

Data Analysis Investigation 2-A



Skill Check

Initiating and Planning

Performing and Recording

✓ Analyzing and Interpreting

✓ Communicating

Materials

- graph paper

**Biomass of Winter Skate
(1975-2004)**

Year	Biomass
1975	59
1976	70
1977	34
1978	54
1979	47
1980	57
1981	54
1982	47
1983	27
1984	25
1985	25
1986	26
1987	43
1988	40
1989	47
1990	32
1991	48
1992	40
1993	30
1994	14
1995	16
1996	20
1997	20
1998	18
1999	15
2000	13
2001	8
2002	5
2003	7
2004	8

Is the Winter Skate Endangered in Nova Scotia?

Skates are flat-bodied fish that are related to sharks.

In Atlantic Canada, there is a small winter skate fishery.

Also, many skates are unintentionally caught in fisheries aimed at catching groundfish, a commercially important species that feeds and dwells near the bottom. In this investigation, you will graph and analyze population data for winter skates off Nova Scotia.

Question

Should the winter skate be listed under Canada's Species at Risk Act?

Organize the Data

1. Examine the table, which lists the biomasses of winter skates captured in summer samples taken off Nova Scotia.
2. Graph the data in the table. For each year, you should have one point on the graph. This type of graph is called a scatter plot.

Analyze and Interpret

1. To show the overall trend, estimate a *line of best fit*. To do this, carefully look at the points and draw a single straight line that you think best estimates the population trend.
2. Describe the pattern over time shown on your graph.

Conclude and Communicate

3. Predict the biomass for 2010. Consider using extrapolation. Is there more than one justifiable estimate for this biomass?
4. According to the Species at Risk Act, a species is *endangered* if it is likely to become extinct in Canada in the near future. Endangered species are entitled to special protection. Would you recommend to Environment Canada that the winter skate population off Nova Scotia be listed as endangered?
5. What if listing the winter skate population as endangered would restrict the groundfish industry? Groundfish make up about half the total catch in Atlantic Canada. How would this affect your decision?

Extend Your Inquiry and Research Skills

6. **Research** Find out more information about the Species at Risk Act.
 - a. What is the history of the Species at Risk Act?
 - b. Evaluate the effectiveness of the Species at Risk Act.

Inquiry Investigation 2-B

Skill Check

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Safety Precautions



- Remember proper techniques for using a microscope, including handling the microscope with care.
- If you have a mirror on the microscope, do not direct it toward the Sun.

Materials

- 2 plastic cups with labels
- felt marker
- 50 mL graduated cylinder
- paramecium culture
- medicine dropper
- yeast culture
- toothpicks
- methyl cellulose
- 6 microscope slides
- scissors
- 30 cm cotton thread
- tweezers
- 6 cover slips
- light microscope
- plastic wrap
- 2 rubber bands
- distilled water

Science Skills

Go to Science Skills Toolkit 8 for more information on using a microscope.



What Happens When Food Is Limited?

Paramecia (paramecium, singular) are unicellular organisms that are commonly found in freshwater ponds and marshes. They are covered in fine hair-like structures, which they beat to move themselves around and to sweep bacteria and other small food particles into a pore that serves as a mouth. In this investigation, you will study the factors that limit the growth of a paramecium population in a given volume of water over three weeks.

Question

How are population size and growth related to food supply?

Prediction

Make a prediction about the patterns you will see if you graph population size versus time. Make specific predictions about an ecosystem in which food is available and an ecosystem in which food is limited.

Procedure

1. Make two copies of the data table below. Title one “Added Food” and the other “Limited Food.”

Day	Number of Paramecia in Sample			Average Number of Paramecia
	Slide 1	Slide 2	Slide 3	
1				
3				
5				

2. Label one cup “added food” and the other cup “limited food.” Using the graduated cylinder, carefully measure 10 mL of paramecium culture into each plastic cup.
3. Using the marker, draw a line on each cup to indicate the level of the water.
4. Add one drop of yeast culture into the cup labelled “added food.”
5. Using the toothpick, smear a small amount of methyl cellulose in the middle of each of three slides. The methyl cellulose should cover an area that is roughly the size of a cover slip.
6. Cut the thread into 12 pieces, each about 5 mm long.

