

**PhyloEcoBiogeography:  
Biome Relationships**

Ecology Letters, (2009) 12: 693-715 doi: 10.1111/j.1461-0248.2009.01314.x

**REVIEW AND SYNTHESIS** The merging of community ecology and phylogenetic biology

**Jeannine Cavender-Bares et al. 2009**

```

graph TD
    PH(Phylogenetic history) --> T(Traits)
    T --> E(Ecosystem processes)
    T --> C(Communities)
    C --> E
    E --> PH
    E --> T
    E --> C
    
```

**Phylogenetics can inform ecological processes at many scales**

**PhyloEcoBiogeography:  
Biome Relationships**

Examined speciation events within Southern Hemisphere continental biome types

1. Most speciation events of trees (and herbs) occur within same biome type OR between similar biome types

Michael Crisp et al. (2009) *Nature*

Only 356 shifts occurred in 10,800 speciation events

**PhyloEcoBiogeography:  
Biome Relationships**

Examined speciation events within Southern Hemisphere continental biome types

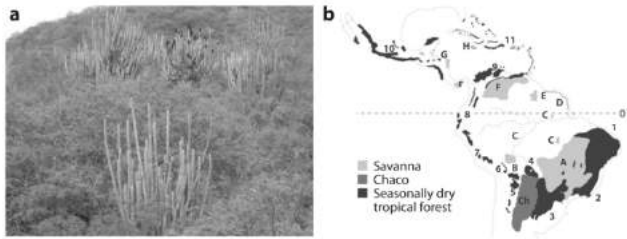
2. Most transoceanic colonizations occur within same biome type
3. Niche conservatism NOT adaptive radiation is seen in S. Hemisphere diversification

Michael Crisp et al. (2009) *Nature*

within same biome

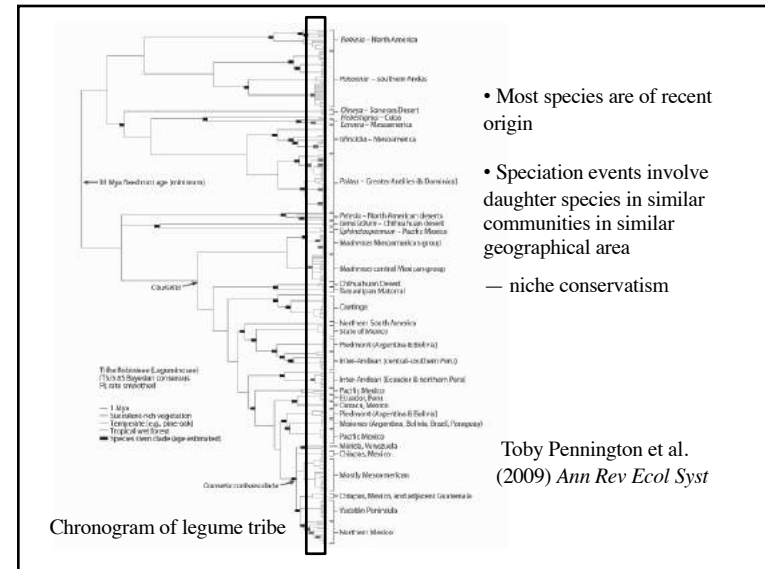
between two biomes

PhyloEcoBiogeography:  
Biome Relationships



Examined phylogenetic and biogeographical relationships within Seasonally Dry Tropical Forests

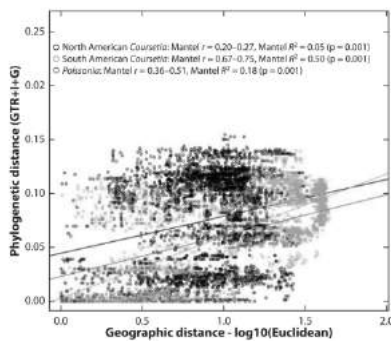
Toby Pennington et al. (2009) *Ann Rev Ecol Syst*



- Most species are of recent origin
- Speciation events involve daughter species in similar communities in similar geographical area
- niche conservatism

Toby Pennington et al. (2009) *Ann Rev Ecol Syst*

PhyloEcoBiogeography:  
Biome Relationships



- Strong correlation of geographic distance and phylogenetic distance!

