

# Statistical modeling responses of bioassessment indices to eutrophication stressor gradients

Presentation to Science Panel

April 19, 2017

# Objectives

- Support decisions on numeric guidance (e.g., a numeric objective) for biostimulatory nutrients or conditions that protect biological integrity.

# Process and Approach

- Present stakeholder and regulatory advisory groups with overall approach, and ascertain key points to consider
- Review approach with science panel, and identify best ways to tackle concerns
- Present model results to advisory groups and review implications

# Measuring Biostimulatory factors and eutrophication indicators

- Nutrient concentrations: Total N and Total P
- Organic matter: Benthic chl A or AFDM, streambed algae cover

Other co-factors we may include (but don't need numeric guidance now):

- Biostimulatory conditions (temp, velocity, shading)
- Habitat quality

# Responses: measures of biological integrity

- Benthic macroinvertebrates
  - CSCI
- Benthic algae
  - Soft/Diatom indices (ASCIs)

When available, we can link ranges of index scores linked to BCG bins.

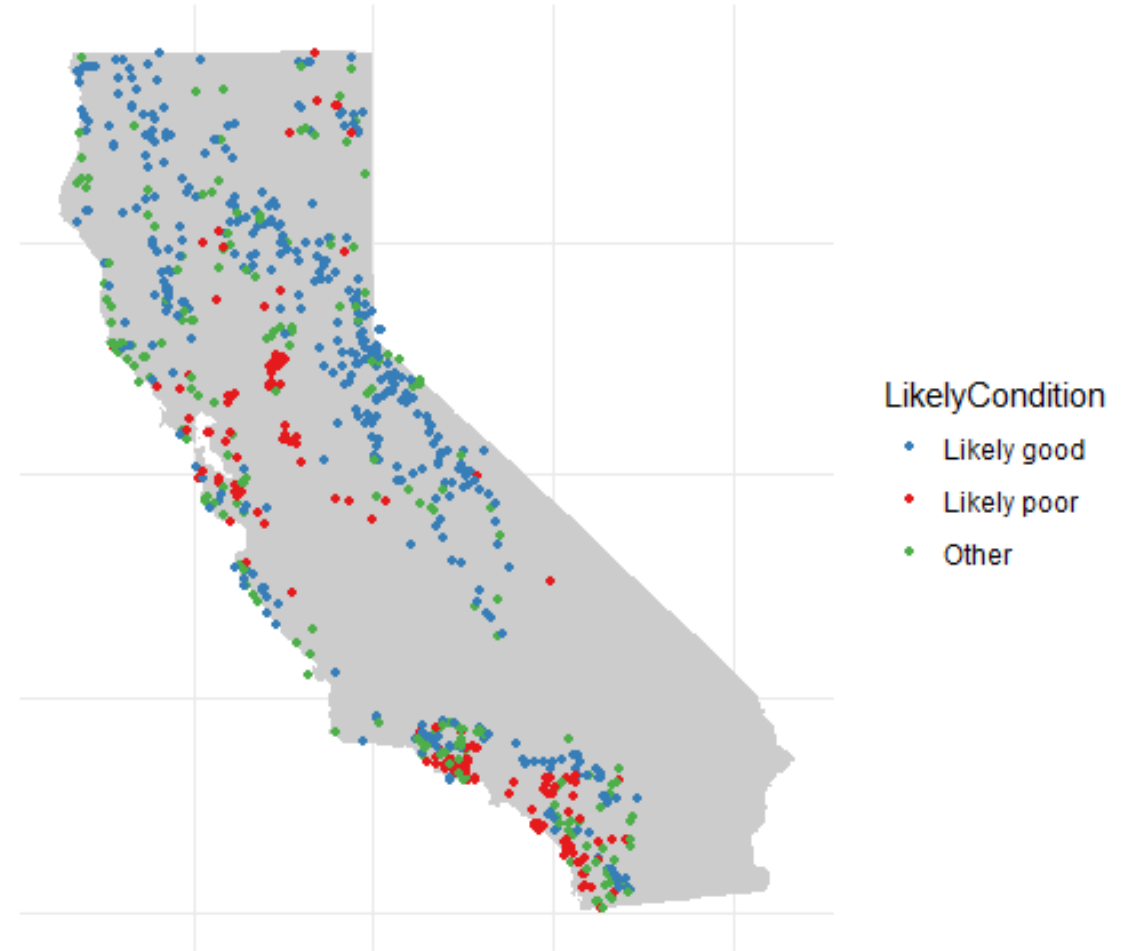
(in interim, we'll use thresholds based on reference distributions)

## Species-level responses

- Thresholds derived for species responses may be more protective than those derived for indices, but links to beneficial uses less clear.
- May support diagnosis and causal assessment of eutrophication impacts.

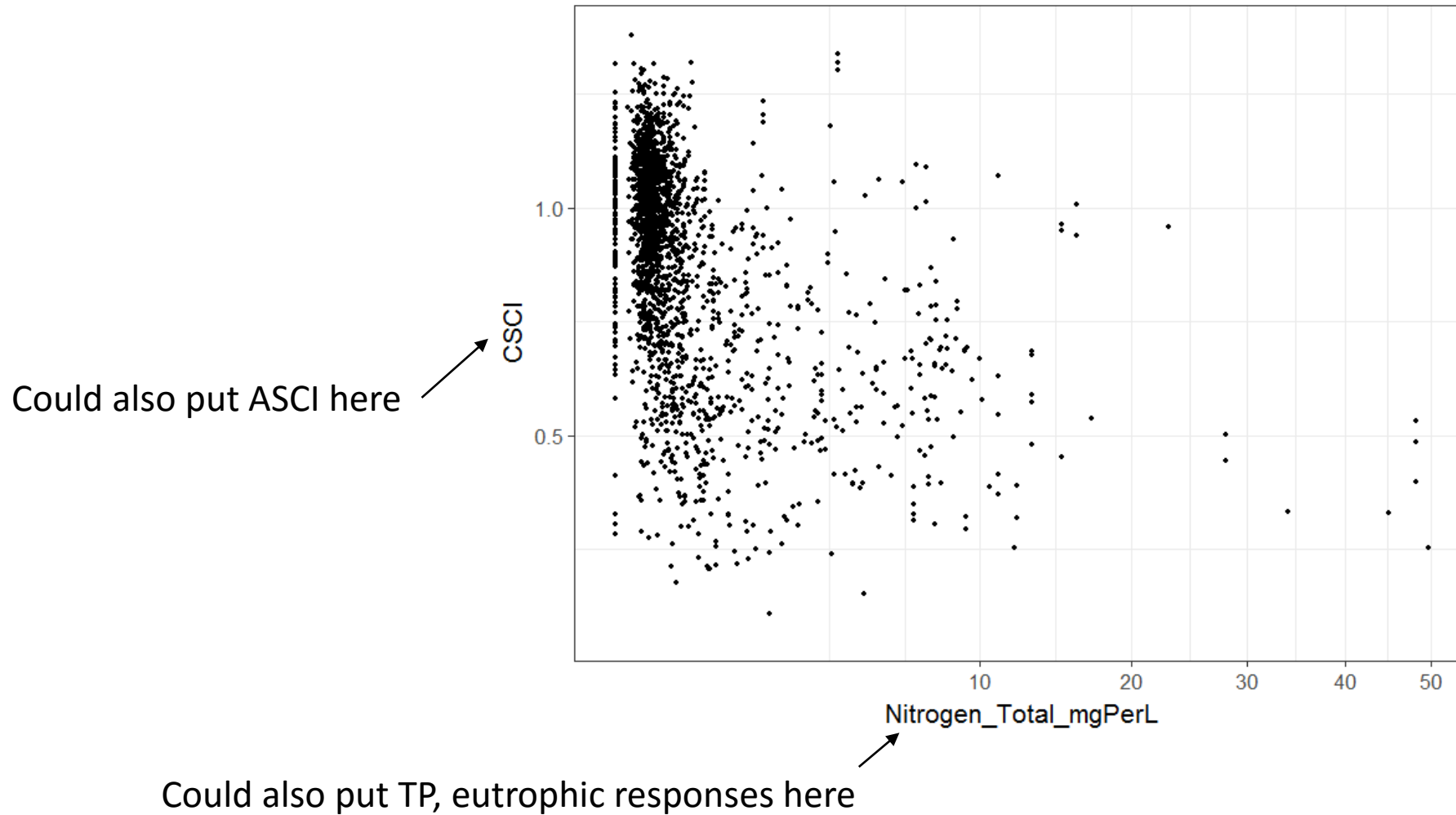
# How is our data set?

