Biology Lecture 2.1-2.11

Section 2.1

Individuals >> Populations >> Community >> Ecosystems >> Bioshere

(of same species) (same sp. in same place) (diff. Pops. in same place) (community & abiotic environ.) (all the ecosyst.)

I. Populations - a group of interbreeding (reproducing) individuals living in the same place. The same species.

eg. The Seagull population at Oceanside Harbor, Ca. 1999.

1. When ecologists want to test hypothesis they usually study whole populations because the individuals w/in a pop. vary; there are many variations w/in pops. because of different genes they inherited from their parents.

Question?

Why would it be misleading to study only individuals of a population as opposed to the whole pop.

Answer:

1. Scientific observations and conclusions are more accurate (true) about the pop.
2. Scientists can see what is happening through out the community.
3. If one pop. changes [eg. in size, habitat], may effect other pops. Ecologists are able to predict the changes in pops.

Section 2.2

↑ The size of a pop. continually changes through time.

egs. 700 ponderosa pines in Colorado; 1980.

In 1990, there were only 500; or 200 less in 10 years.

Expressed as a rate: **-** 200 trees/10 years, or **-20 trees per year**

NOTE: this rate is an average value; all of the trees could have been lost in one year due to fire.

Question?

What does a loss of 200 trees mean to an ecologist?

I. Four Rates that Determine Pop. Size:

1. Mortality rate - the number of deaths in a pop. per unit of time; decreases the pop. size.
   eg. **-**20 pines/year die
2. Natality rate - the number of births in a pop. per unit of time; increases the pop. size.
   eg. 180 humans born/minute
3. Immigration - the number of individuals in a pop. that move into an area per unit time; increases the pop. size.
   eg. 1000 Swallows/7 days in San Juan Capistrano
4. Emigration - the number of individuals in a pop. that move out of an area per unit time; decreases the pop. size.

- The size of any pop. is the result of the relationships among these 4 rates!
- Growth rate of a pop. - the sum of these rates.

eg. The human growth rate is 1.8 % per year!…. Scary…..

Section 2.3

In nature, pop. Size varies between upper & lower limits depending on the 4 rates above.

1. Lower limit = zero (extinct)
2. Upper limits = depends on the environment.

I. Environment – an orgs. surroundings; it can ….

1. slow pop. Growth
2. kill individuals
3. stimulate growth

II. The environment is made up of 2 parts:

- Biotic – living (or recently living). Eg. Neighbors, cats,diseases
- Abiotic – nonliving. Eg. Space, soil, sunlight, wind, water.
- Both parts effect the size of a pop.

III. Limiting Factors – any biotic or abiotic factor that slows pop. growth either directly or indirectly.

eg. Mosquito pop. ↓ in the winter, so the swallows fly south where it's warmer & more food.

Direct: weather >> mosquito pop. size

Indirect: weather >> swallow pop. size

A. Other Limiting Factors:

- H_2O – all orgs. need water for life
- Space – all orgs. need space to live; some orgs. need more than others. eg. Corn plants can be crowded, but Mt. Lions can't, i.e. animals need more space than plants.

B. Density – the # of individuals that occupy a certain amount of space.

- Density is related to available food in that space. (see fig. 2.7)

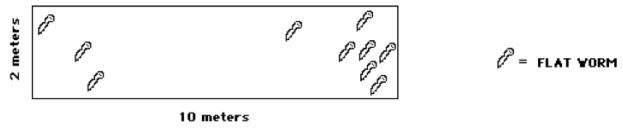
Egs. Mice in a crowded cage have plenty of food, but little space. i.e. high density

↑ food; ↑natality; eventually ↓ in food; thus ↑ mortality

Question?

What is the **population density** of the following population of FLAT WORMS in individuals per meter^2?

$$\text{Density} = \frac{\text{\# of organisms}}{\text{area}} \quad ; \quad \text{Area } (m^2) = \text{Length X Width}$$



Answer: **10 flatworms; Area = 2 m x 10 m = 20 m^2**
Population density = 10 flatworms/20 m^2 = 0.5 fw/m^2

IV. Communities are not permanent- they change:
Disturbance - a major feature of most communities. e.g. storms, fires, floods, droughts & human activities
•damage biological communities
•remove organisms from communities
•alter the availability of resources

A . **Ecological succession** - a *transition in the species composition* of a community following a disturbance (*natural or man-made*).

Section 2.4:
Abiotic & biotic factors work together to influence pop. size.
Resources – available matter & energy. Eg. Food, water, space they are limited, or finite.
They control pop. sizes.

