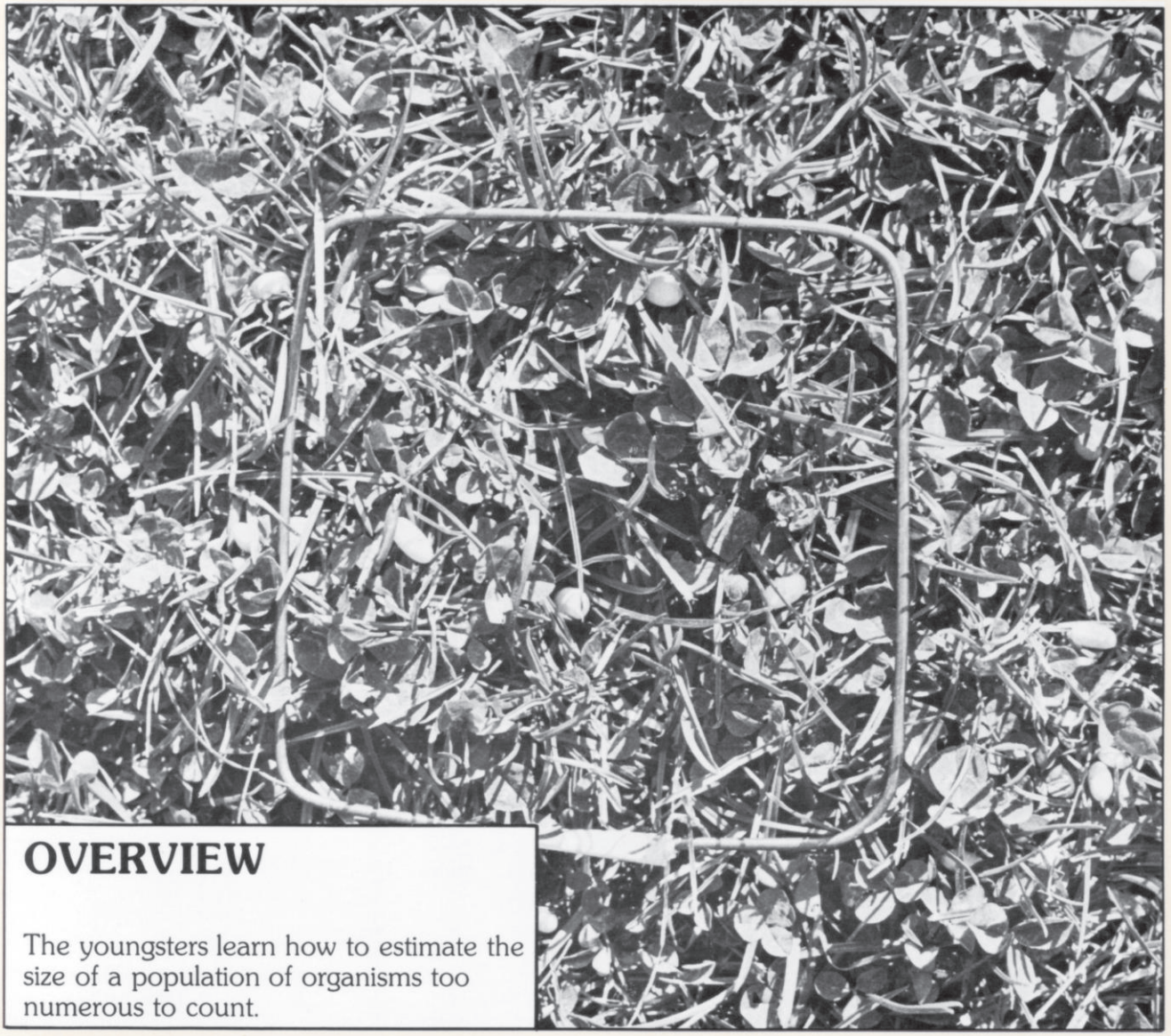
BEAN BUGS

BIO KEY

Sampling Technique
Population Census
Arithmetic



OVERVIEW

The youngsters learn how to estimate the size of a population of organisms too numerous to count.

