Bird Beans

Grade Level: upper elementary/ middle school
Duration: 30-40 minutes
Skills: critical thinking, comparison, collection and interpretation of data, vocabulary, discussion, and visualization
Subjects: science and math

Concepts
- Research is vital for shorebird conservation.
- Through research we learn what shorebirds need and what we can do to conserve them.
- Some shorebirds concentrate in great numbers at their stopover sites, which provide large populations of birds for study.
- Because of this concentration, shorebird populations are extremely difficult to count.
- Estimating population trends helps alert biologists to potential problems within a habitat.

Vocabulary
- census
- population
- migration
- stopover
- sample
- bias
- camouflage
- transect

Overview
Using beans and their desktops, students learn and practice techniques for estimating a population of shorebirds.

Objectives
After this activity, students will be able to:
- Explain why biologists conduct shorebird population censuses at migration stopovers.
- Define the terms population, census, sample, and bias.
- Describe how camouflage might affect census numbers.
- Instruct another classmate on how to estimate, as accurately as possible, the population size of a large group of moving shorebirds (or other organism).

Materials
- One copy for every two students of the *Sampling Populations* reading
- One *Bird Beans Student Worksheet* for every two students
- Large, dry beans (about two-thirds cup per pair)
- Measuring cups or paper cups
- String (about three feet per pair)
- One pair of scissors for every two students

Introduction
In their rush to get to the summer breeding grounds as soon as the weather allows, many Arctic-nesting shorebirds *migrate* almost simultaneously. They also tend to share the same important *stopover* wetlands along the migratory flyways. Flocks of shorebirds appear at these "rest stops" in the hundreds, thousands, hundreds of thousands, and even millions! Many shorebird flocks were even larger before nineteenth century market-shooters took their toll.

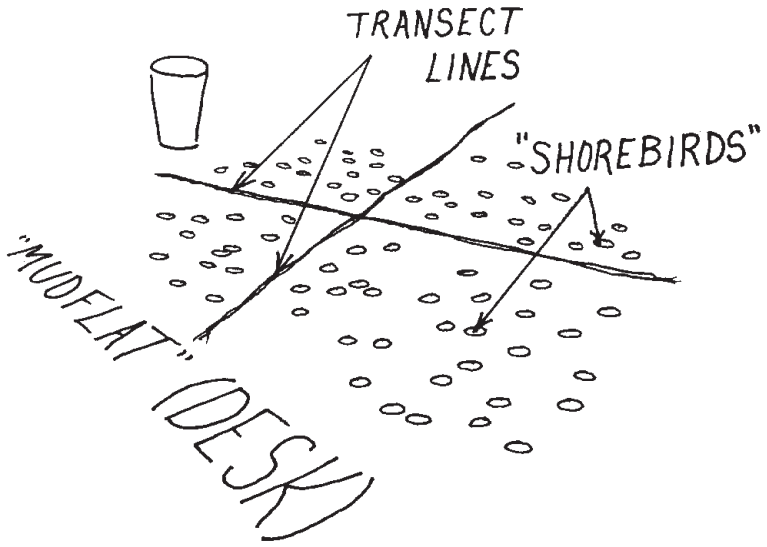
An accurate *census* (count) of these shorebirds is necessary each year, or every several years, to note and understand any changes in the *population* sizes of these migrating birds. Significant changes in the population size may alert biologists to potential problems within the birds' habitat.

However, counting such huge flocks before they fly away or split up is not an easy task. Working fast, yet gathering accurate numbers, is critical. Biologists have devised several methods that make counting large groups of wildlife easier.

Procedure
1. Discuss with students how large shorebird flocks can become during migration. Have older students read the *Sampling Populations* sheet. Are they ready to try counting big numbers, or do they want to learn some "tricks" to make it easier?

2. Divide students into groups of two and give each pair a Bird Beans Student Worksheet.

3. Have each pair measure and cut two pieces of string about 18 inches long.



4. Have each pair measure out two-thirds cup of beans. Tell them that each cup holds a "population of shorebirds" to estimate. If enough measuring cups are not available, or students are younger, give them each a five ounce paper cup nearly full of beans.

