Paper discussion

L Ranjard et al., Modelling competition and dispersal in a statistical phylogeographic framework, 2014

Discussed by Richel Bilderbeek
https://github.com/richelbilderbeek/Science

git GitHub

One-slide summary

- Model with alignment, spatiality, dispersal and competition
- Is tested on simulated data to recover the parameters put it
- Recovery is claimed to be good
- Is set to work on an alignment of spatially sperated species
- The model is shown to make its best estimate

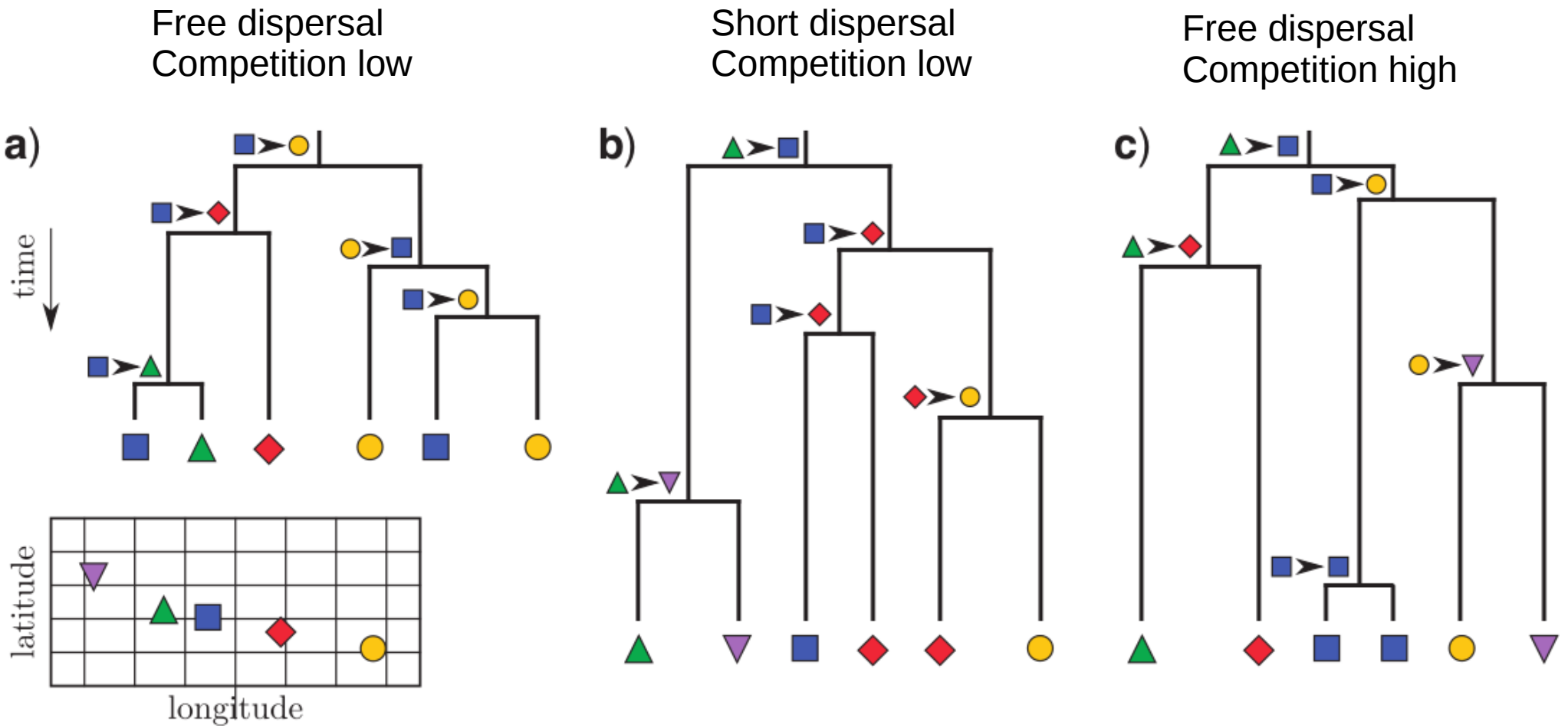
Overview

- Idea of the model
- Parameters of the model
- Parameter recovery
- Natural system
- Estimating parameters from natural system
- Discussion

Idea of the model

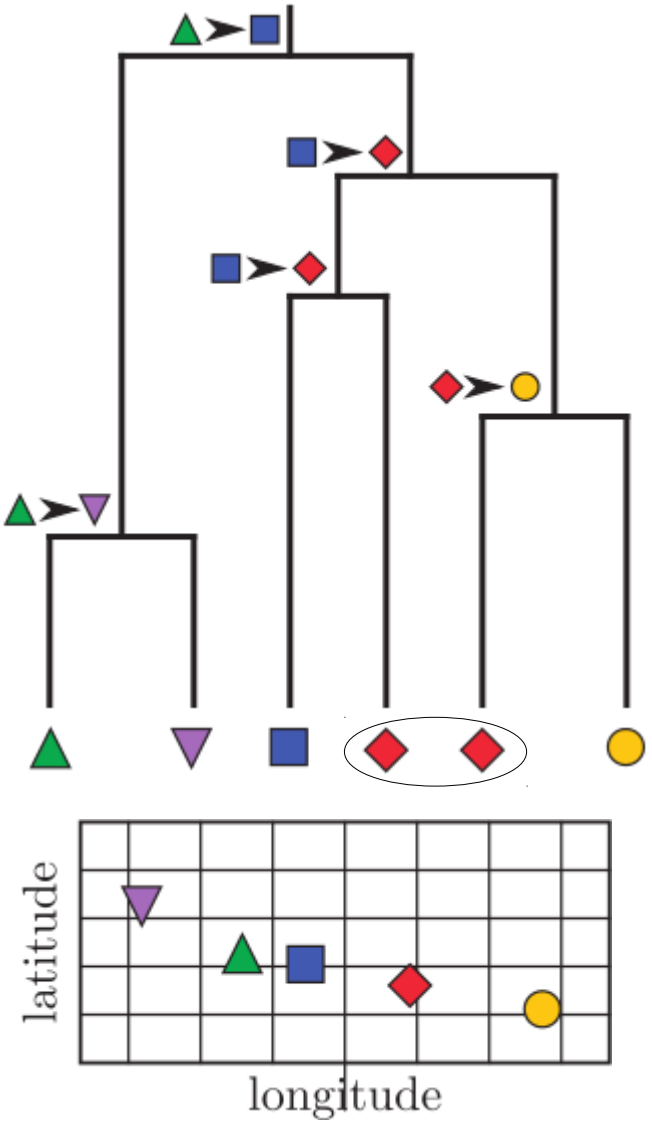
Competition and dispersal

- Different combinations of competition and dispersal result in different phylgenies



