Post-ENM Analysis

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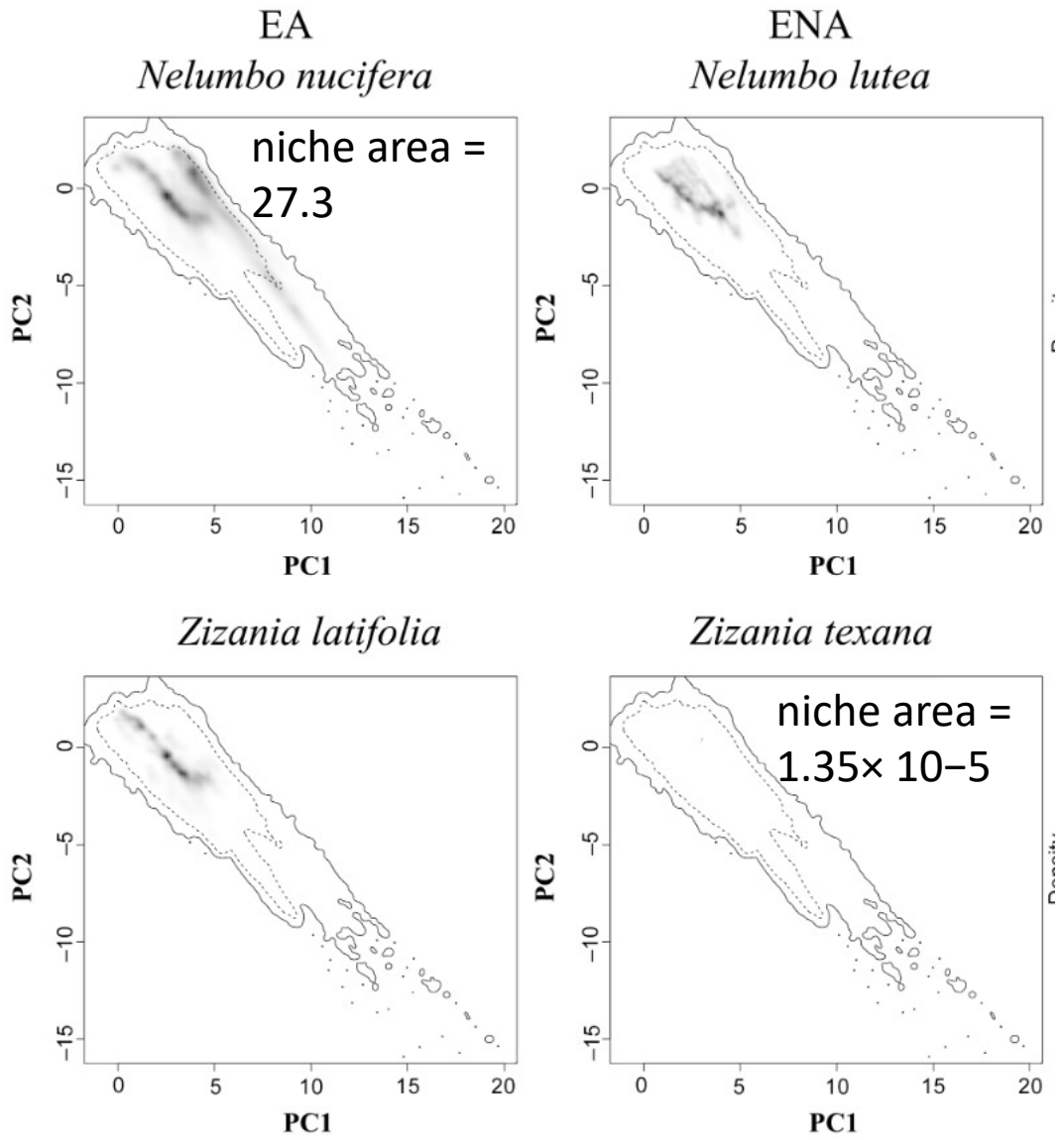
Post-ENM

- Analysis without ENMs
- Overview of commonly used post-modeling analysis.
  - Niche Breadth
  - Niche Overlap
  - Geographic Overlap
  - Niche Identity and Background test
  - Age overlap correlation test

