USING BIOLOGICAL INTEGRITY TO STRUCTURE WATER QUALITY CRITERIA: CALIFORNIA AND BEYOND

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TAKE HOME MESSAGES

- Criteria for many constituents do not lend themselves to lab approaches
- Field based approaches are continuing to surge in use
- California is applying such approaches to nutrients
- This is good news for field biology…

EVOLUTION OF ASSESSMENT

Original “indices” were single metric, tolerance based – saprobien, HBI

Second generation indices were multimetric/assemblage based – MMI, O/E, % Model Affinity

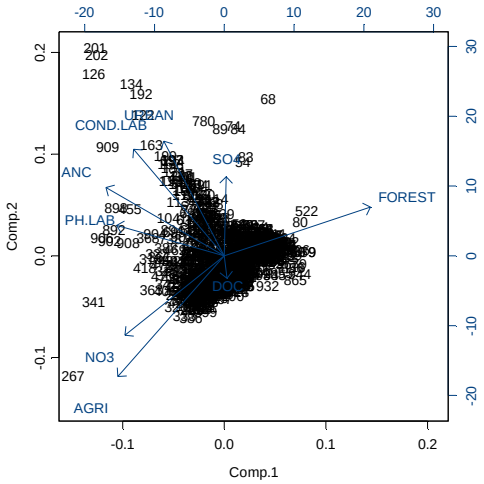
But there is a lot of information stored in taxonomic presence/absence and abundance

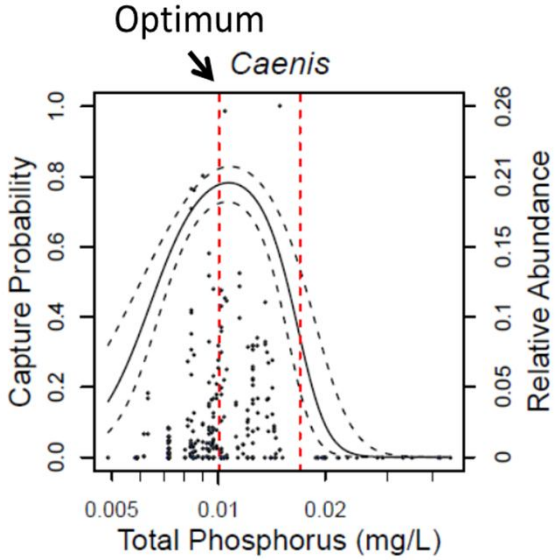
RISE OF CAUSAL ASSESSMENT

Causal assessment (Stressor Identification, CADDIS) spurred disentanglement

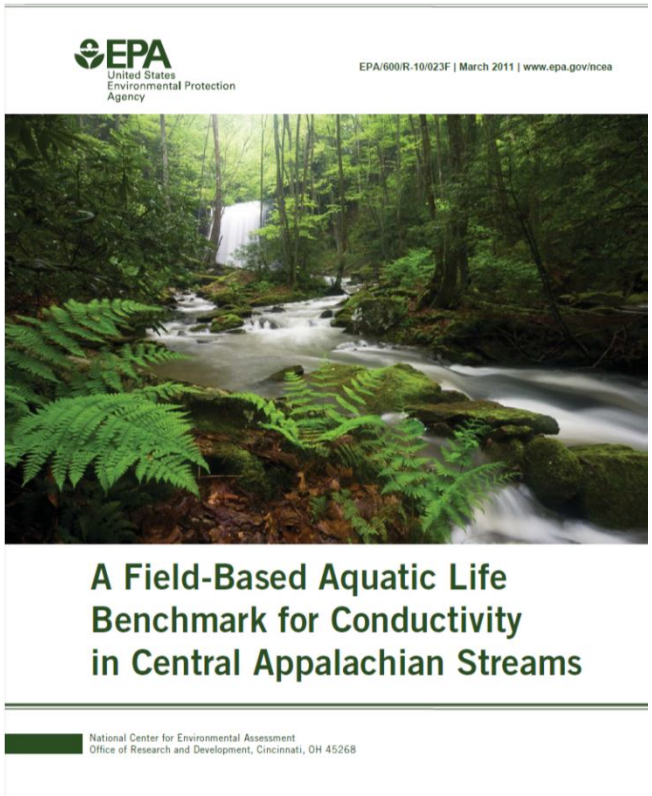
Why is my site impaired? What is the cause?

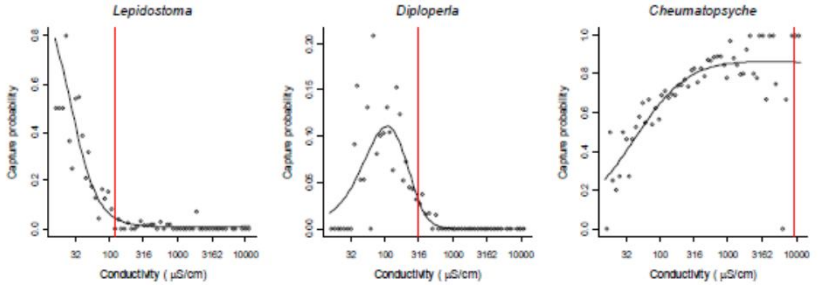
Can the taxa tell me?