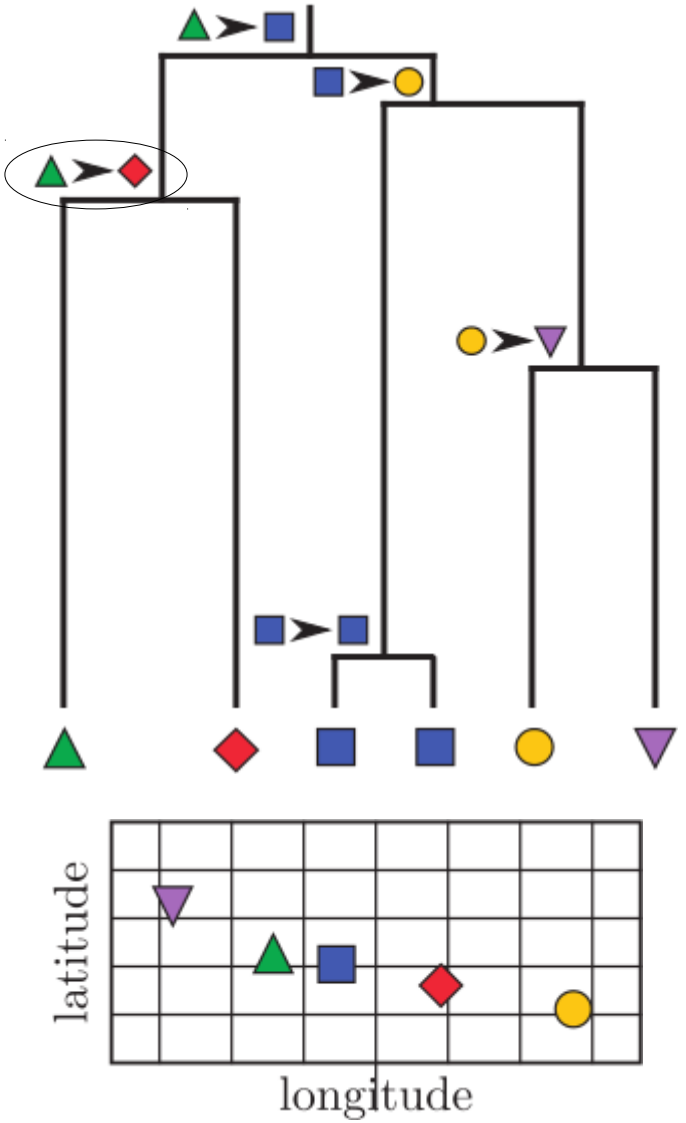
Short dispersal

- Islands can only colonize the adjacent islands
- Competition is low, as ◆ gets colonized twice



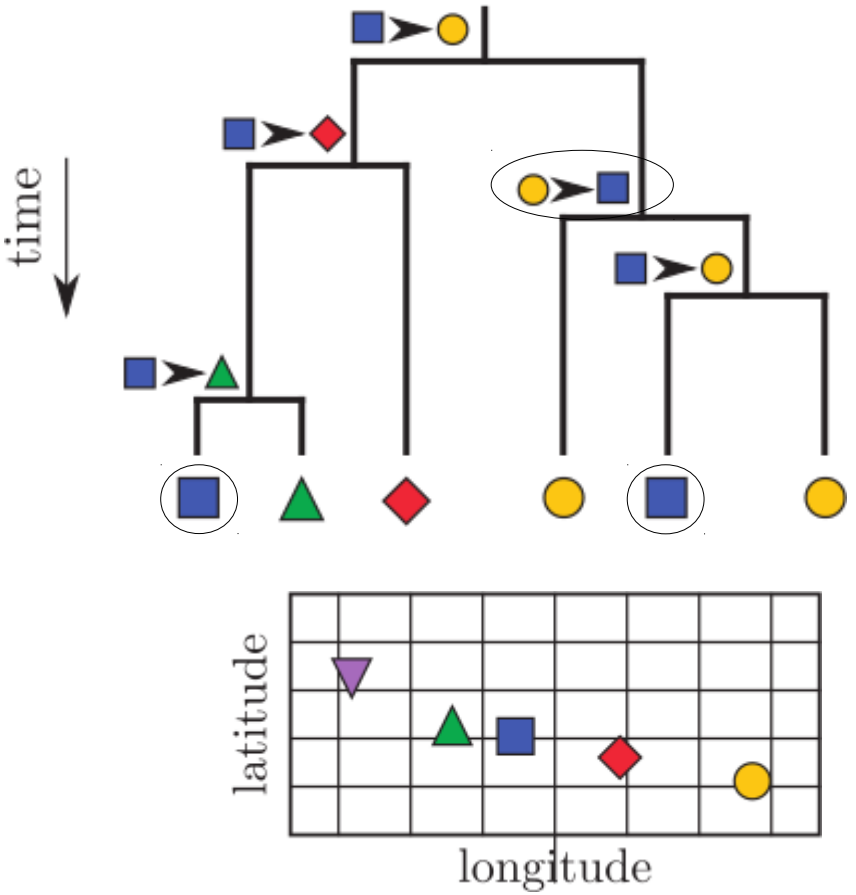
Competition high

- Hard to colonize an occupied island
- Dispersal is free in this case, as ▲ colonizes ◆



