Data Analysis Investigation 2-A

Is the Winter Skate Endangered in Nova Scotia?

Skill Check

Initiating and Planning

Performing and Recording

✓ Analyzing and Interpreting

✓ Communicating

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.

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

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

- ✓ Initiating and Planning
- ✓ Performing and Recording
- ✓ Analyzing and Interpreting
- ✓ Communicating

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 cyclinder
- 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

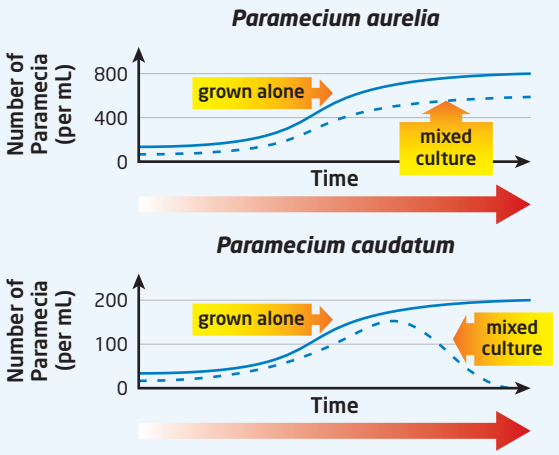
1. Why did you count three samples for each culture, rather than one sample?
2. Compare the shapes of your graphs. What can you infer about the role of food in limiting population growth?

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

Initiating and Planning

Performing and Recording

✓ **Analyzing and Interpreting**

✓ **Communicating**

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?