

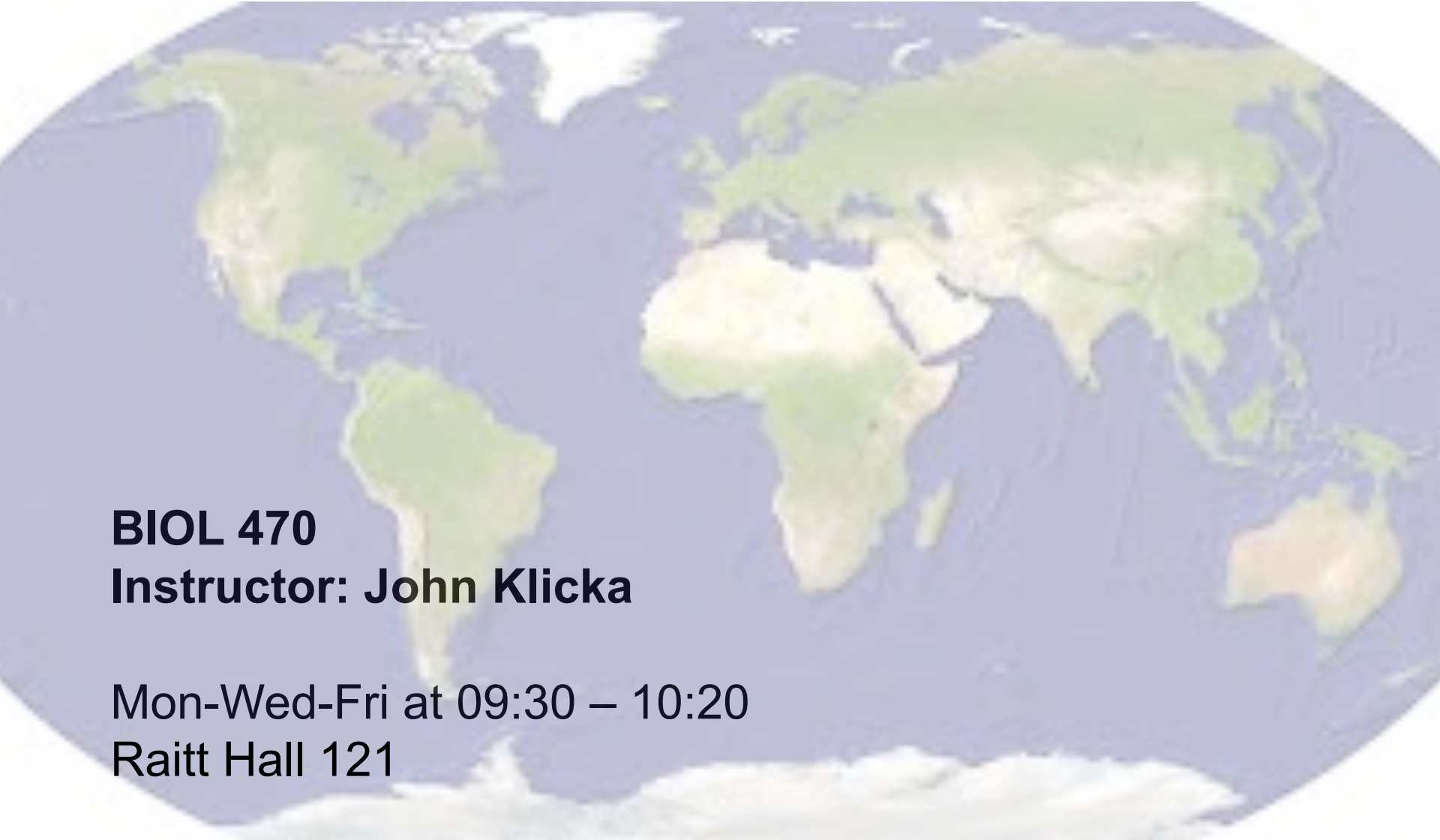
Welcome to Biogeography!

BIOL 470

Instructor: John Klicka

Mon-Wed-Fri at 09:30 – 10:20

Raitt Hall 121



Instructor: John Klicka

klicka@uw.edu / 206-685-7201 (Burke Museum)

Office: 205A Burke

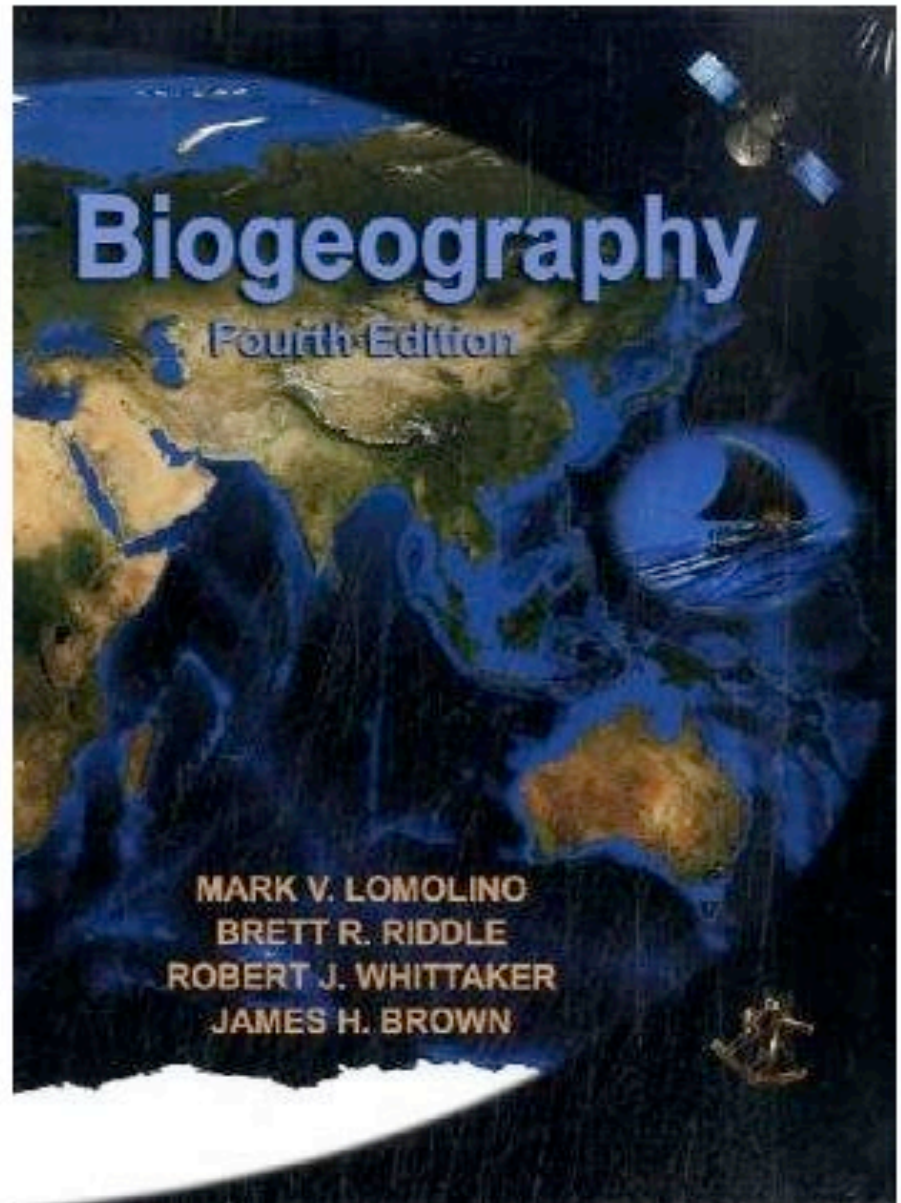
Office Hours: M & W, 10:30 - noon
or by appointment



