US EPA ARCHIVE DOCUMENT

Establishing Reference Conditions for Assessing the Biological Integrity of Western Streams

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Why am I here?

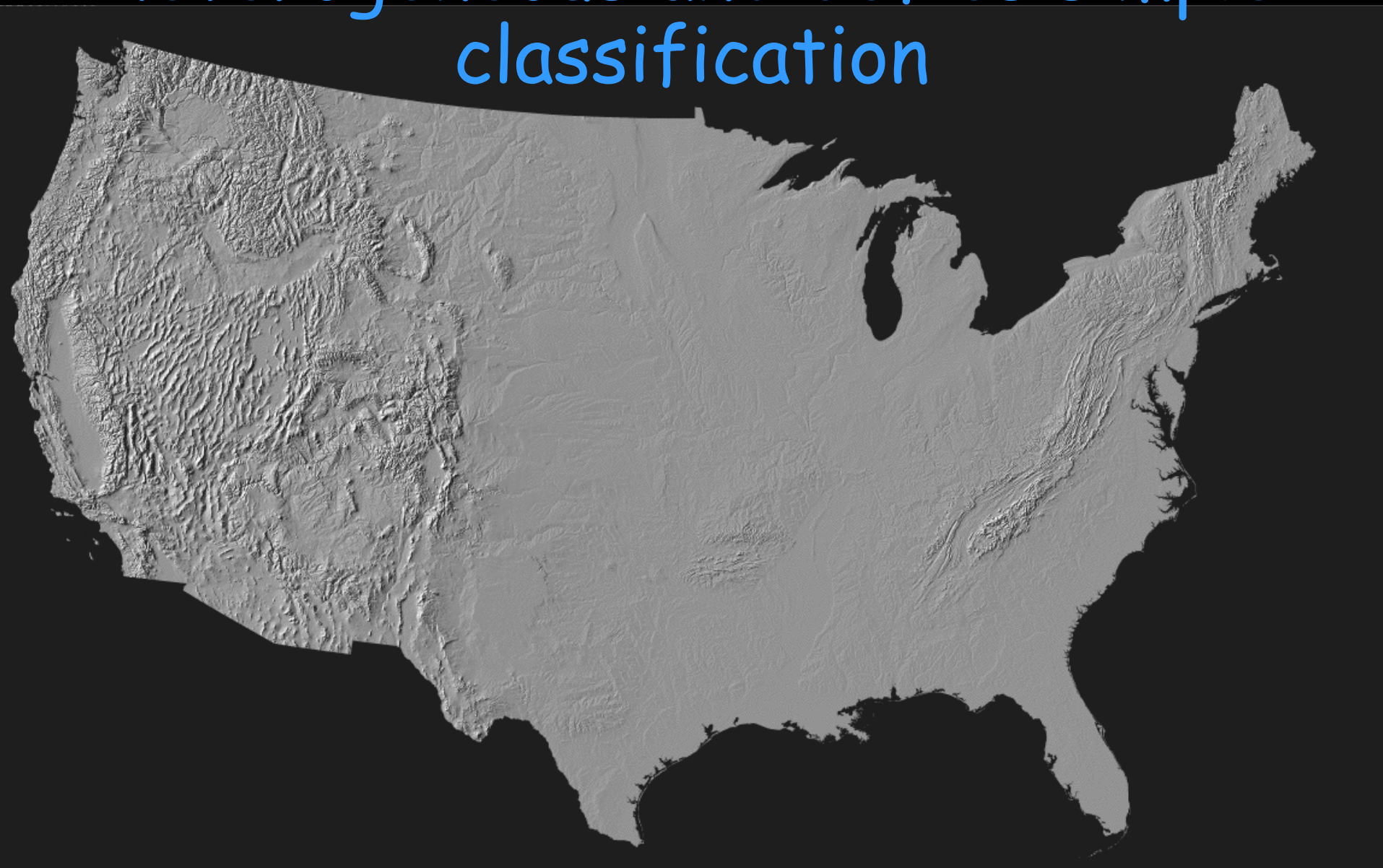
My collaborators and I are working to develop and test scientifically defensible and interpretable methods to quantify biological condition in western and other landscapes.

We have been especially interested in aiding partnerships between USFS, BLM, and States.

Ecosystem Heterogeneity and Biological Assessments

If we don't account for natural variability, we will confound human effects with the effects of naturally occurring factors and thus draw incorrect inferences regarding the true condition of a site.

