DEPARTMENT OF BIOLOGICAL SCIENCES

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COURSE

BIO 110 (GENERAL BIOLOGY)

ON ECOLOGY

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ECOLOGY

- The term ecology was introduced by the German biologist Ernst Heinrich Haeckel in 1866; it is derived from the Greek *oikos* (“household”) and OLOGY, “the study of, sharing the same root word as *economics*.

- Thus, the term implies the study of the economy of nature. Modern ecology, in part, began with Charles Darwin in developing his theory of evolution, Darwin stressed the adaptation of organisms to their environment through natural selection, also making important contributions were plant geographers, such as Alexander von Humboldt, who were deeply interested in the “how” and “why” of vegetational distribution around the world.

- **Evolution of Definitions of Ecology**
  - **Heackle (1870):** By ecology we mean the body of knowledge concerning of the economy of Nature- the investigation of the total relations of the animals to its inorganic and organic environment"
  - **Burdon-Sanderson (1890s):** Elevated Ecology to one of the three natural divisions of Biology: Physiology-Morphology-Ecology
  - **Elton (1927): "**Scientific natural history"
  - **Andrewartha (1961)**: "the scientific study of the distribution and abundance of organisms".
  - **Odum (1963):** The structure and the function of Nature"

- Generally, **Ecology** is the scientific study of the processes regulating the distribution and abundance of organisms and the interactions among them, and the study of how these organisms in turn mediate the transport and transformation of energy and matter in the biosphere (i.e., the study of the design of ecosystem structure and function).

Ecology

- The study of the interactions of living things (organisms) with each other and their physical environment. Note : **Interaction, Organisms and environment**

- **Interactions** determine distribution and abundance of organisms.
- **Two main themes in ecology are:**
  - Where do organisms live? and Why?
  - How many organisms are present? and Why?
- **ecology** was historically an observational science, often descriptive → natural history.

Organism and its Environment

- In biology, an **organism** is any contiguous living system or **biological** entity, such as an animal, plant, fungus or bacterium.

- The “Environment” all of the external factors affecting an organism.
- Is a general term referring to climate, air, water, soil, temperature.

- An organism’s environment has both abiotic and biotic components.

  -Abiotic components are nonliving chemical and physical factors such as temperature, light, water, and nutrients.

- - Biotic components are living factors such as other organisms.

Ecological Organization

Ecological research scale ranges from individuals to the biosphere.

- Individual/Organismal
- Population
- Community
- Ecosystem
- Landscape
- Biome
- Biosphere

1 **Individual/Organismal** is concerned about the way in which an individual interacts with its environment.

2 **Population**: all the members of a species inhabiting a given location. Group of interacting and interbreeding organisms. Populations are made up of all the members of a species living in the same place at the same time.

a population is a group of organisms of the same species living in the same place at the same time.

3

Community: is the study of the interactions among a collections of species that inhabit the same geographic area all the interacting populations in a given area. Interacting populations which significantly affect each other's distributions and abundance (hot spring wetland….).

A community includes all the populations of the area. The community and the abiotic factors make up the ecosystem. a community consists of the organisms that live in an area and interact

4. **Ecosystem**: the living community and the physical environment functioning together as an independent and relatively stable system . Set of organisms and abiotic components connected by the exchange of matter and energy (forest, lake, coastal ocean). Or, “ the smallest units that can sustain life in isolation from all but atmospheric surroundings.

- There are many examples of ecosystems - a pond, a forest and a grassland

Landscape

- Landscape: Research in Landscape ecology focuses on the factors controlling exchanges of energy, materials and organisms across multiple ecosystem.
- interactions among ecosystems
- The goal is to predict the responses of different organisms to changes in landscape, to ultimately facilitate ecosystem management

Biome

- Biomes are larger units of organization that categorize regions of the Earth's ecosystems.
- Regions of the earth that are similar in organism type although the particular species differ
- Driven largely by climate – temp., water,
- Other factors – soil,

