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Vegetation community composition and strategies along environmental gradients in an anthropized estuary

Markus Neupert, Michaël Aubert & Estelle Langlois
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INRAE



**UNIVERSITÉ
DE ROUEN**
N O R M A N D I E



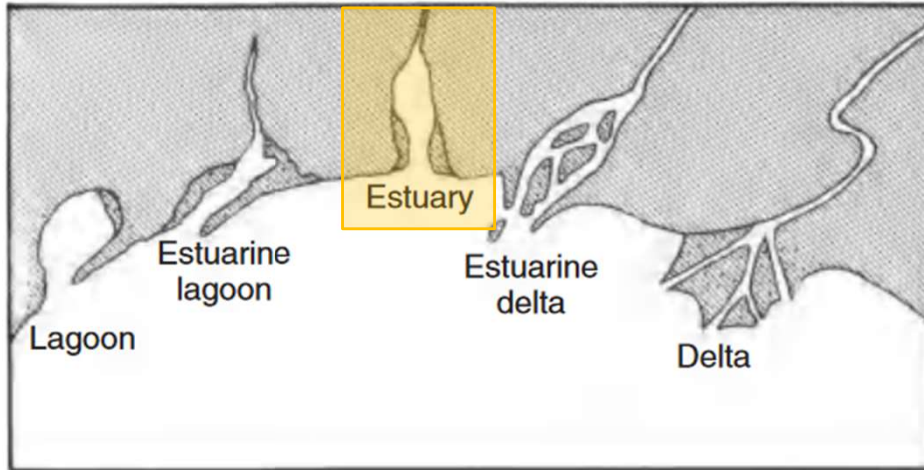
COASTAL WETLANDS

- Subjected to strong abiotic constraints:
 - Salinity,
 - Inundation frequency.
- Numerous ecosystem services:
 - Biomass production,
 - Water purification,
 - Carbon sink,
 - Flood protection.
- Often highly anthropized.
- Cover less than 5% of Earth's terrestrial surface, yet 30% of the global population lives in their proximity.

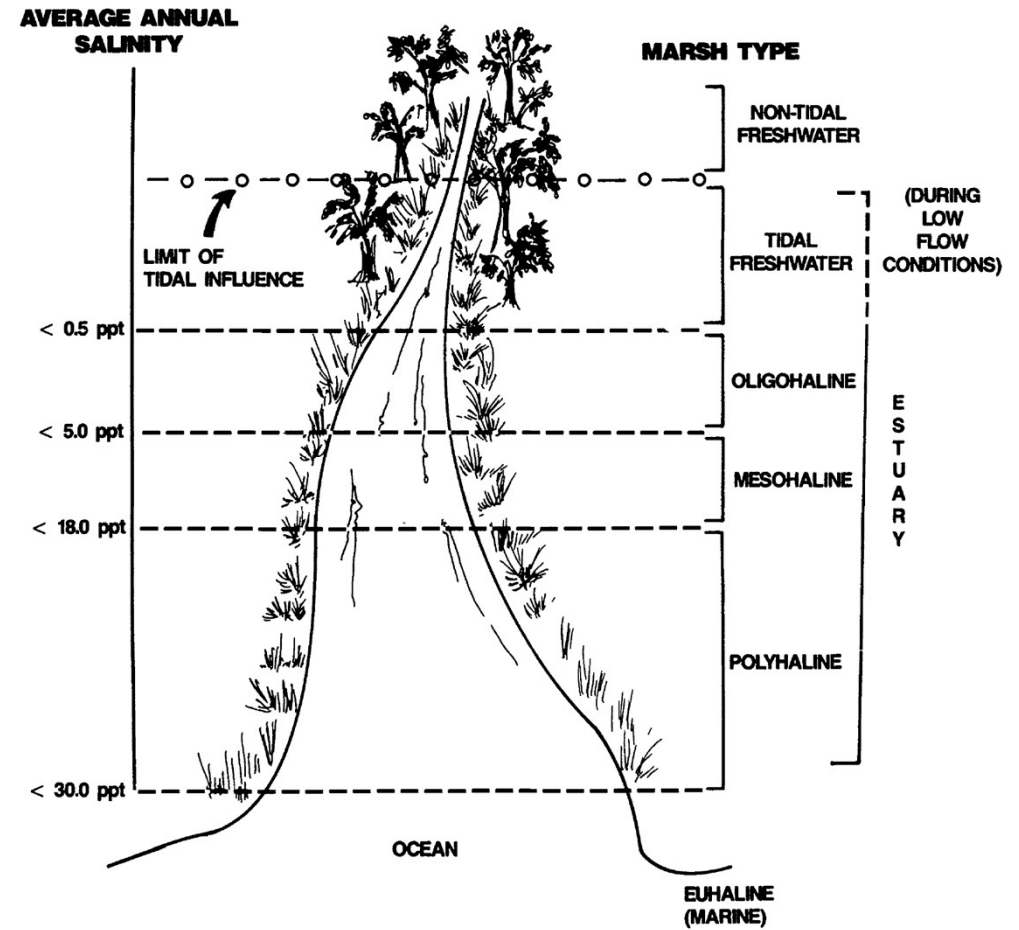
(Millennium Ecosystem Assessment, 2005)



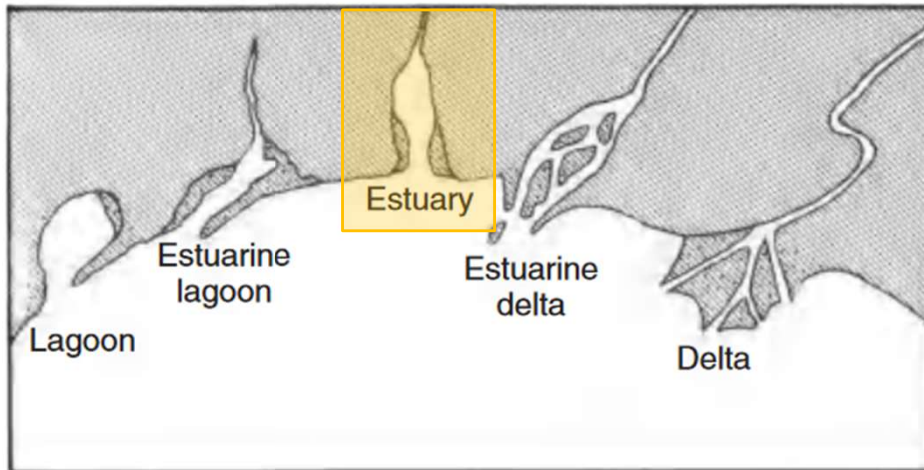
COASTAL WETLAND TYPES



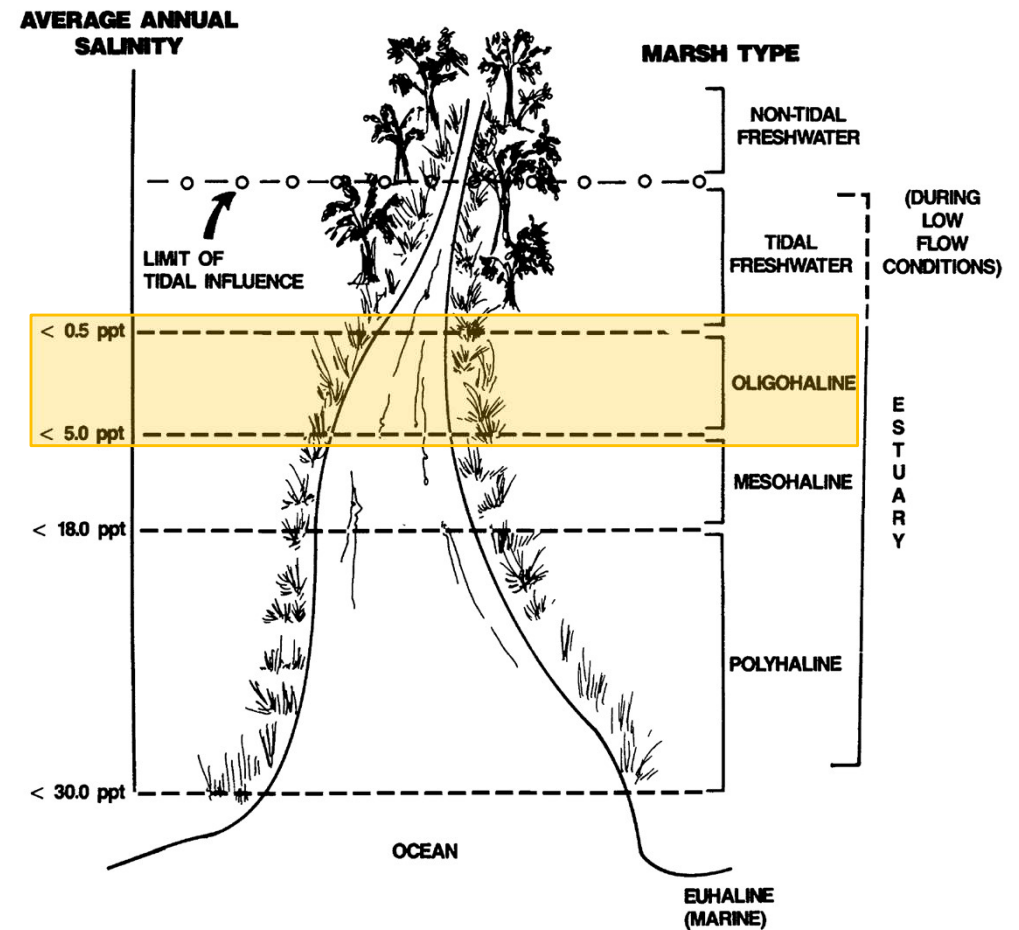
- Estuary = succession of marshes.



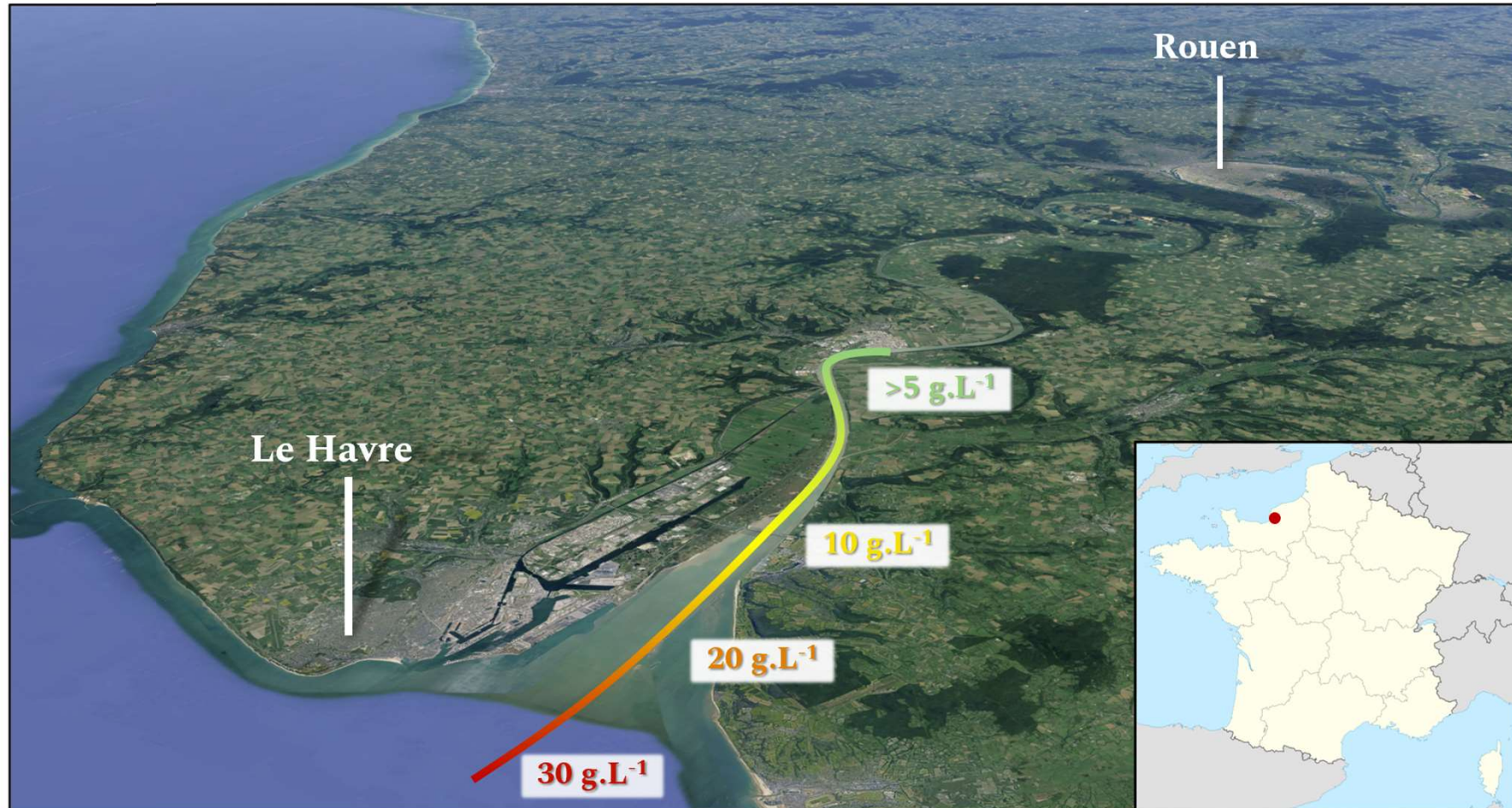
COASTAL WETLAND TYPES



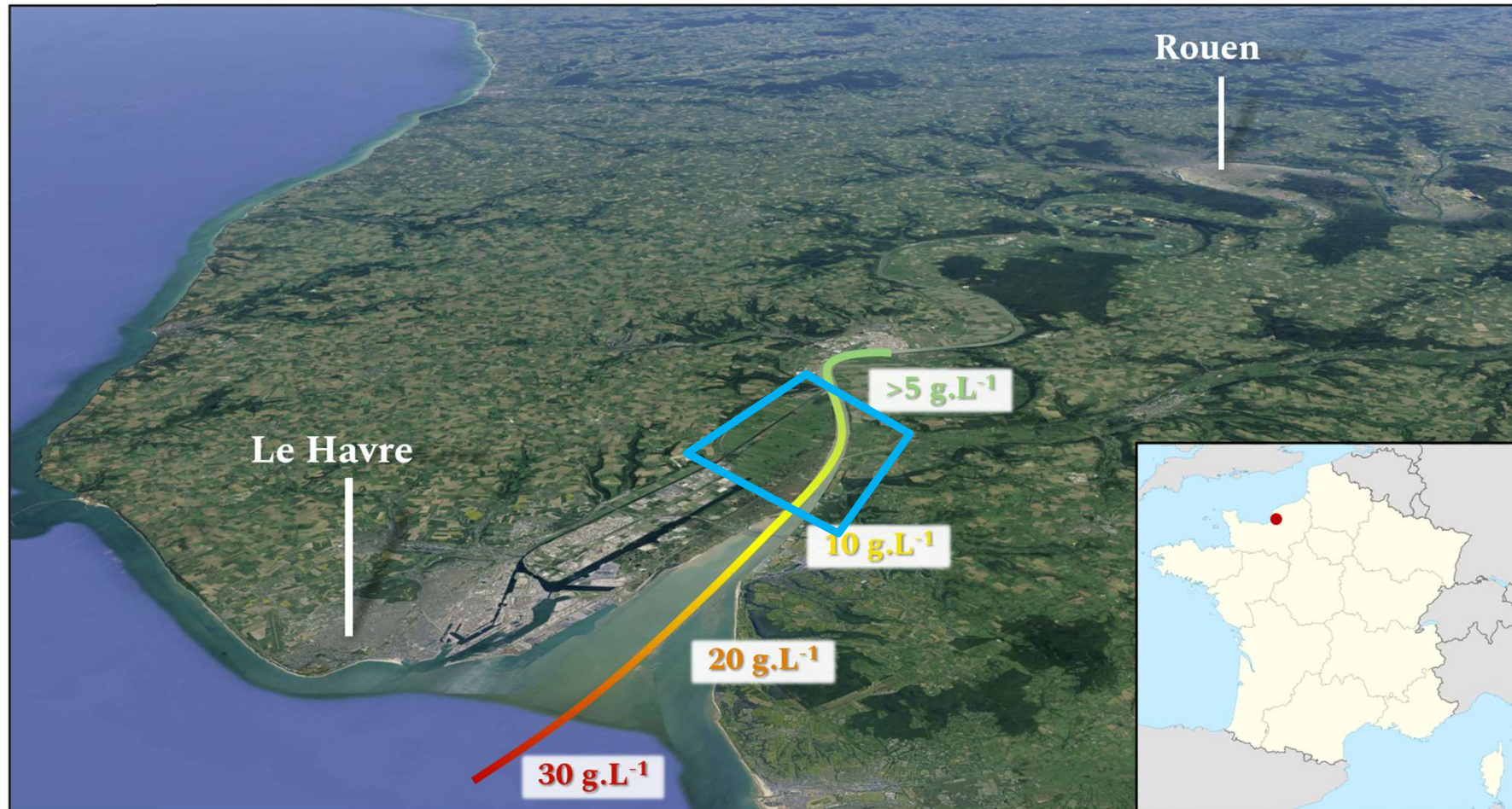
- Estuary = succession of marshes.
- Oligohaline marshes mark the boundary of the salinity constraint.
- They are severely understudied.



