Aquatic Ecology, Disturbance, and Floodplains

A Concurrent Session at the 41st Annual Salmonid Restoration Conference
Santa Rosa, California, March 26-29, 2024

Session Coordinator: JD Wikert, *USFWS*

This session demonstrated a wide breadth of knowledge around ecology, hydrology, geomorphology, modeling, predation, restoration, planning, coordination, outreach, and regulation that are all part of successful management of salmonid populations.

Presentations

Timing
of
Periphyton Scour and Recovery
for
Food Web Dynamics
in
a Mediterranean River System

Eric B Peterson Trinity River Restoration Program (U.S. Bureau of Reclamation)
Chris Laskodi Trinity River Restoration Program (Yurok Tribal Fisheries Program)
Ben King Humboldt State University
Ken Lindke Trinity River Restoration Program (Ca. Dept. of Fish and Wildlife)

Trinity River Restoration Program

Trinity River

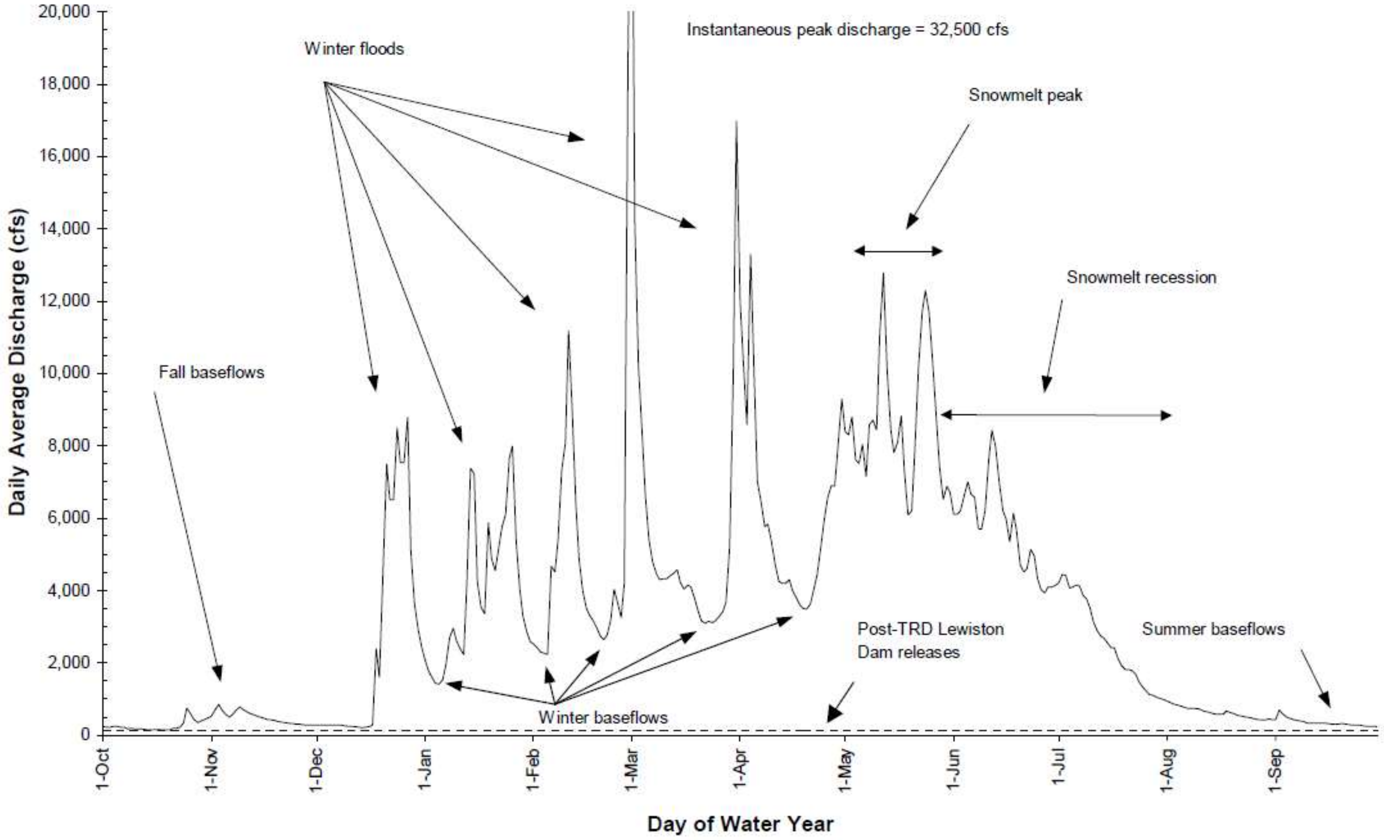


Figure 4.10. Trinity River at Lewiston streamflow hydrograph illustrating hydrograph components typical of a watershed dominated by rainfall and snowmelt runoff (Extremely Wet water year 1941).

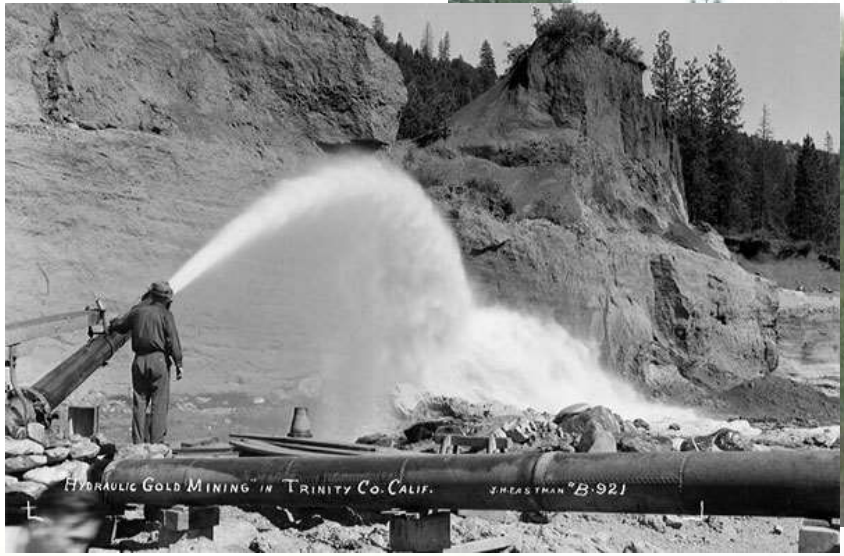
Peterson et al. (2024) Periphyton, SRF.

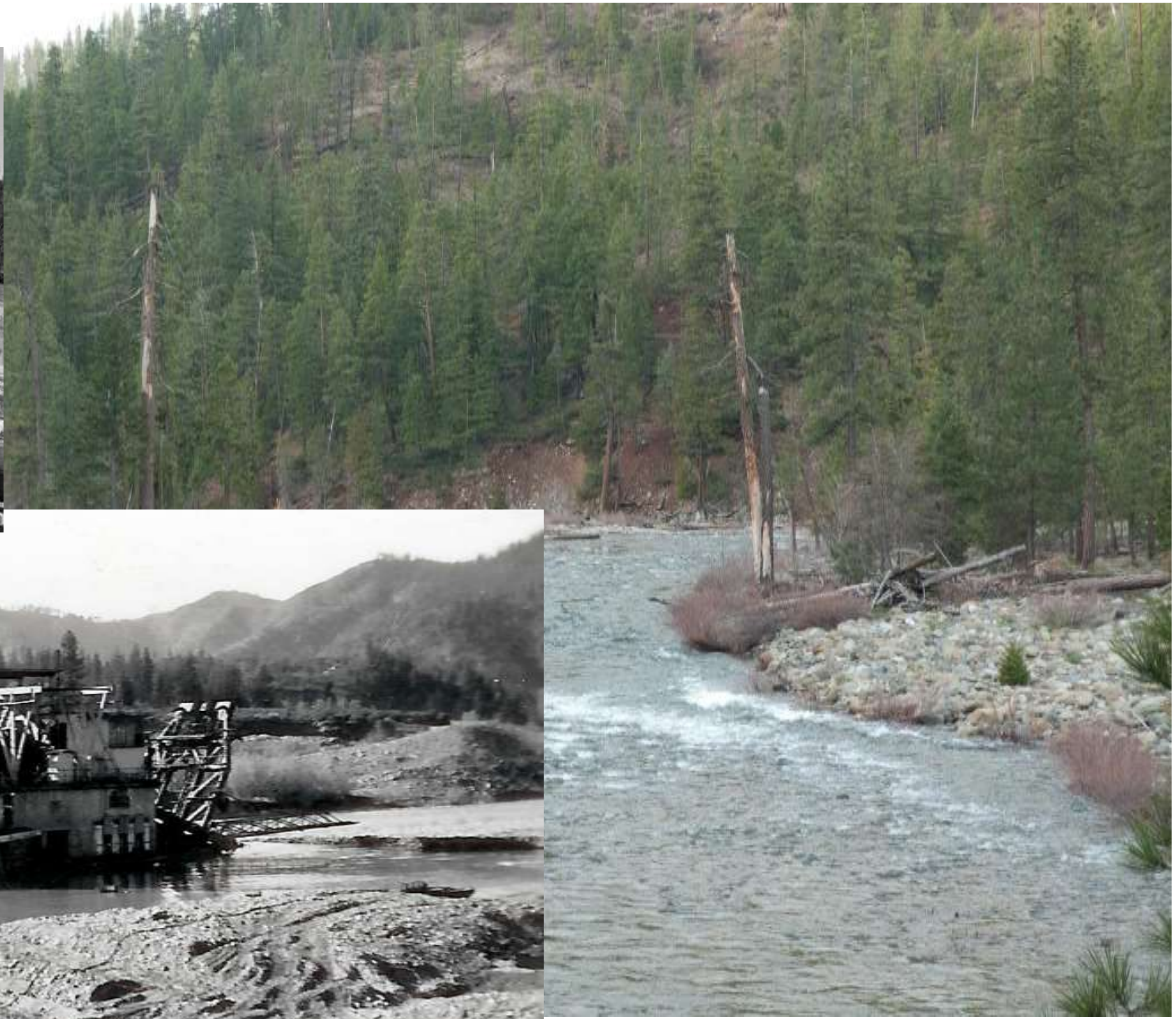
Form Function

Peterson et al. (2024) Periphyton, SRF.

~~Form~~ Function

1849 – 1950ish



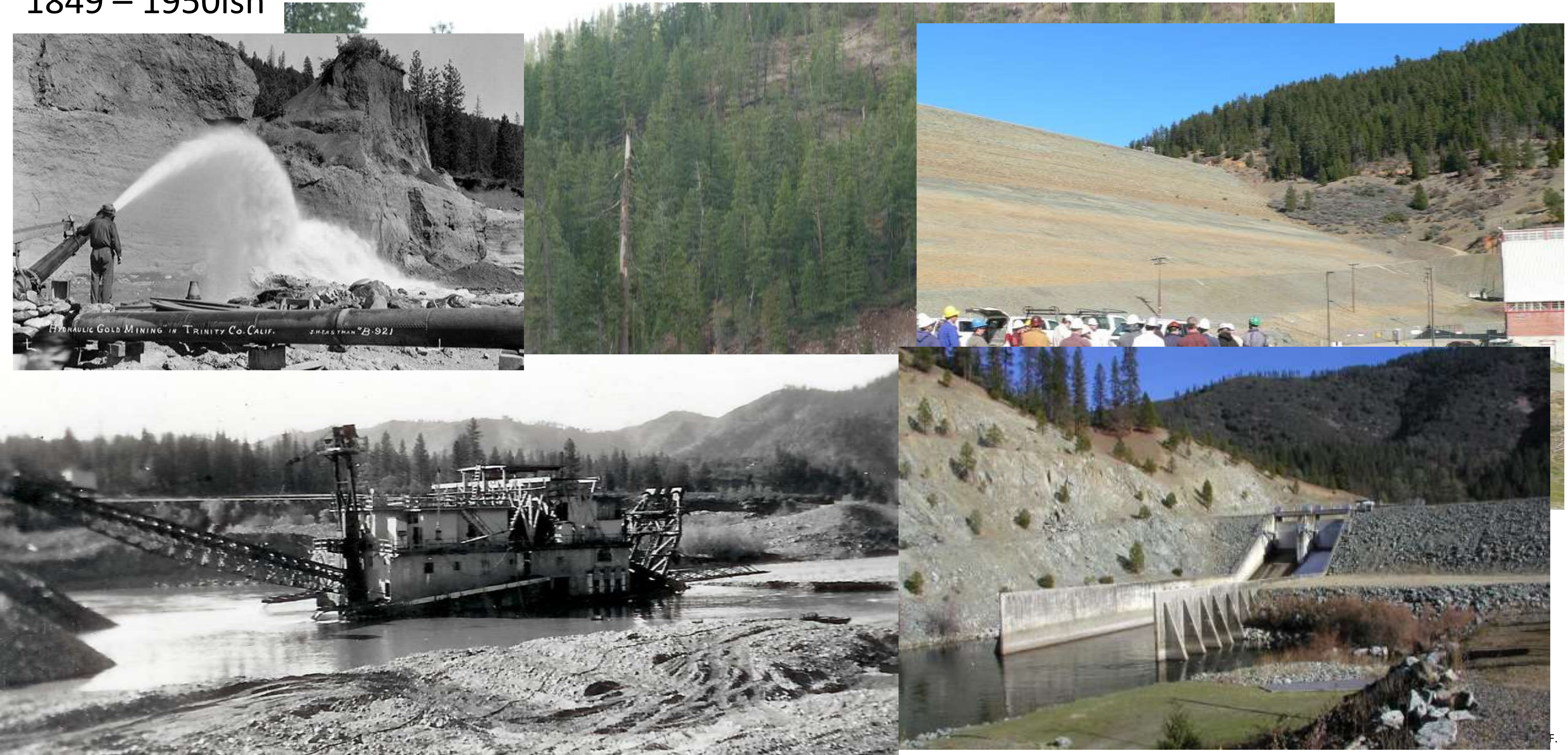


Peterson et al. (2024) Periphyton, SRF.

~~Form~~ ~~Function~~

1849 – 1950ish

1960 – ???



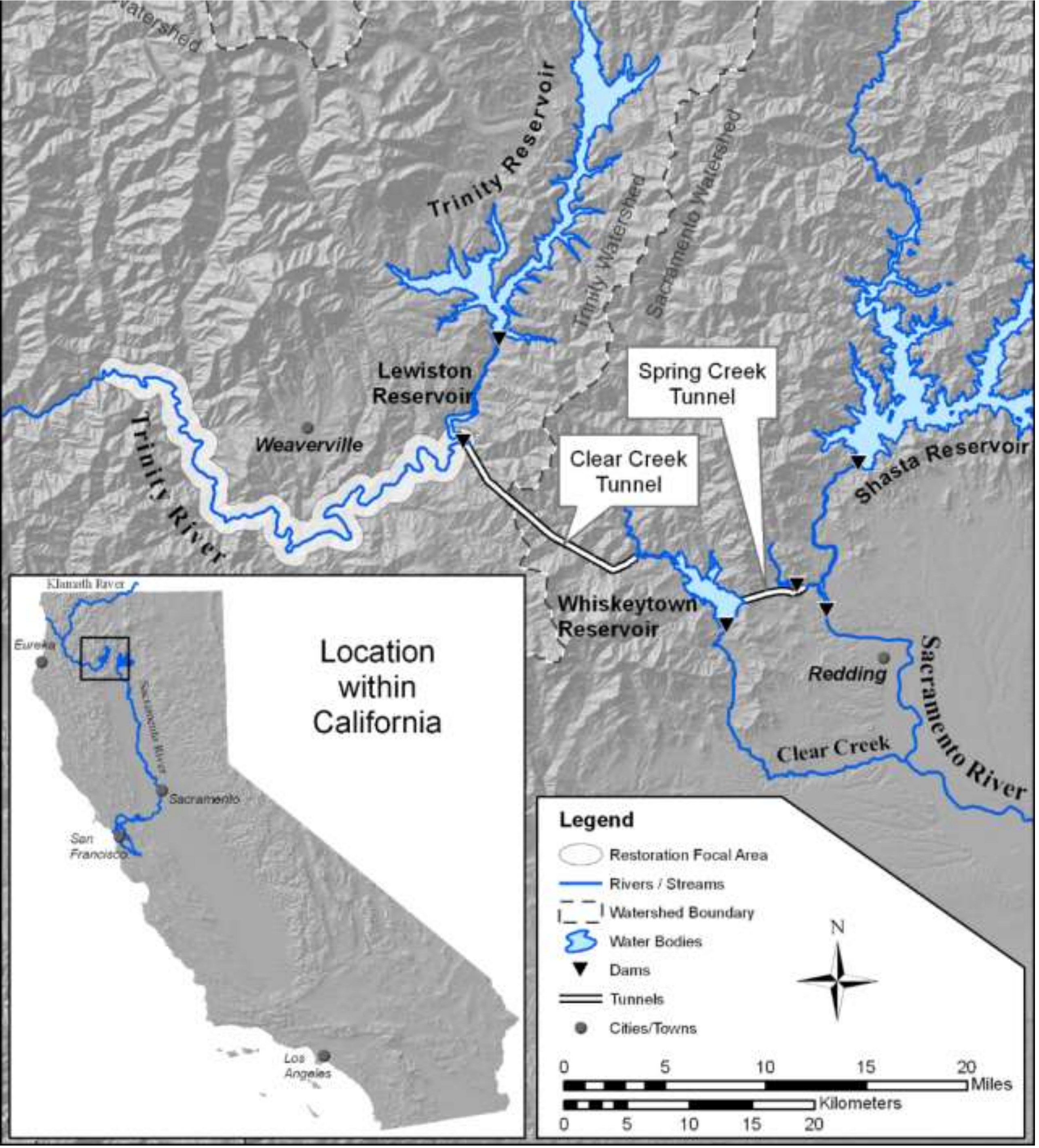
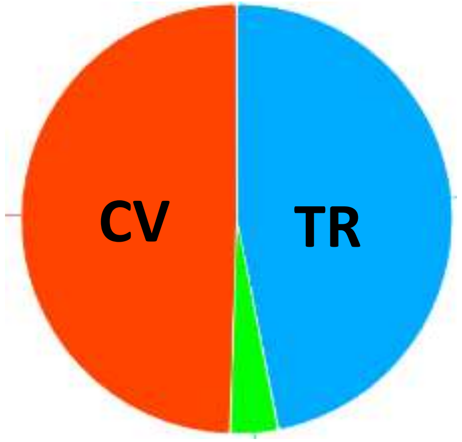


Photo: Van Matre family

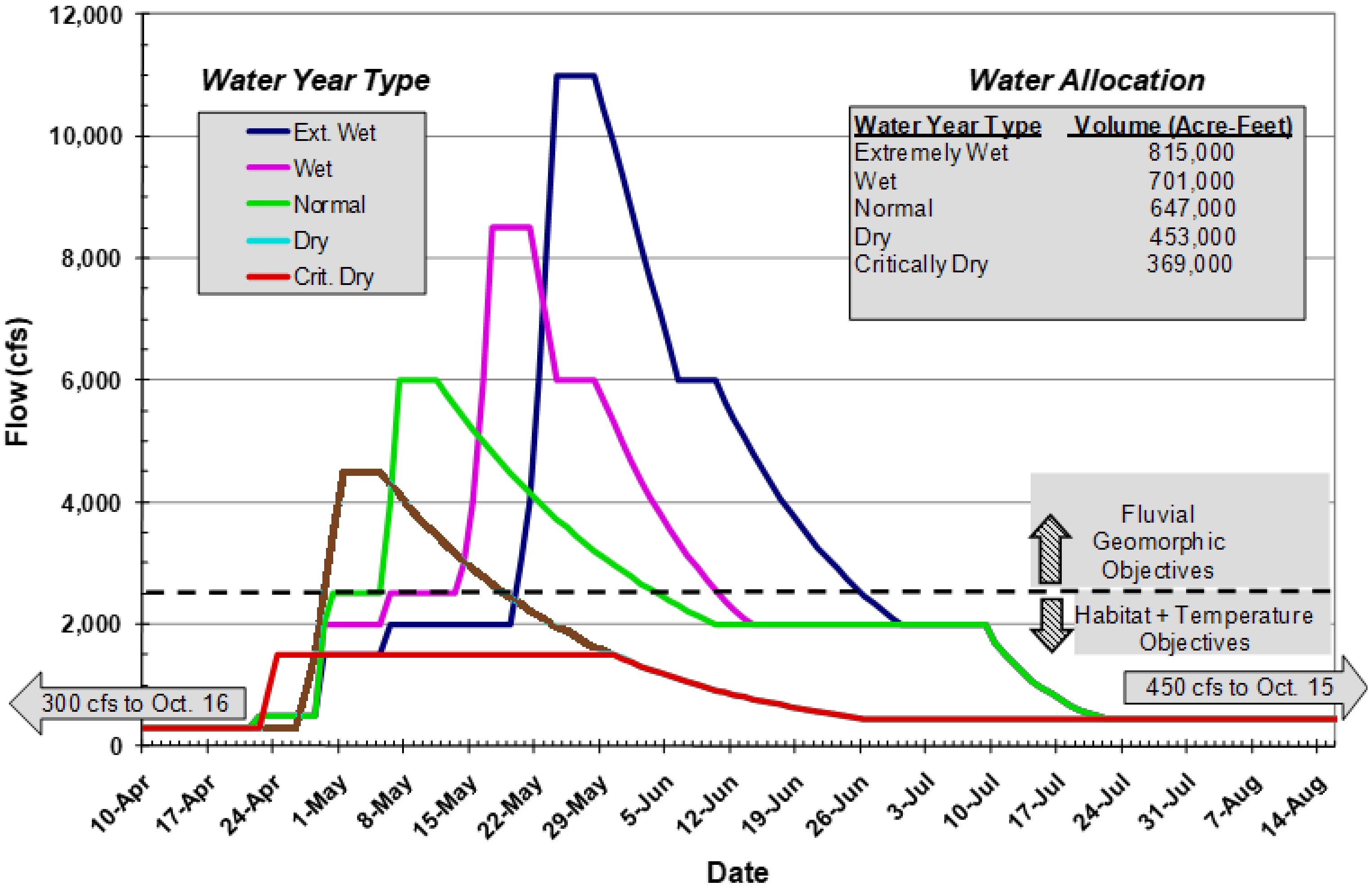
First 10 years of full operation (1964-1973): 89% of the reservoir flowed to through the tunnels to the Central Valley

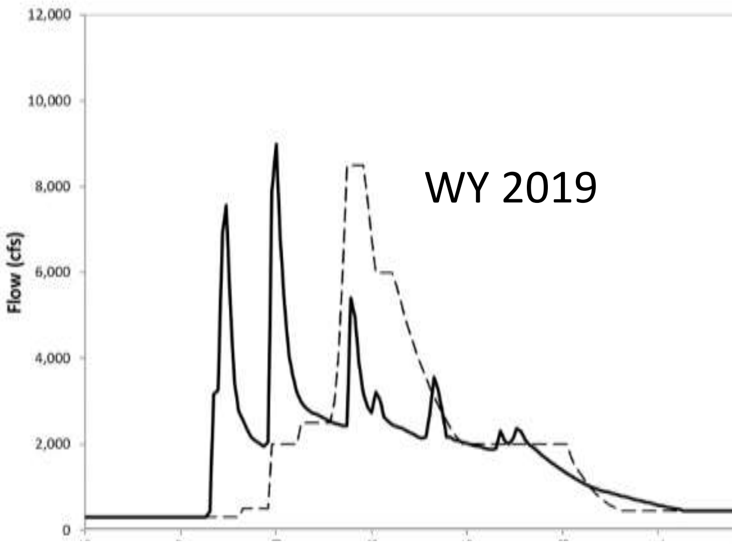


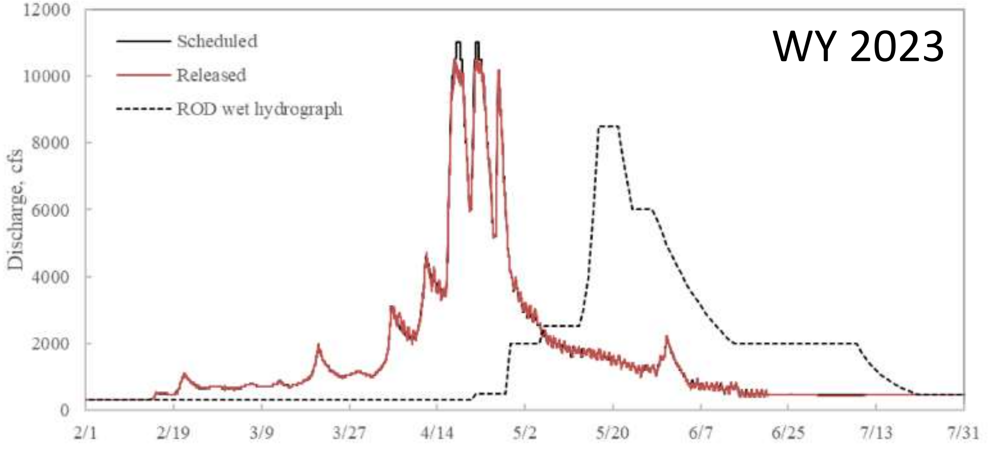
Peterson et al. (2024) Periphyton, SRF.

As of the 2000 Record of Decision (ROD) *"variable"*

"recommend possible adjustments to the annual flow schedule"

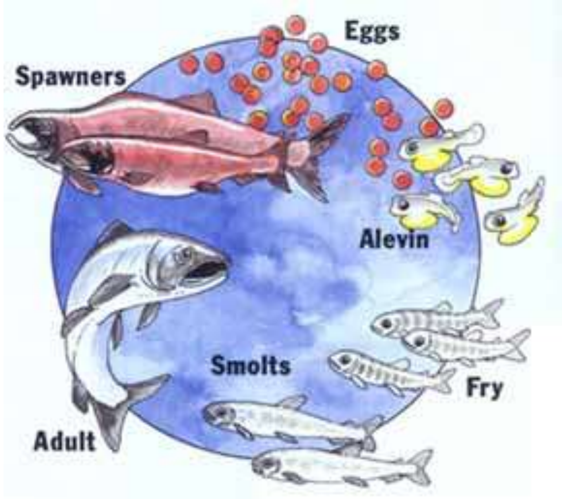


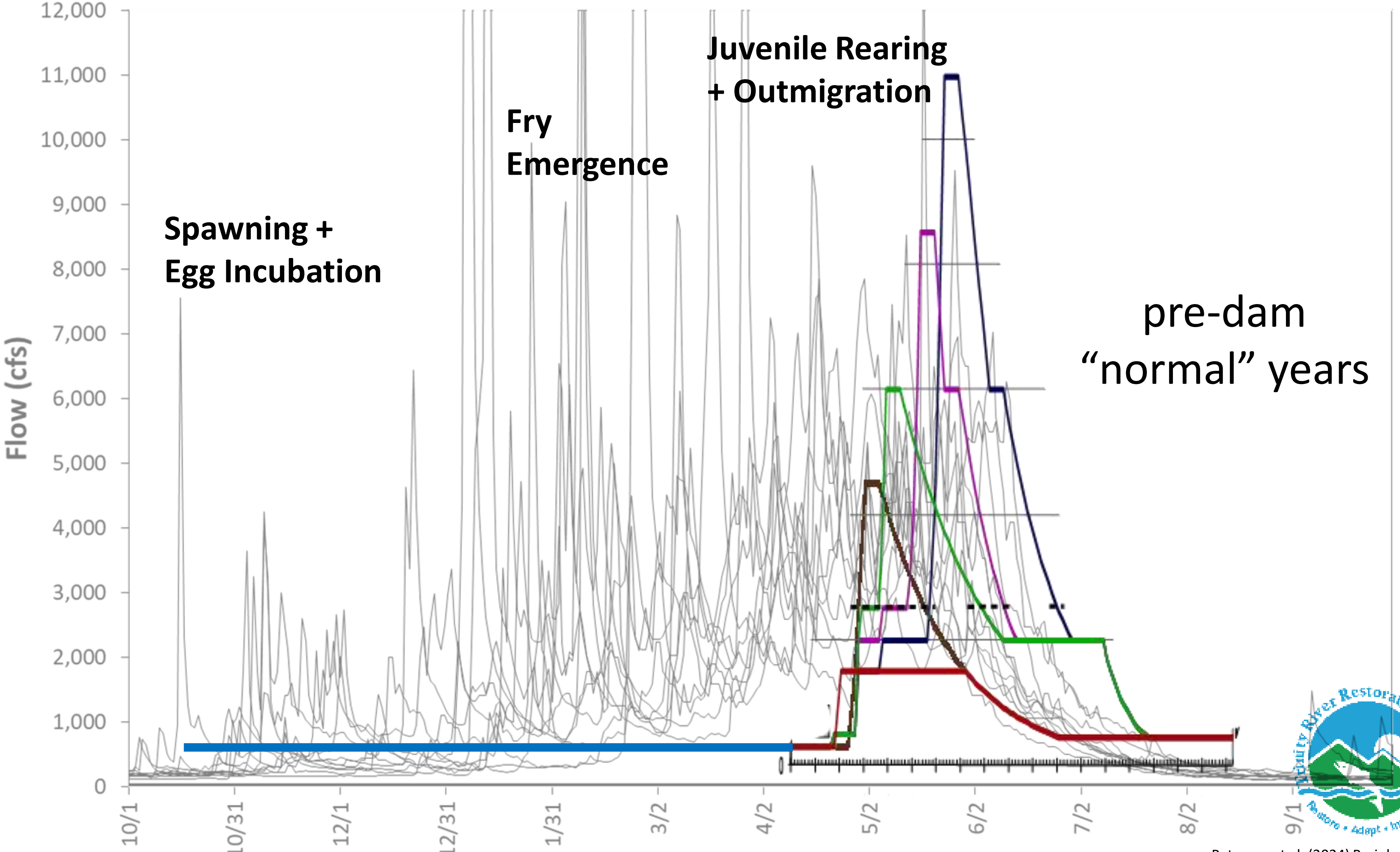




Peterson et al. (2024) Periphyton, SRF.

Salmon life cycle vs Mediterranean hydrology

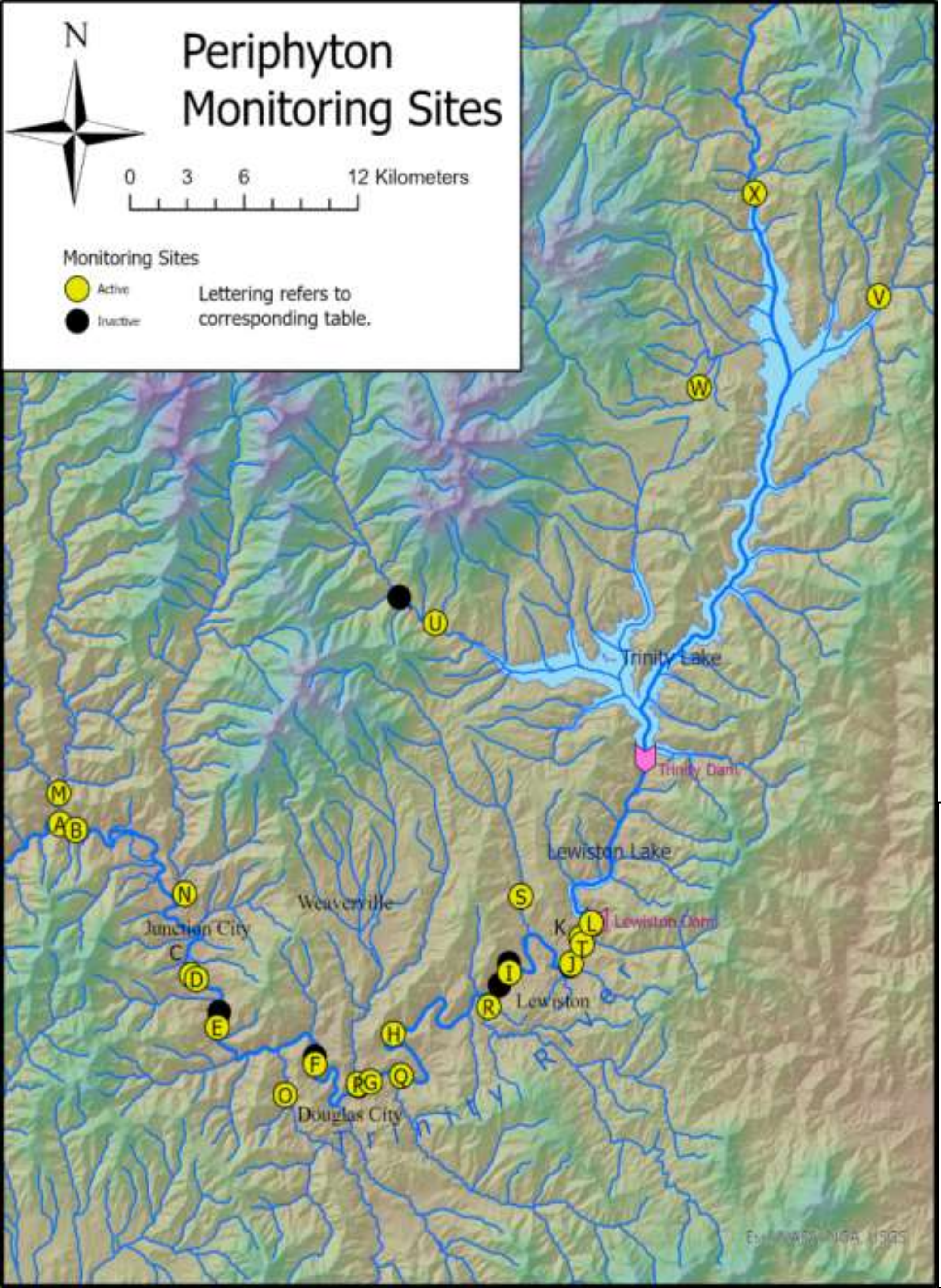


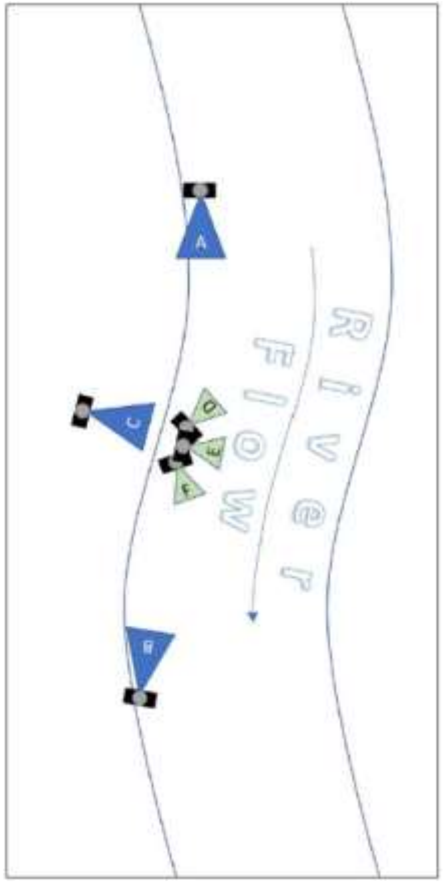


Peterson et al. (2024) Periphyton, SRF.

So what about periphyton? (~algae~)

Peterson et al. (2024) Periphyton, SRF.



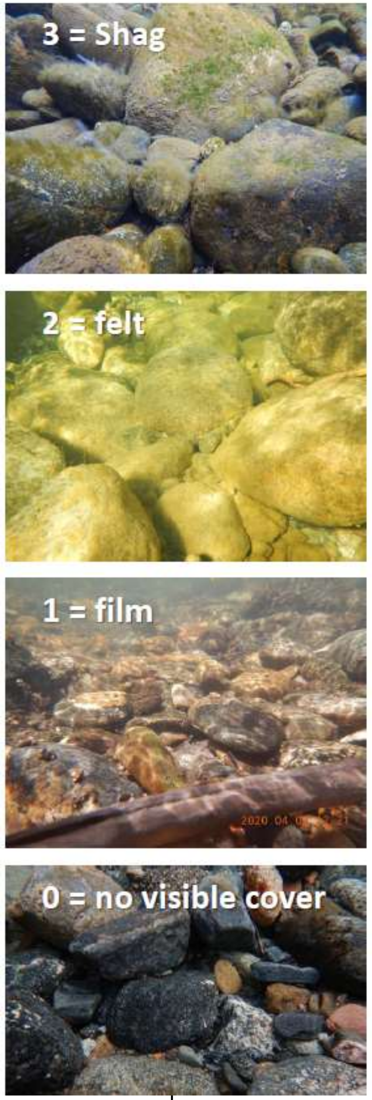


Even numbered months, plus July

- February
- April
- June
- July
- August
- October
- December

Started in 2020

Cover Scores

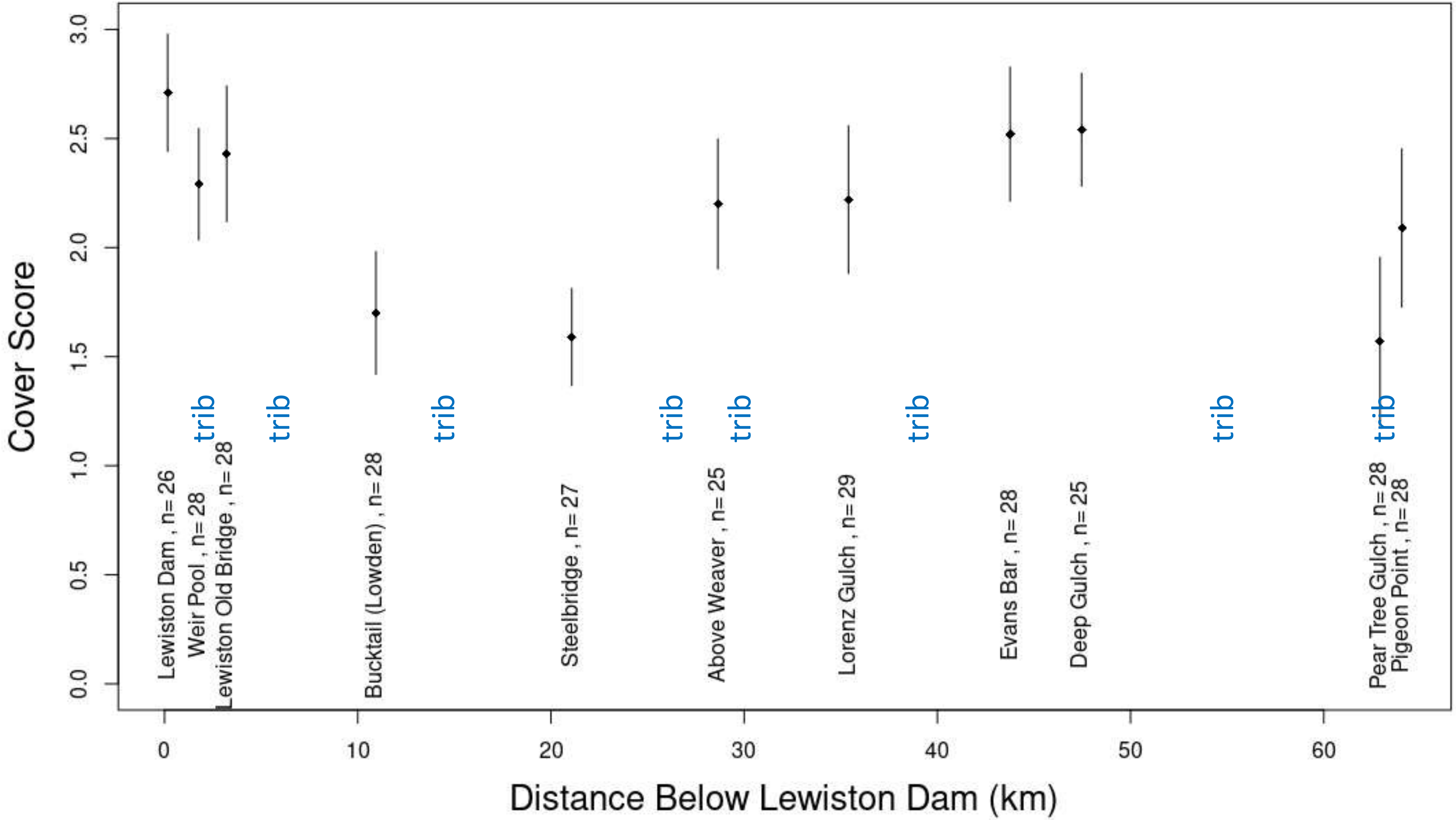


Pendulous Scores

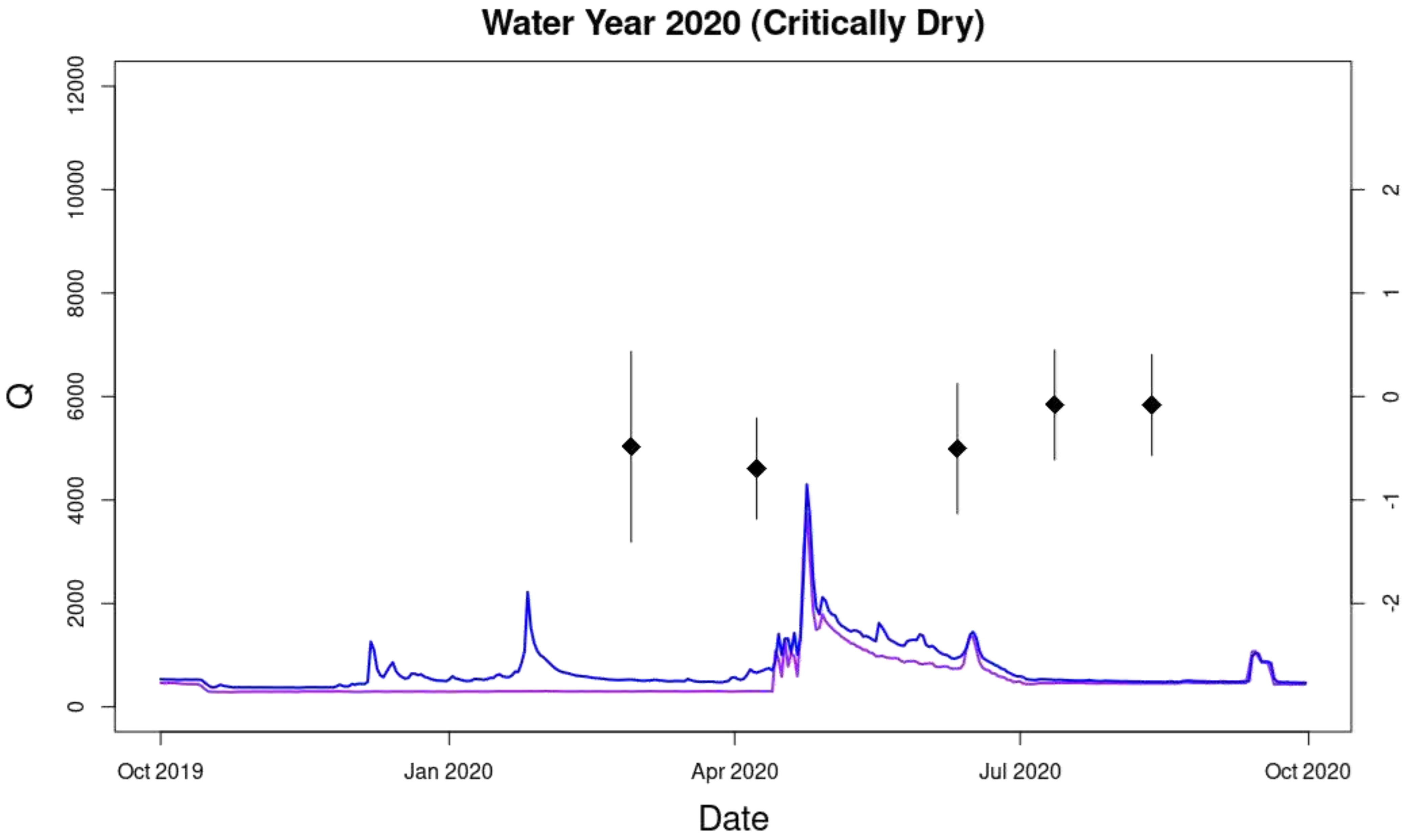
Peterson et al. (2024) Periphyton, SRF.

