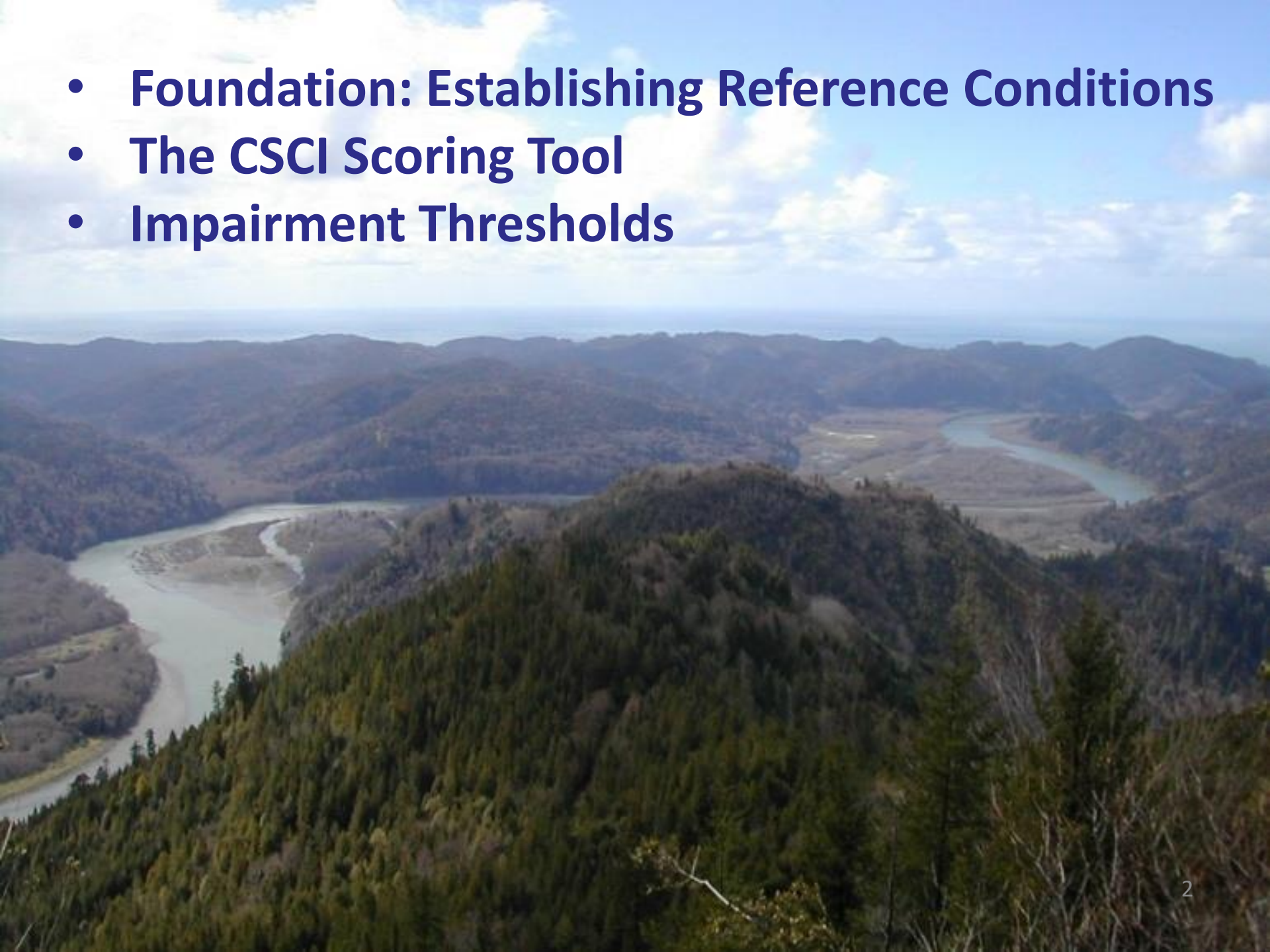
An overview of the California Stream Condition Index (CSCI)

- **Foundation: Establishing Reference Conditions**
- **The CSCI Scoring Tool**
- **Impairment Thresholds**



SWAMP's Infrastructure Investments
(2000-2012)

- **SWAMP has standard methods:** field, lab, data management, reporting, QA
- **SWAMP methods used widely throughout CA**
- **Biological Objectives will standardize interpretation**

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CA's Ecological Indicators

Multiple Indicators – BMIs, algae, (fish), riparian vegetation

Multiple waterbody types – large rivers, non-perennial streams, lakes, wetlands

Start with invertebrates and perennial streams

Benthic invertebrates are ideal ecological assessment tools

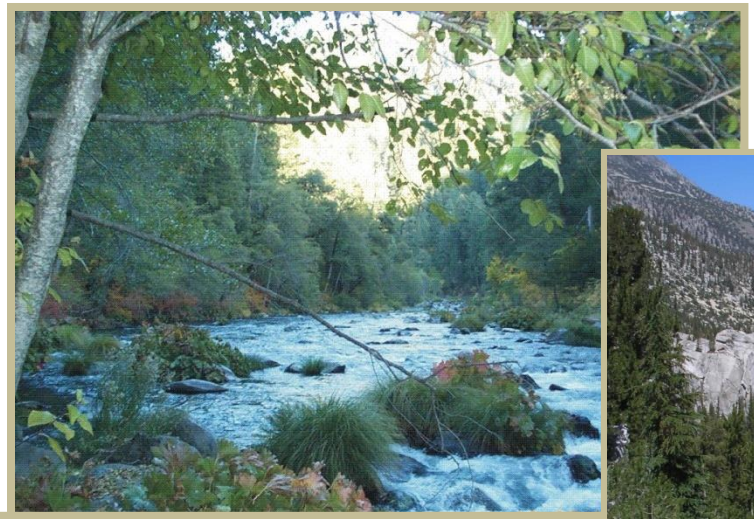
- *Ubiquitous, abundant and diverse*
- *Responsive to stress*
- *Information rich*

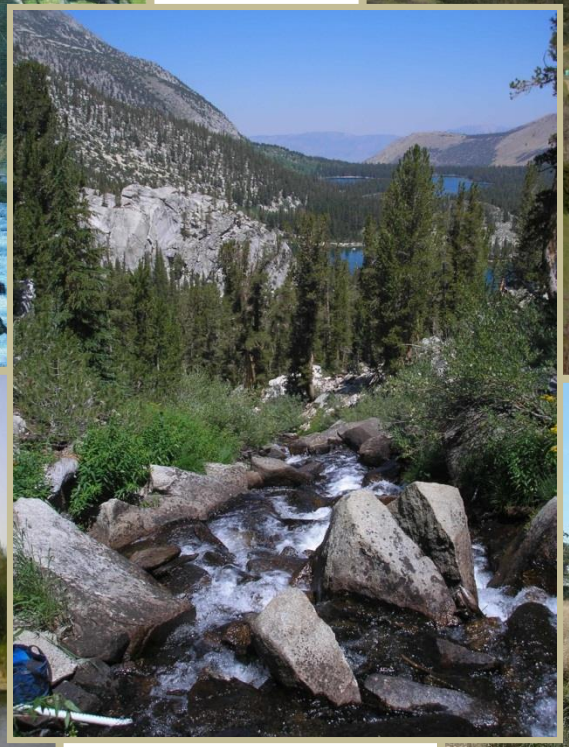
How to convert a list of species into a condition score?

Reference condition approach is a widely accepted standard

Compares biology at test sites to biology at similar **reference sites** (sites with low levels of disturbance)

Scoring tools depend on reference sites to account for natural sources of variation

