Tracing groundwater: Household use, spring flows, and water in streams

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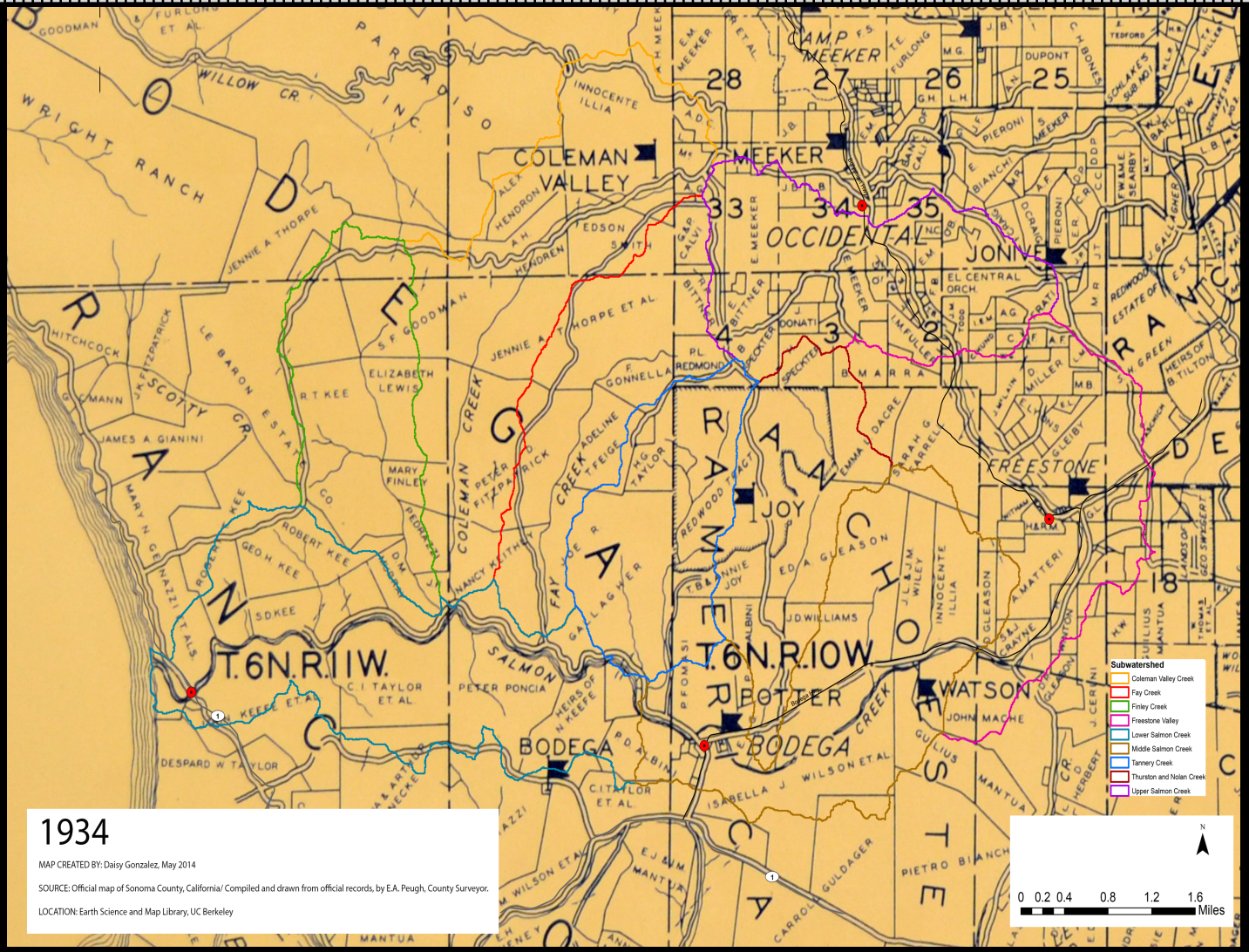
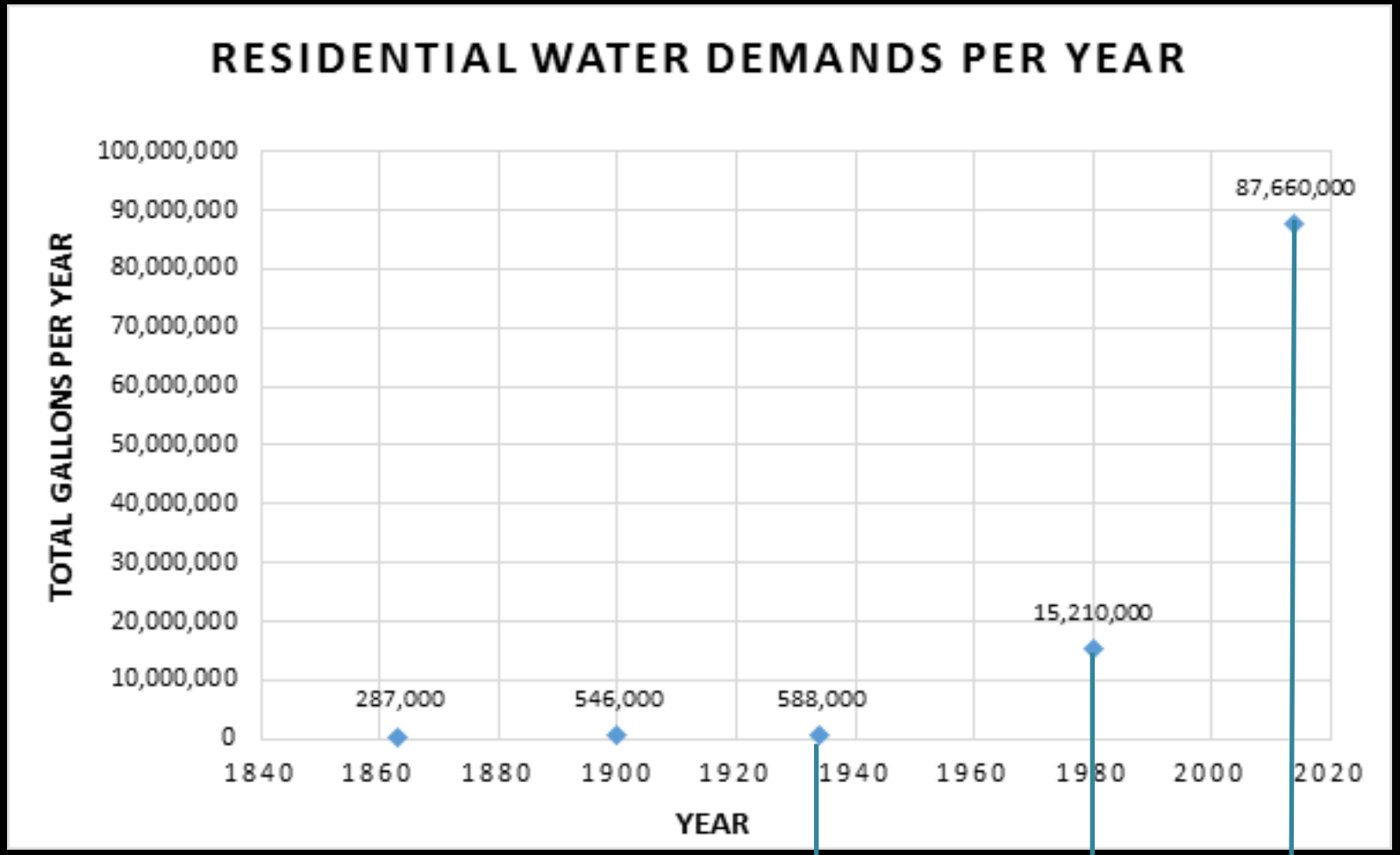
How has residential water use changed over time?



