Macro-Ecology, Predictive Models, and the Biodiversity Status of Aquatic Ecosystems

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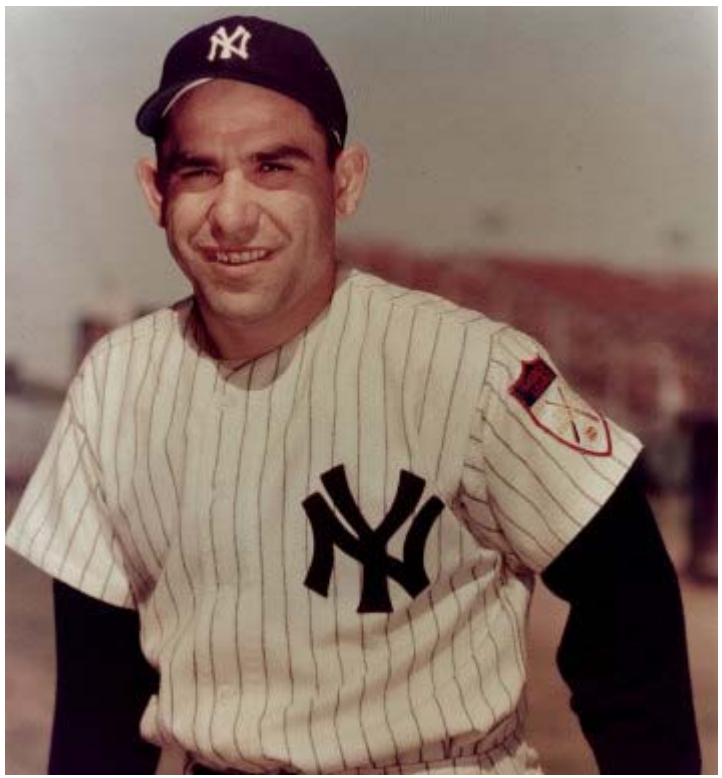
UtahState UNIVERSITY

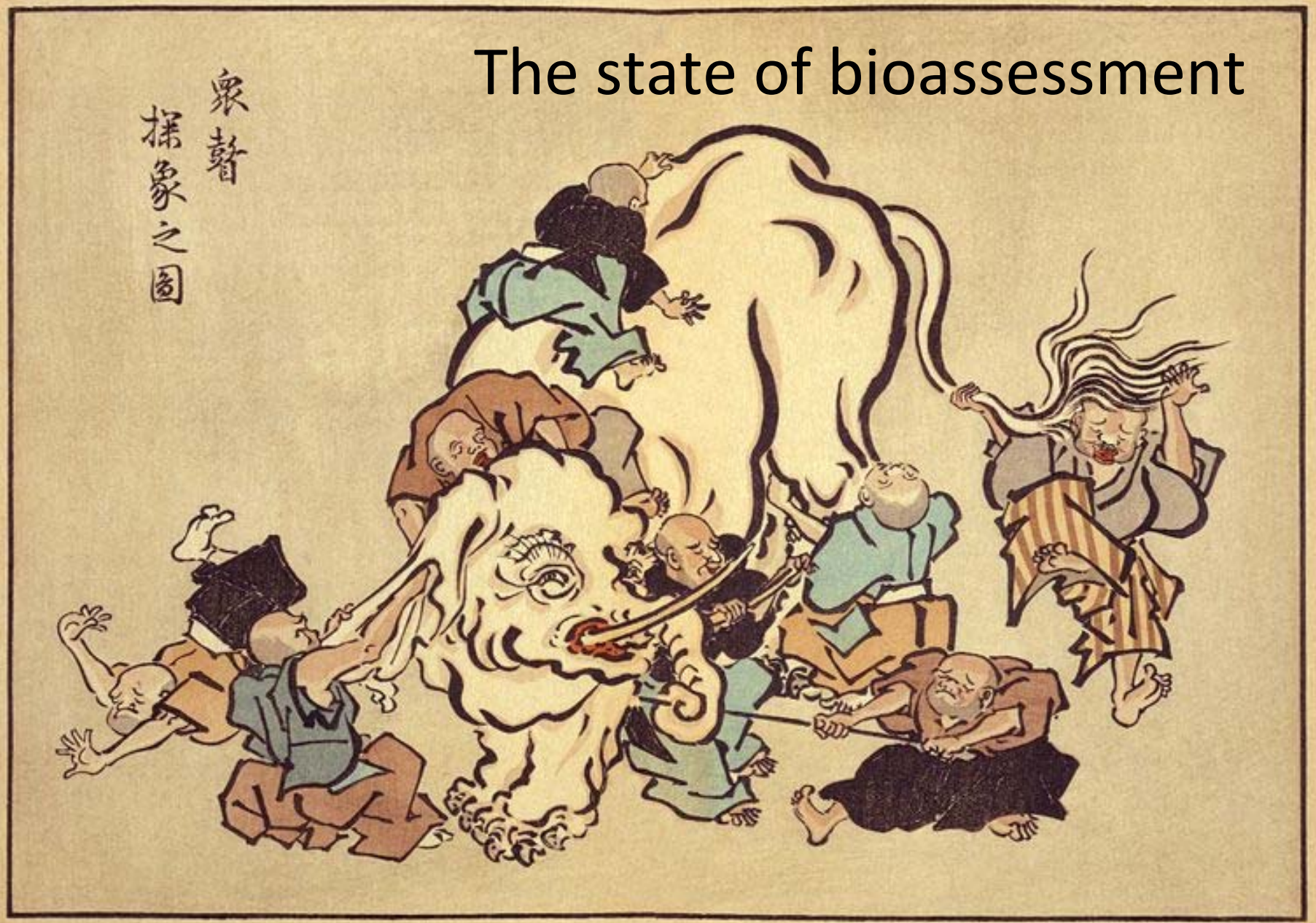
Measuring the condition of the Nation's ecosystems:



