Flying High with Fledglings

Overview:
Students will create a graph of the number of nests and fledglings of bald eagles in Virginia and make inferences on the reasons behind the growth curve.

SOL Objectives:
Math 7.18, 8.3, 8.12, 8.14
Science 6.1, 6.9, LS.1, LS.7, LS.11, LS.12

Background:
The bald eagle became our national symbol in 1782. As our national symbol, it holds a special place in the hearts of our citizens. Even though the bald eagle has been protected from direct harm by people since the Bald Eagle Protection Act of 1940, its habitat was not protected. By the 1960's the eagle population began to seriously decline until 1972, when it was placed on the U.S. Endangered Species List. The decline was the result of DDT poisoning, a pesticide that caused the shells of the eggs to be thin and the embryos to develop improperly. The use of DDT in the United States was banned in 1972.

The Endangered Species Act provided protection of any eagle's nest site and surrounding habitat. In 1977, the Virginia Department of Game and Inland Fisheries, (DGIF) began tracking the number of nests and the number of young fledged. Eagles lay 1 to 3 eggs each year during their reproductive life. Since eagles begin nesting in late winter, biologists are able to fly over the nests and count the number of young before the leaves appear on the trees. Later in the year, boat trips counted the number of juvenile and adult birds along Virginia's tidal rivers. The data table on page 24, shows the number of nests and the number of young fledged.

The table that follows shows a recovering population of eagles. The population will begin to level off once the carrying capacity is reached. **Carrying capacity** is the number of individuals that a given ecosystem can support during the year. Several limiting factors determine the number of eagles an area can support, including the availability of large trees capable of supporting nests, the distance to a river or other source of food, and the frequency of disturbance by outside factors such as boats or people walking near the nest site. Mated pairs tend to be territorial around their nests and will defend their nest site from other birds. They will continue to use the same nest year after year, adding more sticks each winter until the nest may weigh close to 100 pounds.

Eagles will congregate in feeding areas along the rivers and other areas where there is a plentiful food source. The sudden availability of a food source such as a fish kill or other carrion can be detrimental to the population if that food source is contaminated by pesticides or another poison. Eagles are capable of flying long distances during any given day; or an area may host a large number of birds one week and a small number the following week. The ability to travel long distances to a food source may cause a sudden decrease in the population along a river or in a region.

Problem:
Determine if there is a relationship between the number of eagle fledglings and improved environmental conditions. Did the number of eagles increase with the banning of the pesticide DDT? What other factors may have contributed to the number of eagles nesting in Virginia?

Data table

Eagle Nest's and Fledglings by Year

Date	Year	Active Nests	Young Fledged
1977	1	31	18
1978	2	36	18
1979	3	34	20
1980	4	35	35
1981	5	39	40
1982	6	45	40
1983	7	52	51
1984	8	60	57
1985	9	65	84
1986	10	66	83
1987	11	73	107
1988	12	80	118
1989	13	92	88
1990	14	104	142
1991	15	110	153
1992	16	131	141
1993	17	149	172
1994	18	144	158
1995	19	154	223
1996	20	180	243
1997	21	214	321
1998	22	229	314
1999	23	230	326
2000	24	270	414
2001	25	312	465
2002	26	329	501
2003	27	371	454
2004	28	401	612

Key strokes:

1. Refer to Appendix I. Calculator Set Up
2. Enter data into graphing calculator. Press **STAT**, **ENTER** and clear L_1 and L_2 by placing the cursor on L_1 and pressing **CLEAR** and **ENTER** Repeat for L_2. Enter **Year Number** data into L_1 and **Number Fledged** into L_2.