- Samples statewide collected since mid 1990s (most since 2008)
- Good representation of high-scoring sites across most regions
  - Sites in poor condition mostly in South Coast, Central Valley, Bay Area

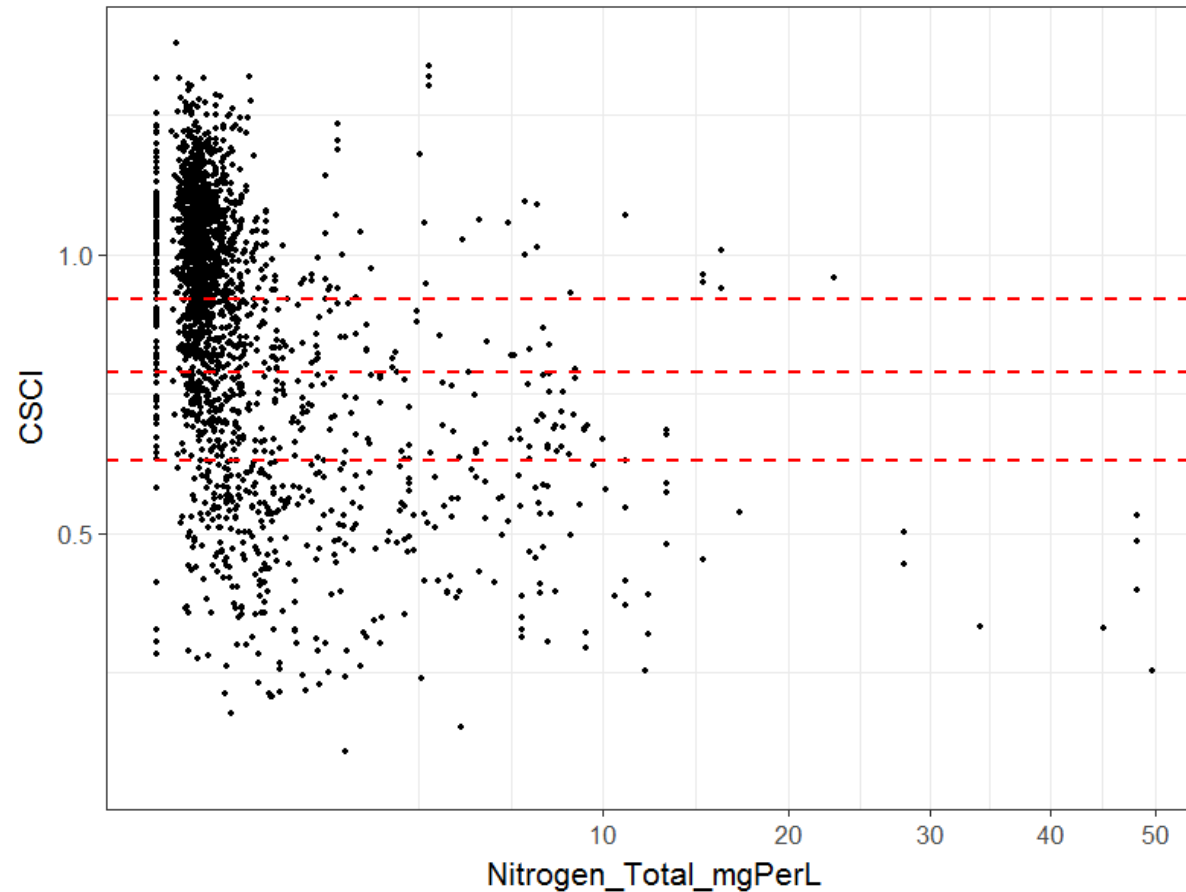


Region	Likely biological condition		
	Good	Poor	Other
North Coast	84	4	40
Chaparral	72	30	58
South Coast	70	124	94
Central Valley	3	33	8
Sierra Nevada	164	3	34
Deserts and Modoc	39	10	26