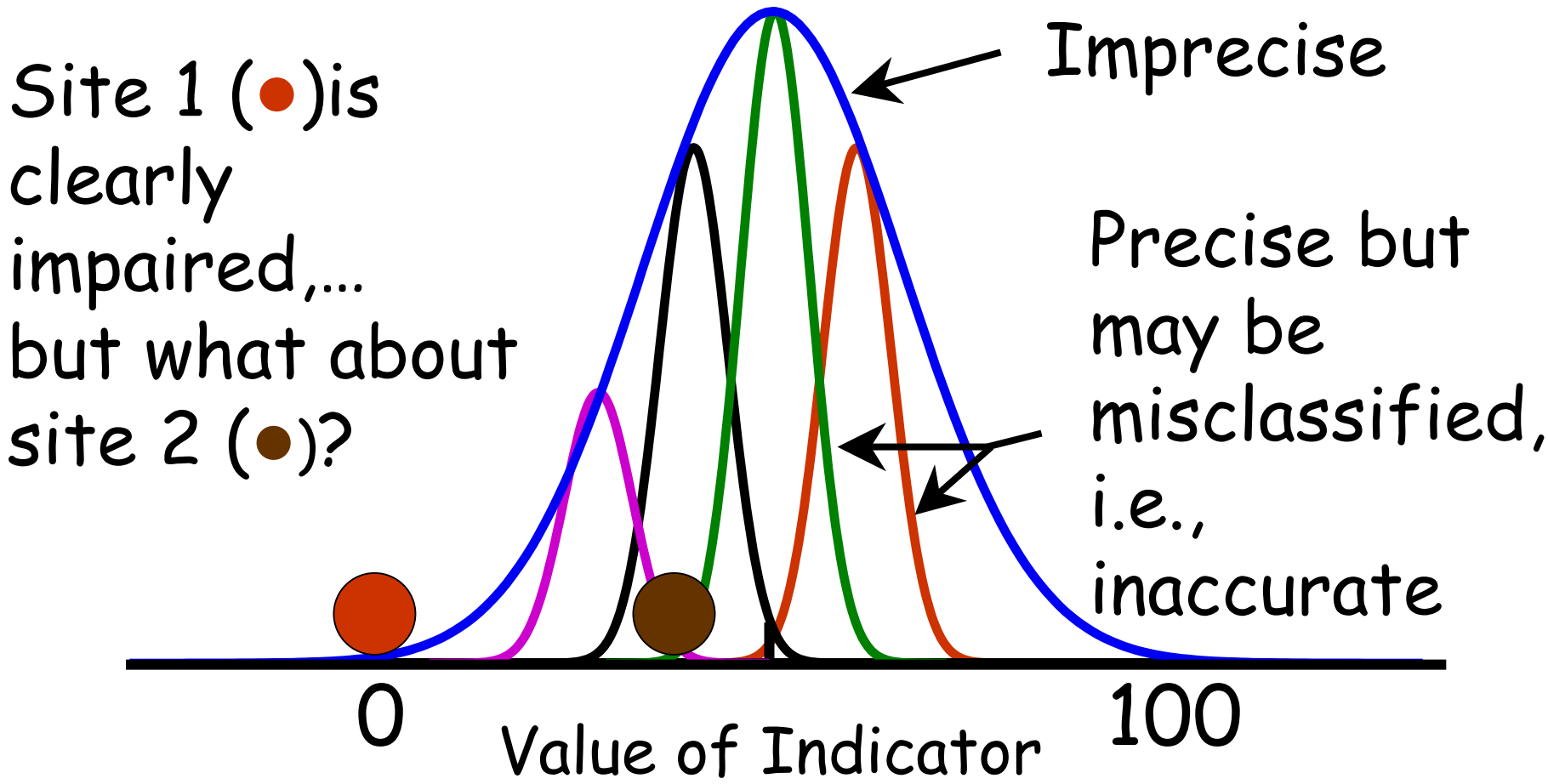
The West is especially heterogeneous and defies simple classification



Accounting for Natural Variability is not a Trivial Task

In a heterogeneous world, the expected biota can vary markedly from place to place in response to multiple natural environmental gradients and mistakes in 'classifying' sites can have important consequences.

Imprecise or inaccurate estimation of expected condition can increase both Type I and II errors



Partitioning Effects of Natural Factors

- Many naturally occurring environmental factors are known to affect aquatic biota.
- How can we 'partition' those effects as efficiently as possible such that we can derive reasonably precise estimates of expected conditions and thus allow assessments that are sensitive enough to meet management targets?

