



Supervised by
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A/Prof G.A. Verboom



Environmental turnover predicts plant species richness & turnover

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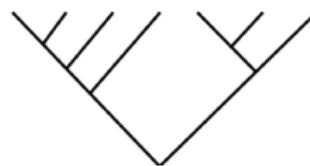


Comparing the Greater Cape Floristic Region
&
the Southwest Australia Floristic Region

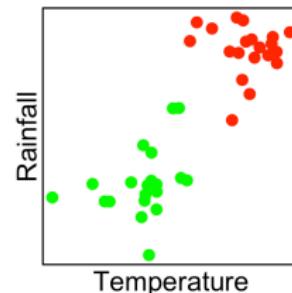
Species richness (S)

Species richness (S)

Speciation



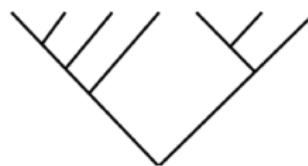
Co-existence



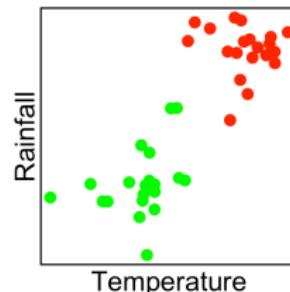
Species richness (S)

Extremely high S ?

Speciation



Co-existence



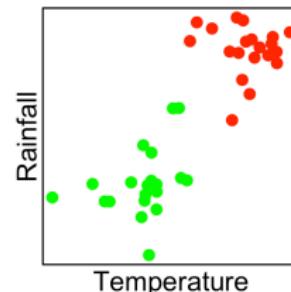
Species richness (S)

Environmental heterogeneity (EH)

Speciation



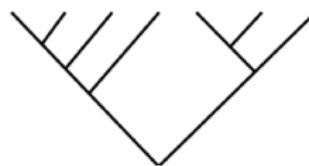
Co-existence



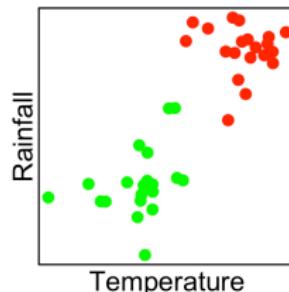
Species richness (S)

Environmental heterogeneity (EH)

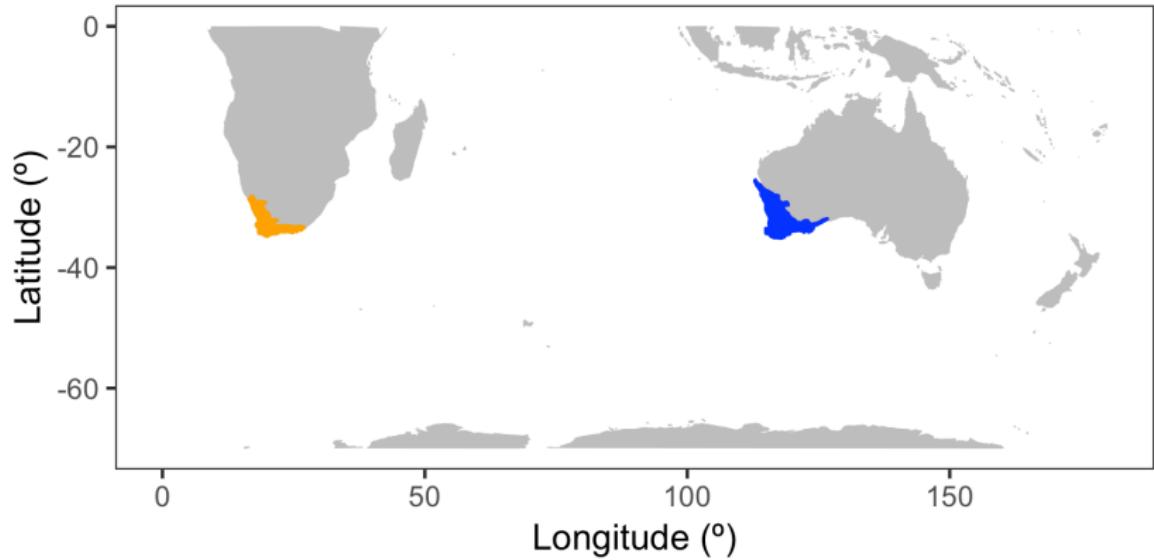
Speciation *along ecological gradients*



Co-existence *within ecological space*



The Cape & SWA



Similar

- Environments
- Plant ecologies

*mediterranean, winter rainfall
serotiny, sclerophyllly*



But different

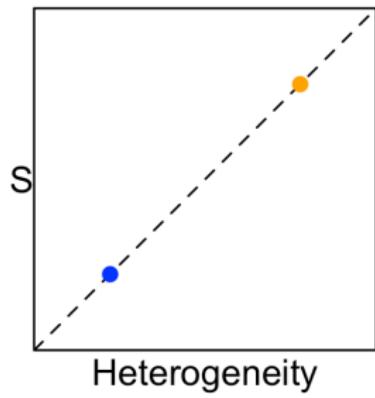
- S per unit area
- Topographies

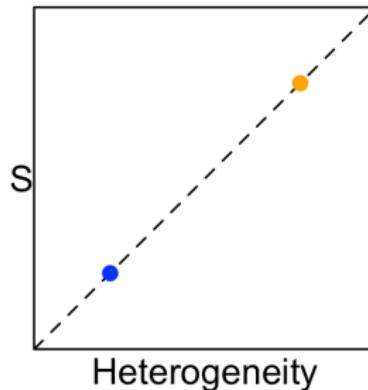
Cape > SWA
mountainous vs flat



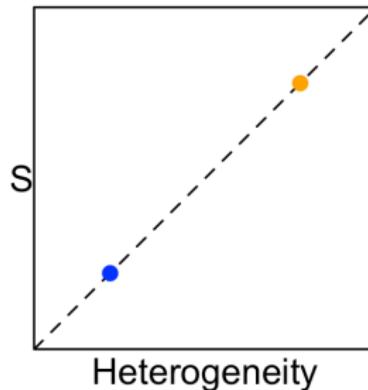
- EH shown previously as NB in the **Cape**¹
- Does this extend to **SWA**?

