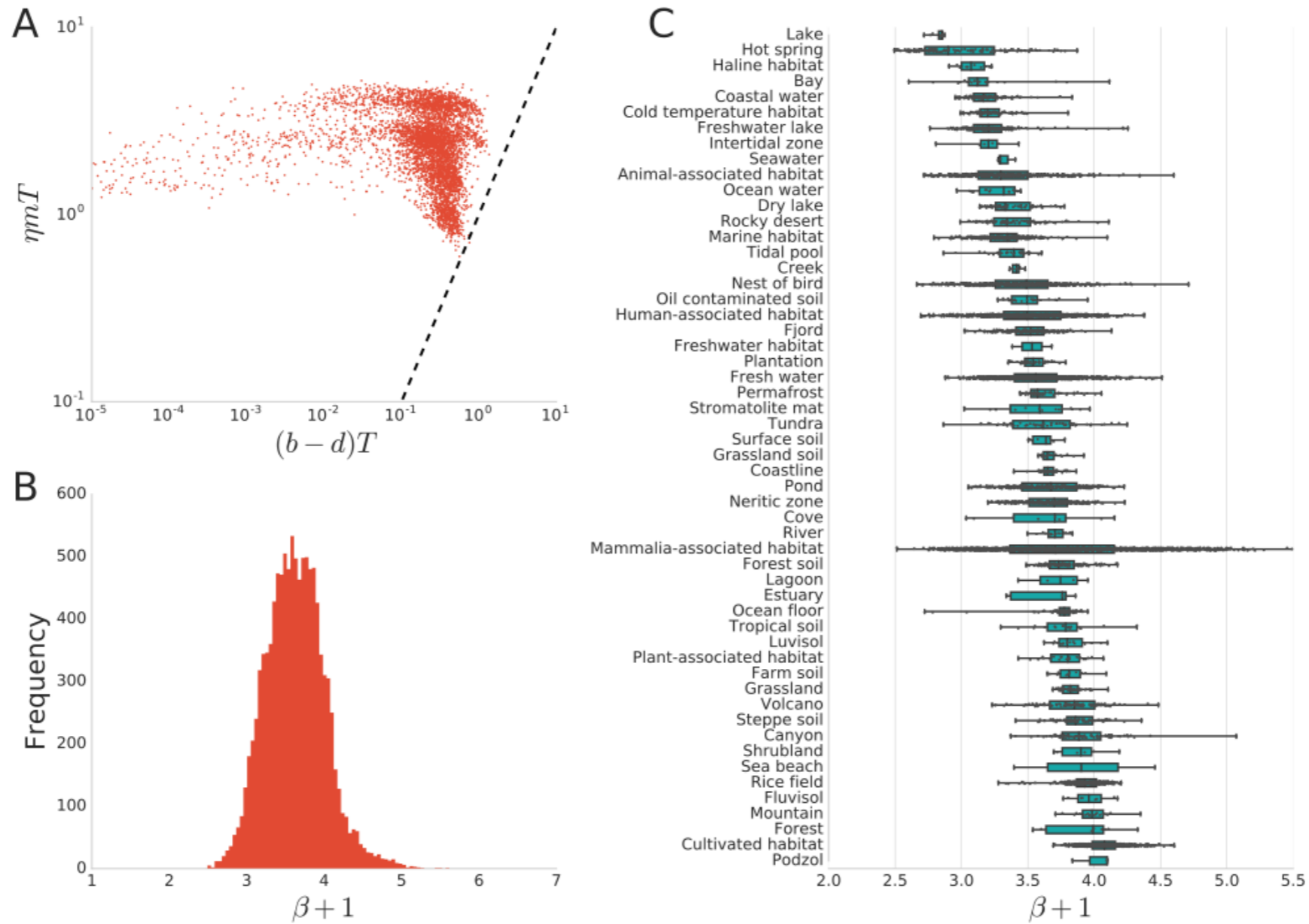


A circular phylogenetic tree diagram with a light blue background. The tree is composed of many branches radiating from a central point, with some branches highlighted in darker blue. The diagram is enclosed within a circular frame that has a dashed outer edge and a solid inner edge.

ALICE DOUCET BEAUPRÉ

COARSE-GRAINED
MICROBIAL ECOLOGY AND
PHYLODYNAMICS

WHAT IS THE TEMPO AND DYNAMIC OF MICROBIAL DIVERSIFICATION?



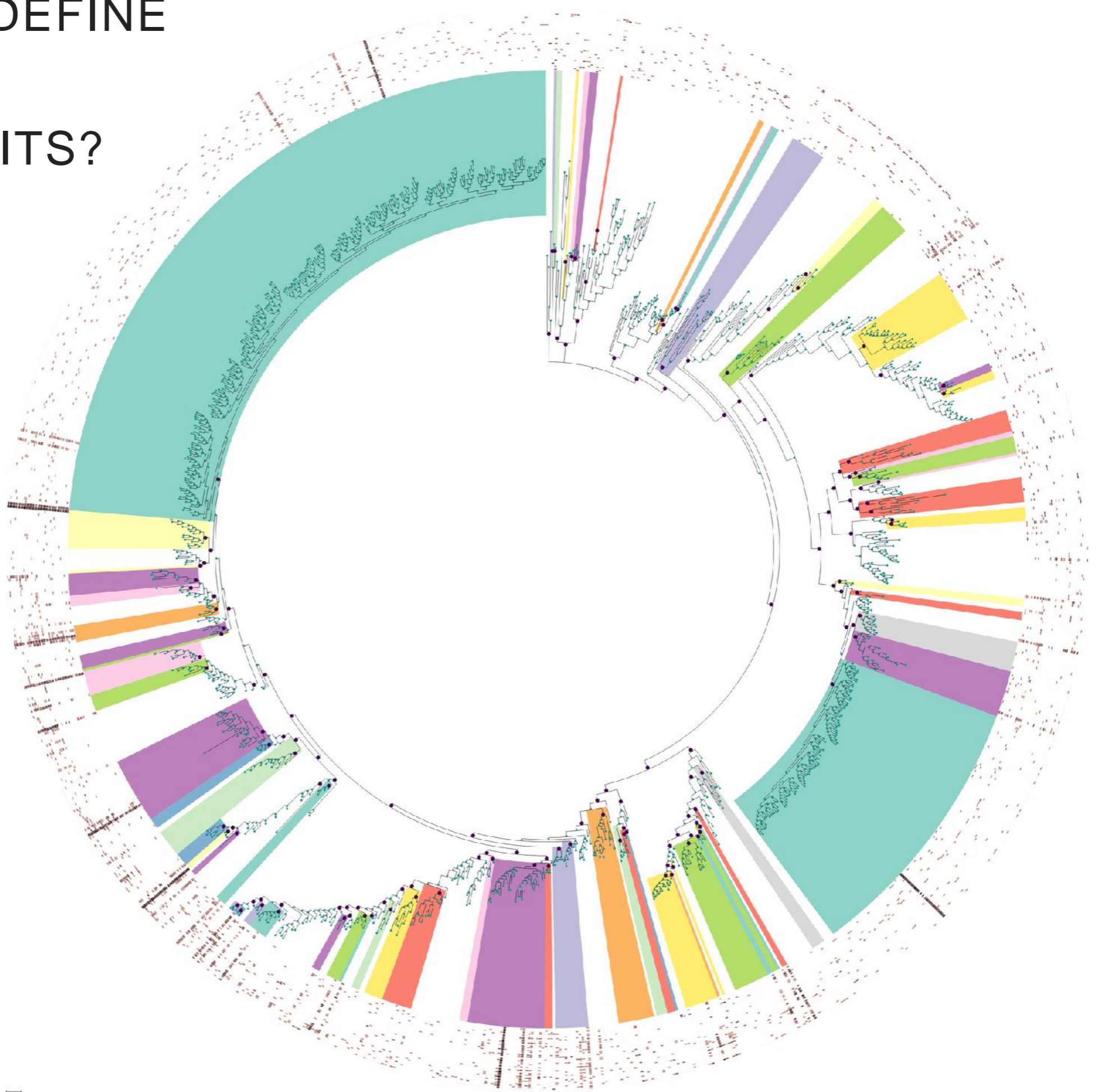
Birth-Death-Heterogeneous innovation model

