Klamath Basin Fisheries Collaborative
2024 Annual Meeting

June 12 - 13, 2024

Klamath Falls, Oregon



“If you want to go fast, go alone; If you want to go far, go together”

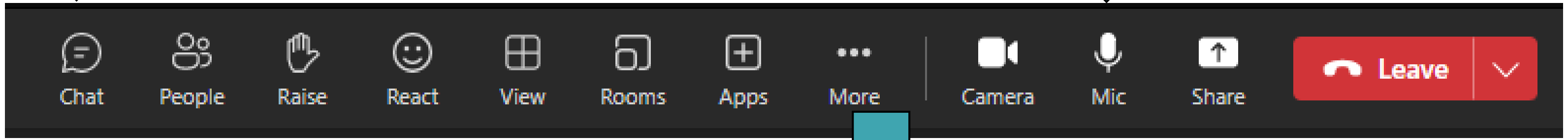
Use the meeting chat if you need assistance.

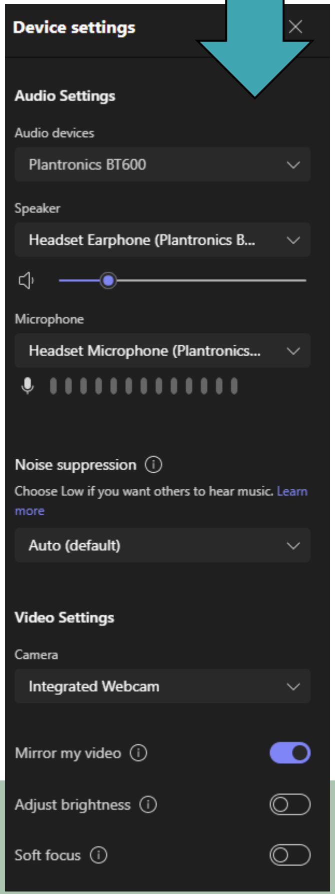
Chats can be seen by all participants.

Please mute yourself when not speaking.

Use *6 to mute phone audio.

Use the microphone icon on the control bar to mute computer audio.





If you are having problems with audio/video, check your device settings.

Virtual participants:

Please turn on web cameras on to facilitate discussion

In-person participants:

Please sign in on sheet

Please grab a name tag

Welcome – Day 1

- Co-Chair Welcome
- Logistics
- Overview of the day
- Lunch
- Post meeting survey (QR code at end)

Timeline	Agenda items
8:00 am	Welcome/ Announcements
8:30 am	Key Note Speaker
9:10 am	Presentations: Research & Monitoring of fish-Life history and population health
10:10 am	**Break**
10:20 am	Array Map and Array Workshop
12:00 pm	**Lunch**
1:00 pm	Presentations: Dam Passage & Removal
1:40 pm	KBFC Website & Collaborative Database Demo
2:40 pm	**Break**
2:50 pm	Presentations: Research & monitoring of fish-PIT and telemetry tagging
3:40 pm	Basin Updates
6:00 pm	Group Social at Falls Taphouse

Keynote Speaker

Jeff Duda

USGS

Collaboration and Dam Removal

Conceptualizing the ecosystem response to dam removal – experiences from the Elwha

Jeff Duda
U.S. Geological Survey, Western Fisheries Research Center, Seattle

Klamath Basin Fisheries Collaborative
Klamath Falls
7 June 2024

USGS science for a changing world

Outline

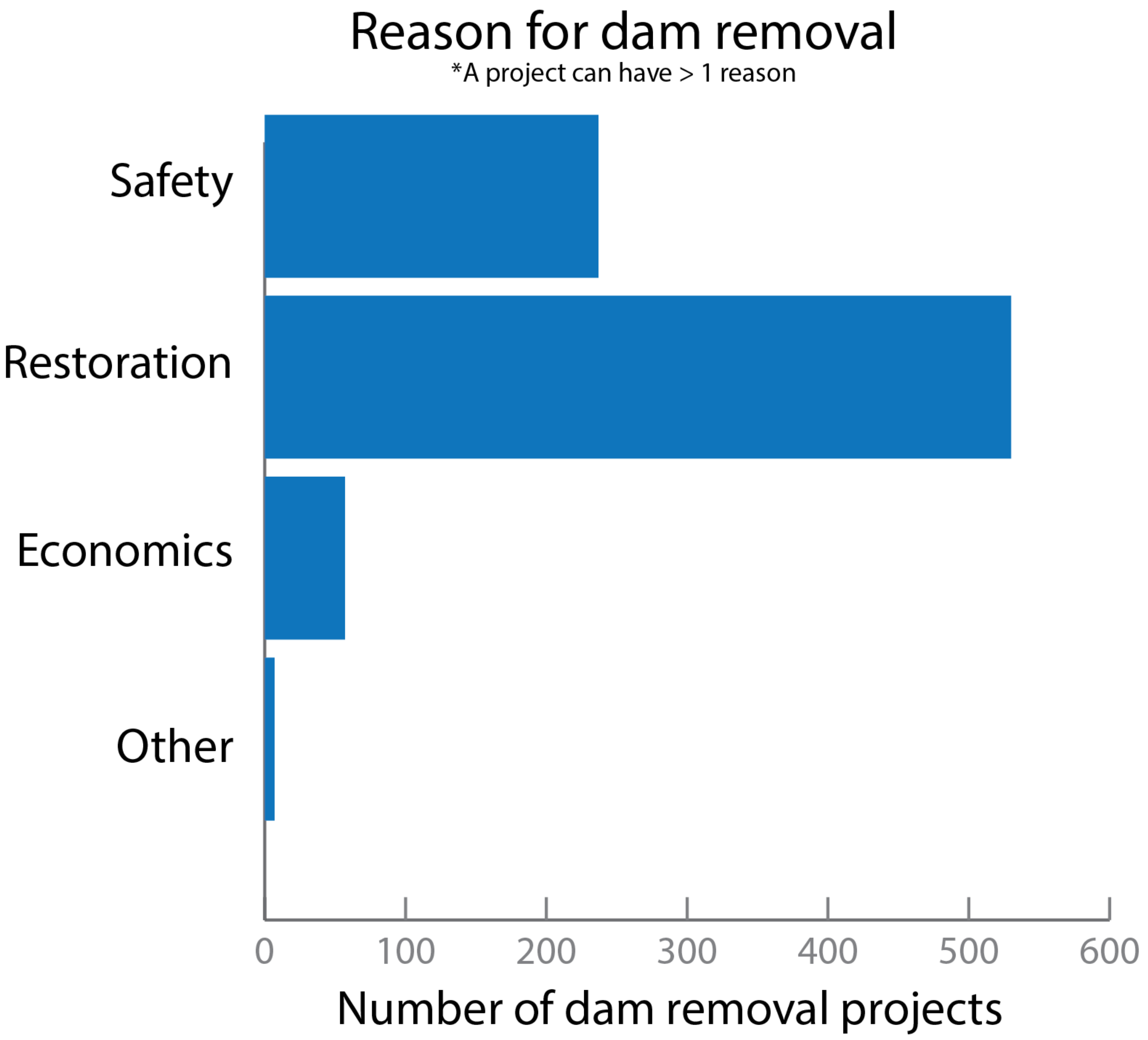
- The Big Picture – context and themes of dam removal
- Conceptual models of ecological response to dam removal
- Examples from the Elwha
- Why collaboration matters

J Duda_USGS

USGS science for a changing world

Why dam removal?

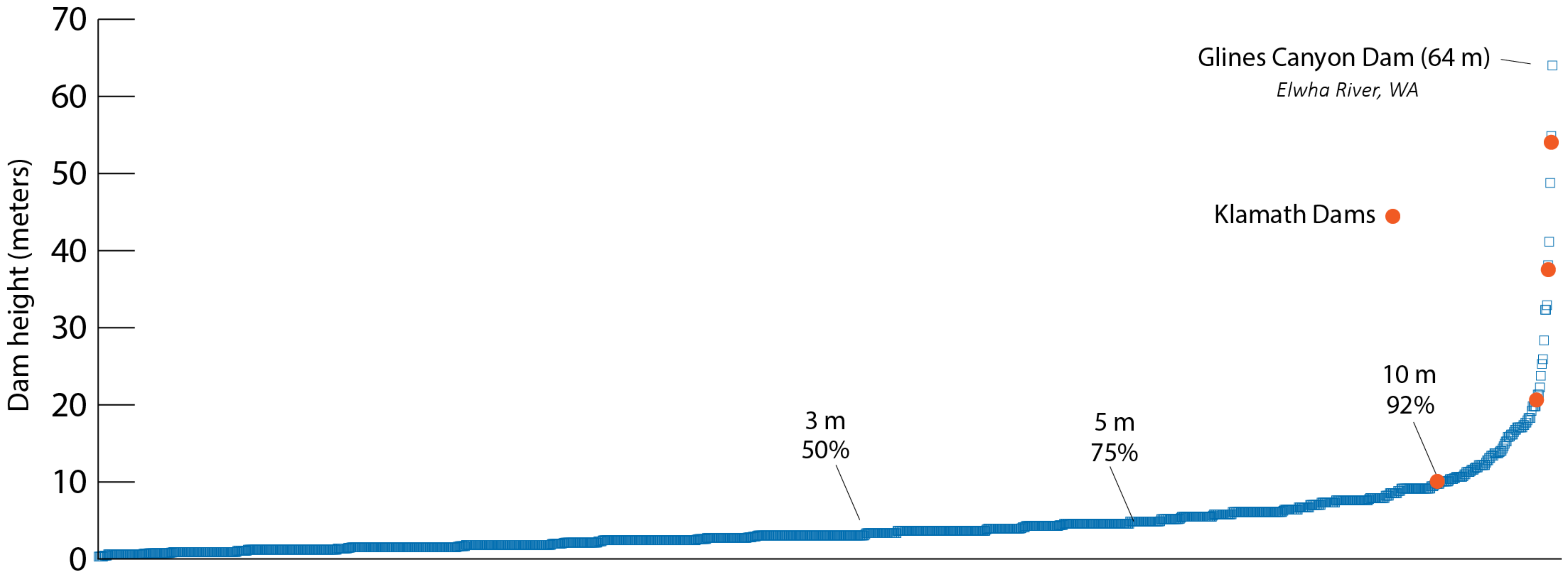
- Safety
- Sedimentation
- Obsolete
- Restoration



Modified from Duda et al. 2023. Frontiers in Ecology and Evolution

Factors driving dam removal will continue

The New York Times



Data from American Rivers (2021): Figshare
N = 1405 removed dams

Source: U.S. Army Corps of Engineers

Consequences can be severe

Rising flood waters advance on Midland, Michigan, after the breach of the Edenville and Sanford dams.

Edited by **Jennifer Sills**

Preparing for proactive dam removal decisions

Science AAAS

July 2020

Farshid Vahedifard[1]*, Kaveh Madani[2,3], Amir AghaKouchak[4], Sannith Kumar Thota[1]

"To prepare for future decisions, scientists should document, share, and analyze the collected data and lessons from both past and ongoing dam removal missions."

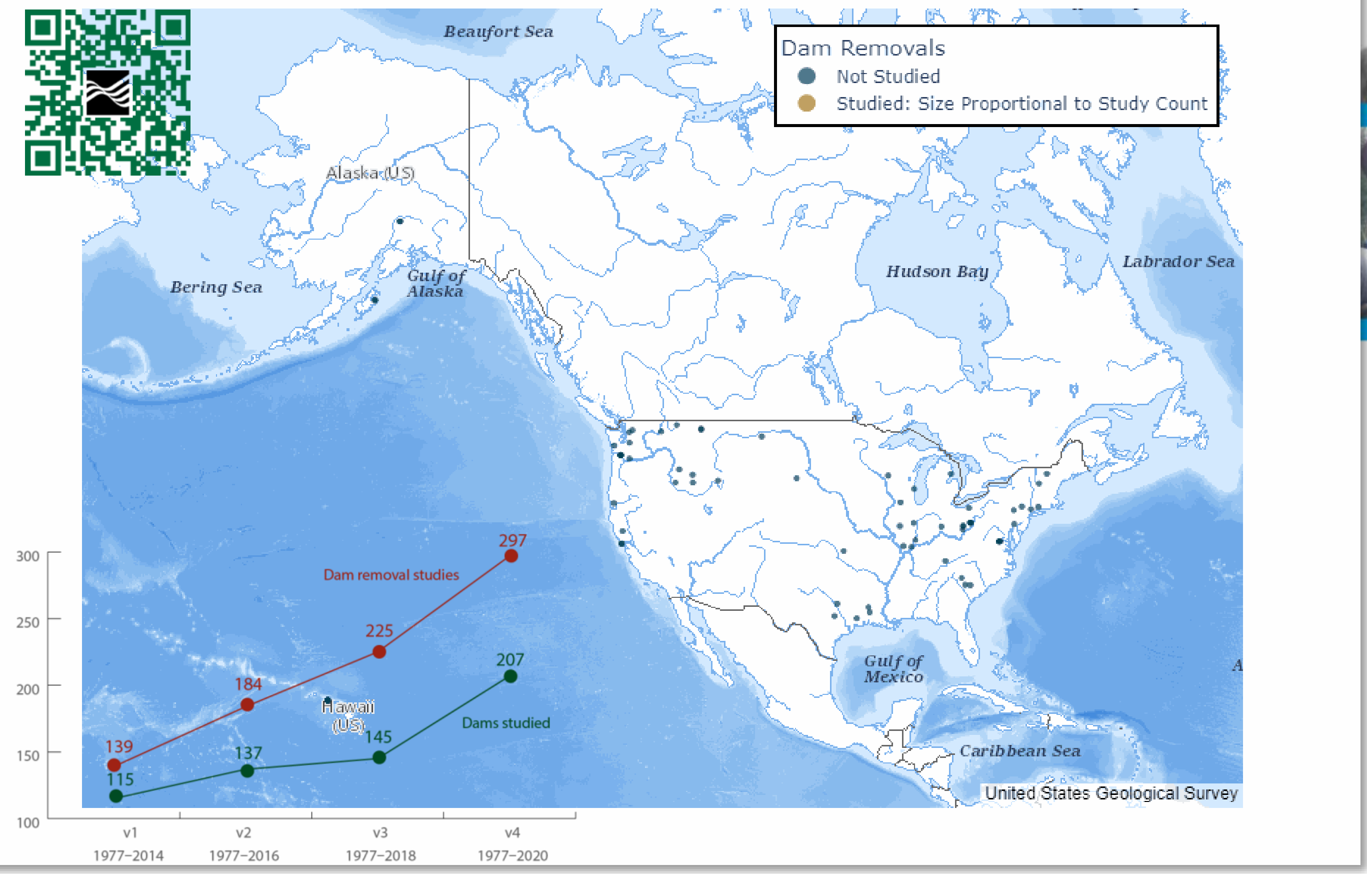
USGS John Wesley Powell Center for Analysis and Synthesis

Working Group

Dam removal: synthesis of ecological and physical responses

https://data.usgs.gov/drip-dashboard

Dam Removal Studies Through Time: Unknown



USGS John Wesley Powell Center for Analysis and Synthesis

Working Group

Dam removal: synthesis of ecological and physical responses

AGU PUBLICATIONS

Water Resources Research

COMMENTARY

10.1002/2017WR020457

The first six authors significantly contributed to the preparation of the article.

Dam removal: Listening in

M. M. Foley[1], J. R. Bellmore[2], J. E. O'Connor[3], J. J. Duda[4], A. E. East[1], G. E. Grant[5], C. W. Anderson[6], J. A. Bountry[7], M. J. Collins[8], P. J. Connolly[9], L. S. Craig[10], J. E. Evans[11], S. L. Greene[12], F. J. Magilligan[13], C. S. Magirl[14], J. J. Major[15], G. R. Pess[16], T. J. Randle[7], P. B. Shafroth[17], C. E. Torgersen[12], D. Tullos[18], and A. C. Wilcox[19]

sciencemag.org SCIENCE

PERSPECTIVES

ECOLOGY

1000 dams down and counting

Dam removals are reconnecting rivers in the United States

By J. E. O'Connor,[1] J. J. Duda,[2] G. E. Grant[3]

WIREs WATER

Advanced Review

Status and trends of dam removal research in the United States

J. Ryan Bellmore,[1*] Jeffrey J. Duda,[2] Laura S. Craig,[3] Samantha L. Greene,[4] Christian E. Torgersen,[4] Mathias J. Collins[5] and Katherine Vittum[2]

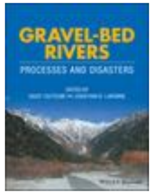
PLOS ONE

Landscape context and the biophysical response of rivers to dam removal in the United States

Melissa M. Foley, Francis J. Magilligan, Christian E. Torgersen, Jon J. Major, Chauncey W. Anderson, Patrick J. Connolly, Daniel Wieferich, Patrick B. Shafroth, James E. Evans, Dana Infante, Laura S. Craig

Geomorphic Responses to Dam Removal in the United States – a Two-Decade Perspective

Jon J. Major, Amy E. East, Jim E. O'Connor, Gordon E. Grant, Andrew C. Wilcox, Christopher S. Magirl, Mathias J. Collins, and Desiree D. Tullos



JAWRA JOURNAL OF THE AMERICAN WATER RESOURCES ASSOCIATION

SYNTHESIS OF COMMON MANAGEMENT CONCERNS ASSOCIATED WITH DAM REMOVAL[1]

Desirée D. Tullos, Mathias J. Collins, J. Ryan Bellmore, Jennifer A. Bountry, Patrick J. Connolly, Patrick B. Shafroth, and Andrew C. Wilcox[2]

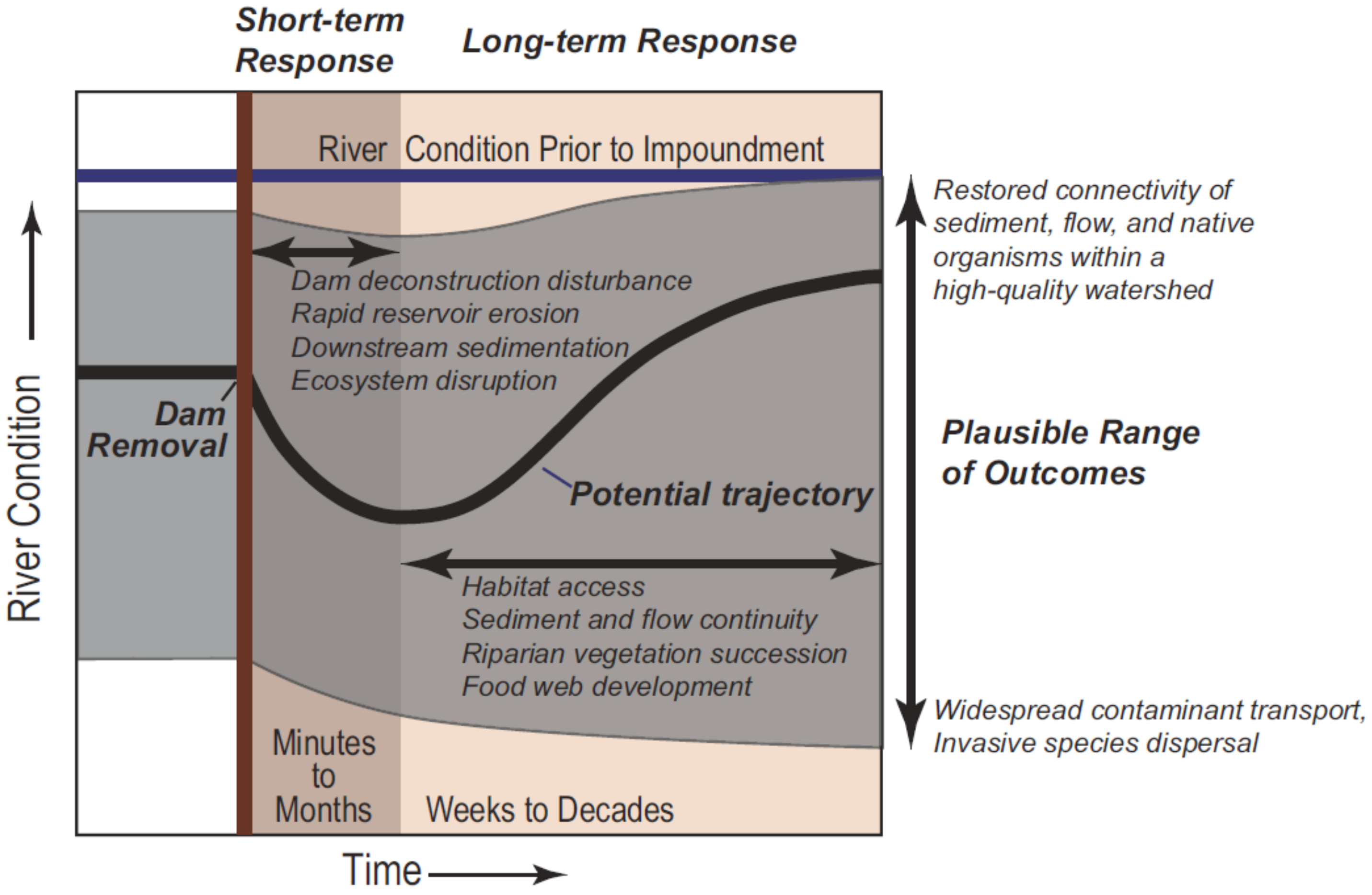
ELEMENTA Science of the Anthropocene

River restoration by dam removal: Enhancing connectivity at watershed scales

F.J. Magilligan[1*] • B.E. Graber[2] • K.H. Nislow[3] • J.W. Chipman[1] • C.S. Sneddon[4] • C.A. Fox[4]

USGS

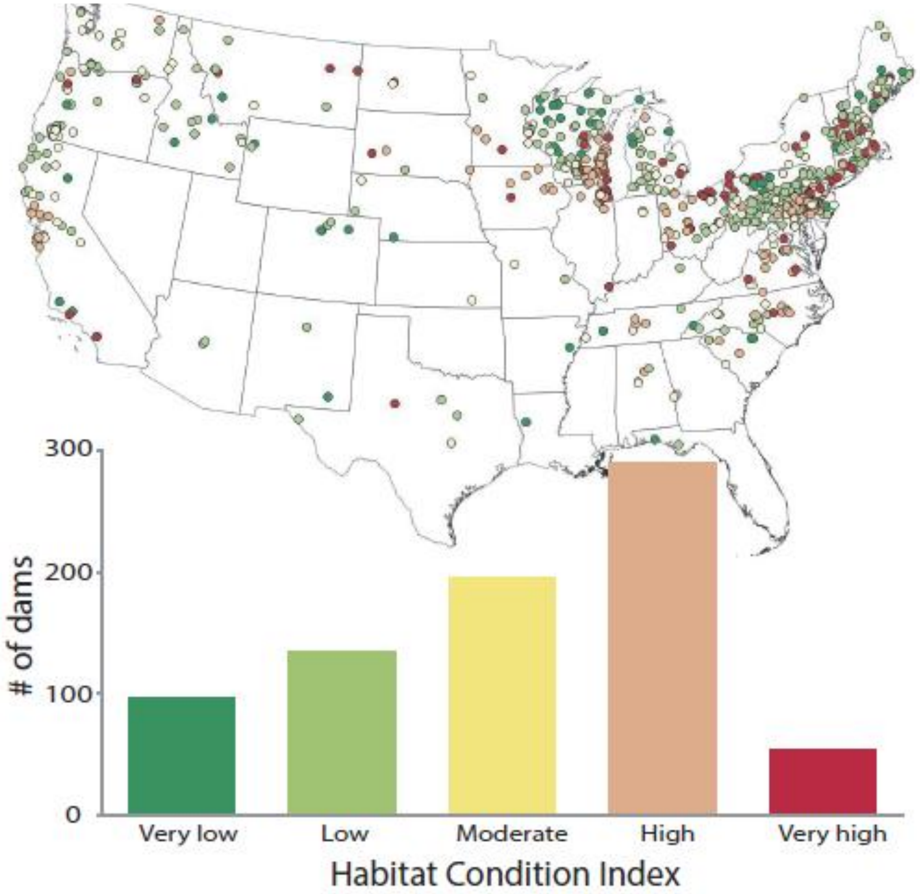
A heuristic model among a vast amount of variability



Foley et al. 2019 Water Resources Research

Challenge#1 in understanding and predicting recovery trajectories is that ecological responses vary spatially and temporally

Challenge#2: The local and regional context of each dam and watershed is distinct, and therefore, the responses to removal are unique.



Foley et al. 2017 PLoS ONE

Predicting dam removal outcomes

Powell Center

Overview Articles

BioScience • *January 2019/ Vol. 69 No. 1*

Conceptualizing Ecological Responses to Dam Removal: If You Remove It, What's to Come?

J. RYAN BELLMORE, GEORGE R. PESS, JEFFREY J. DUDA, JIM E. O'CONNOR, AMY E. EAST, MELISSA M. FOLEY, ANDREW C. WILCOX, JON J. MAJOR, PATRICK B. SHAFROTH, SARAH A. MORLEY, CHRISTOPHER S. MAGIRL, CHAUNCEY W. ANDERSON, JAMES E. EVANS, CHRISTIAN E. TORGERSEN, AND LAURA S. CRAIG

These conceptual models:

- Use a systems approach to define the processes affecting ecological responses to dam removal
- Clarify how ecological transitions in 3 main spatial domains are affected by dam removal
- Illustrate that responses are complex but *predictable*

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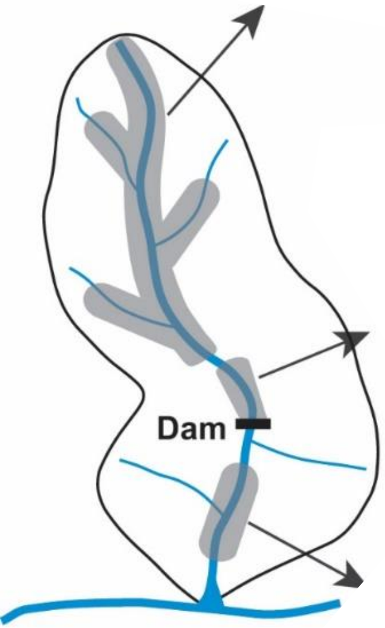
science for a changing world

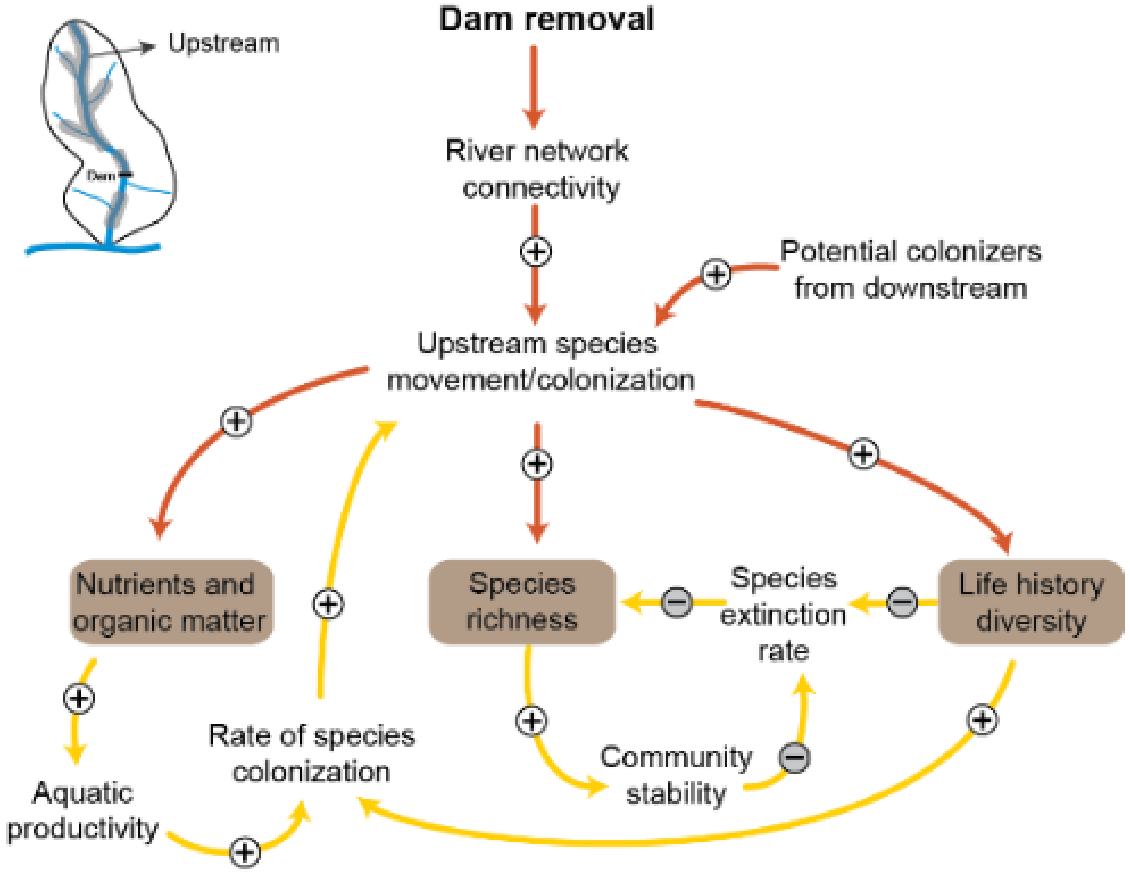
Drivers of ecosystem response

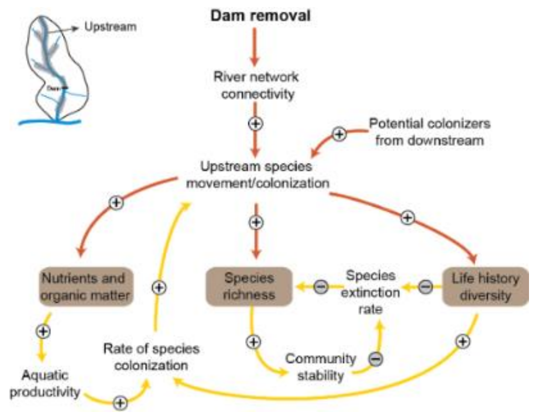


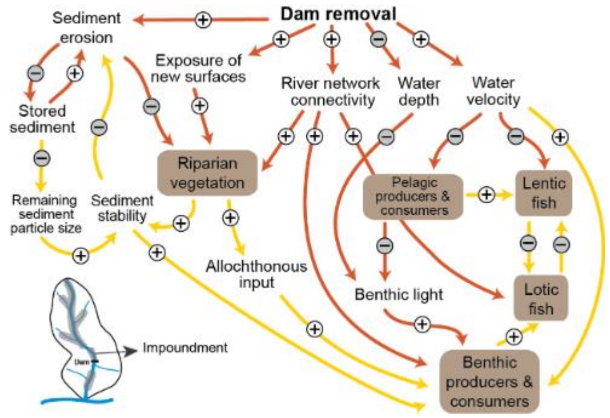
Spatial domain	Dominant processes driving change	Examples
Upstream	Longitudinal connectivity	• Fish passage • Nutrient subsidies • Cross-boundary interactions
Former reservoir	Lentic to lotic	• Species turnover/community structure • Channel and floodplain evolution • Upland and riparian revegetation
Downstream	Physical fluxes	• Sediment transport/deposition • Increase turbidity • Natural flow, sediment, temperature regime

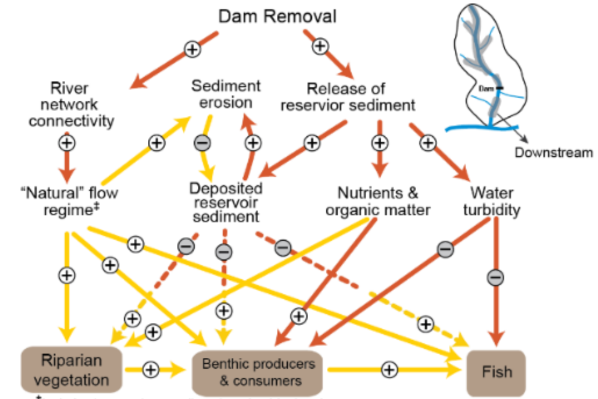
Bellmore et al. 2019. BioScience

Causal loop conceptual models



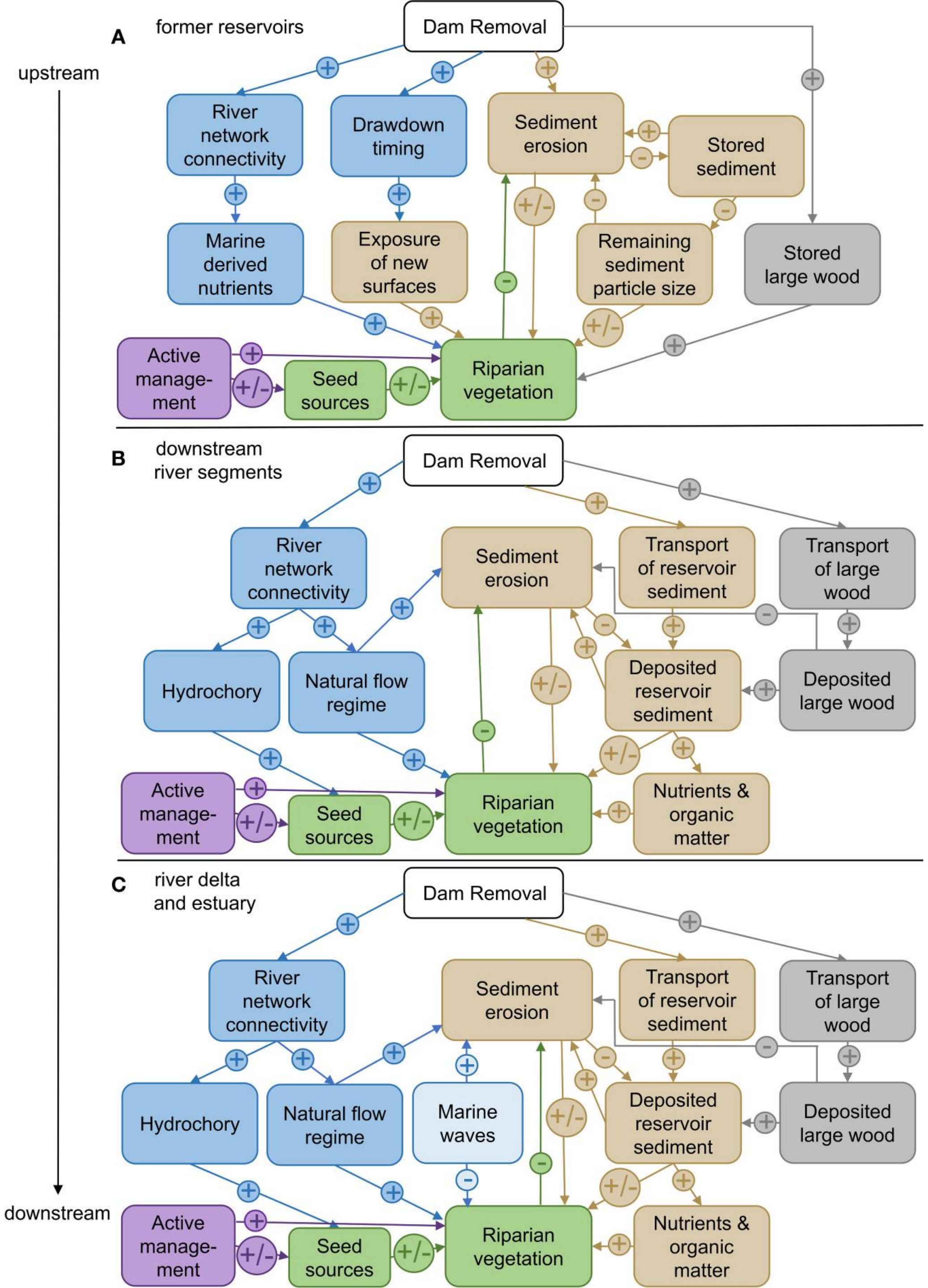






Bellmore et al. 2019. BioScience

Conceptual models are adaptable



REVIEW article

Front. Ecol. Evol., 13 February 2024
Sec. Conservation and Restoration Ecology
Volume 12 - 2024 | https://doi.org/10.3389/fevo.2024.1272921

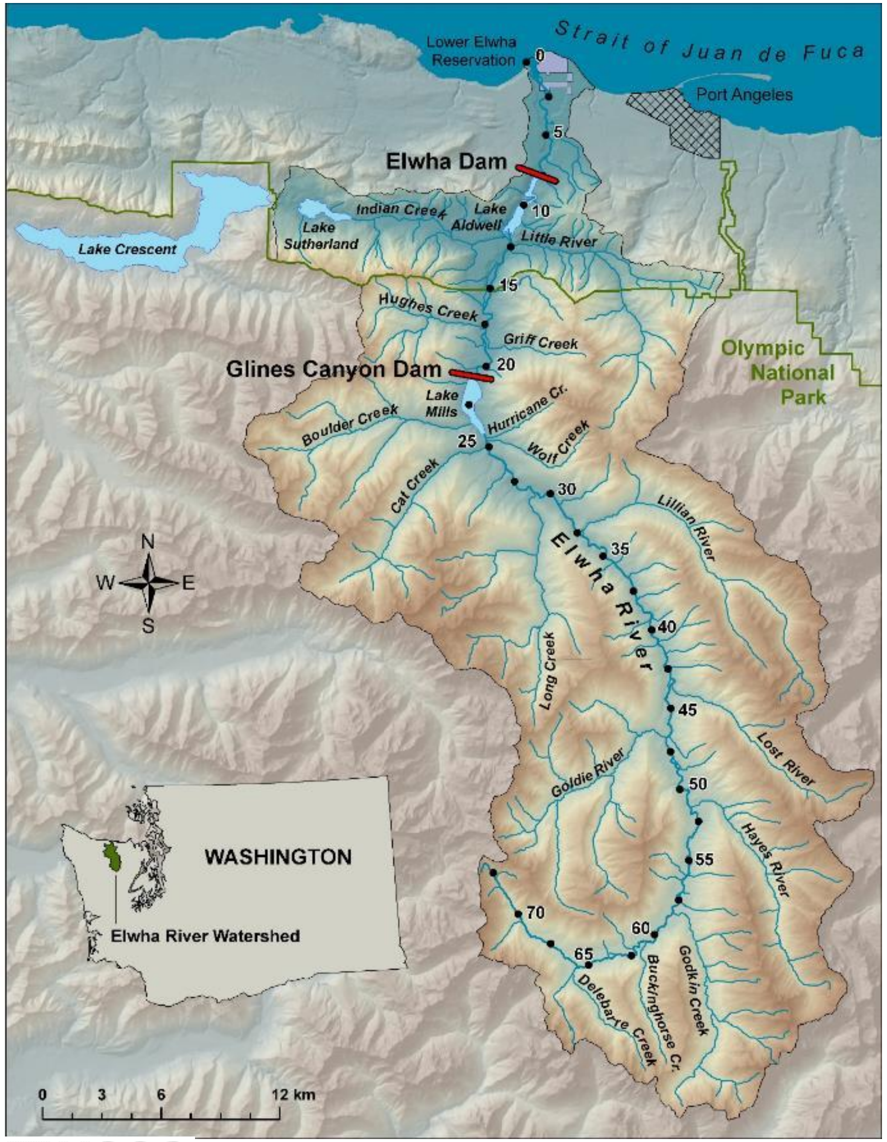
This article is part of the Research Topic
Large-Scale Dam Removal and Ecosystem Restoration
View all 23 Articles >

Vegetation responses to large dam removal on the Elwha River, Washington, USA

Patrick B. Shafroth[1*] Laura G. Perry[1,2] James M. Helfield[3] Joshua Chenoweth[4] Rebecca L. Brown[5]

Elwha basics

>90% Habitat lost
~98% decline of salmon populations



USGS

Elwha Dam

- 32 m concrete gravity
- Completed in 1912

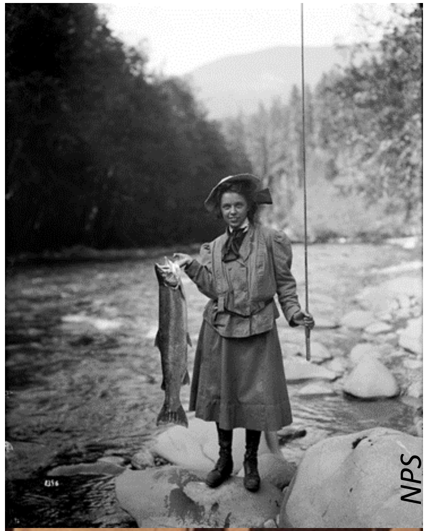
- Removed in 2012
- ~8 mo.

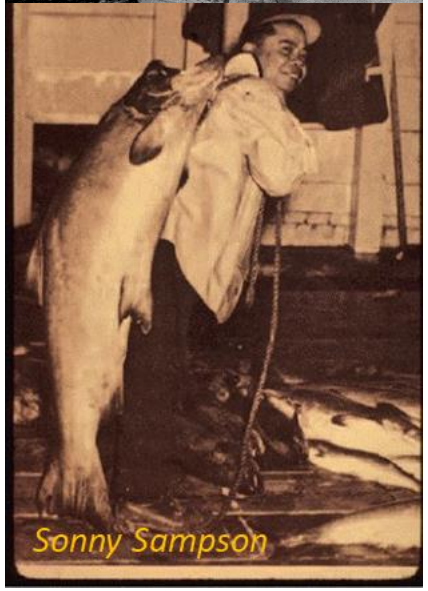
Glines Canyon Dam

- 64 m concrete arch
- Completed in 1927

- Removed in 2014
- ~36 mo.

Dam photographs courtesy John Gussman





Planning and executing dam removal on the Elwha River

- Purchase of dams: $29 million US
- Cost of removal: $27 million US
- Dam removal mitigation: $269 million US
  - Industrial water treatment
  - Drinking water treatment
  - Raise flood control levees
  - Compensate floodplain property owners
  - Transition Tribal reservation from septic to city sewer
  - Rebuild Tribal fish hatchery
  - Revegetation of reservoir surfaces
  - Scientific monitoring (primarily flow and sediment)

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U.S. Department of the Interior

NOAA

Elwha Klallam Tribe

Powell Center

AmeriCorps

Sea Grant Washington

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National Park Service

Clallam County Marine Resources Committee

Western Washington University

Peninsula College

The Evergreen State College 1967

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Trout Unlimited

U.S. Fish & Wildlife Service

Coastal Watershed Institute

Washington Department of Fish and Wildlife

Department of Ecology State of Washington

University of Washington 1861

Smithsonian Institution

Bureau of Reclamation

Washington Conservation Corps

United States Environmental Protection Agency

Shreffler Environmental

Puget Sound Partnership

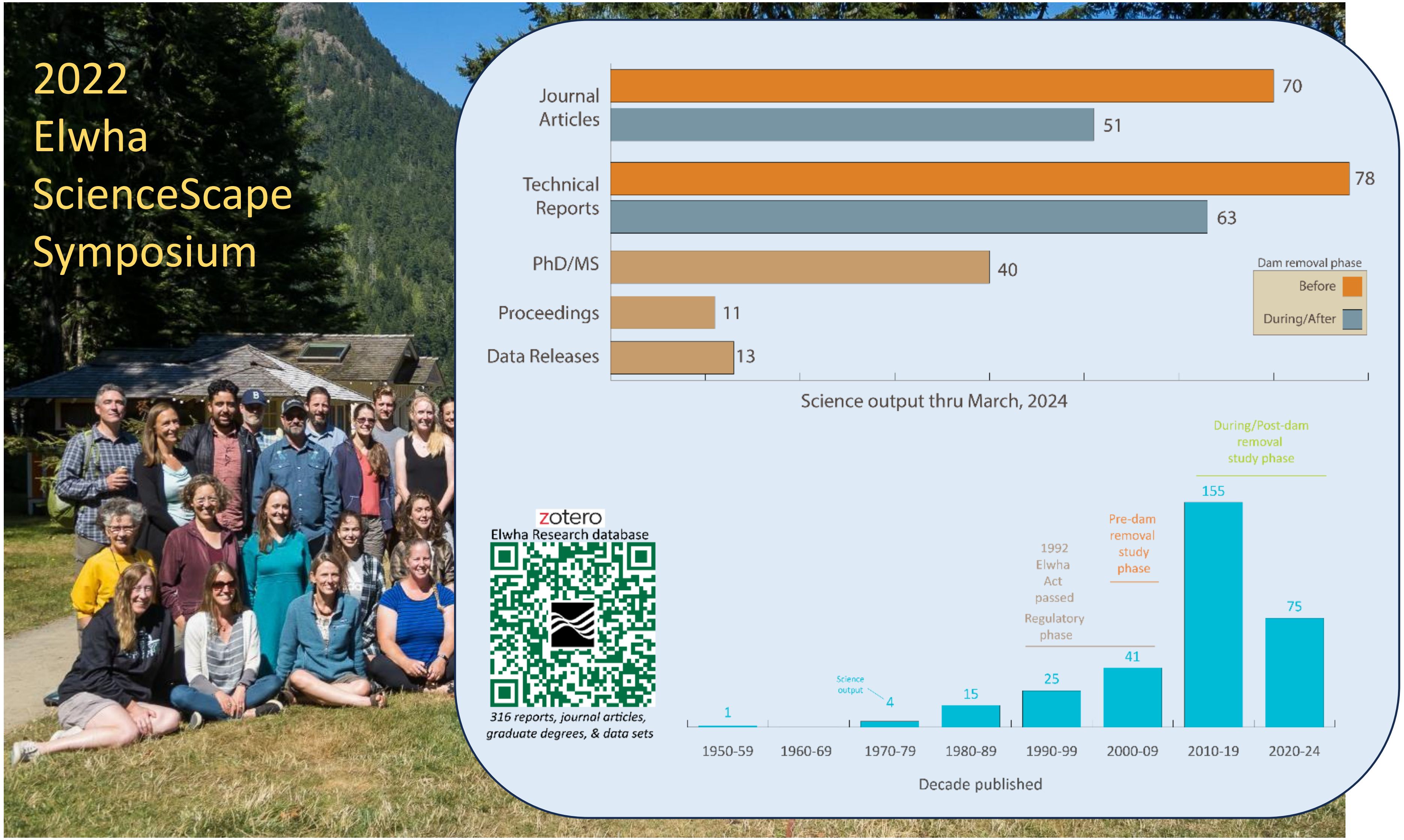
National Parks Conservation Association

Forest Service U.S. Department of Agriculture

The University of California Davis

K Denton & Associates

Elwha's Secret Sauce: Maintaining and Building Partnerships



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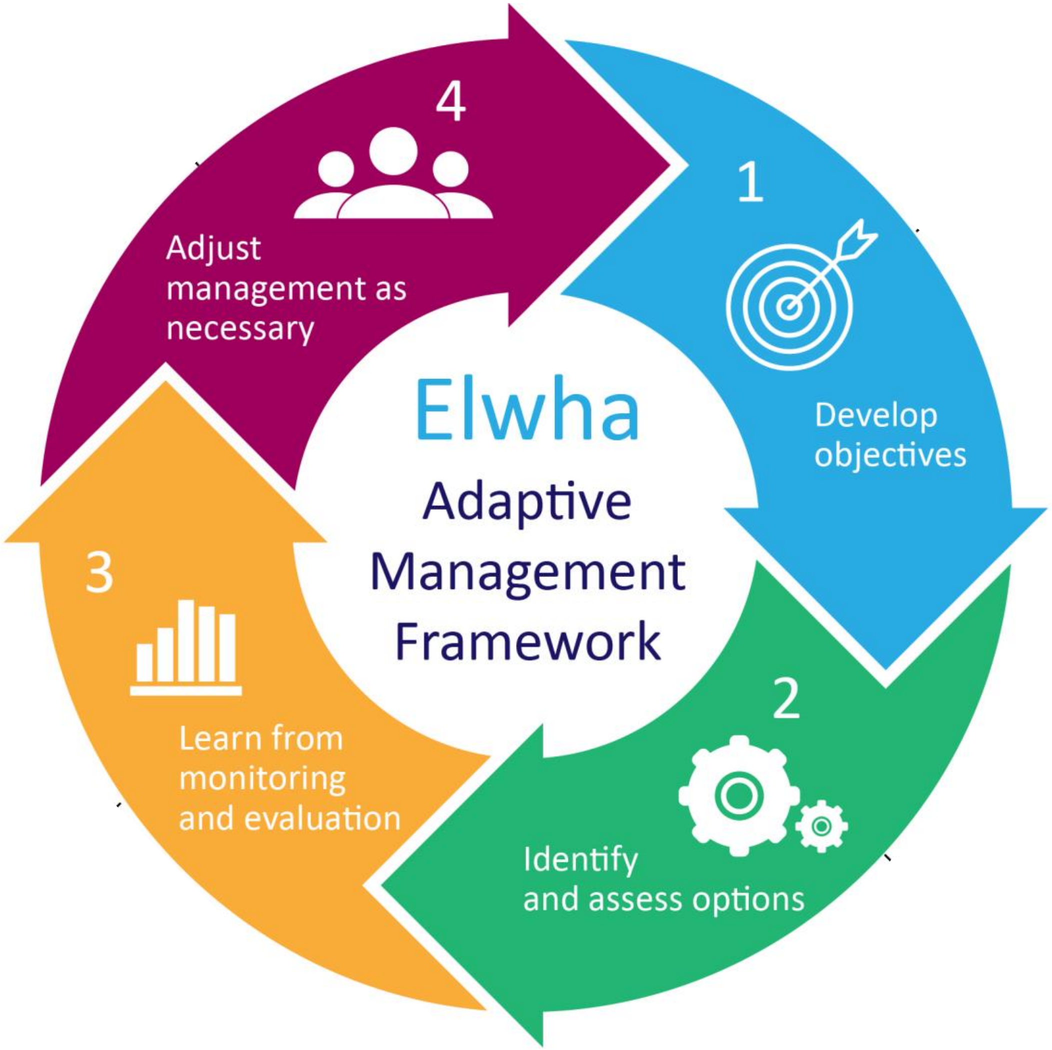
Elwha Fisheries Technical Committee

- Group of state, tribal, federal scientists focused on Elwha fisheries and dam removal; has been meeting for ~25 years.
- Created info for BiOPs, Elwha recovery plan (2008), and Elwha Monitoring and Adaptive Management Plan (2014).
- Diversity of goals, values, backgrounds, and agency mandates



Collaboration bar

From Peters et al. 2024. Frontiers in Ecology and Evolution.

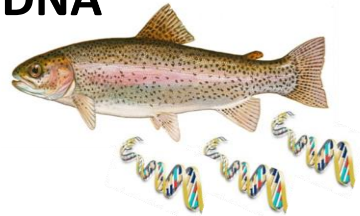
Field methods to assess distribution, abundance, and diversity

Radiotelemetry

Seining

Juvenile Monitoring

Environmental DNA



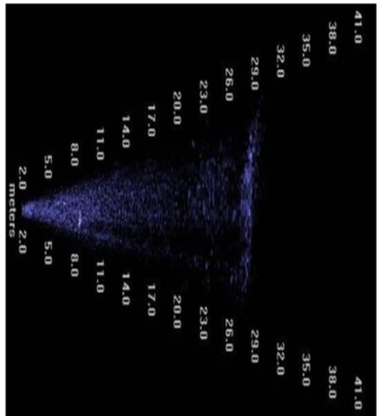
Redd Surveys

Genetic analysis

Pack Mules

Riverscape Snorkel Surveys

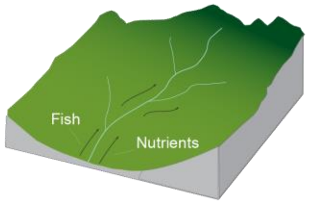
Sonar



Ear Bones

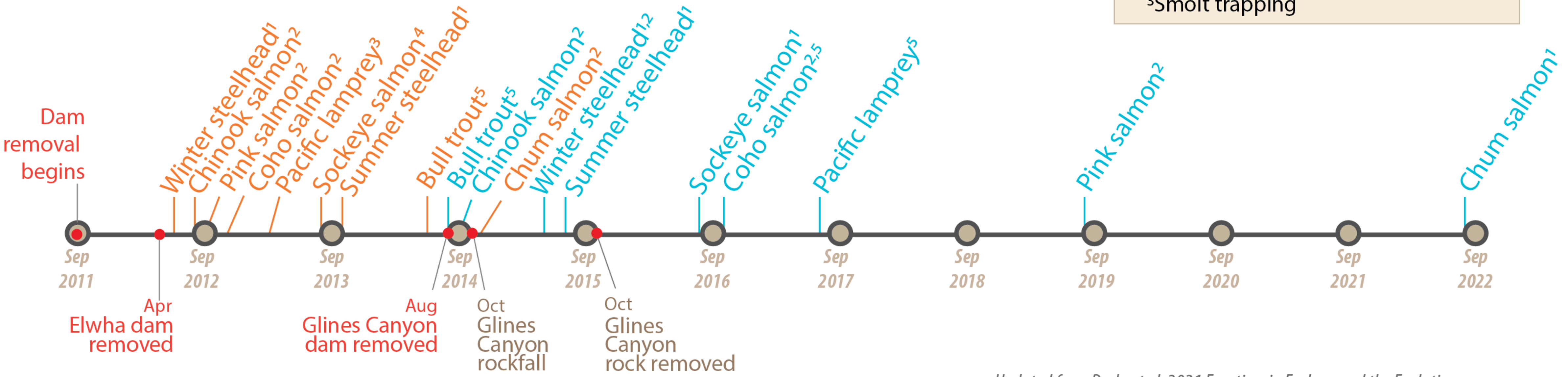
Drift Tangle Net

Summary of anadromous fish upstream of the dams



Timeline - Migratory fish response to a reconnected Elwha River

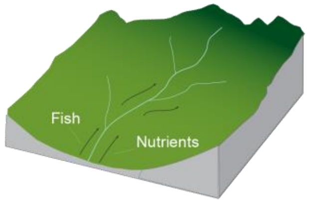
First adult observation
Upstream of Elwha Dam
Upstream of Glines Canyon Dam
Methods of detection
[1]Snorkeling
[2]Redd survey
[3]Smolt trapping
[4]Tangle netting
[5]Radio-telemetry



Updated from Duda et al. 2021 Frontiers in Ecology and the Evolution

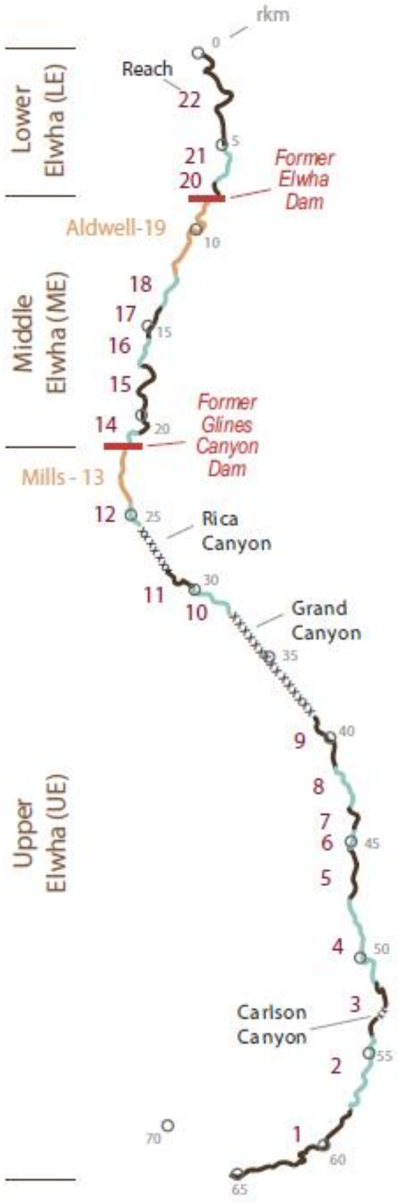
USGS science for a changing world · NOAA · National Park Service · Elwha Klallam Tribe · U.S. Fish & Wildlife Service · Washington Department of Fish and Wildlife · Trout Unlimited · Shreffler Environmental

Riverscape surveys before and after dam removal



The "Riverscape Approach"

- Continuously collected adult and juvenile fish data from headwaters to the sea.
- **Adults**: Bull Trout, Resident Trout, Chinook salmon, Steelhead
- **Juveniles**: Coho, Chinook, Trout.



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J Duda_USGS

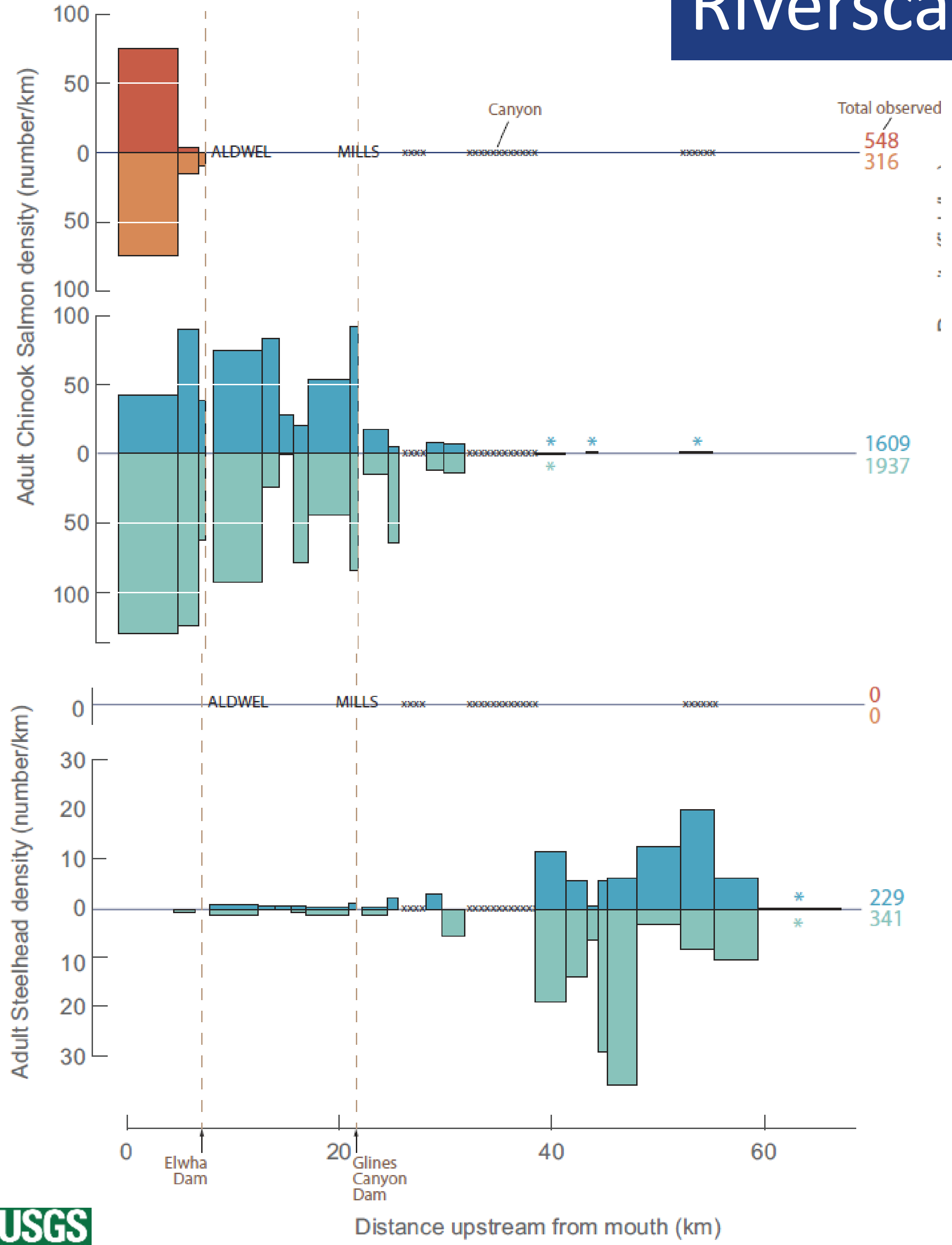
ORIGINAL RESEARCH
published: 09 December 2021
doi: 10.3389/fevo.2021.765488

River:

J Duda_USGS

USGS science for a changing world · NOAA · National Park Service · Elwha Klallam Tribe · U.S. Fish & Wildlife Service · Washington Department of Fish and Wildlife · Trout Unlimited · Shreffler Environmental · Western Washington University · Peninsula College · K Denton & Associates

Riverscape results for two threatened species



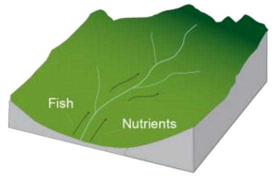
Chinook

- Before dam removal, Chinook limited to downstream of Elwha Dam
- After dam removal, adults detected upstream of each dam, but densities highest in reaches downstream of Glines Canyon

Summer Steelhead

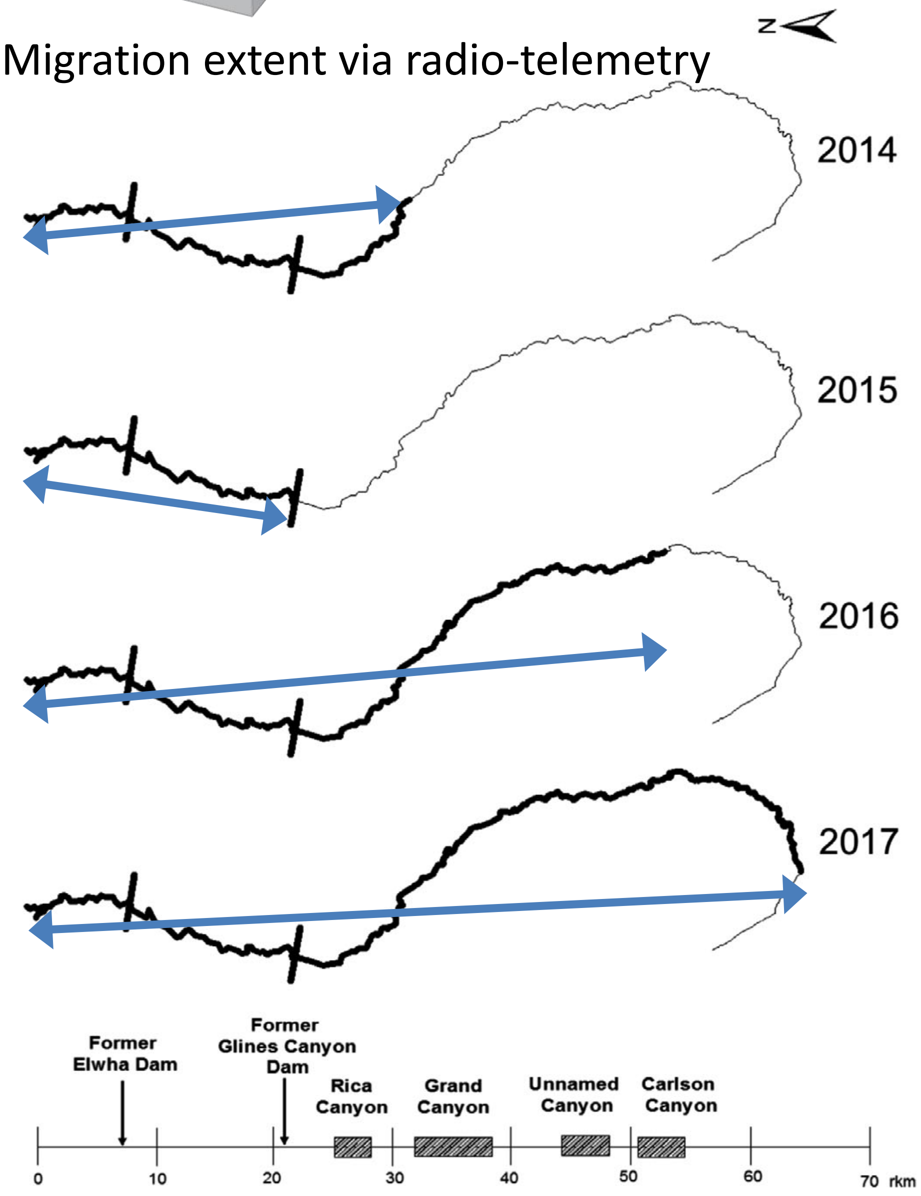
- Before dam removal, scarce (presumably extirpated)
- After dam removal, large increases driven by "reawakening of anadromy" from resident trout populations (Fraik et al. 2021).

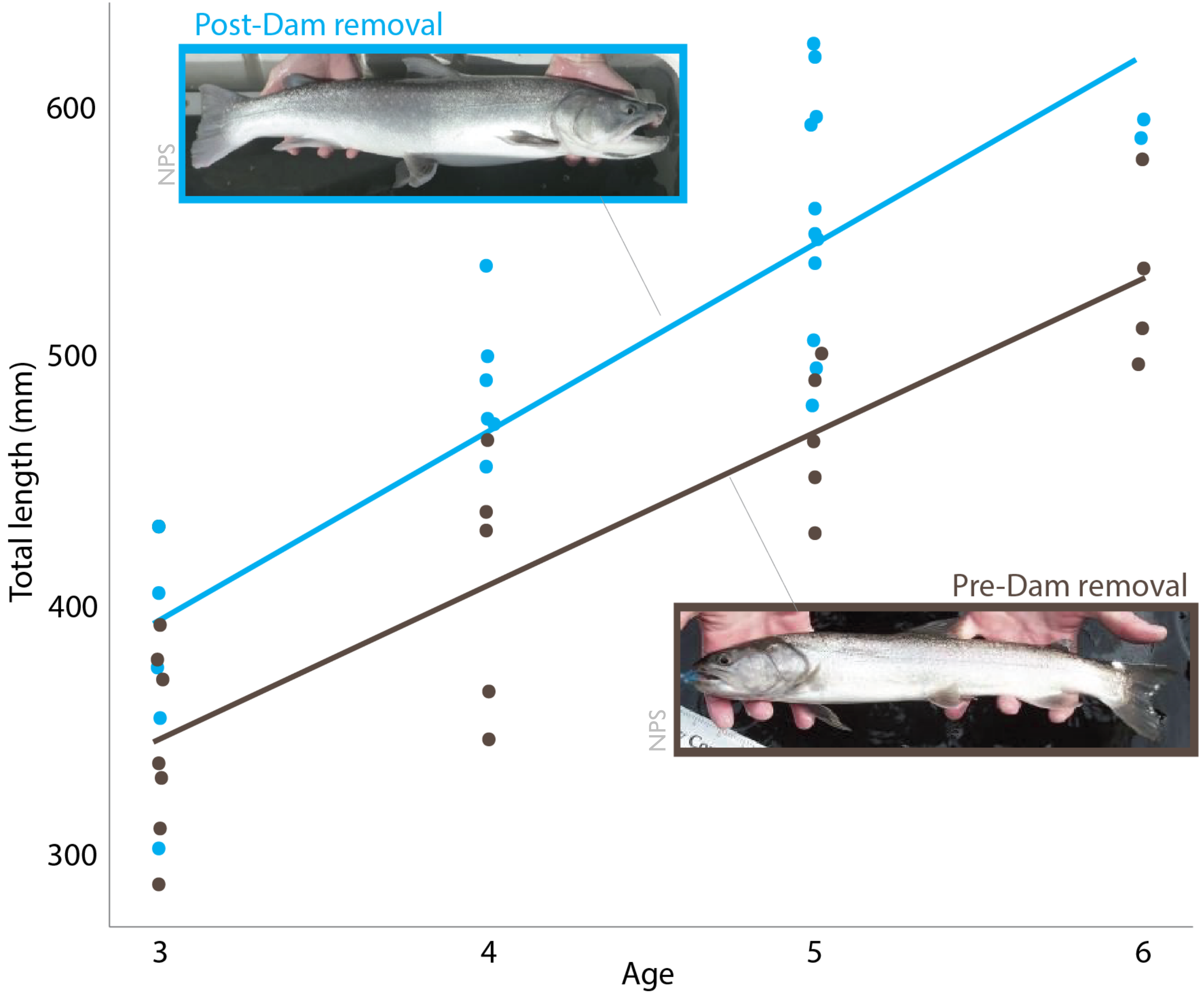
From Duda et al. 2021. Frontiers in Ecology and Evolution



Bull trout: Reawakening of whole river migration

Migration extent via radio-telemetry





Brenkman et al. 2019
North American Journal of Fisheries Management

Viable Salmon Population Metrics: Chinook

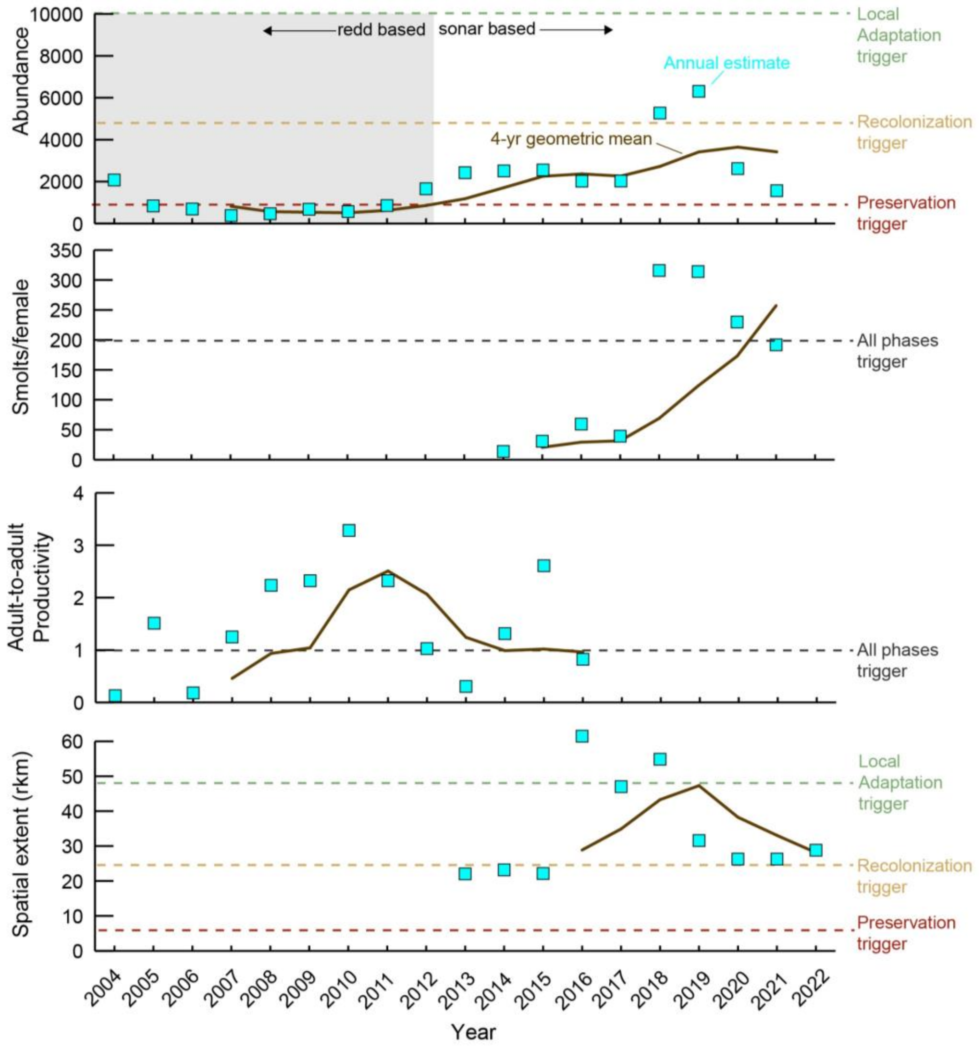
Preservation → Recolonization phase

Abundance increasing, exceeding trigger value ☑

Juvenile productivity (smolts/female) increasing after 2017, exceed trigger value ☑

Adult productivity stable, but not meeting goals X

Spatial extent variable, exceeding preservation and at times recolonization trigger values ☑



From Peters et al. 2024. Frontiers in Ecology and Evolution

Viable Salmon Population Metrics: Winter Steelhead

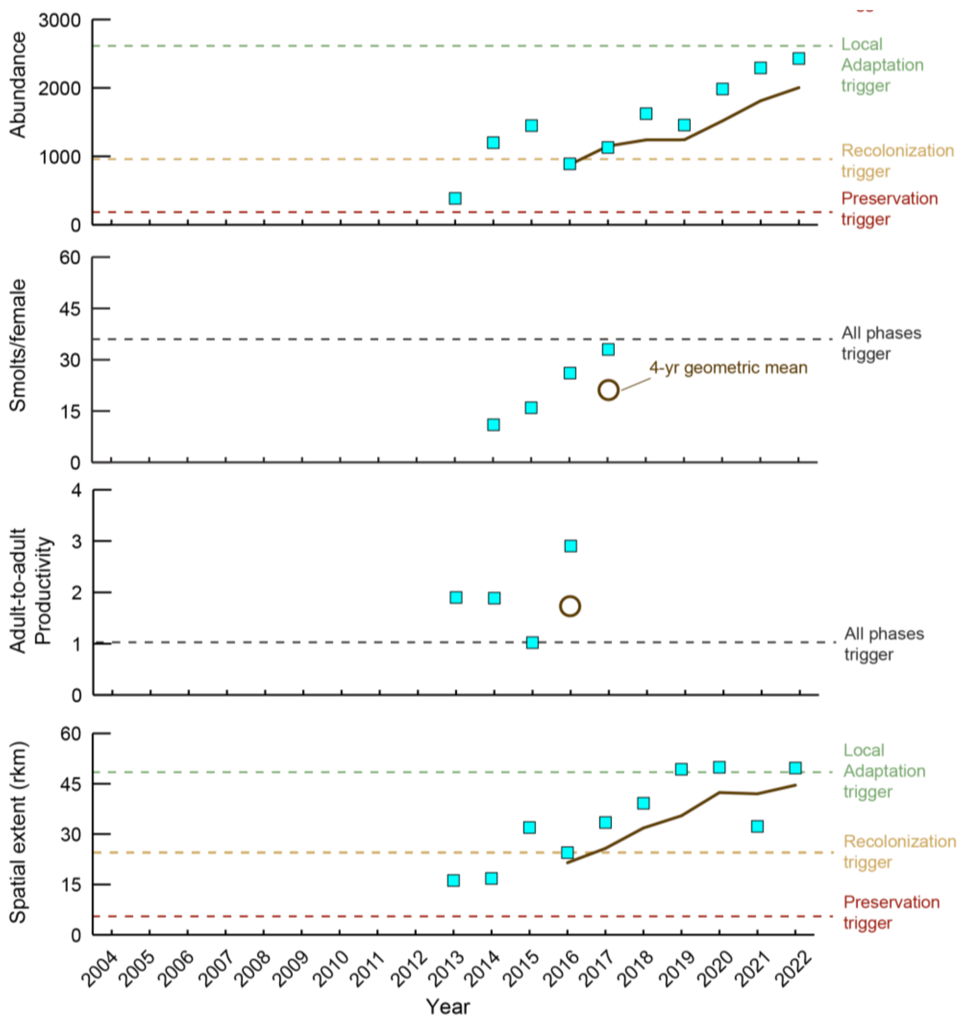
Preservation → Recolonization phase

Abundance increasing, exceeding phase trigger value ☑

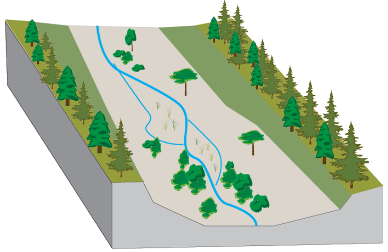
Juvenile productivity (smolts/female) increasing, nearing trigger value ?