Required Textbook

Lomolino, MV, BR Riddle, RJ
Whittaker, JH Brown. 2010.
Biogeography 4th edition,
Sinauer & Associates, Inc.
878 pp.

One copy will be on reserve
at Odegaard Library





Course website:

Google klickalab.com

- Look for “Biogeography” heading

A world map showing the continents of North America, South America, Europe, Africa, Asia, and Australia. The map is centered on the Atlantic Ocean and is rendered in a light blue and green color scheme. The text is overlaid on the left side of the map.

Grading

Midterm 1 = 30%

Midterm 2 = 30%

Final exam = 40%



Exams:

Exams will be a combination of short essay questions, short answer, multiple choice, and true/false questions that are designed to test not only your general knowledge of the topics, but also your critical thinking skills.

Keys to success:

- Attend all lectures!
- Ask questions!
- Read assigned chapters on time!
- If personal problems arise during the quarter, please contact me.

Laptops in lecture are only for note-taking!!



TURN OFF YOUR PHONES!

Chap. 1: The Science of Biogeography



What is Biogeography

Book says:

Biogeography is the study of the distribution of organisms, both past and present (traditional definition)

Biogeography is the science that attempts to document and understand spatial patterns of biodiversity (current definition) .

Biogeography is the study of the distribution of **biodiversity** over space and time. It aims to reveal where organisms live, at what abundance, and why.

Diversity on the Earth

Book says:

- Between 5 – 50 million species of plants, animals, and a nearly inconveivable number of microbes on the Earth today
- Less than 2 million of these have been formally described



Understanding Biodiversity

...identifying biodiversity

Diversity on Earth

- ~2 million formally recognized species; – Fraction have known distribution and range of characteristics
- Estimated – 2-100 million current species on earth (most unclassified are invertebrates)
- Millions (or likely billions??) of species currently extinct (small fraction of these preserved as fossils)
- More extinct than extant species



How is global biodiversity estimated?

Prior to 1982, most biologists thought 2-5 million species

Terry Erwin's experiment in eastern Peru:

Fogged 19 *Luehea seemannii* canopies and collected fallen insects



How is global biodiversity estimated?

Terry Erwin's experiment in eastern Peru :

Found 1200 beetle species in 19 *Luehea seemannii* tree canopies;
estimated 162 were host-specific

50,000 total tropical tree species

Calculation – $162 \times 50,000 = 8,100,000$ host-specific beetles in tropical trees

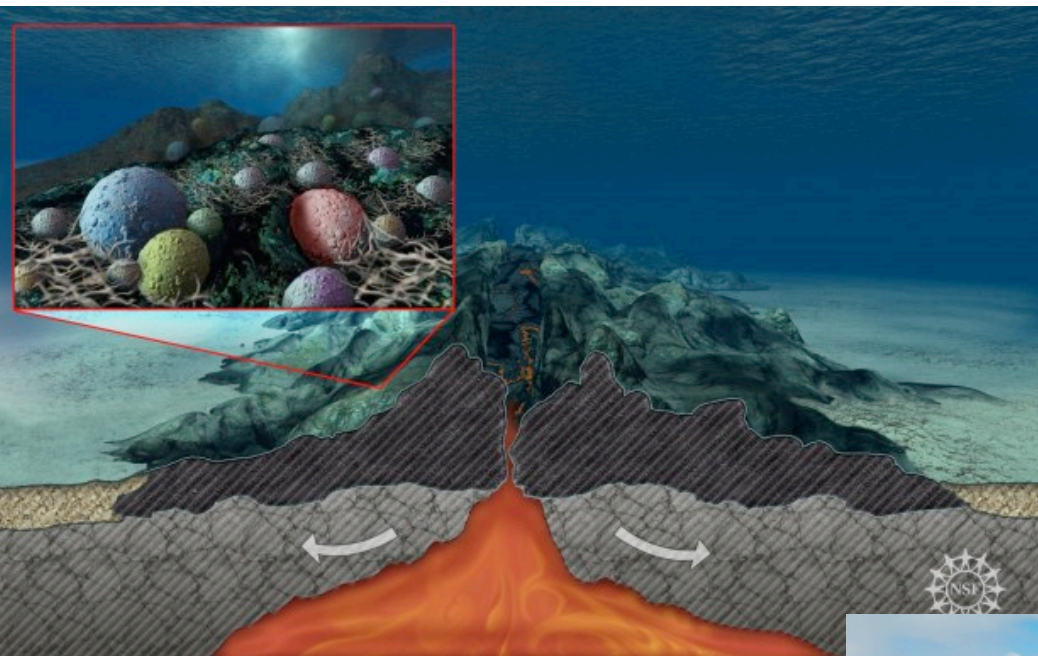
Beetles represent only 40% of all members of Arthropods

Calculation – $8,100,000 / 0.4 = 20,250,000$ spp of Arthropods in tropical canopies

Assumed canopies have twice diversity of ground

Calculation – $20,250,000$ (canopy spp) + $10,125,000$ (ground spp) =

30,375,000 spp of arthropods in tropical rainforest!



