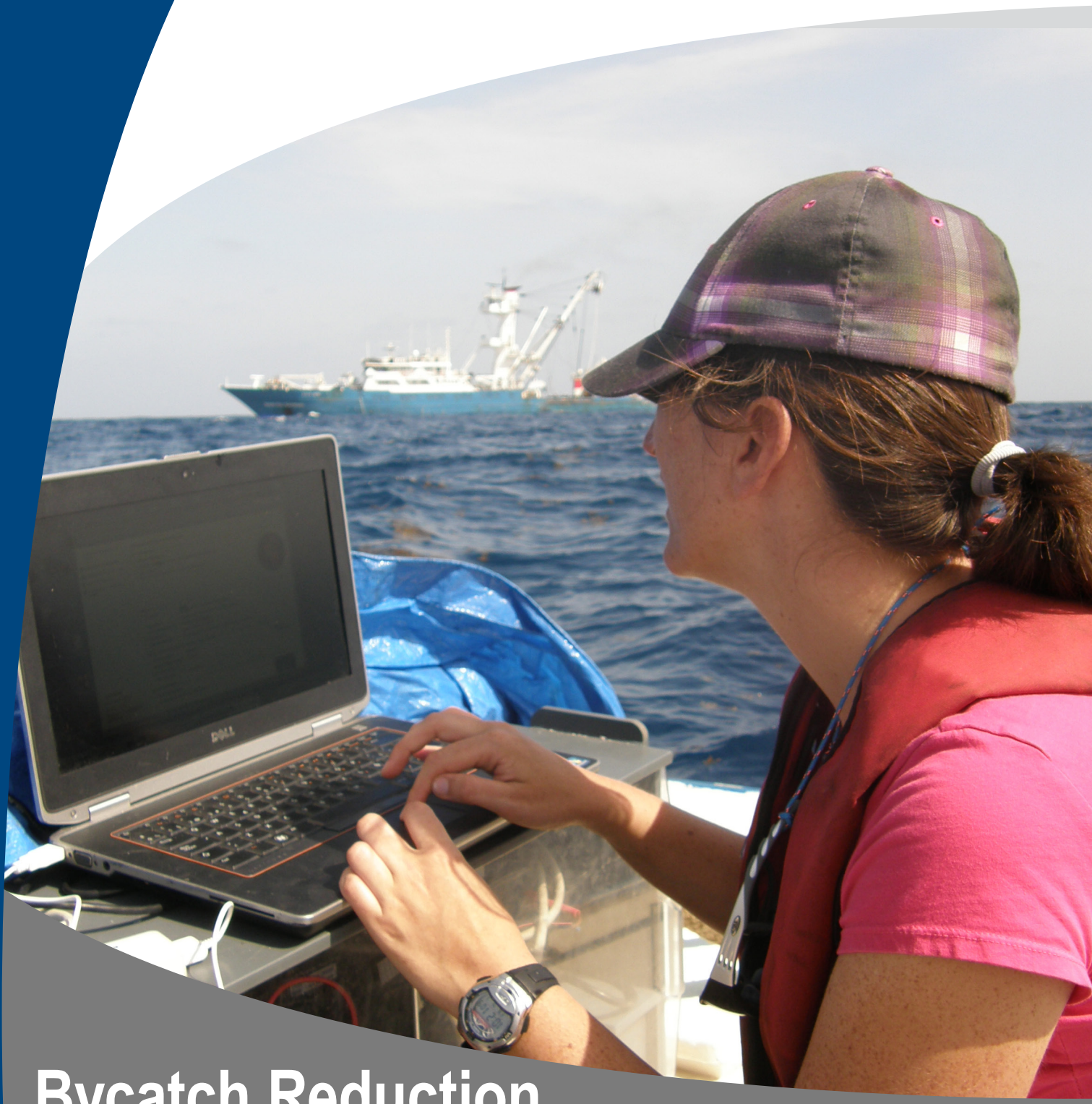
NOAA FISHERIES



Bycatch Reduction Engineering Program

FY 2019 Report to Congress

Funding Bycatch Reduction

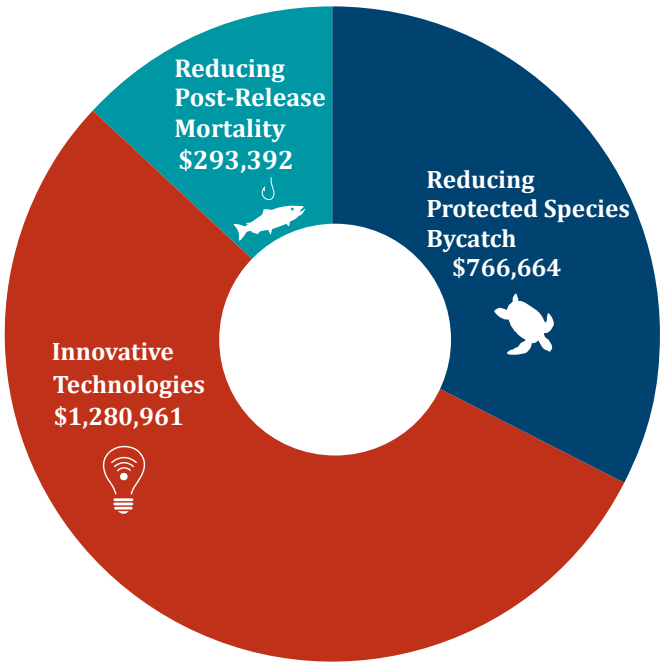
Bycatch occurs when fishermen discard catch of marine species, or when resources like marine mammals, seabirds, or protected fish are harmed or killed by fishing gear. Reducing bycatch in fisheries can improve the recovery of protected species and have positive biological, economic, and social impacts. NOAA's National Marine Fisheries Service (NOAA Fisheries) has long been committed to reducing bycatch through management, monitoring, research, enforcement, education, and communication efforts, as described in the 2016 National Bycatch Reduction Strategy.

The Bycatch Reduction Engineering Program (BREP) supports technological solutions and conservation engineering practices that minimize bycatch and bycatch mortality in managed fisheries. Since fiscal year 2012, NOAA Fisheries has supported 159 BREP awards worth more than $23 million to external partners including state governments, academia, and the fishing industry. The awards are geographically diverse and address four different priorities: reducing protected species bycatch, developing innovative technologies, improving fishing practices, and reducing post-release mortality. The vast majority of BREP projects involve the fishing industry, ensuring that these key stakeholders are engaged in the development of new bycatch solutions. The results of many BREP-funded projects inform new regulations or other management action, including recent legislation promoting the use of descending devices, a technology that BREP-funded researchers investigated as early as 2012.

Highlights & Outcomes

