Date

Populations and Communities • Guided Reading and Study

# **Studying Populations**

This section describes how scientists study population density, size, and growth. The section also explains how factors such as food, space, and weather limit how large populations can become.

### **Use Target Reading Skills**

Before you read, preview the red headings. In the graphic organizer below, ask a question for each heading. As you read, write the answers to your questions.

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Question	Answer

**Determining Population Size** 

### **Determining Population Size**

Match the type of study with its example.

### Type of Study

- \_\_\_\_\_ **1.** direct observation
- \_\_\_\_\_ **2.** indirect observation
  - \_\_\_\_ **3.** sampling
  - \_\_\_\_\_ **4.** mark-and-recapture study

#### Example

- **a.** Counting the number of nesting sites in an area
- **b.** Counting all the crabs that live in a tide pool
- c. Counting hawks with and without bands on their legs
- **d.** Counting the number of red maples in a small area to estimate the number in the entire forest

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### **Studying Populations** (continued)

### **Changes in Population Size**

- 5. How can populations change in size?
- 6. What is the major way in which new individuals are added to a population?
- 7. The number of births in a population in a certain amount of time is the
- 8. What is the major way that individuals leave a population?
- 9. The number of deaths in a population in a certain amount of time is the
- **10.** Is the following sentence true or false? If the birth rate is greater than the death rate, population size decreases.

Match the term with its definition.

	Term	De	inition							
	_ <b>11.</b> immigration	a.	Leaving a population							
	_ <b>12.</b> emigration	b.	Moving into a population							
13.	Is the following sentence true or false? of individuals in a specific area.	Pop	oulation density is the number							

#### **Limiting Factors**

- 14. An environmental factor that causes a population to decrease is called a(n) \_\_\_\_\_\_.
- **15.** What are some limiting factors for populations?
- 16. The largest population that an area can support is called its
- 17. Is the following sentence true or false? Space is often a limiting factor for plants. \_\_\_\_\_
- 18. What are some ways weather conditions can limit population growth?

Date

#### Populations and Communities • Section Summary

## **Studying Populations**

#### **Key Concepts**

- How do ecologists determine the size of a population?
- What causes populations to change in size?
- What factors limit population growth?

Some methods of determining the size of a population are direct and indirect observations, sampling, and mark-and-recapture studies. Direct observation involves counting the members of a population one by one. Indirect observation involves counting tracks, nests, or other signs rather than the organisms themselves.

Many times, it is not possible to count every member of a population because the population is too large or spread out or the members are hard to find. Instead, ecologists make an estimate of the population. An **estimate** is an approximation of a number, based on reasonable assumptions. One type of estimating involves counting the number of organisms in a small area (a sample), and then multiplying to find the number in a larger area.

Ecologists sometimes use a technique called mark and recapture. Some animals are first captured, marked, and released into the environment. Then another group is captured. The ecologists count the marked animals in this group. Using a mathematical formula, the ecologists can estimate the total population of those animals in the area.

**Populations can change in size when new members enter the population or when members leave the population.** The major way in which new individuals are added to a population is through the birth of new offspring. The **birth rate** of a population is the number of births in a population in a certain amount of time. The major way that individuals leave a population is by dying. The **death rate** is the number of deaths in a population in a certain amount of time. If the birth rate is greater than the death rate, the population will generally increase in size. If the death rate is greater than the birth rate, the population size will generally decrease. The size of a population can also change when individuals move into or out of the population. **Immigration** means moving into a population. **Emigration** means leaving a population. Graphs are useful to show changes in the size of a population over time.

One way to state the size of a population is in terms of **population density**—the number of individuals in a specific area. Population density is calculated by dividing the number of individuals in the population by the total area. The result tells how many individuals there are per unit area.

A **limiting factor** is an environmental factor that prevents a population from increasing. **Some limiting factors for populations are food and water**, **space**, **and weather conditions**. The largest population that an environment can support is called the **carrying capacity**. Populations and Communities • Review and Reinforce

# **Studying Populations**

### **Understanding Main Ideas**

Answer the following questions on a separate sheet of paper.

- **1.** A vegetable garden is 12 meters long by 7 meters wide. In one square meter, you count two toads. Estimate the population of toads in the garden.
- **2.** What are two ways that the size of a population can increase? What are two ways that the size of a population can decrease?