Two Primary Approaches to Partitioning Variance

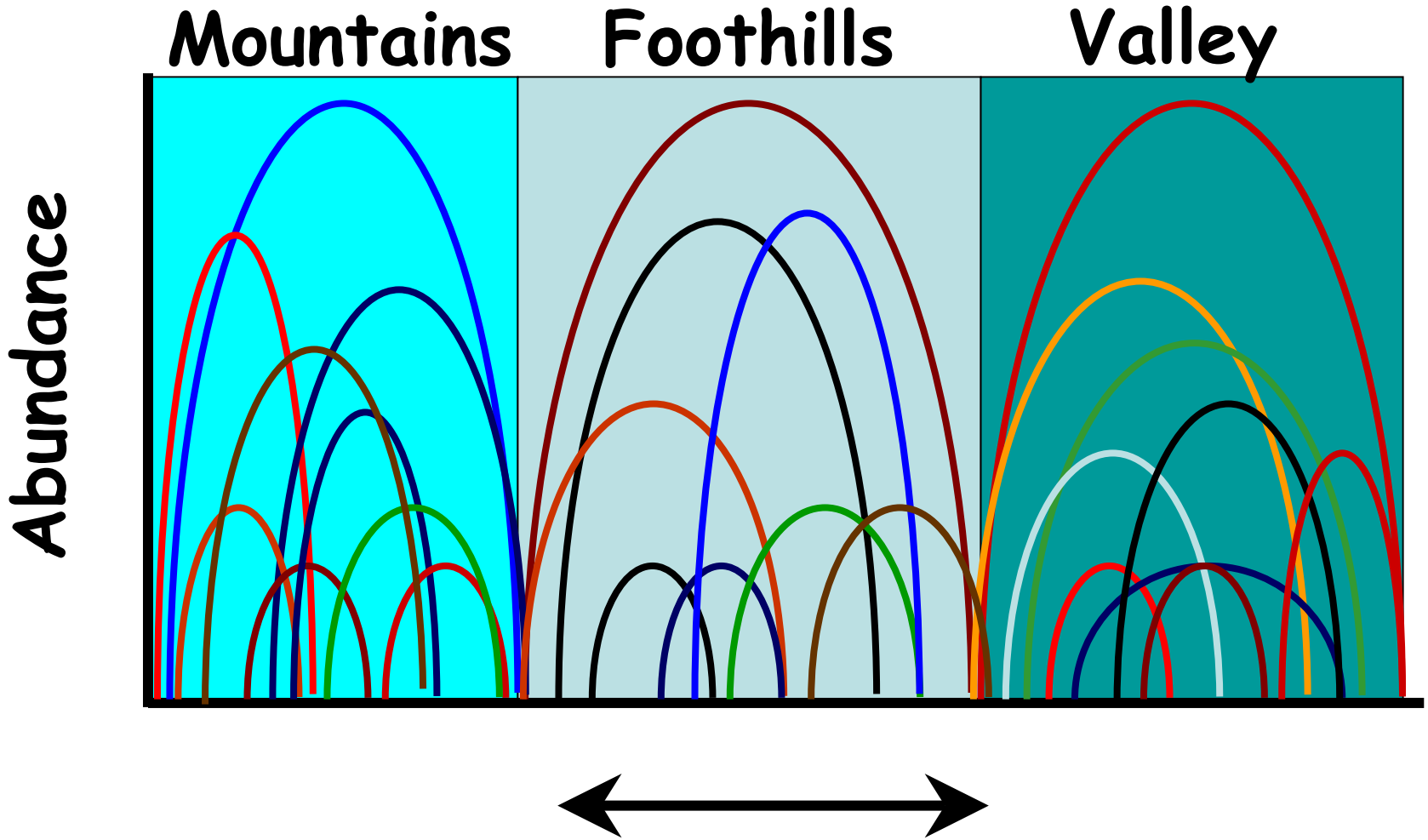
Spatial Classification

- Landscape scale
- Assumes:
  - landscape features are good predictors of local habitat conditions and thus the biota.
  - habitat and biota are similar within regions.

Modeling

- Local scale
- Assumes:
  - local habitat is not necessarily strongly correlated with landscape features.
  - habitat and biota continuously vary along environmental gradients within regions.

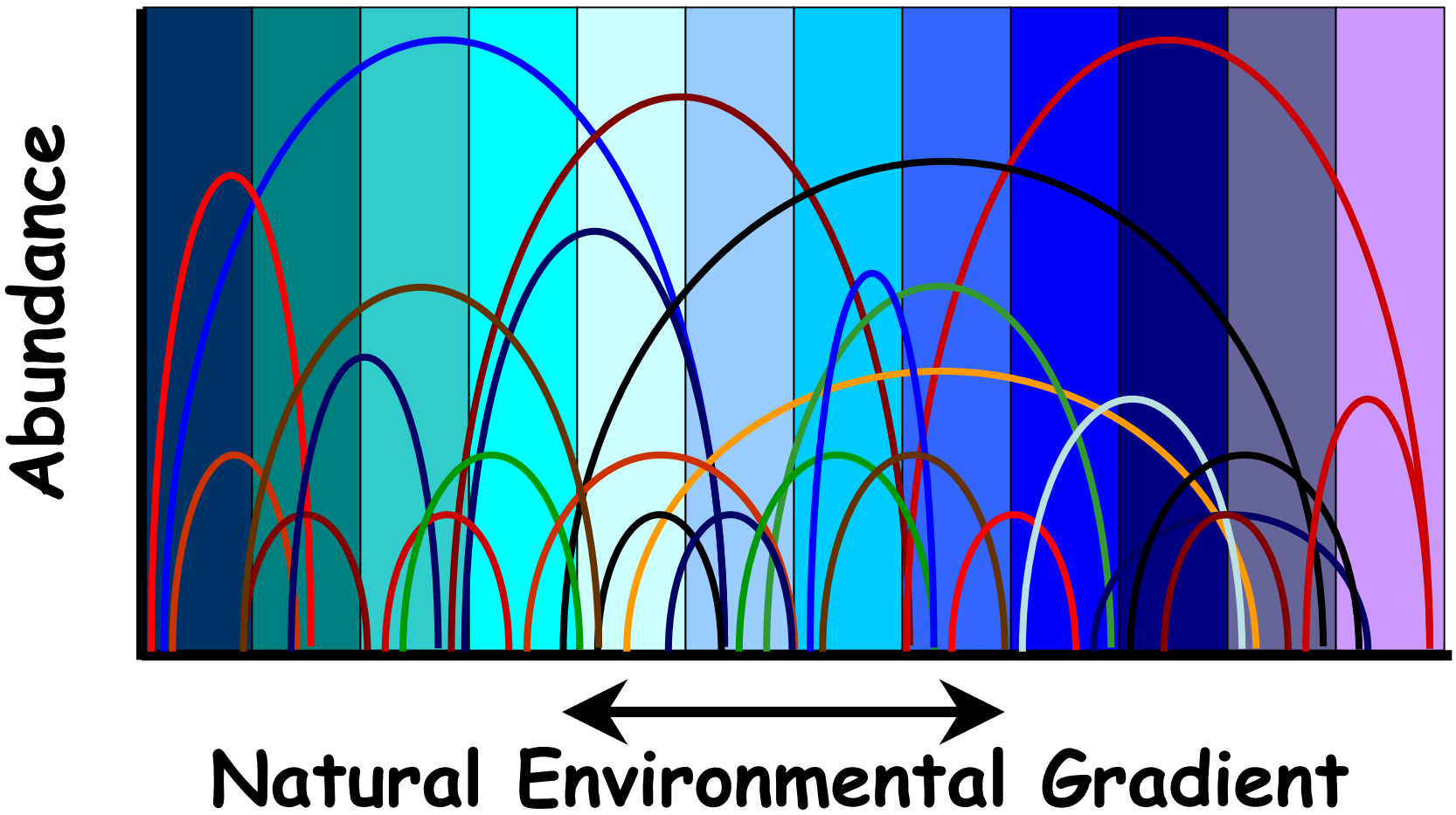
Aggregated Distributions of Species



Individualistic Distributions of Species

How Many Classes?

