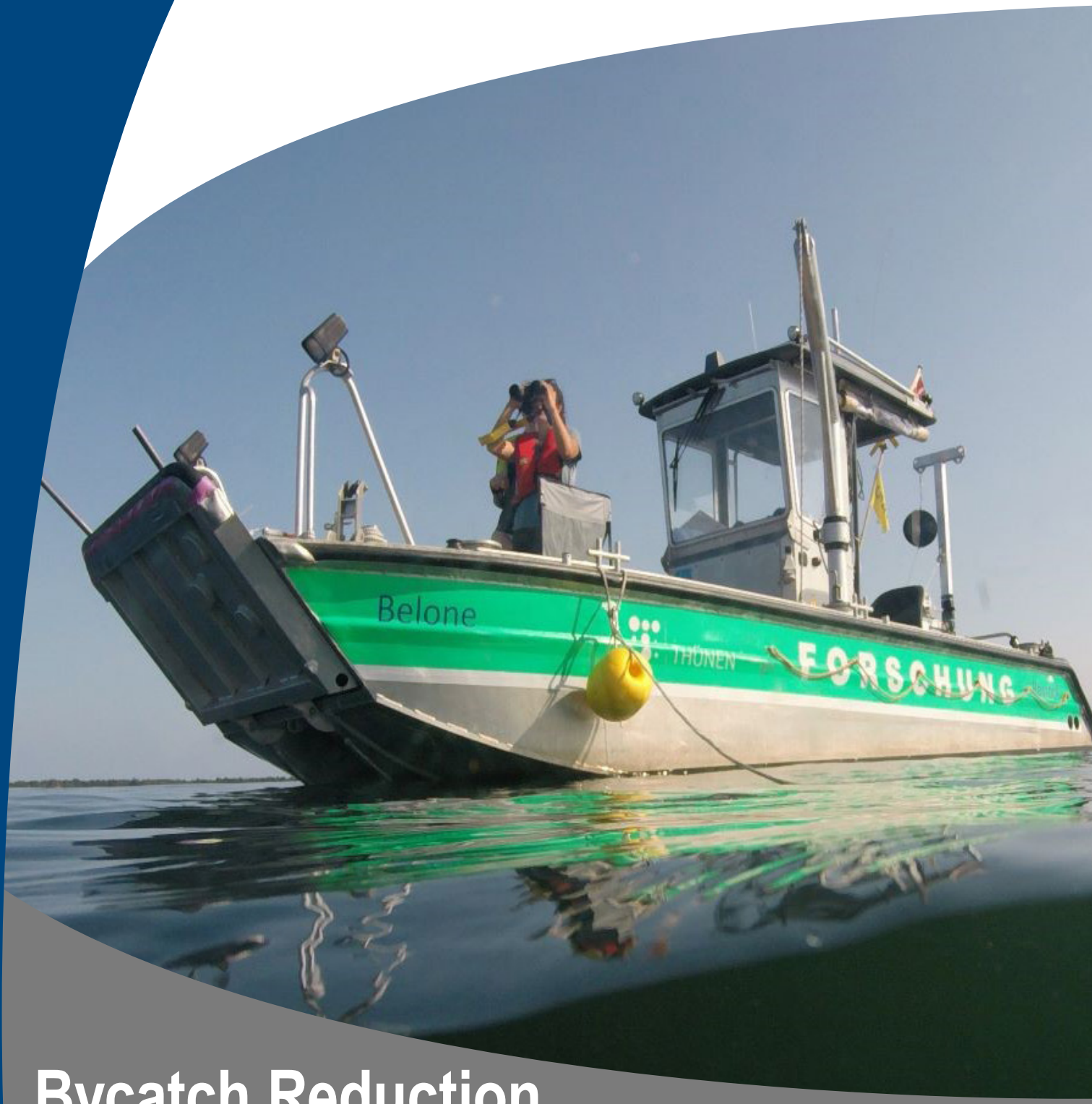
NOAA FISHERIES



Bycatch Reduction Engineering Program

FY 2020 Report to Congress

Funding Bycatch Reduction

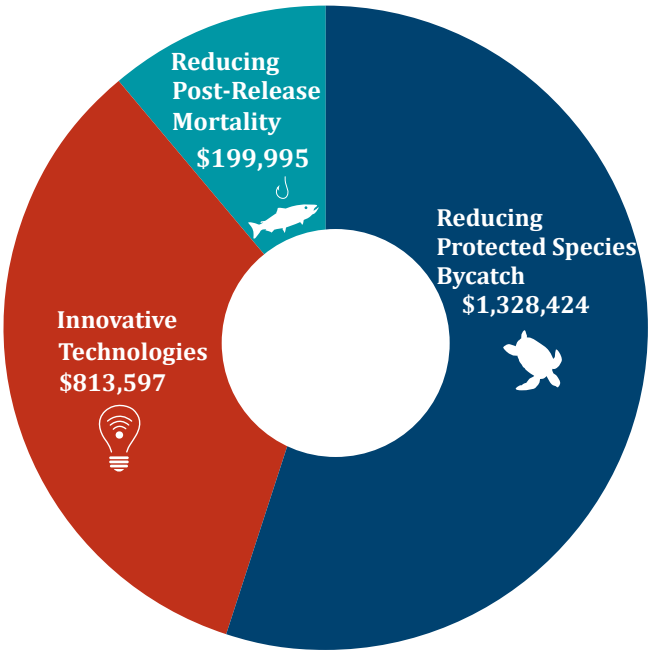
Bycatch occurs when fishermen discard catch of marine species, or when resources like marine mammals, seabirds, or protected fish are harmed or killed by fishing gear. Reducing bycatch in fisheries can improve the recovery of protected species and have positive biological, economic, and social impacts. The National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) 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), authorized under Section 316 of the Magnuson-Stevens Fishery Conservation and Management Act, supports technological solutions and conservation engineering practices that minimize bycatch and bycatch mortality in managed fisheries. From FY 2012 through 2020, NMFS has supported 145 BREP awards totaling nearly $21 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 developing solutions to address bycatch issues. The results of many BREP-funded projects inform new regulations or other management actions.

Highlights & Outcomes

This report summarizes the outcomes of 13 BREP awards funded by NMFS in FY 2020, totaling over $2.3 million. Most of the work detailed here was scheduled to occur during calendar year 2021; however, several projects are still ongoing, and some were delayed as a result of the COVID-19 pandemic. 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 and fisheries stakeholders.

2020 Funding by Priority



Reducing Protected Species Bycatch 2020

Seven 2020 BREP projects addressed bycatch of protected species, including sea turtles, whales, dolphins, and sea lions. These projects took place on the U.S. West and East coasts, in Alaska and the Pacific Islands, and internationally.

