

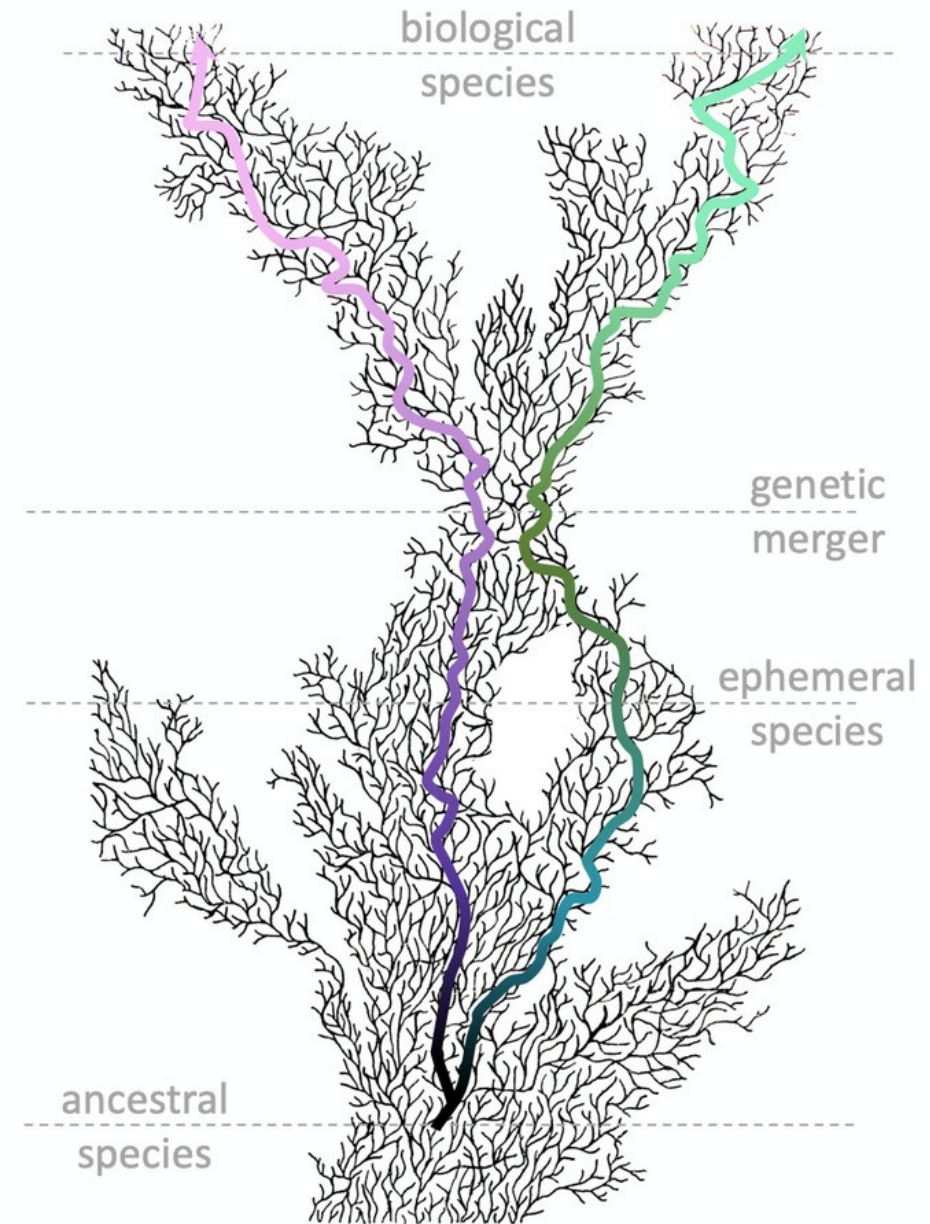
# Species as units of biological diversity

