Biogeography

Introduction to Evolution and Scientific Inquiry

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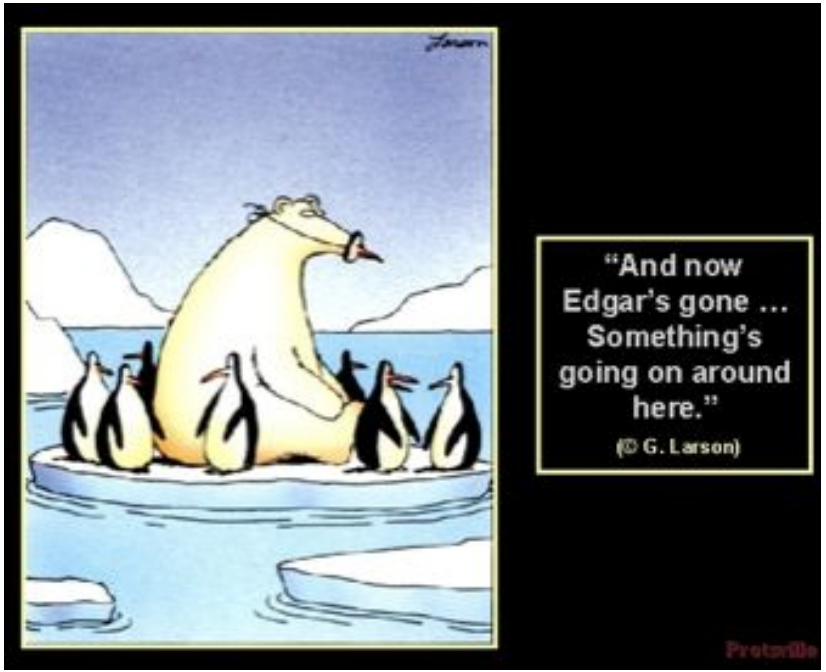
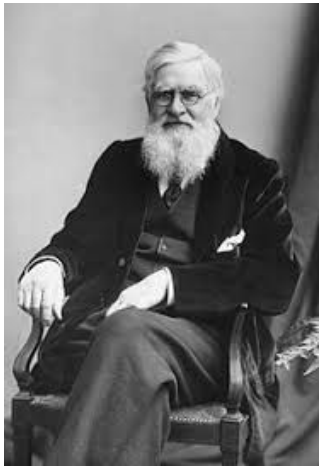
Biogeography

- **Biogeography** is the study of the geographic distribution of species and the processes which give rise to these distributions

- E.g., this is..not right.



Alfred Russell Wallace: "Father" of biogeography



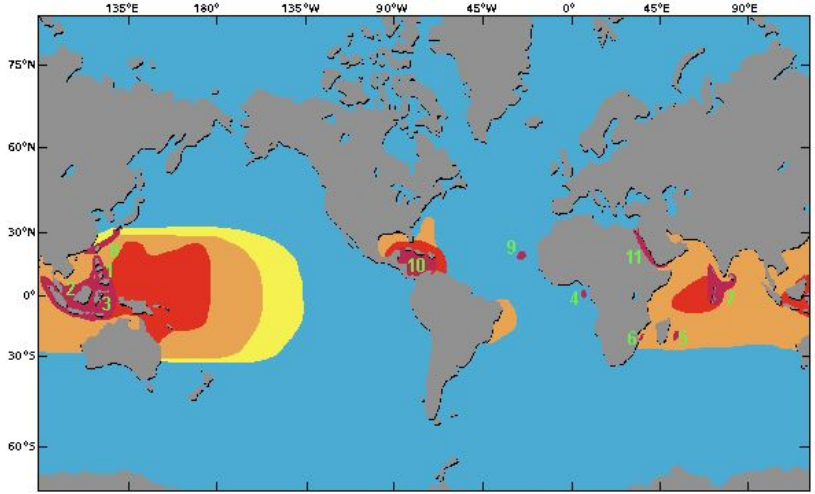
Wallace's Line

Observed distinct fauna (animal) distributions on different sides of this line.

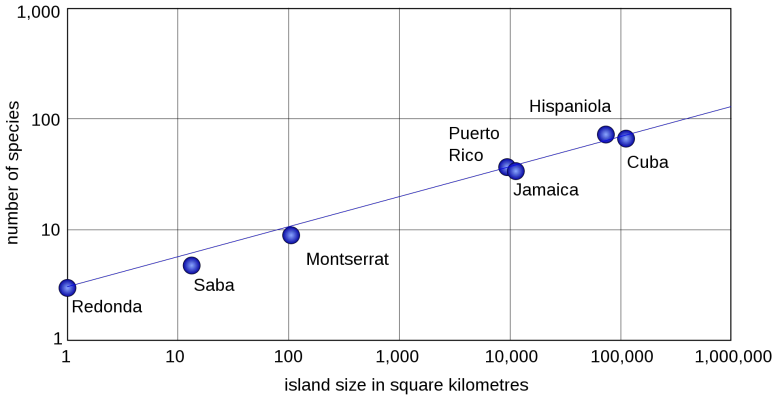
The earliest "biogeographic border"