7. Using the tweezers, place four pieces of cotton thread on each slide. These threads, together with the methyl cellulose, will be obstacles for the paramecia and slow down their movement enough for you to count them. Number each slide.
8. Place one drop of paramecium culture from the cup labelled “added food” on each slide. Put a cover slip over the drop on each slide.
9. Using the low power of the microscope, count the number of paramecia in one field of view on each slide.
10. Record your counts in your data table for added food. Calculate and record the average.
11. Repeat steps 5 to 10 for the culture in the cup labelled “limited food.”
12. Cover each cup with plastic wrap, and secure the plastic wrap with a rubber band. Make several small holes in the plastic wrap so that air can enter.
13. Clean your slides and cover slips in preparation for the next samples. Repeat steps 5 to 11 every two days (or more, as your teacher directs). Always wash your hands after completing the procedure.
14. Add distilled water to each cup every few days to keep the water level constant.
15. After three weeks, make a line graph of your data for each culture. Put “Average Number of Paramecia” on the y -axis and “Time (days)” on the x -axis.

Analyze and Interpret

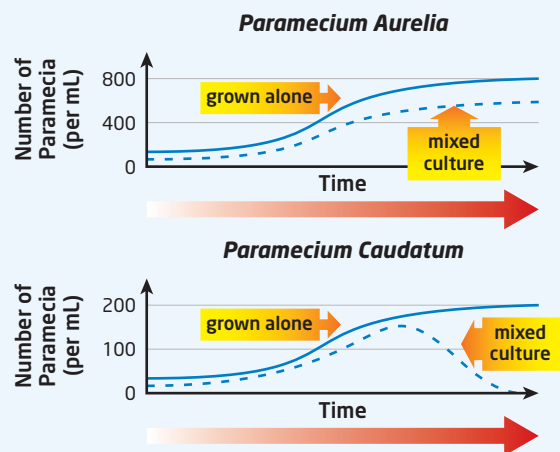
1. Why did you count three samples for each culture, rather than one sample?
2. Compare the shapes of your graphs. What can you infer about the role of food in limiting population growth?

Conclude and Communicate

3. Predict the effect of doubling the amount of food added to a paramecium culture. Explain your answer.
4. You counted the paramecia in one field of view to estimate changes in the population size over time. Outline a method you could use to estimate the size of the entire population of paramecia in each cup.

Extend Your Inquiry and Research Skills

5. **Inquiry** The following graphs show the results of an experiment with two species of paramecia. This experiment was first carried out by population biologist G. F. Gause. He observed the growth of populations of these two species when each population was grown alone and when the two populations were grown together. Study the two graphs, and answer the following questions.



- a. What is the carrying capacity for each of the two species, *Paramecium aurelia* and *Paramecium caudatum*?
- b. What happens to the carrying capacity of each paramecium when the two species are mixed?
- c. What can you infer about each species of paramecium's ability to compete?

Data Analysis Investigation 2-C

Skill Check

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Putting Your Foot in Your Mouth

In the table below, various patterns of consumption are expressed as an estimate of the number of hectares that each lifestyle pattern consumes.

Question

What is your ecological footprint?

Ecological Footprint Estimates

Pattern of Consumption	Hectares (per year)							
	0	0.2	0.3	0.6	1.0	1.5	2.1	3.0
Meat per week		never				few times	most days	daily
Processed food	very little		<50%	>50%				
Imported food	very little	about 25%	25 to 50%	>50%				
People in household			>4	4	3	2	1	
Size of home		apartment	small house	medium house	large house			
Renewable energy	yes			no				
Public transport per week		<100 km	>100 km					
Car transport per week		<50 km		50–150 km	150–300 km	300–450 km		
Added consumption for vehicle type	small vehicle or hybrid	medium vehicle	large vehicle					
Flying hours per year			3–5	5–15	16–25	26–40	41–100	>100

Organize the Data

1. For each pattern of consumption, choose the best description for your own situation. Record the number of hectares you require.
2. Calculate your ecological footprint.