$$\sim \frac{1}{k\beta+1} \quad \beta \simeq 2.6$$

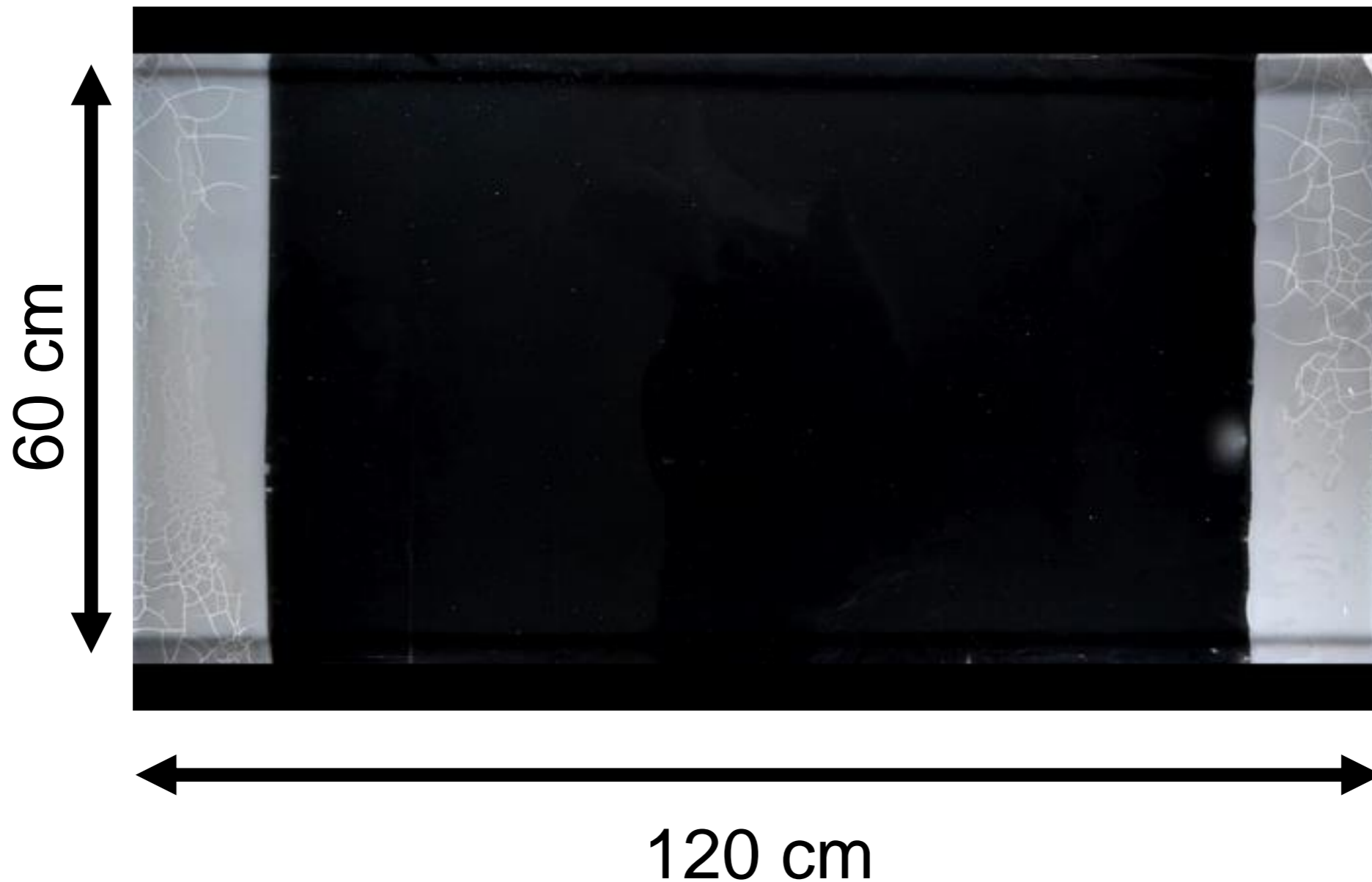
HOW CAN WE DEFINE MEANINGFUL CONTEXTUAL MICROBIAL UNITS?

ALTERNATIVE
TAXONOMIC
UNITS

URN CASCADE
NULL MODEL

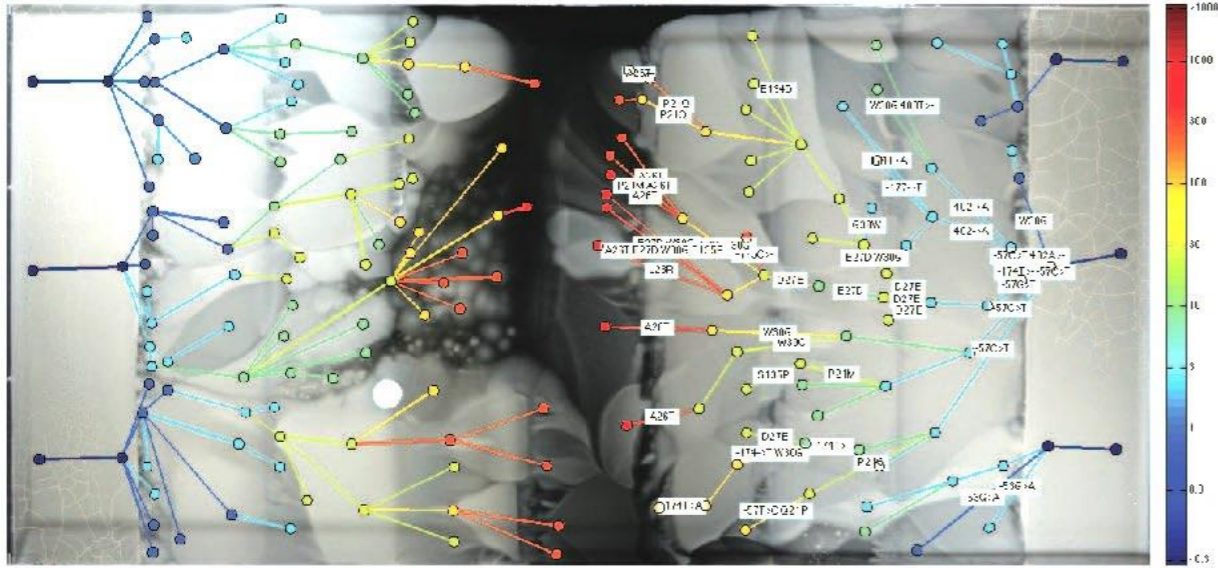


MEGA-plate experiments @ Kishony Lab

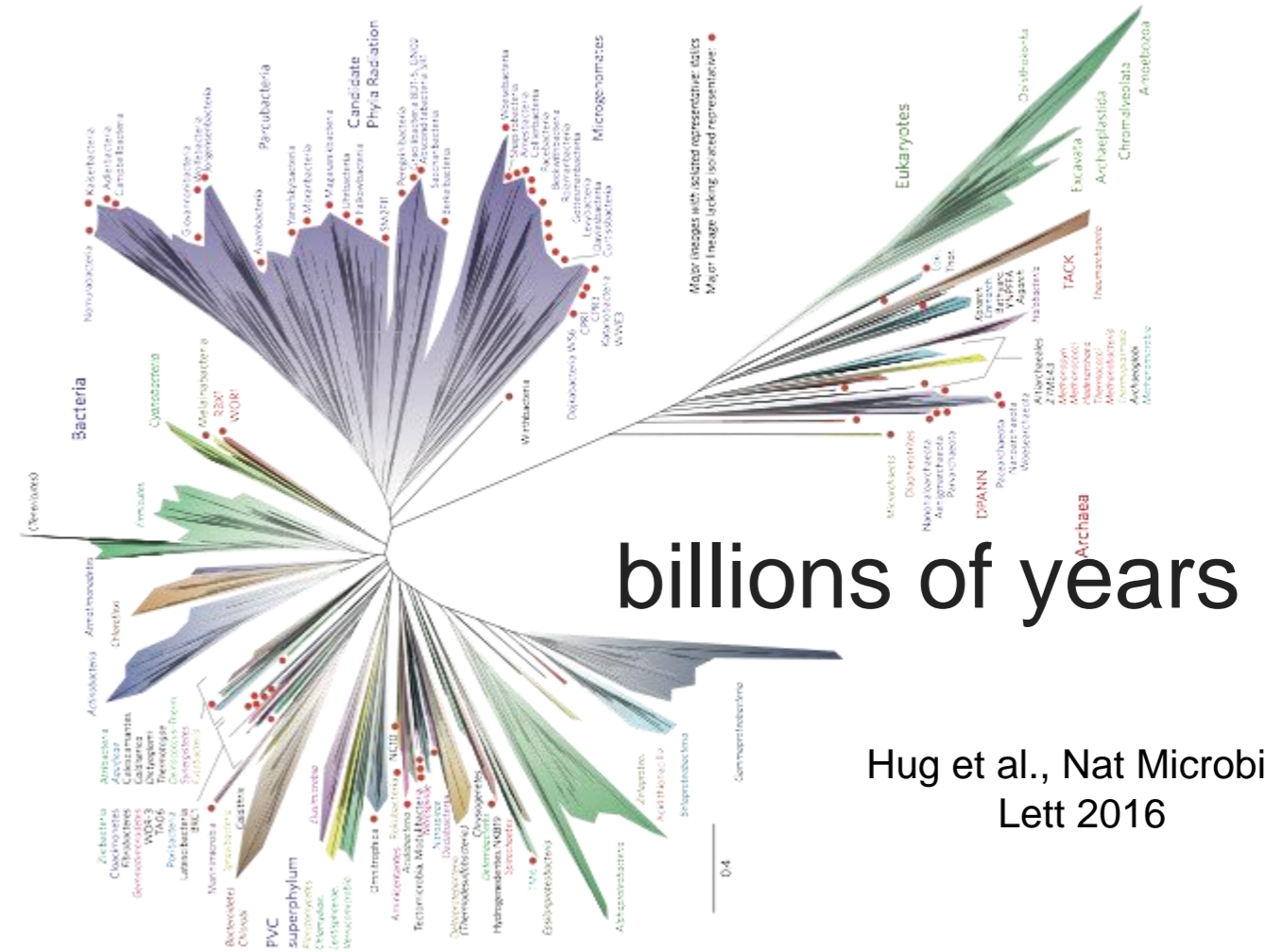


Spatiotemporal microbial evolution
on antibiotic landscapes
Baym et al, Science (2016)

