

Question

- ◆ There is a species of trout that is endemic to Germany. This means it is
- A. Becoming extinct
 - B. Evolving quickly
 - C. Localized in this area
 - D. Losing population
 - E. diseased

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Environmental Science *Systems and Solutions* FOURTH EDITION

Results from question: What are you interested in?

- 55 energy/alternative energy
- 31 climate change
- 30 sustainability
- 21 agriculture/organic vs. commercial/GMO
- 16 population increase
- 16 extinctions/evolution
- 13 pollution/toxics
- 9 water (including desalination)
- Other topics included: parks, forests, appalacian trail, effects of human consumption, personal activities that can help, pollution and sustainability in 3rd world countries, UCSD and local farms, biology, green business and economics, the atmosphere, etc.

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Question

◆ Which 2 elements tend to be the limit on plant growth?

- A. CO₂ and H₂O
- B. Carbon and Zinc
- C. Nitrogen and Phosphorus
- D. Sulfur and Hydrogen
- E. Carbon and Oxygen

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Environmental Science

*Systems
and Solutions*

FOURTH EDITION

Michael I. McKinney
Robert M. Schoch
Logan Yonavjak



Chapter 4

THE DISTRIBUTION OF LIFE ON EARTH

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Introduction

- **Currently, life on Earth has been able to adapt into unprecedented diversity partly due to a relatively stable climate.**
- **We do not even know how many species exist; estimates range from 5-30 million; 2 million are known.**
- **We are directly and indirectly causing them to go extinct (1,000 to 10,000 times the rate of 'natural' extinction) without even gauging the level of complexity and diversity that exists.**
- **Species do not exist uniformly over Earth's surface .**

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Evolution of the Biosphere

- **In the 1950s, Miller and Urey demonstrated that the complex molecules possessed by all living things are readily produced under laboratory conditions that resemble the early environments of Earth.**
- **These experiments and other lab work, combined with the fossil record, support the idea that life arose from natural processes.**

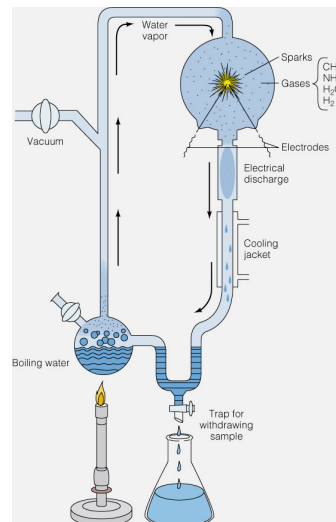


Figure 4-1 Miller's and Urey's experiment.

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Evolution through Natural Selection

- Once life originated, it diversified into different kinds or organisms through natural selection.
- As Darwin first documented in 1859, biological evolution occurs from natural selection of individual variation:
 - Nearly all populations exhibit variation among individuals.
 - Individuals with advantageous traits will tend to have more fertile offspring.
 - Advantageous traits will therefore become widespread in populations.

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Isolation Promotes Speciation

- Reduction of habitat may leave small isolated populations, called peripheral isolates.
- Barriers may form to isolate small populations.
- Out-migration to an isolated area may form small separated populations.

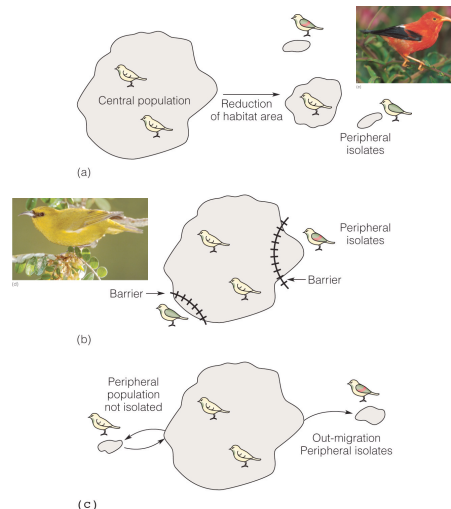


Figure 4-2 Isolation of populations promotes speciations.

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Isolation Promotes Speciation

- Darwin was not aware of the work of Gregory Mendel, and the laws of inherited variation (1865), which laid the groundwork for understanding the mechanism of natural selection; heritable traits (now known as genes).