Analyze and Interpret

1. What is your greatest area of consumption? What is your least?

Conclude and Communicate

2. Describe two strategies that would allow you to reduce your ecological footprint.

Extend Your Inquiry and Research Skills

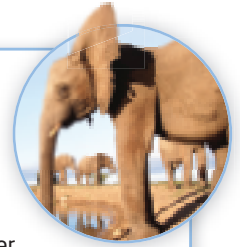
3. **Research** Find out more about how an ecological footprint is calculated. What factors are considered in the calculation? Can you think of any factors that should be added to the calculation?

Chapter 2 Summary

2.1 Populations and Resources

Key Concepts

- Populations tend to increase exponentially when there are available resources.
- When resources that are needed by populations become limited, the carrying capacity of an ecosystem has been reached.
- Human alterations of an ecosystem, such as through urban sprawl, often reduce the carrying capacity of the ecosystem for other species.



2.2 Interactions Among Species

Key Concepts

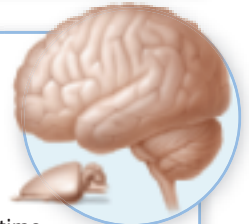
- Each species occupies an ecological niche, which has biotic and abiotic components.
- Many species, such as bog plants, occupy narrow niches for which they are superbly adapted.
- Predation, competition, mutualism, and parasitism are four major kinds of relationships between species.
- These relationships help to define a species' niche and influence the distribution and abundance of the species.



2.3 Human Niches and Population

Key Concepts

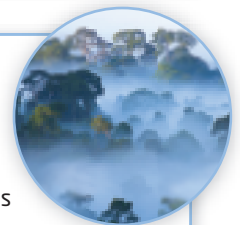
- The ecological niche of humans has been broadened by our intellectual abilities and the development of technology.
- Humans have altered the ecosystems that support us, so our carrying capacity is high.
- Modern human societies are still subject to the ecological principle of carrying capacity.
- Human growth has rapidly accelerated over the past 400 years, with a current doubling time of less than one human lifetime.
- An ecological footprint is used to describe the impact of a person's or population's consumption habits on the supporting ecosystems.



2.4 Ecosystem Services

Key Concepts

- When a species occupies its niche, it provides ecosystem services for other organisms.
- Forests influence climate and play a vital role in the regulation of watersheds.
- Insects provide many ecosystem services, including pollination and decomposition.
- The health of migratory bird populations is dependent on the health of the ecosystems they visit during their migration.
- Ecological connectivity means that international co-operation is necessary to keep ecosystems sustainable.
- Visual beauty and spiritual appreciation are two services that ecosystems provide for humans.



Chapter 2 Review

Make Your Own Summary

Summarize the key concepts in this chapter using a graphic organizer. The Chapter Summary on the previous page will help you identify the key concepts. Refer to Study Toolkit 4 on pages 566-567 to help you decide which graphic organizer to use.

Reviewing Key Terms

Match each key term listed below to its definition.

- | | |
|--------------------------------|----------------------|
| a. carrying capacity | e. mutualism |
| b. connectivity | f. parasite |
| c. ecological footprint | g. population |
| d. ecological niche | |
1. a symbiotic relationship between two species in which both species benefit from the relationship (2.2)
 2. a group of organisms of one species that lives in the same place, at the same time, and can successfully reproduce (2.1)
 3. the biotic and abiotic factors that are necessary for a species to survive (2.2)
 4. the size of population that can be supported indefinitely on the available resources and services of an ecosystem (2.1)
 5. an organism whose niche is dependent on a close association with a larger host organism (2.2)
 6. the measure of the impact of an individual or a population on the environment (2.3)
 7. the links and relationships between ecosystems that are separated geographically (2.4)

