1.2 Ecosystems

The abiotic components of an ecosystem support the life functions of the biotic components of an ecosystem. Organisms within communities constantly interact to obtain resources such as food, water, sunlight, or habitat. Examples of these interactions in ecosystems include commensalism, mutualism, parasitism, competition, and predation. Every organism has a special role, or niche, within an ecosystem.

Words to Know

commensalism
competition
ecosystem
mutualism
niche
parasitism
predation

Understanding the history of ancient forests can help us manage forest ecosystems better in the future. Researchers from universities in British Columbia are studying natural records such as soil sedimentation patterns, ancient seed piles, tree ring growth, forest fire scars, and ice cores (Figure 1.15). They are also analyzing written materials, maps, land surveys, weather observations, photographs, and newspaper stories. This exciting new field of study is called historical ecology.

Historical ecology raises important questions about what natural ecosystems are. It also helps us determine whether we should restore them to a natural state. In an attempt to answer these questions, researchers are tracing the effects of human activities and natural events in forests over time. These records reveal the long-term effect of human activities such as livestock grazing, fire suppression, and timber harvesting. They also show how natural events such as drought and disease can affect forests over time.

Did You Know?

The Tl'azt'en First Nation is located in north-central British Columbia. Tl'azt'en peoples refer to themselves as "Dakelh," which means we travel by water.

Figure 1.15 Researcher measuring the circumference of a tree

Since there are many gaps in these records, projects have been undertaken to acquire more information. For example, the Tl'azt'en First Nation is working with the University of Northern British Columbia at the John Prince Research Forest near Fort St. John. This community has vast experience with the boreal spruce forests of the area, acquired over thousands of years of direct contact. The Tl'azt'en First Nation has also been involved in timber harvesting and land management. Incorporating their detailed knowledge of the plants, animals, and natural occurrences of the forest into the ecological history of the area will help people make better management decisions in the future. These efforts will help preserve this valuable forest ecosystem.

1-2A Your Local Environment

Find Out ACTIVITY

You have been asked by a local community group to create a video about the area in which you live. The video will be shown to people who have just moved into your area and want to know something about the local environment. In this activity, you will prepare the script that will be used to film the video.

What to Do

1. Work with a partner. Review the handout your teacher will give you about the elements of a good video script.
2. Brainstorm a point-form list describing the weather, landforms, streams, lakes, plants, animals, and other natural features in your area.
3. Brainstorm another list describing what you know about the history of your area or how the area has changed over the last 5 to 10 years.
4. Decide on the best way to present your information in a video, and write up your script.
5. Compare your script with those of other students in your class. Update your script with any new information.
6. For the next few weeks, collect Internet, newspaper, or magazine articles, maps, weather observations, and photographs about your area. Find out what changes have occurred in your area over the last 100 years and identify any environmental issues such as damage to natural areas or projects to repair environmental damage. If possible, interview family members, neighbours, and elders who have lived in your area for a long time.
7. Continue to revise your script based on any new information you gather or learn as you work through the rest of this unit.

What Did You Find Out?

1. Explain how you organized the information about your area in your script and why.
2. How did your script compare to other students' scripts? (For example, some scripts may be documentaries; others may be theatre plays.)
   (a) What information did the scripts have in common?
   (b) What information was different?
3. Describe one change you made to your script based on any new information you gained from the work of your classmates.
4. Identify one topic about your area you would like to research further and explain why.

Word Connect

Ecology is a branch of science that deals with the interactions of organisms and their environments. Scientists who study these interactions are called ecologists. "Eco" comes from the Greek word *oikos*, which means a dwelling place or habitation.

Parts of an Ecosystem

At the beginning of section 1.1, you learned that biomes can be subdivided into smaller divisions called ecosystems. An **ecosystem** has abiotic components such as oxygen, water, nutrients, light, and soil that interact with biotic components such as plants, animals, and micro-organisms. Biomes contain many types of ecosystems. Ecosystems can cover many hectares of land, such as the antelope brush grasslands of the South Okanagan Valley (shown on page 2) or the coastal Douglas fir ecosystems on Vancouver Island (Figure 1.16). Ecosystems can also be small, such as a tidepool or a rotting log.

Figure 1.16 Coastal Douglas fir ecosystem

Within ecosystems are habitats. A **habitat** is the place in which an organism lives. For example, the sculpin is a well-camouflaged fish that lives between the rocks at the bottom of a tidepool (Figure 1.17). Another example is the red-backed salamander, which makes its nest in the decaying wood of a fallen tree (Figure 1.18).