Squirrel Population in a City Park, 1992-1999

*The graph above shows how the size of the squirrel population in a city park changed over time. Use the graph to answer questions* 3–5*.* 

- 3. Over which time period(s) did the squirrel population decrease?
- 4. Over which time period(s) did the population increase?
- **5.** In which year did the population reach its lowest point? What was the size of the population that year?
- 6. What causes a population to change in size?
- **7.** Identify three limiting factors that can prevent a population from increasing. Explain how each factor limits a population's size.

### **Building Vocabulary**

On a separate sheet of paper, define each of these terms in your own words.

- 8. population density
- 9. carrying capacity
- **10.** immigration

#### Populations and Communities • Enrich

## **Unlimited Population Growth**

Suppose that the organisms in a population have unlimited food, water, space, and other resources. Also suppose that the organisms are not killed by other organisms or by disease. With no limits on its growth, the population would increase at its highest possible rate.

Bacteria are microscopic, single-celled organisms that are often used to study population growth. Most bacteria reproduce by splitting in half. Under ideal conditions, bacteria can divide about every 30 minutes. In the first half hour, one bacterium produces two bacteria. In the second half hour, the two bacteria split to produce four bacteria. In the third half hour, the four bacteria split to produce eight bacteria. Every 30 minutes, the population doubles!

*Use the table on the right to answer the following questions. Write your answers on a separate sheet of paper.* 

- **1.** How many bacteria will there be in 10 hours? Fill in the blank rows to complete the table.
- **2.** On a sheet of graph paper, graph the data in your completed table.
- **3.** Describe the shape of the graph, and explain what it shows about the bacteria population.
- 4. Does the graph show what usually happens in real life? Why or why not?

Time (hours)	Number of Bacteria
0	1
0.5	2
1.0	4
1.5	
2.0	
2.5	
3.0	
3.5	
4.0	
4.5	
5.0	
5.5	
6.0	
6.5	
7.0	
7.5	
8.0	
8.5	
9.0	
9.5	
10.0	

Name\_

Date

Populations and Communities • Skills Lab

# **Counting Turtles**

### Problem

How can the mark-and-recapture method help ecologists monitor the size of a population?

### **Skills Focus**

calculating, graphing, predicting

### Materials

- model paper turtle population
- calculator
- graph paper

### Procedure

- **1.** The data table shows the results from the first three years of a study to determine the number of snapping turtles in a pond.
- **2.** Your teacher will give you a box representing the pond. Fifteen of the turtles have been marked, as shown in the data table for Year 4.
- **3.** Capture a member of the population by randomly selecting one turtle. Set it aside.
- 4. Repeat Step 3 nine times. Record the total number of turtles you captured.
- **5.** Examine each turtle to see whether it has a mark. Count the number of recaptured (marked) turtles. Record this number in the data table.

### Data Table

Year	Number Marked	Total Number Captured	Number Recaptured (with Marks)	Estimated Total Population
1	32	28	15	
2	25	21	11	
3	23	19	11	
4	15			

Populations and Communities • Skills Lab

### Counting Turtles (continued)

#### Analyze and Conclude

Write your answers in the spaces provided.

**1. Calculating** Use the equation below to estimate the turtle population for each year. The first year is done for you as a sample. Write your calculations on a separate sheet of paper. If your answer is a decimal, round it to the nearest whole number. Record the population for each year in the last column of the data table.

Total population =  $\frac{\text{Number marked} \times \text{Total number captured}}{\text{Number recaptured (with marks)}}$ 

Sample (Year 1):

 $32 \times \frac{28}{15} = 59.7$  or 60 turtles

- **2. Graphing** On the next page, graph the estimated total populations for the four years. Mark years on the horizontal axis. Mark population size on the vertical axis.
- **3. Interpreting Data** Describe how the turtle population has changed over the four years of the study. Suggest three possible causes for the changes.

**4. Predicting** Use your graph to predict what the turtle population will be in Year 5. Explain your prediction.

**5. Communicating** Write a paragraph that explains why the mark-and-recapture method is a useful tool for ecologists. When is this technique most useful for estimating population size?

#### **Populations and Communities** • Skills Lab

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#### More to Explore

Suppose that only six turtles had been recaptured in Year 2. How would this change your graph?