

## Section 1.2 How Organisms Interact in Ecosystems



**Figure 1.11** This bull elk will have to compete with other bulls to find a mate.

A scientific study of the elk in Figure 1.11 might reveal what kind of food he prefers, how often he eats, and how far he roams in search of food or shelter. Although the elk may spend a great deal of time alone, he also interacts with other individuals of his own species. For example, during the mating season, this male elk will probably battle with other male elk as they compete for mates. All organisms depend on other organisms for food, shelter, reproduction, or protection. Thus, it is important to study an organism's relationships with other organisms to better understand its life.

### Levels of Organization

In order to organize and communicate their studies, ecologists define the interactions among organisms at different levels. As shown in Figure 1.12, in addition to studying individuals, ecologists study populations, communities, and ecosystems.

**Figure 1.12** Study the illustrations to see the relationships among the four levels of biological organization.



Level 1: individual



Level 2: population



Level 3: community



Level 4: ecosystem

### Populations

A **population** is a group of individuals of the same species, living together in one ecosystem. For example, all the blue grouse in an alpine meadow are a population. Biological populations vary in size depending on factors such as the species, time of year, weather, or abundance of food. For example, a population of woodland caribou in northern British Columbia might contain thousands of individuals. A population of rare spotted bats in the Okanagan or Cariboo region of British Columbia might have only a few individuals.

Individuals in a population often compete with each other for habitat. Food, water, and shelter make up an organism's **habitat**, the place in which it lives.

How the organisms in a population share the resources of their habitat determines how far apart the organisms must live and how large the population can become. Some species have behaviours that help to reduce competition. For example, the adult and juvenile stages of the rough-skinned newt in Figure 1.13 have different habitat needs. Newt larvae live in ponds. Adult newts live in or under logs in the forest near the pond. The larvae eat small aquatic animals. The adults feed on slugs and worms. Since the larvae and adults live in different places and eat different foods, they can share the same space without competing with each other. You will learn more about the habitat of one population of animals in the Find Out Activity on the next page.



**Figure 1.13** Adult and juvenile rough-skinned newts have different needs, which allow them to share the same habitat.

### Communities

Populations share their environment and interact with populations of other species. A **community** is made up of all the interacting populations that live in an area. For example, the pine forest community in Figure 1.14 includes animals such as mule deer, hummingbirds, and spotted bats as well as the pine trees. Plants such as Saskatoon berry and balsamroot are also part of the community. In every community, each species has a particular habitat.



**Figure 1.14** The animals and plants in the ponderosa pine forest make up a community.

**READING Check** ✓  
Is a herd of elk a population or a community? Explain your answer.



## Find Out **ACTIVITY 1-D**

### Designer Habitat

What does an organism's habitat look like? Consider a river otter, for example. A river otter lives near a stream, a lake, or a river. It eats fish, frogs, and sometimes mice and birds. It makes a den on land in a burrow, a hollow tree, or an abandoned beaver lodge. Find out how another British Columbia animal meets its basic needs.



#### What You Need

- sheet of paper
- pencil
- dip net (optional)
- jar (optional)
- small cardboard box (such as a shoe box)
- art supplies

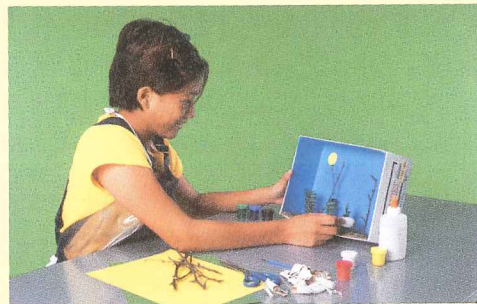
#### Safety Precautions

- If you disturb an animal's habitat (for example, if you turn over a stone or dig a hole in the sand), always return the habitat to the condition in which you found it.

