CHAPTER 5: BIODIVERSITY, SPECIES INTERACTIONS, AND POPULATION CONTROL

APES 2013

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WAYS SPECIES INTERACT

- Interspecific competition - members of two or more species interact to gain access to the same limited resource (ex. food, light, space...)
- Predation - one member of a species (predator) feeds on all or part of a member of another species (prey)
- Parasitism - one organism (parasite) feeds on the body or energy of another organism (host) usually living on or in the host
- Mutualism - interaction that benefits both species
- Commensalism - interaction that benefits one species but has little or no effect on the other
- ALL OF THESE INTERACTIONS HELP TO LIMIT POPULATION SIZE

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COMPETITION FOR RESOURCES

- When two species compete for a single resource, their ecological niches overlap.
- Competitive Exclusion Principle - no two species can occupy the same niche for very long
  - One will have to either migrate, change its behaviors, suffer population decline, or become extinct.

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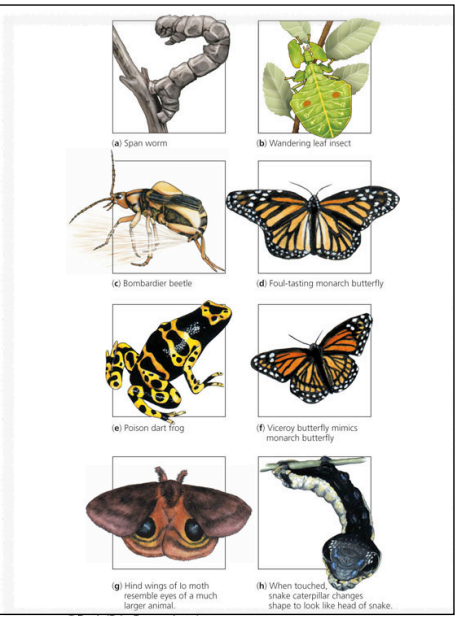
Predator Avoidance

Camouflage (a & b)
Chemical Warfare (c - e)
Warning Coloration (d & e)
Mimicry (f)
Deceptive Looks (g)
Deceptive Behavior (h)



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Predator Prey Relationships and Evolution

- Simply, to survive, predators must eat prey and prey must avoid being eaten. This results in huge selection pressures put on each.
  - Prey develop traits that help them escape predation
  - Predators develop traits that increase ability to feed on prey.
- Coevolution - when the evolution of one species impacts the evolution of another species

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Example of Coevolution

- Bats and Moths
  - Bats evolved the ability to use sonar to spot prey in the dark. Some moths have developed the ability to decipher those frequencies and escape.
  - Some bats have evolved to counter this by changing the frequency of their sounds.
  - In response, some moths have evolved the ability to produce high frequency clicks that jam the bats' signals.
- This promotes the sustainability of both species as well as biodiversity.
- REMEMBER: Evolution is not species designing strategies. It is a long process of populations responding to environmental conditions through natural selection.

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EXAMPLES OF PARASITISM

- Some live inside the host
- Some attach to the outside
- Some move from one host to another
- Some remain with a single host
- This can also cause **coevolution**

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EXAMPLES OF MUTUALISM

(a) Oxpeckers and black rhinoceros

(b) Clownfish and sea anemone

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EXAMPLES OF COMMENSALISM

- Epiphyte (air plant) - roots on the trunk of a tree without penetrating or harming the tree. The epiphyte gains greater access to water and sunlight.

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Reducing Competition

- Resource Partitioning - some species evolve to reduce niche overlap.
  - Usually by using resources at different times, different ways, or different places.

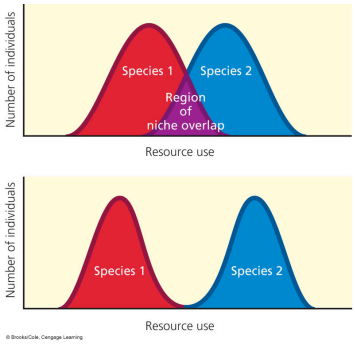

Fig. 5-7

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Limiting Growth of Populations

- Populations dynamics - how distribution, numbers, age structure, and density of populations change in response to environmental changes

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Population Distribution

- **Figure 5-10**
- Clumping - ex. elephants
- Uniform distribution - ex. creosote bushes
- Random dispersion - ex. dandelions

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POPULATION NUMBERS

- Birth rate
- Death rate
- Immigration
- Emigration
- Population Change = (Births + Immigration) - (Deaths + Emigration)

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AGE STRUCTURE

- Age structure - the proportions of individuals at various ages
  - Usually described in relation to ability to produce offspring
    - Pre-reproductive
    - Reproductive
    - Post-reproductive

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POPULATION GROWTH

- Biotic potential - capacity for population growth under ideal conditions
- Intrinsic rate of increase (r) - rate at which the population would grow with unlimited resources
  - Those with a high r value usually reproduce early in life, have short generation times, can reproduce many times, and have many offspring each time they reproduce

