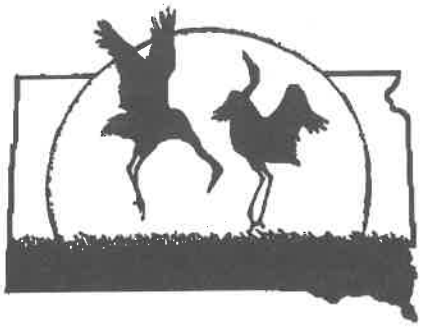

PRAIRIE POPULATIONS

Prairie Populations

Prairie Populations is a South Dakota wildlife population census activity for students in grades 5-10.

Objectives

This activity is designed to provide the students with an open-ended problem solving situation that integrates mathematics and language arts with biology. The activity is designed as a unit that takes the students through an entire learning cycle in which they investigate and experiment, learn from experts through a practical, real life situation, and finally apply the knowledge and skills they have learned. Students will be able to: 1) explain why scientists census wildlife populations; 2) use a variety of techniques to estimate a population; 3) apply their mathematical skills of estimation, multiplication, averaging, geometry, fractions and percents 4) learn about waterfowl populations at a South Dakota wildlife refuge; and 5) demonstrate their knowledge and skills by conducting a census of their choosing.

Method

Students will be presented with a population to census. They must assess the problem, design two procedures to estimate the population, determine which procedure yields the most accurate information, and make a report on the best census technique as determined by their investigations. Students will then learn about real-life population census activities at a South Dakota wildlife refuge. Finally, students will conduct and report on a census of their own choosing.

Background

There are many instances when biologists are interested in the size of wildlife populations. A population is defined as the individuals of a single species found at a particular location at a particular time. Most often biologists census populations as a basis for wildlife management decisions. For example, an accurate estimation of the males and females in a population must be known before managers can decide how many hunting or fishing licenses can be issued. Population censuses are conducted to determine if a species is threatened or endangered. Species with very low populations are included on state and/or federal lists that insure special consideration will be taken to protect the species from extinction. Some populations are monitored because too many of the species could cause serious habitat deterioration problems for people, livestock or agriculture crops. When populations exceed acceptable levels, control measures are initiated.

These could include establishment of hunting seasons to harvest excess numbers or, in cases of insect problems, application of pesticides.

In many cases, population censuses include information about the sex and age group ratios. These data are important for predicting future trends within the population. A population with very few juveniles, for example, could indicate that the species is experiencing a disruption of the reproductive cycle that will soon result in a population crash. Biologists use this information to call for studies of the ecology of the species to determine the exact nature of the problem.

Biologists also are interested in assessing wildlife die-offs. Possible causes for bird kills are:

- Flocks of birds migrating during bad weather, especially at night, can die in large numbers when they collide with the wire supports attached to tall TV and radio towers;
- Misapplication of pesticides such as leaving the compound on the surface of the ground and not incorporating it into the soil. The birds, mistaking the pesticide granules for grit, eat them and die. (Many grain-eating birds eat grit, gravel or small pebbles to help them grind up food in their gizzards);
- Botulism is a disease caused by the bacterium, *Clostridium botulinum*. Large flocks of aquatic birds have died when they ate decayed aquatic vegetation contaminated with the botulism organism. The organism attacks the bird's nervous system causing paralysis and death. Such die-offs are common in South Dakota;
- Newcastle's disease is a highly infectious viral disease that can kill wild birds such as pheasants, cormorants and pelicans. There is no cure for this disease, a fact which worries the poultry industry since chickens are also susceptible. A die-off of cormorants and pelicans, as a result of Newcastle's disease, occurred in July and August, 1992 at Piyas, Waubay, and Bitter Lakes in eastern South Dakota.;
- Avian cholera, another highly contagious bacterial disease, can kill healthy waterfowl in as little as eight hours. The bacterium that causes this disease is *Pasturella multocida*. It attacks the bird's internal organs, and death normally results from internal bleeding. This disease is a problem in South Dakota.
- Unusually severe storms with extreme temperatures or winds can be destructive to wildlife.

When death of large number of plants or animals occurs, biologists are called to assess the extent of the problem. Even in these situations, when the organisms are dead and therefore stationary, it is difficult to obtain accurate counts. Censusing by counting each individual in an entire area is usually too time consuming and costly, and sometimes impossible. Good estimating strategies are essential. Scientists have developed several techniques to help determine approximate population size:

- sampling representative portions of the populations and extrapolating the results;
- making transects through the study area and counting everything that touches the transect line;
- marking off grids and counting randomly chosen sections;
- employing a capture/recapture formula developed for mobile populations;
- randomly selecting individuals in stationary populations and measuring the distance to their nearest neighbors as a means of calculating density;
- a sophisticated mathematical procedure that involves graphing and probability theory.

Details of these procedures can be found in most ecology textbooks.

Materials

Items that will be needed are 200 (or more) toothpicks (more elaborate models could be used), a grassy field, stakes, string, paper, graph paper, pencils, calculators, tape measures, and several hula-hoops (for older students who can calculate areas of circles).

Procedure

1. Review the concept of population. Ask the students to brainstorm about why biologists might want to know how many individuals there are in a particular wildlife population. Discuss their ideas and either suggest additional ones or have students contact wildlife biologists for more information.