Adult productivity stable, exceeding trigger value ☑

Spatial extent increasing, almost exceeding trigger value for local adaptation phase ☑



From Peters et al. 2024. Frontiers in Ecology and Evolution

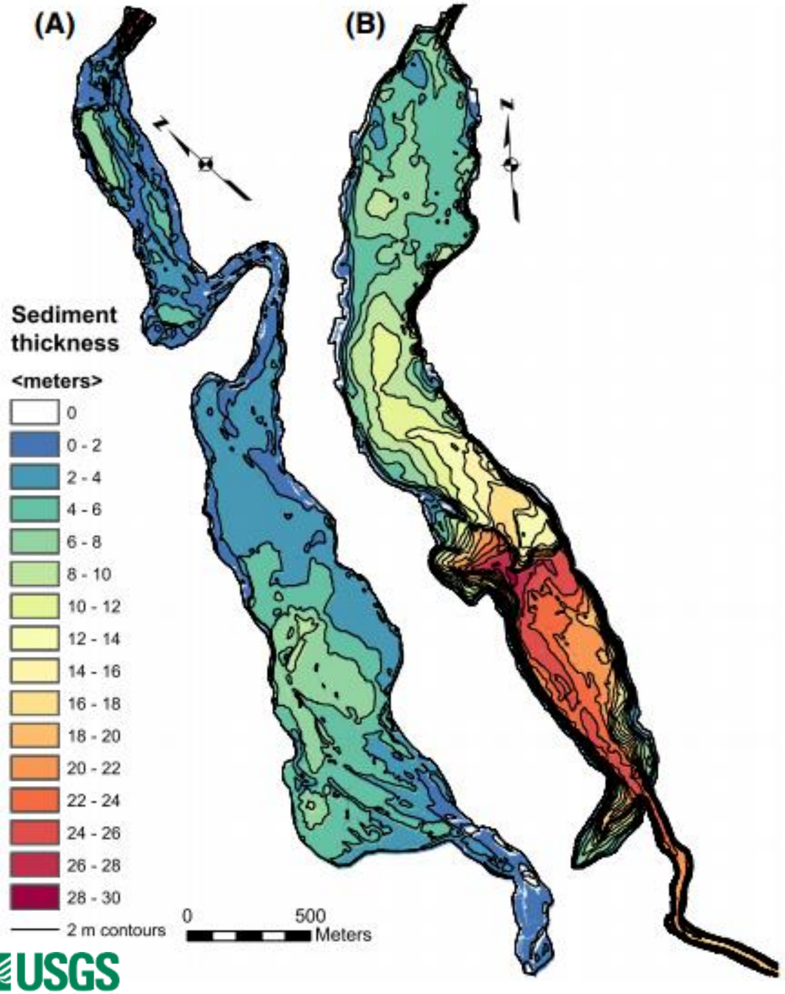


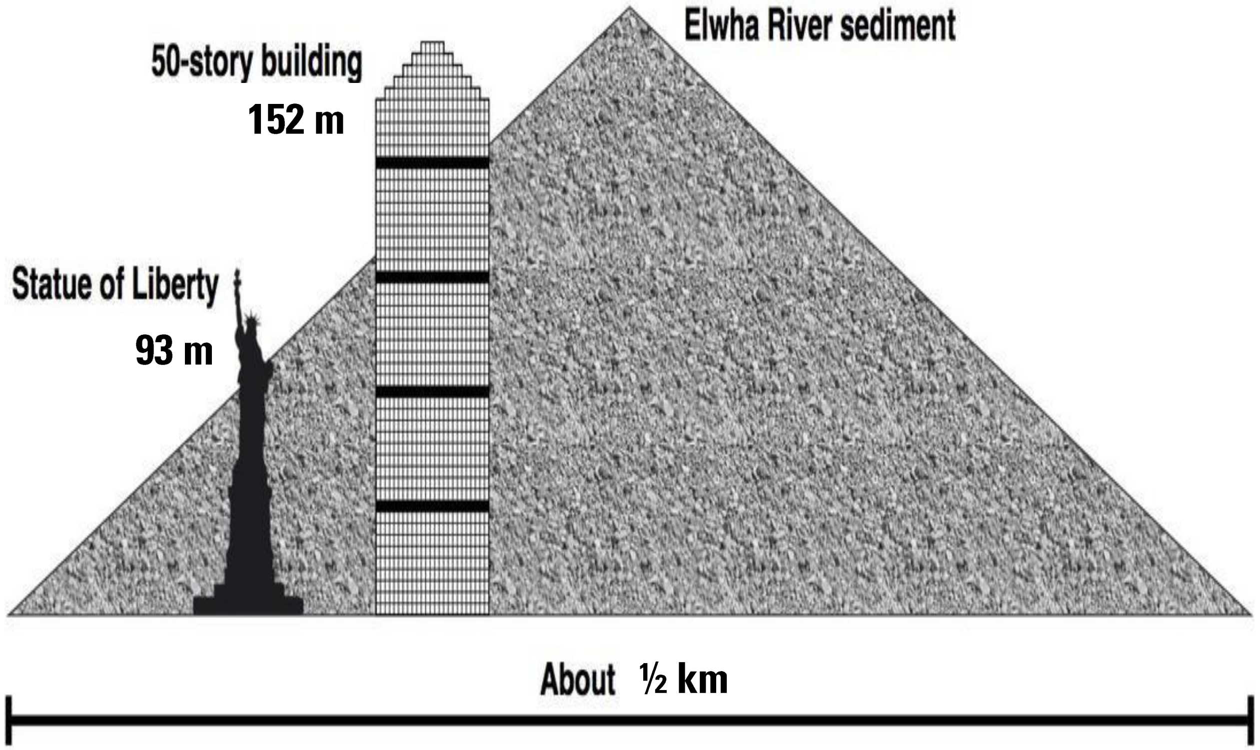
Former reservoirs – sediment redistribution

Both reservoirs contain 21 million m^3 of sediment

Aldwell

Mills





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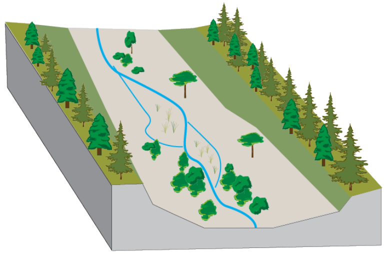
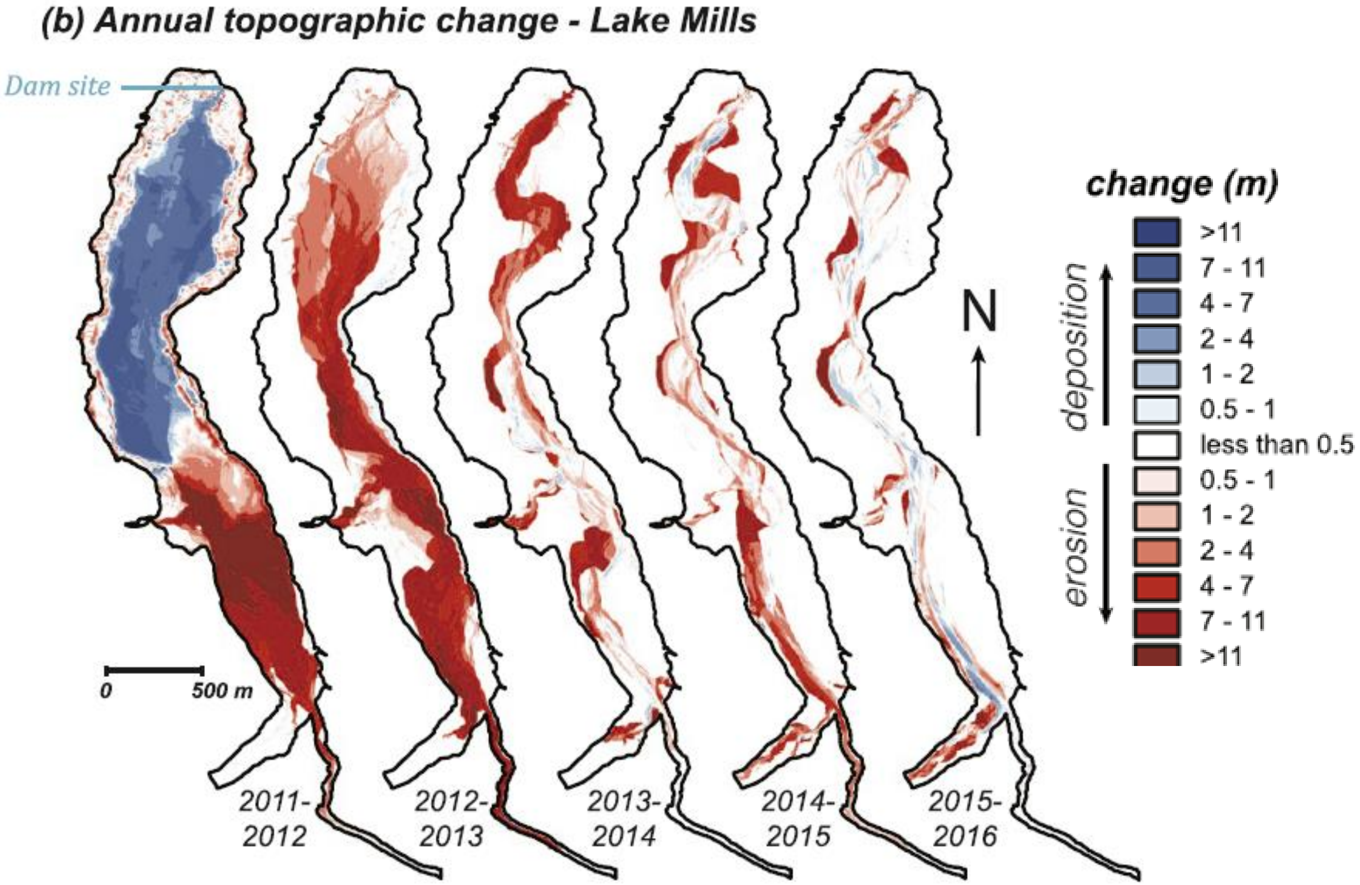
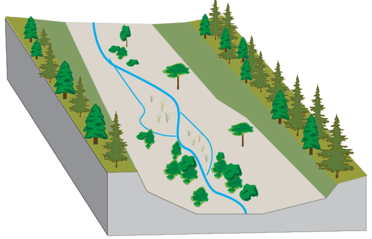


Former reservoirs – sediment redistribution

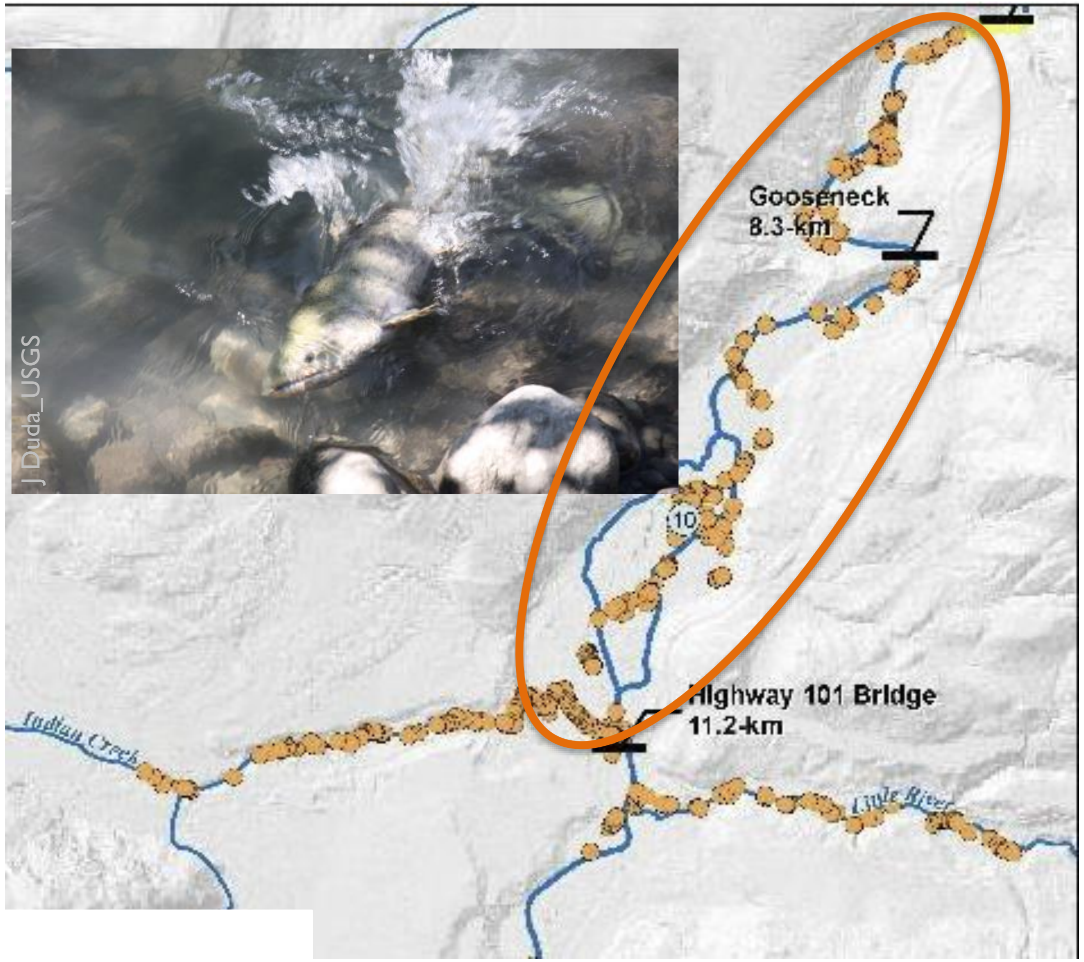


Ritchie et al. 2018. Scientific Reports



Former reservoirs – novel ecosystems emerge

Chinook spawning



McHenry et al. Technical Report 2020

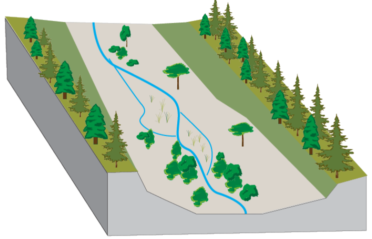
Riparian/Upland revegetation

No. of Plots	Coarse Sediments 25	Fine Sediments 38	Significant Level
Summarized cover of all species	11.58 ± 7.55	106.9 ± 35.4	***
No. of species	13.84 ± 5.47	17.76 ± 5.96	**
No. of wetland species	1.8 ± 1.04	5.45 ± 1.9	***
No. of alien species	3.68 ± 2.06	3.32 ± 1.86	NS

Prach et al. 2019 Restoration Ecology 2020

University of South Bohemia in České Budějovice Faculty of Science

Former reservoirs – novel ecosystems emerge



Lower Elwha Klallam Tribe (with permission)

BRIEF RESEARCH REPORT article

Front. Ecol. Evol., 26 March 2024
Sec. Conservation and Restoration Ecology
Volume 12 - 2024 | https://doi.org/10.3389/fevo.2024.1266474

This article is part of the Research Topic
Large-Scale Dam Removal and Ecosystem Restoration
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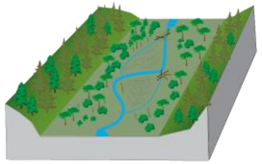
Establishment of terrestrial mammals on former reservoir beds following large dam removal on the Elwha River, Washington, USA

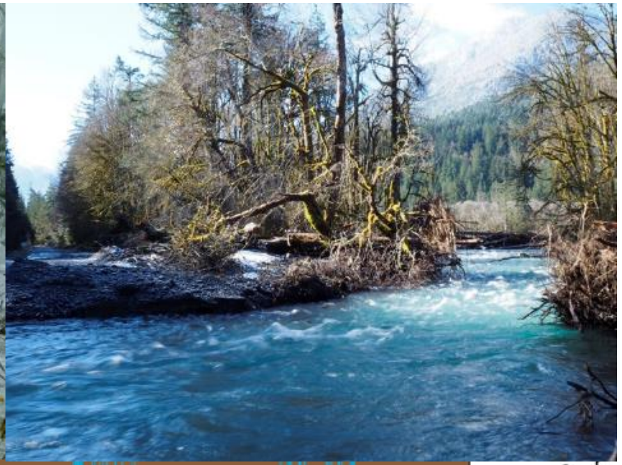
Rebecca M. McCaffery[1*] Sara J. Cendejas-Zarelli[2] Katy R. Goodwin[1] Patricia J. Happe[3] Kurt J. Jenkins[1]
Kimberly A. Sager-Fradkin[2*]

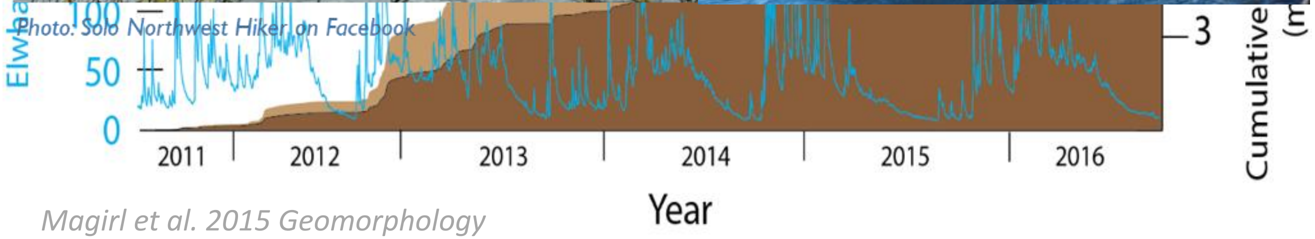
USGS science for a changing world



Downstream– here comes the sediment, wood, and shifting geomorphologies

Photo: Solo Northwest Hiker on Facebook



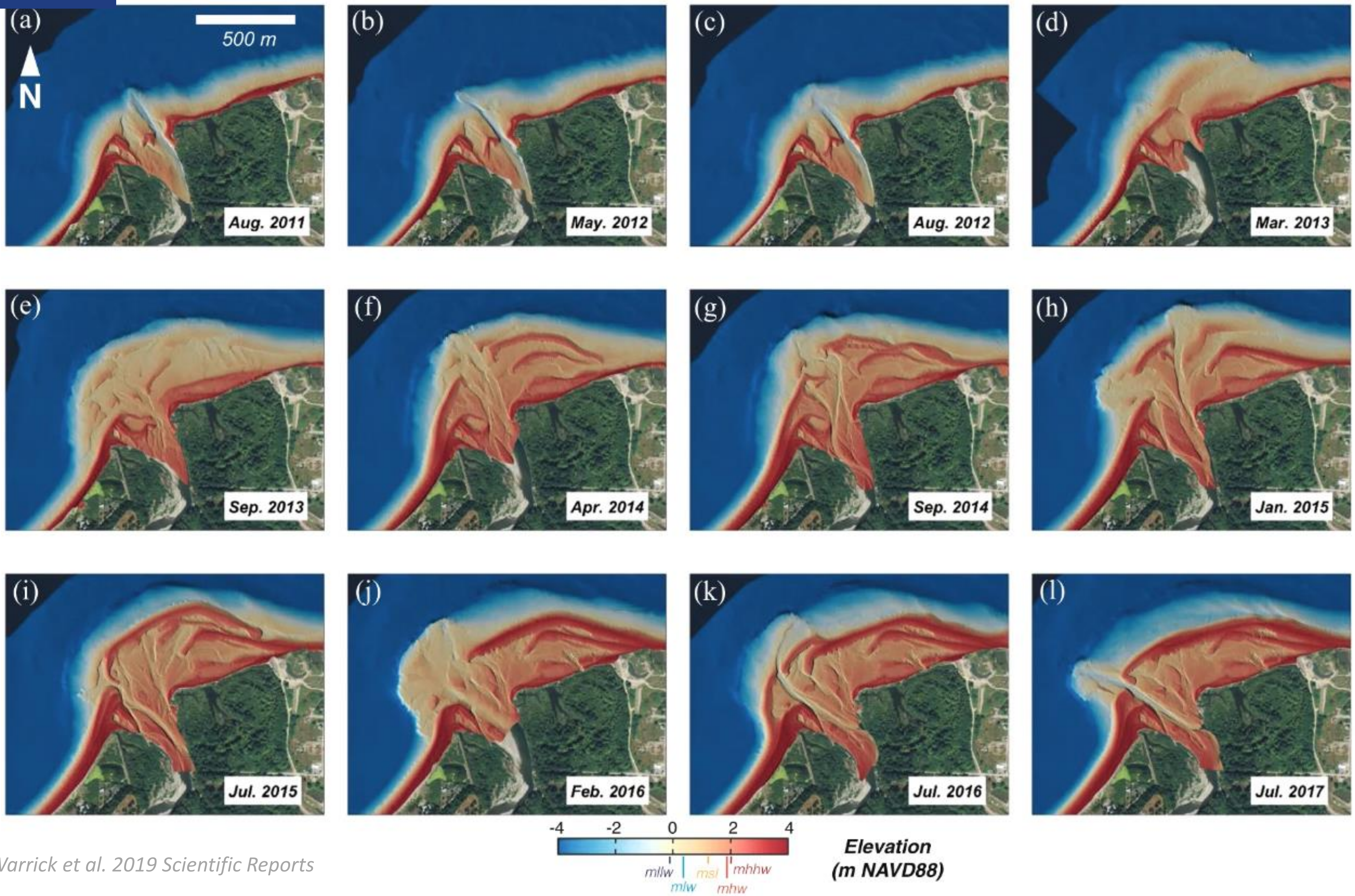


Magirl et al. 2015 Geomorphology

Photo: Tom Roorda

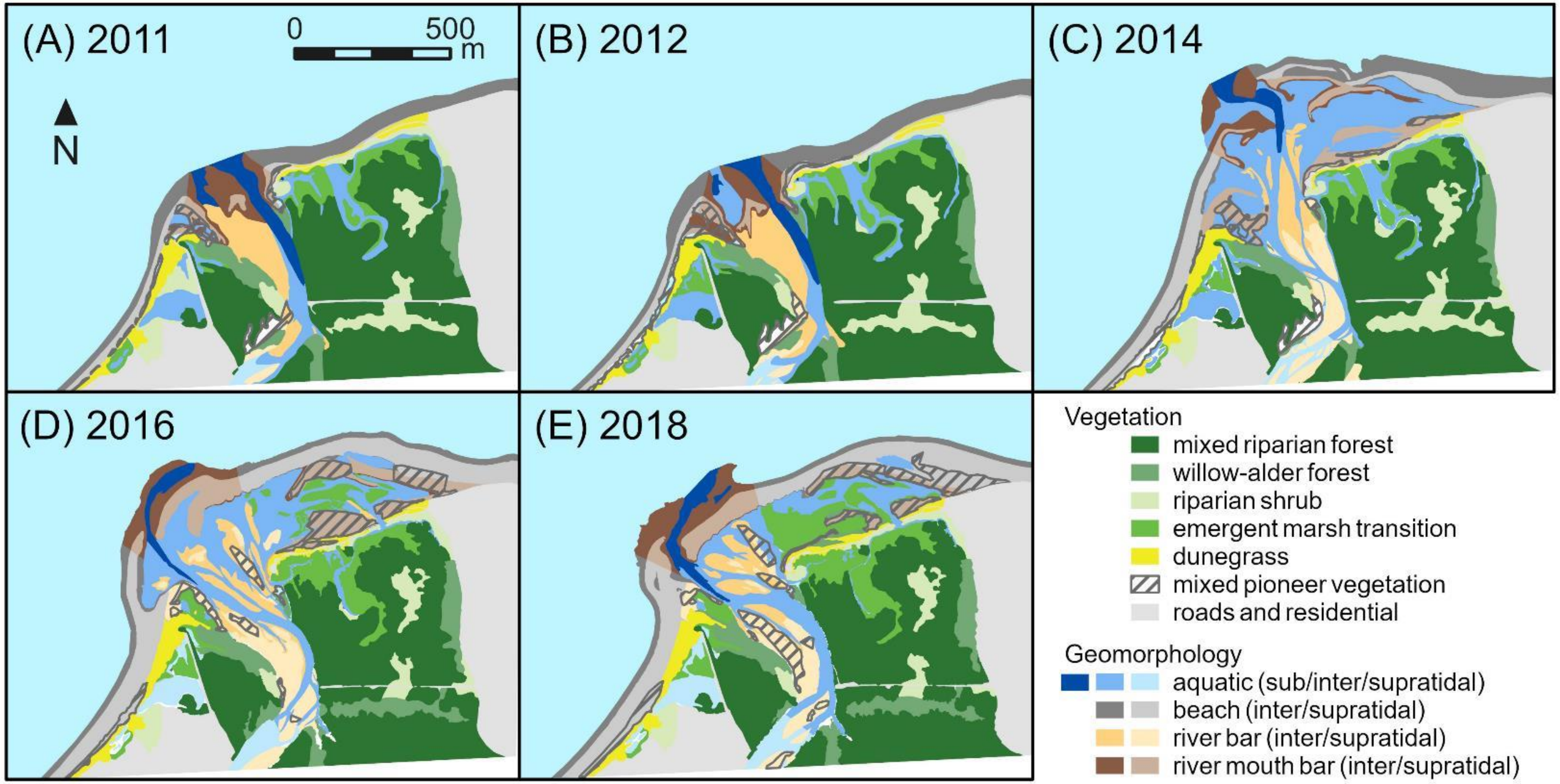
Morley et al. 2020 PloS One

Coastal response



Warrick et al. 2019 Scientific Reports

Coastal response



10-yr Vegetation Increase:

Marsh + 6.5 ha

Pioneer + 5.2 ha

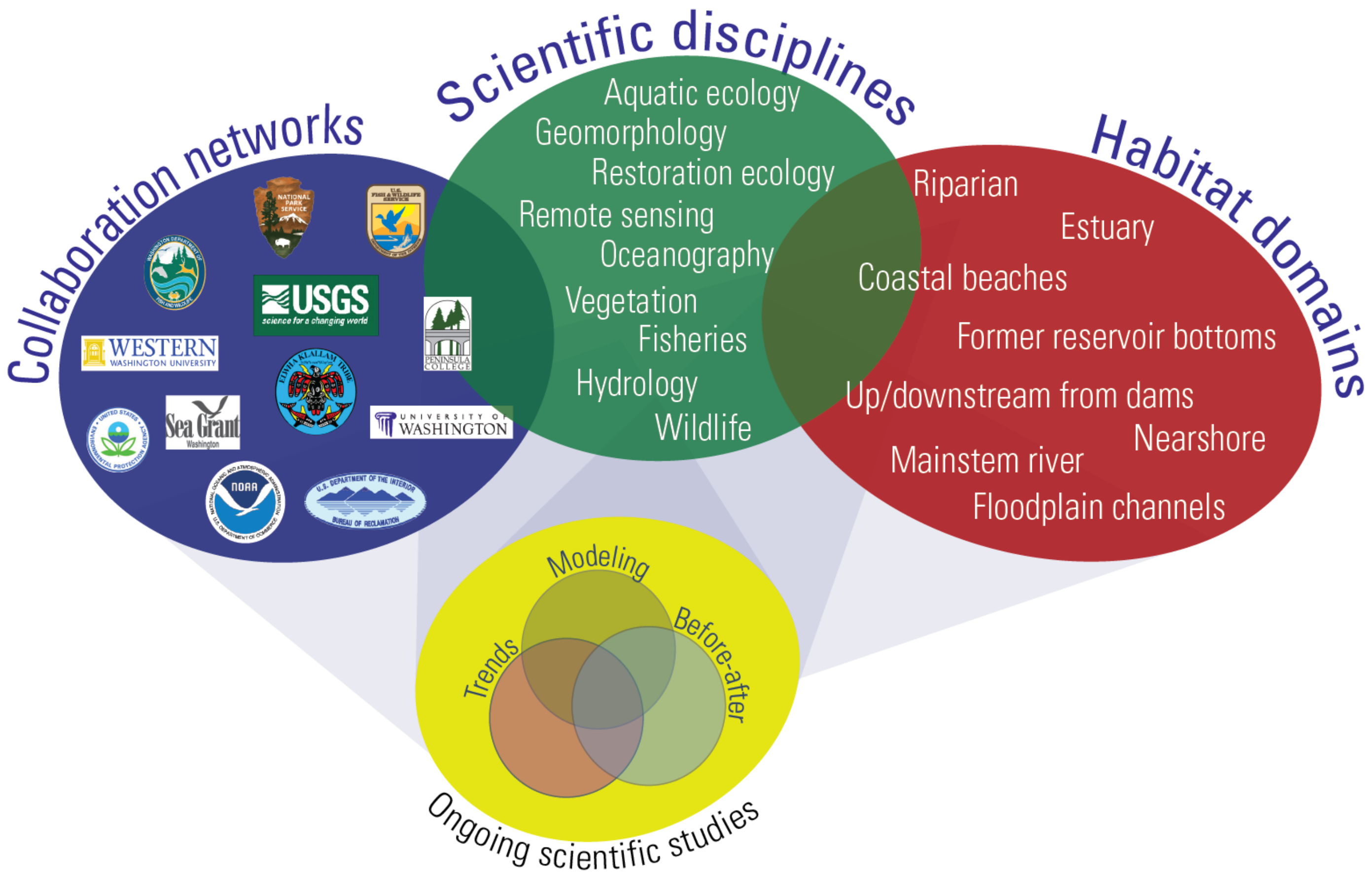
Willow/Alder +2.6 ha

Foley et al. 2017 Ecological Monographs; Perry et al. 2023 Frontiers in Ecology and Evolution

USGS science for a changing world

Multiple collaborations, disciplines, and study areas

Elwha River Science Portfolio



Collaboration networks

- A force multiplier: more funding, expertise, and tools;
- Coordinated multidisciplinary studies;
- Can expand the types of questions, amount and duration of data collection;
- Communication is KEY.

Parting thoughts

- Think long-term, multiple generations in the future
  - Curate data, metadata and tissue/DNA libraries for long-term use
  - Pass on knowledge and foster next generation of scientists
  - Regularly revisit and update goals and aspirations for multi-disciplinary collaborations and studies
  - Publish your study results!

Thank you

Acknowledgements

- The Lower Elwha Klallam Tribe
- National Park Service
- U.S. Fish and Wildlife Service
- USGS
- The Powell Center Dam Removal working Group
- Resources Legacy Fund
- American Rivers
- Bureau of Reclamation
- Army Corps of Engineers

S. Acker
J. Anderson
P. Bakke
J. Bastow
T. Beechie
D. Berry
H. Berry
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A. Fraik
K. Frick
J. Geffre
A. Geffre
C. Gelardin
G. Gelfenbaum
B. Goodwiller
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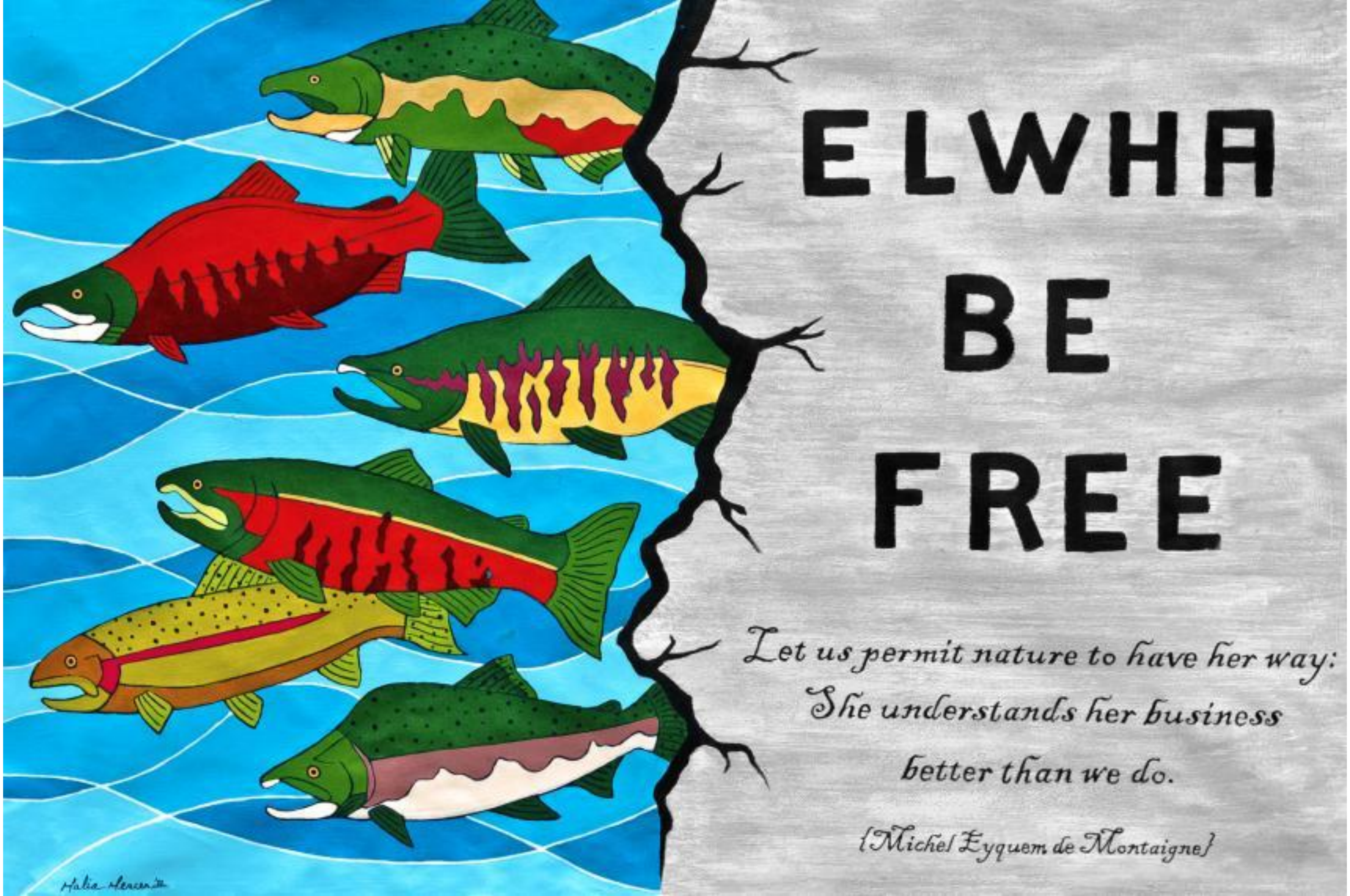

ELWHA
BE
FREE
Let us permit nature to have her way:
She understands her business
better than we do.
{Michel Eyquem de Montaigne}

Nate Mantua- NOAA

The Changing Ocean for Klamath Salmon and Steelhead

NOAA FISHERIES

SWFSC

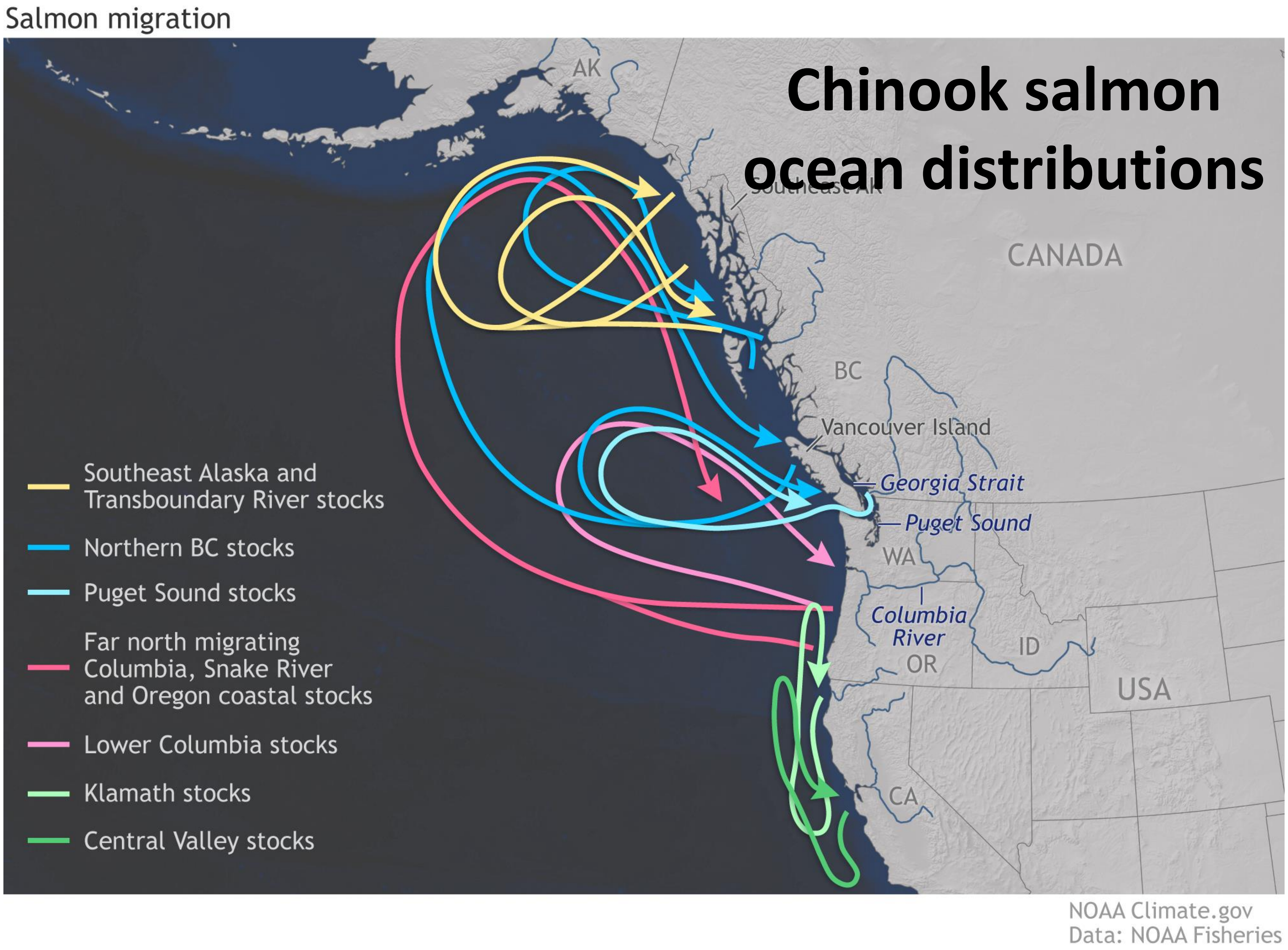
Climate and Changing Ocean Conditions

Nate Mantua

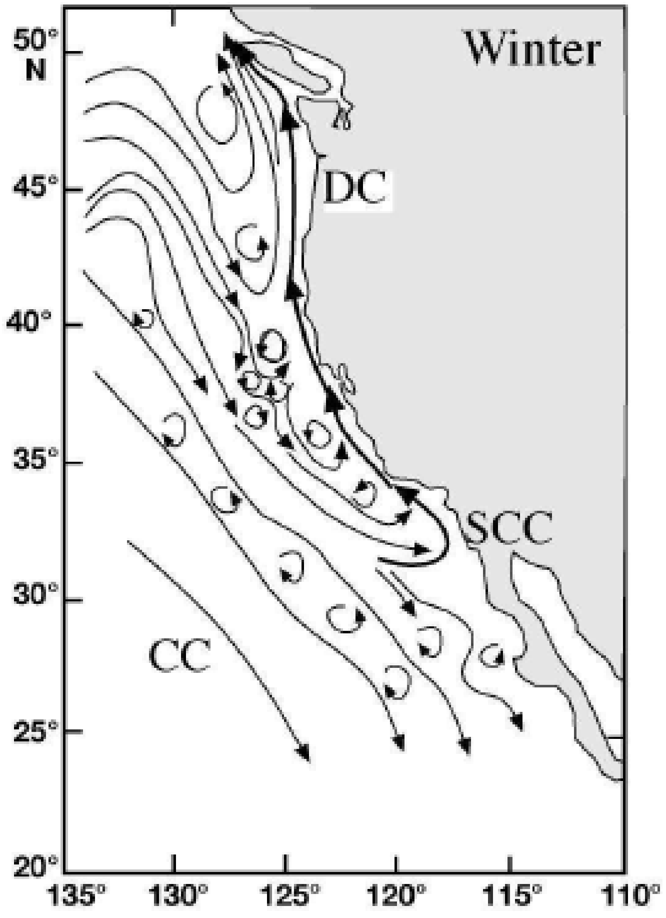
NOAA Southwest Fisheries Science Center

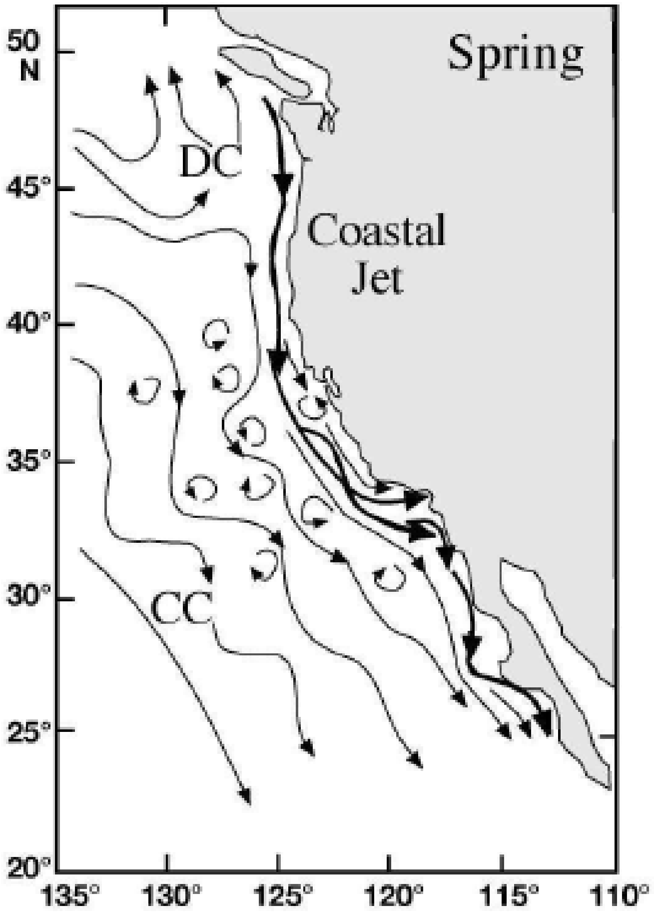
Santa Cruz, CA

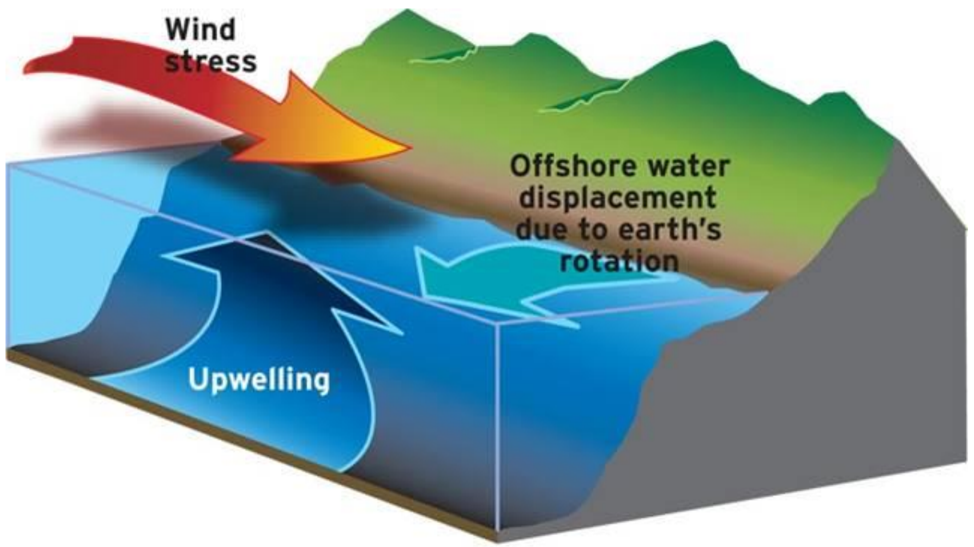
Chinook salmon ocean distributions



Coastal upwelling



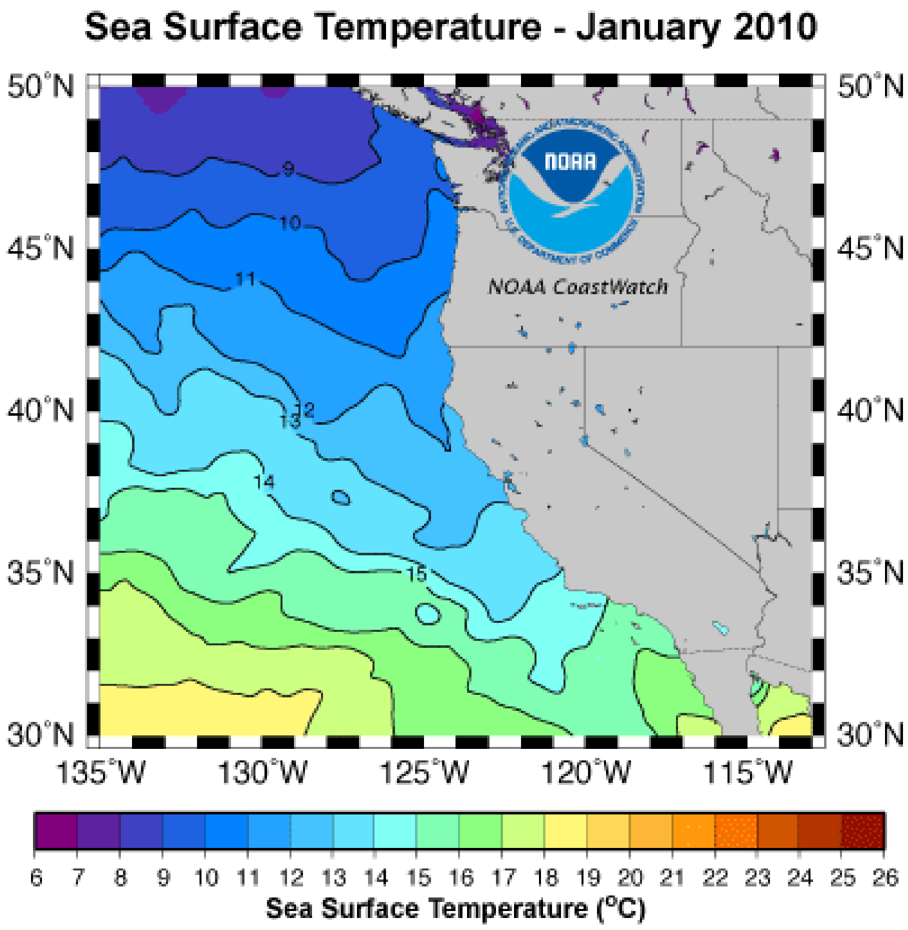


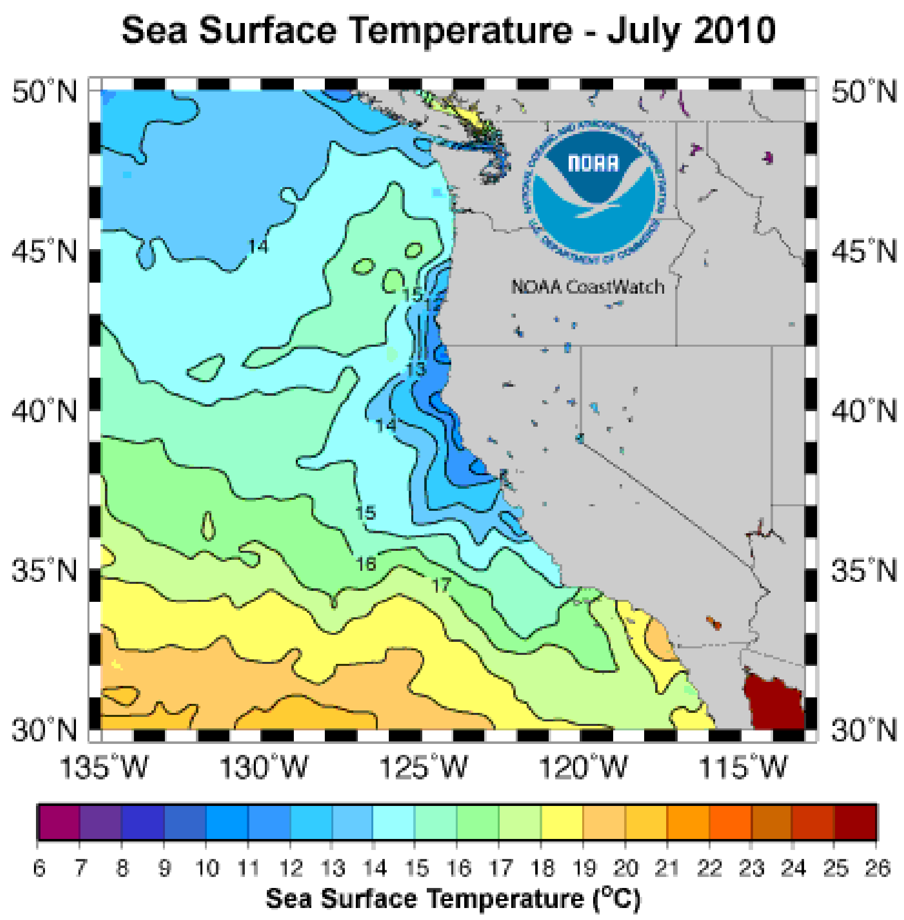


Spring and summer winds from the N/NW cause coastal upwelling and N to S upper ocean currents

Fig from http://www.nwfsc.noaa.gov

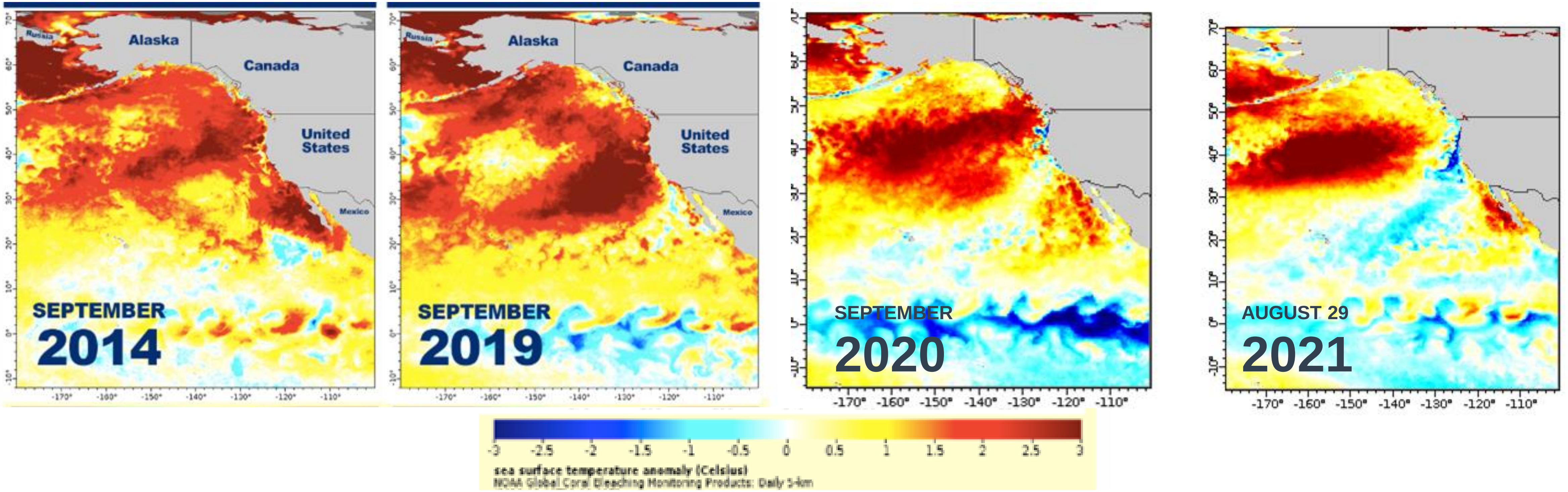
Winter vs. Summer SSTs





Frequent Marine Heatwaves from 2014-2023

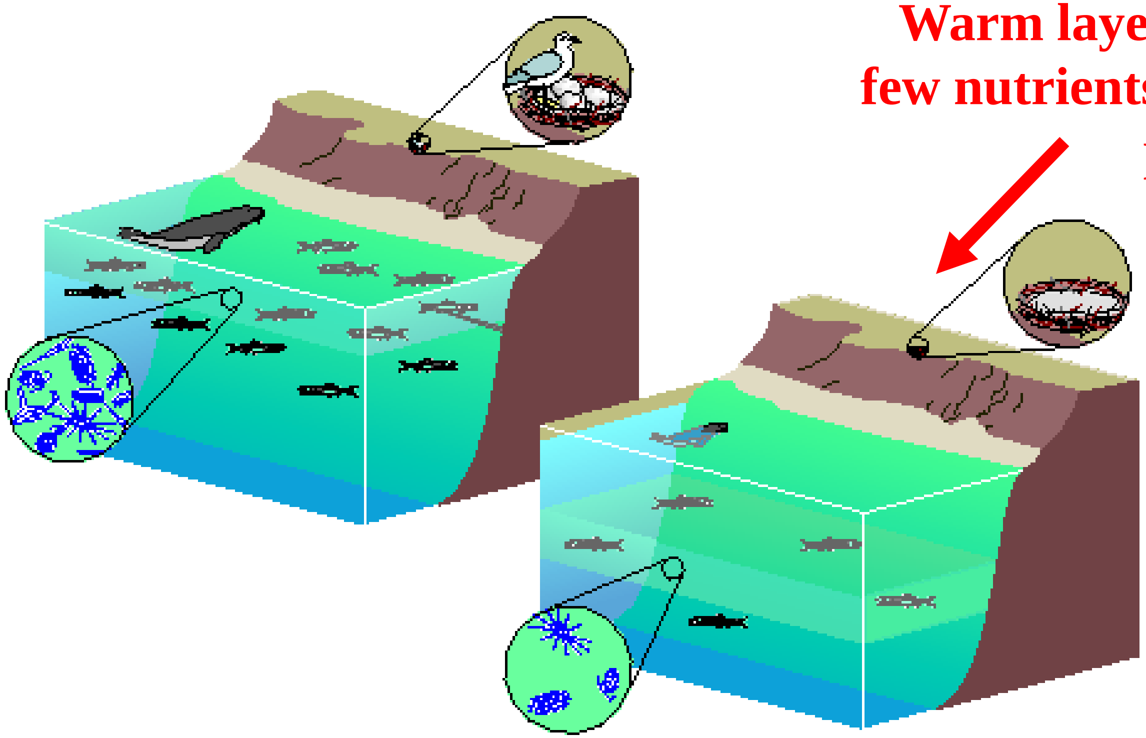
Extreme and persistent warm periods have affected the northeast Pacific, bringing widespread impacts on marine life and fisheries.



https://www.fisheries.noaa.gov/feature-story/new-marine-heatwave-emerges-west-coast-resembles-blob

The California Current System food web

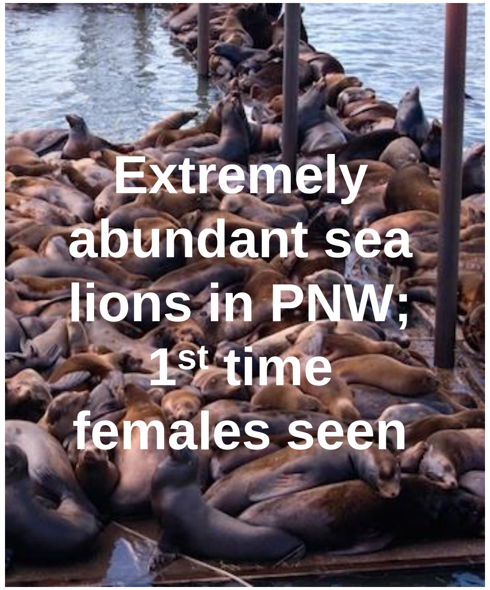
When the upper ocean is cool, it is weakly stratified, there are abundant nutrients, high phytoplankton production, and large lipid-rich “boreal” or “subarctic” zooplankton krill (*Euphausia pacifica* and *Thysanoessa spinifera)* that feed higher trophic levels (forage fish, sea birds, piscivorous fish, marine mammals…)



Warm layered ocean, few nutrients, low food production

Unusual sightings in 2015/16

Swordfish caught along Oregon coast



Warm water species we've seen before but earlier or unusually abundant

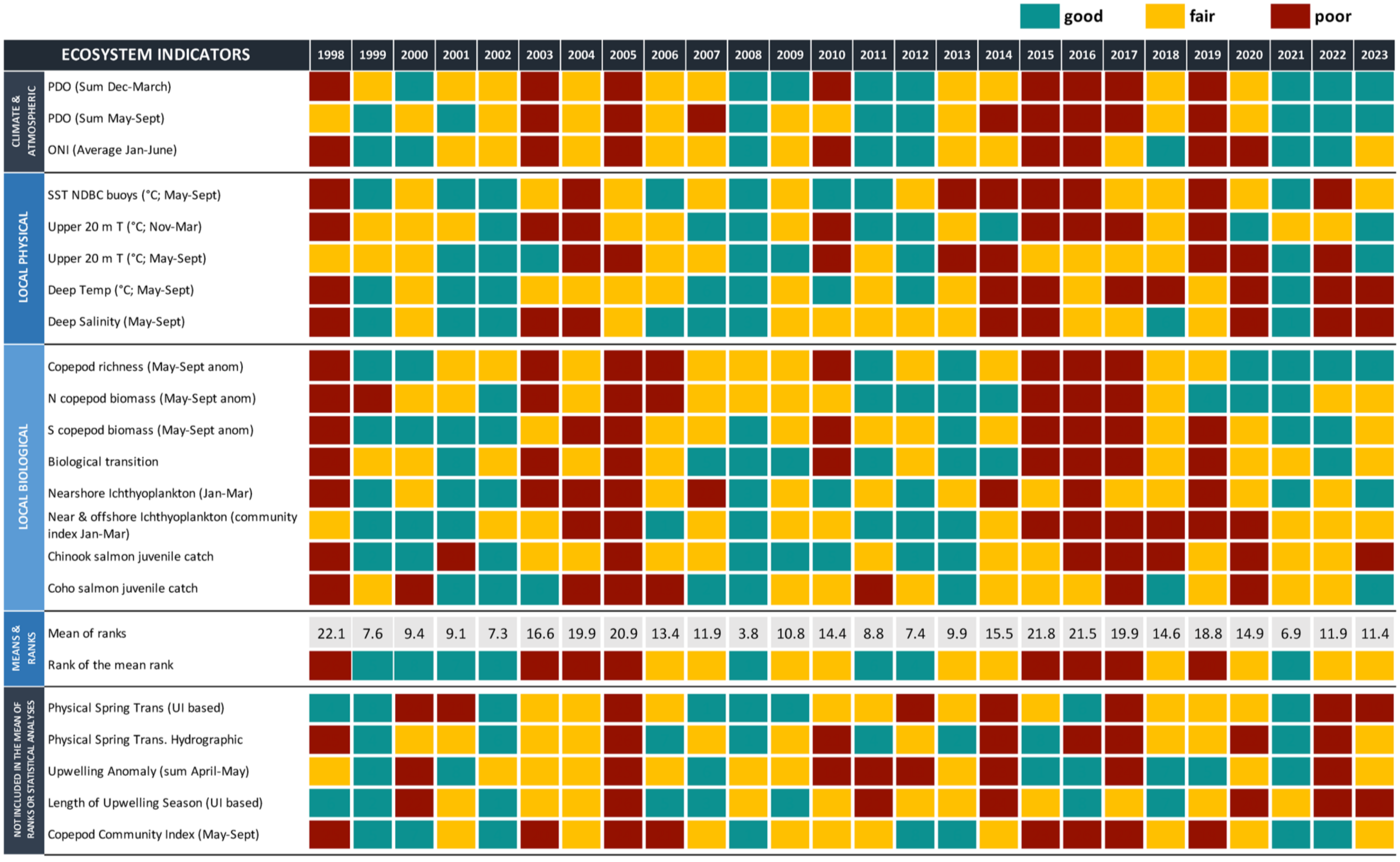
Opah caught off Oregon Coast

Skinny coho & Chinook in ocean

From Laurie Weitkamp, NOAA NWFSC

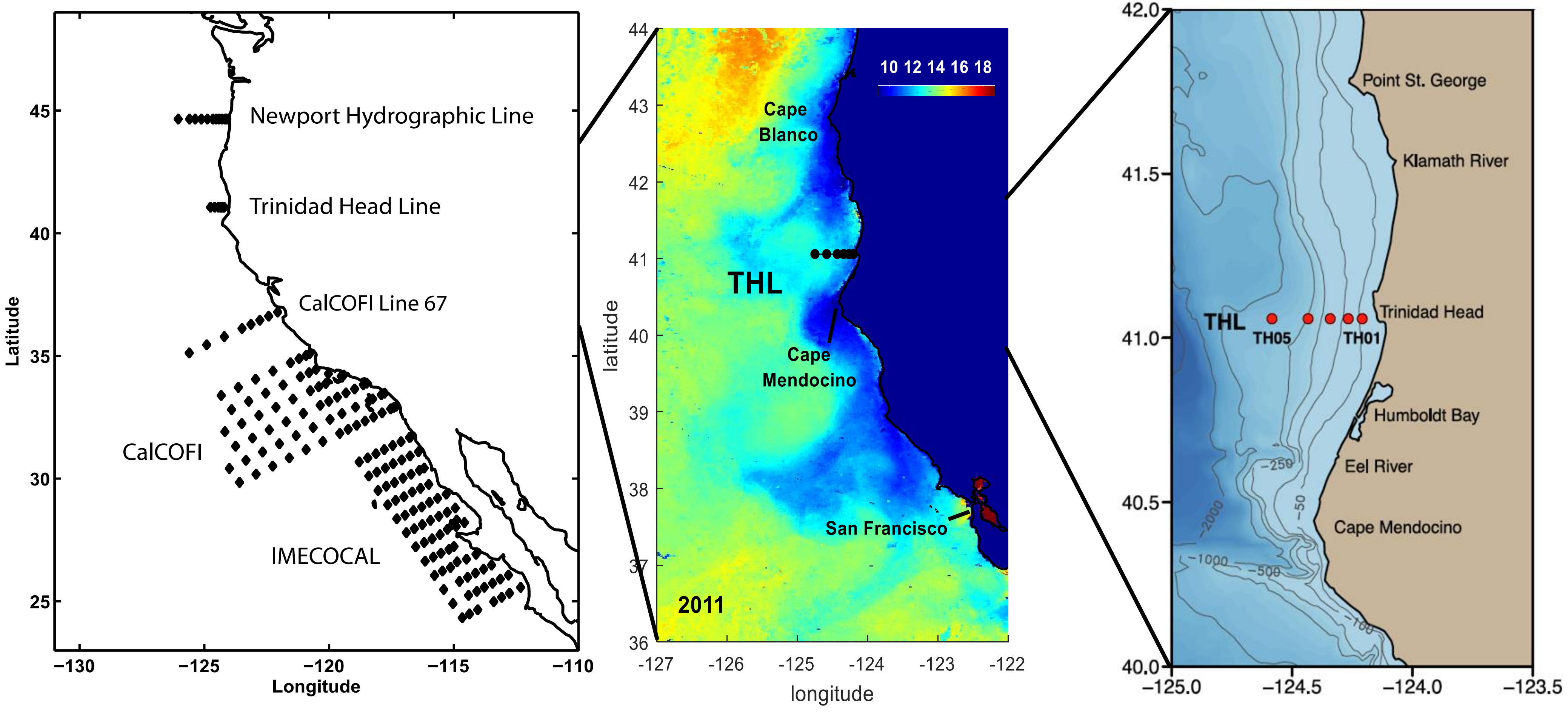
Newport Line Ecosystem Indicators

- Most physical and biological indicators pointed to poor ocean conditions for NW salmon in recent warm years

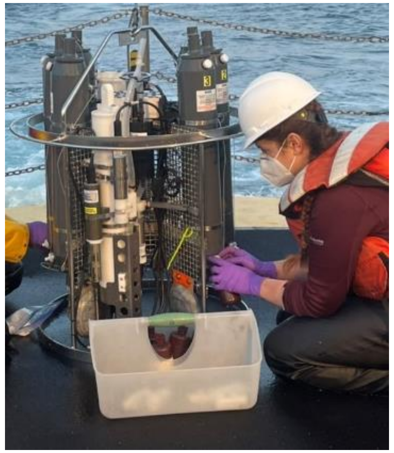


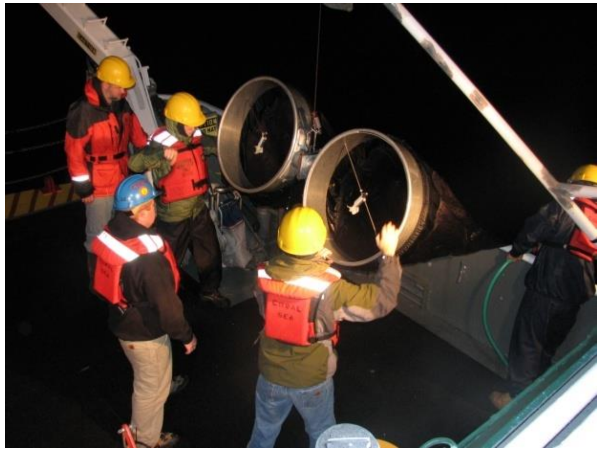
The Trinidad Head Line (THL)

Five stations: 3 over narrow shelf, 2 over upper slope
(slide from Eric Bjorkstedt, NOAA/HSU)



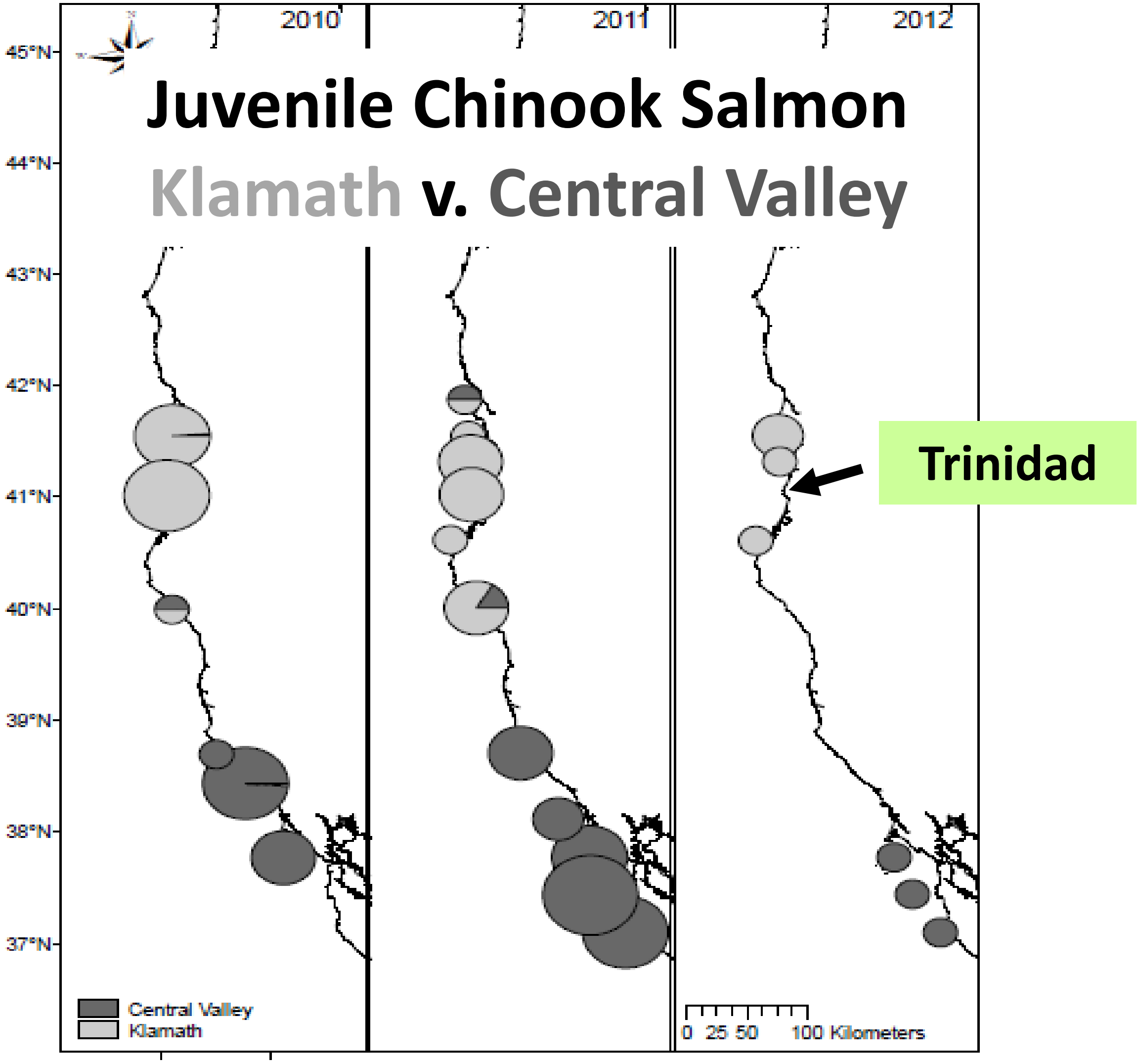
THL: sampling krill, copepods, and water properties ~monthly since 2008





Slide from Eric Bjorkstedt NOAA/HSU

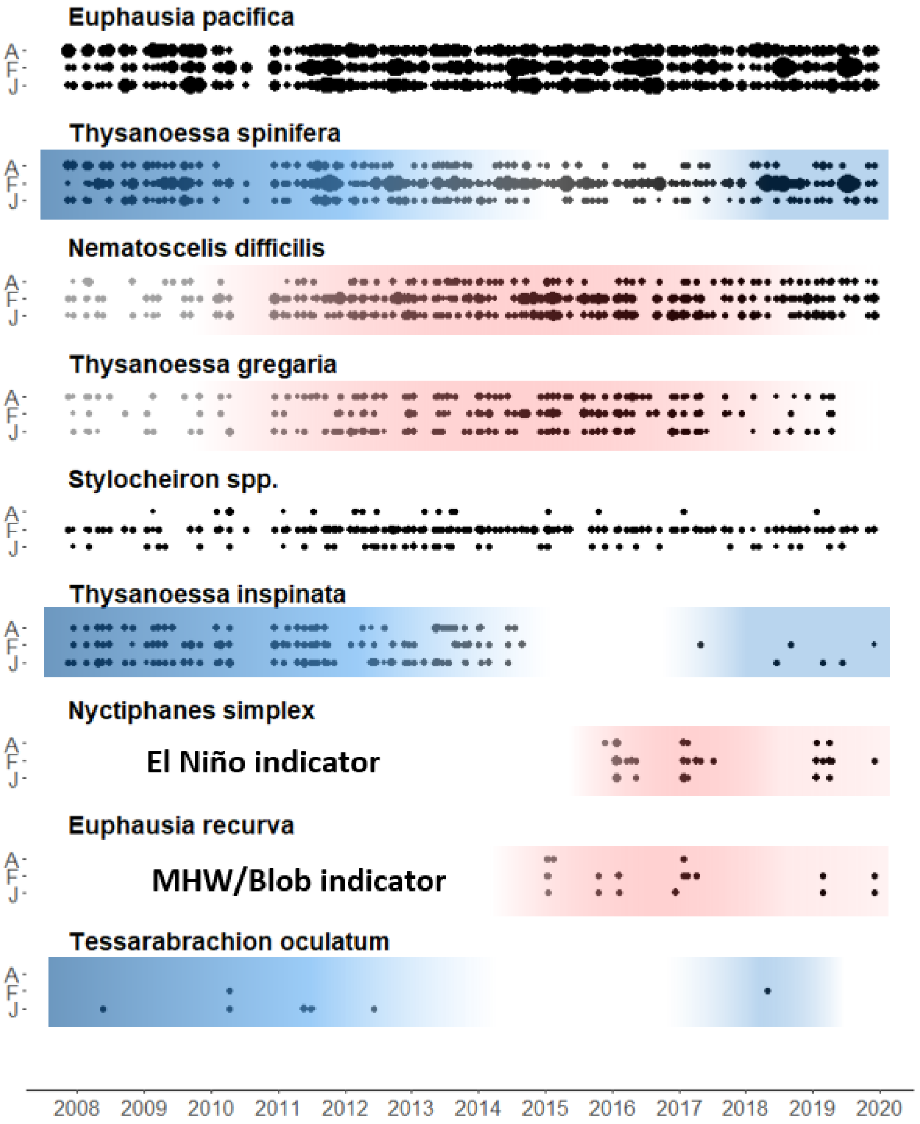
Early (and late) marine habitat for Klamath River salmon

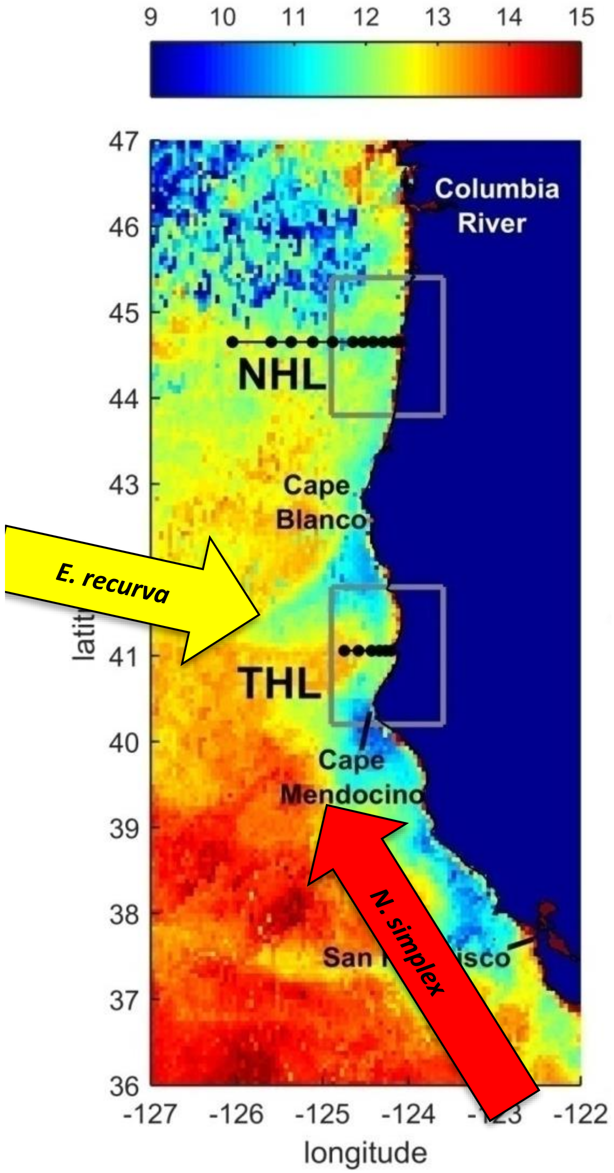


Hassrick et al. 2016

General patterns

- Marine Heatwaves and El Niño events drive shifts in zooplankton assemblages (e.g., krill, copepods, pyrosomes, etc.)





