

# Main Points

- 1) Recap from 8 November
- 2) Macroecology: two patterns
  - pattern 1: the abundant center rule
  - example: abundant centers and global conservation (Channell and Lomolino reading)
  - pattern 2: the abundance-occupancy relationship
- 3) Latitudinal gradients: three ideas
  - idea 1: Connell's hypothesis and geographic ranges
  - example: niche overlap in Lynx spp
  - idea 2: Janzen's hypothesis and mountain passes
  - idea 3: an ecological hypothesis for latitudinal gradients
  - example: latitudinal gradients in H. sapiens cultures

**Pre-Reading: Monday Nov 20 Smith et al 2010**

**Optional test #3 is Monday 4 December (was originally Wednesday 6 December)**

**Final is Monday 18 December in this room, 115pm-315pm. Final is cumulative.**

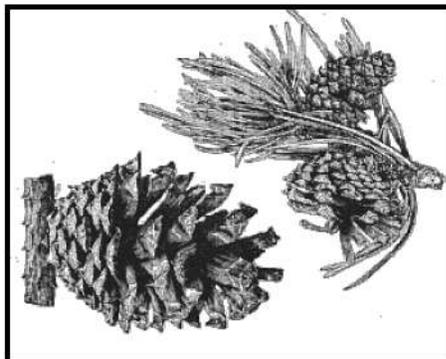
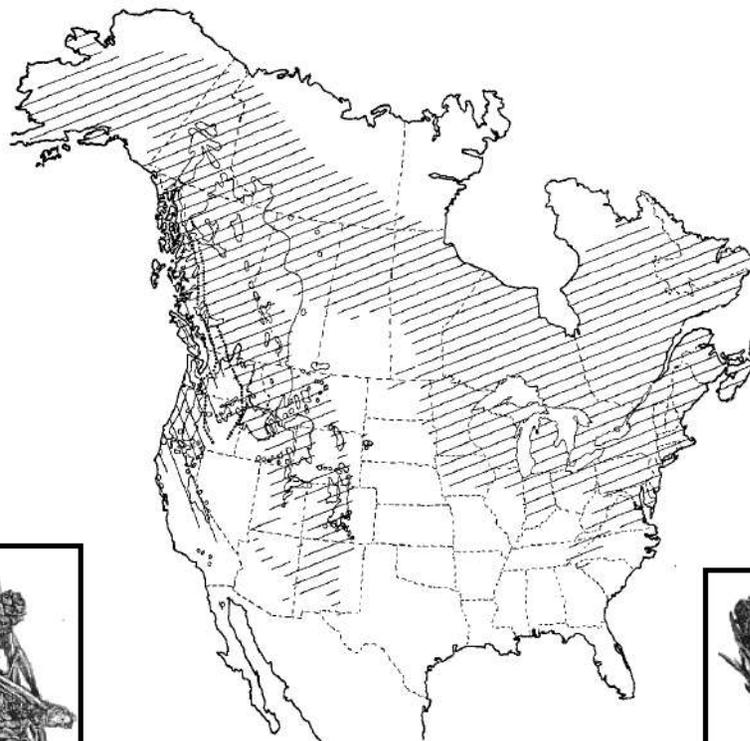
**Terms: macroecology, abundant center rule, spatial autocorrelation, rank-abundance distribution, Connell's hypothesis, Janzen's hypothesis, Rapoport's rule**

# Lab, Lab Final and Notes

- **Lab grade: there are 7 quizzes, not 8. The low will be dropped. Then the average of the remaining 6 will be used for the 7<sup>th</sup> quiz. This will result in a total of 140 points for the quizzes.**
- **Lab final is during your regularly-scheduled lab time (Monday 4 December or Wednesday 6 December).**
- **Open labs will be held the week of Nov 27 – Dec 1 (TBA)**
- **Attend as many or as few of these as you want.**
- **Format:**
  - 80 pts = 40 stations worth 2 pts each.**
  - you will be given a sheet with the scientific name of every mammal you have seen in lab, plus many others.**
  - this sheet will not contain common names, nor names of higher taxonomic groups (orders, families, subfamilies).**
  - the test will cover everything you've learned in lab.**

Lecture 16 recap: the Red Queen hypothesis states that continued evolution is needed to stay a “step ahead” of predators and competitors (or prey). This can lead to evolutionary arms races and coevolution. We discussed an example of coevolution in parapatric squirrels in the genus Tamiasciurus.