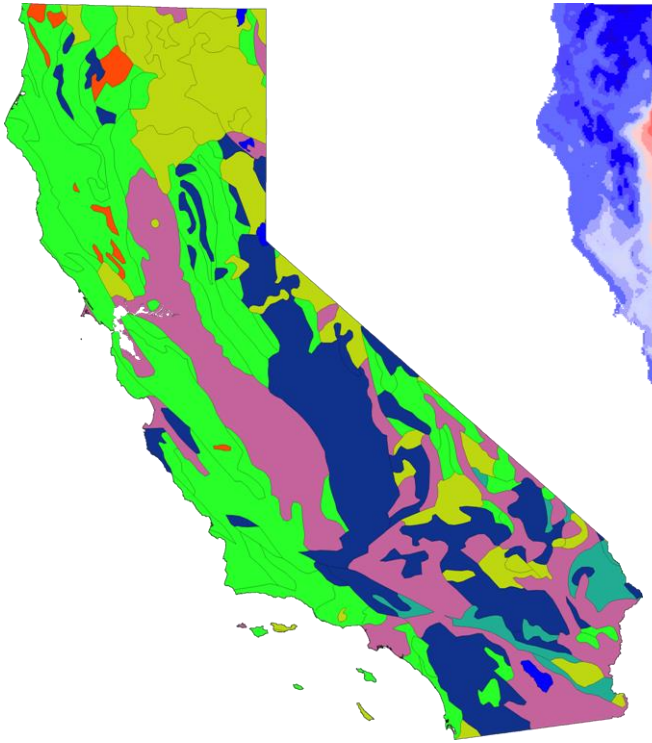




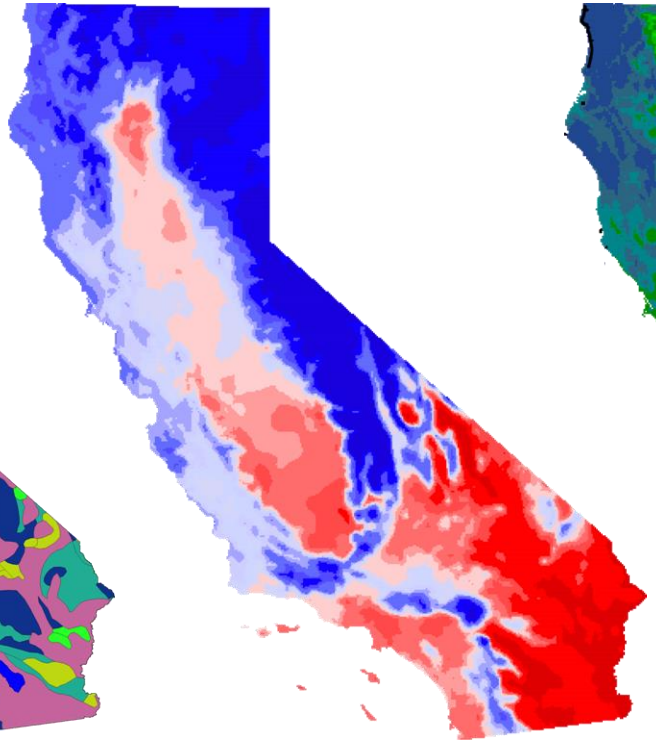
Technical Challenges: California is not Kansas

Strong natural gradients result in a large degree of **natural variation** in biological communities

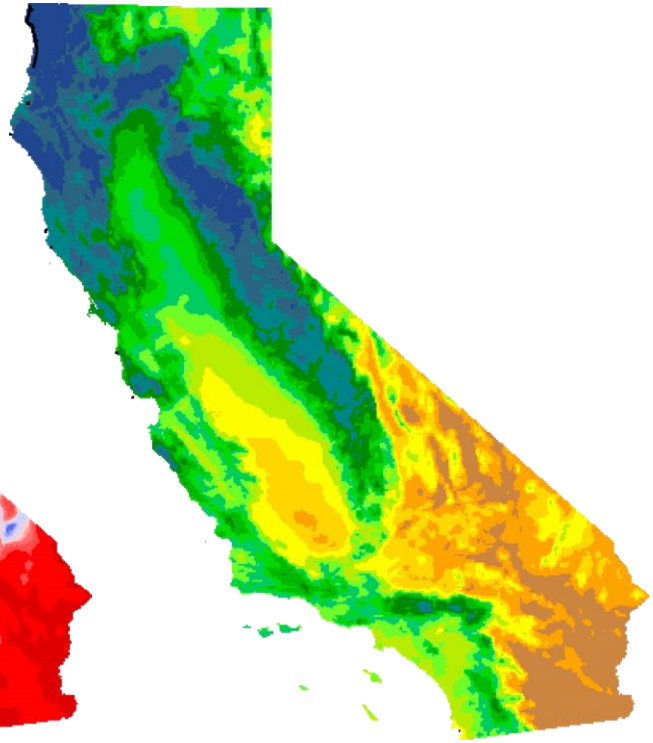
Geology



Temperature

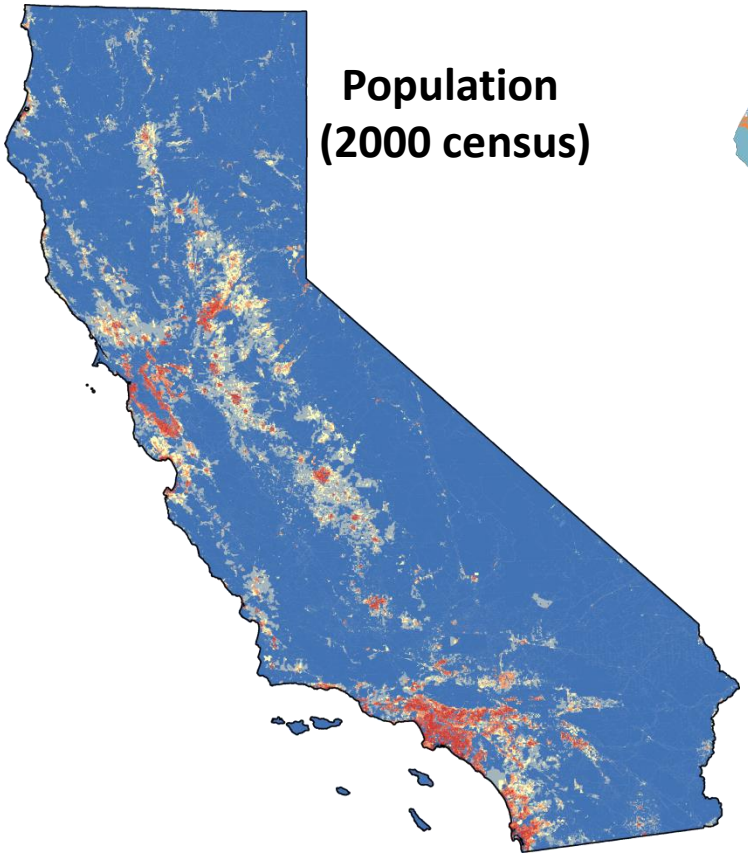


Precipitation

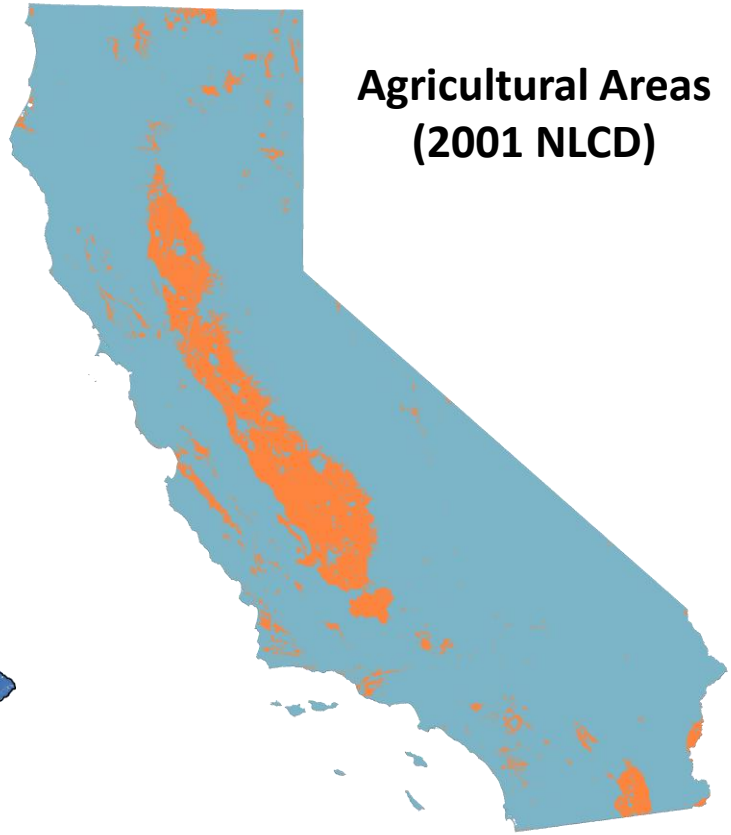


Technical Challenges: California IS Kansas

High degree of development (e.g., impervious surface and intensive agriculture) in some regions



Population (2000 census)



Agricultural Areas (2001 NLCD)