THE SEINE ESTUARY



THE SEINE ESTUARY



THE SEINE ESTUARY



Introduction

Material &
Methods

Results

Discussion &
Conclusion

THE SEINE ESTUARY



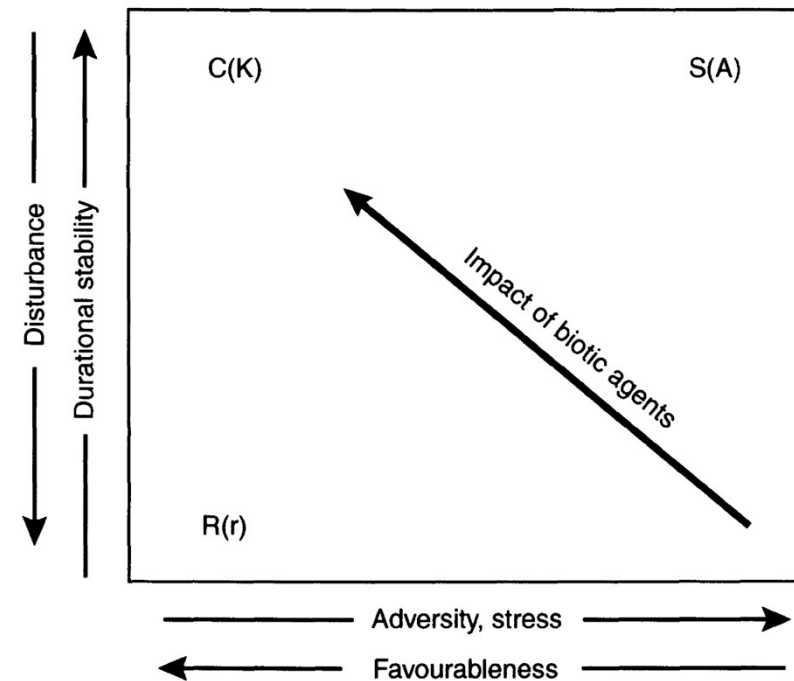
THE SEINE ESTUARY



HYPOTHESES

1. Tidal restriction **truncates** the salinity and inundation gradients ...
 - a) ... which results in **different vegetation communities** ...
 - b) ... that can be explained by the **modified** physical and chemical **parameters** of these environments.

2. Different abiotic conditions select fitting plant life **strategies**.

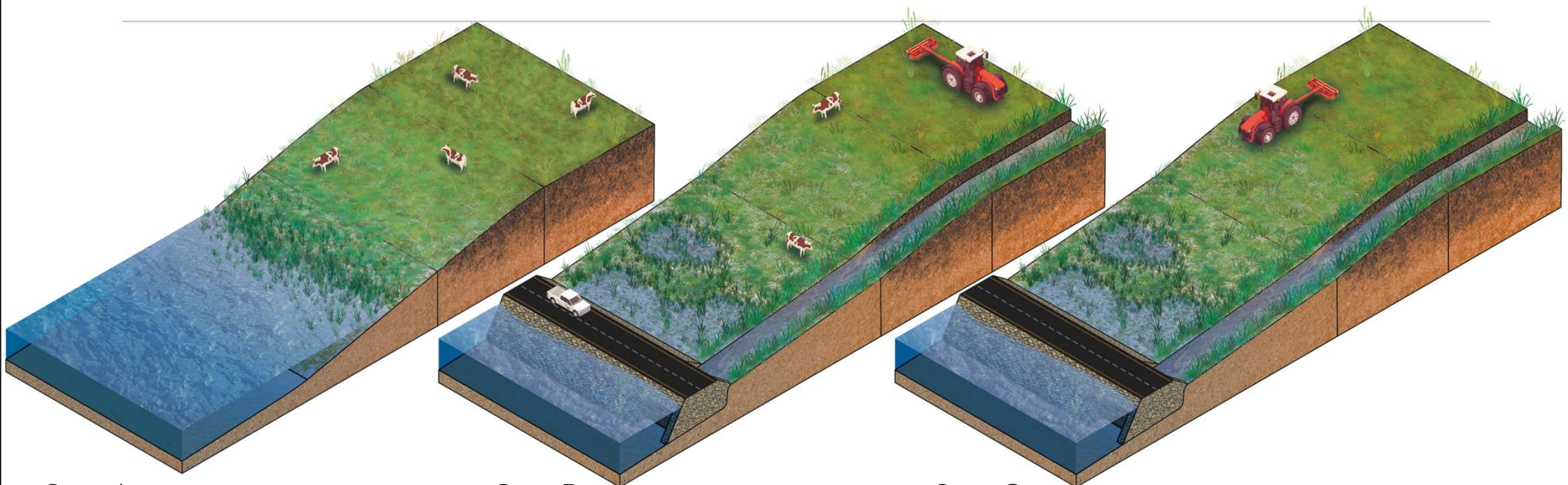


From: Keddy, P. A. (2001). *Competition*

THE SITES



THE SITES



Site A:

- Connected,
- Grazed,
- Salinity +

Site B:

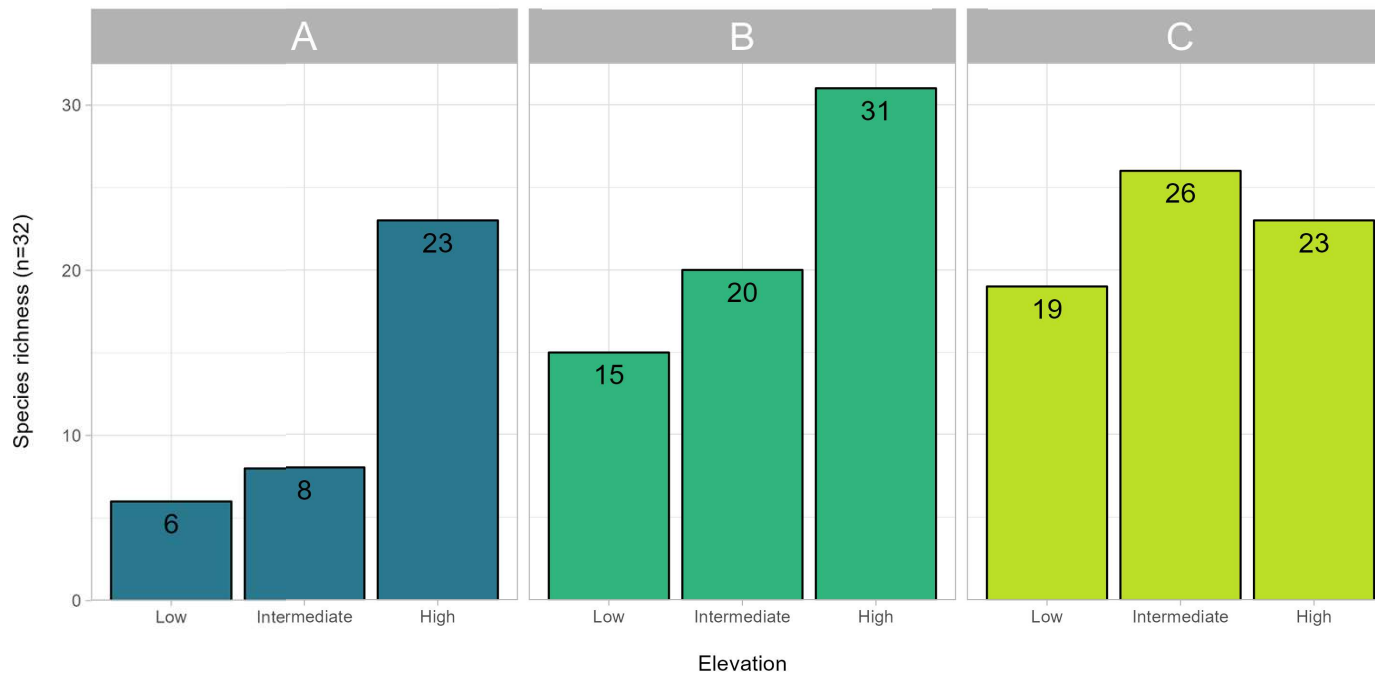
- Restricted,
- Grazed+Mowed,
- Salinity +

Site C:

- Restricted,
- Mowed,
- Salinity ++

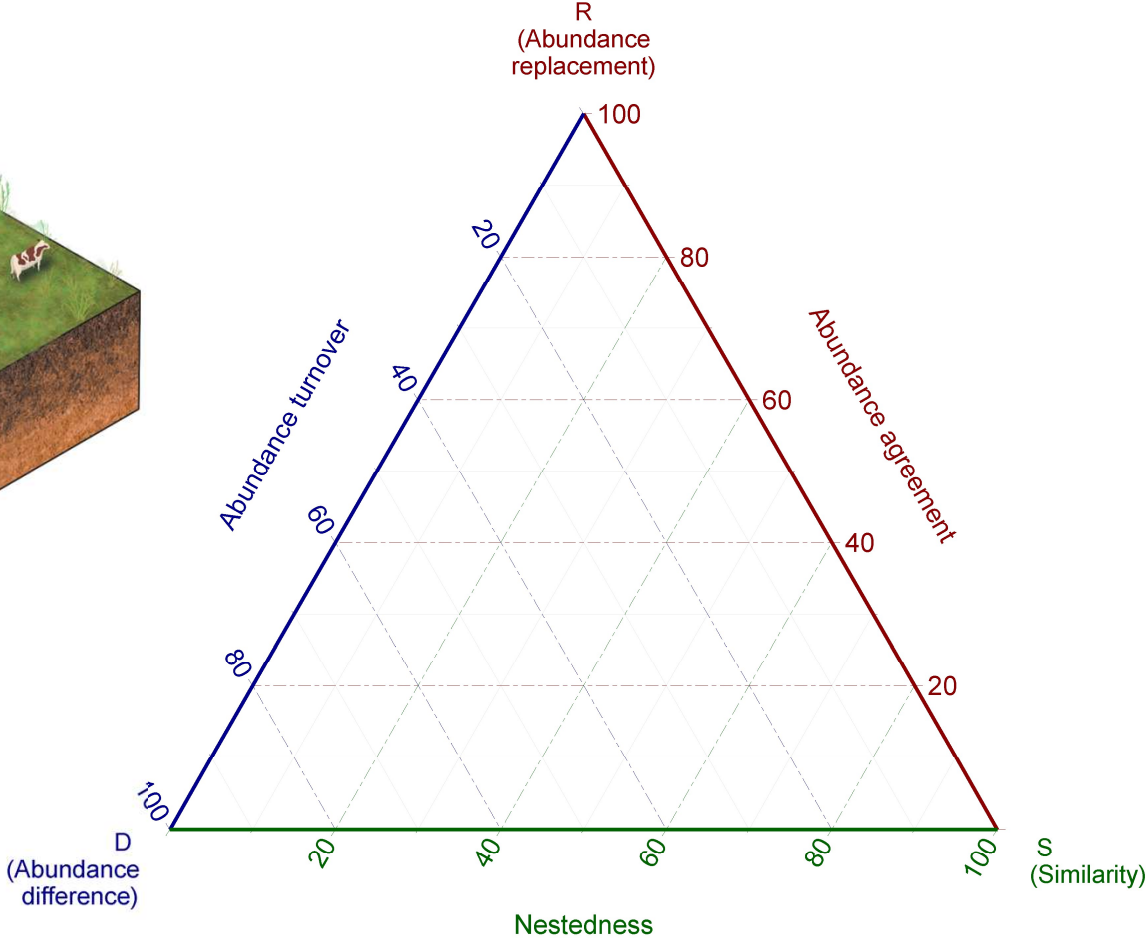
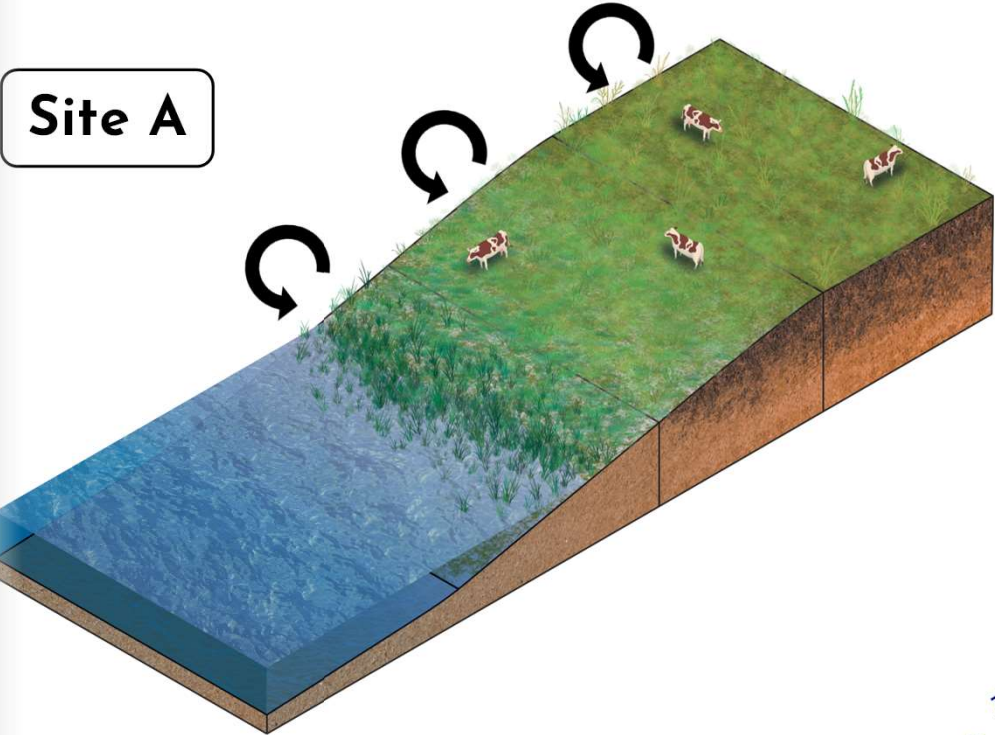
- *Vegetation surveys in 4×4 m squares in 2019, 2020 and 2021.*
- *Soil physical and chemical analyses in 2019-2020.*

