Chapter 5
Populations

Section Objectives:

- Compare and contrast exponential and linear population growth.
- Relate the reproductive patterns of different populations of organisms to models of population growth.
- Predict effects of environmental factors on population growth.

Principles of Population Growth

- A population is a group of organisms, all of the same species, that live in a specific area.
- A healthy population will grow and die at a steady rate unless it runs out of food or space, or is attacked in some way by disease or predators.
- Scientists study changes in populations in a variety of ways.

Principles of Population Growth

- One method involves introducing organisms into an environment that contains abundant resources and then watching how the organisms react.

Principles of Population Growth

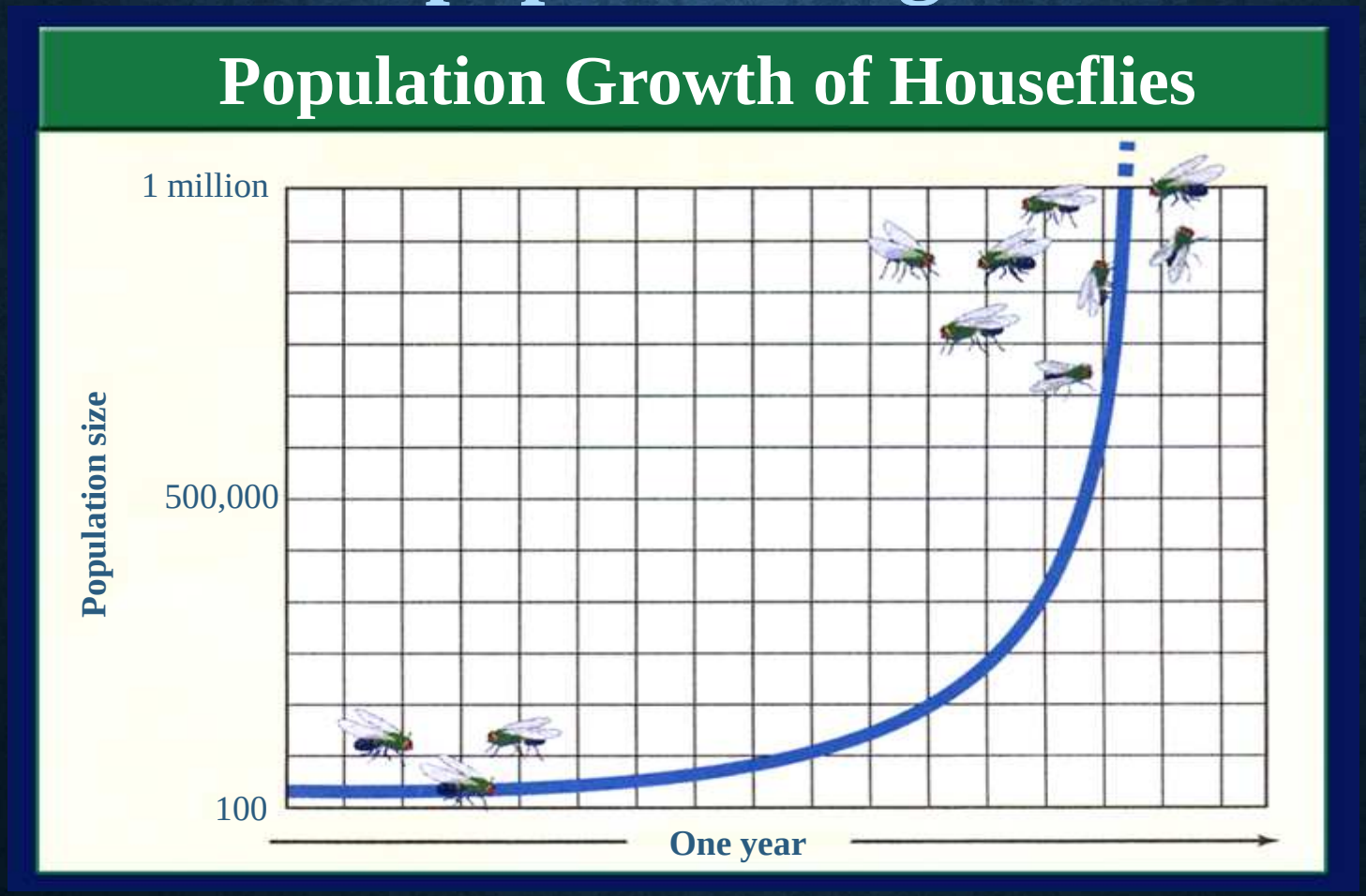
- Studies of populations of larger organisms, such as an elk population in a national park, require methods such as the use of radio monitors.

