Net Gain, Net Effect

Below are suggested adaptations to Net Gain, Net Effect (Council for Environmental Education: ProjectWet 2005) to incorporate information learned from Dr. Jensen's presentation and subsequent discussion.

Background

The United Nations estimates that 380 million people currently are commercial fishermen or fish farmers (aquaculture).

NOTE- while this activity is about using nets to catch fish, as is most common in the world; many other practices are also used to catch fish. Additionally, not all fishing nets are created equal, meaning that while some nets can do a lot of damage to the habitat or catch a lot of bycatch there are other nets that are used in sustainable fisheries.

Procedure

In step 2 when you the students are deciding what fish species the beans will represent, consider using the following species (we have included in parentheses the actual fishing methods used to catch these species as most are not caught in nets):

Lima bean = Striped Bass (hook & line) or Shark (hook & line)

Pinto bean = Black Sea Bass (net, pot/trap, hook & line) or Summer Flounder (net)

Black bean = Scup/Porgie (net, pot/trap, hook & line) or American Eel (pot/trap)

Lentil/Rice = Blue Crab (trotline) or Menhaden (net)

After step 8, consider having the students repeat step 7 however this time they are able to make two passes through the "ocean." This is to show that the number of fishermen is an important factor in how many and which species of fish are removed from the ocean. After the first pass the students should deposit their "catch" onto the table before they make a second pass through the "ocean." After the second pass have the students count the number of each species of fish caught, and record the numbers on the data sheet. Once everyone has tallied their numbers discuss the results between the one pass and two pass turns. Relate those results to an increase in the number of fishermen participating in a fishery. Ask the students what they think are the benefits (more jobs, more money) and costs (fewer fish, only short term benefit) to more fishermen in a fishery. Ask the students to think about how they could limit more and more fishermen from joining a fishery.

Netting Worksheet

	Coarse Net		Fine Net		Comments
Species	**1 hand used**	**2 hands used**	**1 hand used**	**2 hands used**	
(Lima)					
(Pinto)					
(Black)					
(Lentil/Rice)					

	Coarse Net		Fine Net		Comments
Species	**1 pass**	**2 passes**	**1 pass**	**2 passes**	
(Lima)					
(Pinto)					
(Black)					
(Lentil/Rice)					

Ocean Lecture & Educator's Night Jan. 19, 2012

Net Gain, Net Effect

Objectives

Students will (1) describe the evolution of fishing techniques, and (2) interpret the changes in technology on fish populations.

Method

Students conduct a simulation to explore the evolution of fishing and the effects of changing technology on fish populations.

Materials

Nets of differing mesh size (see table on page 89): onion bags, potato bags, fruit bags, netting from hardware store, or plain cloth fabric for nets; 1 pound each of lima beans, pinto beans, black beans, lentils, and rice; writing materials; four containers that are large and deep enough to hold one-fourth of the beans and grains

Background

Throughout history, people have caught fish for food, to sell to others, for fun, and for sport. One type of fishing is subsistence fishing, where the number of fish caught is no more than a family could consume. Commercial fishing is another type of fishing and differs from subsistence fishing because the fish are caught and then sold to others. Sport fishing differs from commercial fishing because the catch is not sold for profit. (Source: American Sportfishing Association)

Humans have been engaged in fish gathering since prehistoric times. Research suggests that methods of catching fish started with humans wading into drying wetlands at the edges of large shallow lakes, and using bare hands and clubs. These are the first known uses of fish as a human food source. As time passed, new techniques were invented. Native people built rock weirs or dams on streams and rivers to trap and spear the fish in holding ponds. Eventually, baskets were formed that allowed fish to swim downstream into intricately woven baffles that prevented their escape. (Source: American Sportfishing Association)

Fishing equipment has evolved over the years. Stone Age anglers used some sort of line, such as vines, and tied gorges to the end of the line. Gorges were a type of primitive hook that was made of bone, flint, and thorns or turtle shells. The earliest hook was made from copper about 7,000 years ago. Today, fishhooks are made from steel.

Fishing poles and lines written about in Chinese literature 4,000 years ago were described as wooden fishing poles with lines made from silk. Fishing lines were also made from plant fibers, human hair, cotton, and linen. Today, nylon is the most preferred material used for fishing line. Fishing rods have been made from many materials such as bamboo and steel, but today are typically made from fiberglass.

