

Introduction to Biogeography

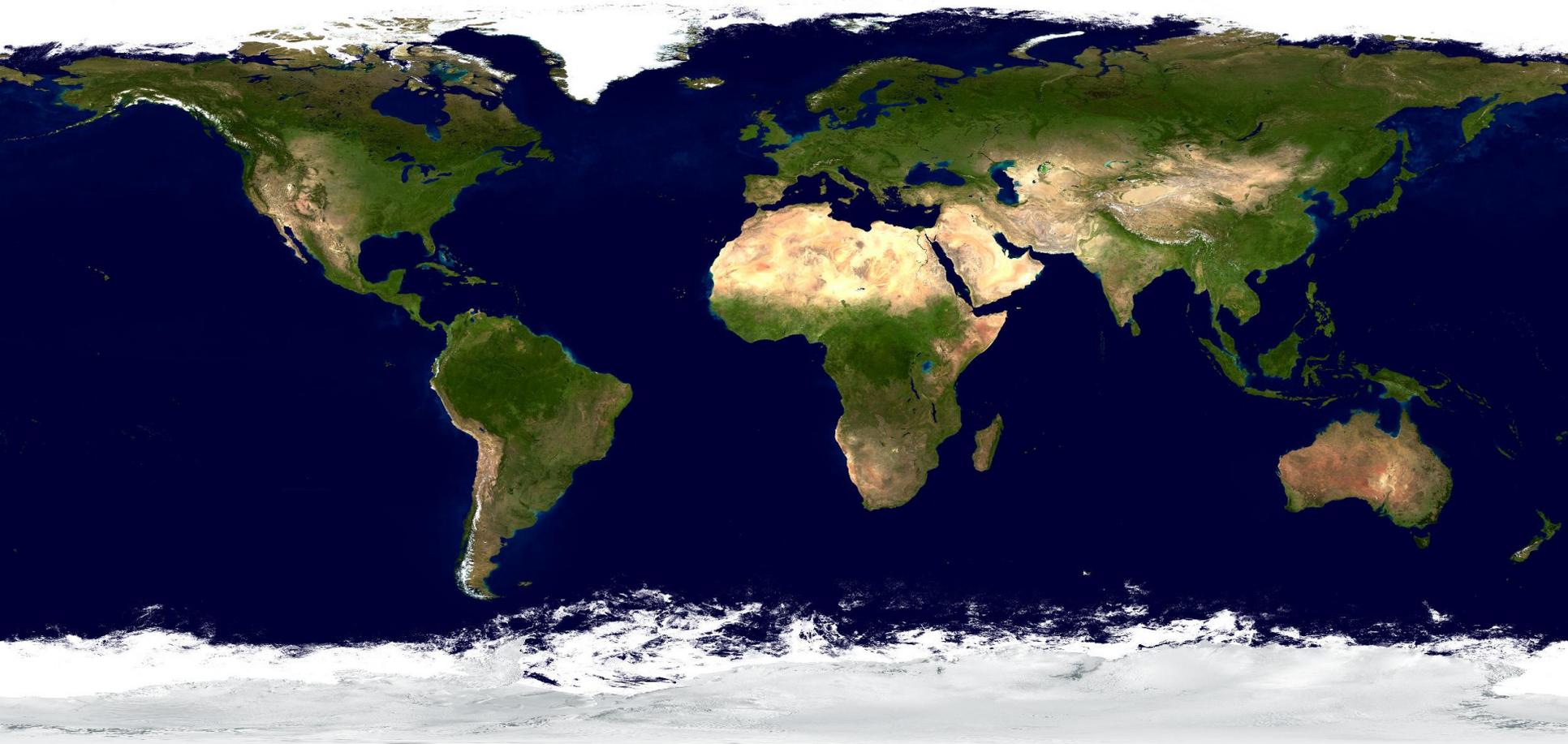


Image credit: www.oera.net/How2/PlanetTExs/EarthMap_2500x1250.jpg

Introduction to Biogeography

Biogeography: The study of the patterns and processes that influence the distribution of species and their characteristics or traits (in the past, present and future). Biogeography also looks at patterns of diversity (e.g., why do we find more species in South American than in North America?)