How fast do populations grow?

- The growth of populations is unlike the growth of pay you get from a job.

- Populations of organisms, do not experience linear growth. Rather, the graph of a growing population starts out slowly, then begins to resemble a J-shaped curve.

How fast do populations grow?



How fast do populations grow?

- The initial increase in the number of organisms is slow because the number of reproducing individuals is small.
- Soon, however, the rate of population growth increases because the total number of individuals that are able to reproduce has increased.

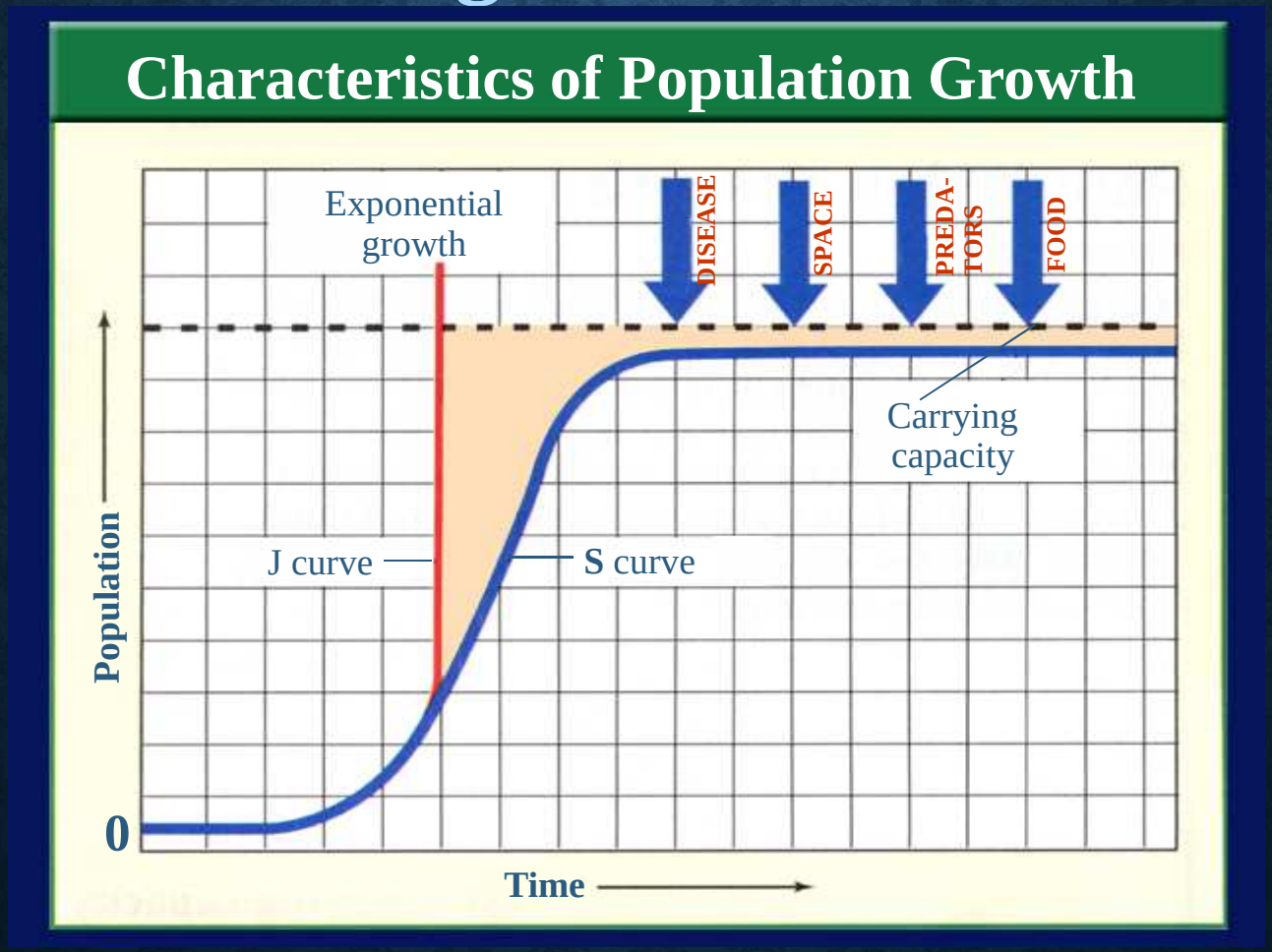
Is growth unlimited?

- A J-shaped growth curve illustrates exponential population growth.
- Exponential growth means that as a population gets larger, it also grows at a faster rate.
- Exponential growth results in unchecked growth.