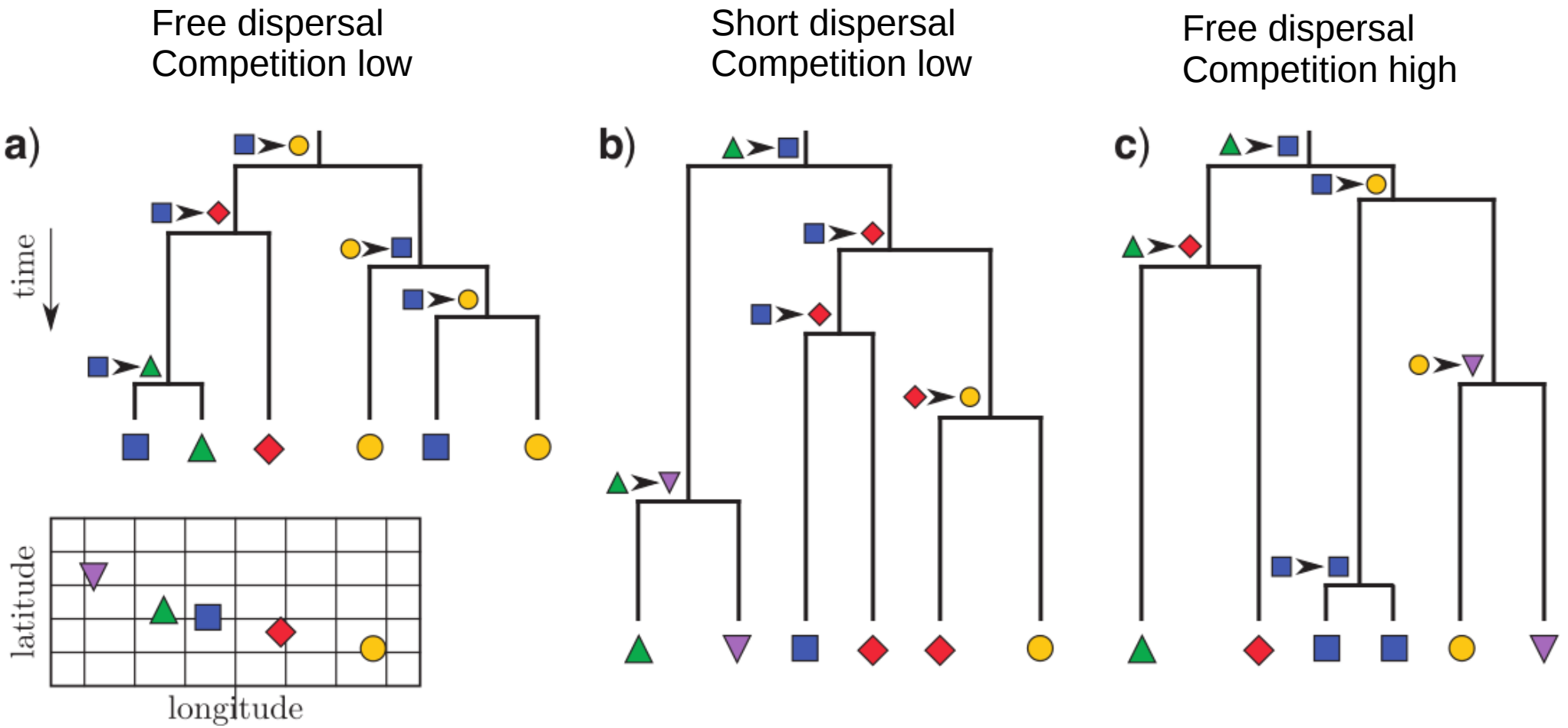
Both

- Competition is low, as ■ gets colonized twice
- Dispersal is free, as ● colonizes ■



Competition and dispersal

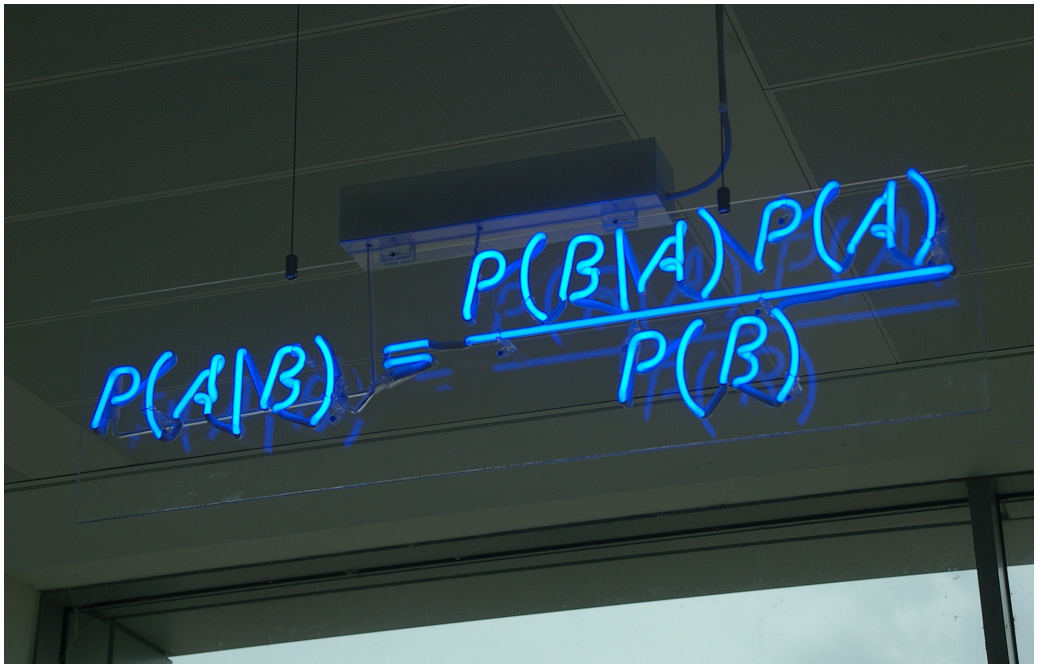
- Different combinations of competition and dispersal result in different phylgenies



Model details

Bayes' theorem

- A: parameters
- B: data
- P(A|B): posterior, the certainty of the parameter estimates given the data
- P(B|A): likelihood, how well the data fits, given the parameters
- P(A): prior distribution, the chance these parameters occur
- P(B): marginal likelihood, normalization factor, the chance this data is measured