BACKGROUND

One of the basic tasks of field biology is finding out how many organisms live in a study site. There are several ways of determining the size of a population of organisms. (A ***population*** is a group of organisms of the same kind that lives and reproduces in a particular area.) Some populations, such as a clump of elm trees on a lawn, are relatively small and can be censused by simply counting the trees. Other populations, however, such as the grass plants in a lawn or lady bugs in a meadow, are relatively large and their numbers must be estimated because counting them would take too long. The quadrat census technique suggested here is appropriate for estimating large populations of organisms that move very slowly or do not move at all.

To estimate the size of a large population, you can count *all* the individuals in a small, measured area of the study site and then multiply that count by the number of small areas in the whole study site. This small area is called a ***quadrat***. The best size for a quadrat depends on

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the size and abundance of the organism being counted. For bean bugs, the square decimeter is a good size. (1 decimeter = 10 centimeters or 0.10 meter; 1 square decimeter = 100 square centimeters or 0.01 square meter.)

Averaging the counts from several randomly selected quadrats gives a better estimate of the number of organisms per quadrat, because populations are often not distributed uniformly throughout an area. Wire squares the same size as the quadrat are useful for this purpose. The square can be tossed into the area, and the number of organisms enclosed in the square can be counted.

For example, your study-site area is 40 square meters, and your quadrat size is 1 square decimeter. You take seven random samples by tossing your quadrat square into the study site seven times. Your counts are: 8, 6, 12, 3, 0, 16, and 11 bean bugs. Add the sample counts together and divide the total by the number of samples: $56 \div 7 = 8$ bean bugs per quadrat. There are 40 square meters in your study site and 100 square decimeters in a square meter. Thus, you have a total area of 40×100, or 4000 square decimeters. There is an average of 8 bean bugs in every square decimeter, so you multiply the total number of square decimeters (4000) by 8: $4000 \times 8 = 32{,}000$ bean bugs.

CHALLENGE: ESTIMATE THE NUMBER OF INDIVIDUALS IN A POPULATION TOO NUMEROUS TO COUNT.

MATERIALS

For each team of two:

1 wire square, 10 cm × 10 cm (1 square decimeter) (See the "Preparation" section.)
1 index card* and pencil

For the group:

1 data board or large drawing pad*
1 marking pen*
1 pound of bean bugs (e.g. mung beans*, split peas, lentils)
masking tape*
wire cutters* and pliers
2 meter sticks* or meter tapes*
1 ball of string*
4 large nails*

* Available from Delta Education.

PREPARATION

Group Size. This activity is suitable for any size group.

Time. Plan on forty to fifty minutes for this activity.

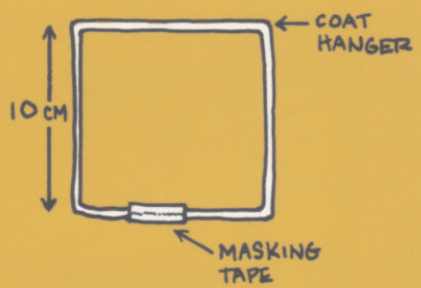
Site. Choose a section of lawn 35 to 50 square meters in area. Mark off the boundaries of the area with string and nails. By marking the area off in whole meters on a side (e.g. 5 m × 8 m), you can avoid having to deal with decimals or fractions.

Materials

1. Bean Bugs. Select beans of a color and size that will make the beans easy for the kids to find and count on the lawn. Before meeting with your group, determine how many bean bugs you are going to introduce into your study site. Unless you want to count them all, you will have to estimate the number yourself, either by weight or volume. If you have an accurate scale, weigh out an ounce of

beans, count them, and multiply by 16 (if you have a pound of beans, of course!). If you do not have a scale, try a measuring cup. Determine how many measuring-cup ounces of beans you have. Then count a tablespoon full of bean bugs. Multiply the number of beans in a tablespoon by 2 (the number of tablespoons in an ounce). Then multiply this product by the number of ounces of beans you have. (Note: There are eight ounces in a cup.)

2. Wire Squares. You can make the wire squares from coat hangers. Untwist the hooks and straighten out the hangers. Cut each hanger into two 40-cm lengths. Bend the wire into squares 10 centimeters on a side. Tape the free ends of each square together with masking tape.