5. Ask them to write down quickly their best guess of how many "birds" they have in their cups. Each member of the pair may have a different guess.

6. Now have each pair spread their "birds" out on their desk which now represents a mudflat. Direct them to spread the beans in a single layer on the desk (mudflat) as evenly as possible without counting them out.

   Optional: Set aside five beans. Concentrate on what five beans look like. Now try "dividing" the beans with your eyes into groups of five. Count those groups of five as best you can, either with or without using your fingers. In other words, count by fives. Do not worry about getting the exact number. Encourage students to race through this step. Repeat, using groups of ten instead of five.

7. Instruct them to divide their "birds" into two sections by laying the string across the center. Lay the other string at right angles to the first, dividing the beans into four sections of approximately equal areas.

8. Ask students to count all the "birds" in one square. Write down their answers on Line 3A and multiply this answer by four (the four quadrants).

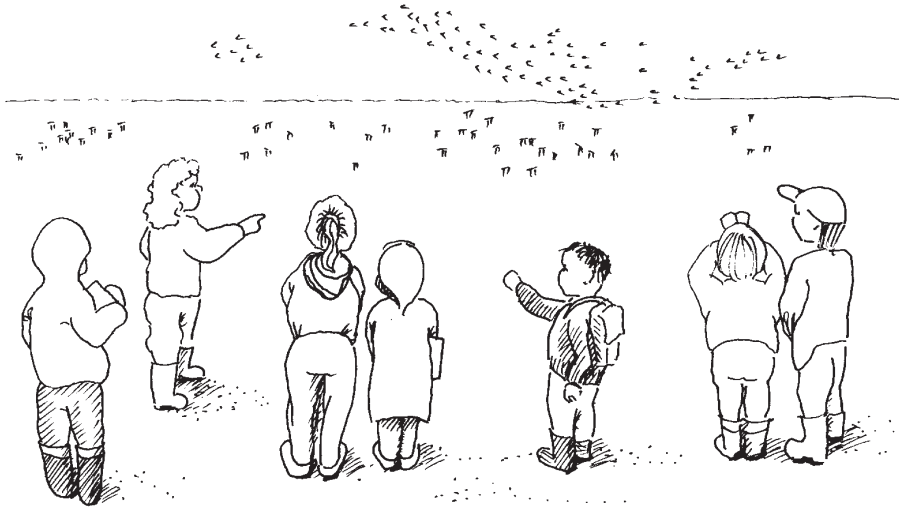
10. Now have them count and record the number of "birds" in each of the other three squares. Follow the directions on Line 4, add these four numbers together, and write down the result.

11. Look at the answers the students got. Compare and discuss the results as a class. Remind the students that when they look at a real flock of shorebirds, they will not be able to divide it with string or even fences. They will have to use their eyes to mentally divide either the flock (beans) or the beach (area of desk that encloses all beans) that the flock is on into equal groups of birds; then multiply to obtain the total.
    - Which was closer to the actual number — their guesses, the sum of the four counted areas, or the result of multiplying the birds found in one quarter of the area by four?
    - Who guessed high and who guessed low?
    - How can we determine how many bird beans the entire class has without counting any more beans? (Count the number of pairs of students, and multiply that number by the number of beans your group has. This method works only if every pair has approximately the same number of beans, of course.)

12. After dividing the beans into four sections with two strings and multiplying, repeat the step using three strings to divide into six sections, and four strings to divide into eight sections.

13. For a more challenging and realistic experience, and to test for *bias*, use a mixture of three different kinds of beans (for example., kidney, pinto, and navy) as your "shorebird population." Also try counting them against different colored paper backgrounds that match either the light or dark colored beans. How does this make population sampling an even greater challenge?

14. Practice this counting procedure on a shorebird observation field trip. If such flocks are not seen, have them practice by counting trees in a park or people in a field.