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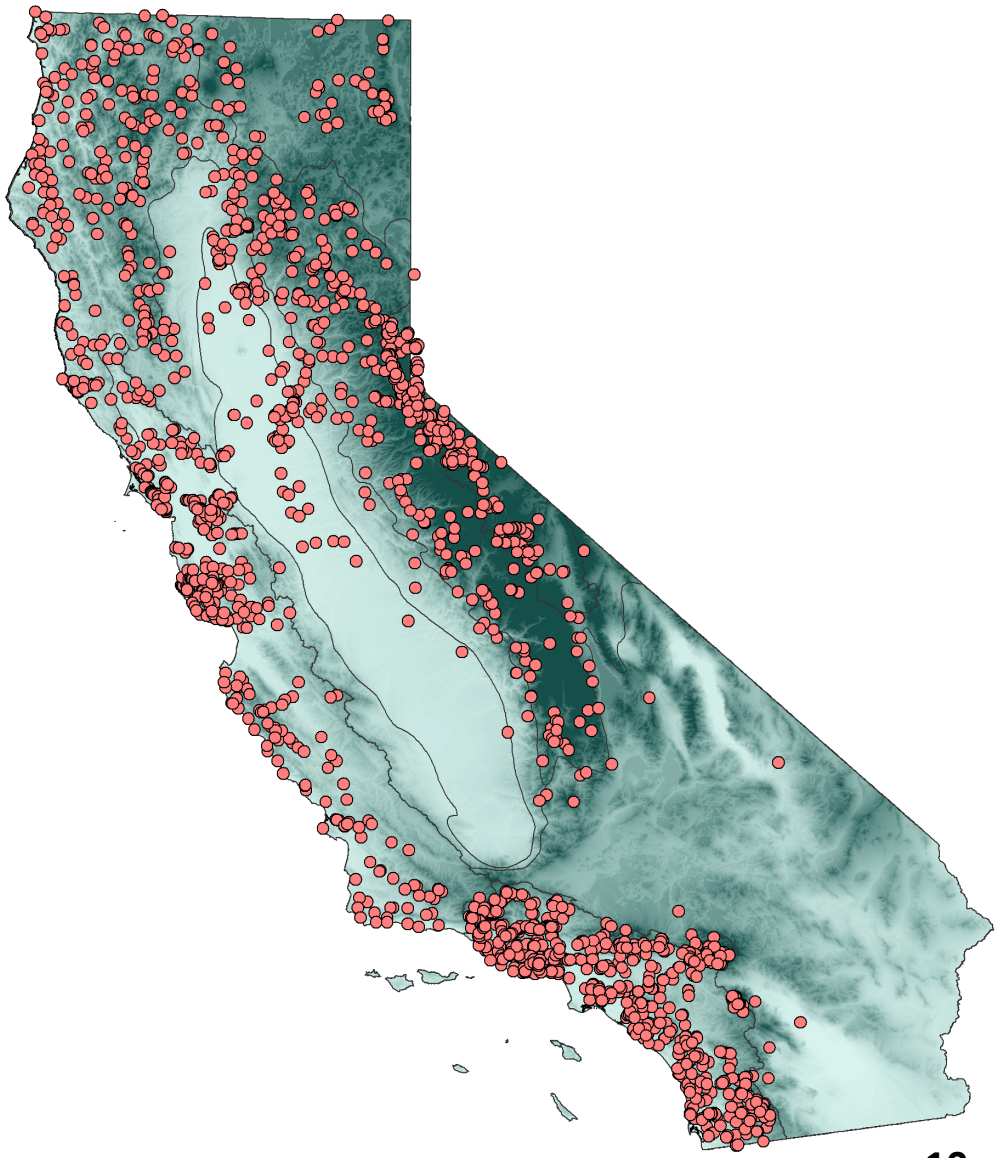
Reference site selection

Screened > 2400
candidate reference sites



Objectives:

1. Reference pool represents CA stream diversity

2. Biological at reference sites is minimally influenced by stress

Reference criteria: only allow sites with low levels of human activity

Filtered screening dataset with a large suite of GIS and reach-scale data (> 170 variables)

- Landuse
- Infrastructure
- Hydromodification
- Fire history, dams, mines
- Invasive invertebrates, plants
- Instream and riparian habitat
- Water chemistry

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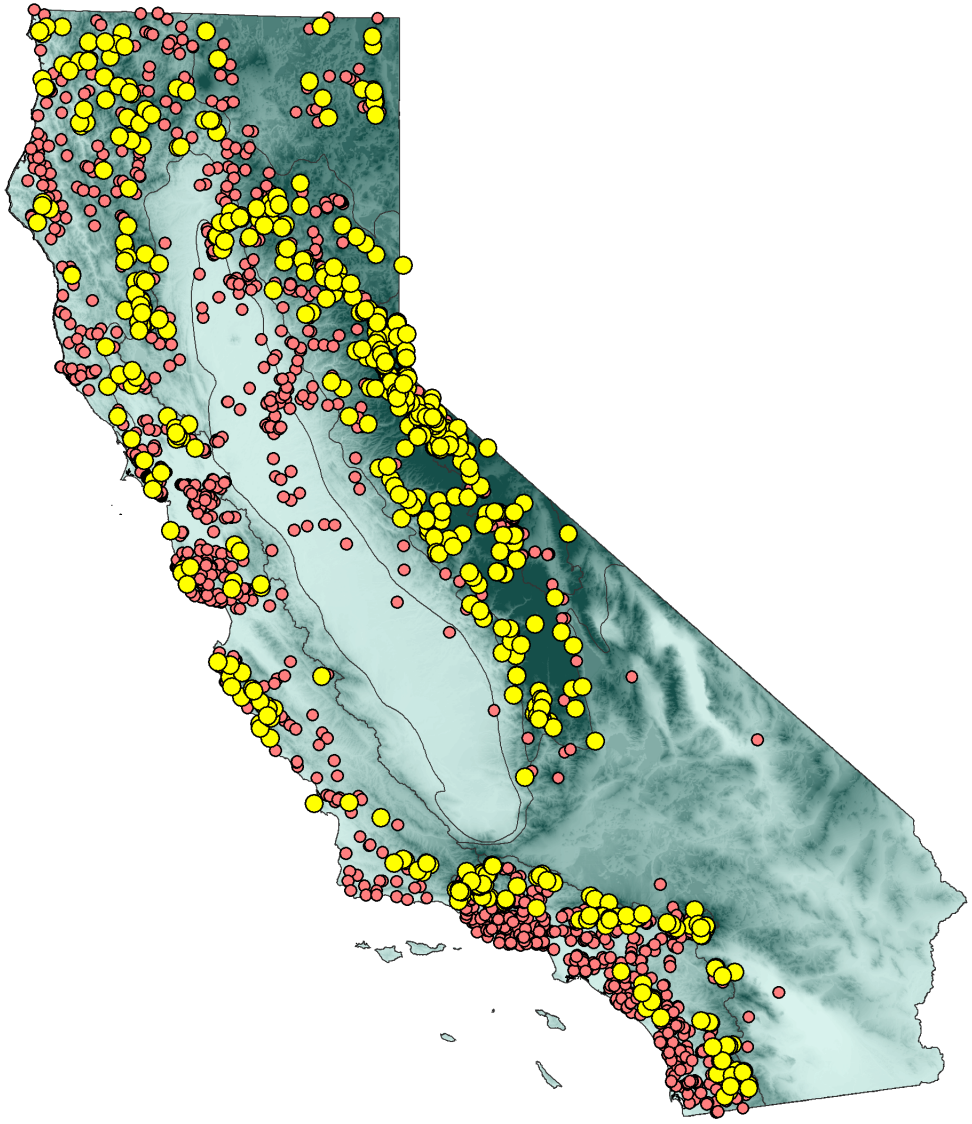
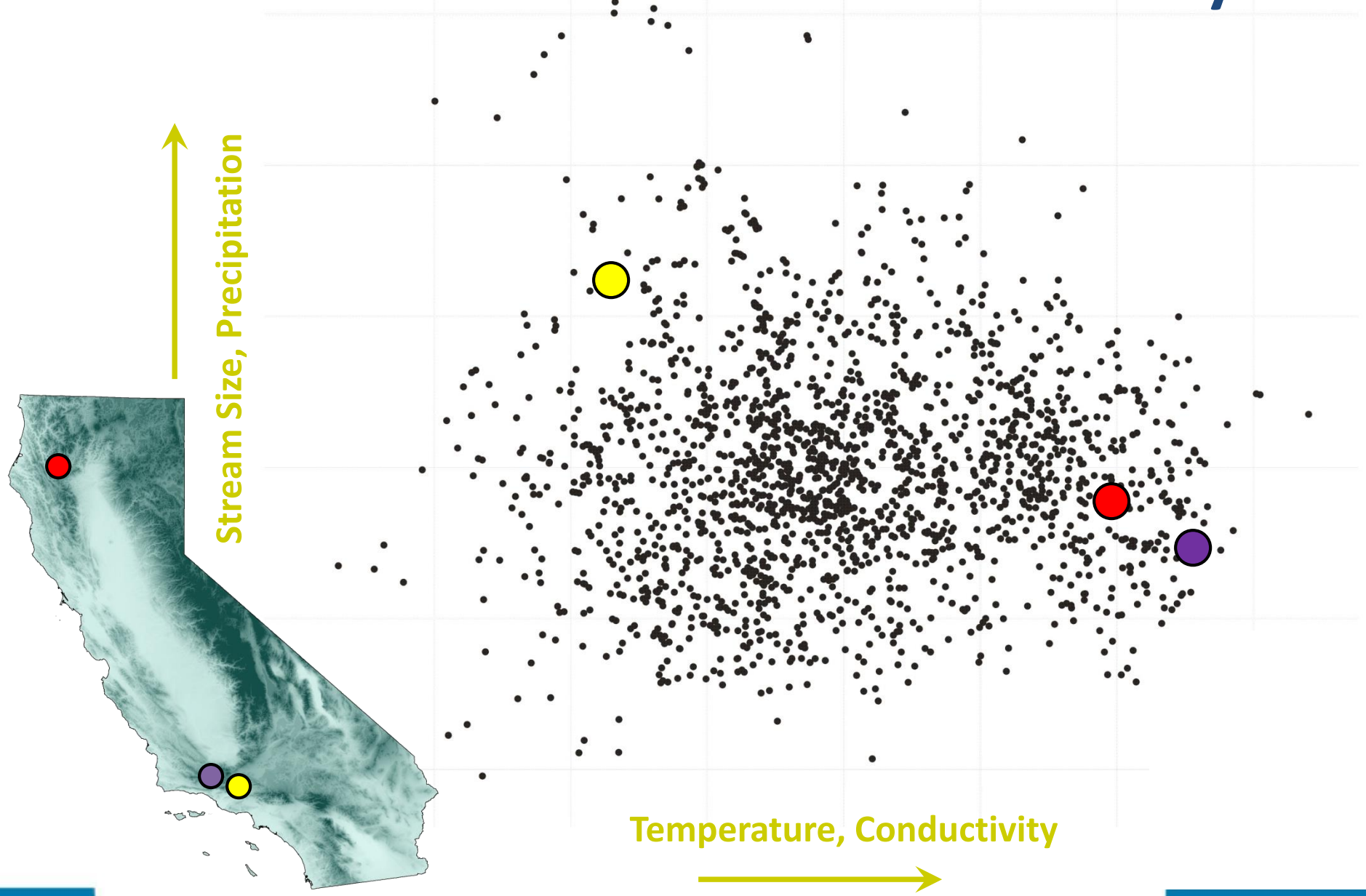
Broad geographic coverage

