Response of Juvenile Salmonids to Habitat Restoration in Humboldt Bay, CA

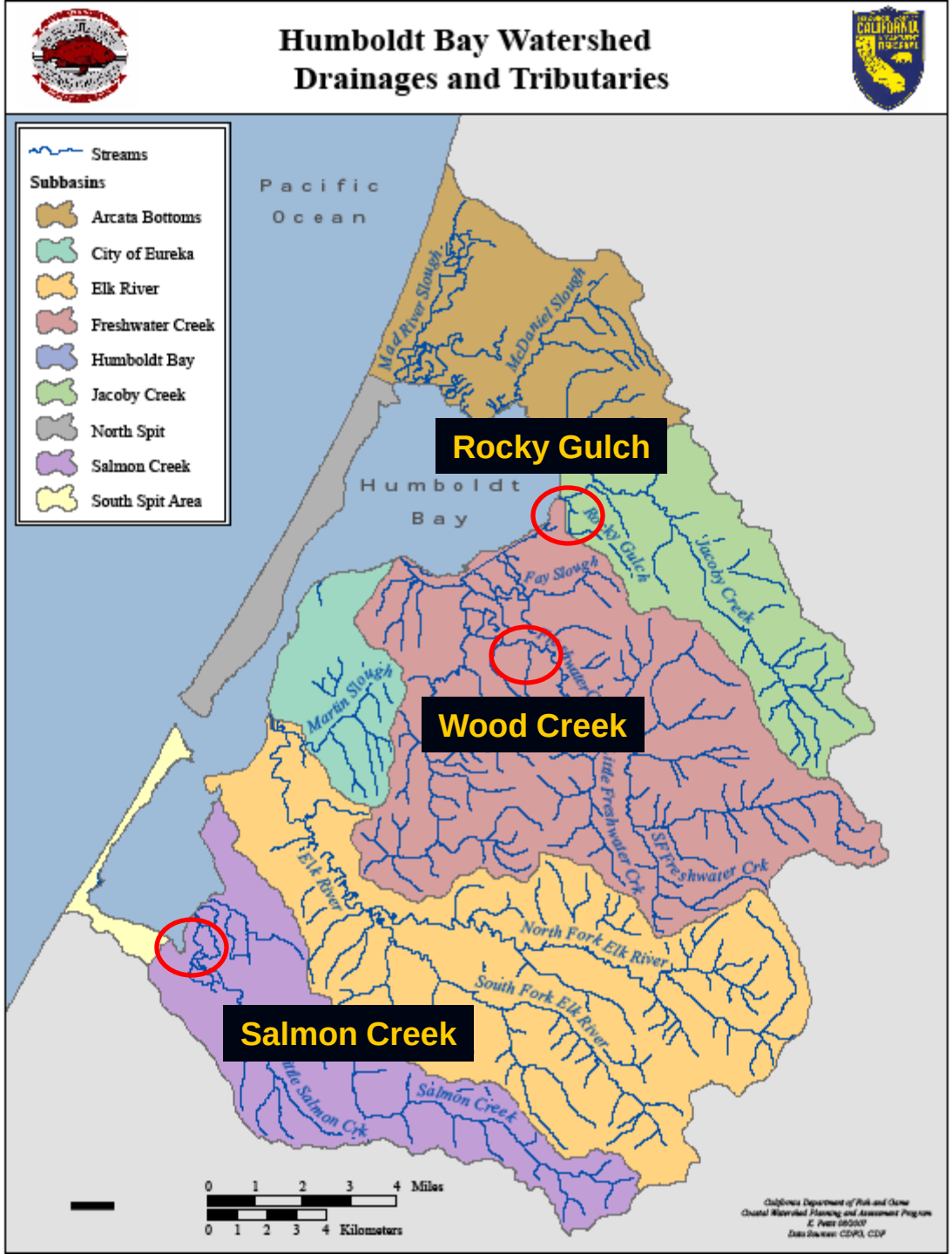
Michael Wallace
California Department of Fish and Wildlife

What did the fish tell us about habitat needs and use?