#### What to Do

1. Work with a partner. Choose either (a) or (b).
  - (a) Look for animals in your schoolyard or in another outdoor area nearby. Carefully turn over rocks and logs. Look for animals in ponds and ditches. Watch for birds flying overhead. Choose one animal, and **observe** it closely without disturbing it.
  - (b) At a library or on the Internet, research the habitat needs of one animal that lives in your region of British Columbia.

2. Draw four large circles on a sheet of paper. Label the circles "food," "water," "shelter," and "space." Describe the habitat of the animal you chose to study by filling in the circles. Consider what your animal needs for shelter. For example, some birds nest in holes in dead trees that are still standing. Also consider where your animal lives and how much space it needs. For example, grey whales live in the Pacific Ocean. They travel the ocean from Mexico to Alaska.
3. Use the cardboard box and the art supplies to make a **model** that shows the habitat of the animal you chose to study. Display your model in the classroom.



#### What Did You Find Out?

1. Compare the habitat you studied with the habitat studied by another pair of students. How are the habitats the same? How are they different?
2. What are five changes that might affect the survival of the animal you studied? Think about small changes, such as someone riding a bicycle through its habitat. Also think about large changes, such as a flood or a drought.

#### Extension

3. All organisms need a certain amount of space. If there are too many organisms in a habitat, space can become limited. What might happen if your classroom space was decreased to half its current size?

## Ecosystems

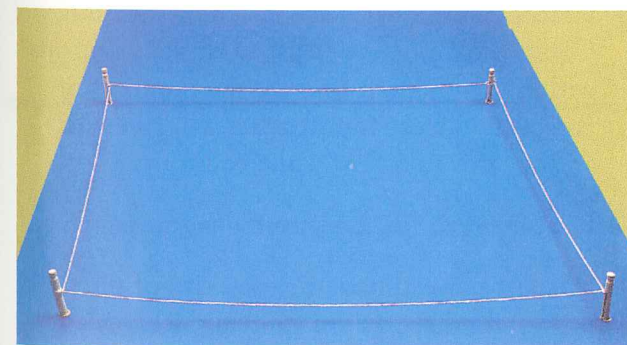
Communities are affected by abiotic conditions such as the average amount of sunlight and rain, and the average temperature of the region. An ecosystem includes a biological community as well as the abiotic parts of the environment that affect this community.

The intertidal marine ecosystem shown in Figure 1.15 is on the rocky shoreline of British Columbia's Pacific coast. Tides, weather, the type of sand or rock on which the plants and animals live, and the amount of sunlight and rain that reach the communities are just a few of the abiotic parts of this ecosystem.

Abiotic factors such as the amount of rain or sunshine are almost the same across an ecosystem. You can consider a rotting log with all the organisms that live in or on it to be an ecosystem. You could also consider a forest to be an ecosystem.

### Sampling Populations

Ecologists study ecosystems to learn about relationships between organisms and any changes in populations that take place over a long period of time. For example, ecologists might want to know if a population is declining. For very small ecosystems, you could count all the plants and animals. For large ecosystems, this would be impossible. You could, however, estimate the numbers of plants and animals. Ecologists estimate population sizes in ecosystems by **sampling**. One of the most popular sampling methods involves a **quadrat**, a square that marks off a specific area (see Figure 1.16). The students in Figure 1.17 are conducting a quadrat study on the rocky shoreline of Vancouver Island. You will have an opportunity to use a quadrat in the next investigation.



**Figure 1.16** You can make a quadrat by joining wooden pegs with string.



**Figure 1.15** Intertidal marine life survives in an area that is covered by the ocean for part of the day. During the remainder of the day, it is exposed to sunlight, wind, or rain.

#### READING CHECK

Describe an individual, a population, a community, and an ecosystem in a freshwater pond or tidal pool. A tidal pool is a small pond that remains on a beach when the tide is out.



**Figure 1.17** These students are sampling the intertidal zone using a quadrat.



- ★ Measuring
- ★ Inferring
- ★ Interpreting Data
- ★ Communicating

# Sampling Populations in an Ecosystem

In this investigation, you will sample the populations of several organisms in an ecosystem. You will use a quadrat to count the individuals in a small area of the ecosystem. The ecosystem you study could be your schoolyard, a park, a meadow, a field, or any another ecosystem.