What can limit growth?

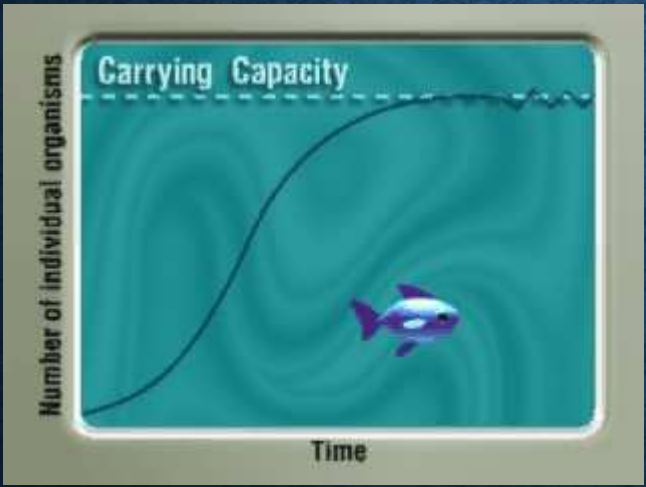
- Limiting factors, such as availability of food, disease, predators, or lack of space, will cause population growth to slow.
- Under these pressures, the population may stabilize in an S-shaped growth curve.

What can limit growth?



Carrying capacity

- The number of organisms of one species that an environment can support indefinitely is its carrying capacity.



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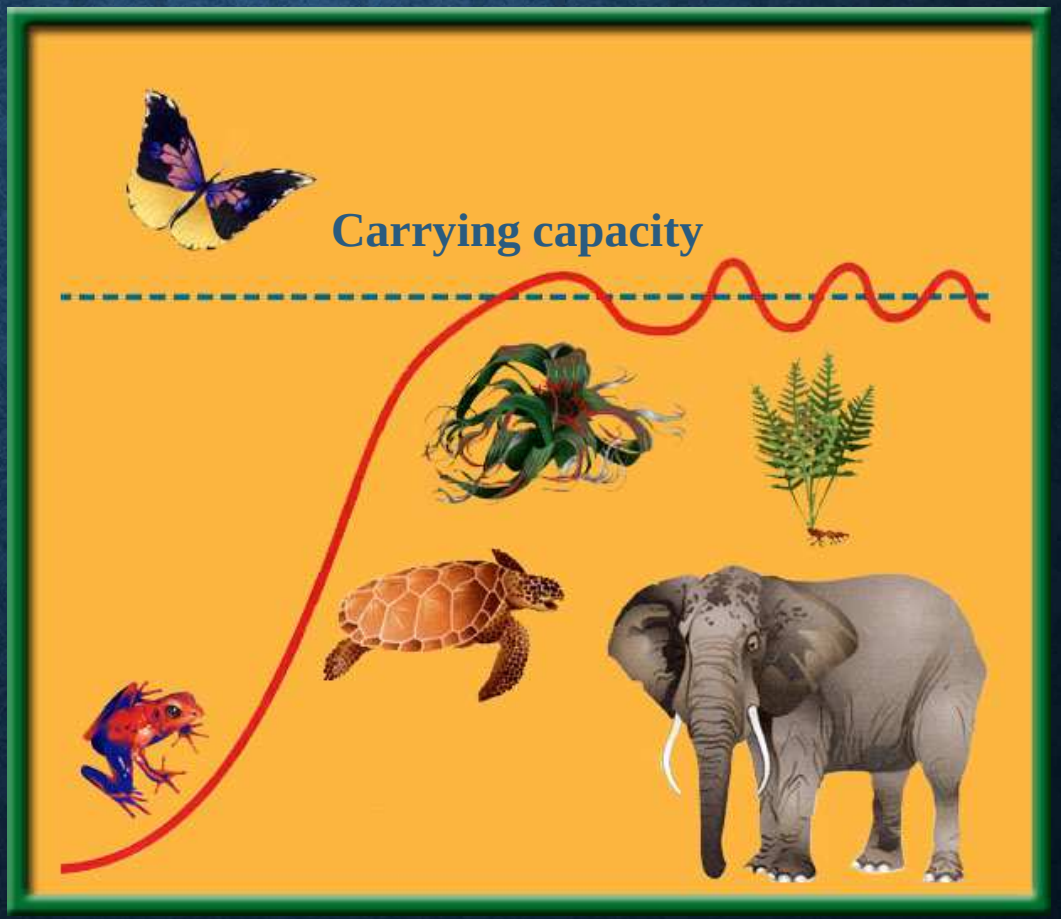
- When a population overshoots the carrying capacity, then limiting factors may come into effect.

