Chapter 53

Community Ecology

Essential questions

- What factors structure a community?
- What species & how many are present in a community?
- In what way do the populations interact?
- What roles do species play in the community?
- How do communities change over time?

Community Ecology

- Community
  - Group of species living close enough together for potential interaction
- Community Ecology
  - Study of interactions among all populations in a common environment

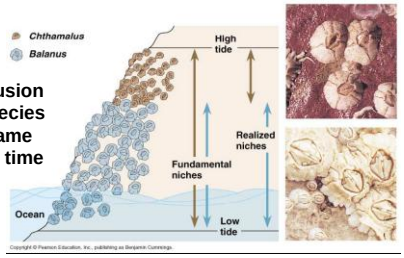
Interspecific interactions

- Symbiotic Interactions
  - Competition (-/-)
    - Complete for limited resources
    - 2 species cannot coexist in a community if their **niches** are identical
  - Predation / parasitism (-/+)
  - Mutualism (+/+)
    - Lichens (algae & fungus)
  - Commensalism (+/0)
    - Barnacles that attach to a whale

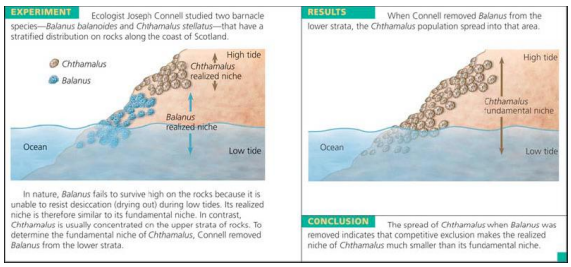
Niche

- An organism's niche is an ecological role
  - Habitat = address, niche = profession

Competitive Exclusion
No two similar species can occupy the same niche at the same time

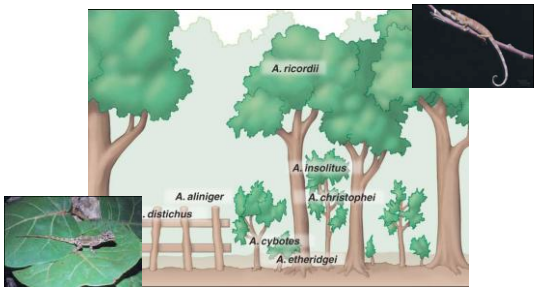


Niche & competition



Resources partitioning

- Reduce competition through microhabitats



Predation Drives Evolution

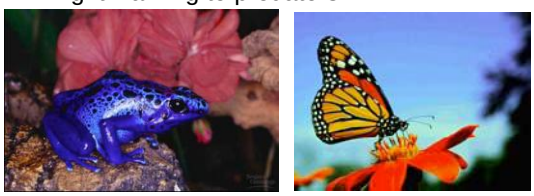
- Predator adaptations
  - Locate & subdue prey
- Prey adaptation
  - Elude & defend

Cryptic coloration

- Camouflage

Aposematic coloration

- Bright warning to predators



Batesian mimicry

- Palatable or harmless species mimics a harmless model

Batesian mimicry

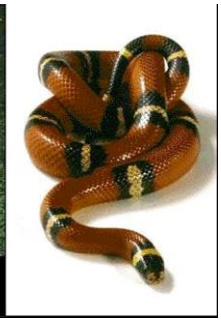
- Convergent evolution

Mullerian mimicry

- Two or more unpalatable species look like each other

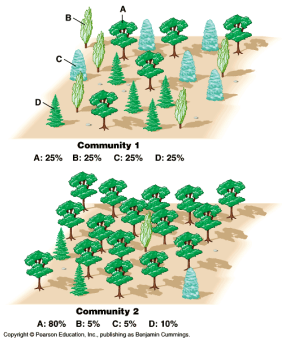

What kind of mimicry?

What kind of mimicry?

