NOAA FISHERIES

Bycatch Reduction Engineering Program

2013 Annual Report to Congress

Importance Of Bycatch Reduction

Bycatch occurs when fishing operations discard fish or interact with marine mammals, seabirds, or sea turtles. Bycatch can have significant biological, economic, and social impacts on fisheries. Reducing bycatch can improve the recovery of endangered marine mammals, sea turtles, seabirds, and fish. Coastal communities benefit by reducing bycatch of species that are valuable targets in other fisheries. In support of our mission to sustainably manage the nation's fisheries, NOAA's National Marine Fisheries Service (NOAA Fisheries) has been investing in technological and engineering solutions to reduce bycatch, and in 2012 began funding external partners from state governments, academia, and the fishing industry.

External Grant Program Summary

The mission of the Bycatch Reduction Engineering Program (BREP) is to develop technological solutions and change fishing practices to minimize bycatch and reduce post-release injury and mortality of non-target species in our nation's fisheries. BREP grants have addressed bycatch of sponges, corals (deep and shallow), protected species, and non-target fish in commercial and recreational fisheries. The BREP also strengthens cooperation and collaboration between NOAA Fisheries and the fishing industry by giving priority to research projects that have strong management application.

This report highlights outcomes and management applications of projects funded with $2.44 million in FY 2012 in four priority areas: reducing protected species bycatch, reducing post-release mortality, improving fishing practices, and developing innovative technologies. Project highlights include:

- Researchers in Florida are developing timed-release chemical shark repellants that could reduce shark bycatch by 18 to 35 percent depending on the type and intensity of repellent used.
- In the North Pacific, researchers have found that by using illumination they can reduce Chinook salmon bycatch by attracting the fish toward escape areas in Pacific hake midwater trawl nets.
- In the Northwest, researchers found that using a sorting grate that allow the smaller, target fish (Pacific hake) to pass through leads to a 26 percent reduction in widow rockfish bycatch.

The report also identifies projects funded in FY 2013, although results from these projects will not be available until next year.

MSA Requirement

Section 316(a) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) states:

Not later than 1 year after the date of enactment of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006, the Secretary, in cooperation with the Councils and other affected interests, and based upon the best scientific information available, shall establish a bycatch reduction program, including grants, to develop technological devices and other conservation engineering changes designed to minimize bycatch, seabird interactions, bycatch mortality, and post-release mortality in federally managed fisheries.

Section 316(d) of the MSA requires the Secretary of Commerce to transmit an annual report to the Senate Committee on Commerce, Science and Transportation and the House of Representatives Committee on Natural Resources that:

1. Describes funding provided to implement this section.
2. Describes developments in gear technology achieved under this section.
3. Describes improvements and reduction in bycatch associated with implementing this section, as well as proposals to address remaining bycatch or seabird interaction problems.

This report responds to the requirements of Section 316(d) of the MSA. This report also provides updates on BREP projects funded in 2012. Additional information about our efforts to address remaining bycatch or seabird interaction problems is available online at www.nmfs.noaa.gov/by_catch/bycatch_BREP.htm.

Reducing Protected Species Bycatch

In 2012, three projects funded through the BREP addressed the issue of reducing protected species bycatch. These projects were focused on the West Coast and in the Northeast and examined interactions with a number of species, including whales and salmon. As a result of BREP funding, these projects have made substantial progress identifying gear types and methods to reduce bycatch of Chinook salmon and to reduce Atlantic right whale encounters with lobster gear.

The Pacific States Marine Fisheries Commission researched how artificial light could help Chinook salmon escape nets used in the Pacific hake midwater trawl net fishery. The Pacific hake fishery is the largest groundfish fishery by volume off the U.S. West Coast. When fishing for Pacific hake, this fishery also accidentally catches endangered Chinook salmon. If the Pacific hake fishery catches too many Chinook salmon as bycatch, the hake fishery may have to reduce or stop fishing. Researchers worked with Pacific hake fishermen and a net manufacturer to encourage Chinook salmon to use an escape flap that had already been designed for the Pacific hake nets. The researchers found that artificial light attracts the salmon and may be a solution to further enhance existing Chinook salmon escapement devices in the Pacific hake midwater trawl. Preventing bycatch of Chinook salmon will allow more effective fishing of abundant Pacific hake.