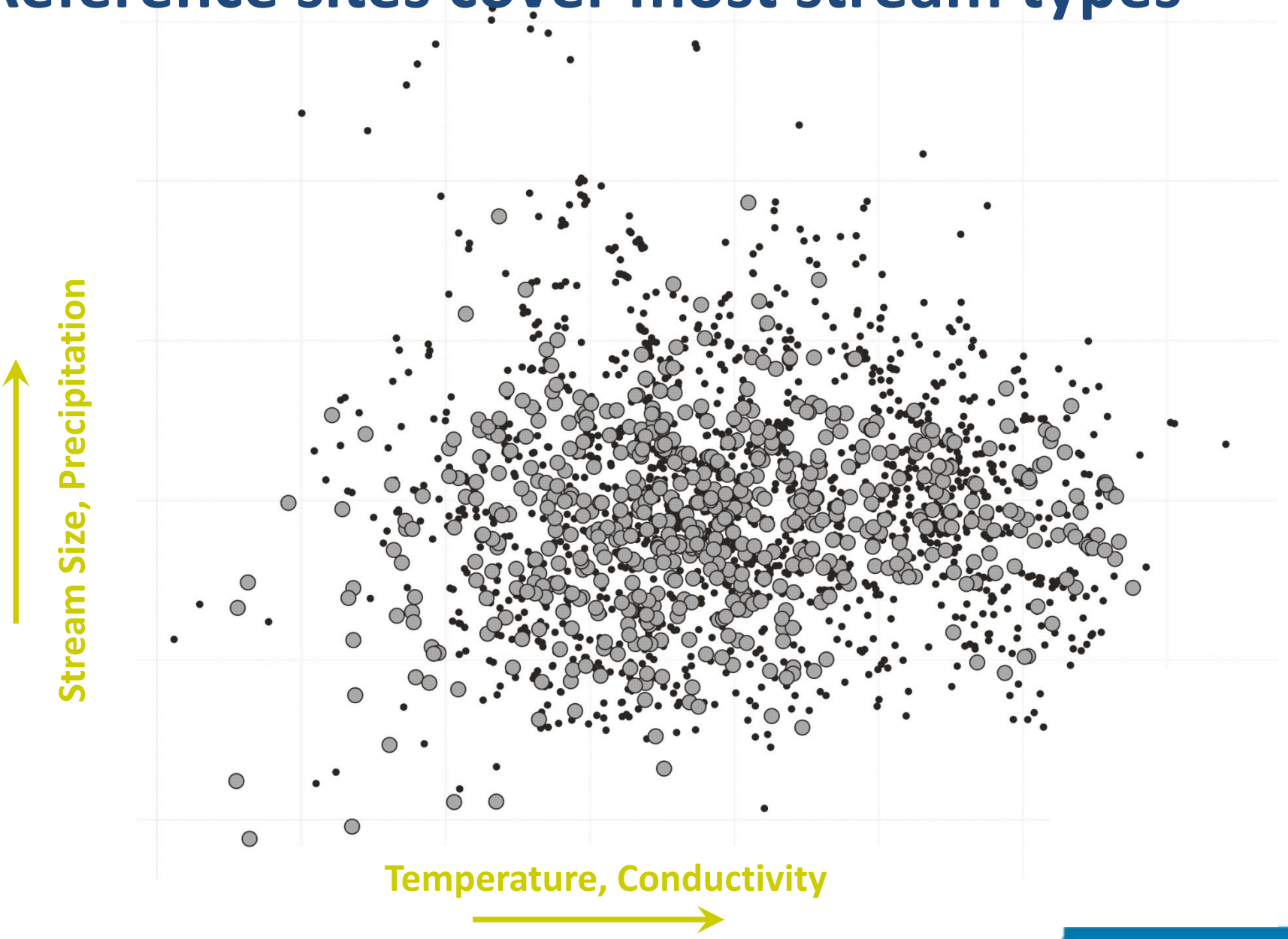
REGION	n
North Coast	75
Central Valley	1
Coastal Chaparral	57
Interior Chaparral	33
South Coast Mountains	85
South Coast Xeric	34
Western Sierra	131
Central Lahontan	114
Deserts + Modoc	27
TOTAL	**586**