Molecular Ecology, MUNI, 7. 11. 2024

# The concept of species

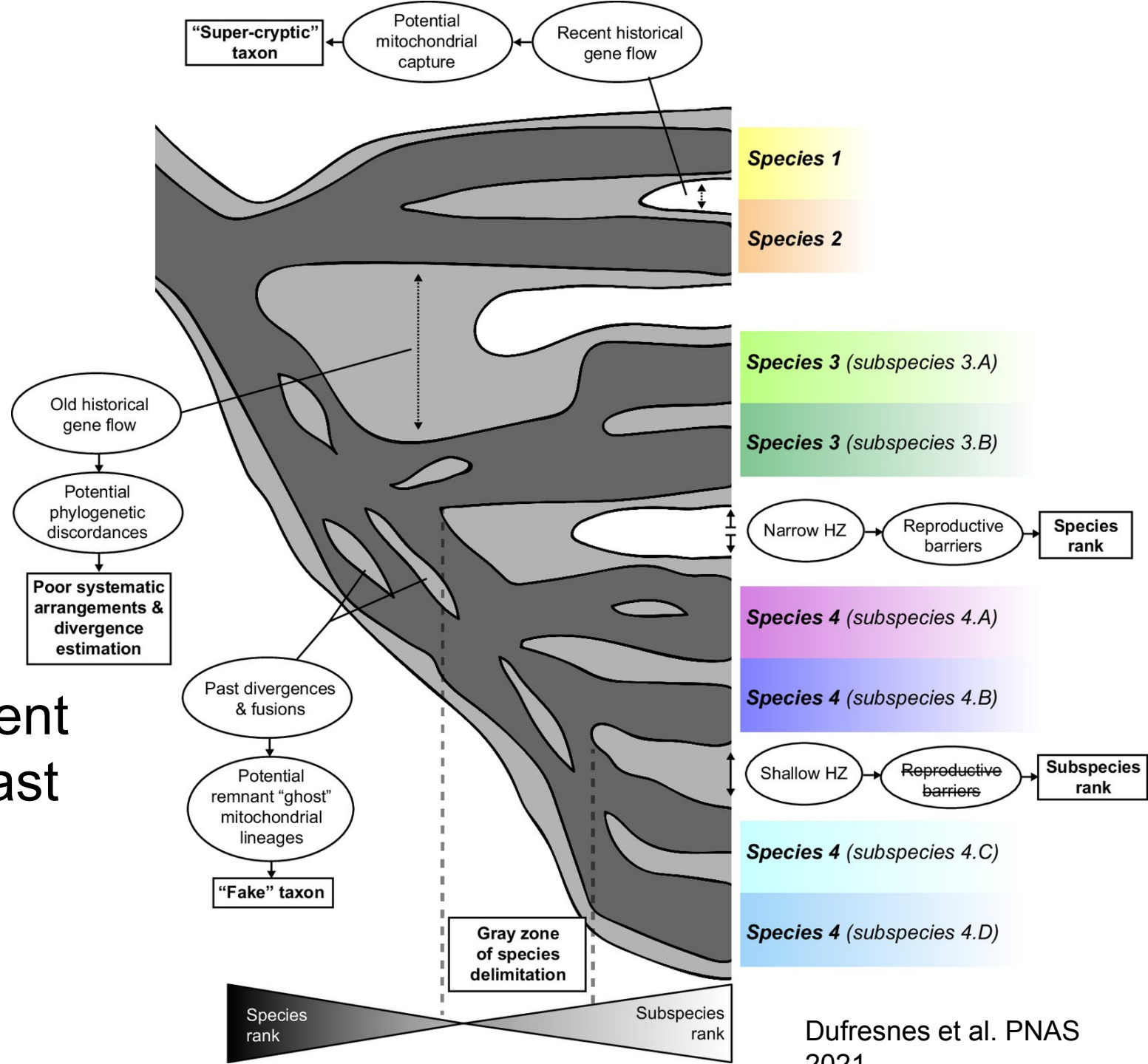
- reproductive communities
  - colonization, survival
- functional groups
  - ecosystems, coexistence
- species = independent evolutionary lineages
- ✗ evolutionary lineages are:
  - fractal
  - possibly ephemeral

(a) Species formation in time



# The concept of species

- species = independent & persistent evolutionary lineages
- evidence:
  - experimental – in present
  - statistical – from the past