Analysis without ENMs

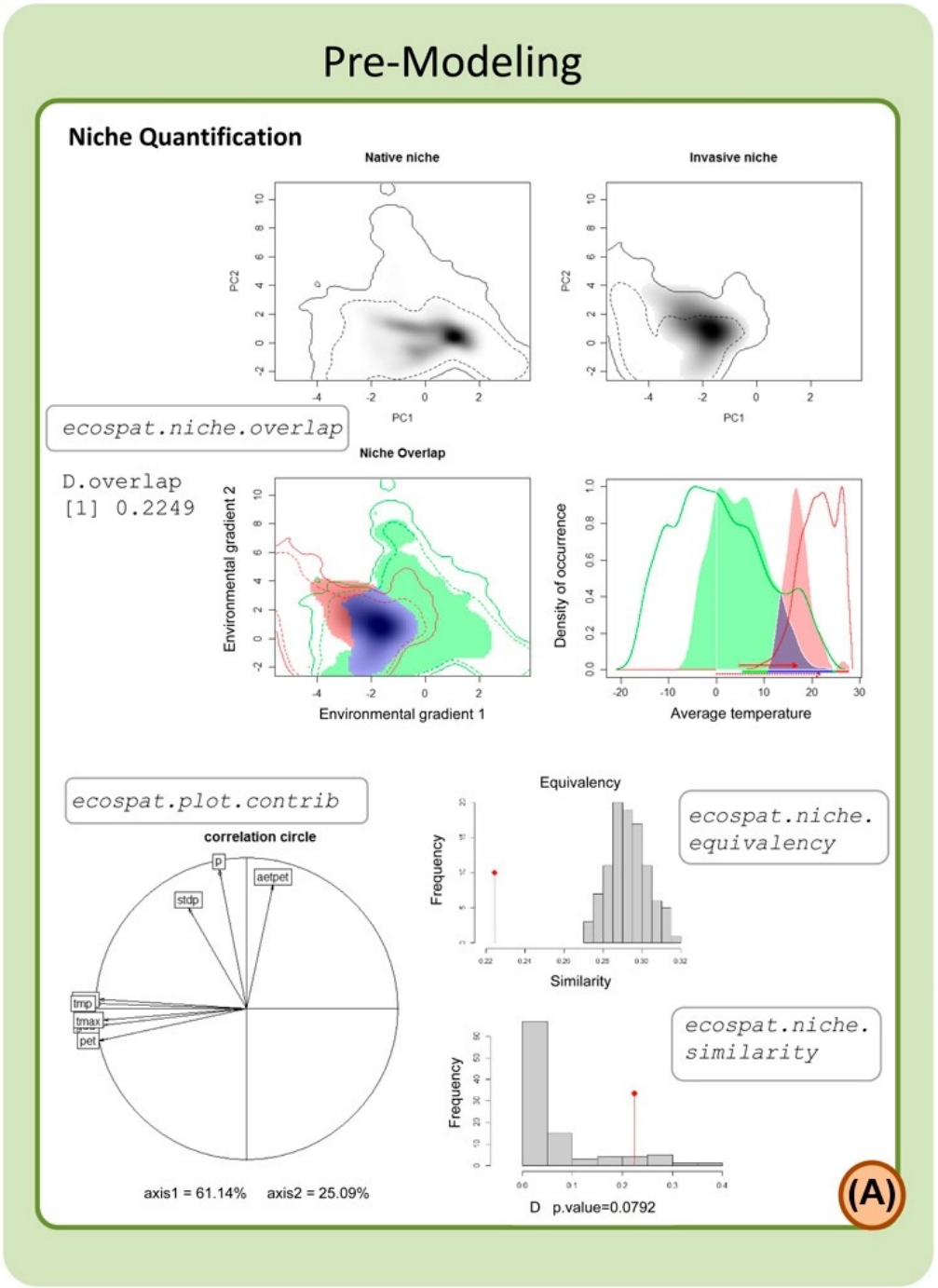


- Niche area calculations based **on 'ecospat' R package.**
- Niche area is equal to the variance of ecological space along PC1 × variance of ecological space along PC2
  - Larger niche area = more suitable area
- The solid line represents the total niche area within the study area, and the dotted line represents 50% of the niche area within the study.

Melton et al. 2022. Global Ecology and Biogeography.

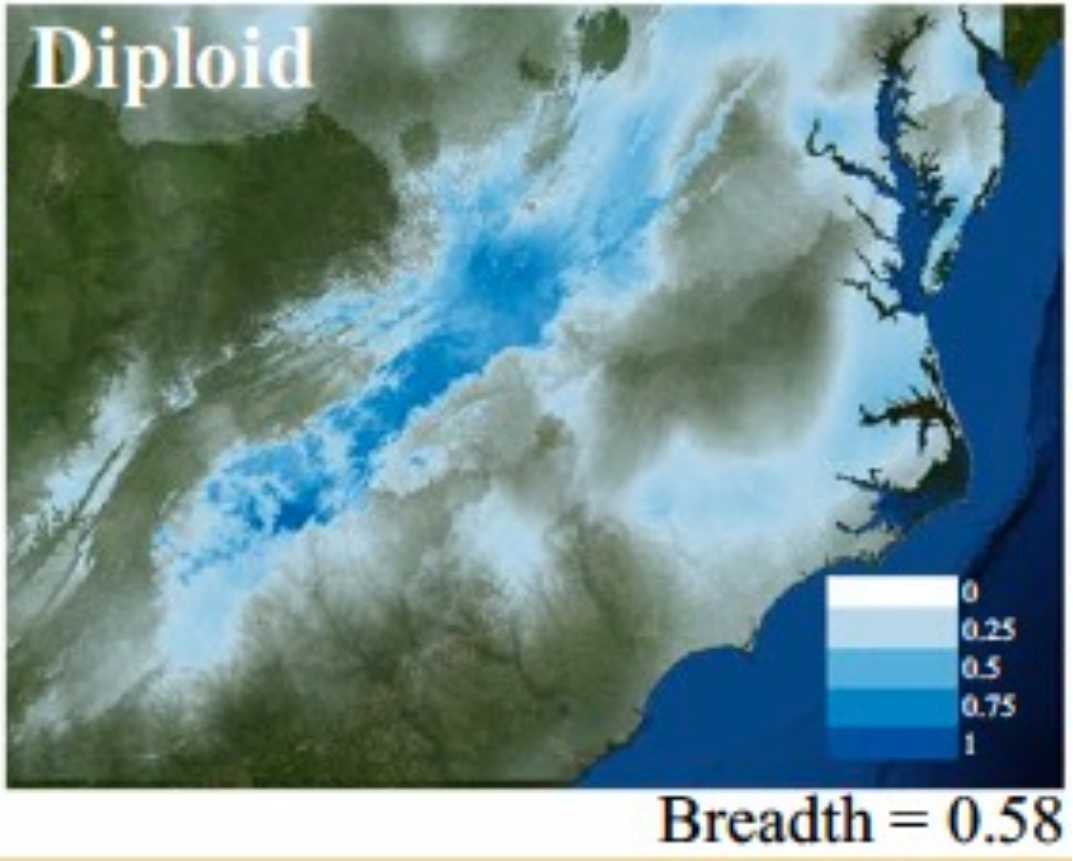
ecospat

- **Niche occupancy**
- **Niche overlap** based on Schoener's D
  - Ranges from 0 to 1
  - 0 represents no niche similarity between the models
  - 1 represents completely identical niches
- **Correlation circle**
  - Plots contribution of initial variables to variation seen in the data.
- **Niche Equivalency** (Graham et al. 2004)
  - Are the niche of two species indistinguishable?
- **Niche Similarity** (Peterson et al. 1999)
  - Can the niche of one species predicted that of another?