Mountains Foothills Valley

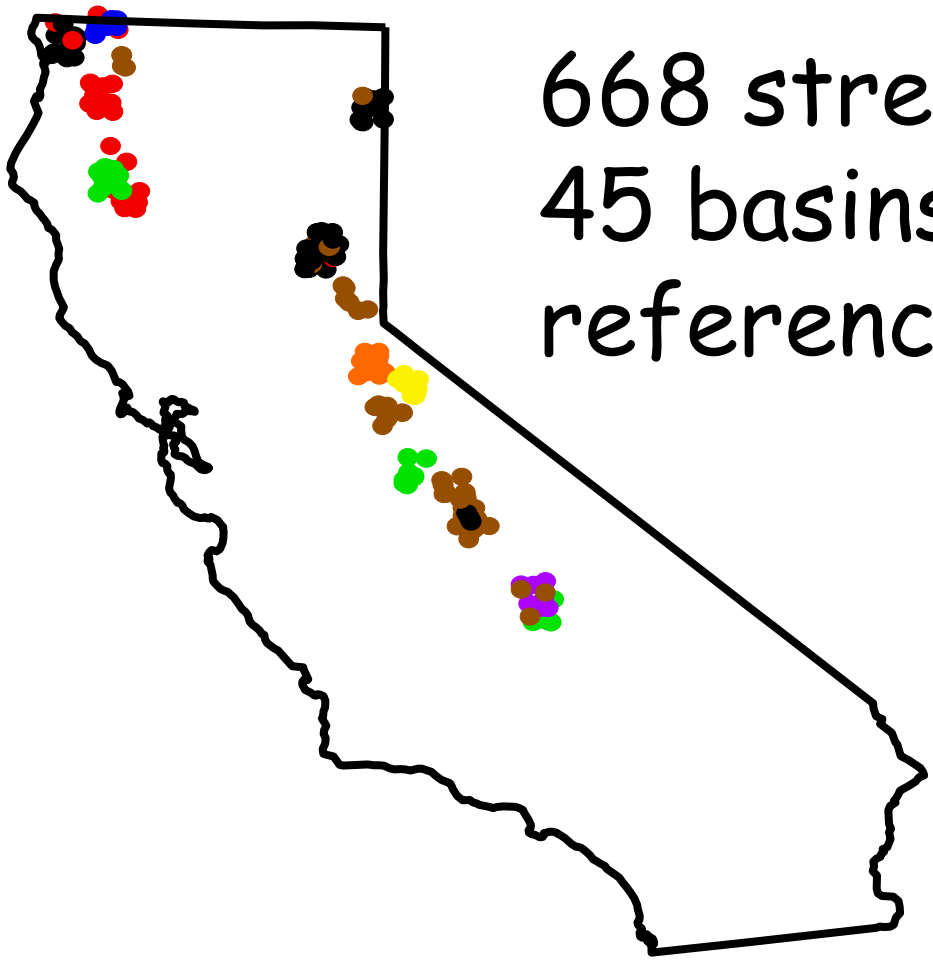


I am working under the assumption that biotic distributions are largely continuous and that partitioning natural variability in biota will require that we develop models capable of predicting that variation.

Examples (and a little history) of work to date:

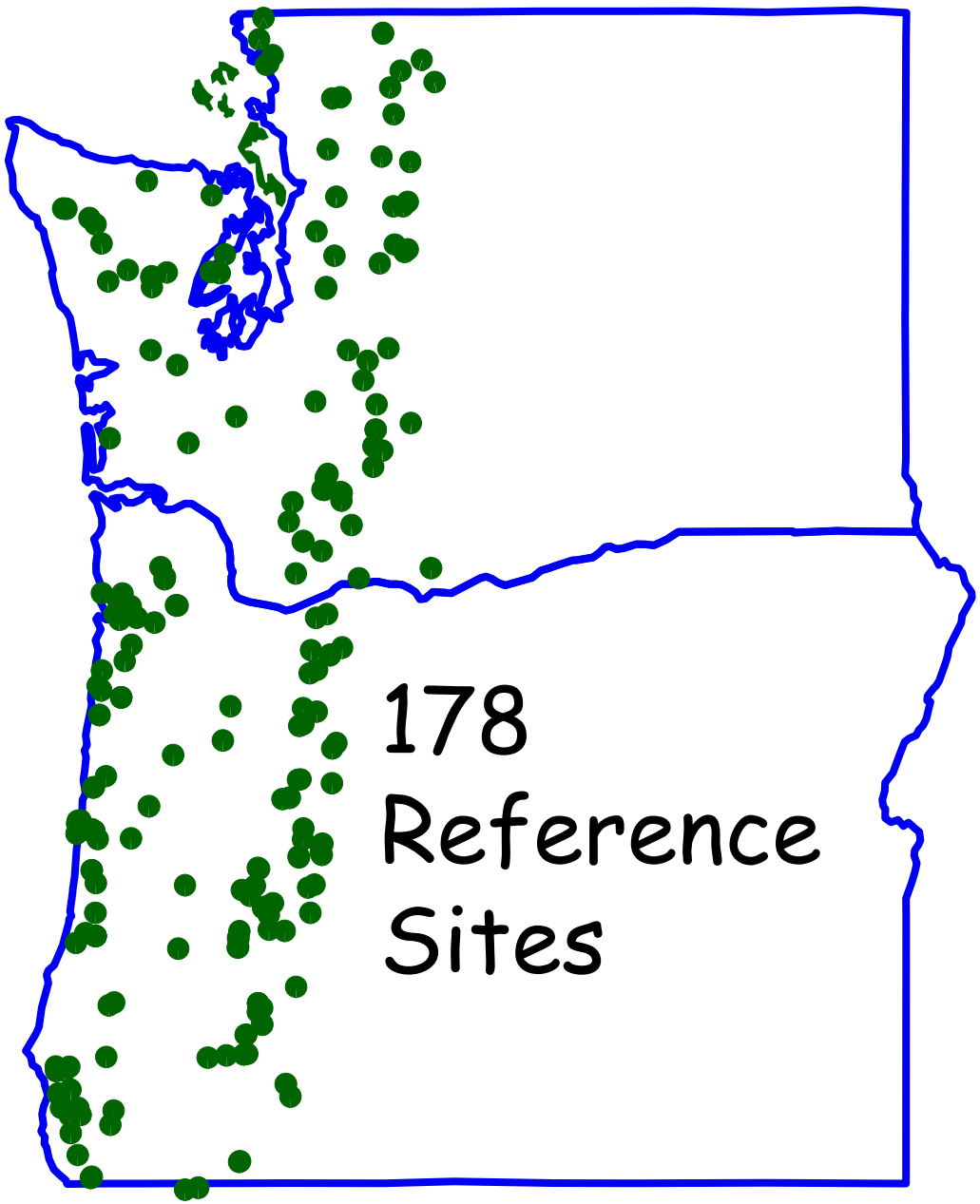
Field Studies Designed to Improve Stream Assessments

We started "small" in the beginning with a project funded by the Forest Service



668 stream reaches in 45 basins including 233 reference reaches

The results of the CA project lead to additional work in western Oregon and Washington in collaboration with the USFS, EPA, ORDEQ, and WADOE.