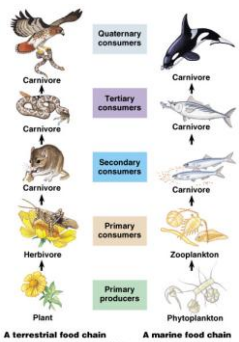
Species Diversity

- Greater the diversity = greater the stability



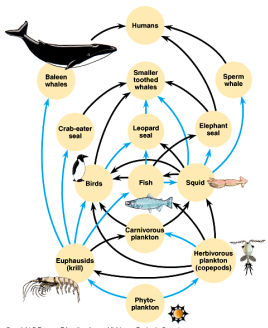
Trophic Structure

- Food Chains
  - Feeding relationships
  - Food chain usually 4 or 5 links = trophic levels
  - Length the food chain limited by inefficiency of energy transfer



Food Webs

- Food Chains are hooked together into food webs
- Who eats whom?
  - A species may weave into web at more than 1 trophic level
    - "there's always a bigger fish"

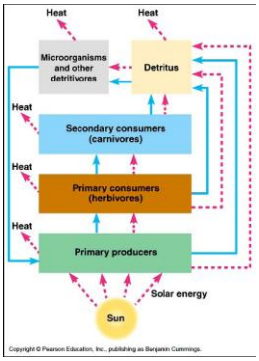


Energy Transfer in an ecosystem

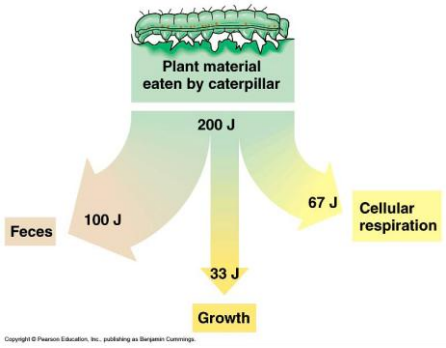
- Energy in
  - From the sun
  - Captured by autotrophs = producers
- Energy through
  - Food chain
    - Transfer of energy from autotrophs to heterotrophs (herbivores to carnivores)
    - Heterotrophs = consumers

Energy transfer

- Energy moves through
  - Energy transfer is inefficient (<20%)
  - Loss at each level
- Nutrients are recycled
  - decomposers

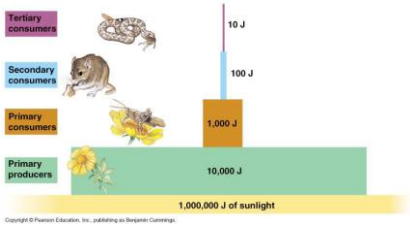


Energy Inefficiency



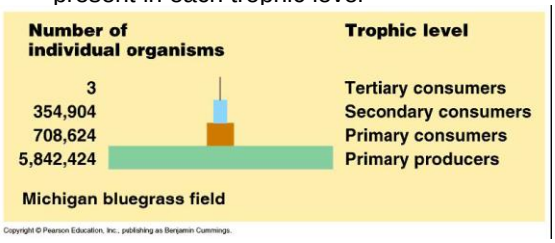
Pyramids of production

- Represent the loss of energy from a food chain
  - How much energy is turned into biomass



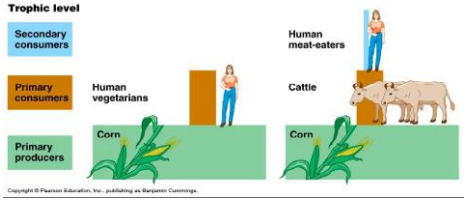
Pyramid of numbers

- Levels in pyramids of production are proportional to number of individuals present in each trophic level



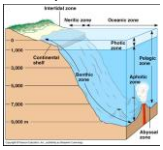
Implications

- Dynamics of energy through ecosystems have important implications for human populations
  - What food would be more ecologically sound?



