
The Distribution of Life

Module 3 • i2P • Biodiversity



I believe that there is a subtle magnetism in Nature, which, if we unconsciously yield to it, will direct us aright.

~Henry David Thoreau



TROPICAL POLAR BEARS

If you were to go fishing in a lake, wherever you live, be it the United States, Canada or Kenya, it is very unlikely that you will find a Great White Shark on the end of your fishing line. It would be equally surprising for you to see a Polar Bear ambling down the street on your walk to school in the morning. In the Amazon, the i2P team is unlikely to discover a new species of tropical Polar Bear. Polar Bears are adapted to life in cold environments and would not last long in the tropics.



Figure 1: Polar Bear, unlikely to be moving to the tropics soon(source: [US Fish & Wildlife](#)).

Like the Polar Bear, most species of life are adapted to live in very specific habitats. Camels can survive long spells without water, Coconut Palms need a great deal of heat, and Penguins survive best in the cold. Each species is adapted to survive in a specific habitat or niche. As a consequence there is a patchwork distribution of different species of life across the world, each possessing unique traits that allow them to survive in their native habitat.

The distribution of life on Earth however is not equal. There are some environments such as the Amazon Rainforest that enjoy a relative abundance of life. Similarly there are harsh and unforgiving environments such as the Antarctic Plateau where one would be hard pressed to find any life form.

BIOMES

As we have learned in previous modules (see Module 1) biodiversity is “the variability among living organisms from all sources and the ecological complexes of which they are

a part; this includes diversity within species, between species, and of ecosystems.” (see: [biodiversity](#)) By considering how species of life are distributed around the world this module focuses on the global distribution of ecosystems or biomes.

A biome is an ecological community of organisms associated with particular climactic and geographic conditions, such as deserts, grasslands, and tropical rainforests (see: [biome](#)) A biome often contains many ecosystems. Biomes are complex entities that have ill-defined borders. For instance, the separation between the tropical rainforest biome and the subtropical rainforest biome may be very subtle for an individual walking between them. Nonetheless biomes serve as important categories for defining and quantifying ecological systems. It is by classifying tropical rainforests as a discrete biome that scientists have been able to observe and measure the decrease in rainforests from an estimated 12 percent of the world's terrestrial surface to the current 5 percent.



Figure 2: A leaf from a tree that lives in a boreal biome (source: [David Monniaux](#))

