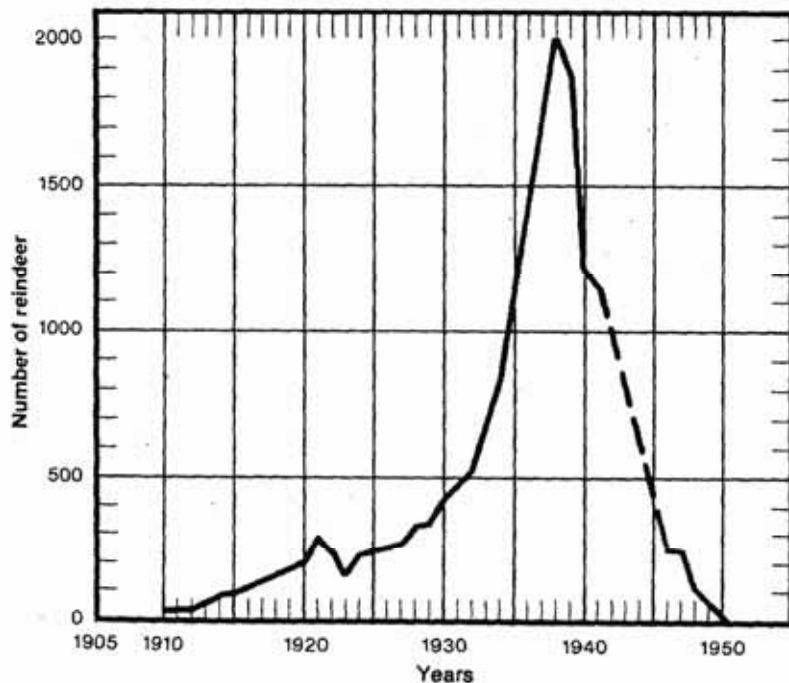


## Part A—Reindeer Population

## Procedure

In 1911, 25 reindeer—4 males and 21 females—were introduced onto Saint Paul Island, one of the Pribilof Islands in the Bering Sea near Alaska. Saint Paul Island is approximately 106 square kilometers in size (41 square miles), and is more than 200 miles from the mainland. On Saint Paul Island there were no predators of the reindeer, and no hunting of the reindeer was allowed. The graph below indicates what happened to the reindeer population on the island between 1911 and 1950. Use the graph to answer the following questions.

Figure 2.7



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- What was the size of the population at the beginning of the study?
  - In 1920?
  - What was the difference in the number of reindeer between 1911 and 1920?
  - What was the average annual increase in the number of reindeer each year between 1911 and 1920?
- What was the difference in population size between the years 1920 and 1930?
  - What was the average annual increase in the number of reindeer in each of the years between 1920 and 1930?
- What was the average annual increase in the number of reindeer in each of the years between 1930 and 1938?
- During which of the three periods—1911–1920, 1920–1930, or 1930–1938—was the increase in the population of reindeer greatest?
- What was the greatest number of reindeer found on Saint Paul Island between 1910 and 1950?
  - In what year did this occur?
- In 1950, only 8 reindeer were still alive. What is the average annual decrease in the number of reindeer in each of the years between 1938 and 1950?

## Discussion

1. Probably not. Saint Paul Island is more than 200 miles from the mainland. Reindeer are strong swimmers, but the distance is too great for emigration or immigration to have a major effect.

2. Population growth is exponential. Exponential growth is characterized by doubling. A few doublings lead quickly to enormous numbers. With a larger population base to start with in 1930, the growth between 1930 and 1938 would be great.

3. Overgrazing, death of plants, destruction of other animal habitats, and accumulation of wastes.

4. Overgrazing resulted in death of plants and insufficient food to support the population. Weakened by a lack of food, the reindeer were prey to disease and the reproductive rate could decline drastically.

5. It would probably die out because it is too small to recover.

6. (a) 1912            (b) 1 year  
 1915                3 years  
 1920                5 years  
 1930                10 years  
 1934                4 years  
 1937                3 years

(c) It became longer until 1930 and then became shorter and shorter.

7. The population crested after 1938.

8. (a) Natural controls take effect and can, as in this example, have a drastic effect—total population dies out.

(b) Predators and hunting might have prevented exponential growth and destruction of the environment. That would have controlled the population by maintaining the carrying capacity of the environment.

What do you think  
 the dotted portion of  
 the graph represents?

## Part B

## Procedure

1. Students may need guidance in selecting scales for their graphs. You may wish to prepare a sample for them to copy. Increments of 200 years work well on the horizontal axis (A.D. 1 to A.D. 2000), and increments of 1000 million on the vertical axis (0 to 6000 million).