Di Cola et al. 2017. Ecography.

Post-ENM: Niche Breadth

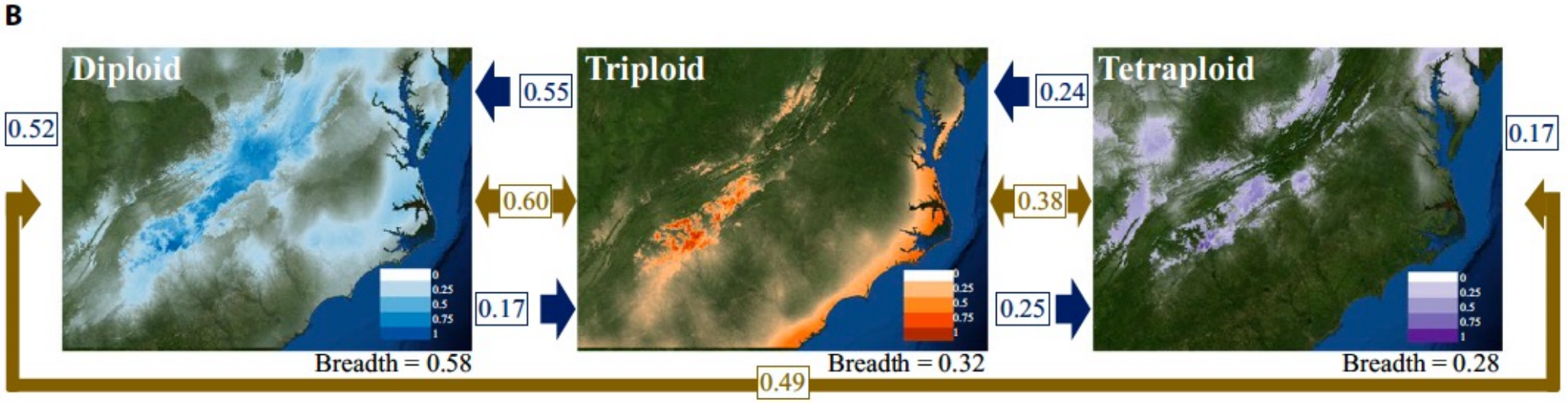


Niche breadth:

- is a means of calculating the breadth of suitable climatic factors for a species, providing a value ranging from 0 to 1.
- larger values represent more generalist species with wider climatic tolerances
- smaller values represent more specialized species with more narrow tolerance

Gaynor et al. 2018. American Journal of Botany.

Post-ENM: Niche Overlap



Niche overlap (gold):

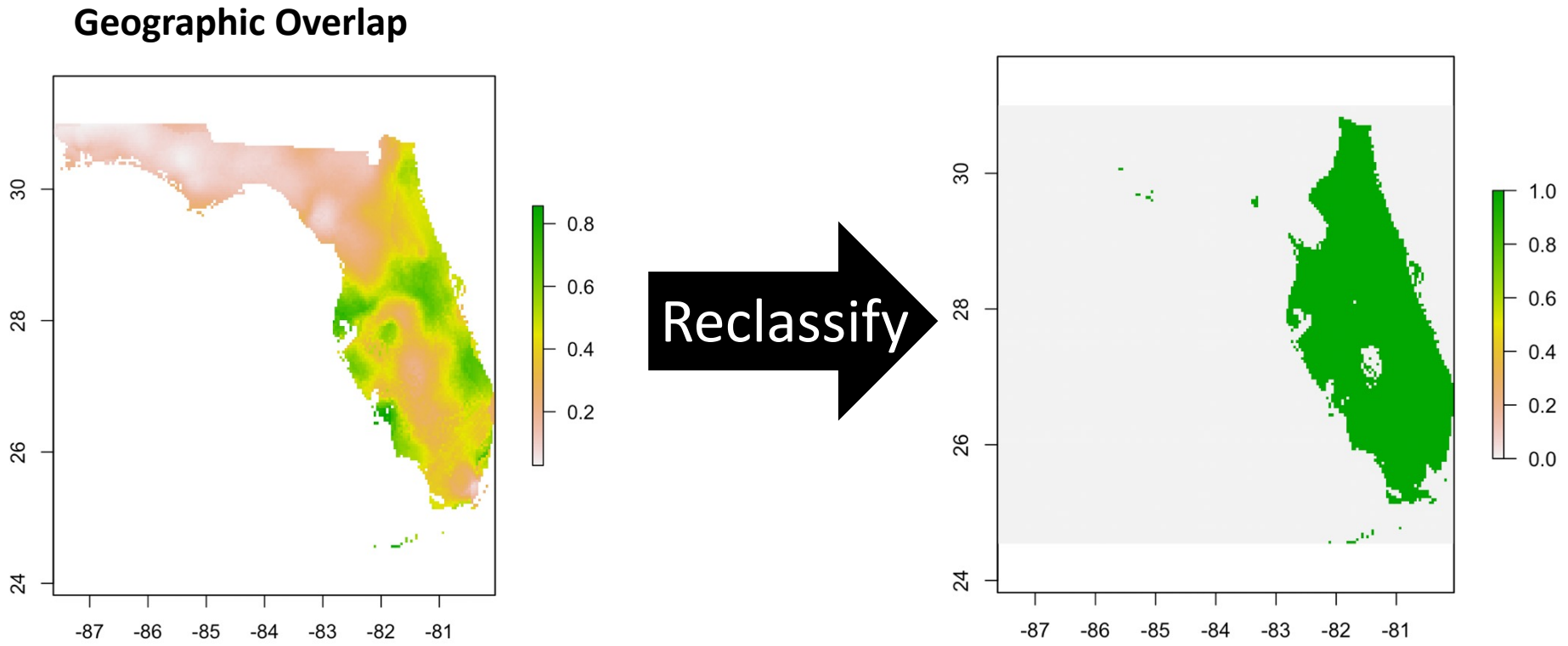
- Schoener's D ranges from 0 to 1
- 0 represents no niche similarity between the models
- 1 represents completely identical niches

