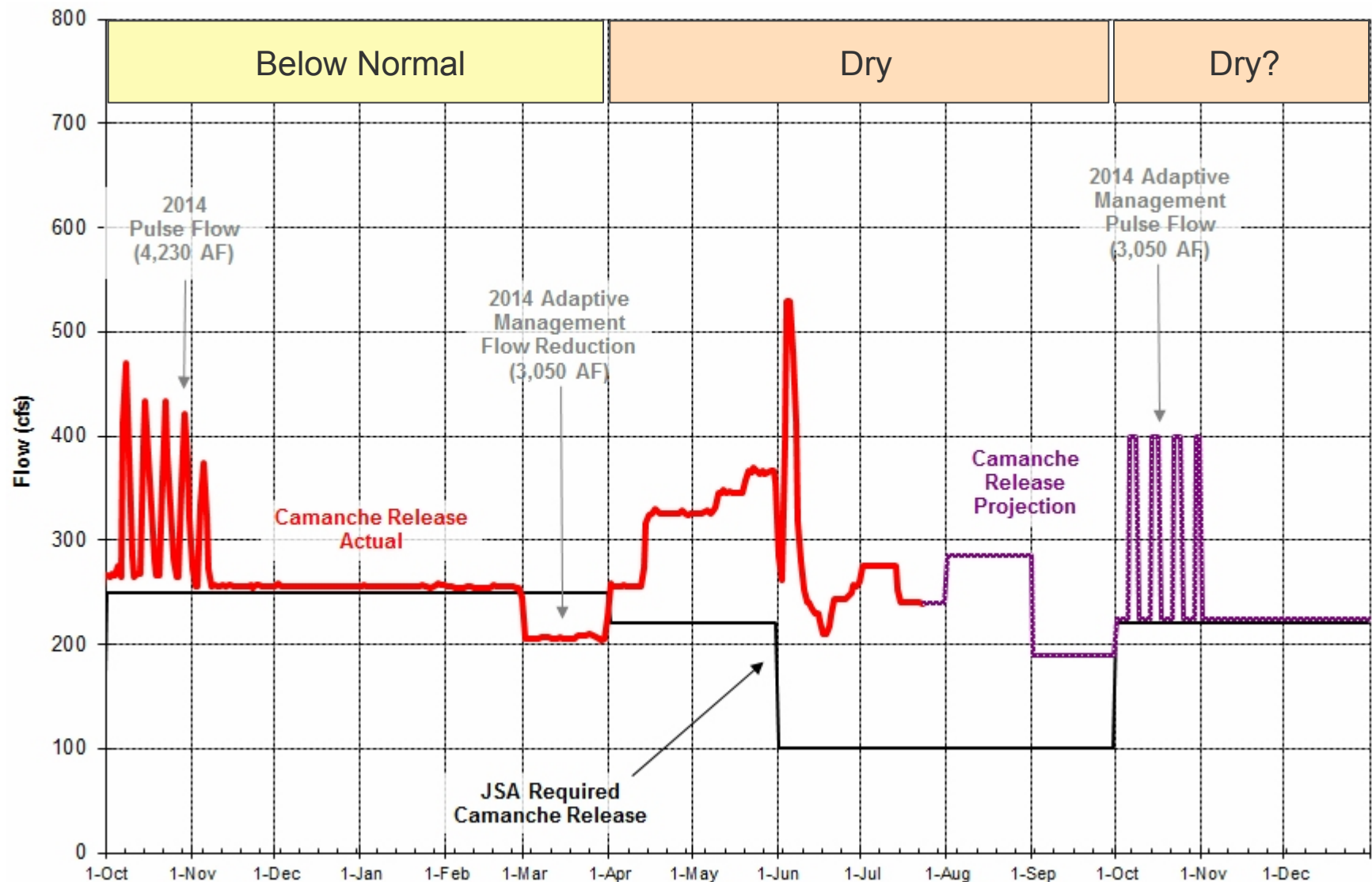
After



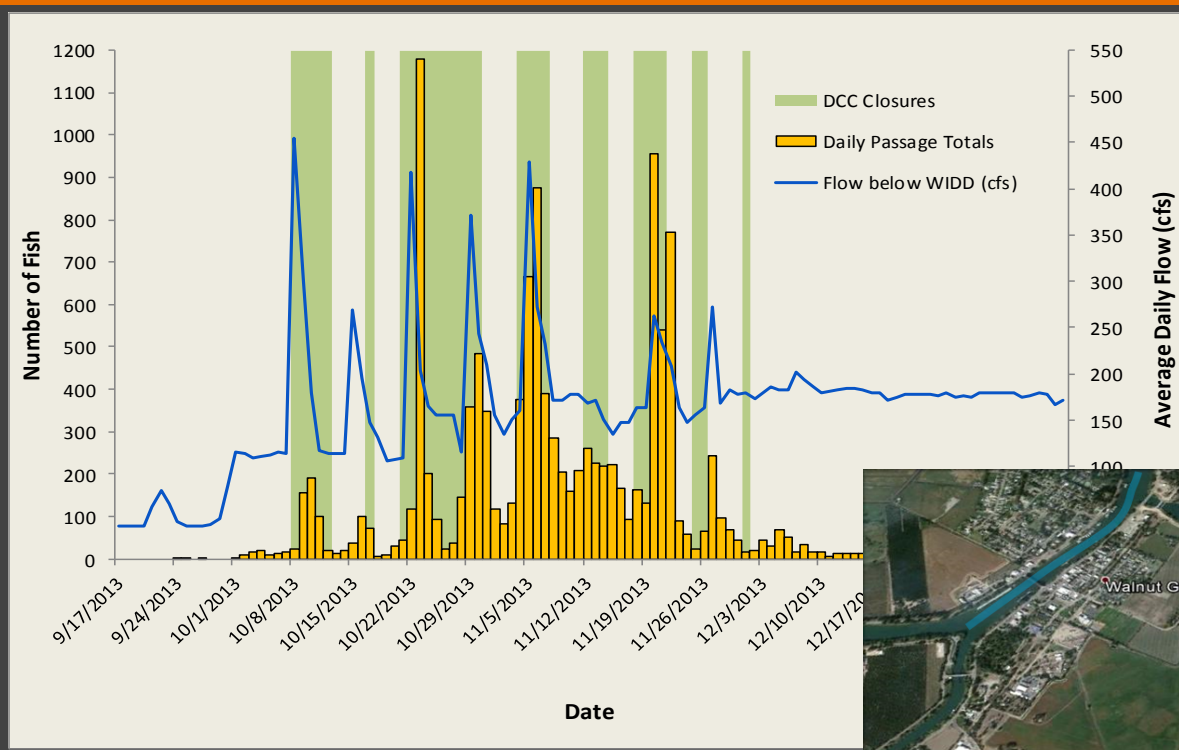
More Water



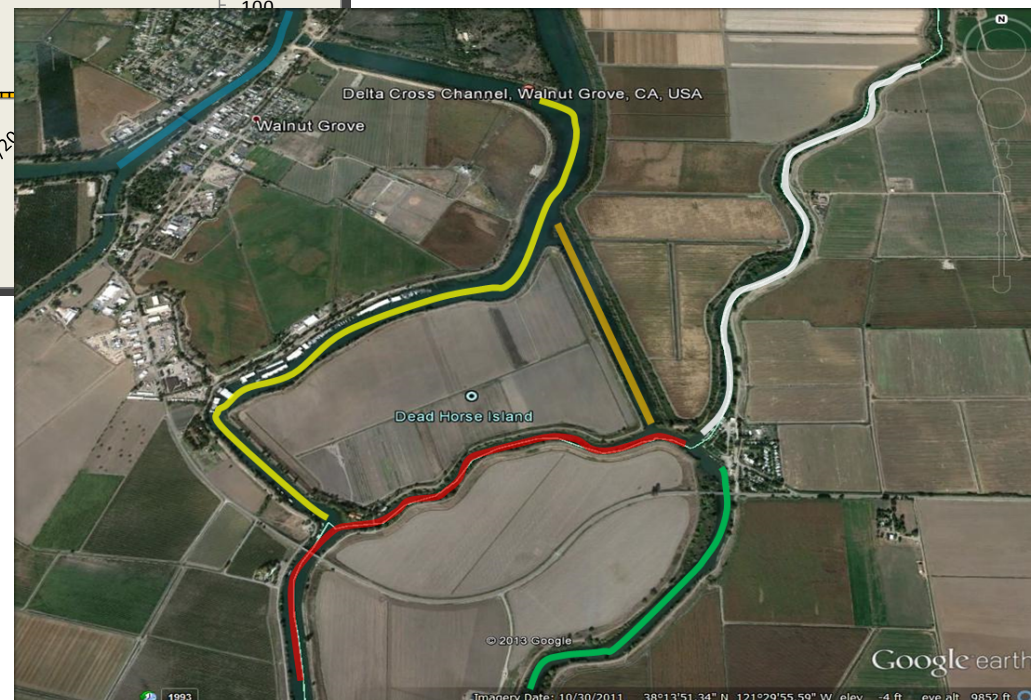
Adaptive Flow Manipulation



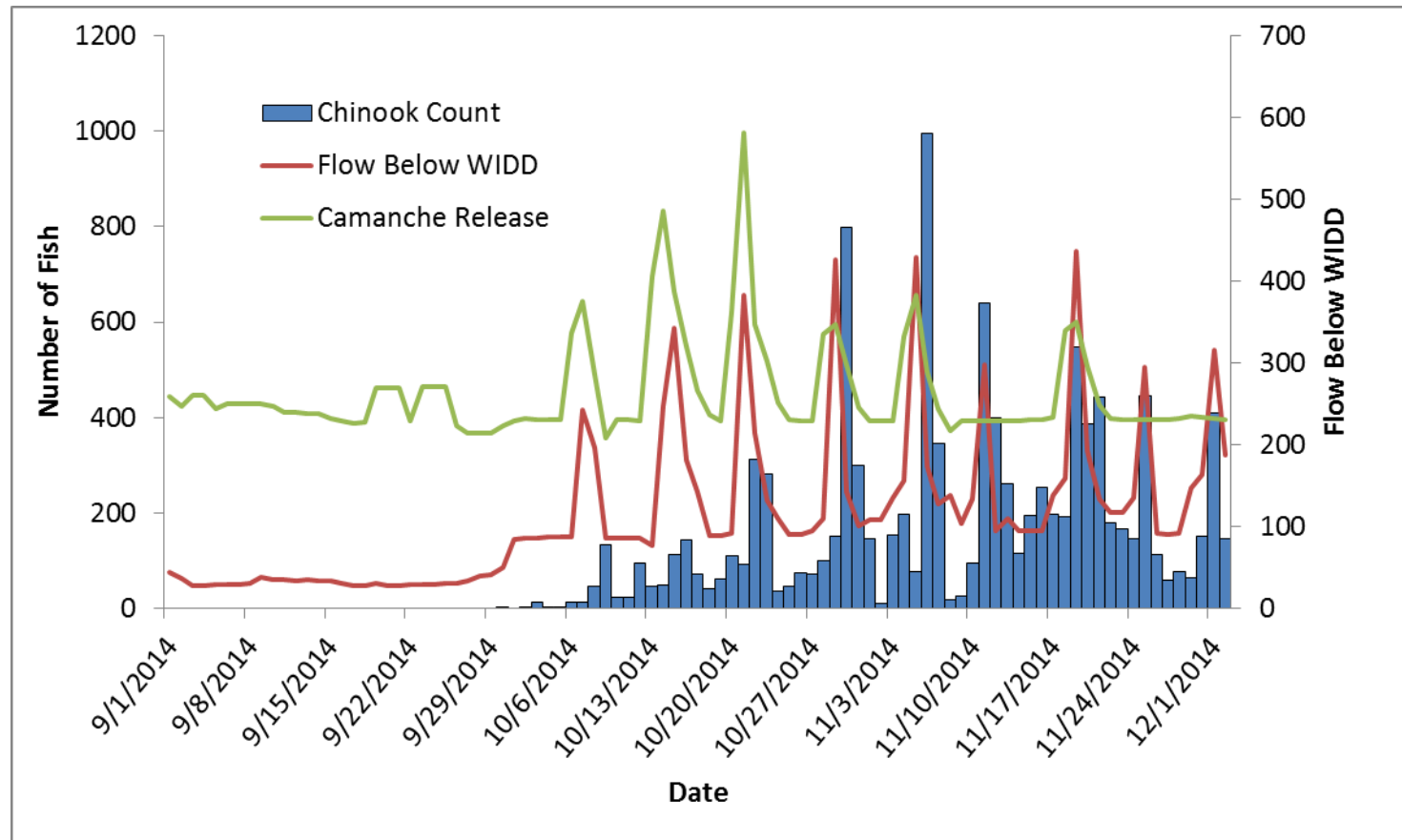
Attraction Flows and Delta Ops



Year	Stray to American
2008	65.5%