Bacteria in earth's crust, beneath the sea

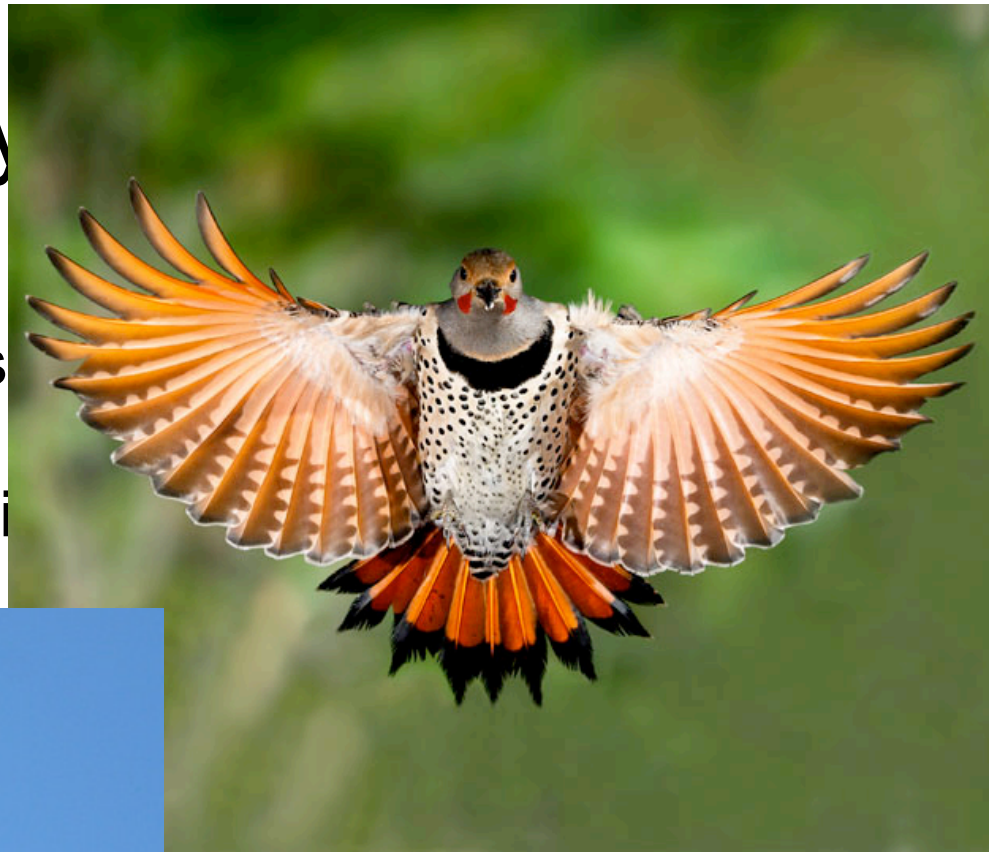
Thermophilic microbes



Why is biodiversity

1. Number of undescribed species

2. Efforts to document species



difficult (i.e. ecotypes, hybrids)

What do these biodiversity issues have to do with biogeography?



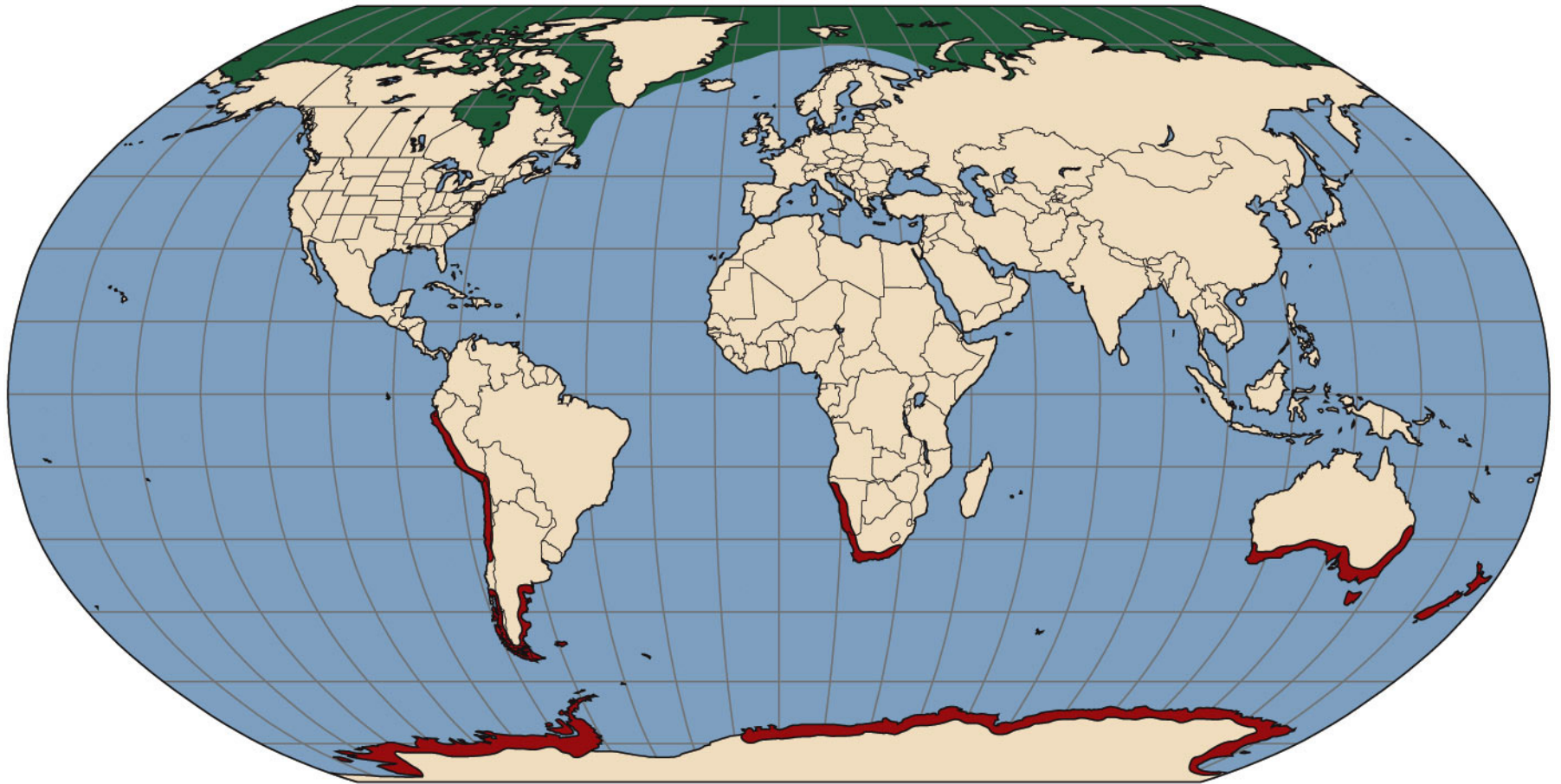
...almost every species is restricted to a small geographic area and a narrow range of environmental conditions.

