



# Approaches to Defining Reference Condition for the NWCA

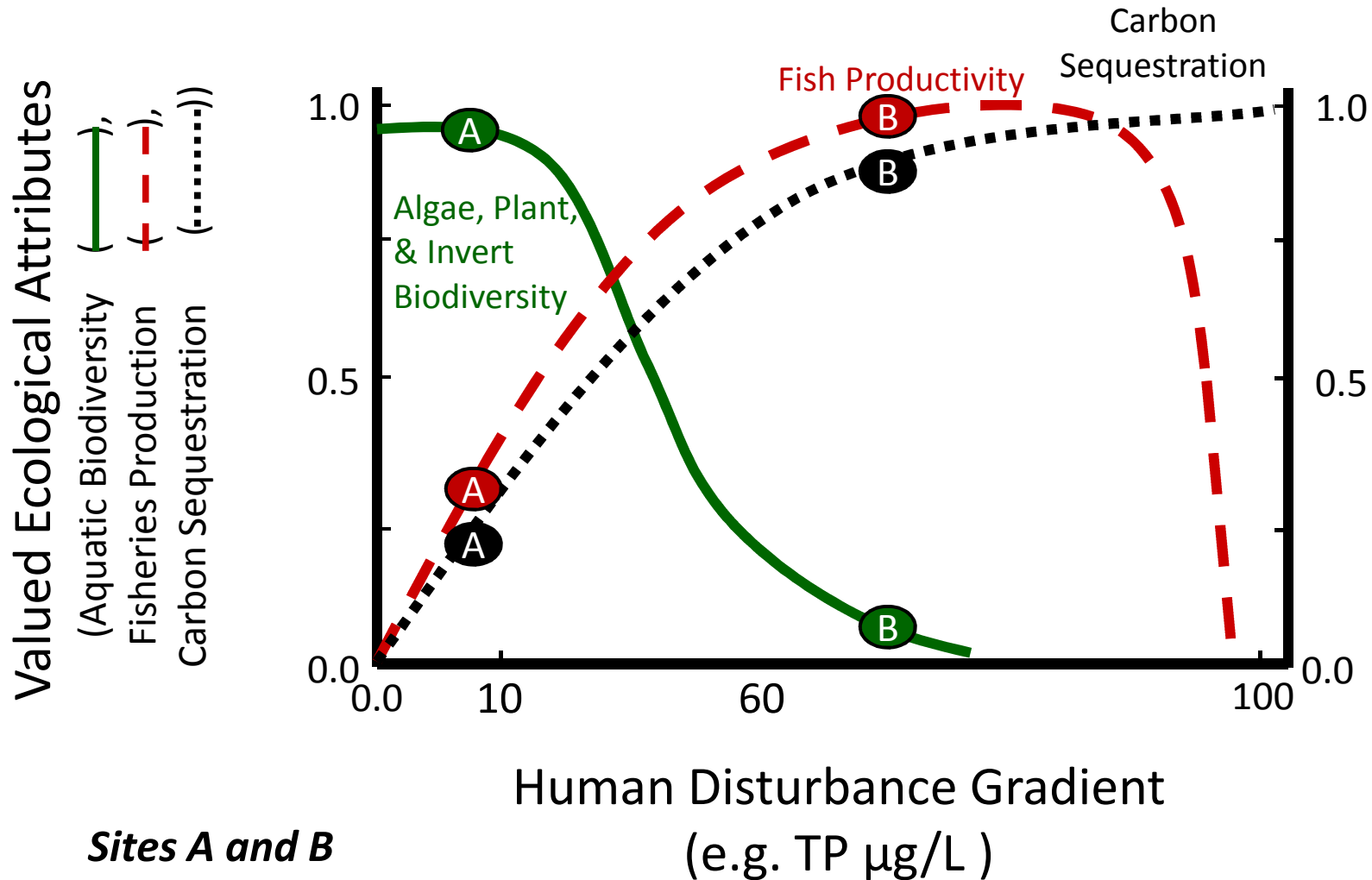
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# Challenges for Wetlands: great natural variability

