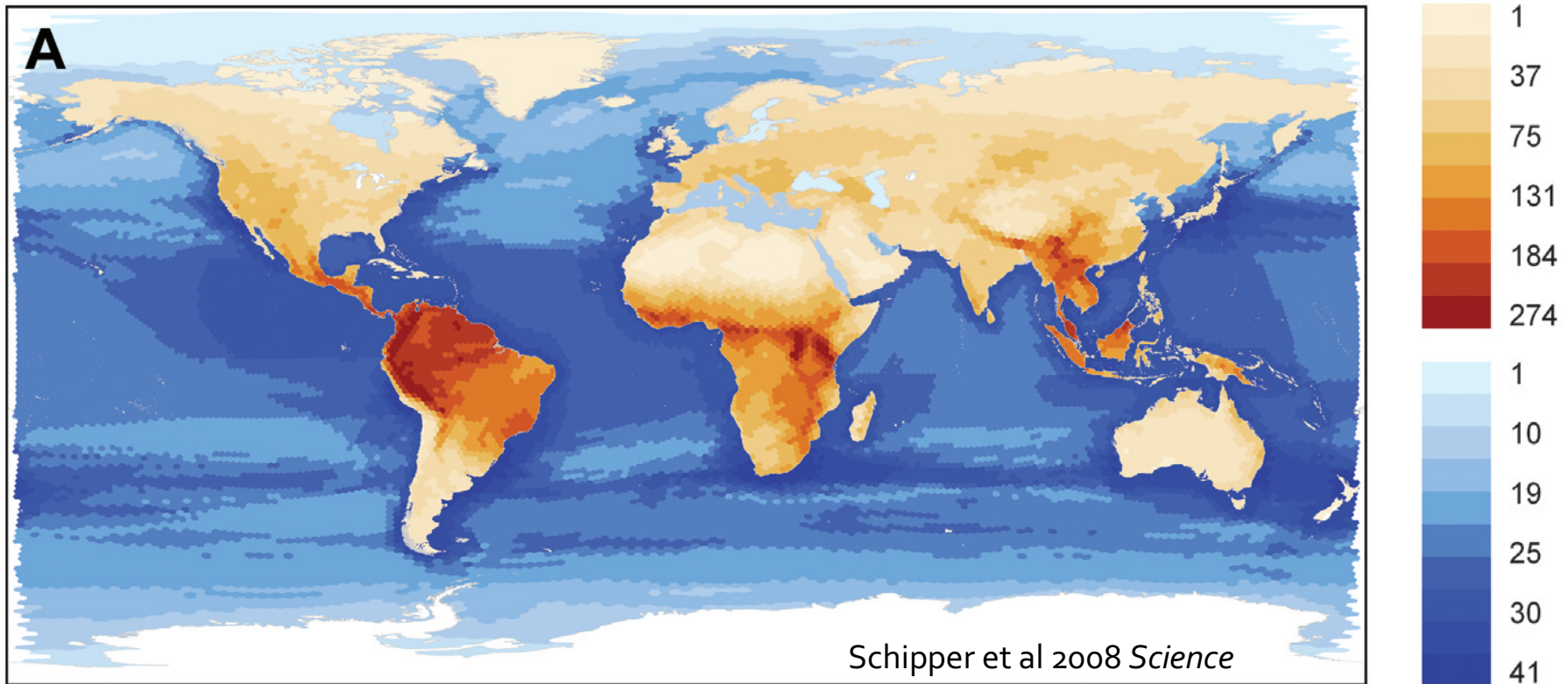


# Global diversity



- An example: species diversity in mammals

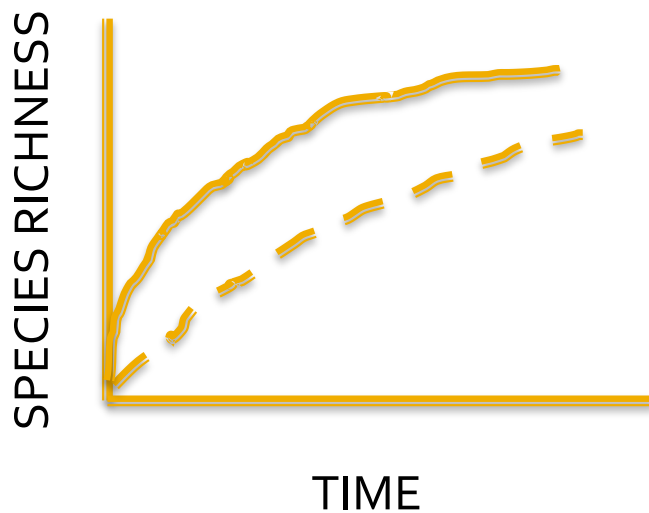


# Quiz

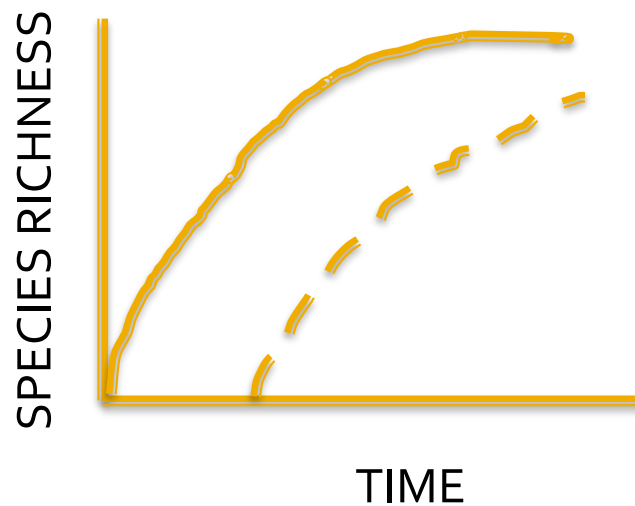
TO BEST ILLUSTRATE THE EVOLUTIONARY EXPLANATIONS FOR LATITUDINAL DIVERSITY GRADIENTS, WHICH (IF ANY) OF THE FOLLOWING SHOULD BE SWITCHED?

- A) TITLES
- B) AXES LABELS
- C) LEGENDS

TIME FOR DIVERSIFICATION



DIVERSIFICATION RATE



LEGEND:  
TROPICS  
TEMPERATE



# Latitudinal Diversity Gradients: Key concepts

- **Latitudinal diversity gradient**
- Mid-domain effect
- Evolutionary hypotheses
- Abiotic hypotheses
- Biotic hypotheses



