

Getting Ready...

- What is a population?
- What limits the size of a population?
- How can human activities affect a population?



Calgary in 1884



Grande Prairie during the 1920s

Science Log



Recall what you know about populations to answer the questions in *Getting Ready*. When you finish this chapter, review your answers. Make any changes based on what you learn.

The photographs on these pages show how Alberta's landscape has changed over the last 100 years. What has happened to Alberta's population during that time? Where do most of the people live today — in rural communities or in major cities? How has our way of life changed?

Since 1900, the human population in Alberta has increased dramatically, from 75 000 to about 3 million people. The population of Earth was 1.6 billion in 1900 and reached 6 billion in 1999. Earth's population could double before you become a senior citizen.

The increasing human population raises several serious questions. Where will 12 billion people live? How will we produce twice as much food as we do today? How will we generate twice as much electricity and find fuel for twice as many vehicles? Where will we dump twice as much garbage?

In this chapter, you will look at the factors that affect the size of a population. You will also examine how the increasing human population is affecting the plants and other animals with which we share the biosphere.



Lethbridge during the 1940s

What You Will Learn

In this chapter you will learn:

- how birth rate, death rate, immigration, and emigration determine the size of a population
- that most environments have a carrying capacity for each population
- how abiotic and biotic factors limit the size of a population
- how competition, predation, and parasitism control population size
- how human activities can affect the populations of other living things

Why It Is Important

- As an adult, you may have to make decisions that relate to how the human population affects other organisms in the environment. If you understand how population sizes are controlled in nature, you will understand what might happen as the human population grows.

Skills You Will Use

In this chapter you will:

- examine how a population changes in size
- investigate how biotic and abiotic factors can limit the size of a population
- analyze a predator-prey relationship
- research how exotic species affect natural populations
- examine how growing human populations have affected many living organisms
- examine ways to control mosquitoes and defend an opinion on this issue

Starting Point



Threatened Wildlife

The increase in Alberta's human population has created problems for many other living things. Human activities, such as logging, draining wetlands, cultivating cropland, and building cities, can all cause loss of natural habitat for certain organisms. Loss of habitat threatens the survival of many species of plants and animals.

What to Do



1. Working in teams, use your library and/or electronic resources to collect information on at least one organism in Alberta that is considered to be at risk of disappearing.
2. Develop an action plan that describes what you can do to protect this species.
3. Present your information as a report, display, or multimedia presentation to other members of your class.

Internet CONNECT

www.mcgrawhill.ca/links/science.connect1

Earth's human population reached 6 billion in 1999, and continues to increase. In this Internet Connect activity, you will graph the increase in human population over a short time interval. Go to the above web site, then to **Internet Connects, Unit D, Chapter 13**, and then to **Human Population Growth**.



Edmonton in 2000

13.1 Changing Populations

READING check

How do ecologists define a population?



Figure 13.1 Pupils at an Edmonton school in 1898

Ecologists define a **population** as a group of **individuals** of the same species, living together in the same place at the same time. An individual is one member of a population. The class pictured here is a population. It includes individuals (students and teachers) of the same species (humans), in the same place (a school in Edmonton), at the same time (1898). If you want to identify a population, you need to know three things: the species, where they live(d), and when they live(d).

Populations can change in size over time. We can find out how healthy a population is by calculating its rate of increase or decrease. For example, a population that is decreasing quickly is considered to be at risk.

Find Out **ACTIVITY**

Population Change

S K I L L C H E C K

Initiating and Planning

Performing and Recording

☀ Analyzing and Interpreting

Communication and Teamwork



Burrowing owl

In this activity, you will determine the rate of change for the population of burrowing owls between 1979 and 1987.

Burrowing owls live underground, usually in unused gopher holes. They spend the summers in Alberta and winters in the southwestern United States. Burrowing owls are active during the day, when they catch and eat insects and mice. A female owl lays six to 12 eggs. She sits on them in the burrow for about four weeks. The young begin to hunt for themselves about two months after they hatch.

In 1979, ecologists estimated that about 2100 breeding pairs of burrowing owls lived in Canada. By 1987, the population had dropped to 700 pairs. At what rate is this population decreasing?

What You Need

pencil
paper

What to Do

1. Calculate the change in population between 1979 and 1987.
2. Calculate the average annual rate of change in the population.
2. Identify two factors that you think may have played a role in the change in the population of burrowing owls.
3. What do you think has happened to the population of burrowing owls since 1987?

What Did You Find Out?

1. If you were a naturalist, would you be concerned about burrowing owls? Explain.

Internet CONNECT

www.mcgrawhill.ca/links/science.connect1

Burrowing owls are considered at risk in Alberta. What factors are limiting the population of these owls? What does the future hold? For more information on burrowing owls, go to the above web site. Go to **Internet Connects, Unit D, Chapter 13**, and then to **The Life and Times of the Burrowing Owl**.

Did You Know?

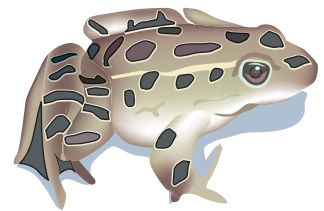
Northern leopard frogs, woodland caribou, and swift foxes are *all* considered at risk in Alberta.