This report summarizes the outcomes of 16 BREP awards funded by NOAA Fisheries in fiscal year 2019, totaling over $2.3 million. Most of the work detailed here was scheduled to occur during calendar year 2020. As a result of the COVID-19 pandemic, some of that work was delayed and the projects extended; several are still ongoing. This report shows that bycatch reduction research, as with any research, can result in a range of outcomes. Finding technological solutions to bycatch problems is a multi-year and multi-disciplinary endeavor requiring technical expertise, collaboration with fishermen, and effective communication with managers.

2019 Funding by Priority



Reducing Protected Species Bycatch 2019

Five 2019 BREP projects addressed bycatch of protected whales and seabirds, particularly the issue of whale entanglement in the vertical lines of lobster and crab fisheries. These projects took place on the U.S. West and East Coasts and the Pacific Islands.

Coastal Monitoring Associates ($119,746): Low-cost timed release for ropeless traps

Whale and turtle entanglements in fishing gear continue to be a significant bycatch issue in trap and pot fisheries, in which fishermen use ropes and buoys to locate and haul back their gear. This project focused on single-trap fishing in inshore waters, where low cost and simplicity are extremely important to fishermen. Researchers developed and demonstrated a timed release system that secures the trap line and float to the top of the trap. Fishermen set the timer for the amount of time they want the trap to be deployed, and when that time is reached, the line and float are automatically released. Testing has shown the gear to be reliable with lobster, black sea bass, and crab traps in a variety of ocean conditions. Researchers also developed a tablet application to allow gear tracking in the absence of surface floats. The timed release system is now in commercial production and has been selected for testing and potential certification by the State of California.

