rijksuniversiteit groningen

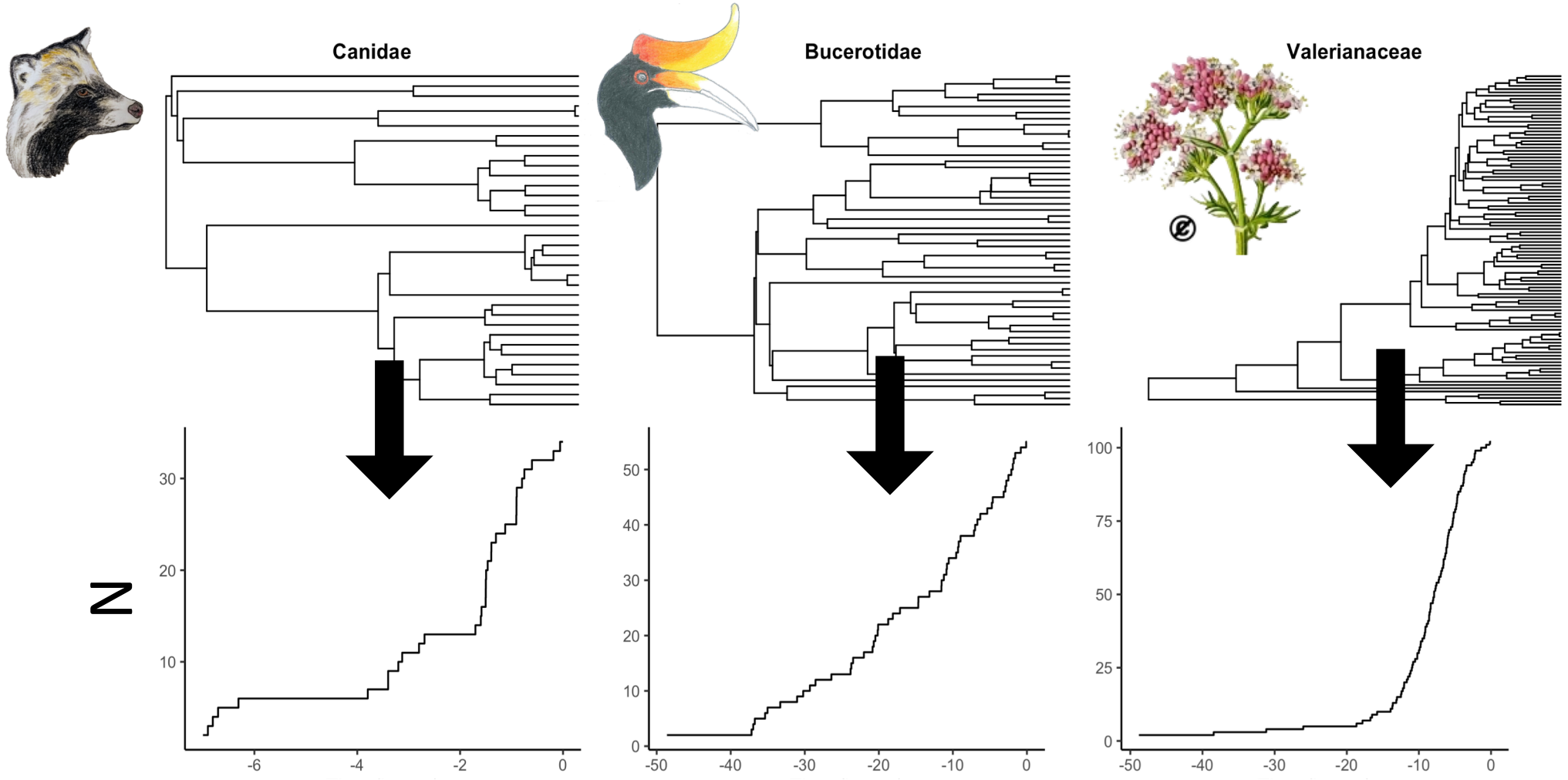
UNIVERSITY of STIRLING

BES Autumn Symposium — Wednesday 28th October

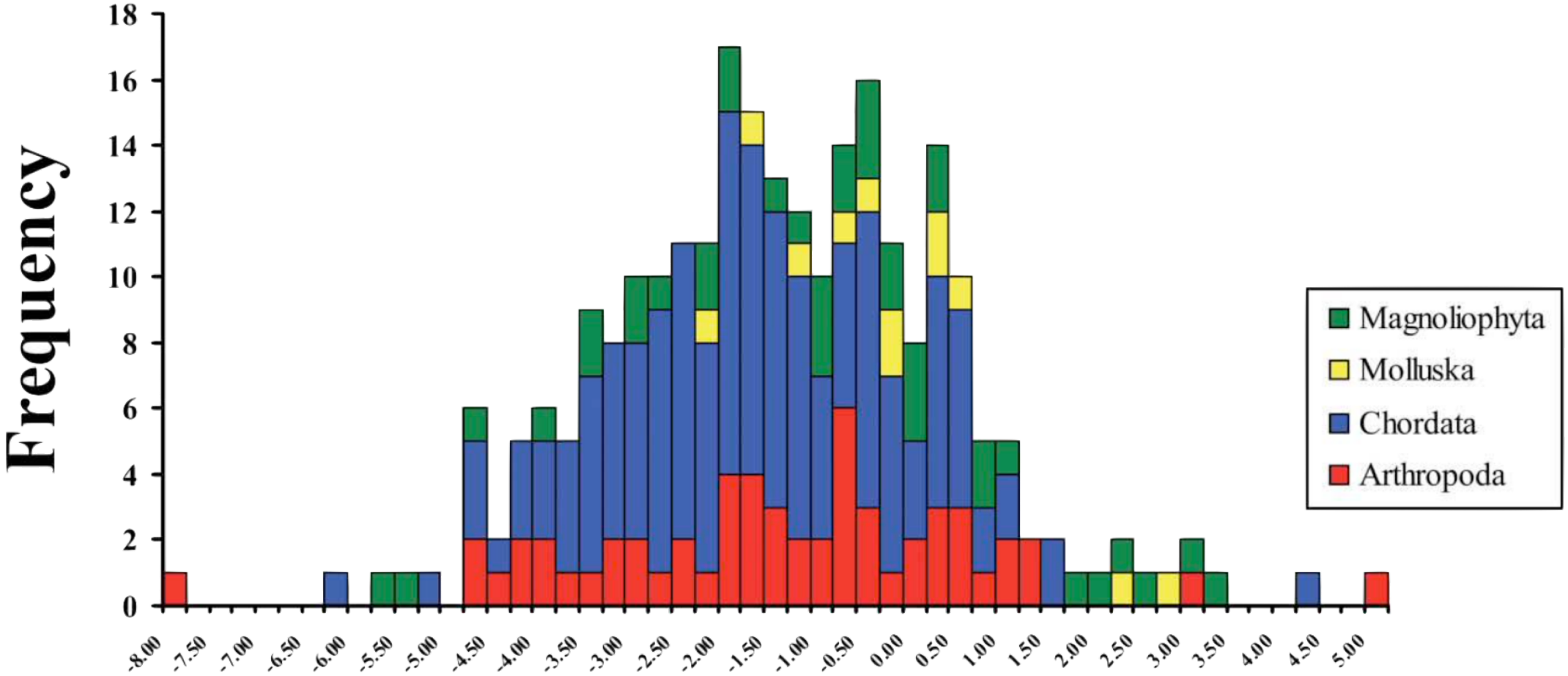
Detecting diversity-dependence in the branching patterns of phylogenies

Théo Pannetier, César Martinez, Lynsey Bunnefeld, and Rampal Etienne

Studying diversification from phylogenetic trees



Diversification slows down over time in many phylogenies



McPeek (2008) Am. Nat.

