

Lecture Seven: Ecology

Ecology (from the Greek *oikos* meaning "house" or "dwelling", and *logos* meaning "discourse") is the study of the interactions of organisms with each other and their environment.

Always remember that Ecology is a **SCIENCE**, not a sociopolitical movement (e.g., environmentalism). The Ecologist engages in the hypothetico-deductive method to pose questions and devise testable hypotheses about ecosystems.

The hierarchy. We should be able to define each of the following.

- * species -
 - * population -
 - * community -
 - * ecosystem -
 - * biome -
 - * biosphere -

The **ECOSYSTEM** is all living communities (**biotic**) and their associated non-living (**abiotic**) environmental components in a defined area. Examples in southern Florida:

Everglades - a shallow wetland, or marsh

Hammock - hardwood (i.e., flowering tree) forest on higher ground within the Everglades

Pine rocklands – on higher ground, maintained by fire which prevents hardwoods from taking over.

Coral Reef

Estuary

Mangrove

Evolution by natural selection is driven by ecological interactions in these habitats.

Levels of Ecological Study

ORGANISMAL ECOLOGY - the study of individual organisms' behavior, physiology, morphology, etc. in response to environmental challenges.

POPULATION ECOLOGY - the study of factors that affect and change the size and genetic composition of populations of organisms.

COMMUNITY ECOLOGY - the study of how community structure and organization are changed by interactions among living organisms

ECOSYSTEM ECOLOGY - the study of entire ecosystems, including the responses and changes in the community in response to the abiotic components of the ecosystem. This field is concerned with such large-scale topics as energy and nutrient cycling.

Abiotic Components of the Biosphere

The plant community of a particular region depends on the **CLIMATE**--the combination of temperature, water, light, and wind. And the flora (plants) directly affects the composition of the fauna (animals).

TEMPERATURE:

- * contributes to erosion & creation of soil
- * affects what animals and plants can survive in an area, since different organisms have different tolerances for cold and heat

WATER:

- * The chemical balance of living tissues is a challenge in terrestrial and freshwater environments
- * species that have secondarily returned (what does this mean? HINT: dolphins and whales have secondarily returned to marine water) to marine environments face osmotic challenges, as the ocean is now saltier than when their ancestors left it.
- * important component in erosion & creation of soils

SUNLIGHT:

- * intensity varies with location and time of year
- * daily duration varies with location and time of year
- * angle of incidence of the sun (seasonal changes)
- * competition for light is an important selective factor in many environments, and this has driven selection of many species
- * photosynthesis wavelengths primarily in the blue & red regions of spectrum; understory and underwater regions have varying levels of these wavelengths, with red light being lost first, and blue light last.
- * Animals and plants react to light/dark cycles with behavioral changes. (e.g.,

Circadian rhythms)

WIND:

- * contributes to erosion
- * affects perceived temperature via evaporation & convection
- * affects desiccation rate
- * affects growth form of plants

ROCKS/SOIL:

- * topography creates habitat
- * mineral (inorganic nutrient) content of rock affects flora
- * pH of rock/soil affects flora
- * substrate composition affects any water in contact with that substrate

MAJOR ENVIRONMENTAL DISTURBANCES:

- * fire
- * severe storms (hurricanes, tornadoes, etc.)
- * volcanic activity
- * oh, heck. Comets, too.

A Wee Bit of ORGANISMAL ECOLOGY

The ability of an organism to survive the extremes of its environment determine its survival and reproduction. This is the basis of natural selection. The success of individuals in an ecosystem determines the structure of the population in that ecosystem.

Animals can be categorized by their ability (or inability) to control their internal environment (salt balance, water balance, temperature, etc.):

* **REGULATORS** - organisms able to use metabolic means to regulate their internal environments in response to environmental changes.

Example 1: thermoregulation (temperature control)

o Healthy mammals and birds are able to control their internal temperatures at a very constant level.

Example 2: osmoregulation ("salt balance")

o Some species of fish can migrate from salt to freshwater habitats every year with their breeding cycle (they're called "anadromous" fish). Other species can migrate from freshwater to marine habitats every year with their breeding cycle (they're called "catadromous" fish). These fish can maintain constant salt balance in their tissues via their renal systems (kidneys and associated structures), even when their environments vary drastically in salinity.

* **CONFORMERS** - organisms whose internal conditions are controlled primarily by environmental conditions.

Example 1: thermoregulation

o most insects cannot control their internal body temperature to any great degree. Rather, their bodies are usually the same temperature as the environment.

Example 2: osmoregulation

o Echinoderms (things like starfish, sea urchins, etc.), entirely lacking an excretory system, are strictly limited to marine environments, and their tissues have the same salinity as sea water.

We can also categorize animals based on (1) where they get their heat and (2) how they regulate their body temperature:

- * **ectotherm** - obtains heat primarily from the environment (a conformer)
- * **endotherm** - obtains heat primarily from metabolic reactions (a regulator)
- * **poikilotherm** - temperature regulated primarily by environment (a conformer)
- * **homeotherm** - temperature regulated by internal mechanisms (a regulator)

There is a continuum of tolerances to various environmental challenges within and among species. Beyond certain levels of any given factor, a lethal range exists. (Consider this for our own species!)

Short-term responses to environmental changes are known as ADAPTATIONS. These are governed by the internal control (homeostatic) mechanisms in the individual, but the limits are set by the EVOLUTIONARY HISTORY of that individual.

Individual adaptations to change may include:

physiological acclimation

Some species are able to physiologically ACCLIMATE (gradually change their tolerance levels) in a slowly changing environment, but this ability, too, is controlled by genes that have been selected over evolutionary time.

morphological change

Morphology may change in response to environment (consider coat changes; shape changes of crustaceans to environment)

behavioral adaptation.

Behavioral adaptations allow an animal to respond relatively quickly to environmental challenge.

Ecosystem Ecology

Most everyone has seen a **FOOD WEB**.

The food web is made up of organisms at different levels of feeding, known as **TROPHIC LEVELS**:

- * **primary (1^o)producers** - organisms that can perform photosynthesis.
- * **primary (1^o)consumers** - organisms that eat primary producers.
- * **secondary (2^o)consumers** - organisms that eat primary consumers.
- * **tertiary (3^o)consumers** - organisms that eat secondary consumers.
- * **quaternary (4^o)consumers** - organisms that eat tertiary consumers

...and so on.

DECOMPOSERS are a special type of consumer that can eat dead, organic matter (detritus, carrion) and convert it back into its inorganic components.

We also can categorize animals on the basis of the exact type of food they eat. You all have heard of...

- * **carnivore** - animal that eats meat
- * **herbivore** - animal that eats plant matter
- * **omnivore** - animal that eats a variety of things (plant and animal)

But don't forget...

- * **detritivore** - eats dead, organic matter (detritus), but does not decompose it
- * **insectivore** - eats insects
- * **frugivore** - eats fruits

Insert your own favorite "vore" here!

The Food Web reflects the flow of **ENERGY** and **NUTRIENTS** through ecosystems, which we'll cover in more detail later. But for now, we're going to create our own Food Web in a Florida Ecosystem.