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Environmental Resistance

- Environmental Resistance - combination of all factors that act to limit growth of a population
- Carrying Capacity (K) - maximum population a given species can sustain indefinitely without being degraded

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Logistic Growth

- Logistic growth - rapid exponential growth followed by a steady decrease in population growth until the population size levels off

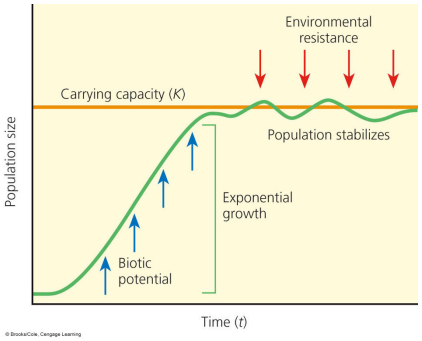

Fig. 5-11
Sigmoid (S-shaped) curve

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Ex. Sheep in Tasmania

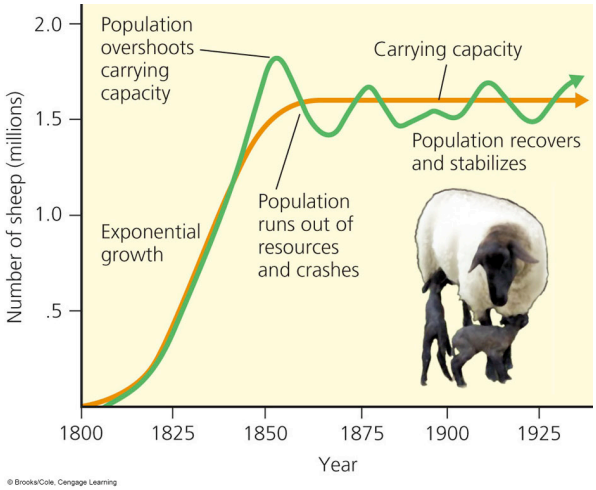

Fig. 5-12

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POPULATION CRASH

- When a population exceeds the habitat's carrying capacity, the population will crash.

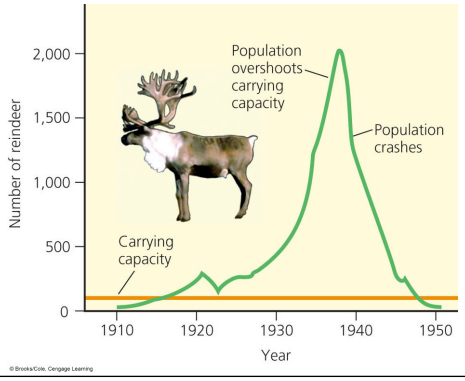

Fig. 5-13

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REPRODUCTIVE PATTERNS

- r-selected species - species with an ability for a high rate of population increase
  - Usually have many, small offspring and give them little or no parental care (ex. bacteria, algae, rodents, turtles...)
  - Often opportunists (reproduce and disperse rapidly when conditions are favorable)

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REPRODUCTIVE PATTERNS

- K-selected species - competitor
  - Tend to reproduce later in life, have a small number of offspring with long life spans, care for young
  - Tend to do well in competitive conditions

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r-selected vs. K-selected

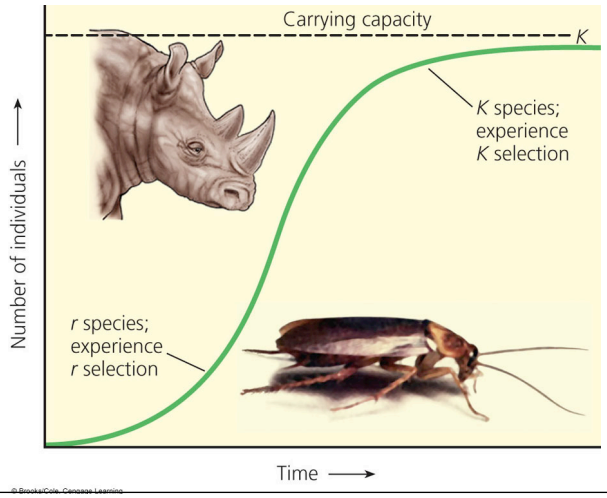

Fig. 5-14

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IMPACT OF GENETIC DIVERSITY

- Loss of genetic diversity plays a huge role in small, isolated populations
  - Founder effect - few individuals in a population colonize a new habitat geographically isolated from other members of the population
  - Demographic bottleneck - few individuals of a population survive a catastrophic event and lack of genetic diversity limits ability to rebuild population (lack of diversity makes them more susceptible to genetic disease)
  - Genetic Drift - random changes in gene frequency in a population that lead to unequal reproductive success (some individuals breed more than others and their genes begin to dominate the gene pool)
  - Inbreeding - individuals in a small population mate with one another (can happen after a bottleneck). This can increase the frequency of defective genes within a population.

