Bycatch:
Off the Hook

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Summary
Explore bycatch issues and various reduction strategies using data from the National Marine Fisheries Service.

Objectives

- Identify and define types of bycatch.
- Recognize regional fisheries, gear, bycatch and management efforts.
- Evaluate experimental data to select the best temperature and bait combinations for fishing and avoiding bycatch.

Vocabulary
Bycatch, Target catch, Incidental catch, Discarded catch, Prohibited species, CPUE, Bycatch mitigation

Introduction
As we follow reports of declining fisheries, another issue is also raising concerns about how we harvest from the sea. Bycatch is a global problem that is associated with almost every type of fishery, gear, and body of water. Bycatch can be harmful not only by killing or injuring threatened species, but also by wasting fishermen's time and money. Let's start by defining bycatch and related terms:

Target Catch – The species of fish or catch that is (or are) primarily sought in a fishery, (ex. tuna, shrimp, flounders).
Incidental Catch -- catch of non-targeted species that is kept.
Discarded Catch -- portion of the catch returned to the sea as a result of economic, legal, or personal considerations.
Bycatch -- Discarded catch plus incidental catch.
Prohibited species -- Any species that, by law, must be returned to the sea.
CPUE-(catch per unit effort) the total catch divided by the total fishing effort (a product of the total number and size of boats and the number of days they fished).
Bycatch mitigation- efforts to make bycatch less severe.

Bycatch is not a simple issue of wanted and unwanted fish. Bycatch is a complex problem that involves supply and demand, endangered species, sustainable fisheries and livelihoods. The number of people fishing or fish-farming internationally has doubled since 1970. Globally, more than 1 billion people depend on fish as a primary source of protein. In 1994, the Food and

Grade Level:
9-12

Lesson Time:
1-2 hr

Materials Required:
Loggerhead hook & bait data, Leatherback hook & bait data, Swordfish hook & bait data, Loggerhead temperature data, Leatherback temperature data, Swordfish temperature data

Natl. Science Standards
Click here for a list of the aligned National Science Education Standards.

Related Resources
Bycatch, Sea turtles, Fisheries, Endangered species, Conservation

Agriculture Organization estimated that between 17.9 and 39.5 million tons (average 27.0 million) of fish are discarded each year in commercial fisheries. How has bycatch changed since the FAO's report ten years ago? How can fishermen meet the demands of fish consumption while sustaining the ocean's resources?

The U.S. has several management and policy acts that serve as regulation and policy tools. Let's start by exploring the following:

REGULATIONS

National Environmental Policy Act of 1969

The National Environmental Policy Act (NEPA) ensures that every major federal action maintains the balance between human activities and environmental needs. NEPA requires agencies to prepare a detailed environmental impact statement (EIS) describing the potential environmental consequences for every major federal action that significantly impacts the quality of the environment (ex. NOAA would submit an EIS if they wanted to close a fishery).

The Marine Mammal Protection Act of 1972

The U.S. Congress passed the Marine Mammal Protection Act (MMPA) to protect the marine mammals that live in the world's oceans. This legislation is the foundation for policies preventing the capture, injury, harassment, or killing of all species of whales, dolphins, seals, sea lions, walruses, manatees, dugongs, polar bears, and sea otters.

The Endangered Species Act of 1973

The Endangered Species Act outlines the program that conserves threatened and endangered plants and animals and the habitats in which they are found. The U.S. Fish and Wildlife Service of the Department of the Interior maintains a database of endangered and threatened species. (Sea turtles are a good example of a threatened or endangered species that are impacted by bycatch).

Magnuson-Stevens Fishery Conservation and Management Act of 1996

Originally enacted in 1976, the Magnuson-Stevens Fishery Conservation and Management Act (MSA) is the primary law governing marine fisheries management in U.S. federal waters. Congress passed the MSA to claim rights to the fishery resources of the continental shelf within the U.S. exclusive economic zone (EEZ). The MSA established eight regional fishery management councils with each council focusing on a specific coastal region. Each council is composed of individuals who have fisheries expertise with balanced representation from the various fisheries in the region. Councils develop fishery management plans (FMPs) and plan amendments that regulate marine fisheries in federal waters. Generally, individuals representing fishing interests compose the majority of councils, with state and government agency representatives making up the remaining seats.

BYCATCH REDUCTION STRATEGIES

In addition to regulations, what are some strategies that managers use to manage or reduce bycatch? Officials can suspend fishing or close a fishing ground for a given amount of time. Certain gear types can be banned (ex. high seas drift nets) or specific gear modifications can be required (ex. TEDs -Turtle Excluder Devices). A gear's discard catch efficiency can also be

regulated (ex. enforcement of mesh, hook, or escapement panel size restrictions) and discard quotas can be limited. Incentive and disincentive programs can also be useful.

REPORTING BYCATCH
How is bycatch information collected in the U.S.? The National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries) deploys <u>fishery observers</u> to collect data from U.S. commercial fishing and processing vessels. NOAA Fisheries observers have collected fisheries data since 1972. Observers monitor fishing activities on all US coasts and collect data from over 20 different fisheries for a range of conservation and management issues.