Sea Mammal Education Learning Technology Society ($231,824): Fishing and testing of innovative ropeless lift-bag fishing system

Vertical lines, or ropes that connect fishing gear on the seafloor to floating buoys, are the primary source of entanglements of the critically endangered North Atlantic right whale. This project examined the advancement of ropeless (otherwise known as "on-demand") fishing technology in the Northeast lobster, crab, and other trap gear fisheries to reduce the risk of North Atlantic right whale entanglements. Instead of using vertical lines, ropeless fishing systems secure the rope near the sea floor, and then fishermen use an acoustic trigger to release the rope, which floats the gear to the surface to be hauled onto the vessel. However, this technology creates new challenges for fishermen that rely on visual aids at the sea surface (buoys) in order to find and retrieve, or avoid, fishing gear located on the sea floor. In this study, researchers developed and tested a ropeless, lift-bag system integrated with acoustic tracking technology that generates virtual gear markings on the seafloor and at the sea surface. This research is ongoing, but initial trials have delivered promising results. Industry collaboration—particularly among fishermen, state and federal researchers, technology companies, and other gear experts—continues to be integral to the success of the study.

A SMELTS lobster raft triggered from the seafloor by commercial fishermen off vessel. Credit: Michael Moore WHOI

LobsterLift, LLC ($119,890): A ropeless, self-surfacing, modular lobster trap retrieval system with the goal of reducing marine mammal bycatch

Critically endangered North Atlantic right whales face many threats, including entanglement in vertical lines from fixed-gear fisheries.

