Bycatch Reduction Engineering Program
2011 Annual Report to Congress

Issued Pursuant to Section 316(d) of the Magnuson-Stevens Fishery Conservation and Management Act (as Reauthorized and Amended in 2006)

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
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Executive Summary

Section 316(a) of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (MSA) required the development of a bycatch reduction engineering program (BREP). The MSA language is described in more detail in the Introduction to this report (page 4). NOAA allocated $1,963,490 to implement the BREP in 2011. This amount included a $150,000 grant to the World Wildlife Fund (WWF) to support its Smart Gear Initiative. Besides the WWF grant, BREP funds were distributed in the following manner to NMFS Regions and Headquarters Offices (including for the National Seabird Program, which is funded by the BREP):

- Northeast--$306,250
- Southeast--$462,986
- Northwest--$327,960
- Southwest--$227,555
- Alaska--$289,478
- Pacific Islands--$117,770
- Office of Sustainable Fisheries (Atlantic HMS)--$74,000

In terms of bycatch problems addressed, BREP funding in 2011 (not including the WWF grant) fell into the following categories:

- Fish (including ESA species)--$1,224,404
- Sea turtles--$247,257
- Seabirds--$229,059
- Marine mammals--$112,770

The BREP has made significant progress in 2011 to develop technological devices and other conservation engineering designed to minimize bycatch, seabird interactions, bycatch mortality, and post-release mortality in federally managed fisheries. 2011 BREP projects to reduce bycatch in Gulf of Mexico shrimp and longline fisheries, Atlantic gillnet and trawl fisheries, Alaska and Northwest trawl fisheries, California and Southeast recreational fisheries, and Hawaii-based longline fisheries, as well as to enhance documentation and monitoring of seabird bycatch around the country, will help NMFS meet its obligations under the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, Marine Mammal Protection Act, and the U.S. National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries. In addition, 2011 BREP investments in underwater video camera systems that will be loaned to the fishing industry will help strengthen cooperation and collaboration between NMFS and the fishing industry.

2011 REPORT ON THE BYCATCH REDUCTION ENGINEERING PROGRAM RELEVANT TO SECTION 316(d) OF THE MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT REAUTHORIZATION ACT OF 2006

Introduction

Section 316(a) of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (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." The National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS) established its Bycatch Reduction Engineering Program (BREP) through a NMFS Policy Directive signed January 11, 2008, by the NOAA Acting Assistant Administrator for Fisheries. This Policy Directive (see Appendix 1) contains terms of reference for the BREP, as well as the following BREP mission:

> "The mission of the BREP is to develop technological solutions and investigate changes in fishing practices designed to minimize bycatch of fish (including sponges and deep sea and shallow, tropical corals) and protected species (including marine mammals, seabirds, and sea turtles) as well as minimize bycatch injury and mortality (including post-release injury and mortality)."

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 Resources that:

1. Describes funding provided to implement this section (see pp. 5—6);
2. Describes developments in gear technology achieved under this section (see pp. 7—87); and
3. Describes improvements and reduction in bycatch and seabird interactions associated with implementing this section (see pp. 7—88), as well as proposals to address remaining bycatch or seabird interaction problems (see pp. 88—90).

This report responds to the requirements of Section 316(d) of the MRA. (Section 316 of the MSA appears in its entirety in Appendix 2.)

Funding Provided to Implement the BREP in 2011

Funding to implement the BREP totaled $1,963,490 in 2011. The majority of this funding ($1,413,490) came from a NOAA budget line item entitled Reducing Bycatch. In addition, NMFS allocated an additional $400,000 to the BREP to fund projects related to Annual Catch Limit restrictions due to bycatch from a NOAA budget line item entitled MSA Implementation – Annual Catch (ACL). Finally, the BREP managed a $150,000 grant to the World Wildlife Fund for its Smart Gear Initiative. Table 1 lists the projects funded to implement the BREP in 2011. Individual projects, developments in gear technology related to these projects, and improvements and reduction in bycatch and seabird interactions associated with these projects are described on pages 7—84. Many of these projects leveraged funds from sources outside NMFS and involved partners from other federal agencies, state governments, nongovernmental organizations, universities, and the fishing industry. In addition, many of these projects were collaborations with the fishing industry involving payments to charter commercial fishing vessels as collaborative research platforms.