Results: Variation Within River… so standardize by site

std = C – SiteMean / SiteSD

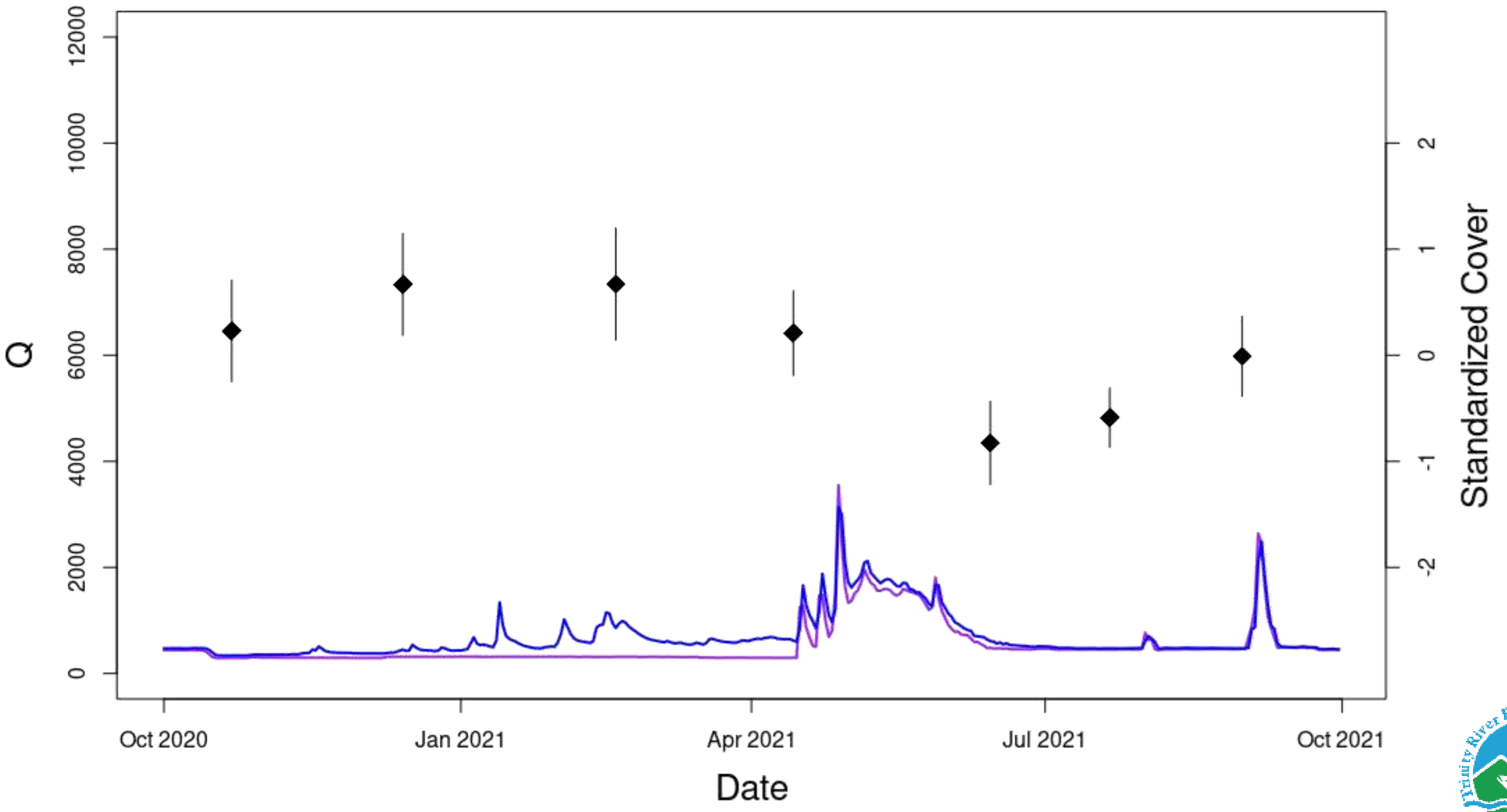


Peterson et al. (2024) Periphyton, SRF.

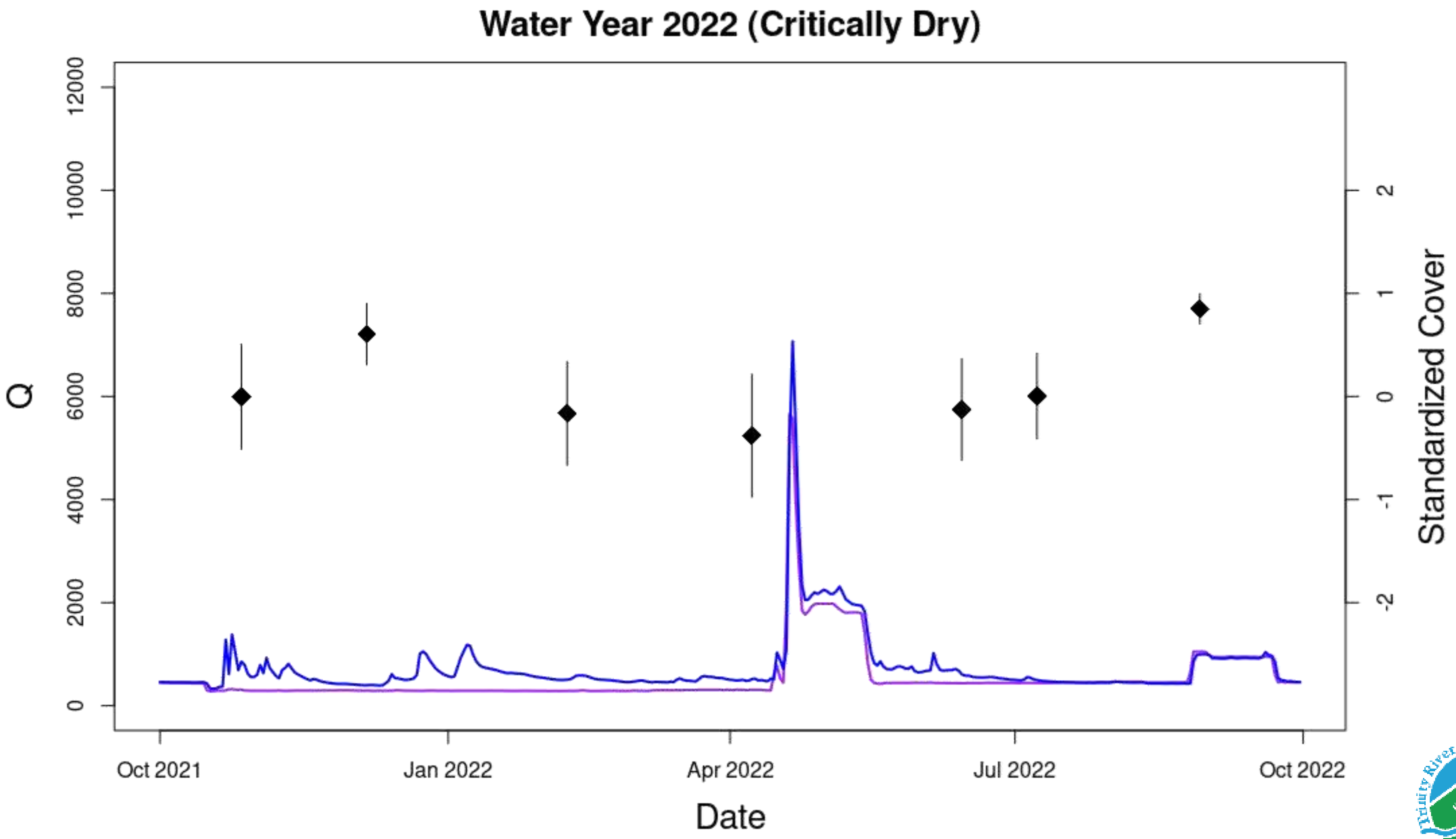


Peterson et al. (2024) Periphyton, SRF.

Water Year 2021 (Critically Dry)

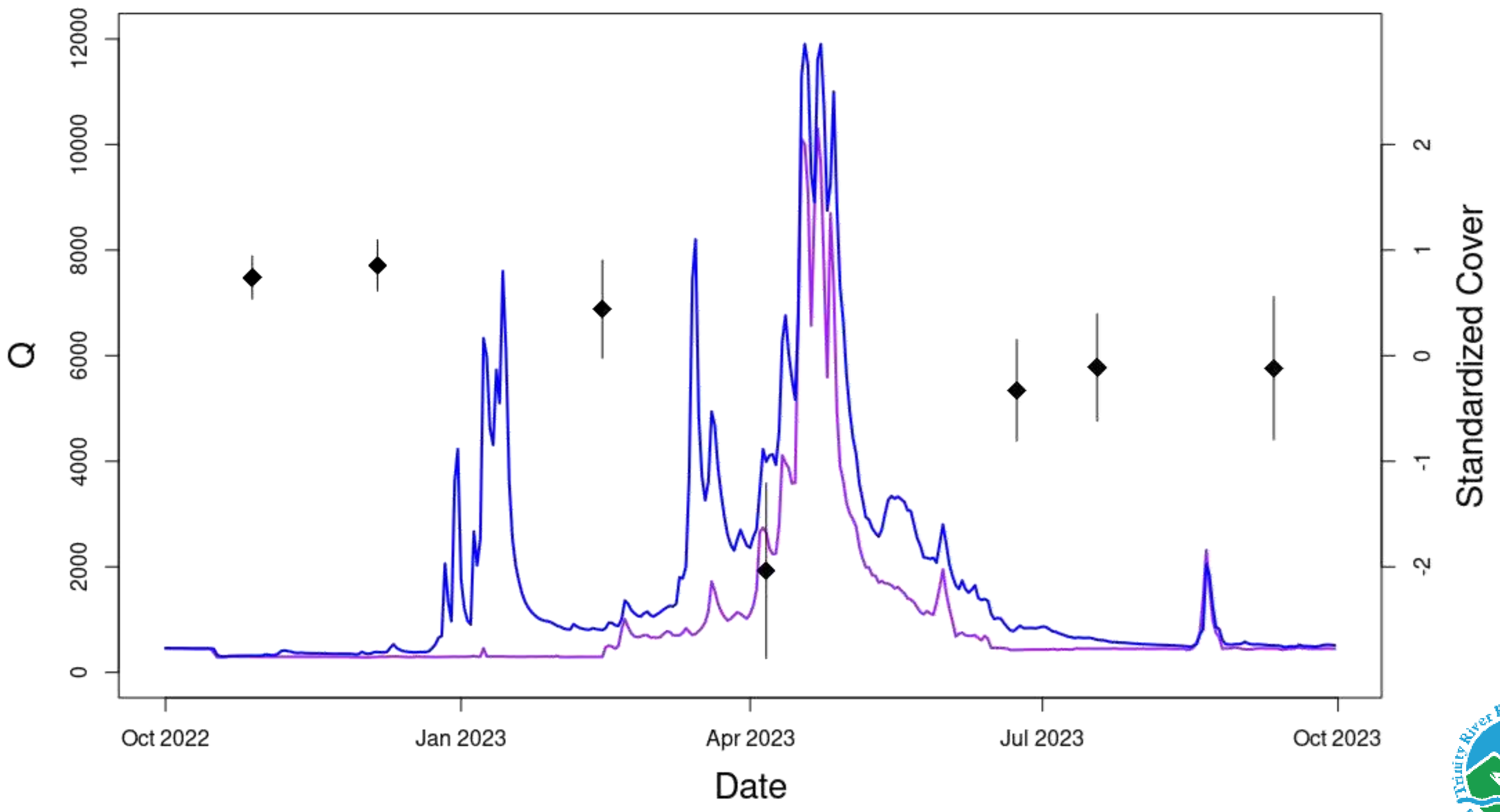


Peterson et al. (2024) Periphyton, SRF.



Peterson et al. (2024) Periphyton, SRF.

Water Year 2023 (Wet)

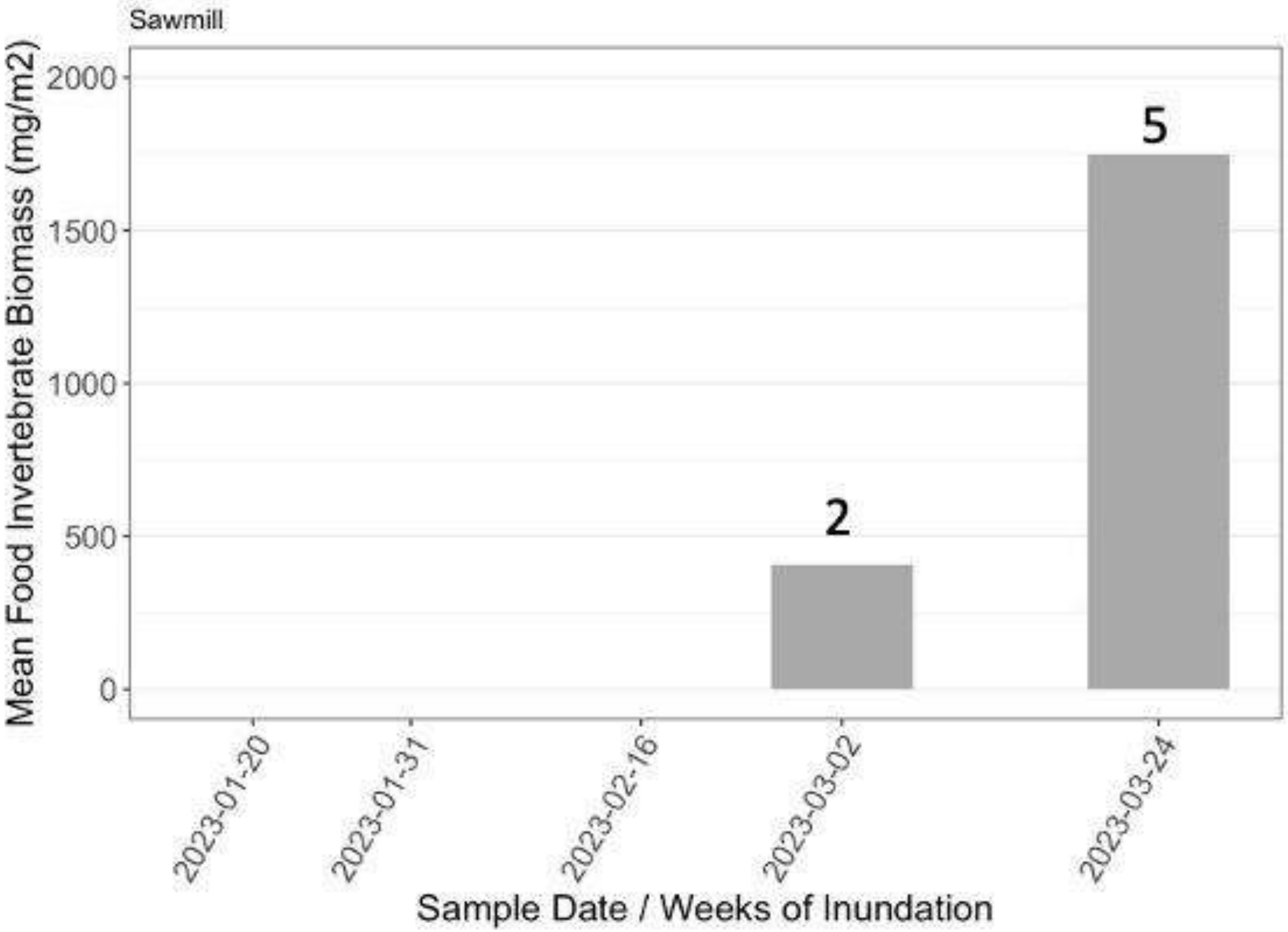


Peterson et al. (2024) Periphyton, SRF.

Peterson et al. (2024) Periphyton, SRF.

Correspondence to Sawmill BMI

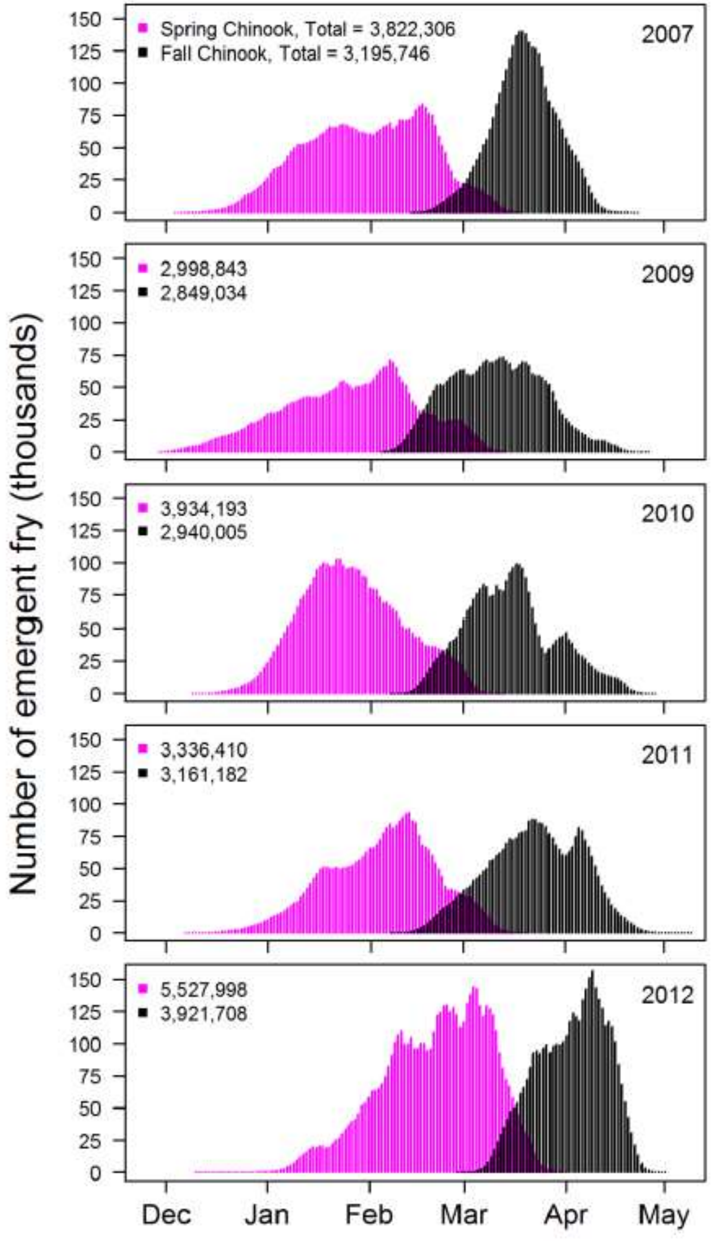
Benthic Macroinvertebrates (BMIs) are the main food resource for juvenile salmonids.



Samples collected using 0.09 m^2 hess sampler.

Peterson et al. (2024) Periphyton, SRF.

Emergence timing and increasing abundance



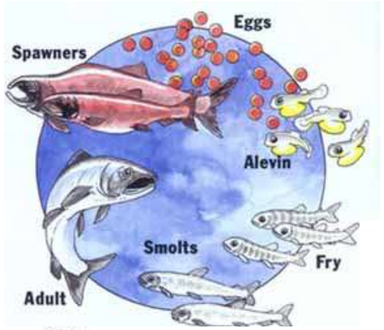
Perry et al. 2018

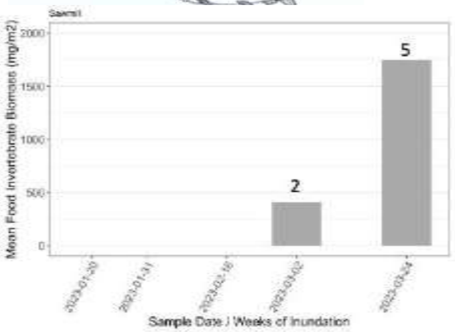
Patterns observed so far are compatible with work on the Eel River by Dr. Mary Power et al. (e.g. 2008, etc.)

Peterson et al. (2024) Periphyton, SRF.

The big picture is coming into focus…

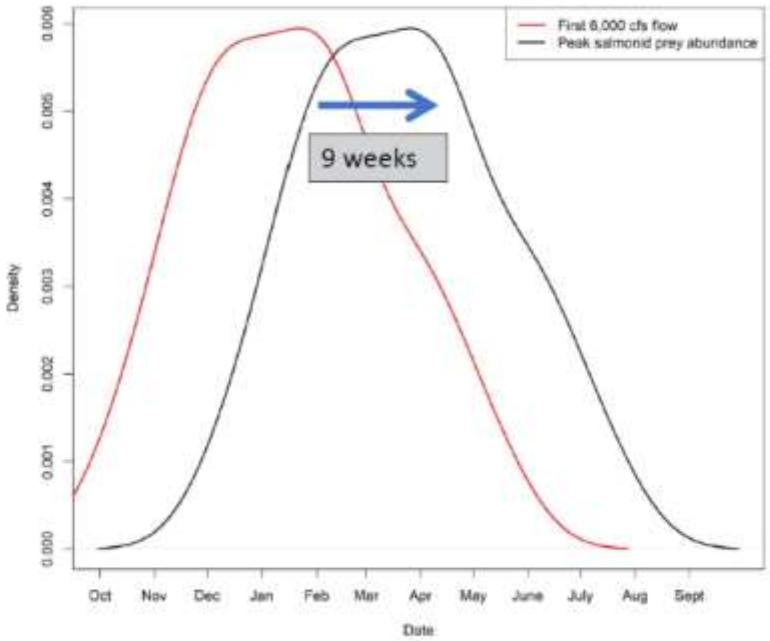
- Periphyton / BMI develop on floodplain within weeks of inundation.
- P/BMI are scoured from gravels in the central channel during bed mobilization events and also recover (similar rates?).
- Natural bed mobilization mostly occurs prior to, or early within juvenile rearing and high consumption needs.
- Steadily increasing base flows enable P/BMI development on floodplains that *likely* compensates for any late occurring bed mobilization. (? – *really an hypothesis*)

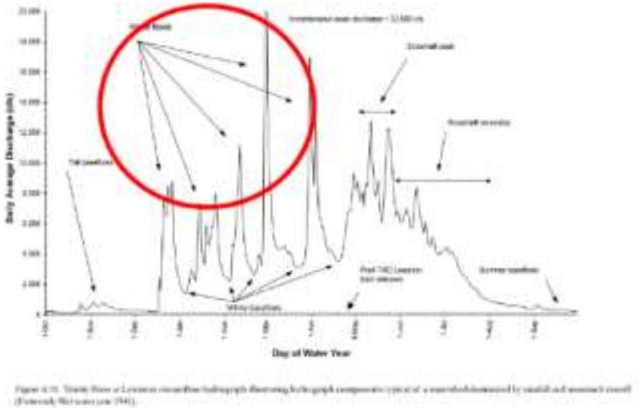




More 'nice to know'…

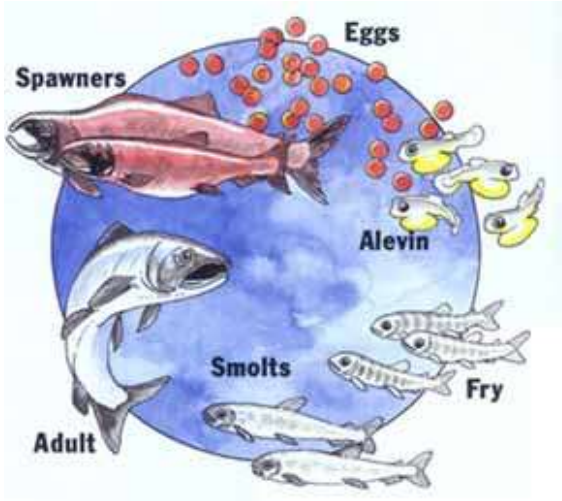
- Relationship of P/BMI scour to bed mobilization?
- Rates of development of P/BMI on various floodplain surfaces?
- Rates of recovery of P/BMI within channel after mobilization?
- Affects of floods / bed mobilization on food drift?
- Duration of food drift pulses during and after bed mobilization?
- Impact of suspended sand on P/BMI scour?
- Can foodscape be predictively modeled for scheduled dam releases?

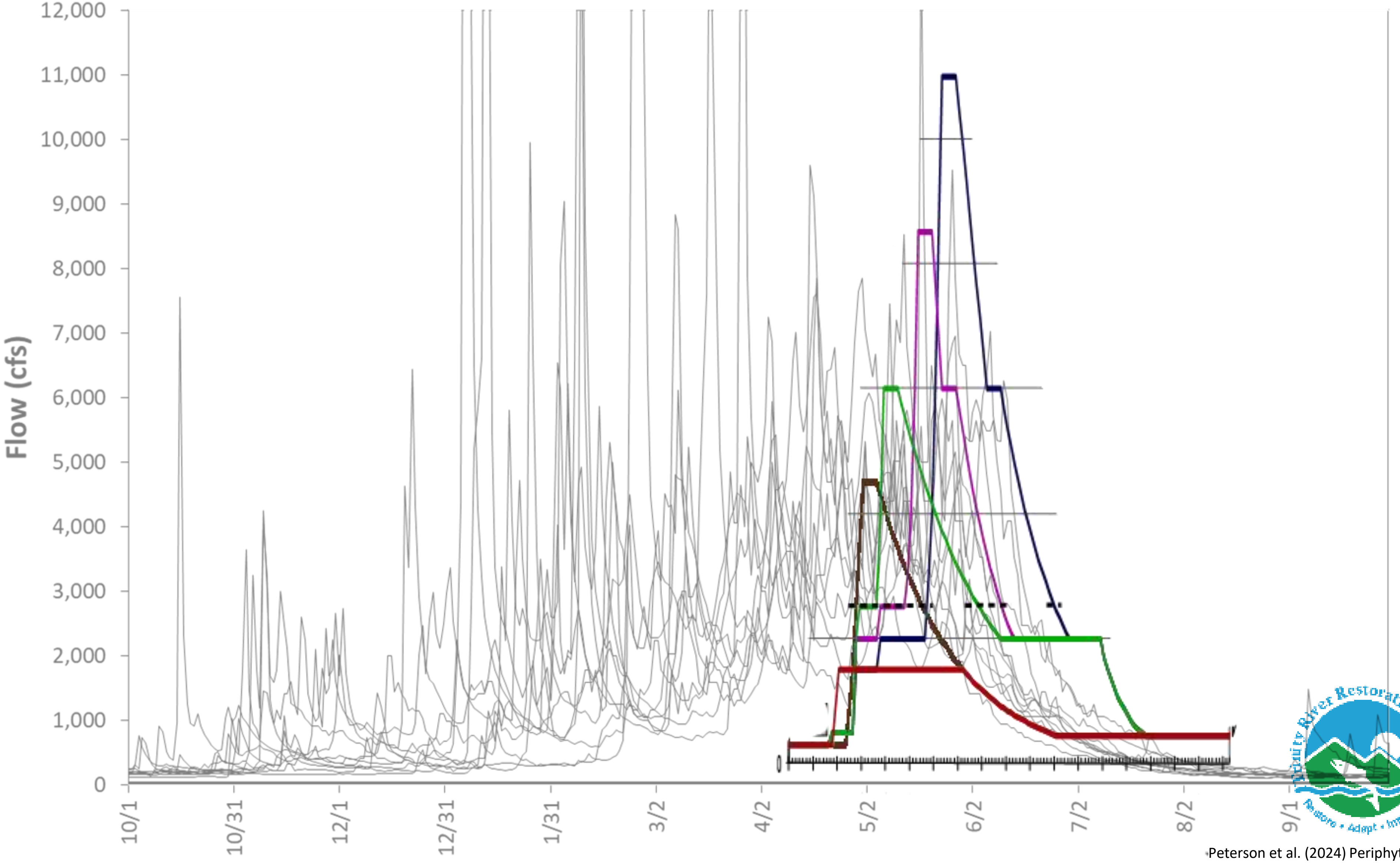




Peterson et al. (2024) Periphyton, SRF.

Circling back to flow management





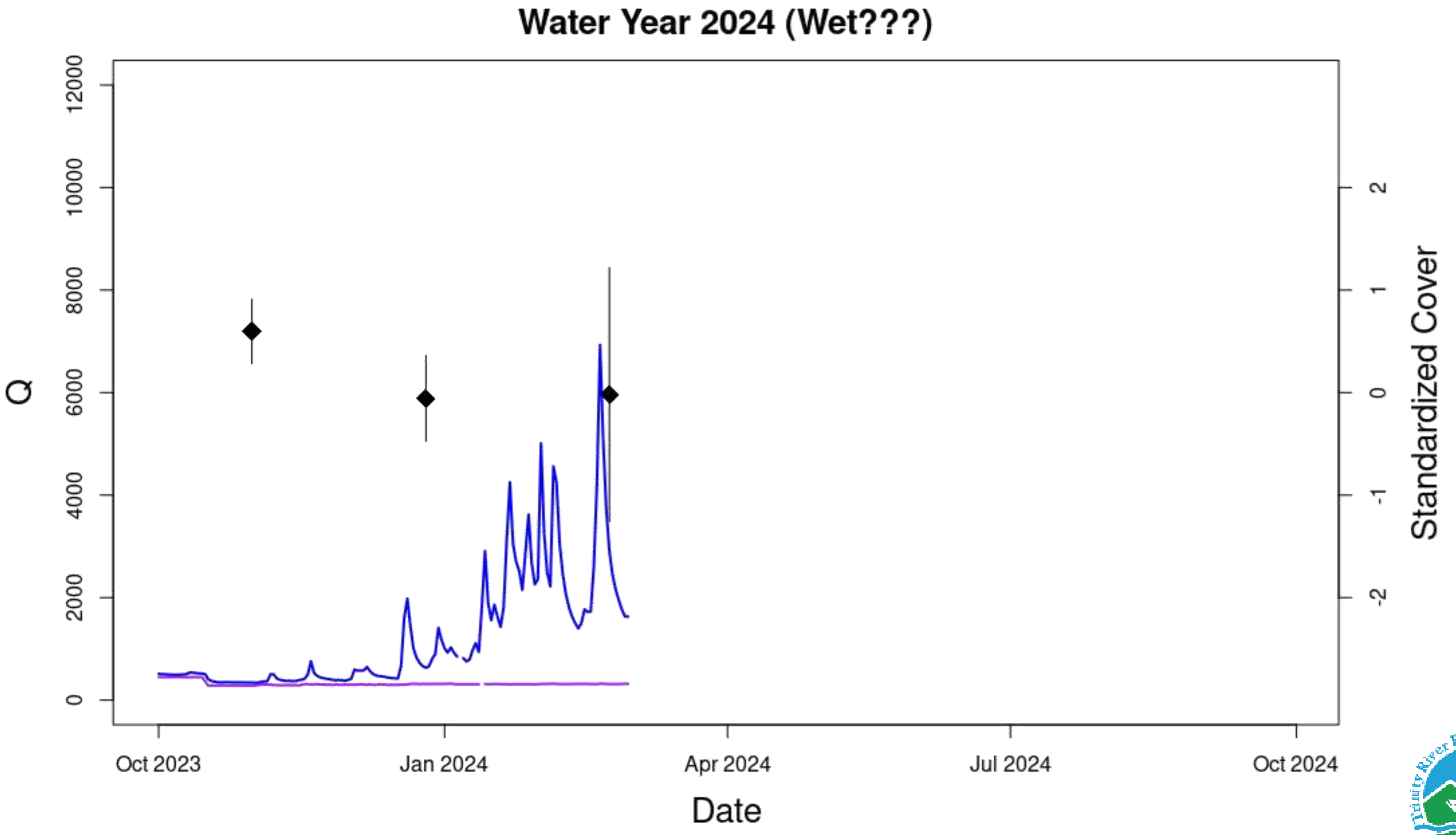
Peterson et al. (2024) Periphyton, SRF.

Questions?

Thank you!

- Co-authors
- TRRP Workgroup Participants
- TRRP Office
  - In particular James Lee who got me started on periphyton monitoring
- Mary Power, other periphyton folks I've kicked ideas around with

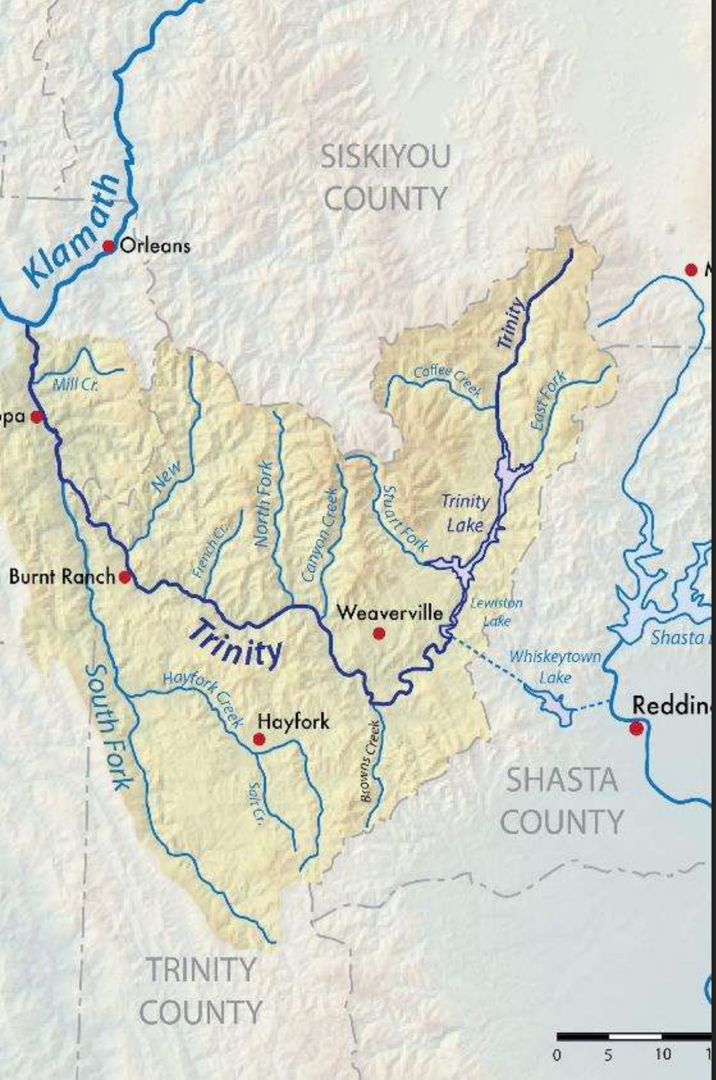
Filamentous green alga *Cladophora,* hosting diatoms *Cocconeis* and *Epithemia*



Peterson et al. (2024) Periphyton, SRF.

The Effects of Scour and Marginal Habitat Inundation on Trinity River Invertebrate Biomass and Density with Potential Implications for Juvenile Salmonid Food Resources

Ben King (CPH)
Alison O’Dowd (CPH)
Darren Ward (CPH)
Nicholas Som (CPH)
Chris Laskodi (TRRP , Yurok Tribal Fisheries)
Kyle De Juilio (TRRP, Yurok Tribal Fisheries)



Trinity River Background

- Largest tributary of the Klamath
  - 7,600 km^2 watershed and 266 km long
- Historically supported strong anadromous salmonid populations
- Indigenous populations (Hoopa Valley Tribe, Nor Rel Muk Wintu)
- Arrival of Euro-American settlers
  - Hydraulic Mining

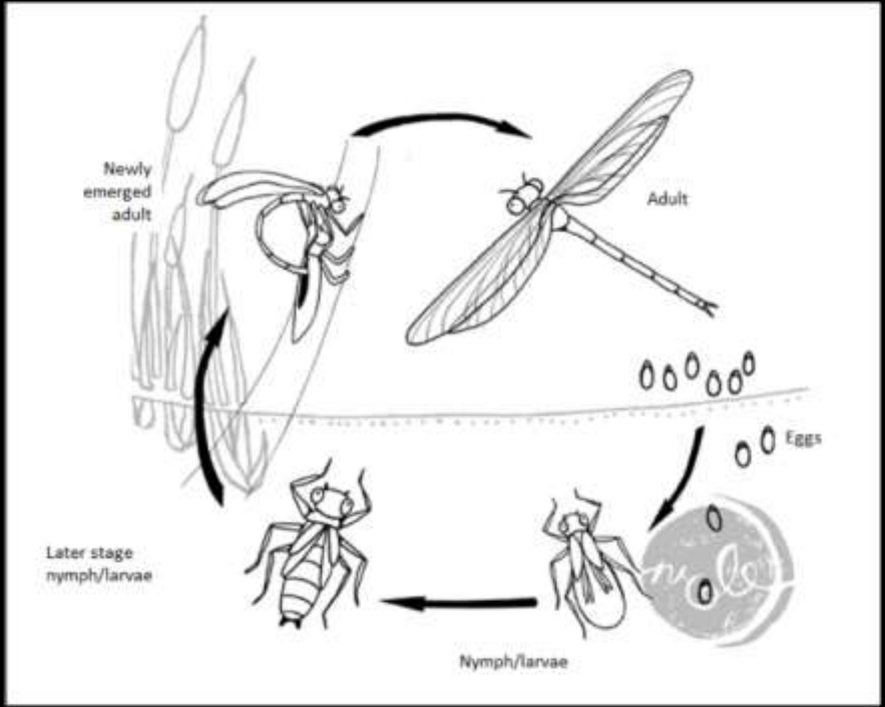
Trinity Dam (Source: Bureau of Reclamation)

Lewiston dam (Photo taken by Alison O'Dowd , 2023)

Damming of the Trinity

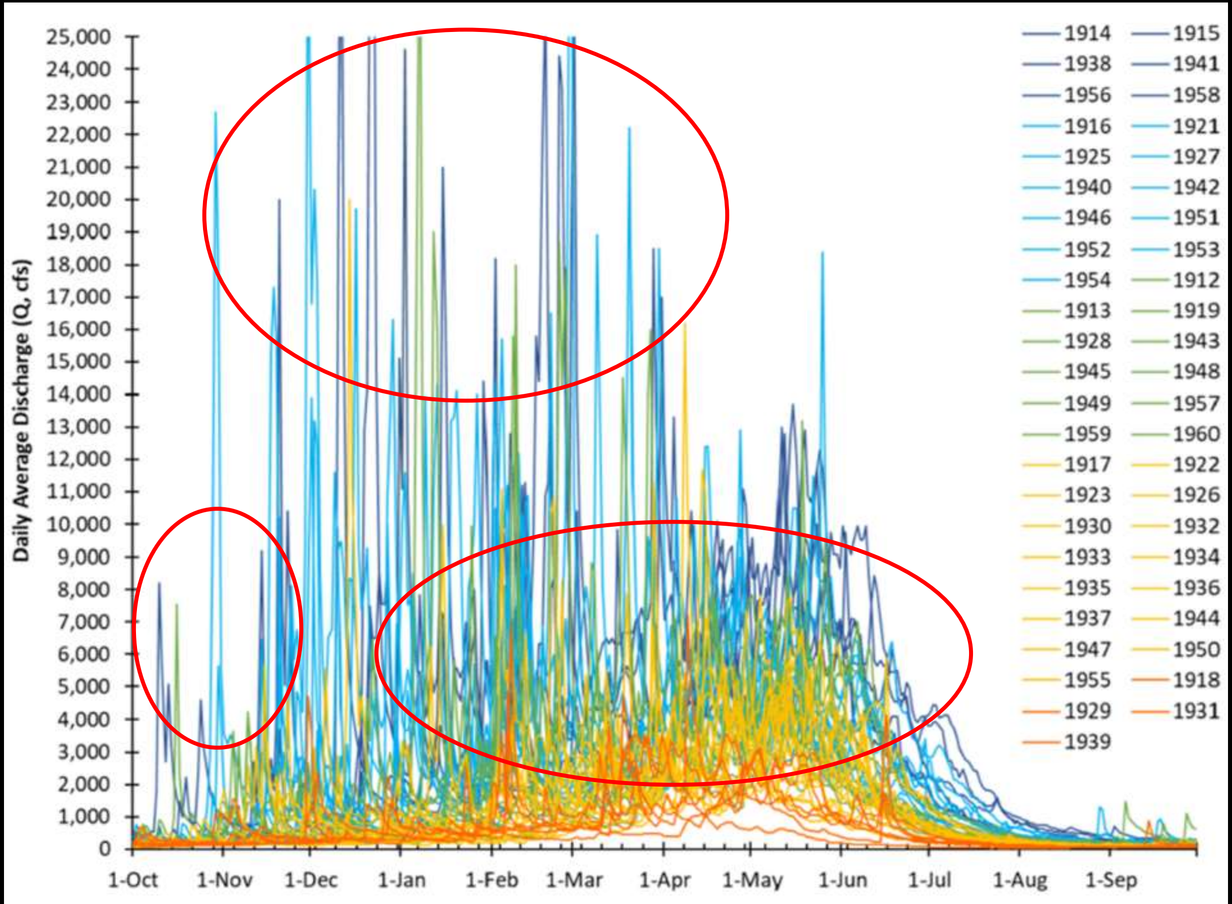
- Trinity River Division (TRD) of the Central Valley Project (CVP)
- Trinity and Lewiston dams (1962 & 1963)

Direct Impacts of Dams on Invertebrates



- BMI communities are highly influenced by the flow regime
  - Disruptions to phenology (Munn and Brusven 1991)
  - Scour can act as a benthic “reset button” (Power et al. 2008)
  - Communities downstream of dams can exhibit a decline in diversity and an increase in tolerant taxa (Munn and Brusven 1991)

Variability Characterized Pre-Dam Trinity River Hydrology

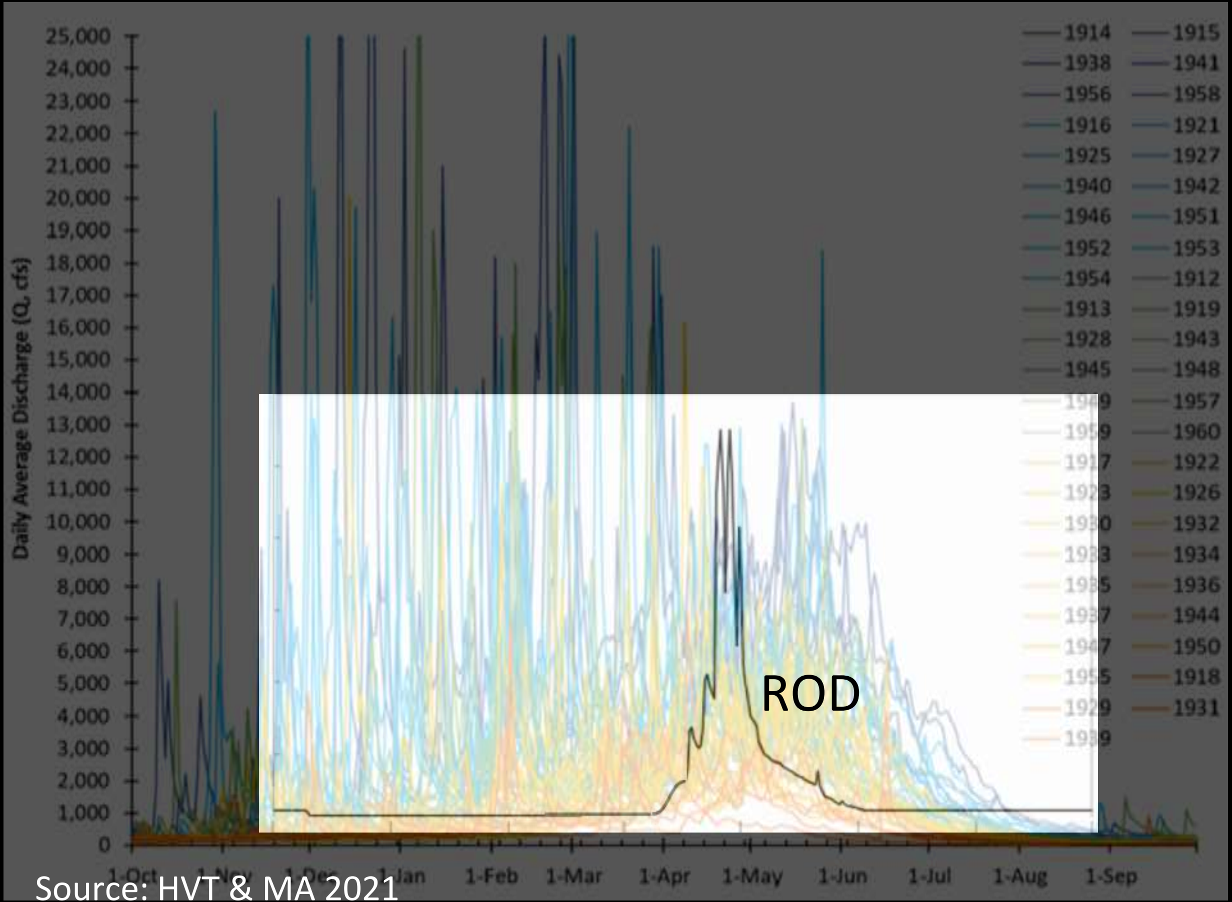


Source:
HVT & MA 2021

Underexplored Consequences of Altered Trinity River Hydrology

- Shift in the timing of scouring flows

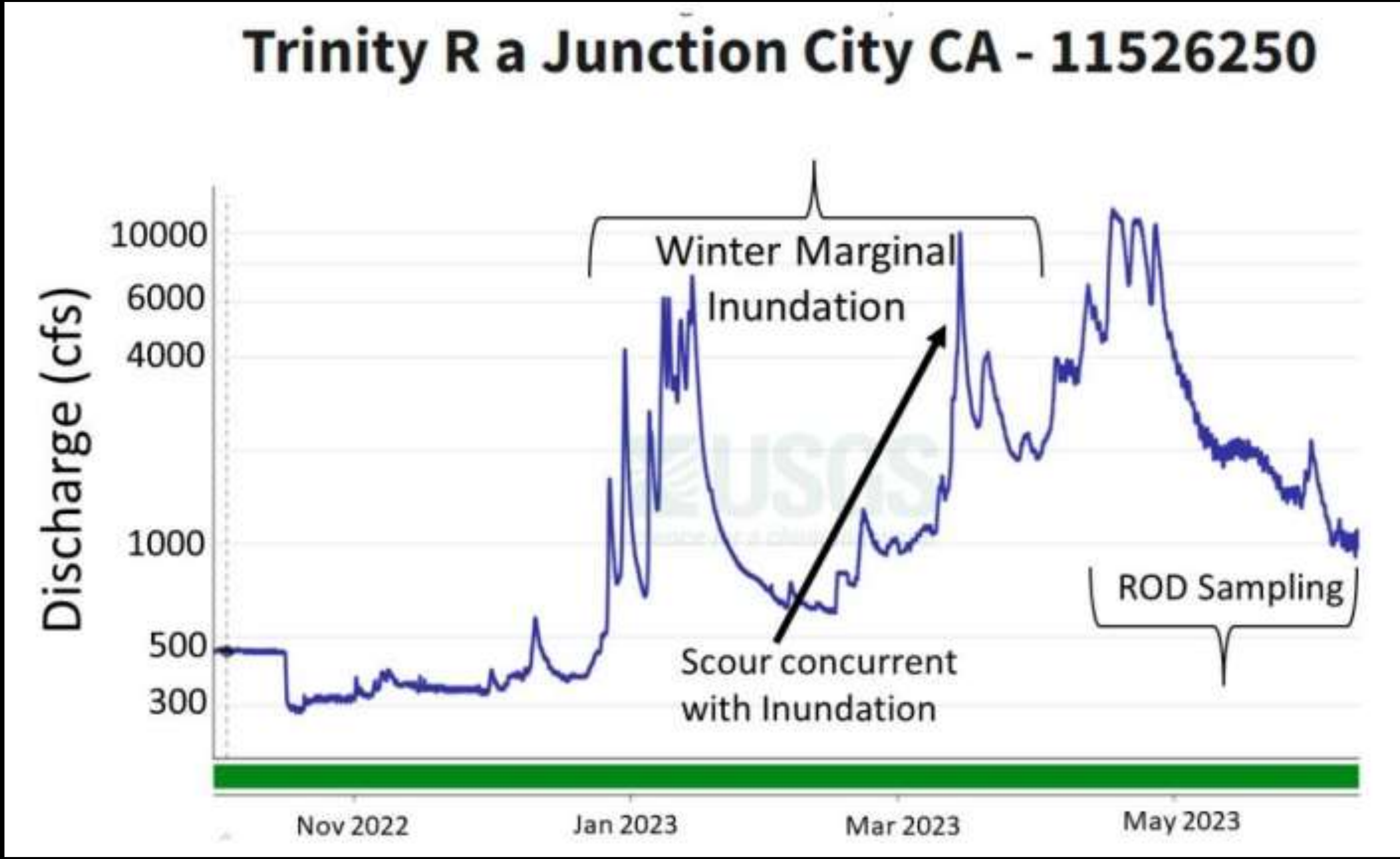
- Shift in the timing and duration of elevated baseflow period
  - Elevated baseflows inundate marginal habitats (floodplains)



Source: HVT & MA 2021

Benthic macroinvertebrates (BMIs) are an important food resource for juvenile salmonids

A Surprising Turn of Events



- A wet winter provided the opportunity to study scour and marginal habitat inundation

Research Objectives/Questions

1. Assess the impact of a scouring event on Trinity River BMI biomass and density in the perennial channel.

1. Assess the relationship between juvenile salmonid food biomass and density to increasing durations of marginal habitat inundation between January and June 2023.