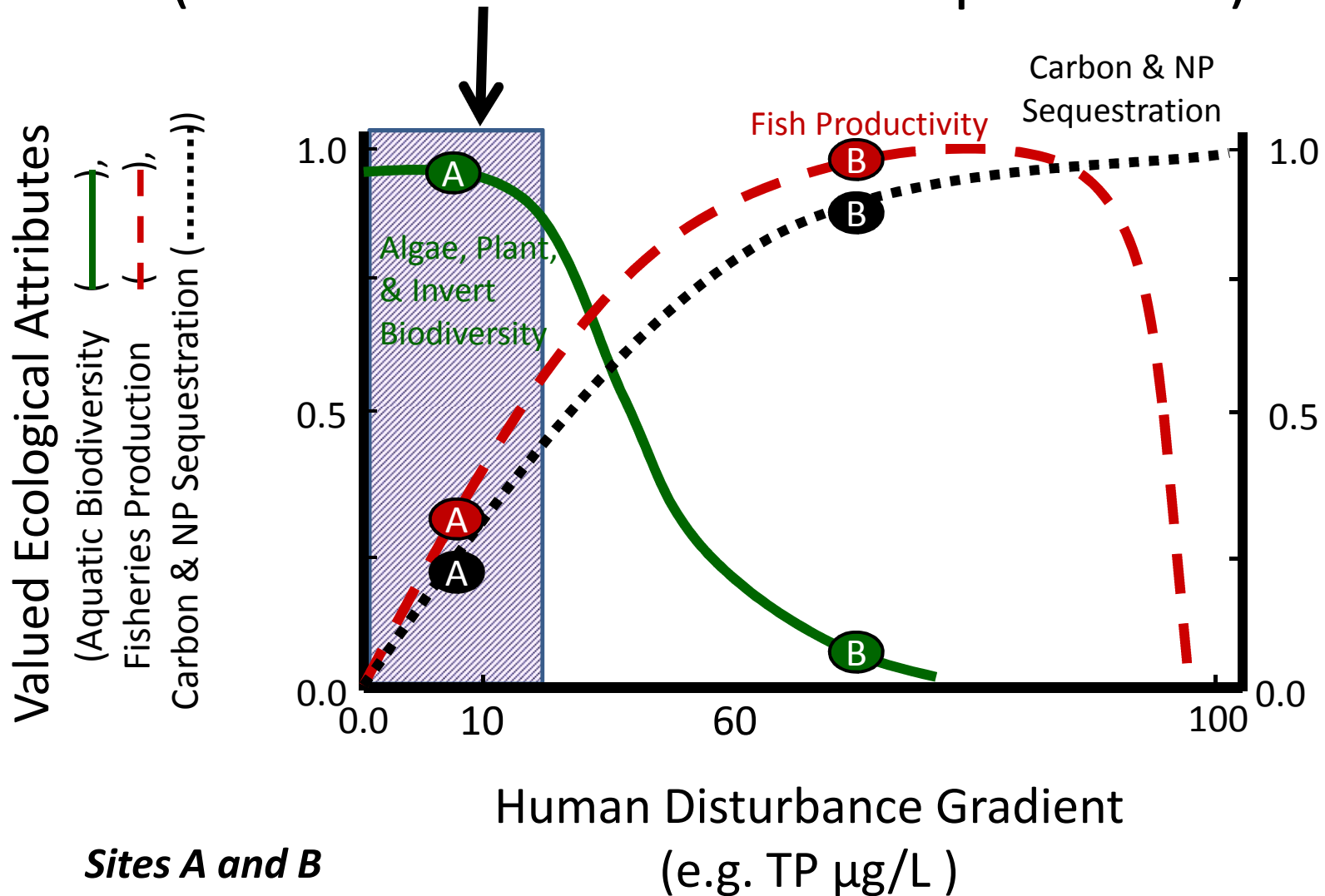


Bonanza Creek LTER, Tanana River Floodplain, Fairbanks, Alaska

# Challenges for Wetlands: assessing both ecological condition and services

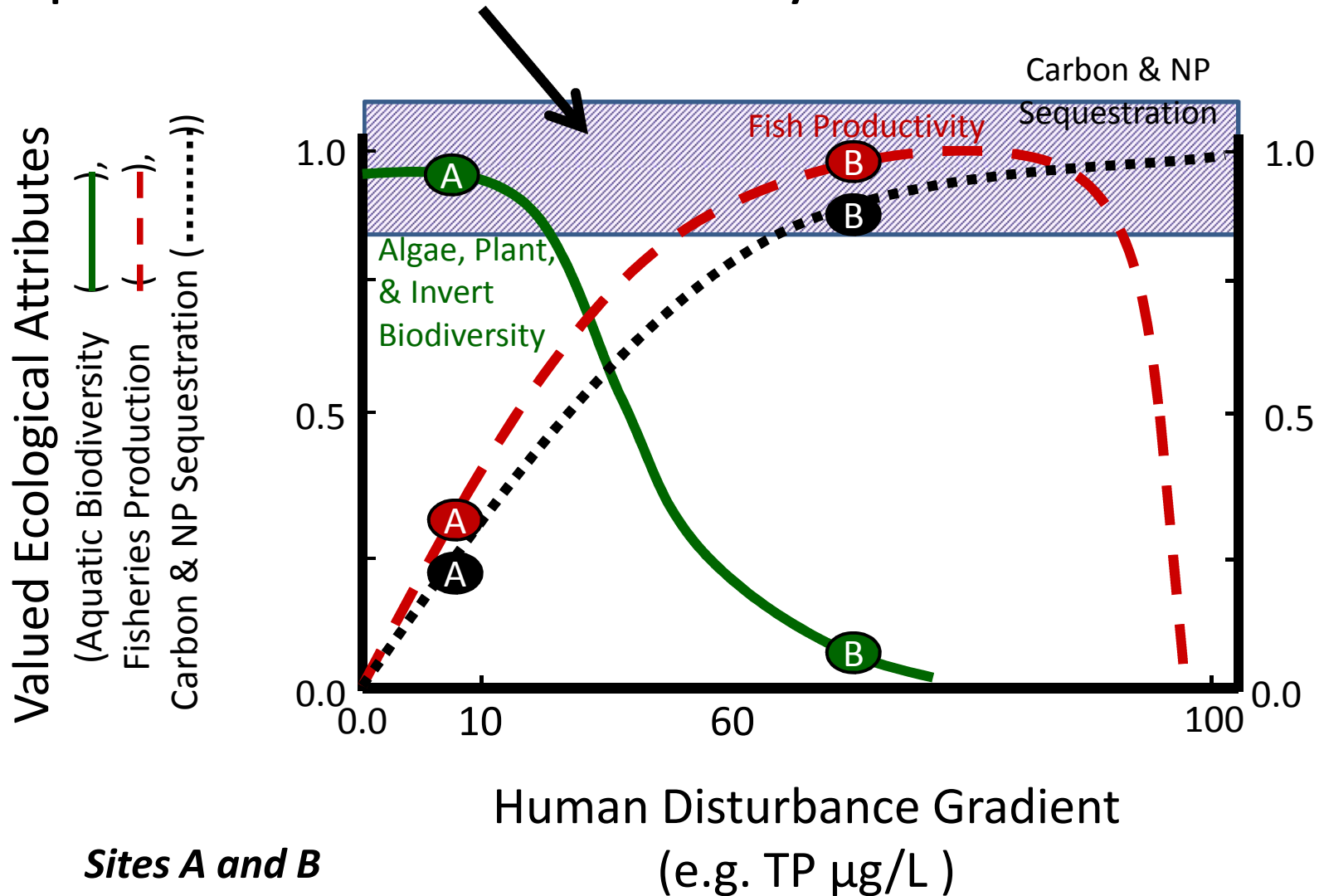


# Challenges for Wetlands: assessing both ecological condition and services (Reference Condition for Aquatic Life)



# Challenges for Wetlands: assessing both ecological condition and services

(Expected Condition for Ecosystem Services & HWB)



# Context & Application for Characterizing Reference Condition

- Goals for Management = Expected Condition
  - Can accommodate assessment of condition & services
- Reference condition (RC)
  - Comparable to minimally disturbed condition in rivers, streams, and lakes (as well as coastal zones)
  - 75<sup>th</sup> percentile of reference condition
  - Assessment
    - Modeled versus Regional MMIs
    - Good, Fair, and Poor with 75<sup>th</sup> and 95<sup>th</sup> %tiles of RC
- Clean, dirty, and dingy reference models
- Modeled Multimetric Indices of Biological Condition

# Context & Application for Characterizing Reference Condition

- Goals for Management = Expected Condition
- Reference condition (RC)
- Clean, dirty, and dingy reference models
  - Clean: Only references sites used to characterize RC
  - Dirty: All sites (clean and dirty) used to model RC
  - Dingy: More and more dirty sites added to clean sites to eliminate problems with low sample sizes at characterization of RC
- Modeled Multimetric Indices of Biological Condition
  - Account for natural variability in reference condition
  - Model site-specific, expected (reference) condition based on naturally varying features (e.g. climate, hydrology) among sites

# Three Tier Reference Site Filtering Approach\*

- I. Compile available lake water chemistry databases that contain necessary screening variables. Develop ecoregion-specific screening criteria to make a first filter of the data for least-disturbed lakes
- II. Digitize watersheds for filtered lakes, make a second filter of GIS watershed land cover and road density information
- III. Examine aerial photos of lakes passing filters I and II to examine 100 m buffer around lake. Categorize them into disturbance classes for final use as reference lakes

