

Name _____

Class _____

Minutes _____



Population and Carrying Capacity Lab

TOTTEN
SCIENCE

This lab was created by Mr. Buckley from Edward Knox High School. Credit is given for this original activity to Mr. Buckley.

Problem: What lessons can we learn from the Kaibab deer?

Objectives:

1. to graph data on the Arizona Kaibab deer population from 1905~1939
2. to analyze the possible reasons for the changes in the deer population
3. discuss some changes which would have better suited the Kaibab deer population



Introduction:

The environment may be changed by biotic factors as well as by relationships between organisms and the physical (abiotic) environment. The **carrying capacity** of an ecosystem is the maximum number of organisms that an area can support on a sustained or continuing basis. The population density (number of individuals per unit area) may produce such profound changes in the environment that the environment becomes unsuitable for the continued survival of that species. Humans can also interfere with natural interactions of species with their environments with either positive, negative, or neutral effects. This activity will show how these some of these human interactions influenced a population of deer in Arizona.

In 1905, the deer population on the Kaibab Plateau in Arizona was estimated to be about 4,000 on 300,000 hectares of range. The average carrying capacity of the range was estimated to be about 30,000 deer. On November 28, 1906, President Theodore Roosevelt created the Grand Canyon National Game Preserve to protect what he called the "finest deer herd in America."

Unfortunately, by this time, the Kaibab forest area was severely overgrazed by sheep, cattle, and horses. Most of the tall, perennial grasses had been eliminated in the area. The first step in protecting the deer was to ban all hunting in the area. Then, in 1907, the Forest Service tried to exterminate the natural predators of the deer, killing approximately 800 mountain lions, 20 wolves, 7400 coyotes, and 500 bobcats between 1907 and 1939.

Signs that the deer population was out of control began to appear as early as 1920. The most important sign was severe and rapid deterioration of range grass and abundance and quality. The forest service then reduced the number of livestock grazing permits to allow more grass for the deer. By 1923, however, the deer were reported to be near starvation and the range conditions were described as "deplorable."

A Kaibab Deer Investigation Committee recommended that all livestock not owned by local residents be immediately removed from the range and that the number of deer in the herd be reduced by 50 percent (culling) as quickly as possible. Deer hunting was reopened and during the fall of 1924, about 675 deer were killed. These deer represented only 10 percent of the number that had been born that spring!

Today, the Arizona Game Commission carefully manages the Kaibab area with regulations geared to specific local needs. Hunting permits are issued and predators are protected to keep the deer in balance with their range so that the herd size does not exceed the carrying capacity.

Materials: graph paper, pencil

Procedure:

- Construct a graph of deer population size (y-axis) vs. year (x-axis) using the data chart (below)
- Draw a horizontal line representing the carrying capacity
- Answer the conclusion questions

Data/Results:

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

Conclusion Questions

1. During 1906 and 1907, which 2 methods did the Forest Service use to protect the Kaibab Deer?
2. Were these methods successful? Explain using data from the graph
3. How many total predators were eliminated from the preserve between 1907 and 1939?
4. What was the relationship of the deer herd population size and the carrying capacity of the range in (a) 1915, (b) 1920, and (c) 1924 (Explain your answer using NUMBERS from the data chart or graph.) ?
5. Did the Forest Service program appear to be successful between 1905 and 1924. Explain using data from the graph

6. Why do you suppose the population of deer declined in 1925 although the elimination of many predators occurred?
7. Do you think any changes occurred in the carrying capacity of the range between 1900 and 1940. Describe what you think occurred.
8. Why do you think the deer population size was 4000 in 1900 when the carrying capacity was actually 30,000 deer?
9. If the Forest Service had not interfered with the deer population, what do you think would have happened to the deer population?
10. Based on these lessons, suggest what YOU would have done in the following years to manage to deer herds: (a) 1915 and (b) 1923
11. It is a criticism of many population ecologists that the pattern of population increase and subsequent crash of the Kaibab deer population would have occurred even if a bounty had not been placed on the predators. Explain a logical reason for this statement.
12. What future management plans would you suggest for the Kaibab deer herd?
13. Assuming (erroneously) that no other factors interact, identify the dependent and independent variables in the interaction between the Kaibab deer and their predators and defend your identification.