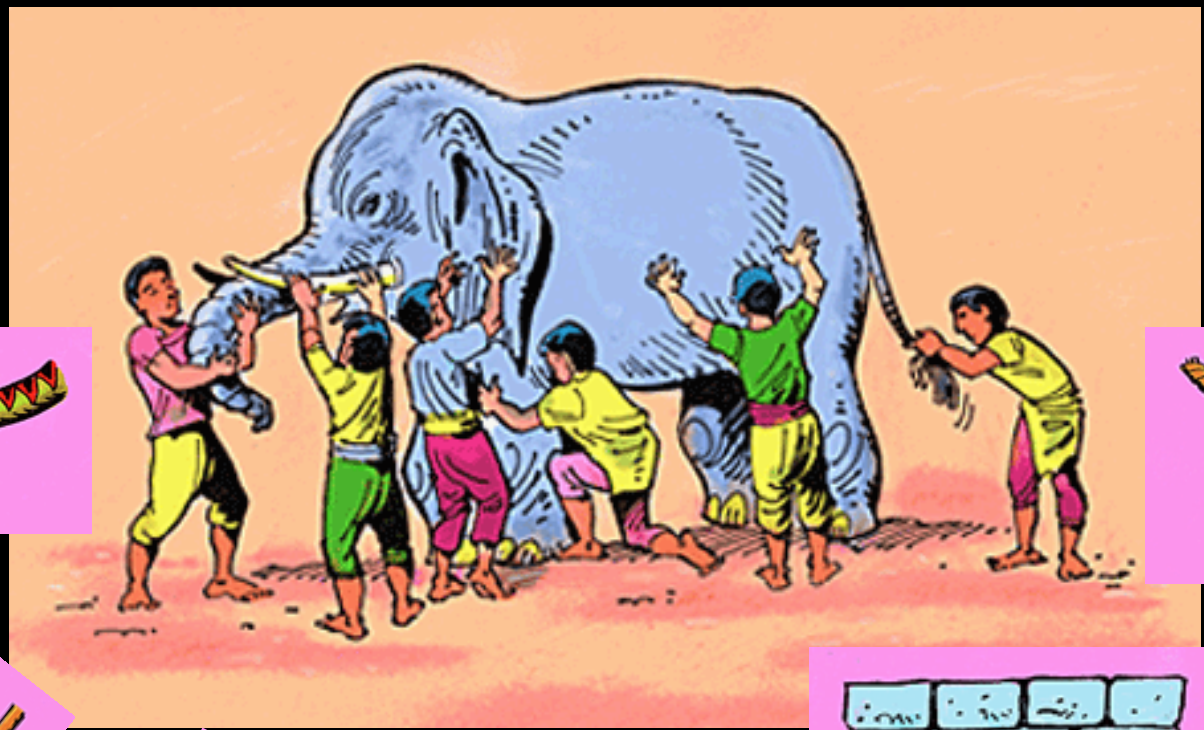
Yogi Berra

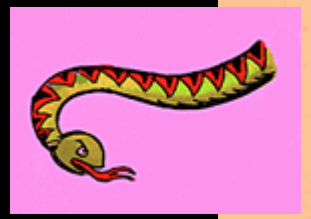
"You've got to be very careful if you don't know where you're going, because you might not get there."

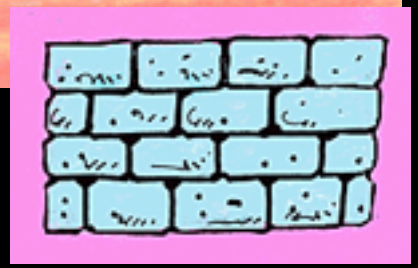
The state of bioassessment



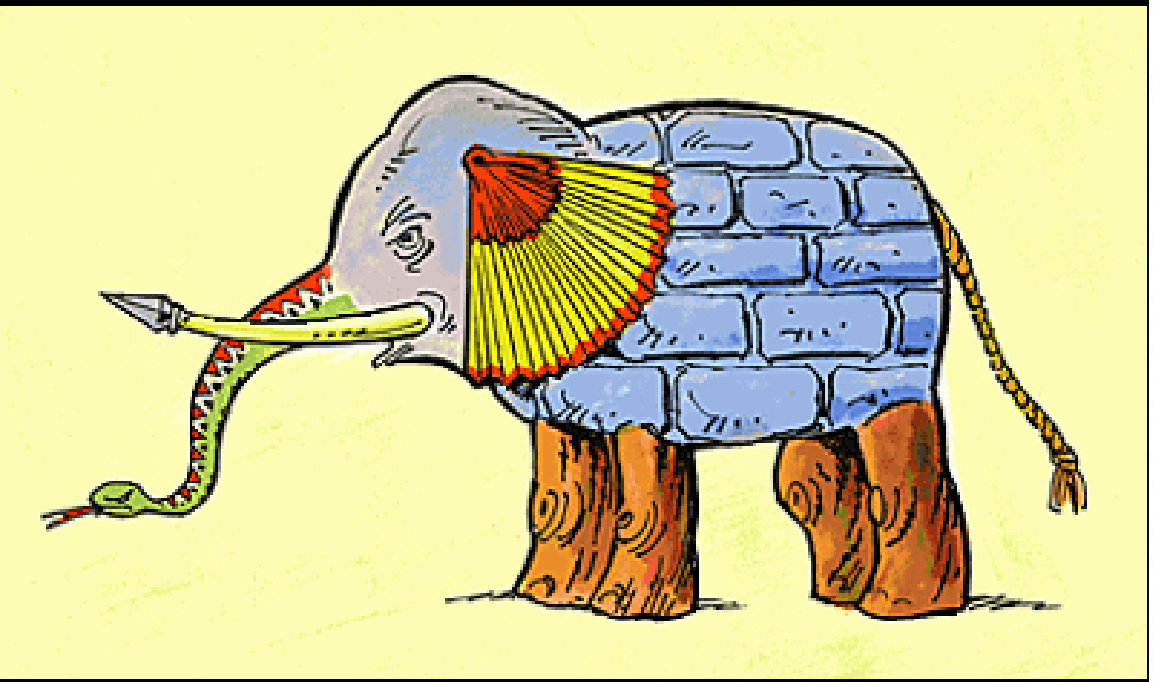
The various ‘ologists’ at work.

