

# Island Fox

## A POPULATION IN TROUBLE

### ACTIVITY



#### Focus Question

What is the predator-prey relationship between golden eagles and island fox?

#### Activity Overview

In the delicate ecosystem of the Channel Islands, a series of small changes can have devastating results. The Channel Islands once had a large population of island fox, one of the smallest fox species in the world. However, the population of island fox began to fall in the mid-1990s. A series of changes to the ecology, including the introduction of golden eagles, may have been the cause of this devastating decrease in the island fox population.

Scientists monitor changes in population size that occur over time and look for relationships between species. In this activity, you will examine the relationship between island fox and golden eagle populations on Santa Cruz Island. Table 1 shows the number of island fox and golden eagles over a twelve-year period. You will examine the data and use the TI-73 Explorer™ to graph and analyze the values.

How do the populations of island fox and golden eagles change over time? What factors are causing the decrease of the island fox on the island?

**Table 1 — Population of Island Fox and Golden Eagles on Santa Cruz Island**

| Year | Number of Island Fox | Number of Golden Eagles |
|------|----------------------|-------------------------|
| 1990 | 1225                 | 2                       |
| 1991 | 1150                 | 3                       |
| 1992 | 900                  | 5                       |
| 1993 | 720                  | 8                       |
| 1994 | 520                  | 12                      |
| 1995 | 400                  | 17                      |
| 1996 | 280                  | 20                      |
| 1997 | 240                  | 23                      |
| 1998 | 200                  | 24                      |
| 1999 | 180                  | 25                      |
| 2000 | 160                  | 25                      |
| 2001 | 150                  | 25                      |
| 2002 | 150                  | 25                      |

Data Adapted



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### Part A — Island Fox Population

A graph that shows how the population size of a species changes over time is called a population growth curve. Typically, three distinct phases occur when populations grow or decrease: an initial slow-change phase, a middle rapid-change phase, and a final equilibrium phase. In the final equilibrium phase, the number of individuals in a population does not change significantly. The population growth curve in Figure 1 identifies the three phases in a growing population. The population growth curve in Figure 2 identifies the three phases in a decreasing population.

### Typical Population Growth Curves

Figure 1 — Increasing Population

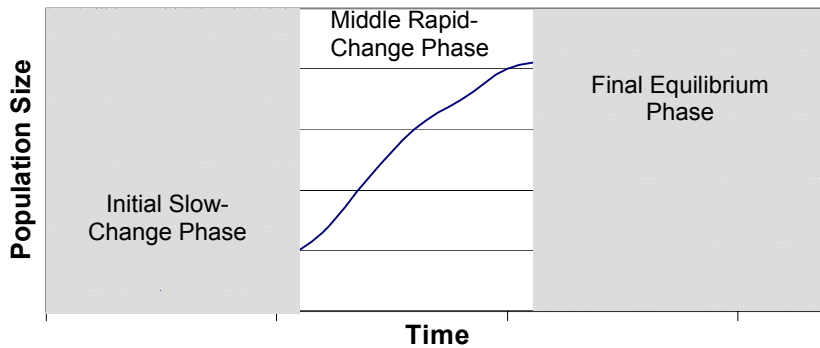
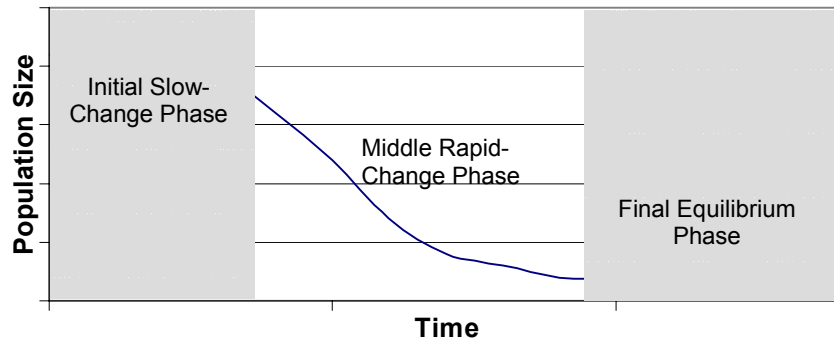


