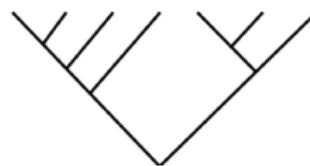


*TODO: Add Powerpoint coverslide  
manually*

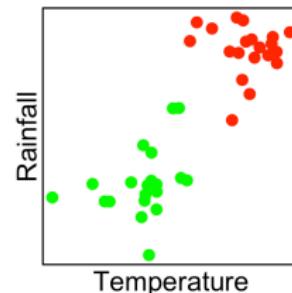
# Species richness ( $S$ )

# Species richness ( $S$ )

Speciation



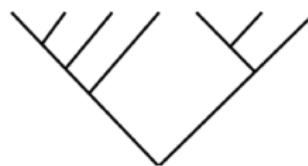
Co-existence



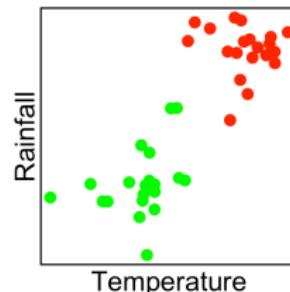
# Species richness ( $S$ )

Extremely high  $S$ ?

Speciation



Co-existence



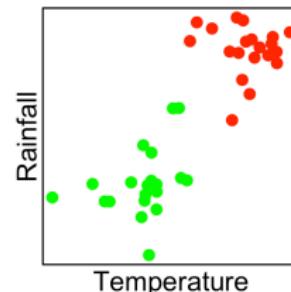
# Species richness ( $S$ )

Environmental heterogeneity (EH)

Speciation



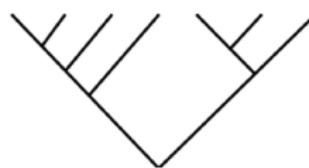
Co-existence



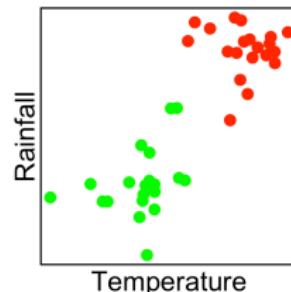
# Species richness ( $S$ )

Environmental heterogeneity (EH)

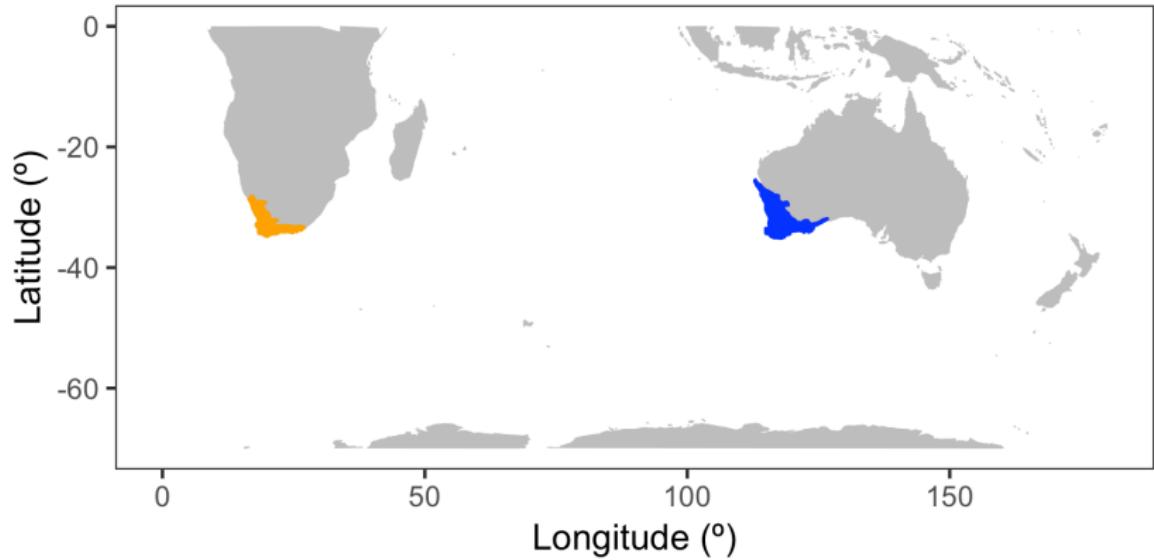
Speciation *along ecological gradients*



Co-existence *within ecological space*



# The Cape & SWA



# Similar

- Environments
- Plant ecologies

*mediterranean, winter rainfall  
serotiny, sclerophyllly*



# But different

- $S$  per unit area
- Topographies

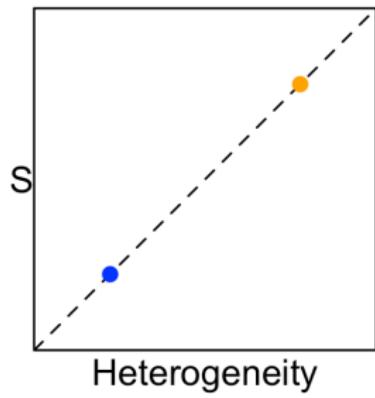
Cape > SWA  
mountainous vs flat

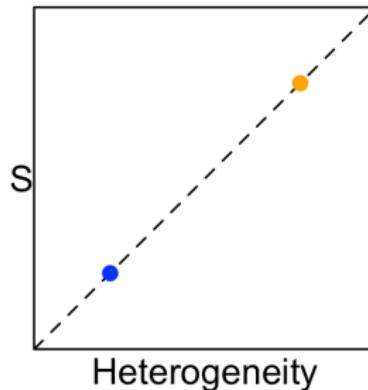


- EH shown previously as NB in the **Cape**<sup>1</sup>
- Does this extend to **SWA**?

