Bycatch Reduction Engineering Program

2014 Annual Report to Congress

NOAA FISHERIES

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

Highlights from FY2013

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 projects strengthen cooperation and collaboration between NOAA Fisheries and the fishing industry by engaging partners in critical research projects and prioritizing research projects that have a strong management application.

This report highlights outcomes and management applications of projects funded with $2.39 million in FY2013. They represent four priority areas:

Reducing Protected Species Bycatch

Innovative Technologies

Improving Fishing Practices

Reducing Post-Release Mortality

FY2013 project highlights:

- In the Northeast, researchers used an an enhanced communication network and real-time maps to allow longfin squid fishermen to avoid butterfish "hot spots" and reduce bycatch by 54 percent.
- Researchers on the West Coast have found that using LED lights can reduce bycatch of the endangered eulachon in the ocean shrimp trawl fishery by up to 91 percent.
- In the mid-Atlantic, scientists developed a modified gillnet that reduced sturgeon interactions by more than 60 percent in Virginia and North Carolina.

The report also identifies projects funded in FY 2014, although results from these projects will not be available until next year.

Reducing Protected Species Bycatch

In 2013, four BREP-funded projects specifically addressed protected species bycatch along the West Coast, Mid-Atlantic, and Southeast. They examined interactions with protected species such as eulachon, Atlantic sturgeon, and sea turtles. As a result of BREP funding, all four projects have made substantial progress in modifying gear to reduce bycatch and training longline fishermen to increase post-release survival.

Researchers with the Pacific States Marine Fisheries Commission have found that using LED lights attached to the trawl fishing line can reduce the amount of threatened eulachon bycatch in the ocean shrimp trawl fishery by up to 91 percent. Eulachon (Columbia River smelt) is regularly caught as bycatch in small-mesh fisheries. Although the ocean shrimp trawl fishery uses a rigid-grate device designed to block fish, the small smelt fit through the grate. To develop an alternative, researchers examined the effect of lights on the ability of fish, including smelt, to avoid the net and escape underneath—with little to no shrimp loss. In addition to the substantial reduction in smelt bycatch, the lights reduced small flatfish bycatch by almost 70 percent and darkblotched rockfish by more than 80 percent. As a result of this study and the involvement of the ocean shrimp fleet, the majority of vessel operators are voluntarily buying and attaching LED lights to their trawls.

Left: A pink shrimp haul without the use of LED lights shows threatened Eulachon (smelt) bycatch. Right: The results of LED lights hung on the trawl lines. Below: One of the LEDs attached to a net to show fish an escape route.

Researchers with Chesapeake Scientific and Cardno Entrix have modified gillnet gear used to catch valuable striped bass and southern flounder in Virginia and North Carolina, respectively, to reduce interactions with protected sturgeon. Bottom-feeding sturgeon are particularly vulnerable to sink gillnets, which typically lie along the bottom. Researchers found that they could make the gear more selective by reducing the height of the gillnet and lifting it slightly off of the bottom. This study showed that the modified gillnet design reduced interactions with sturgeon by more than 60 percent in North Carolina and Virginia. These gear modifications also increased catch of striped bass, but reduced catch of southern flounder. This information may be used to further modify gear or form new regulations to help the commercial harvest of southern flounder and striped bass, with fewer interactions with protected sturgeon.

A loggerhead turtle escaping through a Turtle Excluder Device, or TED.

The Gulf and South Atlantic Fisheries Foundation, in partnership with academics and fishermen, evaluated several design modifications to topless trawls used in the Atlantic summer flounder fishery to further reduce interactions with sea turtles. Summer flounder is one of the most sought after commercial and recreational fish along the Atlantic coast and are mainly caught commercially in bottom trawls. The summer flounder fishery currently uses turtle excluder devices to reduce turtle bycatch; however bottom trawls equipped with a turtle excluder device have also resulted in significant loss of target species. Their research showed that the design modifications, which include a 160-foot headrope (top line of the trawl) rather than the more traditional length of 65 feet, reduced overall sea turtle bycatch by about 50 percent. Although the experimental topless trawl is tending bottom properly, the larger headrope allows some finfish to escape along with sea turtles. Future work will include stabilizing the trawl opening to allow sea turtles to escape while increasing the summer flounder catch.

