

# Patterns of Diversity

Ani Mardiasuti

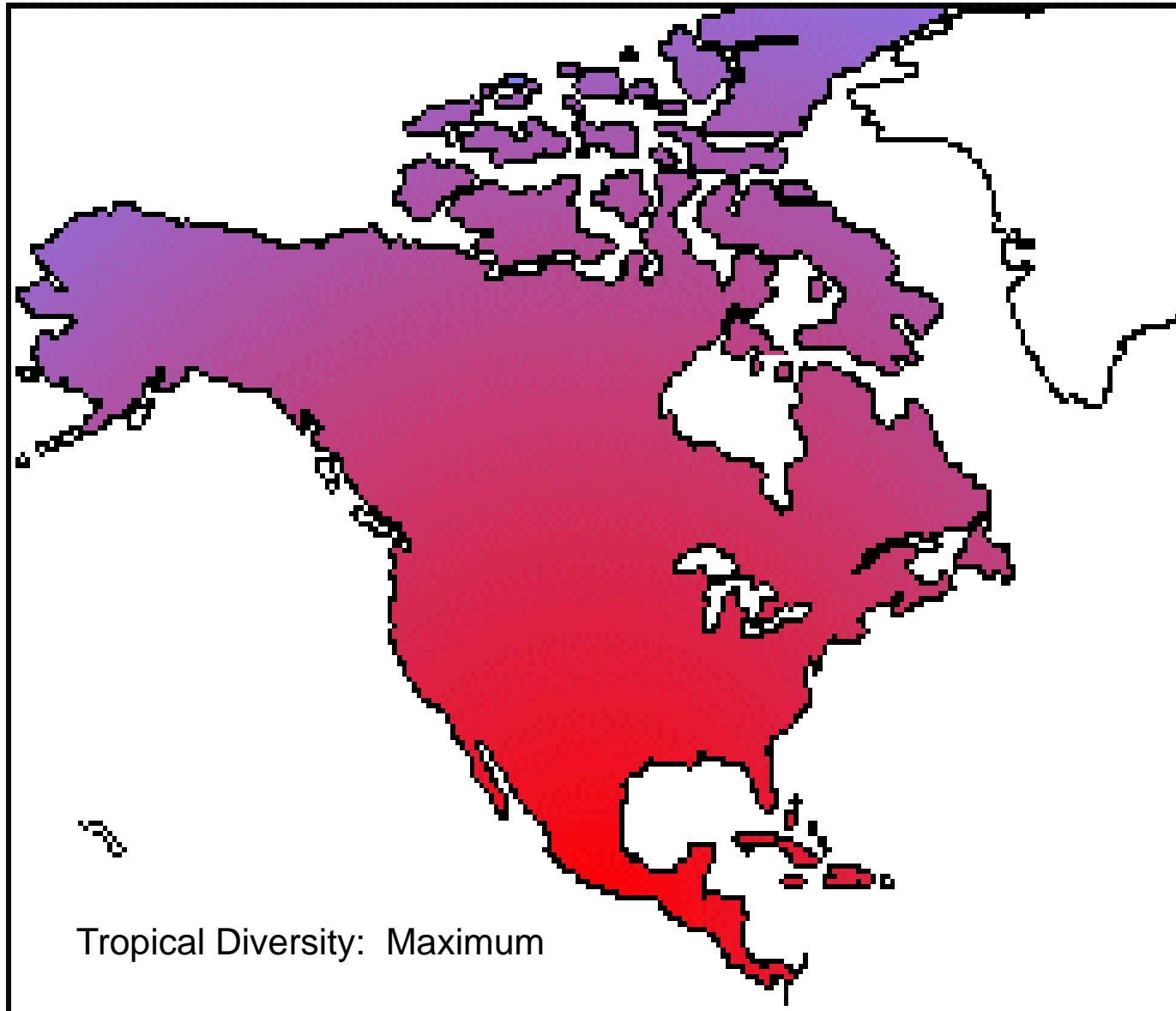
# Patterns of Species Richness

- Species richness is not constant through space
- Positively related to: area, environmental variability
- Negatively related to: latitude, altitude
- Have a complex relationship with:
  - time since disturbance
  - nutrients
  - predation rate
  - productivity
- Islands tend to have low species richness

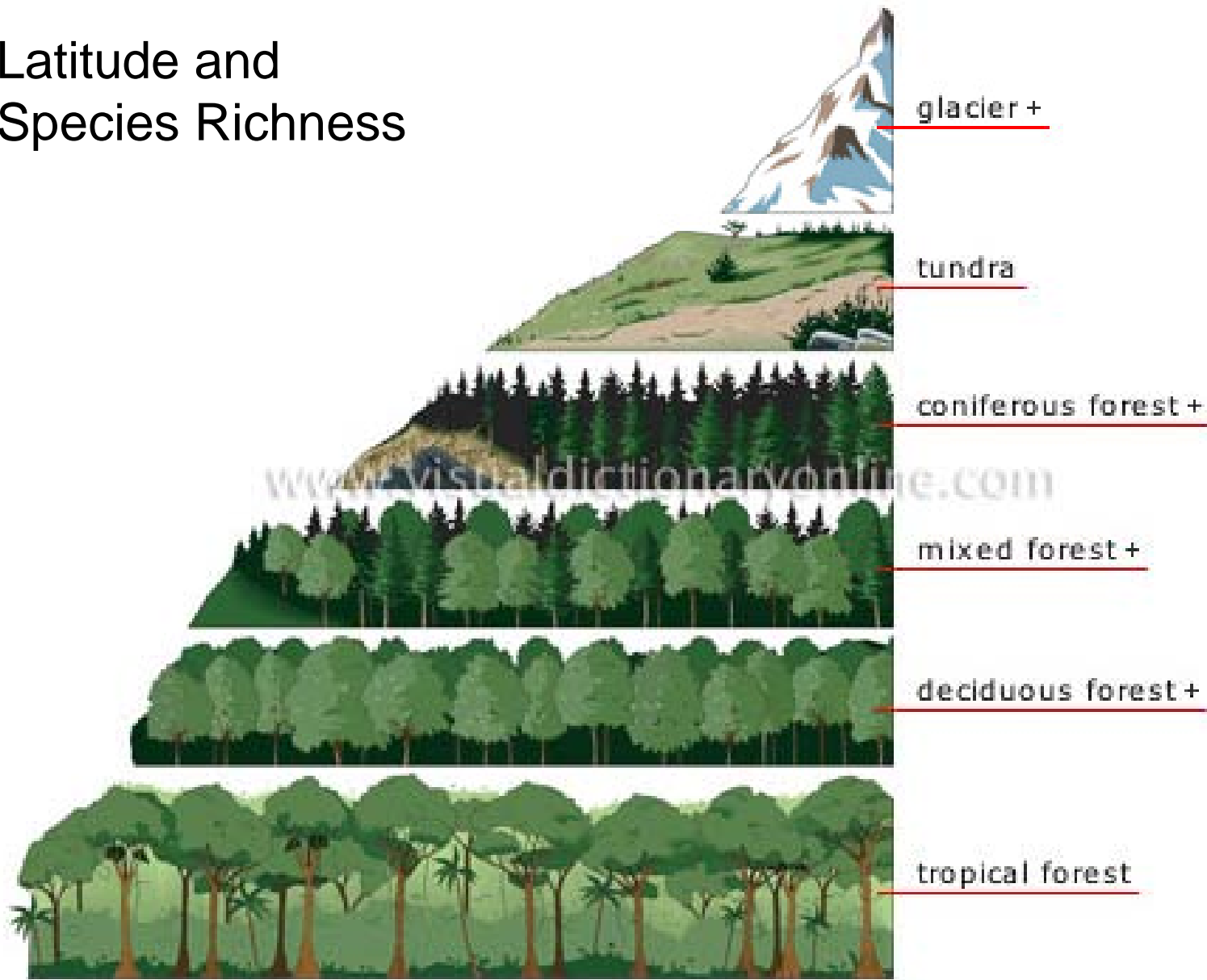
# Latitudinal Gradient

- Gradient: continuous change in some characteristic over space or time
- Richness → increases as one approaches the equator
- Based on research on various birds, reptiles, ants, molluscs, crustaceans, mammals, plants