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<sup>1</sup>Cramer & Verboom 2016. *J. Biogeography* 44(3)

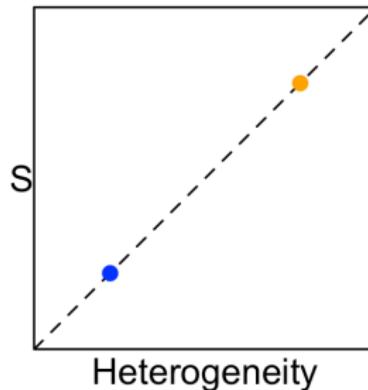




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Hypothesis      Cape vs SWA

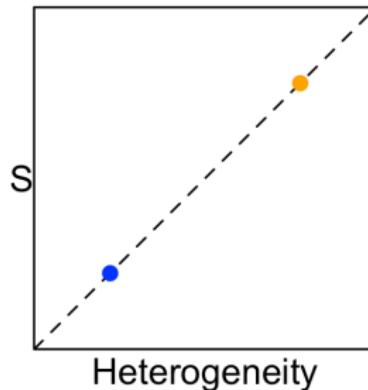
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| Hypothesis         | Cape vs SWA |
|--------------------|-------------|
| Degree of EH       | >           |
| Floristic turnover | >           |

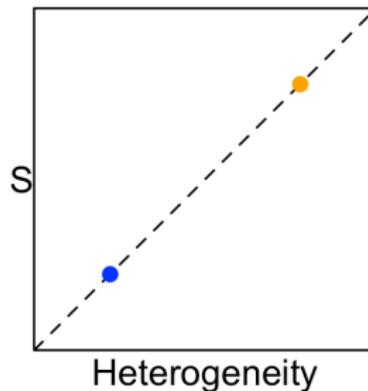
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| Hypothesis         | Cape vs SWA |
|--------------------|-------------|
| Degree of EH       | >           |
| Floristic turnover | >           |
| $S \sim EH$        |             |

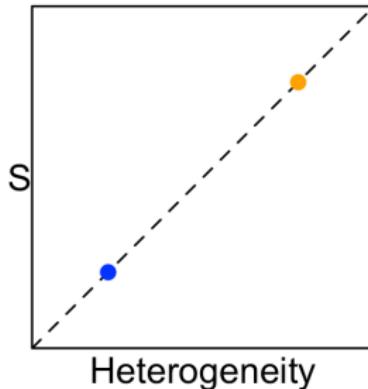
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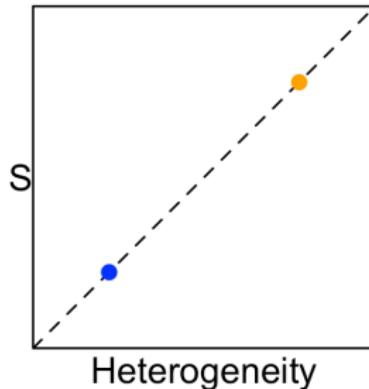
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| Hypothesis         | Cape vs SWA |
|--------------------|-------------|
| Degree of EH       | >           |
| Floristic turnover | >           |
| $S \sim EH$        | Both        |

---



| Hypothesis         | Cape vs SWA |
|--------------------|-------------|
| Degree of EH       | >           |
| Floristic turnover | >           |
| $S \sim EH$        | Both        |
| Types of EH        |             |



| Hypothesis         | Cape vs SWA       |
|--------------------|-------------------|
| Degree of EH       | >                 |
| Floristic turnover | >                 |
| $S \sim \text{EH}$ | Both              |
| Types of EH        | Topography? Soil? |

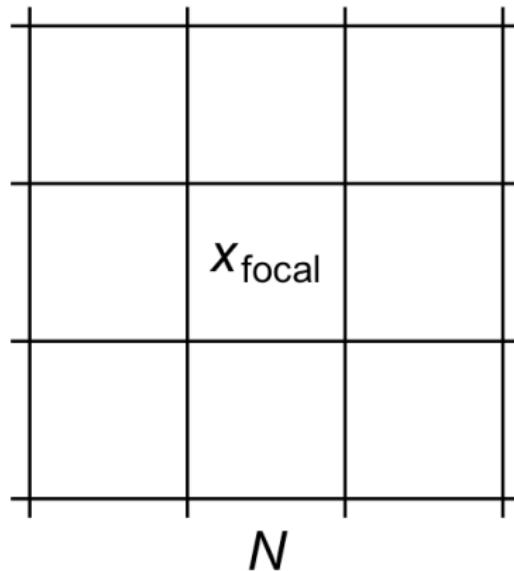
# Data sources

- Each region's boundaries
- Environmental data
  - NASA MODIS, CHIRPS, SoilsGrid250m
- Vascular plant occurrence records
  - GBIF

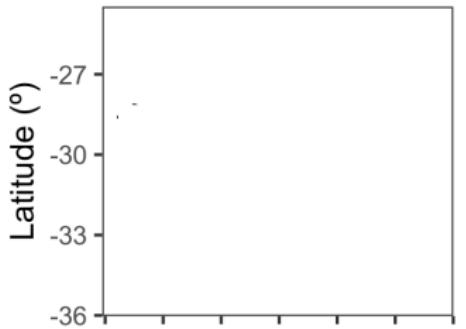
# Quantifying EH

Local neighbourhood  $N$  about cell  $x_{focal}$

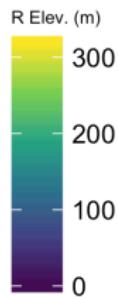
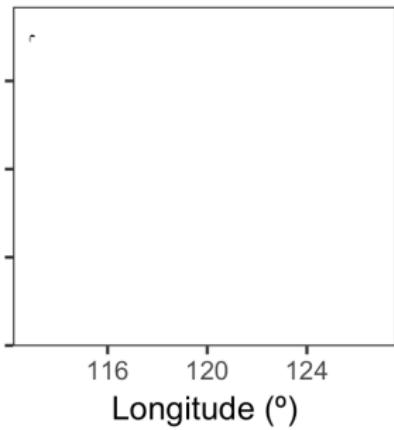
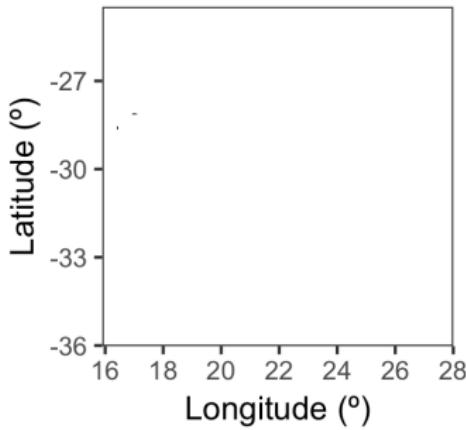
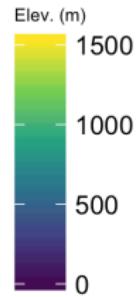
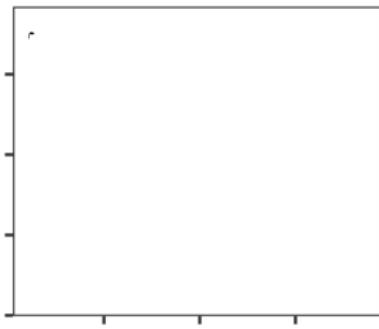
$$\text{Roughness } R(N) = SD_{focal}(N)$$