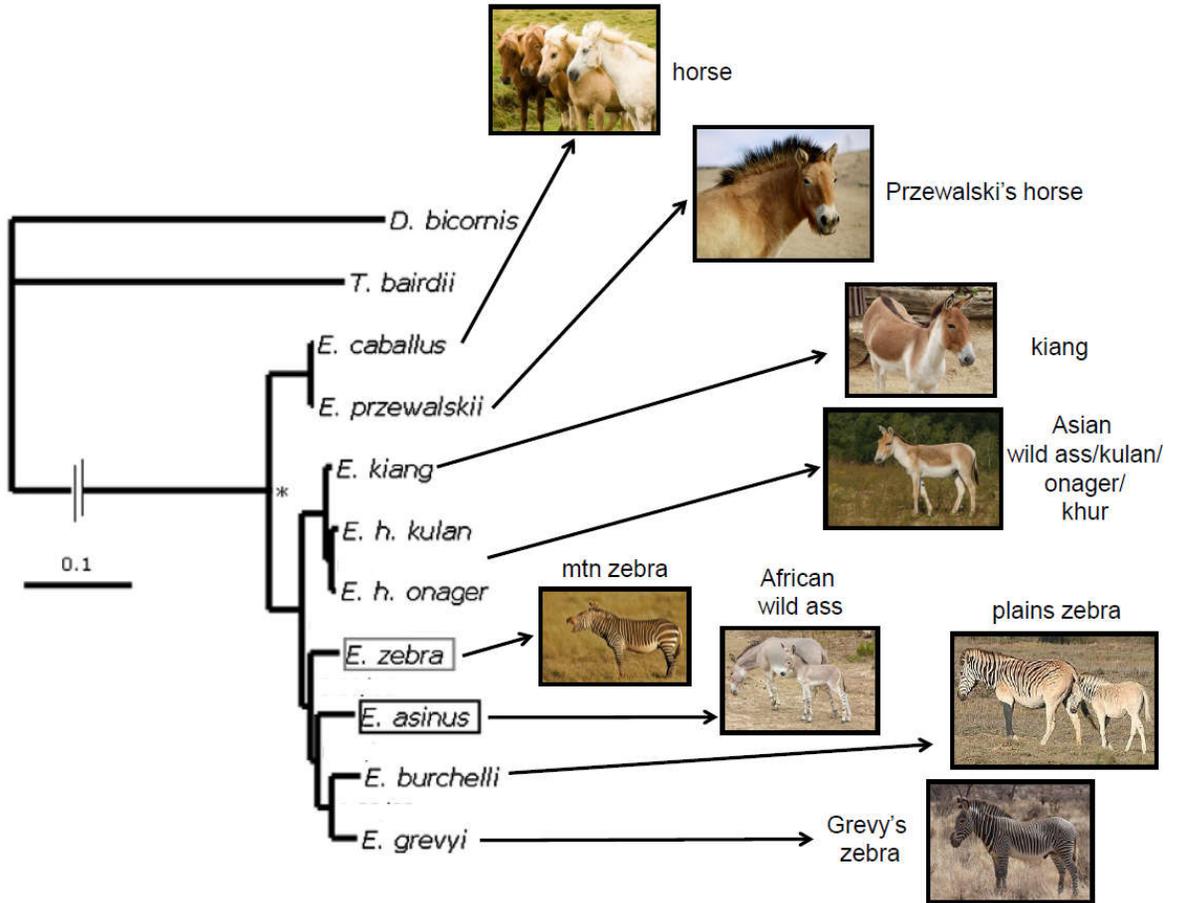
## Coevolution and parapatry



/// Tamiasciurus hudsonicus  
||| Tamiasciurus douglasii  
🌲 Pinus contorta

**Lecture 16 recap: we discussed phylogenetic inertia, the tendency for non-adaptive traits to persist, just because they have been inherited through evolutionary time.**

22,000 years ago  
France



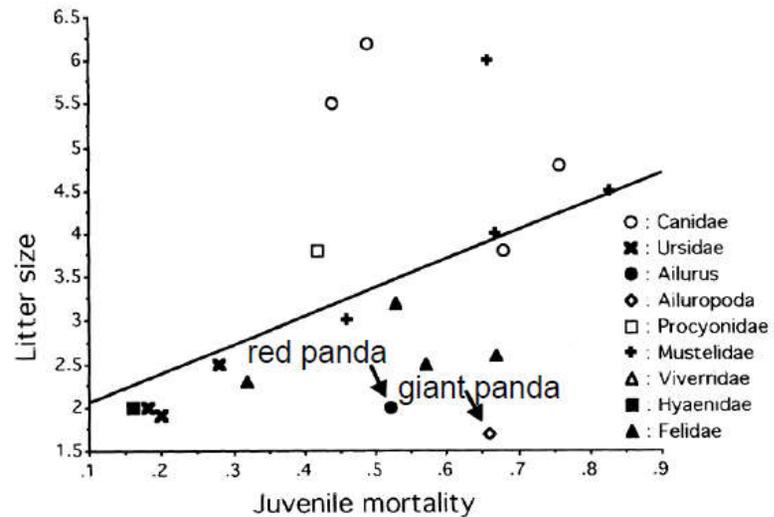
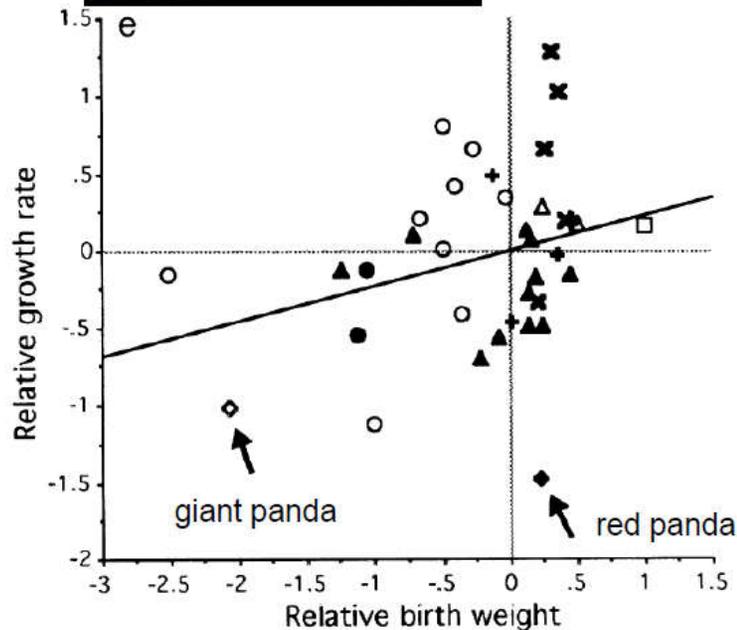
Lecture 16 recap: in extreme instances, this can lead to disaptation, in which traits or behaviors that evolved to confer a benefit (or at least didn't come at a cost when they evolved) now come at cost because of differences in the current environment.