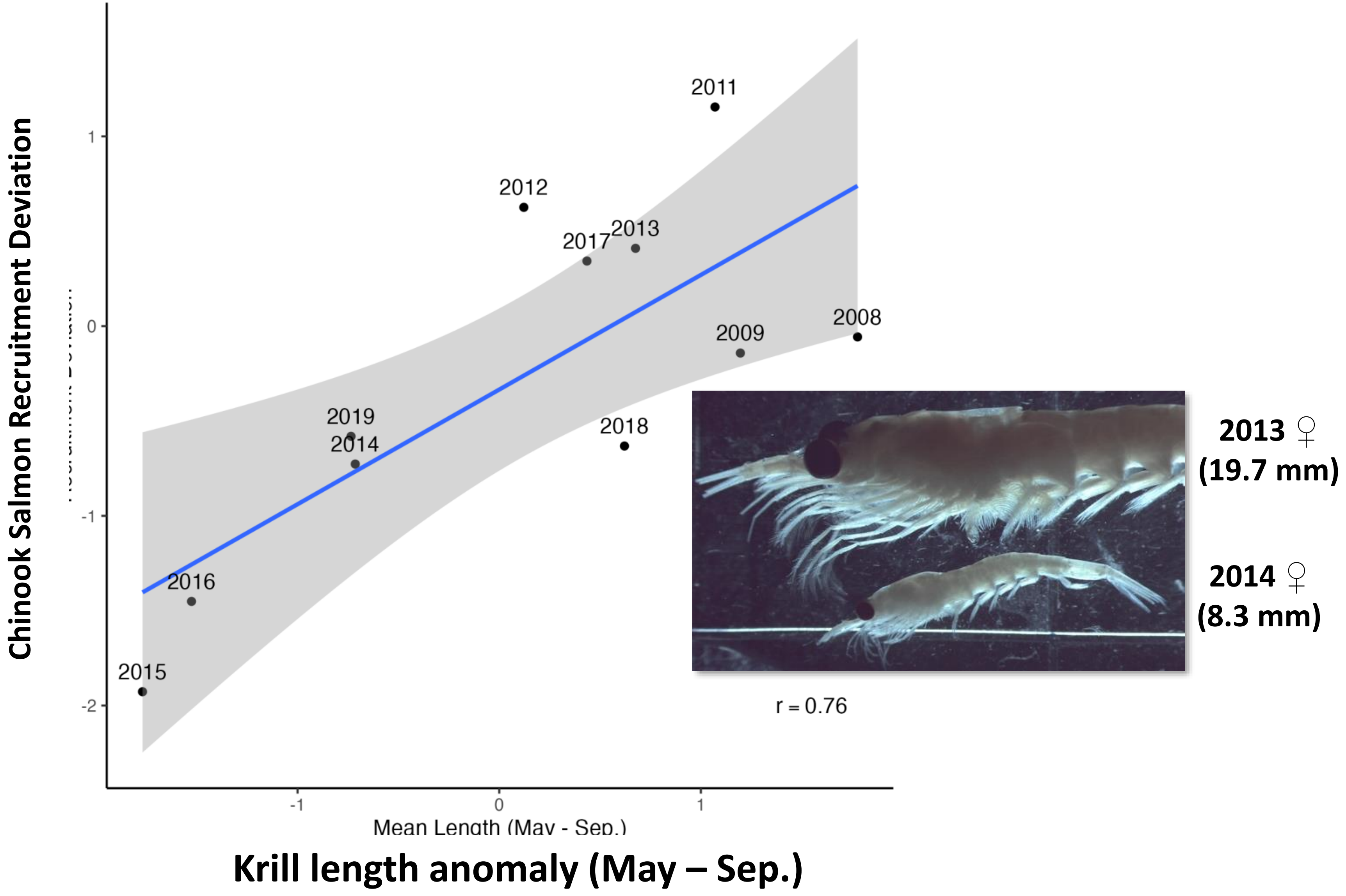
Slide from Eric Bjorkstedt NOAA/HSU

General patterns

Changes in krill populations: size of adult krill size declines during warm periods.

Krill size seems to be an indicator for Klamath.

Unpublished data from Eric Bjorkstedt NOAA/HSU



Thiamine Deficiency in CA salmon

Discovered in CV hatchery Chinook in January 2020

Fish and humans can't make B_1, get it from diet.

- Reduced growth, neurological disorders, immunosuppression, damage to the blood-brain barrier, increased parasitic infestation , **reproductive failure**

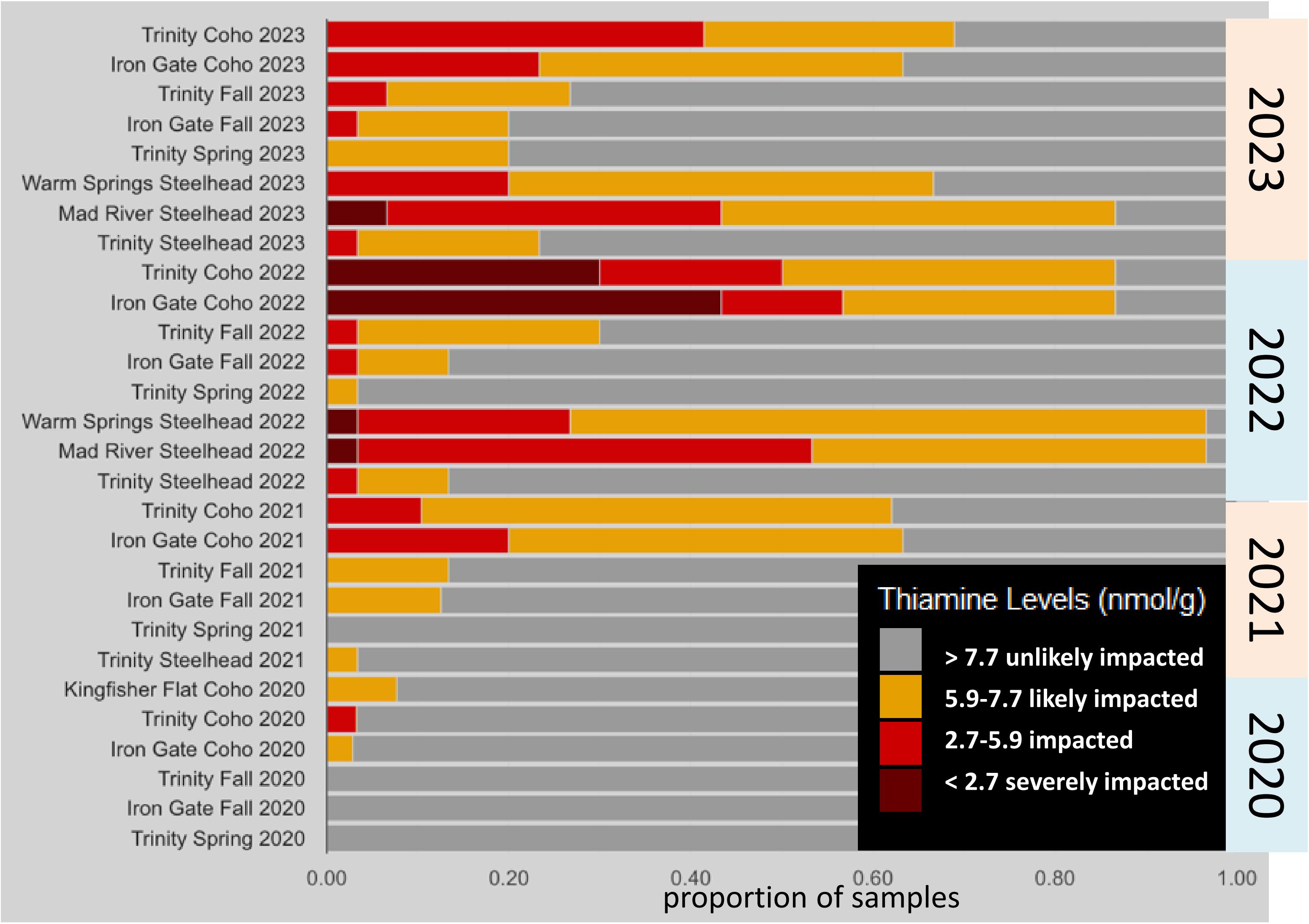
Deficient Thiamine Levels

Fall run fry videos from Rachel Johnson, NMFS

Increasing thiamine deficiency in coastal salmon and steelhead

Thiamine deficiency increased for coastal salmon/steelhead from 2020-2023

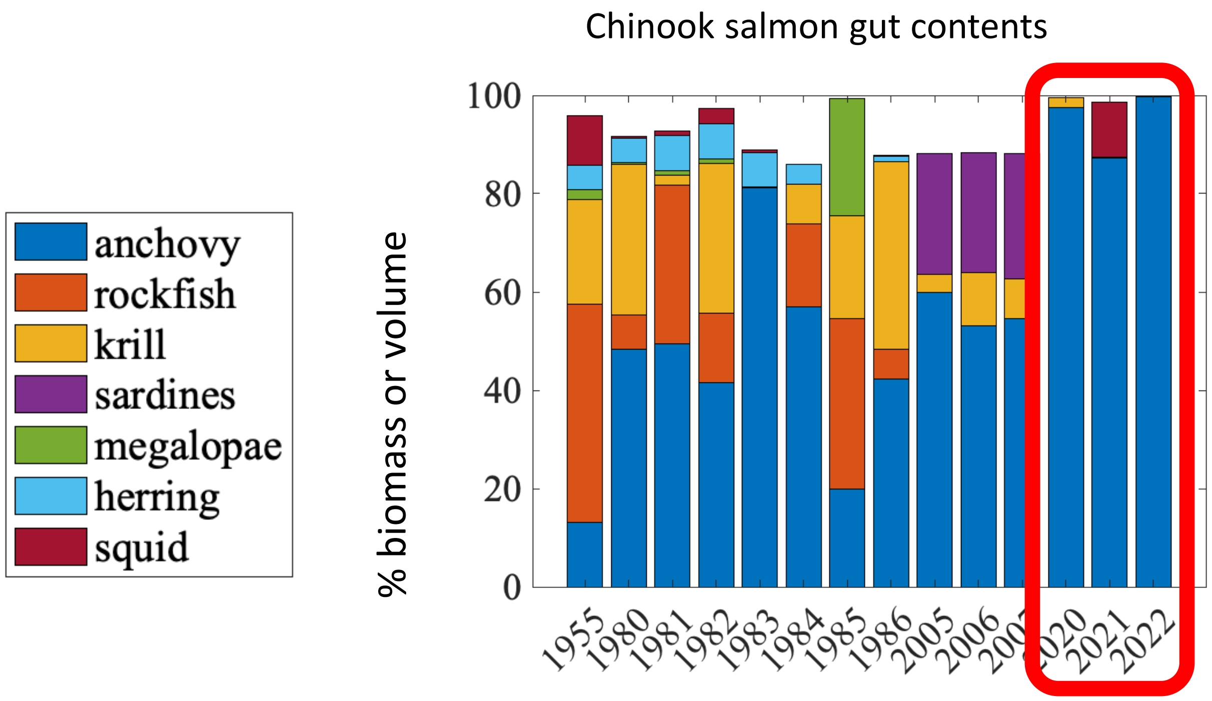
- coho salmon and steelhead have had the lowest egg thiamine concentrations



Unpublished data from Jacques Rinchard SUNY Brockport and Tommy Williams NOAA

The anchovy diet hypothesis

Anchovy-dominated diets!
97% (2020), **86%** (2021), and **99.7%** (2022) – anchovies carry the enzyme *thiaminase* that destroys thiamine

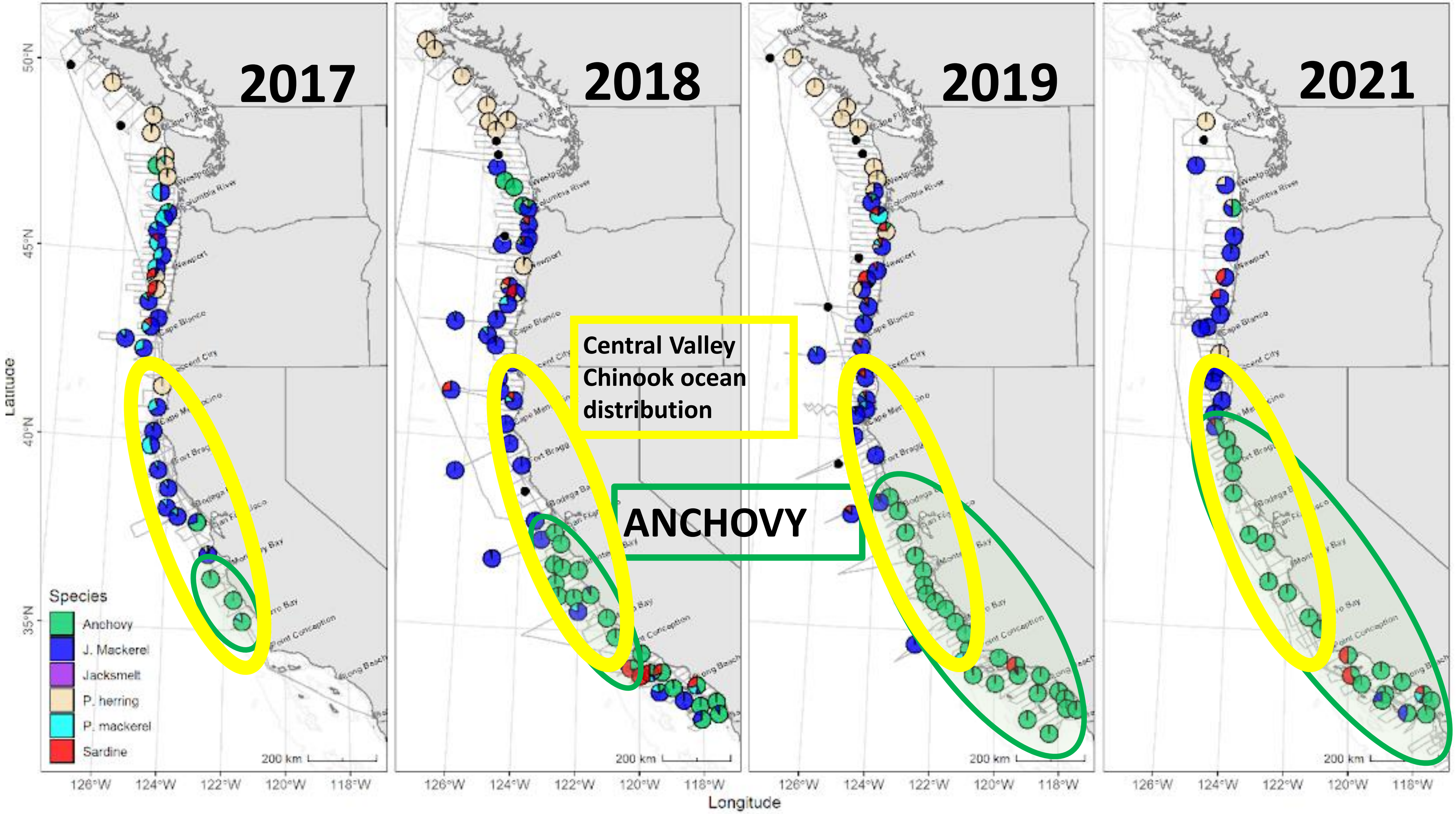


%volume pre-2020 from Thayer et al 2014, MEPS

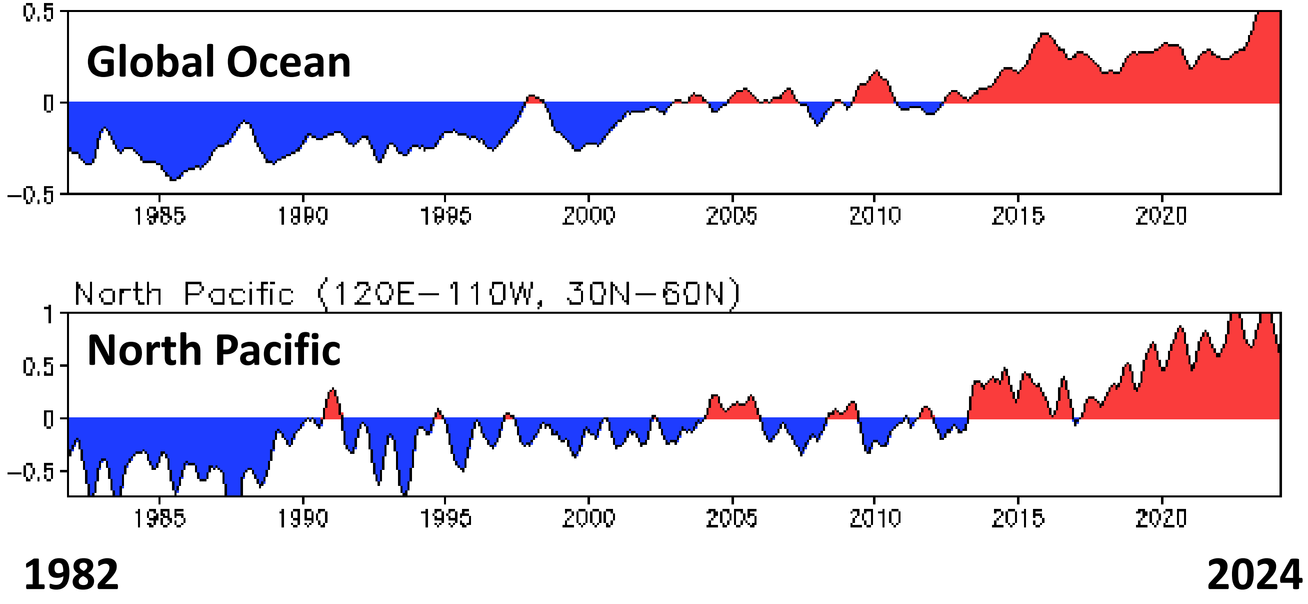
Picture from John Field, SWFSC

Coastal Pelagic Species from NMFS Summertime acoustic-trawl surveys

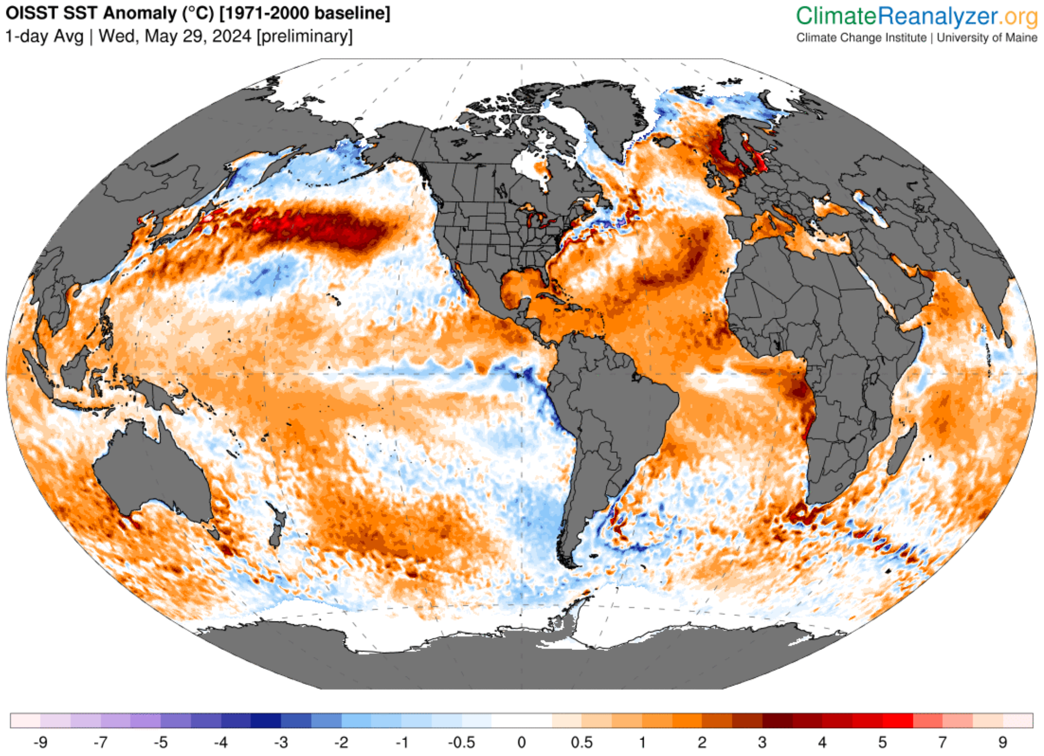
(NMFS Tech Memos; figure from K. Stierhoff, NMFS)



Global ocean and the North Pacific have been record warm since 2015



Surface Temperature anomalies: May 29, 2024



La Niña (a cold tropical Pacific) historically came with cooler global temperatures, and much cooler temperatures along the entire West Coast – but not from 2020-2022

The future

- By 2100, projected upper ocean warming is 2 to 6 times that observed so far
  (Cheng et al. 2022, Nature Reviews)

- There will be no "new normal"
  – Maybe better to think about transitions to a warmer ocean

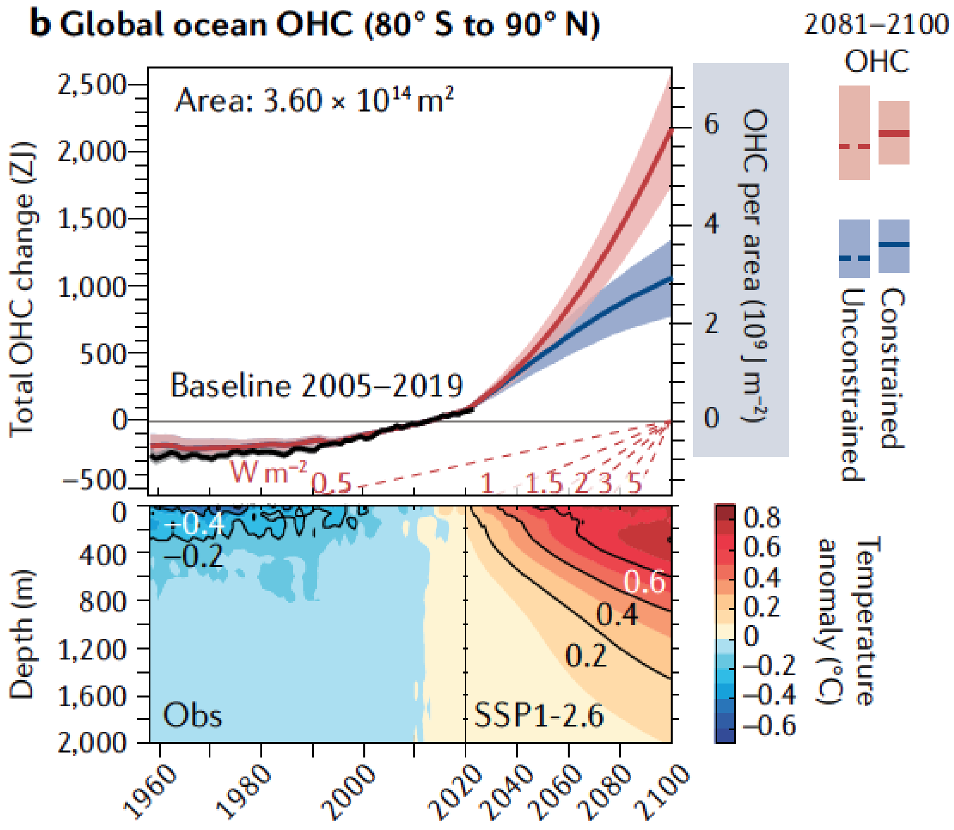
- Recent events provide glimpses of our no-analog future
  – But only a blurry view?

- Our salmon and steelhead need to adapt to change throughout their lifecycle

REVIEWS

Past and future ocean warming

Lijing Cheng[1,2], Karina von Schuckmann[3], John P. Abraham[4], Kevin E. Trenberth[5,6], Michael E. Mann[7], Laure Zanna[8], Matthew H. England[9,10], Jan D. Zika[10,11], John T. Fasullo[5], Yongqiang Yu[1], Yuying Pan[1,2], Jiang Zhu[1,2], Emily R. Newsom[8], Ben Bronselaer[12] and Xiaopei Lin[13,14]



Nature Reviews, 2022

https://doi.org/10.1038/s43017-022-00345-1

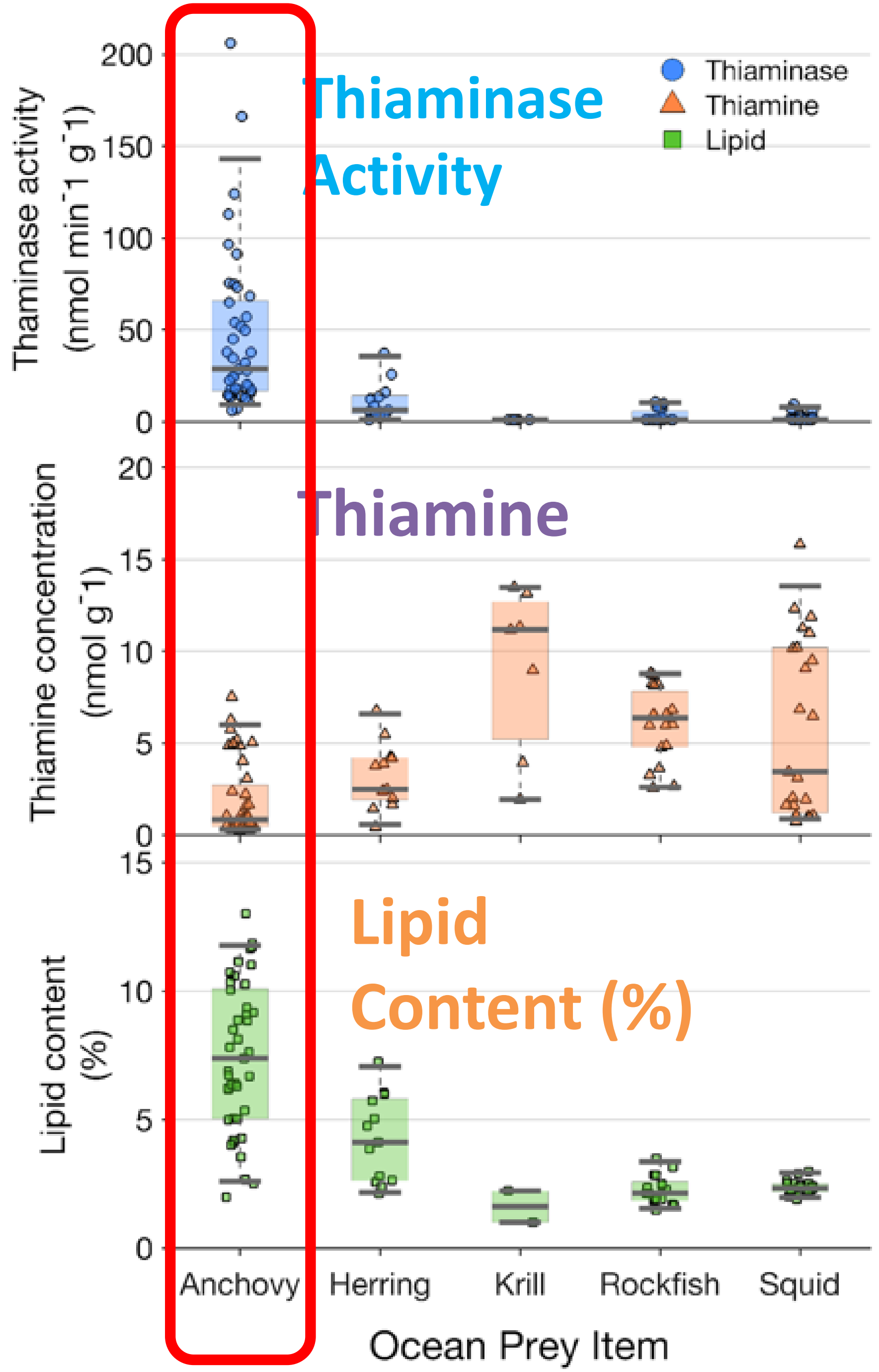
Questions?

Prey Nutrition

Anchovies are especially high in thiaminase activity, low in thiamine, and high in lipid content

- Thiaminase is a thiamine degrading enzyme; high lipids may also cause oxidative stress that depletes thiamine

We are also looking at stable isotopes and fatty acid profiles to connect salmon egg thiamine levels to prey



Chris Adams – Michigan Tech University

Assessing migratory life history variation and population genetic structure of Oncorhynchus mykiss in a spring-fed Klamath River tributary

Movement, Survival, and Population Structure of *Oncorhynchus mykiss* in a Spring Fed Klamath River Tributary

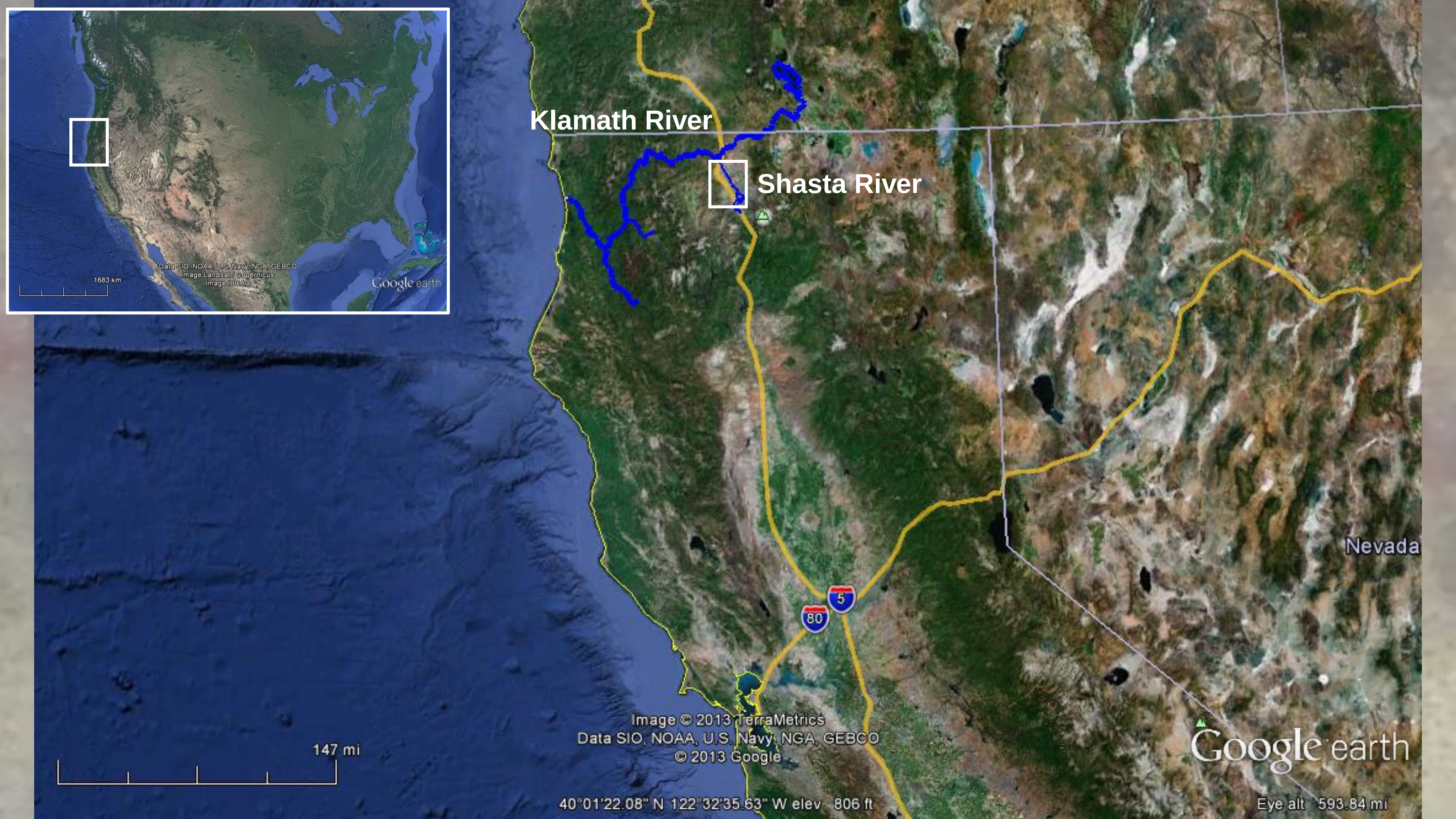
Christopher C. Adams[1], Tasha Q. Thompson[2], Caitlin E. Bean[3],
Casey J. Huckins[1], Amy M. Marcarelli[1]

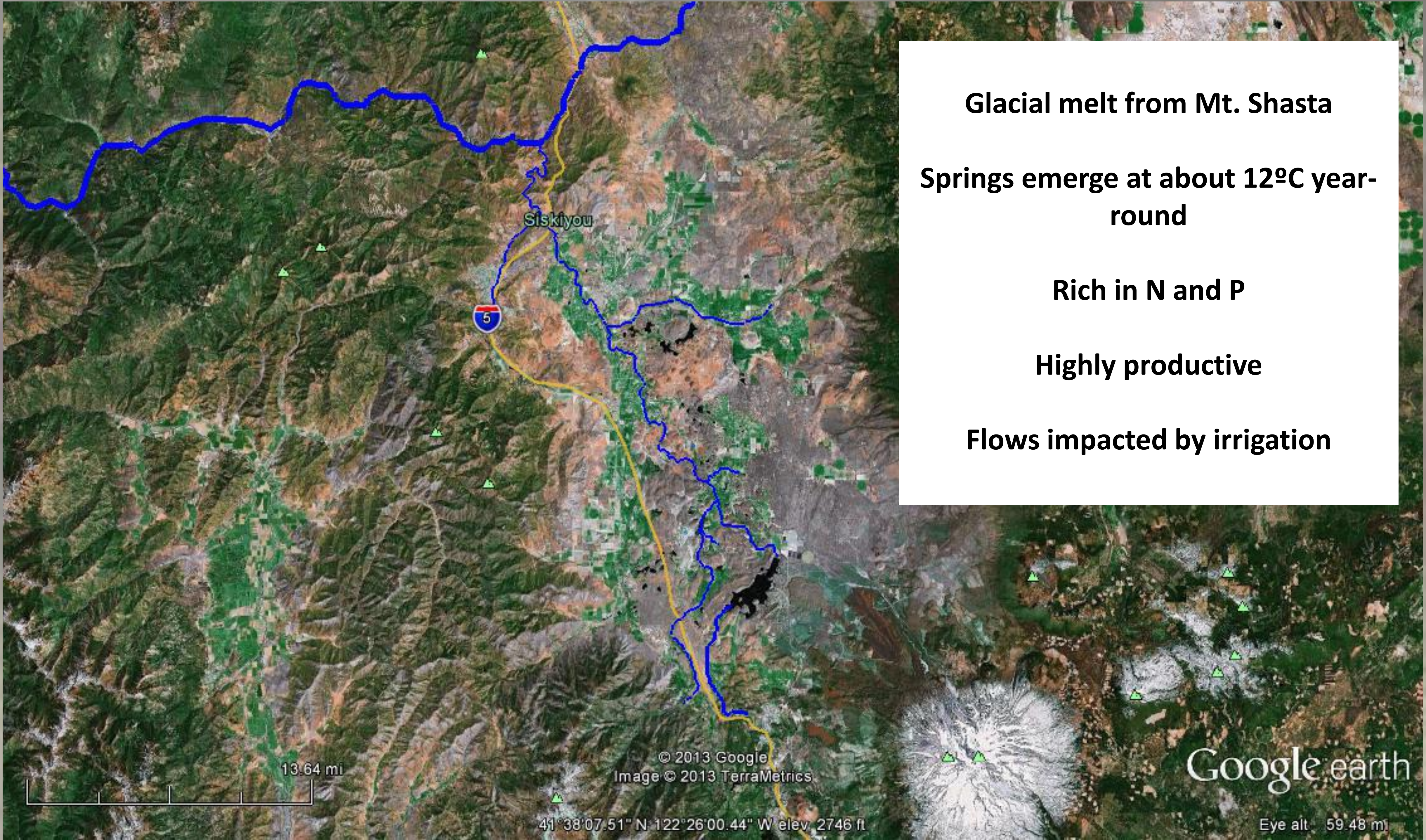
Oncoryhncus mykiss
Steelhead/Rainbow Trout

Can occupy lotic, lentic, or both habitats

Migratory form (steelhead) migrate from river to ocean (or lake) habitat

High plasticity in age of outmigration/maturation within and among populations


Klamath River
Shasta River
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Image IBCAO
1683 km
Google earth
Nevada
80
5
Image © 2013 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2013 Google
147 mi
40°01'22.08" N 122°32'35.63" W elev 806 ft
Eye alt 593.84 mi
Google earth



Glacial melt from Mt. Shasta

Springs emerge at about 12ºC year-round

Rich in N and P

Highly productive

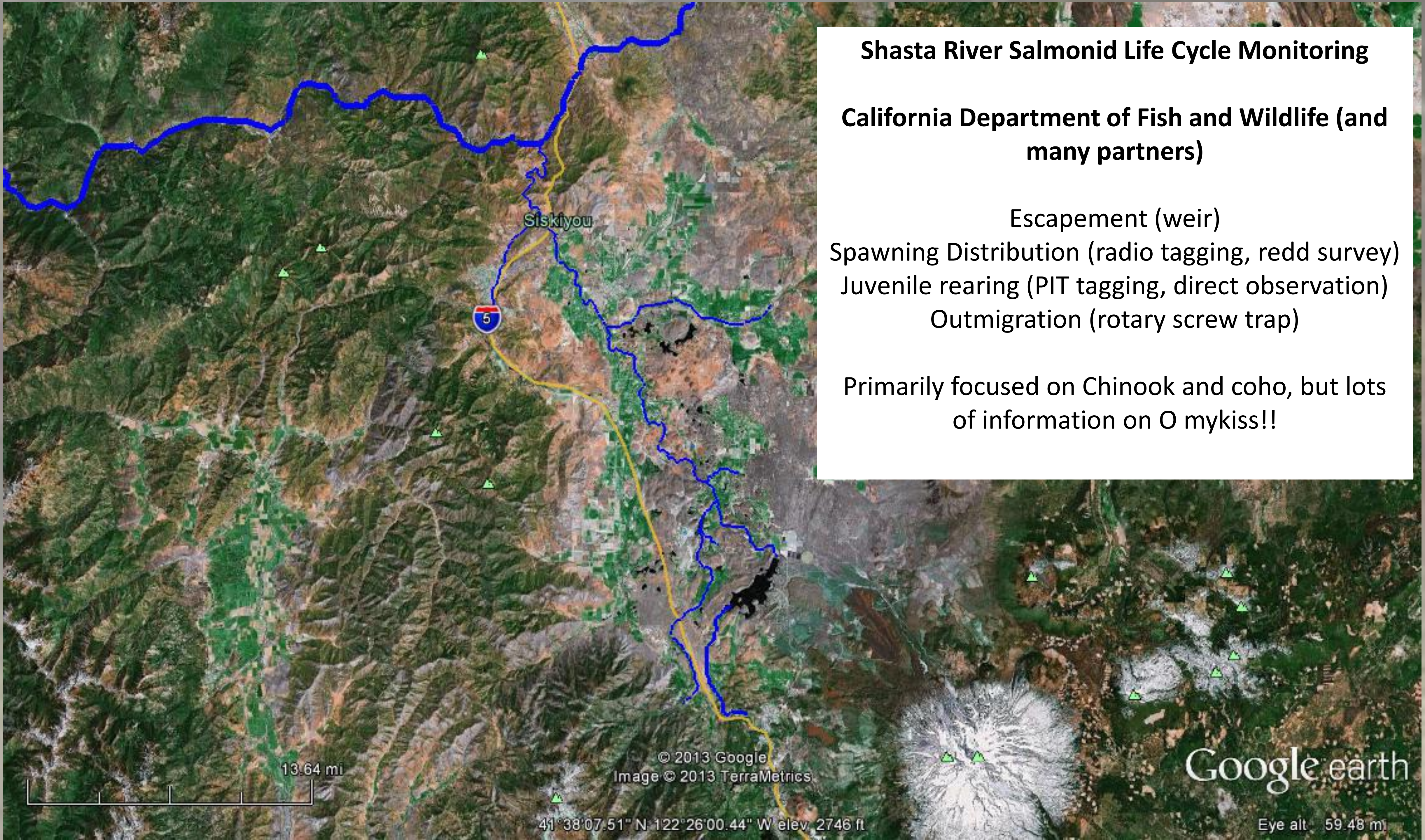
Flows impacted by irrigation

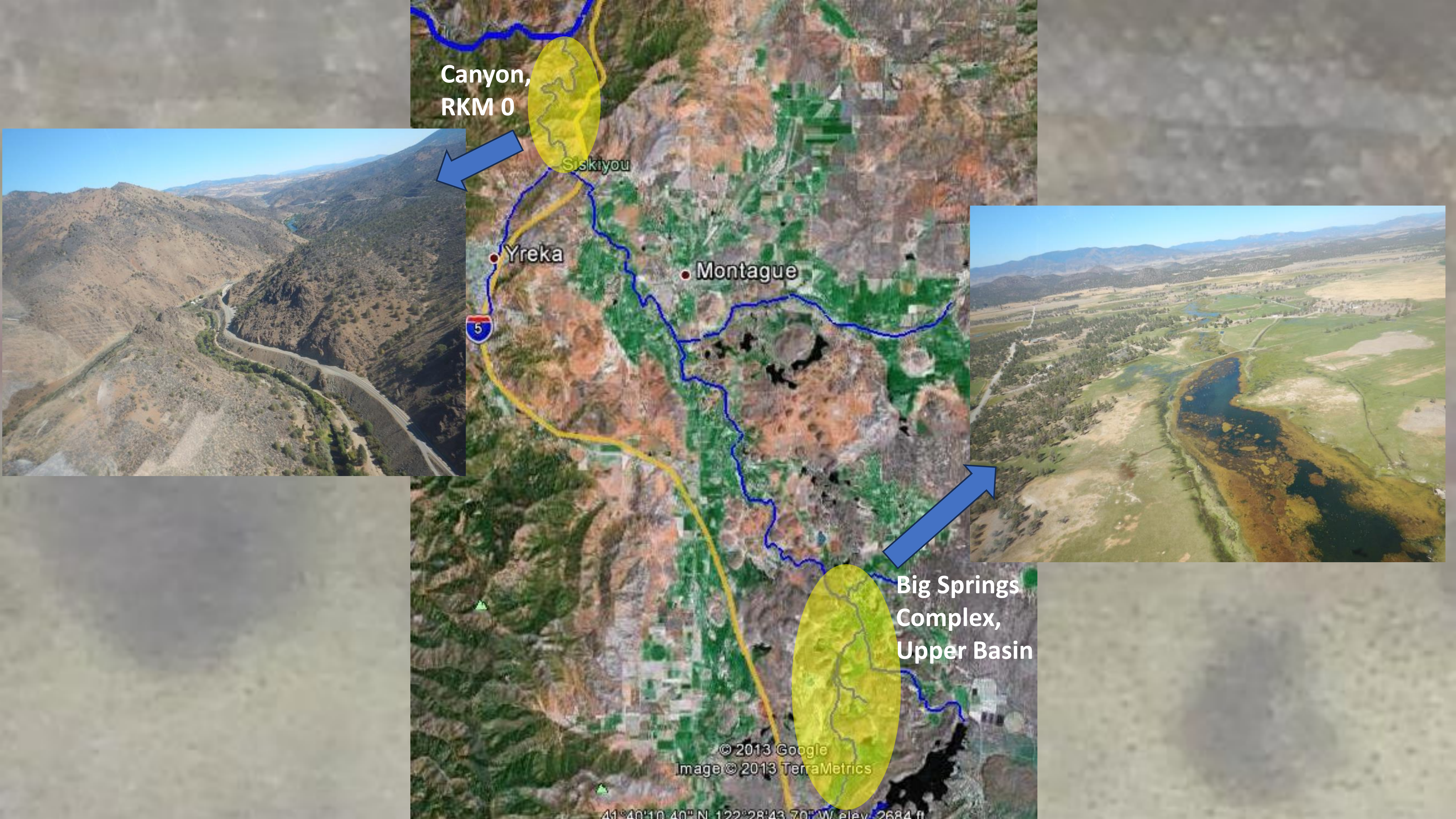
Shasta River Salmonid Life Cycle Monitoring

California Department of Fish and Wildlife (and many partners)

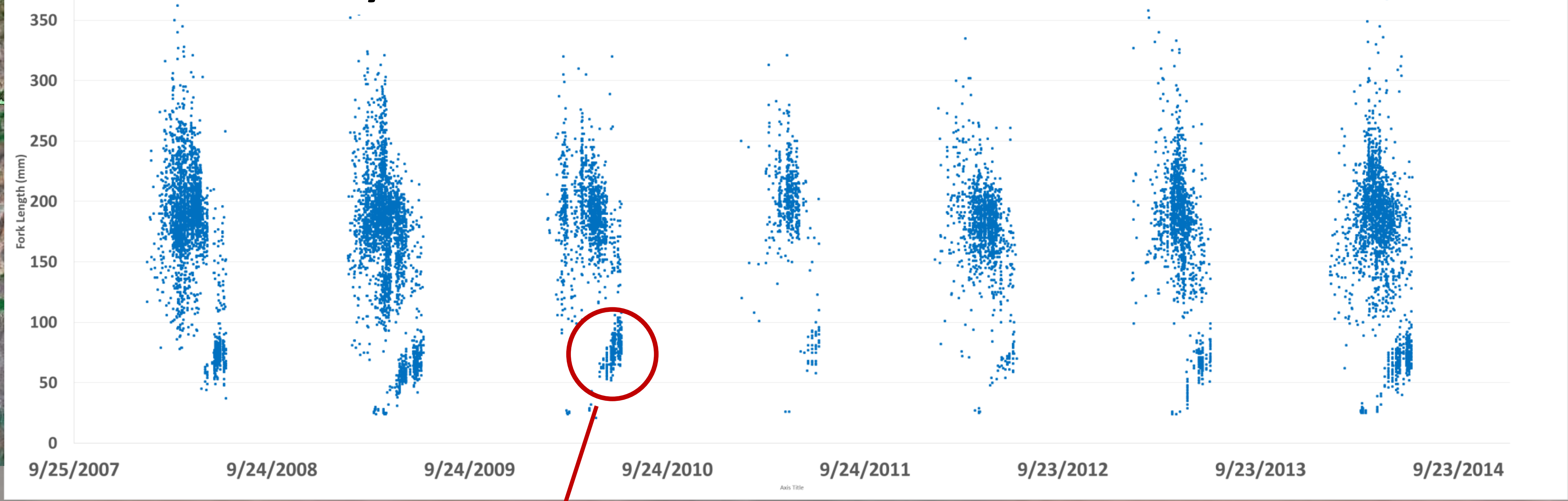
Escapement (weir)
Spawning Distribution (radio tagging, redd survey)
Juvenile rearing (PIT tagging, direct observation)
Outmigration (rotary screw trap)

Primarily focused on Chinook and coho, but lots of information on O mykiss!!



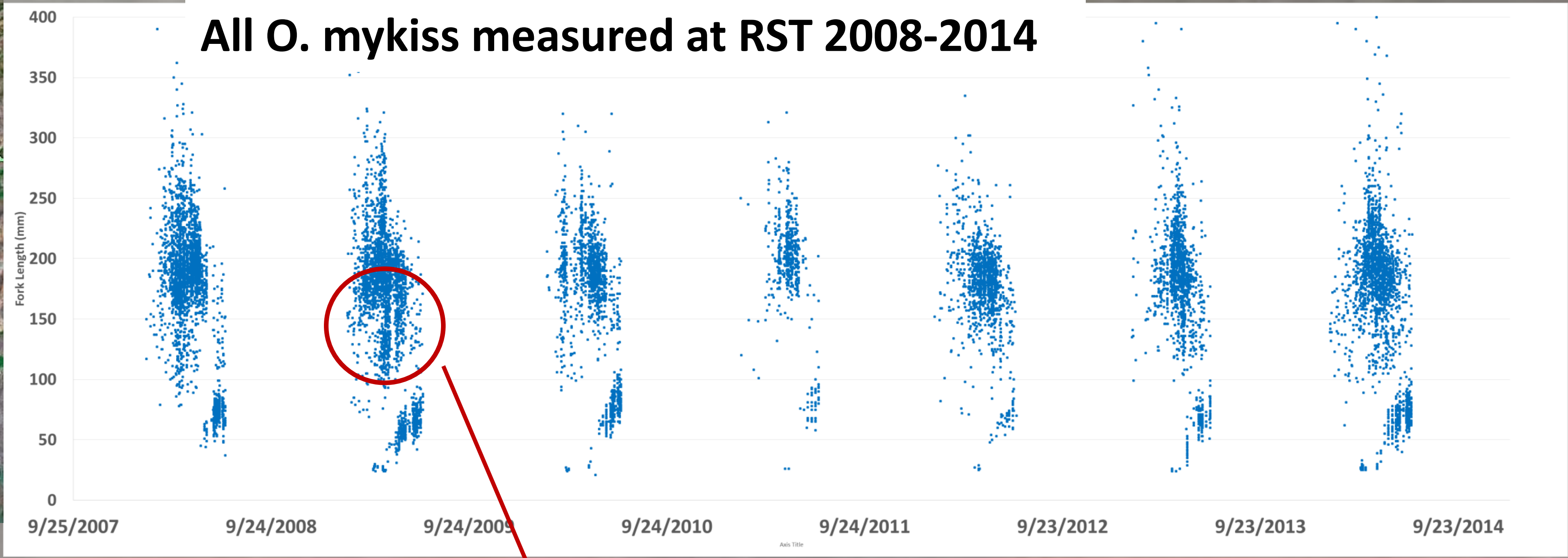

Canyon,
RKM 0
Siskiyou
Yreka
Montague
5
Big Springs
Complex,
Upper Basin
© 2013 Google
Image © 2013 TerraMetrics

All O. mykiss measured at RST 2008-2014



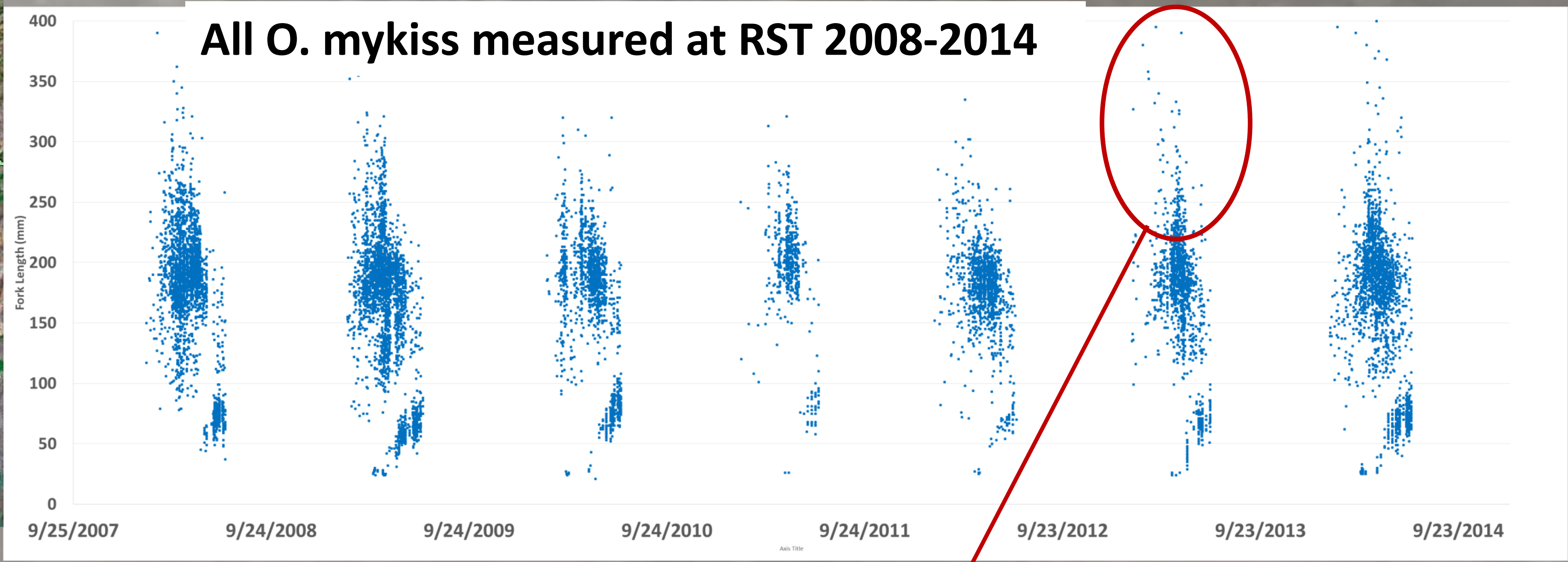
Age-0 O. mykiss leaving Shasta River weeks-months after emerging from gravel

All O. mykiss measured at RST 2008-2014

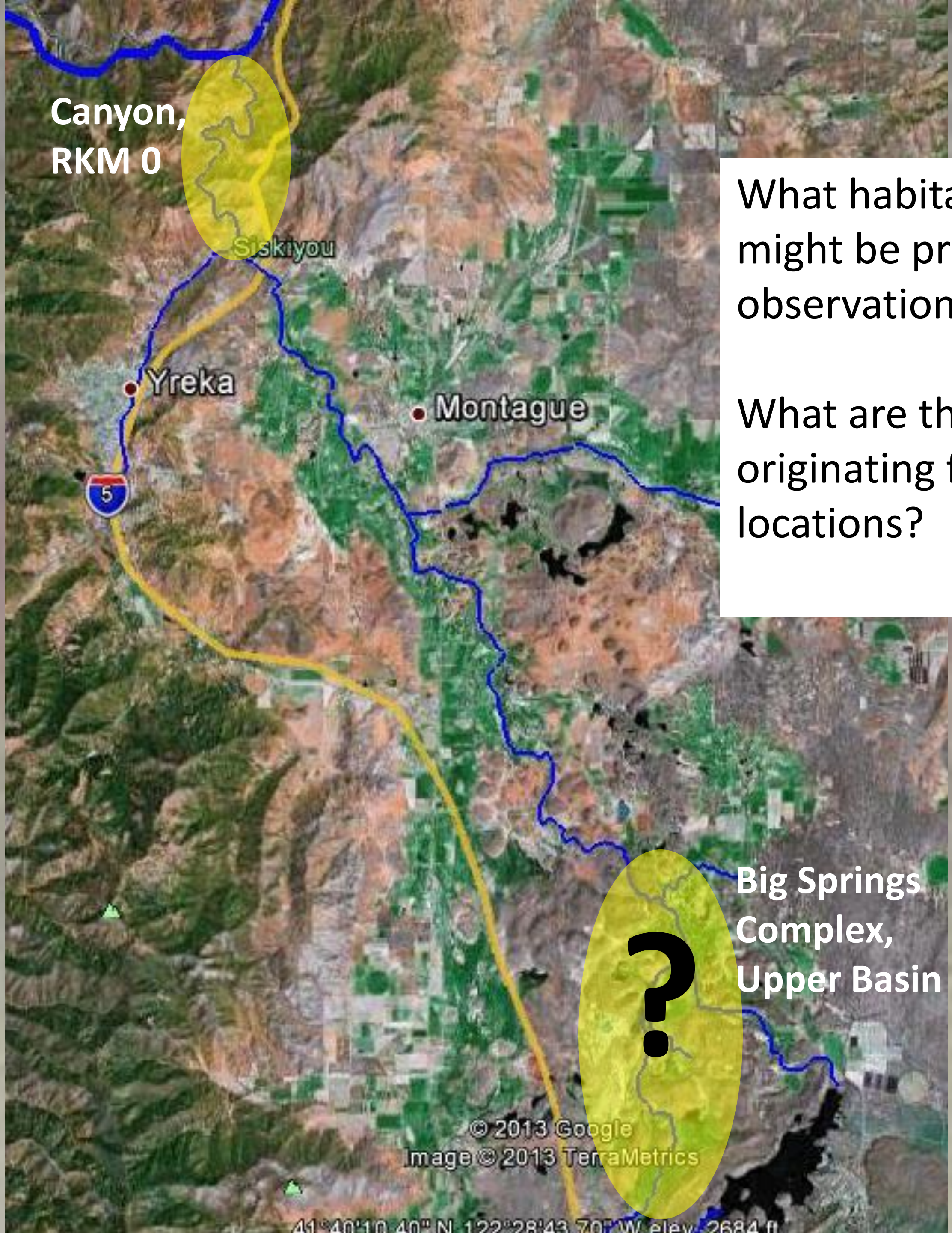


O. mykiss leaving Shasta at age-1

All O. mykiss measured at RST 2008-2014

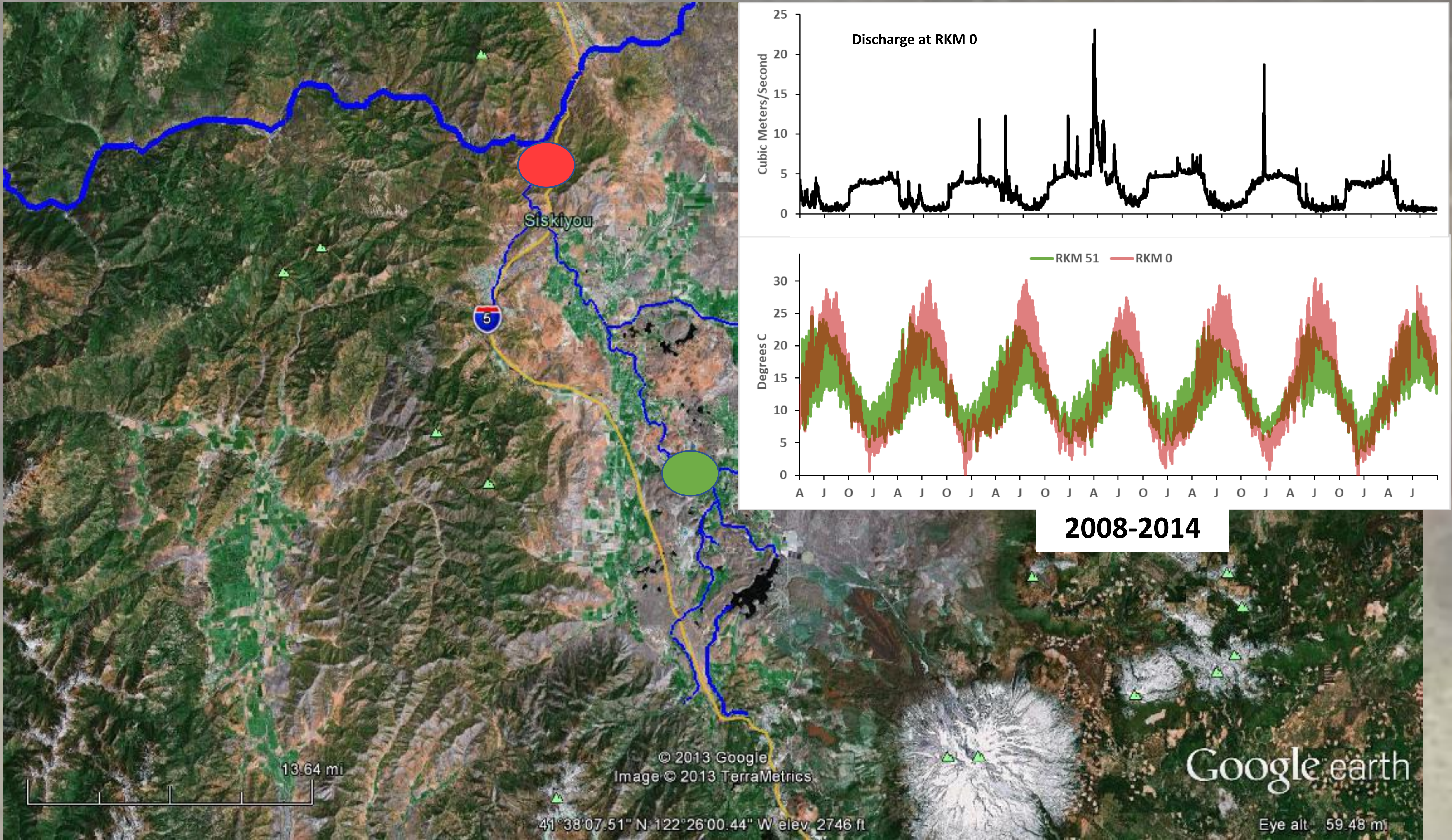


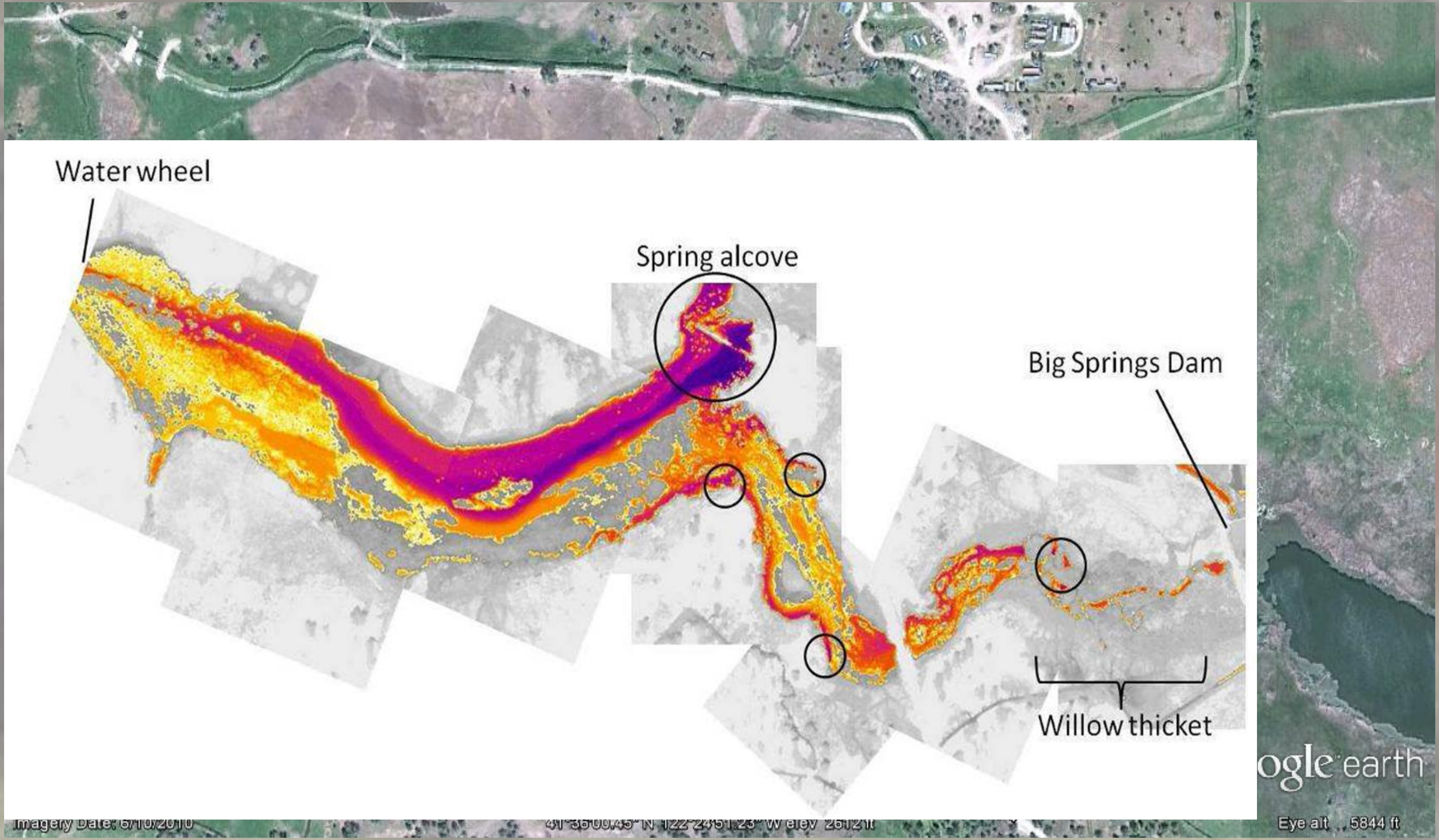
Large sexually immature, unknown origin



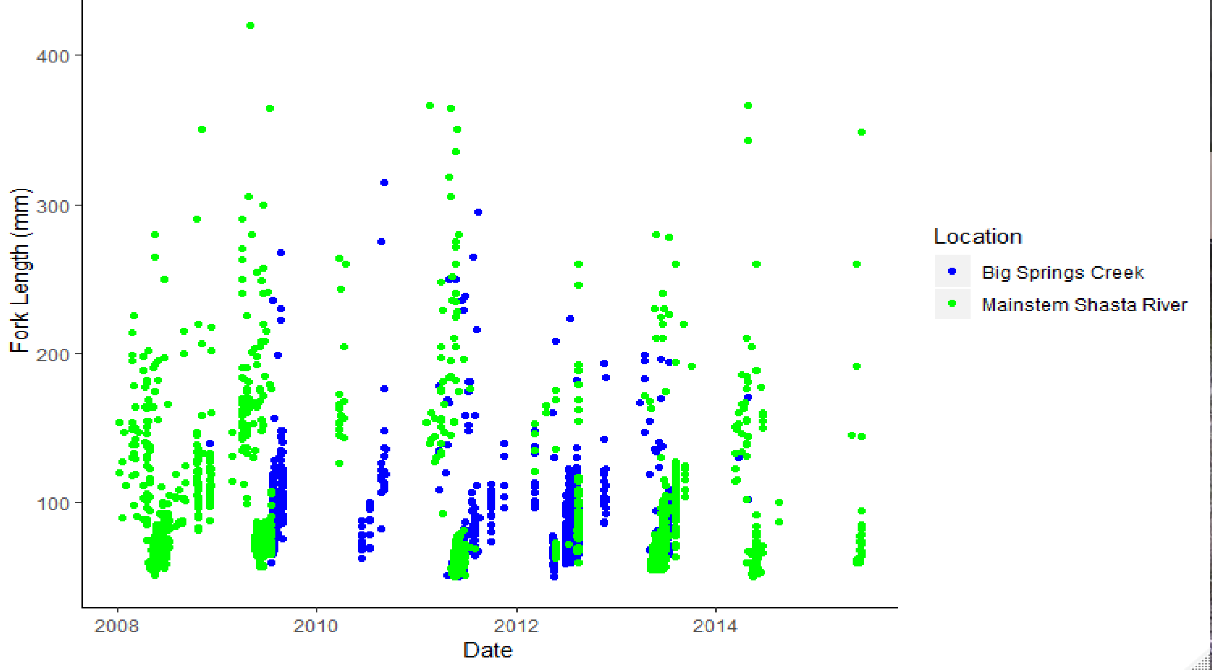
What habitats/environment factors might be producing/influencing the observations of O. mykiss at RKM 0?

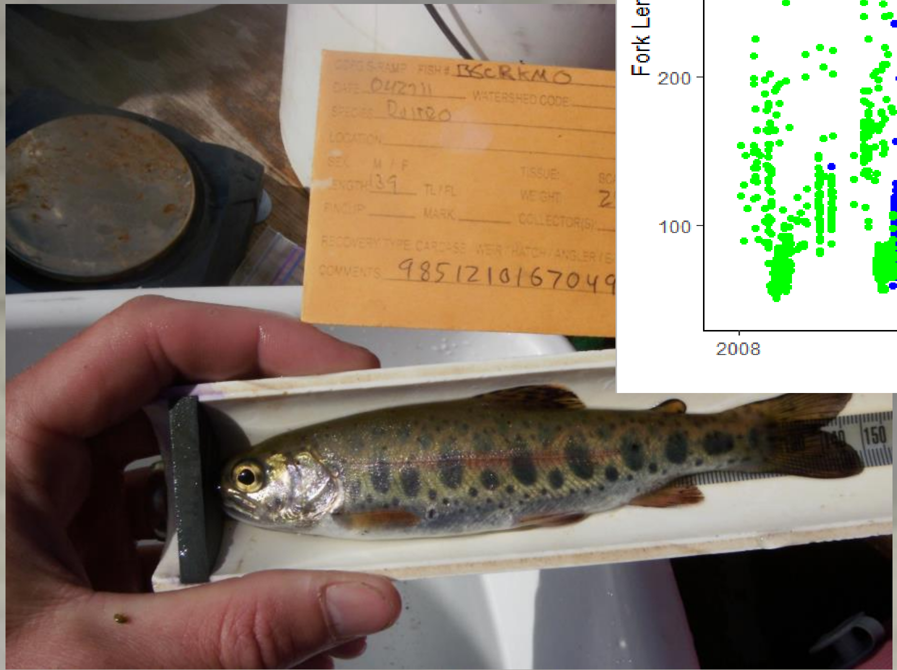
What are the life histories of O. mykiss originating from different spawning locations?