Scientists with international organization SUBMON trained U.S. longline fishermen to increase post-release survival of sea turtles. Incidental capture in longline fisheries is a threat to sea turtles along both coasts and the Gulf of Mexico. Longlines are used in several important fisheries such as swordfish, tuna, and halibut. Fishermen have implemented many changes in longline fisheries, but sea turtle bycatch remains an issue. Although fishermen release the turtles they catch, the turtles' survival depends on fishermen's handling practices. SUBMON held workshops in Hawaii, the Gulf of Mexico, and along the East Coast to teach techniques for handling incidentally caught sea turtles in longline fisheries. Fishermen were instructed in turtle anatomy and physiology, hook removing techniques, and how to select the most effective technique. This project is expected to reduce sea turtle post-release mortality by 30 to 50 percent.

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 MSA. Additional information about our efforts to address remaining bycatch or seabird interaction problems is available on our website.

Reducing Post-Release Mortality

Five 2013 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. These projects are helping determine post-release mortality rates for many species, such as summer flounder, coastal sharks, reef fish, rockfish, and halibut. The information can then be used to help reduce mortality rates in these and other fisheries. Research on these species has focused in the Mid-Atlantic, Gulf of Mexico, Pacific Northwest, and Alaska regions.

In the Mid-Atlantic, researchers with Fairleigh Dickinson University worked to determine the optimal hook size for anglers to land legal-size flounder while 1) reducing the number of non-target and undersized fish caught and 2) improving the survival of released fish. Summer flounder is a favorite among recreational fishermen and is one of the most common species caught with hook-and-line gear and released in the Atlantic. Researchers examined the effects of different hook sizes and concluded that larger hooks landed significantly larger fish, reduced overall discards, and decreased potential discard mortality. Researchers are currently working through the state management process to recommend hook size regulation changes that could be used to lower the minimum size while maintaining the same season length and creel size limit.

By gathering halibut length and weight data and using smartphone technology, Alaskan recreational fishermen can improve survival for halibut after release.

Researchers at Mote Marine Lab continue to measure post-release mortality of large coastal sharks caught in the Florida commercial shark fishery. Sharks are more vulnerable to fishing pressures and impacts of post-release mortality due to their slow growth and late maturity. Researchers worked with commercial longline fishermen to tag sharks with acceleration data loggers to enable data recovery from these large, wide-ranging species. The data show whether the sharks survived after capture and release and provide additional information to estimate a recovery period after capture. The research results indicate that post-release mortality rates range from 0 to 67 percent and vary greatly by species, with sandbar, tiger, and bull sharks showing greater resilience and blacktip and spinner sharks showing more vulnerability to capture stress. Determining post-release mortality rates for these species is a crucial piece of information for management groups to understand the impact of bycatch on Florida shark populations.

Researchers with the Florida Fish and Wildlife Conservation Commission worked cooperatively with charter vessel operators to test rapid descent as an alternative method for the safe release of reef fish—primarily snapper and grouper—caught on hook-and-line gear in the recreational fishery in the Gulf of Mexico. Gulf snapper and grouper are highly targeted by recreational fishermen but are also highly susceptible to the effects of barotrauma. Typically, anglers "vent" the fish by placing a needle or hollow tool into the swim bladder to allow gases to escape before releasing the fish at the surface. This allows the fish to safely return to the ocean bottom. As an alternative to venting and release at the surface, this study tested the use of rapid descent and recompression to reduce post-

release mortality. Researchers also tried the depth at which a fish would need to be returned to increase survival. Preliminary results indicate differences between snapper and grouper in the release depth required for the fish to recompress and regain swimming capabilities.

Recreational fishermen teamed with researchers from Scripps Institution of Oceanography to examine the effectiveness of descending devices for rockfish suffering from barotrauma. Barotrauma occurs when fish are brought too quickly to the surface and can result in serious injury or inability to swim upon release. Rockfish experience high rates of catch-and-release mortality associated with barotrauma. Descending devices can be used to return these fish quickly to the bottom, minimizing the impact of barotrauma. Because much of the physical trauma should be alleviated by recompression, this study also looked at how low oxygen levels at depth and capture stress contributed to increased mortality. Rockfish survival following release using descending devices was approximately 80 percent. Researchers also found that an oxygen level below 28 percent saturation is stressful and potentially lethal. This improved understanding of how low levels of dissolved oxygen contribute to mortality will allow for refinement of the catch-and-release process and the implementation of release guidelines and regulations to maximize survival.

