The “Big”eye Catcher

For use with Fish Watch at www.fishwatch.gov

Grade Level
9-12

Materials
- Small “nets” of different size mesh
- 1 bag of colorful goldfish (bigeye tuna)
- 1 bag of orzo pasta (small fish)
- 1 bag of elbow pasta (juvenile fish)
- ¼ bag of penne pasta (sharks)
- 4-5 tablespoons sprinkles
- 1 large shallow container
- Copies of PMI chart
- Copies of Fisheries Catch Record

Audio/Visual Materials
- Projector
- Computers with Internet (one for each group of students)

Teaching Time
Two to Three 45-minute class periods

Seating Arrangement
Groups of three to five

Key Words
- Bycatch
- Non-target species
- Purse seine
- Longline fishing
- Pacific bigeye tuna

Focus
- Bycatch

Focus Questions
- What is bycatch and how does it impact marine species?
- What are the pluses and minuses of longline fishing?
- What are the pluses and minuses of purse seine fishing?

Learning Objectives
- Consider the pluses, minuses, and interesting elements (PMI strategy) as it relates to methods and techniques for fishing bigeye tuna
- Explain the concept of bycatch and why it is a problem
- Discuss ways to minimize effects of bycatch

Background Information

"Bycatch" is the incidental capture of non-target species of marine mammals, sea turtles, seabirds, and fish during fishing. Problems related to bycatch include:

National Science Education Standards

Grades 9-12

Content Standard C: Life Science

- Behavior of organisms

Content Standard E: Science and Technology

- Abilities of technological design
- Understandings about science and technology

Content Standard F: Science in Personal and Social Perspectives

- Natural resources
- Science and Technology in local, national, and global challenges

Ocean Literacy Essential Principles

Essential Principle 6

The ocean and humans are inextricably connected.

Fundamental Concept b

From the ocean we get foods, medicines, and mineral and energy resources. In addition, it provides jobs, supports our economy, serves as a highway for transportation of goods and people, and plays a role in national security.

Fundamental Concept e

Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution and physical modifications (changes to beaches, shores and rivers). In addition, humans have removed

- Impedes or prolongs recovery of animals on the Endangered Species Act list of threatened and endangered species
- Prolonged recovery of overfished stocks and exacerbates overfishing conditions Waste of ocean resources
- Waste of time for fishermen due to increased sorting time, bait loss, and fishing gear damage
- Possible closures of entire fisheries if bycatch levels are too high

Bycatch has long been recognized as a global issue. Bycatch occurs because *fishing methods are not perfectly selective for the target species (including targeted size range and/or sex), or because incidental take of marine mammals, sea turtles, or seabirds may occur as a result of fishing activities. Bycatch may* also occur when regulatory restrictions prohibit retention of particular species, sexes, or size ranges. Therefore, some bycatch occurs in commercial fisheries, and higher rates of bycatch occur in fisheries with less selective fishing methods and practices.

What's Being Done?

For over 25 years NOAA Fisheries Service has been conducting research, implementing fishery observer programs, and establishing various measures to monitor and reduce bycatch. To do this, the NOAA Fisheries partners with many groups and organizations such as researchers/academics, environmental groups, industry groups, take reduction teams, the Consortium for Wildlife bycatch reduction, and others.

Bycatch can be reduced primarily through a combination of developing and then switching to more selective fishing gear and methods, and reducing or changing fishing effort (in time, geographic areas, or within the water column). Research to develop more selective fishing gear is ongoing, and includes innovative new designs that include Turtle Exclusion Devices or other methods of allowing non-target species to find their way out of a trap or net.

NMFS and the fishing industry have made significant progress in modifying fishing gear and practices to minimize bycatch and protected species interactions in federally managed fisheries, including the development of bycatch reduction devices and turtle excluder devices in Atlantic and Gulf of Mexico trawl fisheries, requirement of “pingers” for gillnets in Northeast fisheries (to alert marine mammals to the gear), development of escape vents in trawls in Alaskan and Northwest fisheries, and modifications to pelagic longline off Hawaii and the East Coast, including requirements for circle hooks.

Programs implemented to reduce bycatch generally result in lower levels of bycatch, although the magnitude will vary. For example, seabird bycatch in Alaska dropped a great deal after NOAA Fisheries started requiring seabird avoidance measures including streamer lines in 1997. Streamer lines are long strips of plastic attached to longlines that flap in the wind and scare seabirds off of bait as the longlines are set in ocean waters. Seabird bycatch in Alaska groundfish fisheries have decreased by 80% since streamer lines have been used by Alaska longline vessels.

most of the large vertebrates from the ocean.

Fundamental Concept g

Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean.

Essential Principle 7

The ocean is largely unexplored.

Fundamental Concept c

Over the past 40 years, use of ocean resources has increased significantly; therefore, the future sustainability of ocean resources depends on our understanding of those resources and their potential and limitations.