¹Cramer & Verboom 2016. *J. Biogeography* 44(3)

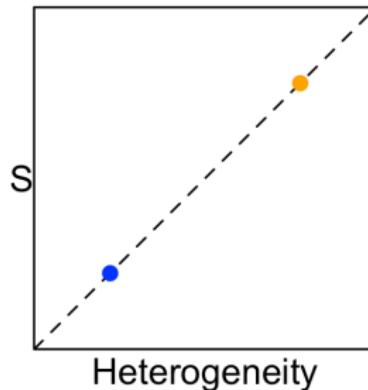




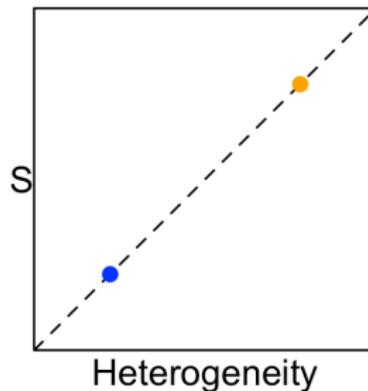
Hypothesis Cape vs SWA



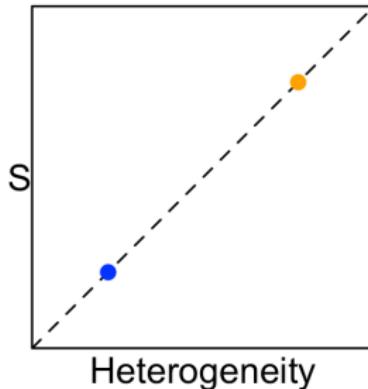
Hypothesis	Cape vs SWA
Degree of EH	>
Floristic turnover	>



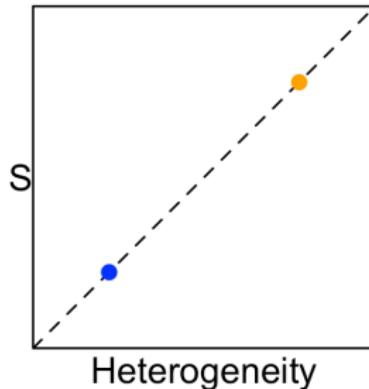
Hypothesis	Cape vs SWA
Degree of EH	>
Floristic turnover	>
$S \sim EH$	



Hypothesis	Cape vs SWA
Degree of EH	>
Floristic turnover	>
$S \sim \text{EH}$	Both



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Degree of EH	>
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$S \sim EH$	Both
Types of EH	



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

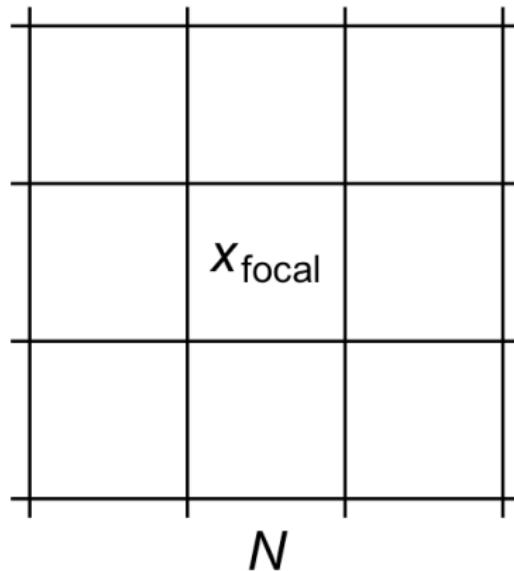
Data sources

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

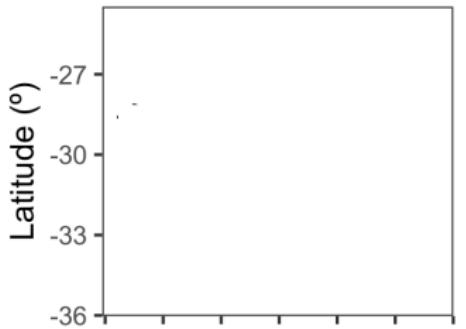
Quantifying EH

Local neighbourhood N about cell x_{focal}

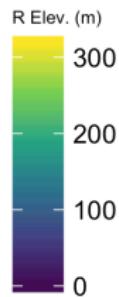
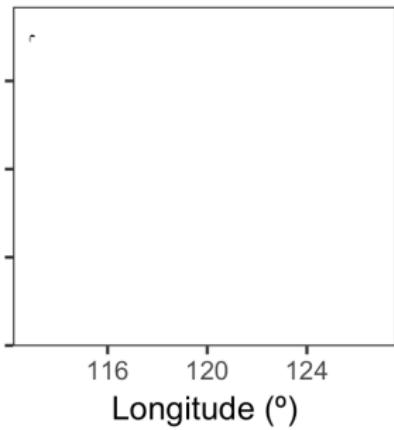
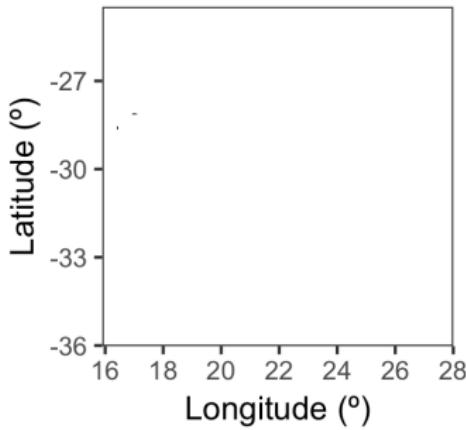
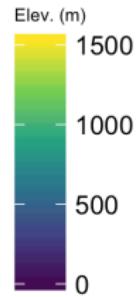
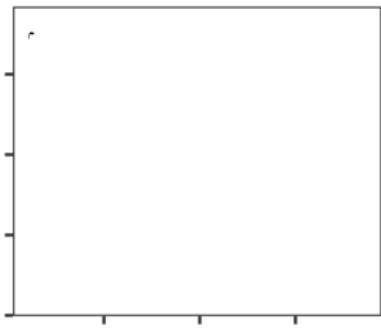
$$\text{Roughness } R(N) = SD_{focal}(N)$$



