INVESTIGATION 14.1.1

Inquiry Skills

● Questioning	● Planning	○ Analyzing
○ Hypothesizing	● Conducting	● Evaluating
● Predicting	● Recording	● Communicating

Estimating Population Size

In this investigation, you will apply quadrat and mark–recapture sampling methods to estimate the size of a weed population.

Ecologists need to count organisms for different reasons. They may want to count cells on a microscope slide to test whether food-processing plants are meeting health standards, or count trees in a forest to assess the health of an ecosystem, or count salamanders in a stream to assess the impact of pollutants. For many kinds of organisms, it is virtually impossible to physically count each member of a population.

Materials

weed (plant) identification guide
tape measure
wooden mallet
stakes (18 per group)
string
blunt-tip scissors
piece of white chalk
foamed polystyrene "peanuts" in a plastic bag
black marker

Question

How can you test predictions of the estimated size of a population?

Be sure not to touch the weeds, especially if you have allergies to weeds. Take care not to trip over the string around your selected study site.

Procedure

Part I: Quadrat Study

1. With two or three other students, choose a study site around your school and select a local weed species within this site. Do not touch any weeds. Identify the species using field guidebooks or other references.

(a) Predict the estimated size of the weed population. Make a note of your reasoning.

2. In your schoolyard, use a tape measure to mark off a 10-m × 10-m square and use a mallet to drive a stake into the ground at each corner.
3. Loop string around each of the four stakes to mark the boundaries of the site. Be sure the string is tightly attached. Exercise care not to trip over the string during this procedure.

(b) Describe the location of your site, including such abiotic factors as light exposure and soil conditions. Record these observations in an accurately labelled data table.

4. To avoid bias in site selection, randomly select an area within the site to represent the first quadrat by closing your eyes and tossing a piece of white chalk into the square. Make the point where the chalk landed the centre, and use the tape measure to mark off a 1-m × 1-m square. Use the stakes and strings to complete the quadrat.

(c) Record the number of individuals of your chosen plant species within the quadrat in an accurately labelled data table.

5. Repeat step 4 and (c) twice.

(d) Calculate the average population density per square metre using the data obtained from all three quadrats.

(e) Multiply the population density by 100 to estimate the total number of organisms in the larger site. Record this information in your data table.

Analysis

(f) In the quadrat sampling method, why is it necessary to close your eyes when selecting a quadrat site?

(g) Compare the average population size to the size counts obtained for each individual quadrat.

(h) Why is it important to use more than one sample?

Evaluation

(i) Compare your group's results with those of other groups. How close were your predictions? Account for any differences observed in the results.

(j) Explain why sampling an animal population using the quadrat method would be more challenging than sampling a plant population using this method.

Part II: Mark–Recapture Method

6. Obtain a plastic bag of foamed polystyrene "peanuts" from your teacher.

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(k) Predict the number of peanuts in the bag and record your prediction.

7. Mark each peanut with black ink and return them all to the bag. Shake and stir the contents of the bag to mix the peanuts thoroughly.
8. Capture 40–50 peanuts from the bag.

(l) Record in your data table the number you have captured.

9. Recapture a sample of similar size without looking into the bag to see whether you're recapturing peanuts with or without marks.

(m) From your recaptured sample, record in your data table the total number of recaptured peanuts and the number of those that are marked.

10. When you have finished recording, return all the peanuts to the bag. Shake the bag to mix the peanuts.
11. Obtain data for two additional recaptures by repeating steps 9 and 10. Be sure to repeat the records required by (m).

Analysis

(n) From each of your three sets of data from your table, one set from each recapture, calculate a population estimate (N) for the peanuts in the bag by using the following formula:

$$N = \frac{\text{total number marked} \times \text{total recaptured in each sample}}{}$$

Calculate an average population estimate from your three answers.

Evaluation

(o) Compare your three values for the peanut population in your bag: your original prediction (k); your average estimate (n); and the actual population size as revealed by your teacher.

(p) List three factors that could have reduced the accuracy of your total estimate.

(q) Change one of the factors you listed in (p) and perform two more counts using the mark–recapture method. Analyze the new data and discuss how this factor influenced your population estimate.

(r) If migration occurred in this population, how would this influence the reliability of your estimate?

Synthesis

(s) Weed growth in many areas of the province are perceived to be a significant problem. The Ministry of the Environment has asked that some school yards be surveyed for local weed species in an effort to assess the problem. Your school has been selected to share its quantitative data from the quadrat sampling study. Write a report to the Ministry of the Environment outlining your school's weed situation. Include the following in your report:

(i) a summary of the quantitative data obtained in Part I of this investigation

(ii) an interpretation of this data in relation to the local weed species problem

(iii) an assessment of the sampling technique in terms of its reliability and accuracy, and any improvements you believe would increase the accuracy of your data.