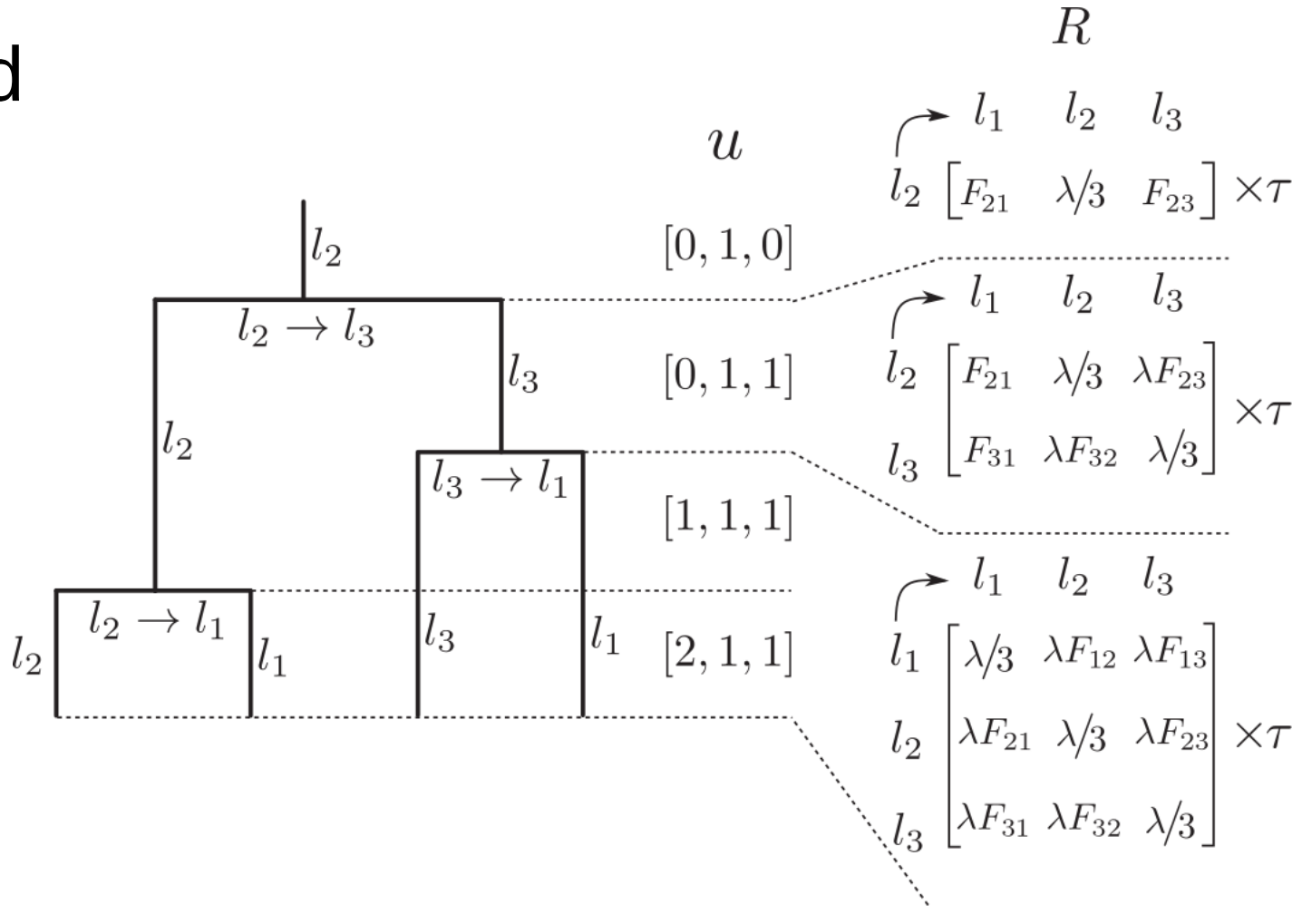


Model parameters

- Lambda: competition
  - Lambda < 0: unoccupied patches are preferred, (indicating competition)
  - Lambda > 0: occupied patches are preferred
- Sigma: dispersal
  - Sigma e [0,10]
- Tau: overall dispersal
  - Tau e [0,10]

Likelihood

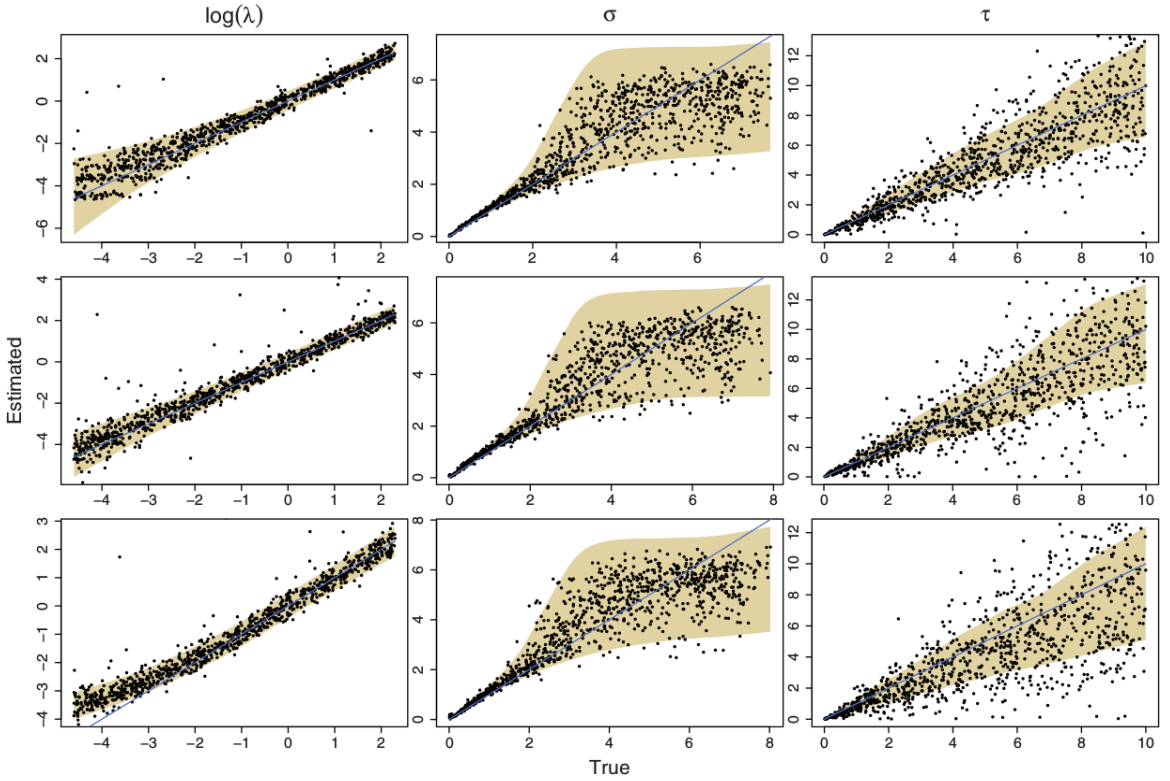
- A function to determine the probability of finding a phylogeny-parameter-combination by chance
- Not analyzed