Figure 2 — Decreasing Population



A major cause for a change in population size is a difference between the number of births and deaths. In Figure 1 the number of births was higher than the number of deaths so the initial slow-change phase and middle rapid-change phase indicate a population size increase. Figure 2 shows that the number of deaths is higher than the number of births during the first two phases, so the population size decreases. High numbers of deaths are often caused by an increase in predator population. Predators are animals that eat other animals that are their prey. A population of predators can grow until the population of prey becomes limiting. If predators are unable to find and capture prey, they may soon become extinct.

## ACTIVITY

### Materials\*

TI-73 Explorer™



TI-73 Explorer™



**A POPULATION IN TROUBLE**

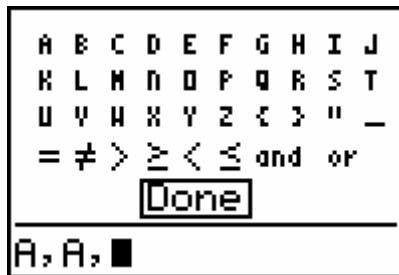
**Procedure**

**1 Reset the TI-73 Explorer™ to the default settings.**

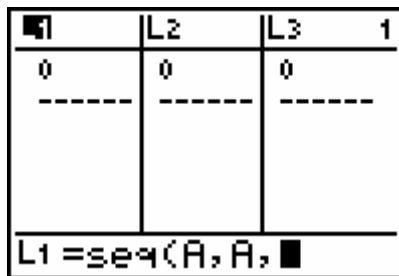
- a. Turn on the TI-73 Explorer™.
- b. Press  $\boxed{2nd}$   $\boxed{[MEM]}$   $\boxed{7}$   $\boxed{2}$   $\boxed{2}$ .
- c. Press  $\boxed{2nd}$   $\boxed{[MEM]}$   $\boxed{6}$   $\boxed{[ENTER]}$   $\boxed{MODE}$ .

**2 Enter your data in the TI-73 Explorer™.**

- a. Press  $\boxed{[LIST]}$ .
- b. You can enter the years from Table 1 in the TI-73 Explorer™ manually or automatically. If you want to enter the years manually, enter each number in L1. After entering each number, press  $\boxed{[ENTER]}$ . If you want to enter the numbers automatically, follow the steps below and then proceed with Step 2.c.
  - 1) Use the arrow keys to move the cursor to the top of L1, highlighting L1.
  - 2) Press  $\boxed{2nd}$   $\boxed{[STAT]}$   $\boxed{\blacktriangleright}$   $\boxed{7}$  to select seq(. This function allows you to create a sequence of numbers.
  - 3) Press  $\boxed{2nd}$   $\boxed{[TEXT]}$ .
    - i. Select A by using the arrow keys and press  $\boxed{[ENTER]}$ .
    - ii. Press  $\boxed{,}$ .
    - iii. Select A by using the arrow keys and press  $\boxed{[ENTER]}$ .
    - iv. Press  $\boxed{,}$ .



- 4) Select Done by using the arrow keys and press  $\boxed{[ENTER]}$ .



- 5) Type 1990  $\boxed{,}$  2002  $\boxed{,}$  1. This will create a sequence of numbers that will represent the years starting at 1990 and ending at 2002, with an increment of one year.