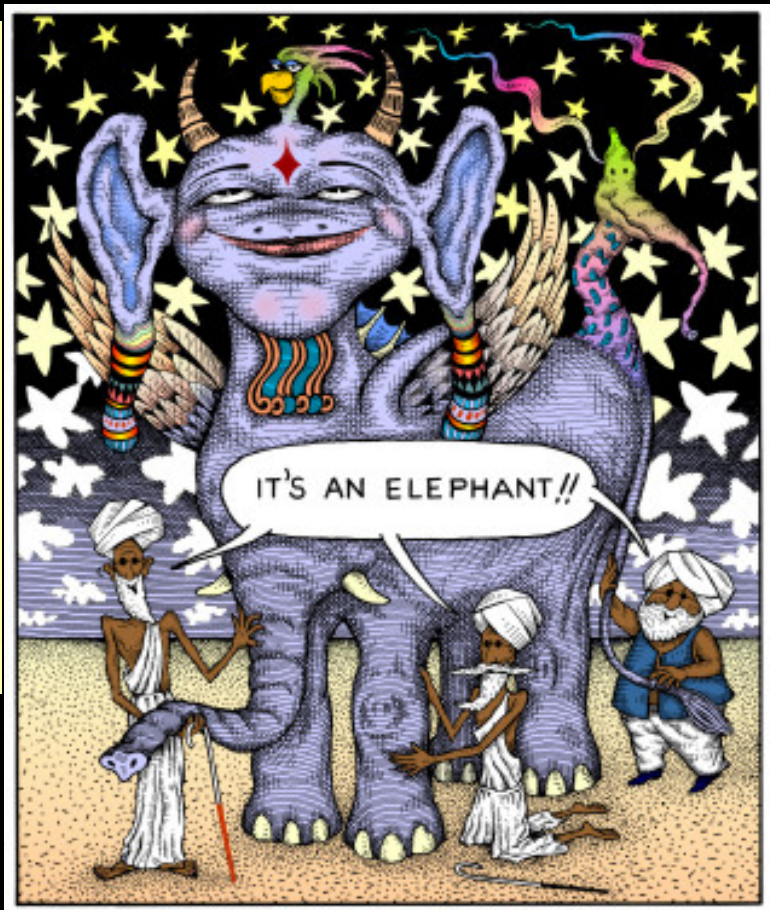




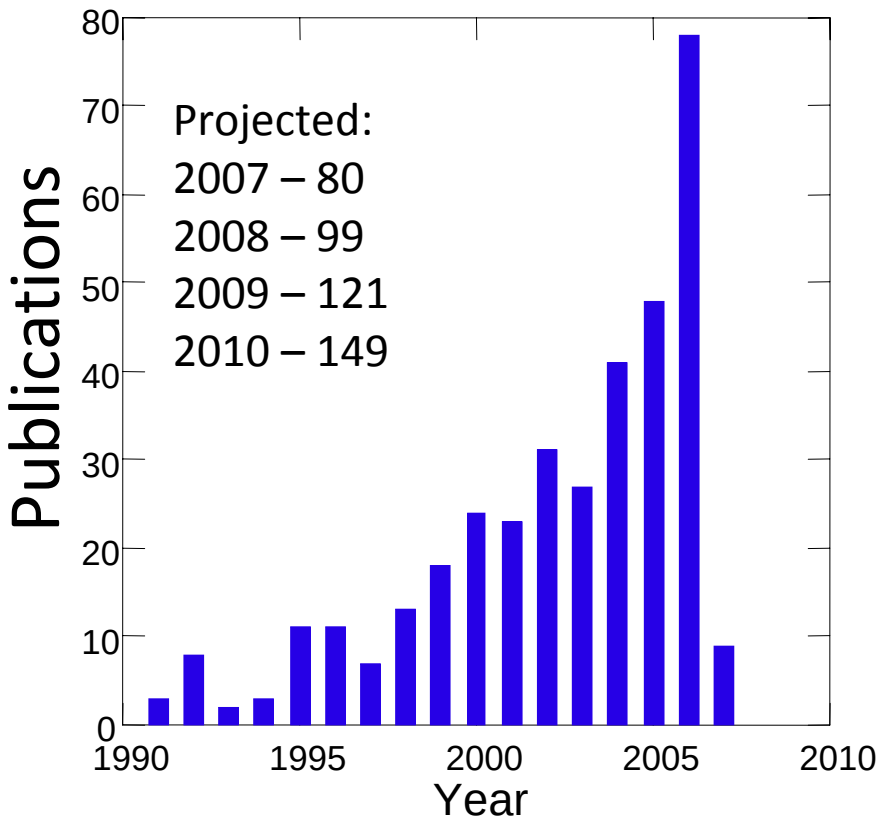


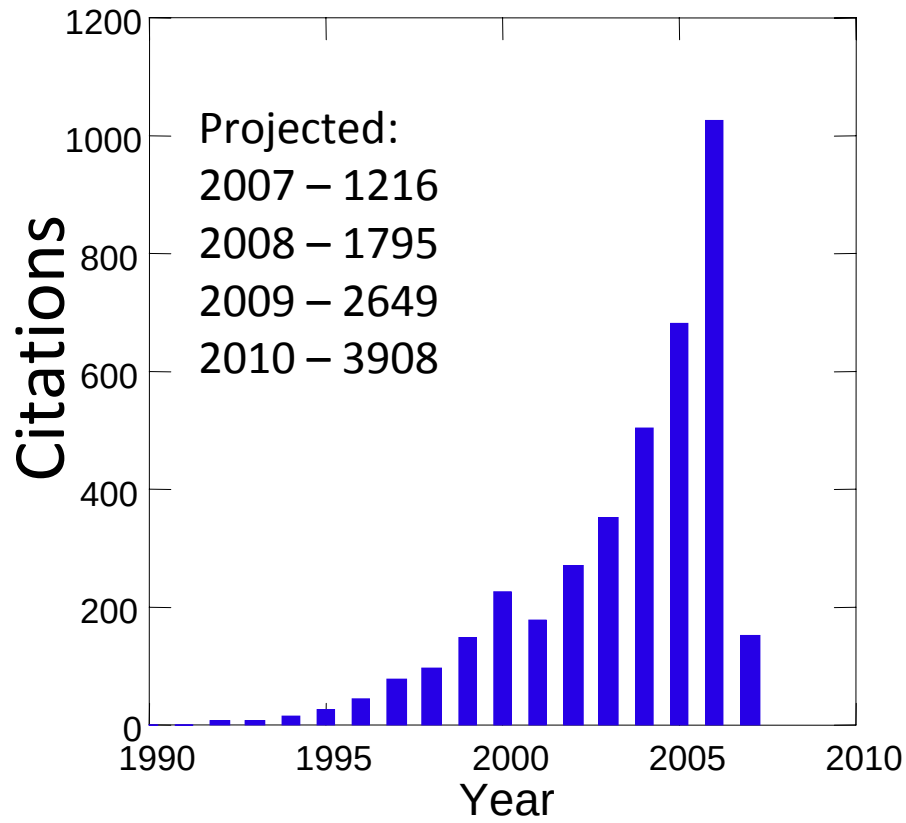
Our assessments are only as good as our science.





Publications and Citations per Year Bioassessment and Biological Indicators in Freshwater Ecosystems





Much debate on:

- What should we measure? Indicators/ Indices
- What does the measurement mean? Baselines/ Benchmarks

