Capture–recapture practical and fishery plan.

Name: Class: Date:

A bag of dried beans stands for a population of fish you cannot count. Estimate its size by capture–recapture, the method on screen 2, then check your estimate against the real number. Page 3 is for the plan on screen 10.

PRACTICAL Capture–recapture with beans

You need

- a paper bag or a container you cannot see into
- a permanent marker: the tags
- a calculator
- 200 to 500 dried beans: the population
- a small cup or scoop: the net

Method

1. Without looking, scoop one cupful of beans from the bag. Count them: this is M. Mark each one with a dot and let the dots dry.
2. Put the marked beans back, close the bag and shake it well, so that the marked beans mix through the population.
3. Without looking, scoop a second cupful. Count all the beans in it (n) and the marked beans (m), and record them. Put the beans back and shake the bag again.
4. Repeat step 3 until you have five second samples.
5. Work out N = M × n ÷ m for each sample, then the mean of your five estimates.
6. Last of all, count every bean in the bag. This is the real number.

$$N = M \times n \div m$$

M is the number of beans marked, n the number in a second sample, m the marked beans in it, and N the estimate.

RESULTS Your samples

Beans marked in the first sample, M: _____

Second sample	Beans in it (n)	Marked beans (m)	Estimate, N = M × n ÷ m
1			
2			
3			
4			
5			
Mean of the five estimates			
Real number of beans			

QUESTIONS How good is the estimate?

1 Work out the percentage error of your mean estimate: (mean − real number) ÷ real number × 100. How close was your estimate?

2 Why must the marked beans mix through the bag before you take the second sample?

3 The method assumes that the population is closed, that every bean is equally likely to be caught, and that no marks are lost. Which of these does the bag of beans meet? Which might real fish not meet, and why?

4 Predict what would happen to the estimate if some marks rubbed off before the second sample. Then test it: rub the marks off five beans, and take one more sample.

5 Would a bigger scoop make the estimate more reliable? Explain, using your results or the 20 repeat surveys on screen 2.

6 Tags can fall off real fish. Suggest one way scientists could find out how often that happens.

SCREEN 10

Plan a fishery

The bay's data. Model data, made up for this plan.

Tagging survey

Fish tagged and released	150
Fish caught a month later	120
Of those, fish with tags	12

Last year

Births	900
Deaths, including 250 caught	870
Fish arriving from other reefs	60
Fish leaving for other reefs	40

Scientists estimate that the bay can support about 3,000 fish, and that its fish grow in the same way as the lake on screen 4, but with a carrying capacity of 3,000 fish instead of 10,000.

1. How many fish are in the bay? Show your working, and say what your estimate assumes.

2. What was the growth rate, R, last year? Was the population growing or shrinking?

3. What is the largest catch the bay could sustain, and at what population? Would you take that much each year? Why, or why not?

4. What rules would you set? Think about a catch limit, closures, green zones, and who should be involved, including the Traditional Owners of the bay's Sea Country.

5. What would you monitor each year, and what would you do if the stock fell below 20% of the carrying capacity?