Check Your Understanding

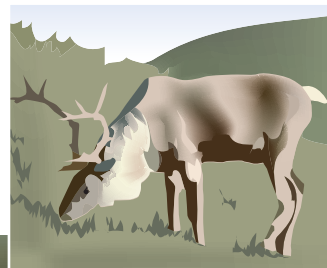
1. Use an example to help you define or describe the following terms: individual, population.
2. In your Science Log or notebook, explain why each of the following are incomplete descriptions of a population.
 - (a) 200 northern leopard frogs in Bow Valley Provincial Park
 - (b) 25 woodland caribou in the Prairie Creek/Red Rock Creek herd
 - (c) 10 swift foxes in 1987
3. Calculate the rate of change per year for each of the following populations.
 - (a) 30 grey wolves in a provincial park in 1930 and 15 wolves in the same park in 1940.
 - (b) Four individual peregrine falcons in 1970 and 10 falcons nesting in the same area in 1990.
4. Do you think any human activities had an impact on the populations of the grey wolf and the peregrine falcon in question 3? Explain.

Key Terms

population
individual



Northern leopard frog



Woodland caribou



Swift fox cubs

13.2 Population Growth and Decline

Four factors determine the size of a population at any given time. Figure 13.2 can help you identify these four factors and find out how they affect the size of a population.

Figure 13.2

The population of any organism, such as the mountain whitefish shown here, is determined by four factors. Study the illustration to learn how population size is determined by

- birth rate,
- death rate,
- immigration, and
- emigration.

Death Rate

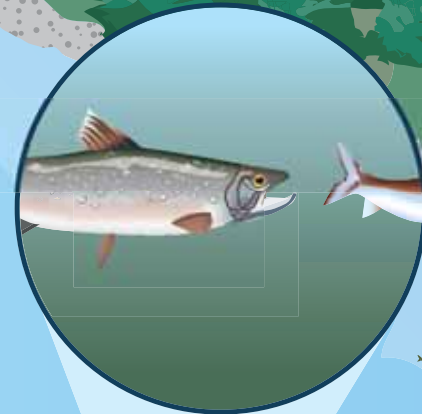
This mountain whitefish is just about to be eaten by a predatory bull trout. A factor that results in the decrease of a population size is the death rate.

The **death rate** is defined as the number of individuals that die during a specified time (usually a year). Predation, disease, and competition for food can all affect the death rate of a population.

Migration

These mountain whitefish are immigrating. **Immigration** refers to coming into an area. They may immigrate because their new home has a greater food supply.

Immigration is a factor that increases the size of a population in an area.



Birth Rate

These fish have spawned. Their fertilized eggs are starting to develop into new members of the mountain whitefish population.

The main cause of a population's increase is the organism's birth rate. The **birth rate** is the number of young produced by a population over a period of time (usually a year). Birth rates are affected by :

- environmental conditions — when conditions are poor, fewer babies are born;
- nutrition — well-fed mothers have more and healthier babies;
- the density of the population — fewer young are born in crowded areas; and
- the number of young produced by each mature female each year.

Emigration

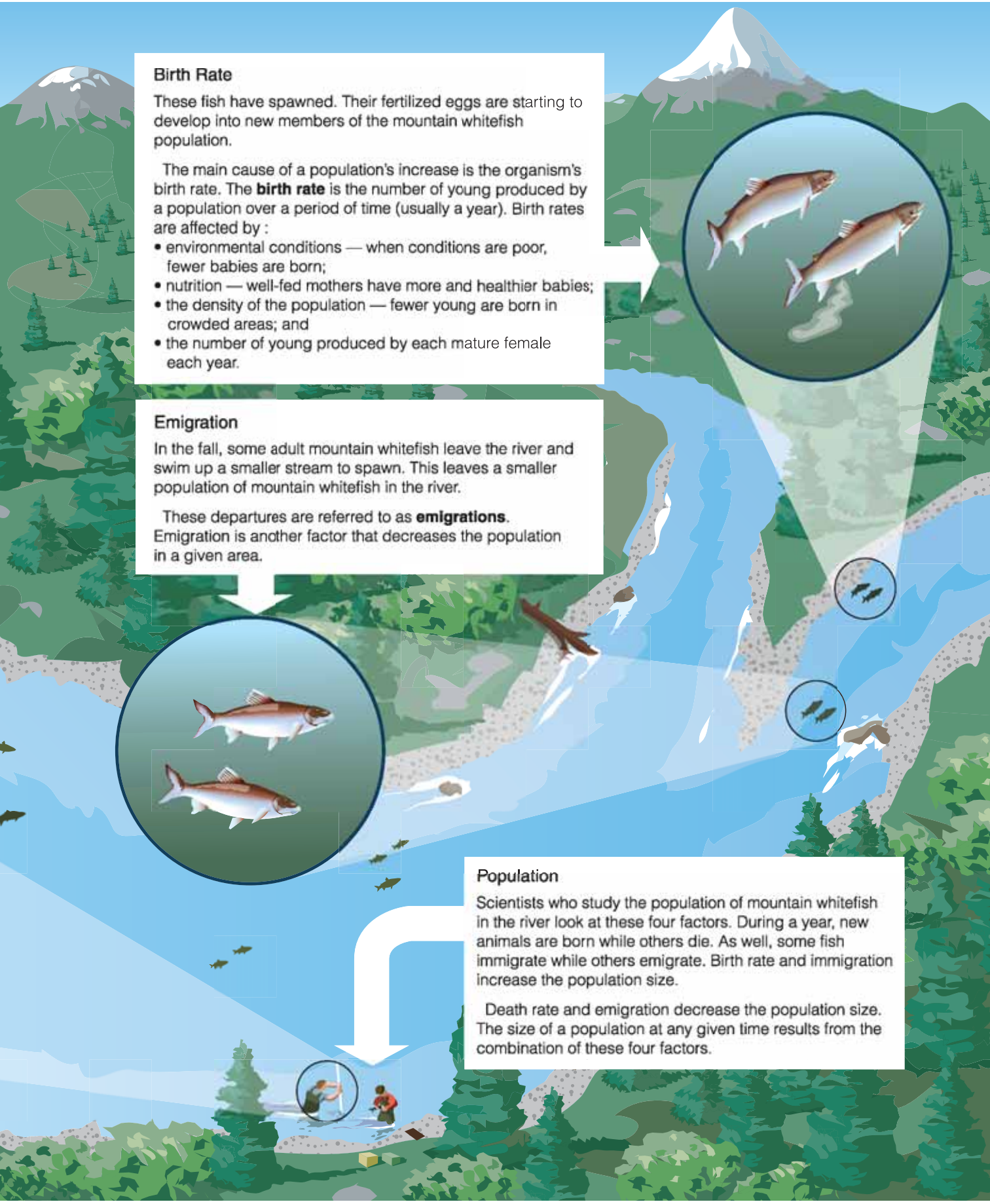
In the fall, some adult mountain whitefish leave the river and swim up a smaller stream to spawn. This leaves a smaller population of mountain whitefish in the river.