Parcel study by Daisy Gonzales (with Noel Bouck and Diane Masura) 2014

Residents use 5 times more groundwater than in 1980

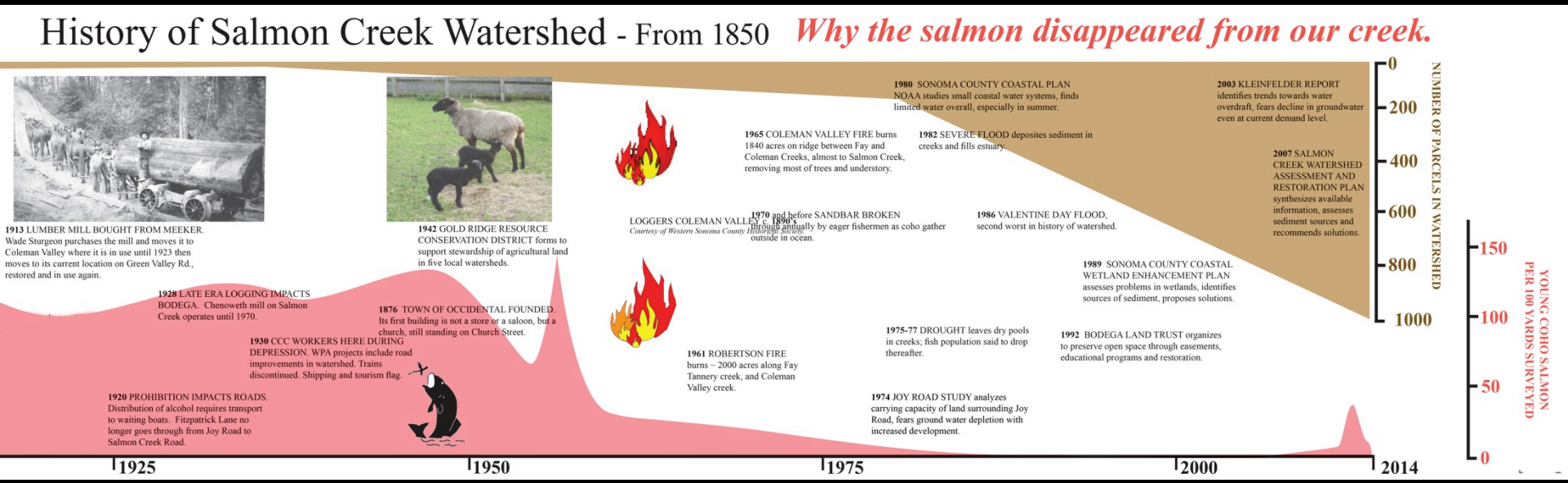


1.8 acre-feet in 1940

47 acre-feet in 1980

269 acre-feet in 2014

Groundwater use creates scarcity for other human residents



and contributes to salmon and steelhead decline

We know fish and people need more water in dry years.

What now?

Discuss with your neighbor

Did you experience water scarcity during the last few years of drought?

Did you change your water use practices during the last drought?

Are you concerned about future droughts? If so, what specifically concerns you?

Multispecies commons: Salmon are good to think with relationally and across scales

[Lummi Nation]

Overview

1. Approach: Seeking justice through collaboration
1. The circumstance: Salmon and intermittent flows
2. What emerges: Multispecies commons
3. Where next? Hyporheic imaginaries

Motivation:
Will salmonids persist in California?

[Katz and Moyle 2012]

Most water and fisheries governance happens at large scales.

But salmon live or die in little streams.

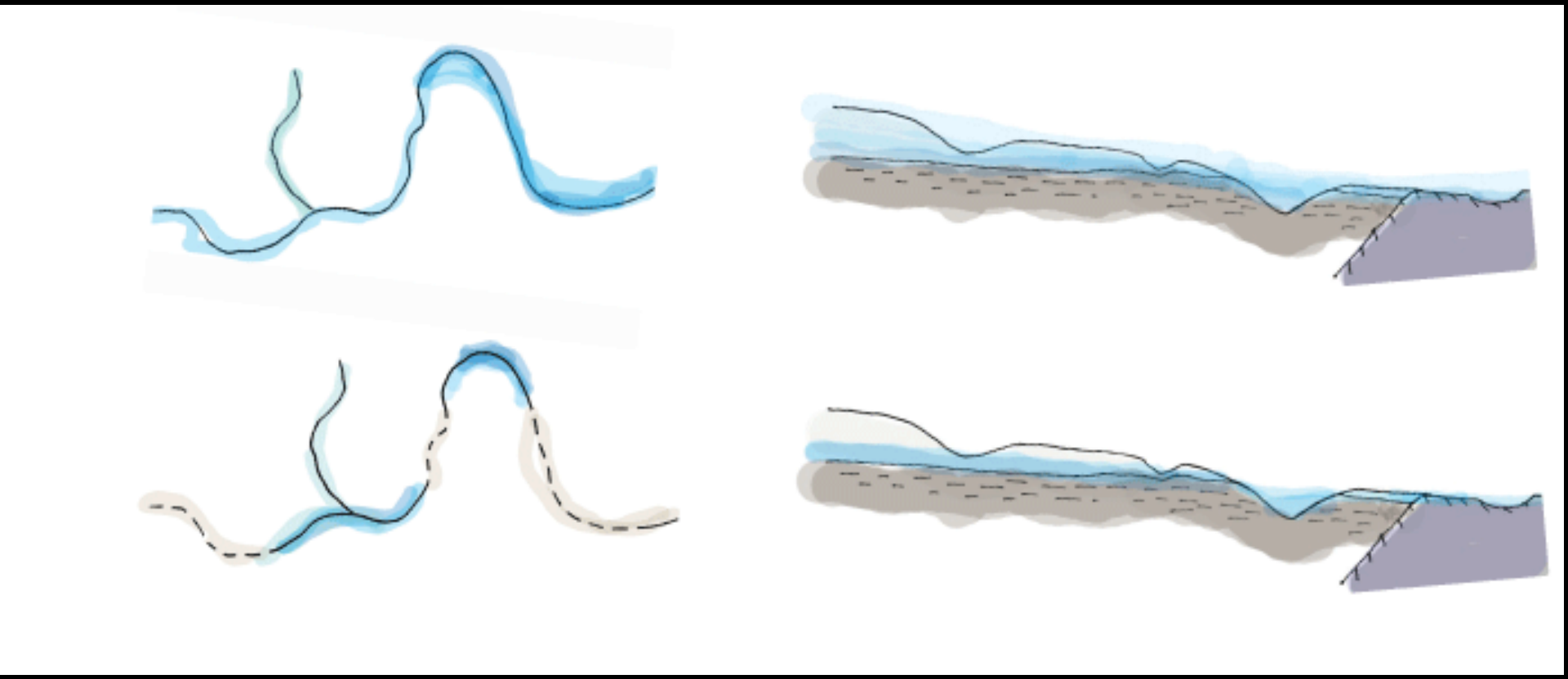
Small and intermittent streams have been neglected in governance.

Local places are where alternate inhabitation strategies evolve.

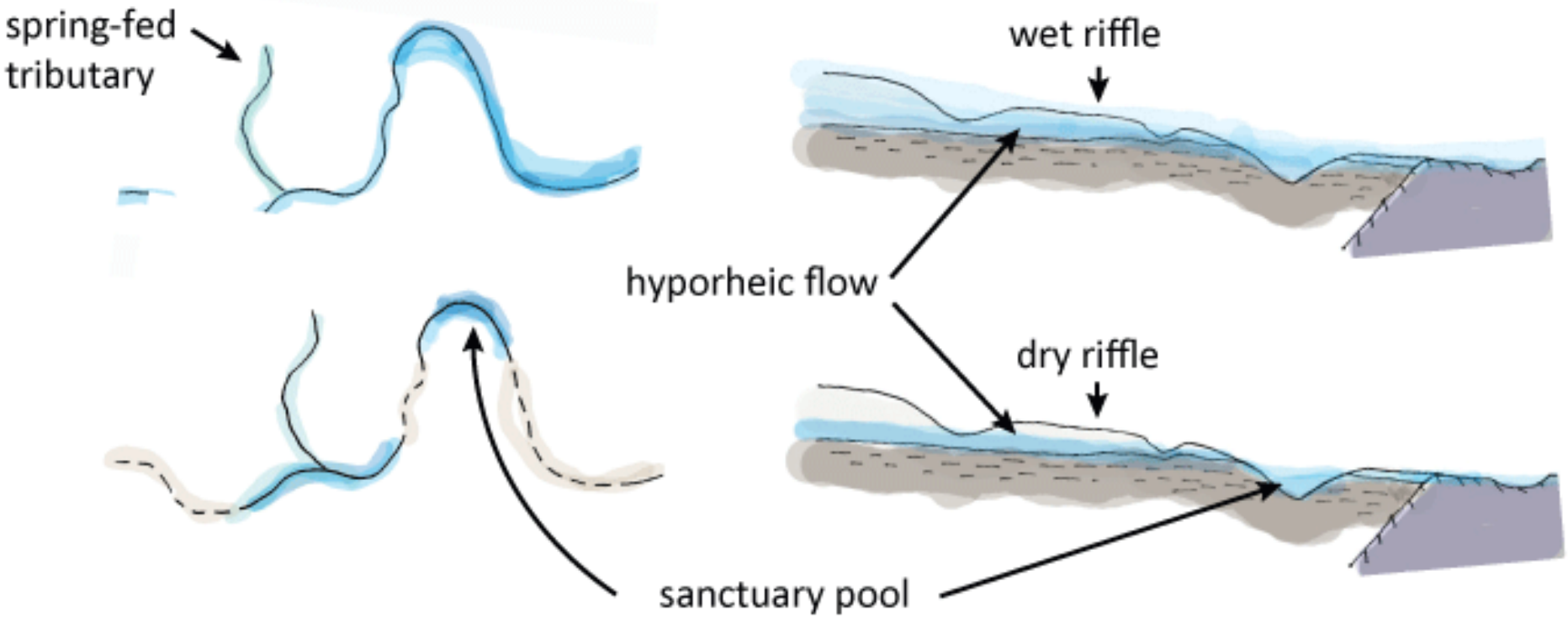
Local residents concerned about their water supply flows for salmon & trout.

