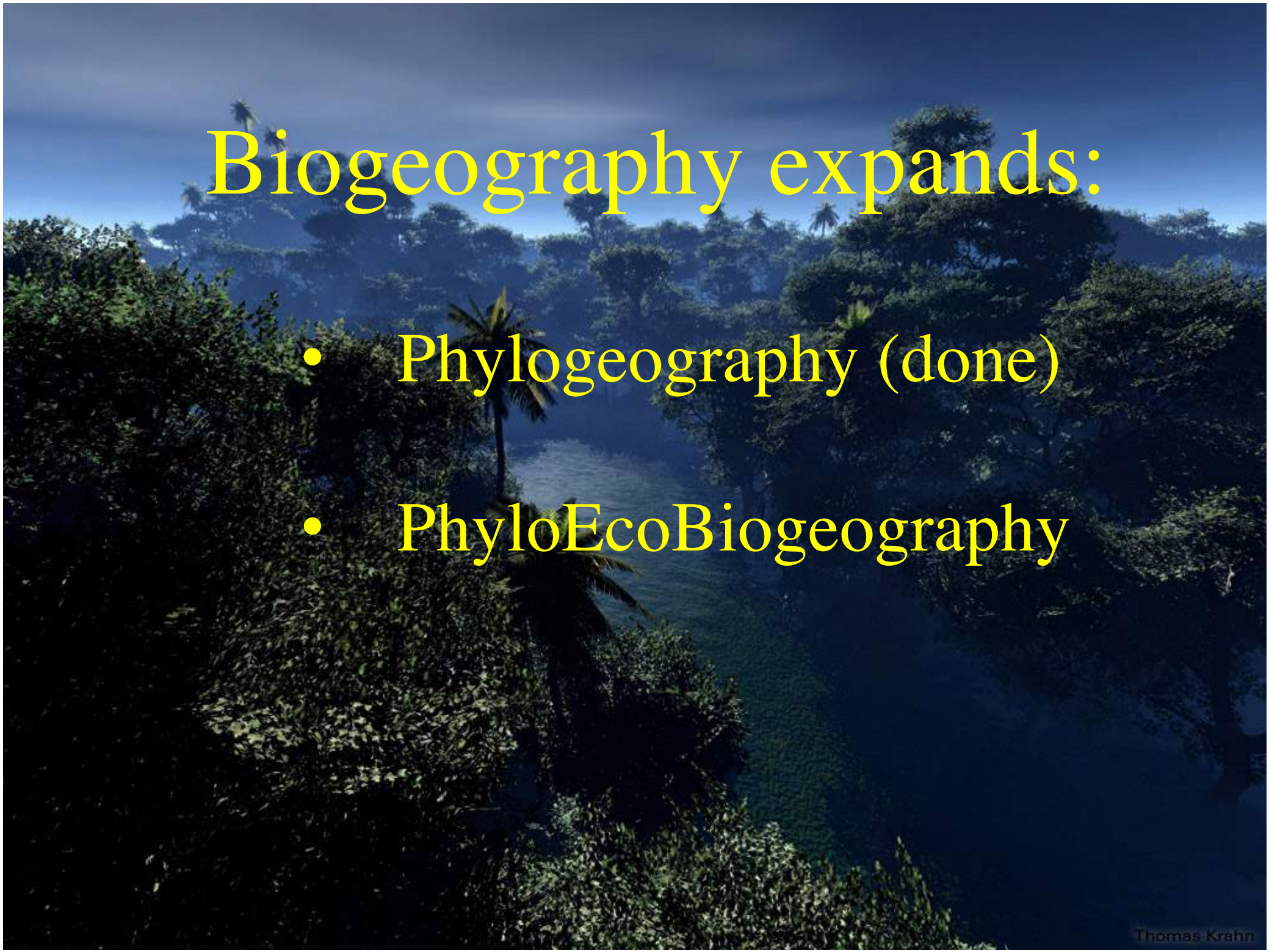


Biogeography expands:

- Phylogeography (done)
- PhyloEcoBiogeography

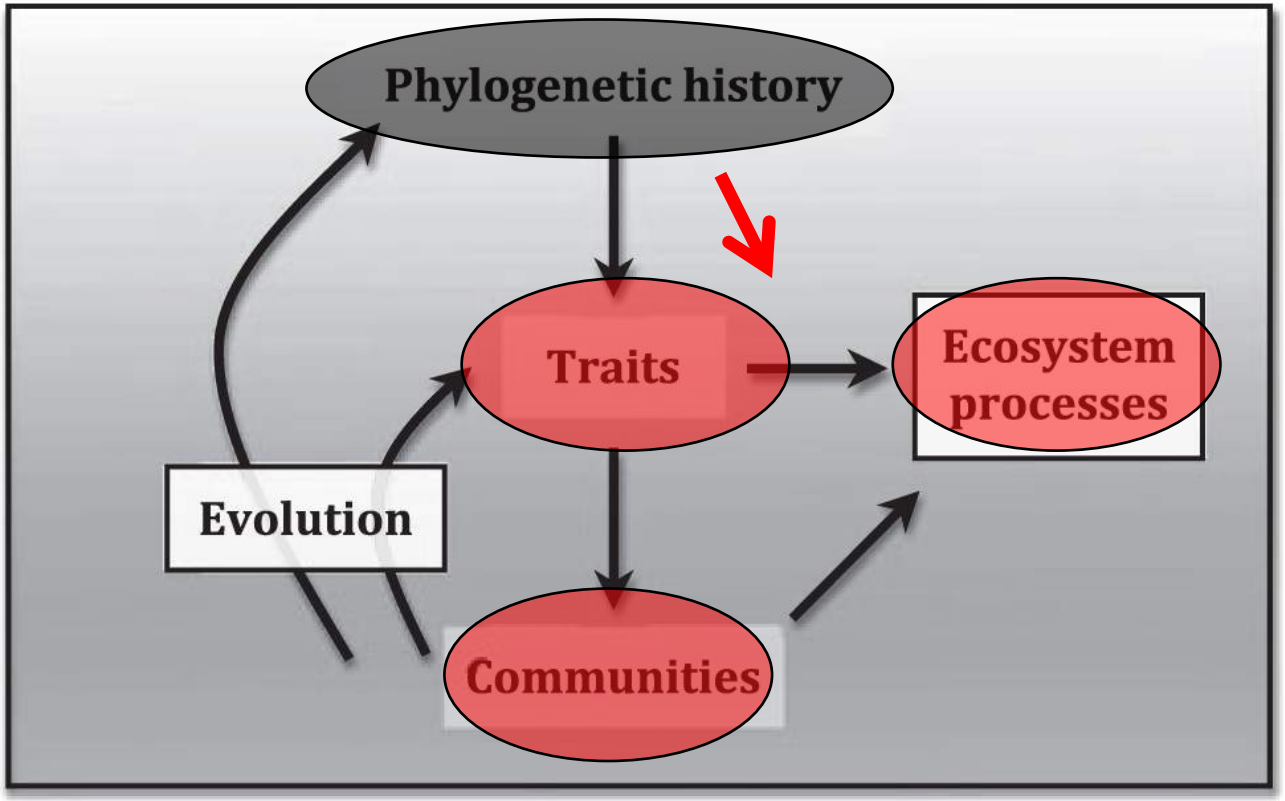
PhyloEcoBiogeography: Biome Relationships