The Gulf of Maine Lobster Foundation collaborated with Maine lobstermen to reduce interactions between lobster gear and right, humpback, and fin whales. The Maine lobster fishery is worth $300 million annually and uses lobster traps that are attached to buoys (fixed gear). Fixed gear is commonly used in several economically important fisheries, including lobster. Sometimes whales are injured or killed if they become entangled in the lines that connect the trap to the buoy. With this award, the grantees collected information about the distribution and density of fixed gear off the shore of Maine. This information may be used to develop new rules that will help fishermen continue harvesting lobster without risking too much interaction with protected whales.

Top, Researchers from the Pacific States Marine Fisheries Commission (PSMFC) test the use of artificial light to encourage salmon to use an escape flap on Pacific hake nets. Credit: PSMFC. Bottom, Researchers from the New England Aquarium test how using different colored ropes help right whales avoid entanglement with fishing gear. Credit: New England Aquarium Corporation.

A group of New England Aquarium researchers in Boston assessed ways to make it easier for right whales to see and avoid the ropes used with fixed gear. The researchers learned that right whales can see orange and red ropes at the greatest distances. The researchers plan to conduct additional analyses to determine whether the whales change their behavior in response to ropes they can see. Fishermen will help test the different rope colors in an operational lobster fishery. Preliminary results suggest that changing rope colors to orange and red may help reduce the probability of collisions between endangered right whales and vertical fishing ropes.

Reducing Post-Release Mortality

Three 2012 BREP recipients examined how to reduce post-release mortality in both commercial and recreational fisheries. Post-release mortality occurs when a non-target fish is released alive but dies shortly after being released. Reducing post-release mortality is an important contribution to bycatch reduction research. These projects focus on a number of species in the Gulf of Maine, Pacific Islands, and Pacific Northwest. While many of these projects are still underway, progress has been made in determining and improving post-release mortality rates for Atlantic cod, billfish, and Dungeness crab.

Researchers at the New England Aquarium are working with recreational anglers to improve the survival of Atlantic cod caught and released in the recreational fishery. In New England, Gulf of Maine cod is an iconic fish that is subject to overfishing. Over the past 5 years recreational landings of cod have accounted for a significant portion of the total cod removed from the Gulf of Maine. Researchers and fishermen tag the fish to track survival of fish caught and released. Using these data, researchers plan to develop "best capture and handling practices" to increase the survival of cod caught in the recreational fishery. Fieldwork for this study has started, cod have been tagged, and 29 tagged cod have been detected on receivers. Tagging and tracking of cod, determining the survival rate of discarded cod, and adopting best practices for recreational fishermen to increase survival of released cod will help promote the sustainability of cod in the Gulf of Maine.

Scientists at Queen's University in Canada researched characteristics of billfish physiology to help improve the chances for billfish survival after they have been caught and released from pelagic longline fisheries. Some billfish species are overfished, while the status of others remains unknown. In the Pacific Islands, Pacific billfish are often caught as bycatch in longline fisheries targeting yellowfin and bigeye tuna. Although these billfish are released, we do not know their survival rates. Researchers tagged billfish that had been released from pelagic longline gear to track their movement. In addition, researchers also used tissue and blood samples to better understand the relationship between stress and survival after a billfish has been caught and released. This information will help develop fishing practices that promote long-term survival of released fish and healthy billfish populations.

Researchers at Oregon State University are working to determine mortality rates for Dungeness crab bycatch in Oregon's directed crab fisheries. Dungeness crab supports an important fishery on the West Coast, and in 2012 fishermen harvested more than 53 million pounds. To determine post-release mortality rates, more than 3,500 crabs have been tagged and released during crabbing trips along Oregon's coast. Researchers are also evaluating the effectiveness of the Reflex Action Mortality Predictor (RAMP) methodology as a way to determine post-release mortality rates. RAMP methodology relates reflex impairment of bycatch to a probability of mortality, and could be a quick, cost-effective way to determine mortality rates. For the Dungeness crab, a RAMP score of zero (no reflexes missing) would mean the animal is in the best condition, whereas a score of 6 (all reflexes missing) is an animal in the poorest condition. Although data have not been fully analyzed, preliminary results of the RAMP study suggest that the probability of mortality is higher when a crab received a RAMP score of 2 or higher. If RAMP is determined to be effective, it has the potential to be used in various U.S. fisheries to determine survival.