136 endangered coho salmon detected in this pool + 18 threatened steelhead trout

The circumstance: Intermittent flows

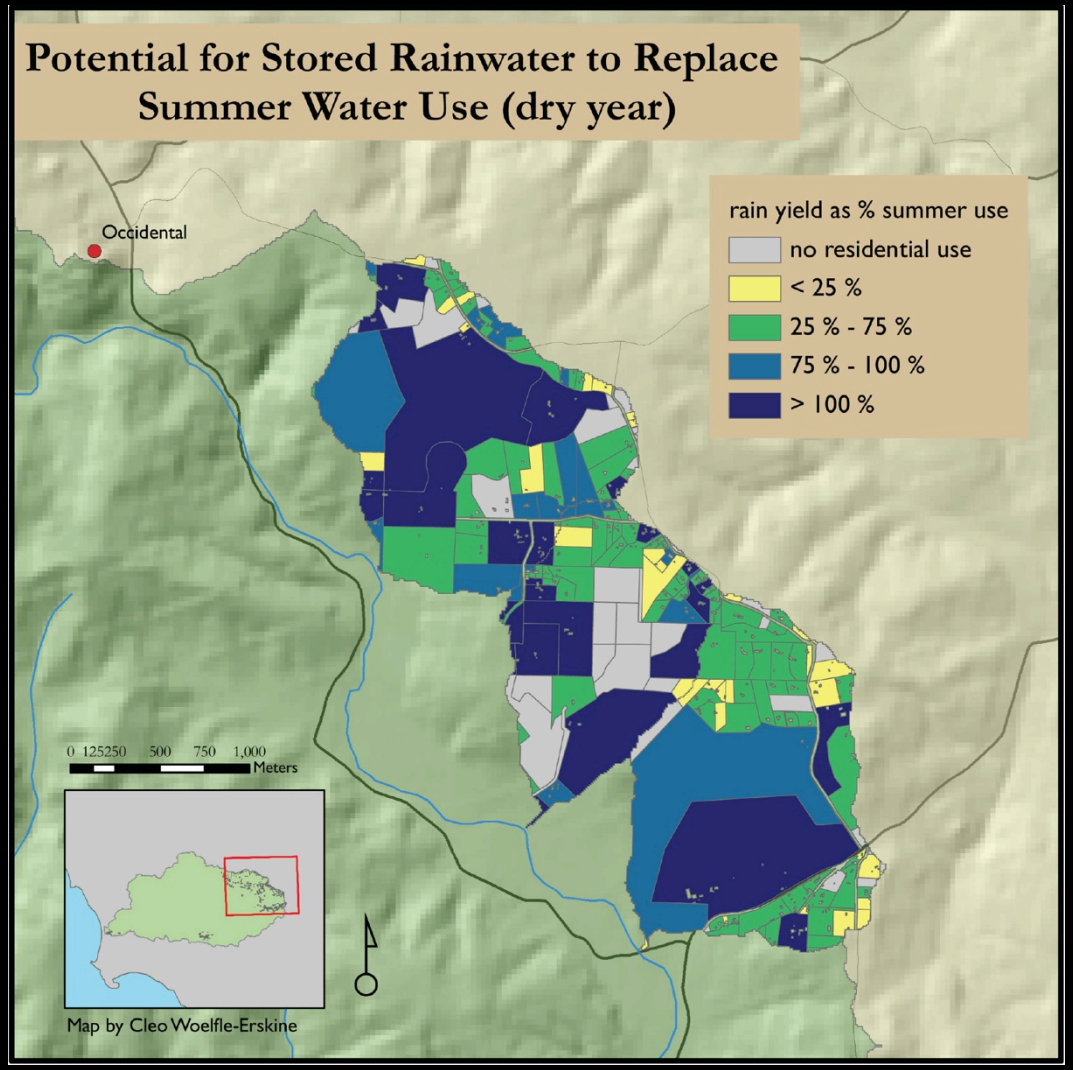


First, a little jargon...



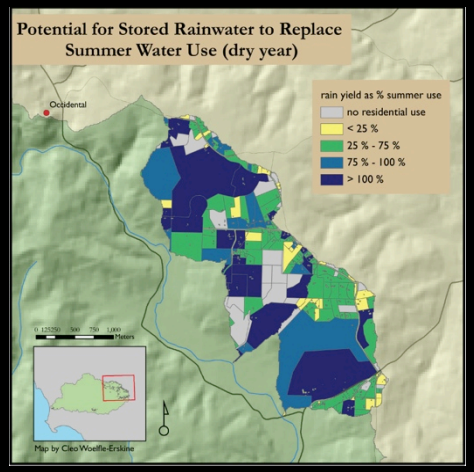
Community concern:

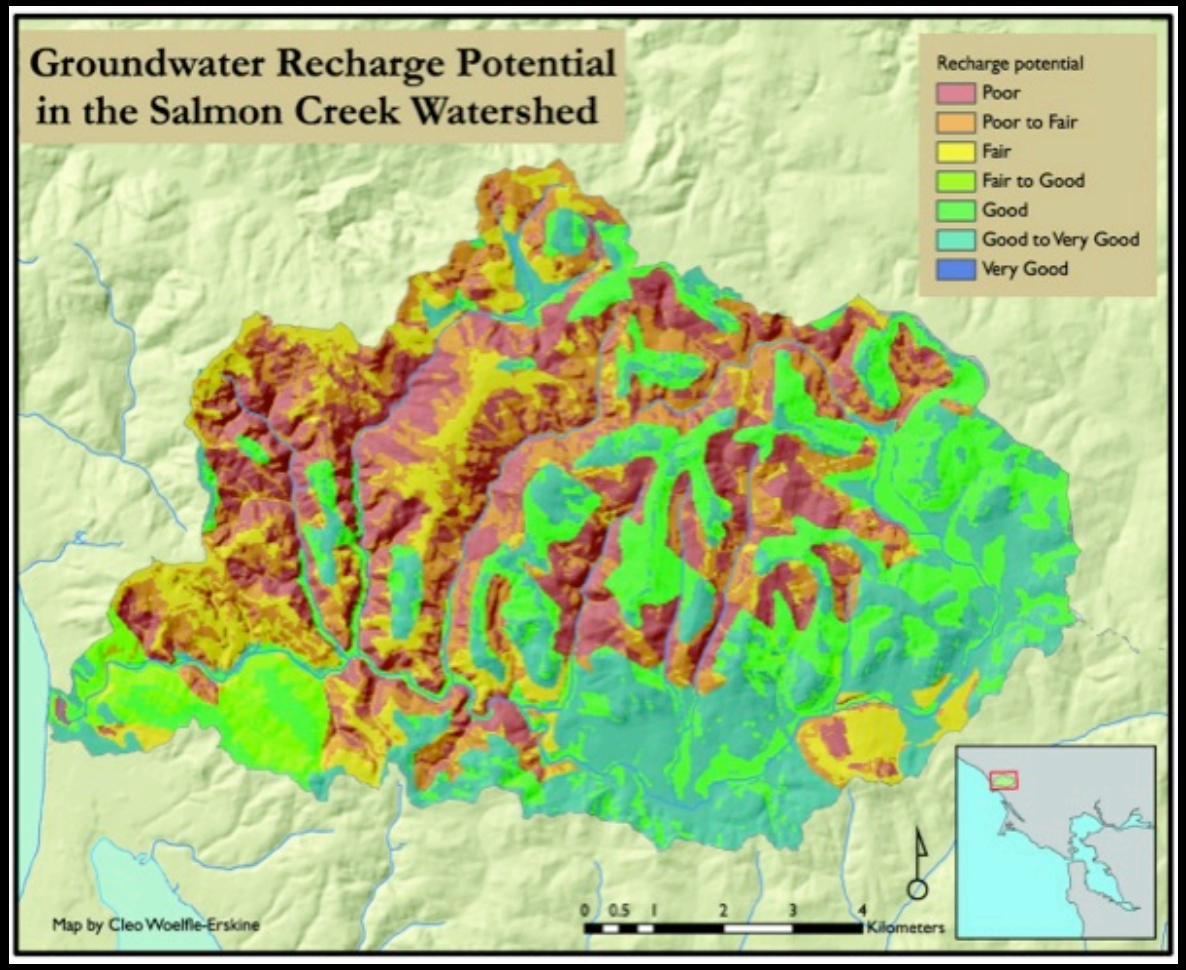
Which is more likely to increase late-summer streamflow – Rainwater harvesting?