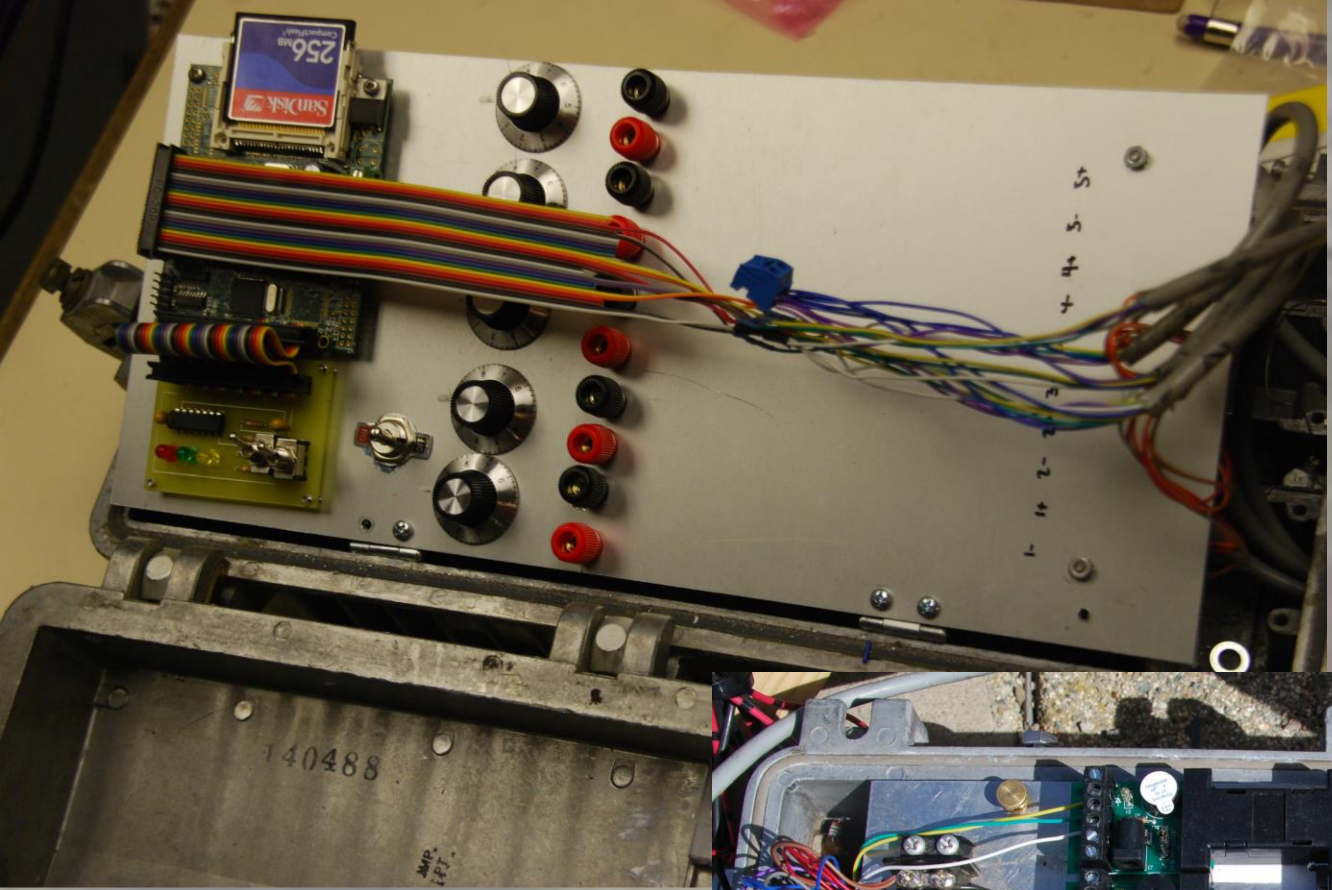

Discharge at RKM 0
Cubic Meters/Second
0 5 10 15 20 25
RKM 51
RKM 0
Degrees C
0 5 10 15 20 25 30
A J O J A J O J A J O J A J O J A J O J A J O J A J O J A J
2008-2014
Siskiyou
5
© 2013 Google
Image © 2013 TerraMetrics
13.64 mi
41°38'07.51" N 122°26'00.44" W elev 2746 ft
Google earth
Eye alt 59.48 mi

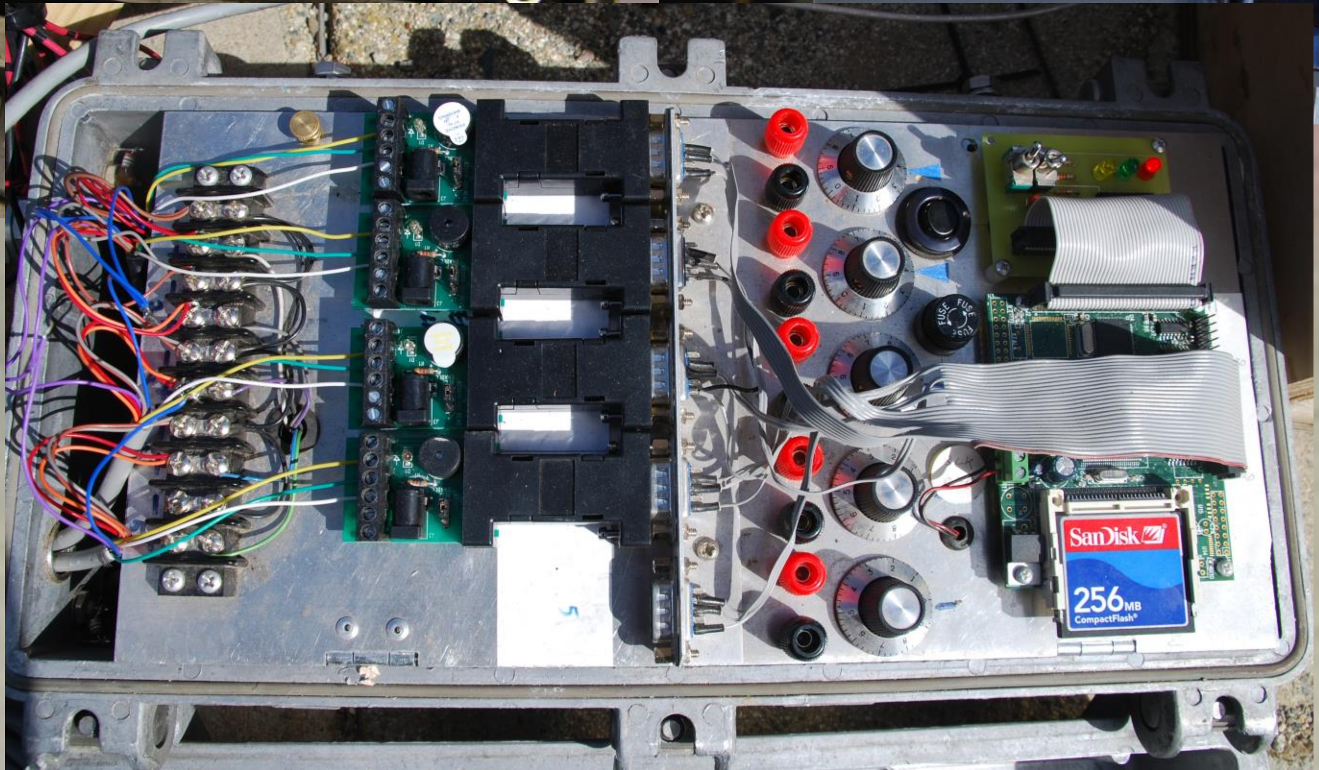

Water wheel
Spring alcove
Big Springs Dam
Willow thicket
ogle earth
Imagery Date: 6/10/2010
Eye alt 5844 ft

2256 *O. mykiss* PIT tagged in upper basin 2008-2014

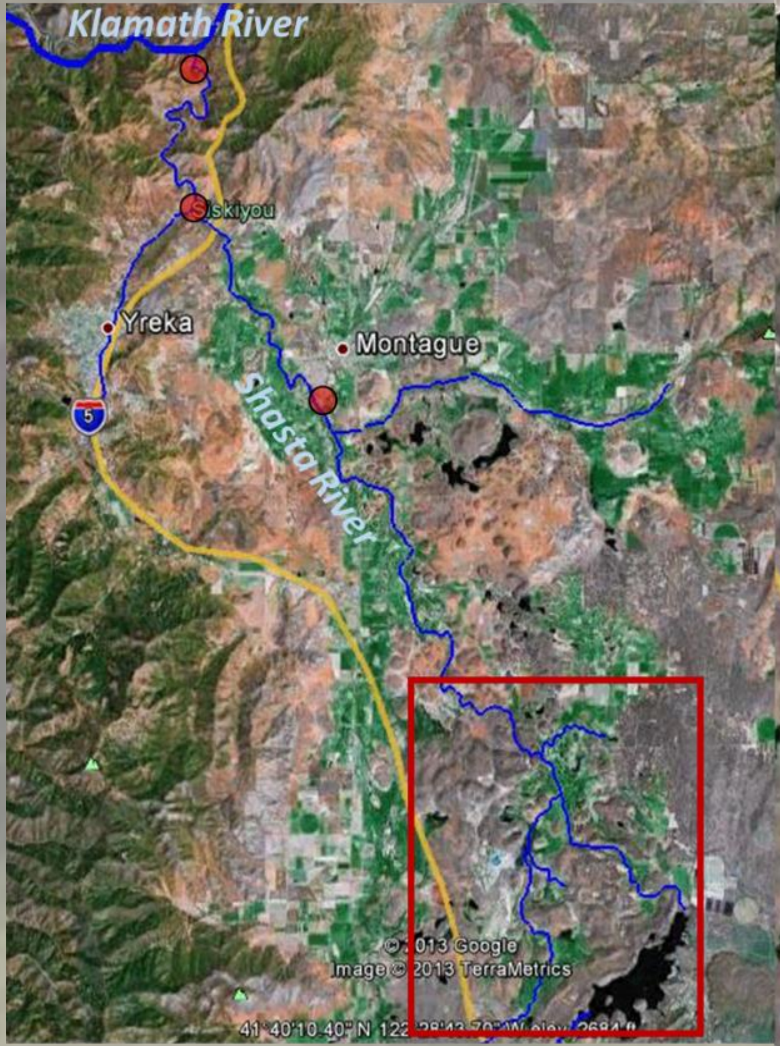





140488

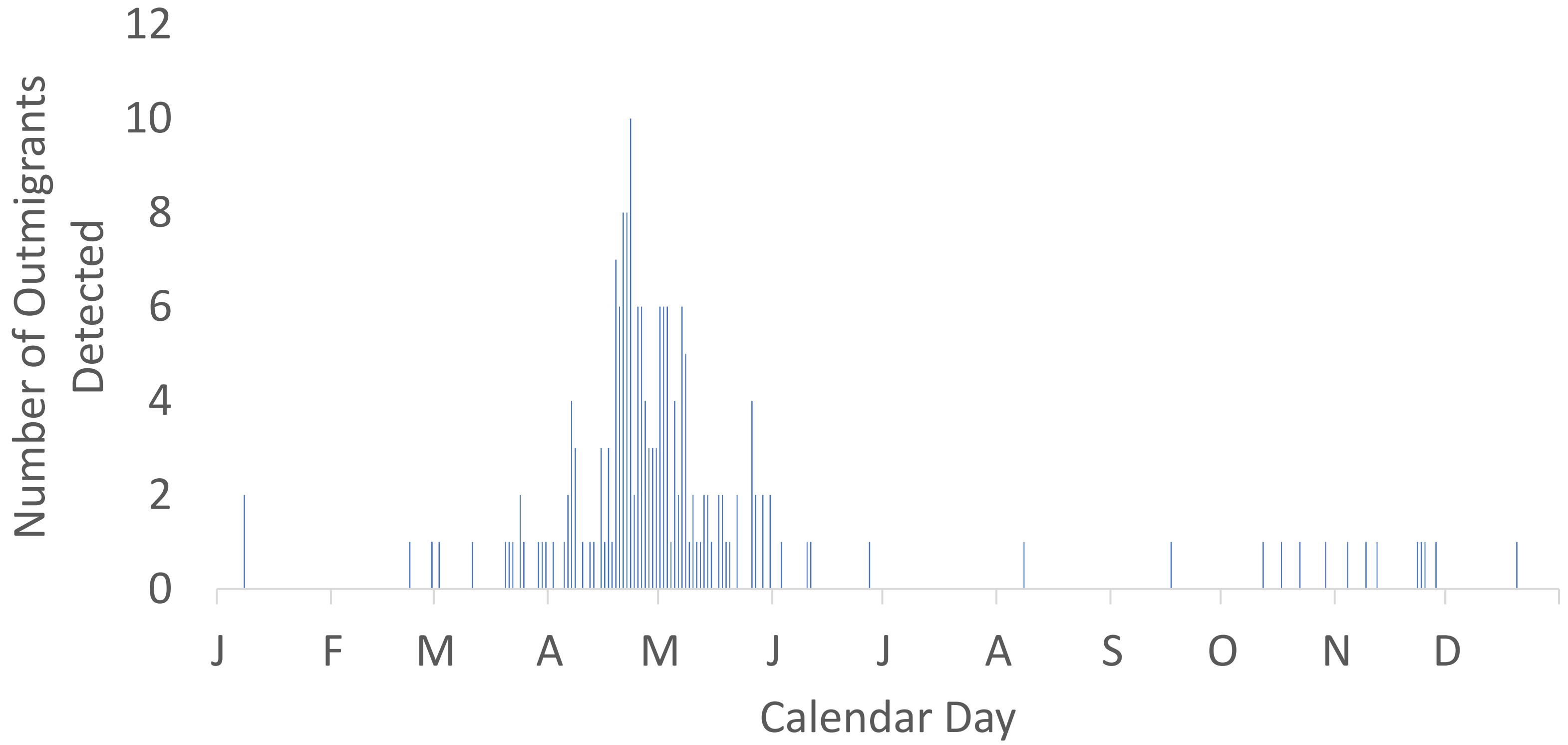
WIEGMANN

SanDisk
256MB
CompactFlash

PIT TAG ANTENNA LOCATIONS



O. mykiss

Upper Basin Total Tagged	Encountered at least 10 days after tagging	Outmigrate at age 0	Outigrate at age 1	Outmigrate Age 2	Upper Basin Resident
2556	1226	11	156	12	130



Are there isolated populations of O. mykiss in the Shasta River or is it one partially migrating population: is there population structure?

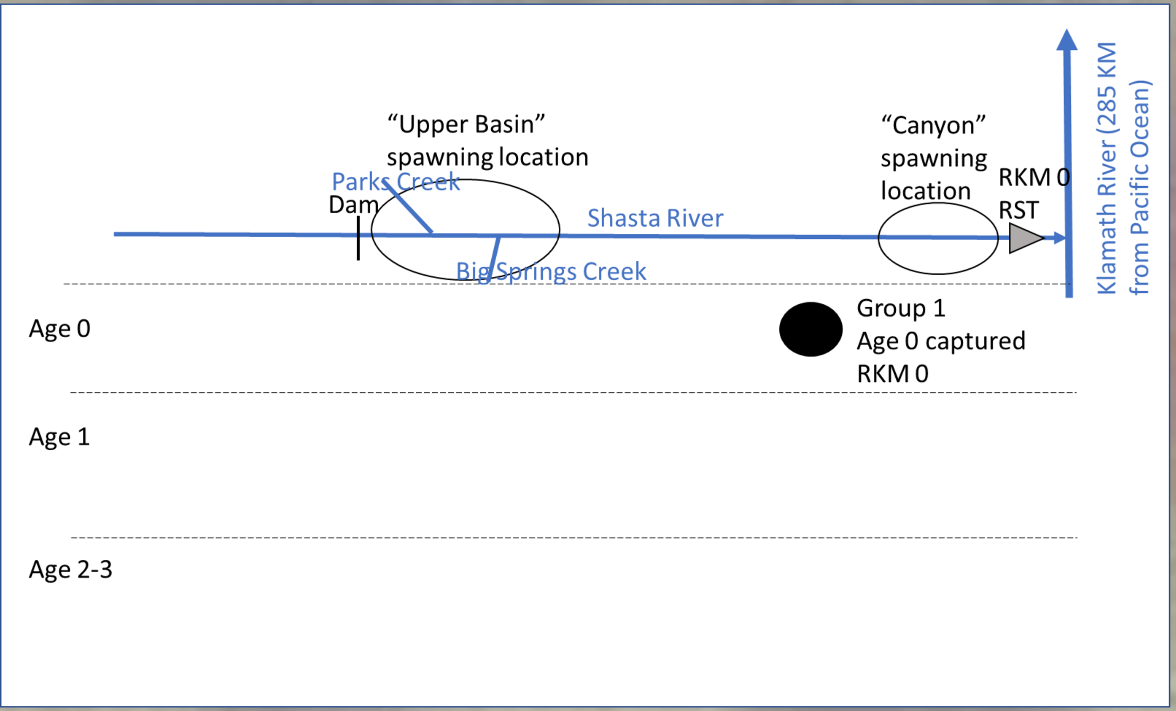
Identify "life history groups" based on capture and tagging data

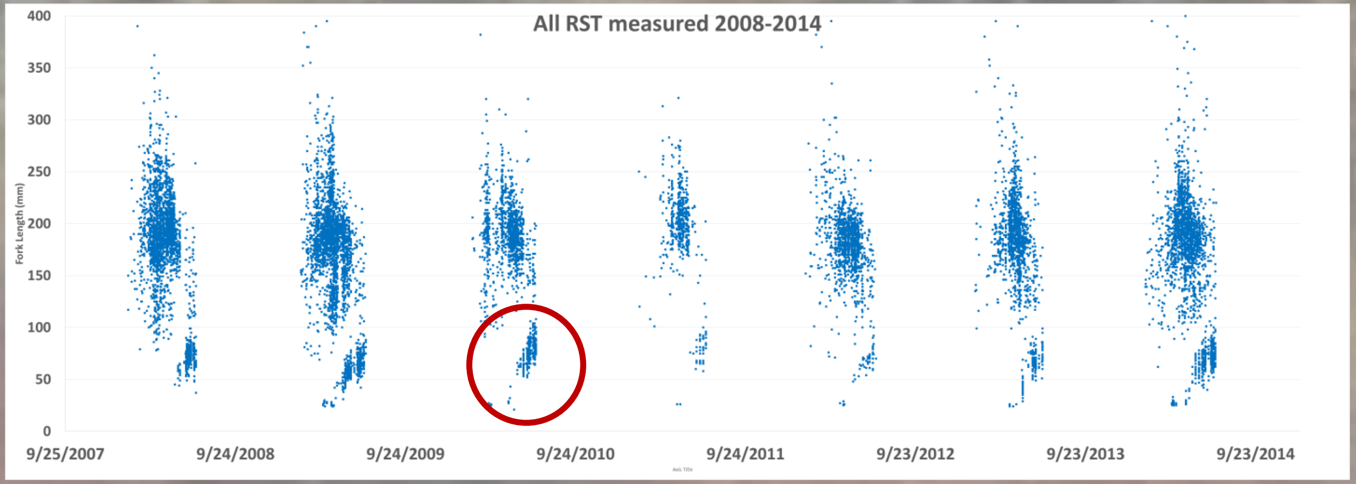
Talk to smart geneticist people and send them little pieces of fish!

Had collected scales most *O. mykiss* tagged

GROUP 1

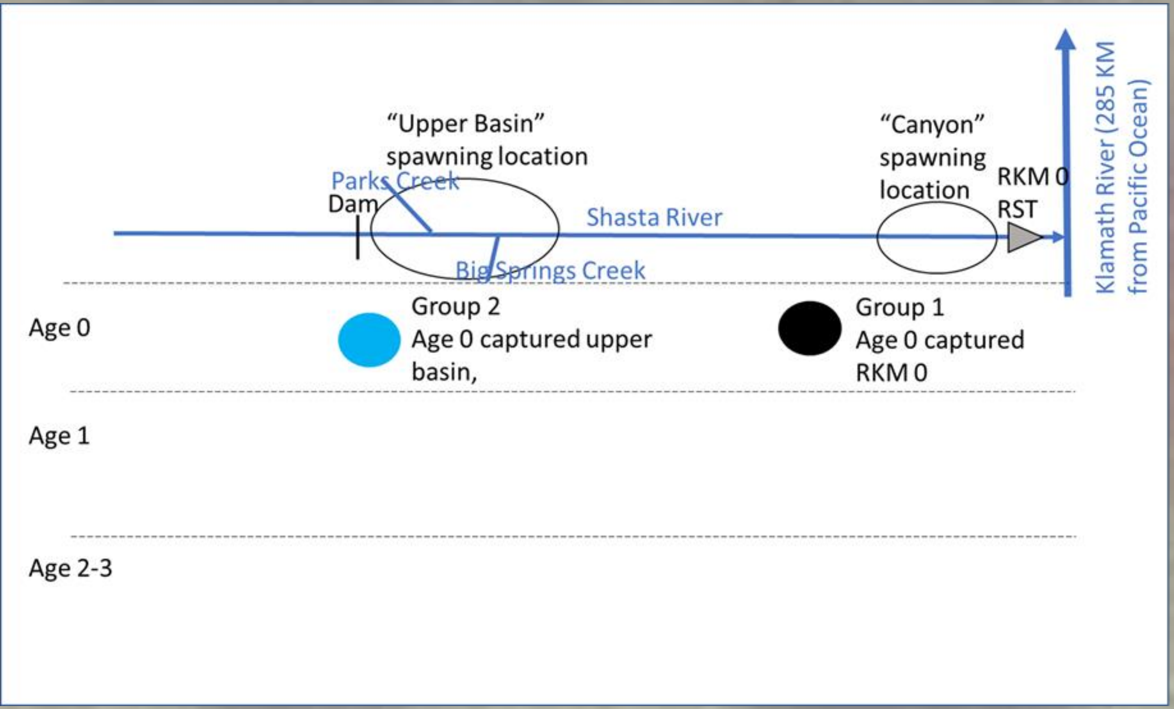
Spawned in canyon, out-migrate at age 0 when conditions become unfavorable

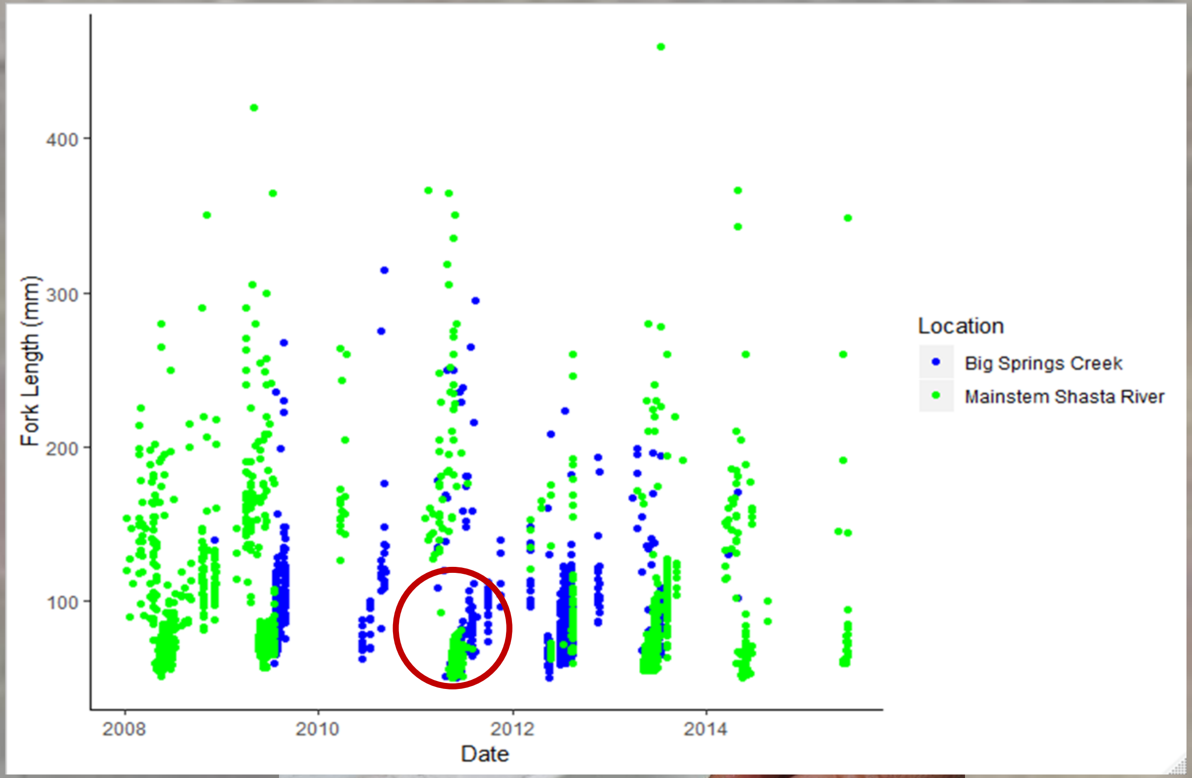




GROUP 2

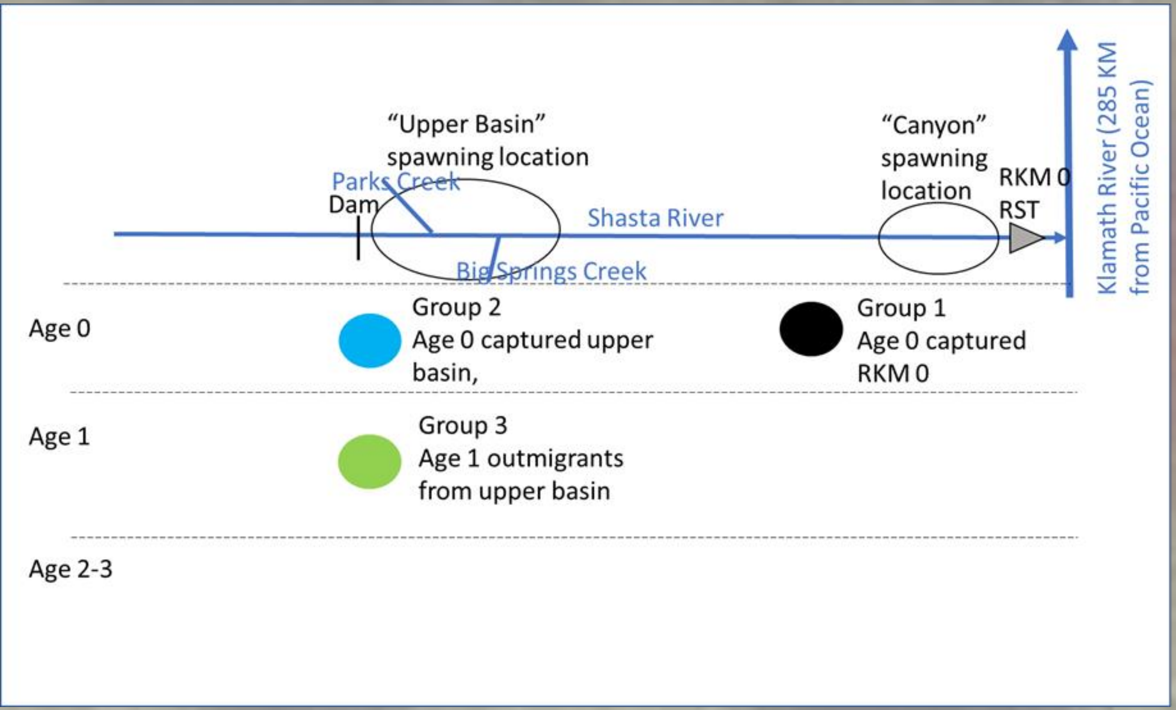
Age 0 in Upper Basin (unknown life history)

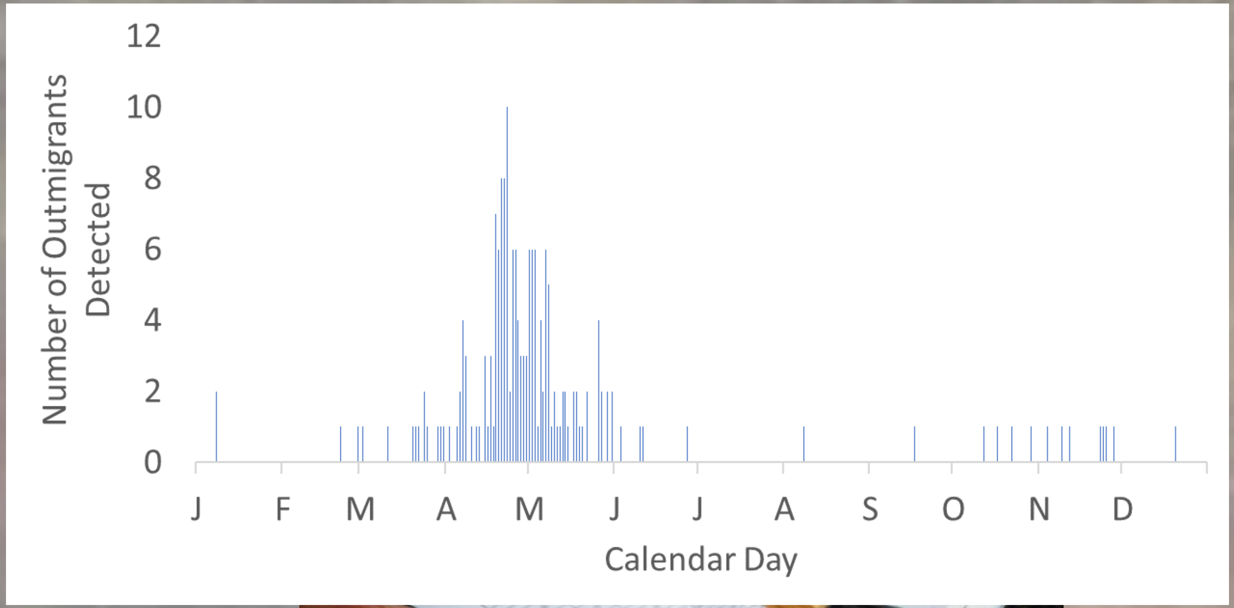


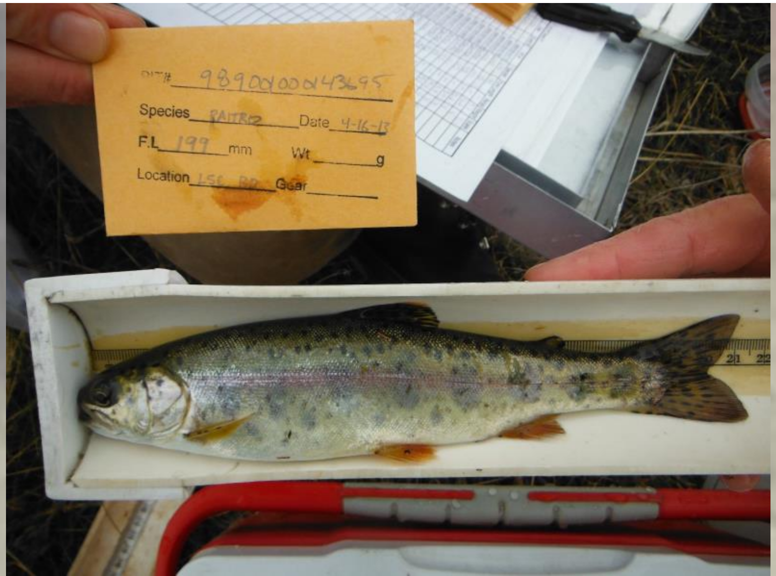


GROUP 3

Age 1 Outmigrant from Upper Basin

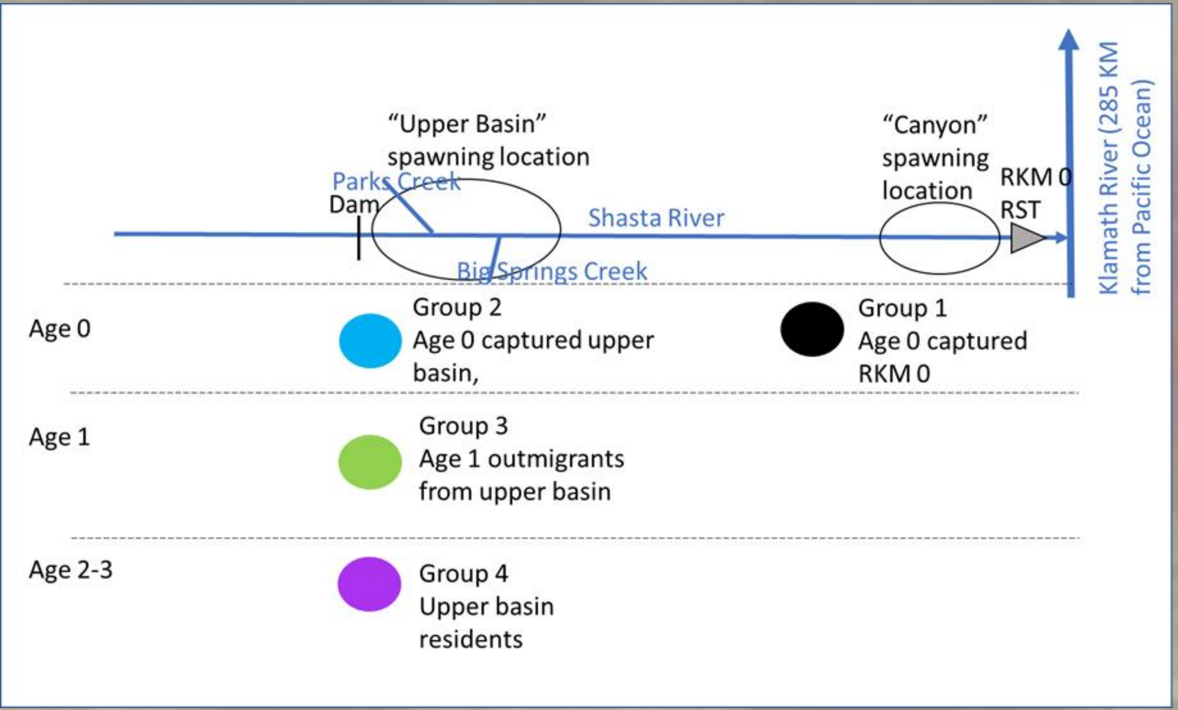




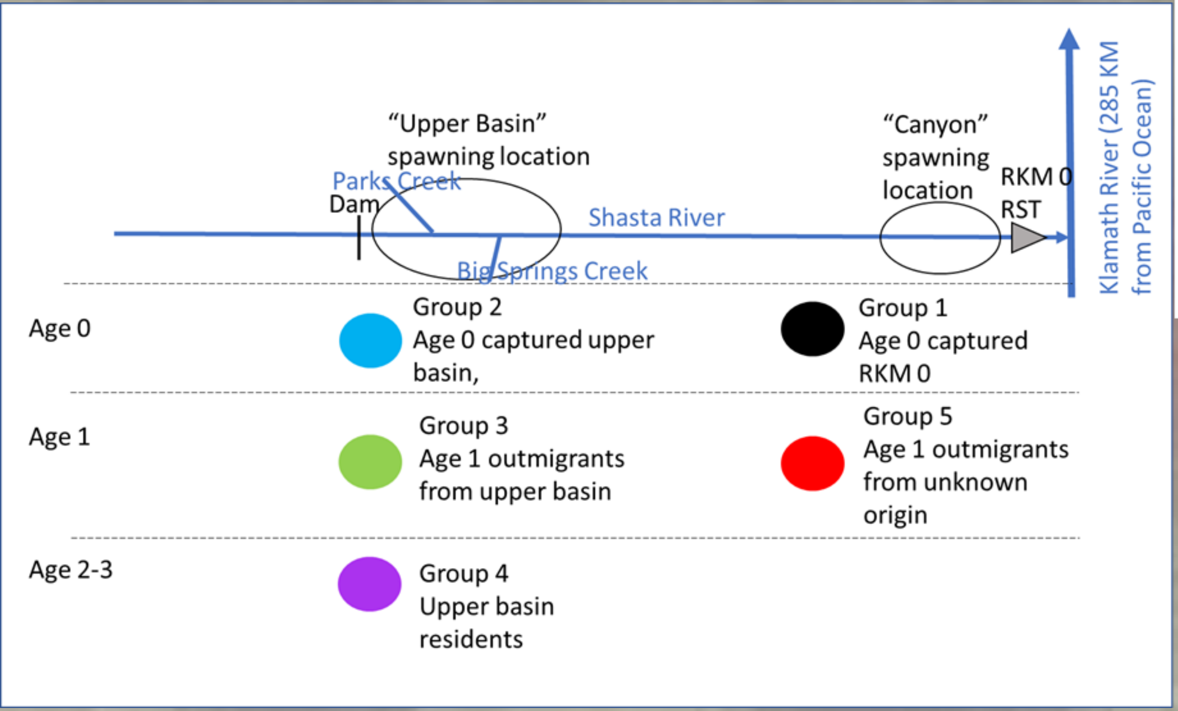


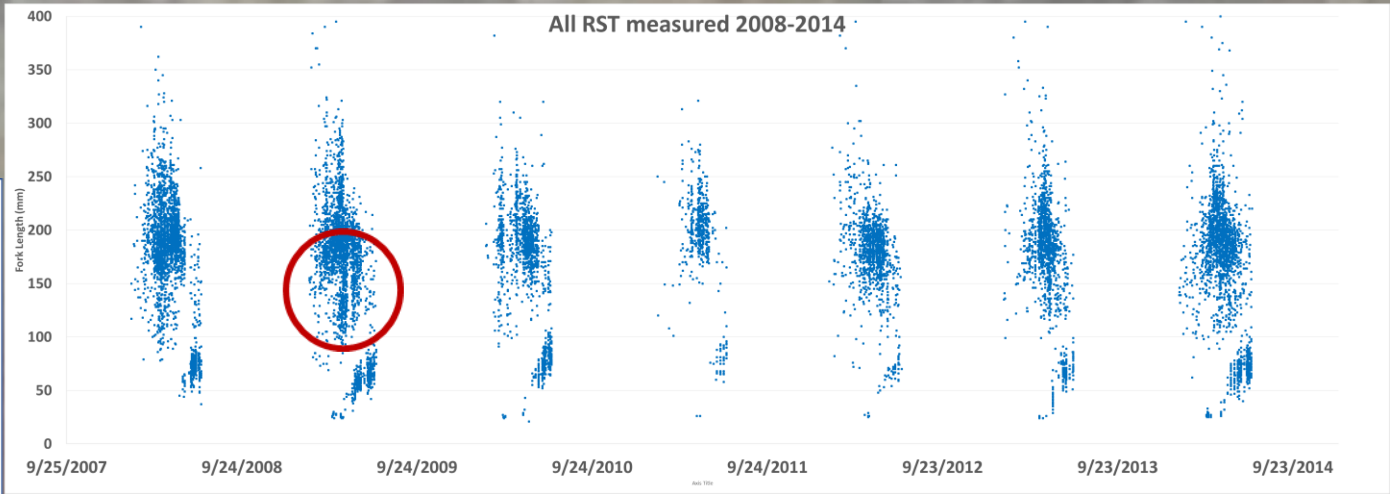
GROUP 4

Upper Basin Resident



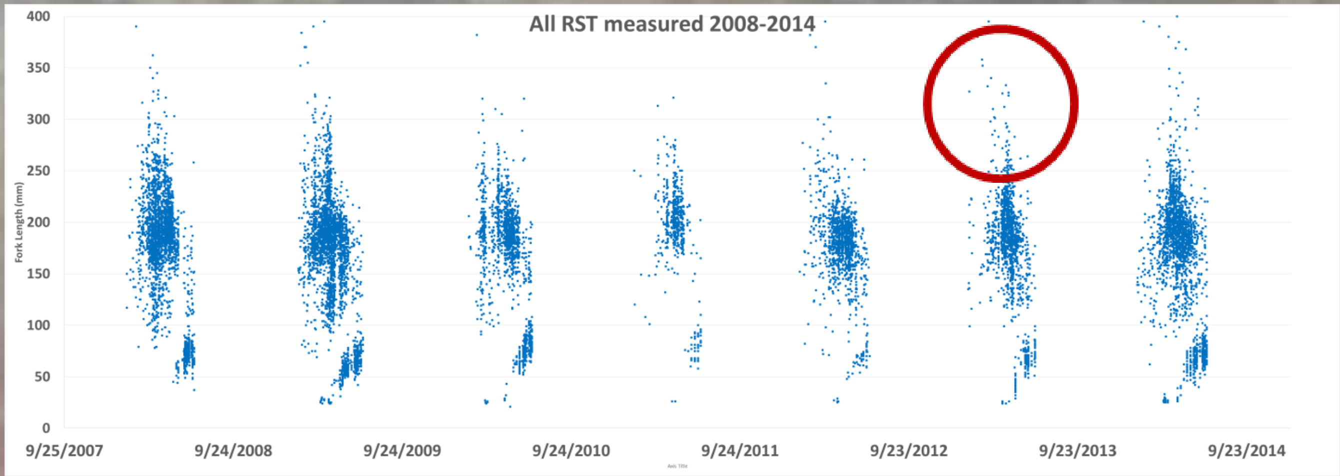
Age 1 Outmigrant Unknown Origin

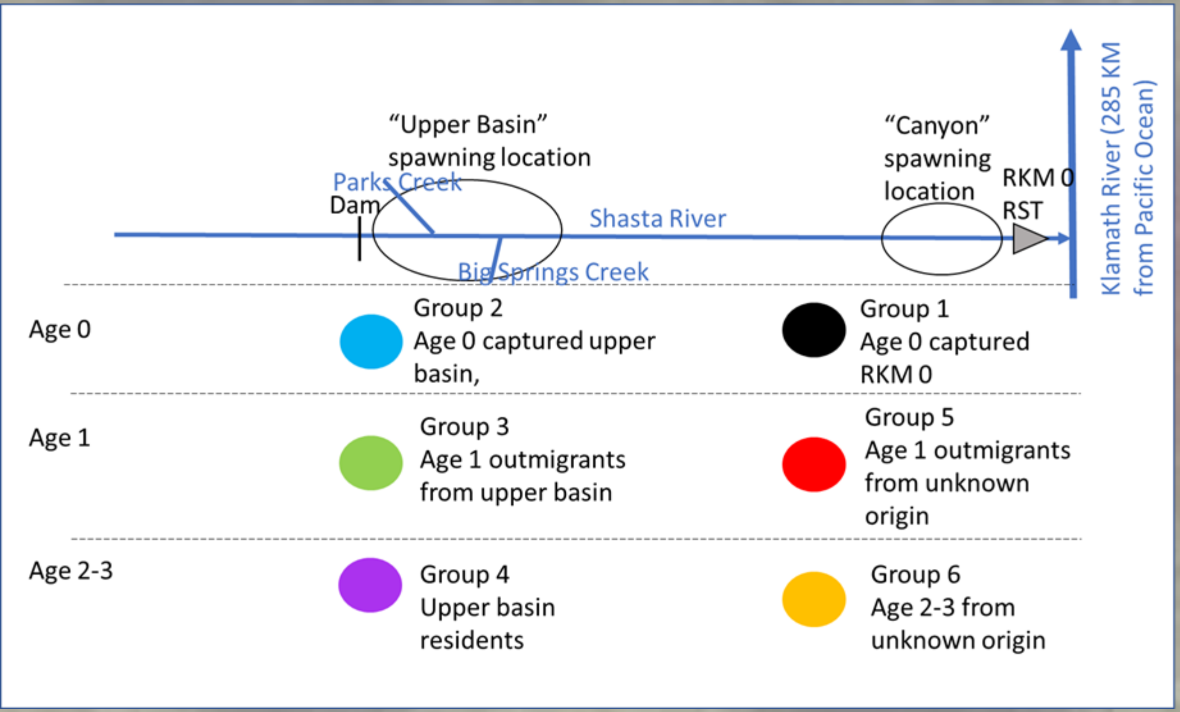




GROUP 6

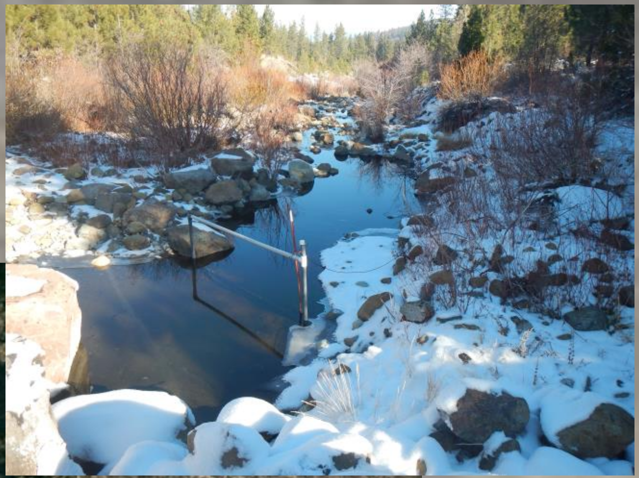
Age 2,3 + at RKM 0, Unknown Origin

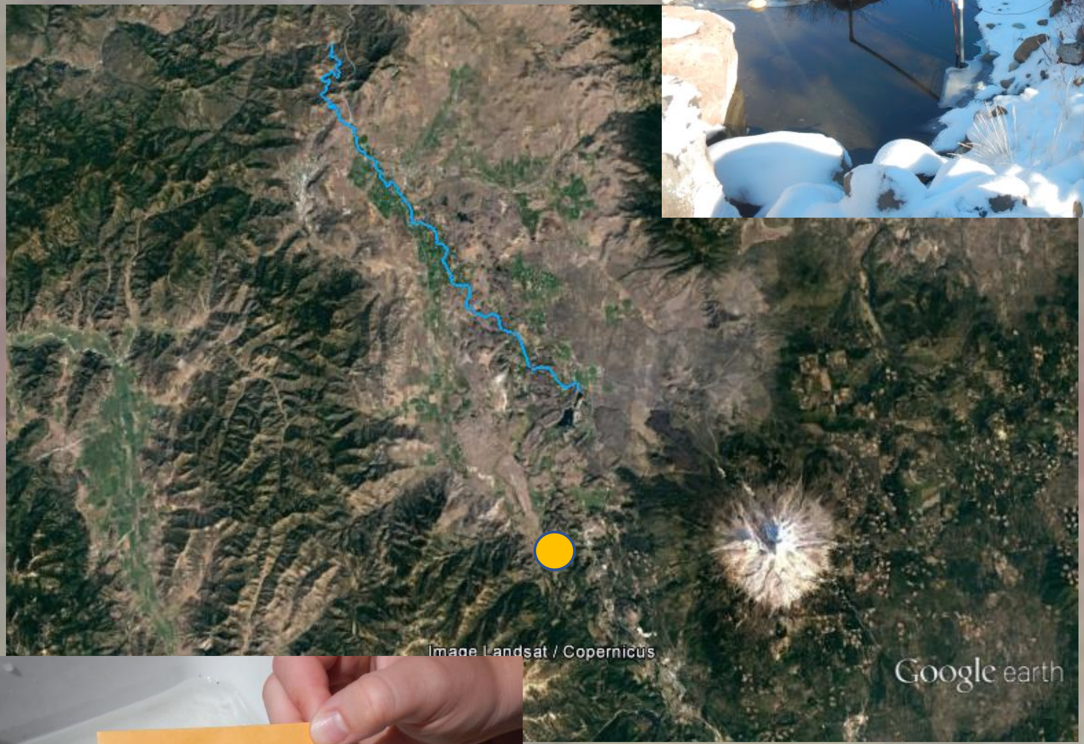


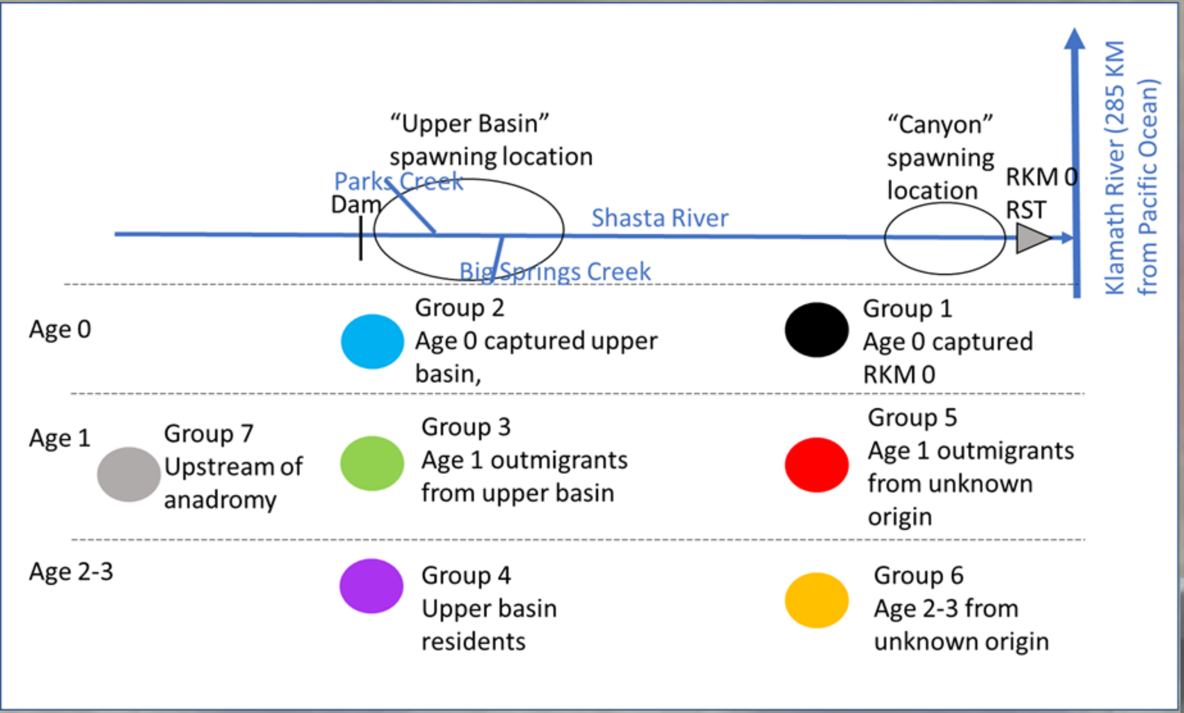


GROUP 7

Upstream of Anadromy

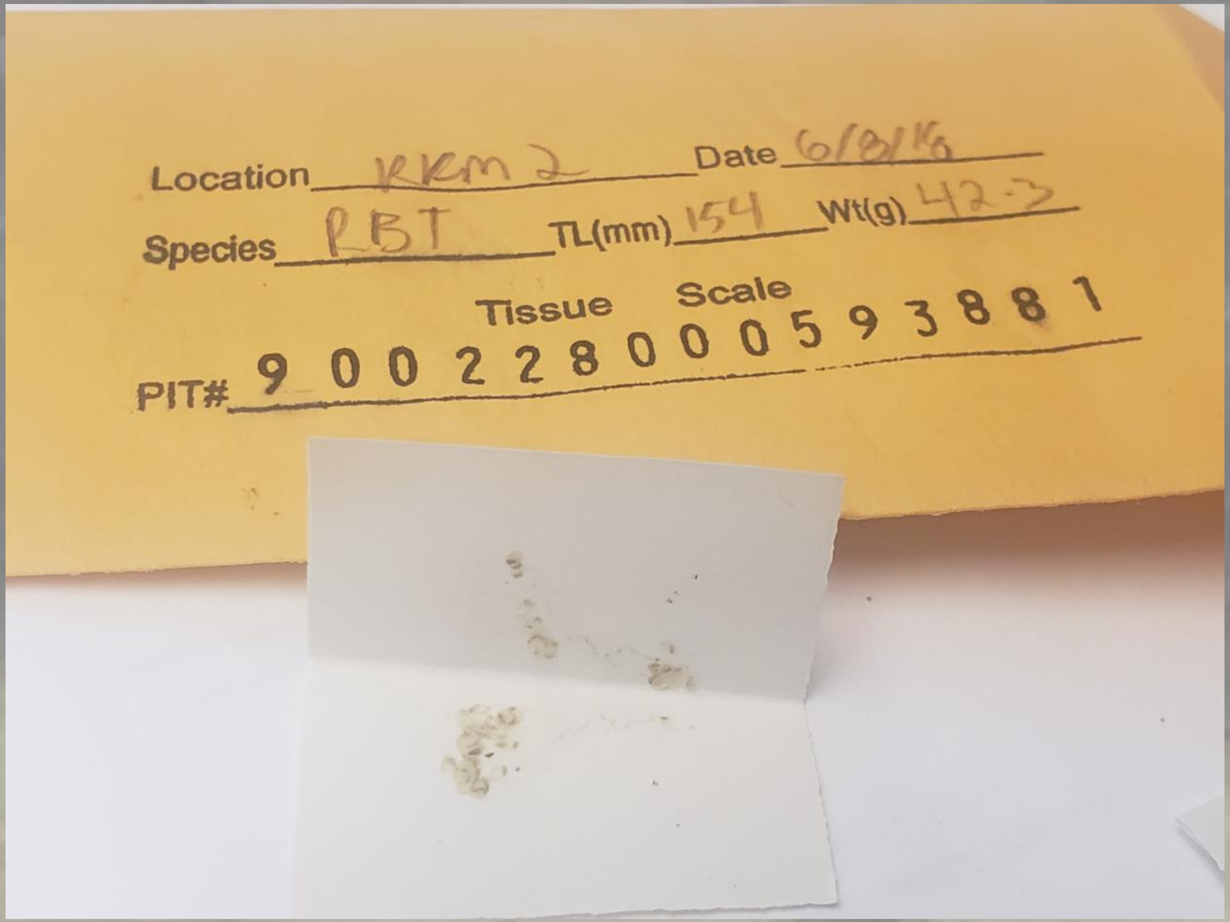


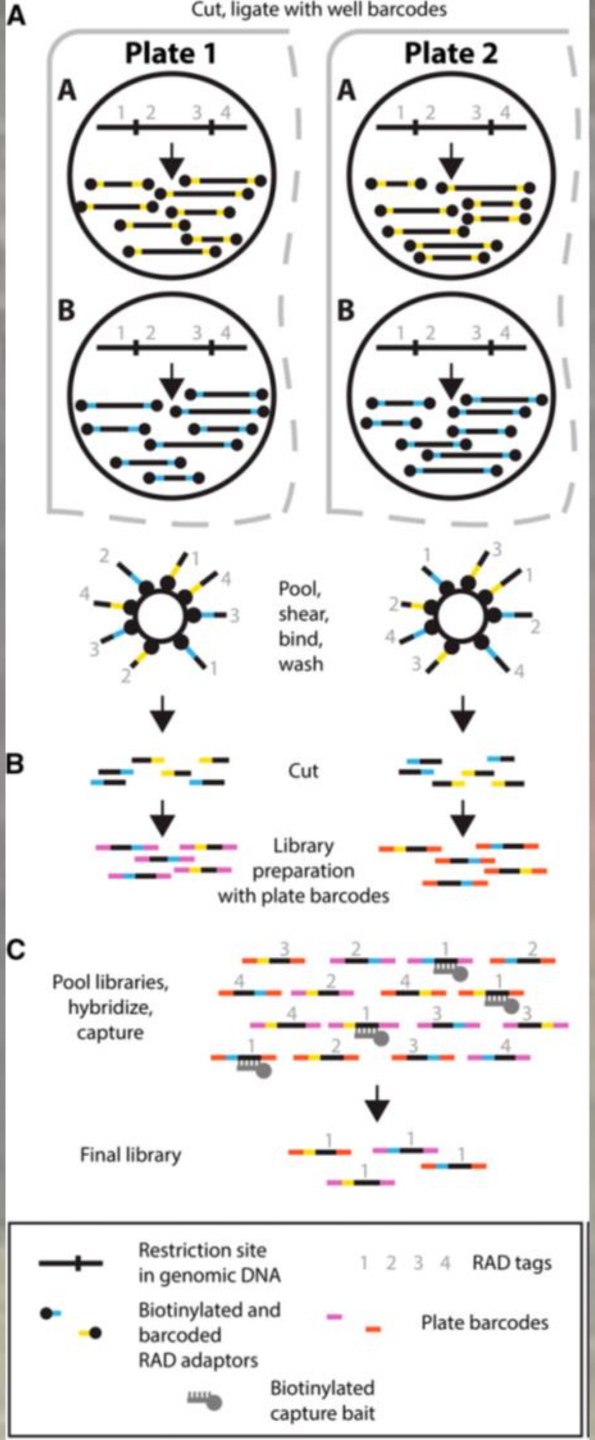


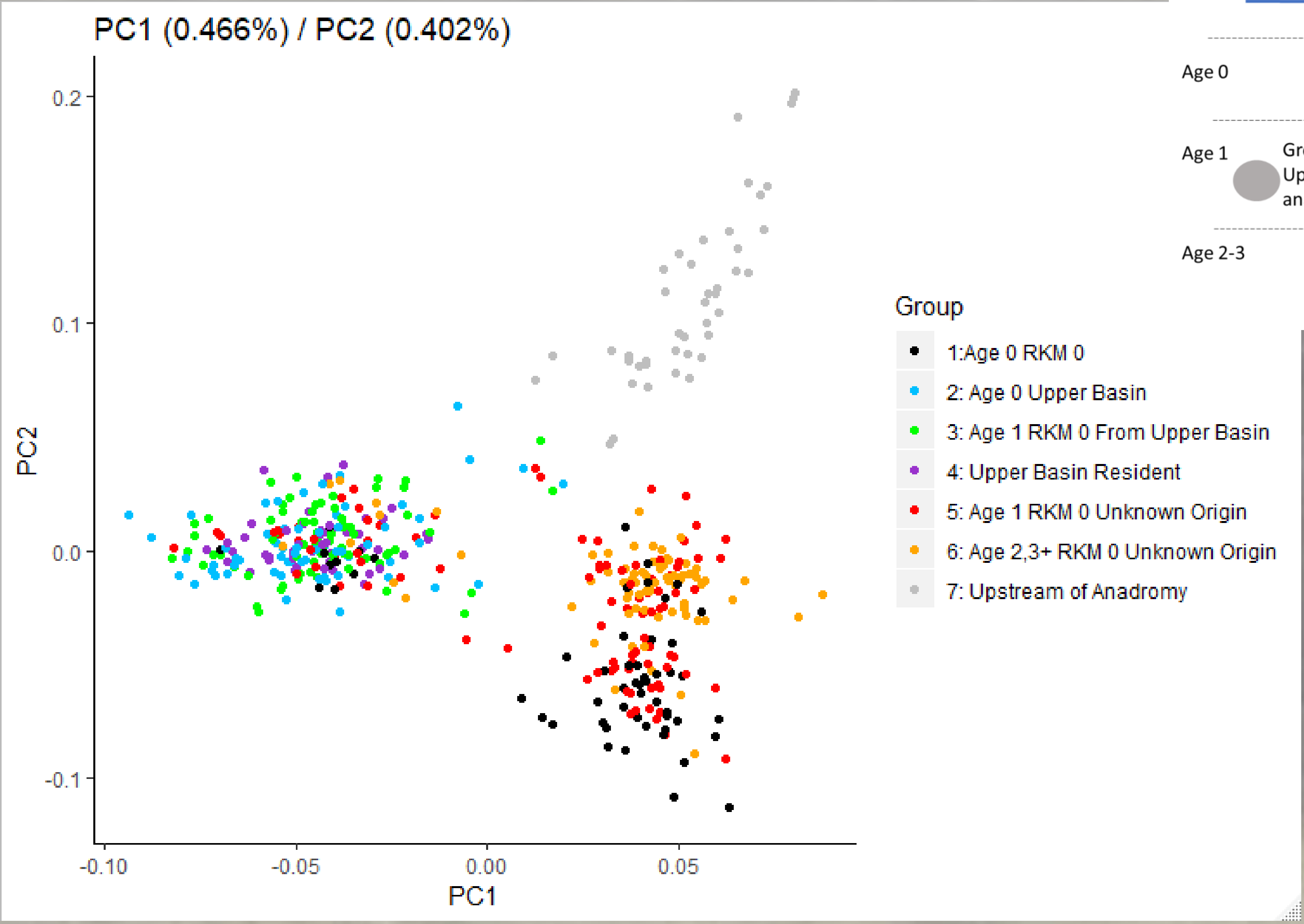


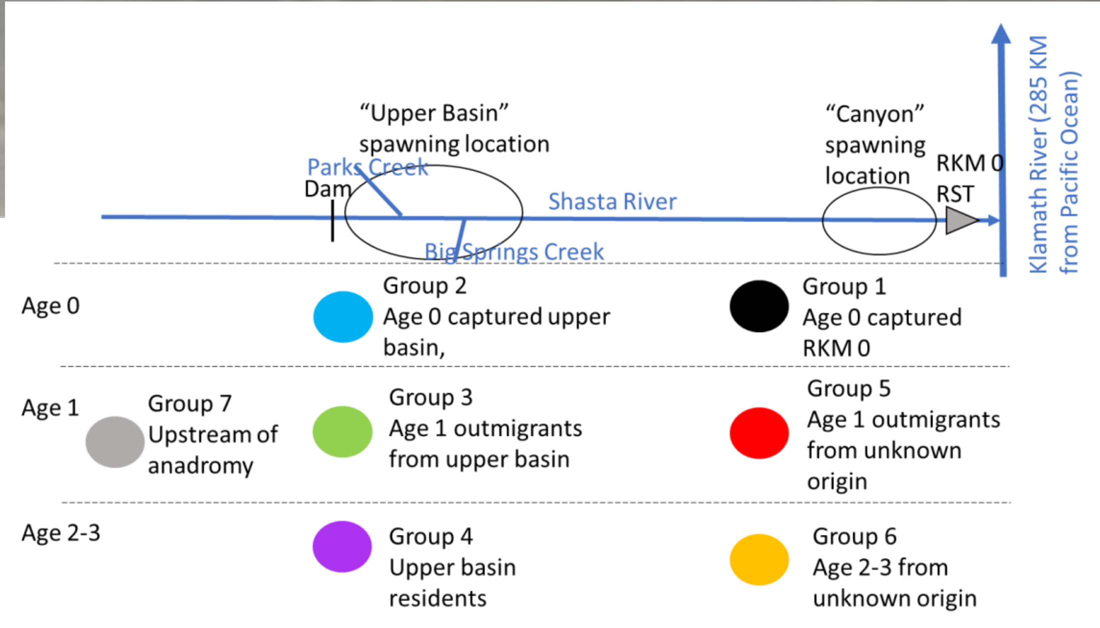
Partnered with Dr. Mark Miller and Tasha Thompson at UC Davis

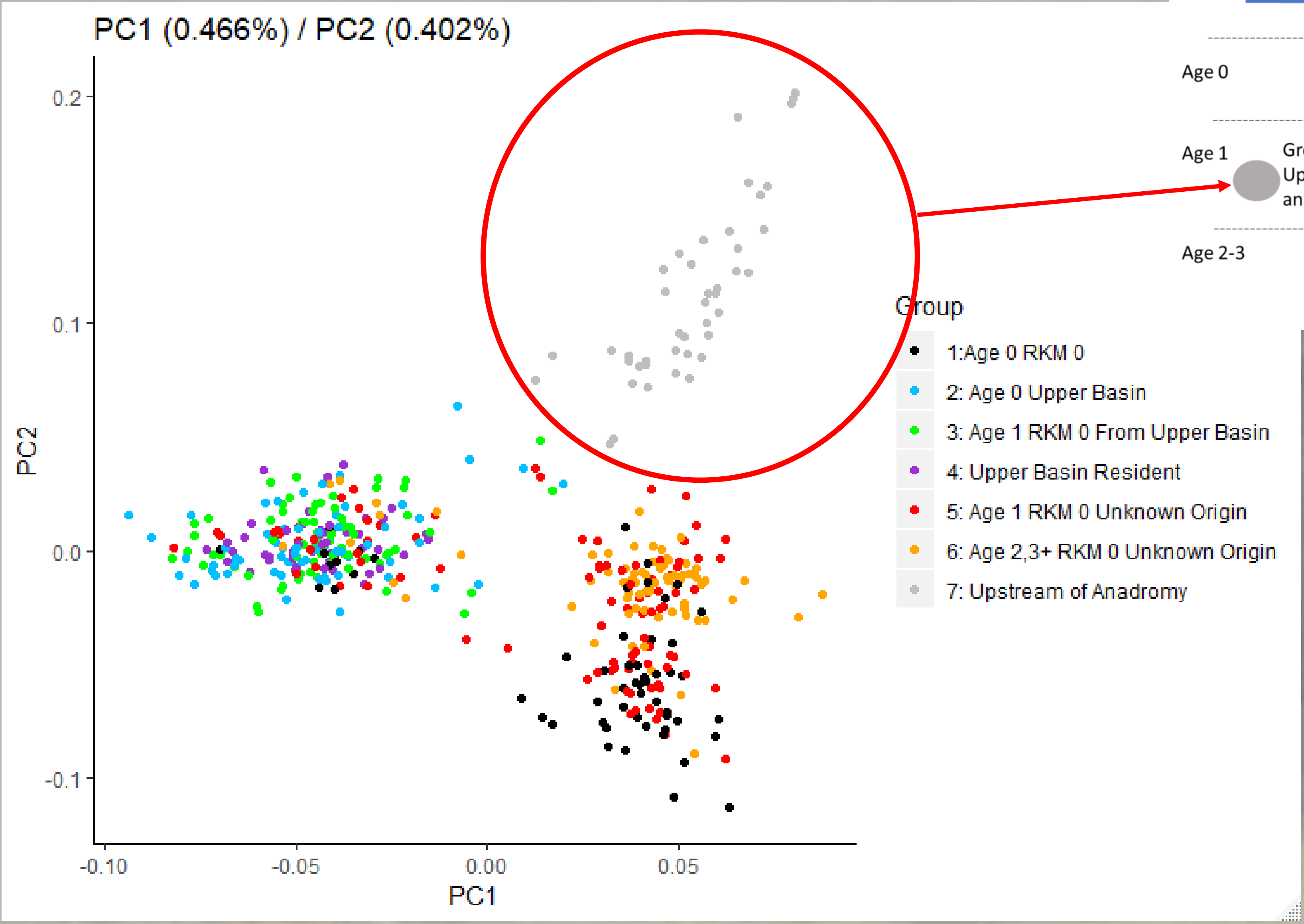
DNA analyzed from 552 samples

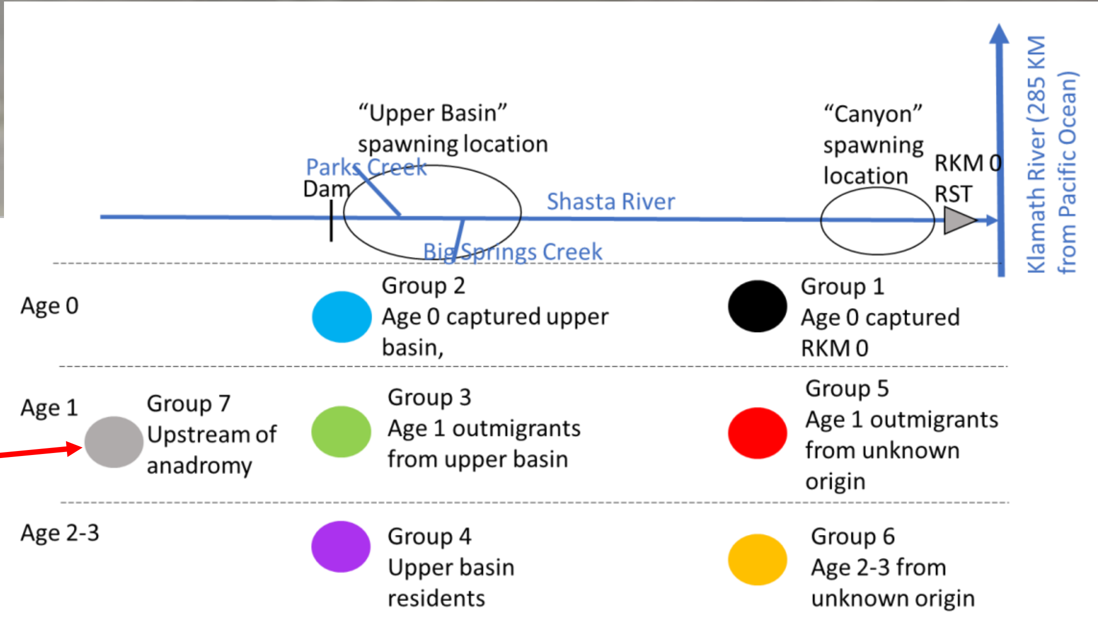




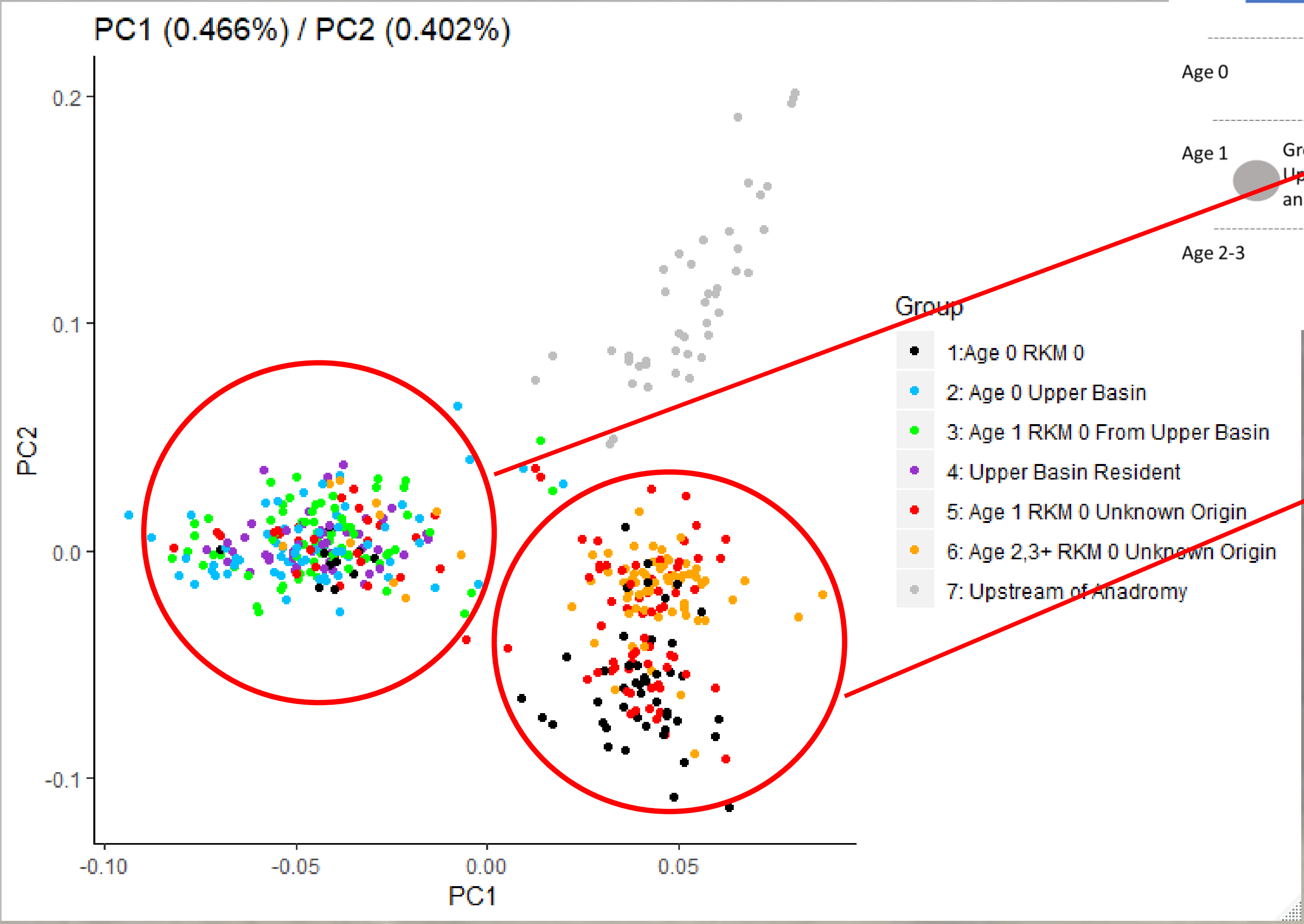

PC1 (0.466%) / PC2 (0.402%)
PC2
0.2
0.1
0.0
-0.1
-0.10
-0.05
0.00
0.05
PC1
Group
1:Age 0 RKM 0
2: Age 0 Upper Basin
3: Age 1 RKM 0 From Upper Basin
4: Upper Basin Resident
5: Age 1 RKM 0 Unknown Origin
6: Age 2,3+ RKM 0 Unknown Origin
7: Upstream of Anadromy

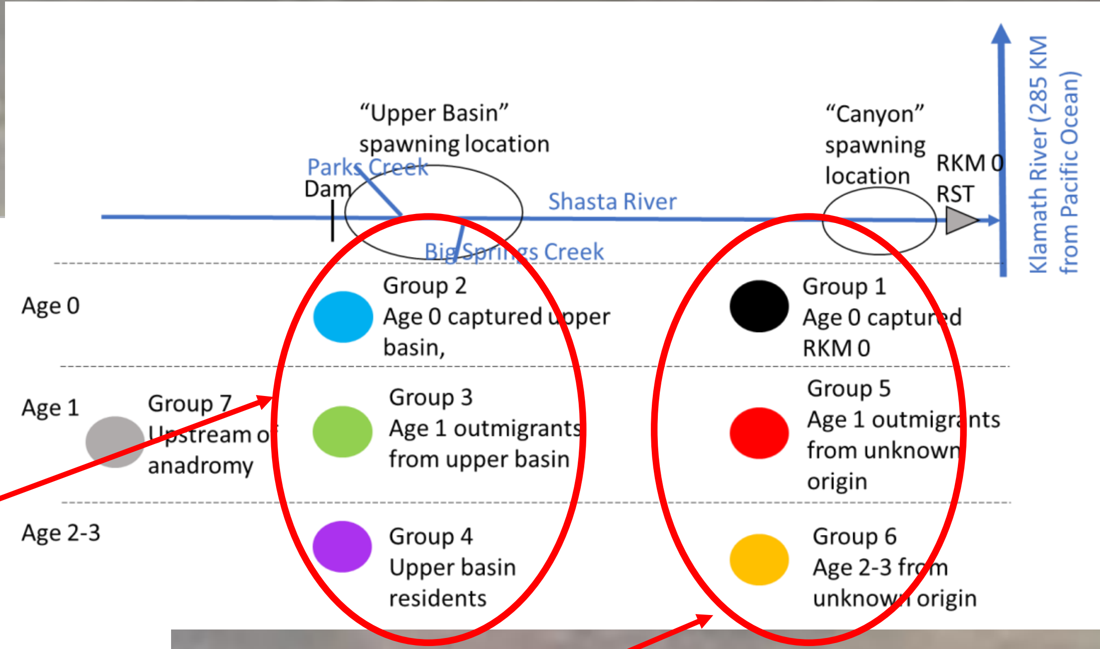

"Upper Basin" spawning location
Parks Creek
Dam
Shasta River
Big Springs Creek
"Canyon" spawning location
RKM 0
RST
Klamath River (285 KM from Pacific Ocean)
Age 0
Group 2
Age 0 captured upper basin,
Group 1
Age 0 captured RKM 0
Age 1
Group 7
Upstream of anadromy
Group 3
Age 1 outmigrants from upper basin
Group 5
Age 1 outmigrants from unknown origin
Age 2-3
Group 4
Upper basin residents
Group 6
Age 2-3 from unknown origin





