

Activity - Counting Pikas in a Population

Purpose: Ecology- Populations- Colorado Connection

Museum Connection:

At the museum, just like the zoo, we have scientists who study wild animals in the field. Students get an opportunity to engage in the practices of science used by our real-world scientists. Also, be sure to come visit our wildlife dioramas on the second and third floors of the museum to learn all about Colorado and North American animals.

Videos:

WATCH Video 1: [Scientists in Action: Protecting Pikas- With the Front Range Pika Project](#) (4:48)

WATCH Video 2: [Scientists in Action: Protecting Pikas- With Conservation Biologist: Erica Garoutte PhD](#) (6:00)

Main Idea: (Introduction)

A REAL- WORLD SCIENCE PROBLEM

In the [videos](#), you saw that people are concerned about how a warming climate might be affecting pika populations. **Does climate change decrease the number of pikas in a population?** In order to answer that question, we need to know how many pikas there are. How do scientists, like Dr. Erica Garoutte count pikas from year to year? It is impossible to catch them all, so they have to estimate. One method that scientists use is called “the mark-recapture method”. In this activity, you will learn how to estimate the number of pikas in a population, using a method that scientists really use. You will also test to see if the method really works.

Background Information For Educator/Parent: (see below. Do not reveal to student doing this activity)

Sources: Not applicable

Suggested Age Range: Ages 10-17

Activity Time: 45-60 min

Prep Time: 5-10 min

Materials

- White beans (or any large dried bean that can be marked on)
- Paper or plastic bag (small is better)
- Colored Markers (at least two colors)
- Calculator

Talking Points: (LEARNING OUTCOMES)

In this activity you will:

- **View** two videos that describe how scientists study pikas
- **Estimate** the size of a population
- **Compare** your estimate to the real count
- **Use** a model to **Test** the “mark-recapture” method of counting a population

Step-by-Step Instructions:

1. Start by watching the two videos about pikas linked above.

In this activity, you will be using a model. The white beans will represent pikas. The bag will represent their local habitat.



OUR HYPOTHESIS

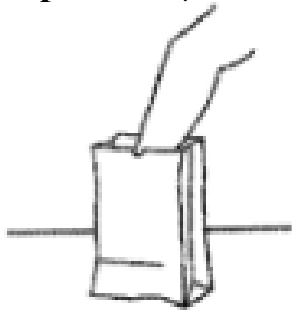
If the size of an animal population changes, **Then** the mark-recapture method will reflect the change 100 % accurately, **because** mark-recapture method works well for estimating population size.



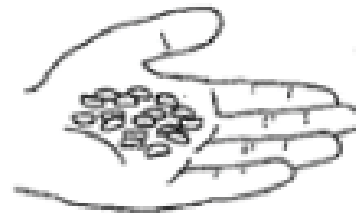
YEAR 1: In the first year of her field study, Dr Erica Garoutte goes out to count the pikas at various sites. She does her first capture and release of pikas. Before she releases them, she puts a small tag on some of them so that she can recognize them when she sees them again. Let's do that now with our "bean pikas"!

1. Get a paper bag filled with white beans from an adult who has put beans in it for you. Like a real scientist counting pikas in the field, it is better if you don't know how many beans are in the bag.

Capture "Capture" and count some beans as shown in figure 1 below.



a. Put your hand in the bag and grab a handful.



b. Count the beans.