Geographic Overlap (blue):

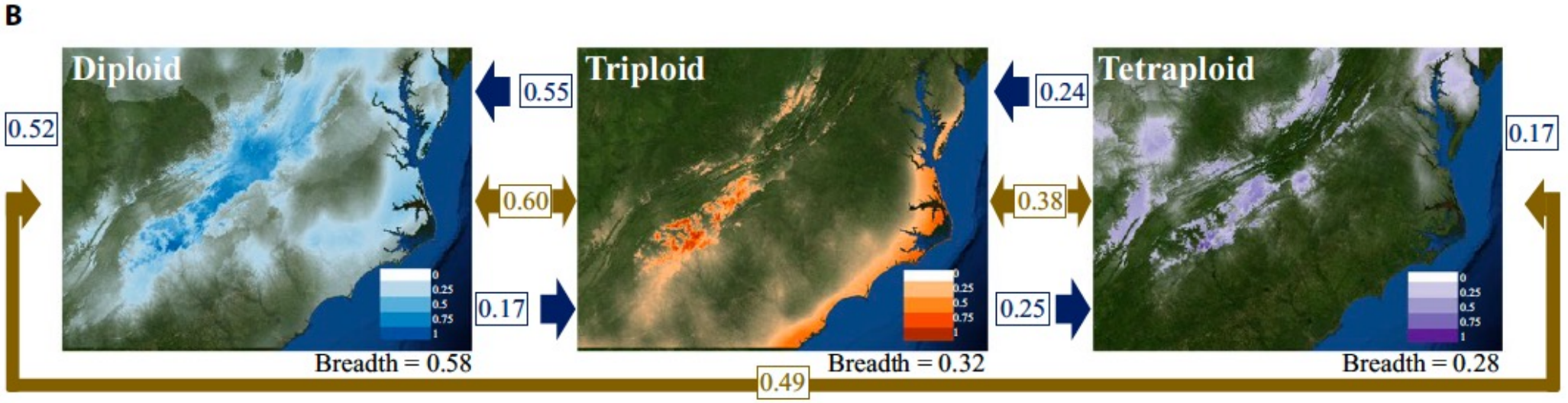
- percentage of points found in the models A distribution relative to those in the model Bs distribution.

Gaynor et al. 2018. American Journal of Botany.

Post-ENM


Geographic Overlap
30
28
26
24
-87
-86
-85
-84
-83
-82
-81
0.8
0.6
0.4
0.2
Reclassify
30
28
26
24
-87
-86
-85
-84
-83
-82
-81
1.0
0.8
0.6
0.4
0.2
0.0

Post-ENM: Geographic Overlap



Geographic Overlap (blue):

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Gaynor et al. 2018. American Journal of Botany.

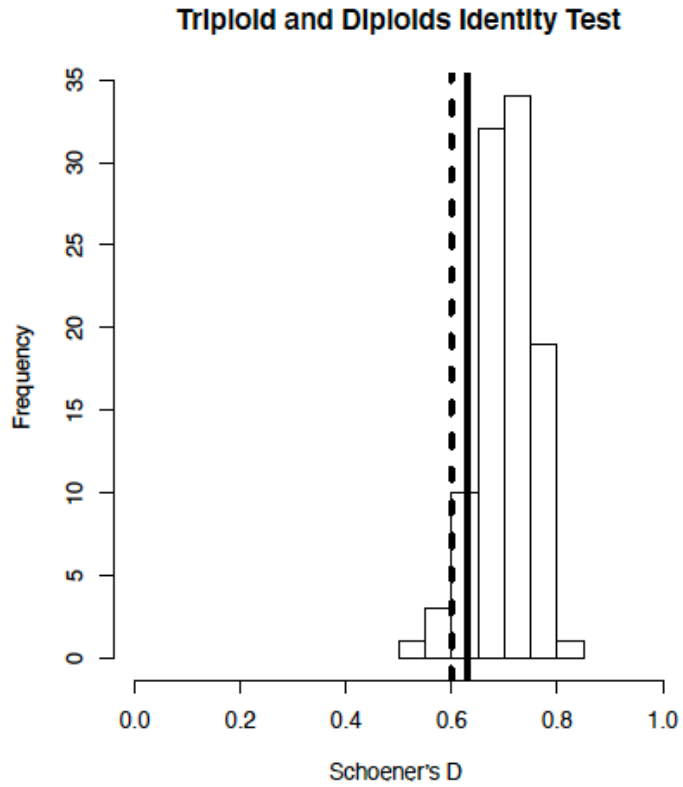
Niche Identity and Background Test

Niche Identity Test:

- **Niche Equivalency** (Graham et al. 2004)
  - Are the niche of two species indistinguishable?
- Compares niche models with the same number of occurrence records as the original models, but with randomly distributed localities x 100

Niche Background Test:

- **Niche Similarity** (Peterson et al. 1999)
  - Can the niche of one species predicted that of another?