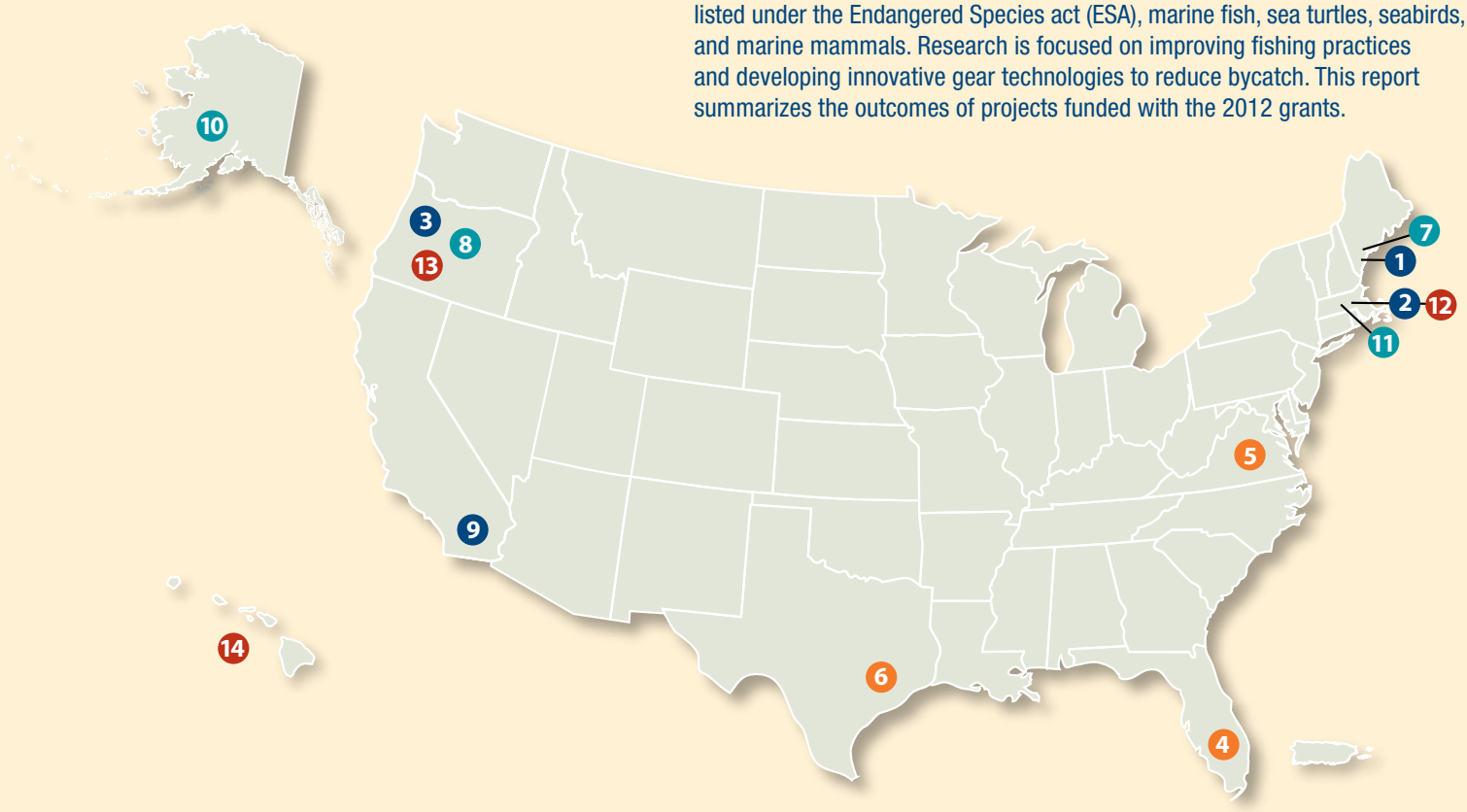
U.S. Fishermen Involvement

U.S. fishermen are involved with all aspects of BREP research, from designing new gear and assisting with data collection, to verifying and testing the application of gear in the field. It is important that fishermen be involved at all levels of research, as commercial and recreational fishermen will be the ones using and implementing results from successful projects. Fishermen bring a unique perspective on the issues of bycatch to the projects and are knowledgeable about what solutions may or may not work in their fisheries. By sharing information, fishermen and scientists can work together to reduce and prevent bycatch. Here are some ways fishermen were involved in FY 2012 projects:

- Testing whether different colored buoy lines may deter right whales in an attempt to reduce interactions between lobster gear and protected species.
- Helping determine and establish best handling and release methods to increase survival of overfished Atlantic cod in the recreational cod fishery.
- Returning tagged Dungeness crab to help researchers understand mortality rates of tagged and released crabs.
- Aiding in the development and trial of bycatch reduction devices to exclude rockfish and salmon from catches of Pacific hake.
- Testing prototypes of bycatch reduction devices on commercial shrimp fishing vessels in the Southeast.
- Helping design, test, and deploy deep-set buoy gear to selectively target swordfish at depth and reduce bycatch in the Pacific.