The Alaska Charter Association examined how smartphone technology could minimize handling of recreationally caught Pacific halibut and improve their survival. Guided recreational halibut anglers in Alaska must release halibut that are too small, but measuring a halibut in the water is very difficult. By developing a method to quickly assess halibut size in the water, researchers could reduce release mortality and increase safety. Using halibut head and length data, researchers developed a smartphone application. Anglers take a picture of the halibut's head while in the water and the app predicts the fish's length and weight.

Researchers tag sharks to gather data on survival and recovery after release.

Fishermen's Involvement

U.S. fishermen are involved with many aspects of BREP research—from designing new gear and assisting with data collection, to testing gear in the field. Fisherman participation is important, as commercial and recreational industries will be implementing the results of successful projects. Fishermen bring a unique perspective to the projects and are knowledgeable about what solutions may or may not work in their fisheries. By sharing information, fishermen and the scientific community can work together to reduce and prevent bycatch. Fishermen-involved projects include:

- Groundfish fishermen along the Pacific coast participated on a project steering committee to design research fishing plans, which provide guidance on where and how much fishing will occur, what data will be collected, observer coverage, and a set of thresholds to follow if other overfished species are encountered.
- More than 35 fishing vessels active in the longfin squid fishery have provided more than 500 bycatch reports that identify bycatch hotspots of butterfish, shad, and river herring.
- In the Southwest researchers have engaged cooperative fisheries to help design, test, and deploy deep set buoy gear to selectively target swordfish at depth and reduce bycatch.
- West Coast fishermen targeting flatfish participated significantly in sea trials and development of bycatch reduction devices (BRDs) that increased access to target species and reduced catches of sablefish and rockfish.
- Shrimp fishing vessels have collaborated in studies by volunteering to attach green LED lights to the fishing lines of their trawls, subsequently reducing smelt and other fish bycatch.

Fiscal Year 2013
16 Projects • $2.39 million

Reducing Protected Species Bycatch

1. Cardno ENTRIX—Modify commercial fishing gear to reduce Atlantic sturgeon interactions in North Carolina & Mid-Atlantic gillnet fisheries ($200,000)

2. Gulf & South Atlantic Fisheries Foundation, Inc.—Evalute a topless bottom trawl design to exclude sea turtles ($238,000)

3. Pacific States Marine Fisheries Commission—Increase visibility of trawl components to reduce threatened eulachon (smelt) bycatch in the ocean shrimp trawl fishery ($89,095)

4. SUBMON—Train longline fishermen and observers to increase post-release survival of accidentally captured sea turtles and other protected species ($28,540)

Improving Fishing Practices

5. Pacific States Marine Fisheries Commission—Reduce sablefish and rockfish bycatch in West Coast groundfish bottom trawl flatfish fishery ($138,124)

6. Pfleger Institute of Environmental Research—Facilitate the development and implementation of deep-set buoy gear off the California coast ($147,152)

7. University of Maryland Eastern Shore—Determine the impacts of trap fishing on Mid-Atlantic seafloor habitats, with emphasis on structure-forming invertebrates ($93,235)

Innovative Technologies

8. BelleQuant Engineering—Model the dynamics of Baleen whale entanglements in fishing gear ($101,931)

9. Cornell University—Enhance the bycatch avoidance communication network ($202,654)

10. Integrity Fishing Corp—Use a light-weight riser sweeper to minimize impacts to bottom habitat in the otter trawl fishery ($101,000)

11. The Nature Conservancy—Test pot gear innovation for the West Coast groundfish trawl fishery ($138,233)

Reducing Post-Release Mortality

12. Alaska Charter Association—Use digital imaging to reduce recreationally released halibut mortality in Alaska ($186,725)

13. Fairleigh Dickinson University—Optimize gear size and post-release mortality reduction in New Jersey summer flounder hook and line fishery ($122,911)

14. Florida Fish and Wildlife Conservation Commission—Explore methods for the safe release of reef fish recreationally caught on hook-and-line gear in the Gulf of Mexico ($185,843)

15. MOTE Marine Laboratory—Test technology to assess large coastal shark bycatch mortality ($255,847)

16. University of California, San Diego (Scripps Oceanograpy)—Examine low oxygen as cause of mortality following catch-and-release barotrauma to rockfish ($183,997)