[Woelfle-Erskine 2012. Do salmon want humans to harvest rain?]

...or groundwater recharge?





[Woelfle-Erskine 2012. Do salmon want humans to harvest rain?]

An ecological puzzle

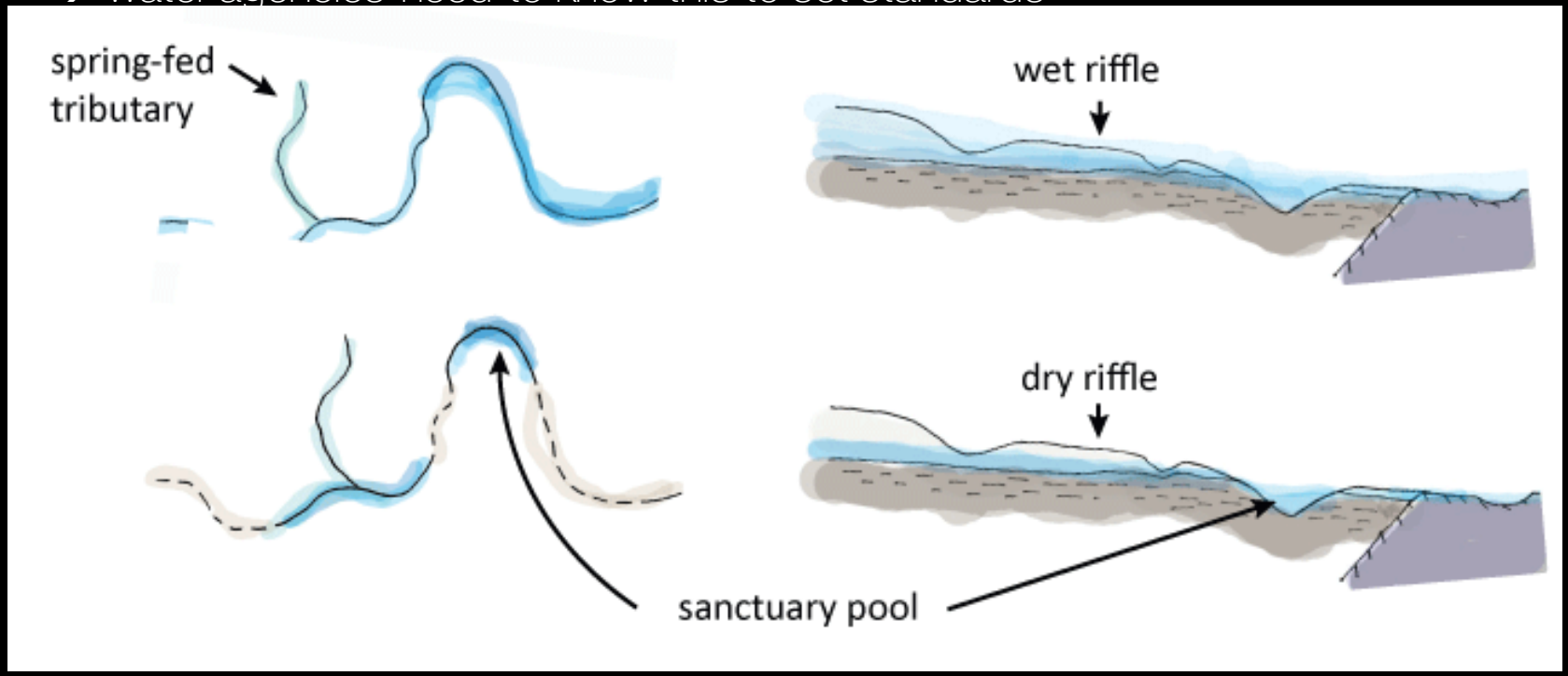
Intermittent streams can be good salmonid habitat.

[Wignington et al, 2006]

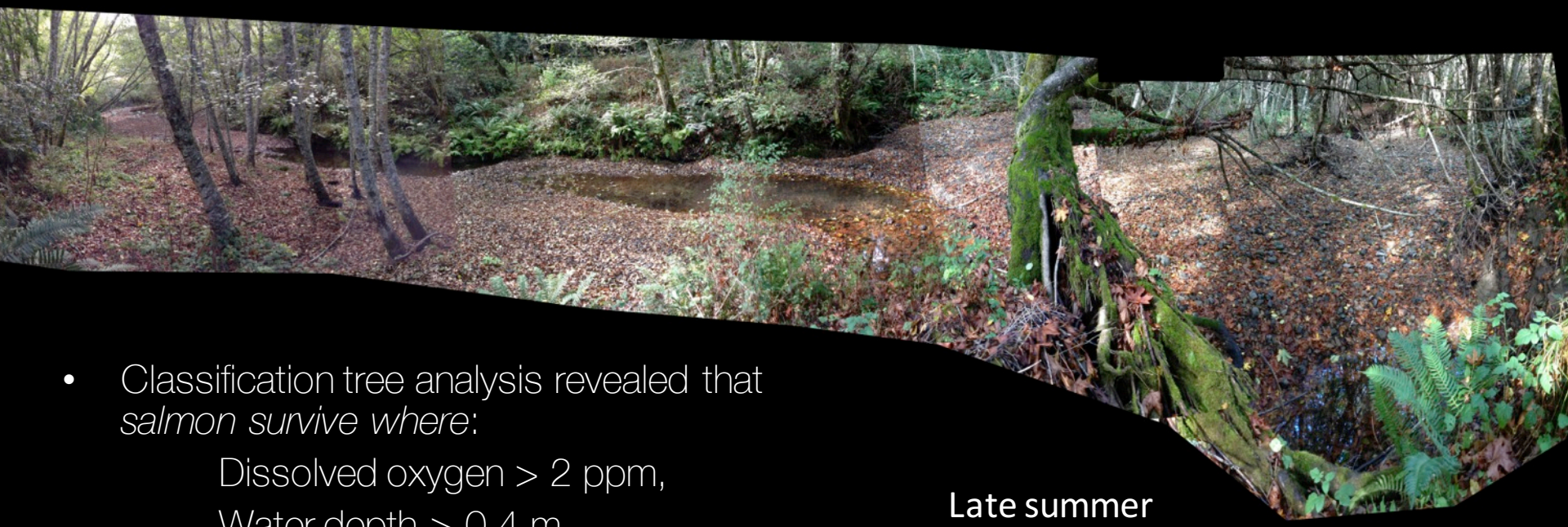
More water increases survival. [Grantham et al. 2012, Hwan and Carlson in revision]

But how much more water do fish need?