The timed release system developed by Coastal Monitoring Associates installed on a spiny lobster trap. Credit: Bart Chadwick.

Eric Gilman, LLC ($98,900): Demonstration of practicality and safety of alternative branchline weighting designs that reduce seabird catch risk in the Hawaii pelagic longline deep-set fishery

In Hawaii, longline fisheries target tuna but can also catch black-footed and Laysan albatrosses, which feed on bait when it is near the surface of the water during gear deployment and haulback. Pelagic longline fishermen may attach weights to lines that contain baited hooks, in order to keep the gear oriented deeper in the water and maximize catch rates of targeted species. These weights also reduce albatross bycatch by helping the bait sink more quickly, reducing the amount of time that it is near the surface of the water. The closer the weight is to the hook, the faster the bait sinks and the longer it stays below the surface. This research engaged longline fishermen to determine the practicality, safety, and economic viability of placing weights directly adjacent to hooks, instead of the current configuration, which places the weights farther from the hooks. Researchers first surveyed fishermen to find out which hook configurations they found viable, and then tested one of their preferred options at sea. Unfortunately, the experimental configuration reduced the catch rate of tuna by 54 percent, possibly because having the weight close to the hook made it easier for fish to escape. Building on this research, field testing of a new experimental hook that has a weight integrated into it is now underway in the Hawaiian tuna fishery.

Researchers from Eric Gilman, LLC holding baited lines. Credit: Eric Gilman.

Reducing Protected Species Bycatch 2019

Maine Department of Natural Resources ($198,018): Assessing the feasibility of time tension line cutter use in fixed gear fisheries as a gear modification to reduce entanglement risk for the endangered North Atlantic right whale

Entanglement in fixed fishing gear, like the gear used in trap and pot fisheries, poses a significant threat to the recovery of the North Atlantic right whale, one of the world's most endangered whales. In this project, researchers tested a gear modification called the Time Tension Line Cutter, which has gained interest from fishermen because of its ability to maintain the strength of vertical lines while fishermen haul their gear, and also provide a mechanism to break the rope if a whale encounters it. This device is integrated with the vertical line on a trap or pot, and is programmed to cut the line when it records prolonged tension. The device can be set to distinguish a level of tension and time interval that indicates a whale entanglement from that of normal fishing operations, and cut the line when both criteria are met. Researchers have tested 50 units throughout New England and collected feedback from fishermen, resulting in modifications throughout the project to make the device integrate better with fishing operations. They also held a final workshop to facilitate a discussion of the feasibility of the device as a gear modification to reduce the risk of entanglement to large whales.

Researchers from the Maine Department of Natural Resources tested a gear modification called the Time Tension Line Cutter to reduce entanglement risk for the endangered North Atlantic right whale. Credit: iStock.

New England Aquarium ($125,000): Whale release ropes as a large whale bycatch mitigation option

Whale entanglement is an issue in trap and pot fisheries around the country, and one mitigation solution is to lower the amount of force needed to break the vertical lines used in those fisheries. Weaker ropes could reduce severe injuries or complex entanglements, because the entangled whale could be able to more quickly break free from the heavy gear on the seafloor. However, it was unclear whether fixed gear fishermen would still be able to haul their gear using weaker ropes, and whether whales would actually break free when entangled in weaker ropes. To answer these questions, researchers teamed up with ocean engineers to model lobster and crab gear configurations and measure the tensions placed on lines when hauling for fishing, towing at different speeds (to mimic an entangled whale), and when subjected to forces associated with common whale behaviors. They compared the time it takes to break the rope in these different configurations to the time it would take to break a stronger standard rope. Their findings indicate that using the weaker ropes would dramatically reduce whale entanglement duration (likely also reducing whale injury) and that weaker ropes could be used in most fishing scenarios.