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| L1   | L2    | L3    | 1 |
|------|-------|-------|---|
| 1990 | 0     | 0     |   |
| 1991 | ----- | ----- |   |
| 1992 |       |       |   |
| 1993 |       |       |   |
| 1994 |       |       |   |
| 1995 |       |       |   |
| 1996 |       |       |   |

L1 =...1990, 2002, 1

6) Press **ENTER**.

| L1   | L2    | L3    | 1 |
|------|-------|-------|---|
| 1990 | 0     | 0     |   |
| 1991 | ----- | ----- |   |
| 1992 |       |       |   |
| 1993 |       |       |   |
| 1994 |       |       |   |
| 1995 |       |       |   |
| 1996 |       |       |   |

L1(1)=1990

c. Enter the number of island fox from Table 1 in L2. After entering each number, press **ENTER**.

| L1   | L2   | L3    | 2 |
|------|------|-------|---|
| 1990 | 1125 | ----- |   |
| 1991 | 1150 |       |   |
| 1992 | 900  |       |   |
| 1993 | 720  |       |   |
| 1994 | 520  |       |   |
| 1995 | 400  |       |   |
| 1996 | 280  |       |   |

L2(1) =1225

**3 Make a graph of the number of island fox and years.**

- a. Press **2nd** [PLOT]
- b. Press **1** to define Plot1

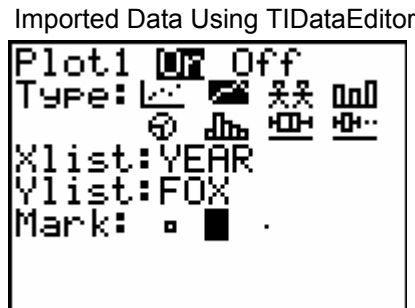
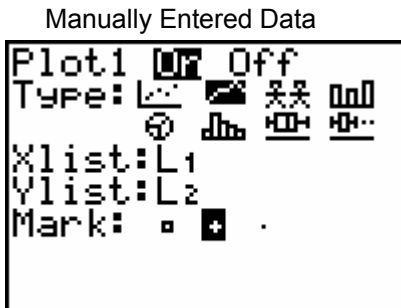
|                     |             |   |  |
|---------------------|-------------|---|--|
| <b>SIMPLE PLOTS</b> |             |   |  |
| <b>1</b>            | Plot1...Off |   |  |
|                     | ↙ L1 L2     | □ |  |
| <b>2</b>            | Plot2...Off |   |  |
|                     | ↗ L1 L3     | □ |  |
| <b>3</b>            | Plot3...Off |   |  |
|                     | ↗ L1 L4     | + |  |
| <b>4</b>            | PlotsOff    |   |  |

- c. Turn Plot1 On by pressing **ENTER**
- d. Press **↙** **ENTER** to select line graph (↗).



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- e. Set the Xlist. Press  $\square$   $\square$  [2nd] [STAT] [1] to select L1 (year) for the X-axis.  
Note: If you imported data using the TIDataEditor press  $\square$   $\square$  [2nd] [STAT] and scroll down to YEAR using  $\square$  then press [ENTER].
- f. Set the Ylist. Press  $\square$   $\square$  [2nd] [STAT] [2] to select L2 (number of island fox) for the Y-axis. Note: If you imported data using the TIDataEditor press  $\square$   $\square$  [2nd] [STAT] and scroll down to FOX using  $\square$  and then press [ENTER].
- g. Press  $\square$   $\square$  [ENTER].



- h. Press [GRAPH].
- i. Press [ZOOM] [7] to adjust the scale on your graph.

**4** Complete the Data Analysis section. Answer the questions in your journal.

### Data Analysis

While observing the graph, press [TRACE] and use the arrow keys ( $\square$ ) and ( $\square$ ) to move the cursor along a line. The X-coordinate and Y-coordinate of each data point are displayed below the graph.

**Make a sketch of your graph in your journal. Answer questions 1–5 in your journal by observing your graph.**

- 1** Describe how the island fox population changed between 1990 and 2002?
- 2** Between which years did the initial slow-change phase, the middle rapid-change phase, and the final equilibrium phase occur?
- 3** What is the population size of the island fox at equilibrium?
- 4** By observing the trend in the data, what do you think the island fox population was in 2003? Explain.
- 5** On an island such as Santa Cruz, island fox are unable to migrate. Therefore, changes in population size are determined by the balance between the number of births and deaths. How do the numbers of births and deaths compare between 2001 and 2002? Explain.