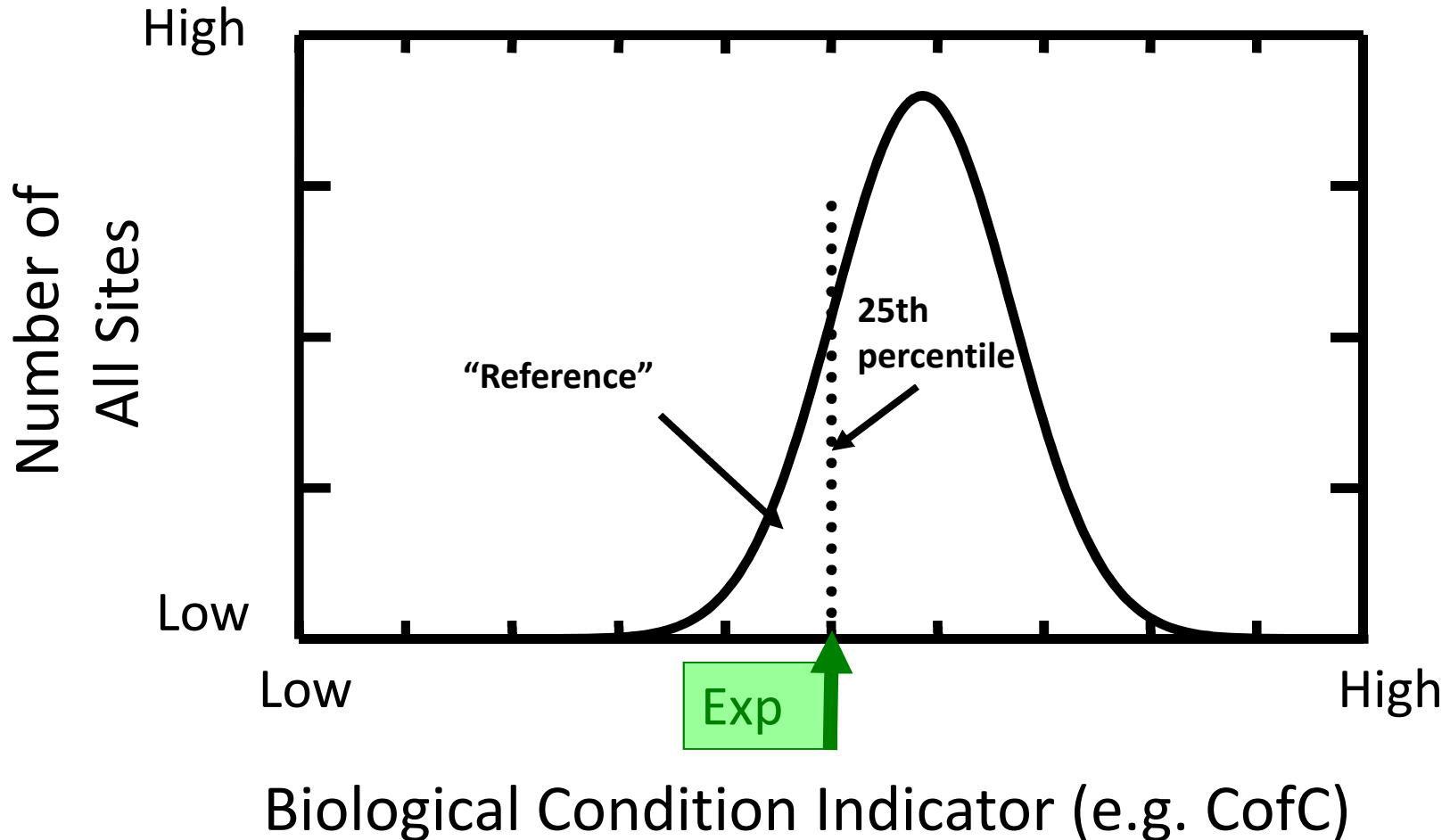


# Screening Criteria by Ecoarea

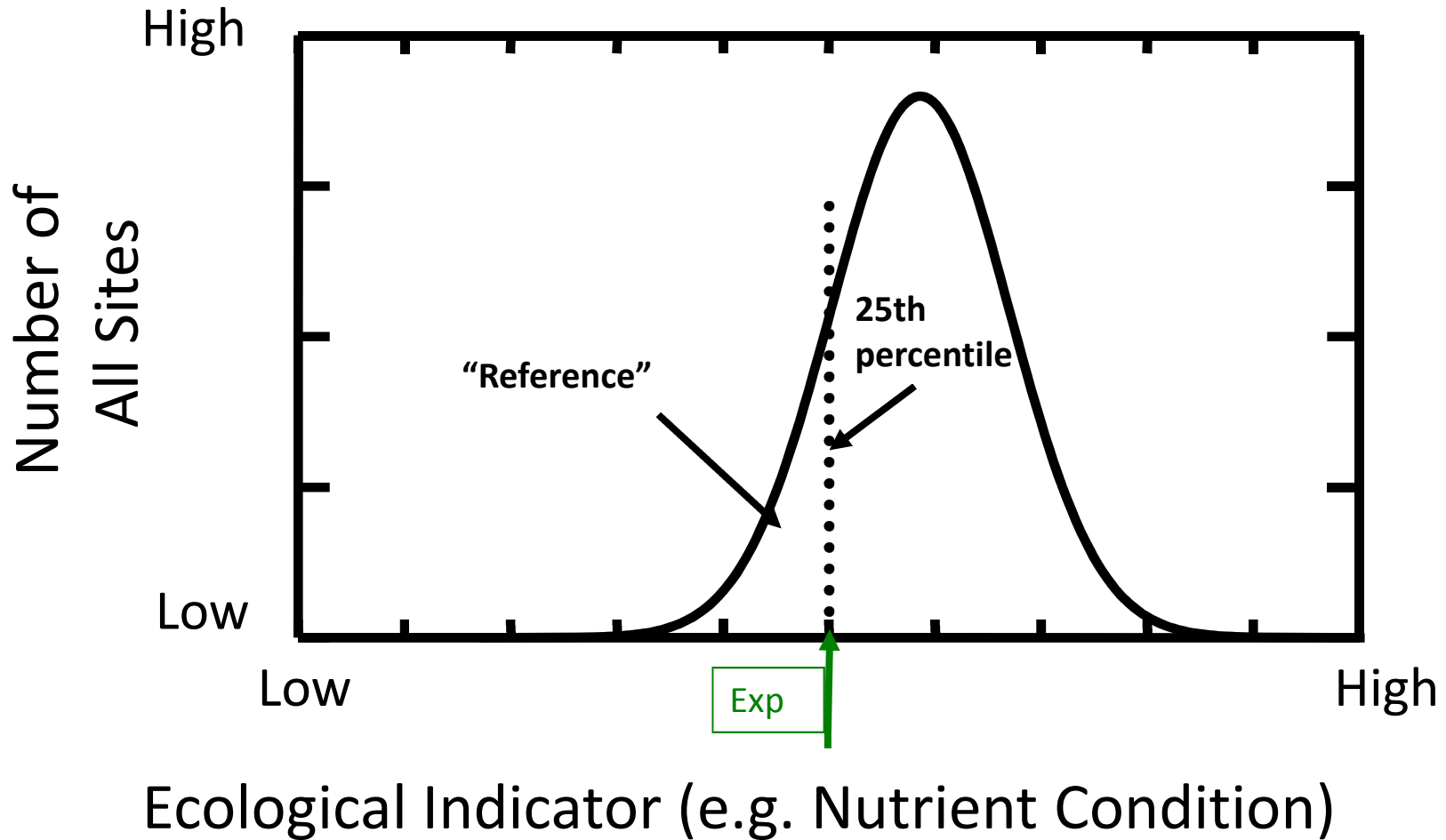
## Must Pass All Screens

Criteria	Adirondacks & New England Uplands	Maine Lowlands	Coastal	NY/VT Lowlands
ANC (ueq/L)	> 50 or DOC > 6	> 50 or DOC > 6	> 50 or DOC > 6	> 50 or DOC > 6
Sulfate (ueq/L)	< 200	< 200	< 200	< 200
Chloride (ueq/L)	< 20	< 400	< 400	< 100
Nitrate (ueq/L)	< 5	< 5	< 5	< 5
Total P (ug/L)	< 10	< 10	< 15	< 20

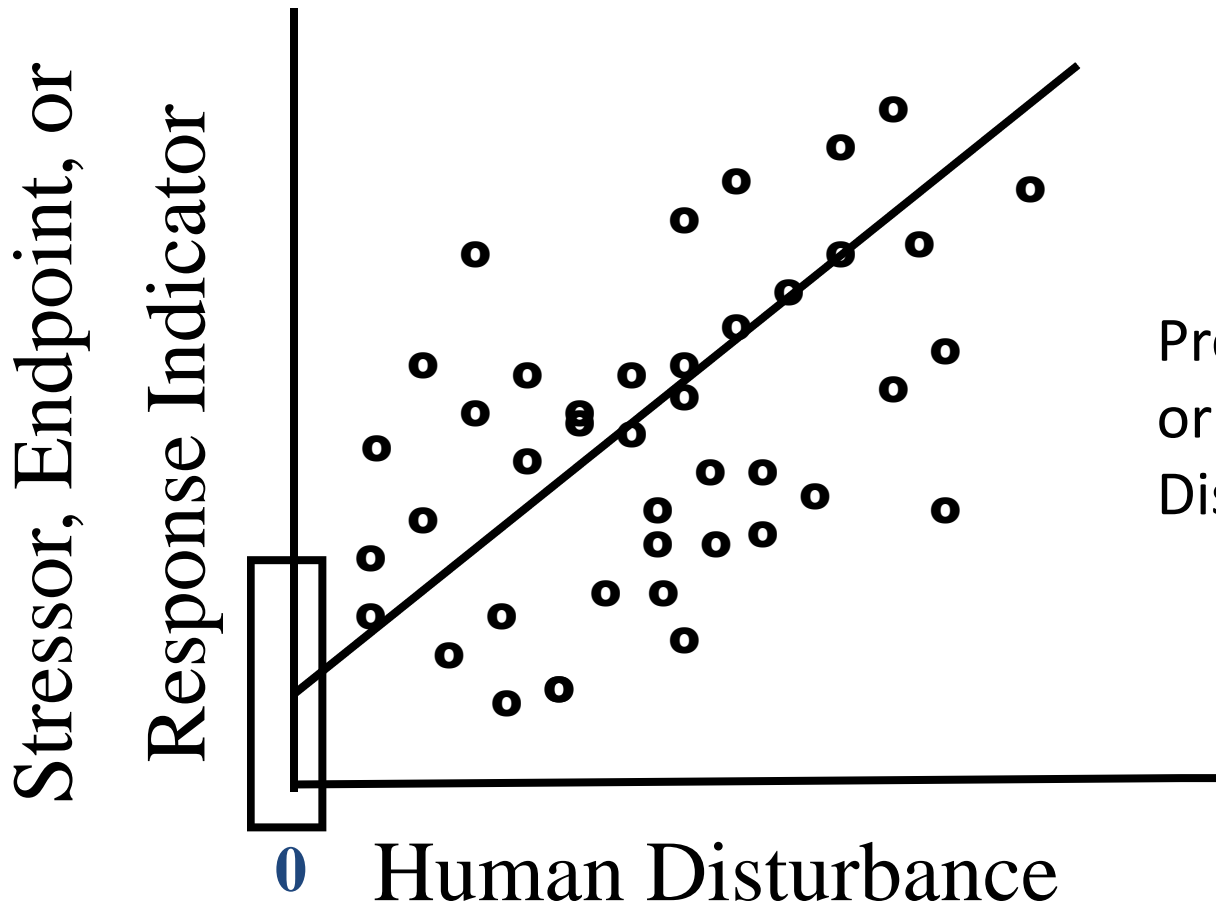
# “Reference Site” Frequency Distribution Approach