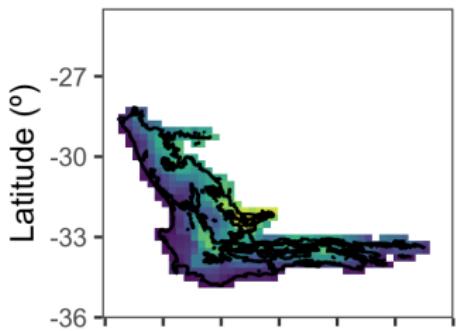
Cape



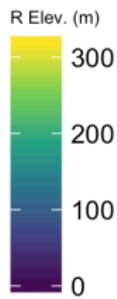
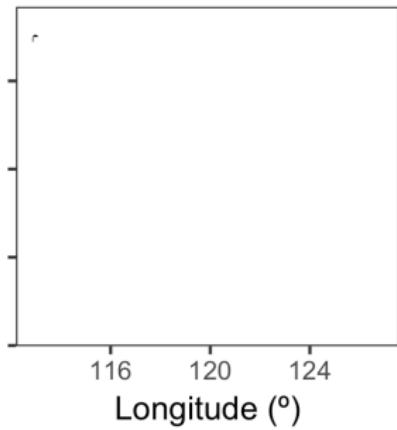
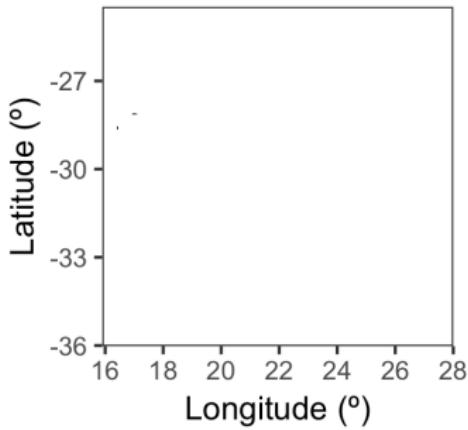
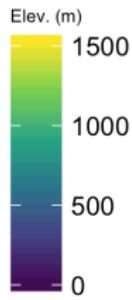
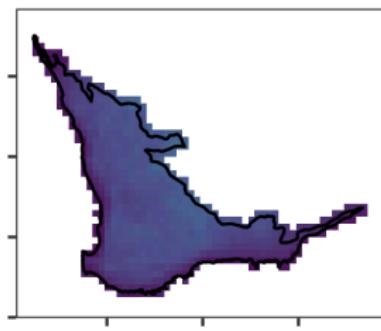
SWA



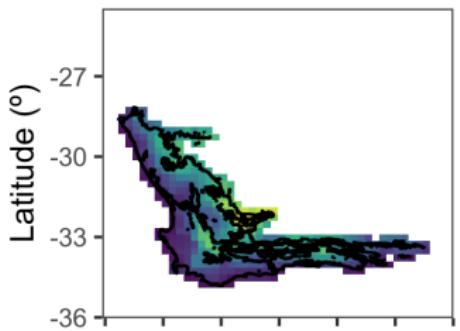
Cape



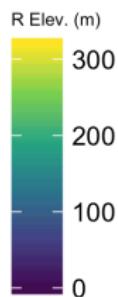
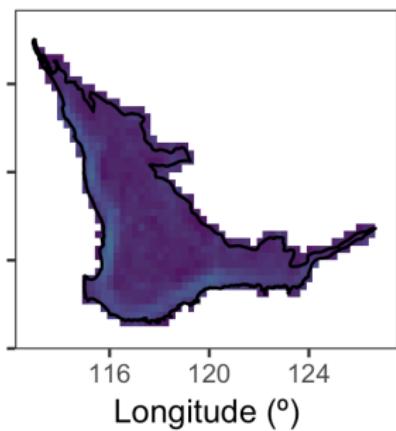
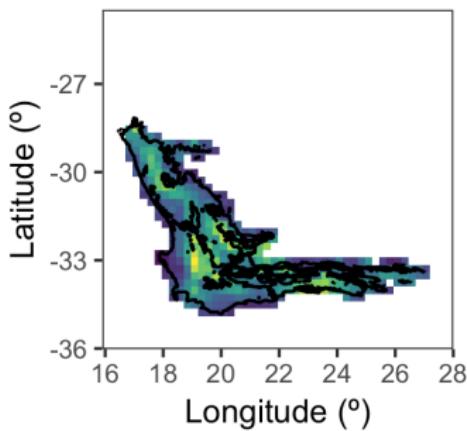
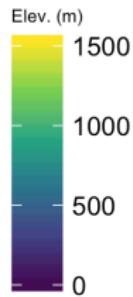
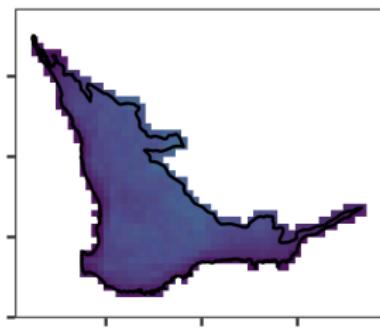
SWA