Community-level Indicators

MMI/IBI

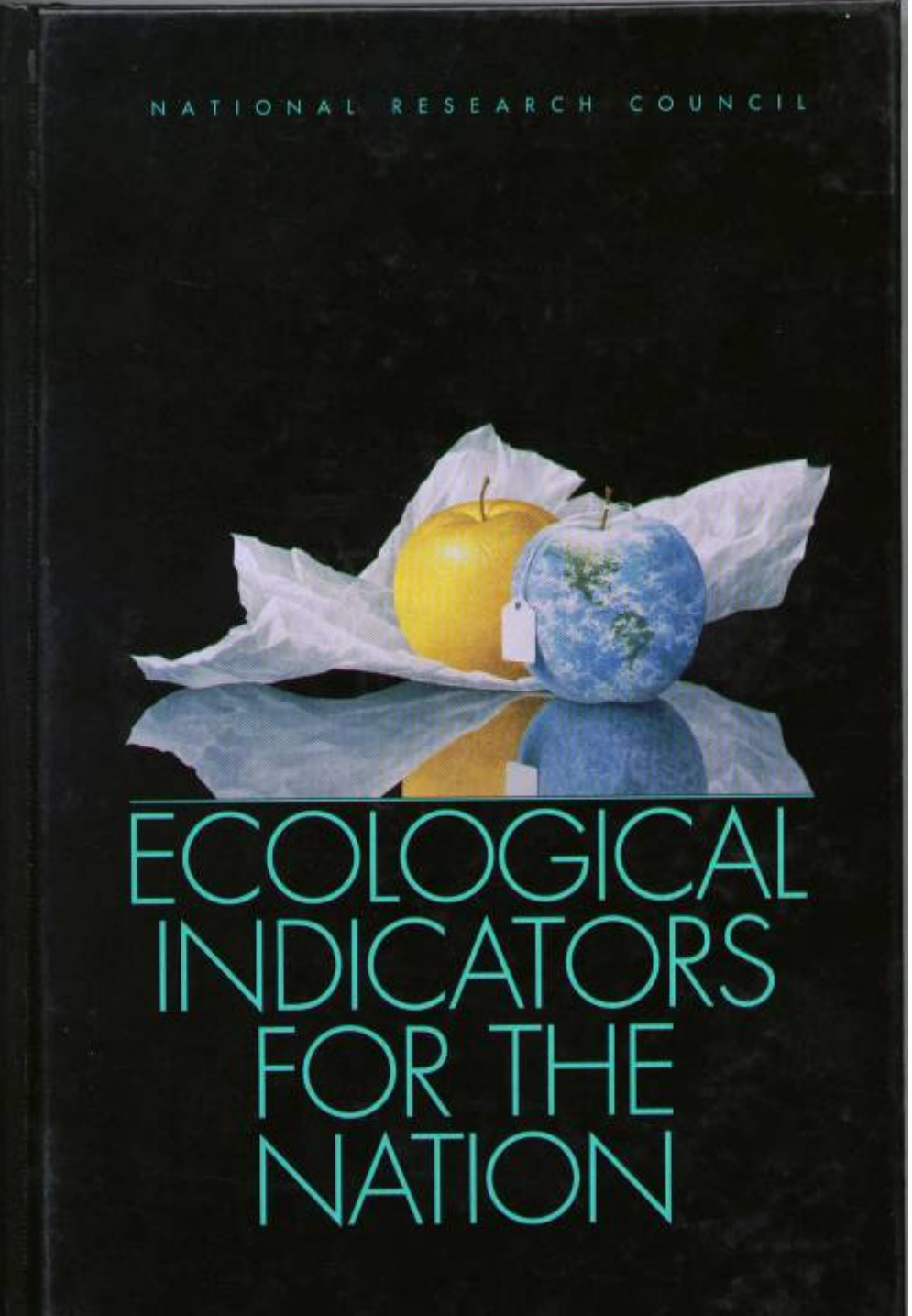
$BI = \sum TV_i * n_i / N$

O/E (taxa, other)

E = 8 taxa

O = 3 taxa

O/E = 0.38



Criteria for Evaluating Indicators

General Importance
Conceptual Basis
Reliability
Scale
Statistical Properties
Data Requirements
Skills Required
Data Quality
Data Archiving
Robustness
Inter-region Compatibility
Costs, Benefits, and Cost-Effectiveness

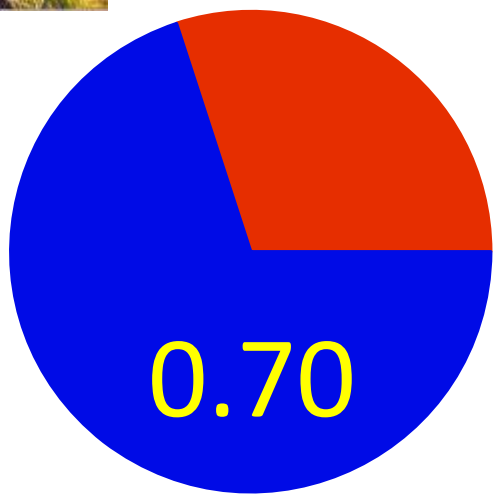
A Hypothetical Example of Using O/E to Compare "Apples and Oranges"