LobsterLift team lead Cormac Hondros-McCarthy, teaching a commercial lobsterman how to use the gear in Gloucester, MA. Credit: LobesterLift Team

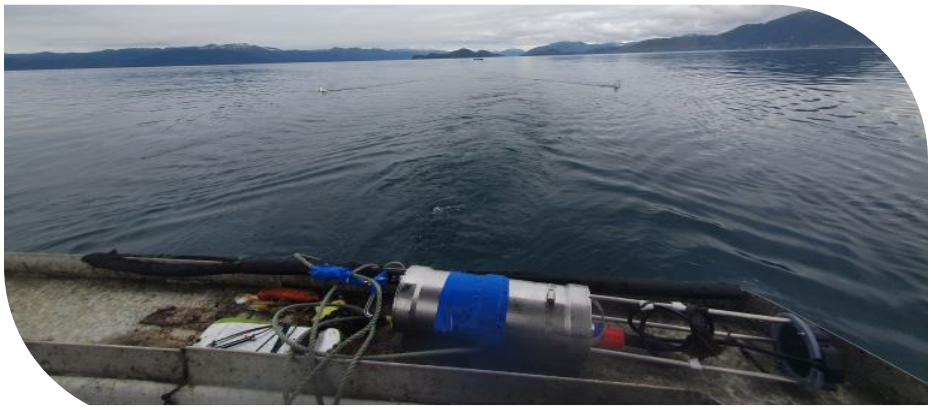
This project focused on low-cost, ropeless (or "on demand") fishing solutions that will allow trap and pot fisheries to coexist with whales. Researchers developed a low-cost and watertight pneumatic assembly connected to a buoy system, dubbed the LobsterLift. Using a smartphone application, fishermen send a signal to the LobsterLift to inflate a buoy that brings the traps from the seafloor to the surface. Through rigorous testing with lobster industry participants, and in collaboration with state and federal scientists and fishing gear experts, the team demonstrated that the ropeless gear can be reliably recovered and easily redeployed in a short time, which is extremely important to fishermen.

Reducing Protected Species Bycatch 2020

Alaska Department of Fish and Game ($212,052): Preserving catch of salmon troll fishermen while reducing interactions with Steller sea lions: Targeted Acoustic Startle Technology (TAST) to deter Steller sea lions from troll gear in Southeast Alaska

A Steller sea lion pup tugs on a fishing lure hooked on its mother's mouth, likely as a result of stealing a salmon from fishing gear. Credit: AKDFG

Global conflicts and interactions between fisheries and marine mammals are well documented. In Southeast Alaska, Steller sea lions are known to follow commercial salmon fishery participants using trolling gear (baited hooks that are trailed behind a moving boat to catch Chinook and coho salmon) and take fish from their lines, which is particularly concerning in an area where fishing is one of the few occupations available to residents. In this study, researchers sought to reduce sea lion interactions with "salmon trollers" using recently developed targeted acoustic startle technology, or TAST. The team first tested TAST on schools of salmon to ensure the equipment would not interfere with fishermen's ability to catch salmon. The researchers then tested TAST on herds of Steller sea lions, and during fishing operations, to determine its deterrent capabilities. Sea lions were seen foraging, trailing fishing vessels, and interacting with fishing gear during the trials but moved away and ceased interactions when TAST was activated. Although trials and data analysis are ongoing, these preliminary results suggest TAST can reduce Steller sea lion interactions with salmon trollers and help preserve the culture and economy of small fishing communities in Southeast Alaska. weaker ropes could be used in most fishing scenarios.



The fisheries pod ready to be deployed off the back of a commercial salmon troller in Southeast Alaska. Credit: Thomas Goetz

Reducing Protected Species Bycatch 2020

SUBMON ($161,256): Improving the understanding of decompression sickness and its post-release impact in marine turtles incidentally captured by trawl fisheries

Decompression sickness (DCS) is a debilitating and potentially fatal condition caused when gasses that are dissolved in the blood and organs under high pressure emerge as bubbles in the body as pressure decreases (for example, when animals are brought to the surface quickly after being captured at depth).

DCS is known to occur in many bycatch species, and has been diagnosed in sea turtles incidentally captured by trawl and gillnet fisheries. In fact, previous studies in Italy and Brazil suggest as much as 100 percent of examined bycaught turtles are diagnosed with DCS, and many needed specialized treatment to recover. Under normal fishing practices in the United States, sea turtles are to be released immediately; however, it is unclear if they can "re-compress" by resuming normal or even modified diving behavior.