Cape



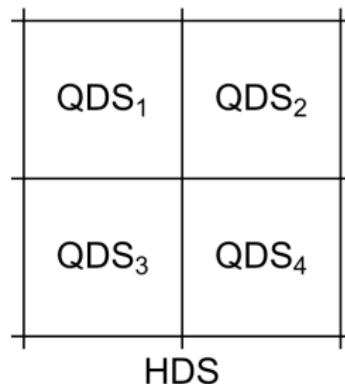
SWA

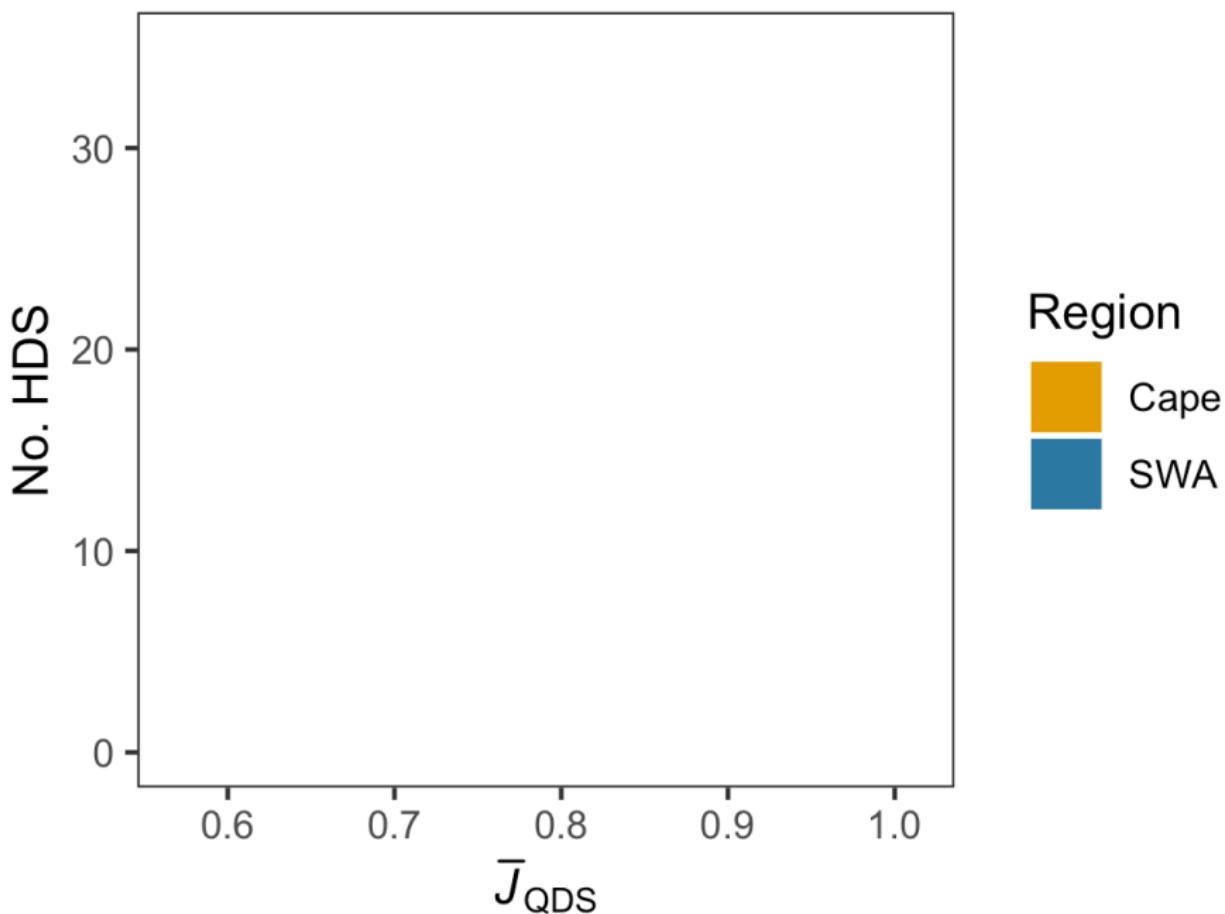


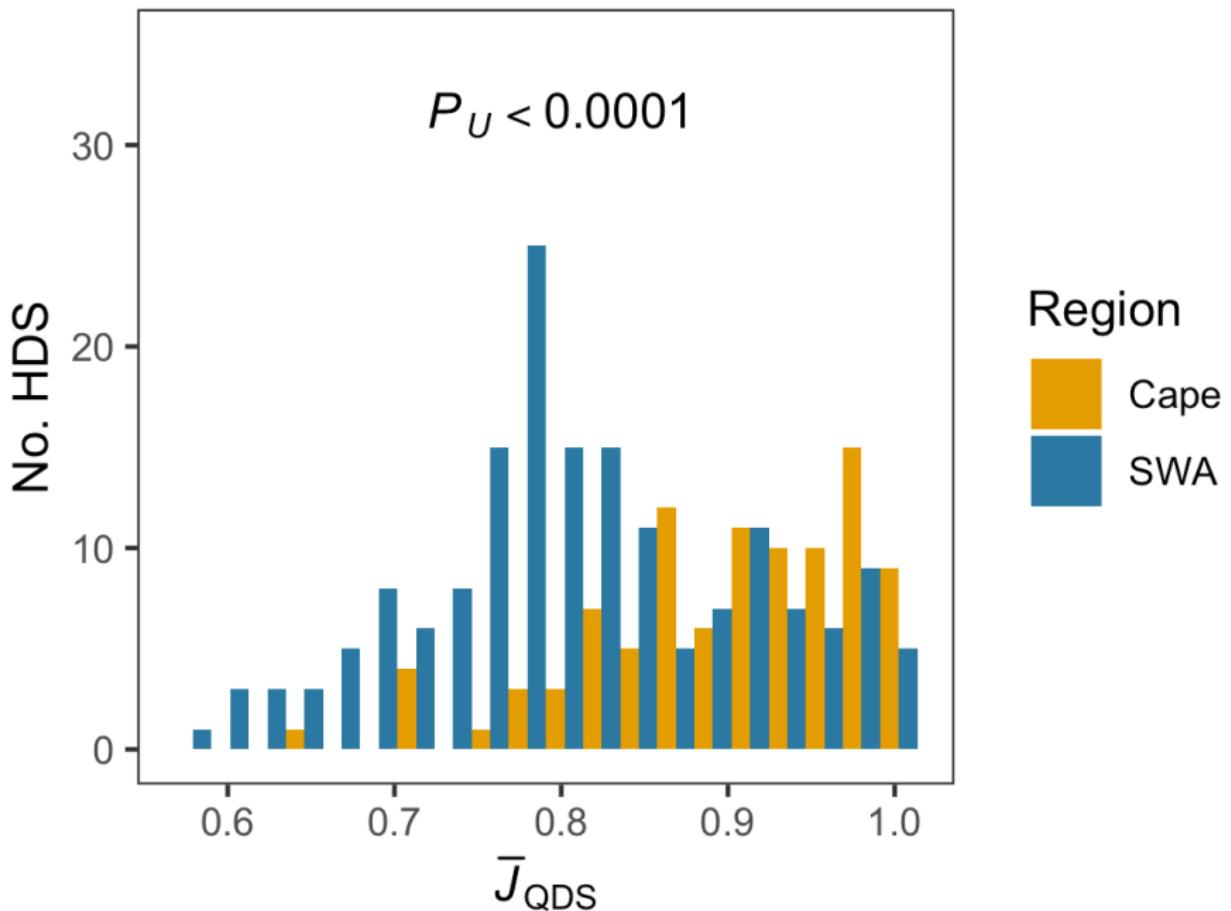
Species turnover

Each HDS is composed of 2–4 QDS

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







Relating S & EH: BRT-modelling

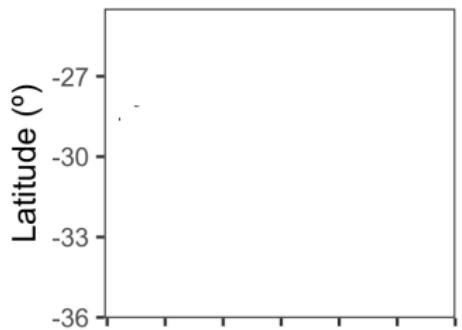
- Machine-learning
- Non-linear, complex & multivariate datasets

Relating S & EH: BRT-modelling

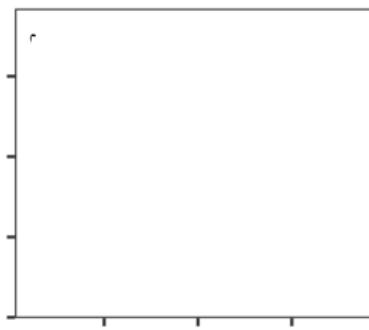
- Machine-learning
- Non-linear, complex & multivariate datasets