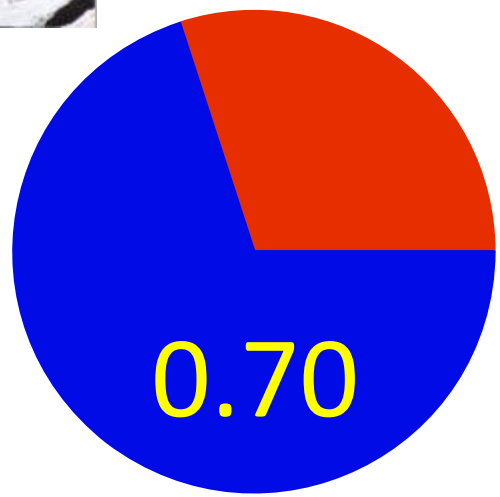
O = 7

E = 10

O = 21

E = 30



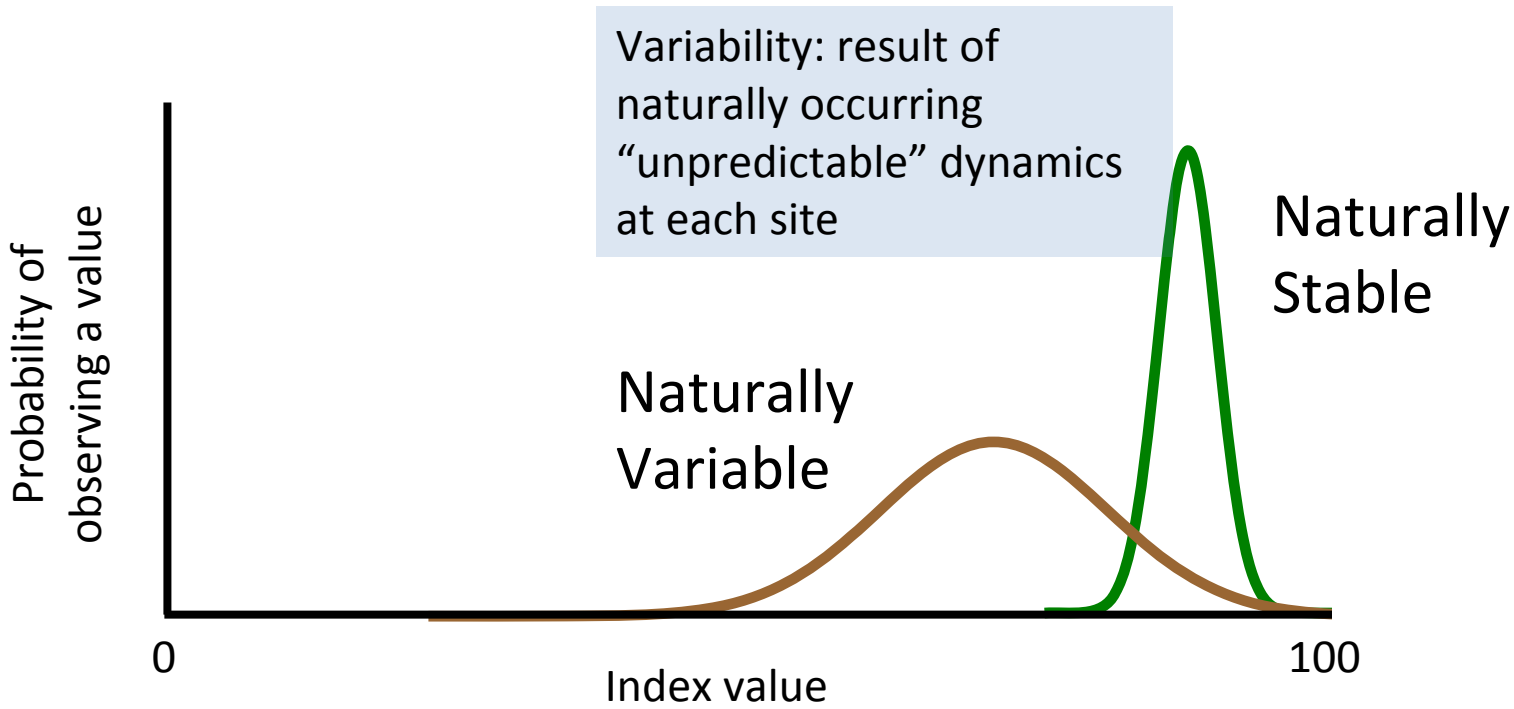


The Technical Challenge:

Accurately and precisely describing the biota expected in different water bodies in a region.

The reference condition

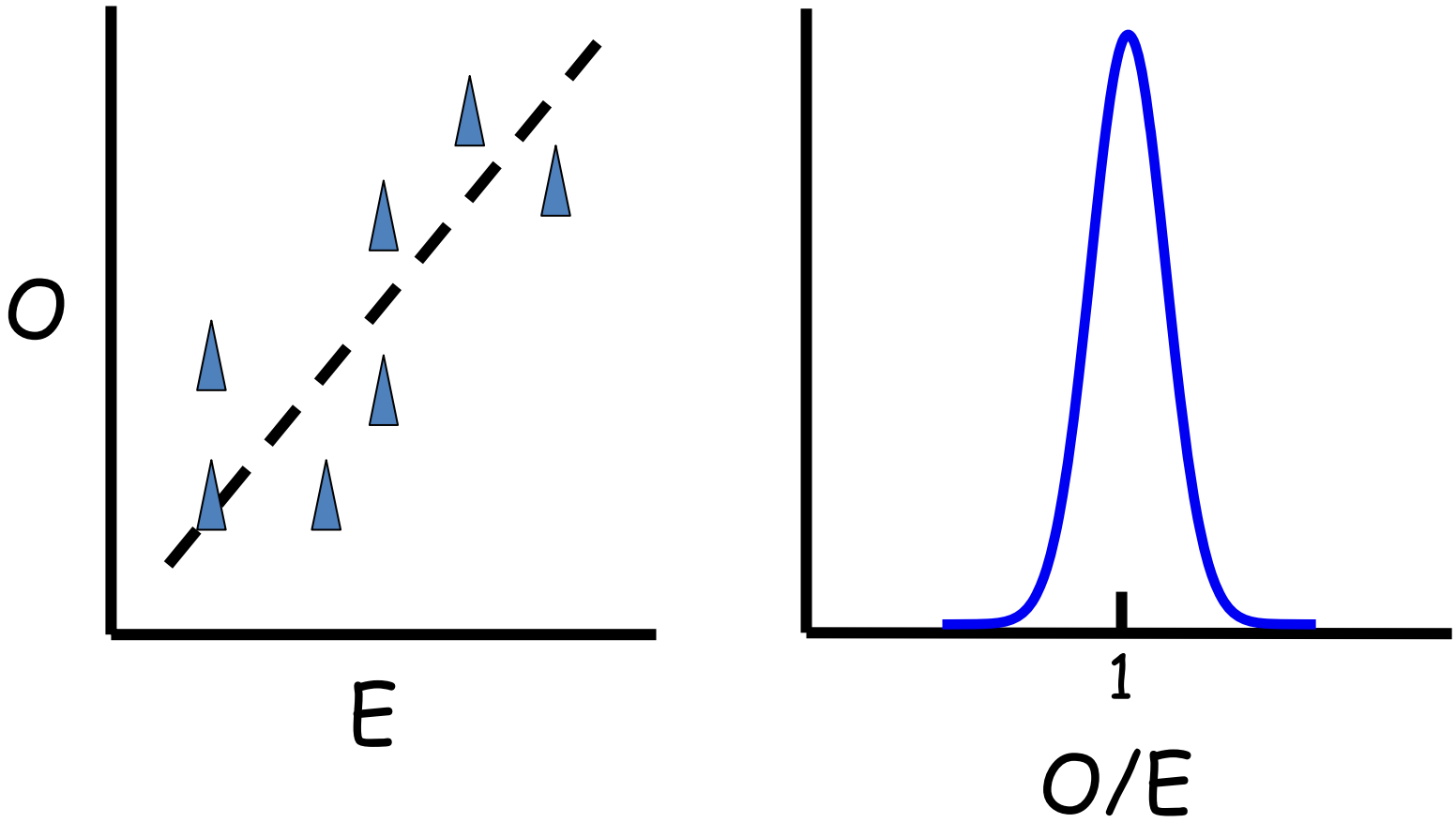
the likelihoods of observing different index values under those conditions specified as reference