# African striped mice: *Lemniscomys*

MORPHOGROUPS

X

GENETIC LINEAGES



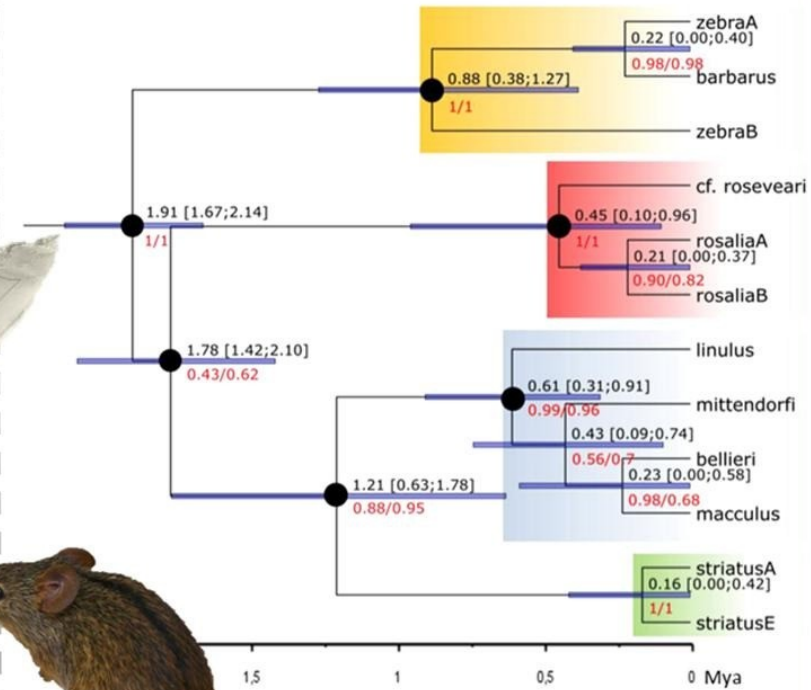
BARBARUS



GRISELDA



STRIATUS



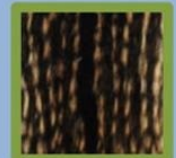
BARBARUS



GRISELDA