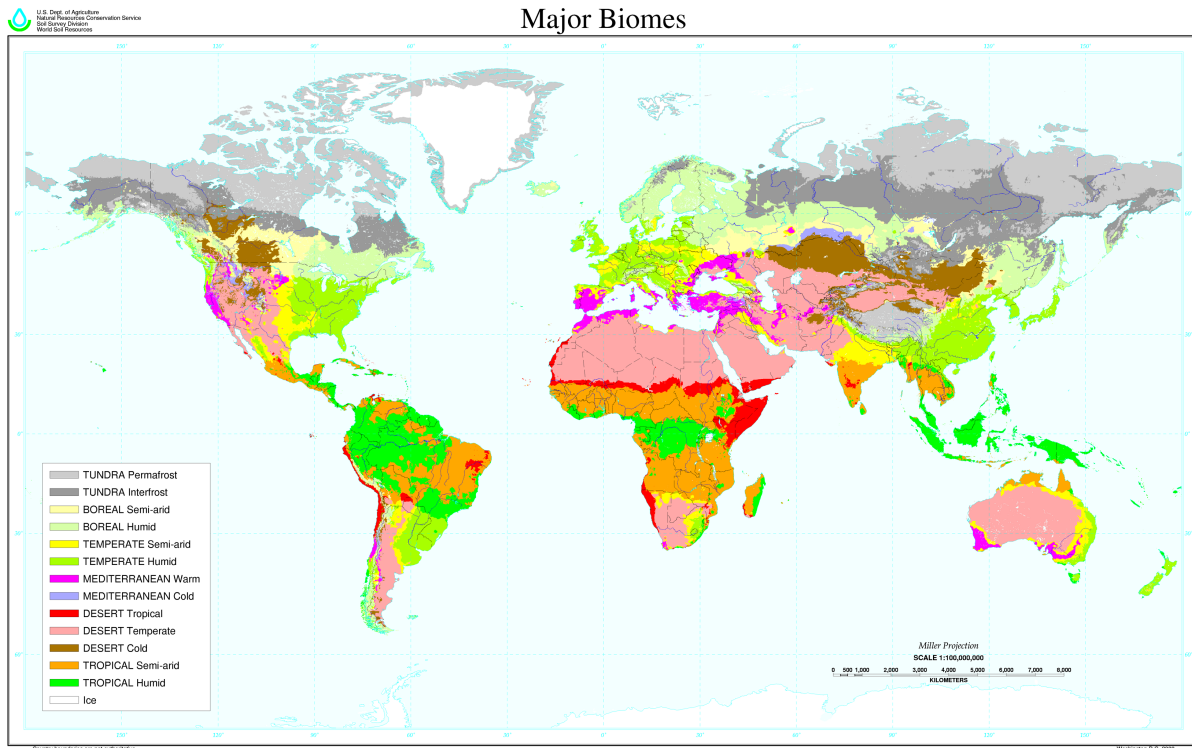


Figure 2: Major Terrestrial Biomes of the World (Source: [USDA](#)). Tropical Rainforests are in bright green.

Biomes are separated into two broad categories:

- Terrestrial
- Aquatic

TERRESTRIAL BIODIVERSITY

Terrestrial biomes are the category of ecological regions found on land, and aquatic biomes those found in the ocean and fresh water systems. Although the total number of terrestrial biomes is disputed, scientists have agreed on at least eight: tundra, taiga, temperate deciduous forest, scrub forest, grassland, desert, tropical rainforest, and temperate rain forest.

Terrestrial Biomes are largely differentiated by climactic and geographic factors. Temperature plays a significant role in determining what species can survive in a habitat, with warm and consistent temperatures providing a more hospitable environment. Consequently as one moves away from the equator toward the poles of the Earth, or rises in elevation, the average temperature cools and the biodiversity of the habitat decreases.

Humidity also plays an important role in determining the scope of

Did You Know?

Compared to other regions, insects are scarce in Antarctica. Only 67 species have been recorded, and most are parasites, like lice which live in the feathers and fur of birds and seals., where they are protected from the harsh climate for much of the time. Collemola (springtails) are the only free-living insects. They feed on algae and fungi, and remain dormant in winter.

see: [cold insects](#)



Figure 3: The Antarctic biome supports much less life than the tropical rainforest biome (sources: [Joe Mastrianni](#) & [Tiago Florese](#))



biodiversity of a biome. Water is an essential element of all life and relative abundance of water increases biodiversity. It follows then that the Amazon Rainforest with one of the highest rates of precipitation on the planet is home to abundant biodiversity. Conversely deserts, even those that are warm, such as the Sahara, have a relative paucity of life forms compared to warm moist environments like tropical rainforests. Following these principles it becomes clear that the land environment with the least biodiversity on Earth will be the coldest, driest location on the planet. Indeed, Antarctica the coldest, driest habitat on Earth is also the least biologically diverse location on the planet.

AQUATIC BIOMES

The largest part of the biosphere by size is made up of aquatic biomes. There are two principle categories of aquatic biomes: freshwater and marine. It was in the aquatic biome that life first arose 3.8 billion years ago, and remained there for almost three billion years before migrating onto land. Although the aquatic biome is the largest category by size it does contain fewer species than there are on land (see: [aquatic](#)). The climactic principles of terrestrial biodiversity apply, in part, in the aquatic domain. Cooler waters host less biodiversity than biomes with warm waters. Water becomes cooler with greater depth and as one moves away from the equator, and this reflects the presence of less biodiversity in these regions (see: [marine](#)).



Figure 4: A green turtle (source: [Mila Zinkova](#))

HOTSPOTS

Based on the density of species there are some regions of the world that are considered to be “hotspots” for biodiversity. Hotspots were defined by British ecologist Norman Myers in 1988 as locations of high biodiversity that were threatened with destruction. To qualify as a hotspot, a region must contain at least 1,500 species of endemic vascular plants (> 0.5 percent of the world’s total) and must have lost at least 70 percent of its original habitat. There are 34 designated biodiversity hotspots in the world that contain 50% of the world’s endemic plant species and 42% of the world’s endemic terrestrial

vertebrates (see: [hotspots](#)). Collectively the hotspots make up only 1.4 % of the world's surface. Myers has proposed that these locations should be preferentially preserved in the global effort to conserve biodiversity, arguing that conserving a significant proportion of the planet's biodiversity by focusing on only 1.4 % of the world's surface will be very cost effective (see: [conservation](#)).