Biogeography is a broad discipline but has two main “branches”:

Ecological Biogeography: present distributions and geographic variation in diversity, how biotic and abiotic interactions influence species distributions

Historical Biogeography: reconstructing the origin, dispersal and extinction of species or taxonomic groups.

Introduction to Biogeography

Two branches of Biogeography:

1. Ecological Biogeography:

- contemporary processes
- recent past
- interactions between species (e.g., predation and competition)
- interactions with abiotic environment

2. Historical Biogeography:

- speciation and extinction
- continental drift
- glaciation
- evolutionary lineages

Many questions use a combination of ecological and historical hypotheses

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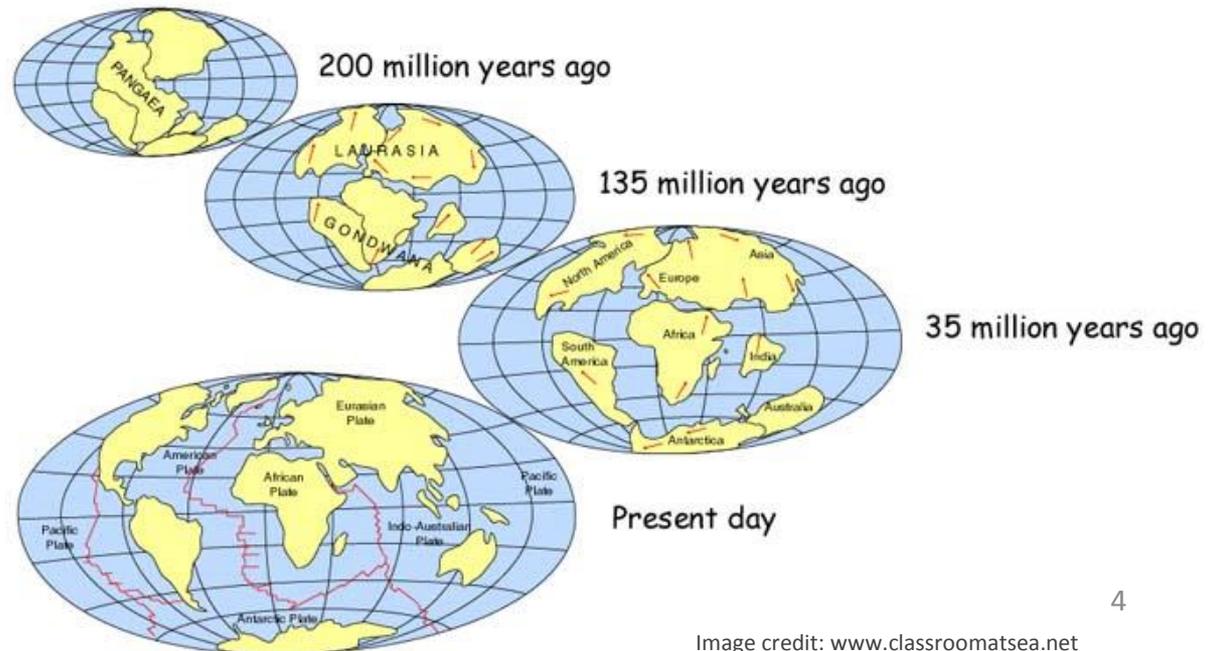
Some common questions in biogeography:

Why do different regions of the globe that are physically and environmentally similar have different species?

What limits species distributions? What prevents a species from colonizing other areas?

Why are the tropics so biologically diverse relative to higher latitude regions?

Where, when, and under what conditions have species originated?

