



## **Section 3406 (b)(1)**

# **Anadromous Fish Restoration**

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**U.S. Fish and Wildlife Service**



Photo: USBR



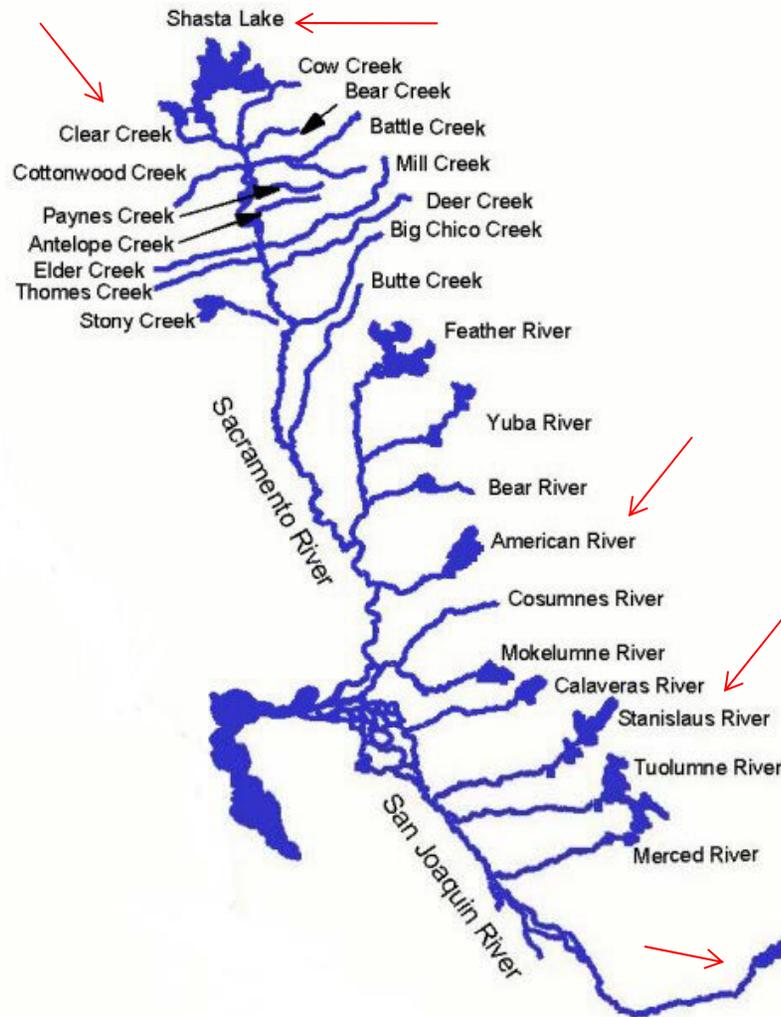
Photo: USFWS



# ANADROMOUS FISH RESTORATION PROGRAM



## Background



- The Central Valley Project Improvement Act (CVPIA) was signed into law in 1992.
- The CVPIA directs the Secretary of the Interior to develop and implement a program that makes all reasonable efforts to double natural production of anadromous fish in Central Valley rivers and streams.
- The Final Restoration Plan (FRP) identified 289 actions to be implemented by the Program that would help achieve the Act's anadromous fish doubling goal.
- The impacts of this programmatic-level Restoration Plan were analyzed in the CVPIA Programmatic Environmental Impact Statement and the Record of Decision was signed in 2001.
- The FRP focused on 26 watersheds, Misc. creeks, westside tributaries, and the Delta.

CVPIA Public Meeting March 15<sup>th</sup>, 2012



## Introduction

### (b)(1) Program Goal

- “implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long term basis, at levels not less than twice the average levels attained during the period of 1967-1991 (Section 3406(b)(1) of the CVPIA).”
- AFRP Chinook Salmon Natural Production Targets

Central Valley	990,000
Fall Run	750,000
Late-Fall Run	68,000
Spring Run	68,000
Winter Run	110,000



Photo: EBMUD



## Introduction

### (b)(1) Program Goal

- AFRP Anadromous Fish Production Targets

Steelhead	13,000
Green sturgeon	1,966
White sturgeon	11,142
Striped Bass	2,500,000
American shad	4,300

- Additional information on AFRP production targets and estimates can be found in the 2011 CAMP Annual Report.

[http://www.fws.gov/sacramento/Fisheries/CAMP-Program/Documents-Reports/Documents/2011\\_CAMP\\_annual\\_report.pdf](http://www.fws.gov/sacramento/Fisheries/CAMP-Program/Documents-Reports/Documents/2011_CAMP_annual_report.pdf)

GREEN STURGEON (Adult and Juvenile)



WHITE STURGEON (Adult and Juvenile)