Baym et al, Science (2016)

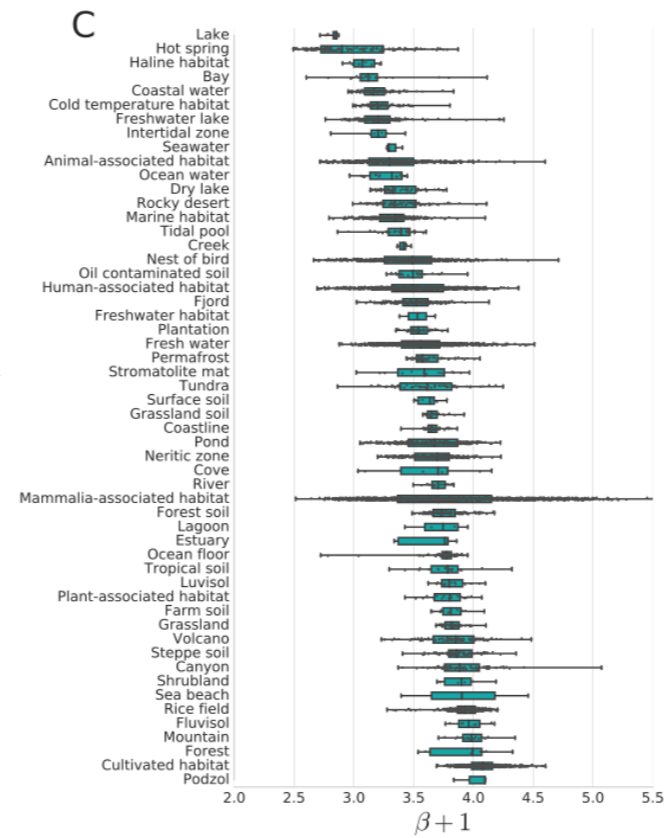
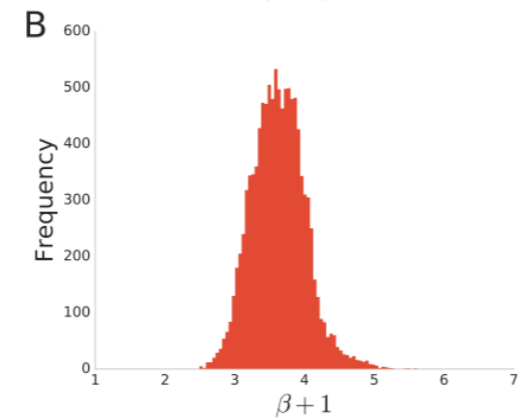
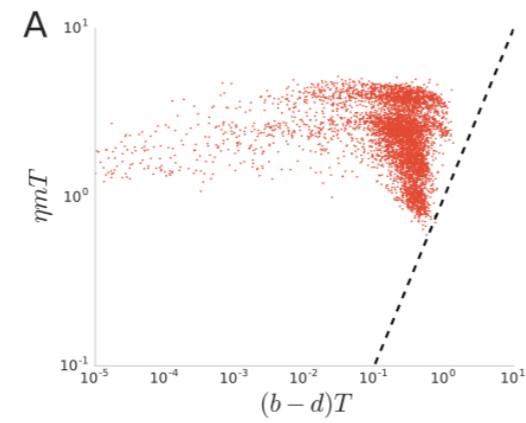
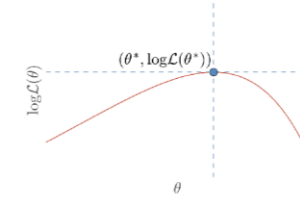
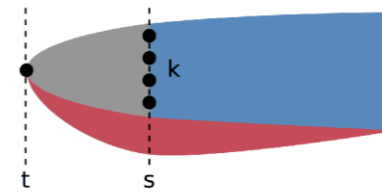
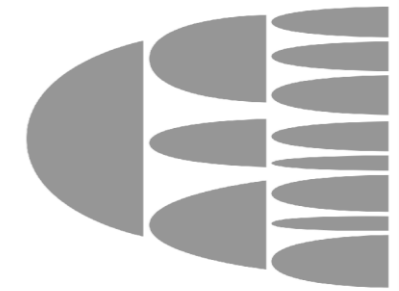
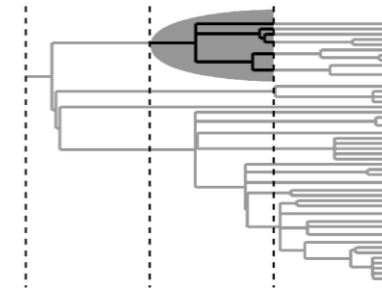
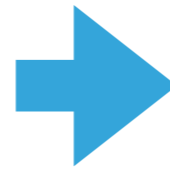


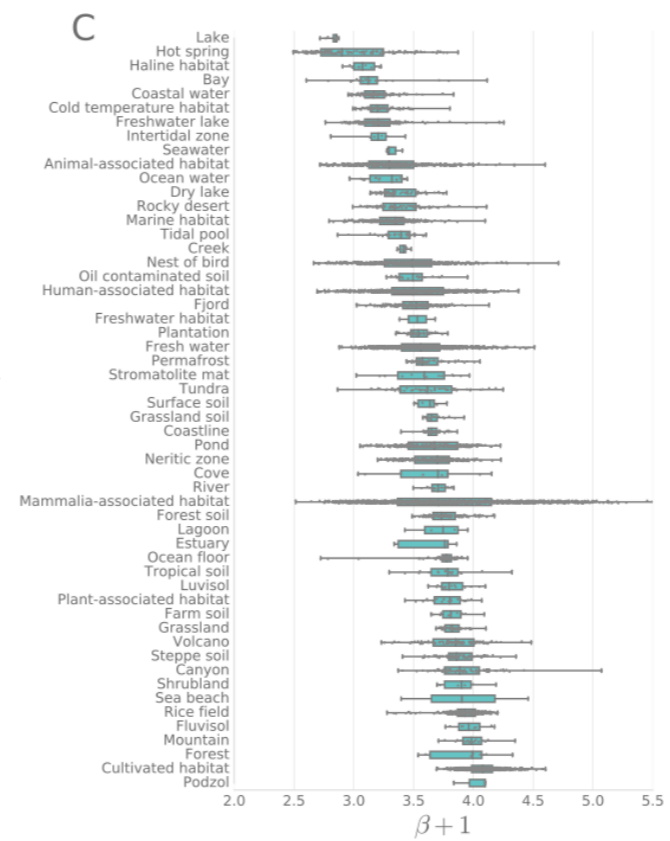
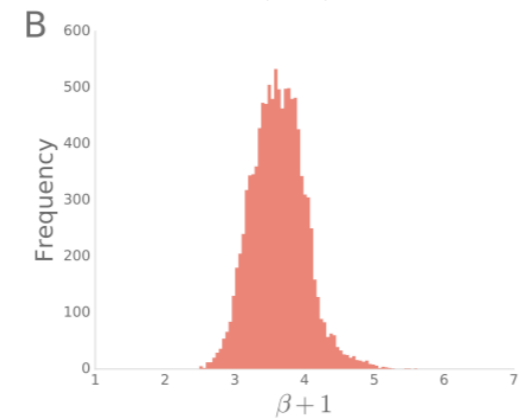
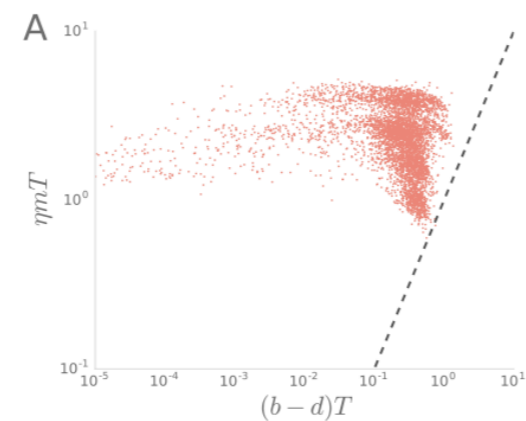
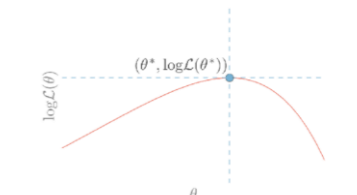
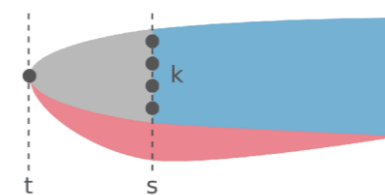
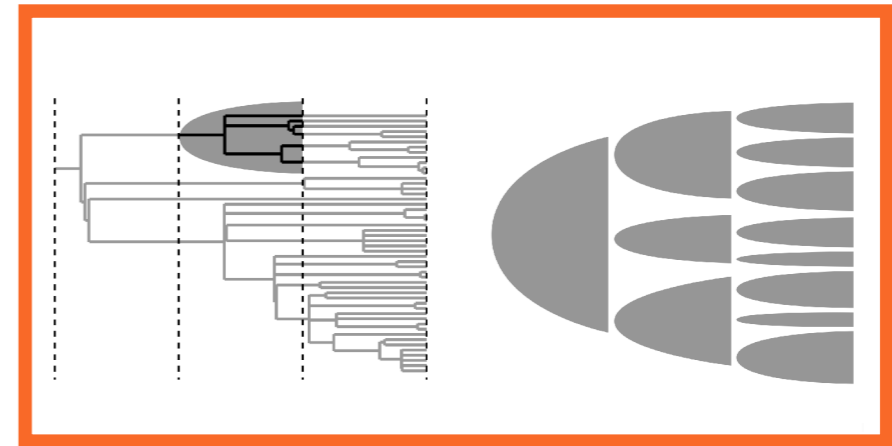
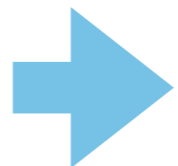
12 days



