# Management of Wildlife Resources

by Dave Fitzpatrick

***Grade level*** 10-12

***Time required***
Five 45 minute periods

***Materials/Technology***
Computer with spreadsheet software
Computer simulation Worksheet
Information on Bison Range and the Pablo Allard Herd.


## Summary
Using a mathematical model and a spreadsheet, students will examine how wildlife management policies affect the size of large animal populations.


## Objectives
The student will:
1) discover how mathematical models are used to predict real world outcomes.
2) construct a spreadsheet that incorporates a mathematical model to predict big game herd sizes.
3) use their spreadsheet to manage a bison herd for profit.
4) Students learn the history of the National Bison Range and the Pablo Allard Herd.

## Montana Science Standards addressed
1) Students design, conduct, evaluate and communicate scientific investigations.
2) Students demonstrate knowledge of characteristics, structures and functions of living things, the process and diversity of life, and how living organisms interact with each other and their environment.
3) Students understand how scientific knowledge and technological developments impact society.

## Assessment
Evaluate students' ability to apply the concepts and skills by preparing a similar population problem and asking students to construct their own spreadsheet. Have them key in predator-prey relationships.

## Procedural notes
The management of large herds of game (e.g. deer or elk) requires careful consideration of several factors, including harvesting policies. Generally, a state or tribal department of natural resources considers the effects of a given policy over a number of years. This is often done with the aid of a computer based mathematical model. The chart in the lesson was prepared as a first step in developing a model using actual deer survival rates that were determined by studying the populations in a particular state. In this activity, the student is asked to complete the model and use it to predict population sizes under varying conditions. The lesson is based on a wildlife activity found in a 1976 National Council of Teacher of Mathematics yearbook.

A second assignment asks the student to manage a bison herd as a business, controlling not only population size, but also costs. You can obtain actual costs for bison and past bid sheets by calling the National Bison Range in Moiese, Montana at 406-644-2211.

## Further Information

For further information about this lesson, contact the author at

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Computer Simulations

The management of large herds of game (deer or elk, for instance) requires careful consideration of many factors, including harvesting policies. Generally, a state or tribal department of natural resources considers the effect of a given policy over a number of years. This is often done with the aid of a computer based mathematical model. The chart below was prepared as a first step in developing a model for herds of deer. The data on survival rates have been determined by studying the deer populations in a particular state.

| | Current number | Survival rate | Yearly harvest |
|---|---|---|---|
| Adult males | M | .95 | H |
| Adult females | F | .95 | h |
| Male fawns | m | .50 | none |
| Female fawns | f | .45 | none |

***Problems***

Use the information in the chart above to answer the following.

1) If fawns are considered adults after one year, write equations for determining:

   A) Adult males after one year  A =

   B) Adult females after one year  B =

2) The number of fawns born during a year depends on how many adult females survive. Here the expectation is 48 male fawns and 42 females fawns per 100 surviving adult females, rates of .48 and .42 respectively. Write equations for:

   A) Male fawns after one year  m =

   B) Female fawns after one year  f =

   C) Herd size after one year  Herd size =

3) Describe how you can use the relationships you have developed above to investigate the effects of a given harvesting policy over a period of 25 years.

4) This set of relationships is a mathematical model that can be used to predict the effects of different management policies over time on a herd with initial populations of M, F, m, and f. Design a spreadsheet that will predict these variables for 25 years. Use the following headings:

| | | |
|---|---|---|
| Year # | # adult females | # female fawns |
| # adult males | # male fawns | Total herd size |

*Hint:* Formulae for values to be kept the same are $E$5 or $A$10, etc. This keeps them locked when you copy down.

5) Test the computer model for the following beginning herd size data and print out the final 10 year data:

| | | |
|---|---|---|
| M = 10,000 | m = 3,000 | h = 2,000 |
| F = 8,000 | f = 4,000 | |

6) Graph the data acquired for years 1 through 10. Determine if the line for each group is straight and if a defining equation can be found. Use the equation to determine future numbers in years:

A) 15

B) 20

7) The current bison population on the National Bison Range is about 300. Assume that 40% are adult males, 35% are adult females, 14% are male calves and 11% are female calves. Establish a constant harvesting policy that will maintain the population at about the same level over the next five years.

8) Find the average sale price of bison over the last few years. Add columns to your spreadsheet incorporating the prices into all areas. When you purchase bison you must subtract the costs and when sold you add the costs. Run your bison herd as you would a business. Add in costs of land, etc.