8th Spring-run Chinook Symposium

July 26-28, 2016 in Chico, CA

Session Overview

- Sponsors:
  - PG&E
  - Northern California Water Association
  - Friends of Butte Creek
  - California Conservation Corps

The year's Symposium will highlight regional status reports on Spring-run Chinook populations, instream flow studies and fish passage assessments, water conservation and transactions, and how to translate research and genetics into implementation and recovery actions. Field tours will include visits to the legendary spawning grounds in Upper Butte Creek and PG&E's hydroelectric retrofit projects; salmon and steelhead fish passage in Lower, Deer, Mill and Antelope Creek that have been prioritized for instream flow enhancement and fish passage projects; a Clear Creek Spring Chinook Restoration tour; and a tour of Lower Butte Creek Water Diversions.

Presentations

Monitoring and Status of Spring-run Chinook Reports

(Slide 4) *Mill, Deer, and Antelope Creeks Monitoring Status Reports*
Matt Johnson, California Department of Fish and Wildlife

(not included) *Movement and Survival Rates of Wild Chinook Salmon Smolts from Mill Creek to the San Francisco Bay 2013 – 2015*
Jeremy Notch, Southwest Fisheries Science Center, NOAA Fisheries

(Slide 26) *Movement and Survival Rates of Butte Creek Spring-run Chinook Salmon Smolts from the Sutter Bypass to the San Francisco Bay*
Flora Cordonleani, Ph.D., Southwest Fisheries Science Center, NOAA Fisheries

(Slide 50) *Clear Creek and Battle Creek Spring-run Restoration Actions and Population Status*
Matt Brown, Clear Creek and Battle Creek Program, Red Bluff Fish and Wildlife Office, U.S. Fish and Wildlife Service

(Slide 95) *Spring-run Chinook Population Trends on the Upper Klamath, Trinity, and Salmon River*
Mike Belchik, Senior Scientist, Yurok Tribe

Mill, Deer, and Antelope Creek Spring-Run Chinook Monitoring

Matt Johnson
CDFW


CALIFORNIA
DEPARTMENT OF FISH & WILDLIFE
Clear Creek
Redding
Sacramento R
Battle Creek
N.F. Battle Creek
S.F. Battle Creek
N.F. Cottonwood Cr
Beegum Creek
Cottonwood Creek
Antelope Creek
N.F. Antelope Cr
S.F. Antelope Cr
Mill Creek
Red Bluff
Deer Creek
Thomes Creek
Big Chico Creek
Butte Creek
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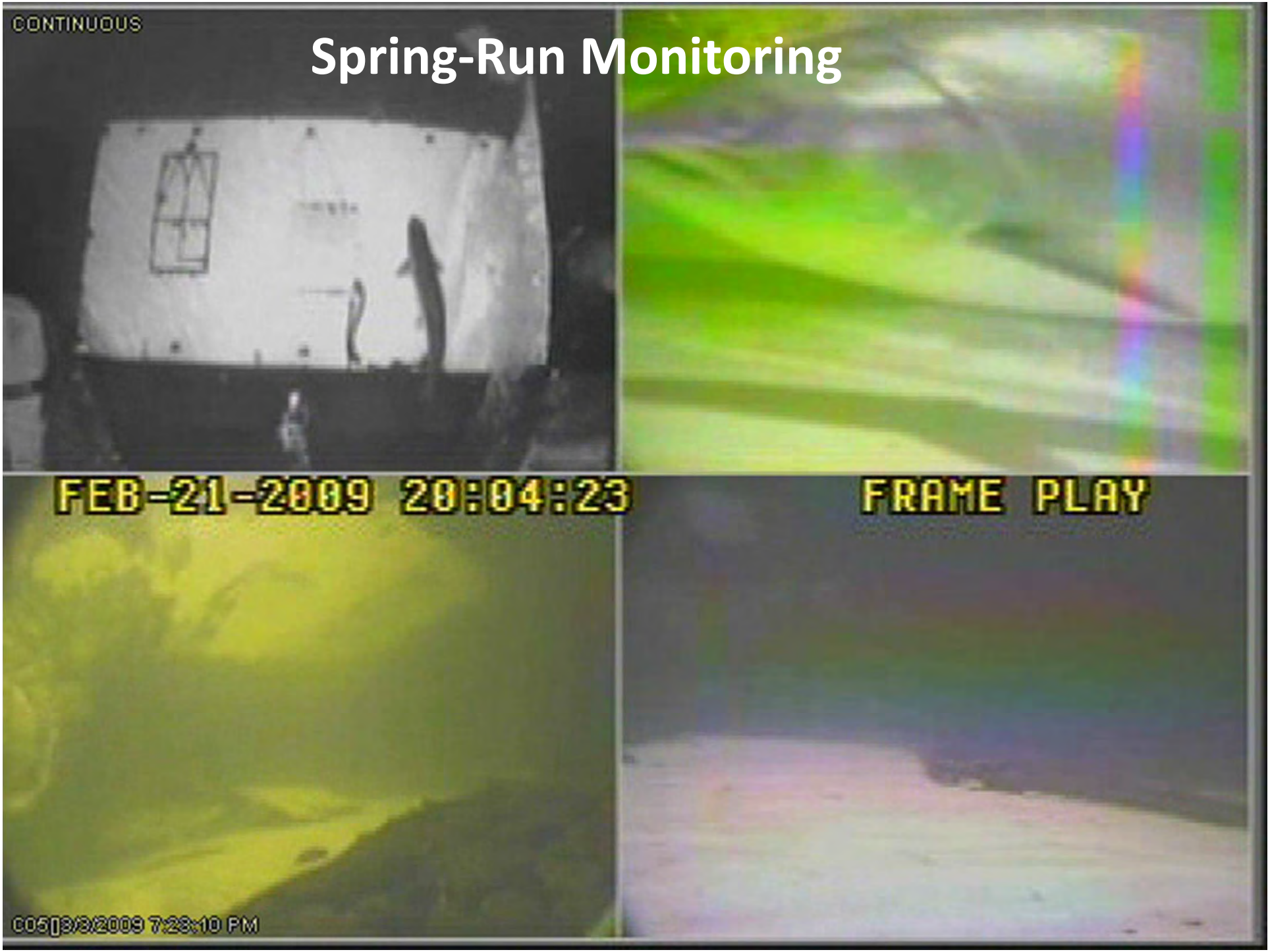
Spring-Run Monitoring

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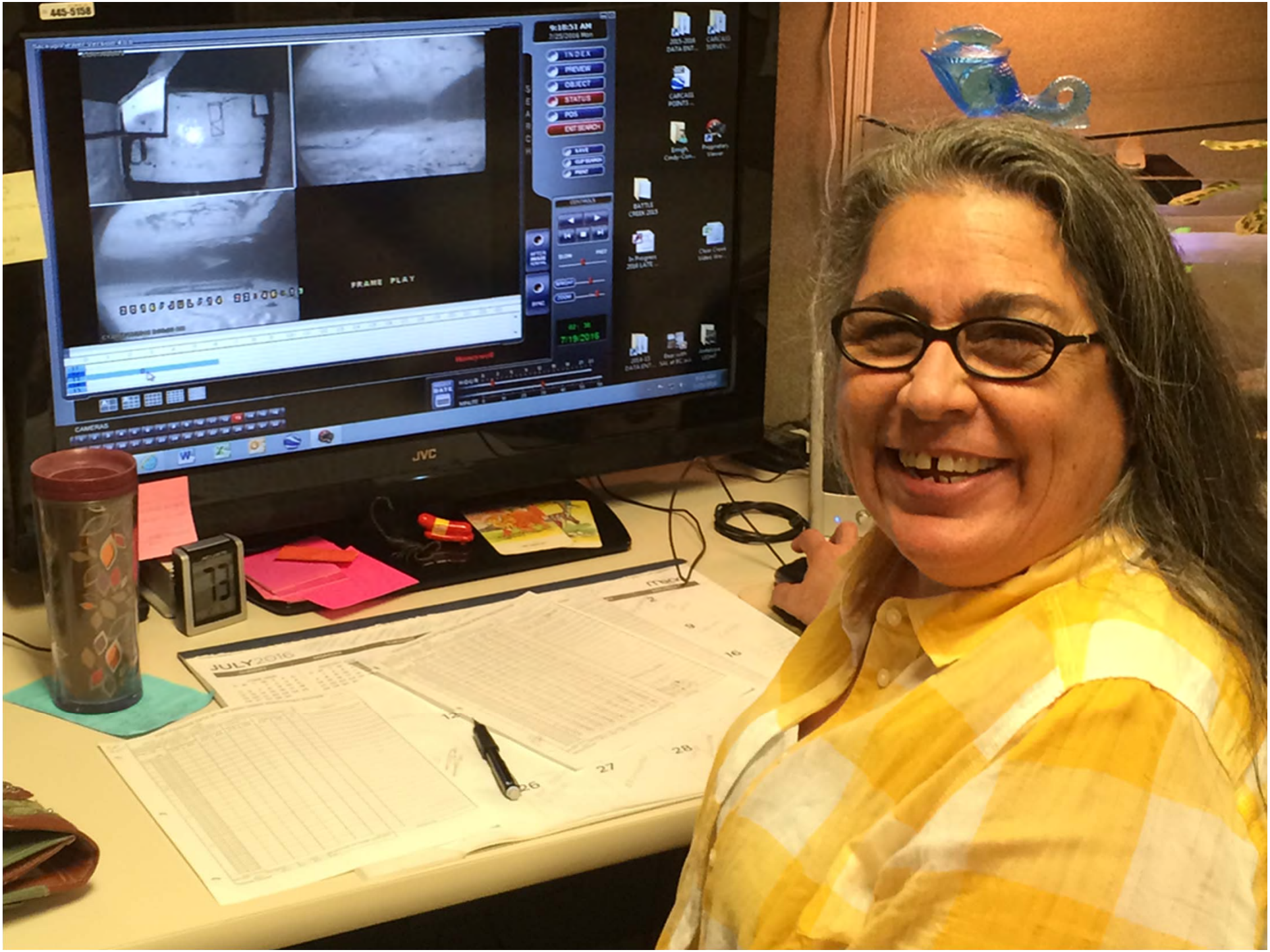
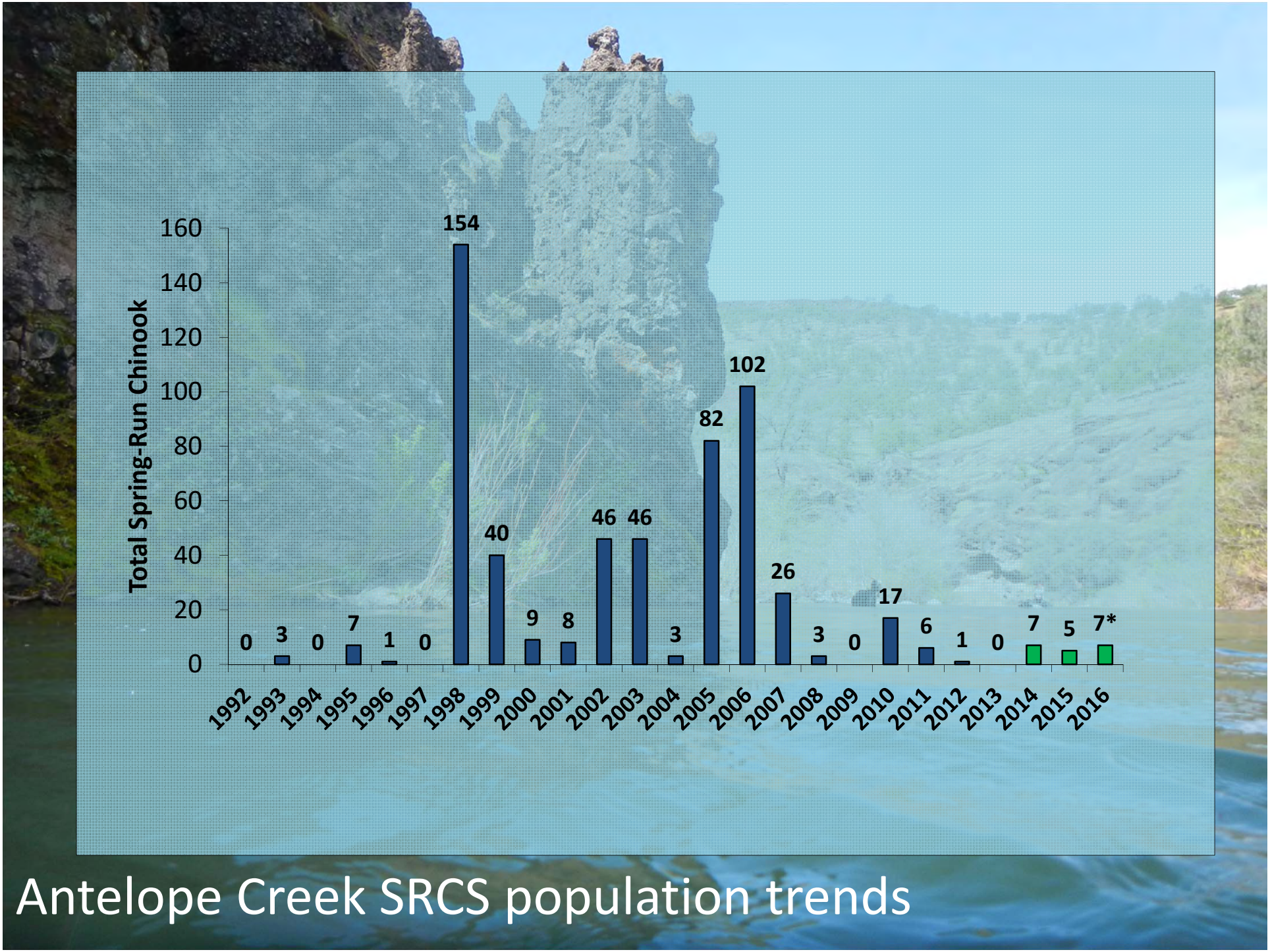
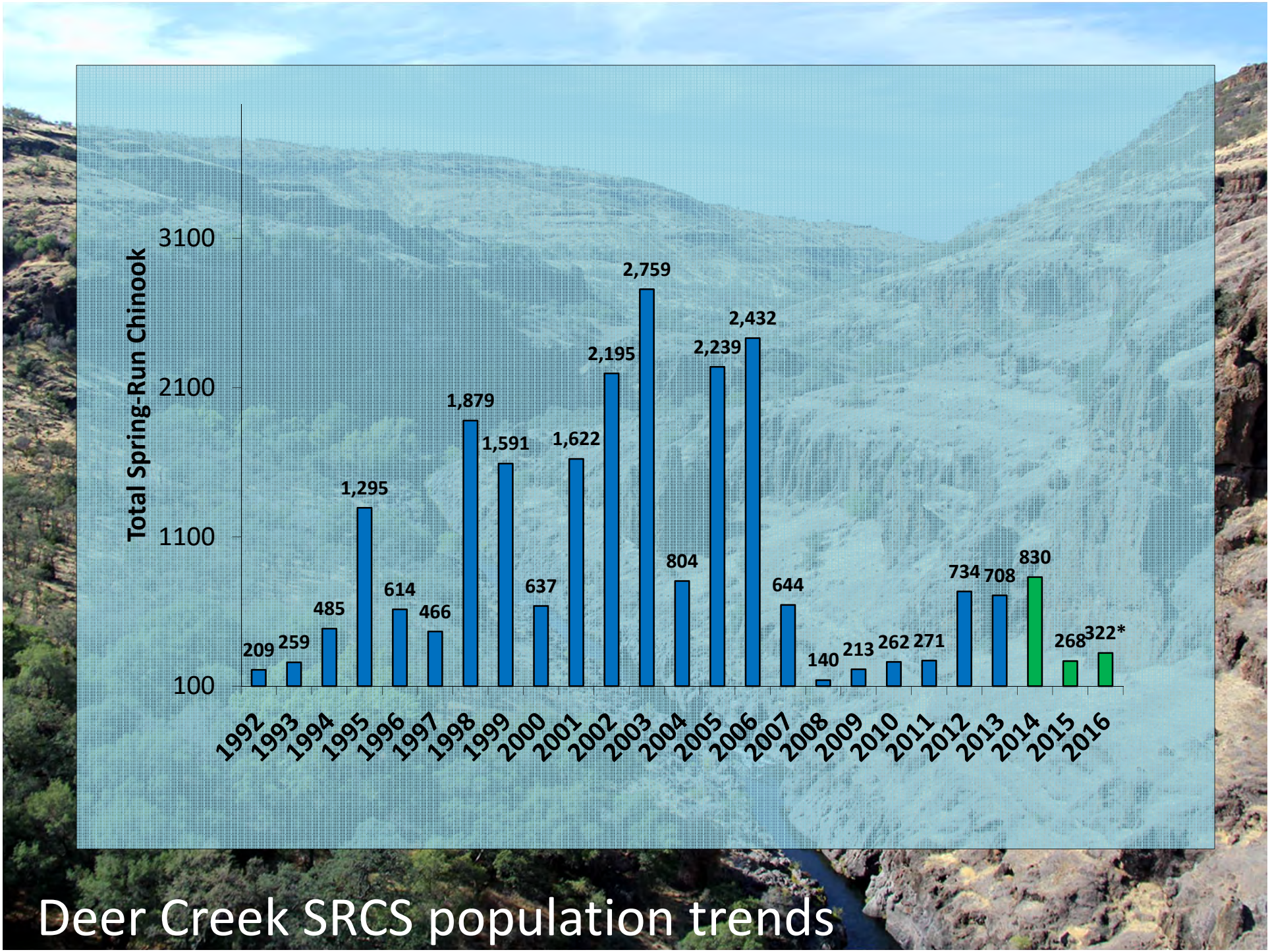

FRAME PLAY
JVC
JULY 2016

Recent monitoring results:

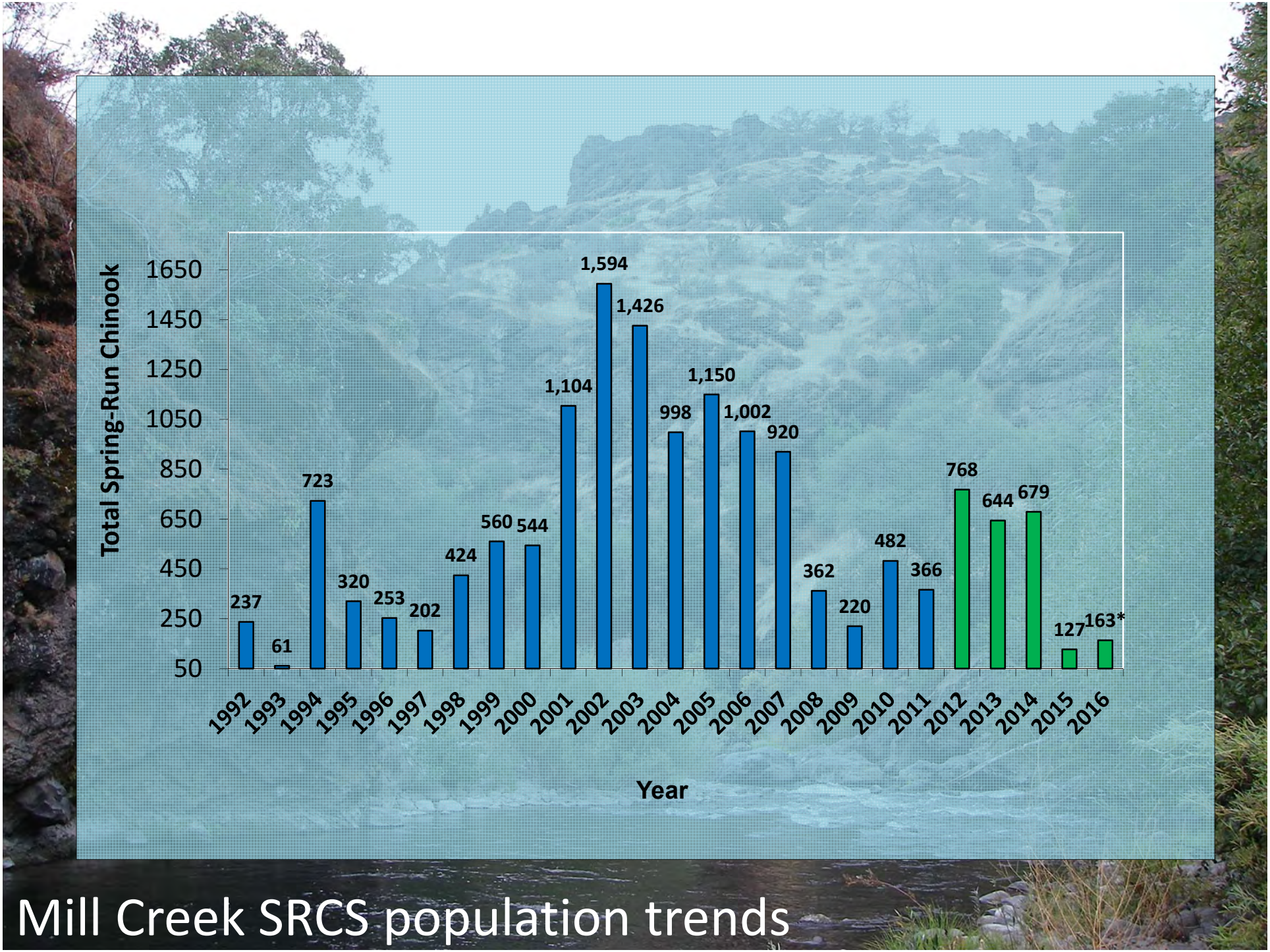
Year	Antelope		Deer		Mill	
	video	snorkel	video	snorkel	video	redd
2014	7	0	830	641	679	440
2015	5	0	268	99	127	116
2016	7*	n/a	322*	n/a	163*	n/a



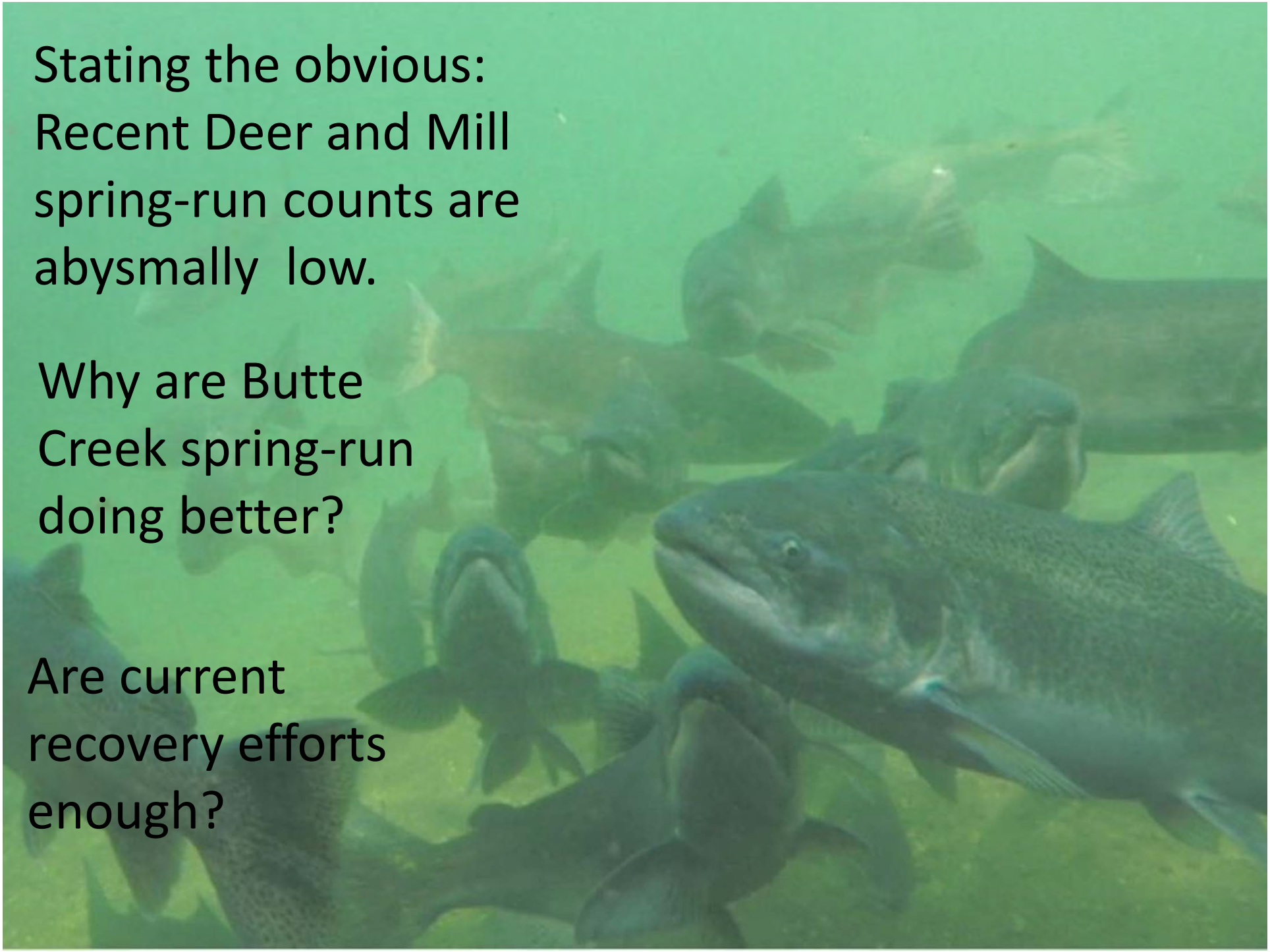
Antelope Creek SRCS population trends



Deer Creek SRCS population trends



Mill Creek SRCS population trends



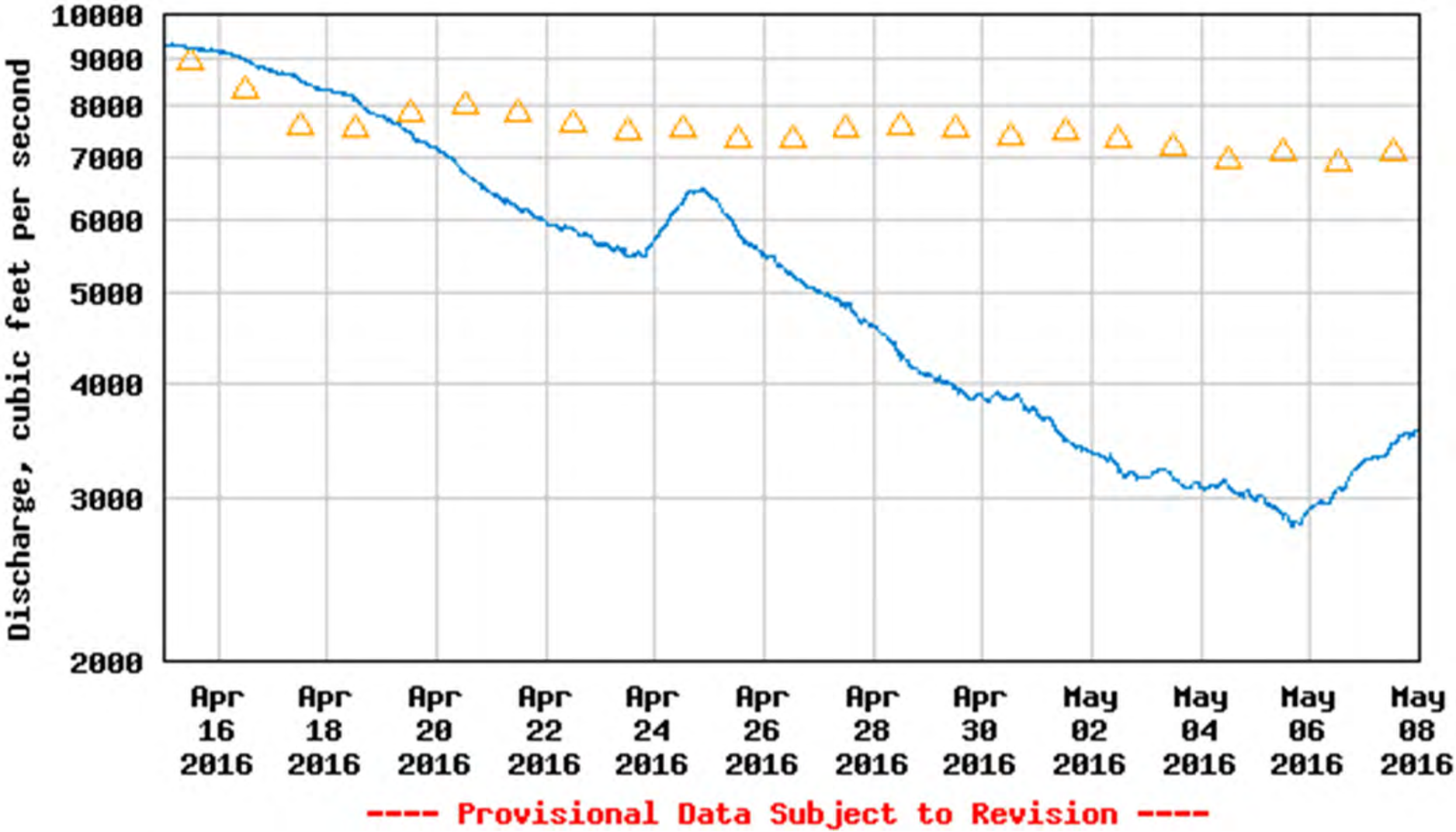
Stating the obvious: Recent Deer and Mill spring-run counts are abysmally low.

Why are Butte Creek spring-run doing better?

Are current recovery efforts enough?