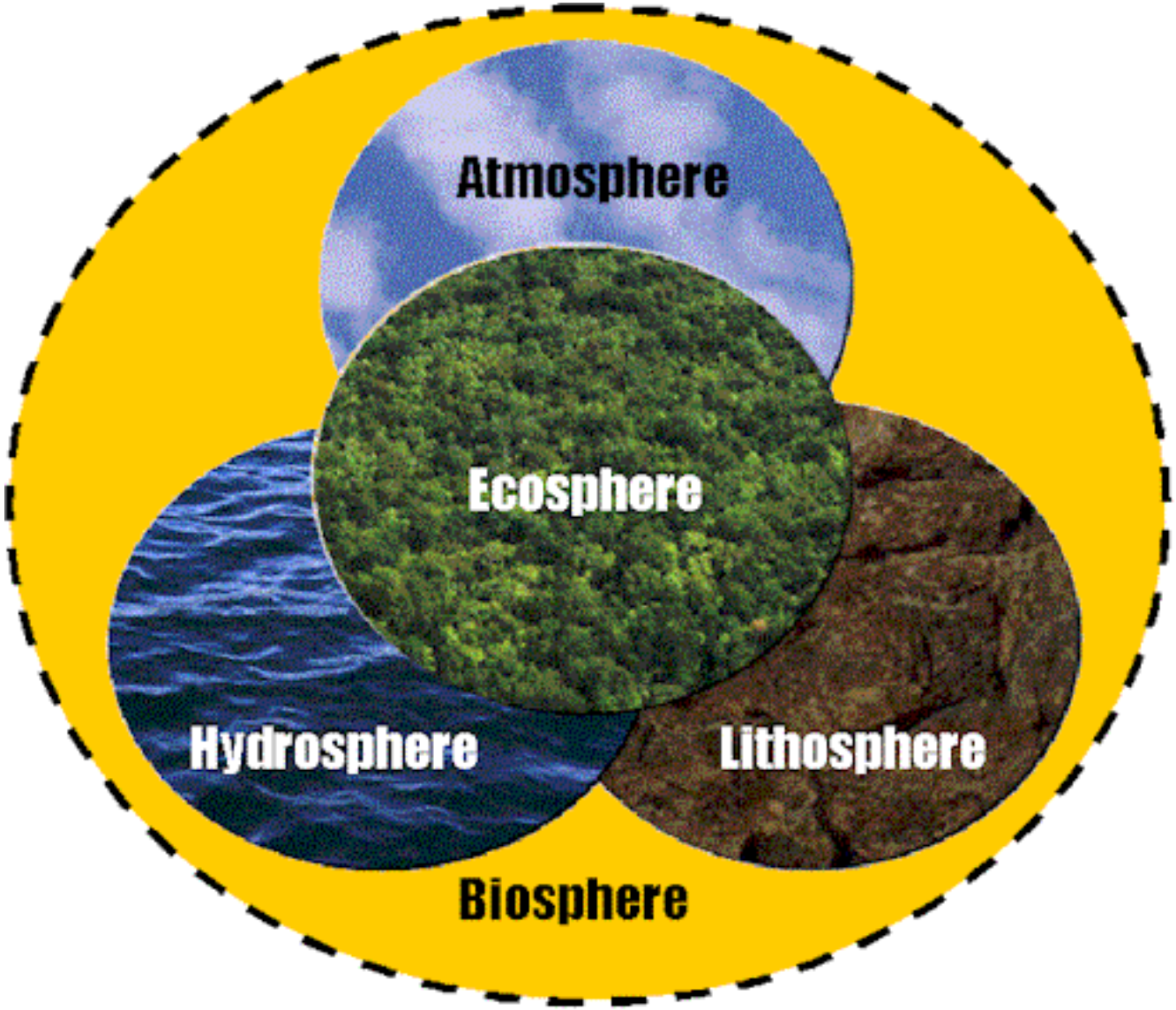
5. Biosphere: The largest scale of ecological organization is the biosphere: the total sum of ecosystems and landscape on the planet.

The biosphere is the part of earth where all life is found, and it consists of biotic (living) factors as well as abiotic (nonliving) factors such as air, soil, water, and sunlight.

The earth's ecosystem interacting with the physical environment as a whole to maintain a steady state system intermediate in the flow of energy between the high energy input of the sun and the thermal sink of space (merge with atmosphere, lithosphere hydrosphere)

- "is the portion of the earth where life exists"

The biosphere is composed of numerous complex ecosystems.


Atmosphere
Ecosphere
Hydrosphere
Lithosphere
Biosphere

(a) Organismal ecology.
How do humpback whales select their calving areas?

(b) Population ecology.
What enviromental factors affect the reproductive rate of deer mice?

(c) Community ecology.
What factors influence the diversity of species that make up a particular forest?

(e) Landscape ecology.
To what extent do the trees lining the drainage channels in this landscape serve as corridors of dispersal for forest animals?

(d) Ecosystem ecology.
What factors control photosynthetic productivity in a temperate grassland ecosystem?

Summary

- A **Species** is a single organism. A **Population** is a group of organisms of the same species that can interbreed and produce fertile offspring. Organisms that aren't in the same population can't have fertile offspring (kids that can have kids). In other words, a cat and a dog can't be considered a population because they can't produce a normal kid. However, 2 dogs or 2 cats would be considered a population.

- A **Community** would be 2 different populations put together in the same place at the same time. Such as a group of zebra and a group of elephants that live in the same area of Africa. They would be considered a community.

- An **Ecosystem** is just the community plus the abiotic factors in that environment. So in other words, that same zebra and elephants, if you added in all the water, sunlight, soil, and temperature in that environment it would be called an "ecosystem". Simple, I know.

- **Landscape** is the interaction between people and place; the bedrock upon which our society is built. A picture representing a section of natural, inland, woodland.
- Landscape composed of an interacting of ecosystems and populations of many species

- **Biome** is a an area of planet that can classified according to the plants and animals that live in it. It is defined as a community of various plants and animals that inhabit a particular type of geographic region of Earth. Biomes are often defined by their climate, rainfall/water characteristics, elevation, and plant characteristics (leaf type, spacing, etc)
- And finally, the **Biosphere** is the entire sphere of life. Basically the earth.