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

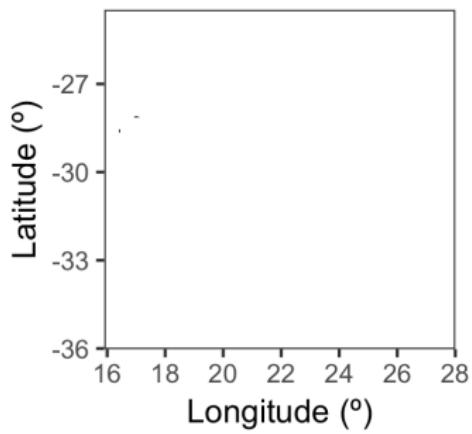
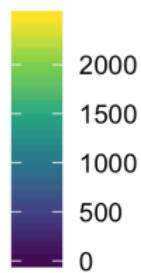
Cape



SWA

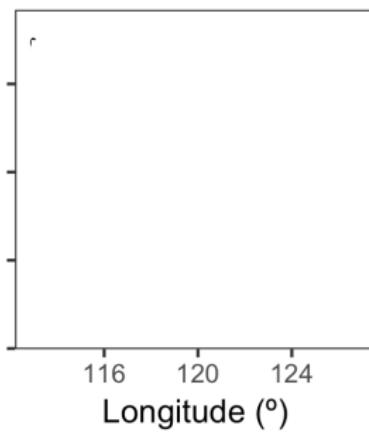
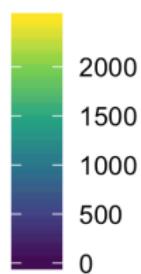


S_{QDS}



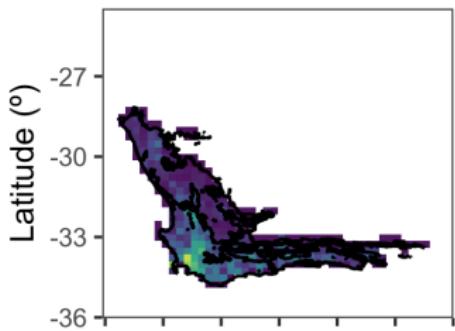
Longitude ($^{\circ}$)

\hat{S}_{QDS}

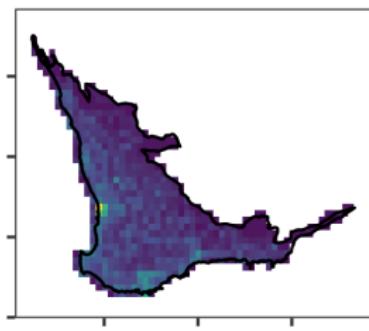


Longitude ($^{\circ}$)

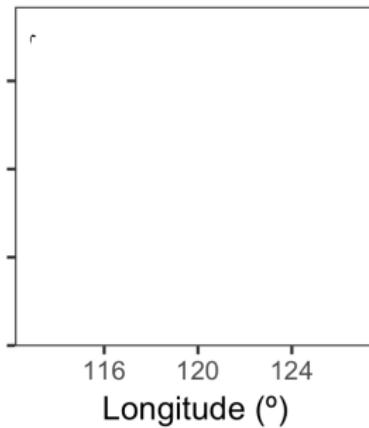
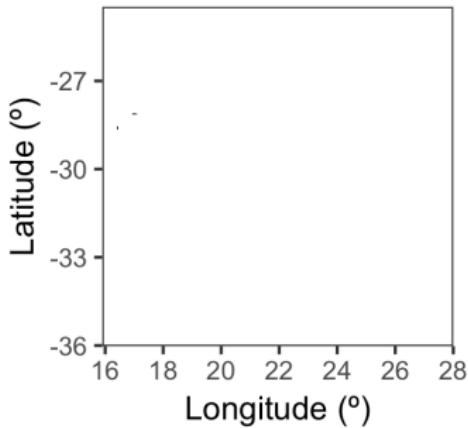
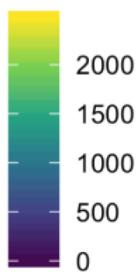
Cape