USGS

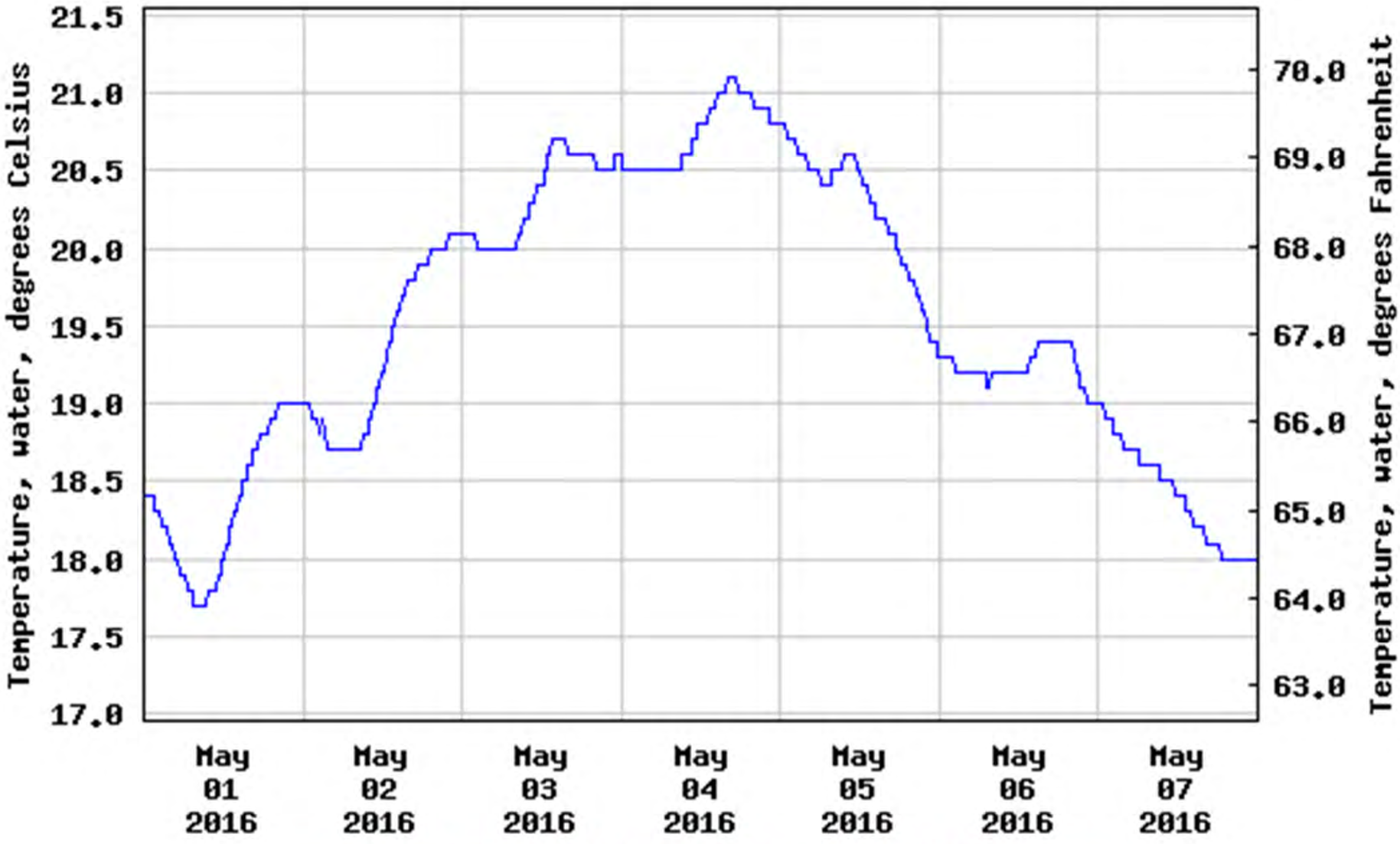
USGS 11390500 SACRAMENTO R BL WILKINS SLOUGH NR GRIMES CA



Lake Shasta May, 2016

USGS

USGS 11390500 SACRAMENTO R BL WILKINS SLOUGH NR GRIMES CA




110
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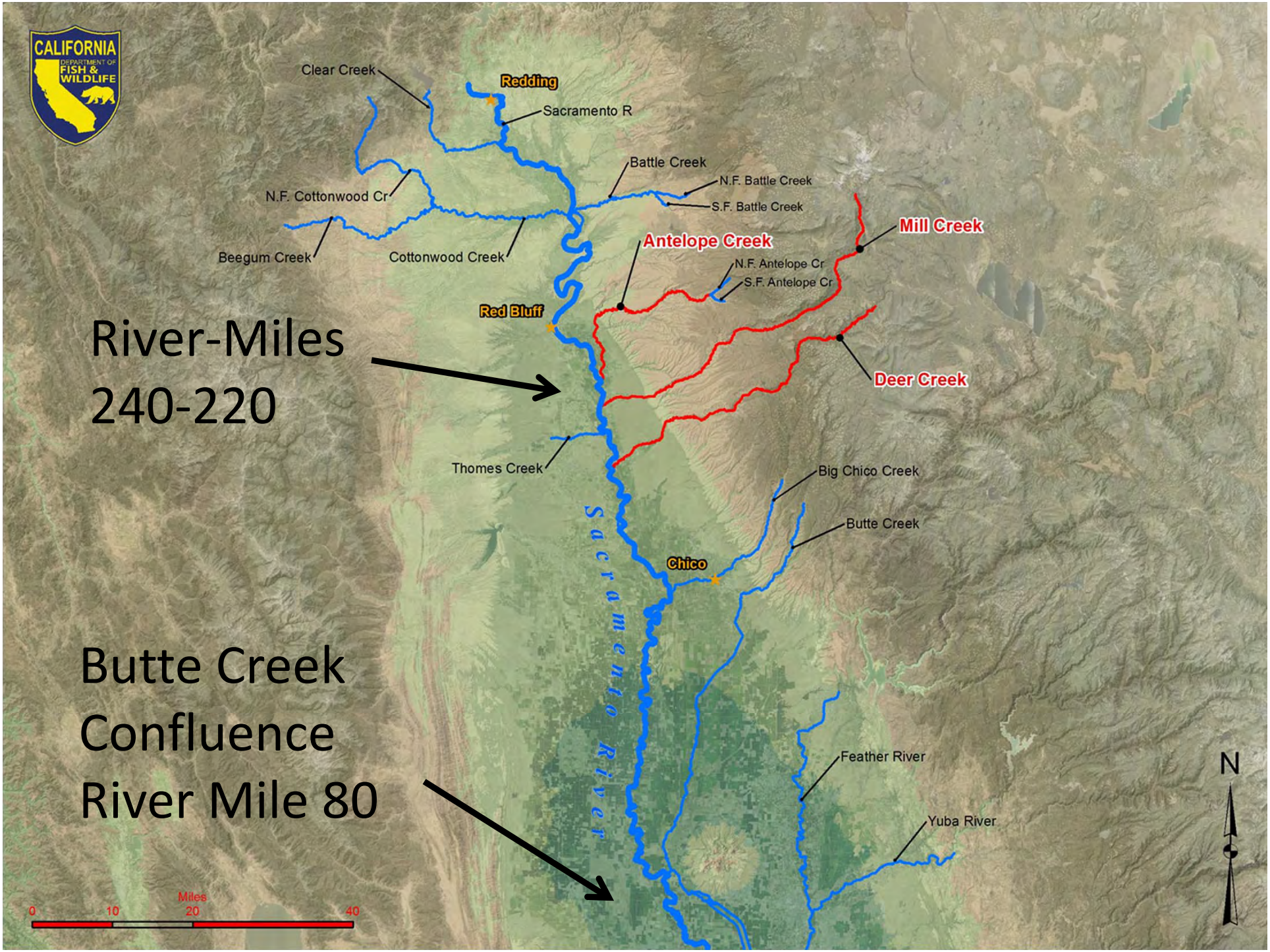
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Clear Creek
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Battle Creek
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Beegum Creek
Cottonwood Creek
Antelope Creek
N.F. Antelope Cr
S.F. Antelope Cr
Mill Creek
Red Bluff
Deer Creek
River-Miles
240-220
Thomes Creek
Big Chico Creek
Butte Creek
Chico
Sacramento River
Butte Creek
Confluence
River Mile 80
Feather River
Yuba River
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Miles
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Sutter Bypass March, 2016

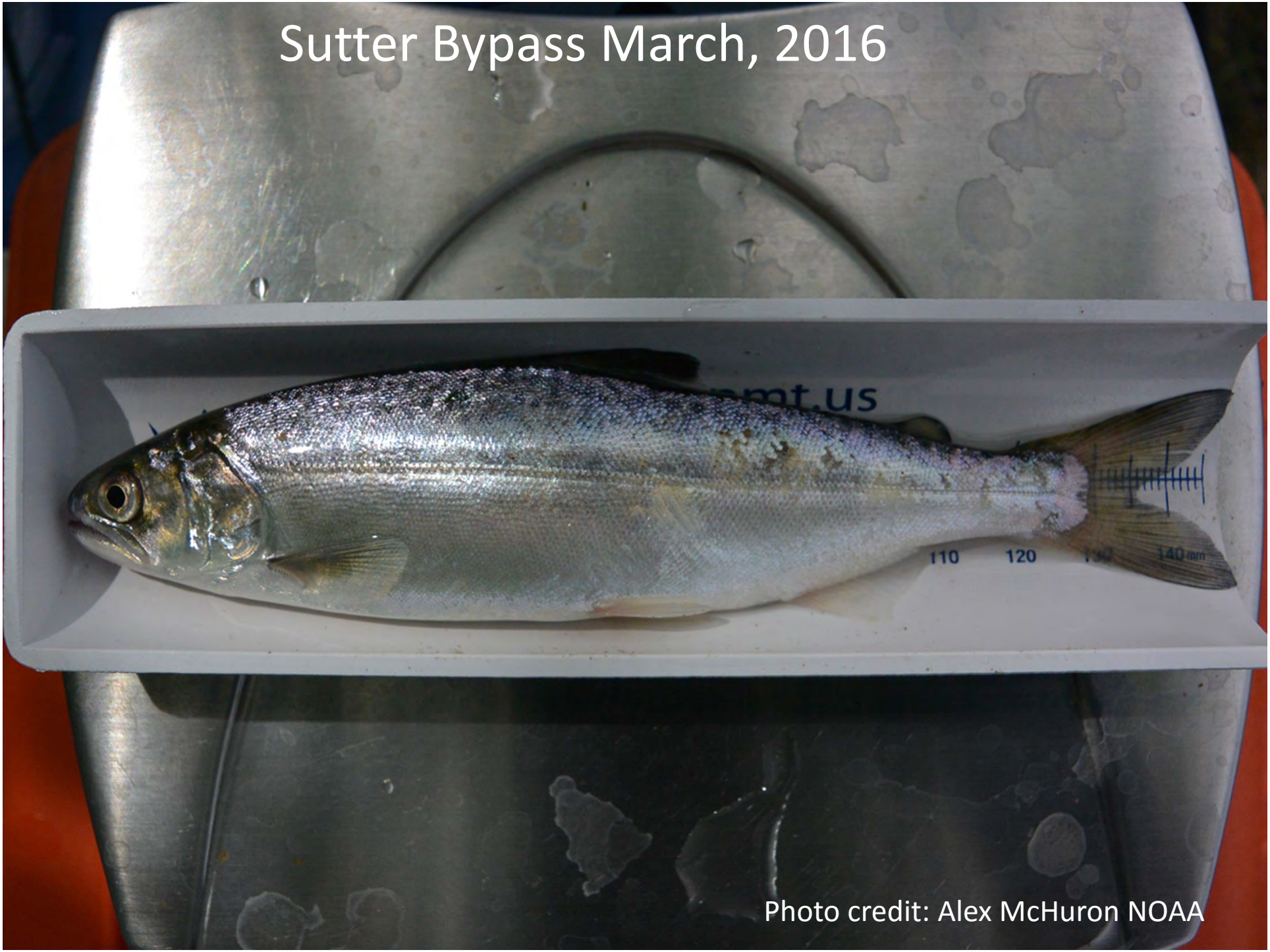


Photo credit: Alex McHuron NOAA

Lower Mill Creek May, 2016

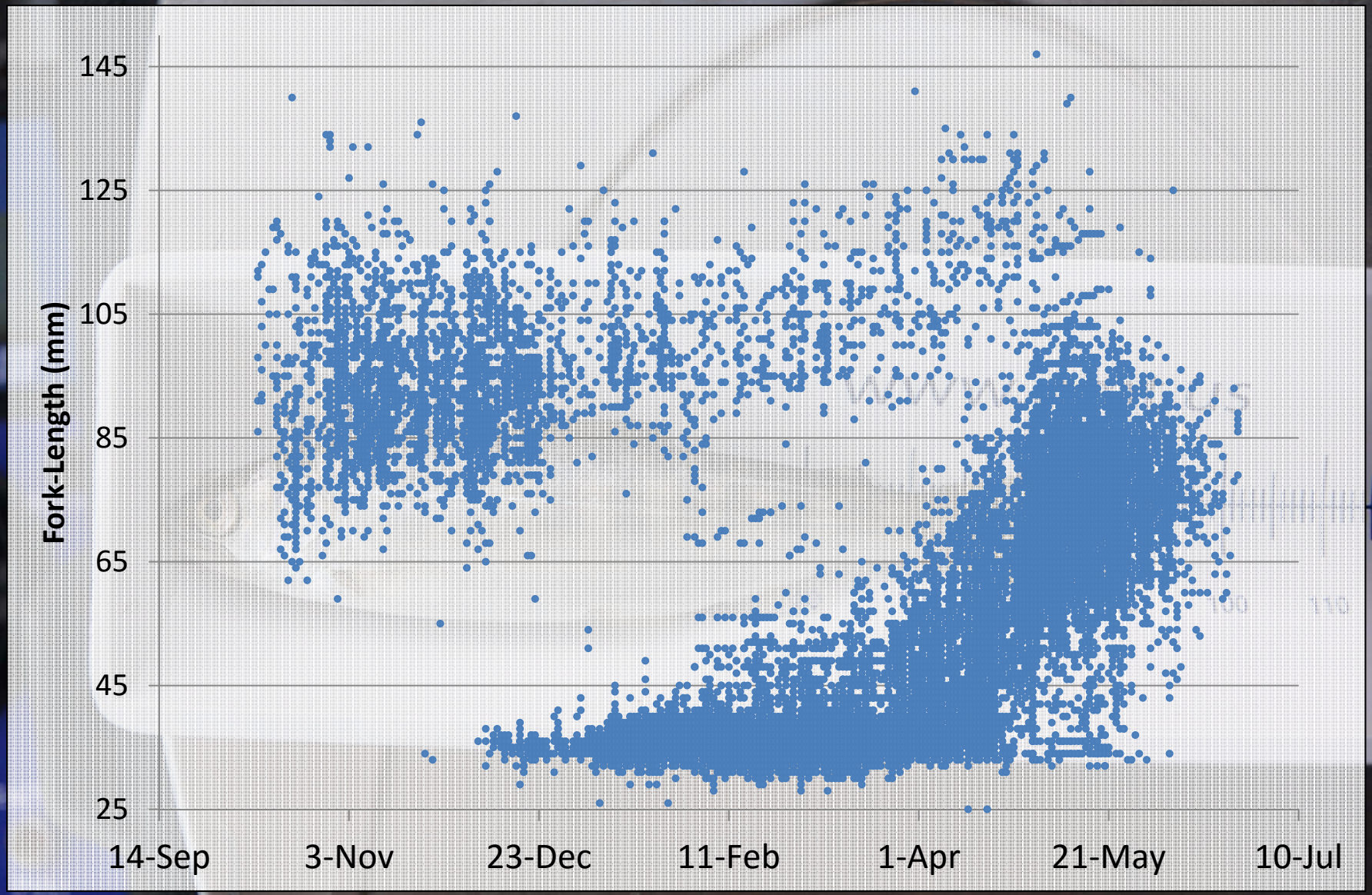
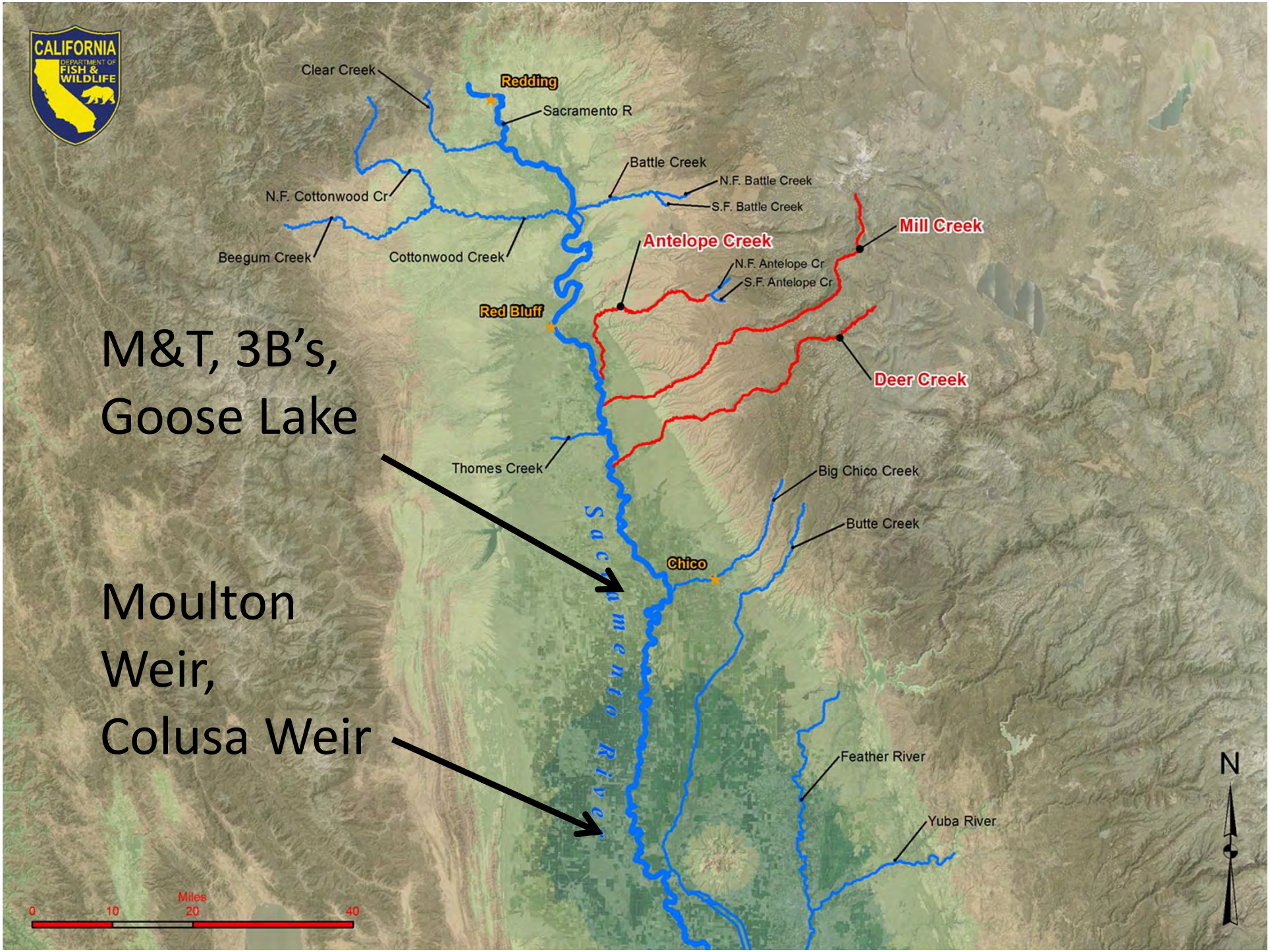


Photo credit: Alex McHuron NOAA



M&T, 3B's,
Goose Lake

Moulton
Weir,
Colusa Weir

Acknowledgements:

Curtis Milliron, Brad Henderson, Jason Roberts, Doug Killam, Sam Plemons CDFW

Stan Allen, Ryan Revnak, Byron Mache, Brendan Barney PSMFC

Sean Heyes, Arnold Ammond, Jeremy Notch, Alex McHuron NOAA

End

Movement and Survival rates of Butte Creek spring-run Chinook salmon smolts throughout their migration to the Ocean

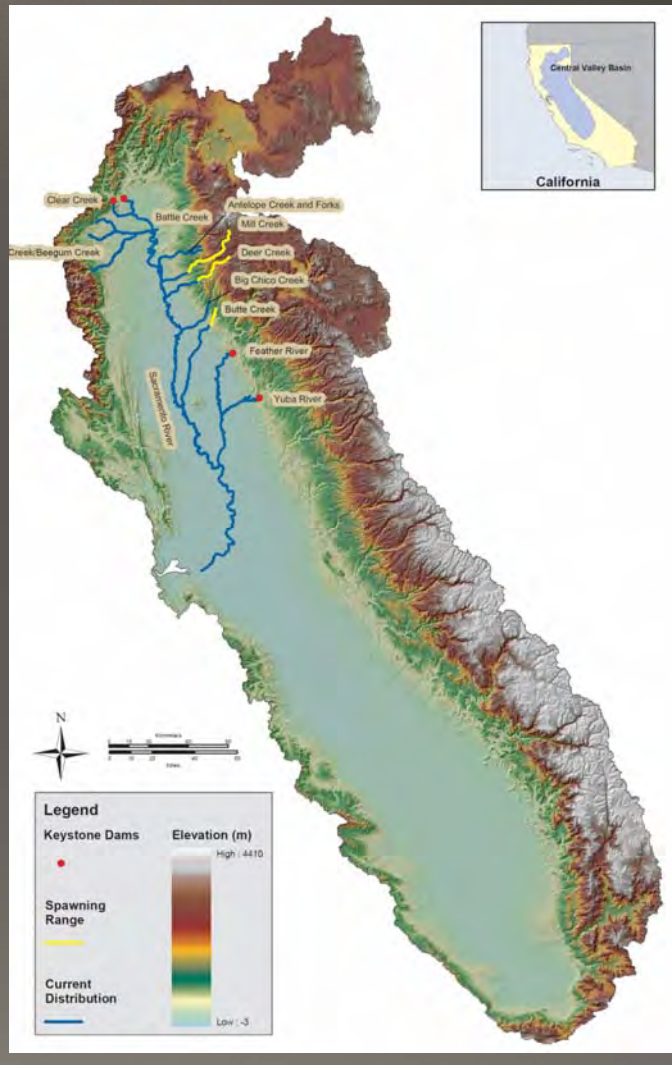
8th Spring-run Chinook Symposium
July 26, 2016

Flora Cordoleani, Arnold Ammann, Jeremy Notch and Alex Mc-Huron

UC Santa Cruz – NMFS/NOAA Santa Cruz

Central Valley spring-run Chinook viability status

- Only 3 out of 18 or 19 historic independent populations of CV spring-run Chinook salmon are extant: Mill, Deer, and Butte creeks
- Represent only the Northern Sierra Nevada diversity group
- Listed as threatened under the federal Endangered Species Act (ESA) since 1999.

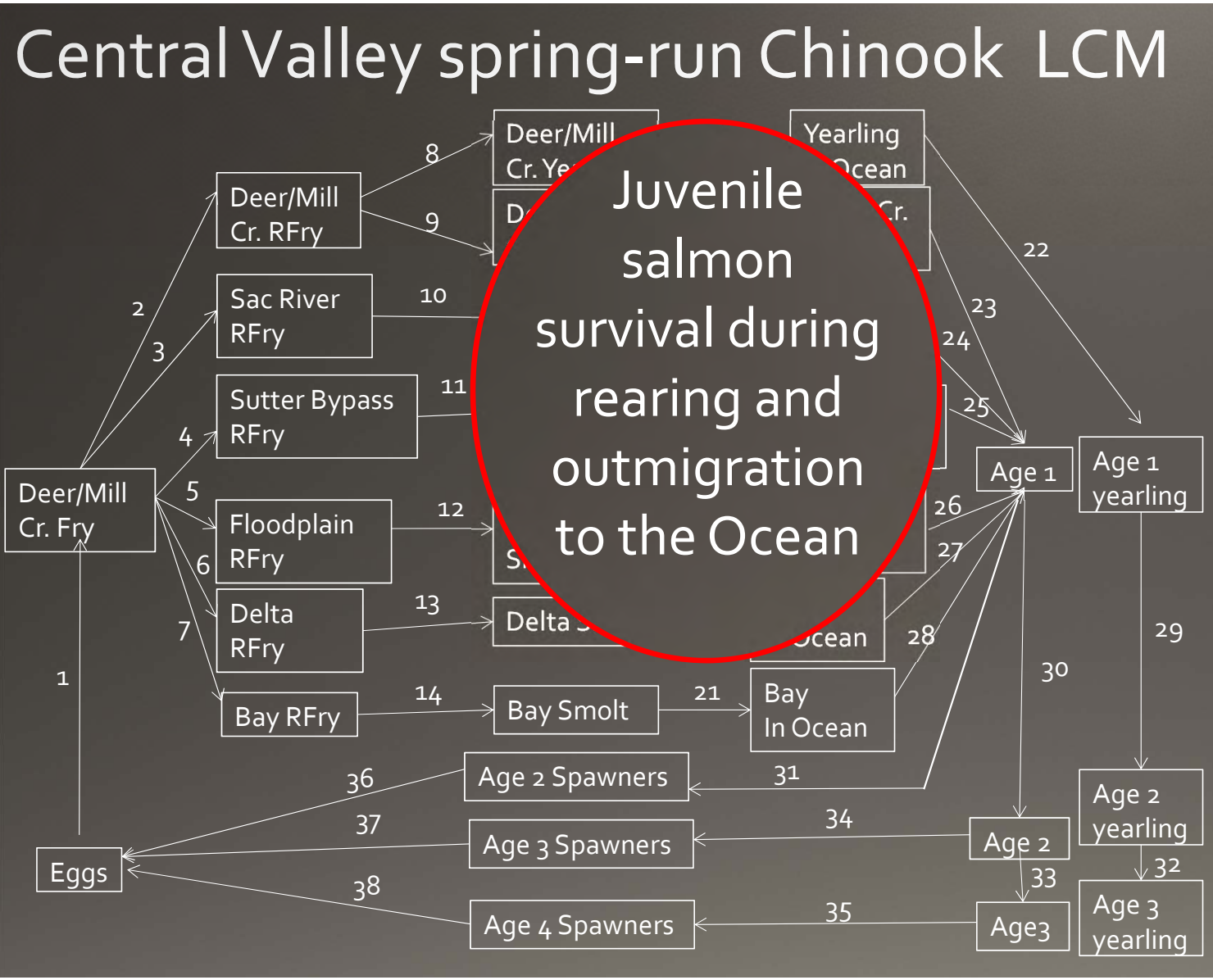


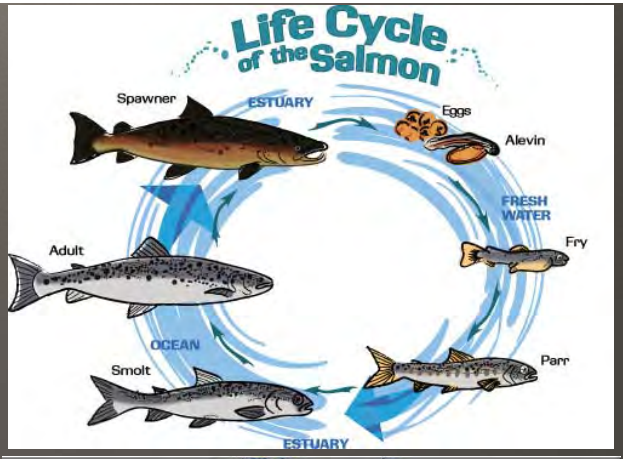
Central Valley spring-run Chinook viability status

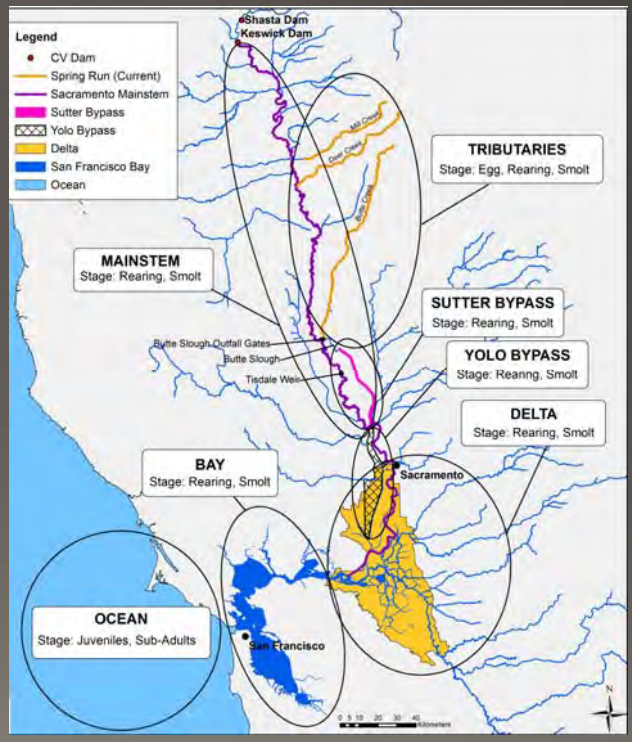
"The status of the CV spring-run Chinook salmon ESU has probably improved on balance since the 2010 status review, through 2014, with Mill and Deer Creek populations improving from high extinction risks to moderate extinction risks. Butte Creek, has remained at low risk, and all viability metrics had been trending in a positive direction, up until 2015."

"The recent declines of many of the dependent populations, high pre-spawn and egg mortality, and uncertain juvenile survival during the 2012 to 2015 drought, ocean conditions, as well as the level of straying of FRFH spring-run Chinook salmon to other CV spring-run Chinook salmon populations are all causes for concern for the long-term viability of the CV spring-run Chinook salmon ESU."
[Johnson and Lindley, SR viability report (2016) and NOAA-NMFS 5 year status review report (2016)]

Central Valley spring-run Chinook LCM

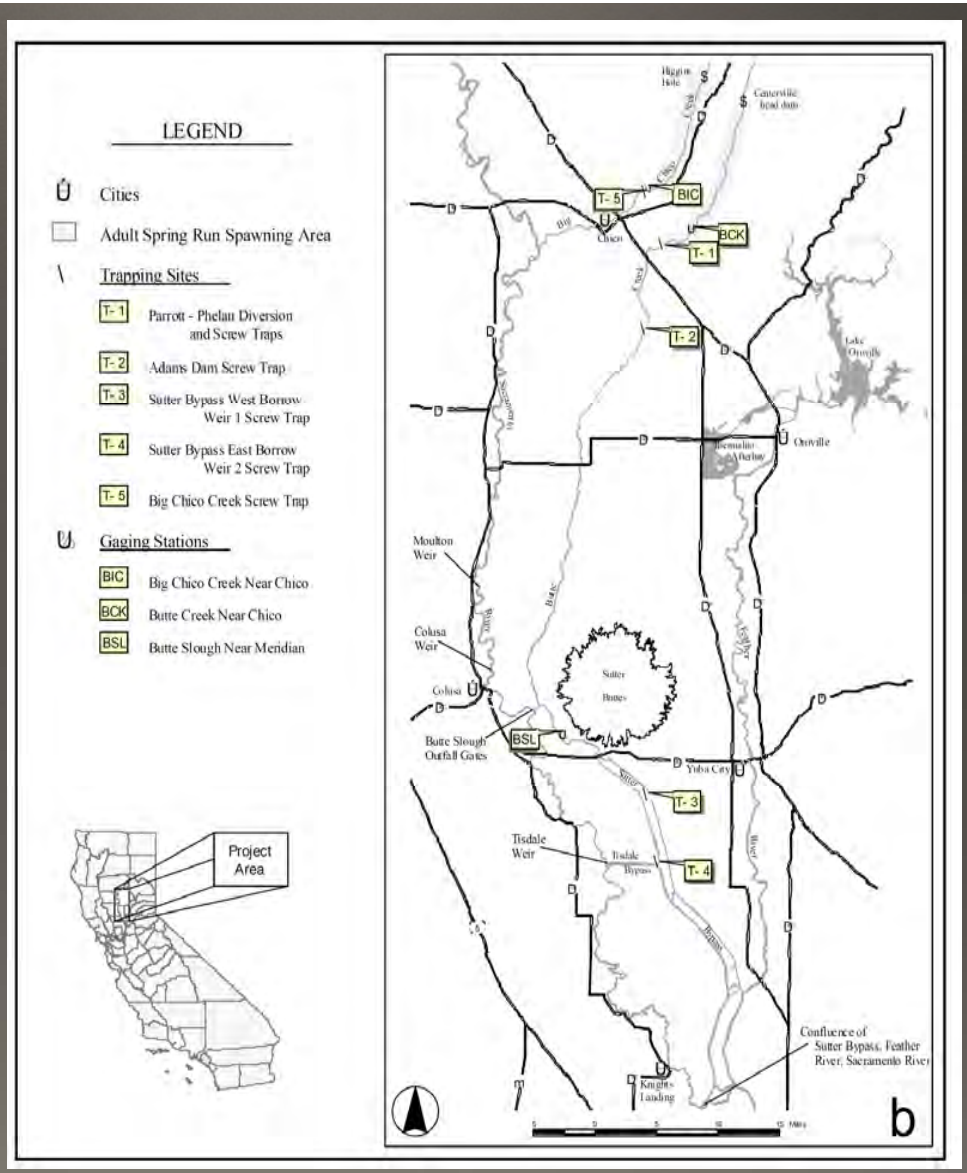




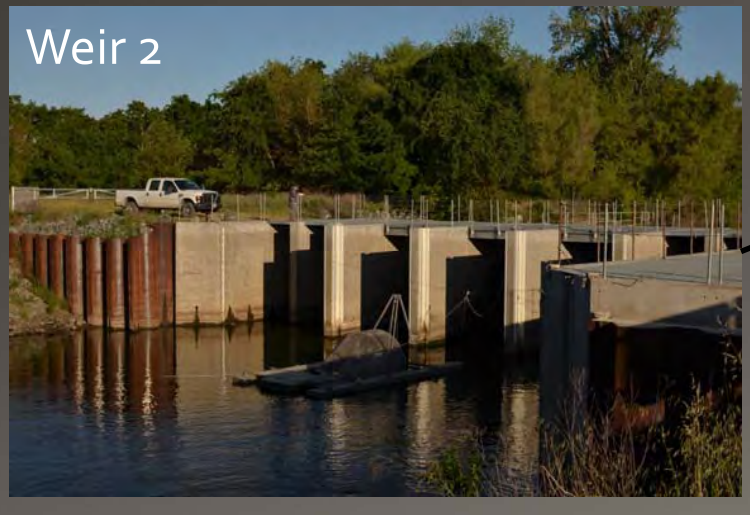


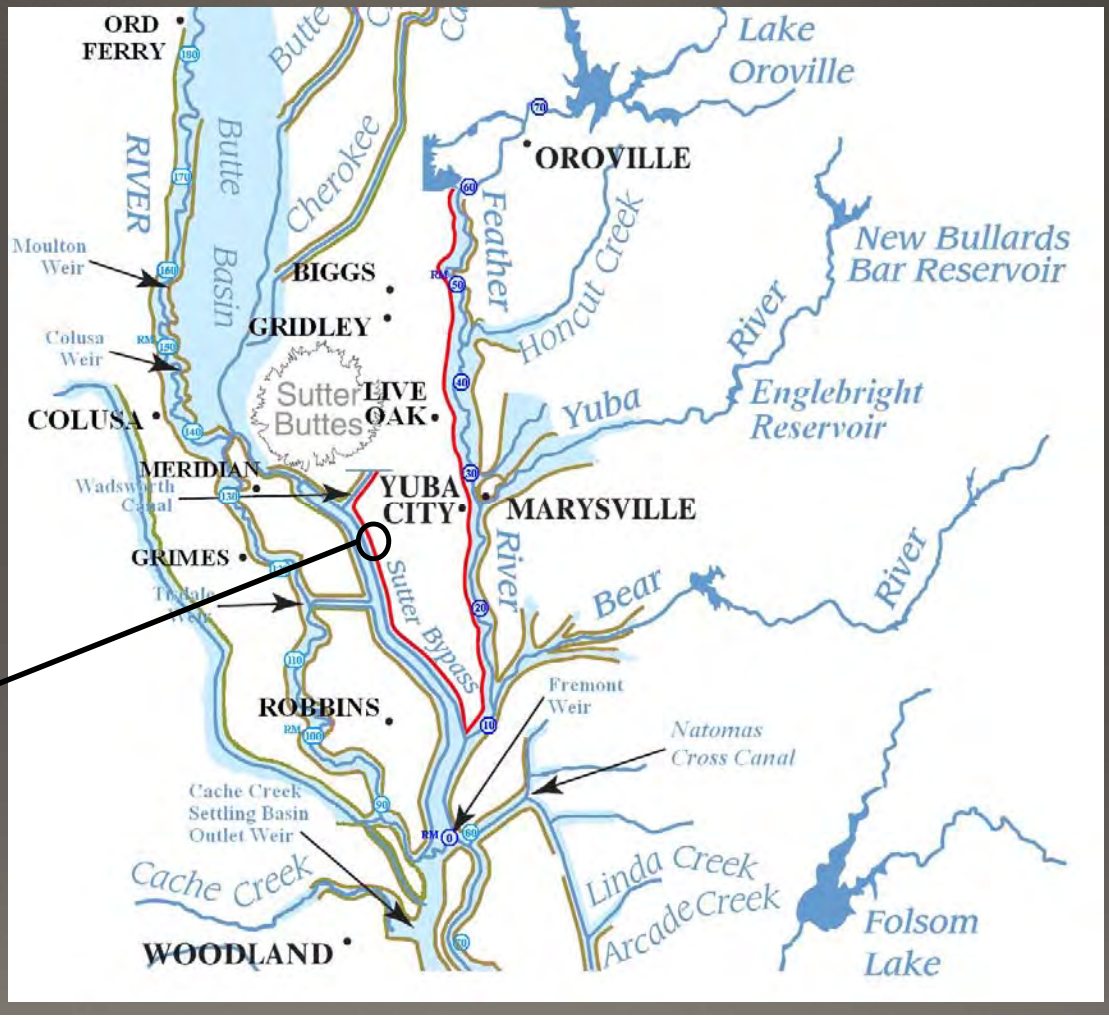
Butte Creek & Sutter Bypass

- Butte Creek originates in the Lassen National Forest
- Butte Creek is connected to the Sacramento River through the Butte Slough outfall gates and the Sutter Bypass
- Sutter Bypass = Floodplain of 40km composed of two canals (East and West borrow)
- Moulton, Colusa and Tisdale weirs spill water from the Mainstem into Butte Creek system
- Important rearing habitat for Butte Creek Chinook salmon juveniles