Fundamental Concept d

New technologies, sensors and tool are expanding our ability to explore the ocean. Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles

Pacific Bigeye Tuna

The Pacific bigeye tuna is one of many types of fish where fishermen struggle with bycatch. While fishermen targeting bigeye tuna often end up with bycatch when using their longlines, bigeye are also inadvertently brought in as bycatch when other fish are being targeted in a purse seine. Additionally, when fishing for the Pacific bigeye tuna, it is common for the bycatch to be juvenile bigeye and yellowfin tuna, which is a huge concern. Almost all of the U.S. commercial harvest of bigeye tuna comes from the Pacific (the Atlantic fishery is small). About half is caught incidentally by the purse seine fishery targeting skipjack throughout the tropical eastern Pacific; this catch is canned along with skipjack and yellowfin and sold as “light” tuna. The Hawaii longline fishery harvests the other half. A small amount of this fresh catch is exported; the remaining fresh supply is sold in U.S. markets. U.S. West Coast–based commercial fisheries no longer harvest much tropical tuna (yellowfin, bigeye, and skipjack) — less than 1 percent of the eastern Pacific-wide catch.

Bigeye tuna are an important part of the tuna fisheries throughout the Pacific Ocean and are caught by both surface and deeper longline gears. There are two stocks of bigeye in the Pacific – the western and central Pacific stock and the eastern Pacific stock. In the western and central Pacific, large distant-water longline fleets from Japan and Korea and smaller, fresh sashimi longline fleets based in several Pacific Island countries harvest the majority of bigeye tuna. In the eastern Pacific, the commercially important tropical tuna species (yellowfin, bigeye, and skipjack) are mainly harvested by vessels from the Central and South American fishing fleets.

U.S. commercial fishermen harvest bigeye tuna incidentally in the purse seine fishery and with deep-set pelagic longlines on the high seas. Other domestic fisheries harvest smaller amounts of bigeye tuna. Although none of these fishing gears typically impact habitat, purse seines and longlines sometimes incidentally catch other marine species. Many purse seine fishermen use fish aggregating devices (FADs) to target tunas. FADs are natural floating or man-made objects that are found or placed on or near the ocean surface and used to attract schooling fish underneath. However, FADs can also attract non-target and bycatch species, including juvenile tunas, sharks, other fish, and occasionally protected species. Bycatch of juvenile yellowfin and bigeye tuna is the most significant issue in the purse seine fishery. In the eastern Pacific and western and central Pacific, purse seiners are prohibited from fishing in certain areas and with FADs at certain times of the year to regulate fishing effort and reduce bycatch of juvenile tunas. Fishermen are also required to retain all tuna caught in the purse seine fishery. This measure is partly intended to encourage fishermen to target larger, more profitable adult tunas, rather than juvenile tunas (they are prohibited from discarding juvenile tunas to make room in their fish holds).

Interactions with protected species such as sea turtles, marine mammals, and seabirds in these fisheries are rare and survival rates are estimated to be high. Management restricts the type of fishing gear that can be used and prohibits fishing in certain areas to minimize impacts on protected species. In addition, longline fishermen are trained in safe handling and release techniques for sea turtles, seabirds, and marine mammals and carry and use specific equipment for handling and releasing these animals. Scientists and managers continue to

monitor bycatch in these fisheries through logbooks and fishery observer programs.

Sources:
www.fishwatch.gov
stateofthecoast.noaa.gov/com_fishing/bycatch.html

Learning Procedure

1. Before beginning this lesson, mix together the goldfish crackers, all sizes of pasta, and the sprinkles and pour them into the container. Tell students that the container represents the ocean with a variety of organisms living in it.

2. Design a key with images that shows which species each of the materials represents, and project it on the board so students can refer to it.

3. Introduce the term “bycatch” by showing students images of different types of fishing gear, noting that different sized mesh nets are used to catch different target species. Be sure to discuss purse seines and longlines as fishing methods that result in bycatch. The United National Food and Agriculture Organization has a comprehensive website explaining many fishing gear types. Discuss why bycatch is a concern.

4. Before students begin “fishing” have them work in their small groups to explore the FishWatch site, www.fishwatch.gov to learn more about Pacific bigeye tuna and the fishing methods used to catch them (purse seine and longline).

5. Divide students into small groups and tell them they are fishermen who are going to fish for Pacific bigeye tuna, which are represented by the medium-sized pasta. Give each group a net, and tell them the nets represent a purse seine, which is a type of net with a drawstring-like mechanism which is dragged alongside a purse seiner boat. Purse seines target schooling fish, such as Pacific bigeye tuna, and scoop them up in the net by pulling a purse line to close the net, much like a purse is closed by a drawstring.

