SCIENTIST IN RESIDENCE PROGRAM™

Science Unit: Marine Communities & Fisheries

Lesson #2: Bycatch Simulation Activity

Lesson Summary:
In this lesson, students review major ocean threats including overfishing, pollution (runoff, plastics, oil), habitat destruction, warming and ocean acidification, and discover that fishing is the greatest threat to our oceans today. Overfishing, bycatch and habitat damage and the most significant concerns associated with fishing, and the sustainability of a fishery depends largely on the type of fishing gear used.

Grade level:	Presented to grade 4/5 and 5; appropriate for grades 3 – 7 with age appropriate modifications
Duration of lesson:	1 hour and 15 minutes

School Year:	2015/2016
Developed for:	George M. Weir Elementary School, Vancouver School District
Developed by:	Jean Marcus (scientist); Amber Burma and Angelina Yu (teachers)

Learning Objectives

In this lesson, students will:

1. Brainstorm and review major ocean threats.
2. Discover that how we fish matters since gear types greatly determine whether a particular fishery is sustainable or not.
3. Explore how fishing with bottom trawls can damage habitat and catch unwanted species (bycatch).
4. Measure bycatch in a simulated fishing activity.

Materials

The materials below are for ONE group. Groups of four students work well.
- Aquarium (glass Tupperware container 8x6 inches)
- Decorative sand (1 bag, 300g)
- 40 small beads
    - 3 colours: yellow = shrimp, orange = crab, brown = flatfish
- 5 mini pom-poms (green; to simulate sea turtles)
- 1 pipe cleaner (cut up into 4-5 small pieces to simulate habitat like coral, sponges)
- 1 small hand-held mesh strainer
- 3 small containers for sorting beads (or 1 ice cube tray)
- 1 Worksheet #1
- 1 pencil

Vocabulary

Word:	Brief definition
Fishing methods	The variety ways to catch fish. Fishing methods can damage the seafloor (i.e. bottom trawling and dragging) and other methods can have little impact on the seafloor (i.e. long-lining, hook-and-line fishing and trap fishing)
Overfishing	The fishery is being exploited above a level which is believed to be sustainable in the long term, with no potential room for further expansion and a higher risk of stock depletion/collapse
Trawling	Dragging a trawl net through the water or along the seafloor (called bottom trawling) to catch fish or other commercially important species (e.g. shrimp)
Bycatch	Unwanted fish and animals caught accidentally in fishing gear and discarded overboard, dead or dying
Organism	An individual living thing, like an animal or plant

Background Information

There are many threats to our global ocean today, including overfishing, pollution (runoff, plastics, oil), habitat destruction, warming, and ocean acidification. Perhaps surprisingly, many scientists argue that fishing is the currently the greatest challenge facing global marine ecosystems. This is because commercial fishing can lead to overfishing, bycatch and habitat damage. The type of fishing gear greatly determines if a particular fisheries is sustainable or not; for example bottom trawling can damage habitat and catch unwanted species (bycatch), while shrimp and crab traps have minimal habitat impacts and do not usually catch other species. This lessons explores the negative impacts of bottom trawling and challenges students to think about more sustainable ways to fish.

Lesson Detail

Introduction

This lesson provides a general introduction to threats to the ocean, with a focus on the negative impacts of fisheries. Below is a proposed flow for covering all the needed information, and each bullet can be a slide (or series of slides) to guide discussion:

- What do you think are the major threats to the ocean? Review key threats; some examples are:
  o Pollution such as plastics, oil spills
  o Ocean acidification: rising atmospheric carbon dioxide is causing the ocean to become more acidic
  o Fishing: can decrease wild populations of marine organisms and hurt habitat

- What is the most major threat faced by the ocean? Fishing!

- Overview of fishing in Canada:
  - Shift in late 1800s from subsistence fishing to industrial fishing
  - Most fishing used to happen near shore, on continental shelf, in neritic zone
  - But Canadian fishermen are now fishing farther north and in deeper waters. Why and How?
- Fishing facts: Pacific Region
  - 200,000 tons fished from ocean off BC each year
  - Industry is worth over $300 Million
- Most fished species off BC (or whichever area you choose to focus on): e.g., hake, salmon, rockfish, halibut
- Why is fishing harmful?
  - Bycatch: all non-target species brought onboard during any fishing activity. Certain types of fishing gear have high rates of bycatch.
  - Habitat damage: damage caused to the physical seafloor and associated structure forming species including cold-water corals, sponges, seaweed etc. Certain types of fishing gear damage habitat.
  - Overfishing: focus of next lesson.
- Fishing gears: How we fish matters
  - Type of fishing gear greatly determines if a particular fisheries is sustainable or not
  - What types of fishing gear do you know?
- How we fish on the west coast of Canada:
  - Most common gears: Prawn trap, Scuba dive, Groundfish bottom longline, Shrimp Beam Trawl, Groundfish Otter Trawl, Midwater Trawl, Hook and Line, Salmon Purse Seine, Midwater Salmon Gillnet