## Question

How can you sample the populations of an ecosystem and examine the interactions among these populations?

## Safety Precautions



- Do not harm any animals in your sample area.
- If you disturb a habitat be sure to return it to its original condition.

## Apparatus

- 4 pegs (such as tent pegs)
- thermometer
- ruler
- hand lens
- clipboard

## Materials

- paper or notebook
- string
- plant, insect, and bird field guides (optional)

## Skill

### POWER

For tips on making a data table, turn to SkillPower 5.

## Procedure

- 1 Before you go to your study site, create a data table similar to the one shown here, for each quadrat you will study. Take your tables to your study site.

Name of species	Average # individuals per square metre	Estimated total population

- 2 When you arrive at your study site, sit quietly and **observe** it. **Record** everything that you can see, hear, and even smell to give an overall description of your study site.
- 3 Toss your pencil at random in your study site. Build a quadrat with one corner where the pencil lands.
- 4 **Measure** the temperature on the surface of the ground within the quadrat and in the air above it. **Record** these temperatures and any other abiotic factors within the quadrat. For example, is the ground soil, mud, or rock?
- 5 Choose at least five types of plants and five kinds of animals that are inside the quadrat. Count the number of each of these organisms within the quadrat. **Record** the numbers in your data tables. Your teacher will give you a list of tips to follow while counting.
- 6 Repeat step 5 for four more quadrat samples.
- 7 **Measure** or estimate the total size of the ecosystem that you are studying. **Record** your results.

## Analyze

1. Calculate the average number of each organism per square metre. (See Sample Calculation) Record your results in your data table.
2. Multiply the average number of each organism per square metre by the number of square metres in the whole ecosystem. See the example in the Sample Calculation. Record your results.

## Sample Calculation

The numbers of blue beetles counted in five quadrats (1 m<sup>2</sup>) are 13, 15, 16, 14, and 13.

The total number of blue beetles in five quadrats is 71.

$$\text{Average} = \frac{\text{total number of blue beetles}}{\text{total area of quadrats}}$$

$$= \frac{71 \text{ blue beetles}}{5 \text{ quadrats} \times 1 \text{ m}^2}$$

$$= 14.2 \frac{\text{blue beetles}}{\text{m}^2}$$

$$\text{Total ecosystem area} = \text{length} \times \text{width of ecosystem}$$

$$= 50 \text{ m} \times 20 \text{ m}$$

$$= 1000 \text{ m}^2$$

$$\text{Estimated population of blue beetles} = 14.2 \frac{\text{blue beetles}}{\text{m}^2} \times 1000 \text{ m}^2$$

$$= 14\,200 \text{ blue beetles}$$

## Conclude and Apply

3. Write a description of the ecosystem you studied. Include the different types and numbers of plants and animals. Also include the abiotic factors (non-living things) that affect this ecosystem.
4. Why did you sample more than one area in this investigation?
5. Why do you think you were asked to choose your sample areas by chance (by tossing your pencil)?

## Extend Your Knowledge

6. Try to identify any unknown organisms by matching them with illustrations in plant and animal guides or by working with other students in your class.

## Extend Your Skills

7. Wait for weather conditions to change, and repeat the study. How are the results of your second study different from the results of your first study? How are they similar? What do you think accounts for any differences?



## Pause & Reflect

Clams, crabs, sea cucumbers, seaweeds, and over a dozen different kinds of sea stars live in intertidal areas (see Figure 1.17). Local people say, "When the tide is out, the table is set." In your notebook, explain what this expression might mean.

### Key Terms

population  
habitat  
community  
sampling  
quadrat

## Section 1.2 Summary

Organisms and their interactions with the abiotic parts of their environment can be organized into different levels: individuals, populations, communities, and ecosystems.