# “All-Site” FD Approach – Best Available

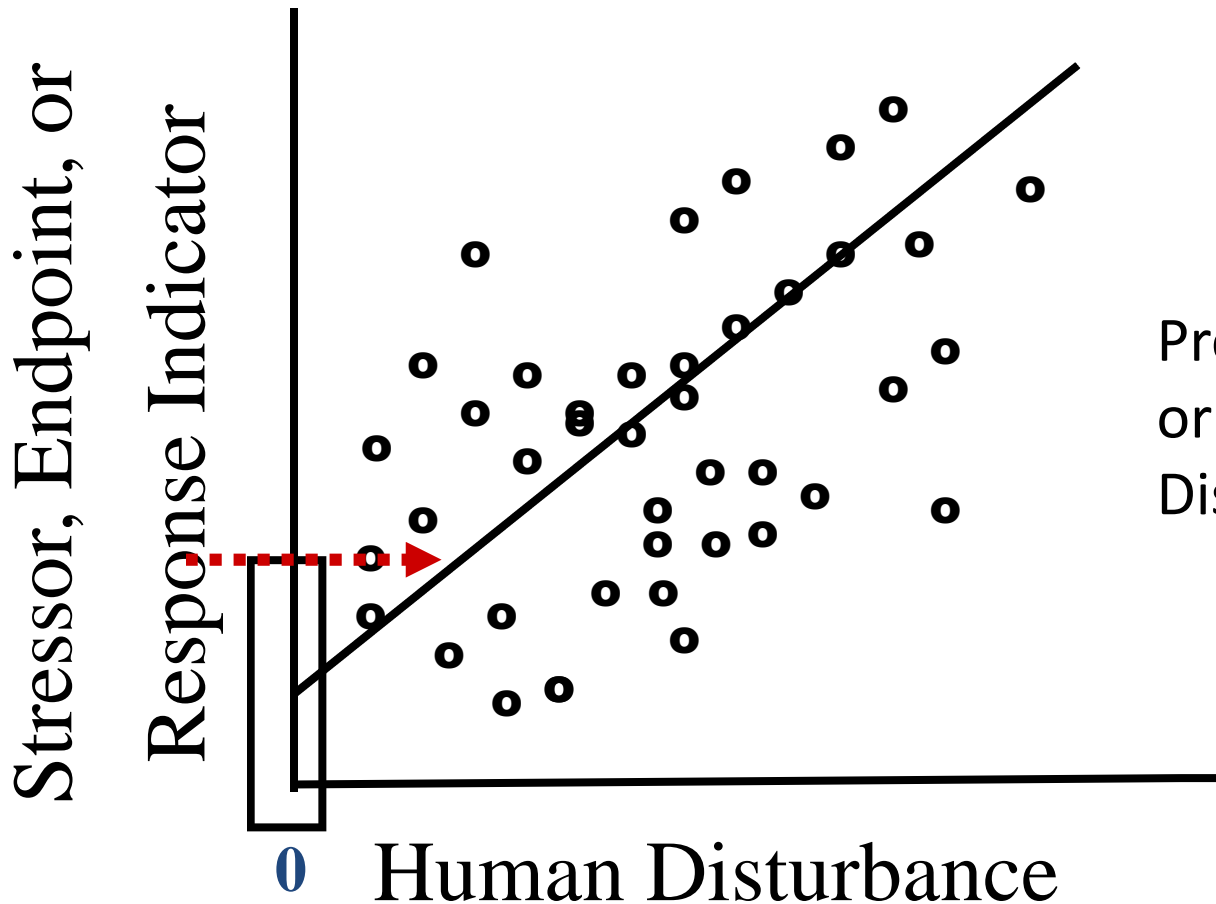


# Predictive Modeling of Natural Condition



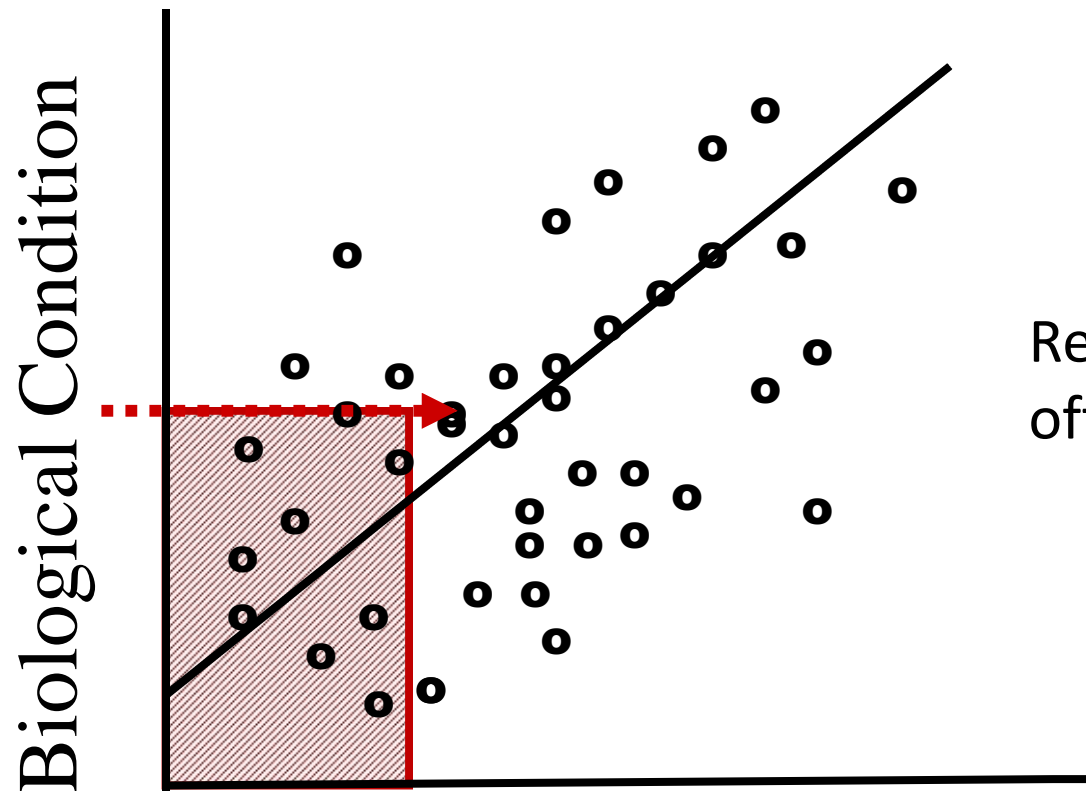
Predict Valued Attribute  
or Stressor when Human  
Disturbance is Zero

