

Lecture: Biomes

The structure of an ecosystem is defined by its soil, climate, flora and fauna. A large geographic region characterized by a certain type of ecosystem is known as a **BIOME**.

Major Aquatic Biomes

These occupy most of the biosphere. Life originated in the oceans, and stayed there for nearly 3 billion years. The oceans are the most influential of all features affecting climate and biomes.

Aquatic Biomes may be...

- | | | |
|--|---|--|
| 1. Freshwater:
lakes/ponds
rivers/streams | 2. Freshwater/brackish:
estuaries
wetlands | 3. Marine:
intertidal regions
coral reefs
oceanic pelagic zones
abyssal zones |
|--|---|--|

We Can Classify Aquatic Biomes on the basis of various properties such as...

Light

Light is absorbed by water and by living aquatic organisms

photic zone - light sufficient for photosynthesis

aphotic zone - light insufficient for photosynthesis

Temperature

Temperatures vary with depth, and aquatic habitats of any depth generally have a

thermocline--a narrow band of water where temperature suddenly changes.

Productivity (

As you will learn later, **productivity** is a measure of how much biomass (dry organic matter) a particular ecosystem gains over a specified period of time.

oligotrophic - deep, nutrient poor, water very clear

eutrophic - shallower, nutrient rich, murky with phytoplankton
(a note on CULTURAL EUTROPHICATION)

mesotrophic - in between the above two classifications

Major Terrestrial Biomes

Terrestrial Biomes are determined by climate which, in turn, determines the flora of the biome. Plant species can be characterized by their need for water:

xeriphyte - plant adapted for survival in very dry habitats

hydrophyte - plant adapted for survival in very wet habitats

mesophyte - plant adapted for survival in moderate (not too wet, not too dry) habitats

Biomes and ecosystems are characterized by many species, but of special note to the ecologist concerned with conservation are the...

Keystone species - A species upon which many other species in an ecosystem depend for survival. (e.g., Alligator in the Everglades)

Indicator species - A species whose numbers can tell us about the health of the ecosystem. (When the population numbers of an indicator species decline, something is wrong. (e.g. corals in the Biscayne National Park)

- ☆ **Polar Biomes at the north (Arctic) and south (Antarctic) poles**
 - o Located above 60° North and South latitudes
 - o Arid (for the reasons described in the section on climate)
 - o Bitterly cold temperatures
 - o Day length varies tremendously, with 24 hour daylight or night at the solstices.
 - o Low animal diversity
 - o Most photosynthetic organisms are marine (most solar energy captured in water).
 - o Some typical vertebrates you might find here: penguins (Antarctic only; no penguins in the North), seals, walruses, whales, polar bear. Many marine fish, invertebrates
- ☆ **Arctic Tundra**
 - o Located just south of the polar regions in the northern hemisphere.
 - o Arid (as are the polar regions)
 - o Characterized by **permafrost**: a permanently frozen layer of soil, which may be deeper in summer than in winter, but still prevents the growth of large trees with deep roots.
 - o most plants are scrubby and small
 - o lichens (fungus/algae symbiosis) are a major photosynthetic food source
 - o High winds and cold temperatures prevail
 - o Very short days in winter, very long days in summer
 - o Typical vertebrates: reindeer/caribou, Snowy Owls, Grizzly Bear, Brown Bear, Wolf, Arctic Fox, Ptarmigan (a partridge-like bird), migratory birds, lemmings and other small rodents
- ☆ **Coniferous (Boreal) Forest (also known as "taiga")** .
 - o Found south of the arctic and tundra regions, primarily in the northern hemisphere
 - o Northern boreal forest receives tremendous snowfall in winter; the conical shape of pines may help them shed snow and avoid damage to their branches from the weight of snow.
 - o Highly endangered, these ecosystems are being rapidly logged out, especially in North America.
 - o Also found in the Andes of South America and in vast areas of Siberia
 - o Major plant form: evergreen, coniferous trees such as pines, firs, spruce, etc. (cone-bearing trees). Under the trees grow shrubs, mosses, ferns, etc.
 - o Relatively high levels of rainfall, but short days in the winter.
 - o Typical vertebrates: deer, wolf, bear, foxes, many migratory birds, squirrels, rabbits, etc.
 - o Higher species diversity than tundra.
- ☆ **Temperate Deciduous Forest**
 - o Found south of the coniferous forest in areas of relatively high rainfall and relatively high elevation, but with longer day length than in coniferous regions
 - o Major plant form: **deciduous** (i.e., trees that seasonally drop their leaves) flowering trees and shrubs.
 - o Typical temperate deciduous forest areas are the NE U.S. and most of Europe.
 - o Typical vertebrates: deer, wolf, bear, foxes, many migratory birds, squirrels, rabbits, etc. Higher species diversity than coniferous forest. Some species hibernate in winter.
- ☆ **Prairie (Temperate Grassland)**
 - o Distinct seasonal changes, moderate rainfall, extremely rich, organic soil.
 - o Major plant forms: annual grasses and flowering plants; some areas with more standing water become marshes characterized by small trees such as willows
 - o Very fertile land, but with harsh seasonal variations: hot summers, cold winters
 - o The *veldt* of South Africa, the *puszta* of Hungary, the *pampas* of Argentina, the steppes of Central Asia, and the plains of the central U.S. are all examples of this biome.
 - o Most of these grasslands have been converted to farmland for human use, but

some native grasslands have been preserved.