This project identified 7 easily measured predictor variables useful in modeling invertebrate assemblage composition

Elevation

Latitude

Channel slope

Wetted Width

Day past 1 Jan

Coast Range ER

Olympics Rainshadow ER

This model allowed us to assess the condition of potentially impaired sites by comparing the observed fauna (O) with that expected (E) to occur

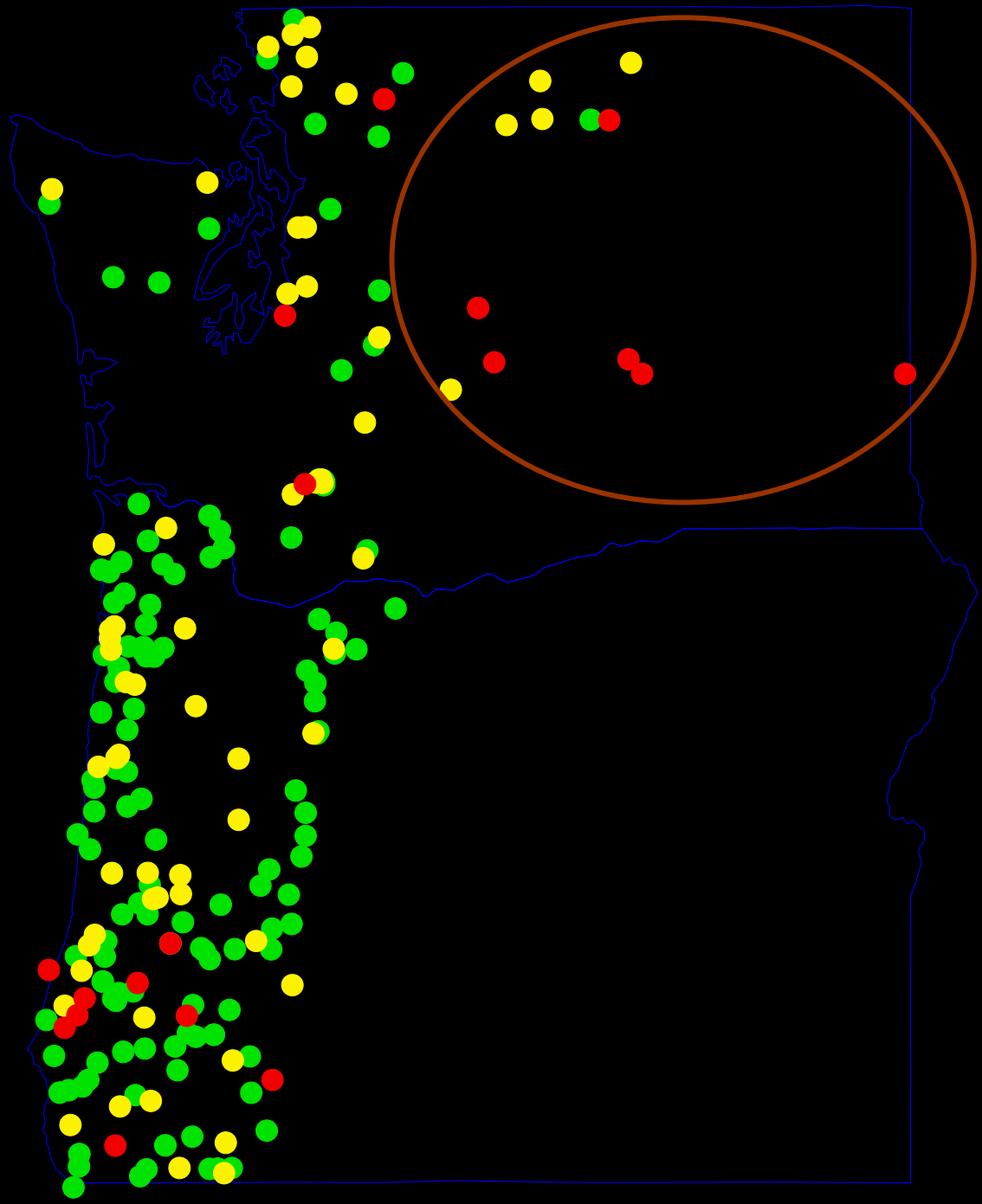
O/E is a measure of impairment.

Spatial distribution of O/E values for test sites examined thus far.

