Ecology - Interactions in Communities

**Symbiotic Relationships** ("living together")

- *symbiosis* - dissimilar organisms living together

  *symbiont* lives in / on a second species, *host*

- parasitism and mutualism influence community structure the most
Ecology - Symbiotic Relationships

**Parasitism**

• one organism benefits at the expense of another
  
  *parasite* obtains nutrients from living in/on *host* species

• specialized form of predation
  
  • many parasites have adapted to a specific host
Ecology - Symbiotic Relationships

Parasitism

• endoparasites (internal)
  ex. tapeworms, hookworms

• ectoparasites (external)
  ex. mosquitoes
Ecology - Symbiotic Relationships

**Mutualism**
- symbiosis that benefits both organisms

**Trophic mutualism**
- plants and nitrogen-fixing bacteria
  \[ N_2 \rightarrow \text{bacteria} \rightarrow \text{NH}_3 \rightarrow \text{used by plants} \]
- animals and intestinal microbes
  termites, cows, humans
Ecology - Symbiotic Relationships

Trophic mutualism
• between animals -- cleaner fish

Dispersive mutualism.
• Plant pollinators (birds, insects and bats)

plants get gametes dispersed <--- pollinator gets energy
Ecology - Symbiotic Relationships

Defensive mutualism

- Ant and the swollen thorn Acacia

  --> Acacias have thorns and foliar nectaries
  --> Ants use acacias as nests and for food
  --> Ants defend acacia against herbivores and competing plants
Ecology - Symbiotic Relationships

Commensalism

- one organism benefits with no harm to the other

ex. “hitchhiker” species
   (whale and the barnacle)
   (algae growing on shells or backs of species)
## Summary Interspecific Interactions

<table>
<thead>
<tr>
<th>Interaction</th>
<th>Effect on Species</th>
<th>Effect on Population Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competition</td>
<td>- / -</td>
<td>Detrimental to both species</td>
</tr>
<tr>
<td>Predation (parasitism)</td>
<td>+ / -</td>
<td>Beneficial to predator, harmful to prey</td>
</tr>
<tr>
<td>Mutualism</td>
<td>+ / +</td>
<td>Beneficial to both species</td>
</tr>
<tr>
<td>Commensalism</td>
<td>+ / o</td>
<td>One species benefits the other is unaffected</td>
</tr>
</tbody>
</table>
Two major processes sustain all ecosystems:

- **energy flow** - exchange of energy through ecosystem
  - light \rightarrow \text{plants} \rightarrow \text{organisms} \rightarrow \text{decomposers} \rightarrow \text{heat energy}
  - chemical energy

- **chemical cycling** - use and reuse of chemical elements

- organism interaction
Ecology - Ecosystem Ecology

**Trophic Structure**

- determines path of energy flow and chemical cycling

*Trophic levels* - a step in the transfer of food or energy

*Food chain* - transfer of energy between trophic levels
### Food chains

<table>
<thead>
<tr>
<th>trophic level</th>
<th>terrestrial</th>
<th>aquatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>4º consumers</td>
<td>carnivore</td>
<td>carnivore</td>
</tr>
<tr>
<td>3º consumers</td>
<td>carnivore</td>
<td>carnivore</td>
</tr>
<tr>
<td>2º consumers</td>
<td>carnivore</td>
<td>carnivore</td>
</tr>
<tr>
<td>1º consumers</td>
<td>herbivore</td>
<td>zooplankton</td>
</tr>
<tr>
<td>Producers</td>
<td>plants</td>
<td>phytoplankton</td>
</tr>
<tr>
<td>Detritivores</td>
<td></td>
<td>detritus from trophic levels</td>
</tr>
</tbody>
</table>
Types of heterotrophs

- **herbivore** - obtains energy by feeding on primary producers
- **carnivore** - flesh-eating organism
- **omnivore** - feed on both plants and animals
Food webs

- species usually have alternate food source
- this relationship is expressed with a web diagram
Efficiencies of ecosystems

**solar radiation**  35% reflected back into space
  14% absorbed by atmospheric gases
  51% absorbed by earth's surface

**Infrared absorption** ("greenhouse effect")
- the effect of heat retention in the lower atmosphere as a result of absorption and re-radiation of terrestrial radiation by clouds and gases
Ecology - Energy Flow in Ecosystem Ecology

photosynthesis efficiency

energy of sunlight captured \(=\) 1.5% solar energy available

• this low efficiency is due to:
  reflection
  low efficiency of chemicals (chlorophyll)
Ecology - Energy Flow in Ecosystem Ecology

**Biomass**
- the amount of living organic material in an ecosystem

**Primary Productivity**
- the rate at which biomass is produced by plants in the form of organic substances
Ecology - Energy Flow in Ecosystem Ecology

Eltonian Pyramids

- a graphical representation of the trophic structure and function of an ecosystem

- the first trophic level of producer organisms (usually green plants) forms the base of the pyramid

- three types: of numbers, of biomass, and of energy
Ecology - Energy Flow in Ecosystem Ecology

Energy Pyramids

- efficiency of energy transfer between trophic levels

**Ecological efficiency** (Lindemann's efficiency)

\[
\frac{\text{energy assimilated by trophic level } (N)}{\text{energy assimilated by the next lower trophic level } (N-1)} = 10\%
\]
Energy Pyramids

- This cumulative loss of energy from a food chain can be represented by an energy pyramid.

Producers

1° consumers

2° consumers

3° consumers

herbivores

photosynthetic organisms

90% E loss @ each level

90% E loss @ each level
Ecology - Ecosystem Ecology

Biomes

• major types of ecosystems that cover large geographic areas
• characterized by distinctive vegetation, organisms and climate
Ecology - Ecosystem Ecology

**Aquatic Biomes**

- occupy the largest part of the biosphere

<table>
<thead>
<tr>
<th>Freshwater biomes</th>
<th>Marine biomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>lakes  ponds</td>
<td>estuaries</td>
</tr>
<tr>
<td>rivers  streams</td>
<td>oceans</td>
</tr>
<tr>
<td></td>
<td>coral reefs</td>
</tr>
</tbody>
</table>
Aquatic Biomes
Terrestrial Biomes

- distribution by latitude and/or altitude
Ecology - Ecosystem Ecology

Terrestrial Biomes

- Tropical forest
- Savanna
- Desert
- Polar and high-mountain ice
- Chaparral
- Temperate deciduous forest
- Coniferous forest
- Temperate grassland
- Tundra (arctic and alpine)
Ecology - Defining our Biome

Temperate deciduous forest

• deciduous trees (shed leaves)
• moderate rain and temperature
• mid-latitudes
Ecology - Defining our Biome

Wetlands / Estuaries

• estuary
  – a coastal body of water
  – free connection to the open sea
  – ocean water is diluted by fresh water