Effects of Wetland Plant Communities on Denitrification Rates: A Meta-Analysis

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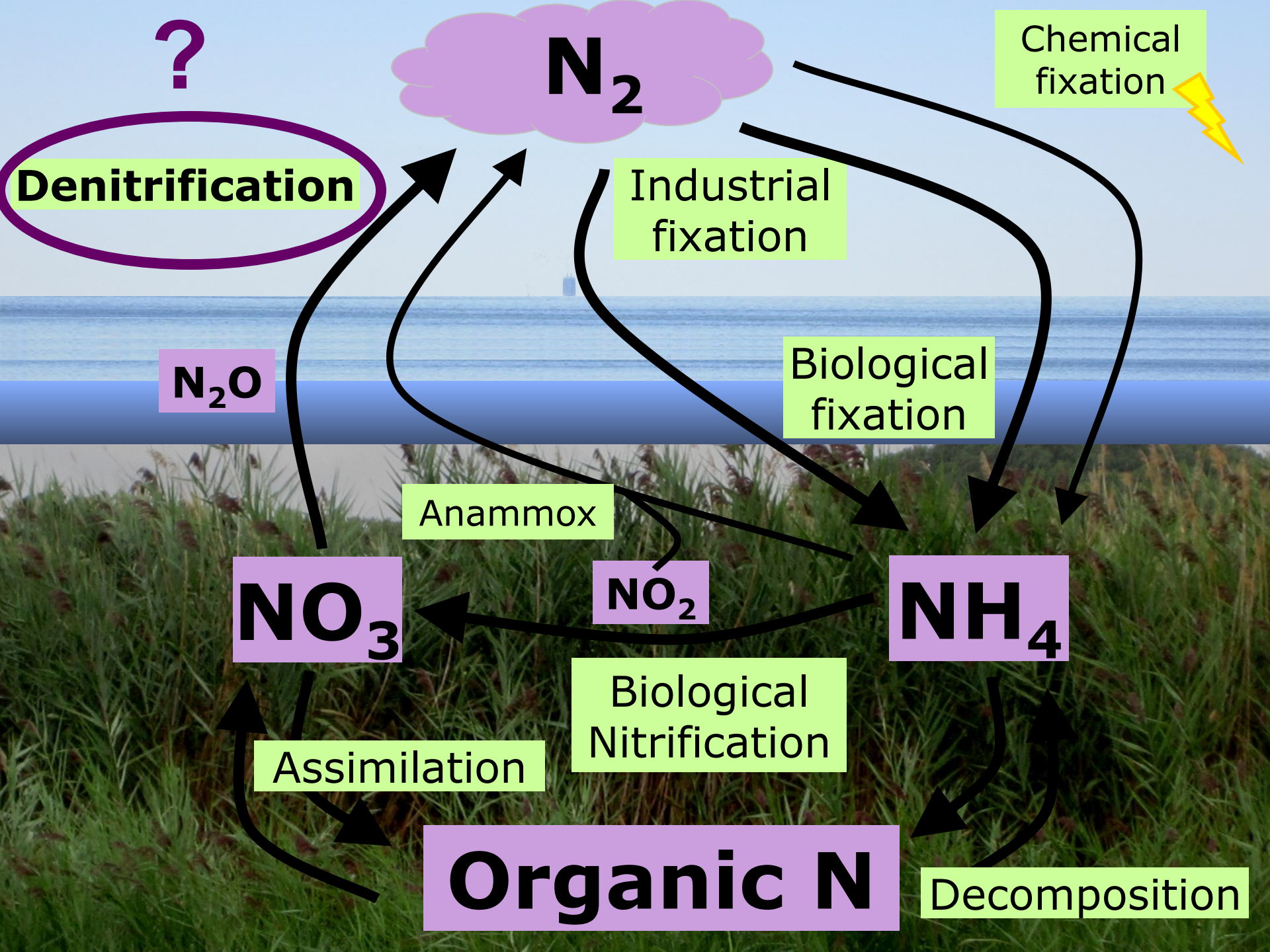
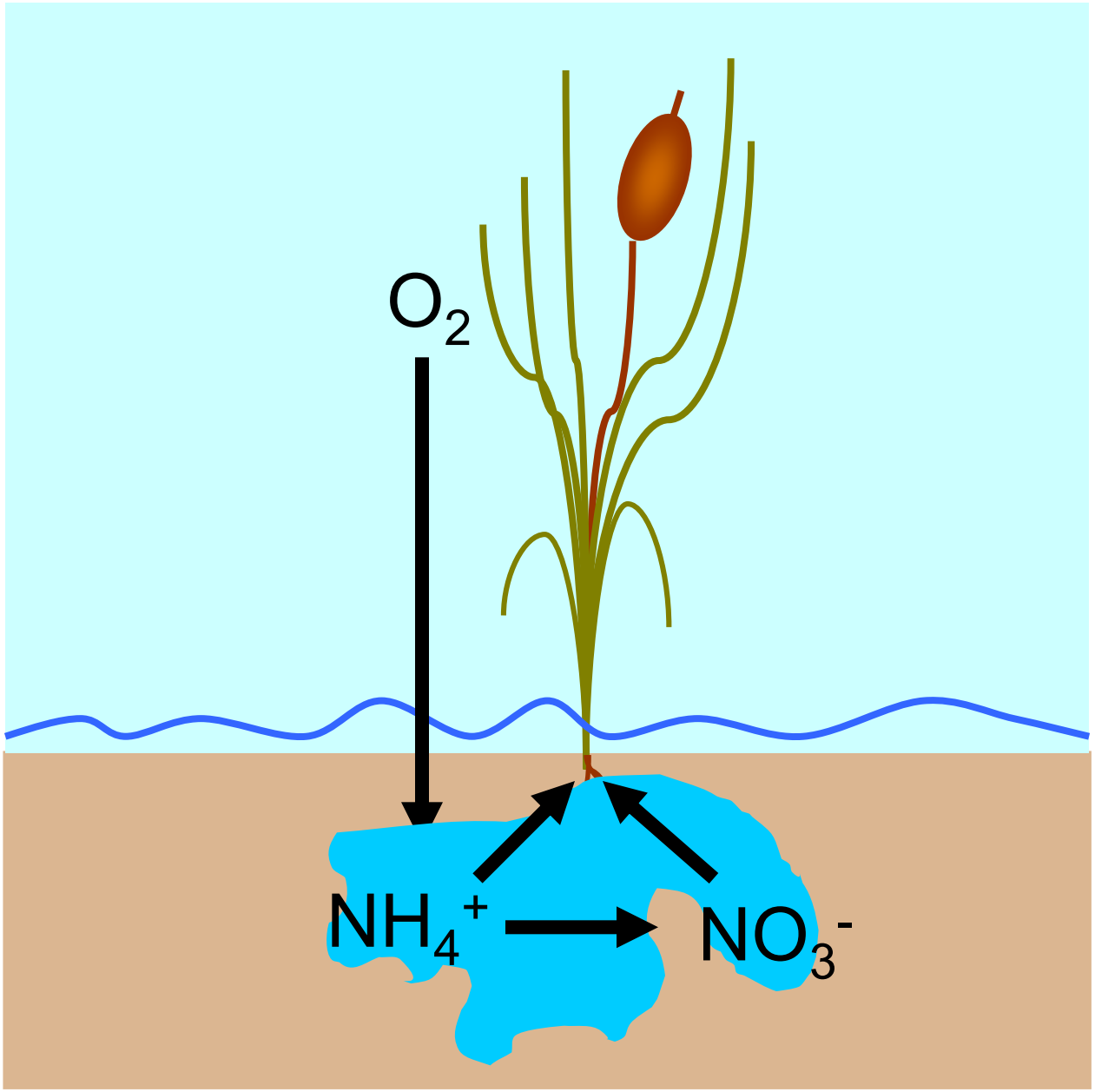
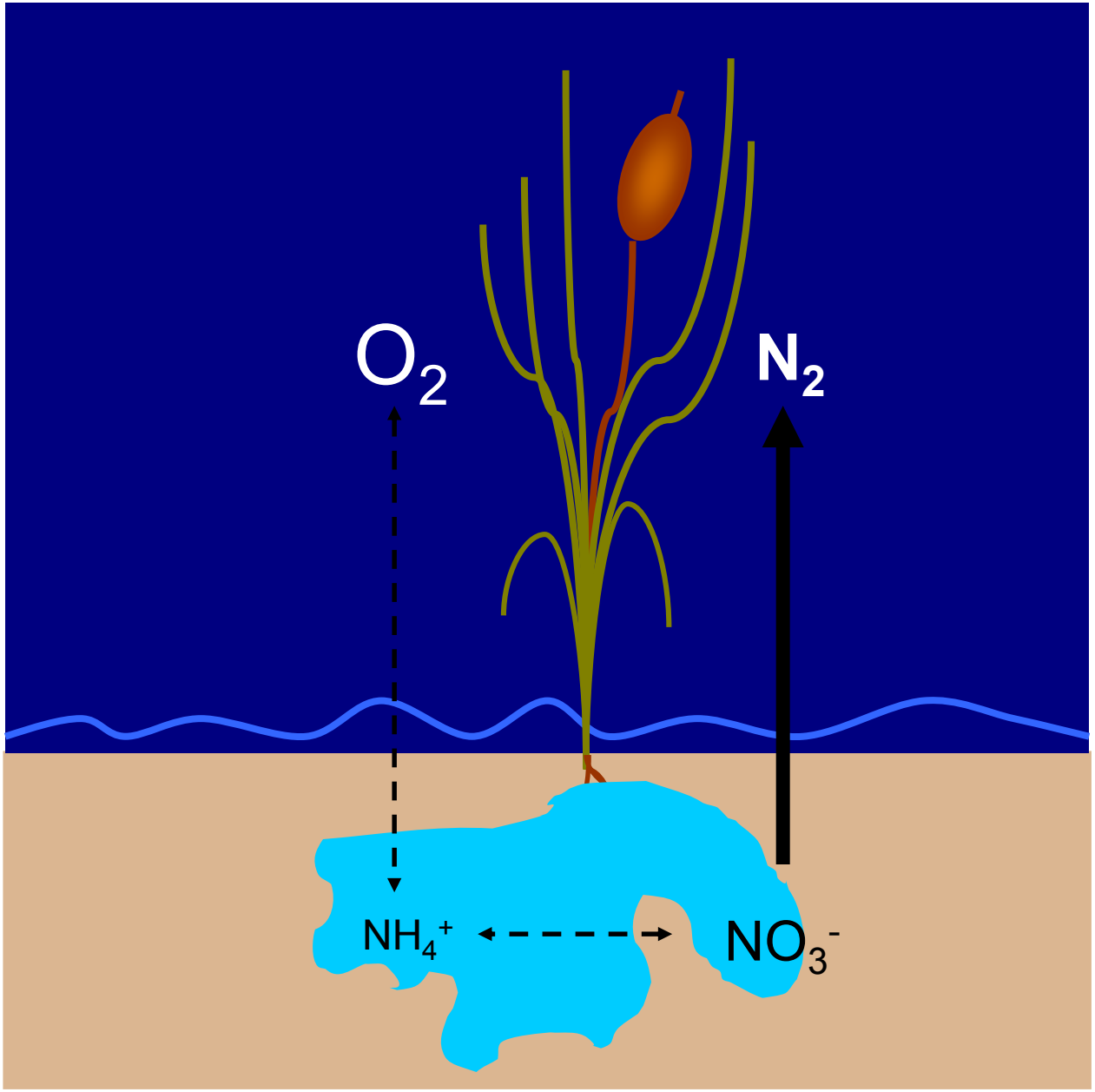

