Reintroduction of Salmon into their Historic Habitats (Two-Part Session)

A Concurrent Session at the 35th Annual Salmonid Restoration Conference held in Davis, CA from March 29 – April 1, 2017.

Session Overview

- Session Coordinators:
  - Curtis Knight, CalTrout
  - Rob Lusardi, Ph.D., CalTrout/UC Davis

Climate change, aging water infrastructure, successive years of drought, and increasing demand for water resources has precipitated strong declines in salmonids throughout California. Compounding this, longitudinal and lateral disconnections from historical spawning and rearing habitat has triggered a loss of salmonid life history diversity, making species less resilient to change. As a result, reintroductions of salmonids to historical habitat has occurred or is proposed as a recovery strategy. Dam removal, trap and haul above high head dams, reintroduction of captive bred animals, and improving lateral connectivity to historical floodplain habitat are proposed methods to improve salmonid life history diversity, abundance, population redundancy and, ultimately, resilience to change. We seek abstracts that examine the methods, science, and policy implications of salmonid reintroductions to historical habitat.

Presentations

Part 1 of Afternoon session

(Slide 4) *Reconciliation and Reintroduction: A Community and Science-Based Recovery Plan for the Yuba River Watershed*
Gary Reedy, South Yuba River Citizens League

(Slide 36) *Coalition Based Steelhead Recovery Efforts in Southern California – South Coast*
Sandra Jacobson, Ph.D., California Trout

(Slide 52) *Estimating Potential Salmonid Habitat and Carrying Capacity in the Upper Mainstem Eel River, California, USA*
Emily Cooper, graduate student Humboldt State University

Reconciliation and Reintroduction; Recovery of Salmon and Steelhead in the Yuba River Watershed

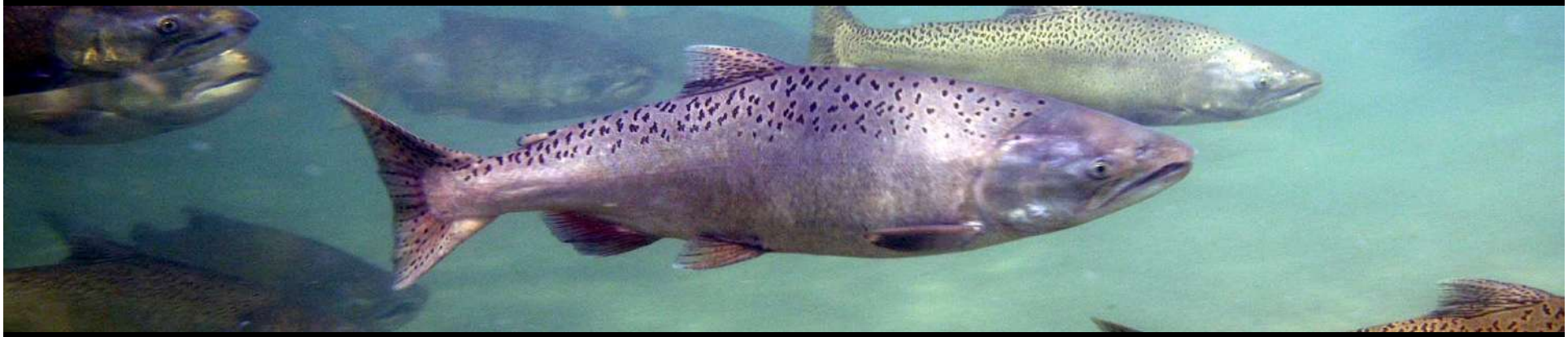
Gary Reedy
Yuba Partners
River Science Consulting

Salmonid Restoration Federation
April 1, 2017

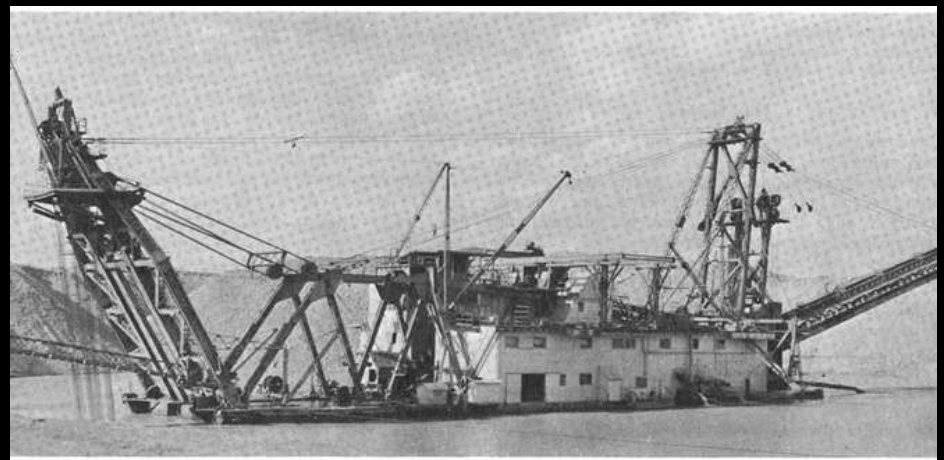
Reconciliation, Reintroduction and Recovery in the Yuba River

OUTLINE

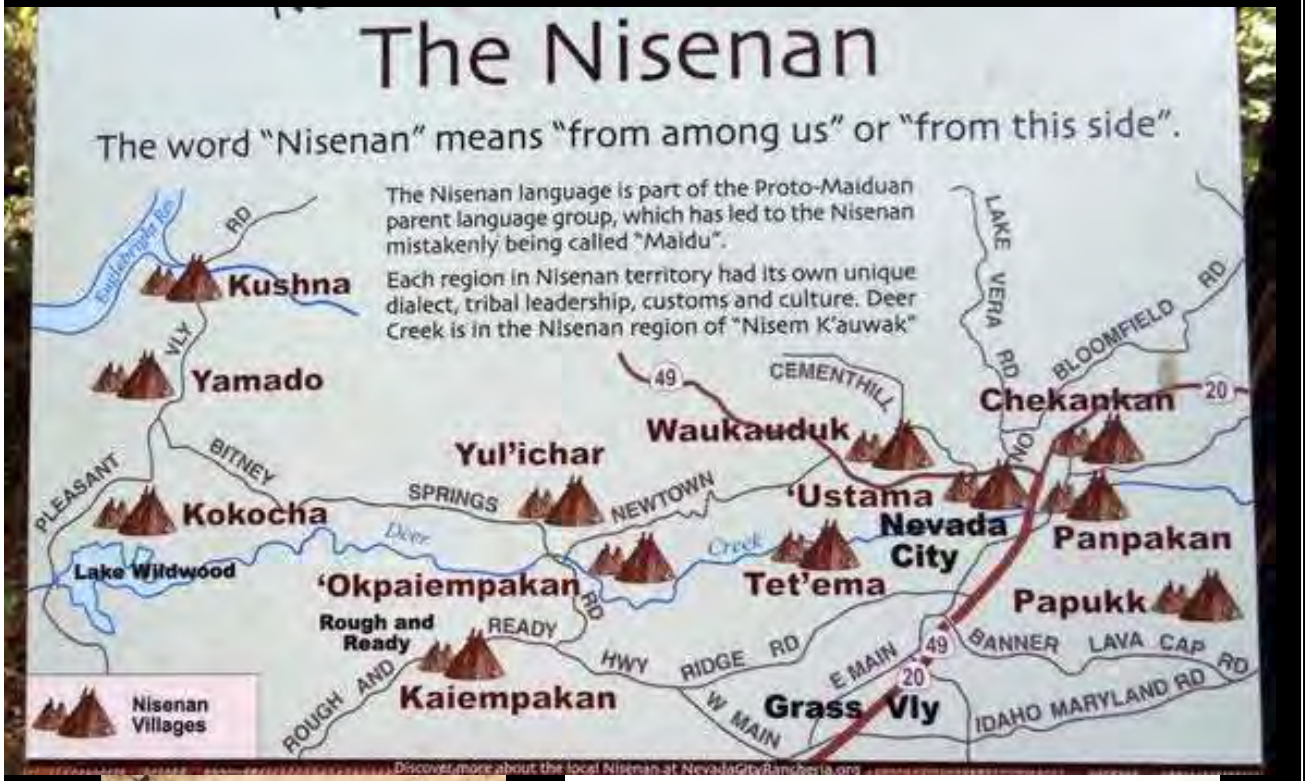
1. Why is Reconciliation needed?
2. From Reintroduction Controversy to Recovery Coordination
3. Priorities -- The Lower Yuba River Action Plan

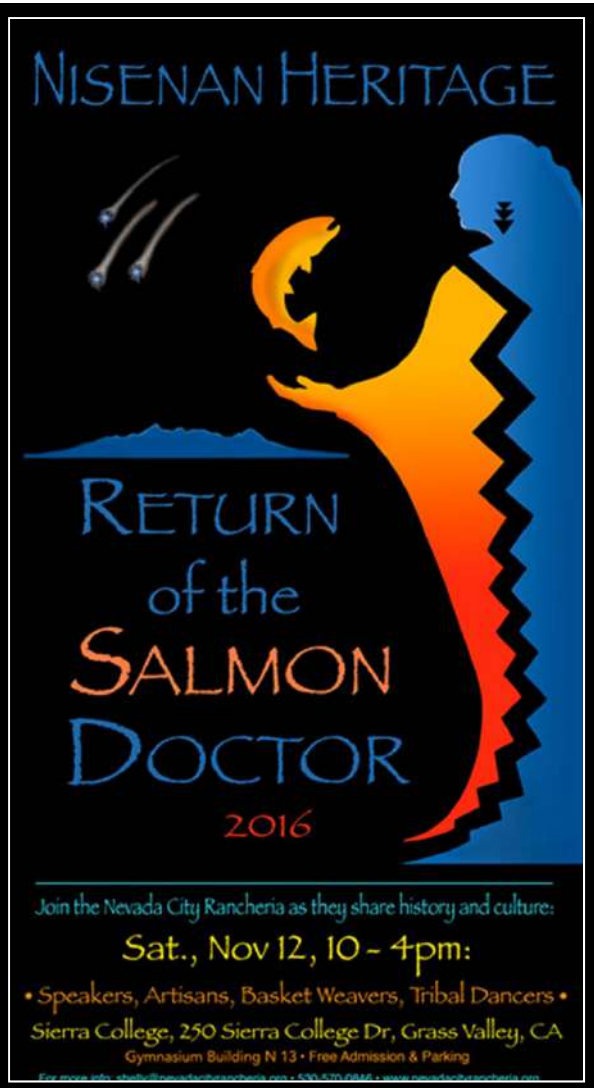


A History of Environmental Devastation and Exportation of Wealth



o 28. Yuba Consolidated Dredge, Hammonton District. Dredge No. 17 operated in the district in Yuba County until 1966. This photo v
taken a decade earlier.





Photos from Nevada City Rancheria. Nisenan Tribe

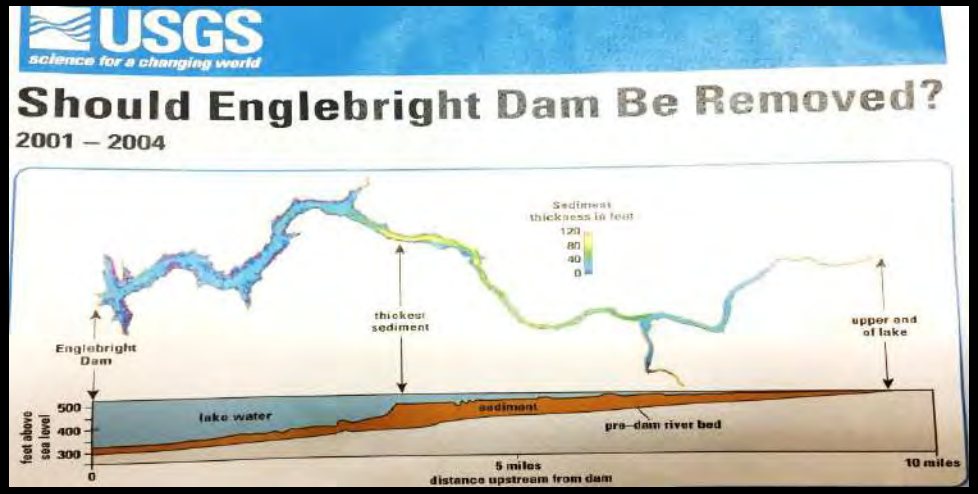
Dams Built for Mining and Debris Control and Subsequently Used for Water Diversion and Hydropower

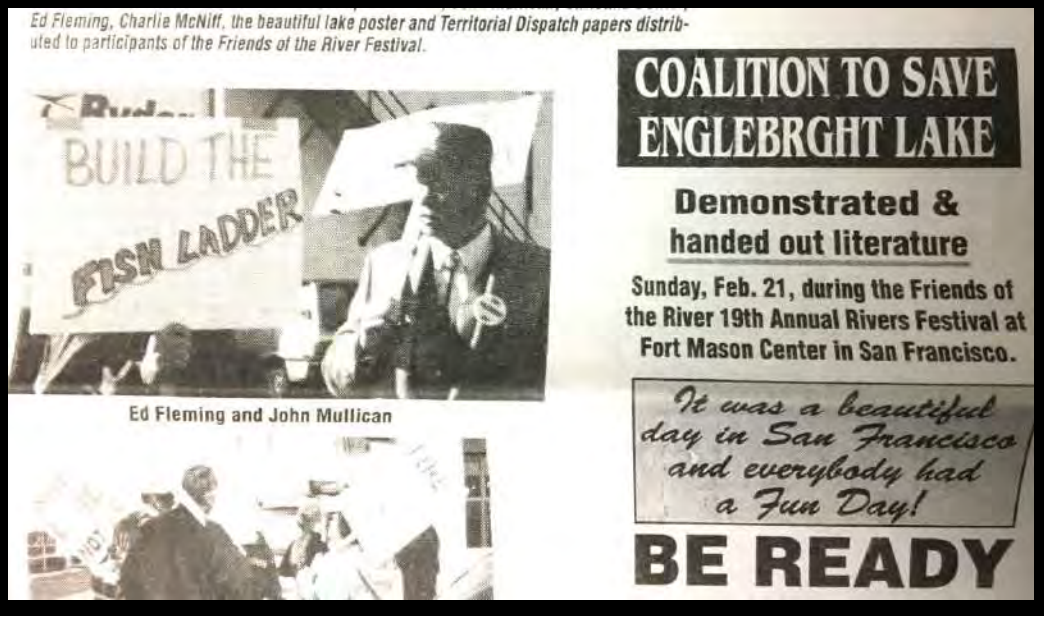
USACE's Daguerre Pont Dam (1910) and Englebright Dam (1941)

USACE's Yuba River Dams Unremediated

- **Daguerre Fish Passage Improvement Project (1999-2005**) - no follow through.
- **ESA Consultation and Biological Opinions**
  - 2006 BiOp litigated by SYRCL and Friends of the River.
  - 2012 BiOp (Jeapordy) litigated by Justice Dept and Yuba County Water Agency
  - 2013 Biological Assessment claims "no action" and dams as baseline.
  - 2014 non-BiOp for Englebright and only ladder cleaning and voluntary measures for Daguerre.
- **Army Corps' Ecosystem Restoration Feasibility Study**
  - DEIS forthcoming ?
  - Alternatives to include improved fish passage?

The Upper Yuba River Studies Program (2000-2006)





Technical Report

Upper Yuba River Watershed Chinook Salmon and Steelhead Habitat Assessment

Prepared for

California Department of Water Resources

November 2007

Prepared by

Upper Yuba River Studies Program Study Team

Yuba Salmon Forum (2009-?)

Participants

National Marine Fisheries Service
Yuba County Water Agency
California Department of Fish and Wildlife
Army Corp of Engineers
PG&E
Nevada Irrigation District
Placer Co. Water Agency
U.S. Forest Service
State Water Resources Control Board
U.S Fish and Wildlife Service
American Rivers
Trout Unlimited
California Sport Fishing Protection Alliance
Foothills Water Network
South Yuba River Citizens League
Sierra Club
Nisenan Tribal Council
Friends of Auburn Ravine
Sierra Fund

Status

- Convened as Multi-Party Forum with Charter and Goal:
  - Identify and implement actions to recover Threatened salmon and steelhead
- $3M in studies and reports focused on habitat availability and reintroduction alternatives
- "Most promising alternatives" selected by three caucuses (2015):
  - Collect and Transport to North Yuba
  - More Volitional Fish Passage Investigations
  - Lower Yuba Enhancements
- Six participants became restricted by YSPI confidentiality
- Facilitation and coordination funding by NMFS ceased in 2016

Yuba Salmon Forum (2009-?)

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Nevada Irrigation District
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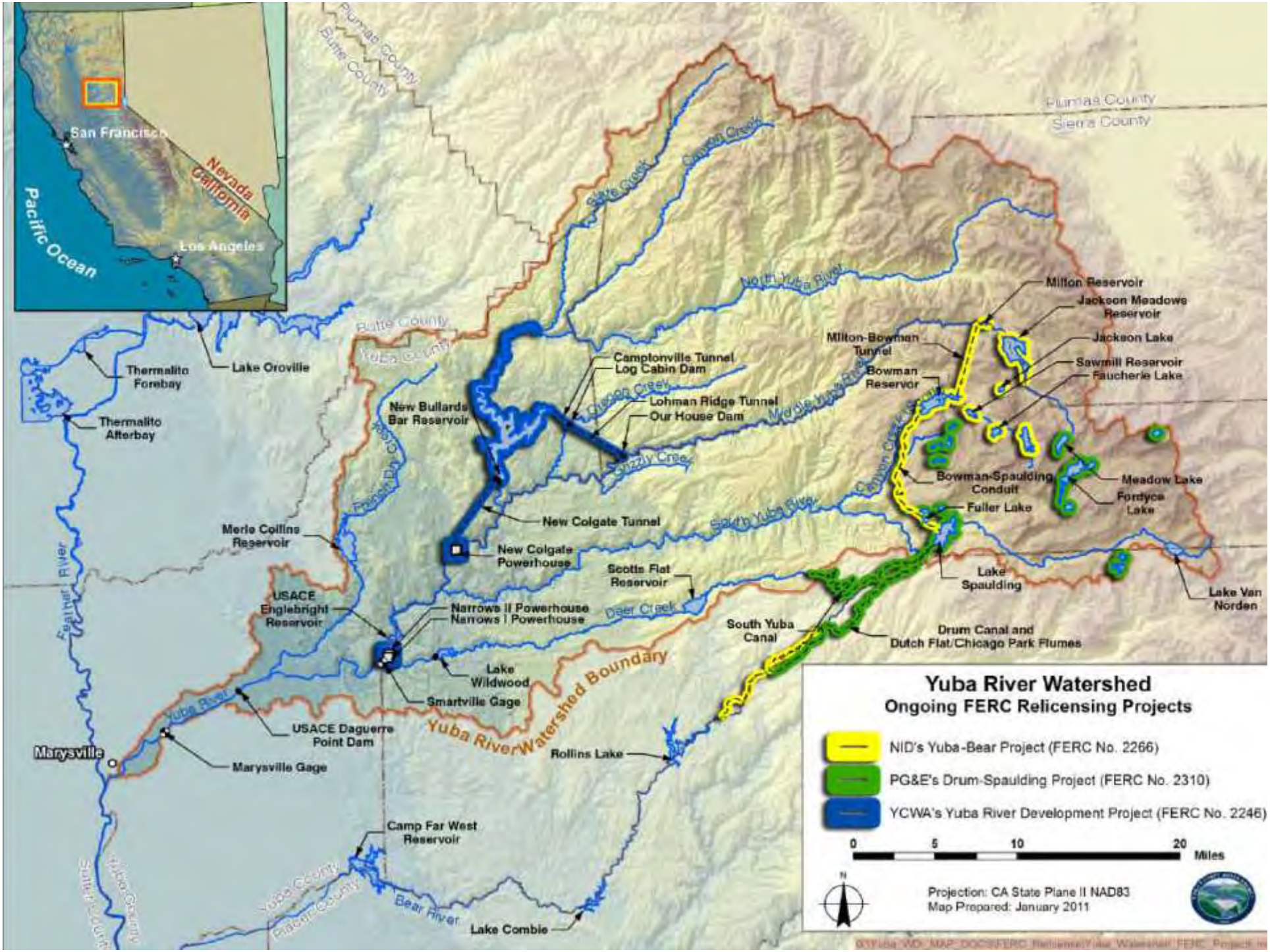
Yuba Salmon Partnership Initiative