Table 1. Projects funded to implement the BREP in 2011

Project Title	*Funding Provided*	*Recipient*
Turtle Excluder Device (TED) Technology: Evaluations and Fisher Outreach	$150,557	NMFS Southeast Fisheries Science Center
World Wildlife Fund's Smart Gear Initiative	$150,000	World Wildlife Fund
Fishing Technology and Conservation Engineering to Reduce Trawl Bycatch in Alaskan Fisheries	$141,000	NMFS Alaska Fisheries Science Center
Shrimp Trawl Bycatch Reduction	$130,457	NMFS Southeast Fisheries Science Center
Continuation of Research Project for Reducing Bycatch of Atlantic Sturgeon in the Monkfish Gillnet Fishery	$126,800	NMFS Northeast Fisheries Science Center
Continued Support for a Contract Employee to Assist with Gear Research	$117,650	NMFS Northeast Fisheries Science Center
Continued Funding for a Fishing Gear Technician at the Northwest Fisheries Science Center	$107,830	NMFS Northwest Fisheries Science Center
Ability of Southern California Deepwater Rockfish to Survive Barotrauma Following in-situ Recompression	$104,290	NMFS Southwest Fisheries Science Center
Developing, Testing, and Demonstrating Bycatch Reduction Devices in West Coast Trawl Fisheries	$93,670	NMFS Northwest Fisheries Science Center
NMFS National Seabird Program	$88,068	NMFS Alaska Regional Office; NMFS Office of Science and Technology
Acoustically Observing False Killer Whales in the Hawaii-Based Tuna Longline Fishery	$87,770	NMFS Pacific Islands Fisheries Science Center
Determining Post-Release Survivorship using Alternative Angling Techniques in the Recreational Fishery for Common Thresher Sharks	$78,265	NMFS Southwest Regional Office

Improving the Selectivity of Bottom Trawls to Reduce Bycatch of Pacific Halibut in the West Coast Groundfish Trawl Fishery	$76,250	NMFS Northwest Fisheries Science Center
Green-Stick Gear Bycatch and Bycatch Mortality Characterization in the Northern Gulf of Mexico Atlantic Tuna Fishery	$74,000	NMFS Office of Sustainable Fisheries
Skimmer Trawl TED Testing in North Carolina Inshore Waters	$49,000	NMFS Southeast Fisheries Science Center
Providing Direct Observation Video Camera Systems to Fishermen for Their Use in Evaluating Industry-Designed Bycatch Reduction Devices – Year 2	$40,710	NMFS Northwest Fisheries Science Center
Alaska Fisheries Science Center Coordinated Seabird Studies	$40,000	NMFS Alaska Fisheries Science Center
Monitoring Seabird Bycatch in Northeast Commercial Fisheries	$40,000	NMFS Northeast Fisheries Science Center
Examining the Efficacy of Modified Circle Hooks in Reducing the Bycatch of Undersized Lutjanid and Serranid Fishes	$37,000	NMFS Southeast Fisheries Science Center
Reducing Bycatch in the Penaeid Shrimp Fishery Utilizing TEDs with Two-Inch Bar Spacing	$33,372	NMFS Southeast Fisheries Science Center
Evaluating the Physiological Status of Large Pacific Blue Marlin Captured in the Pacific Longline Fisheries: Implications for Post-Release Survival and Biochemical Correlates of Morbidity and Mortality	$30,000	NMFS Pacific Islands Fisheries Science Center
Commercial Longline Sea Turtle Mitigation	$25,900	NMFS Southeast Fisheries Science Center
Pinniped Deterrence in Recreational and Commercial Fisheries	$25,000	NMFS Southwest Regional Office
Seabird Bycatch in the Western North Atlantic Fisheries	$24,000	NMFS Southeast Fisheries Science Center
Assessing the Potential of the Tow Time Data Logger	$21,800	NMFS Northeast Fisheries Science Center
Estimating Snow Crab Mortality as a Function of Weather Conditions during the Eastern Bering Sea Snow Crab Fishery	$20,410	NMFS Alaska Fisheries Science Center
Temporal Variation in Seabird Distribution and Density in the Eastern Tropical Pacific	$20,000	NMFS Southwest Fisheries Science Center
Evaluation of Weaker Circle Hooks to Release Bluefin Tuna in the Yellowfin Tuna Longline Fishery	$12,700	NMFS Southeast Fisheries Science Center
Coastal Observation and Seabird Survey Team	$7,491	University of Washington
Fisheries-Independent Marine Bird Surveys at the Northwest Fisheries Science Center	$7,000	NMFS Northwest Fisheries Science Center
Gained in Translation: Accessing Seabird Bycatch in Russian and Japanese Gillnet Fisheries	$2,500	NMFS Northwest Fisheries Science Center
Total	$1,963,490	