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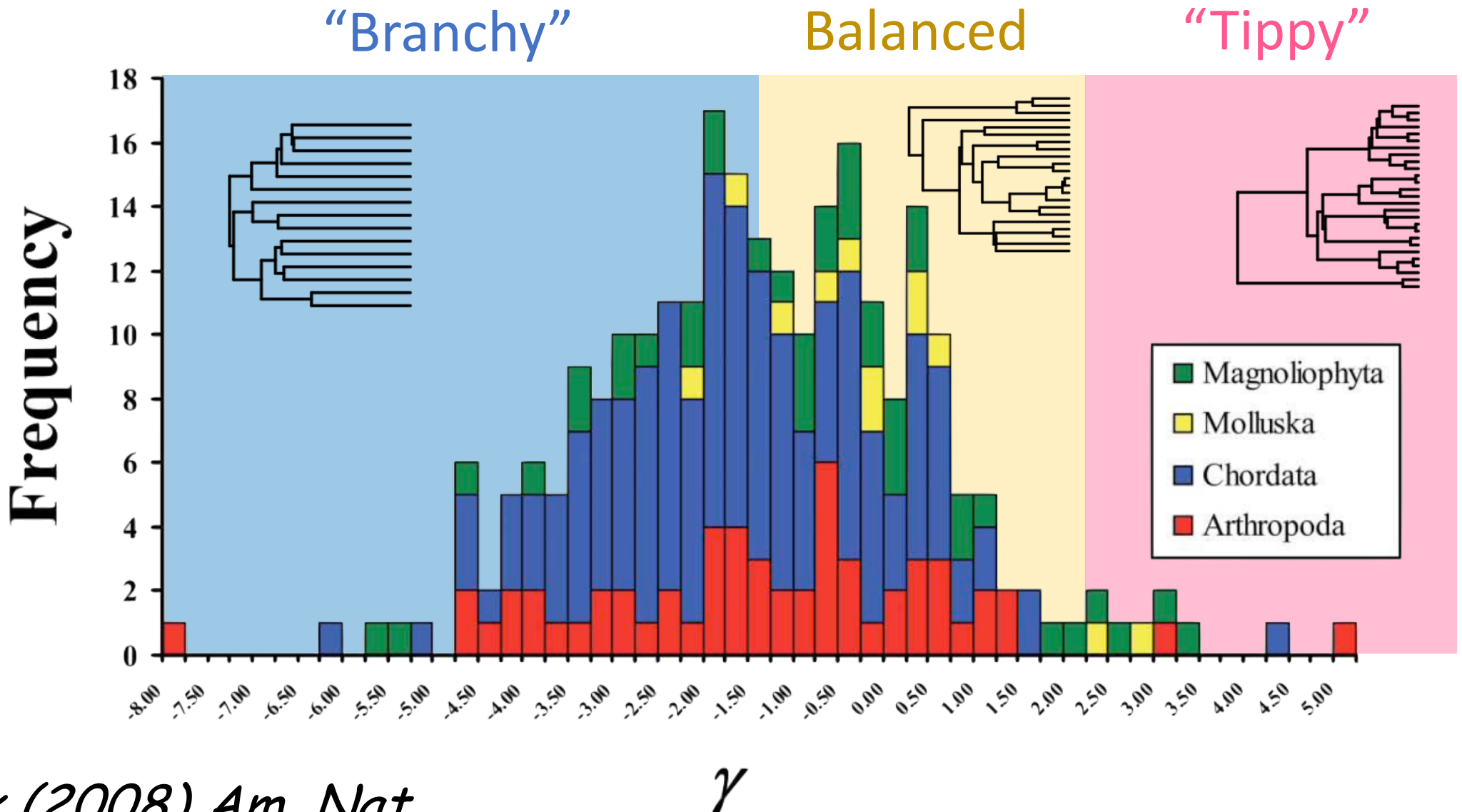