Hug et al., Nat Microbiol
Lett 2016

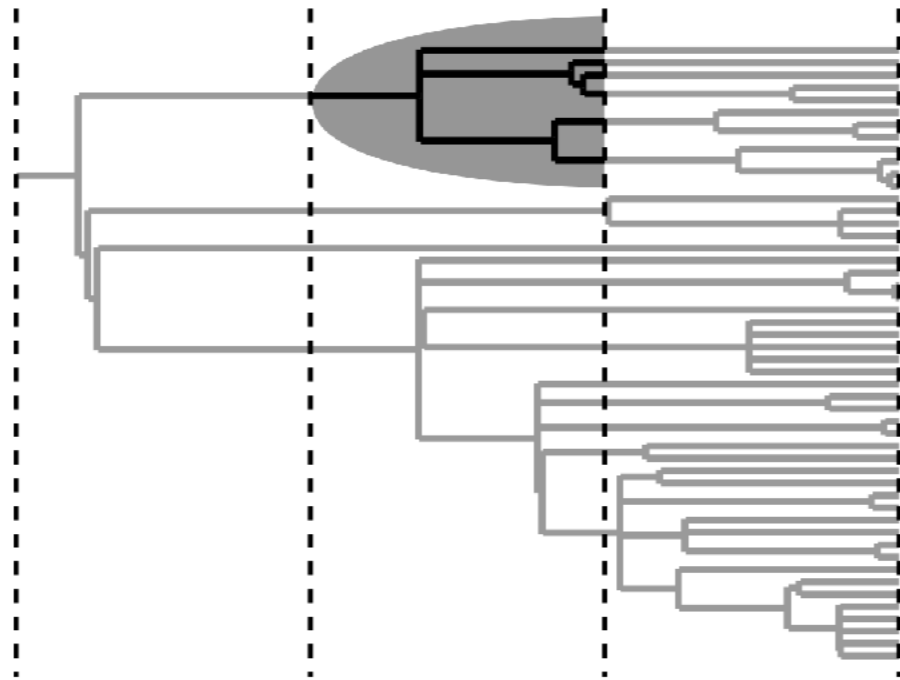
HOW CAN WE INTERPOLATE
MICROBIAL ECOLOGY AND
EVOLUTION ACROSS SCALES?