A few biogeographical patterns

Biodiversity hotspots in the tropics



Islands tend to have fewer species

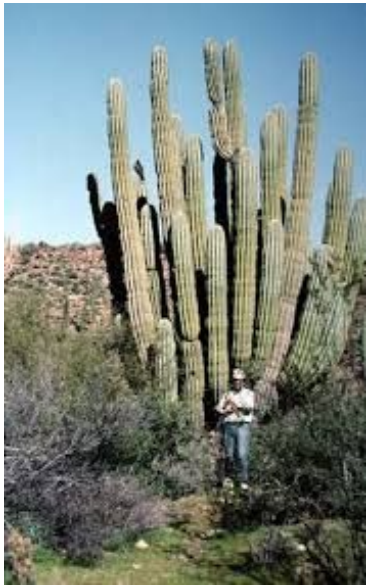


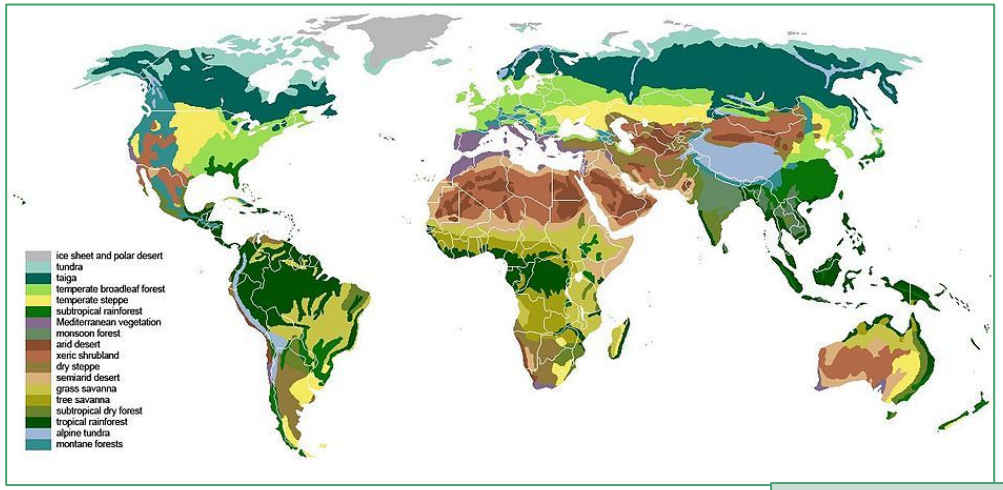
How do species get to live where they do?

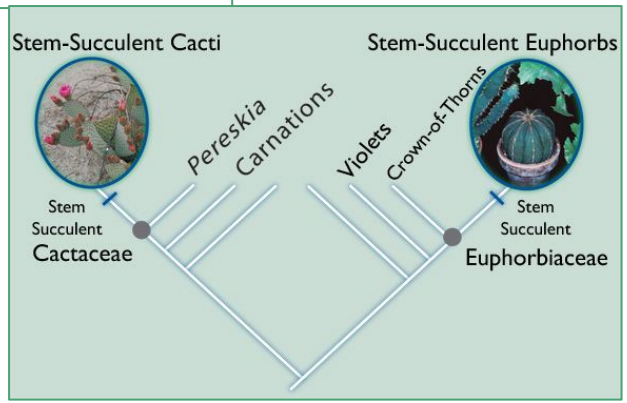
- **Vicariance**: Changes in *geography* drive changes in species distributions
  - The Earth moves you
- **Dispersal**: A species extends its geographic range into a new area where it did not previously live
  - You move somewhere else

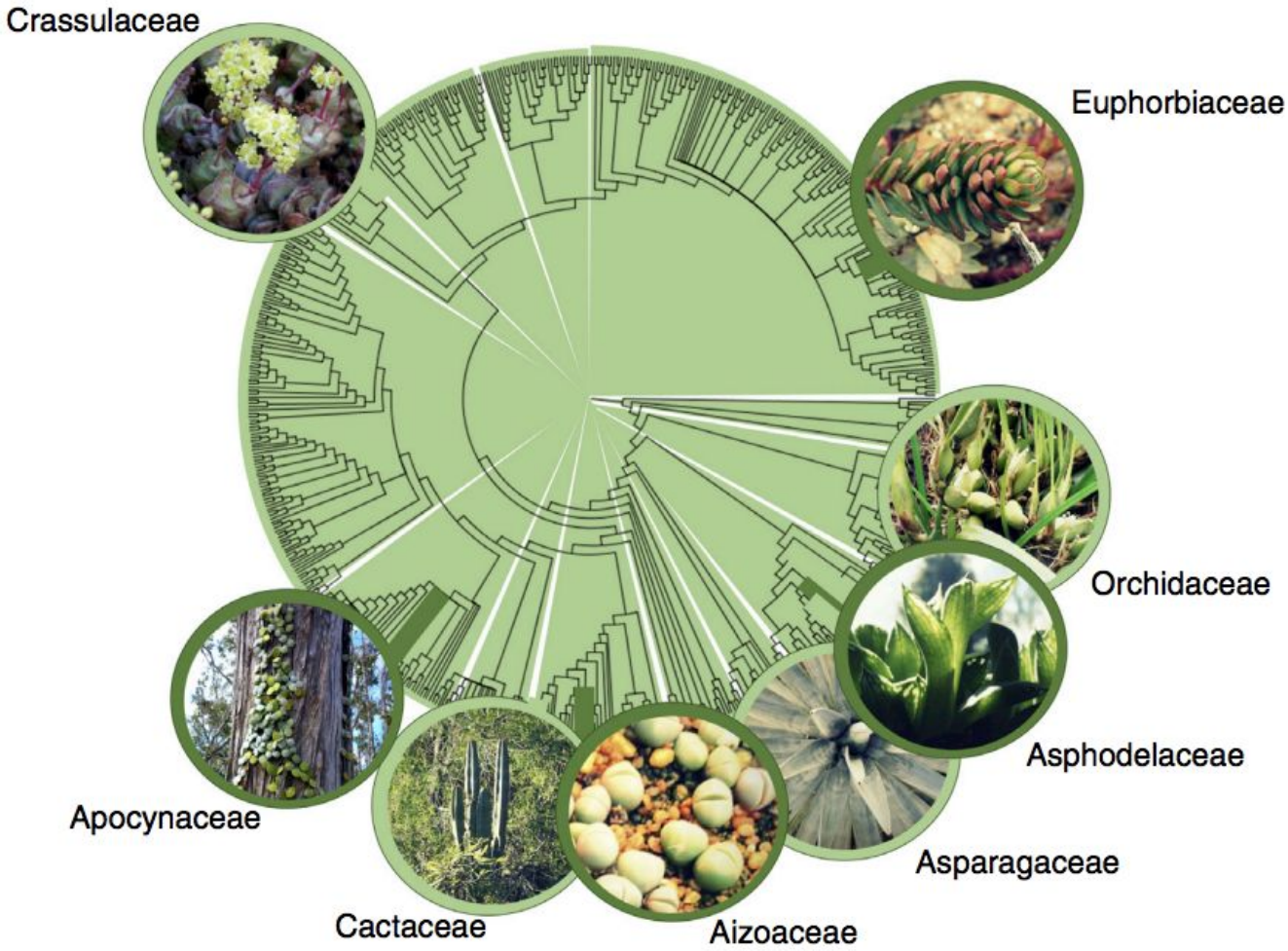
- One of two things will happen when a species ends up in a new geographic region.
  - It adapts to the new environment and survives
  - It fails to adapt to the new environment and goes extinct
  - **Hence, we see many adaptations!**