Warren et al. 2010. ENMTools: a toolbox for comparative studies of environmental niche models

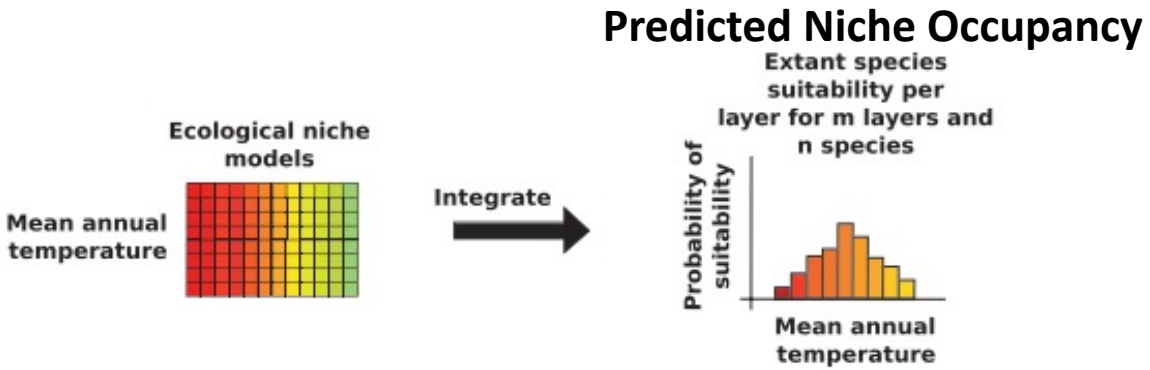
Niche and Phylogenetics

Point-Based

- Principal Component Analysis (PCA)
- Age-overlap correlation test:
  - Range &point based

Model-based

- Phylogenetic PCA (pPCA)
- Blomberg's K statistic and Pagel's lambda
- Ecological Niche Shifts
  - R package l1ou



Folk et al. 2018. The American Naturalist.

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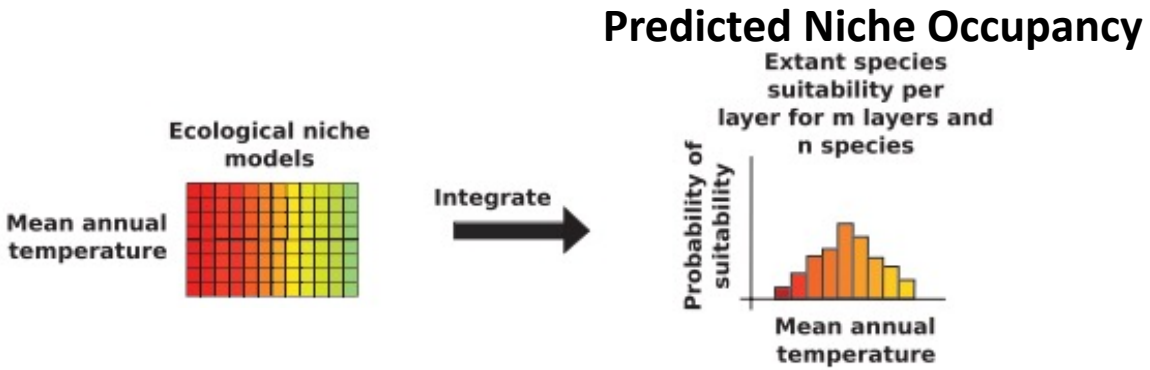
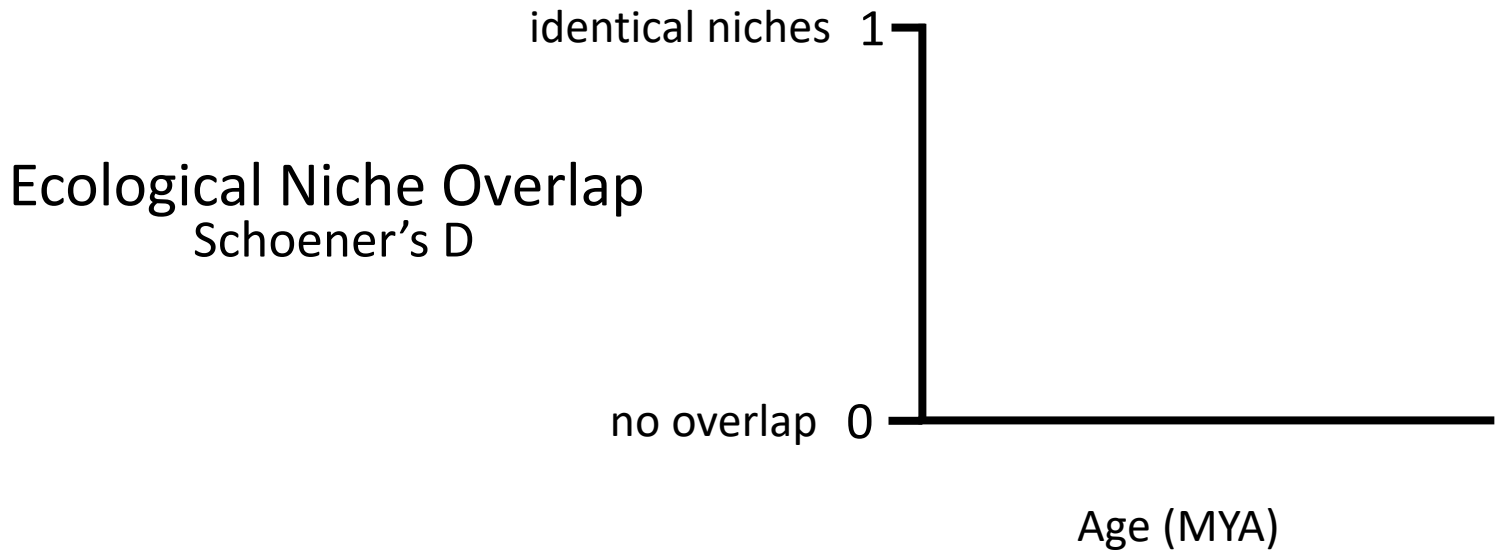
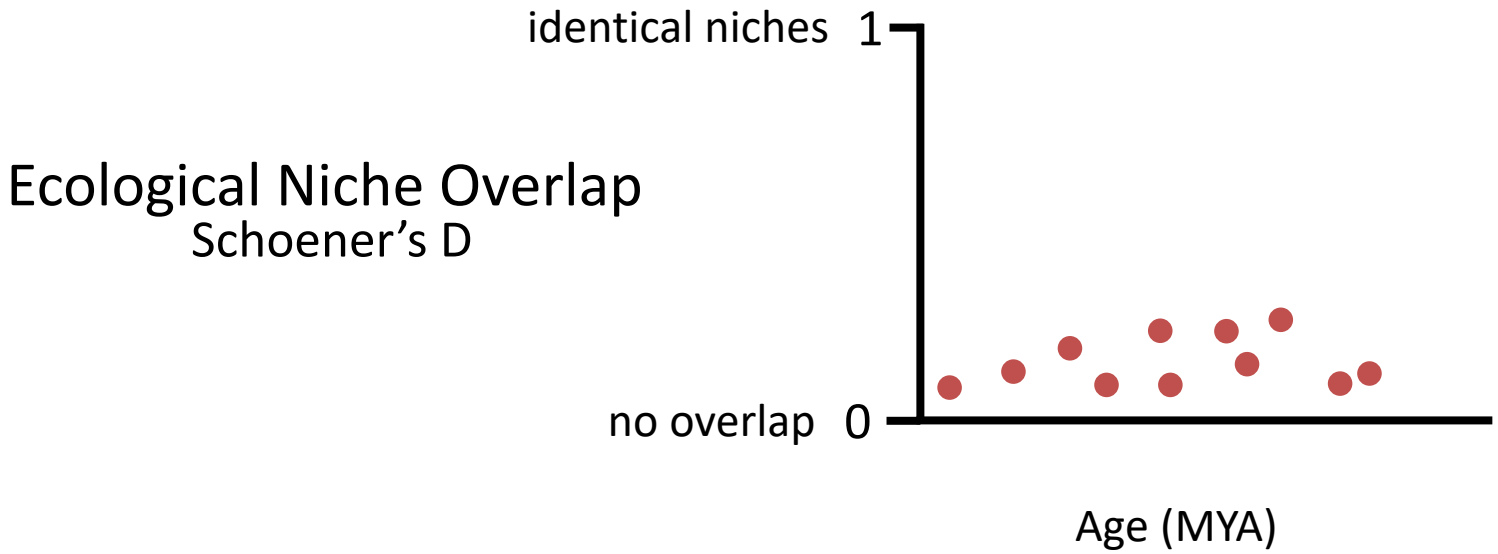