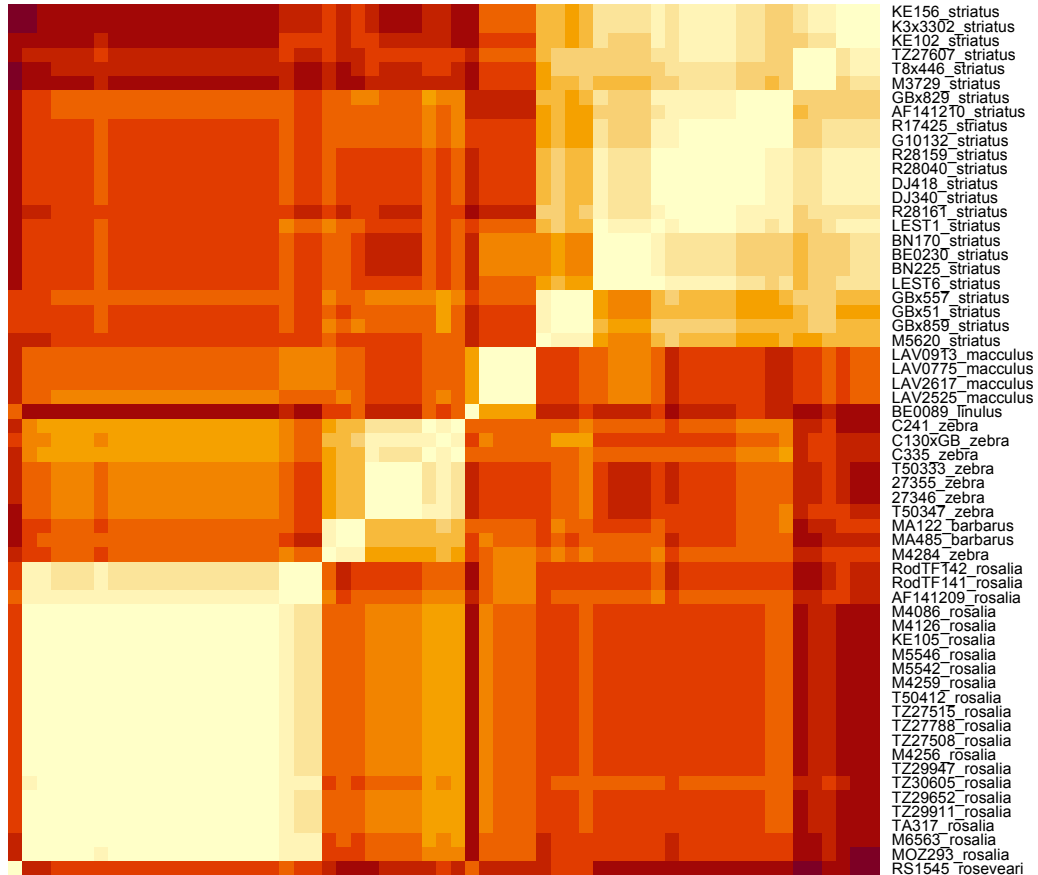
MACCULUS



STRIATUS

# Single-locus methods: genetic distances

## Matrix of genetic distances



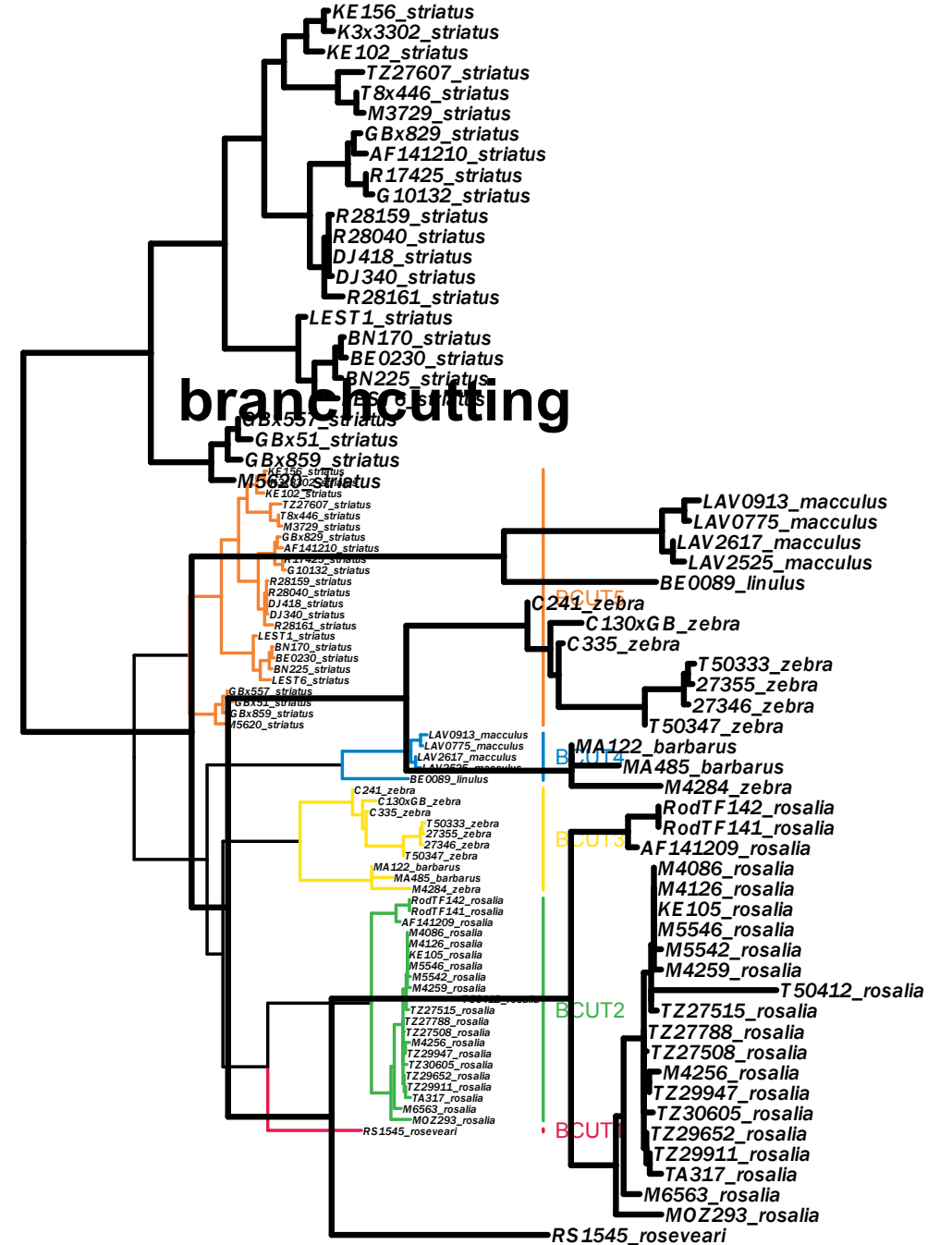
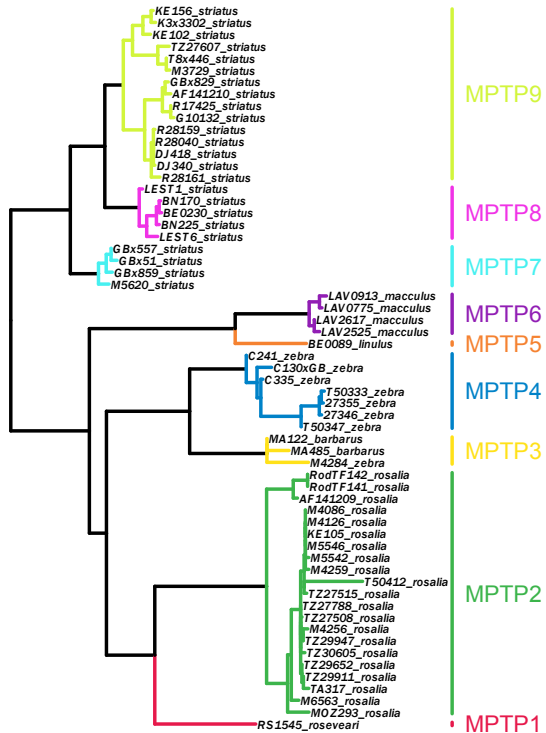
## Barcode gap