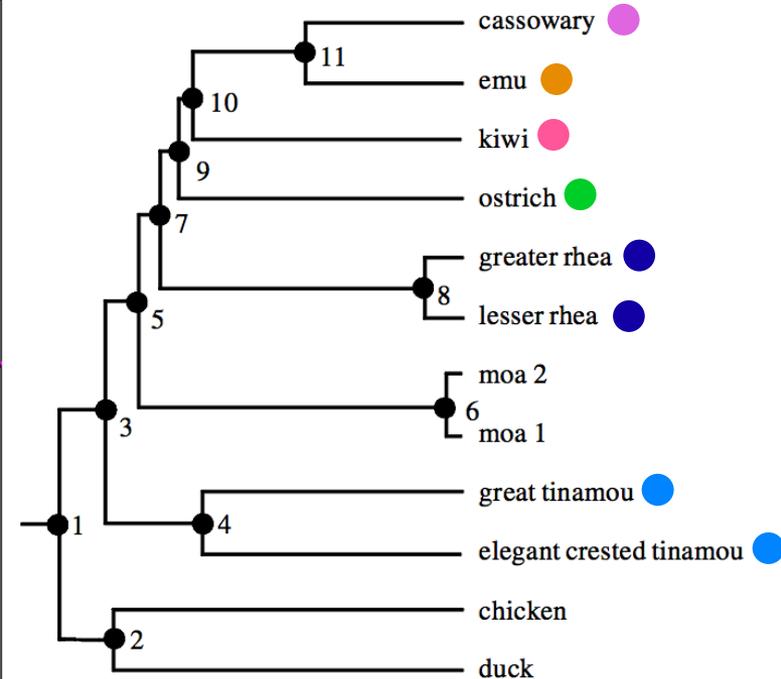
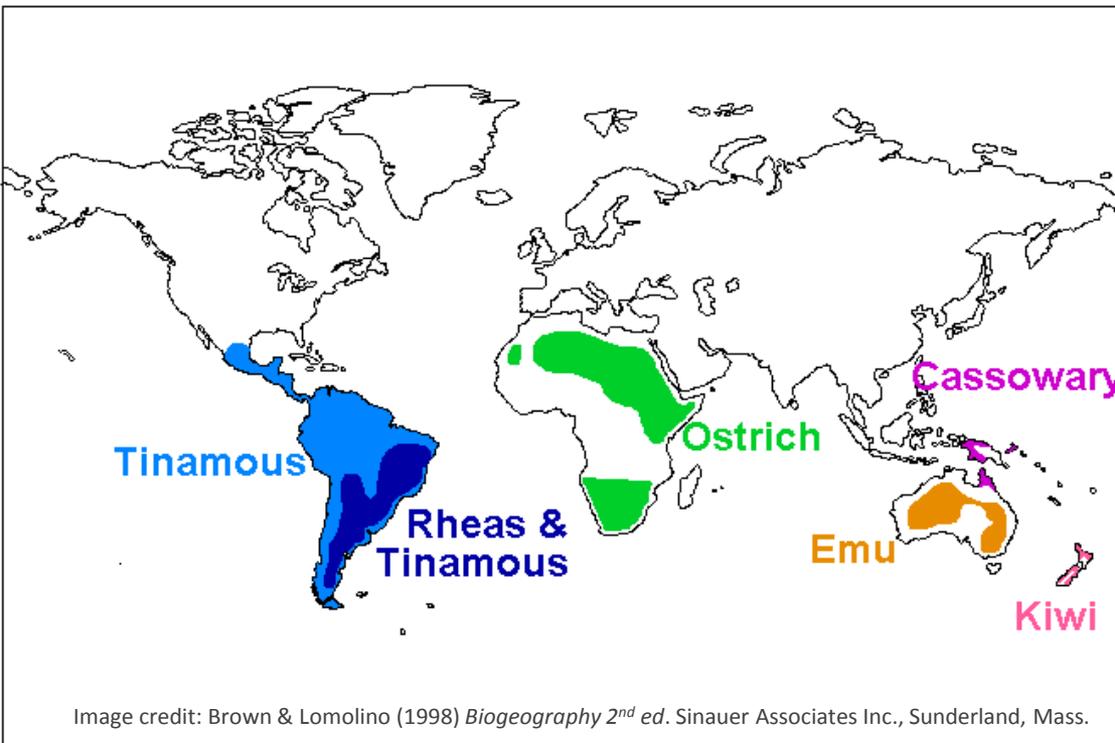


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Example questions in biogeography:

How did the *disjunct* distribution of flightless birds originate?