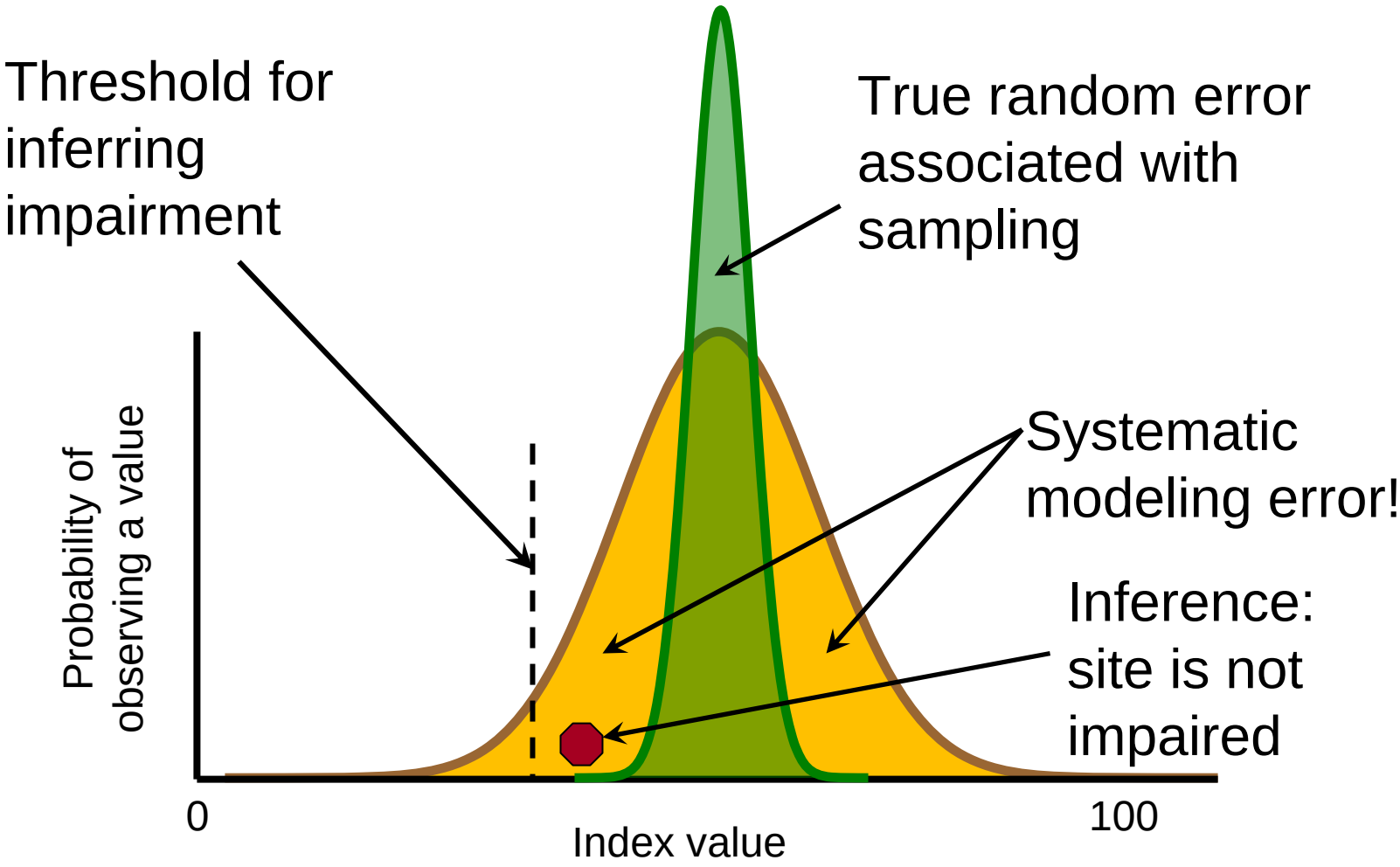
Reference condition issues

- reference = pristine
- reference = similar quality
- reference = site specific
- reference = stable
- reference variation = random error

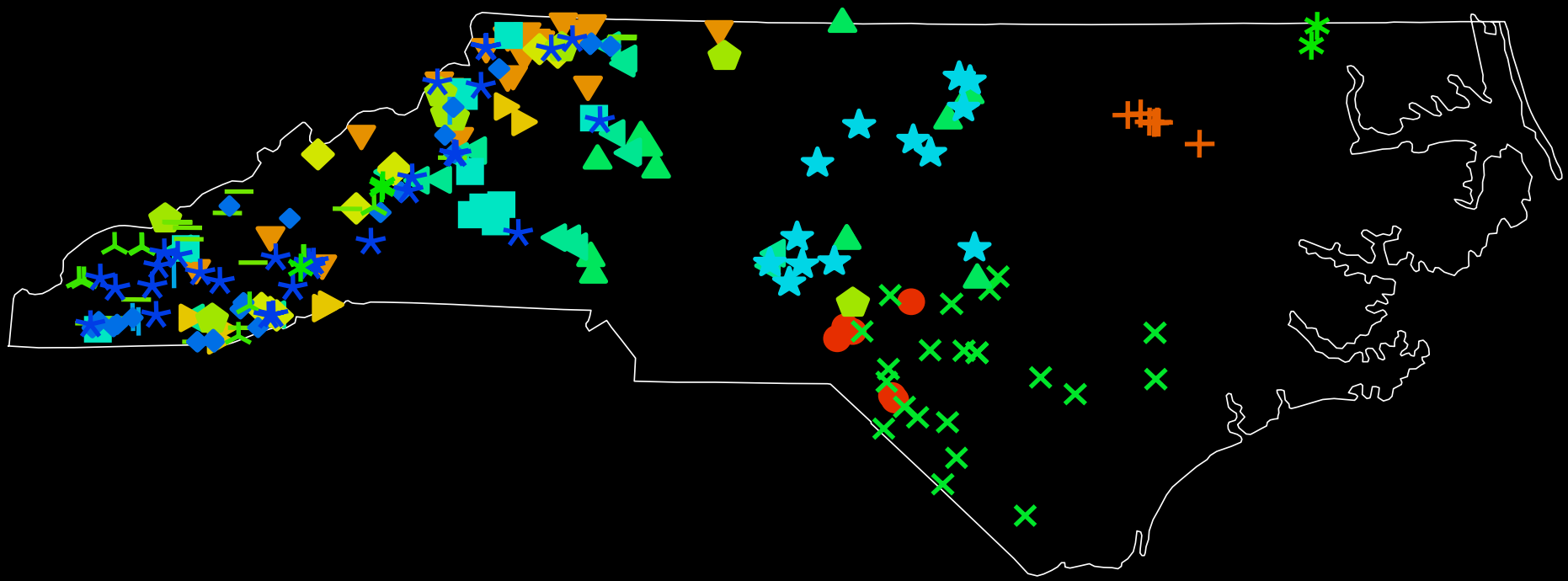
Describing Model Error



Sources of Model Error



Distribution of 17 reference site groups defined by invertebrate species composition.

