Population Ecology

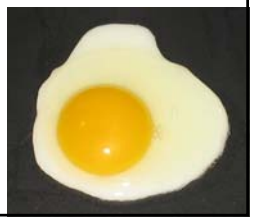
Populations are made up of individuals

- A population is all the individuals of a species that live together in an area
- Several species may share a habitat but they each have their own niche.

Niche = a position or role taken by an organism within its community.

Two types of reproduction

- Asexual- Only one parent needed. There is no exchange of genetic material when creating offspring.
- Sexual- An exchange of gametes occurs prior to fertilization. Two parents are needed to create an offspring



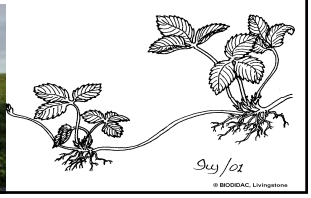
Asexual Reproduction

What are the advantages of asexual reproduction?

- Only need one organism – less complicated
- Can quickly colonize new habitats with fewer organisms

What are the disadvantages of asexual reproduction?

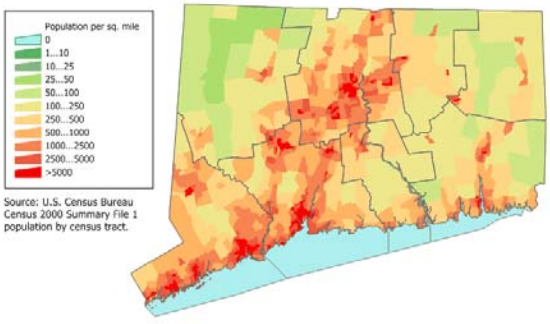
- Offspring genetically identical – no variation!



Sexual Reproduction

- Fertilization of the female's eggs with sperm from a male creates variation in their offspring.
- Offspring are genetically different from each other and only 50% the same as each parent

Four Rates determine population size



Four Rates determine population size

The rate at which individuals die within a population

Mortality

decreases the population size

#1

Four Rates determine population size

BIRTHRATE

increases the population size

The rate at which new individuals are created by reproduction

#2

Four Rates determine population size

The rate at which new individuals leave the area

Emigration

Decreases the population size

#3

Four Rates determine population size

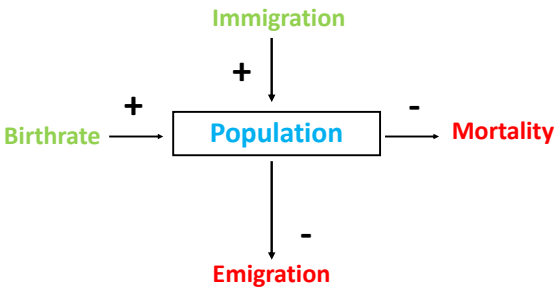
Immigration

increases the population size

The rate at which new individuals enter the area

#4

Four Rates determine population size



Density: measurement of population per unit area or unit volume

Pop. Density = # of individuals ÷ unit of space

In 2012 Connecticut was the 4th most densely populated state with 741.4 people per square mile.
(total population was 3,590,347)

Density: measurement of population per unit area or unit volume

Pop. Density = # of individuals ÷ unit of space

In 2012 Connecticut was the 4th most densely populated state with 741.4 people per square mile. (total population was 3,590,347)

Using the above information how many square miles of land are there in CT?

Space = $\frac{\text{\# of Individuals}}{\text{Pop Density}}$

Density: measurement of population per unit area or unit volume

Pop. Density = # of individuals ÷ unit of space

In 2012 Connecticut was the 4th most densely populated state with 741.4 people per square mile. (total population was 3,590,347)

Space = $\frac{\text{\# of Individuals}}{\text{Pop Density}}$

Space = $\frac{3{,}590{,}347}{741.4}$

4,842 = $\frac{3{,}590{,}347}{741.4}$

CT's total area including water is 5543

Growth Rate

Birth Rate - Death Rate = rate of growth

(How many individuals are born vs. how many die)

If birthrate is > death rate = rate of natural increase

If birthrate is < death rate = rate of natural decrease

How Do You Affect Density?

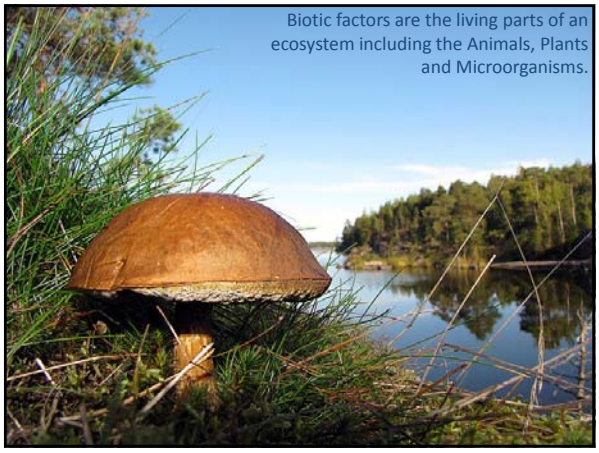
1. **Immigration:** movement of individuals into a population
2. **Emigration:** movement of individuals out of a population
3. Biotic factors: in the environment that have an increasing effect as population size increases
4. Abiotic factors: in the environment that affect populations regardless of their density

Biotic factors:

bios from the Greek for 'life.'