Project Summaries—Northeast

Project Title
Continuation of Research Project for Reducing Bycatch of Atlantic Sturgeon in the Monkfish Gillnet Fishery

BREP Funding Provided
$126,800

Location of Research
NMFS Northeast Fisheries Science Center

Resource Challenge
At the request of the Atlantic States Marine Fisheries Commission, NMFS's Northeast Fisheries Science Center (NEFSC) estimated the total bycatch of Atlantic sturgeon in sink gillnet and otter trawl gear based on observer data collected on a portion of commercial fishing trips from Cape Hatteras, NC through Maine for 2001-2006. For sink gillnet gear, Atlantic sturgeon bycatch ranged between 2,752 and 7,904 sturgeon annually, averaging about 5,000 sturgeon per year. Atlantic sturgeon bycatch in otter trawl gear similarly ranged between 2,167 and 7,210 sturgeon with an average of about 3,800 sturgeon per year. However, bycatch mortality was markedly different between the two gear types. For sink gillnet fisheries, the estimated annual mortality ranged from 352 to 1,286 sturgeon, with an average mortality of 649 sturgeon per year, or approximately 13% mortality of Atlantic sturgeon caught in sink gillnet gear. The majority of sturgeon bycatch mortality was attributed to the monkfish sink gillnet fishery. The total number of sturgeon killed in otter trawl gear could not be estimated because only three sturgeon mortalities were reported in the observer database, suggesting a low fishing mortality rate.

In 2010 the NEFSC received BREP funds to conduct a comparative test of sturgeon bycatch rates between similar gillnets with and without tie-downs. The results of this project showed a reduction of sturgeon catch in gillnets without tie-downs (or in "stand-up" gillnets), but this reduction was not significantly different from zero ($p=0.1158$). Additionally, the stand-up gear caught nine common dolphins compared to the tied-down gear, which did not catch any cetaceans. In regards to the targeted catch, 66.2% of the target monkfish were landed in the control tie-down nets, which represented a statistically significant difference ($p<0.0001$). Similarly, 84.9% of winter skate, the dominant species landed by weight (11,831kg), was landed in the control tie-down gillnets, which was also statistically significant ($p<0.0001$). A similar study conducted by Delaware State University subsequent to this found similar rates of sturgeon bycatch between the tie-down and standup gear.

Because the comparison between experimental stand-up gillnets and traditional tie-down gillnets resulted in a large loss of targeted species as well as a non-significant reduction of sturgeon, it was evident that this modification was not effective and further work was needed to both retain the targeted catch and reduce the sturgeon bycatch. This identified

need led to the development of low-profile gillnets that were tested in November-December 2011 (Figure 1). The results of this work are being analyzed but suggest that the loss of targeted species is low. In addition, the lower-profile gillnets caught fewer sturgeon, although these results need to be analyzed to determine whether this loss is significant.