6. Each student group gets one sweep of their net in the container to catch fish. They then sort through their catch, noting the number of individuals in each species caught. They should record their catch results and answer the questions in the Student Worksheet.

7. Have each group report their catch statistics to the rest of the class. Point out the number of non-targeted species that were caught. Discuss their answers to the worksheet questions.

8. Explain that fishermen are supposed to report their catches to NOAA Fisheries Service to help fisheries managers keep track of fish populations to ensure their sustainability. Data from fishermen is one tool of many tools used to monitor fisheries. Ask only one or two student groups to “report” their catches to the NOAA Fisheries Service.

9. Have students visit the big eye tuna seafood profile on www.fishwatch.gov to determine how big eye tuna are caught as bycatch (in purse seines and on longlines).

10. Using the United National Food and Agriculture Organization’s tuna fishing techniques website (see Additional Resources) and the Fish Watch web site: www.fishwatch.gov, ask students to think about the plusses and minuses of longline fishing and purse seine fishing. Each group should then choose one fishing technique (longlining or using a purse seine) and complete the PMI (Plus, Minus, Interesting) chart. Students should list all the plusses, all the minuses and anything interesting about this style of fishing. For more information on the PMI strategy by Edward DeBono, refer to: http://www.is-toolkit.com/workshop/pmi/BuildingVisionPMIModel.pdf

11. After the PMI activity, be sure to discuss the different fishing methods used for catching bigeye tuna. Ask, “What are the impacts on bigeye tuna as a result of these two types of fishing?” “Can you think of anything fishermen can do to reduce the amount of bycatch when fishing for bigeye tuna?”

The Bridge Connection

www.vims.edu/bridge
Use the search function to search for "bycatch" to access lesson plans and many additional resources.

The “Me” Connection

Ask students if they or anyone in their family participates in recreational or commercial fishing. Discuss how bycatch could impact them personally, whether they are fishermen or buy and consume fish.

Connections to Other Subjects

Mathematics, Language Arts, Environmental Policy

Evaluation

Assessment could include students’ understanding of the concept of bycatch, their data analysis, and participation in class discussions. Additionally, the PMI activity can serve as an assessment for their understanding of fishing techniques and the problems that result.

Extension

1. Incorporate mathematics into this activity by having students determine the mean, median, and mode of the species caught. They can then compare their answers and analyze the data for any relationship to the mesh of their nets. Students should also drag their nets two or three more times and discuss what happens to each species as the populations decrease.

2. Students can debate which fishing technique is best for bigeye tuna. Using their PMI charts and the results of their research, students can simulate a debate defending the fishing method they researched.

Additional Resources

NOAA State of the Coast
stateofthecoast.noaa.gov/com_fishing/bycatch.html

NOAA Fisheries Service – Bycatch Reduction and Engineering Program
www.nmfs.noaa.gov/bycatch.htm

NOAA Fisheries Office of Protected Resources - Fisheries Interactions/Protected Species Bycatch
www.nmfs.noaa.gov/pr/interactions/

NOAA Fisheries Feature – Magnuson-Stevens Act
www.nmfs.noaa.gov/msa2007/

FAO Gear Type
www.fao.org/fishery/geartype/search/en

FAO Fishing Techniques

Tuna Purse seining:
www.fao.org/fishery/fishtech/40/en

Longlining:
http://www.fao.org/fishery/fishtech/1010/en

FAO Species Fact Sheet for Big Eye Tuna
http://www.fao.org/fishery/species/2498/en

Fishermen “Get Smart” about Reducing Bycatch
http://www.nmfs.noaa.gov/stories/2011/11/17_smartgear.html

Porpoise Bycatch Prevented with Proper Pinger Use
www.nmfs.noaa.gov/stories/2011/10/07_porpoise_bycatch_prevented.html

New Fishing Hooks Protect Bluefin Tuna in Gulf of Mexico
www.nmfs.noaa.gov/stories/2011/04/hooks_protect_blufin_tuna_in_gulf_of_mexico.htm

Northeast Distant Fishery Sea Turtle Bycatch Reduction Project
www.nmfs.noaa.gov/mediacenter/turtles/

Hook Ingestion by Sea Turtles
www.nmfs.noaa.gov/by_catch/bycatch_turtle_hook_ingest.htm

Information about Pacific bigeye tuna can be found on the FishWatch site
www.fishwatch.gov

Name of Group _____

Student Worksheet
Fisheries Catch Record

Species	**Number Caught**	**Percent of Total Catch**
Juvenile tuna and yellowfin		
Turtles or dolphins		
Sharks		
Pacific bigeye tuna		
Sardines/small fish		
Total number of all animals caught		

1. Determine the percentage of each species caught.

2. What percentage of the catch was non-target species, or bycatch?

3. What do you think happens to the non-target species?

4. What do you think can be done to lessen the impacts of bycatch?

P	M	I
(Plus)	(Minus)	(Interesting)