Study Sites

https://commons.wikimedia.org/wiki/File:Trinity_CA_watershed_map

Study Sites

Sawmill

Source: Alison O'Dowd

Source: Ben King

Pear Tree

Lorenz Gulch

Source: Ben King

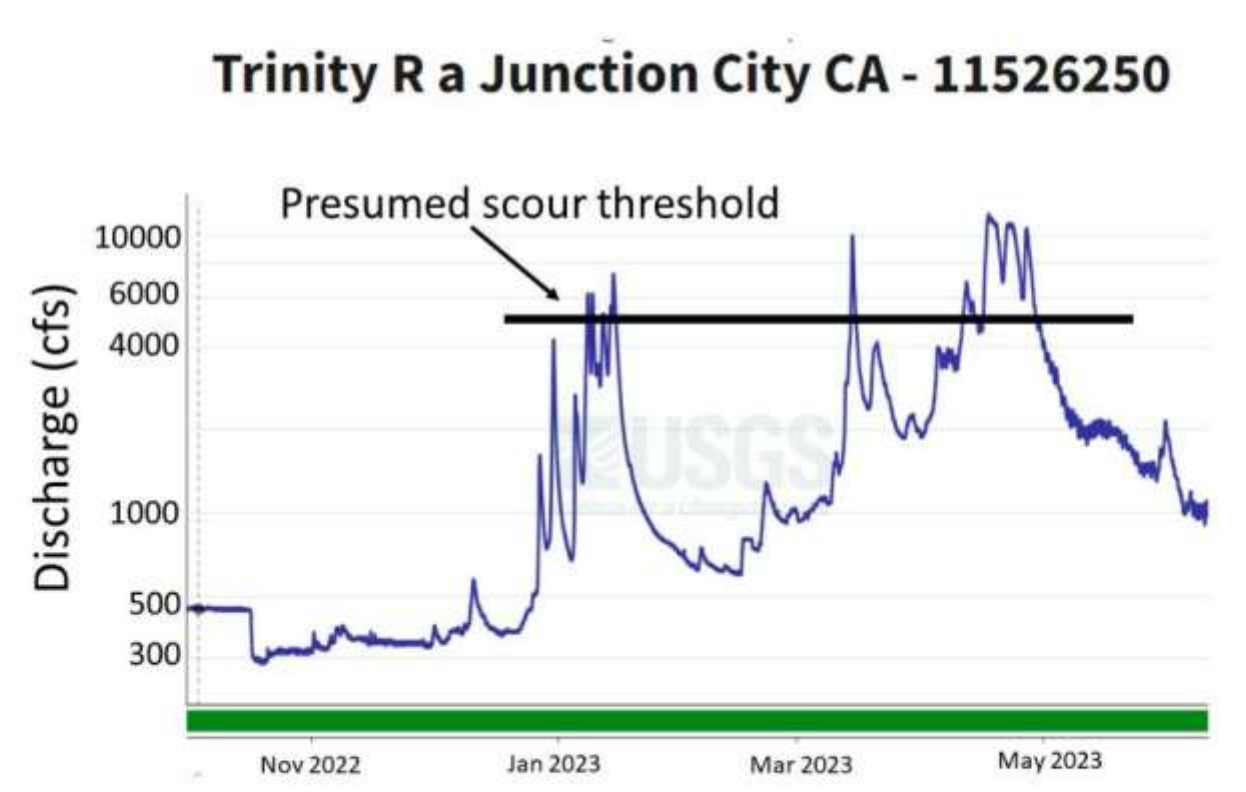
Junction City

Source: Ben King

Field Methods

- Hess sampler to sample invertebrates in the benthos
- Monthly sampling of the perennial channel from October – March to examine the impact of scour
- Sampling of newly inundated marginal habitats at ~ 2-week intervals (2-wks, 4-wks, 6-wks, etc.)
- January 20th , 2023 – March 24th, 2023

Determining "Scour" Threshold



- 4,000 cfs -> Approximate initiation of coarse bedload transport (Gaeuman et al. 2017)
- 5,000 cfs -> Approximate threshold for significant bedload transport (Gaeuman et al. 2023)

Laboratory Methods

Source: Ben King

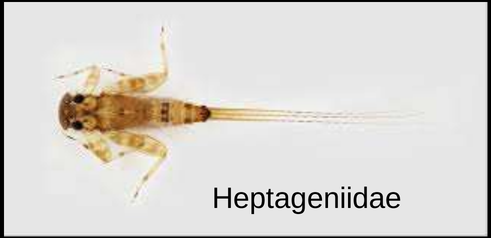
Source: Ben King

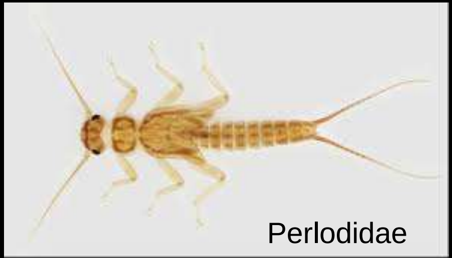
- Samples preserved in 90% ethanol in the field
- n = 160 samples processed total
- 50% subsample with large and rare taxa included
- Identified taxa to family using dissecting microscope
- Length-mass regressions to calculate biomass

Determining what is Fish "Food"

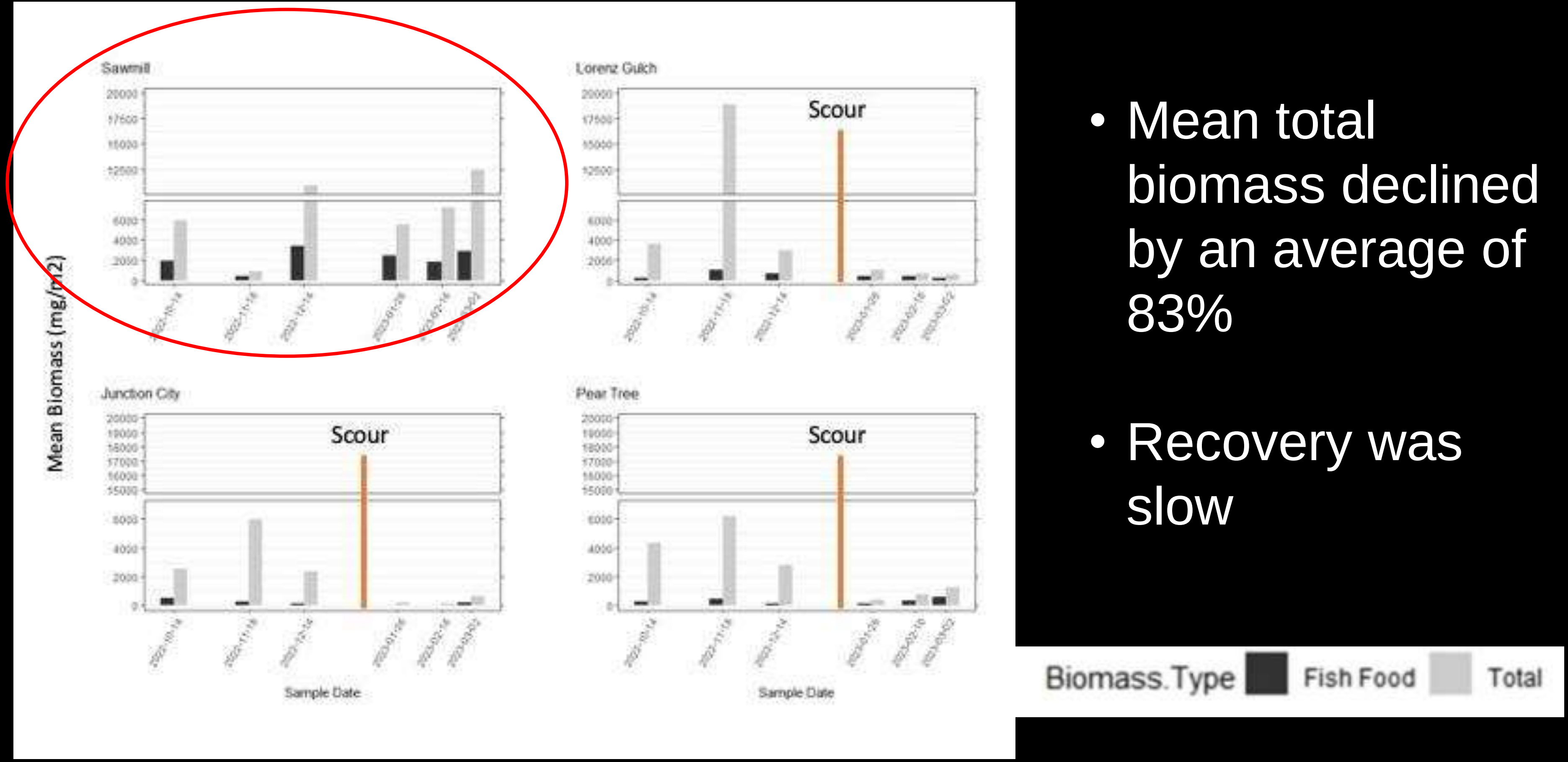
- 2018 Trinity River juvenile Chinook diet study* (n=580 diets)
- Top six taxa by biomass:
  1. Heptageniidae
  2. Ephemerellidae
  3. Baetidae
  4. Chironomidae
  5. Perlodidae
  6. Glossosomatidae
- These 6 taxa accounted for 76% of all biomass in Chinook diets*
- Individuals >18 mm in length were excluded from this study

*Starkey-Owens (2020)



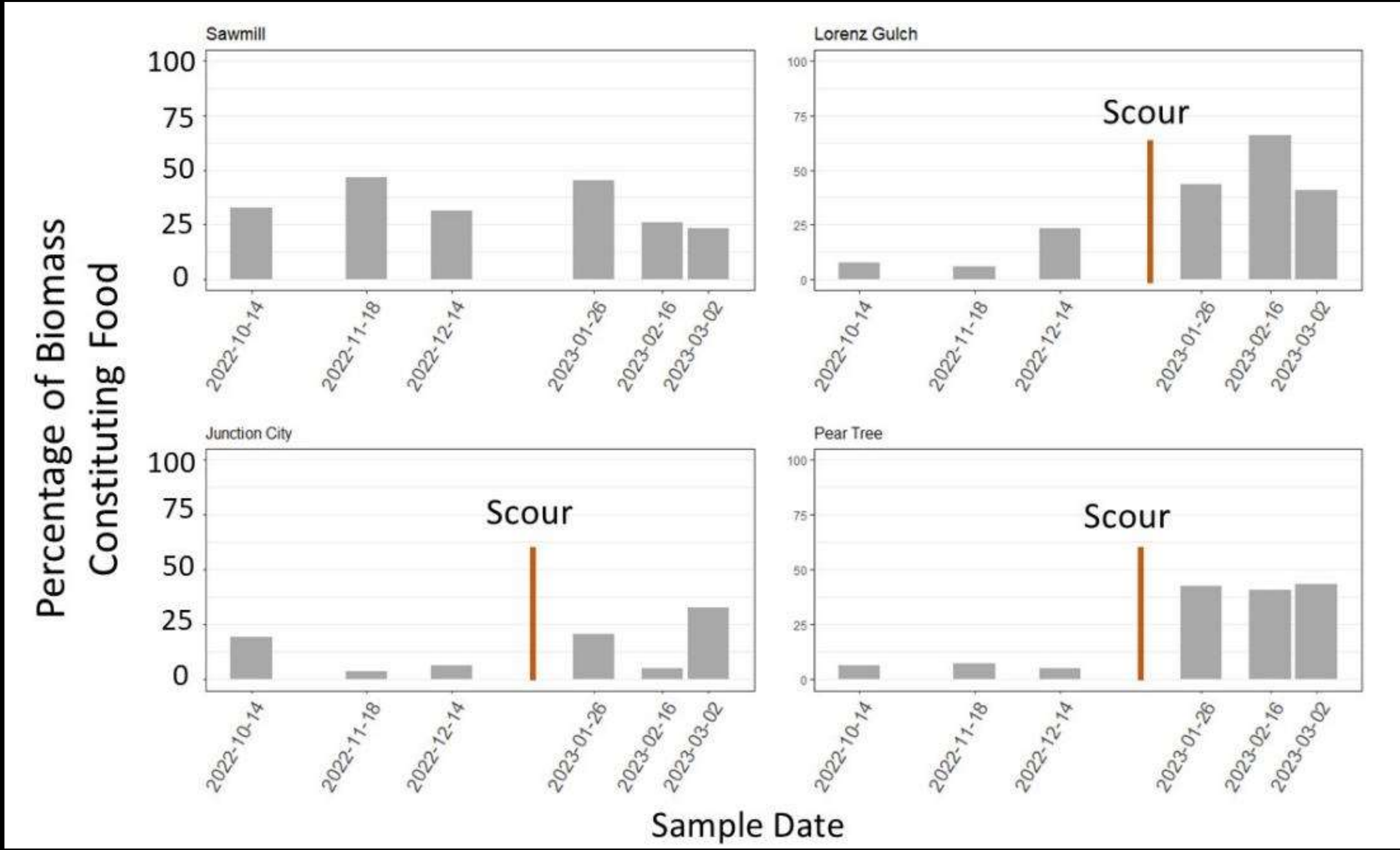


Scour dramatically reduces benthic biomass

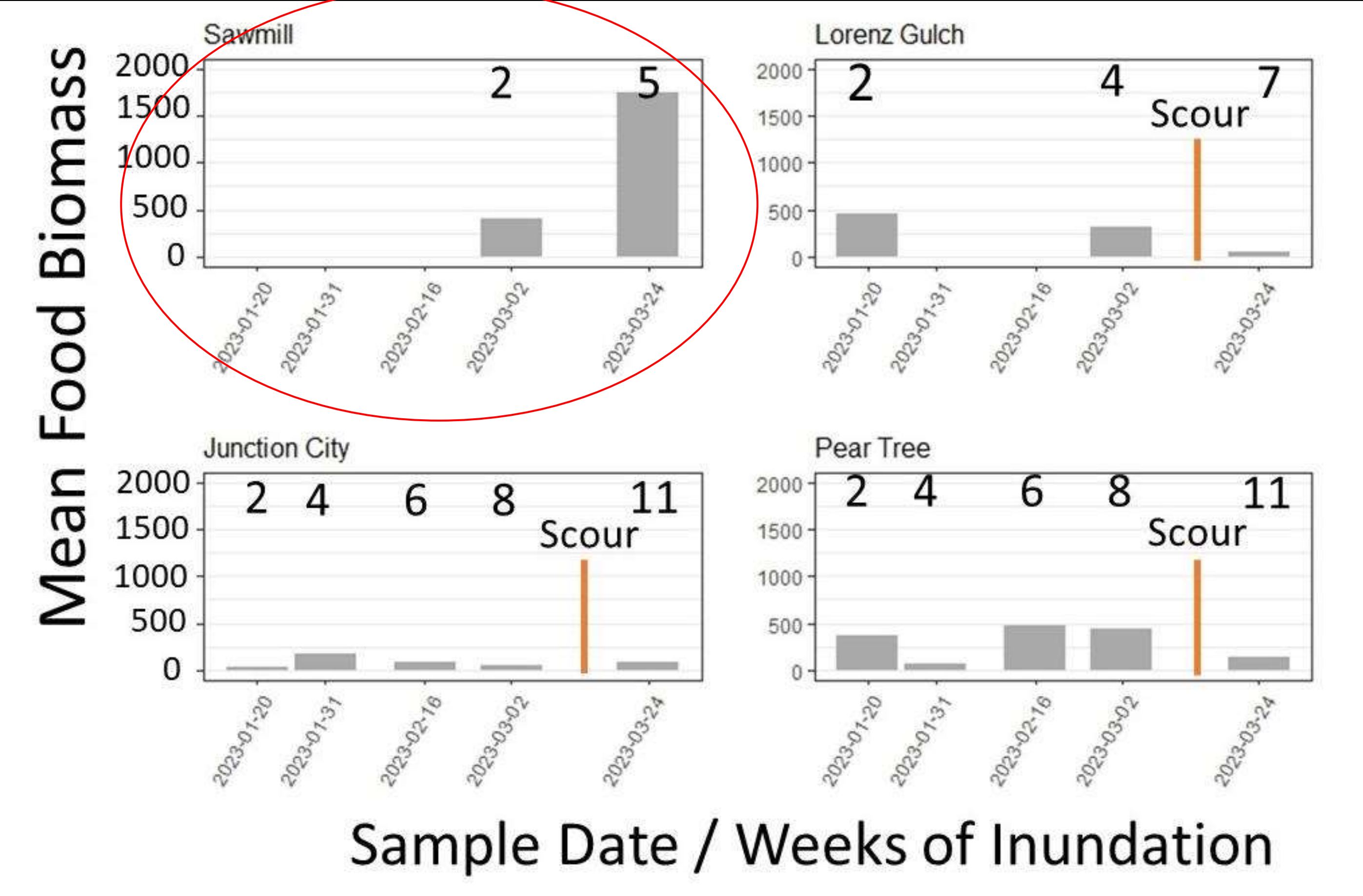


- Mean total biomass declined by an average of 83%
- Recovery was slow

Scour leads to an increase in the percentage of community biomass that is food

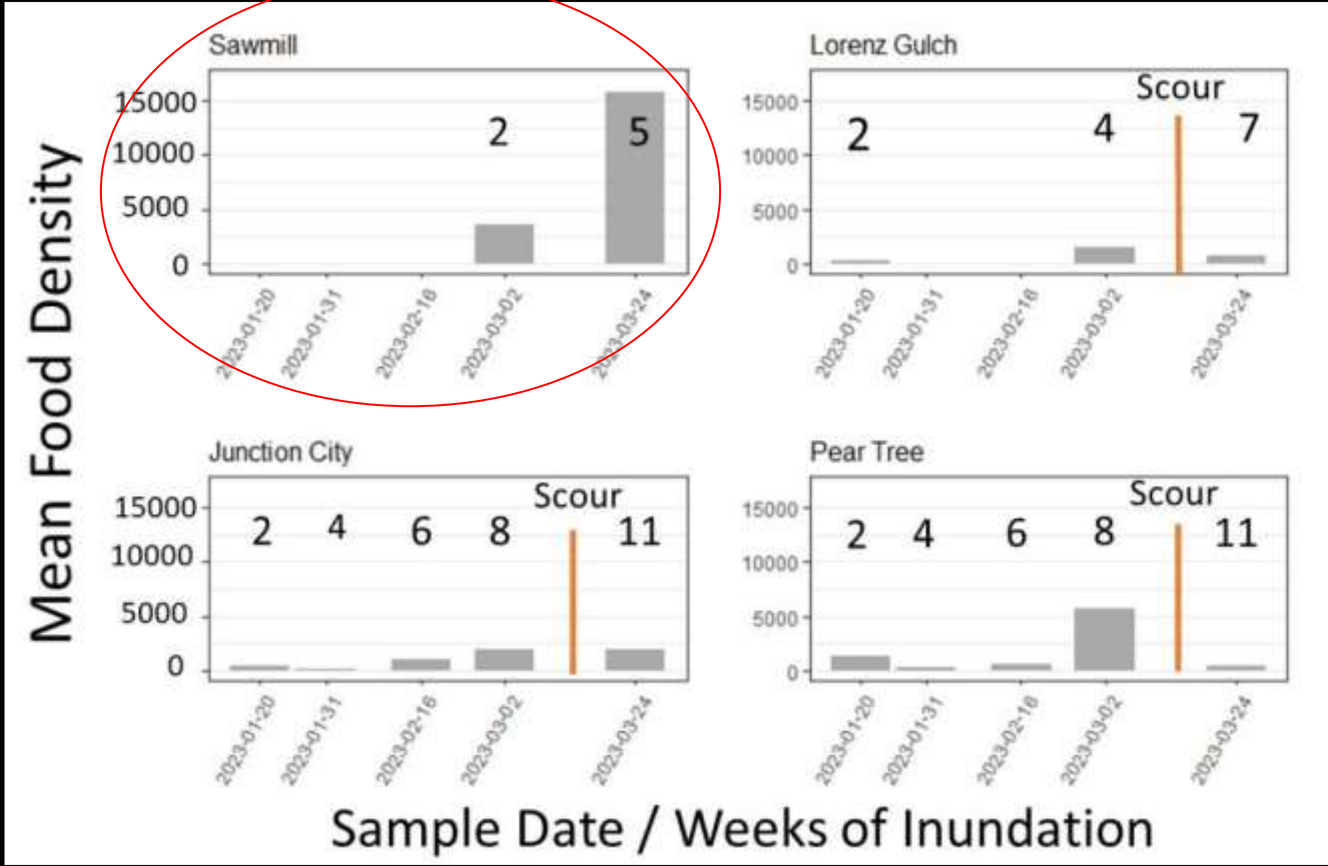


Inundation of marginal habitats leads to colonization of BMIs that are fish food



- BMI colonization occurred within two weeks at all sites
- Lacking consistent patterns
  - Complicated by a scour event

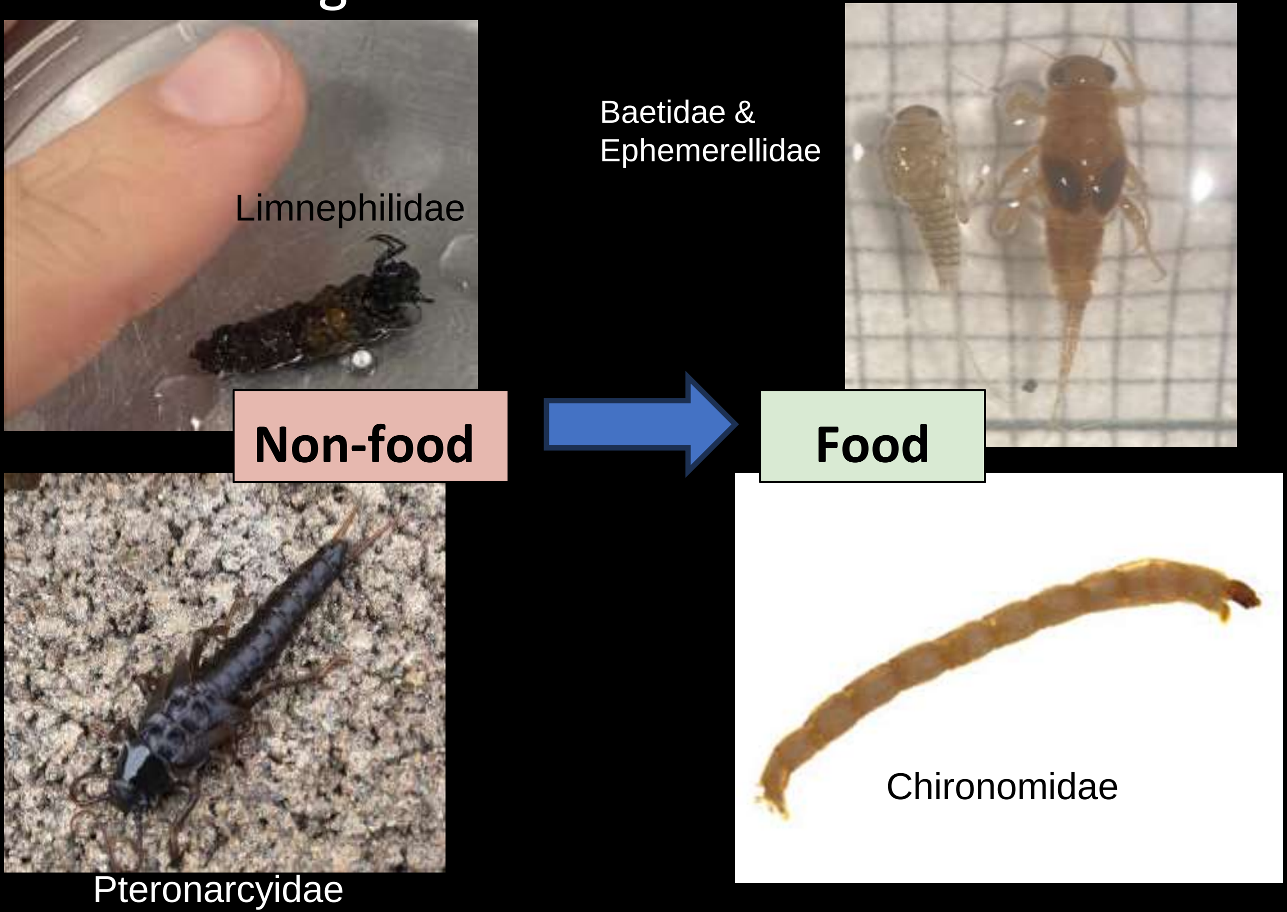
Invertebrate density highlights the delay in colonization



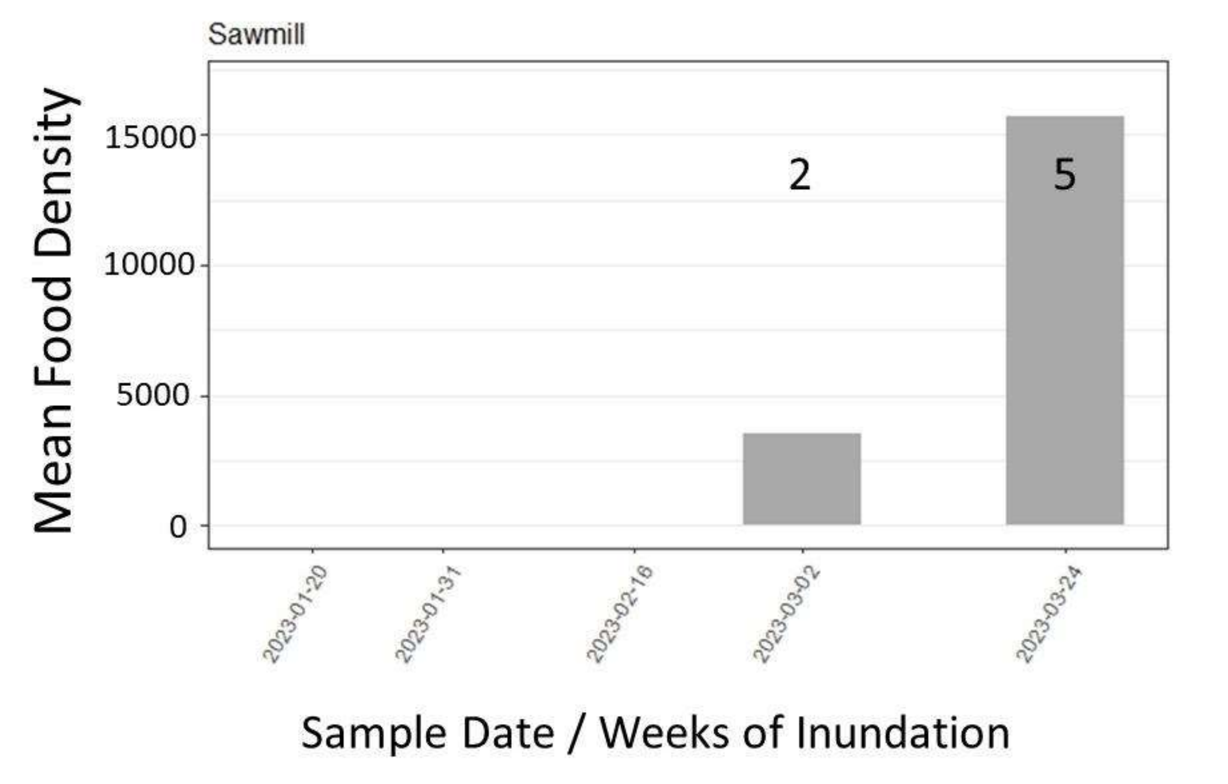
Density generally increased after 4-6 weeks

Discussion: Shift in community biomass from non-food to food following scour

- Scour dramatically reduces benthic densities and biomass
  - Slow recovery has been noted in other studies (Mundahl & Hunt 2011)

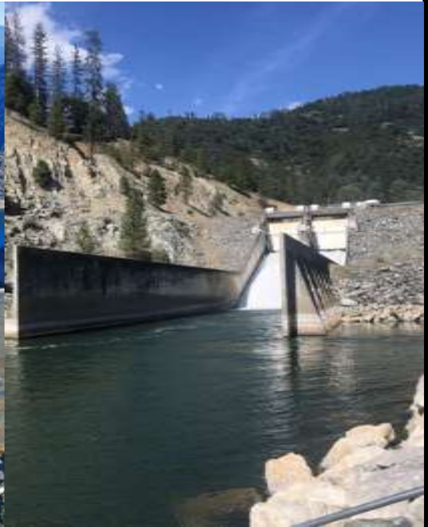


Invertebrates Responded Strongly to Inundation at Sawmill



Extremely high densities driven by fast colonizing taxa, namely chironomids

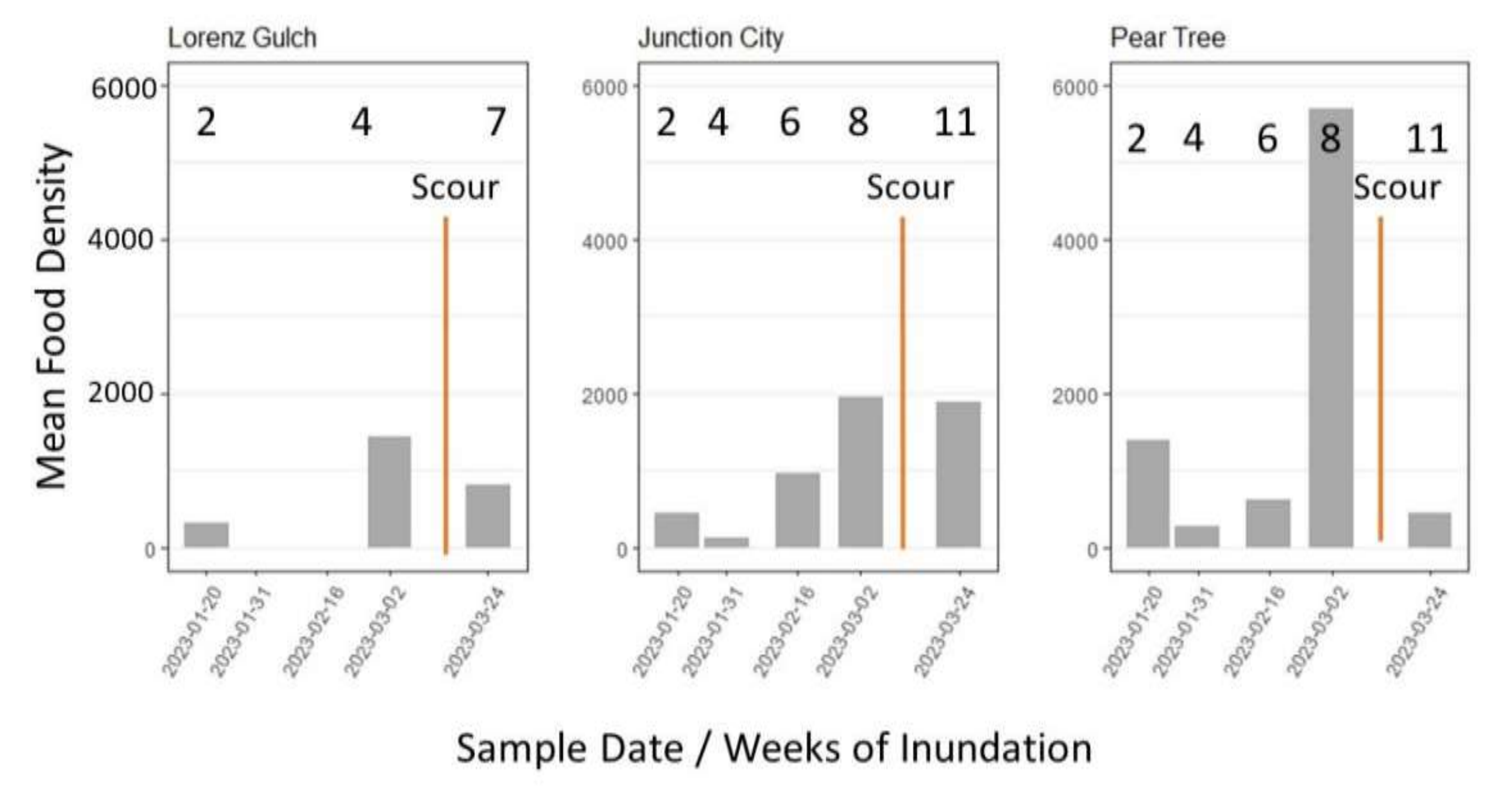




Why was Sawmill so different?

- Extensive periphyton community that was less developed at the other sites
  - Potentially due to reservoir-derived nutrient enhancements
  - Hatchery related nutrients?
- More comprehensive food web development

Bottom Line: There is fish food in newly inundated habitats



- Food located in prime real estate for juvenile salmonids
- Lots of chironomids
  - High abundances may indicate an increase in accessibility for fish

Source: Maddie McNerthney


Source: Chris Laskodi

Conclusions and Recommendations

- Scour clearly acts as a “reset button” for benthic communities
  - Biomass recovery is slow
  - Post scour community biomass is more heavily composed of juvenile salmonid food taxa
    - Dominance of fast colonizing, small bodied taxa

- The current timing of dam released scouring flows (mid April) is potentially disruptive to juvenile salmonid food resources during outmigration
  - Scouring flows should occur sooner in the water year

Conclusions and Recommendations

- Invertebrates colonize newly inundated habitats, including juvenile salmonid food taxa
  - Elevated baseflows would benefit more fish during winter
- Process-based restoration and capacity for self renewal
  - Effects of scouring flows and marginal inundation extend beyond simply food resources

Questions?

Acknowledgements

Project Guidance

- Dr. Alison O'Dowd (CPH)
- Dr. Nicholas Som (CPH)
- Dr. Darren Ward (CPH)
- Chris Laskodi (Yurok Tribe)
- Kyle De Juilio (Yurok Tribe)

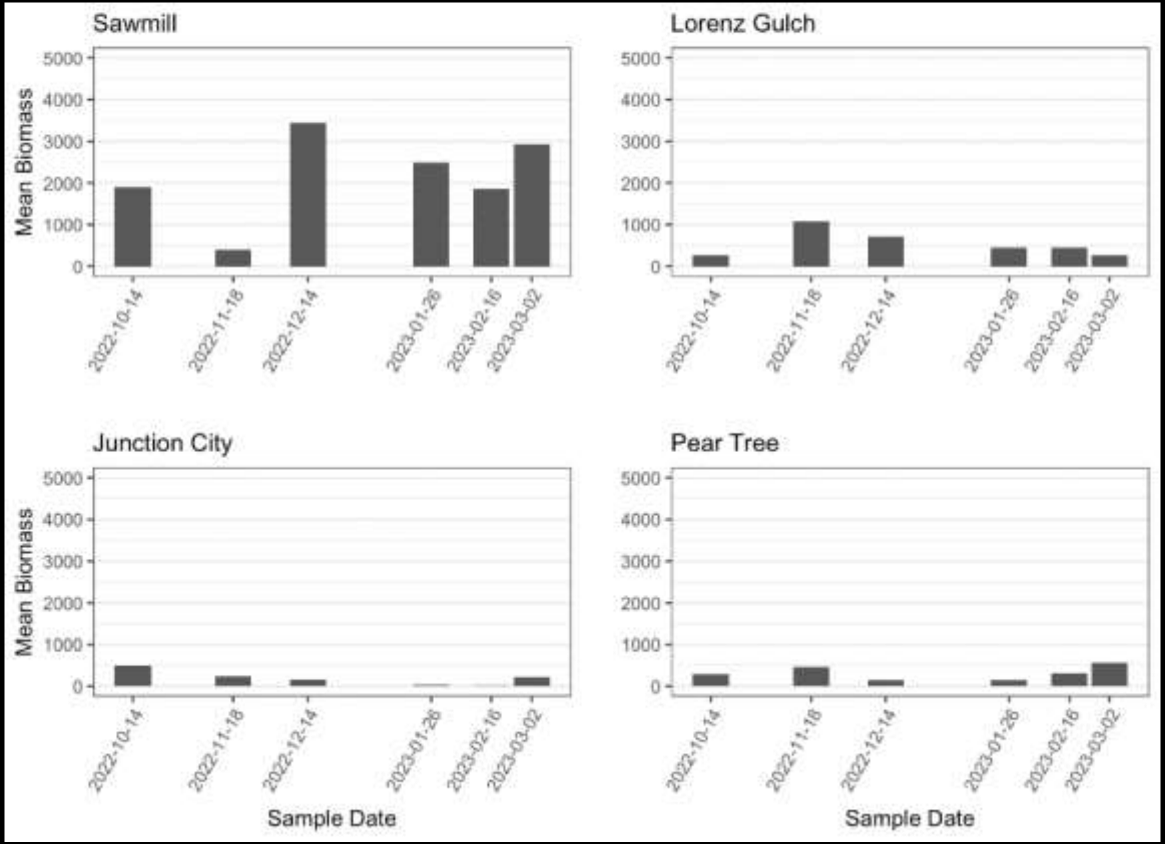
Field and Lab Help

- Chris Laskodi
- Yadao Inong
- Chad Martel
- Thomas Masten
- Maddie McNerthney
- Elizabeth Uemura
- Kelly Corcoran
- Michael Paige
- King Baptista
- Victoria Budke
- Amanda Podkomorka
- Blake Gonzalez
- Mic O'Neil
- Chloe Piper-Wasem
- Liam Hay
- Sarah Guttierez
- Julie Avina

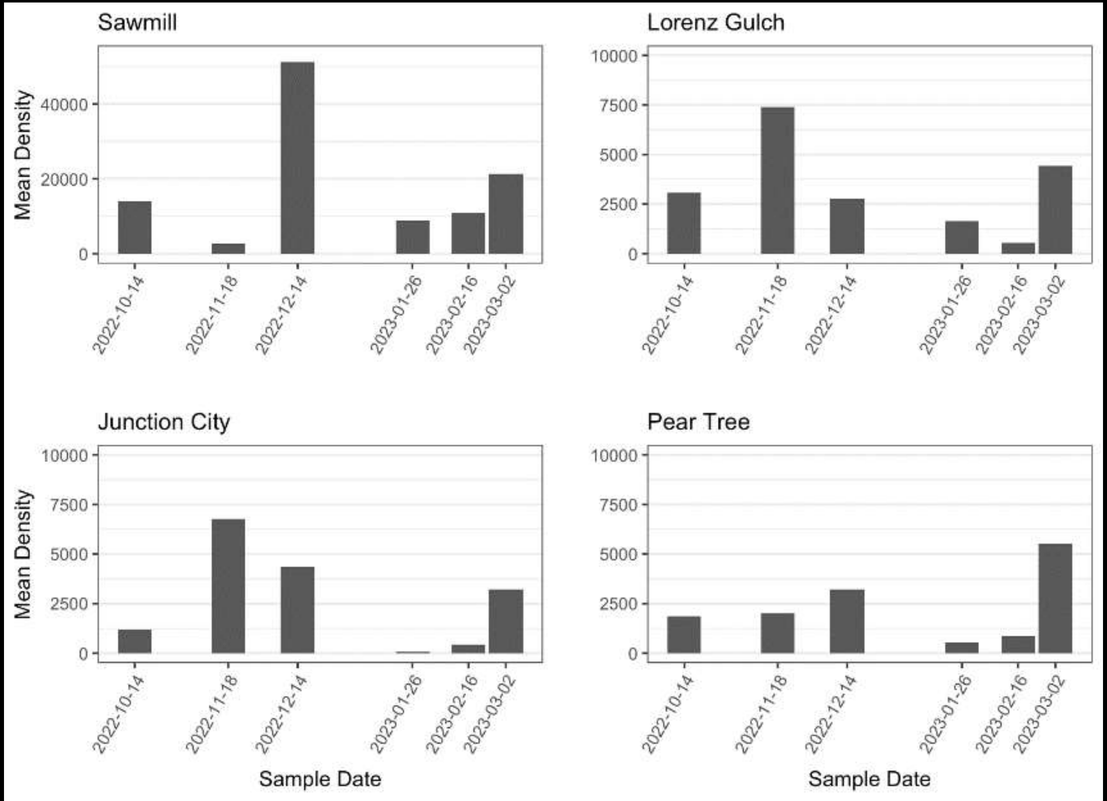
Funding

- Trinity River Restoration Program (TRRP)

Food biomass matches or exceeds pre-scour levels after 47 days post-scour



Food density approached or exceeded pre-scour levels after 47 days post-scour



41st Annual Salmonid Restoration Conference
Santa Rosa, CA
March 26-29, 2024

Aquatic Ecology, Disturbance, and Floodplains

O. Mykiss Resilience, a Remarkable Example within the Lower Santa Ynez River Basin, Santa Barbara County, CA

Timothy H. Robinson
Senior Resource Scientist, Fisheries Division Manager
Cachuma Operation and Maintenance Board

Water Supply
Santa Ynez River Reservoirs

Reservoir	Watershed Area (mi^2)	Completed (yr)	Delivery Tunnel (mi)	As-Built Storage * (acre-feet)	2021** Storage Max (acre-feet)	Storage Loss (%)	Current Storage *** (acre-feet)	Current Capacity *** (%)
Lake Cachuma	417	1953	Tecolote (6.4)	214,200	192,978	9.9%	191,207	99.1%
Gibraltar	216	1920	Mission (3.7)	145,003	4,693	96.8%	4,725	100.7%
Jameson	14	1930	Doulton (2.2)	7,228	4,848	32.9%	4,858	100.2%

* With 3 feet of added storage at Lake Cachuma in 2004.