# Models let us link bio-integrity to bio-stimulation



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BCG bin 1/2

BCG bin 3

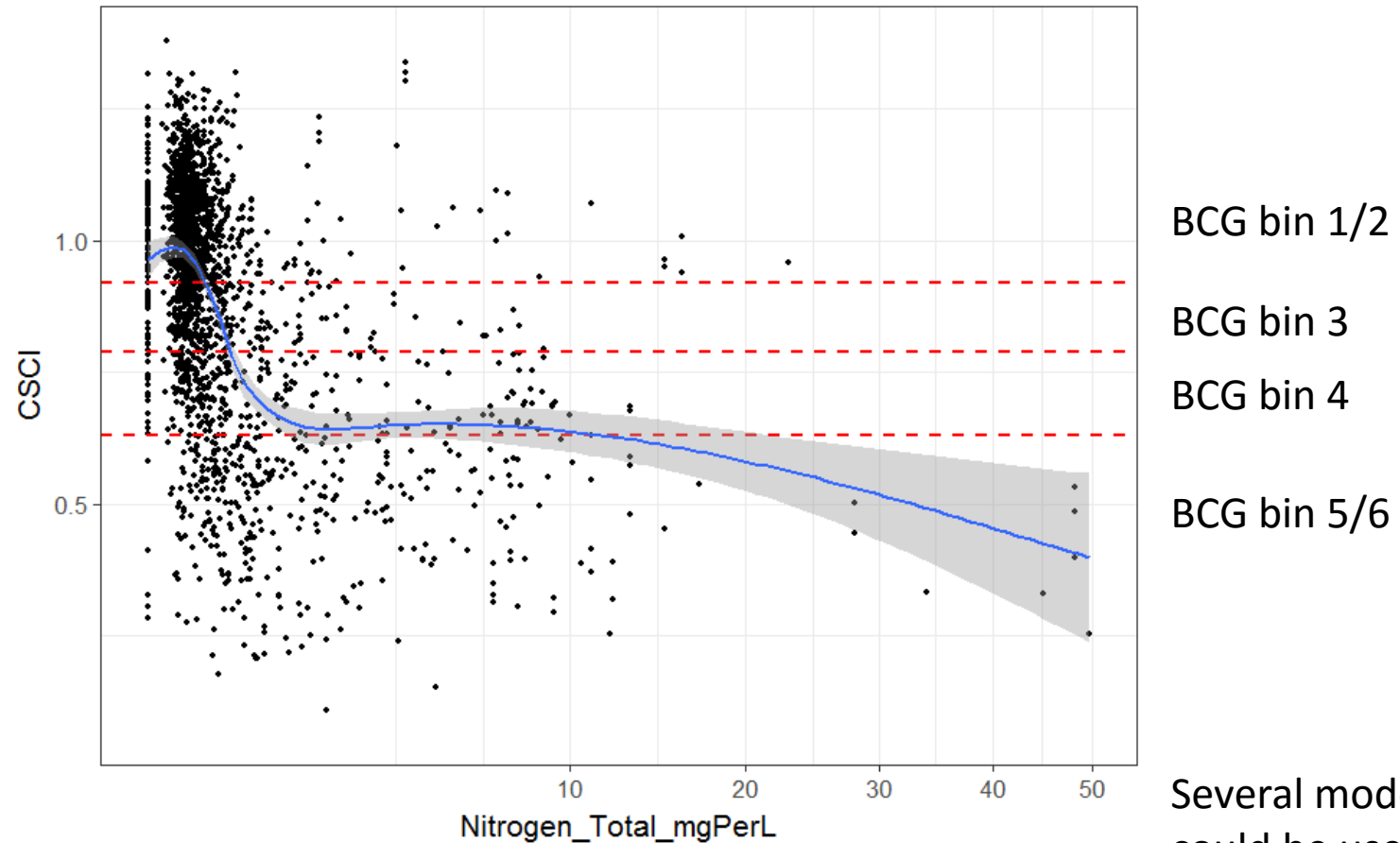
BCG bin 4

BCG bin 5/6

Thresholds derived through expert panel process. WB selects bins where protection is a priority.

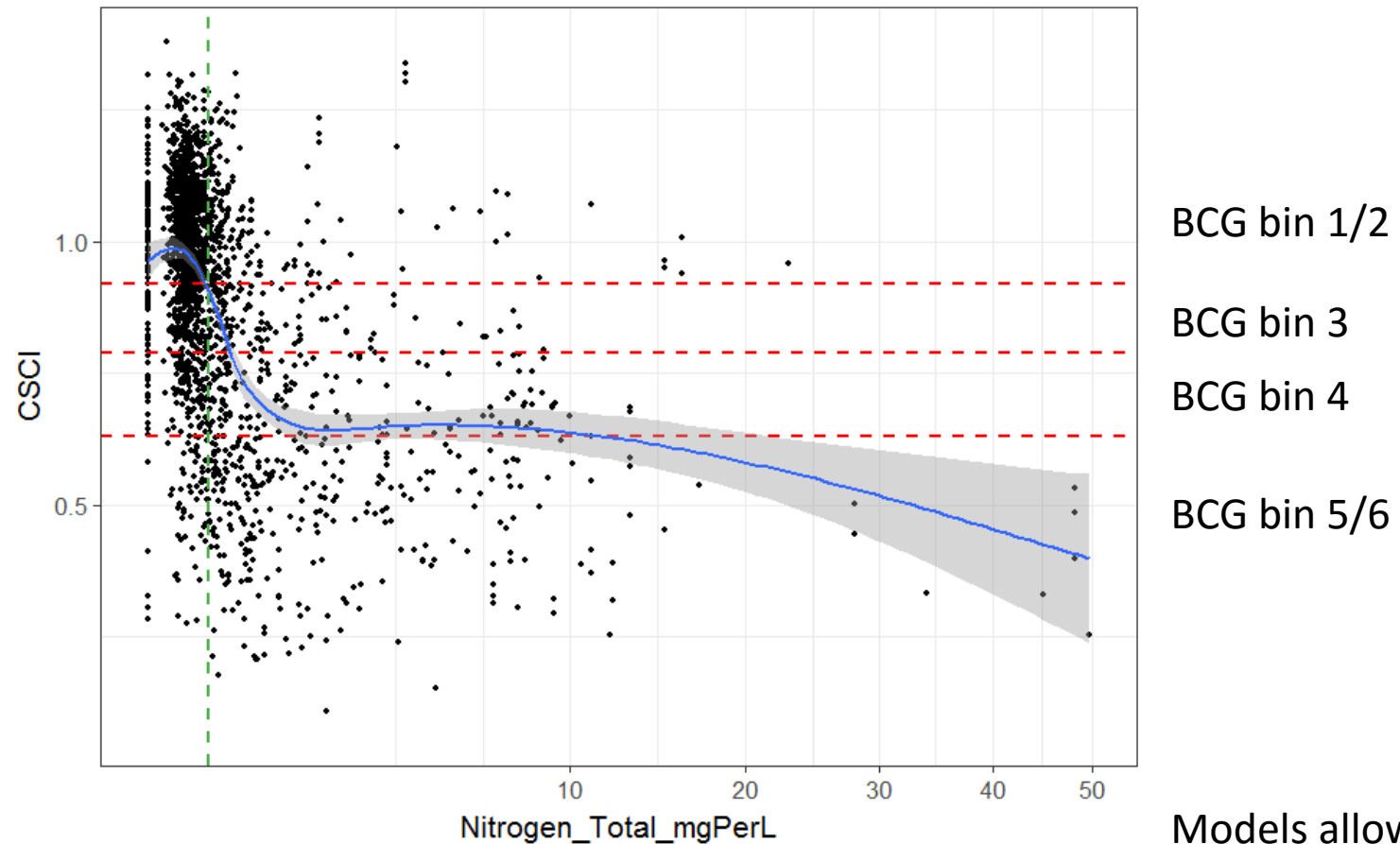


# Models let us link bio-integrity to bio-stimulation



Several modeling approaches could be used to draw this line.

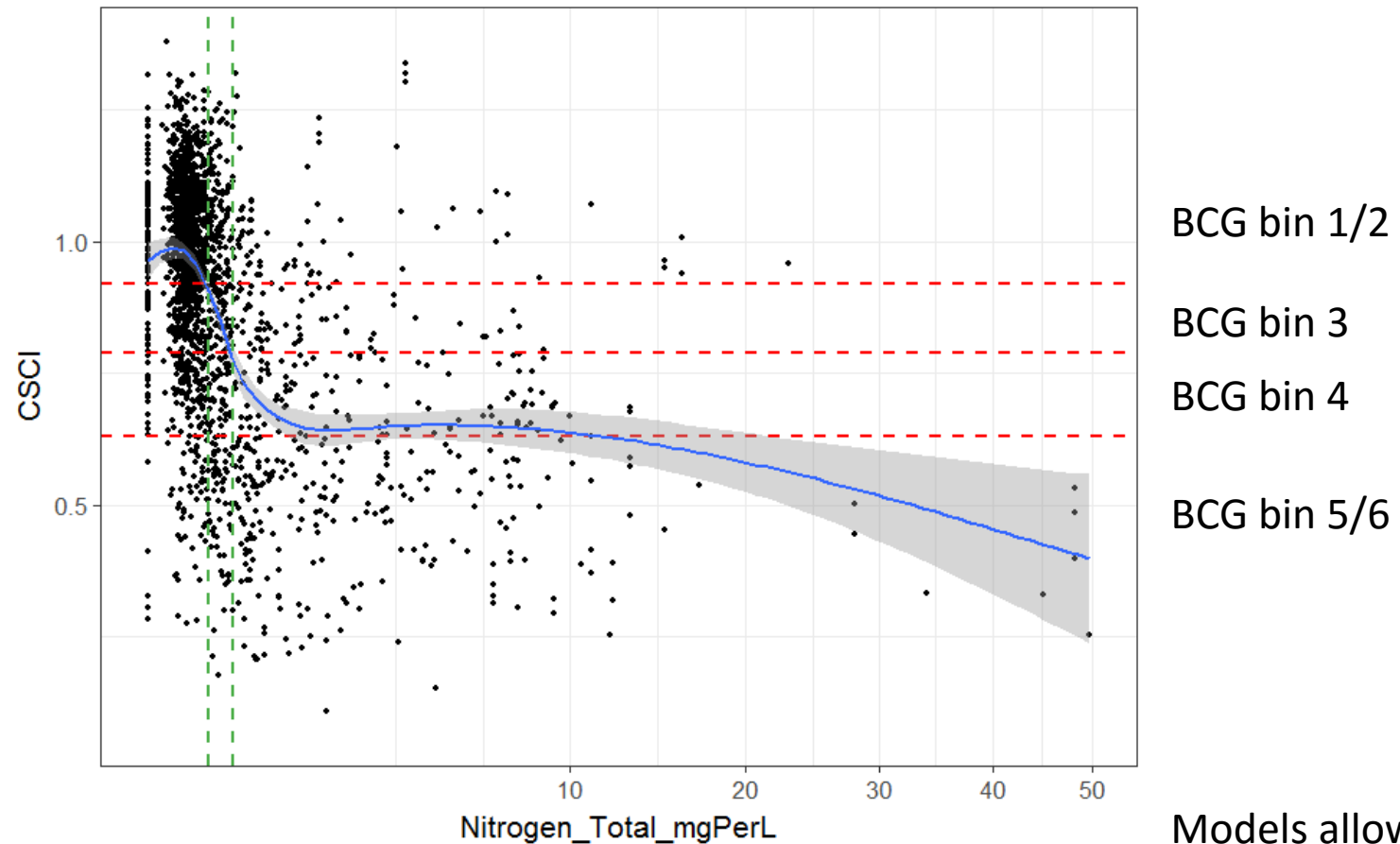
# Models let us link bio-integrity to bio-stimulation