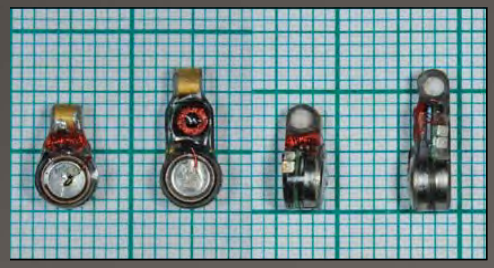
Study site: Sutter Bypass Weir 2





Acoustic tagging study

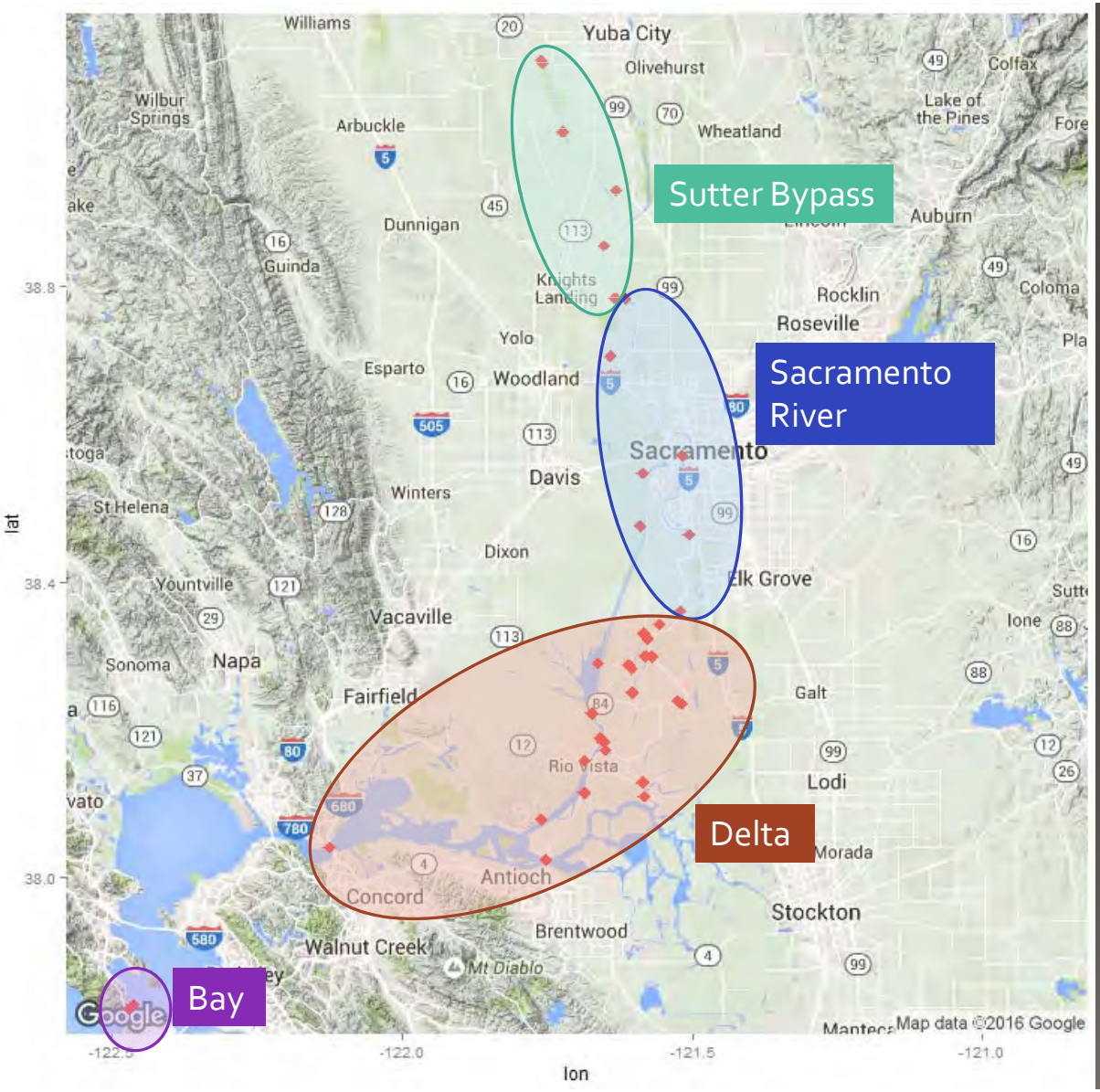
- Juvenile Salmon Acoustic Telemetry System (JSATS)
- Smolts > 80 mm



0.28g and 0.3g Lotek JSATS acoustic tags

Receivers Map

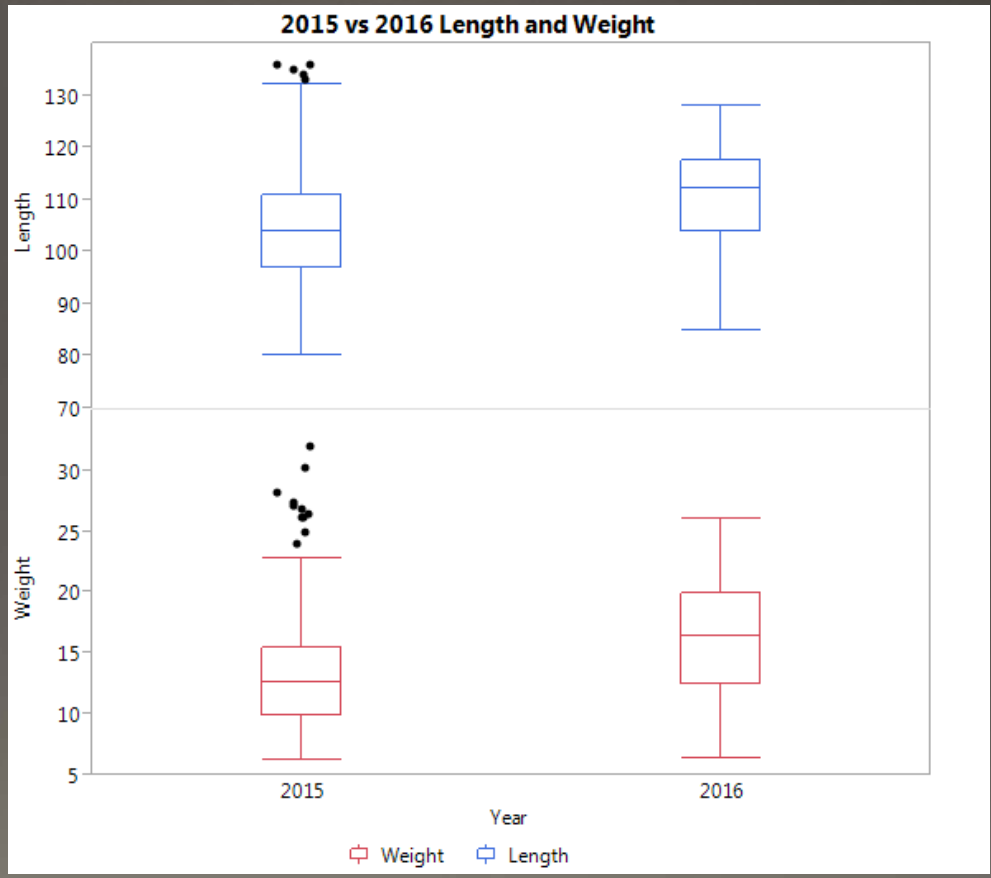
- 500 Km array of acoustic receivers



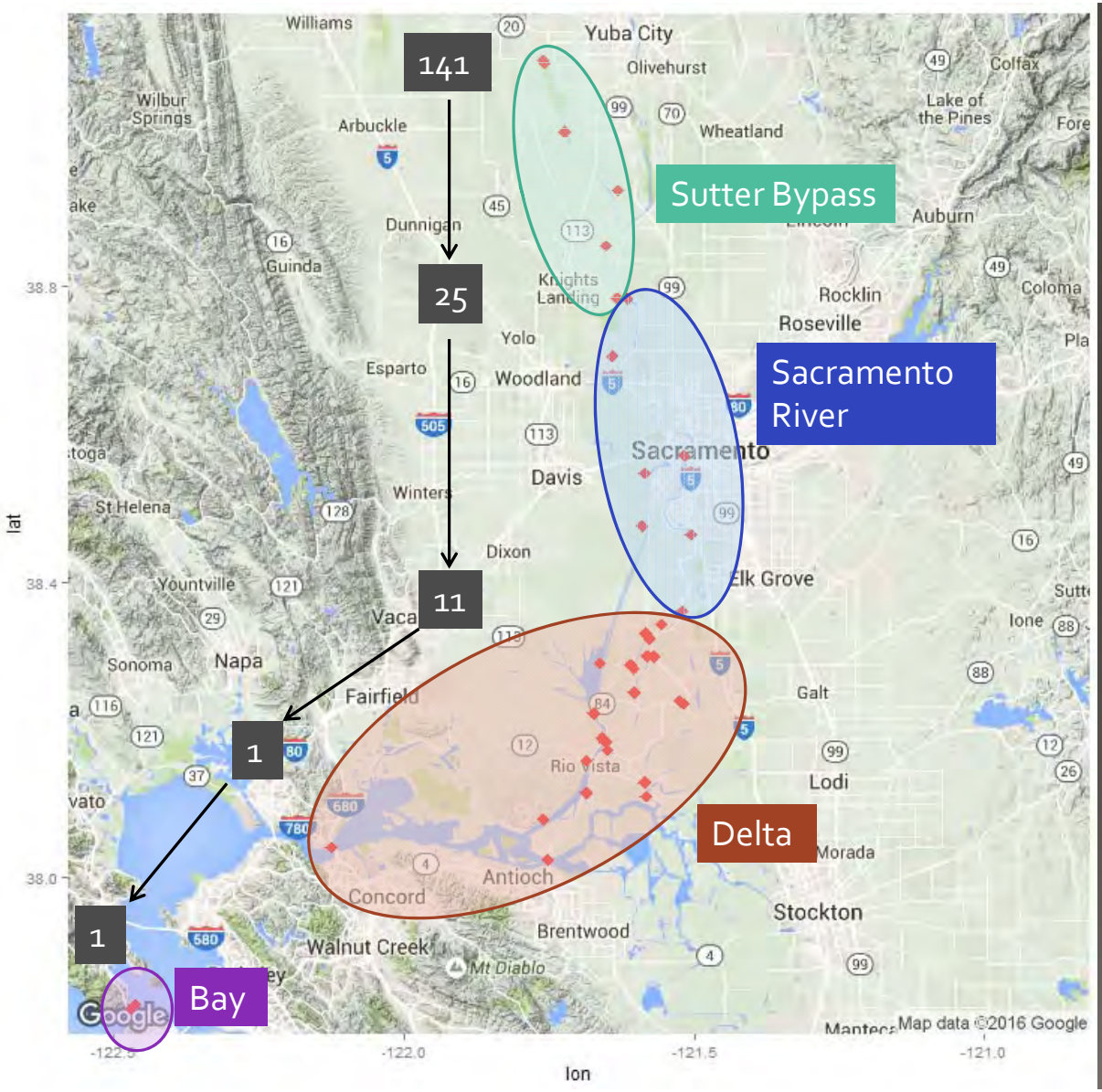
2015 vs 2016 tagged fish

- 141 fish tagged between April 6 - 16 2015
- 200 fish tagged between April 14 - 18 2016

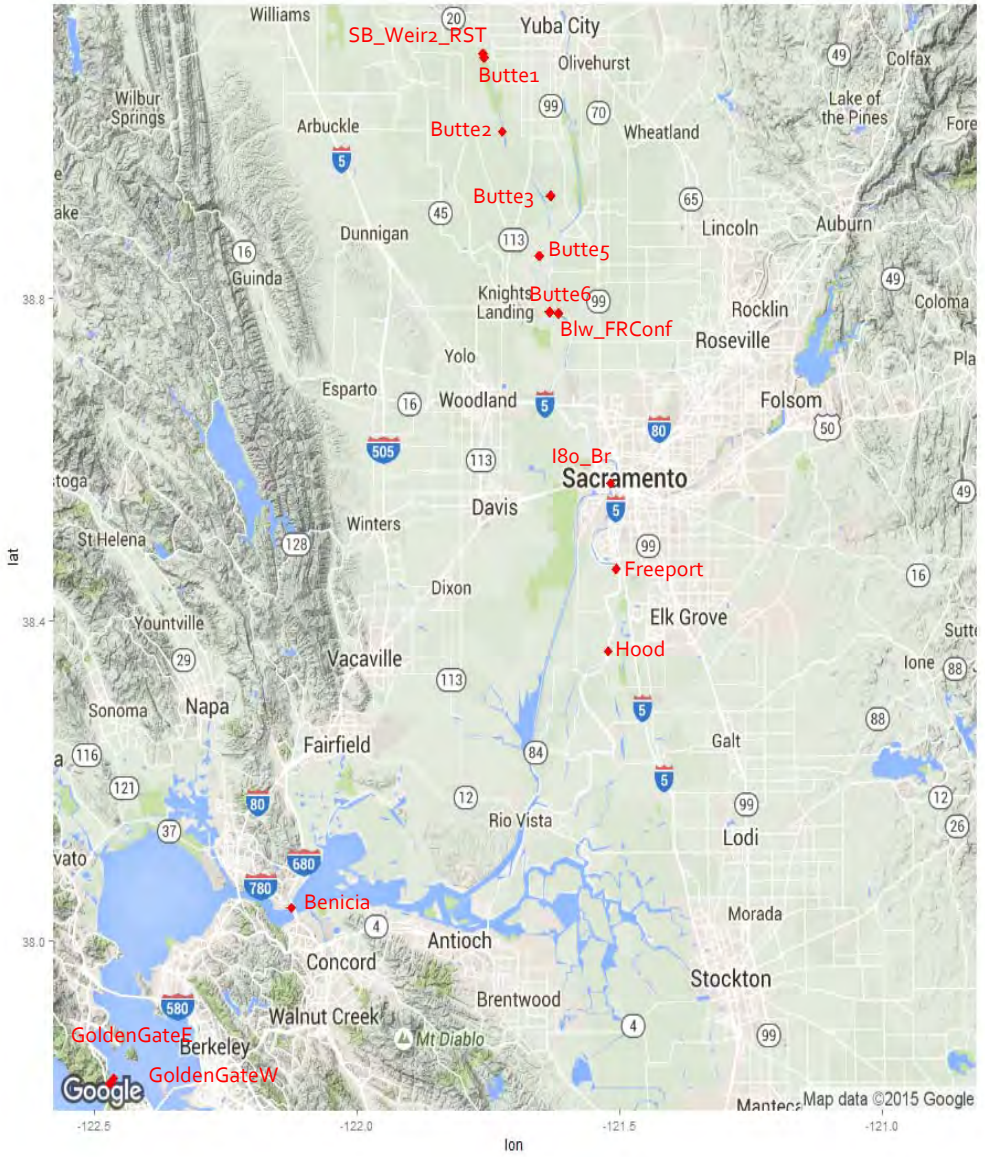
Year	n	Weight –grams (SD)	Length – mm (SD)
2015	141	13.47 (5.36)	104.75 (12.28)
2016	200	16.68 (7.68)	110.02 (10.93)



2015 detections map



Simplified receivers map

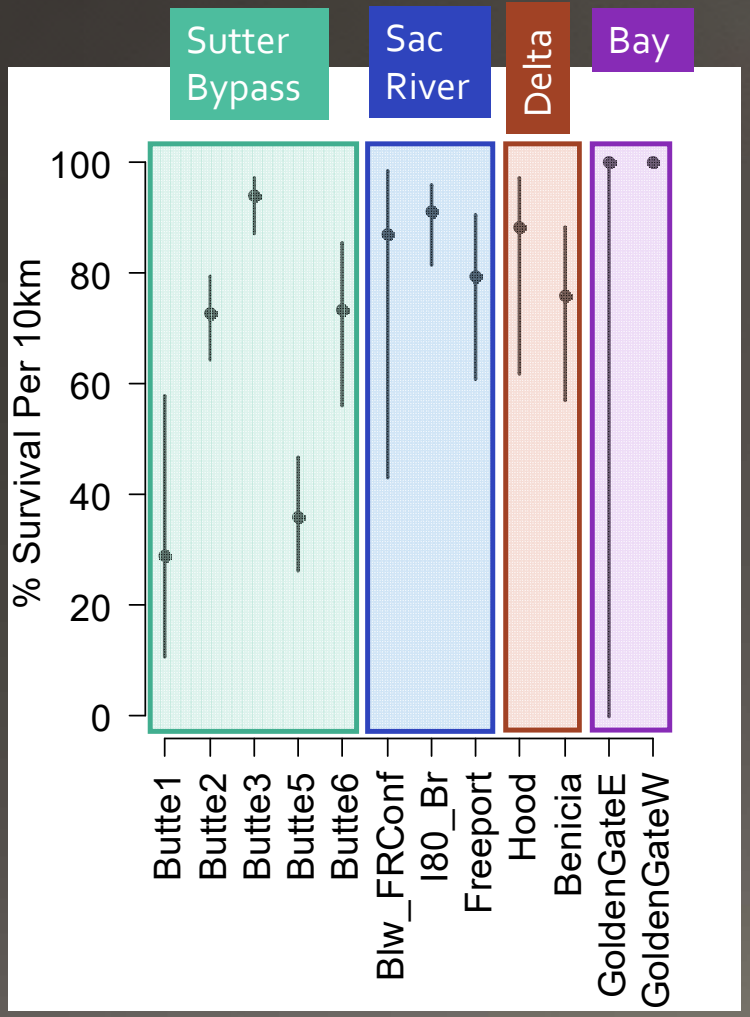


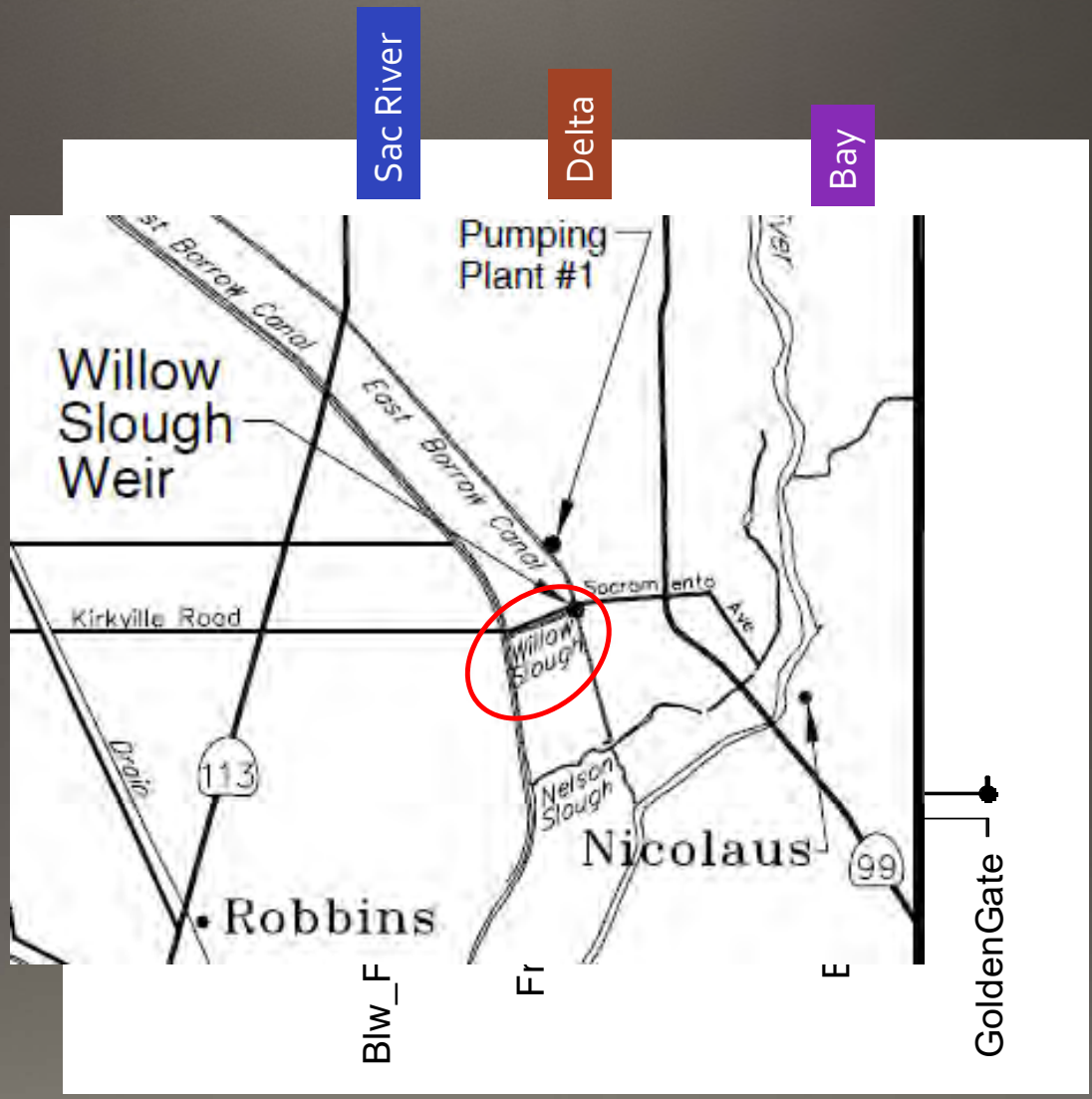
Cormack-Jolly-Seber survival model

- Reach-specific survival rates and detection probability estimated with a spatial form of the Cormak-Jolly-Seber (CJS) model (RMark library)
- Covariates: fish length, fish weight, water temp at release, water temp at each detection site
- Best Model:

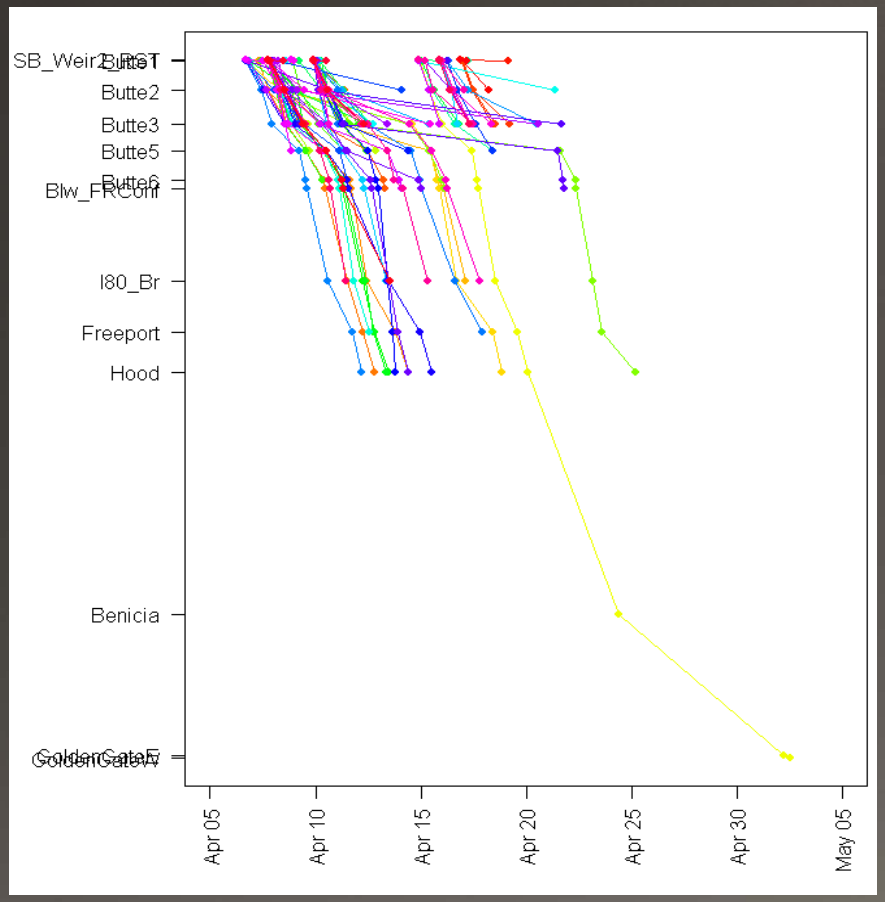
Phi	p	model	npar	AICc	DeltaAICc	weight
~reach+ length + temp	~1	Phi(~reach + length + temp)p(~1)	15	553.3976	0	0.653821
~reach + temp	~1	Phi(~reach + temp)p(~1)	14	555.545	2.147476	0.223429
~reach+ length	~1	Phi(~reach + length)p(~1)	14	557.9941	4.596546	0.065665