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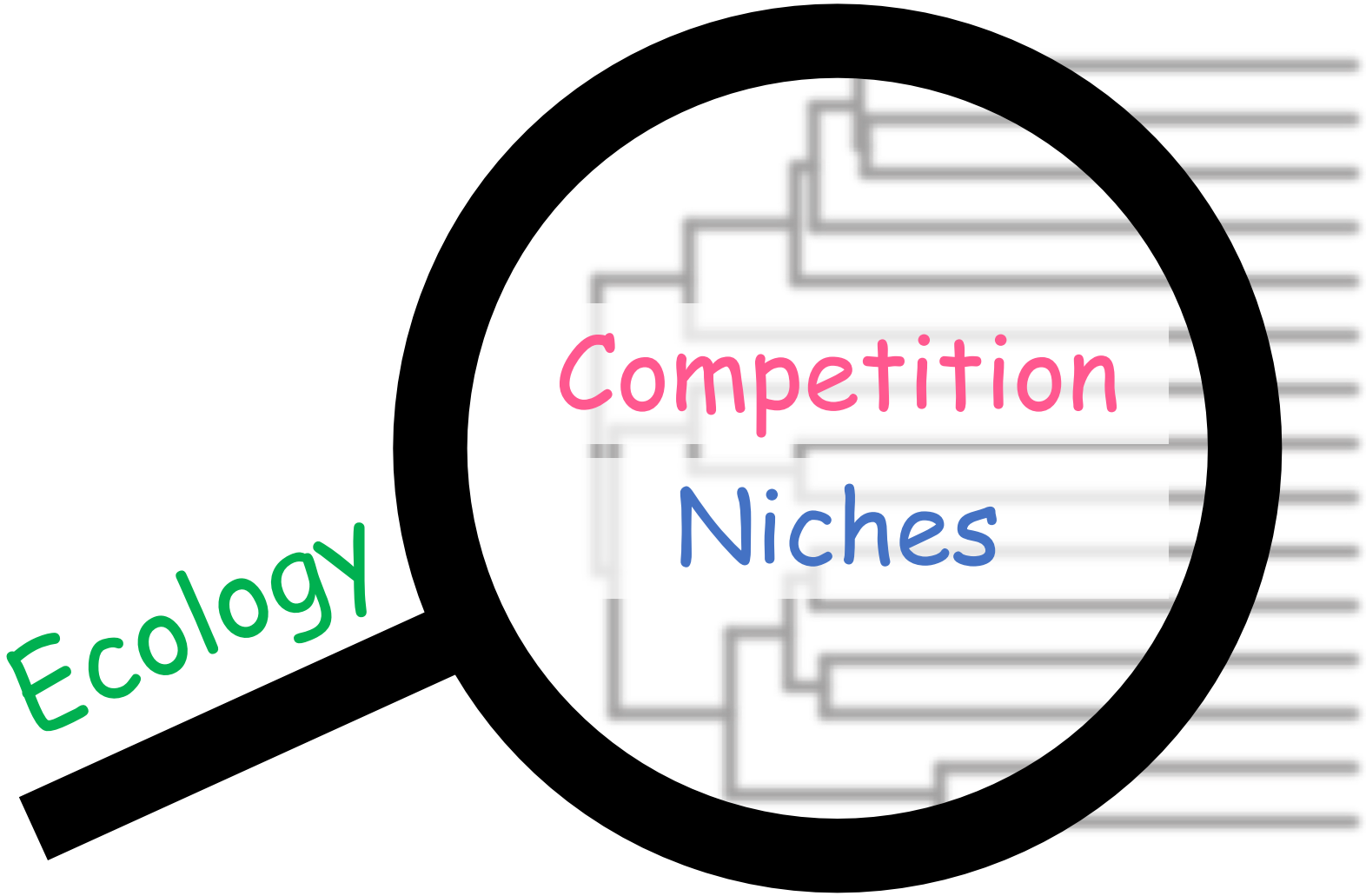
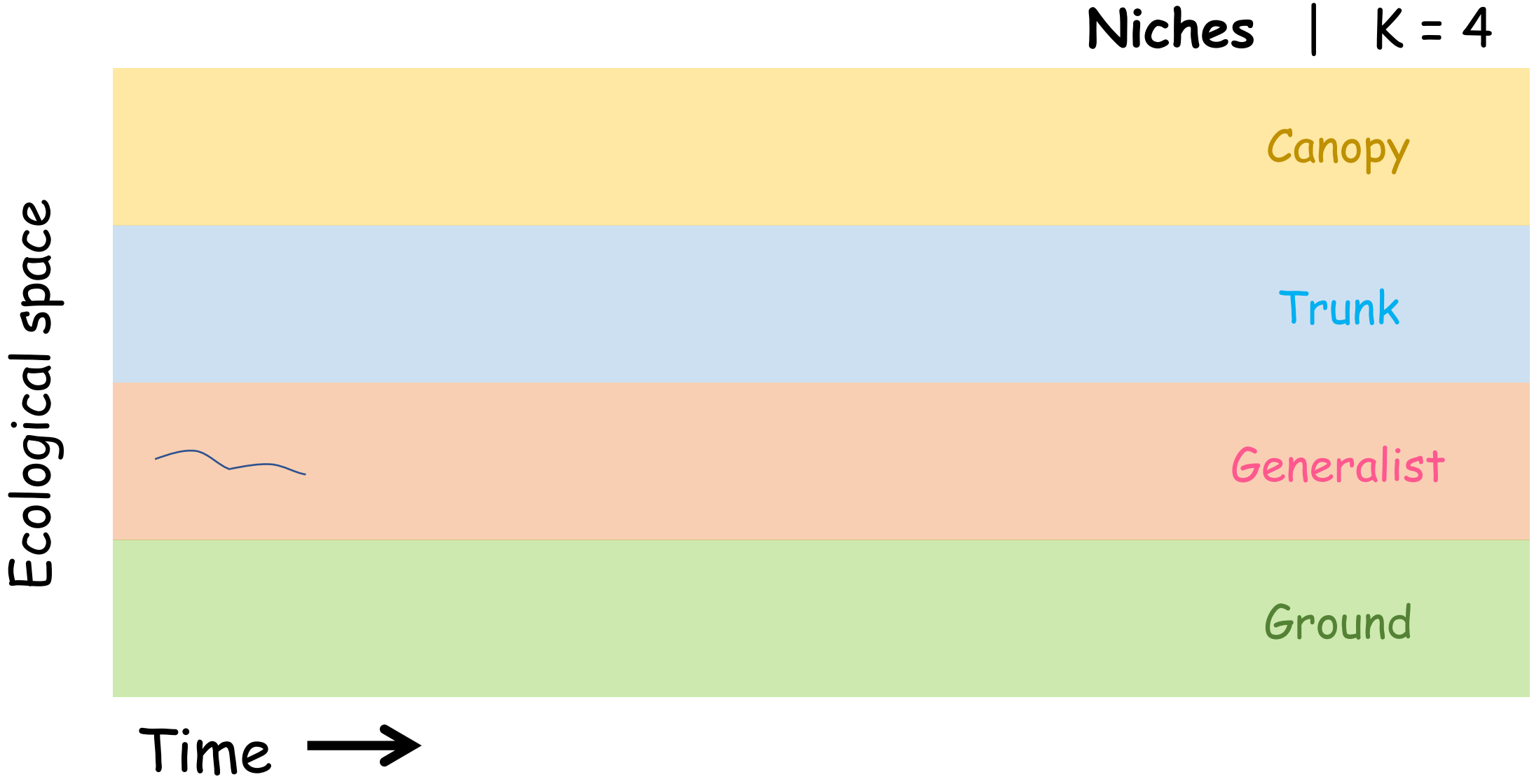
Diversification slows down over time in many phylogenies

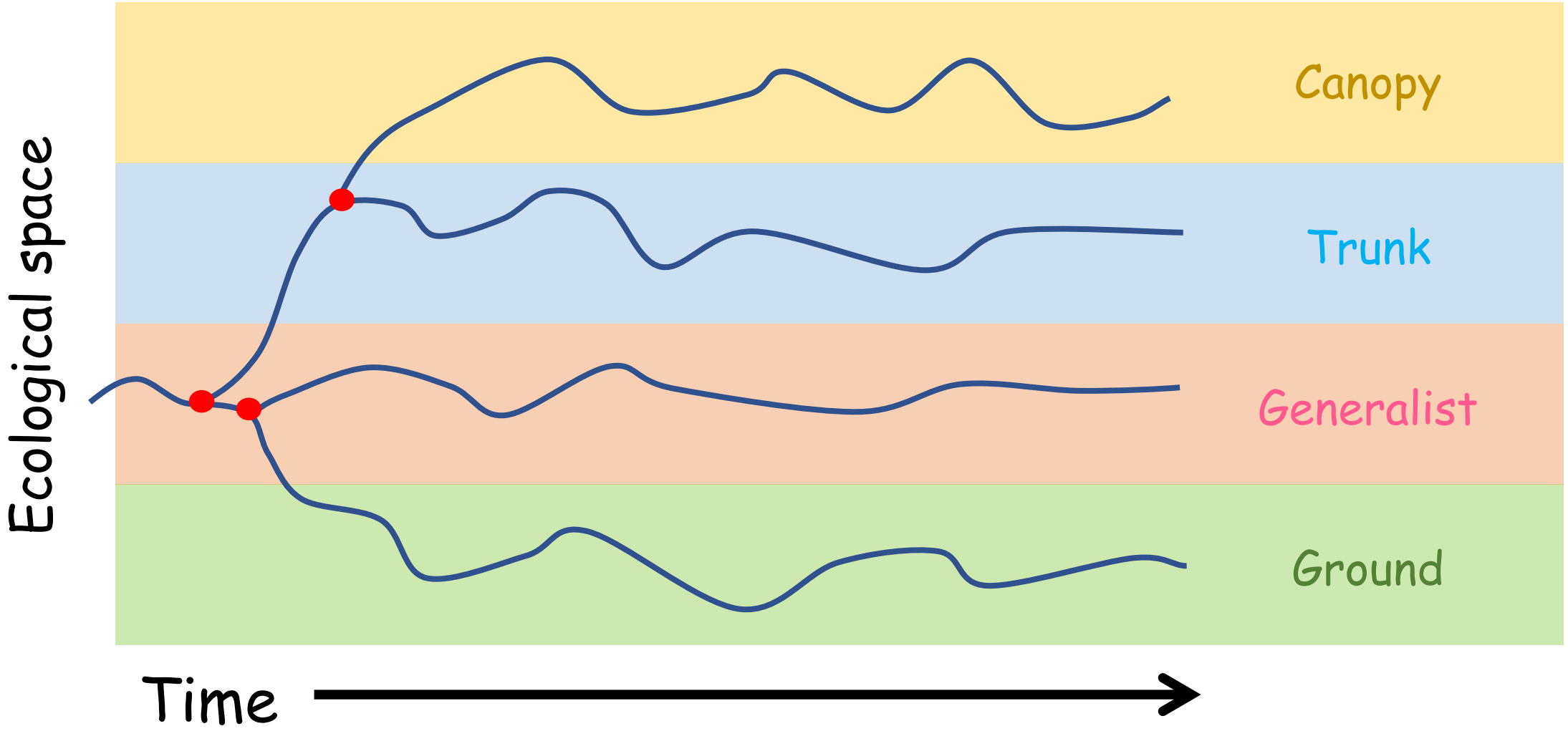
Why?