Why are flightless birds usually *endemic*?



Hadrath & Baker (2001) *Proc. R. Soc. Lond. B* 268: 939-945

Case study: Green sea turtles on Ascension Island



Photo credit: www.volunteer-conservation-thailand.org

Green sea turtle (*Chelonia mydas*)

Green sea turtles are found in tropical oceans throughout the world. Female turtles return to nest on the beaches where they were born (natal homing). Feeding grounds may be located thousands of kilometers from nesting beaches.

A nesting beach is located on Ascension Island on the mid-Atlantic ridge between South America and Africa.

Question: How did the turtles establish a colony on Ascension Island that is so isolated (about 2,000 km from Brazil)?

Case study: Green sea turtles on Ascension Island

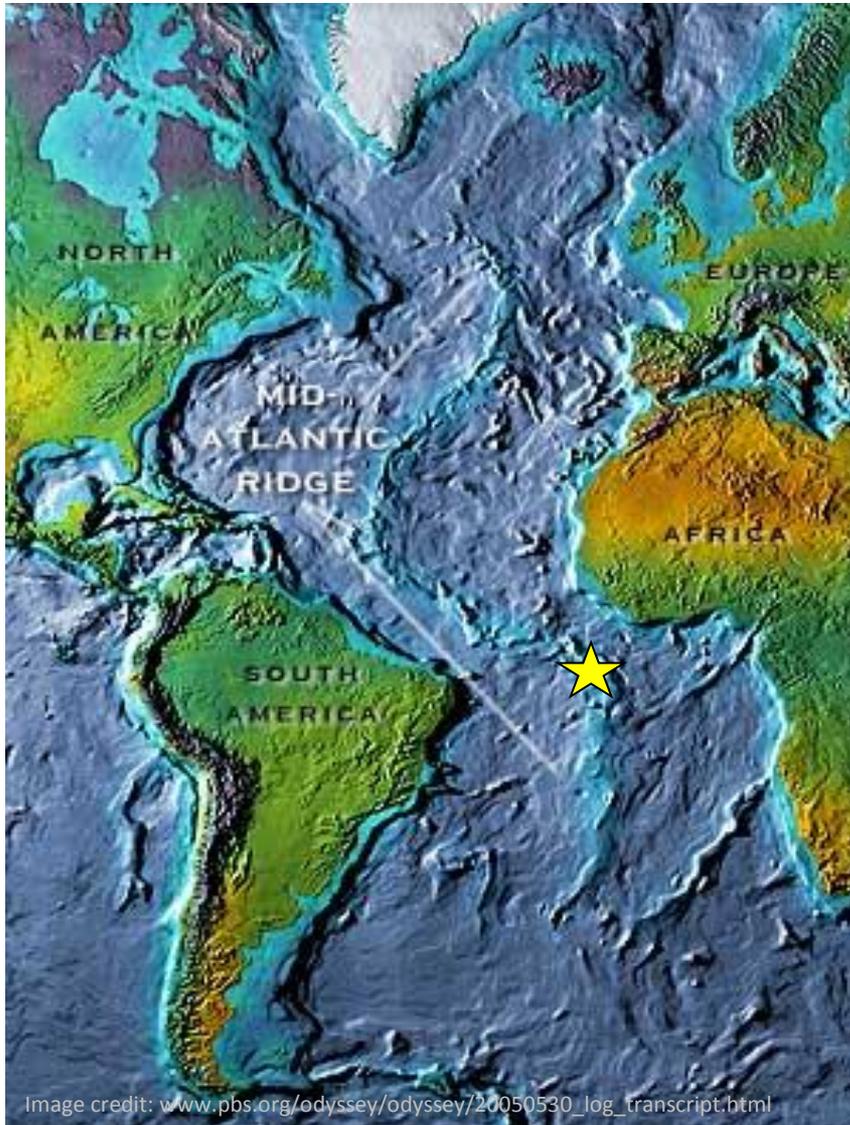


Image credit: www.pbs.org/odyssey/odyssey/20050530_log_transcript.html

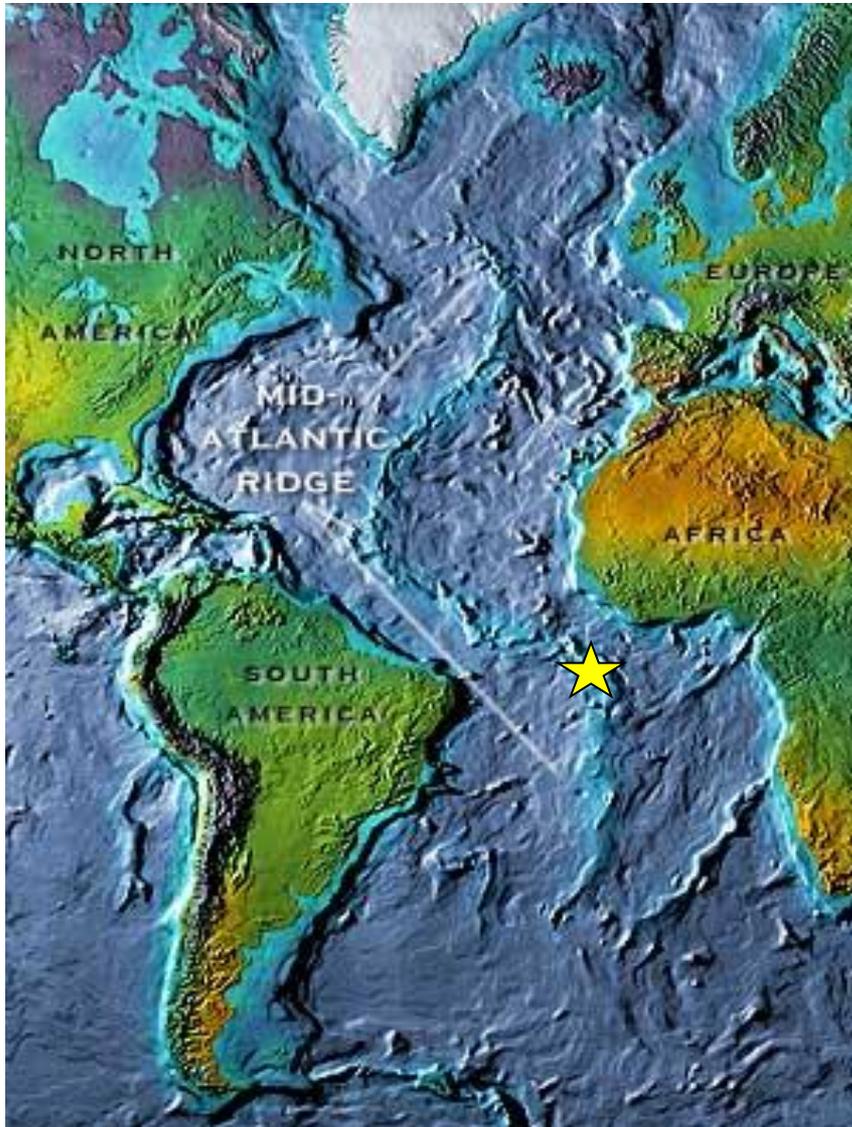
Dispersal hypothesis:

They arrived relatively recently. Some females “strayed” from their natal beach, found Ascension Island, and established a nesting beach.