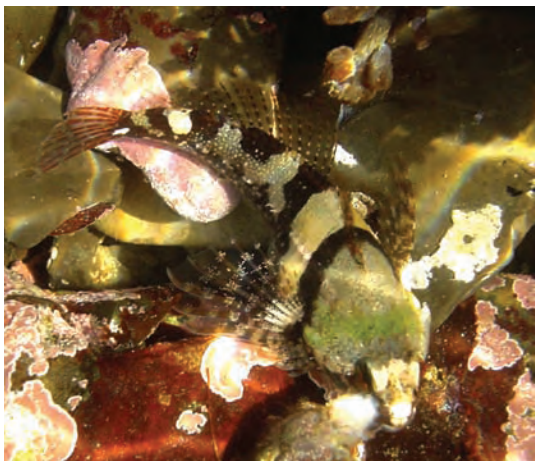


Figure 1.17 The sculpin blends in with its habitat so well that it is difficult to see.

Figure 1.18 Red-backed salamander and its nest

Abiotic Interactions in Ecosystems

The abiotic components of terrestrial ecosystems, such as oxygen, water, nutrients, light, and soil, are just as important as the organisms that live in them.

Plants and animals cannot survive without oxygen. Think about how you feel when you are stuck in a crowded, stuffy room. Without an adequate supply of oxygen, you may begin to feel dizzy. In wetlands, water plants such as certain types of grass and algae produce oxygen, which is used by other organisms that live in water. If the plant life in a wetland is damaged because of pollution (Figure 1.19), you may see fish gulping for air.

Figure 1.19 Gasoline or oil leaking from automobiles can reduce the amount of oxygen available to plants and organisms in a wetland ecosystem.

The cells of most living things contain between 50 and 90 percent water. Without water, no organism would survive. You can go longer without food than you can without water. Water also carries nutrients from one place to another in ecosystems. **Nutrients** such as nitrogen and phosphorus are chemicals that are required for plant and animal growth. You will learn more about nutrients and ecosystems in section 2.2.

Light is required for **photosynthesis**, a chemical reaction that converts solar energy into chemical energy usable by plants. Ecosystems vary in the amount of light they receive. For example, in marine ecosystems, the amount of light decreases in deeper water, so fewer plants can grow (Figure 1.20). In the forest canopy, much more light is available for photosynthesis (Figure 1.21). You will learn more about the importance of photosynthesis in ecosystems in section 2.2.

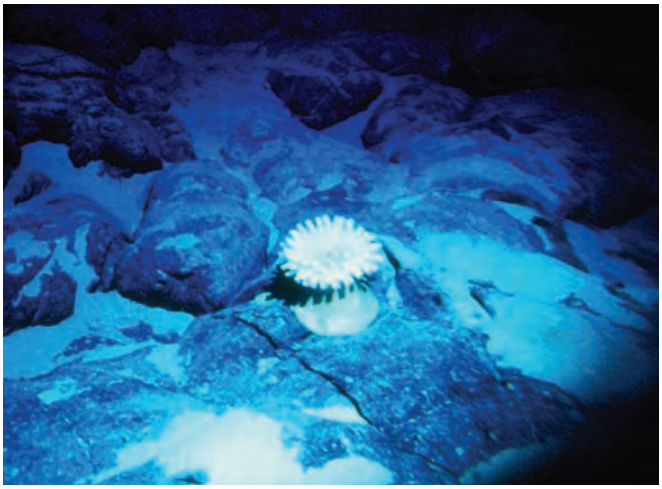


Figure 1.20 Marine ecosystems receive very little light for plant growth.

Figure 1.21 The forest canopy receives more light than lower layers of a forest.

Did You Know?

Topsoil, the surface layer of soil, is the richest soil layer in life and nutrients. In this uppermost layer, more oxygen and water are available for soil organisms, and there is more organic matter available from dead plant and animal materials and animal waste.

Soil is an important part of terrestrial ecosystems. Soil provides nutrients for plants and supports many species of small organisms. A square metre of soil may contain as many as 1000 different species of invertebrates (animals without backbones). Several thousand species of bacteria can be found in one gram of soil (Figure 1.22). Soil anchors plants in one place and absorbs and holds water, making it available for both plants and animals. Soil organisms maintain soil structure. For example, earthworms dig tunnels through the soil (Figure 1.23). The tunnels allow water and nutrients to move more easily through the soil, making them available to plants and other soil organisms. Some soil organisms, such as bacteria, break down pollutants, and others, such as ground beetles, store carbon by eating insects, because all living things, including insects, contain carbon.

Figure 1.22 One species of soil bacteria

Figure 1.23 Earthworms in soil

Reading Check

1. What is an ecosystem?
2. What is a habitat?
3. What are three abiotic components of ecosystems necessary for supporting life?
4. Explain why soil is important to ecosystems.

Biotic Interactions in Ecosystems

A **species** is a group of closely related organisms that can reproduce with one another. A **population** refers to all the members of a particular species within an ecosystem. In the ecosystem of Williams Creek, near Terrace, many populations interact, such as speckled frogs, mosquitoes, grizzly bears, moose, mountain goats, bald eagles, salmon, western red cedar, western hemlock, and black cottonwood trees. All of these populations form a community. A **community** is all the populations of the different species that interact in a specific area or ecosystem (Figure 1.24). These biotic interactions are sometimes ordered in an **ecological hierarchy** of organism, population, community, and ecosystem.

internet connect

You can design your own ecosystem in a bottle without leaving your computer. Find out how to build a virtual ecosphere. Start your search at **www.bcscience10.ca**.