## An Evolutionary Failure

Ailurus



Ailuropoda



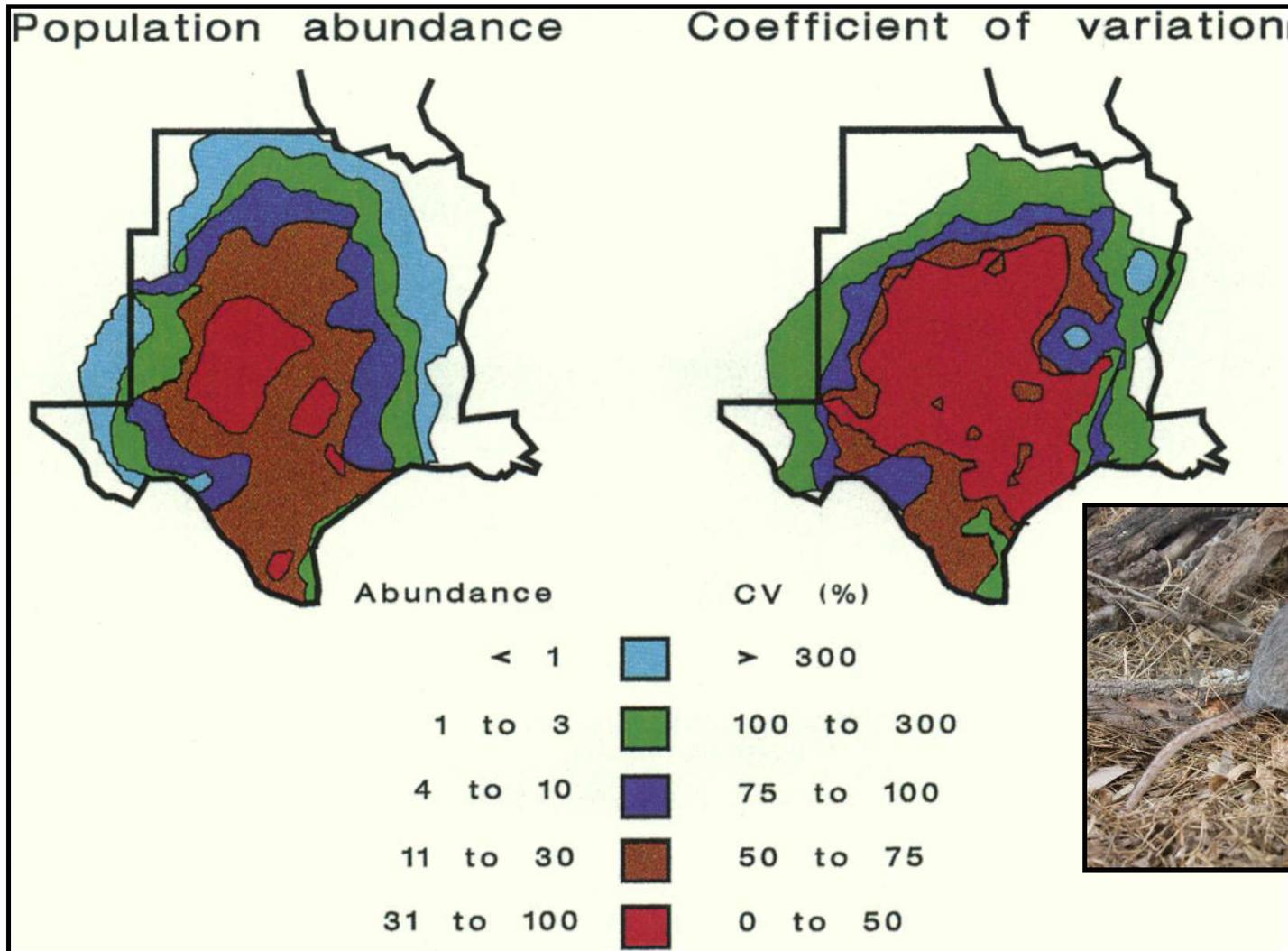
# Introduction to Macroecology

- **macroecology = way of studying relationships between organisms and their environment that involves characterizing and explaining patterns of abundance, distribution, and diversity**
- **usually conducted at large spatial and/or temporal scales**
- **focus on generality over precision**

# Macroecology—Abundant Center Rule

- **Abundance and distribution reflect the response of local populations to local conditions**
- **Abundance and distribution reflect the extent to which local environments meet requirements of species**
- **Environmental variables that affect abundance and distribution are spatially autocorrelated**

# Macroecology—Abundant Center Rule

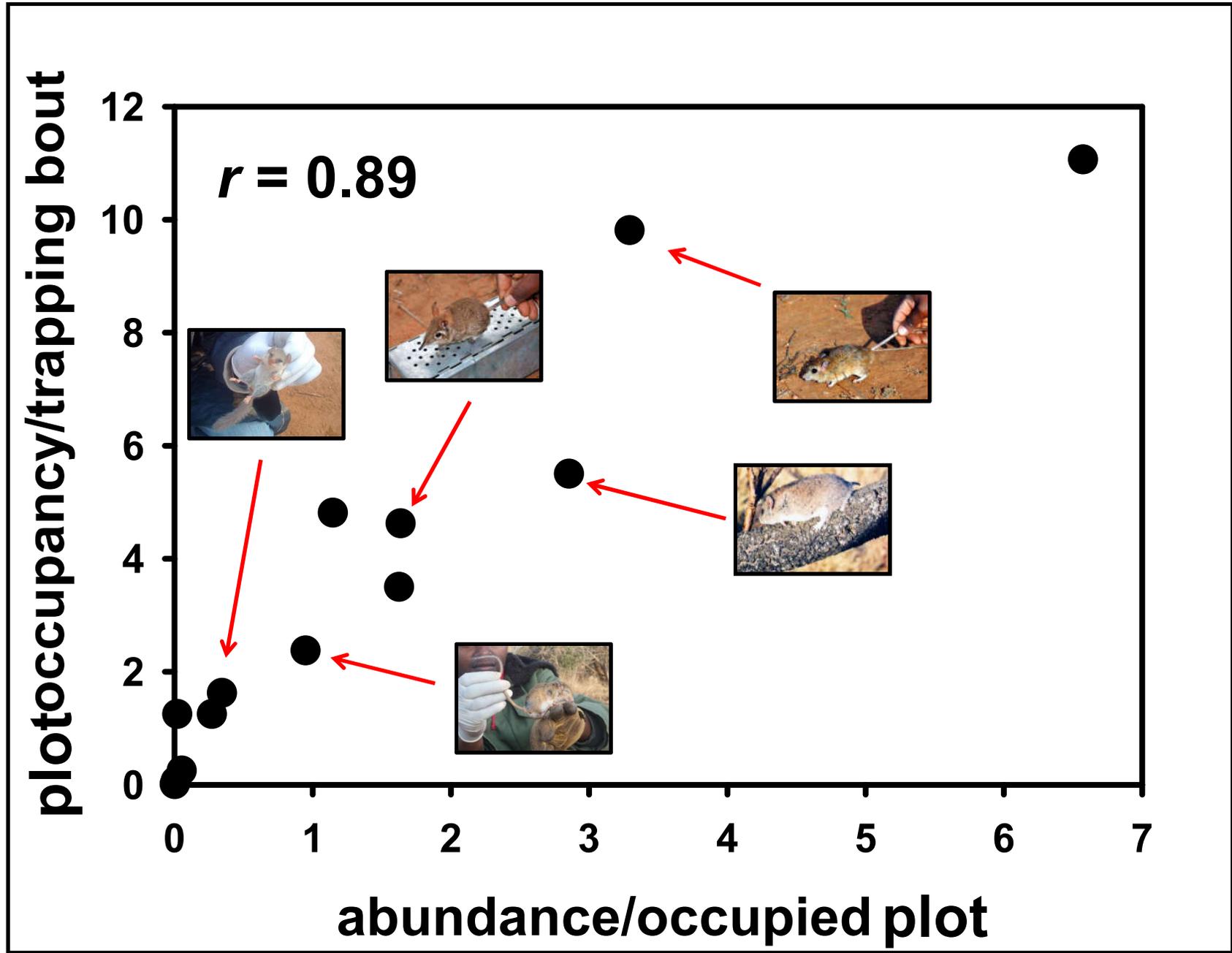


**Discussion question: Channell and Lomolino used the abundant center rule to come up with a hypothesis regarding global patterns of range collapse. What was their hypothesis? Was it supported? Why, or why not?**



## **Macroecology—positive Abundance-Distribution Relationship**

- **Most species have restricted distributions**
- **Species that are broadly distributed tend to be common within their distributions**
- **Species that are narrowly distributed tend to be rare within their distributions**



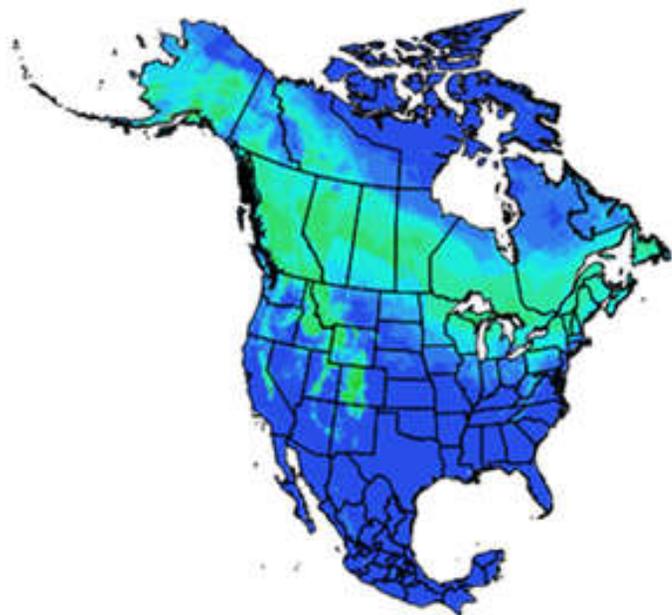
- **Connell's hypothesis = species interactions are limiting in benign conditions; abiotic factors are limiting in stressful conditions**



