IDX G9 Biology H

Study Guide Issue S1 Monthly 2

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Contents:

5.1 How Populations Grow

Describing Populations

- **Population**: a group of organisms of the same species that lives in a given area.
- **Sampling**: a technique sometimes used to estimate population size. In this procedure, the organisms in a few small areas are counted and projected to the entire area.
    - **Random quadrant sampling**: counting numbers in small, randomly located, squares within the total area.
        - Population size=(mean number per quadrat·total area)/area of each quadrat

    - **Capture-mark-release-recapture**

        - Population size=(n1·n2)/n3
        - n1=# of initially caught& marked
        - n2=# of second caught
        - n3=# of marked (in the first step) in the second sample

Scientists study population's:

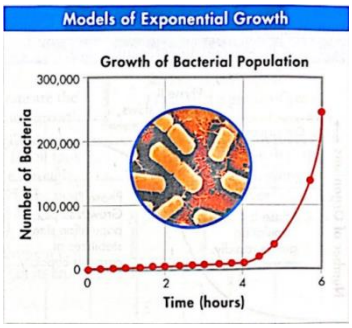
- **Geographic Range**
    - The area inhabited by a population
    - Vary depending on the species
- **Density and Distribution**
    - Population density: the number of individuals per unit area
    - Vary depending on the species
    - Spatial distribution: the pattern of spacing of a population
        - Clumped: aggregate in patches; resource availability and behavior
        - Uniform: evenly spaced; social interactions (e.g. territoriality)
        - Random: independent position; No strong attractions or repulsions.
- **Growth Rate**
    - Determines whether the population size increases, decreases, or stays the same
        - Zero growth rate: neither increase nor decrease in size
        - Positive (high) growth rate: increase in size
        - Negative growth rate: decrease in size
- **Age Structure**
    - The number of males and females of each are a population contains
        - Most species reproduce until they reach a certain age
        - Among animals, only females produce offspring
    - Age structure can be graphed in population pyramid, a type of double sided bar graph

Population Growth

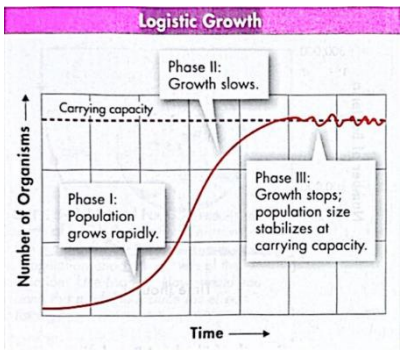
- The factors that can affect population size are
    - **Natality** (crude birth rate) – The number of birth in a population, expressed per 1000 population per year
    - **Mortality** (crude death rate)- The number of death in a population, expressed per 1000 population per year

- **Immigration**- members arriving in the population
- **Emigration**- members leaving the population
- **Growth**: I+N>E+M
- **Stability**: I+N=E+M
- **Decline**: I+N<E+M

- **Exponential Growth**
  - Under ideal conditions with unlimited resources, a population will grow exponentially
  - J-shaped growth curve
    - Lag phase- slow growth period
    - The growth rate is proportional to the size of the population



- **Logistic Growth**
  - Logistic growth occurs when a population's growth slows and then stops, following a period of exponential growth, at the population's carrying capacity
    - Carrying capacity (K):The maximum number of individuals in a species that an environment can support for the long term
    - Carrying capacity is limited by:
      - Food& water availability
      - Space for territories& nesting
      - Availability of mates
      - Disease
      - Predation
      - Environmental change
  - S-shaped curve
    - Phase 1: Exponential growth phase
      - Few predators
      - Less disease
      - Plentiful resources, no competition
      - Population grows exponentially
    - Phase 2: Transitional phase
      - Predators increase
      - Disease



        - Competition increase
        - N decreasing, M increasing
        - Population grows slower
    - Phase 3: Plateau phase
        - I+N=E+M
        - The population begins to stop growing

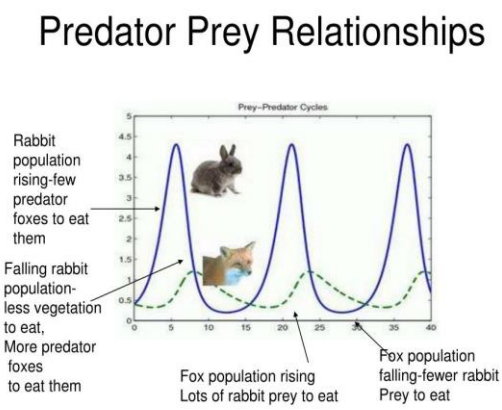
5.2 Limits to Growth

Limiting Factors

- Determine the carrying capacity of an environment
- Controls the growth of a population
- **Density dependent limiting factor** has varied impact based on the population density
- **Density independent limiting factor** impacts the population no matter the population size
- How do distinguish between these factors?
    - Ask your self this question: If there are only 10 people on this planet, is this factor still a prevalent issue? If the answer is yes, the factor is a density independent factor. Otherwise, it is a density dependent factor.

Density dependent limiting factor

- **Competition** of resources such as food, water, space, sunlight, mates, etc.
- **Predation and Herbivory**
    - **Predator-Prey Relationship** Population of predator and prey cycle up and down over time.
    - **Herbivore Effects** Also cycle up and down, similar to predator-prey relationship.