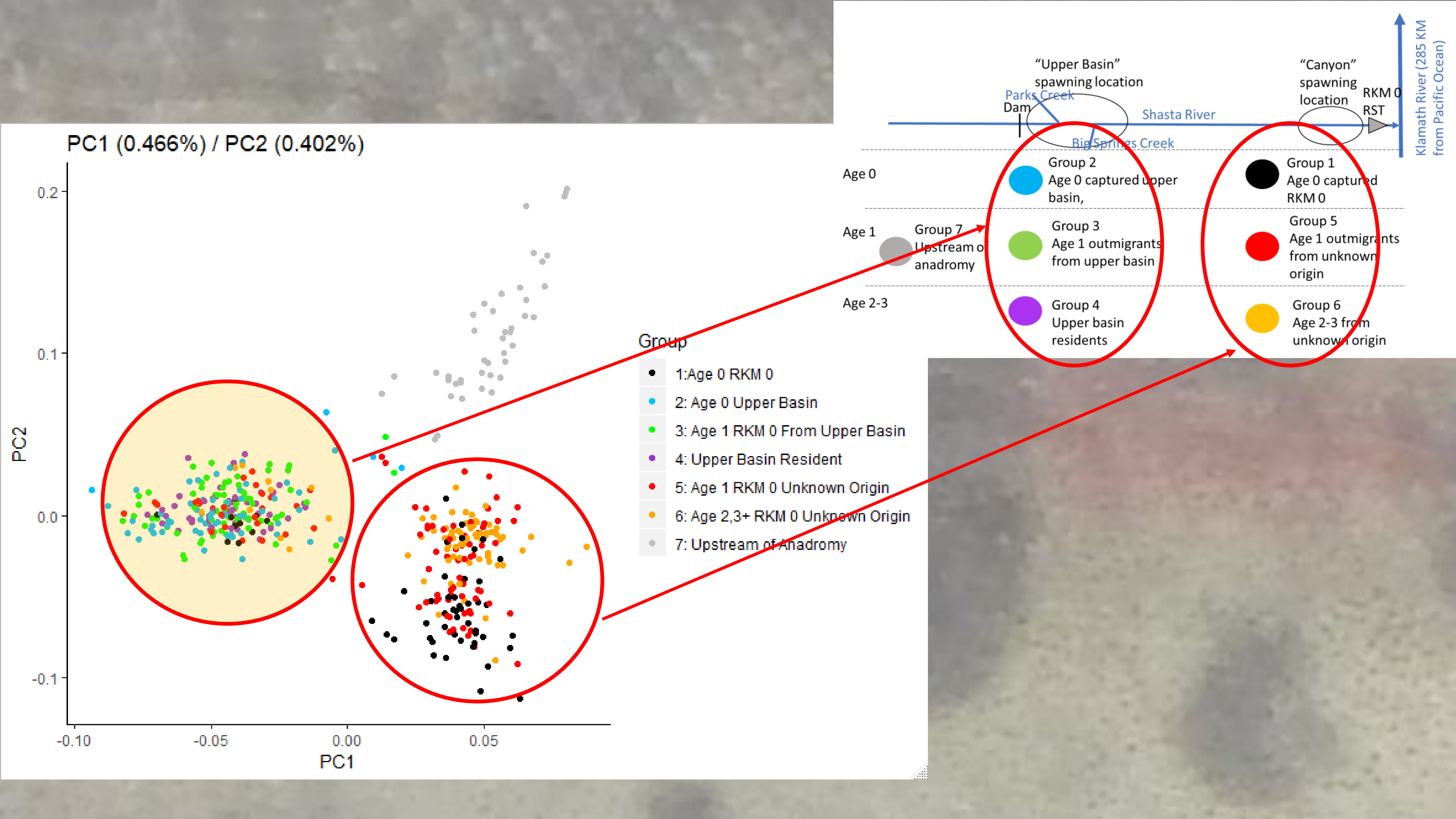
Separate breeding population upstream of migration barrier





Upper basin samples cluster separate from RKM 0 samples (a few age 0 and age 2,3+ from upper at RKM 0)

Unknown age 1 (red) from both



PC1 (0.466%) / PC2 (0.402%)
PC2
PC1
0.2
0.1
0.0
-0.1
-0.10
-0.05
0.00
0.05
Group
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3: Age 1 RKM 0 From Upper Basin
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"Upper Basin" spawning location
Parks Creek
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Big Springs Creek
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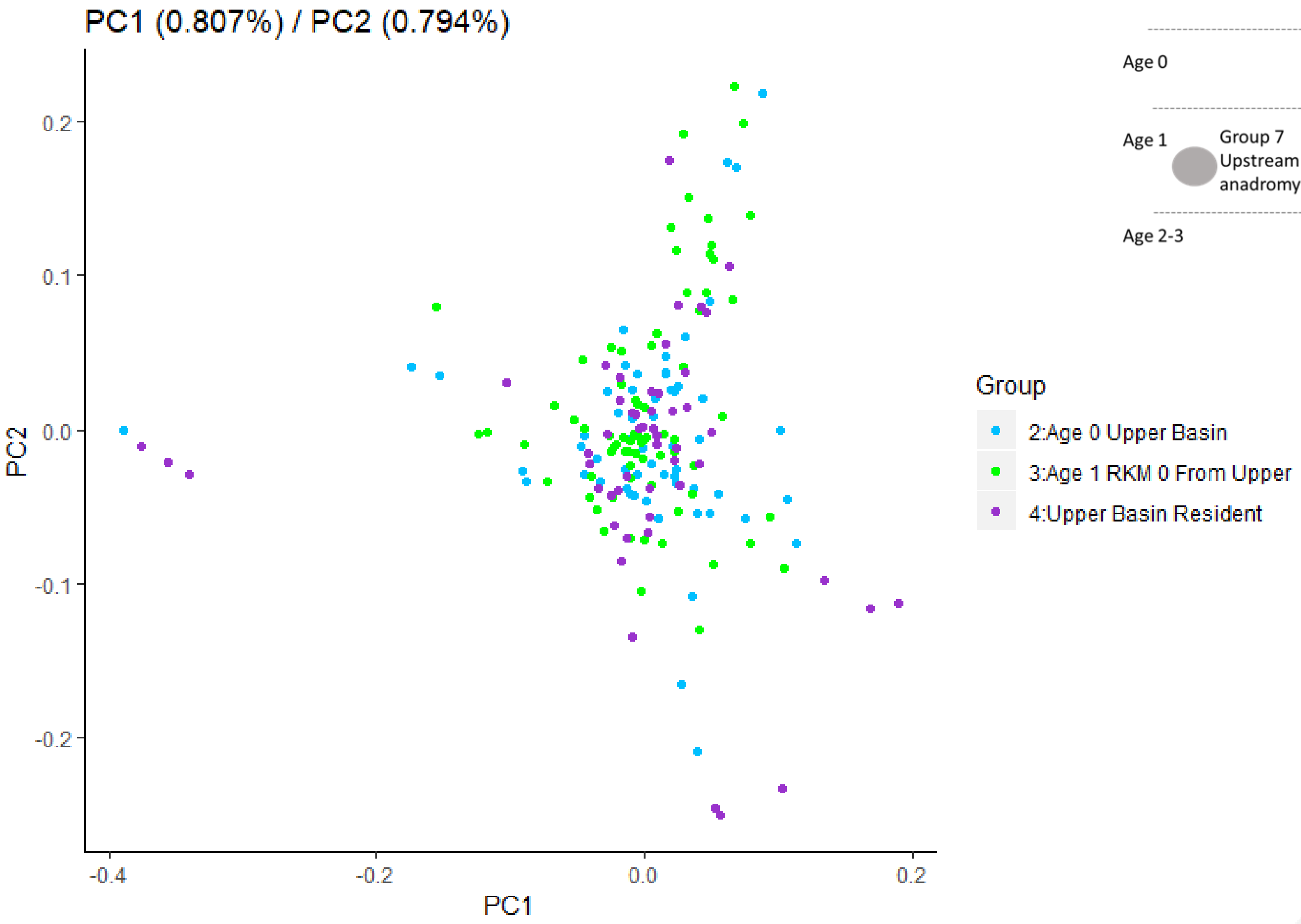
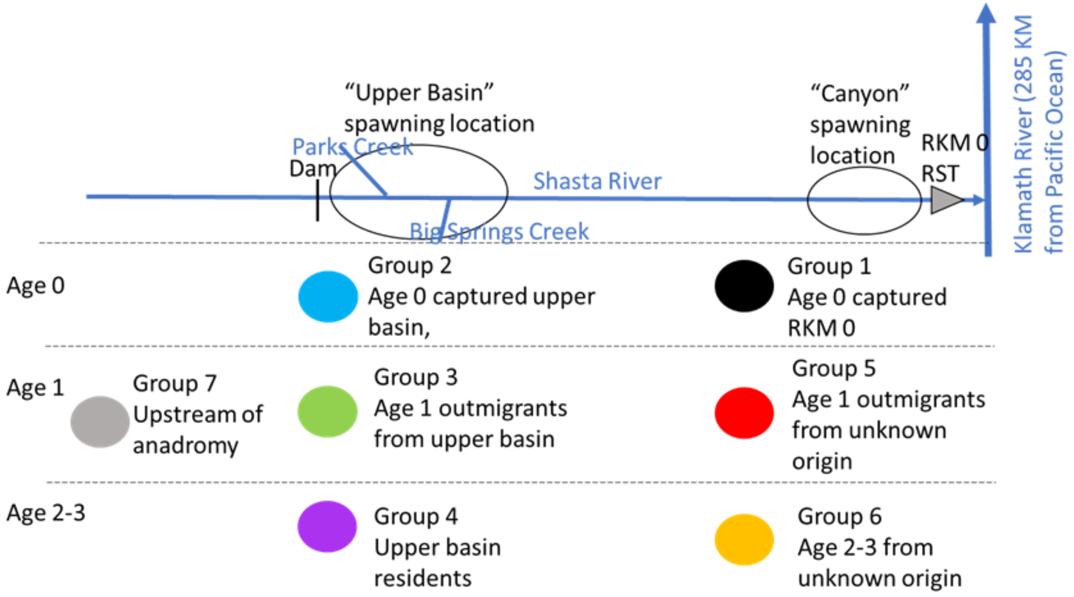
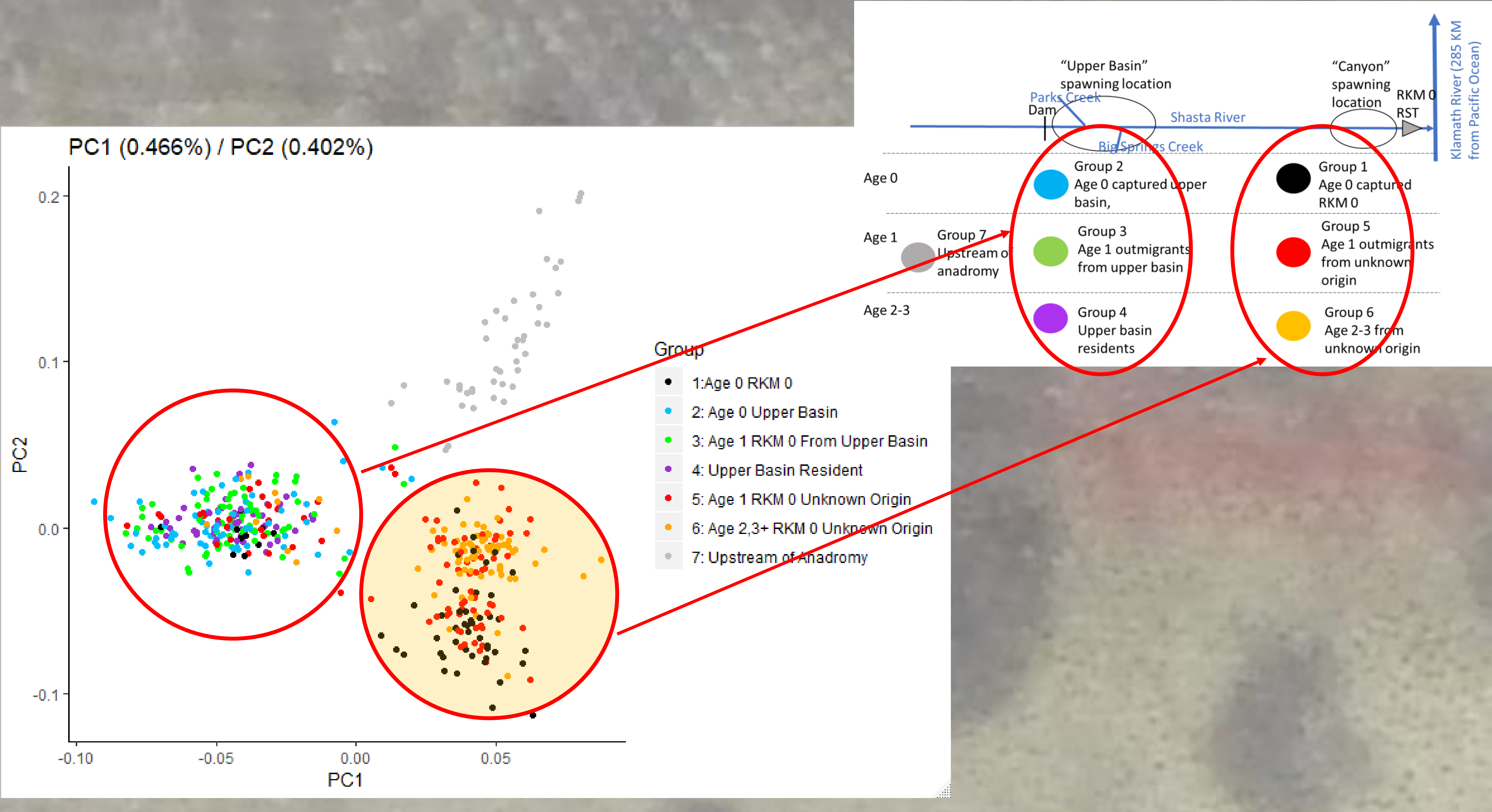
RKM 0
RST
Klamath River (285 KM from Pacific Ocean)
Age 0
Age 1
Age 2-3
Group 7
Upstream of anadromy
Group 2
Age 0 captured upper basin,
Group 3
Age 1 outmigrants from upper basin
Group 4
Upper basin residents
Group 1
Age 0 captured RKM 0
Group 5
Age 1 outmigrants from unknown origin
Group 6
Age 2-3 from unknown origin





Within upper basin: no clear pattern, one partially migrating population


PC1 (0.466%) / PC2 (0.402%)
PC2
PC1
0.2
0.1
0.0
-0.1
-0.10
-0.05
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Klamath River (285 KM from Pacific Ocean)
Age 0
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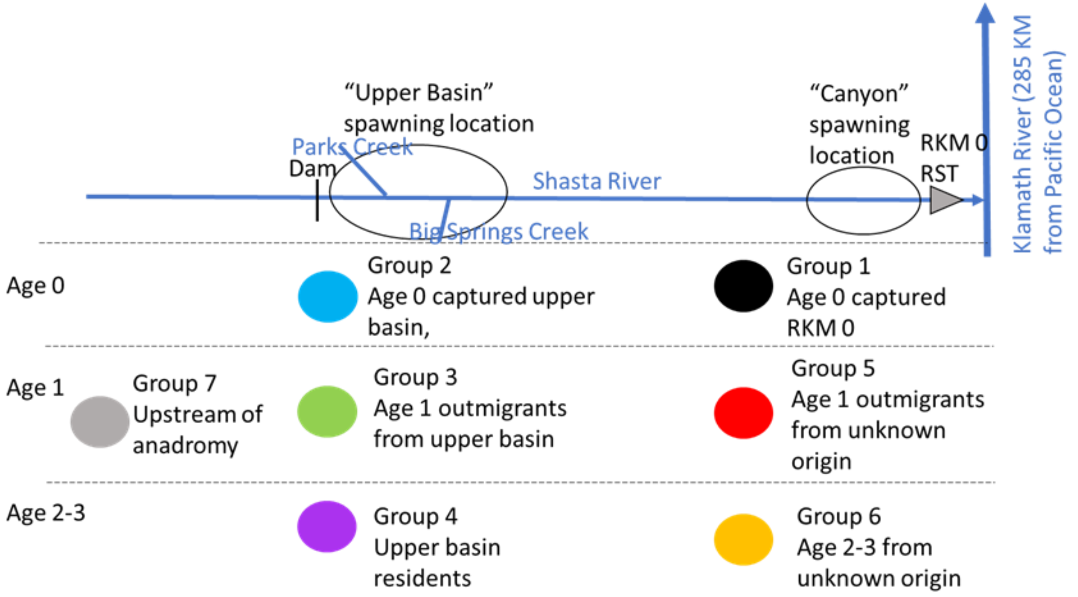
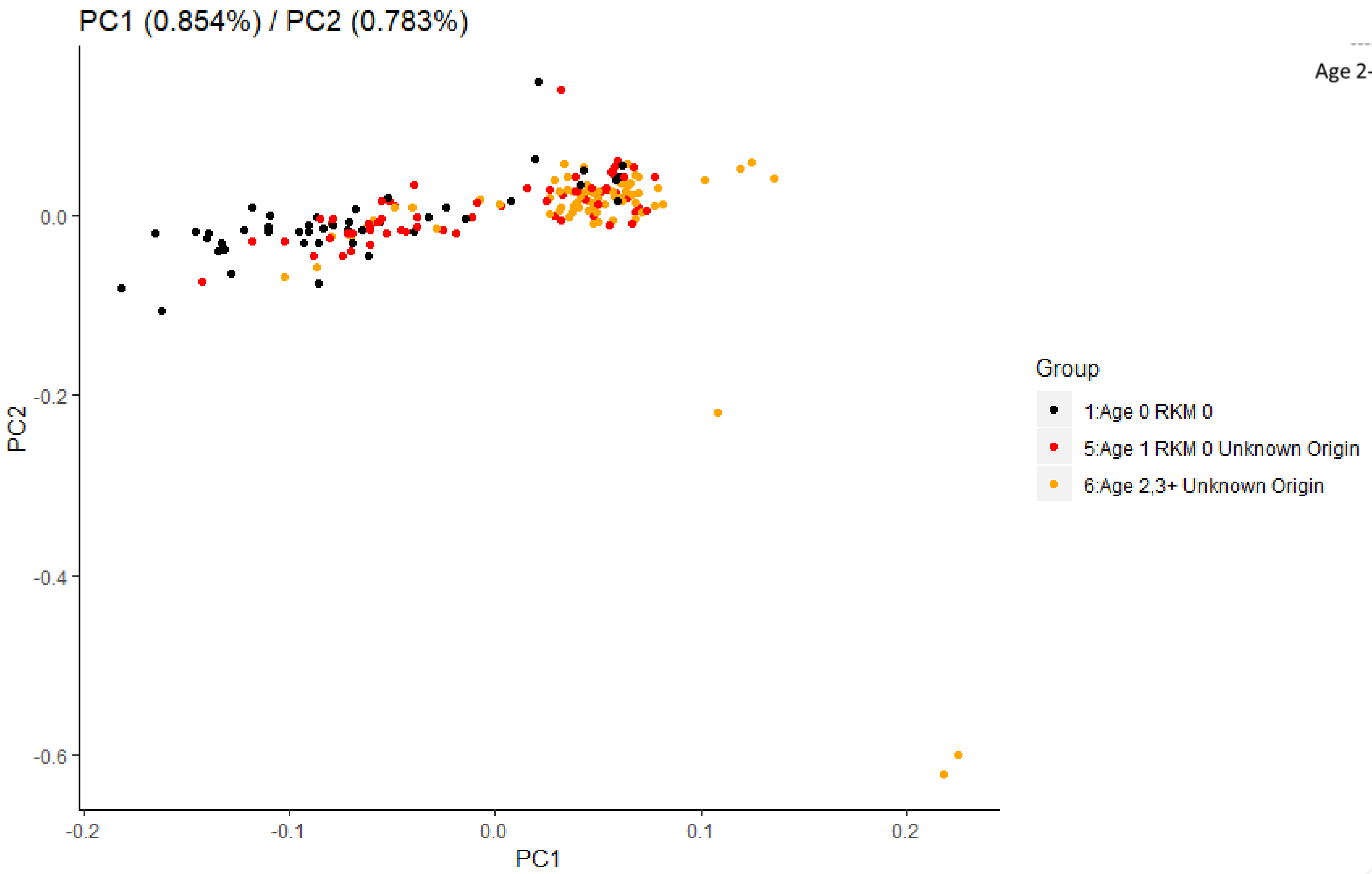
Group 2
Age 0 captured upper basin,
Group 1
Age 0 captured RKM 0
Group 7
Upstream of anadromy
Group 3
Age 1 outmigrants from upper basin
Group 5
Age 1 outmigrants from unknown origin
Group 4
Upper basin residents
Group 6
Age 2-3 from unknown origin

Some unknow age 1 group with age 0, must be finding nearby rearing habitat





Age 2,3+ cluster together

Spawning timing? (Late age 0 not sampled)

Originate outside of Shasta River?

Habitat Restoration

Cattle Exclusion Fencing

Conservation of Cold Spring Inflows

Biologically Informed Releases from Dwinnell Dam (coho centric)

How have these changes altered *O. mykiss* survival and life history?

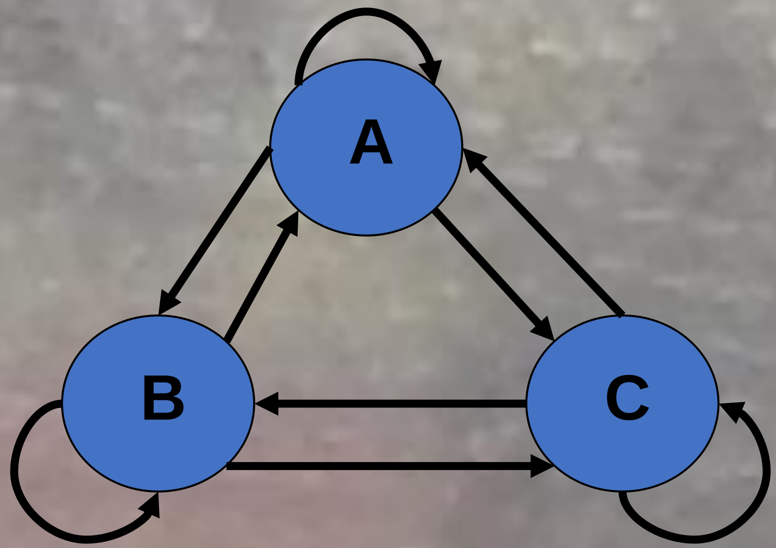
Mark-recapture Modeling

Individually mark an animal	Sample for the individual again	Sample for the individual again
1	1	1
1	0	1
1	0	0

Alive, but not detected

Capture History Matrix

Multi-state Mark-recapture Model



Mark an animal in a state	Sample for the individual in all states	Sample for the individual in all states
A	B	B
B	0	A
C	A	0

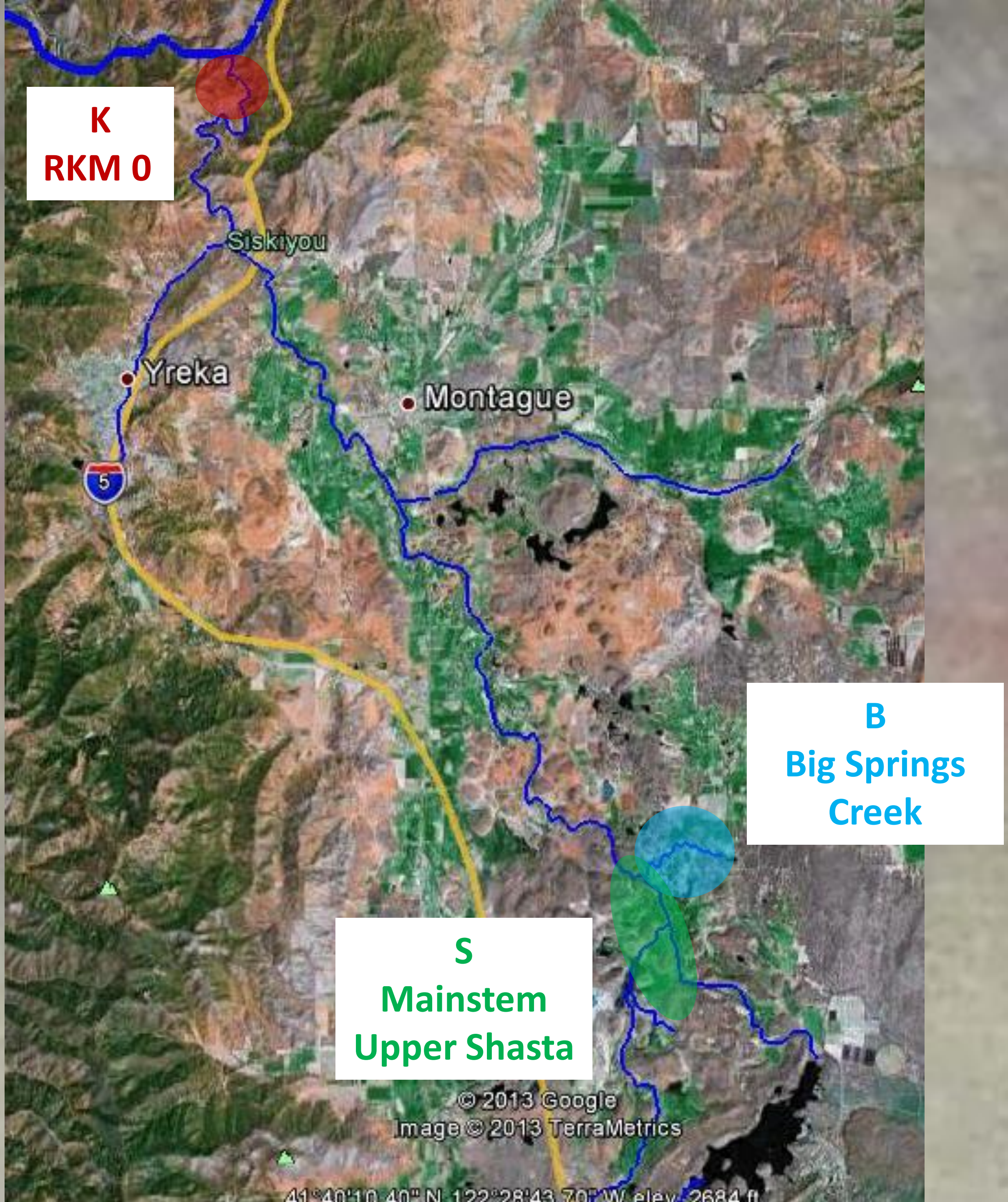
Multi-state Probability Estimates

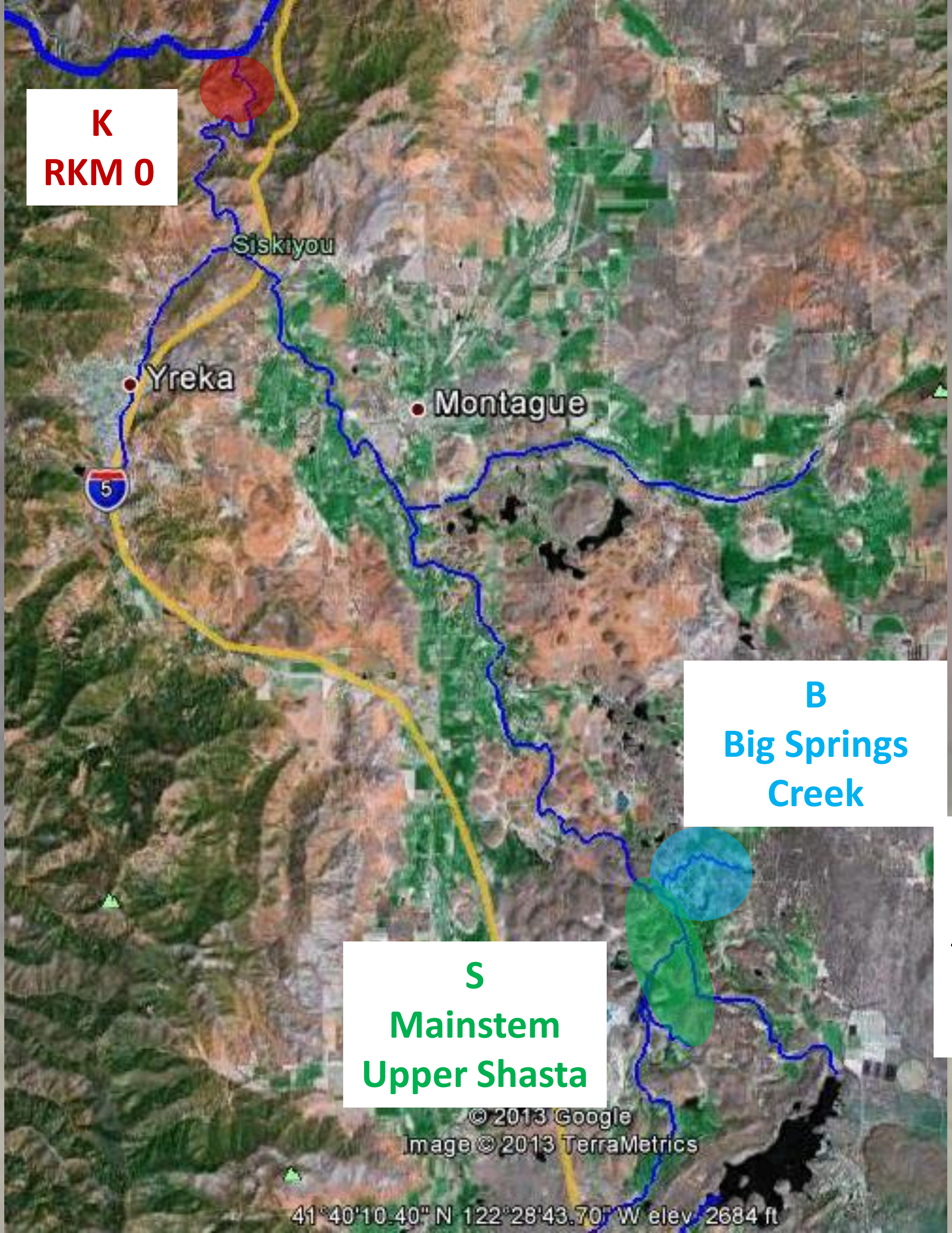
p **Detection in each state at each occasion**

S **Apparent survival in each state over each interval**

Ψ Transition from each state to each other state over each interval

Host of assumptions…..


K
RKM 0
Siskiyou
Yreka
Montague
5
B
Big Springs
Creek
S
Mainstem
Upper Shasta
© 2013 Google
Image © 2013 TerraMetrics



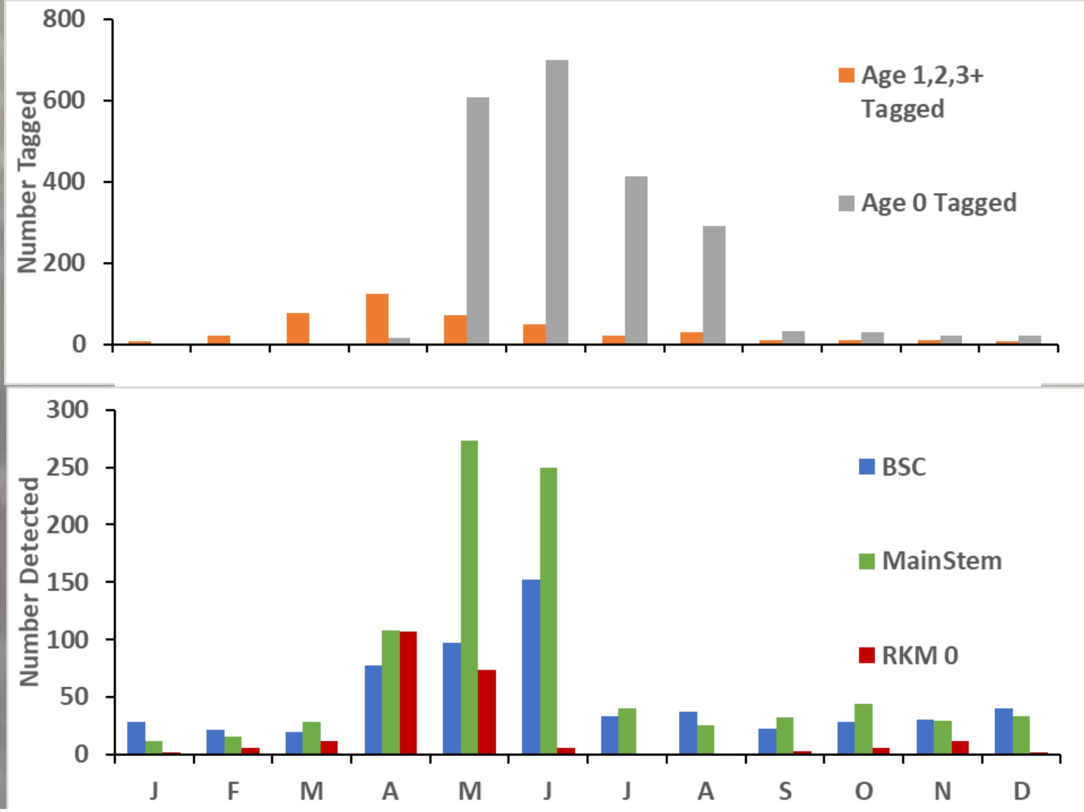
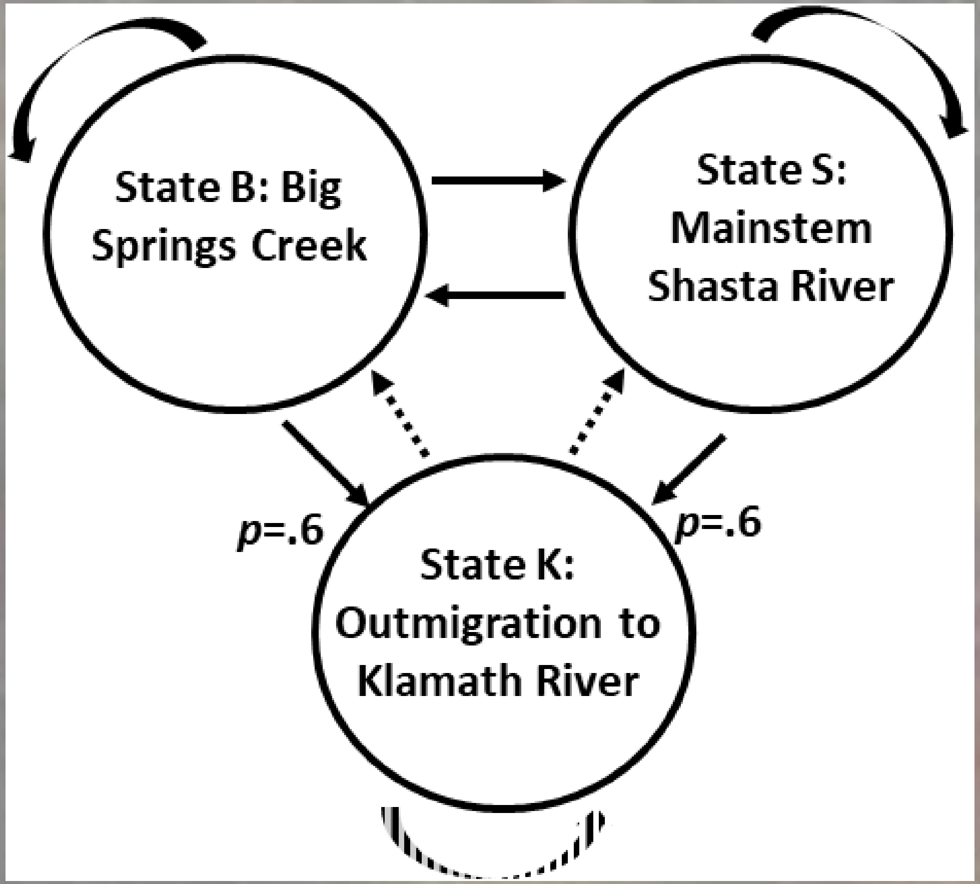
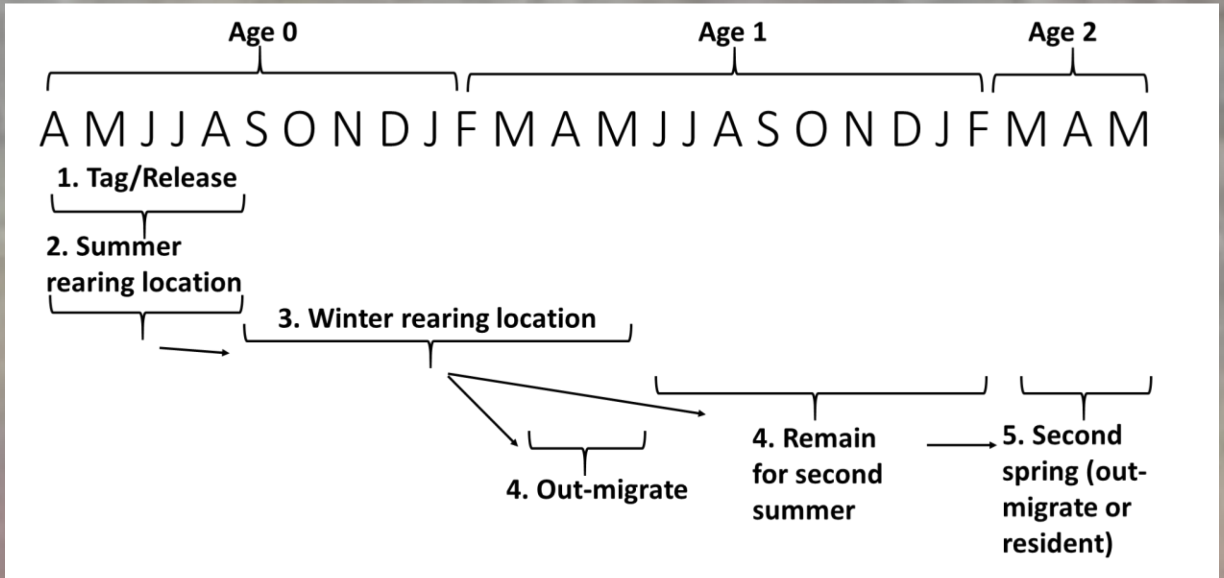


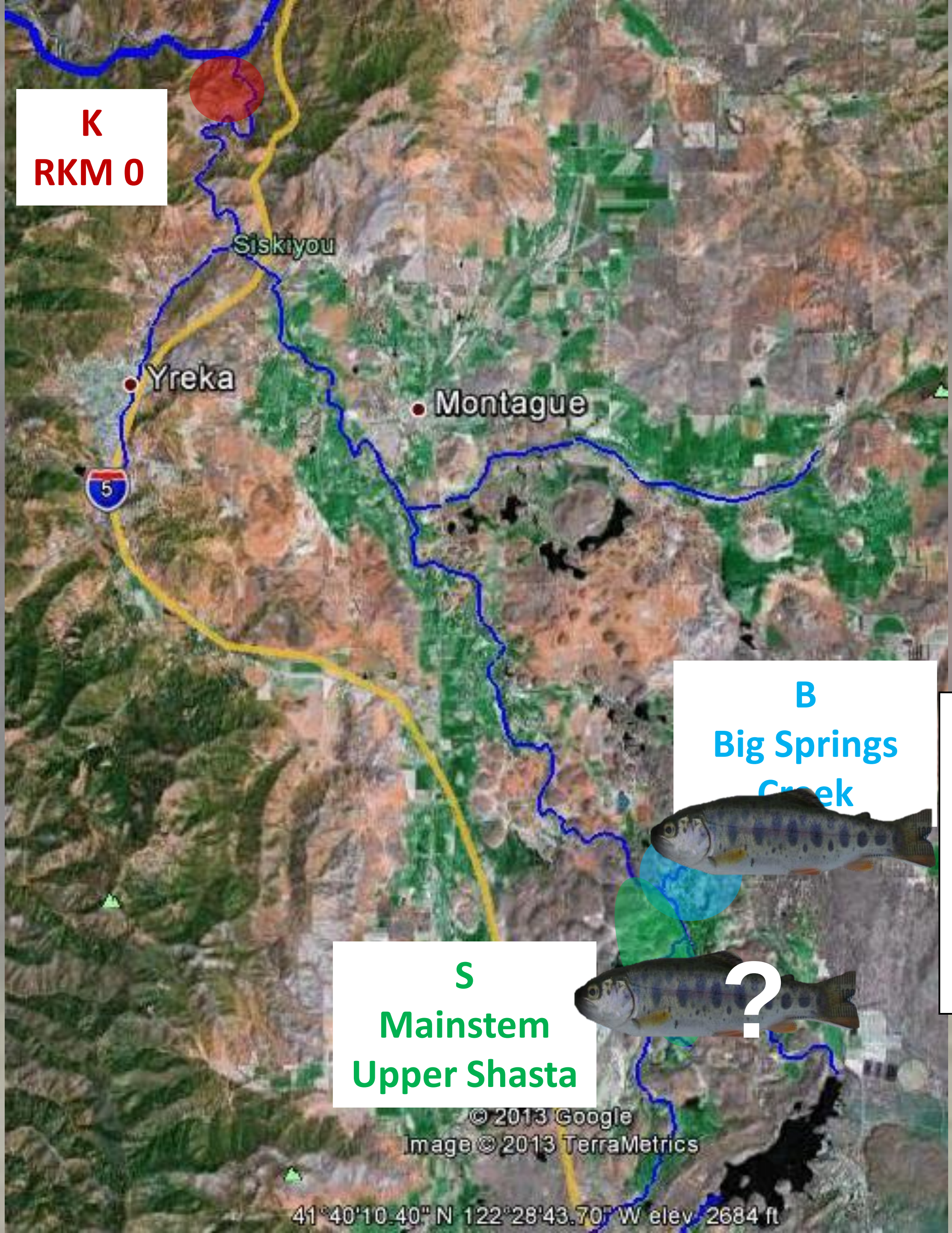
Figure 8. Monthly total number of Shasta River *O. mykiss* tagged (top) and detected (bottom), 2008-2014 combined. Note difference in y-axis scales.

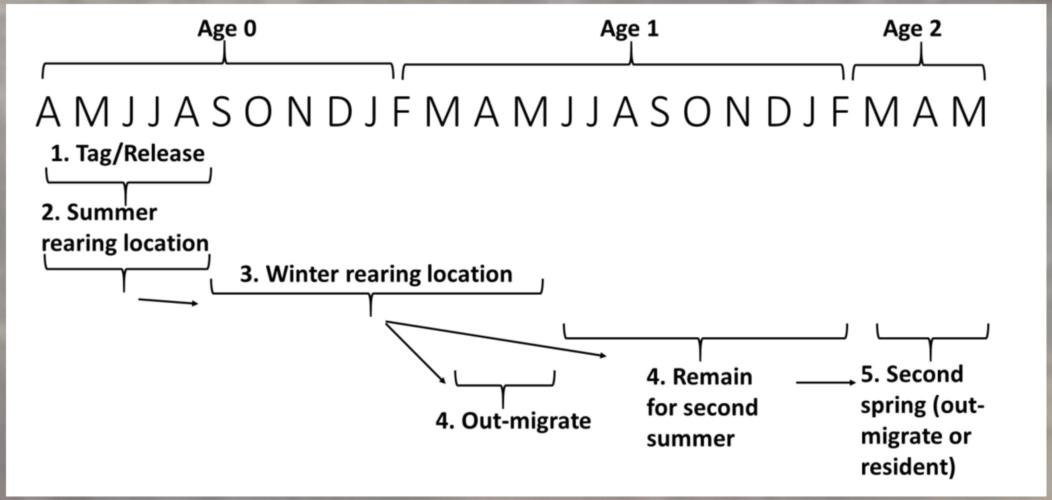




- **Figure 6.** Schematic of the spatial (top) and temporal (bottom) structure of the multi-state survival and movement model. Dashed arrows indicate movement parameter fixed to zero.

- Some movement parameters fixed:
- *p*= 0.6 at K based on previous study of antenna/RST efficiency with tagged coho
- Movement from K to upstream stated fixed to 0 (individuals removed from analysis once out-migrated)





Tag	Summer	Winter	Spring 1	Spring 2
B	B	S	K	0
S	0	B	S	K

Model Selection and Parameter Estimation

Program Mark
Input capture history and assign to a pre-restoration group (2008-2010) or post-restoration group (2011-2012)

Construct models constraining certain parameters to test for differences in survival, movement, and detection probability

Frequency of each capture history for maximum likelihood estimate of *apparent* Φ, ψ, and *p*

Compare models using AIC

C-hat estimation for overdispersion and correction factor in parameter estimation

	Detection Probability *p*		Survival Probability *S*		Out-migration Probability (ψ to K)	
Model Name	**Location**	**Group**	**Location**	**Group**	**Location**	**Group**
Fully Interactive						
p same Loc	X					
p same Grp		X				
p same Loc and Grp	X	X				
S same Loc			X			
S same Grp				X		
S same Loc and Grp			X	X		
ψ to K same Loc					X	
ψ to K same Grp						X
ψ to K same Loc and Grp					X	X

Table 2. Models constructed to test for differences in detection probability, survival, and out-migration probability of upper Shasta River basin tagged *O. mykiss*. X indicates parameters that were constrained by either location (mainstem Shasta River and Big Springs Creek) or by group (pre- or post-restoration).

Model Selection and Parameter Estimation

Models with differences in p and ϕ across locations and groups were best supported. The model with differences in out migration across locations, but not groups was best supported.

C-hat 1.39 (acceptable overdispersion in data)

Model	Number of Parameters	QAICc	Delta QAICc	AICc Weights	Model Likelihood	QDeviance
Fully Interactive	51	4750.28	0.00	0.79	1.00	172.69
p same Grp	46	4752.88	2.61	0.21	0.27	185.58
p same Loc	46	4789.40	39.12	0.00	0.00	222.09
p same Loc and Grps	42	4811.56	61.28	0.00	0.00	252.45

Model	Number of Parameters	QAICc	Delta QAICc	AICc Weights	Model Likelihood	QDeviance
Fully Interactive	51	4750.28	0.00	0.82	1.00	172.69
S same Grp	43	4753.27	2.99	0.18	0.22	192.11
S same Loc	45	4768.39	18.11	0.00	0.00	203.14
S same Loc and Grp	44	4777.69	27.41	0.00	0.00	214.49

Model	Number of Parameters	QAICc	Delta QAICc	AICc Weights	Model Likelihood	QDeviance
ψ to K same Grp	46	5410.71	0.00	0.98	1.00	199.64
Fully Interactive	51	5418.88	8.17	0.02	0.02	197.54
p same Loc	46	5423.34	12.63	0.00	0.00	212.28
S same Grp	43	5424.66	13.96	0.00	0.00	219.76
ψ to K same Loc and Grp	43	5434.00	23.29	0.00	0.00	229.09
ψ to K same Loc	47	5439.82	29.11	0.00	0.00	226.70
S same Loc	45	5441.37	30.67	0.00	0.00	232.36
S same Loc and Grp	44	5452.31	41.60	0.00	0.00	245.35
p same Grp	46	5465.11	54.40	0.00	0.00	254.05
p same Loc and Grps	42	5491.64	80.93	0.00	0.00	288.78

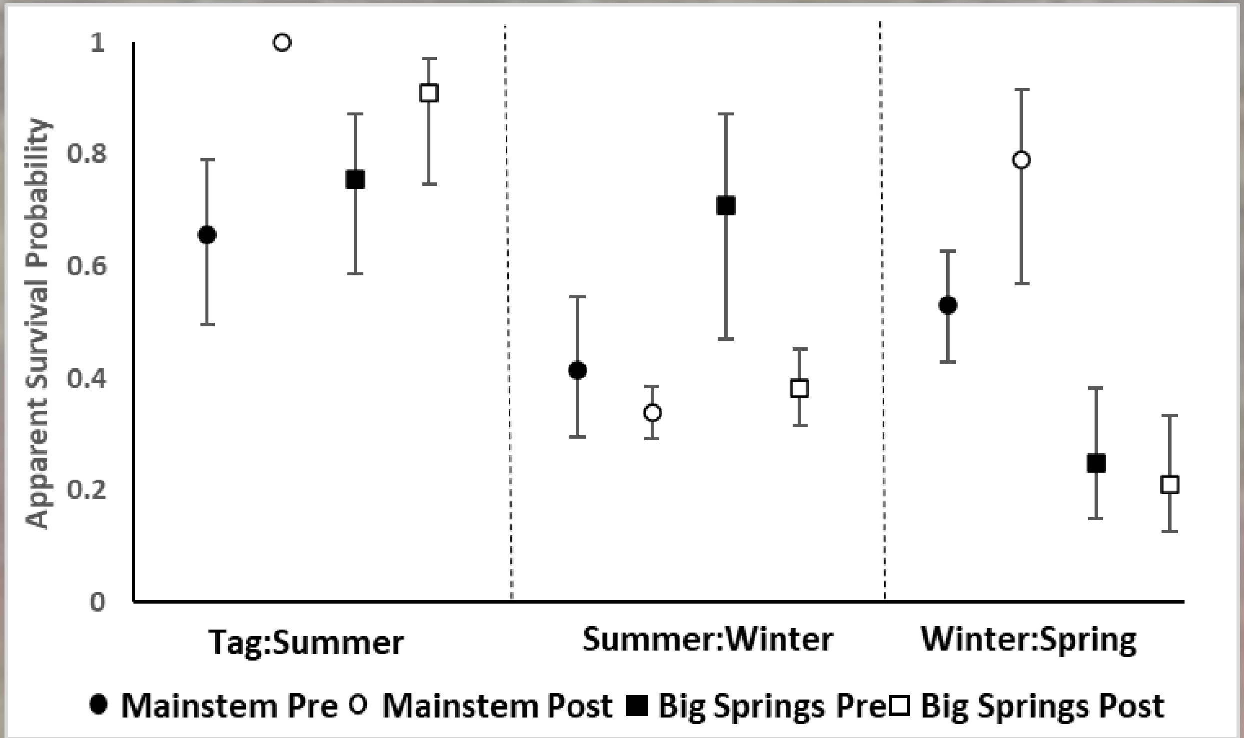


Figure 10. Survival probability estimates for tagged *O. mykiss* in the Shasta River (from model *ψ to K same Grp*). Sampling occasions on the x-axis indicate the three intervals seasonal survival was estimated. Filled symbols represent the pre restoration group (2008-2010) and empty symbols represent the post-restoration group (2011-2014).

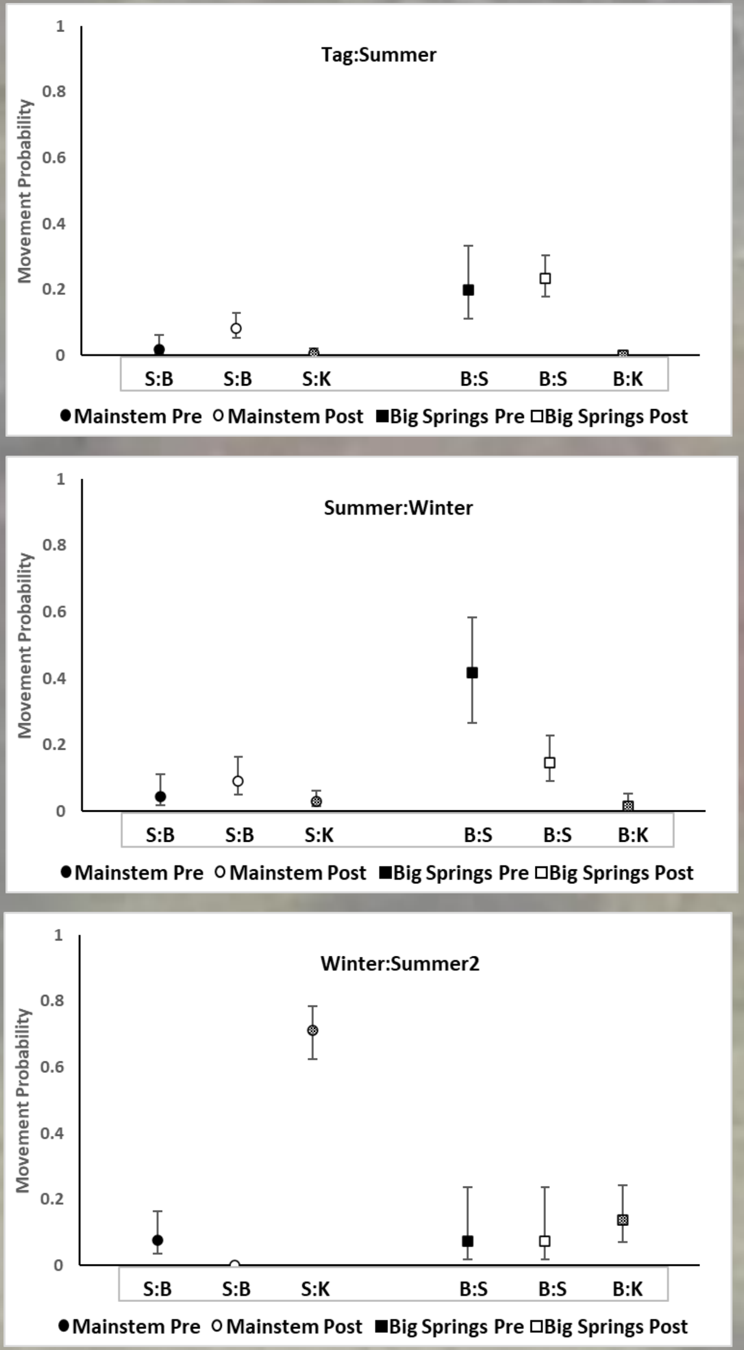


Figure 11. Movement probability estimates for tagged *O. mykiss* in the Shasta River (from model *ψ to K same Grp*). Location on the x-axis indicate location where the the movement initiated and terminated. S = Shasta River mainstem B = Big Springs Creek, K = out-migration. Symbols fill represent restoration group; filled = pre-restoration (2008-2010), empty = post-restoration (2011-2014), hatched = both groups combined.

Acknowledgements

Work on the Shasta River was an incredible collaboration between government agencies, nonprofit organizations, tribes, and university researchers. These include the California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, NOAA Fisheries, USGS, Bureau of Reclamation, Karuk Tribe, Yurok Tribe, The Nature Conservancy, California Trout, Shasta Valley Resource Conservation District, Americorps Watershed Stewards Program, University of California Davis, and Humboldt State University. Special thanks to California Department of Fish and Wildlife staff Bill Chesney, Mark Pisano, Gary Curtis, Morgan Knechtle, many filed crews, and funding through the Sport Fish Restoration Act. Kerry Mauro was instrumental in developing PIT tag technology.


Questions?
fishwizllc@gmail.com

Amy Fingerle- UC Berkeley

Salmon and Mid-Klamath Rivers Spring-Run Chinook (Ishyâat) research collaboration: results from the first year

Collaborative conservation of *ishyâat* in a spring-run Chinook stronghold: results from the first year

UC Berkeley: Amy Fingerle, Stephanie Carlson, Ted Grantham

Karuk Tribe: Toz Soto, Beau Quinter

Salmon River Restoration Council: Karuna Greenberg, Miranda Velarde, Sophie Price

Wild Salmon Center: Matt Sloat, Tasha Thompson, Jon Hart

UC Davis: Mike Miller

Klamath Basin Fisheries Collaborative
2024 Annual Meeting

Please contact Amy Fingerle (amyfing@berkeley.edu) for more information about this presentation.

Photo: Michael Bravo

Break

10 minutes

Jacob Krause- USGS
Betsy Stapleton- SRWC
Array map discussion

Gabriel Brooks- NOAA

PIT Antenna Workshop: From Design to Deployment

Lunch

1 hour

Tommy Williams- NOAA

Monitoring for diversity: tracking movement and timing

Monitoring for diversity: tracking movement and timing

Thomas Williams

Research Fisheries Biologist
Southwest Fisheries Science Center
Fisheries Ecology Division – Santa Cruz, California

Jimmy Faukner
Fish Biologist
Yurok Tribal Fisheries
Yurok Tribe

Klamath Falls, Oregon
12 June 2024

Motivation for presentation

Introduce a framework for examining the movement of *O. mykiss* in the Klamath River following dam removals to inform management, conservation, and restoration.

Motivation for presentation

Motivate and facilitate basin-wide monitoring effort.

- *O. mykiss* is the only salmonid species that is currently distributed throughout the Klamath Basin. *O. mykiss* provides the best candidate species to begin monitoring at a basin-wide scale due to its wide distribution.
- Current coverage through existing array network and outmigrant traps is sufficient to warrant increased PIT tagging of juveniles.
- What questions about *O. mykiss* would the Klamath Basin Fisheries Collaborative as a group like to work on answering?

VSP Viable Salmonid Populations

Viability of populations are evaluated based on four parameters (VSP parameters):

- **abundance**
- **population growth rate**
- **spatial structure**
- **diversity**

ESU viability

- **catastrophic events**
- **long-term demographic processes**
- **long-term evolutionary potential**

McElhany et al. 2000. Viable salmonid populations and the recovery of Evolutionarily Significant Units. NOAA Technical Memorandum NMFS-NWFSC-42.

http://www.nwr.noaa.gov/1salmon/salmesa/pubs.htm

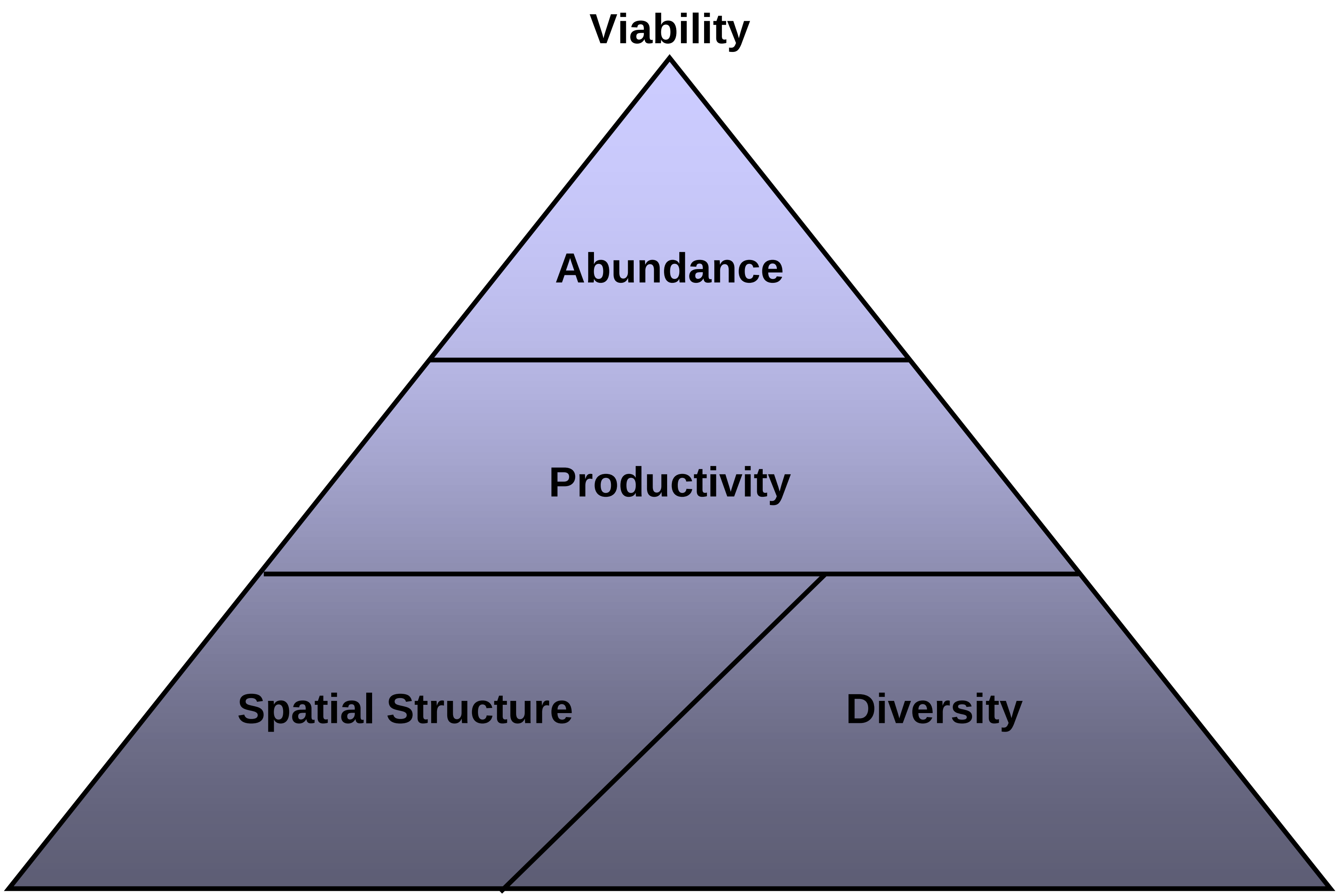
Critical data needs for viability assessments

Spatial structure

- distribution of fish within a population's freshwater distributional area
- habitat conditions are often quite heterogenous
- a highly restricted distribution of fish use or suitable habitat would pose risk

Diversity

- genetic
- life history (e.g., run timing)
- diversity of habitat allows for expressions of diversity of life histories
- movement within and between life stages and stream network



Williams et al. In Preparation

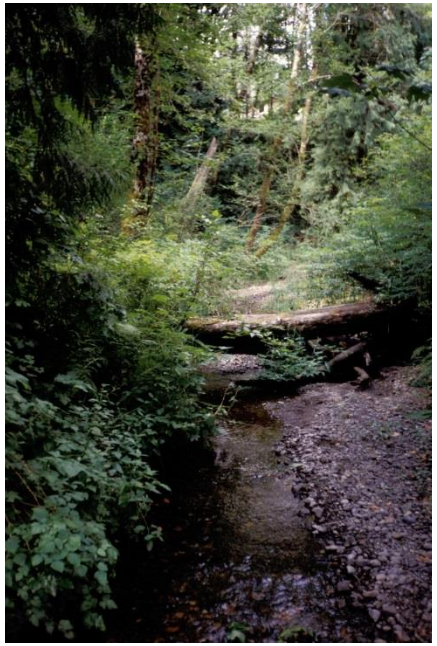
To be viable (i.e., persist) – fish need to be able to track changes in environment

- Individuals (within and between life stages)
- Populations
- Strata/Biogeographic group
- ESUs
- Species

Photo: M. Capelli

Salmonid Populations and ESUs Persist by Tracking Changes in Environmental Conditions

- **Straying by adults**
- **Relatively high fecundity**
- **Juvenile dispersal/movment**
- **Distribution of run-timing**
- **Distribution of age at ocean entry**
- **Overlapping generations** ***(Chinook and steelhead, coho to some degree)***
- **For steelhead, non-anadromous and anadromous life-history types**



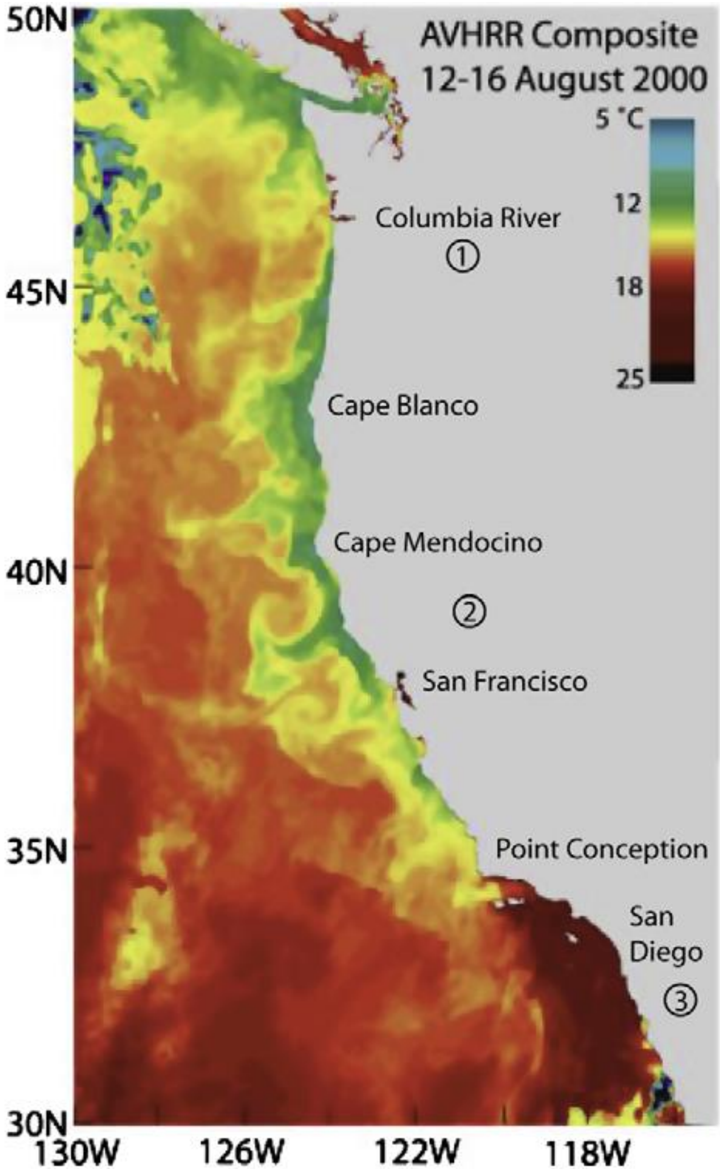
Photos: T. Williams

Natural disturbance events that influence salmonid populations throughout their range include:

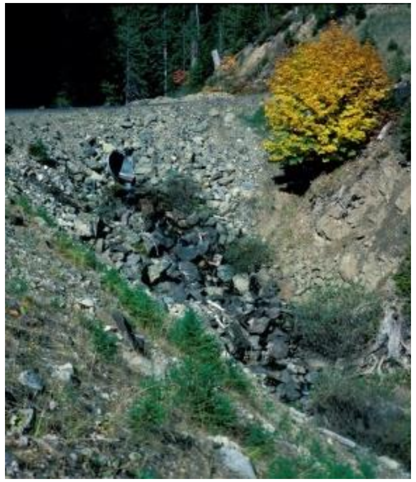
- fires
- landslides
- glaciers
- earthquakes
- volcanic eruptions
- floods

The California Current System is dynamic

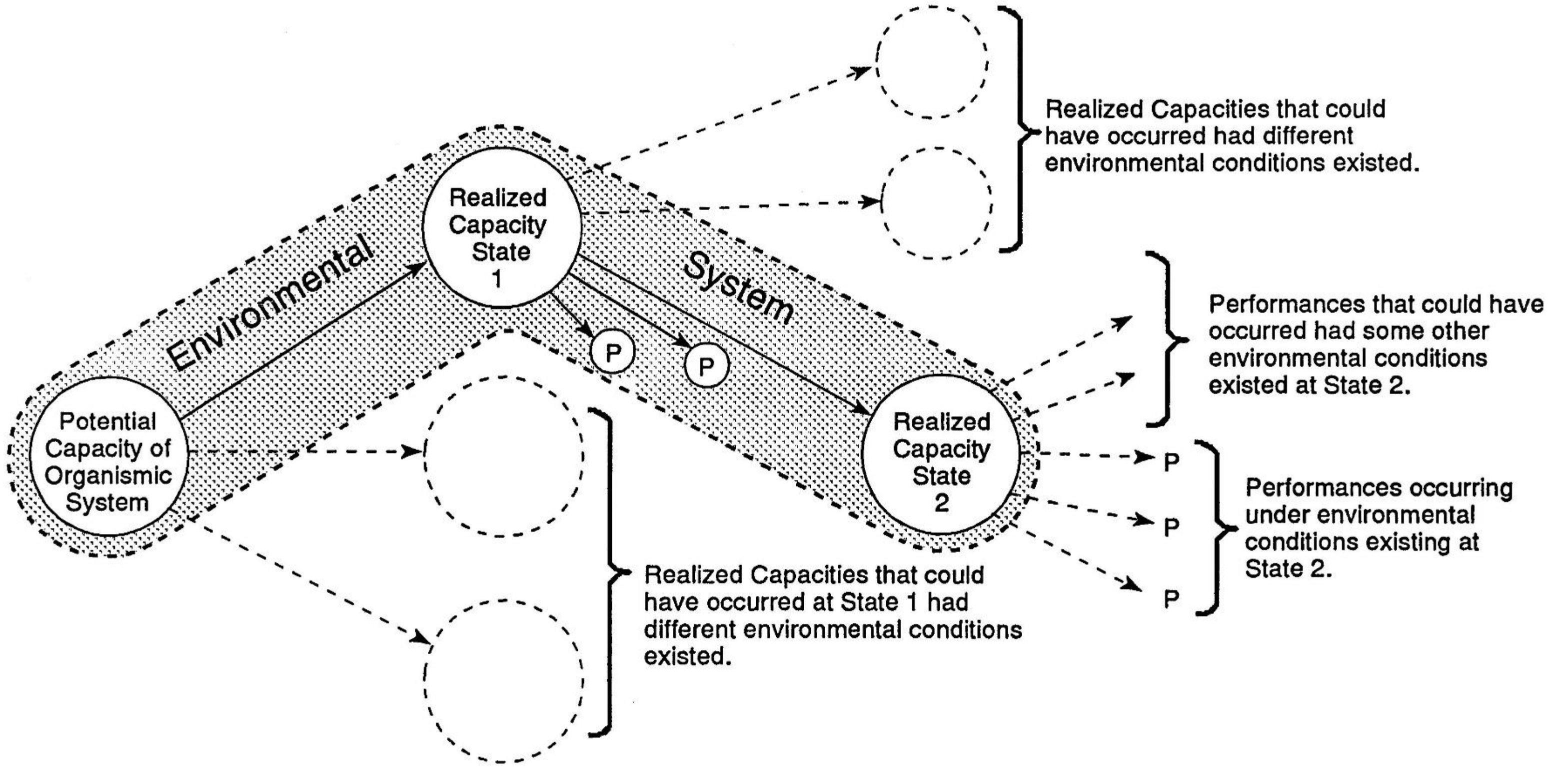
This mid-summer surface temperature snapshot shows how complex and diverse "ocean conditions" are at any given time in response to variable weather, winds, ocean currents, etc.



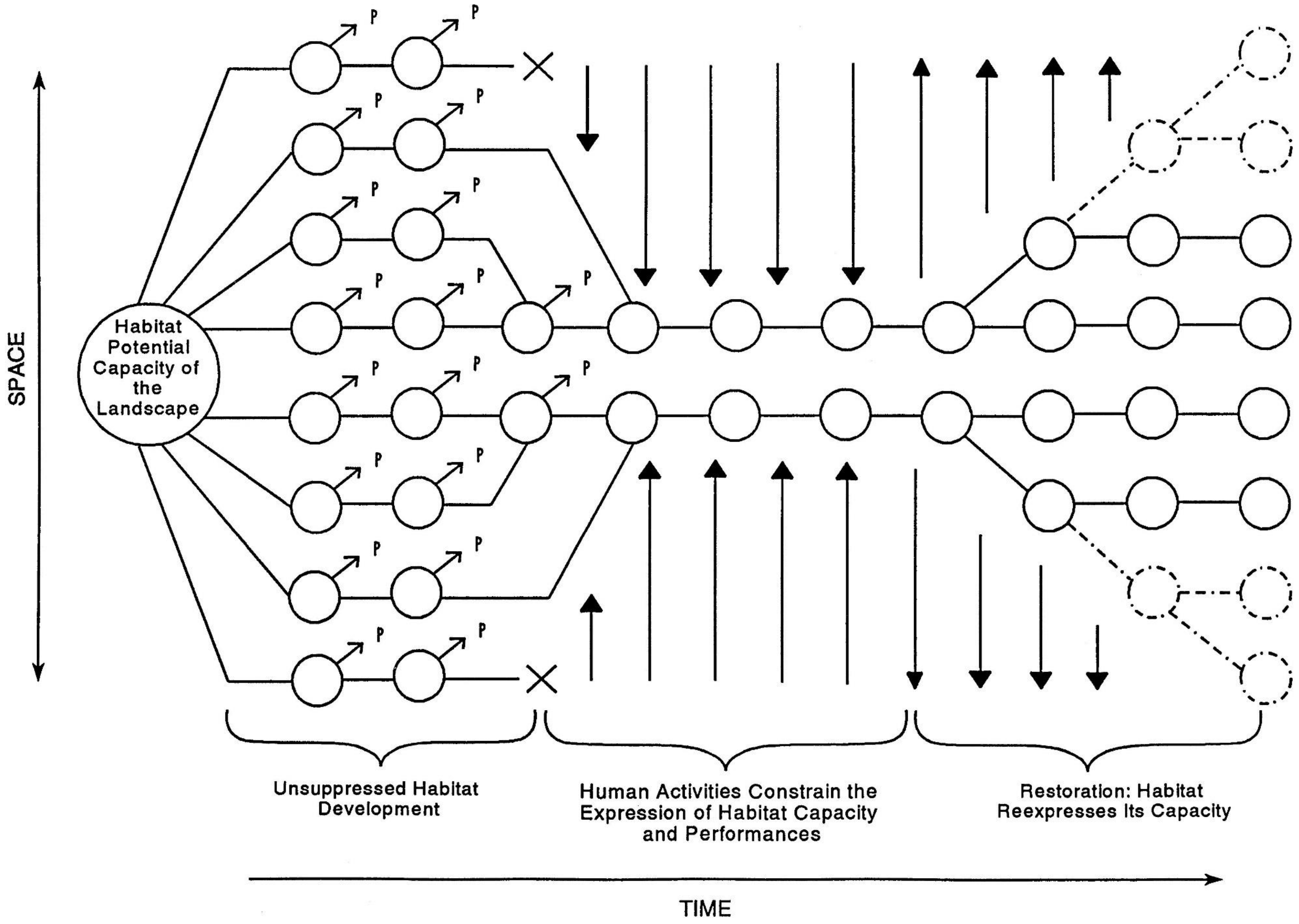
Anthropogenic constraints that can influence the ability of salmonid populations to track changes in environmental conditions include:



- **urbanization**
- **land management activities**
- **fire (magnitude, frequency, intensity)**
- **water diversion and withdrawal**
- **flooding (magnitude, frequency)**



From Ebersole et al. 1997. Envir. Mgt. 21:1-14.