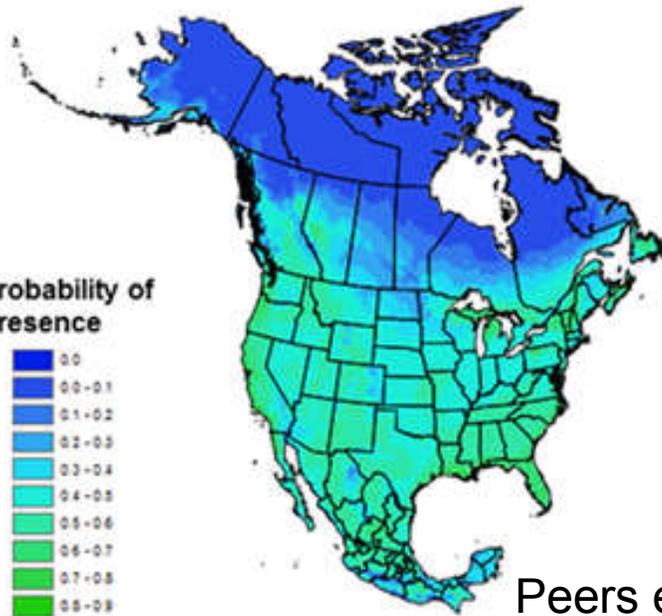
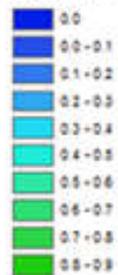
L. canadensis



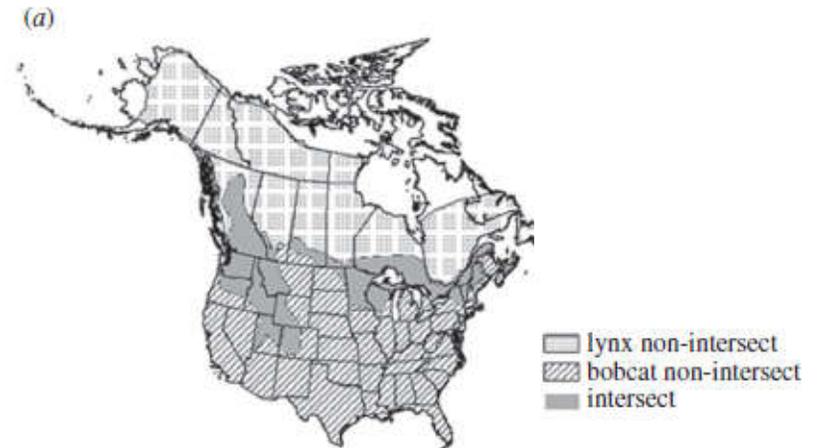
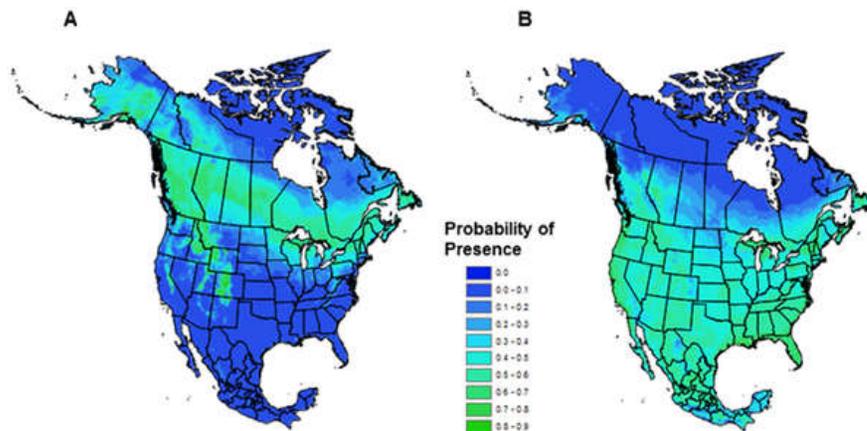
L. rufus



Probability of Presence



- **Connell's hypothesis** = species interactions are limiting in benign conditions; abiotic factors are limiting in stressful conditions



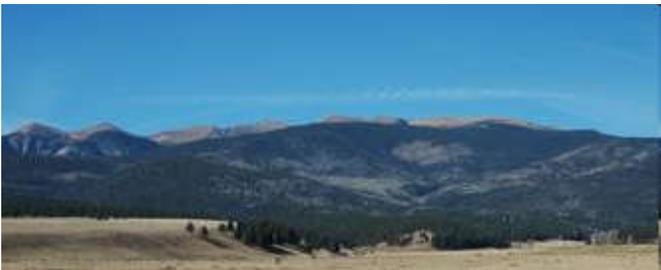
# Why mountain passes are higher in the tropics

1° latitude  $\simeq$  111 km

111 km (toward the poles)  $\simeq$  -1° C

220 m increase in elevation  $\simeq$  -1° C, so...

San Juan Mts, Colorado (June)



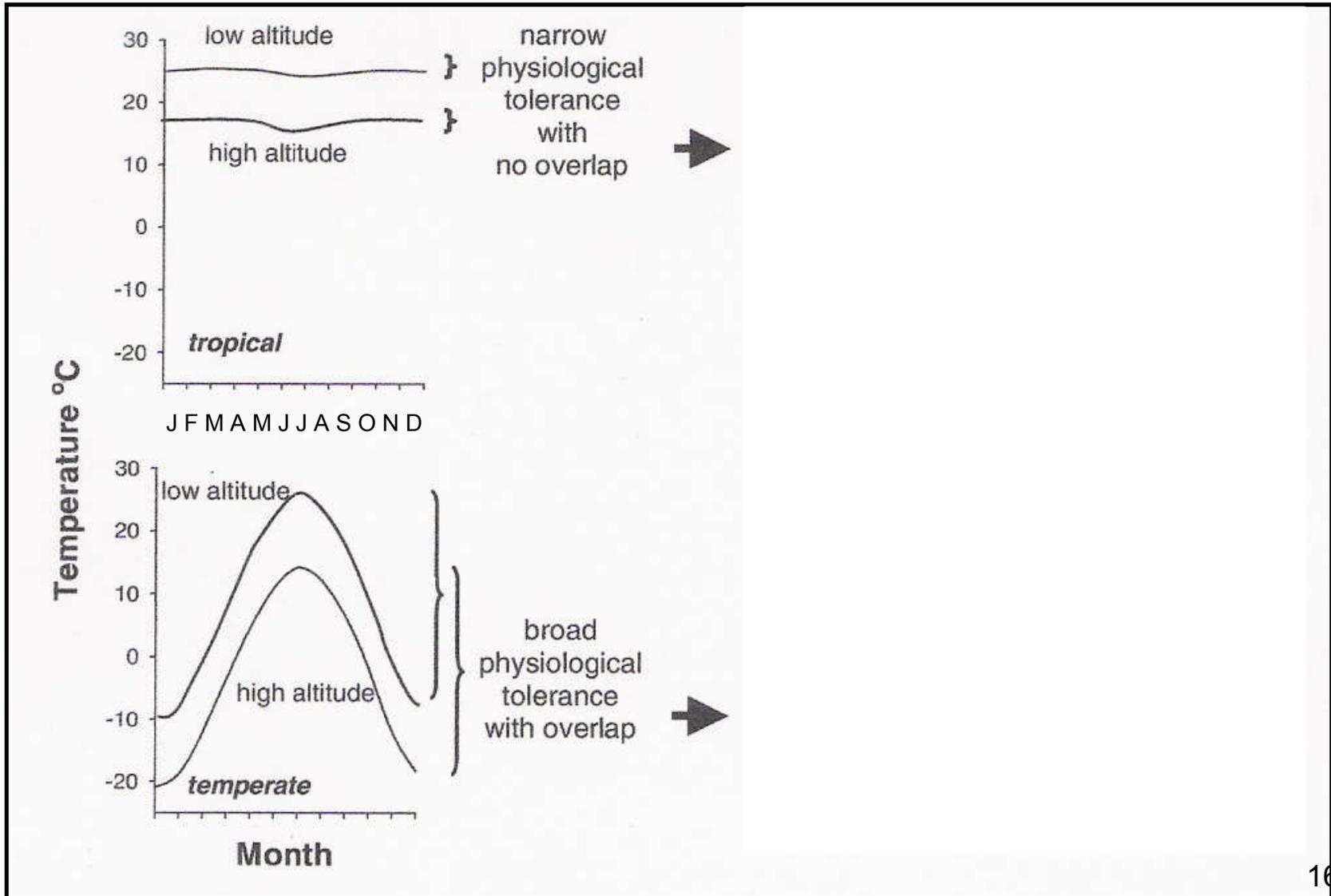
San Juan Mts, Colorado (Dec)