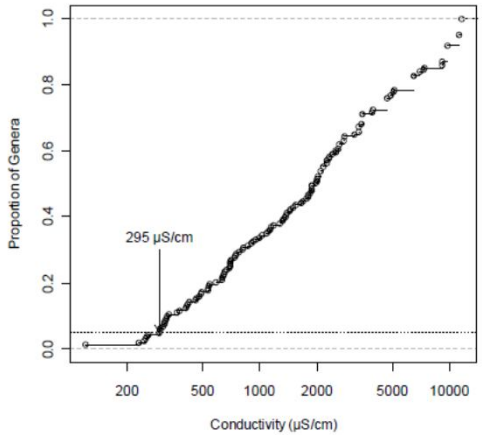




AT THE SAME TIME - FIELD BASED CRITERIA







FIELD BASED CRITERIA – STRESSOR-RESPONSE GUIDANCE

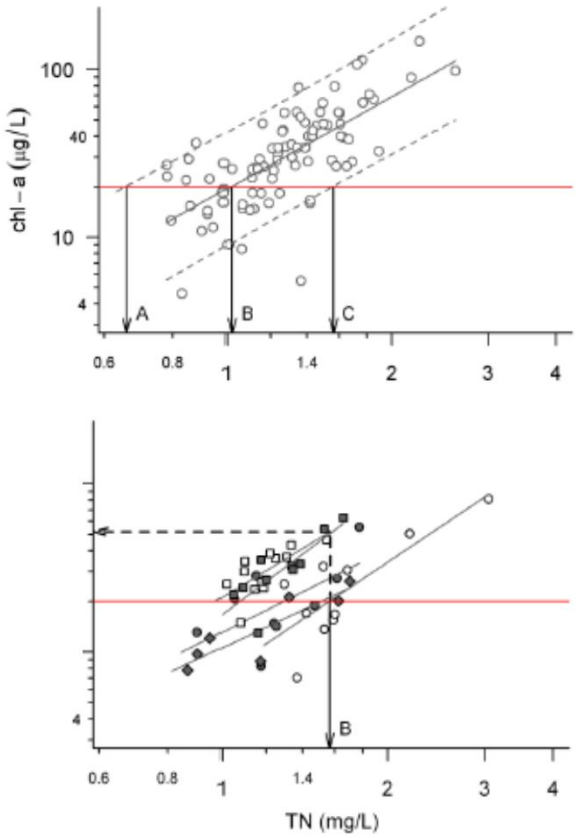
United States Environmental Protection Agency

Office of Water
Mail code 4304T

EPA-820-S-10-001
November 2010

Using Stressor-response Relationships to Derive Numeric Nutrient Criteria

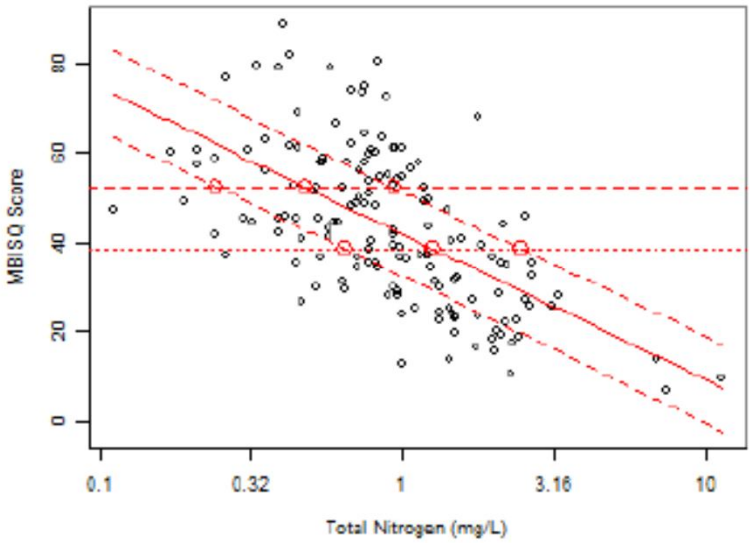
Office of Science and Technology
Office of Water
U.S. Environmental Protection Agency
Washington, DC