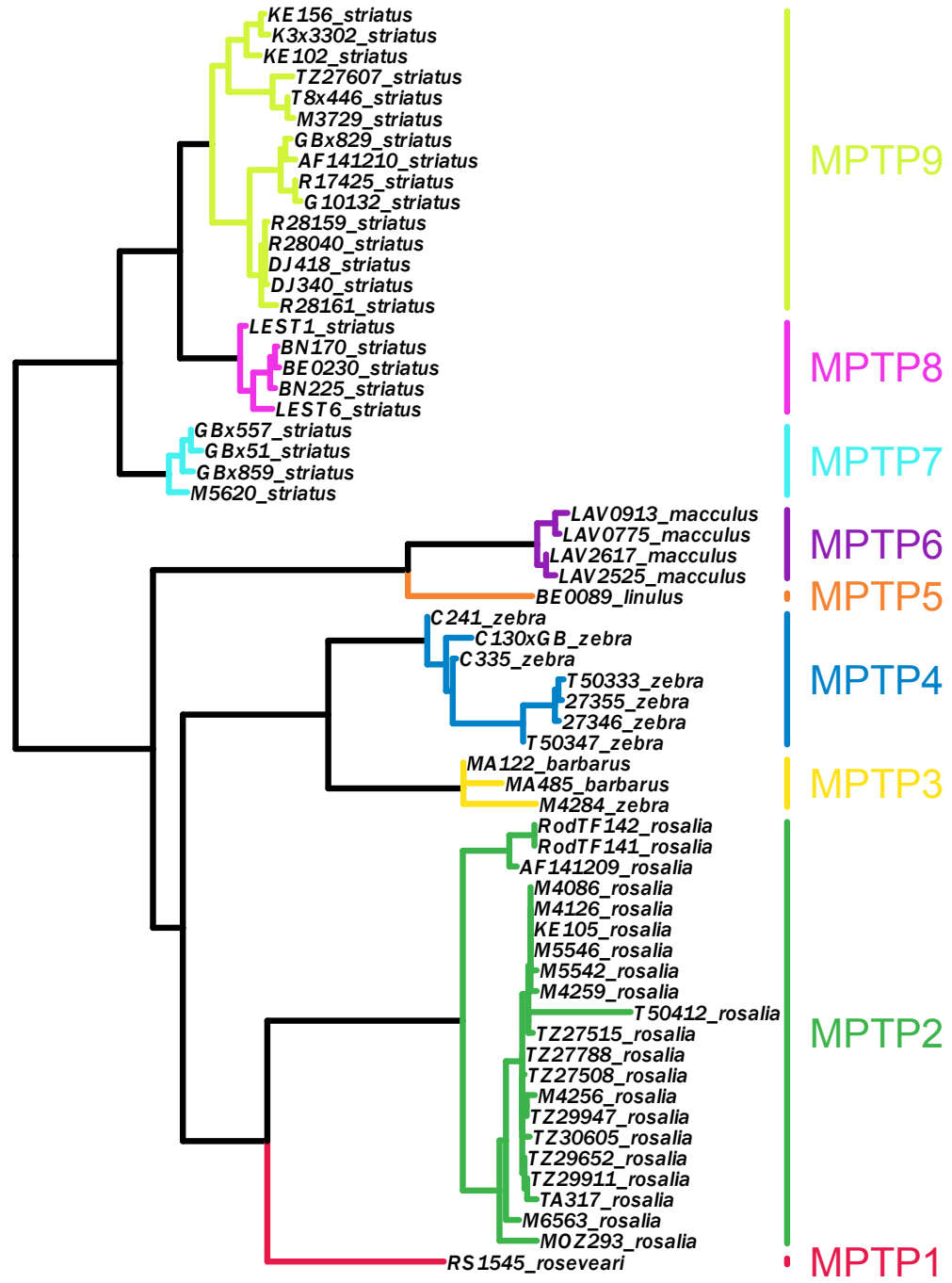
rule of thumb 2% - 11% (Bradley & Baker 2001) → ASAP (Puillandre et al. 2021)