Turtle CC22009 before being released. Credit: NEMA, Núcleo de Educação e Monitoramento Ambiental

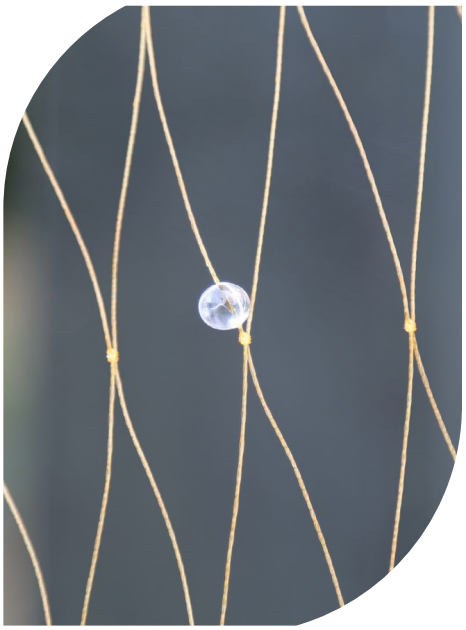
Observer carrying out an ultrasound scan on a captured loggerhead turtle on board the trawler. Credit: NEMA, Núcleo de Educação e Monitoramento Ambiental

In this study, researchers examined and monitored the release of incidentally captured sea turtles aboard Southern Brazil trawl vessels to determine post-release impacts to the turtles. The sea turtles were examined for signs of DCS via ultrasound scans, blood tests, and other physical and neurological tests, and released with a satellite transmitter to confirm turtle survival for the first 3 weeks. Field work is ongoing, but four trips have been completed. Of the 11 sea turtles that were captured and could be released, four (36%) died within days. Results of this study may inform strategies to mitigate post-release impacts to sea turtles incidentally caught in U.S. fisheries.

Reducing Protected Species Bycatch 2020

Thünen-Institute for Baltic Sea Fisheries ($199,275): Avoidance reaction of small cetaceans to an acoustically enhanced gillnet: an international collaborative research to reduce their bycatch in Europe and in the U.S.

Bycatch is widely considered a significant global threat to many species of whales, dolphins, and porpoises. In this study, researchers developed a special net to reduce the bycatch of harbor porpoises in gillnet fisheries. The researchers systematically simulated the echolocation properties of objects of all shapes and sizes and found that small acrylic glass spheres (or pearls) resonate at a frequency that matches the echolocation properties of the harbor porpoise. In other words, when a standard gillnet is equipped with the small pearls (termed a "pearl net"), the netting becomes more acoustically visible to the harbor porpoise. To test the gear, the team observed the behavior of harbor porpoises around conventional gillnets and the pearl net in two ways: visually using standard tools that observe marine mammal behavior above the water, and acoustically using hydrophones positioned below the water. Although data analysis is still underway, the preliminary results suggest that harbor porpoises have an earlier avoidance reaction toward the pearl net compared to a conventional gillnet.