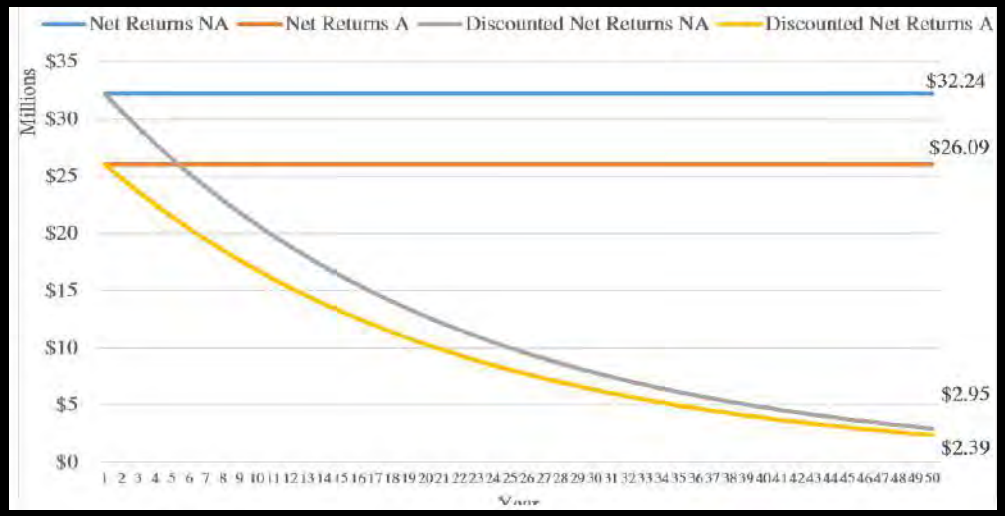
May 8th, 2015

- Term Sheet
- Concept Plan

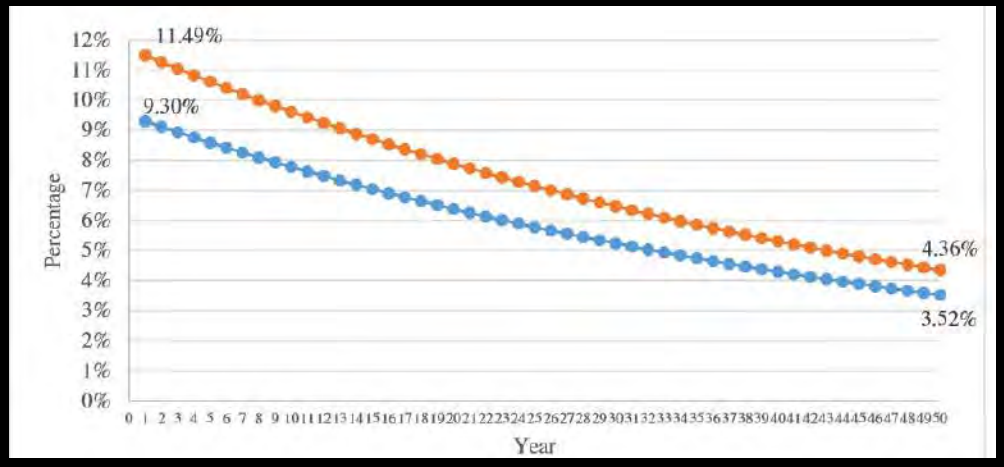
The Trap and Haul Controversy


San Francisco
Nevada
California
Pacific Ocean
Los Angeles
Plumas County
Butte County
Sierra County
Yuba County
Nevada County
Placer County
Sutter County
Colusa County
Yolo County
Solano County
Thermalito Forebay
Thermalito Afterbay
Lake Oroville
New Bullards Bar Reservoir
Camptonville Tunnel
Log Cabin Dam
Lohman Ridge Tunnel
Our House Dam
New Colgate Tunnel
New Colgate Powerhouse
Merle Collins Reservoir
Scotts Flat Reservoir
USACE Englebright Reservoir
Narrows II Powerhouse
Narrows I Powerhouse
Lake Wildwood
Smartville Gage
USACE Daguerre Point Dam
Marysville
Marysville Gage
Yuba River Watershed Boundary
Rollins Lake
Camp Far West Reservoir
Bear River
Lake Combie
Feather River
Deer Creek
Oregon Creek
Slate Creek
Canyon Creek
North Yuba River
Grizzly Creek
Middle Yuba River
South Yuba River
Milton Reservoir
Jackson Meadows Reservoir
Jackson Lake
Milton-Bowman Tunnel
Bowman Reservoir
Sawmill Reservoir
Faucherie Lake
Bowman-Spaulding Conduit
Fuller Lake
Meadow Lake
Fordyce Lake
Lake Spaulding
Lake Van Norden
South Yuba Canal
Drum Canal and Dutch Flat/Chicago Park Flumes
Yuba River Watershed
Ongoing FERC Relicensing Projects
NID's Yuba-Bear Project (FERC No. 2266)
PG&E's Drum-Spaulding Project (FERC No. 2310)
YCWA's Yuba River Development Project (FERC No. 2246)
0
5
10
20
Miles
N
Projection: CA State Plane II NAD83
Map Prepared: January 2011

YCWA's Annual Net Returns from Hydropower, Ancillary Services and Water Sales

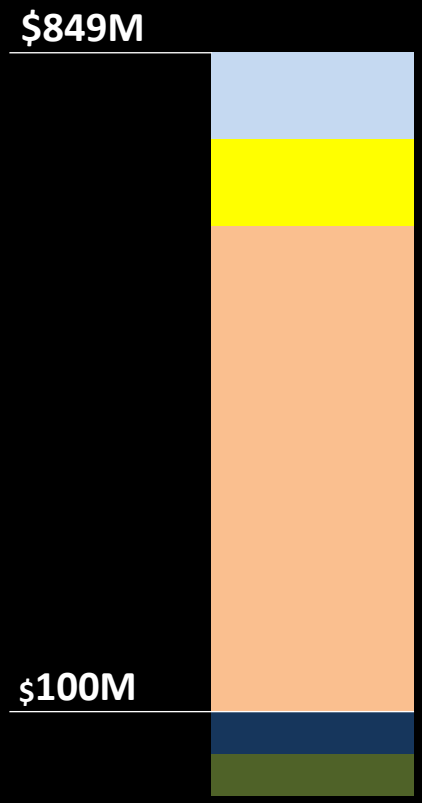


Annual Amortized Payments for $100M Expenditure



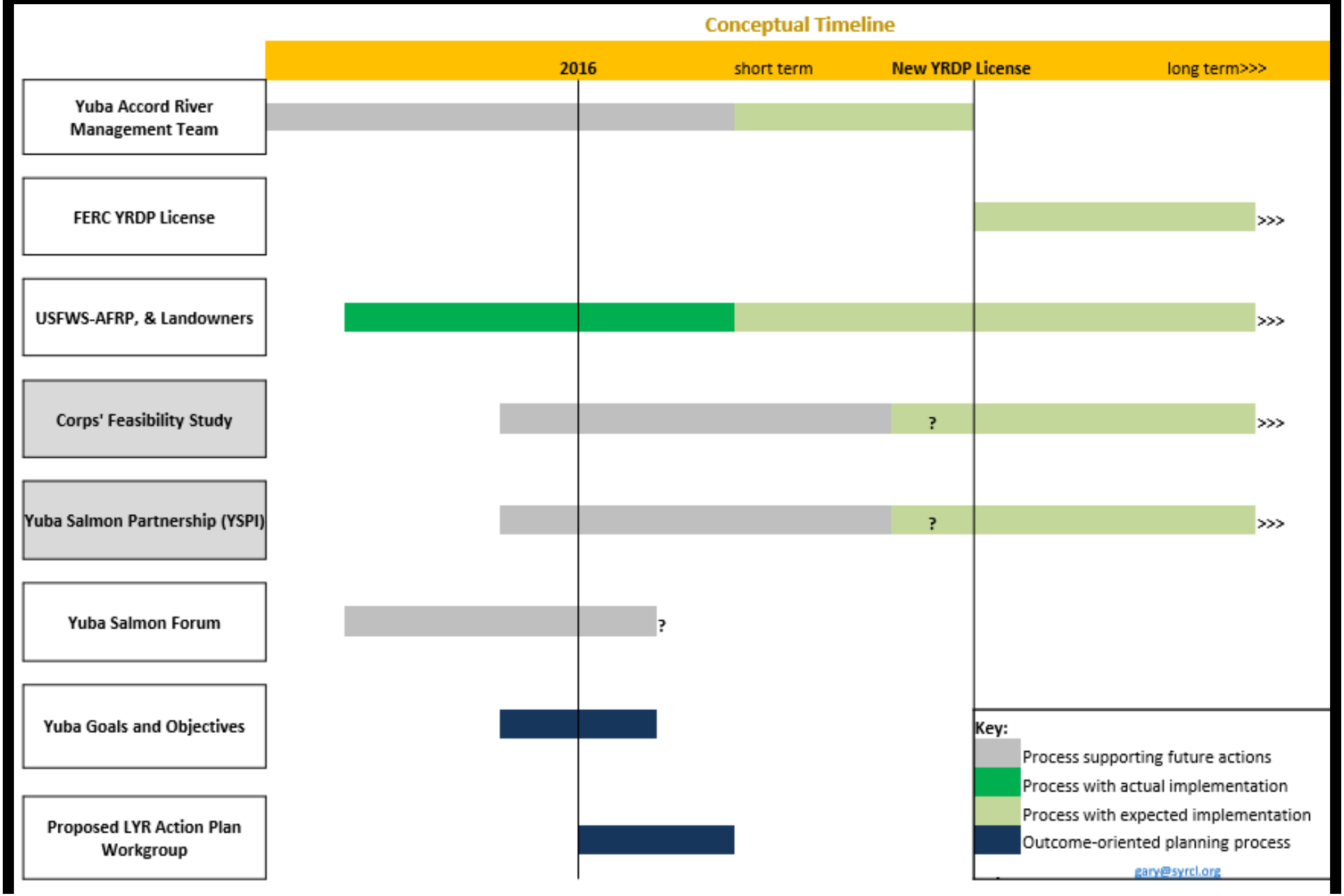
Kaplan, J.D. 2015. The Financial Feasibility of YCWA to Fund Restoration Projects. Pacific Agroecology LLC

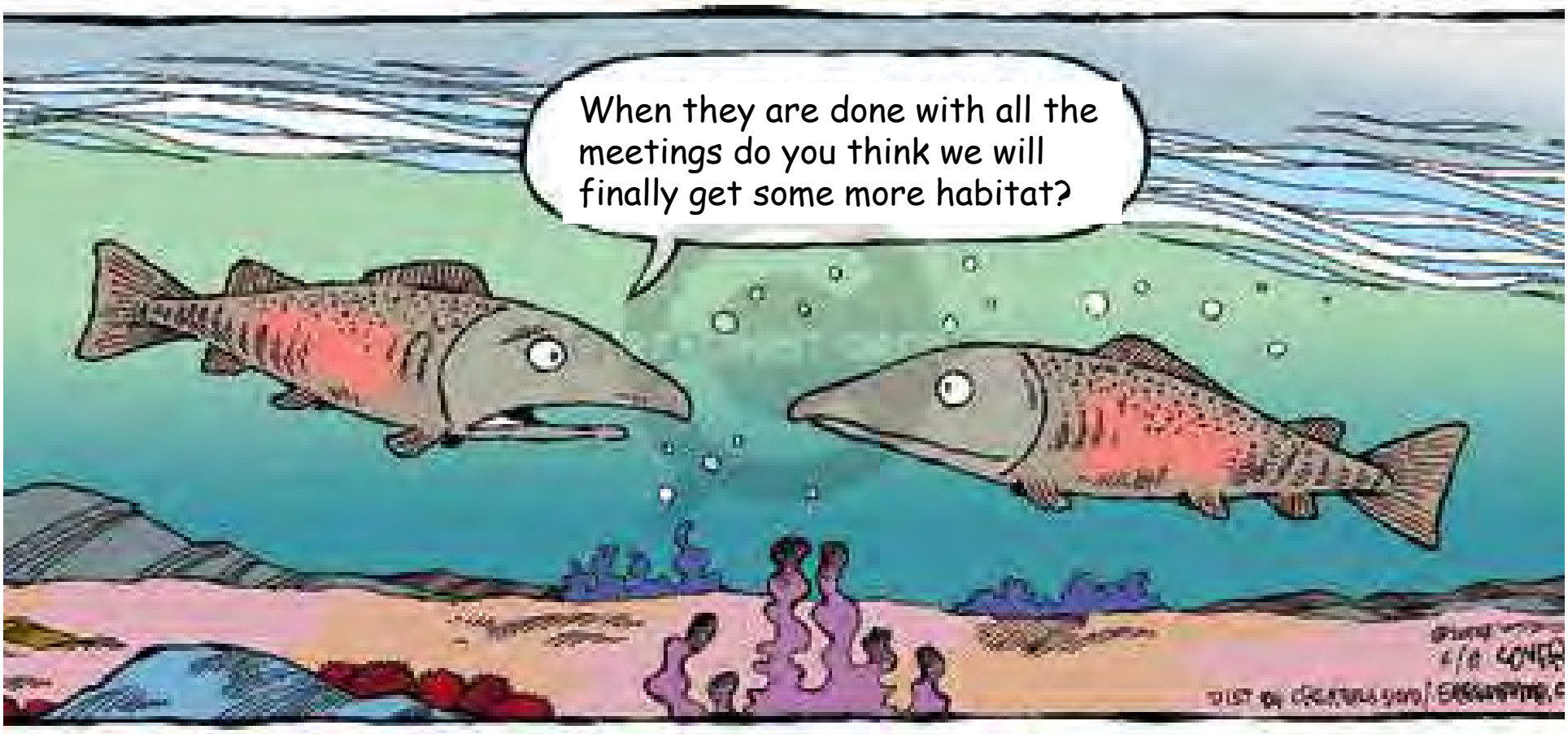
YCWA's Share of Estimated Cost of YSPI Concept Plan Implementation



From Cost Estimates in YSPI Concept Plan (2015)

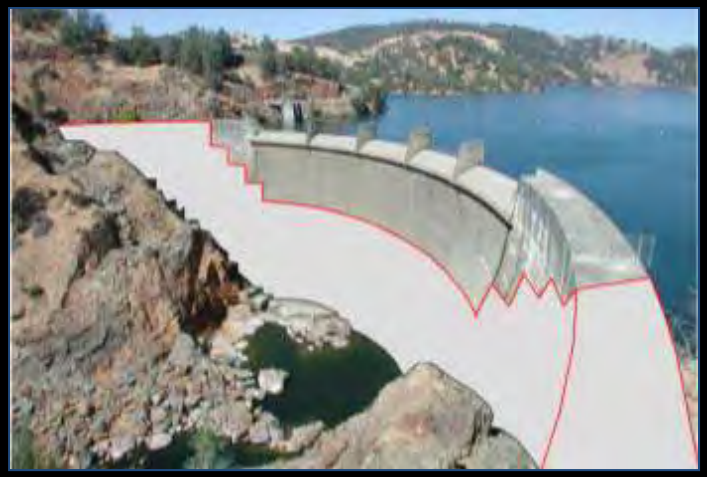
Processes! Where and When is the Action?




When they are done with all the meetings do you think we will finally get some more habitat?

Priorities for Reconciliation and Recovery of Salmonids in the Yuba River Watershed

- Maintain the Yuba Salmon Forum as an open stakeholder process
- Develop Biological Goals and Objectives
- Develop a long-term plan for volitional fish passage while planning any trap and haul program.
- Focus on Lower Yuba River Actions



The Lower Yuba River Action Plan

- Updating NMFS 2012 Recovery Plan actions for the Yuba River.
- Incorporating local knowledge
- Building on pilot projects and on-the ground initiatives
- Setting targets and measuring progress with Biological Goals and Objectives

Potential Recovery Actions for the Lower Yuba River

- Riparian enhancement
- Large wood placement
- Side-channel and backwater construction/enhancement
- Benching and floodplain lowering
- Levee (or training wall) setback
- Rice field rearing
- Daguerre Point Dam fish passage improvement
- Spawning gravel and habitat enhancement near Englebright
- Segregation weir
- Conservation easements and cooperative land use

cbec
eco engineering

Hydrology | Hydraulics | Geomorphology | Design | Field Services

Photo courtesy: Tom Johnson

Hydrologic and Geomorphic Analysis to Support Rehabilitation Planning for the Lower Yuba River from Parks Bar to Marysville

SYRCL

Prepared for:
South Yuba River Citizens League

November 2013

Funding provided by: U.S. Fish and Wildlife Service - Anadromous Fish Restoration Program

cbec Project # 13-1003

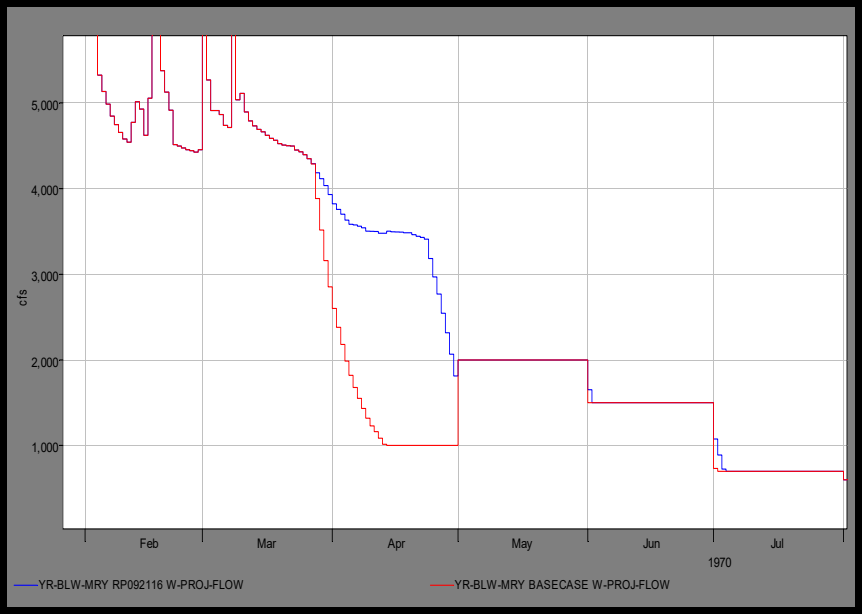
Habitat Expansion Agreement for
Central Valley Spring-Run Chinook Salmon
and California Central Valley Steelhead

FINAL HABITAT EXPANSION PLAN

November 2010

Prepared by:
California Department of Water Resources
and Pacific Gas and Electric Company

Juvenile salmonid productivity!



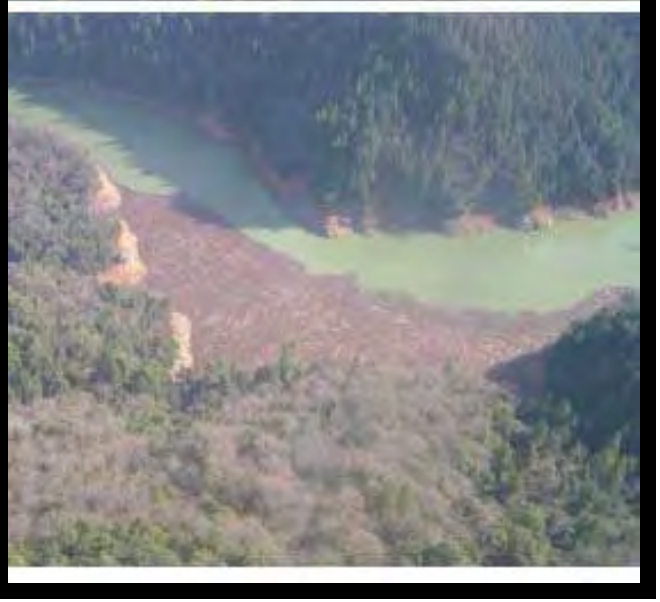
Hammon Bar Riparian Enhancement Project

Funded by the Bella Vista Foundation, the Anadromous Fish Restoration Program, and PG&E