TN<0.2  
50% of being in BCG 1/2 or better

Models allow us to identify  
numeric values associated with  
each bin

# Models let us link bio-integrity to bio-stimulation

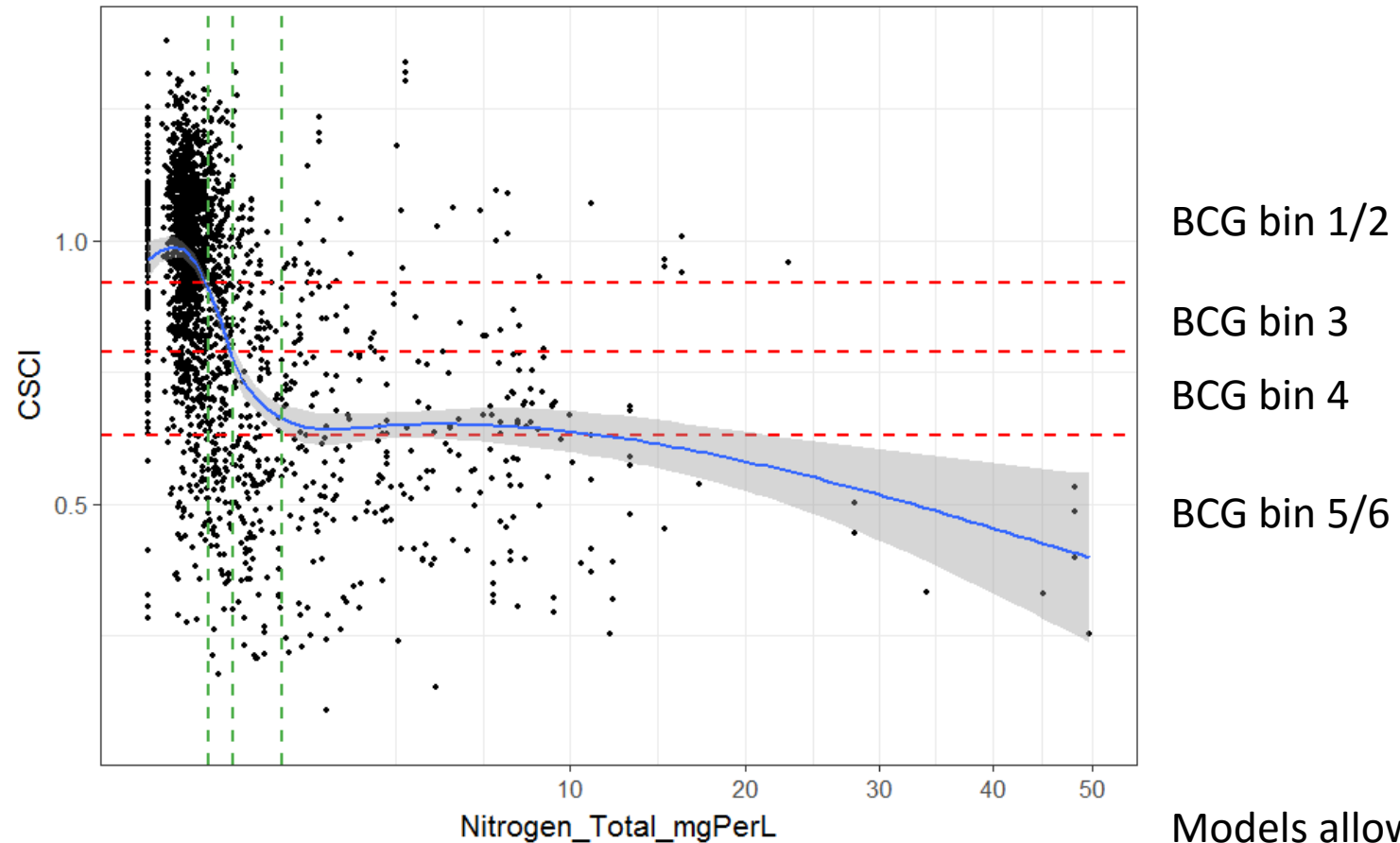


TN < 0.4  
50% of being in BCG 3 or better

BCG bin 1/2  
BCG bin 3  
BCG bin 4  
BCG bin 5/6

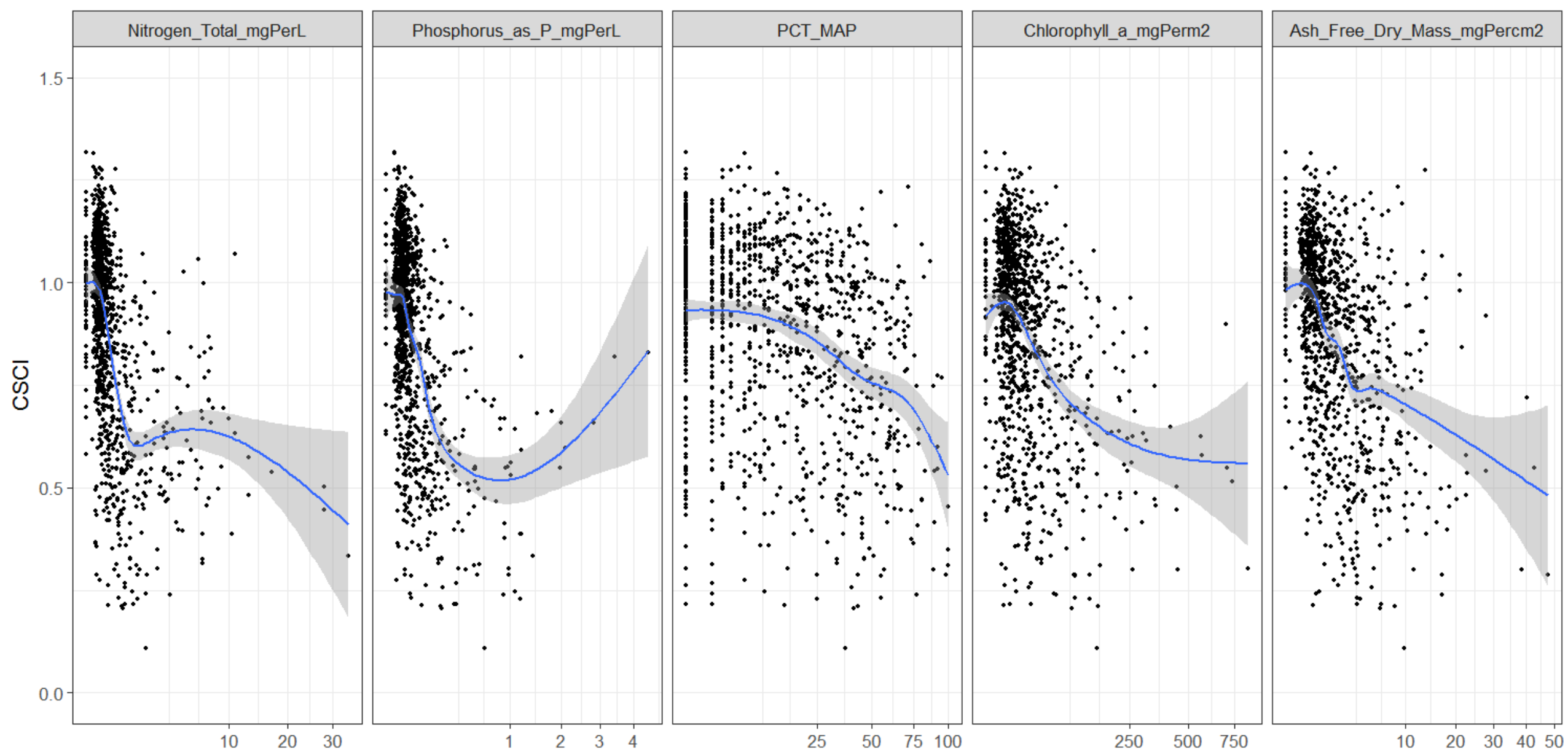
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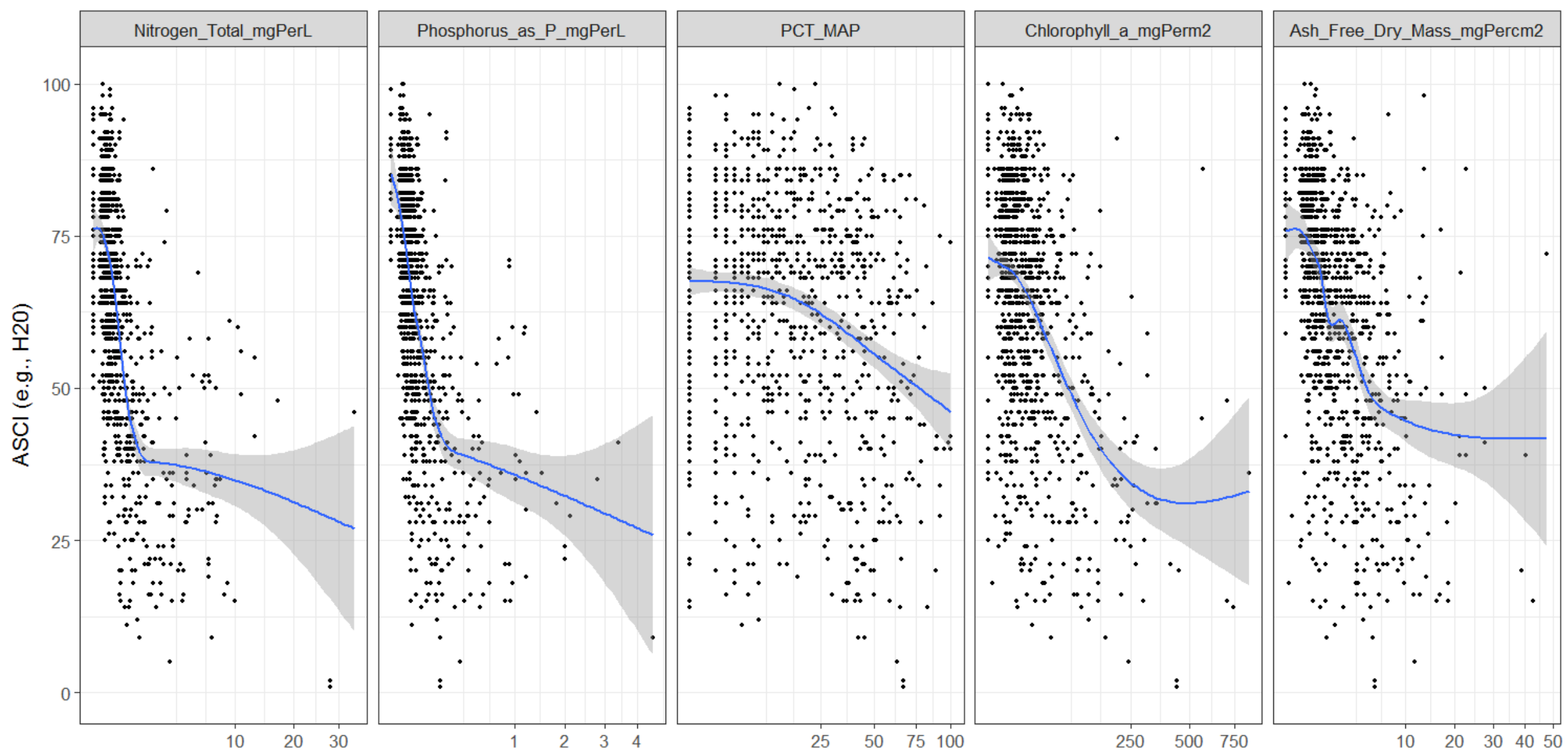


