BEAN BUGS

BACKGROUND

QUADRAT CENSUS TECHNIQUE

All plants and animals live with others of their kind in populations. Some populations are relatively small and you can census them by counting them. For instance, in a lawn there may be some elm trees which can be censused in a few seconds by counting. There are, however, populations that are relatively large and their number must be estimated, since counting them would take too long. The technique suggested here is called a quadrat technique and is appropriate for estimating populations of organisms that move very slowly, or not at all. A census of the grass plants in a lawn, or lady bugs in a meadow, could be conducted with a quadrat technique.

OUTLINE OF QUADRAT TECHNIQUE:

If you can't count all the individuals of a population in a study area, you count all the individuals in a small area of the study site and multiply by the number of these small areas in the whole study area. This small area is called a quadrat. A convenient area for a quadrat might be a square meter, a square centimeter, or a square decimeter, depending on the size of the organism being censused. The square decimeter is a nice-sized quadrat for bean bugs. You may never have heard of a decimeter.

1 decimeter = 10 centimeters or 1/10 meter
1 square decimeter = 100 square centimeters or 1/100 square meter

Since the population may not be (and usually is not) uniformly distributed throughout the study area, you will want to take several samples, that is count the individuals in several different quadrats. These several quadrats should be randomly selected to avoid investigator biases. Wire quadrats are useful because they can be tossed into the study area (random samples) several times (multiple samples), and the results averaged. This average is the estimated number of organisms per quadrat. Now all you have to do is figure out the number of these quadrat-sized areas in your study area and multiply this number times the number of organisms per quadrat to arrive at an estimate of populations.

Example:
Your study area is 40 square meters; your quadrat is 1 square decimeter.
You take 7 random samples: 8, 6, 12, 3, 0, 16, 11
Add these samples: 8+6+12+3+0+16+11=56
Average these samples: 56 divided by 7 = 8 organisms per quadrat.

Since there are 100 square decimeters in a square meter, and there are 40 square meters in your study area, you multiply 100x40 to get the number of quadrats in the study area, 4000. At 8 individuals per quadrat, you multiply 8 x 4000 – 32,000 organisms in the population.

Bean bugs (mung beans, split peas, lentils, etc.) are make-believe animals which you can introduce into your study site for the purpose of using the quadrat technique for estimating populations. We suggest bean bugs rather than one of the populations living in your study site because you can control the population; you know how many bean bugs you put into the study site. Once your investigators have completed their estimates, the population can be verified by comparing results against the known population size. If the investigators get results that are reasonably close, they will feel confident using the technique in the field. To emphasize the usefulness of the technique, it is recommended that you follow through with some censuses of plants and animals living in your study site.

MATERIALS

For the group:
1 data board
1 marking pen
1 lb. bean bugs
2 meter sticks
1 ball of string
4 nails

For each Investigator:
1 wire quadrat 10 cm. x 10 cm. square
1 paper and pencil

PREPARATION

Before meeting with your group, determine the population size of bean bugs you are going to introduce into your study site. In other words, you will have to figure out how many beans are in the bag. 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 an ounce of beans, count them, and multiply by 16 (if you have a pound of beans!). If you don't have a scale, try a measuring cup. See how many ounces (measuring cup ounces) of bean bugs you have. Then count a tablespoon full of bean bugs and multiply: two tablespoons – 1 ounce; 8 ounces = 1 cup. That is all the advance preparation necessary, but keep in mind that, before starting the activity with your group, you will want to designate a portion of your study area as the bean bug study area. It should be about 35 square meters and outlined with string.

ACTION

First, you will want to measure off a section of your lawn as the bean bug study areas. An area about 35 to 50 square meters is about right for a pound of bean bugs. Have several volunteers measure off the area and mark it with string using a ball of string and nails. This will require some time and the students may want help from others in the class.

Presenting the Problem:

When the bean bug area is ready, tell the group, "I have here a population of bean bugs. I am going to introduce them into the lawn in this bean bug area." Walk around inside the roped-off area and distribute bean bugs evenly throughout the area. Then say, "We now have a population of bean bugs living in your lawn. Does anybody have an idea how we could find out how many bean bugs there are in the population?" Entertain some suggestions. Focus attention on ideas that contribute to a quadrat estimate technique like "We can count the bean bugs in a little area, maybe a square meter, and then multiply by the number of square meters in the whole study area." Lead the discussion t o an outline of the technique, then say, "the technique you have outlined is called a quadrat estimate technique." Tell them that a good quadrat has these qualities:

1. Several random samples: the more the merrier, and random is the rule. (They should throw one-decimeter square wires in the air and let them fall.)
2. Average the sample (8+6+12+3+0+16+11) divided by 7 = 8.
3. Multiply the average by the total square decimeters in the bean bug area.

You might want to outline these three points on the data board. Quadrat squares and tape measures are provided to help them with their estimates. Tell them that you know how many bean bugs there are on the lawn. Then let them try the quadrat technique to see if it works. Have everyone do his own estimate and tell you when he is finished.

WHAT DO YOU THINK?

When everyone has completed an estimate, record the results on the data board. Reveal your "accurate" estimate at this point. Estimates can be expected to vary over a wide range. Discuss the range and ask them what might be responsible for the range. Some of these are:

Samples not random
Incomplete counts of bean bugs in the sample area; they can be hard to see
Too few samples
Arithmetic errors

Non-uniform distribution of the bean bugs.

Ask one of the students to average all the estimates made by the investigators and compare that estimate with the estimate you determined in advance. Is it close? Closer than any of the individual estimates? Why?

Follow Through

- Redo the activity to census some of the living organisms in your study site. Remember to calculate the area of your study area carefully.
- Are there worms on the lawn? Estimate the population of a species of worm.
- Here is an arithmetic problem: How big would a single leaf be that was equal to the total leaf area of the grass in the lawn? Compare this with the size of the leaf equal to the total broadleaf area on the lawn.
- Look at the soil in the lawn. Examine a cubic decimeter section. Count one type of soil organism, and estimate the population size of the organism in a to square meter/1 decimeter deep plot.
- Estimate the number of grass plants growing on a lawn.
- Estimate the number of trees in an orchard or woodlot (without counting them all).

What To Do Next

Sticklers
How Many Organisms Live Here?