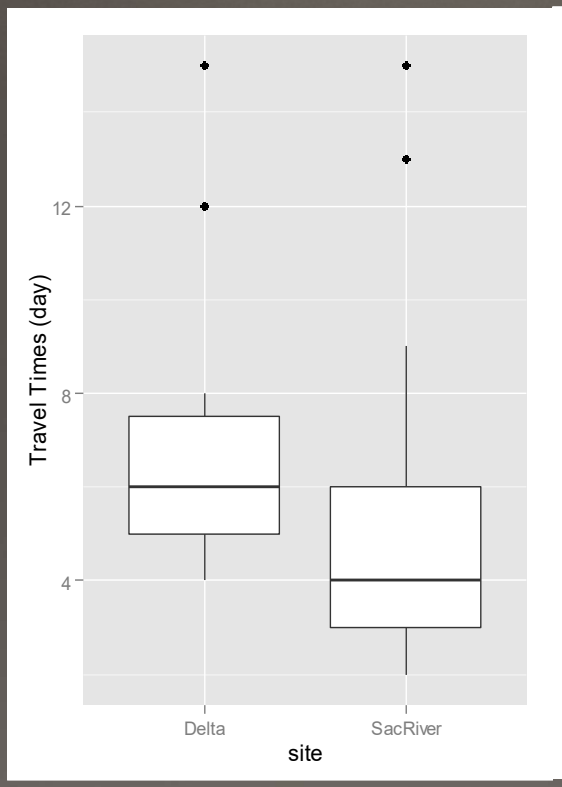
2015 survival estimates

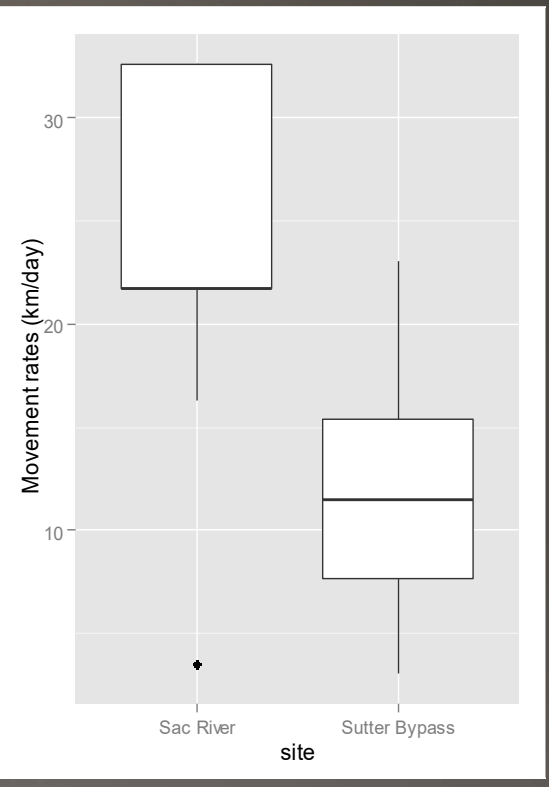




2015 migration pattern and movement rate

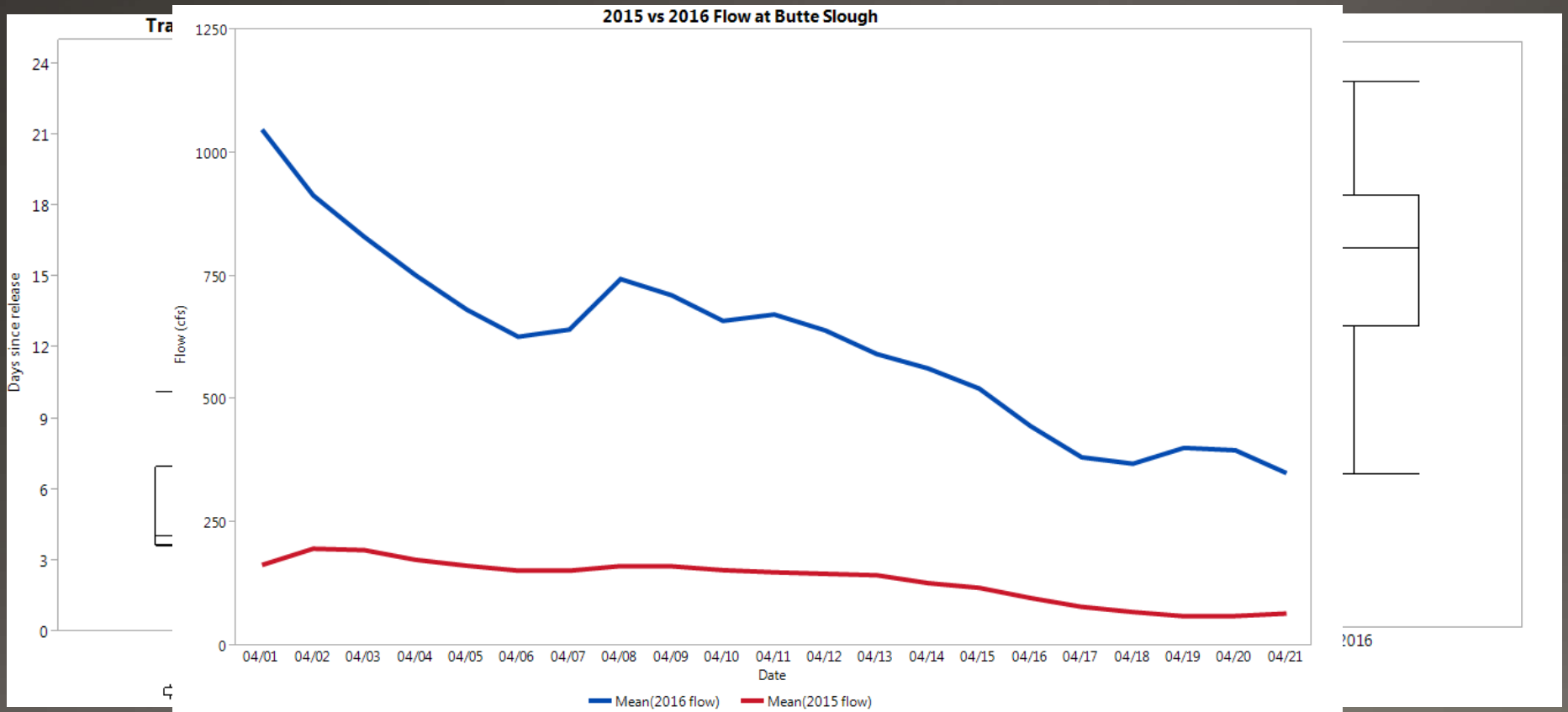






2015 vs 2016 real time travel time

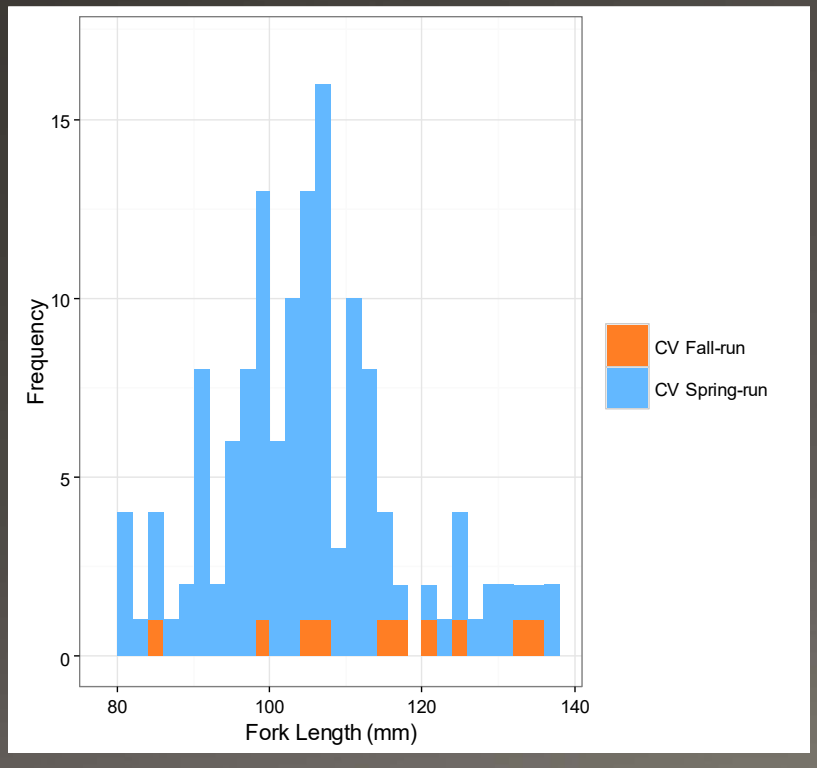
- Real time receiver at Tower Bridge (rkm 172)



Genetic Assignment. SR vs FR

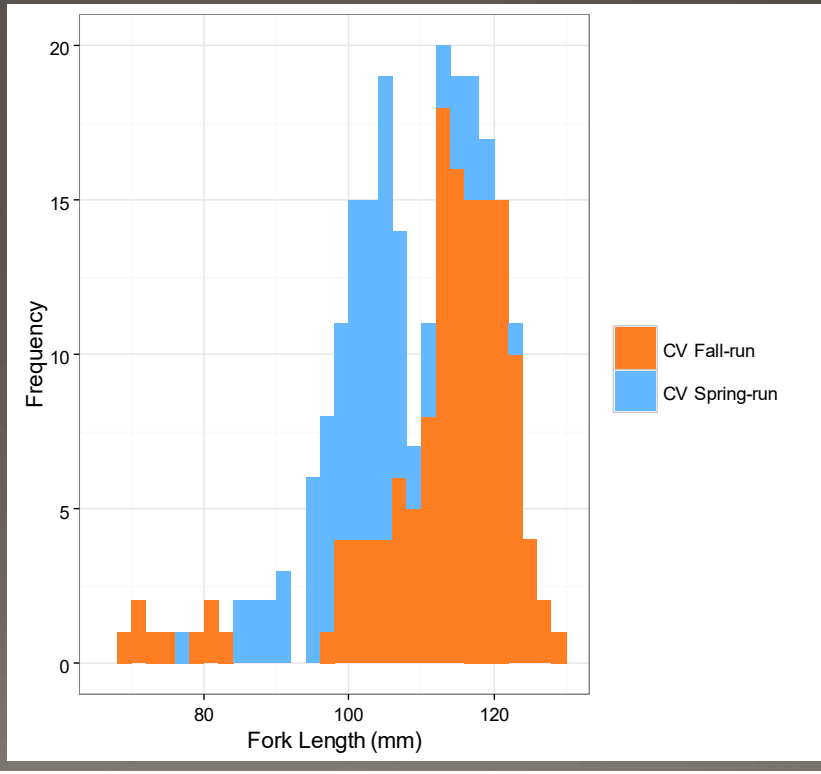
2015

Group	min	max	Mean	sd	freq
CV fall-run	84	135	113.6	14.1	10
CV spring-run	80	136	104.1	11.7	129



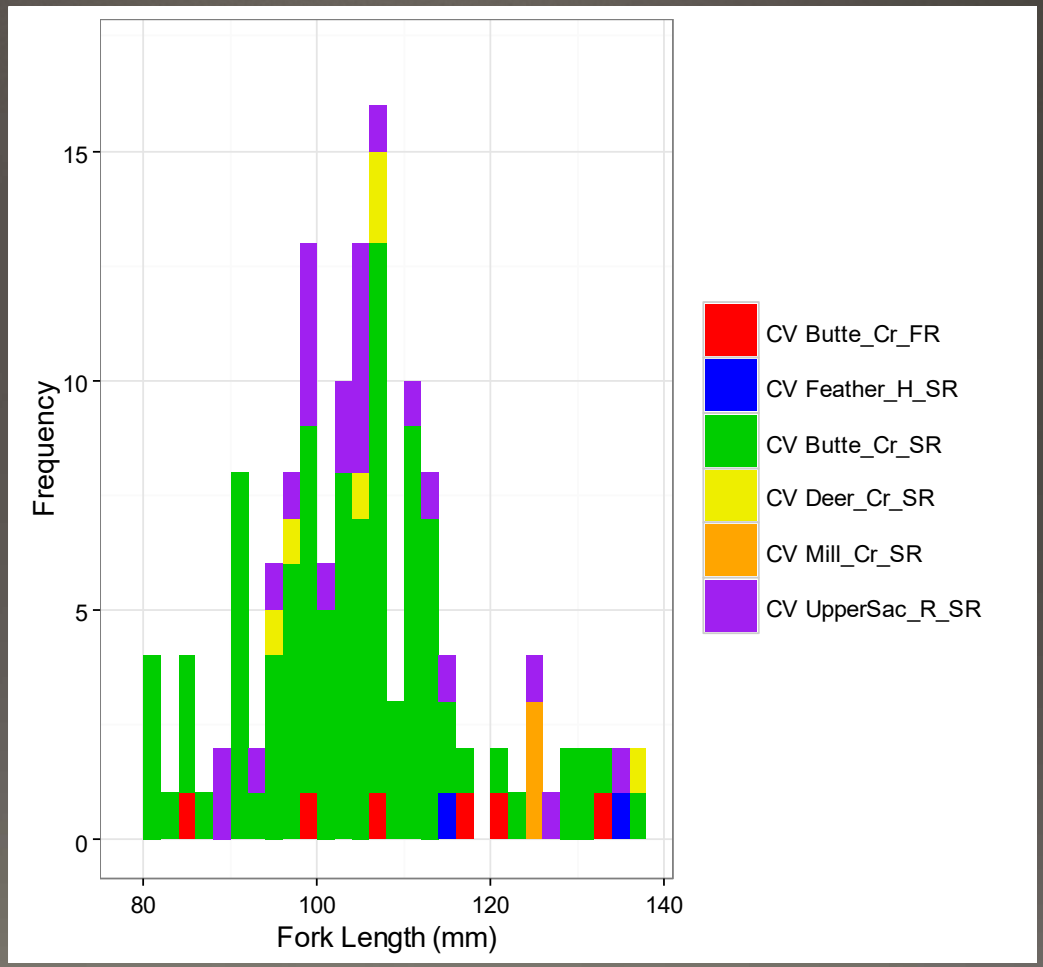
2016 (200 tagged fish + 34 sampled fish)

Group	min	max	mean	sd	freq
CV fall-run	69	128	111.7	11.8	141
CV spring-run	76	122	102	8.2	92



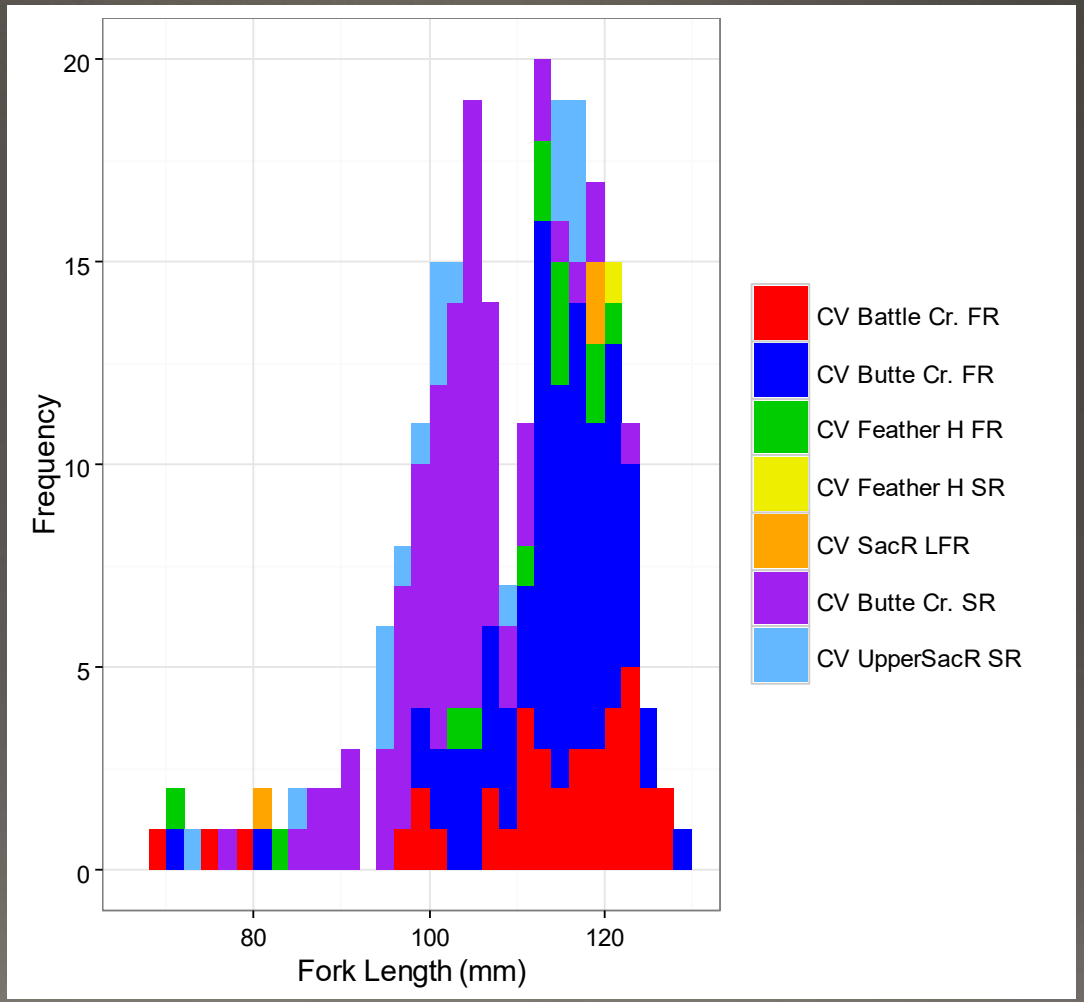
Genetic Assignment. CV stocks 2015

Group	min	max	Mean	sd	freq
CV Butte Cr. FR	84	132	109.7	16.9	6
CV Feather H. SR	114	135	124.5	14.8	2
CV Butte Cr. SR	80	136	103.3	11.6	98
CV Deer Cr. SR	95	136	107.7	14.9	6
CV Mill Cr. SR	124	125	124.3	0.6	3
CV UpperSacR SR	88	134	104.7	11.3	24



Genetic Assignment. CV stocks 2016

Group	min	max	Mean	sd	freq
CV Battle Cr. FR	69	126	11.7	13.8	38
CV Butte Cr. FR	70	128	113.1	8.9	81
CV Feather H FR	71	121	107.5	15	13
CV Feather H SR	120	120	120	NA	1
CV SacR LFR	80	119	106	22.5	3
CV Butte Cr. SR	76	122	101.8	7.8	78
CV UpperSacR SR	72	117	102.8	12.3	19



Take home message

- 2015 was a very dry year and Butte Creek spring-run smolt survival was very low, especially in two reaches of the Sutter Bypass that could be caused by detection issues and fish confusion

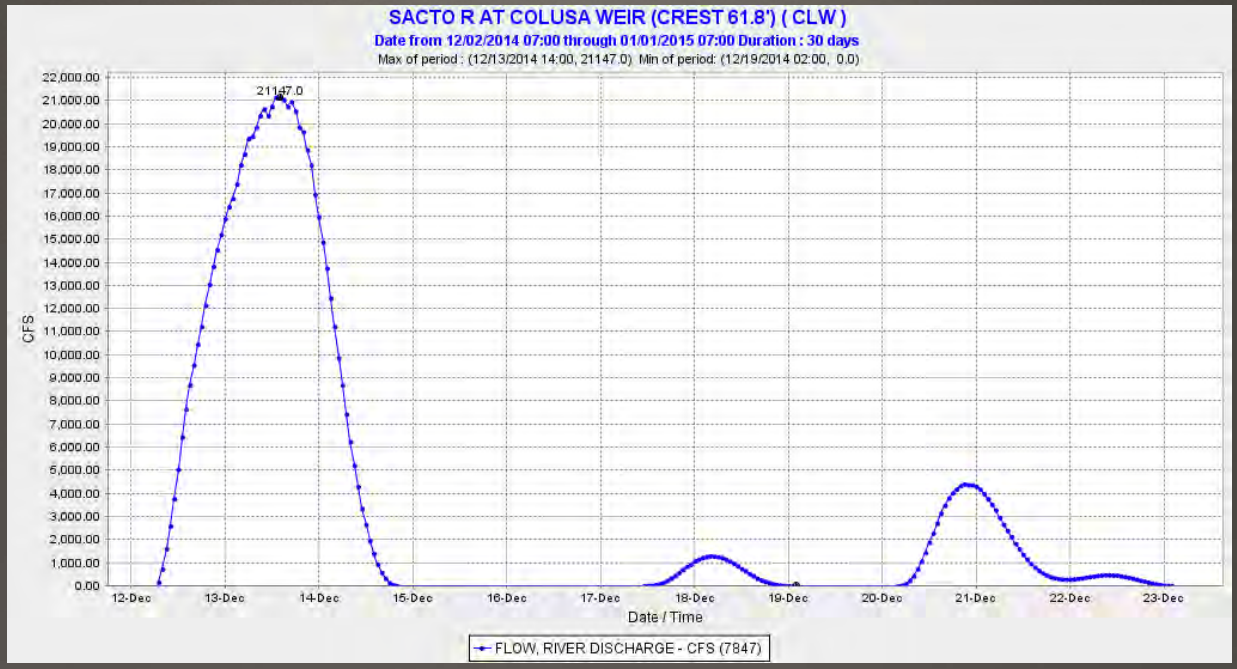
- Preliminary results for 2016 show that tagged fish are bigger and migrating faster to the Delta than in 2015

- More FR than SR fish tagged in 2016 (7% of FR in 2015 vs 63% in 2016)

Take home message

- Proportion of Chinook salmon coming from the Mainstem to the Bypass is higher in 2016 than in 2015

(25% in 2015 vs 30% in 2016)



Source: CDEC

Source: Alex McHuron

Future directions

- Keep performing acoustic study to compare survival obtained for different water type year, assess the impact of drought events
- Expand Butte Cr. spring-run Chinook salmon monitoring program to evaluate juvenile production and survival in upper Butte Creek watershed and for smaller fish
- Evaluate the rearing potential in the lower Butte Cr. system for different flooding scenario

Many thanks to:

- UCSC
- NMFS/NOAA
- US Bureau of Reclamation
- CA Department of Water Resource
- CA Department of Fish and Wildlife

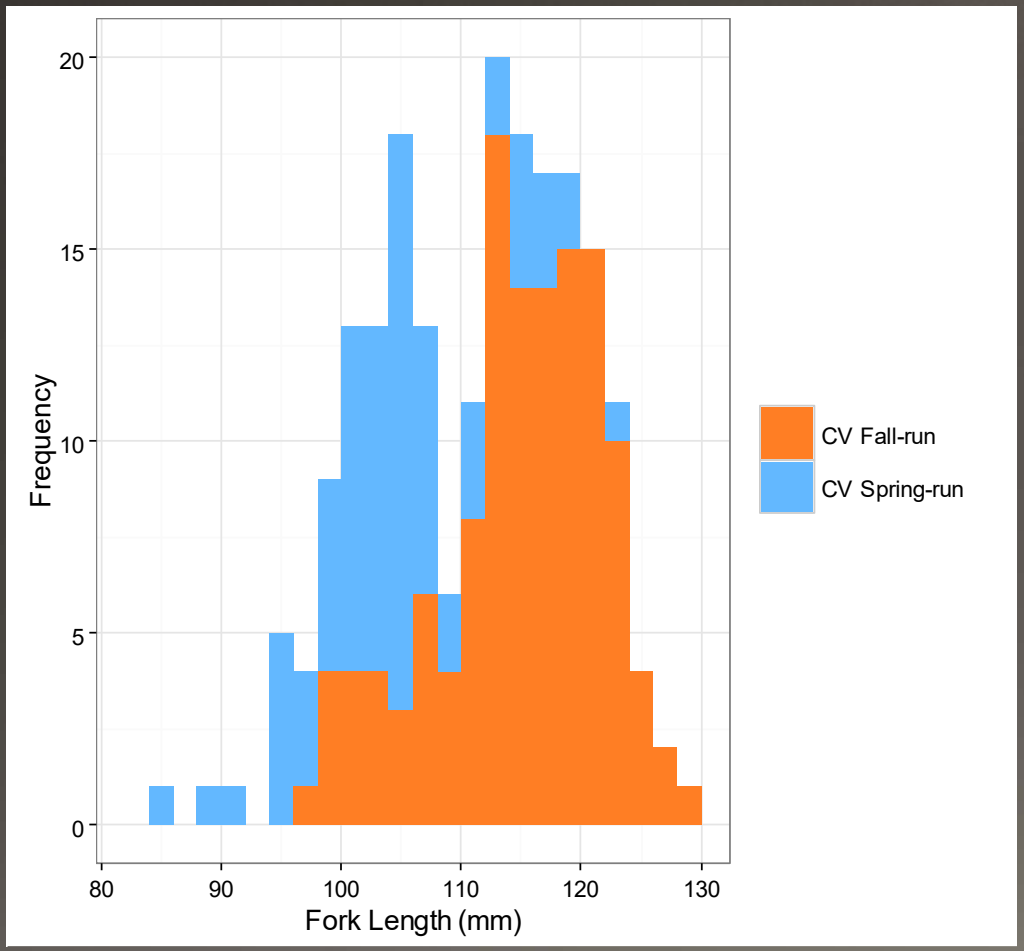
Funding: USBR Drought Grant

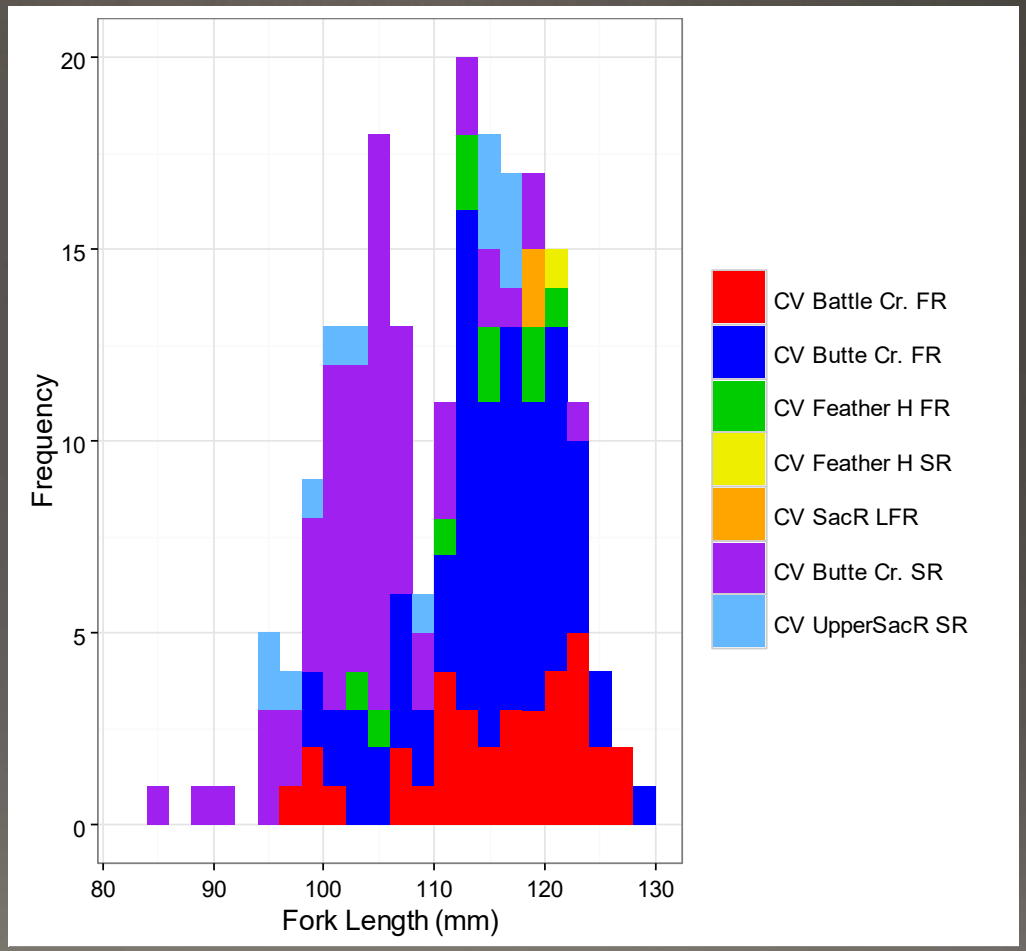
Genetic Assignment. CV stocks 2016

FishID	NumLoc	Rank	Group	FullEM	NumLoc	Rank	Group	FullEM	Numloc	Rank	Group	FullEM
SB2016-029	91	1	CentralValleyfa--Butte_Cr_fa	44.95	91	2	CentralValleyfa--Feather_H_fa	23.18	91	3	CentralValleyfa--Battle_Cr	22.511
SB2016-030	83	1	CentralValleyfa--Butte_Cr_fa	67.256	83	2	CentralValleyfa--Battle_Cr	22.464	83	3	CentralValleyfa--Sacramento_R_lf	4.19
SB2016-031	91	1	CentralValleyfa--Battle_Cr	78.551	91	2	CentralValleyfa--Butte_Cr_fa	11.366	91	3	CentralValleyfa--Sacramento_R_lf	4.14
SB2016-032	91	1	CentralValleyfa--Feather_H_fa	37.28	91	2	CentralValleyfa--Butte_Cr_fa	30.085	91	3	CentralValleysp--UpperSacramento_R_sp	18.344
SB2016-033	91	1	CentralValleyfa--Battle_Cr	48.023	91	2	CentralValleyfa--Butte_Cr_fa	22.278	91	3	CentralValleysp--Deer_Cr_sp	13.433
SB2016-038	76	1	CentralValleysp--Butte_Cr_Sp	68.82	76	2	CentralValleysp--UpperSacramento_R_sp	24.337	76	3	CentralValleyfa--Butte_Cr_fa	2.797

62 fish have a Numloc>90 & FullEM >80

FishID	NumLoc	Rank	Group	FullEM	NumLoc	Rank	Group	FullEM	NumLoc	Rank	Group	FullEM
SB2016-004	91	1	CentralValleyfa--Battle_Cr	92.019	91	2	CentralValleyfa--Butte_Cr_fa	6.768	91	3	CentralValleyfa--Feather_H_fa	0.804
SB2016-005	91	1	CentralValleyfa--Butte_Cr_fa	87.554	91	2	CentralValleyfa--Battle_Cr	7.499	91	3	CentralValleyfa--Mokelumne_R_fa	2.015
SB2016-008	91	1	CentralValleysp--Butte_Cr_Sp	86.979	91	2	CentralValleysp--UpperSacramento_R_sp	12.995	91	3	CentralValleysp--Mill_Cr_sp	0.008
SB2016-020	91	1	CentralValleysp--Butte_Cr_Sp	91.564	91	2	CentralValleysp--UpperSacramento_R_sp	8.379	91	3	CentralValleyfa--Feather_H_fa	0.022


Frequency
20
15
10
5
0
80
90
100
110
120
130
Fork Length (mm)
CV Fall-run
CV Spring-run

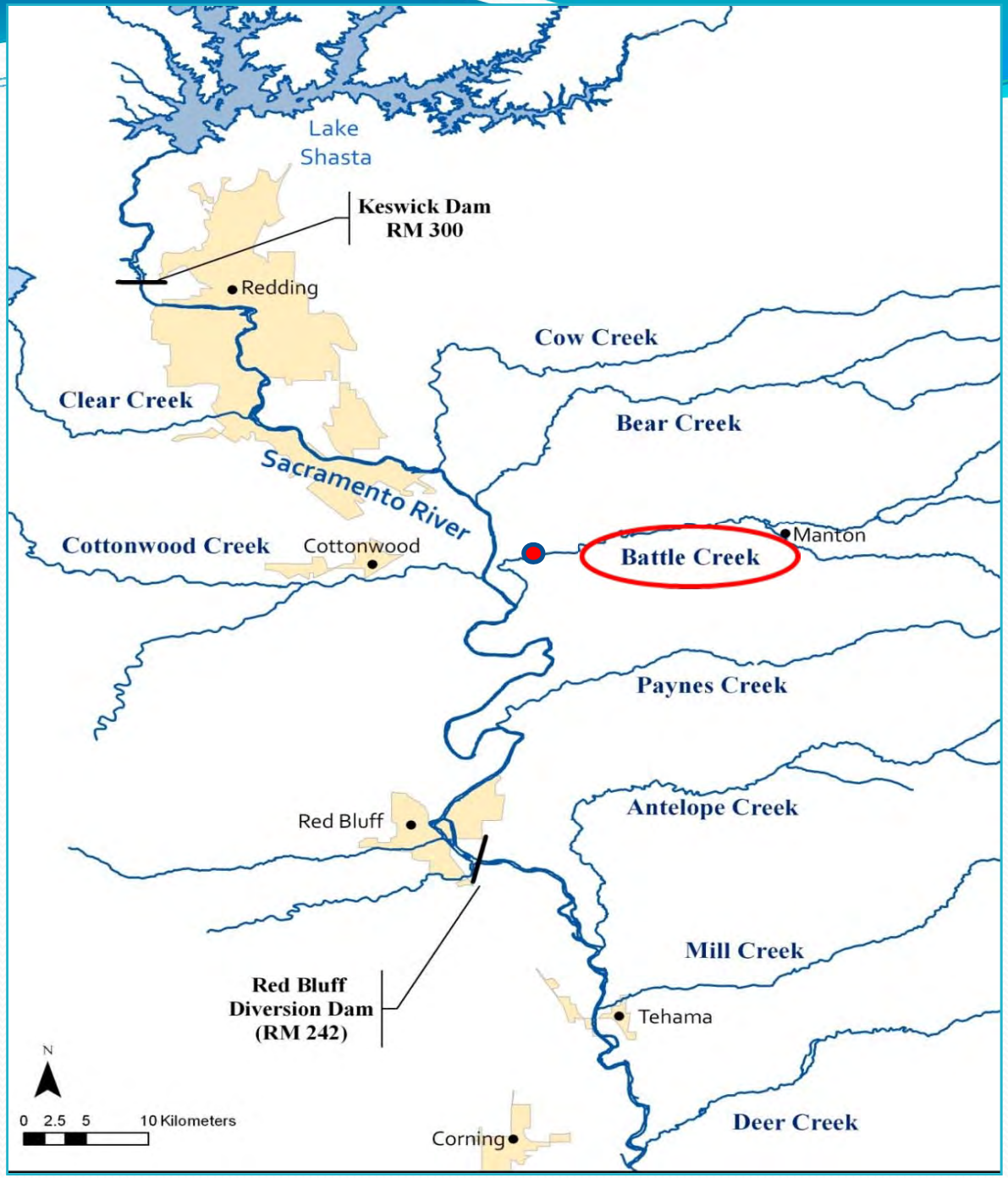

Frequency
20
15
10
5
0
80
90
100
110
120
130
Fork Length (mm)
CV Battle Cr. FR
CV Butte Cr. FR
CV Feather H FR
CV Feather H SR
CV SacR LFR
CV Butte Cr. SR
CV UpperSacR SR