** 2021 was the last bathometric survey.

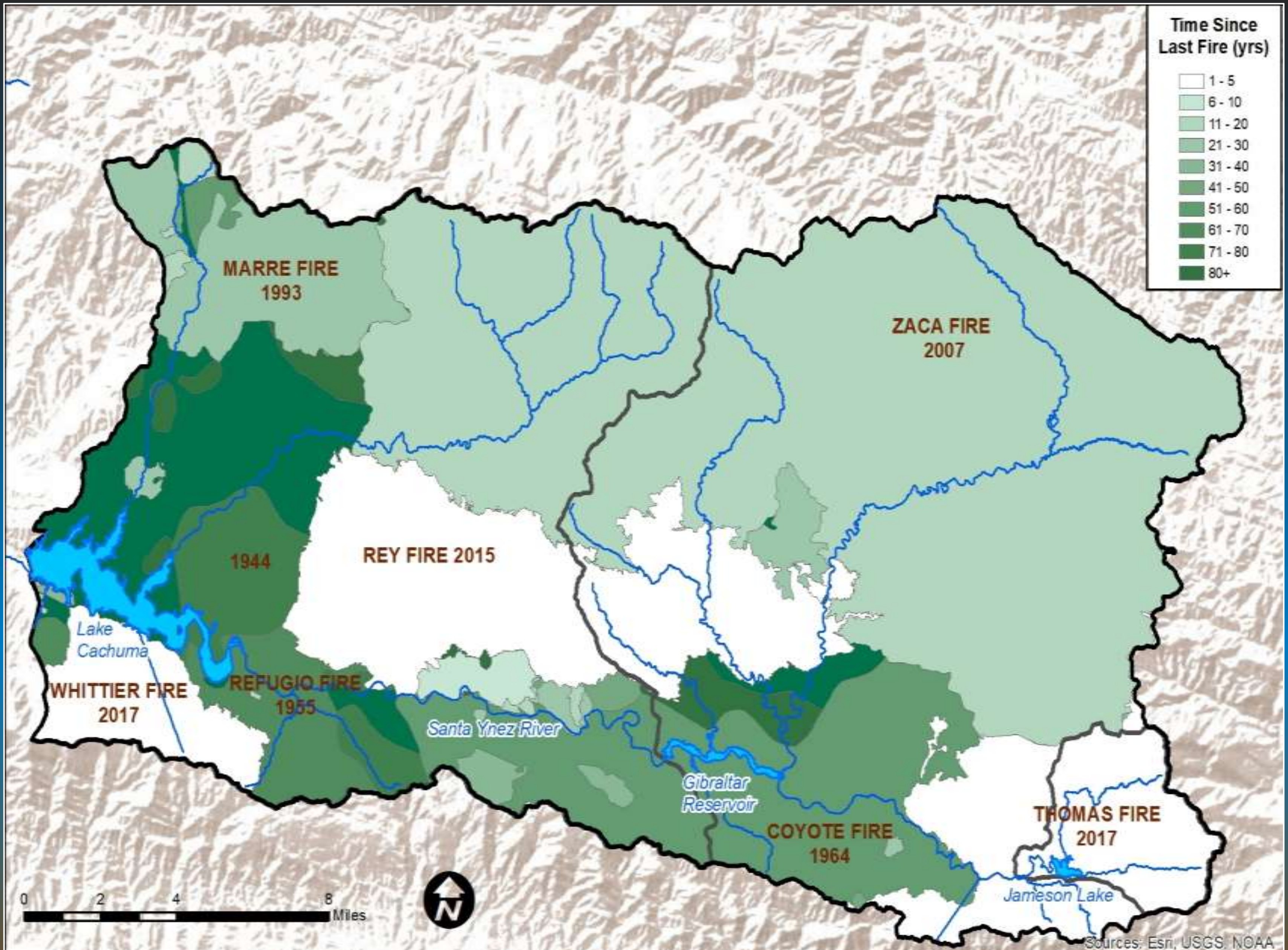
*** As of 2/28/24.

Lake Cachuma and Bradbury Dam

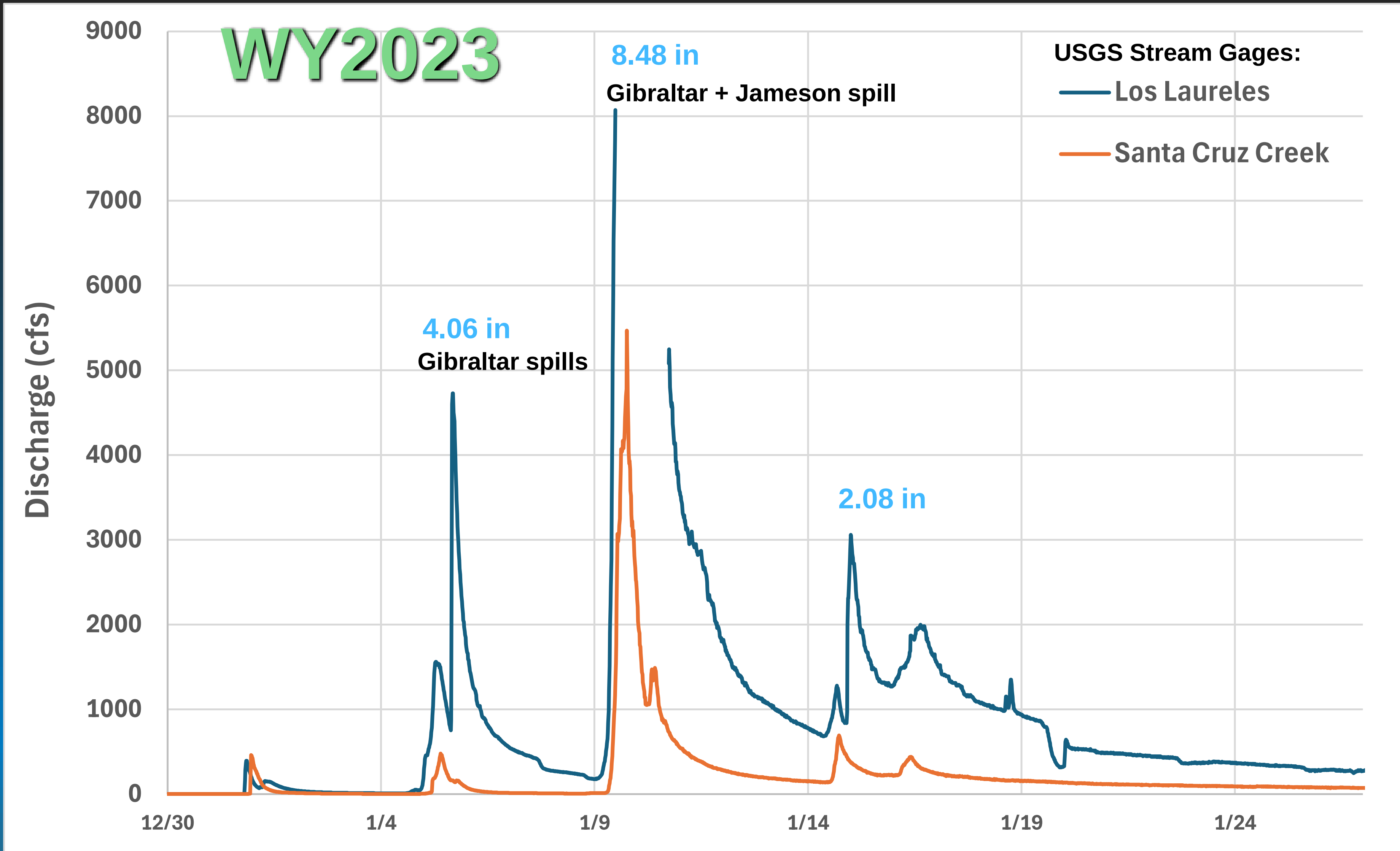
Storage loss: 9.9%

- **Capacity: 192,978 af (2021)**
- **Annual entitlement: 25,714 af**

Wildfires within the Lake Cachuma Watershed



Downstream Delivery Systems

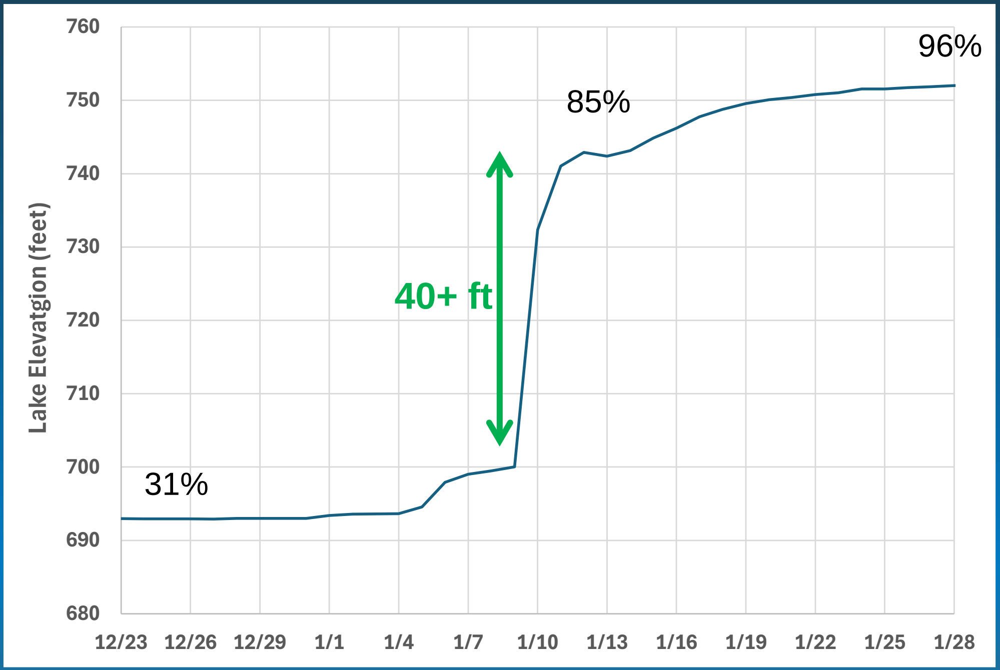


Factors:

- Low lake level (31% capacity)
- High tributary flow
- Whittier Fire (2017)
- Full basin discharge
- Gibraltar sediment to the sill

Mudflow (WY2023)

Rapid Lake Rise



Results:

- Mudflow (Turbidite)
- High fine sediment delivery to the LSYR
- Sediment deposition between 4 to 24 inches in LSYR
- Degraded water quality (high NTU and low DO)
- Impacts to the downstream fishery (native and non-native)

Outlet Works Discharge (1/11/23)

Stilling Basin Condition (1/12/23)

General Downstream Condition

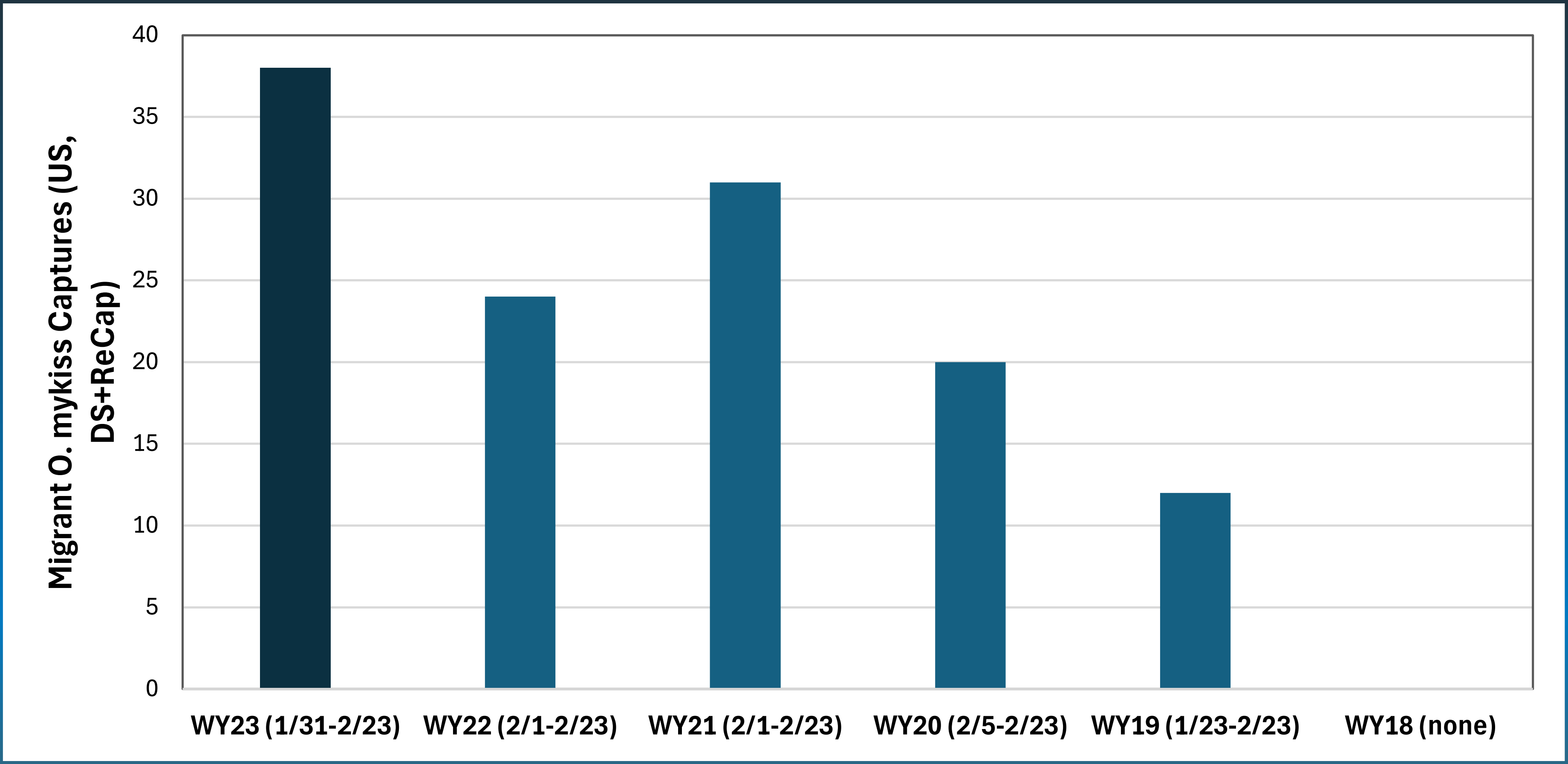
Turbidity (NTU): 1.44 (upper Hilton) to 3600+ LSYR**)**

***O. mykiss*:** 11 rescues/relocations and 29 mortalities



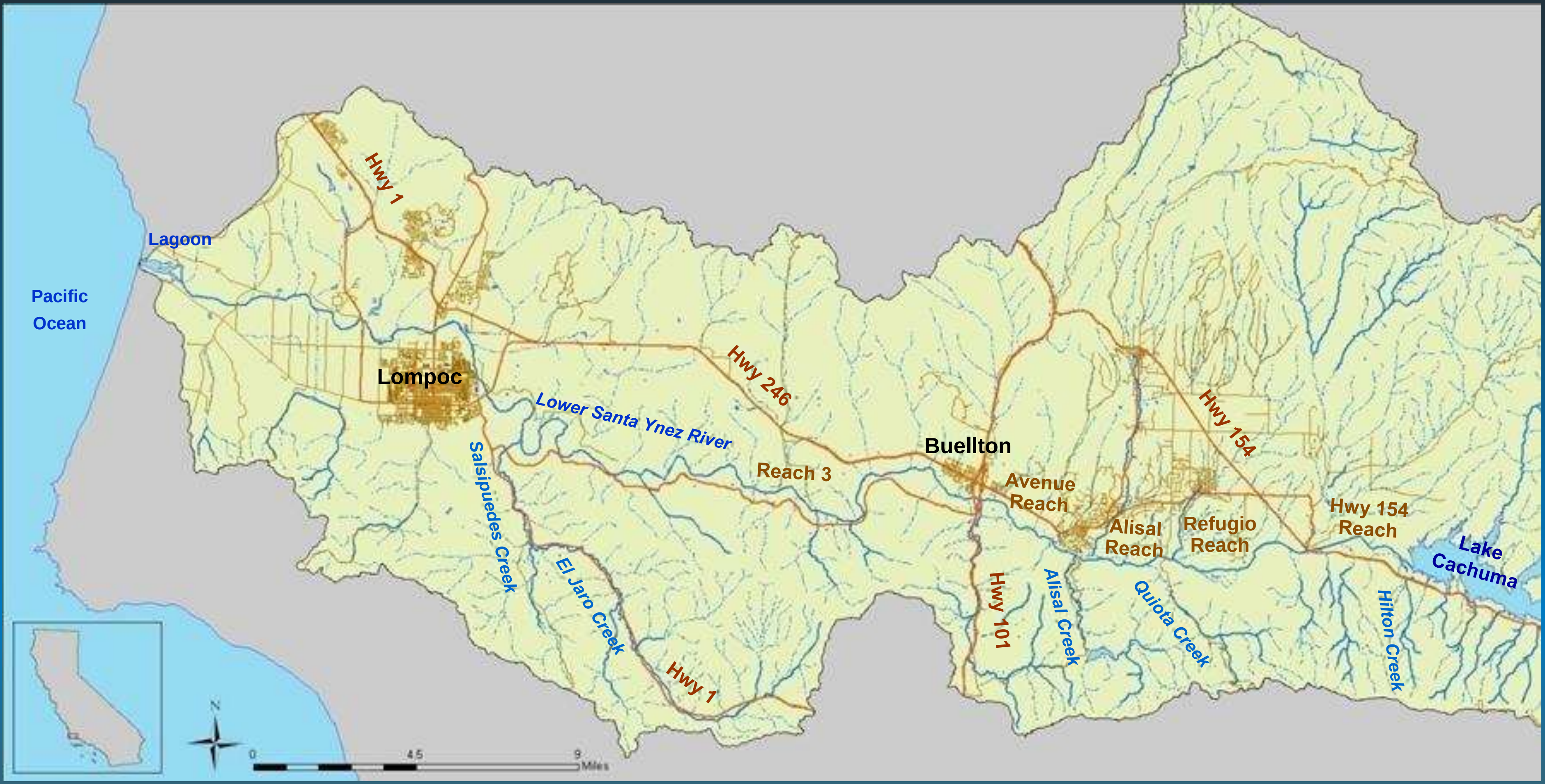

Other species mortalities: 187 carp, 67 LMB, 24 catfish, 37 sunfish, 91 sculpin, 116 crayfish, + 10 Bull frog tadpoles

Hilton Creek Migrant Trapping



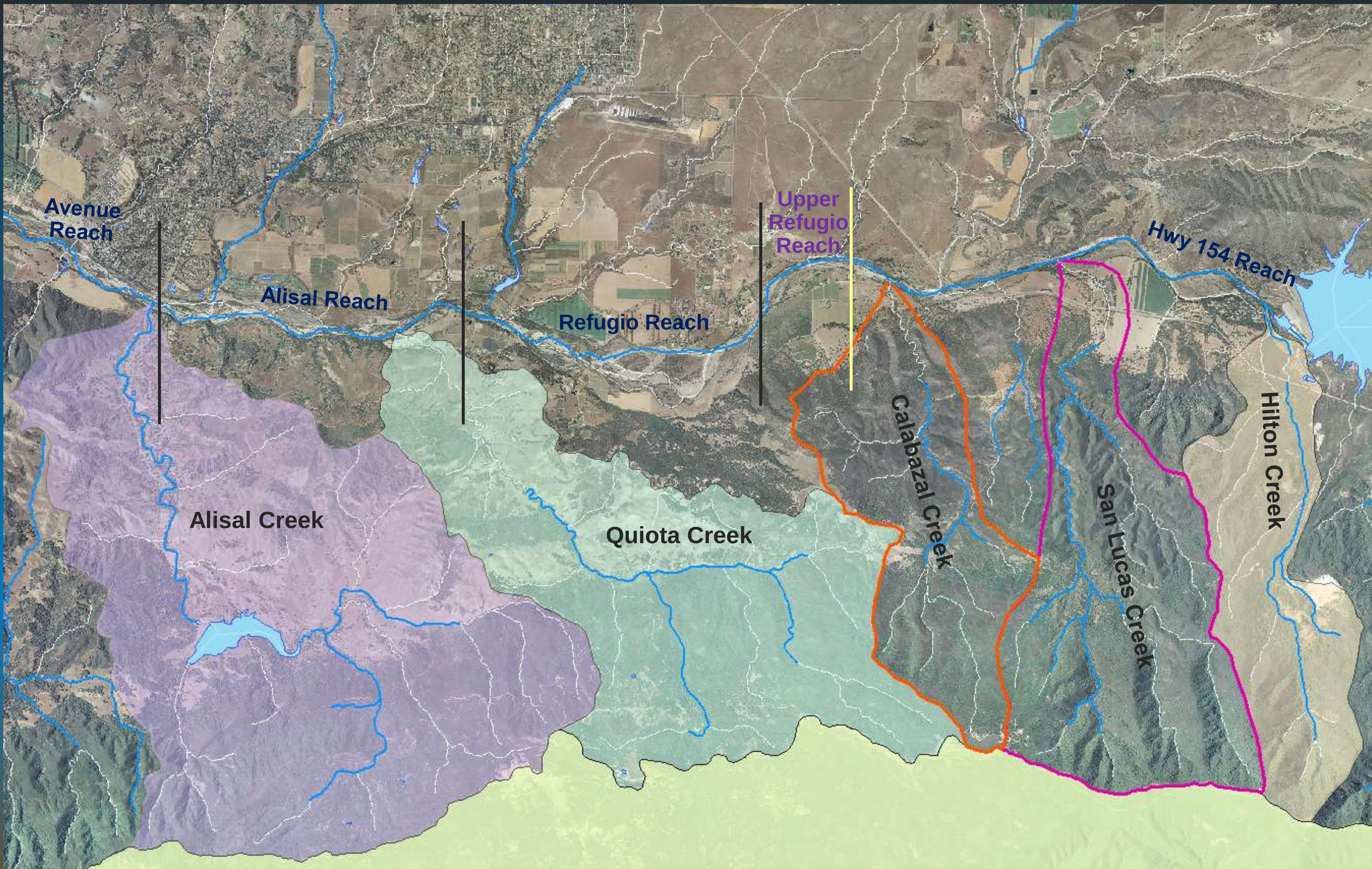
2/23/23 end of WY2023 migrant trapping due to State listing of steelhead

Snorkel Survey Reaches

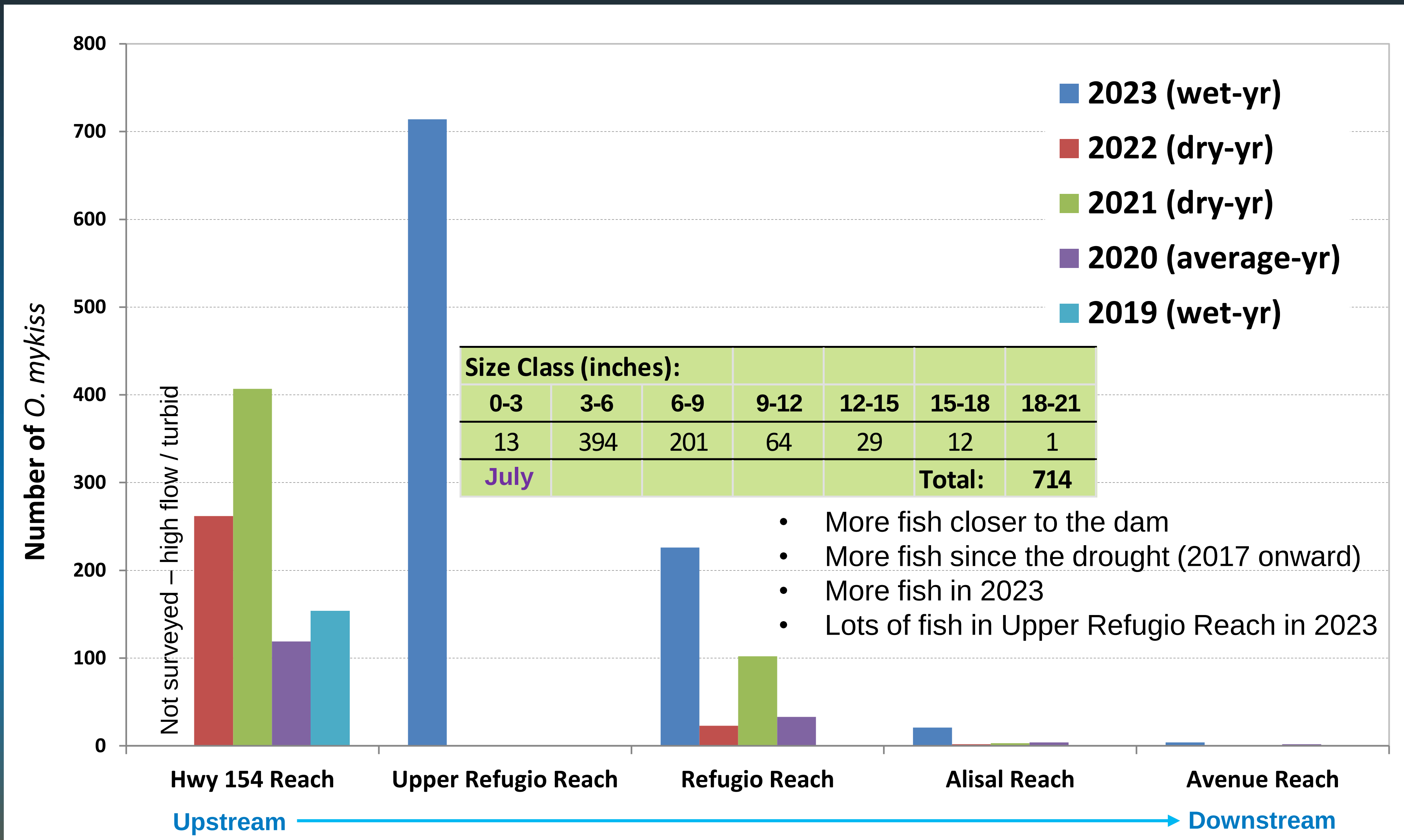


Potential Refuge Habitats

Potential Refuge Habitats



Summer Snorkel Survey (2023-2019)



Size Class (inches):						
0-3	3-6	6-9	9-12	12-15	15-18	18-21
13	394	201	64	29	12	1
July					Total:	714

- More fish closer to the dam
- More fish since the drought (2017 onward)
- More fish in 2023
- Lots of fish in Upper Refugio Reach in 2023

Hydrogen Sulfide detection 2022

Lower Release Point (LRP) Energy Diffuser Box

Toxicity level for rainbow trout - 0.0087 mg/L

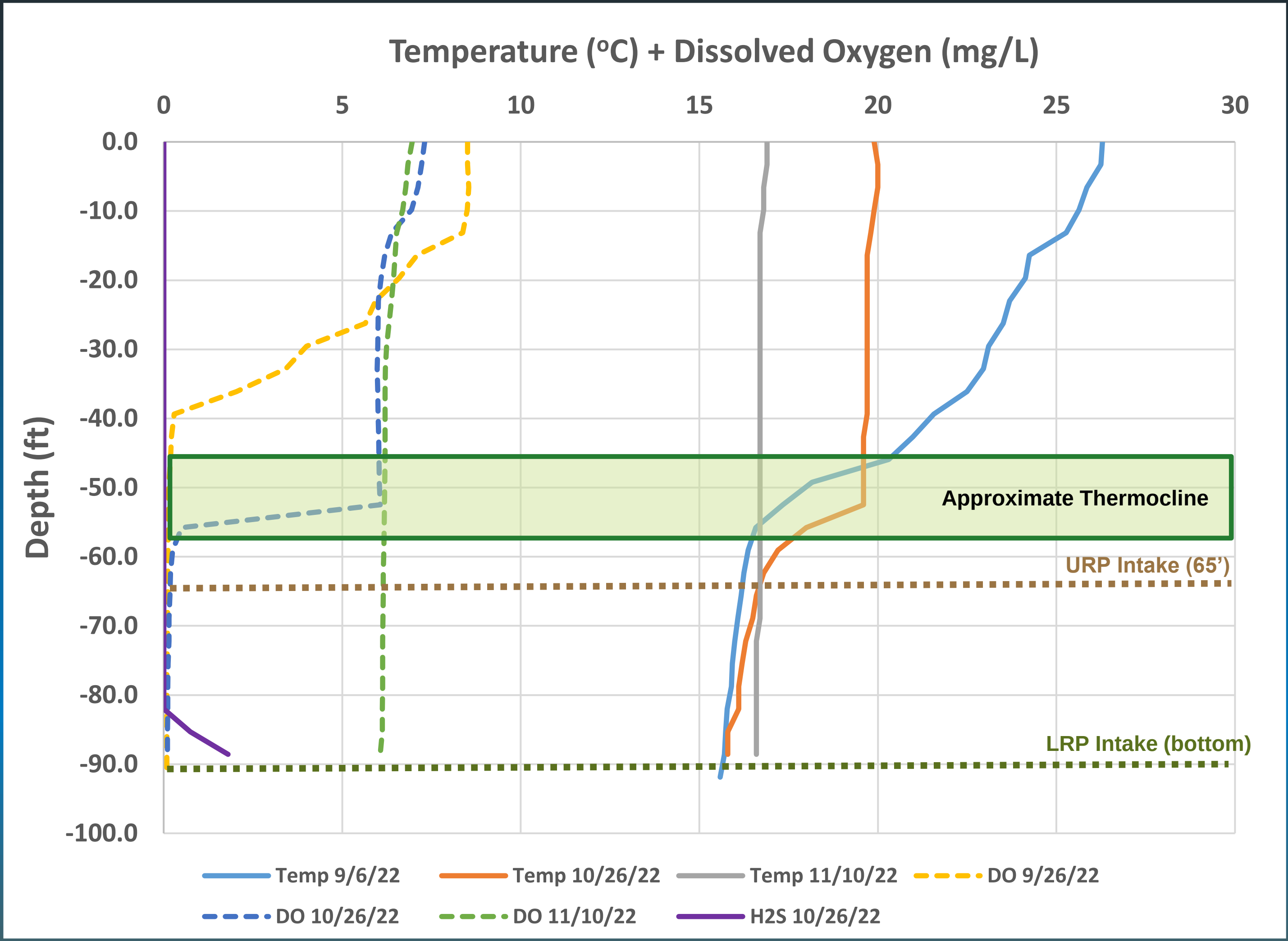
Observations:

- White coating on the walls of the energy diffuser box and rocks on the cascade indicating sulfur fixing algae.
- Immediately after the lake turned over on 11/7-8/22, the source of sulfur stopped, and all surfaces lost their white coating.
- H_2S gas sensor was sounding the alarm with concentrations well above 10 ppm at the pipe outlet within the Energy Diffuser Box.
- After lake turnover, there was no sulfur smell nor detection on the gas meter.

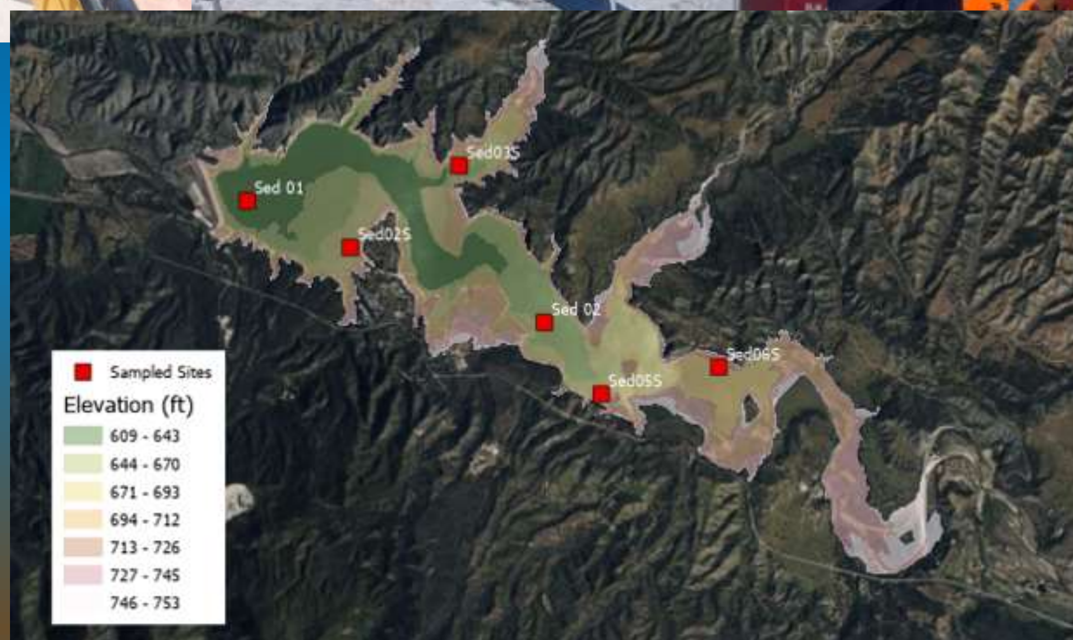
H_2S with Water Quality

Observations:

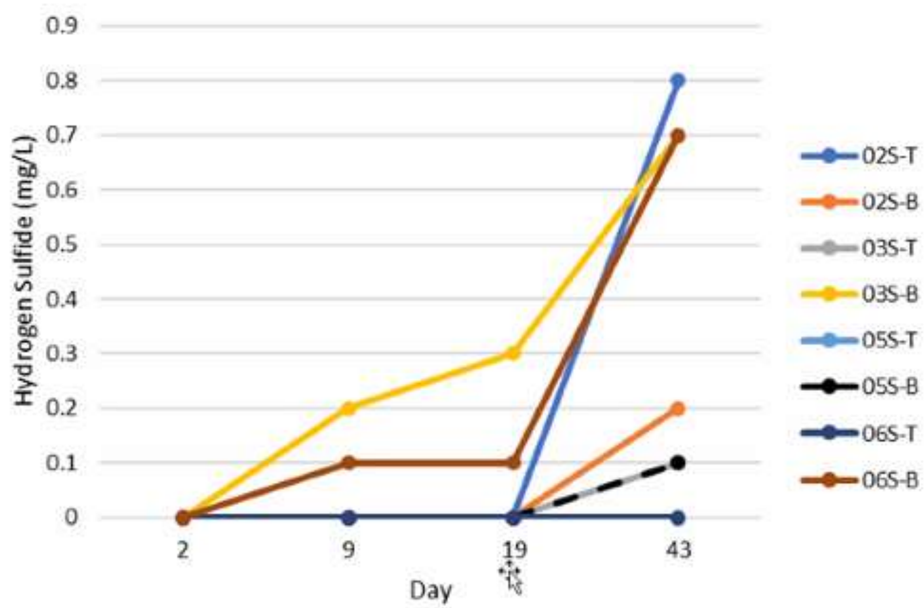
- The lake was stratified with a well-defined thermocline going into the fall.
- Both the URP and LRP intakes were below the thermocline going into the fall.
- H_2S was only detected near the bottom of the lake.
- Lake turnover occurred between 11/7-8/22.
- No H_2S was detected within the zone of the URP intake, suggesting that the H_2S source for the URP may be the sediments within the HCWS pipeline.



NLA Gravity Corer

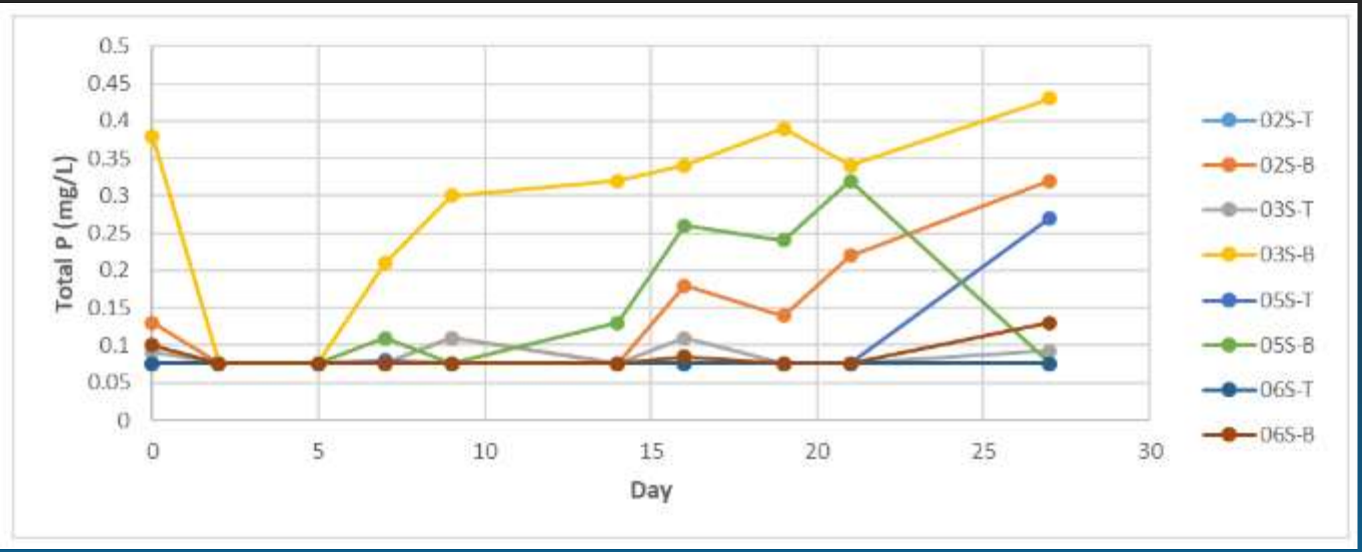


- *What is the sulfide flux from lake sediments to the water column under anoxic conditions?*
  - *Hydrogen sulfide release was measured in sediment incubations under anoxic conditions*
  - *Release was measured from both freshly deposited and aged sediments*
  - *Concentrations were above aquatic health risk levels*

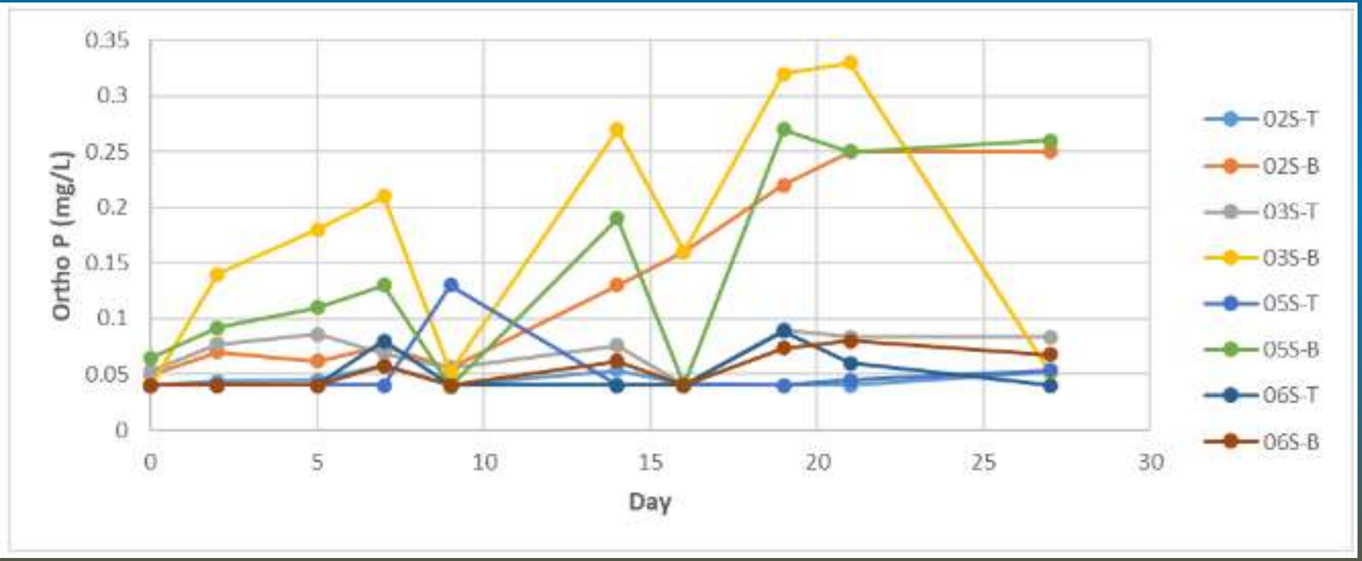


Anoxic Conditions:

- Total P



- Ortho P



Conclusions

- *O. mykiss* are extremely resilient
- Global Warming: expect extremes
- Lake stratification can present difficulties for the downstream fishery
- Reservoirs have a finite life expectancy – challenges follow
- No easy or inexpensive solutions
- Don’t give up on Southern California steelhead, they are still here!

Questions

Thanks for your attention!