Fiscal Year 2012 Projects

NOAA allocated $2.44 million to the BREP in 2012. These projects are being implemented across the country and address a wide variety of topics—fish listed under the Endangered Species act (ESA), marine fish, sea turtles, seabirds, and marine mammals. Research is focused on improving fishing practices and developing innovative gear technologies to reduce bycatch. This report summarizes the outcomes of projects funded with the 2012 grants.



Reducing Protected Species Bycatch

1. **Gulf of Maine Lobster Foundation**—Maine fishing industry monitoring program ($181,530)
2. **New England Aquarium Corporation**—Enhancing the visibility of fishing ropes to reduce right whale entanglements ($231,079)
3. **Pacific States Marine Fisheries Commission**—Use of artificial light to enhance the escapement of Chinook salmon when used in conjunction with a bycatch reduction device in a Pacific hake midwater trawl net ($130,043)

Improving Fishing Practices

4. **Florida Keys Community College**—Performance of a long-lasting shark repellent bait for bycatch reduction during commercial pelagic longline fishery ($234,311)
5. **GeoEye Imagery Collection Systems Inc.**—Geospatial preference modeling and real-time catch reporting in support of an Atlantic bluefin tuna avoidance system ($227,636)
6. **Texas A&M University**—Enhancing proof of concept procedures of potential bycatch reduction devices in the southeastern shrimp fishery ($83,571)

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7. **Gulf of Maine Research Institute**—Testing in-trawl image collection and analysis to quantify and record bycatch in the Atlantic herring/mackerel mid-water trawl fishery ($127,649)[1]
8. **Pacific States Marine Fisheries Commission**—Reducing the bycatch of overfished and rebuilding rockfish species in the U.S. Pacific hake fishery ($144,598)
9. **Pfleger Institute of Environmental Research**—Testing modified deep-set buoy gear to minimize bycatch and increase swordfish selectivity ($150,272)
10. **University of California, San Diego**—Using combined video/acoustic recordings of marine mammal/fishing gear interactions to evaluate utility of passive acoustic monitoring (fieldwork to take place primarily in Alaska; $202,476)
11. **University of Massachusetts Dartmouth**—Testing of a modified groundgear to reduce yellowtail flounder and juvenile cod in the large mesh groundfish fishery on Georges Bank ($184,674)

Reducing Post-Release Mortality

12. **New England Aquarium Corporation**—Elucidating post-release mortality and "best capture and handling" methods in sublegal Atlantic cod discarded in Gulf of Maine recreational hook-and-line fisheries ($248,659)
13. **Oregon State University**—Field validation of the RAMP approach for determining crab bycatch mortality ($68,289)
14. **Queen's University**—Estimating post-release mortality in istiophorid billfish ($226,039)

[1] Project was awarded then withdrawn by the applicant due to technological complications. Funds were returned to NOAA.

Fiscal Year 2013 Projects

In September 2013, NOAA Fisheries awarded 16 grants totaling $2.39 million under the BREP. These projects are being implemented across the country and address a wide variety of topics, including fish listed under the ESA, marine fish, sea turtles, seabirds, and marine mammals. Research is focused on improving fishing practices and developing innovative gear technologies to reduce bycatch. Results for the projects funded with the 2013 grants will be available next year.

Reducing Protected Species Bycatch

1. **Cardno ENTRIX**—Commercial fishing gear modifications to reduce Atlantic sturgeon interactions in North Carolina and Mid-Atlantic gillnet fisheries ($200,000)
2. **Gulf and South Atlantic Fisheries Foundation, Inc.**—Further evaluation of a topless bottom trawl design with regard to excluding sea turtles ($238,000)
3. **Pacific States Marine Fisheries Commission**—Reducing ESA-listed eulachon bycatch in the ocean shrimp trawl fishery: can increasing the visibility of trawl components improve bycatch reduction? ($89,095)
4. **SUBMON**—Training of U.S. longline fishermen and fishery observers to increase post-release survival of accidentally captured sea turtles and other protected species ($28,540)[1]

Improving Fishing Practices

5. **Pacific States Marine Fisheries Commission**—Reducing sablefish and rockfish bycatch in the U.S. West Coast groundfish bottom trawl directed flatfish fishery ($138,124)
6. **Pfleger Institute of Environmental Research**—Facilitating the development and future implementation of a deep-set buoy gear fishery off the California Coast ($147,152)
7. **University of Maryland, Eastern Shore**—Determination of the impacts of trap fishing on Mid-Atlantic benthic habitats, with emphasis on structure-forming invertebrates ($93,235)

[1] This international project is taking place in Honolulu, Hawaii; Long Island, California; and the Gulf of Mexico.