These departures are referred to as **emigrations**. Emigration is another factor that decreases the population in a given area.

Population

Scientists who study the population of mountain whitefish in the river look at these four factors. During a year, new animals are born while others die. As well, some fish immigrate while others emigrate. Birth rate and immigration increase the population size.

Death rate and emigration decrease the population size. The size of a population at any given time results from the combination of these four factors.



Something Fishy Going On

Every year, thousands of fish are trapped in irrigation canals throughout Alberta. Most of these fish will die. This increases the death rate of the population. As you would expect, a higher death rate reduces the population size. People like Kirsten Norris try to reduce the death rate.

Kirsten is a Special Projects Co-ordinator for Trout Unlimited Canada in Calgary. She works with volunteers to capture the fish and return them to their natural habitat. Kirsten became interested in the environment in high school. She volunteered to work hands-on with Trout Unlimited. She gained valuable experience that helped her get her job.

What can you do to learn more about the environment? Offer your services and get involved. You *can* make a difference.



Figure 13.3 Kirsten helps to co-ordinate the fish rescue from an irrigation canal.

Key Terms

- death rate
- immigration
- birth rate
- emigration

Check Your Understanding

1. What factors are responsible for increasing the size of a population?
2. What factors are responsible for decreasing the size of a population?
3. Explain how environmental conditions might affect birth rate.

13.3 Limiting Factors

READING Check

What happens when a population cannot get enough food or water?

Imagine that no organisms in a given population died. This population would continue to grow. A graph of the size of this population is shown in Figure 13.4. The results of such a growth are suggested by Figure 13.6, on the next page.

Fortunately, organisms do die for many reasons. Resources, such as light, food, water, or space, become very scarce. This causes individuals in the population to die or not reproduce.

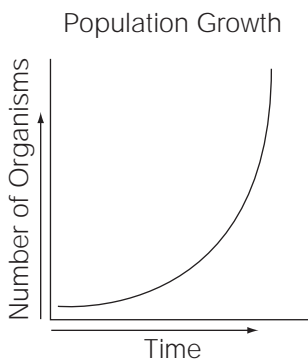


Figure 13.4 Without limiting factors, a population can grow very quickly.

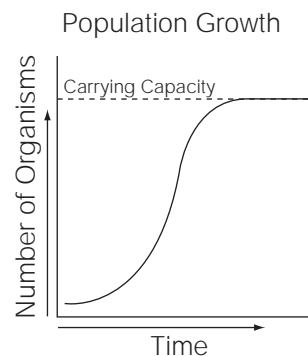


Figure 13.5 The growth of a population slows down as resources in the environment become scarce. The resources are called limiting factors.



Figure 13.6 This plague of locusts is eating an Ethiopian farmer's millet crop. Imagine having an equally large number of mosquitoes, houseflies, or wasps!

Light, food, water, and space are called **limiting factors**. They limit the growth of a population. A graph of a normal population size is shown in Figure 13.5 on page 260. This population is controlled by limiting factors. What do you think might control the plague of locusts in Figure 13.6?

Most populations cannot increase beyond a certain size. If a population lives in an environment with sufficient or enough resources, it grows. As the population uses up the resources in the environment, it stops growing. The population size levels off. At this point, the population size has reached the carrying capacity of the environment. The **carrying capacity** is the number of individuals that a given environment can support.

Abiotic Limiting Factors

Almost anything that affects the lives of organisms can be a limiting factor. Several factors in the non-living, physical environment can limit the size of a population by reducing birth rate and increasing death rate. These types of factors are called **abiotic limiting factors**. They include:

- **Water** — All organisms need water. Many organisms live in water.
- **Matter** — A poor supply of matter such as carbon and nitrogen can slow the growth of plants.
- **Weather** — Extreme cold or heat, or too much rain or a drought, can decrease the birth rate and increase the death rate of most living things.