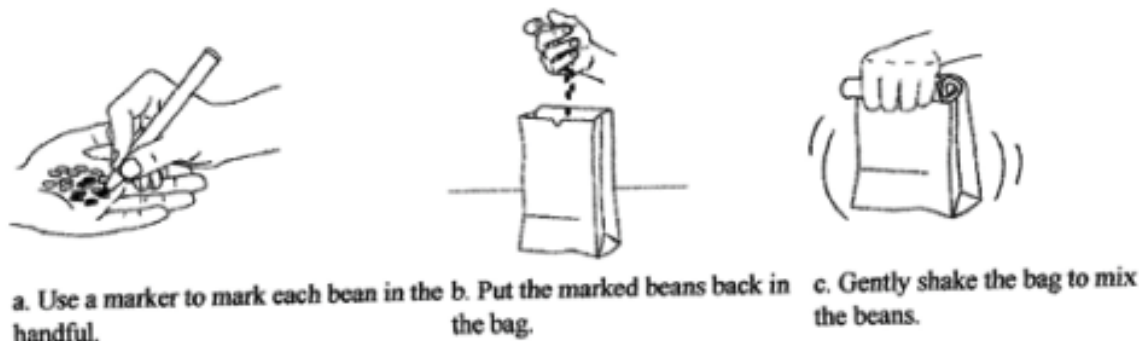
figure 1- Capture & Count

- c. Write the number in Table 1, in the column called "First Capture"**

TABLE 1: PIKA POPULATION SAMPLING

First capture	Recapture Total	Recapture Marked	Population Estimate	Actual Population

2. Mark the beans you “captured” (pulled out of the bag) .



YEAR 2 : In the second year of her study, Dr. Erica Garoutte goes out again to count the pikas. She begins capturing and releasing them. She notices that some are tagged and some are not. She records the number of each. Back in her office, she uses this information to estimate the number of pikas in the population. Let’s do that now with our “bean pikas”!

3. Recapture Recapture a new sample

- Take a new handful and count it. (Don’t put them back yet!)
- Write this number in Table 1, under “Recapture Total”
- Count just the marked beans in your new handful.
- Write this number in Table 1, under “Recapture Marked”
- Now, return all beans to the bag.

4. Population Estimate Estimate the size of the population. Use a calculator and the formula below.

Formula:

$$\text{Population Estimate} = \frac{\text{First capture} \times \text{Recapture Total}}{\text{Recapture Marked}}$$

Look at the example below, then fill in your own numbers

EXAMPLE:

First Capture 10 X Recapture Total 12 = Product = 120

Product 120 ÷ Recapture Marked 4 = Population Estimate = 30

YOUR DATA :

First Capture _____ X Recapture Total _____ = Product = _____

Product _____ ÷ Recapture Marked _____ = Population Estimate = _____



ENVIRONMENTAL CHANGE: The climate continues to get warmer and the amount of tundra with cooler habitats for pikas shrinks. *A number of pikas have died.* Dr. Garoutte will not find these pikas when she returns to the field in Year 5.

YEAR 5: In the fifth year of her study, Dr. Garoutte goes out again to count the surviving pikas. She begins capturing and releasing them. This time she marks all of the ones she captures with a different colored tag. Let's do that now with our "bean pikas".

5. Killed by warming climate

Remove a small handful "dead" beans (any beans) from the bag and set them aside. Count these and write the number in Table 2, "Killed by warming climate". Set these beans aside.

6. Survivors

Remove a handful of "survivor" beans

- Count them. Write the number in Table 2 under "Survivors First Capture."
- Mark these survivors with a second color. Return them to the bag.

TABLE 2: PIKA POPULATION SAMPLING AFTER CLIMATE CHANGE

Survivors First capture	Survivors Recapture Total	Survivors Recapture Marked	Survivors Estimate	Killed by Warming Climate	Actual Survivors

7. Survivors Recapture

Remove a new sample of beans

- Count the total. Write it in Table 2 under "Survivors Recapture."
- Count the number from this handful that have the new survivors color. Write this number under "Survivors Recapture Marked."
- Return these beans to the paper bag

8. Survivors Estimate

Use the formula below to calculate the survivors estimate.

Formula:
$$\text{Population Estimate} = \frac{\text{Survivors First capture} \times \text{Survivors Recapture Total}}{\text{Survivors Recapture Marked}}$$

Survivors First Capture _____ X Survivors Recapture Total _____ = Product = _____
 Product _____ ÷ Recapture Marked _____ = Population Estimate = _____

Write the Survivors Estimate in Table 2

9. **Actual Survivors** Find the number of actual survivors

- Dump the bag. Count all the beans.
- Write this number under “Actual Survivors” in Table 2

ANALYSIS: TESTING THE SCIENTIST’S METHOD - DOES IT WORK?