?
N_2
Chemical fixation
Denitrification
Industrial fixation
N_2O
Biological fixation
Anammox
NO_3
NO_2
NH_4
Biological Nitrification
Assimilation
Organic N
Decomposition


O_2
NH_4^+
NO_3^-


O_2
N_2
NH_4^+
NO_3^-

Denitrification?

Physical Variables?

Nitrogen Inputs

Organic Content

Hydrology / Redox

Majority of Research

Vegetation or No Vegetation?

Identity of Plant Community?

Dominant Species?

Our Analysis

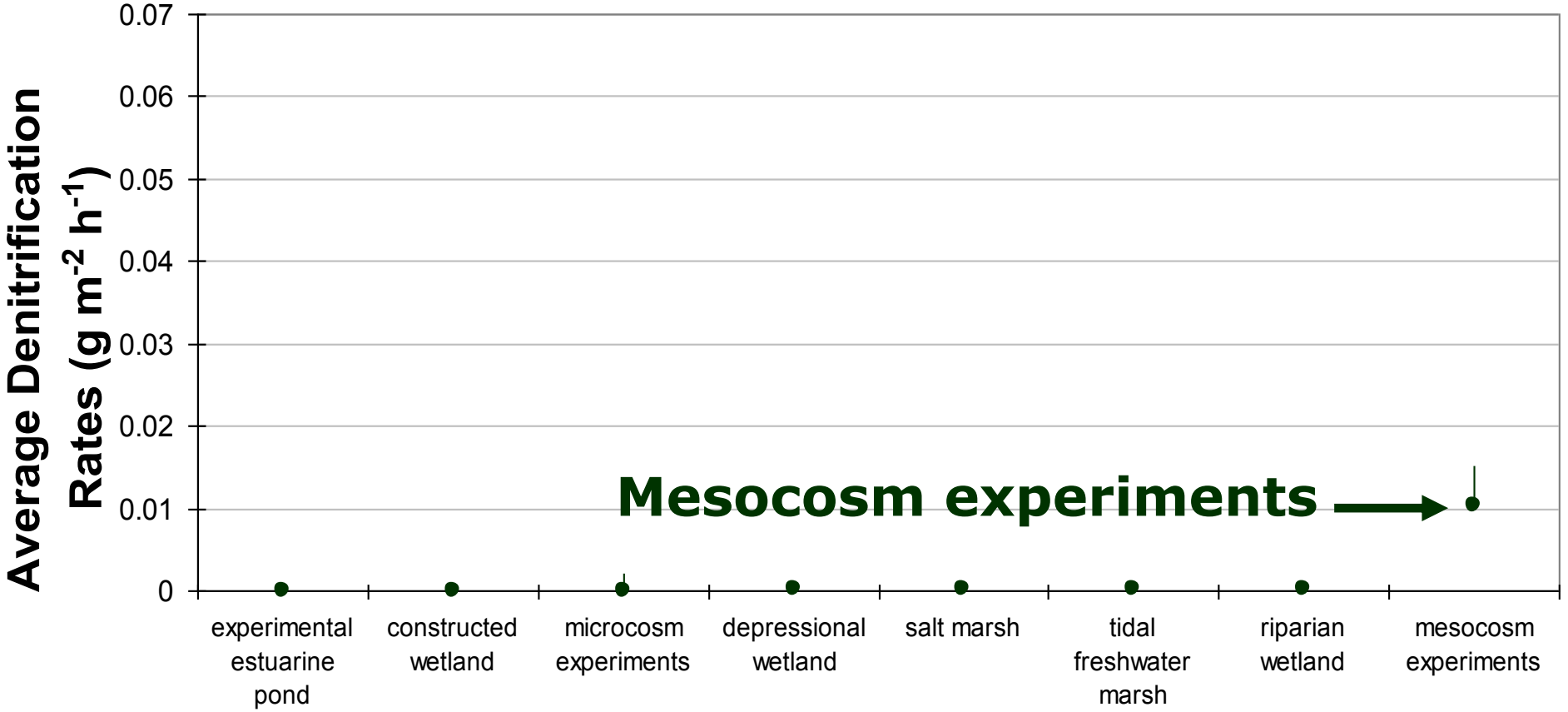
Systematic Review and Meta-Analysis

Systematically reviewed all literature using keywords "**denitrification**," "**plant**," and "**wetland**"

- Included all studies which measured denitrification rates within a **clearly defined plant community**
- Excluded studies that did not report **error** and **sample size**

Questions

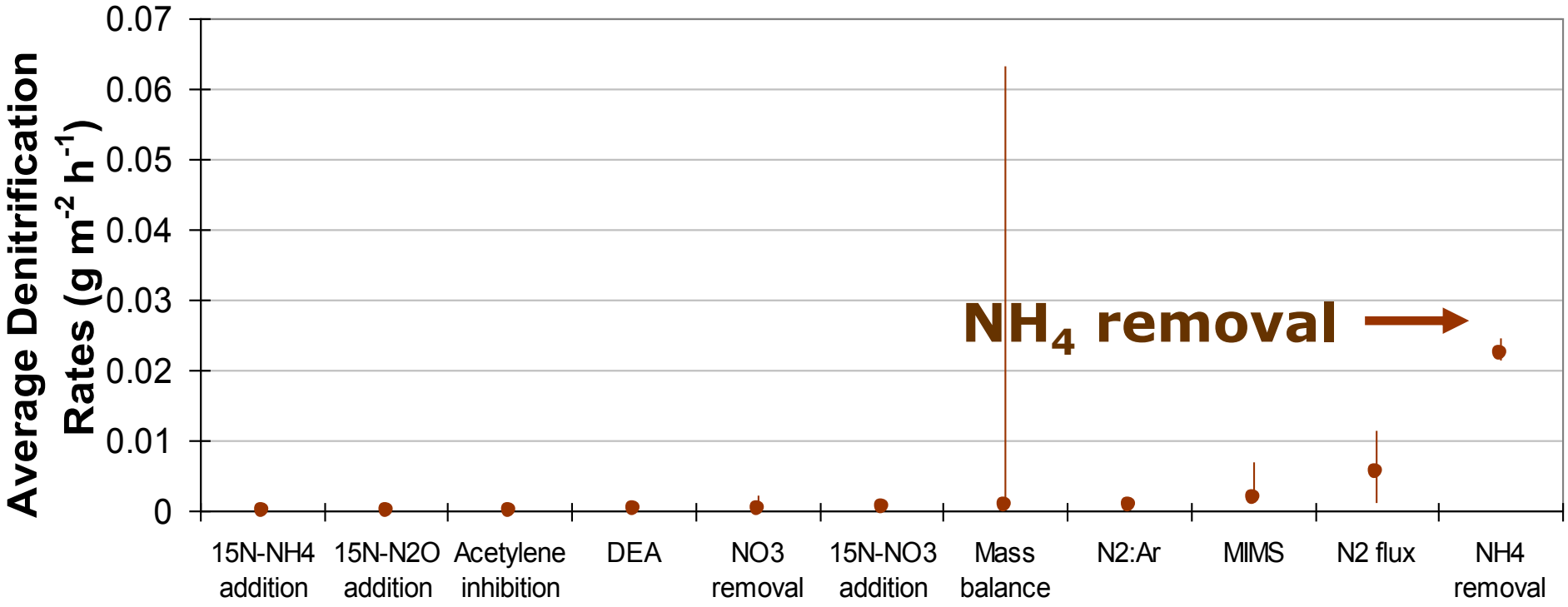
1. Do denitrification rates differ among **plant communities**?
   - Among methods?
   - Among wetland systems?
2. What if we **control for geophysical differences**?
3. Is there a general "**effect of vegetation**"?