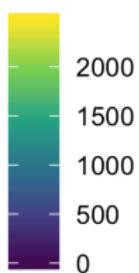
SWA



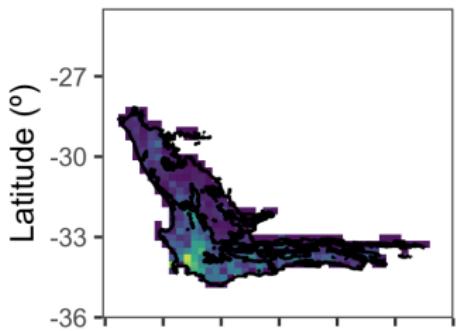
S_{QDS}



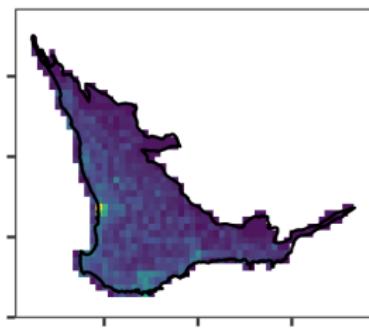
\hat{S}_{QDS}



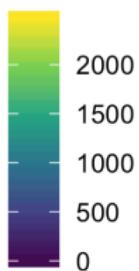
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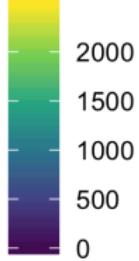
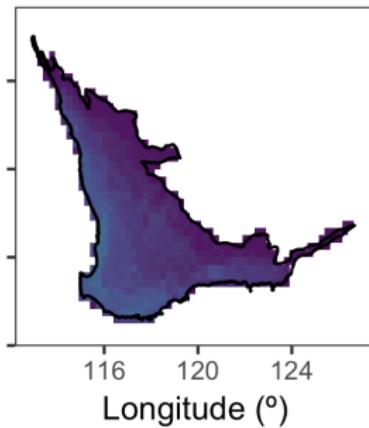
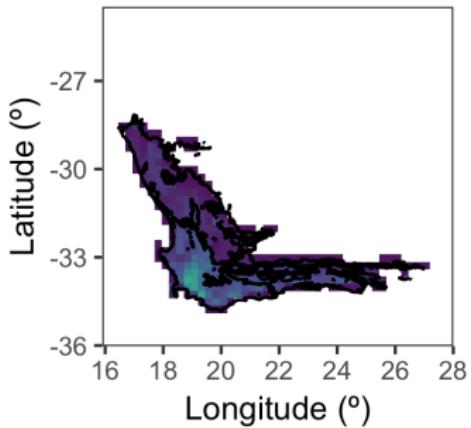
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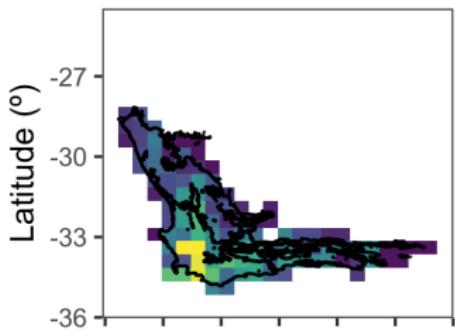
S_{QDS}



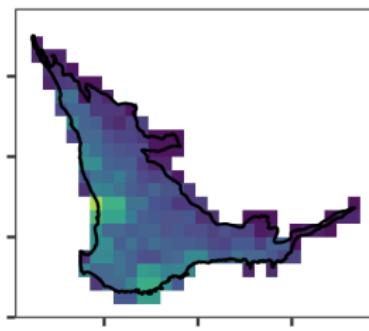
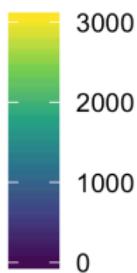
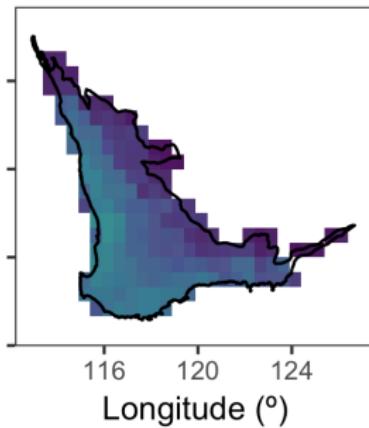
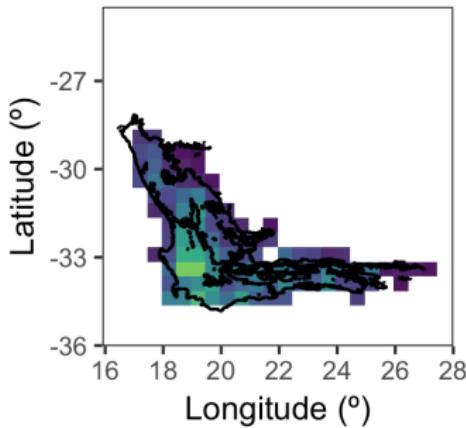
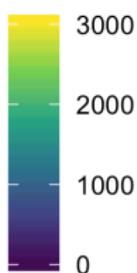
\hat{S}_{QDS}