2009	41.2%
2010	17.9%
2011	6.5%



2014 Results of Pulse pattern

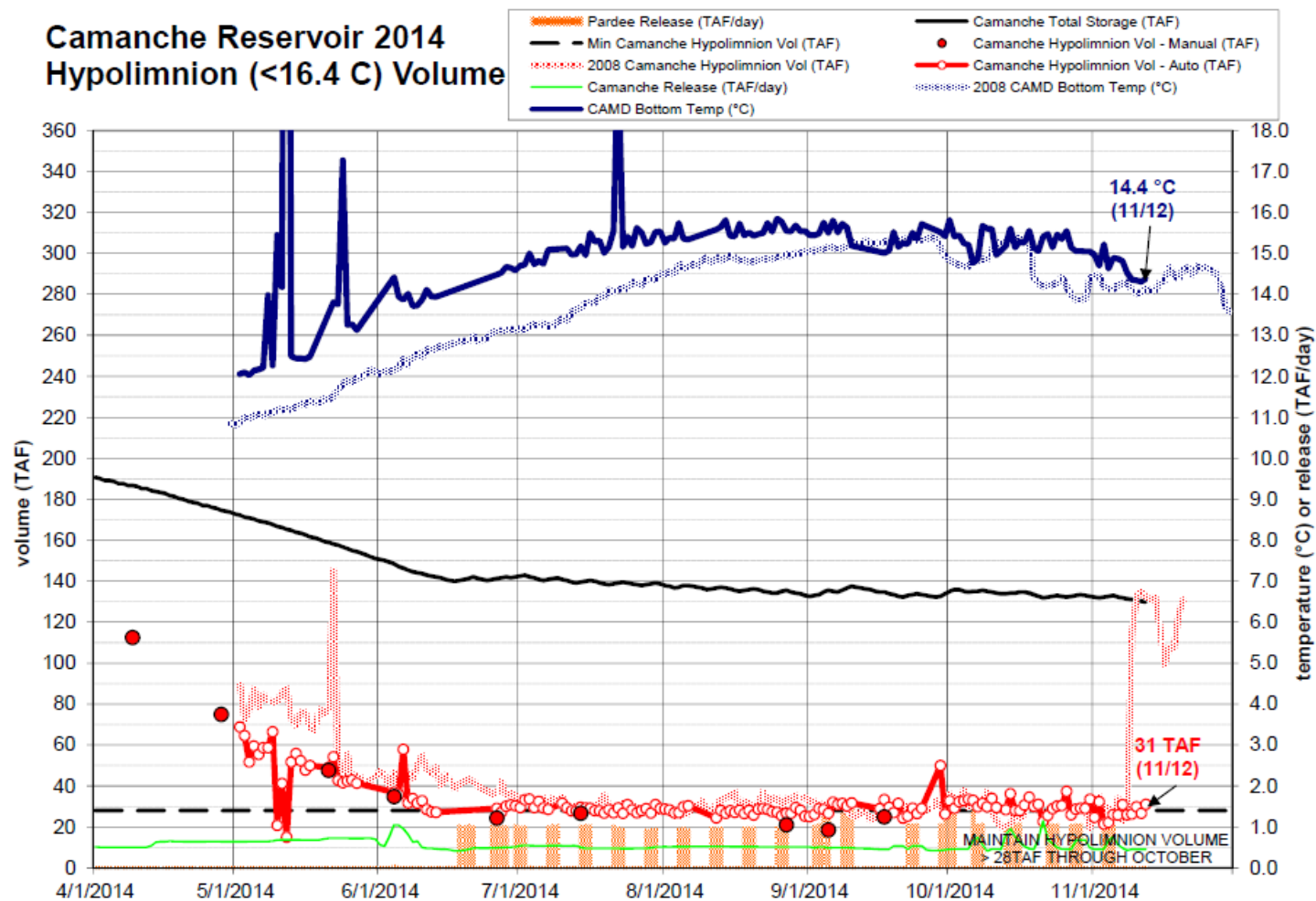


N=10,971 as of 12/2

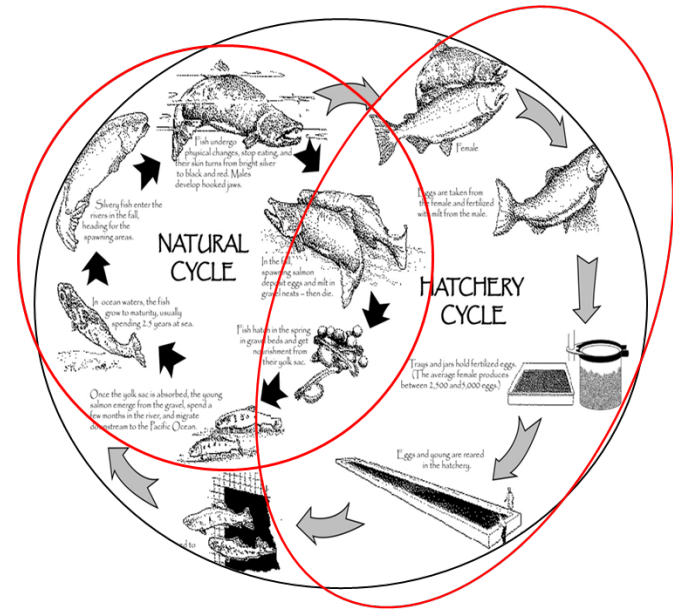
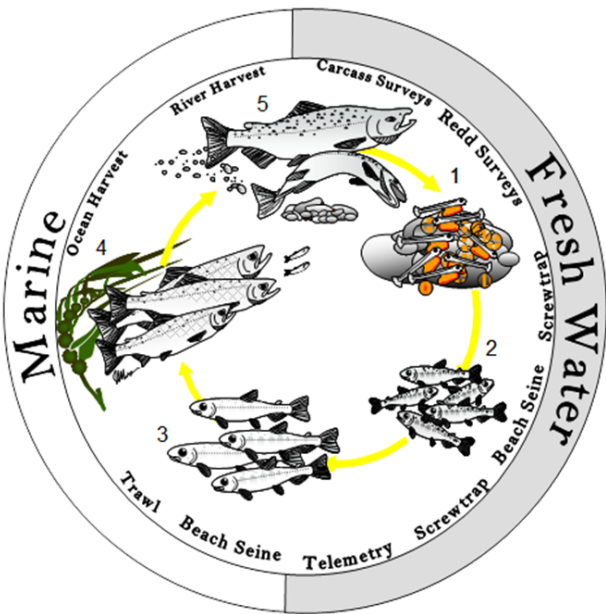
Reservoir Manipulation



Camanche Reservoir 2014 Hypolimnion (<16.4 C) Volume