Additional Activities

Assemble and Use Transect Frames
In fieldwork (conducted in the natural habitat of the organism), *transects* are a way of dividing habitat into small, representative *samples* of the entire area. A study of the sample is far less time-consuming, and perhaps less expensive, than a study of the entire area or population. If we assume that the sample is very similar to the rest of the area, then anything we learn from the sample helps us understand the total.

Ask students to construct transect frames ("windows") of approximately two inches using paper or cardboard squares.

Repeat the bird-bean counting activity, following these steps:

1. Measure the height and width of the spread beans.

2. Calculate how many two inch transects fit inside the spread of beans, or simply rotate the transect around the pile, counting how many times it fits.

3. Count how many beans are in one square.

4. Multiply the number from Step 2 by the bean count from Step 3.

Transects can also be used on field trips to examine the invertebrates on a beach or insects in the grass. Students can randomly toss their frames out three times and examine what is found within the sample. Compare the samples or average them together if they are all located in the same area.

Advanced Study of the Population Census Technique
Taking a population census is another commonly used method in wildlife biology and management. Discuss with students — or invite a wildlife biologist to the classroom to discuss — the reasons why censuses are important.

What does a census tell us? (The number present in one place at one time.) What it does not tell us is the significance of the census number. For instance, a census does not tell us whether a population is healthy or not. We need some baseline data to compare it with. How is census information useful to humans? Often it is most useful when compared to other information, like the number present in other areas or the number present in the same place in a different season, a different year or under different weather conditions.

Your discussion may include terms like:
- change over time
- population trends (declines or growth over time)
- inter-year variability (differences between years)
- intra-year variability (differences within one year)
- baseline data (initial or historical information often presumed to be taken at a time of typical environmental conditions and useful for future comparison should there be a major or catastrophic event like El Niño or an oil spill)

Bird Beans Student Worksheet

Directions: Pretend that the beans you spread on your desk are a flock of shorebirds. Follow your teacher's directions to try and "count the birds." Use this page to record your answers.

1. How many birds do you guess are in your cup?

   Name:_____Guess:_____

   Name:_____Guess:_____

2. How many groups of five birds do you have? _____

3. A. How many birds are in one (of the four) sections?_____

   B. Multiply the above number by four:

   _____ x 4 = _____
   (Number in one section) (Number of total birds)

4. Count the number of birds in the other three sections and add them together to get the total number of birds:

   _____ + _____ + _____ + _____ = _____
   (Total number of birds)

5. Was your guess too high or too low? _____

Sampling Populations

Estimates are more than a random guess made by researchers. Biologists watch and become familiar with the behavior of the species they are surveying, study photographs of a known number of birds at various concentrations, and practice making estimates via computer-generated models and exercises.

Why do biologists count birds and what do they do with this information?
Knowing the exact size of a population is less important to biologists than knowing how the population numbers of individual species change over time. Careful counts can alert biologists to serious population declines and justify management protection. Counts can also tell biologists whether or not their management efforts are helping a species to increase its population numbers.

What are some of the difficulties in counting birds?
The total size of a population is difficult to know for species with thousands or millions of moving individuals. Biologists therefore estimate the number of animals in a given population. Shorebird populations are most easily estimated when they congregate in large flocks at migratory stopover sites. When shorebirds are in their breeding or wintering habitats, they are much more spread-out, making them even more difficult to count.

Mistakes can occur when there is *bias* or *sampling error*. Bias occurs when some characteristic of a population causes it to be over or under-represented. For example, in an estimate of a flock of mixed species, the estimate would likely be less accurate for small, drab-colored, hard-to-see species (one that was well *camouflaged*) than for a brightly colored bird. One type of sampling error, observer variability, occurs when individual observers regularly make incorrect estimates. Look at the following numbers observers recorded while counting the same flock of birds:

Observer 1	*246,000 birds*
Observer 2	*638,100 birds*
Observer 3	*638,900 birds*
Observer 4	*638,400 birds*
Observer 5	*1,452,800 birds*

From this example, we can see that observers two, three, and four do not show much variability, but observers one and five show great variability when compared to other observers. Some observers regularly estimate too high, others too low. If you are making important counts, it is important to know what type of observer you are.