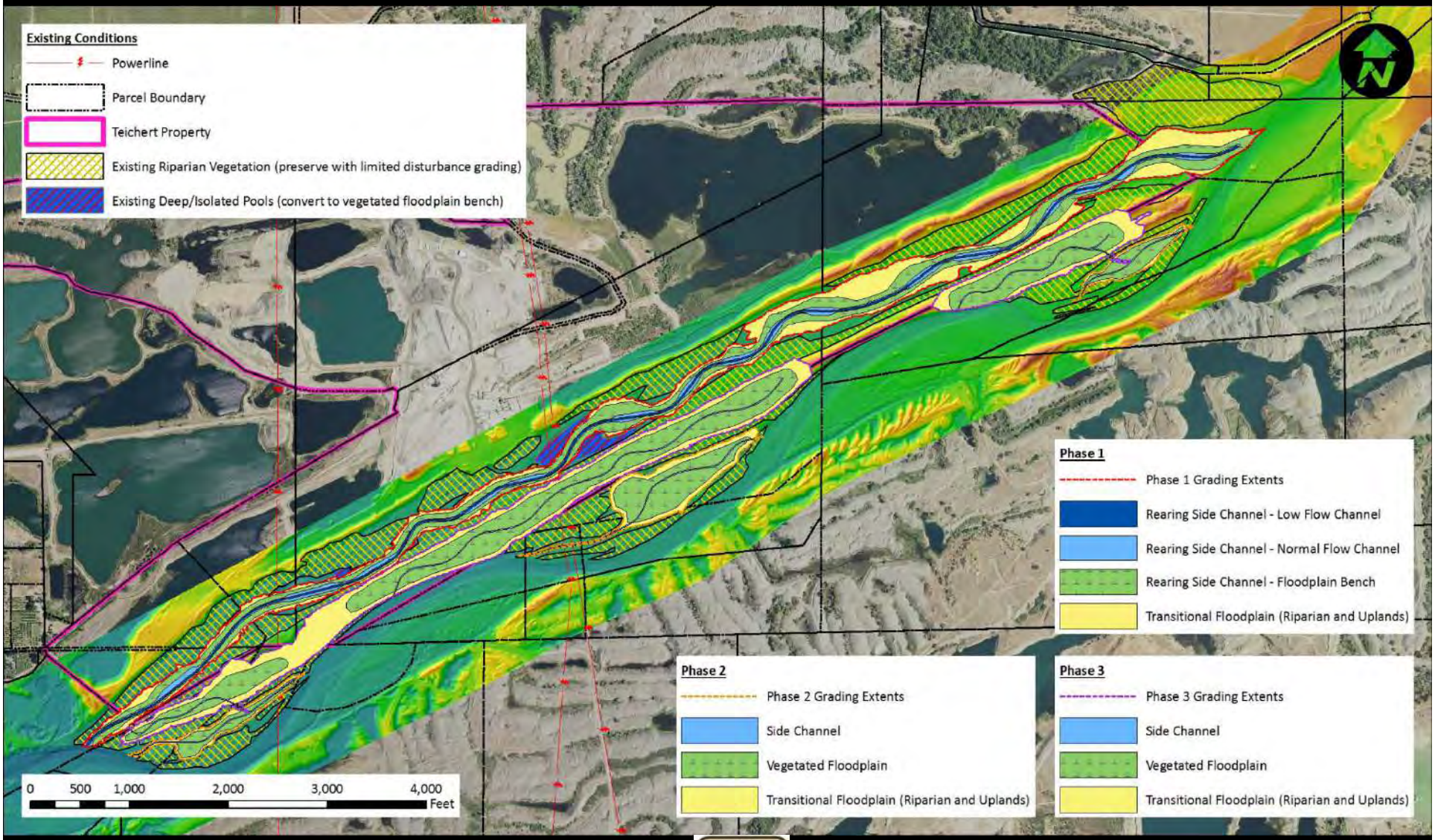
yubariver.org/restoration

Hammon Bar Riparian Enhancement Project

Large Woody Material

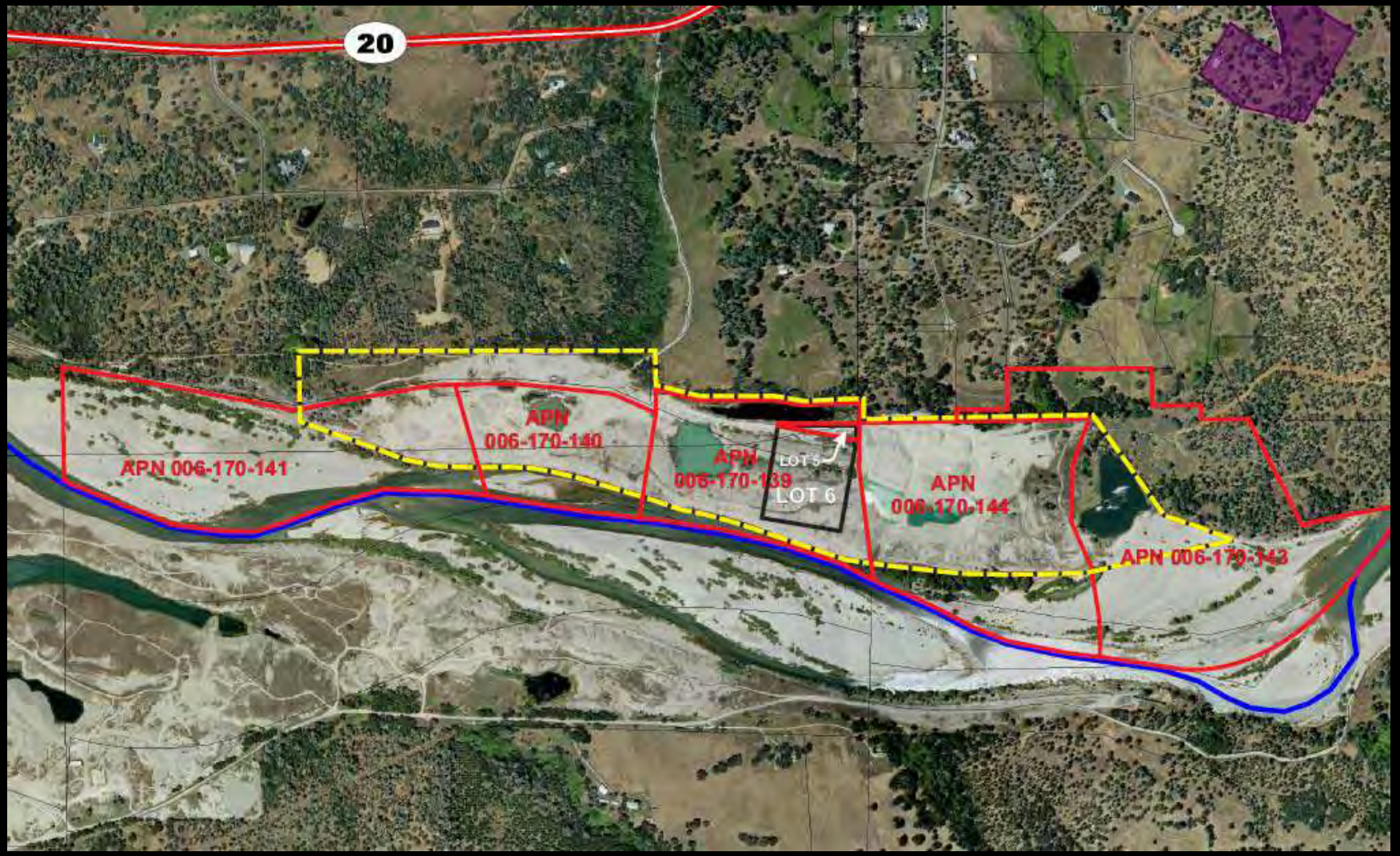


Hallwood Side Channel and Floodplain Restoration Project



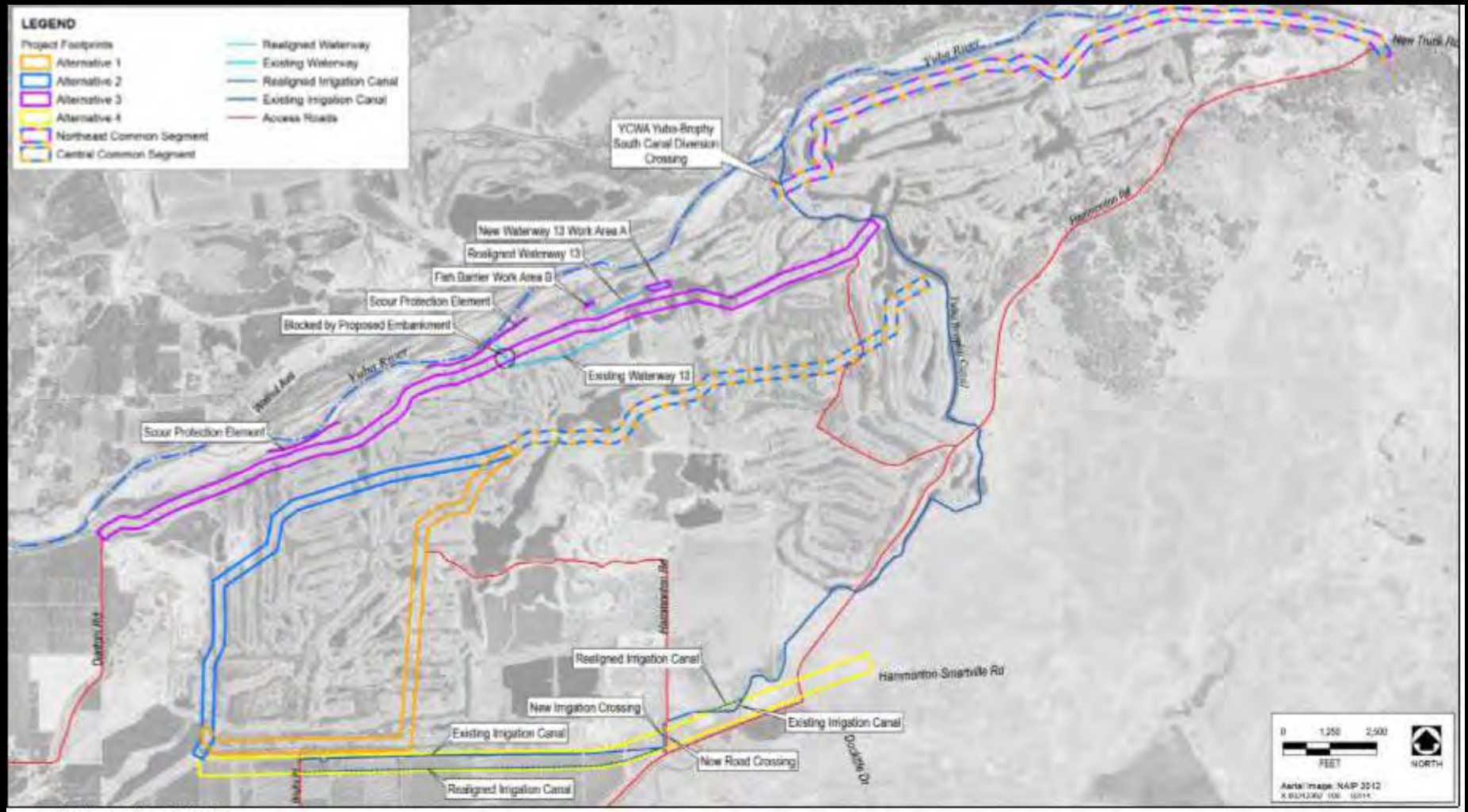
Preliminary Design

Long Bar



Parcels on Long Bar (red) and reclamation plan boundary (yellow)

Goldfields Flood Protection Need is a Opportunity for Large-scale Floodplain Restoration

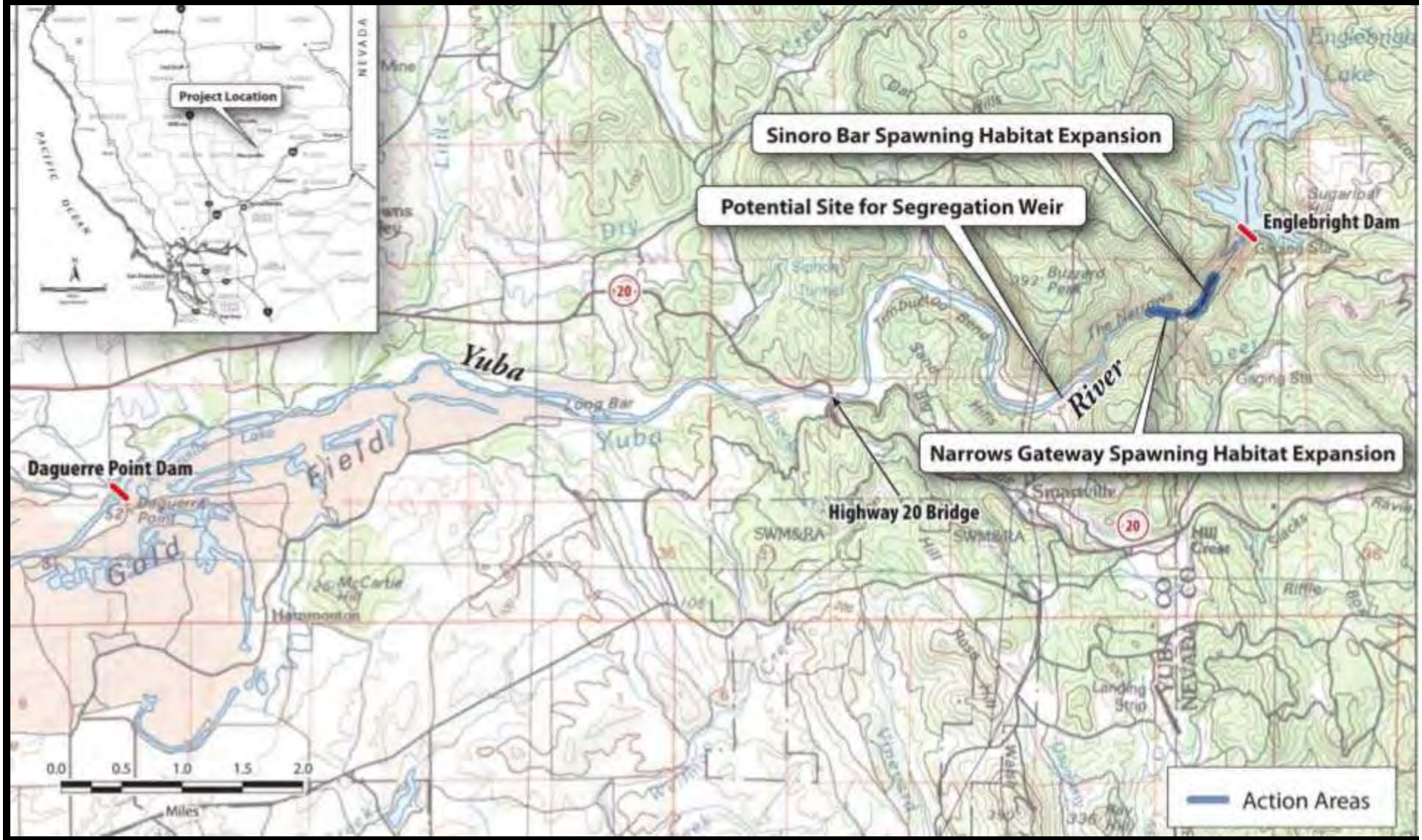


Source: TRLIA 2013, adapted by AECOM in 2014

Exhibit 2-1

Yuba Goldfields 200-Year Flood Protection Alternatives

Spawning Enhancements and Segregation Weir for Recovery of Spring-Run Chinook is Near-term Feasible



CDWR and PG&E Habitat Expansion Plan (2010)

Reconciliation, Reintroduction and Recovery of Salmonids in the Yuba River Watershed

Thank You!

Contacts:
Rachel Hutchinson, SYRCL River Science Director, rachel@syrcl.org
Gary Reedy, Yuba Partners Restoration Ecologist, garyreedy@gmail.com

"Trap and Haul" Plan for the Yuba River Watershed

Read by the numbers to learn about the Trap and Haul Plan

2 Trucks would transport adult salmon to the North Yuba and juvenile salmon to the Lower Yuba River bypassing 40 miles of river in the middle of the watershed.

4 A Juvenile Salmon Capture Facility (aka Floating Surface Collector) would be placed in the north arm of New Bullards Bar Reservoir. The facility would include expansive nets, and would ultimately place fish into containers to be transported by boats over the length of New Bullards Bar Reservoir.

3 Adult Salmon Release Facility would be constructed on the North Yuba River, including concrete ponds to de-stress fish.

Map Legend:

- Stream with no salmon
- Stream with salmon, no steelhead
- Stream with salmon and steelhead
- Major Canal Diversions
- Major Dams
- Proposed Facilities

8 Habitat in the North Yub River is limited by the ar of suitably cool water in summer and early fall when adult spring-run Chinook salmon hold and spawn. Habitat is currently limited to the uppermost 5-23 miles of the North Yuba below Loves Falls. Scientists predict that warming due to climate change will increase water temperatures by more than 3° C in the next 30 years, possibly eliminating all such suitable habitat.

5 A Juvenile Salmon Transfer Pier Facility would be used to move containers of fish from boats to trucks.

1 Adult Salmon Capture Facility (concept design pictured) would be constructed on the Lower Yuba River, reinforcing the permanence of Daguerre Pt Dam.

North Yuba River
Milton Dam
Bowman Dam
Middle Yuba River
49
Our House Dam
New Bullards Bar Dam
South Yuba River
Colgate Powerhouse
Spaulding Dam
49
Nevada City
Englebright Dam
Grass Valley
Daguerre Pt Dam

7 Englebright Dam and hydropower facilities would remain unchanged.

9 If successful in creating a populatio of spring-run Chinook salmon for the North Yuba River, the plan would requir perpetual funding for facilities and operation, while not helping steelhead trout which are also at risk of extinction.

6 A Juvenile Salmon Release Facility would be constructed on the lower Yuba River, including concrete ponds to de-stress fish after transport.

SOUTH YUBA RIVER SYRCL CITIZENS LEAGUE

For more information go to yubasalmonnow.org

"Volitional" Fish Passage Vision for the Yuba River Watershed

Read by the numbers to learn about SYRCL's vision for restoring wild Yuba salmon

1 Volitional fish passage would allow both steelhead trout and spring-run Chinook to swim freely between the ocean and habitats up to natural barrier waterfalls on the Middle and South Yuba Rivers, as well as up to the North Yuba River below New Bullards Bar Dam.

2 Red highlights of the map show where steelhead trout or salmon could be found within a continuum of connected river habitats, providing many important ecological benefits. Some tributaries would provide additional habitat for steelhead trout.

Map Legend:

- Stream with no salmon
- Stream with salmon, no steelhead
- Stream with salmon and steelhead
- Major Canal Diversions
- Major Dams

6 A fish ladder could be constructed at Our House Dam along with a screen to protect juvenile fish from entering the tunnel diverting water to New Bullards Bar Reservoir.

3 The Lower Yuba River is the priority for habitat restoration that would enable salmon populations to improve in abundance, diversity and resilience. This picture shows some of the rare habitat that could be vastly expanded. Daguerre Point Dam could be removed as part of this comprehensive and sustainable effort to restore the river ecosystem.

5 Increased flows and habitat restoration below New Bullards Bar Dam would secure cold water for salmon into the future with a warmer climate and less snowpack.

North Yuba River

Milton Dam

Bowman Dam

Middle Yuba River

49

Our House Dam

New Bullards Bar Dam

South Yuba River

Colgate Powerhouse

Spaulding Dam

49

Engleb

Daguerre Pt Dam

7 Habitat is limited by the area of suitably cool water in summer and early fall when adult spring-run Chinook hold and spawn. Habitat is thus limited to the uppermost 6-9 miles of the Middle Yuba River and 0-2 miles in the South Yuba River. The amount depends upon potential climate conditions and specific releases from upstream reservoirs. Additional habitat could be achieved through greater releases of flow. See #5 regarding additional habitat in the lower North Yuba River.

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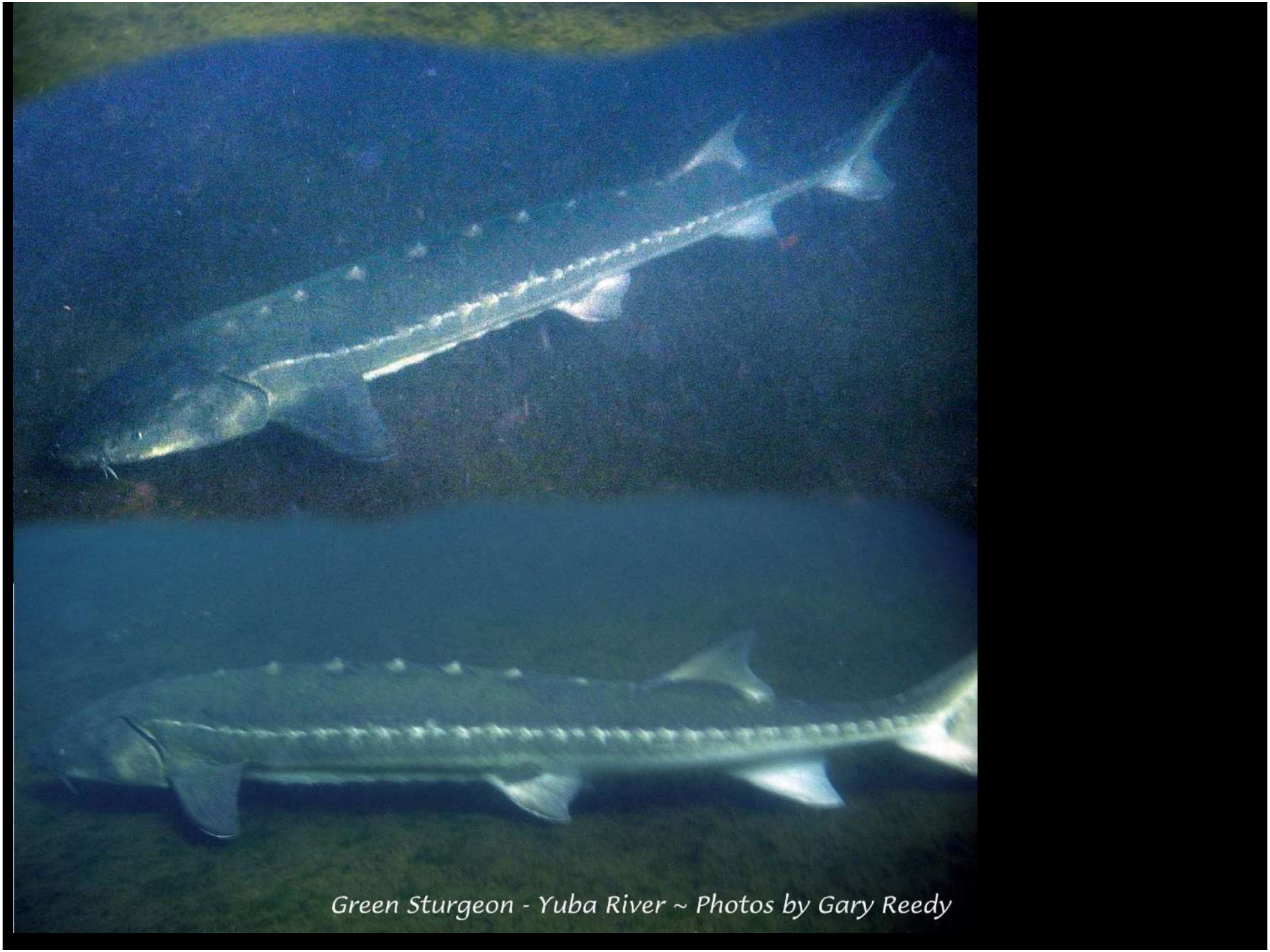
"Notched" Englebright Dam

SOUTH YUBA RIVER CITIZENS LEAGUE SYRCL

For more information go to yubasalmonnow.org


USACE's
Englebright Reservoir
Power Tunnel Intake
NARROWS 2 POWERHOUSE
Capacity: 46.7 MW
Rated Head: 236 ft
Rated Flow: 3,400 cfs
Turbine Type: Francis (1)
USACE's Englebright Dam
Height: 260 ft
Crest Elevation: 527 ft
Type: Concrete, Arch
NARROWS 2 POWERHOUSE
PARTIAL BYPASS
Capacity: 650 cfs
NARROWS 2 POWERHOUSE
FULL BYPASS
Capacity: 3,000 cfs
Narrows 2 Access Road
(on State & YCWA land)
PG&E's 12 MW Narrows #1
Penstock and Powerhouse
Rated Flow: 730 cfs


Green Sturgeon - Yuba River ~ Photos by Gary Reedy

Coalition-based Southern California Steelhead Recovery – South Coast

35th Annual SRF Conference
Sandra Jacobson, CalTrout
29 March – 1 April, 2017

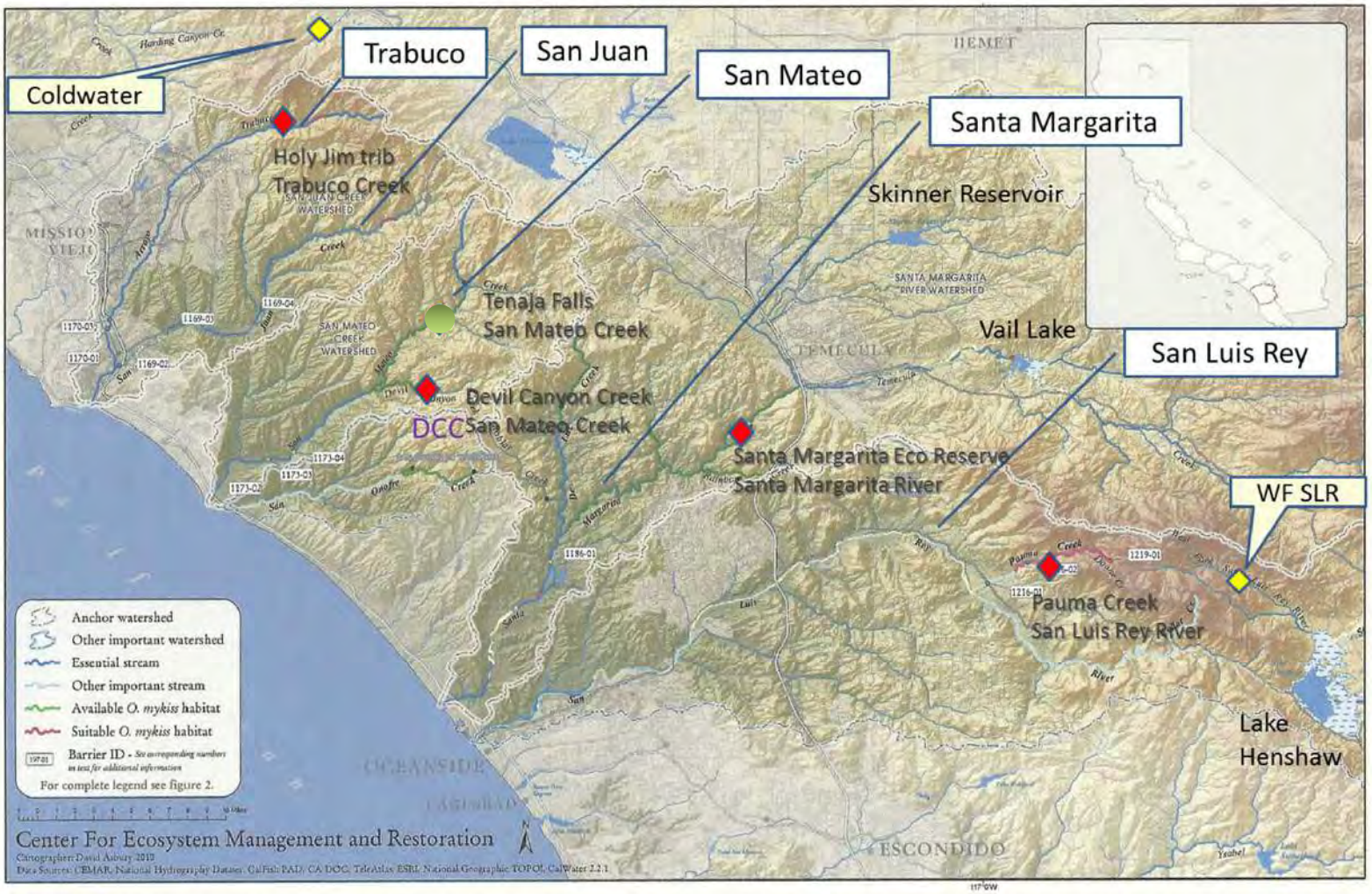
Photo: Kerwin Russell, RCRCD
Coldwater Creek, 1/22/17
Santa Ana River watershed,

Coalitions in ESA Listing Area - Southern California Steelhead

Adapted from NMFS Southern California Steelhead Recovery Plan (2012)
So Cal Steelhead Coalitions funded through CDFW Fisheries Restoration Grants Program

Focal Steelhead Watersheds

High Priority watersheds: NMFS Steelhead Recovery Plan Core 1 Population designation



- Native trout populations: Coldwater Canyon Creek (Santa Ana River), WF San Luis Rey (San Luis Rey River)
- Proposed new connected metapopulations (red symbols).