# What is diversity, and is it even important?

- Diversity: the number and variety of organisms in a specified geographic area
- Sources of diversity = unresolved problem
- Controversial relationship between species diversity and community attributes
- Variation in species diversity is complex
  - Basis for some of the fundamental unsolved problems in community ecology



# Mid-domain effect

- Even if species latitudinal ranges are random, we still expect to see more species if we 'walked' an equatorial transect (vs. a more temperate one)
- A useful null model to compare with

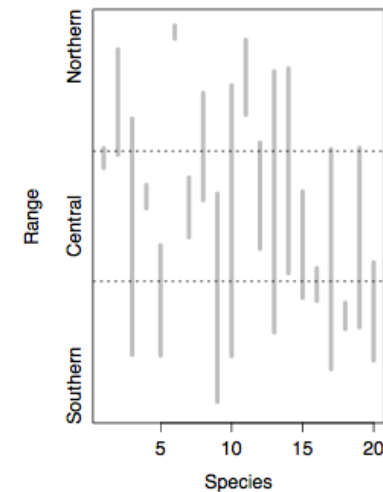
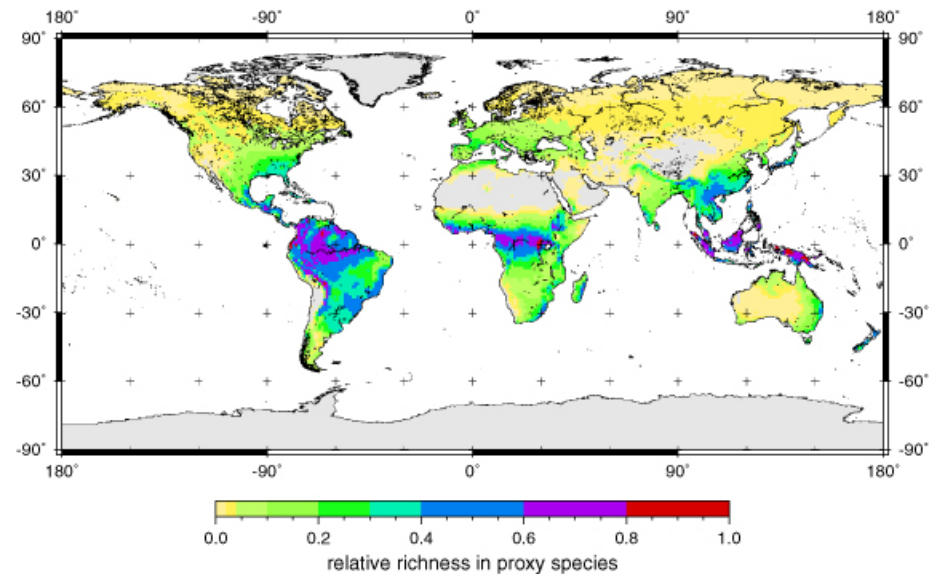