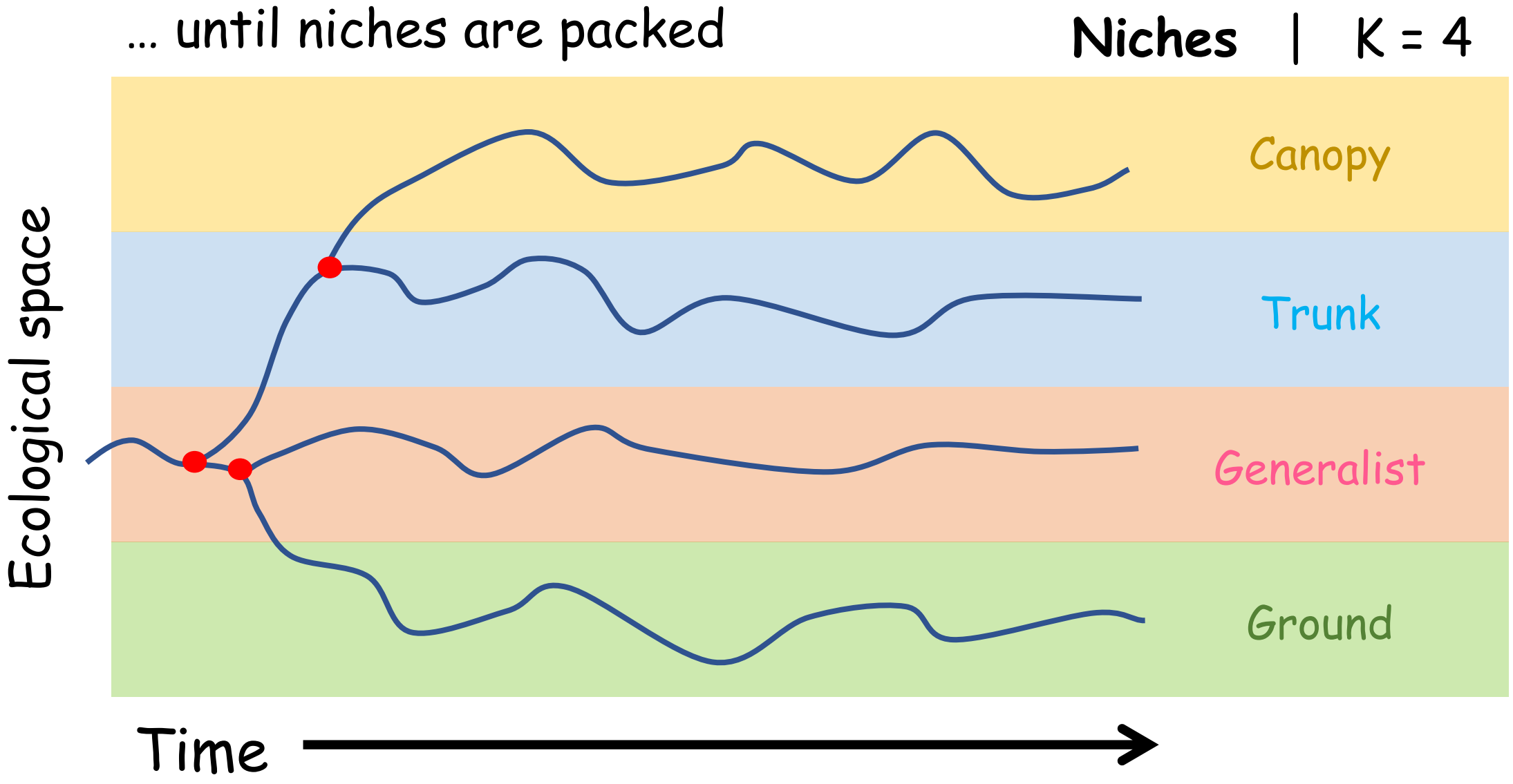



Niches | K = 4
Canopy
Trunk
Generalist
Ground
Ecological space
Time

Competition promotes speciation…

Niches | K = 4




… until niches are packed
Niches | K = 4
Canopy
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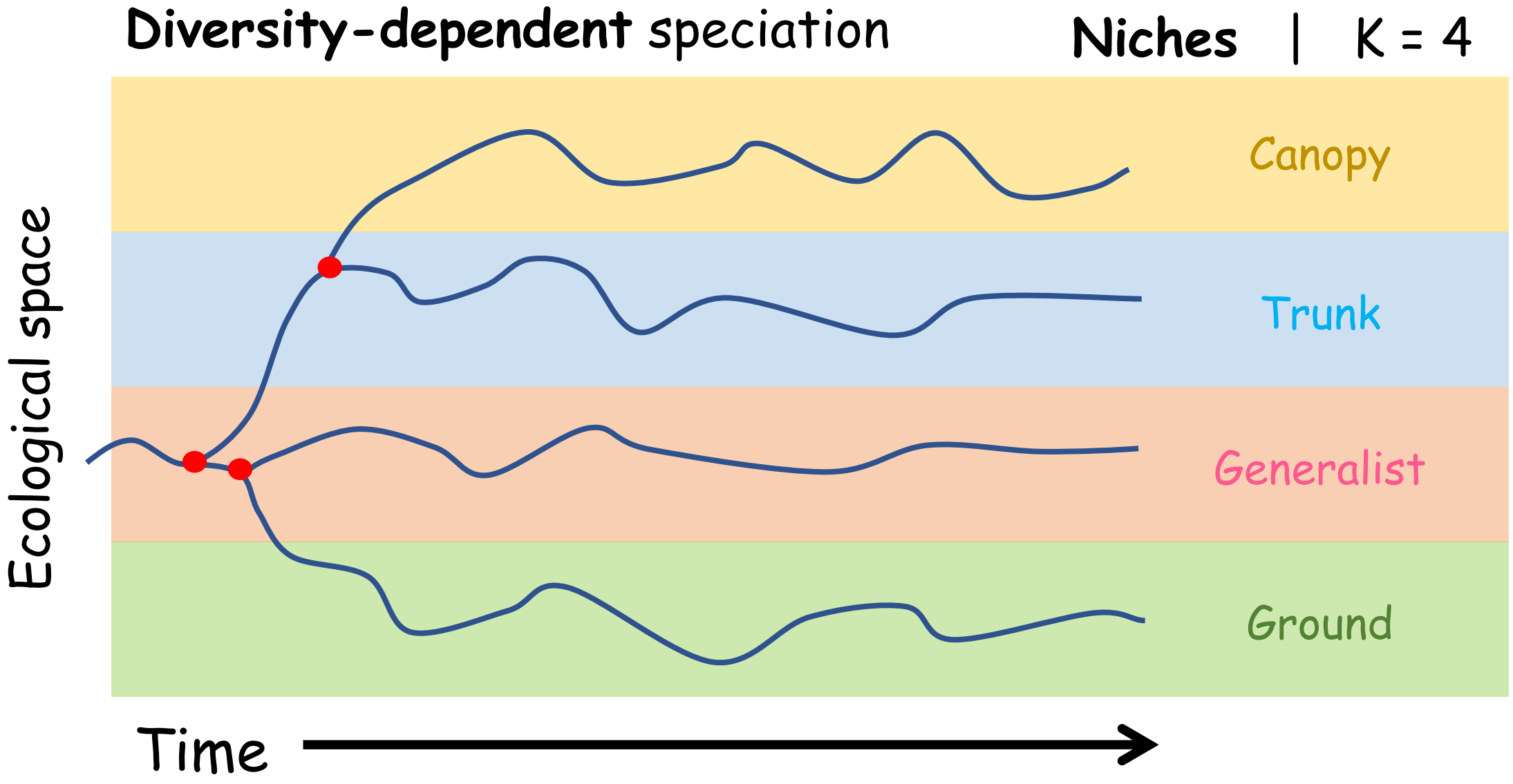
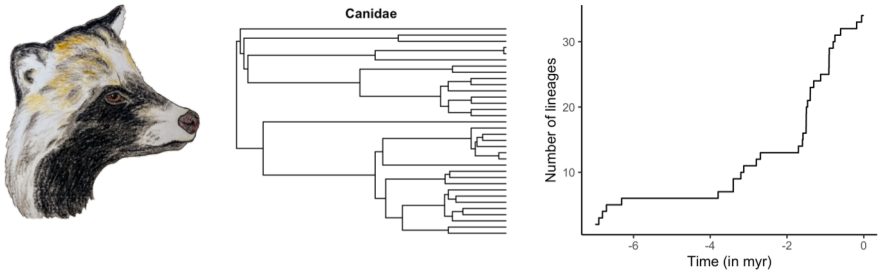
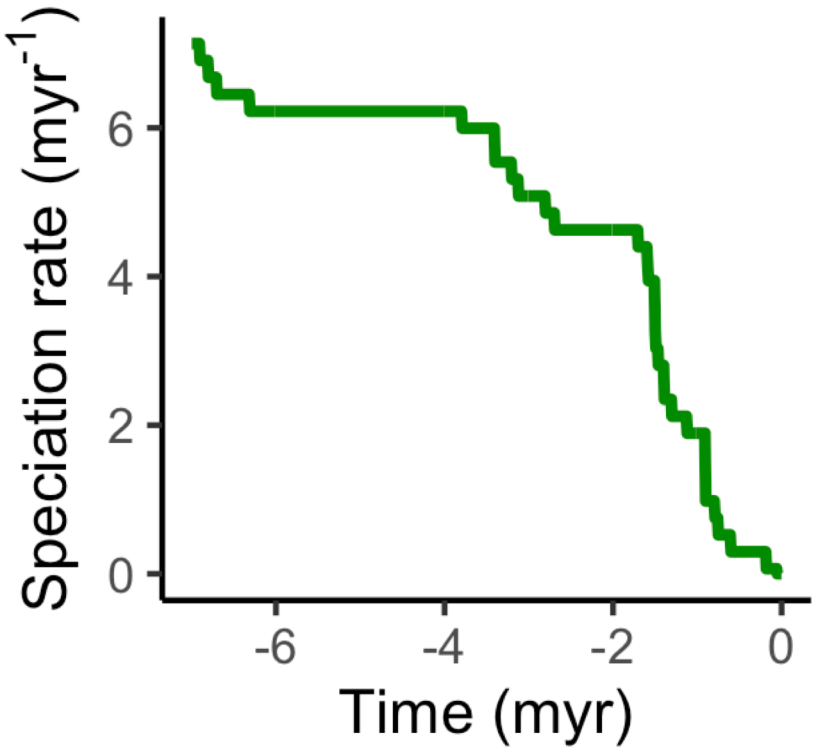