Monitoring and Research



Escapement Monitoring



Escapement Monitoring

Redd Surveys



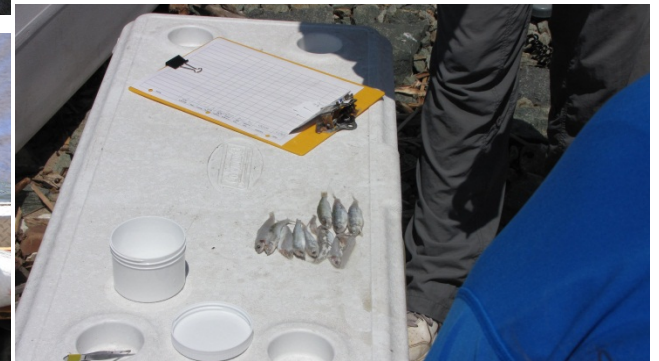
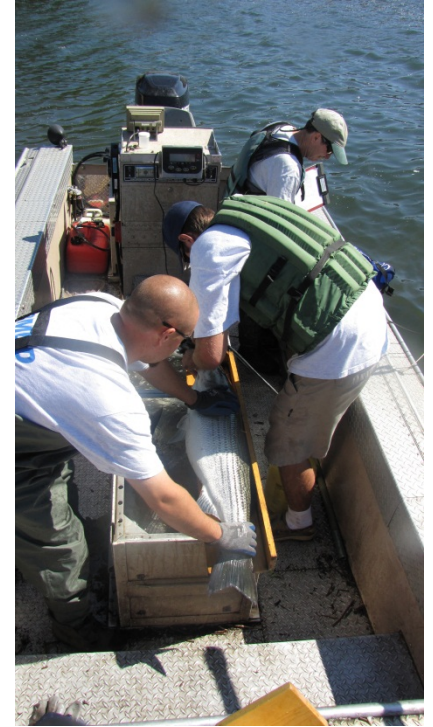
- Count salmon redds (nests)
- Distribution
- Habitat use and preferences
- In-river escapement estimate when needed