Carrying capacity

- Deaths begin to exceed births and the population falls below carrying capacity.



Reproduction Patterns

- In nature, animal and plant populations change in size.
- Biologists study the factor that determines population growth—an organism's reproductive pattern, also called its life-history pattern.
- A variety of population growth patterns are possible in nature.

Rapid life-history patterns

- Rapid life-history patterns are common among organisms from changeable or unpredictable environments.
- Rapid life-history organisms have a small body size, mature rapidly, reproduce early, and have a short life span.

Slow life-history patterns

- Large species that live in more stable environments usually have slow life-history patterns.

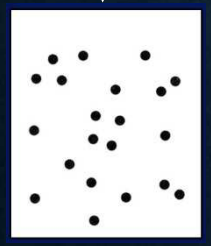
Slow life-history patterns

- Slow life-history organisms reproduce and mature slowly, and are long-lived. They maintain population sizes at or near carrying capacity.

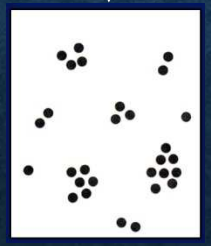
Density factors and population growth

- How organisms are dispersed can be important.
- Three patterns of dispersal are random, clumped, and uniform.

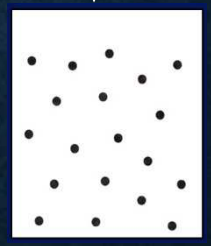
Random



Clumped



Uniform



Density factors and population growth

- Ecologists have identified two kinds of limiting factors that are related to dispersal: density-dependent and density-independent factors.
- Population density describes the number of individuals in a given area.

Density factors and population growth

- Density-dependent factors include disease, competition, predators, parasites, and food.
- Disease, for example, can spread more quickly in a population with members that live close together.

Density factors and population growth

- Density-independent factors can affect all populations, regardless of their density.

- Most density-independent factors are abiotic factors, such as temperature, storms, floods, drought, and major habitat disruption.

Organism Interactions Limit Population Size

- Population sizes are limited not only by abiotic factors, but also are controlled by various interactions among organisms that share a community.

Predation affects population size

- When a predator consumes prey on a large enough scale, it can have a drastic effect on the size of the prey population.
- Populations of predators and their prey are known to experience cycles or changes in their numbers over periods of time.

Predation affects population size

- The data in this graph reflect the number of hare and lynx pelts sold to the Hudson's Bay Company in northern Canada from 1845 through 1935.

Predation affects population size

- In field studies, predation increases the chance that resources will be available for the remaining individuals in a prey population.

Competition within a population

- Competition is a density-dependent factor.
- When only a few individuals compete for resources, no problem arises.
- When a population increases to the point at which demand for resources exceeds the supply, the population size decreases.

The effects of crowding and stress

- When populations of certain organisms become crowded, individuals may exhibit symptoms of stress.
- As populations increase in size in environments that cannot support increased numbers, individual animals can exhibit a variety of stress symptoms.

The effects of crowding and stress

- These include aggression, decrease in parental care, decreased fertility, and decreased resistance to disease.
- They become limiting factors for growth and keep populations below carrying capacity.

Section Objectives:

- Identify how the birthrate and death rate affect the rate at which a population changes.
- Compare the age structure of rapidly growing, slow-growing, and no-growth countries.
- Explain the relationship between a population and the environment.

World Population

- In the United States, a census is taken every ten years.
- One of the most useful pieces of data is the rate at which each country's population is growing or declining.
- These figures are the basis for demography, the study of human population size, density and distribution, movement, and its birth and death rates.

Human population growth

- Human population growth is different because humans have the ability to change their environment.
- People live longer and are able to produce offspring that live long enough to produce offspring, hence, a population grows.

Calculating growth rate

- There are a number of factors that determine population growth rate.
- These are births, deaths, immigration and emigration.
- Birthrate is the number of live births per 1000 population in a given year.

Calculating growth rate

- Death rate is the number of deaths per 1000 population in a given year.
- Movement of individuals into a population is immigration.

Calculating growth rate

- Movement out of a population is emigration.
- Birthrate – Death rate = Population Growth Rate (PGR)
- If the birth rate of a population equals its death rate, then the population growth rate is zero.

Calculating growth rate

- If the PGR is above zero, more new individuals are entering the population than are leaving, so the population is growing.
- A PGR can also be less than zero.