So, **if** this “mark-recapture” method used by scientists really works, **then....** “The **Survivors** plus **those killed by the warming climate** should equal the number of individuals in the **Original Starting Population.** “

Look at Table 2

Add the “**Actual Survivors**” plus “**Killed by Warming Climate**”. The answer is the “**Actual Population Total**”. Record that number in **Table 1**

Your Advantage:

In the real world, scientists could never know how many pikas they started with when they first count them because they could never capture ALL of them. It’s just impossible. At the beginning of this activity, you did not know how many beans were in the bag .

But in this activity, since your pikas are actually “beans”, you **CAN** find all of them.

- Count all of the beans now to see how many of them you actually started with in the bag.

If the answer you just wrote in table 1 (Actual Population Total) matches or is pretty close to it, then the method used by scientist works!

A. How did the estimated number of beans compare to the actual number in the bag?

B. Was our original hypothesis supported? Give evidence to support that claim?

ONE FINAL USEFUL REAL-LIFE THING TO DO



REPORTING HER RESEARCH:

People want to know: “Is the warming climate causing some of the pika to die off? If so, what percentage of the pika have died off?”

Scientists need to develop their skills in reading, writing, discourse, and math. They take their time to write and present on their findings. Dr Garoutte’s research can be shared with conservation groups and government agencies in order to help protect wildlife.

Calculate

In the step above, you calculated the number for “Actual Population Total” and wrote it in Table 1.

Now use the formula below to find the percentage of the population that died as a result of the warming climactic conditions.

Formula: $\frac{\text{Killed by warming climate}}{\text{Actual Population Total}} \times 100\% = \text{Percentage killed by warming climate}$

Killed by warming climate _____ ÷ Actual Pop. Total _____ x100%

= Percentage killed by disease = _____

Other Ideas

What things might cause your results to be more reliable or less reliable, especially when counting real animals? (e.g., sources of error, problems with data collection, things that could make the math more reliable or less)

Background Information For Educators/Parents: (Preparation, Tips, and other Tricks— Don't share this information with students. This is to set up the activity ahead of time for them.)

- **Activity Preparation- 5-10 min**
 - Before doing the activity:
 - Make up the bags. Simply put around 100 dry light-colored beans into a bag. The number does not need to be exact. Bags should not be transparent. Note: White beans work well for marking. Avoid pinto or other spotted beans.
 - If possible, print the activity. If a printer is not available, students can record their data and calculations on a blank piece of paper.
- **Student Considerations**
 - If possible, let students work in pairs, ideally with another person their age or older. (e.g., a sibling, parent etc.) . It's more fun that way. They can take turns handling the beans and recording the data. They can even check each other's calculations.
 - **Adaptations for Special Needs:** If students have learning disabilities, you might have them handle and count the "population" while a peer, parent or sibling reads directions and records data. If a student has poor fine motor control and is physically unable to perform the population counts, he or she could read and record the procedure aloud, and could present the results. You might use a tape recorder for results if writing is problematic. If a student is colorblind, be sure the two markers are not red and green.
- **Sample Data:**
 - **Table 1:** First Capture Total, 22; Recapture Total, 28; Recapture Marked, 6; Calculated Population Estimate, 102; Actual Population Total, 100.
 - **Table 2:** Survivors First Capture Total, 26; Survivors Recapture Total, 22; Survivors Recapture Marked, 4; Calculated Survivors Estimate, 71; Killed by Warming climate, 14; Actual Survivors Total, 86 (percentage affected, 16%).
 - **Their Hypothesis** should be supported and their estimate should be within 20% of the actual number of beans that you put in the bag.
 - **Final Report for Government or Other Conservation Groups:**
 - Their report might include things like the following:
 - It might not be possible to know exactly when disease strikes a population.
 - Also, capturing the required number of animals would be difficult. It most likely would not be possible to catch them all at once. When they are released, they likely would not all stay in one small area.