Taxonomists categorize all life forms, e.g humans

- Domain eukaryotic (i.e. animal, plant, or fungus)
- Kingdom animalia, (i.e. not a plant, fungus, bacteria, protoza or algae)
- Phylum Chordata (i.e. left/right symmetric body and notochord)
- Class Mammal (i.e. not a reptile, amphibian, bird, or lamprey)
- Order Primate (not a marsupial, elephant, rodent, armadillo, etc. (around 25 types of mammals))
- Suborder Haplorrhini (i.e. not a monkey, gibbon, or marmoset)
- Family Homidae (i.e. not a chimp, gorilla, or orangutan)
- Genus Homo (i.e. not a neanderthal)
- Species (H. Sapiens)

Changes Through Time

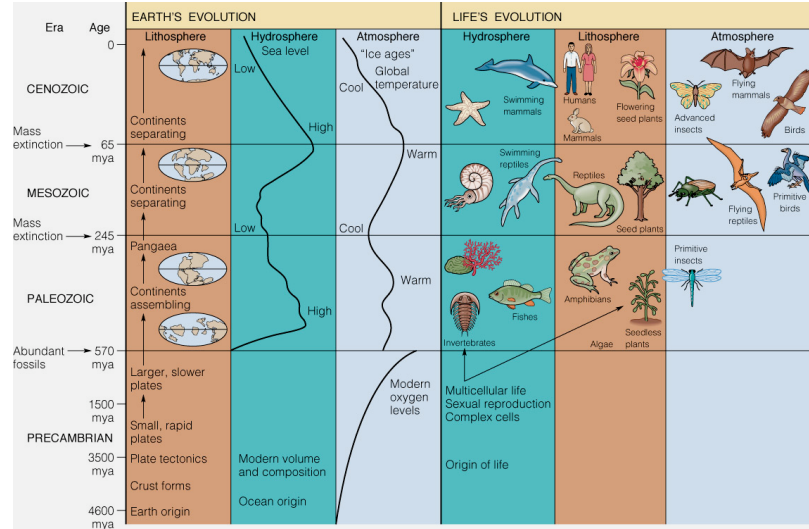


Figure 4-3 Earth's geological evolution and life's evolution.

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Patterns of Diversification

- **Over time the level of diversity has tended to increase.**
- **A major explosion of life (the Cambrian Explosion) recorded in the fossil record occurred about 570 million years ago.**
- **There have been several major extinctions (for instance, at the end of the Mesozoic Era with the extinction of the dinosaurs).**

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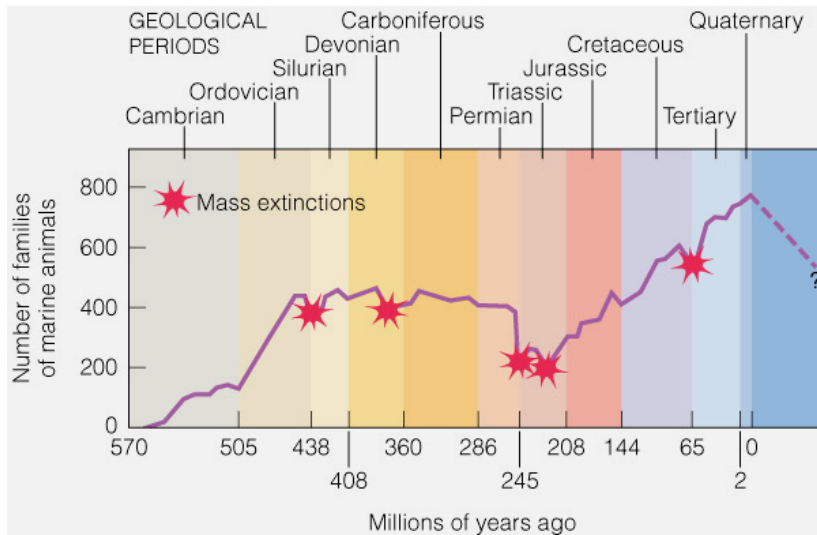


Figure 4-7 Five mass extinctions have temporarily lowered biodiversity in the oceans.