Wetland System

p = 0.004

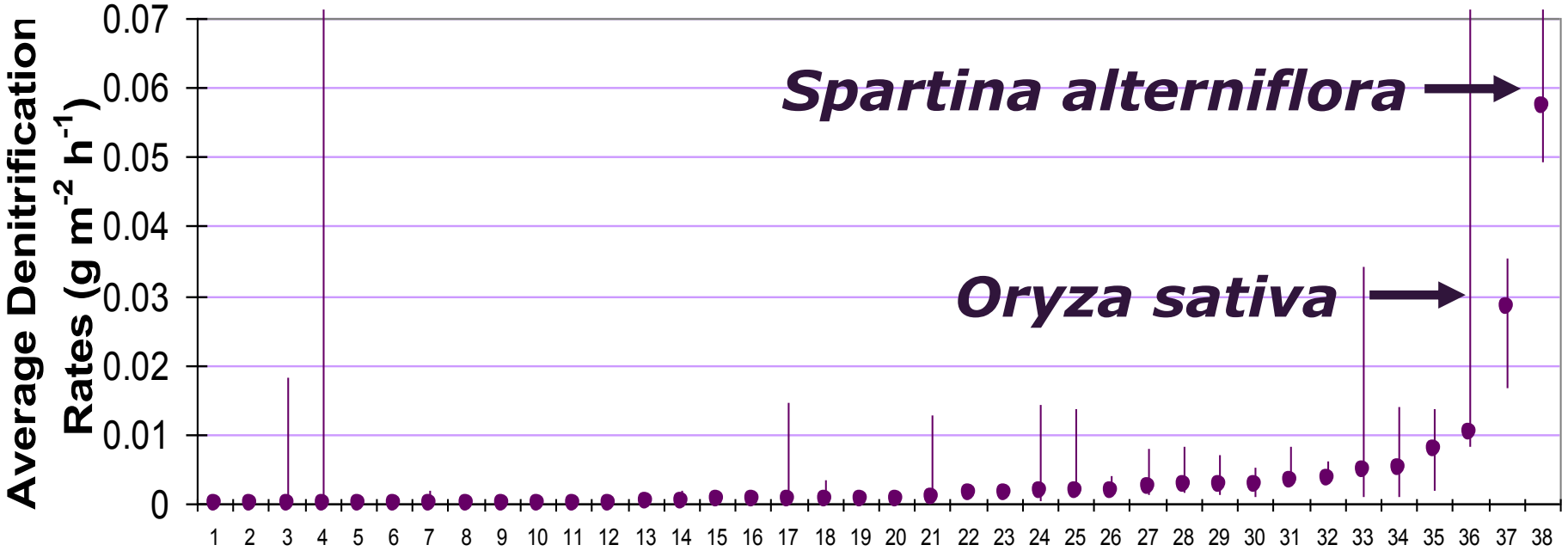
14% of total variation explained



Denitrification Measurement Method

p = 0.041

8% of total variation explained



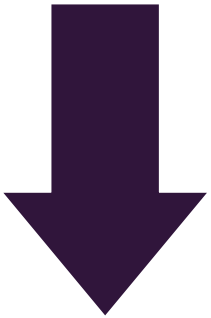
Plant Community

(Dominant Species)

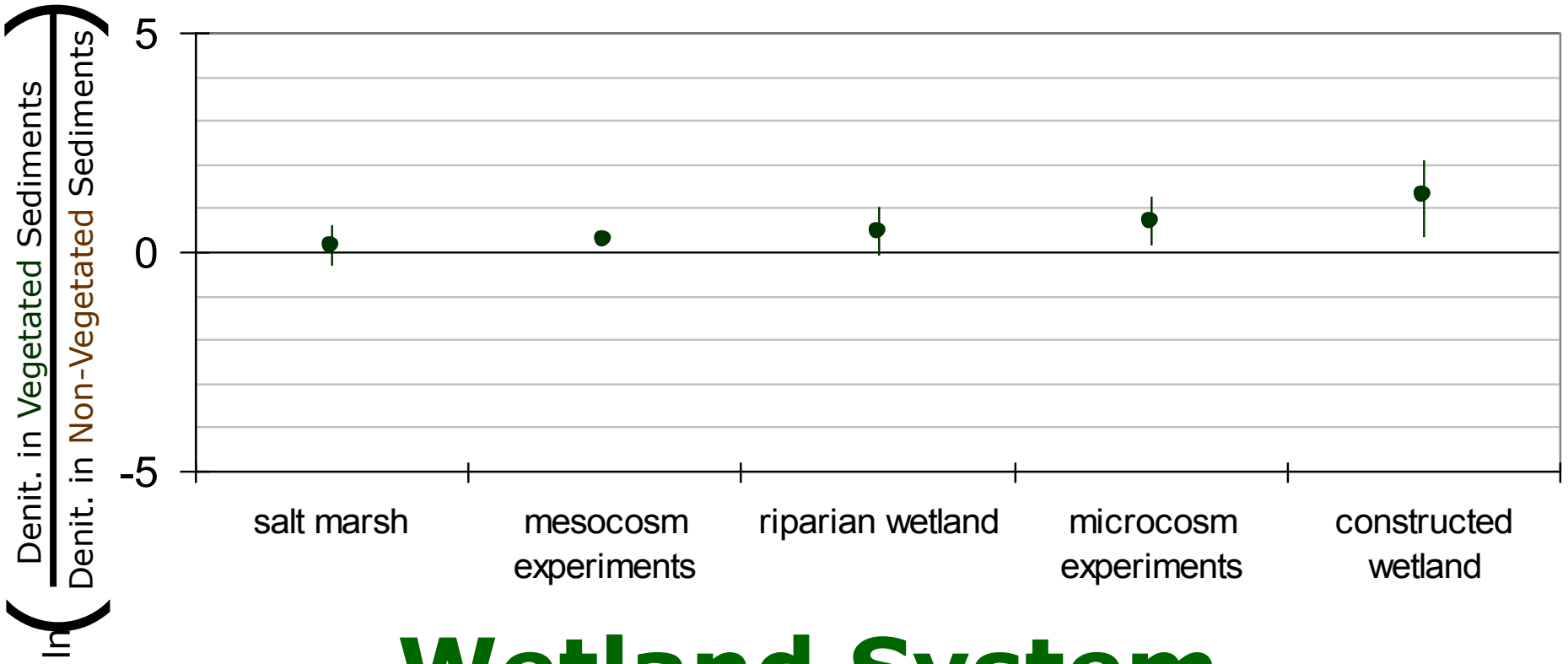
p = 0.004

28% of total variation explained

$$\ln\left(\frac{\text{Denitrification in } \mathbf{Vegetated} \text{ Sediments}}{\text{Denit. in } \mathbf{Non\text{-}Vegetated} \text{ Sediments}}\right)$$



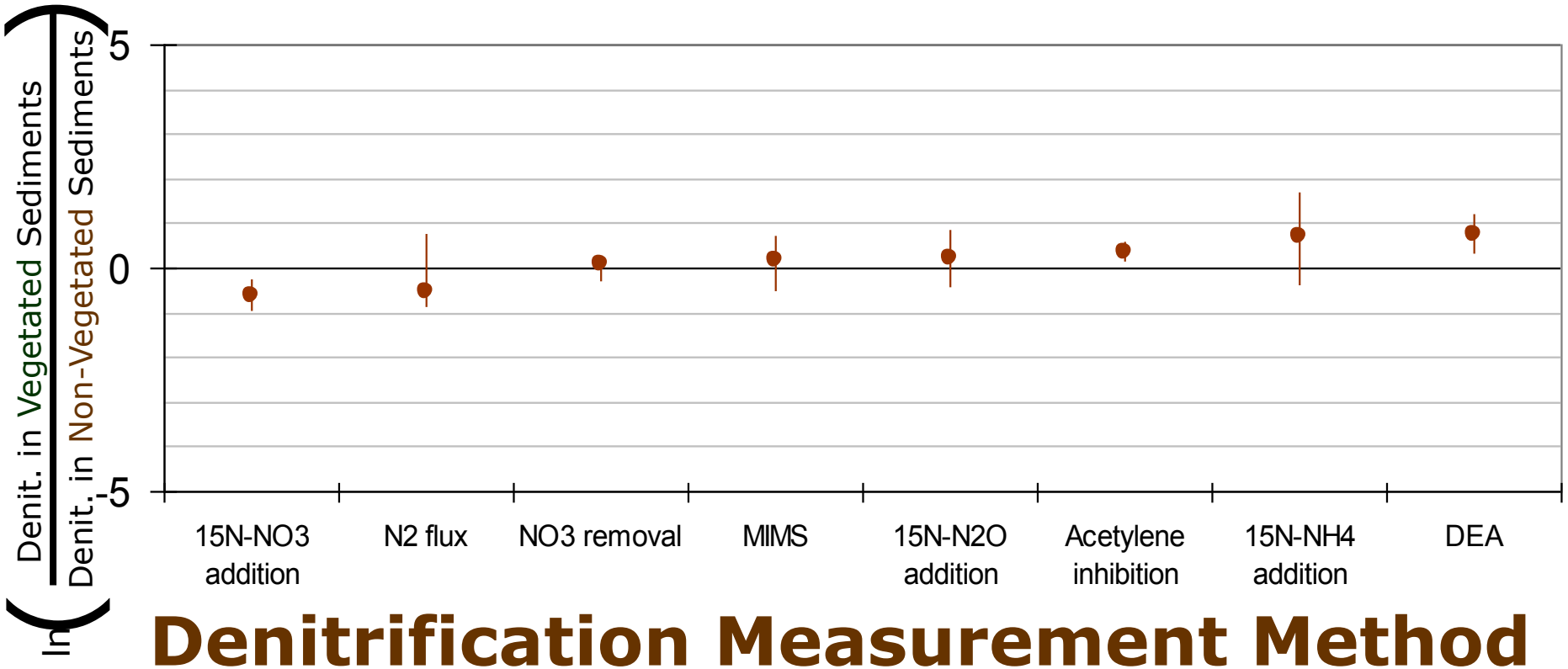
"**Effect of vegetation**"
relative to non-vegetation