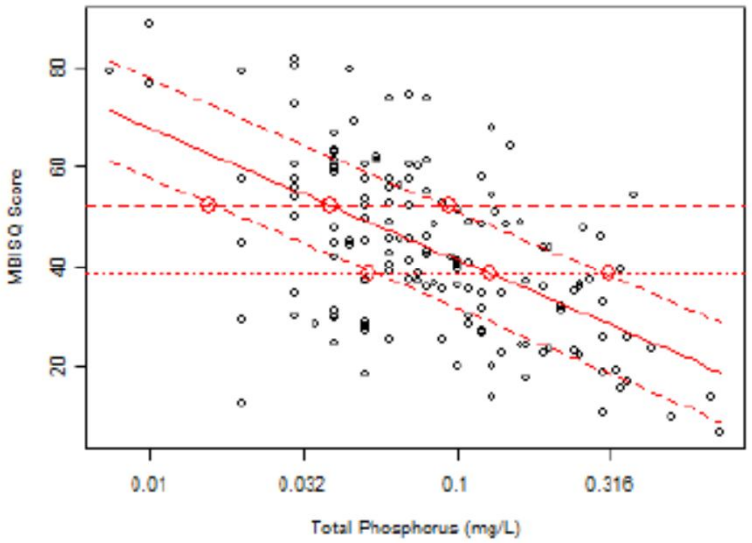


EXAMPLE APPLICATIONS
NUTRIENT CRITERIA DEVELOPMENT - MS

Extensive work in MS on nutrient criteria development is relying on field data

Using a variety of models





West Bioregion – MBISQ multimetric

NUTRIENT CRITERIA DEVELOPMENT - MS

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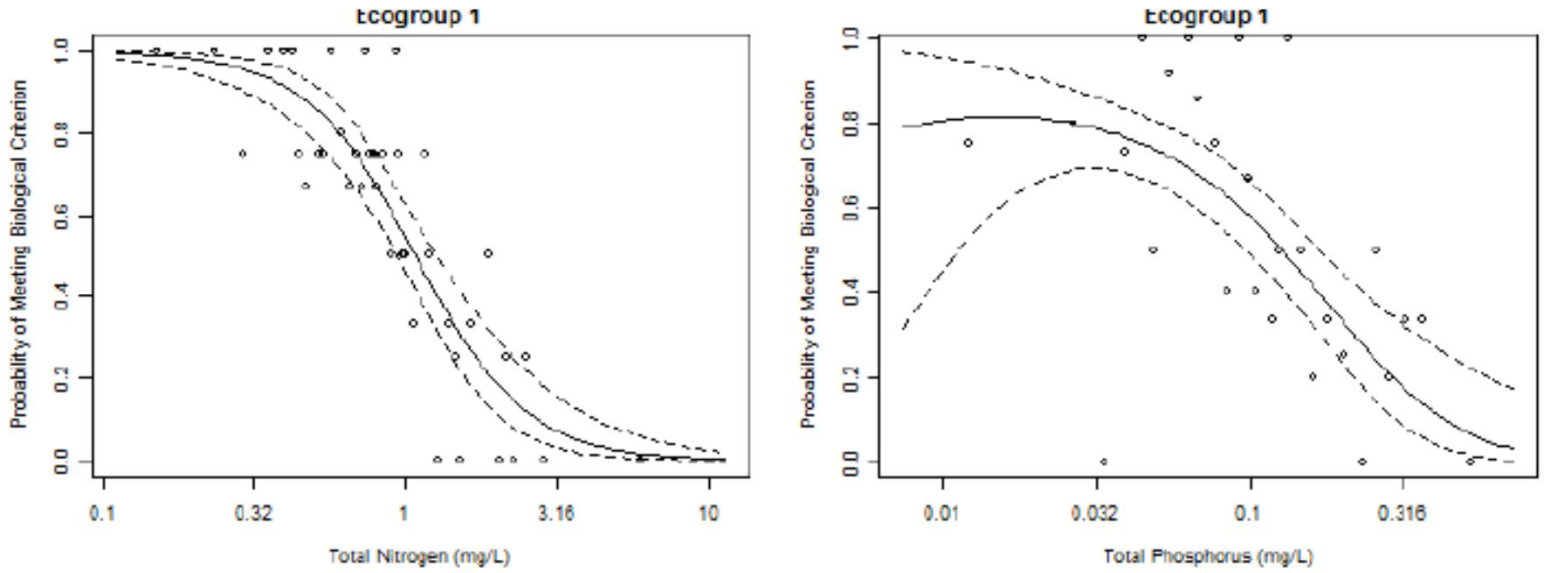
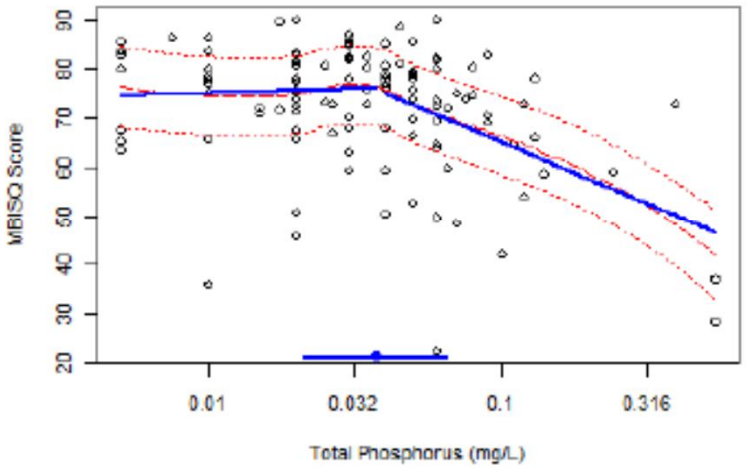
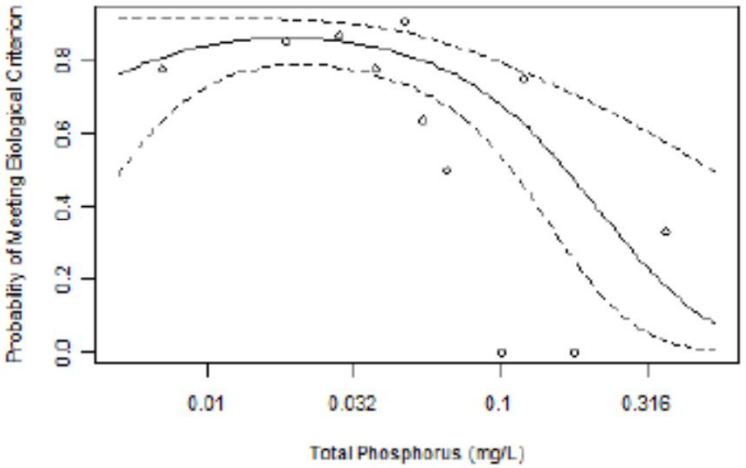