Summary of Findings

- Appears at least three juvenile coho life history patterns in FW and Elk R Sloughs
- Juvenile coho rear in non natal freshwater stream-estuary ecotone for months
- Juvenile coho use mainstem channels in summer/fall and smaller off channel tributaries in winter/spring
- Ricker 2011-Once ‘stream’ habitat carrying capacity reached, lower basin/estuary populated by YOY emigrants
- Ricker 2011- Lower basin/estuary providing majority of smolt production when populated by YOY emigrants
- Salmonids grow faster in stream-estuary ecotone than stream habitat
- Coho residing in estuary/FW ecotone may have higher marine survival

Project Planning


Humboldt Bay Watershed
Drainages and Tributaries
Streams
Subbasins
Arcata Bottoms
City of Eureka
Elk River
Freshwater Creek
Humboldt Bay
Jacoby Creek
North Spit
Salmon Creek
South Spit Area
Pacific
Ocean
Humboldt
Bay
Mad River Slough
McDaniel Slough
Rocky Gulch
Jacoby Creek
Fay Slough
Martin Slough
Wood Creek
Elk River
Little Freshwater Crk
SF Freshwater Crk
North Fork Elk River
South Fork Elk River
Little Salmon Crk
Salmon Creek
Salmon Creek
0 1 2 3 4 Miles
0 1 2 3 4 Kilometers