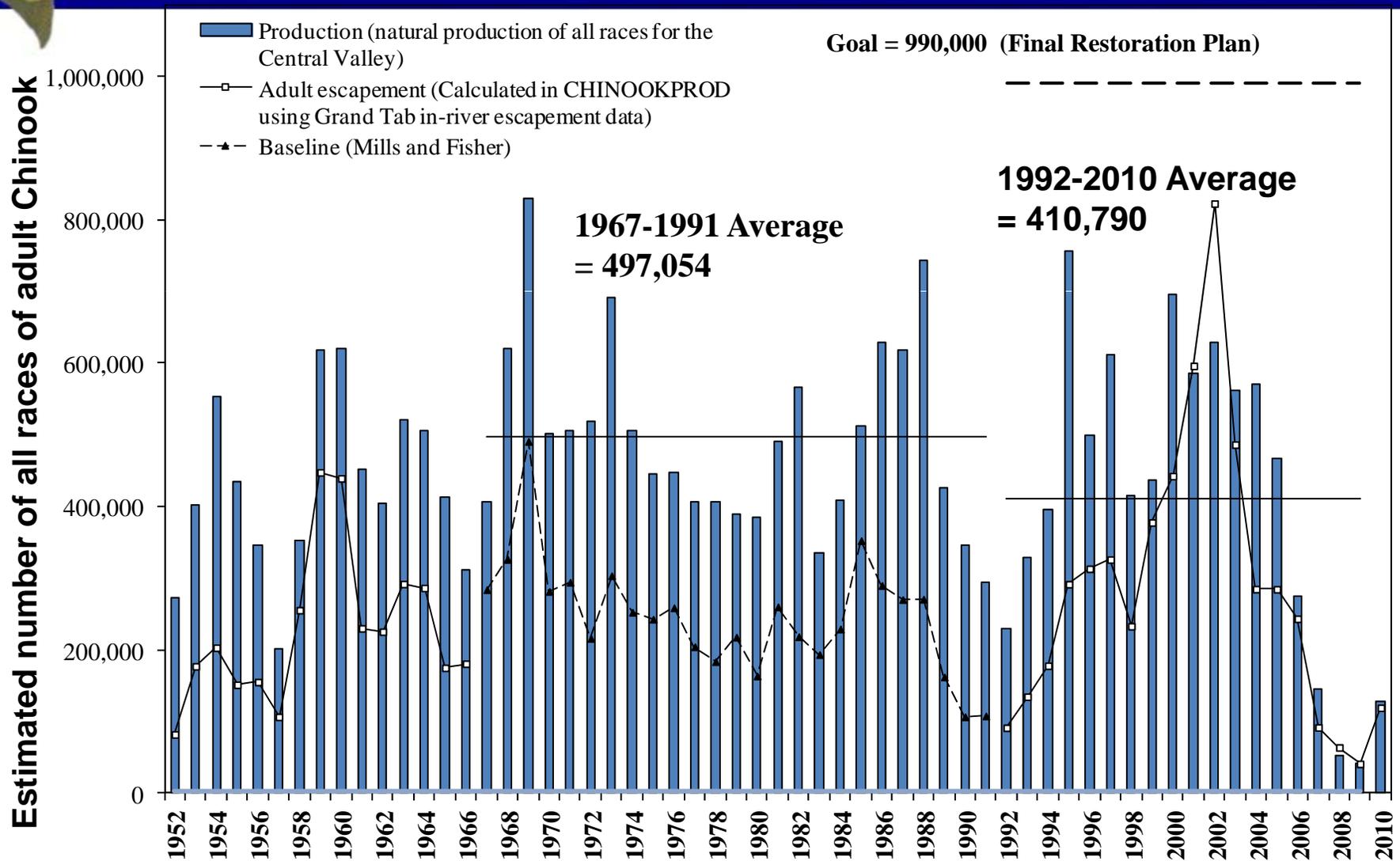
## **(b)(1) Objectives**

- Improve habitat for all life stages of anadromous fish through provisions of flows of suitable quality, quantity, and timing, and improved physical habitat.
- Improve survival rates by reducing or eliminating entrainment of juveniles at diversions.
- Improve the opportunity for adult fish to reach their spawning habitats in a timely manner.
- Collect fish population, health, and habitat data to facilitate evaluation of restoration actions.
- Integrate habitat restoration efforts with harvest and hatchery management.
- Involve partners in the implementation and evaluation of restoration actions.

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## Chinook Salmon Production Estimate



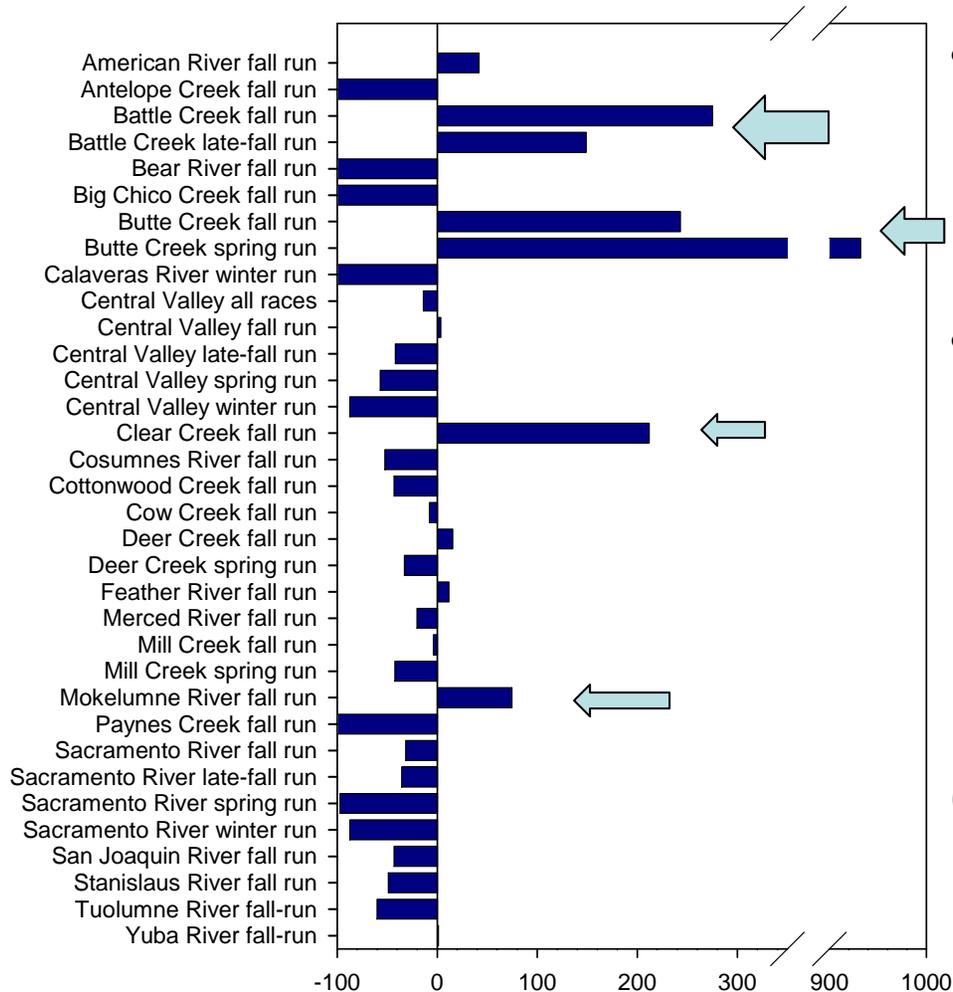
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## Chinook Salmon Production



- The percent of natural production during the doubling period (1992-2010) in relation to the baseline period (1967-1991).
- The doubling goal for Chinook salmon production for the period of 1992-2010 has been exceeded on Clear, Butte, and Battle creeks and has been nearly met on the Mokelumne River.