Convergent evolution in similar habitats is a signal of adaptation

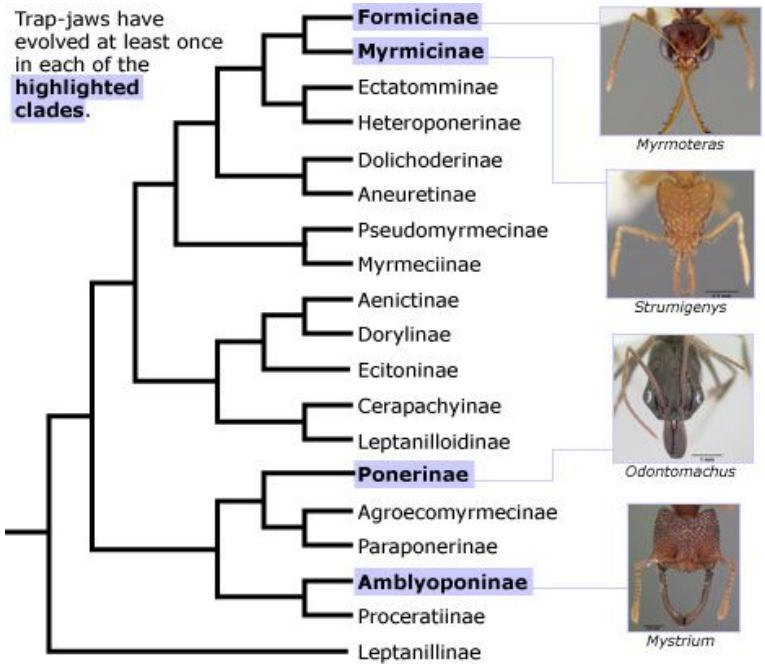




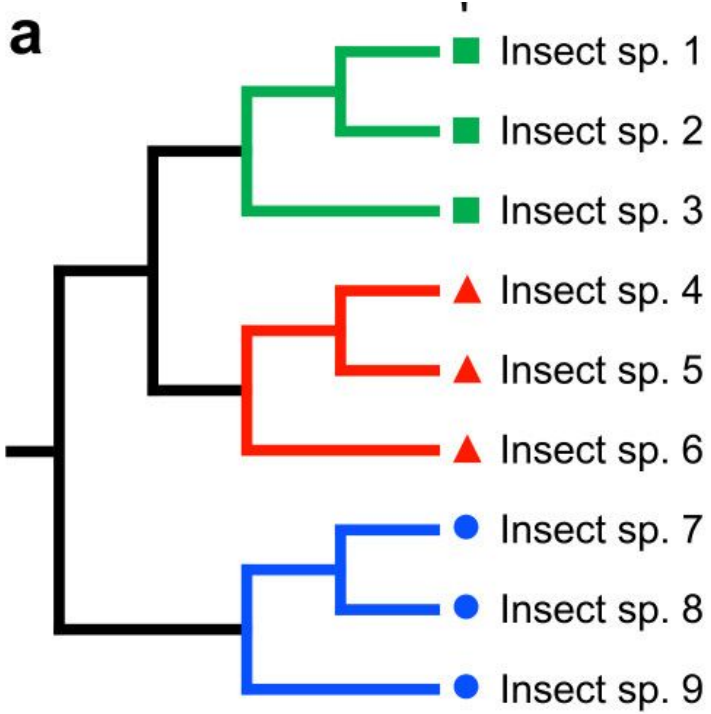


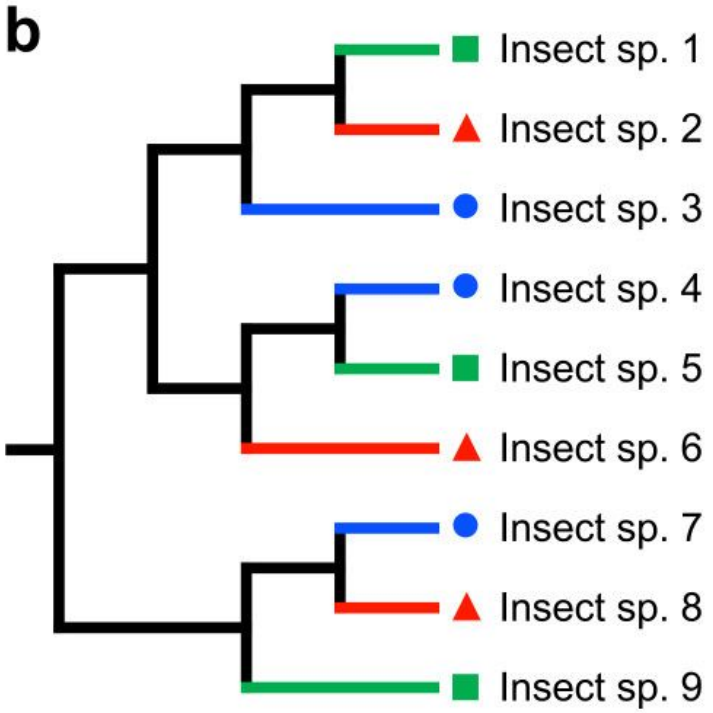

Crassulaceae
Euphorbiaceae
Orchidaceae
Asphodelaceae
Asparagaceae
Aizoaceae
Cactaceae
Apocynaceae

Convergence often signals adaptation



Species history from phylogenies



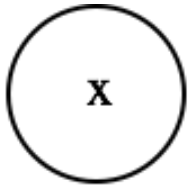


Each color is a distinct geographic area

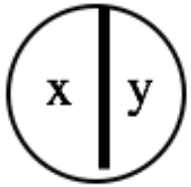
Speciation, vicariance, and phylogenies