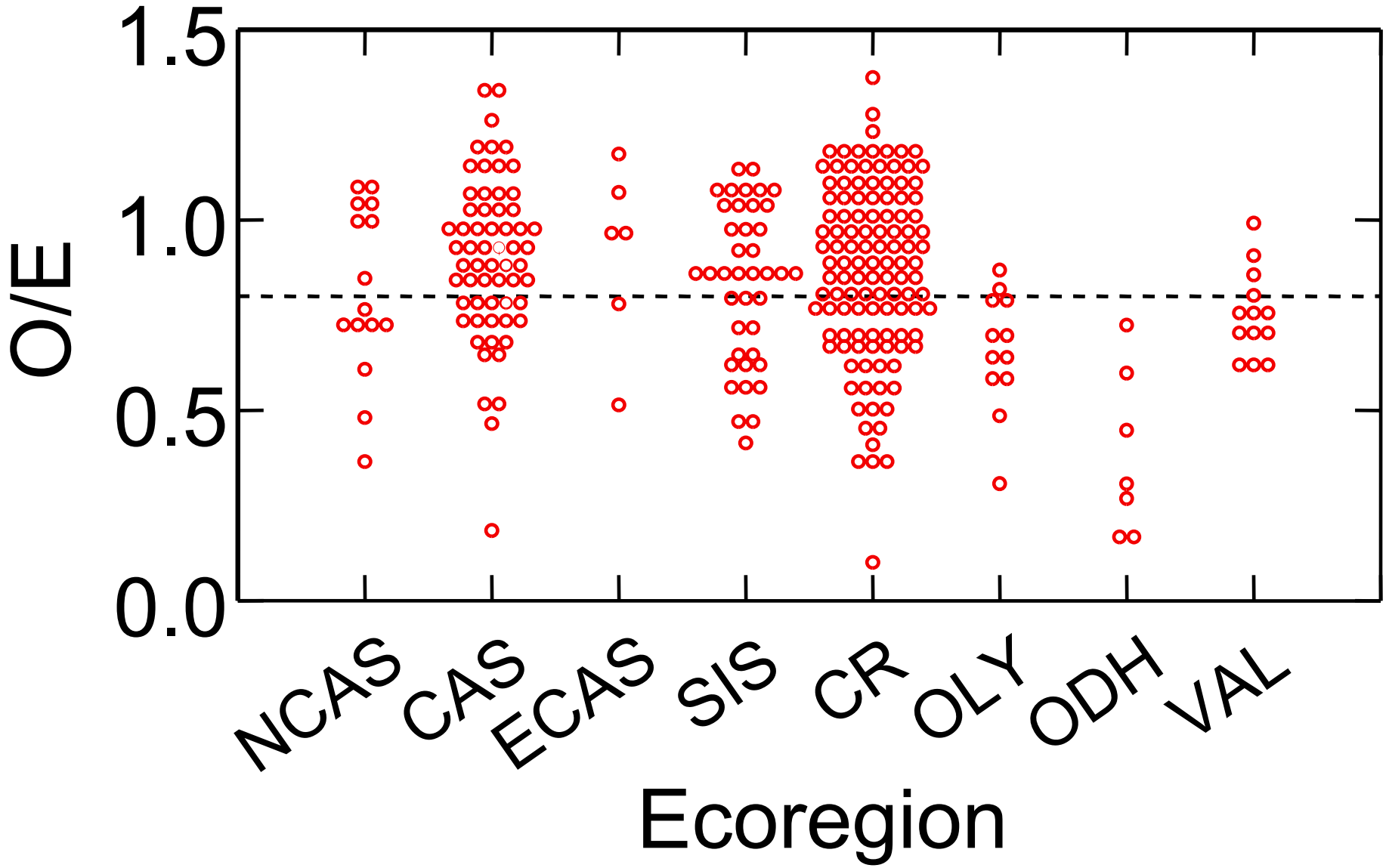
Green > 0.8

Yellow 0.5 - 0.8

Red < 0.5

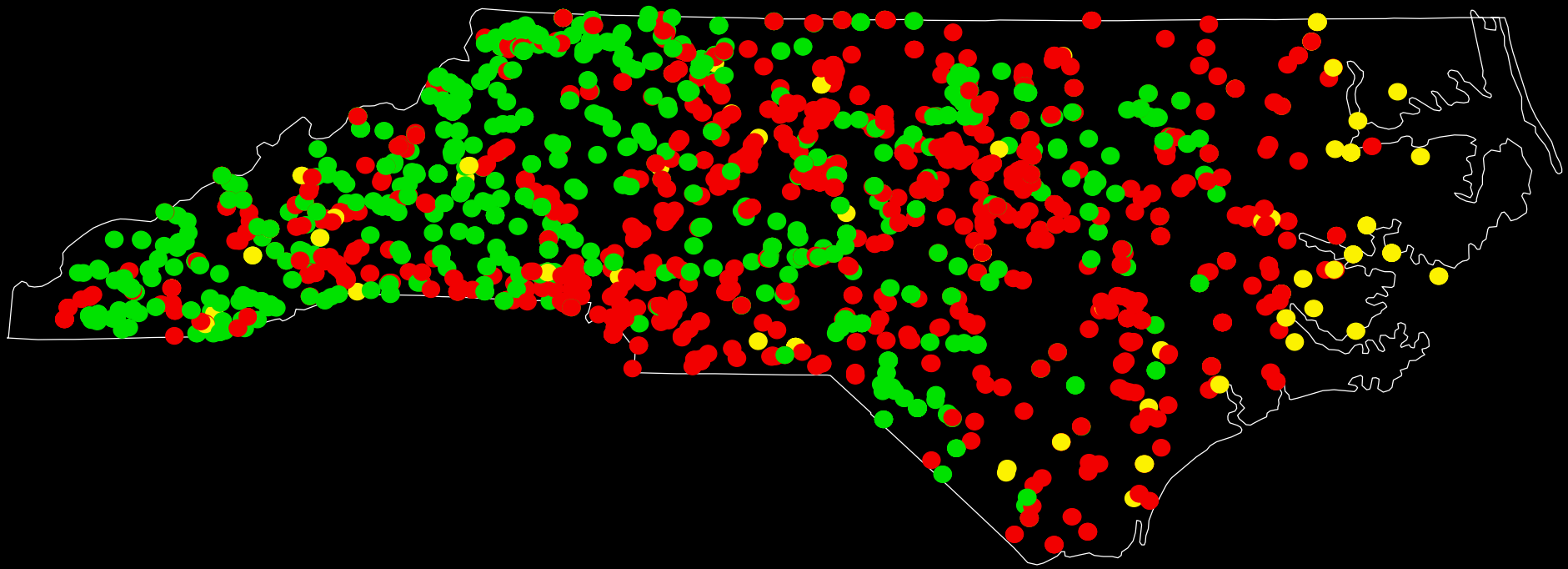


Distribution of O/E values for test sites in different ecoregions



A More Spatially & Temporally Complete Example

Distribution of samples from North Carolina with O/E values above (green) and below (red) the threshold value of 0.84.



