Chapter 42 – Population Ecology

Ecology

The study of the interactions of organisms with each other & with the physical environment

It includes the study of how an individual organism is adapted to its environment, but also includes studying the following:

Population – All the organisms within an area belonging to the same species

Community – All the various populations interacting at a locale

Ecosystem – Encompasses a community of populations interacting with the abiotic (non-living) environment

Biosphere – The portion of the earth’s surface where living things exist
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Ecological levels

Organism  Population  Community  Ecosystem
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Density & Distribution of Populations

**Population density** – is the number of individuals per unit area or volume

**Population distribution** – is the pattern of dispersal of individuals within the area of interest

3 patterns of distribution

**Uniform, Random, Clumped**

What factors can determine the density or distribution of a population?

**Abiotic** factors (nonliving)

**Biotic** factors (living)

What factors determine where you live?
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Patterns of Population Growth

All populations have a particular pattern of growth

**Biotic potential** – The highest possible per capita rate of increase for a population

The factors that determine whether the biotic potential is high or low are:

1. The usual number of offspring per reproduction
2. The chances of survival until age of reproduction
3. How often each individual reproduces
4. The age at which reproduction begins

Exponential growth – the **J-shaped curve**

The J-shaped curve has two phases:

1. **Lag phase** – growth is slow due to small population size
2. **Exponential growth phase** – growth is accelerating & the population is exhibiting its biotic potential

Under what conditions would a population experience this exponential growth?
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Environmental Resistance

1. Food
2. Accumulation of waste
3. Increased competition
4. Predation

Due to environmental resistance, exponential growth cannot be maintained indefinitely

Logistic growth – \textit{S-shaped growth curve}

The S-shaped curve has 4 phases:

1. \textbf{Lag phase} – growth is slow due to small population size
2. \textbf{Exponential growth phase} – growth is accelerating & the population is exhibiting its biotic potential
3. \textbf{Deceleration phase} – the rate of population growth slows down
4. \textbf{Stable equilibrium phase} – Little or no growth, births = deaths

\textit{Carrying capacity} – The number of individuals the environment can normally support
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Patterns of population growth
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r-strategists vs K-strategists

Depending upon the characteristics of the organism, organisms will follow a biotic potential or carrying capacity type reproductive strategy

The r-strategists

1. High biotic potential – reproduce very fast
2. Are adapted to live in a variable climate
3. Produce many small, quickly maturing offspring = early reproductive maturity
4. “Opportunistic” organisms

The K-strategists

1. Adaptations allow them to maintain population values around the carrying capacity
2. They live long lives
3. Reproduce late
4. Produce few, large, offspring
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Regulation of Population Size

**Density-Independent factors** – Factors that kill a certain percentage of the population regardless of its size “Wrath of God”

1. Natural disasters
2. Severe weather
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Regulation of Population Size

**Density-Dependent Factors** – Factors that have a greater effect as the size or density of the population increases

Competition for space & food can modify the population size by affecting the following processes

1. **Behavioral responses**
   - A. Cessation of mating
   - B. Poor parental care
   - C. Increased aggressive behavior = Contest competition / social dominance

2. **Physiological responses**
   - A. Increased spontaneous abortions
   - B. Delayed maturation – Alter reproductive cycles
   - C. Hormonal changes – Alter / stop reproductive cycles
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Density-dependent effect

Decline as a result of sudden resource depletion

Exponential growth

Number of Reindeer

1910 1920 1930 1940 1950
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Principle of Competitive Exclusion

Two species that compete for the same limited resources cannot indefinitely occupy the same area.

How do species coexist in the same limited environment?

**Habitat** – The place where it lives (Pond, Desert, Rain Forest)

**Niche** – The unique way that an organism interacts with its environment. Includes temperature, lighting, food sources.

**Fundamental niche** – All the places & ways in which a species could live

**Realized niche** – The niche that a species actually occupies due to competition