The Ecological Function of Oysters in the Chesapeake Bay
A MWEE for AP and Honors Environmental Science Classes

Taken from Module 3 of **Experiencing the Chesapeake Bay: Pathway from High School to the Environmental Sciences** – a NSF supported program which partners Morgan State University Estuarine Research Center and W.E.B. DuBois High School.

Overview

In this teaching module, the students will be introduced to the important ecological roles, life history, and habitats of oysters in Chesapeake Bay. The current impacts of oyster restoration and management will also be discussed.

Objectives

- Understand the basic ecological roles of oysters in the Chesapeake Bay ecosystem.
- Introduce the current impacts of oyster restoration and management.
- Conduct an oyster feeding experiment to demonstrate the value of oyster filtering in the Chesapeake Bay ecosystem.

Background

Excerpted from the Chesapeake Bay Foundation Website - (http://www.chesapeakebay.net/bfg_eastern_oyster.aspx)

The Eastern Oyster

The **Eastern Oyster** (*Crassostrea virginica*) is one of the most famous and recognizable aquatic species in the Chesapeake Bay

The eastern oyster is a bivalve mollusk with rough shells that vary in color from grayish to white.

- The right, or top, valve (shell) is flat.
- The left, or bottom, valve is cupped and has a purple muscle scar on the inside.
- The size and shape of the shells varies depending on the oyster's environment, but they generally grow to about an inch per year.

Where does the eastern oyster live?

- Oysters can be found in shallow areas of the Bay and its tributaries, from depths of 8 to 35 feet.
- Oysters range from brackish waters to the salty lower Bay (~ 5-35 ppt).
- Oysters are concentrated in areas with shell, hard sand or firm mud bottoms. These areas are called oyster bars or beds.

- Oysters attach to one another, forming dense reefs that provide habitat for many other fish and invertebrates.

How does the eastern oyster reproduce?

Oysters spawn in early summer in response to rising water temperatures.

- Adults release eggs and sperm into the water, where they are fertilized. Females can produce about 100 million eggs per year.
- After spawning, oysters are thin and watery because they have used up their stored food reserves. They grow larger and stronger as the weather cools.
- In less than 24 hours the fertilized eggs develop into larvae.
- For the next two to three weeks the free-swimming larvae grow until they are ready to settle.
- During this time they develop an eyespot and a foot, which is used to crawl and "explore" a surface before settlement.
- When they reach this stage, they have 48 hours to find a hard surface
- When they find a suitable surface to settle on, the larvae secrete a liquid cement-like substance, which fixes the left valve into place. Attached juvenile oysters are called spat.
- Oysters are able to change gender. During their first few months they are bisexual. By their first winter, most become male; in another year, most become female.

How do Oysters Feed?

Oysters are filter feeders. This means that they feed by pumping large volumes of water through their gills and filtering out plankton and other particles. As they filter water to get food, oysters also remove nutrients, suspended sediments and chemical contaminants, helping to keep the water clear and clean for bay grasses and other underwater life. One oyster can filter more than 50 gallons of water per day.

How do Oysters Provide Habitat and Food?

Oysters provide underwater habitat in the form of aquatic reefs. With their many nooks and crannies, oyster reefs can create 50 times the hard surface area of an equally sized flat mud bottom. Hundreds of Bay creatures, including sponges, sea squirts, small crabs and many species of fish, need hard surfaces like those found on aquatic reefs to survive.

In addition to providing habitat, oysters are a source of food for a host of animals.

- Oyster larvae are eaten by anemones, sea nettles and other filter feeders.
- Flatworms and mud crabs feed on new spat.
- Older spat and first-year oysters are preyed upon by blue crabs and some species of fish.
- Oysters lying exposed on intertidal flats are food for some shorebirds, such as the American oystercatcher.