West Bioregion – Probability of impairment curves

NUTRIENT CRITERIA DEVELOPMENT - MS

Extensive work in MS on nutrient criteria development is relying on field data

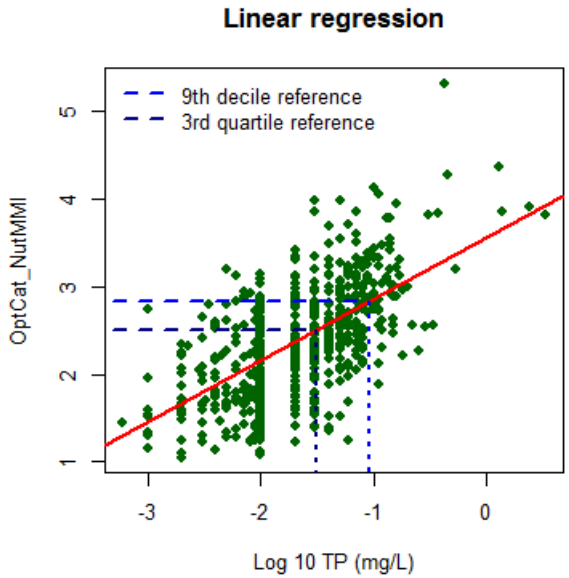


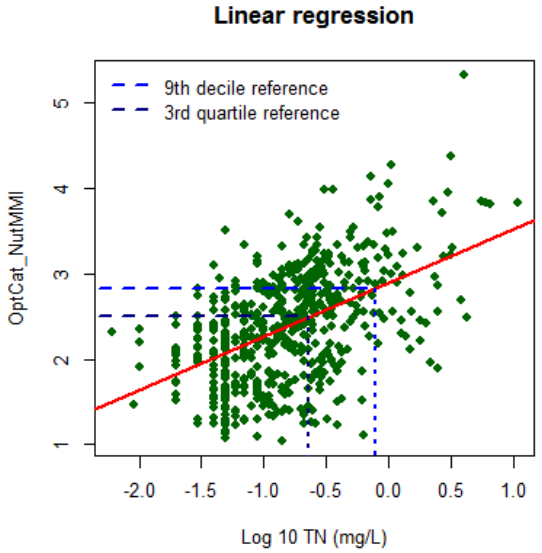


Southeast Bioregion – Split point regression and impairment probability

NUTRIENT THRESHOLD DEVELOPMENT - OR

OR exploring the development of nutrient screening tools – with periphyton

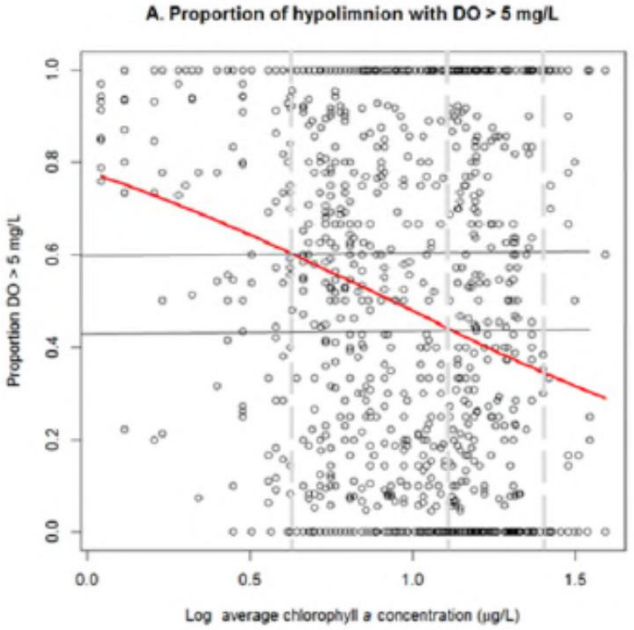




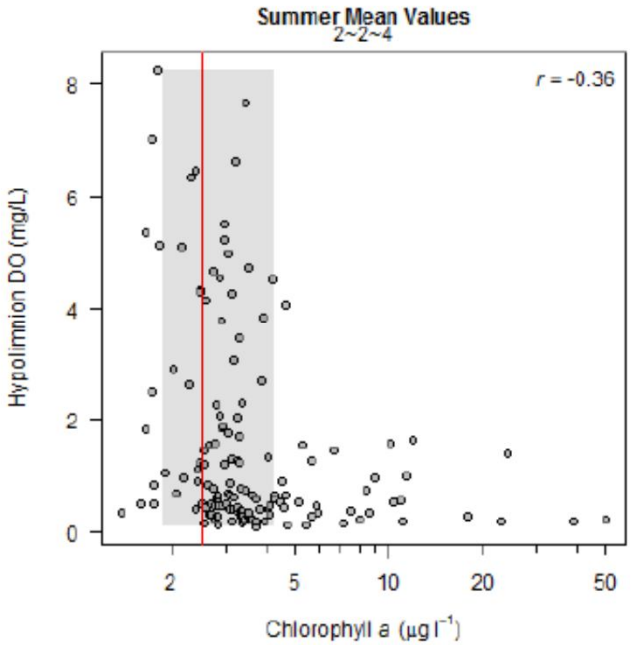
WEMAP Periphyton MMI

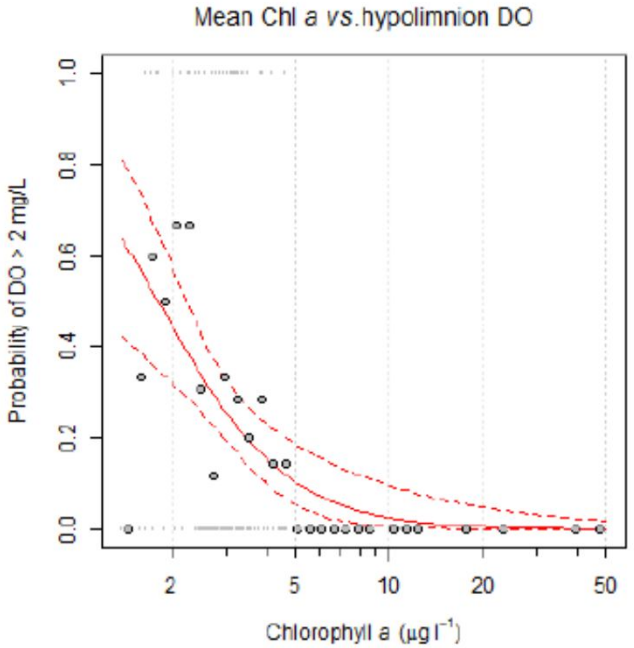
NUTRIENT THRESHOLD DEVELOPMENT – TN AND WI LAKES

Developing endpoints for lakes to set watershed downstream protection values



TVA Lake Data and DO





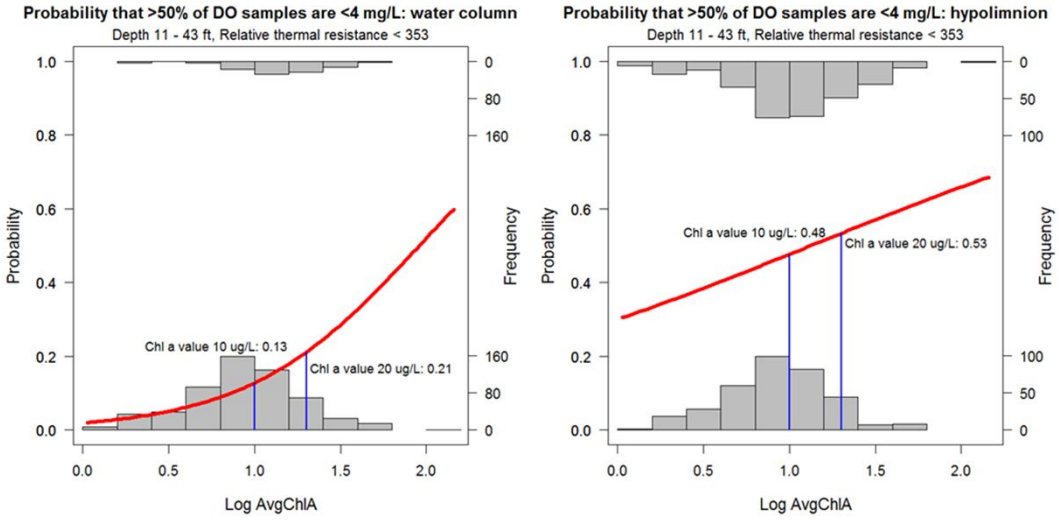
WI Lake Data and DO

RESPONSE TARGET MUST LINK TO VALUED CONDITION

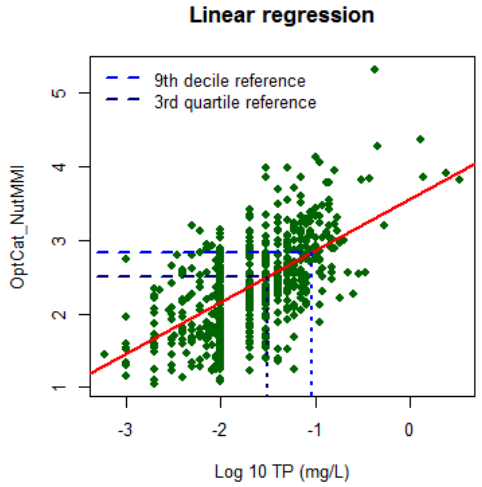
A clear linkage to a desired endpoint is important