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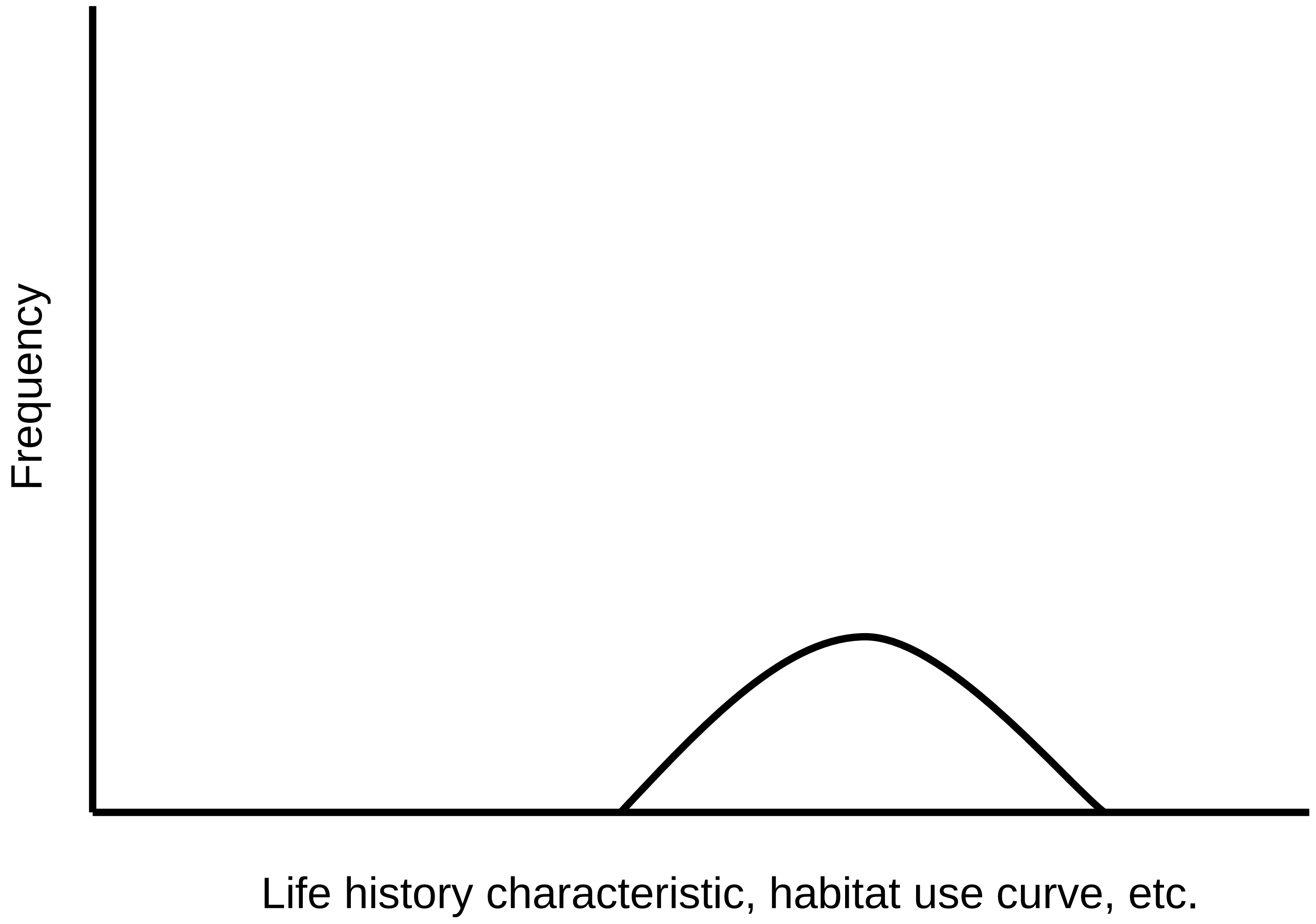
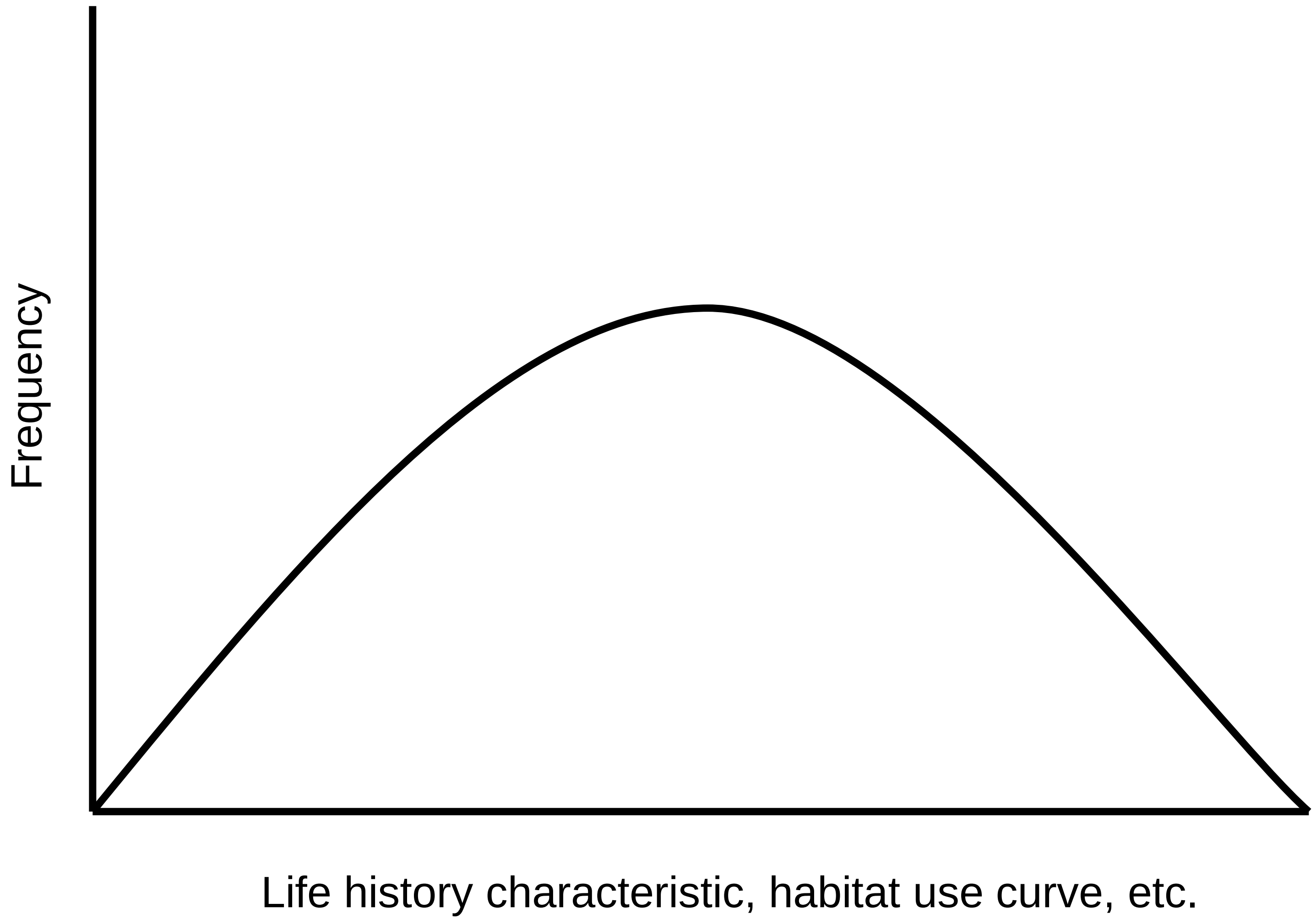

Frequency
Life history characteristic, habitat use curve, etc.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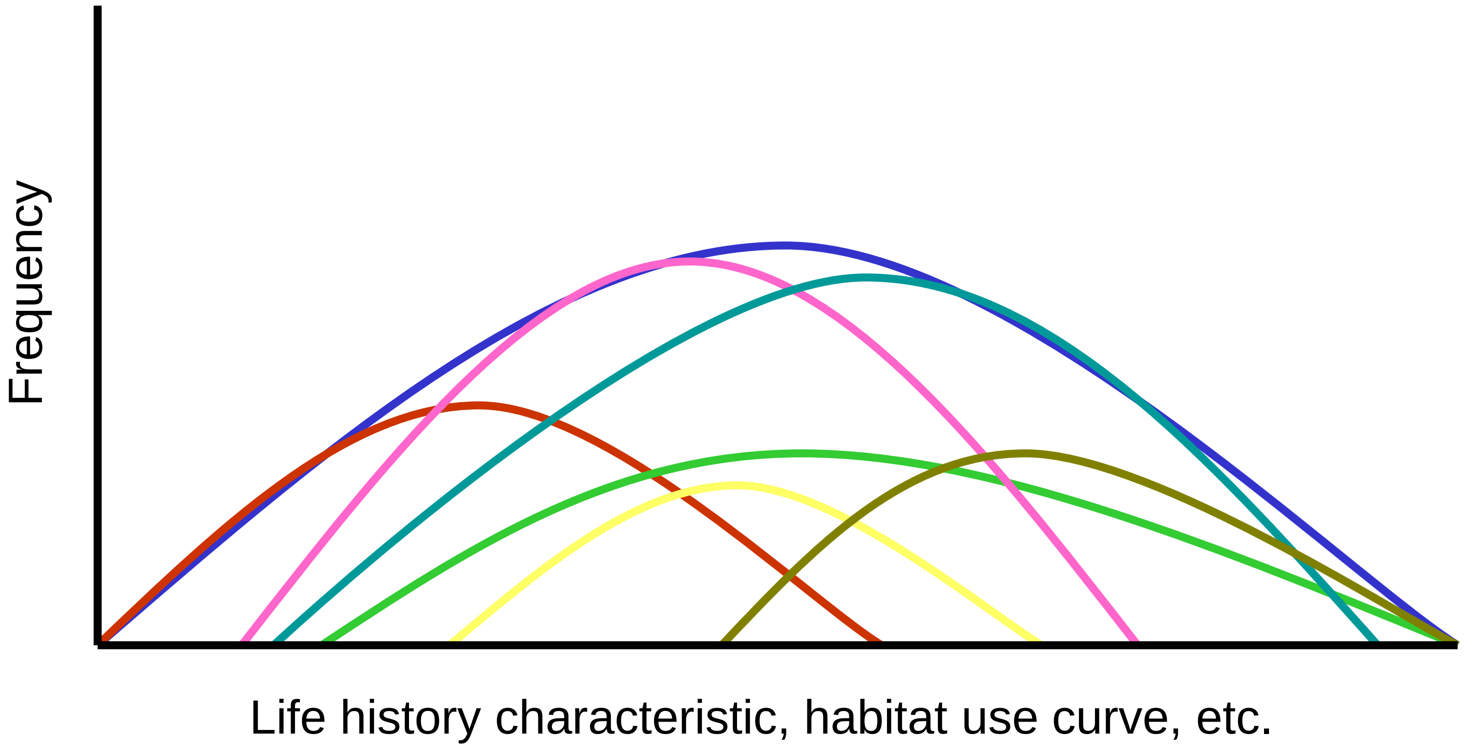
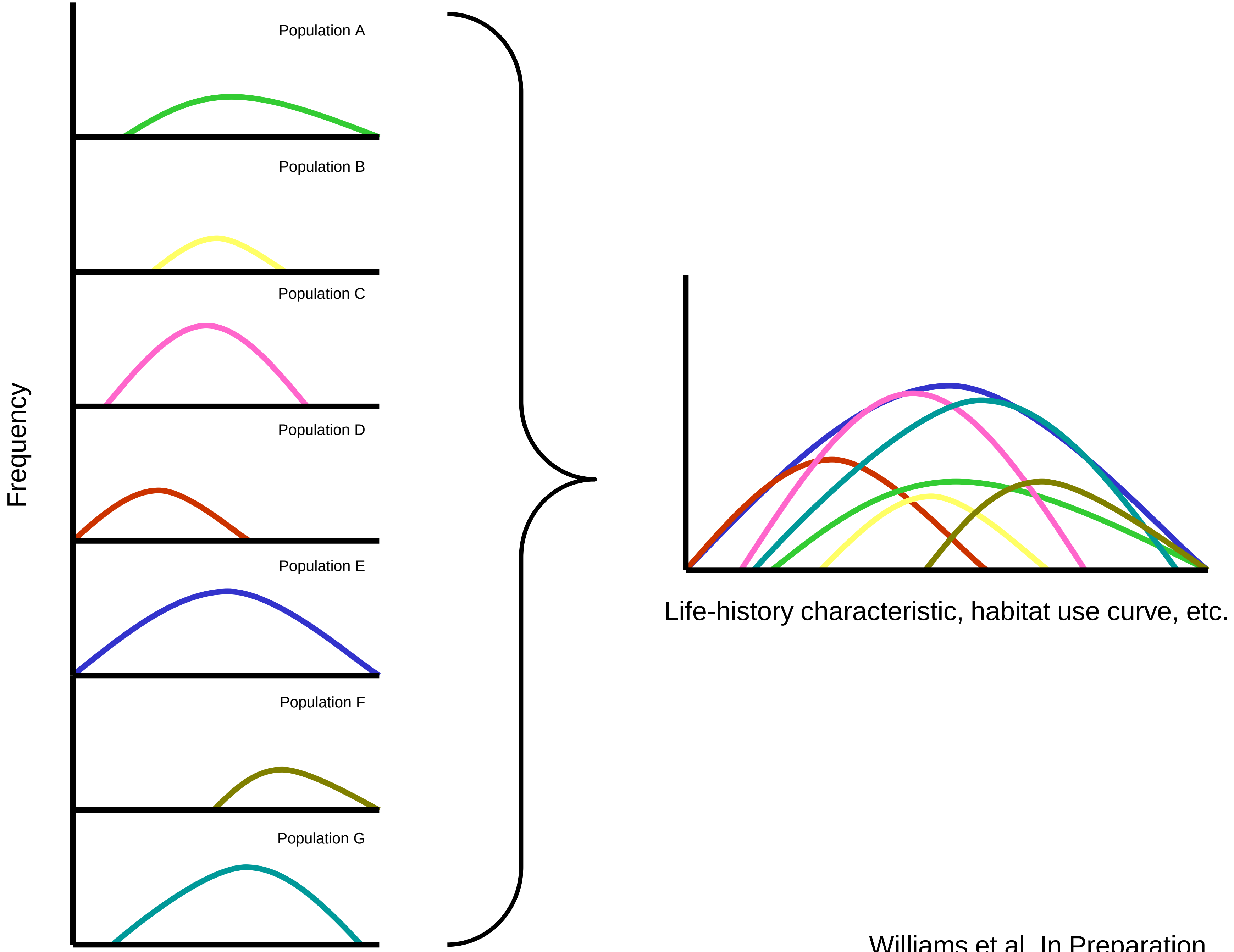


Williams et al. In Preparation



Williams et al. In Preparation

T & J Assumptions / Acknowledgements

- There is an existing network of PIT arrays and downstream outmigrant trapping located in tributaries throughout Klamath Basin that are operated and maintained by diverse and engaged partners.
- There is an existing database available that allows relatively easy access for uploading and downloading data – facilitating collaboration.
- Leverage PIT tagged fish from other studies throughout the Klamath Basin.

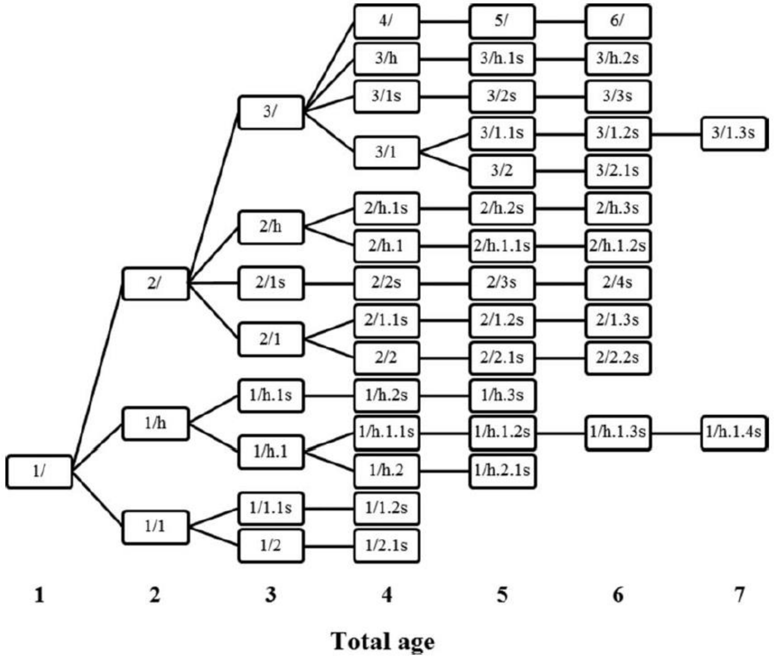
T & J Assumptions / Acknowledgements

- Partners in the Basin have the expertise to capture, tag, and release juvenile *O. mykiss.*
- The main constraint at this point is the lack of PIT tagging juvenile steelhead not the ability to detect them (i.e., we need to tag more fish).
- PIT tags are relatively inexpensive.
- Limited funds and staff, focus on tags not arrays at this time.
- The **C** in KBF**C** is for **COLLABORATIVE**

Examples from Klamath and other watersheds:

Hodge et al. 2016

- *O. mykiss* - offspring(s) can exhibit different ecotype/behavior than parent(s)
- Important for conservation, /restoration, and monitoring.
- *Note: think dynamic distributions not necessarily unique "categories" as presented by Hodge et al. 2016*



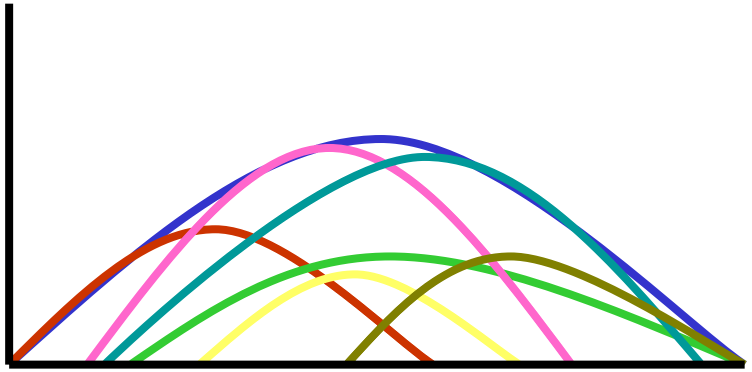


FIGURE 2. Life history pathways observed in *O. mykiss* from the lower Klamath River basin (see Table 1 for abbreviations).

Examples from Klamath and other watersheds:

Piotrowski 2021

- *O. mykiss* between dams harbored the anadromous-associated alleles at frequencies comparable to known anadromous collections downstream in the Trinity River.
- Identified isolated collections of coastal *O. mykiss* above the current dam sites in Upper Klamath Lake tributaries that appear distinct from potential historical hatchery sources on the mainstem Klamath River and one stock that is currently released in the Upper Klamath Basin.
- At one locus associated with timing of freshwater entry and arrival time on spawning grounds, observed a mixture of early-returning, heterozygous, and late-returning genotypes in the Lower Klamath Basin and in the Klamath River between Iron Gate Dam and Link River Dam.

Examples from Klamath and other watersheds:

Hereford et al. 2021

- Genetic surveys support the conclusion of a coastal *O. mykiss* legacy historically in the Upper Klamath Basin.

Brewitt and Danner 2014

- Observed movement from mainstem to tributaries contingent on water temperatures and food.
- Great example of tracking change in the environment at over short time intervals and over short distances.

Examples from Klamath and other watersheds:

Lower Klamath River

- Observed use of tributaries in the lower Klamath River (McGarvey, Waukell, Panther, and Salt creeks) for non-natal use by juvenile *O. mykiss* and coho salmon.

Hahlbeck et al. 2021

- Tagging studies observed adult *O. mykiss* (Redband) moving among cool water tributaries and warm/hot Upper Klamath Lake water habitat. Cool water tributaries provided thermal refuge for spawning while warm/hot lake habitat was available for foraging/feeding opportunities.
- Great example of tracking change in the environment at over short time intervals and over short distances.

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- **Current coverage through existing array network and outmigrant traps is sufficient to warrant increased PIT tagging of juveniles.**
- **What questions about** ***O. mykiss*** **would the Klamath Basin Fisheries Collaborative as a group like to work on answering?**

? Now What ?

T & J Thoughts / Suggestions

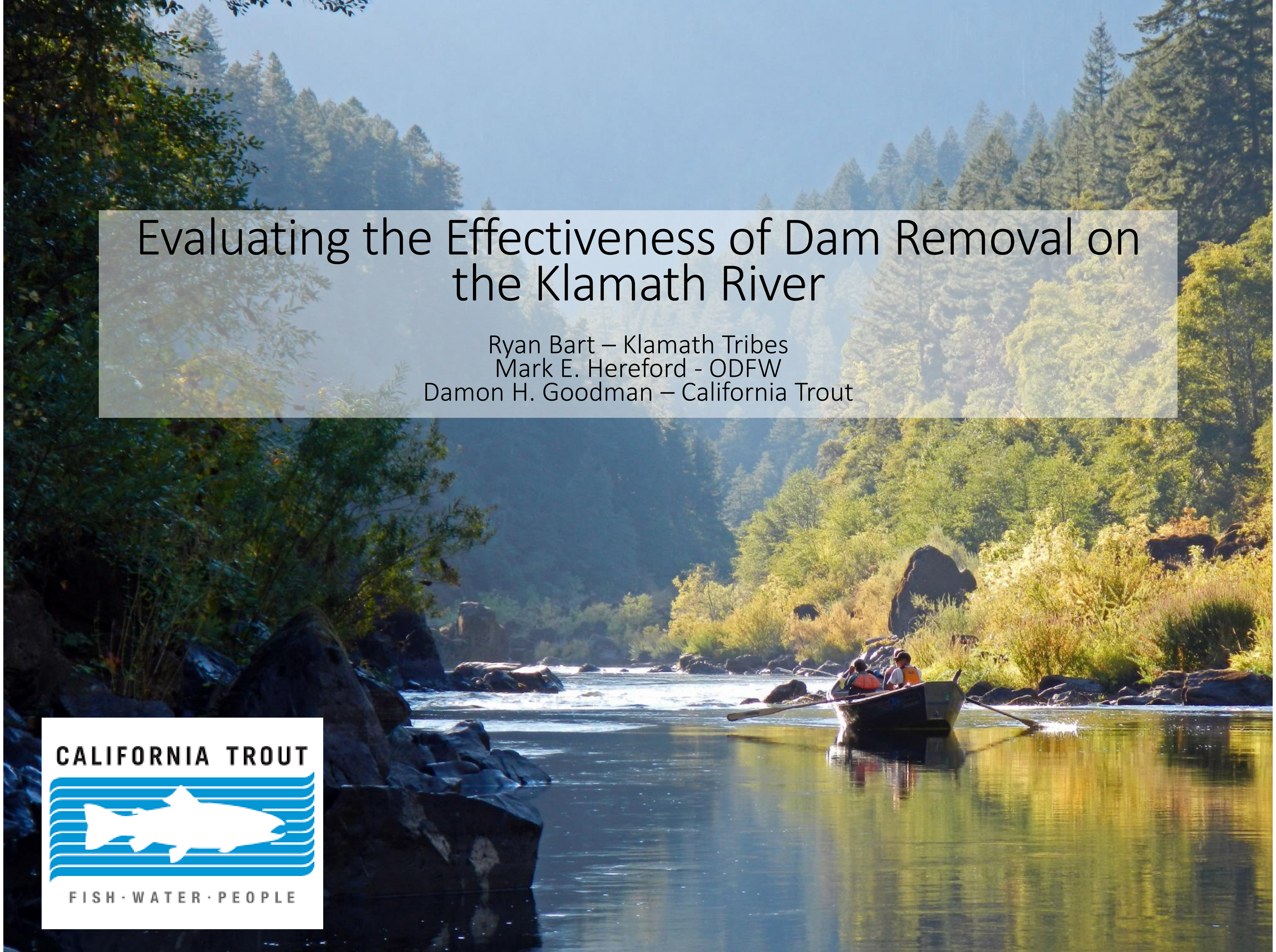
Develop specific research/monitoring questions

•Through KBFC – via email, survey interested partners
•Through KBFC – set up call in coming weeks
•Working group – determine feasibility to muster crews for capture and tagging, sampling protocols, data standards, permits, etc.
•Working group – find funds for PIT tag purchase

•Your thoughts ? ? ?

Damon Goodman- California Trout

Evaluating the effectiveness of dam removal on the Klamath River using SONAR and radio telemetry



Evaluating the Effectiveness of Dam Removal on the Klamath River

Ryan Bart – Klamath Tribes
Mark E. Hereford - ODFW
Damon H. Goodman – California Trout

CALIFORNIA TROUT
FISH · WATER · PEOPLE

Klamath Dam Removal
A Source of Inspiration

Klamath Dam Removal
A Source of Inspiration
and Controversy……

SCIENCE & ENVIRONMENT

California county declares local emergency over Klamath River water quality concerns

By **Jane Vaughan** (Jefferson Public Radio)
March 27, 2024 12:49 p.m.

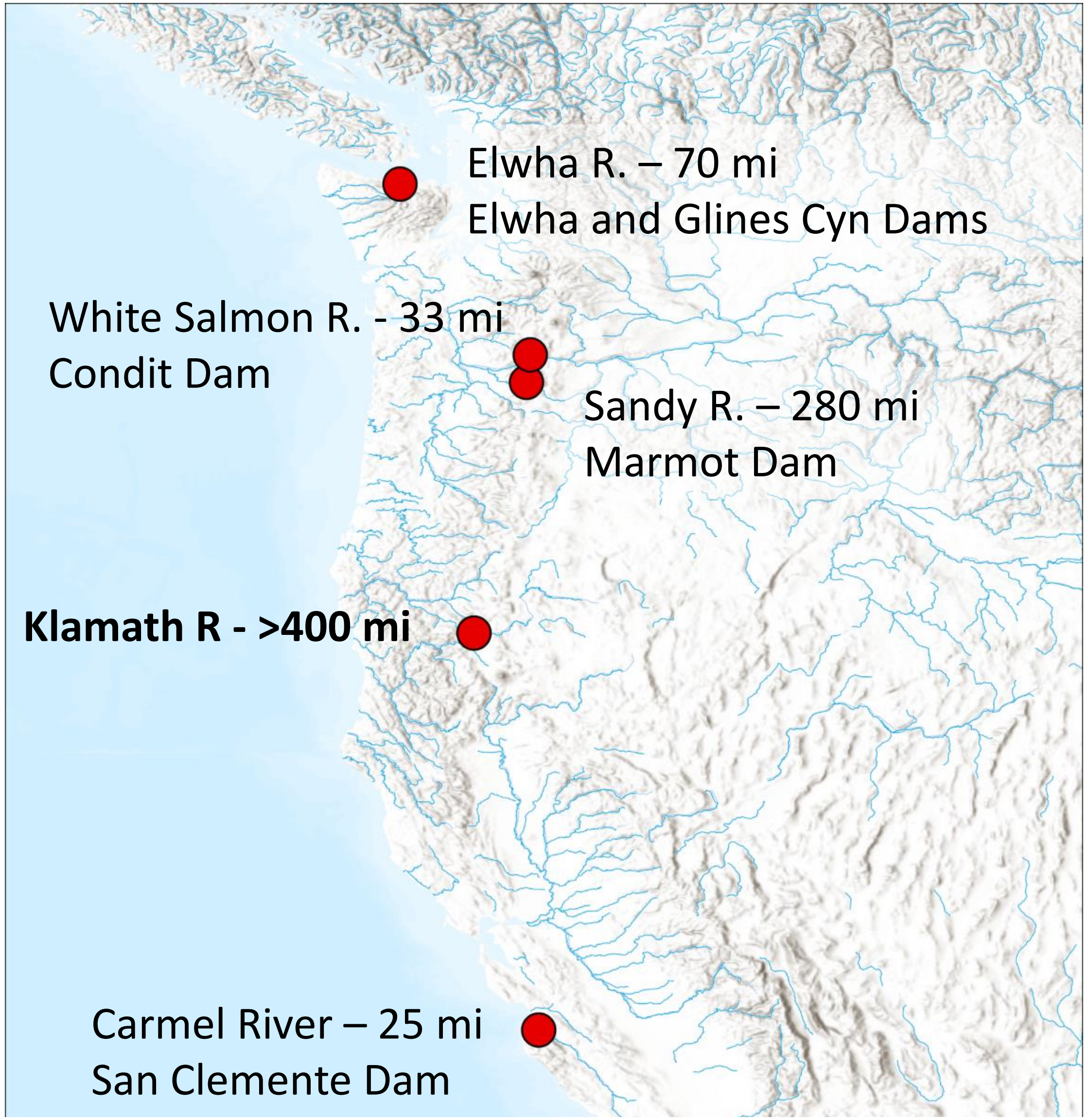
The Klamath River carving through the bed of the former Copco Lake reservoir.
Juliet Grable / JPR

Klamath River: And The Award Goes To…

Congratulations on the first annual 'River of Death' award

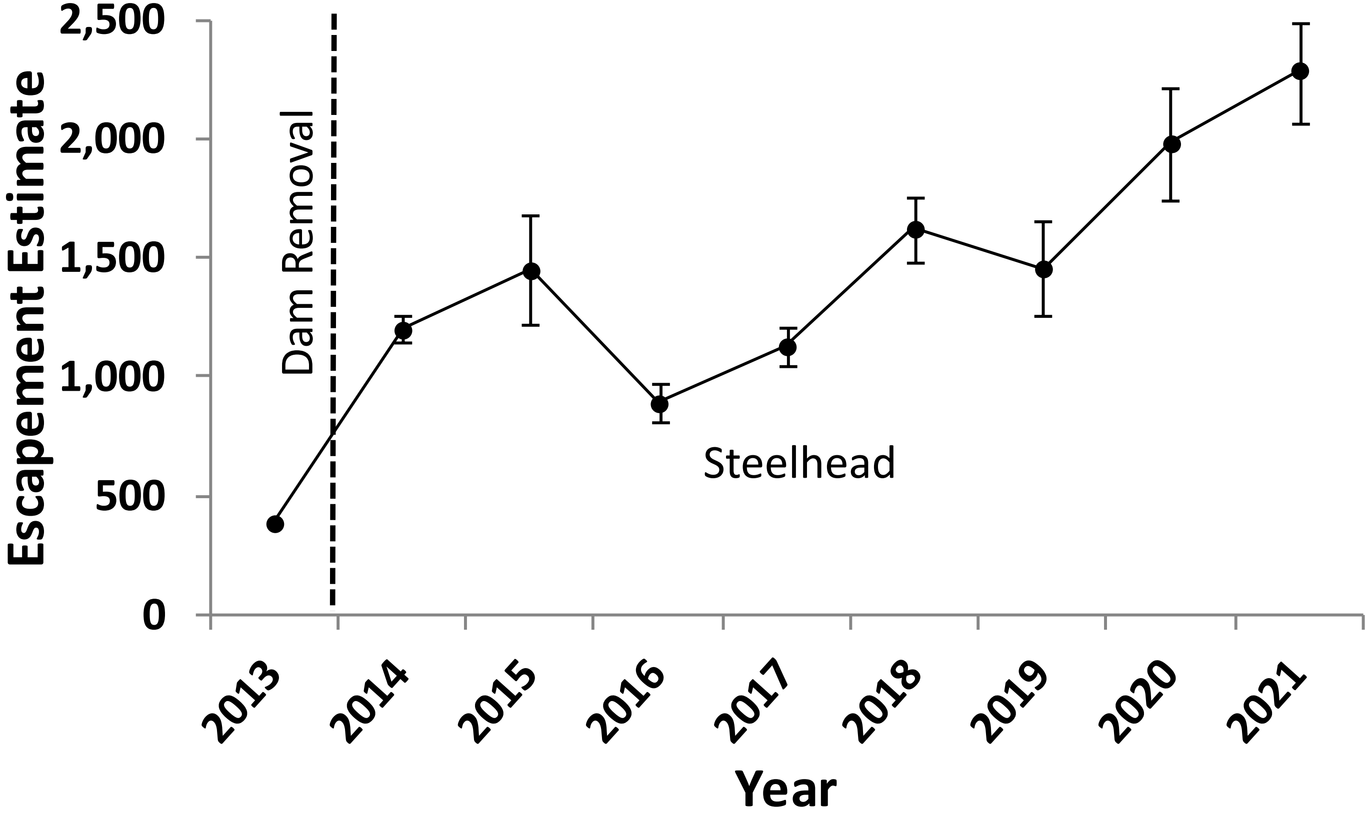
By William Simpson, March 11, 2024 3:44 pm

'River of Death' award. (Photo: Lindsay Rhea for William Simpson)

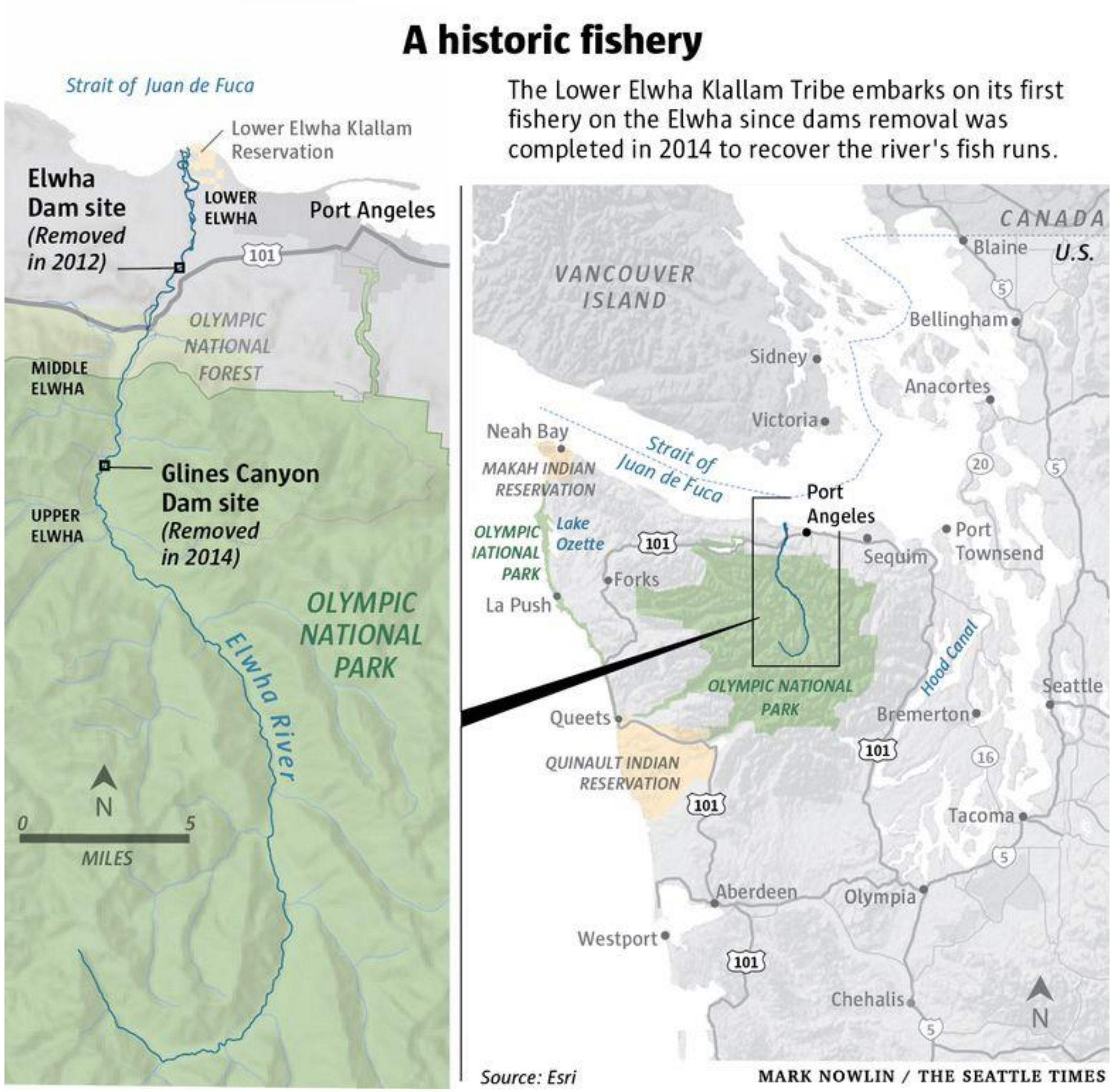


After 100 years dams are beginning to fall
Each one has its own story

Results from the Elwha



Tribe catches coho salmon on free-flowing Elwha River, a first since dam removals



How will Klamath Stocks Respond to Dam Removal?

A Fishy Working Group

The Importance of Individuals

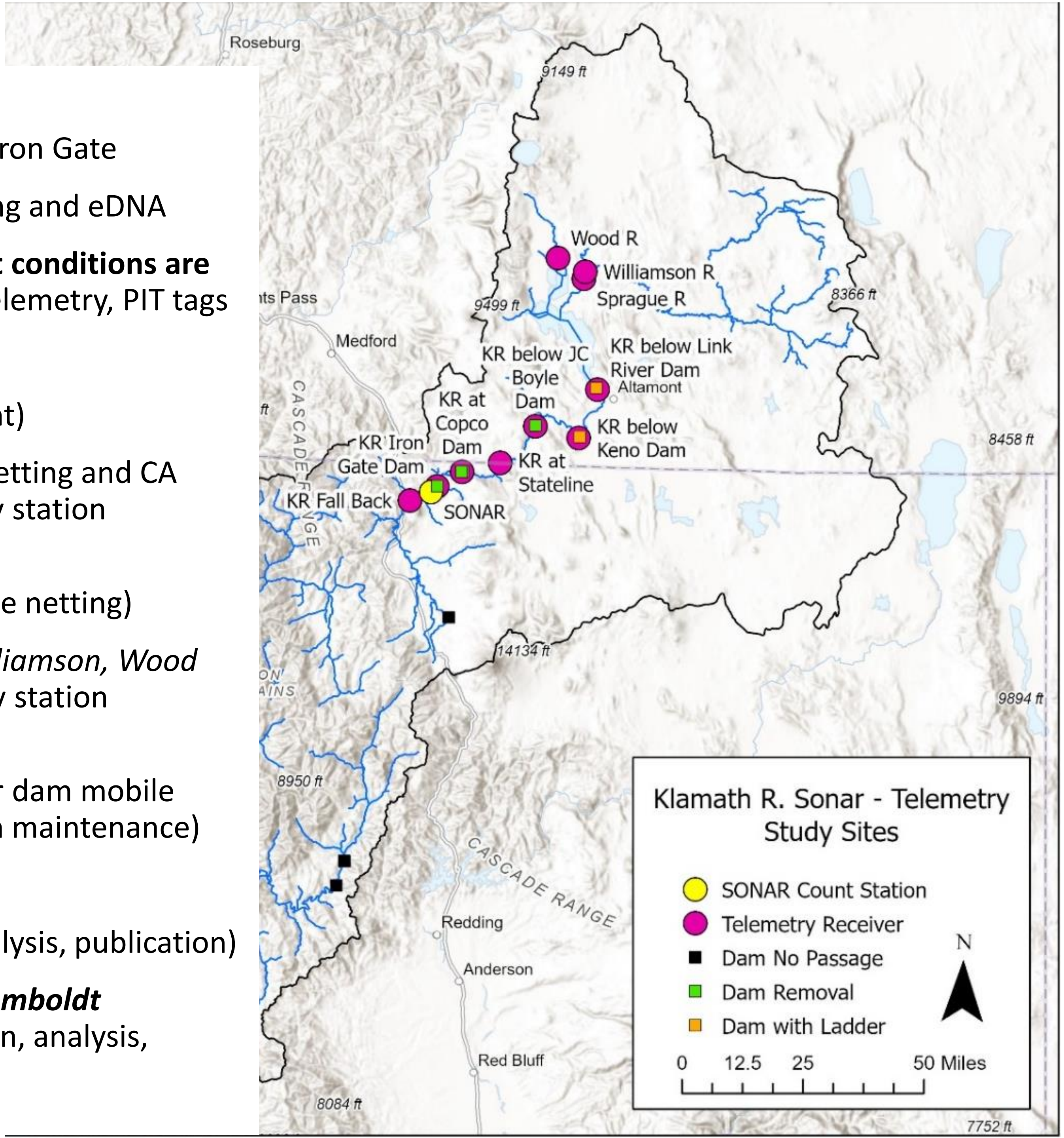
Toz Soto and Alex Corum – Karuk Tribe
Oshun O'Rourke – Yurok Tribe
Ryan Bart – Klamath Tribes
Bog Pagliuco, Tommy Williams, George Pess, Cyril Michel – NOAA Fisheries
Torrey Tyler, Eric Reiland - Bureau of Reclamation
Ryan Fogerty, Bill Pinnix - USFWS
Crystal Robinson and Kurt Bainbridge – CDFW
Mark Hereford, Benji Ramirez - ODFW
Nicholas A. Som – USGS CRU and Cal Poly, Humboldt
Keith Denton – K. Denton and Associates
Daniel Chase - RES
Damon H. Goodman – California Trout

Study Design

- **How Many?** – SONAR below Iron Gate
- **What Species?** – Tangle netting and eDNA
- **Where are they going & what conditions are they experiencing?** – Radio telemetry, PIT tags

Partners

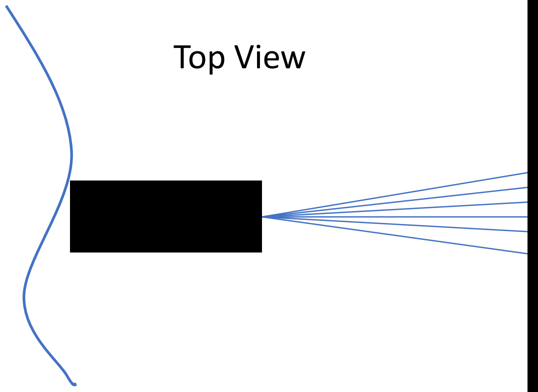
- ***CalTrout*** (project management)
- ***Karuk Tribe*** (SONAR, tangle netting and CA mobile tracking and telemetry station maintenance)
- ***Yurok Tribe*** (SONAR and tangle netting)
- ***Klamath Tribes*** *(Sprague, Williamson, Wood mobile tracking and* telemetry station maintenance)
- ***ODFW*** (State line to Link River dam mobile tracking and telemetry station maintenance)
- ***CDFW*** (one tech for SONAR)
- ***SWFSC*** (telemetry design, analysis, publication)
- ***Keith Denton and Cal Poly Humboldt*** (SONAR/apportionment design, analysis, publication)

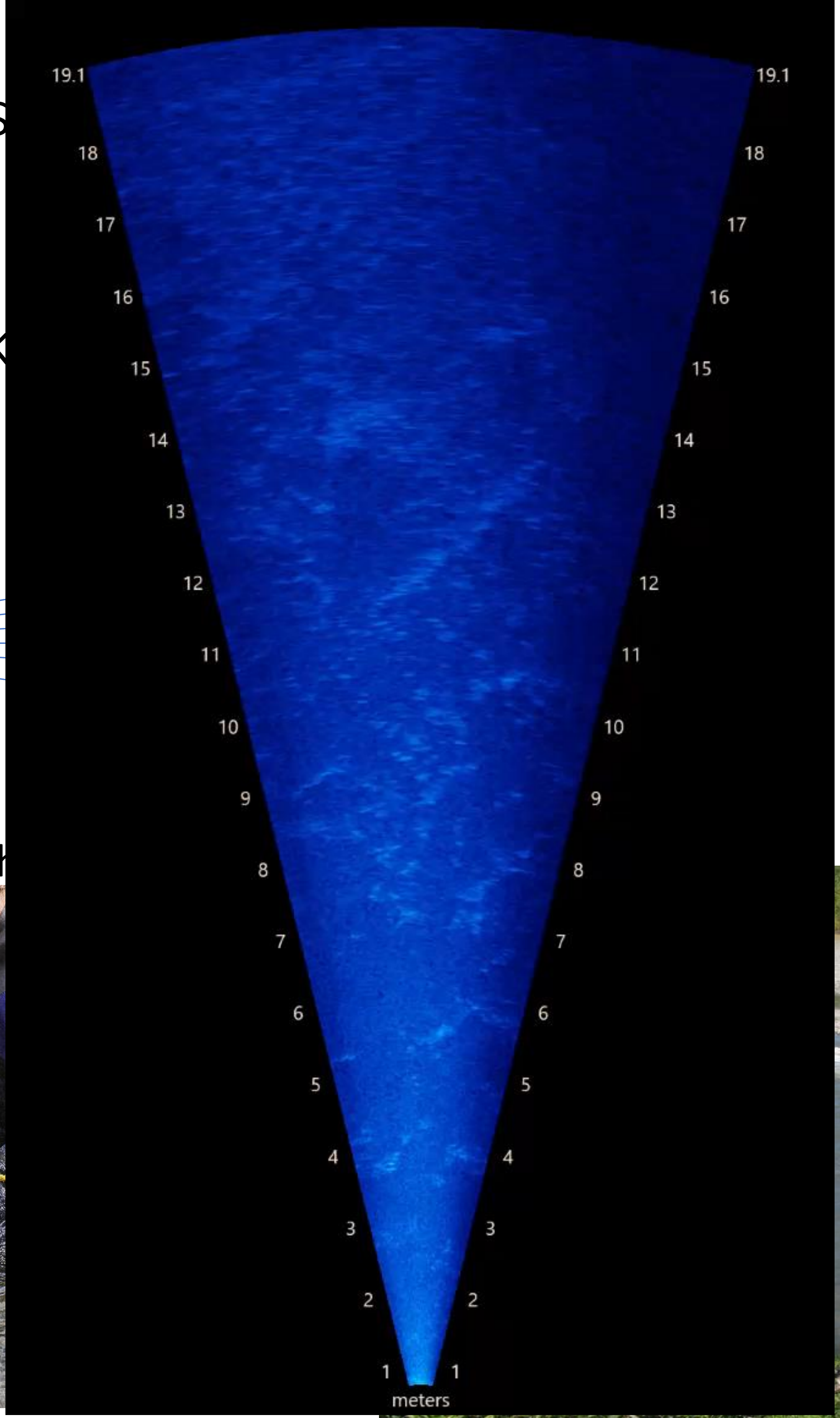


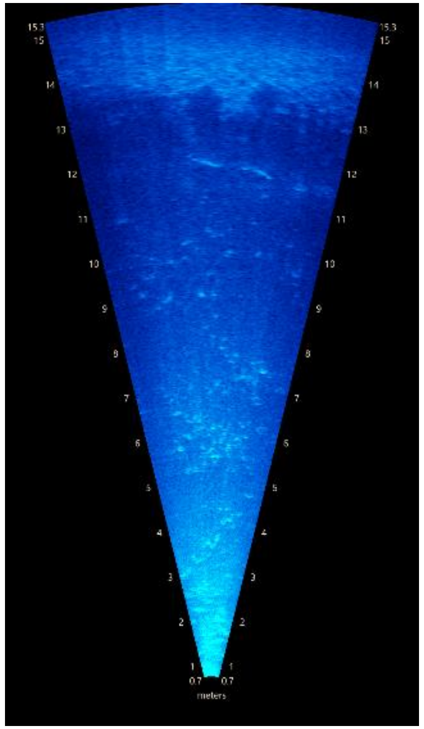
Us

-Yuk

Top View

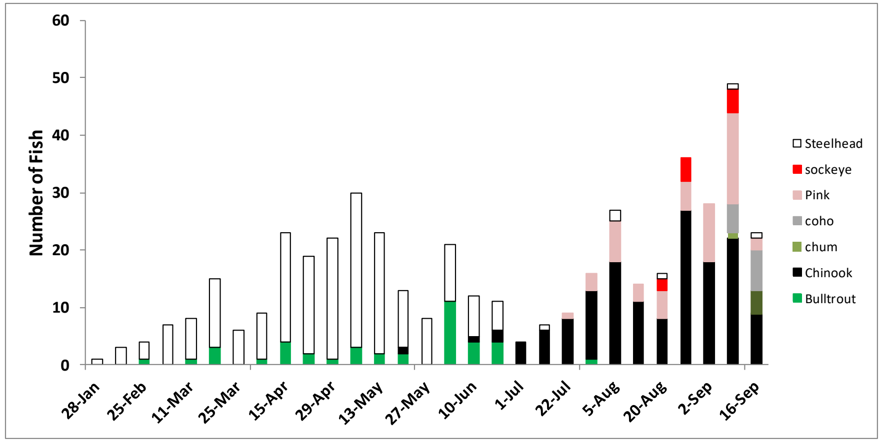




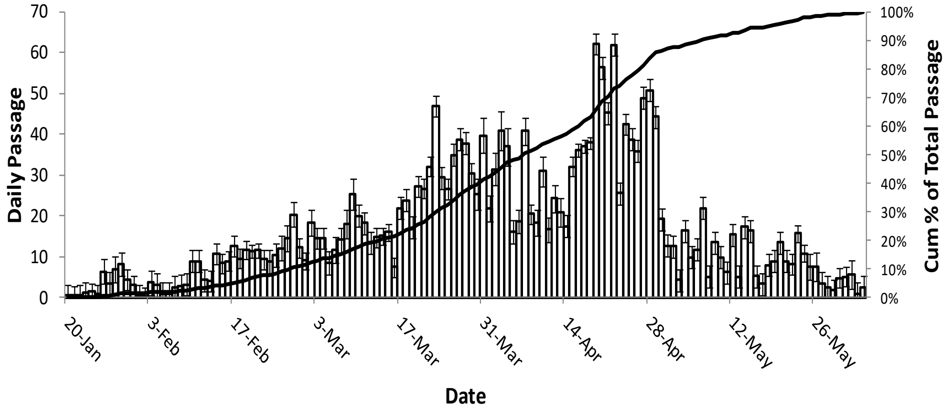


Keith Denton - Elwh

Species Composition

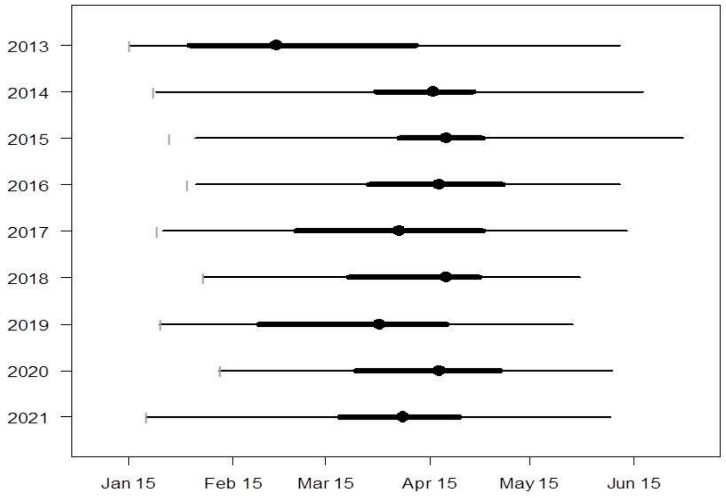


Daily passage

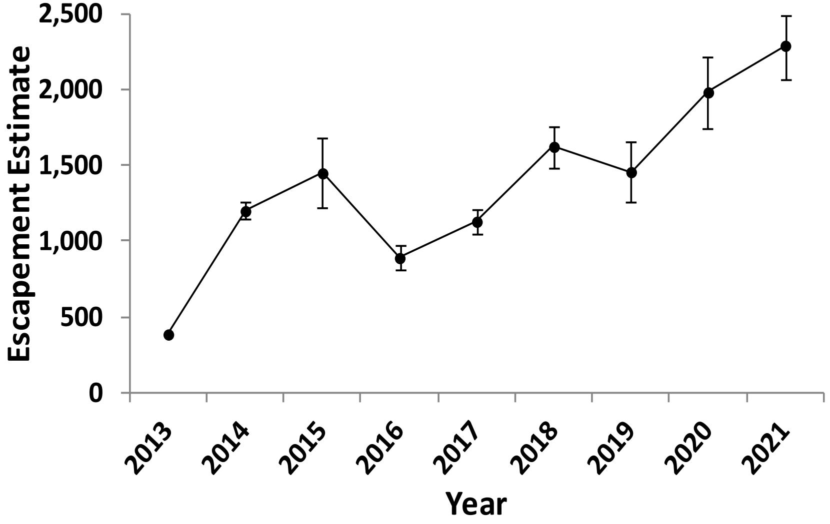


RESULTS

Run Timing

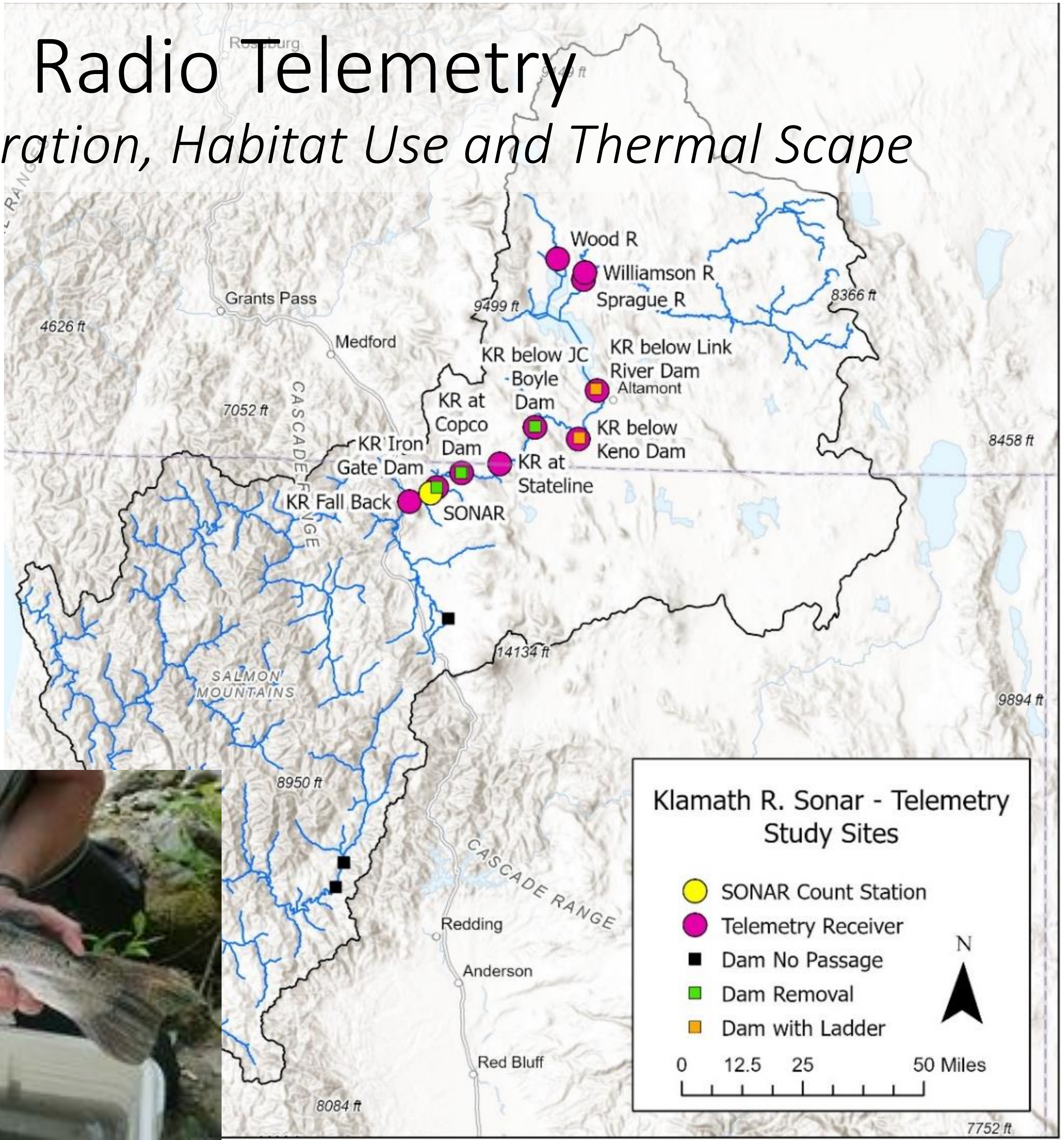


Annual Population Trends



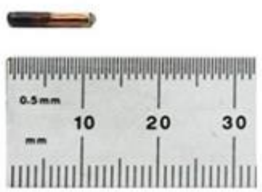
Radio Telemetry

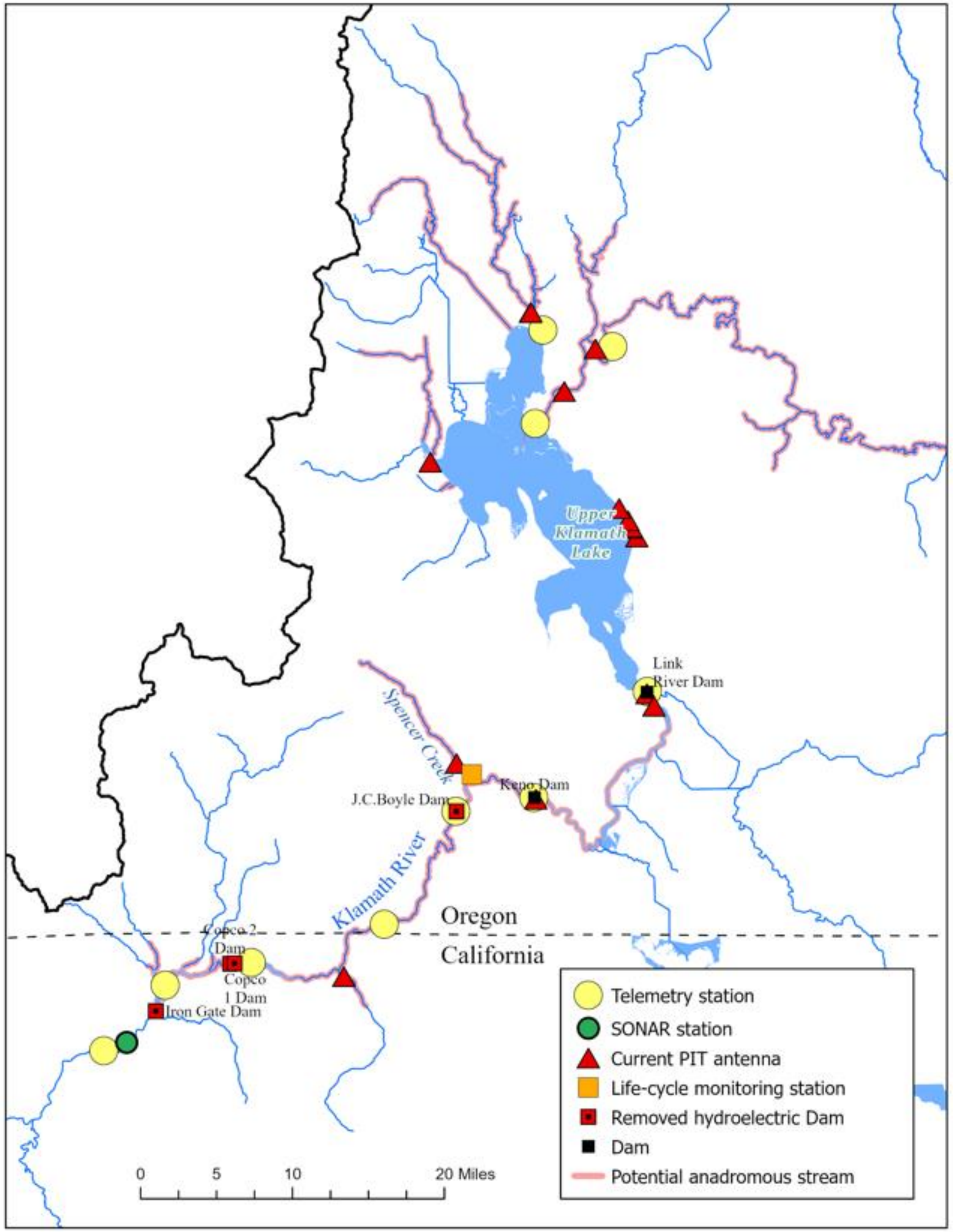
Tracking Migration, Habitat Use and Thermal Scape



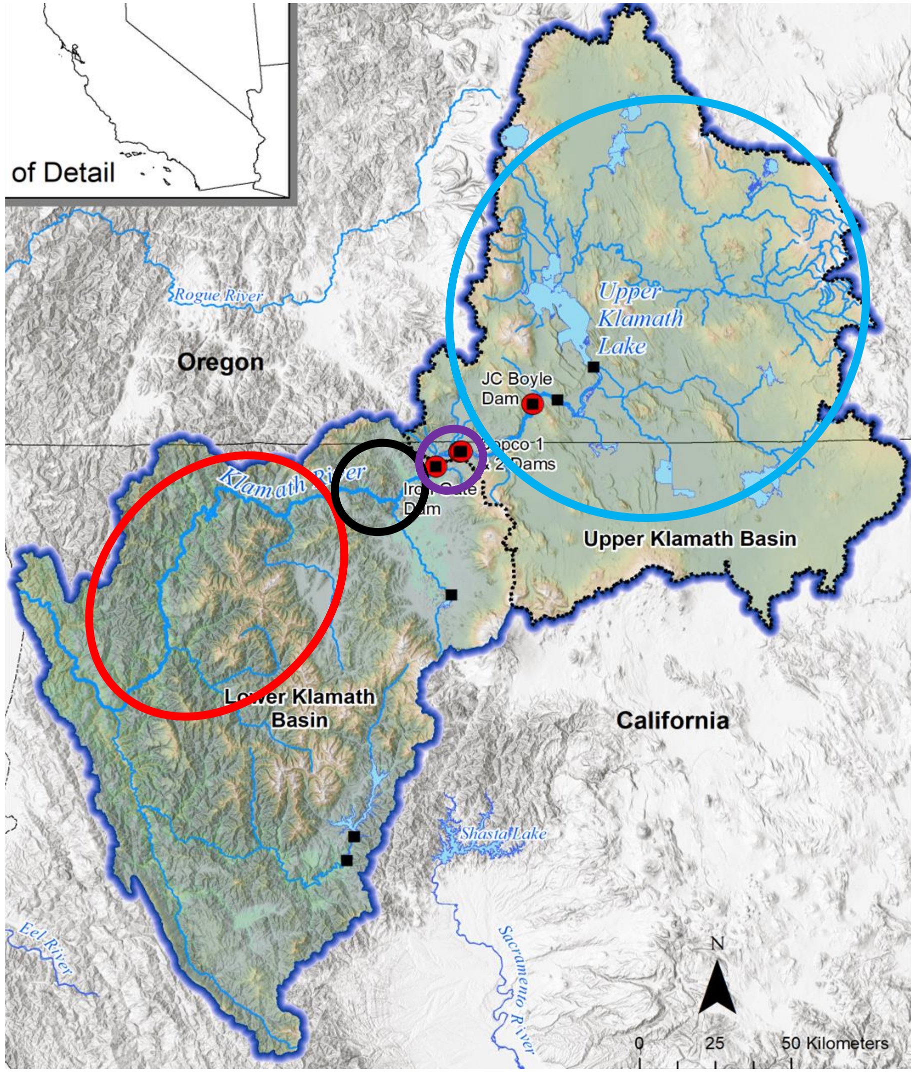
PIT tagging and detection

- In addition to radio tagging, PIT tagging captured adults
- Will allow for detections at other key locations
  - Klamath River tributaries, Keno Dam fish ladder, Link River fish ladder, tributaries to UKL, Pelican Bay
- A key component to this will be the Klamath Basin PIT tag database





Complementary Monitoring Designs



Current and Future Monitoring efforts

Karuk/USFS/MKWC/CDFW – carcass and redd counts – lower and mid Klamath tributaries

Karuk/Yurok/USFWS – carcass and redd counts - Iron Gate to Wingate Bar

CDFW – PIT, carcass and redd counts – 4 tributaries in the Reservoir Reach

ODFW – Carcass and redd counts in mainstem Klamath River upstream of stateline and tributaries to UKL, life-cycle monitoring in Spencer Creek

This project - ~350 -400 miles of habitat

- Klamath Mainstem from Iron Gate to Keno Dam and Link River Dam
- Beaver Creek and Spencer Creek tributaries in reservoir reach
- Williamson River and Tributaries
- Wood River and tributaries
- Sprague River and tributaries

Questions?

TOP 6 CALIFORNIA DAMS OUT

NOAA FISHERIES

Humboldt Area Foundation

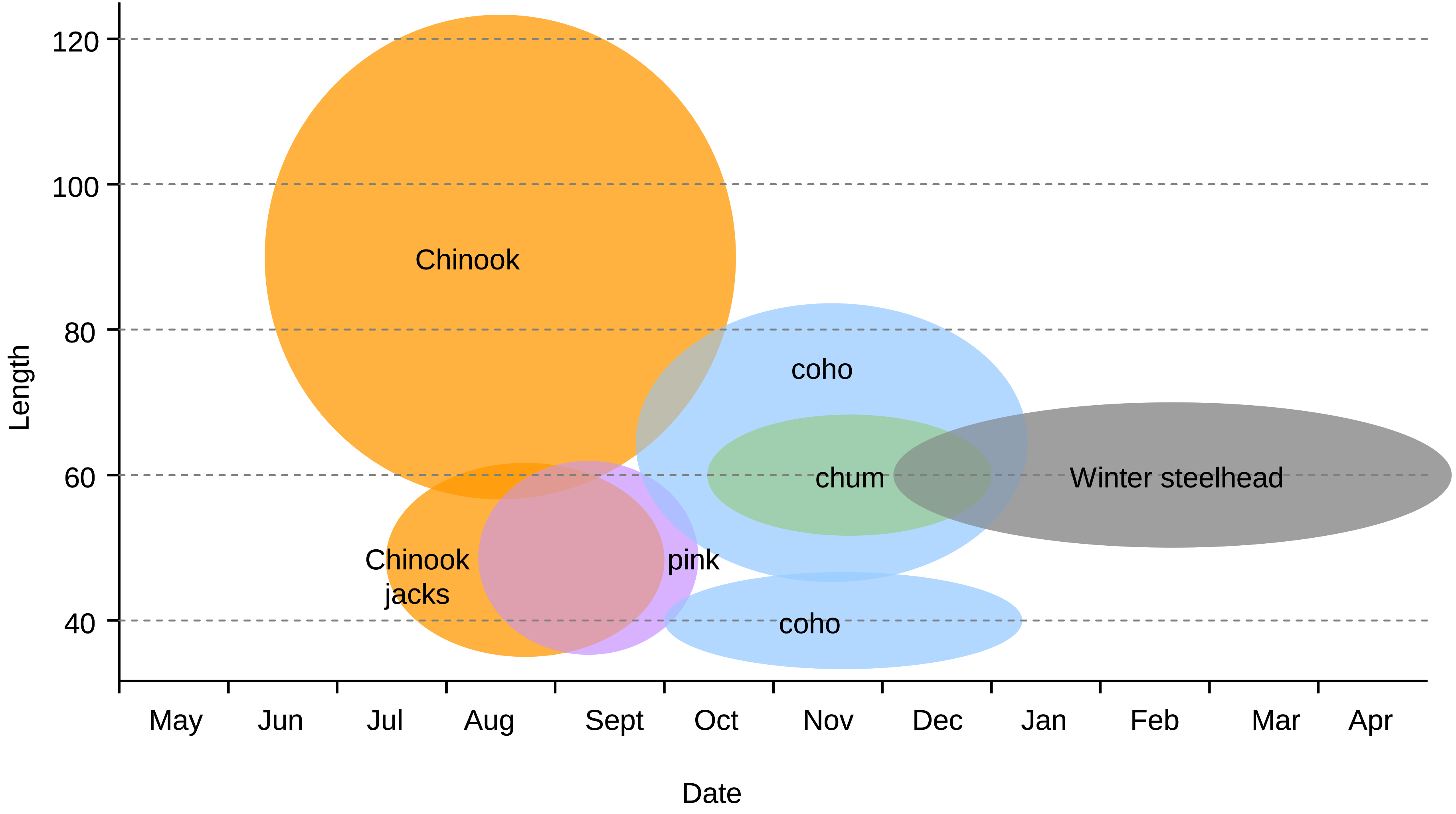
Wild Rivers Community Foundation

Bella Vista Foundation

U.S. Fish & Wildlife Service
Department of the Interior

Species Composition

Moving beyond single-species monitoring



Elwha R Example

KBFC Data Exchange: Past Milestones, Current Progress, Future Vision

Greg Wilke, Erin Benham, Monica Diaz and Rachael Paul-Wilson
Pacific States Marine Fisheries Commission | US Geological Survey

June 2024
Annual Meeting Klamath Basin Fisheries Collaborative

Funded by:

Structured Data Sharing

- Controlled vocabulary
- Data exchange standards
- Data sharing agreement

Field Name	Field Description	Data Type	Rules Codes Conventions
FishOrigin	Hatchery where the fish was reared. Field is *only applicable to Mark events* of hatchery reared fish.	Pick list:	**FALLC**: Fall Creek Hatchery **IRONG**: Iron Gate Hatchery **KLAMT**: Klamath Tribes Hatchery **USGOF**: Gone Fishing USFWS Sucker Hatchery **TRIRI**: Trinity River Hatchery **OKLAM**: ODFW Klamath Hatchery
Species	Species of the fish	Pick list:	Suckers: **Lost River Sucker, Shortnose Sucker, Klamath Largescale Sucker, Klamath Smallscale sucker, U** Salmonids: **Coho Salmon, Chinook Salmon, Steelhead Trout, Brown Trout, Rainbow Trout, Redband Tr** Other common species: **Western Ridged Mussel, White Sturgeon, Green Sturgeon, Pacific Lamprey, N** **Oregon Spotted Frog, Cascades Frog, Unknown Frog** **Unknown Species, Other**
PITTagPrimary	Unique 13-character code of the embedded tag or strongest tag, if more than one. If tags are equal in strength, then the older tag is the primary tag.	Hexadecimal or decimal format, varchar(16)	
PITtagSecondary	Unique 13-character code of the embedded weaker or secondary equal-strength PIT tag, if fish is double	varchar(16)	
TagComments	General tag comments during the MRR event.	varchar(1000) - json	
AcousticTag	Acoustic tag code, if present.	varchar(50)	
RadioTag	Radio tag code, if present.	varchar(50)	
CodedWire	Coded wire tag code, if present.	varchar(50)	
FloyTag	Floy tag code, if present.	varchar(50)	
PhysicalMarks	External, physical marks visible on the fish. Multiple options may be chosen.	Pick list:	**LMAX**: Left Maxillary- Left maxillary is clipped or removed. **RMAX**: Right Maxillary- Left maxillary is clipped or removed. **EMAX**: Entire Maxillary- Entire maxillary is clipped or removed. **ADIPO**: Adipose- Adipose fin is clipped. **LPELV**: Left Pelvic- Left pelvic fin is clipped. **RPELV**: Right Pelvic- Right pelvic fin is clipped. **UCAUD**: Upper Caudal- Upper caudal fin is clipped. **LCAUD**: Lower Caudal- Lower caudal fin is clipped. **ULCAUD**: Upper and Lower Caudal- Lower caudal fin is clipped.

