chapter 4 Population Ecology

section 1 Population Dynamics

Before You Read

On the lines below, explain why animals that live in your area might be found in greater or smaller numbers than in other places on Earth. Then read the section to learn about factors that limit the growth of any population.

MAIN Idea

Populations of species are described by density, spatial distribution, and growth rate.

What You'll Learn

- concepts of carrying capacity and limiting factors
- ways in which populations are distributed

Read to Learn

Mark the Text

Identify Concepts
Highlight each question heading in this section. Then use a different color to highlight the answers to the questions.

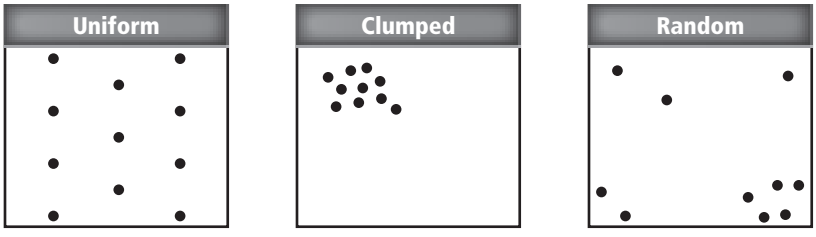
Population Characteristics

Every organism belongs to a population. A population is a group of organisms of the same species that live in a specific area. Populations of organisms include plants, animals, and bacteria. All populations have certain characteristics, such as population density, spatial distribution, and growth rate.

What are common patterns of dispersion?

Population density is the number of organisms per unit area. For example, there was an average of four American bison per square kilometer in Northern Yellowstone in 2000.

Dispersion is the pattern of spacing of a population within an area. The figure below shows three main types of dispersion—uniform, clumped, and random. Black bears are dispersed in a uniform, or even, arrangement. American bison are dispersed in clumped groups or herds. White-tailed deer are dispersed in random groups.

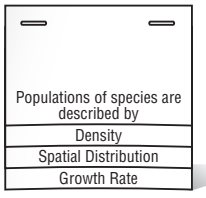


Picture This

1. **Apply** Wolverines spread across their range, with each individual patrolling a territory of about 320 km^2. What type of dispersion do wolverines represent?

FOLDABLES™

Record Information
Make a layered Foldable from two sheets of paper to record what you learn about how populations of species are described.



What limits spatial distribution?

No population lives in all habitats of the biosphere. A species might not be able to expand its spatial distribution because it cannot survive the conditions in the new area. Abiotic factors, such as temperature, humidity, and rainfall, could make the new area unlivable for a species. Biotic factors, such as predators and competitors, also might prevent a species from surviving in the new area.

Population-Limiting Factors

All species have limiting factors. Limiting factors keep a population from growing indefinitely. For example, the food supply is a limiting factor. The number of individuals in a population cannot increase beyond the amount of food available to support that number.

There are two categories of limiting factors. They are density-independent factors and density-dependent factors.

What limiting factors are density independent?

Recall that population density is the number of members of a population per unit area. A **density-independent factor** is any factor in the environment that does not depend on population density. Usually these factors are abiotic. For example, populations are limited by weather events such as drought, floods, and hurricanes.

Human activities can also be density-independent limiting factors. For example, dam building alters the water flow of rivers, limiting some species. Pollution resulting from human activities reduces the available resources by making air, water, and land toxic in some areas.

Reading Check

2. Explain why water pollution is a density-independent factor.

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What limiting factors are density dependent?

A **density-dependent factor** is any factor in the environment that depends on population density. Often these are biotic factors, such as disease, competition, parasites, and predators.

Disease Outbreaks of disease tend to occur when a population has increased and population density is high. When population density is high, individuals come into contact more frequently. Frequent contact enables disease to spread easily and quickly between individuals. The spread of disease limits populations of humans as well as protists, plants, and other animals.