Carcass Surveys



- CWT recovery
- Pre-spawn mortality
- Collect biological samples
- In-river escapement estimate when needed

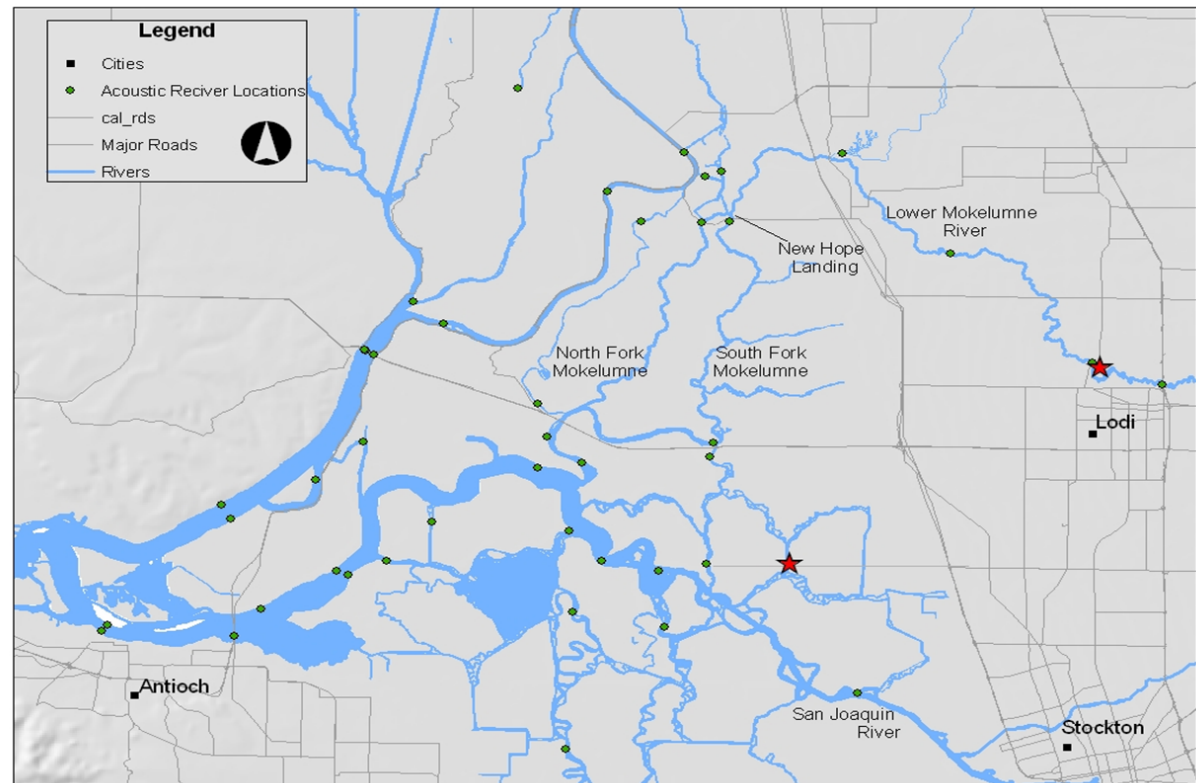
Predators = Passage issue for juveniles



Predator Removal Project



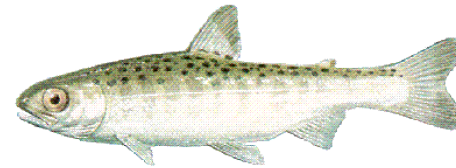
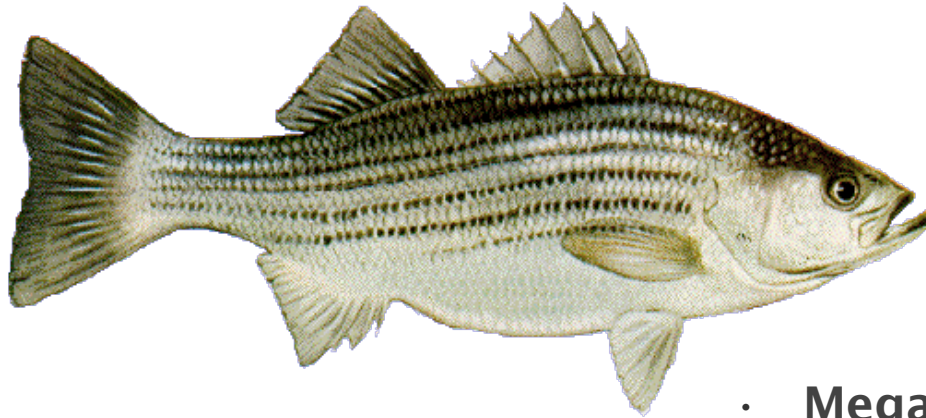
- 1) Remove predators below WIDD to reduce predation on outmigrating Chinook salmon and steelhead smolts
- 2) Track striped bass movement through the use of acoustic telemetry technology



