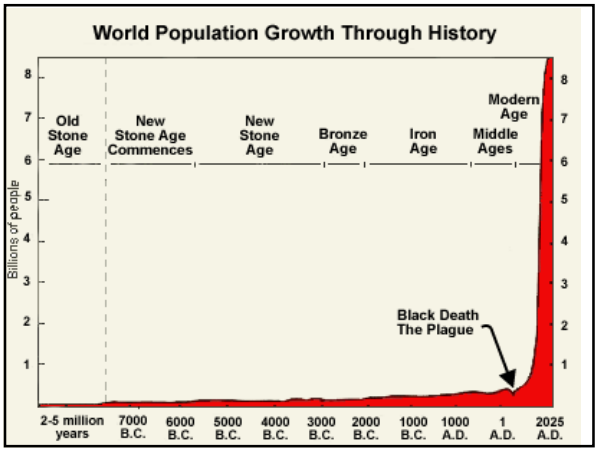
Population Dynamics Outline

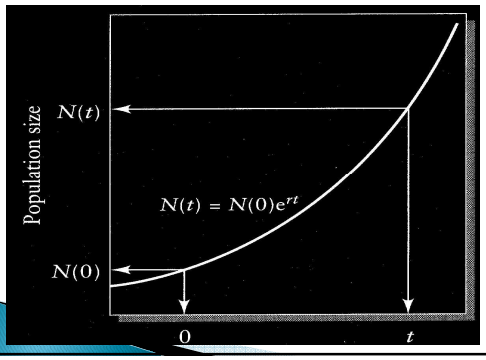
- Population Dynamics and Carrying Capacity
  - Characteristics of a Population
  - Reproductive Strategies

Population Growth

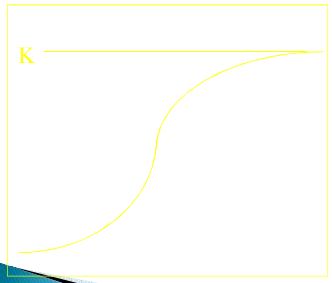
- Populations show two types of growth
  - Exponential
    - J-shaped curve
    - Growth is independent of population density
  - Logistic
    - S-shaped curve
    - Growth is not independent of population density



Exponential Growth Graph



Logistic Growth



Because of Environmental Resistance, population growth decreases as density reaches carrying capacity

Carrying Capacity (K)

- Exponential curve is not realistic due to carrying capacity of area
- Carrying capacity is maximum number of individuals a habitat can support over a given period of time due to environmental resistance (sustainability)

- Biotic Potential
  - factors allow a population to increase under ideal conditions, potentially leading to exponential growth
- Environmental Resistance
  - affect the young more than the elderly in a population, thereby affecting recruitment (survival to reproductive age)

Biotic Potential

- Ability of populations of a given species to increase in size
  - Abiotic Contributing Factors:
    - Favorable light
    - Favorable Temperatures
    - Favorable chemical environment – nutrients
  - Biotic Contributing Factors:
    - Reproductive rate
    - Generalized niche
    - Ability to migrate or disperse
    - Adequate defense mechanisms
    - Ability to cope with adverse conditions

Environmental Resistance

- Ability of populations of a given species to increase in size
  - Abiotic Contributing Factors:
    - Unfavorable light
    - Unfavorable Temperatures
    - Unfavorable chemical environment – nutrients
  - Biotic Contributing Factors:
    - Low reproductive rate
    - Specialized niche
    - Inability to migrate or disperse
    - Inadequate defense mechanisms
    - Inability to cope with adverse conditions

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Characteristics of a Population

- Population – individuals inhabiting the same area at the same time
- Population Dynamics: Population change due to
  - Population Size – number of individuals
  - Population Density – population size in a certain space at a given time
  - Population Dispersion – spatial pattern in habitat
  - Age Structure – proportion of individuals in each age group in population

Population Density

- Population Density is the amount of individuals in a population per unit habitat area
  - high densities – Mice
  - low densities – Mountain lions
- Density depends upon
  - social/population structure
  - mating relationships
  - time of year

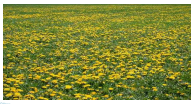
Population Dispersion
spatial pattern of distribution