Wetland System

p = 0.187

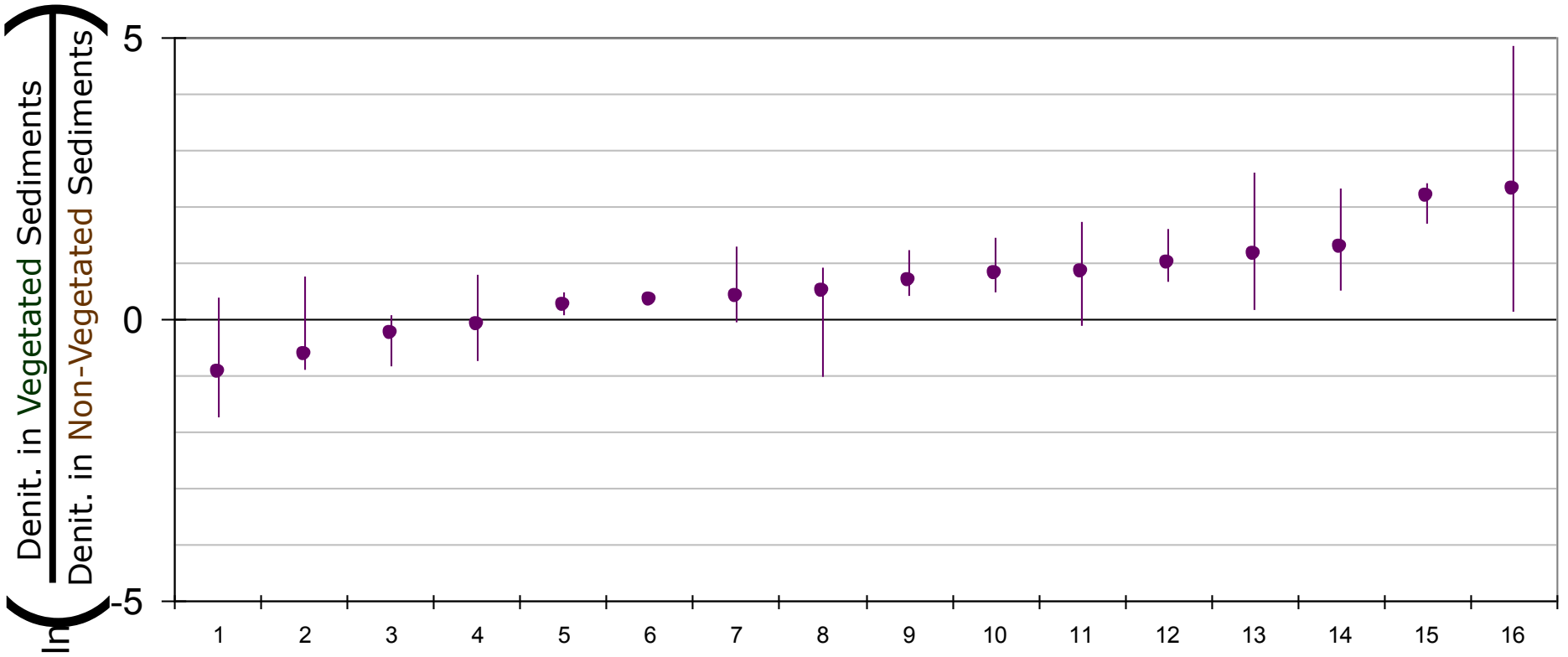
<10% of total variation explained



Denitrification Measurement Method

p = 0.284

14% of total variation explained



Plant Community

p = 0.04

38% of total variation explained

“Effect of Vegetation”?

$$\ln\left(\frac{\text{Denitrification in } \mathbf{Vegetated} \text{ Sediments}}{\text{Denit. in } \mathbf{Non\text{-}Vegetated} \text{ Sediments}}\right)$$

Yes.

On average, vegetation **increases** denitrification

x 1.55

Denitrification?

Physical Variables?

Nitrogen Inputs

Organic Content

Hydrology / Redox

Control for physical variables with "**effect of vegetation**" metric

Vegetation or No Vegetation?

Identity of Plant Community?

Dominant Species?

?

Denitrification?

Vegetation or No Vegetation?

Effect of Vegetation

x 1.55

Identity of Plant Community?

Dominant Species?

Explains

38%

of remaining variation

?