SPECIES RICHNESS

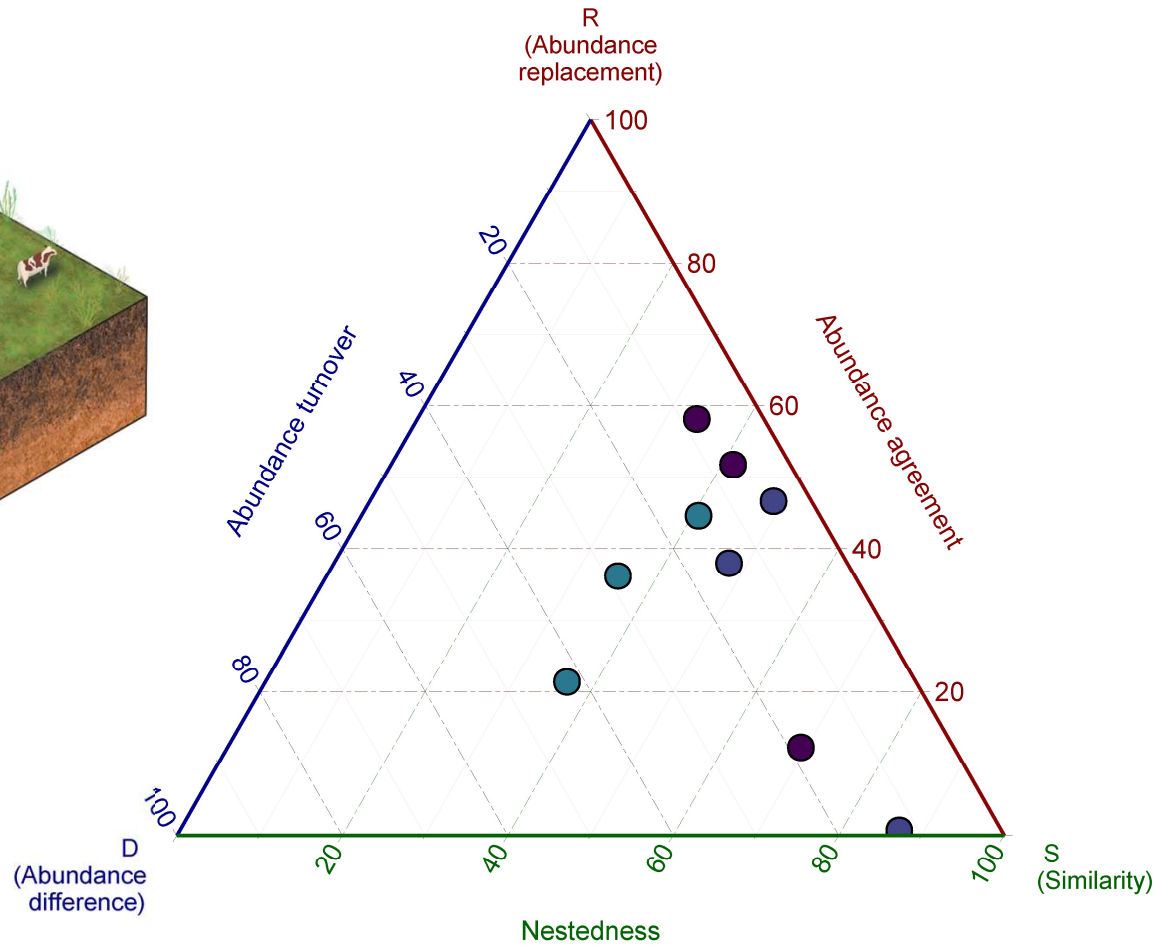
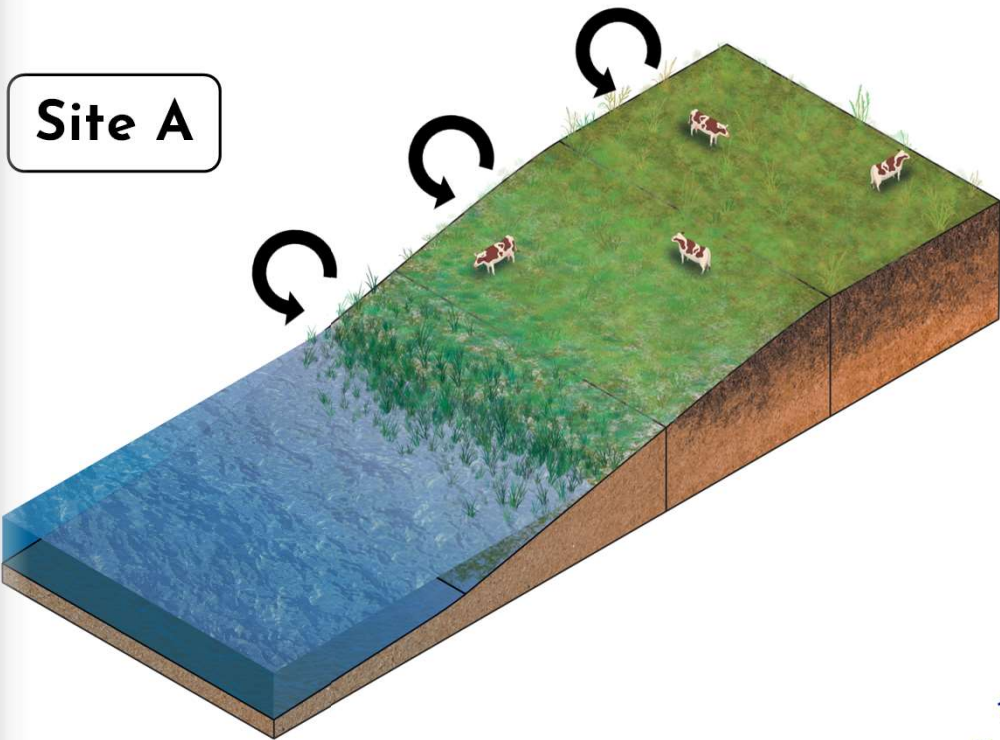


- Steep gradient on control site A;
- Gradient with higher richness on site B;
- Different pattern on site C.

RESULTS: DIVERSITY

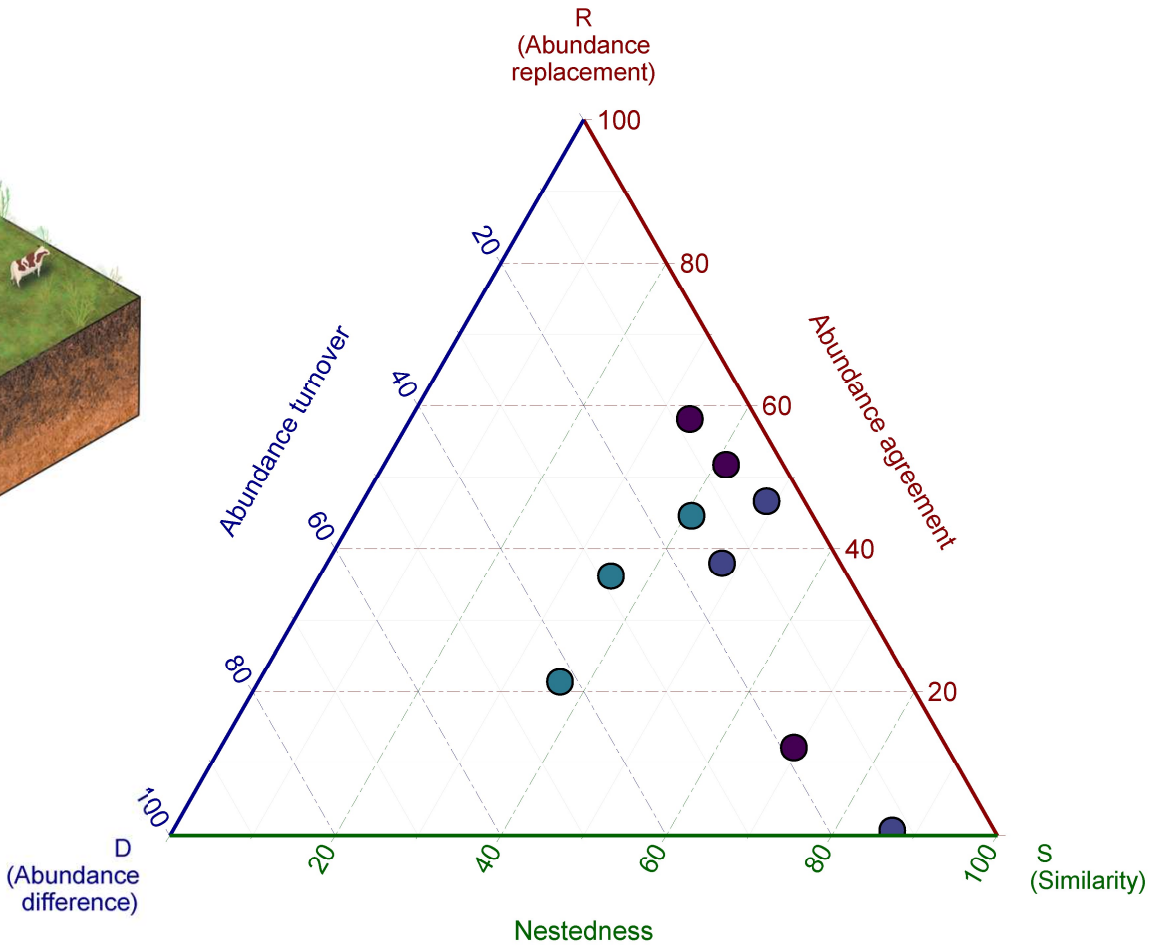
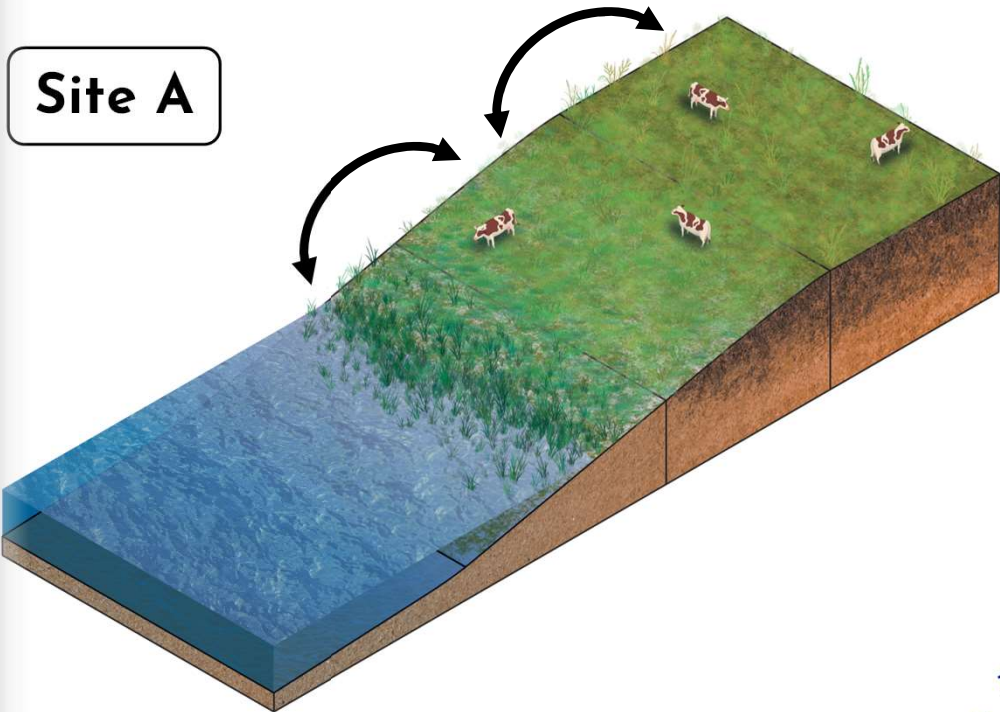


RESULTS: DIVERSITY



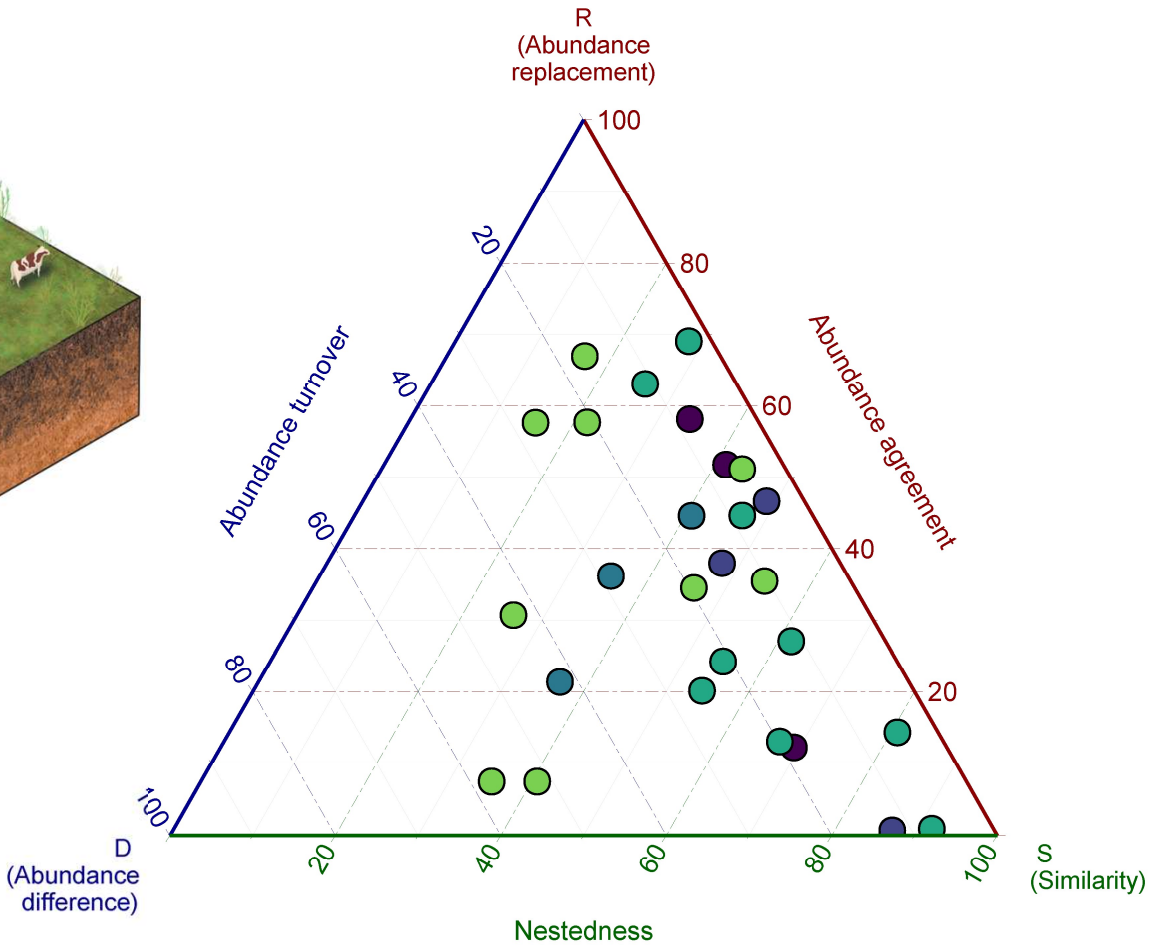
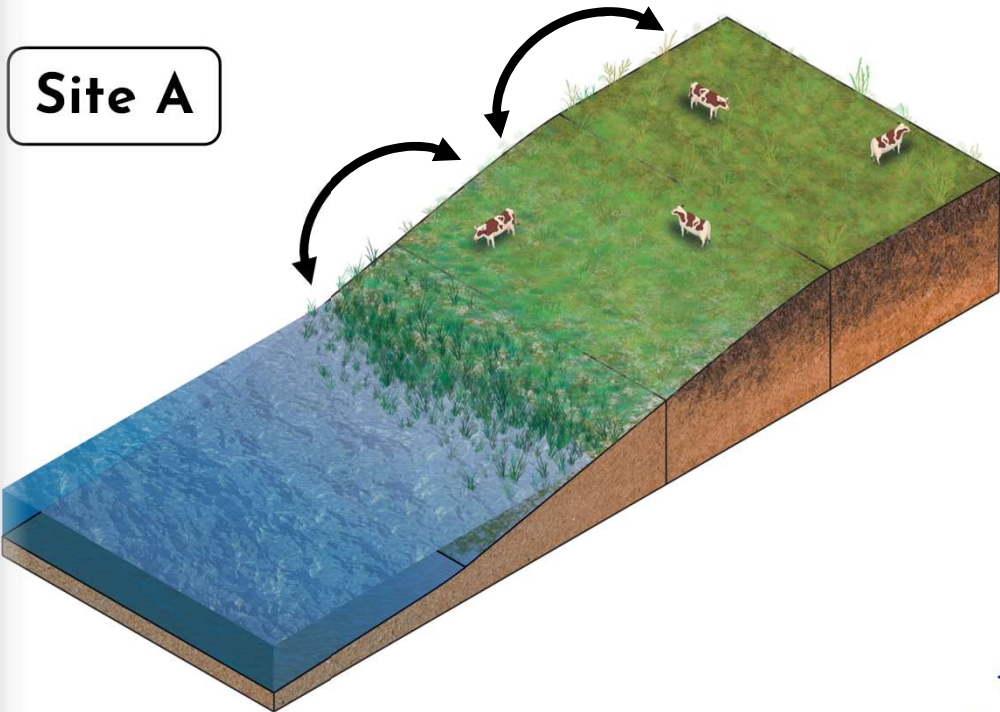
RESULTS: DIVERSITY