The **spatial patterns of global biodiversity** are a consequence of the ways in which the limited geographic ranges of millions of species overlap and replace each other over the Earth's vast surface.

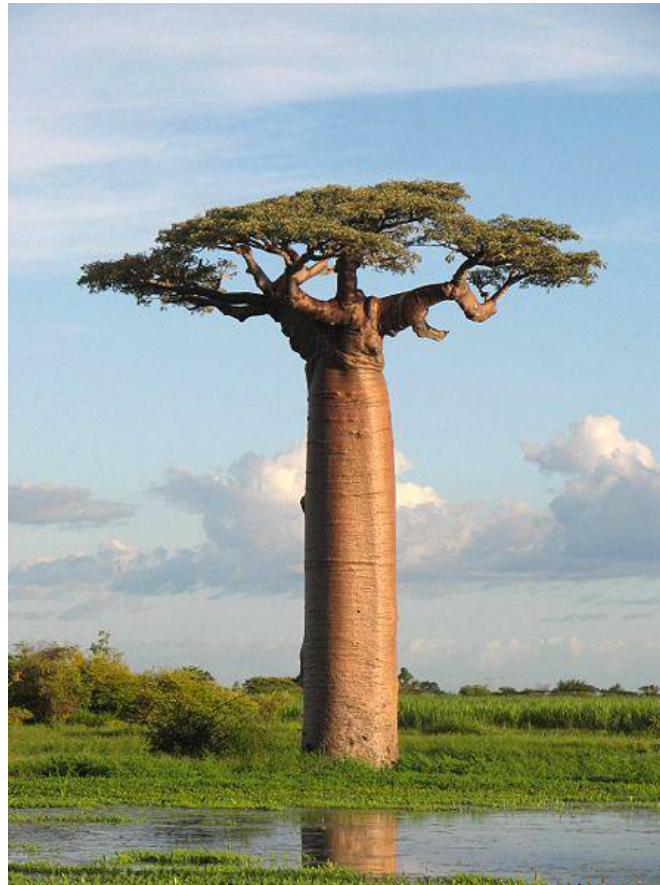
What sort of questions
do biogeographers ask?



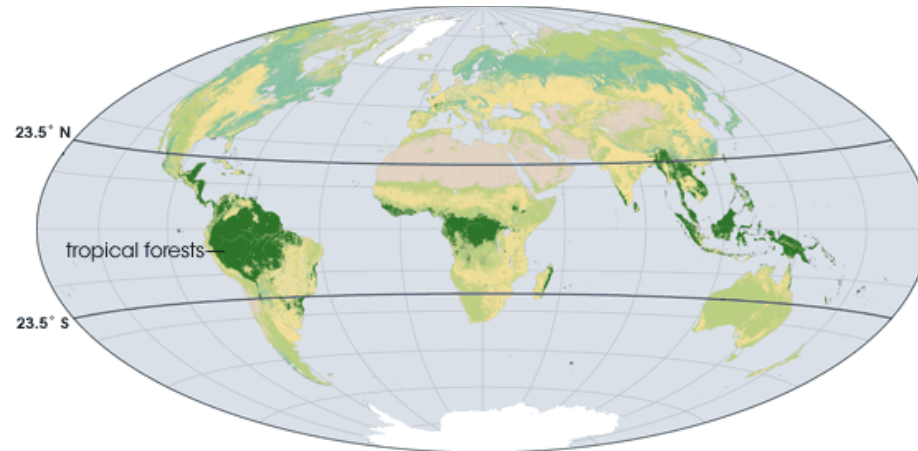
Why do geographic ranges differ among species?



- Why does Madagascar have such a distinctive fauna and flora?



- Why do the tropics have more biodiversity than other regions on Earth?



- How have glacial episodes of the Pleistocene Epoch shaped distributions and patterns of extant biota?



- Why are armadillos only found in South and North America?

?



■ = armadillo range



- How are oceanic islands colonized and why do they contain relatively few species?