Fiscal Year 2014
22 Projects • $2.41 million

Reducing Protected Species Bycatch

1. Pacific States Marine Fisheries Commission—Using LED lights to help Chinook salmon escape Pacific hake trawls ($113,227)

2. Marine Biological Laboratory—Avoiding bycatch/entanglement of turtles and whales with aquaculture gear ($205,000)

Improving Fishing Practices

3. Cornell University Cooperative Extension Marine Program—Expand the bycatch avoidance communication network ($70,000)

4. University of Rhode Island—Reduce bycatch of sublegal Jonah crabs in the lobster fishery ($190,000)

5. Texas A&M University—Test techniques for minimizing discard mortality of Gulf of Mexico red snapper and validate survival with acoustic telemetry ($205,000)

6. University of Massachusetts, Dartmouth—Avoid overfished flounder with semi-pelagic trawling on Georges Bank ($205,000)

7. Vast Array Corporation—Test prototype devices to reduce leader-line length on pelagic longline catch ($51,935)

8. Gulf and South Atlantic Fisheries Foundation—Increase compliance and enforcement of turtle excluder and bycatch reduction devices in the southeastern shrimp fishery—a NOAA Fisheries/Industry workshop ($83,632)

9. Environmental Trawling Solutions, Inc.—Reduce bottom impact through the Wing Trawling System; comparisons to otter trawl doors ($105,434)

10. Florida Keys Community College—Assess performance of a long-lasting shark repellent bait during commercial pelagic longline fishing ($48,579)

11. FishNext Research—Explore approaches to avoid interactions with structure-forming invertebrates during Pacific Ocean perch fishing on the Bering Sea slope ($52,570)

Innovative Technologies

12. Pacific States Marine Fisheries Commission—Examine the effectiveness of netting turned 90 degrees to reduce bycatch in a multispecies bottom trawl fishery ($137,384)

13. Makah Tribe—Test the Makah Tribe's traditional fishing knowledge to reduce bycatch in recreational halibut fisheries ($68,324)

14. University of California, San Diego (Scripps Oceanography)—Test the viability of a "smart" hook for reducing bycatch of shark, turtle, skates, and marine mammals in pelagic and demersal longline fisheries ($190,000)

Reducing Post-Release Mortality

15. Cascadia Research Collective—Assess movements of false killer whales in relation to longline fishing interactions ($158,066)

16. Mote Marine Laboratory—Use technology to assess and reduce large coastal shark bycatch mortality ($180,000)

17. University of California, Santa Cruz—Use outreach to change recreational rockfish practices to decrease post-release mortality of protected species ($109,082)

18. Standford U., U.C. Santa Cruz, The Nature Conservancy, Marine Conservation Initiative & San Diego State U.—Provide real-time fisheries management tools for ecological and economic sustainability ($240,107)

Improving Fishing Practices

Three 2013 BREP-funded projects aimed to improve fishing practices in fisheries for West Coast groundfish, swordfish, and black sea bass. These projects are showing 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 with the Pacific States Marine Fisheries Commission tested a selective flatfish sorting grid designed to reduce catch of sablefish and rockfish in the groundfish trawl fishery—one of the biggest commercial fisheries on the West Coast. The trawl gear used by commercial groundfish fishermen often catches sablefish and rockfish (which have relatively low catch limits) and halibut (which are prohibited due to low stock levels). When fishermen catch their limit of sablefish and rockfish, they must stop fishing for the relatively more abundant and highly lucrative groundfish. The use of a sorting grid reduced catches of sablefish, shelf rockfish, and slope rockfish by 97.0 percent, 80.3 percent, and 64.0 percent, respectively. Catch of Pacific halibut (a prohibited species) was reduced by 90.3 percent. The sorting grid demonstrated the substantial reductions in bycatch while retaining the targeted groundfish.

West Coast commercial groundfish fishermen often catch sablefish and rockfish, which have relatively low catch limits.

Scientists with the Pfleger Institute of Environmental Research conducted trials with experimental deep-set buoy gear designed to selectively target swordfish at depth during the day. Although swordfish are abundant, the gear used to harvest them can also catch billfish, sharks, and tuna. Without more selective gear, swordfish fishermen are forced to stop fishing for swordfish before they reach their limit. Experimental low-impact hook-and-line gear trials were performed from both research and cooperative fishing vessels off the Southern California coast in 2014. Swordfish catch during the trial was nearly double the catch rates associated with previous trials. Bycatch rates continued to remain low (around 3 percent), suggesting high selectivity for swordfish and other marketable species.