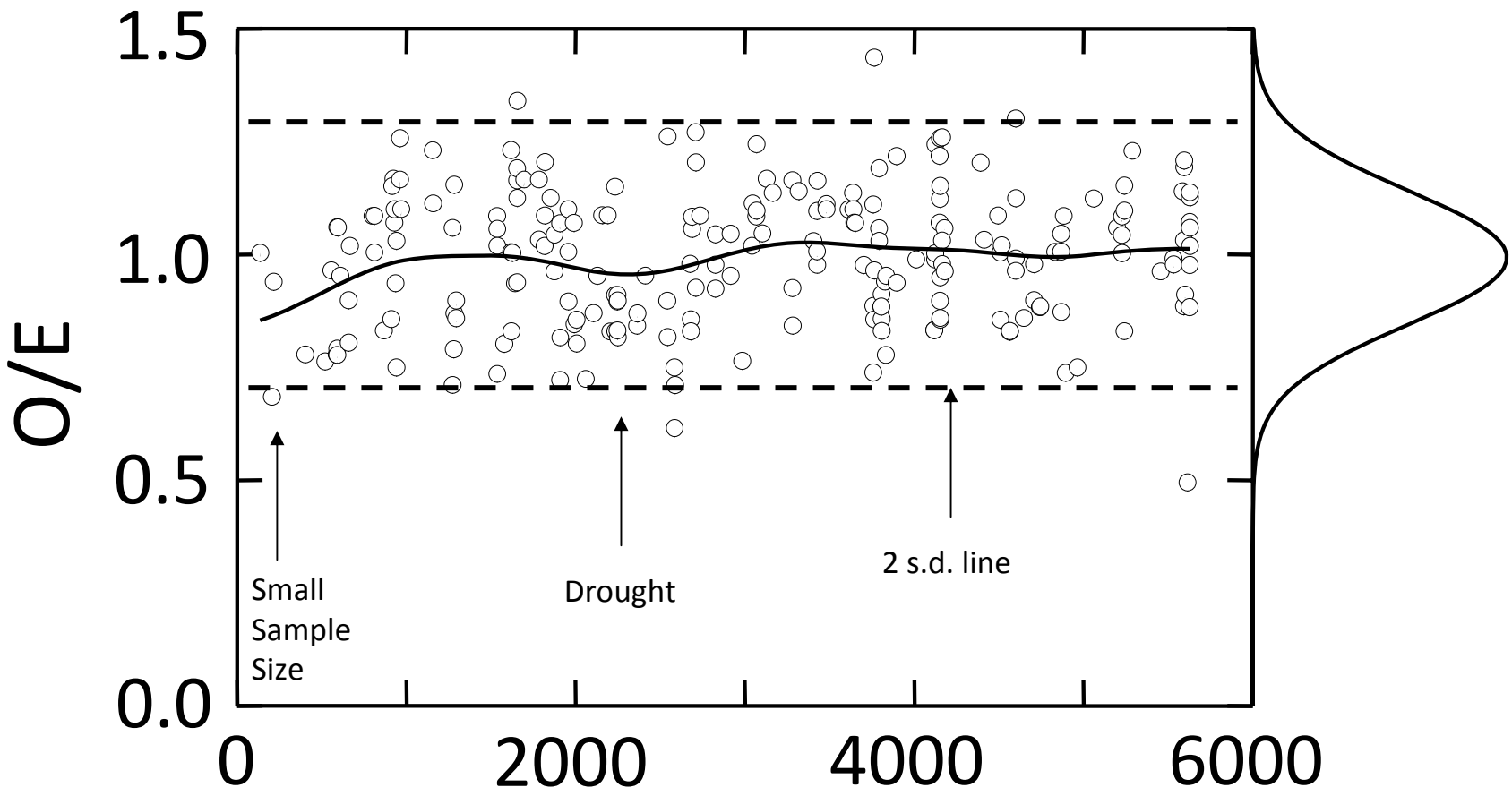


Predictor Variables

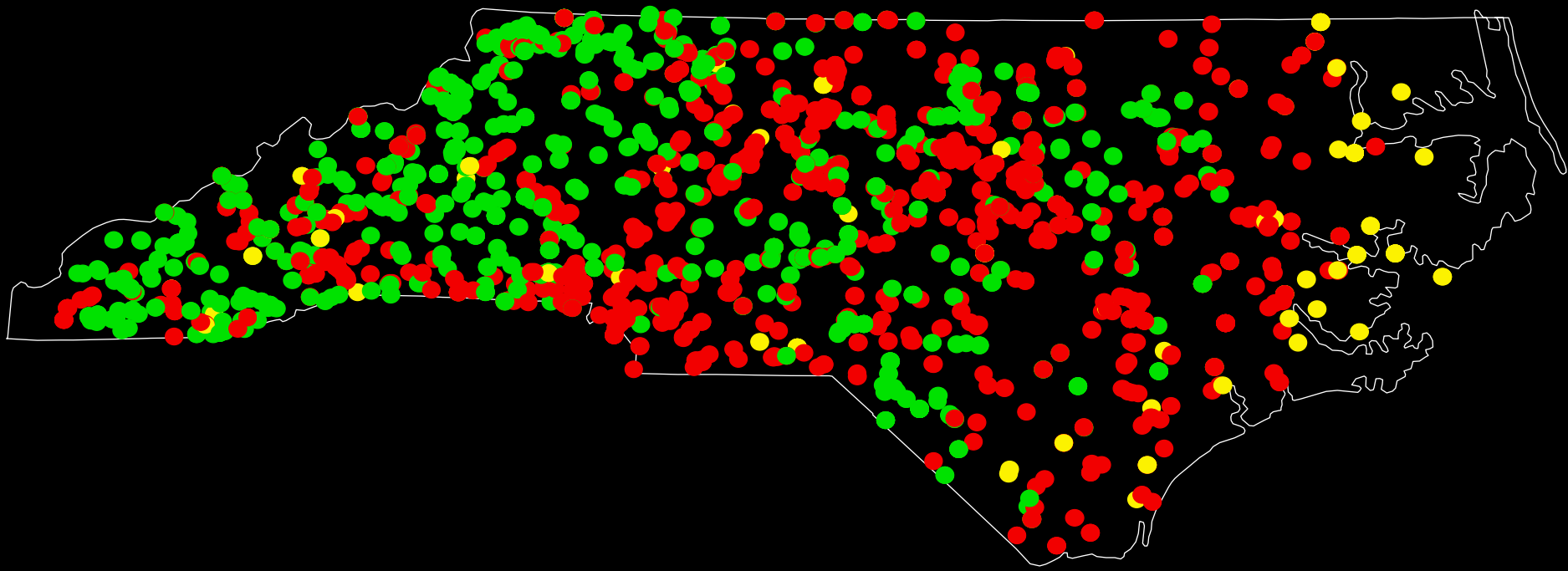
- latitude
- longitude
- elevation
- distance from source
- drainage area
- stream width
- stream depth
- gradient
- day of year

How stable are distributions of reference values?

Data from North Carolina Reference Sites



Distribution of samples that passed (green) and failed (red) assessment based on the O/E threshold of 0.84 (5th percentile of reference values).



Ecoregion	% of Test Sites ≠ Reference*	Mean O/E**
Coastal Plain	72	0.54
Piedmont	56	0.66
Mountains	36	0.77

