Fiddle Facts

Grade Level

5th-12th

Objectives

* To develop skills in estimating population sizes.

* To be able to describe fiddler crab behavior.

* To be able to describe sexual selection and provide examples.

N.C. Standard Course of Study

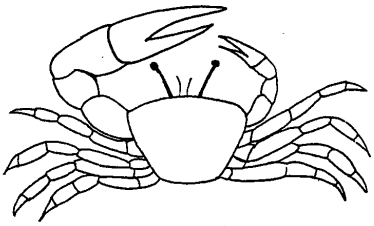
Biology
(Bio.2.1.2, Bio.2.1.4)

Overview:

Through a classroom exercise and a field activity students will study fiddler crab behavior and learn how populations of organisms are scientifically estimated.

Materials:

- ruler
- quarter
- paper
- pencil
- calculator
- fiddler crab population page (included)



Background:

It is quite a sight to see a colony of fiddler crabs scurrying across a mud flat. These tiny crabs are among the most abundant and interesting of all the animals in the estuary. Fiddler crabs (*Uca pugilator*) are found in large numbers digging holes in the mud flat at low tide. As you approach, hundreds of these tiny creatures momentarily freeze, and then scurry down into their burrows out of sight. If you sit quietly and watch them you will notice that the male crab has a huge claw that it waves back and forth. This movement of the claw is why this crab is called “the fiddler”. Female fiddler crabs are a little smaller, less colorful than the male and lack the large claw.

The eyes of a fiddler crab sit up on stalks away from the body which allows the crab to see in all directions. If a bird flies over a nearby crab colony, the fiddlers will run to the entrances of their burrows using a strange sort of sideways walk. If the bird continues to approach, they will disappear. The males, more conspicuously colored, will be the first to hide from the predators and the last to sneak back out of their burrows once danger has passed.

The burrow serves several purposes for the crab. It protects them from predators, is used during mating, and protects the fiddler crab from the incoming tide. The crab digs a burrow by pushing the legs on one side of its body into the ground, then pulls up a lump of soil and carries it away from the entrance of the hole. The sides of the burrow are constantly smoothed with the walking legs. The fiddler crab will dig its burrow until it reaches the level of ground water where the earth is

moist. When the tide rolls in, the crab pulls sections of soil toward the inside of the burrow with its feet and forms a thick plug over the entrance to the burrow. The fiddler is left inside, dry and protected from the salt water and from predators.

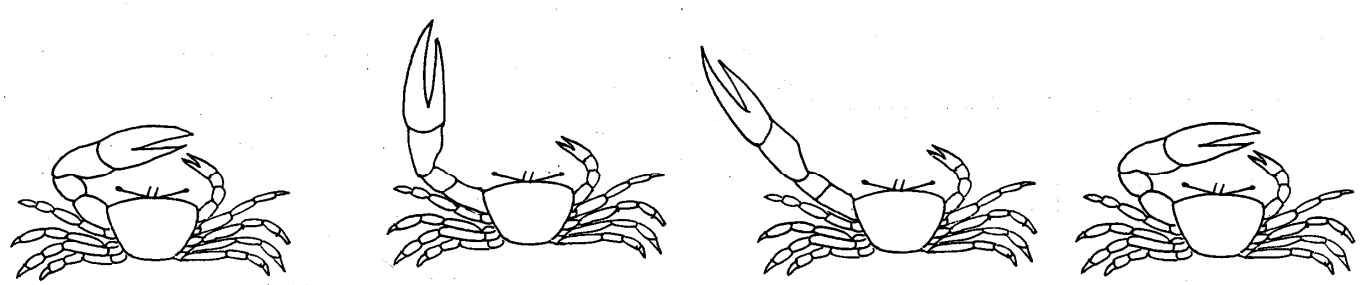
The Big Fight

Sometimes you can see two male crabs carrying out a ceremonial fight over a female or a territory. The two crabs approach each other with a stiff-legged walk (like two cowboys in an old western movie), and take turns hitting each other with their large claws in an attempt to push away or overturn the other crab. These fights are actually a fixed behavior and do not cause either crab serious injury. If one crab dances around with more of an implied threat, it "wins" and the other crab will usually flee into its burrow.