Recovering the model parameters

Recovering the model parameters

- Uses 100 taxa
- Line: value put in
- Dots: value estimated
- Area: 95% confidence interval



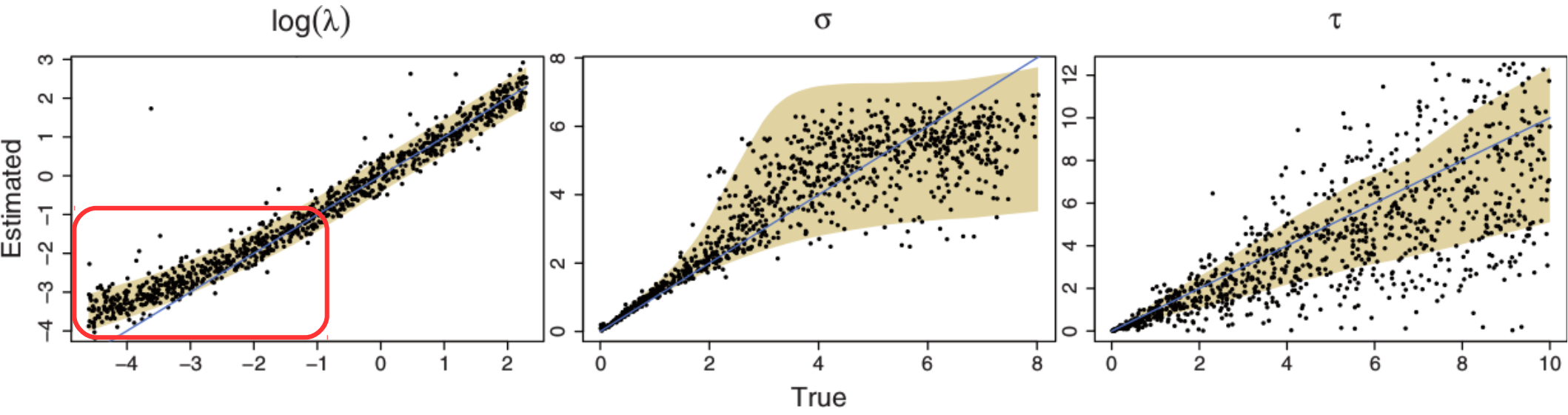
Lambda: competition parameter

sigma: dispersal parameter

tau: overall dispersal rate

Recovering the model parameters

- For 50 taxa the estimation is worst
- The competition parameter is 'slightly overestimated' when lambda < 0
  - unoccupied patches are preferred
  - competition is strong