# Single-locus methods: tree structure

mPTP = multi-rate Poisson tree processes



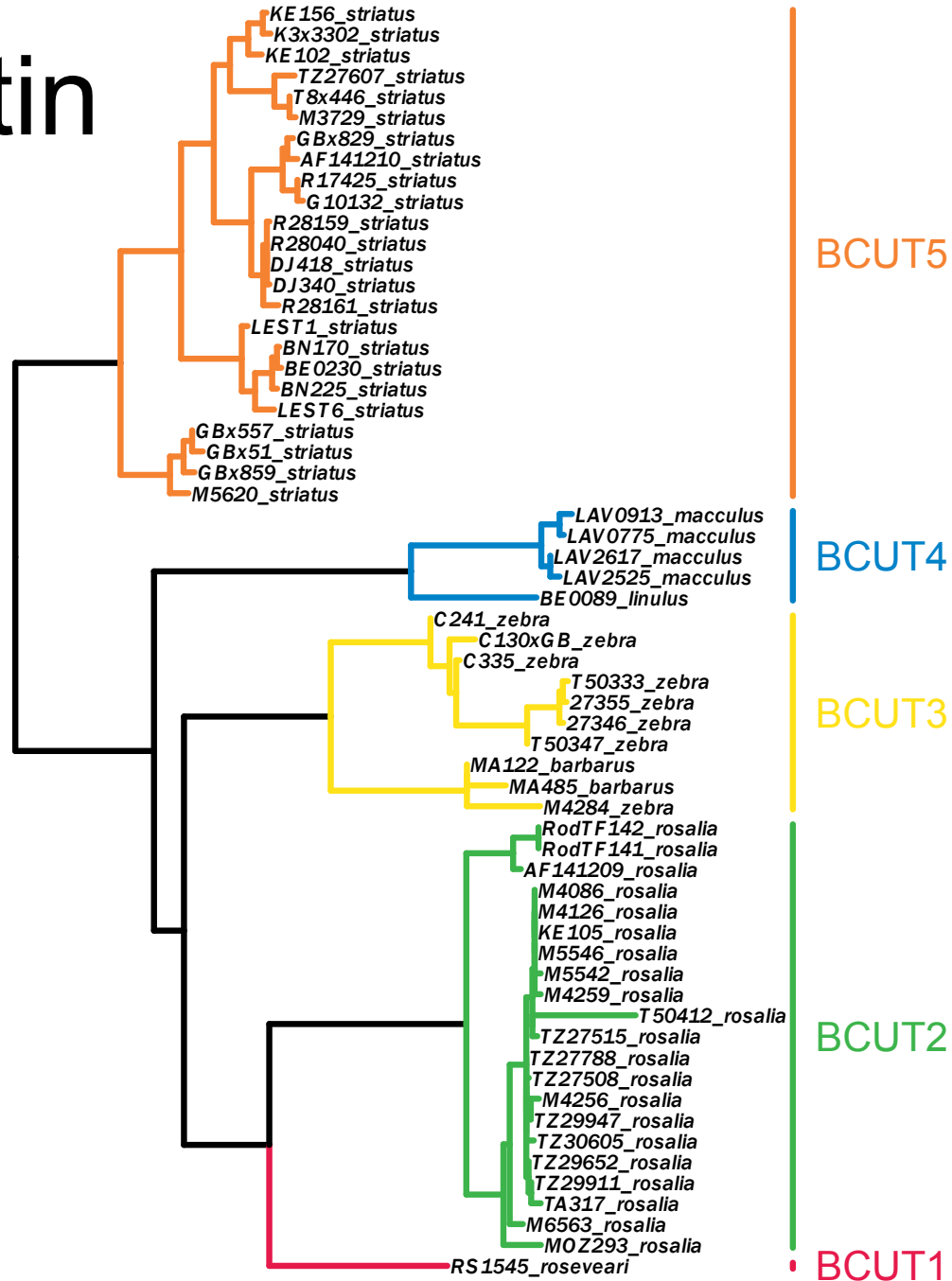
# mPTP



tree =  
interspecific  
backbone  
+  
intraspecific  
crowns

exponential  
distributions of  
branch lengths

# branchcutting



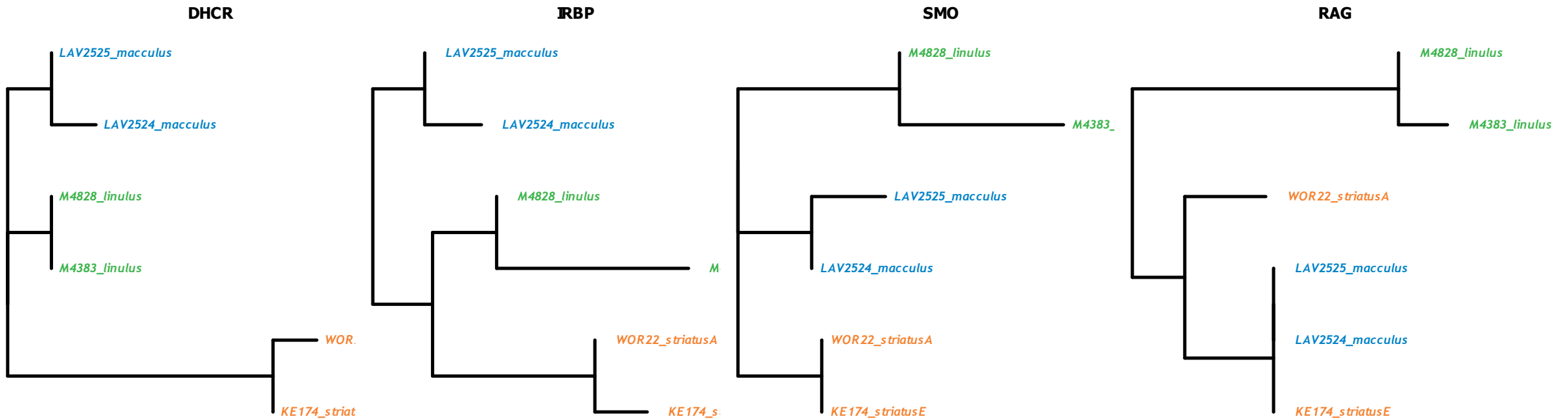
tree =  
interspecific  
backbone  
+  
intraspecific  
crowns