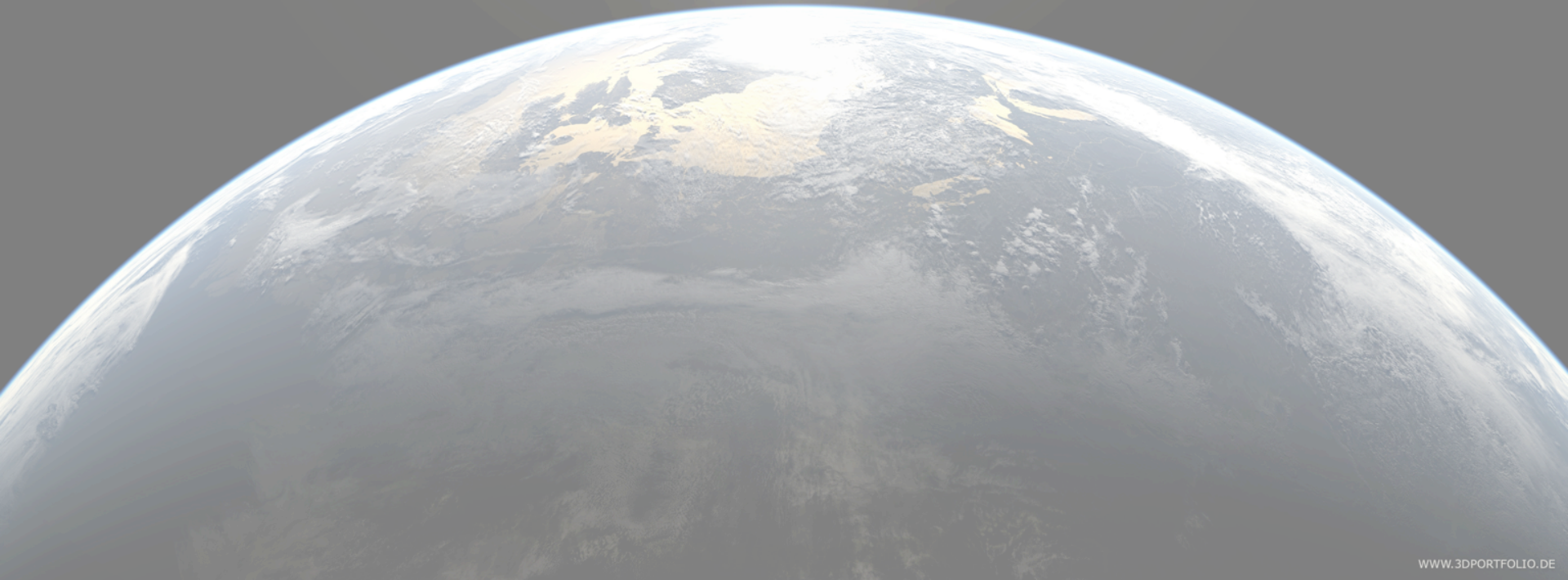


- Why do trees on mountains stop growing at a certain elevation?

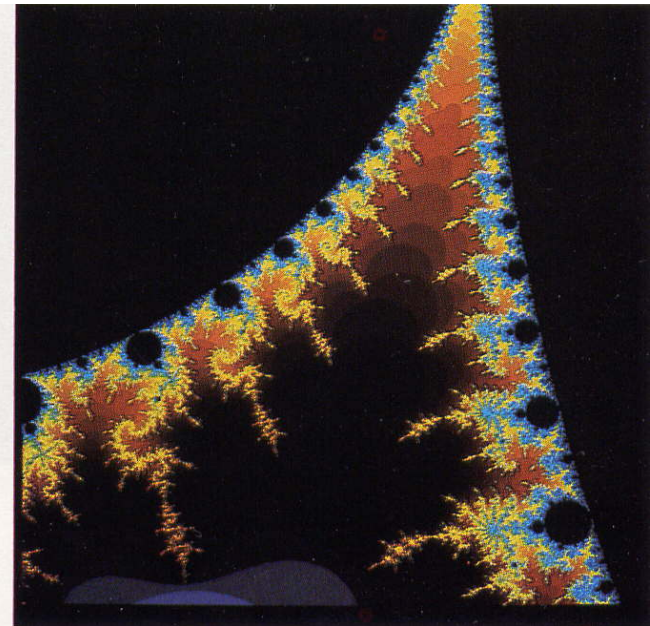
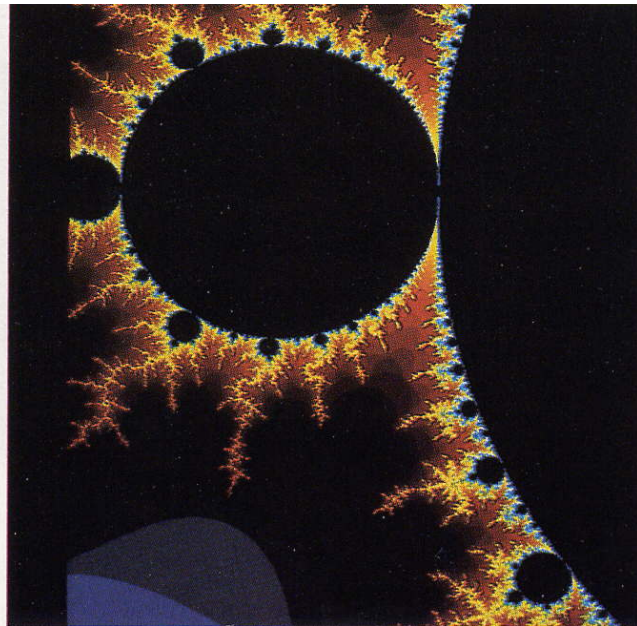
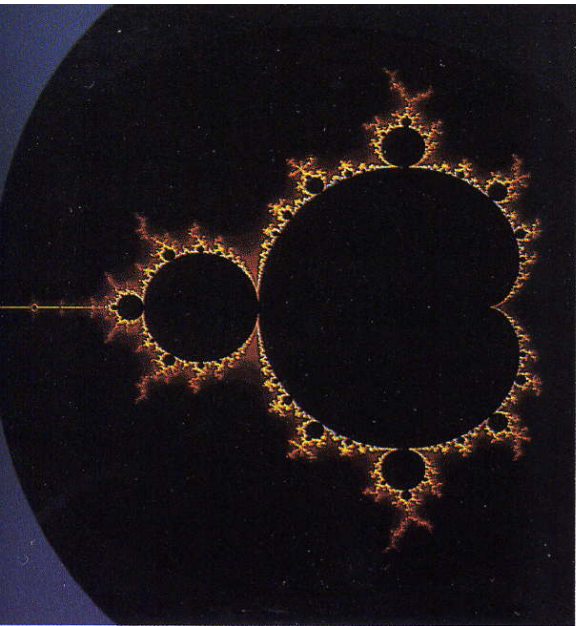