Overview

- Background – Lake Cachuma
- Mudflow (WY2023) – impacts within the reservoir and downstream
- Lake Cachuma Monitoring – sediment delivery, nutrient loading, instruments, and lake management

Lake Management

General Lake Condition:

- P Inactivation Using Chemicals (Alum)
- Hypolimnetic Oxygenation/Aeration
- Biomanipulation
- Benthic Barriers
- Phytoremediation
- Algal Treatment (algaecides)

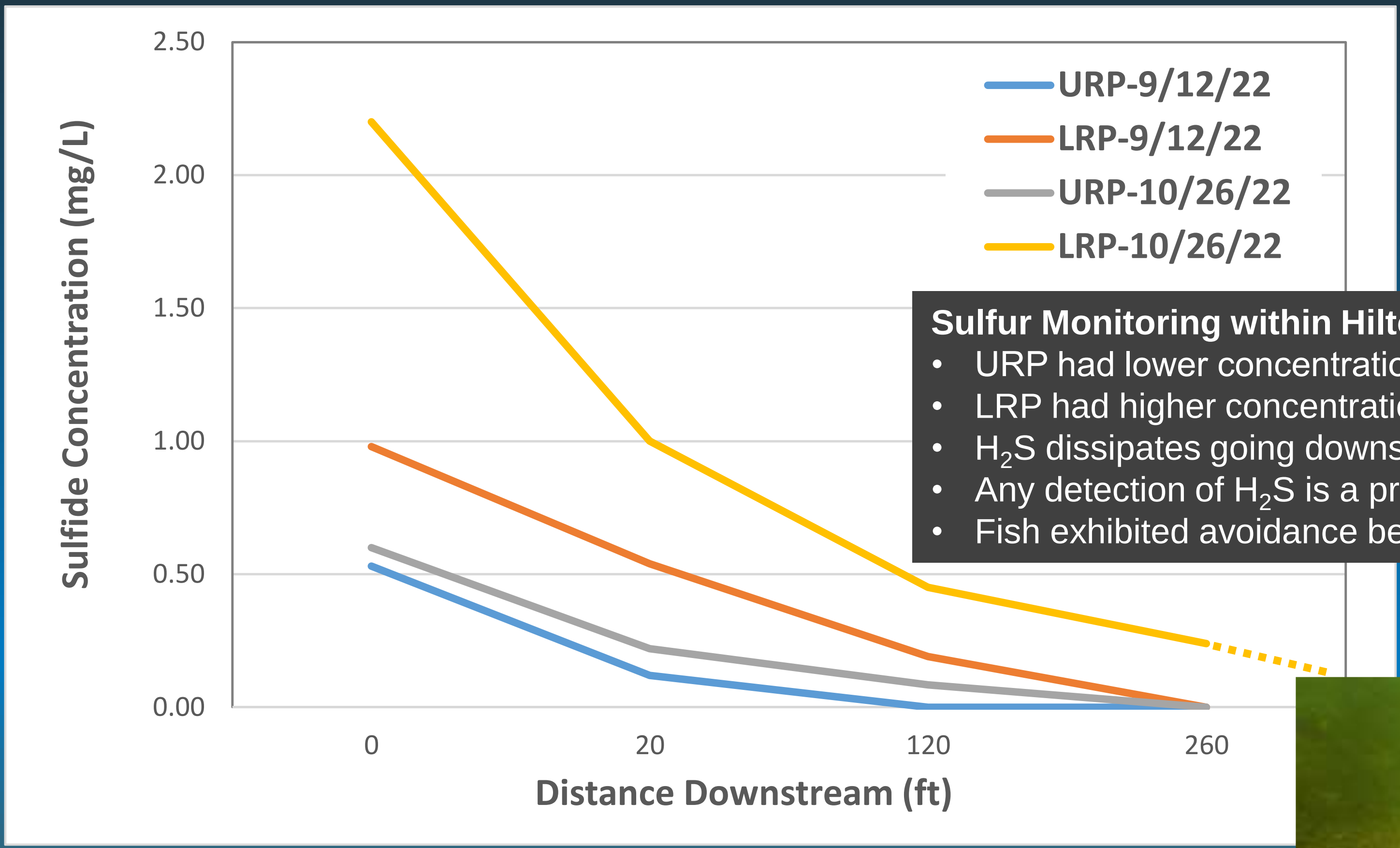
Water Treatment Plan Intake:

- Vary the intake elevation by water quality condition

LSYR Fishery:

- Raise the Stand-Pipe for the Outlet Works
- Hypolimnetic Oxygenation/Aeration

Longitudinal Profile of Sulfide (H_2S) Concentration



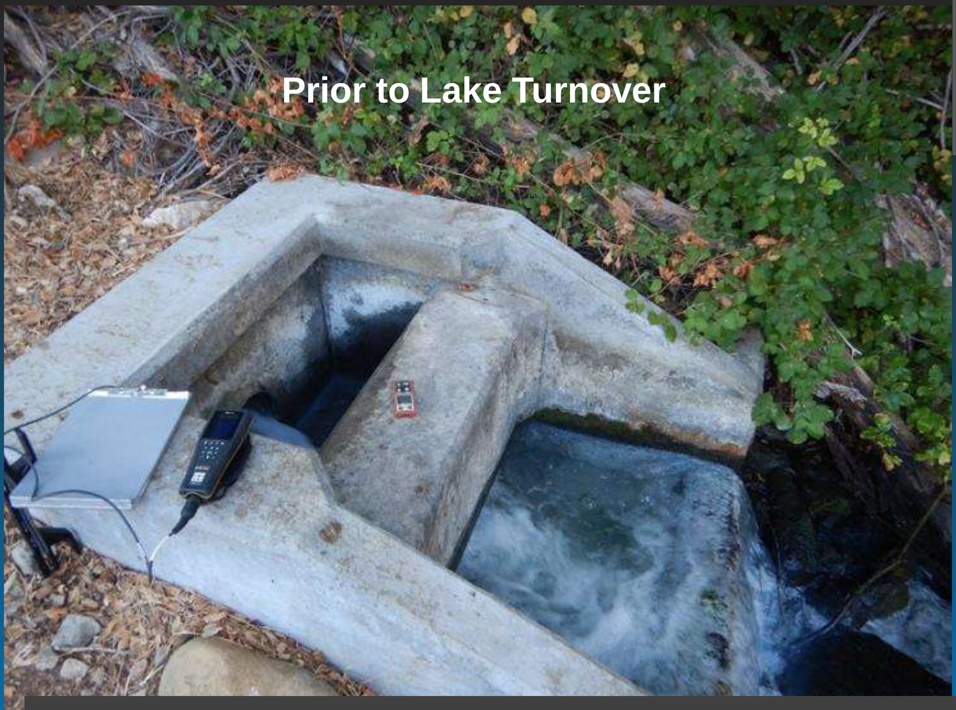
Sulfur Monitoring within Hilton Creek Results:

- URP had lower concentrations (intake at 65’)
- LRP had higher concentration (intake lake bottom)
- H_2S dissipates going downstream
- Any detection of H_2S is a problem for fish (0.0087 mg/L)
- Fish exhibited avoidance behavior

Lake Cachuma – Monitoring/Studies

- Hydrogen Sulfide (H_2S) detection in the summer of 2022
- 2023 Lake Nutrient Investigation (N, C, P and S) related to algae bloom (source and flux)
- Instruments
- Lake Management

Upper Release Point (URP) Energy Diffuser Box



Observations:

- A strong sulfur smell and white coating on surfaces associated with the URP and the LRP were first observed in early August 2022.
- The odor was so strong enough after the start of the WR 89-18 release (8/8/22) that the County Health Department came out to Bradbury Dam to investigate.
- USGS called to investigate expressing concern for the health of their field techs servicing their equipment near the LRP.
- H_2S gas sensor was sounding the alarm with concentrations well above 10 ppm at the pipe outlet within the Energy Diffuser Box.

NLA Gravity Corer

A vision for enhancing and managing the lower Stanislaus River for fish, wildlife, and people

J.D. Wikert and Rocko Brown

A fish biologist and a fluvial geomorphologist walk into a bar…

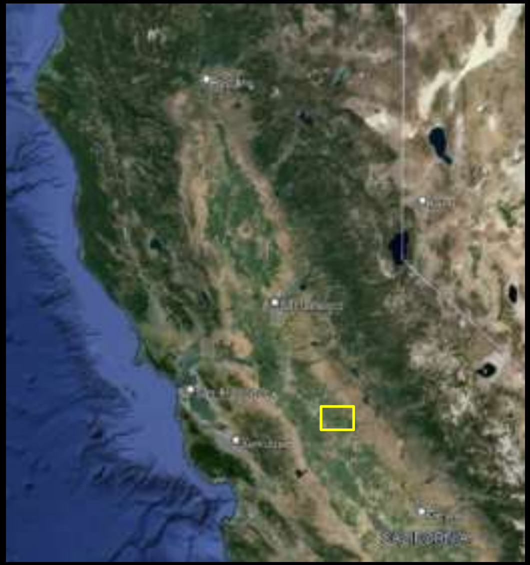
Acknowledgements

Staff at CFS

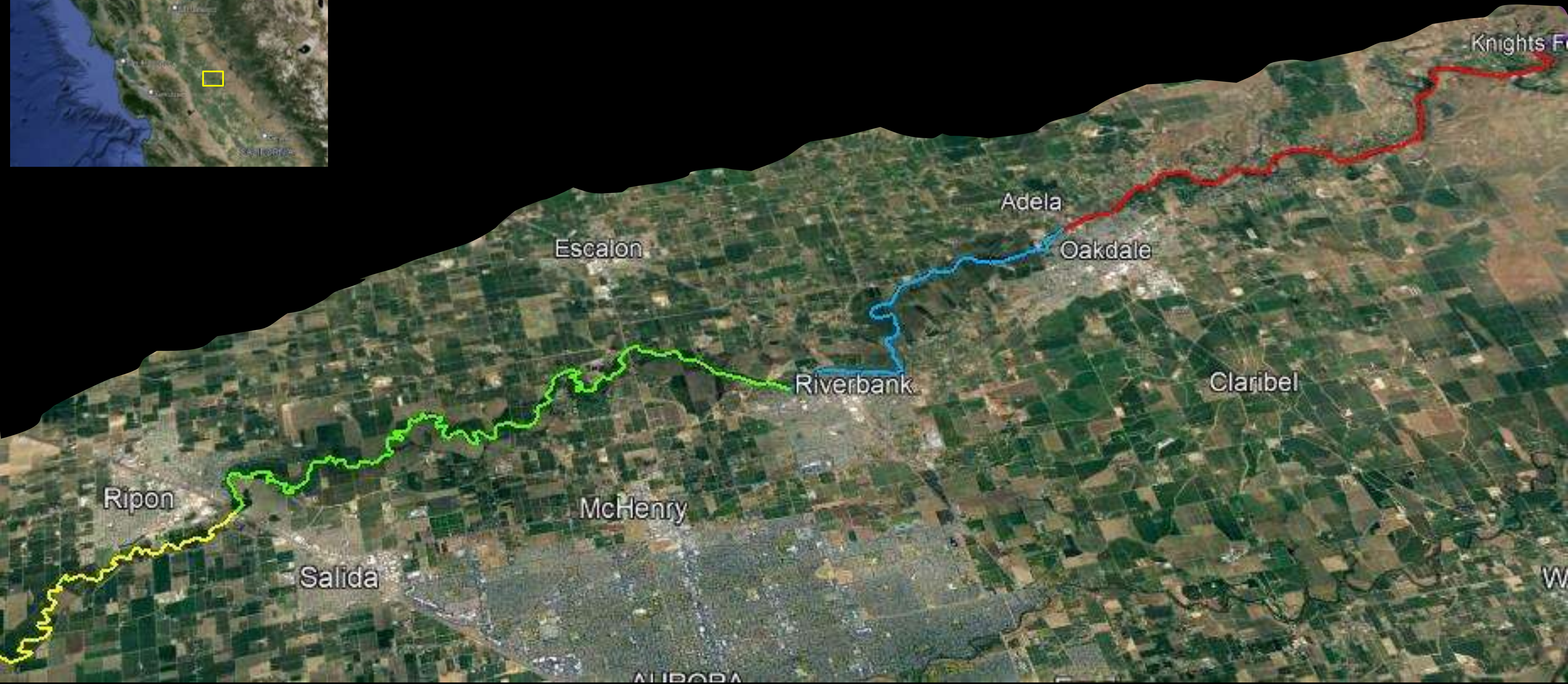
CVPIA

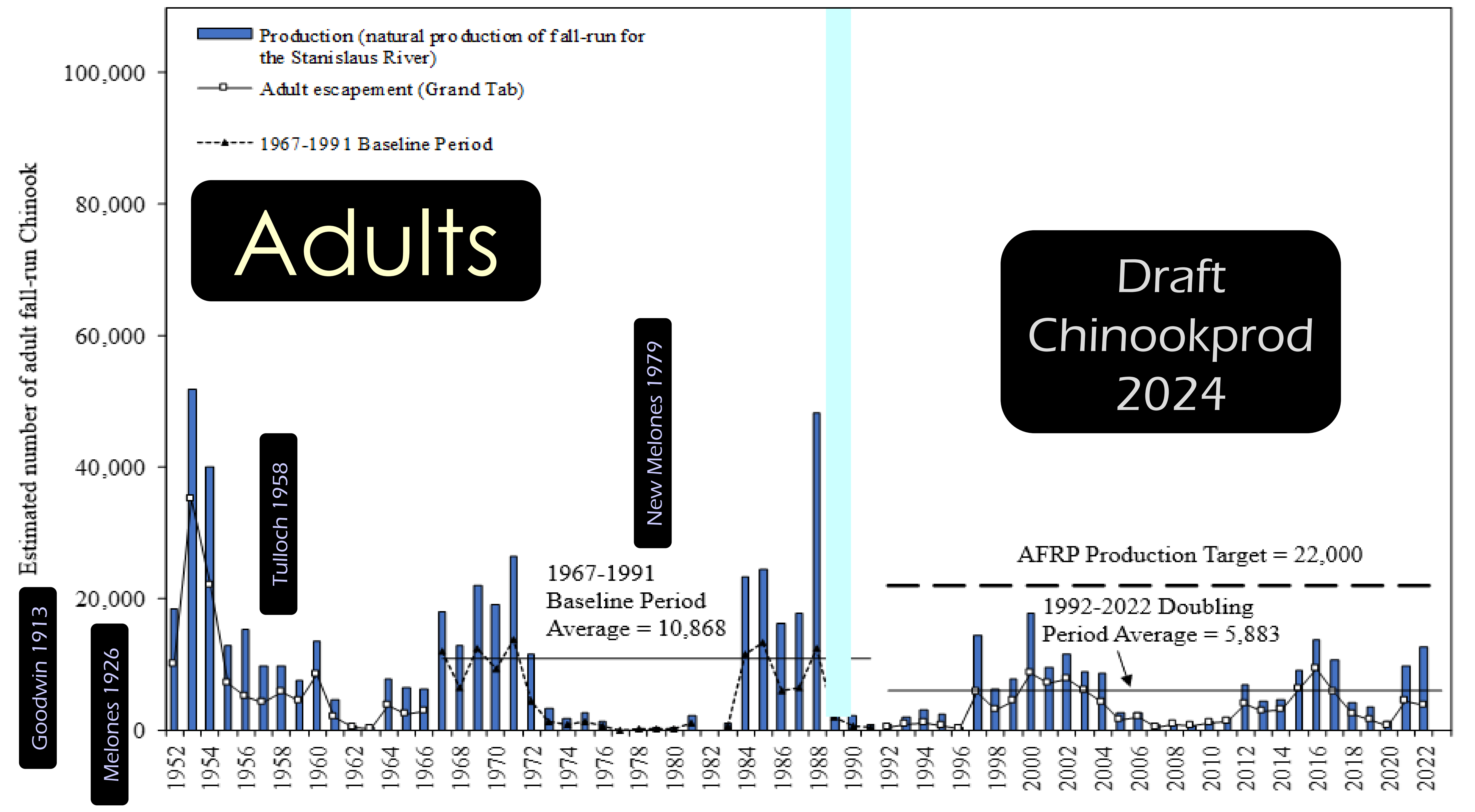
Carl Mesick

Lots of people publishing good information



Stanislaus River





Production (natural production of fall-run for the Stanislaus River)
Adult escapement (Grand Tab)
1967-1991 Baseline Period
Adults
Draft Chinookprod 2024
Estimated number of adult fall-run Chinook
100,000
80,000
60,000
40,000
20,000
0
Tulloch 1958
New Melones 1979
Goodwin 1913
Melones 1926
1967-1991 Baseline Period Average = 10,868
AFRP Production Target = 22,000
1992-2022 Doubling Period Average = 5,883
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022

History

Stanislaus River looking upstream at Knights Ferry ~1860/1870

Online archive of California

https://calisphere.org/item/ark:/13030/kt2s2016kt/

Too Many Dams!

Goodwin 1913
Melones 1926
Tulloch 1958
New Melones 1979

Flatlined flows

Changed hydrograph pattern

Changed water temperatures

Impeded gravel inputs

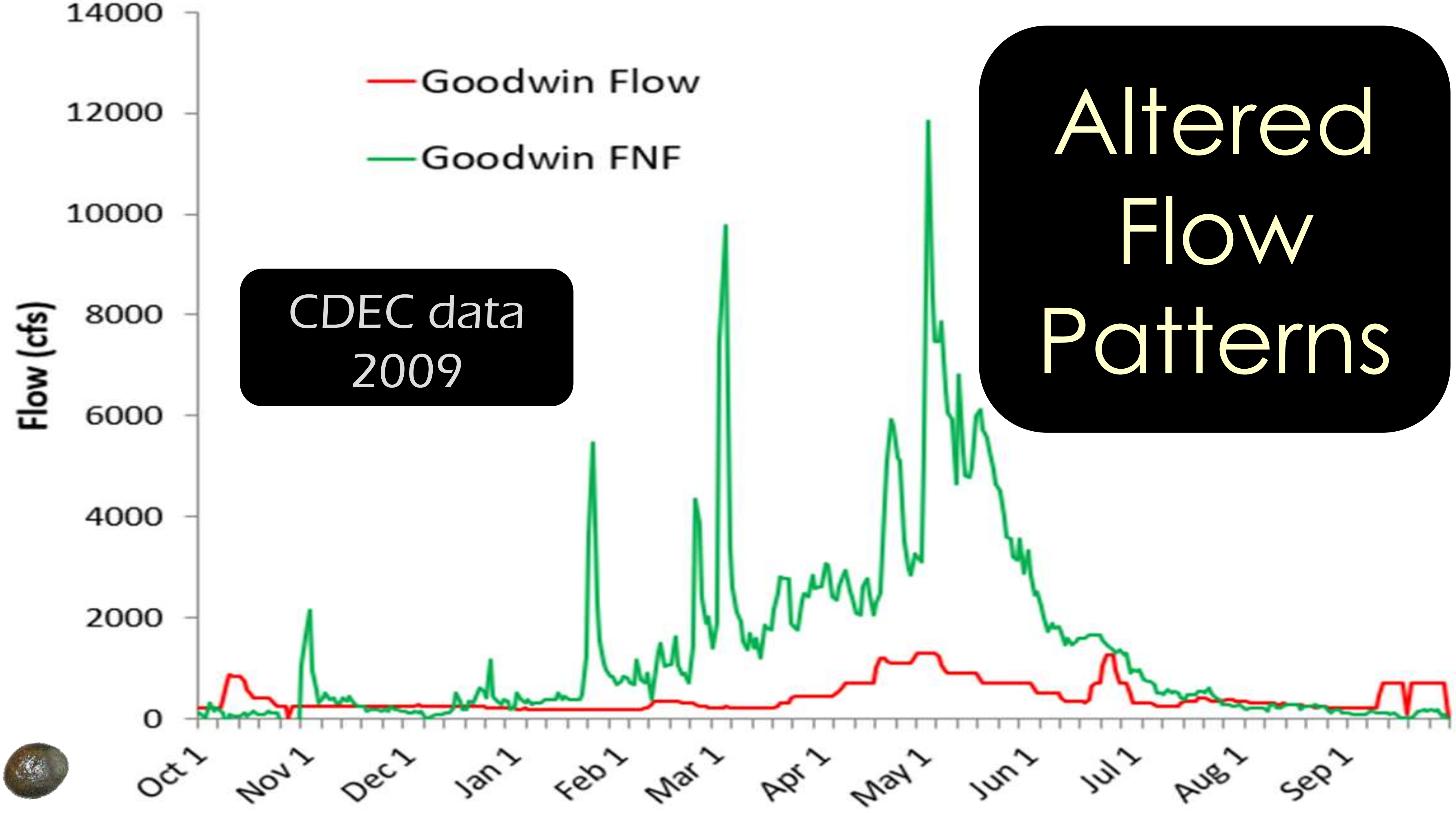
Goodwin Dam

Water Diversions

Reduced flow volume and magnitude

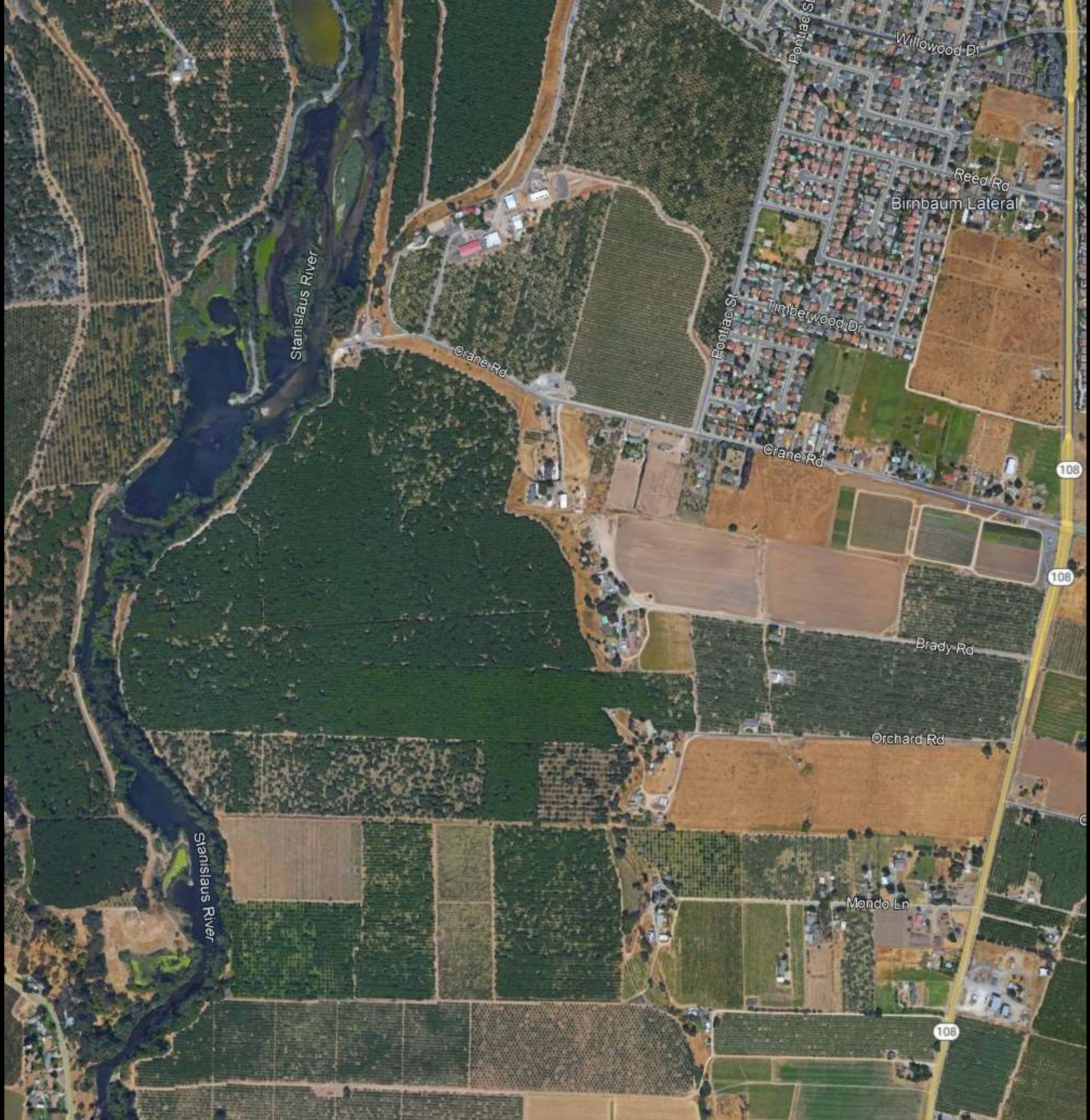
Goodwin Dam showing SSJID and OID diversions

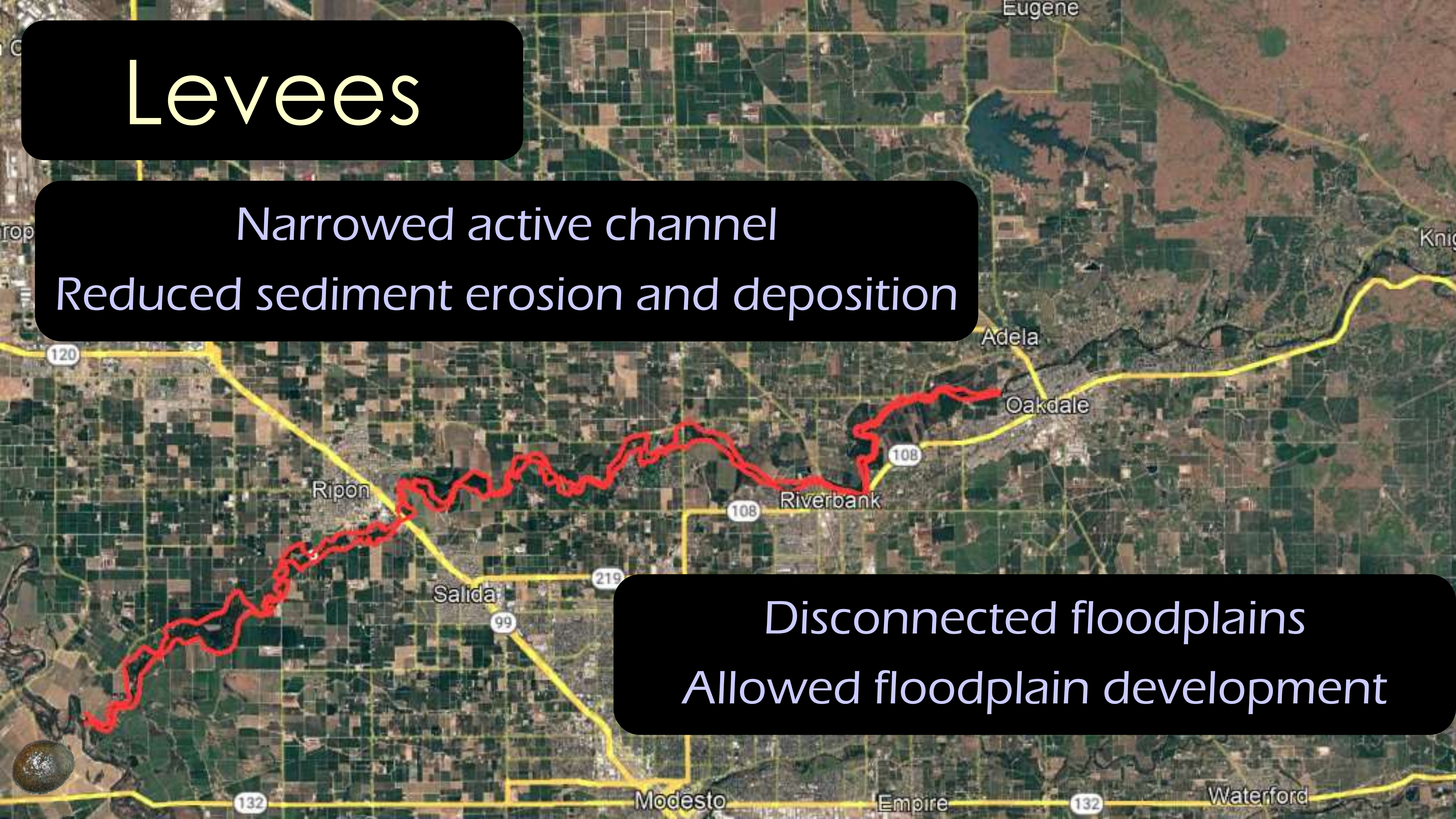
Altered Flow Patterns



Gravel Mining

- Removed coarse sediment
- Created unnatural pools
- Deepened and widened river



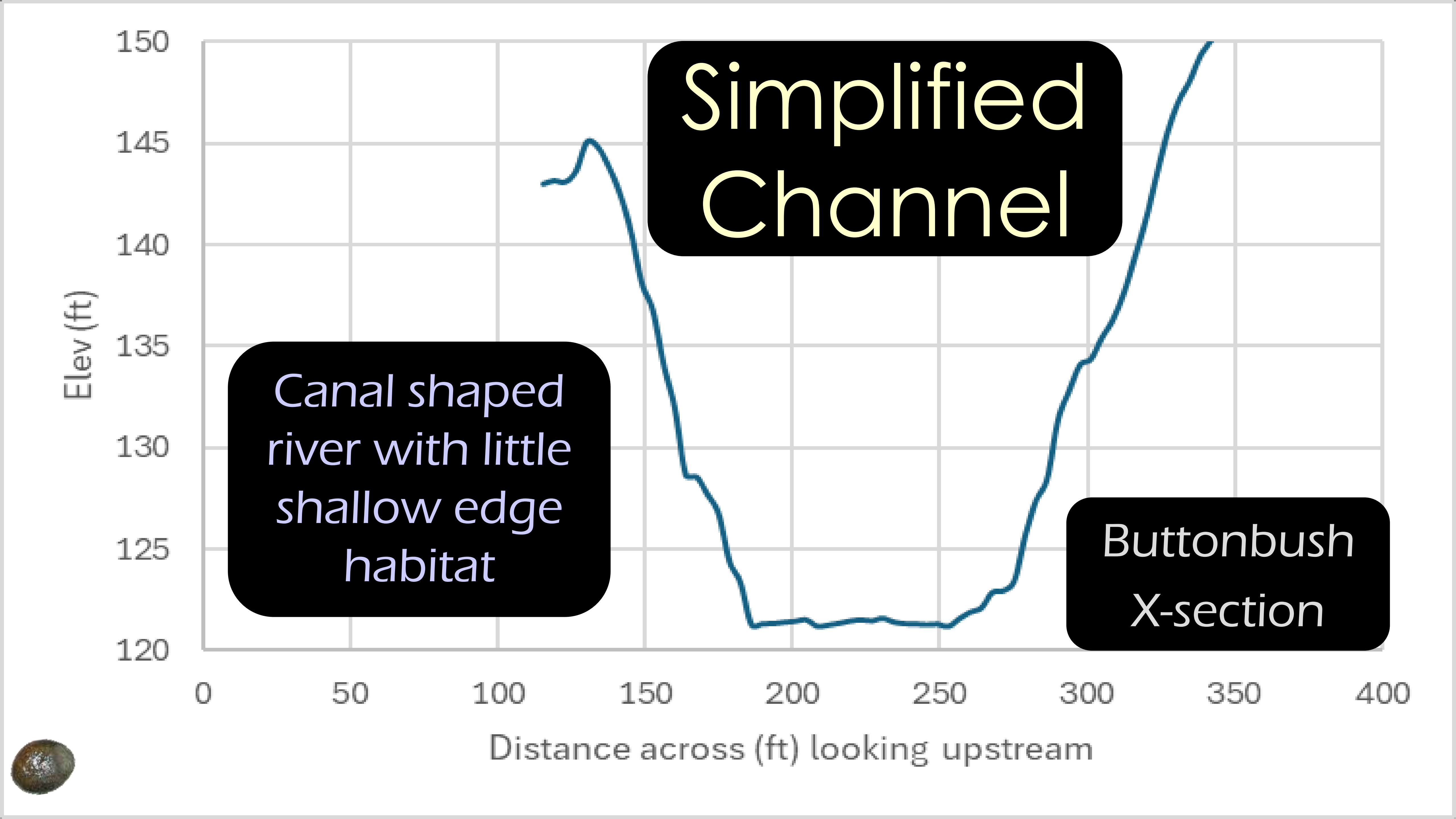

Levees
Narrowed active channel
Reduced sediment erosion and deposition
Disconnected floodplains
Allowed floodplain development
Eugene
Adela
Oakdale
Riverbank
Ripon
Salida
Modesto
Empire
Waterford
120
108
219
99
132

Floodplain Development

Turned riparian habitat into houses, businesses, or agriculture

Riverbank CA

Google Earth



Simplified Channel
Canal shaped river with little shallow edge habitat
Buttonbush X-section
Elev (ft)
150
145
140
135
130
125
120
0
50
100
150
200
250
300
350
400
Distance across (ft) looking upstream

Impacts

Reduced Spawning Habitat

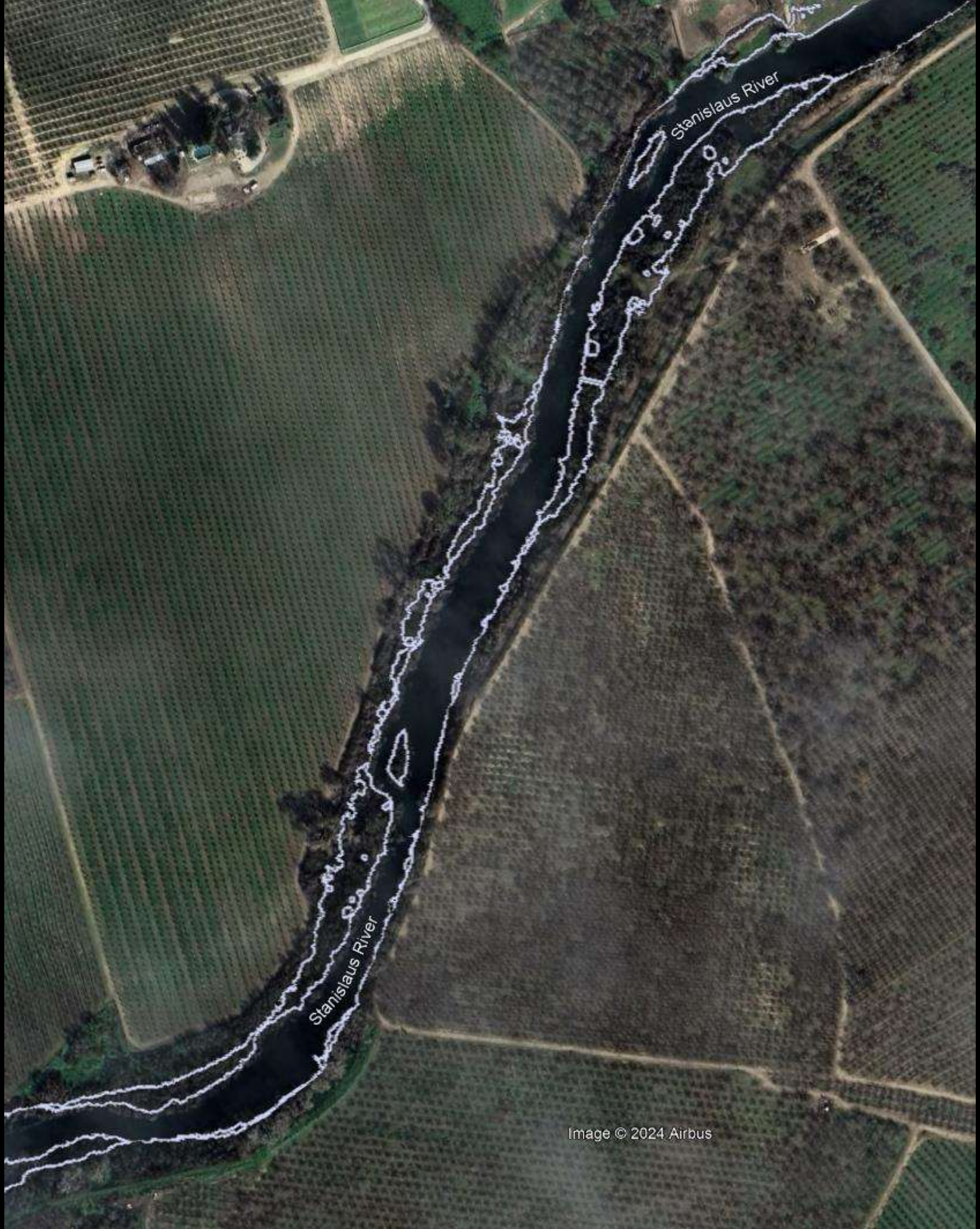
Spawning habitat decays without coarse sediment inputs or lateral sources