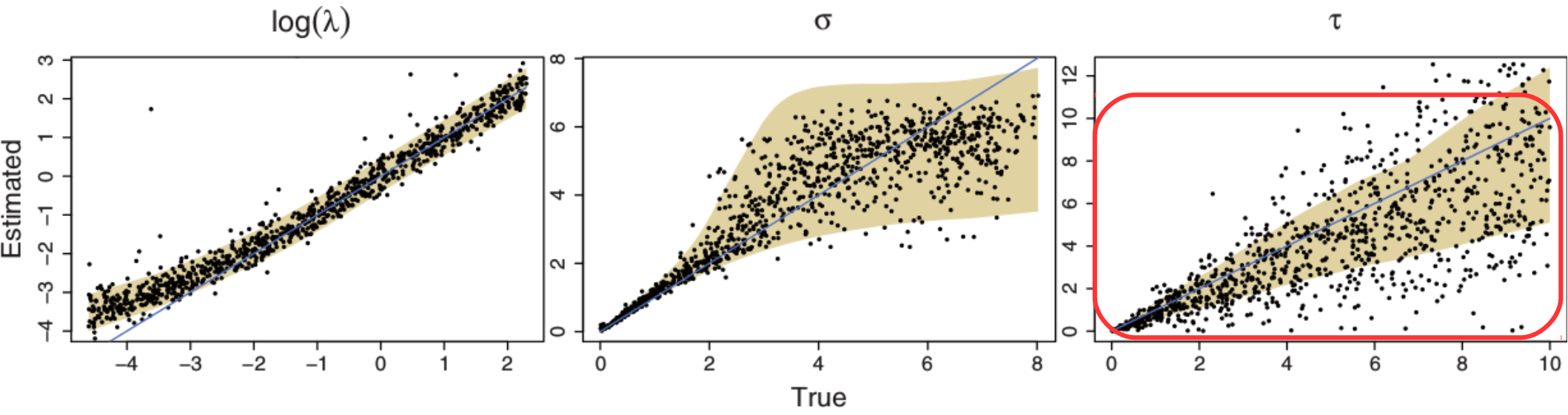
competition parameter

dispersal parameter

overall dispersal rate

Recovering the model parameters

- For 50 taxa the estimation is worst
- The overal dispersal is underestimated



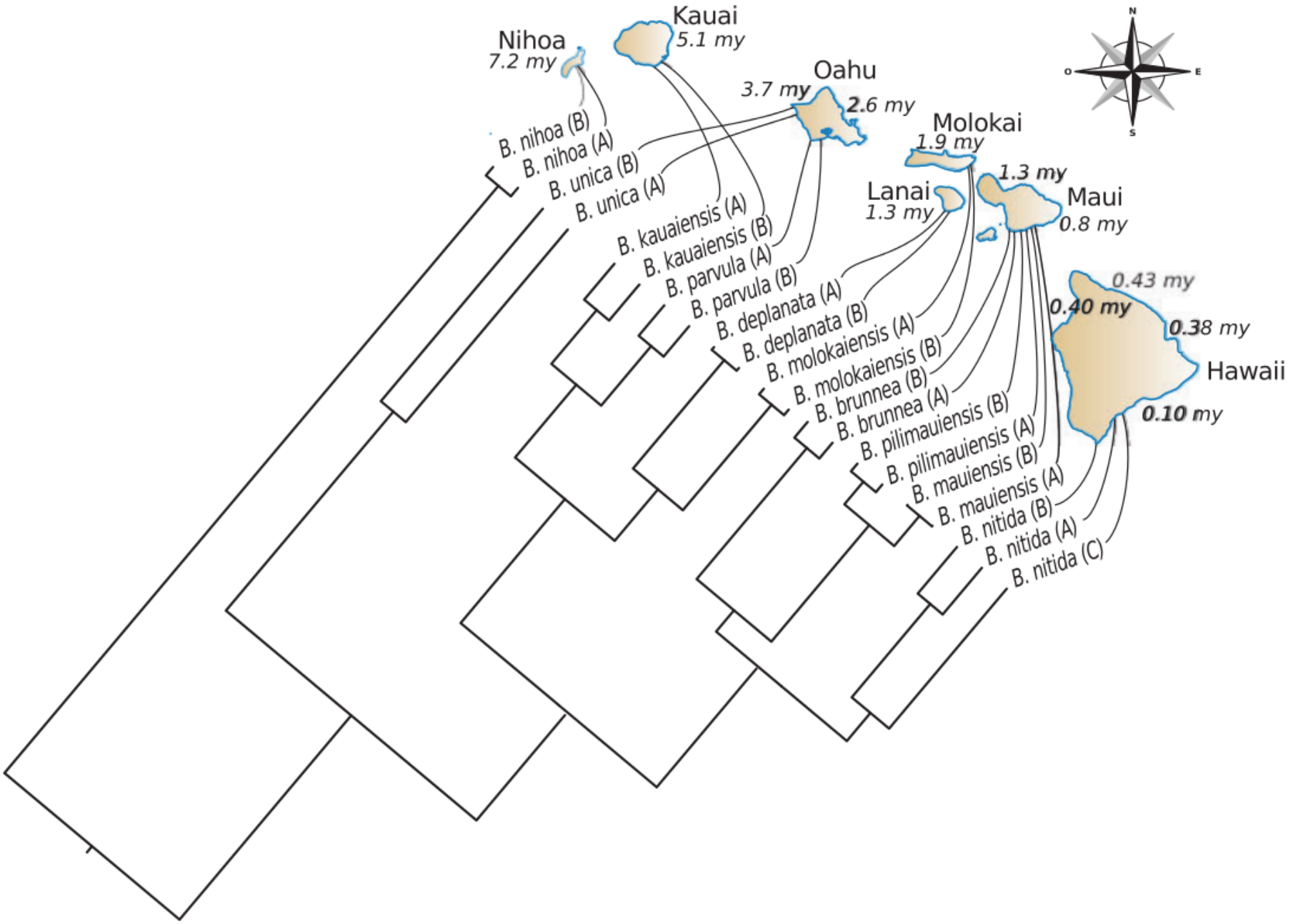
Natural system

Banza

- Banza: genus of the katydids (Tettigoniidae) family that is endemic to Hawaii
- Katydids are also known as bush crickets or long-horned grasshoppers (but are not grasshoppers)