Site A

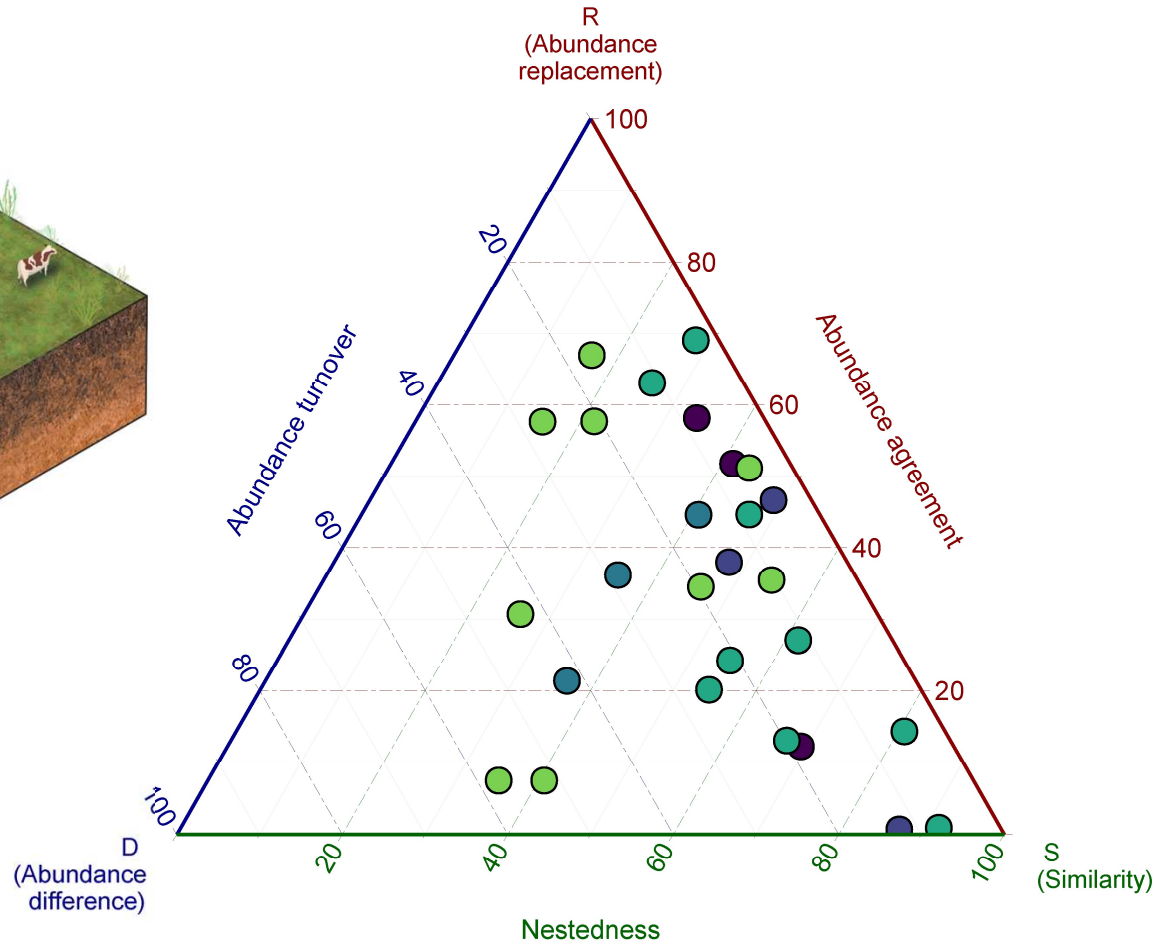
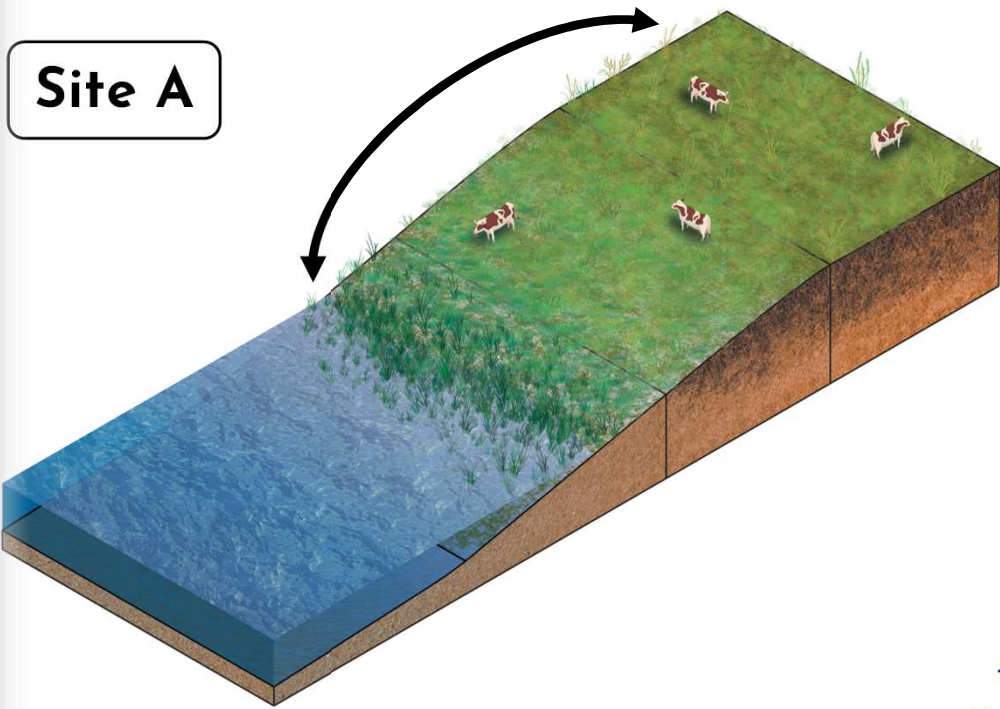


RESULTS: DIVERSITY

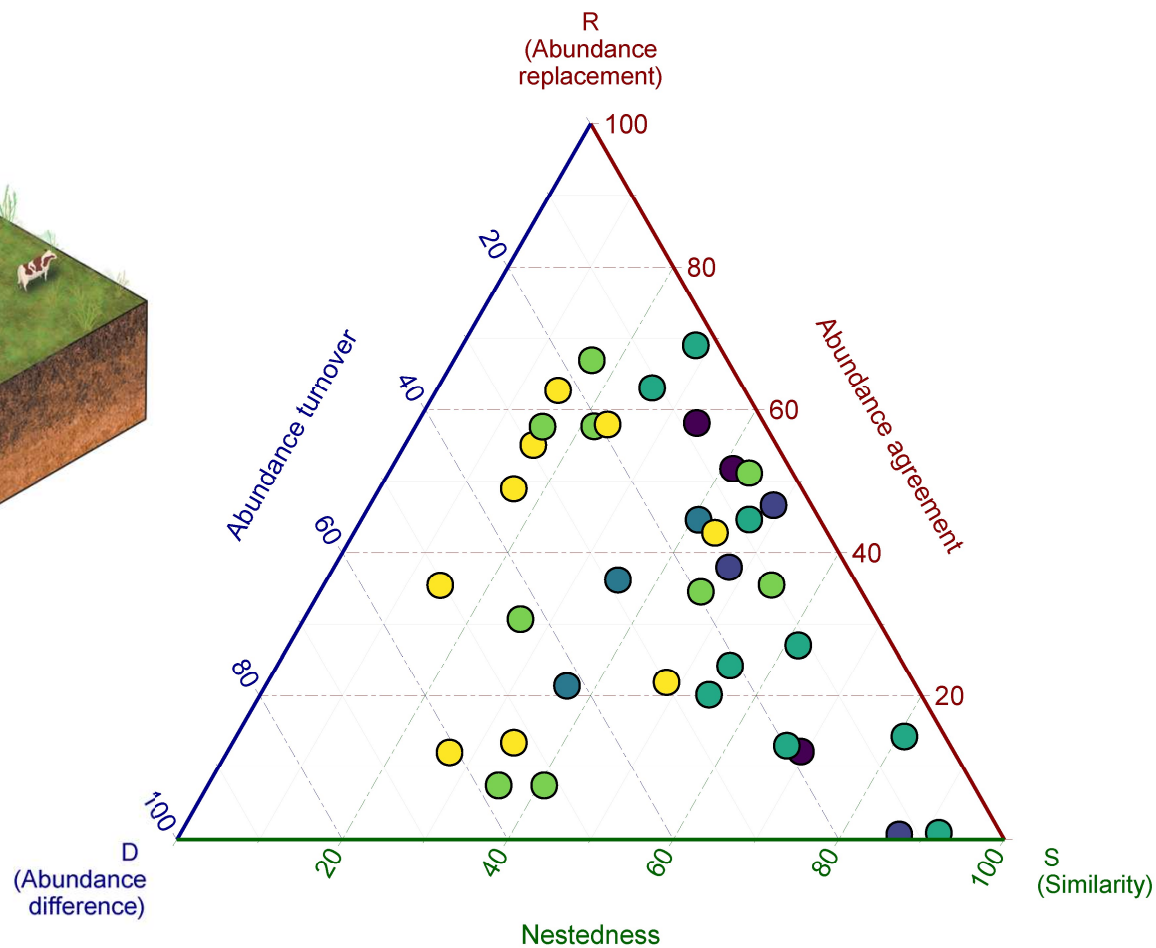
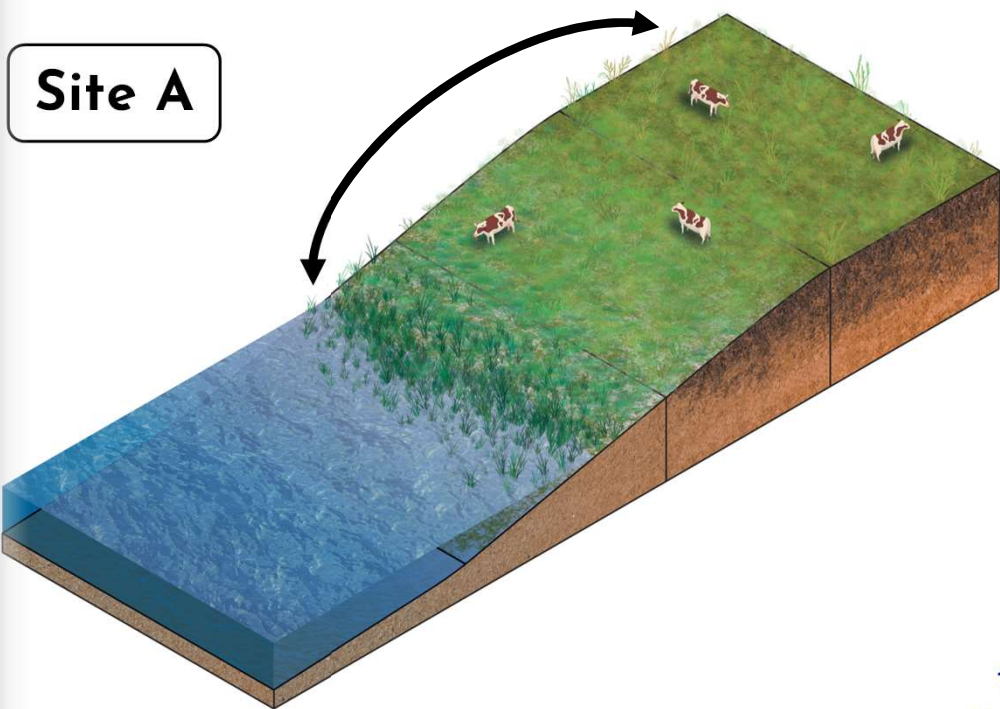
Site A



RESULTS: DIVERSITY

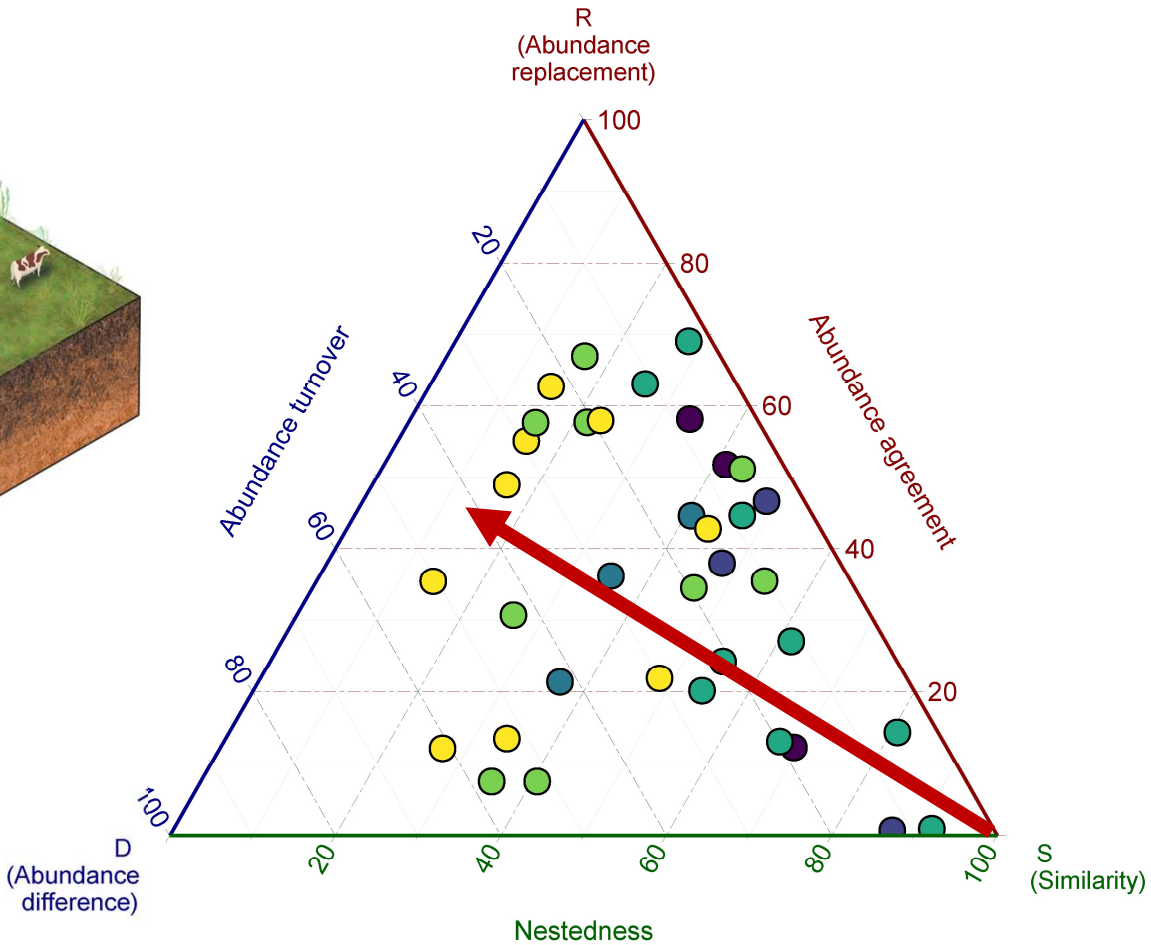
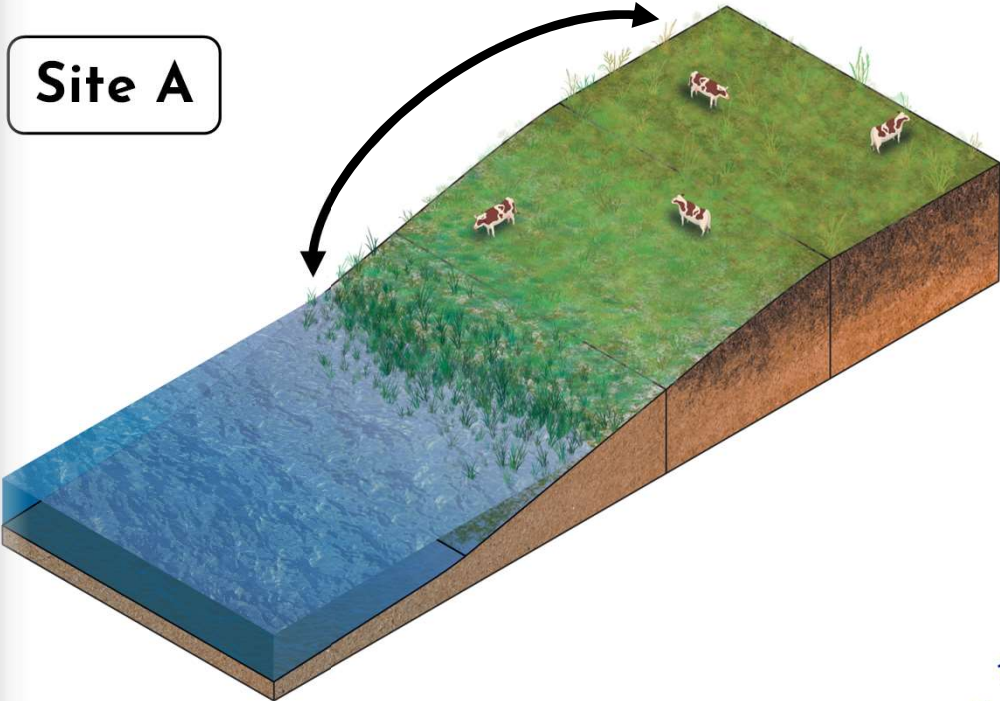