Grade Level: 5–8

Subjects Areas: Mathematics, Social Studies, Environmental Education, Science

Duration: one 30- to 60-minute session

Group Size: any

Setting: indoors or outdoors

Conceptual Framework Topic Reference: ECIB, ECIIA

Key Terms: technology, fishing

Appendices: Simulations

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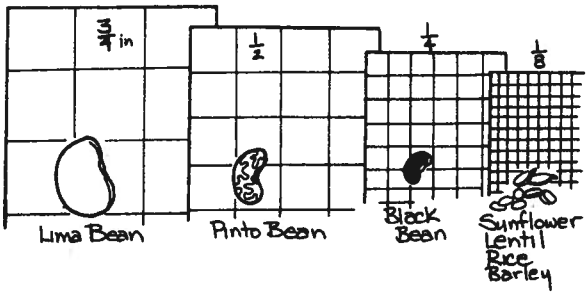

The use of boats and rafts for fishing purposes evolved during the Stone Age. The first evolution in boat design came about when fishing boats shifted from a dugout—a narrow boat, made from hollowed trees and propelled by paddles—to sailing vessels. The development of sails allowed fishing vessels to extend their range and catch. The creation of steam and diesel-driven fishing fleets provided a method for the vessels to rapidly maneuver to any spot in the ocean.

The invention of the net enabled fishing to move from sustaining a family or tribe to an economic venture. Over time, the net evolved in size, design, and effectiveness. Many nets are now available for catching different fish species in a variety of situations. Gill nets, purse seines, trammel nets, and drift nets have all improved the fishers' catch rate. Yet these advancements have also introduced new problems, such as the impact on other marine life, size discrimination, over-fishing, and loss of marine habitats.

Nets, combined with the range and maneuverability of steam and diesel boats, made it possible to catch larger amounts of smaller fish. For commercial fishing companies, a problem is created when mixed species are caught in the same net. Because most fishers have a specific fish species to catch, the other species that are caught inadvertently must be discarded. Over 20 million tons of fish and other marine animals, about one-fourth of the global catch, are killed and discarded by commercial fishers. (Source: National Coalition For Marine Conservation) Those discarded fishes are known as "bycatch."

Along with the developments in boats and nets, changes have taken place with fishing equipment. Commercial fishers now routinely use complex sonar fish finders, radio communications, spotter aircraft, computerized navigational equipment, at-sea catch processing, and other similar sophisticated tools.

With the remarkable advances in technology and the growth in investment of fishing trawlers and factory processing ships, fisheries became overfished and exploited. The amount of fish caught in the world's oceans grew from 19 million tons in 1950 to 88 million tons in 1988. With the oceanic fisheries being fished at or beyond capacity, scientists saw a substantial change in the oceanic fish catch in 1989. According to the U.S. Department of Agriculture's National Marine Fisheries Service, 90 fish species found off the shores of the United States have been depleted.

In the United States, the fishing industry is a $3.5 billion business. The largest fishing nations of the world are Japan, Russia, and China. Fish supply the main source of protein for nearly half of the more than 5 billion people on the planet. Nearly 14 million tons of sardines, herring, and anchovies are netted commercially each year, while approximately 32 million tons of other kinds of fish are caught annually.

The high demand for seafood and the modern, technologically advanced fishing fleets have led to a modification in the world's fish species. Widespread depletion of certain ocean predators such as sharks and tunas can upset the predator-prey relationship of the oceans. Overfishing not only disrupts food chains but also can threaten marine ecosystems.

One example of a fish species on its way to recovery is the swordfish. Swordfish roam most of the world's tropical and temperate oceans. They have a large dorsal fin and a rigid, sword-like beak. Swordfish can weigh up to 1,200 pounds but average 250 pounds.