Native Rainbow Trout Populations
San Diego, Orange, Riverside Counties

West Fork San Luis Rey River
San Diego County

Coldwater Canyon Creek
Riverside County

South Coast Coalition Participants

Coalition Mission: Implement Federal Recovery Plan
Impact Area: San Diego, Orange, Riverside Counties

Coalition Leadership:
CalTrout, Coalition Lead
Trout Unlimited, Co-chair

Federal: National Marine Fisheries Service, U.S. Fish and Wildlife Service, U.S. Forest Service (Cleveland National Forest), U.S. Marine Corps – Camp Pendleton, U.S. Geological Survey

State and Districts: California Department of Fish and Wildlife, Riverside-Corona Resource Conservation District; Vista Irrigation District, Santa Monica Mountains Resource Conservation District, Caltrans, SD Regional Water Quality Control Board

Tribal Nations: Pauma Band of Luiseño Indians, Pala Band of Mission Indians

Nonprofits: California Trout, Trout Unlimited, Santa Margarita Ecological Reserve, Sierra Club, Audubon-Starr Ranch, The Escondido Creek Conservancy, Mountains Restoration Trust, SW Council of International Federation Fly Fishers, Aquasolver, Golden State Flycasters, San Diego Fly Fishers

Conservation Goals

- **CONNECT:** establish two connected steelhead populations in focal watersheds in ten years
  - Coastal steelhead populations that are connected to ocean and to each other in focal watersheds

- **CREATE**: establish more unconnected native rainbow trout populations from two to eight for risk mitigation/diversity
  - Expand native trout populations into high quality refuge sites; may be within same watershed or neighboring one; may be occupied or unoccupied.


Andrew Dickinson / Mike McVey, Santa Margarita River


Kerwin Russell, Coldwater Creek

Connect Strategy: for Anadromy

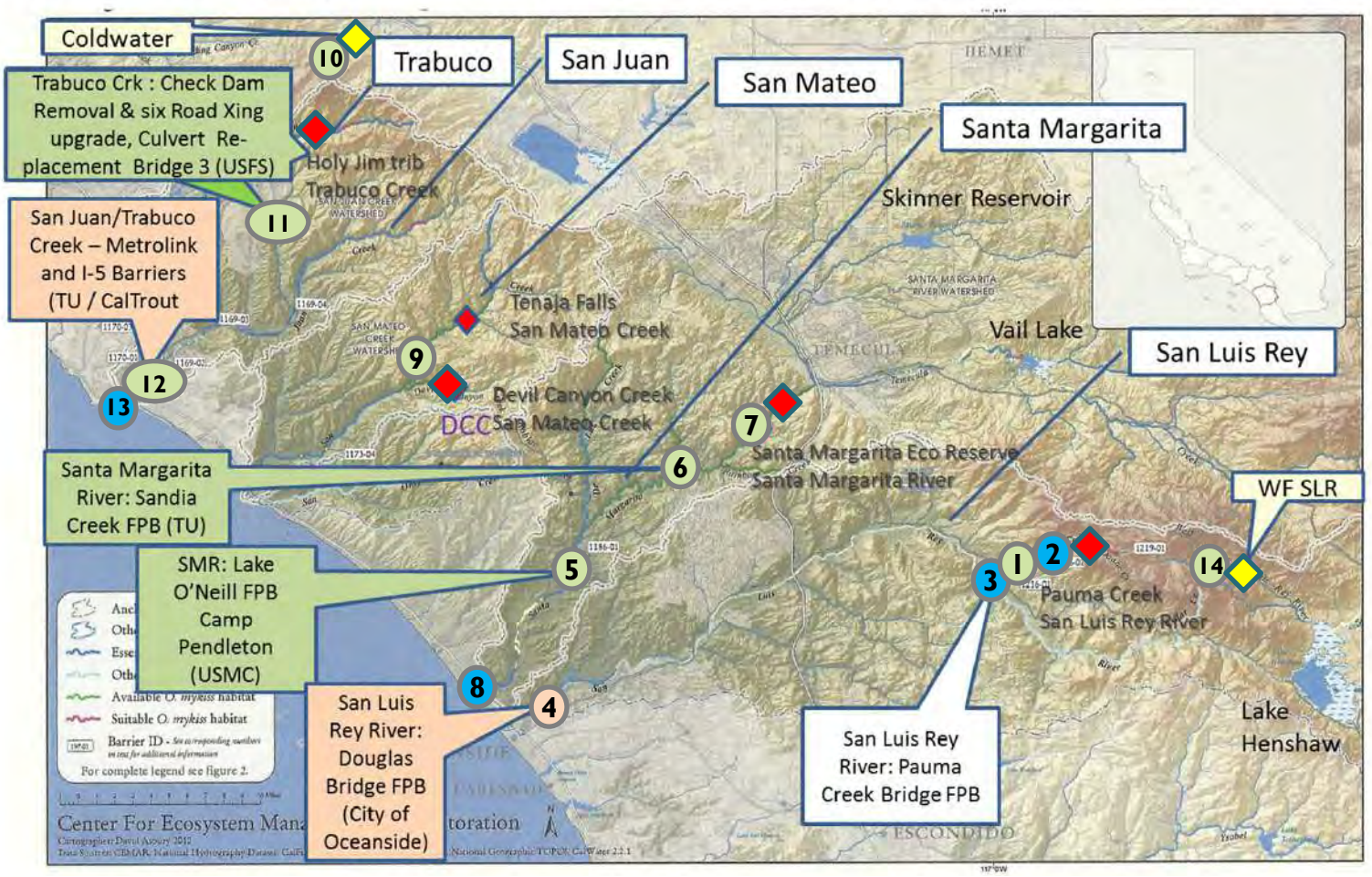
- Remove fish passage barriers
- Improve habitat – remove exotics
- Water conservation / water quality
- Preserve native trout populations

Low-Flow Crossing Barrier
Santa Margarita River

Interstate 5 Bridge Array – Trabuco Creek
Fish Passage Barrier

Exotics Removal
Santa Margarita River - upstream

Project Implementation Status



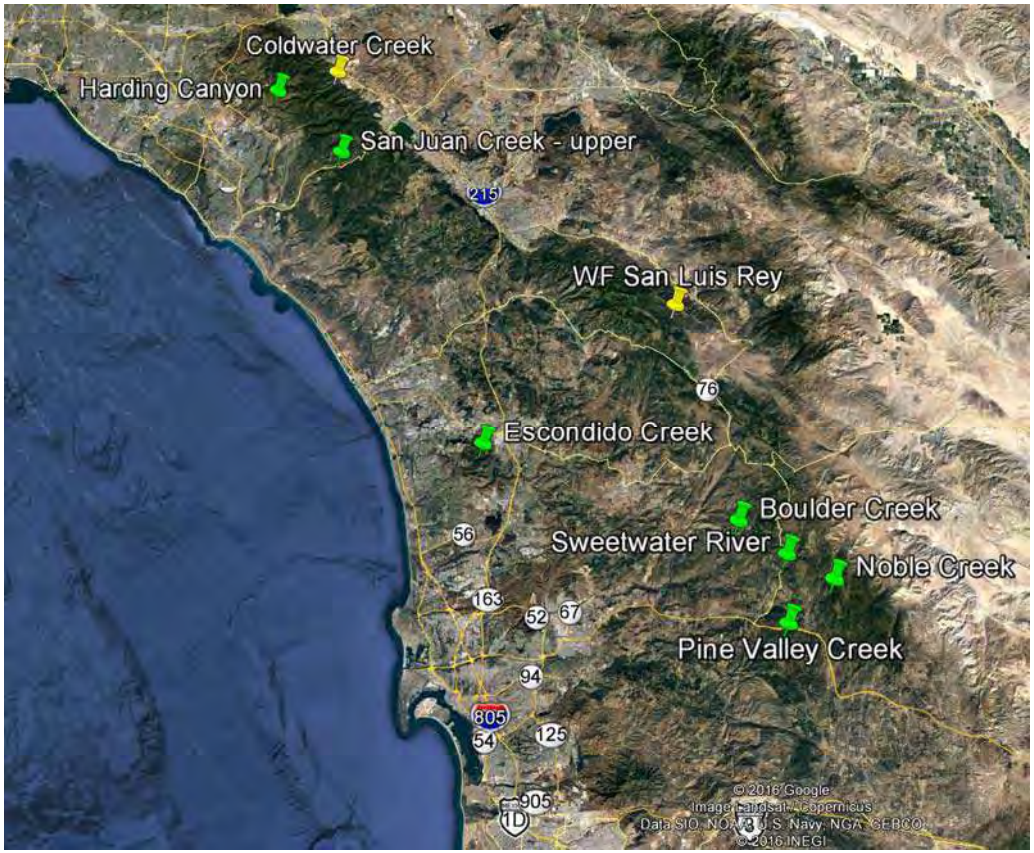
Base map from Center for Ecosystem Management and Restoration (Oakland);
Annotated here to show NMFS high priority steelhead recovery rivers and steelhead Coalition projects.

Underway **In development**

Create Strategy: for Residents

- Native Trout sub-population Expansion Plan
  - -under development and still in early conceptual stages
  - -area proposed is South Coast region, Southern California
  - -provides a step-wise methodology for expanding native rainbow trout sub-populations from two to eight in 10 years;
  - -first draft completed; second draft to be circulated more widely for agency review and discussion
- Translocation of native rainbow trout embryos into suitable habitat
  - -increase geographic diversity
  - -increase genetic diversity (breeding matrix).
  - -not a conservation hatchery; not artificial propagation.
- Strategy follows Andrews et al (2016)
  - -successful in Cherry Creek, tributary to Madison River in Montana "Performance of Juvenile Cutthroat Trout Translocated as Embryos from Five Populations into a Common Habitat".
- A parallel approach to establishing anadromous populations to support long-term viability of endangered steelhead, given their precariously low numbers at the southernmost extent of their range.

Increase Geographic Diversity



Use guidelines from NMFS Recovery Plan and State Plans to develop approach for Native Rainbow Trout Sub-population Expansion. Yellow tacks = existing; Green tacks = proposed

Characterize Habitat

Optimize Habitat

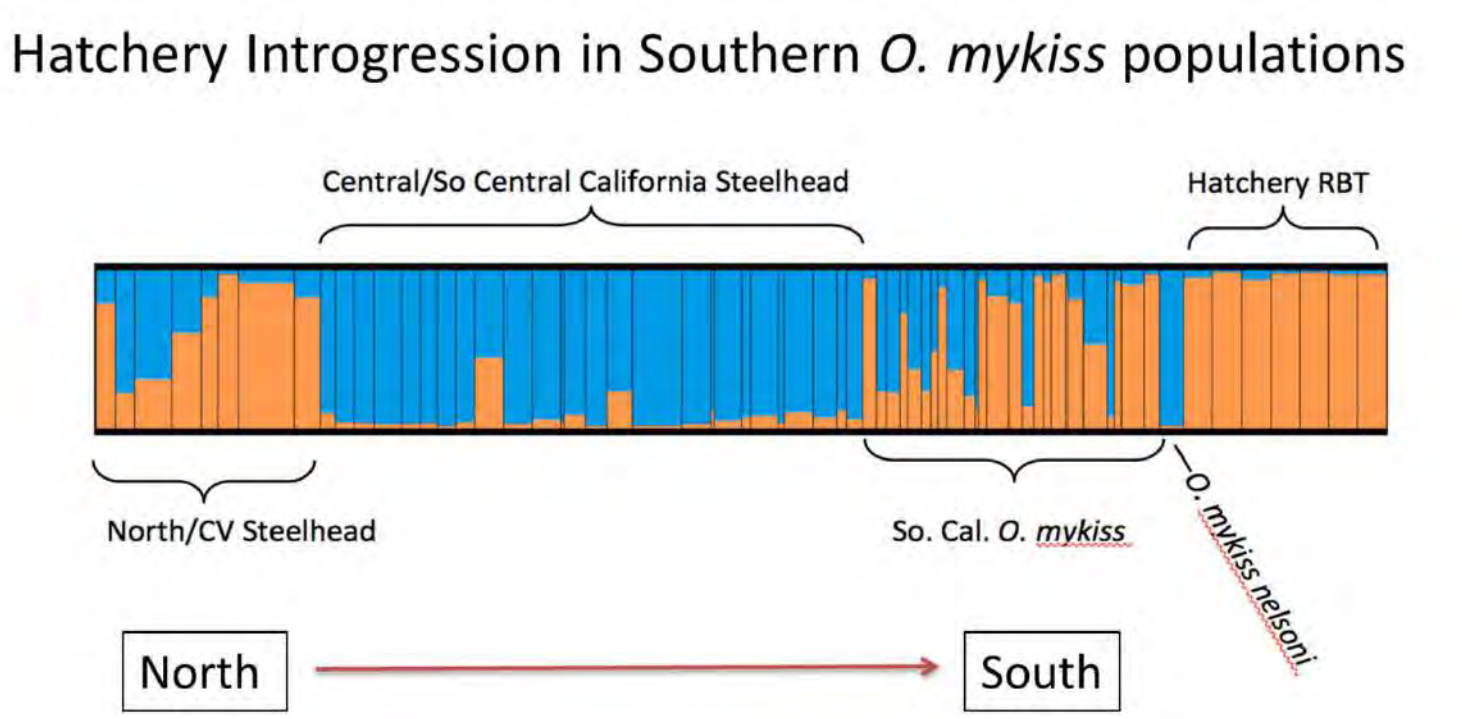
Implement Plan

Target Population Goals by 2025

Location	Current Population Estimate	Target Population (Native Rainbow Trout)
Coldwater Canyon Creek	**~400 Native (Native/Wild)**	400
Harding Creek	0	50
San Juan Creek	0	150
Escondido Creek	0	150
WF San Luis Rey	**~150 Native (Native/Wild)**	150
Sweetwater River	50 wild / hatchery lineage	100
Noble Creek	50 wild / hatchery lineage	50
Pine Valley Creek	25 wild / hatchery lineage	50
Total unconnected	550 Native	1100 Native (100% increase)

Proceed methodically with expansion of 1-2 areas/year;
small pilots; regulatory process (above barriers)
Adhere to breeding matrix to mitigate bottlenecks;
inbreeding/outbreeding effects
Assess habitat and impact on existing species
Monitor success in meeting objectives (following slides)

Increase Genetic Diversity



Fractional ancestry Analysis *O. mykiss* (Garza lab)
Orange = derived primarily from hatchery rainbow trout lineages
Blue = blue represent ancestry of coastal steelhead lineage, while
Intermediate values are populations with some introgression and shared ancestry from both lineages.

From Southern California Population Genetics Study (2014)

Methodology

Spawn adults from native rainbow trout donor populations
(enclosure confined; temporarily ~10 adults to minimize impact)

Collect eggs and milt for cryopreservation

Take parental fin clips for genetic analysis

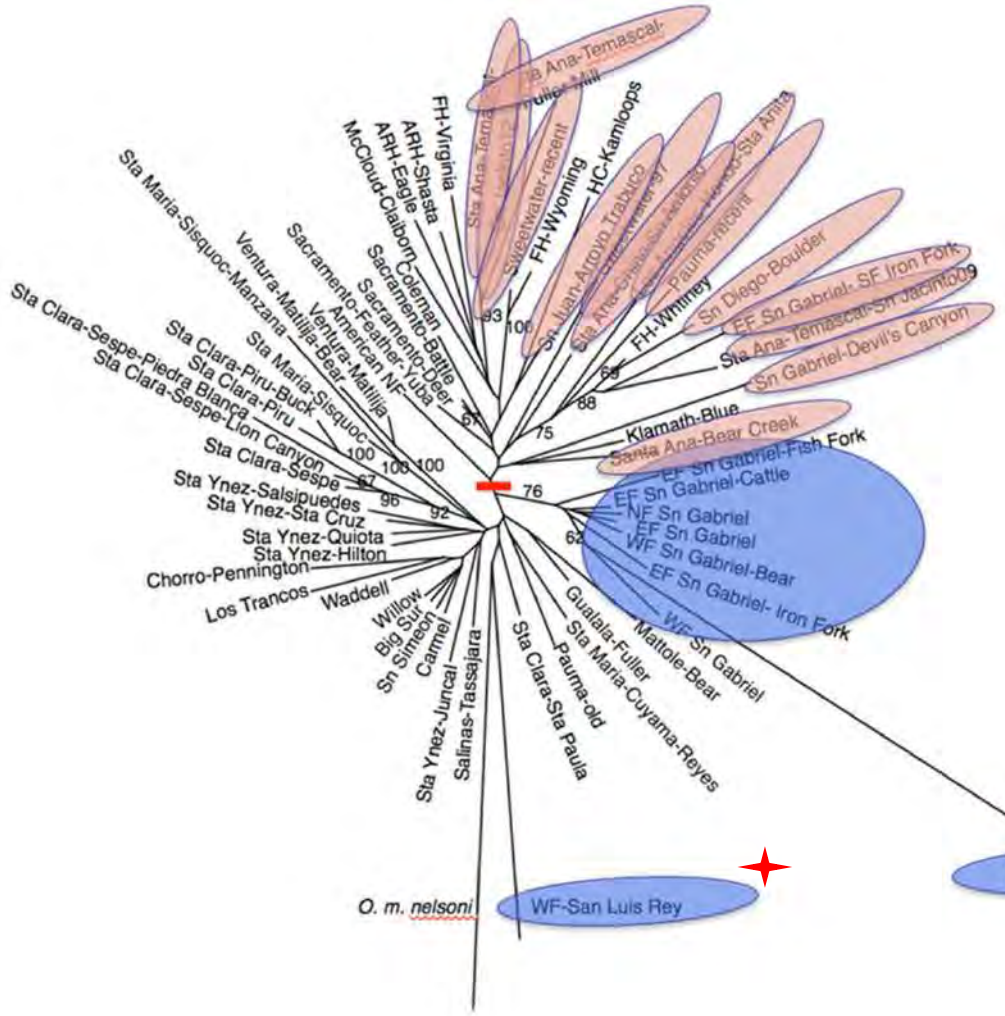
Perform *in vitro* fertilization streamside; incubate in facility to eyed stage

Transfer embryos to Remote Site Incubators (RSI) at 3 sites in target habitat
Mix embryo lineages; Incubate until fry hatch then release

Perform juvenile sampling at 6 mo., 1 year and 2+ years to quantify success

-abundance: population survey
-diversity: genetic analysis
-productivity: redd count, size distribution
-morphology: body weight, fork length, lipid content
-location: distance from release site, PIT tag analysis

Power of genetics to support Resiliency



WF San Luis Rey and Coldwater populations have lowest genetic diversity

Neighbor Joining Dendrogram from Southern California *O. mykiss* population genetics study (Abadia-Cardoso et al 2016; Jacobson et al 2014). Those that cluster with hatchery rainbow trout strains are shown in pink, while those closer to coastal *O. mykiss* populations are blue.

Connect and Create

Together, these approaches address two fundamental elements of steelhead recovery in a Connect and Create strategy by:

- connecting steelhead populations with the ocean and each other via actions that support anadromy;
- creating geographically distinct sub-populations of native rainbow trout via actions that reduce fragmentation and inbreeding, and increase resiliency to environmental events that cause extirpation.