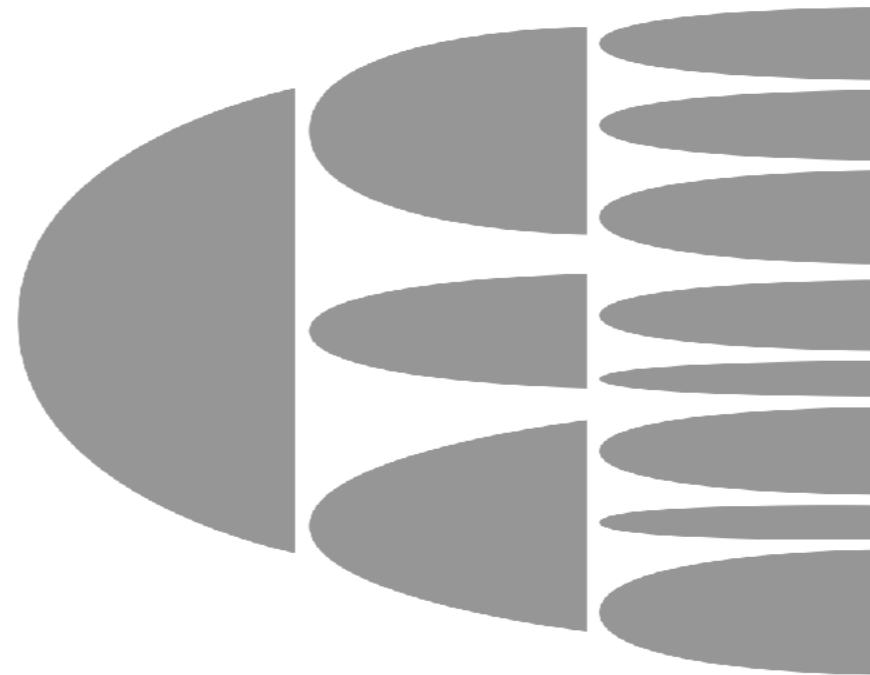


COARSE-GRAINING STEP

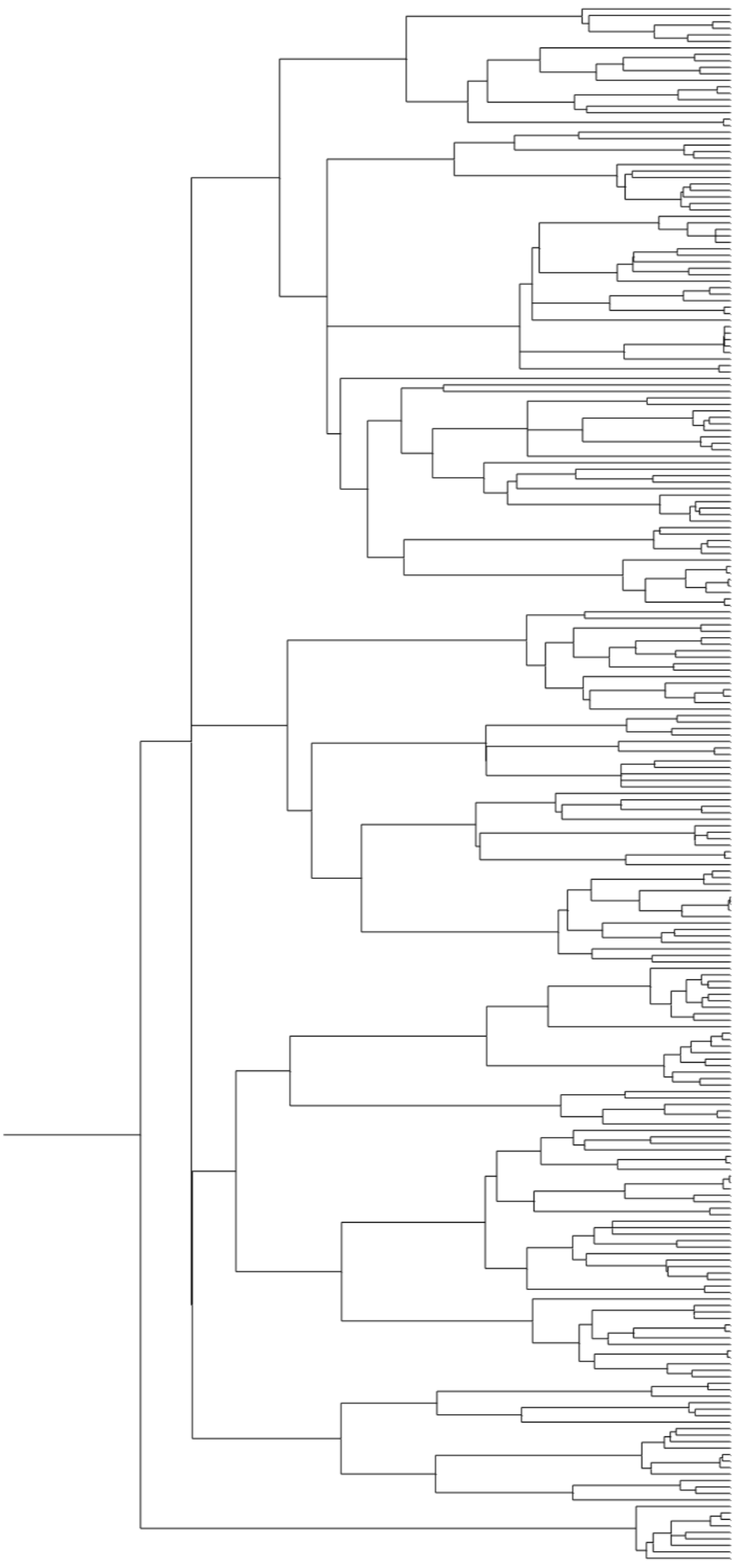
A Coarse-grain tree



B Extract individual chunks

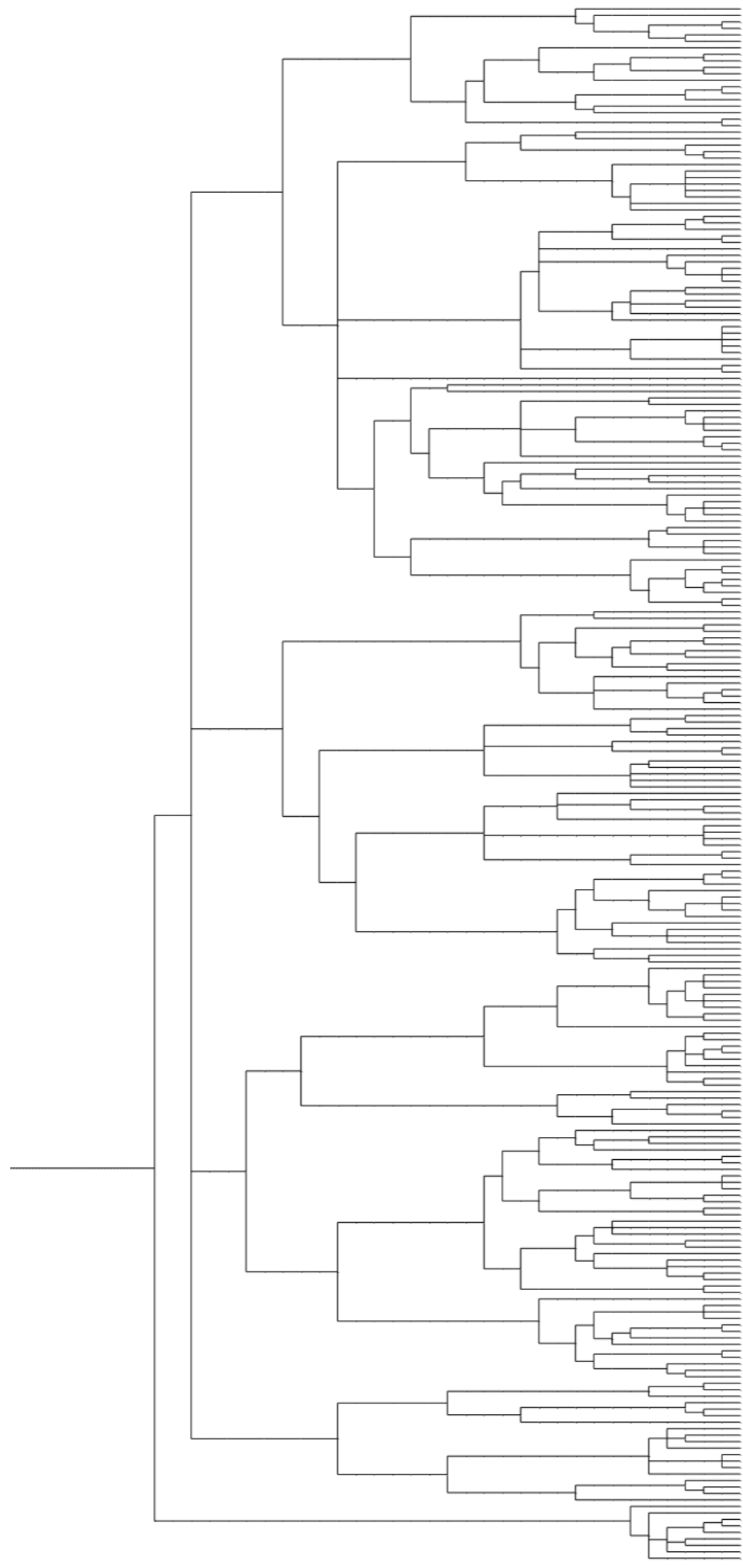


8



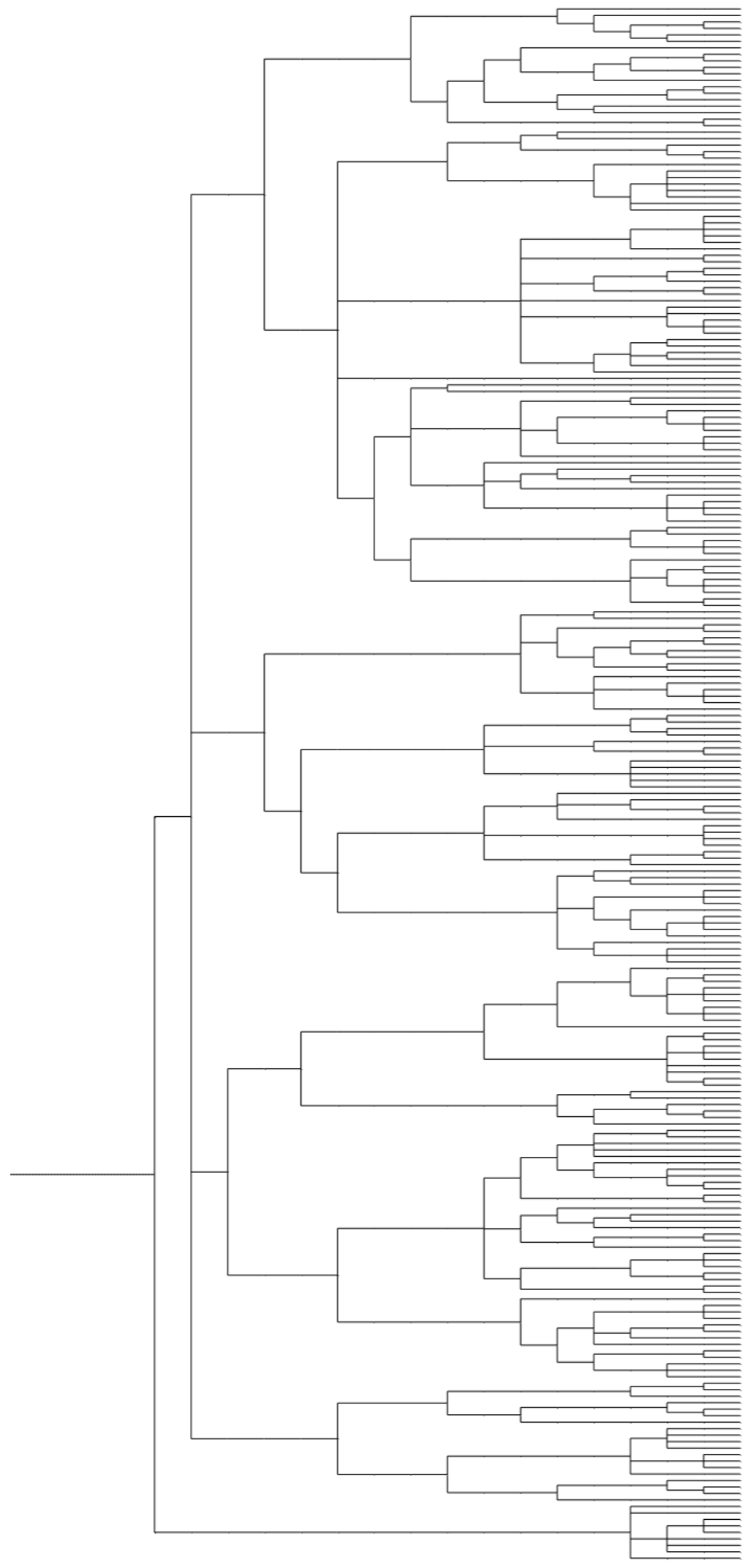
Model_∞

∞
↓
32