Banza nihoa

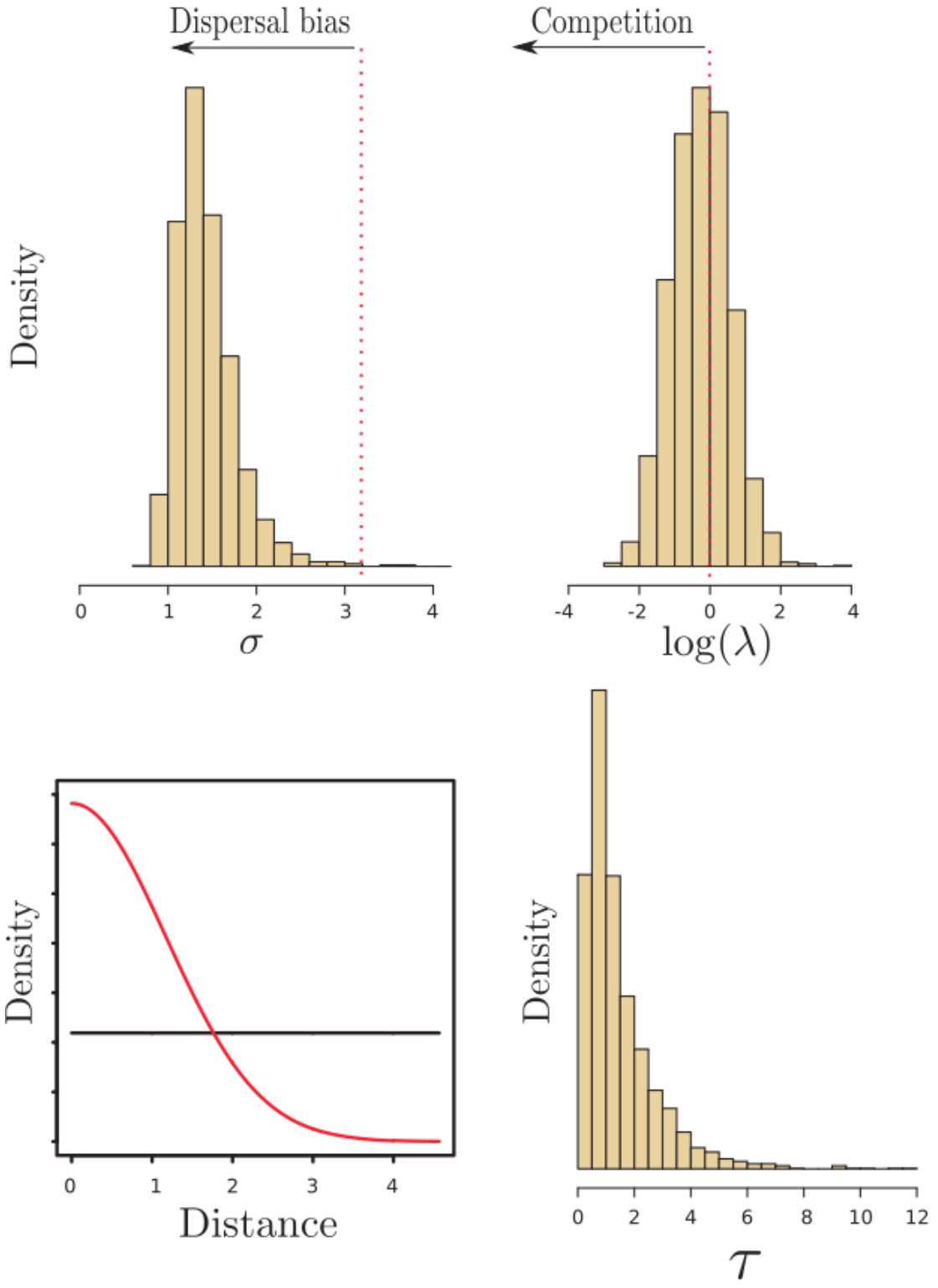
Phylogenetic tree



Estimating parameters from natural system

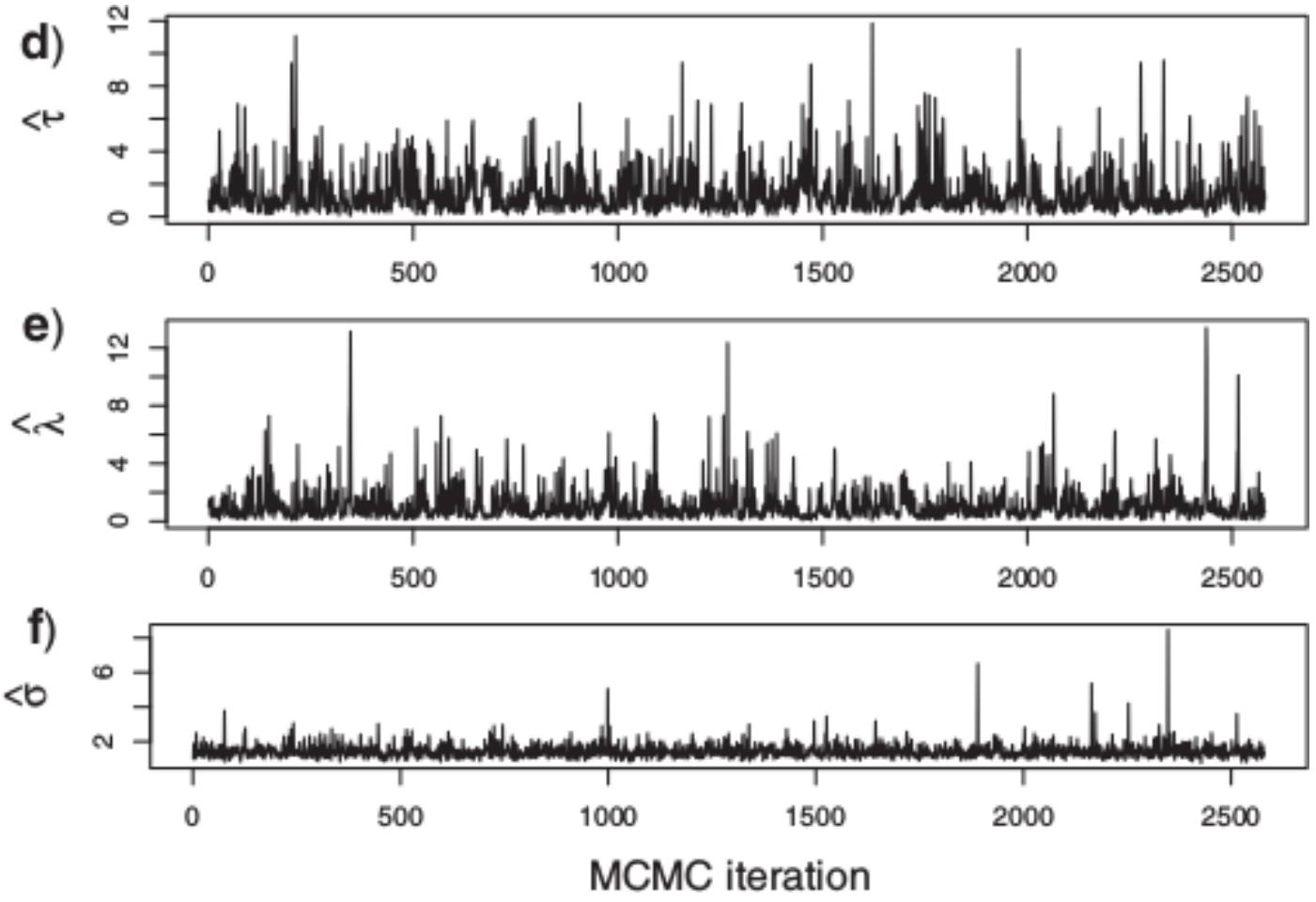
Posterior

- A high-quality (converged) estimation (posterior) has a smooth distribution of parameter estimates
- This is the case



Posterior

- A high-quality estimation has regular parameter estimates in time (no visible burn-in)
- This is the case