Sweetwater River, 2010

Courtesy of Dale Dalrymple, GSF

Contact Information

CALIFORNIA TROUT
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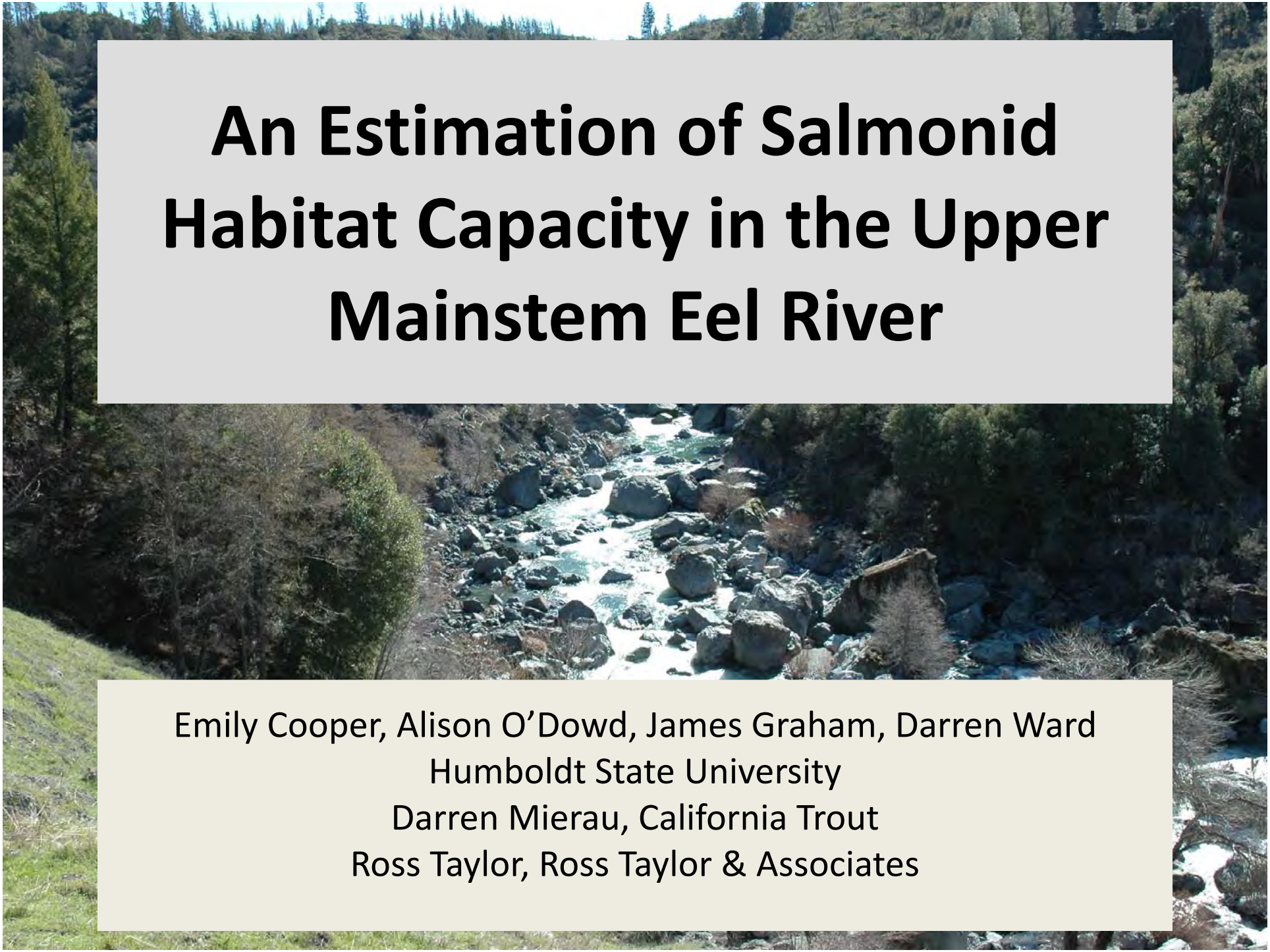
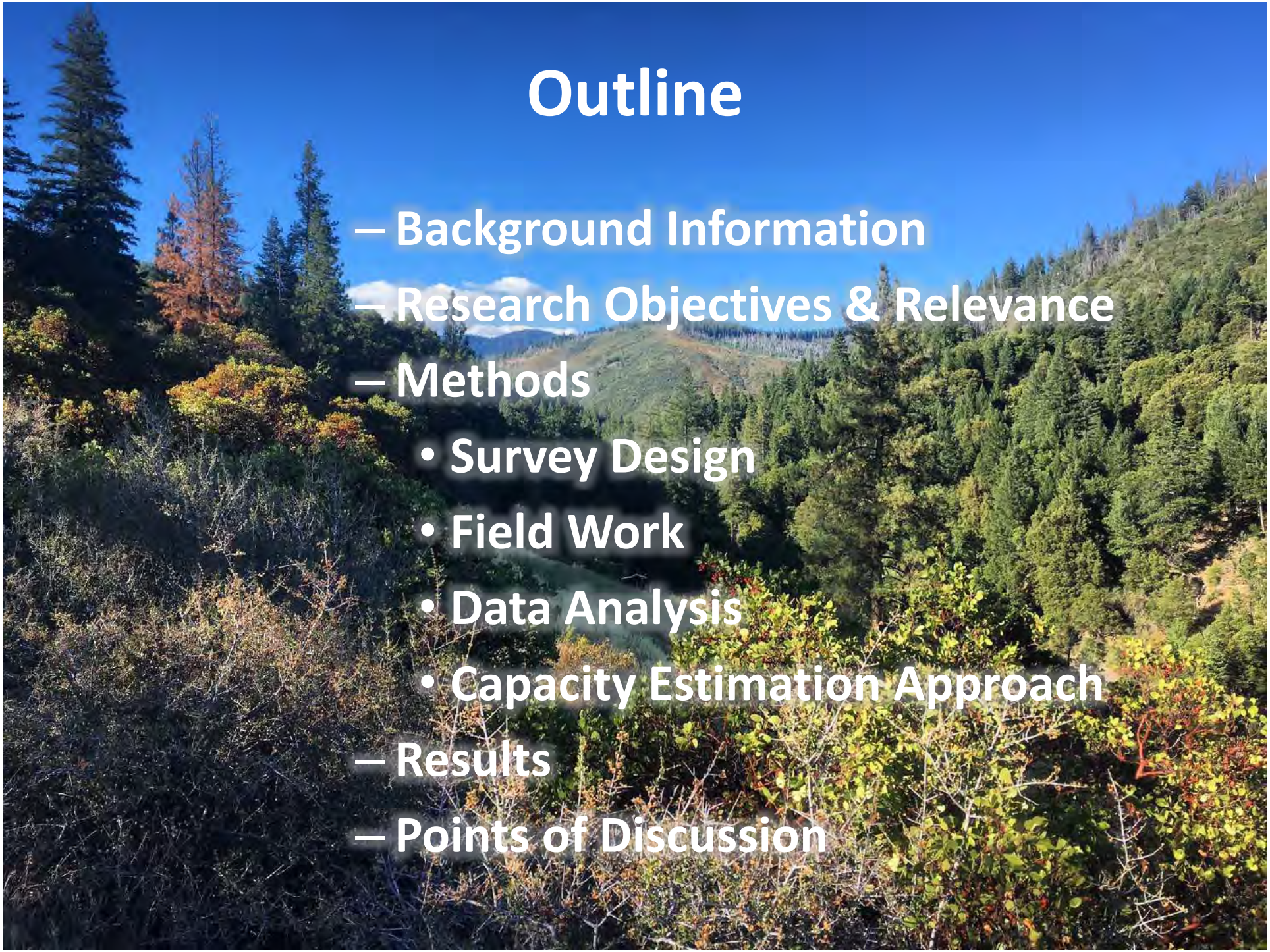
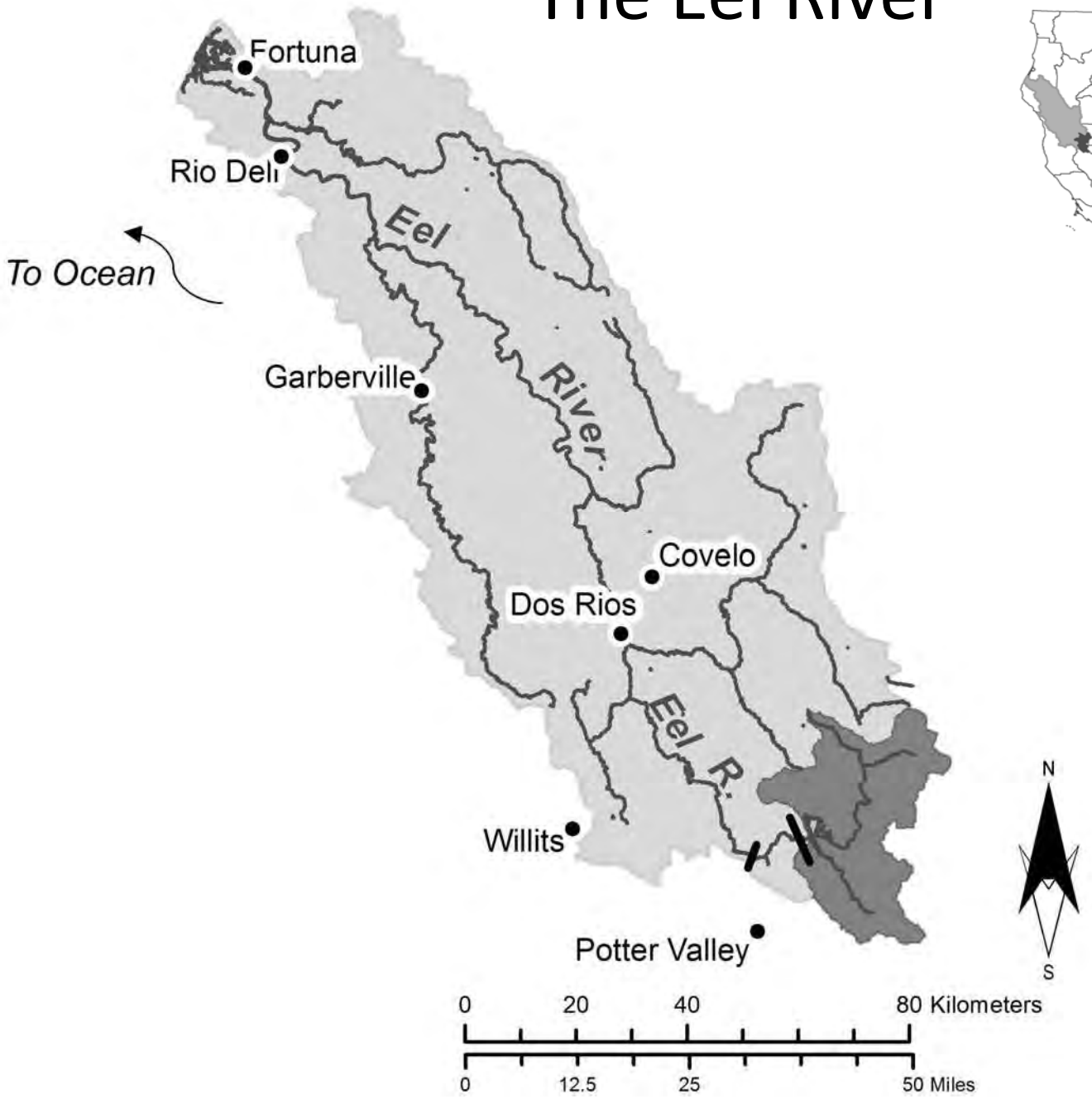


An Estimation of Salmonid Habitat Capacity in the Upper Mainstem Eel River

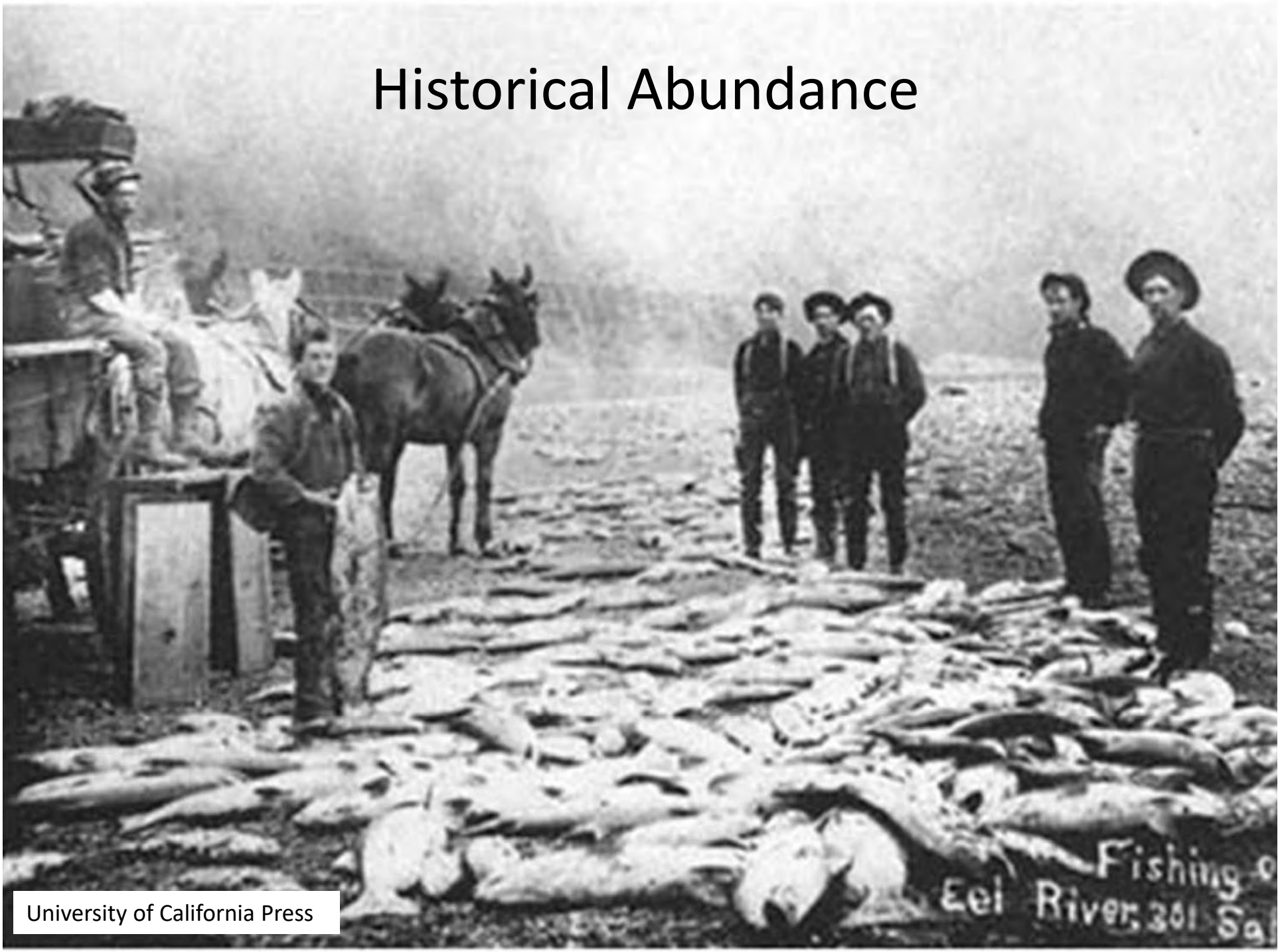
Emily Cooper, Alison O'Dowd, James Graham, Darren Ward
Humboldt State University
Darren Mierau, California Trout
Ross Taylor, Ross Taylor & Associates


Outline
– Background Information
– Research Objectives & Relevance
– Methods
• Survey Design
• Field Work
• Data Analysis
• Capacity Estimation Approach
– Results
– Points of Discussion

The Eel River

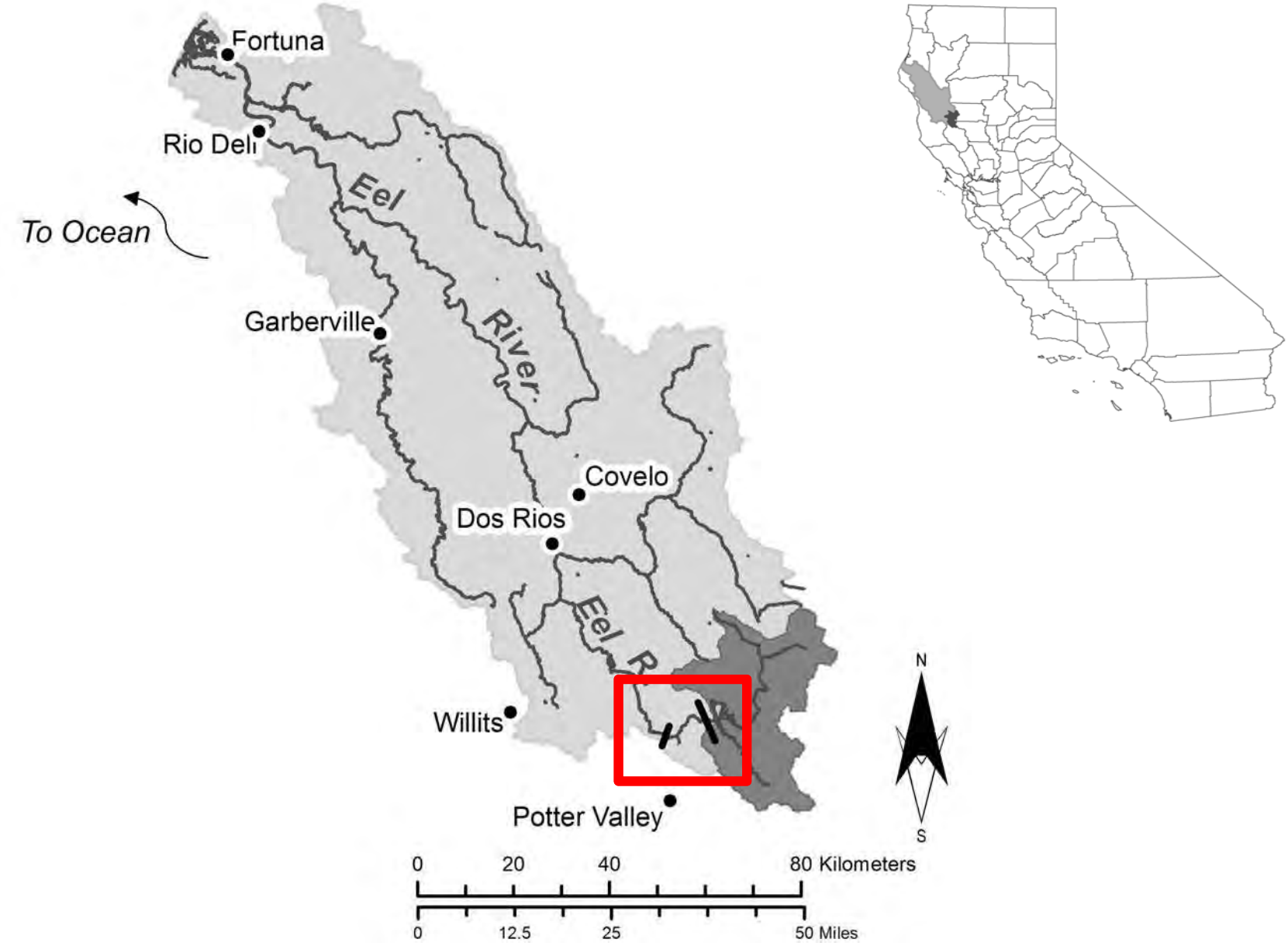


Historical Abundance



University of California Press

Potter Valley Project



Cape Horn & Scott Dam

FOER, 2016

Kovner, 2016

Research Objectives

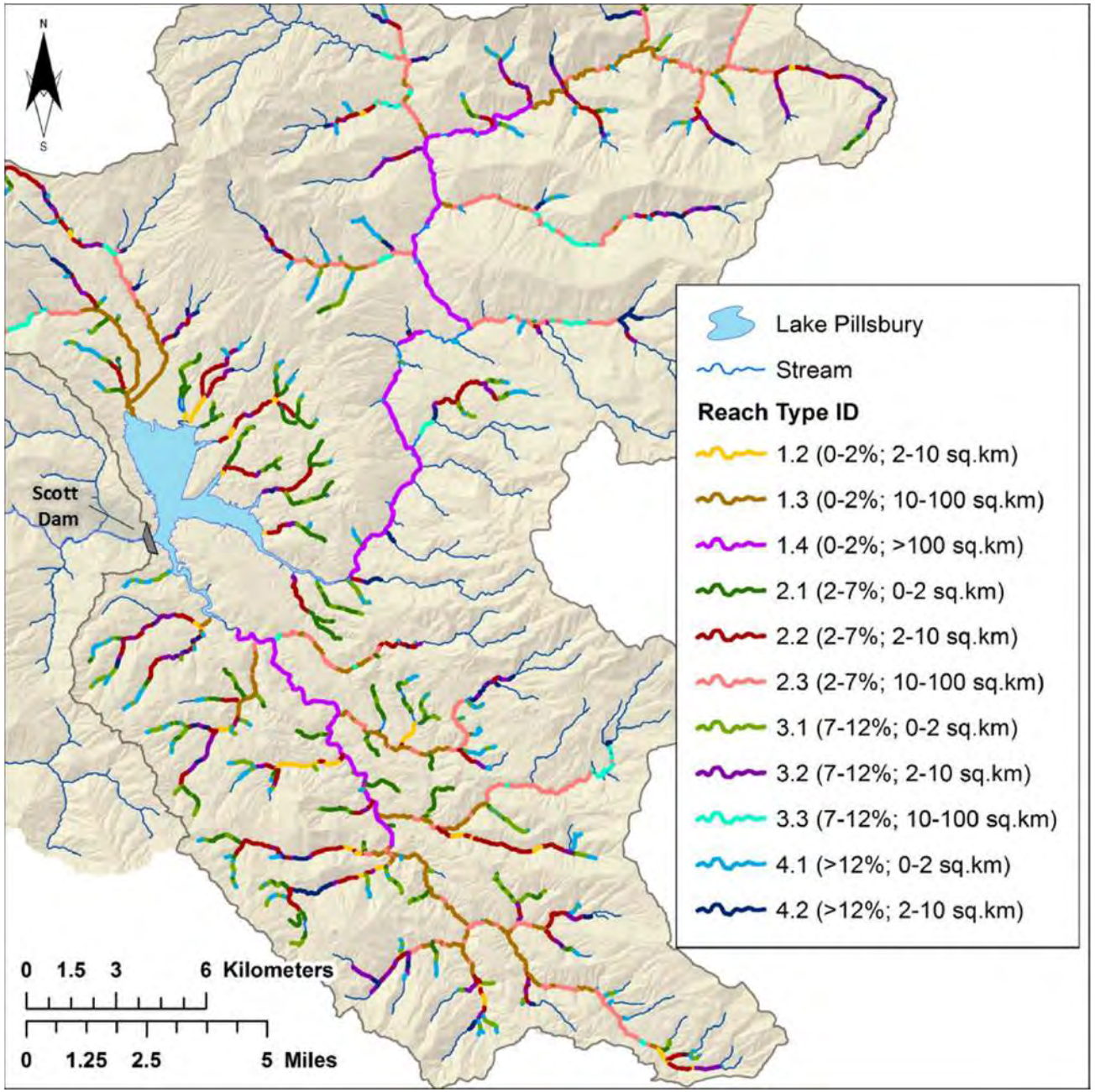
In the upper mainstem Eel River upstream of Scott Dam:

1) Quantify and characterize anadromous salmonid spawning and rearing habitat

2) Estimate population capacity for Chinook salmon and steelhead trout if the Potter Valley Project were either modified or removed.