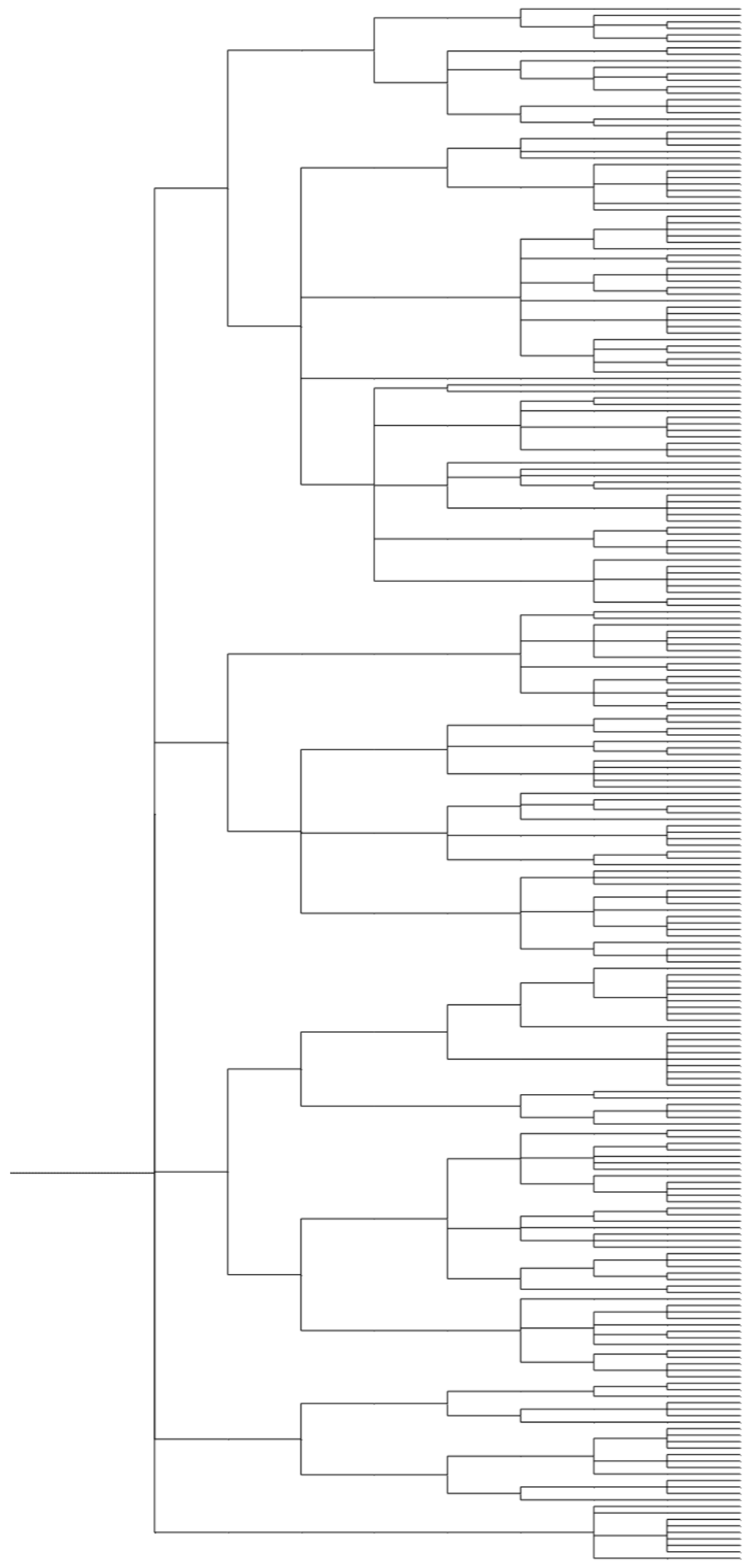
Model ∞
↓
Model₃₂

∞
↓
32
↓
16



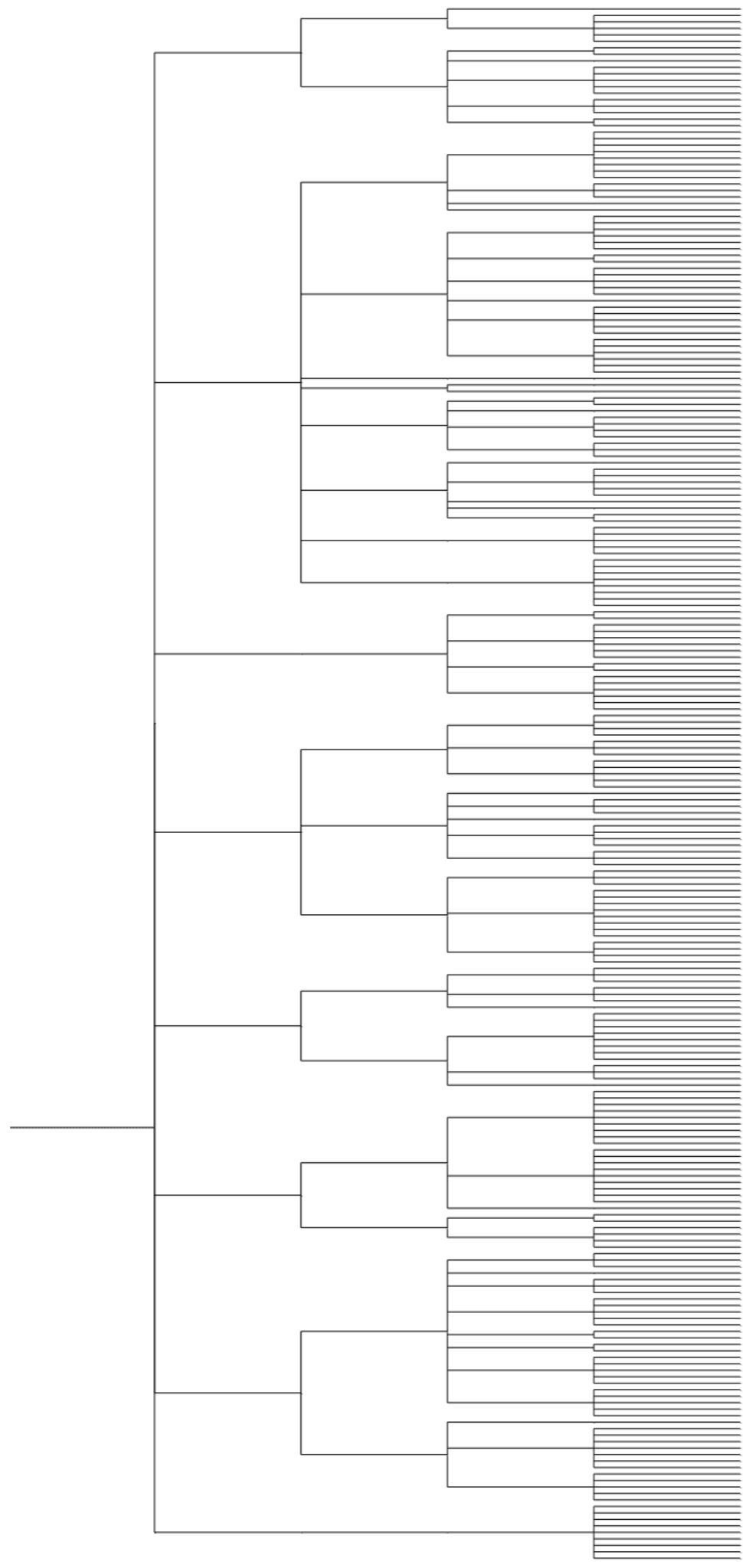
Model $_{\infty}$
↓
Model₃₂
↓
Model₁₆

∞
↓
32
↓
16
↓
8



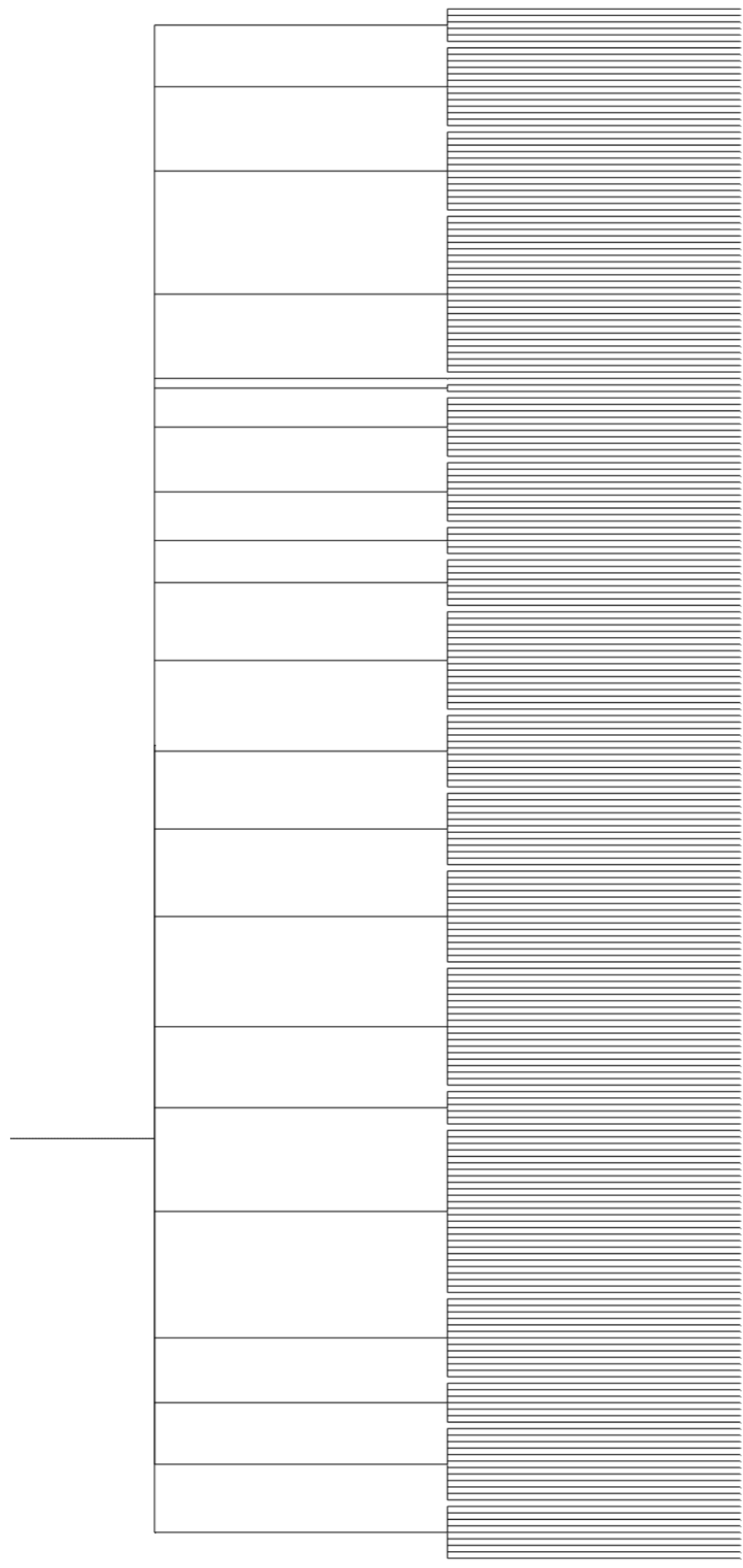
Model $_{\infty}$
↓
Model₃₂
↓
Model₁₆
↓
Model₈