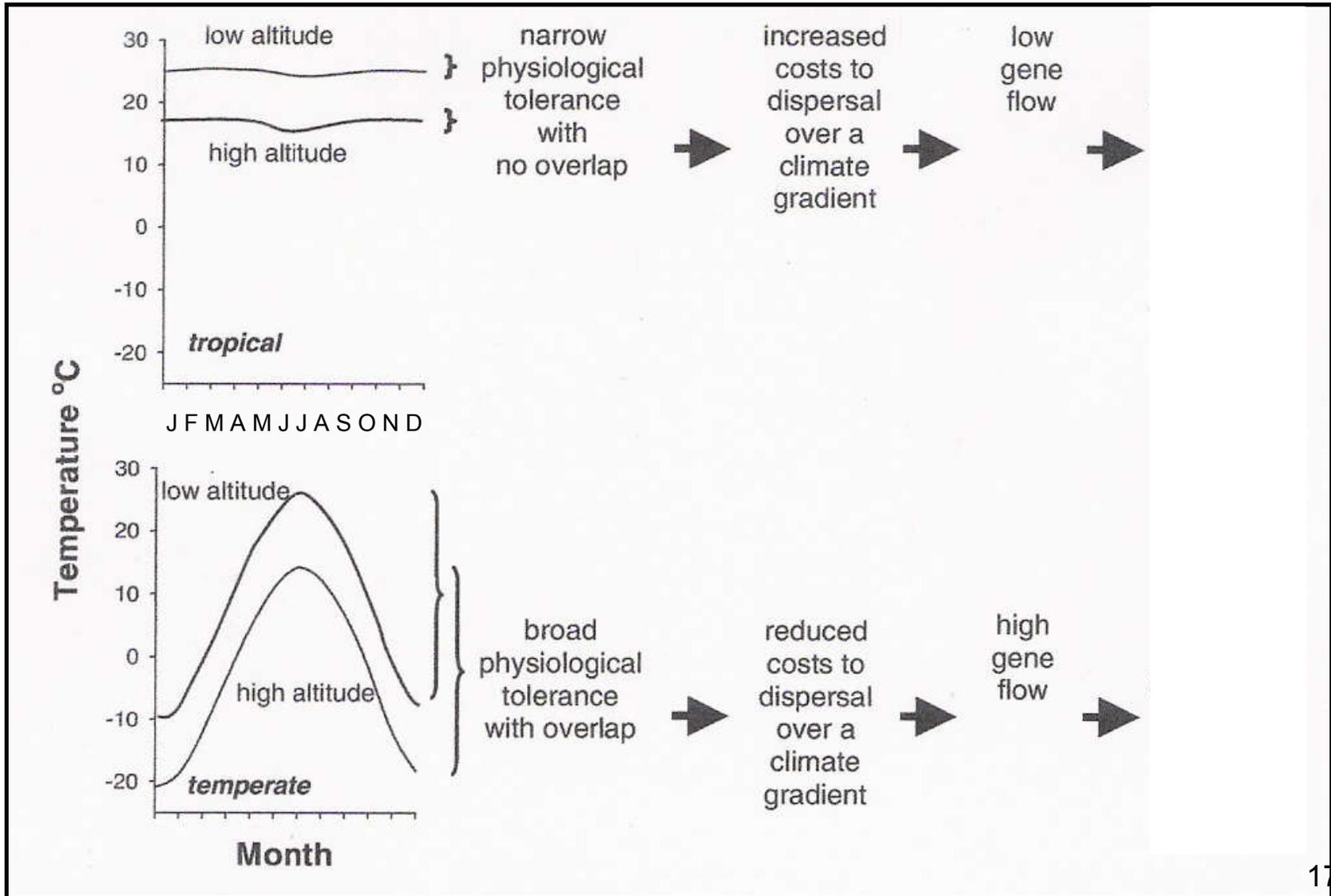
Tarrazu Quepos Mts  
Costa Rica (Dec)