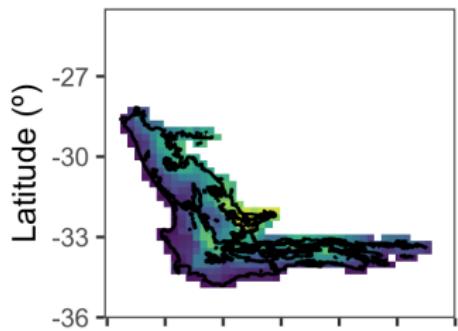
Cape



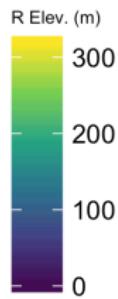
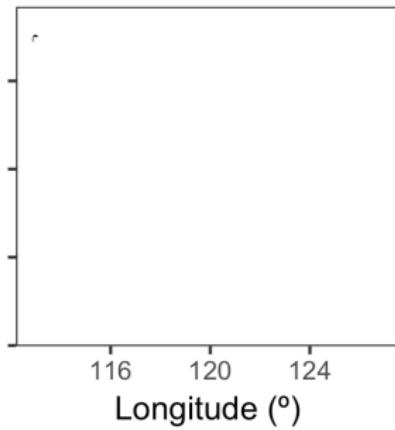
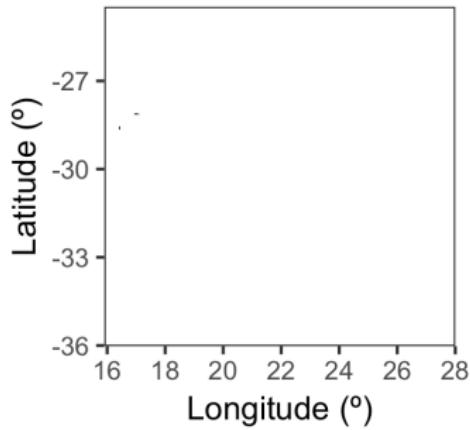
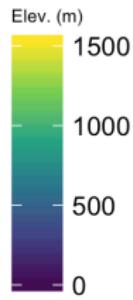
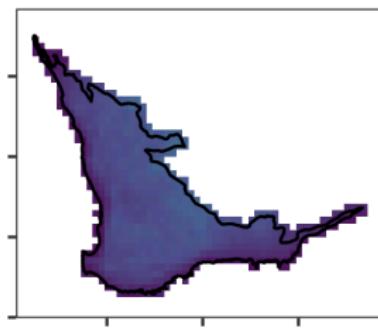
SWA



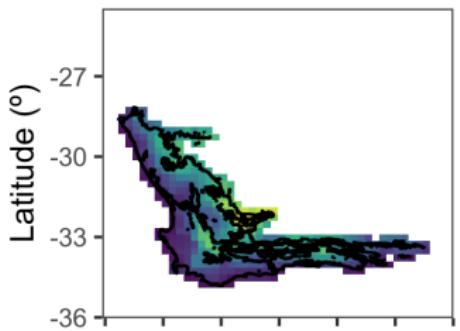
Cape



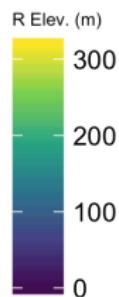
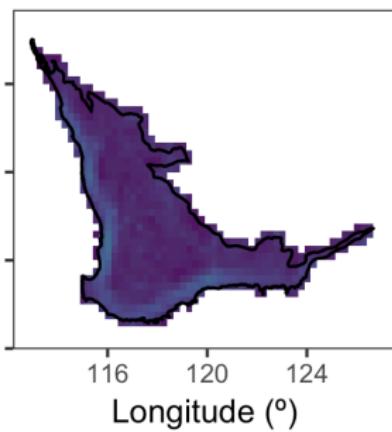
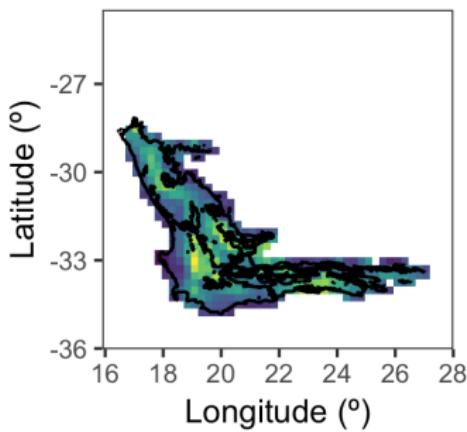
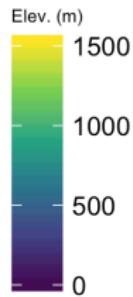
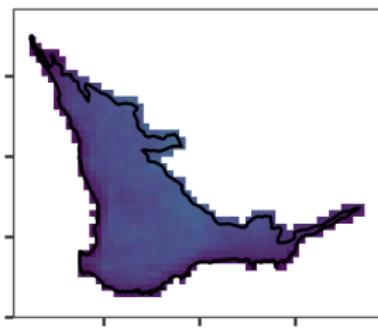
SWA