DidYouKnow?

Humans can live about 40 days without food, but only about four days without water.

DidYouKnow?

In April 1967, several blizzards dropped a record 175 cm of snow on southern Alberta. These storms killed many animals and plants.



Describe the non-living (abiotic) factors that can limit the growth of populations.

Abiotic Limiting Factors

Environmental conditions can affect the growth and development of living things. The pH (acidity) of the soil or water is one such factor. In this investigation, you will determine if the pH of water affects the germination of chicory seeds.

Problem

How does the pH of water affect the rate of seed germination?

Hypothesis

Develop your own hypothesis for this investigation.

Safety Precautions



- Follow your teacher's directions for conducting investigations safely.
- Wash your hands thoroughly and clean up the work area after the investigation.

Apparatus

- 3 petri dishes
- 3 medicine droppers
- 3 short strips of pH paper
- scissors



The level of pH affects the hatching of brine shrimp eggs. Fewer eggs hatch in acidic conditions. Does pH also affect the rate of seed germination?

Materials

- 30 chicory seeds
- 3 paper towels
- vinegar
- sodium hydroxide solution
- tap water
- masking tape
- pencil

Procedure

1 Develop a chart to help you organize and collect your data.

2 Use the masking tape and a pencil to make the following labels: petri dish 1 — vinegar; petri dish 2 — tap water; petri dish 3 — sodium hydroxide.

3 Fold the paper towels in quarters so each piece is four layers thick.

4 Using the bottom of the petri dish as a guide, draw a circle on each paper towel.

5 Use the scissors to cut out the paper towels. You should have 12 paper towel circles to use in Steps 6–8.

6 (a) Using one of the medicine droppers, place one drop of vinegar on the pH paper. Record the pH.

(b) Place two paper towel circles into the bottom of petri dish 1.

(c) Place 10 seeds on the paper towel circles in the petri dish.

(d) Cover the seeds with two more paper towel circles.

(e) Use the medicine dropper to add enough vinegar to moisten the paper towels.

(f) Place the cover on the petri dish and place it in a dark, warm environment.

7 (a) Using a second medicine dropper, place one drop of tap water on the second pH paper. Record the pH.

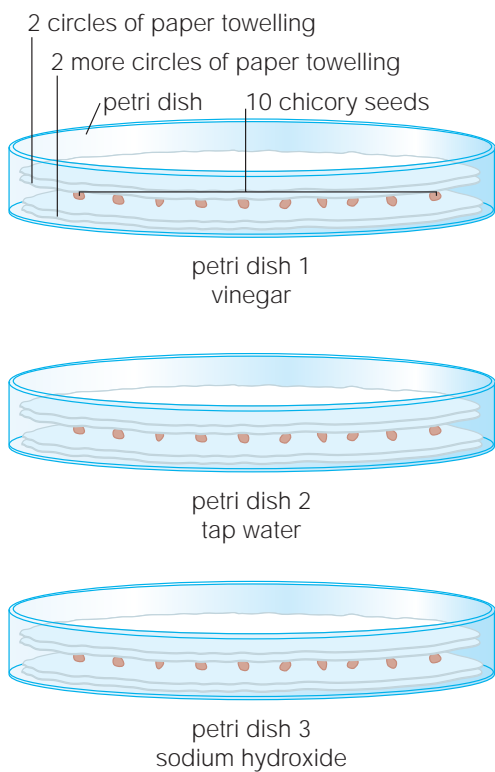
(b) Place two paper towel circles into the bottom of petri dish 2.

(c) Place 10 seeds on the paper towel circles in the petri dish.

(d) Cover the seeds with two more paper towel circles.

(e) Use the medicine dropper to add enough tap water to moisten the paper towels.

(f) Place the cover on the petri dish and place it in a dark, warm environment.



- (a) Using a third medicine dropper, place one drop of sodium hydroxide on the third pH paper. Record the pH.
- (b) Place two paper towel circles into the bottom of petri dish 3.
- (c) Place 10 seeds on the paper towel circles in the petri dish.
- (d) Cover the seeds with two more paper towel circles.
- (e) Use the medicine dropper to add enough sodium hydroxide solution to moisten the paper towels.
- (f) Place the cover on the petri dish and place it in a dark, warm environment.
- After 1 day, carefully remove the covers and top layers of paper towel from each petri dish. Observe the seeds and record your observations.
- 1 Observe your seeds on Days 2, 3, and 4. Record your observations.

Analyze

1. In which petri dish did the most seeds germinate? What was the pH in this petri dish?
2. In which petri dish did the fewest seeds germinate? What was the pH in this petri dish?

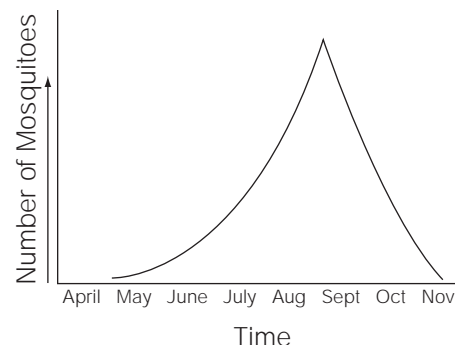
Check Your Understanding

1. Identify one abiotic factor that might limit the growth of the following populations:
 - (a) seedlings growing on the forest floor
 - (b) trees growing on a mountainside
 - (c) plants growing in a desert
2. The graph shows the growth curve of a population of mosquitoes.
 - (a) Explain how weather affects the population of mosquitoes between June and September.
 - (b) Explain how weather affects the population of mosquitoes between September and November.
 - (c) How might this growth curve appear in a tropical climate?