# Predictive Modeling of Natural Condition



Predict Valued Attribute  
or Stressor when Human  
Disturbance is Zero

# Predictive Modeling of Reference Condition



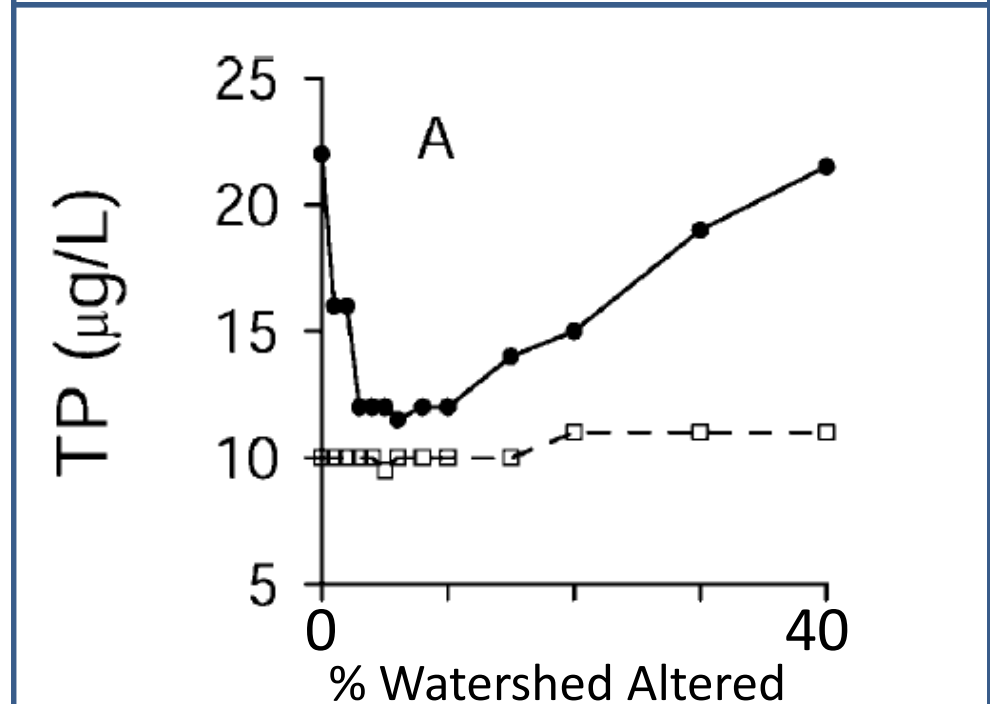
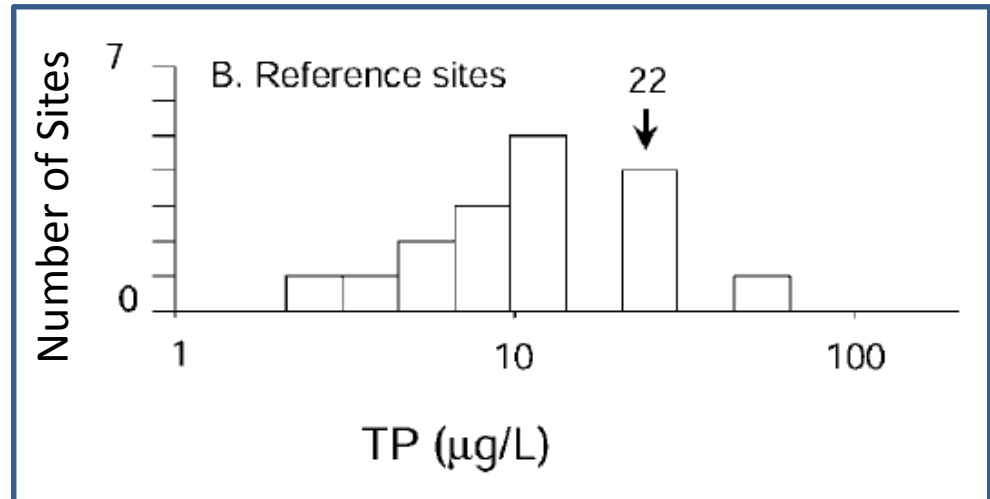
Reference Conditions  
often have  $HD > 0$

0 Human Disturbance

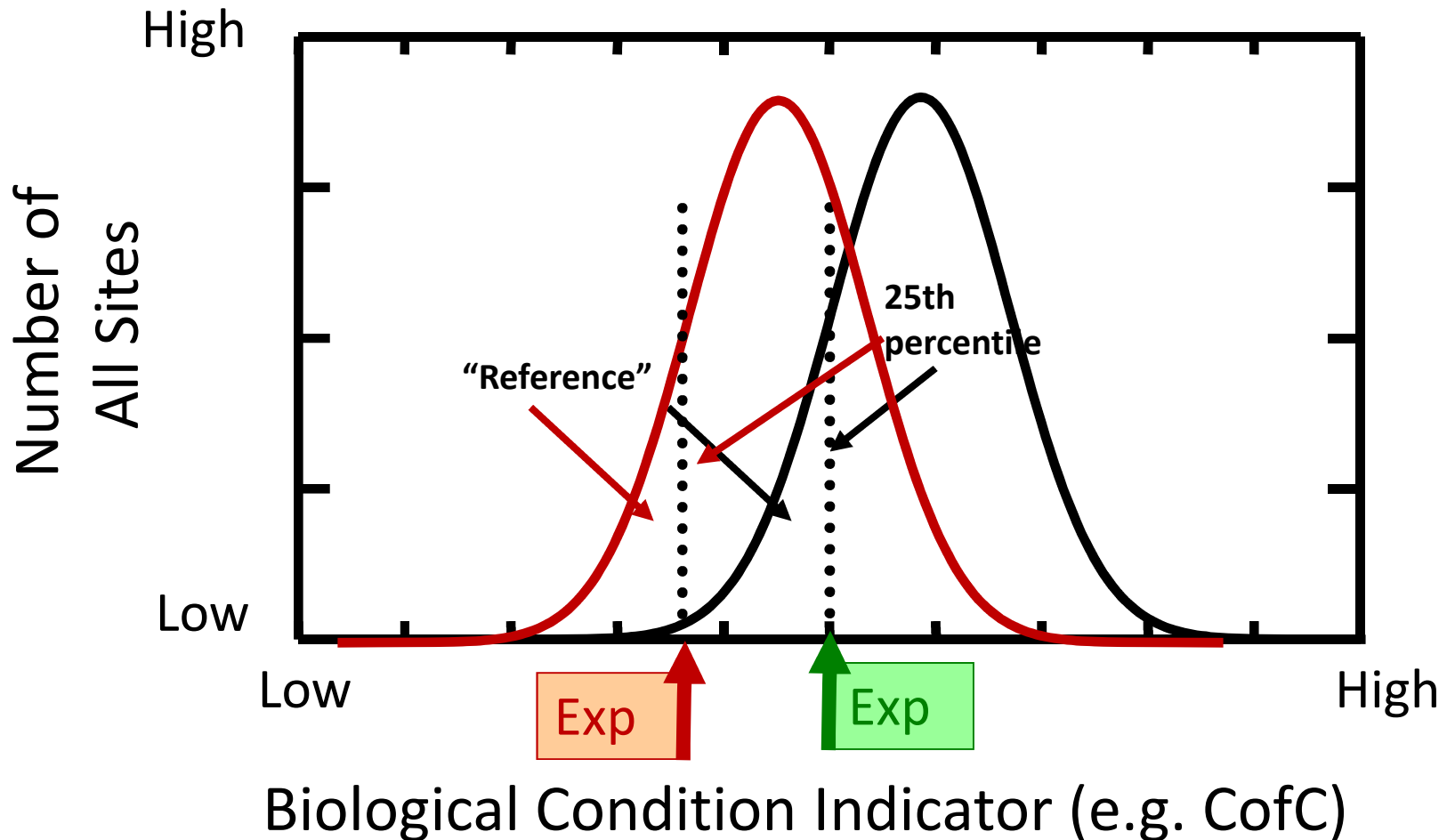
# Dingy Model: add dirty sites to clean

(e.g. Stevenson et al. 2008. JNABS (FS))

- Determining TP reference condition
- Too few reference sites for accurate determination of 75<sup>th</sup> percentile = 22  $\mu\text{g TP/L}$
- Successively added sites with greater and greater % watershed altered and monitored median and 75<sup>th</sup> percentiles
- Selected 75<sup>th</sup> percentile before increase in TP, 12  $\mu\text{g TP/L}$