Funding Research



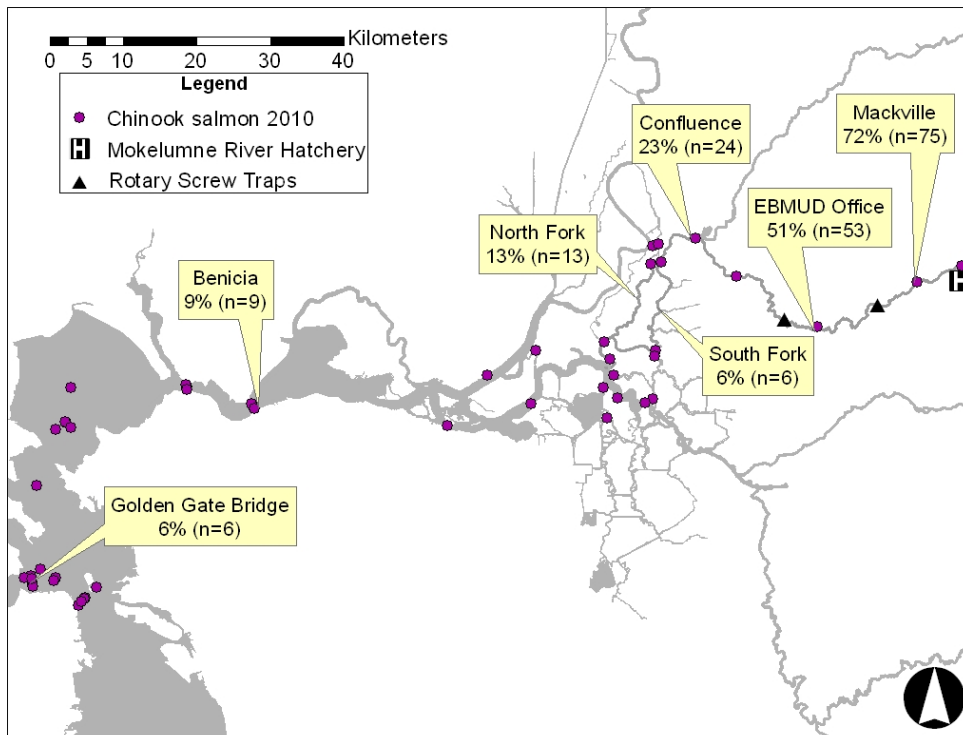
Interactive effects of a non-native predator and anthropogenic habitat alterations on native juvenile salmon



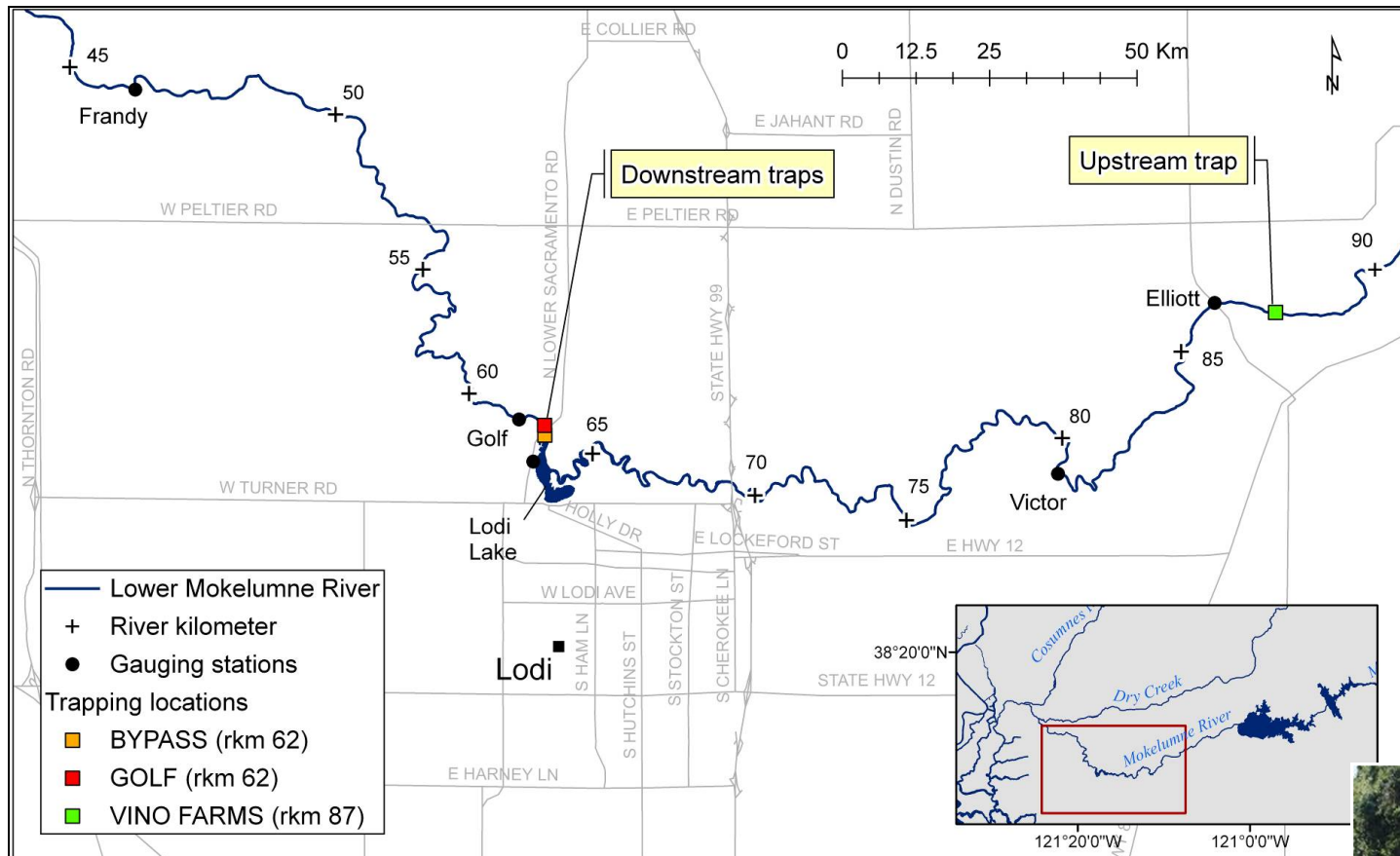
- Megan Sabal
- Mark Carr (UCSC), Sean Hayes (NMFS), Joe Merz (Cramer), Jose Setka (EBMUD)

Acoustic Telemetry

- Juvenile Chinook
- Steelhead
- Adult Chinook
- Predator movements



Juvenile Migration Monitoring



Habitat Restoration



Restoration: Over 20 years of habitat improvement on the lower Mokelumne River



• **Since 1990, roughly \$1.4 million dollars have been contributed for spawning habitat rehabilitation projects on the LMR**