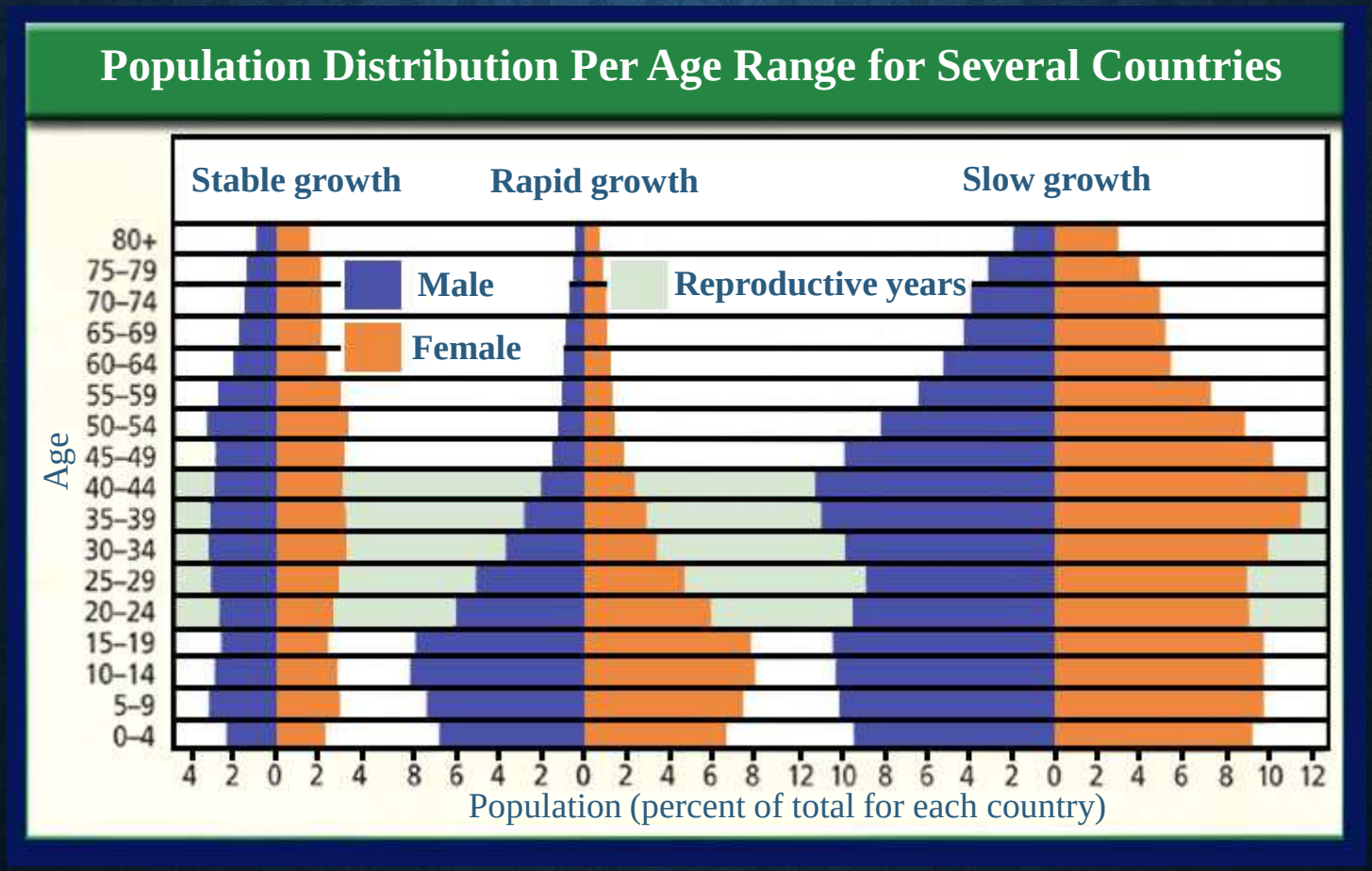
Doubling time

- Another quantitative factor that demographers look at is the doubling time of a population.
- Doubling time is the time needed for a population to double in size.
- The time it takes for a population to double varies depending on the current population and growth rate.

Doubling time

- Doubling time can be calculated for the world, a country, or even a small region, such as a city.

Age structure



Ecology and growth

- The needs of populations differ greatly throughout the world.
- Sometimes, a population grows more rapidly than the available resources can handle.

Ecology and growth

- Resources that are needed for life, such as food and water, become scarce or contaminated.

Ecology and growth

- The amount of waste produced by a population becomes difficult to dispose of properly.
- These conditions can lead to stress on current resources and contribute to the spread of diseases that affect the stability of human populations both now and to come.