Cape



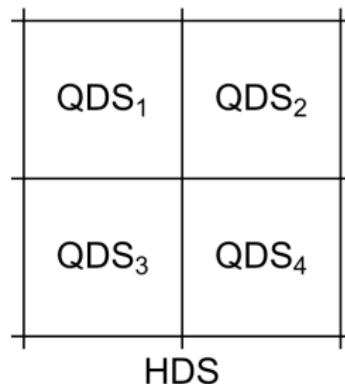
SWA

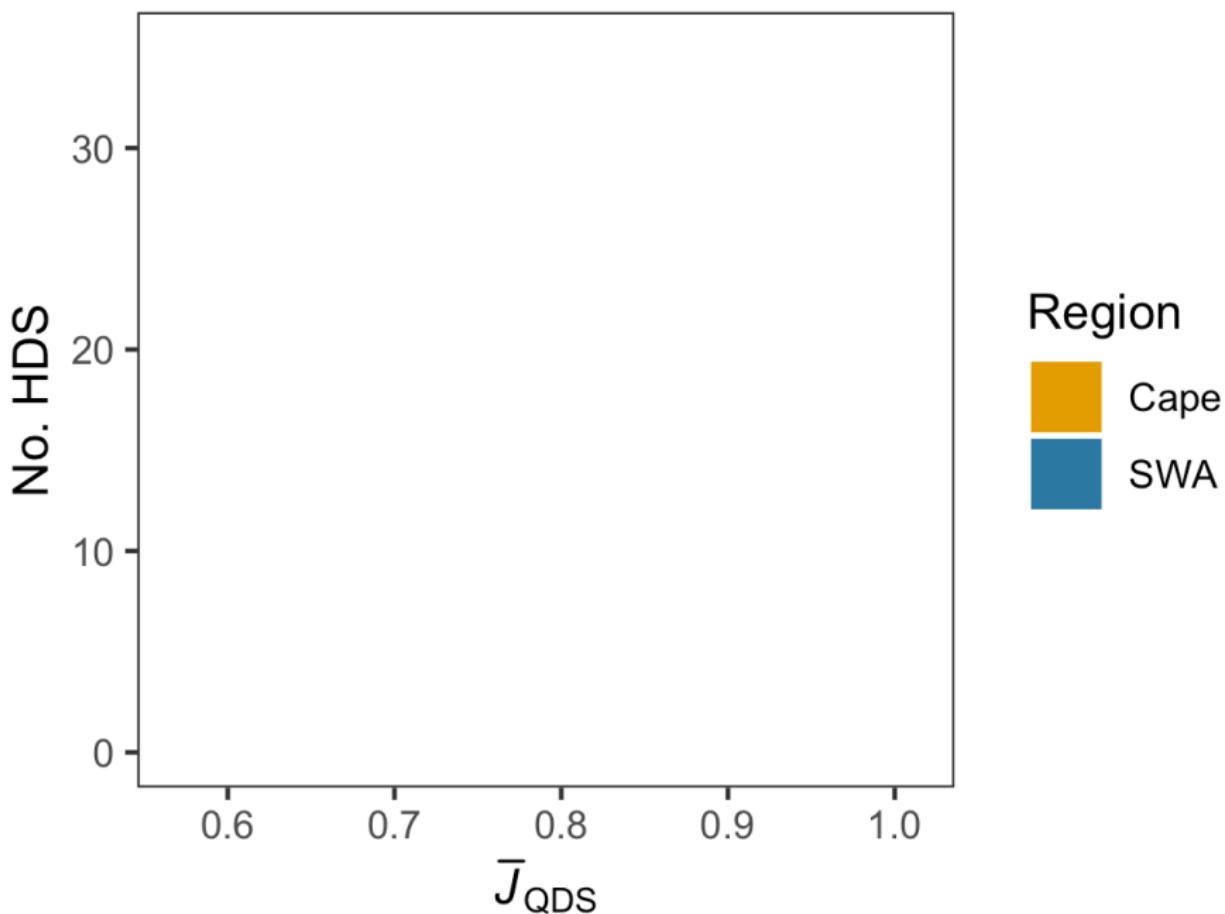


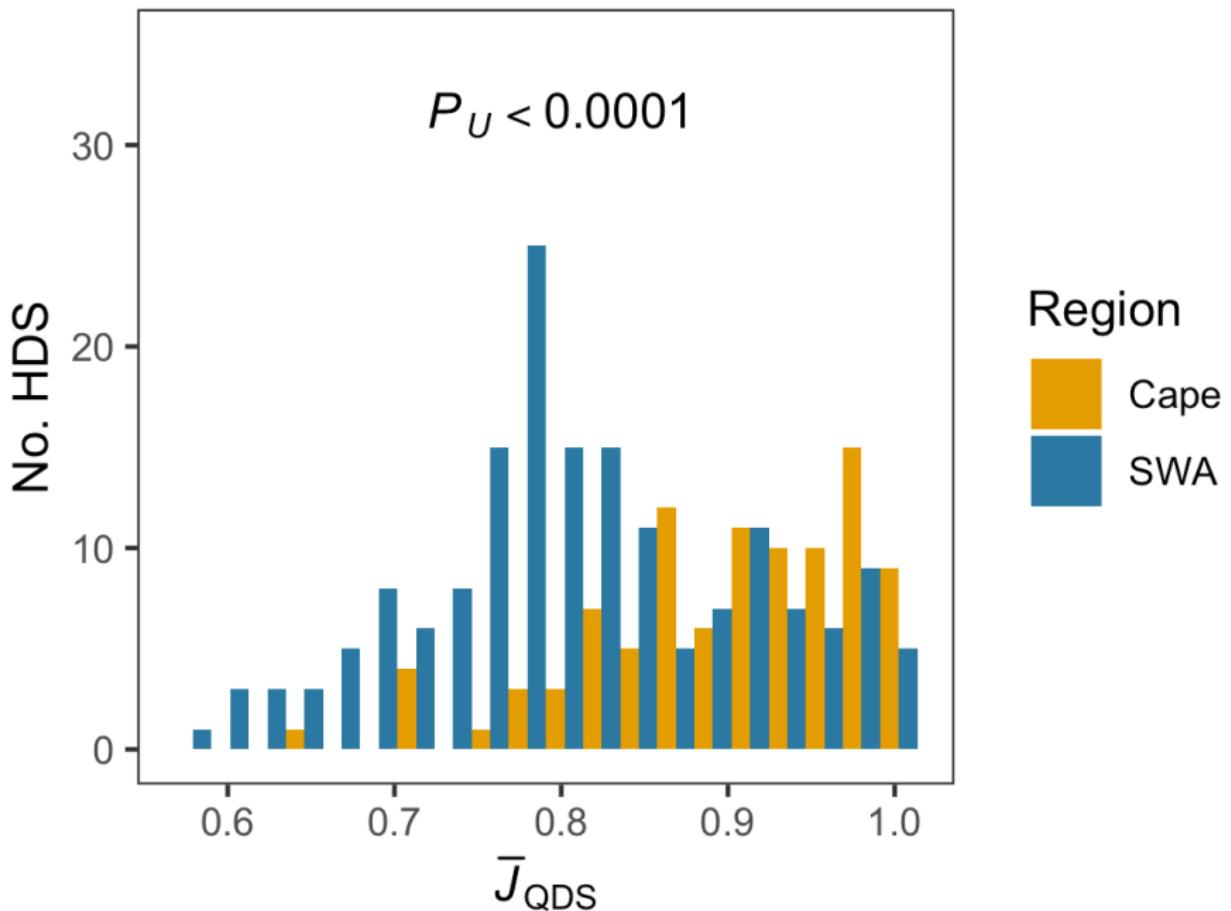
# Species turnover

Each HDS is composed of 2–4 QDS

$$\bar{J}_{QDS} = \text{average Jaccard distance between QDS}$$







# Relating $S$ & EH: BRT-modelling

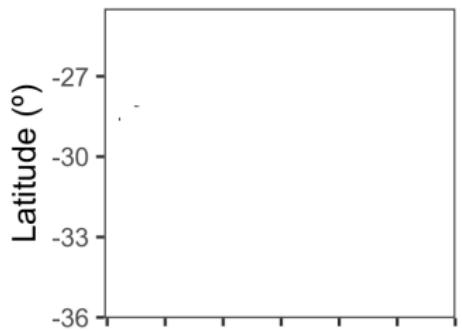
- Machine-learning
- Non-linear, complex & multivariate datasets

# Relating $S$ & EH: BRT-modelling

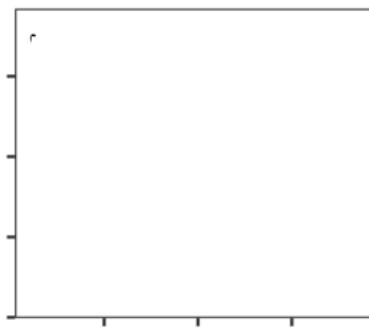
- Machine-learning
- Non-linear, complex & multivariate datasets

$$\hat{S} = w_1 \begin{array}{c} \text{L} \\ \text{U} \\ \text{T} \end{array} + w_2 \begin{array}{c} \text{L} \\ \text{U} \\ \text{T} \end{array} + w_3 \begin{array}{c} \text{L} \\ \text{U} \\ \text{U} \\ \text{T} \end{array} + \dots + w_n \begin{array}{c} \text{L} \\ \text{U} \\ \text{T} \end{array}$$

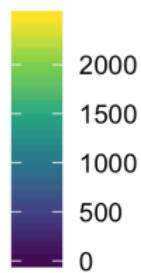
Cape



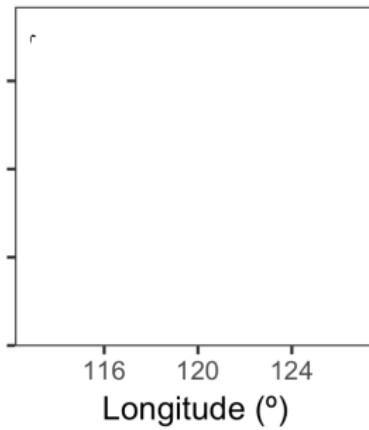
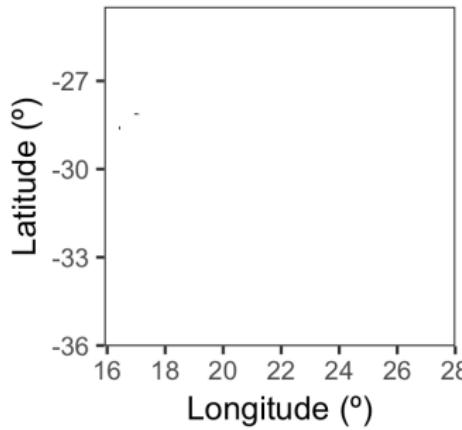
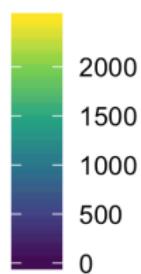
SWA



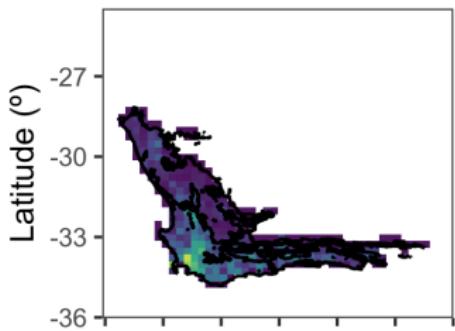
$S_{QDS}$



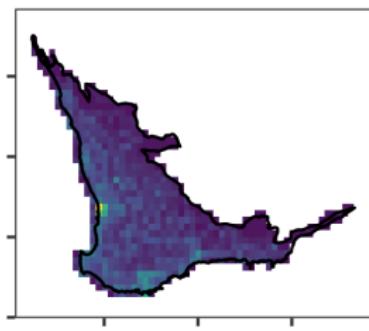
$\hat{S}_{QDS}$



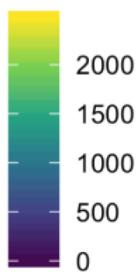
Cape



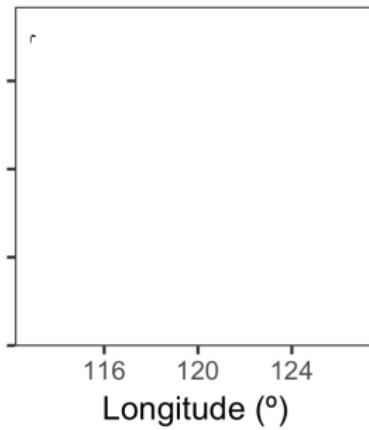
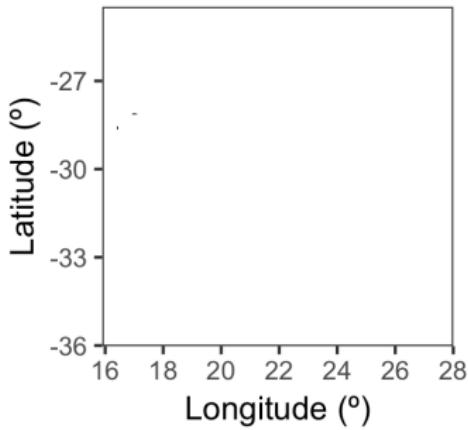
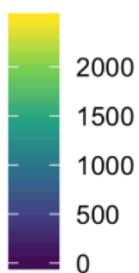
SWA