Spawning near Lovers Leap

Reduced Food Production

Lack of seasonally inundated habitats reduce macroinvertebrate production

CFS staff sampling invertebrates



Reduced Rearing Habitat

Disconnected floodplains reduce habitat

Reduced Predation Refugia

Lack of shallow water and complexity leaves juveniles vulnerable

Rainbow trout trying to hide near substrate

Increased Water Temperature

Delays adult migration and spawning

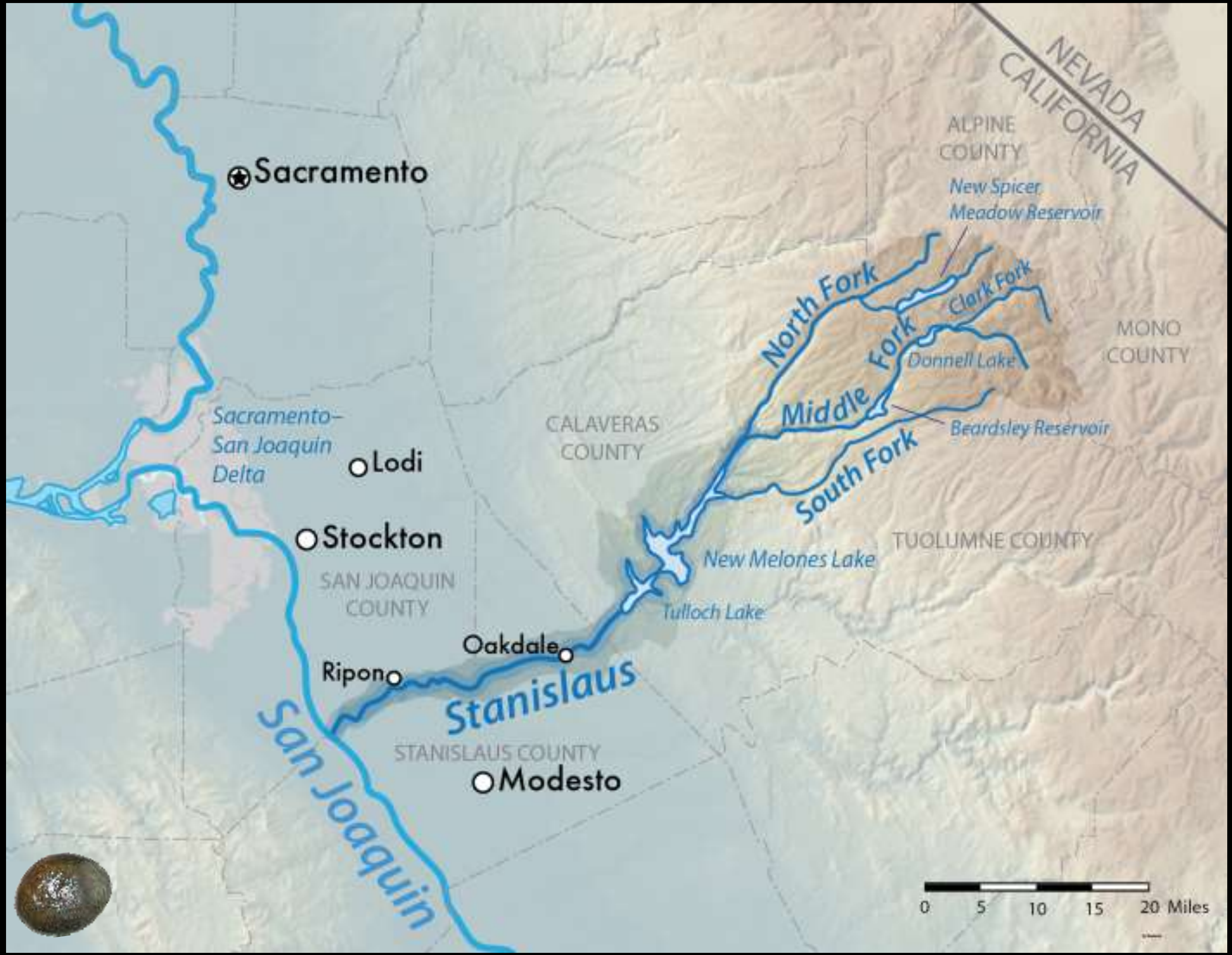
Increases disease

Inhibits smoltification

Increase predator metabolism

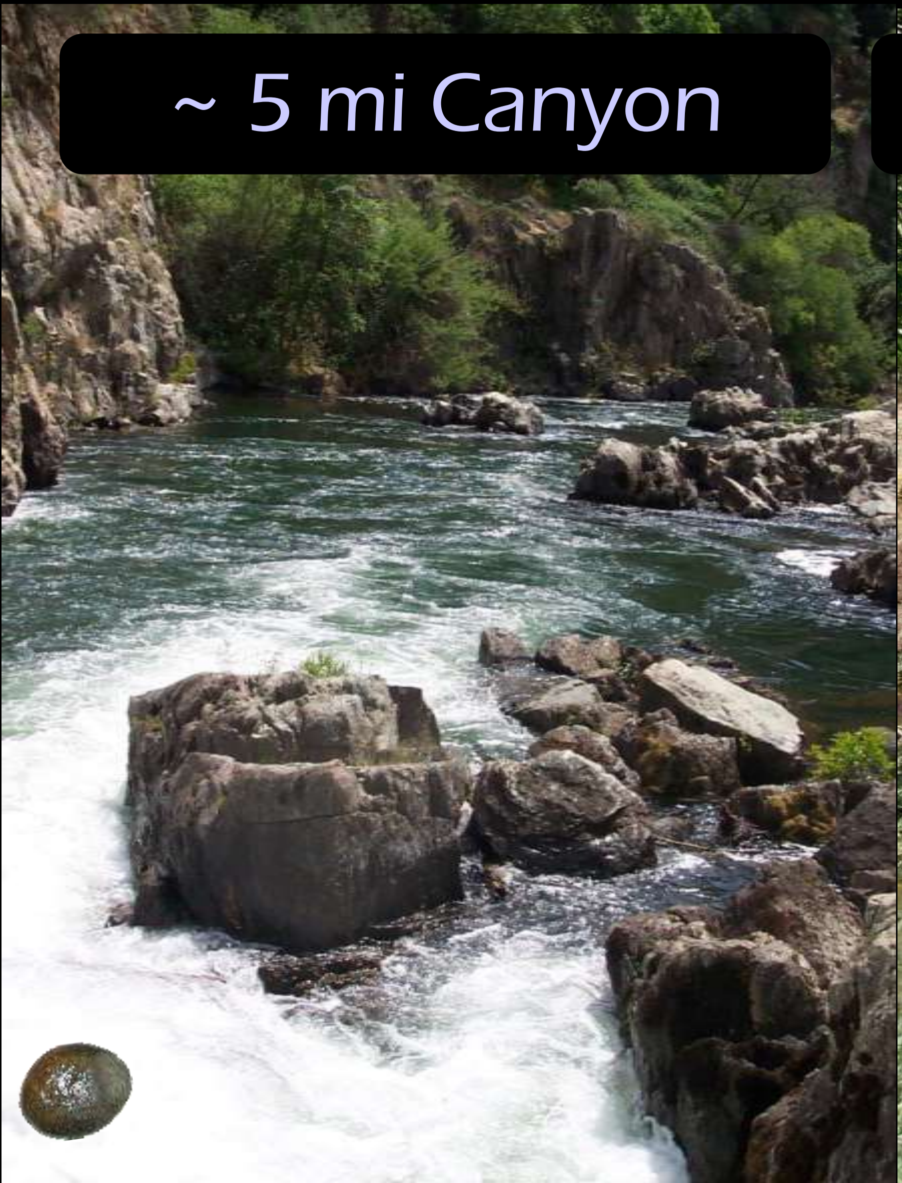
Martha Stewart

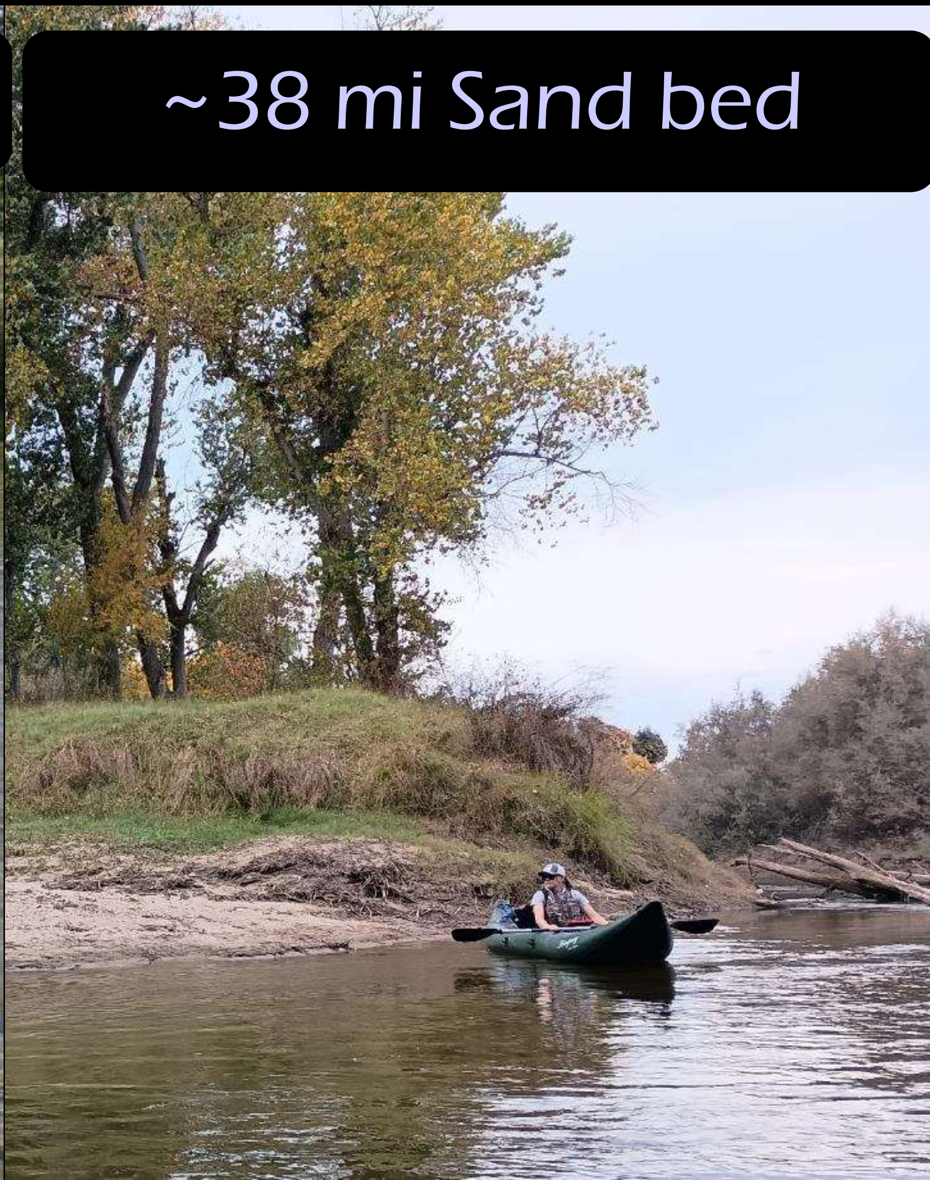
Watershed

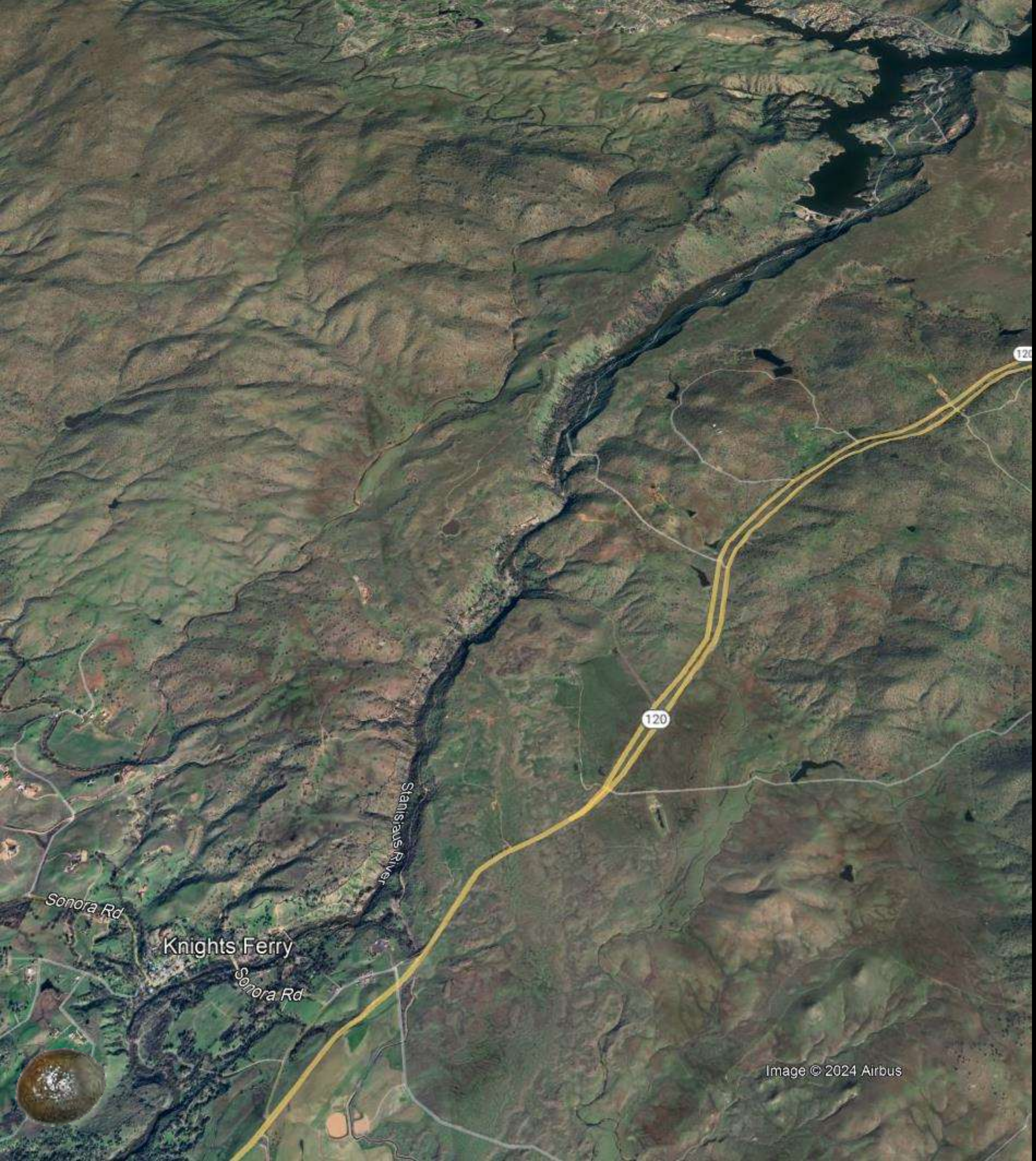


~58 miles accessible to anadromous salmonids

River Reaches







Canyon

Bedrock V mostly devoid of gravel/cobble

High canyon walls offer temperature refuge

High gradient

Limited habitat

Gravel Bedded Reach

Remnant spawning gravels

Simplified channel

Poor food production

Medium to low gradient

Lovers Leap

Sand Bedded Reach

Highly armored

Simplified channel

Low gradient

Limiting Salmonid Factors

Rearing habitat

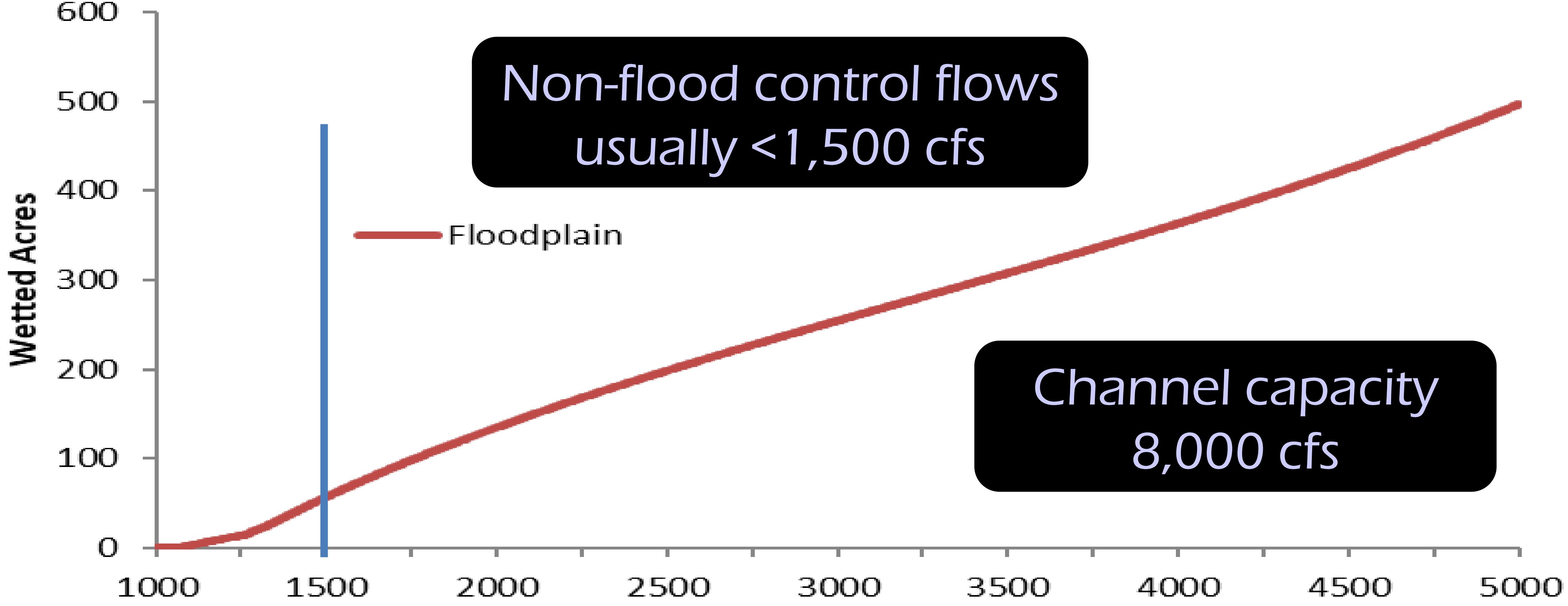
Outmigration temperature

Predation

Riparian recruitment

Hatchery impacts

Rearing Habitat



Non-flood control flows usually <1,500 cfs

Channel capacity 8,000 cfs

1964 flows >40,000cfs Kondolf et al. 2001

Migration Temperatures

EPA 2003 smolting

Nobriga et al. 2021 predation

Sturrock et al. 2020 life-history diversity and selection

Accomplishments

After a slow start,
Things are moving faster

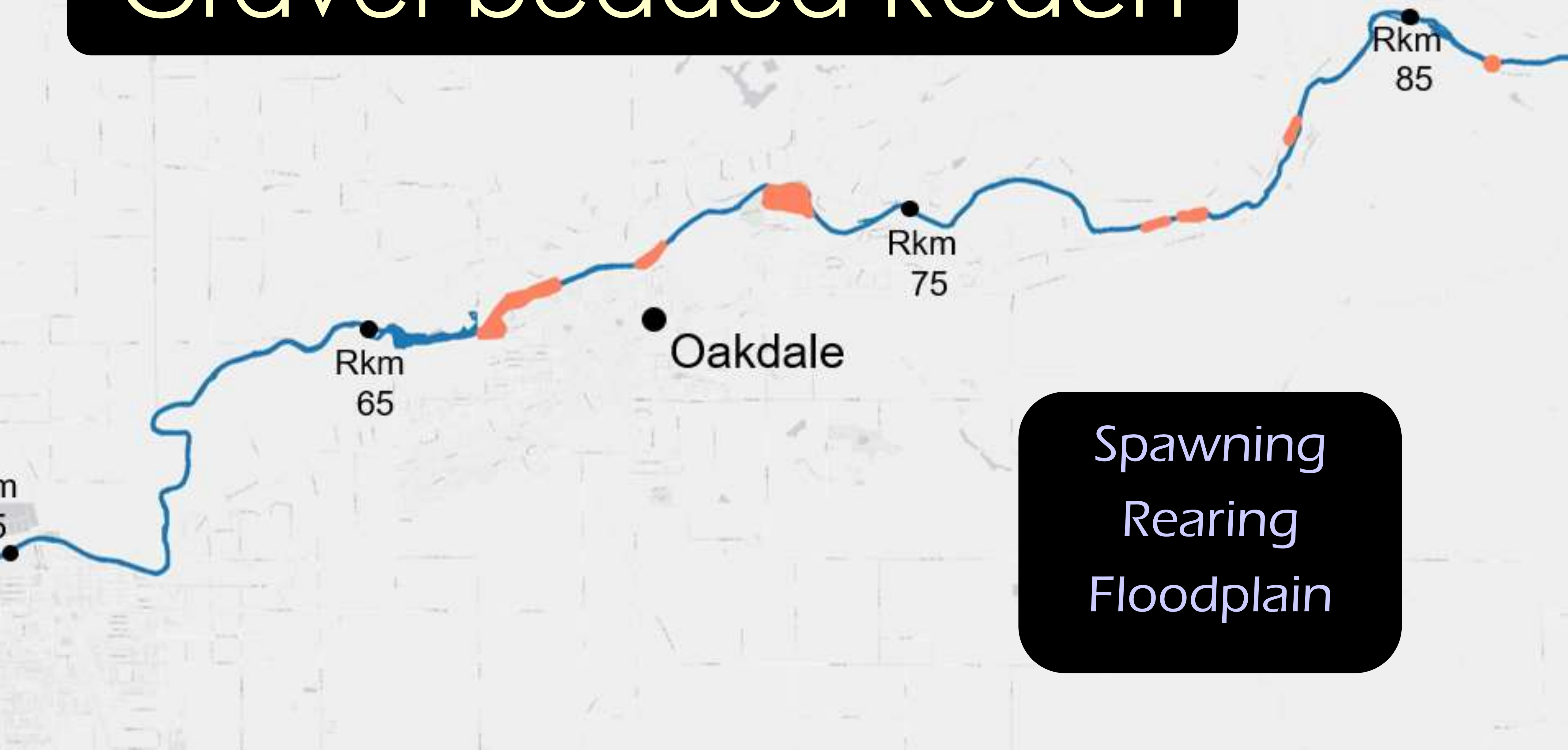
Rodden Road Gravel

Canyon

Gravel augmentation since 1994

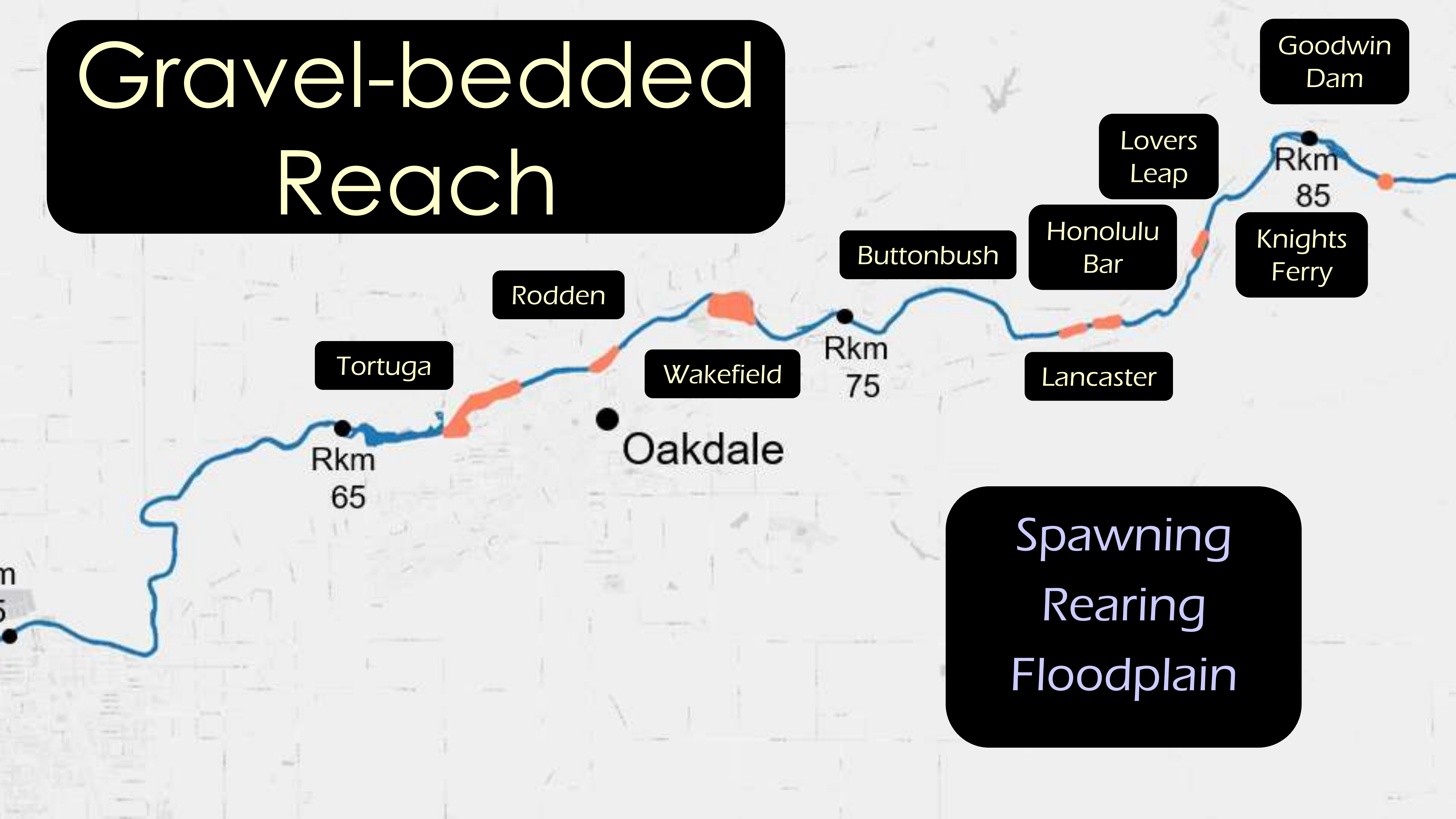
Kondolf 2001
20K cy
Our average
3K cy

Gravel-bedded Reach

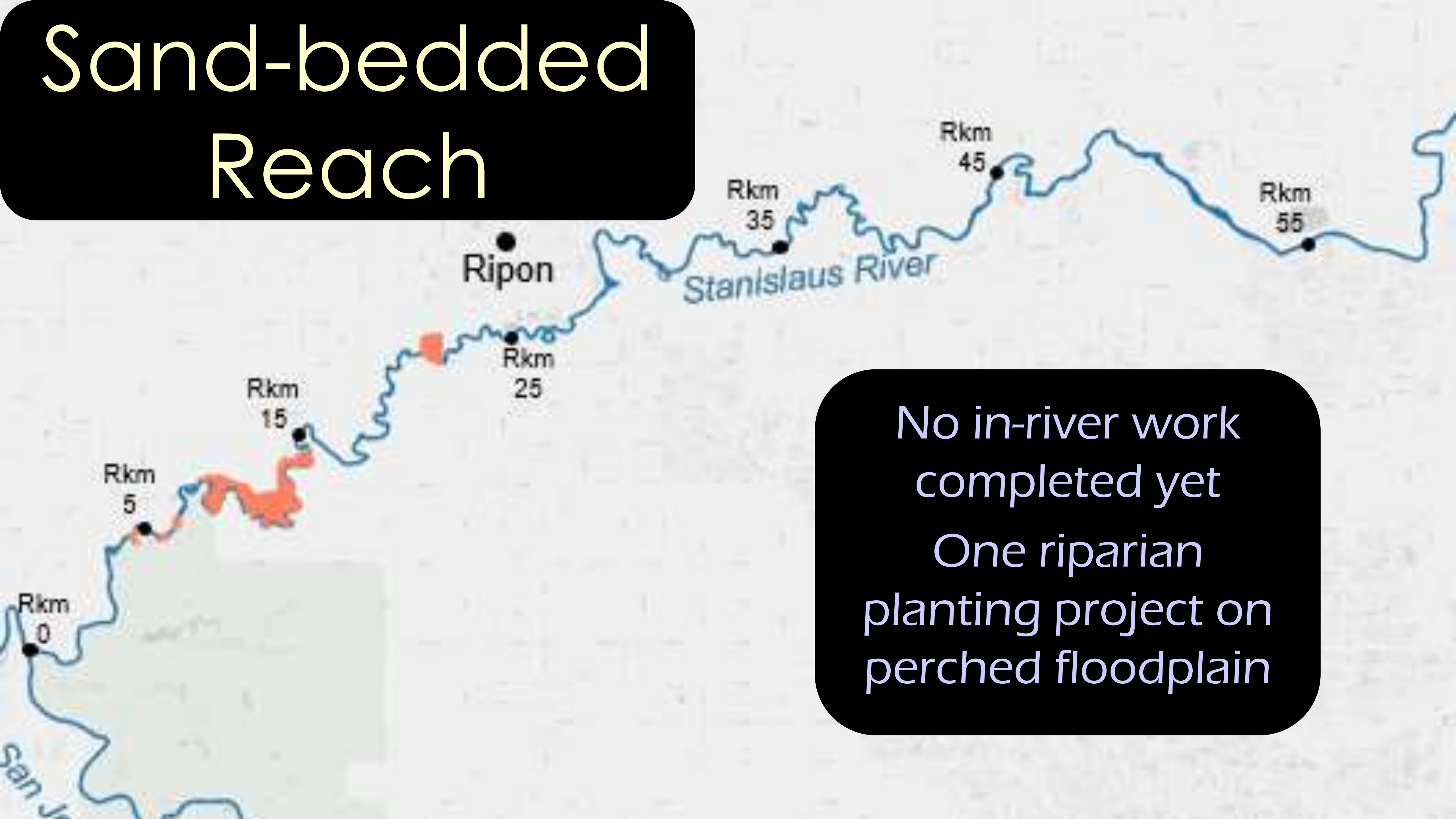


Spawning
Rearing
Floodplain

Gravel-bedded Reach



Sand-bedded Reach



No in-river work completed yet

One riparian planting project on perched floodplain

Vision for the Future

Plan at a watershed scale

Identify needs and opportunities

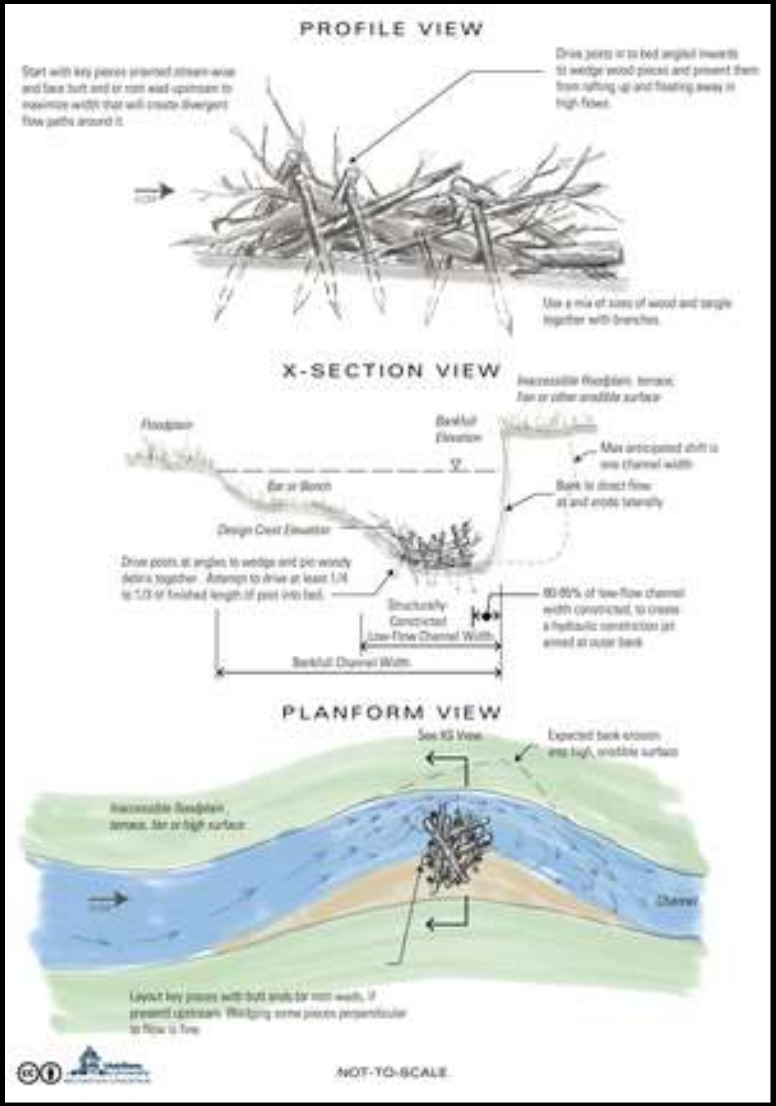
Leverage expertise

Staff turnover limits progress

Visionary Astronomer Carl Sagan


Traditional Fixes
Gravel augmentation
Floodplain reconnection
Mine pit isolation

Newer Fixes



Process based restoration - PBR

Land acquisition

Rip-rap removal

Managing hydrograph for riparian recruitment and fluvial-geomorphologic process

Riverscapes Restoration Design Manual

Newer Fixes

Tuolumne River
Dos Rios 2013

Newer Fixes

Tuolumne River
Dos Rios 2022

Data Driven Framework

Use data

Assess best opportunities

Stop just doing easy opportunities

Opportunities identified

Tools

GIS Ranking

Models

Partnerships

Migratory Corridor ranking criteria

Access

Infrastructure

Number of parcels

Area

Stressor Addressed

Inundation

Off-channel

Habitat Efficiency

Rest Stop need

Expanded Focus

Salmonids+

(keystone species)

Other species

Flood control

Recreation

Carbon sequestration

Mitigation

Avoid impacting other species

What's Next?

Lots of new projects

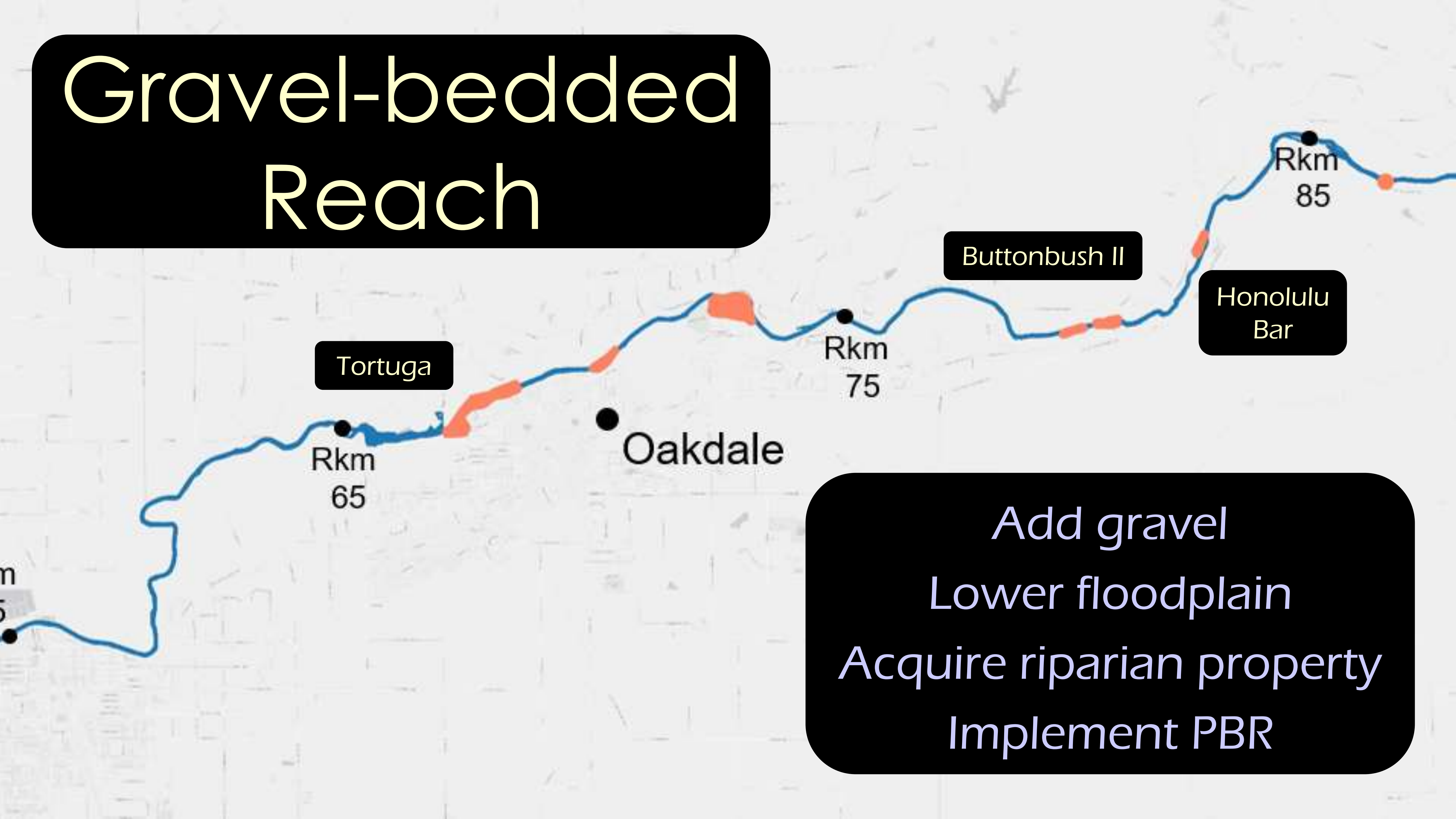
And revisited projects


Canyon
Stanislaus River
Tulloch Dam Rd
Goodwin Dam Recreation Area
Tulloch Rd
Add gravel
Acquire
floodplain parcel
for restoration

Gravel Addition

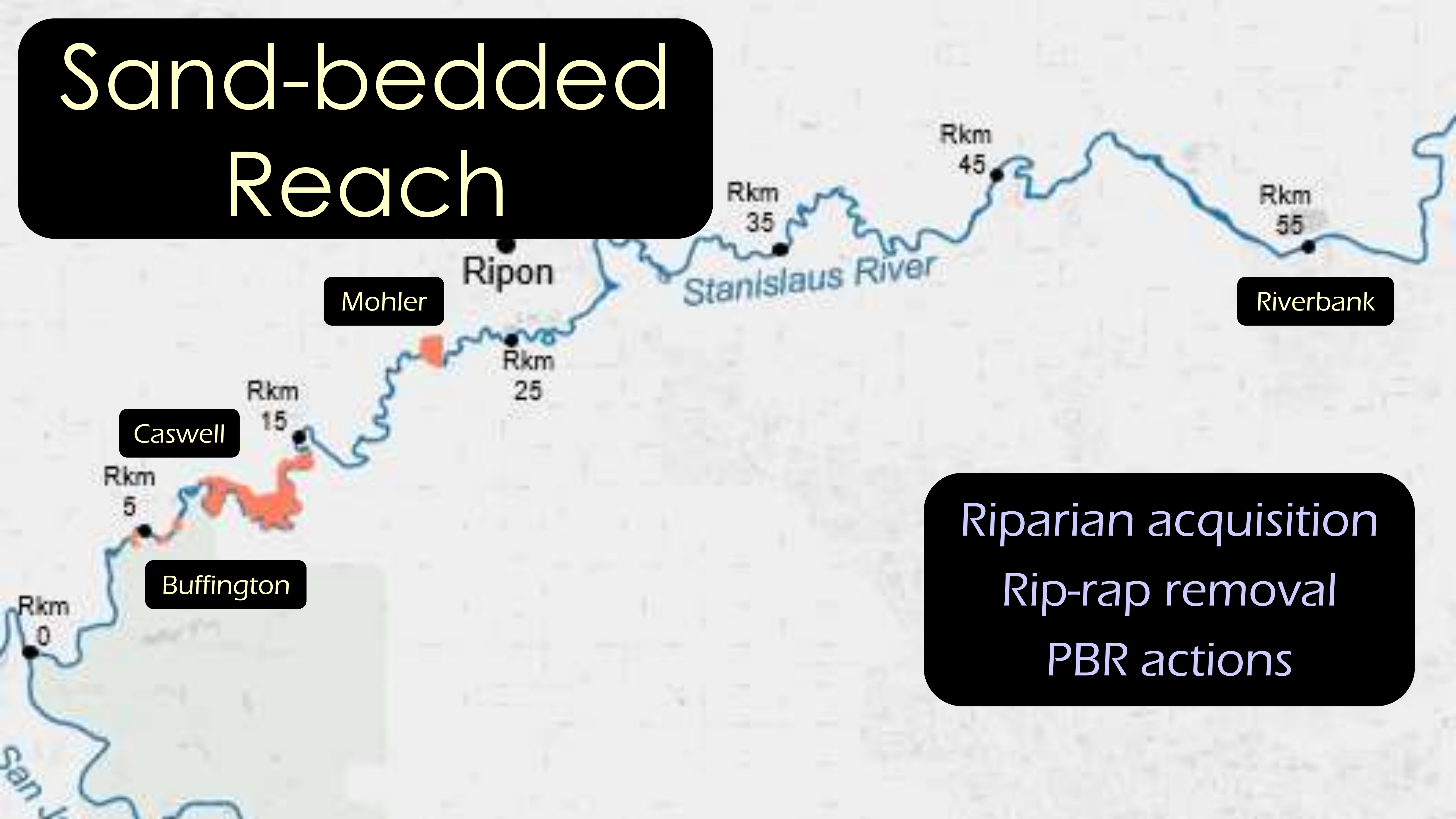
5,000 tons
summer 2024
More to come

Gravel-bedded Reach



Add gravel
Lower floodplain
Acquire riparian property
Implement PBR

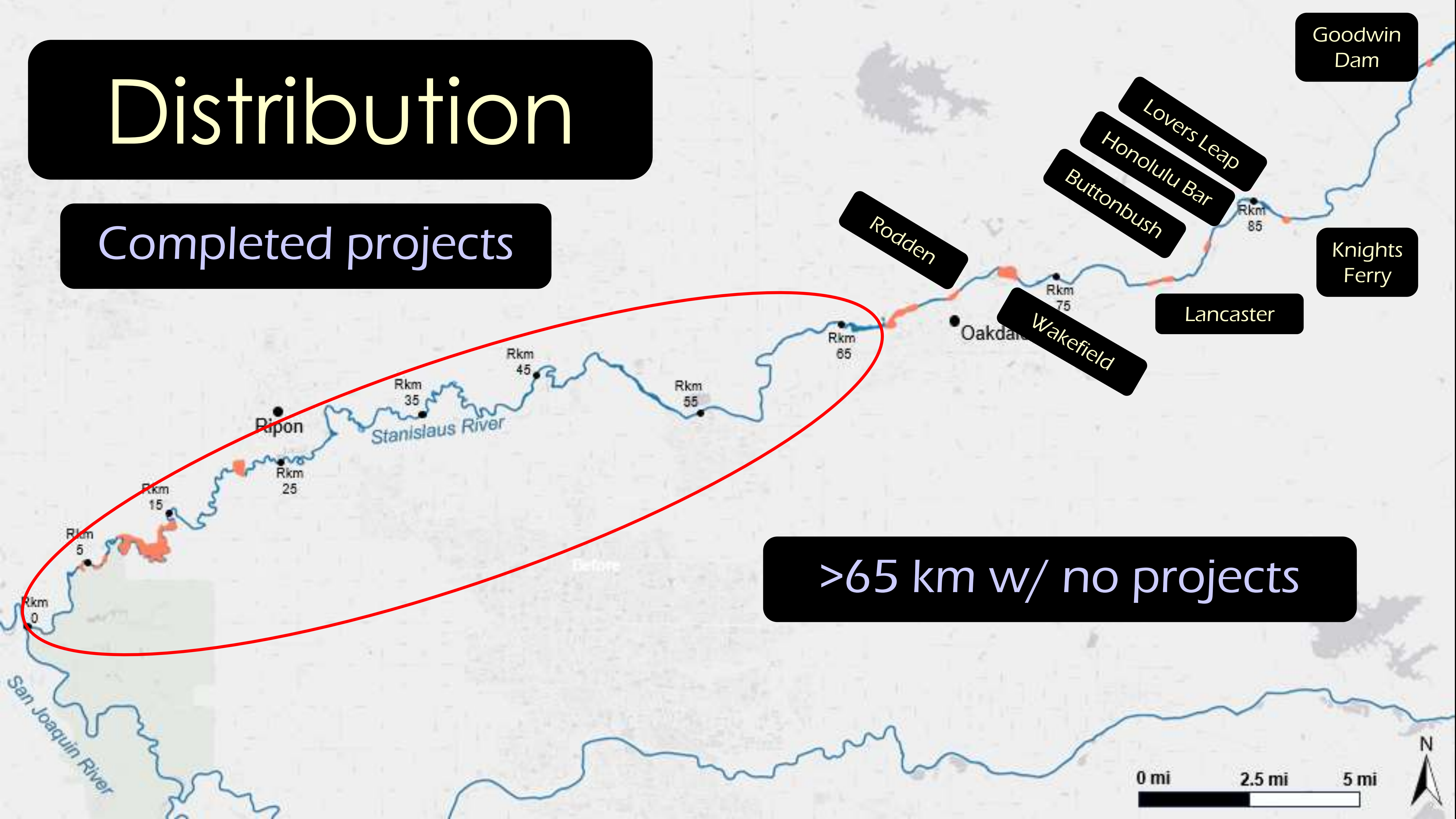
Sand-bedded Reach



Riparian acquisition
Rip-rap removal
PBR actions

Distribution

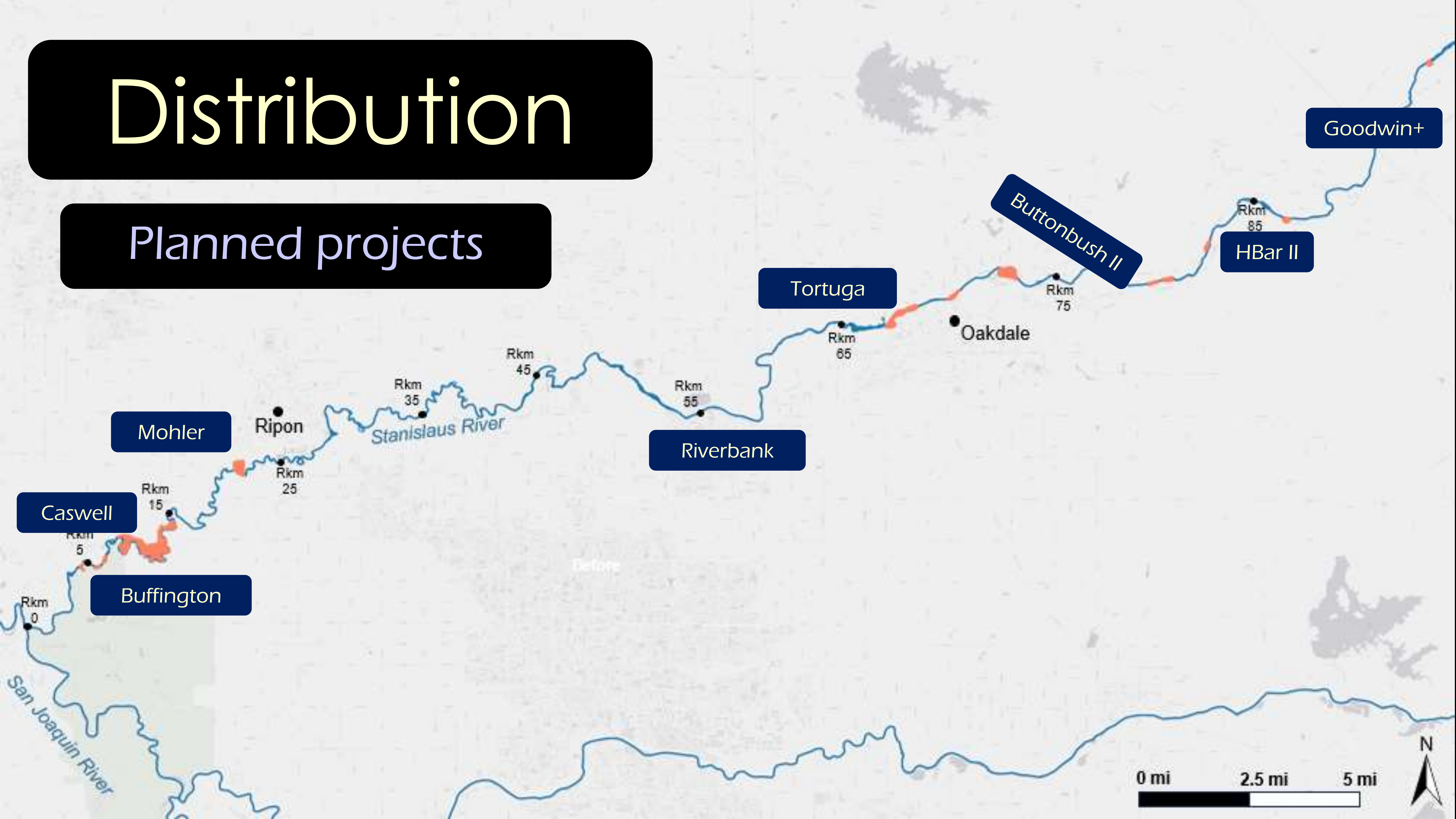
Completed projects

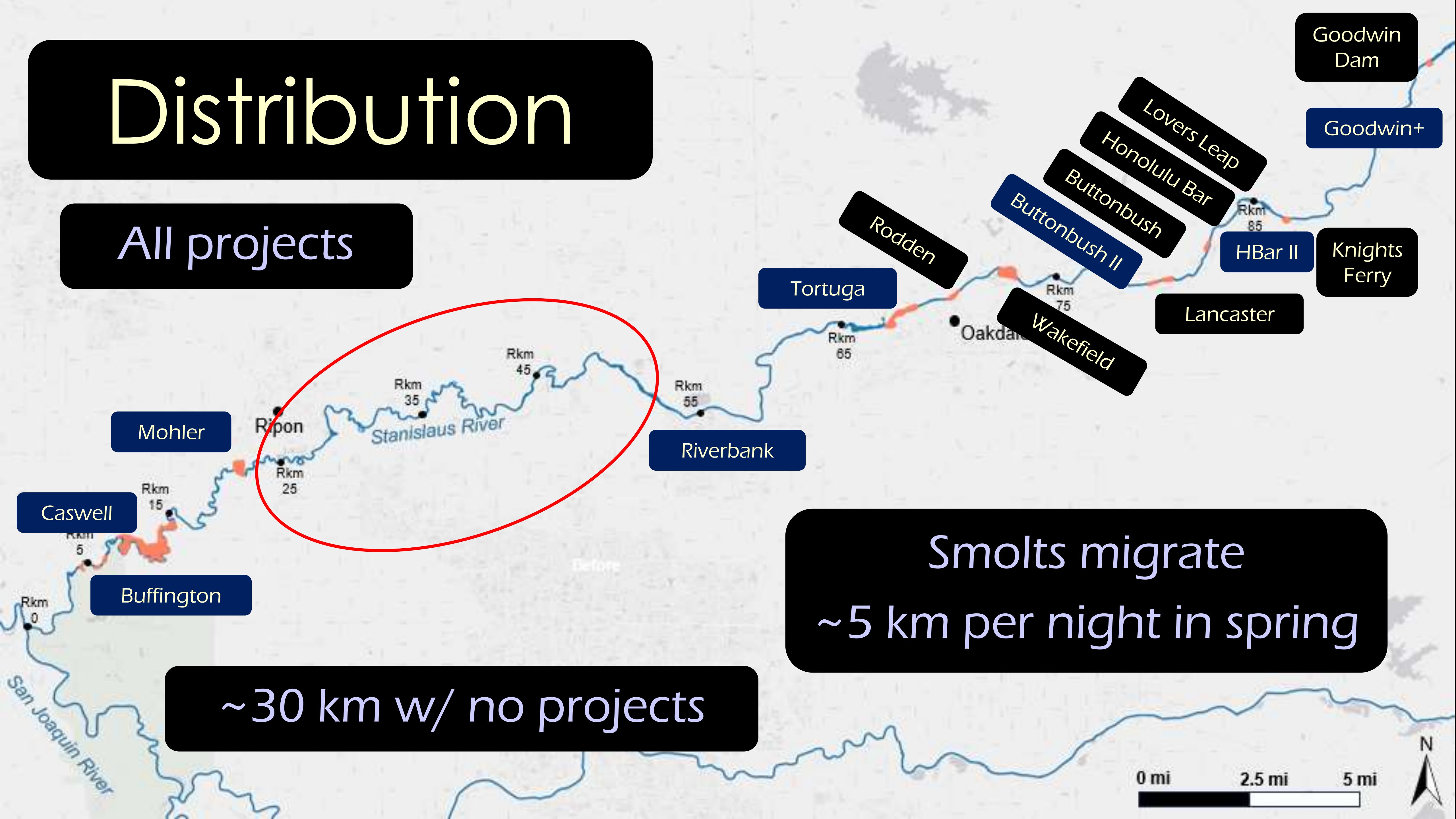


>65 km w/ no projects

Distribution

Planned projects




Distribution
All projects
~30 km w/ no projects
Smolts migrate
~5 km per night in spring
Goodwin Dam
Goodwin+
Lovers Leap
Honolulu Bar
Buttonbush
Buttonbush II
Rodden
Tortuga
HBar II
Knights Ferry
Lancaster
Wakefield
Riverbank
Mohler
Caswell
Buffington
Ripon
Stanislaus River
San Joaquin River
Rkm 0
5
Rkm 15
Rkm 25
Rkm 35
Rkm 45
Rkm 55
Rkm 65
Rkm 75
Rkm 85
0 mi
2.5 mi
5 mi
N

Timing

1994 -? Goodwin gravel
1999 – Knights Ferry Gravel
2007 - Lovers Leap Gravel
2008 – Knights Ferry Gravel II
2011 – Lancaster Road
2012 – Honolulu Bar
2017 – Buttonbush
2023 – Wakefield

2024 – Buttonbush
2025 – Tortuga
2025 – Mohler
2026 – Caswell
2027 – Buttonbush II
2027 – Honolulu Bar II
2028 – Riverbank
And lots more…

Who?