Diversity-dependent speciation
Niches | K = 4
Canopy
Trunk
Generalist
Ground
Ecological space
Time

Modelling and inferring diversity-dependence in phylogenies

$$\lambda(N(t)) = \lambda_0 \left(1 - \frac{N(t)}{K}\right)$$

$$\rightarrow L(\lambda(N(t)) \mid \text{tree})$$





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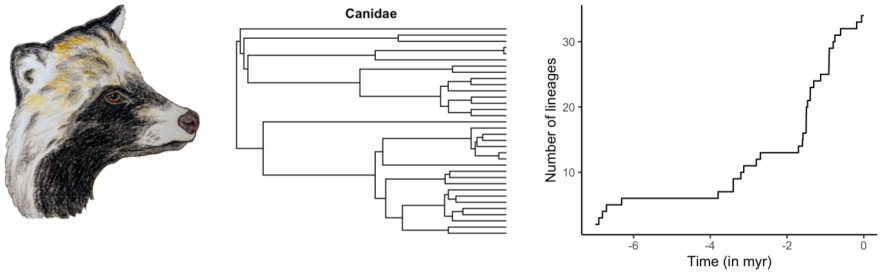
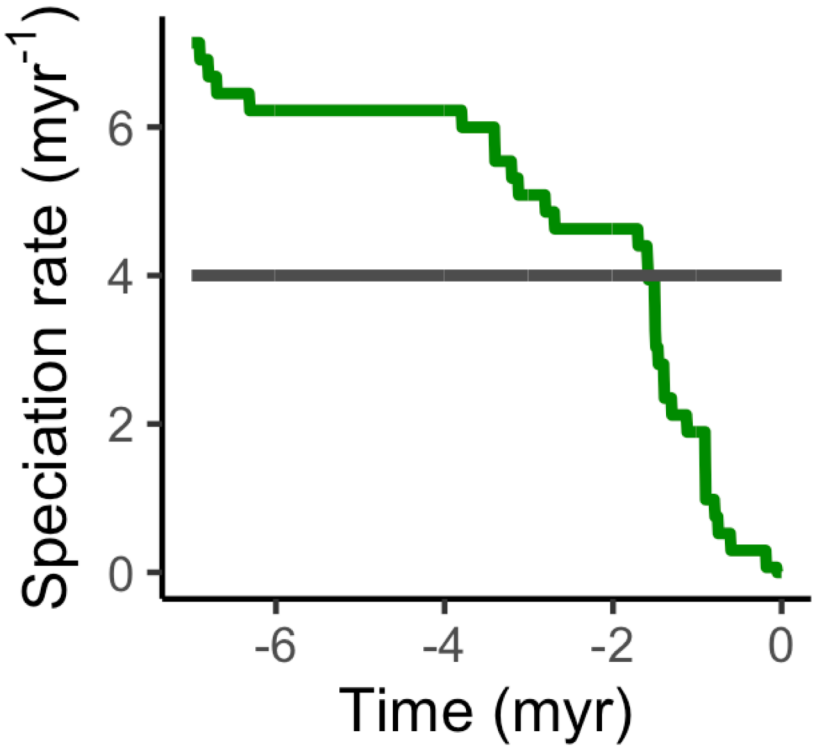