Biotic: of, relating to, or resulting from living things, especially in their ecological relationships.

The living parts of an ecosystem including the Animals, Plants and Microorganisms.



Biotic factors are the living parts of an ecosystem including the Animals, Plants and Microorganisms.

Abiotic factors:

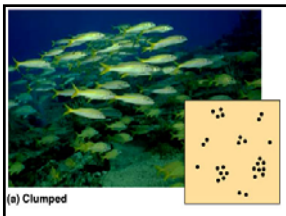
A from the Greek for 'without.'

Abiotic: of, relating to, or resulting from nonliving things, especially in their ecological relationships.

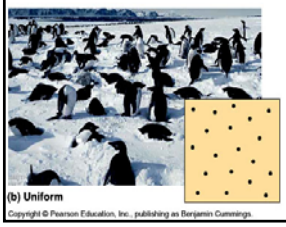
- Temperature
- Rainfall and Water
- Sunlight
- Soil conditions
- Air and wind currents
- Chemicals and pollution
- Available space

▪Abiotic factors: the nonliving things in an environment such as: Temperature, Rainfall and moisture, Sunlight, Soil conditions, Air and wind currents, Chemicals and pollution

view of the Monument Valley, Between Arizona and Utah



(a) Clumped



(b) Uniform

Population Dispersion

describes the spacing of organisms relative to each other

(c) Random

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Carrying Capacity

Carrying Capacity:

- The maximum population size that can be supported by the available resources
- There can only be as many organisms as the environmental resources can support

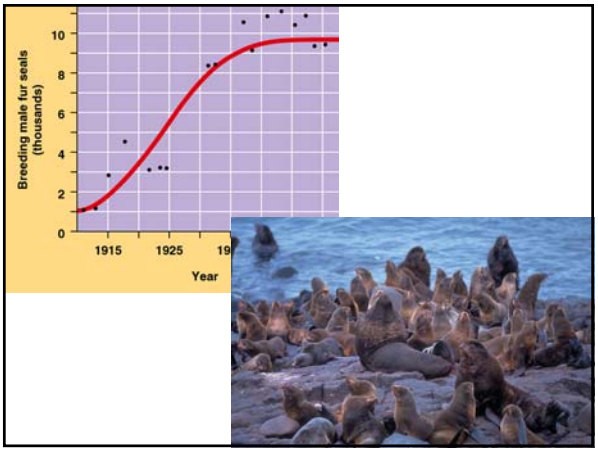
Factors Limiting Growth Rate

- Declining birth rate or increasing death rate are caused by several factors including:
  - Limited food supply
  - The buildup of toxic wastes
  - Increased disease
  - Predation

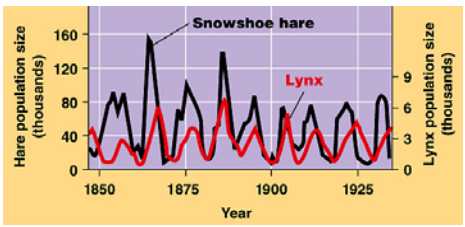
Exponential Growth Curve

Time	Number of Cells	
0 minutes	1	$= 2^0$
20	2	$= 2^1$
40	4	$= 2^2$
60	8	$= 2^3$
80	16	$= 2^4$
100	32	$= 2^5$
120 (= 2 hours)	64	$= 2^6$
3 hours	512	$= 2^9$
4 hours	4,096	$= 2^{12}$
8 hours	16,777,216	$= 2^{24}$
12 hours	68,719,476,736	$= 2^{36}$

Figure 35.3A



"Booms" and "Busts"



Reproductive Strategies

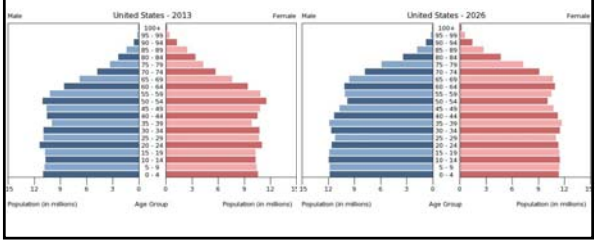
- R Strategists
  - Short life span
  - Small body size
  - Reproduce quickly
  - Have many young
  - Little parental care
  - Ex: cockroaches, weeds, bacteria