Reducing Protected Species Bycatch 2019

Sea Mammal Education Learning Technology Society ($225,000): Developing and testing innovative ropeless lobster fishing gear to reduce bycatch of North Atlantic right whales

Entanglement in the vertical lines of fixed-gear fisheries is one cause of population decline in the critically endangered North Atlantic right whale, and an issue for other whale and turtle species. In this project, researchers developed and tested a lift bag system for ropeless fishing. Using this system, fishermen can acoustically trigger an inflatable bag attached to a lobster or crab trap, which raises the trap to the surface, eliminating vertical lines entirely. Researchers and fishermen worked collaboratively to refine and test this system, including developing GPS-integrated acoustic gear marking to make gear easier to find on the seafloor and at the surface.

The Sea Mammal Education Learning Technology Society developed and tested ropeless lobster fishing gear to reduce bycatch of North Atlantic right whales. Credit: Richard Riels.

Researchers from the Sea Mammal Education Learning Technology Society retrieving ropeless lobster fishing gear. Credit: Richard Riels.

Innovative Technologies 2019

In 2019, nine BREP-funded projects on the West and East Coasts focused on innovative technology, including testing new harvest methods and gear designs, to understand bycatch.

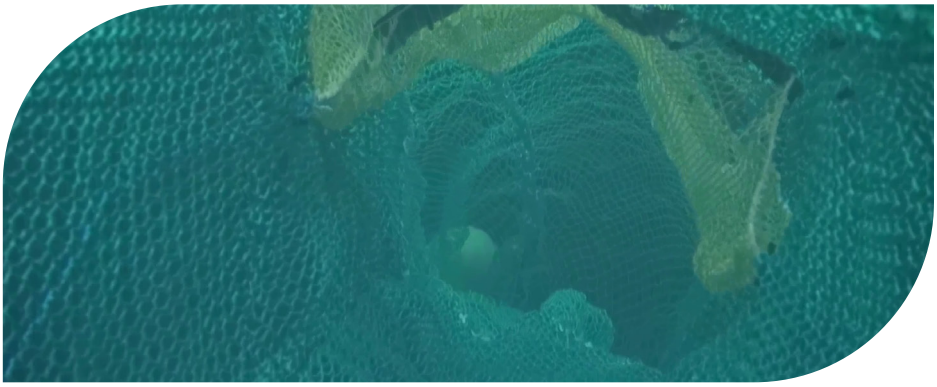
Cornell University ($75,169): Advancing bycatch reduction technology in New England small mesh multispecies fisheries--outreach and technology transfer of the large mesh belly panel

The addition of a large mesh belly panel to trawl nets has been shown to reduce the bycatch of overfished yellowtail flounder in the Northeast small mesh multispecies fishery, but barriers remain to the gear's uptake by fishermen. This BREP grant funded outreach, education, and financial assistance to encourage fishermen to include the large mesh belly panel as part of their fishing gear. Researchers helped fishermen to sign up for a voucher program to pay for the large mesh belly panel, monitored and recorded fishermen's qualitative observations about the gear, and communicated this information to the fishing gear manufacturers and fishery managers. The targeted number of vouchers have been distributed, and researchers are continuing to work with manufacturers and fishermen to encourage improvements to and use of the gear.

Researchers at Cornell University encouraged fishermen to include large mesh belly panels as part of their fishing gear. Credit: Tara McClintick.

FishNext Research ($199,697): Reducing bycatch using real-time video and active release

Recent video transmission technology allows trawl fishermen to see fish, including bycatch species, as the fish pass through the trawl net during fishing. However, their options for what to do about such bycatch, such as stopping fishing activity, have been limited and costly. In this study, researchers designed and tested gear that would allow fishermen to temporarily route fish out of the net, including a moving net panel that can direct fish into or out of the trawl, a water kite to move the net panel, and an electronic system to allow fishermen to move the kite from the vessel. The design was improved through multiple rounds of testing, including at-sea trials on a trawling vessel, where it was demonstrated that the full system works. The testing is ongoing and researchers expect further refinements to the gear from additional trips this fall.