PIT Tag Antennas

Solar panels and data storage

Antennas at pond opening


Cobra
Fish n' Dive

Rocky Gulch Restoration & Monitoring

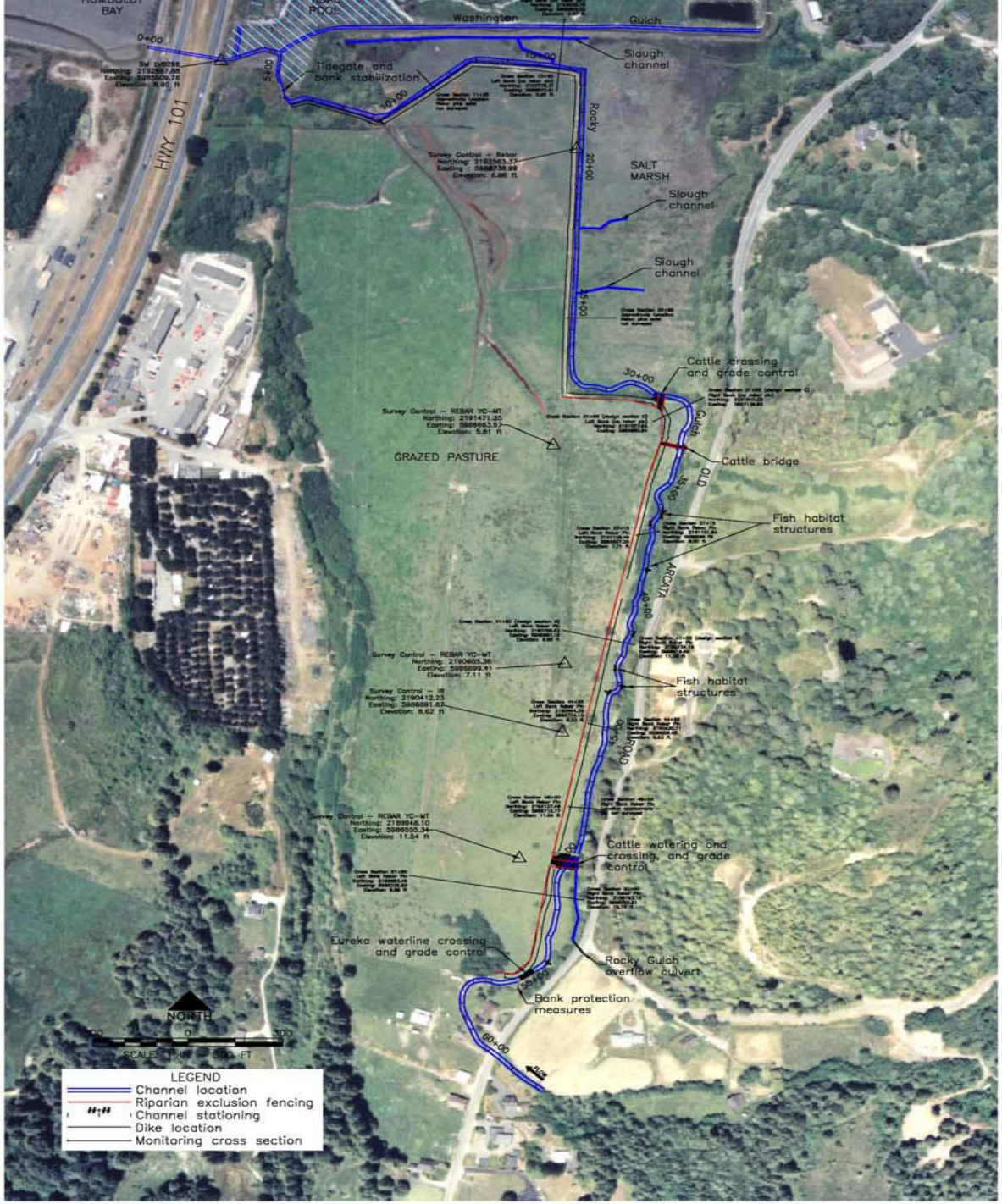
Landowner: Rodoni Family

Project Planning: McBain and Trush

Design Engineer: Jeff Anderson & Assoc.

Fish Monitoring: CA Dept Fish & Game

Funding: SFRA; CDFG; FRGP; NOAA; USFWS


HUMBOLDT BAY
HWY 101
Washington Gulch
Tidegate and bank stabilization
Slough channel
Rocky
SALT MARSH
Slough channel
Slough channel
Cattle crossing and grade control
GRAZED PASTURE
Cattle bridge
OLD
Fish habitat structures
ARCATA
Fish habitat structures
Cattle watering and crossing, and grade control
Eureka waterline crossing and grade control
Rocky Gulch overflow culvert
Bank protection measures
NORTH
SCALE
FT
LEGEND
Channel location
Riparian exclusion fencing
Channel stationing
Dike location
Monitoring cross section

Coho Salmon Catches 2007-2009

Dates	Rocky Gulch	Wood Creek	Martin Slough	Total
Jan-Mar 07	48	86	4	138
Apr-Jun 07	29	29	71	129
Jul-Sep 07	0	17	17	34
Oct-Dec 07	1	17	22	40
Jan-Mar 08	20	125	123	268
Apr-Jun 08	16	50	76	142
Jul-Sep 08	0	1	7	8
Oct-Dec 08	0	5	17	22
Jan-Mar 09	28	46	435	509
Apr-Jun 09	3	22	247	272