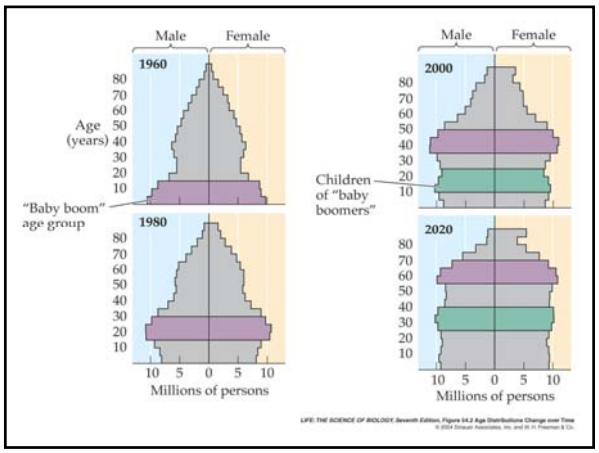
Reproductive Strategies

- K Strategists
  - Long life span
  - Large body size
  - Reproduce slowly
  - Have few young
  - Provides parental care
  - Ex: humans, elephants

Age Distribution

- Distribution of males and females in each age group of a population
- Used to predict future population growth

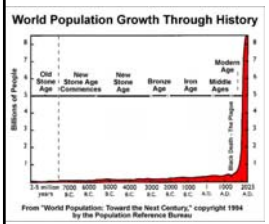




Human Population Growth

The Human Population

- Doubled three times in the last three centuries
- Over 7.1 billion people in 2013



COMPONENTS OF US POPULATION CHANGE

One birth every 8 seconds

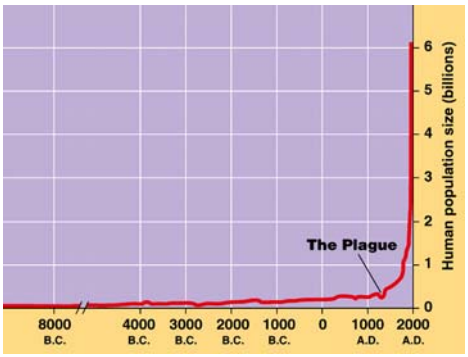
One death every 12 seconds

One international migrant (net) every 44 seconds

Net gain of one person every 12 seconds

http://www.census.gov/popclock/

History of the Human Population



Human Population Growth

- Why doesn't environmental resistance take effect?
  - Humans can alter their environment
  - Technological advances
    - The cultural revolution
    - The agricultural revolution
    - The industrial-medical revolution

Human Culture & the Ecosystem

- Complex brain caused new responses to the environment.
- Culture = ideas & behaviors passed on through teaching & learning
- When the rate of technology increased so did cultural developments

Establishment of Agriculture

- Planting & harvesting wild food plants
- Tame, herd and breed animals for food & clothing
- **Slash-and-burn agriculture**- cut down vegetation, dry, then burn it
- Soil became depleted (no more nutrients), moved to a new area.

Evolution of Agriculture

1. Small areas, simple tools, just food for families
2. Larger areas, better tools with **animal-powered plows**, food for villages
3. Increased crop production by **diverting hand-dug canals to irrigate crops.**
4. More crops = **surplus** which was **stored or sold** for other goods.
5. New crafts: weaving, tool making, pottery

Results of Agriculture

- Human populations **increased** dramatically
- Cities began to develop
- Nutrient rich soil, water, forests, grazing land & wildlife **decreased** dramatically .

Industrial Revolution

- Bigger machines: trains, cars, trucks, tractors, ships powered by fossil fuels
- Further degradation of soil and greater amounts of pollution (contributed to the downfall of earlier civilizations)
- More people migrated from rural to urban areas

Problems Created

- Increased pollution
- Depleted resources
- Degraded farmland, forests, oceans
- “throwaway lifestyle”
- Consume the most energy & goods
- Create bulk of the world’s waste/pollution
- Acid rain

What Affects Human Change Over Time

- Atmospheric, nitrogen oxide & emotional stressors
- Family Planning
- Modern travel-spread diseases at global level
- Modern technology- medicines, computers
- **We must find stability in population size, technology, and consumption of resources**.

World Cooperation Is Needed

- Air pollution (acid rain) drifts to other countries
- Water pollution flows into oceans
- Nuclear power plant accidents; **Chernobyl**
  - Large clouds of radioactive particles spread from Russia to neighboring countries.
  - Causing cancer, tumors, cataracts and sterility for humans

Something Good from Chernobyl?

- Humans have not lived there for 20 years.
- *However, the still-contaminated* ecosystem rebounded to support a greater level of biodiversity with an increased number of each type of organism.
- **Human activity had a greater impact on the ecosystem than the nuclear disaster itself.**

?

What factors will impact human populations as we continue to grow?

Can we continue to grow?

Technology Can Help Solve Problems

- Population growth can be controlled by: family planning & inexpensive contraceptives
- Air pollution can be controlled by: reducing waste of metals, paper, resources & energy use
  - Switch from fossil fuels to energy from the sun, wind, flowing water & nuclear power

More Sustainable Agriculture

- Produce high-quality foods with little resources
- Focus on the long-term condition of the soil
- Use clean energy sources, Conserve water
- Control pests without biocides
- Use organic fertilizer
- Crop rotation

Personal Commitment Required

- What kind of world do you want?
- What changes are you willing to make to get it?
- Simple changes go a long way such as: fluorescent lighting, don't let the water run the entire time while showering or brushing your teeth, …….