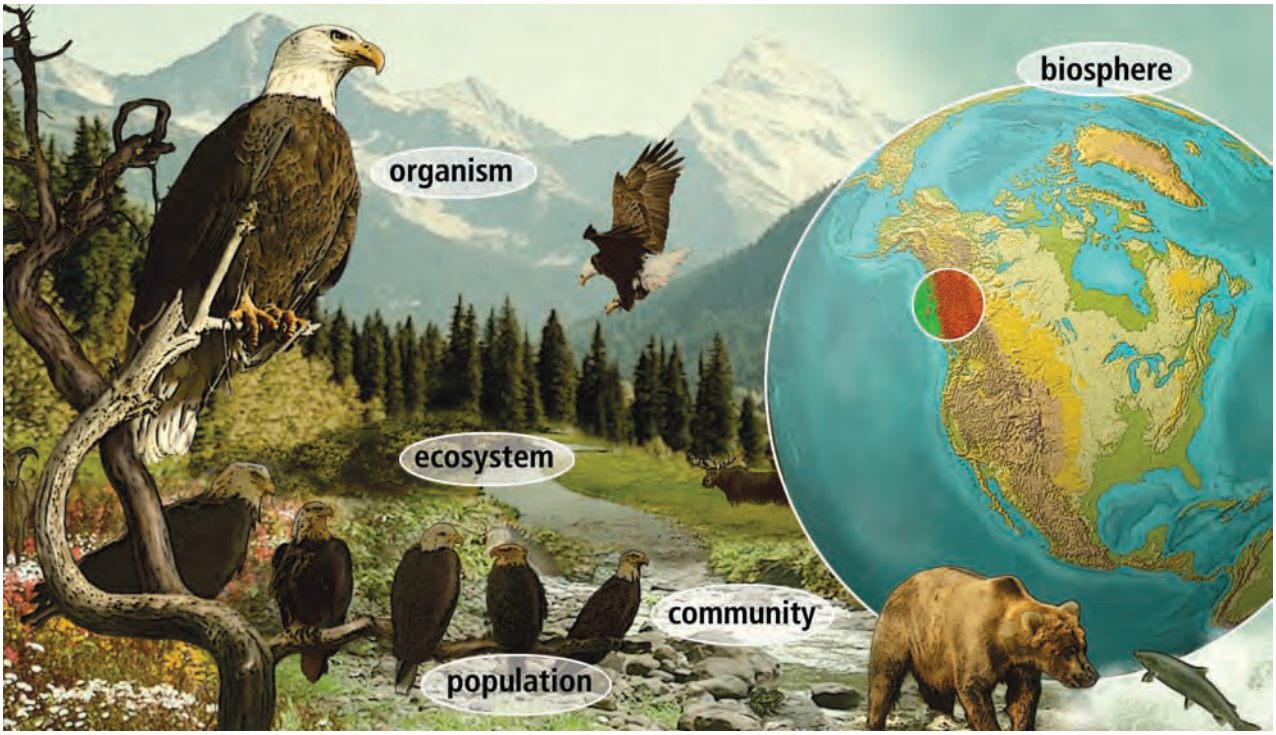


Figure 1.24 The Williams Creek ecosystem

Reading Check

1. What is a species?
2. What is a population?
3. What is a community?

Biotic Interactions in Populations

Within an ecosystem, organisms interact constantly within their species and with other organisms. Three kinds of interactions in ecosystems are commensalism, mutualism, and parasitism.

Figure 1.25 The candy-striped shrimp finds shelter on a crimson anemone.

Symbiotic Relationships

Commensalism, mutualism, and parasitism are examples of symbiosis or symbiotic relationships. **Symbiosis** refers to the interaction between members of two different species that live together in a close association.

Commensalism

Commensalism is a symbiotic relationship in which one species benefits and the other species is neither helped nor harmed. Often the host species provides shelter or transportation for the other species. For example, in Queen Charlotte Sound, the crimson anemone provides shelter and protection for the candy-striped shrimp (Figure 1.25). The colour of the crimson anemone is similar to that of the candy-striped shrimp. This colouring allows the shrimp to hide from predators, and the anemone is not harmed. Another example of commensalism is the relationship between barnacles and whales. Barnacles attach to whales and are transported to new locations in the ocean (Figure 1.26). Whales are not harmed in this process, and the barnacles benefit from new food sources.

Figure 1.26 The humpback whale transports barnacles that are attached to its pectoral fin.