Chinook Salmon Natural Production Estimates:

<http://www.fws.gov/stockton/afrp>

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## Chinook Salmon Production



Watershed and Chinook salmon run	Baseline period (1967 – 1991) natural production averages	Doubling period (1992 – 2010) natural production averages	P values associated with changes in the average production between the 1967-1991 and 1992-2010 time periods
* Indicates a fish hatchery is present in the watershed			
<b>Battle Creek fall run *</b>	<b>5,013</b>	<b>17,977</b>	<b>0.0005</b>
<b>Battle Creek late-fall run *</b>	<b>273</b>	<b>681</b>	<b>0.0006</b>
<b>Butte Creek fall run</b>	<b>765</b>	<b>2,466</b>	<b>0.036</b>
<b>Butte Creek spring run</b>	<b>1,018</b>	<b>10,035</b>	<b>0.000</b>
<b>Clear Creek fall run</b>	<b>3,576</b>	<b>10,940</b>	<b>0.0001</b>
<b>Mokelumne River fall run *</b>	<b>4,680</b>	<b>8,024</b>	<b>0.019</b>

- Significant increase in the average natural production of fall run Chinook salmon between the baseline period and the doubling period in Battle, Butte, Clear creeks and in the Mokelumne River.
- Significant increase in the average natural production of late-fall run Chinook salmon between the baseline period and the doubling period in Battle Creek.
- Significant increase in the average natural production of spring run Chinook salmon between the baseline period and the doubling period in Butte Creek.



## **(b)(1) Program Status**

### **CVPIA Program Activity Review (CPAR) Accomplishments**

- **Total of 128 High and Medium Priority Actions from the Final Restoration Plan.**
  - 75 are Non-structural Actions with Endpoints of which 25 (33%) have been completed to date.
  - 53 are Structural Actions with Endpoints of which 21 (38%) have been completed to date.
- **About 23% of all Restoration Plan actions and evaluations (289) have been completed in the 1992 to 2010 time period.**

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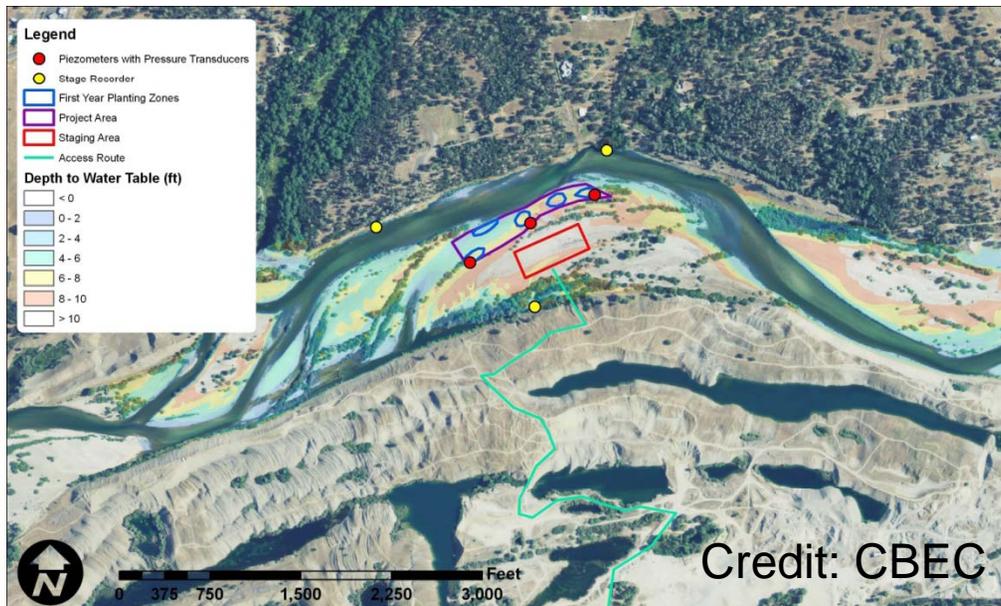
## (b)(1) Habitat Restoration



### FY 2011 Accomplishments

#### Yuba River Hammon Bar Restoration

- All the environmental documents were completed in 2011 to implement a riparian restoration pilot project.
- Five acres were planted with cottonwood and willow pole cuttings to restore riparian habitat in the lower Yuba River (Evaluation 4).
- Total Cost \$315,000



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## (b)(1) Habitat Restoration



### FY 2011 Accomplishments

### Mokelumne River Spawning Habitat

- Purchased and placed 4,166 yds<sup>3</sup> of coarse sediment to improve natural production of Chinook salmon and steelhead at several spawning sites (Actions 2 and 7).
- Total Cost \$500,000



Photo: USFWS



Photo: USFWS

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## (b)(1) Habitat Restoration

### FY 2011 Accomplishments

#### American River Spawning and Rearing Habitat Restoration Project

- Environmental Compliance Documents and Permits were completed.
- Restored a dewatered side-channel ¼ mile long and enhanced an existing gravel bar with 5,000 yds<sup>3</sup> (Action 5).
- Total Cost \$410,418



Photo: USFWS



Photo: USFWS



# (b)(1) Habitat Restoration



## FY 2011 Accomplishments

### Merced River Ranch Floodplain Restoration

- Added 28,000 yds<sup>3</sup> of coarse sediment for spawning (Action 3).
- Once completed in 2013, the Merced River Ranch Floodplain Enhancement Project will restore up to 6 acres of riparian floodplain and 1.23 miles of spawning habitat.
- Total cost to date \$1,474,254



Photo: USFWS



Photo: USFWS

# Merced River Ranch

An aerial photograph of the Merced River Ranch. The image shows a winding river flowing through a landscape characterized by terraced hills and dense green forest. The river is the central focus, curving through the terrain. The hills are covered in a mix of green trees and dry, yellowish-brown vegetation. The overall scene is a mix of natural beauty and agricultural or managed land.