Null model

$\lambda = \lambda_0$ Diversification is constant

$$\rightarrow L(\lambda \mid \text{tree})$$



Modelling and inferring diversity-dependence in phylogenies

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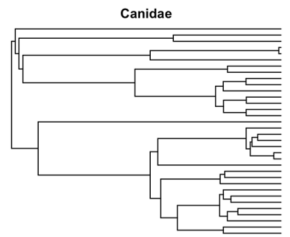
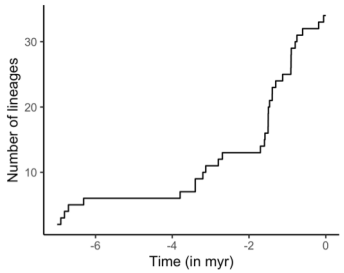
→ $L(\ \lambda(N(t)) \mid$  $)$



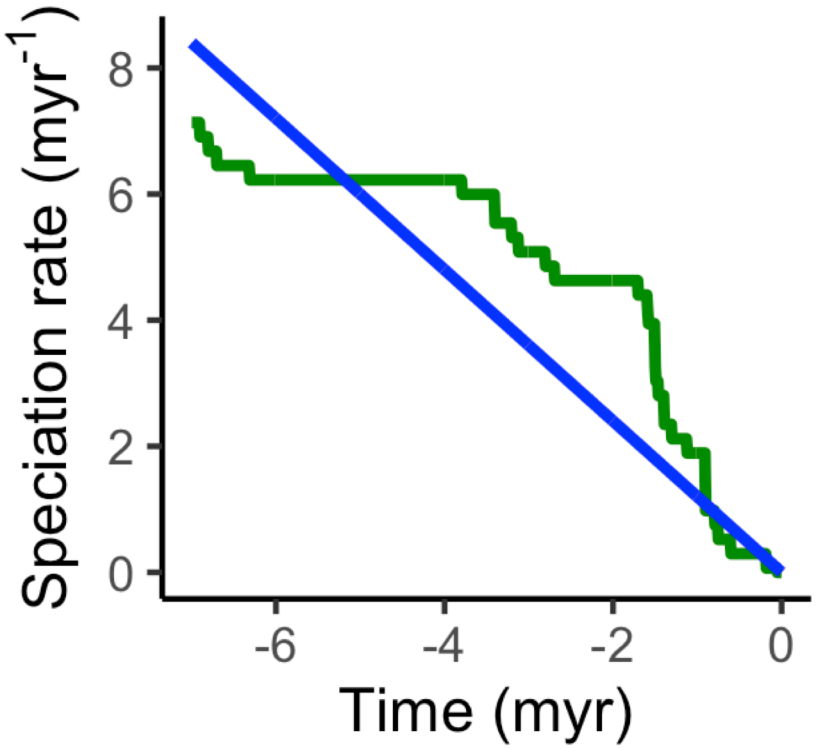


Null model

$$\lambda(t) = \lambda_0 (1 - \alpha\ t)$$

Diversification declines over time

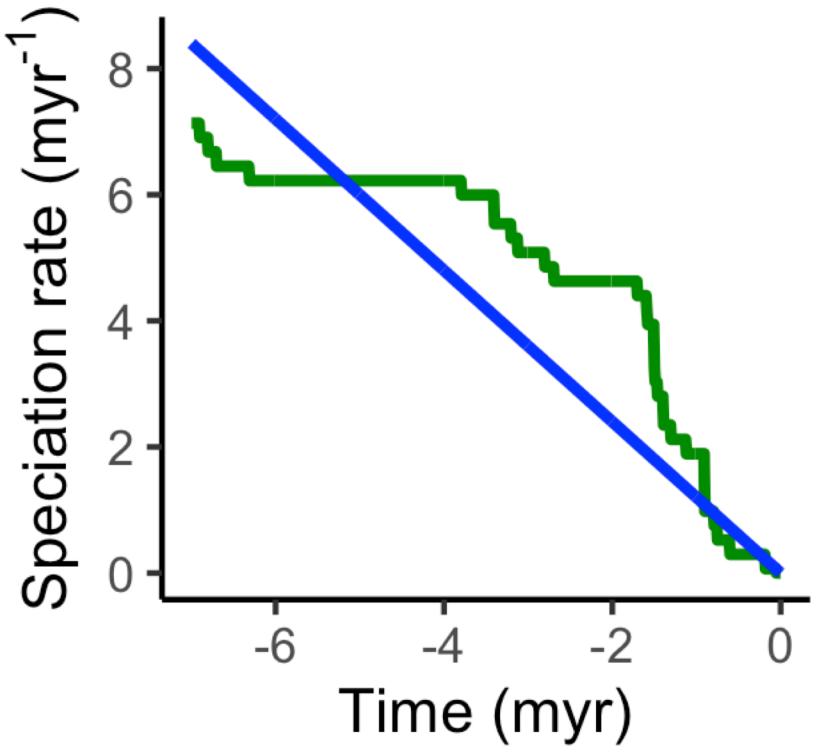
→ $L(\ \lambda(t) \mid$  $)$



This thesis:

Can diversity-dependence (DD) be distinguished from time-dependence (TD) alone in all-else-equal conditions?

$\lambda(N(t))$ and $\lambda(t)$ are arbitrary functions



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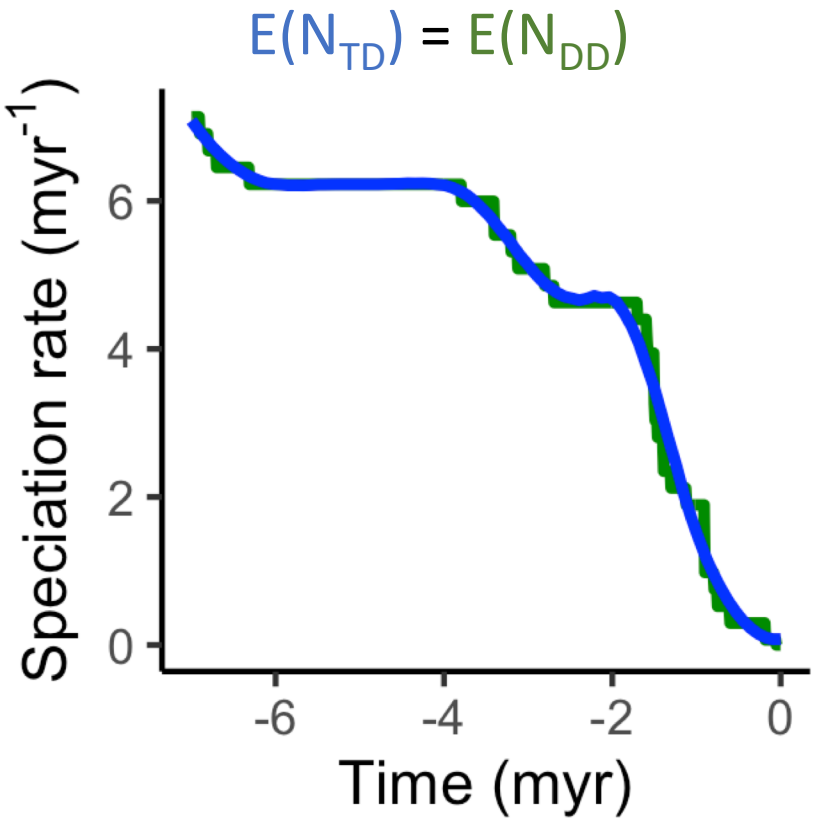


Same expected speciation rate, but feedback between diversity and speciation in DD

Can diversity-dependence (DD) be distinguished from time-dependence (TD) alone in all-else-equal conditions?