Figure 1.27 Spanish moss

Spanish moss, which is commonly called old man's beard, can be found in the temperate rainforests of British Columbia (Figure 1.27). Spanish moss and the trees it grows on are another example of commensalism. Spanish moss lives on trees in rainforests and has no roots. It is an epiphyte, like the orchids of tropical rainforests. Epiphytes are plants that are supported by or anchored on other plants, but they usually do not obtain water or nutrients from these hosts. Spanish moss wraps its stem around trees and grows high into the forest canopy, where more sunlight, nutrients, and moisture are available. The feathery structure of Spanish moss captures nutrients and moisture from the air.

Mutualism

Mutualism is a symbiotic relationship in which both organisms benefit. In some mutualistic relationships, two species are unable to survive without each other. The relationship between certain plants and bees, wasps, bats, or other pollinators illustrates this dependent relationship. Moth-pollinated plants often have spurs or tubes that are the exact length of a certain moth's feeding tube. Snapdragon flowers open only for bumblebees that are of a specific mass (Figure 1.28).

Western red squirrels and northern flying squirrels (Figure 1.29) of the boreal forests of British Columbia feed on an underground fungus that is critical to the trees' ability to absorb water and nutrients. After eating the fungus, the squirrels spread fungal spores in their droppings over the forest floor. The dispersal and growth of the fungus promotes the growth of young tree seedlings.

In another type of mutualism, one species defends another species against attacks in return for food and shelter. For example, in savanna (tropical grassland) biomes, a species of aggressive ant lives in the hollow thorns of the bullhorn acacia bush. The ants sip nectar from the tips of the bullhorn acacia's leaflets (Figure 1.30). In return for food and shelter, the ants protect the plant by aggressively fighting off other insects and animals by stinging them.

Figure 1.28 A bumblebee collecting the pollen of a snapdragon

Figure 1.29 The northern flying squirrel eats almost nothing else except lichens and fungi.

Figure 1.30 Mutualism is demonstrated in the symbiotic relationship between these ants and the bullhorn acacia plant.

Figure 1.31 Lichens are often found on rocks and trees.

The most famous example of mutualism is that of lichens (Figure 1.31). Over 2500 types of lichens exist, and they can be found in every biome on Earth. Each lichen has an alga (plural: algae) and a fungus that live in a mutualistic relationship with each other. The alga produces sugars and oxygen for the fungus through photosynthesis. In return, the fungus provides carbon dioxide, water, minerals, and protection from dehydration for the alga.

1-2B Considering the Interactions between Species

Think About It

Mutualism is an important interaction between species. In this activity, you will create two fictional species that interact in a mutualistic relationship.

Materials

- paper
- coloured markers

What to Do

1. Working with a partner, decide on two imaginary species. Brainstorm the characteristics of each species that allow them to interact in a way that is beneficial to both species. (**Hint:** Think about the adaptations each species has that suit it to the other species.) Your species can live in water, in the air, or on the land. Try to come up with examples that have not been discussed in class. Be creative.
2. Choose an appropriate name for each species.
3. Draw and label a diagram that shows the interaction of the two species.
4. Write a paragraph about your diagram describing the mutualistic relationship of the two species.
5. Compare your diagram with those of the rest of the class.

What Did You Find Out?

1. Make a class list of all the types of adaptations shown in the mutualistic relationships of all the imaginary species.
2. Did any of the groups illustrate a mutual relationship that is actually found in nature? If so, describe it.

Parasitism

Parasitism is a symbiotic relationship in which one species benefits and another is harmed. Parasites are usually much smaller and more numerous than their hosts. Parasites may live in or on a host and obtain food from the host's blood or body tissues. Usually, the host is not killed, but a parasite can cause a great deal of damage to a host's body and organs, weakening it and sometimes causing it to die. Some parasites can live on different hosts. Other parasites can live on only one host.

There are about 3200 species of parasites that can infect humans, and 100 of these species are worms. For example, a type of worm that infects both humans and dogs is called a hookworm. *Ancylostoma caninum* is the species that infects dogs. Hookworms live in soil and animal feces. When dogs are exposed to soil or feces contaminated with hookworms, these blood-sucking microscopic parasites can penetrate their skin. The hookworm enters the bloodstream and travels to the intestine where it attaches by its teeth (Figure 1.32) to the intestinal wall.

The mountain pine beetle is a well-known insect parasite that is devastating the lodgepole pine and white pine forests of British Columbia. You will learn more about this parasite in Chapter 3. Not all parasites are small. In the jungles of southeast Asia lives a type of parasitic flowering plant called *Rafflesia arnoldii*. This plant produces the world's biggest flower, and it lives only on the tetrastigma vine (Figure 1.33). *Rafflesia arnoldii* has no leaves or stem, but it has strands of tissue called filaments that grow into the tetrastigma vine to obtain food, which weakens the vine.

Figure 1.32 *Ancylostoma caninum* has pairs of teeth that attach to the wall of a dog's intestine. The hookworm obtains food from a host's blood.