Photo: Cramer Fish Science

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## (b)(1) Habitat Restoration

### FY 2011 Accomplishments

#### Stanislaus River Floodplain Restoration (Action 2)

- Environmental Compliance Documents and Permits were completed.
- The Lancaster Road Project was completed and restored 640 feet of riparian side-channel habitat for fall run Chinook salmon and steelhead (Total Cost \$470,543).
- The Honolulu Bar Project will restore 2.5 acres of riparian floodplain, add 8,100 yds<sup>3</sup> of spawning gravel, and restore 485 feet of side-channel habitat (Scheduled for 2012) for fall run Chinook salmon and steelhead (Total AFRP Cost \$660,170).
- Addresses Action III.2.3 in NMFS OCAP BO



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## (b)(1) Habitat Restoration



Photo: USFWS



Photo: USFWS

Lancaster Road Project - Before

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## (b)(1) Habitat Restoration



Photo: USFWS



Photo: USFWS

Lancaster Road Project - After

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## (b)(1) Habitat Restoration



Photo: USFWS



Photo: USFWS

Lancaster Road Project – After (600 cfs)

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## (b)(1) Habitat Restoration



### FY 2011 Accomplishments

#### Tuolumne River Bobcat Flat

- Environmental Compliance Documents and Permits were completed.
- Phase 2 was completed that excavated 19,000 yds<sup>3</sup> of gravel and restored up to 8 acres of highly disturbed [floodplain](#) and 1.6 miles of fall run Chinook salmon and steelhead spawning and rearing habitat (Action 2).
- Total Cost \$619,433

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## (b)(1) Habitat Restoration



Source: McBain & Trush, 2009.

MOORE BIOLOGICAL



FIGURE 3  
ARTISTS RENDERING OF PHASE II WORK

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## (b)(1) Fish Screens

### FY 2011 Accomplishments

#### Antelope Creek Juvenile Fish Passage Improvement Project at Edwards Diversion Dam (Action 1).

- Feasibility study completed, environmental documents and permits initiated, and designs were developed.
- Total cost to date \$60,000



Photos: CDFG

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## (b)(1) Fish Passage

### FY 2011 Accomplishments

#### Antelope Creek Tehama Wildlife Area Road Crossing Project (Action 1)

- Construction designs and environmental compliance documents completed.
- Once completed in 2012 it will improve passage to 13 miles of spawning and holding habitat for spring run Chinook salmon.
- Addresses Action I.3.5 in NMFS OCAP BO
- Total Cost \$800,000



Photo: USFWS



Photo: USFWS



Photo: USFWS



## (b)(1) Fish Passage

### FY 2011 Accomplishments

#### Cow Creek Millville Diversion Dam Fish Passage Project (Action 3)

- Environmental compliance documents and permits for a boulder weir fishway were completed in 2011.
- This project will provide access to an estimated 10 miles of fall run Chinook salmon and steelhead habitat.
- Total AFRP Cost to Date \$90,000



Millville Ditch Co. Dam on Clover Creek "Leslie on dam"

Source: Glen Campbell 2006



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## (b)(1) Fish Passage

### Cottonwood Creek Anderson-Cottonwood Irrigation District (ACID) Siphon Project (Action 2)

- Construction was completed in FY 2011.
- This project improved passage to 30 miles of spawning habitat for fall Chinook salmon, spring Chinook salmon, and steelhead.
- Total AFRP Cost \$130,000



### Cottonwood Creek ACID Siphon Fish Barrier

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## (b)(1) Fish Passage

### FY 2011 Accomplishments (cont'd)

#### Calaveras River Passage Improvement Project (Action 3)

- The Budiselich Flashboard Dam boulder weir retrofit was completed.
- This project restored access to about 10 miles of habitat for salmon and steelhead.
- Total AFRP cost \$294,453



### Budiselich Flashboard Dam Boulder Weir Fishway



## **(b)(1) Monitoring**

### Project specific Monitoring

- evaluates restoration actions success

### Demonstration Projects

- showcases new technologies or methodology through evaluations studies
- short term (1 to 3 years)

### Sharing Equipment

- MOU or Agreements

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## (b)(1) Monitoring



### VAKI Riverwatcher Fish Counting System

- **Currently have two AFRP VAKI Fish Counting Systems being operated by CDFG at the Yuba River Daguerre Point Dam and a fish counting weir with a VAKI system in the Stanislaus River operated by Tri-Dam.**



Photo: USFWS



Photo: FishBio

**Yuba River Daguerre Point Dam Monitoring**

**Stanislaus River Fish Counting Weir**

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## (b)(1) Monitoring Results