TN<1  
50% of being in BCG 4 or better

Models allow us to identify  
numeric values associated with  
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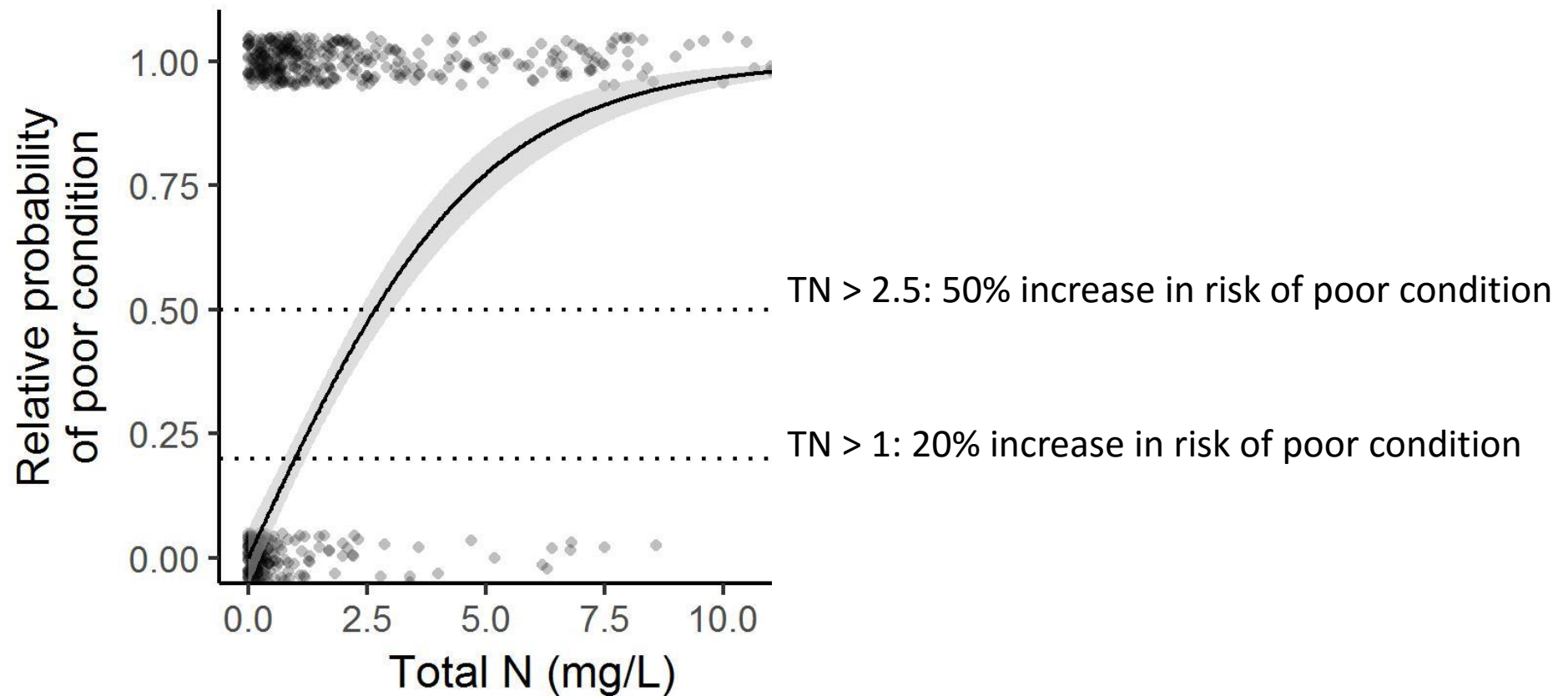


Most of the “action” is at fairly low concentrations.



Algae likely to show a similar pattern.