Folk et al. 2018. The American Naturalist.

Age overlap correlation test



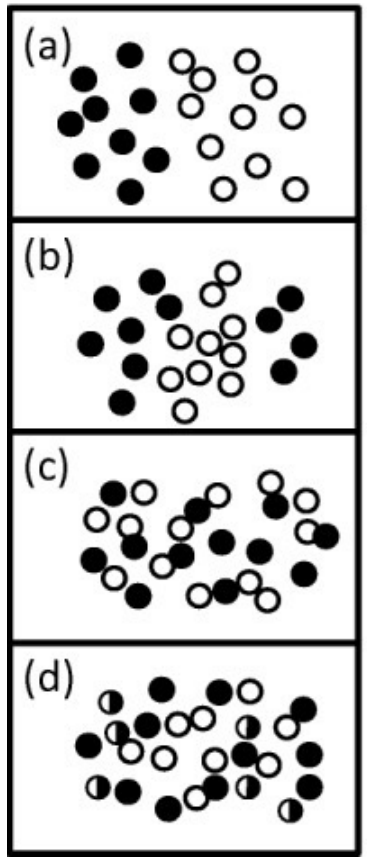
Age overlap correlation test



Mode of Speciation	Intercept	Slope
Sympatric	> 0.5	
Allopatric	< 0.5	positive
Parapatric	< 0.5	near or below 0

Fitzpatrick & Turelli. 2006. Evolution.