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

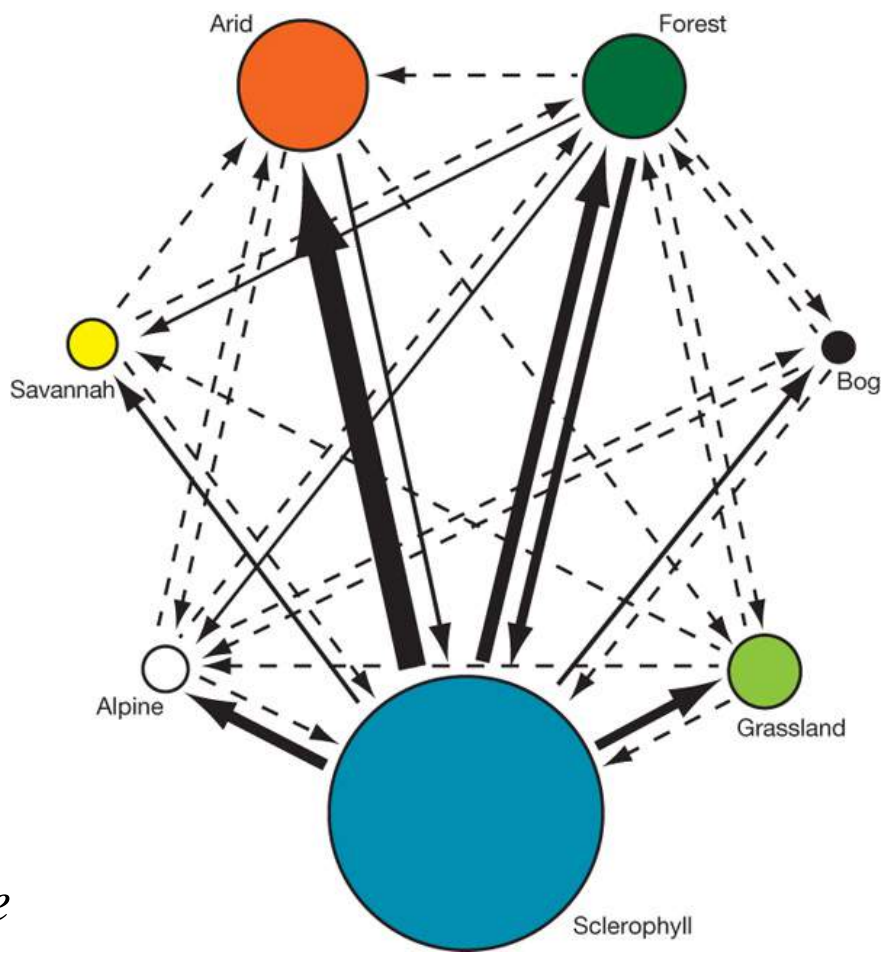


Phylogenetics can inform ecological processes at many scales

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



Only 356 shifts occurred in 10,800 speciation events

Michael Crisp et al. (2009) *Nature*

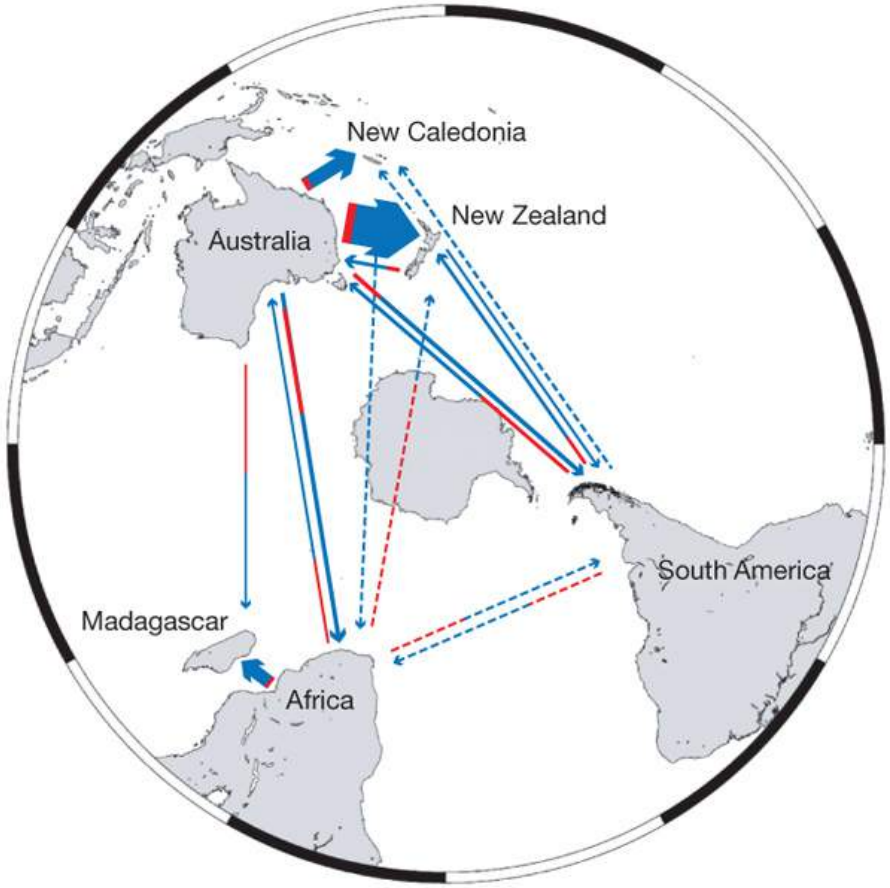
PhyloEcoBiogeography: Biome Relationships

Examined speciation events within Southern Hemisphere continental biome types

2. Most transoceanic colonizations occur within same biome type

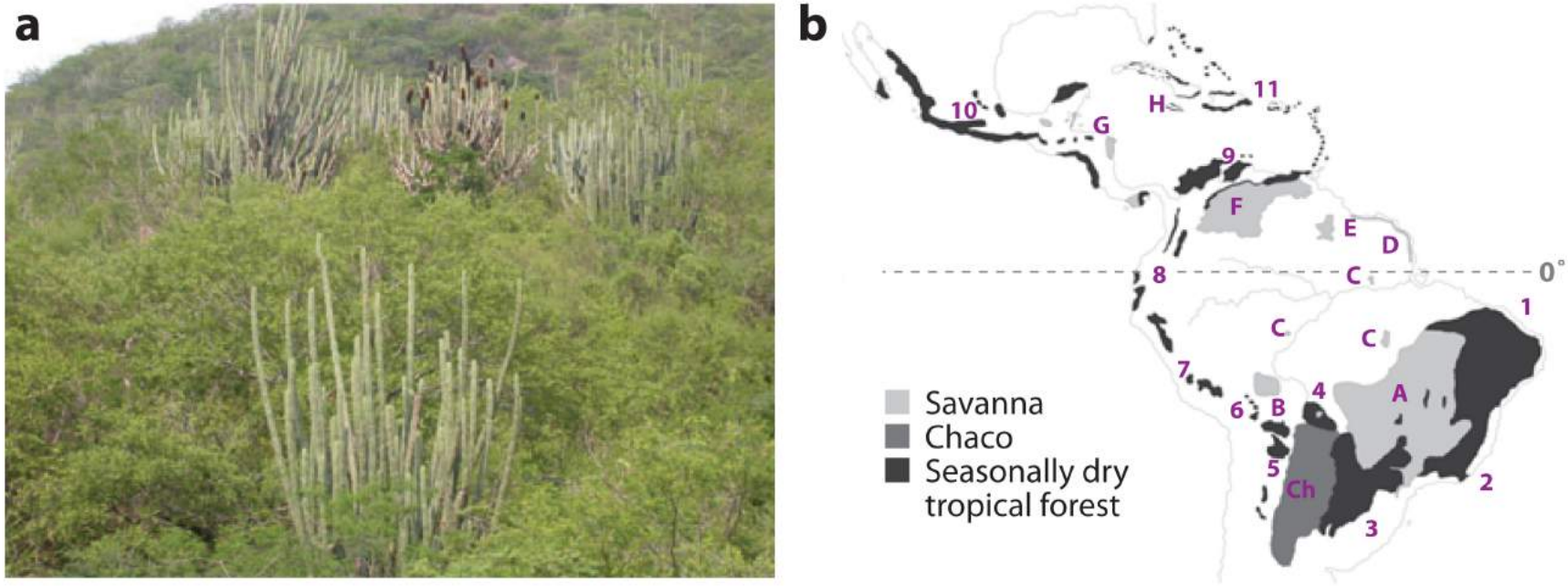
3. Niche conservatism NOT adaptive radiation is seen in S. Hemisphere diversification