"Ecological change" is not necessarily sufficient – should be adverse change

Can be regulatory (e.g., DO criteria) or ecological (reference based)



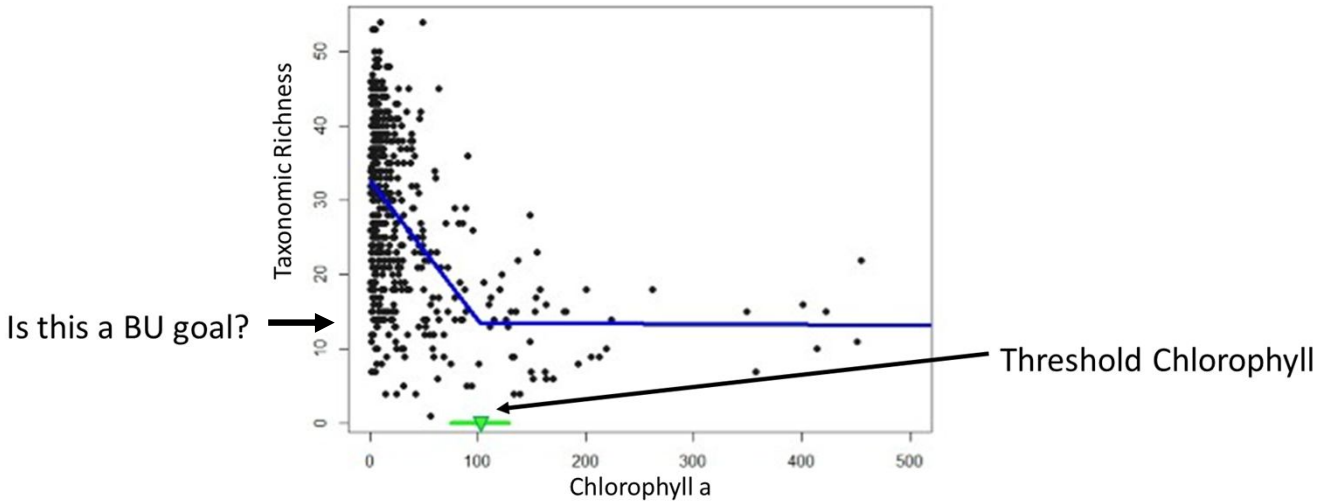
MS Lake Analysis – linking Chl a endpoint to DO standard

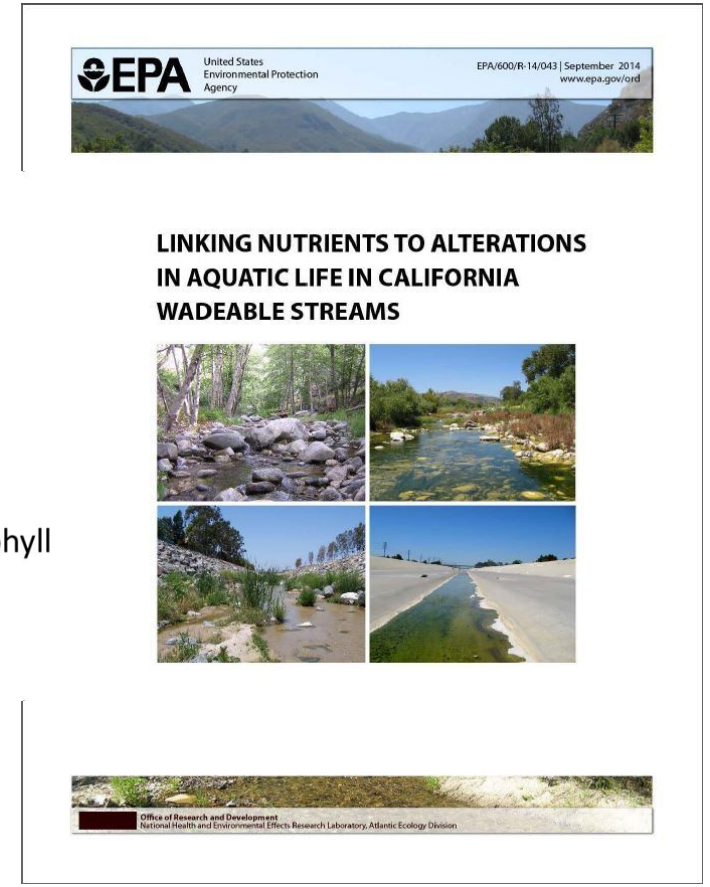


OR Periphyton – MMI target based on reference

CALIFORNIA – STREAM NUTRIENT CRITERIA

Fetscher et al. 2014

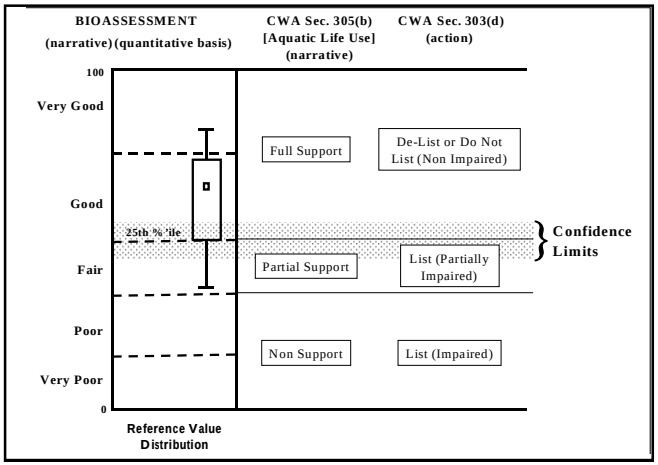




Again "ecological change" not necessarily sufficient.
How do these change points relate to designated/beneficial use goals?
CA has not yet defined these goals.