Figure 1.33 *Rafflesia arnoldii* grows close to the jungle floor. Its flower has a diameter of 100 cm and a mass of 11 kg.

internet connect

Another form of parasitism is called brood parasitism, in which one species of bird lays its eggs in the nest of another species. Cowbirds often lay their eggs in the nests of other birds, such as vireos, which can affect the survival rate of their hosts' offspring. Find out more about brood parasitism. Start your search at **www.bcscience10.ca**.

Reading Check

1. What is symbiosis?
2. What is commensalism?
3. Give an example of mutualism.
4. Give an example of parasitism.

Niches

Organisms have special roles in the ecosystems in which they live. The term **niche** is used to describe these roles. An organism's niche includes the way in which the organism contributes to and fits into its environment. All the physical, chemical, and biological interactions required for a species to survive, grow, and reproduce are part of the organism's niche. Within its niche, an organism interacts with other individuals of the same species or with individuals of other species. For example, great blue herons always live near water, where they can fish and nest in nearby trees and bushes. They often feed alone but will tolerate the presence of other birds. Because of their long legs, great blue herons can find food in deeper water, which allows them to occupy a niche that other heron species with shorter legs cannot (Figure 1.34). Often interactions involve competitions for food and other resources, such as water, sunlight, or habitat.

Figure 1.34 Great blue heron

Competition

Competition is a harmful interaction between two or more organisms that can occur when organisms compete for the same resource (such as food) in the same location at the same time. The health of an organism and its ability to grow and reproduce is reduced if the organism expends energy to compete against other organisms. For this reason, competition can limit the size of a population.

Some plants have characteristics that make them successful competitors. For example, spotted knapweed releases chemicals into the soil, which prevents the growth of other plants and allows the knapweed to populate a field quickly (Figure 1.35). This plant spreads rapidly and is also a successful competitor because one plant alone can produce 25 000 seeds. Because of these qualities, spotted knapweed is one of the worst rangeland weeds in British Columbia.

Animals such as coyotes usually hunt in packs to kill large animals, such as deer and elk. However, in areas where only smaller animals, such as rabbits, squirrels, and mice are available for food, coyotes will hunt on their own and compete with other coyotes, especially if these food sources are scarce (Figure 1.36).

Figure 1.35 Spotted knapweed

Figure 1.36 Although coyotes often hunt together, they will compete with each other over habitat or food sources.

Did You Know?

Some scientists believe that modern seabirds, such as pelicans and albatrosses, occupy the same niche once occupied by the pterosaur, a type of prehistoric flying vertebrate. Although pterosaurs were long thought to be a type of reptile, there is evidence that they may have been warm-blooded (able to maintain their own internal body temperature).

internet connect

Ecologists use the term "herbivory" to describe the predation of plants by herbivores (plant eaters). Many plants have adaptations, such as thorns and toxins, that reduce the impact of these predators. Find out more about these adaptations. Start your search at **www.bcscience10.ca**.

Predation

In ecology, **predation** is the term used to describe predator-prey interactions in which one organism (the predator) eats all or part of another organism (the prey). As a result, one organism benefits and the other is harmed. Predation, as you will learn in section 2.1, also moves energy through an ecosystem.

Predatory animals have adaptations that make them effective predators. Predator adaptations may include highly developed senses such as very good eyesight or a keen sense of smell. The sharp, pointed teeth, or "fangs," of a cougar (Figure 1.37) are an adaption that make this predator better able to catch its prey.

Figure 1.37 Cougars have long canine teeth.

Figure 1.38 Porcupines have sharp spines.

Prey animals also have adaptations that keep them from being eaten. For example, porcupines have spines (Figure 1.38). Turtles and clams have hard shells. Newts produce poisonous substances. Other forms of adaptation, such as camouflage, allow prey animals to hide from predators. For example, stick bugs, which are eaten by birds, look like twigs (Figure 1.39). Mimicry is an adaptation in which a prey animal mimics another species that is dangerous or tastes bad. For example, the viceroy butterfly looks like the bitter-tasting monarch butterfly and so is avoided by predators (Figure 1.40).

Figure 1.39 Stick bug

Figure 1.40 Viceroy butterfly (A) and monarch butterfly (B)

The size of a prey population can be affected by the number of predators. In Figure 1.41, the lynx is the predator and the snowshoe hare is the prey. In this example, the prey population grows when there are few predators. When the predator population is high, the prey population shrinks.