- An ecosystem involves interactions between abiotic (physical) and biotic (living) factors. The members of the community in the ecosystem and environment must interact to maintain a balance.

An **ecosystem** is self-sustaining if the following requirements are available:

a. A constant source of energy and a living system capable of incorporating this energy into organic molecules.

b. A cycling of materials between organisms and their environment.

In all environments, organisms with similar needs may compete with each other for resources, including food, space, water, air, and shelter.

Abiotic factors

- Are those physical and chemical factors which affect the ability of organisms to survive and reproduce

Some Abiotic Factors:

1 intensity of light
2. range of temperatures
3. amount of moisture
4. type of substratum (soil or rock type)
5. availability of inorganic substances such as minerals
6. supply of gases such as oxygen, carbon dioxide, and nitrogen
7. pH

Abiotic (Chemical factors)

- Oxygen
- Salinity
- pH
- water,
- nutrients,
- Soil or rocks,
- weather, etc.

Abiotic (Physical factors)

- Temperature
- Light
- Soil structure
- Fire
- Moisture

Each of the prior listed abiotic factors varies in the environment and, as such, may act as a limiting factor, determining the types of organisms that exist in that environment.

Some examples

1. A low annual **temperature** common to the northern latitudes determines in part the species of plants which can exist in that area.
2. The amount of **oxygen** dissolved in a body of water will help determine what species of fish live there.
3. The **dry** environment of desert regions limits the organisms that can live there.

Biotic factors:

- All the living things that directly or indirectly affect the environment
- Thus, the organisms, their presence, parts, interaction, and wastes are all biotic factors.

- Biotic means living, and biotic factors are the other, living parts of the ecosystem with which an organism must interact. The biotic factors with which an organism interacts depend on whether it is a producer, a consumer, or a decomposer.

Biotic factors

- The presence of competitors or predators (organisms that kill their prey)herbivores (organisms that eat plants or algae) may limit an organisms ability to establish itself.

- For example, algae are eaten by sea urchins and limpets, which limits the ability of seaweeds to establish themselves on rocks

- interactions with other organisms
- – Negative: predation or competition
- – Positive: facilitation (e.g., pollinators

Adaptation

- **Adaptation** is the evolutionary process whereby an organism becomes better able to live in its habitat or habitats.
- **Adaptation,** in biology, process by which an animal or plant species becomes fitted to its environment; it is the result of natural selection's acting upon heritable variation. Even the simpler organisms must be adapted in a great variety of ways: in their structure, physiology, and genetics, in their locomotion or dispersal, in their means of defense and attack, in their reproduction and development, and in other respects.
- The word *adaptation* does not stem from its current usage in evolutionary biology but rather dates back to the early 17th century, when it was used to indicate a relation between design and function or how something fits into something else. In biology this general idea has been coopted so that *adaptation* has three meanings. First, in a physiological sense, an animal or plant can adapt by adjusting to its immediate environment—for instance, by changing its temperature or metabolism with an increase in altitude. Second, and more commonly, the word *adaptation* refers either to the process of becoming adapted or to the features of organisms that promote reproductive success relative to other possible features

Habitat and Niches

- The community provides the habitat—the place where particular plants or animals live.
- Within the habitat, organisms occupy different niches.
- A niche is the functional role of a species in a community—that is, its occupation, or how it earns its living. For example, the scarlet tanager lives in a deciduous forest habitat. Its niche, in part, is gleaning insects from the canopy foliage. The more a community is stratified, the more finely the habitat is divided into additional niches.

Nutritional Relationships

A. Autotrophs: can synthesize their own food from inorganic compounds and a usable energy source

B. Heterotrophs: can NOT synthesize their own food and are dependent on other organisms for their food

Types of Heterotrophs:

Saprophytes: include those heterotrophic plants, fungi, and bacteria which live on dead matter - AKA decomposers

Herbivores: plant-eating animals

Carnivores: meat-eating animals

Omnivores: consume both plants and meat

Types of Carnivores:

- Predators: animals which kill and consume their prey
- Scavengers: those animals that feed on other animals that they have not killed

Symbiotic Relationships

- Symbiosis: living together with another organism in close association
- Types of (symbiosis):

1. Commensalism: one organism is benefited and the other is unharmed ex. barnacles on whales, orchids on tropical trees.

2. Mutualism: both organisms benefit from the association ex. nitrogen-fixing bacteria on legume nodules, certain protozoa within termites (also ruminants)

3. Parasitism: the parasite benefits at the expense of the host ex. athlete's foot fungus on humans, tapeworm and heartworm in dogs

- A. Food chain: involves the transfer of energy from green plants through a series of organisms with repeated stages of eating and being eaten
- B. Food web: In a natural community, the flow of energy and materials is much more complicated than illustrated by any one food chain.