Source: Modified from D. Raup and J. Sepkoski 1982. "Mass extinctions in the marine fossil record." *Science* 215: 1501-1503.

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What is Biodiversity?

- Biodiversity is “the variety and variability among living organisms and the ecological complexes in which they occur.”



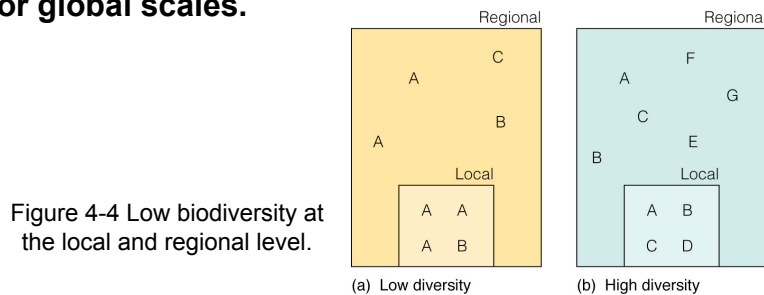
Red-eared sliders.

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Measuring Biodiversity

- **Biodiversity is most commonly measured by counting species.**
- **Species richness is the number of species in an area.**
- **Biodiversity can be measured using local, regional, or global scales.**



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How Many Species?

- **Biodiversity varies widely around the planet and over time.**
- **About 1.8 to 2.0 million species have been described.**
- **Not all groups of organisms or parts of the world have been studied equally. The areas with the most species, the tropics, are the least known.**
- **70% of species on the planet occur in only 12 countries: Australia, Brazil, China, Columbia, Ecuador, India, Indonesia, Madagascar, Mexico, Peru, Zaire**

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Estimating Numbers of Species

- Rain forest insect samples help estimate biodiversity from limited information.
- Ecological ratios use well-studied groups to predict diversity of less-studied groups.
- Species-area curves predict numbers of organisms in unsampled areas.

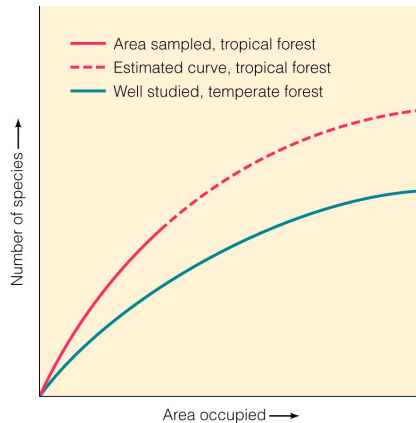


Figure 4-6 Species area curves for well-studied temperate forests compared to tropical forests.

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Biodiversity Today: A Rare Period in Earth's History

- Scientists agree that we exist in a period in history where there is more diversity than ever before.
- The sheer number of species is hard to quantify.
- Terrestrial ecosystems contain more diversity than oceanic ecosystems.

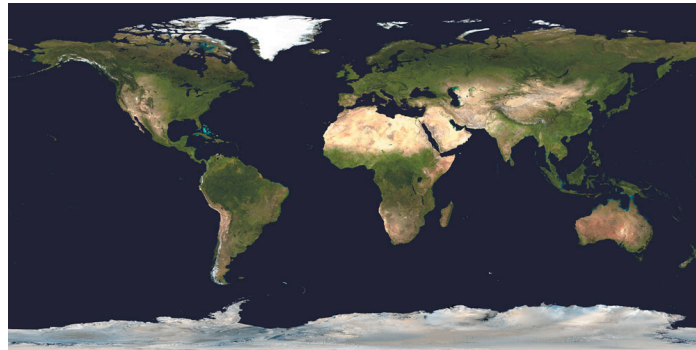


Herd of springbok, southern Africa.

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Biomes and Communities

- A biome is a large-scale category that includes many communities of a similar nature.
- There are seven major types of terrestrial biomes and two major aquatic biomes.



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Biomes are Determined by Climate

- Particularly important is temperature, which is linked to altitude and latitude, as well as moisture/precipitation.