Think it Over

3. Apply Which is an example of a density-dependent factor? (Circle your answer.)

a. frost that destroys tomato plants

b. fungus that spreads from plant to plant

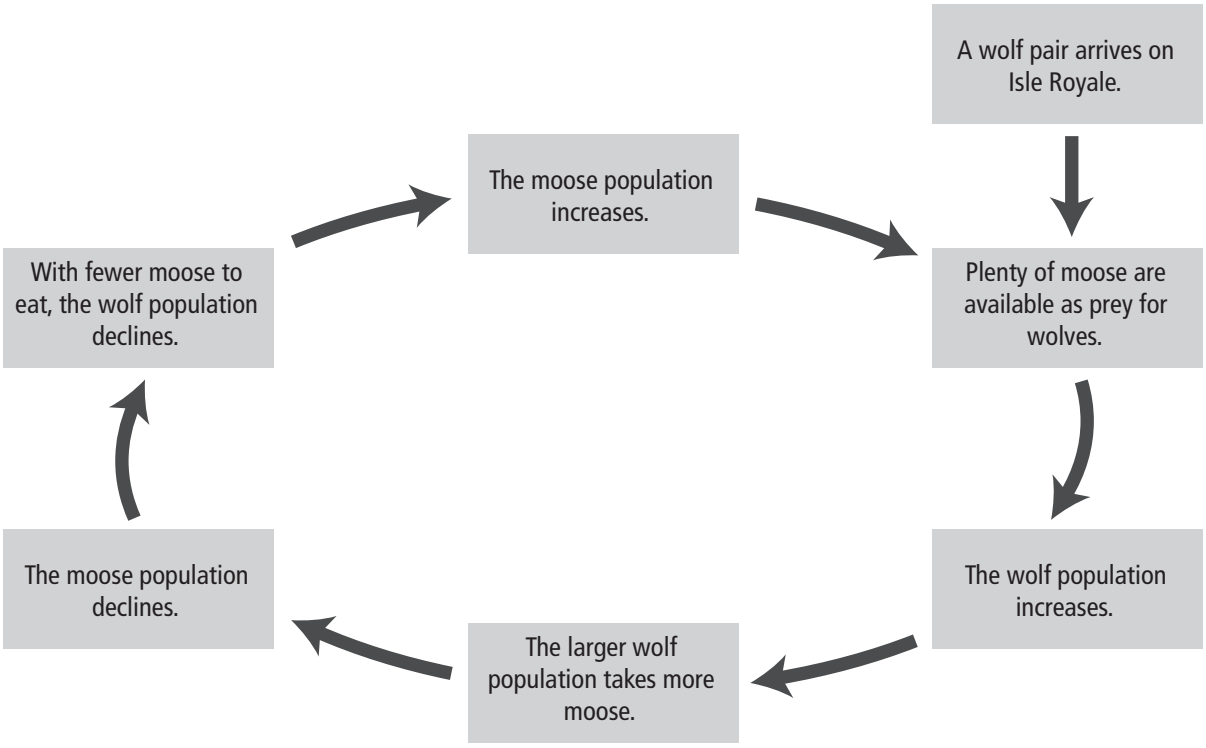
Competition High population density increases competition among individuals for resources. When a population grows to a size that food and space become limited, individuals must compete for the available resources. Competition occurs within a species or between different species that use the same resources. As a result of competition, some individuals might die of starvation. Others move to different areas in search of resources. As population density decreases, competition decreases.

Parasites When population density is high, parasites spread in a way similar to the way disease spreads. The spread of parasites limits population growth.

Predators The figure below illustrates how the interaction of predators and prey limits the populations of both groups. Before the winter of 1947, there were no wolves on Isle Royale, located in Lake Superior. That winter, a pair of wolves crossed the ice on Lake Superior and reached the island. With plenty of moose available as prey, the wolf population increased. Follow the events in the figure below to see how the populations of wolves and moose depend on one another. As the population density of one decreases, the population density of the other increases.

Picture This

4. Predict how the cycle might change for the moose population if the wolves were removed from Isle Royale.



What factors affect a population's growth rate?

The **population growth rate** is a measure of how fast a given population grows. Two factors that influence a population's growth rate are birthrate and death rate. Birthrate, or natality, is the number of individuals that are born in a given time period. Death rate, or mortality, is the number of individuals that die in a given time period.