There are three main classifications

Clumped: individuals are lumped into groups

Uniform: Individuals are regularly spaced in the environment

Random: Individuals are randomly dispersed in the environment



Age Structure

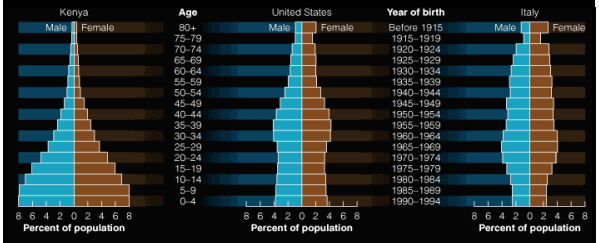
- The age structure of a population is usually shown graphically
- The population is usually divided up into prereproductives, reproductives and postreproductives
- The age structure of a population dictates whether is will grow, shrink, or stay the same size

Age Structure Diagrams

Positive Growth — Pyramid Shape

Zero Growth (ZPG) — Vertical Edges

Negative Growth — Inverted Pyramid



Population Growth

- Population growth depends upon
  - birth rates
  - death rates
  - immigration rates (into area)
  - emigration rates (exit area)

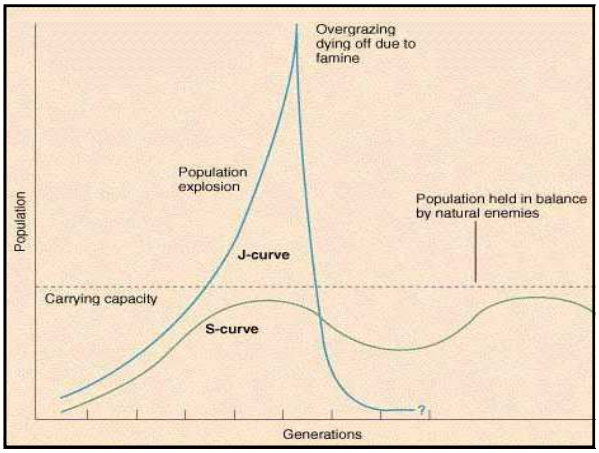
$$Pop = (b + i) - (d + e)$$

ZPG

$$(b + i) = (d + e)$$

Population Dynamics and Carrying Capacity

- Basic Concept: Over a long period of time, populations of species in an ecosystem are usually in a state of equilibrium (balance between births and deaths)
  - There is a dynamic balance between biotic potential and environmental resistance



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Reproductive Strategies

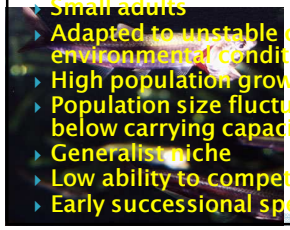
- Goal of every species is to produce as many offspring as possible
- Each individual has a limited amount of energy to put towards life and reproduction
- This leads to a trade-off of long life or high reproductive rate
- Natural Selection has lead to two strategies for species: r – strategists and K – strategists

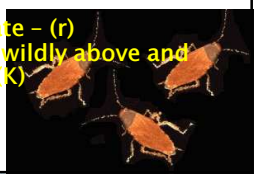
r – Strategists

- Spend most of their time in exponential growth
- Maximize reproductive life
- Minimum life

R Strategists

- Many small offspring
- Little or no parental care and protection of offspring
- Early reproductive age
- Most offspring die before reaching reproductive age
- Small adults
- Adapted to unstable climate and environmental conditions
- High population growth rate – (r)
- Population size fluctuates wildly above and below carrying capacity – (K)
- Generalist niche
- Low ability to compete
- Early successional species

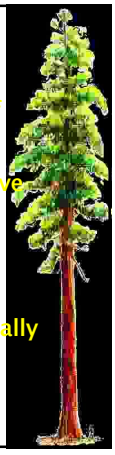




K – Strategists

- Maintain population at carrying capacity (K)
- Maximize lifespan

K – Strategist



- Fewer, larger offspring
- High parental care and protection of offspring
- Later reproductive age
- Most offspring survive to reproductive age
- Larger adults
- Adapted to stable climate and environmental conditions
- Lower population growth rate (r)
- Population size fairly stable and usually close to carrying capacity (K)
- Specialist niche
- High ability to compete
- Late successional species

Survivorship Curves

- Late Loss: K-strategists that produce few young and care for them until they reach reproductive age thus reducing juvenile mortality
- Constant Loss: typically intermediate reproductive strategies with fairly constant mortality throughout all age classes
- Early Loss: r-strategists with many offspring, high infant mortality and high survivorship once a certain size and age