An acrylic glass sphere glued to gillnet. Credit: Thünen Institute/I. Kratzer

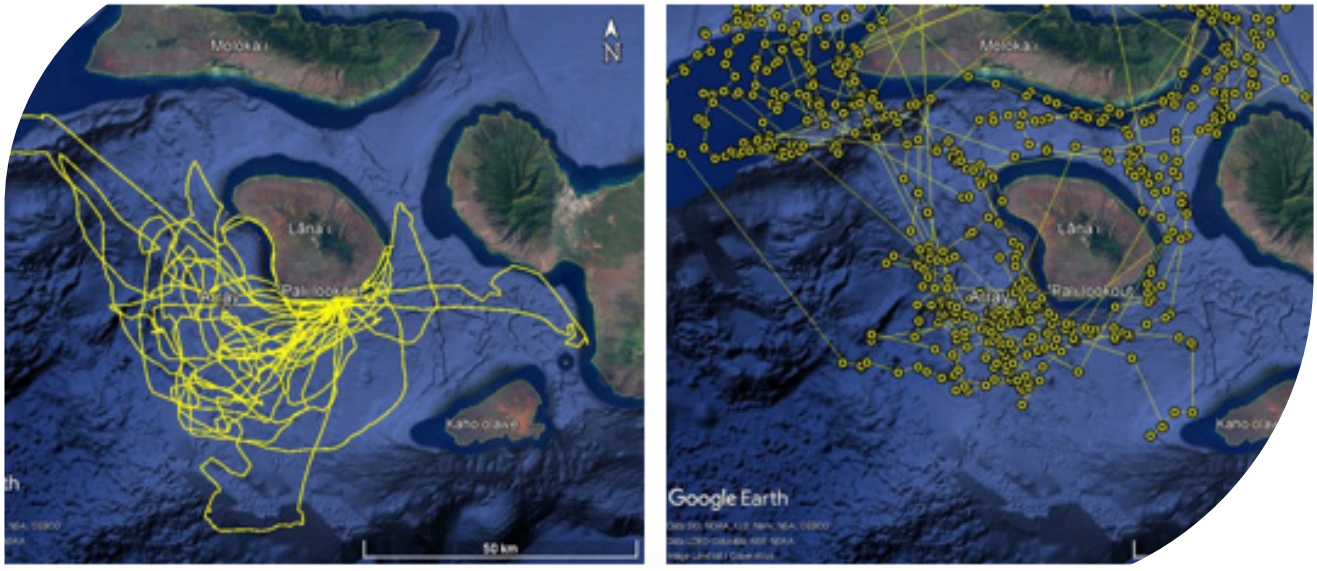
University of Mississippi ($156,193): Acoustic enumeration of sea turtle impacts on Turtle Excluder Devices

The addition of Turtle Excluder Devices (TEDs) to trawl gear has successfully reduced sea turtle bycatch in the Southeast shrimp fishery. It has also introduced new challenges in estimating endangered sea turtle interactions with trawl gear, as required by a 2014 Biological Opinion for the fishery. Instead of relying on highly uncertain estimates based on catch-per-unit-effort data, this study explored the use of acoustic technology and computer algorithms to identify sea turtle impacts with TEDs. The researchers deployed a camera and hydrophone (a microphone that detects sound waves underwater) inside two trawl nets close to the TED to record audio and video during trawling operations. During a 10-day fishing trip, the team observed 51 turtles escaping through the TEDs. Acoustic analysis techniques were then applied to a sample of the data to determine an algorithm that could identify the observed sea turtle interactions. Currently, the algorithm identifies 42 of the turtle impacts and researchers are now working to adjust the algorithm to reduce the number of missed turtles. These promising results coupled with geographic information could also be used to identify sea turtle "hot spots" to avoid, thus further lowering sea turtle interactions in the fishery.

Reducing Protected Species Bycatch 2020

University of California, San Diego ($247,934): Foraging behavior of false killer whales in relation to oceanography and prey: Informing bycatch mitigation for near-shore fisheries around the Main Hawaiian Island

Depredation, or the taking or consuming of fishery catch by predators before it can be hauled on to the vessel, continues to be a significant bycatch issue in global fisheries. Depending on the circumstances, this type of predatory foraging behavior can result in fatal injury to protected species, like marine mammals and sea turtles, and lost revenue to fishermen. In this study, researchers investigated the fine-scale foraging behavior of endangered Main Hawaiian Islands (MHI) false killer whales to better inform managers of bycatch mitigation strategies for near-shore fishing activities. Previous studies have documented a relatively high proportion of individuals in this population with injuries that are consistent with fishing line interactions. However, more information linking foraging behavior to interactions with fishing lines is needed to effectively devise strategies to reduce depredation. The team used a combination of acoustic listening devices, echosounders, and other technologies to track and document prey densities, whales, and associated whale behaviors in the presence of fishing boats. After 16 days in the field, the team encountered 57 groups of whales and dolphins, including two different social clusters (pods) of MHI false killer whales. The study is ongoing, but thousands of photos were taken in the process for individual identification, and biopsy samples were collected from 11 individuals that had not been previously sampled.



Left: small boat effort during field work. Right: tracks from a cluster of false killer whales tagged with acoustic technology; the yellow dots represent the acoustic array of listening devices, and the yellow lines depict the movement of the whales over or near the array. Map credit (Google Earth): RW Baird.