Lines indicate new geographic barriers, and letters (x,y,z) represent species

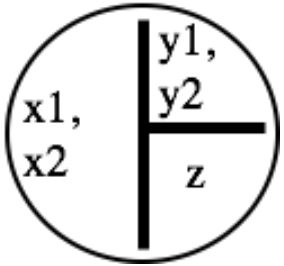
A geographic region



Vicariance event leads to speciation

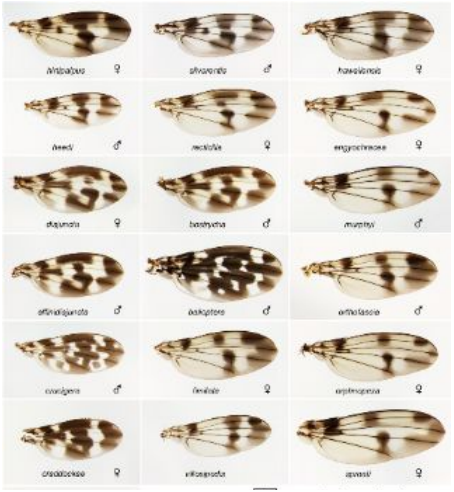


Another vicariance event. How about speciation?



Hawaiian Drosophila species relationships match order of island origin

- Means that *vicariance* is a major determinant of species distributions



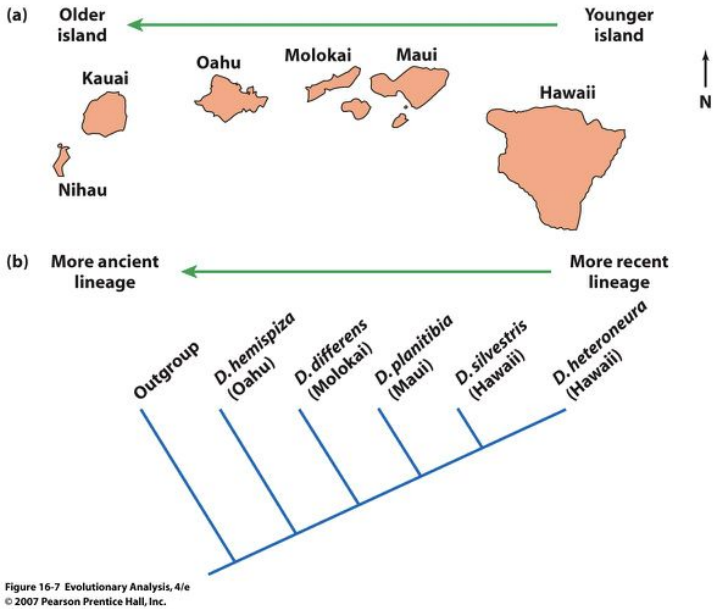
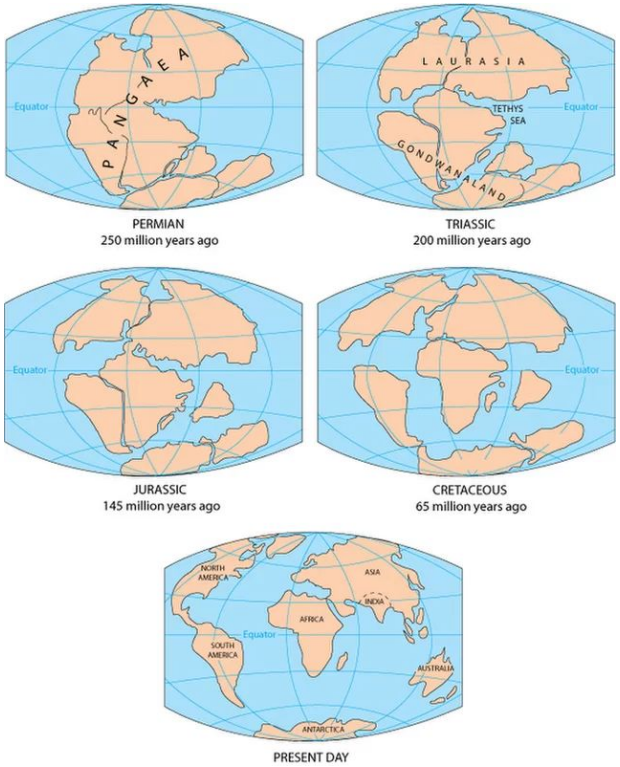