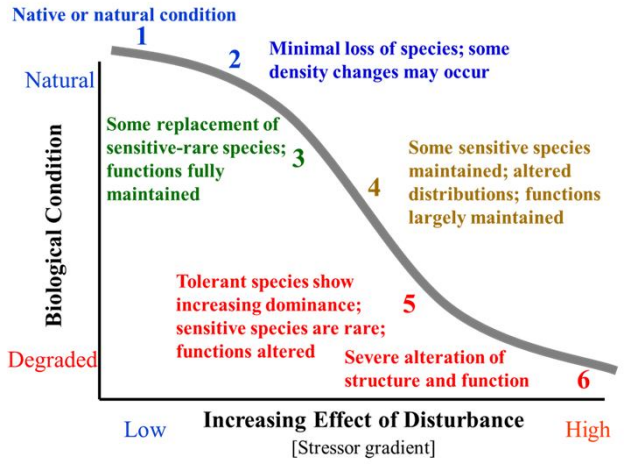
COMMON BIOLOGICAL GOAL SETTING

Statistical property of a least disturbed “reference” population



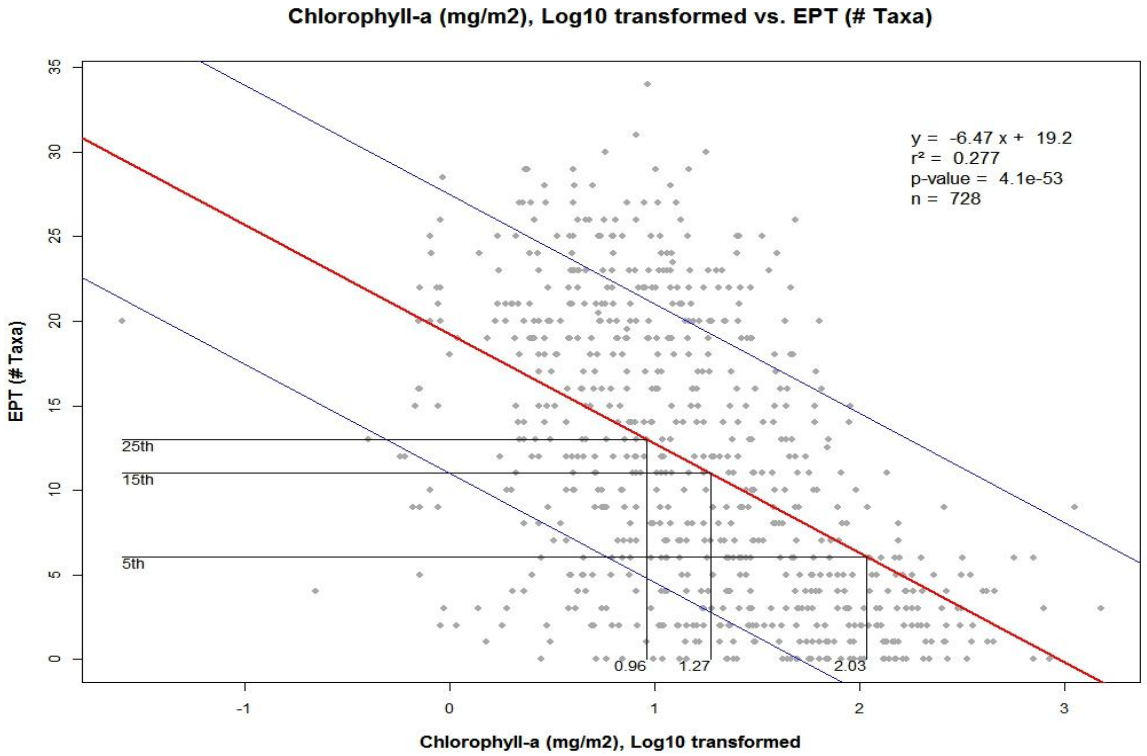
We chose this one
Historical application
Linkage to narrative and CWA goals

Expert elicitation based on the Biological Condition Gradient (BCG)



LINKING RESPONSES TO VALUED CONDITION

- Identified response measures (invertebrates and algae)
- Calculated reference site percentiles (5^{th}, 15^{th}, 25^{th})
- Built simple linear regression models
- Solve for the X condition….

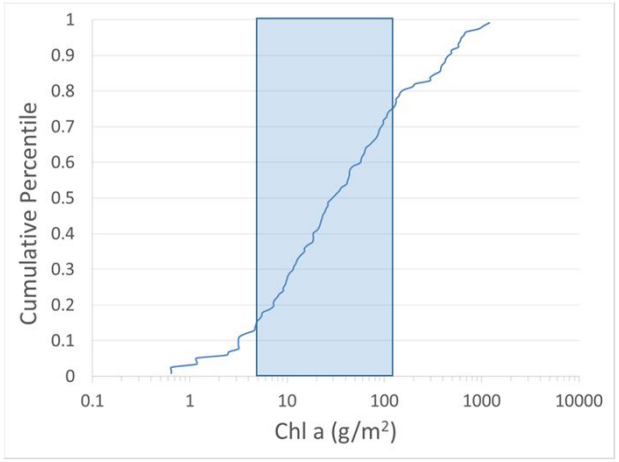


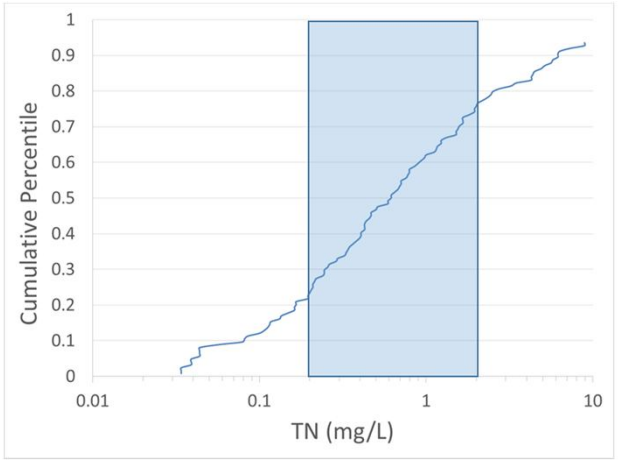
Data: Statewide SWAMP macroinvertebrate dataset metric and Fetscher et al. (2014) stream algae dataset metrics

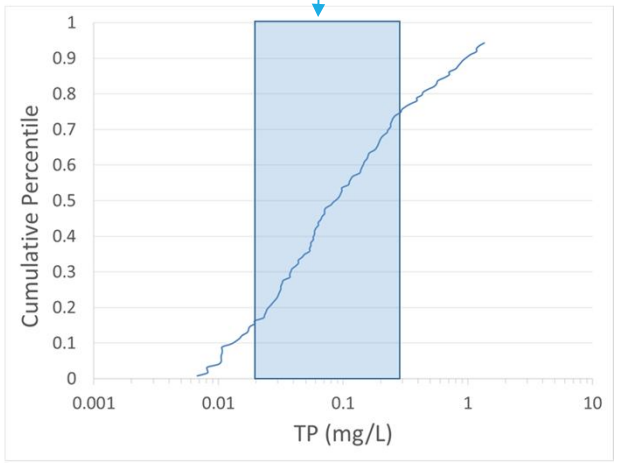
CA INVERTEBRATE MODELS

Nutrient value statistics (linear model)