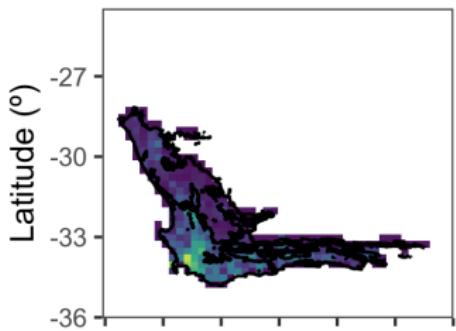
$S_{QDS}$



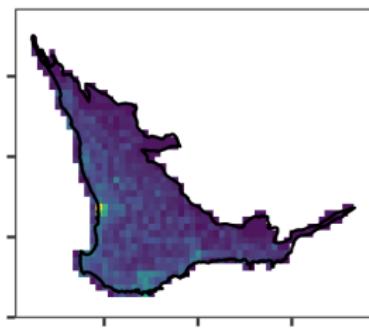
$\hat{S}_{QDS}$



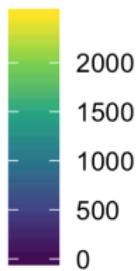
Cape



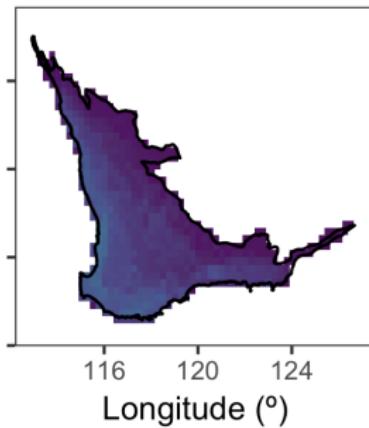
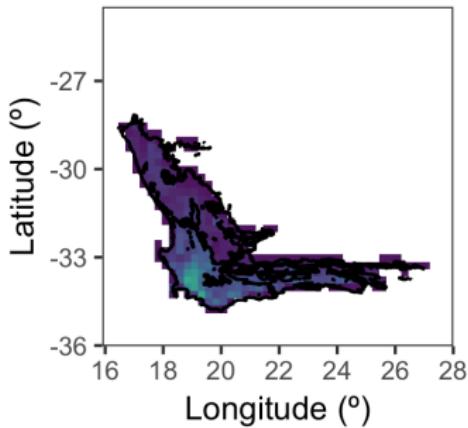
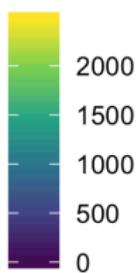
SWA



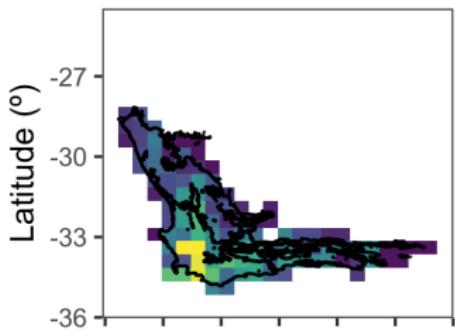
$S_{QDS}$



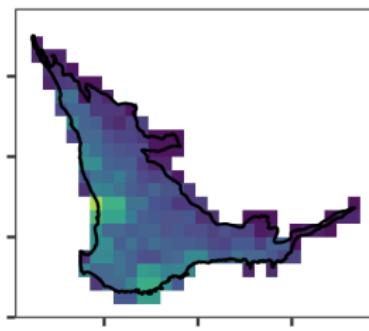
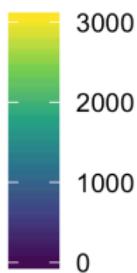
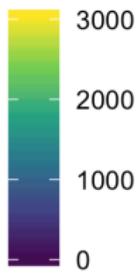
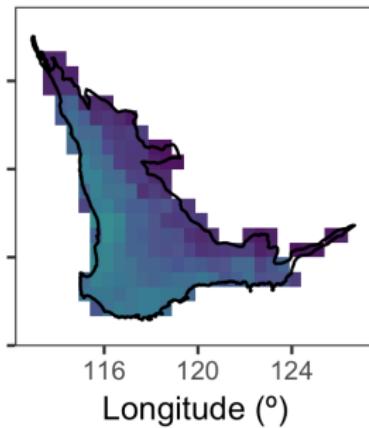
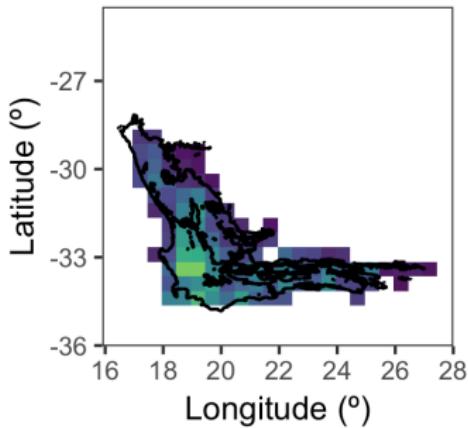
$\hat{S}_{QDS}$