Commercial fishers use long fishing lines stretched dozens of miles and baited with hundreds of hooks to catch and kill swordfish. Since the introduction of this fishing method, there has been a decline in the weight and age of the swordfish catch. Today, the average catch size of the swordfish is 90 pounds compared to a 250-pound average in the 1960s. At 90 pounds, females have not reached a reproductive age and weight, and thus the population size declines. Restoring populations to a healthy level could take up to 10 years or more. Plans are in effect to reduce the international quota for North Atlantic swordfish and the "Give Swordfish a Break" campaign is being supported by chefs, grocers, and consumers throughout the nation. This campaign is aimed at convincing consumers not to buy—and chefs not to serve—swordfish until the government develops and implements a plan for replenishing the depleted swordfish stocks and returning populations to a sustainable level. (Sources: SeaWeb and the Natural Resources Defense Council)

One species of fish that was once considered endangered and now has reached a balance between catch and reproduction rates is the striped bass. The striped bass, also called rockfish, lives in estuarine waters along the Atlantic coast as a juvenile, then moves to coastal waters to feed. In spring, the mature striped bass returns to brackish and fresh water to spawn. The striped bass is a major food and sport fish on the East Coast from Maine to North Carolina. In the late 1970s, the striped bass population began to decline. In 1984, the Atlantic Striped Bass Conservation Act was passed to help recover this species. Effective state and federal programs to protect the striped bass allowed the recovery of stocks, and the species was officially recovered in 1995. (Sources: National Oceanic and Atmospheric Administration and Sea Grant: University of Delaware)

NOTE: This activity does not address ethical questions related to the appropriateness of catching fish for human uses. This dimension may be added at the professional discretion of the educator conducting the activity.

Procedure

1. Prepare the "ocean" by mixing all the beans and grains listed under "Materials," and dividing the mixture equally into the four containers. These will be the four "fishing grounds."
2. For this activity, ask the students to decide what species each bean will represent. Fish species can be hypothetical or can represent local fish species.

   Make a chart matching the beans or grains with the fish they represent. Post the chart.
3. Divide the students into four groups, and ask each group to go to the fishing grounds (the containers of beans and grains).
4. Discuss how fish are caught. Have students seen people catch fish? How were they catching the fish? Could large numbers of fish be caught if all fish were caught with rods or poles? What are some ways to catch large groups of fish at one time? What are some of the ways people traditionally caught fish? After a general discussion on the methods people use to fish, inform the students that they will now simulate the catching of fish using nets.
5. Next, distribute the netting materials. The net materials must be cut into 4" × 6" squares. The number of nets needed will depend on how many students share a net. Provide one net for every three students.
6. With the coarsest netting in hand, ask the students to "fish." Using only one hand, students are to hold the nets between their thumb and first finger (see Diagram A). This distance is known as the catching area. Ask the students to make one pass with their nets through the fishing grounds.

For Younger Students

Educators may want to demonstrate how to use each net. When it is the students' turn, allow the students to make only one pass through the "ocean." Give each student a sheet of paper representing a boat. Instruct the students to deposit

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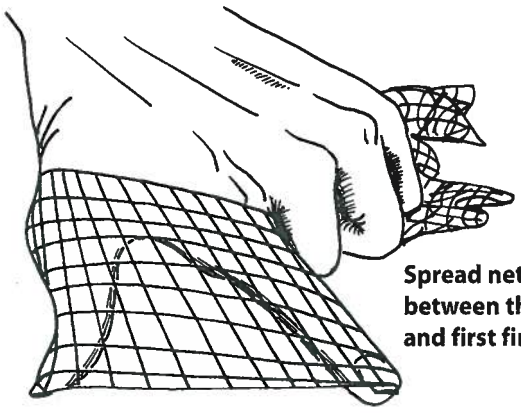

Diagram A

their "fish" on the boat. Count the number of each species of fish caught, and record the numbers on a data sheet.

7. Next allow the students to use both hands (see Diagram B). Make one pass through the "ocean." Count the number of each species of fish caught, and record the numbers on a data sheet. Repeat this process several times.
8. Discuss the results between the one-hand and two-hand techniques. Relate those results as an improvement in technology. For example, using both hands may represent the shift from hand-powered boats with cast nets to trawlers.
9. Analyze the species the students have netted. The smaller lentils and the rice will often slip through the netting and escape capture. The larger species—the limas and the pintos—are the most likely to have been caught. Ask students what they could do to catch more fish. Discuss possible options with them.
10. Ask the students to return all the fish to the ocean containers so that they can try fishing with a smaller-mesh net. Distribute a net with fine mesh (less than one-fourth inch). Again, the net needs to measure about 4″ × 6″.
11. Tabulate and discuss the results. OPTIONAL: Repeat with the nets of other size mesh. Discuss.
12. Return all the fish to the ocean.