Innovative Technologies 2020

In 2020, five BREP-funded projects along the West and East coasts and in Alaska and the Gulf of Mexico focused on innovative technology to address bycatch issues, including testing new harvest methods and gear designs.

Pacific States Marine Fisheries Commission ($185,389): Testing a Flexigrid system to reduce bycatch of juvenile sablefish in the West Coast groundfish bottom trawl fishery: An international collaboration

In this study, researchers examined the use of a flexible sorting grid system to reduce juvenile sablefish catches in the West Coast groundfish bottom trawl fishery. Sorting grids are a proven way to reduce bycatch of non-target species in the fishery, like Pacific halibut and other flatfish and roundfish species.

However, a sorting grid system to reduce catches of smaller-sized and juvenile fishes of targeted species have not been evaluated. The researchers collaborated with Norway, Denmark, and U.S. industry participants to test a flexible grid-system (Flexigrid), which consists of a double grid attached to the top and bottom of the trawl net to provide smaller-sized fish more opportunity to escape. One of the grids tested demonstrated more than a 45 percent reduction in juvenile sablefish catch, on average, while also maintaining catches of adult sablefish and other target species such as Dover sole and lingcod. Testing is ongoing, but these positive preliminary results indicate that trawlers can improve the utilization of the sablefish resource by using a dual-sorting Flexigrid system. The team plans to continue its collaborations in 2023 with U.S. fishermen and gear experts to enhance the gear's ability to reduce catch of juvenile sablefish and garner support for the voluntary use of the gear in the fishery.

Fishers and scientists sorting out sablefish and other groundfish from a codend catch for data collection. Credit: PSMFC

The charter vessel used during the gear trials of this collaborative research study. Credit: PSMFC

Innovative Technologies 2020

Pacific States Marine Fisheries Commission ($174,750): Reducing seafloor and benthic macroinvertebrate impacts using semi-pelagic trawl technology to harvest U.S. West Coast demersal groundfishes

Conventional bottom trawl gear is very effective at herding groundfishes toward the mouth of the trawl net, but its bottom-tending characteristics can have detrimental impacts on the physical habitat and bottom-dwelling organisms, including crabs, urchins, anemones, and sea stars. In this study, researchers compared the catch efficiency of West Coast groundfishes and trawl-seafloor interactions between conventional bottom trawl gear and a semi-pelagic trawl design where the bottom-tending gear is slightly elevated off of the seafloor. Researchers attached contact sensors to the two trawl designs, and also used sonar and video cameras to monitor and inspect for trawl-seafloor interactions. The results indicate that the semi-pelagic trawl design can improve ecosystem sustainability by mitigating impacts to bottom-dwelling organisms and habitat, without affecting the catch efficiency of target species such as sablefish, lingcod, and Dover sole. Ongoing outreach efforts on these results have already yielded positive feedback, leading some fishermen to make the switch to the semi-pelagic trawl gear to target West Coast groundfishes.

A bottom contact sensor placed on a trawl door designed to fish off bottom when rigged to a groundfish bottom trawl. The bottom contact sensor was used to confirm that the off-bottom doors were fishing above the seafloor. Credit: PSMFC

Innovative Technologies 2020

Natural Resources Consultants, Inc. ($81,769): Refining gear modifications to avoid crab bycatch in Bering Sea Pacific cod and halibut pot fisheries

In the Bering Sea and Aleutian Islands, crab species like king crab, snow crab, and tanner crab are considered prohibited species and must be discarded when caught as bycatch during non-crab fishing operations. This project continued engineering and testing of gear modifications to address the issue of crab bycatch in the Pacific cod and halibut fisheries in Alaska. Researchers successfully coordinated with industry stakeholders to develop and test feasible modifications to traditional pot fishing gear, including slick ramps that make it difficult for crabs to reach the pot entrance, and sock triggers and false tunnels, which introduce barriers to crabs trying to enter a pot. Lab testing was complete in March 2022, and final field trials occurred during the fall cod fishery in September 2022. The results suggest that newer pot entrance modifications, including sock triggers and false tunnels, appear to be more effective at avoiding crab bycatch while maintaining catch rates of Pacific cod or halibut at acceptable levels. Early reports back from vessels that tested these modifications were supportive, and the project team was able to present preliminary findings to the North Pacific Fishery Management Council.