Key Terms

limiting factor
carrying capacity
abiotic limiting factor

A Population of Mosquitoes
in Central Alberta



13.4

Biotic Limiting Factors

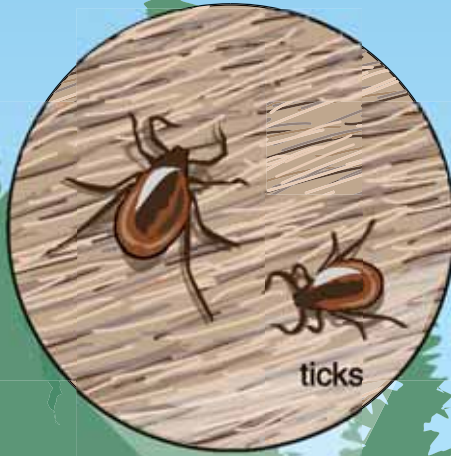
DidYouKnow?

A single moose in northern Alberta can be host to over 50 000 ticks. Some moose get so full of ticks that they rub off their skin trying to scratch the itchy bites. These moose are referred to as “ghost” moose.

Many biotic factors can also affect the sizes of populations. Figure 13.7 shows you how.

Biotic limiting factors are ways that interactions among living organisms might affect the size of a population. Competition, predation, and parasitism can cause the birth rate to drop and/or the death rate to increase. These factors help control the populations of organisms in an ecosystem. Read the text boxes in Figure 13.7 to find out how competition, predation, and parasitism affect populations of plants and animals. The words in boldface are key terms.

Figure 13.7



Parasitism

Organisms that live on or in another living **organism** are called **parasites**. The deer and hawk in this picture are called **hosts**. This relationship between organisms is called **parasitism**.

External parasites live on the skin of the host. They eat the hair, feathers, scales, or skin of the host, or suck the blood of the host. Internal parasites live inside the tissues of the host.

Most parasites only weaken their host; they do not kill it.



Predation

A **predator** is an animal that catches, kills, and eats another animal. The victim is called the **prey**. This relationship is referred to as **predation**.

Predation affects both predator and prey populations. It obviously benefits the predators. However, it also benefits the prey species.

Predators usually eat the sick, old, or weak prey individuals. This leaves more food for the healthy animals in the prey population.

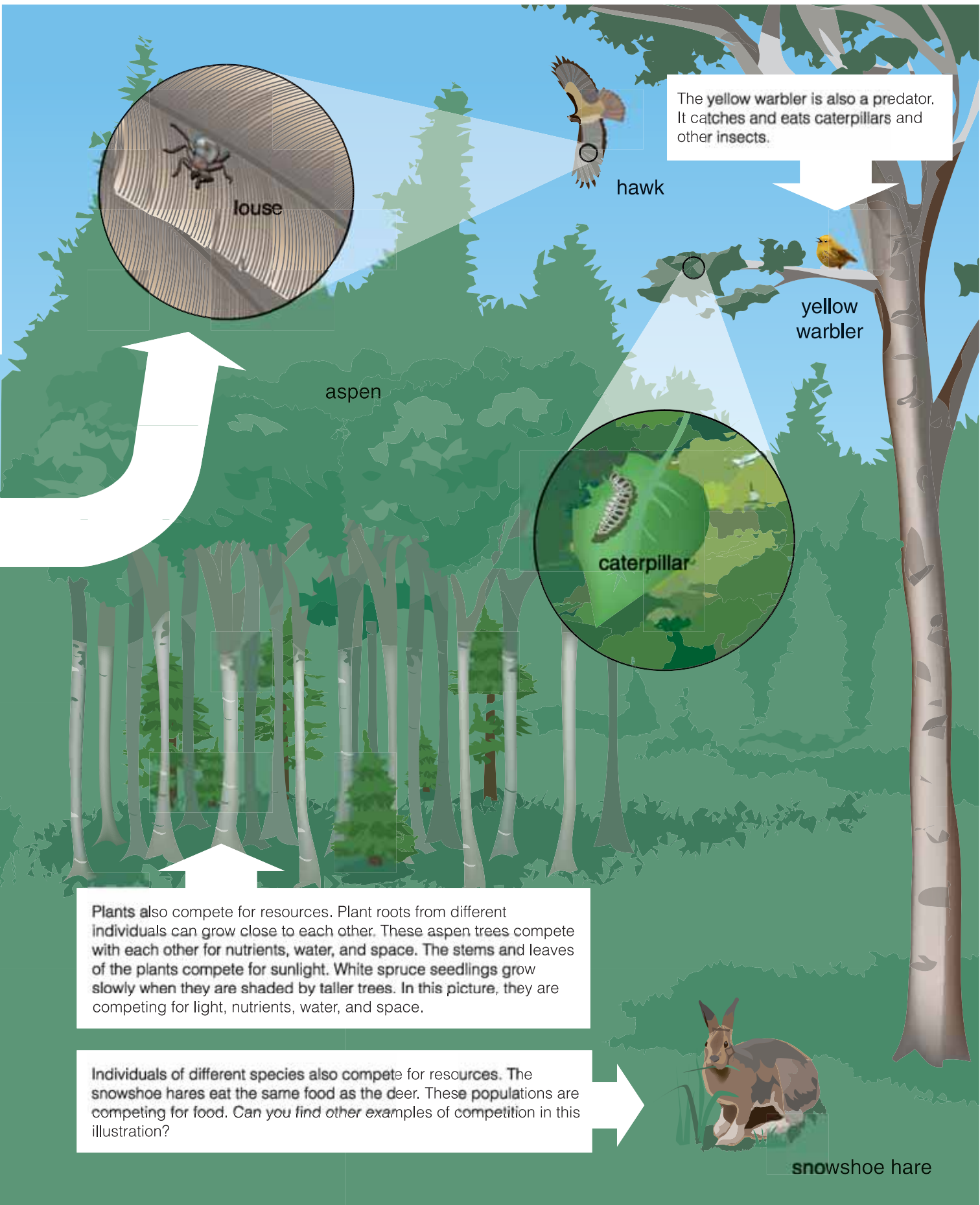
Can you see any other predator-prey interactions in this illustration?