Fetscher et al. (2014) Threshold Ranges



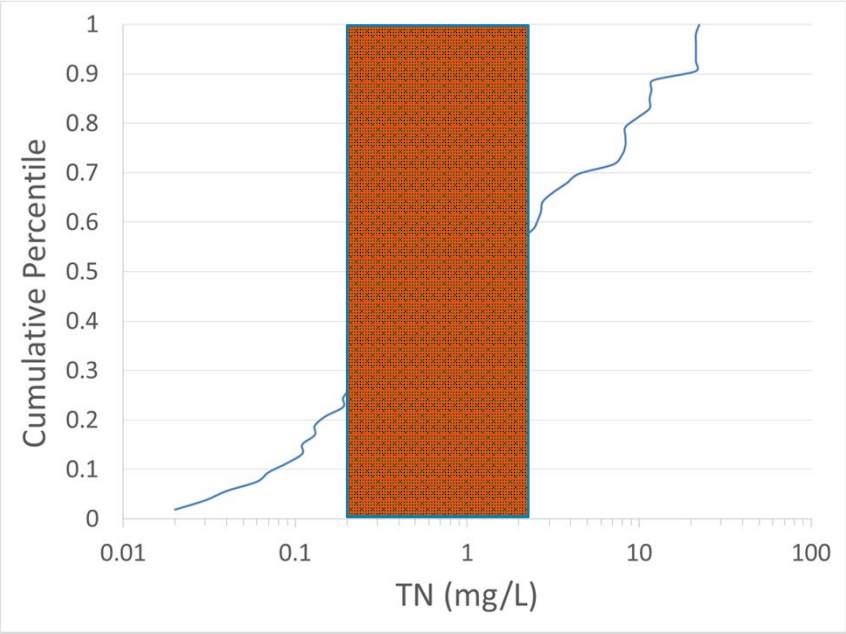




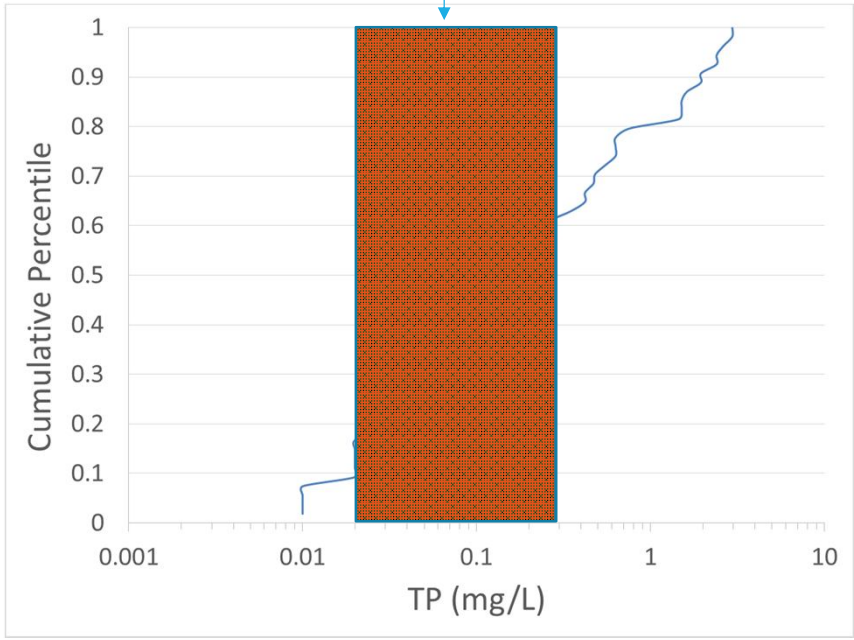
Only significant regressions, in the expected direction, with interpolated values

CA ALGAL MODELS

Nutrient value statistics (linear model)



Fetscher et al. (2014) Threshold Ranges



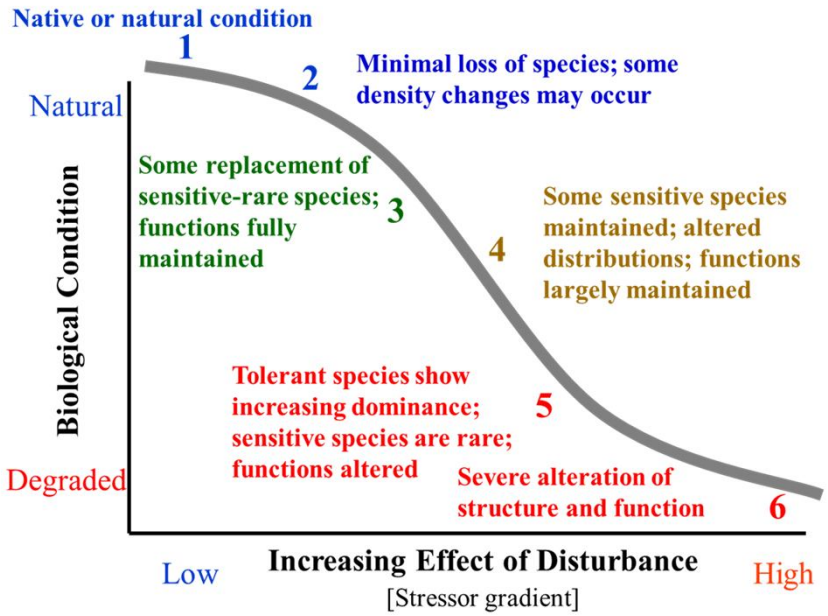
Only significant regressions, in the expected direction, with interpolated values