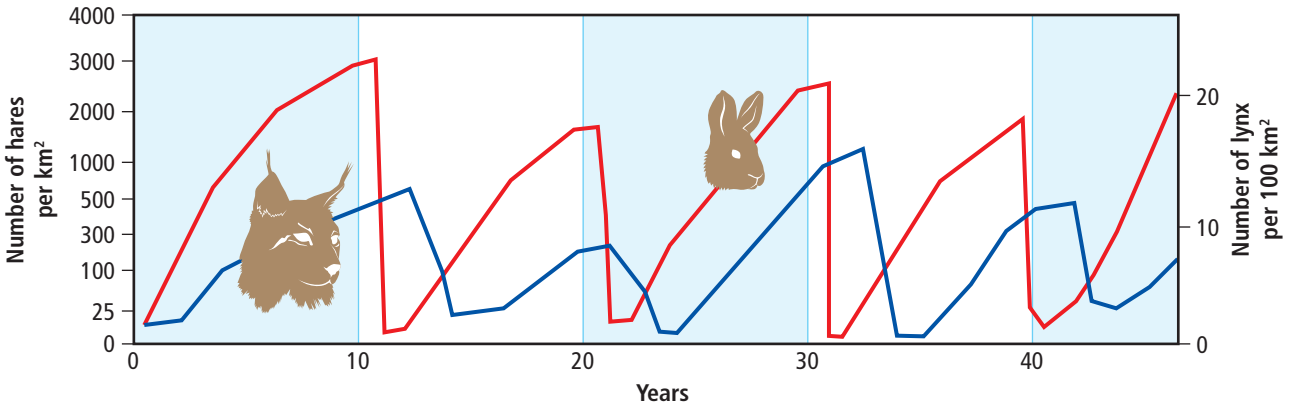


Figure 1.41 The predator-prey relationship between lynx and snowshoe hares

Suggested Activity

Find Out Activity 1-2C on page 49

Predator-prey relationships are extremely complex. Many prey populations are regulated by factors other than predation, such as availability of food and space and by rates of population growth.

Reading Check

1. What is a niche?
2. What resources do organisms compete for?
3. What is predation?
4. Provide one example of a predator.
5. State two ways in which prey avoid predators.

Explore More

The Vancouver Island marmot, which lives only on mountain slopes of Vancouver Island, is Canada's most endangered animal. Find out more about the marmot's ecosystem and how efforts are being made to save this unique animal. Start your search at **www.bcscience10.ca**.

Biodiversity in Ecosystems

A land area or water body that has a large variety of organisms, or great biodiversity, is often an indicator of the health of an ecosystem. Most biodiversity losses are a direct result of habitat loss. Each ecosystem, such as a forest or a wetland, has unique biotic and abiotic components that contribute to the availability of food, water, and nutrients for all organisms. Forest ecosystems, for example, prevent soil erosion, store nutrients, control climate, and provide habitat for many species of plants, mammals, birds, fish, and amphibians. Forests also benefit humans by providing a source for timber products (Figure 1.42) and medicine. Wetlands purify water and prevent flooding (Figure 1.43).

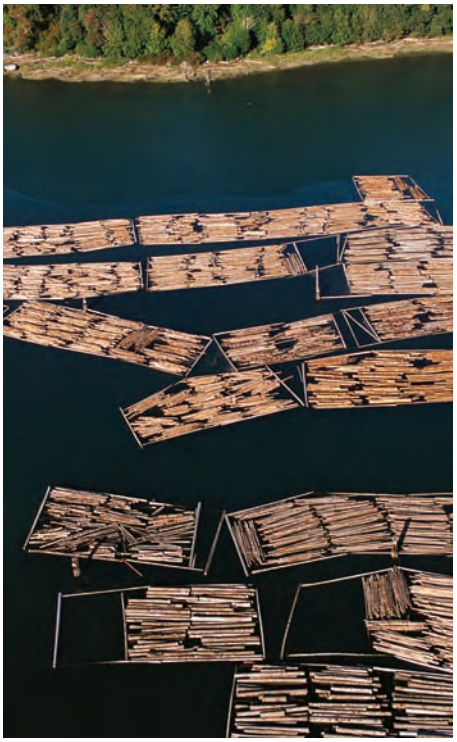


Figure 1.42 Forests have been an important part of the economy of British Columbia, providing logs for lumber and papermaking.

Figure 1.43 Wetlands provide habitat for a variety of water-tolerant plants, for birds such as herons, geese, ducks, and for other animals, such as fish, moose, deer, and beaver.

As humans continue to use and expand into ecosystems in all parts of the world, maintaining the biodiversity of ecosystems becomes more difficult. Many places, such as British Columbia, are developing ecosystem management plans, which try to balance human activities with the preservation of ecosystem biodiversity. In British Columbia, the greatest threat to ecosystems is human activity and the expansion of cities. Preserving enough of an ecosystem to maintain biodiversity will be an ongoing challenge in our province.

1-2C Predator-Prey Simulation

Find Out ACTIVITY

In this activity, you will simulate predator-prey relationships and graph your findings.