Vicariance hypothesis:

They arrived a long time ago. Ancestors of Ascension Island turtles nested on beaches of islands adjacent to S.A. coast throughout the late Cretaceous (135-65 mya). Over the last 70 my, these islands have been displaced by *sea-floor spreading* (2 cm/year).

Case study: Green sea turtles on Ascension Island



How can biogeography provide a test to distinguish these hypotheses?

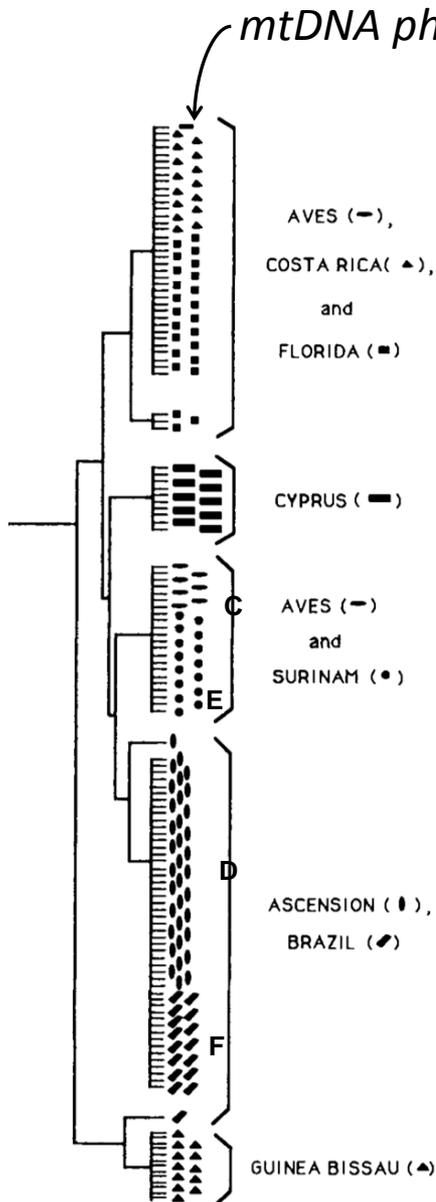
Dispersal and *vicariance* hypotheses are part of an age-old divide in biogeographic inference.

What predictions do the two hypotheses make that can be used to distinguish between them by collecting data?