Energy Budget

- Production by autotrophs sets the energy budget so an ecosystem
  - Marine ecosystems
    - Light, temperature & nutrients (depth)
  - Terrestrial ecosystems
    - Light, moister, temperature & nutrients (latitude & climate)

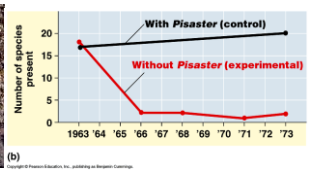


Community structure

- If remove a species from a community, it will change the entire community structure
- Dominant species
  - Most abundant species or highest biomass (total weight) in a community
- Keystone species
  - Exert an important regulating effect on other species in a community

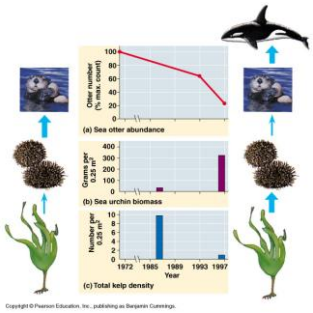
Keystone Species

- Influential ecological role
  - Not necessarily dominant or most abundant



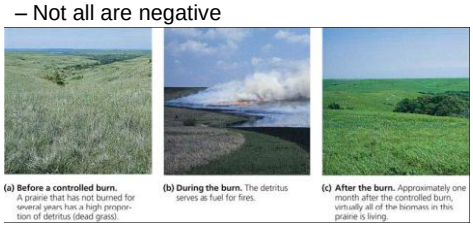
Keystone Species

- Sea otter is keystone predator in North Pacific
- What is the impact of the whale?



Disturbances

- Most communities are in a state of non-equilibrium due to disturbances
  - Fire, weather, human activities, etc.
  - Not all are negative



(a) **Before a controlled burn.** A prairie that has not burned for several years has a high proportion of detritus (dead grass).

(b) **During the burn.** The detritus serves as fuel for fires.

(c) **After the burn.** Approximately one month after the controlled burn, virtually all of the biomass in this prairie is living.

Disturbances

- Disturbances are often necessary for community development & survival

Ecological Cycle

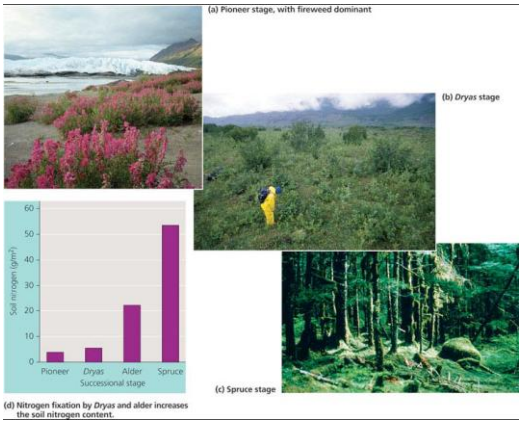
- Fire as part of a natural community cycle

Ecological succession

- The sequence of community changes after a disturbances
  - Transition in species composition over ecological time
    - Year or decades

Primary succession

- Begins with virtually lifeless area without soil, then…
  - Bacteria
  - Lichens & mosses
  - Grasses
  - Shrubs
  - trees



Succession

- From mosses & lichens to shrubs & trees

Secondary succesion

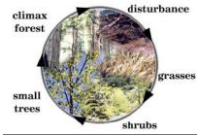
- Existing community cleared, but soil intact

(a) **Soon after fire.** As this photo taken soon after the fire shows, the burn left a patchy landscape. Note the unburned trees in the distance.

(b) **One year after fire.** This photo of the same general area taken the following year indicates how rapidly the community began to recover. A variety of herbaceous plants, different from those in the former forest, cover the ground.

Climax forest

- Plant community dominated by trees representing final stage of natural succession for specific location
  - Stable plant community developed through stages
  - Remains essentially unchanged in species composition for as long as site remains undisturbed
    - Birch, beech, maple, hemlock
    - Oak, hickory, pine



Climax Forest

- The species mix of the climate forest is dependent on the abiotic factors of the region
  - Solar energy levels
  - Temperature
  - Rainfall
  - Fertility & depth of soil