Multivariate view of natural diversity



Reference sites cover most stream types



Using reference sites to set expectations for test sites

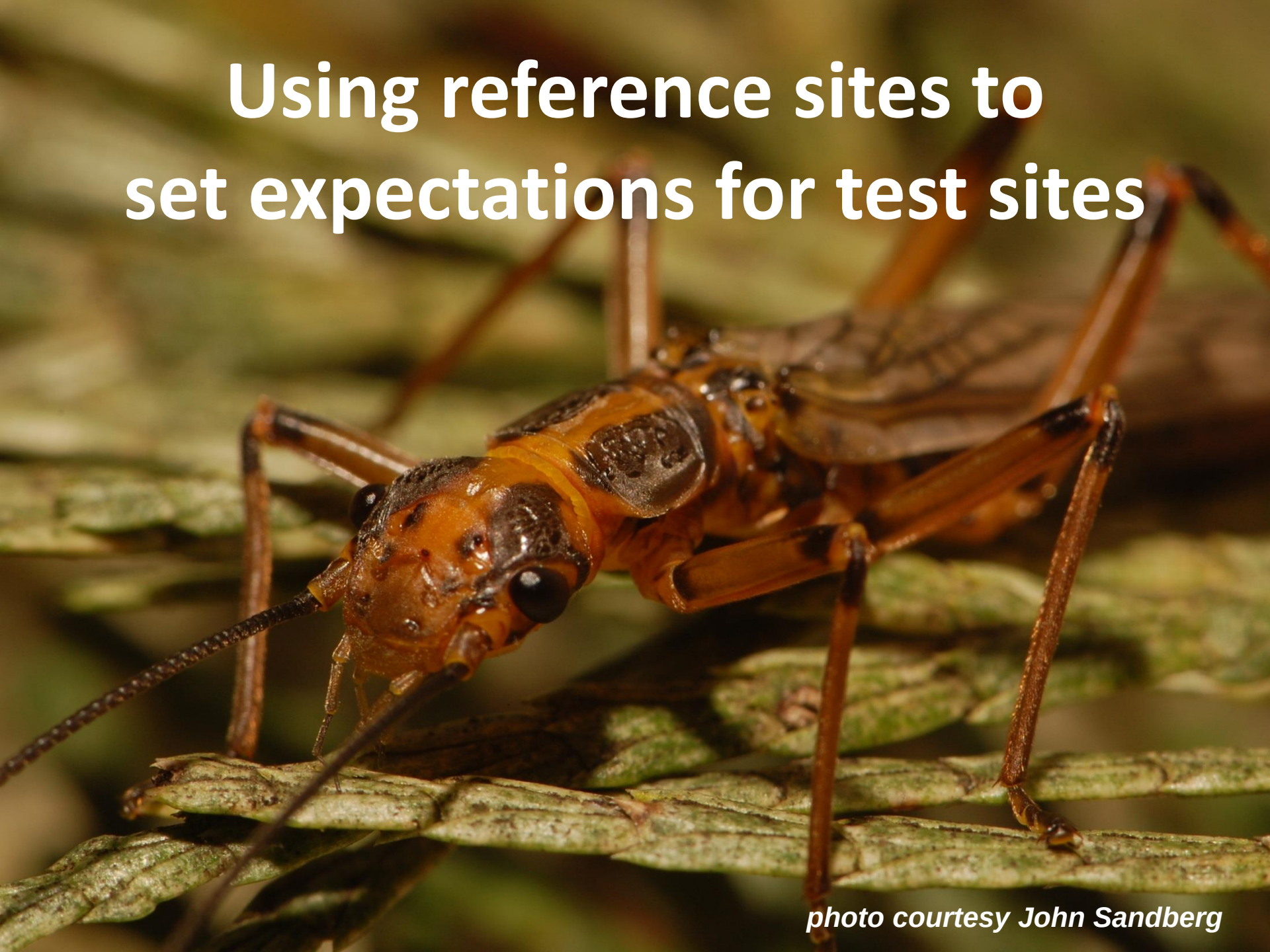


photo courtesy John Sandberg

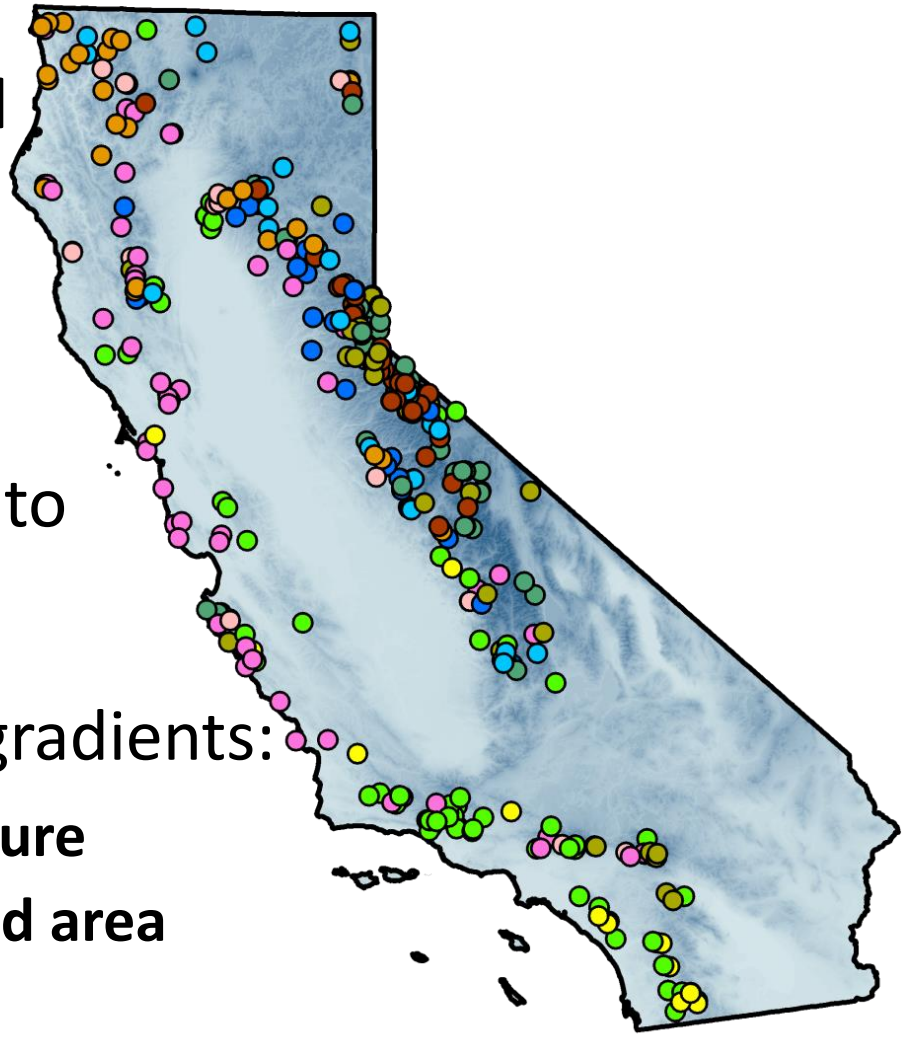
The California Stream Condition Index (CSCI) combines two common approaches

- **Species loss component (taxonomic completeness)**
- **Ecological structure component**

Both account for natural sources of variation, but measure different aspects of biotic health

Species Loss Component

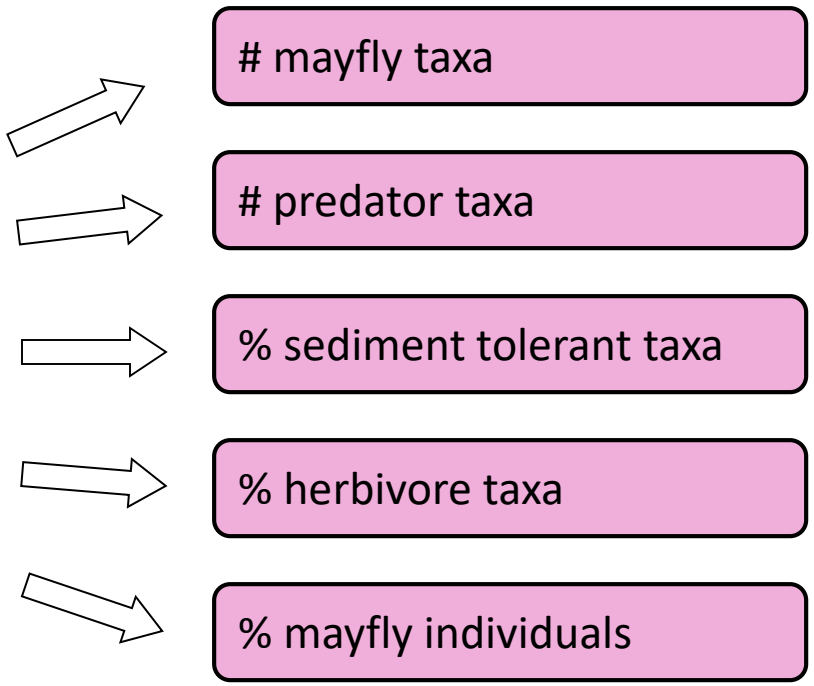
- Compare number of **observed** to number of **expected** taxa
- Test sites are compared to **groups of similar reference sites** to determine which taxa to "expect"
- Similarity based on 5 natural gradients:
  - **Latitude**
  - **Elevation**
  - **Precipitation**
  - **Temperature**
  - **Watershed area**



Ecological Structure Component

Species list is converted into metrics representing diversity, ecosystem function, and sensitivity to stress

Taxon	Count
Mayfly species 1	43
Mayfly species 2	12
Mayfly species 3	2
Beetle species 1	1
Beetle species 2	1
Midge genus 1	65
Midge species 1	3
Midge species 2	10
Midge genus 2	3
Dragonfly species 1	2
Stonefly species 1	1
Stonefly species 2	14
Worm species 1	9
Worm species 2	2



Ecological Structure Component

- Expected metric values are based on reference sites
- Expected metric values are adjusted to account for major natural gradients

CSCI predicts the species and metric values to expect at a test site based on **natural environmental factors**