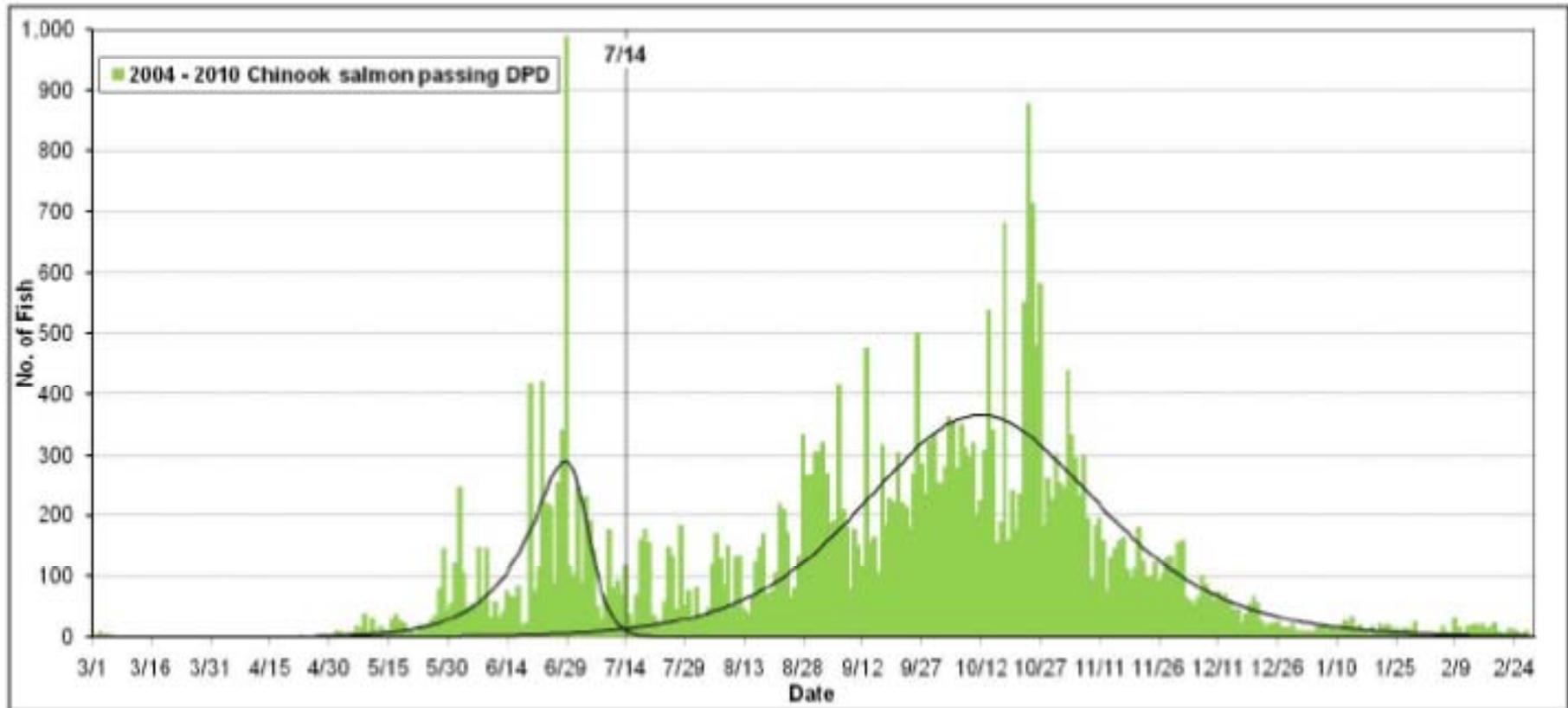


Figure 5-5. Daily number of Chinook salmon passing upstream of Daguerre Point Dam during the combined 2004-2010 biological years. Bars indicate the combined VAKI Riverwatcher daily counts and lines indicate the predicted daily distributions of spring-run and fall-run Chinook salmon based on the fitting of two generalized logistic functions to the data.

Credit: USCOE 2011

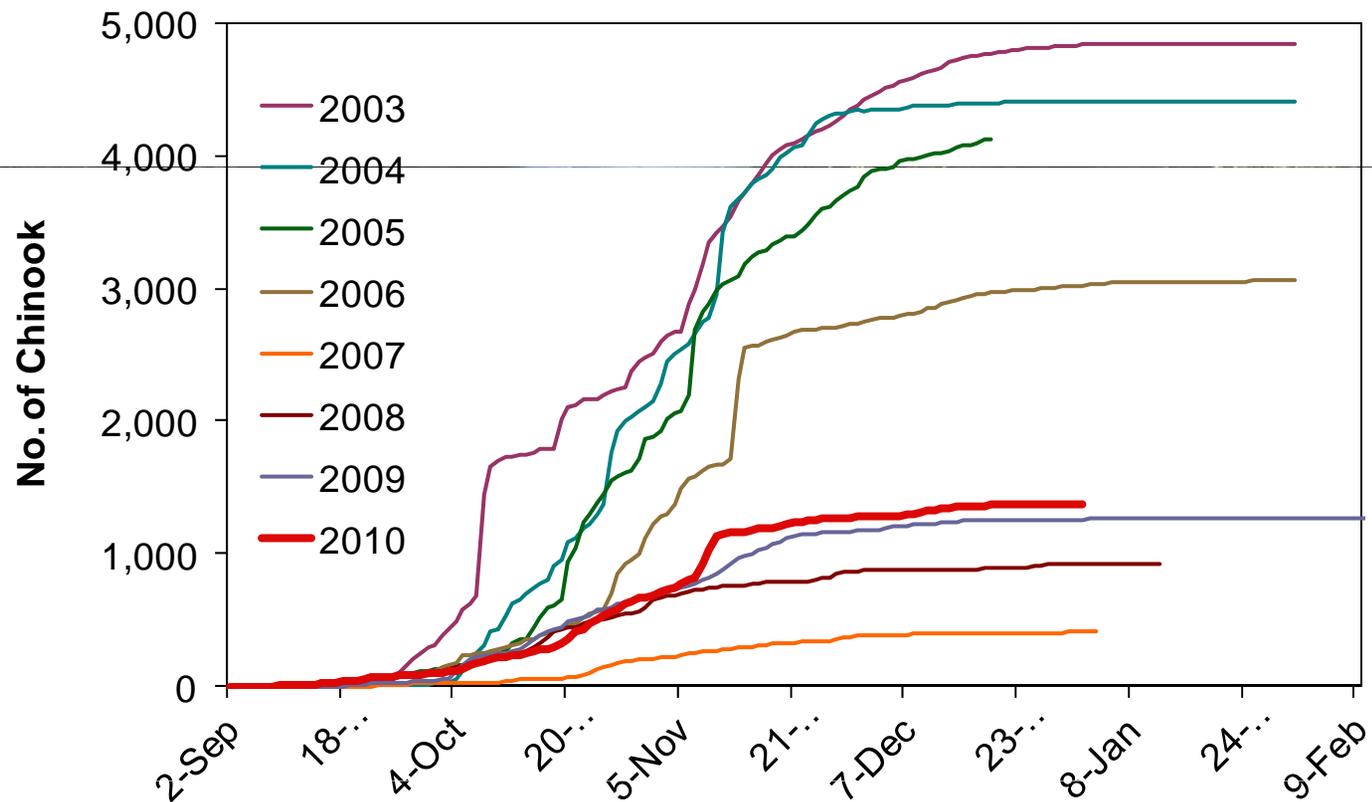
# ANADROMOUS FISH RESTORATION PROGRAM



## (b)(1) Monitoring Results



Cumulative Chinook Passage at the Stanislaus River Weir



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## FY11 (b)(1) Monitoring Projects



- Identify sturgeon spawning habitat and use in the Feather and Yuba rivers with sonic telemetry (Evaluations 5 and 7).
- Underwater video surveys were conducted in the Yuba River on May 24 – 26, 2011 and 4 green sturgeon were documented in the Daguerre Point Dam plunge pool.



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## FY11 (b)(1) Monitoring Projects



- Identify sturgeon spawning habitat and use in the San Joaquin River system (Evaluation 4).
- Twenty-four white sturgeon eggs were captured by egg mats in late April through early May 2011, representing the first documentation of sturgeon spawning in the San Joaquin River basin.