Michael Crisp et al. (2009) *Nature*



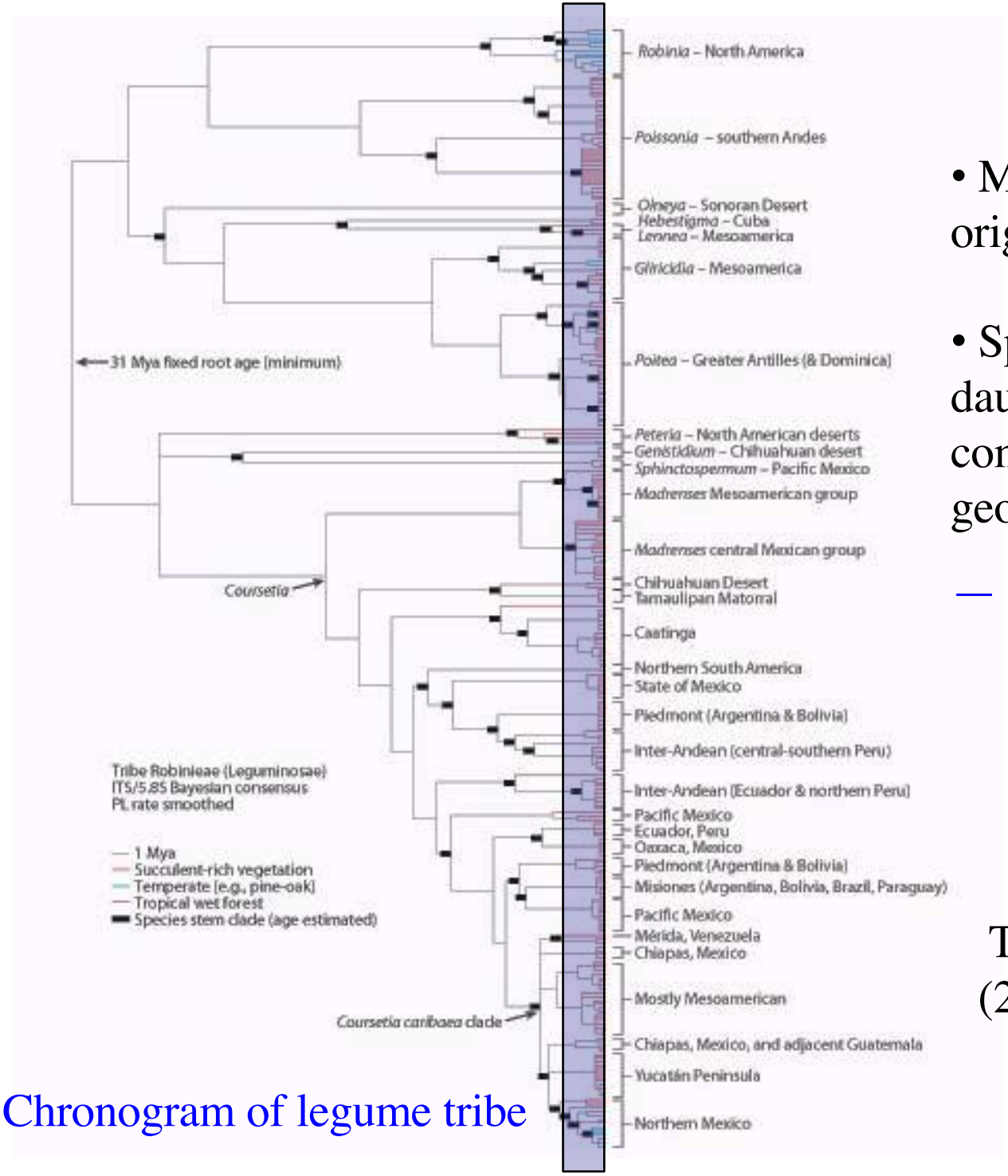
within same biome
between two biomes

PhyloEcoBiogeography: Biome Relationships



Examined phylogenetic and biogeographical relationships within Seasonally Dry Tropical Forests