Collaborators with the University of Maryland and Virginia Institute of Marine Science studied the potential disturbance risk to bottom ecosystems (corals) in the mid-Atlantic posed by commercial trap-fishing for black sea bass. Black sea bass are structure-oriented fish, living on live-bottom and reef habitats, and fish are targeted by dropping traps near or on these habitats. Scientists worked with local fishermen to study the impacts of trap-fishing on live-bottom habitat. Live-bottom habitats are highly fragmented and sparse off the coast of Maryland, so adverse impacts from disturbance will affect a large portion of available black sea bass habitat. Results of this ongoing study show that traps landed on live-bottom habitat only about 5 percent of the time. However, 46 percent of the experimental traps made contact with live-bottom habitats during the retrieval process. This was due to traps dragging along the ocean floor with the added weight of the catch.

Innovative Technologies

Developing new fishing gear technologies is important to continuing to reduce bycatch in U.S. fisheries. In 2013, BREP funded four projects in the Northeast, Mid-Atlantic, and Northwest centered on improving this technology. Refinements and research are still underway, but bycatch was reduced through new devices and updating the methods of using gear. Research is also underway to better understand animal behavior to further reduce species' interactions with fishing gear.

Researchers with Cornell University Cooperative Extension have minimized bycatch of butterfish, river herring, and shad in the longfin squid fishery by improving information about locations to avoid. Implementation of a butterfish bycatch cap in 2011 may significantly impact the longfin squid fishery. Working with commercial fishing industry partners, researchers formed the Bycatch Avoidance Communication Network to collect and report real-time observations of butterfish, river herring, and shad hotspots. This helps the squid fishery avoid those areas and reduce fleet-wide bycatch. In 2014, butterfish bycatch was reduced by 55 percent, as compared to 2012 without the avoidance network. The butterfish bycatch cap has not been reached in the past 2 years. This program also demonstrated that river herring bycatch in the longfin squid fishery is minimal, so no river herring/shad bycatch cap is necessary at this time.

Researchers with Integrity Fishing Corporation developed a lightweight riser sweep trawl in an effort to minimize bottom habitat (e.g., coral) impacts in the otter trawl fishery in the northwest Atlantic Ocean. In order to reduce damage to bottom habitats, an experimental otter trawl sweep was developed with fewer bottom-contact points. The resulting Light Weight Riser Sweep was 33 percent lighter and had 69 percent fewer bottom contact points when compared to the control sweep. The new bottom trawl was tested in the Gulf of Maine while targeting pollock. Pollock catch rates using the Light Weight Riser Sweep were not significantly reduced. Use of the Light Weight Riser Sweep did, however, result in significant reductions in bycatch rates for American lobster (54.0 percent), Atlantic cod (61.7 percent), American plaice (67.5 percent), and monkfish (91.2 percent). Overall, the catch rate of all bottom species was reduced by 84 percent.

Scientists with Bellequant Engineering developed a virtual whale entanglement simulator to help determine which gear types and whale behaviors lead to entanglements and the severity of those entanglements. Through virtual testing of different, new, or previously untested gear types, this virtual whale entanglement simulator will help avoid or lessen the severity of baleen whale entanglements with lobster and crab fishing gear in particular.

In a collaborative approach, fishermen from the Ilwaco Fishermen and Marketing Cooperative and The Nature Conservancy successfully developed and tested an innovative fish trap designed to catch lingcod without catching rockfish and Pacific halibut. Co-op members have traditionally used bottom trawls, traps, and hook-and-line gear to catch groundfish, including lingcod. Recently, however, large areas off the coast of Washington were closed to all bottom fishing to prevent the catch of overfished rockfish species and Pacific halibut. Researchers and fishermen designed a modified pot or trap that will catch lingcod, while allowing rockfish to escape. Preliminary results show that catch rates of sablefish and lingcod using a modified pot were twice those using standard pots. Additionally, fishermen caught no yelloweye rockfish, only two canary rockfish, and seven Pacific halibut—well below the quota allocated for the project. If lingcod can be selectively harvested within closed areas, alternative management strategies can be considered. These are significant, early steps on the path from innovation to commercial use.

BREP-funded collapsable-wing pot allows fishermen to catch lingcod, but exclude protected Pacific rockfish.

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