Footage of a bycatch reduction panel built by FishNext Research. Credit: FishNext Research.

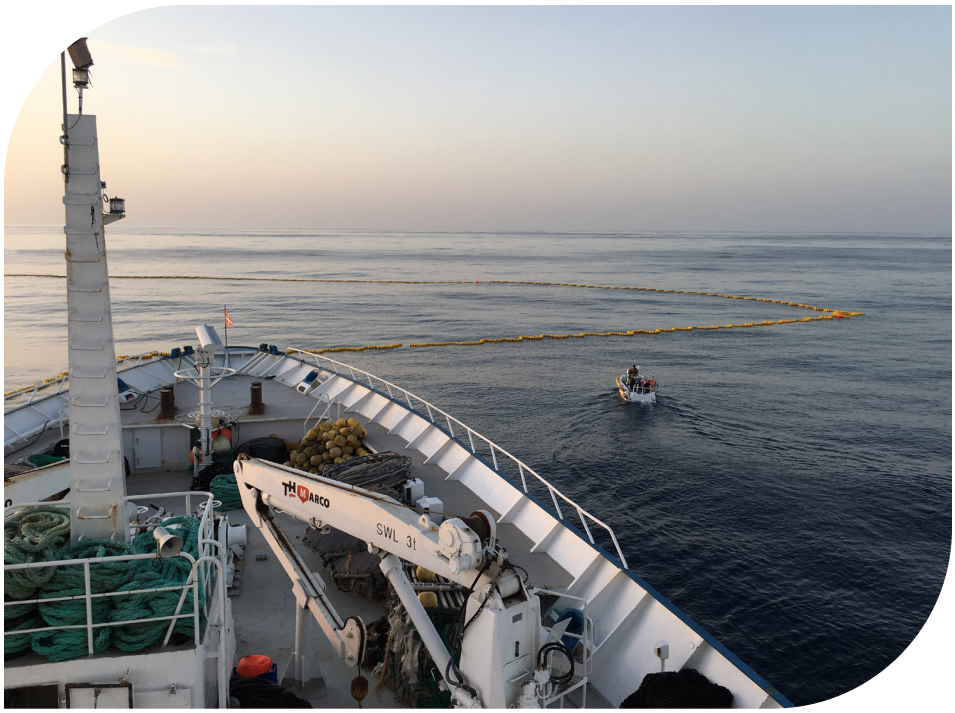
Innovative Technologies 2019

Gulf of Maine Research Institute ($127,329): Improving the selectivity of the ultra-low opening trawl to reduce bycatch of Atlantic cod

The goal of this project was to test whether a modification of the ultra-low opening trawl net would further reduce the bycatch of cod, a species that is both overfished and subject to overfishing, while retaining the same amount of flounder in the Gulf of Maine. The modified net included a large mesh panel over the entrance of the net, which could block cod from entering and guide them over the top of the net. Initial field trials found that the modified net did not reduce cod bycatch, and had lower catch overall, compared to the original net. Researchers made further modifications to the net and re-tested it in the summer of 2021, finding that the catch of flatfish was similar, and the catch of monkfish higher, in the modified net as compared to the original. However, no cod were caught in either type of net during the 2021 trials, making it impossible to determine whether the modifications are effective at excluding cod from the net. Researchers plan to present their findings at the Maine Fishermen's Forum in 2022.

International Seafood Sustainability Foundation ($140,020): Acoustic discrimination to avoid purse seine catches of undersized yellowfin tuna

Fishermen using purse seine gear to catch tuna deploy fish aggregating devices to attract three species of tuna in tropical waters. Because the three species are subject to different management restrictions, fishermen would like to know which species are present around a fish aggregating device before they begin fishing, so they can avoid catching a species that is overfished. In this project, researchers are working to understand the acoustic properties of yellowfin tuna, to enable fishermen to avoid fishing at these devices where this currently-overfished species makes up a high proportion of the fish present. Fishermen already use sonar and echo-sounders to evaluate the size and position of schools of tuna, so using acoustics to better discriminate between species of tuna is a natural way to avoid catching yellowfin tuna while targeting other species. The field study will take place in Panama, and is currently on hold due to COVID-19 travel restrictions.