A. Factors that affect resource availability:
1. relationships between orgs. such as…… ??
eg. Predation, disease, competition

B. Carrying capacity – the greatest # of individuals that a space can support indefinitely w/out degrading the environment.
- all pops. sizes are determined by the environment's carrying cap
- all pops. sizes fluctuate over time while maintaining a homeostatic balance.
- J- curve (exponential growth) and S-curve (stable growth)

Homeostasis = relatively stable pop. size between upper & lower limits.

Section 2.5:
Population density fluctuates over time.
- some pop. changes are permanent. e.g. Extinction

Question?
Density of pops. continually increase & decrease. Give 4 factors that determines the pop. growth rate?
- Consider the Norway Rat pop. in Baltimore, Ma. In 1942. (see fig. 2.8 on pge 36)

Section 2.8: Few Barriers Prevent Human Dispersal
- More than 6 billion humans on earth today.
- In the 1989, the human pop. increased by the pop. size of Ca. Pen, Tx, and NY. combined!

Question? How might these human pop. increases affect state parks, beaches & stadiums?

GEE WHIZ … Statistics!
- 30 born/yr./1000 people; 10 die/yr./1000 people = 1.8% ↑/yr.
- 260, 000 people born /day; 180 born /minute.

By the year 2000:

~60% of all the people in the world will be living in countries that are partly or all tropical.
20% in china (↑ 2.5% annually)
20% in developed /industrialized countries (↑ 0.5% annually)

Question?
Why is there a discrepancy between the annual increases?

Answer:
People living in industrialized countries control ~85% of the world's wealth & materials.
Also, they enjoy a higher standard of living, (20X higher).

Factors that may explain human pop. growth:

- ↑ natality; ↓ mortality …… better medical tech?
- Food supply is more reliable.
- Climate is not a major factor, ie. we can live anywhere?
- Few physical barriers, ie. we have planes, trains, etc..

(See fig. 2.14 on page 42)

Section 2.9: Earth's Carrying Capacity is Limited

Question?
Many parts of the earth are sparsely populated. Why would space be a limiting factor?

- Not all scientists agree on the exact carrying capacity for humans.
- Some areas in the world have already reached their carrying capacity; resources have been tapped out. Where?
- 3 limiting factors for human carrying capacity:

1. Food – requires land (space). Agriculture can cause pollutants
2. H_2O – must be sanitary to prevent disease; polluted? e.g. Malaria, yellow fever, typhoid, cholera, dysentery
3. Space – to live; to grow food; shopping malls?

Space ↓ with an ↑ demand for houses, etc..

GEE WHIZ!
8 houses occupy 1 hectare of land. This is enough space to provide food for 3 people.

Section 2.10: Uneven Dist. of Food Can Limit Pop. Size

- In some parts of the world food is a limiting factor.
- Currently, there is enough food in the world to support all the humans, but these food sources are unevenly distributed.
- Not everyone has access to the same quality of food.
- Good nutrition is paramount to the growth of a pop.
- Too much of one type of food can cause disease; variety of foods is essential for good health.

e.g. too much fat leads to heart disease (CHD); a diet of just corn bread is not nutritious.

Famine – massive food shortage.

Question?
What countries are currently experiencing a famine?

Calorie – a measure of chem. energy in food molecules.
Eg. Caloric requirements for teens:
Female – 1200 – 3000/day
Male – 2100 – 3900/day

- some people do not get enough calories/day; leads to malnutrition. The body will begin to metabolize
- (break down) stored carbos, fats, then muscle (protein).
- a meal of just plant material does not provide enough energy and nourishment for humans; animal products w/ plants do.
- Animals are expensive to raise; thus meats are costly to buy.

More statistics:
To provide a human w/ 3,000 cals. of food:
1. A farmer must raise 30,000 cals. of plant material(feed)
2. In US, 90% of the 30,000 cals. is used to feed animals raised for meat.

- In other parts of the world farmers can't afford to buy meat or raise animals for meat.
- The amount of land that can be farmed is limited; therefore,
  ↑ in population; ↓ amount of land for raising food

In US, farming is very productive, but @ the expense of huge amounts of fossil fuels (nonrenewable resources). This is a HIGH energy-losing system. Eg. for 1 calorie of energy we grow, we only get a return of 0.1 cals. "negative return"

In nonmechanized farming practices the energy return is
10 – 20 calories per 1 calorie spent. "positive return"

Section 2.11: Human Activities Change The Environment

- In the last 200 yrs. the composition of the environment has changed drastically.

1. Acid rain – SO_2, NO_2 emitted from power plants.
2. Urban smog – cars, power plants
3. Depletion of the ozone – climatic changes; global warming.
4. Burning of fossil fuels - greenhouse effect; global warming.
5. Deforestation – ↑ soil erosion & flooding.
6. Polluted water & land – depletion of potable ground water due to chem. spills, & industrial effluent water.

Remember: THINK GLOBALLY, BUT ACT LOCALLY!