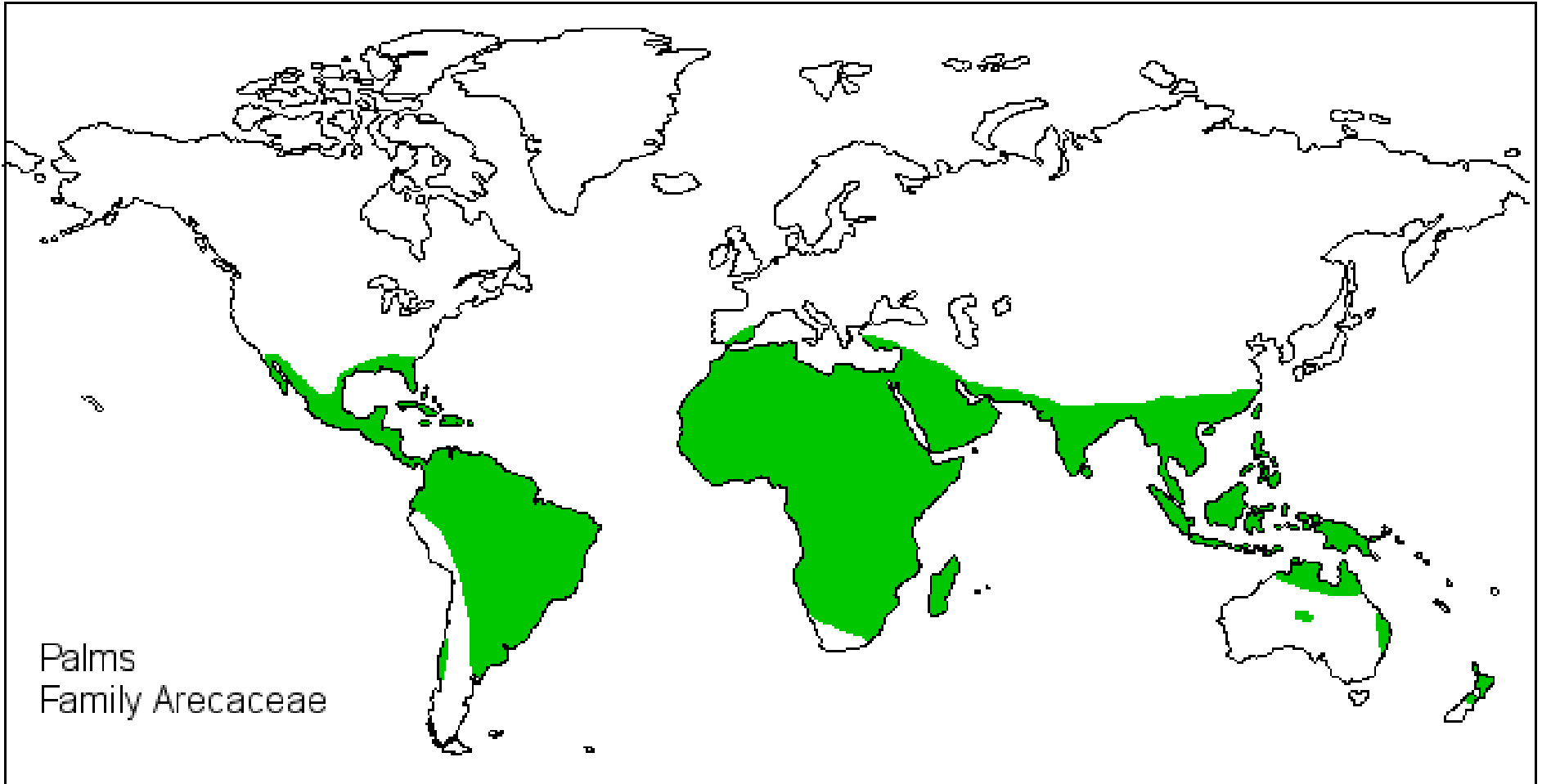
# North American Mammals



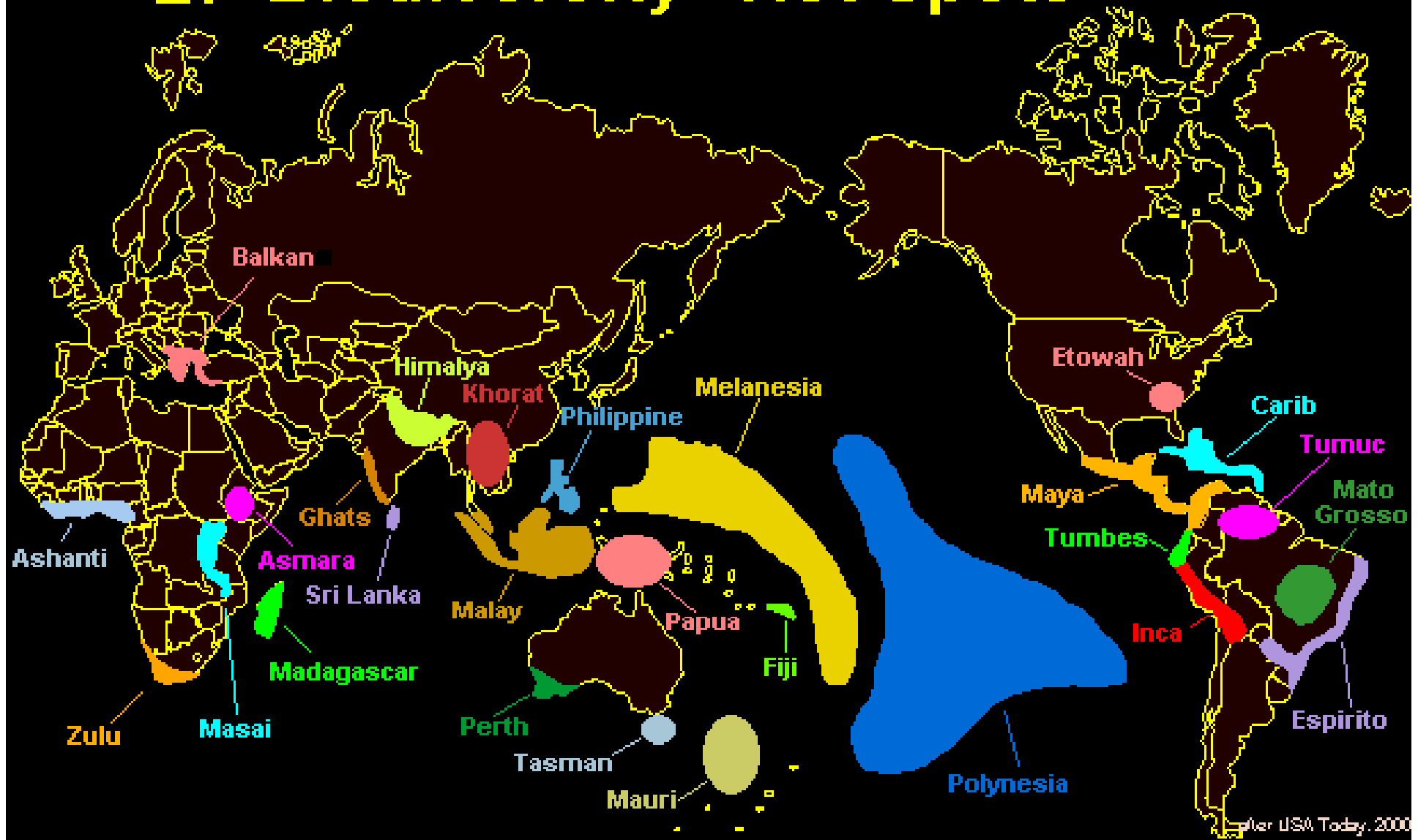
# Latitude and Species Richness



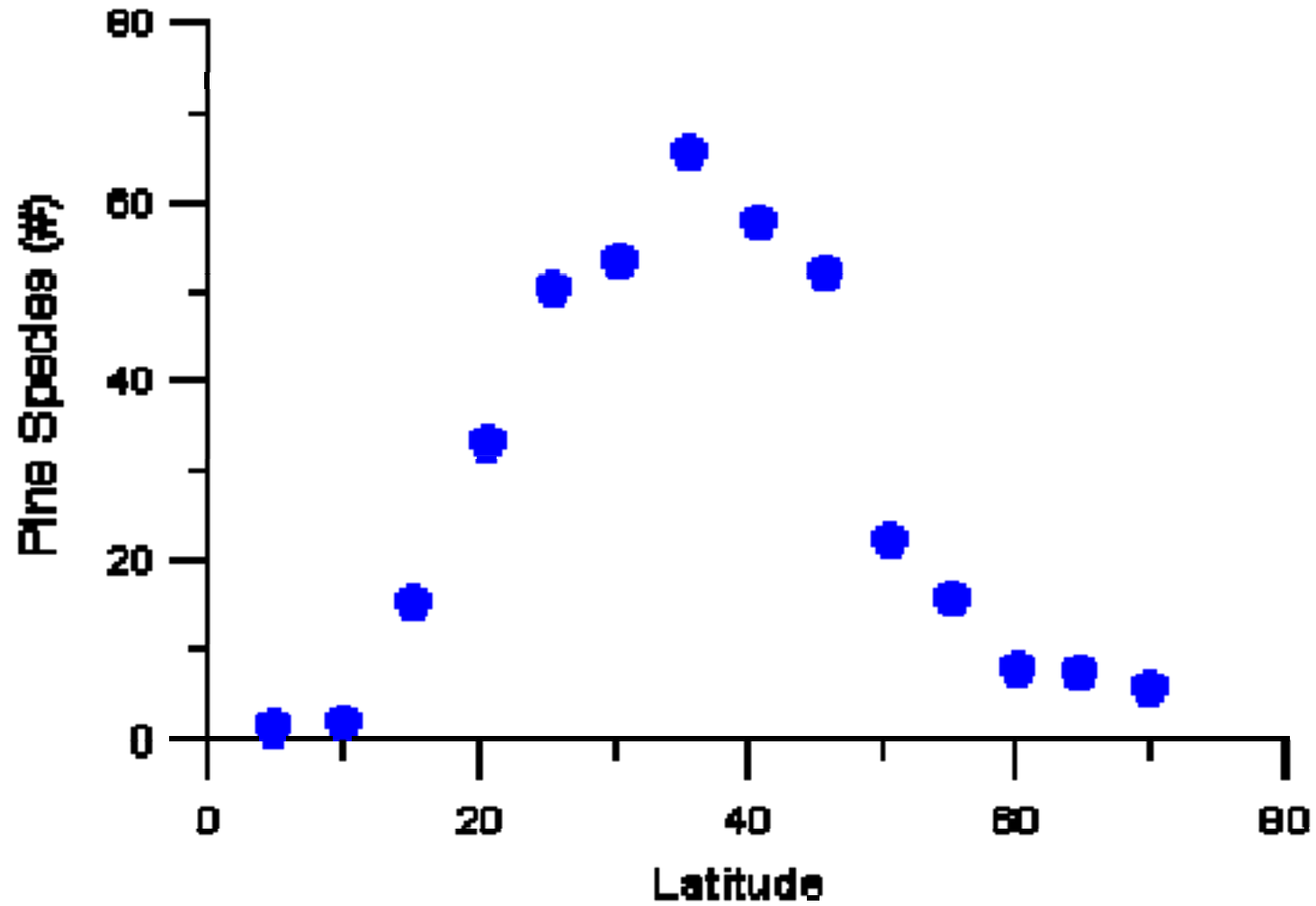
# Tropical Diversity: Palms



# 27 Biodiversity "Hot Spots"

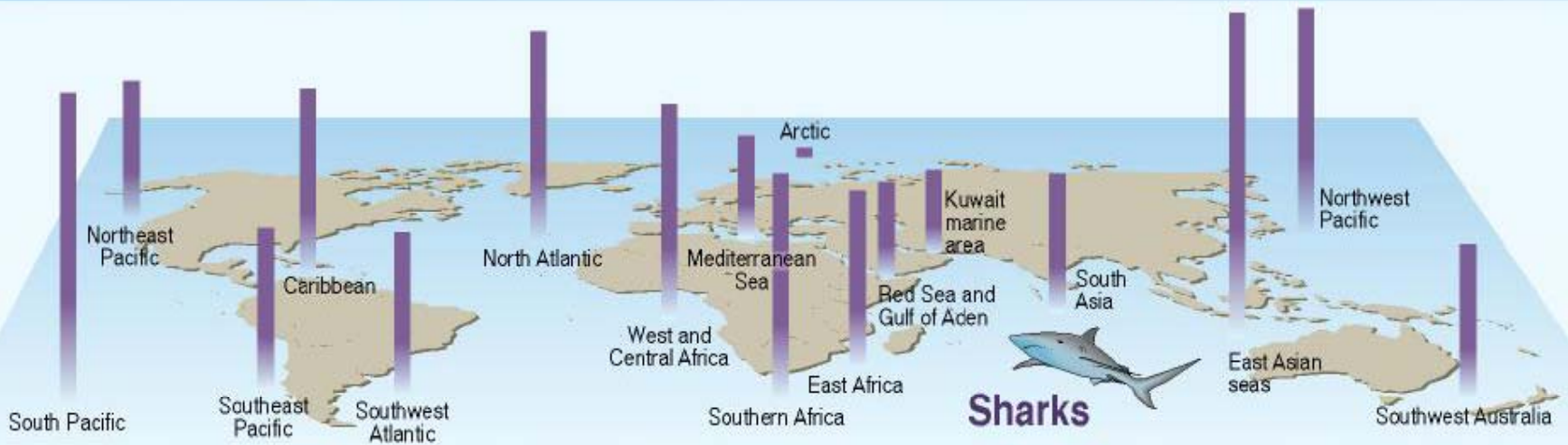