Clear Creek and Battle Creek Spring Chinook Status and Restoration Actions

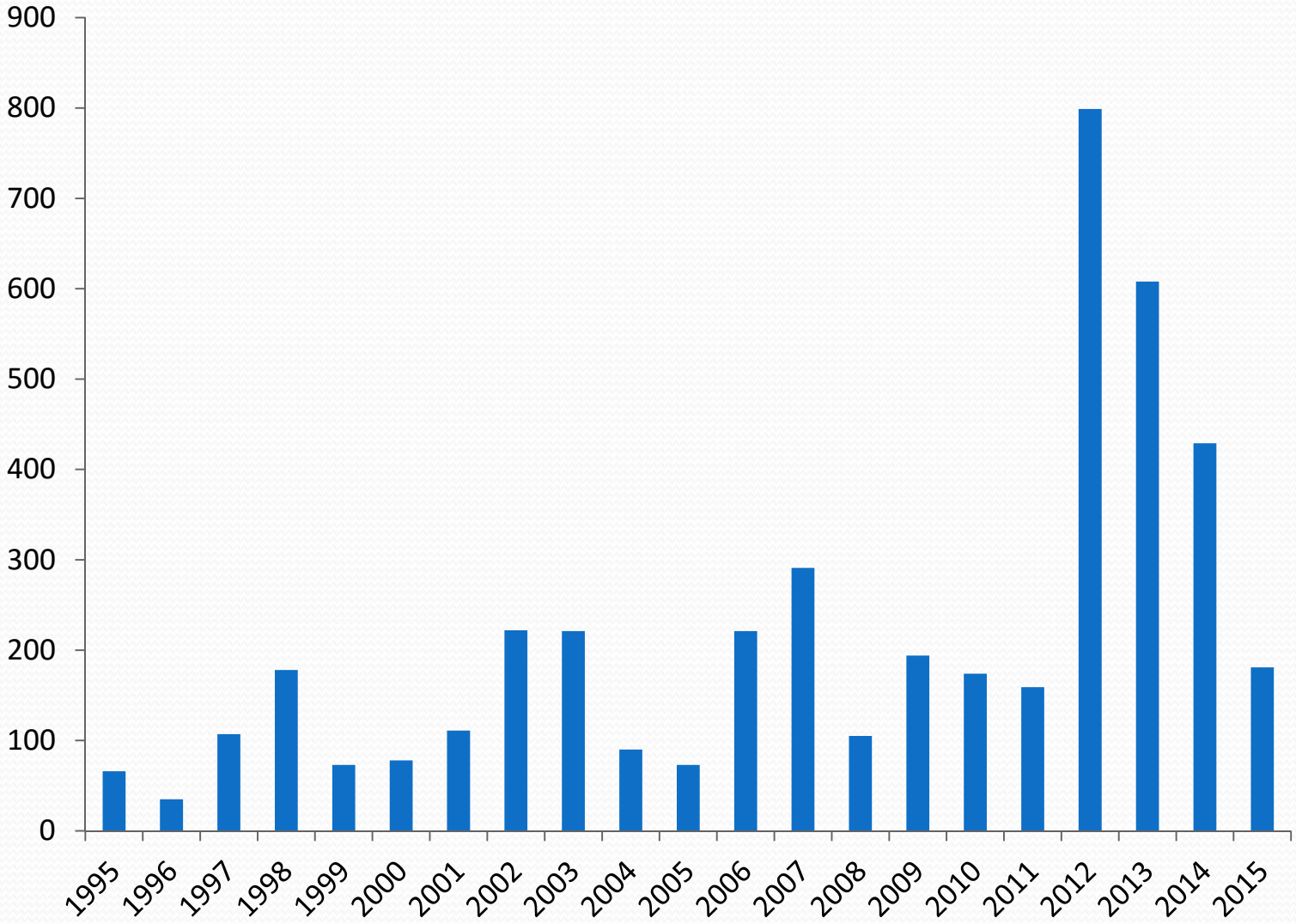
Matt Brown
USFWS, Red Bluff
July 26 2016

Battle Creek

- Adult Counts
- Decreased Spawning Success
- High Temperatures
- Wildcat Dam Removal!
- Ponderosa Fire Disaster
- Closing off South Fork
- Natural Barriers
- Future Plans and Actions
- Genetics

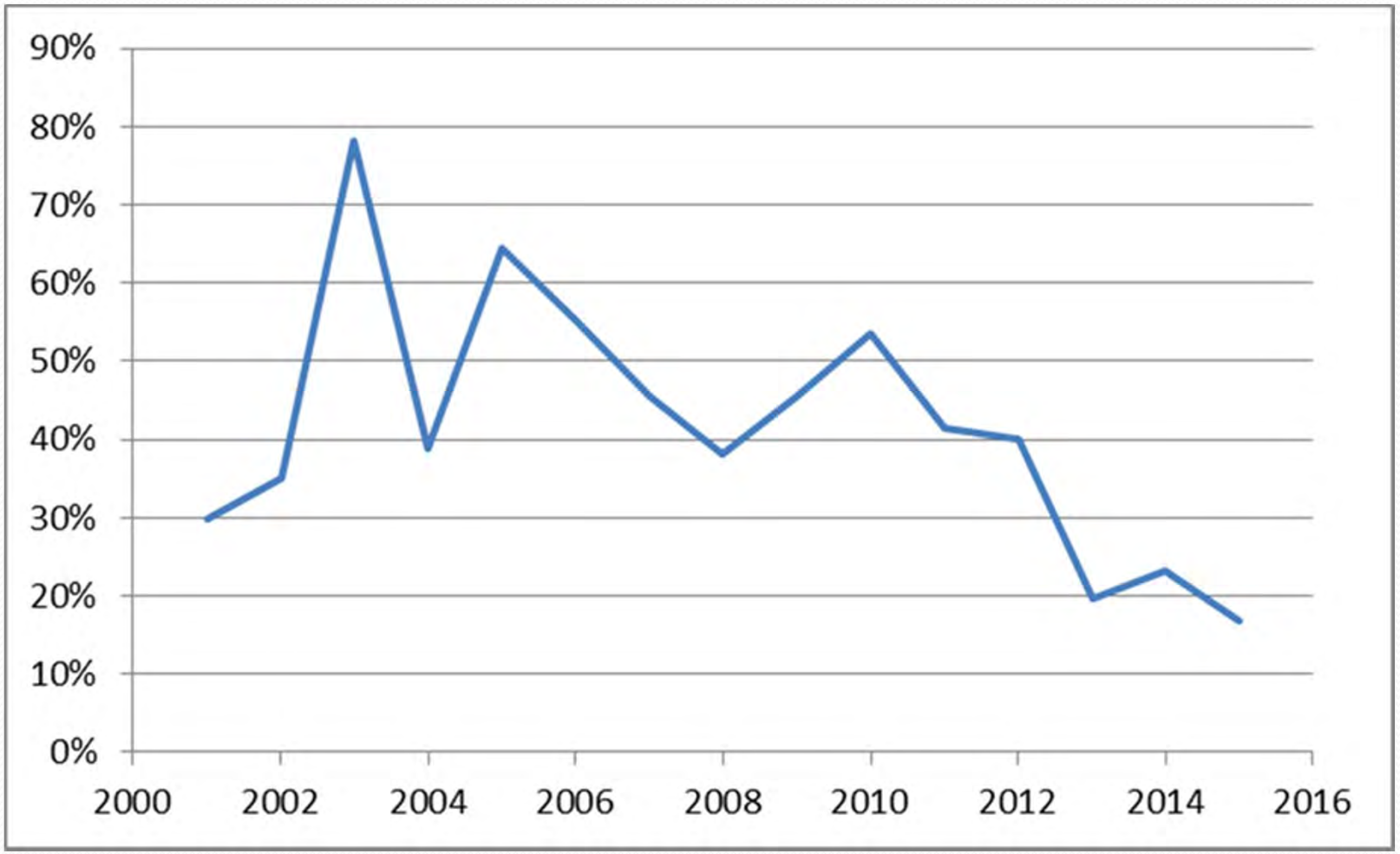

Lake
Shasta
Keswick Dam
RM 300
Redding
Cow Creek
Clear Creek
Bear Creek
Sacramento River
Cottonwood Creek
Cottonwood
Manton
Battle Creek
Paynes Creek
Antelope Creek
Red Bluff
Mill Creek
Red Bluff
Diversion Dam
(RM 242)
Tehama
N
0 2.5 5 10 Kilometers
Corning
Deer Creek

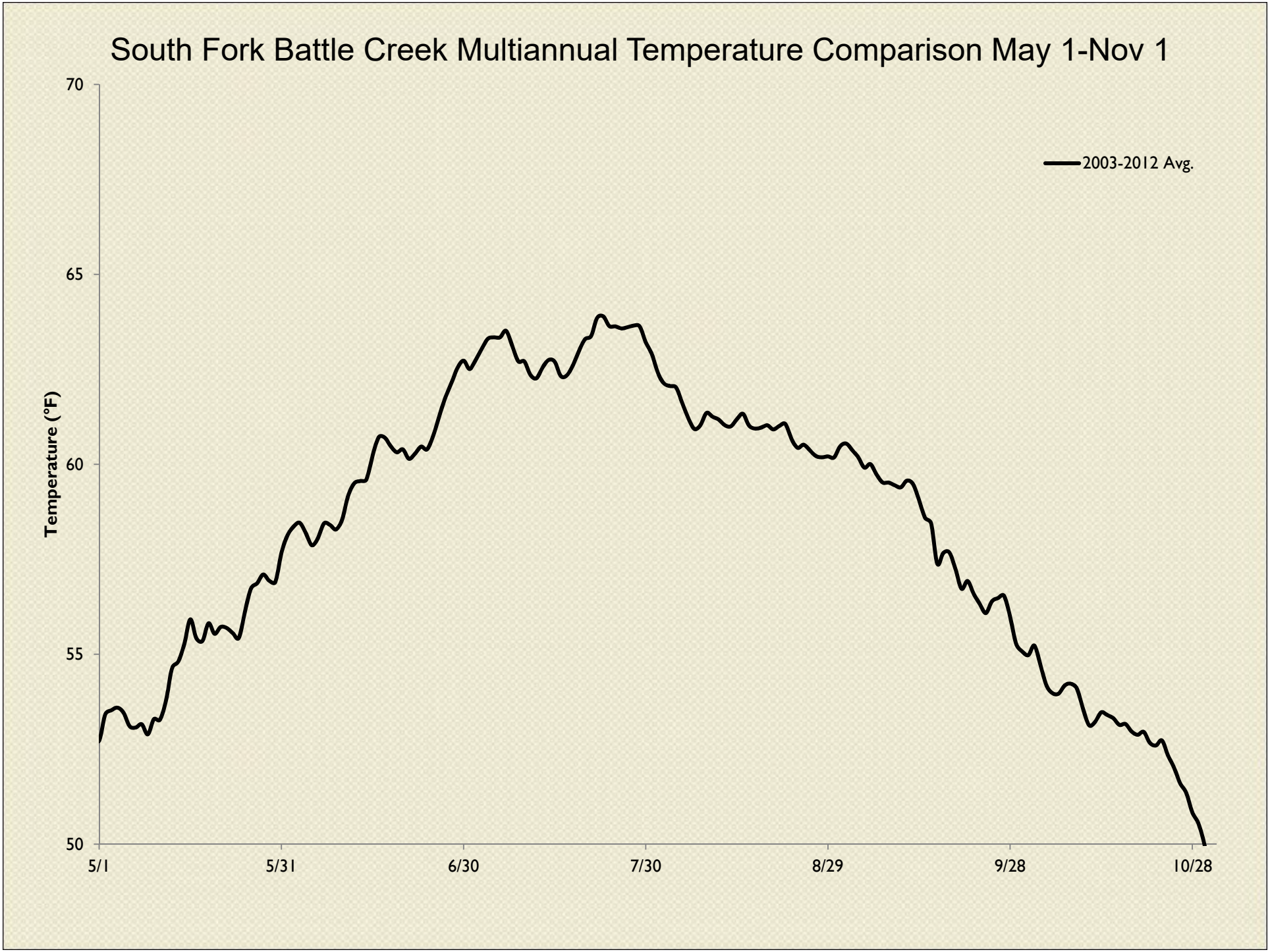
Battle Creek Spring Run Escapement

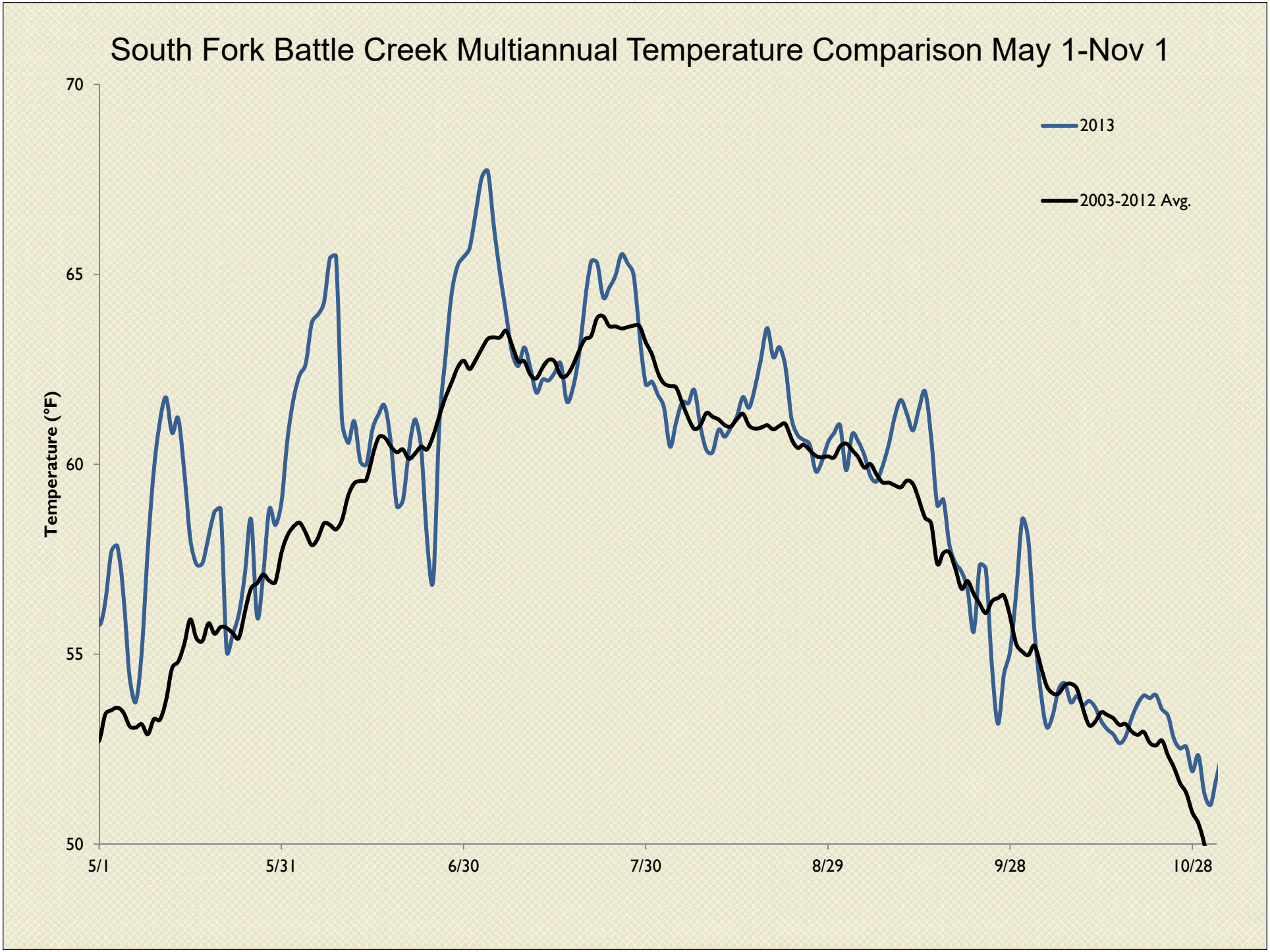


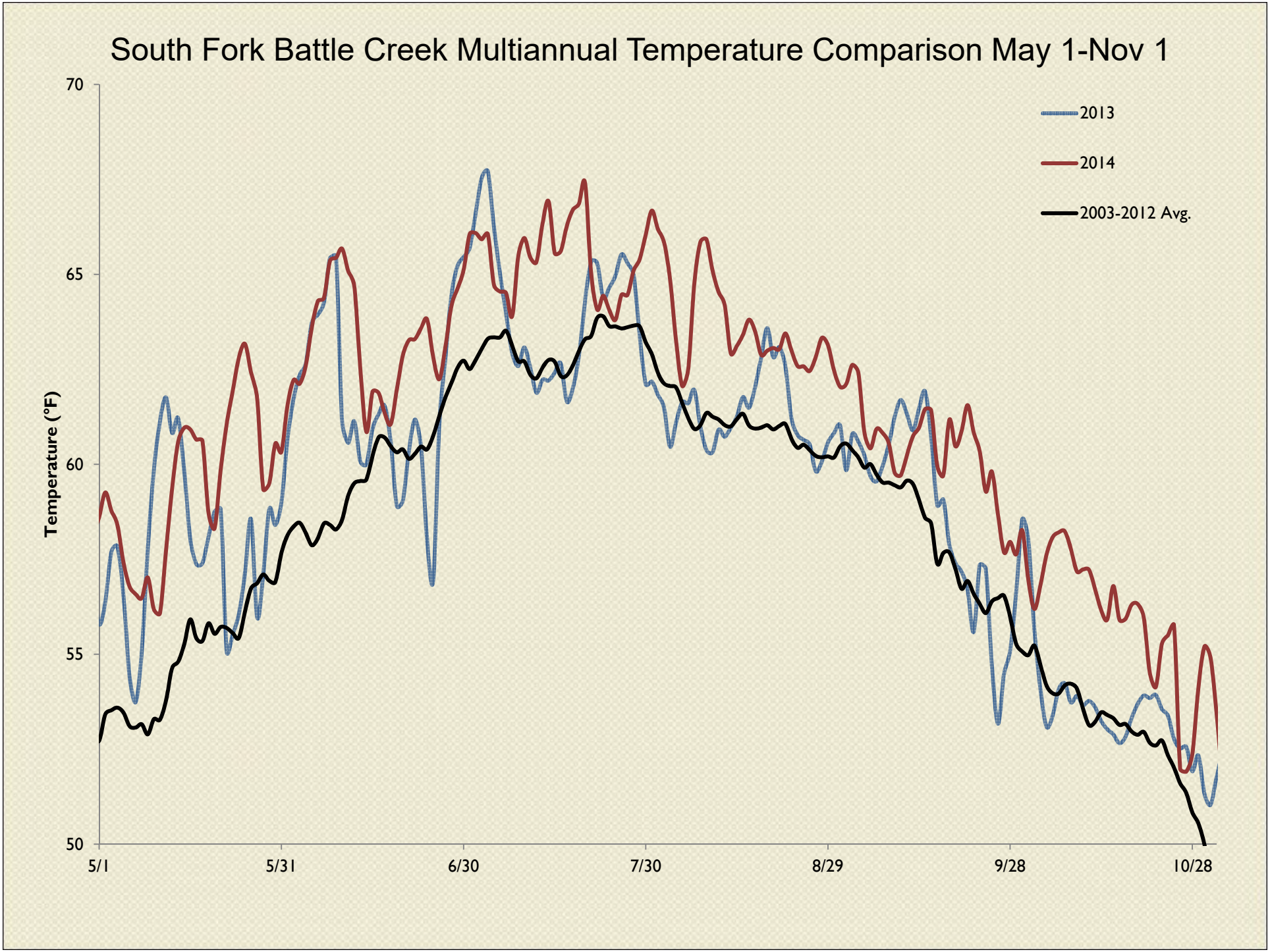
Decreased Spawning Success

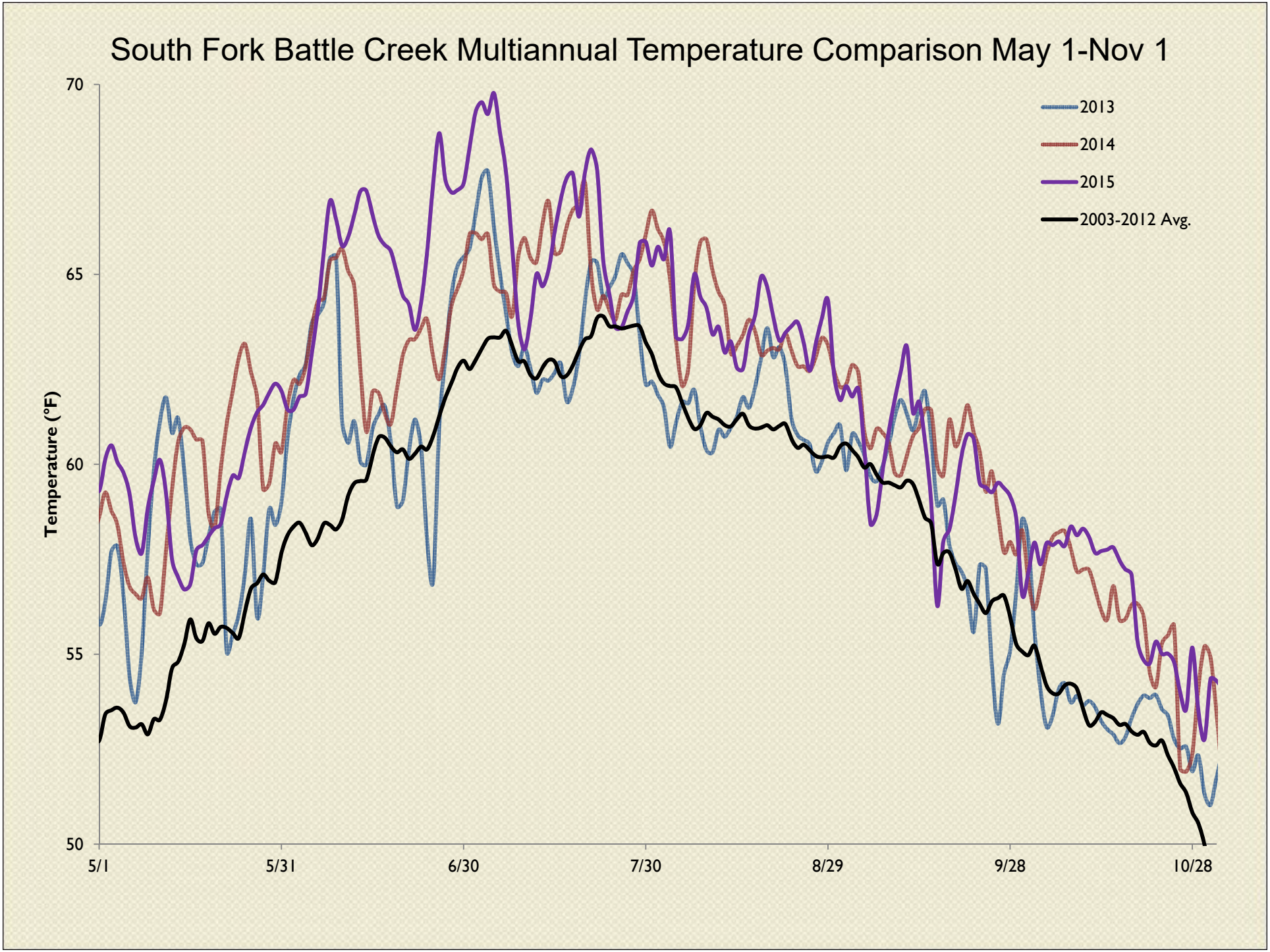
Lower Percent Redds Per Salmon



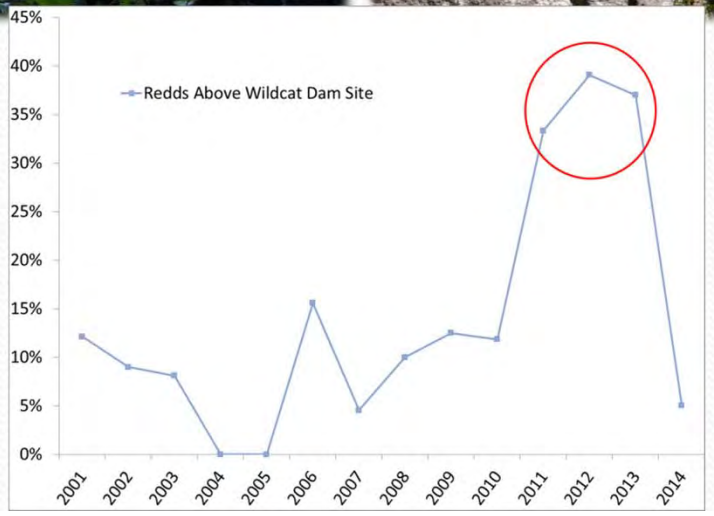

South Fork Battle Creek Multiannual Temperature Comparison May 1-Nov 1
70
65
60
55
50
Temperature (°F)
2003-2012 Avg.
5/1
5/31
6/30
7/30
8/29
9/28
10/28


South Fork Battle Creek Multiannual Temperature Comparison May 1-Nov 1
70
65
60
55
50
Temperature (°F)
5/1
5/31
6/30
7/30
8/29
9/28
10/28
2013
2003-2012 Avg.


South Fork Battle Creek Multiannual Temperature Comparison May 1-Nov 1
70
65
60
55
50
Temperature (°F)
5/1
5/31
6/30
7/30
8/29
9/28
10/28
2013
2014
2003-2012 Avg.


South Fork Battle Creek Multiannual Temperature Comparison May 1-Nov 1
70
65
60
55
50
Temperature (°F)
5/1
5/31
6/30
7/30
8/29
9/28
10/28
2013
2014
2015
2003-2012 Avg.

Wildcat Dam Removal 2010



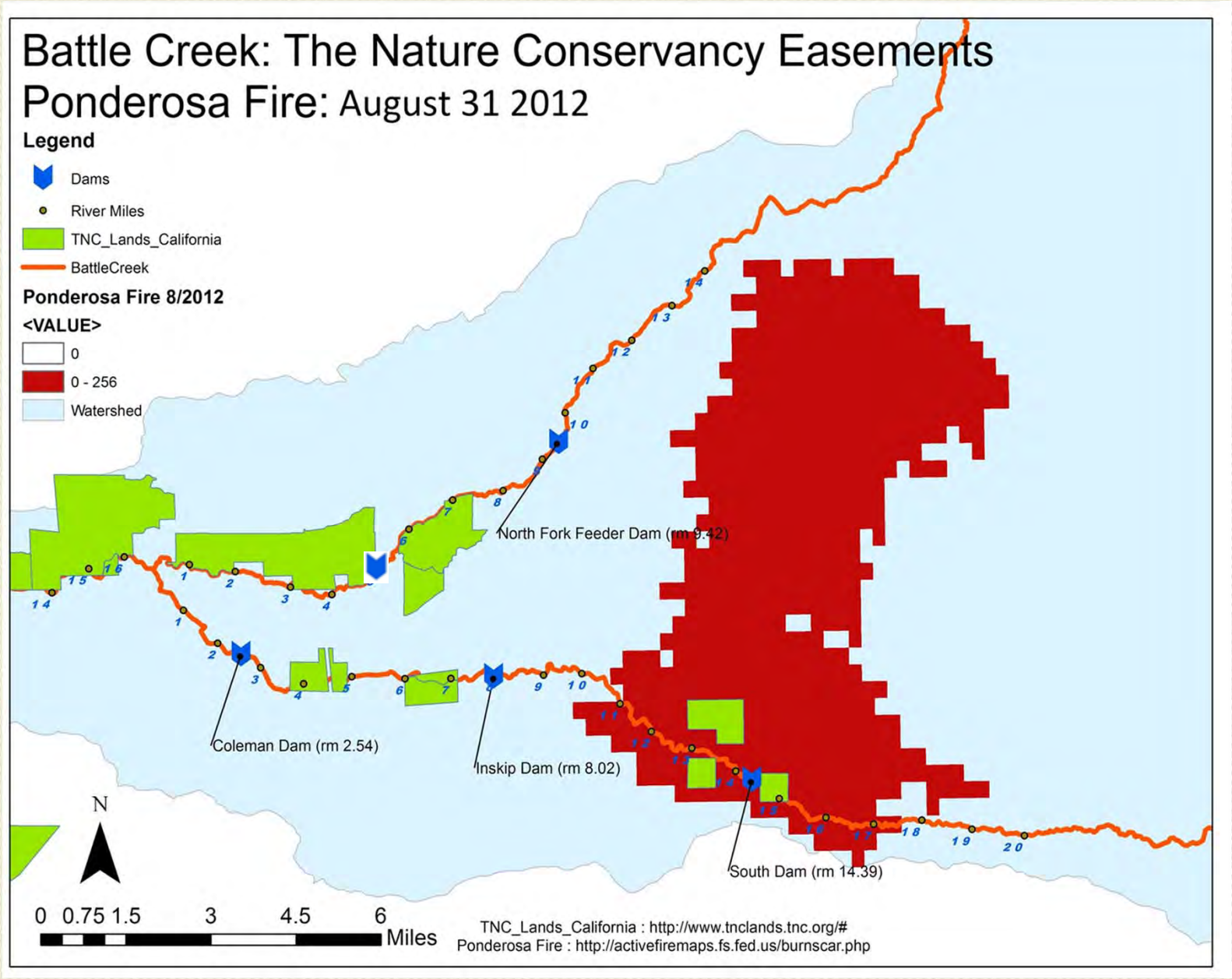
Monitoring Salmonid Passage at Natural Barriers

- Increased flows for passage
- Monitor live fish and redd distribution
- Total barrier blown up 2012

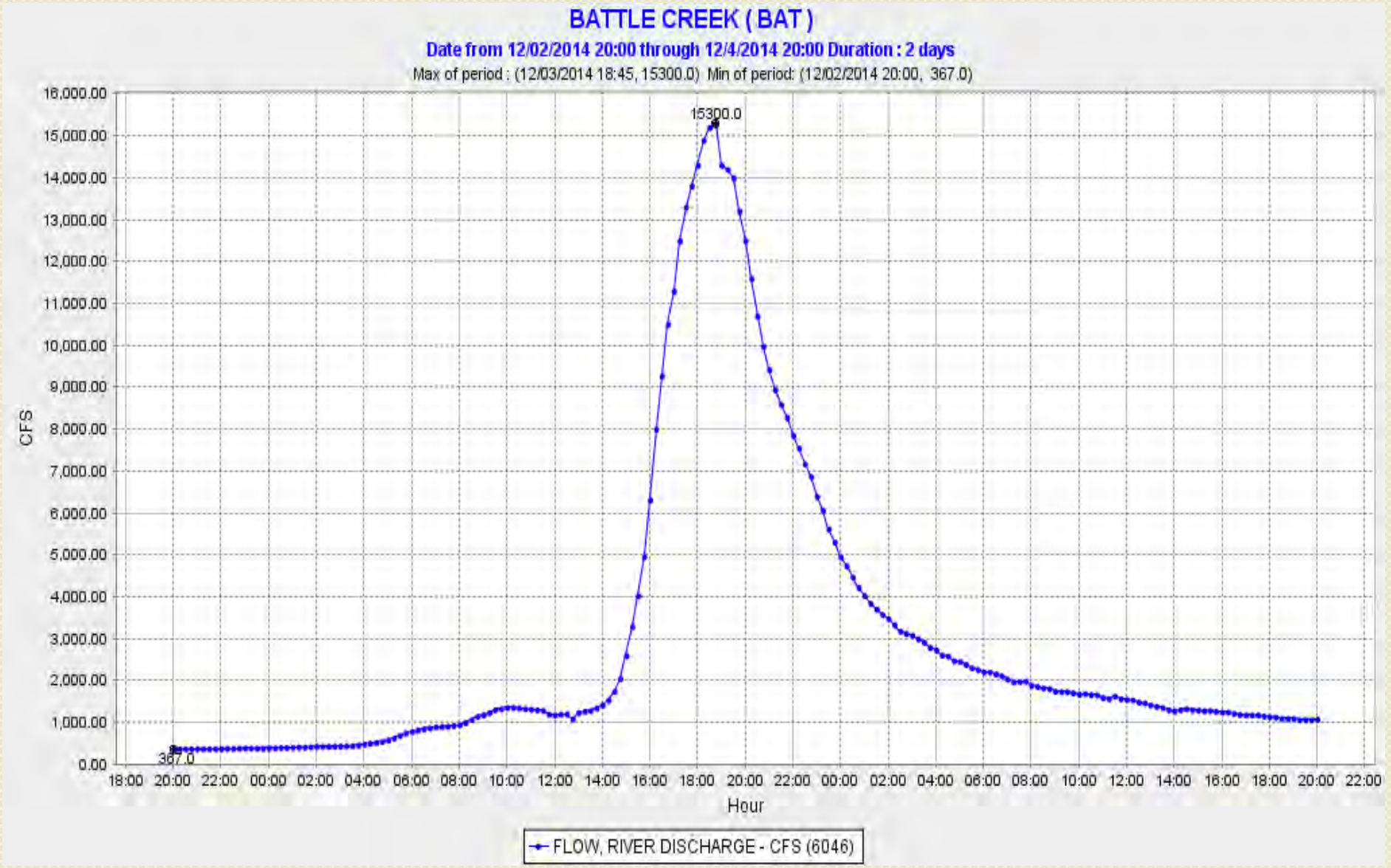
Low Flow Barriers

- Measure geometry, water velocity, water depth
- Photo points
- Revisit periodically
- Passage better in wetter years
- Need More Flow!