A small boat carrying scientists and scientific echosounder equipment from a large purse seine vessel to an enclosed tuna aggregation to take acoustic readings. Credit: Udane Martinez – AZTI.

Innovative Technologies 2019

Massachusetts Division of Marine Fisheries ($176,572): Bycatch reduction of red hake in the southern New England silver hake trawl fishery

The red hake stock is overfished with overfishing occurring in southern New England. This stock is caught in the same areas and using the same gear as the whiting (also called silver hake) stock, which is at a healthy population level. Fishermen are concerned that red hake's stock status could trigger regulations that would prevent them from catching whiting as well. Past research suggests that red hake remain closer to the seafloor than whiting, meaning that a more selective gear may allow fishermen to take advantage of this difference and catch whiting while reducing red hake bycatch. In this project, researchers will test a modification, called the large-mesh belly panel, to existing commercial trawl gear in the southern New England whiting fishery. The large gaps in the large-mesh belly panel, which is inserted at the bottom part of the trawl net, are expected to allow bottom-tending fish, including red hake, to swim down and out of the net while whiting will be retained beyond the panel. Field testing was delayed due to the COVID-19 pandemic, but researchers plan to resume in the spring of 2022.

Natural Resources Consultants, Inc ($100,874): Testing Gear modifications to avoid bycatch in Bering Sea Pacific cod and halibut pot fisheries

To address the issue of crab bycatch in Pacific cod and halibut pot fisheries in Alaska, researchers first convened a meeting with gear manufacturers and fishermen to talk about possible modifications to avoid catching crab while maintaining catch of target species. Crab is a prohibited species with high discard mortality, and reducing crab bycatch became a priority after a sudden increase in bycatch in 2018. After identifying several promising modifications, researchers manufactured them and tested them in a controlled laboratory setting. Modifications that worked in the lab are being tested by commercial fishermen in the field. These include sock triggers and false tunnels, which introduce barriers to crabs trying to enter a pot, and slick ramps, which make it difficult for crabs to reach the pot entrance. Field testing is ongoing, but preliminary results suggest that sock triggers and false tunnels are the most likely to be effective at avoiding crab bycatch without lowering the amount of Pacific cod or halibut caught in the pots.

Pacific States Marine Fisheries Commission ($165,000): Development and testing of a rockfish bycatch reduction device for the Pacific hake fishery: a collaborative study between fishing industry and gear researchers

Bycatch of rockfish is an ongoing issue in the Pacific hake fishery, lowering the amount of Pacific hake that can be harvested due to regulatory limits on rockfish bycatch. In this project, researchers and fishing industry participants have been developing and testing gear modifications to more selectively catch hake and reduce bycatch of rockfish. Researchers investigated two categories of gear modifications: sorting grids, which use differences in the shape and size of the two species to exclude rockfish from the net, and open escape windows, which use differences in the species' behavior and swimming ability to exclude rockfish. Preliminary findings suggest that open escape windows are more effective than sorting grids at reducing rockfish bycatch while maintaining the catch rates for hake.

Innovative Technologies 2019

University of Mississippi ($125,250): Shark bycatch reduction in tuna/swordfish fisheries: the potential for using ultra-high molecular weight polyethylene leaders to encourage shark "bite-offs"

Because large sharks are common bycatch in commercial gear designed to catch swordfish and tuna, fishery participants need gear that will retain the target species but allow sharks to escape. Researchers at the University of Mississippi are testing whether a simple change in the type of fishing line used to catch swordfish and tuna could reduce shark bycatch. The new type of line, an ultra-high molecular weight polyethylene, breaks more easily than the standard line when cut with a blade. Researchers hypothesized that polyethylene line would be more easily cut by sharks' blade-like teeth, releasing the sharks from the line while retaining swordfish and tuna (which have differently-shaped teeth). To date, they have found a 75 percent reduction in shark bycatch on hooks using polyethylene line as compared to the standard line type.