→ water agencies need to know this to set standards



Results: Salmon and intermittent flows



- Classification tree analysis revealed that *salmon survive where*:

  Dissolved oxygen > 2 ppm,

  Water depth > 0.4 m,

  Volume > 5 m^3

- Logistic regression revealed that the *'days disconnected' (# of days with no flow over the riffles) was an important predictor of salmon survival*

Late summer census, n = 136 (83% survival)

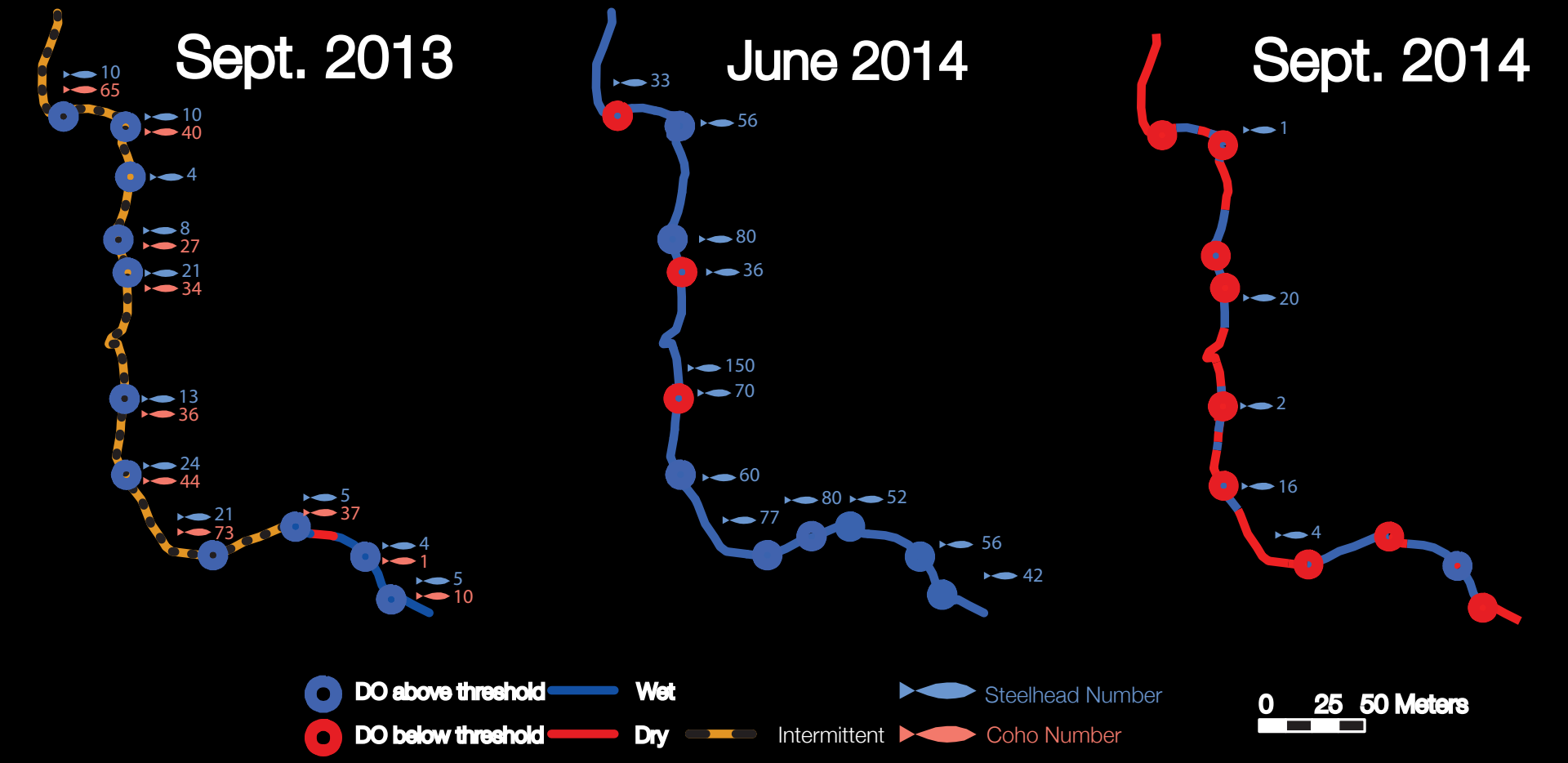
Field hydro-ecology

These results informed citizen monitoring

days disconnected –

How long are pools disconnected?
wet-dry mapping:
→ citizen science
→ 3 years & 28 creek walkers
→ 9 km surveyed last year

Citizen + academic science reveal pattern and process of mortality during drought



[Woelfle-Erskine, Larsen, Carlson, accepted pending revisions. "Abiotic habitat thresholds for salmonid over-summer survival in intermittent streams," Ecosphere]

What can water management learn from intermittent flows?

Ecological study: identifies drivers of late-summer mortality documented by local creek-walkers & agency biologists.

Small coastal watersheds—and their intermittent streams—are important sanctuaries for salmonids; can foster collaborative management.

Collaborative research on water scarcity identifies an opportunity to increase water equity through rain tank program.

What can water management learn from intermittent flows?

Collaborative research on water scarcity identifies an opportunity to increase water equity through rain tank program.

For low-income residents

Subsidized rain tanks → gardens: food security.

Trucking in water when wells dry is unaffordable

For middle-income residents

Willing to contribute more, ~25 % of cost

Ridge-top residents want to participate

Is Salmon Creek an emerging multispecies commons? [Ostrom 1990]

Local water cultures foster different individual water use practices & environmental imaginaries: [Peet and Watts 1996]

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How will we know if reduce, reuse, recharge is working?

[Peet and Watts 1996]

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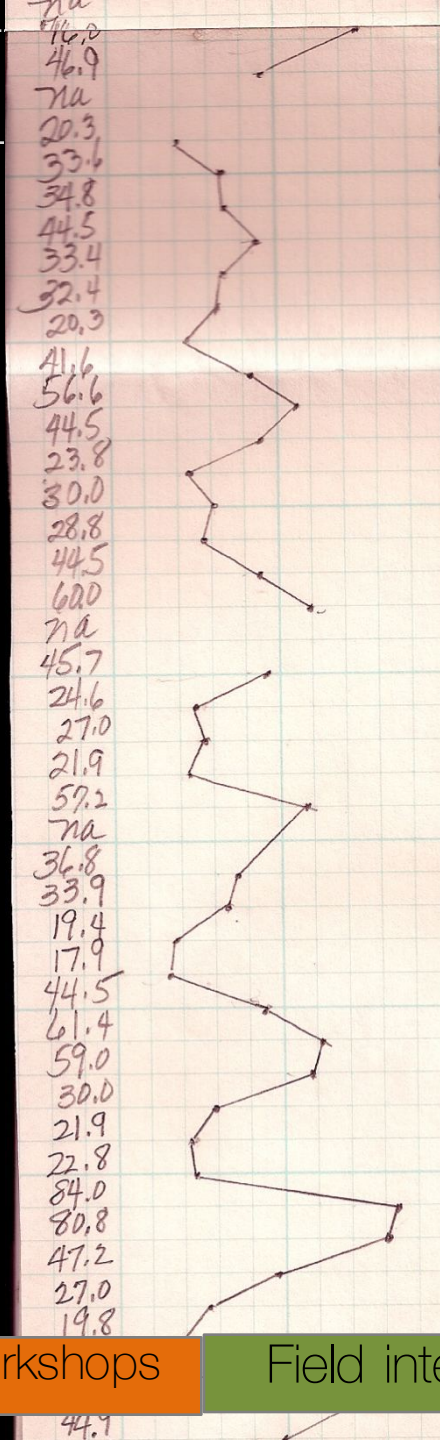
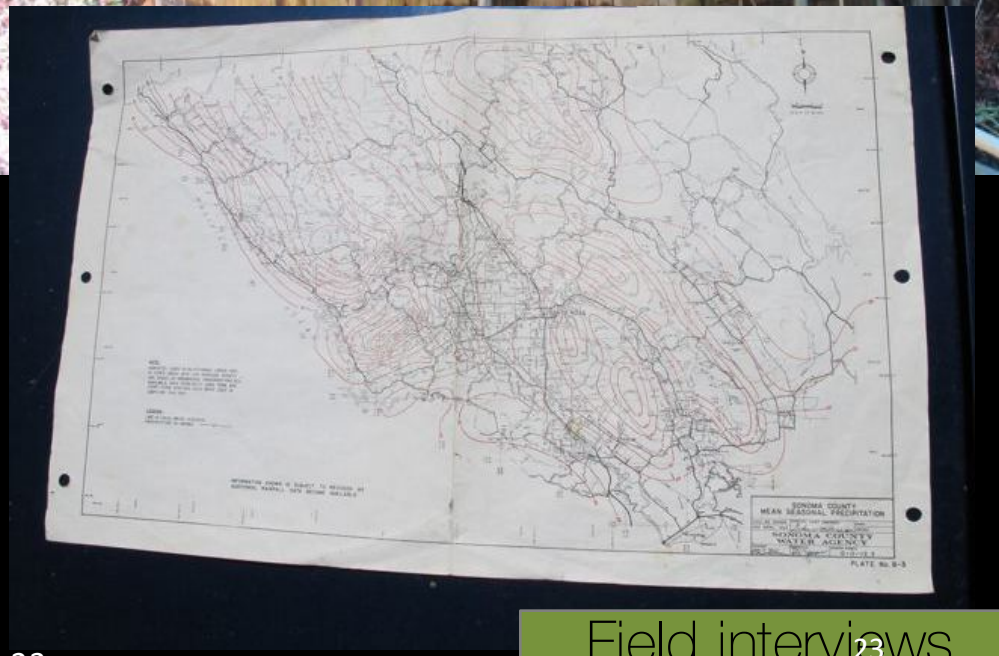
Well measurement: after a storm