RESULTS: DIVERSITY



RESULTS: DIVERSITY

Site A



Introduction

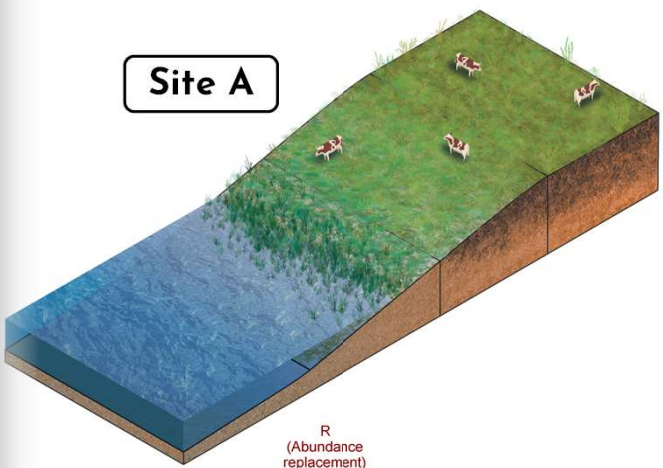
Material & Methods

Results

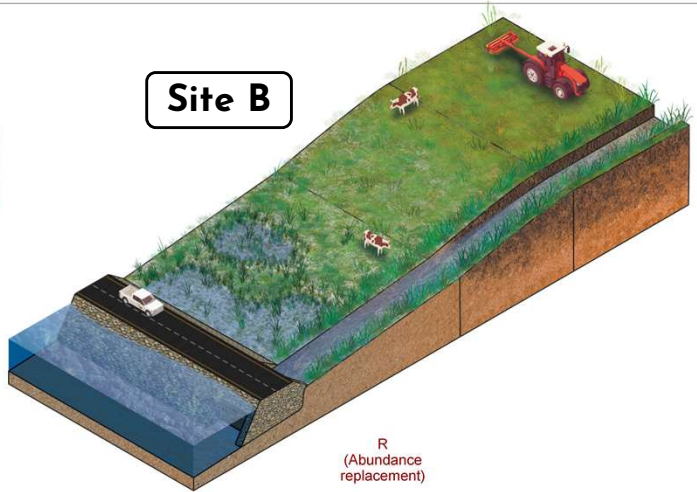
Discussion & Conclusion

RESULTS: DIVERSITY

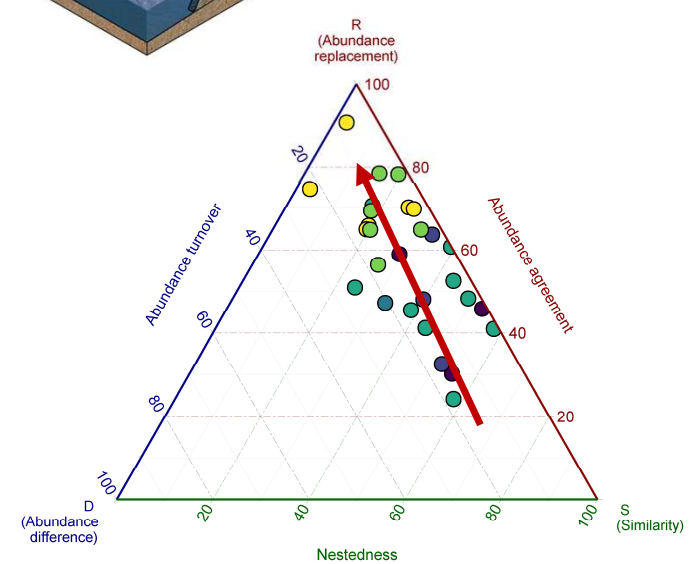
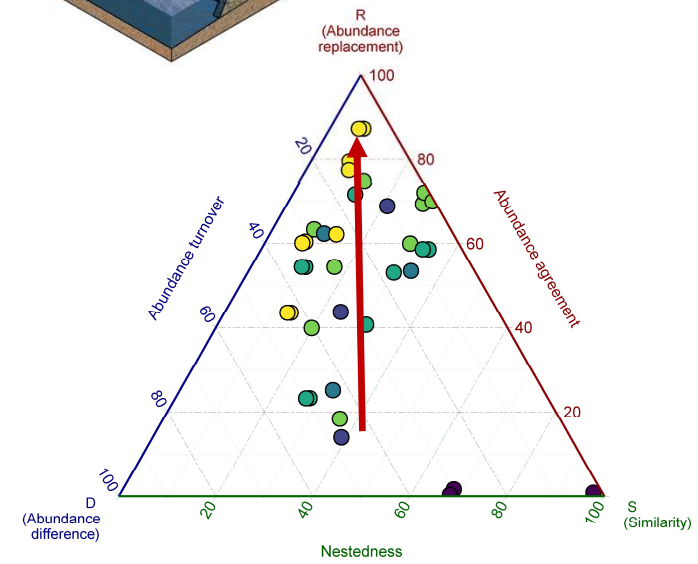
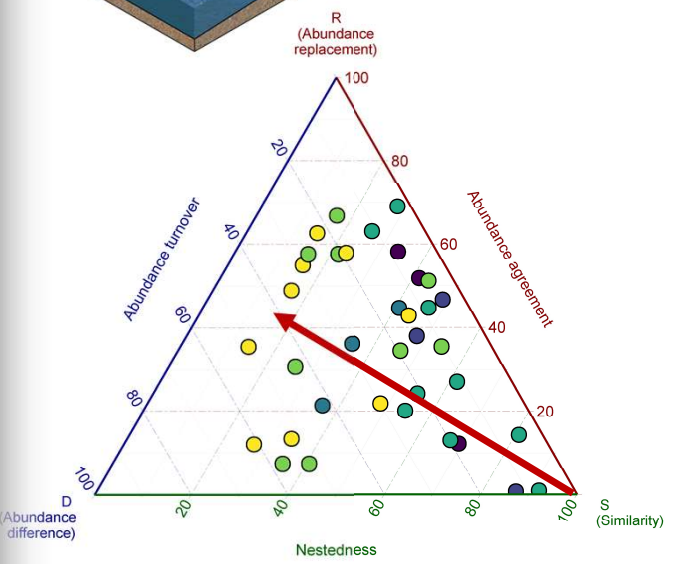
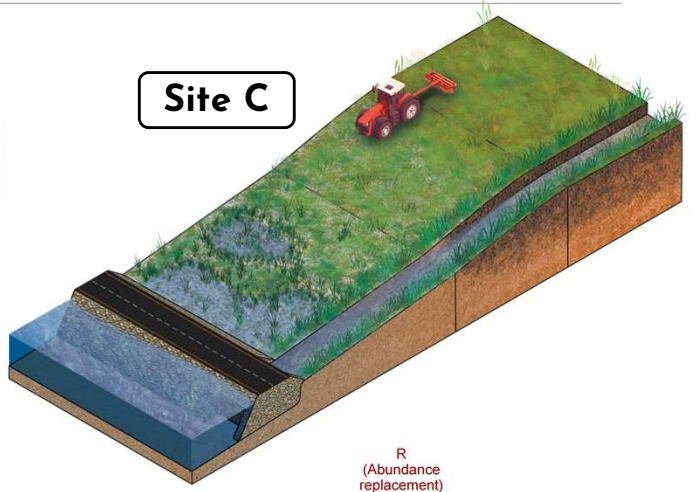
Site A