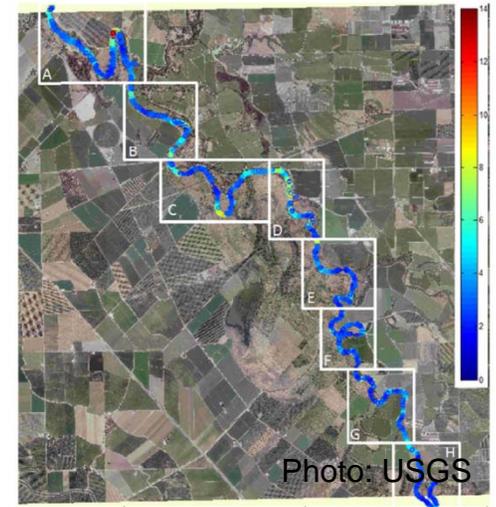


Figure 7 – ADCP depths (in meters) throughout the reach. Lettered windows refer to locations shown in figures 8 and 9.



Photo: USFWS

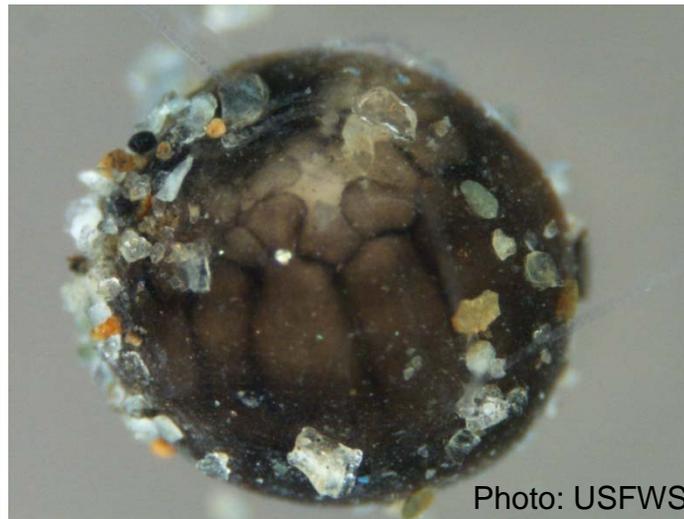


Photo: USFWS

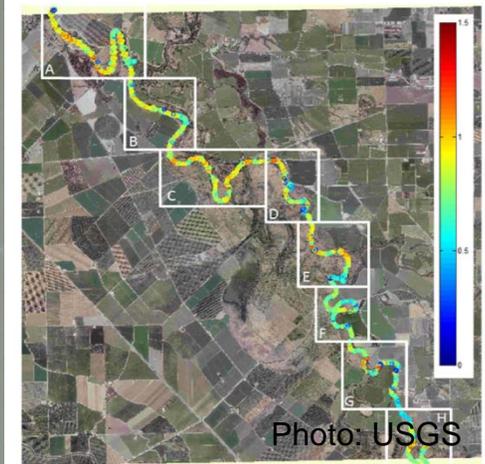


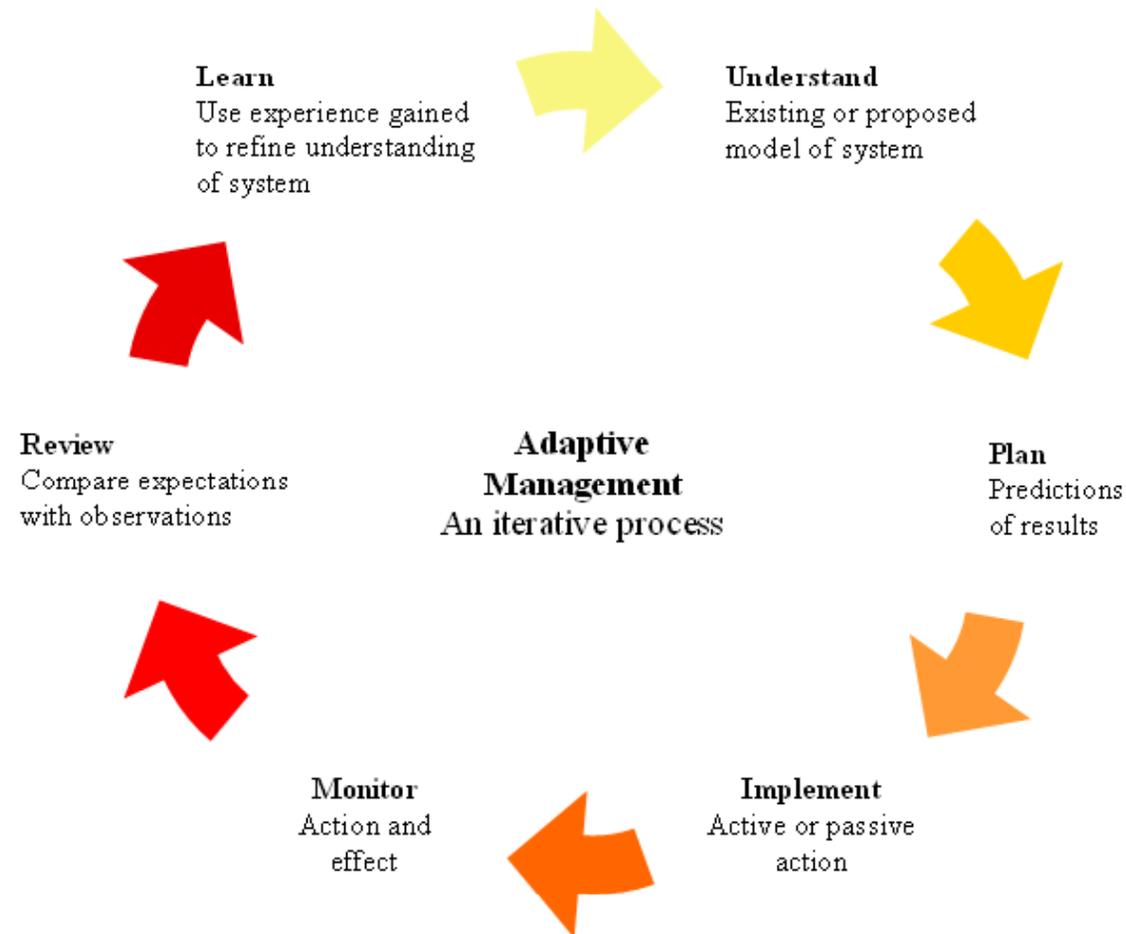
Figure 10 – ADCP velocities (in meters per second) throughout the reach. Lettered windows refer to locations shown in figures 11 and 12.



