Ghostbusting the Chesapeake

Lesson Time : 45 minutes
Grade Level : 6-12
Vocabulary: marine debris, derelict crab pot, ghost pot, bycatch

Summary
Even when crab pots are lost or abandoned at sea, they continue to catch animals. The unintended victims of the pots typically cannot escape, and are trapped until they die. This bycatch can include crabs, fish, diving birds and turtles. The pots or other gear will continue to fish until, after many years on the sea floor, they finally decay. Through a special program at the Virginia Institute of Marine Science, scientists are working with watermen to collect derelict, or "ghost" crab pots and fishing nets that have been lost or abandoned. Students will explore catch data collected by the watermen from the ghost pots.

Objectives

- Analyze column graphs of data from recovered derelict fishing gear
- Analyze pie charts of animal species caught in derelict fishing gear
- Calculate the loss of potential catch caused by derelict fishing gear
- Calculate percent composition and percent change
- Describe the ecological impacts (+ and -) of ghost pots

Introduction

Marine debris comes in all shapes and sizes, from balloons and soda bottles, to sneakers and even boats! Essentially anything that has been lost or abandoned and is not supposed to be in the ocean or on the sea floor—naturally—is marine debris. Very often, marine debris can cause serious harm to the plants and animals that live in the ocean, injuring or killing them, and cause problems for people swimming or boating.

Carried from land to the ocean by wind, streams, and rivers, debris can then be transported by ocean currents around the globe. During the 2016 International Coastal Cleanup, 470,000 volunteers picked up more than 7.5 million pounds of marine debris. Though this is a very impressive haul, there are still millions of pounds of trash and debris that plague our ocean and coasts.

Commercial Crabbing in Virginia
The extraordinarily popular blue crab, *Callinectes sapidus*, has been a staple in Chesapeake Bay's

long fishing history. In Virginia, all crabbing (commercial and recreational) is regulated by the Virginia Marine Resources Commission (VMRC). As in most states where blue crabs are found, commercial crabbing requires a limited-quantity license. The license dictates how many crab traps, or pots, the waterman is allowed to put into the water, the type of pot, and the time of year he or she is allowed to set out pots.

Two different types of pots are used in the blue crab fishery, depending on which life stage of crab the watermen are targeting. The typical hard crab pot is very familiar to coastal residents and tourists in the Mid-Atlantic. The peeler pot is used to catch crabs preparing to molt, or peel out of, their existing shell (exoskeleton) as they grow in size. This pot has the same shape, but it has smaller openings and a slightly different architecture, due to the bait that is used. In one version of the peeler pot, instead of using food to lure molting females, watermen will place between one and three adult male crabs in the trap to attract females. Shedding females are in search of a mate and respond to chemical cues released by the males. Once peelers are removed from the pot, they are transferred to land-based shedding tanks and left to shed their exoskeletons. The resulting soft-crab is then processed, packaged, and sold.

Crab pots are set out on the Bay floor and have a tethered buoy so that the watermen can find and retrieve them again. These buoy lines are occasionally cut if other boaters accidentally run over the buoys, or the lines can disintegrate with age. The result is an unmarked, and often irretrievable, pot. Pots can also be lost due to strong storms. Rough seas may push the pots out of the waterman's usual work area, or roll the pots, which causes the buoy lines to tangle and results in the buoy floating below the water's surface, where it cannot be seen by watermen. On average, watermen may lose approximately 20% of their crab traps in a single season. In 2009, Virginia issued 1,867 commercial crab pot licenses. Those 1,867 licenses accounted for 392,175 pots (both hard crab and peeler pots; Havens et al., 2010). When these pots are lost or abandoned, they continue to catch animals, and because the derelict pots (also known as ghost pots) can no longer be found by the watermen, they are not emptied, and in most cases, the animals caught inside die, until the pot can no longer fish.

Ghost pots have a varying life expectancy depending on their construction. On average, a galvanized wire pot can continue to ghost fish for about two years before it is too broken down. However, vinyl-coated wire pots can continue to ghost fish for roughly four years.

Despite all of the negatives, there is some good that may come from a ghost crab or eel pot (used to catch American eels, which are mostly exported to Europe and Asia). The wire of these pots has been found to be a very good place for oyster larvae to set and aggregate. This map shows areas where ghost pots were removed that had attracted substantial oyster settlement.

A Problem and A Solution

As a result of a drastically low blue crab population, the VMRC decided to close the winter crab dredge fishery in 2008. In this fishery practice, watermen drag a heavy iron frame with teeth across the sea floor, dislodging buried crabs, which are then deposited into a bag behind the toothed frame. Most often, these dislodged crabs, which bury in the sediment in winter to escape cold Bay waters, are gravid, or pregnant, females. Removing gravid females further hurts the failing population.