# Models allow us to explore different levels of risk tolerance

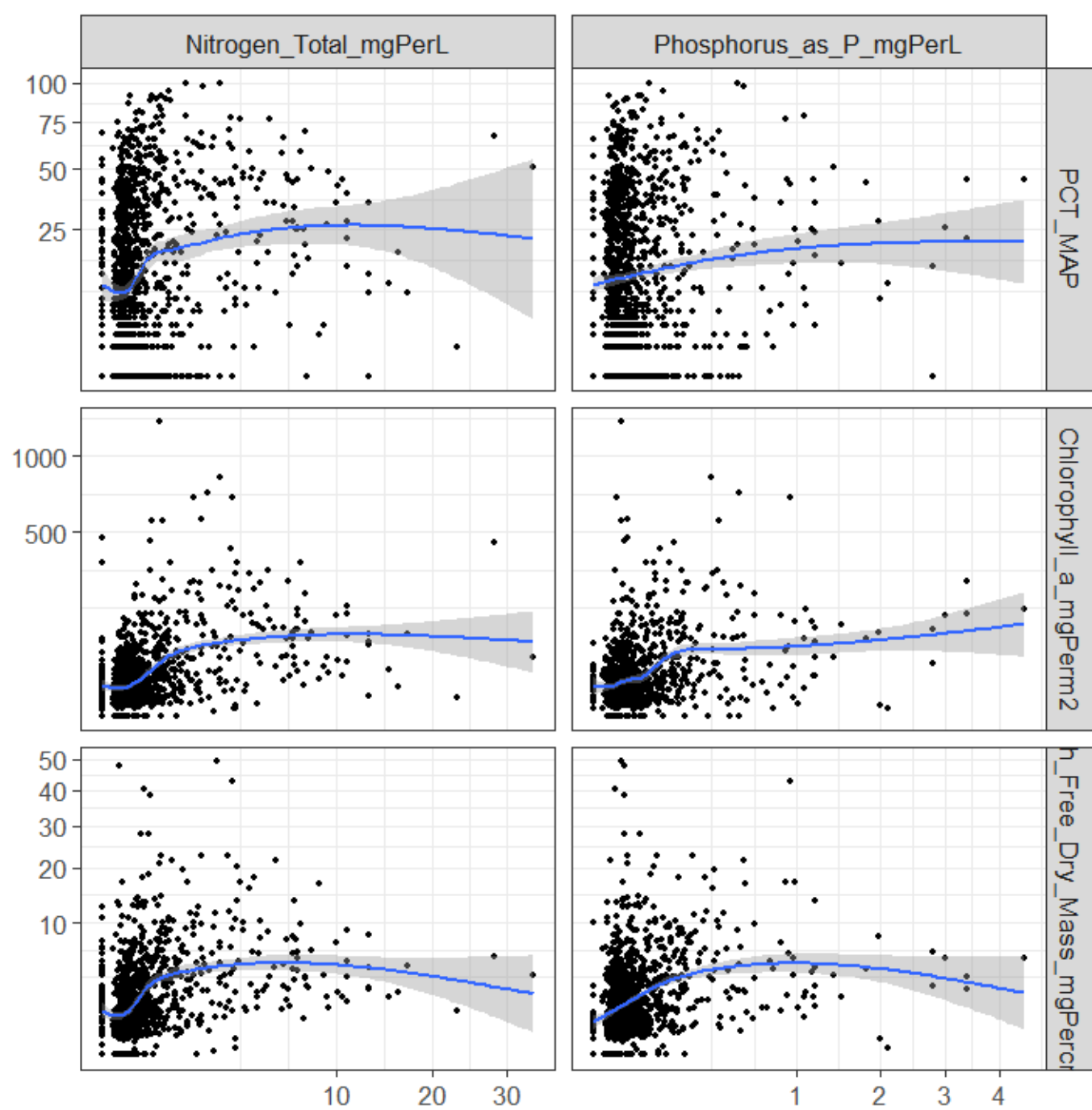


# Considerations in developing a model

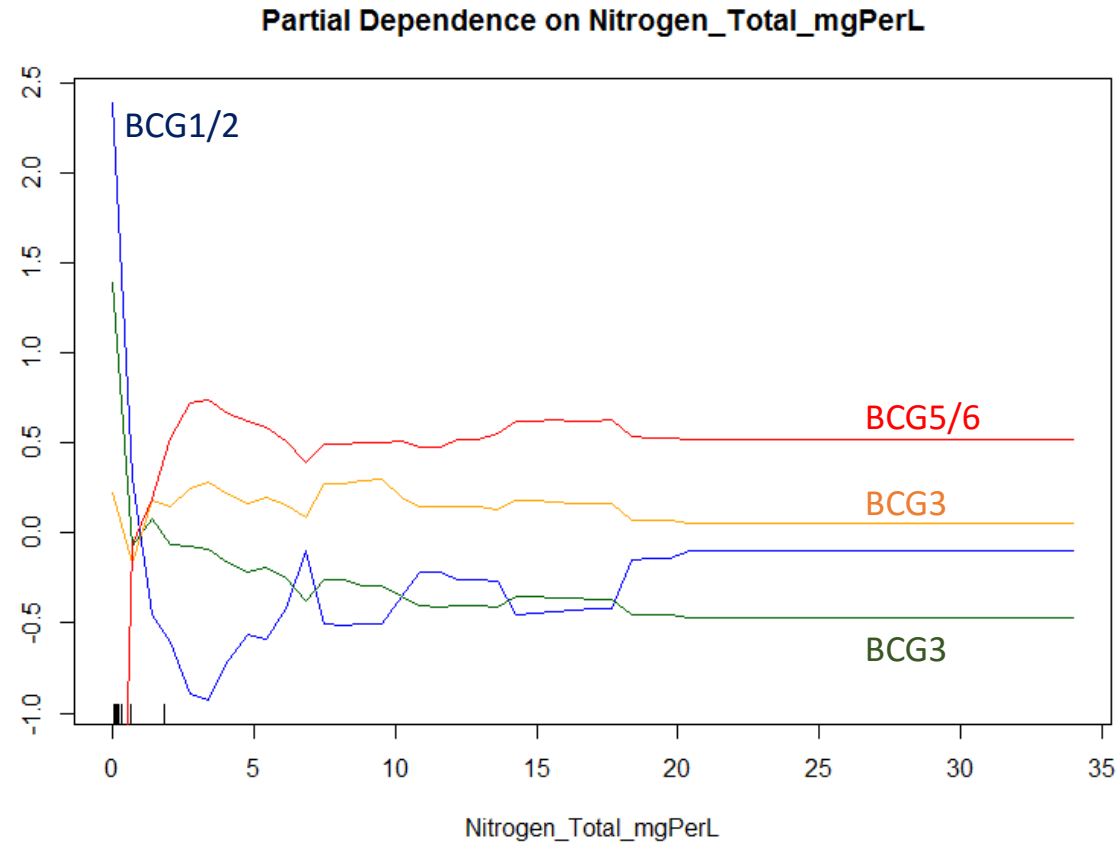
- Several types of models may be suitable (e.g., logistic regression, random forest, etc.)—what works well, in the panel’s experience?
- Broad-scale applicability: Statistical models vs. “watershed approach”
- Probabilistic: What levels of nutrients/OM have an acceptably low probability of poor CSCI/ASCI scores?
- Interactions: Can you account for interacting effects of two or more biostimulatory stressors?
- Site-specificity: Are certain sites more responsive/resilient to nutrient inputs than others?
- Confounding: Can you disentangle biostimulation from habitat degradation or other stressors that affect bio-integrity?