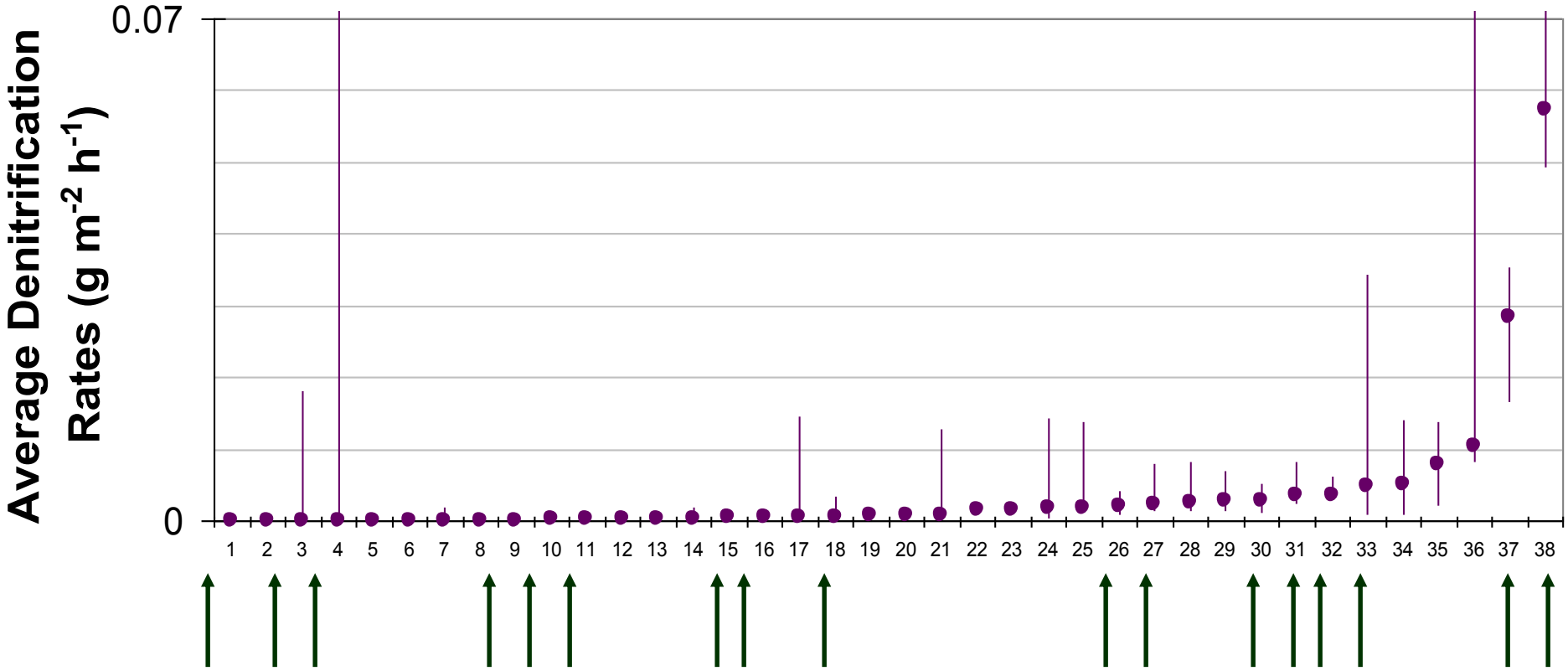
Possible Solutions

1. Estimate effect of each **dominant species**

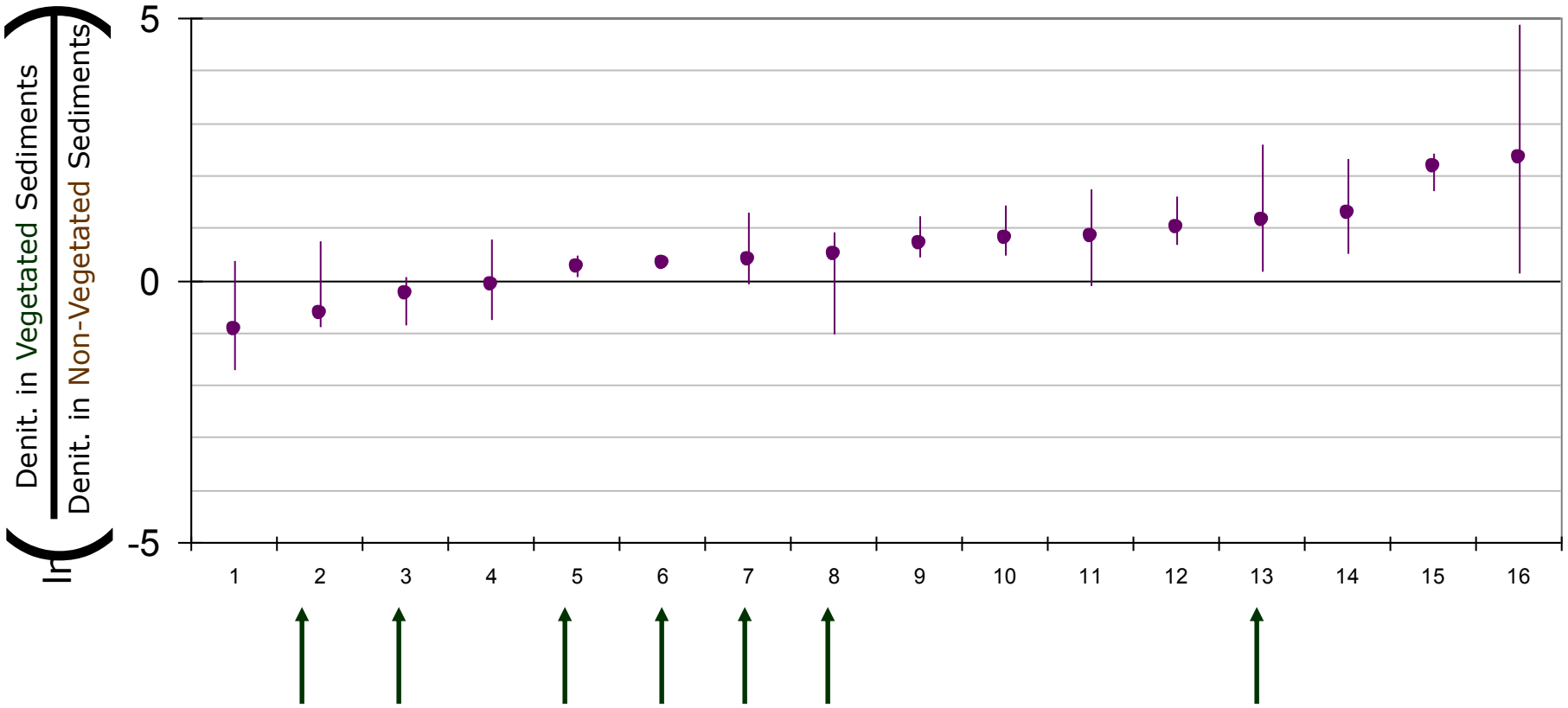
2. Sort into **functional groups**

