Population Biology

- Population-all of the individuals of a species that live together in one place at one time.
- Population size
  - is the number of individuals in a population.
  - has an important effect on the ability of the population to survive.

- A small population is more likely to become extinct:
  - in the case of random events or natural disaster
  - due to inbreeding where the population is more genetically alike. Recessive traits are more likely to appear.
  - with reduced variability it is harder to adapt to changes.
- Population density
  - the number of individuals in a given area.
  - if they are too far apart they may only rarely encounter one another resulting in little reproduction.
    - Population size is limited by:
      density-dependent factors
      - Disease
      - Competition
      - Predators
      - Parasites
      - Food
      - Crowding
    - The greater the population, the greater effect these factors have.
    - Ex. Black plague in the Middle Ages – more deaths in cities
    - density-independent factors
      - Volcanic eruptions
      - Temperature
      - Storms
      - Floods
      - Drought
      - Chemical pesticides
      - Major habitat disruption (as in the New Orleans flooding)
- Most are abiotic factors

Growth of Populations

- When Populations have nothing to limit their growth they will grow unchecked.

- The maximum size that a population can reach is referred to as Biotic potential

Biotic Potential

- Population Size is the present number of a certain species
- Population growth is the increase of a population size in a certain period of time

- Biotic potential is the maximum number of organisms of one species that an environment can maintain
- Limiting factors are anything that would keep a population from reaching its 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

Multiple factors may limit population growth

- declining birth rate or increasing death rate
- The regulation of growth in a natural population is determined by several factors
  - Disease
  - limited food supply
  - the buildup of toxic wastes
  - increased disease
  - predation

Population Growth Curve

- When you observe a population that has no or few limiting factors the curve is a J curve
- An environment cannot maintain a J curve population growth.
- So in reality the curve has to turn into a S curve

PREDICTING POPULATION GROWTH

- Nearly all populations will tend to grow exponentially as long as there are resources available.
- Two of the most basic factors that affect the rate of population growth are the birth rate, and the death rate.
- r(rate of growth)=birth rate – death rate

- Exponential growth curve: population growth plotted against time. (J curve)
- As a population gets larger, it also grows at a faster rate.
- This is the maximum population growth under ideal circumstances.
- Includes plenty of room for each member, unlimited resources (food, water) and no hindrances (predators).
- Logistic model: This model accounts for the declining resources available to populations as they grow.
- It assumes the birth and death rates are not constant.
- As the population grows, births decline and death rises.
- Eventually birth=death so the population stops growing.
- Carrying capacity (K): The number of organisms of one species that an environment can support indefinitely.

PREDICTING POPULATION GROWTH, Two modes of population growth.

POPULATION GROWTH STRATEGIES

There are 2 ways a population can prosper:

-Growth Strategy #1 (r strategy) characterized by exponential growth, which results in temporarily large populations, followed by sudden crashes in population size. Ex. Insects, bacteria, some plants J Curve

  - live in unpredictable and rapidly changing environments
  - Reproduce quickly when conditions are favorable
  - Many offspring: small, mature rapidly, no parental care
  - *r* = rate of growth

-Growth Strategy #2 (K-strategy): characterized by a high degree of specialization. Ex. Trees, whales, tigers, etc. S curve

  - Live in stable and predictable environments
  - Can compete effectively
  - Reproduce late in life
  - Few offspring: large, mature slowly, often much parental care
  - K = carrying capacity
  - <u>Logistic growth</u> is slowed by population-limiting factors

Emigration

- When an area becomes unsuitable organisms will move out of the area to find a better area.

Immigration

- When organisms move into an area (the better area that they move into

Population Size

- Natality

  - Number of individuals added through reproduction
  - Total Fertility Rate – Average number of children born alive per female in her lifetime
- Mortality
  - Number of individuals removed through death
  - About every 10 years, both hare and lynx populations have a rapid increase (a "boom") followed by a sharp decline (a "bust")
- Principles of population ecology may be used to
  - manage wildlife, fisheries, and forests for sustainable yield
  - reverse the decline of threatened or endangered species
  - reduce pest populations
  - IPM = Integrated Pest Management

The Spread of Shakespeare's Starlings

- In 1890, a group of Shakespeare enthusiasts released about 120 starlings in New York's Central Park
- Today: over 100 million starlings, spread over N. Amer.

Human Population growth

- doubled three times in the last three centuries
- about 6.1 billion and may reach 9.3 billion by the year 2050
- improved health and technology have lowered death rates
- The history of human population growth
- The age structure of a population is the proportion of individuals in different age-groups

What is the answer to this problem?

- Education
- Technology
- Moral responsibility

Ecological result of human population

- The **ecological footprint** represents the amount of productive land needed to support a nation’s resource needs