- o Typical vertebrates: American Bison (sometimes erroneously called "buffalo"), prairie dog, jackrabbit, fox, coyote, deer, many migratory birds (especially predatory birds such as hawks and falcons), etc. Many animals hibernate in winter.

☆ **Savanna (Tropical/Subtropical Grassland)**

- o Distinct seasonal changes, highly seasonal rainfall (harsh dry season), rich, organic soil.
- o Major plant forms: annual grasses and flowering plants; Trees are generally very drought tolerant and have high canopies due to herbivory by large animals such as elephants and giraffes.
- o Fire is a major abiotic component of this biome, and most plant species have evolved to withstand periodic fires
- o Very fertile land, but with harsh seasonal variations: very wet season followed by extremely harsh dry season (during which most animals migrate away)
- o Lush grass and shrubby growth in the rainy season provides ample food for large animals, but they must migrate to greener pastures during drought.
- o Typical vertebrates: grazing hoofed mammals (gazelles, antelopes, etc.), lions, leopards, cheetahs, elephants, giraffes, true buffalo (Water Buffalo, Cape Buffalo), rhino, hippopotamus, etc.

☆ **Chaparral (Mediterranean Scrub Forest)**

- o Found in arid regions with Mediterranean climate (e.g., southern California, Spain, European and African areas bordering the Mediterranean Sea; southern tip of Africa, southwestern tip of Australia)
- o Winters are rainy and mild; summer days are long, hot, and very dry
- o Characterized by periodic, seasonal fires
- o Major plant forms: Dense, spiny, evergreen shrubs (some of these produce seeds that will germinate and grow only after they've been through a fire.)
- o Typical vertebrates: coyote, mule deer, various rodents, many lizards, snakes, birds etc.

☆ **Tropical Rainforest**

- o Found worldwide (at least in times past) around the equator
- o Extremely high levels of rainfall
- o Poor nutrient content in soils due to high levels of rainfall
- o Most biodiverse terrestrial biome: 50% of all species live here!
- o Tremendous plant diversity; large trees have shallow root systems evolved to be able to quickly absorb nutrients as soon as they become available (due to decay of dead things), before the rains wash them away.
- o Very dense plant growth and very high level of productivity
- o In mature rainforest, the forest floor is relatively clear of plants, since upper canopy of trees blocks most sunlight. With treefall a new growth of shrubby "**pioneer species**" germinates from the soil and provides cover for the forest to re-grow.
- o Typical vertebrates: More than 50% of all the earth's terrestrial animal species are found in the tropical rainforest. Representatives of just about every major animal group.

☆ **Desert**

- o Extremely arid (dry). Very hot in the daytime; in some regions, extremely cold at night
- o High nutrient levels in the soil due to very little rainfall (it doesn't wash away)
- o Sparse plant life due to very low humidity and available water
- o Plantlife is **xeriphytic** (from the Greek *xeri*, meaning "dry" and *phyt* meaning "plant"): evolved to have special adaptations to store and avoid losing water.
- o typical plants: cactus, Yucca, xeriphytic shrubs of various species, spectacular explosion of flowering annuals comes with the spring rains

o typical vertebrates: drought-tolerant mammals such as desert foxes, burros, snakes, lizards, tortoises, jackrabbits, desert-adapted birds

Remember the link between soil nutrient content and precipitation.

Which biomes have the highest productivity?

Which have the highest and lowest soil nutrient content?

Which are most useful to humans for agriculture?

Which are the most endangered?

Which would have the most profound effect on us, if they were lost?

Plant types:

* **xeriphyte** - plant adapted for survival in very dry habitats

* **hydrophyte** - plant adapted for survival in very wet habitats

* **mesophyte** - plant adapted for survival in moderate (not too wet, not too dry) habitats

The Florida Everglades: Our Own Personal Biome

The Everglades is a major Florida ecosystem with characteristics of both terrestrial and aquatic biomes. Everglades National Park (ENP) contains dry land areas:

hardwood hammock

Here, hardwood (flowering) trees grow in dense profusion, sheltering smaller shrubs and other plants with their shade. Many are xeriphytic. Despite the great amount of water in the Everglades, the soil is porous, and quickly drains moisture.

Examples of plants: Gumbo limbo tree, Eastern Live Oak, Poisonwood, Cocoplum, Pigeon plum

pineland scrub

Here the dominant species is the Dade County Slash Pine (*Pinus elliotii*), but many other small, xeriphytes (i.e., plants adapted for dry habitats) live.

Examples of plants: Dade County Pine, Saw palmetto, many different xeriphytic shrubs and annuals.

ENP also contains vast expanses of wetland covered by shallow, slow-moving water. It has been called a "River of Grass" because of the sawgrass that grows in the shallow marsh and is a major keystone species in this part of the Everglades.

marsh - shallow, slow-moving water

swamp - shallow, stagnant water that doesn't move much

Can you think of keystone and indicator species in the Everglades?