backbone =  
structurally  
important branches



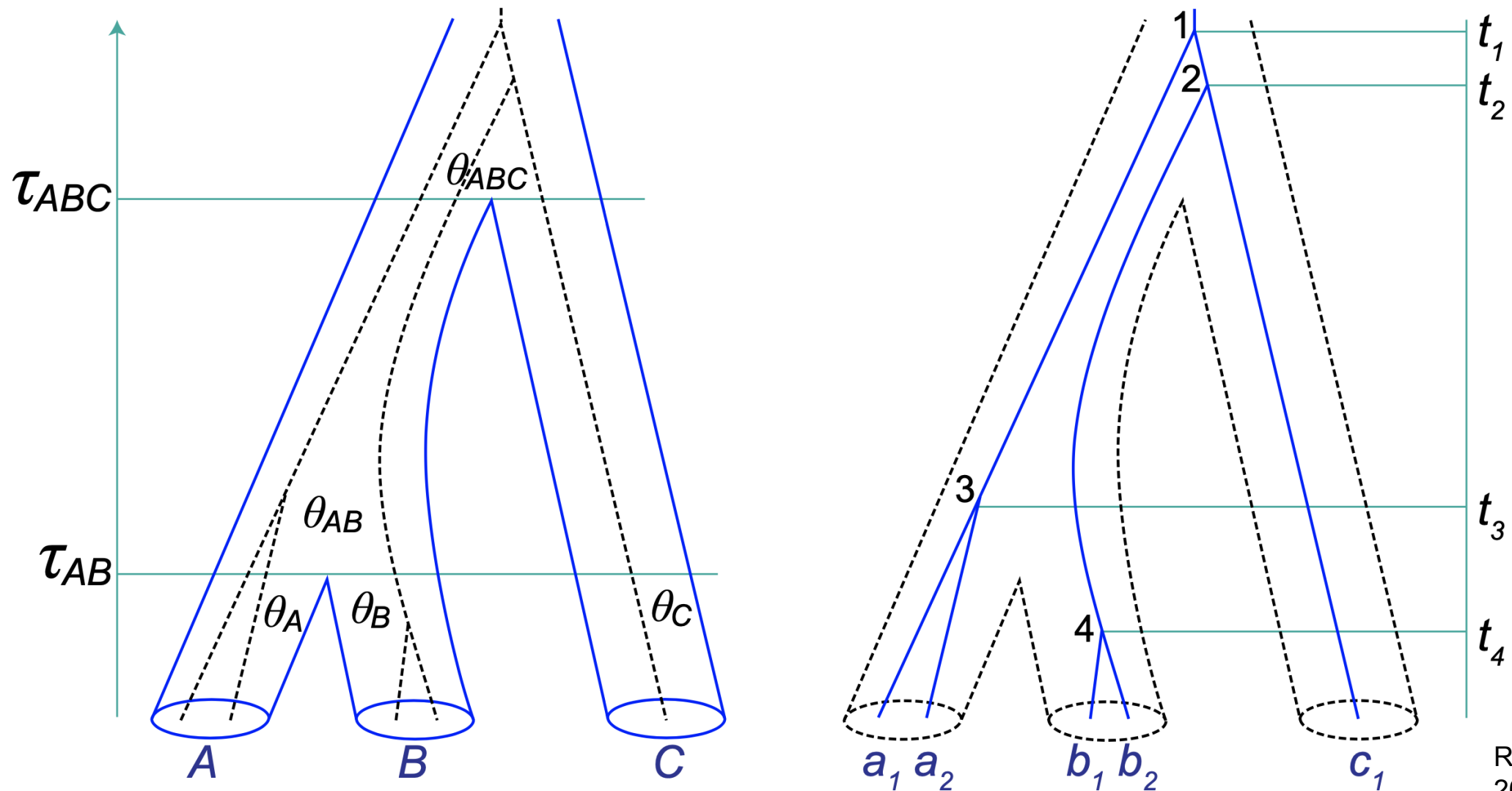
# Multi-locus methods

reciprocal monophyly?



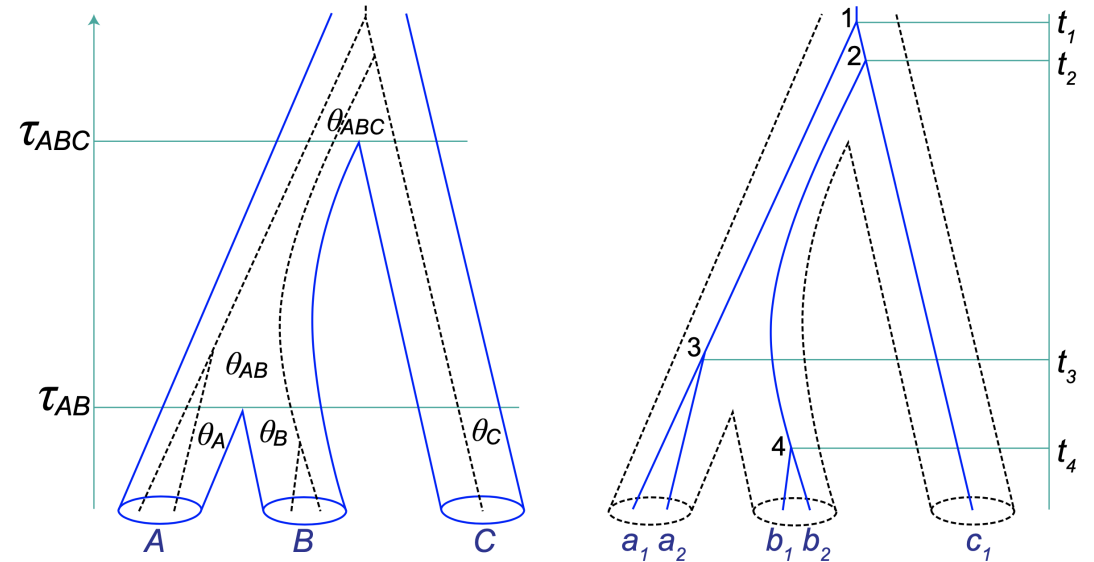
gene tree incongruence!