Competition

Individuals compete for resources such as food (animals), **nutrients** (plants), shelter, light, and water. This is called **competition**.

Animals compete with others in their own species. For example, each deer has the same needs as every other deer in the population. The individual deer compete for food, shelter, and mates. Stronger animals get the best food, while weaker animals may not get enough.





The yellow warbler is also a predator. It catches and eats caterpillars and other insects.

hawk

yellow warbler

louse

caterpillar

aspen

Plants also compete for resources. Plant roots from different individuals can grow close to each other. These aspen trees compete with each other for nutrients, water, and space. The stems and leaves of the plants compete for sunlight. White spruce seedlings grow slowly when they are shaded by taller trees. In this picture, they are competing for light, nutrients, water, and space.

Individuals of different species also compete for resources. The snowshoe hares eat the same food as the deer. These populations are competing for food. Can you find other examples of competition in this illustration?

snowshoe hare

Find Out **ACTIVITY**



Predator-Prey Interactions



It is natural for many populations to fluctuate (increase and decrease) in size. In some cases, these fluctuations follow a regular pattern. For example, when a prey population is large, the amount of food available to the predator increases. As a result, the birth rate of the predator may go up.

When this happens, more and more of the prey are eaten, which causes a decrease in the prey population. The population of predators then goes down because their food supply has decreased. The whole cycle begins again.

What to Do

1. Examine the graph of data collected in Canada.

What Did You Discover?

1. Why do you think the population of:
 - (a) hares decreased between 1845 and 1855?
 - (b) lynx decreased between 1855 and 1860?

SKILLCHECK

Initiating and Planning

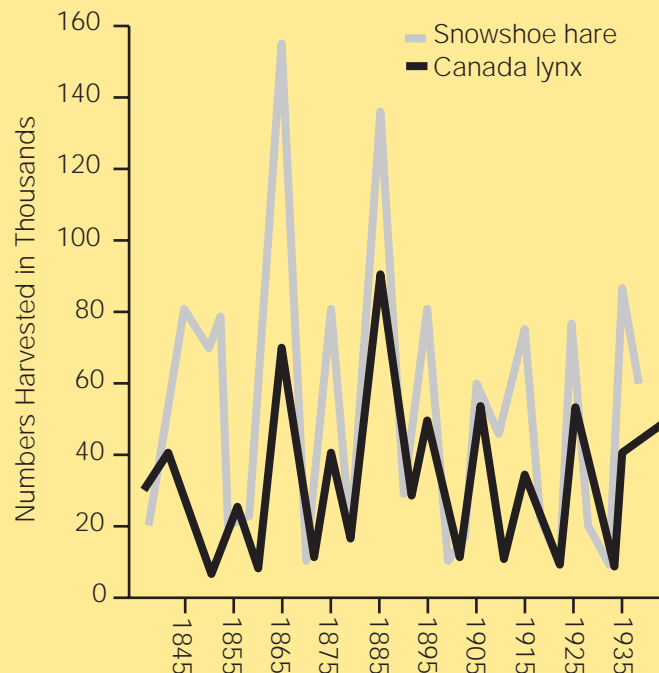
Performing and Recording

Analyzing and Interpreting

Communication and Teamwork

- (c) hares increased between 1855 and 1865?
 - (d) lynx increased between 1860 and 1865?
 - (e) hares decreased between 1865 and 1870?
2. Besides predation, suggest three other biotic factors that may have resulted in the decrease in the hare population in 1865.
Hint: Go back to Figure 13.7 (on page 264) if you are having trouble answering this question.
 3. Do you think insects, such as the mosquito, have similar population cycles? Explain.

Lynx and Hare Populations



Scientists discovered the lynx and hare populations by looking at old reports from the Hudson's Bay Company trading posts.

Reproduction Rate

Let's look at a hypothetical population produced by two houseflies, one male and one female.

Suppose the following about this population:

- There is no predation, parasitism, competition, or disease.
- No flies immigrate or emigrate.
- All the offspring survive and reproduce.

The two houseflies start reproducing in April. By August, 191 010 000 000 000 000 000 houseflies could be flying around! The **reproductive rate** of these organisms is huge.