Materials

- 8 textbooks
- 200 small (2 cm) cardboard squares (each represents a prey animal)
- 12 large (8 cm) cardboard squares (each represents a predator)
- data table
- graph paper
- coloured pencils

What to Do

1. Working in a group of three, decide who will control the prey animals, who will control the predators, and who will be the data recorder. Your teacher will give you a data table.
2. Clear all other materials off your table. Construct a forest habitat as instructed by your teacher.
3. Read the following rules. You will need to refer back to them as you do the simulation.
    - Controllers of prey animals and predators must stand 0.5 m from the habitat entrance when tossing the squares.
    - When one half or more of a prey animal square is covered by a predator square, the prey animal has been captured and is removed from the habitat.
    - In each round, each predator that captures at least three prey animals survives.
    - If fewer than three prey animals are captured, the predator dies and is removed from the habitat.
    - In each round, each predator that captures at least three prey animals survives and reproduces (producing a new generation). Therefore, one additional predator will be tossed into the habitat for every three prey animals caught.
    - If all predators die, then a new predator is tossed into the habitat.
    - The prey population doubles each generation, so if 10 prey animals survive, the next generation (round) starts with 20 prey animals.
    - The maximum carrying capacity of this forest habitat is 200 prey animals. (Carrying capacity is the ability of an ecosystem to supply enough resources such as food, water, and shelter for continued survival.)
4. Begin the simulation. The prey animal controller tosses three prey animals into the habitat. The predator controller then tosses one predator into the habitat at these prey animals.
5. Continue the simulation for 20 generations or until all the prey animals are captured. The data controller records all data for each generation in the data table provided by your teacher.
6. Construct a graph with two lines using the data from the "Total Prey Animals" and "Total Predators" columns for each generation. Label the *x*-axis from generations 1 through 20. Label the *y*-axis "Population Numbers." Determine the intervals you will use to plot the population numbers.
7. Use one colour of pencil to plot the points for the total prey animals. Use another colour of pencil to plot the points for the total predators for each generation.
8. Connect the points to form the prey animals' graph line. Use another colour of pencil to connect the points for the predators' graph line.

Science Skills

Go to Science Skill 5 for information on how to construct a graph.

What Did You Find Out?

1. Describe the relationship between the prey and predator lines on your graph.
2. Predict what the graph would look like after 12 generations if all the predators were lost to a disease. Sketch this graph.
3. Predict what the graph would look like after 12 generations if all the prey animals were lost to a disease. Sketch this graph.
4. Predict what would happen to the predator and prey populations if half of the prey animals' habitat were destroyed by the construction of a shopping mall.

Wild, Weird, Wonderful

www Science

Beware the Rough-Skinned Newt

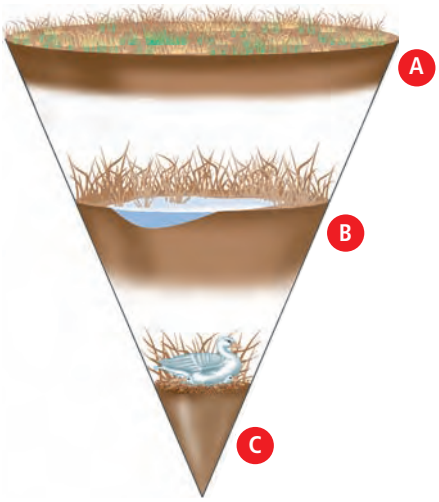
The rough-skinned newt, which is native to British Columbia, has two remarkable adaptations for defence. When threatened, the newt flips up to show its bright red-orange belly, and takes on a U shape, which is read as a stop sign by predators. If a predator is not frightened away by the defensive posture, the newt then releases a neurotoxin (a chemical that affects the nervous system) that causes nerves to stop functioning, paralyzing the predator. The toxin from one newt could kill 100 humans.

If a newt produces a lot of toxin, it will have less energy to reproduce. If the newt produces too little toxin, it will be eaten. Today, the only predator of the rough-skinned newt is the garter snake. Some garter snakes have a genetic mutation that makes them resistant to the toxin. Scientists have discovered that this mutation changes a protein on nerve cells that bind to the toxin so the toxin does not paralyze the snake. However, this ability to resist the toxin also comes at a cost. The more resistant the snake is to a newt's neurotoxin, the more slow moving it becomes. Why? Because the mutated protein causes less effective nerve and muscle function and makes the snake more vulnerable to its predators.

In areas where newts produce low levels of toxin, garter snakes have a low resistance to the toxin. In areas where populations of newts produce intermediate levels of toxin, garter snakes have an intermediate resistance. In populations where newts produce very high levels of toxin, garter snakes have high resistance. In these populations with high toxin levels, there will be fewer newts because they will produce fewer offspring. There will also be fewer garter snakes because the toxin makes them so slow moving and vulnerable to capture by their predators. Thus, the populations of newts and garter snakes are kept in balance.

Checking Concepts

1. List the following terms in order from smallest to largest: biome, biosphere, community, ecosystem, single species, population.
2. How is a habitat different from a niche?
3. Identify which letter represents a biome, which represents a habitat, and which represents an ecosystem in the diagram below.