ESRCD
FWS
CFS
USBR
Fishbio
Cbec
CDFW

USACE
Private Landowners
SSJID
OID
Oakdale
TRT
Tri-Dam

Not Easy!

You need a team

Maintain momentum despite staff turnover

Shared vision

Vision Needs

One or more champions

Planning at scale

Good data

Adaptive Management

Persistence

Outreach

Ownership

Shameless Plug

Rocko Brown – Beaver Session: Friday Morning
The Process Paradox: Overcoming Challenges for Process-Based Restoration in the Regulated Rivers of California's Central Valley

J.D. Wikert – Oops Session: Friday Afternoon
Honolulu Bar Restoration
A Decade Later, How Did We Do?

Lovers Leap Gravel I

7,650 cy

18 sites

1999

Lovers Leap Gravel II

25,000 cy

25 sites

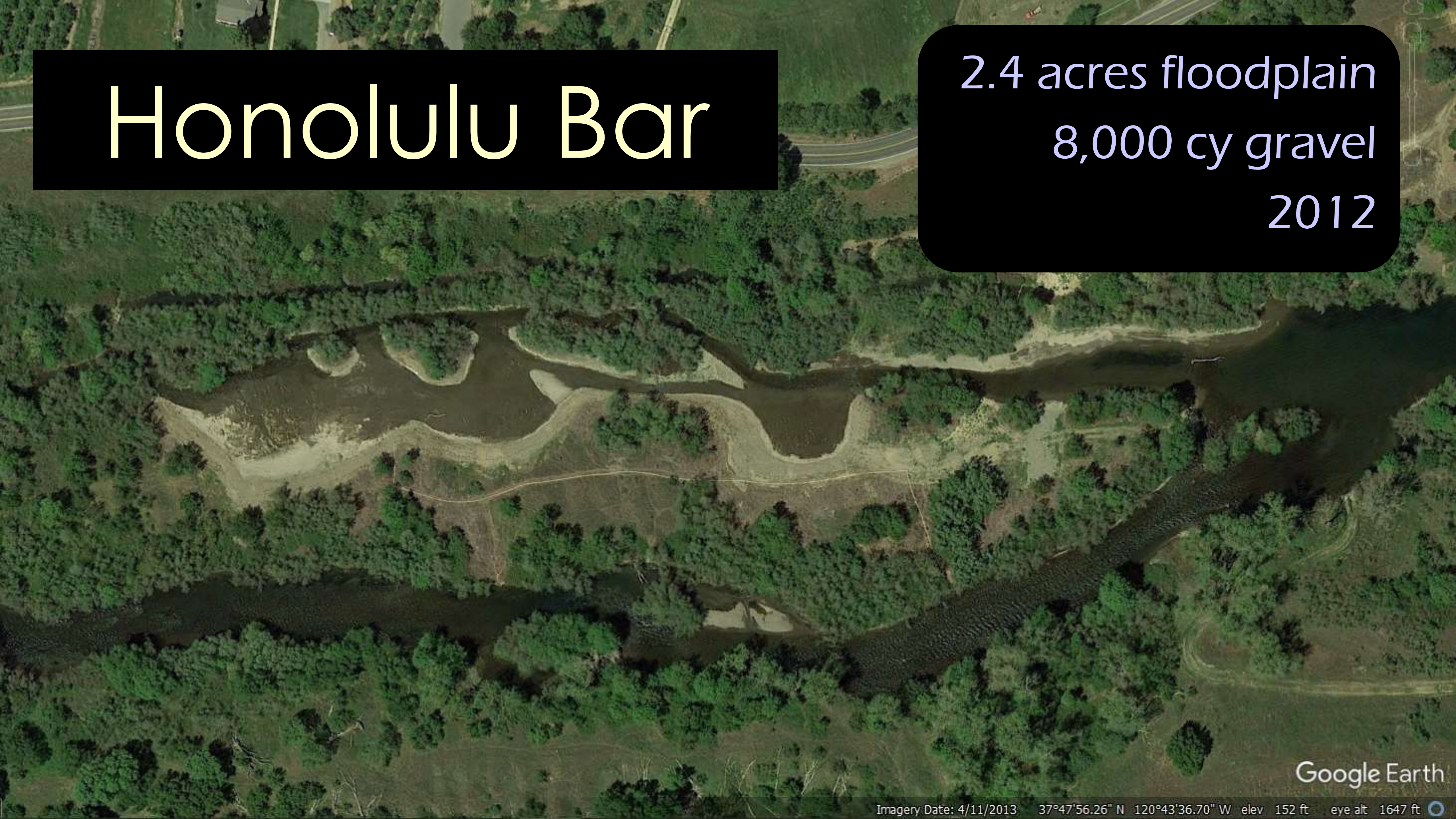
1 instream mile

2007


Lancaster Road
650 ft of seasonal side-channel
2011

Honolulu Bar

2.4 acres floodplain
8,000 cy gravel
2012

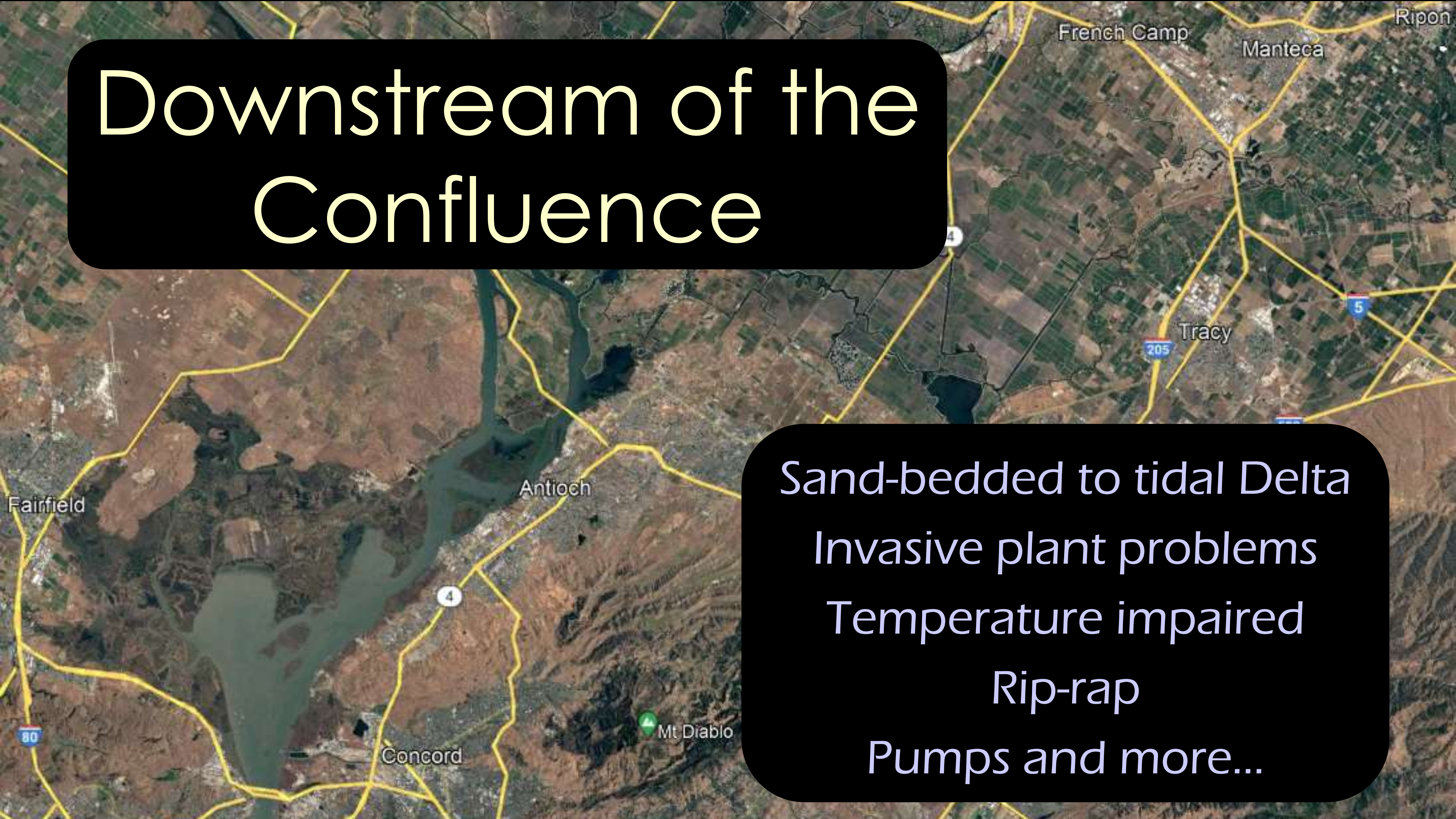



Buttonbush
4.4 acres
seasonal
side-channel
2,838 cy
gravel
2017


Rodden Road
4.9 acres
1,250 cy
2018


8.5 acres
2023
Stanley
Wakefield

Downstream of the Confluence



Sand-bedded to tidal Delta

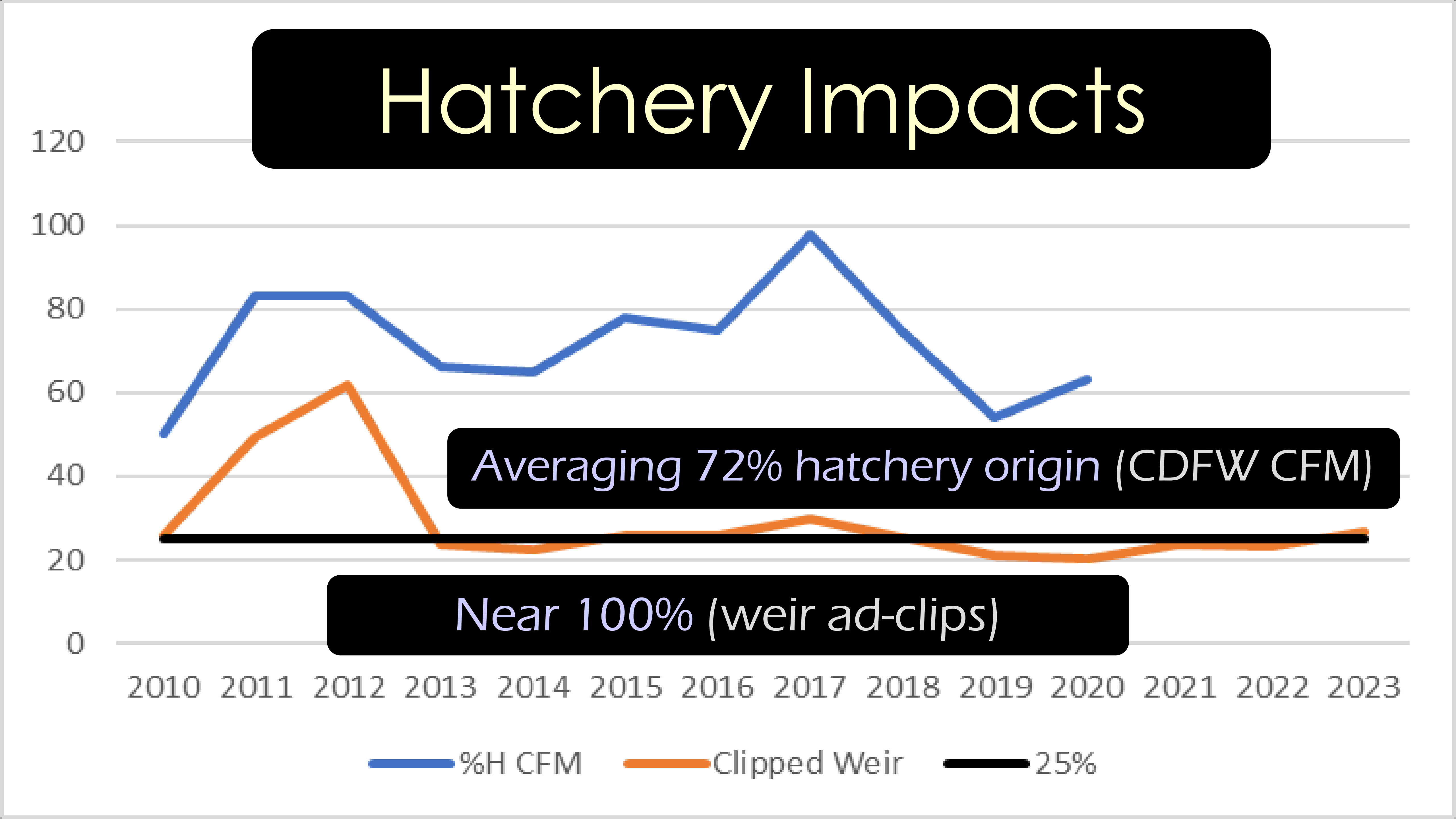
Invasive plant problems

Temperature impaired

Rip-rap

Pumps and more…


Egg to Tributary Confluence Survival
Juveniles
SWRCB data
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017


Hatchery Impacts
120
100
80
60
40
20
0
Averaging 72% hatchery origin (CDFW CFM)
Near 100% (weir ad-clips)
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
%H CFM
Clipped Weir
25%

Other Limiting Factors

Public access

Wildlife corridors

Fish Friendly Farms and Floodplains

SAN MATEO RESOURCE CONSERVATION DISTRICT

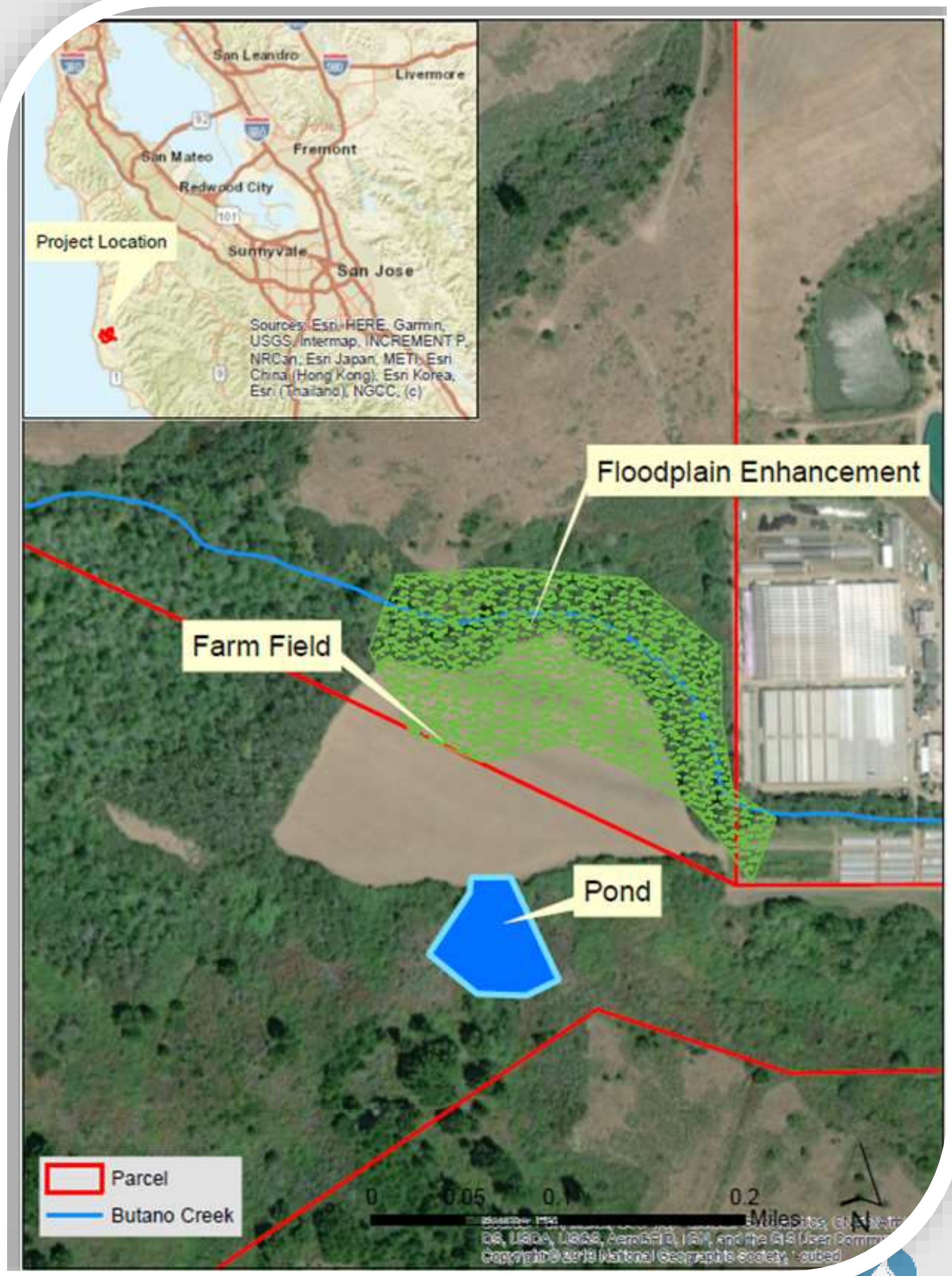
Presentation to

Salmonid Restoration Federation

March 2024

PROJECT LOCATION

- Pescadero-Butano watershed (Butano Creek)
- Central location to many ongoing/completed restoration efforts in the Butano sub-watershed



PROJECT NEED

- Chronic incision of streams resulting from past land use practices. Altering of stream dynamics. Over 90% of historic floodplain disconnected
    - loss of depositional zones for sediment
    - Overall loss of wetland/aquatic habitat
    - Reduced flood attenuation and increased stream velocities
- Flow impairment due to diversions
    - Decreased habitat quality and availability
    - Degraded water quality
    - Downstream effect in the Pescadero Lagoon Marsh Complex

PARTNERSHIPS

Peninsula Open Space Trust (POST)

Fifth Crow Farms

Funders – Wildlife Conservation Board, NOAA, USFWS, POST

Regulatory Agencies

RCD

PROJECT GOALS

- Create a new inset floodplain
- Increase frequency and duration of inundation of the existing riparian floodplain; building on previous project from 2016 downstream
- Re-establish sediment deposition and storage on the floodplain, reduce the amount of sediment being delivered to downstream areas
- Promote aggradation in the channel to limit upstream incision and bank erosion
- Enhance habitats to benefit special status fish and wildlife species
- Enhance streamflow
- Water conservation for agriculture

THE NITTY GRITTY

- GOALS
- 2D HYDRAULIC MODEL
- CONSTRUCTION
- RESULTS

THE CHARGE

SAN MATEO RESOURCE CONSERVATION DISTRICT

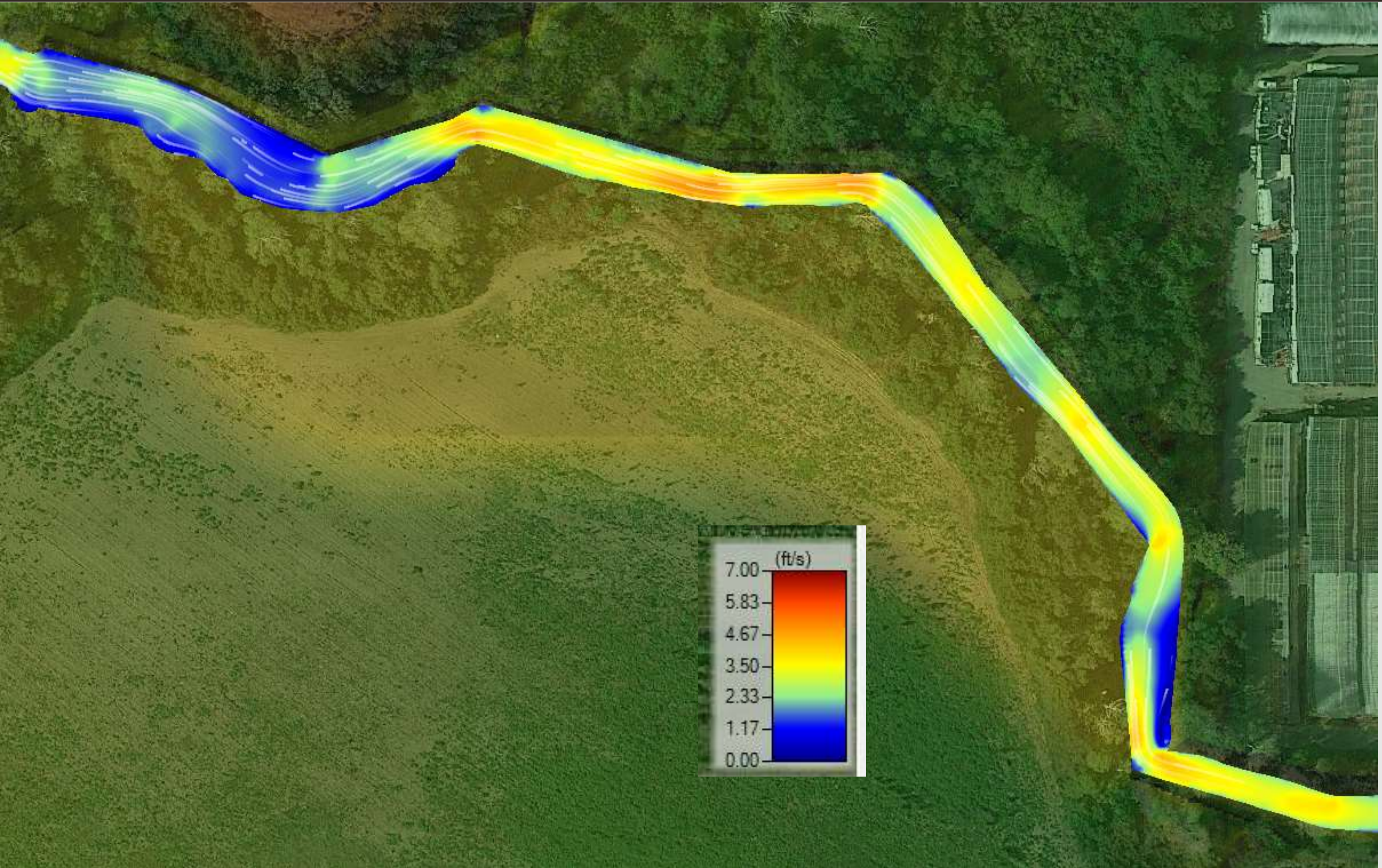
RDG

- MAXIMIZE DISRUPTION
- INUNDATE FLOODPLAIN 10% OF THE YEAR ON AVERAGE
- GO BIG AND MAKE IT MESSY
- EXCAVATED 3-FT TO 9-FT (63,000 CY)

2D HYDRAULIC MODELING

SAN MATEO RESOURCE CONSERVATION DISTRICT

RDG



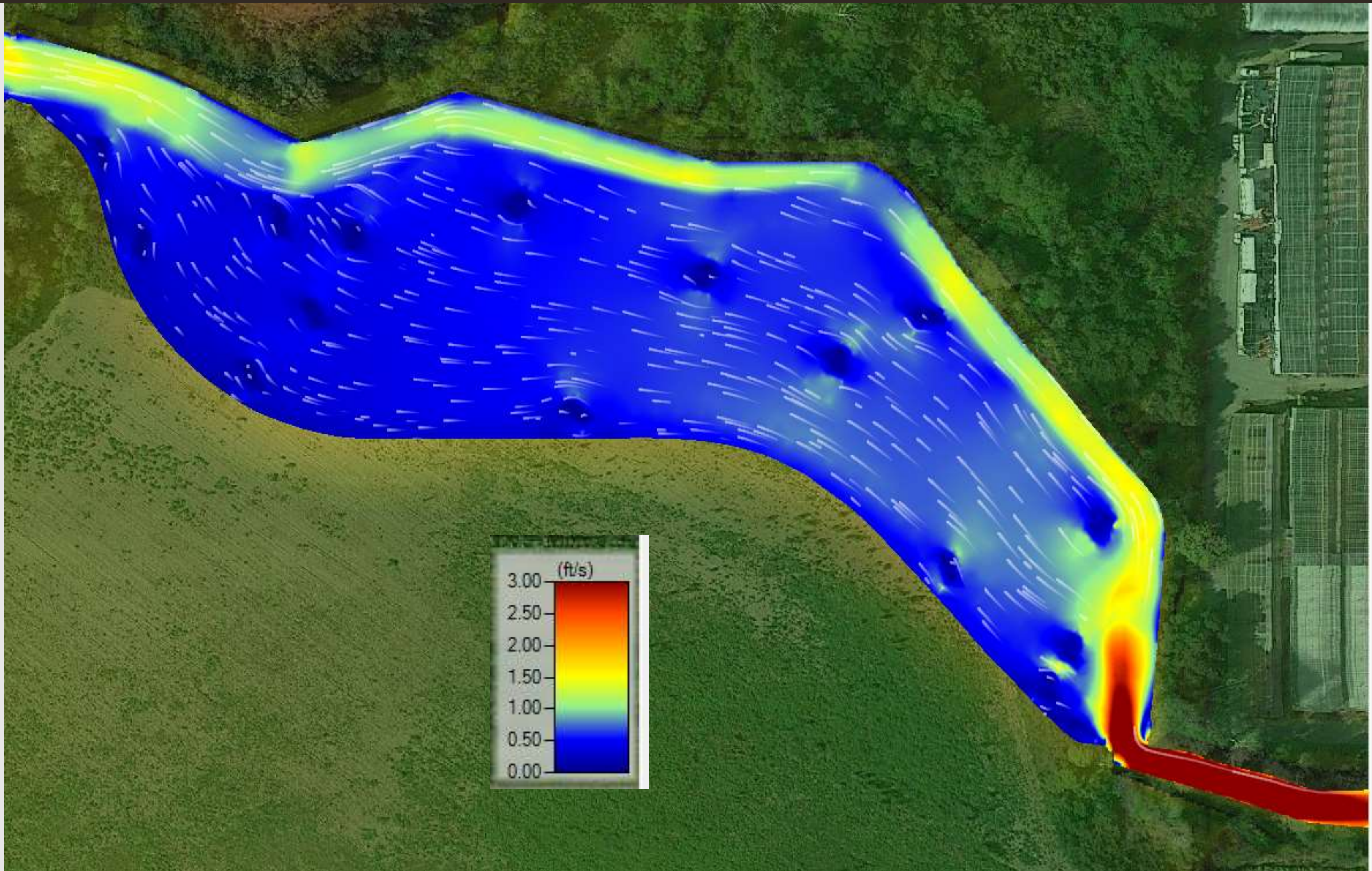
EXISTING CONDITIONS

OVERBANK FLOW ~2-YEAR

1% EXCEEDANCE SHOWN

2D HYDRAULIC MODELING

- PROPOSED CONDITIONS
- 1% EXCEEDANCE SHOWN



CONSTRUCTION JUST BEGINNING

SAN MATEO RESOURCE CONSERVATION DISTRICT

RDG

KEEPING IT SIMPLE

SAN MATEO RESOURCE CONSERVATION DISTRICT

RDG

FLOODPLAIN ROUGHNESS (15-20)

CHOP AND DROP ALDERS (25-35)

SIMPLE

SAN MATEO RESOURCE CONSERVATION DISTRICT

RDG

LIVING RIFFLES (6)

MODULAR LOG JAM

TO MAKE IT MESSY

SAN MATEO RESOURCE CONSERVATION DISTRICT

RDG

MODULAR LOG JAM

NOVEL IDEAS

FLOODPLAIN ROUGHNESS

MORE DIFFICULT BUT EFFECTIVE

NOVEL IDEAS

SAN MATEO RESOURCE CONSERVATION DISTRICT

RDG

PROMOTING PREFERENTIAL FLOW PATHS

RESULT

SAN MATEO RESOURCE CONSERVATION DISTRICT

RDG

RESULT

4.2 ACRES OF FLOODPLAIN

2.1 ACRES OF TRANSITIONAL RIPRIAN AREA

Thank you!

CHRISTINA KELLEHER, SAN MATEO RCD

Christina@sanmateoRCD.org

MATT THOMAS, PE

RESTORATION DESIGN GROUP

MATT@RDGMAIL.COM

@sanmateoRCD

Role of Wildfire in the Recovery of Endangered Southern California Steelhead

National Marine Fisheries Service

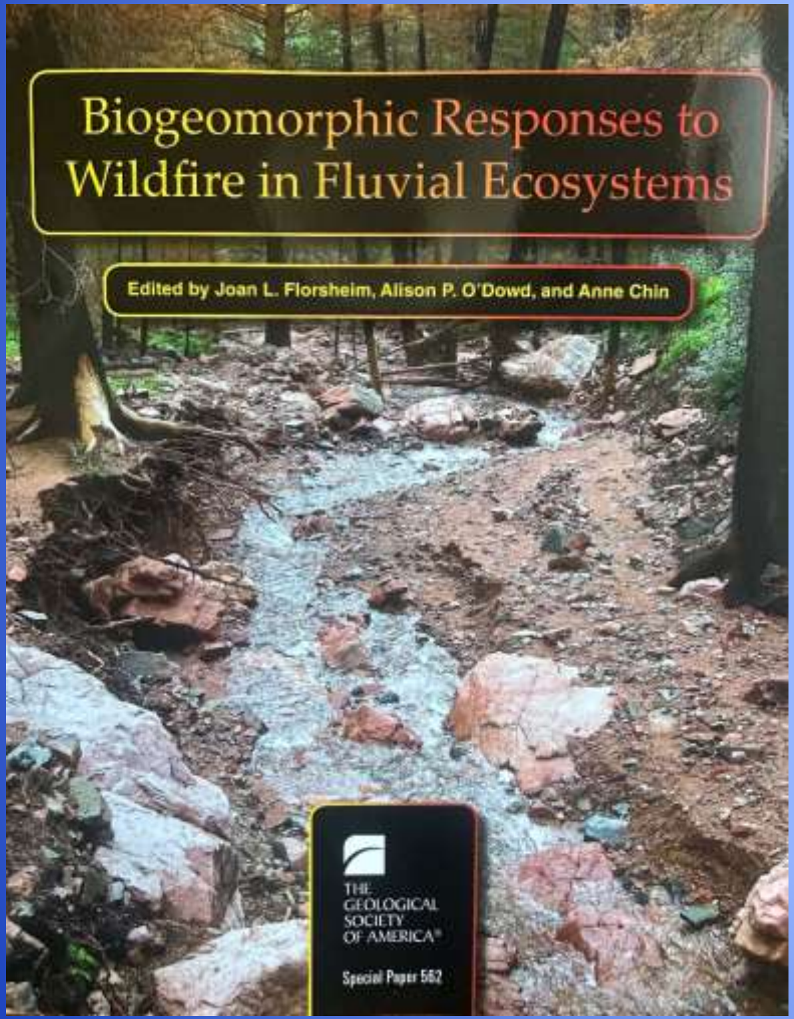
Salmonid Restoration Federation Conference

Santa Rosa, CA
March 26, 2024

Mark H. Capelli
Steelhead Recovery Coordinator

National Marine Fisheries Service

Southern California Steelhead Listing



The Geological Society of America
Special Paper 562

The role of wildfires in the recovery strategy for the endangered southern California steelhead

Mark Henri Capelli
National Marine Fisheries Service, West Coast Region, California Coastal Office, 113 Harbor Way, Suite 150, Room 106, Santa Barbara, California 93109, USA

ABSTRACT

Southern California steelhead (*Oncorhynchus mykiss*) occupy wildfire-prone watersheds from the Santa Maria River in Santa Barbara County to the Tijuana River at the U.S.-Mexico border. This tectonically active landscape is characterized by a Mediterranean climate, highly erosive soils, and a fire-dependent chaparral/ coastal sage scrub-dominated plant community. These features create an unstable landscape to which the southernmost steelhead populations have adapted over the past 20 m.y. Wildfires help to create and maintain essential features of the species' freshwater habitats, including boulder-forced and step pools, which provide oversummering rearing habitat, and spawning gravels, which are essential for reproduction. Disturbance events can also periodically render steelhead spawning and rearing habitat locally inaccessible or unsuitable for the freshwater reproductive phase of their life-history.

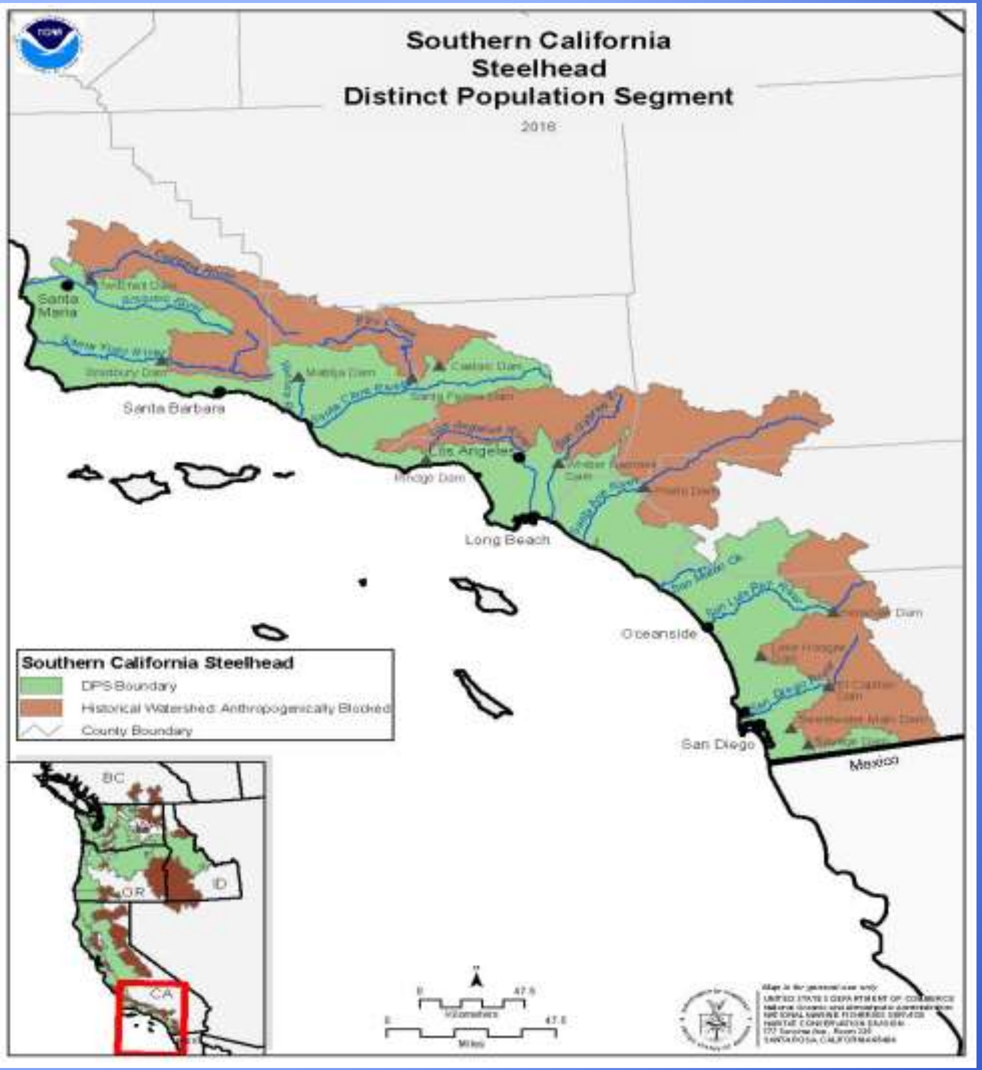
The episodic nature of wildfires, floods, and droughts characteristic of southern California is reflected in river and stream evolution as a cyclical rather than a linear process. These disturbance events have become more frequent, intense, and extensive as a result of anthropogenic climate change and the increased extent of the urban- wildland human interface with chaparral/coastal sage scrub and forested lands, including the four U.S. national forests in southern California.

The long-term viability of southern California steelhead populations requires that they be able to persist under the foreseeable natural disturbance regime characteristic of southern California. The recovery strategy pursued by the National Marine Fisheries Service (NMFS) for the listed endangered southern California steelhead has recognized the essential role of wildfire in the species' life-history and its role as one of the major natural disturbances that pose a risk to the listed species. Using a wildfire- frequency analysis, NMFS has adopted a recovery strategy consisting of population redundancy and spatial separation to maximize the persistence of the species in the face of wildfire and associated geomorphic processes and facilitate the species' ability to evolve adaptations in response to changing environmental conditions.

Southern California Steelhead Listing

Southern California Steelhead DPS

Santa Maria River – Tijuana River



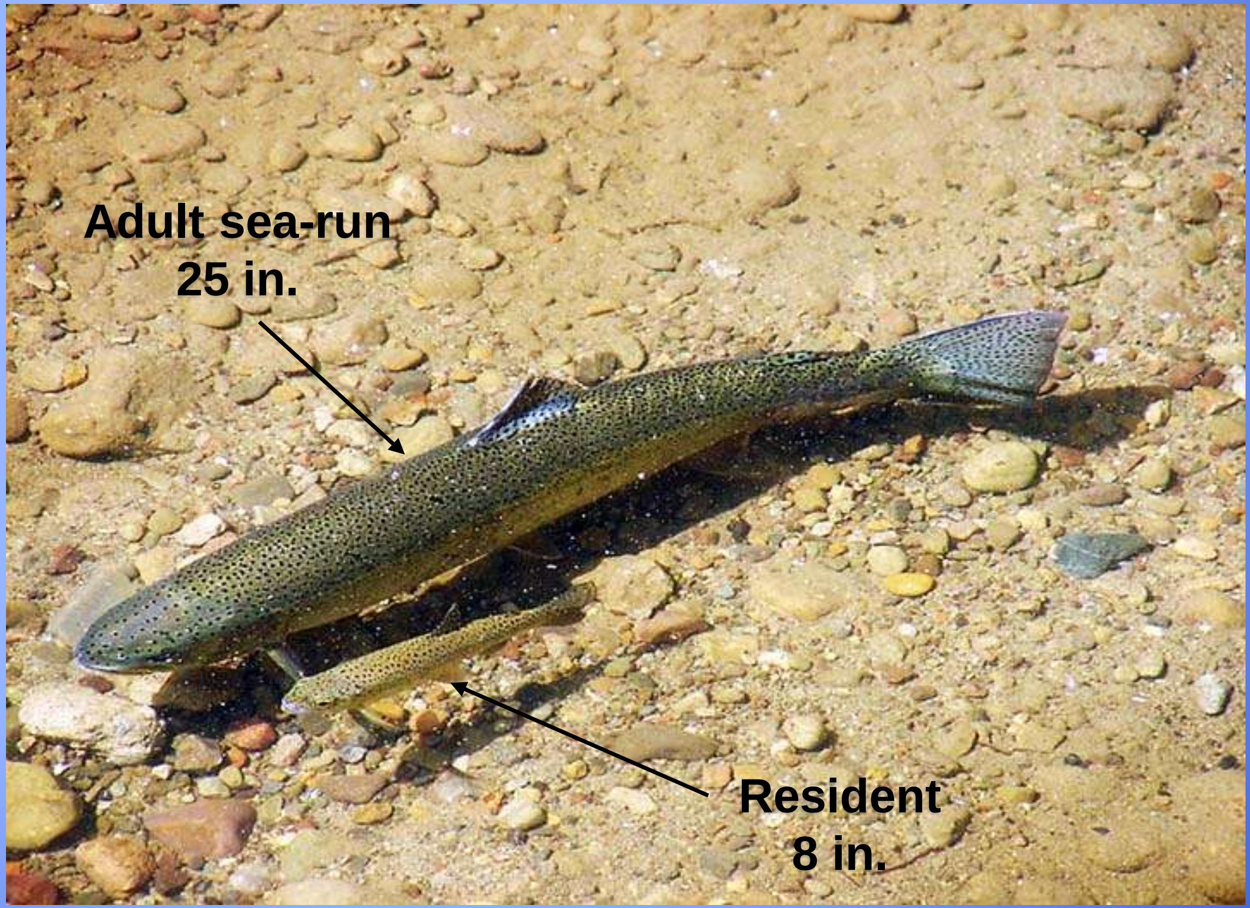
Southern California Steelhead

Genomic Basis of Anadromy/Residency: Omy5

Southern California

Steelhead/Resident

Rainbow Trout



Maria Ygnacio Creek, Santa Barbara Co. 2017

National Marine Fisheries Service

NMFS Technical Recovery Team

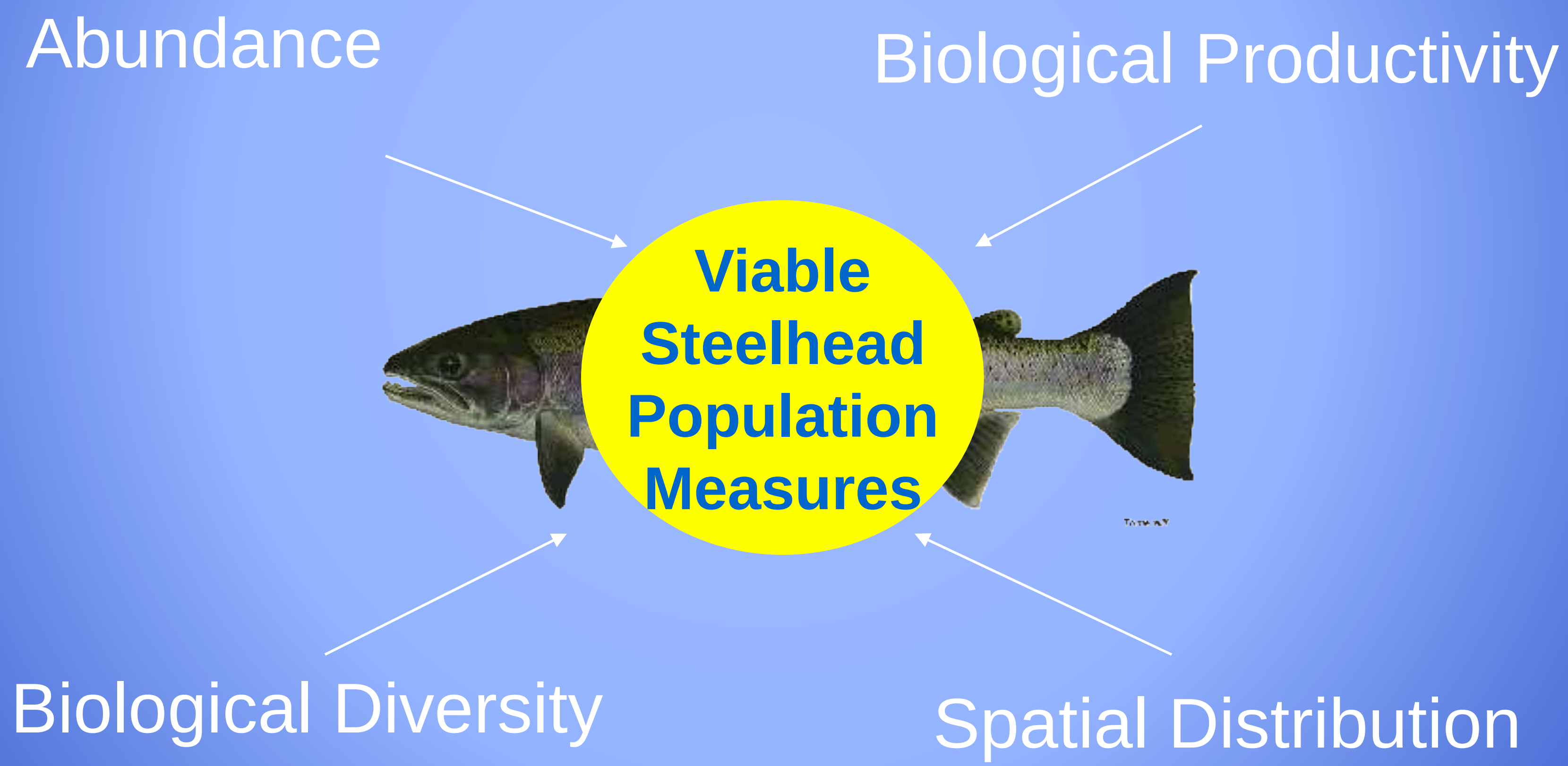
Scientific Framework

1. TRT appointed by Regional Administrator and chaired by Dr. David Boughton, NOAA Fisheries Santa Cruz Laboratory

Dr. David A. Boughton	Dr. .Peter A. Adams
Dr. Eric Anderson	Dr. Craig Fusaro
Dr. Edward Keller	Dr. Elise Kelley
Leo Lentsch	Dr. Jennifer Nielsen
Katie Perry (DFG)	Dr. Helen Regan
Dr. Jerry Smith	Dr. Camm Swift
Dr. Lisa Thompson	Dr. Fred Watson