∞
↓
32
↓
16
↓
8
↓
4



Model $_{\infty}$
↓
Model₃₂
↓
Model₁₆
↓
Model₈
↓
Model₄

∞
↓
32
↓
16
↓
8
↓
4
↓
2



Model $_{\infty}$
↓
Model₃₂
↓
Model₁₆
↓
Model₈
↓
Model₄
↓
Model₂

Model_∞



Model₃₂



Model₁₆



Model₈



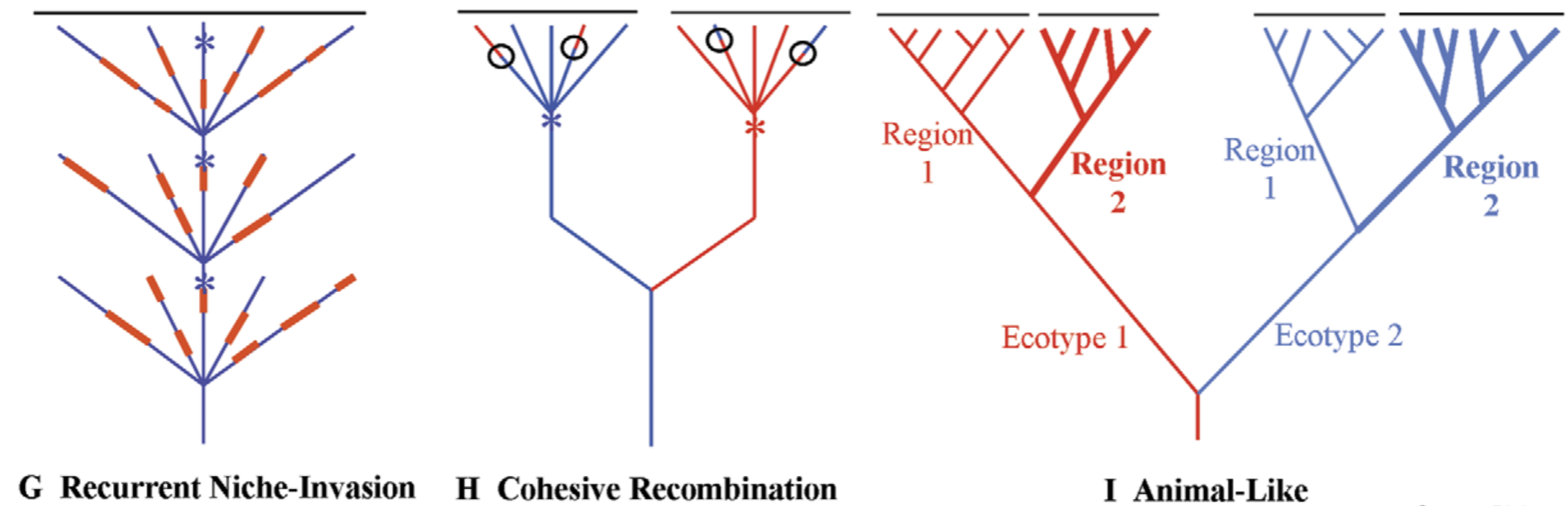
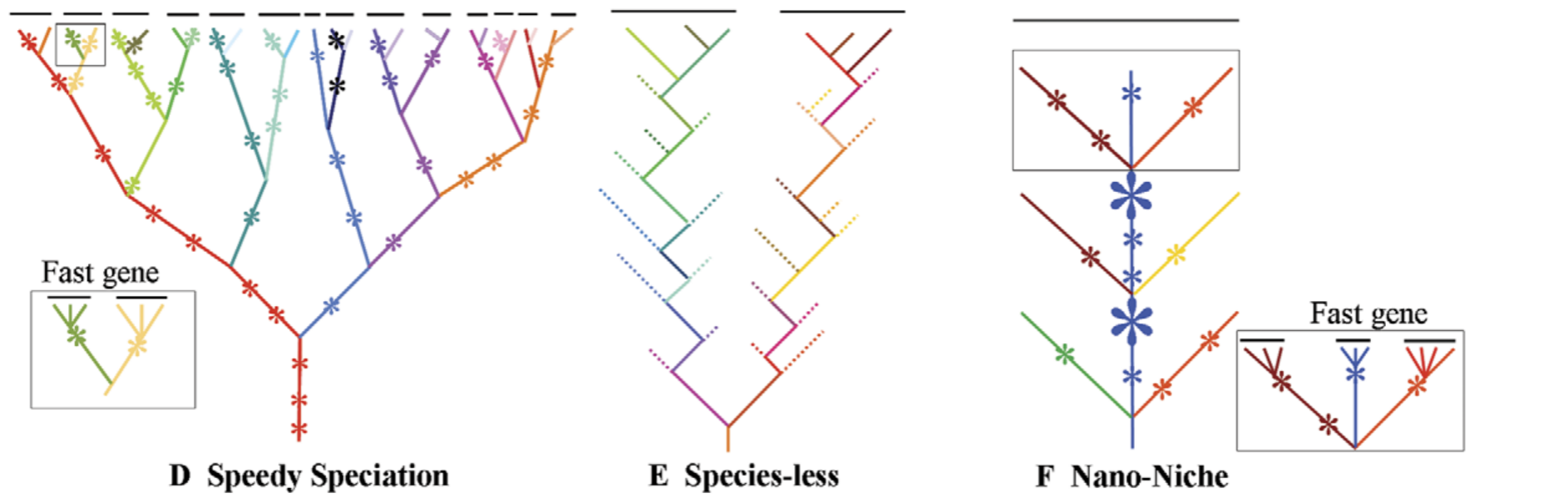
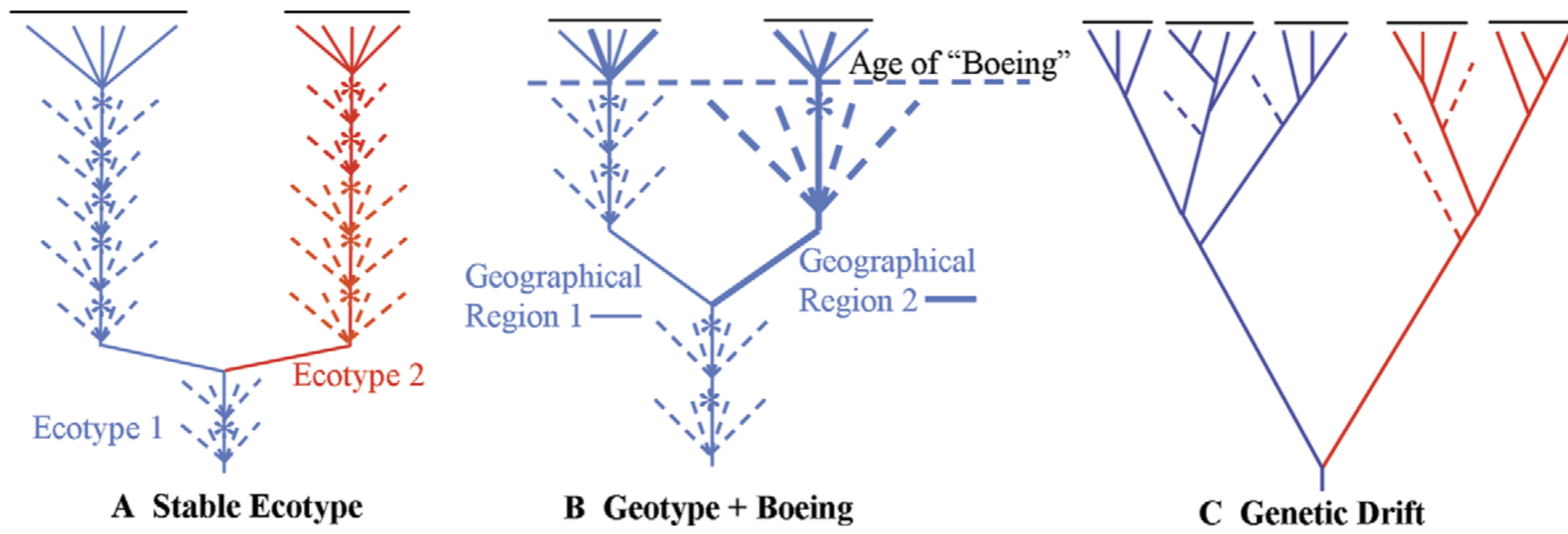
Model₄