Three life history types for coho salmon

Wood Creek Restoration & Monitoring

Landowner: North Coast Regional Land Trust

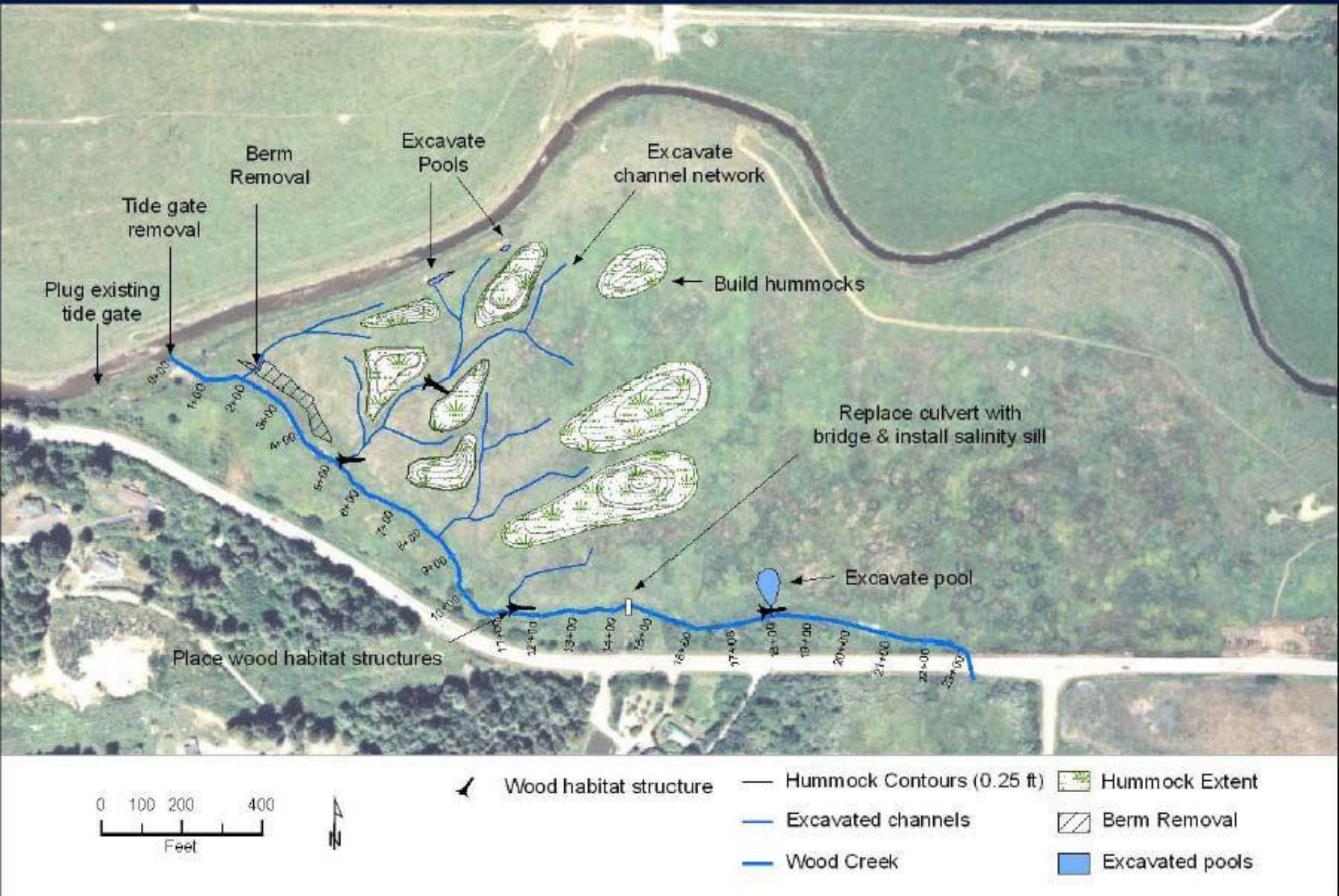
Project Planning: Redwood Community Action Agency

Design Engineer: Jeff Anderson & Assoc.