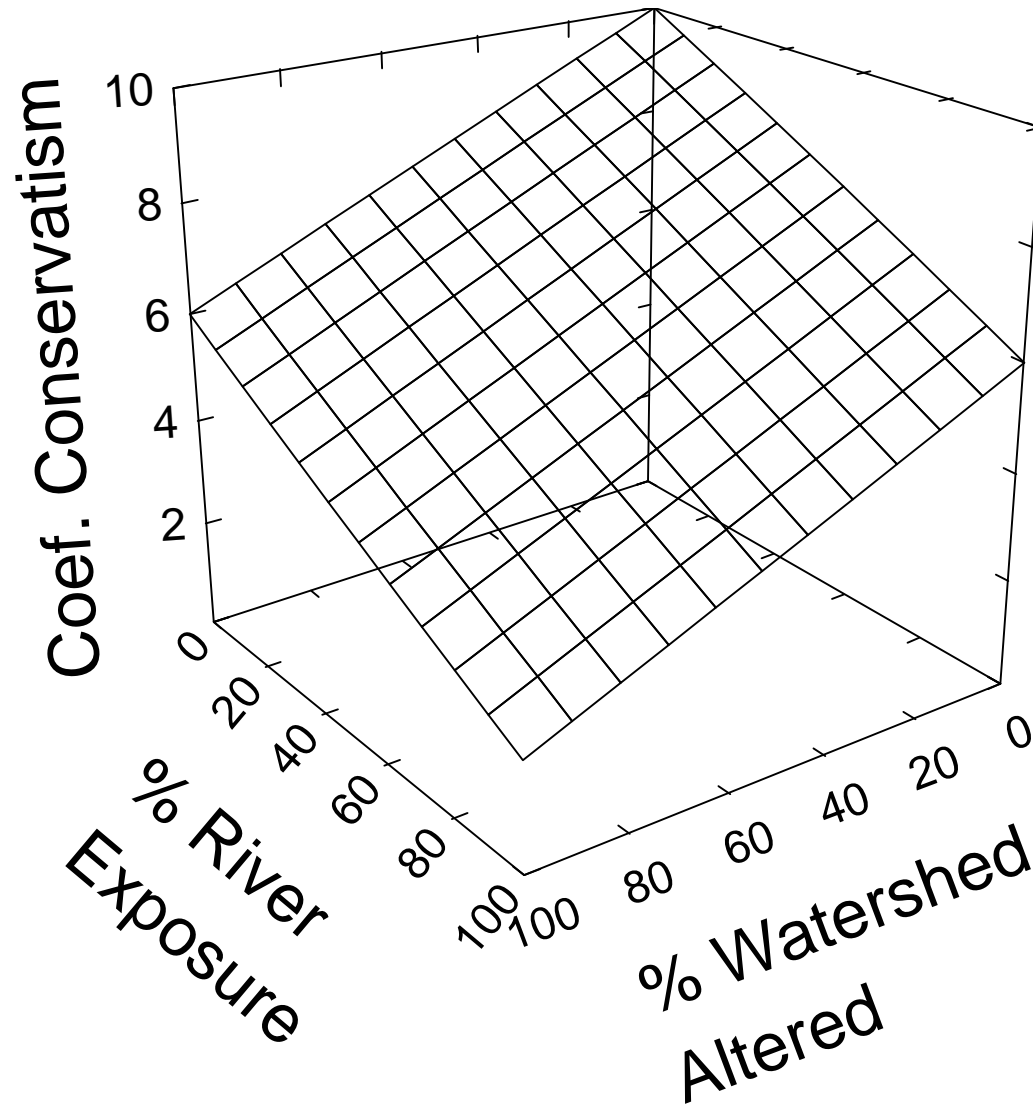
# Account for Natural Variability: Region & Wetland Class “Reference Site” Frequency Distribution Approach





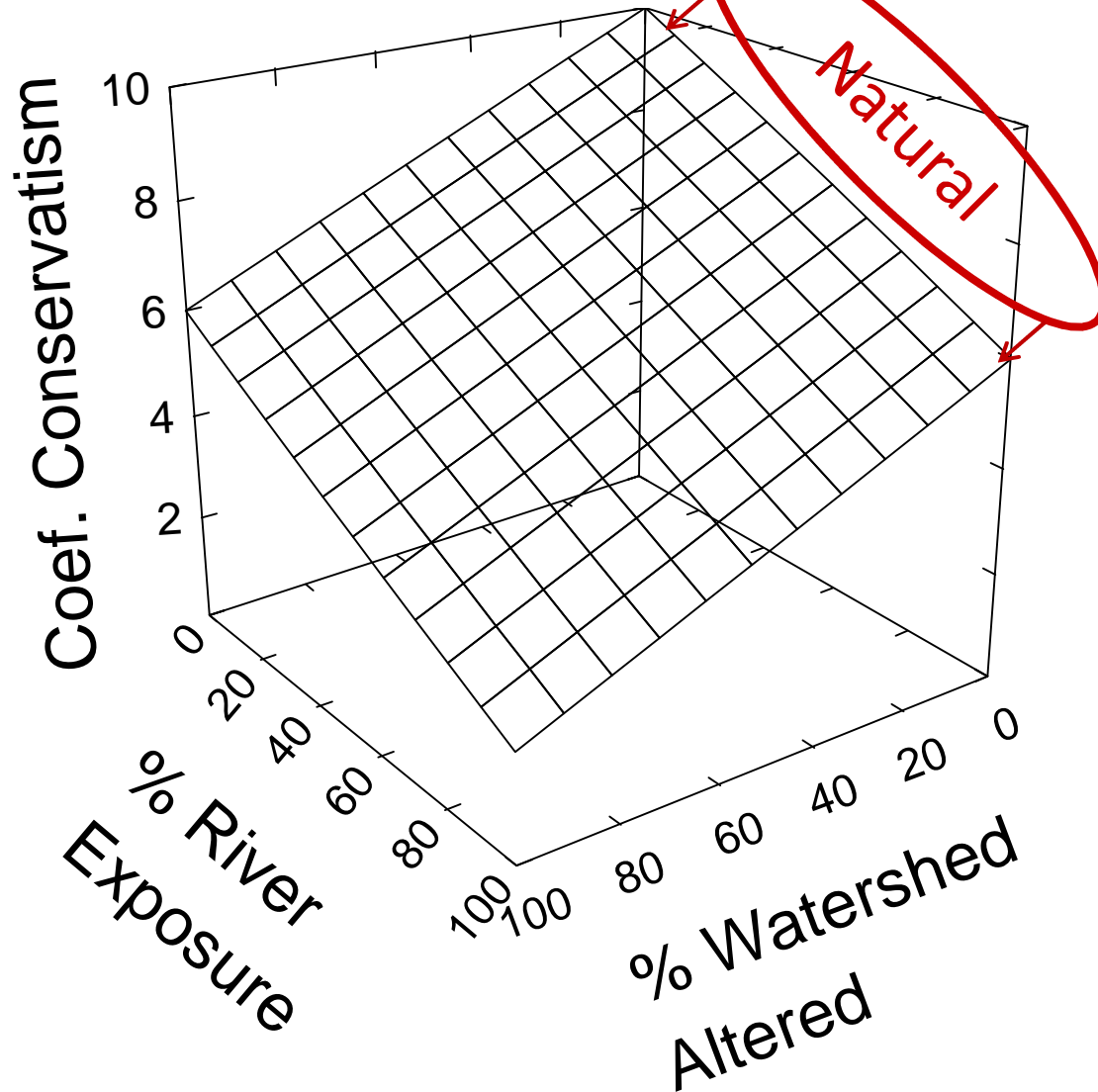
# Predictive Modeling of Natural Condition

(accounting for natural variation among systems)