Researchers at the University of Mississippi are testing whether a simple change in the type of fishing line used to catch swordfish and tuna could reduce shark bycatch. Credit: Glenn Parsons.

Wild Fish Conservancy ($171,050): Evaluation of an experimental commercial pound net for stock-selective harvest and ecological monitoring in the Lower Columbia River, Oregon

Bycatch of Endangered Species Act-listed wild salmon constrains commercial fishermen's ability to catch hatchery-raised salmon in the Pacific Northwest, resulting in the loss of jobs and industry in coastal fishing communities. Researchers working with local salmon fishermen in the Columbia River engineered, deployed, and evaluated a modified salmon trap that allows for the selective harvest of hatchery salmon and release of wild salmon. Instead of the conventional gillnet gear, which results in air exposure, handling time, and entanglement, the maze-like salmon trap keeps fish swimming in the river until fishermen separate them, releasing the wild-origin fish. Beginning in August of 2021, commercial operations began using the modified salmon trap, the first such commercial operation in Oregon waters since 1948.

Researchers from the Wild Fish Conservancy evaluated an experimental commercial pound net for stock selective harvest. Credit: Jamie Glasgow, WFC.

Reducing Post-Release Mortality 2019

Two BREP-funded projects explored how to reduce post-release mortality in commercial fisheries in Hawaii and on the East Coast. Results from these projects could help improve understanding and management of post-release mortality in species including sharks and turtles.

Hawaiian Fresh Seafood ($98,392): Improving post-hooking survivorship of marine turtles and sharks: designing and testing a cost effective line-cutter prototype for use in the Hawaii longline fishery

When species like sea turtles and sharks are incidentally caught and released in longline fisheries, the trailing gear left on the animal and stress associated with capture are primary drivers of post-hooking mortality. In this project, researchers developed and tested a prototype line cutter that could help fishermen safely release bycaught sharks and turtles, while minimizing the amount of trailing gear and handling time in order to promote survival. The prototype line cutter needed to be able to cut through a large tuna hook, be waterproof, travel down a line without introducing slack into the line, and be triggered at a distance. After the prototype was developed, researchers tested it in the field on a longline fishing trip, where they used it to release all of the 14 sharks that were incidentally caught on the trip. Video cameras captured images of the sharks swimming away with a minimal amount of trailing gear.

Researchers from Hawaiian Fresh Seafood are seen above posing with the pre-prototype line cutter. Credit: Hawaiian Fresh Seafood/Caleb McMahan.

A fishing crew deploys a line cutter with a shark visible underwater. Credit: Hawaiian Fresh Seafood/Caleb McMahan.

Reducing Post-Release Mortality 2019

University of Missouri ($195,000): Quantifying and reducing post-release mortality of shortfin mako sharks captured as bycatch in pelagic longline fisheries

Shortfin mako sharks, an overfished and globally endangered species, are often encountered as bycatch in pelagic longline fisheries targeting tuna and swordfish. Conservation concerns led to the adoption of strict catch and release requirements for pelagic long-line fishermen: any mako shark brought to the boat alive is required to be released with minimum harm to the shark. For such regulations to be effective at their goal of helping the stock to recover, it is important that a significant number of released sharks ultimately survive. High post-release survival would lend support for the efficacy of the regulations, whereas low post-release survival would reduce total reported landings but ultimately have negligible effect on population recovery. The goal of this research is to measure the post-release mortality of shortfin mako sharks released in the pelagic longline fishery, and identify factors that increase their chances of survival post-release. Researchers are working to deploy satellite tags on mako sharks captured and released in the fishery, to provide information on how many of the sharks survive to 30 days after release and what factors are associated with survival. Despite COVID-19 delays, researchers have deployed 20 tags on sharks thus far, and have detected no mortalities. They plan to deploy more tags in the fall of 2021.

Researchers from the University of Missouri are working to deploy satellite tags on shortfin mako sharks that are captured and released to provide information on factors associated with survival. Credit: Michael Byrne.

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