Purpose of Activity:
Each group will conduct this activity to simulate what trawling for shrimp does to other species (bycatch) and habitat.

Methods and Instructions:

1. Organize students to work in groups of four. Explain that they will pretend to be shrimp trawl fishers. To simulate catching shrimp (orange beads) they will drag a mesh sieve along the sand (to simulate bottom trawling).

2. Aquarium setup: Each group of students sets up their aquarium with a thin layer of sand. After the sand is in place, sprinkle your 40 beads that represent different marine organisms on top of the sand. Place your mini pompoms on the sand to simulate sea turtles. For habitat, place 4-5 pieces of pipe cleaners in the sand to simulate coral and sponges. See photo of set up below.

3. Activity: Each group will conduct 3 passes with the bottom trawl:

    a. To simulate trawling, drag your "net" along the length of the aquarium and shake out the excess sand (over the aquarium). Put the beads, pompoms and pipe cleaners you captured in your sieve (net) into your sorting container. Count the number of "organisms" and "habitat" you collected on Worksheet 1.

    b. Repeat step 1 two more times. After each pass, enter your data in Worksheet 1. Do not disturb your aquarium set up in between trawl passes.

    c. Complete the bycatch calculations on Worksheet 1 using the data you collected.

Closure Discussion

- One student per group shares the results of their bycatch activity with the class. The teacher collates bycatch results and summarizes the range of answers for the class.
- Teacher leads a class discussion on any questions / challenges identified by the students.

Suggested Discussion Questions

1. Ask students to imagine how we can fish more responsibly in general? How can we reduce habitat damage and bycatch?
2. How might we catch shrimp more responsibly? Can you imagine what types of fishing gear might not hurt habitat and/or catch unwanted species?

References

1. Susanna D. Fuller, Candace Picco, Jennifer Ford, Chih-Fan Tsao, Lance E. Morgan, Dorthea Hangaard, Ratana Chuenpagdee. 2008. How We Fish Matters: Addressing the Ecological Impacts of Canadian Fishing Gear. 2008. Ecology Action Centre, Living Oceans Society, and Marine Conservation Biology Institute. <http://www.howwefish.ca>

2. Natascia Tamburello. 2011. SeaChoice.org for Healthy Oceans; Sustainable Seafood: An Educators Guide for Grades K-6. SeaChoice 2011. < http://www.seachoice.org/wp-content/uploads/2011/09/SeaChoiceKit_DL_01062011.pdf>

Bycatch Worksheet

Marine organisms
orange beads = shrimp
yellow beads = crab
brown beads = flatfish
green pompoms =
sea turtles

Habitat
Pipe cleaners = coral, sponges

	Trawl #1	Trawl #2	Trawl #3	Total
Marine Organisms				
Shrimp				
Crab				
Flatfish				
Sea turtle				
Total Organisms				
Habitat				
Coral				

Bycatch = $\dfrac{\text{total \# of crab + flatfish + sea turtles caught}}{\text{total \# organisms caught}}$

= _____

= _____%

For every 1 shrimp you caught, how many others marine organisms did you catch? _____

Bycatch Worksheet (sample)

Marine organisms
orange beads = shrimp
yellow beads = crab
brown beads = flatfish
green pompoms = sea turtles

Habitat
Pipe cleaners = coral, sponges

	Trawl #1	**Trawl #2**	**Trawl #3**	**Total**
Marine Organisms				
Shrimp	4	3	3	10
Crab	2	2	3	7
Flatfish	3	2	2	7
Sea turtle	1	1	4	6
Total Organisms	10	8	12	30
Habitat				
Coral	1	1	2	4

Bycatch   =   total # of crab + flatfish + sea turtles caught
                         total # organisms caught

            =   20
                 30

            =   **66.7 %**

For every 1 shrimp you caught, how many others marine organisms did you catch? ___2.0_