Workshops | Field inte

Local knowledge of springs



Field interviews

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Salmon counting

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Field interviews

Gold Ridge RCD land, water and wildlife projects

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Programs

Water Resources

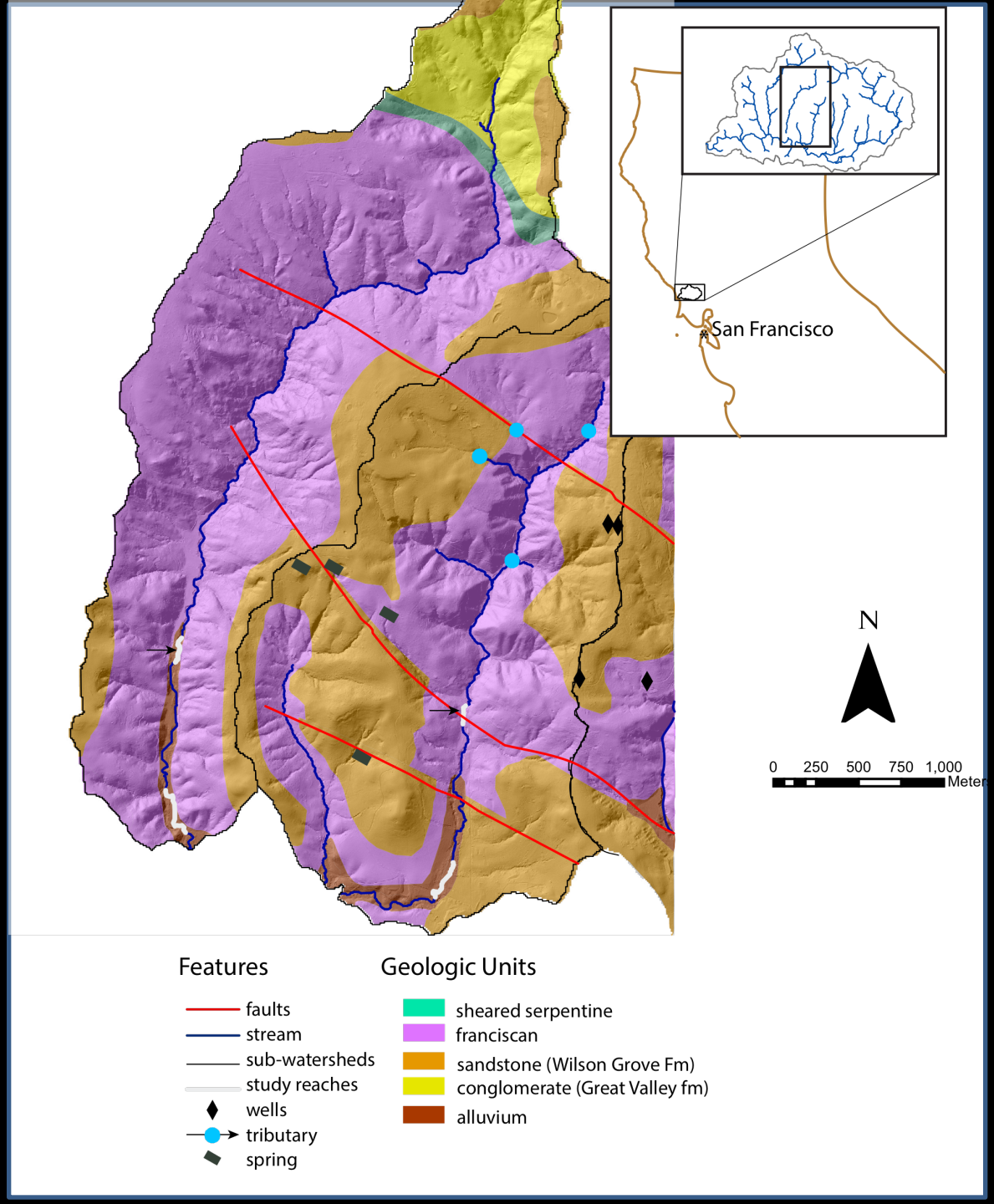
Watershed Health

The RCD holds in mind the concept that "We are all downstream" when designing plans for watershed health. The RCD pays attention to upstream sources of negative impacts on watershed health such as rural stormwater management, upland habitat quality, and accumulated sedimentation. These upstream impacts affect multiple water quality factors throughout the watershed: water temperature, turbidity, nutrient-load, velocity,