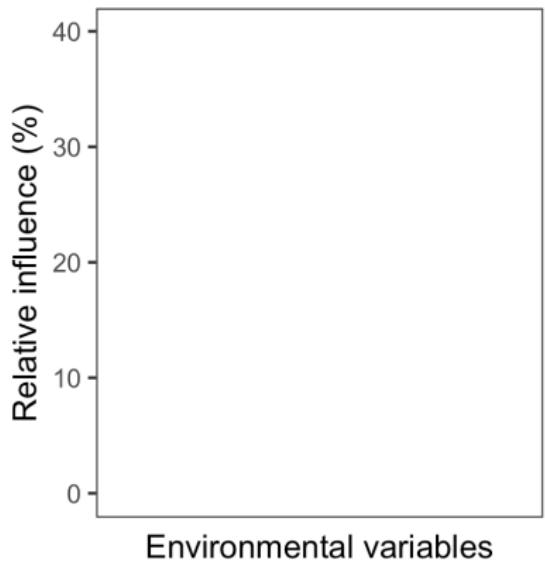
Cape



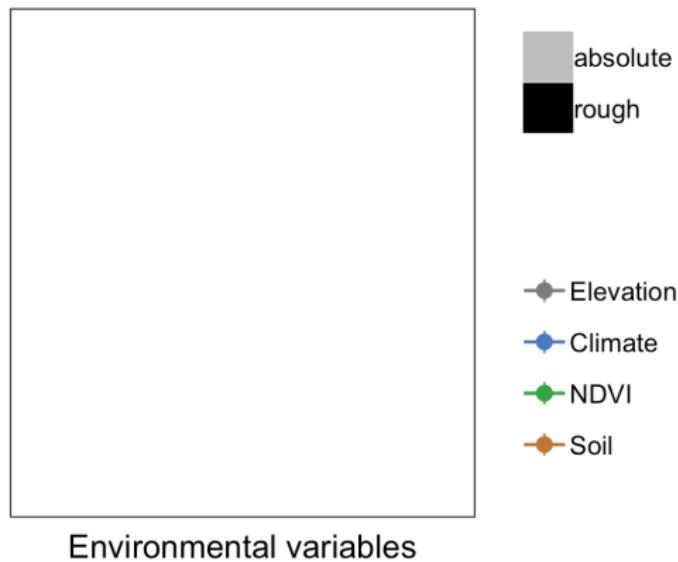
SWA

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

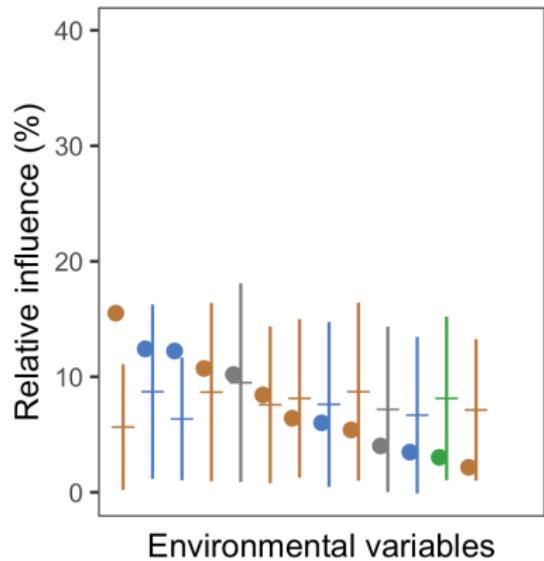
Cape richness QDS



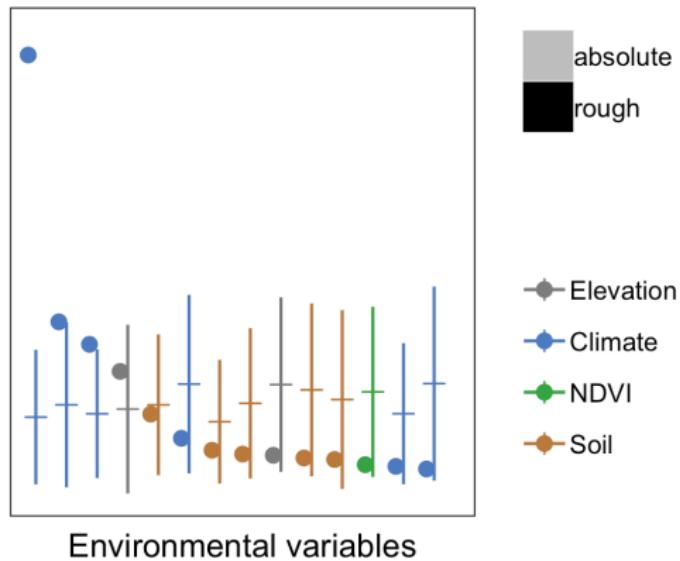
SWA richness QDS



Cape richness QDS



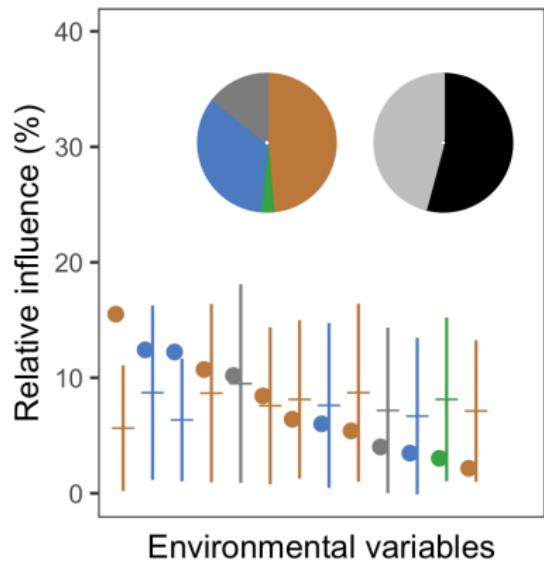
SWA richness QDS



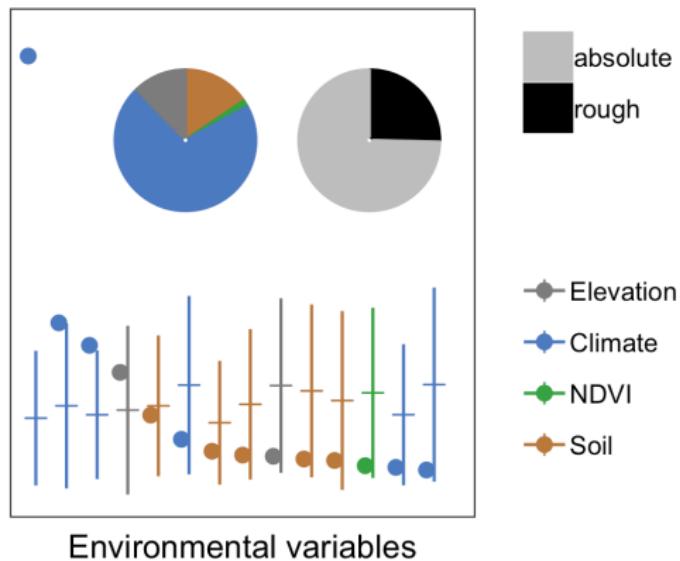
absolute
rough

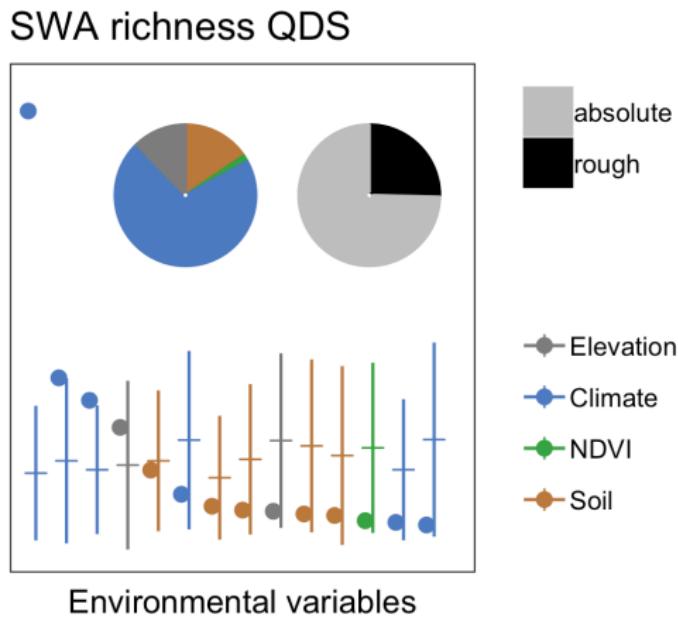
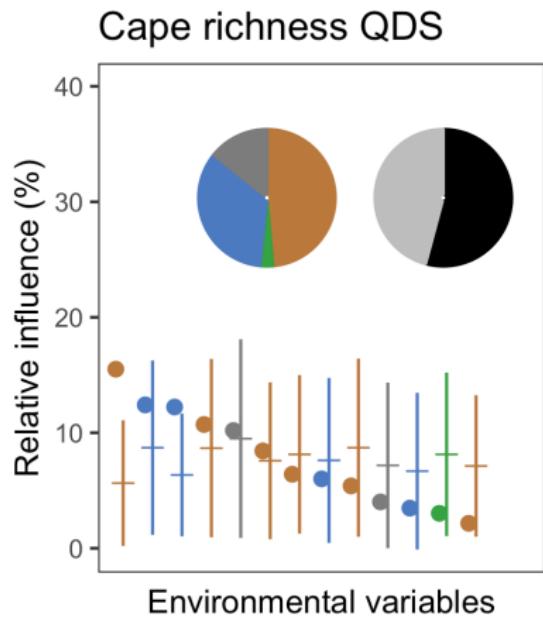
• Elevation
• Climate
• NDVI
• Soil

Cape richness QDS

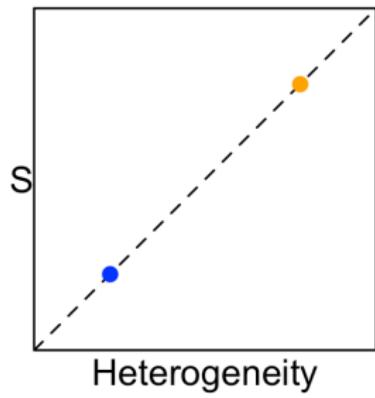


