

Living In Ecosystems- Population Dynamics

Chapter 30

Population Growth

- Populations are composed of groups of individuals of the same species living together.
 - Critical Properties that affect the dynamics populations
 - Population Size
 - Population Density
 - Population Dispersion
 - Capacity for Growth

Population Growth

- A population's actual rate of increase is the difference between birth rate and death rate corrected for migration.
- Innate capacity for growth of any population is exponential.
 - Even when rate of increase remains constant, the actual increase in the number of individuals accelerates rapidly as the size of the population grows.

Population Growth

- Exponential Growth Model
 - Assumes population growing without limits at its maximal rate. (r = biotic potential)

$$dN/dt = r_i N$$

- N = Number of individuals in population
- dN/dt = Rate of change in population size over time
- r_i = Intrinsic rate of increase

Population Growth

- Carrying Capacity (K)
 - Number of individuals an area can indefinitely support.
- Logistic Growth Model
 - As population approaches its carrying capacity, its growth rate slows as resources become scarce.

$$dN/dt = rN (K - N/K)$$

- Sigmoid Growth Curve

Two Models of Population Growth

Influence of Population Density

- Density-Dependent Effects

- Effects are independent of population size and act to regulate growth (weather).
- Density-Dependent Effects
 - Effects are dependent on size of population and act to regulate growth (resource competition).
 - Have increasing effect as population size increases.

Population Demography

- Sex Ratio
 - Proportion of males and females in a population.
 - Usually directly related to number of females in the population.

The Niche and Competition

- Niche - Biological role in community.
 - Fundamental - Theoretical role
 - Realized - Actual role
- Competition - Two or more organisms attempt to use same resource.
 - Interference - Fighting
 - Exploitative - Consuming shared resources
 - Interspecific - Different species
 - Intraspecific - Same species

Barnacle Competition

Competitive Exclusion

- Gause - No two species can coexist in the same niche indefinitely.
 - When two species coexist on long-term basis, their niches differ in one or more features.
 - Otherwise, one is eventually driven to extinction.

Resource Partitioning

- Sympatric Species - Occupy same geographical area but avoid competition by utilizing different portions of the habitat.

Resource Partitioning

- Allopatric Species - Do not occupy same geographical area, thus are not usually in competition.

Symbiosis

- Symbiotic Relationship - Two or more species of organisms live together, and at least one gains benefit.
 - Commensalism - One species benefits while other neither benefits or is harmed.
 - Mutualism - Both species benefit.
 - Parasitism - One species benefits while the other is harmed.

Plant Defenses

- Predator-Prey Interactions
 - Morphological Defenses
 - Thorns, spines, plant hairs
 - Chemical Defenses
 - Secondary chemical compounds
- Evolution of herbivores avoiding plant defense allows access to a new resource without competition from other herbivores.

Animal Defenses

- Feeding on plants rich in secondary compounds may have added benefit.
 - Blue Jays and Monarch Butterflies
- Defensive Coloration
 - Aposomatic Coloration - Advertise poisonous nature with bright coloration.
 - Cryptic Coloration - Camouflage
- Chemical Defenses

Predator-Prey Cycles

- Predation is consumption of one organism by another.
 - Under simple laboratory conditions, predators often exterminate their prey, and then become extinct themselves when they run out of food.
 - If refuges are provided for the prey, a few individuals usually exist, and then repopulate after the predators die out.

Predator-Prey Cycles

- Snowshoe Hares (*Lepus americanus*).
 - Food - Willows
 - Predators - Canada Lynx (*Lynx canadensis*)

Predator- Prey cycle

Biodiversity

- Measure of number of different types of species in an area.

- Crucial to ecosystem preservation.
- Biodiversity Promotion
 - Ecosystem Size
 - Larger ecosystems, usually have higher levels of biodiversity
 - Latitude
 - Length of growing season
 - Climatic stability

Latitudinal Cline in Species Richness