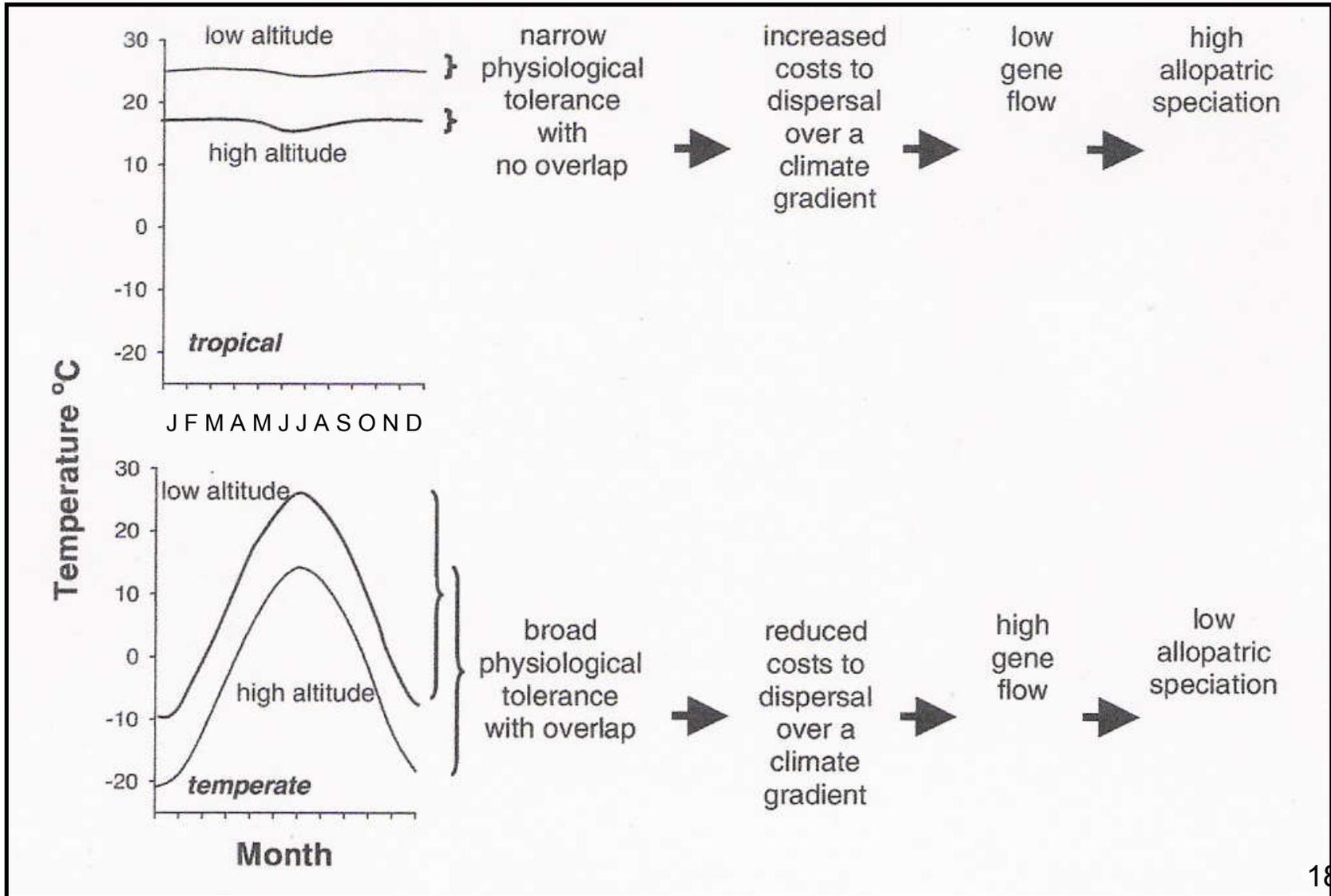
# Why mountain passes are higher in the tropics



# Why mountain passes are higher in the tropics



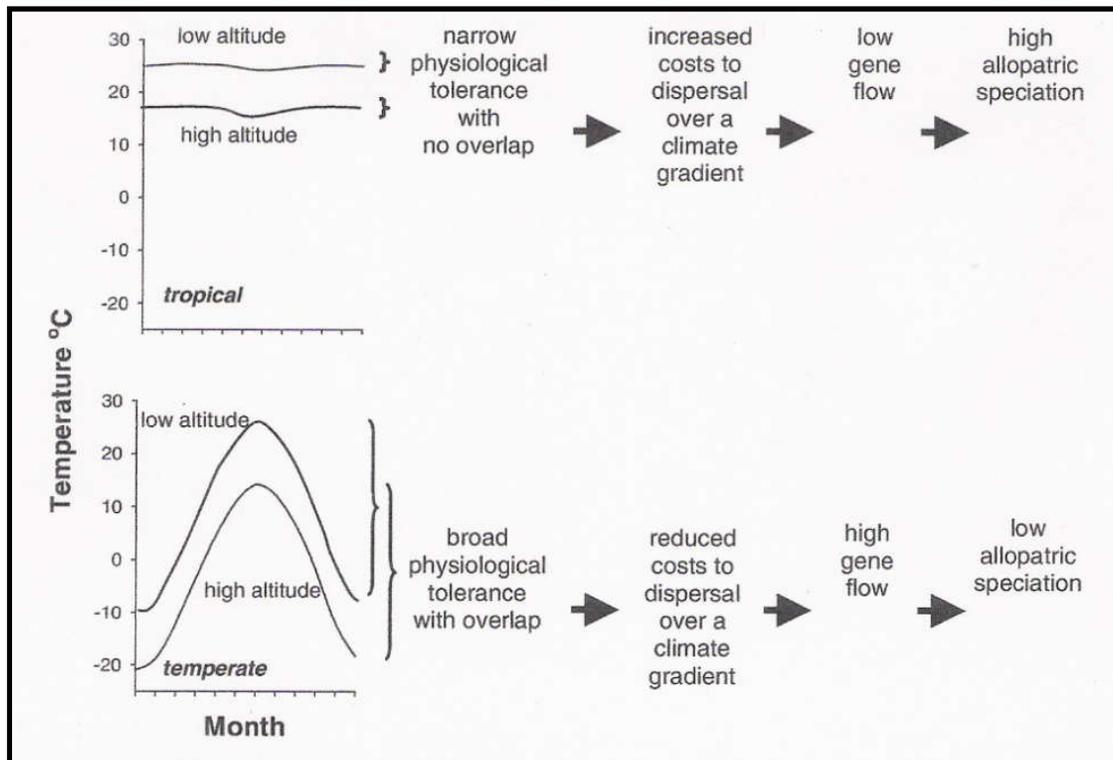
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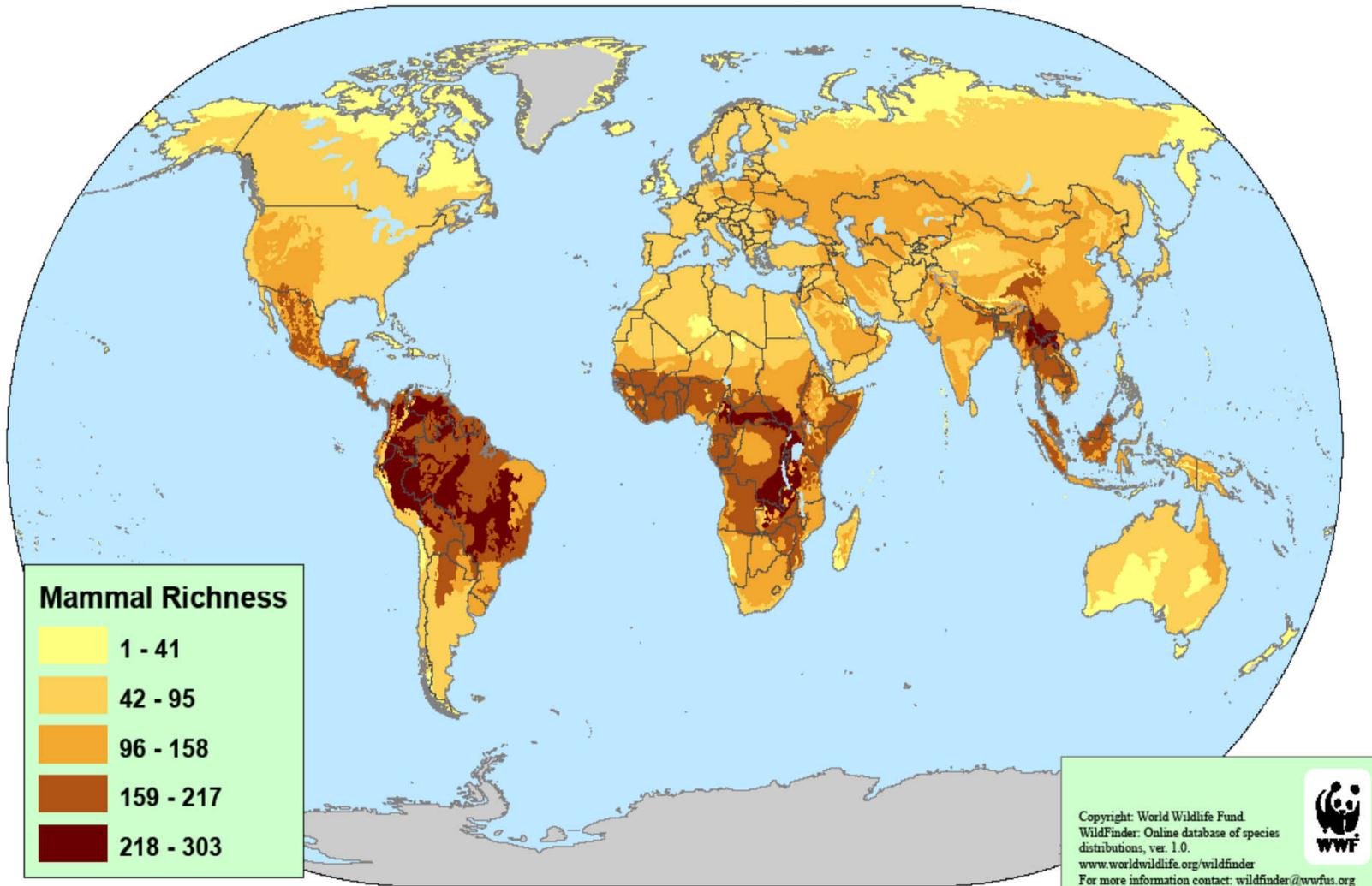
# Why mountain passes are higher in the tropics