3. Use **functional traits** as predictors

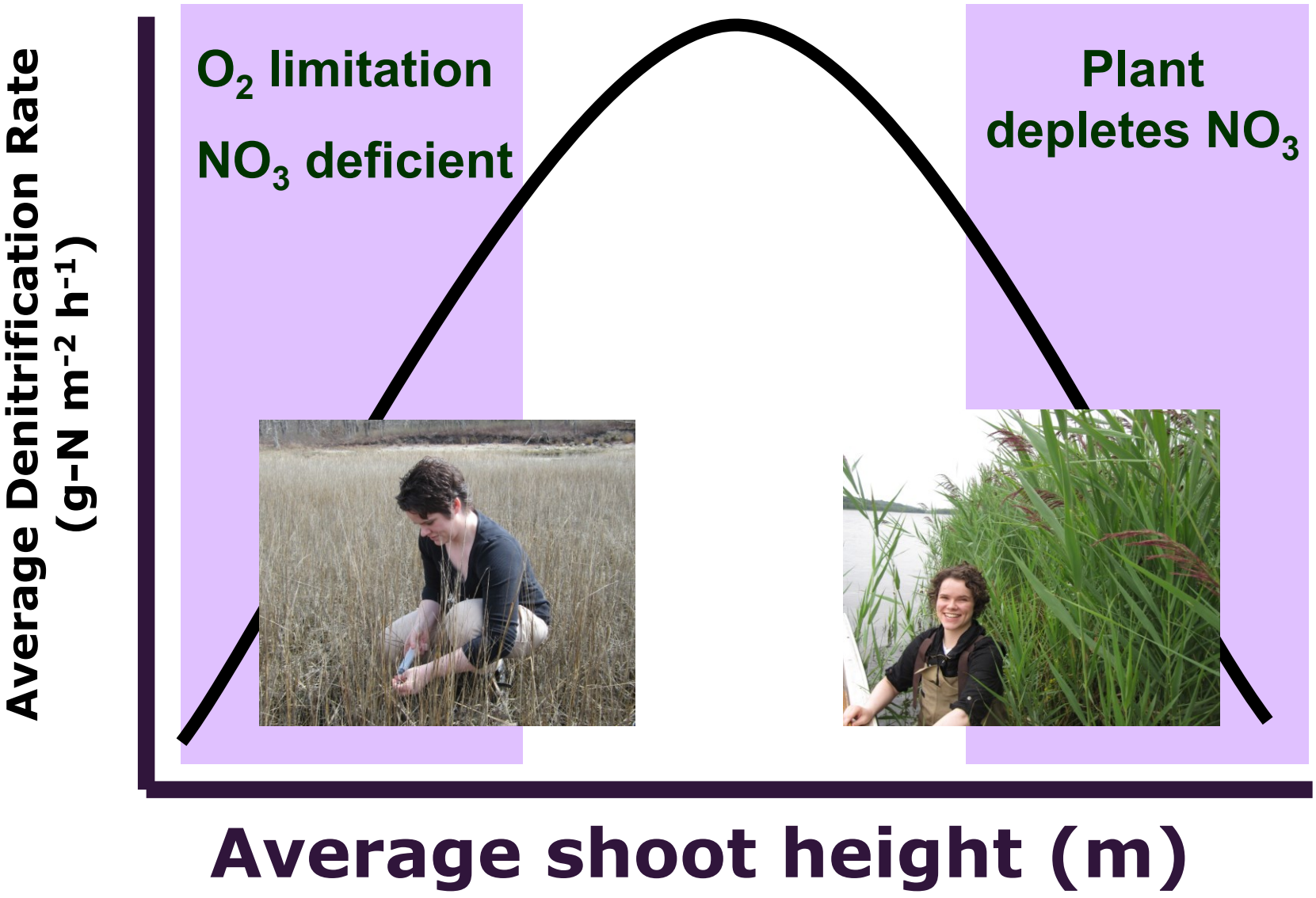
Functional Groups?



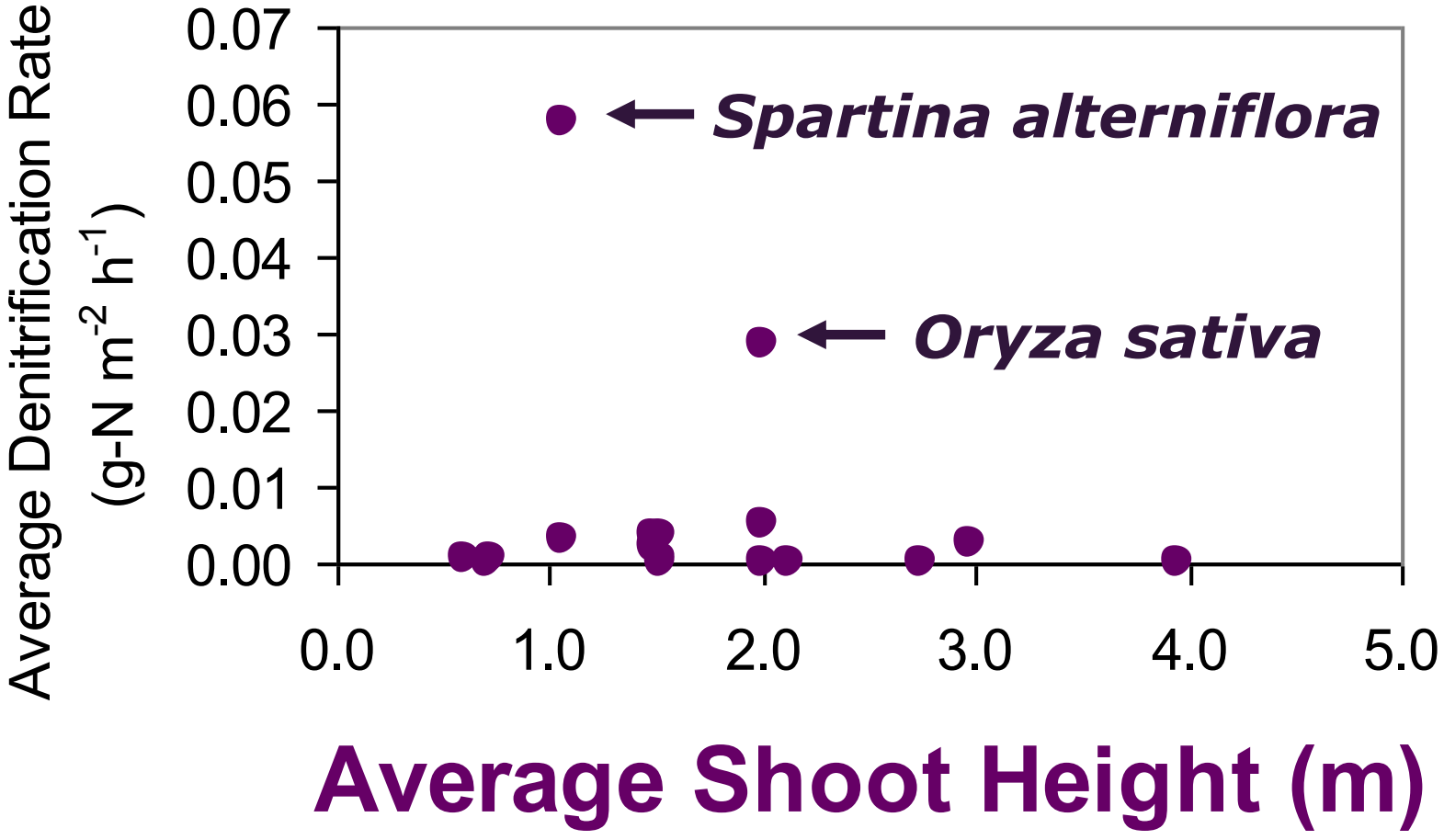
Functional Groups?