Ongoing collaborations with UC Berkeley and others

student ecologists approach Salmon Creek

Tracing groundwater to summer stream flow



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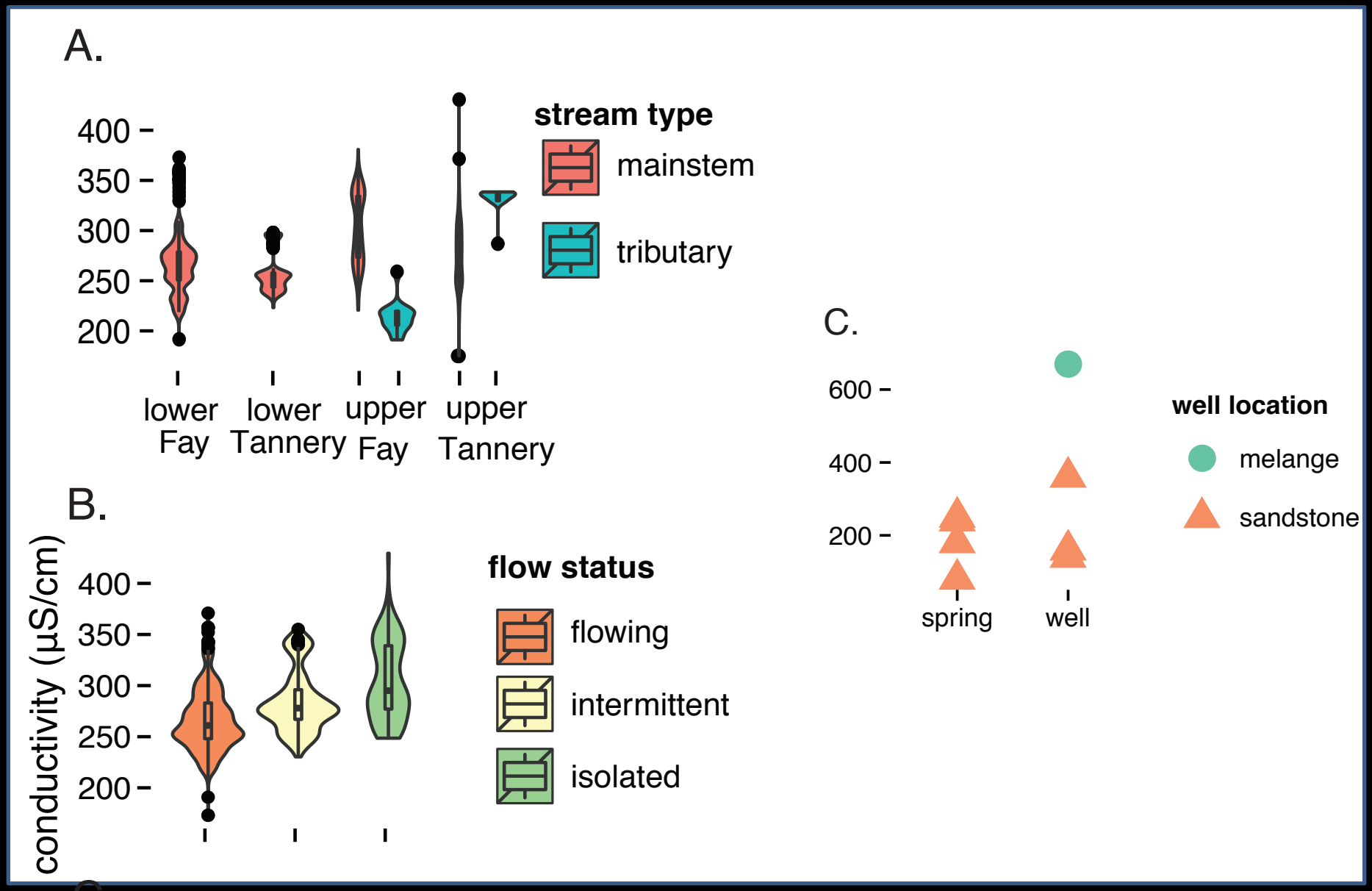
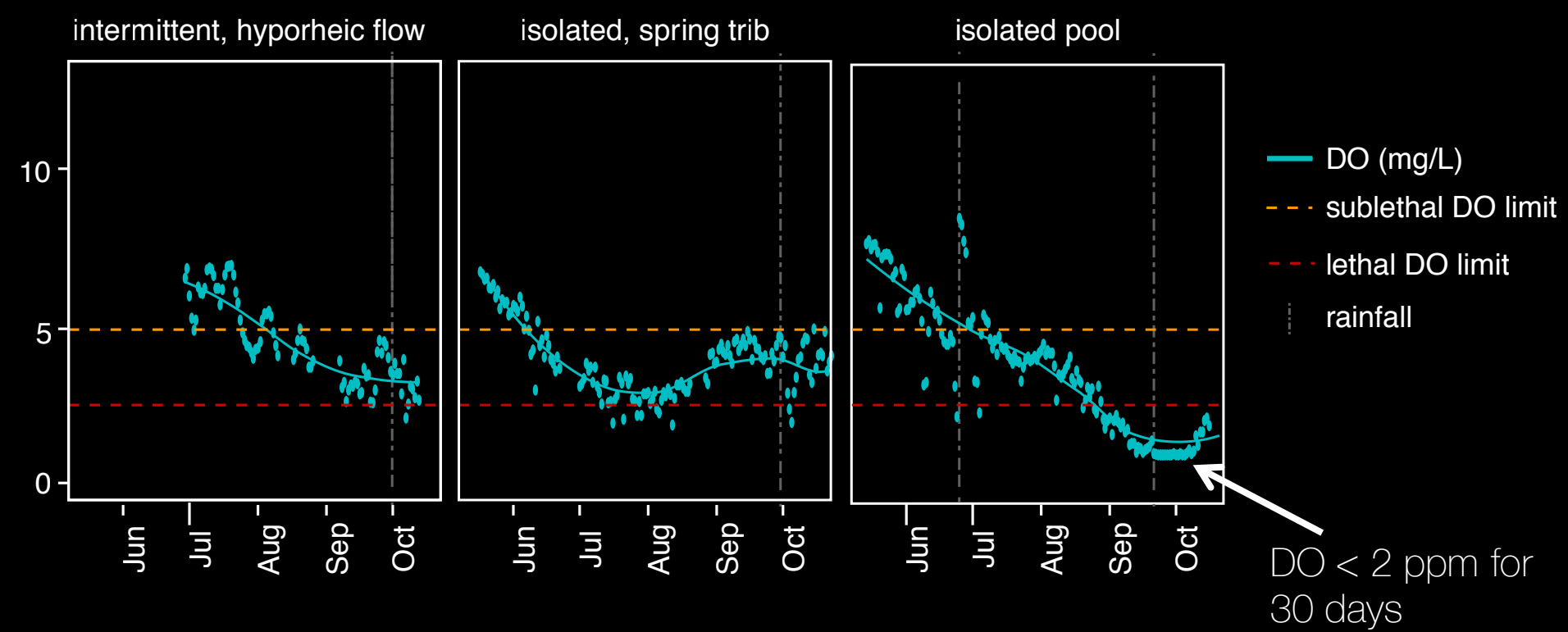


Dissolved oxygen dynamics as streams get drier

58 % survival

12 % survival

no survival



Thank you! And thanks to the collaborative!

Salmon Creek Watershed Council: Lauren Hammack, Erna Andre, David Shatkin, Noel Bouck, Diane Masura Michael Fawcett, Kathleen Kraft

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Outside: July Cole, The Water Underground, Jess Weir, Brian Peterson

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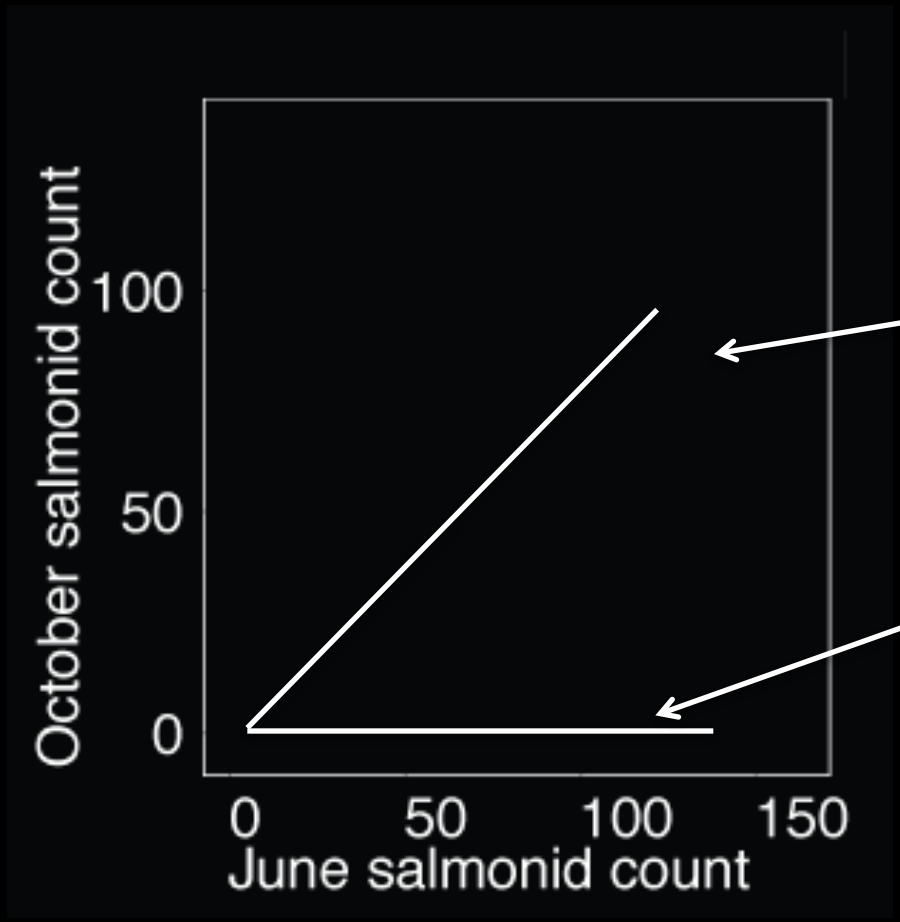
A
Early & late summer fish counts and DO by pool