Figure 16-7 Evolutionary Analysis, 4/e

Geologic changes over time by continental drift



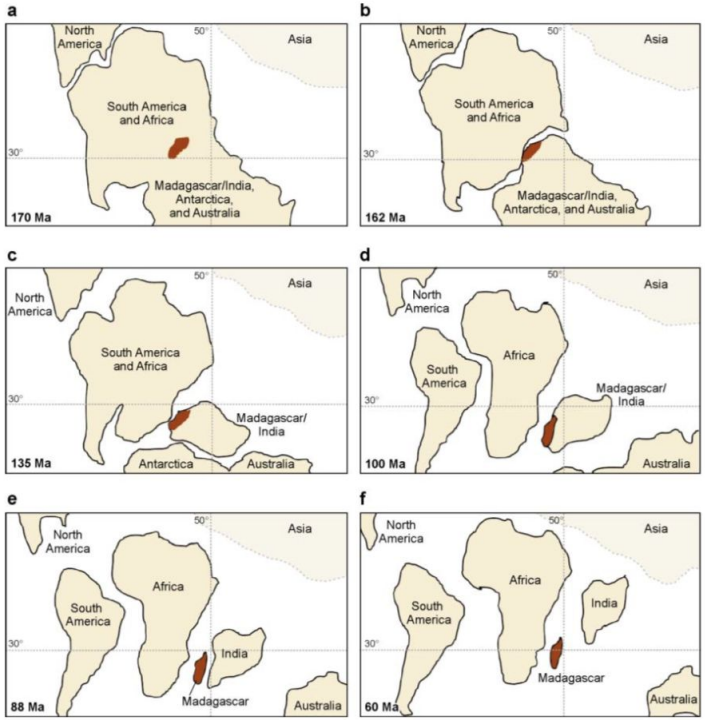


Figure 1

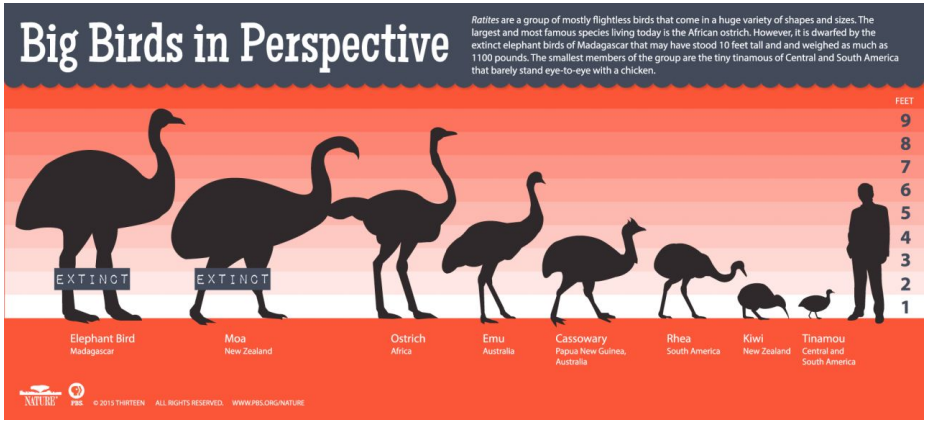
Paleoreconstructions of the breakup of Pangea, and Madagascar's subsequent geographic isolation. Redrawn from (Scotese 2000).

