The Education Program at the
New Jersey Sea Grant Consortium
22 Magruder Road Fort Hancock, NJ 07732 732-872-1300   njseagrant.org

CATCH, TAG and RELEASE

OVERVIEW

Determining the number of fish living in a given body of water is crucial to maintaining fish stocks and preserving species. During this lesson, students participate in a simulation of fish tagging and recapture, a method used by marine biologists and fisheries managers to estimate fish populations.

OBJECTIVES

Following completion of this lesson, the students will be able to:
1. Apply estimation strategies for problem-solving purposes;
2. Become familiar with one aspect of a marine biologist's work.

GRADE LEVELS

6th - 12th grades

NJCC STANDARDS

Science Indicators:
5.1, 5.3, 5.4
Mathematics Indicators:
4.5A, 4.5C, 4.5D, 4.5E, 4.1A, 4.1C, 4.4

MATERIALS

- One bag each of two flavors of goldfish crackers (pretzel and cheese work best) or bingo chips, beans or other small objects that can be used as "fish."
- One goldfish bowl or similar holder.
- A large scoop (such as one used for ice cream or flour).
- Markers, paper, pencils, calculators (optional).

PROCEDURES

To begin, ask students how they might figure out how many fish of a particular kind (i.e. windowpane flounder) live in a given area (i.e. Sandy Hook Bay). Following a group discussion where all answers are accepted and evaluated for validity, explain to students that they will participate in a fish tagging and recapture activity that simulates one method used by marine biologist and environmental managers to estimate fish populations.

To start activity, pour one bag of crackers or bingo chips/beans/etc. into the fishbowl. Have students guess how many crackers are in the bowl. Record all guesses. Discuss estimation strategies. Next, take out a scoop of crackers. Count them. This will be your total tagged sample. "Tag" them by replacing them with the second variety of cracker or by marking them in some way, such as a dot from a magic marker. Then, throw the "tagged" fish back into the bowl. Mix them up. Take out another scoop. Count them. How many are "tagged?" Set up a table like the one below (the numbers here are examples; yours will vary):

TRIAL	**1**	**2**	**3**	**4**	**5**	**6**
n	2					
t	18					
T	24					
N	?					

From this table you will eventually set up a proportion to solve for the total of goldfish in the bowl using the formula described in the next section of this lesson plan.

You could make an estimate of the number of goldfish in the bowl from one try, but the odds are it wouldn't be accurate. In order to get a fair sample allowing for random distribution, you must average the results of several attempts. Record each count. Your table then might look something like this:

TRIAL	**1**	**2**	**3**	**4**	**5**
t	2	4	2	3	0
n	18	21	15	18	16
T	24	24	24	24	24
N	216	126	180	144	0

There are several ways to use the data collected from the goldfish cracker activity.

1. The class can find the average of the calculated N's and use this as an estimate:

   216 + 126 + 180 + 144 = 666   666/4 = 167

2. Or treat the samples as one large sample and calculate N:

   t = 2+4+2+3+0=11 n = 18+21+15+18+16=88   T= 5x24=120

Or:

$$\frac{T}{N} = \frac{t}{n} \rightarrow \frac{120}{5N} = \frac{11}{88} = 192$$

Are both answers (167, 192) reasonable?

BACKGROUND

The relationship between tagged and untagged fish and the subtotal and total population of fish can be expressed using the following formula:

$$\frac{T}{N} = \frac{t}{n}$$

T = number of fish tagged
N = total number of fish in area
t = number of tagged fish recaptured in second sample
n = total number of fish captured

For example, imagine that 40 flounder were caught, tagged, and released. Next, 10 were recaptured, and half of those had the scientists tag. The equation would look like this:

$$\frac{40}{N} = \frac{5}{10}$$

By solving for N, the scientist can estimate that there are 80 windowpane flounder in Sandy Hook Bay.

Ask students how this information might be valuable to the marine biologist or fisheries manager? (setting catch limits, protecting fish stocks)

EXTENSIONS

Student can check the result by counting all the goldfish crackers. Compare to original estimates. Try variations with the numbers of samples taken. What effect does taking 10 samples have on the result --15--2? Ask students to devise a rule of thumb for a minimum number of samples that is likely to yield an accurate estimate? Ask them to set up criteria for an accurate estimate.

Rev. 11/11/10

Sea Grant
NJ Sea Grant Consortium

The New Jersey Sea Grant Consortium (NJSGC) is an affiliation of colleges, universities and other groups dedicated to advancing knowledge and stewardship of New Jersey's marine and coastal environment. NJSGC meets its mission through its innovative research, education and outreach programs. For more information about NJSGC, visit njseagrant.org.