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POPULATION DENSITY

- Population density - number of individuals in a population found in a particular area or volume
- Density-dependent population controls - predation, parasitism, infectious disease, and competition for resources
- Density-independent - effect is not dependent on density of a population (ex. freeze in late spring, fire, pollution...)

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TYPES OF POPULATION CHANGE

- Stable - slight variations above and below carrying capacity (ex. species in undisturbed areas with few fluctuations)
- Irruptive - high peak and then crash (ex. insects)
- Cyclic (boom-and-bust) - regular population rises and falls (ex. lemmings every 3-4 years)
- Irregular - no pattern

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CYCLIC: LYNX AND HARE

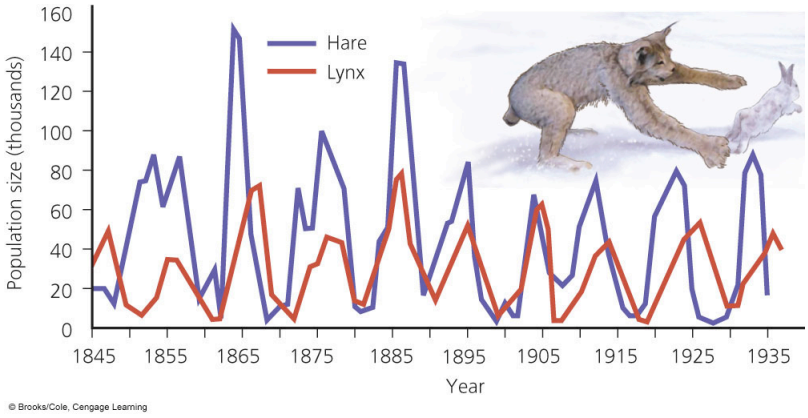

Fig. 5-15

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ECOLOGICAL SUCCESSION

- Ecological Succession - gradual change of species composition in a given area
  - Colonizing (Pioneer) Species - first to arrive and are eventually replaced by other species
- Primary Succession - gradual establishment of biotic communities in lifeless areas where there is no soil in a terrestrial ecosystem or bottom sediment in an aquatic ecosystem
- Secondary Succession - series of communities or ecosystems with different species develop in places containing soil or bottom sediment

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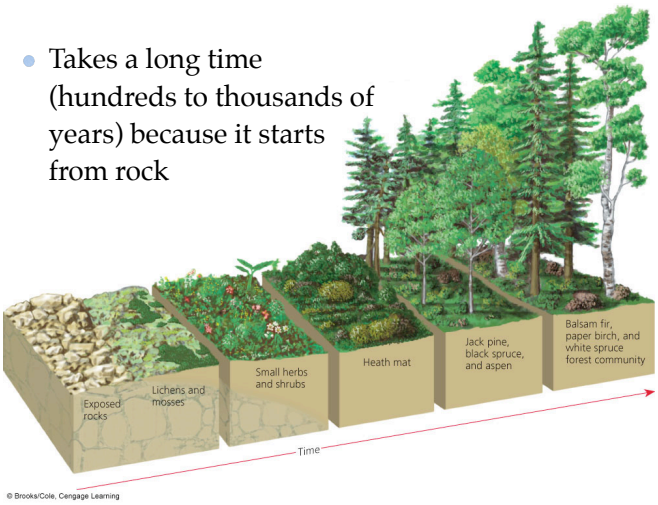
PRIMARY SUCCESSION

- Takes a long time (hundreds to thousands of years) because it starts from rock



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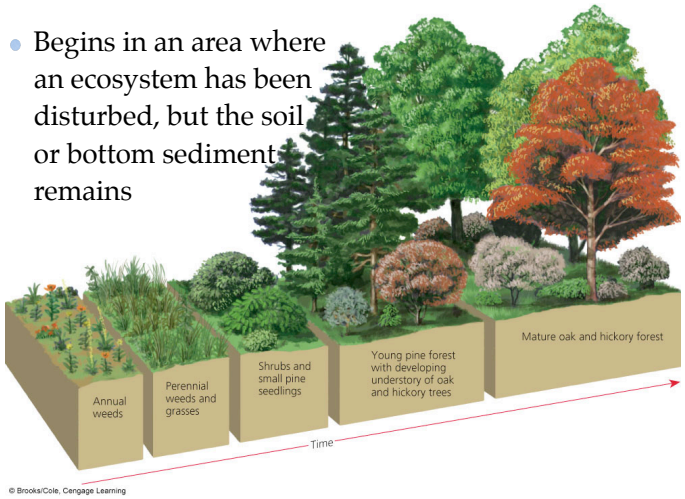
SECONDARY SUCCESSION

- Begins in an area where an ecosystem has been disturbed, but the soil or bottom sediment remains



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