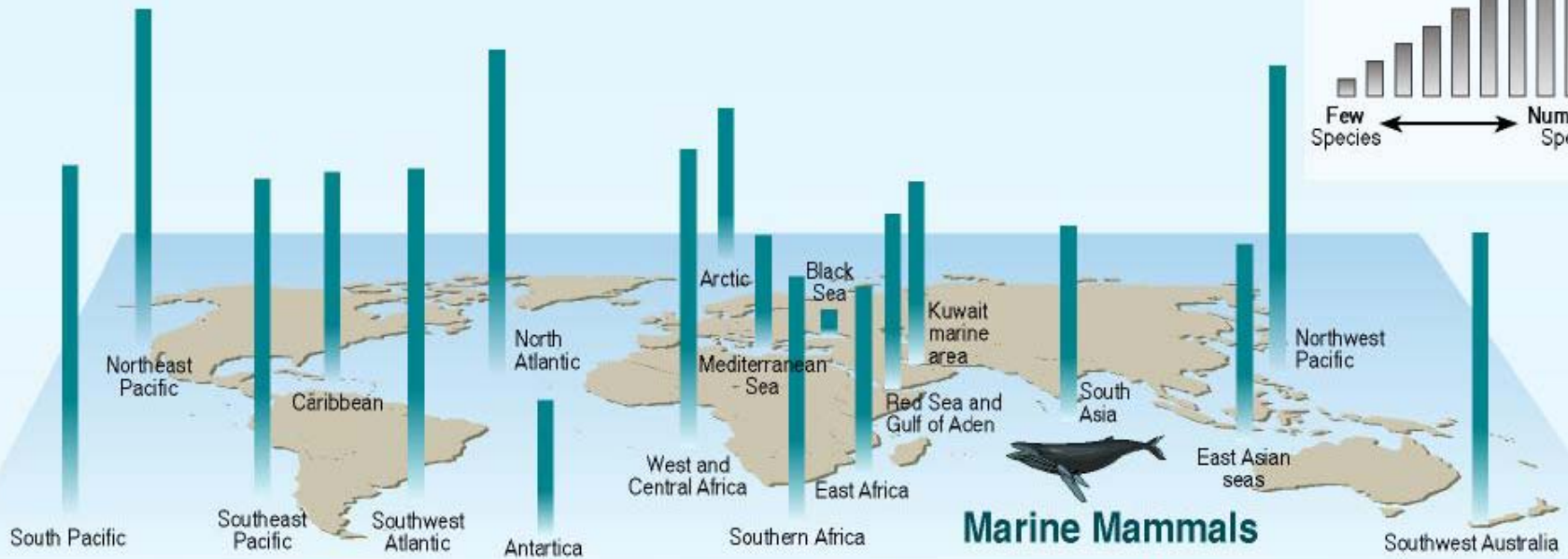
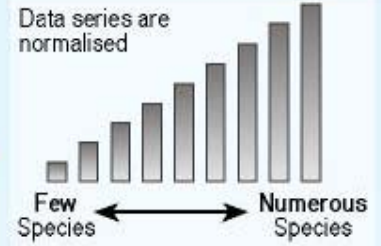


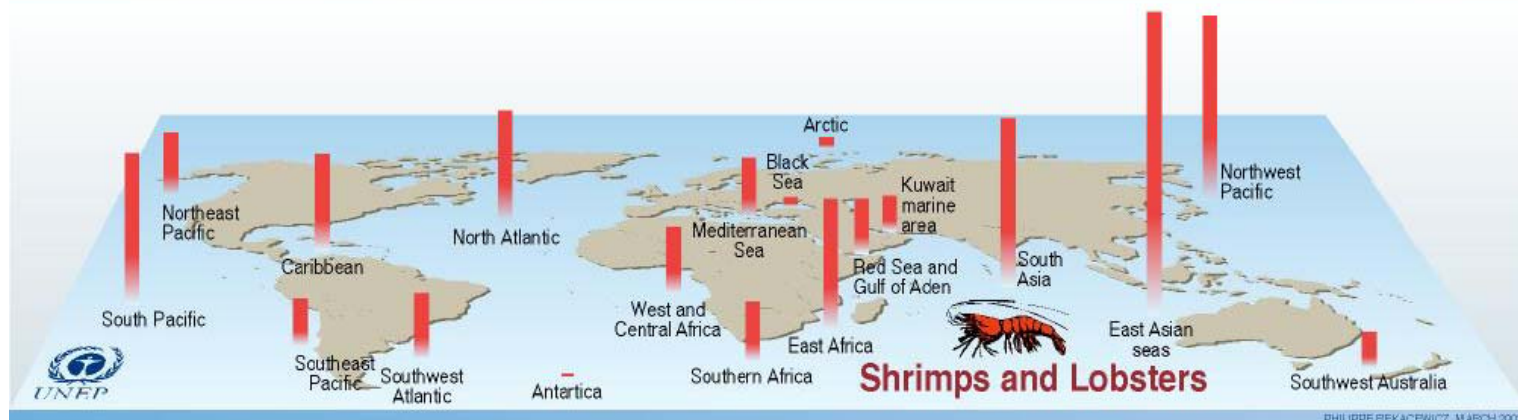
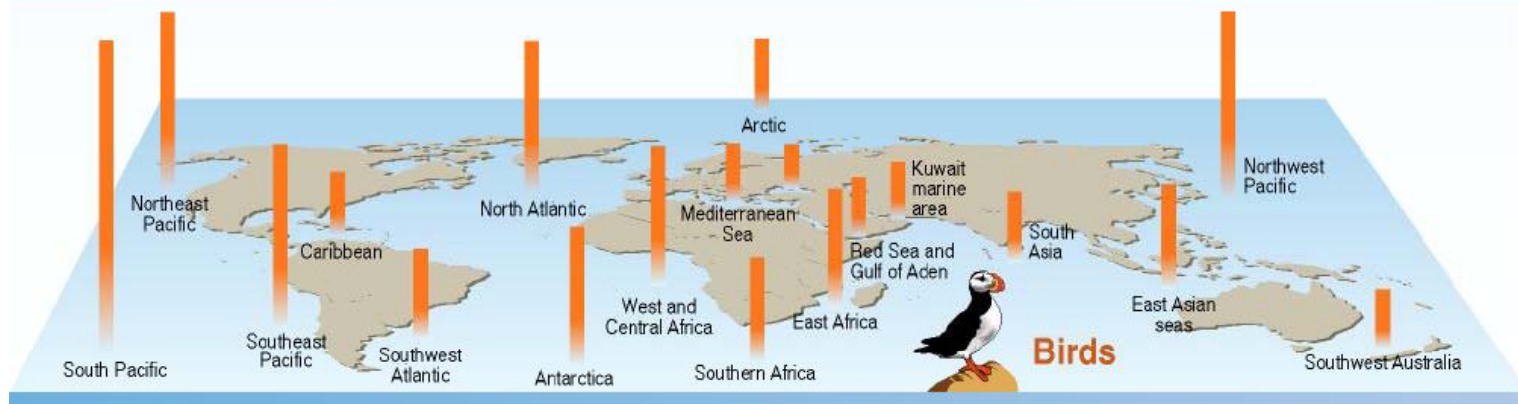
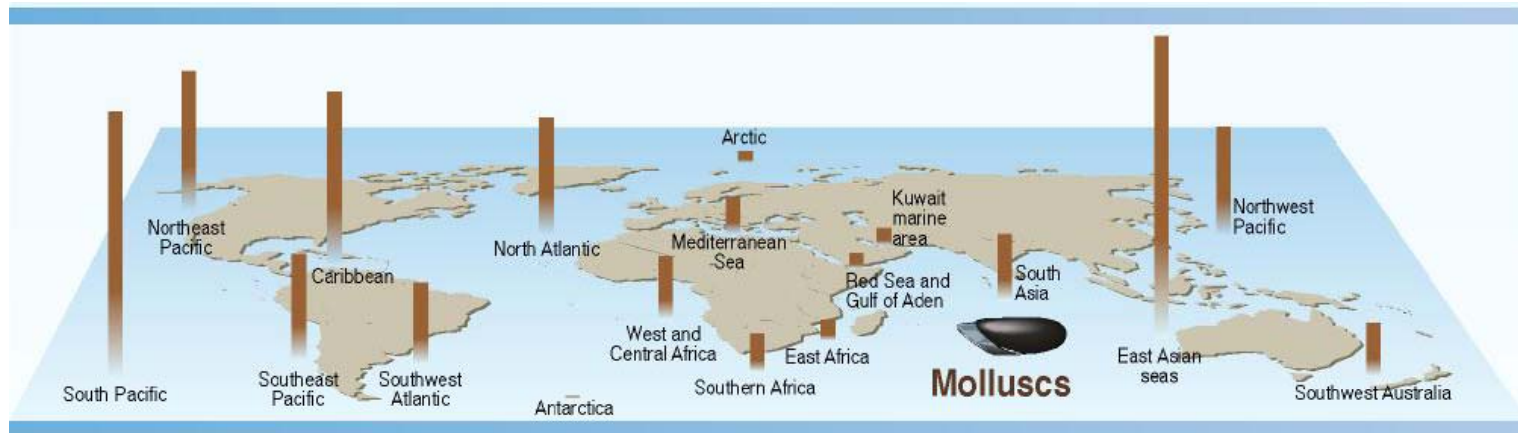
# Tropical Diversity - Exceptions : *Aphids*, *Pinus*