* 5th % of reference site values

** Species model (p>0.5)

Assessing Individual Taxa

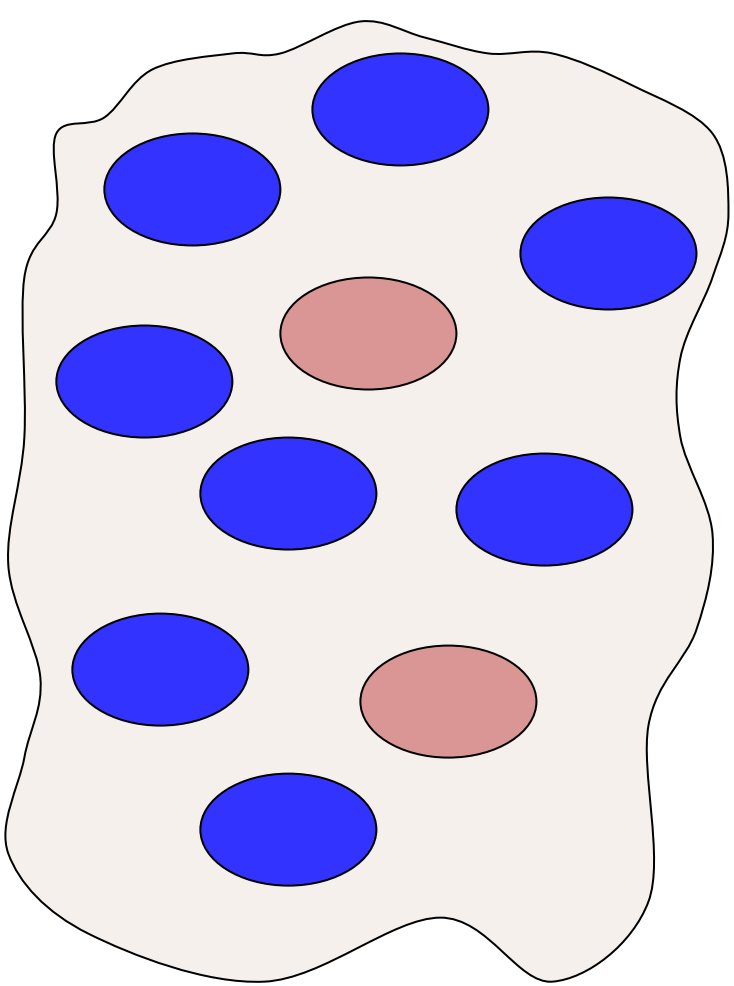
Monitoring frequencies of detection (FD) measures changes in a taxon's region-wide status.

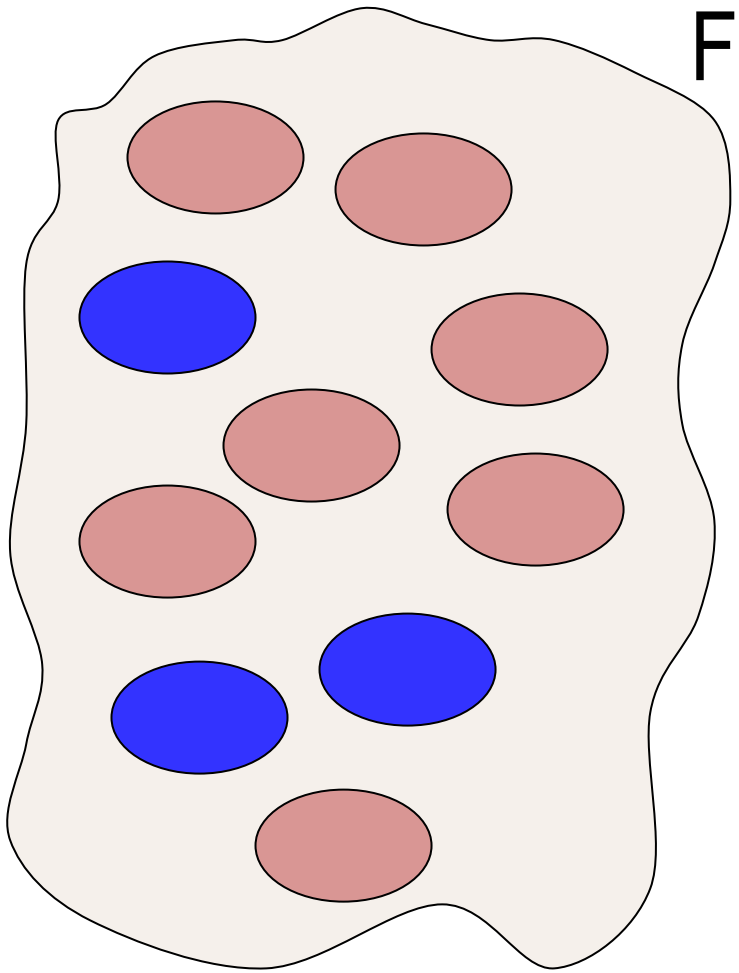
Baseline Conditions

Current Conditions

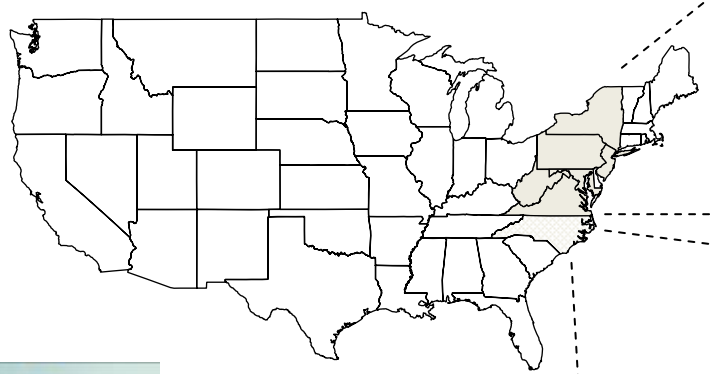
$\Delta FD = 0.5$

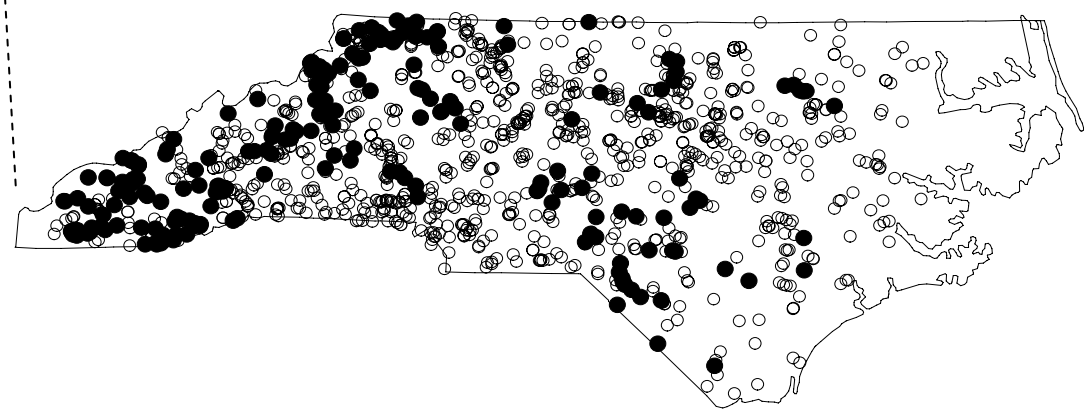
$F_o/F_e = 0.37$





Example with stream invertebrate data from North Carolina and the Mid-Atlantic Highlands





% of Decreaser (%D) and Increaser (%I) Taxa
Z-Test (Fo ≠ Fe)

	North Carolina			MAH		
Taxon	N	%D	%I	N	%D	%I
Dragonflies	47	13	23	15	7	27
Clams/Snails	30	27	17	21	17	19
True Flies	291	28	13	177	21	23
Beetles	55	20	15	32	16	25
Worms	82	11	18	45	2	24
Stoneflies	71	54	0	35	46	3
Caddis Flies	157	65	4	51	35	12
Mayflies	131	50	4	33	55	9
Total Taxa	910	36	11	432	23	21

Are we there yet?

90% of the game is half mental.
(Yogi Berra)