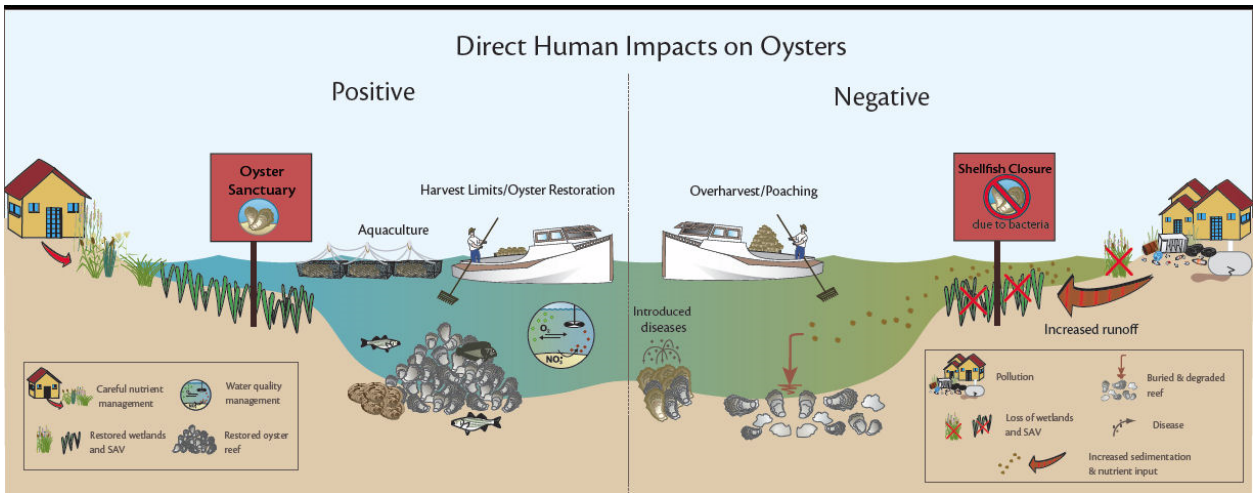
Oyster restoration and management

The eastern oyster is a Chesapeake Bay icon. Since the late 19th century, the oyster industry — including the catch, sale, shucking, packing and shipping of oysters — has contributed millions of dollars to the region's economy and built a rich history and cultural heritage in the Bay region.

Oysters have been around for millions of years - they were used for food, tools, weapons and decoration. During the early 1600s in the Chesapeake region, oyster bars were so numerous and large, that they were reported as navigation hazards by Captain John Smith. Today, the state of the oyster fishery in the Chesapeake has dwindled to less than one percent of its historical mass. Key reasons for this decline include:

- Overharvesting
- Habitat Destruction
- Disease
- Sedimentation and pollution

The following figure shows the direct human impacts on Oysters.



Restoring oysters to ecological prominence in the Chesapeake Bay will take dedicated scientific research and innovation. Work is underway in several areas, including:

1. **Disease** - From ecologists to molecular biologists, scientists are working to better understand the two parasites responsible for major Chesapeake Bay oyster mortalities, Dermo and MSX.

2. **Disease-resistance** - Researchers in the mid-Atlantic are partnering through

CROSBreed to develop hatchery-raised strains of native Chesapeake oysters that have been bred to resist both MSX and Dermo.

3. **Oyster planting** - Disease-free oyster spat from the Horn Point Laboratory's hatchery fuels the work of the Oyster Recovery Partnership (ORP), a diverse collaboration of stakeholders working to produce and plant oyster spat on shell for various restoration projects throughout the region.

4. **Reef reconstruction** - With the large natural oyster reefs mostly gone, where do you plant the oyster spat? Reef reconstruction is largely seen as a solution, but questions remain. Where should they be located? What size should they be? How many reefs will it take to make a difference? Scientists are researching the answers to these questions and more, including the ecological value of reefs and oyster longevity in relation to disease and reef structures.

5. **Aquaculture** - What is the future role for aquaculture in the Bay? How might it work? What are the best policies to promote an appropriate oyster aquaculture industry in Maryland?

Oyster Feeding Experiment

Materials Needed

- PowerPoint presentation on oysters in the Chesapeake Bay.
- Nine 12 L fish tanks filled with 7.5 L of River water.
- At least 33 similarly sized live oysters that have been cleaned of attached organisms.
- Live phytoplankton cultures to use as oyster food.
- 100 ml graduated cylinder
- Air pumps and air stones.
- 2 ml disposable pipettes.
- Hand-held Aqua-fluor fluorometer and cuvettes.
- Student lab sheet.

Preparation

- Review the PowerPoint presentation The **Chesapeake Bay Oyster**. Modify this presentation to best convey this information to students.
- Copies of the final oyster feeding experiment and student lab sheet will be distributed to students during the field trip.

Procedure

- Setting up the experiment- Different densities of oysters per tank
    - Each treatment will be based on the number of oysters in the tanks: control (no oysters); low oyster density (1 oyster) and high oyster density (10 oysters).
    - Each treatment will have three replicates (three tanks).
    - Each tank will be filled with 7.5 liters of Patuxent River water.

- Starting the experiment- adding live algae
  - Add the same volume of algae to each tank (this amount will be determined by cell density of culture).

- Adding oysters to control and treatments (3 replicates)-
  Add oysters-
  - The control will contain no oysters.
  - The low treatment will contain 1 oyster.
  - The high treatment will contain 10 oysters.
  - Each treatment and the control will have 3 replicates.

- Taking initial fluorescence readings
  - Immediately stir each tank and pipette 2 ml of water into a cuvette- use the fluorometer to take the initial fluorescence reading for each tank.
  - Record the reading on the lab data sheet.
  - Explain the relationship between fluorescence and amount of algae in the water.

- Every 30 minutes for 1.5 hr take another reading for each tank
  - Follow the procedure of the initial reading.
  - Record the average of the replicate fluorescence readings on the lab sheet.

Interpreting the results

- Plotting the data:
  - Use the student lab sheet to plot the fluorescence reading for the 3 treatments for each time period.
  - Based on the fluorescence reading (the max and min fluorescence readings), the scale of Y-axis may need to be modified.
  - Try to use different colors or symbols to represent different treatments.

- Based on the results, have teams of students discuss the following questions:
  - What are the ecological roles of oysters in the Chesapeake Bay?
  - What is the importance of oyster restoration in the Chesapeake Bay?

Note: The afternoon lab group will continue the oyster experiment that was started in the morning by the first lab group. At the end of the experiment there will be readings taken at 6 different time periods. At the end of the day, the entire group will gather to discuss the results of the experiment.