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



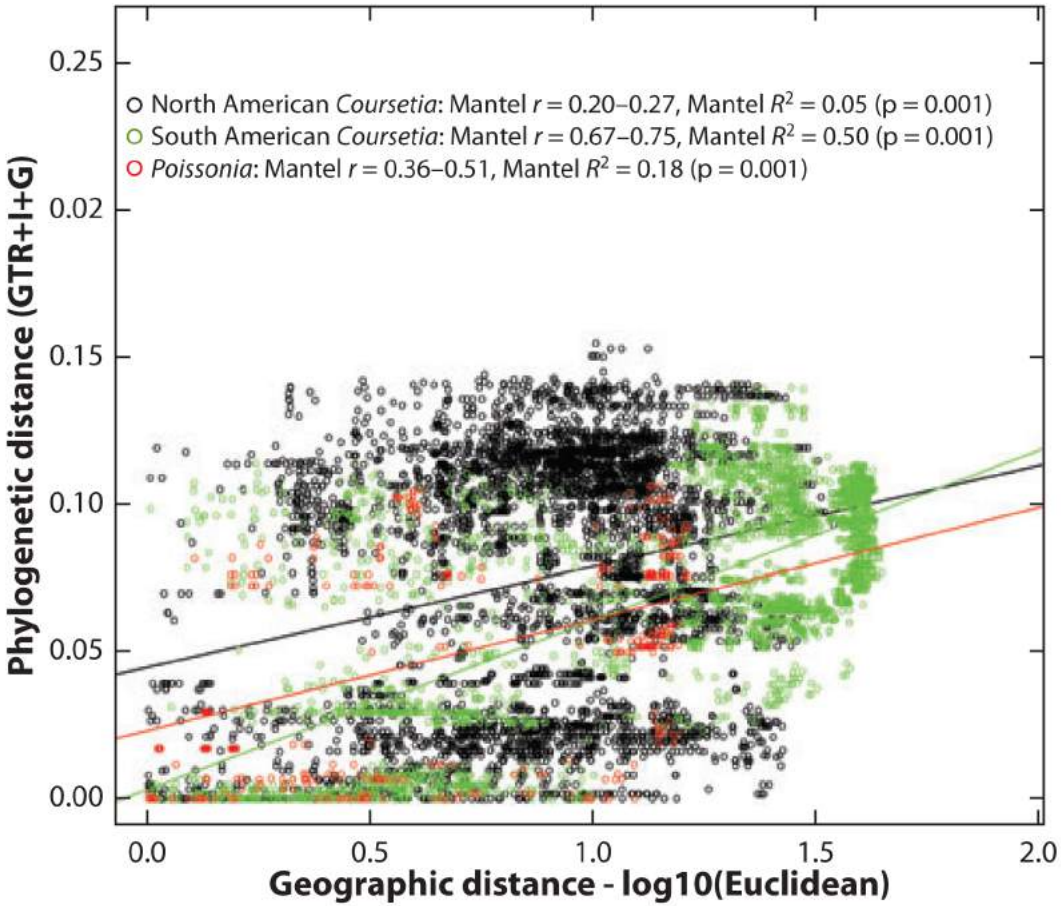
Chronogram of legume tribe

- 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



Mantel test

- Strong correlation of geographic distance and phylogenetic distance!

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

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

C. breweri

C. concinna

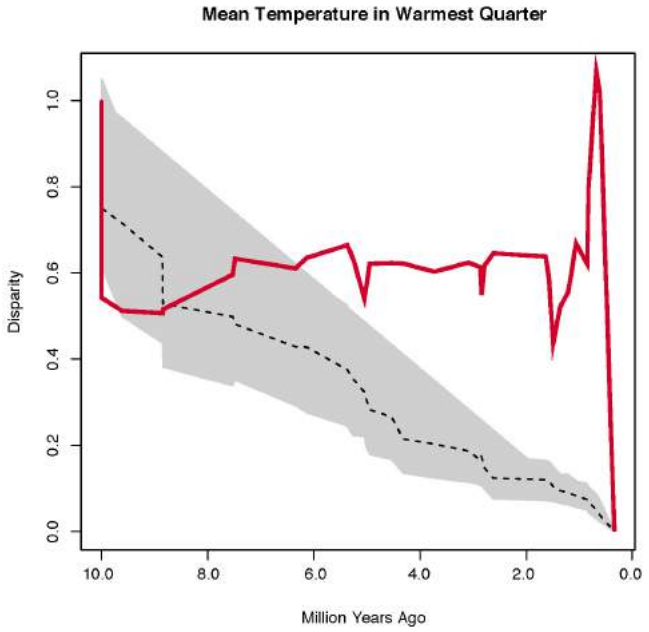
PhyloEcoBiogeography: Evolution of Niche