To get an idea of some regional U.S. fisheries, the gear used, and associated bycatch species, let's review the following summary of fisheries involved in the National Observer Program :
SOUTH ATLANTIC
FISHERIES: Spanish mackerel, king mackerel, golden crab, snapper, grouper, black sea bass, wreckfish, spiny lobster
GEAR: Handline, rod & reel, bandit, gillnet, cast net, spear, trap, trawl, dip net, snare
BYCATCH: had associated bycatch of finfish, Nassau grouper, sea turtles, seabirds, invertebrates, sharks, coral, hagfish, hake
GULF OF MEXICO
FISHERIES: large pelagic species (such as sharks), snapper-grouper reef fish longline, hook and line, shrimp, spiny lobster, stone crab
GEAR: longline, handline, bandit, rod & reel, buoy, bottom longline, reef pot and trap, spear, powerhead, cast net, trawl
BYCATCH: tunas, sharks, billfishes, marine mammals, sea turtles, finfish, invertebrates, coral, goliath and Nassau grouper
CARIBBEAN
FISHERIES: reef fish, spiny lobster
GEAR: longline, hook and line, trap, pot, gillnet, trammel net, dip net, handline, rod and reel, slurp gun, spear, snare
BYCATCH: finfish, invertebrates
WESTERN PACIFIC
FISHERIES: Pelagic fish
GEAR: longline
BYCATCH: sea turtles, sharks, birds, and marine mammals

WHAT HAPPENS TO BYCATCH?
What happens when a fish or other animal is unintentionally caught? Sometimes fish or other animals are simply released overboard (<u>discarded</u>) if they cannot be kept due to size, sex, or species regulations. The question of whether or not the animal survives after being released is a complex one. There are protocols that carefully detail proper release techniques of captured animals and a suite of new techniques and <u>tools</u> that are being used to free fish and other bycatch species such as sea turtles.

C.mydas with ingested hook
image courtesy of Chris Johnson

Data Activity
Did you notice that in the regional summaries above, a common bycatch species in almost every U.S. fishery was sea turtles? From 2001 to 2003 five different sea turtle bycatch mitigation techniques were investigated in the Western Atlantic Ocean by NOAA in cooperation with the Blue Water Fishermen's Association. Investigators compared the difference among different hook types, bait, and temperature regimes (the targeted species was swordfish). Let's take a look at some of their preliminary results:

HOOK & BAIT TREATMENTS
Loggerhead Sea Turtle Catch by Hook and Bait Type
1. Using mackerel, which hook type caught the most loggerheads? Which hook type caught the fewest?
2. Using squid, which hook type caught the most loggerheads? Which hook type caught the fewest?
3. What is the estimated percent reduction in catch of each of the hook/bait treatments as compared to the J hook?
4. Which combination of hook and bait caught the fewest loggerheads?

Leatherback Sea Turtle Catch by Hook and Bait Type
1. Using mackerel, which hook type caught the most leatherbacks? Which hook type caught the fewest?
2. Using squid, which hook type caught the most leatherbacks? Which hook type caught the fewest?
3. What is the estimated percent reduction in catch of each of the hook/bait treatments as compared to the J hook?
4. Which combination of hook and bait caught the fewest leatherbacks?

Swordfish were the targeted species in this study. This means that the boats and fishermen who participated in the study usually fish for swordfish. Let's take a look at how swordfish responded to the different treatments involving hooks and bait.
Swordfish Catch by Hook and Bait Type
1. Using mackerel, which hook type caught the most swordfish? Which hook type caught the least?
2. Using squid, which hook type caught the most swordfish? Which hook type caught the least?
3. What is the estimated percent increase or decrease in swordfish catch for each of the hook/bait treatments as compared to the J hook?
4. Which combination of hook and bait caught the most swordfish?

TEMPERATURE
Billfish spend a lot of time near the warmer, upper water column of the ocean, but many dive to greater depths to look for food. Let's explore the temperature of the water where the most (and fewest) loggerheads, leatherbacks, and swordfish were caught.
Loggerhead Catch by Temperature
Within what temperature range were most of the loggerheads captured?

[Leatherback Catch by Temperature](#)
Within what temperature range were most of the leatherbacks captured?

[Average Swordfish Weight by Temperature and Hook/Bait Type](#)
Within what temperature range were most of the swordfish captured?

SUMMARY QUESTIONS:
1.What hook/bait combination would be best to minimize the number of both loggerhead and leatherback sea turtles caught on longline gear in the Northeast Western Atlantic Ocean?How would this rank as the choice of swordfish fishermen?
2. What hook/bait combination would be best to maximize the catch of swordfish, and what effect would it have on sea turtle bycatch as compared to the hook/bait combination in question 1?
3. In what temperature regime would it be best to fish in order to reduce the number of loggerhead and leatherback sea turtles caught, while maximizing the catch of the target species (swordfish)?
4. Considering sea turtle bycatch reduction, increase in catch of the target species, and temperature, how could fishermen in the Northeast Western Atlantic Ocean use information from these studies to improve their catch while avoiding threatened or endangered species (i.e. what fishing practices can these longline fishermen adopt)?
5. If circle hooks are more expensive than J hooks, what could regulatory agencies do to encourage the use of circle hooks by fishermen?

Check your answers with our [Answer Key](#).