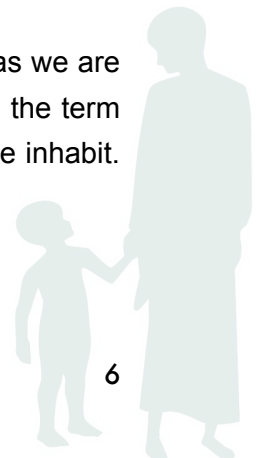
ANTHROPOGENIC BIOMES

Although climate and geology have a significant bearing on the biodiversity of a biome, any discussion of the distribution of life on Earth would not be complete without addressing man-made or anthropogenic biomes. Anthropogenic biomes are ecosystems caused and influenced by human activity, and are principally the byproduct of agriculture, urbanization, forestry, and over-consumption of resources. With the support of technology, human activity has now reshaped a significant proportion of the Earth's biosphere. This is seen in the deforestation of rainforest for use as agricultural land, and the loss of fish stocks due to overfishing. Studies have demonstrated that human activity has now reshaped over 75% of the earth's ice free land mass. Human activity now rivals climate and geography as a primary influence on the Earth's biodiversity. Human activity has resulted in the displacement of traditional species from many of the Earth's longstanding biomes.



Figure 5: New York City is an extreme example of an anthropogenic biome (source: [Daniel Schewn](#))

The loss of traditional biomes can have profound consequences for humanity, as we are dependent upon the natural world for our long-term welfare. Biodependence is the term coined to describe the co-dependence of human beings on the natural world we inhabit. Walter Reid of the World Resources Institute has written,



"A fundamental rationale for the conservation of biological diversity is that biodiversity is inseparable from humanity. From the standpoint of our relationship to other species on earth, and from the standpoint of our relationship to future human generations, we have a moral-as well as utilitarian-responsibility to maintain the planet's richness of species and genetic diversity." (see: [humanity](#))

Definition:

Carrying Capacity of the Earth

Ecologists define carrying capacity as the "maximal population size of a given species that an area can support without reducing its ability to support the same species in the future."

For mankind the carrying capacity of the Earth is the upper limit of human beings the planet can sustain. In simple terms this translates into the capacity of the Earth to provide food to sustain the human population. There is a maximum amount of food the planet can produce and hence a maximum human population.

Scientists are concerned that a reduction in biodiversity will decrease the carrying capacity of the Earth. In other words a decrease in biodiversity will result in a decreased capacity of the planet to furnish the food needed to sustain human life. Add to this that there has been tremendous growth in the world's population from 1.6 to 6.1 billion people during the 20th century, and continued growth in this century. Few disagree that human population growth can continue without running out of food and water.

see: [population growth](#)

Did You Know?

In *An Essay on the Principle of Population*, published in 1798, economist Thomas Robert Malthus made his famous prediction that world population growth would outrun the food supply. This prediction was based on the assumption that population, if unchecked, increases at a geometric rate, while food supply grows at an arithmetic rate.

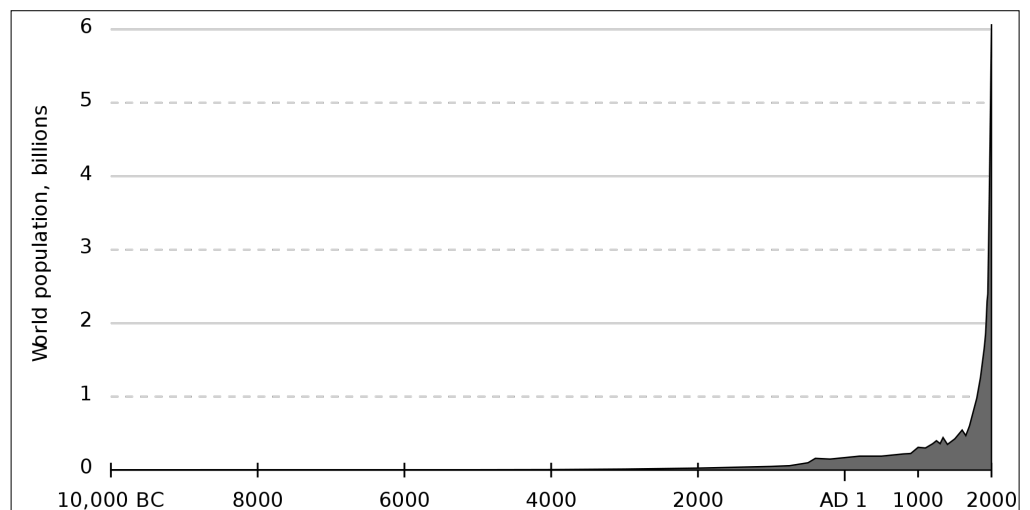


Figure 4: World human population (est.) 10,000 BC–2000 AD (source: [ELI](#))