*The fundamental question of
biogeography:*

*How and why does biodiversity vary
over the surface of the earth?*

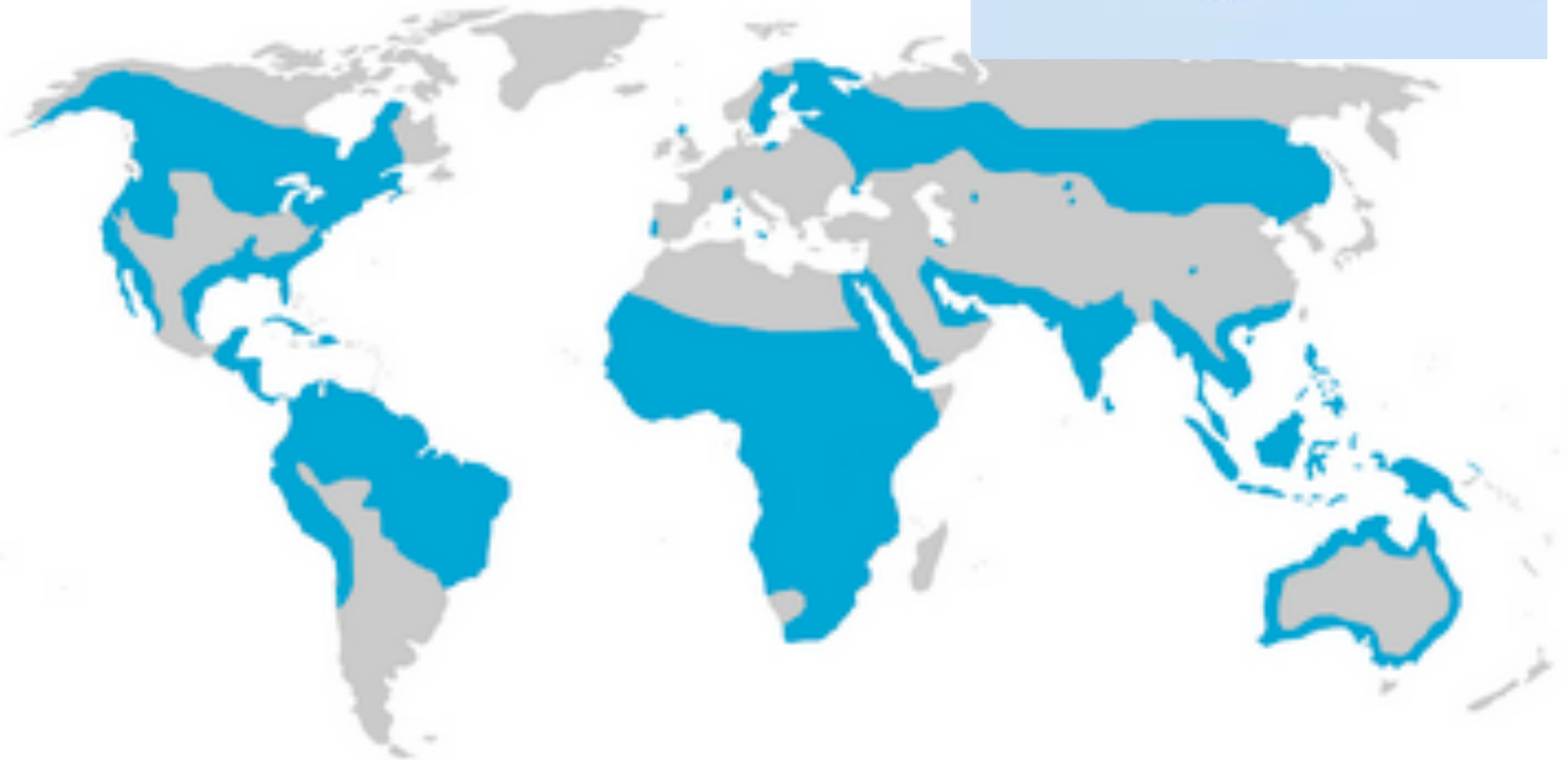


Scale Issues



Osprey (*Pandion haliaetus*)

A “cosmopolitan” distribution





Temporal *and* spatial scale



Temporal and Spatial Scale:

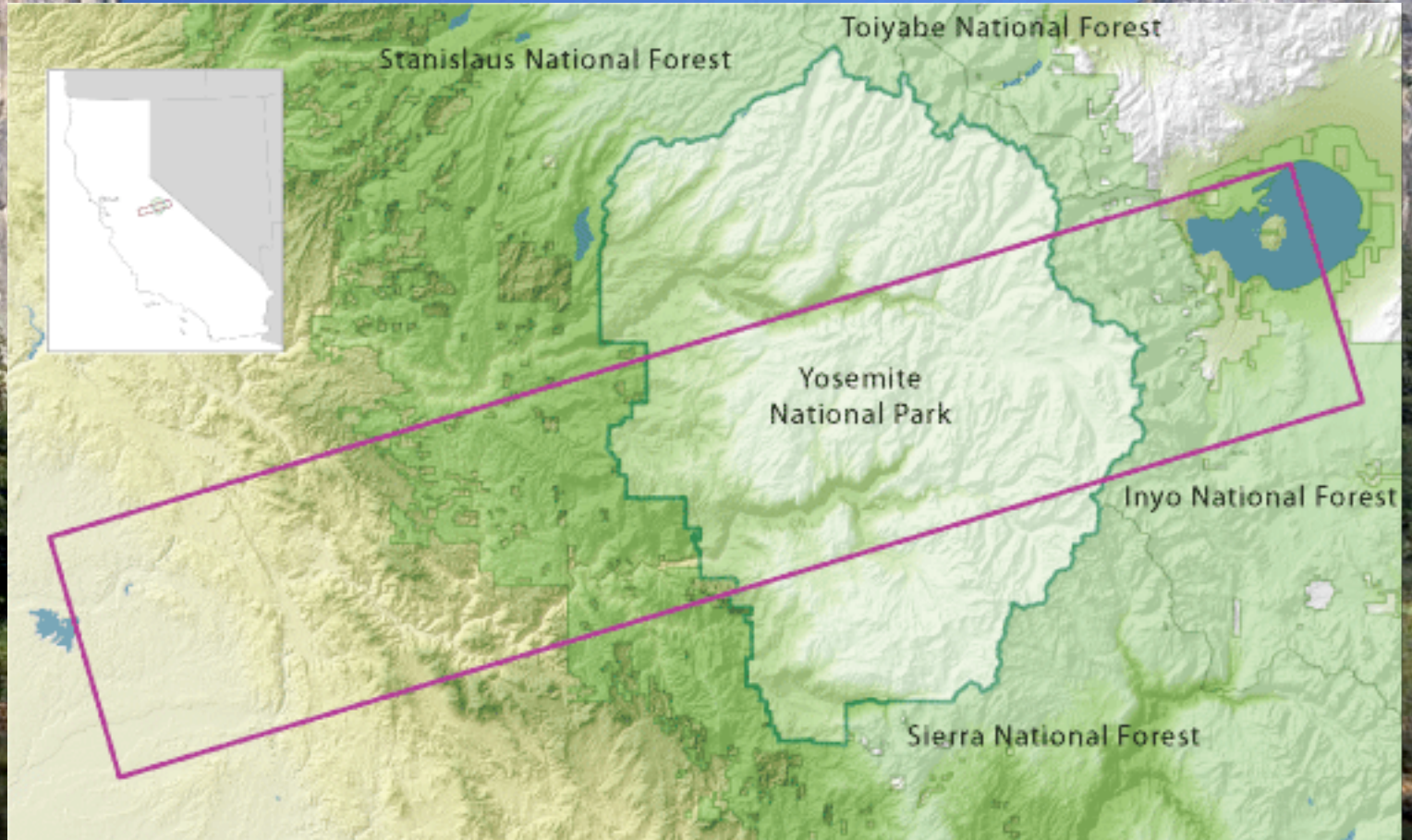
1905, McClure



1988, Veblen



Yosemite National Park



Isthmus of Panama....

Great American Interchange



Biogeographers, like most biologists, typically specialize in one way or another.

One form of specialization would be taxonomic. As a result we find:

- a. Zoogeographers (animals)
- b. Phytogeographers (plants)
- c. Microbial biogeography (little studied)

Typically, we see even greater specialization, i.e., we might find one expert specializing on the zoogeography of viperid snakes.... or on a particular geographic region

Approaches to Biogeography

- **Historical Biogeography** – Reconstruct the origins, dispersal, and extinctions of taxa and biotas
- **Ecological Biogeography** – Accounts for the present distributions in terms of interactions between organisms and their physical and biotic environments
- **Paleoecology** – Bridges the gap between these two fields, investigating the relationships between organisms and past environments, and using data on both the biotic composition of communities (abundance, distribution, and diversity of species) and abiotic conditions (climate, soils, water quality, etc.) to reconstruct the evolutionary and geographic development of biotas.

Doing contemporary biogeography

Biogeography differs from other sciences in that it is primarily a comparative, observational science rather than an experimental (manipulative) one. The scale of time and space involved in most of the processes precludes experimentation.

As a result, biogeographers rely heavily on “natural experiments” and on the impact of anthropogenic changes.



In addition, biogeography typically relies on the cumulative contribution of many people working over long periods of time.

One scientist must rely on the work of his predecessors, and build on it.



William Bartram, 18th Century naturalist who wrote about the flora of the southeastern U.S.

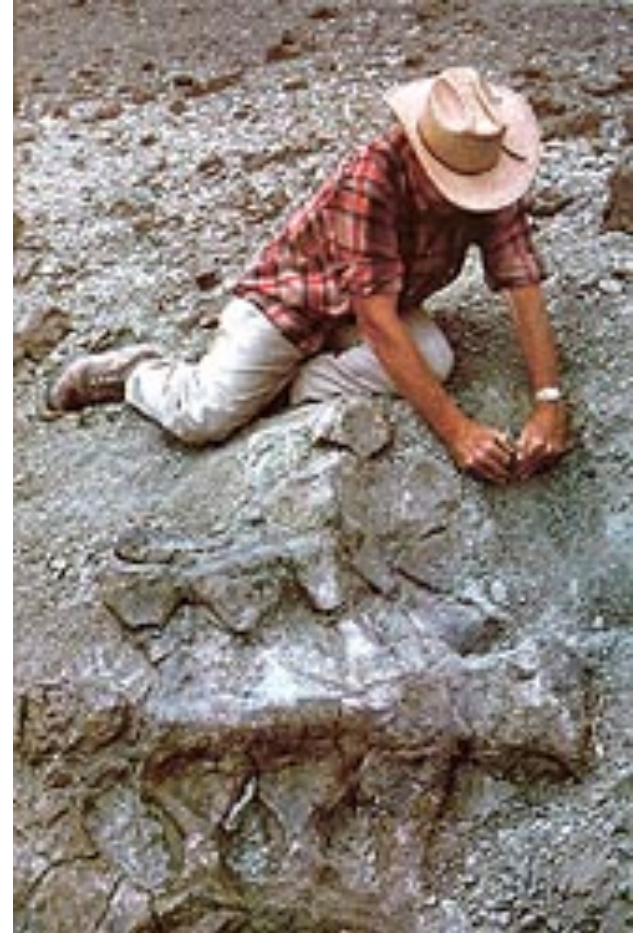
Brian Keener, 21st Century plant systematist who studies the flora of the southeastern U.S.



Finally, biogeography is typically a synthetic science.

This means that the work occurs at the interface of many different scientific disciplines,

i.e. ecology, taxonomy, systematics, evolution, geography, geology, paleontology, climatology, limnology, oceanography, etc.