For Younger Students

The activity may conclude with a discussion at this point. What happens when the different kinds of nets are used? Is it good to let the smaller fish through the net? Why or why not? What might happen if people fished from just one part of the ocean? OPTIONAL: Construct a bar graph to show the numbers of fish caught using the different nets and different techniques of netting.

13. Inform the students that all the fish, beans through rice, are all the same species and that no fish smaller than the black bean species size can be caught. A fine of one point will be added to the score for each of the smaller fish caught during this round. A regulatory agency responsible for monitoring fishing practices gives each team 10 seconds to put the undersized fish back in the ocean after each netting. Appoint two members of each fishing team to play the regulatory agency role.

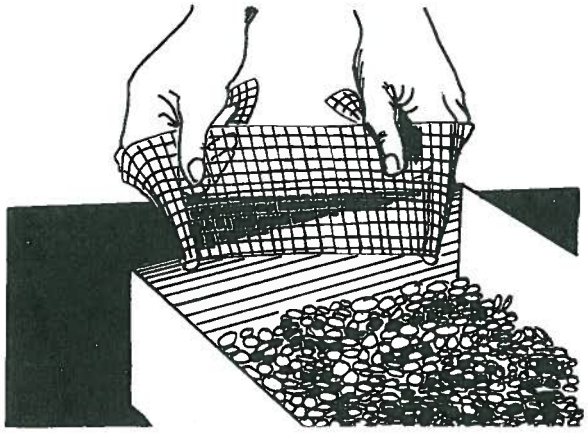

Diagram B

14. Instruct the commercial fishers to use the fine mesh net (less than one-fourth inch mesh). Empty the net onto the table, and return the undersized fish to the ocean. At the end of 10 seconds, the team must stop. The representatives of the regulatory agency will count the undersized fish that are still left on the table and fine them one point for each one.
15. Discuss the economics involved. Can the people fishing afford to return all the undersized fish to the sea? What are their options? Should we release undersized fish? If yes, why? If no, why not?
16. Repeat this round with one of the larger-mesh nets. Is there an advantage to letting the smaller fish get through the net over returning them by hand? What aquatic animals might be caught in these larger nets?
17. Ask the students to summarize what they have learned. Review the general history of fishing, including how each change may have affected fish populations. Consider possible impacts on fish habitats as well. Identify some of the potential positive and negative issues related to the advancement of commercial fishing.

    The Netting worksheet provided below may be helpful.

Extensions

1. Create an illustrated history of the fishing net.
2. Use nets of different sizes to try to catch aquatic organisms in a local pond or stream. Observe and record any differences in what the nets catch. Be extremely careful to return any animals to their habitats unharmed.

NOTE: Check regulations with your state's wildlife agency regarding net use; in some areas it is against the law to use nets in local waters.

3. Who "owns" the fish in the sea? In streams? In lakes? In ponds? In other aquatic habitats? Who is responsible for conserving and protecting fish species?
4. Research the regulations on personal, non-commercial fishing in fresh water and in marine environments.
5. Research the regulations on commercial fishing in fresh water and in marine environments.
6. Discuss the role of aquaculture (fresh water) and mariculture (marine) aquatic farming. How will this emerging field affect commercial fishing? What possible positive effects, if any, on fish populations and habitat might there be from a change to aquaculture?

Netting

		Coarse Net		Fine Net		Comments
	Number of Hands Used	1	2	1	2	
Species	Lima lunker					
	Pinto porgies					
	Black bass					
	Lentil moonbeans					
	Rice wrasses					

continued

Mariculture? What possible negative effects, if any?

7. Research the fishing industry in your state. What methods are most commonly used to catch fish in your state? What regulations apply to commercial fishing in your state? Are they different from, or similar to, the regulations for personal and recreational fishing?
8. Research the international treaties and organizations dedicated to conserving and protecting oceanic habitats.

Evaluation

For Younger Students

1. Draw three pictures showing different ways that fish are caught. Mark the picture that shows the way most fish are caught.

For Older Students

2. Describe how fishing has changed from prehistoric times to the present. How have these changes affected fish populations?