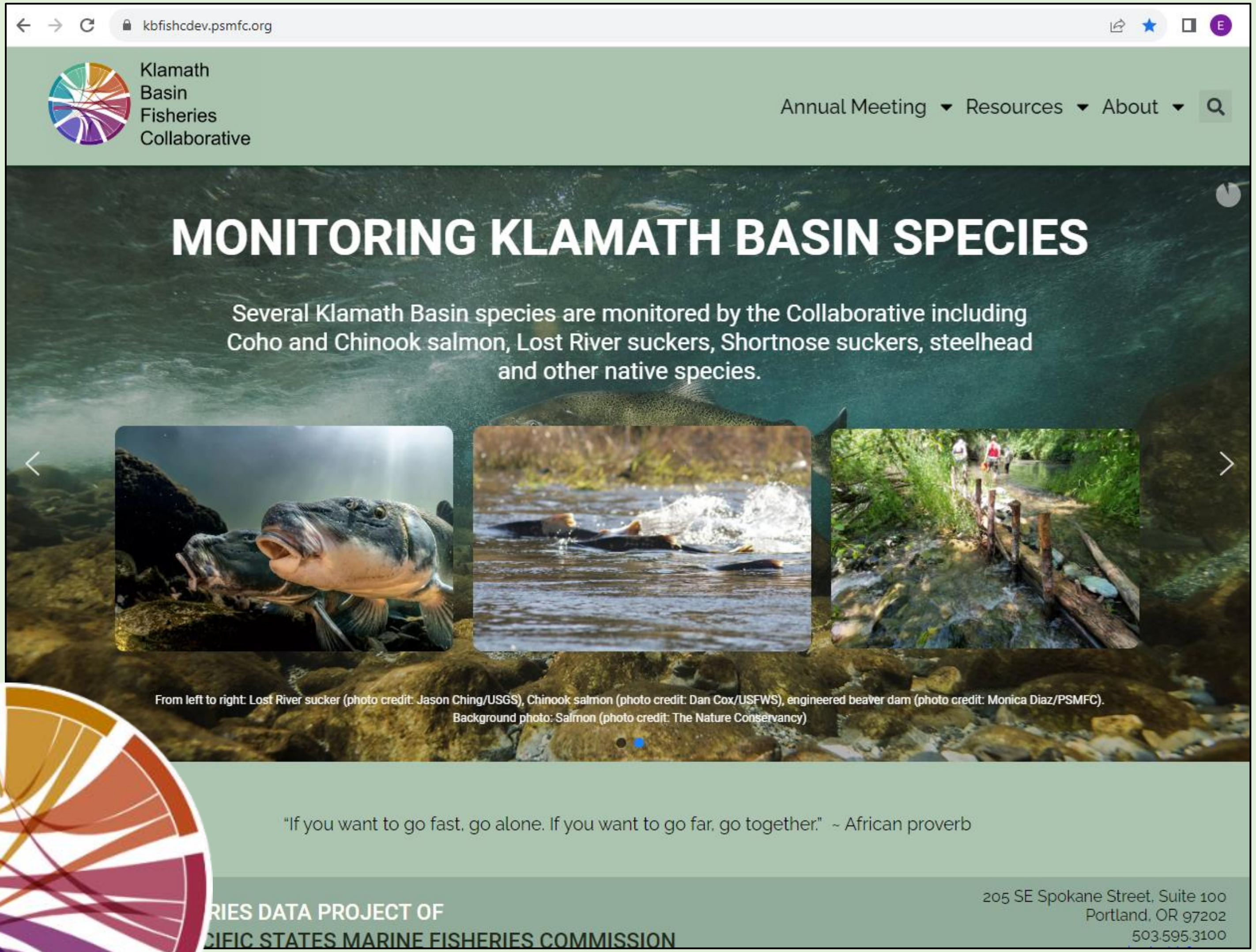
Example of DES with Controlled Vocabulary (excerpt)

Data Exchange Support

- Database
- API data exchange
- Electronic data collection

Data Exchange Support

- Database
- API data exchange
- Electronic data collection
- Website
- Data exchange portal



https://www.kbfishc.org/

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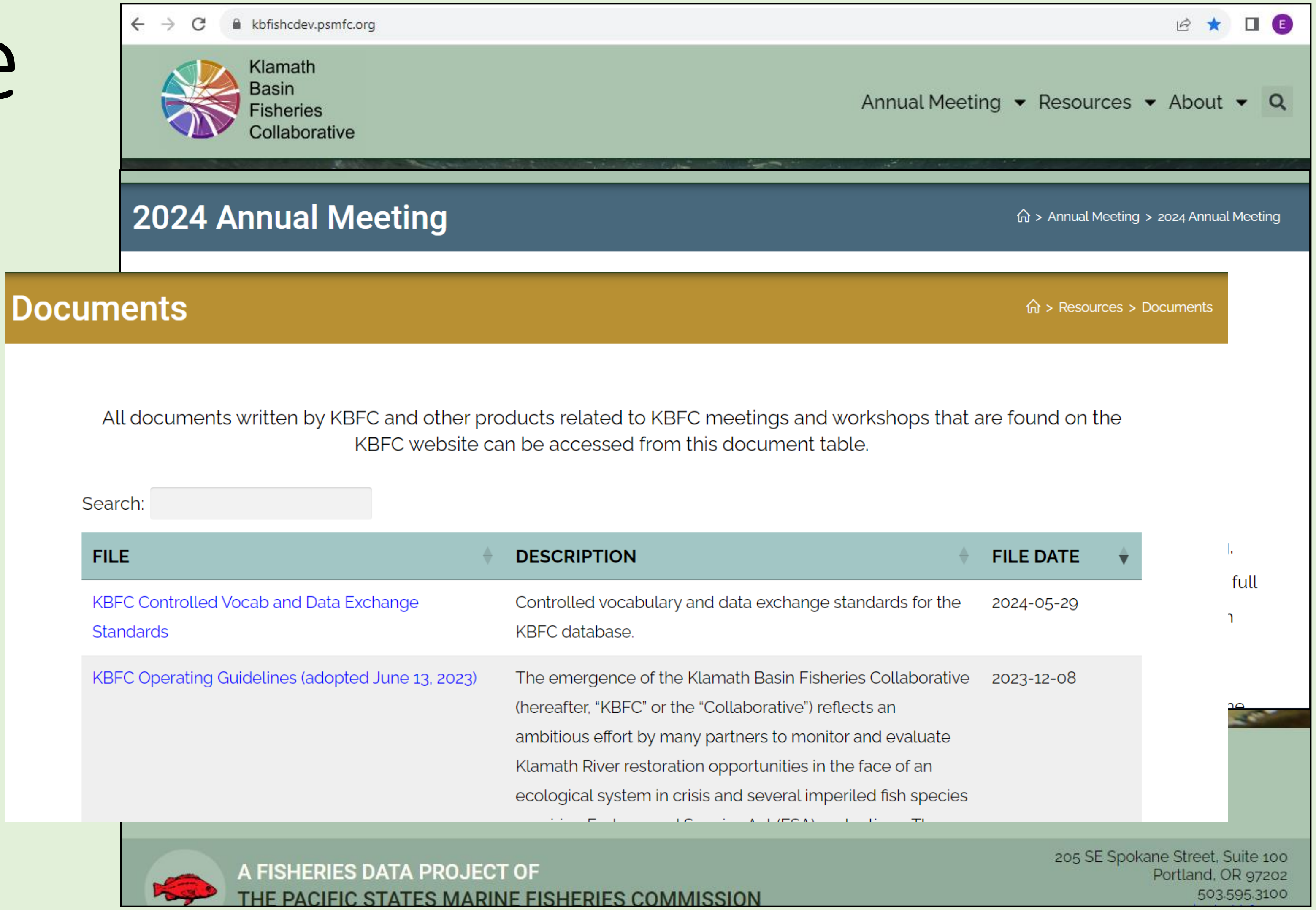

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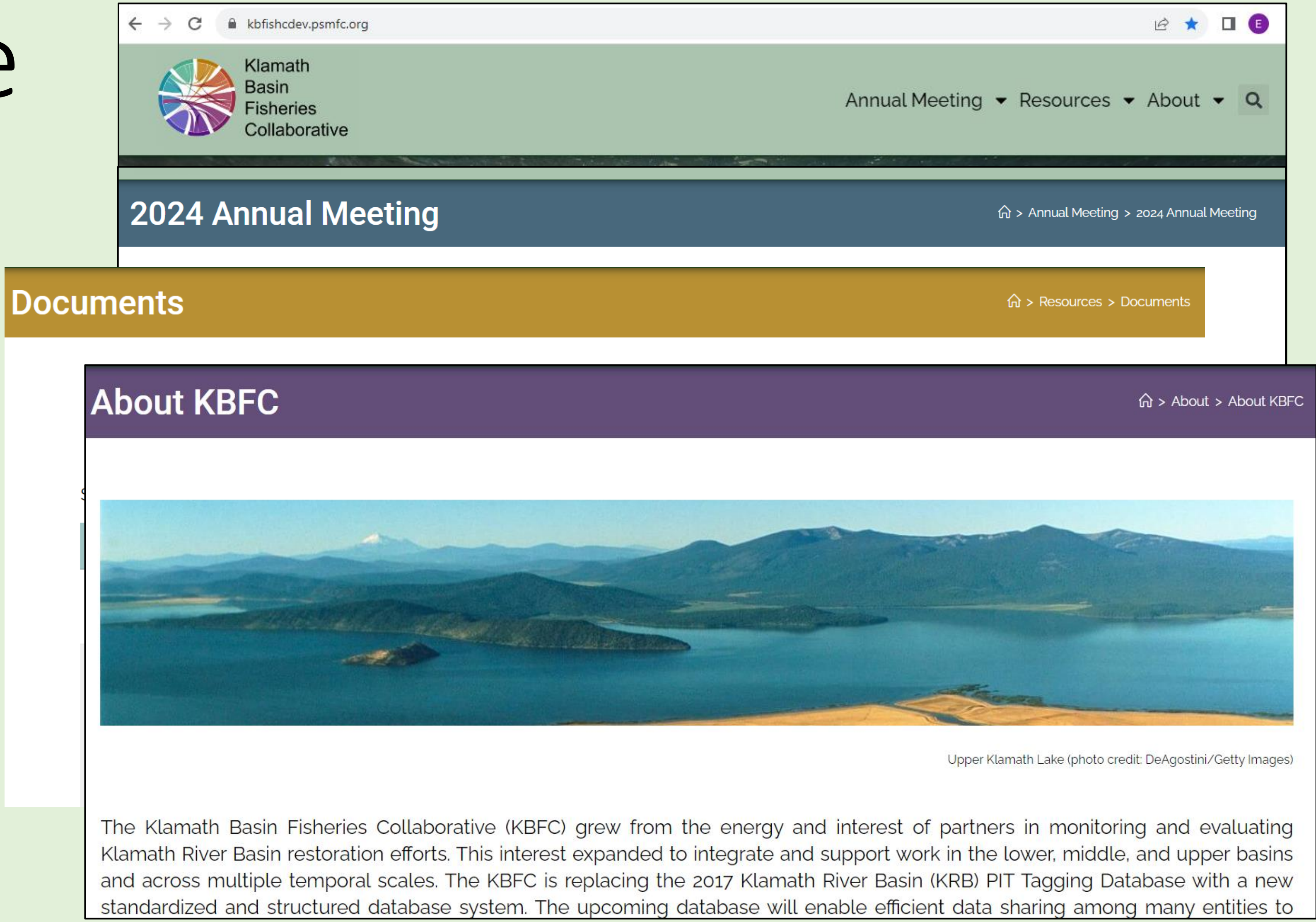

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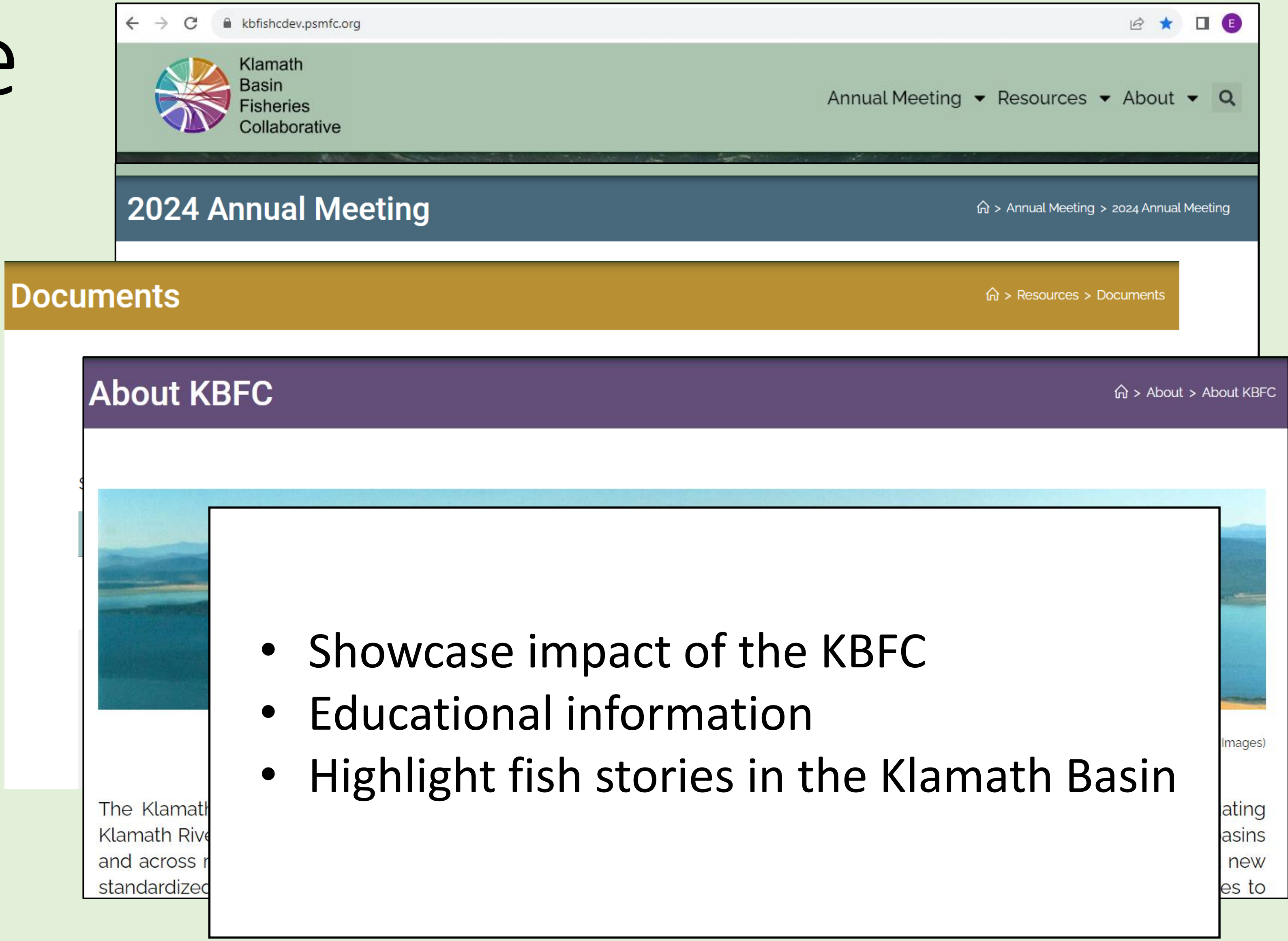

- Showcase impact of the KBFC
- Educational information
- Highlight fish stories in the Klamath Basin

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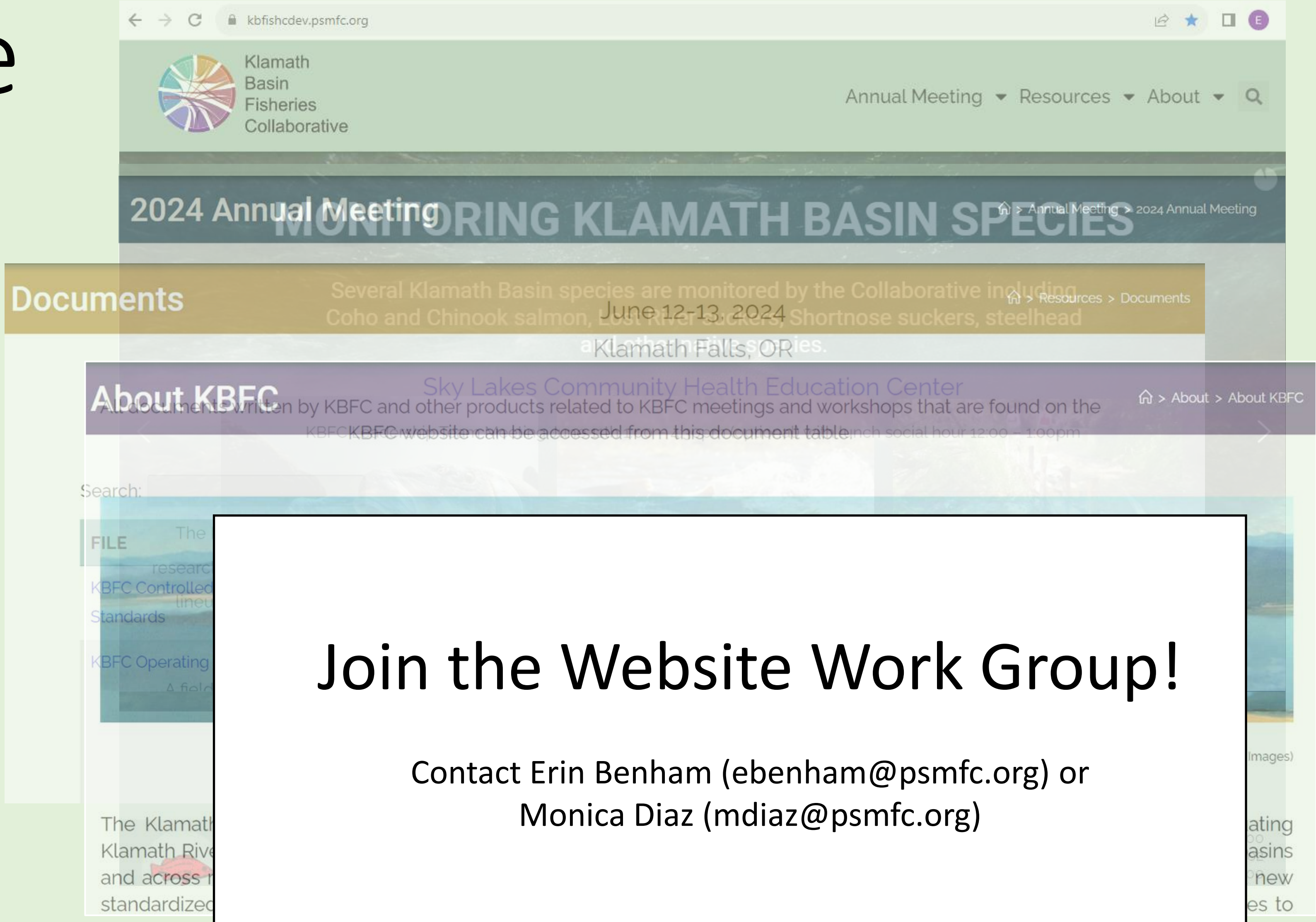
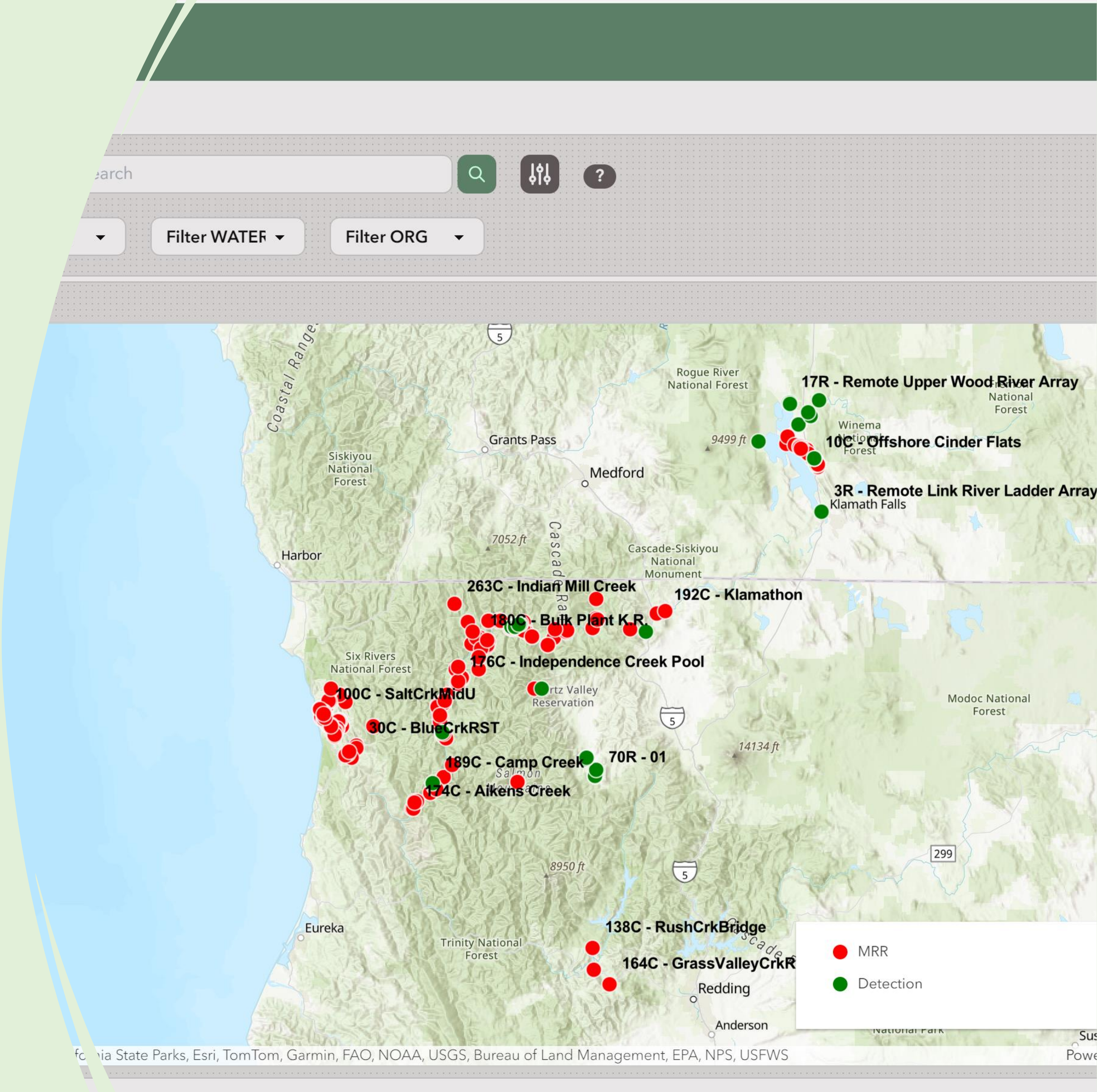


Join the Website Work Group!

Contact Erin Benham (ebenham@psmfc.org) or
Monica Diaz (mdiaz@psmfc.org)

Introduction to the Data Exchange Portal

- Development over the past year
- Facilitates fish and restoration monitoring
- Tool for collaboration among partners



Permissioned Data Access

- Admin-only full data access
- Basic Data Permission Level
  - Request access to data
- Technical Data Permission Level
  - Full access to shared detection data (physical and remote) for your fish
- Collaborative project data sharing

84,434 27,994

	ENCOUNTER	TYPE	PITTAG	SITE	ORG	EVENT TYPE	SPECIES	SEX
	2015-07-07 22:02	Detection	3D9.1C2DFFB2D3	41R	KARUK		COHO	UNKN
	2015-07-06 21:19	Detection	3D9.1C2DFFABFD	41R	KARUK		COHO	UNKN
	2015-06-10 03:27	Detection	3D9.1C2E0013EB	43R	KARUK		COHO	UNKN
	2015-06-02 23:56	Detection	3D9.1C2E065FCA	43R	KARUK		COHO	UNKN
	2015-06-02 00:00	Capture	3D9.1C2E001B8F	26C	YUROK	RECAP	COHO	UNKN
	2015-06-01 18:32	Detection	3D9.1C2E001B8F	33R	YUROK		COHO	UNKN

Based on your MARK records – can view other agency Detections and Recaptures/Recoveries

Edit Project

ID: USGS_pre2024

Organization: USGS | United States Geological Su

Title: USGS_pre2024

Data steward: USGS Unknown Unknown

Project designation: USGS_pre2024

Biologist: USGS Unknown Unknown

Collaborators: YUROK,NOAA

Start date: 2000-01-01

Project status:

End date: 2023-12-31

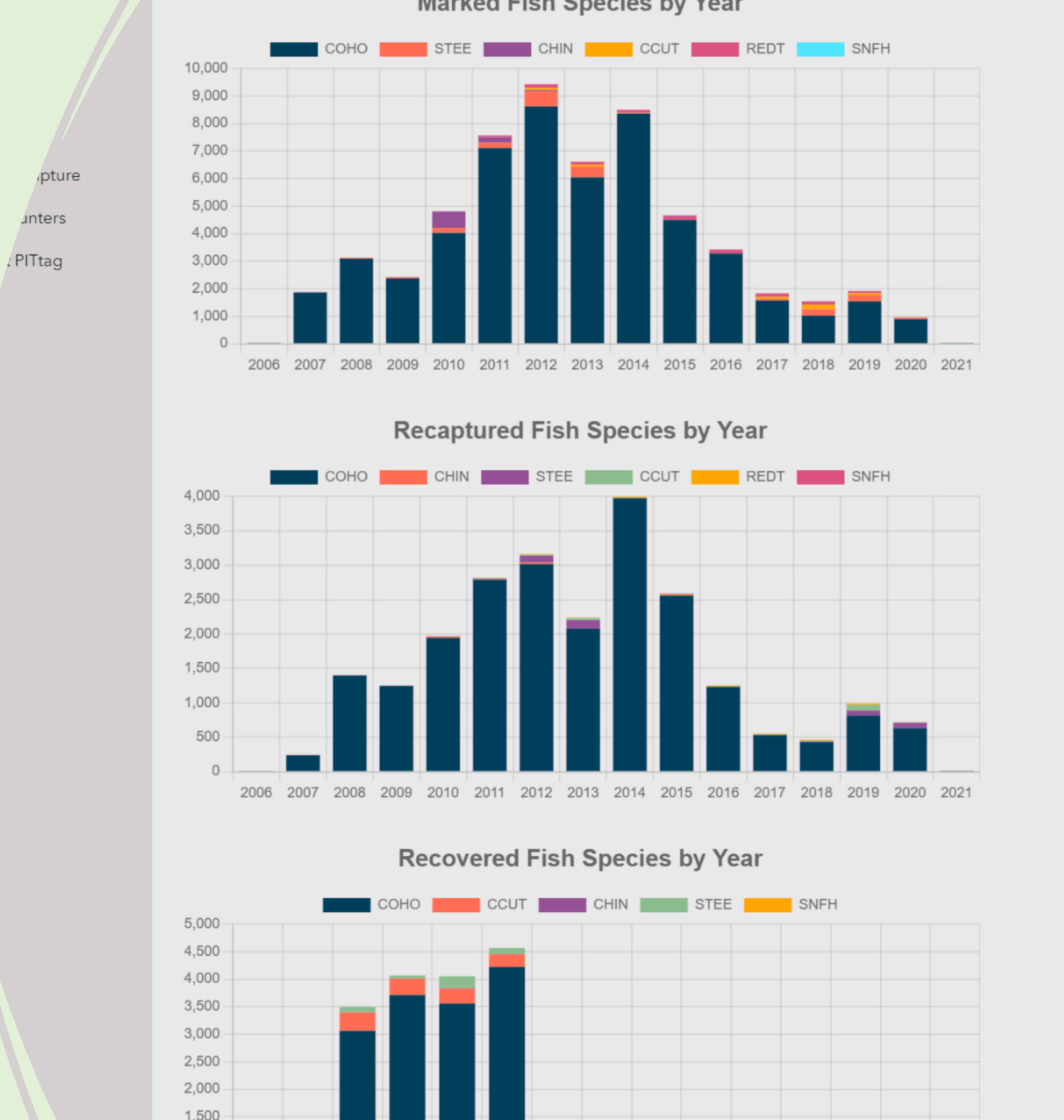
Comments:

Administrative Functions

- User management by administrators
- Agency management
- Admin support for users

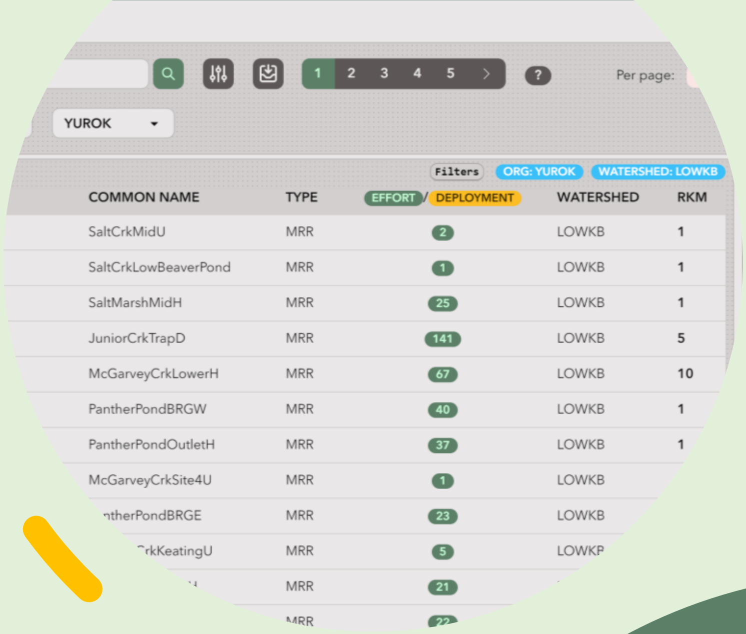
Data Dashboard

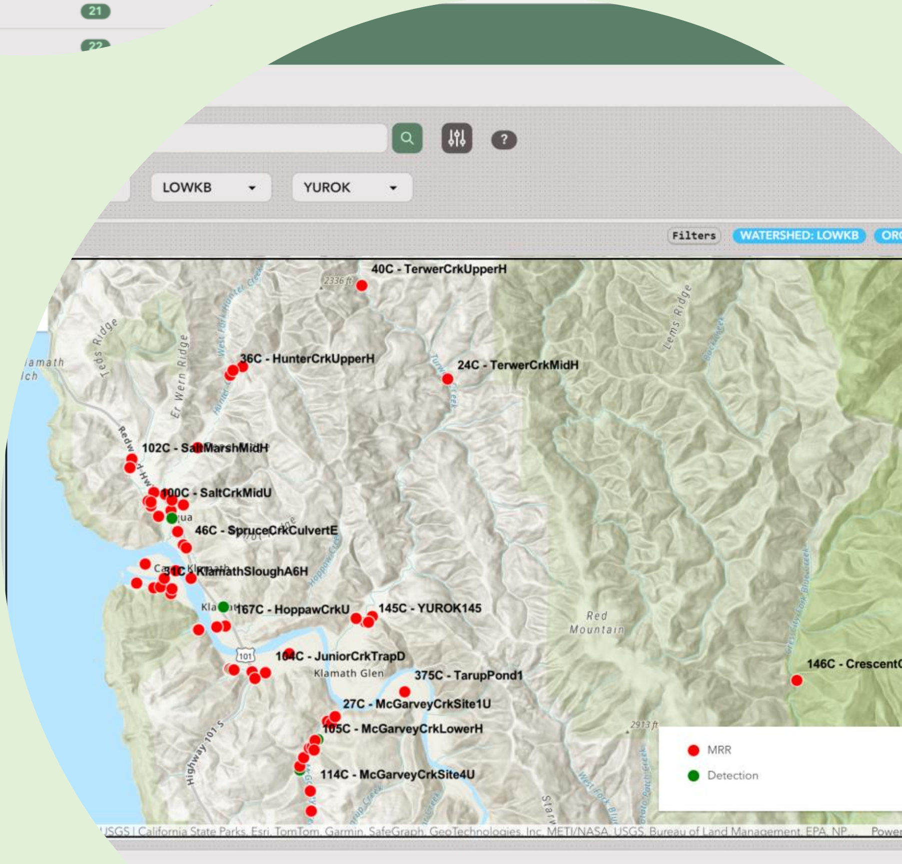
- Overview of collaborative data
- Trend charts
- Easy chart copying

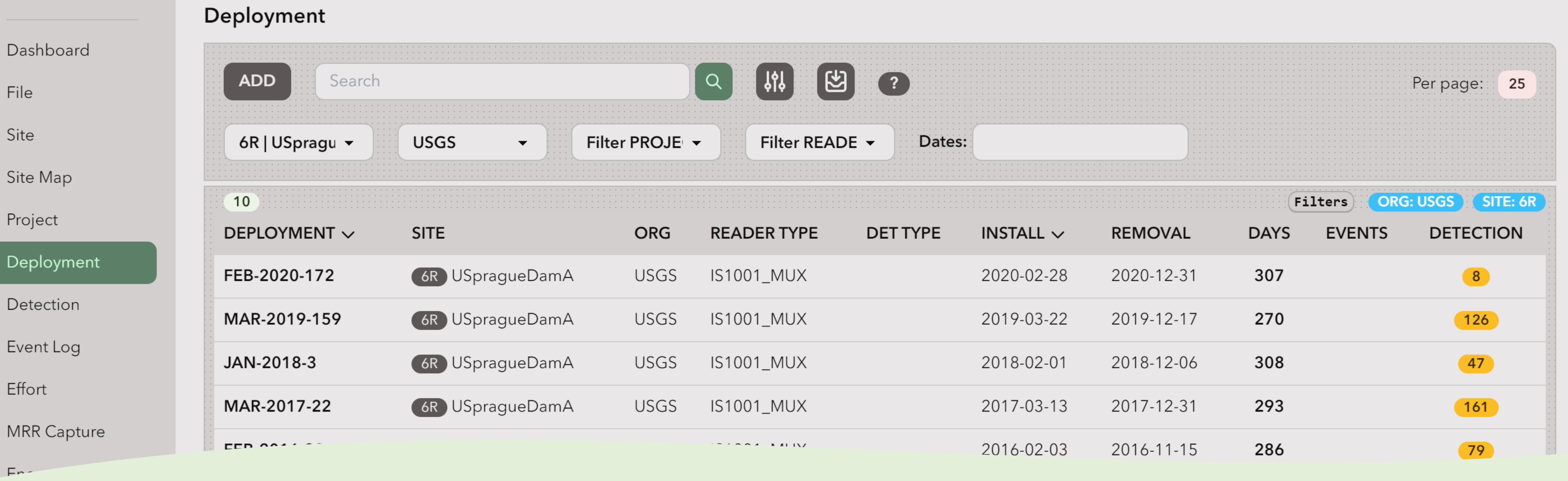


Site List / Site Map

- Visibility of all sites
- No agency-specific site assignment
- Map limitations





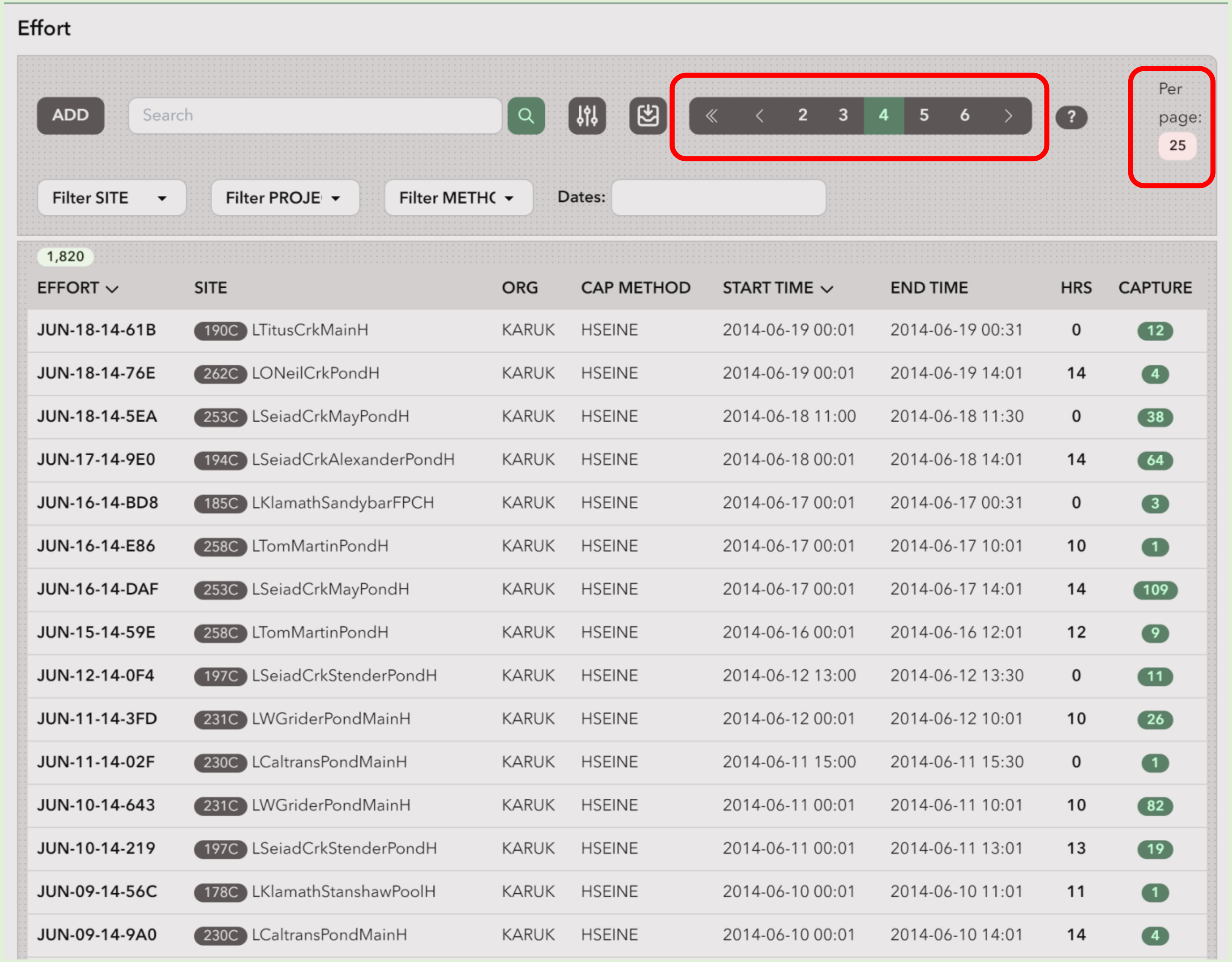


Primary Data Type Pages

- Deployment, Detection, Effort, MRR Capture, Test Pit Tags
- Similar functionality across pages

Data Listing

- Pagination for large datasets
- Customizable page size



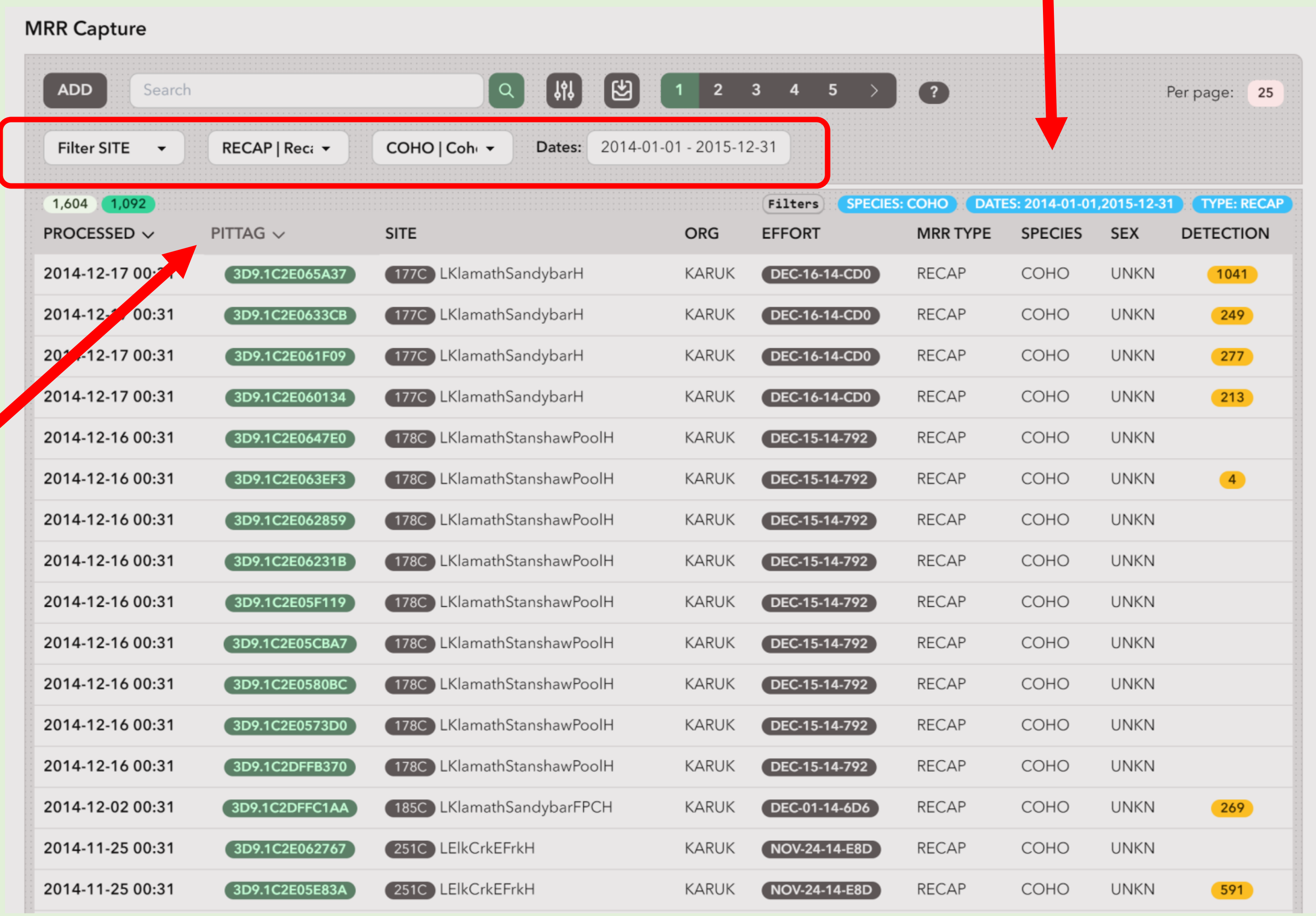
EFFORT	SITE	ORG	CAP METHOD	START TIME	END TIME	HRS	CAPTURE
JUN-18-14-61B	190C LTitusCrkMainH	KARUK	HSEINE	2014-06-19 00:01	2014-06-19 00:31	0	12
JUN-18-14-76E	262C LONeilCrkPondH	KARUK	HSEINE	2014-06-19 00:01	2014-06-19 14:01	14	4
JUN-18-14-5EA	253C LSeiadCrkMayPondH	KARUK	HSEINE	2014-06-18 11:00	2014-06-18 11:30	0	38
JUN-17-14-9E0	194C LSeiadCrkAlexanderPondH	KARUK	HSEINE	2014-06-18 00:01	2014-06-18 14:01	14	64
JUN-16-14-BD8	185C LKlamathSandybarFPCH	KARUK	HSEINE	2014-06-17 00:01	2014-06-17 00:31	0	3
JUN-16-14-E86	258C LTomMartinPondH	KARUK	HSEINE	2014-06-17 00:01	2014-06-17 10:01	10	1
JUN-16-14-DAF	253C LSeiadCrkMayPondH	KARUK	HSEINE	2014-06-17 00:01	2014-06-17 14:01	14	109
JUN-15-14-59E	258C LTomMartinPondH	KARUK	HSEINE	2014-06-16 00:01	2014-06-16 12:01	12	9
JUN-12-14-0F4	197C LSeiadCrkStenderPondH	KARUK	HSEINE	2014-06-12 13:00	2014-06-12 13:30	0	11
JUN-11-14-3FD	231C LWGriderPondMainH	KARUK	HSEINE	2014-06-12 00:01	2014-06-12 10:01	10	26
JUN-11-14-02F	230C LCaltransPondMainH	KARUK	HSEINE	2014-06-11 15:00	2014-06-11 15:30	0	1
JUN-10-14-643	231C LWGriderPondMainH	KARUK	HSEINE	2014-06-11 00:01	2014-06-11 10:01	10	82
JUN-10-14-219	197C LSeiadCrkStenderPondH	KARUK	HSEINE	2014-06-11 00:01	2014-06-11 13:01	13	19
JUN-09-14-56C	178C LKlamathStanshawPoolH	KARUK	HSEINE	2014-06-10 00:01	2014-06-10 11:01	11	1
JUN-09-14-9A0	230C LCaltransPondMainH	KARUK	HSEINE	2014-06-10 00:01	2014-06-10 14:01	14	4

Data Filter/Sort & Search

- Multiple filters and sorting options
- Blue labels for active filters
- Search functionality

Applied filters

Sort



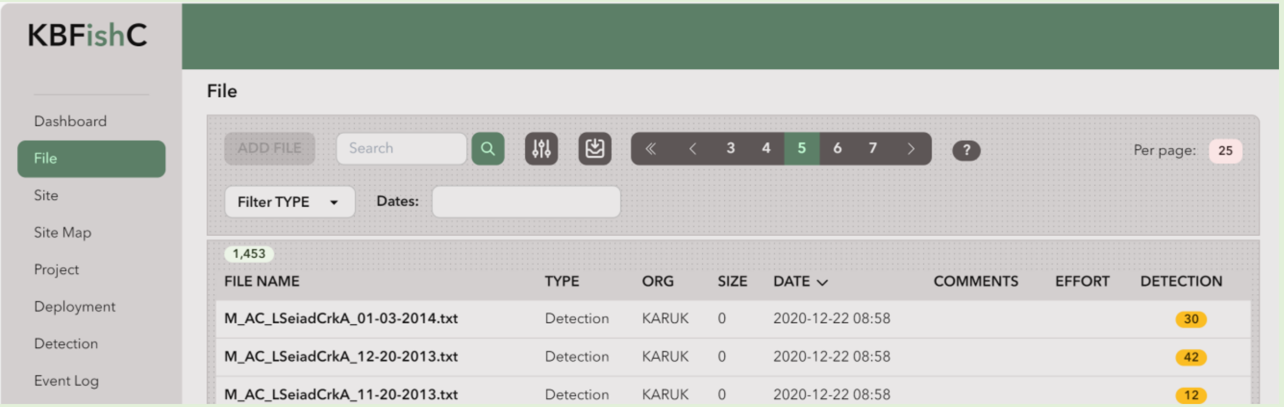
PROCESSED	PITTAG	SITE	ORG	EFFORT	MRR TYPE	SPECIES	SEX	DETECTION
2014-12-17 00:3[illegible]	3D9.1C2E065A37	177C LKlamathSandybarH	KARUK	DEC-16-14-CD0	RECAP	COHO	UNKN	1041
2014-12-[illegible] 00:31	3D9.1C2E0633CB	177C LKlamathSandybarH	KARUK	DEC-16-14-CD0	RECAP	COHO	UNKN	249
20[illegible]-12-17 00:31	3D9.1C2E061F09	177C LKlamathSandybarH	KARUK	DEC-16-14-CD0	RECAP	COHO	UNKN	277
2014-12-17 00:31	3D9.1C2E060134	177C LKlamathSandybarH	KARUK	DEC-16-14-CD0	RECAP	COHO	UNKN	213
2014-12-16 00:31	3D9.1C2E0647E0	178C LKlamathStanshawPoolH	KARUK	DEC-15-14-792	RECAP	COHO	UNKN	
2014-12-16 00:31	3D9.1C2E063EF3	178C LKlamathStanshawPoolH	KARUK	DEC-15-14-792	RECAP	COHO	UNKN	4
2014-12-16 00:31	3D9.1C2E062859	178C LKlamathStanshawPoolH	KARUK	DEC-15-14-792	RECAP	COHO	UNKN	
2014-12-16 00:31	3D9.1C2E06231B	178C LKlamathStanshawPoolH	KARUK	DEC-15-14-792	RECAP	COHO	UNKN	
2014-12-16 00:31	3D9.1C2E05F119	178C LKlamathStanshawPoolH	KARUK	DEC-15-14-792	RECAP	COHO	UNKN	
2014-12-16 00:31	3D9.1C2E05CBA7	178C LKlamathStanshawPoolH	KARUK	DEC-15-14-792	RECAP	COHO	UNKN	
2014-12-16 00:31	3D9.1C2E0580BC	178C LKlamathStanshawPoolH	KARUK	DEC-15-14-792	RECAP	COHO	UNKN	
2014-12-16 00:31	3D9.1C2E0573D0	178C LKlamathStanshawPoolH	KARUK	DEC-15-14-792	RECAP	COHO	UNKN	
2014-12-16 00:31	3D9.1C2DFFB370	178C LKlamathStanshawPoolH	KARUK	DEC-15-14-792	RECAP	COHO	UNKN	
2014-12-02 00:31	3D9.1C2DFFC1AA	185C LKlamathSandybarFPCH	KARUK	DEC-01-14-6D6	RECAP	COHO	UNKN	269
2014-11-25 00:31	3D9.1C2E062767	251C LElkCrkEFrkH	KARUK	NOV-24-14-E8D	RECAP	COHO	UNKN	
2014-11-25 00:31	3D9.1C2E05E83A	251C LElkCrkEFrkH	KARUK	NOV-24-14-E8D	RECAP	COHO	UNKN	591

Data Entry - File Uploading

- Manual entry for some data
- Auto-parsing of uploaded files
- Immediate validation

Manual data entry

Data upload -> automated insertion

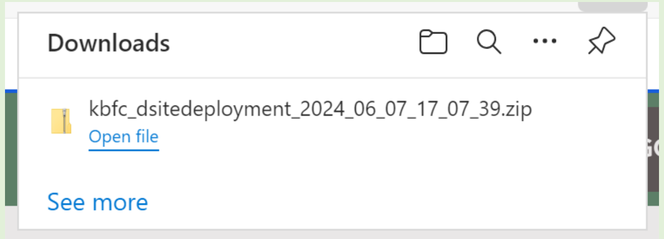


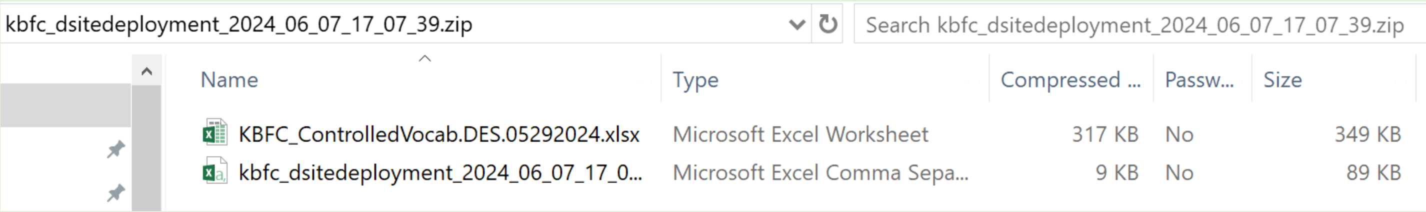
Data Downloading

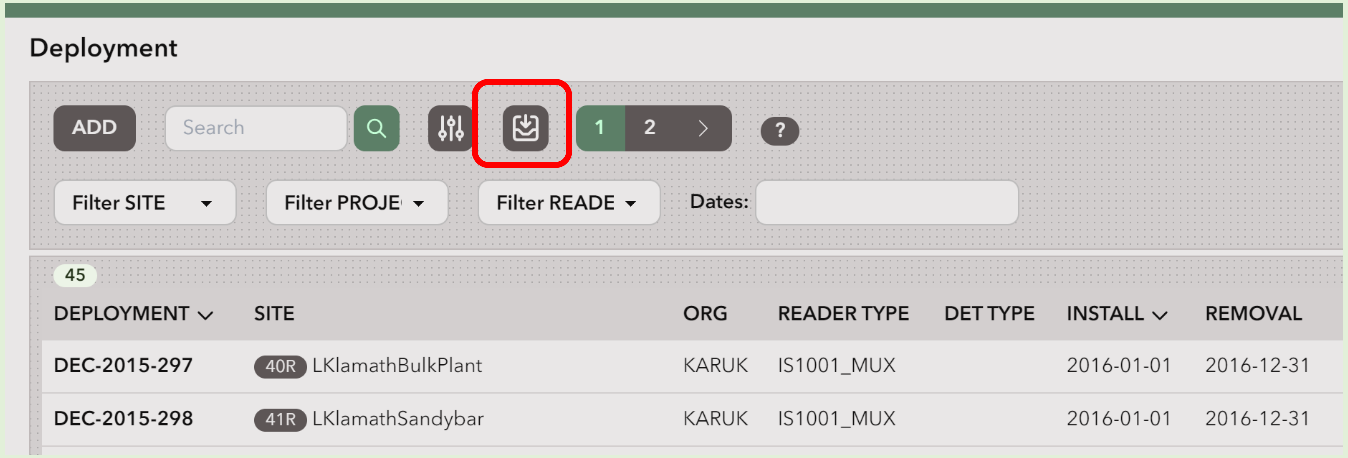
CSV/Excel downloads

Filtered and sorted data

Limit of 10,000 records

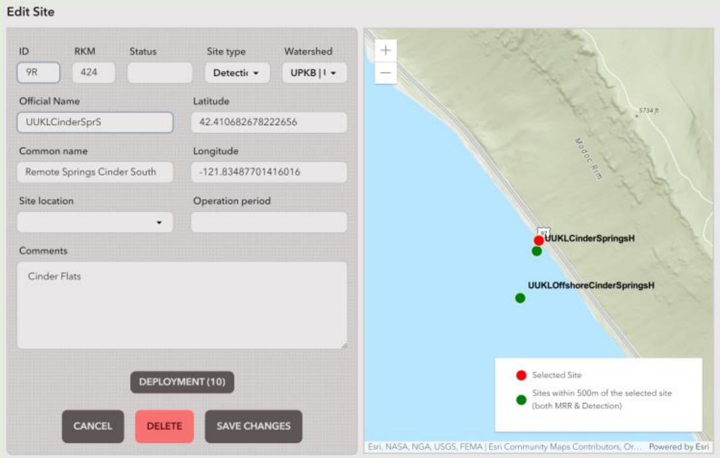


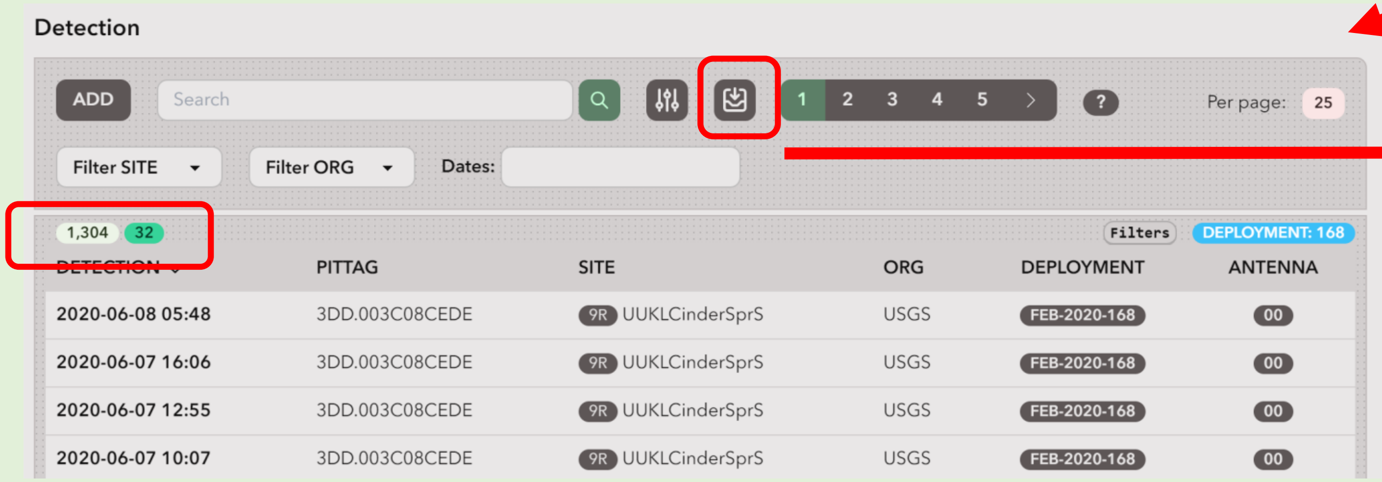


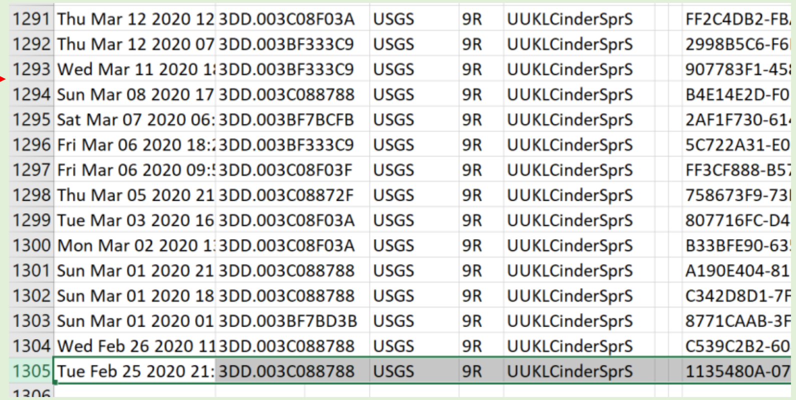


Navigation

- Bubble links and buttons
- Flexible, but requires practice

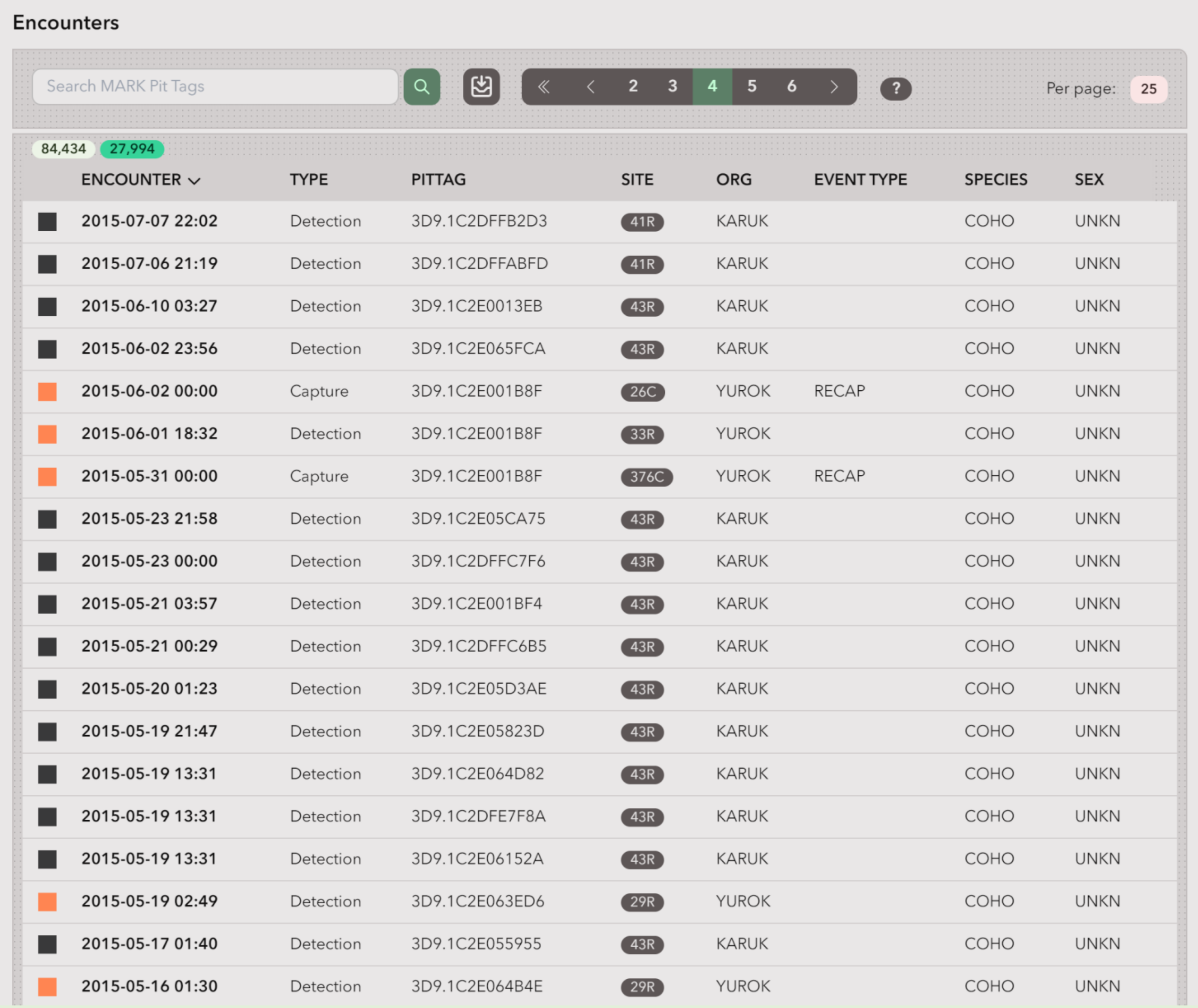






Mark Encounters

- Combination of detections and captures
- Temporal filter and raw data download
- Search for tag records



Encounters

Search MARK Pit Tags | « ‹ 2 3 4 5 6 › | ? | Per page: 25

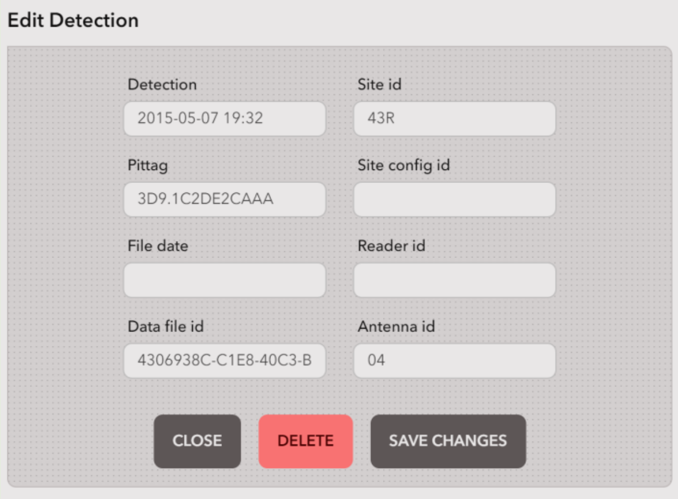
84,434 27,994

ENCOUNTER	TYPE	PITTAG	SITE	ORG	EVENT TYPE	SPECIES	SEX
2015-07-07 22:02	Detection	3D9.1C2DFFB2D3	41R	KARUK		COHO	UNKN
2015-07-06 21:19	Detection	3D9.1C2DFFABFD	41R	KARUK		COHO	UNKN
2015-06-10 03:27	Detection	3D9.1C2E0013EB	43R	KARUK		COHO	UNKN
2015-06-02 23:56	Detection	3D9.1C2E065FCA	43R	KARUK		COHO	UNKN
2015-06-02 00:00	Capture	3D9.1C2E001B8F	26C	YUROK	RECAP	COHO	UNKN
2015-06-01 18:32	Detection	3D9.1C2E001B8F	33R	YUROK		COHO	UNKN
2015-05-31 00:00	Capture	3D9.1C2E001B8F	376C	YUROK	RECAP	COHO	UNKN
2015-05-23 21:58	Detection	3D9.1C2E05CA75	43R	KARUK		COHO	UNKN
2015-05-23 00:00	Detection	3D9.1C2DFFC7F6	43R	KARUK		COHO	UNKN
2015-05-21 03:57	Detection	3D9.1C2E001BF4	43R	KARUK		COHO	UNKN
2015-05-21 00:29	Detection	3D9.1C2DFFC6B5	43R	KARUK		COHO	UNKN
2015-05-20 01:23	Detection	3D9.1C2E05D3AE	43R	KARUK		COHO	UNKN
2015-05-19 21:47	Detection	3D9.1C2E05823D	43R	KARUK		COHO	UNKN
2015-05-19 13:31	Detection	3D9.1C2E064D82	43R	KARUK		COHO	UNKN
2015-05-19 13:31	Detection	3D9.1C2DFE7F8A	43R	KARUK		COHO	UNKN
2015-05-19 13:31	Detection	3D9.1C2E06152A	43R	KARUK		COHO	UNKN
2015-05-19 02:49	Detection	3D9.1C2E063ED6	29R	YUROK		COHO	UNKN
2015-05-17 01:40	Detection	3D9.1C2E055955	43R	KARUK		COHO	UNKN
2015-05-16 01:30	Detection	3D9.1C2E064B4E	29R	YUROK		COHO	UNKN

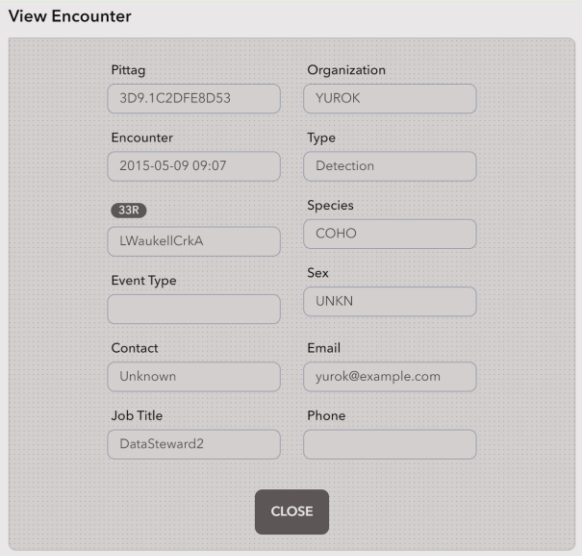
Mark Encounter Data Views

- Owner data view
- Technical data view
- Basic data view

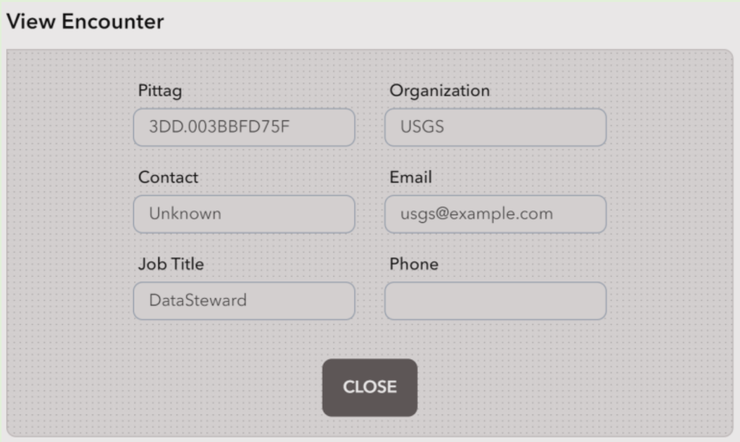
Owner data view



Technical data view



Basic data view



Conclusion

- Many milestones accomplished over the past year
- Emphasis on collaboration and data sharing benefits
- Thank you to KBFC members and Leadership Team

…and others!

- Interested in joining the Website Work Group?

  Contact Erin Benham (ebenham@psmfc.org) or Monica Diaz (mdiaz@psmfc.org)

Break

Returning at 2:40

Toz Soto- Karuk Tribe
Harrison Marrow- SRWC
Jimmy Faukner- Yurok Tribe

The Use of Coho Salmon PIT Tag Data to Determine Juvenile Life History Contributions to Adult Returns and More!

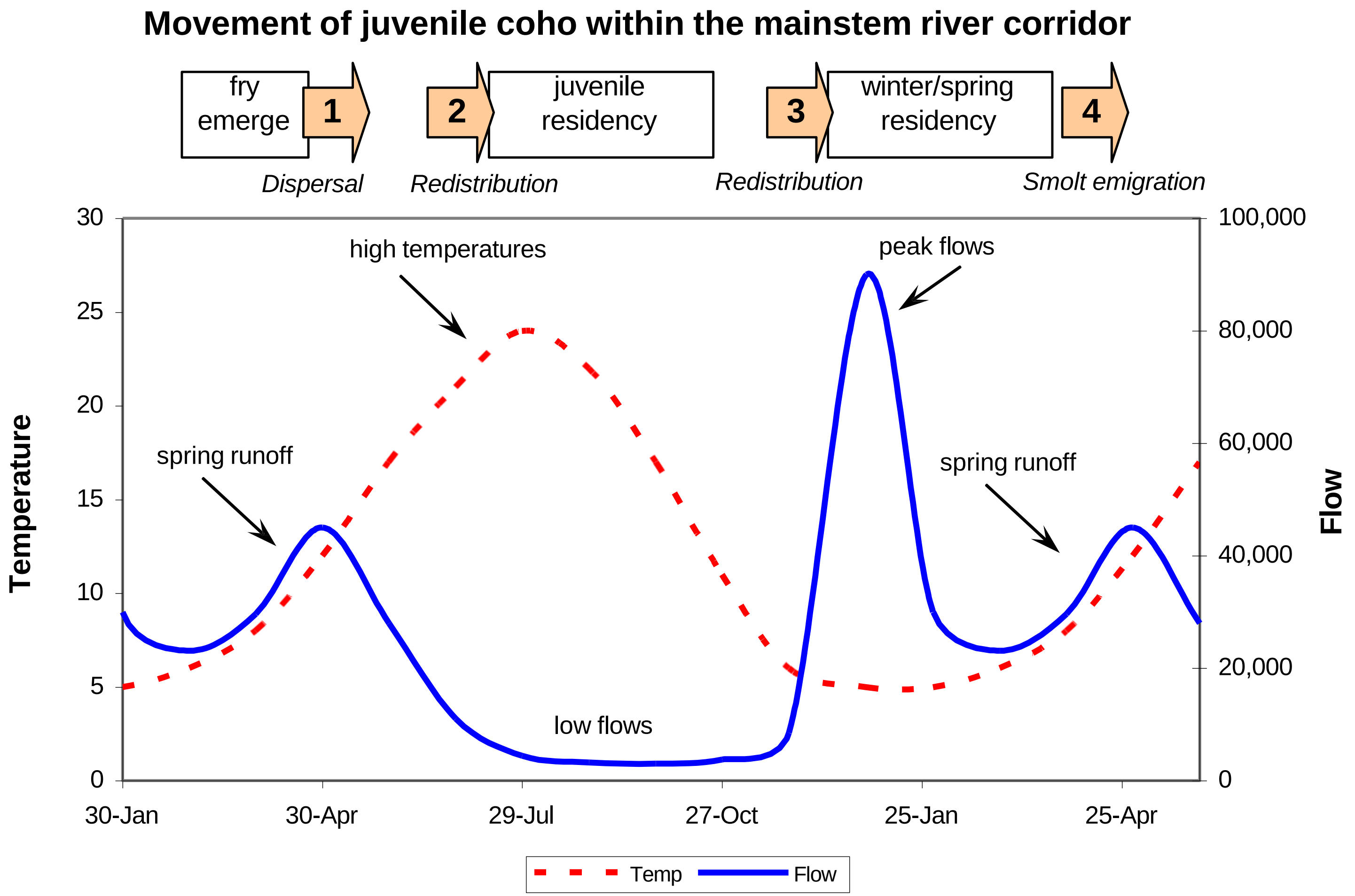
The Use of Coho Salmon PIT Tag Data to Determine Juvenile Life History Contributions to Adult Returns and More!