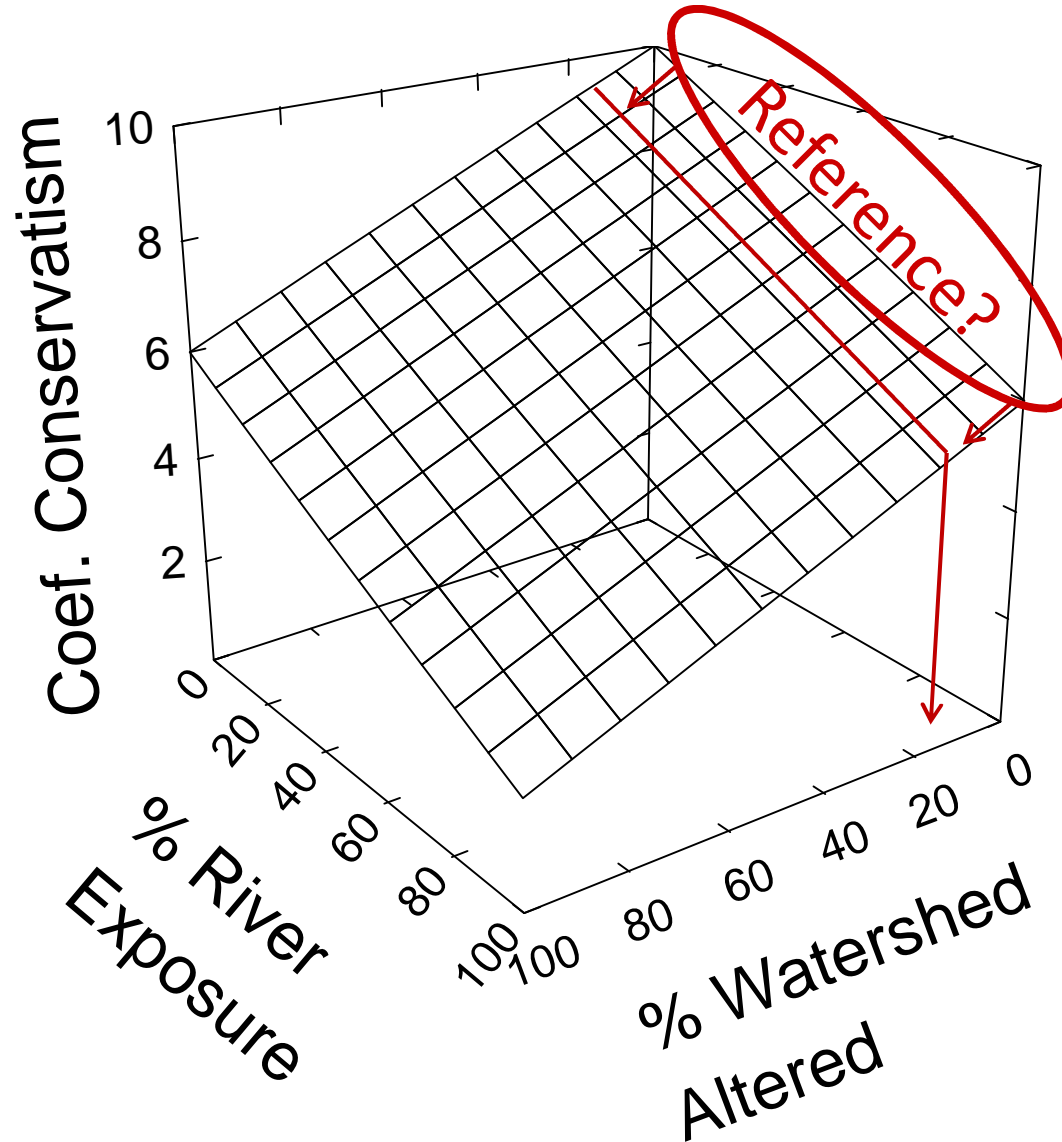
# Predictive Modeling of Natural Condition

(accounting for natural variation among systems)



# Predictive Modeling of Natural Condition

(accounting for natural variation among systems)



# Streams Predictive Model

## Predicted Natural TP

$$\ln(\text{ug/L TP}) = 6.883$$

$$+ 1.110(\% \text{Watershed Ag+Urb})$$

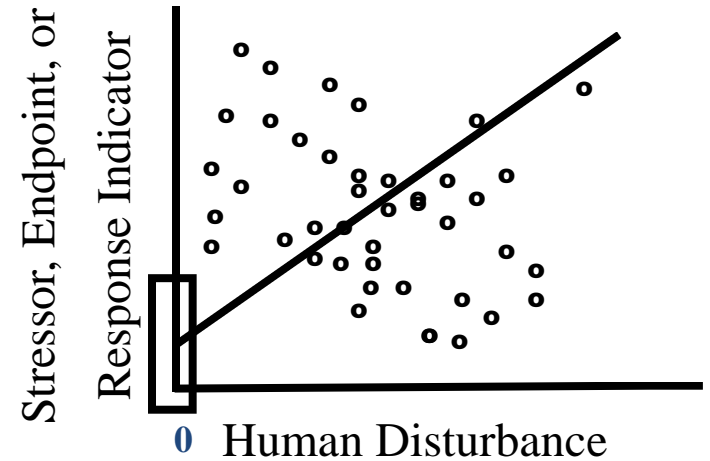
$$- 0.301(\ln(\text{Watershed Slope}))$$

$$- 4.173(\% \text{ Riparian Zone as Wetlands})$$

$$+ 0.679(\ln(\% \text{ Watershed as Wetlands}))$$

$$+ 0.216(\ln(\text{Avg.Width}))$$

$$- 1.325(\ln(\text{Channel Sinuosity}))$$



Adjusted  $R^2=0.539$

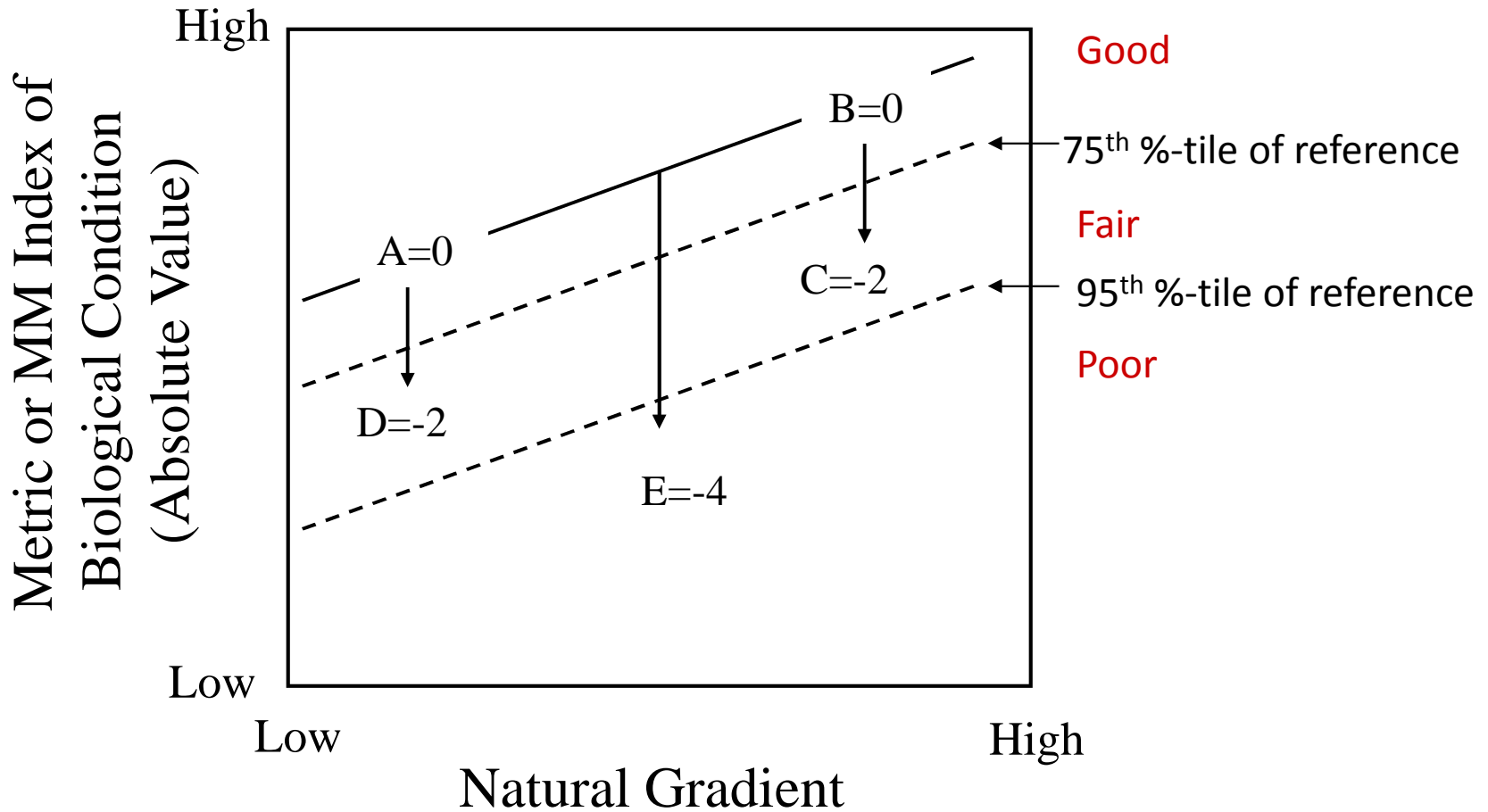
# Frequency Distribution Benchmarks

## TP Reference Condition (MDEQ STORET Data)

Sites	Agriculture + Urban Land Use	# Obs (N)	TP Conc
All	NA	279	22.0 $\mu\text{g TP/L}$
Ref	0% Watershed Disturbed	0	NA
Ref	<10% Watershed Disturbed	16	15.5 $\mu\text{g TP/L}$
Ref	<25% Watershed Disturbed	48	30.2 $\mu\text{g TP/L}$