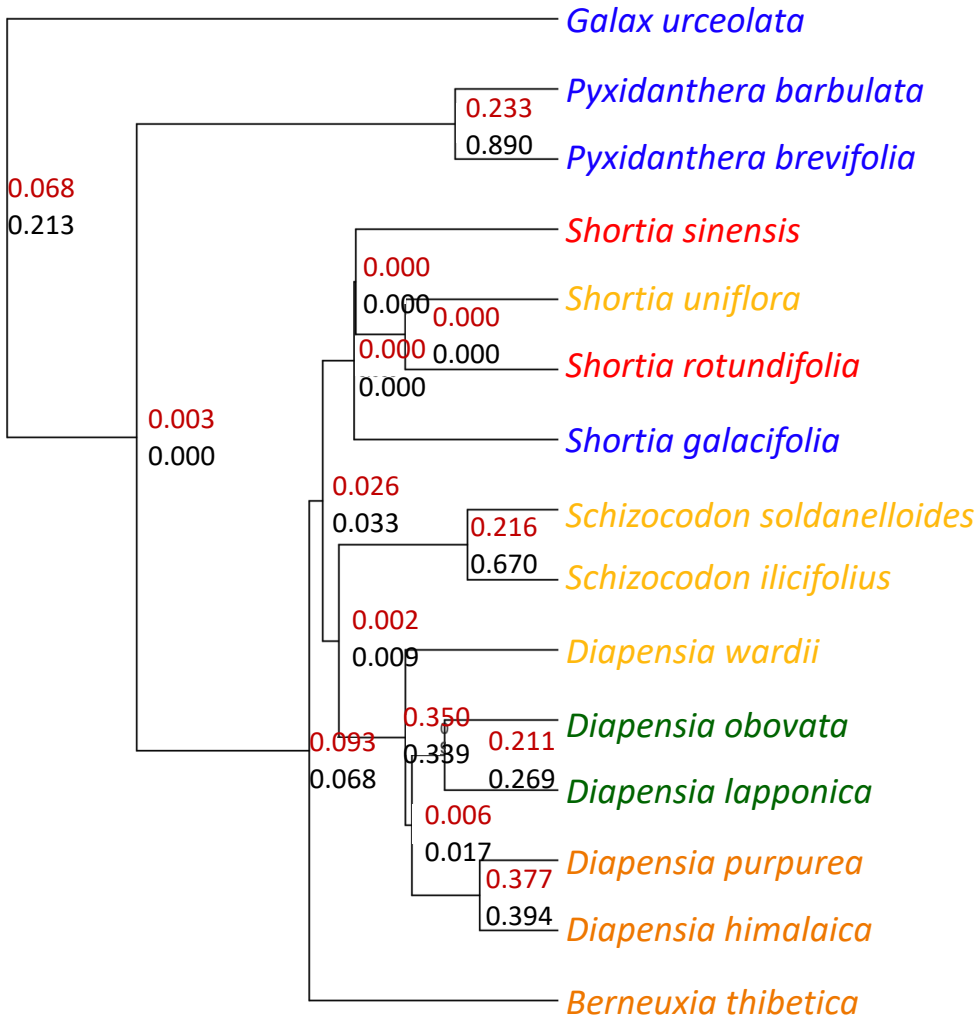
Age overlap correlation test

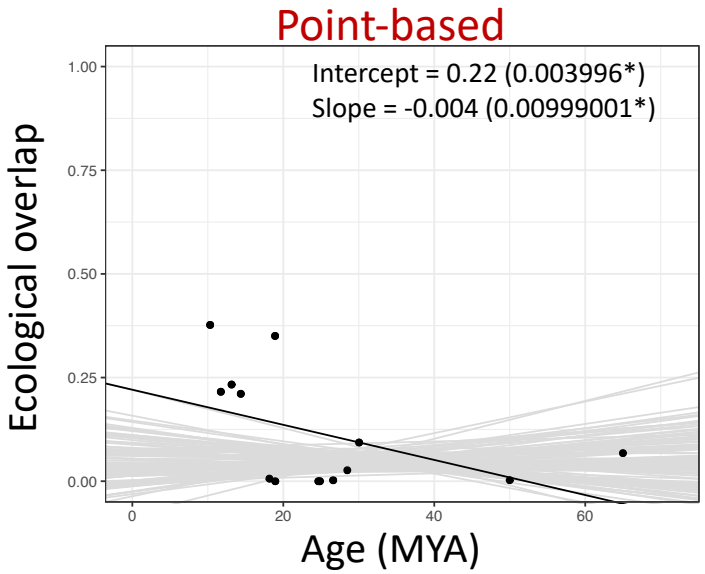


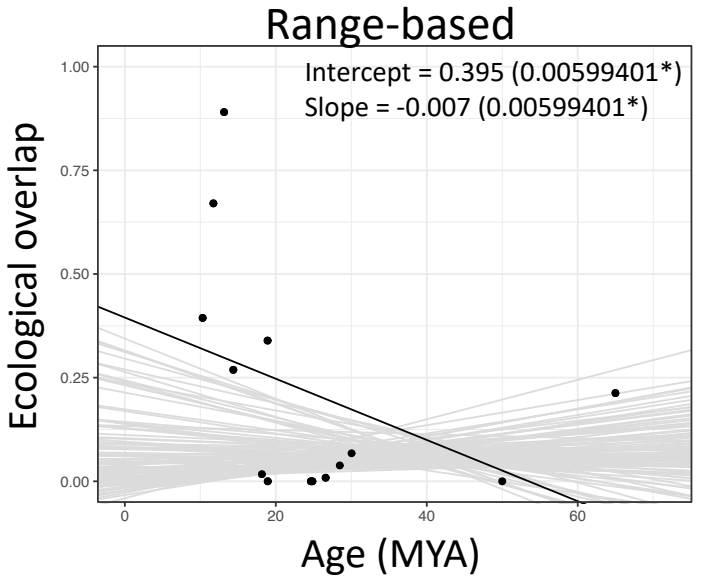
Spatial overlap measure			Example of possible interpretations of overlap pattern
Range Overlap	Point Overlap	Local co-occurrence	
low	low	low	Allopatric speciation with broad geographic barrier as isolating mechanism
high	low	low	Allopatric speciation with finer-scale landscape features as isolating mechanism
high	high	low	Sympatric speciation with habitat filtering
high	high	high	Sympatric speciation with ecological trait divergence

Cardillo and Warren. 2016. Global Ecology and Biogeography.