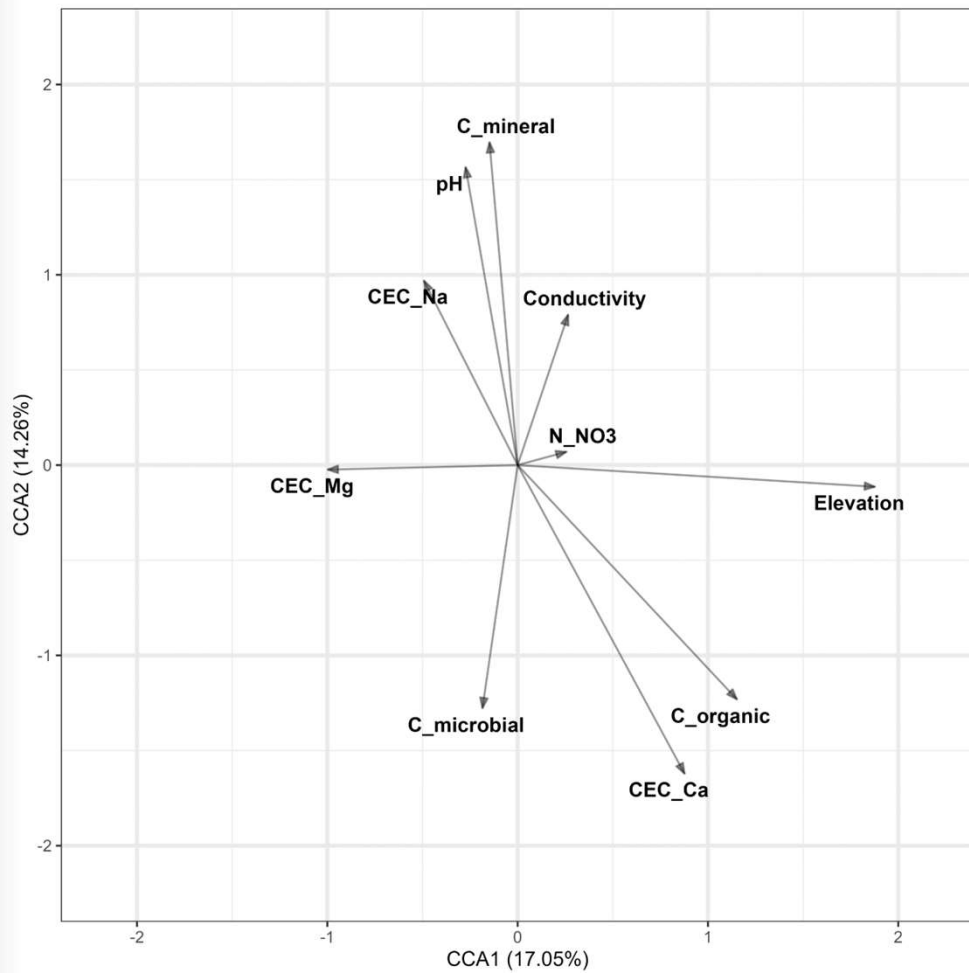
Site B



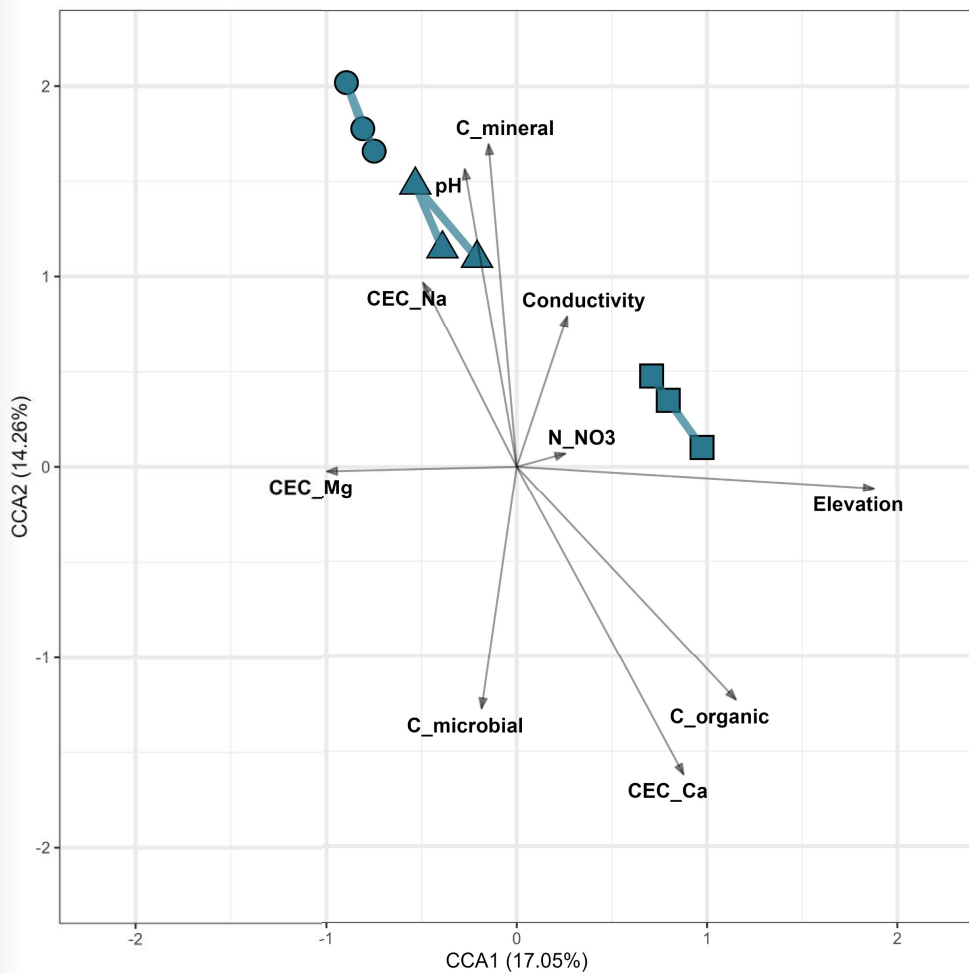
Site C



RESULTS: ABIOTIC FACTORS



RESULTS: ABIOTIC FACTORS

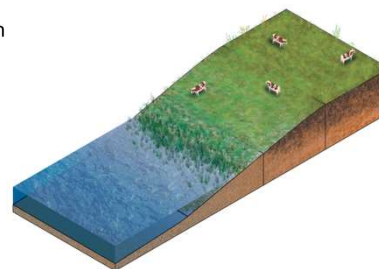


Topographical level

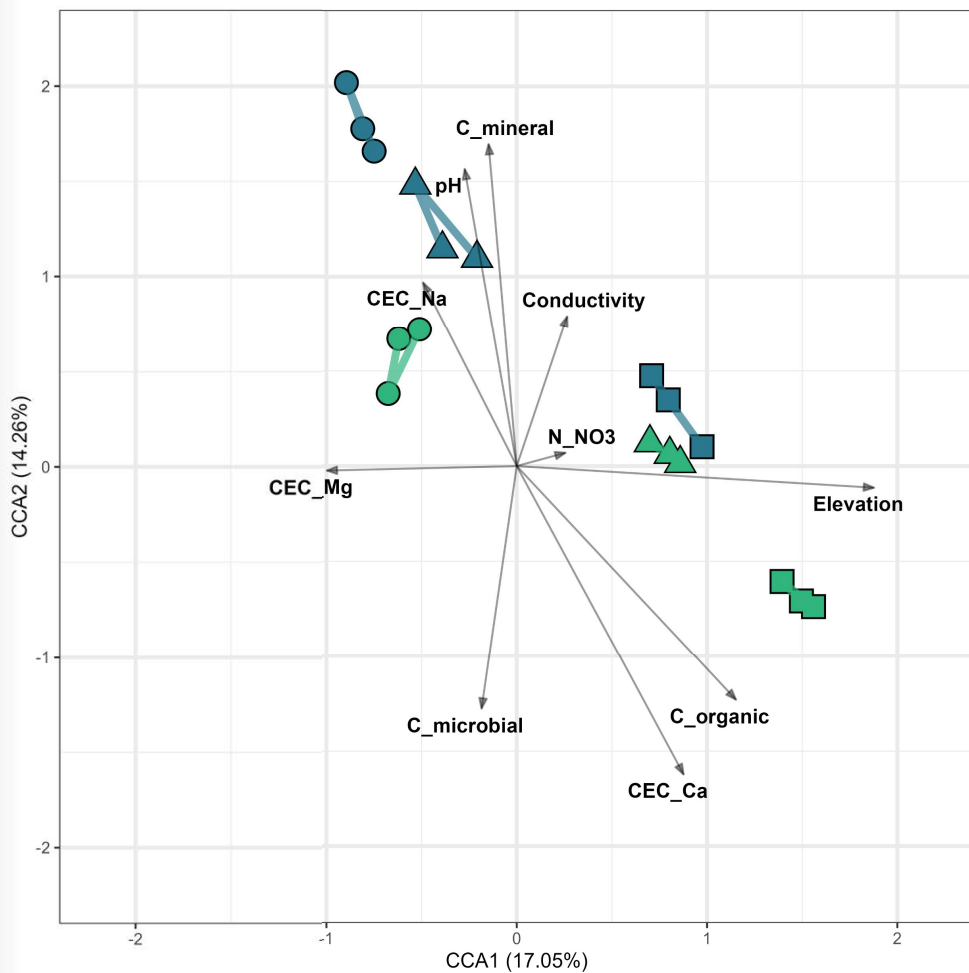
- Low
- ▲ Intermediate
- High

Site

- A
- B
- C



RESULTS: ABIOTIC FACTORS

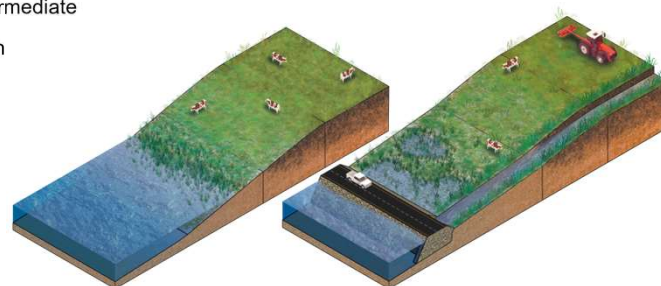


Topographical level

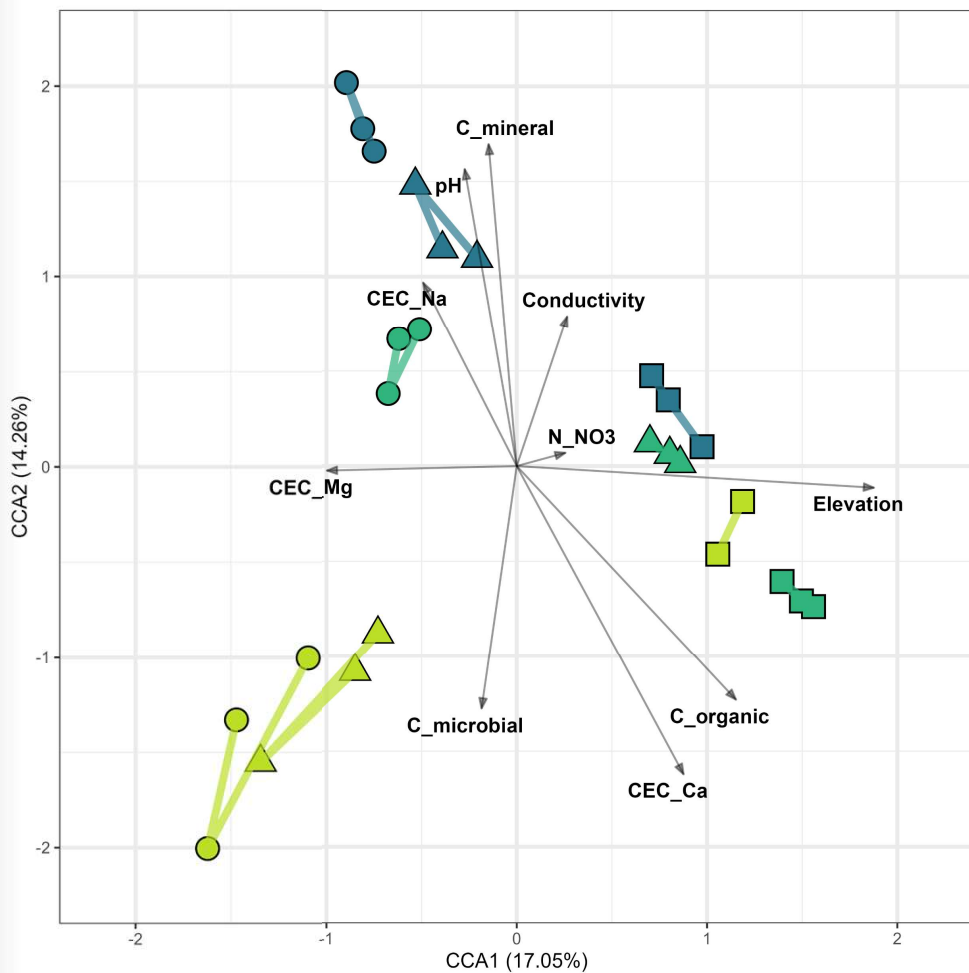
- Low
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- High

Site

- A
- B
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RESULTS: ABIOTIC FACTORS



Topographical level

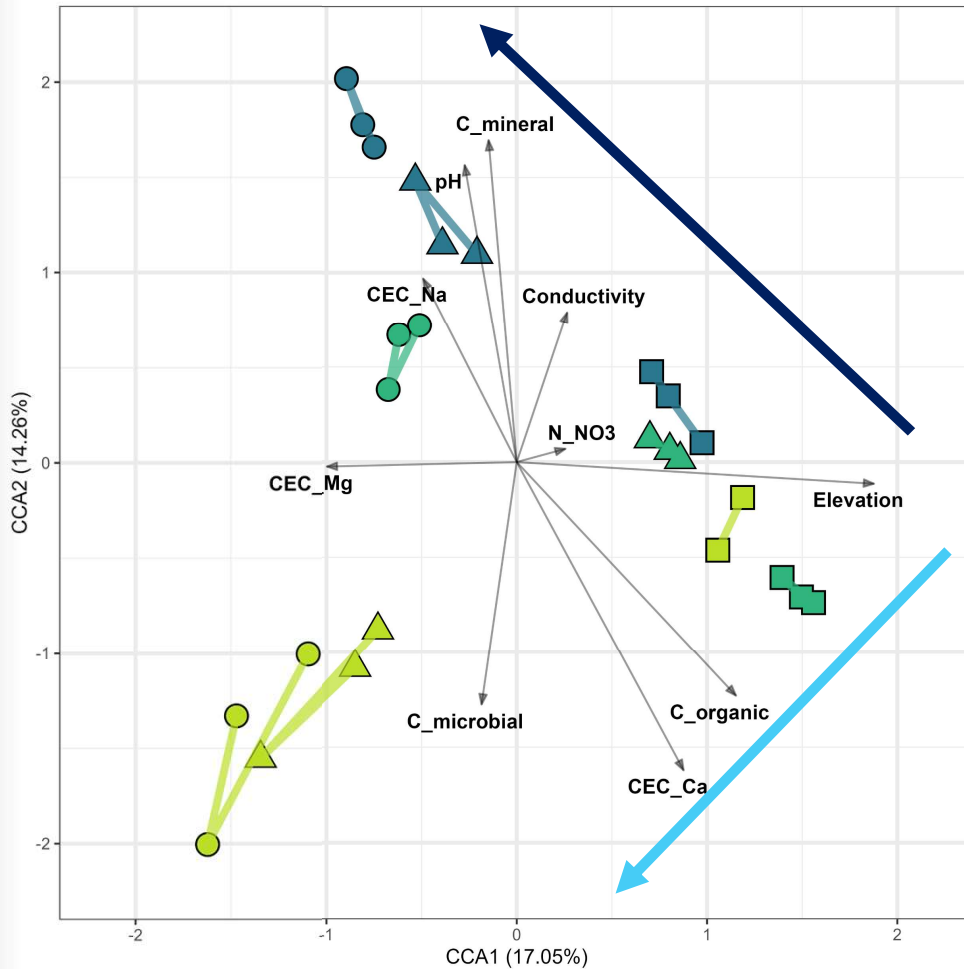
- Low
- ▲ Intermediate
- High

Site

- A
- B
- C



RESULTS: ABIOTIC FACTORS



- Convergence of the higher elevations.
- Divergence of the lower elevations.
- Site C is peculiar:
 - Freshwater upwelling from karst aquifer,
 - Water retention due to small floodgate.

Topographical level

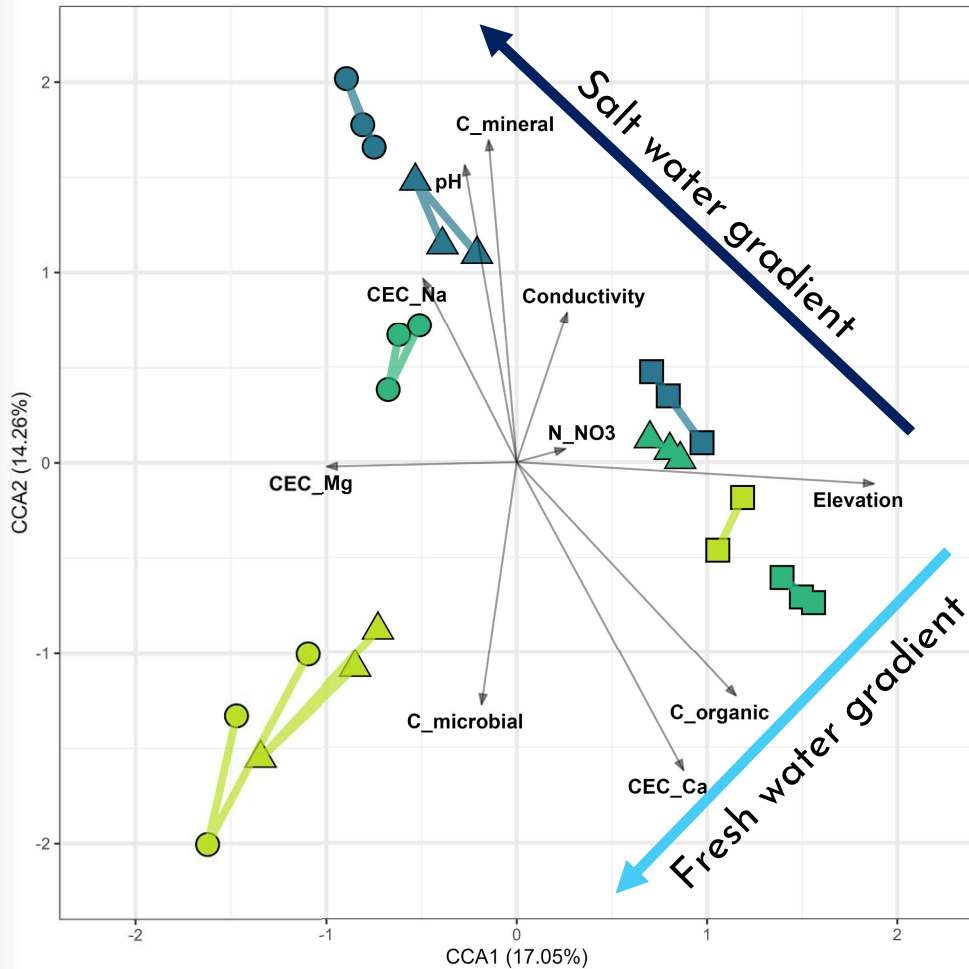
- Low
- ▲ Intermediate
- High

Site

- A
- B
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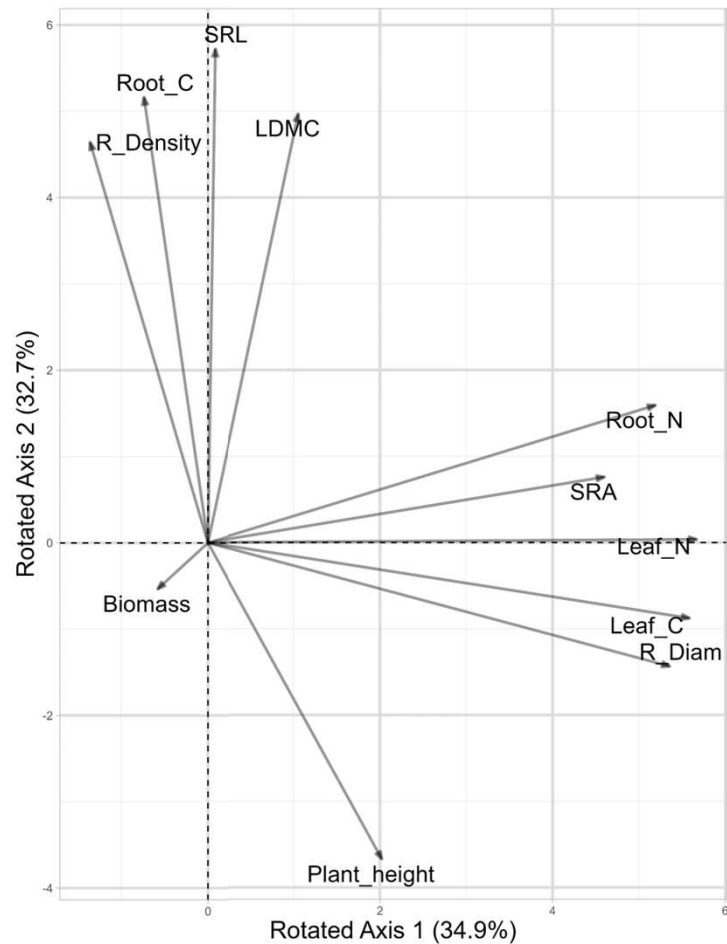
- Low
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Site