Emigration and immigration also affect the rate of population growth. **Emigration** (em uh GRAY shun) is the number of individuals moving away from a population. **Immigration** (ih muh GRAY shun) is the number of individuals moving into a population.

Reading Check

5. Name four factors that influence a population's growth rate.

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Exponential Growth The graph below shows how a population of mice would grow if there were no environmental limiting factors. The graph starts with a population of two adult mice. They breed and have a litter of young. At first, the population increases slowly. This slow period is the lag phase in the graph. Without limiting factors, all of the young survive and breed. The population increases rapidly, or grows exponentially. All populations grow exponentially until some limiting factor slows the growth. Notice that exponential growth gives the graph a J shape.

Picture This

6. Calculate the increase in the mouse population between months 23 and 25. Show your work.

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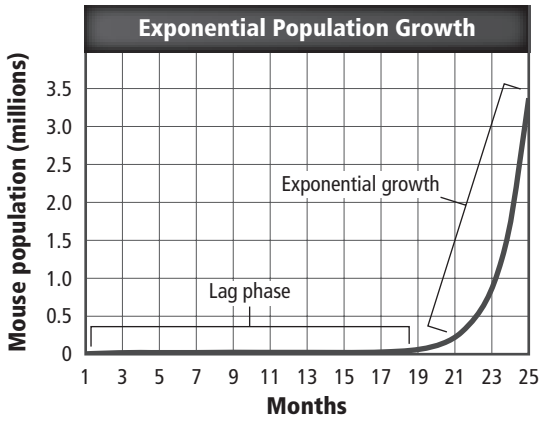
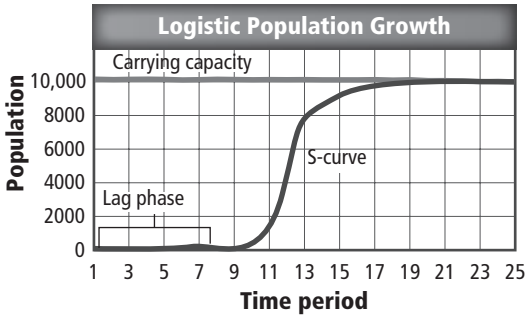


Logistic Growth Populations cannot grow exponentially forever. At some point, the rapidly increasing population will strain available resources. Then population growth will slow or stop. A population stops increasing when the number of deaths outnumbers the number of births or when emigration exceeds immigration. Logistic growth occurs when the population's growth slows or stops at the population's carrying capacity.

Carrying Capacity The graph below shows logistic growth. Notice that the graph begins in a J-shaped pattern of exponential growth, as in the previous graph. Then limiting factors slow population growth, causing the graph to bend into an S-shape. This S-pattern is typical of logistic growth. The population stops growing at the carrying capacity, as shown on the graph. The **carrying capacity** is the maximum number of individuals in a species that an environment can support for the long term. Carrying capacity is limited by resources such as water, oxygen, and nutrients.

When populations develop in an area with plenty of resources, there are more births than deaths. The population reaches the carrying capacity, and resources become limited. If a population becomes larger than the carrying capacity, there will be more deaths than births because there are not enough resources to support the population. The population falls below the carrying capacity as individuals die. Populations tend to stabilize near their carrying capacity.



How do reproductive strategies differ?

Species vary in their reproductive factors, such as the number of offspring born during each reproductive cycle, the age that reproduction begins, and the life span of the organism. Both plants and animals are placed into reproductive strategies based on their reproductive factors.

Rate strategists, or *r*-strategists, are small organisms. They usually have short lives. They produce as many offspring as possible and do not nurture them. Typically, the population of *r*-strategists is controlled by density-independent factors and does not stay near the carrying capacity.

Carrying-capacity strategists, or *k*-strategists, are large organisms. They usually have long lives. They produce few offspring and nurture them. Typically, the population of *k*-strategists is controlled by density-dependent factors and stays near the carrying capacity.

Picture This

7. Identify For the population represented on the graph, what is the maximum number of individuals that the environment can support over a long time period?

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Reading Check

8. Summarize the reproductive strategies of *r*-strategists and *k*-strategists for ensuring continuation of their species.

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