The Mating Dance

Male fiddler crabs also use the large claw to attract a female. The male will situate himself beside his burrow and if a female approaches, the male will repeatedly bow down and vigorously wave its large claw at the female. It seems as if the male is waving and inviting the female over. If the female selects that male as a mate, she will follow him down into the burrow where mating occurs.

Crab waving



Sexual Selection

The huge claw on the male fiddler crab seems to have evolved for two purposes: mate attraction and ceremonial fighting. The claw is so large and cumbersome, that it is of little use to the crab in getting food. Evolutionary biologists believe that the claw of the fiddler crab is an example of sexual selection. Sexual selection occurs when an organism develops a trait that appears to be in opposition to survival but is advantageous to getting a mate.

Charles Darwin believed that as males of a species competed for mates, some of the males would randomly be born with strange characteristics like a large claw. Darwin suggested that females would select these unusual males to mate with because they appeared to be good at surviving even though they had some oddity, and thus the trait stayed around in the gene pool and was passed on to the offspring. There are a number of other examples of sexual selection: horns on a deer, feathers on a peacock, or coloration on a bird.

Part 1: Classroom Activity:

Biologists are often given the task of taking a population census of organisms in order to determine range and health of that population. Often it is not possible to count every single individual or it is too time consuming. For example, on Sapelo Island, Georgia, biologists have estimated that there are more than eight million fiddler crabs per acre. In this activity you will estimate the number of fiddler crabs on a hypothetical mud flat in North Carolina. You want estimation to be as accurate as possible.

A. Examine the diagram of a fiddler colony. Your task is to estimate the number of fiddler crabs in the total population by taking "random" samples.

B. Take a quarter and flip the quarter until it lands on the diagram of the fiddler colony. Without moving the quarter, draw a circle around it. Count the number of fiddler crabs that lie within or on the circle you drew and record this number. Number of crabs in **circle 1:** _____ This represents your first random sample.

C. Repeat the coin toss until you have a total of three fiddler crab samples. Number of crabs in **circle 2:** _____ Number of crabs in **circle 3** _____

D. Add up your count and divide by three. This gives you the average number of fiddler crabs per circle. **average** _____

E. Calculate the area of your circle (area = πr^2 or ~ 4.9 cm^2).

F. You know the average number of fiddler crabs per circle (part D) and need to estimate the total number of fiddler crabs in the colony. To estimate the total population, multiply your average by 65, since the diagram is about 65 times as big as the area inside the circle. **Estimated population size _____.**

G. If you combine your results with those from others in your class, you should get something close to the actual number of fiddler crabs on the diagram. Ask ten other people for their results and determine the overall average crab population count.

Estimation 1 _____

Estimation 2 _____

Estimation 3 _____

Estimation 4 _____

Estimation 5 _____

Estimation 6 _____

Estimation 7 _____

Estimation 8 _____

Estimation 9 _____

Estimation 10 _____

Total Average _____

Use your data to answer the following questions:

1. How far from the class average of the ten samples was your estimation of the number of fiddler crabs in the colony?

2. Why did different people get different estimations?

3. How accurate do you think your estimation really was? What errors may have occurred?

4. What other populations would scientists need to estimate rather then actually count?

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Fiddle Facts

Part 2: Field activity

Materials:

- meter sticks (or 1 meter quadrants made from PVC pipe and elbows)
- datasheet
- pencil
- tape measure
- calculator
- small metal survey flags or wooden stakes

Schedule a field trip to a salt marsh. Make sure you consult a tide calendar prior to scheduling the trip so that you arrive when the tide is low. Students will need to wear shoes that can get muddy and wet. When you get to the site search for the highest density of fiddler crab burrows and then mark off the area surrounding it with small metal survey flags or wooden stakes. Be sure that your area is fairly large so that several groups of students can work in the area at the same time. The area should span from the high marsh down to the water.