Fish Monitoring: CA Dept Fish & Game

Funding: SFRA; CDFG; FRGP; NOAA; USFWS

Wood Creek Project Design



New Off-Channel Pond

Coho Salmon Catches 2007-2010

Dates	Rocky Gulch	Wood Creek	Martin Slough	Total
Jan-Mar 07	48	**86**	4	138
Apr-Jun 07	29	**29**	71	129
Jul-Sep 07	0	**17**	17	34
Oct-Dec 07	1	**17**	22	40
Jan-Mar 08	20	**125**	123	268
Apr-Jun 08	16	**50**	76	142
Jul-Sep 08	0	**1**	7	8
Oct-Dec 08	0	**5**	17	22
Jan-Mar 09	28	**46**	435	509
Apr-Jun 09	3	**22**	247	272
Jul-Sep 09		**4**		
Oct-Dec 09		**4**		
Jan-Mar 10		**140**		
Apr-Jun 10		**22**		
Jul-Sep 10		**2**		
Oct-Dec 10		**5**		
Jan-Mar 11		**20**		
Apr-Jun 11		**37**		
Jul-Sep 11		**48**		
Oct-Dec 11		**33**		
Jan-Mar 12		**268**		
Apr-Jun 12		**107**		

Comparison of Annual Coho Use of Wood Creek Pond 2010-2012

Year	Total Number Coho Detected	Number of Freshwater Creek Coho Detected	Total Number Coho Detected Jan-Mar
2010*	153	46	140
2011	45	28	20
2012	305	70	249

* Antenna installed 1/29/10

Wood Creek March 2, 2012 **Water Quality Site**	**Depth (feet)**	**Water Temperature (° C)**	**Salinity (ppt)**	**Dissolved Oxygen (mg/l)**
Time 0940 hrs				
surface	0.5	6.9	0.2	6.30
middle	2.0	10.0	4.4	5.79
bottom	4.0	13.4	6.8	0.78
Wood Creek August 7, 2012 **Water Quality Site**	**Depth (feet)**	**Water Temperature (° C)**	**Salinity (ppt)**	**Dissolved Oxygen (mg/l)**
Time 1715 hrs				
surface	0.5	17.4	4.4	7.05
middle	2.0	24.4	13.1	12.53
bottom	4.0	23.0	14.2	15.91

Monitoring Results

- Brackish water more prevalent after flap gate removed and crossing replaced
- New pond and culvert pool remain fresh water through winter and spring
- Pond supported large numbers of coho throughout Winter and Spring 2010,fewer in 2011, and large numbers again in 2012
- Preconstruction - coho found distributed throughout main channel; Post construction - majority found in pond and culvert pool

Monitoring Results (cont.)

- Mean residence time in pond was:
  - 23 days (range 1-87 days) in 2009/10
  - 26 days (range 1-67 days) in 2010/11
  - 11 days (range 1-96 days) in 2011/12
- In 2009/10 only 7% of coho captured in pond contained PIT tags, so the 153 coho were only a small portion of coho rearing in pond
- The pond antenna detected coho from throughout the Freshwater Cr basin tagged by CDFG the previous fall; 46 in 2010, 28 in 2011, and 70 in 2012.

Salmon Creek Estuary Restoration & Monitoring

Landowner: U.S. Fish and Wildlife

Project Planning: Mitch Ferro-PCFWWRA

Design Engineer: Mike Love and Assoc.

Fish Monitoring: CA Dept Fish & Game

Funding: SFRA; CDFG; FRGP; NOAA; USFWS others

Salmon Creek

Photo by David Kenworthy

The Number of Juvenile Coho Salmon Steelhead Trout and Tidewater Goby Captured[a] in Off Channel Ponds and Old Salmon Creek Stream Channel 2011-2012

	Pond 1			Pond 2			Pond 3			Pond 4			Old Channel		
Date	**CO**	**SH**	**TG**	**CO**	**SH**	**TG**	**CO**	**SH**	**TG**	**CO**	**SH**	**TG**	**CO**	**SH**	**TG**
11/11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/11	0	1	3	0	0	20	0	0	3	0	0	0	0	2	0
01/12	1	3	20	1	2	26	0	0	0	0	0	0	0	0	0
02/12	9	1	1	0	0	80	0	0	0	0	0	0	0	0	0
03/12	49	6	1	5	1	37	1	0	0	0	0	0	0	0	0
04/12	0	1	0	0	0	33	0	0	0	0	0	0	0	0	0
05/12	31	0	1	7	1	12	0	0	0	0	0	0	0	0	0
06/12	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0
7-9/12	0	0	462	0	0	168	0	0	0	0	0	0	0	0	0
10-12/12	0	0	2163	0	0	0	0	0	0	0	0	1	0	0	0
Total	**90**	**12**	**2651**	**15**	**4**	**377**	**1**	**0**	**3**	**0**	**0**	**1**	**0**	**2**	**0**