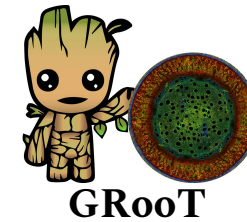
- A
- B
- C



RESULTS: TRAITS



TRY

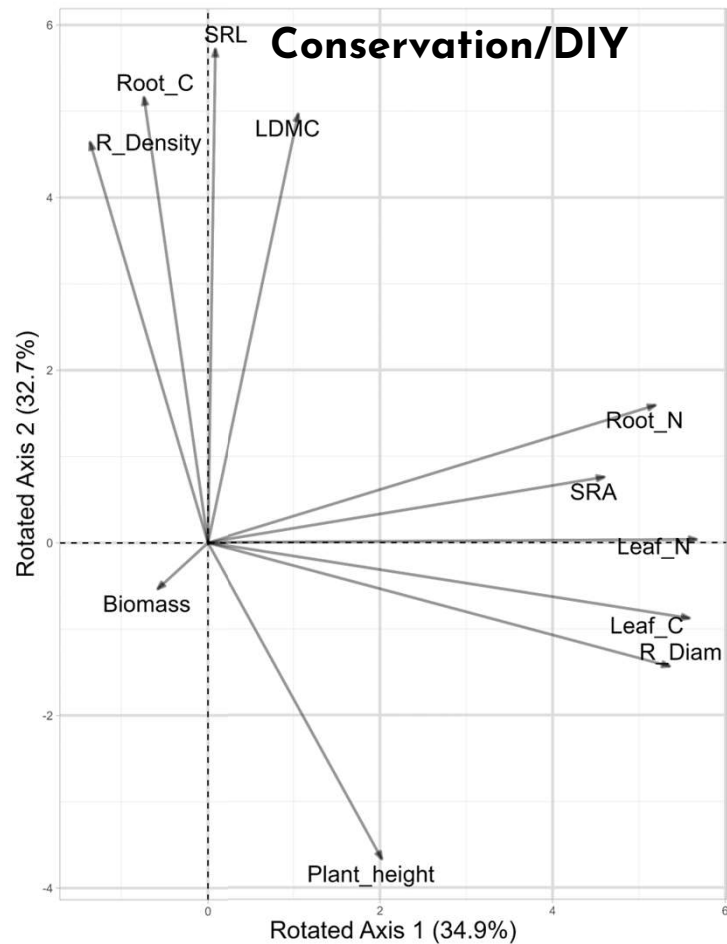


CWM, adjusted for species richness difference between sites



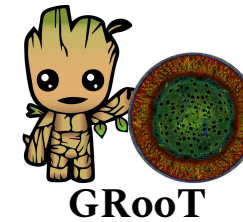
PCA

RESULTS: TRAITS



Acquisition/Collaboration

TRY

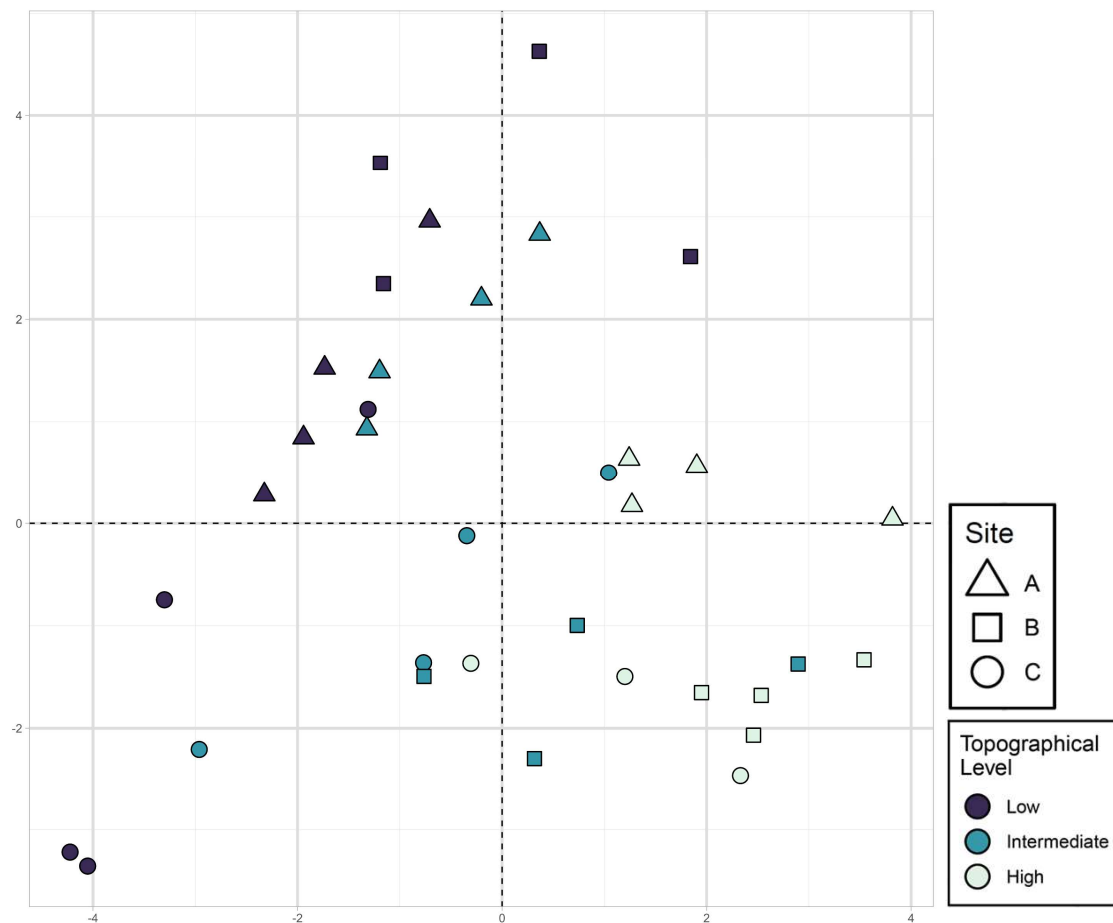
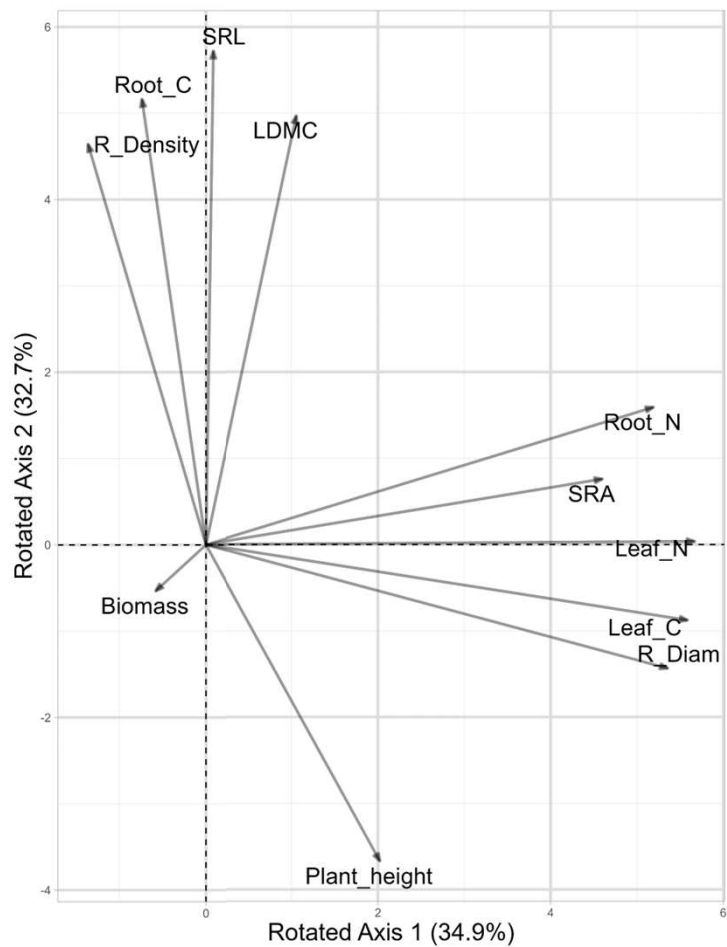


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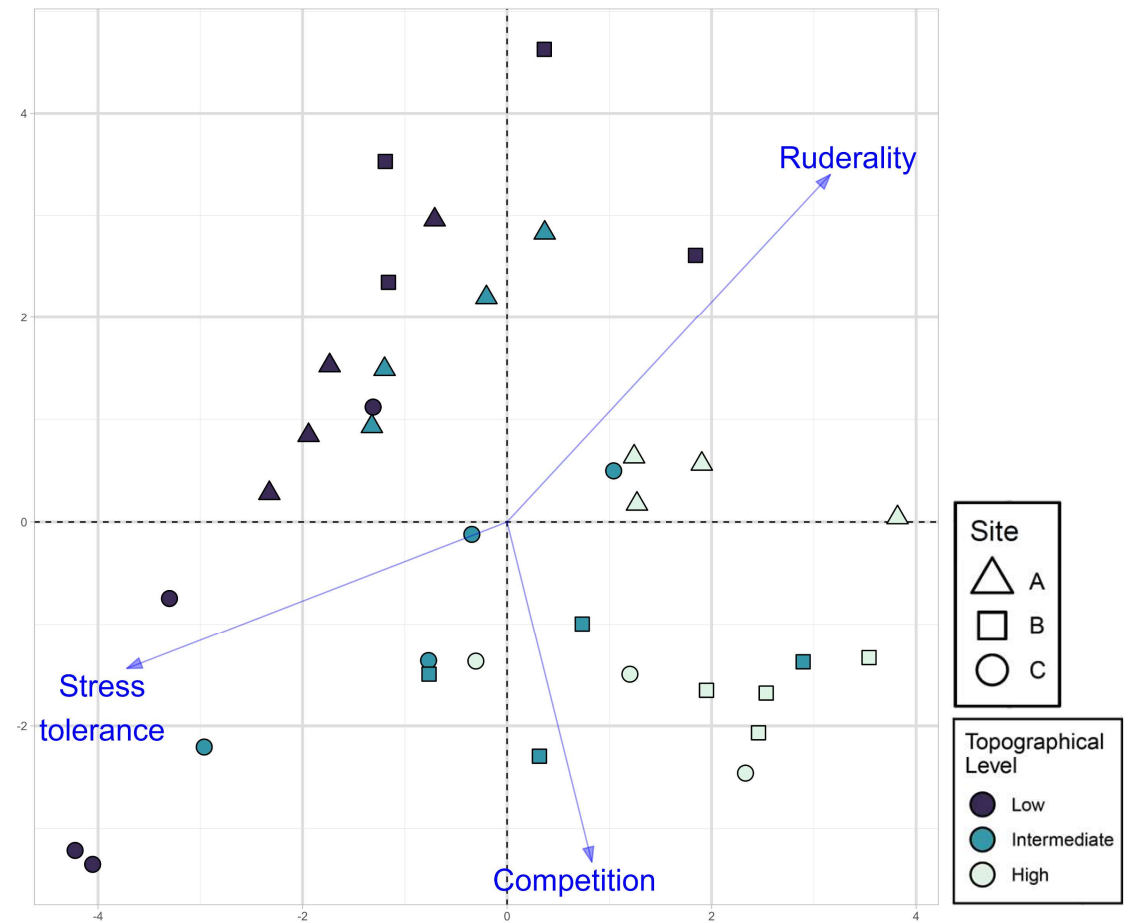
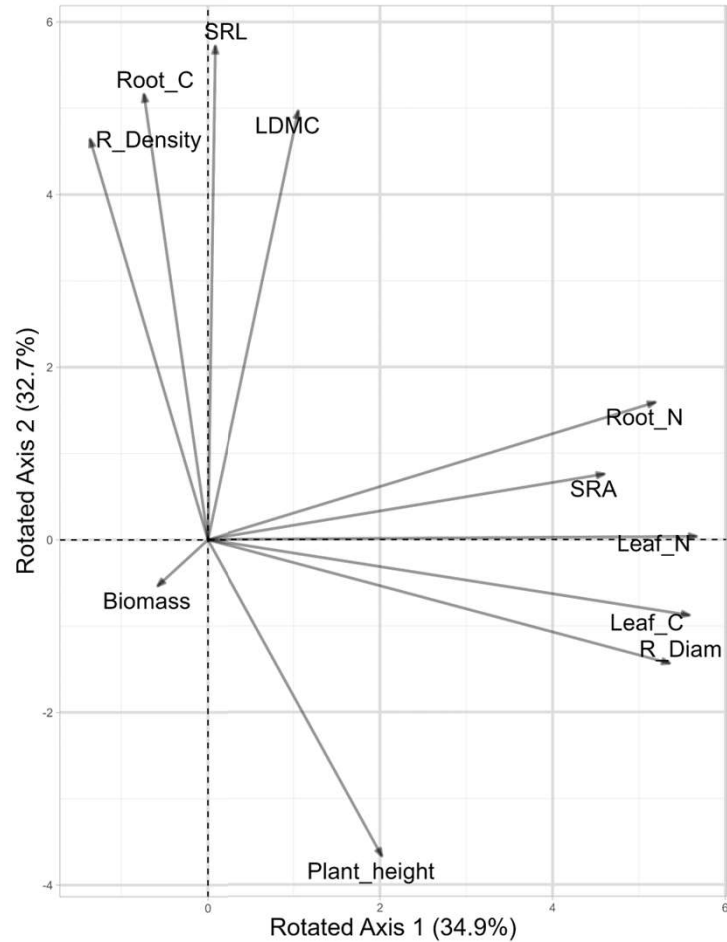


PCA

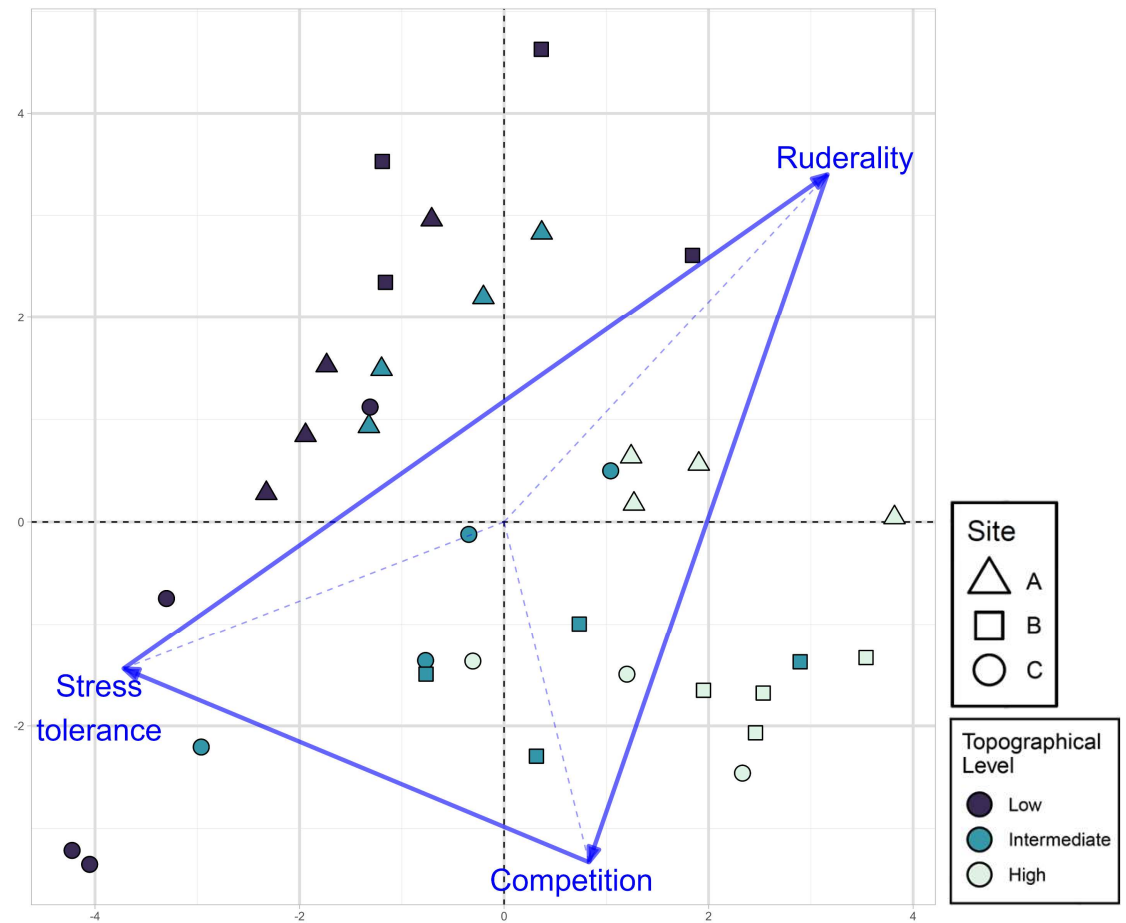
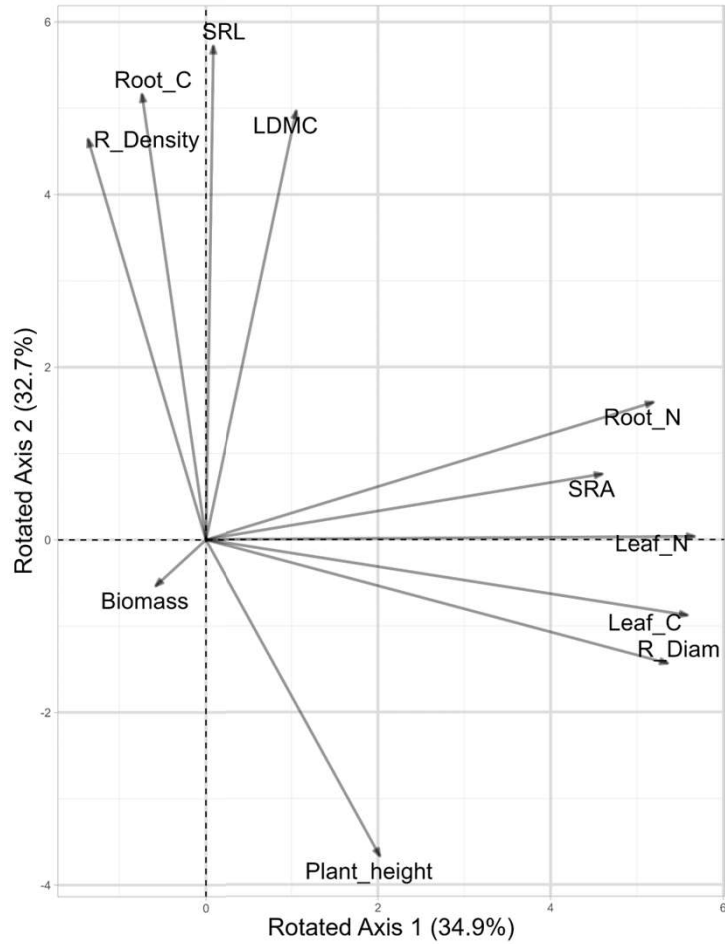
RESULTS: TRAITS