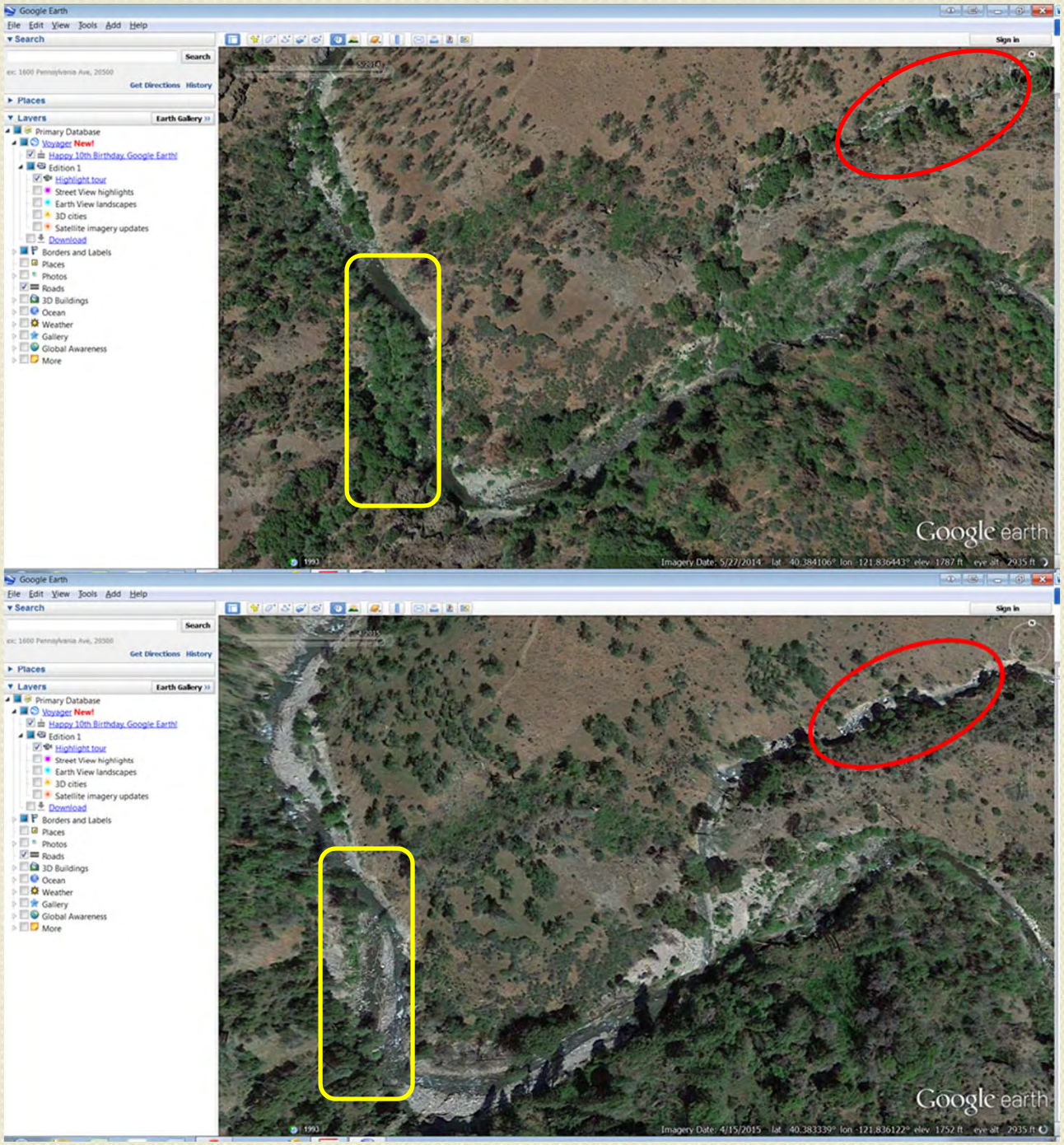
Fire and Sediment Effects on South Fork Battle Creek




Ponderosa Aftermath


BATTLE CREEK (BAT)
Date from 12/02/2014 20:00 through 12/4/2014 20:00 Duration : 2 days
Max of period : (12/03/2014 18:45, 15300.0) Min of period: (12/02/2014 20:00, 367.0)
15300.0
367.0
CFS
Hour
FLOW, RIVER DISCHARGE - CFS (6046)

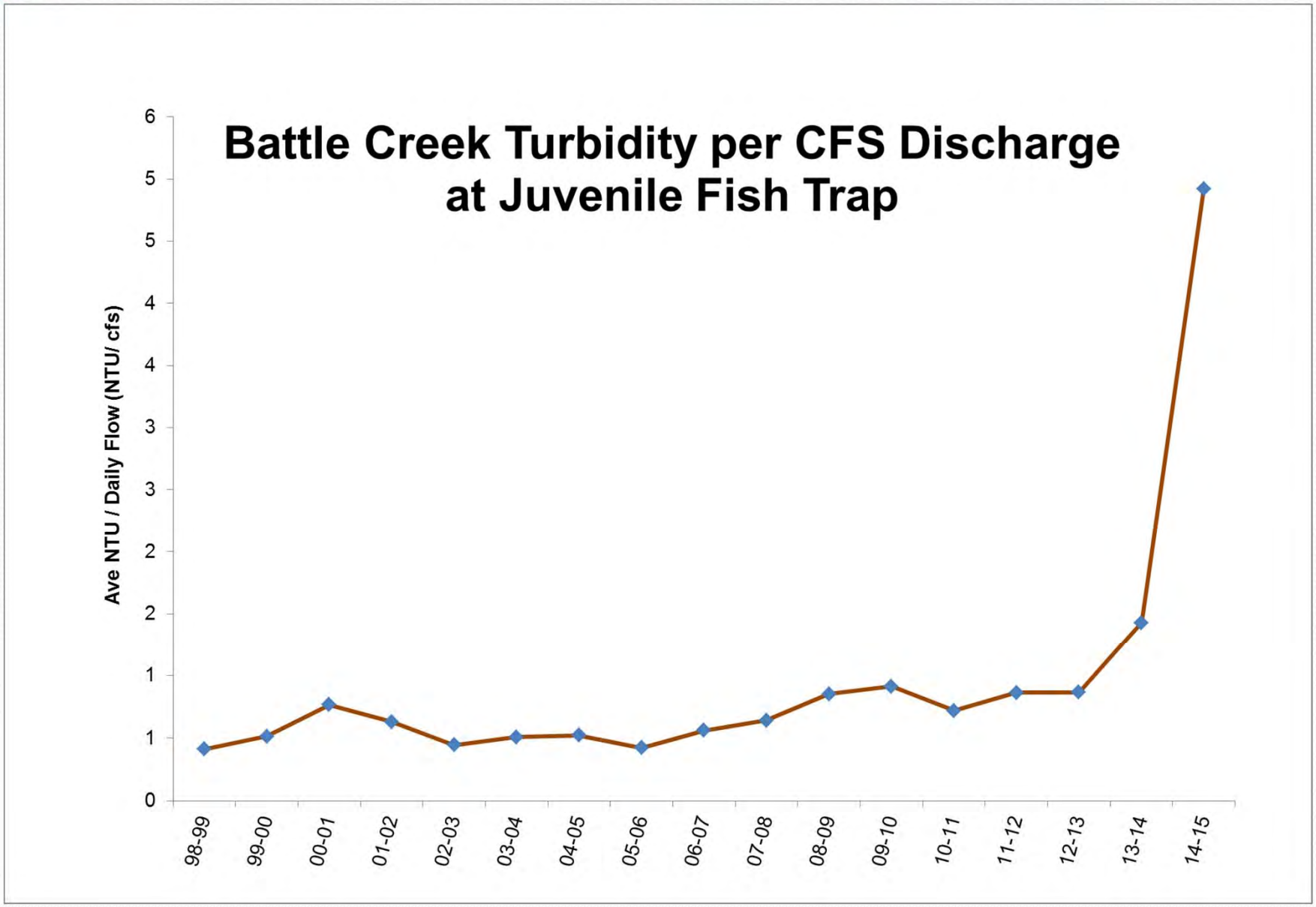
Coleman NFH Barrier Weir


Google Earth
File Edit View Tools Add Help
Search
Places
Layers
Earth Gallery
Primary Database
Voyager New!
Happy 10th Birthday, Google Earth!
Edition 1
Highlight tour
Street View highlights
Earth View landscapes
3D cities
Satellite imagery updates
Download
Borders and Labels
Places
Photos
Roads
3D Buildings
Ocean
Weather
Gallery
Global Awareness
More
Sign in
Google earth
Google Earth
File Edit View Tools Add Help
Search
Places
Layers
Earth Gallery
Primary Database
Voyager New!
Happy 10th Birthday, Google Earth!
Edition 1
Highlight tour
Street View highlights
Earth View landscapes
3D cities
Satellite imagery updates
Download
Borders and Labels
Places
Photos
Roads
3D Buildings
Ocean
Weather
Gallery
Global Awareness
More
Sign in
Google earth


Soap Creek
05/13/2014 12:10


Soap Creek
07/13/2015 14:10


05/01/2014 14:28


Battle Creek Turbidity per CFS Discharge at Juvenile Fish Trap
Ave NTU / Daily Flow (NTU/ cfs)
6
5
5
4
4
3
3
2
2
1
1
0
98-99
99-00
00-01
01-02
02-03
03-04
04-05
05-06
06-07
07-08
08-09
09-10
10-11
11-12
12-13
13-14
14-15

Holding and Spawning Habitat Filled With Sand

Used Weir to Close off South Fork

Upcoming Plans, Actions, and Challenges

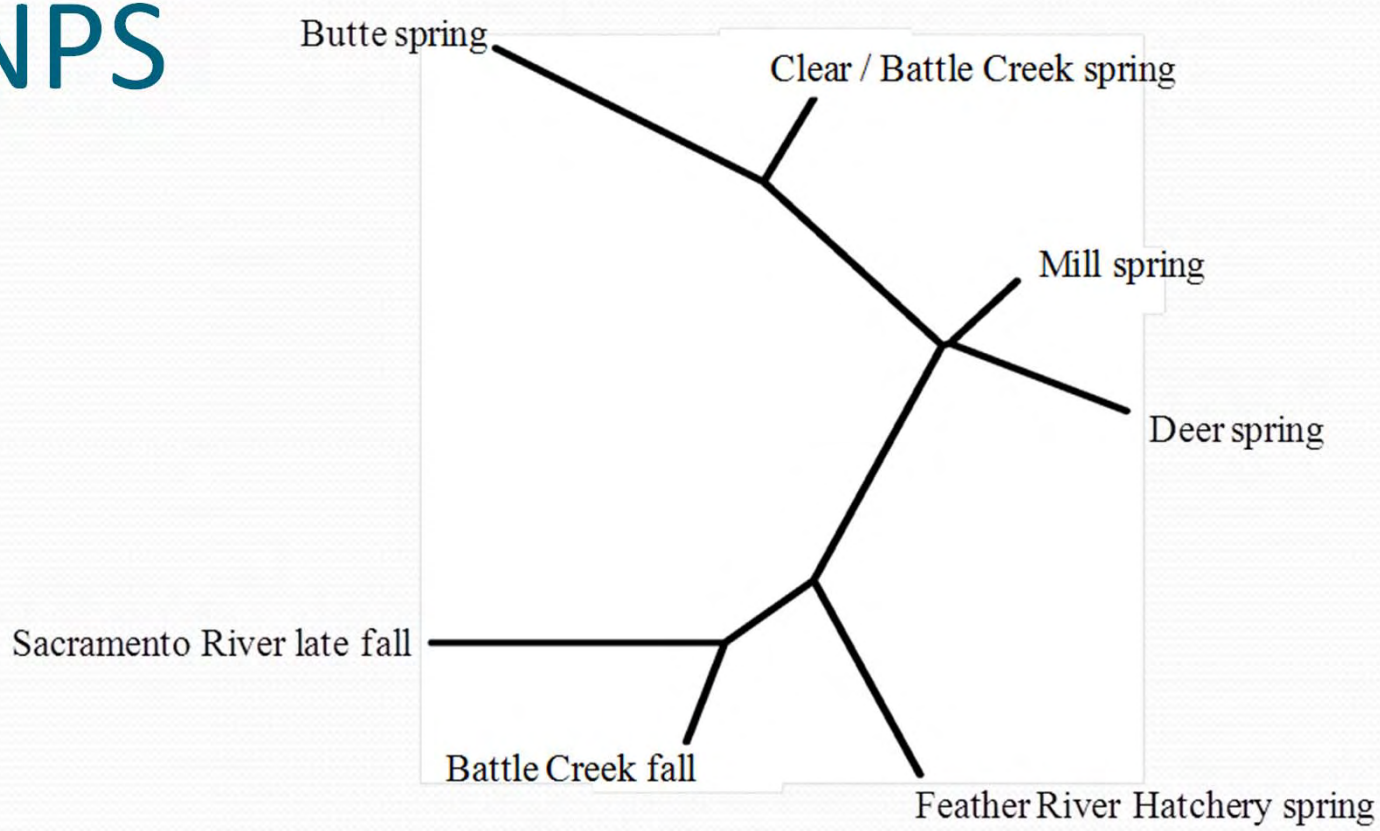
- Winter Chinook Reintroduction Plan
- Coleman National Fish Hatchery Adaptive Management Plan-studies forthcoming
- New Fish Trap and Fish Sorter

- Phase 2 of Battle Creek Restoration Project
  - Physical modeling of new fish screen and fish ladder
  - Final designs being developed
  - Construction in 2018
- Removal of four dams

- Getting Higher Flows in North Fork
- Opening Up the New Fish Ladder @ Eagle Canyon

New Fish Screens and New Fish Ladders

Genetic Distances Among Sacramento River Chinook-SNPS



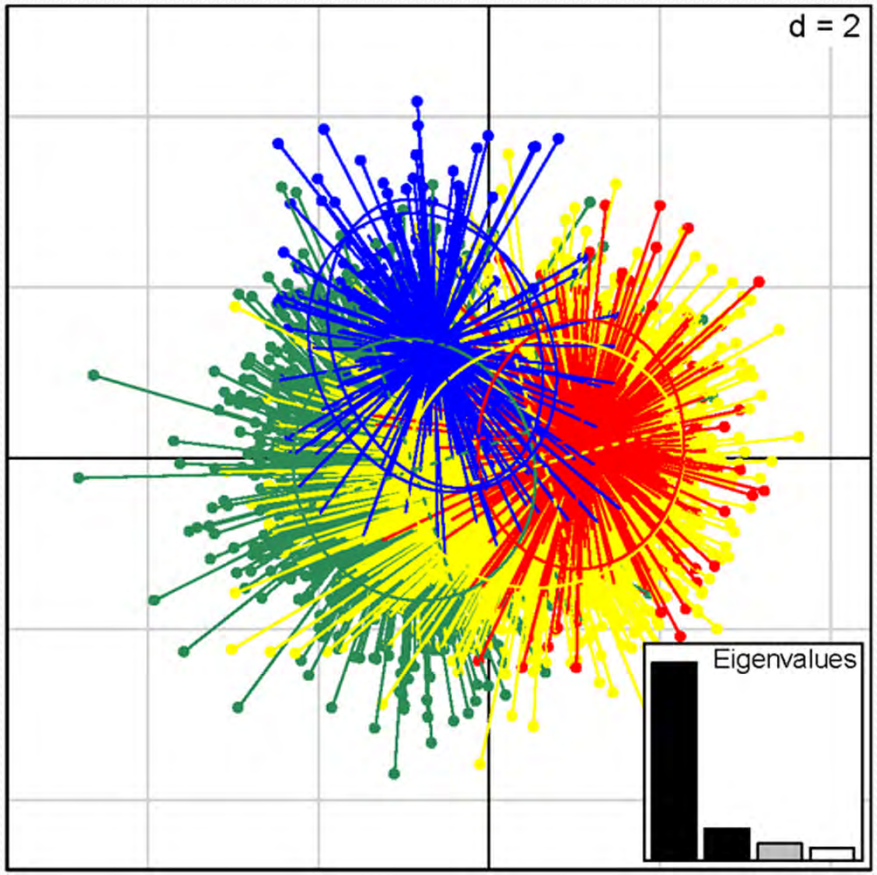
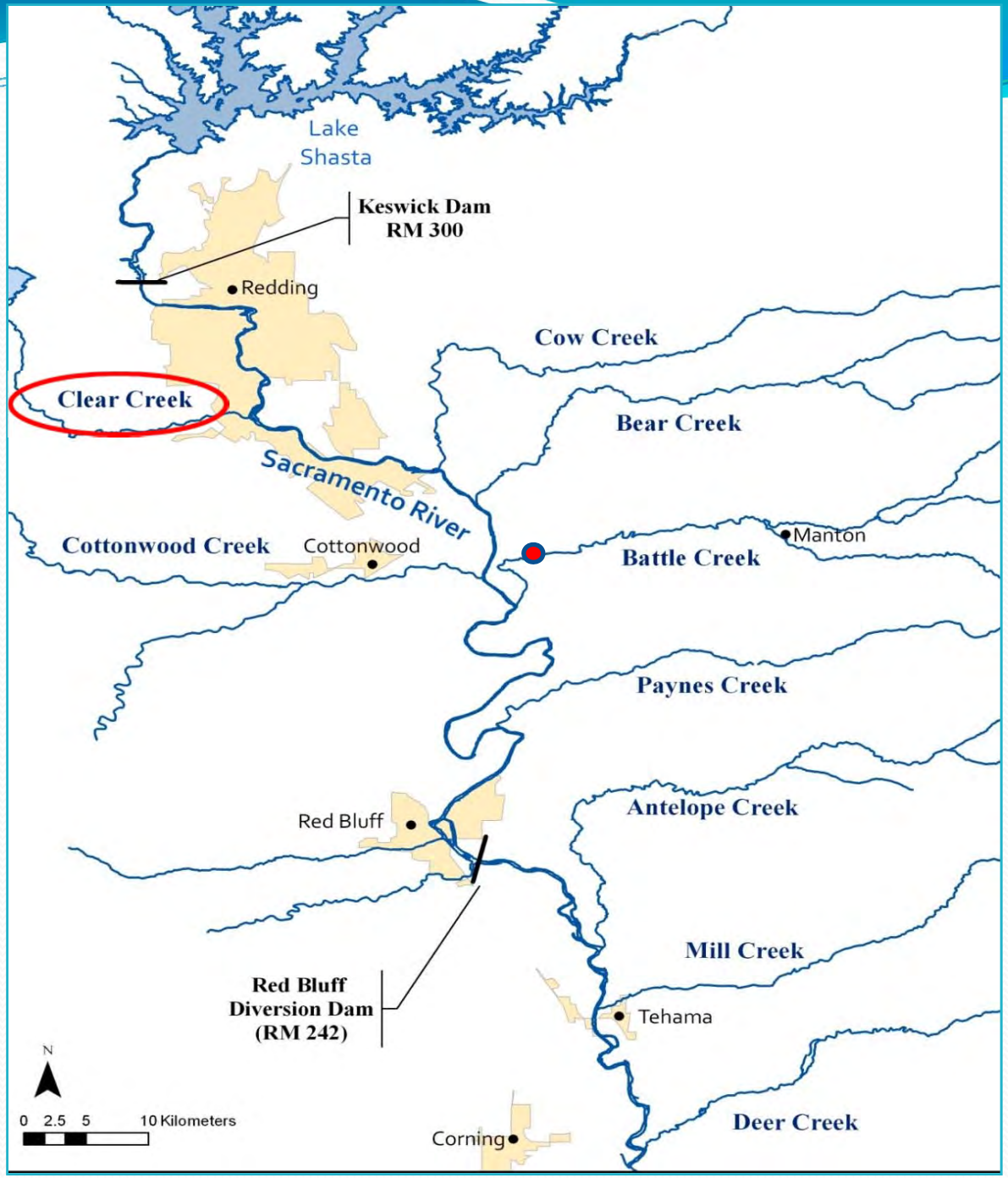
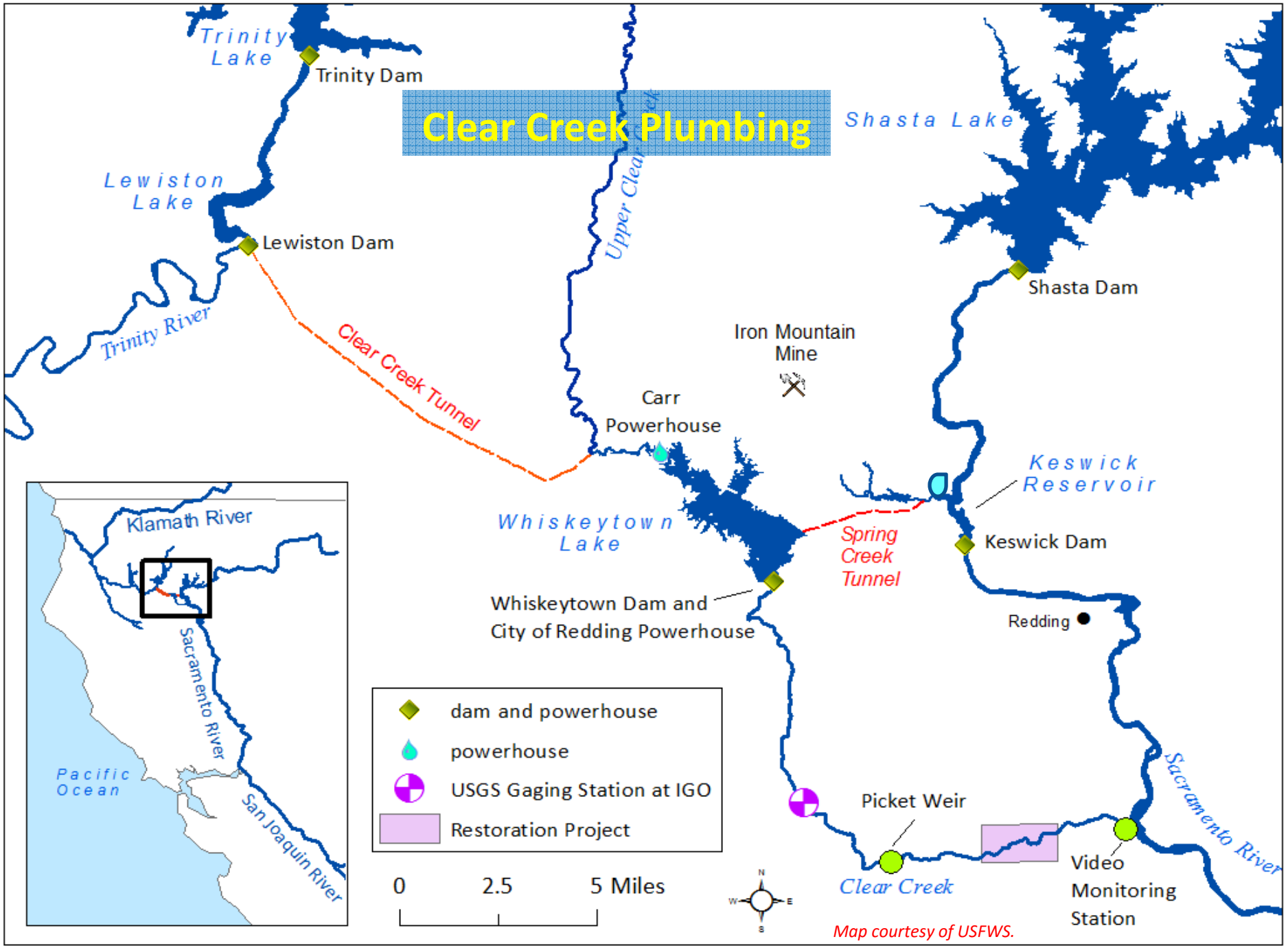


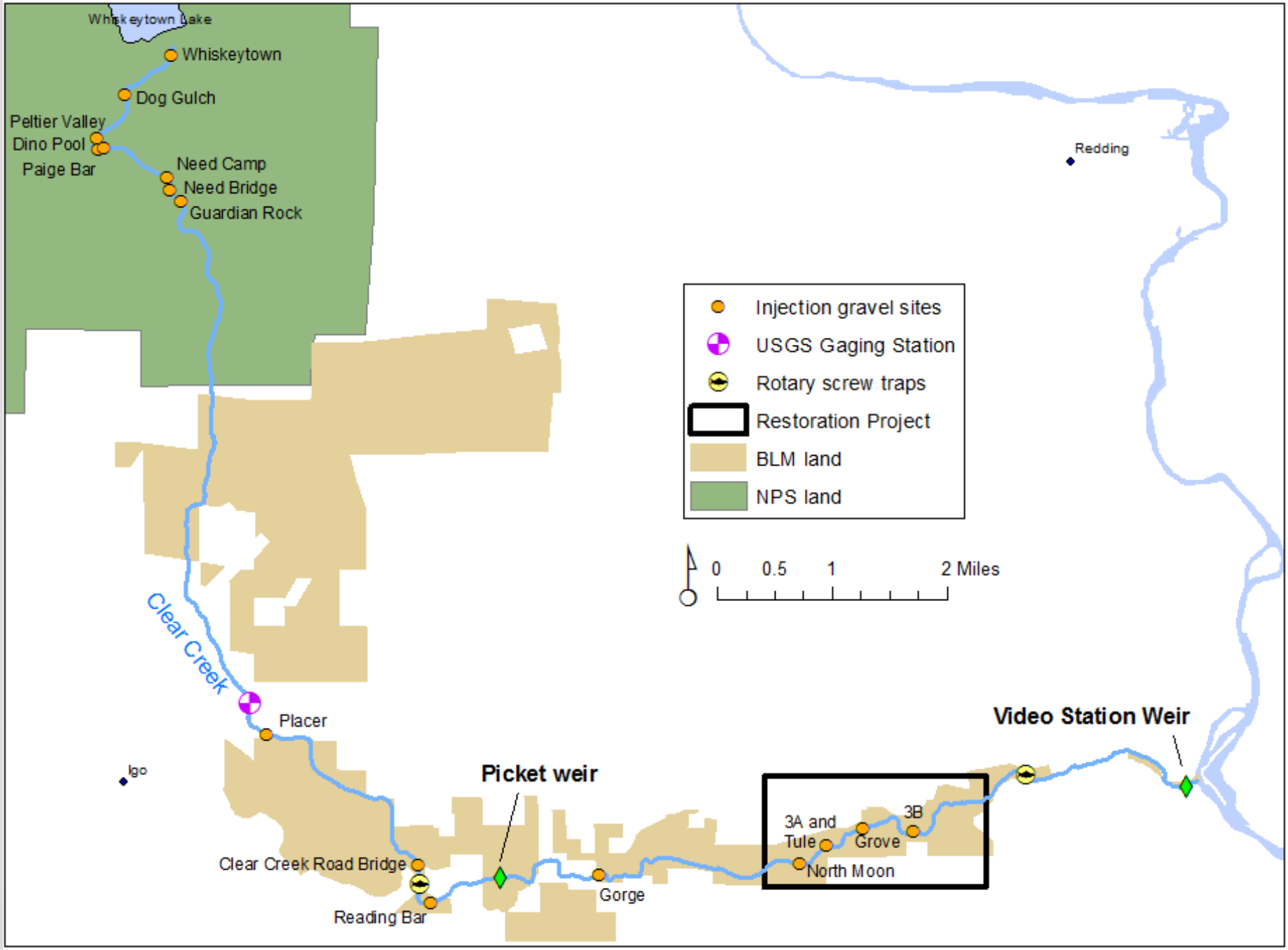
Figure 1. Discriminant Analysis of Principal Components (DAPC) plot of individual spring run Chinook salmon. Baseline fish from Butte Creek (red) and Mill and Deer Creeks (both blue), are shown, as well as spring baseline fish from Clear Creek (yellow) and Battle Creek (green). The relative eigenvalues of the axes are shown, indicating that the first (x) axis accounted for most of the variation.

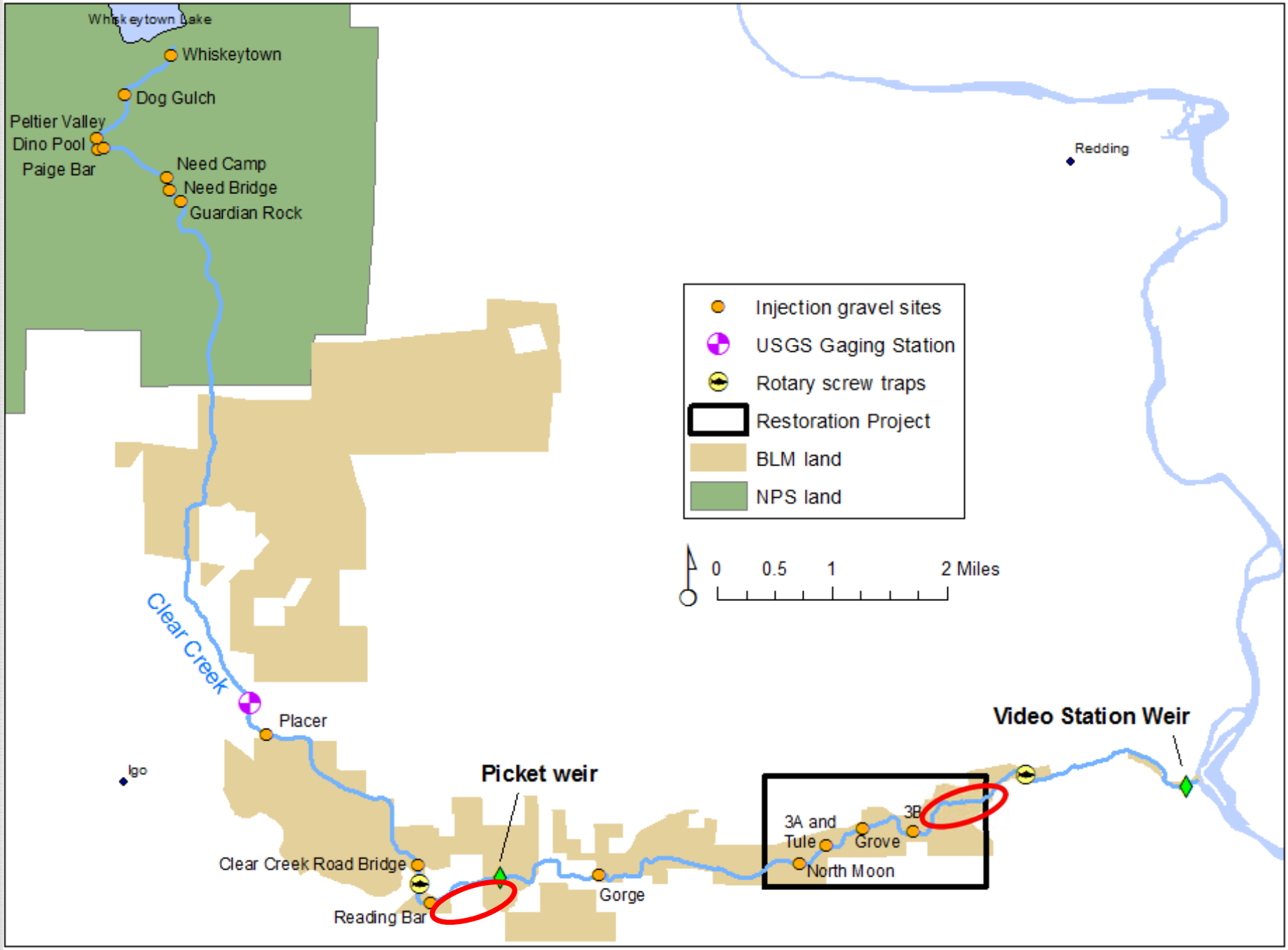
Clear Creek Spring Chinook

- Adult Counts
- Poor Distribution
- Temperatures
- Successful Juvenile Production
- Pulse Flows to Attract Adults into Clear Creek
- Resistance Board Weir
- Habitat Construction?