2. Choose a large open area - grassy lawn, field, park or school yard - that should be staked out by the teacher and eventually measured by the students. An area 100' by 50' would do. Randomly scatter throughout the study area a predetermined number of models representing dead birds. The size of the area and number of birds should be chosen with consideration of the difficulty of the mathematics that will be required to complete the activity. For younger students use increments of 100 models so the calculation of fractions (or percent) will be easier. **Students should not be told the size of the field or the number models.**

3. Present the students with the following problem: During the late summer of the year a motorist was passing by a tall radio tower near an open field that had some water in it. The motorist noticed many dead birds scattered about. He was so concerned by this unusual sight that he contacted a wildlife biologist in the nearest South Dakota Game, Fish and Parks office. The biologist examined the field and took a few of the birds on which to run tests to determine the cause of the tragedy. The biologist had to determine the number of birds that were lost for a report that she was required to file with the South Dakota state government. Because counting each individual bird was too time consuming and costly, the biologist wanted to devise a strategy to estimate the number of birds killed.

4. Have the students work in small groups. The students have two tasks. First, to brainstorm and/or research the possible causes that would result in a large die-off of birds as described in the scenario. Some possibilities are explained for the teacher's reference in the background section above.

Second, the students should design a population estimation strategy for the biologist to use that will be the most accurate. To help in this endeavor, tell the students you have prepared a model of the situation for them to experiment with in which one toothpick represents one dead bird. Provide each team a piece of graph paper on which they can construct a scale drawing. First, have the students calculate the area of the field containing the dead birds. (Students who cannot yet calculate areas can do the activity by establishing grids of whatever size they would like and counting the number of grid boxes in the scale drawing).

5. Each group should decide on two techniques that could be used to estimate the number of dead birds in the field. Use one trial of each of the two techniques to estimate the population. When sampling the field, students can count the models but they should not move or remove them. The hool-a-hoops or grids made of string can be used to delineate sample sections of the field.

6. Once a group has estimated the population using two different strategies, tell them the actual number of dead birds in the field. Students should then calculate the accuracy of their procedures. Ask students what could be done to increase the accuracy of their procedure. If they suggest using larger samples or increased numbers of trials have them make these improvements, recalculate the total, and see if the accuracy of their estimate is improved. Finally have the students join hands and walk the entire length of the field picking up each toothpick they see. What percent accuracy was obtained using this strategy? Younger students who are not yet familiar with the idea of a percent

can do the entire exercise using fractions.

7. Have the student groups share their results with the other teams. The students should discuss the relative merits of each technique. How did the techniques compare in difficulty, time required, and accuracy?

8. Each student should write a report recommending a census technique to the biologist. The report should describe the census technique, contain a labeled to-scale drawing of their sampling, and explain why the student recommends that particular strategy. Remind the students that an excellent solution is one that provides high accuracy, is easy to do, and requires the least amount of time and effort.

South Dakota Experience

Ask each student to guess how many geese stop at Sand Lake National Wildlife Refuge during the spring migration. Geese migrate through South Dakota early each spring on their way to their Canadian breeding grounds and again in the fall on their return trip south. They stop over at Sand Lake to rest and eat during March and April, and again in October and November. Biologists count the number of geese to determine how many individuals use the Sand Lake resource during migration. Spring migration populations of geese at Sand Lake NWR average 600,000 birds with peaks reaching as high as 1.3 million birds in some years.

After doing the Prairie Population activity, students should be taken to a wildlife refuge where they can visit with refuge personnel to learn about the value of the refuge to wildlife populations, find out about causes of bird deaths at the refuge, and discuss population census activities conducted at the refuge. The addresses and phone numbers of the refuges in South Dakota are listed in the Natural Source Chapter 1: South Dakota Directory.

Application

Now that the students have an understanding of why population censusing is important, how counts can be made, and have learned about a population that is counted yearly in South Dakota, they should be prepared to use the knowledge they have acquired. Ask the students to conduct a census of any population (such as number of dandelions in the school yard or the number of left handed students in the school) that is of interest to them, and write a brief description of the census strategy they used and a summary of their findings.

Evaluation

Products produced by the students can be used for evaluation.

Extension

1. Have students select a sampling technique and estimate the total from one sampling of the population of bird models. Repeat the calculation based on the average of two samples, then three samples and so on. Have students graph the accuracy achieved using each number of trials. At what point does an increase in the number of trials no longer significantly improve the accuracy of the estimation? Students can determine the optimum number of trials that should be used in order to achieve the most accurate census.

2. Have students test their ability to estimate populations by using, *Wildlife Counts*, a computer wildlife counting simulation that is used to train wildlife biologists and help them practice their skills.

References

The idea for this activity developed from my having heard a research presentation by Dr. Philibert and her colleagues from the University of Saskatchewan. I am grateful to Dr. Philibert for granting me permission to use the study as a model for the activity.

Philibert, Helene and G. Wobeser and R. Clark, 1990. Estimation of Mortality in Wild Birds: Examination of Methods, U. of Saskatchewan, Saskatoon, Saskatchewan Canada, S7N OWO.

Welty, J.C. and Luis Baptista, 1988. The Life of Birds, 4th Ed. Saunders College Publishing, N.Y.

Resources

Wildlife Counts Computer Simulation, IBM or Apple II, 2215 Meadow Lane, Juneau, AK 99801. Phone: (907) 789-0326

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