NEXT STEP IN CALIFORNIA BIOLOGICAL CONDITION GRADIENT MODELING

Next phase of CA stream nutrient criteria work

Expert elicitation

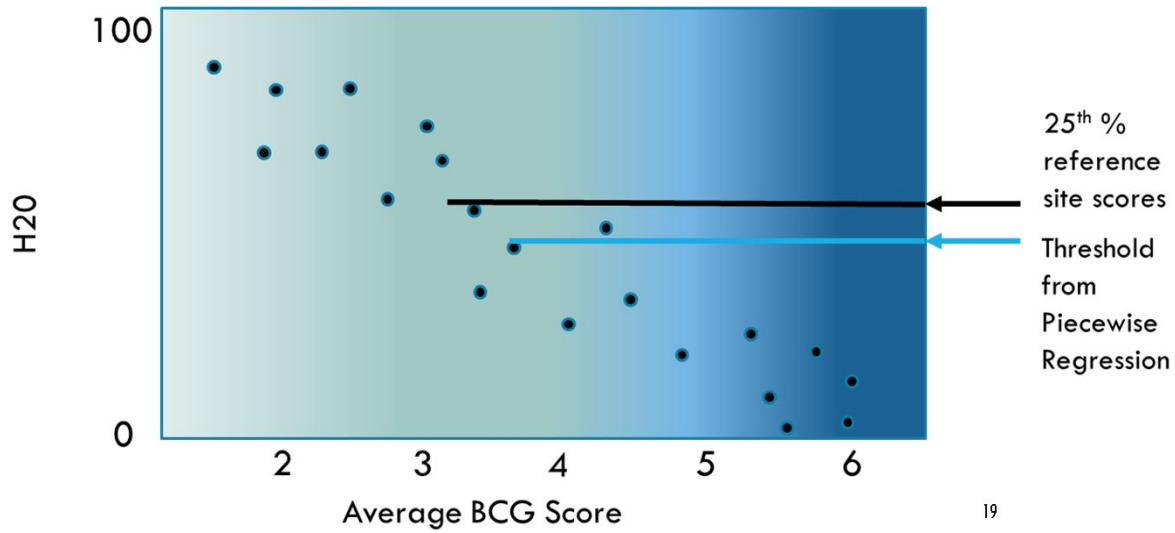
- Experts slot sites into locations along gradient using taxonomic info only
- Both invertebrate and algal data



BIOLOGICAL CONDITION GRADIENT MODELING

Once the sites are slotted:

- Map biotic response/nutrient thresholds to BCG scores
- Translate assessment endpoints into BCG context
- Further strengthen thresholds
- Provides knock on benefits



BIOLOGICAL CONDITION GRADIENT MODELING

BCG

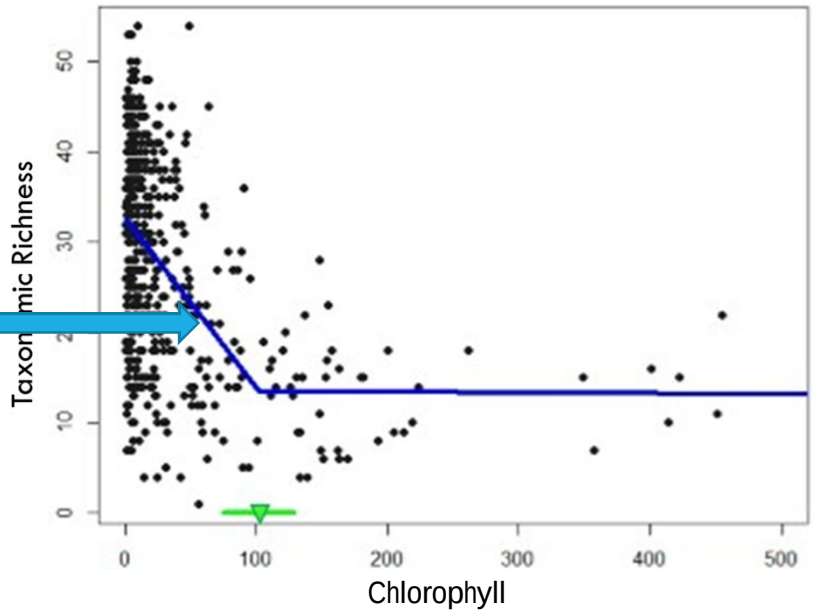
2

3

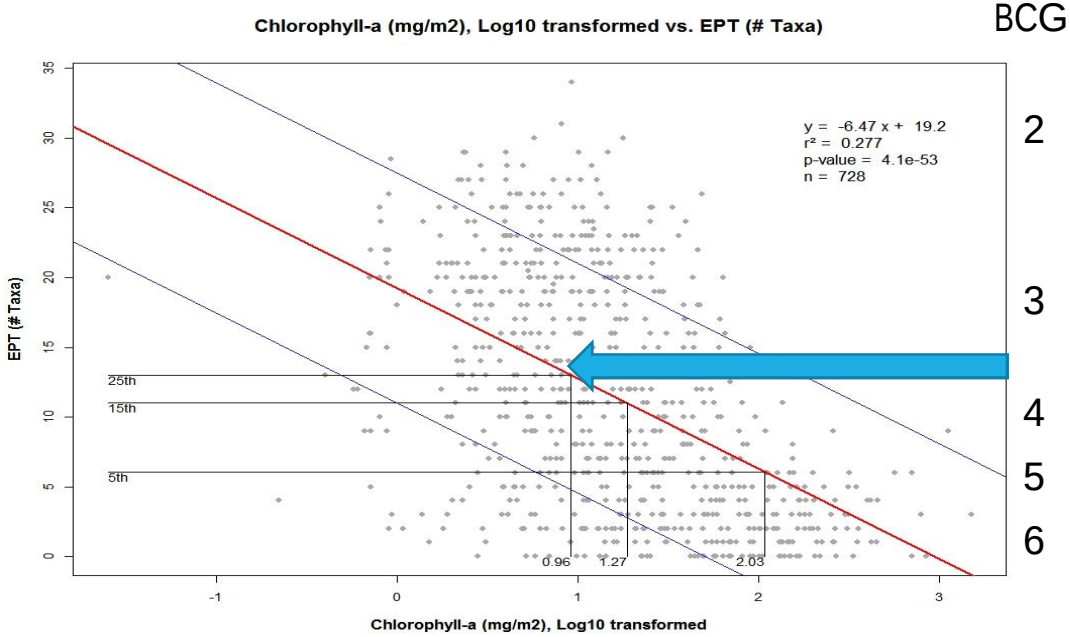
4

5

6



Invertebrate Richness



BCG

2

3

4

5

6

EPT Richness

USING BIOLOGICAL INTEGRITY TO DERIVE CRITERIA ELEMENTS OF AN APPROACH

- Standard high quality biological sampling
- Paired stressor and response models
  - Needn't be statistically complex, but we might want to move there (SEM)
- Classification integration – explicitly or implicitly
  - To reduce variability
- Response anchored to regulatory/management goal
  - Existing criteria, reference base, Biological Condition Gradient

TAKE HOME MESSAGES

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