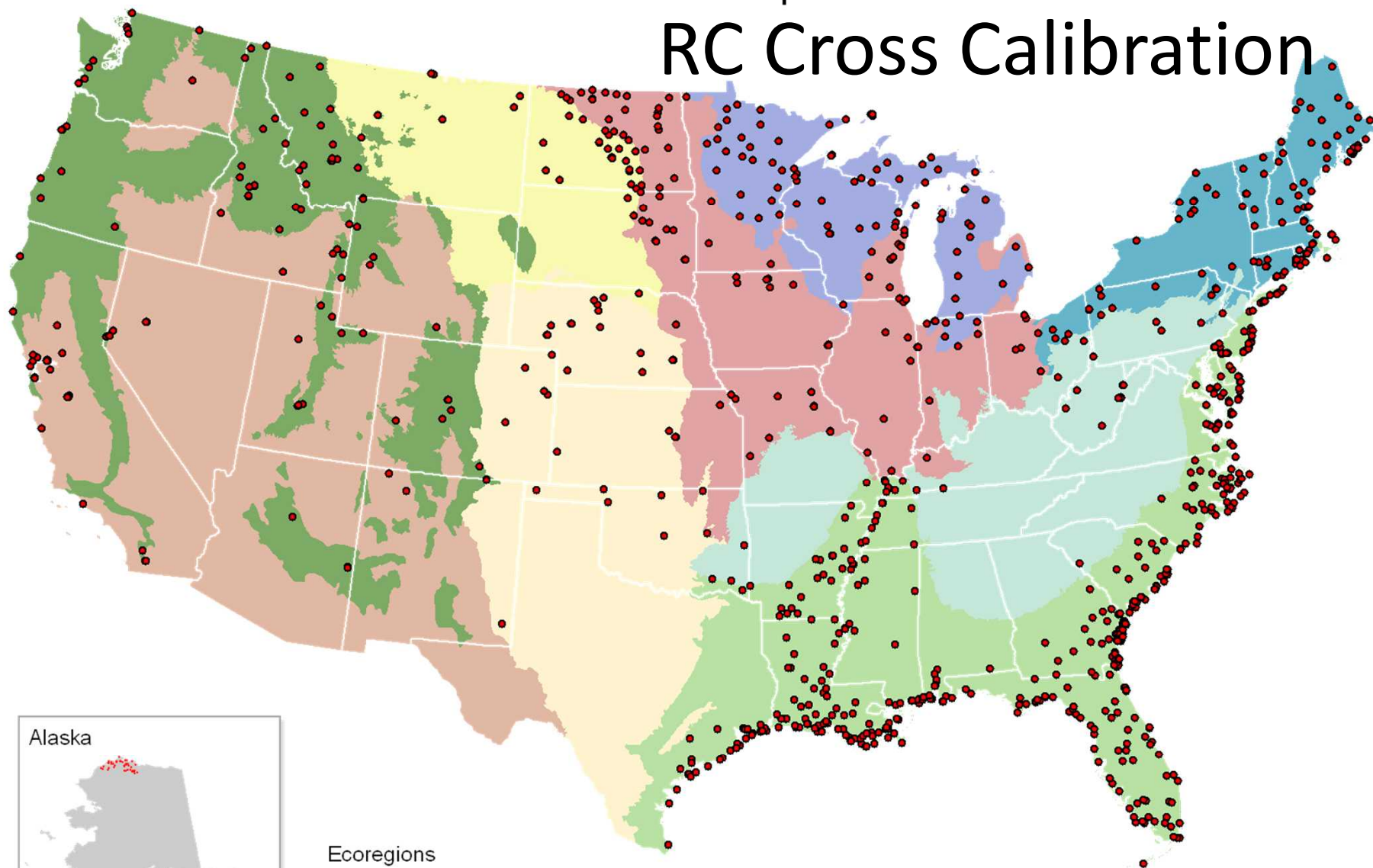
“Natural varies depending upon how you define reference condition.....”

# Condition = Deviation from Expected Reference Condition Accounts for Natural Variation Among Habitats



# 2011 NWCA - Sampled Sites

## RC Cross Calibration

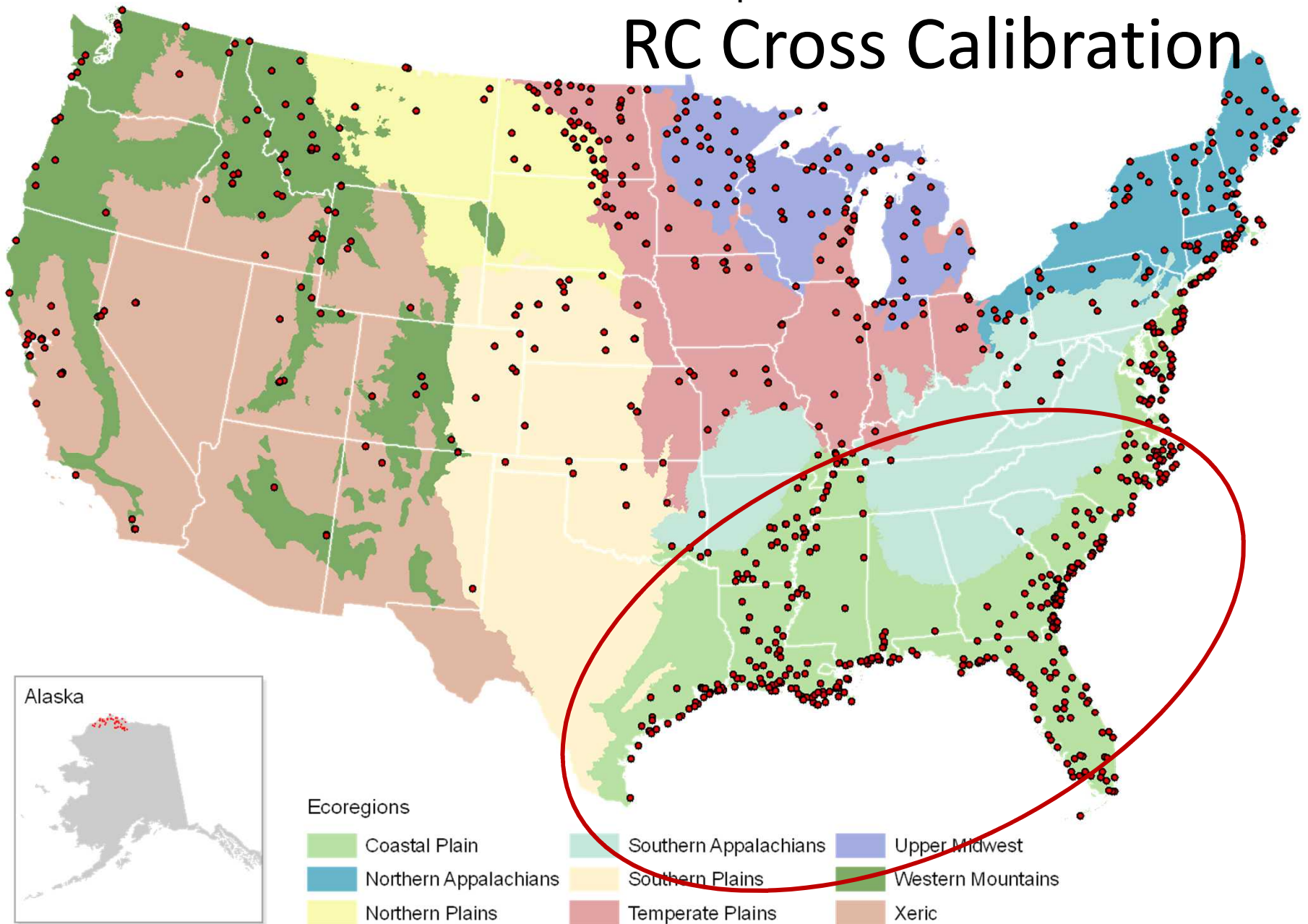


### Ecoregions

- |   |   |   |
|---|---|---|
|  Coastal Plain         |  Southern Appalachians |  Upper Midwest     |
|  Northern Appalachians |  Southern Plains       |  Western Mountains |
|  Northern Plains       |  Temperate Plains      |  Xeric             |

# 2011 NWCA - Sampled Sites

## RC Cross Calibration





# 2011 NWCA - Sampled Sites

## RC Cross Calibration