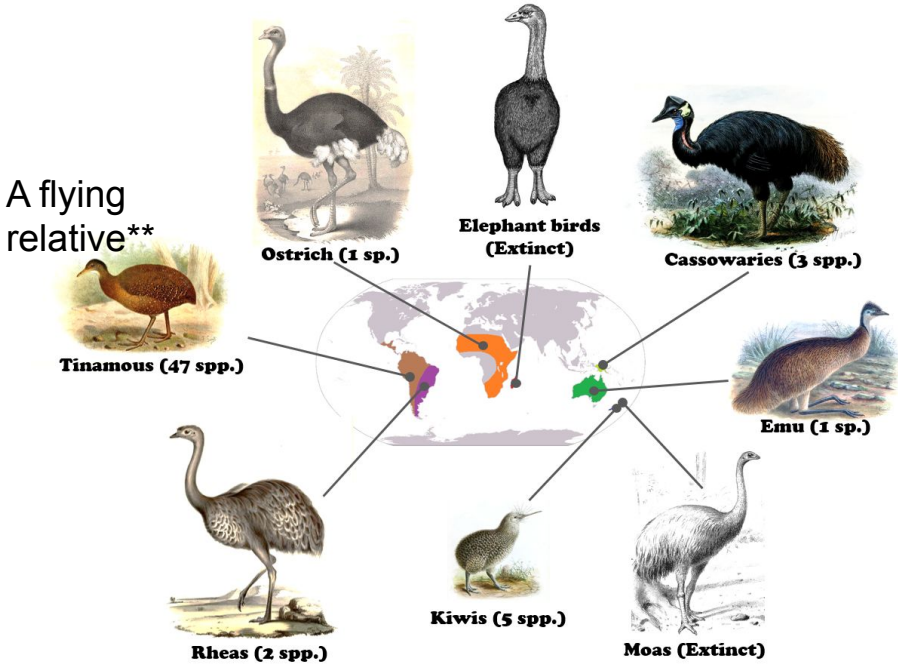
https://www.youtube.com/watch?v=UwWWuttntio

A case study: Ratite Bird Biogeography

Ratites are *flightless birds*.

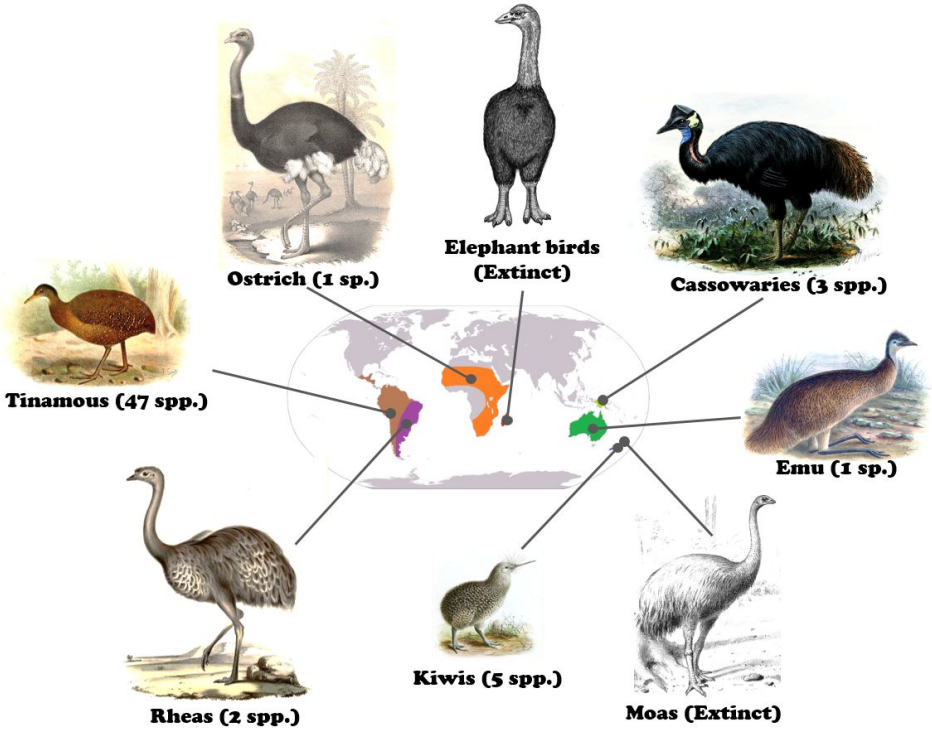
How do they have this geographical distribution?