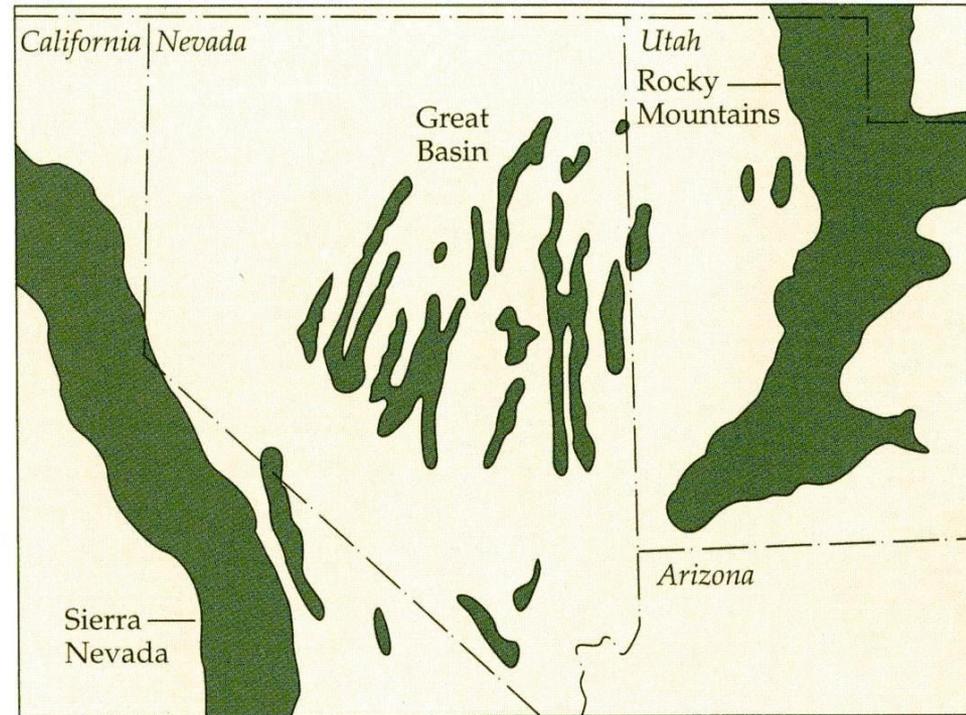
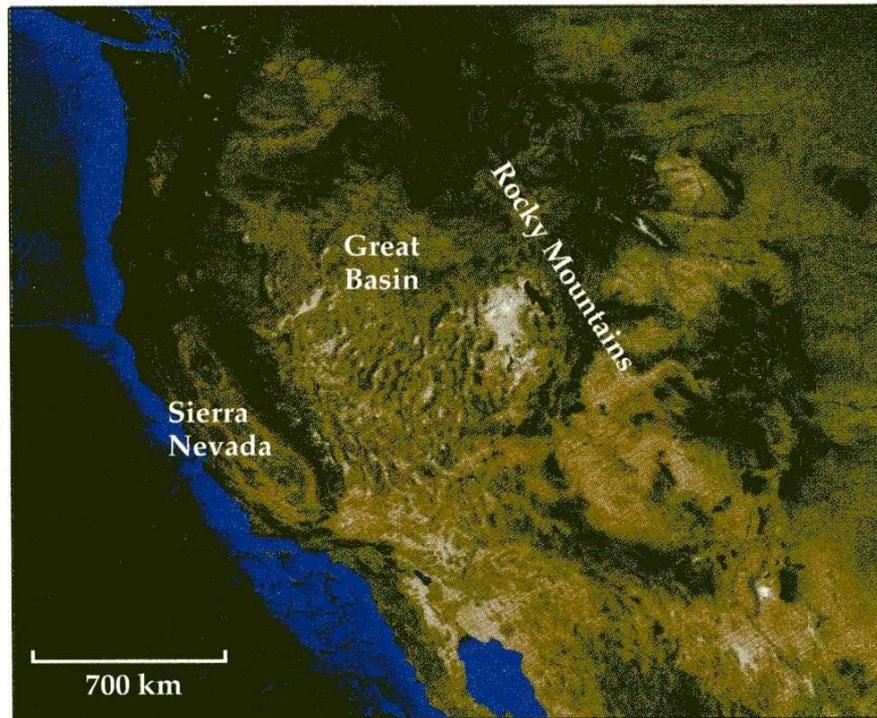
Case study: Green sea turtles on Ascension Island

Turtles from Ascension island nesting colony are genetically identical to turtles from the Brazilian nesting colony.

Green turtles must have dispersed to Ascension Island from Brazil very recently (e.g., within the last 10,000 years)



Case study: Mammal and Bird Diversity in the Great Basin Mountains



North American Great Basin. The image on the right shows areas of forest habitat higher than 2300 m elevation.

(Lomolino *et al.* 2010)

Case study: Mammal and Bird Diversity in the Great Basin Mountains

Several mammal and bird species are restricted to mountain forest habitats.

