The Science Behind Algonquin's Animals

One Fish, Two Fish...

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Grades: 7-10
Subject: science, math, geography
Skills: calculation, estimation, communication
Duration: 60 minutes
Vocabulary: population, dorsal fin, streamer tag, mark-recapture

Objectives:

Students will be able to: 1) estimate the population of fish in a lake.
2) understand and communicate the mark-recapture process.

Method:

Students simulate the mark and recapture of Brook Trout in an Algonquin Park Lake in order to estimate the population.

Background:

Have you ever been canoeing on a lake or fishing and wondered just how many fish were in the lake? Trying to accurately determine the population of a species in an extensive terrestrial area is very difficult. Trying to determine an aquatic population can be nearly impossible. By using a mark-recapture method, fisheries biologists, and researchers in Algonquin Park can accurately estimate the population of fish species in a lake, with confidence.

Fish are captured, then tagged using a numbered, brightly coloured, cylindrical "streamer" tag 2-3 centimetres in length. It is attached to a fish by a nylon thread with an anchor that is injected into the muscle of the fish below the dorsal fin. The tag is easy to attach and is small enough that is does not limit the movement of the fish. It also does not restrict the growth of the fish and will remain securely attached throughout the fish's life.

In order to estimate the fish population of a lake a number of fish are caught and tagged over several days and the number of tagged fish from the current and previous years that were re-caught are recorded.

The data is then put into a mathematical equation known as the Peterson Formula. From this formula a fisheries biologist or technician can determine the population of a particular species in the lake.

Materials:

✔	Items Required	Quantity
	Small paper or plastic cups	One per student or group
	Large clear glass jar (4 litres in size)	One
	Two different sizes of dry, white beans	Enought to almost fill jar
	Individual data sheet (provided)	One per student or group
	Group data sheet (provided)	One
	Black markers	One per student
	Pencil	One per student or group
	Calculator	One per student or group

Procedure:

1) Organize students to work individually or in small groups. Distribute one cup per group along with one black marker, an individual data collection sheet and a calculator.
2) Tell the students they are going to be fishery researchers and are going to calculate the population of Brook Trout in Dickson Lake. Explain that the full jar of beans represents the total number of fish in Dickson Lake. Ask the students to guess how many 'fish' are in the lake. Write these numbers down on the blackboard or overhead and average the guessed population for later reference.
3) Once students have guessed how many 'fish' are in the jar have each group come up to the jar filled with beans and take a partial cup of beans. Tell the students this represents the initial capture process. Have students return to their desks with their catch of 'fish'.
4) Tell the students they now have to mark and count each of their fish and then release them (marked beans represent fish that are equal to or greater than 30 cm). To mark their fish students must colour each with the black marker. Make sure each group keeps track of how many fish they have marked. The ideal total of marked fish in the lake (jar) should be between three

hundred and five hundred, all groups combined. This total of marked fish will represent M in the formula.

5) Once students have marked all their fish have them return the fish back to the jar. When all the marked fish are back in the jar mix or shake the jar vigorously so all the marked fish are not sitting on the top. This will represent a random distribution throughout the larger population.
6) Have each group come up and take another cup of beans. It does not matter if they take a whole or partial cup. Once they have their sample have them return to their desk and have them count their 'fish'. They need to count the number of large fish caught, those equal to or greater than 37 cm (large beans, both tagged and untagged), and record this on their data sheet. They then need to count the number of tagged fish (black beans) and record this number on their data sheets.
7) When each group has counted all their fish and recorded the data, have them return the fish back to the jar. When all fish are returned have each group take another sample and repeat the process until five samples are taken.
8) Have students total up each sample and, using the Peterson Formula, N = M x C / R, have the students calculate the population for Dickson Lake.
    - Where N = number of Brook Trout equal to or greater than 30 cm length at time of tagging (i.e. year one)
    - M = number of fish tagged in year one equal or greater than 30 cm
    - C = number of fish examined in year two equal or greater than 37 cm
    - R = number of fish tagged in year one that were recaptured in year two

    Note: The value of 37 cm for C is based on an average annual growth of 7 cm for a 30 cm Brook Trout.

9) Put the Group Data Sheet on an overhead and record the population from each group and average the group population calculations as a whole.

Evaluation:

Ask students to:

1) Think of conditions in an actual lake that might cause a population of Brook Trout to be higher/ lower than what was calculated using the Peterson Formula.

2) Brainstorm how they could repeat the tagging operation to produce a more accurate population calculation.
3) Prepare a simple outline of the steps taken to calculate the fish population in a lake.
4) List the different sources of error that possibly exist with this technique. How can these errors be minimized?
5) Determine if taking the average of all groups strengthen or weaken the estimates for the Brook Trout population and give reasons for each.

Activities:

1) Have students find out how other animal populations are censused.
2) Research why knowing fish populations are important for fisheries biologists and researchers.
3) Compare the average population calculation with the initial average population. Guess and discuss the possible reasons for any differences. Have students determine the accuracy of the average guess and average calculation by counting all the fishes in the jar. Convey this is a luxury fishery biologists and researchers never have!