## deer2The Lesson of the Kaibab

Introduction: The environment may be altered by forces within the biotic community, as well as by relationships between organisms and the physical environment. The **carrying capacity** of an ecosystem is the maximum number of organisms that an area can support on a sustained basis. The density of a population may produce such profound changes in the environment that the environment becomes unsuitable for the survival of that species. For instance, overgrazing of land may make the land unable to support the grazing of animals that lived there.

Objectives:

* Graph data on the Kaibab deer population of Arizona from 1905 to 1939
* Determine factors responsible for the changing populations
* Determine the carrying capacity of the Kaibab Plateau

Background

Before 1905, the deer on the Kaibab Plateau were estimated to number about 4000. The average carrying capacity of the range was then estimated to be about 30,000 deer. On November 28th, 1906, President Theodore Roosevelt created the Grand Canyon National Game Preserve to protect the "finest deer herd in America."

Unfortunately, by this time the Kaibab forest area had already been overgrazed by sheep, cattle, and horses. Most of the tall grasses had been eliminated. The first step to protect the deer was to ban all hunting. In addition, in 1907, The Forest Service tried to exterminate the predators of the deer. Between 1907 and 1939, 816 mountain lions, 20 wolves, 7388 coyotes and more than 500 bobcats were killed.

Signs that the deer population was out of control began to appear as early as 1920 - the range was beginning to deteriorate rapidly. The Forest Service reduced the number of livestock grazing permits. By 1923, the deer were reported to be on the verge of starvation and the range conditions were described as "deplorable."

The Kaibab Deer Investigating Committee recommended that all livestock not owned by local residents be removed immediately from the range and that the number of deer be cut in half as quickly as possible. Hunting was reopened, and during the fall of 1924, 675 deer were killed by hunters. However, these deer represented only one-tenth the number of deer that had been born that spring. Over the next two winters, it is estimated that 60,000 deer starved to death.

Today, the Arizona Game Commission carefully manages the Kaibab area with regulations geared to specific local needs. Hunting permits are issued to keep the deer in balance with their range. Predators are protected to help keep herds in balance with food supplies. Tragic winter losses can be checked by keeping the number of deer near the carrying capacity of the range.

DATA

1. Graph the deer population data. Place time on the X axis and "number of deer" on the Y axis

|  |  |
| --- | --- |
| DATA TABLE | |
| Year | Deer Population |
| 1905 | 4,000 |
| 1910 | 9,000 |
| 1915 | 25,000 |
| 1920 | 65,000 |
| 1924 | 100,000 |
| 1925 | 60,000 |
| 1926 | 40,000 |
| 1927 | 37,000 |
| 1928 | 35,000 |
| 1929 | 30,000 |
| 1930 | 25,000 |
| 1931 | 20,000 |
| 1935 | 18,000 |
| 1939 | 10,000 |

 Analysis

1. During 1906 and 1907, what two methods did the Forest Service use to protect the Kaibab deer?

2. Were these methods successful? Use the data from your graph to support your answer.

3. Why do you suppose the population of deer declined in 1925, although the eliminated of predators occurred?

4. Why do you think the deer population size in 1900 was 4,000 when it is estimated that the plateau has a carrying capacity of 30,000?

5. Why did the deer population decline after 1924?

6. Based on these lessons, suggest what YOU would have done in the following years to manage deer herds.

1915:

1923:

7. It is a criticism of many population ecologists that the pattern of population increase and subsequent crash of the deer population would have occurred even if the bounty had not been placed on the predators. Do you agree or disagree with this statement. Explain your reasoning.

8. What future management plans would you suggest for the Kaibab deer herd?

## Human Population Growth

Objectives:

You will create a graph of human population growth and use it to predict future growth.  
You will identify factors that affect population growth.

Statistics on Human Population

|  |  |
| --- | --- |
| Year A.D. | Number of People (in billions) |
| 1650 | .50 |
| 1750 | .70 |
| 1850 | 1.0 |
| 1925 | 2.0 |
| 1956 | 2.5 |
| 1966 | 3.3 |
| 1970 | 3.6 |
| 1974 | 3.9 |
| 1976 | 4.0 |
| 1980 | 4.4 |
| 1991 | 5.5 |
| 2000 | 6.0 |
| 2004 | 6.4 |

Instructions for creating your graph.

Place time on the horizontal access. Values should range from 1650 to 2020.   
Place number of people on the vertical access. Values should range from 0 to 20 billion.  
Make sure that your graph is a full page in size and you have the correct labels for the X and Y access and a title for your graph.

Analysis

1. It took 1649 years fro the world population to double, going from .25 billion people to .50 billion people. How long did it take for the population to double once again?

2. How long did it take for the population to double a second time? \_\_\_\_\_\_\_\_\_\_\_ A third time? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Based on your graph, in what year will the population reach 8 billion? \_\_\_\_\_\_\_\_\_\_\_\_\_

4. Based on your graph, how many years will it take for the population of 2004 to double? \_\_\_\_\_\_\_\_\_\_\_\_\_\_

The Earth's Carrying Capacity

Prior to 1950, the death rate was high, which kept the numbers of humans from increasing rapidly. In the 19th Century, the agricultural revolution increased food production. The industrial revolution improved methods of transporting food and other good. In the 20th Century, advances in medicine, sanitation and nutrition have decreased the death rates further. These factors combined to produce the rapid growth of the human population in the 20th century.

As with any population, humans are also limited by factors such as space, amount of food and disease. The carrying capacity is the number of individuals that a stable environment can support. Authorities disagree on on the maximum number of people that the earth can support, though the numbers generally range for 8 to 10 billion. As the population approaches its limit, starvation will increase. Some countries have a much higher growth rate than others. Growth rate is the number of people born minus the number of people that die. Compare the growth rates of the following countries

Most countries are trying to reduce their growth rate. Zero population growth means that as many people are being born as there are dying - to achieve zero population growth, each couple would need to have no more than two children (to replace the parents). Even if this number is achieved, the population will continue to grow because the parents will still live on for decades, as their children have children and their children have children..and so forth. The United States reached zero population growth in the 1980's, and yet the overall population of the US still increases.

Analysis

1. What factors contributed to the world's overall population growth in the last 150 years.

2. Why does a population not level off during the same year it reaches zero population growth?

3. If the carrying capacity of the earth was 9 billion people, when would this number be reached (according to your graph)?

4. What will happen when the human population exceeds the earth's carrying capacity?