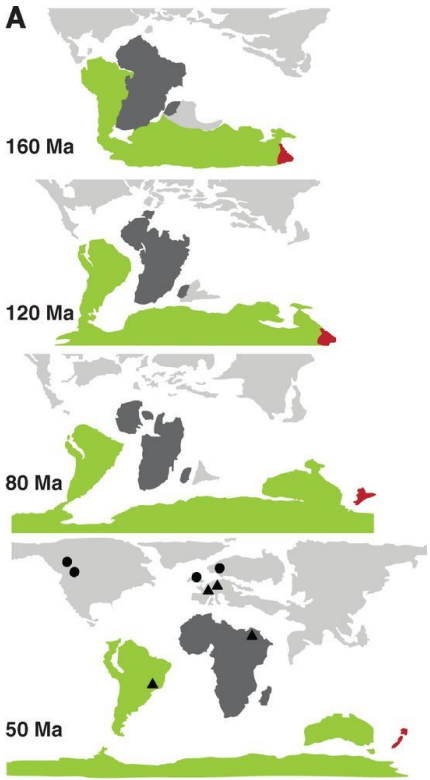


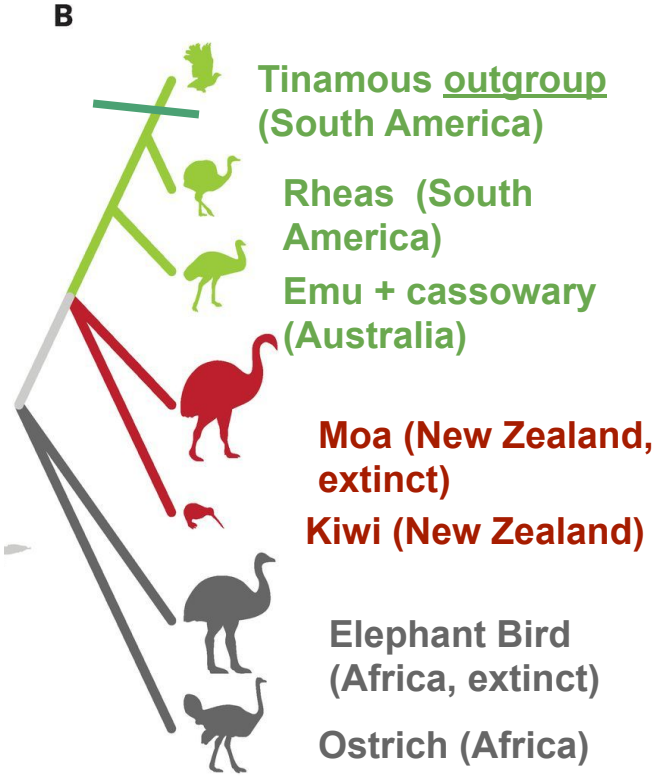
One hypothesis: distribution by vicariance

TRIASSIC
200 million years ago



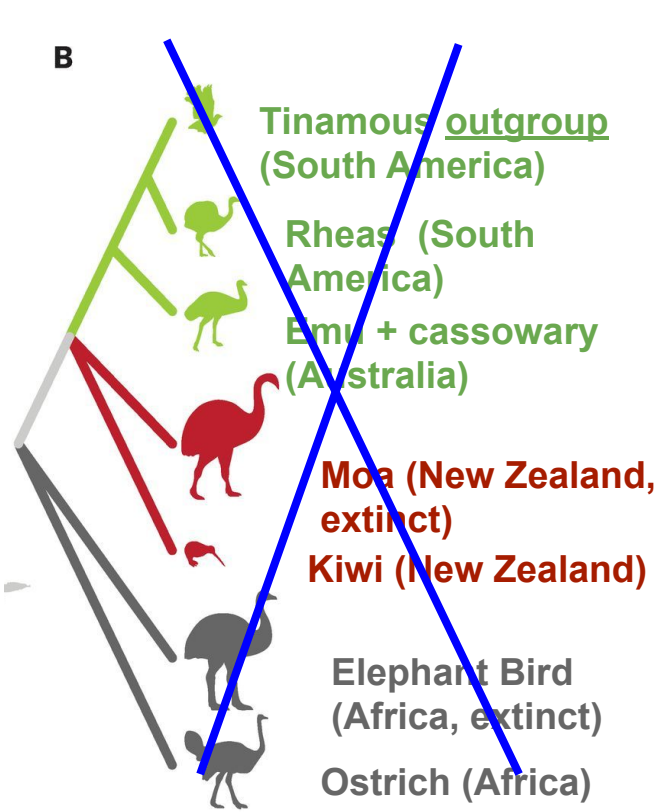
If vicariance, the phylogeny would EXACTLY MATCH the geography changes