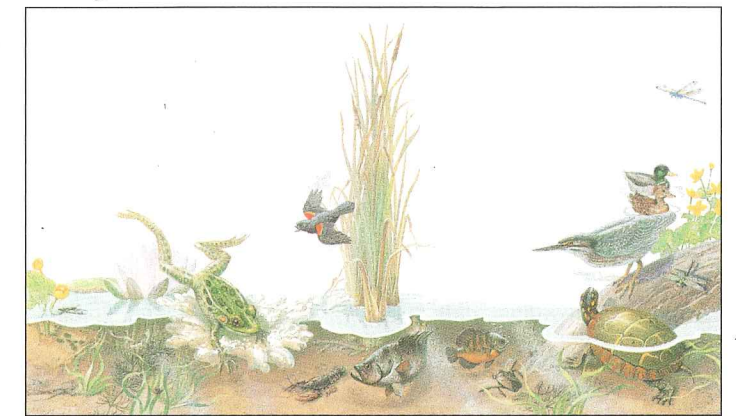
- A population is a group of individuals of the same species that live together in one place at one time.
- A community is made up of all of the interacting populations that live in one area.
- An ecosystem is a community as well as the abiotic parts of the environment with which the populations in the community interact.
- All individuals need a habitat (a place to live). A habitat includes food, water, shelter, and a suitable amount of space for survival.
- A quadrat study is one way to sample an ecosystem. Ecologists can use sampling to learn about the relationships among organisms in a community or to monitor changes in a community over time.

## Check Your Understanding

1. (a) How would you use a quadrat to estimate population sizes?  
(b) Why is the result only an estimate, not an exact number?
2. What are the differences and similarities between populations and communities? Write your answers in a chart.
3. Why would it be useful to do at least two population studies of the same ecosystem, with a period of time between the two studies?
4. **Apply** Imagine that you are a biologist. The company for which you work predicts the effects of building large subdivisions or other building projects. There is a plan to build a new luxury resort on the shore of a large bay. Builders need to know how the project will affect the environment in a few particular ecosystems. Your job is to estimate the number of organisms in these ecosystems. Explain how you could sample
  - (a) the numbers of different insects in a large tree
  - (b) the numbers of different fish in the bay
  - (c) the number of groundhogs in a local golf course
5. **Thinking Critically** A home aquarium contains water, an air pump, a light, algae, a goldfish, and algae-eating snails. What are the abiotic parts of this environment? Which parts of this environment would you consider to be a population? Which parts would you consider to be a community?

## Section 1.3 Roles of Organisms in Ecosystems

Like all other members of human communities, you play several different roles in your daily life. At school, you are a student. You might also be a member of a sports team. Outside of school, you might be a volunteer at a food bank. Similarly, the organisms in a community of plants and animals play different roles. A **niche** [NEESH] is both the space where an organism lives and the role it plays within its ecosystem. To determine an organism's niche, you must look at what it eats, where it lives, and how it interacts with other organisms in its ecosystem.



**Figure 1.18** All these organisms have different roles, or niches, in this pond ecosystem.

## Producers and Consumers

Plants are able to grow using energy from the Sun, carbon dioxide in the air, and water and nutrients in the soil. They fill the niche called producers. **Producers** are organisms that create their own food rather than eating other organisms to obtain food. The algae and water lilies in Figure 1.18 are producers. Producers make life possible for all other organisms on Earth.

Organisms that eat, or consume, food are called **consumers**. They cannot create their own food so they must eat producers or other consumers. All animals are consumers.

## Types of Consumers

Consumers can be divided into three different groups: herbivores, carnivores, and omnivores. **Herbivores** are animals such as cows and herring that eat plants. **Carnivores** are animals that eat other consumers. Carnivores such as lynxes and dolphins eat meat. **Omnivores** are animals that eat both producers and consumers. Thus, they eat both plants and animals.

How are the niches of different organisms connected? How do they affect one another? Complete the next investigation to explore these questions.

## READING Check

Are you a consumer or a producer? Explain your answer. Are you a carnivore, a herbivore, or an omnivore? Explain your answer.