Figure 3: Randomly selected species ranges along a hypothetical southern-northern interval. By chance alone, species are expected to be observed in the central region more commonly.

# Several hypotheses have been proposed to explain latitudinal gradients in species diversity.

1. Evolutionary time
2. Ecological time
3. Climatic stability
4. Climatic predictability
5. Spatial heterogeneity
6. Productivity
7. Stability of primary production
8. Competition
9. Disturbance
10. Predation

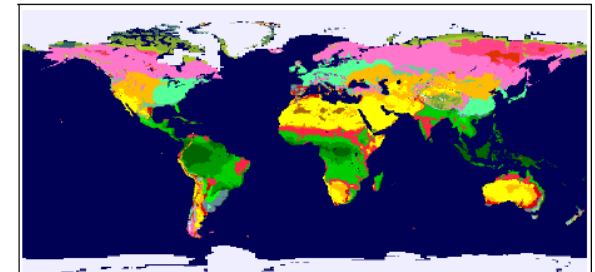


These hypotheses are not mutually exclusive, and different factors may be interacting.

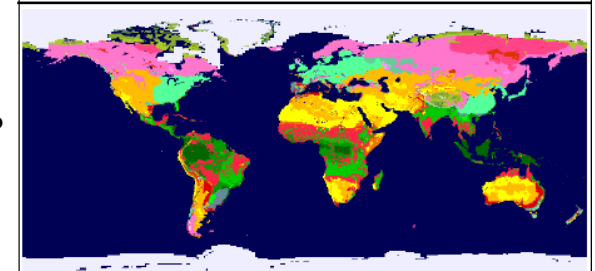
# The age of tropical habitats have allowed for more speciation over time.

1. Evolutionary time
2. Ecological time
3. Climatic stability
4. Climatic predictability
5. Spatial heterogeneity
6. Productivity
7. Stability of primary production
8. Competition
9. Disturbance
10. Predation

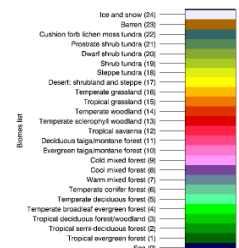
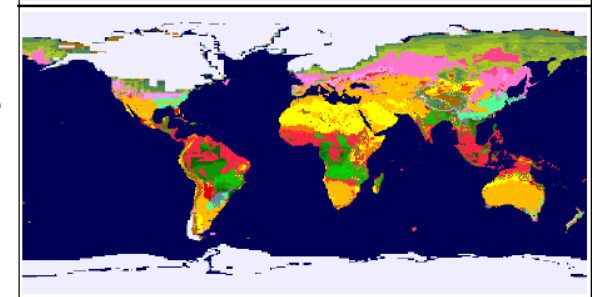
Modern Day