# Species Diversity in the World's Seas, 1990-1998

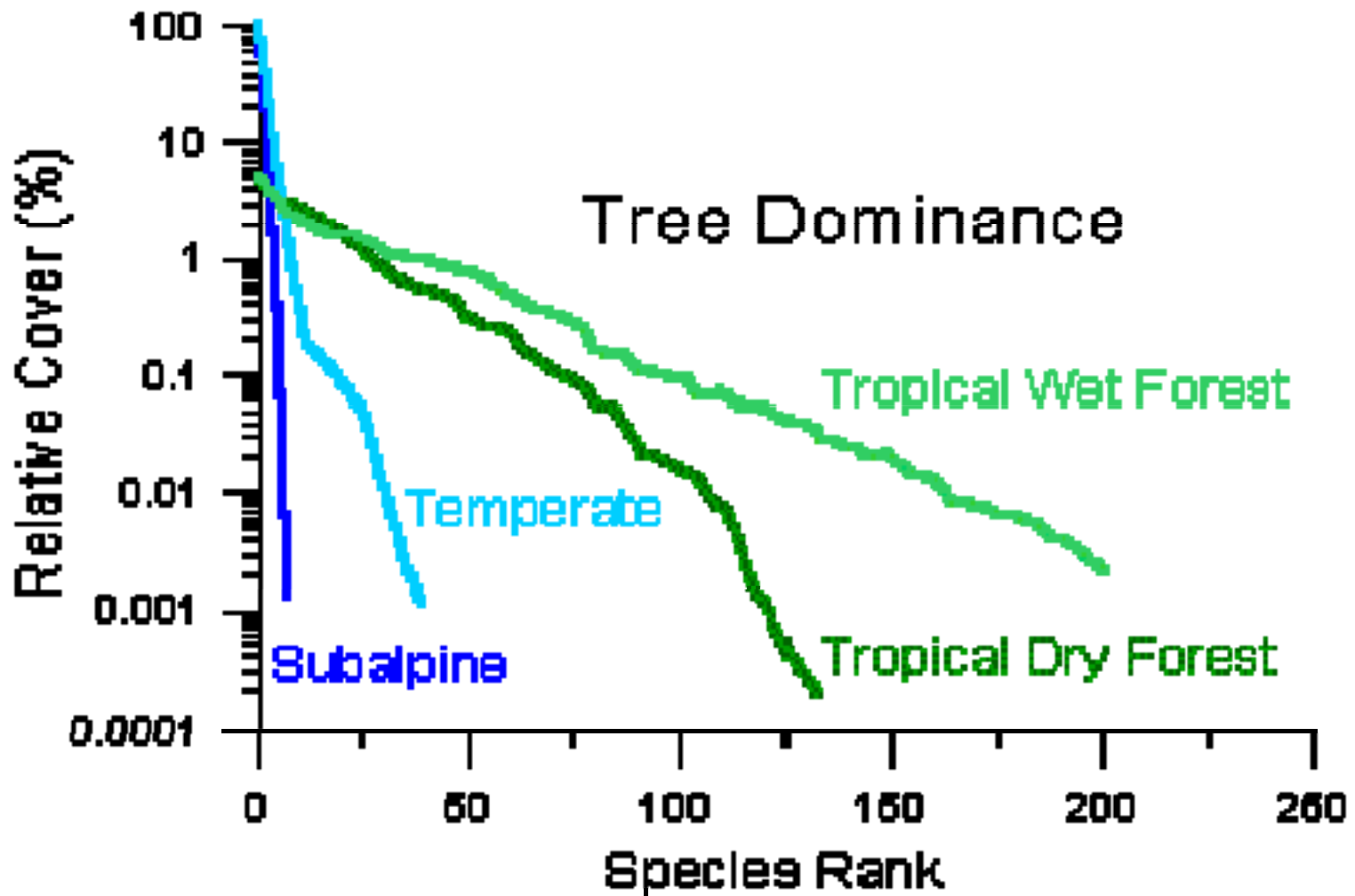




Note: Data have been modified to show the species diversity of each region as a fraction of the most species rich region. The maximum number of marine mammals species in a region is 52, sharks 140, molluscs 1114, birds 115, and shrimps and lobsters: 210.  
 Source: World Resources Institute (WRI), Washington DC, 1998, based on data from UNEP-WCMC.