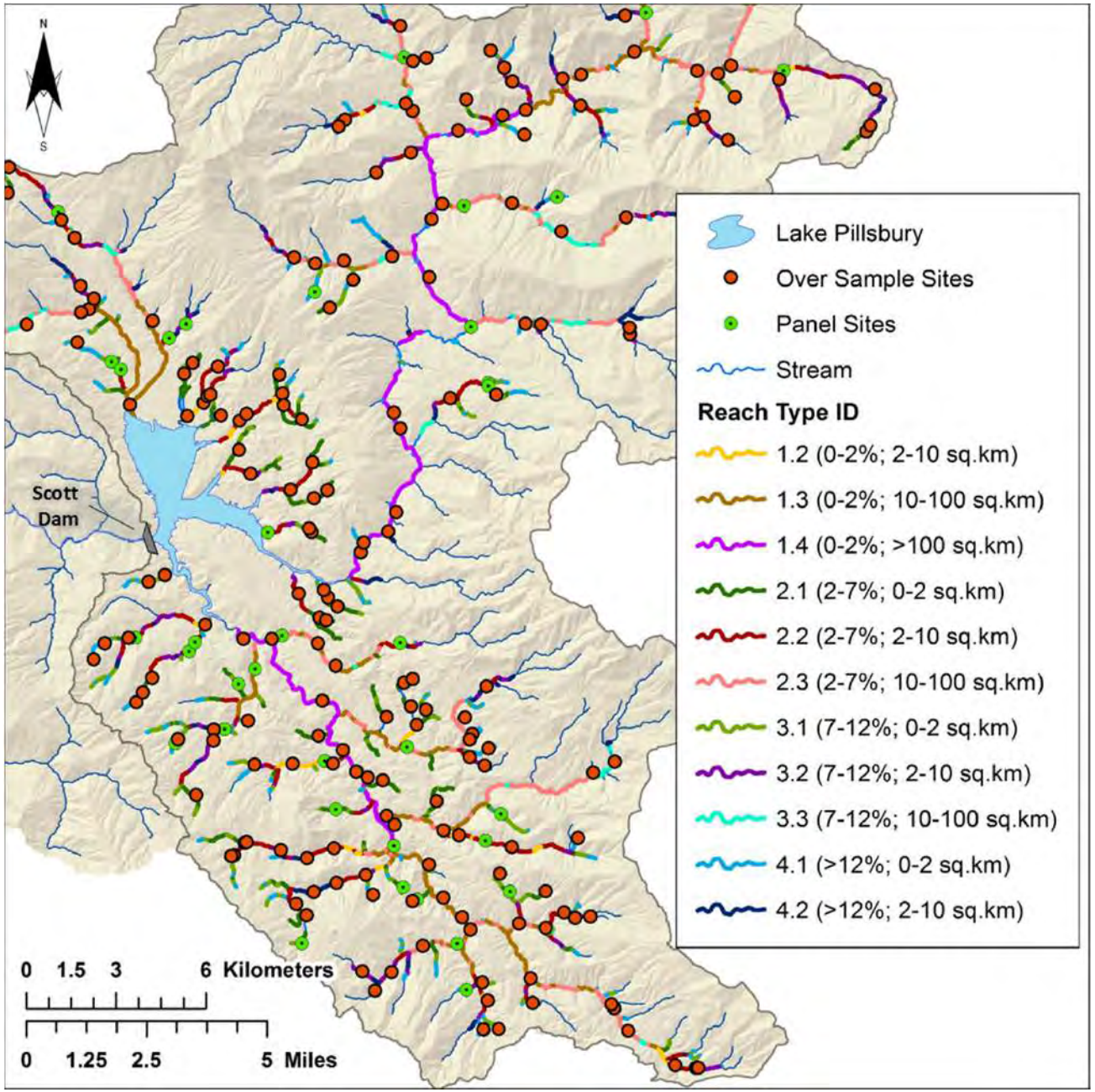
Survey Design

- Stratified "Reach Types"



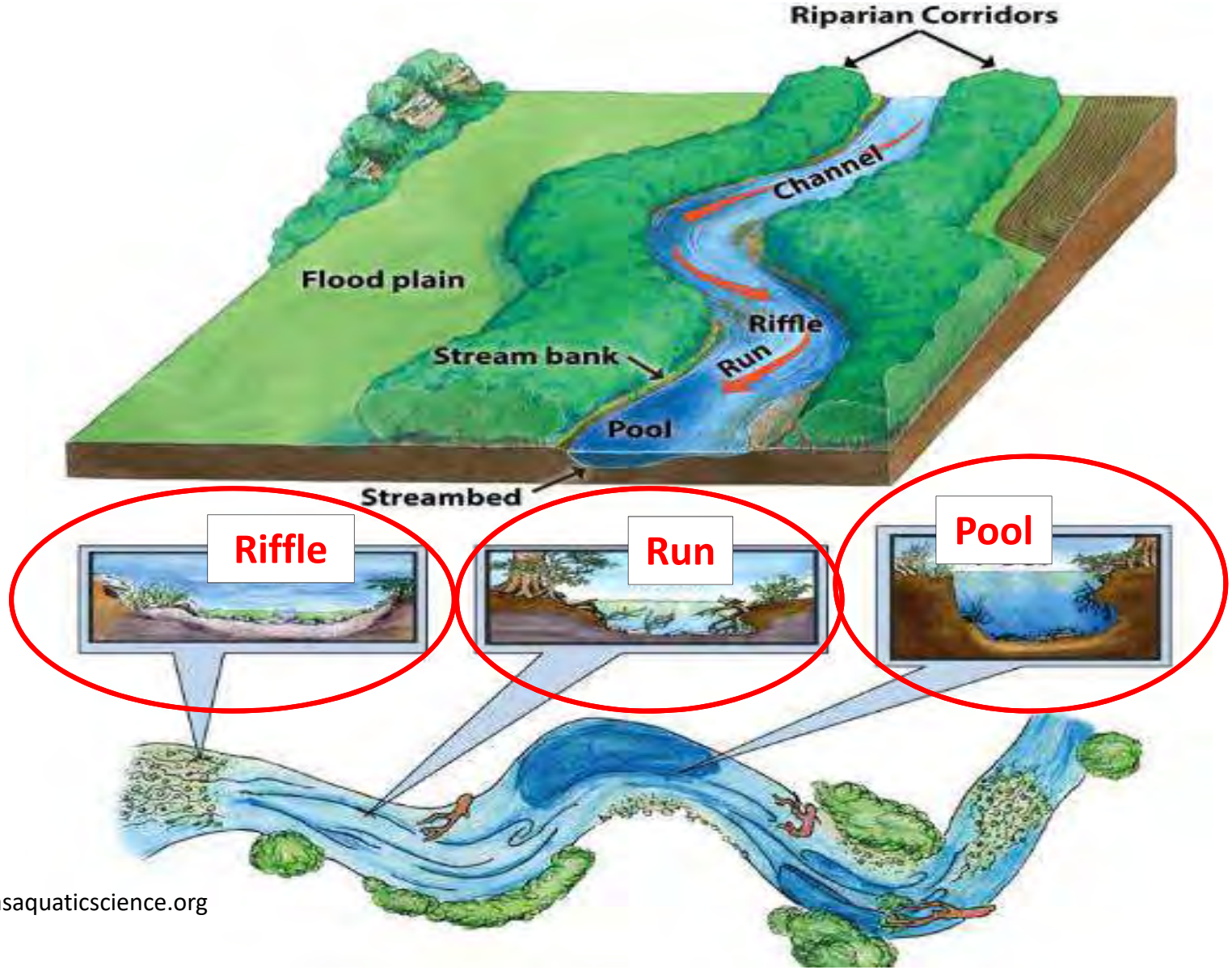
Survey Design

- Stratified "Reach Types"
- GRTS



Habitat Assessment: Field Methods

CDFW *California Salmonid Stream Habitat Restoration Manual, Part III*



Texasaquaticscience.org

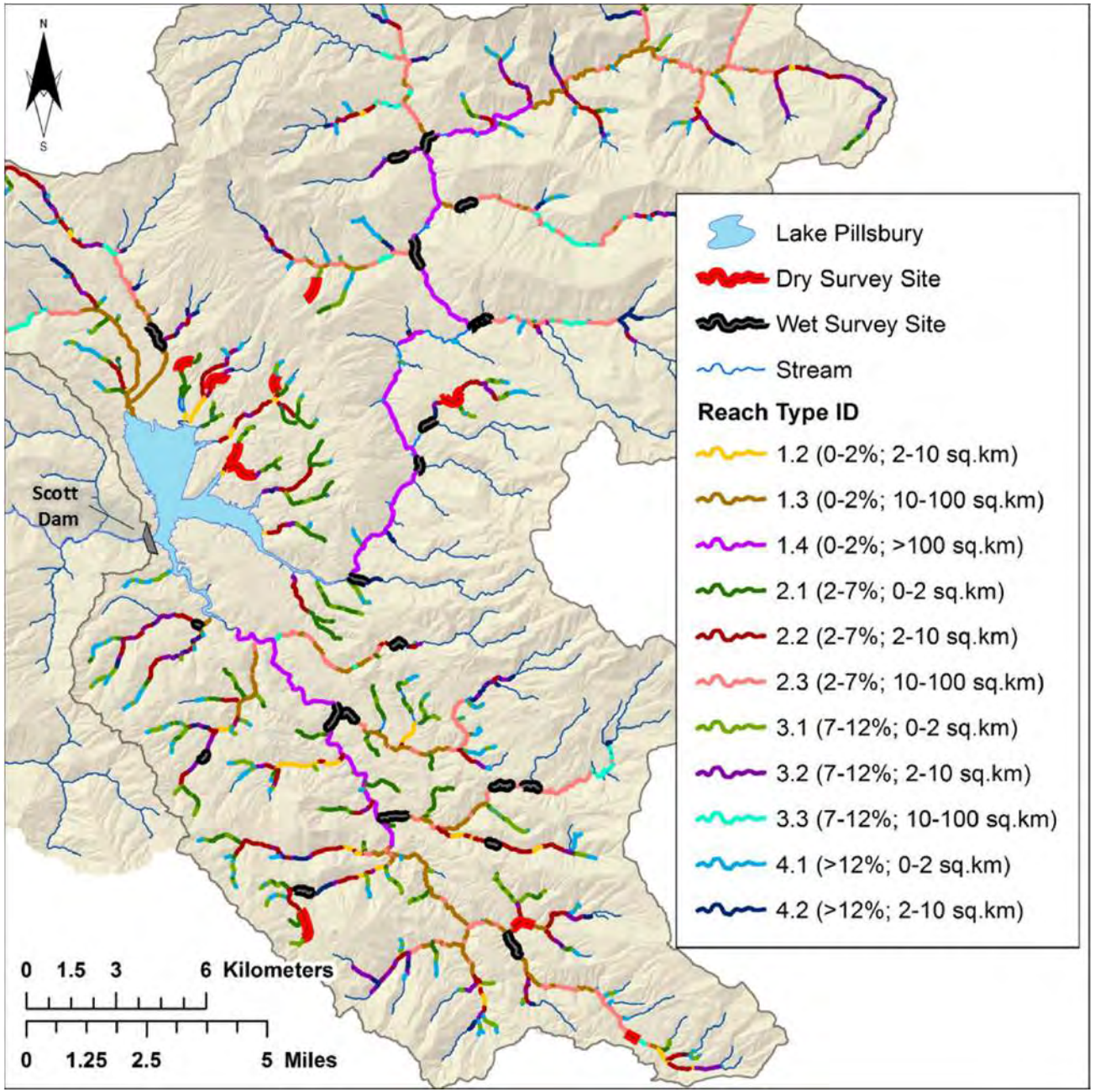
Habitat Assessment: Field Methods

- Unit-scale measurements:
  - Wetted surface area
  - Depth
  - Instream Cover
  - Canopy Cover

- Reach-scale measurements:
  - Discharge (CFS)
  - Substrate Composition
  - Embeddedness (fine substrate)
  - Water Quality
    - Temperature, pH, Turbidity

Survey Design

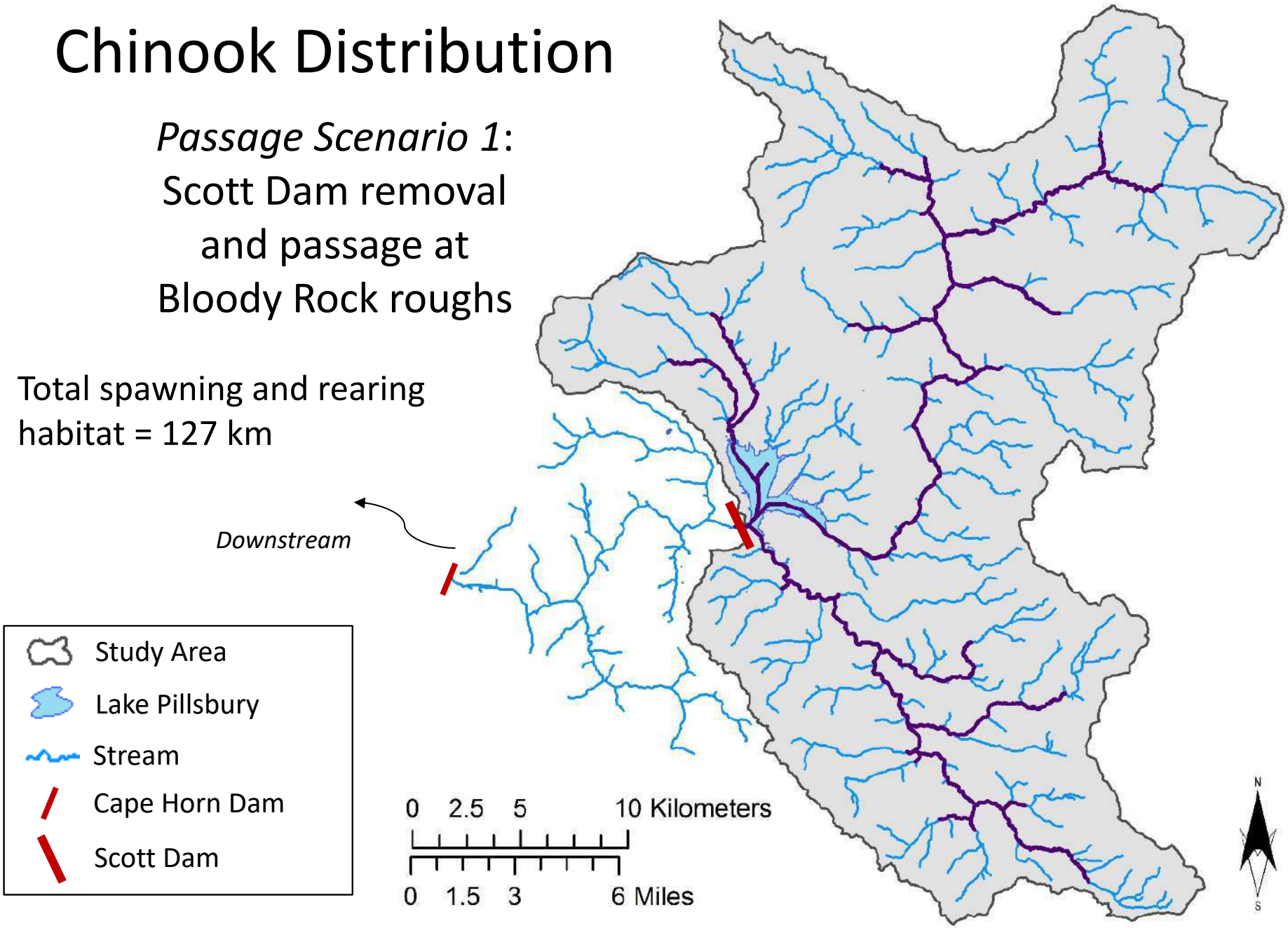
- Stratified "Reach Types"
- Wet & Dry Habitat Surveyed



Chinook Distribution

Passage Scenario 1:
Scott Dam removal
and passage at
Bloody Rock roughs

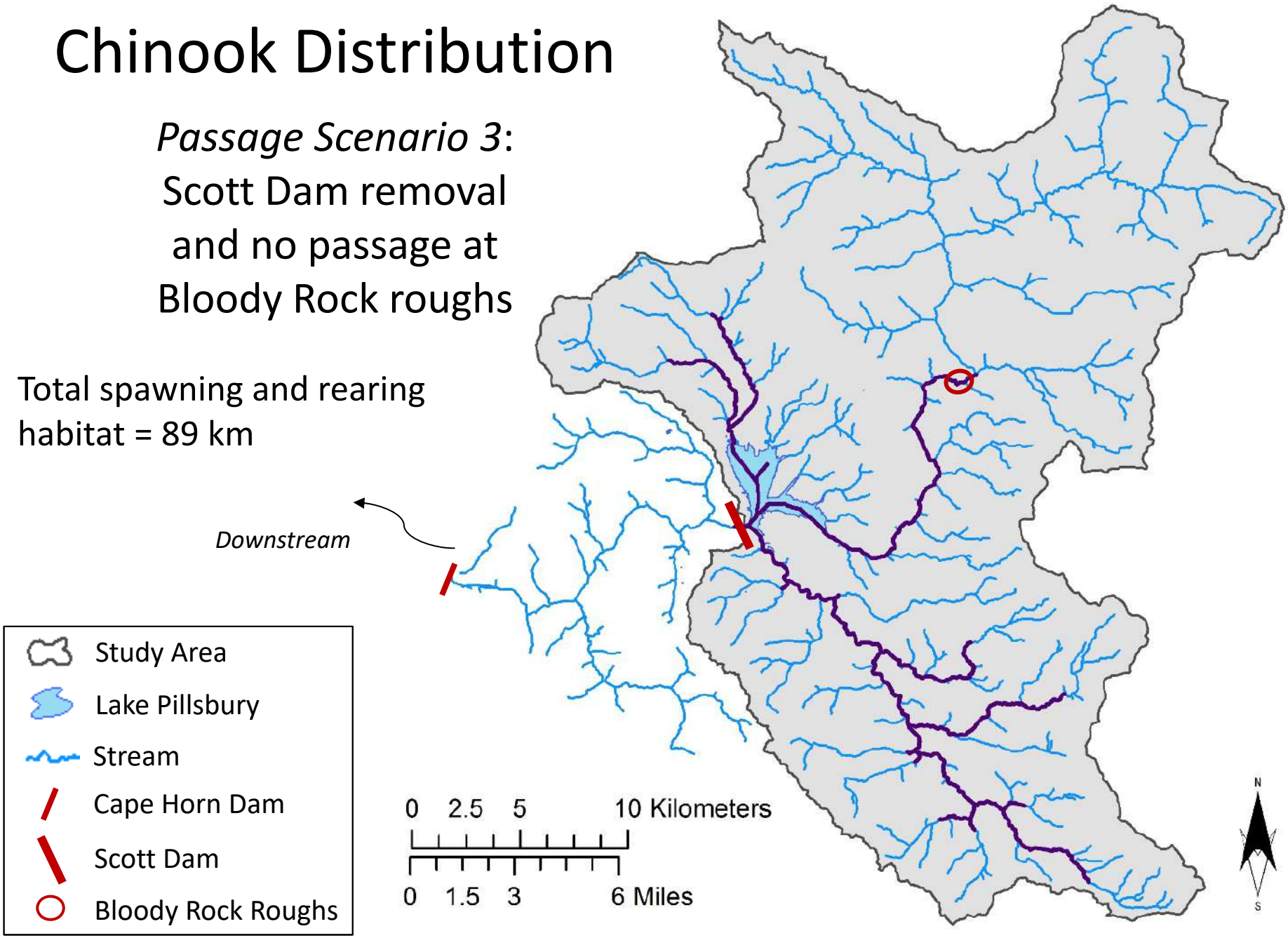
Total spawning and rearing habitat = 127 km



Chinook Distribution

Passage Scenario 3:
Scott Dam removal
and no passage at
Bloody Rock roughs

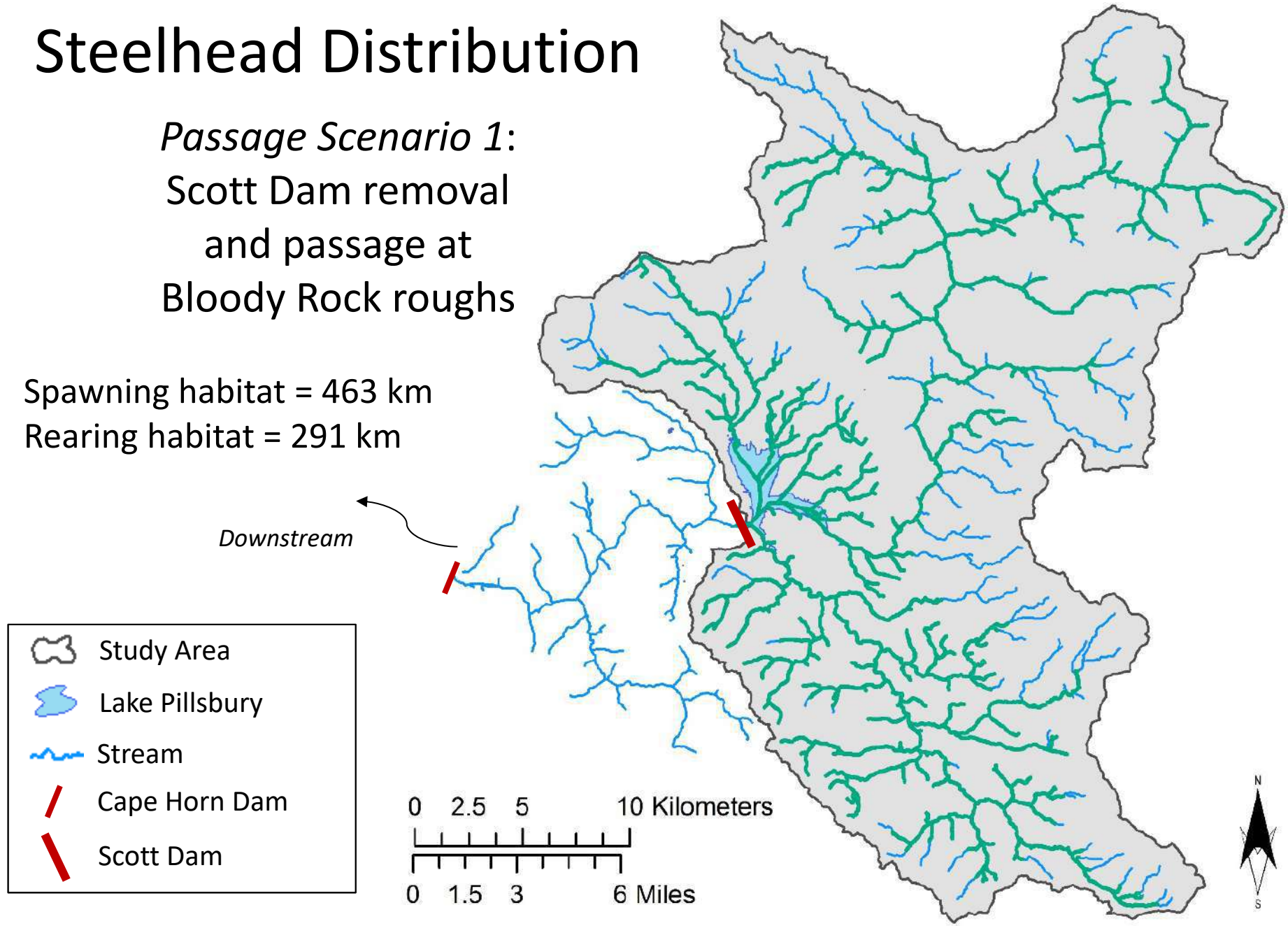
Total spawning and rearing habitat = 89 km