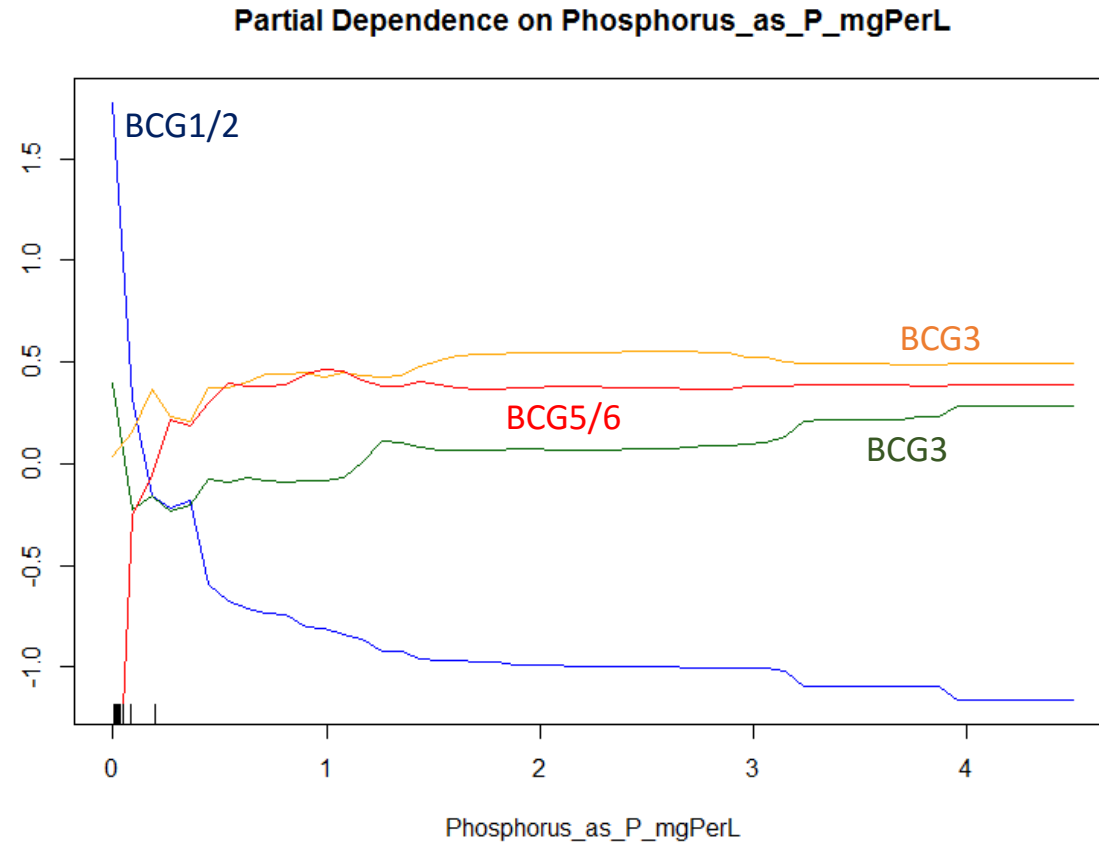
# QUESTIONS



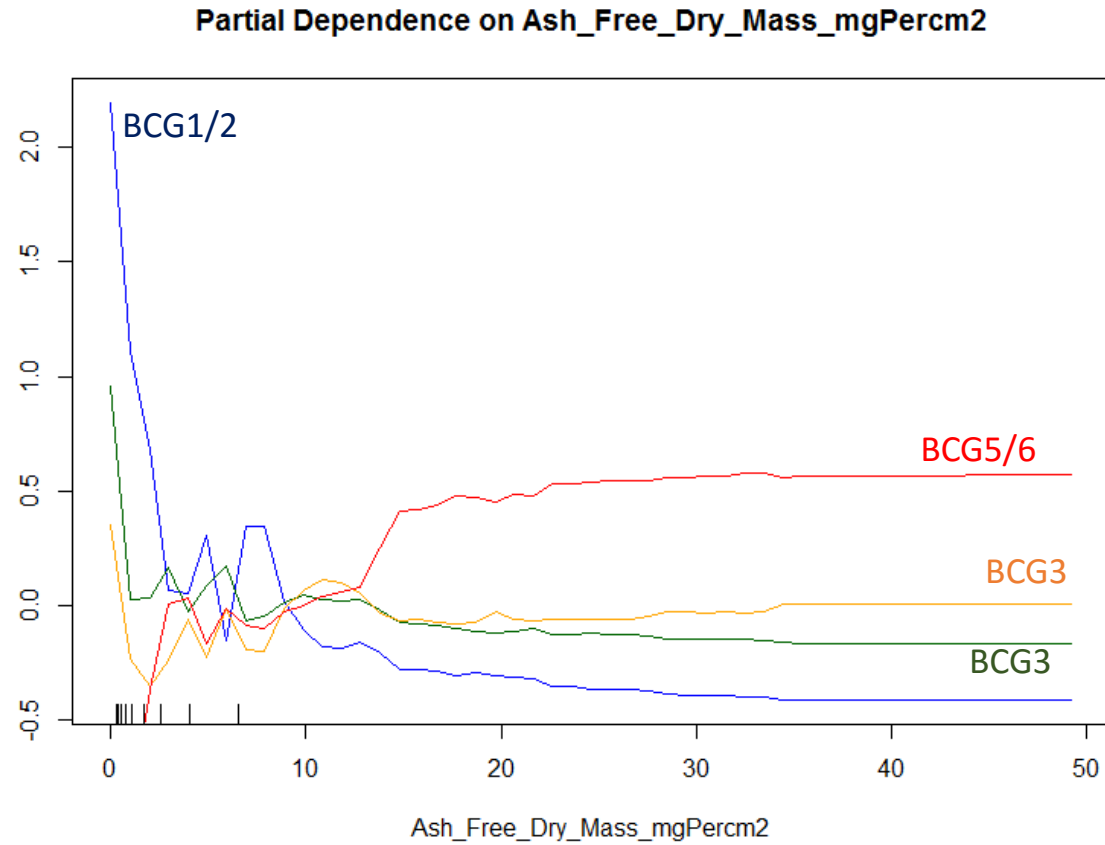
# Partial dependence plots



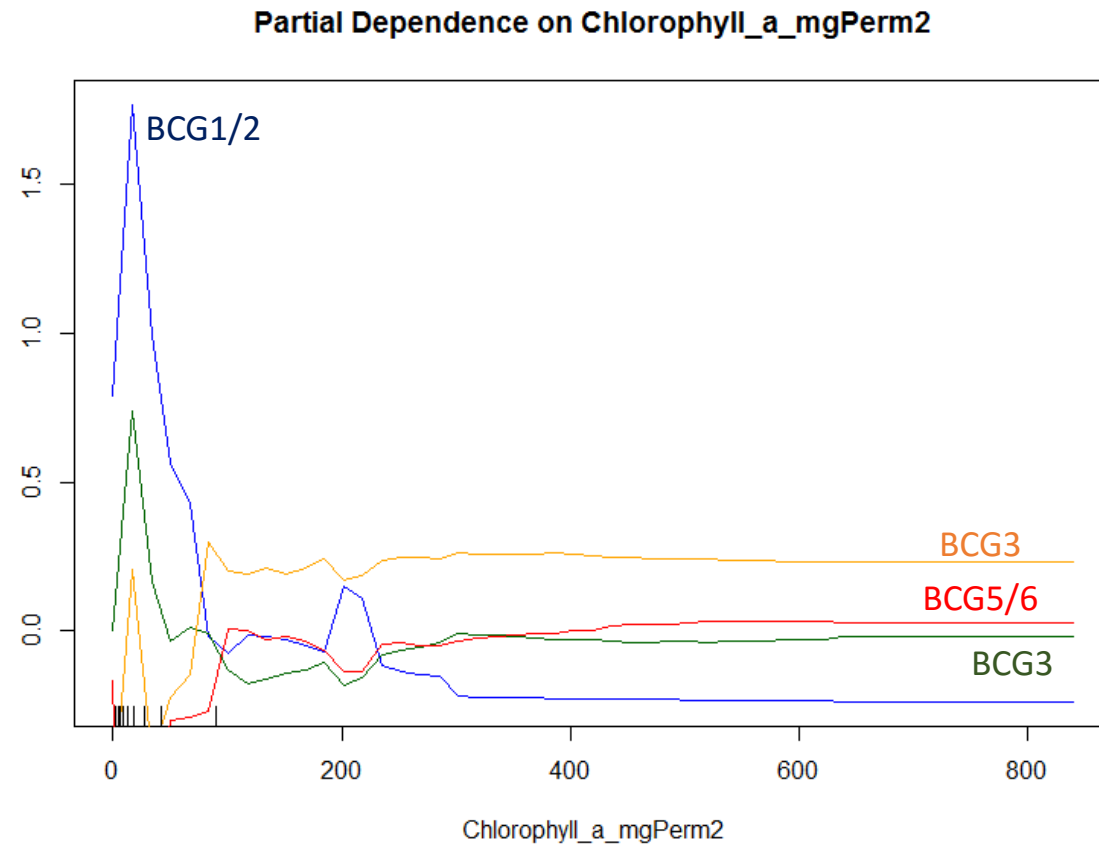
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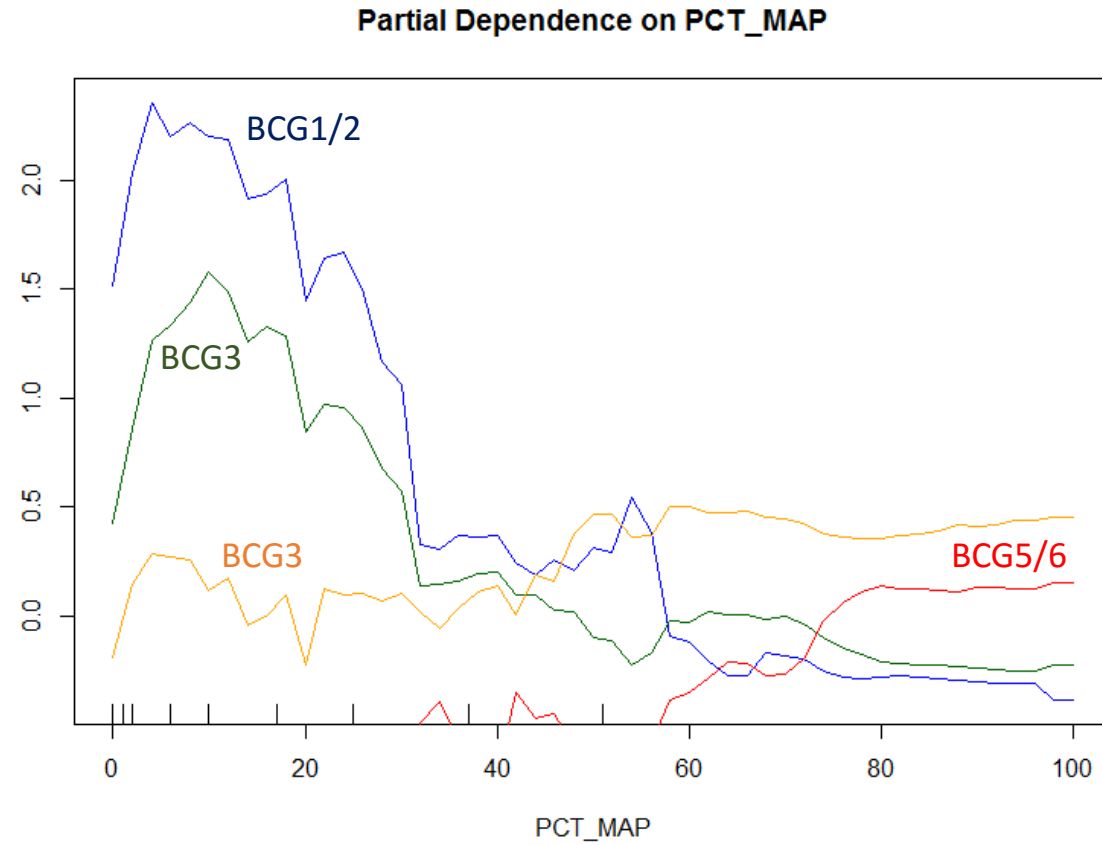
# Partial dependence plots



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# Partial dependence plots



# RF model: BCG~Nutrients + organic matter

- Error rate: 38.15%

		Predicted class			
		BCG12	BCG3	BCG4	BCG56
True class	BCG12	531	29	16	19
	BCG3	119	26	23	26
	BCG4	73	16	30	49
	BCG56	46	9	21	136