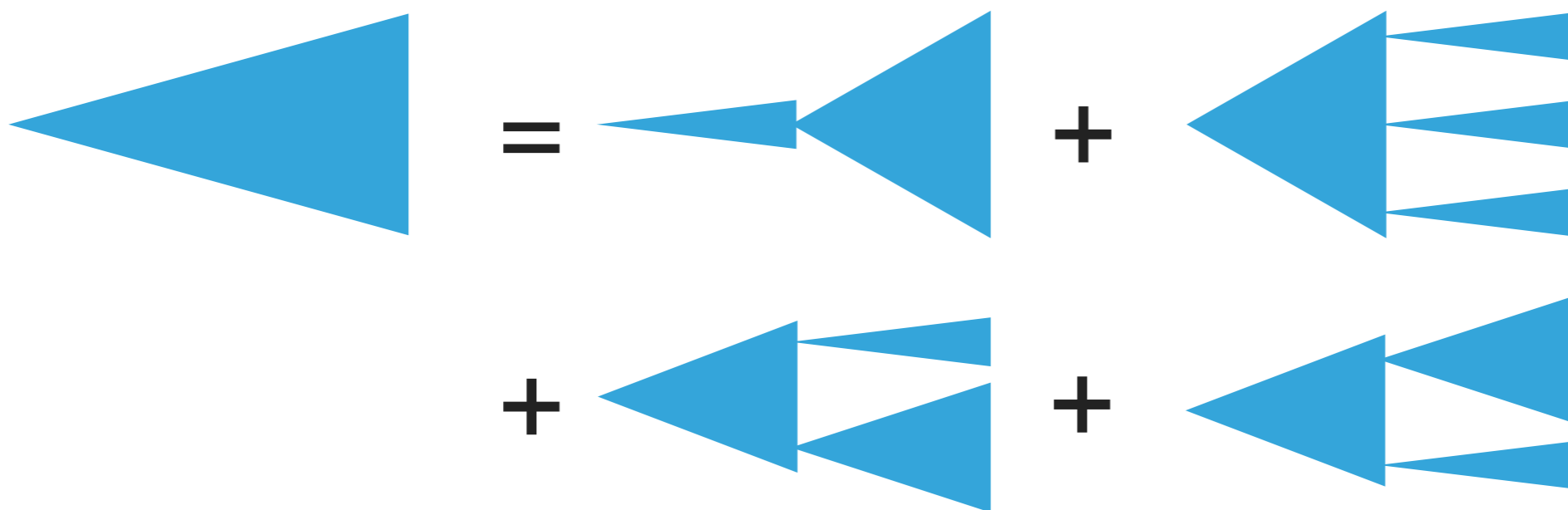
Model₂



Theoretical
microscope



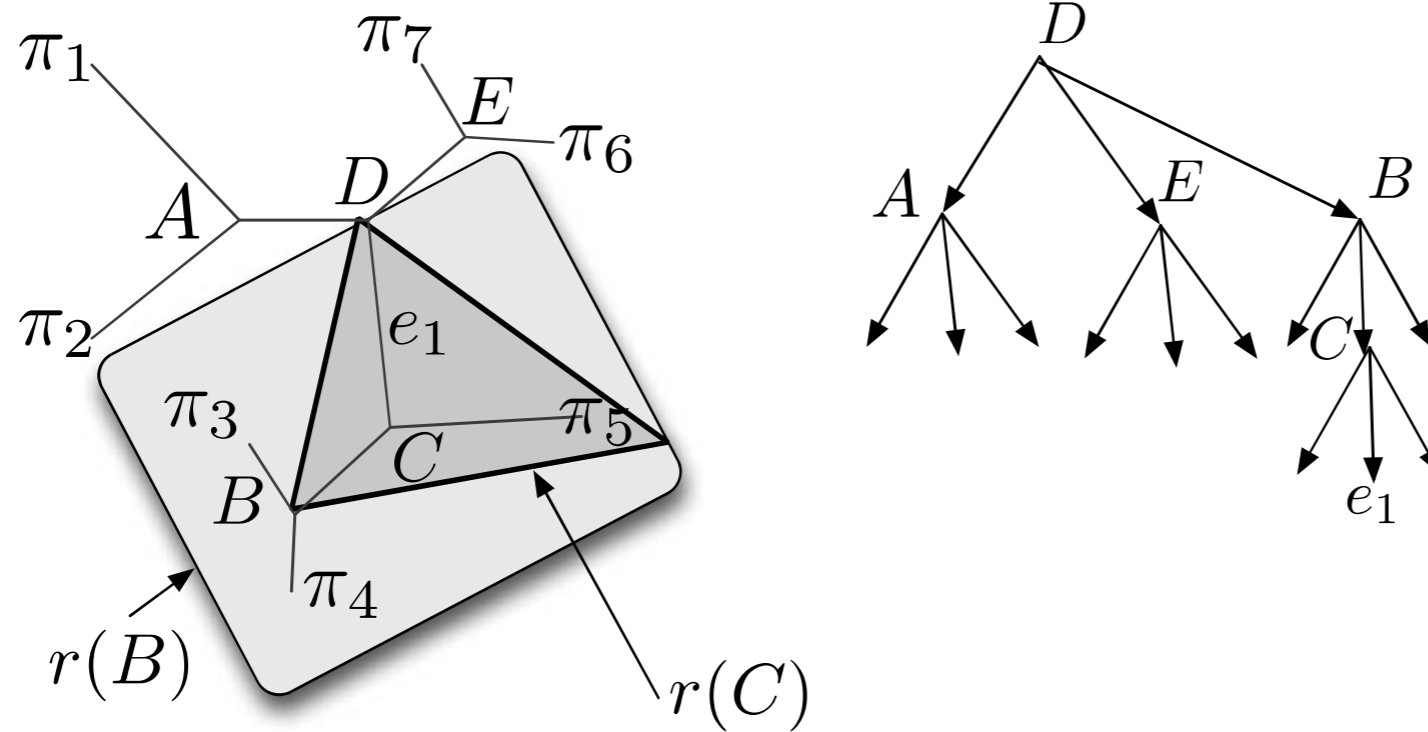
Cohan & Perry (2007)



$$\phi^{(k)}(t, s) = \sum_{c \in \text{Comp}(k)} \phi^{(|c|)}(t, r) \prod_{\lambda \in c} \phi^{(\lambda)}(r, s)$$

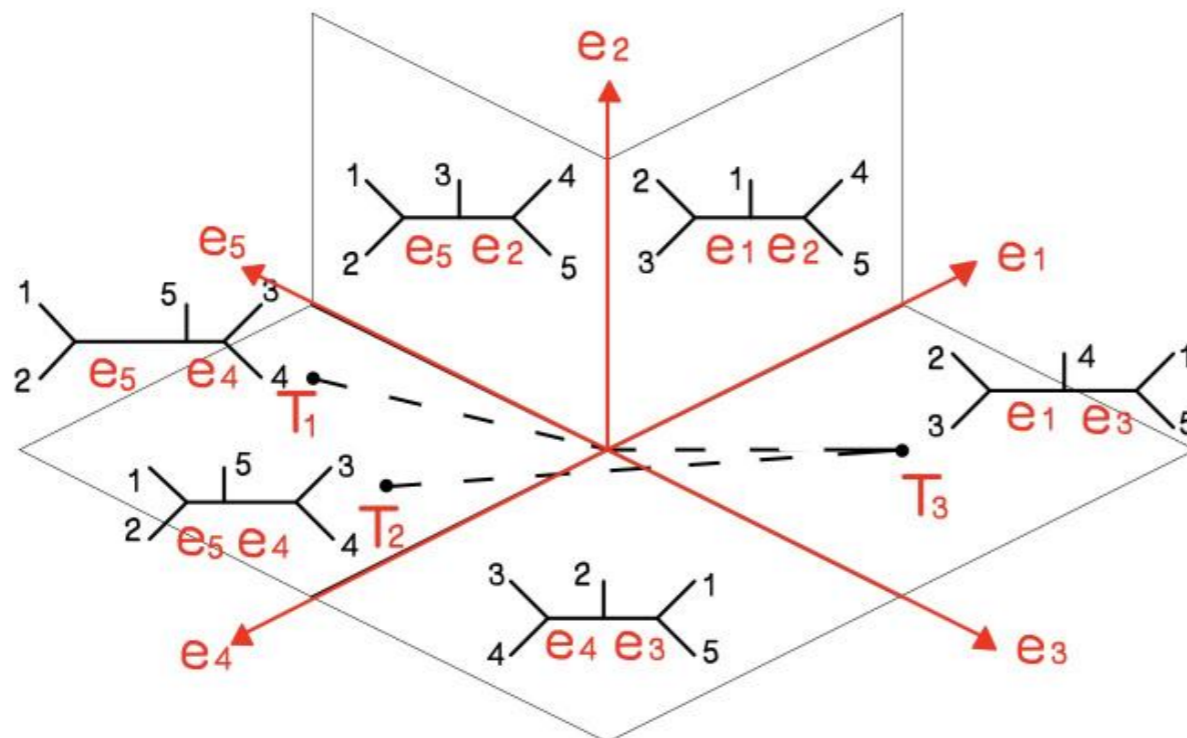


$$\begin{aligned} \Phi_{t,s} &= \Phi_{t,r} \circ \Phi_{r,s} \\ &= \Phi_{t,r'} \circ \Phi_{r',r} \circ \Phi_{r,r''} \circ \Phi_{r'',s} \end{aligned}$$



Fast coarse-grained
 $O(n \log n)$ method

Truskowski *et al* (2012)

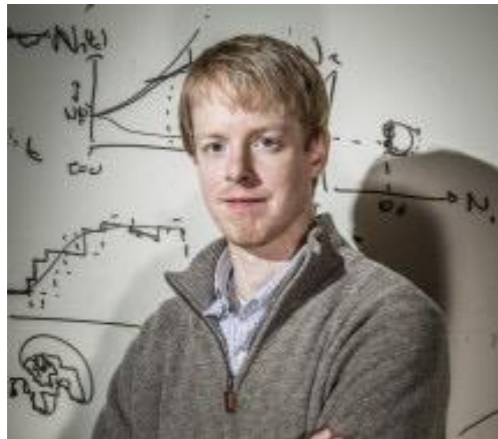


Owen and Provan (2011)

BHV tree space



- doucetb2@illinois.edu
- github.com/alicedb2
- mathema.ca



James O'Dwyer



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