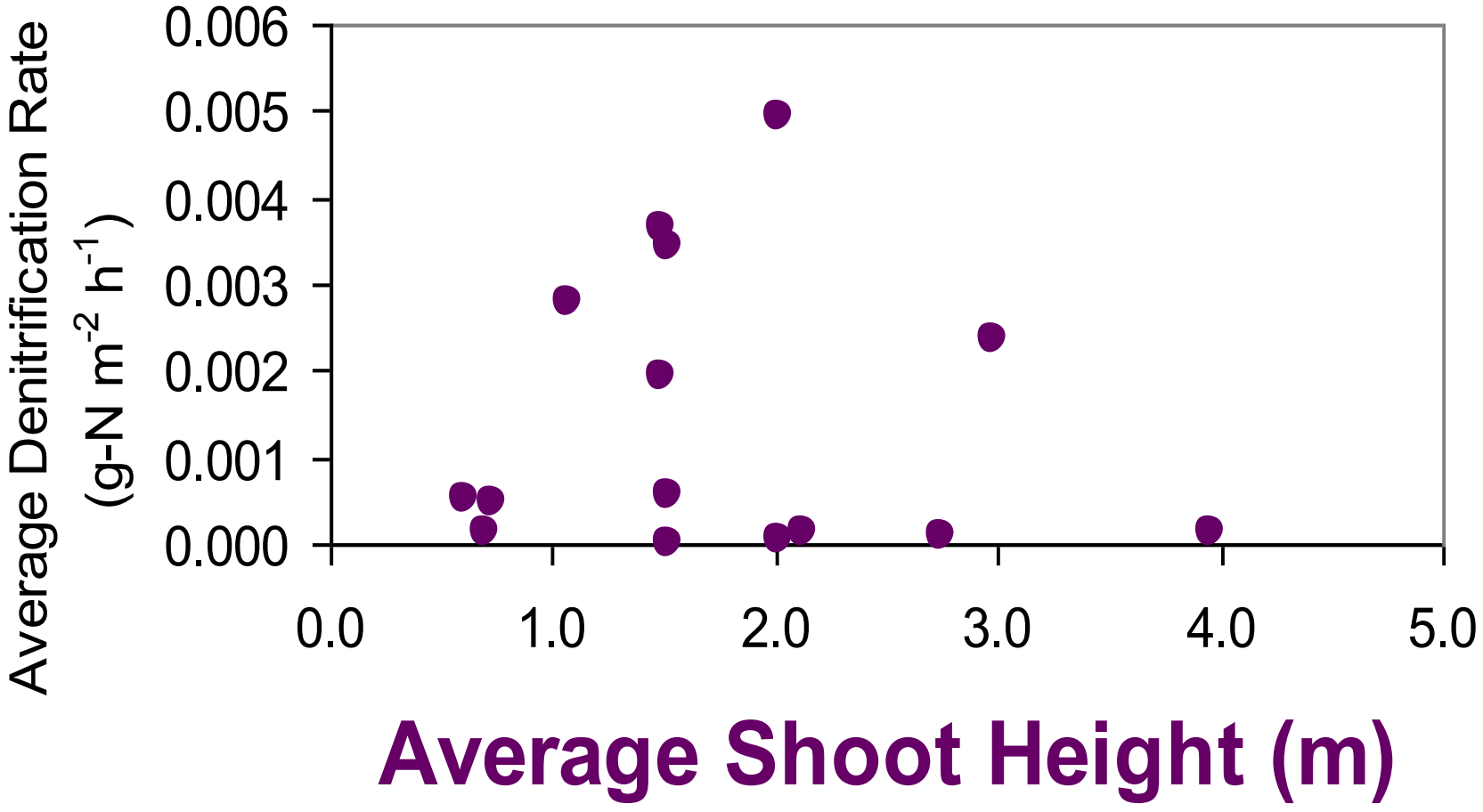
Functional Traits?



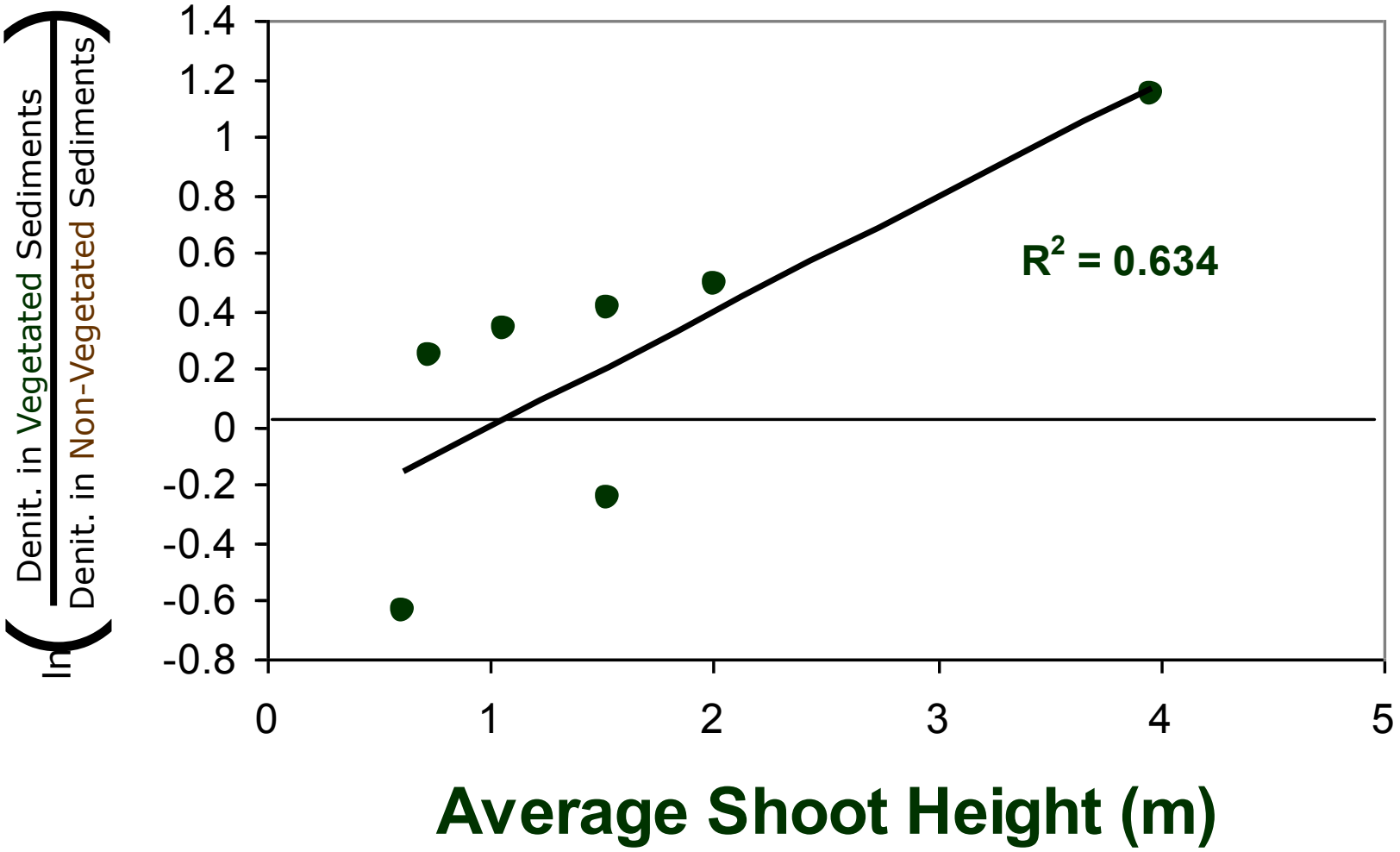
Functional Traits?



Functional Traits?



Functional Traits?



In Summary…

Vegetation increases denitrification **1.55x**

Plant community can explain **38%** of the variation in this effect

Functional traits may offer a way forward

Acknowledgements

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Questions?