Steelhead Distribution

Passage Scenario 1:
Scott Dam removal
and passage at
Bloody Rock roughs

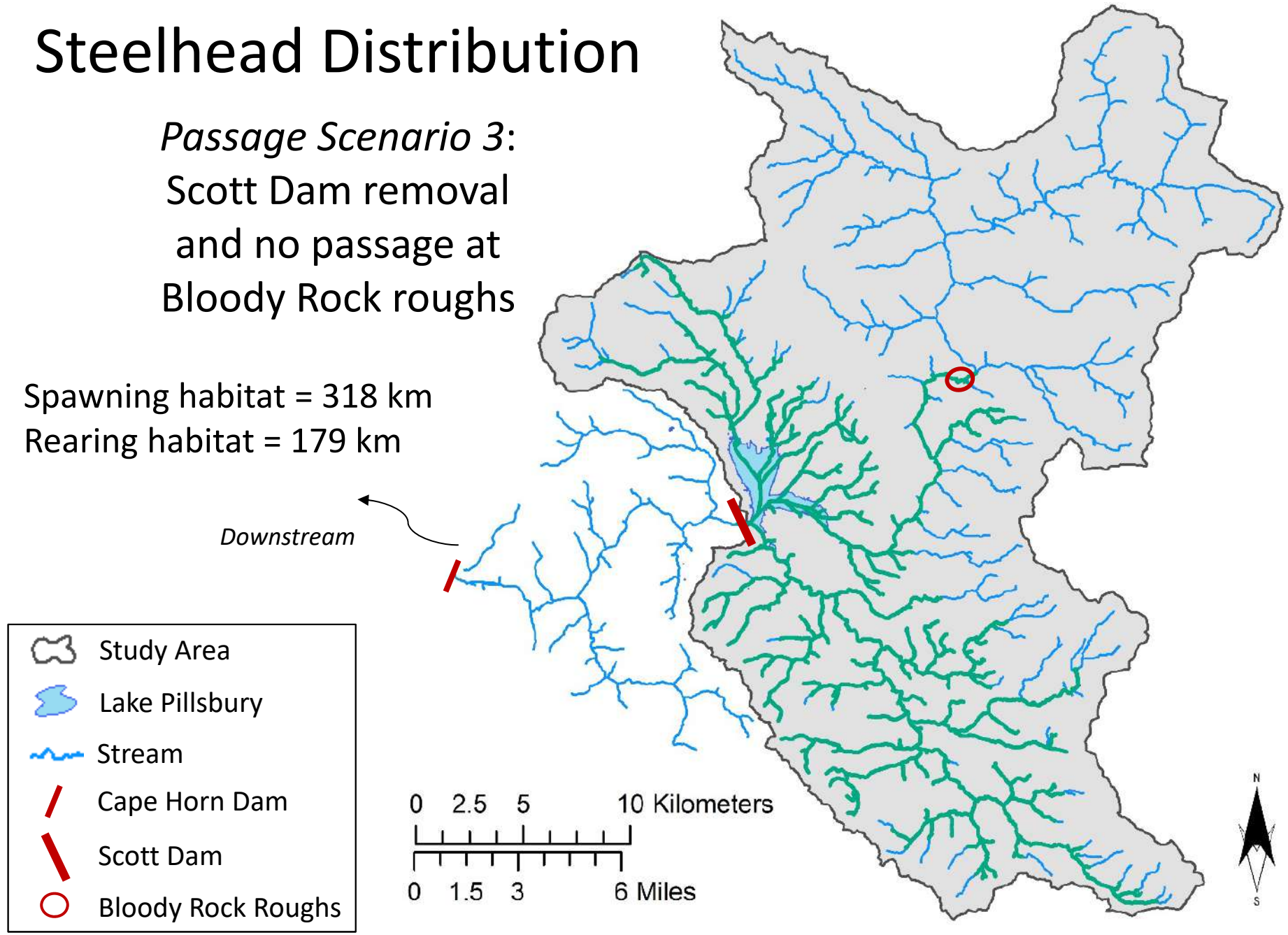
Spawning habitat = 463 km
Rearing habitat = 291 km



Steelhead Distribution

Passage Scenario 3:
Scott Dam removal
and no passage at
Bloody Rock roughs

Spawning habitat = 318 km
Rearing habitat = 179 km



Bloody Rock Roughs Barrier Assessment

2/20/2016 at ~400 cfs

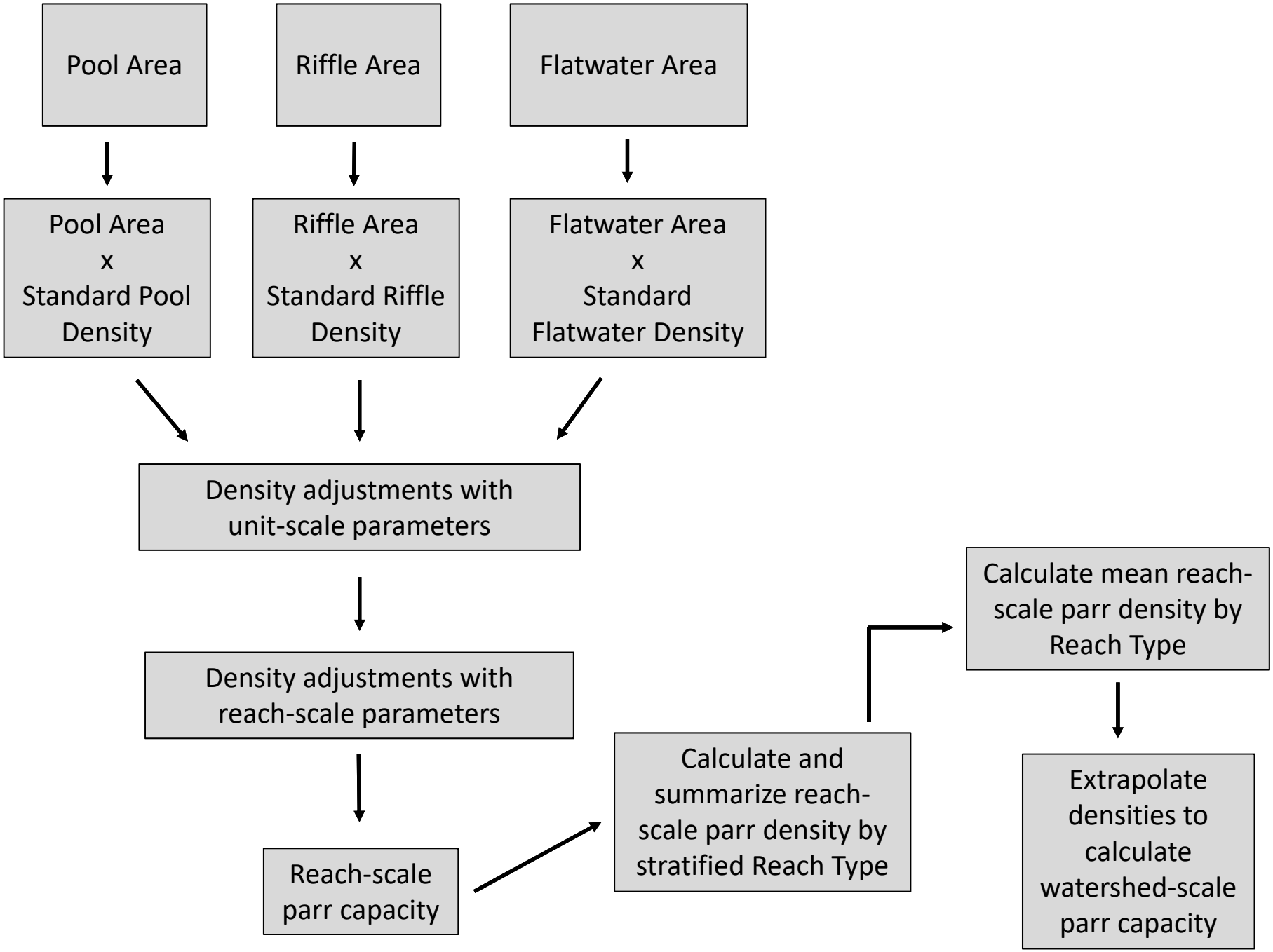
Bloody Rock Roughs Barrier Assessment

5/17/2016 at ~58 cfs

Modeling Habitat Capacity: 1) Unit Characteristic Method

(Cramer & Ackerman, 2009; Cramer 2012)

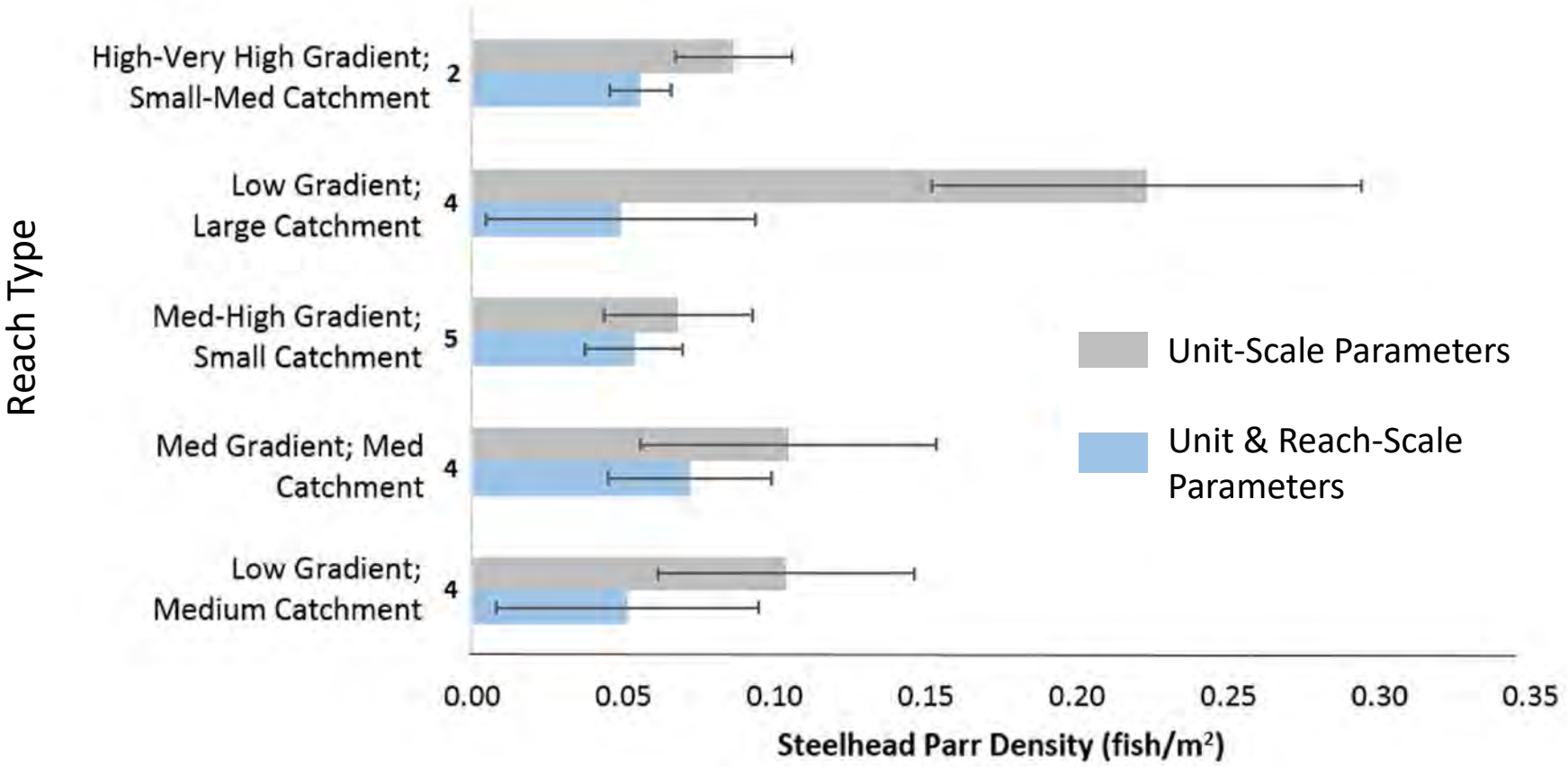
- Measures capacity by identifying life stage most limiting to production
- Relates habitat conditions to fish densities
- Validation: predicted capacity ± 35% of observed capacity


Pool Area
Riffle Area
Flatwater Area
Pool Area x Standard Pool Density
Riffle Area x Standard Riffle Density
Flatwater Area x Standard Flatwater Density
Density adjustments with unit-scale parameters
Density adjustments with reach-scale parameters
Reach-scale parr capacity
Calculate and summarize reach-scale parr density by stratified Reach Type
Calculate mean reach-scale parr density by Reach Type
Extrapolate densities to calculate watershed-scale parr capacity

Steelhead UCM Parr Capacity

Passage Scenario 1: Dam removal and passage at Bloody Rock roughs

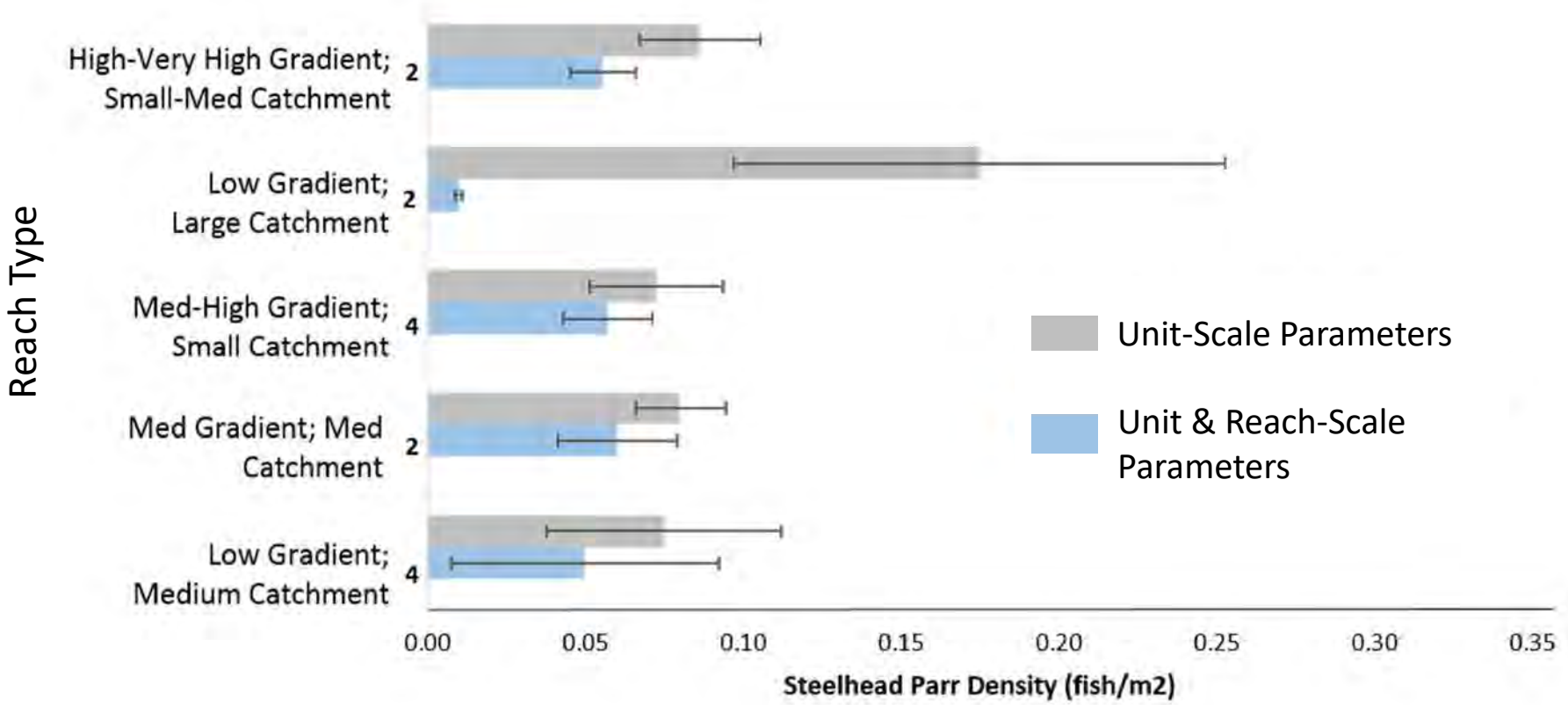
Watershed Scale Capacity = 57,374 Parr (SD 32,081)



Steelhead UCM Parr Capacity

Passage Scenario 3: Dam removal and no passage at Bloody Rock roughs

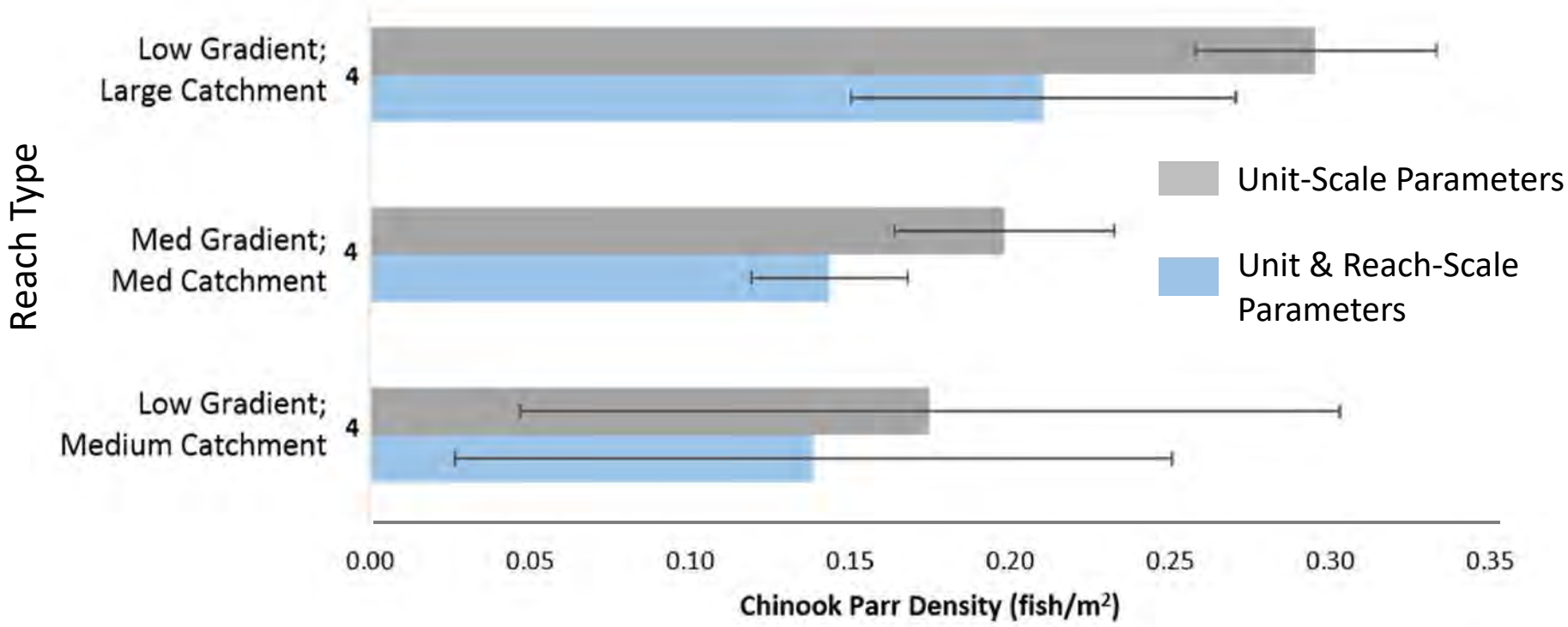
Watershed Scale Capacity = 27,848 Parr (SD 9,982)



Chinook UCM Parr Capacity

Passage Scenario 1: Dam removal and passage at Bloody Rock roughs

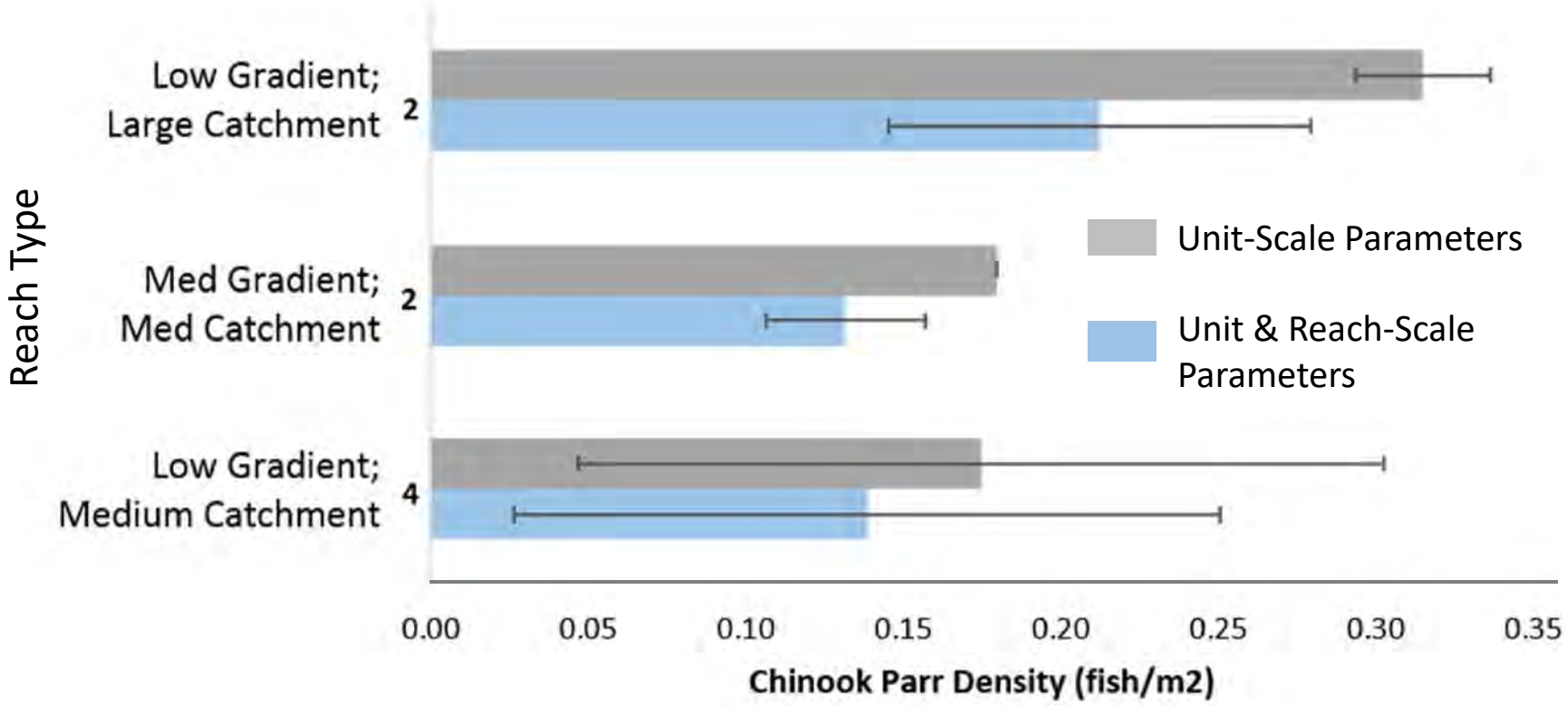
Watershed Scale Capacity = 201,426 Parr (SD 67,550)