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# Adaptive Management



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# Adaptive Management



- Lessons learned

- Mokelumne River Spawning Habitat Integrated Rehabilitation Approach (SHIRA) model used to guide gravel restoration efforts.
  - Redd, habitat, and gravel distribution information is collected annually.
  - Very labor intensive but results have shown high usage of gravel enhanced areas.
  - Redd superimposition has decreased.
  - % of Redds in gravel enhanced area has increased.

# ANADROMOUS FISH RESTORATION PROGRAM



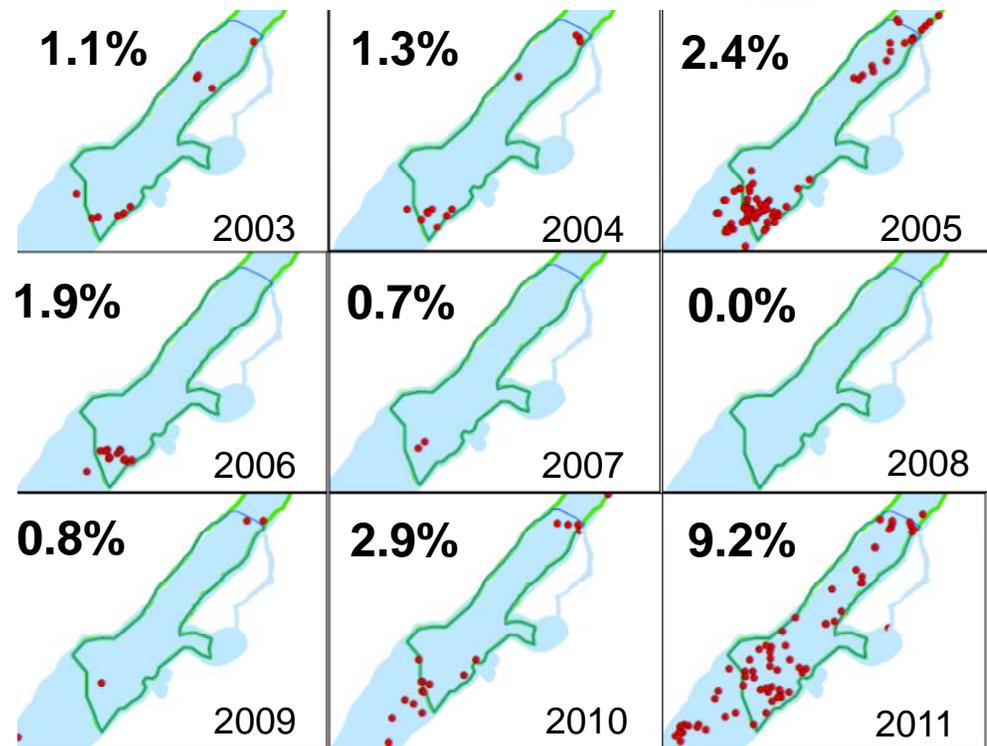
# Adaptive Management



- 2011 SHIRA project area
- SHIRA reach
- 2011 redds

0 0.05 0.1 Km

4-7



- 203 of 563 redds (**36%**) found in SHIRA reach
- 52 of 563 redds (**9%**) found in 2011 project area
- % of redds in project area has increased

Credit: EBMUD

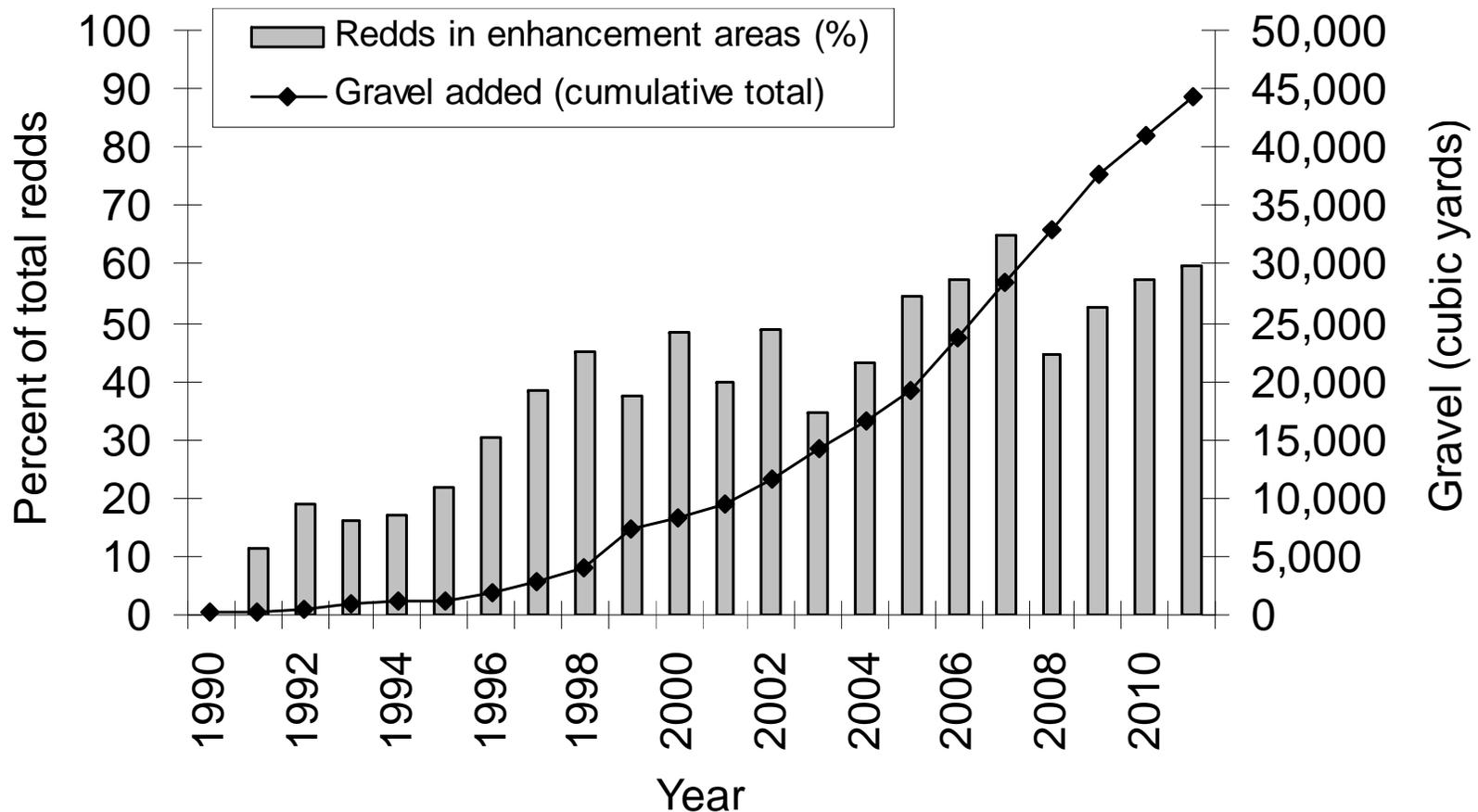
**Mokelumne River Spawning Habitat Improvement Project**