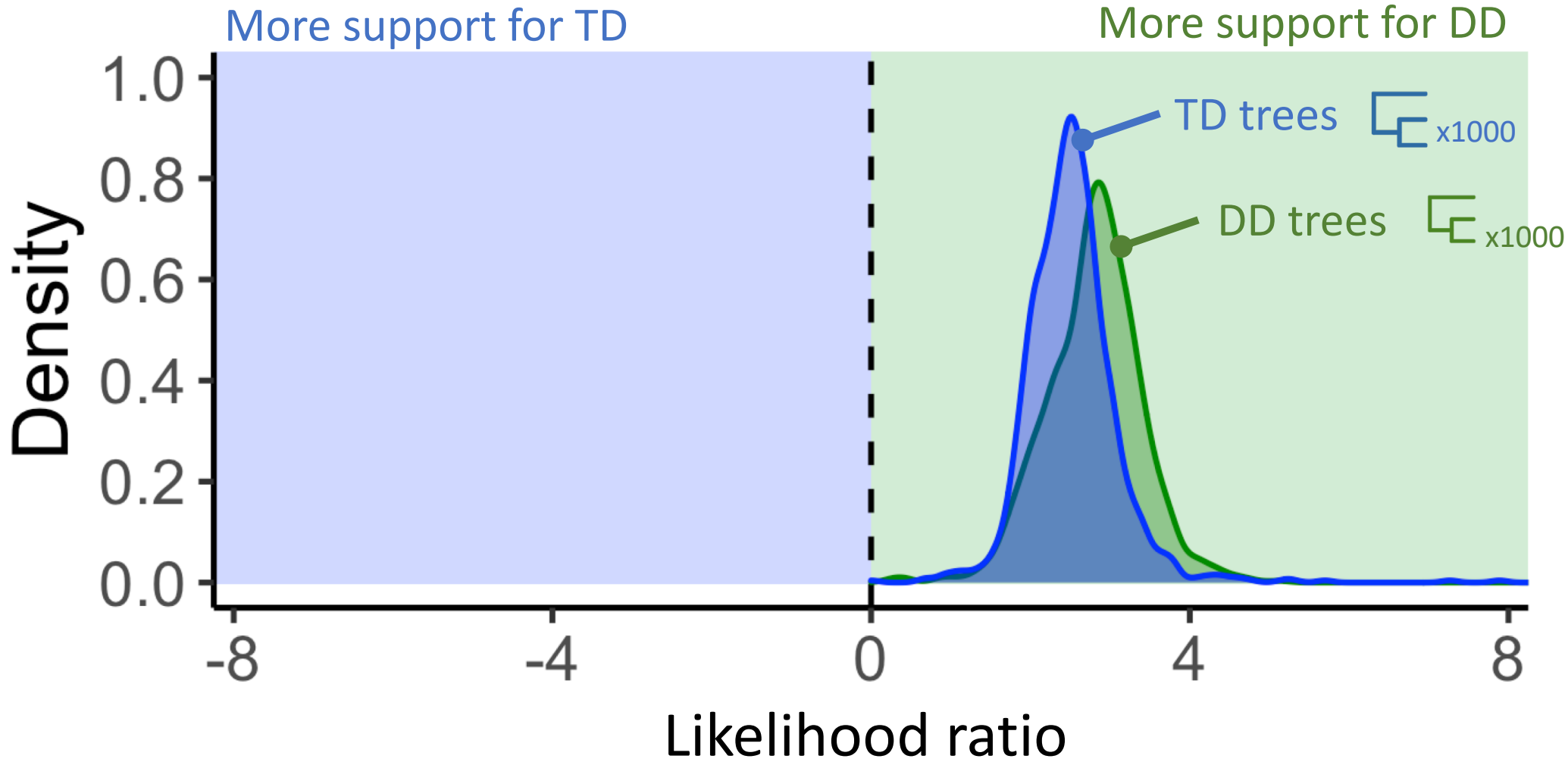
Protocol 1. Simulate trees 2. Likelihood ratio

DD  → $\frac{L(\lambda(N(t)) \mid \text{tree})}{L(\lambda(t) \mid \text{tree})}$ → % DD selected ?

TD  → $\frac{L(\lambda(N(t)) \mid \text{tree})}{L(\lambda(t) \mid \text{tree})}$ → % TD selected ?

Can diversity-dependence (DD) be distinguished from time-dependence (TD) alone in all-else-equal conditions?

Results



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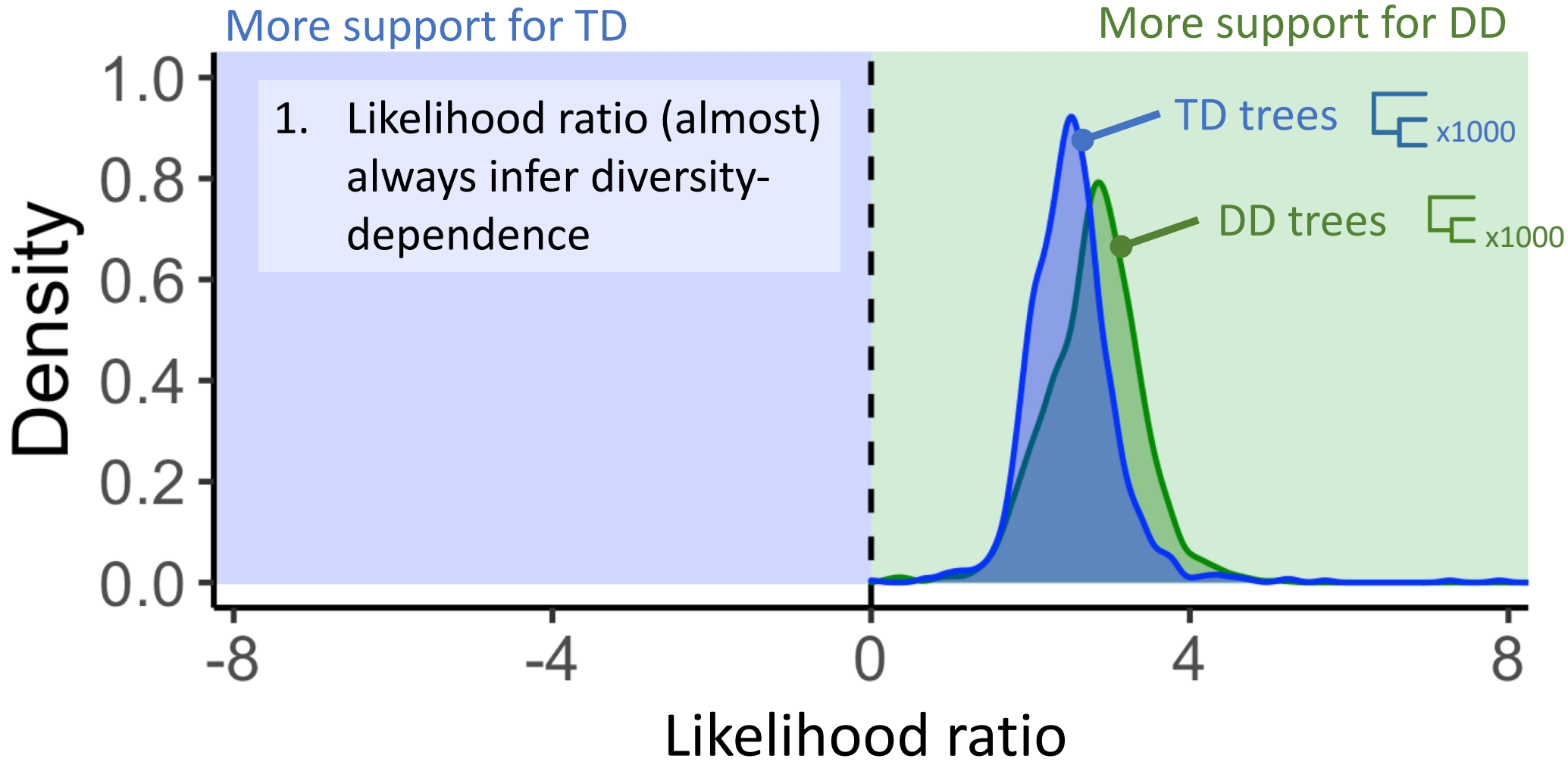