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

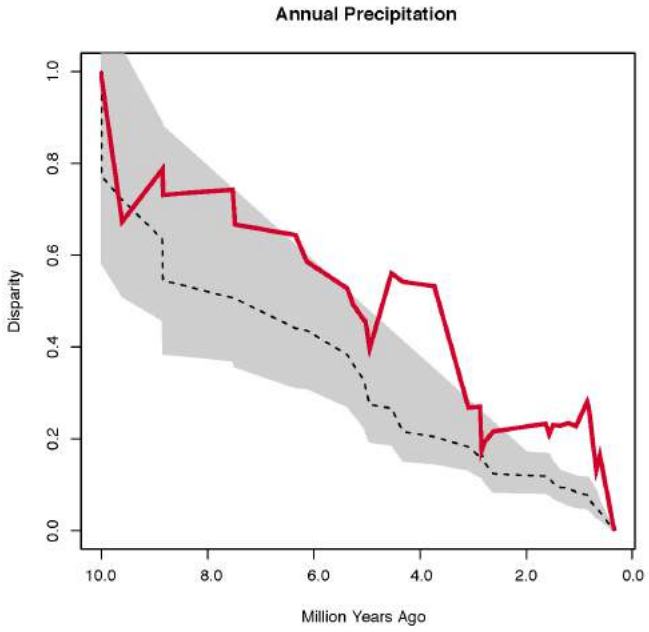
- Temperature and elevation variables show more disparity among close relatives in speciation - adaptive radiation

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

PhyloEcoBiogeography: Evolution of Niche

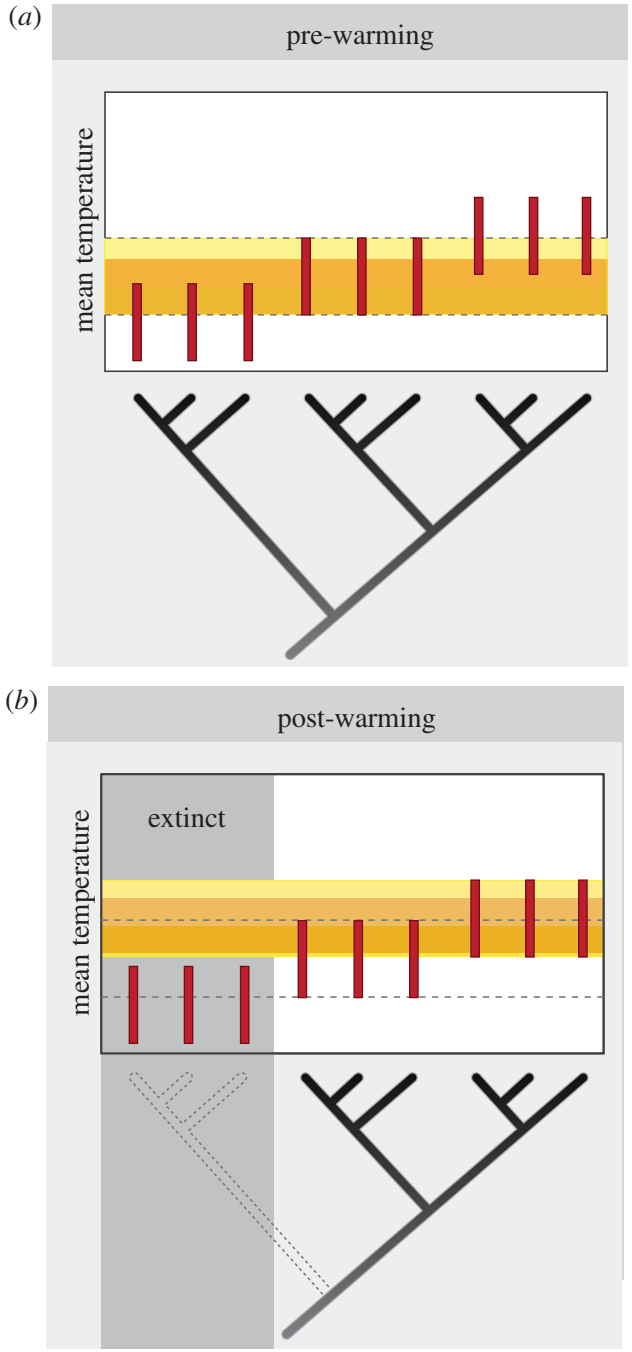


- Temperature shows significant disparity through time < 5mya - adaptive radiation



- Precipitation shows no significant disparity through time - phylogenetic conservatism