# ANADROMOUS FISH RESTORATION PROGRAM



# Adaptive Management



Credit: EBMUD

Mokelumne River Spawning Habitat Improvement Project



# Adaptive Management



- Lessons learned

- In 2010 and 2011, AFRP began implementing floodplain and spawning habitat restoration projects in the American River and Merced River where project monitoring and evaluations provided additional insight for planning future phases of these projects.
  - New alternative was developed for the American River Upper Sunrise Project.
  - Gravel estimates of total volume and composition for the Merced River Ranch restoration project activities proposed for FY12 and available for other future projects were revised.
  - Pre- and Post- project monitoring revealed immediate response from Chinook salmon and steelhead using the AFRP gravel recommendations.



## ANADROMOUS FISH RESTORATION PROGRAM



# Adaptive Management

	Mean %<15.9mm	Mean Apparent Velocity	Mean Survival
Natural Gravel	14.1%	2.08 cm/min	70.1%
6.4 mm Screen	26.7%	1.57 cm/min	72.8%
9.5 mm Screen	19.8%	2.39 cm/min	73.5 %
25.4 mm Screen	1.0%	5.74 cm/min	0.9%



### 6.4 mm screened gravel



- AFRP recommends 5-10% of gravel mixtures used to restore salmonid spawning habitat should contain particles smaller than 16mm (USFWS 2009).



# Adaptive Management



- **Lessons learned**

- Sturgeon studies in FY11 experimented with egg mats and underwater video survey techniques to identify and map sturgeon habitat. Consequently, four green sturgeon adults were found at the pool downstream of Daguerre Point Dam in the Yuba River and 24 white sturgeon eggs were sampled in the San Joaquin River.
  - This information will be used to spatially and temporarily focus our FY12 sampling efforts in the Yuba River, Feather River, and lower San Joaquin River.
  - Information is important to assess fish passage and spawning habitat in the Yuba River and in the San Joaquin River.
  - Physical habitat data will inform future restoration projects.



# Adaptive Management



- Lessons learned

- Preliminary reports, fish monitoring, and assessments regarding fish passage barriers, relative temporal and spatial flows, as well as potential restoration opportunities have been completed by the California Department of Fish and Game (CDFG) and the USFWS.
  - Existing fish ladders and fish screens were surveyed to determine whether they meet current CDFG and NMFS criteria.
  - This information was used to prioritize and plan FY12 fish passage projects and studies in Deer Creek, Cow Creek, and Antelope Creek and help guide future restoration in these watersheds.



# ANADROMOUS FISH RESTORATION PROGRAM



## FY12 (b)(1) AWP

<b>1.1 Program Management</b>	<b>\$495,082</b>
<b>1.2 Program Support</b>	<b>\$1.974 million</b>
<b>1.4 Restoration Actions</b>	<b>\$1.8 million</b>
<b>1.5 Research</b>	<b>\$1.1 million</b>
<b>1.8 Planning</b>	<b>\$293,273</b>
<b>1.12 Monitoring</b>	<b>\$10,000</b>
<b>1.13 Modeling</b>	<b>\$385,000</b>
<b>Total FY12 AFRP Funding</b>	<b>\$6.075 million</b>

# ANADROMOUS FISH RESTORATION PROGRAM



## FY12 (b)(1) Performance Targets

- 14 Habitat Assessments encompassing over 49.5 miles of stream.
- 4 Population Assessments, Studies, and Evaluations
- Fund 7 Restoration Projects that will provide more than 95,000 cubic yards of spawning gravel, restore 186 acres of floodplain habitat, and 8 stream miles.
- 2 Fish Passage Projects that will restore access to 11 miles of habitat.

FRP Structural Actions with Endpoints 5

FRP Non-structural Actions with Endpoints 4

## ANADROMOUS FISH RESTORATION PROGRAM



### FY12 (b)(1) Restoration Projects



- Merced River Snelling Floodplain Restoration Project (Phase 2)(Task 1.4.1)
- Merced River Snelling Channel Restoration Project (Phase 2)(Task 1.4.2)
- Merced River Ranch Floodplain Enhancement (Task 1.4.3)
- Yuba River Hammon Bar Restoration Project (Task 1.4.4)
- Lower American River Spawning and Rearing Habitat Restoration (Task 1.4.5)



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# FY12 (b)(1) Fish Passage Projects



- Deer Creek: Lower Falls Fish Passage Improvement Project (Task 1.4.8)
- Cottonwood Creek: South Fork Cottonwood Ladder Fish Passage Improvement Project (Phase 1) (Task 1.4.10)

# ANADROMOUS FISH RESTORATION PROGRAM



## FY12 (b)(1) Research

- San Joaquin River Sturgeon Acoustic Study (Task 1.5.1)
- Contaminants, Age, and Growth Study for Sturgeon (Task 1.5.2)
- Stanislaus River Juvenile Chinook and *O. mykiss* Mortality Study (Task 1.5.3)
- San Joaquin River Sturgeon Habitat Assessment (Tasks 1.5.4 and 1.5.5)
- Mill and Deer Creeks Wild Juvenile Chinook Acoustic Tagging Investigations (Task 1.5.6)
- Lower Antelope Creek: Geomorphology Study (Task 1.5.7)

# ANADROMOUS FISH RESTORATION PROGRAM



## Questions?

Battle  
Creek  
Chinook  
salmon  
(65 lbs)



Photo: CDFG

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