[a] Fish captured with seine nets and minnow traps
One longfin smelt captured in Pond 1 in January 2012
Captured 37 tidewater goby in Pond 0 Nov-Dec 2012

Salmon Creek March 21, 2012 **Water Quality Site**	**Depth (feet)**	**Water Temperature (° C)**	**Salinity (ppt)**	**Dissolved Oxygen (mg/l)**
Pond 1 (time 1020 hrs)				
West Transect				
surface	0.5	10.1	0.1	9.92
middle	2.3	10.0	0.1	9.25
bottom	4.5	10.0	0.1	9.74
Pond 2 (time 1145 hrs)				
West Transect				
surface	0.5	10.7	0.1	7.98
middle	2.0	10.5	0.1	9.23
bottom	4.0	10.4	0.1	8.42
Pond 4 (time 1030 hrs)				
Inside Transect				
surface	0.5	10.3	0.1	9.13
middle	2.0	10.2	0.1	9.46
bottom	4.0	10.3	0.1	8.83
Salmon Creek July 26, 2012 **Water Quality Site**	**Depth (feet)**	**Water Temperature (° C)**	**Salinity (ppt)**	**Dissolved Oxygen (mg/l)**
Pond 1 (time 1115 hrs)				
West Transect				
surface	0.5	18.5	19.2	6.15
middle	1.5	19.1	25.4	5.98
bottom	3.0	19.8	27.0	4.12
Pond 2 (time 1210 hrs)				
West Transect				
surface	0.5	19.7	16.5	6.79
middle	-	-	-	-
bottom	2.25	24.4	25.8	10.56
Pond 3 (time 1350 hrs)				
Inside Transect				
surface	0.5	18.9	15.5	7.32
middle	-	-	-	-
bottom	2.0	20.1	28.6	6.65

Monitoring Results

- From January to June 2012 CDFG captured 106 juvenile coho salmon in the newly built off channel ponds
- This is more coho than CDFG captured in Salmon Creek from 2005-2011 combined
- From December 2011 to June 2012 CDFG's PIT tag antenna at the opening of the most upstream pond detected 78 coho salmon and 16 steelhead trout

Monitoring Results (con't)

- The most upstream pond remained primarily fresh throughout the winter and spring while the other ponds became more brackish as you moved downstream
- Coho mean residence time in pond was 15 days (range 1-83 days). Detections from Jan to June 2012. SH mean residence time 36 days (1-130 days).
- Tidewater Goby colonized the new ponds during the winter and spring


RESOURCES AGENCY
CALIFORNIA
DEPARTMENT
FISH & GAME
ZEE
ZEE
Keep in a
cool dry
405
65-3-921
N-1743
USA
WORK
PROGRAM
WPA

Recommendations

- Determine target species and life stage
- Create freshwater habitat ??
- Consider your source of fish
- Increase connectivity between watersheds; think laterally instead of linearly
- Off channel habitat not limited to stream-estuary ecotone; creating off channel low gradient habitat should be sited in any appropriate location in the basin

Recommendations (con't)

- How does creating off channel habitat fit in with watershed function?
- Off channel habitat does not need to support salmonids year-round to be a success
- Off channel habitat in stream-estuary ecotone does not need to be used by salmonids every year to be a success
- Plan for periodic maintenance to keep ponds from filling with sediment


HAPPY SCIENCE
525 CLINTON ST.