2. (a) 1660 years.
- (b) Decreasing.
- (c) It is growing exponentially.
3. About 5800 million.

$$4. \frac{(4850 - 4450) \times 100}{4450 \times 5} =$$

$$\frac{40,000}{22,250} = 1.8(\%)$$

$$\frac{70}{1.8} = 39 \text{ years}$$

$$1987 + 39 \text{ years} = 2026$$

## Discussion

1. Both show exponential growth curves.
2. Food, crop land, grazing land, forests, water, and air.
3. (a) Earth is a limited or finite environment. It is an island in space.
- (b) Yes, it has finite resources.
4. Starvation, disease, and war.
5. (a) Birth control, abortion, infanticide, and restriction on number of children parents may have.
- (b) Student opinion.
6. South America, Central America, Africa, India, high birthrate, poor economy, and insufficient food. Canada, United States, severe impact on resources.
7. Northern Europe, low birthrate, and overall education.
8. Immigration
9. Water, living space, food supply, quality of life, justice.

## Discussion

1. Could emigration or immigration have played a major role in determining the size of the reindeer population? Explain your answer.
2. What might account for the tremendous increase in the population of reindeer between 1930 and 1938 as compared to the rate of growth during the first years the reindeer were on the island?
3. What effect might 2000 reindeer have had on the island and its vegetation?
4. Consider all the factors an organism requires to live. What might have happened on the island to cause the change in population size from 1938 to 1950?
5. In 1950, 8 reindeer were still alive. If some of those were males and some females, what do you predict would happen to the population of reindeer in the next few years?
6. (a) Beginning in 1911, in which years did the population double?  
(b) How many years did it take each of those doublings to occur?  
(c) What happened to the doubling time between 1911 and 1938?
7. What evidence is there that the carrying capacity for reindeer on this island was exceeded?
8. (a) What does this study tell you about unchecked population growth?  
(b) What difference might hunting or predators have made?

## Part B—Human Population

## Procedure

1. On a sheet of graph paper, plot the growth of the human population using the data below.

**Table 2.1** Human population growth between A.D. 1000 and 1985

Date A.D.	Human Population (Millions)	Date A.D.	Human Population (Millions)
1	250	1920	1800
1000	280	1930	2070
1200	384	1940	2300
1500	427	1950	2500
1650	470 (Black Death)	1960	3000
1750	694	1975	4080
1850	1100	1980	4450
1900	1600	1985	4850

2. Use your graph to determine the doubling times for the human population between A.D. 1 and 1985.
  - (a) How much time elapsed before the human population of A.D. 1 doubled?
  - (b) Is the amount of time needed for the human population to double increasing or decreasing?
  - (c) What does that indicate about how fast the human population is growing?
3. Extend your graph to the year 2000. What do you estimate the human population will be in that year?

4. Using the equations below, estimate the doubling time for the current population based on the rate of growth from 1980 to 1985. In what year will the present population double?

Rate of growth (in percent) =

$$\frac{(\text{population in 1985} - \text{population in 1980}) \times 100}{\text{population in 1980} \times \text{number of years}}$$

$$\text{Doubling time} = \frac{70}{\text{rate of growth}}$$

### Discussion

1. What similarities do you see between the graph of the reindeer population and the graph of the human population you just constructed?
2. What are the 3 or 4 most important factors required to sustain a population?
3. (a) In what ways is the earth as a whole similar to an island such as Saint Paul Island?  
(b) Does the earth have a carrying capacity? Explain your answer.
4. What might happen to the population of humans on the earth if the present growth rate continues?
5. (a) What methods could be used to reduce the rate of growth of the human population?  
(b) In your opinion, which of those methods would be most acceptable?
6. Cite a place in the world where population growth is a problem today. How is it a problem?
7. Cite a place in the world where population growth is *not* a problem today. Why is it not a problem?
8. What problems in your country are related to the size of the human population?
9. What are the most important 3 or 4 factors to think about with regard to the world population?

## 2.3 The Human Population Uses Huge Amounts of Resources

All the humans on the earth make up one large population. This population is especially important because it can affect all the plants and animals on the earth. There are many reasons for this impact, but two are particularly significant. First, because our population is large, we use huge amounts of the world's resources—such as food, clean water, fuels, and building materials. After we use these resources, we return many to the earth as waste materials that cannot be used again in that form. Second, the number of people on earth is increasing at a tremendous and alarming rate. That means that though we use up many resources now, we will use even more in the future. Is there a limit to the size of the human population?

4

The earth's carrying capacity is finite. The question that seems unanswered is *what* will limit the size of the human population. Will mortality through starvation, disease, and war rise to equal present-day natality? Or will natality be lowered to match the low death rates of today?