- **Location** – elevation, latitude, longitude
- **Watershed size**
- **Climate** – precipitation, temperature
- **Geology** – mineral content, soils

species and metrics **measured** at test site = **Observed**

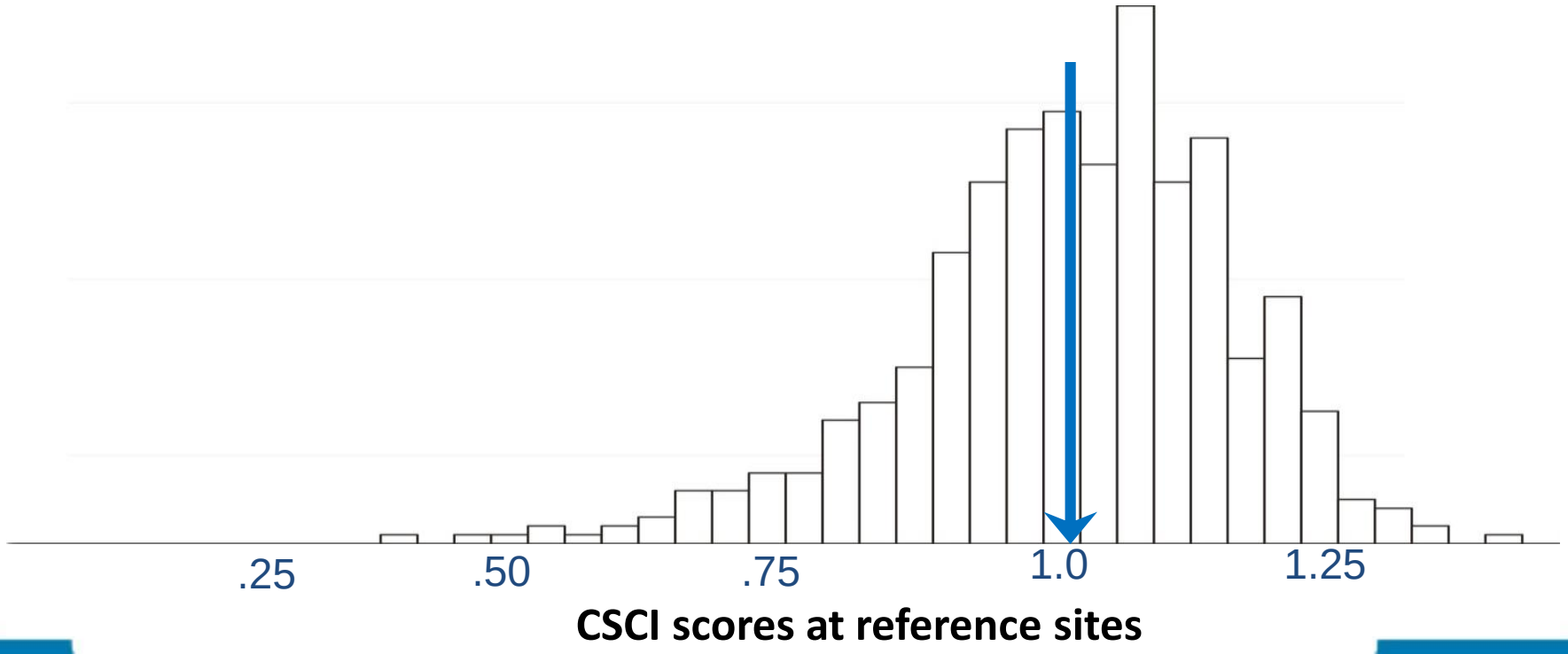
species and metrics **predicted** at site = **Expected**

If O/E is ~1.0, biological integrity is intact

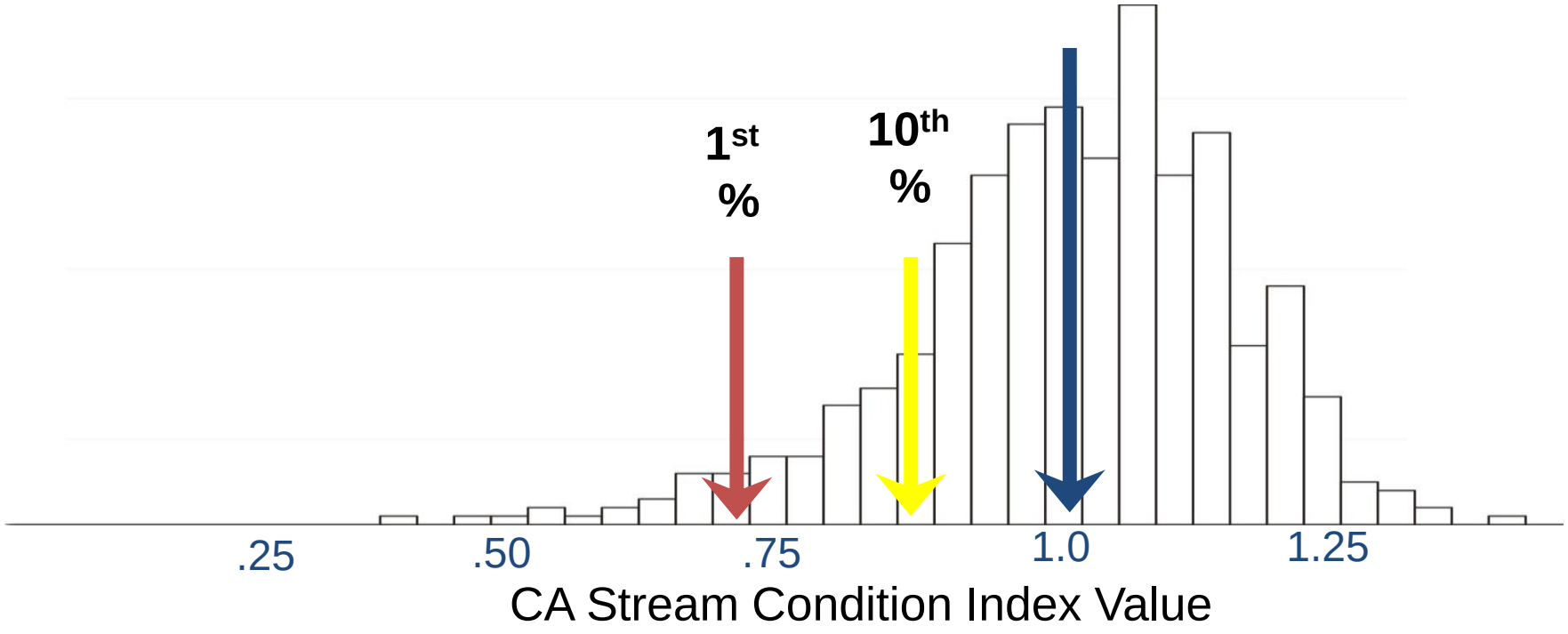
If O/E << 1.0, biological integrity is altered

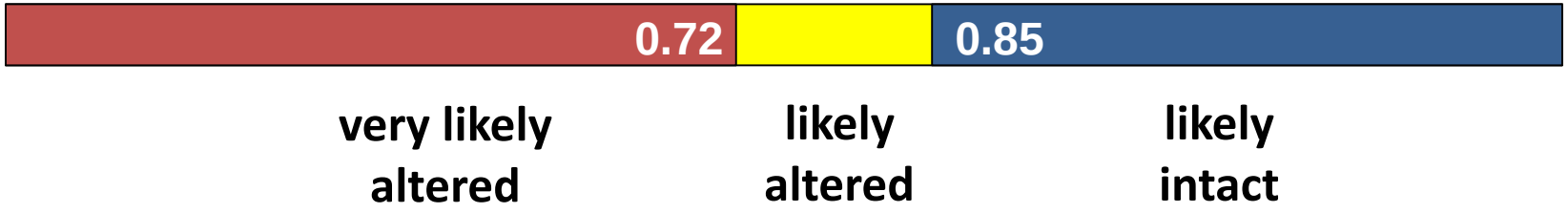
California Stream Condition Index (CSCI) is an average of the two component scores

- CSCI ranges from 0 to >1
- Mean of reference sites 1.01
- Variability in scores is known (± 0.12 sd)