6,000 yr BP

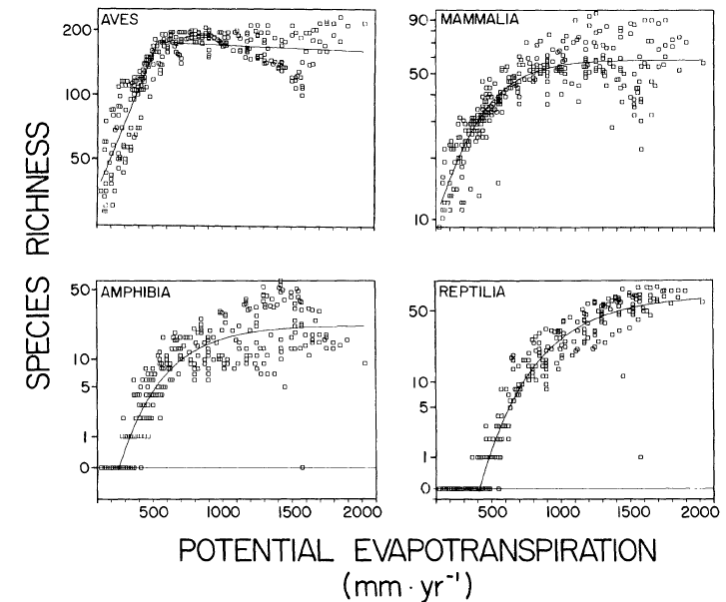


21,000 yr BP



# Tropical environments are more predictable, which allows for greater specialization of resources.

1. Evolutionary time
2. Ecological time
3. Climatic stability
4. Climatic predictability
5. Spatial heterogeneity
6. Productivity
7. Stability of primary production
8. Competition
9. Disturbance
10. Predation



# Greater competition and predation in the tropics allow more species to coexist.

1. Evolutionary time
2. Ecological time
3. Climatic stability
4. Climatic predictability
5. Spatial heterogeneity
6. Productivity
7. Stability of primary production
8. Competition
9. Disturbance
10. Predation





# Disturbance is intermediate in the tropics compared with temperate regions, allowing for greater species diversity.

1. Evolutionary time
2. Ecological time
3. Climatic stability
4. Climatic predictability
5. Spatial heterogeneity
6. Productivity
7. Stability of primary production
8. Competition
9. **Disturbance**
10. Predation



# The tropics contain a more extensive spatial matrix, which promotes higher species coexistence.

1. Evolutionary time
2. Ecological time
3. Climatic stability
4. Climatic predictability
5. **Spatial heterogeneity**
6. Productivity
7. Stability of primary production
8. Competition
9. Disturbance
10. Predation



# Niche conservatism

- If tropics are more species rich, they may not 'supply' species elsewhere, since some species will be maladapted to temperate environments

*Limited dispersal from the tropics*

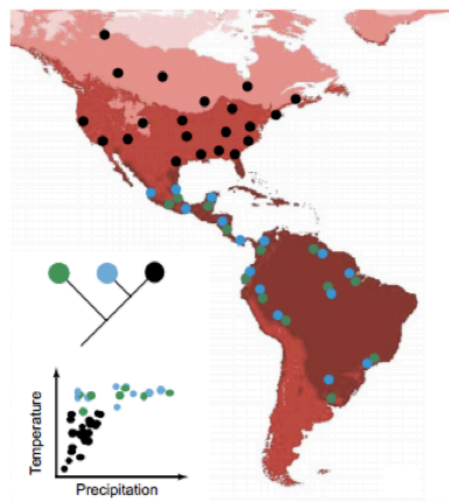


Figure 6: Hypothetical example illustrating niche conservatism and niche evolution. Different colored dots on the map and graph indicate localities for members of three clades. Lighter shades of red indicate colder yearly minimum temperatures. Two of the clades (blue and green) exhibit niche conservatism. Species in these clades are confined to tropical climates and fail to invade other regions despite their geographical proximity. The third clade (black dots) exhibits niche evolution, invading temperate regions (presumably by evolving tolerance to freezing winter temperatures) and no longer occurs in the ancestral tropical region. Adapted from Wiens and Donoghue, 2004.



# Summary

- Latitudinal diversity gradient
  - Mid-domain effect
  - Evolutionary effects
  - Abiotic processes
  - Biotic processes