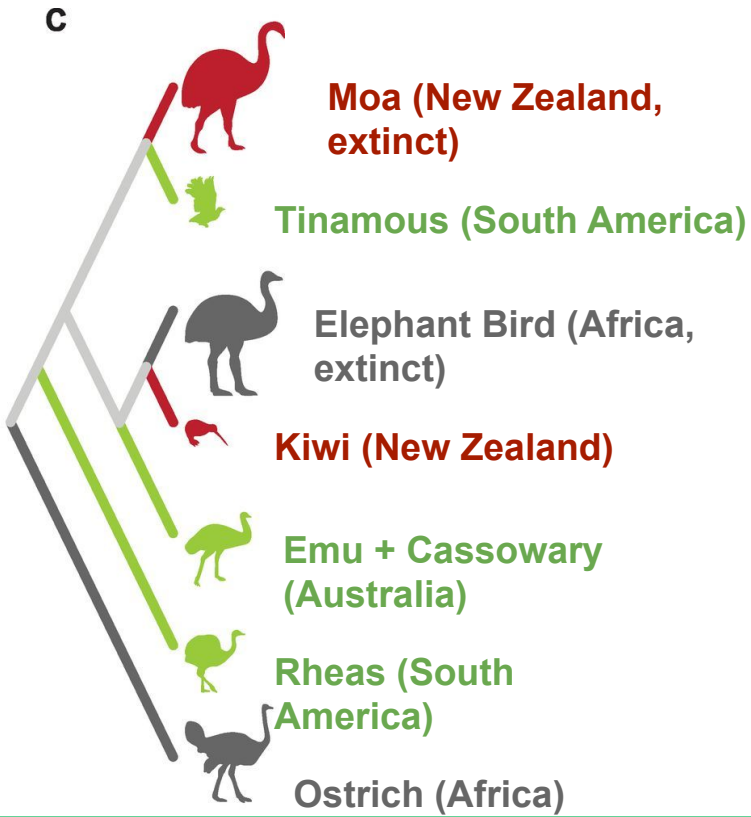




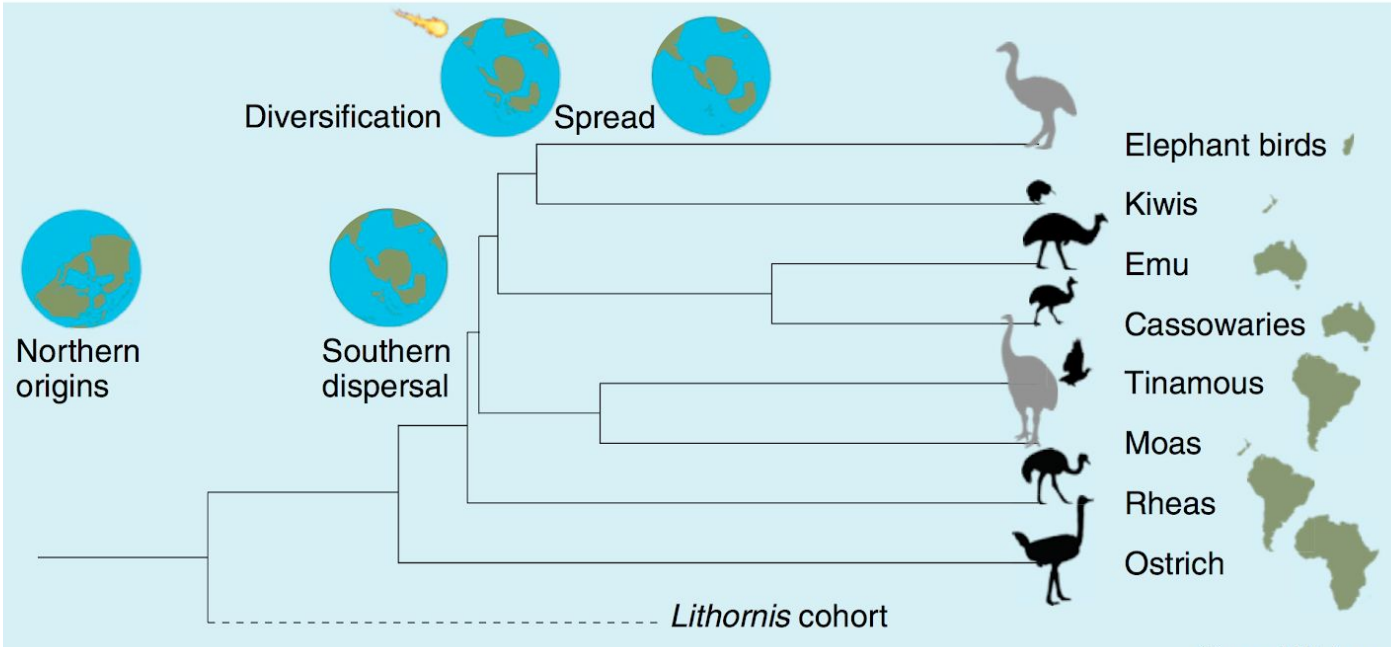
10.1126/science.1251981

The phylogeny made from DNA is very different - so dispersal contributed to speciation



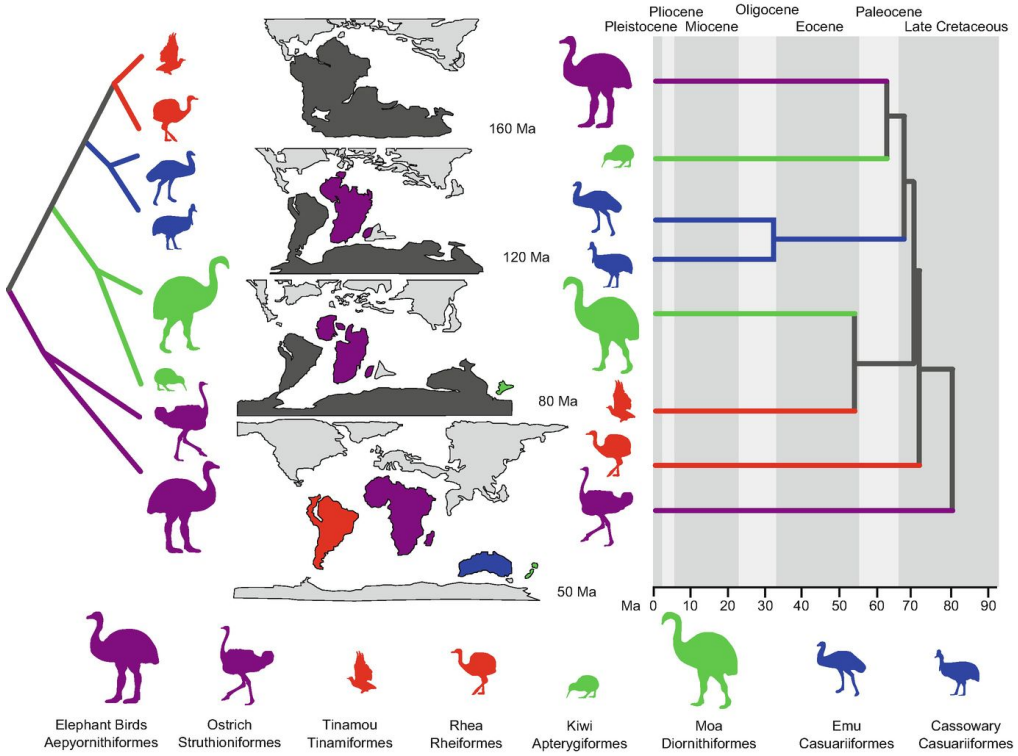


Fossil data reveals a Northern hemisphere (Laurasia) origin



http://dx.doi.org/10.1016/j.cub.2016.12.023

Another overall view



Another example: snapping shrimp