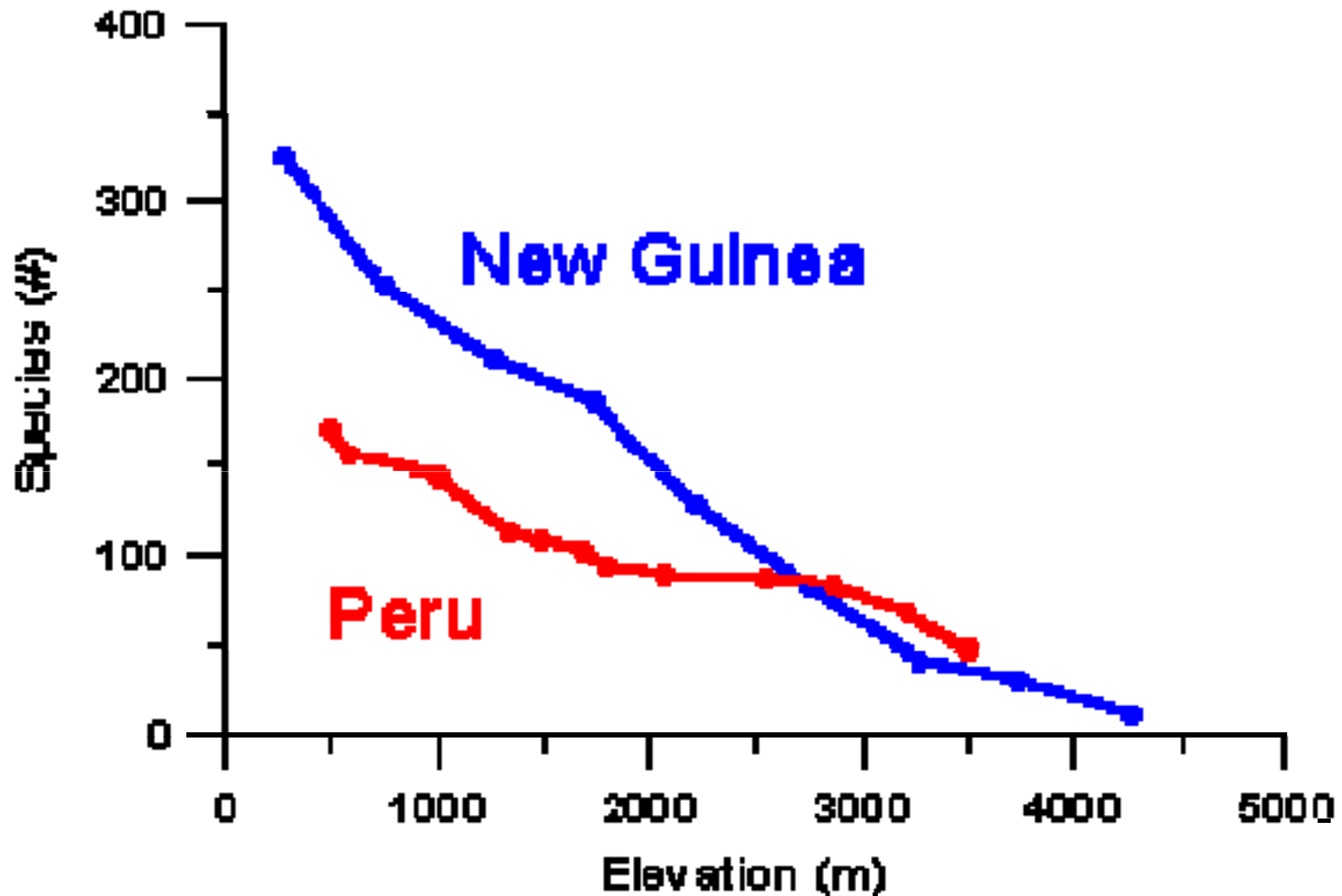
# Dominance-Diversity Relationships

Greater **evenness** of distribution in the tropics

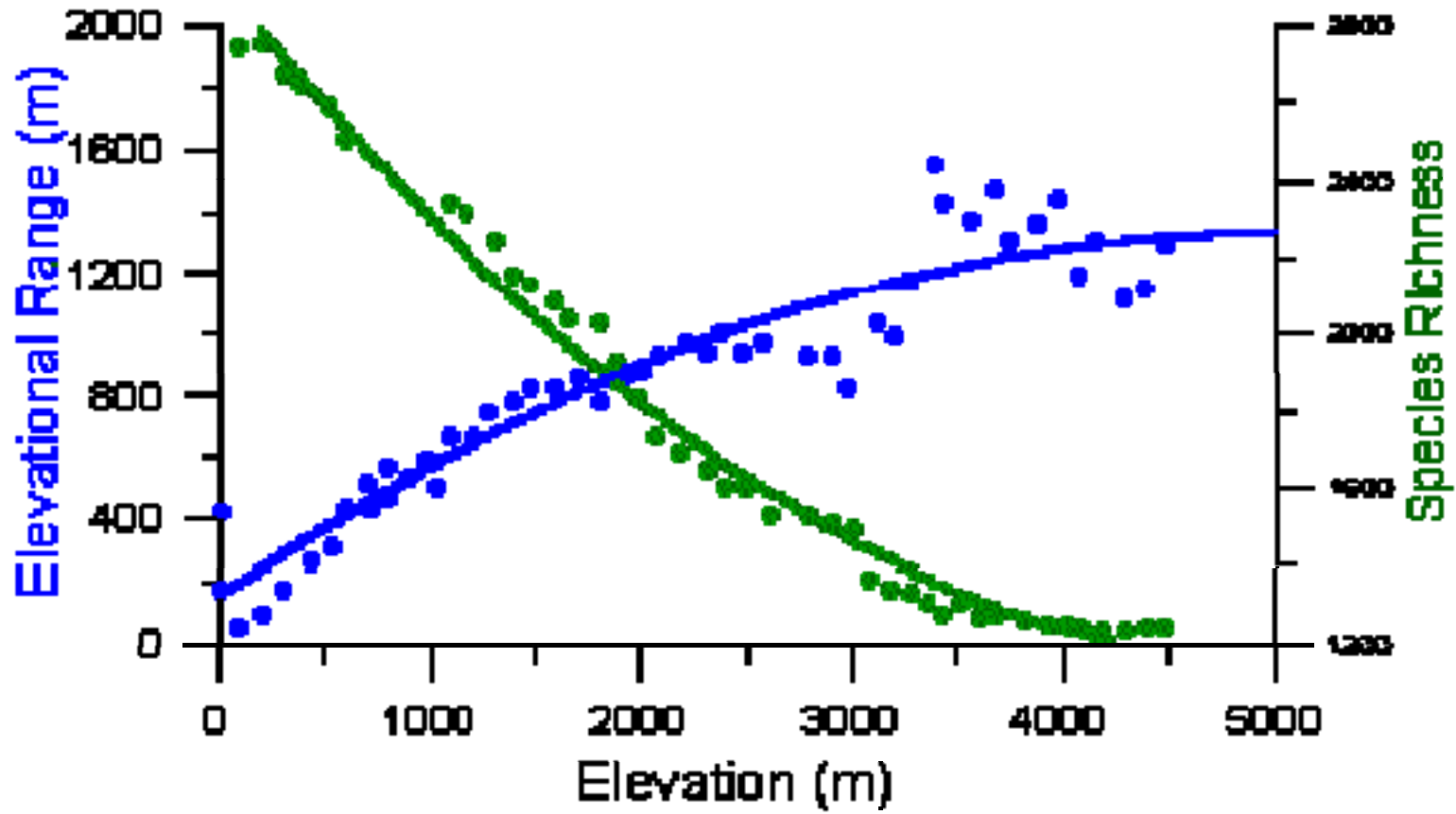


## Diversity Patterns: ELEVATION

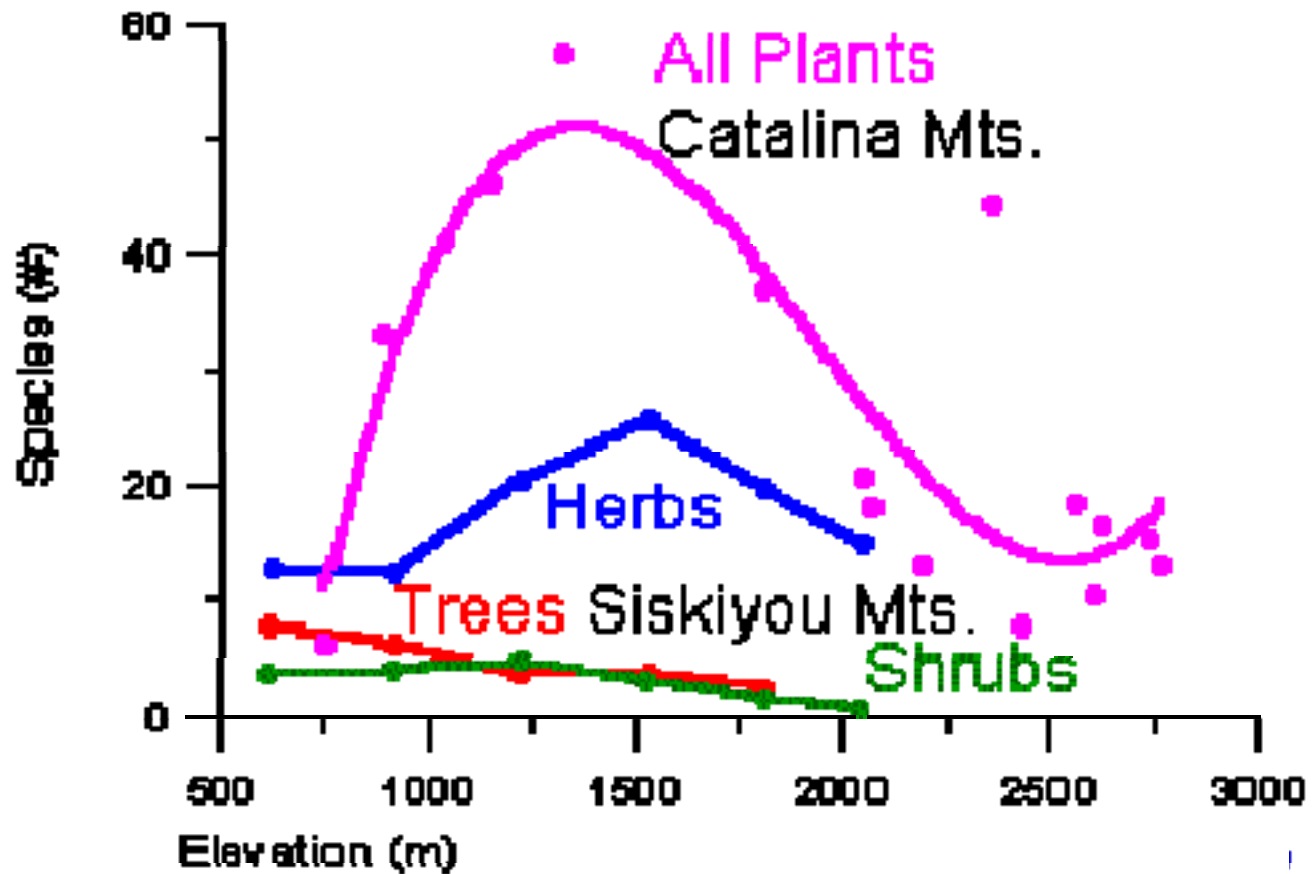
**Elevation:** *typically* diversity decreases toward high elevation