Mean O/E values based on 2408 samples from North Carolina

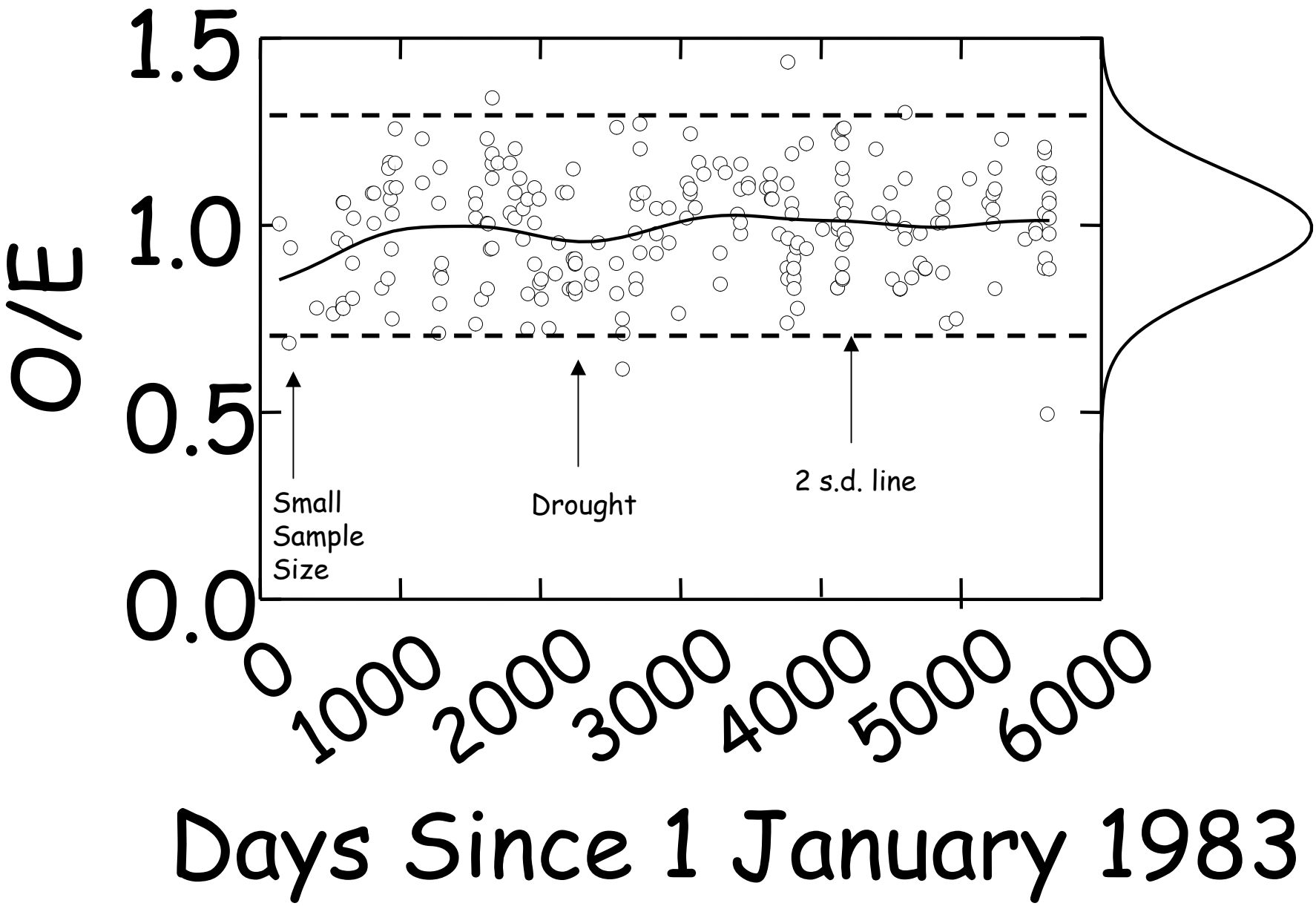
Ecoregion	% of Sites Not = Ref	Mean O/E
Coastal Plain	72	0.54
Piedmont	56	0.66
Mountains	36	0.77

How well do models built with 1-3 years of data apply to longer time spans?