    - Tips on describing graph question: The response should say the population is **fluctuating**, how does the species **impact** each other (which species' increase causes the other species' increase/decrease in population) , and **how long** is each cycle.
    - Top down factor: pressure applied at high trophic level

    - Bottom up factor: involve resource scarce at lower trophic level
- Parasitism and Disease
    - The denser the host population, the more easily parasites can spread from one host to another.
    - If the organisms are sparsely distributed, diseases decline.
    - Example: Starlings and lice, oak trees and fungal diseases.
- Stress from overcrowding
    - Weaken immunity, females neglect (kill or eat their offspring), lower birth rates, higher death rates, increase rates of emigration.
    - e.g. Norwegian lemmings stress collapse.

Density Independent Limiting Factors

- Affect all populations in similar ways, regardless of population size, age, and density.
- E.g. environmental changes: hurricane, drought, wildfire, flood.

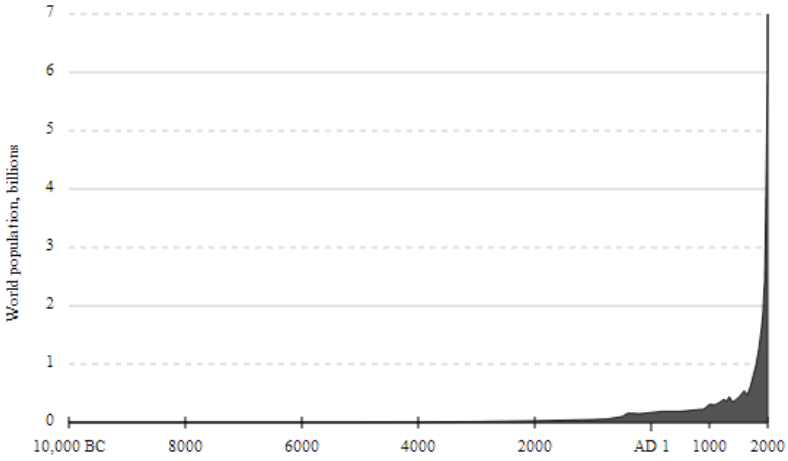
Controlling Introduced Species

- **Endemic species** are species that are native to an area.
- **Alien species** are species that are not native but are introduced by humans.
    - **Invasive species** are alien species that lack predators. They outcompete endemic species.
        - Solution: Introduce **infertile predators** so that the predators would not grow out of control.

5.3 Human Population Growth

Demography

- The study of population size, density, distribution, movement, birth / death rates



Historical Overview of Human Population

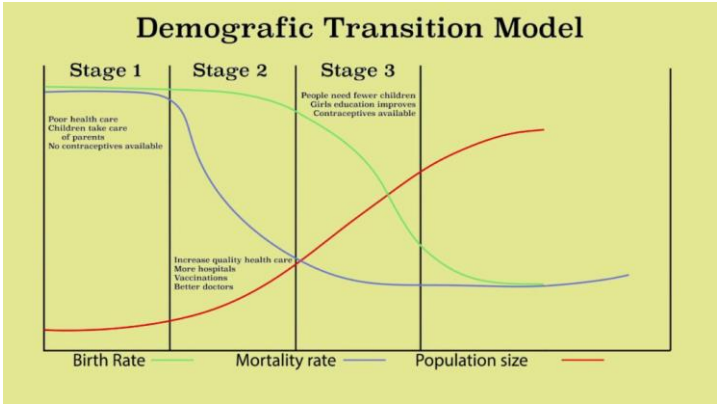
- English economist Thomas Malthus thought that

human population wold be regulated by: competition (war), limiting resource, disease, and other factors.

- Key time periods
    - **10,000 BC** Agriculture begins, but environment was harsh. Predation and disease causes high death rate. Only about 1 billion
    - **1700 AD** Industrial revolution begins, so civilization advances. Life became easier, better medical and healthcare infrastructure, so population increased rapidly since then. Death rate lowered significantly. Grew exponentially and to 8 billion currently.
    - **Top three population country in the world India China and Us**

Demography Transition

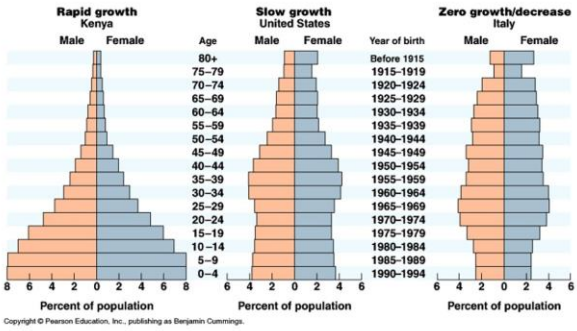
- A change from high birthrates and death rates to low birthrates and death rates.



- **Stage 1** High birthrate and deathrate due to poor medical infrastructre and education.
- **Stage 2** High birthrate due to lack of education, but low death rate due to improved nutrition and medication.
- **Stage 3** Low birthrate and deathrate due to improved living standards, education, and medical care.

Age Structure and Population Growth

Age Structure



In the diagram the first shows a preindustrial stage country the second shows a transitional stage the last shows a industrial stage

- **Age structure** refers to the number of males and females in each stage.
    - Pre-reproductive stage (below 15)
    - Reproductive stage (15 to 45)
    - Post reproductive stage (Above 45)
- Can be used to predict future population growth.

Future Population Growth

- Human population will reach 9 billion people by 2050
- May level out to a logistic growth curve and become stable