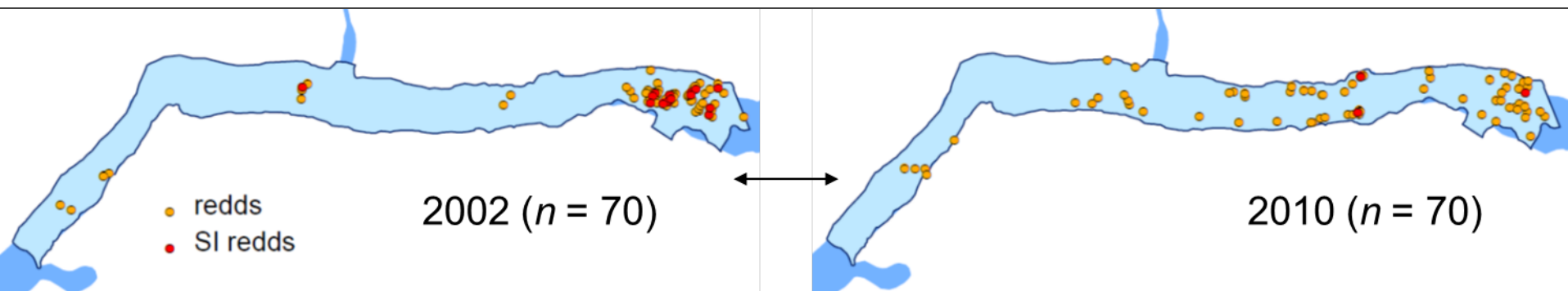
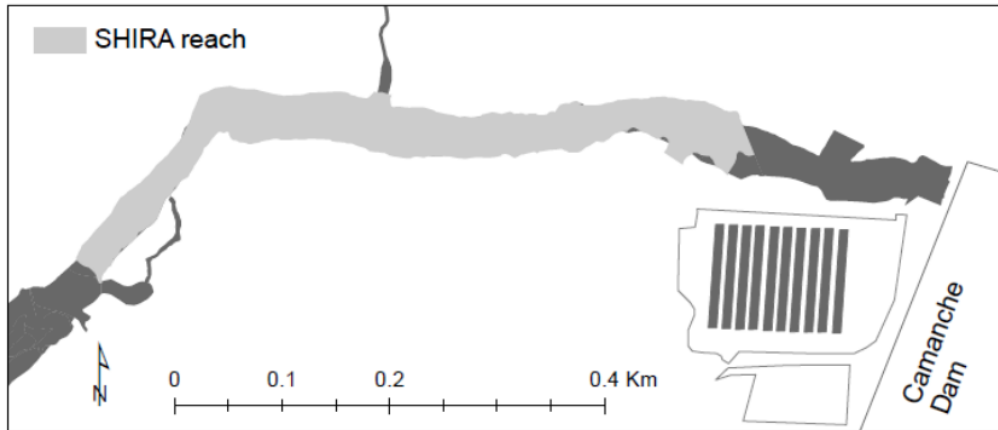
- USFWS – AFRP funding
- EBMUD funding
- CADFW funding
- LMR Partnership funding

Years	Short tons added	Percent of total added
1990–1995	1,608	2%
1996–2000	8,742	13%
2001–2005	15,104	23%
2006–2013	39,978	61%
	65,432	

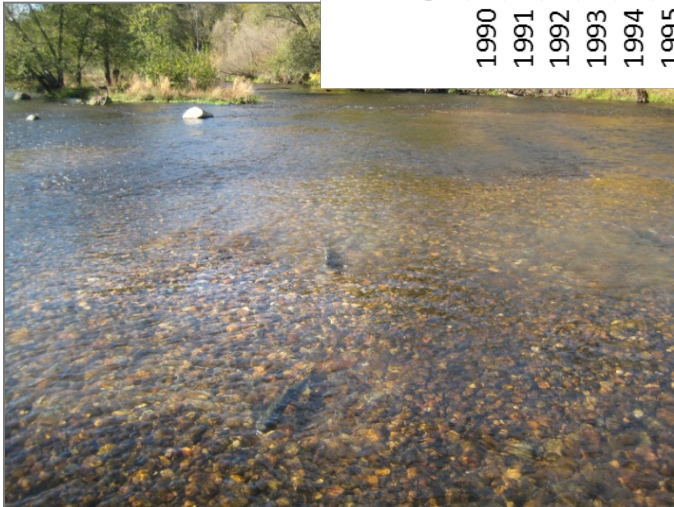
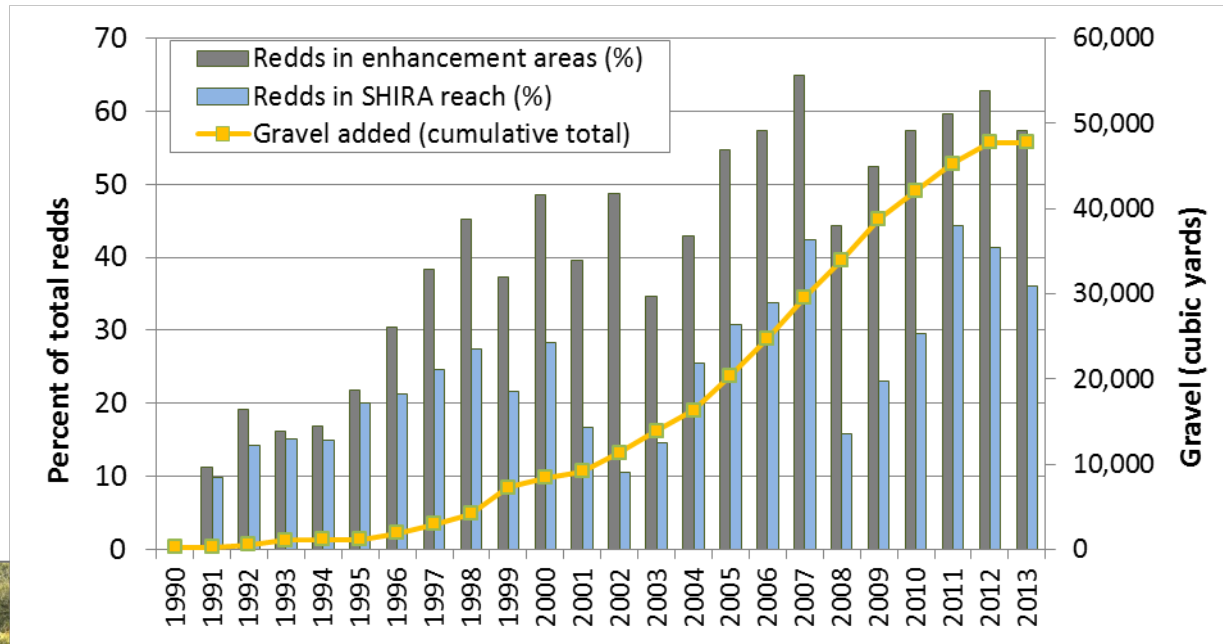


Spawning Habitat Restoration

Started with site specific placement –
developed a reach scale plan to
increase bedslope and developed a
sediment budget for the river