**Janzen's hypothesis** = mountains in the tropics impose stronger barriers to dispersal and gene flow, and result in higher allopatric speciation.

What prediction follows from this?

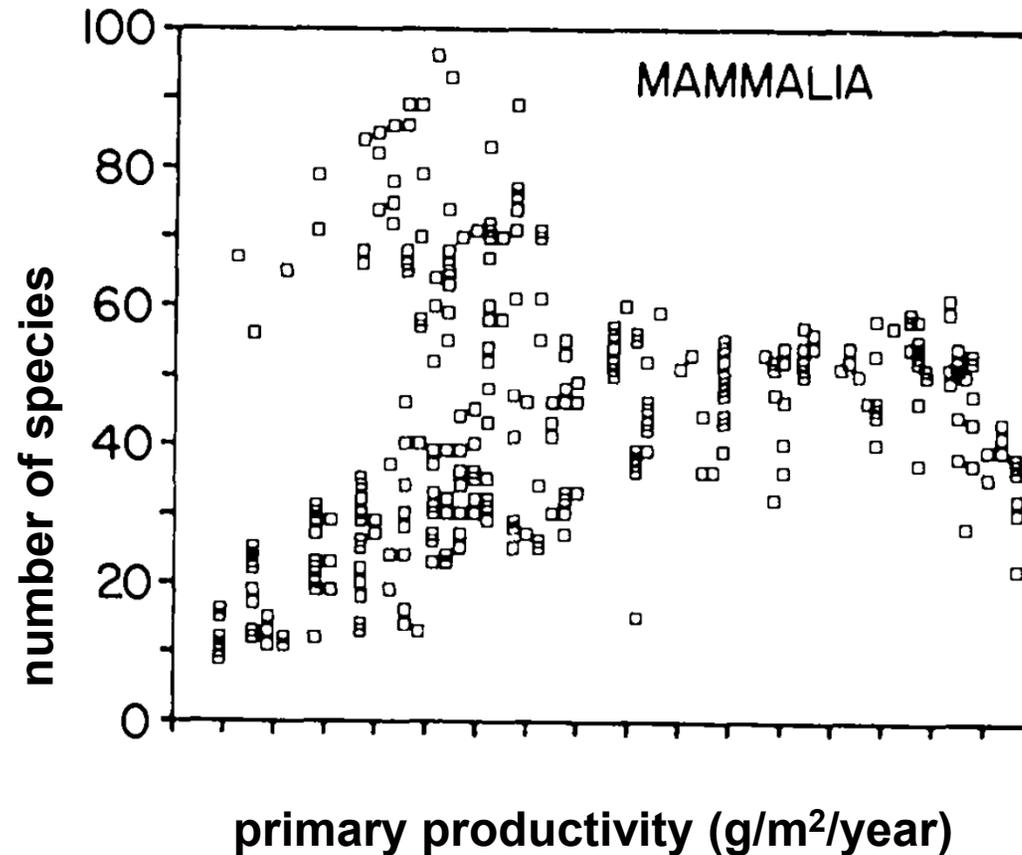


## Mammal Richness by Ecoregion



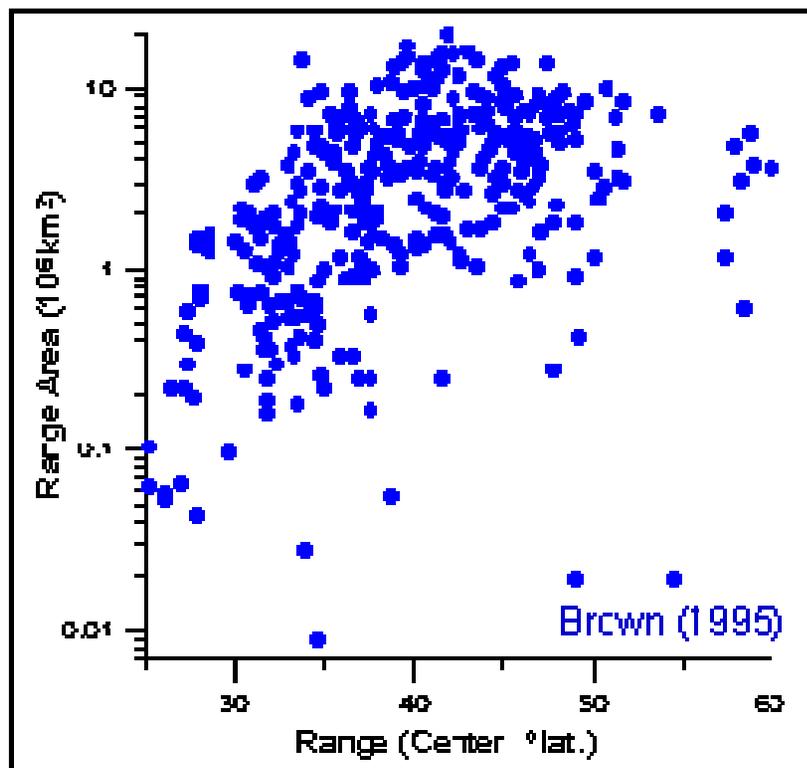
# Latitudinal Gradients: Ecological Hypotheses

- **Productivity (Resource Availability)**  
-- maybe more resources (or less variable resources) can support more species?