So, why aren't the skies black with houseflies? Birds eat them, parasites and diseases kill them, and people swat and spray them. Many larvae starve from competition for food, and many adults die from old age at two weeks old. In reality, these two houseflies have only about two descendants by August.



Figure 13.8 A housefly

READING
check ✓

What limits the number of houseflies?

An ecosystem includes both abiotic and biotic limiting factors. These factors keep populations under control. The size of a population depends on its reproductive rate and all the limiting factors. What do you think happens to a population when human activity interferes with the limiting factors?

Figure 13.9 Few birds raise more than five young in a year. Unlike the housefly, birds care for their young. The young birds are fed and protected by one or both parents. This protection continues until the babies can fly and find or hunt their own food. Most animals with a low reproductive rate care for their young.



Check Your Understanding

1. Identify which biotic limiting factor is described in each of the following.
 - (a) A great horned owl regurgitates a pellet containing the skeletons of four shrews. Owl pellets contain the parts of food that the owl could not digest.
 - (b) Every three or four years, the population of lemmings declines when their food becomes scarce.
 - (c) One species of tick, a blood-sucking animal, lives on the ears of moose.
 - (d) A population of woodland caribou is controlled by a population of wolves.

Key Terms

biotic limiting factor
competition
parasite
host
parasitism
predator
prey
predation
reproductive rate



Figure 13.9 Purple loosestrife was brought into Canada by gardeners who planted it for its beauty. It is beautiful, but also multiplies quickly and crowds out other plants. As a result, it is taking over wetlands across Canada.

DidYouKnow?

Norway rats first arrived in North America about 1775. They came from Europe on merchant sailing vessels. About 100 years later, rats entered the Canadian prairies through Saskatchewan. Under ideal conditions, a single pair of Norway rats can produce 15 000 offspring each year. Imagine how much damage these rodents could do to wheat crops. Rat migration was stopped along Alberta's eastern border by finding and killing every rat that arrived in the province.

The population of humans around the world is putting a strain on the natural world. As our population has increased, more and more species of plants and animals have become extinct or threatened.

Have you or your family ever brought seeds or plants from another country into Canada? Such seeds or plants are called **exotic species**.

Exotic species are plants and animals foreign to an ecosystem. Many compete with native species for resources such as nutrients and shelter. In many cases, no native species eat or predate on the exotic species. Since few are eaten, the population has a low death rate. As a result, the exotic species can reproduce faster than native species and actually replace them. For example, purple loosestrife is an exotic plant that is rapidly reproducing in wetlands across Canada.

Many environmentalists are concerned that exotic species interbreed with native species. For example, in British Columbia there are many salmon farms. These are farms that raise salmon in ocean pens. Most salmon farmers prefer to use Atlantic salmon because they grow faster than western species. The problem with Atlantic salmon is the chance that they can escape from their ocean pens and live in the wild. This could be a major problem because the Atlantic salmon might interbreed with native salmon stocks, possibly damaging the ability of the wild salmon to breed.

Like purple loosestrife and Atlantic salmon, many exotic species have the potential to do a lot of environmental damage:

- Chestnut blight is a fungus that has killed many native chestnut trees.
- English sparrows use the same nesting sites as native species such as the bluebird. Since sparrows are more aggressive, they have replaced the bluebird in some areas.
- Sea lamprey moved through the St. Lawrence Seaway into the Great Lakes. Sea lamprey feed by attaching themselves to the side of a fish and sucking on their blood. The weakened fish die. Lamprey are responsible for killing many native fish species.



Figure 13.10 Atlantic salmon accidentally released into the coastal waters of British Columbia could out-compete native species such as the Chinook salmon.

Internet CONNECT

www.mcgrawhill.ca/links/science.connect1

Some exotic species are also called "invasive plants." These species are not native to a region or country, and have the ability to compete with and replace native species. For more information on exotic species, go to the above web site. Go to **Internet Connects, Unit D, Chapter 13**, and then to **Invasive Plants**.

READING Check

Explain how one exotic species has affected one Canadian habitat.

Find Out **ACTIVITY**

Human Impact — Exotic Species

In this activity, imagine you are a Canadian Customs Officer. You talk to people entering Alberta from other countries. You sometimes find that people try to bring in living plants or animals. But you must not allow these organisms into the country. To help the people understand the issue, you hand them a pamphlet explaining how exotic species can affect the populations of native plants and animals.

What to Do

1. Design and write a one-page pamphlet that you could give to someone who is trying to bring an exotic plant or animal into Canada. Your pamphlet should include:

- an outline of why exotic species are a problem
- an explanation that bringing live plants and animals into the country is one way of spreading exotic species
- an example of one plant or animal species that has been introduced into Alberta or Canada, including the following information:
 - how this exotic species came here
 - how it affects native species
 - what is being done to control its spread

2. Use visuals to help communicate your message.

S K I L L C H E C K

Initiating and Planning

Performing and Recording

☀ Analyzing and Interpreting

☀ Communication and Teamwork

Disc **CONNECT**

Humans have drained wetlands and sprayed chemical pesticides in an attempt to control mosquito populations. Does this work? How do these procedures affect other organisms? Are there better ways to control the mosquito population? To answer these and other questions, load the student CD-ROM onto your computer. Launch the **Mosquitoes** applet and follow the instructions.