# A POPULATION IN TROUBLE

## Part B — Golden Eagle Population

### Procedure

#### 1 Enter your data in the TI-73 Explorer™.

- Press **[LIST]**.
- Enter the number of golden eagles from Table 1 in L3. After entering each number, press **[ENTER]**.

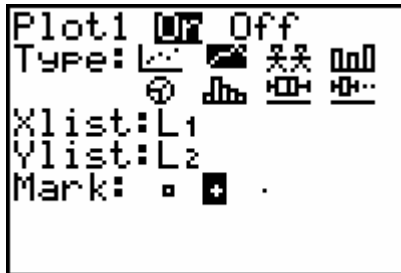
| L1   | L2   | L3 | 3 |
|------|------|----|---|
| 1990 | 1225 | 2  |   |
| 1991 | 1150 | 3  |   |
| 1992 | 900  | 5  |   |
| 1993 | 720  | 8  |   |
| 1994 | 520  | 12 |   |
| 1995 | 400  | 17 |   |
| 1996 | 280  | 20 |   |

L3(1) = 2

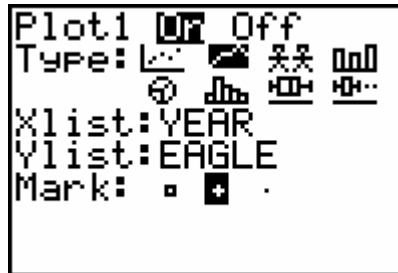
#### 2 Make a graph of the number of golden eagles and years.

- Press **[2nd]** **[PLOT]**.
- Press **[1]** to define Plot1.
- Turn Plot1 On by pressing **[ENTER]**.
- Press **[↓]** **[↓]** **[ENTER]** to select line graph (↘↗).
- Set the Xlist. Press **[↓]** **[2nd]** **[STAT]** **[1]** to select L1 (year) for the X-axis.  
Note: If you imported data using the TIDataEditor press **[↓]** **[2nd]** **[STAT]** and scroll down to YEAR using **[↓]** and then press **[ENTER]**.
- Set the Ylist. Press **[↓]** **[2nd]** **[STAT]** **[3]** to select L3 (number of golden eagle) for the Y-axis. Note: If you imported data using the TIDataEditor press **[↓]** **[2nd]** **[STAT]** and scroll down to EAGLE using **[↓]** and then press **[ENTER]**.
- Press **[↓]** **[↓]** **[ENTER]**.

Manually Entered Data



Imported Data Using TIDataEditor



- Press **[GRAPH]**.
- Press **[ZOOM]** **[7]** to adjust the scale on your graph.

#### 3 Complete the Data Analysis section. Answer the questions in your journal.



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### Data Analysis

While observing the graph, press **TRACE** and use the arrow keys (**→**) and (**↓**) to move the cursor along a line. The X-coordinate and Y-coordinate of each data point are displayed below the graph.

**Make a sketch of your graph in your journal. Answer questions 1–5 in your journal by observing your graph.**

- 1** Describe how the golden eagle population changed between 1990 and 2002?
- 2** Between which years did the initial slow-change phase, the middle rapid-change phase, and the final equilibrium phase occur?
- 3** Using the information provided in the research article and your graphs, describe the factors that may have caused an increase in the golden eagle population.
- 4** What is the population size of the golden eagle at equilibrium?
- 5** By observing the trend in the data, what do you think the golden eagle population was in 2003? Explain.

**Answer questions 6–10 in your journal by observing both graphs.**

- 6** Compare the population size of island fox and golden eagles. During the time period the population size of island fox decreased did the golden eagle population size increase or decrease?
- 7** Compare the population size of island fox and golden eagles. During the golden eagle equilibrium phase how did the island fox population size change?
- 8** Using the information provided in the research article and your graphs, describe the relationship between island fox and golden eagle.
- 9** How would the absence of golden eagles affect island fox populations?
- 10** If island fox were the only prey for golden eagles, what do you think would happen to the population of golden eagles on Santa Cruz Island if the population of island fox became extinct after 2002?

