

# Biological Communities and Species Interaction

## TOLERANCE LIMITS AND SPECIES ABUNDANCE

Tolerance limits- the maximum and minimum levels beyond which a particular species cannot survive or is unable to reproduce ex. temperatures, moisture levels, nutrient supply, soil and water chemistry, and living space.

- different for each species (a group of organisms that can interbreed and produce fertile offspring)
- later discovered that rather than a single factor that limited growth, it was several factors working together that determined biogeographical distribution
- for some species there may be a critical (limiting) factor that determines their abundance and distribution in an area

ex. saguaro cactus, sensitive to low temperatures, will begin to die in 12 hours of freezing temps. Young saguaros are more susceptible to cold than adults

- young animals have more critical tolerance limits than the adults, ex. pupfish
- requirements and tolerances of species often are helpful in understanding the environmental characteristics of an area. The presence of a species can say something about the community and ecosystem

ex. the Ebony spleenwort only grows in basic, calcareous soil

Environmental indicators- species with specific, narrow tolerance limit that tell us something about the area where they are present ex. locoweeds grow in areas with a high soil concentration of selenium and the flower that turns red if it is growing above a land mine!

## Natural Selection and Adaptations

The term adapt used in two ways

1. limited range of physiological modifications, called acclimations, available to individual organisms. ex. house plants inside all winter
2. inheritance of specific genetic traits that allow a species to live in a particular environment  
evolution

- species change gradually through competition for scarce resources and natural selection
- natural selection-a process in which those members of a population that are best suited for a particular set of environmental conditions will survive and produce offspring more successfully than their ill-suited competitors
- natural selection acts on preexisting genetic diversity created by small random mutations and occur spontaneously in every population

- mutations afloat, but in the long run, create amazing diversity
- theory developed by Charles Darwin

Environmental factors that cause selective pressure and influence fertility or survivorship-

1. physiological stresses due to inappropriate levels of some critical environmental factor ex. moisture, light, temp. pH, specific nutrients
2. predation, including parasitism and disease
3. competition
4. luck, sometimes they're just lucky rather than better fit to survive

- selection affects individuals, but evolution and adaptation work at the population level, species evolve not individuals.
- isolation can also drive evolution, and cause for variations in species
- convergent evolution- when through time unrelated organisms evolve to look and act very much alike

### Niche Specialization

habitat- the place or set of environmental conditions in which a particular organism lives

ecological niche- a species' specific habitat, lifestyle, and resource usage habitats. It includes the role played by a species in a biological community.

-biophysical definition proposed by G.E. Hutchinson, he said every species has a range of physical and chemical conditions (temp. acidity, humidity etc) as well as biological interactions (predators, prey present, defenses, nutrition available) within which it can exist

-niches can evolve over time

-law of competitive exclusion states that no two species will occupy the same niche and compete for exactly the same resources in the same habitat for very long

resource partitioning- when competition forces one species to either migrate to a new area, become extinct, or change its behavior or physiology in ways that minimize competition. It can lead to species specialization in order to maximize survival rates.

-niche specialization can cause subpopulations of a single species to diverge into separate species, but resources can only be partitioned so far

## **SPECIES INTERACTIONS**

### Predation

-all organisms need food to live

predator- an organism that feeds directly upon another living organism

-in this broad sense parasites and pathogens may be considered predators

parasites- organisms that feed on a host organism or steal resources from it without killing it

pathogens-disease-causing organisms

-predation is a potent and complex influence on population balance of communities, it involves

1. all stages of the life cycles of predator prey species
2. specialized food obtaining mechanisms
3. specific prey-predator adaptations that either resist or encourage predation. For example prey can evolve into faster runs to survive predator attack!

-predation important factor in evolution because predators prey most successfully on the slowest, weakest, least fit members of their target population, causing the prey species to evolve with protective or defensive adaptations to avoid predation

coevolution- the process when predators evolve mechanisms to overcome the evolved defenses of their prey

### Keystone Species

keystone species- a species (or group of species) whose impact on the population size of other species in its community is much larger and more influential than would be expected from its mere abundance  
-many unexpected species can be a keystone species, ex. tropical figs, microorganisms, American chestnut trees

### Competition

-organisms within a community must compete for all the survival necessities: energy and matter in usable forms, space, and specific sites for life activities  
intraspecific competition- competition among members of the same species  
interspecific competition- competition between members of different species  
--competition more of a race than a fight, animals don't want to risk getting injured, but they both end up suffering because of the competition in one way or another  
-intraspecific competition intense because organisms are fighting directly for the exact same resources  
territoriality- intense form of intraspecific competition in which organisms define an area surrounding their home site or nesting site and defend it, primarily against other members of their own species  
-territoriality helps to allocate resources by spacing members of a species

Symbiosis- intimate living together of members of two or more species

Mutualism- a type of symbiosis in which both members of the partnership benefit.  
ex. lichens being a combination of fungus and a photosynthetic partner, alga or cyanobacterium  
-mutualistic relationship may be important in evolution

Commensalism- a type of symbiosis in which one member clearly benefits and the other apparently is neither benefited nor harmed  
ex. cattle and cattle egrets

Parasitism- a form of symbiosis in which one species benefits and the other is harmed.  
ex. Ms. Law and tropical round worms

Defensive Mechanisms- the way that different prey adapt to either hide from or discourage predators  
ex. toxic chemicals, body armor  
-some organisms produce noxious odors or poisonous secretions  
-plants too produce chemical compounds that make them unpalatable or dangerous to disturb  
ex. poison ivy, stinging nettles

- Batesian mimicry- harmless species that evolve colors, patterns, or body shapes that mimic species that are unpalatable or poisonous
- Mullerian Mimicry- when two dangerous species evolve to look alike  
-others use camouflage

### Community Properties

-productivity, diversity, complexity, resilience, stability, and structure

### Productivity-

primary productivity- rate of biomass production by ecosystem's producers

- higher productivity occurs in areas of high temperature moisture and nutrient availability

#### Abundance and Diversity-

abundance-expression of the total number of organisms in a biological community

diversity- measure of the number of different species, ecological niches, or genetic variation present

-as you go from the equator towards the poles, generally diversity decreases but abundance increases

-productivity is related to abundance and diversity

#### Complexity and Connectedness

complexity-refers to the number of species at each trophic level and the number of trophic levels in a community

-you can have an abundant community that isn't very complex

#### Ecological Succession-

-the process by which organisms occupy a site and gradually change environmental conditions by creating soil, shade, shelter, or increasing humidity. Over time communities become more diverse.

- Primary Succession-occurs when a community begins to develop on a site previously unoccupied by living organisms.  
ex. island, new volcanic flow  
pioneer species- in primary succession, the species that first colonizes the new area  
-often microbes, mosses and lichens  
ecological development- process or environmental modification by organisms
- Secondary Succession-occurs when an existing community is disrupted and a new one subsequently develops at the site  
-disruption may be caused by natural catastrophe, human activity  
climax community- in either primary or secondary succession, when a community develops to the point of stabilization and resists further change  
equilibrium communities/disclimax communities- when landscapes never reach a stable climax in the traditional sense because they are characterized by periodic disruption
- Aquatic Succession-process or succession taking place in a body of water