Chinook UCM Parr Capacity

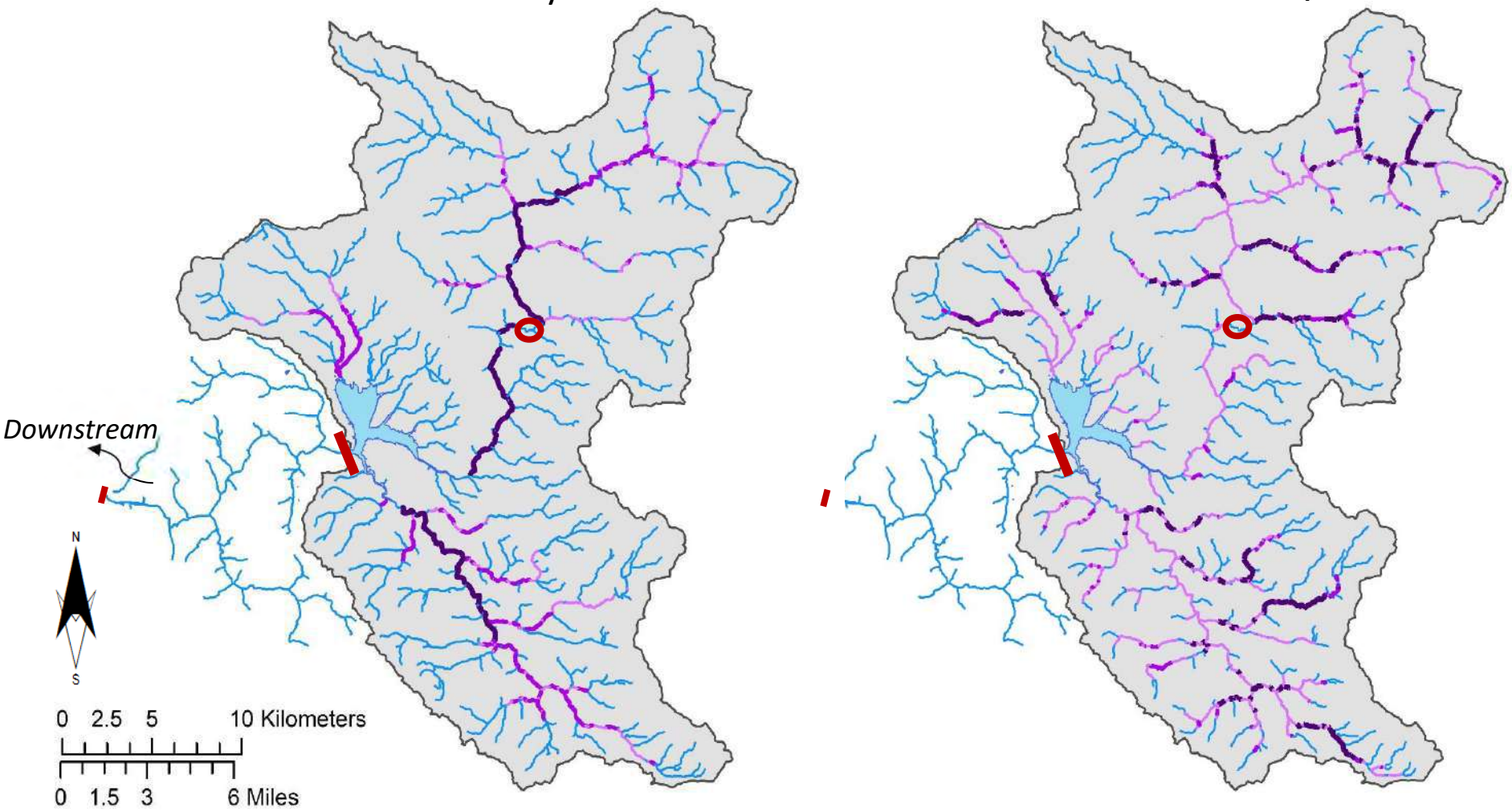
Passage Scenario 3: Dam removal and no passage at Bloody Rock roughs

Watershed Scale Capacity = 65,200 Parr (SD 18,901)



Chinook Parr Density

Steelhead Parr Density



Cape Horn Dam

Scott Dam

Bloody Rock Roughs

Study Area

Lake Pillsbury

Stream

Chinook UCM Density

0.13

0.14

0.21

Steelhead UCM Density

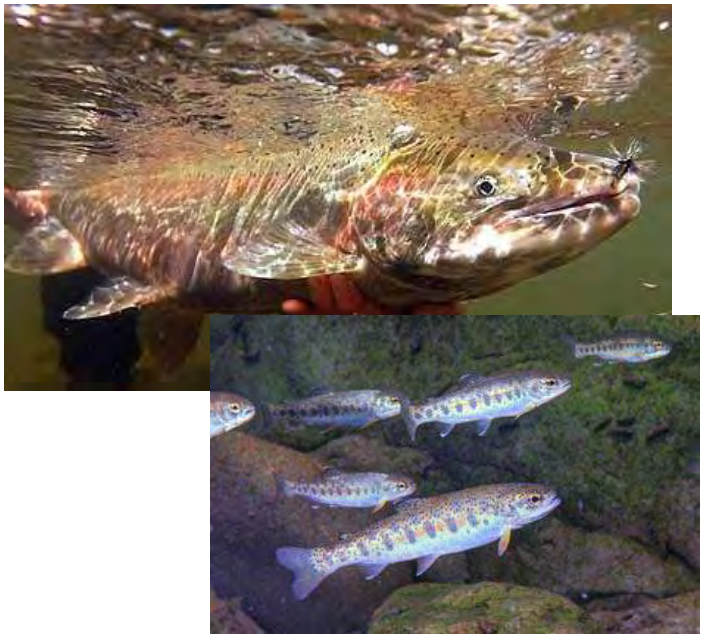
0.05

0.06

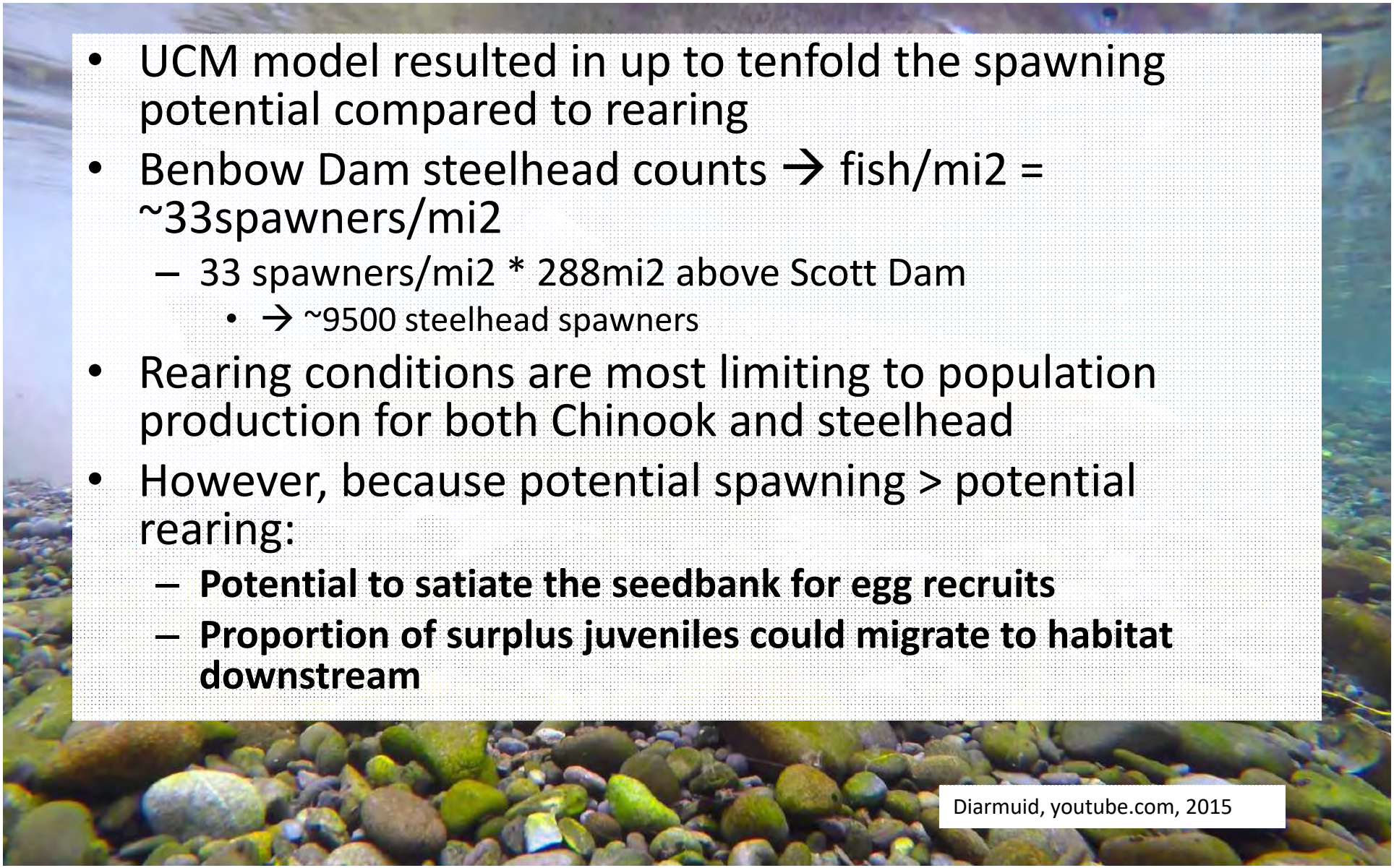
0.07

Parr Estimates → Number of Spawners

- Conversions with subsequent life stage specific survival rates
- Highly variable , many sources of uncertainty, low confidence
- Past abundance estimates (CDFG, 1979; VTN, 1982; NMFS, 2016) :
  - 1,500 – 6,120 steelhead spawners
  - 1,250 – 2,300 Chinook spawners
- This research:
  - 1,044 – 2,088 steelhead spawners
  - 4,593 Chinook spawners

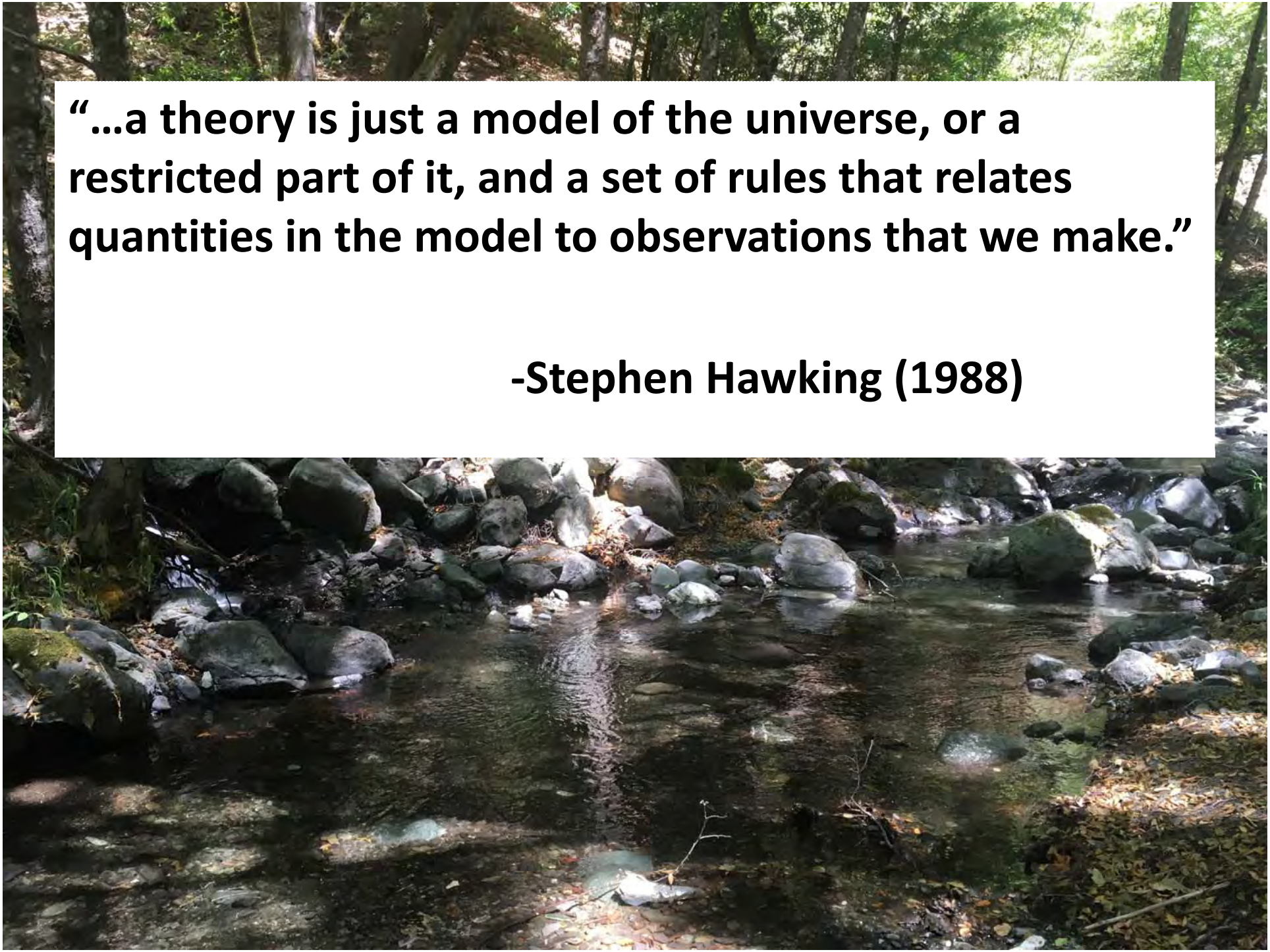


Spawner Capacity



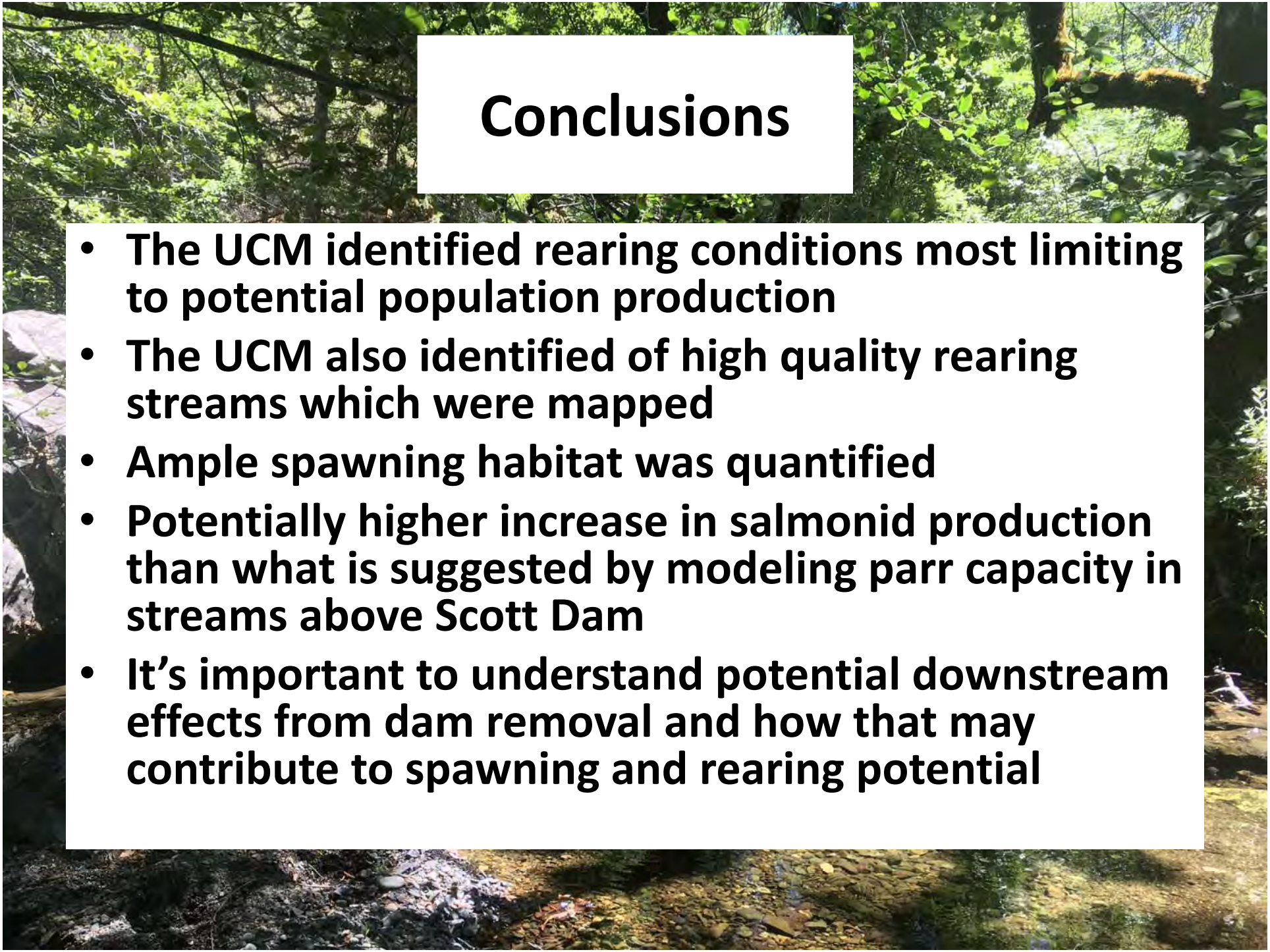
- UCM model resulted in up to tenfold the spawning potential compared to rearing
- Benbow Dam steelhead counts → fish/mi2 = ~33spawners/mi2
  - 33 spawners/mi2 * 288mi2 above Scott Dam
    - → ~9500 steelhead spawners
- Rearing conditions are most limiting to population production for both Chinook and steelhead
- However, because potential spawning > potential rearing:
  - **Potential to satiate the seedbank for egg recruits**
  - **Proportion of surplus juveniles could migrate to habitat downstream**

Diarmuid, youtube.com, 2015



"…a theory is just a model of the universe, or a restricted part of it, and a set of rules that relates quantities in the model to observations that we make."

-Stephen Hawking (1988)



Conclusions

- The UCM identified rearing conditions most limiting to potential population production
- The UCM also identified of high quality rearing streams which were mapped
- Ample spawning habitat was quantified
- Potentially higher increase in salmonid production than what is suggested by modeling parr capacity in streams above Scott Dam
- It's important to understand potential downstream effects from dam removal and how that may contribute to spawning and rearing potential

Acknowledgements

- Dr. Alison O'Dowd, Thesis Advisor
- Dr. Jim Graham & Dr. Darren Ward, Thesis Committee Members
- *Funding from:*
  - California Trout
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  - Water Resources & Policy Initiatives
  - Research, Scholarship, & Creative Activities Program (RSCA), HSU
- *Support & Collaboration from:*
  - Mendocino National Forest Service
  - Ross Taylor & Associates
  - Josh Fuller & David White, National Marine Fisheries Service
  - California Department of Fish & Wildlife
  - Native Fish Society
  - Friends of Eel River
  - Cramer Fish Sciences
  - Field Crew: Erik Daniels, Ariel Dasher, Erik Kenas, Mason Price

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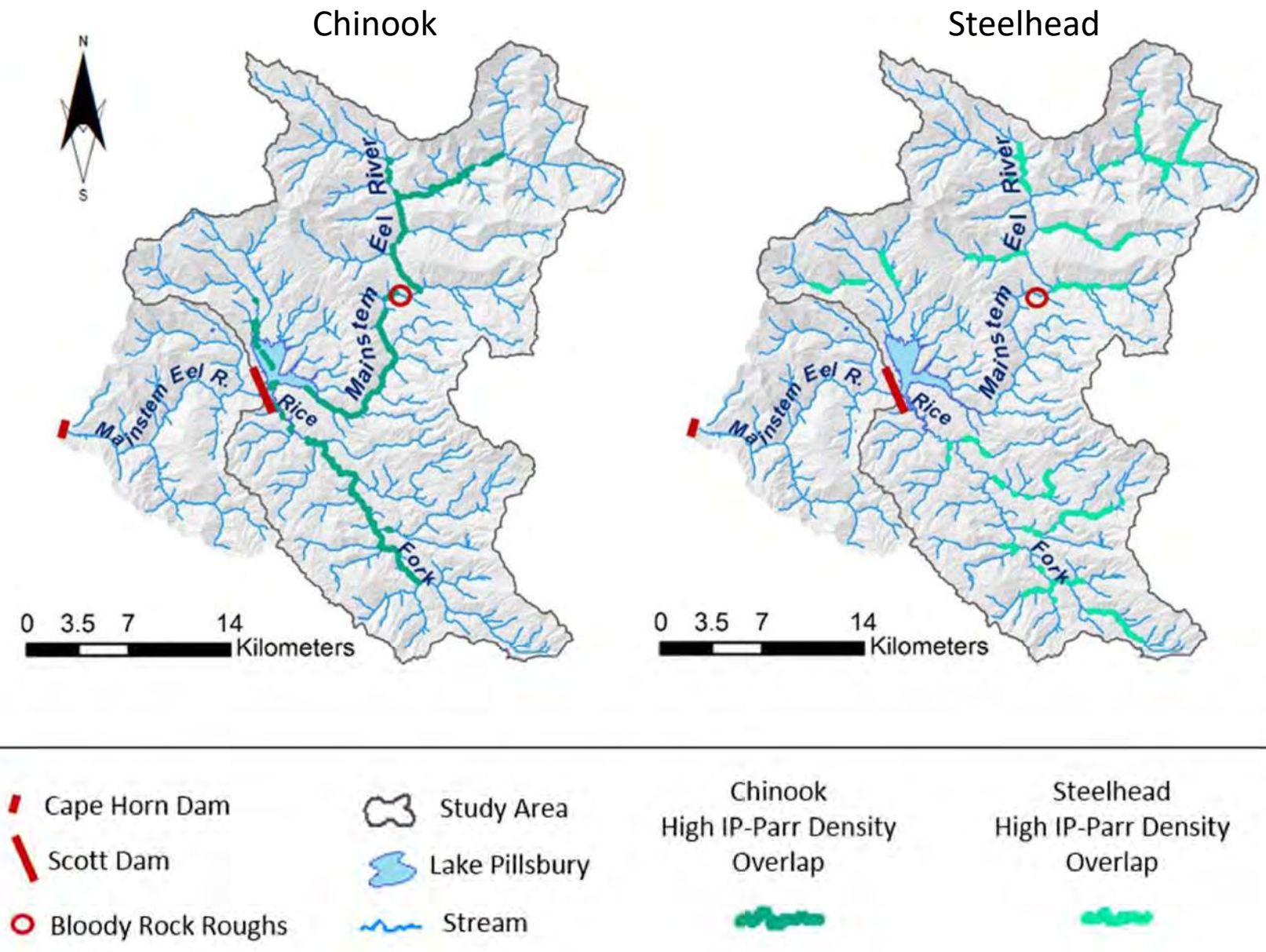
WRPI
Water Resources & Policy Initiatives

COAST
www.calstate.edu/coast/

High Intrinsic Potential + High Potential Density



Quick Facts

- Scott Dam: 162 River mi from Pacific Ocean
- Scott Dam: 138’ high; 805’ wide; 86,000 acre ft capacity
- 12 river mi between Scott Dam and Cape Horn Dam
- Cape Horn Dam: 96’ high; 515’ wide
- Study site drainage area: 288 mi^2
- Elevation range of study site: 1,818’ – 7,057’