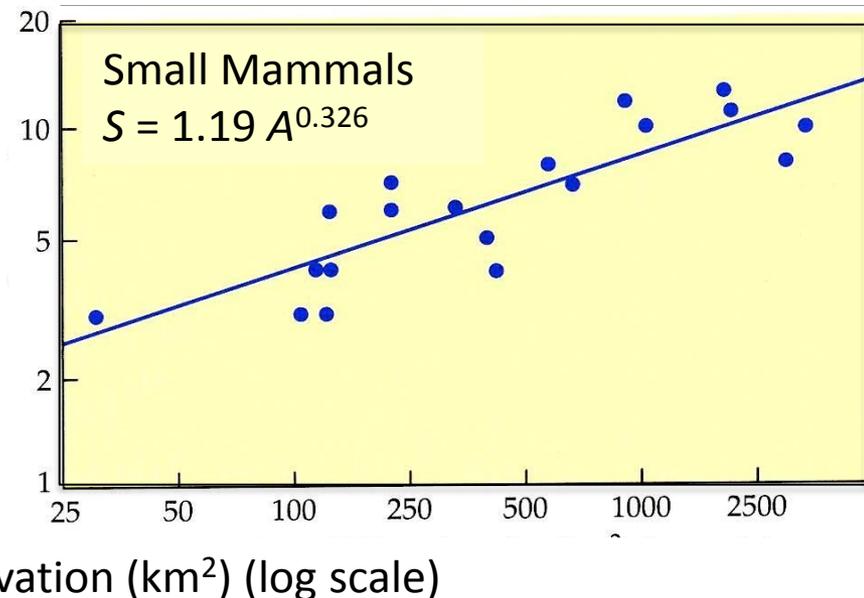
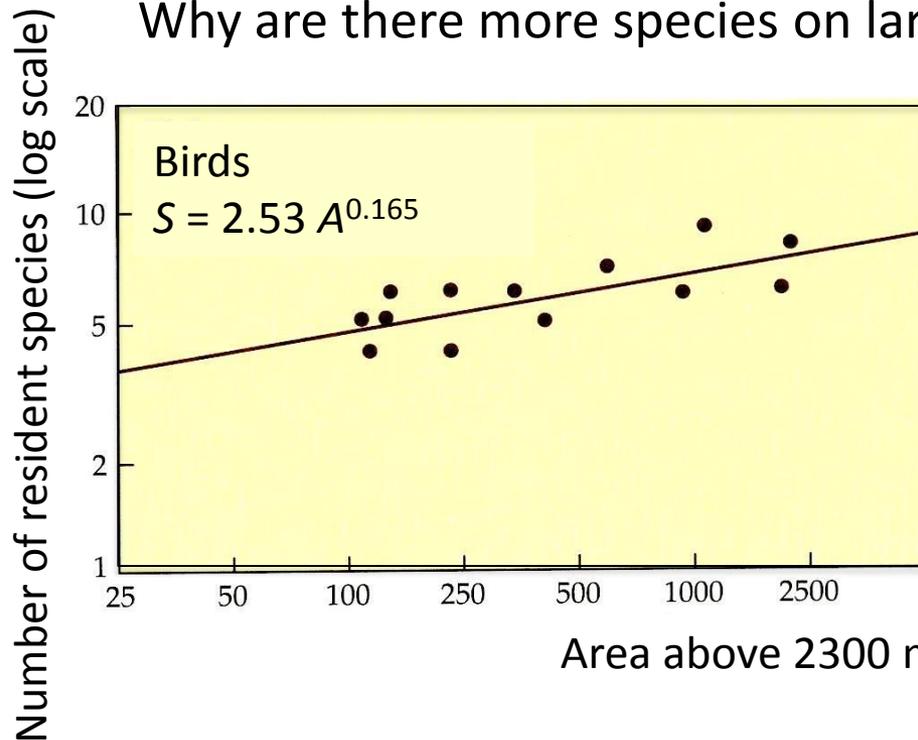


Case study: Mammal and Bird Diversity in the Great Basin Mountains

How does species richness change with area of forest habitat?

Species-area relationship: $S = c A^z$ where S = number of species, A is habitat area and z is the slope of the species - area relationship (log - log space).

Why are there more species on larger “islands” of forest habitat?



Please answer the following questions to the best of your ability:

- 1) Who is Alfred Russel Wallace?
- 2) What is it about the Earth that gives our planet seasons?
- 3) What does the theory of island biogeography help us to predict?
- 4) Draw a phylogeny for 5 species (A-E), so that A-C belong to a single monophyletic clade and E is the most basal lineage.