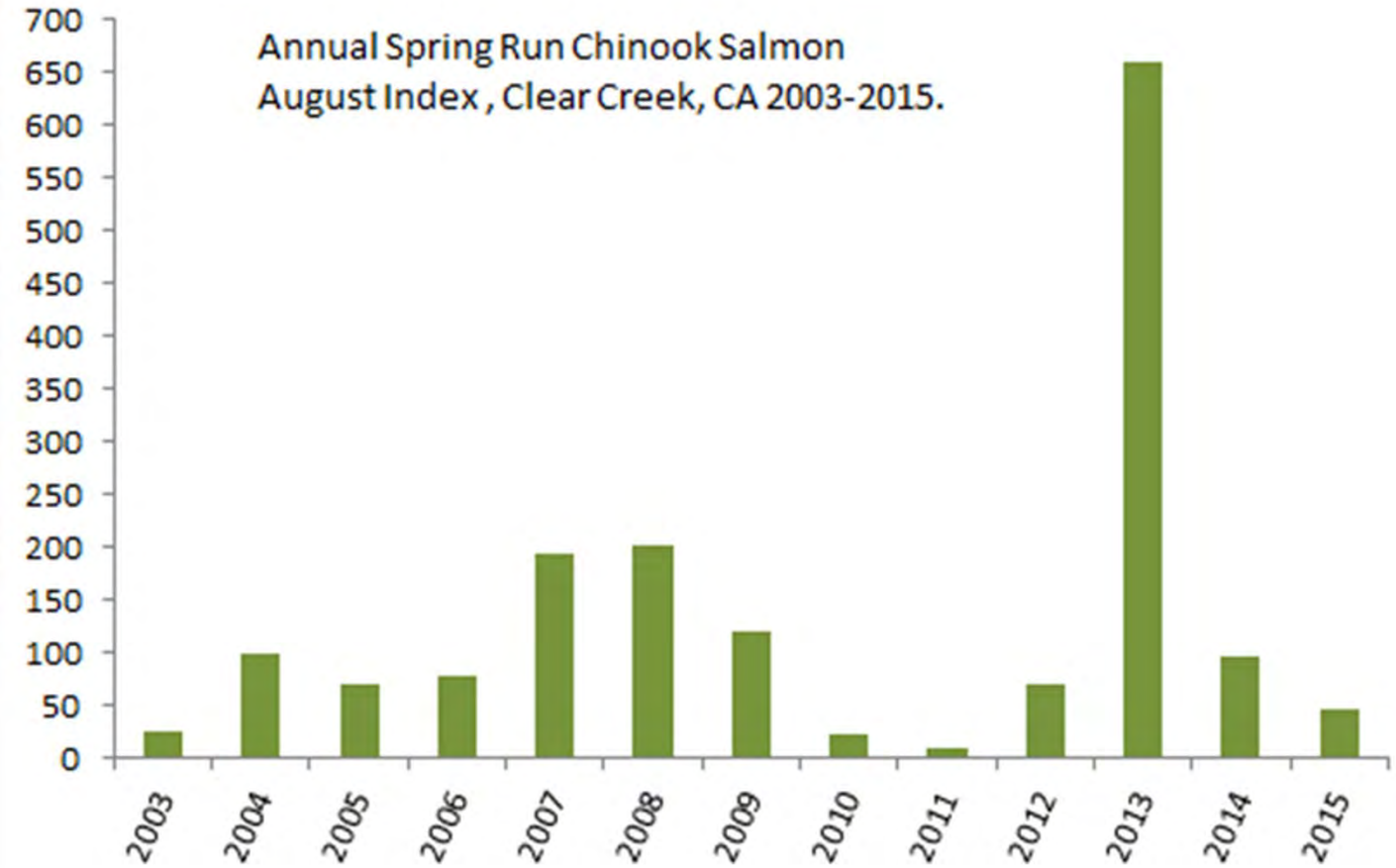

Lake
Shasta
Keswick Dam
RM 300
Redding
Cow Creek
Clear Creek
Bear Creek
Sacramento River
Cottonwood Creek
Cottonwood
Manton
Battle Creek
Paynes Creek
Red Bluff
Antelope Creek
Mill Creek
Red Bluff
Diversion Dam
(RM 242)
Tehama
N
0 2.5 5 10 Kilometers
Corning
Deer Creek


Clear Creek Plumbing
Trinity Lake
Trinity Dam
Lewiston Lake
Lewiston Dam
Trinity River
Clear Creek Tunnel
Upper Clear Creek
Shasta Lake
Shasta Dam
Iron Mountain Mine
Carr Powerhouse
Whiskeytown Lake
Whiskeytown Dam and City of Redding Powerhouse
Spring Creek Tunnel
Keswick Reservoir
Keswick Dam
Redding
Klamath River
Sacramento River
San Joaquin River
Pacific Ocean
dam and powerhouse
powerhouse
USGS Gaging Station at IGO
Restoration Project
0
2.5
5 Miles
Picket Weir
Clear Creek
Video Monitoring Station
Sacramento River
Map courtesy of USFWS.

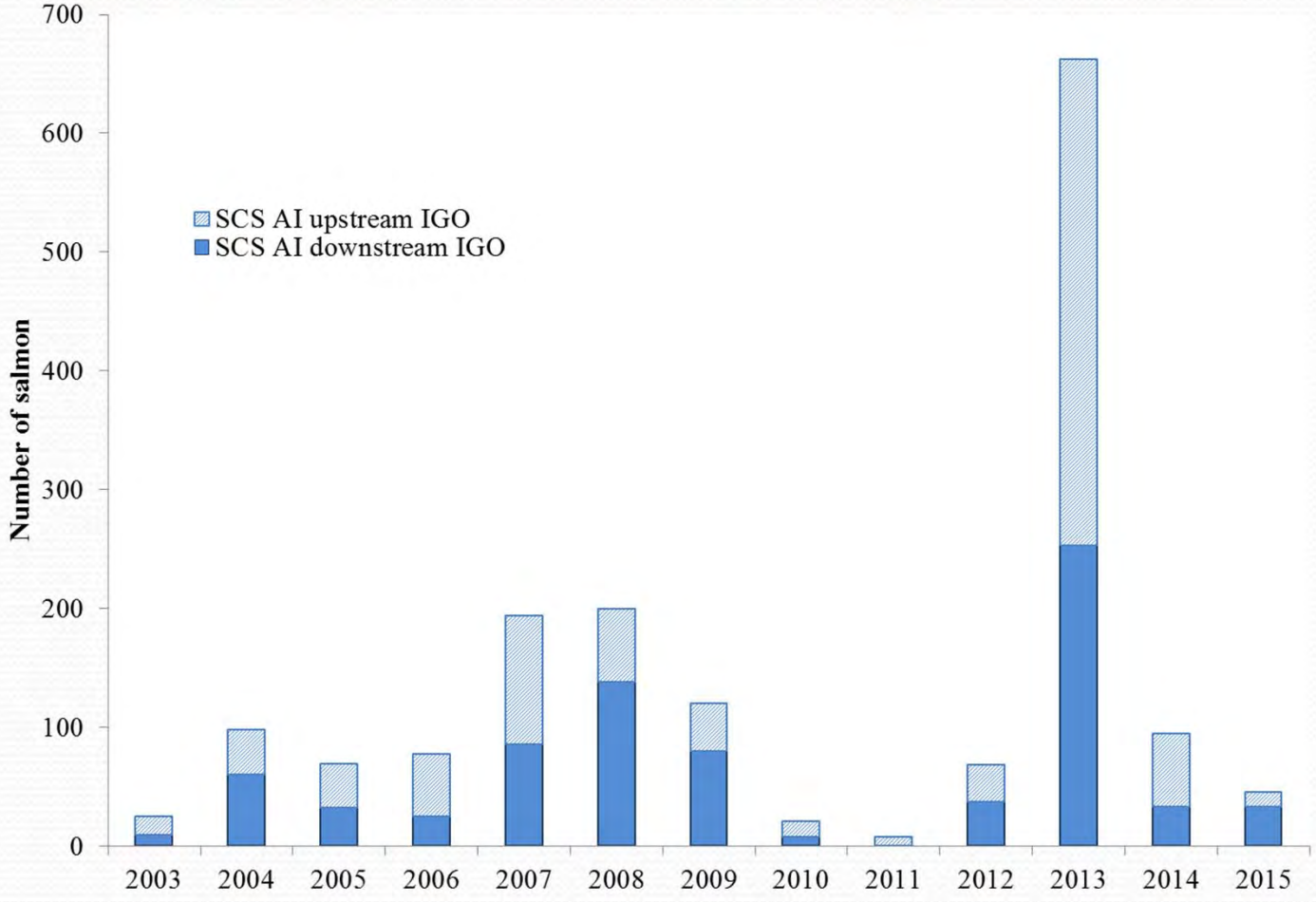

Whiskeytown Lake
Whiskeytown
Dog Gulch
Peltier Valley
Dino Pool
Paige Bar
Need Camp
Need Bridge
Guardian Rock
Redding
Injection gravel sites
USGS Gaging Station
Rotary screw traps
Restoration Project
BLM land
NPS land
0
0.5
1
2 Miles
Clear Creek
Placer
Igo
Picket weir
Video Station Weir
3A and
Tule
Grove
3B
North Moon
Clear Creek Road Bridge
Reading Bar
Gorge

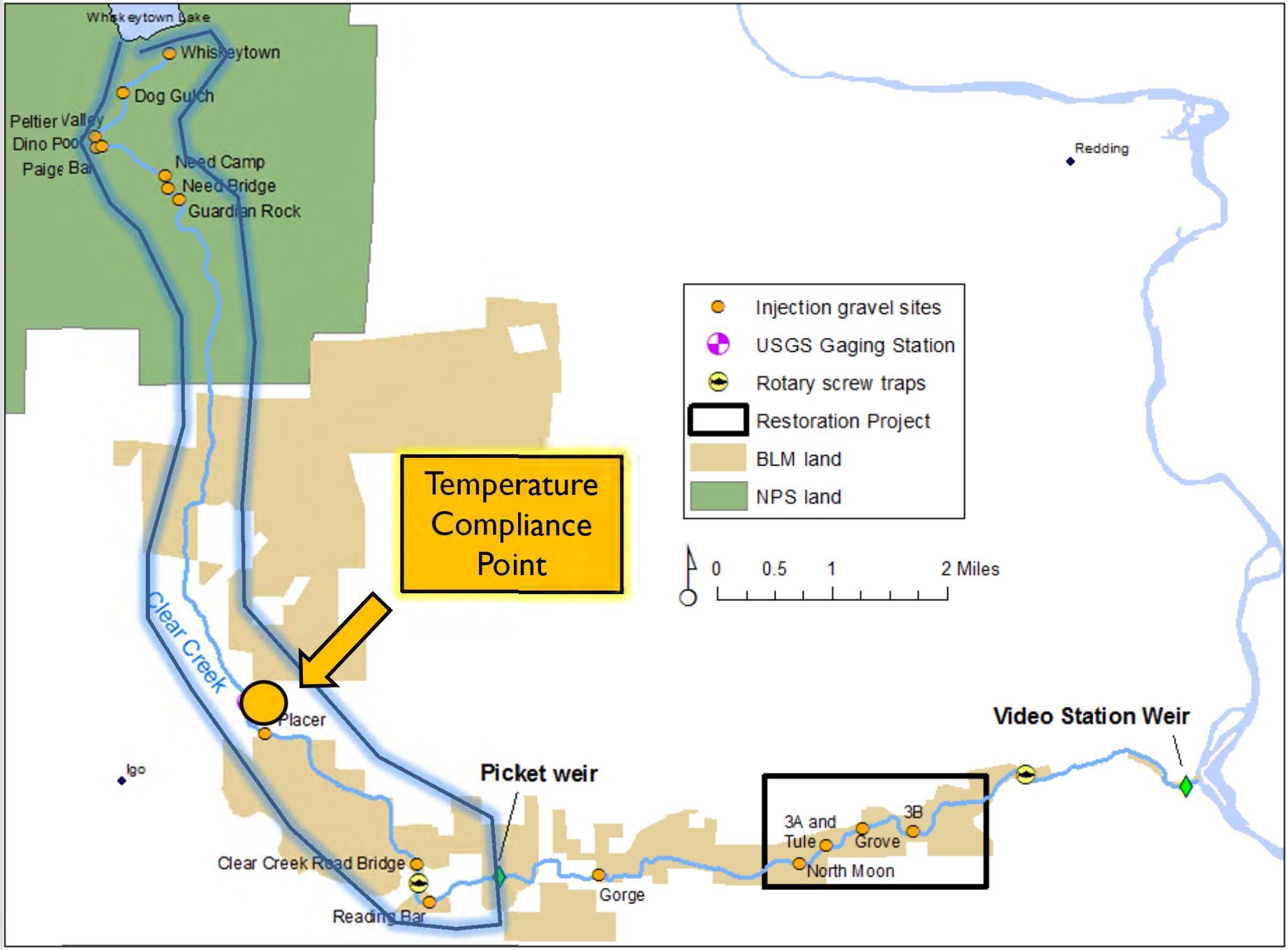

Whiskeytown Lake
Whiskeytown
Dog Gulch
Peltier Valley
Dino Pool
Paige Bar
Need Camp
Need Bridge
Guardian Rock
Redding
Injection gravel sites
USGS Gaging Station
Rotary screw traps
Restoration Project
BLM land
NPS land
0
0.5
1
2 Miles
Clear Creek
Placer
Igo
Picket weir
Video Station Weir
3A and
Tule
Grove
3B
North Moon
Clear Creek Road Bridge
Reading Bar
Gorge

Spring Chinook Snorkel Counts

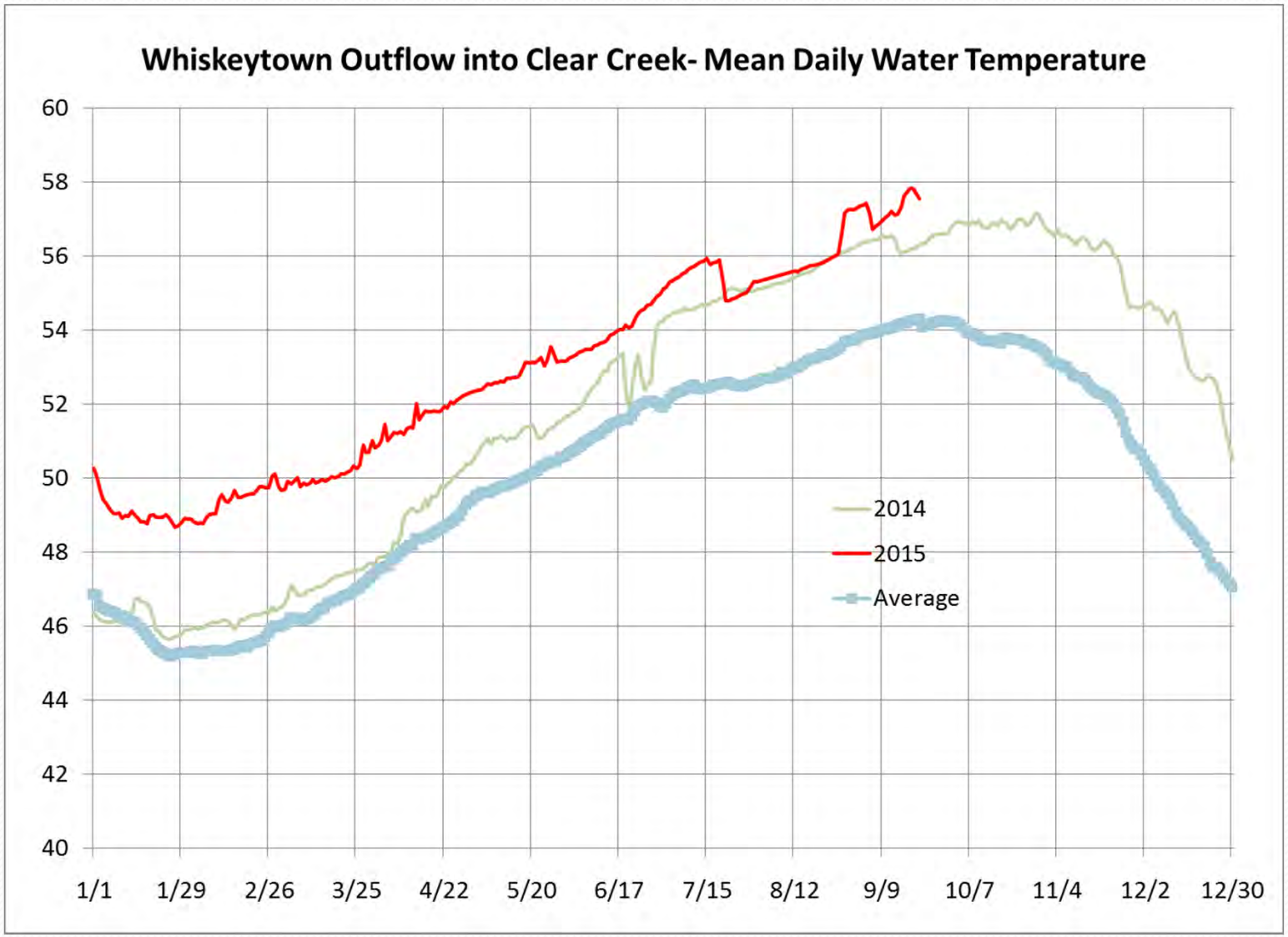


In 2015 Only 27% of SCS Upstream of Igo Gage- Has Averaged 54%

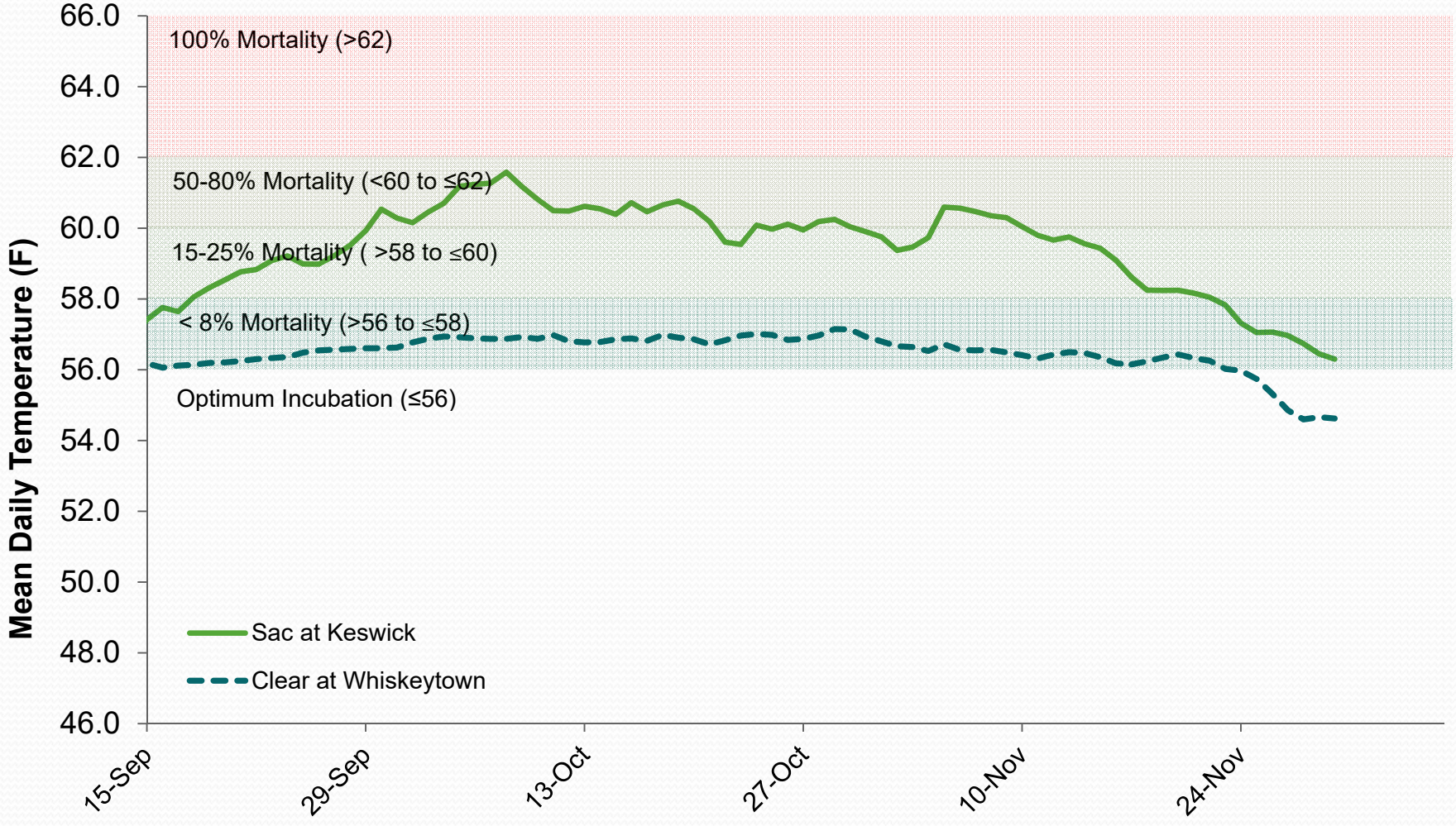



Whiskeytown Lake
Whiskeytown
Dog Gulch
Peltier Valley
Dino Pool
Paige Bar
Need Camp
Need Bridge
Guardian Rock
Redding
Injection gravel sites
USGS Gaging Station
Rotary screw traps
Restoration Project
BLM land
NPS land
Temperature Compliance Point
0 0.5 1 2 Miles
Clear Creek
Placer
Igo
Picket weir
Video Station Weir
3A and Tule
3B
Grove
North Moon
Clear Creek Road Bridge
Reading Bar
Gorge

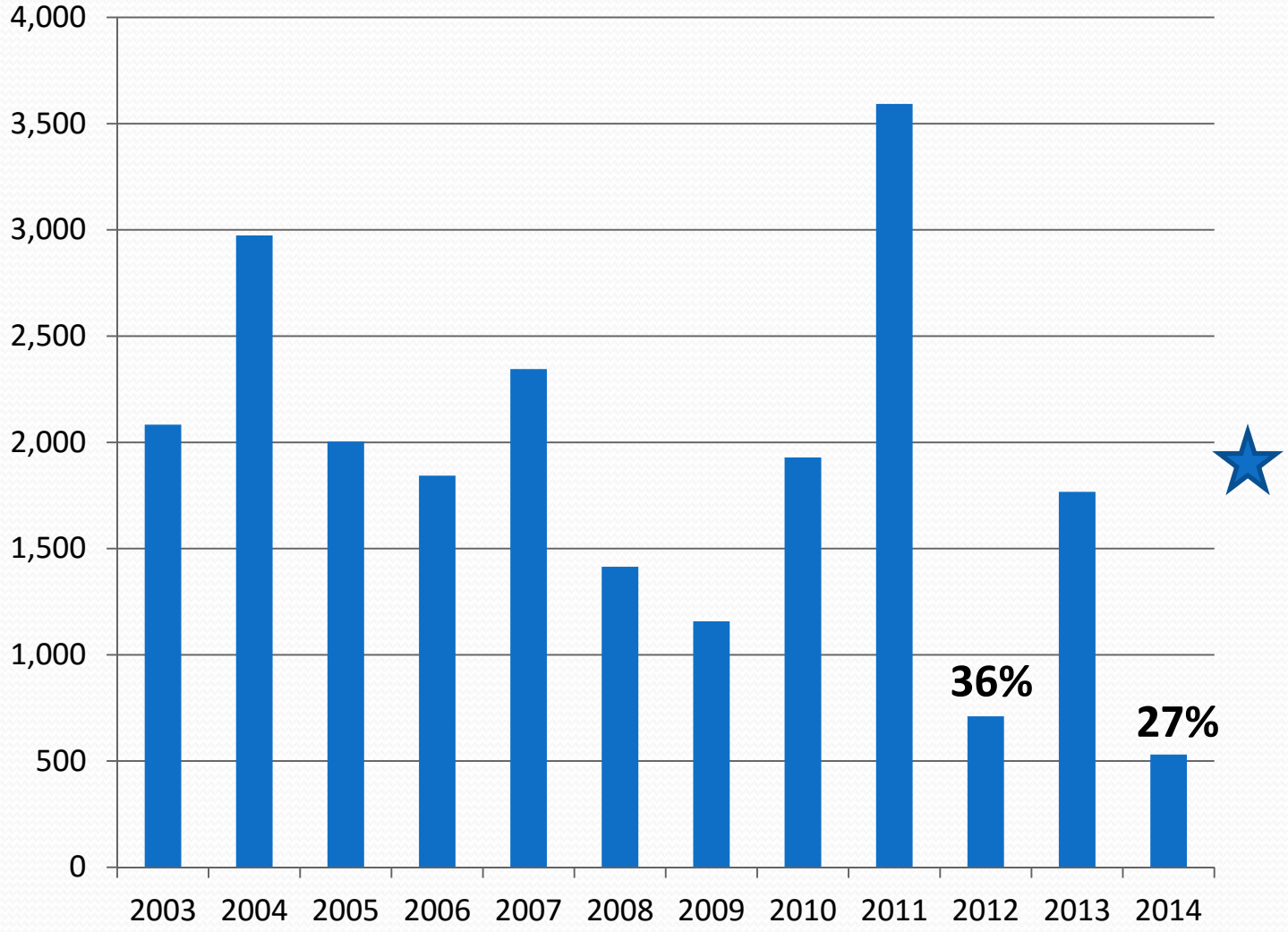
2015: Warmest Summer Water Temperatures Yet



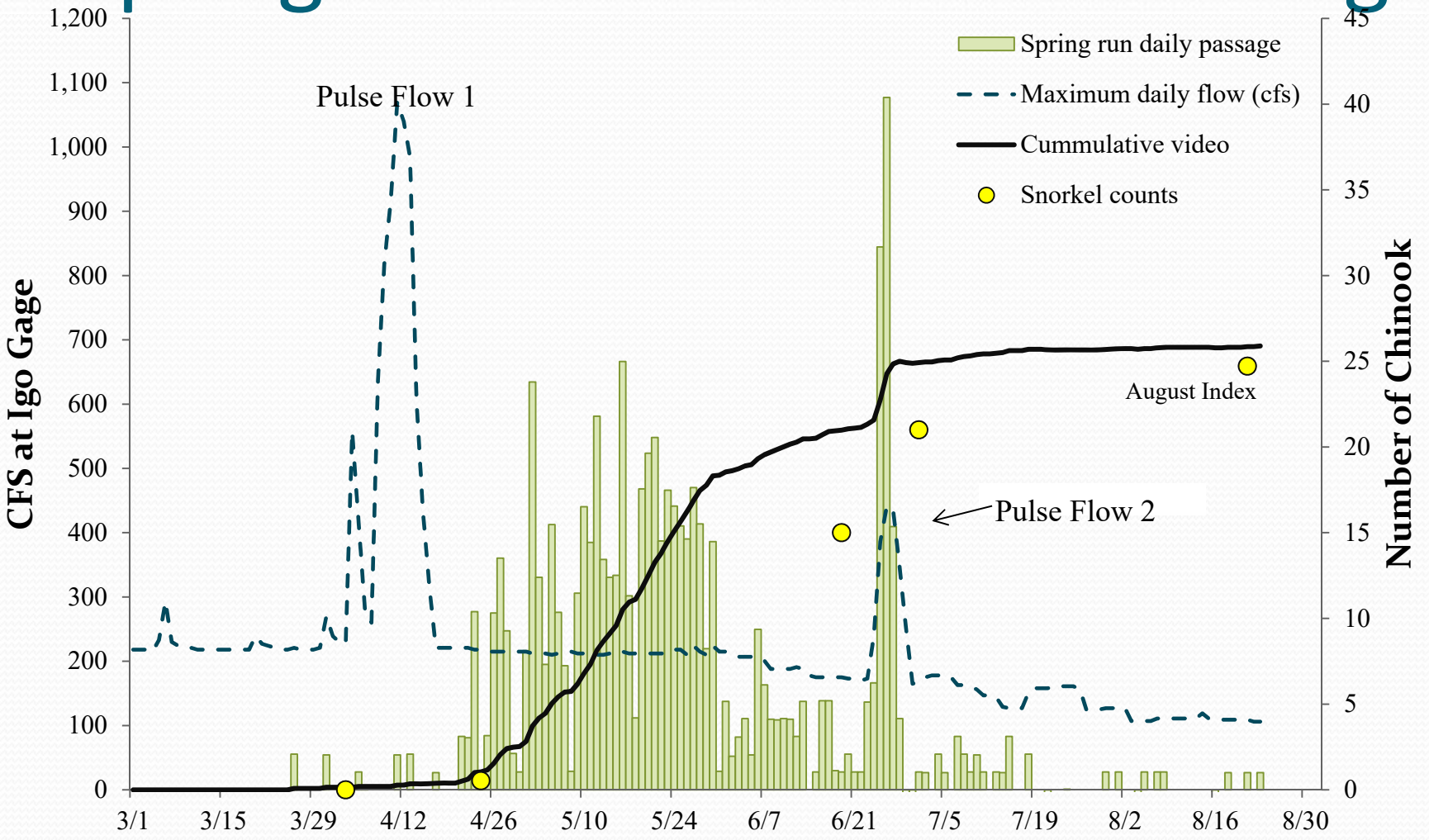
Temperatures During Spring-run Spawning 3°F Lower in Clear Creek