Age overlap correlation test

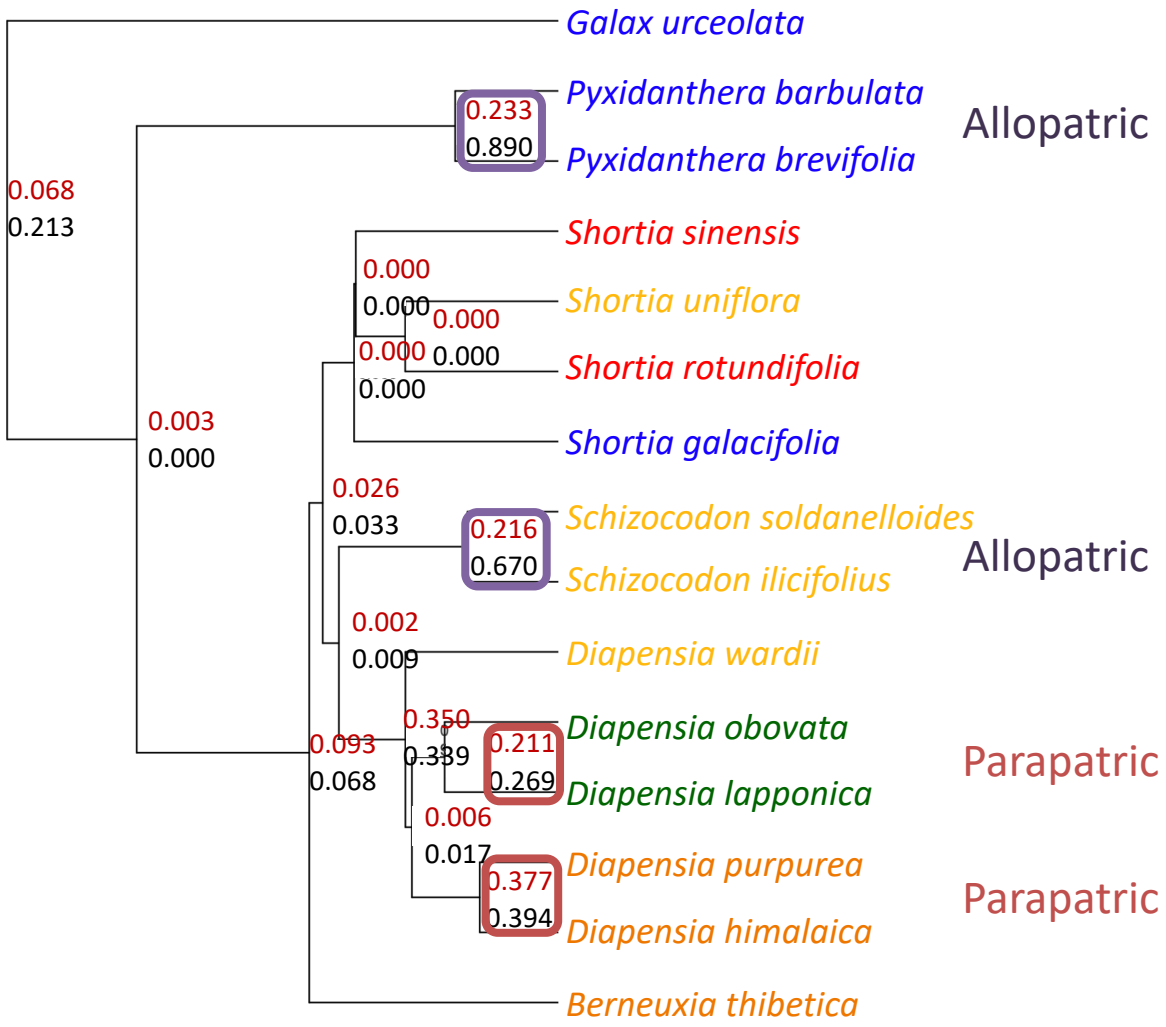


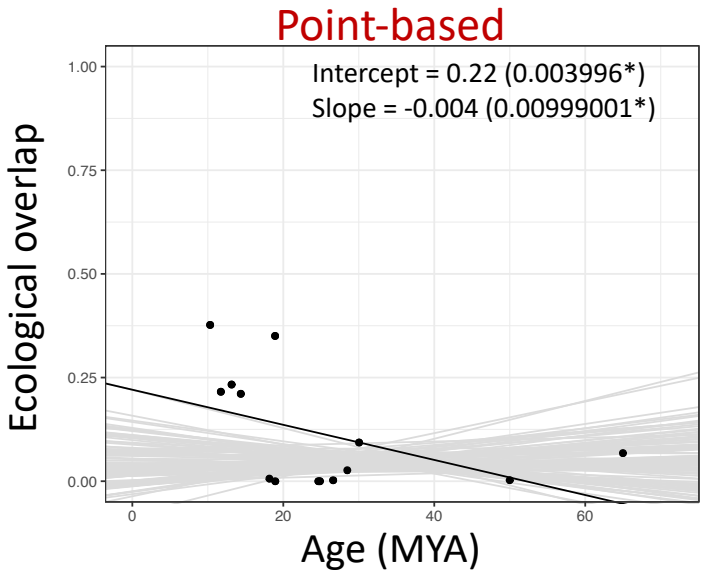


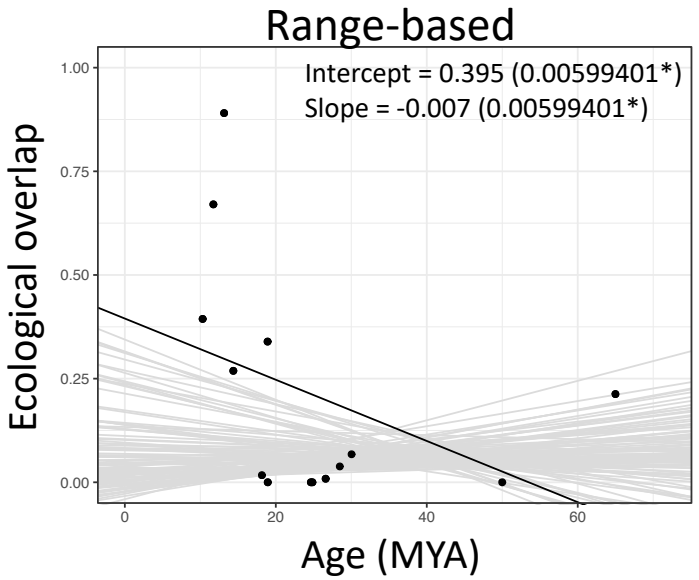


Gaynor et al. 2020. Journal of Systematics and Evolution.

Age overlap correlation test







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