3. Create a scatter plot. Press **2nd, Y=.** Choose 1: Plot 1and On. Use the arrow keys to highlight the choices on *figure 1*

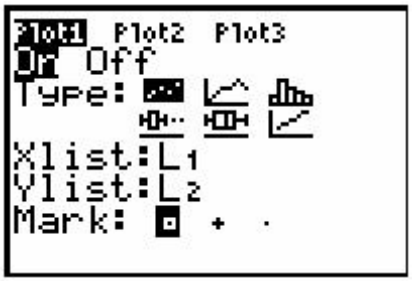
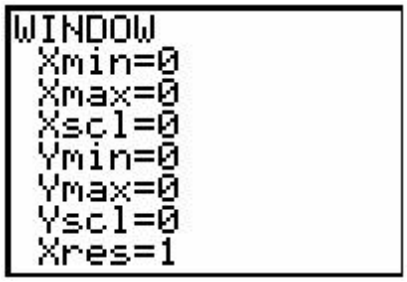


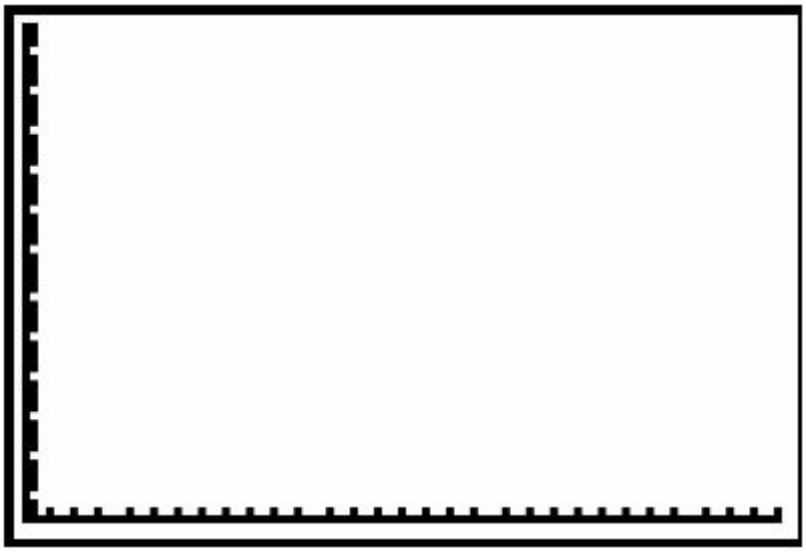
Figure 1

4. Look at your year data to determine:
i. X min _____, X max _____, X scale _____
ii. Y min _____, Y max _____, Y scale _____

5. Press **WINDOW** and replace the 0's with your correct values.



6. Press **GRAPH** and use **TRACE** to draw your plot below. Remember a graph needs a Title, and Axes Labels.



7. The curve of the data suggests that this is an exponential relationship. To create a line of best fit: Press **STAT**, arrow right to **(CALC),** select **0:ExpReg**.

8. Press **2nd** 1, **comma**, **2nd** 2, **comma**, **VARS** ?arrow right to? **Y-VARS**, select 1:Function, select 1:Y_1. Your home screen should look like *figure 2*.

Figure 2

9. Press **ENTER** to complete calculations

10. Press **GRAPH** to view the graph with the line of best fit. Add the line of best fit to your plot above.
11. Press **Y=** to view the equation for the line of best fit.

Analysis Questions

1. Looking at the graph, what inferences can you make about the relationship between the number of young and environmental conditions?
2. What are factors that would affect the population? (Hint: The goal of banning DDT and protection of nest sites and surrounding habitat was to increase the population, was this successful?)
3. Will the population continue to increase indefinitely? Why or why not?

Extensions

1. Use the following directions to determine if in addition to increasing the number of surviving fledglings each year, there has been an increase in the number of nests.

- Enter the nest data in L_3 by pressing **STAT, ENTER** clearing L_3 and typing in the number of nests for each year.
- Use 2nd**, STAT PLOT**, select 2: Plot 2 and create the screen in *figure1* below.