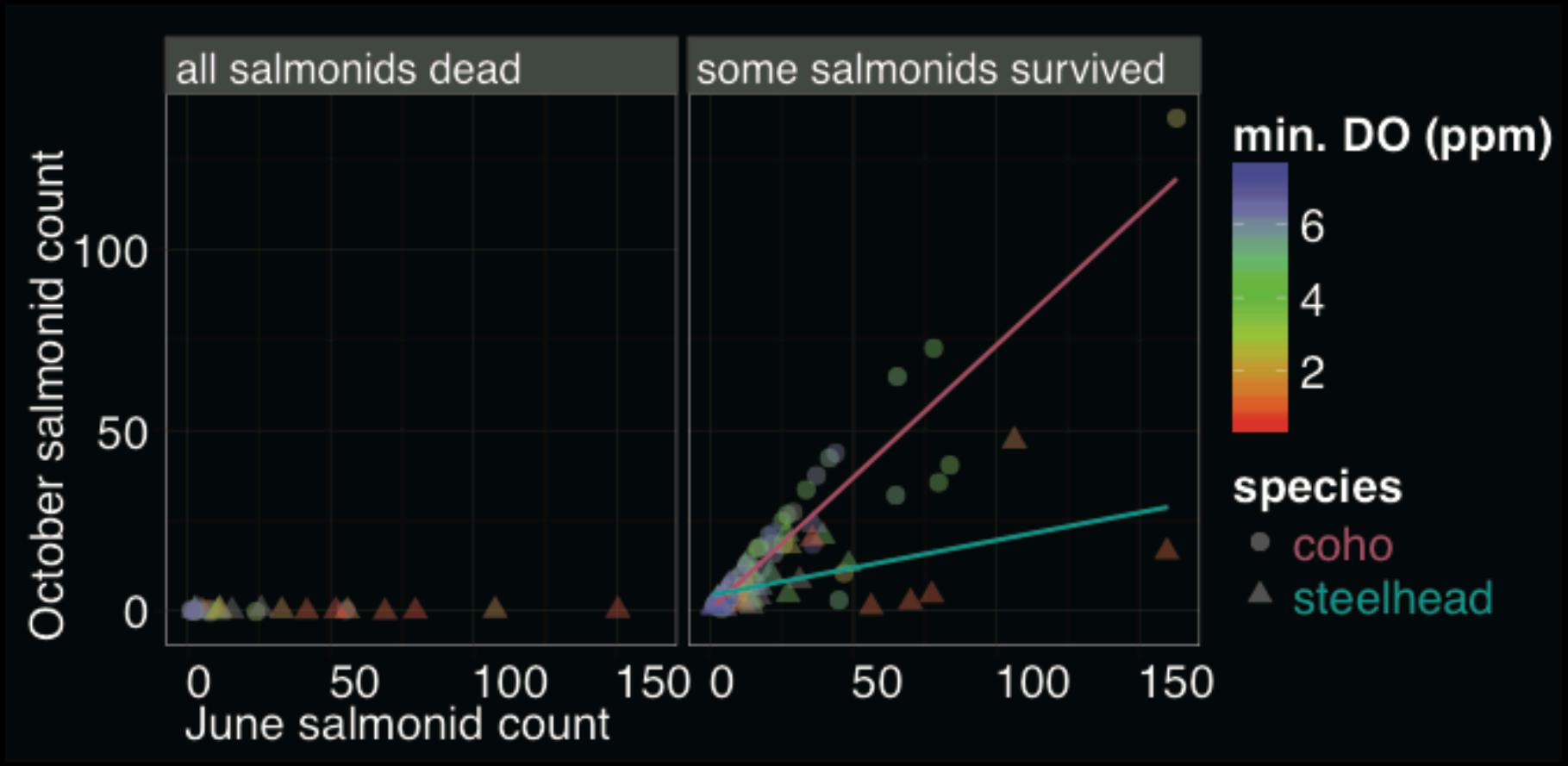


Slope = 1
100 %
survival

Slope = 0
0 % survival

[Woelfle-Erskine, Larsen, Carlson, accepted pending revisions. "Abiotic habitat thresholds for salmonid over-summer survival in intermittent streams," *Ecosphere*]

Some pools with high survival in low oxygen



[Woelfle-Erskine, Larsen, Carlson, accepted pending revisions. "Abiotic habitat thresholds for salmonid over-summer survival in intermittent streams," Ecosphere]

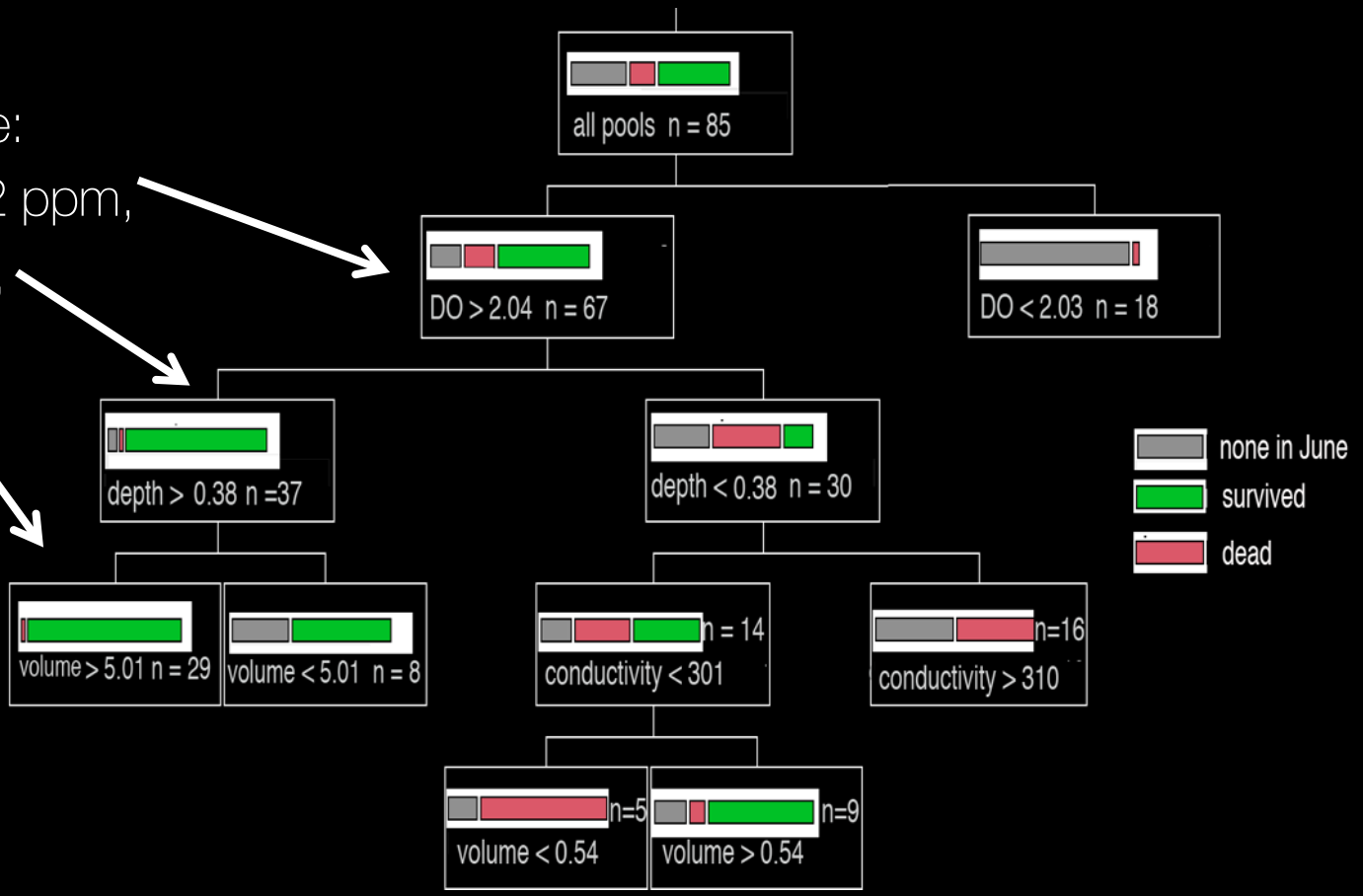
Flow mediates factors that drive salmonid over-summer survival

Salmon survive where:

Dissolved oxygen > 2 ppm,

Water depth > 0.4 m,

Volume > 5 m^3



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These results informed citizen monitoring

Important variables:

June count +
June volume +
days disconnected –

minimum
- volume +
- depth +
- surface area +
- DO –

maximum
- temperature +*
- conductivity –

* For steelhead, but max temp. < 18 ° C

Fragmentation state: a master variable
days with no surface flow