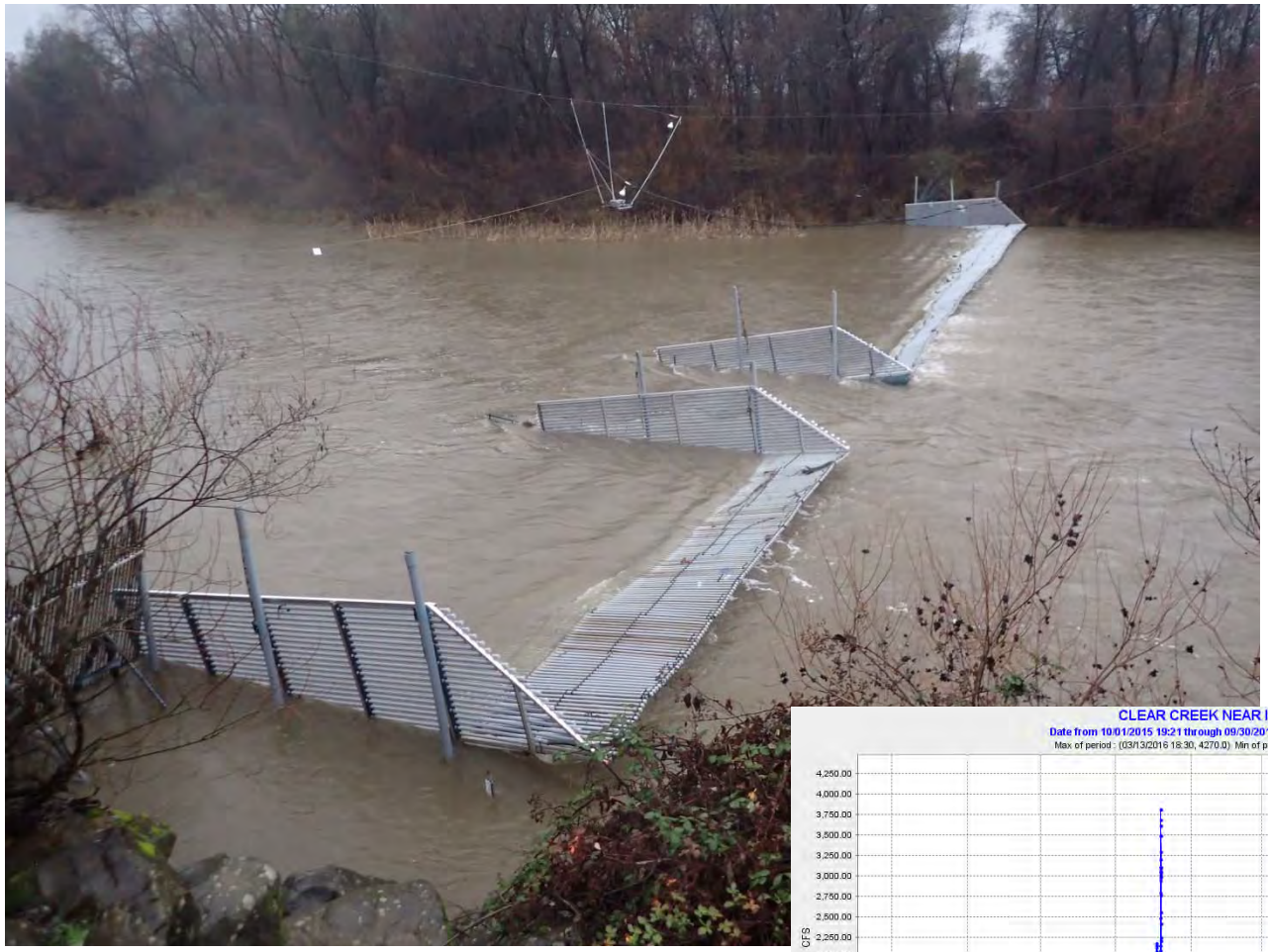
Spring-run Juvenile Productivity

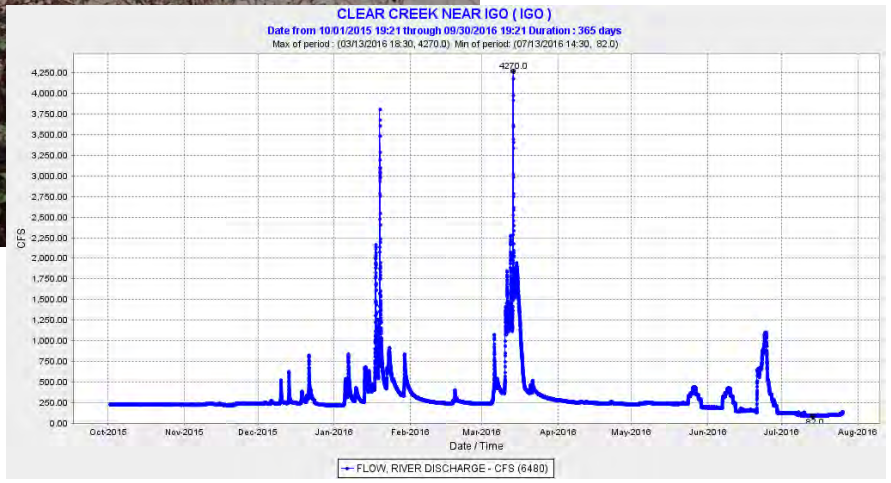


2013 Clear Creek Pulse Flow
Spring Chinook Adult Monitoring



Held Up Pretty Well





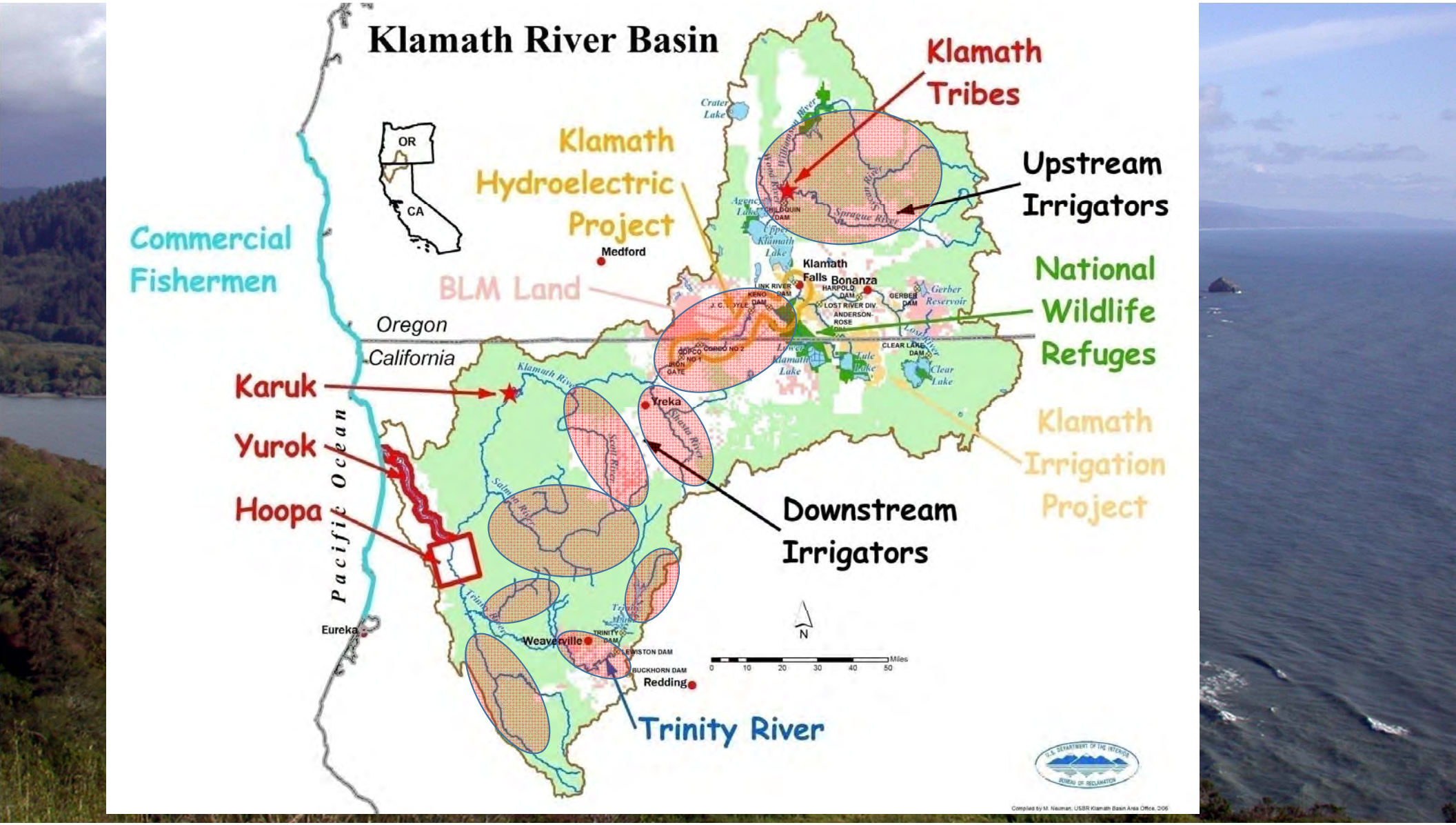
And No Carcasses

Thanks For the Fishes!

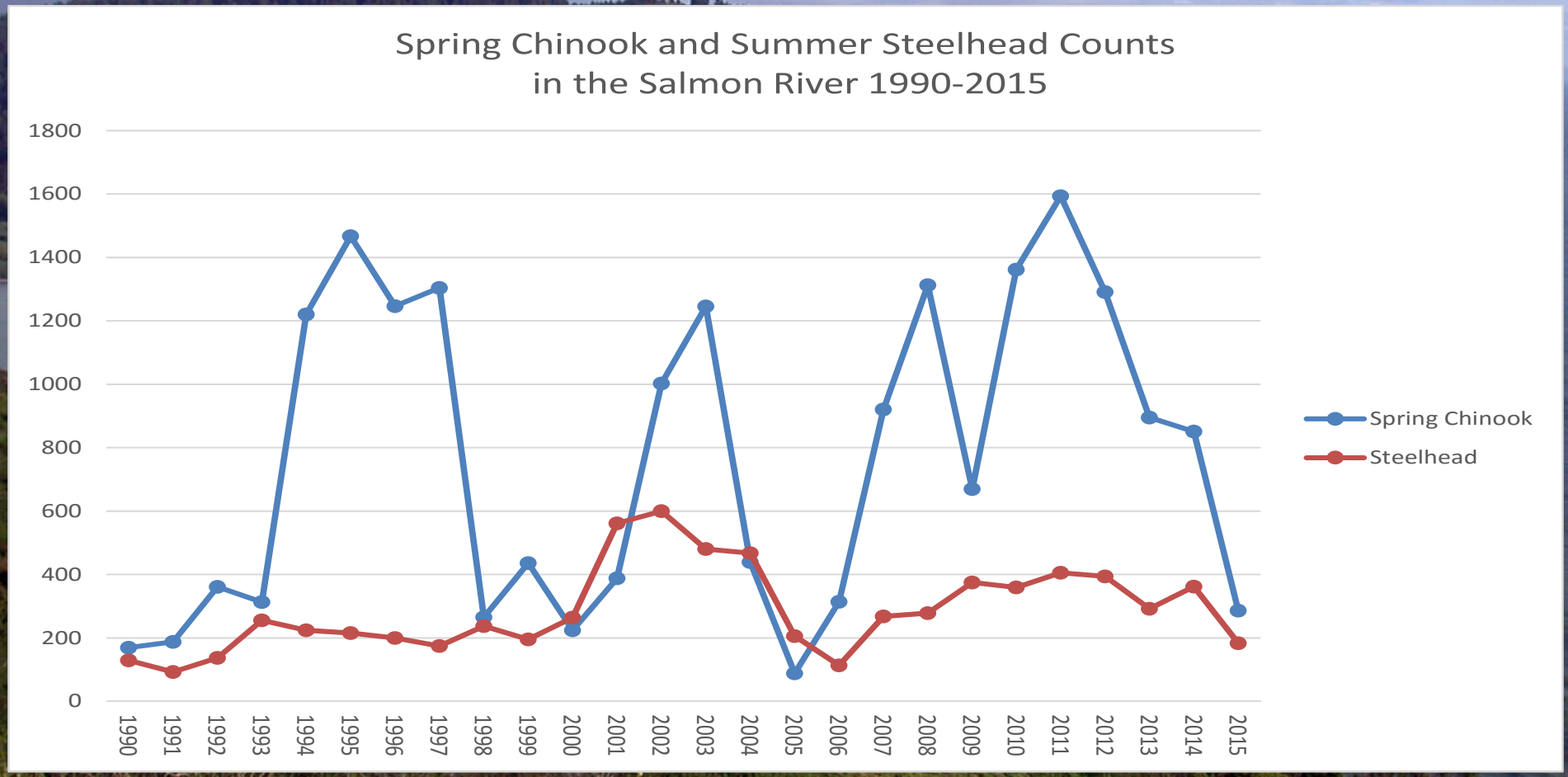

Klamath and Trinity River
Wild Spring Chinook Status and Trends
Michael Belchik
Yurok Tribal Fisheries Program

Spring Run was the Dominant Run in the Klamath and Trinity Rivers

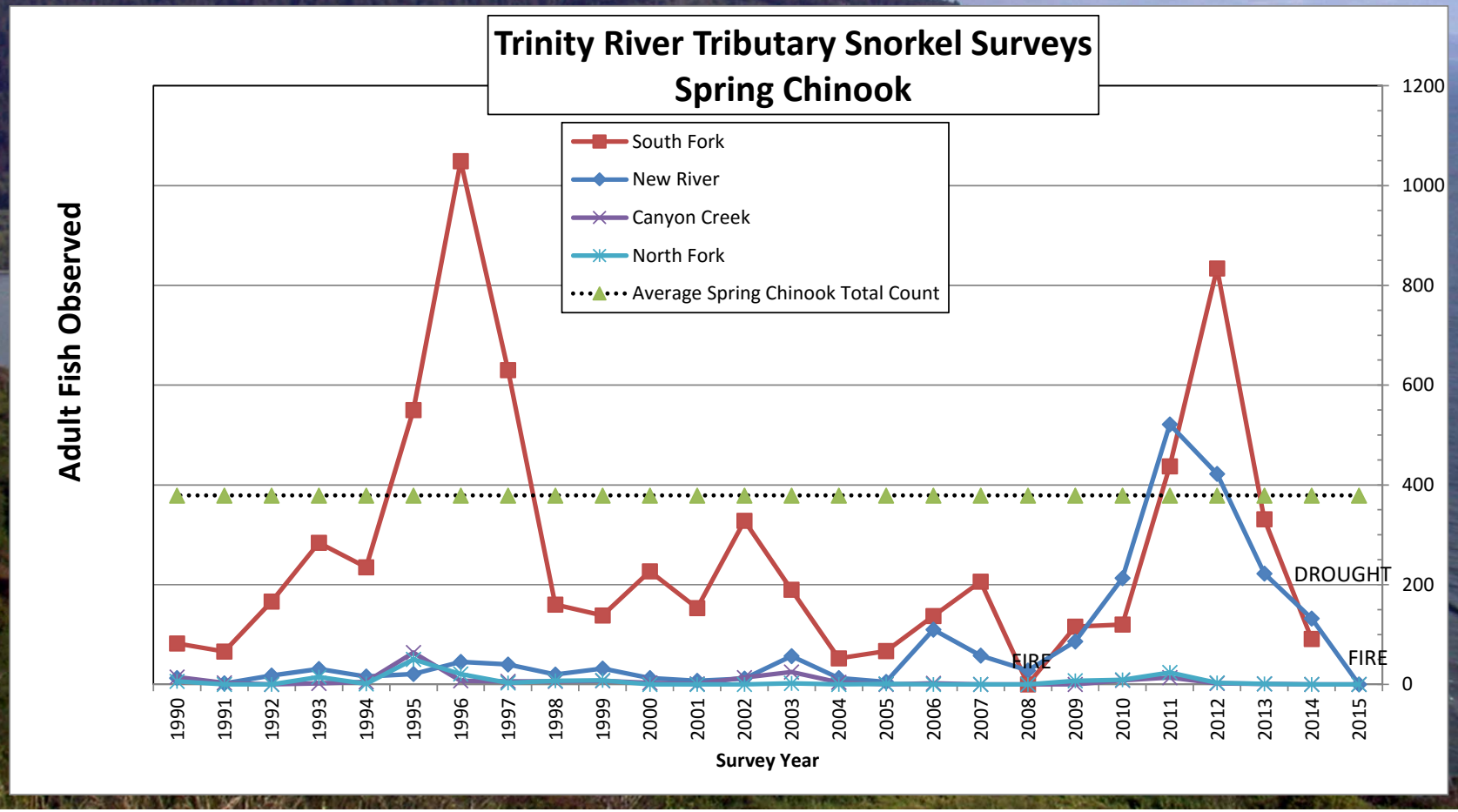
The spring migration,[1] granting that it was once very pronounced, has now come to be limited as to the number of individuals, and is of relatively little economic importance. The fish of this run begin to materially increase in numbers in the latter part of March or early in April and the migration has reached its maximum, and waned before the middle of June. The river at the time of the spring migration is apt to be in a condition of maximum flood[2] as indicated in figure 3,[3] the

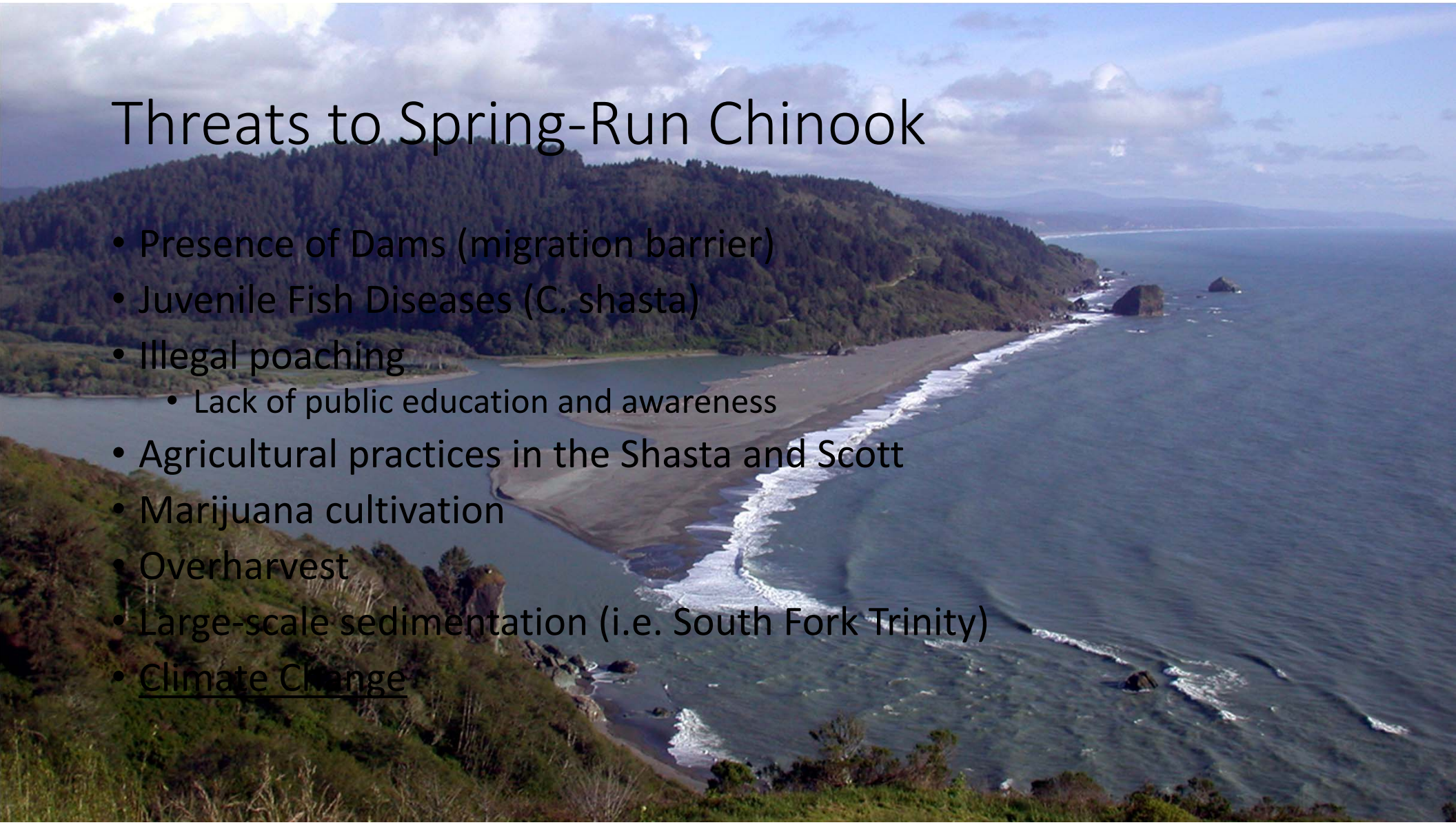

Klamath River Basin
Klamath Tribes
Upstream Irrigators
Klamath Hydroelectric Project
Commercial Fishermen
BLM Land
National Wildlife Refuges
Oregon
California
Karuk
Yurok
Hoopa
Klamath Irrigation Project
Downstream Irrigators
Trinity River
Pacific Ocean
OR
CA
Medford
Klamath Falls
Bonanza
Yreka
Weaverville
Eureka
Redding
Crater Lake
Upper Klamath Lake
Lower Klamath Lake
Gerber Reservoir
Clear Lake
Miles
0 10 20 30 40 50
N

Salmon River Spring Salmon Stronghold



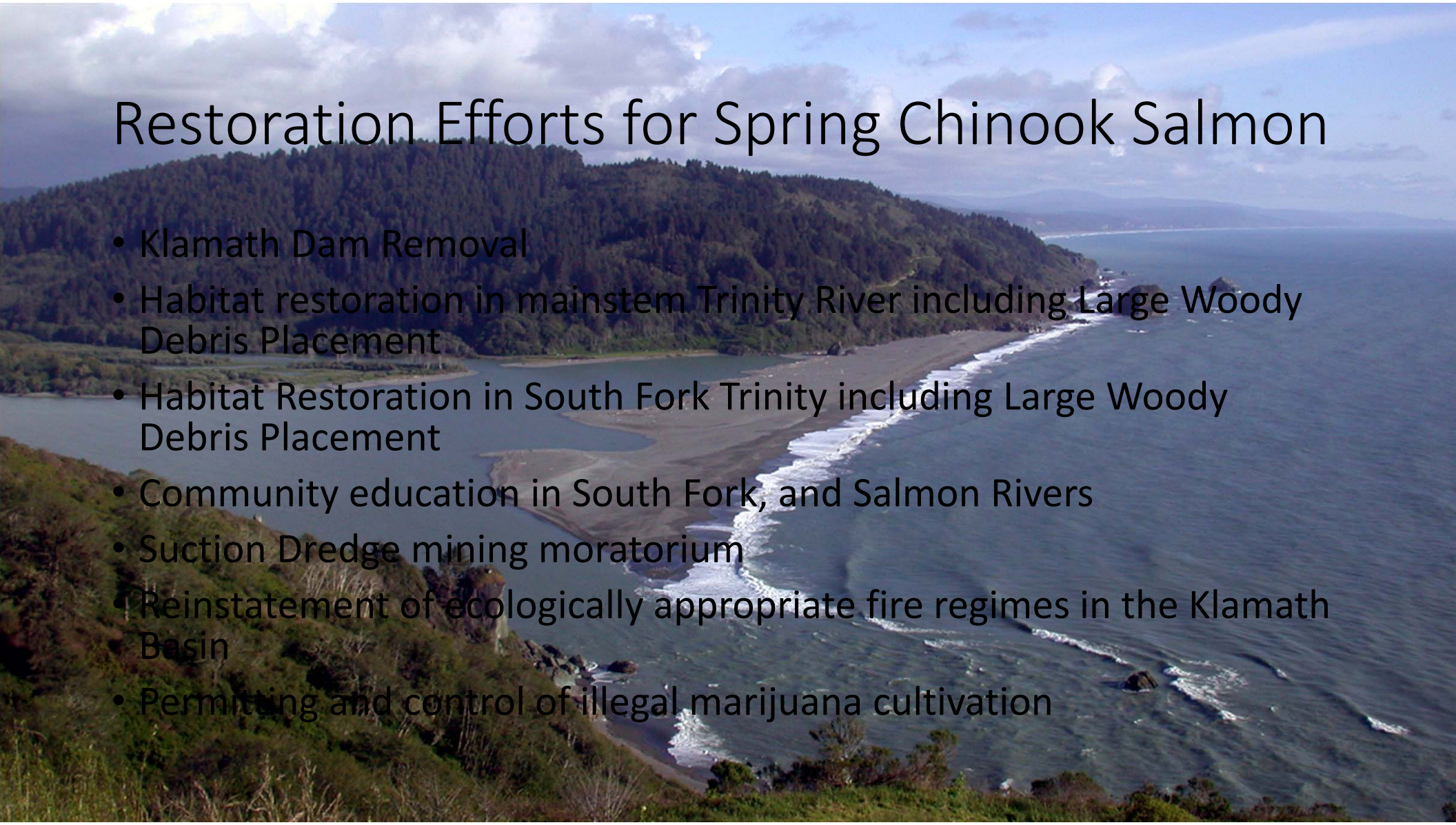
Spring Chinook in Trinity River Tributaries 1998-2014





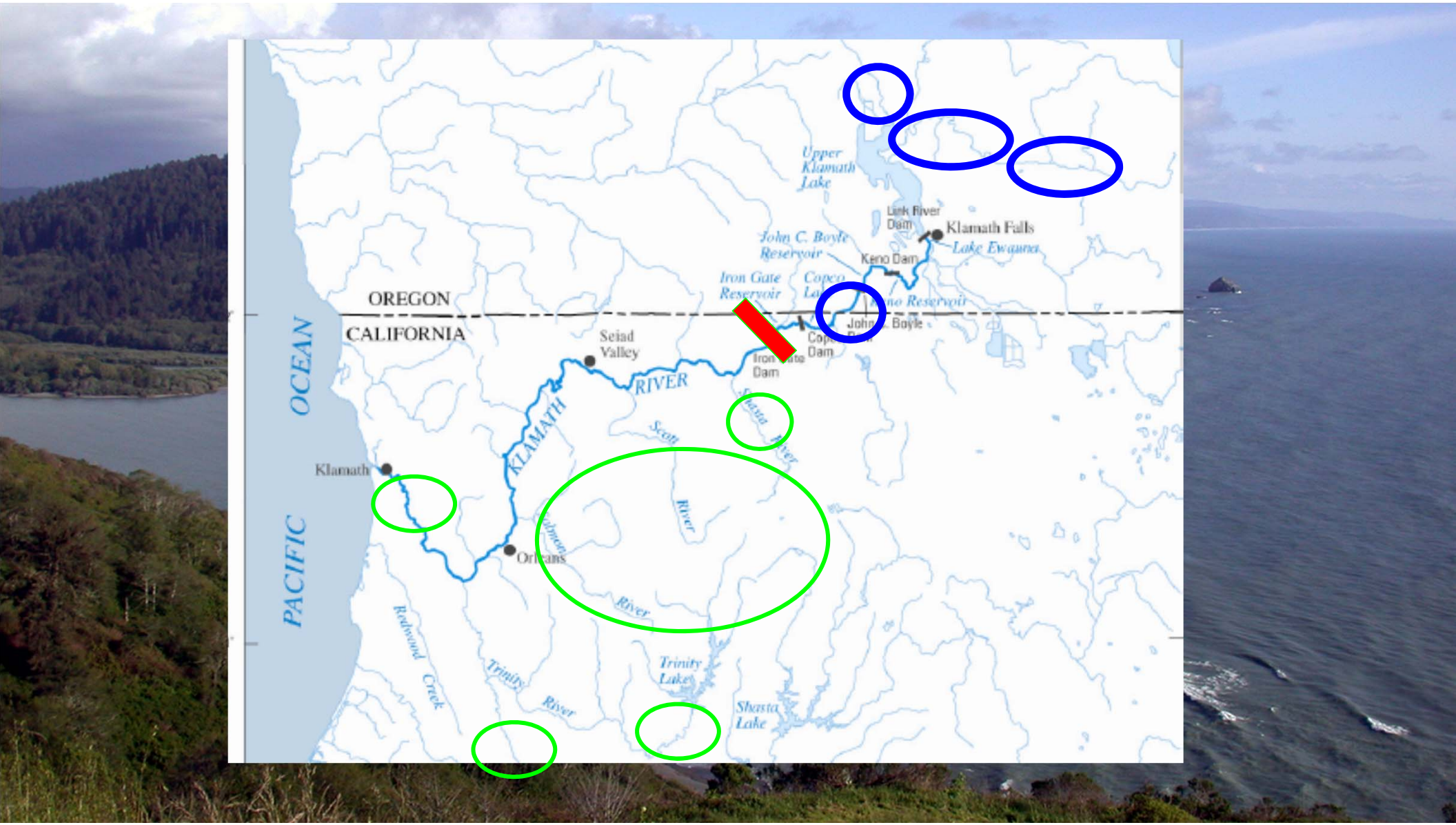
Threats to Spring-Run Chinook

- Presence of Dams (migration barrier)
- Juvenile Fish Diseases (C. shasta)
- Illegal poaching
  - Lack of public education and awareness
- Agricultural practices in the Shasta and Scott
- Marijuana cultivation
- Overharvest
- Large-scale sedimentation (i.e. South Fork Trinity)
- Climate Change



Restoration Efforts for Spring Chinook Salmon

- Klamath Dam Removal
- Habitat restoration in mainstem Trinity River including Large Woody Debris Placement
- Habitat Restoration in South Fork Trinity including Large Woody Debris Placement
- Community education in South Fork, and Salmon Rivers
- Suction Dredge mining moratorium
- Reinstatement of ecologically appropriate fire regimes in the Klamath Basin
- Permitting and control of illegal marijuana cultivation


Upper Klamath Lake
Link River Dam
Klamath Falls
Lake Ewauna
John C. Boyle Reservoir
Keno Dam
Iron Gate Reservoir
Copco Lake
Keno Reservoir
OREGON
CALIFORNIA
John C. Boyle
Copco Dam
Iron Gate Dam
Seiad Valley
KLAMATH RIVER
Scott River
Shasta River
Klamath
Orleans
Salmon River
Trinity River
Redwood Creek
Trinity Lake
Shasta Lake
PACIFIC OCEAN

REINTRODUCTION OF ANADROMOUS FISH TO THE UPPER KLAMATH BASIN:

AN EVALUATION AND CONCEPTUAL PLAN

Prepared for:

Klamath Tribes
POB 436
Chiloquin, OR 97624

--- and ---

Yurok Tribe
POB 1027
Klamath, CA 95548

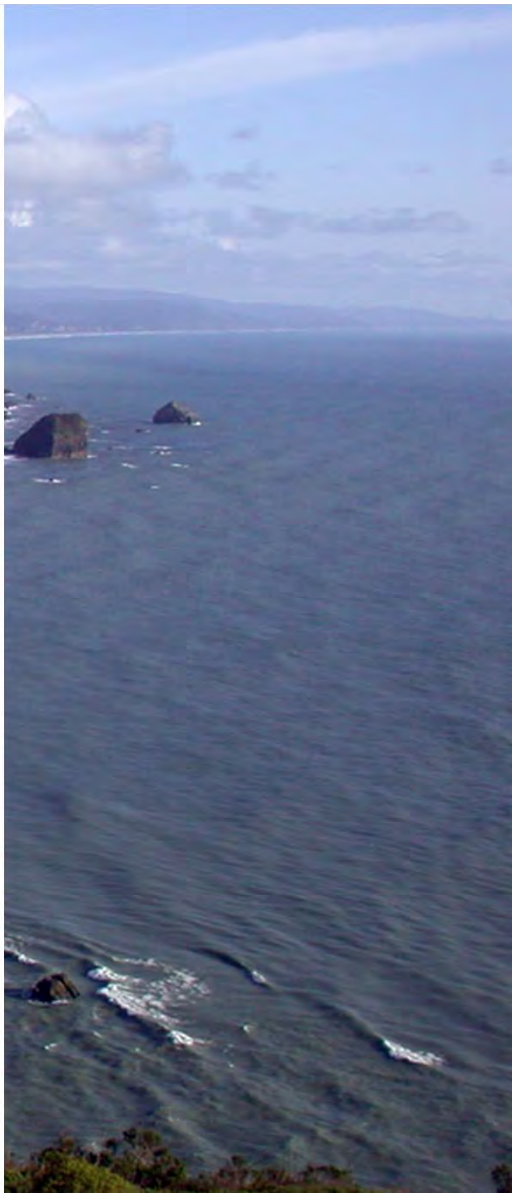
Prepared by:

Charles W. Huntington
Clearwater BioStudies, Inc.
Canby, Oregon

Errol W. Claire
Canyon Mountain Technical Services
Canyon City, Oregon

F. Al Espinosa, Jr.
Espinosa Consulting
Moscow, Idaho

Robert House
BioHouse
Eagle, Idaho



Dam Removal Status

- Amended KHSA signed in April 2016
- Provides for the removal of Iron Gate, Copco 1 and 2, and JC Boyle Dams with PacifiCorp to pay first $200m
- Transfer of facilities to new entity known as the Klamath River Renewal Corporation
- No federal funding involved
- 2020 timeline still the goal for removal
- All four facilities to be removed in a single winter period


Questions?