Figure 13.11 Humans affect species in other ways. Mosquitoes are parasites on warm-blooded animals. Many communities want to control mosquitoes, to prevent them from irritating livestock and spreading disease. Some communities use chemical sprays called **pesticides** to kill the adult mosquitoes or the larvae, which live in ponds. Others use **biological controls** such as larval predators or diseases. Use the Disc Connect applet to find out how well these methods work.



Check Your Understanding

1. An exotic bird was introduced into Alberta. This bird species has no natural predators here but feeds on local seeds and finds natural nesting sites. Predict what will happen to the population of this introduced species.
2. Study Figure 13.11 and read the caption. List two ways that humans have attempted to control the population of mosquitoes.

Key Terms

exotic species
pesticide
biological control

13 Review

Key Terms

population
individual
death rate
immigration
birth rate
emigration

limiting factor
carrying capacity
abiotic limiting factor
biotic limiting factor
competition
parasite

host
parasitism
predator
prey
predation
reproductive rate

exotic species
pesticide
biological control

Reviewing Key Terms

If you need to review, the section numbers show you where these terms were introduced.

- In your Science Log or notebook, match each description in Column A with the term in Column B.

A

- the number of individuals of the same species living in the same place at the same time
- the number of individuals born during a specific period of time
- maximum size of a population the environment can support
- water is this type of limiting factor
- all the white spruce trees in an area need water and sunlight
- a flea feeds on an owl's blood
- caribou move into an area in search of food
- a bull snake catches and eats a Richardson's ground squirrel
- a species introduced into an ecosystem

B

- predation (13.4)
- abiotic limiting factor (13.3)
- exotic species (13.5)
- carrying capacity (13.3)
- immigration (13.2)
- birth rate (13.2)
- parasite (13.4)
- competition (13.4)
- population (13.1)

Understanding Key Ideas

Section numbers are provided if you need to review.

- List the page number where each main idea is found. Then, explain each main idea.
 - definition of a population (13.1)
 - the four factors that determine the size of a population (13.2)
 - maximum population size for a specific environment (13.3)
 - abiotic limiting factors (13.3)
 - biotic limiting factors (13.4)
 - exotic species (13.5)
- Each of the following descriptions of a population is incomplete. Identify what is missing and write a new description in your Science Log or notebook. (13.1)
 - 240 mallard ducks in a slough
 - 12 white-tailed deer in 1998
 - an alpine meadow in 2000
- Which of the following populations is increasing? Explain your answer. (13.2)

Factor	Population A	Population B
birth rate	100 per year	200 per year
death rate	100 per year	100 per year
immigration	50 per year	50 per year
emigration	70 per year	70 per year

- Assume that Populations A and B in question 4 are two populations of deer that live in different areas of the province. Suggest three factors that might explain why one population is increasing while the other is staying about the same size. (13.2)

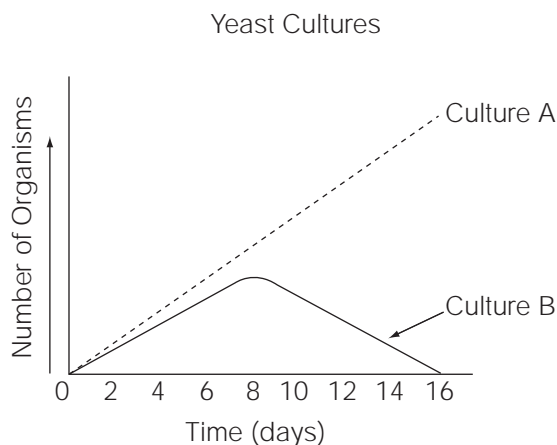
6. Look at the photograph of a mature lodgepole pine. Explain how this mature lodgepole pine tree limits the growth of other plants around it. (13.4)



7. Most parasites do not kill their hosts. Explain why parasites are considered biotic limiting factors. (13.4)

Developing Skills

8. Use the graph to answer the following questions.



Two cultures of yeast are grown in separate test tubes. Culture A has twice as much food as Culture B. All other factors are the same. Once the food was added to each culture, the test tubes were sealed so nothing else could be added. The graph shows the growth curves for both populations.

- Identify the factor that most likely limited the growth of Culture B. (13.3)
- Suggest other abiotic factors that may have limited the growth of Culture B. Explain. (13.3)
- Predict what will eventually happen to Culture A. Explain. (13.3)

Problem Solving/Applying

9. Explain the statement: “Predators do not eliminate the population of prey, they simply remove the surplus.” (13.4)

Critical Thinking

10. Richardson’s ground squirrels live in burrows in prairie ecosystems and eat plants. Their main predators are weasels, badgers, hawks, and falcons. In the 1930s and 1940s, farmers and ranchers hoped to improve their land by poisoning Richardson’s ground squirrels. (13.5)



Richardson's ground squirrel

- What do you think happened to the population of ground squirrels during the 1930s and 1940s?
- The poison took a long time to break down. What other populations of animals might have been affected by this poison?
- Using what you have learned in this chapter, describe one other method that farmers could have used to reduce the population of ground squirrels.

Pause & Reflect

- The population of humans on Earth could double in your lifetime. How do you think this many people will affect the environment? How will the populations of other living things be affected? What, if anything, is being done to control the size of the human population on Earth?
- Go back to the beginning of this chapter on page 254, and check your answers to the Getting Ready questions. Has your thinking changed? How would you answer those questions now that you have investigated the topics in this chapter?