Toby Pennington et al. (2009) *Ann Rev Ecol Syst*

Mantel test

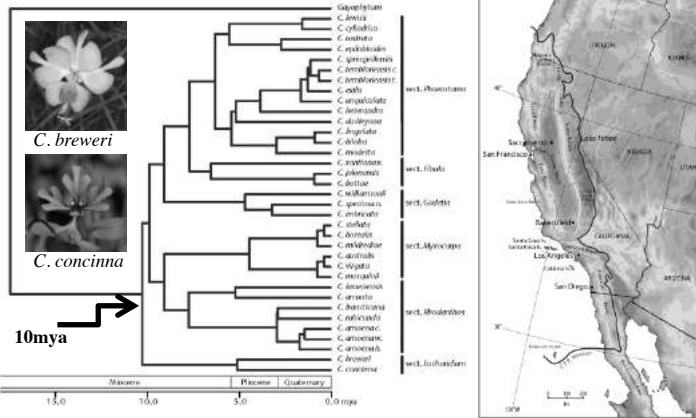
PhyloEcoBiogeography:  
Evolution of Niche

- Climatic niche evolution in California *Clarkia*
- Do related species share similar climatic/elevation niches? (niche conservatism)
- Do related species show significant disparity in climatic/elevation niches? (adaptive radiation)



PhyloEcoBiogeography:  
Evolution of Niche

Chronogram of 35 diploid *Clarkia* species



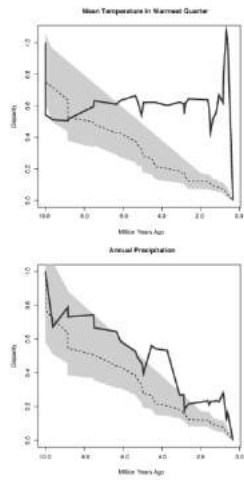
PhyloEcoBiogeography:  
Evolution of Niche

Mean annual temp	Mean temp coldest quarter
Mean diurnal temp range	Annual precipitation
Isothermality	Precipitation wettest month
Temperature seasonality	Precipitation driest month
Max temp warmest month	Precipitation seasonality
Min temp coldest month	Precipitation wettest quarter
Temp annual range	Precipitation driest quarter
Mean temp wettest quarter	Precipitation warmest quarter
Mean temp driest quarter	Precipitation coldest quarter
Mean temp warmest quarter	Elevation

• Temperature and elevation variables show more disparity among close relatives in speciation - adaptive radiation

• Precipitation shows phylogenetic conservatism – close species are more similar in precipitation niche

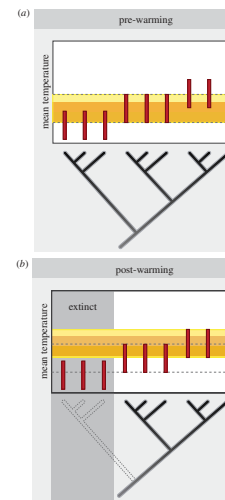
PhyloEcoBiogeography:  
Evolution of Niche



• Temperature shows significant disparity through time < 5mya - adaptive radiation

• Precipitation shows no significant disparity through time - phylogenetic conservatism

PhyloEcoBiogeography:  
Climate Change



Consequences of global warming? do all species have ability to track climate change to their species niche?

• if different lineages of plants and animals have different adaptations to temperature . . .

• then there may be clade specific extinction with global warming

*Davis et al. 2010 – Importance of phylogeny to the study of phenological response to global climate change*