# Multi-species coalescent model



# Multi-species coalescent model

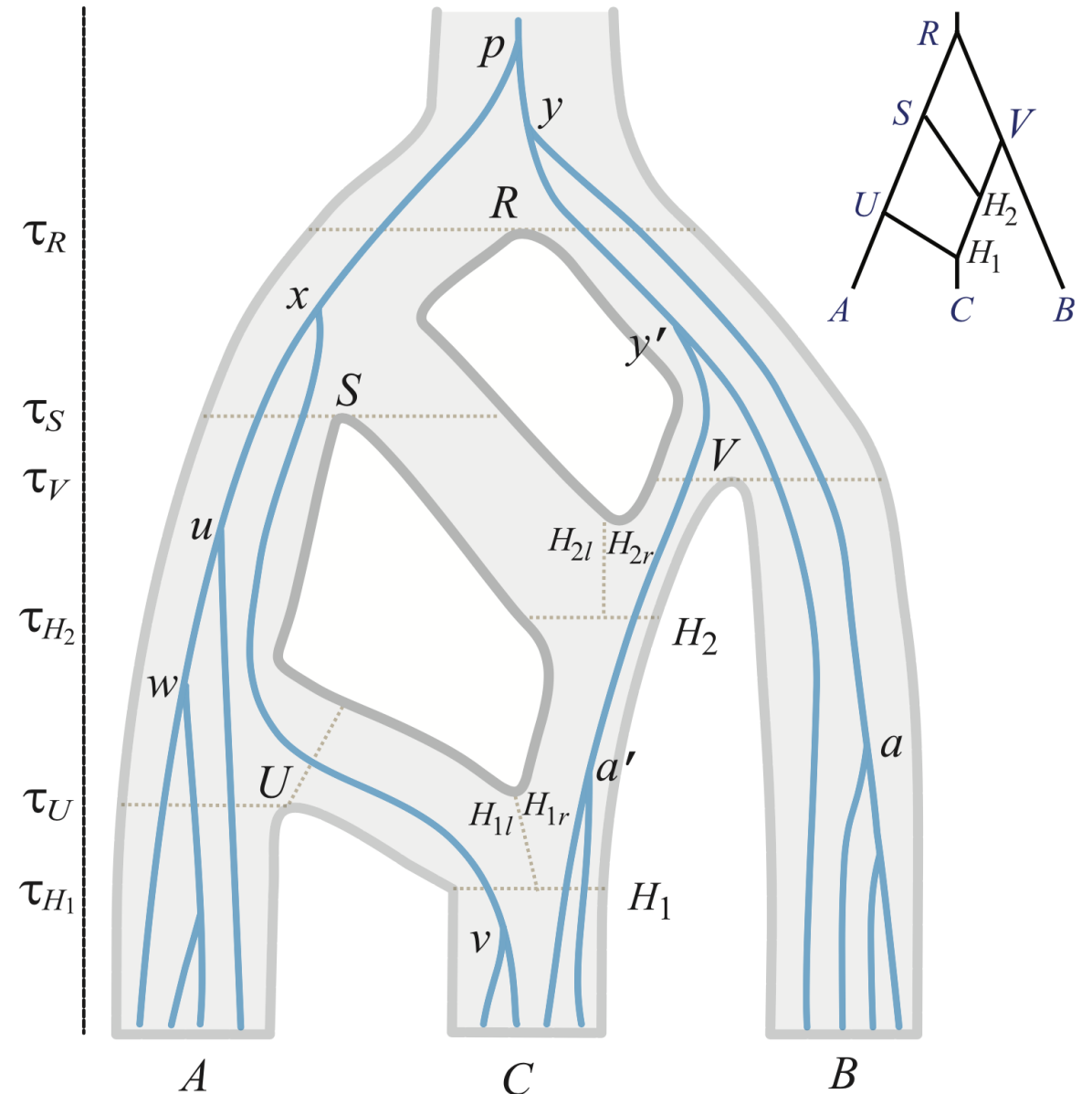
- gene trees embedded in species tree
- deep coalescence ~ incomplete lineage sorting
- increases with pop. size ( $\theta$ ) & decreases with div. time ( $\tau$ )
- zero divergence time  $\iff$  population merger
- BPP software



# Unended quest

- fusions and fissions
- post-divergence gene flow
  - migration
  - introgression
- genealogical distinctiveness
  - rule of thumb  $< 0.2$ ,  $> 0.7$
- genomic distribution of introgressed loci?
- back to experiments?

(a) Species formation in time



# Software & literature

- ASAP
  - <https://bioinfo.mnhn.fr/abi/public/asap/>
- mPTP
  - <https://mptp.h-its.org/#/tree>
  - <https://github.com/Pas-Kapli/mptp>
- branchcutting
  - <https://github.com/onmikula/branchcutting>
- BPP
  - <https://github.com/bpp/bpp>
  - <https://github.com/abacus-gene/hhsd>
- Open Access Book: **Phylogenetics in the Genomic Era**  
<https://inria.hal.science/PGE/>