4. What requirements for life are provided by ecosystems?
5. Why is soil important for terrestrial ecosystems?
6. Why are some organisms in an ecosystem in competition?
7. Give one example of a plant adaptation and one example an animal adaptation for:
   (a) mutualism
   (b) predation
8. Identify each of the following as an example of commensalism, mutualism, parasitism, competition, or predation.
   (a) Some bacteria live in roots of soybean plants, obtain sugars from the plant, and provide nitrogen to the plant.
   (b) Orchids grow high in the canopy of tropical rainforests. The trees on which the orchids grow are not harmed, nor do they benefit from the orchids.
   (c) Tapeworms can live in the intestines of humans. The tapeworm feeds off the nutrients a human host has ingested, making the nutrients unavailable to the host. This can result in malnutrition for the host.
   (d) A western red cedar seedling and a Sitka spruce seedling are both growing in a temperate rainforest. Both require sunlight, nutrients, and water from the environment.
   (e) Some flowers are pollinated by bats. In return, bats receive nectar from the flowers.
9. Provide several reasons why ecosystems are important to the survival of humans.

Understanding Key Ideas

10. Think about the organisms that live in your community. Identify one example of each of the following.
    (a) a competitive relationship
    (b) a predator-prey relationship
    (c) a commensal relationship
    (d) a mutualisitic relationship
11. Many people believe that plants are defenceless. Provide an argument to refute this statement.
12. What will happen when two species compete for the same resources?
13. Describe the effect of the following conditions on a population of predators.
    (a) The number of prey animals is low.
    (b) The number of prey animals is high.

Pause and Reflect

Suppose a city official recently told reporters "Every type of ecosystem must be preserved." Consider what you have learned about ecosystems. Use examples from this section to support the statement.

Prepare Your Own Summary

In this chapter, you investigated the factors that influence the characteristics and distribution of biomes and the adaptations of the plants and animals within them. You have also investigated the interaction of the biotic and abiotic components within biomes and ecosystems. Create your own summary of the key ideas from this chapter. You may include graphic organizers or illustrations with your notes. (See Science Skill 11 for help with using graphic organizers.) Use the following headings to organize your notes:

1. Factors that Influence the Characteristics of Biomes
2. The Distribution of Biomes
3. Adaptations and Biomes
4. Abiotic Interactions in Ecosystems
5. Biotic Interactions in Ecosystems

Checking Concepts

1. Explain the relationship between the biosphere, a biome, and an ecosystem.
2. (a) Name three factors that influence the characteristics of biomes.
   (b) Describe how each of these factors might influence where a biome is located in the world.
3. What two factors are the most important for determining a region's climate?
4. What is a climatograph?
5. Explain the term "adaptation."
6. Use examples to explain the difference between a structural adaptation and a behavioural adaptation.
7. Explain why the temperate rainforest biome is usually found along the coasts of continents.
8. Explain why there are few trees in the grassland biome.
9. What effect does elevation have on the characteristics of a biome?
10. What type of biome might you find at the top of a mountain? Explain.
11. Identify three abiotic components of an ecosystem, and relate their importance to the plant and animal life in an ecosystem.
12. Explain what is meant by "ecological hierarchy."
13. Explain the difference between commensalism and mutualism.
14. How is parasitism different from predation?
15. List three adaptations of prey animals.

Understanding Key Ideas

16. Predict what would happen to a plant if it were moved from a wetland to a desert. Explain your prediction.
17. Why do you think biomes are often classified according to their plant species rather than by the animals that live in the biomes?
18. Explain why hot desert ecosystems can exist on every continent on Earth except Antarctica.
19. Are symbiotic relationships part of an organism's niche? Explain.
20. Why are hosts often not killed in parasitic relationships?
21. Explain how competition can affect the health of an organism and its ability to reproduce.
22. How can the size of a prey population be affected by the number of predators?
23. Use the world map and the graph on the next page to answer this question.
   (a) Match the numbers of the biomes on the world map with the letters on the average annual temperature and average annual precipitation graph.
   (b) Identify the biome for each match.

Applying Your Understanding

24. The yellow-bellied marmot is found in British Columbia and southwestern Alberta. Although the marmot usually lives at elevations of over 3000 m, it is also found on agricultural land in foothills and valleys. Like other members of the marmot family, the yellow-bellied marmot is a major hole digger. Many animals, such as raccoons, foxes, rabbits, and snakes, are successful in marmot country because of the shelter provided by marmot holes. The yellow-bellied marmot primarily eats plants, such as grasses, and occasionally insects, such as grasshoppers.

(a) What type of symbiotic relationship exists between marmots and raccoons? Explain.

(b) Is the marmot primarily a herbivore, a carnivore, or an omnivore? Explain.

Pause and Reflect

In this chapter, you have learned that soil is an important part of terrestrial ecosystems. Franklin D. Roosevelt, who was president of the United States from 1933 to 1945, said "The nation that destroys its soil, destroys itself." Think about what you have learned about soil and ecosystems in this chapter and support or refute (argue against) this statement.