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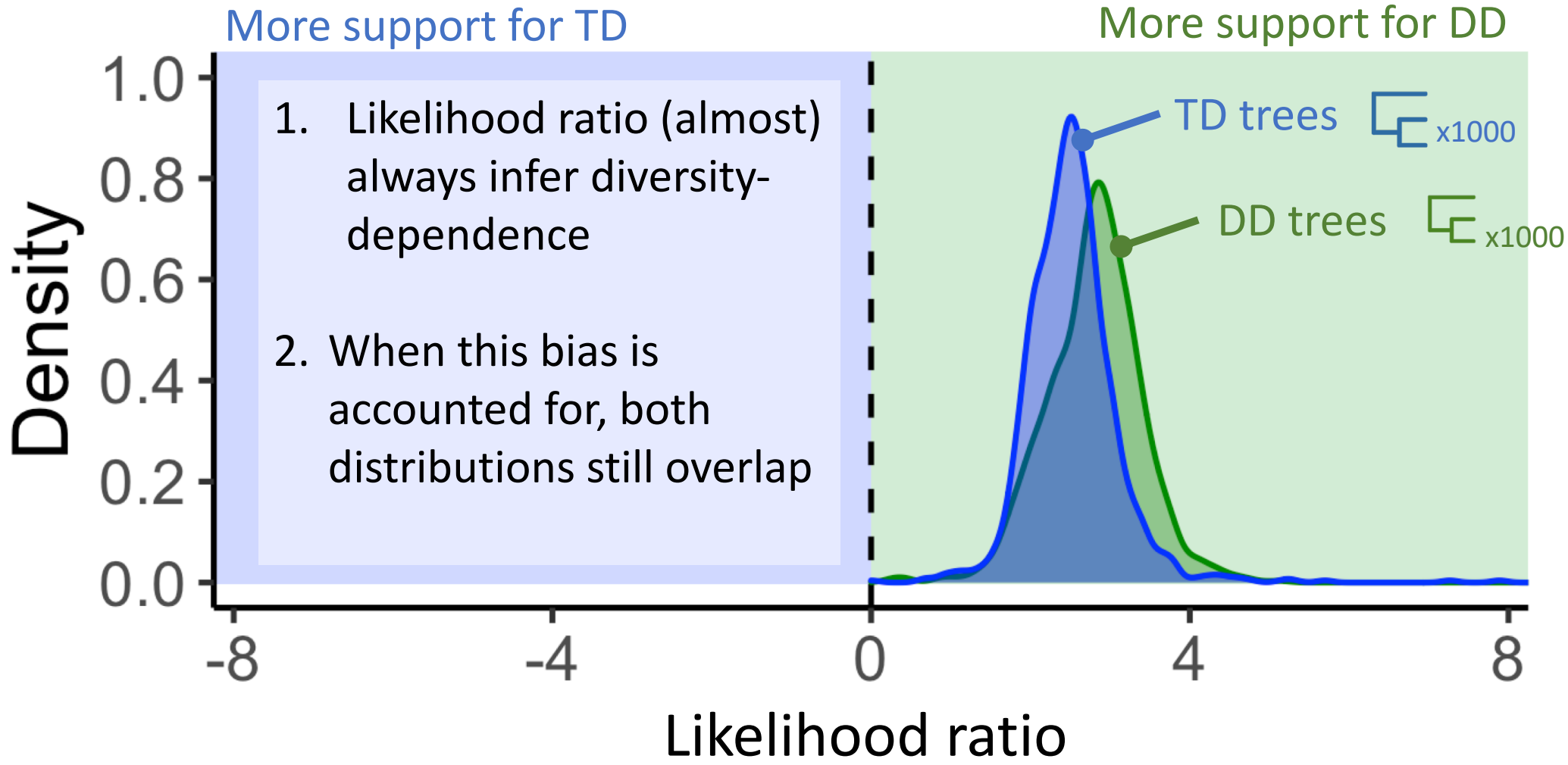

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- Unlikely to be a shortcoming of the method
- Not enough signal for diversity-dependence in the tree alone

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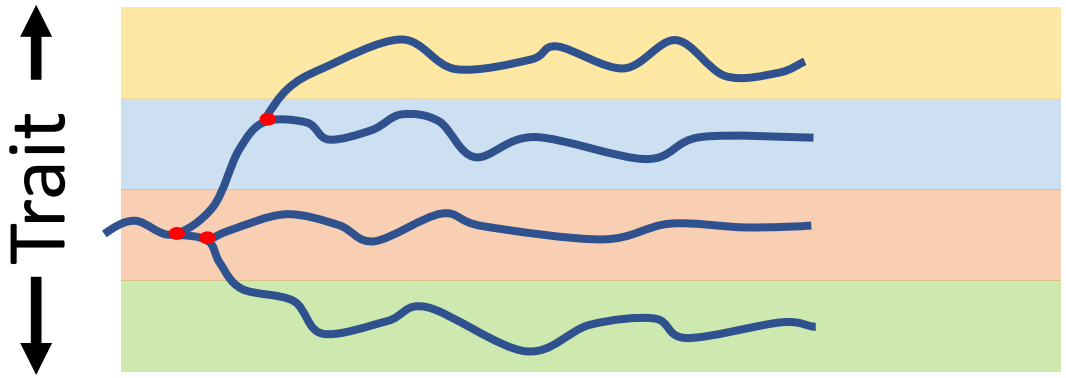

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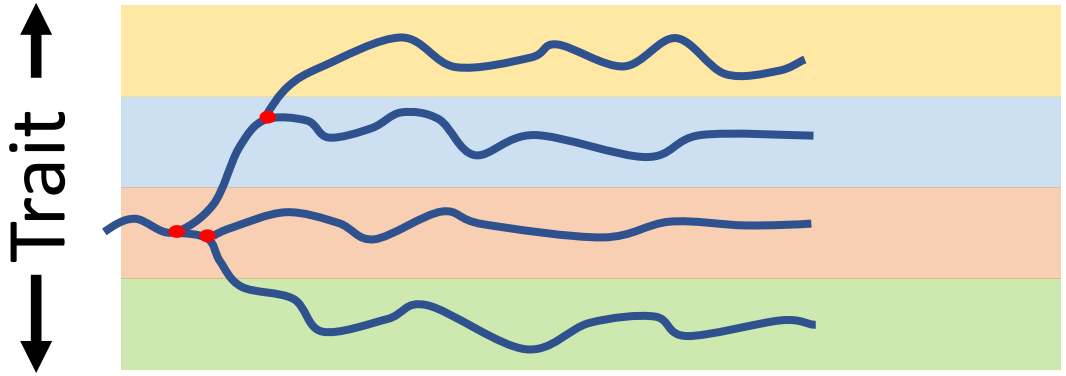

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