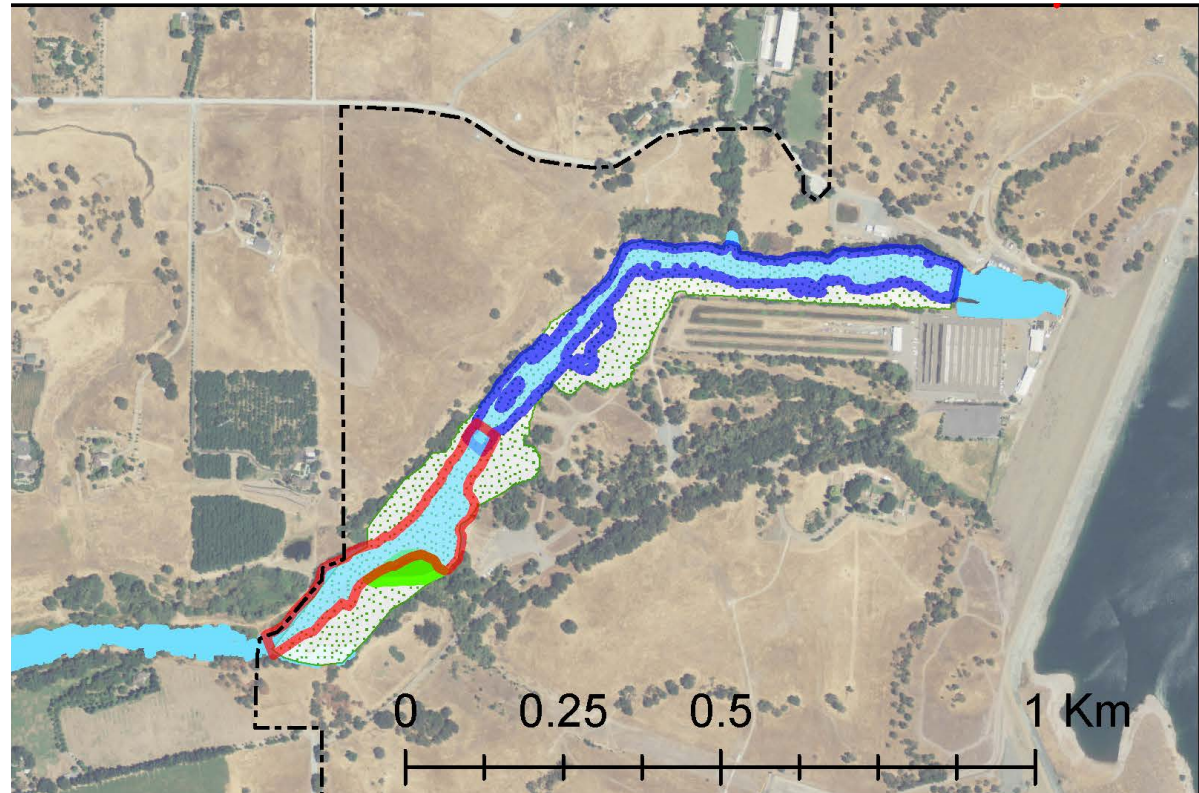


Spawning Habitat Restoration



Rearing Habitat Creation

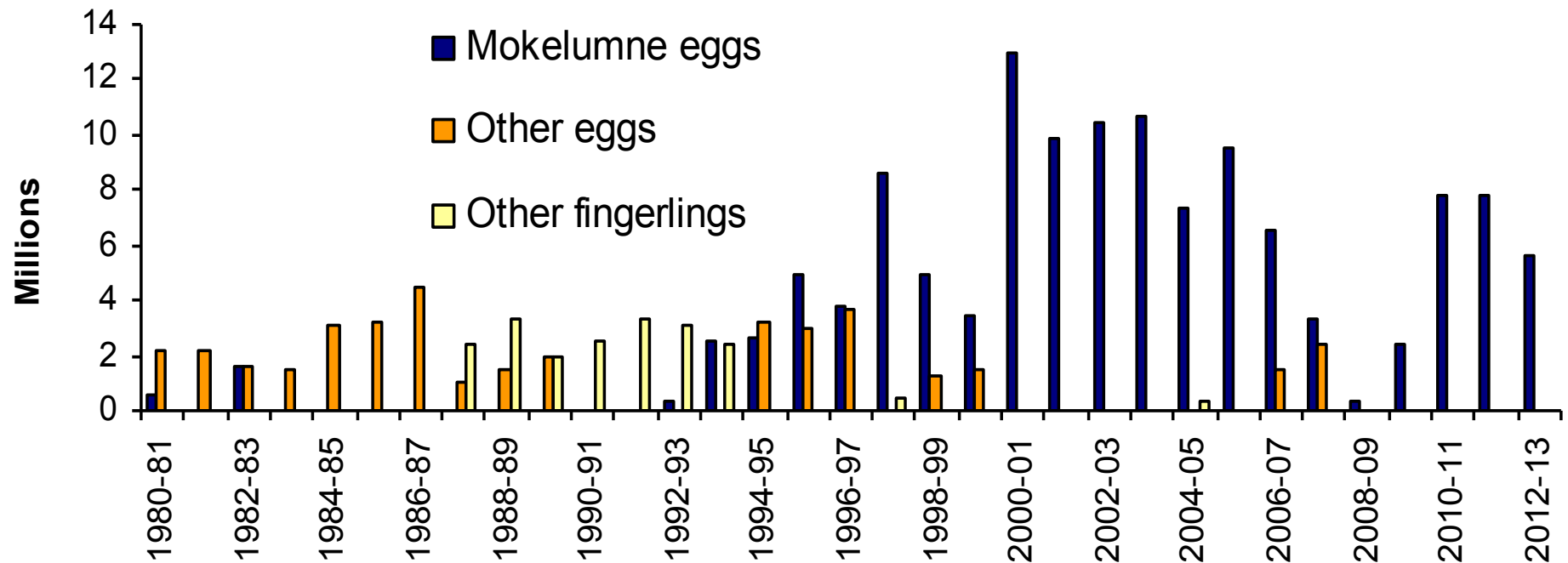
- Floodplain and Side Channel Creation to improve juvenile growth and survival



Hatchery Practices



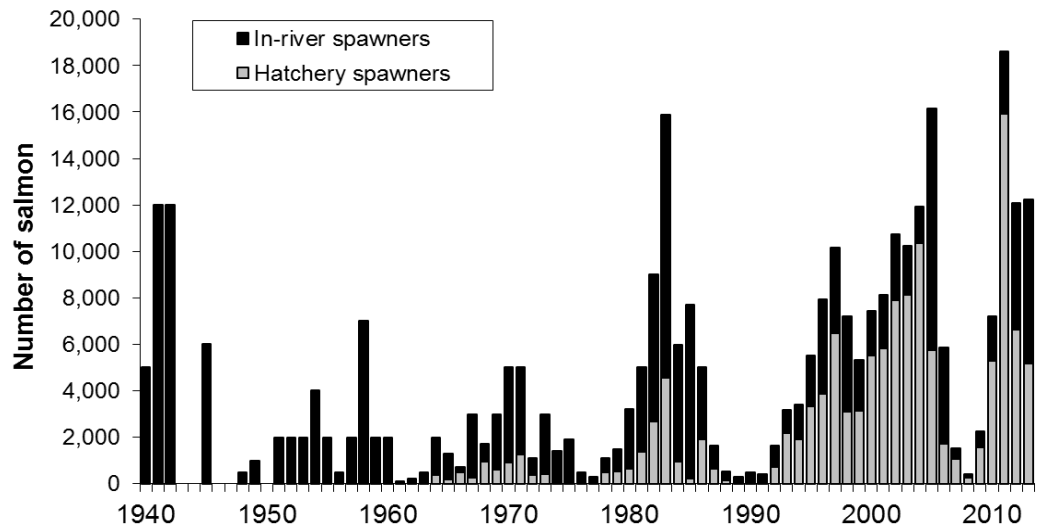
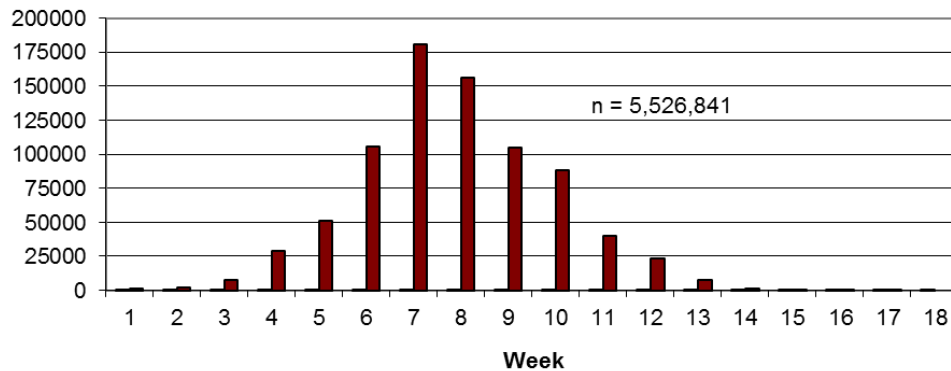
Broodstock Sources