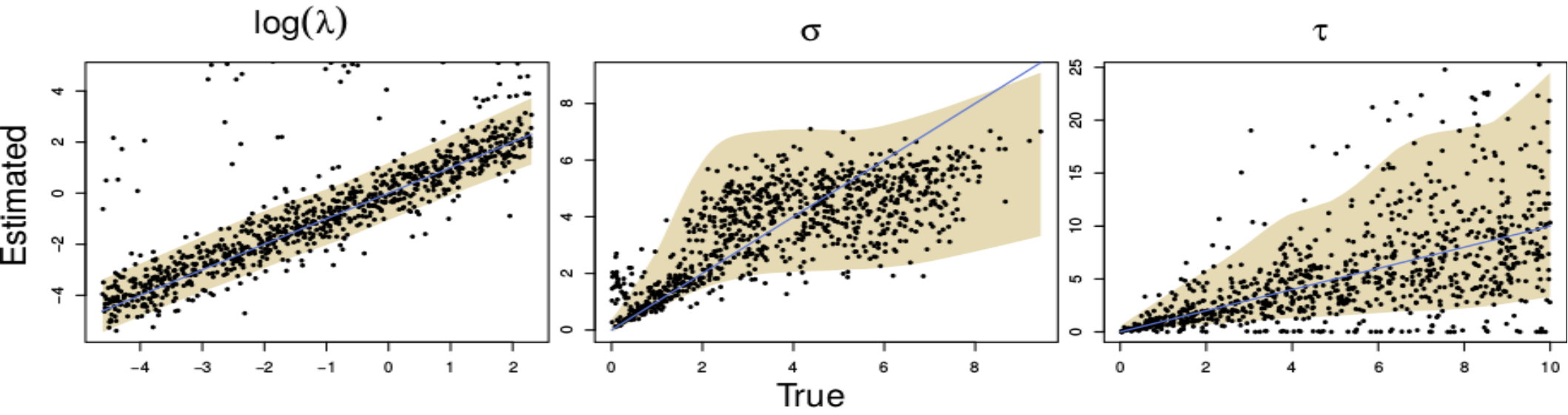
Discussion

Discussion: model

- 'There is no extinction of lineages in our model' (The Dispersal and Colonization Process)
  - this model (Yule) can best be used complete sampling, (AJ Drummond & RR Bouckaert)
- 'We also assumed a coalescent prior on the joint distribution of node heights with constant population size' (Appendix 6)
  - this model (Coalescent Consant Population) can best be used by a small sample of large population, population at equilibrium (AJ Drummond & RR Bouckaert)
- How to combine these two?
- Are these realistic?

Discussion: recovering the model parameters

- For supplement, figure S3:
  - 20 taxa
  - 10 locations
- What is the quality of this recovery?



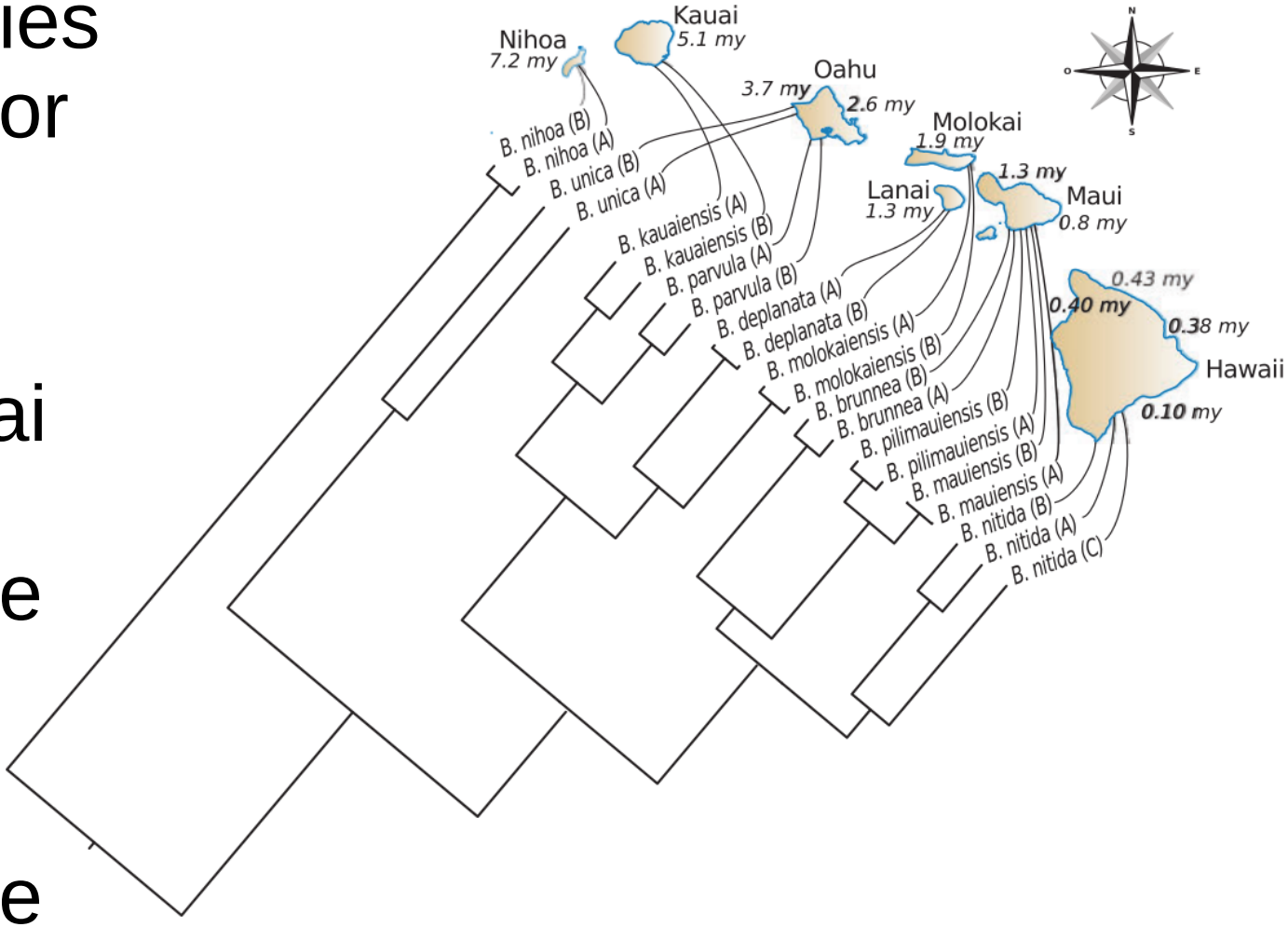
competition parameter

dispersal parameter

overall dispersal rate

Discussion: phylogenetic tree

- Multiple species occur twice, for example, B. nihoa
- Lanai, Molokai and Maui are treated as one island
- Hawaii is treated as one location



Discussion: posterior

- How important are this scatter plots to assess parameter estimate quality?