POPULATION BIOLOGY

Properties of Populations

- ☺ A ***population*** is a group of organisms that belong to the same species and live in a particular place at the same time

- ☺ A ***population's size*** is the number of individuals it contains

- ☺ Increase in the size of a population with time is called ***population growth***

Under ideal conditions, then, a population of organisms could produce many offspring. What would "ideal conditions" be? Charles Darwin estimated that, starting with one pair of elephants, there would be 19 million elephants in only 750 years!

- ☺ The highest rate of reproduction under ideal conditions is called a population's ***biotic potential***
- ☺ A factor that restrains the growth of a population is called a ***limiting factor***
  - Unfavorable temperatures
  - Competition among organisms for food, habitat
  - Disease, predators, lack of food, space

Population Growth Curves

- ☑ show the changes in the size of a population

Population Growth Rate Curves

- ☑ Shows how fast a population grows

- ☑ Demonstrates that, up to a point, the size of a population increases more and more rapidly

- ☑ Then the rate of increase slows down

- ☑ The *number* of organisms still increases, but the *rate* at which new organisms are added to the population decreases

- ☑ When the population growth levels off, the population growth rate approaches zero

When a population arrives at the point where its size is no longer increasing, it has reached the carrying capacity of the environment.

Carrying Capacity

- ✪ The greatest number of individuals in a certain population that a given environment is capable of supporting under a specific set of conditions

- ✪ Can vary with the time of year as conditions change

- ✪ Number of organisms born in a given period of time (***birthrate***) balances the number of organisms that die during that time (***death rate***)

- ✪ At this point, the size of the population remains fairly stable

Population Density

- ♣ Refers to the size of a population that occupies a given area at any given point in time
- ♣ Measures how crowded a population is
- ♣ Expressed as the number of individuals per unit of area or volume
- ♣ The growth of many populations decreases as density increases
- ♣ Gradually, the population density approaches the carrying capacity of the environment
- ♣ When density reaches carrying capacity, birthrate and death rate become about equal and population growth levels off
- ♣ ***Limiting factors are tied to population density***

Population Density, continued

Two kinds of limiting factors, which control population size, have been identified:

1. Density-independent factors

   - ✪ weather, floods, fire, temperature – often related to physical aspects of the environment
   - ✪ Reduce the population by the same proportion, ***regardless of the population's size***
   - ✪ ***NOT*** related to population density

EXAMPLES:
If a forest fire destroys a population of chipmunks, it does not matter if the population of chipmunks is 1 or 100. The fire will destroy either population.
An unseasonable cold snap is a density-independent factor because its severity and duration are completely independent of population size.

2. Density-dependent factors

   - ✪ Most often involve interactions among organisms
   - ✪ resource limitations such as shortages of food or nesting sites
   - ✪ Triggered by ***increasing population density***
   - ✪ Varies with the size of the population – larger the population size, more intense a density-dependent factor will be

Regulation of Population Size

- ☺ Almost all organisms are food for other organisms

- ☺ A ***predator*** is an animal that kills and eats another animal

- ☺ The ***prey*** is the animal killed by a predator.

- ☺ ***Predation*** – the feeding of one organism on another
  ➔ Can be a factor limiting the size of a population

- ➔ Is a density-dependent factor
- ➔ Predator-prey interaction creates a cycle of population increase and decrease in both populations

As the prey population rises and falls in number, so does the predator population, but with a slight lag.

Regulation of Population Size, continued

There are many instances when very small organisms attack organisms much larger than they are.

These kinds of harmful organisms are called ***parasites***.

- ♣ A parasite is an organism that lives on or in another organism (the host) in order to obtain nourishment
- ♣ Parasites ALWAYS harm the host, but usually do not kill it (why do you think that a parasite oftentimes does not kill its host?)
- ♣ Fleas, leeches, tapeworms, and flukes are examples of parasites
- ♣ ***Parasitism*** can be a limiting factor for population size
- ♣ Parasitism is a density-dependent factor

Competition

Different species usually occupy the same area at the same time.

But what happens when a food source shared by several populations of different species in a given area becomes limited?

🡻🡻🡻🡻

The populations of different organisms compete for it, and the competition itself may become a limiting factor.

- ☸ Competition among populations of different species is called ***interspecific competition***
- ☸ It is an example of a limiting factor
- ☸ It is density dependent

Outcomes of interspecific competition

- ☒ Extinction – one species will die out and become extinct in that environment
- ☒ Movement – one species will move into another environment (usually close by)
- ☒ Adaptation – interspecific competition may spur rapid evolution in which a species acquire different traits
  - As a result, the populations no longer compete with each other

Competition continued

Intraspecific competition – competition that occurs between members of the ***same*** species

- May act as a limiting factor when members of a population seek out resources such as food, water, space, or nesting sites
- It is density dependent

Excess intraspecific competition is avoided in many ways:

- Life cycles
  Example: adult frogs do not compete with tadpoles because habitats and foods of frogs and tadpoles are different

- Life spans
  Example: Adult insects die shortly after the young are produced. Thus, old and young do not compete for food, space, or other factors.

- Social behavior (dominance)
  - Behavior patterns based on dominance and chains of command are characteristics of some animal populations
  - Such a pattern is known as a pecking order or ***social hierarchy***
  - Less dominant animals often leave the group, thus reducing competition

- Territoriality – the occupying and defending of specific territories
  - Common in arthropods (spiders, bees, shrimp, lobsters, etc.) and vertebrates
  - In some cases, held by just a few individuals

Human Population

Worldwide, human population growth has risen dramatically since the middle of the nineteenth century. The dotted portion of the curve represents projected future growth. Note the dip in the curve between 1347 and 1351. Do you know what this represents?

- ☒ Human population grew very slowly at first
- ☒ Even after the year A.D. 1, it took 1600 years for the number of humans to double
- ☒ After 1650 – rate of doubling rapidly increased---Why?
- ☒ About this time there was a rapid development of science, technology, and industrialization
- ☒ Population doubled between 1650 and 1850
- ☒ Doubled again by 1930
- ☒ By 1995, world's population estimated at 5.75 billion
- ☒ Projections suggest it will be 10.8 billion by 2050