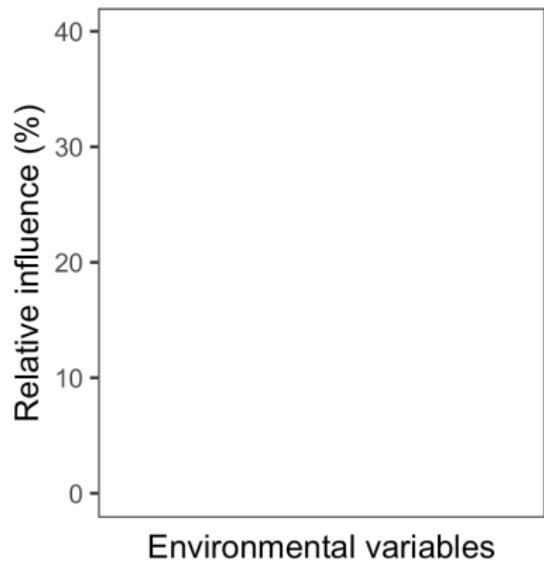
Cape



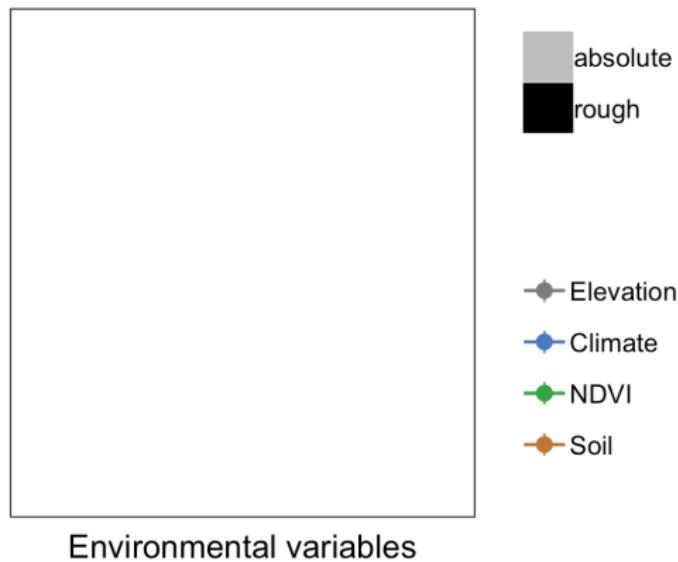
SWA

 $S_{HDS}$  $\hat{S}_{HDS}$ 

Cape richness QDS



SWA richness QDS



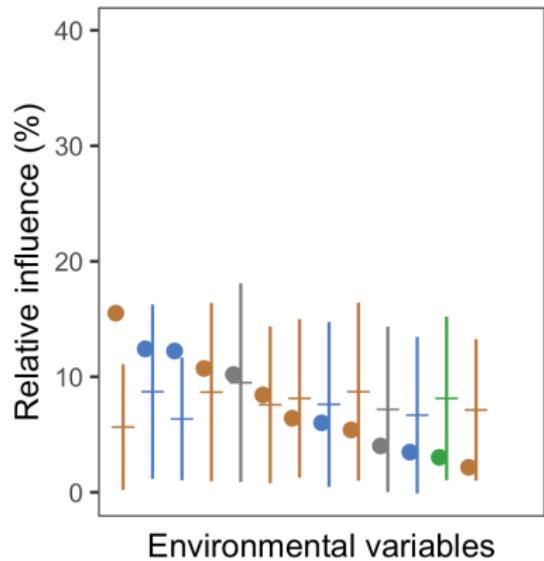
Legend:

- absolute (light gray)
- rough (dark gray)

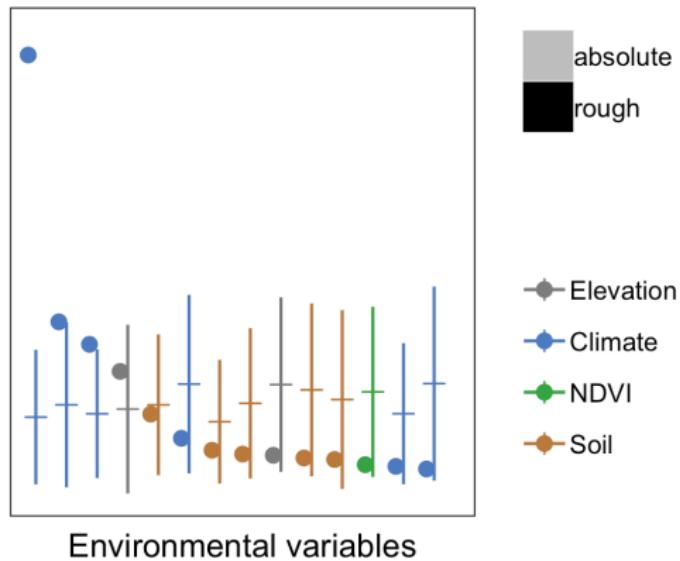
Legend:

- Elevation
- Climate
- NDVI
- Soil

### Cape richness QDS



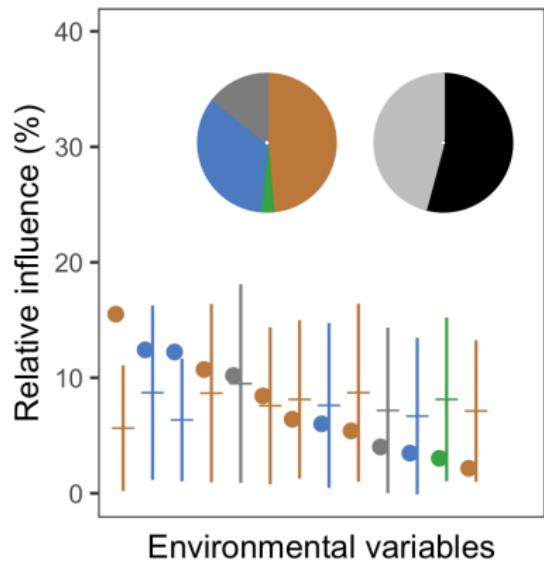
### SWA richness QDS



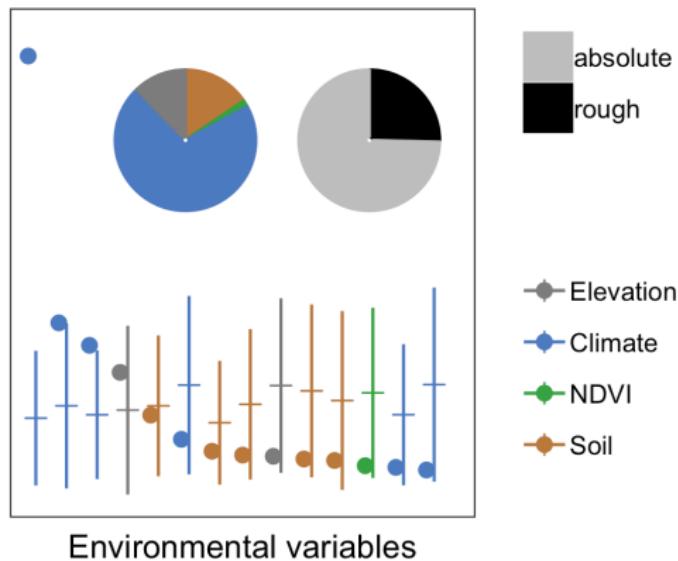
absolute  
rough

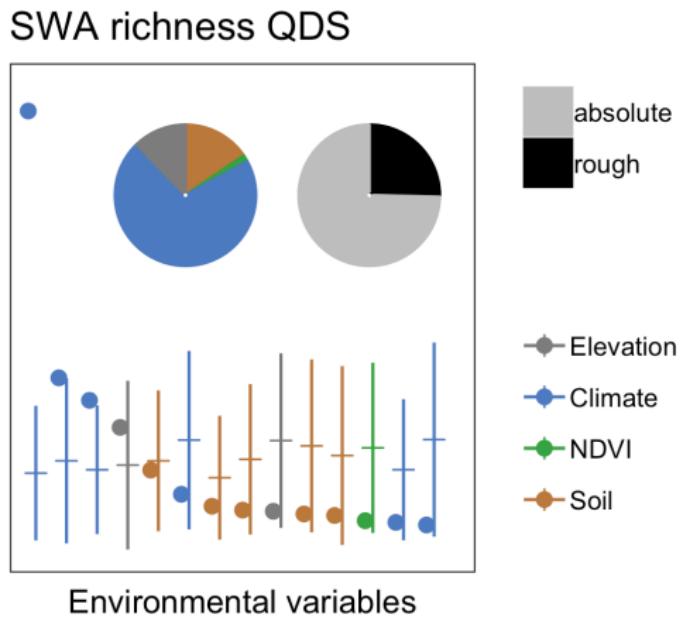
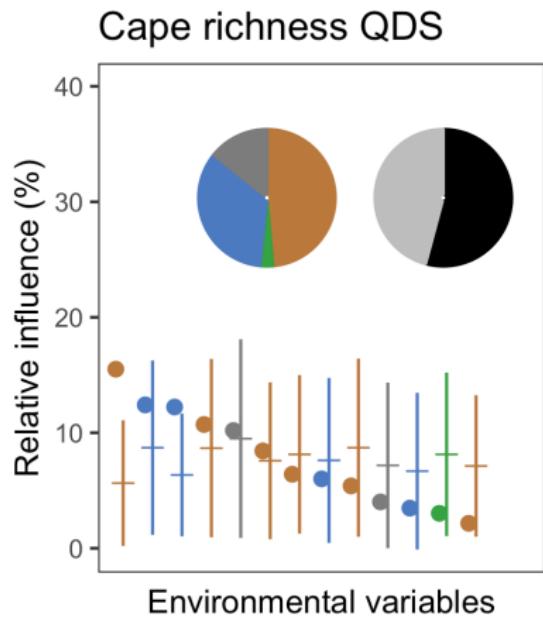
Elevation  
Climate  
NDVI  
Soil

### Cape richness QDS



### SWA richness QDS

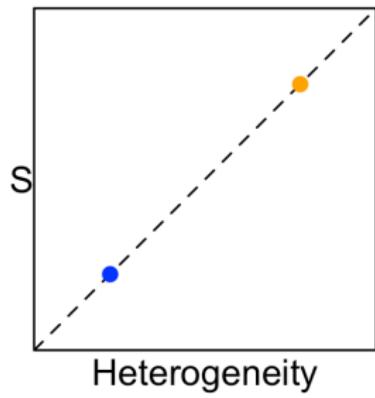


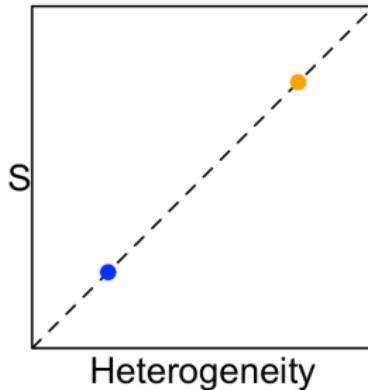



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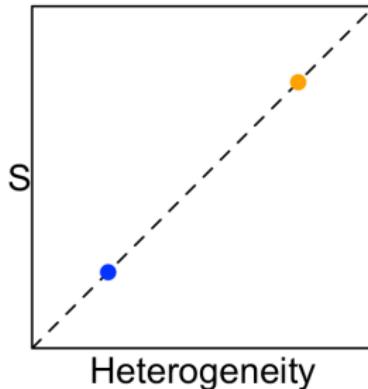
|                          | Cape | SWA               |
|--------------------------|------|-------------------|
| Broad suite of variables |      |                   |
| Roughness, soil          |      | Absolute, climate |

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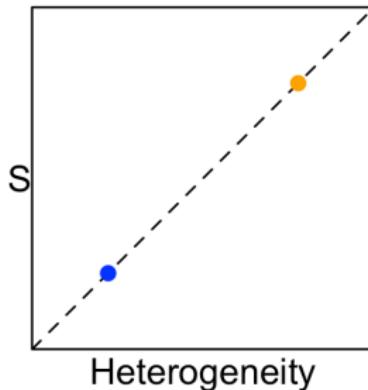




| Hypothesis         | Cape vs SWA       | ✓? |
|--------------------|-------------------|----|
| Degree of EH       | >                 |    |
| Floristic turnover | >                 |    |
| $S \sim EH$        | Both              |    |
| Types of EH        | Topography? Soil? |    |



| Hypothesis         | Cape vs SWA       | ✓? |
|--------------------|-------------------|----|
| Degree of EH       | >                 | ✓  |
| Floristic turnover | >                 | ✓  |
| $S \sim \text{EH}$ | Both              | ✓  |
| Types of EH        | Topography? Soil? |    |



| Hypothesis         | Cape vs SWA       | ✓?            |
|--------------------|-------------------|---------------|
| Degree of EH       | >                 | ✓             |
| Floristic turnover | >                 | ✓             |
| $S \sim EH$        | Both              | ✓             |
| Types of EH        | Topography? Soil? | $\frac{1}{2}$ |

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Soil?

Thank you<sup>1</sup>!



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<sup>1</sup>And an extra thank you to my supervisors, Mike & Tony