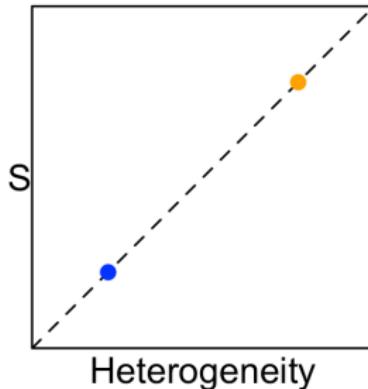
SWA richness QDS



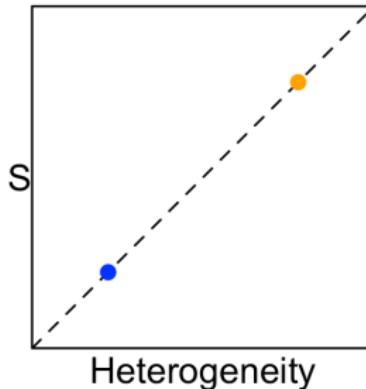


	Cape	SWA
Broad suite of variables		
Roughness, soil		
MAP		
Absolute, climate		

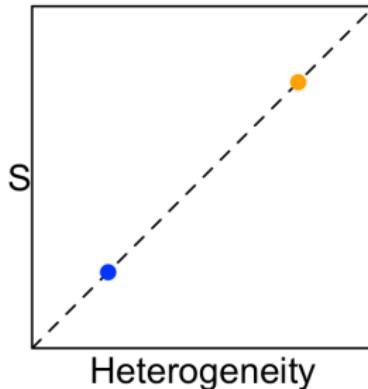




Hypothesis	Cape vs SWA	✓?
Degree of EH	>	
Floristic turnover	>	
$S \sim \text{EH}$	Both	
Types of EH	Topography? Soil?	



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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?	$\frac{1}{2}$

Conclusions

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Soil?

Thank you¹!



¹And an extra thank you to my supervisors, Mike & Tony