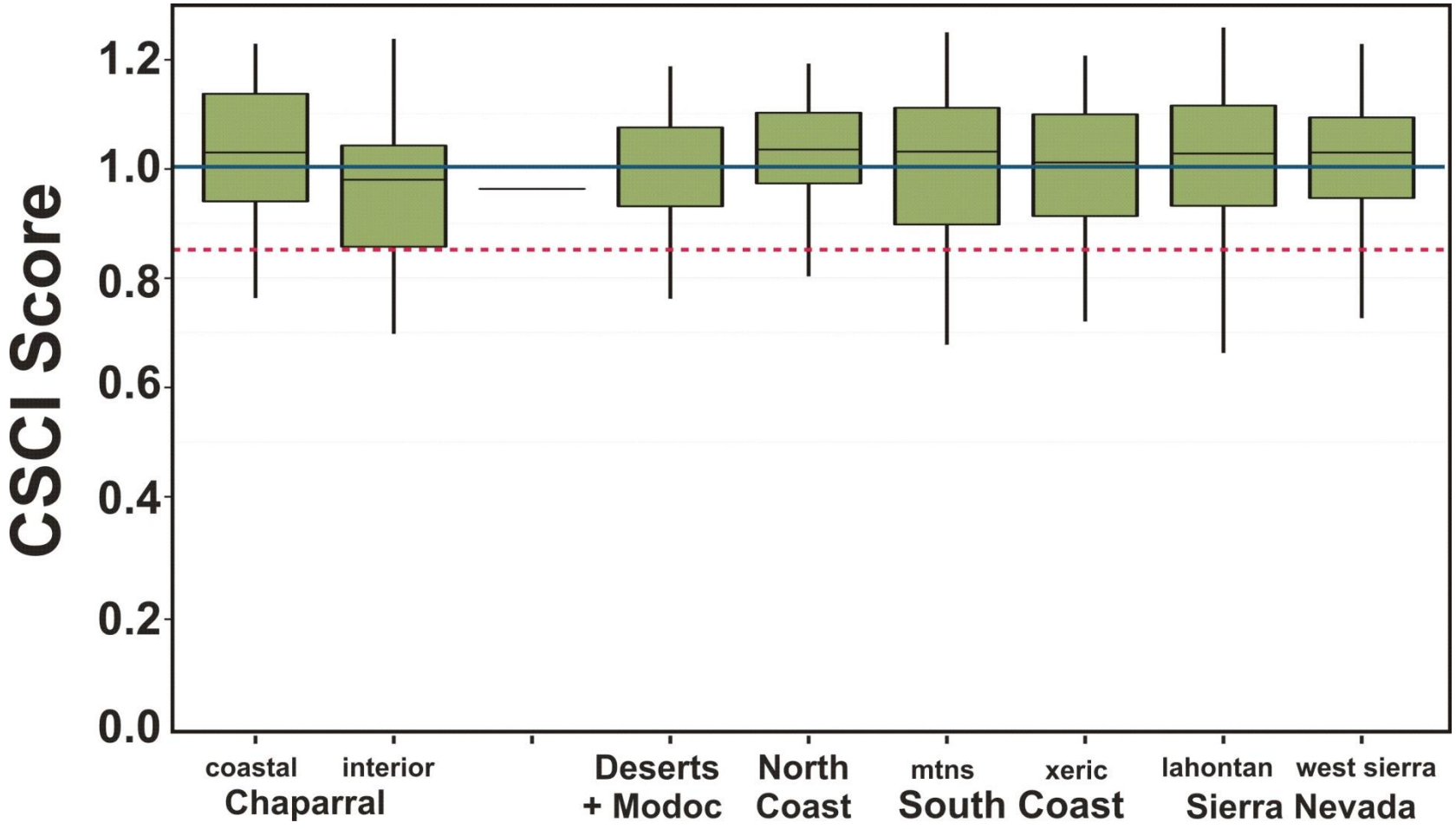
Statistical thresholds





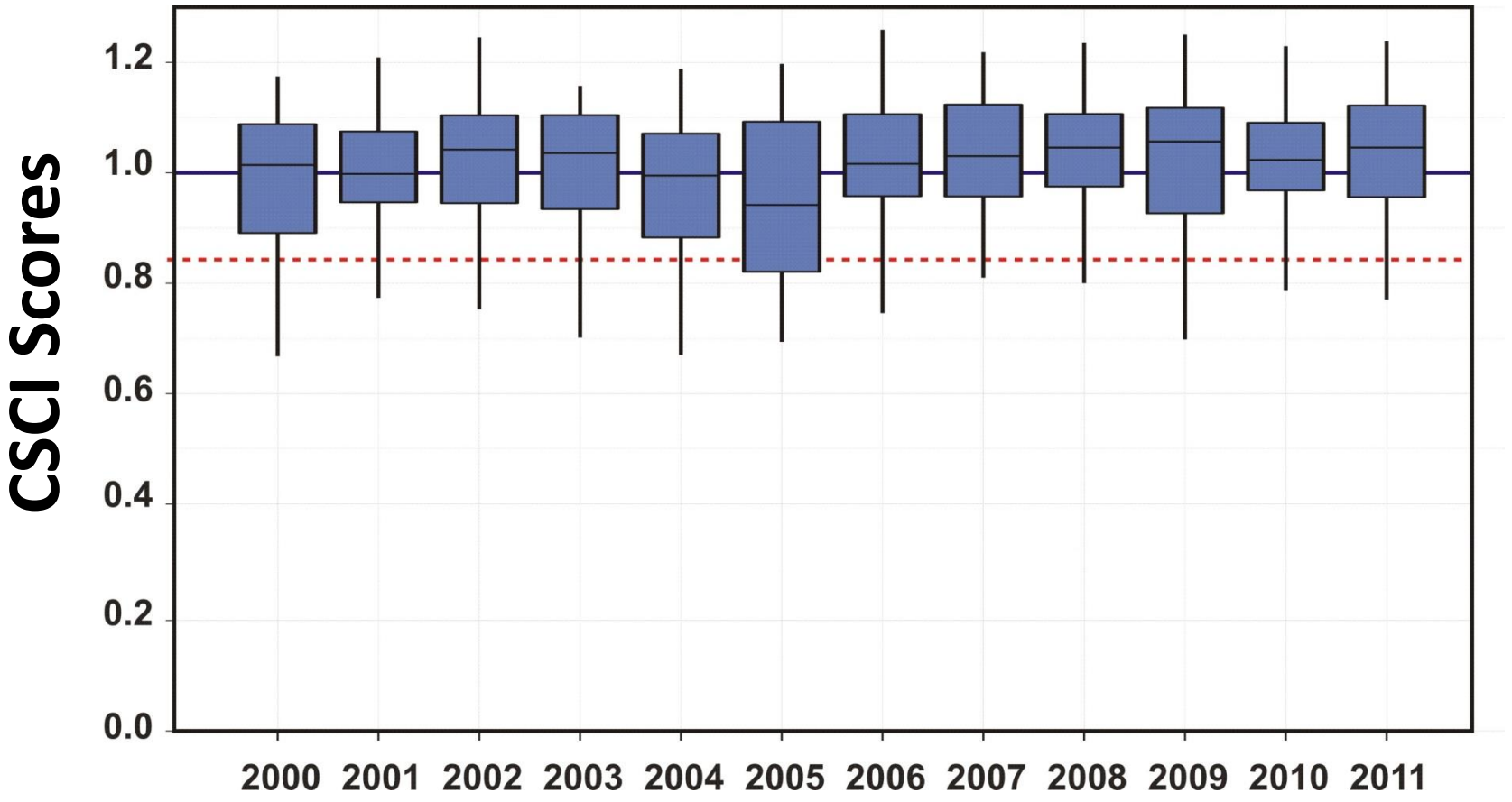
CSCI is consistent in all regions

CSCI scores at reference sites in major CA ecoregions

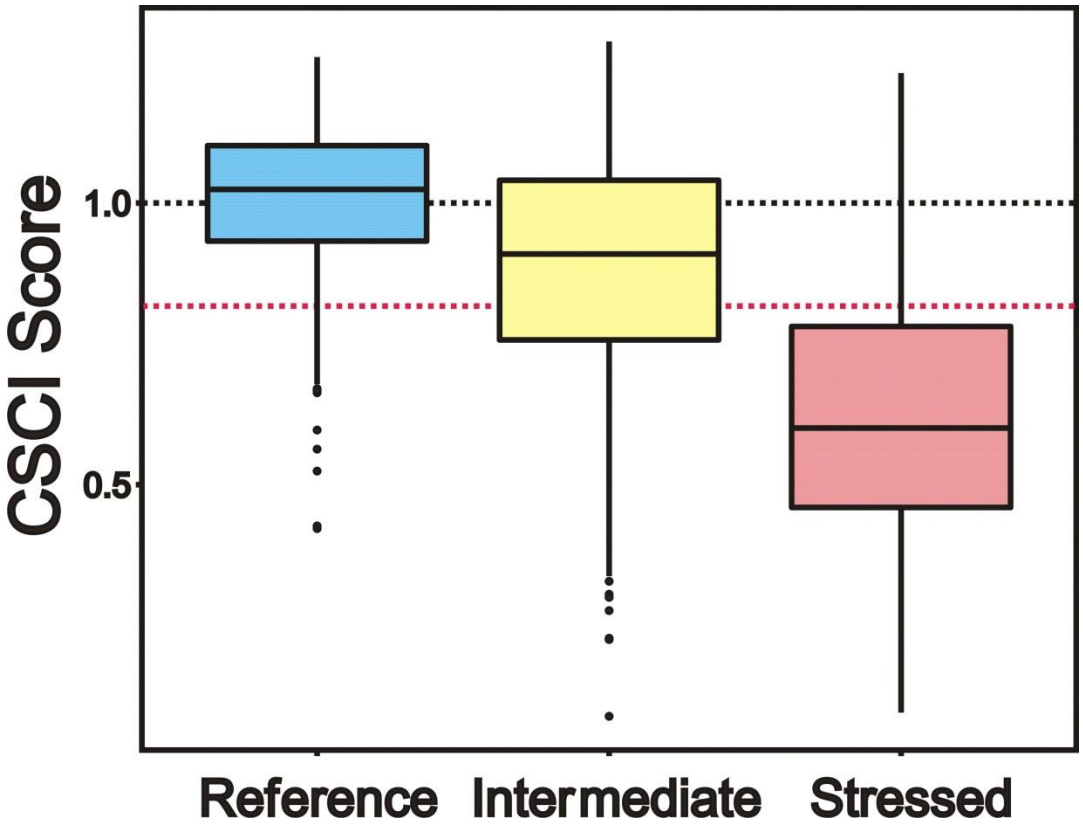


CSCI is consistent over time

CSCI scores at reference sites 2000 - 2011



CSCI is responsive to stress



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Considerations for modified streams