In order to supplement the income lost due to the winter dredge season closure, a new program, funded by the National Ocean and Atmospheric Administration (NOAA) and the VMRC, was begun at the Virginia Institute of Marine Science's Center for Coastal Resources Management in 2008. Fifty-eight watermen, who were affected by the seasonal closure, were employed in Year One of the Virginia Marine Debris Location and Removal Program. Eight additional watermen were added in Year Two. All project participants received training and specialized gear, including a side-scan sonar imager, waterproof digital camera, maps, and data sheets. Most watermen used their usual crab-dredging vessel for the project. Training included NOAA marine mammal avoidance protocols, side scan sonar use, proper crab pot retrieval techniques (to reduce the amount of Bay floor disturbance) and proper data collection methods.

The watermen were restricted to 49 days of on-the-water work between December and March, and were paid $15,000 each, plus fuel and incidentals. This compensation equaled, or even exceeded the average watermen's earnings from dredging blue crabs during the winter season (Havens et al., 2010).

Upon retrieving ghost pots and nets, watermen recorded their contents, photographed the gear, and emptied it. The watermen were then free to reuse viable components, recycle the gear, or dispose of it at the dump.

Data Activity

Applying the information you have learned above, you can now explore catch data reported by watermen involved in the derelict crab pot project from 2008 through 2012. All data used below are available for your own investigation in this spreadsheet: GhostPotData_2008-2012.

Download the Student Worksheet and complete the following analyses.

Gear Data

Using Figure 1, a column graph of removed fishing gear, answer the following questions. (Note: If your students need additional work creating their own graphs, please see Table A in the above Excel workbook for these data, which can be graphed by hand or in Excel.)

1. How many total items were removed from water during the four years of the project?
2. Of all items removed from Bay waters, which kind of item was removed in the greatest number?
3. For each of the gear types, and other debris, calculate the percent composition of the total material removed during this program. (individual gear count / total count) x 100

4. Calculate the percent change in each gear type between each of the four years. Be sure to indicate whether the change is positive or negative.
   For example: [(Year2 count – Year1 count) / Year1 count] x 100

Catch Data
Using Figure 2, pie charts of major bycatch categories, answer the following questions. (Note: If your students need additional work creating their own graphs, please see Table A in the above Excel workbook for these data, which can be graphed by hand or in Excel.)

1. What two animal species were caught in the highest numbers across all four years?
2. What percentage did each of these two species account for in each year's total catch?
3. Calculate the percent change in the number caught of these two species between the two years. Be sure to indicate whether the change is positive or negative.
   For example: [(Year2 percentage – Year1 percentage) / Year1 percentage] x 100

Catch per Unit Effort (CPUE) Data
1. Fill in (a) and (b) in the table to calculate the average number of pots recovered per waterman during the four project-years.

Economic Data

1. Based on Table 1 above, how many total pots (not including nets or other debris) were recovered during the four years of the project?
2. If we assume that 50 crabs per season are caught in each ghost pot, how many crabs are saved, per season, by removing four year's worth of ghost pots?
3. If 6.6 crabs yields 1 kilogram of crabmeat:
   - How many kilograms of crabmeat can be potentially saved for the future years' harvest?
   - Convert the kilograms of crabmeat to pounds? (1kg=2.2 pounds)
4. Crabmeat sells, on average, for $20.00 per pound (wholesale). How much is the saved crabmeat potentially worth?

Discussion

1. Based on Figure 1, why do you think there was an increase in the removal of most types of gear in Year 2 of the project?
2. Why was a substantially higher number of crab pots removed than any other type of gear in both years of data?
3. If more shallow areas were the focus in Year 2 of the project, why might this explain the lower number of nets recovered in Year 2?

4. Based on Figure 2, why do you think the watermen recovered more female blue crabs than male blue crabs in all four years?
5. What is it about the toadfish and whelk's life histories that make them susceptible to being caught in the different types of crab and eel pots?
6. Describe the advantages and disadvantages of the derelict crab pot removal program.
7. Discuss additional ideas for removing derelict crab posts and other marine debris.

Extensions

- Design an excluder device for crab pots that would prevent bycatch from entering the pots.
- Design a crab pot that would not continue to fish after it was lost. (Example: CCRM degradable crab pot panels: http://www.faqs.org/patents/app/2009024968)
- In groups, have students place objects along a path; have a different group of students produce hand-drawn side scan sonar-like images of the debris; have a third group of students develop a system for removing the debris based on the sonar images.
- Incorporate latitude and longitude studies into the gear removal data.

This lesson was written by staff educators at the Bridge Ocean Education Resource Center in collaboration with Virginia Sea Grant. If reusing, presenting, or adapting this lesson please credit the Bridge Ocean Education Resource Center and include the URL below.

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