Some of the greatest names of biology (both past and present) were, or are, biogeographers in the truest sense:

Charles Darwin

Alfred Russel Wallace

John Hooker

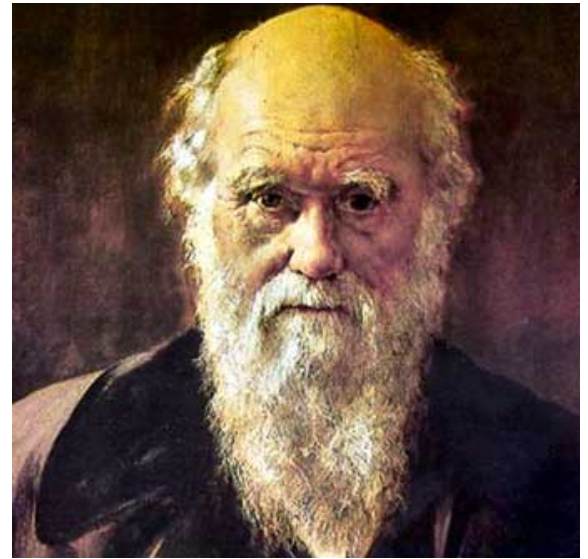
George Gaylord Simpson

Ernst Mayr

Robert MacArthur

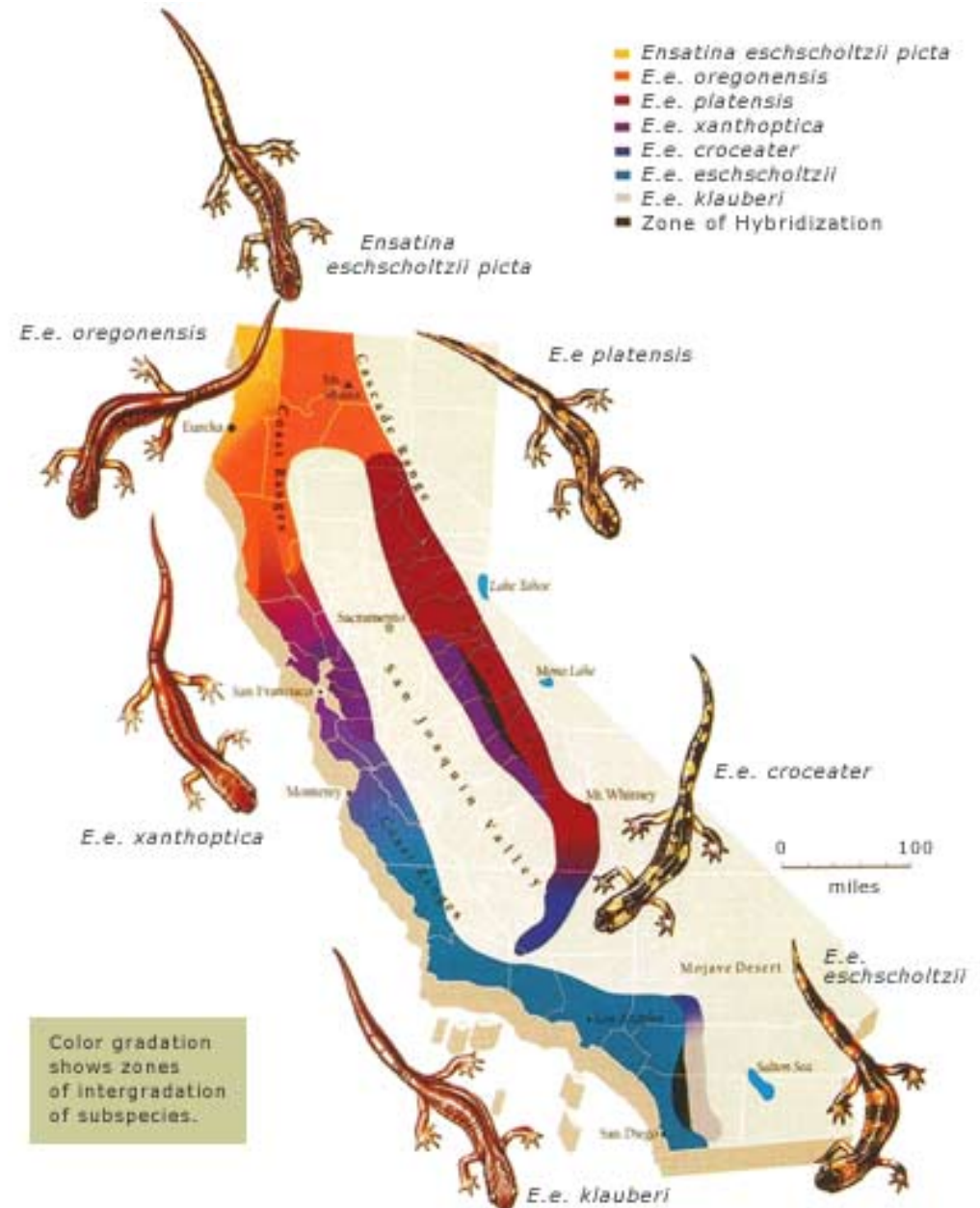
Edward O. Wilson

However, the science of biogeography (as a free-standing field) is relatively young.



“Nothing in biology makes sense except in the light of evolution....

-Dobzhansky



Philosophy of Science

- Scientists try to understand the natural world by explaining its enormous diversity and complexity in terms of general patterns and basic laws.
 - Examine the relationship between pattern and process
 - The occurrence of pattern implies causation by some general process or processes.
 - Searching for mechanistic explanations

Philosophy of Science

Terms and concepts:

- **Pattern** – Non-random, repetitive variation of focal elements (e.g. organisms, species, etc.) among units (e.g. regions, continents, etc.) or along relevant gradients.
- **Uniformitarianism** (or “actualism”) is the assumption that the basic physical and biological processes operating today have been operating throughout time (manifestations of universal scientific laws)

Philosophy of Science

- Inductive Reasoning – From specific observations to general principles.
- Deductive Reasoning – From general constructs to specific cases. (links premises with conclusions)
- Karl Popper (1968)
introduced Hypothetico-Deductive Reasoning –

Popper's scientific method

A good scientific theory contains logical assumptions and consequences, and if these can be proven wrong, then the theory itself must be flawed.

The hypothetico-deductive reasoning advocated by Karl Popper advocates testing a theory by setting up alternative, falsifiable hypotheses.

In this line of reasoning, a theory cannot be proven true. It can only be falsified.