PhyloEcoBiogeography: Climate Change



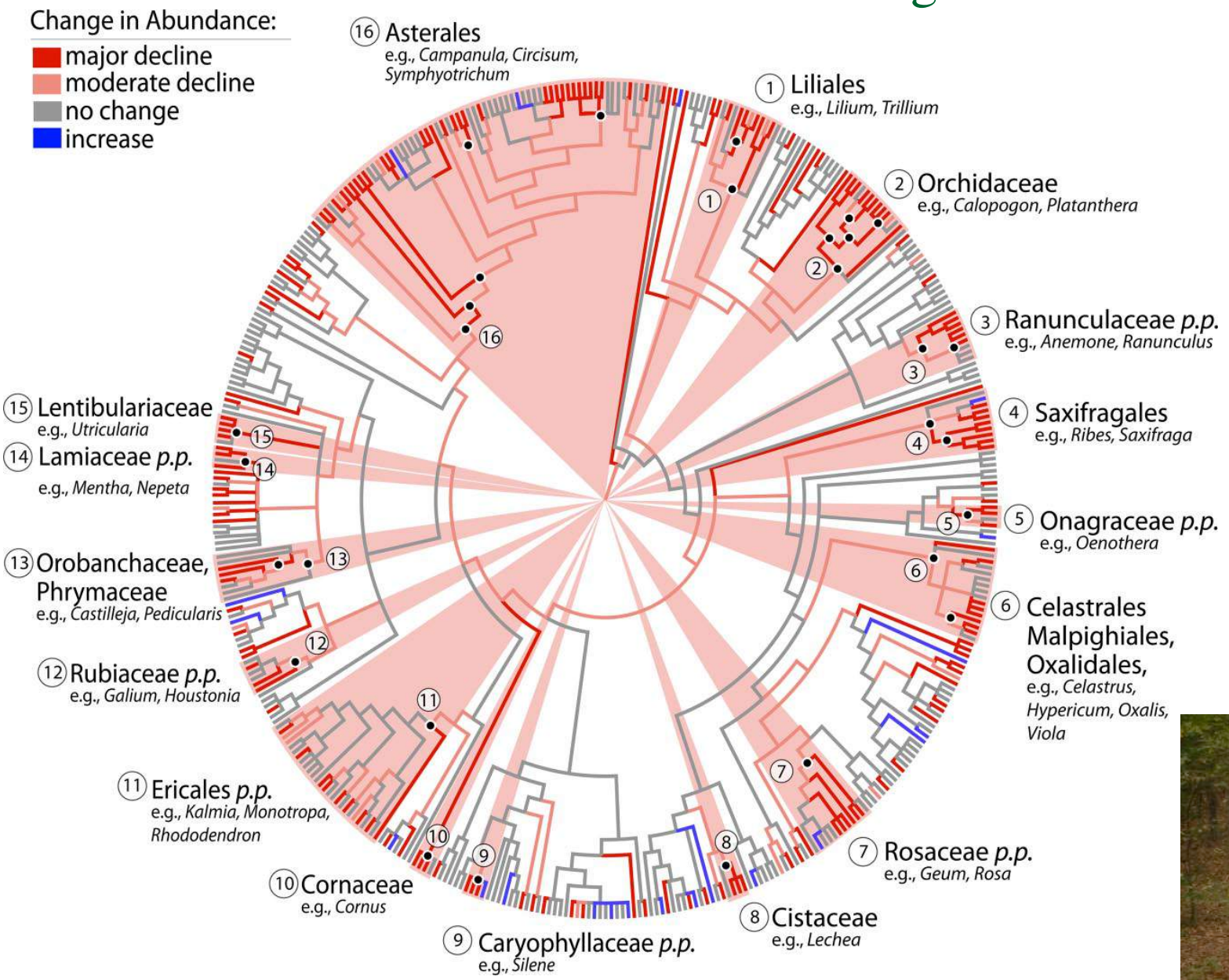
Consequences of global warming? do all species have ability to track climate change to their species niche?

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

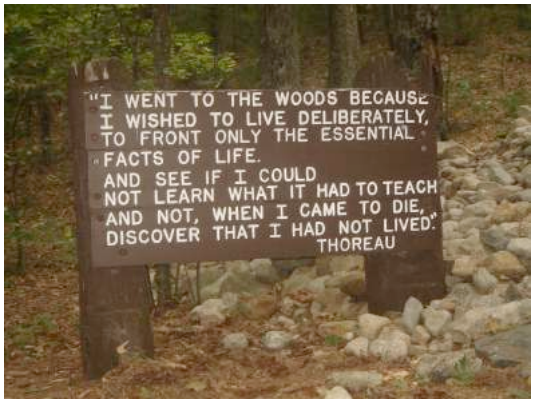
- then there may be clade specific extinction with global warming