Mote Marine Laboratory, Center for Fisheries Electronic Monitoring ($175,433): Application and advancement of innovative technologies for electronic monitoring (EM) in support of best fishing practices for the commercial Gulf of Mexico (GOM) snapper-grouper fishery-Phase II

In the second phase of this study, researchers collaborated with industry partners, NMFS scientists, and management advisors to test the application of innovative technologies to address bycatch issues in the Gulf of Mexico commercial reef fish fishery. Many large sharks that are caught in the fishery as bycatch, some of which are prohibited species, are cut-off (or released) before any biological information can be collected. In order to provide improved identification and documentation of cut-off sharks, the research team fitted an underwater camera, which was developed in Phase I of this project, to the bottom of a longline vessel that already uses an electronic monitoring device to document catch and fishing effort. The research team also tested the application of a "discard chute" and stern cameras to collect length data of discarded fish, and document fish condition post-release in the short term. The high-quality images collected from the study are also linked to vessel GPS coordinates, which allows researchers to identify "hot-spots" for bycatch species, and correlate catch location with environmental data. Results from the study suggest that these innovative technologies can support species stock assessments by providing necessary length data on discarded fish, and inform industry fishing practices and management strategies to minimize bycatch and bycatch mortality in the fishery.

Participating captain, Kenny Daniels, with his vessel. Credit: CFEMM, Center for Fisheries Electronic Monitoring at Mote

Innovative Technologies 2020

Commercial Fisheries Research Foundation ($196,256): Piloting a low-bycatch commercial squid jig fishery in southern New England

Automatic squid jigging is widely used to harvest squid due to its versatility and relatively low costs compared to traditional trawl gear, and virtually zero bycatch. In this study, researchers investigated the potential use of automatic squid jigging machines as an alternative gear type to address longstanding bycatch issues in the East Coast small-mesh squid fishery. The researchers retrofitted two Rhode Island–based trawl vessels (a smaller inshore vessel, and a larger offshore vessel) with automatic jigging systems. Although testing is ongoing, initial trails have yielded consistently low catch rates of squid from the automatic jigs. The project team is currently investigating ways to increase catch rates and maximize commercial viability. The team acknowledged having to overcome a steep learning curve in setting up and operating the jigs, which hopefully will lead to more positive results in the future.

Commercial Fisheries Research Foundation Research Biologist, Thomas Heimann, reviewing automatic squid jig installation instructions with a collaborating fisherman. Credit: CFRF, Commercial Fisheries Research Foundation

Automatic squid jigging machines set up on a Rhode Island-based trawl vessel. Credit: CFRF, Commercial Fisheries Research Foundation

Reducing Post-Release Mortality 2020

In 2020, one BREP-funded project explored how to reduce post-release mortality in recreational shark fisheries on the East Coast. Results from this project could inform NMFS' best handling guidelines and support the recovery of shark populations.

University of Massachusetts-Dartmouth, School for Marine Science and Technology ($199,995): Post-release mortality in recreational-caught shortfin mako sharks: Understanding the effects of capture, handling techniques, and retained gear

In this study, researchers sought to better understand the post-release survival of shortfin mako sharks in the Northeast U.S. recreational shark fishery. Shortfin mako sharks are overfished, and although anglers are required to release them to reduce fishing mortality, there is little information on the extent to which fishing and handling practices used by U.S. recreational shark fishermen impacts their survival after being released. To investigate this, the study team first evaluated the experience levels of recreational shark anglers in the United States, and documented the range of capture and handling practices used when catching and releasing shortfin makos. Then, working directly with recreational anglers, the team tagged mako sharks with archival pop-off satellite tags to determine survival after being released. Preliminary results indicate that most shark anglers in the fishery use the best practice guidelines outlined by NMFS for capturing and handling sharks. However, a moderate level of post-release mortality (roughly 25%) still occurs, which suggests that there may be opportunity to improve the best practice guidelines to further reduce fishing mortality and aid the rebuilding of the shortfin mako shark population.

A recreationally caught shortfin mako shark. Credit: UMass Dartmouth

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