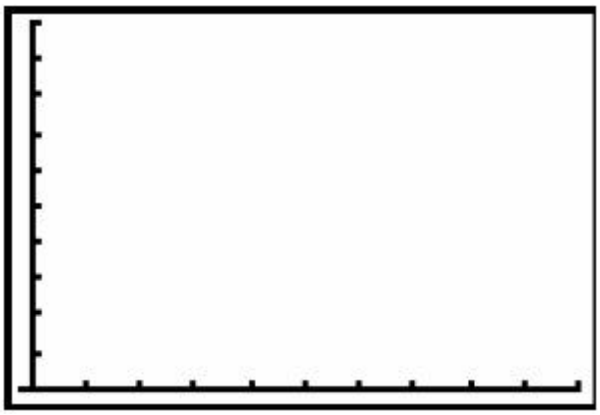
Figure 1

- To create a line of best fit, press **STAT,** arrow right to **CALC** and select O:Exp.Reg.

- On the home screen add **2nd L1, comma, 2nd L3, comma, VARS,** arrow right to **Y-VARS,** select 1:Function, then 2:Y_2. See *figure 2* below.

Figure 2

- Press **ENTER** to complete calculations. Set up the window with the correct values. Press **GRAPH** toview the graph with the line of best fit.
- Draw your graph below. Remember a graph needs a title and labeled axes.



2. Why is it important to analyze the increase of nests in addition to the increase of fledglings?

Teacher Notes – Flying High with Fledglings:

1. The number of fledglings that survive and the number of nests will level off when the population reaches the carrying capacity of the environment. The limiting factors might be available food, nesting sites, number of surviving adults, predation, etc. The population is still expanding exponentially because it has not yet reached carrying capacity.

2. The exponential graph for year and fledglings is below. (*Figure 1)*

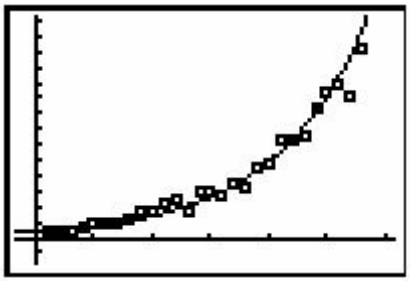


Figure 1

3. The exponential graph for the year and nests is below. (*Figure 2)*

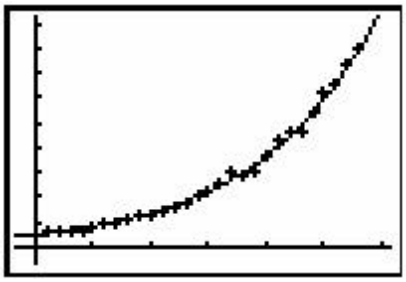


Figure 2

4. If you want to look at the equations for the line of best fit press **Y=** to view them. If you want more manageable numbers, press **MODE** and select 1 or 2 decimal places before doing the line of best fit calculations.

5. If you want to practice sequencing with the students, this can be done in the year list. Use the arrow keys to place the cursor on L_1 and press **2nd LIST,** arrow right to **OPS,** select 5:seq(On the list screen add to seq(X,X,1,28,1). The sequence format is: *seq(expression, variable, begin, end, increment)*

6. **IMPORTANT**. The students must use year number not year because the years are beyond the graphing limits of the calculator screen.

Reference Source:

This exercise was taken directly from a Virginia Department of Game and Inland Fisheries project titled "Wild About Math" funded by a grant from Virginia Environmental Endowment. To download the complete project, visit:
http://www.dgif.state.va.us/education/wildaboutmath.pdf

The Department of Game and Inland Fisheries is a partner with Norfolk Botanical Garden and helps monitor and maintain our resident Bald Eagle population by providing financial and technical support for our Eagle Cam project. DGIF also provides scientific advise in keeping our Bald Eagles happy and safe. To learn more, please visit the Virginia Department of Game and Inland Fisheries at www.**dgif**.state.va.us