

Chapter 5

Key Points and Noteworthy Tidbits

Biological Populations and Communities

- Organisms make up populations that make up communities that make up ecosystems that make up the biosphere.

biosphere → ecosystems → communities →
populations → species → organisms















Members of a community can be dispersed in an area three ways:

- *Clumped*- dense vs. few organisms.
- *Random*- random spacing patterns due to little interaction between members of a population.
- *Uniform*- uniform spacing between individuals.

Ecosystem (Community) Characteristics

1. *Physical appearance*- size, stratification, distribution of populations and species.
2. *Species diversity*- number of different species
3. *Species abundance*- number of individuals of each species
4. *Niche structure*- number of ecological niches; differences and similarities; species interactions.

Interactions Among Species

- Amensalism   one suffers, the other not affected
- Commensalism   one benefits the other not affected
- Competition   one benefits the other suffers
- Mutualism   both species benefit
- Parasitism   one benefits the other suffers
- Predation   one benefits the other suffers
- Saprotrophism   one benefits the other not affected

Amensalism



A tree releases a chemical that kills neighboring plants.

Example: Silver oak leaf litter at pu'u wa'awa'a ranch.

Commensalism



Forms of commensalism

1. **phoresy**- transport mechanism (shark/remora)
2. **inquilinism**- housing feature (orchids (epiphyte)/hapu'u fern or akepa nesting in trunk of large o'hi'a tree)
3. **metabiosis**- use of something another organism created (hermit crab in marine snail shell).

Competition



- **Intraspecific** competition among members of the same species or **interspecific** (competition among members of different species)
- Types of competition:
 1. **interference**-directly between individuals
 2. **exploitation**- (indirect) common limiting resource
 3. **apparent**- (indirect) both sought after by the same predator.

Mutualism



- Symbiotic relationships with both benefiting.
- Mutualism can be:
 1. **obligatory** (dependence on host) or
 2. **nonobligatory** (dependent and independent of symbiotic relationship). Another term for nonobligatory is facultative.

Parasitism



1. **ectoparasite**- living on host like mosquitoes, leeches
2. **endoparasite**- living within the host like a tapeworm.
3. **Epiparasites**- live off of other parasites.
4. **Biotrophic**- keep hosts alive like viruses.
5. **Necrotroph**- eventually kill hosts. (feral cats)
6. **Social parasites**- use behaviors that benefit parasite and harm the host like black birds laying eggs in other birds nests.

Predation



- Predators hunt and kill....parasites keep hosts alive
- **Opportunistic predators**- eat and kill almost anything.
- **Specialized predators**- prey on only certain organisms.
- Predators that eat only meat are called *carnivores*.
- Predators that eat meat and vegetation are called *omnivores*.

Saprotrophism



- Obtain from dead or decaying plants or animals through absorption of soluble organic compounds.
- Examples are:
 - Dung beetles, vultures, fungi, bacteria, protozoa

Keystone Species

- A species whose presence contributes to a diversity of life and whose extinction would lead to the extinction of other forms of life.

Examples of keystone species:

grizzly bears

sea stars

sea otters in kelp forests

prairie dogs

Species Diversity

Organisms that live in different environments are **specifically adapted** to their particular biome.

- Aquatic organisms
- Desert organisms
- Grassland organisms
- Forest organisms
- Temperate scrub forest land organisms
- Tundra organisms

Edge Effects

Two different conditions influencing the plants and animals that live on the edge. If the edge effect is gradual or has indistinct boundaries and over which many species cross, it is called an open community. A community that is sharply divided from its neighbors is called a closed community.

Lovejoy Islands in Brazil 1976 and the 50% land rule.

Biomes

- Species diversity within a biome is directly related to net productivity, availability of moisture and temperature.
- Biomes are classified by the type of dominate plant and animal life.
- There are 8 major biomes of the world. They include: tropical rainforest, tropical savanna, desert, chaparral, grasslands, temperate deciduous forest, temperate boreal forest, arctic and alpine tundra.

Terrestrial and Aquatic Biomes

- Antarctic
- Benthos
- Coastal Zones
- Coral Reefs
- Deserts
- Freshwater wetlands
- Grasslands
- Hydrothermal vents
- Intertidal
- Ocean
- Savannas
- Taiga (coniferous or boreal forests)
- Temperate deciduous forests
- Temperate rain forests
- Temperate shrubland (Chaparral)
- Temperate woodlands
- Tropical rainforest
- Tropical seasonal forest
- tundra

Energy Flow

- The ultimate source of energy is the sun. Plants are able to use this light energy to create food. The energy in food molecules flows to animals through food webs.
- Photosynthesis and Respiration processes.
- Plants produce less CO₂ (respiration) than they absorb (photosynthesis) and therefore become ***net sinks of carbon***.
- Organisms that undergo photosynthesis are called ***photoautotrops***. Factors that affect the rate of photosynthesis are the amount of light and its wavelength, carbon dioxide concentration, the availability of water and temperature.

Food Webs and Trophic Levels

- Primary producers (*autotrophs*) are plants. They convert solar energy into chemical energy through photosynthesis.
- Primary consumers are *heterotrops* (herbivores-plant eaters) and get their energy by consuming primary producers.
- Secondary (and higher) consumers are also heterotrophs and may be either carnivores (meat eaters) or omnivores.
- Primary consumers have developed defense mechanisms, some of which include: speed, flight, quills, tough hides, camouflage, horns and antlers.

Ecological Pyramids

- As energy flows through systems, more of it becomes unusable at each step
- Losses of heat energy occurs as one moves up an energy pyramid conforming to the 2nd law of thermodynamics (entropy).
- Some energy is transferred to the surroundings as heat in any energy conversion.
- Elephants need to eat 5% of their body weight in plant material each day but they can only digest about 40% of the food they eat.
- There is an average 90% loss in available energy as one moves to the next higher trophic level.
- 10% of the energy entering one level passes to the next.

Ecosystem Diversity

Biodiversity

Natural Selection

Evolution

Ecosystem Services

Biodiversity

Biodiversity attempts to describe diversity at three levels: genetic, species, and ecosystem.

- **genetic**- the range of all genetic traits, both expressed and recessive, that make up the gene pool for a particular species.
- **species**- the different number of species that inhabit a specific area.
- **ecosystem**- the range of habitats that can be found in a defined area. Include both biotic and abiotic components.

Natural Selection

- **Stabilizing selection**- affects the extremes of a population and is most common. Deviation from the norm means elimination. (no evolution, decrease in diversity, maintenance of a stable gene pool)
- **Directional selection**- affects the extremes of a population. Individual towards one end of the distribution may do especially well, resulting in a frequency distribution towards this advantage in future generations.
- **Disruptive selection**- acts against individuals that have the average condition and favors individuals at the extreme ends (bimodal). Population is split into two.

Both directional and disruptive selection affects the gene pool. In both cases, the population changes and evolution occurs.

Evolution

Speciation

Segments of a population of one species becomes so isolated the gene flow stops

Convergent evolution

Process whereby organisms not closely related to each other independently acquire similar characteristics while evolving in separate and sometimes varying ecosystems.

Evolutionary relay

Independent species acquire similar characteristics through their evolution in similar ecosystems but not at the same time.

Parallel evolution

Two independent species evolve together at the same time and in the same ecosystem and acquire similar characteristics.

Gradualism and punctuated equilibrium

Evolution is slow, stepwise development of a species over long periods of time.

Ecosystem Services

- The processes by which the environment produces resources.
examples: water, timber, habitat for fisheries, pollination of native and agricultural plants.