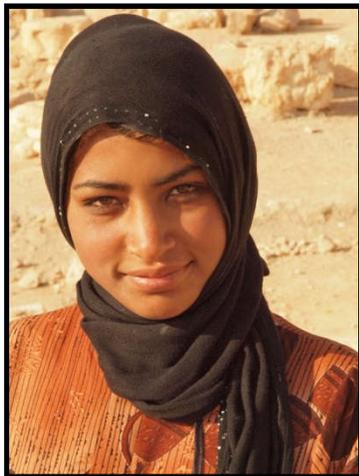
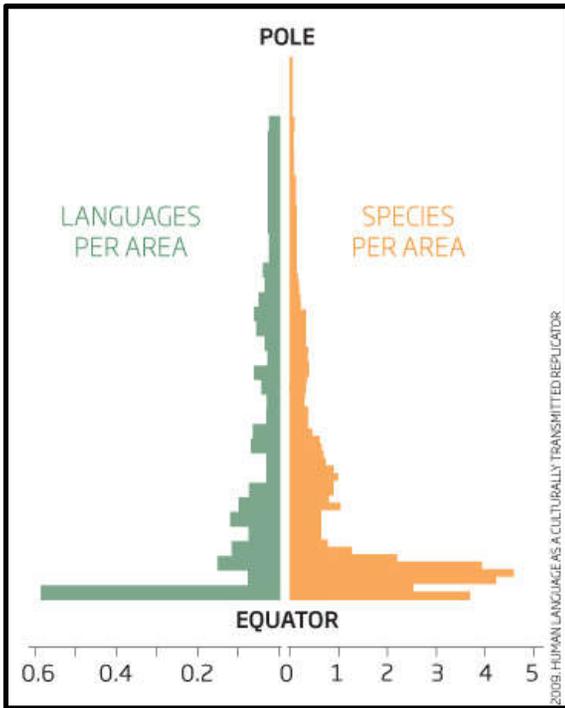


# Latitudinal Gradient in Species' Range Sizes

- **Rapoport's Rule** = tendency for geographic ranges to be smaller near the equator

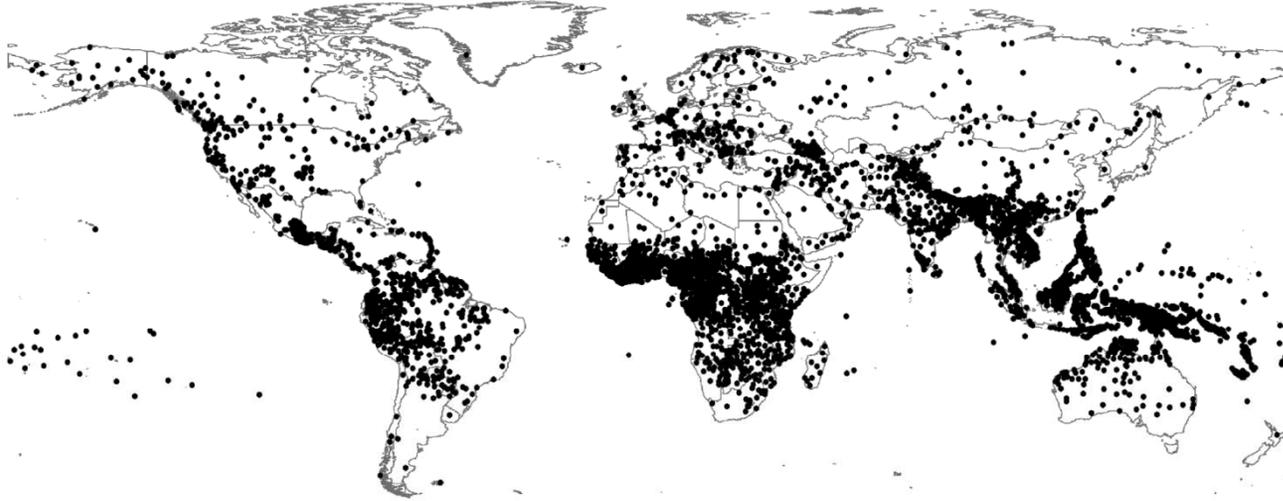


# Latitudinal gradient in third chimpanzee cultures

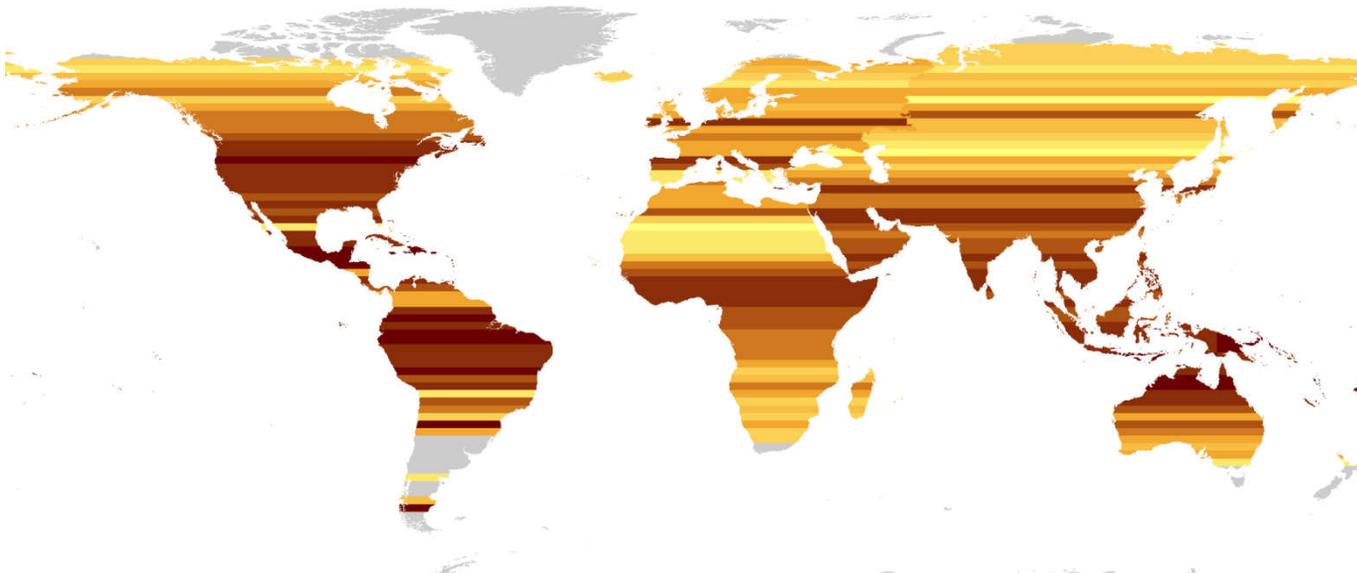


# Latitudinal gradient in third chimpanzee cultures

A



B



# Latitudinal Gradient in Cultural Extent