# Venezuela Birds.

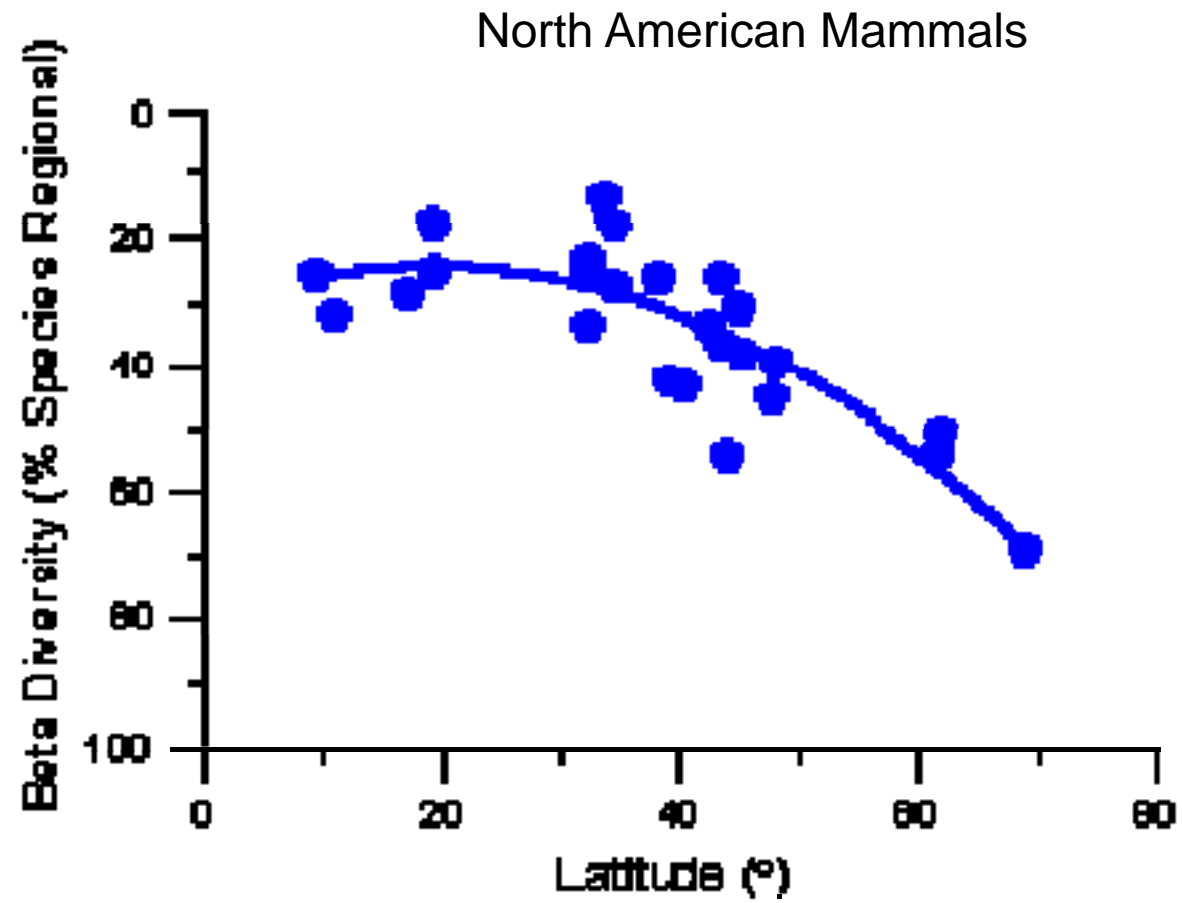


## Other Diversity Patterns - Elevation & Aridity



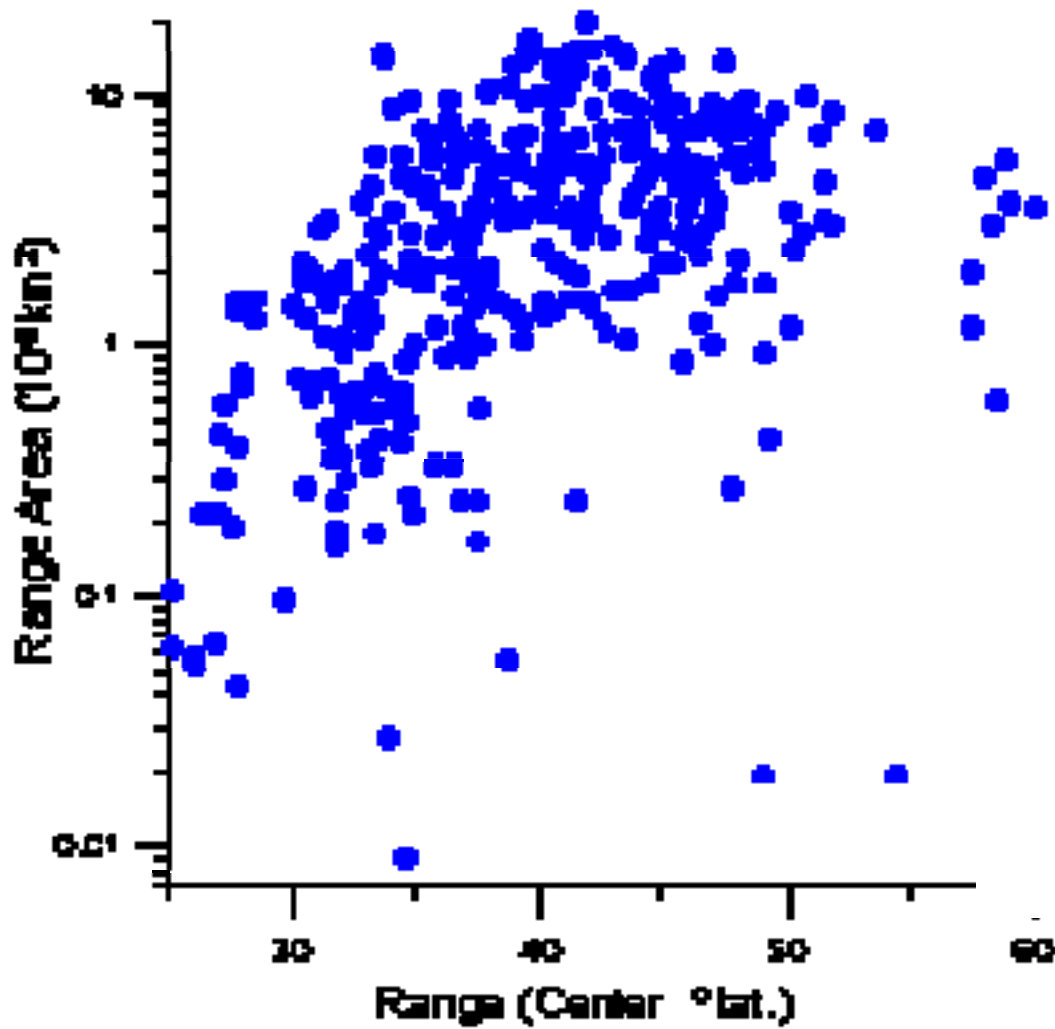
# Habitat Heterogeneity

Beta Diversity decreases poleward



# Rapoport's Rule

Taxa have larger ranges in polar regions

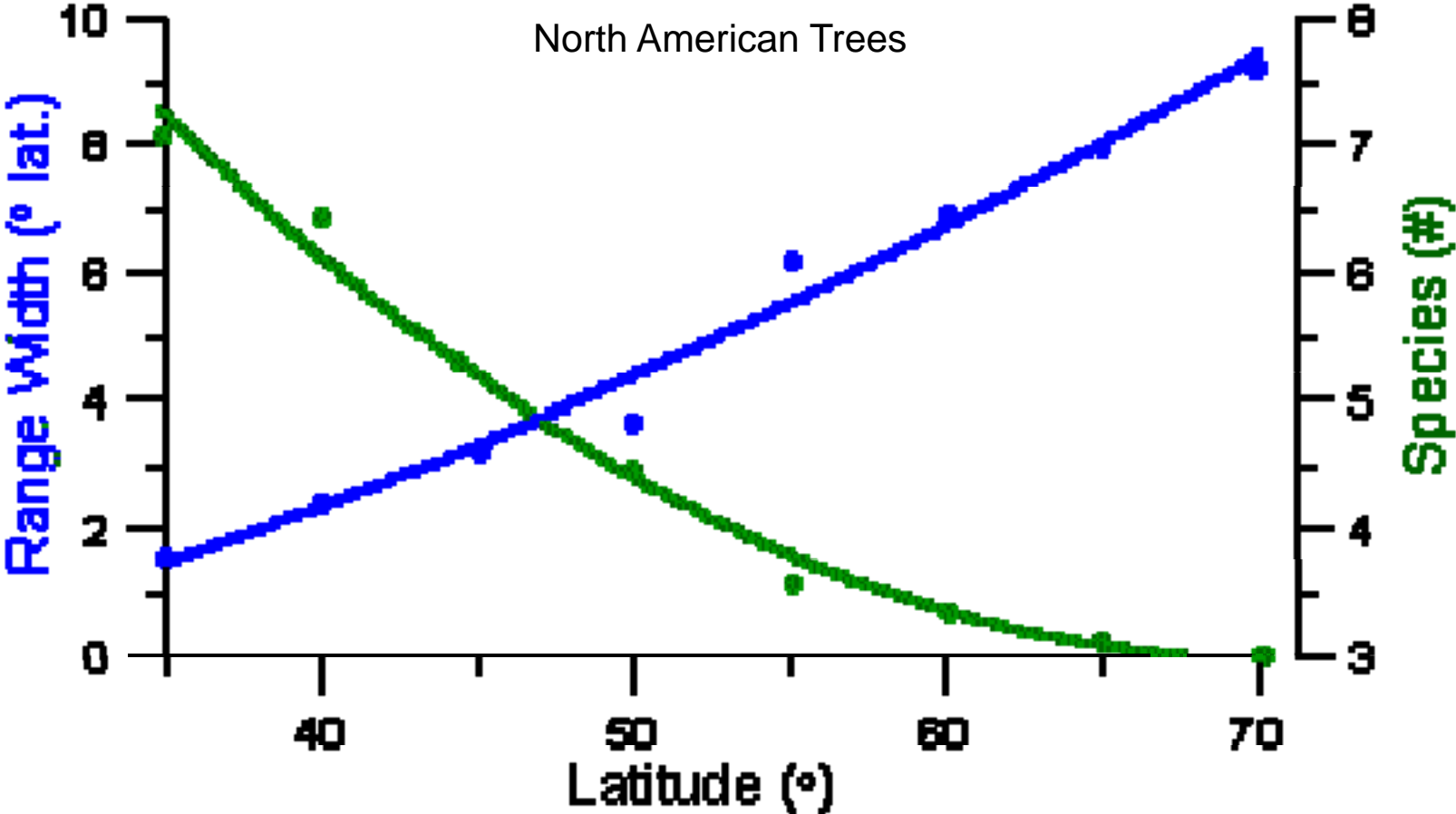


North American Birds

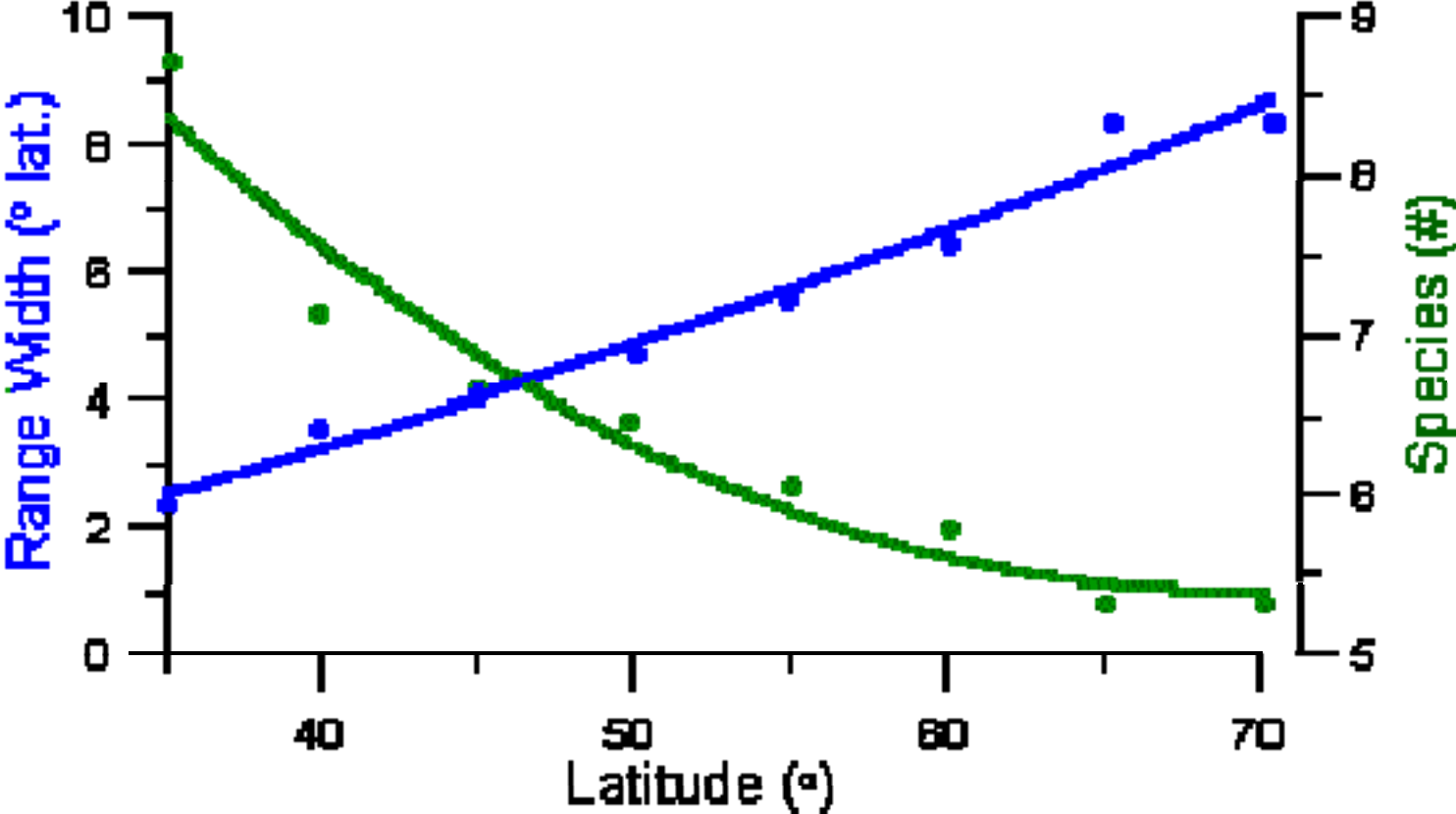


# Rapoport's Rule

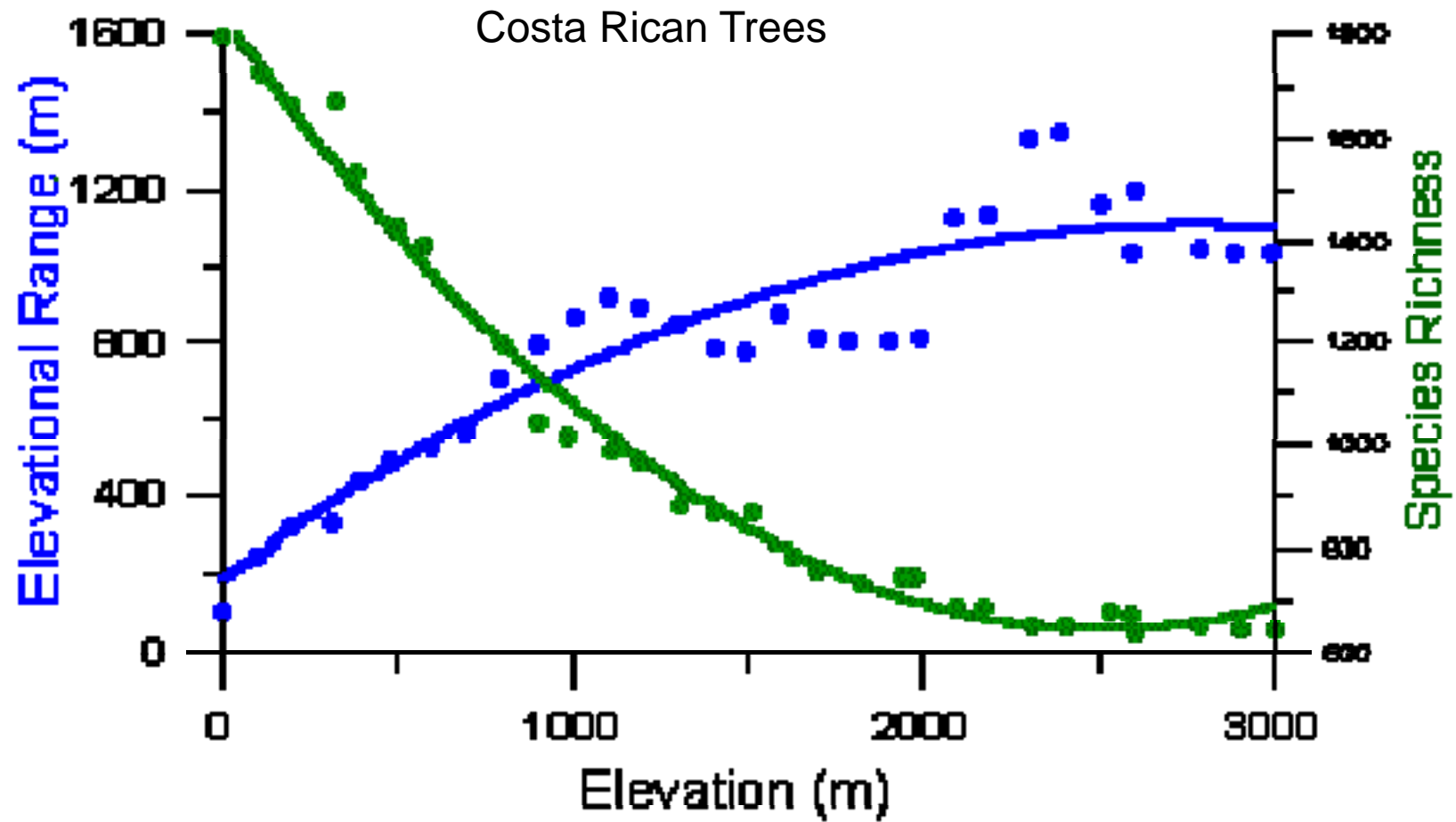
larger ranges in polar regions



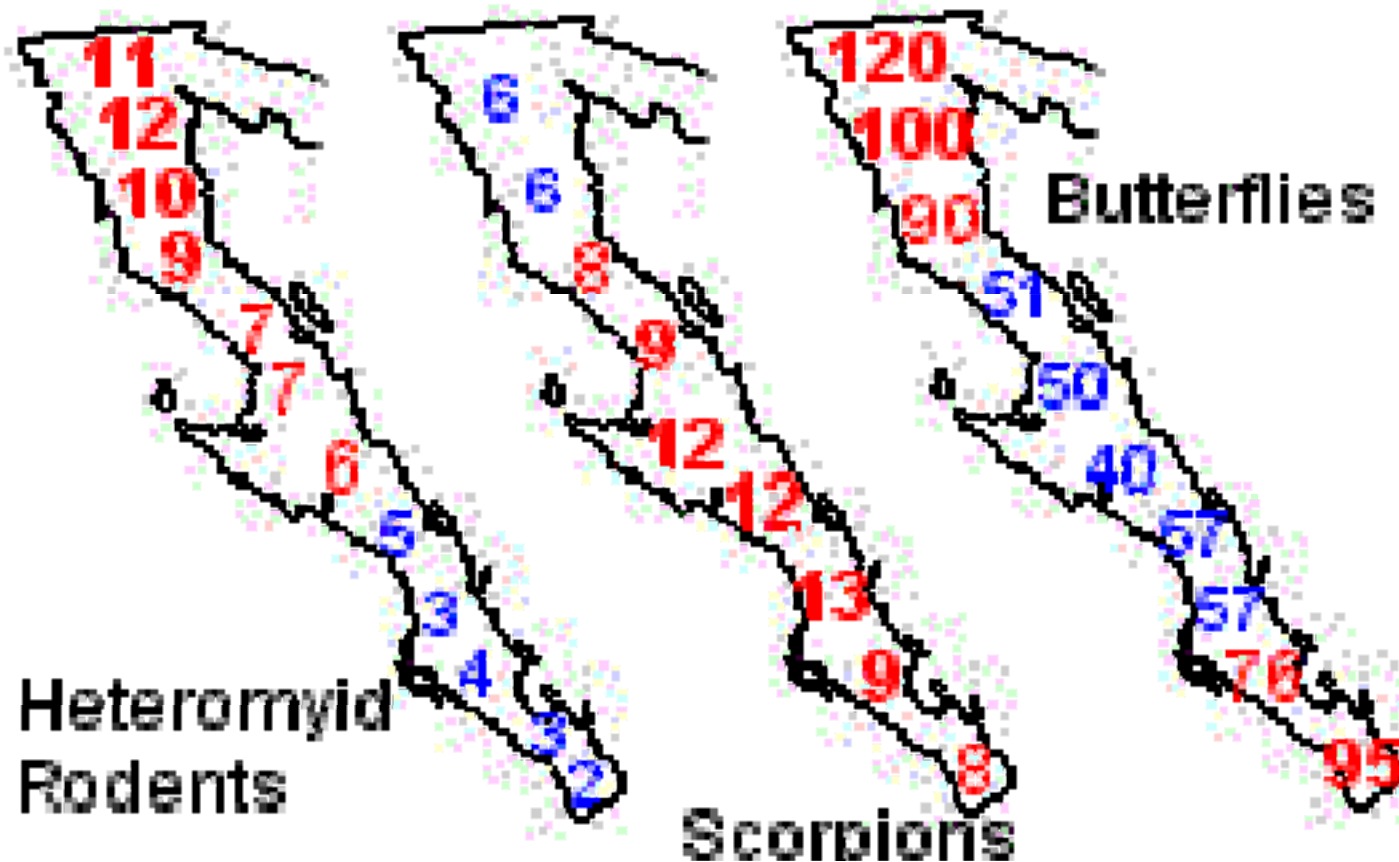
Pacific Coast Mollusks



# Rapoport's Rule - Elevational effect



## Other Diversity Patterns: PENINSULA

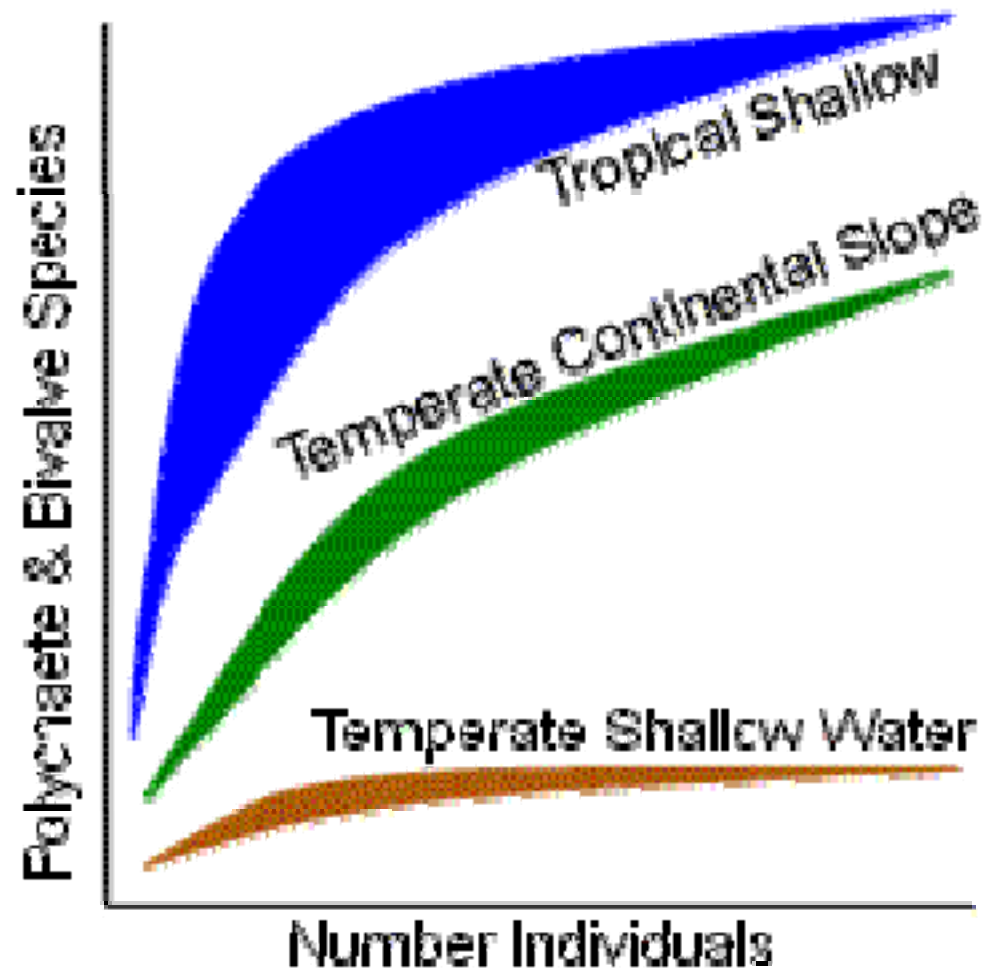


Peninsulas: *typically* diversity decreases toward end of peninsula

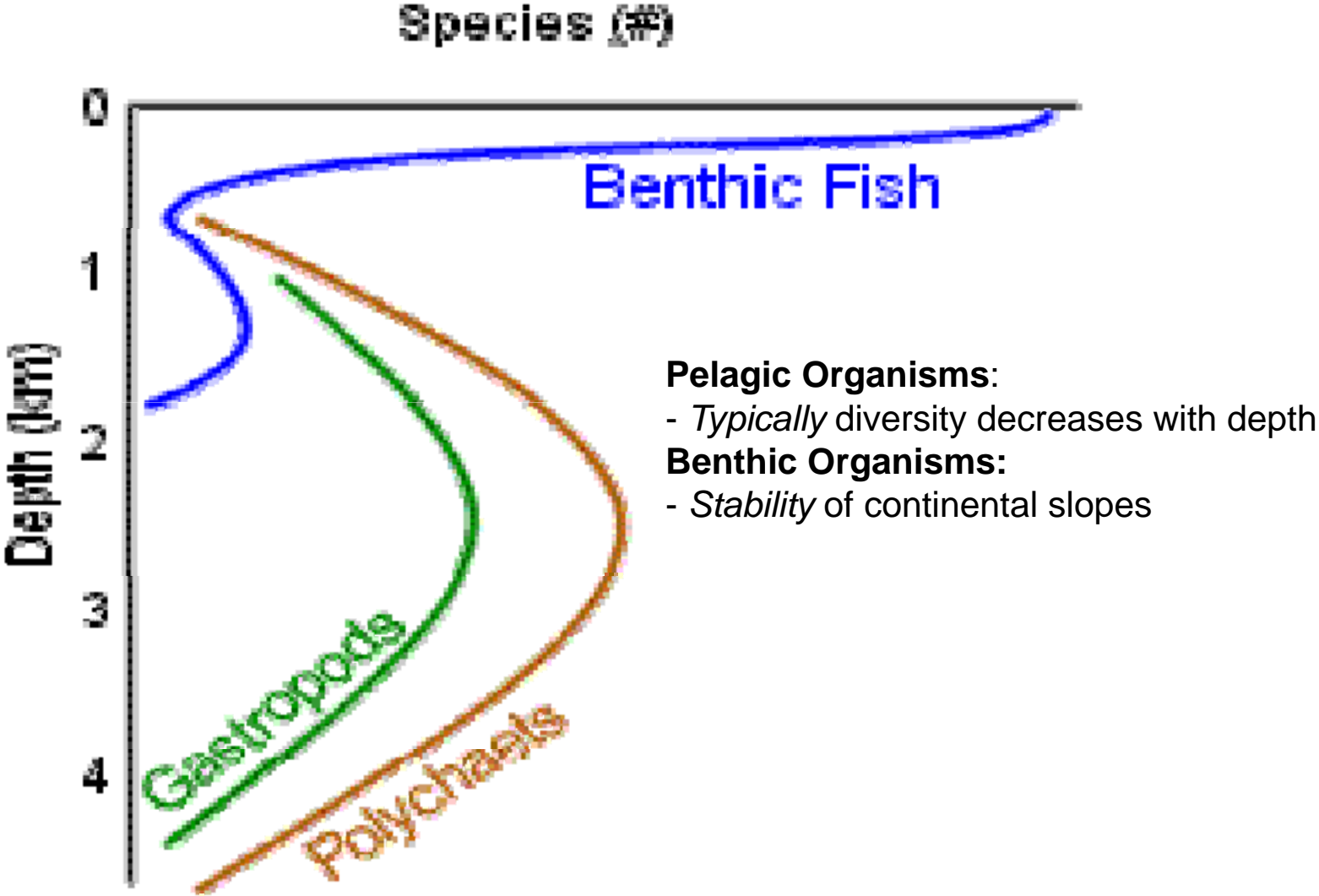
# Aquatic Diversity Patterns

Aquatic Environments:

- *typically* diversity increases with productivity
- polluted freshwater habitats are exceptions