Toz Soto, Karuk Tribe Fisheries Program

Harrison Morrow, Scott River Watershed Council

Jimmy Faukner, Yurok Tribe Fisheries Department

Juvenile Coho Movement



Juvenile Coho Migration Timing of Adult Returns 2008-2014

Migration timing	Number of Fish (41)
Summer 0+	12
Fall 0+	1
Spring 1+	14
Unknown (Summer or Fall)	3
Unknown (Fall or Spring)	6
Unknown	4

Summer Migrant-Non Natal

Fish 16

Tagged in Tom Martin Creek Aug 2010

Cold Water Refuge Aug-Sept-Nov-2010

Adult Returned to Shasta River Nov 2012

985 121016677697,f,,73,Coho salmon,2010-08-17 01:31:00,LTomMartinCrkMainH,KTOC,Seine	JUV
985 121016677697,t,,82,Coho salmon,2010-09-20 12:00:00,LTomMartinCrkMainH,KTOC,Seine	JUV
985 121016677697,t,,82,Coho salmon,2010-11-01 12:00:00,LTomMartinCrkMainH,KTOC,Seine	JUV
985 121016677697,t,,,Coho salmon,2012-11-22 22:31:28,LShasta0A3,CADFG,Remote Allflex	ADULT
985 121016677697,t,,,Coho salmon,2012-11-24 22:36:31,LShasta0C1,CADFG,Remote Allflex	ADULT

Fall Migrant-Non Natal

Fish 10

Tagged in Lower Seiad Creek July 2010	**Rearing in Seiad Creek August 2010**	**Fall Out-migrant Seiad Creek Nov 2010**	**Entered Waukell Creek Dec 2010**	**Spring Out-migrant Waukell Creek April 2011**	**Adult Return to Seiad Creek Nov 2012**

985 121015690394,f,,67,Coho salmon,2010-07-20 01:31:00,LSeiadCrkLowerH,KTOC,Seine	JUV
985 121015690394,t,,71,Coho salmon,2010-08-04 01:31:00,LSeiadCrkLowerH,KTOC,Seine	JUV
985 121015690394,t,,78,Coho salmon,2010-08-31 12:00:00,LSeiadCrkLowerH,KTOC,Seine	JUV
985 121015690394,t,,,Coho salmon,2010-11-23 18:37:39,LSeiadCrkA1,KTOC,Remote MUX	JUV
985 121015690394,t,,,Coho salmon,2010-12-24 07:17:48,LWaukellCrkA2,YTOC,Remote MUX	JUV
985 121015690394,t,,,Coho salmon,2011-04-17 08:09:11,LWaukellCrkA1,YTOC,Remote MUX	JUV
985 121015690394,t,,,Coho salmon,2012-11-14 18:46:38,LSeiadCrkA3,KTOC,Remote MUX	ADULT

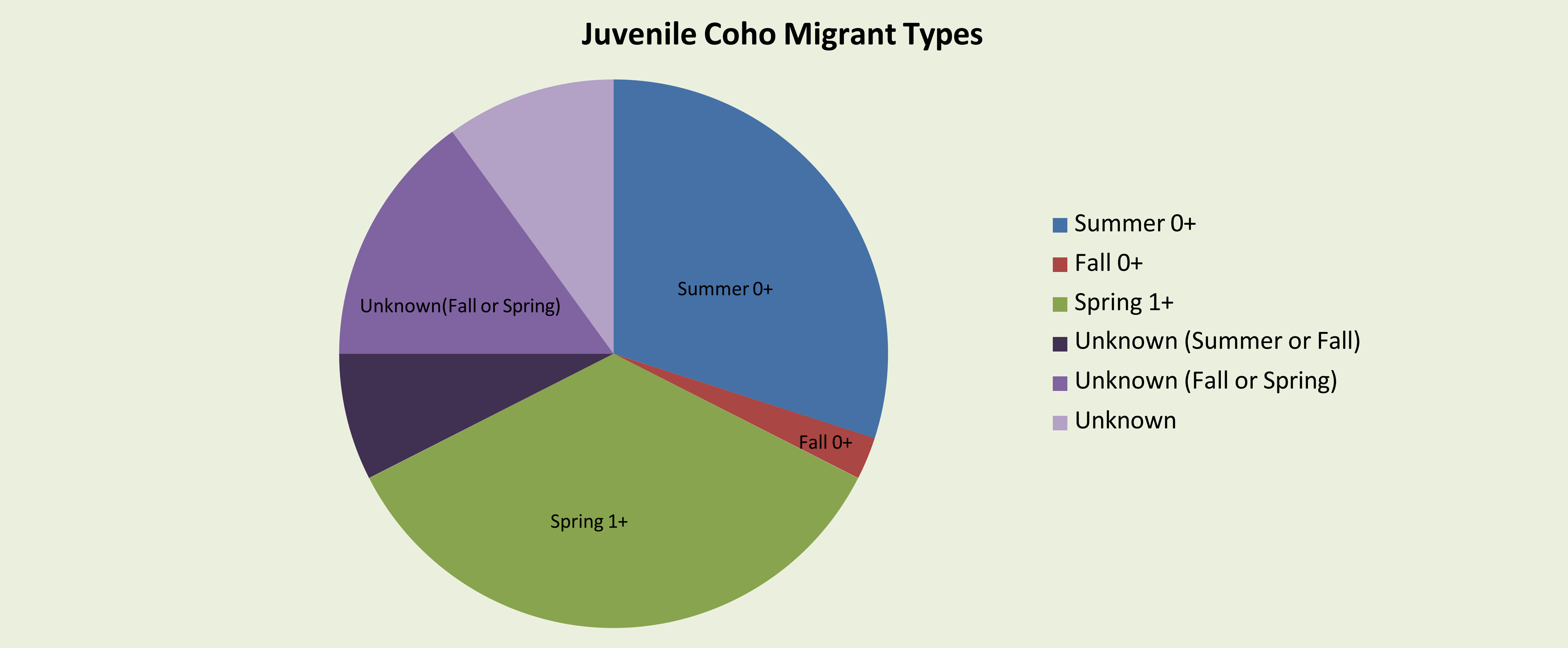
Spring Migrant-Natal

Fish 35

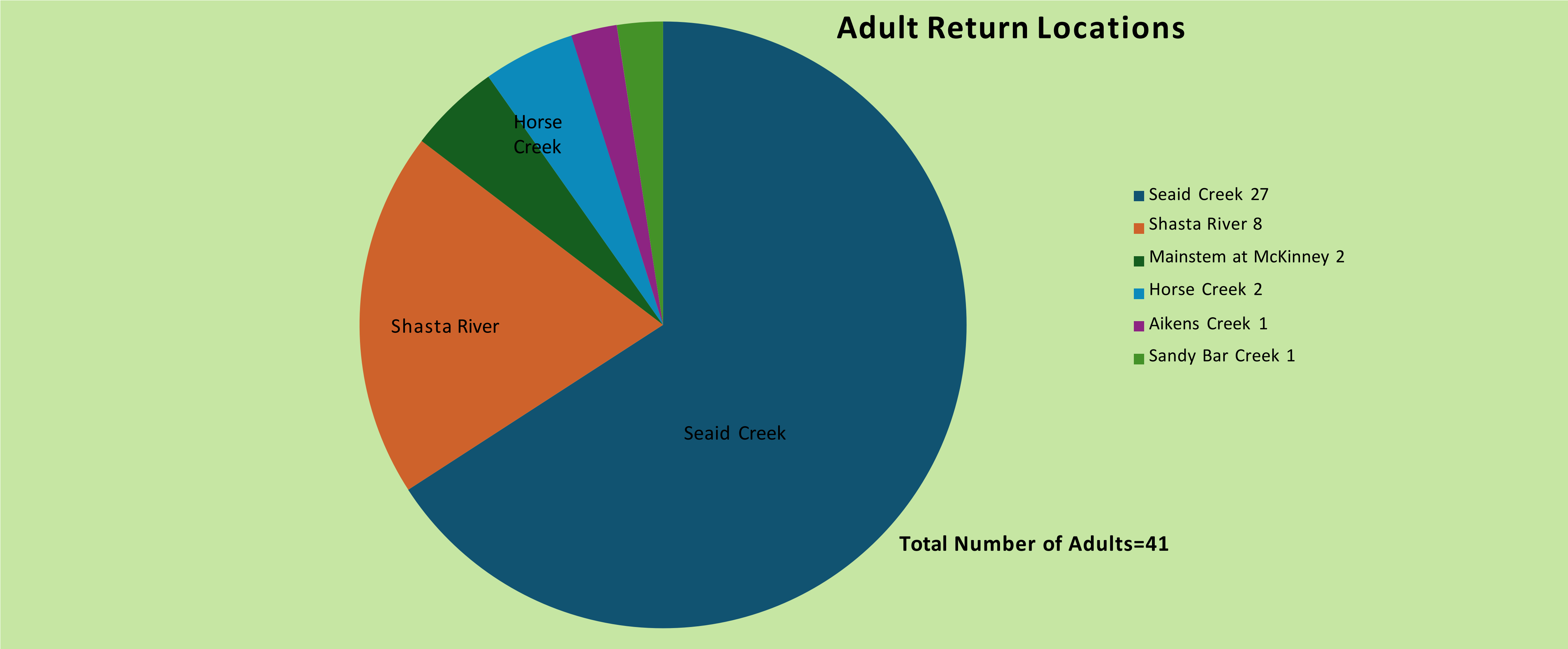
Tagged in Seiad Creek Oct 2011	Over wintered in Lower Seiad Pond-Feb 2012	Spring Out-migrant from Seiad Creek-April 2012	Adult Returned to Seiad Creek-Nov 2013

985 121026911500,f,,70,Coho salmon,2011-10-11 12:00:00,LSeiadCrkLowerH,KTOC,Seine	JUV
985 121026911500,t,,89,Coho salmon,2012-02-10 12:00:00,LCaltransPondMainH,KTOC,Fyke Trap	JUV
985 121026911500,t,,,Coho salmon,2012-04-19 05:33:50,LSeiadCrkA4,KTOC,Remote MUX	JUV
985 121026911500,t,,,Coho salmon,2013-11-15 21:06:19,LSeiadCrkA3,KTOC,Remote MUX	ADULT

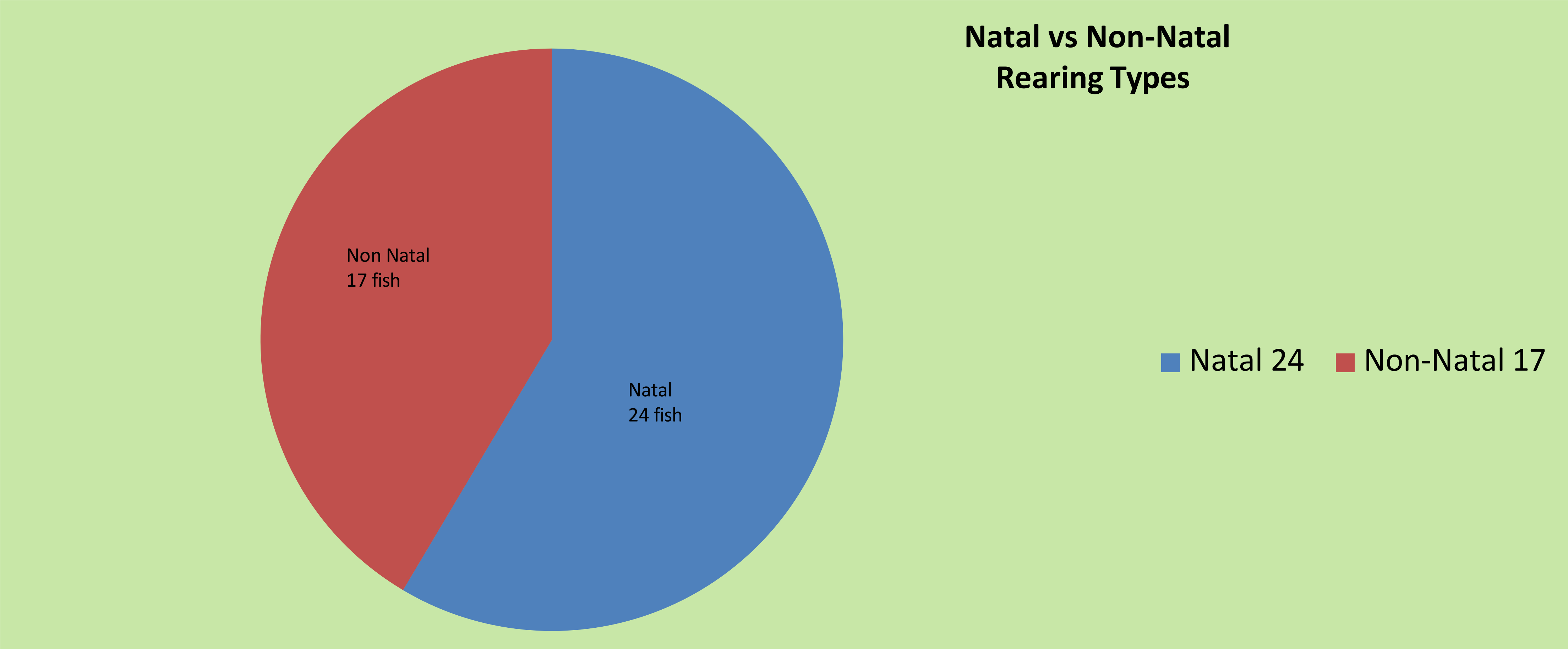
Juvenile Coho Migrant Types

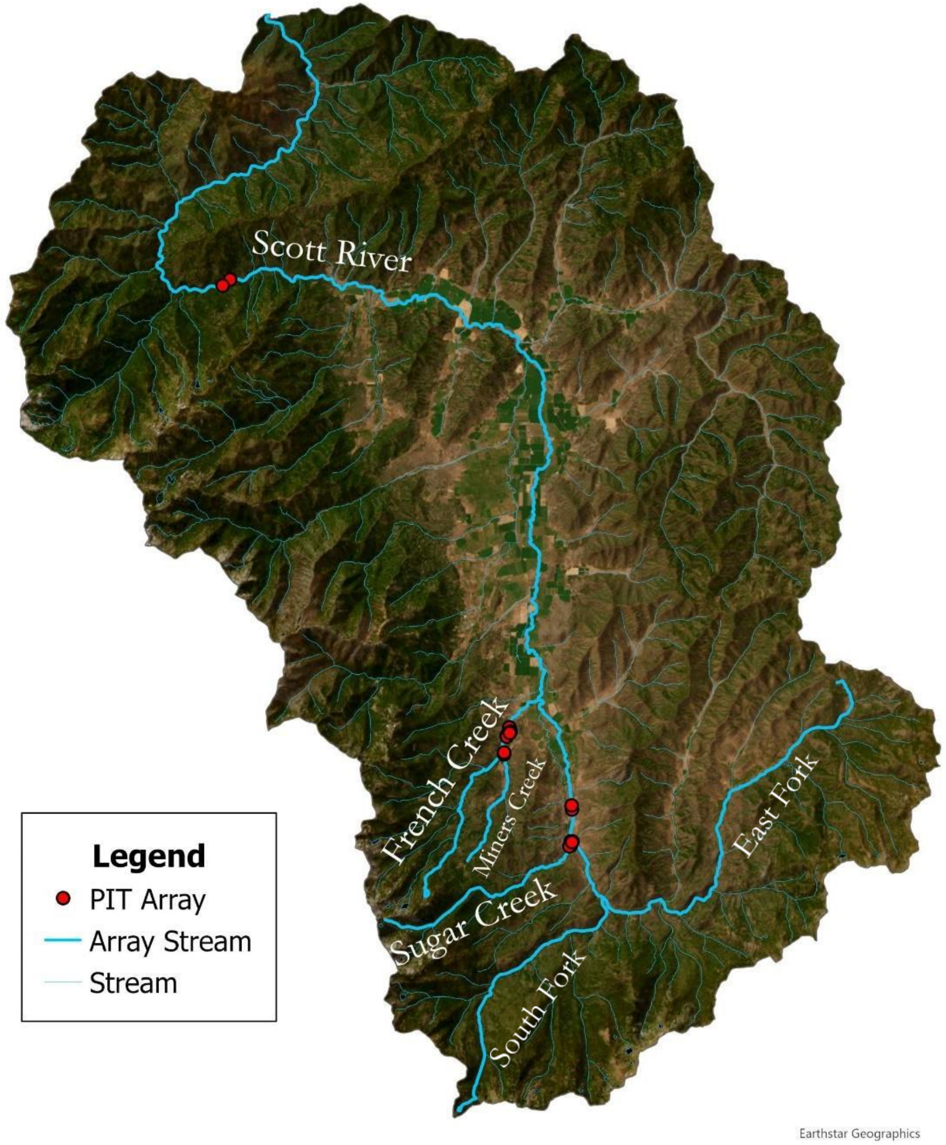


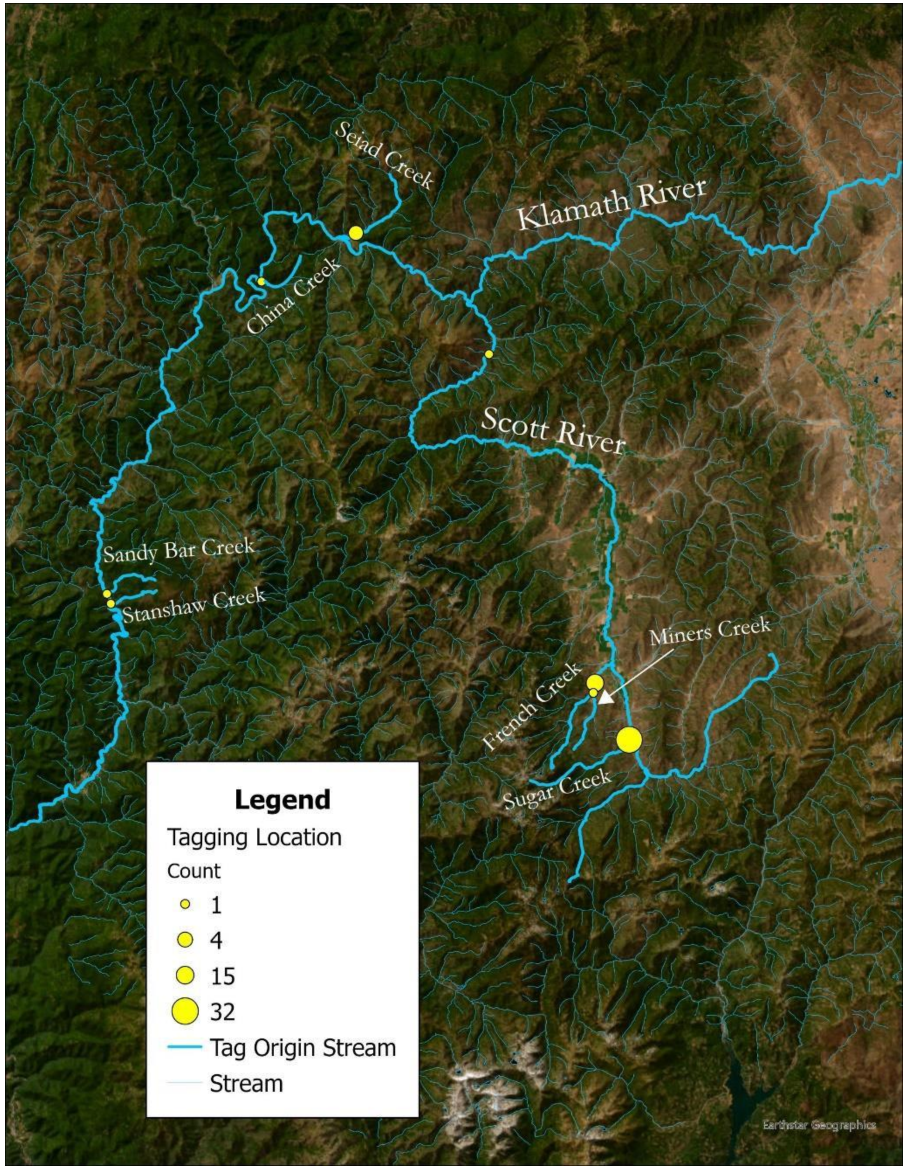
Adult Return Locations



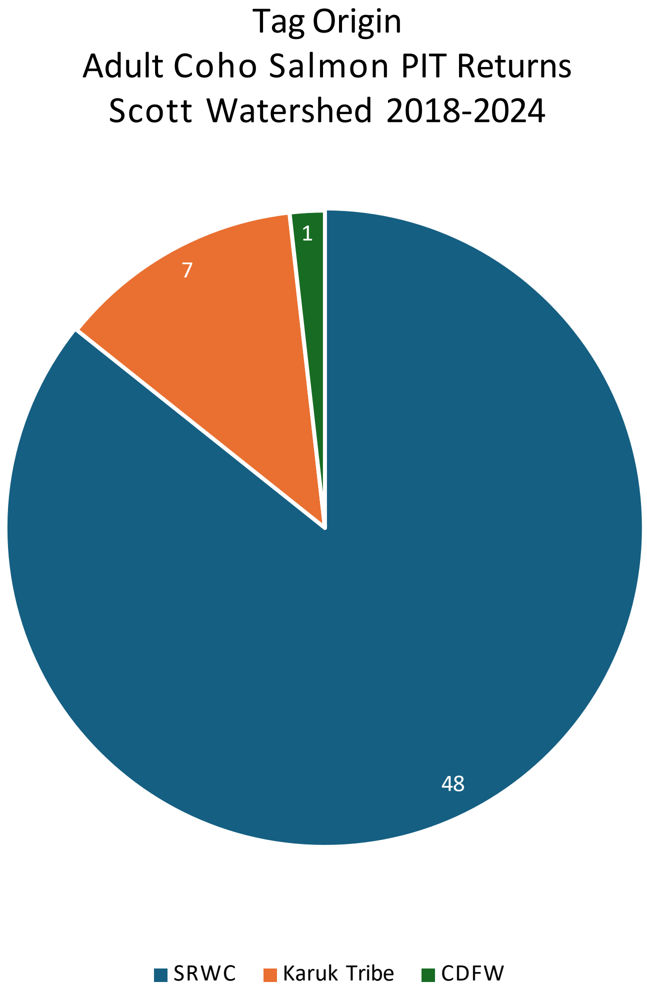
Natal vs Non-Natal Rearing



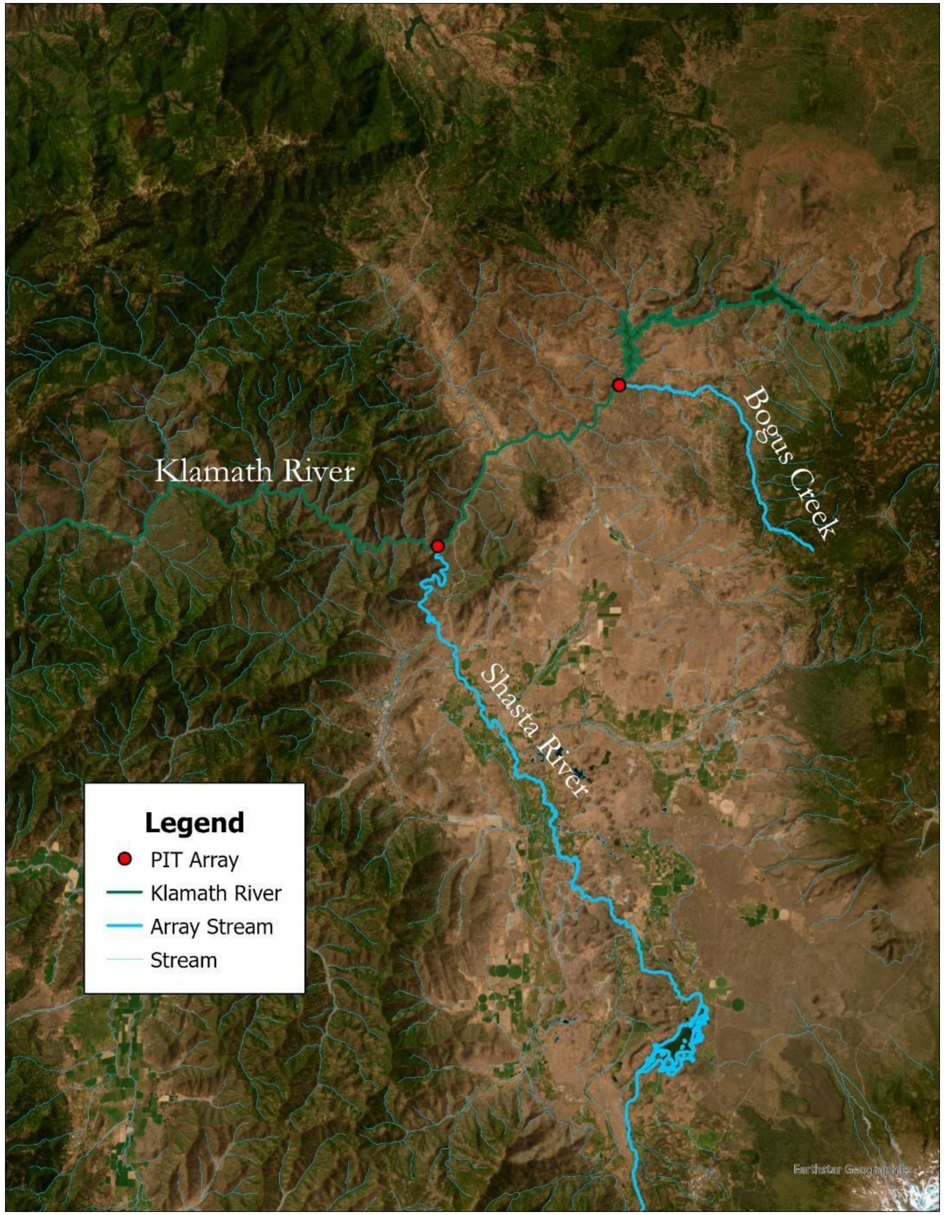

Scott River
French Creek
Miners Creek
Sugar Creek
South Fork
East Fork
Legend
PIT Array
Array Stream
Stream
Earthstar Geographics

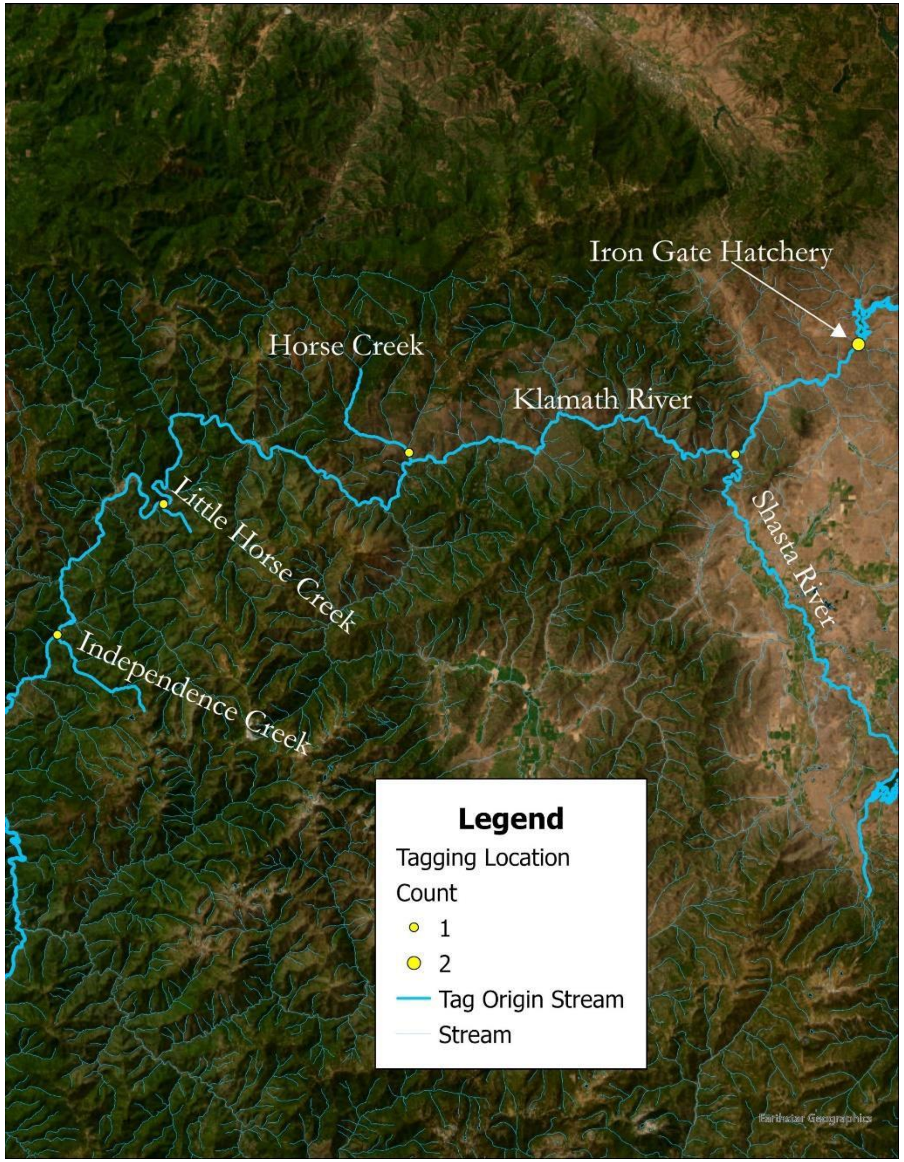


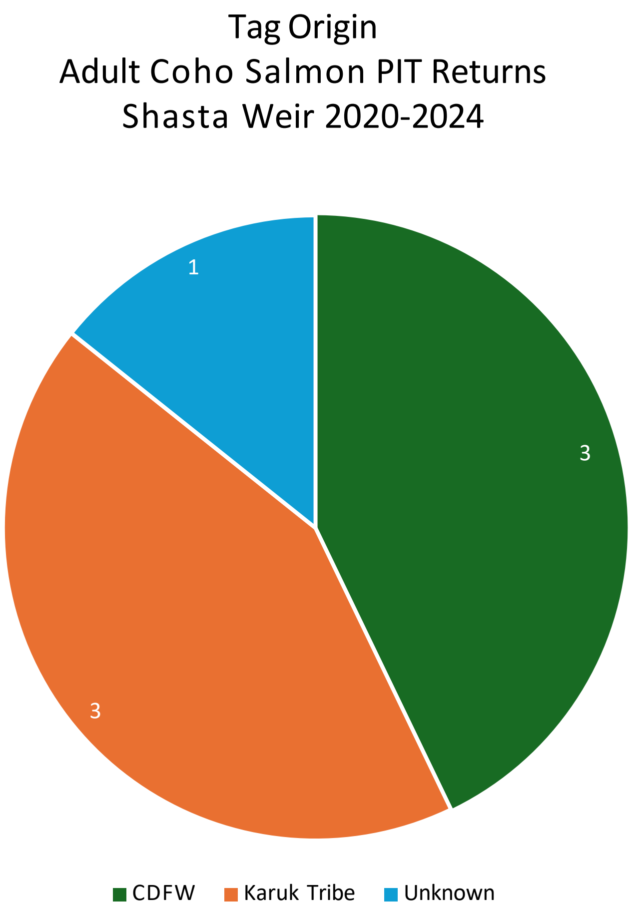
Seiad Creek
Klamath River
China Creek
Scott River
Sandy Bar Creek
Stanshaw Creek
Miners Creek
French Creek
Sugar Creek
Legend
Tagging Location
Count
1
4
15
32
Tag Origin Stream
Stream
Earthstar Geographics



Tag Origin
Adult Coho Salmon PIT Returns
Scott Watershed 2018-2024
1
7
48
SRWC
Karuk Tribe
CDFW


Klamath River
Bogus Creek
Shasta River
Legend
PIT Array
Klamath River
Array Stream
Stream
Earthstar Geographics


Iron Gate Hatchery
Horse Creek
Klamath River
Little Horse Creek
Shasta River
Independence Creek
Legend
Tagging Location
Count
1
2
Tag Origin Stream
Stream

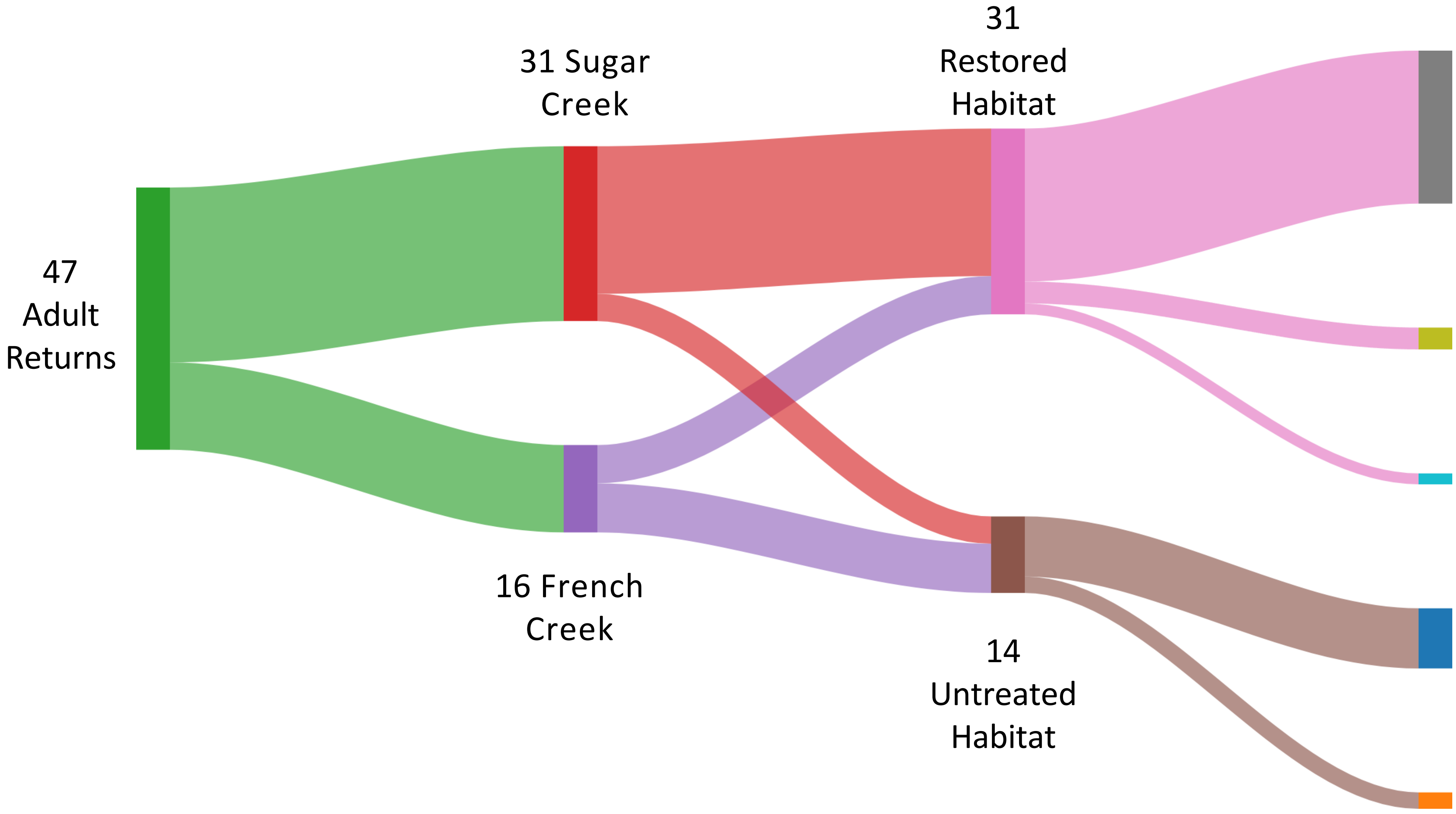

Tag Origin
Adult Coho Salmon PIT Returns
Shasta Weir 2020-2024
1
3
3
CDFW
Karuk Tribe
Unknown

Scott and Shasta Coho Tagged in Mid-Klamath by Karuk Tribe

Tag Date	Tag Stream	Tag Location	PIT Code	FL (mm)	Weight (g)	Adult Detection
8/15/2019	China Creek		989001007222252	82	6.3	detected at scott 80 ft jan 2022
2/5/2020	Sandy Bar Creek	Sandy Bar Pond	989001028156354	94	9.7	detected at scott weir nov 2021
2/25/2020	Seiad Creek	May Pond	989001028156444	86	6.7	detected at scott 80ft jan 2022
1/7/2019	Seaid Creek	Reach 2	989001007220367	64	3.2	detected at scott weir dec 2020
7/1/2021	Stanshaw Creek		989001028144543	69	4.1	detected at scott weir dec 2023
2/1/2019	Seiad Creek	Alexander Pond	989001007221061	72	3.7	detected at scott weir dec 2020
2/25/2020	Seiad Creek	May Pond	989001028155263	101	9.6	detected at scott 80ft jan 2022
9/22/2020	Klamath River	Independence Creek Mouth	989001028154351	83	6.3	detected at shasta weir in dec 2022
10/29/2019	Little Horse Creek	Little Horse Creek	989001028156713	102	13.4	detected at shasta weir in dec 2021
4/16/2019	Horse Creek	Upper Lawrence Pond	989001007221262	110	13.13	detected at shasta weir in jan 2021

*None of these fish detected at the Scott weir site were detected entering French Creek or Sugar Creek

SRWC-Tagged Adult Coho Returns (Age 3)



Number of Returners by Habitat Type 2018-2024	Total Tags Applied in Habitat Type 2016-2022 (% return)
27 BDA Habitat	4,933 (0.55%)
4 Constructed Side Channel/Off-Channel Pond	1,587 (0.25%)
2 Engineered Log Jam	885 (0.23%)
11 Untreated Pool	3,131 (0.35%)
3 Beaver Dam Habitat	129 (2.3%)

Recapture/Detection Location	Coho Recaptured/Detected in Location Different from Mark Location								
	Mark Location								
	French - Control Pools	French - Pretreatment Upstream Stilling Well	Scott River - Upstream of Sugar/Scott Confluence	Sugar - Above OCP Outlet	Sugar - BDA 1	Sugar - Beaver Dam Complex*	Sugar - Below Natural Beaver Dam	Sugar - OCP	Sugar – Control Pools
French - FRGP SC	9 (0.36 RKM)	1 (0.47 RKM)							
French - Control Pools		2 (0.12 RKM)							
French - Pretreatment Upstream Stilling Well	5 (0.12 RKM)								
French - SC BDA 1 Pond (including array 14)	6 (0.24 RKM)	1 (0.36 RKM)							
Sugar - Above OCP Outlet			1 (0.36 RKM)		11 (0.22 RKM)	3 (0.11 RKM)	3 (0.08 RKM)		2 (0.67 RKM)
Sugar - BDA 1 (including array 2A)			31 (0.16 RKM)	2 (0.22 RKM)		26 (0.28 RKM)	1 (0.25 RKM)	1 (0.30 RKM)	1 (0.89 RKM)
Sugar - Beaver Dam Complex (including array 4A/4B)				2 (0.11 RKM)	53 (0.28 RKM)		8 (0.03 RKM)	1 (0.19 RKM)	14 (0.56 RKM)
Sugar - Below Natural Beaver Dam				1 (0.08 RKM)	14 (0.25 RKM)	5 (0.03 RKM)			
Sugar - OCP (including array 3A/3B)			9 (0.46 RKM)	40 (0.12 RKM)	128 (0.30 RKM)	75 (0.19 RKM)	60 (0.16 RKM)		7 (0.75 RKM)


McGarvey Creek

McGarvey Creek Juvenile Coho Salmon Relocation Efforts

Year	Tagging Dates	# PIT Tagged	Not Tagged	Total
2019	August-September	174	8	182
2020	August-September	252	387	639
2021	August-September	202	21	223
2022	August-September	0	32	32
2023	August-September	9	0	9


PIT Tagged Adult Coho Salmon Returning to McGarvey Creek

Return Year	PIT Tag #	Tagging Location	Tagging Date	McGarvey Exit	McGarvey Enter	Age at Return
2020/2021	989001006144735	Upstream Trap	2/4/20	4/7/20	11/15/20	2
	989001006263568	Fish Rescue	8/28/19	1/31/20	11/19/20	2
	989001006145099	Upstream Trap	2/4/20	5/8/20	12/15/20	2
2021/2022	989001006266441	Fish Rescue	8/19/20	4/26/21	10/22/21	2
2022/2023	989001006144967	WF McGarvey BDA#2	8/10/21	1/8/21	11/30/22	2
	989001006266423	Rescue/WF BDAs	8/25/21	11/9/21	12/4/22	2
	989001006266453	Rescue/WF BDAs	8/19/20	4/18/21	12/1/22	3
	989001006266524	Rescue/WF BDAs	8/19/20	4/26/21	12/5/23	3
	989001006144827	Rescue/WF BDAs	8/6/20	5/9/21	12/10/22	3
	989001007226383	Upper McGarvey	8/27/20	ND	12/10/22	3
2023/2024	989001006266398	Rescue/WF BDAs	8/25/21	11/2/21	11/9/23	3
	989001007225987	Rescue/WF BDAs	8/23/21	11/7/21	11/6/23	3
	989001040587857	Waukell US Trap	11/10/22	–	11/6/23	2
	989001006266379	Upper McGarvey	8/27/21	4/4/22	12/4/23	3

McGarvey Creek Adult PIT Tag Returns

- Forty-two returning adults detected since 2010.
- Smolt to adult ratios are highly inaccurate.
- 36% of returning adults over-wintered in non-natal locations.
- Up to 45% of juveniles leave during the late fall/early winter. Range from 5-45%.
- 60% of the fish returned at age 2.
- The proportion of non-natal smolts and natal smolts during outmigration is unknown.
- Since the West Fork of McGarvey BDAs were installed 60% of returning adults have been from juveniles that were relocated to this restoration site.
- Collecting adult return data requires long term monitoring since the number of returning adults varies on a given year.
- Some years there have been no PIT tag returns.
- Highest year had 10 returning adults.

Some General Conclusions

- Summer age-0+ migrants comprised a substantial number of PIT tagged adults in a Mid Klamath tributary (Seiad Creek).
- Late fall/early winter age-0+ migrants comprised a substantial number of PIT tagged adults in a Lower Klamath tributary (McGarvey Creek).
- Juvenile Coho Salmon PIT tagged in Mid Klamath locations contribute to adult returns in both the Scott and Shasta Rivers.
- A large proportion of returning adults in McGarvey Creek are age-2.
- Only one age-2 adult has been detected in both the mid-Klamath (Seiad Creek) and Scott River (Sugar Creek).
- Juveniles PIT tagged in restoration features are well represented in adult returns in all three areas (Lower Klamath, Mid Klamath and Scott River).

Rachelle Tallman- UC Davis

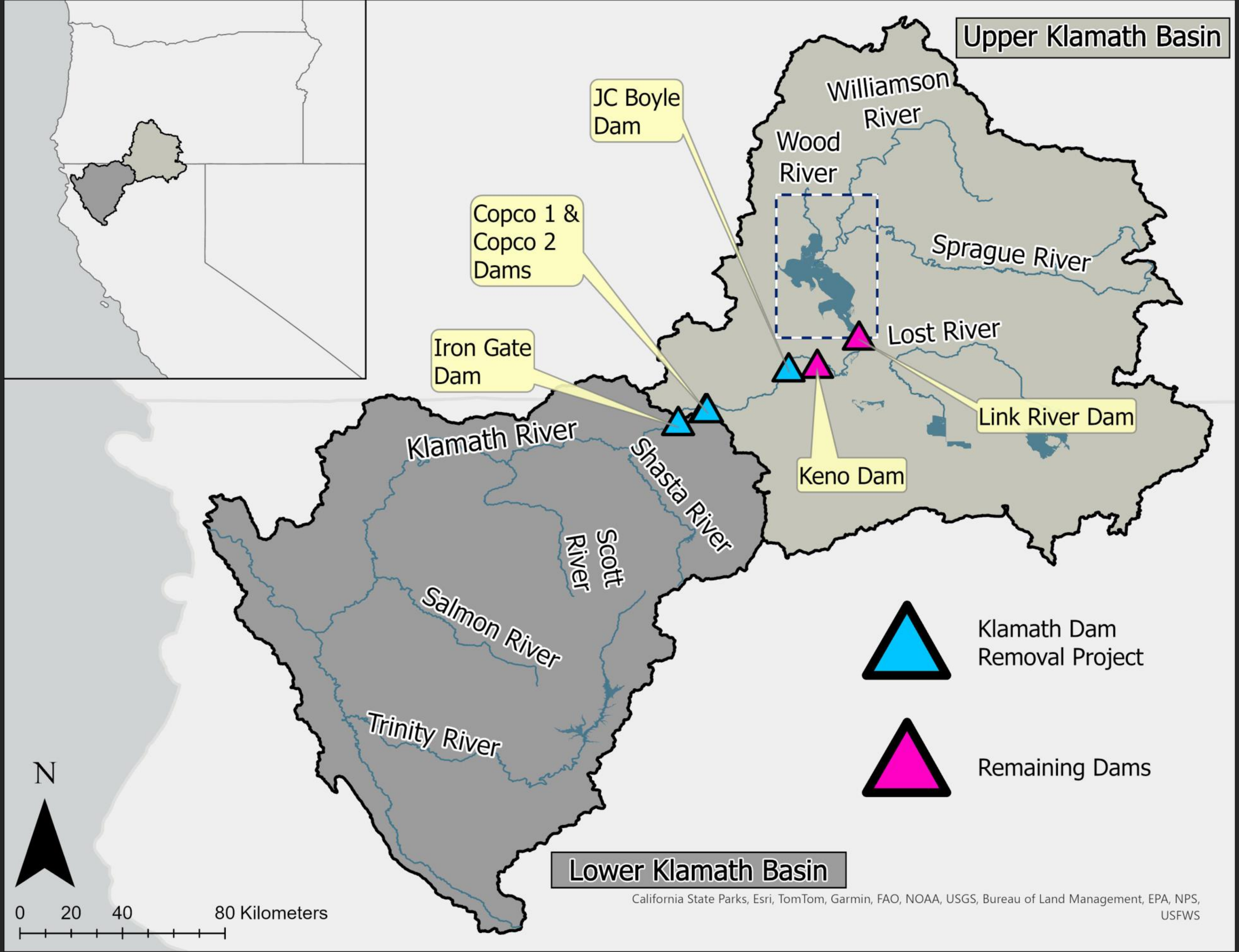
Survival of spring-run Chinook Salmon released in the Upper Klamath River Basin

Survival of spring Chinook Salmon released in the Upper Klamath River Basin

Rachelle Tallman

Graduate Student

UC Davis



Upper Klamath Basin
Williamson River
JC Boyle Dam
Wood River
Copco 1 & Copco 2 Dams
Sprague River
Lost River
Iron Gate Dam
Link River Dam
Klamath River
Shasta River
Keno Dam
Scott River
Salmon River
Trinity River
Klamath Dam Removal Project
Remaining Dams
N
Lower Klamath Basin
0 20 40 80 Kilometers
California State Parks, Esri, TomTom, Garmin, FAO, NOAA, USGS, Bureau of Land Management, EPA, NPS, USFWS

Klamath Basin Timeline

1800

1824
Arrival of Peter Ogden

1864
The Klamath Tribes (TKT) cede 23 million acres

1872-1873
Modoc Wars

1900

1918
Copco 1

1921
Link River Dam

1925
Copco 2

1954
The Klamath Termination Act

1958
JC Boyle Dam

1964
Iron Gate

1966
Keno Dam

1986
Restored Sovereignty

1988
ESA Listing Shortnose and Lost River Sucker

1993
Last successful sucker recruitment

2000

Klamath Basin Timeline cont.

2000

2002
Salmon Fish Kill

2010

2010
Klamath Basin Restoration Agreement

2010
Klamath Hydroelectric Settlement Agreement- signed in 2016

2020

2022
Spring Chinook salmon release

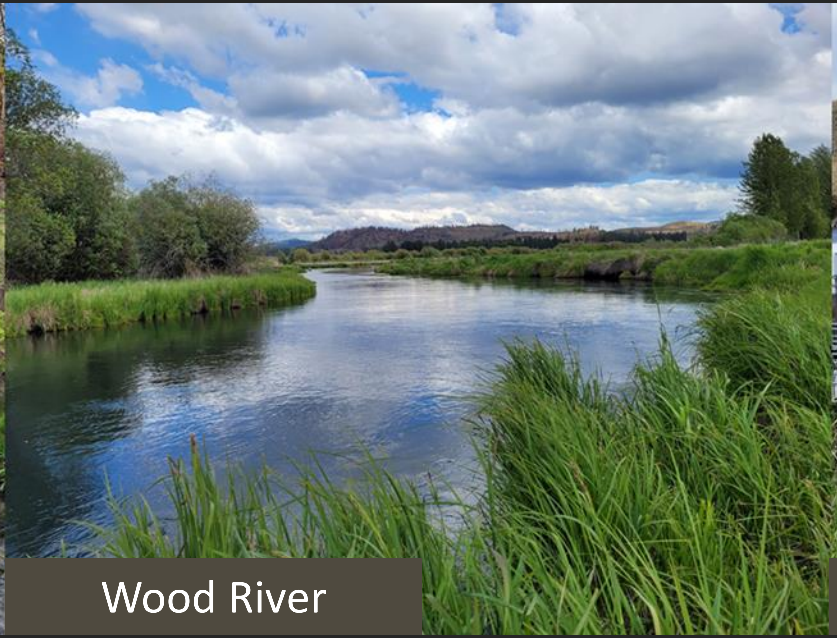
2023
Copco 2 Removal

2024
JC Boyle
Copco 1
Iron Gate
Removal

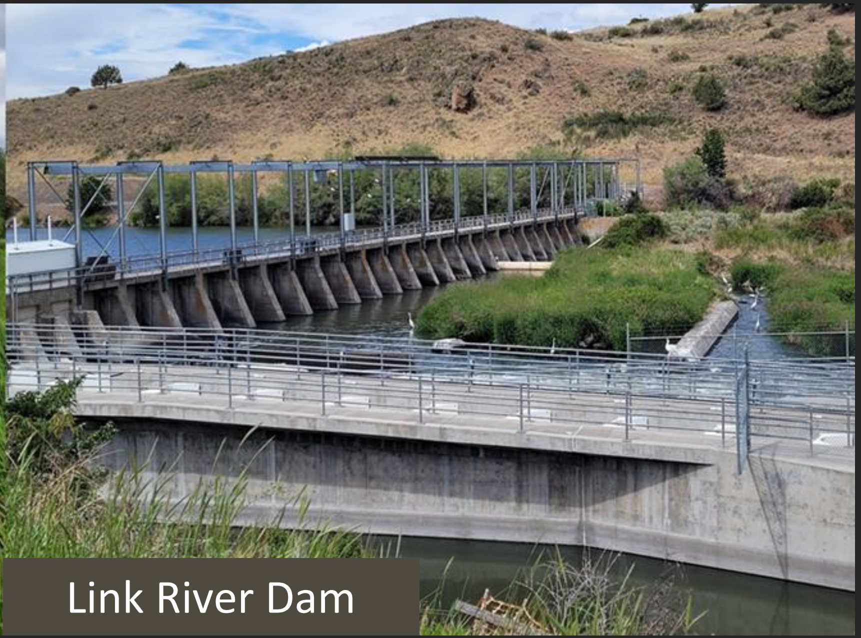

SWIFTWATER
FILMS

What is the out-migration survival of released spring Chinook in the Upper Klamath River Basin?

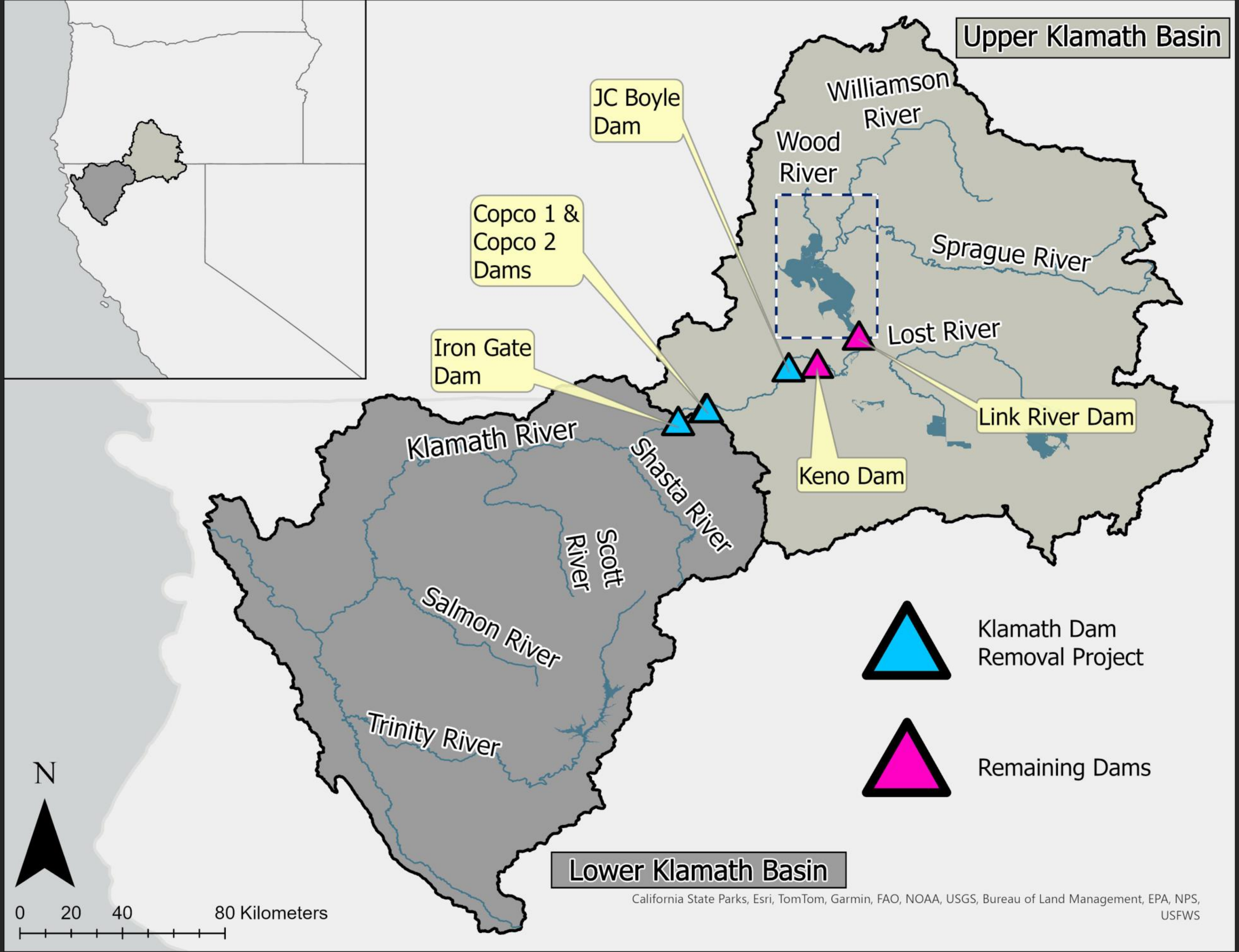
Williamson River



Wood River



Link River Dam



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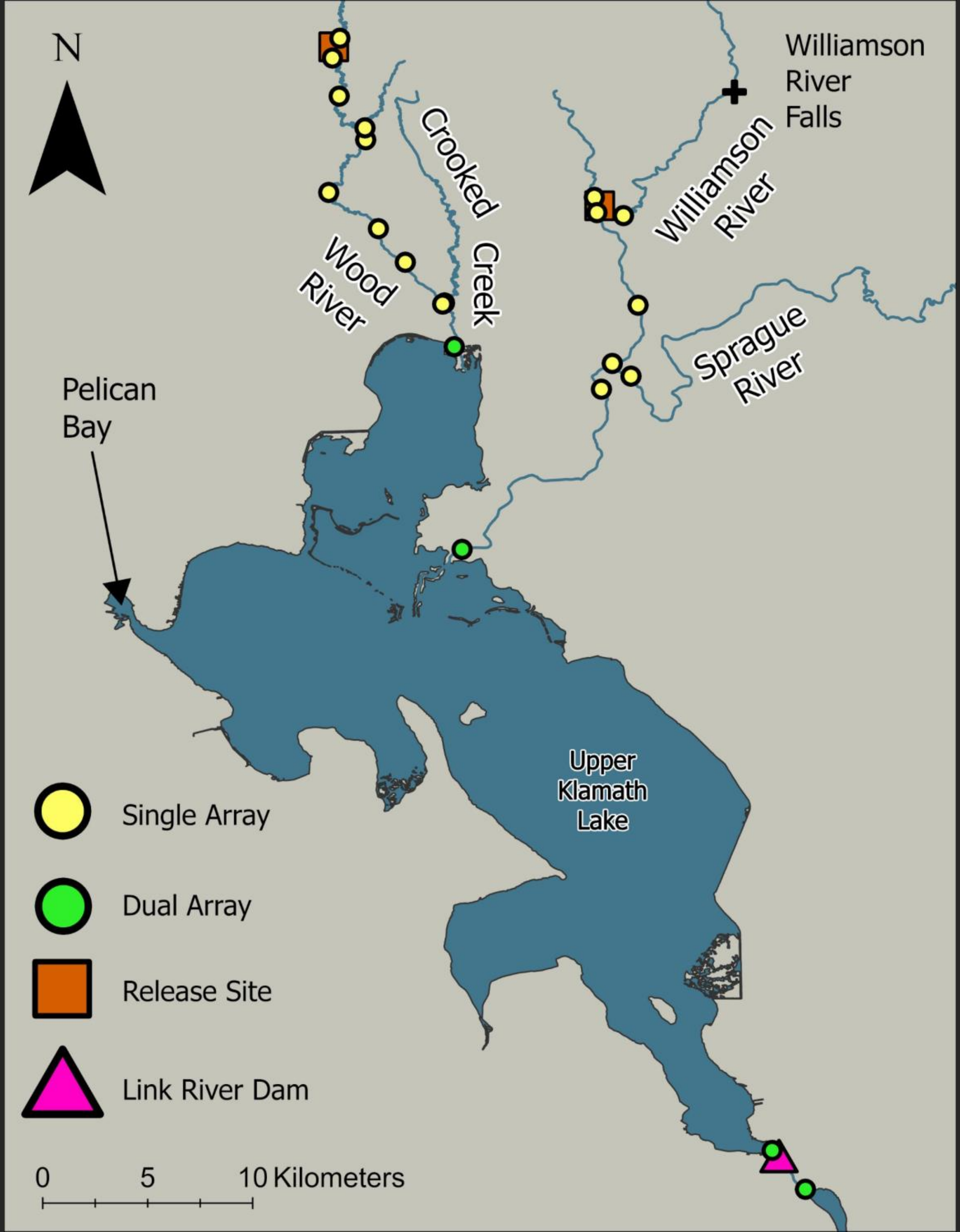

N
Williamson River Falls
Crooked Creek
Williamson River
Wood River
Sprague River
Pelican Bay
Upper Klamath Lake
Single Array
Dual Array
Release Site
Link River Dam
0 5 10 Kilometers

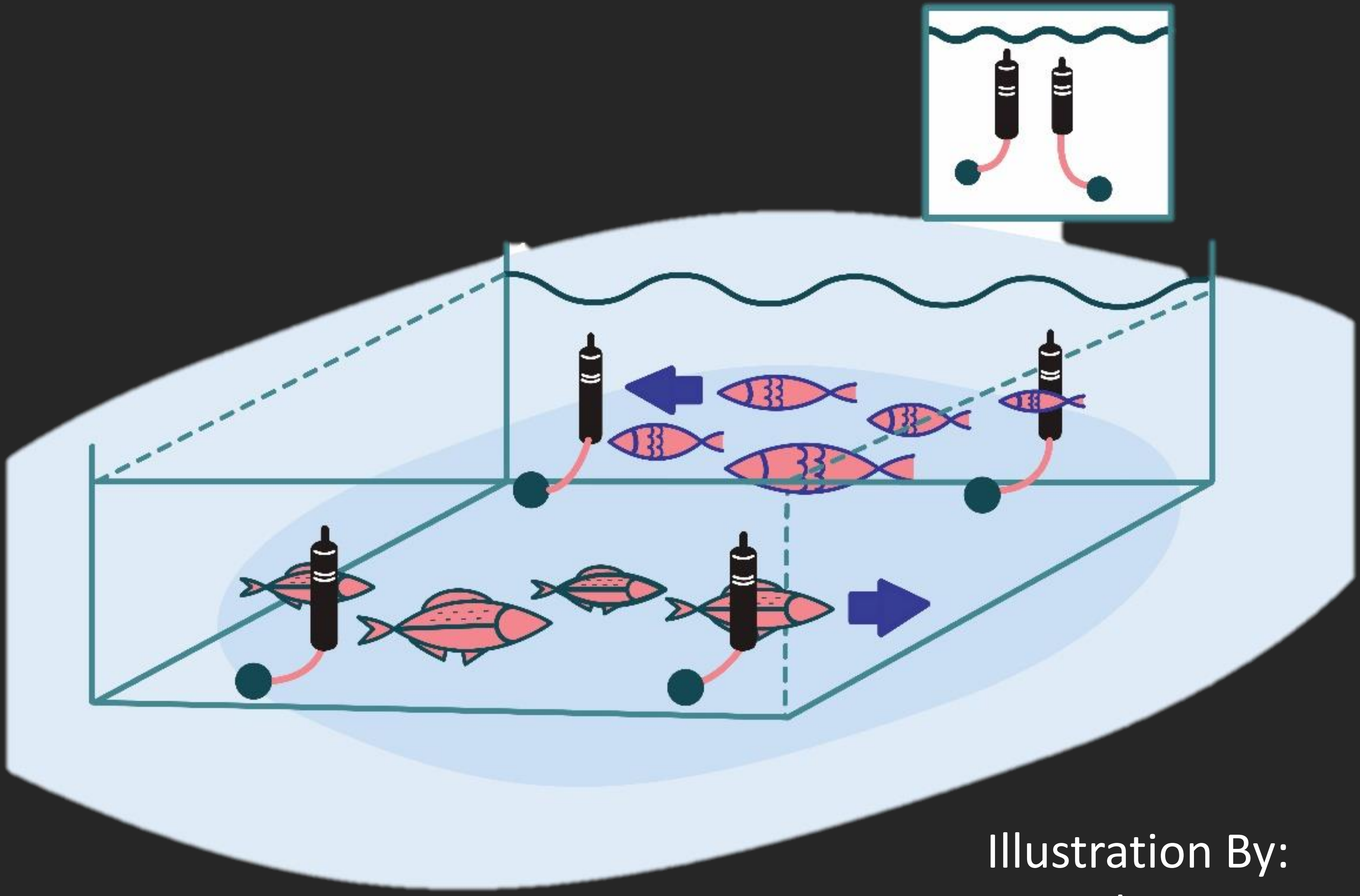


Illustration By:
Vi Hathaivaseevong

Acoustic Telemetry

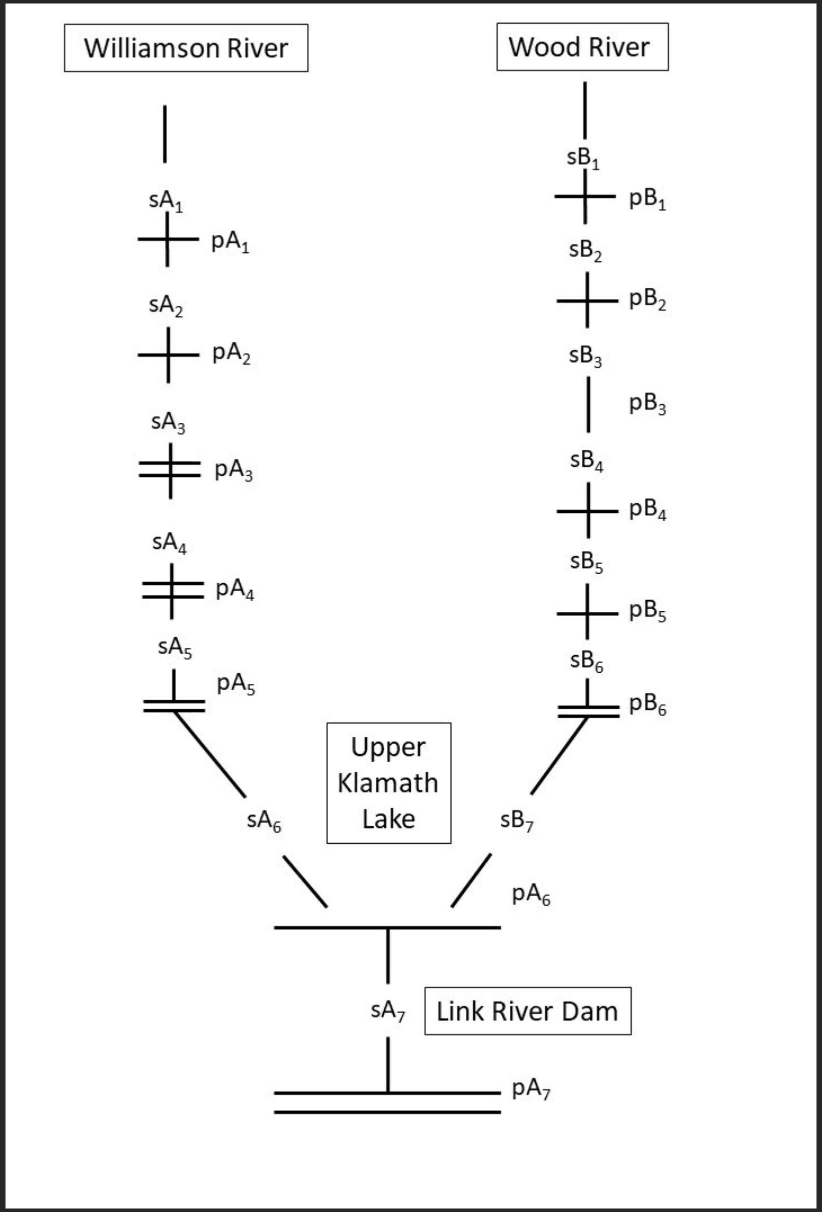
ATS SS 300 Tag

Acoustic tagging from 03/28/22 - 04/01/22

Fish Release 04/04/22

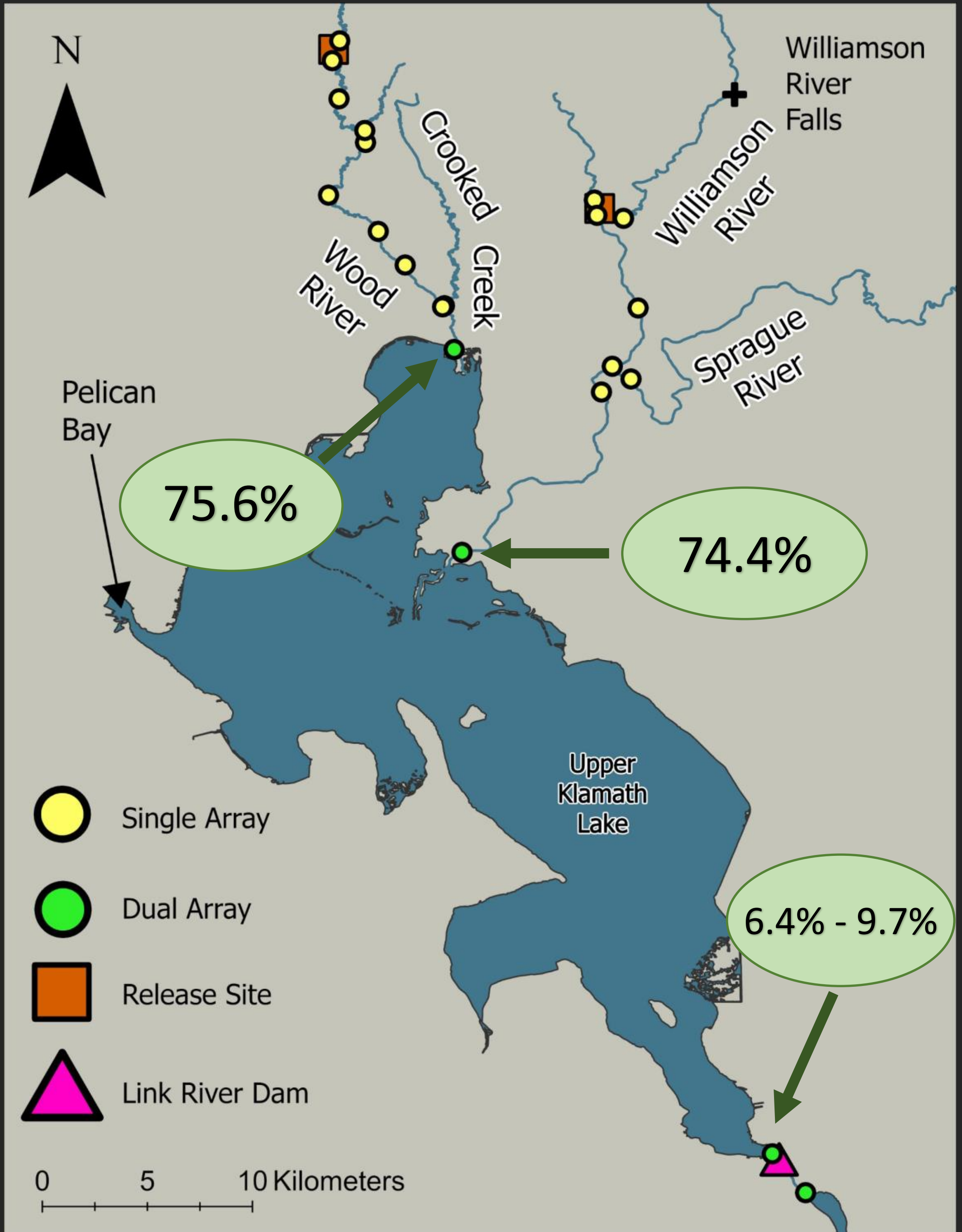
- **513** released in the Williamson River
- **513** released in the Wood River
- **131** were transported to OSU

Multi-State Model



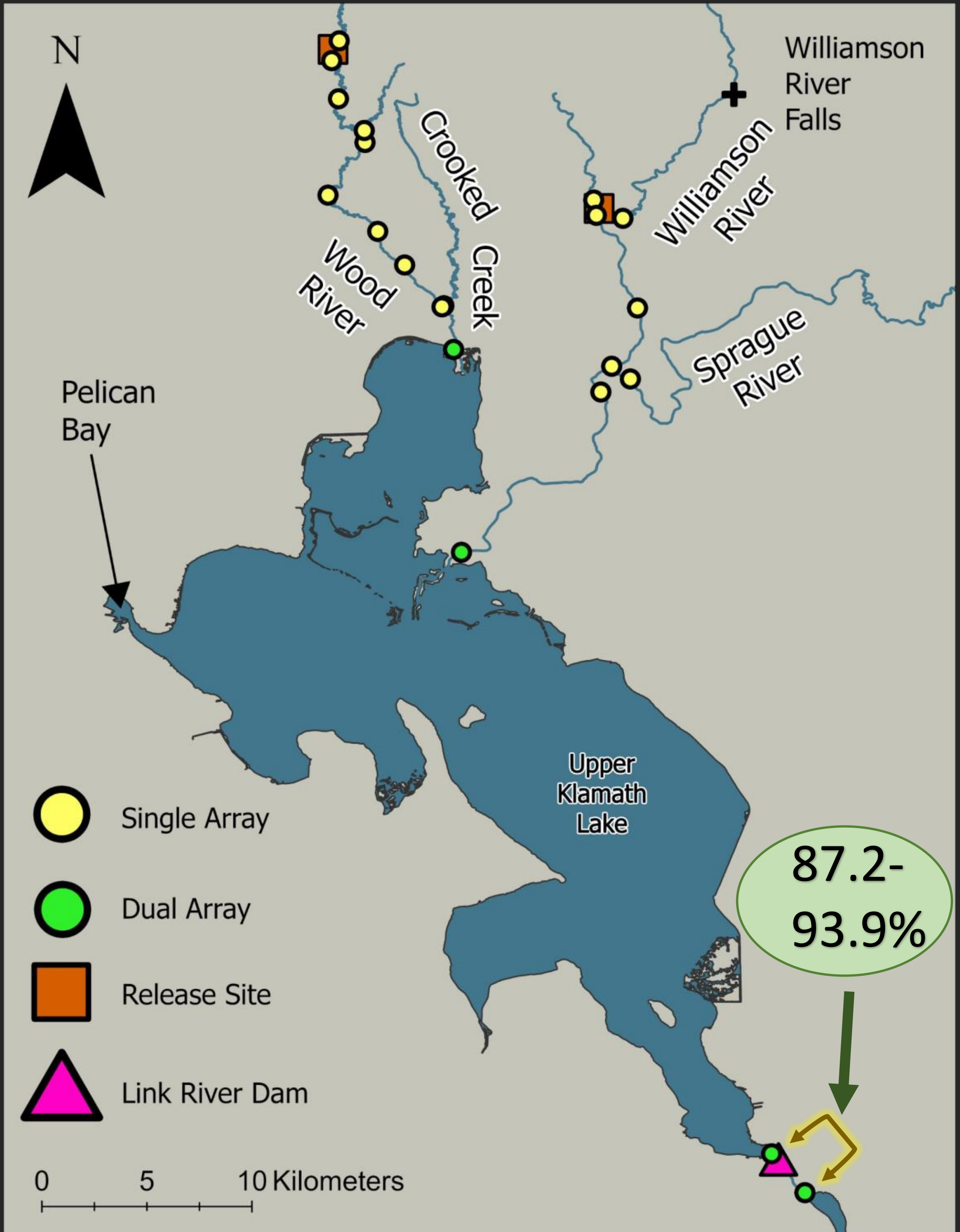
Preliminary Results

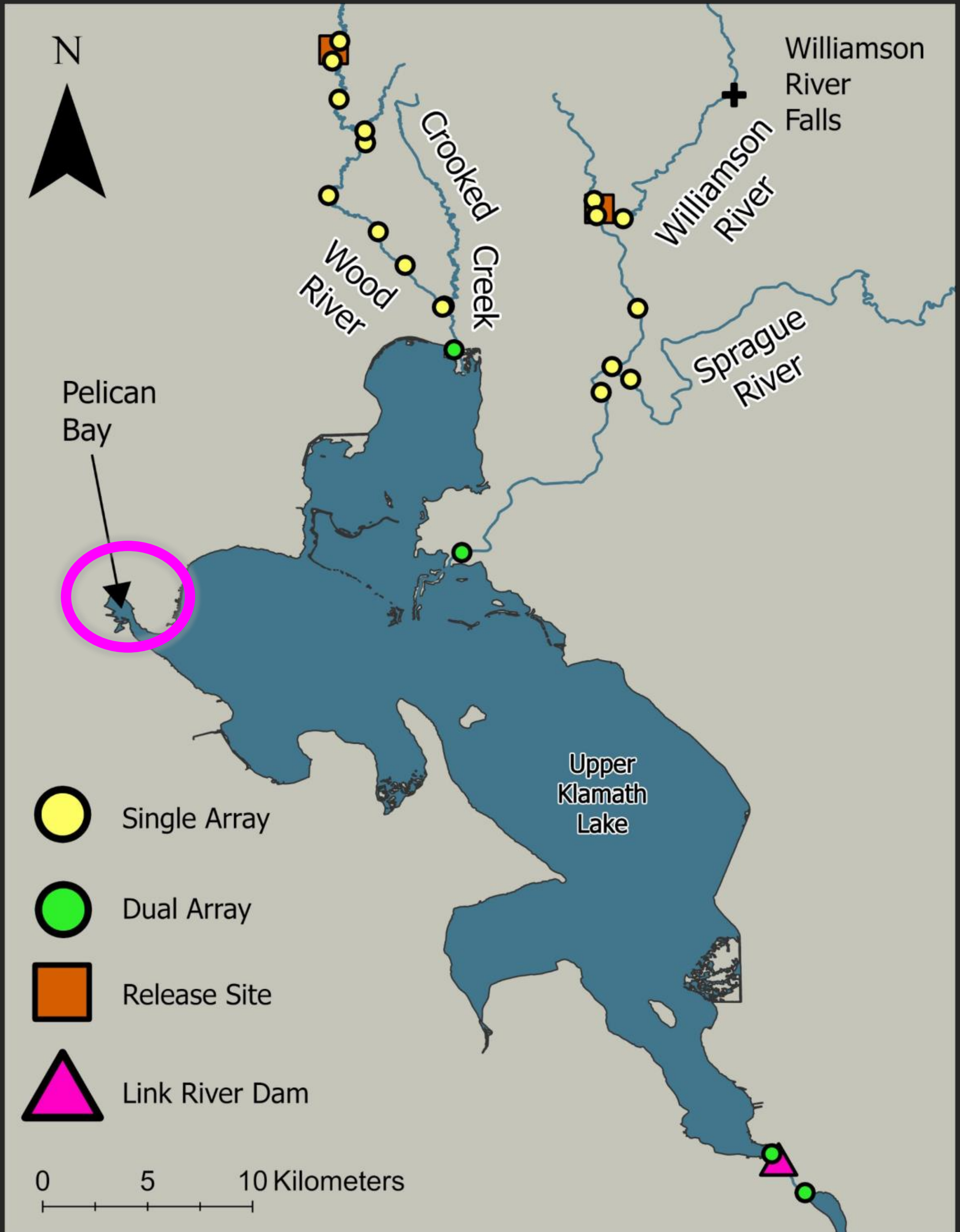
What is the survival of spring Chinook through the upper basin?



Preliminary Results

What is the survival of spring Chinook through the upper basin?




N
Williamson River Falls
Crooked Creek
Williamson River
Wood River
Sprague River
Pelican Bay
Upper Klamath Lake
Single Array
Dual Array
Release Site
Link River Dam
0 5 10 Kilometers

Takeaways / Future Directions

- Survival was high through the Wood and Williamson Rivers
- Survival decreased through Upper Klamath Lake
- Low survival -> cold-water refuge?
- Survival through the Link River Dam Reach was high

Takeaways / Future Directions

- Estimate summer use of cold-water habitats by spring Chinook

Future Studies:

- Deploying acoustic receivers within other cold-water areas in the upper basin

- Deploying more acoustic receivers within Upper Klamath Lake

Estimate survival to the Pacific Ocean!

Special Thanks

NOAA – National Oceanic and Atmospheric Administration, U.S. Department of Commerce

Oregon Fish & Wildlife

Klamath Tribes Judiciary – Klamath Tribal Courts

U.S. Fish & Wildlife Service – Department of the Interior

California Trout – Keeper of the Streams

Trout Unlimited

U.S. Department of the Interior – Bureau of Land Management

California Department of Fish & Wildlife

Bureau of Reclamation

The Nature Conservancy

Oregon State University

Oregon Conservation Recreation

Center for Watershed Sciences – UC Davis

USGS – science for a changing world

Land Acknowledgement:

Since time immemorial the Upper Klamath River basin has been the ancestral homeland of the Klamath, Modoc, Yahooskin-Paiute, and Shasta Nations. These Indigenous Nations maintain a longstanding connection with the land, engaging in ongoing stewardship and spirituality. We recognize the numerous challenges these communities have endured, from historical injustices of genocide, forced land removal, and lack of federal recognition. Many of these challenges continue to persist, representing ongoing hardships for these communities. As researchers, we accept responsibility in educating ourselves about how these injustices continue to impact these communities. We acknowledge that these atrocities also wield a significant influence on our research and management strategies. We are dedicated to amplifying Indigenous voices, knowledge, and resiliency as we continue to educate ourselves while improving our efforts to protect threatened and endangered species.

It is also important to recognize that a land acknowledgement is only a starting point in supporting Indigenous communities. We hope this acknowledgement serves as a catalyst for other scientists to use their platforms in solidarity with Indigenous Nations. We encourage them to actively promote and prioritize the genuine collaboration and incorporation of Tribal voices in research and restoration projects.


Salt


CHILOQUIN


MY HERO
ACADEMIA
Salt


SWIFTWATER
FILMS

Basin Updates

- Scott River Watershed Council
- ODFW
- The Klamath Tribes
- Yurok Tribe
- NOAA
- USGS/Humboldt
- Mid Klamath Watershed Council
- USBR
- USGS

KBFC Membership Form

KBFC Membership Form

Evening Social

Falls Taphouse

2215 Shallock Ave, Klamath Falls, OR 97601