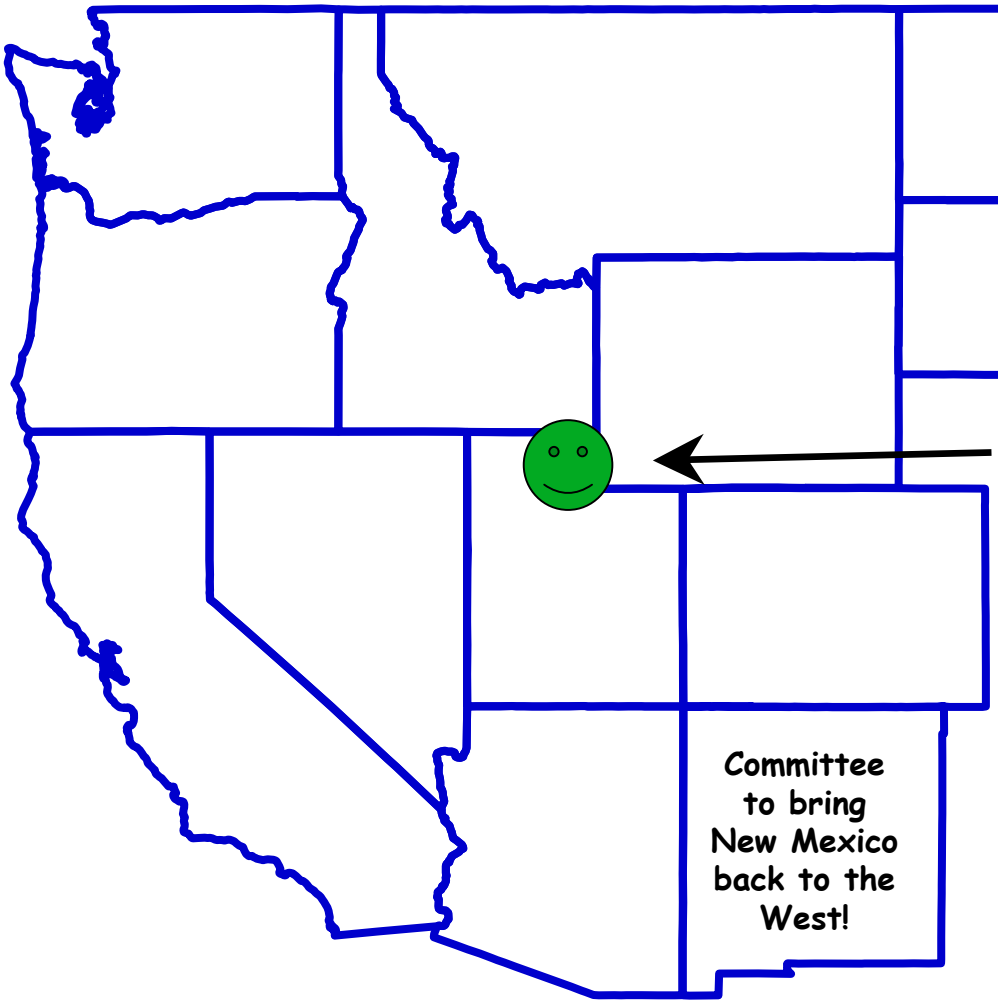
or

Can we really estimate the range of natural variability with a reference site approach?

Invertebrate Data from North Carolina Reference Sites



What next?
We only live once.



Logan, UT

Center of the
Universe for extremely
Reasonable*
Stream
Ecologists (Ecology)

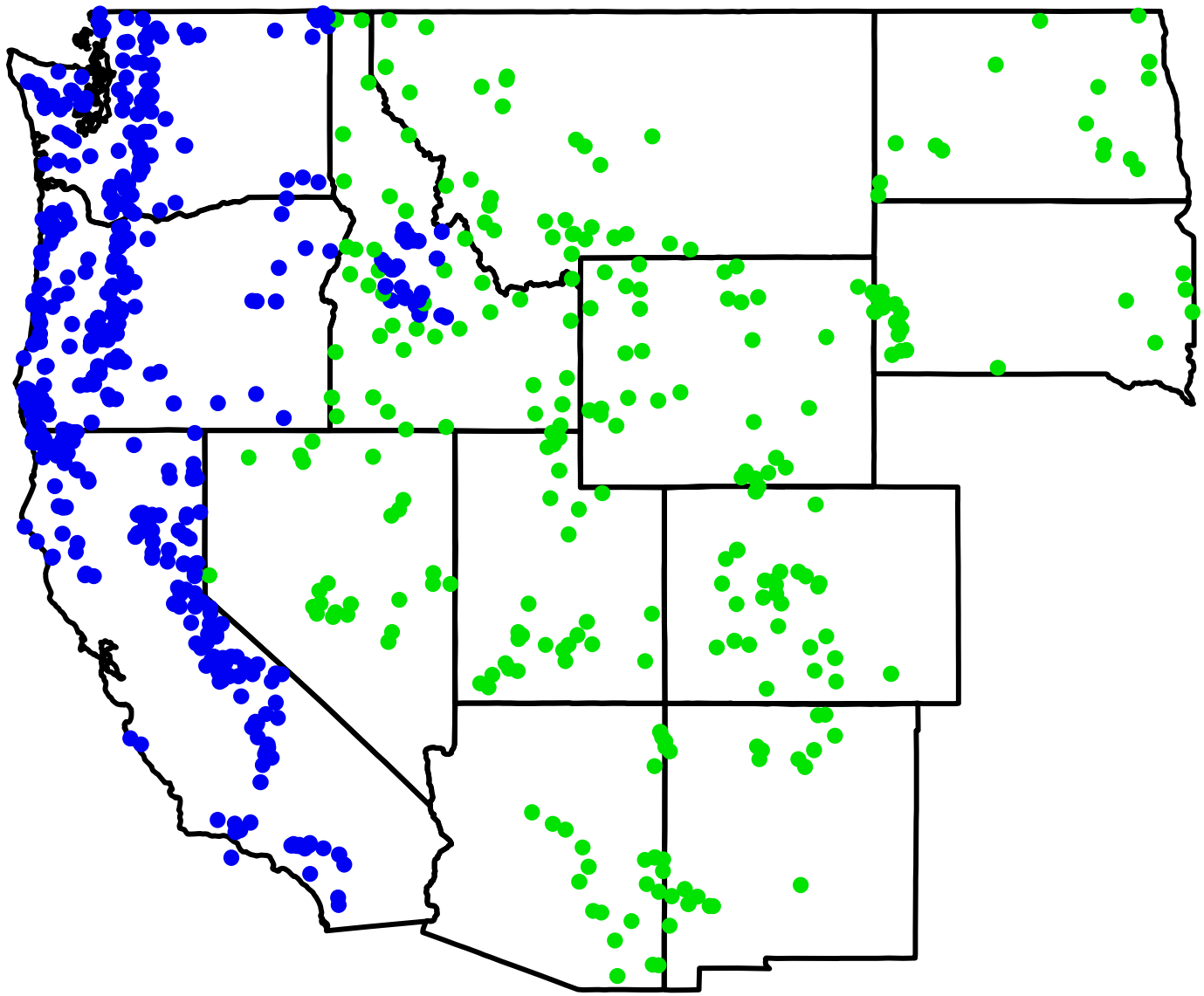
*fill in your favorite 'R' word.

A 13 State EPA STAR Project:

An Empirical Evaluation of Different Approaches to Classifying Stream Reference Sites

in collaboration with USFS, BLM, and many States and Tribes

1,014 Reference Sites Sampled the Same Way
Blue = USFS Supported Sampling, Green = EPA support



Benefits of this Project

- Rigorous test of the effectiveness and generality of different classifications for bioassessment purposes.
- Establishment of a database derived from a large network of reference sites that we will share with others.
- Development of predictive models applicable to most (all?) of the western US that will be available to states, tribes, and federal agencies.
- Data complement EMAP West and models can be applied to EMAP samples to produce a rapid assessment of the condition of streams throughout the West.

Plus, sampling was
really, really, really fun, ….

(most of the time),

(and except for the bear in
New Mexico),

but that's another story.