# Aquatic Diversity Patterns



# Tropical Diversity Maximum: Why?

- Biotic Explanations: change in richness depends on change in the interactions between organisms as one changes latitude
- Abiotic Explanations: looks for relationship between individuals and abiotic characteristics of environment for explanation of latitudinal gradient

# Tropical Diversity Maximum: Biotic Explanation

- Spatial Heterogeneity Theory
  - More plants in tropics mean more places for insects and vertebrates to live
- Competition Theory
  - As we go north, abiotic conditions become more stressful and species are r-selected
  - In the tropics, species are K-selected and compete more
  - Competition reduces niche breadth for each species so that resources support more species.



# Tropical Diversity Maximum: Biotic Explanation

- **Predation Theory**
  - The number of predators and parasites increases in low latitudes
  - Predators can prevent the competitive elimination of species by superior competitors if they depress the size of the population of the dominant competitor
- **Pollinators Theory**
  - The lack of sustained winds in the tropics increases the importance of animal pollination
  - Coevolution between pollinator and plant species leads to specialization

# Tropical Diversity Maximum: Abiotic Explanation

- Time Theory:
  - Time leads to the evolution of greater richness
  - The tropics have not been subject to glaciation and so have had a constant environment for longer than temperate and polar regions
- Productivity Theory
  - Greater productivity (by autotrophs) means more energy is available to support more species
  - Productivity is greater in tropical terrestrial systems in general (longer growing seasons)

# Tropical Diversity Maximum: Abiotic Explanation

- Area Theory
  - Large areas have more species than small areas
- Evolutionary Speed
  - Greater rate of evolution in lower latitudes due to increased temperature that lead to:
    - short generation times
    - higher mutation rates
    - higher selection pressures