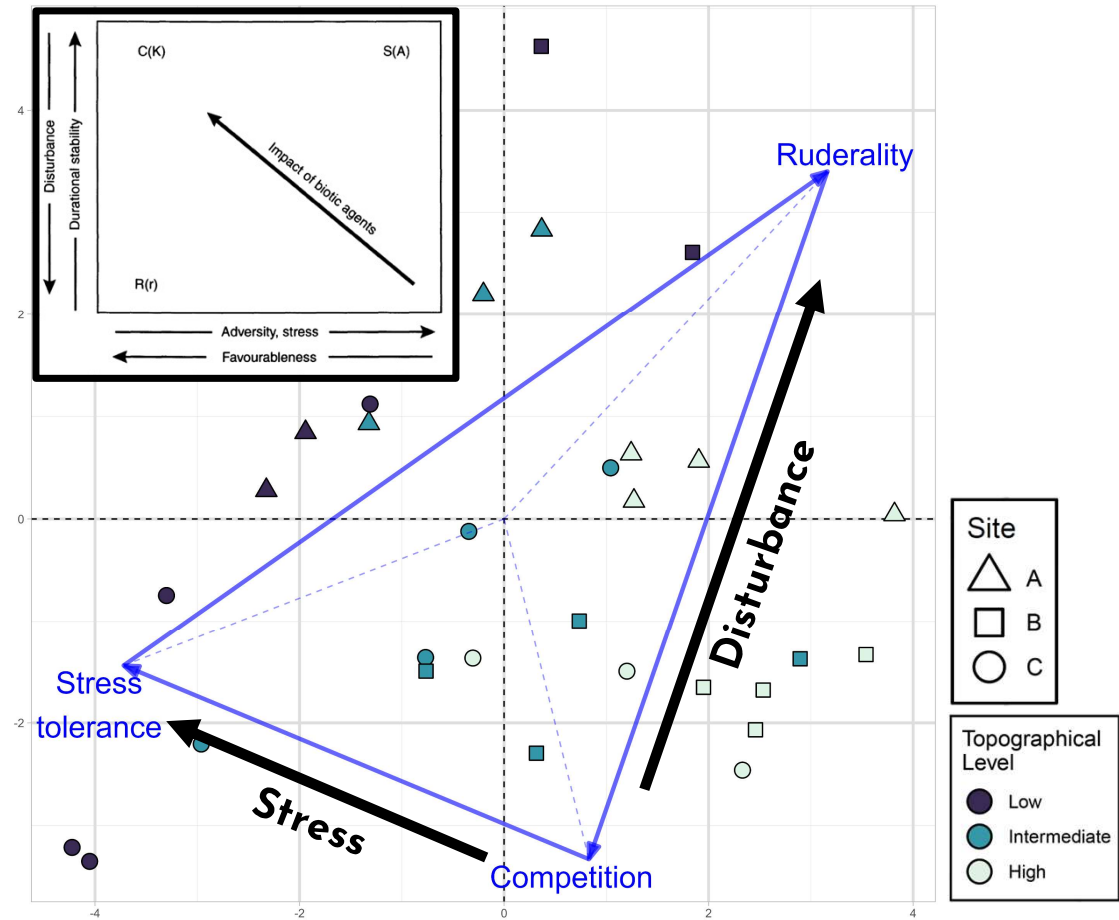
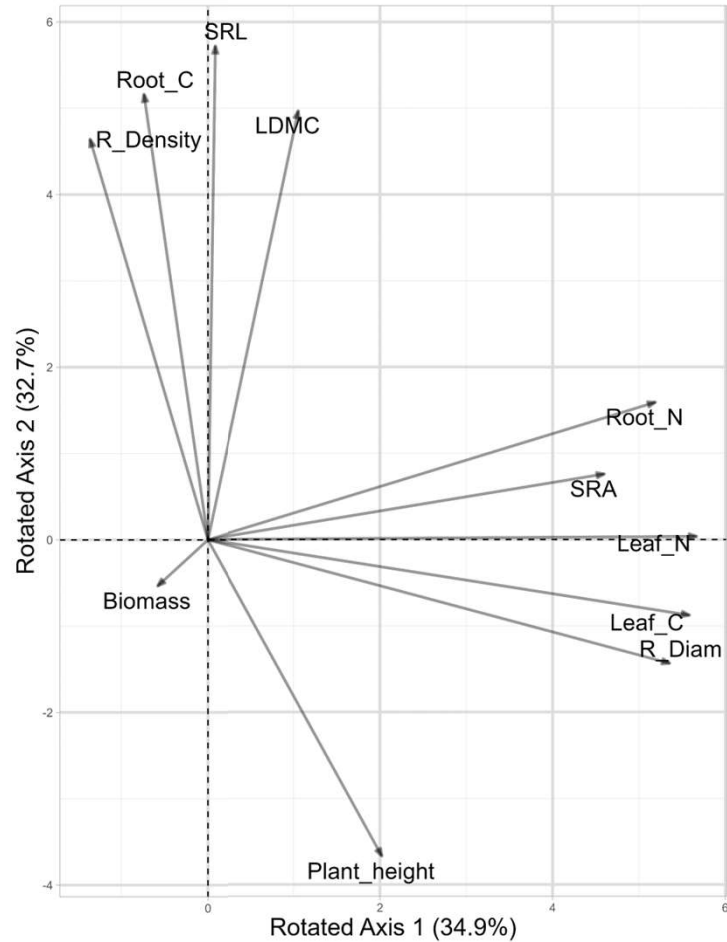
RESULTS: TRAITS



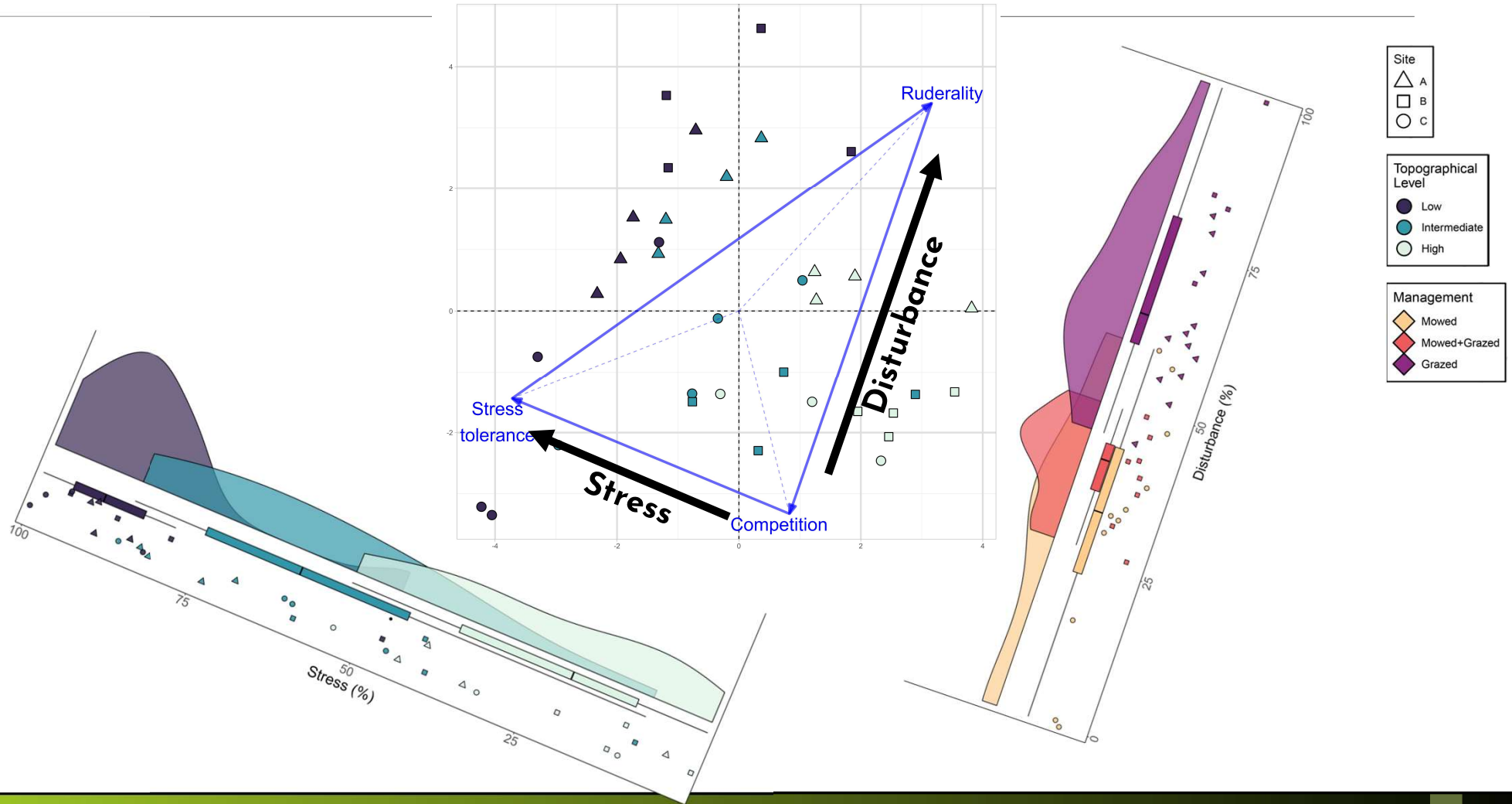
RESULTS: TRAITS



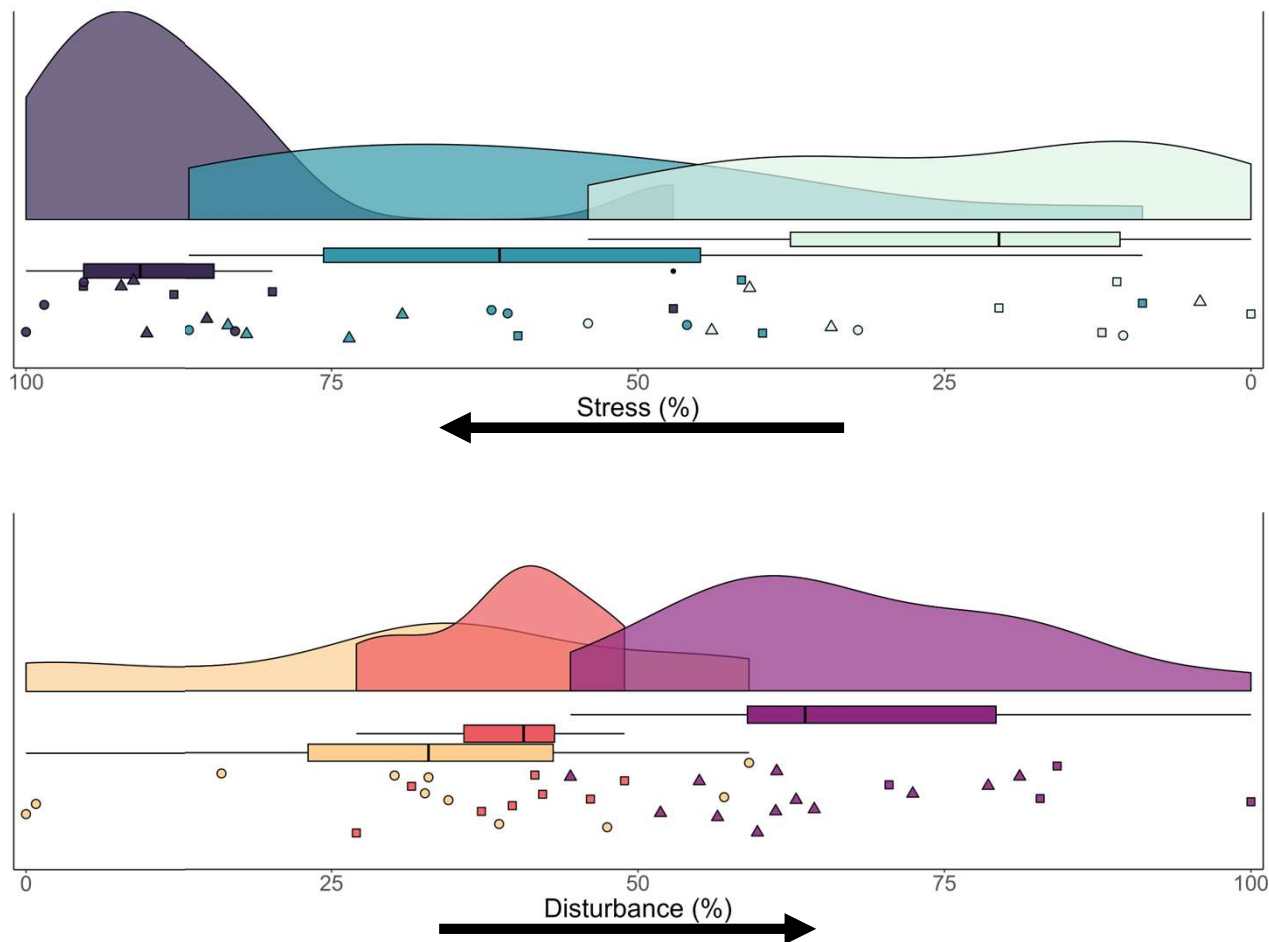
RESULTS: TRAITS



RESULTS: TRAITS



RESULTS: TRAITS



Topographical Level

- Low
- Intermediate
- High

Site

- △ A
- B
- C

Management

- ◇ Mowed
- ◇ Mowed+Grazed
- ◇ Grazed

CONCLUSION

1. Tidal restriction **truncates** the salinity and inundation gradients ...
 - a) ... which results in **different vegetation communities** ...
 - b) ... that can be explained by the **modified** physical and chemical **parameters** of these environments.

2. Different abiotic conditions select fitting plant life **strategies**.



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Tidal restriction can have unwanted side-effects:

- Freshwater retention,
- Carbon release.

Tidal restriction lengthens the stress gradient:

- Site A: 300 m
- Site B: 1,000 m
- Site C: 1,200 m

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Modeling spatial and temporal dynamics of plant species richness across tidal creeks in a temperate salt marsh

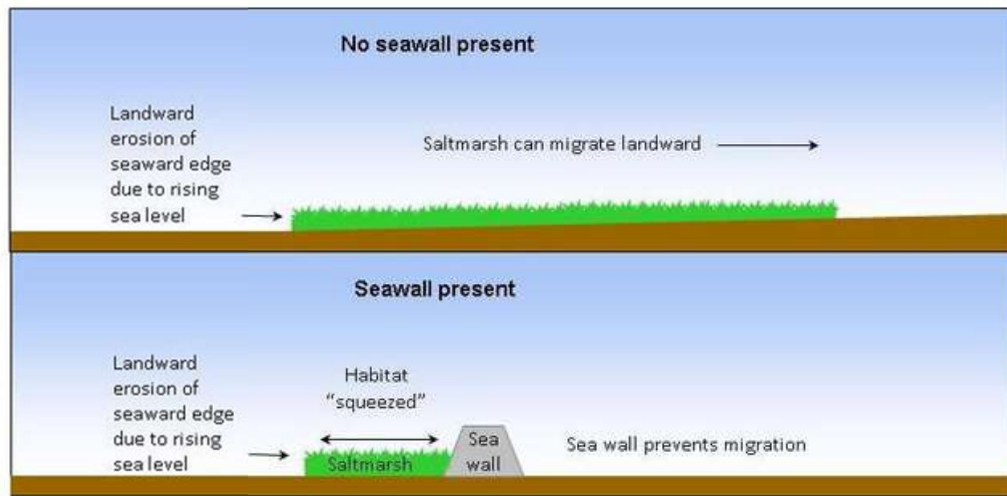
Daehyun Kim

Department of Geography, Seoul National University, Seoul 08826, South Korea

independent variables for both the spatial and temporal dynamics of species richness. In contrast, no environmental variables were consistently significant because of the substantial reduction in their regression coefficients after spatial regression. These results imply that identifying the relevant indicators of richness patterns in salt marshes may be a much more complicated job than previously thought. By revealing the new and statistically more rigorous predictive power of these environmental (i.e. non-spatial) variables, the spatially explicit mod-

PERSPECTIVE

- Rising sea level = salt marshes at risk.
- They may migrate inland, but risk of “coastal squeeze”.
- Tidal restriction as a tool to preserve salt marshes?



Nigel Pontee (2013)



THANK YOU.



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