- We have deliberately expended many resources addressing highly modified streams
  - Enables constructive stakeholder and regulatory advisory group discussions
- Explored several options in multiple pilot studies
  - How to define, where located, what is their range of biological condition
- Can still apply the CSCI in modified streams
  - Still deciding what are appropriate thresholds

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Summary: The CSCI is a significant advance over previous CA biotic indices

- ***Much better reference data set***
  - Bigger, broader, and more rigorously screened
- ***More comprehensive*** assessment of biological integrity
- ***Site-specific expectations***
  - Expected values are customized to each location
- ***Statewide applicability***
  - All perennial wadeable streams can be assessed
  - Consistent meaning throughout California

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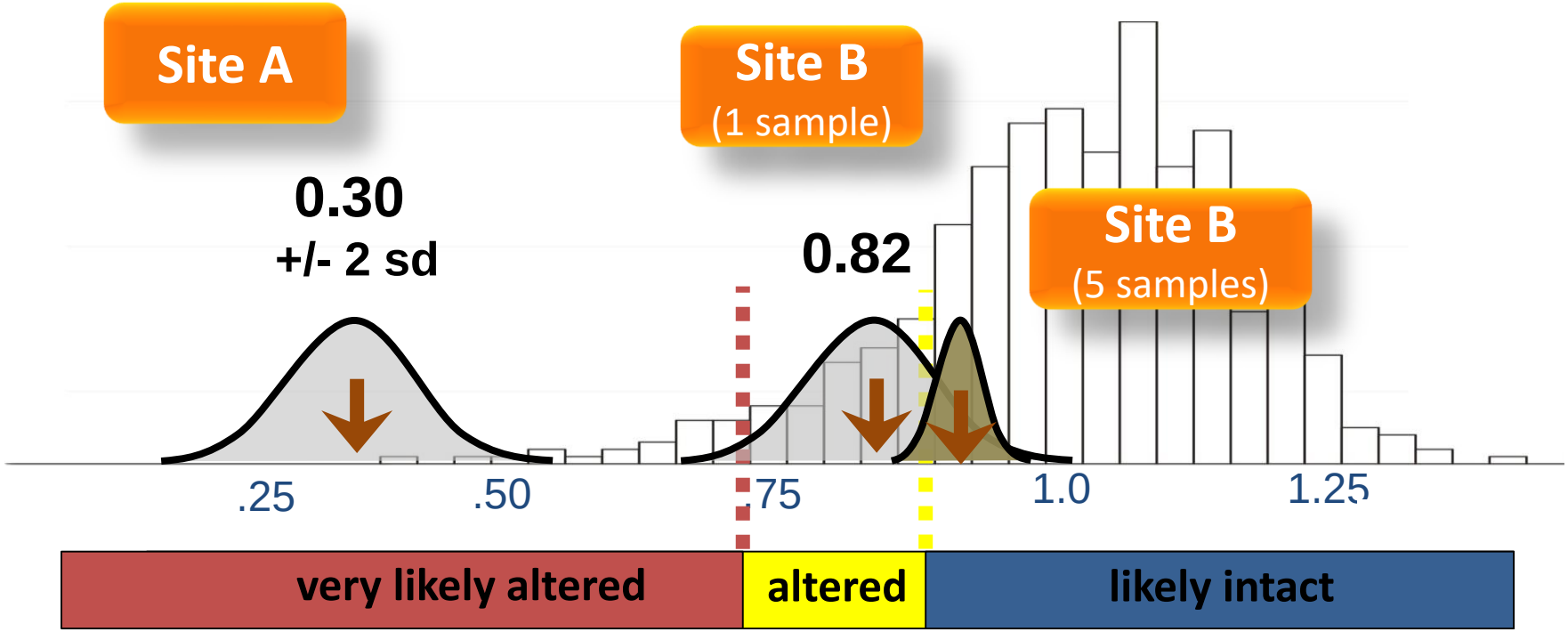
Questions?

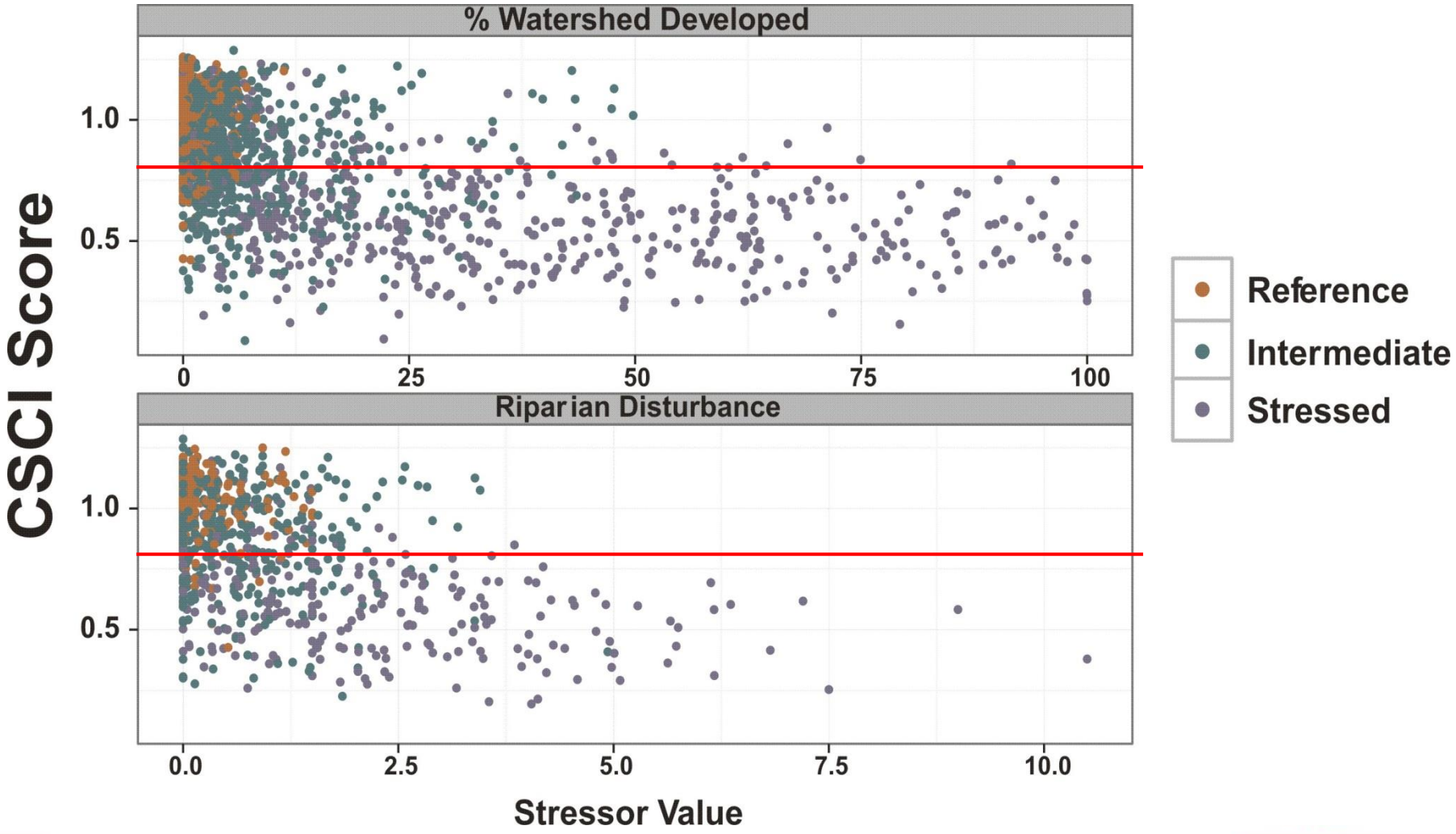
Incorporating test site uncertainty

Use within-site error rate to account for uncertainty around test site score



more certainty with multiple samples

CSCI is responsive to stress



Technical Team

Andy Rehn, *DFG-ABL*

Raphael Mazor, *SCCWRP +DFG-ABL*

Larry Brown, *USGS*

Jason May, *USGS*

David Herbst, *SNARL*

Peter Ode, *DFG-WPCL/ABL*

Ken Schiff, *SCCWRP*

David Gillett, *SCCWRP*

Eric Stein, *SCCWRP*

Betty Fetscher, *SCCWRP*

Kevin Lunde, *SF Water Board*

***Scientific Advisory Panel**