Innovative Technologies

8. **BelleQuant Engineering**—Modeling the dynamics of Baleen whale entanglements in fishing gear ($101,931)
9. **Cornell University**—Enhanced bycatch avoidance communication network for river herring and butterfish ($202,654)
10. **Integrity Fishing Corp.**—Minimizing bottom habitat impacts in the otter trawl fishery with a light weight riser sweeper ($101,000)
11. **The Nature Conservancy**—Pot gear innovation for the West Coast groundfish trawl fishery ($138,233)

Reducing Post-Release Mortality

12. **Alaska Charter Association**—Use of digital imaging technology in the reduction of released halibut mortality in Alaska's recreational fishery ($186,725)
13. **Fairleigh Dickinson University**—Optimization of gear size and post-release mortality reduction in the New Jersey summer flounder hook-and-line fishery ($122,911)
14. **Florida Fish and Wildlife Conservation Commission**—Testing an alternative method for the safe release of reef fishes caught on hook-and-line gear in the recreational fishery in the Gulf of Mexico ($185,843)
15. **MOTE Marine Laboratory**—Novel technology to assess mortality from bycatch in large coastal sharks ($235,847)
16. **University of California, San Diego (Scripps Oceanographic Institution)**—Examining environmental effects on rockfish catch-and-release survival: does low oxygen contribute to mortality following barotrauma? ($183,997)

Improved Fishing Practices

Three 2012 BREP-funded projects aimed to improve fishing practices in fisheries including shrimp and Atlantic highly migratory species. Although work is still ongoing for many of these projects, researchers have had some success developing a shark repellant and reducing bycatch by over 18 percent, and new gear designs are being tested that will further aid in reducing bycatch in shrimp fisheries. These projects show promising initial results in improvements to fishing gear and will aid in decreasing bycatch, reducing protected species interactions, and improving success of sustainable fisheries.

Researchers from Texas A&M University are testing prototypes of new bycatch reduction devices in the shrimp fishery. The commercial shrimp fishery is one of the most economically important fisheries in the Southeast. However, bycatch continues to be an important issue and, although several bycatch reduction devices are on the market, there are still significant losses to shrimp catch or other problems associated with the devices. Some of the bycatch reduction devices (BRD) are integrated with turtle excluder devices (TED), while others are positioned between the TED and the cod end, and another prototype has the BRD in front of the trawl mouth. This project could result in effective, new BRDs that are inexpensive and simple for fishermen to construct and install on their vessels.

Top and bottom, Researchers from Texas A&M University test prototypes of new bycatch reduction devices in the shrimp fishery. Credit: Texas A&M University.

At the Florida Keys Community College, scientists are examining and improving the effectiveness of timed-release chemical shark repellants to reduce shark bycatch. Shark bycatch continues to be a problem in any fishery that uses baited hooks and is not targeting sharks. Previous research has shown that the use of bait infused with timed-release chemical shark repellents can be effective in reducing shark bycatch. Preliminary results from this project have seen a reduction in shark bycatch. However, there are concerns around developing a repellent compound that will last more than 12 hours while still dissolving fast enough that an effective amount of repellent is released within a few hours of initial deployment, as this is when most of the bycatch tends to occur. Future trials of varying compounds and strength will continue. Reducing shark bycatch is important so that shark populations can be conserved.

Atlantic bluefin tuna (ABT) is under strict management regulations at both domestic and international levels to help ensure the survival of this species. In the United States, ABT are often caught in longline fisheries targeting swordfish in the Atlantic and Gulf of Mexico. GeoEye Imagery Collection Systems, Inc., is using Geospatial Preference Modeling to collect data that will be used to develop an ABT Avoidance System for use in the North Atlantic pelagic longline fleet. Data are being collected on environmental preferences for ABT, reproductive states, and oceanographic conditions to help identify "hotspots" of ABT habitat. The goal of this research is to better understand ABT movements and behavior, as well as determine the viability of using an avoidance system to help reduce bycatch of ABT while maintaining catch of targeted species (such as swordfish).