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

PhyloEcoBiogeography: Climate Change



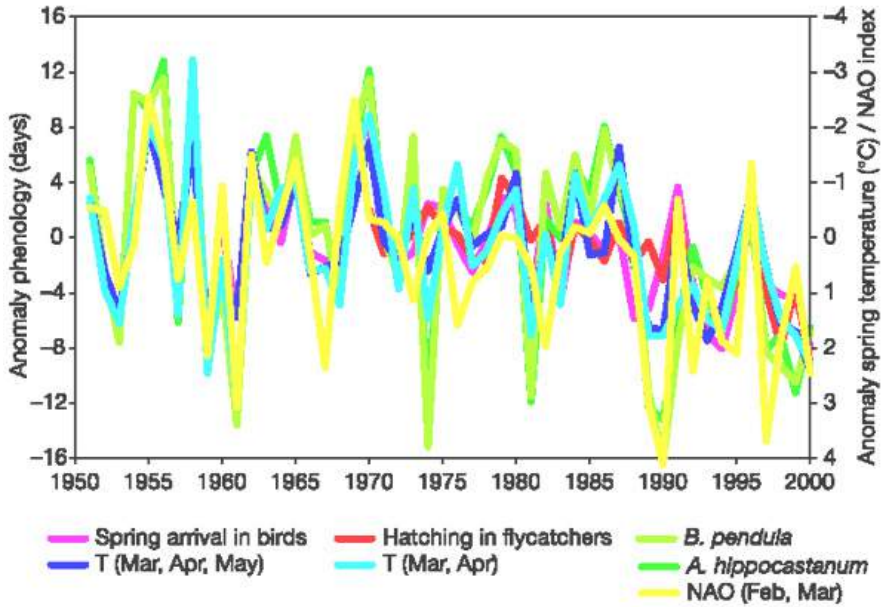
Thoreau Woods
1851 - 2010



PhyloEcoBiogeography:
Climate Change

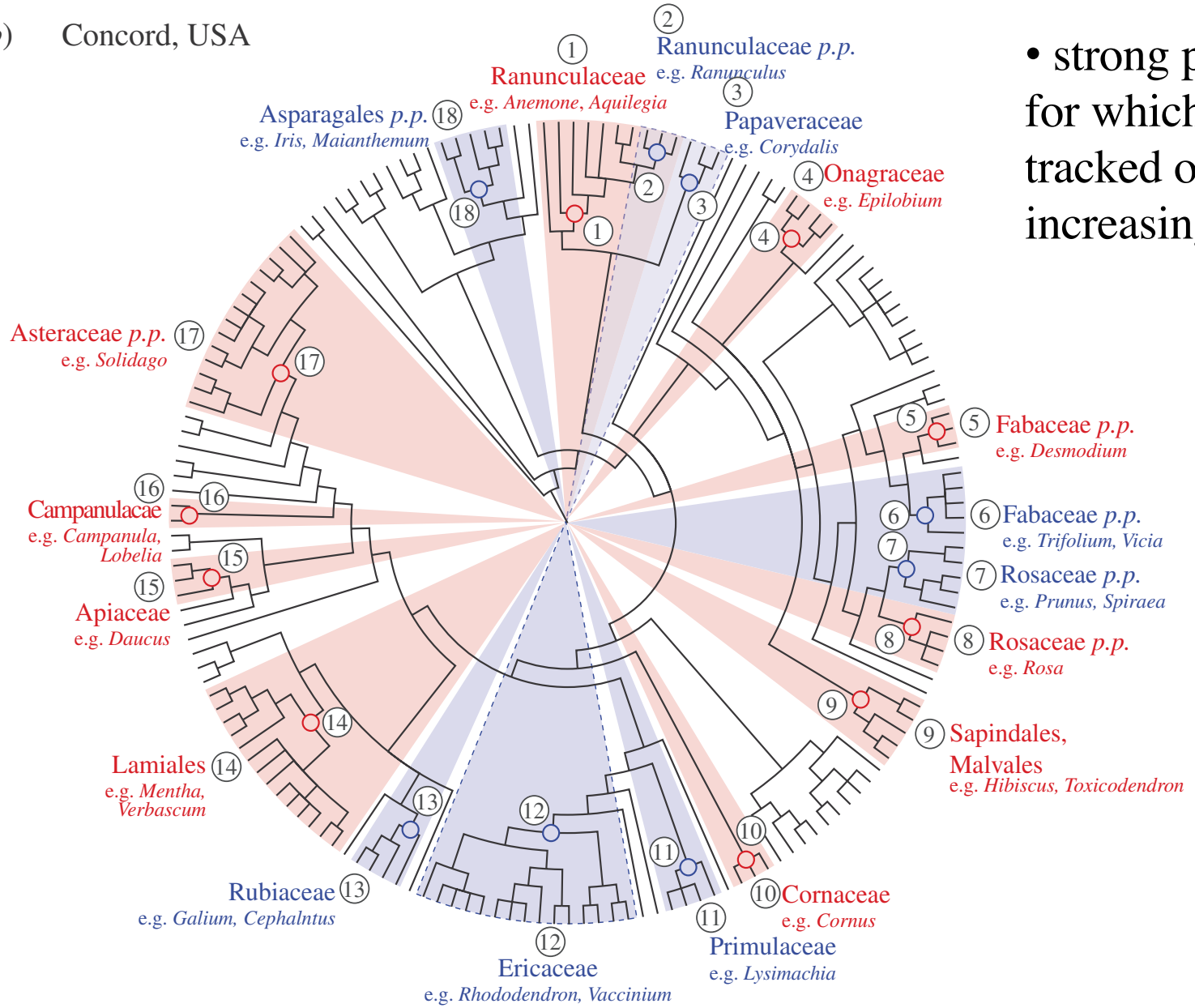
Consequences of global warming? do all species have ability to track climate change to their species niche?

• used flowering phenology (& migratory bird arrival) data from Thoreau's Woods in Concord, MA from 1851-2010



PhyloEcoBiogeography: Climate Change

(*b*) Concord, USA



- strong phylogenetic signal for which families of plants tracked or could not track increasingly warmer springs

trackers

non-trackers

PhyloEcoBiogeography: Climate Change

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

• invasive species were more responsive to tracking and even shifting their flowering phenology