Something's Fishy

Focus

Using tools and materials available on the Web, students will analyze fish seining data. Through this process they will understand that many factors impact ecosystem function and stability.

Learning Objectives

Students will:

- Study and write about biodiversity
- Recognize that biodiversity is a complicated concept and is not easy to quantify
- Compare the physical parameters of two seining locations in Long Island Sound
- Compare certain biological parameters of two seining locations in Long Island Sound utilizing the SEINE Diversity Calculator.
- Become familiar with examples of fish species common to Long Island Sound (LIS) ecosystems
- Apply their knowledge of LIS and utilize real data in order to make predictions about potential human impact on the LIS

Materials

- Online resource articles
- Diversity Calculator from the SEINE Web site
- Long Island Sound seining data
- Student guide sheet

Target Audience

Grades 10-12, but could be adapted for upper middle school students

Teaching Time

Two to four 45-minute class periods

Seating Arrangement

Small Teams (2-3 students)

Background Information

- Resource information about biological diversity, LIS sites, etc.:

1. http://www.lisd/ca/sd/icb/sdvol100num2e.html
2. http://www.canadianbiodiversity.mcgill.ca/english/theory/ecosystemfunction.htm
3. http://carc.org/pubs/v22no1/ecosys.htm

4. http://www.sms.si.edu/IRLSpec/Whats_biodiv.htm
5. http://rewhc.org/biomeasures.shtml
6. http://www.countrysideinfo.co.uk/simpsons.htm
7. http://www.fishbase.org/search.php

- There are several widely accepted diversity indices. Because diversity tends to decrease as environmental stress increases, using a diversity index can help to quantify and compare the relative health of an ecosystem. For example, a comparison of calculated diversity values could illustrate changes in water quality conditions such as light penetration, dissolved oxygen and salinity, which could have a significant effect on levels of biodiversity.

- The SEINE diversity calculator is a computer application that may assist in demonstrating how population changes impact an ecosystem. All diversity indices assume the following:

    1. The categories (species) are well known
    2. All categories (species) are equally different
    3. A measure of "species importance" should be used, such as the number of individuals, biomass, etc.
    4. The community being studied is well defined

- The following definitions about the various indices will be useful when using the SEINE Diversity Calculator:

    1. Species Richness, **S** = the total number of different organisms present in a given area
    2. Diversity Index, **D** = the probability that two randomly selected individuals belong to the same species. The lower the value the greater the diversity.
    3. Index of Diversity, **1-D** = the probability that two randomly selected organisms belong to different species. The greater the value the greater the diversity.
    4. Reciprocal Diversity Index, **1/D** = the number of equally common species that will produce the observed Diversity Index
    5. Shannon Index, **H** = measures the order or disorder within a system.
    6. Evenness, **E** = a measure of how similar the abundance of different species is. Similar abundances will correspond to a value of 1.00. Dissimilar values will cause the Evenness value to decrease.

Learning Procedure

- Students will be shown information slides about two seining sites in Long Island Sound: LSHR (Mouth of the Housatonic River) and LSCB (Clinton Beach)
- Teams of students should consider information about the two seining sites as well as the rivers that lead into them in a way that will allow them

to brainstorm ideas about how the two estuarine ecosystems are different and how they are alike
- Students will be asked to come to consensus about which of the two sites may be experiencing the greatest environmental "stress"
- Teams of students make predictions about how the diversity may or may not be impacted by stress, recording their ideas as they go along.
- Using the sets of seining data students will practice with "fake numbers" before comparing sets of genuine data. This will allow students to see what happens to each diversity index under very specific conditions.
- Distribute student activity sheet (see last page of this activity)

Extensions

- Have teams of students use the diversity calculator to compare differences between sites at each station (location)
- Challenge students to research the niches of each represented species at each site. Which fish are considered to be most tolerant of stress? At what sites are these fish more abundant?
- Have the class contact Jose Pereira at NMFS to obtain site data on salinity, temperature and dissolved oxygen. Students should compare the two sites with respect to these parameters and use this new information to broaden their generalizations about the impact of stressors on diversity.

CT State Science Standards

- *Heredity and Evolution – What processes are responsible for life's unity and diversity?*

  10.5 - Evolution and biodiversity are the result of genetic changes that occur over time in constantly changing environments.

  - Mutations and recombination of genes create genetic variability in populations.
  - Changes in the environment may result in the selection of organisms that are better able to survive and reproduce.

- *Science and Technology in Society – How do science and technology affect the quality of our lives?*

  10.6 - Living organisms have the capability of producing populations of unlimited size, but the environment can support only a limited number of individuals from each species.

  - Human populations grow due to advances in agriculture, medicine, construction and the use of energy.
  - Humans modify ecosystems as a result of rapid population growth, use of technology and consumption of resources.

Something's Fishy: Student Guide Sheet

1. After receiving instructions from your teacher, use the **SEINE Diversity Calculator** to determine the diversity index for the following simulated populations of fish.

Case I: Few species, equally represented

Species	Number
Silverside	40
Mummichog	40
Pipefish	40
Total	*120*

Case II: Many species, equally represented

Species	Number
Silverside	20
Mummichog	20
Pipefish	20
Killifish	20
Puffer	20
Tautog	20
Total	*120*

Case III: One dominant species

Species	Number
Silverside	95
Mummichog	5
Pipefish	5
Killifish	5
Winter flounder	5
Tautog	5
Total	*120*

2. Study the results for Case I and Case II. Describe how their diversity indices compare. For example, if a low **D** value means greater diversity, which Case had greater diversity and why? Which diversity index was the same for both? Explain why.

3. Now study the results for Case III in which one species dominated. Compare it with Case II. Both Cases have the same number of species, but not the same diversity indices. What else, besides the number of different species, must play an important role in ecosystem health?

Stop here for class discussion & reflection.

4. Use the diversity calculator to input real seining data (2005) from LSHR (Housatonic River estuary location at CT Audubon) and LSCB (Clinton Harbor location) as directed by your teacher. Remember that each location will have data for three "sites" along the beach. You should combine the data from all 3 sites before entering the values into the diversity calculator! Keep careful record of the diversity indices at each of the sites. Your instructor may ask you to make a data table.

5. Using what you learned in items 1-3 above, compare the diversity indices at the two sites throughout the summer of 2005. Develop a series of generalizations or conclusive statements about diversity at the two sites. Use the questions below as a guide, but do not let them limit you.

- Describe your findings and try to explain what they mean.
- Are there distinct and consistent trends?
- Do any of the results surprise you? (Compared to your initial predictions!)
- Suggest some variables that the diversity calculator may not take into consideration, but which may be important.
- What new information would you like to have before finalizing your conclusions?