In this activity you will estimate the number of fiddler crab burrows on a section of mud flat. You want your estimation to be as accurate as possible. For the purposes of this activity you will assume one crab is associated with only one burrow. Once you know the number of burrows you can make assumptions about the size of the crab population.

A. Divide class into groups of 5 or 6 students.

B. Examine the size of the colony that you are going to estimate. Each group should randomly select three different regions within the area and measure one square meter. Be sure to select one region near the water, one near the middle and one near the marsh grass.

C. Count the number of crab burrows in each region.

Region 1: number of crab burrows _____

Region 2: number of crab burrows _____

Region 3: number of crab burrows _____

D. Determine the average number of crab burrows in an area by adding your three samples and dividing by three.

Average number of crab burrows per region _____ (*)

Estimate the size of the entire area in square meters. One way to determine the area size is to measure the length and width of the area in meters. Multiply the length times the width to obtain the area in square meters.

Length _____

Width _____

Length _____ m X width _____m = _____ m^2

Estimated size of colony area = _____ square meters (**).

E. Estimate the total number of fiddler crabs in the whole colony. To do this, multiply the average number of fiddler burrows in one square meter by the total number of square meters in the colony overall.

_____Number of fiddler crabs/meter^2 (*)

X _____Colony area in meters^2 (**)

_____Number of total crabs in colony sampled

Obtain and record colony estimates from each of the other groups:

Group 1 _____

Group 2 _____

Group 3 _____

Group 4 _____

Group 5 _____

Group 6 _____

Total _____

F. Determine the average number of fiddler crabs estimated by the class. The average can be obtained by adding the number from each group and getting a total. Divide the total by the number of groups.

Average size of fiddler colony _____

Use your data to answer the following questions:

1. How far from the class average was your estimation of the number of crab burrows in the colony?

2. Why did different groups get different estimations?

3. How accurate do you think your estimation really was? What errors may have occurred?

4. What other populations would scientists need to estimate rather than actually count?

5. If another class came on another day do you think they would get results similar to yours? Why or why not?

Vocabulary:

- population
- estimation
- evolution
- sexual selection
- burrow
- predator
- territory
- colony
- hypothetical

References:

National Science Standards:

Content Standards *Science as Inquiry. [5-8] [9-12]*

Life science. [5-8] [9-12]

Ocean Literacy Principles:

Essential Principles #5. *The ocean supports a great diversity of life and ecosystems. (Fundamental Concept – a, d, f, h)*

Part 1 Questions Teacher page

1. How far from the class average of the ten samples was your estimation of the number of fiddler crabs in the colony?

2. Why did different people get different estimations?

Random sampling is just that: Random. Students should conclude that more samples would give them a more accurate reflection of actual population size.

3. How accurate do you think your estimation really was? What errors may have occurred?

Again students can reflect on sample style and redundancy for better accuracy.

4. What other populations would scientist need to estimate rather then actually count?

There are many examples such as deer, fish, bear, many birds such as pelicans, bald eagles, and plover.

Part 2 Questions Teacher page

1. How far from the class average was your estimation of the number of crab burrows in the colony?
   Same as above

2. Why did different groups get different estimations?
   Random locations were selected to both establish a sampling area as well as random sampling was done by the students when they sampled.

3. How accurate do you think your estimation really was? What errors may have occurred?
   This is subject to different answers by each group. A discussion about errors would be good at this point to see how it might be better if they conducted the sampling again.

4. What other populations would scientists need to estimate rather than actually count?
   As in #4 from the other part, for most animals it is more practical to estimate rather than count because 1) there may be a large population and 2) they may move around a lot and 3) there is less impact on the population if the counts are estimated.

5. If another class came on another day do you think they would get results similar to yours? Why or why not?
   Good question to speculate. Scientists experience different weather patterns will affect the behavior of organisms and cause changes to occur. An example for fiddler crabs behavior change is that they are more active on sunny days than on cloudy, cooler days.

Fiddler Crab Colony