Innovative Technologies

Developing new fishing gear technologies is important to continuing to reduce bycatch in U.S. fisheries, and in 2012 BREP funded four projects centered on improving technology. These projects took place in the Northwest, Northeast, Southwest, Alaska, and Hawaii. Refinements and research are still underway for these projects, but preliminary findings have been positive. There has been success in reducing bycatch through the development of new devices and by updating and changing how gear is used. New research is also underway to better understand how some species interact with fishing gear, which may lead to increased understanding of animal behavior and how to reduce potential interactions with fishing gear.

The Pacific States Marine Fisheries Commission is examining how to reduce bycatch of overfished and rebuilding rockfish species in the U.S. Pacific hake fishery. Developing innovative gear modifications that reduce rockfish bycatch but retain a high proportion of the targeted species is an important issue for the Pacific hake fishery. The Pacific hake fishery operates under annual catch limits, individual fishing quotas, and individual bycatch quotas. Bycatch of rockfish is a concern for many fishermen because limited quota is available for selected species. If fishermen reach their bycatch quota before their hake quota, their season may end with allowable hake quota still in the ocean. This study examined a flexible sorting grate excluder designed to reduce the bycatch of rockfishes in the Pacific hake fishery. The concept of this design is that fish smaller than the sorting grate openings (i.e., Pacific hake) will pass through the grate openings and be retained, while fish larger than the grate openings (i.e., rockfishes) will be excluded. Preliminary findings show that bycatch of widow rockfish, a species of concern, was reduced by 26.6 percent, and the retention of Pacific hake was 92.3 percent. Although refinement of the excluder device is needed to allow the gear to function under heavy fish volumes, this project has been successful in designing a bycatch reduction device for use in the Pacific hake fishery.

Crewmen bring on board a recapture net used with a flexible sorting grate excluder that the Pacific States Marine Fisheries Commission (PSMFC) is testing to reduce bycatch of rockfish in the Pacific hake fishery. Credit: PSMFC.

Researchers from the University of San Diego are developing sound and video recorders to use on fishing gear to explore interactions between fishing gear and sperm whales, killer whales, and false killer whales off the coasts of Alaska and Hawaii. Marine mammal interactions often occur with longline fishing gear when the animals try to remove bait or catch from fishing gear. This is known as depredation, and there is a lack of knowledge about how it works. Passive acoustic monitoring may be a useful technique for detecting the presence of marine mammals around fishing gear, and could provide insight

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into gear depredation rates and behavior. Researchers plan to deploy both cameras and acoustic recorders from fishing gear to determine whether visually documented interactions are accompanied by acoustic cues. Camera trials and deployments have begun in Prince William Sound and trials are planned for Hawaii in 2014. By understanding how depredation and similar interactions work, fishermen and researchers may be better able to prevent such interactions.

Researchers from the University of Massachusetts Dartmouth are testing this modified trawl to reduce yellowtail flounder and juvenile cod bycatch in the Georges Bank large mesh groundfish fishery. Credit: University of Massachusetts Dartmouth.

Off the coast of California, the population of north Pacific swordfish is healthy and considered to be underexploited. But the fishery has several restrictions in place to reduce bycatch of protected species associated with drift gillnets. These restrictions appear to be causing under-exploitation of swordfish. Investigators from the Pfleger Institute of Environmental Research are working with the fishing industry to test deep-set buoy gear that can catch swordfish at a depth (250–350 meters) not frequented by endangered leatherback turtles and other bycatch species. To date, two alternative deep-set buoy gear configurations have been identified. These alternative gears increase deployment and retrieval efficiency, enable better coverage of the water column, and reduce the potential for lost gear.

Researchers from the University of Massachusetts Dartmouth are testing a modified trawl to reduce yellowtail flounder and juvenile cod bycatch in the large mesh groundfish fishery on Georges Bank. The annual catch limit for Georges Bank yellowtail flounder was reduced by 80 percent in 2012, and discards of juvenile cod are one factor hindering the rebuilding of this overfished stock. A new trawl was developed with escape windows installed at the center to allow yellowtail flounder and juvenile cod to escape before entering the trawl. This gear was tested along with unmodified gear in June 2013. Preliminary analyses indicate that the modified gear caught less flounder and juvenile cod than unmodified gear, but the modified gear also caught less legal-sized cod. By using this modified gear, fishermen potentially could reduce yellowtail flounder and juvenile cod discards and make the most of their limited catch allocations in the groundfish fishery.

For more information

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Visit:
www.nmfs.noaa.gov/by_catch/bycatch_BREP.htm

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