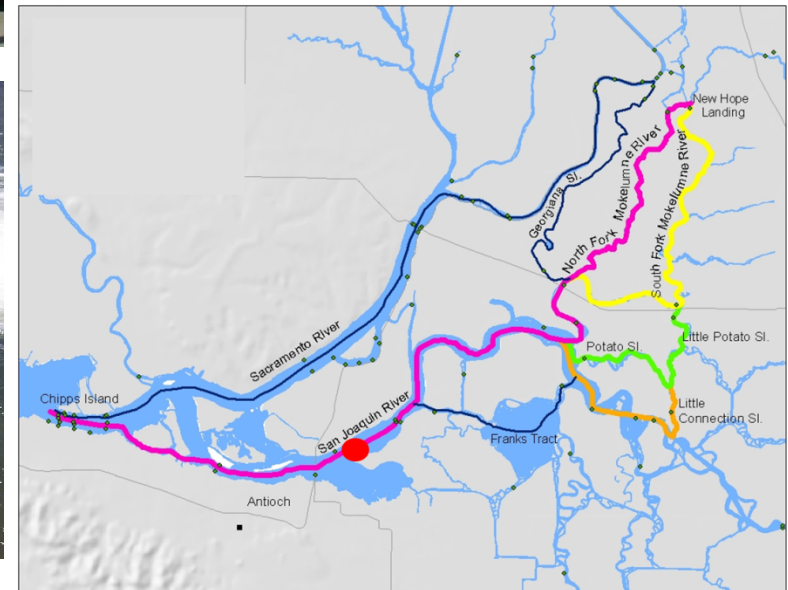
Adaptive Ladder Operations



MRFH Chinook Salmon
Mean Weekly Egg Take 1992 - 2010



Release Locations



Release Strategies



Balancing Increased
Survival with Reduced
Straying
Barging?



Fish above Dams in the Future?



Upper Mokelumne River Group

Foothill Conservancy

Fisheries Agencies

Tribes

Stakeholders

EBMUD

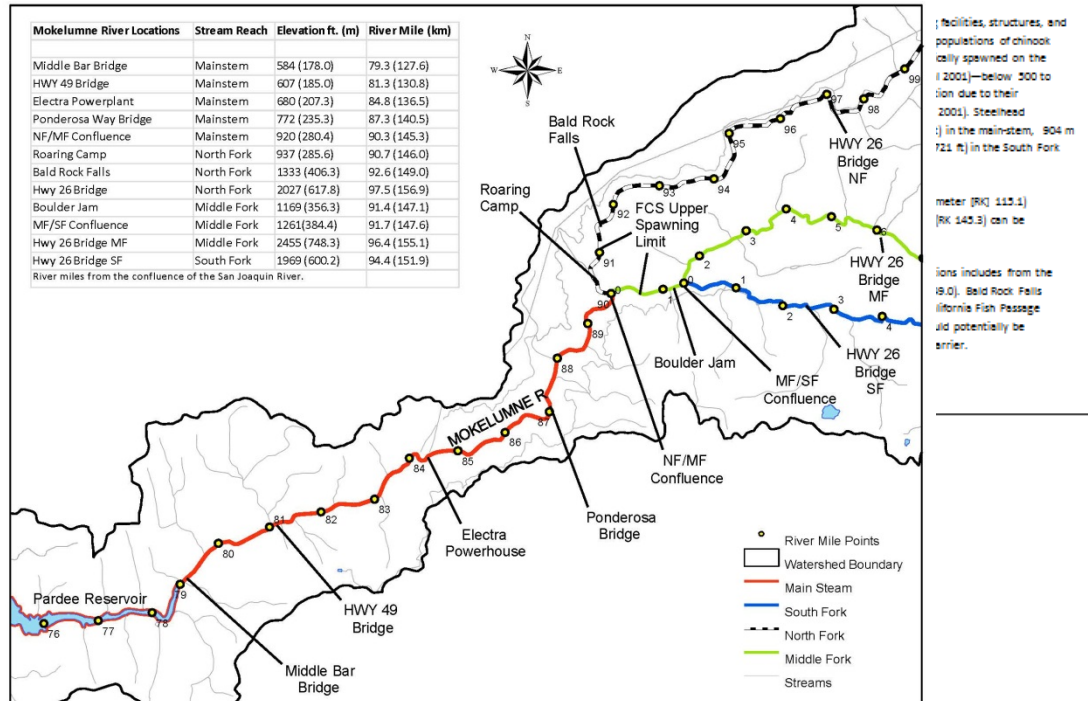
Upper Mokelumne River Anadromous Fish Restoration

Draft

Pilot Fish Reintroduction Project

Introduction

The Upper Mokelumne River Anadromous Fish Restoration Workgroup has prepared a draft pilot project plan to determine the feasibility of moving anadromous fish from the lower Mokelumne River to the Mokelumne River between Middle Bar Bridge and the confluences of the North, Middle, and South Forks. The design is a prescriptively approached project to transport and study the reintroduction of anadromous fish from the Mokelumne River Fish Hatchery or Lower Mokelumne River into the Upper Mokelumne River above Pardee that can be implemented within a 1-5 year timeframe. Key aspects of the project are described below and include: a description and evaluation of the current physical environment and operation of both the upper and lower Mokelumne River reaches and associated reservoirs and facilities; potential sources of fish and appropriate species, numbers and methods to implement the project; and consideration of permitting/permissions required to achieve the goal.



Partnership & Collaboration



Woodbridge Irrigation District

CDFW

USFWS AFRP

NMFS

USBR

Many Landowners Along Mokelumne

UC Davis

UC Santa Cruz

Golden Gate Salmon Association