2. TRT consists of 12 scientists including a representative from the California Department of Fish and Wildlife, and major water purveyor

Viable Salmonid Population (VSP)



National Marine Fisheries Service

Viable Salmonid Population (VSP)

Abundance

Biological Productivity

Viable Steelhead Population Measures

Biological Diversity

Spatial Distribution

Southern California Steelhead

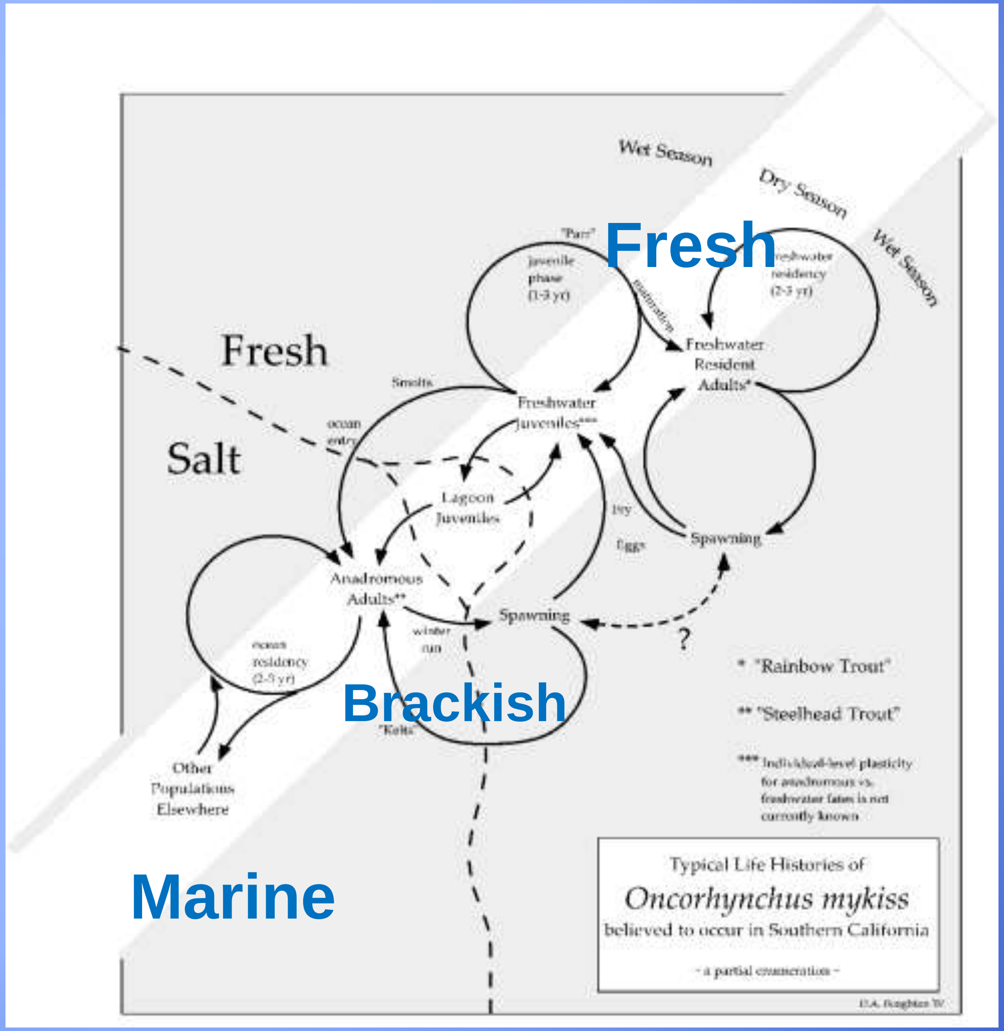
Variable Life-Histories:

Anadromous

Fresh-Water

Lagoon-Anadromous

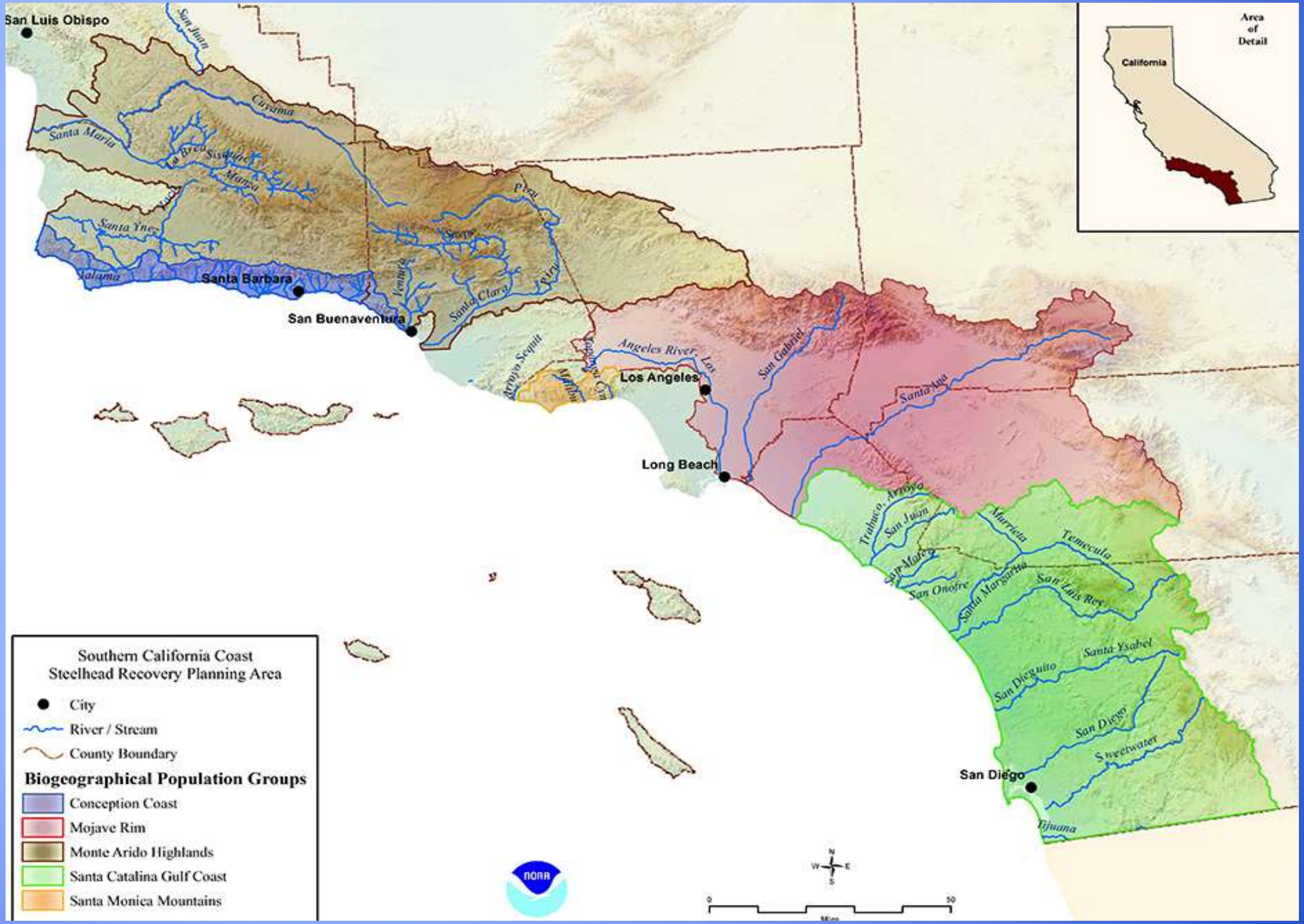
Variations



National Marine Fisheries Service

Southern California Steelhead Listing

5 Biogeographic Population Groups (BPGs)



Principal Findings: ESU/DPS Viability

Goals

1. Preserve over-all species diversity (genetic, phenotypic, life-history)

2. Prevent species from extinction due to catastrophic disturbance (wildfires, flooding, droughts)

Note: 1000-year time horizon

Principal Findings: ESU/DPS Viability

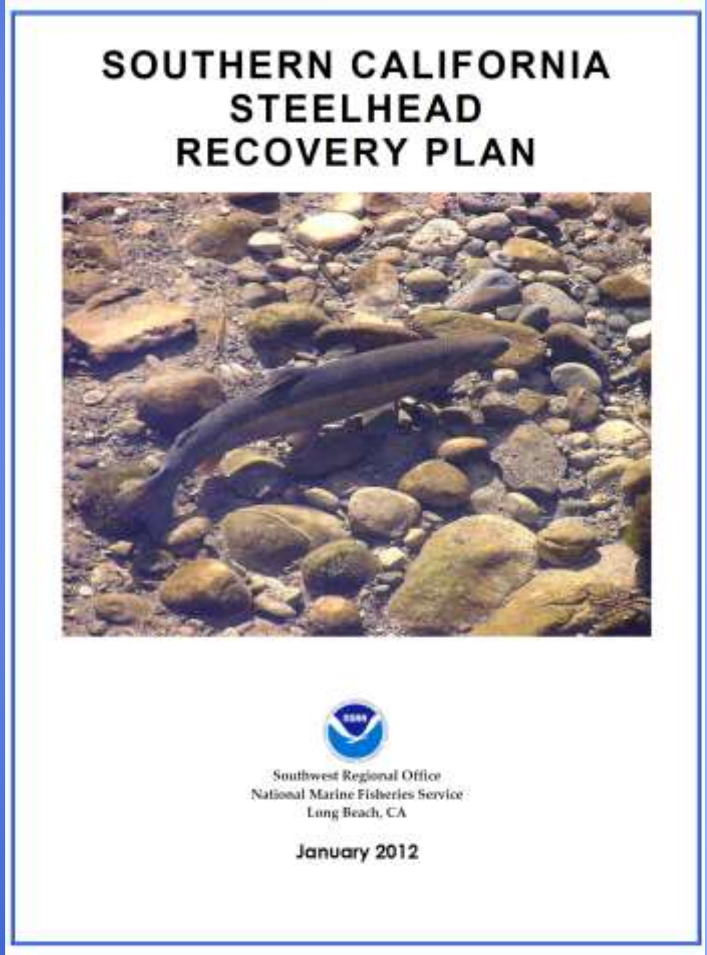
Basic Strategy

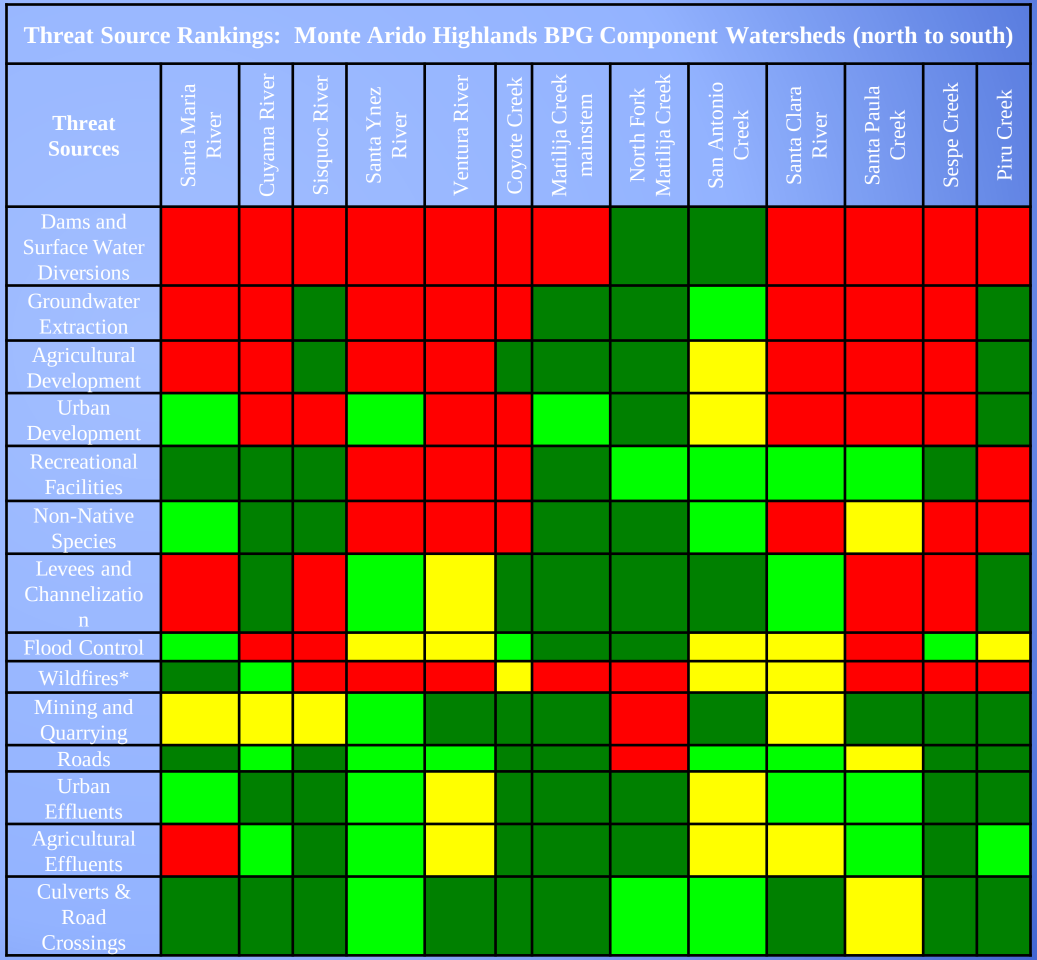
1. Restore *O. mykiss* populations in *representative* diverse biogeographic regions (diversity)

2. Restore *multiple* *O. mykiss* populations in each biogeographic regions (redundancy)

National Marine Fisheries Service

Southern California Steelhead Recovery Plan



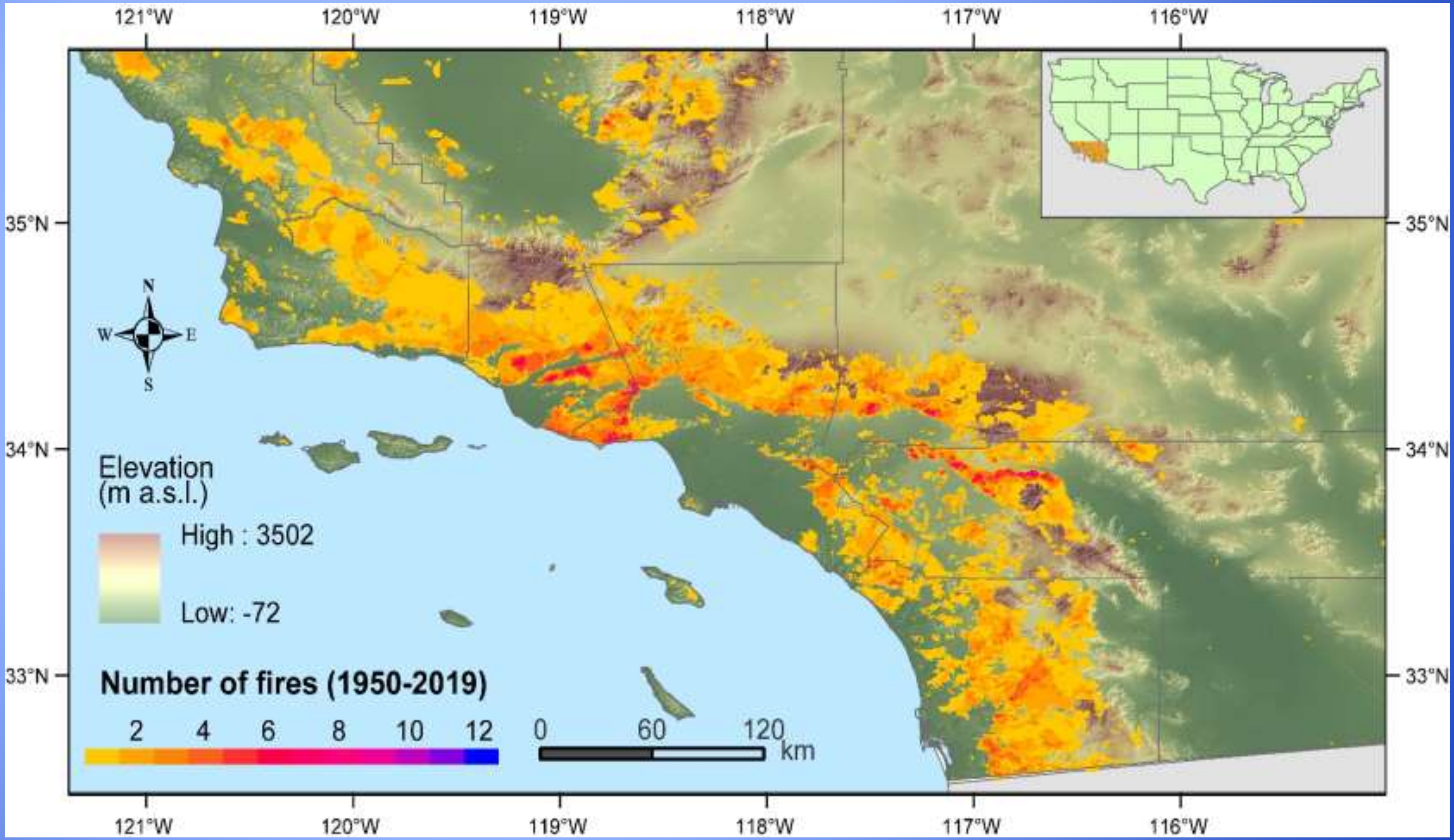


National Marine Fisheries Service

Southern California Fire Frequency

Southern California Wildfires:

1950 - 2019



Total number and distribution of recorded wildfires in southern California from 1950-2019.

Southern California Fire Frequency


Cedar Fire - 2003


Old Fire - 2003

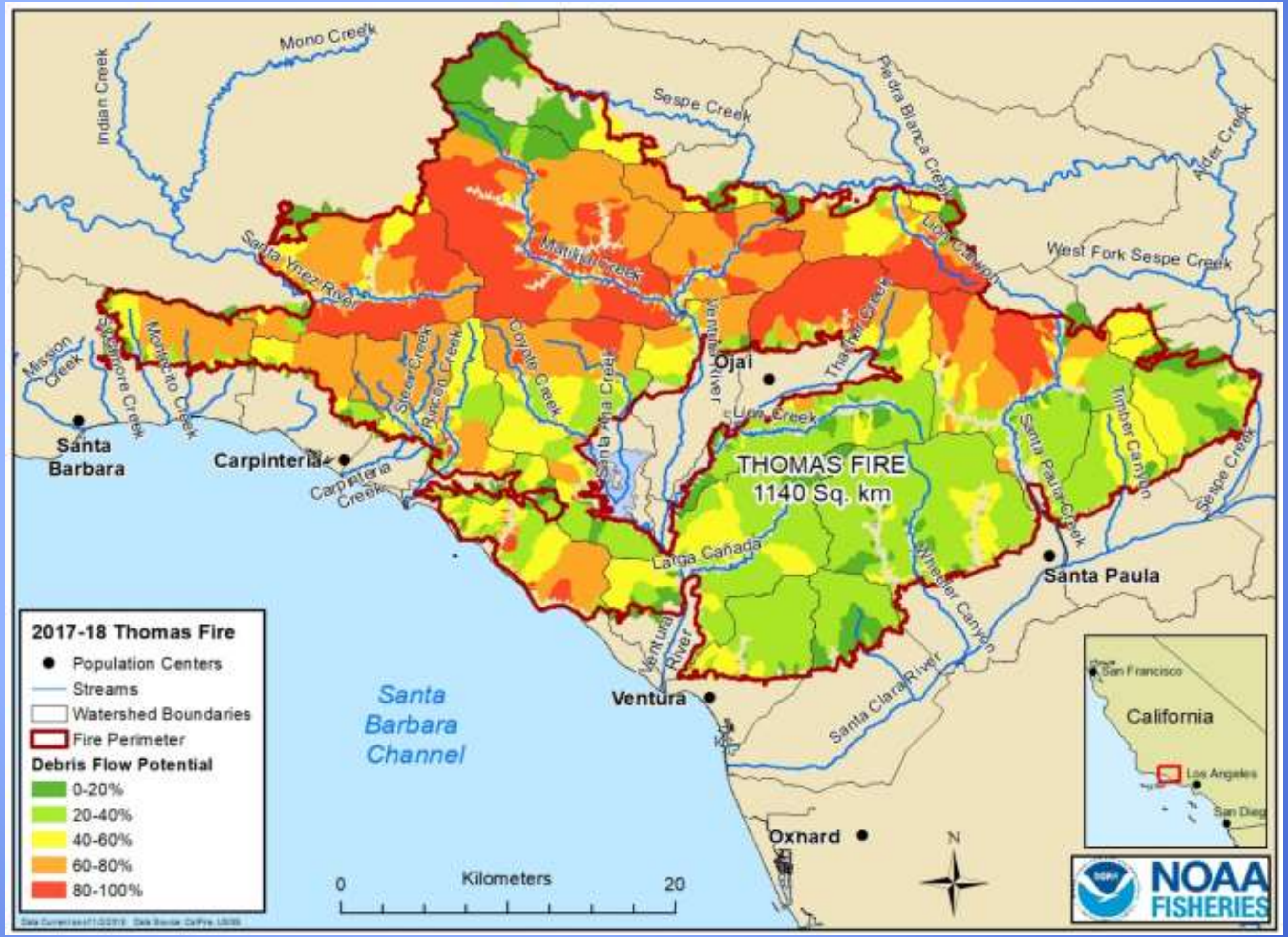

Thomas Fire 2017


Harris Fire - 2007


Station Fire - 2009

Thomas Fire - 2017

Thomas Fire
2017



Thomas Fire - 2017

Matilija Canyon Pre – Post Thomas Fire

National Marine Fisheries Service

Thomas Fire Debris Flow - 2018

Matilija Canyon – Post Thomas Fire/Debris Flow

Before and After Fire Effects

2006 Day Fire: 656 km^2

Santa Clara River - Sespe Creek

2002 - before fire

2008 - after fire

Before and After Fire Effects

2007 Santiago Fire: 115 km^2

Santa Ana River – Harding Creek

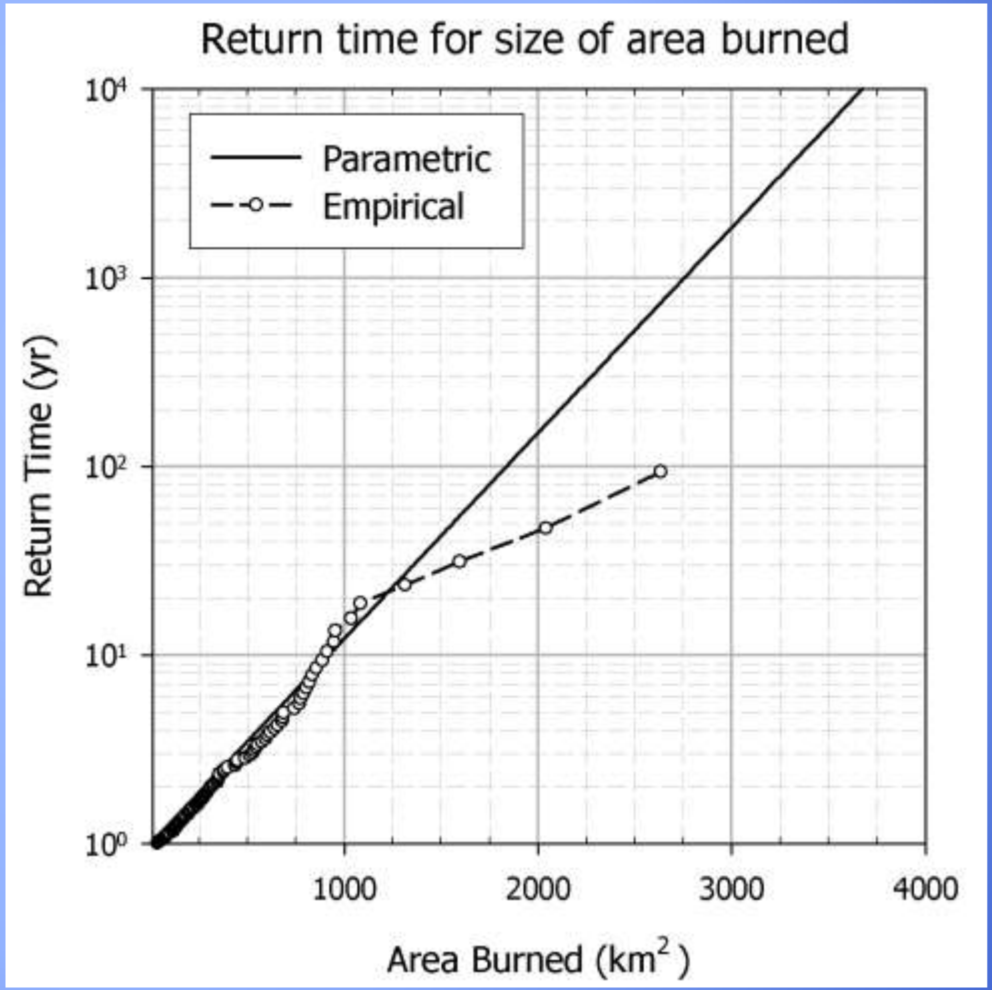
2006 - before fire

2007 - after fire

Southern California Fire Frequency

Projected Thousand-Year Wildfire Burn Area

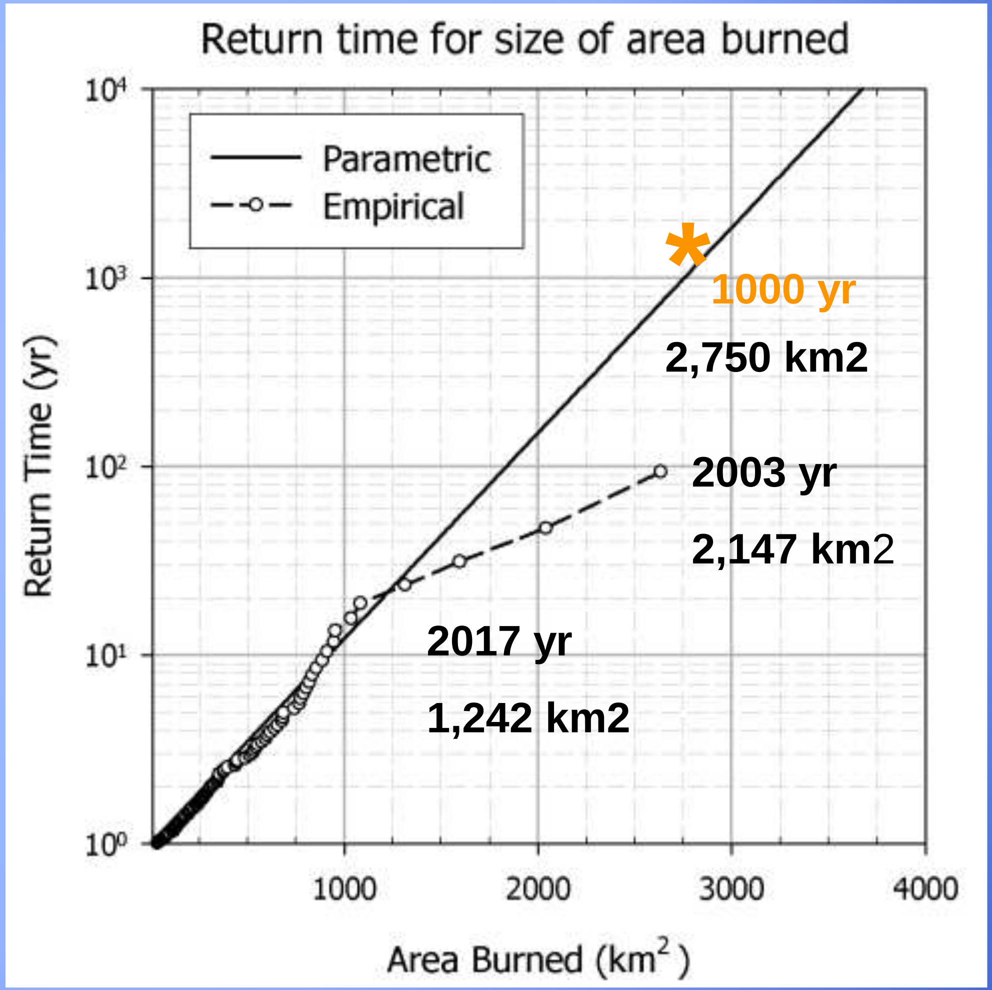
Based on 1910 – 2003 Data



Southern California Fire Frequency

*Projected Thousand-Year Wildfire Burn Area

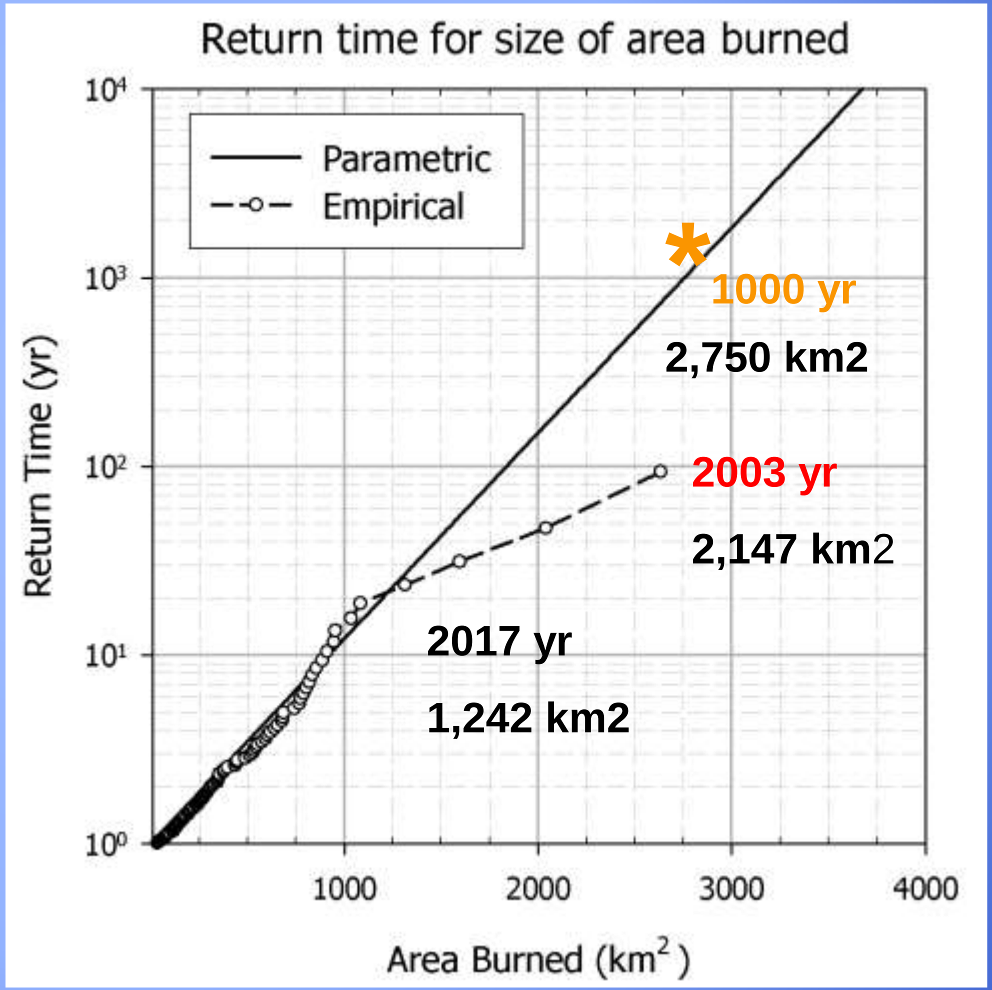
Based on 1910 – 2003 Data



Southern California Fire Frequency

*Projected Thousand-Year Wildfire Burn Area

Based on 1910 – 2003 Data

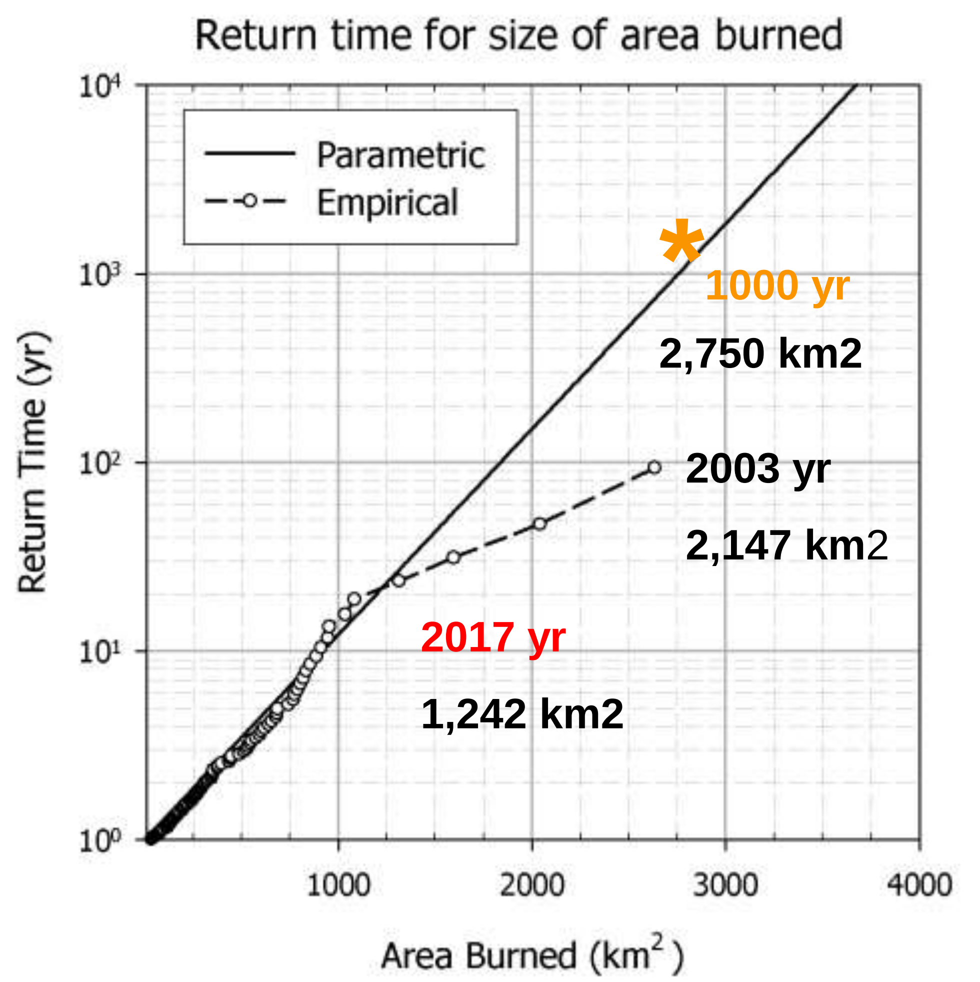


National Marine Fisheries Service

Southern California Fire Frequency

*Projected Thousand-Year Wildfire Burn Area

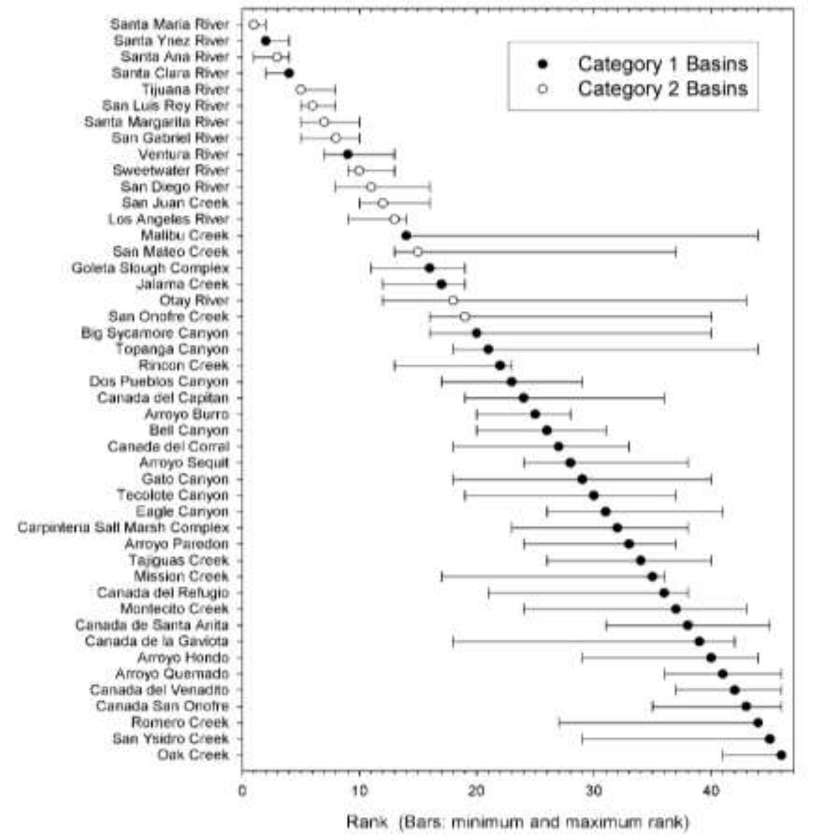
Based on 1910 – 2003 Data

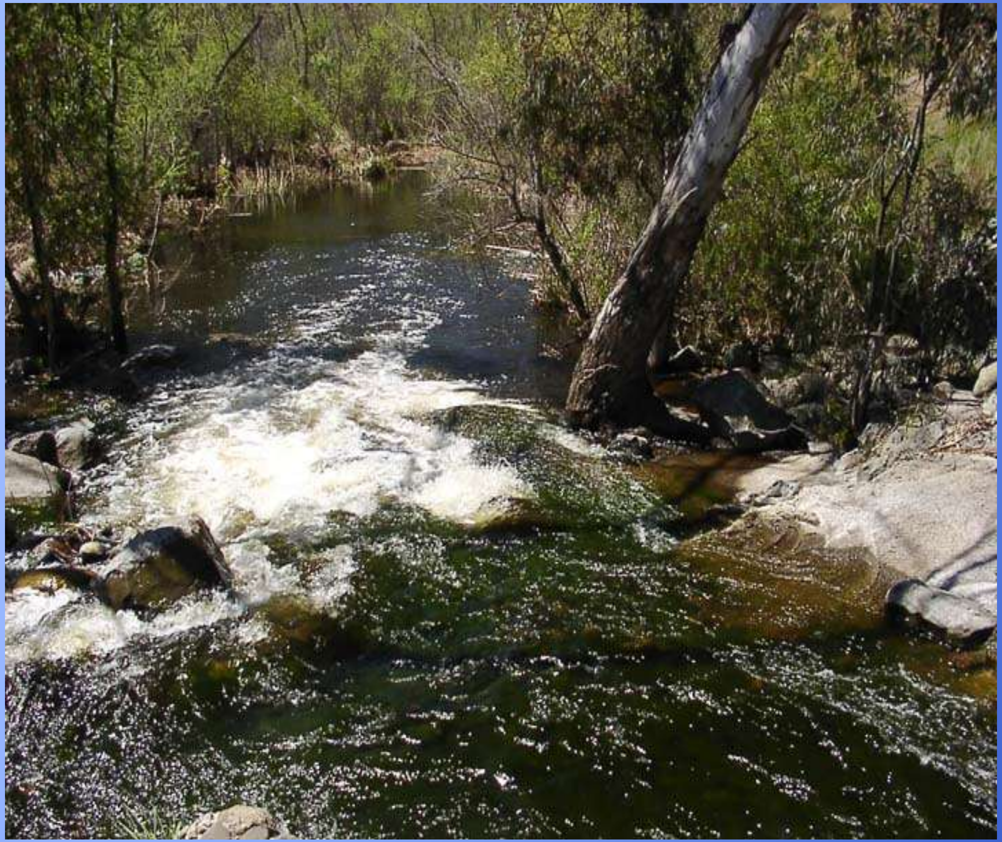


National Marine Fisheries Service

Viability Criteria

Relative Intrinsic Potential Viability

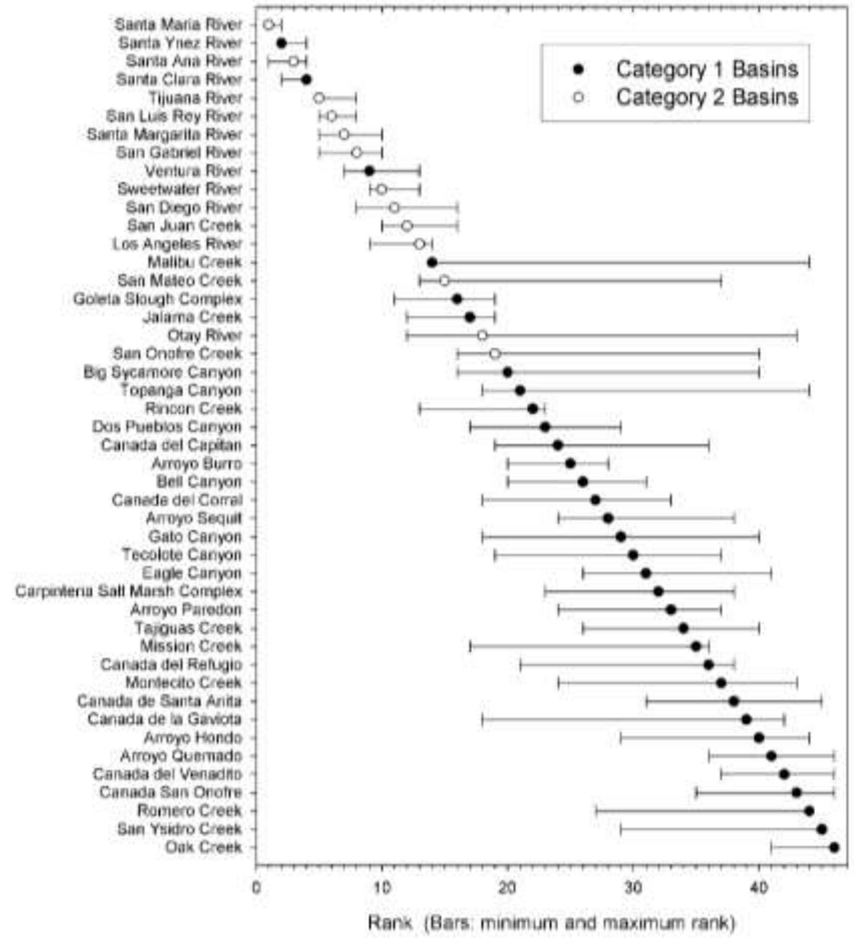




National Marine Fisheries Service

Viability Criteria

Relative Intrinsic Potential Viability



National Marine Fisheries Service

Viability Criteria

Biogeographic Diversity

1) Viable populations inhabit watersheds with drought refugia

2) Viable populations separated by ~ 68 km if possible

5 BPGs	21 Populations
Monte Arido Highlands	4
Conception Coast	3
Santa Monica Mountains	3
Mojave Rim	3
Santa Catalina Gulf Coast	8

Role of Wildfire in the Recovery of Endangered Southern California Steelhead

National Marine Fisheries Service

Salmonid Restoration Federation Conference

Santa Rosa, CA
March 26, 2024

Mark H. Capelli
Steelhead Recovery Coordinator