ACTION

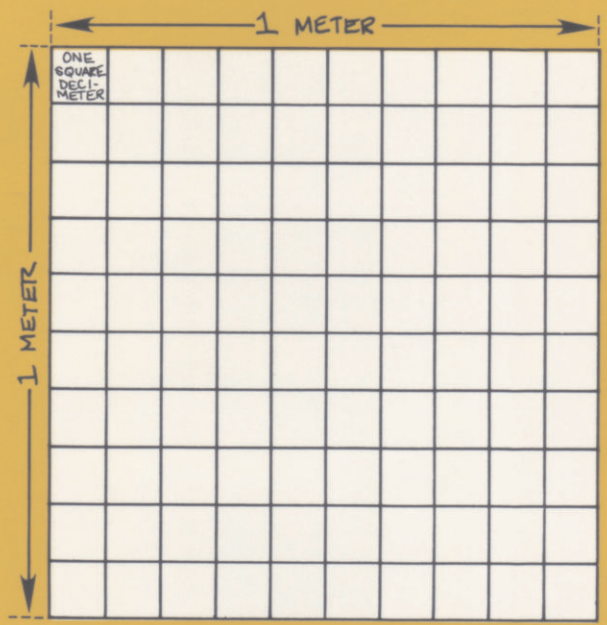
Presenting the Quadrat Census Technique

1. Tell the group that you will introduce a population of bean bugs into the study area marked off with string. Define ***population*** (see the "Background" section), and show the youngsters the bag of beans you are using to represent the bean-bug population.

2. Walk around inside the marked-off area, and distribute the bean bugs evenly throughout the area.

3. Ask if anyone has an idea of how to find out how many bean bugs are in the population. Acknowledge all suggestions, but focus attention on ideas that relate to counting bean bugs in a small area and multiplying by the number of small areas in the site. Explain that such a method of counting organisms is called a ***quadrat census technique***.

4. Tell the youngsters that a ***quadrat*** is a sampling plot whose area is exactly known (that is, the small area in which organisms are counted). Explain that for this activity, the quadrat size is 100 square centimeters or 1 square decimeter.



Show the youngsters a wire square and say that its area is 1 square decimeter. Explain that an accurate quadrat census involves counting the organisms in as many randomly selected quadrats as possible, and then finding the average number of organisms per quadrat. The youngsters will toss their wire squares into the site, count the bean bugs within, and then toss the square again for another count. Using the data board, go over the calculations involved to determine the population size. You may use the example from the "Background" section.

Taking the Quadrat Counts

1. Demonstrate the sampling procedure by tossing a wire square into the study area, and having a couple of youngsters

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count and record the number of bean bugs inside the quadrat. (Give them an index card and pencil.)

2. Divide the group into teams of two. Tell the kids that each team should toss their wire square six to eight times, and record the number of bean bugs in each quadrat sample.

3. Give each team a wire square, an index card, and a pencil, and let them start taking their quadrat counts.

Calculating the Population Estimate

1. As the teams finish taking their quadrat counts, ask them to average their results. Some of the teams may need help with this.

2. Delegate one team to measure the dimensions of the study site so that its area can be calculated.

3. Explain that because there are 100 square decimeters in a square meter, the youngsters must multiply the area of their study site (in square meters) by 100 to get the total number of quadrats in the study site.

4. Tell the teams that all they have to do is multiply their quadrat averages by the number of quadrats in the whole study site to arrive at a population estimate for the entire area.

USING COMMON CENSUS

1. Record each team's estimate on the data board. Explain that you estimated the number of bean bugs in the population before the activity. Reveal your "accurate" estimate at this point.

2. Team estimates can be expected to vary over a wide range. Discuss the range, and ask the teams what might be responsible for the variation. Some possibilities are:

- arithmetic errors.
- incomplete counts of bean bugs in the quadrats (they can be hard to see).
- too few quadrat samples.
- the bean bugs were not uniformly distributed throughout the study area.

3. Average the teams' quadrat averages on the data board to get a group quadrat average. Multiply the group average by the number of quadrats in the study area. Compare this estimate with the estimate you determined in advance. Is it close? Closer than most of the individual team estimates? Why?

BRANCHING OUT

1. Repeat the activity to census lawn plants, worms, lawn moths, or some other common organism in your site.

2. Estimate the number of trees in an orchard or woodlot or the number of homes on several blocks without counting them all.

3. Estimate the number of leaves on a bushy tree.