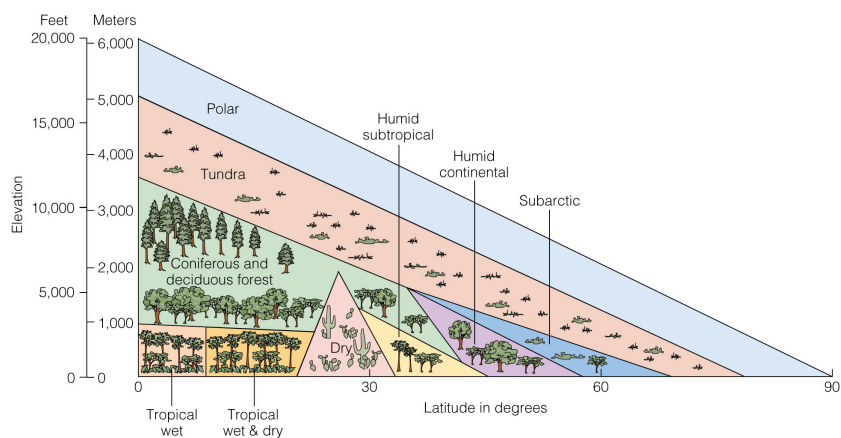


Figure 4-8 Vegetation changes with altitude and latitude.

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Seven Major Terrestrial Biomes

1. Tundra
2. Grassland
3. Savanna (includes chaparral)
4. Desert
5. Taiga
6. Temperate Forest
7. Tropical Forest

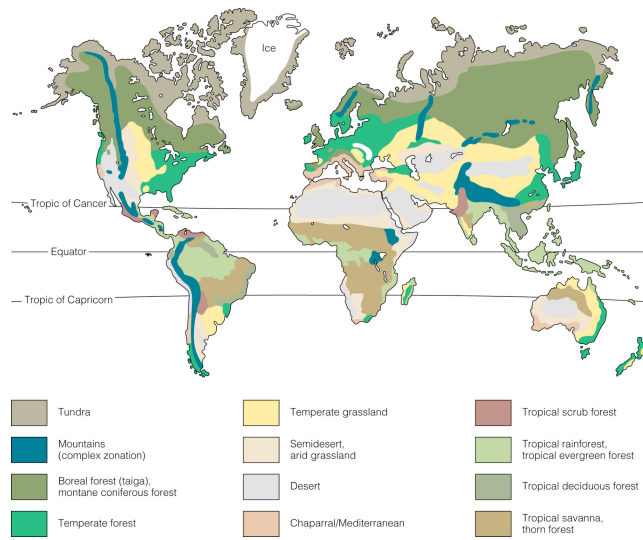


Figure 4-9

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Major Aquatic Biomes

1. Marine
2. Freshwater

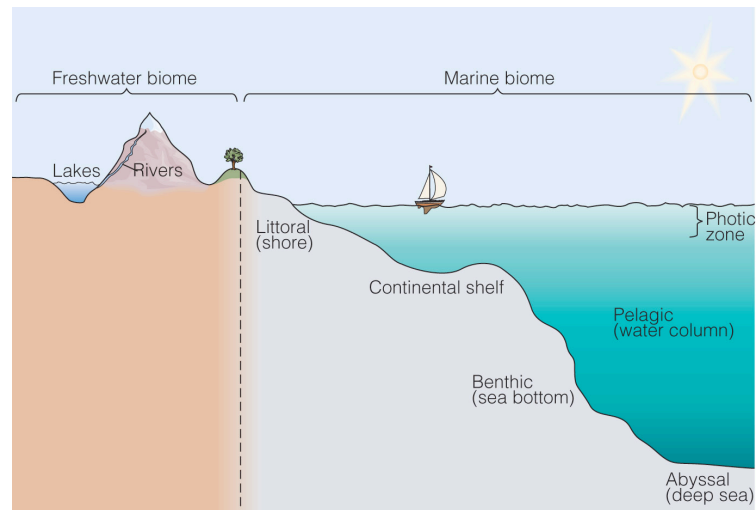


Figure 4-19

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Question

◆ Would you expect to find similar plants in the Swiss Alps and the Himalayan mountains?

A. Yes, same biome

B. No, too far away from each other



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