Knowledge and Understanding K/U

8. Identify a resource, other than nutrients and energy, that is needed by each organism.

a. polar bear	c. nesting tree swallow
b. hibernating bat	

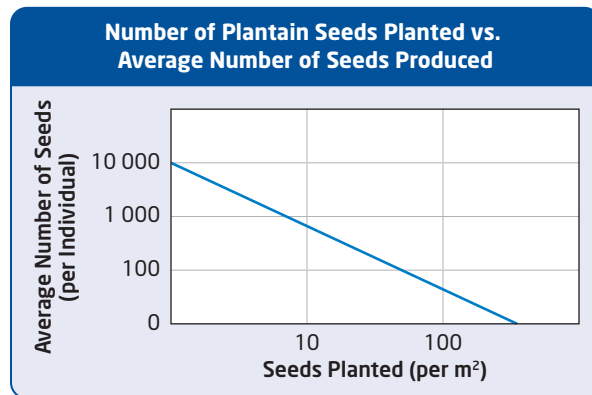
9. What two factors caused the wild turkey to be eliminated in Ontario during the 19th and early 20th centuries?
10. What is one way to reduce the impact of rapid population growth on natural ecosystems and farmland in the Golden Horseshoe?
11. Explain what happens during coral bleaching. What kind of relationship breaks down?
12. In the 1960s, the doubling time for the human population was about 35 years. What is the approximate doubling time now? What does this mean?
13. At the current rate of population increase, how many days are necessary for Earth's population to increase by 34 million people (the approximate population of Canada).
14. Identify how forestry practices can contribute to desertification.
15. What ecological service do aerial insectivores provide?

Thinking and Investigation T/I

16. Most species of songbirds build "cup" nests. A few species, such as the eastern bluebird, are cavity nesters. This means that they only nest in holes. When the European starling was introduced into North America, its population swelled to the tens of millions. At the same time, the populations of some cavity nesters decreased. What is one possible explanation for the decrease?
17. In Activity 2-2, Graphing Population Change, you discovered that the populations of some bird species around Barrie have been changing since the early 1970s. If you wanted to determine whether Barrie's urban sprawl was the cause, what evidence would you look for?
18. Either animals or wind can transport pollen from one flower of a seed plant to another. Which kind of pollination is likely to result in dull, smaller, and non-fragrant flowers? Which kind is likely to result in bright, larger, and fragrant flowers? Explain your answers.

19. The following graph shows the relationship between the number of plantain seeds planted per square metre and the average number of seeds produced per individual.

- Describe the pattern that is shown in the graph.
- What is a possible explanation for this pattern?



20. Extrapolation involves estimating the pattern of a graph beyond the existing data. In **Figure 2.1**, you examined a graph that shows the growth of an elephant population. If you were extrapolating, would you use a straight line, as suggested by the most recent data? Make sure that you consider **Figure 2.5** before answering.

Communication **C**

- BIG IDEAS** Ecosystems are dynamic and have the ability to respond to change, within limits, while maintaining their ecological balance. What are some potential problems that may occur on Earth when the human population reaches its peak?
- BIG IDEAS** People have the responsibility to regulate their impact on the sustainability of ecosystems in order to preserve them for future generations. In Section 2.4, you read about the two ways that coffee is grown. How might what you read influence the type of coffee you would buy? What if shade-grown coffee is more expensive? Would this affect your decision? Explain.
- Have you ever participated in an activity that you consider ecotourism? Describe your

experience. If you have not participated in such an activity, describe and explain an ecotourism activity you would like to participate in.

- Argue why an animal that is hunted by humans, such as the wild turkey, may never reach an ecosystem's carrying capacity. Do you think this is a problem for the ecosystem or the animal?
- Every species contributes innumerable services that benefit other species in its ecosystem. Draw a table, that includes visuals, of examples of these services.

Application **A**

- When populations get too small, they may become extinct unless the remaining individuals can reproduce with individuals from a nearby population. Why would this solution not work for redbreast dace populations?
- Many First Nations cultures believe that humans are the only living things that disregard the laws of carrying capacity. Explain whether you agree or disagree with this statement and why.
- In developed countries such as Canada, the birth rate and death rate are low. In the transition from developing to developed country, the death rate of a country always drops well before the birth rate, usually about two generations before. What would this mean for population growth during the time between the drop in death rate and the drop in birth rate?
- In 1901, the famous early American naturalist John Muir made the following comment about some of his favourite places in the American West: "It is a mistake to suppose that the water is the cause of the tree groves being there. On the contrary, the groves are the cause of the water being there." What did he mean?
- A wildlife biologist observed that an insect-eating migratory bird species was declining summer after summer in Canada. The biologist studied the nesting habits of these birds, but found that they were successfully raising their young. Speculate about what the problem might be.