Figure 1. Sturgeon captured during study of modifications to reduce sturgeon takes in the large mesh bottom set monkfish gillnet fishery (a collaboration with Endeavor Fisheries, Inc., and Delaware State University)

Project Summary

The goal of the November—December 2011 study was to compare bycatch rates for Atlantic sturgeon and harbor porpoises in a comparative experiment in gillnet gear in mid-Atlantic waters as follows:

1) Compare the bycatch rates of Atlantic sturgeon for each net configuration (12 meshes tall with tie-downs, 6 meshes tall with tie-downs);
2) Compare the catch rates of the target species (monkfish and skates) for each net configuration; and
3) Record and compare the bycatch of other NMFS-regulated or protected species (e.g., cetaceans and sea turtles).

The gillnet strings consisted of 10 net panels per string of the same treatment (12 meshes tall with tie-downs, 6 meshes tall with tie-downs). Testing consisted of setting both

treatments in a similar location (block) and keeping all aspects of the operation (e.g. soak time, set direction, haulback speed) standardized between the paired sets. Each treatment of 10 panels was set 60 times for a total of 120 hauls. This number of sets was designed to provide a high level of probability of finding a 20% difference in sturgeon bycatch between treatments.

Fishing trips were conducted by commercial monkfish fishermen on monkfish fishing grounds along the mid-Atlantic coast of the United States. The project was conducted in Statistical Areas 612, 614, and 615, which had high catches of Atlantic sturgeon historically, and was to be conducted during November—December 2011, which is outside of the Harbor Porpoise Take Reduction Plan-regulated segment of the monkfish fishing season. Soak duration was to mimic the average soak duration for the study area, and the contractor carrying out the study was directed to limit the soak time to 96 hours or less.

On board the vessels, total catch, including estimated total weight, was recorded. Lengths were recorded for all target species, or a representative subsample, and all protected species were recorded. Sampling occurred in accordance with NEFSC protocols.

Developments in Gear Technology Achieved
This project started on November 15th, 2011, and concluded on December 18, 2011. The NEFSC developed and awarded contracts for both the data collection and the construction of the modified fishing gear. The data collection was facilitated by the help of two fishermen who are very knowledgeable and involved in the gillnet fishery. This partnership should afford the NEFSC the ability to attain more ideas and better outreach as the NEFSC tackles the issue of reducing sturgeon bycatch in bottom set gillnets.

Improvements and Reduction in Bycatch Associated with This Project
As of this writing, the data collection has been completed, and analysis of the results has begun. The NEFSC anticipates that its collaborative partnerships with industry will assist in the process of attaining a viable solution to this bycatch issue.

Project Title
Continued Support for a Contract Employee to Assist with Gear Research

BREP Funding Provided
$117,650

Location of Research
NMFS Northeast Fisheries Science Center

Resource Challenge
The NMFS Northeast Fisheries Science Center (NEFSC) faces a challenge with existing staff to effectively administer a myriad of protected species research efforts to mitigate the bycatch of sea turtles, sturgeon, cetaceans, and some finfish species in commercial fisheries.

Project Summary
For the past several years, the NEFSC has hired a contractor to assist with ongoing gear research projects being conducted in the region. This contractor has been a great asset in assisting with gear research efforts. In addition to providing technical and logistical help on individual projects, the contractor provides continuity and consistent oversight across multiple gear projects based on his four years of engagement across many gear-based projects. Maintaining this position not only provides continued technical and logistical support, but it also enhances consistency in the NEFSC's overall gear research program. The alternative to employing a long-term contractor would be to fill that technical and logistical support and oversight role on a contract-by-contract basis with whoever is contracted to carry out the research, which would likely lead toward inconsistency in the NEFSC's overall program.

In the past year, the BREP-funded contractor has assisted with the following gear-related projects:

- Scallop dredge video research;
- Seal tagging research;
- Inshore squid trawl research;
- Right whale tagging survey;
- Butterfish escape panel research;
- Offshore butterfish escape panel video and research;
- Raised footrope research and video;
- Remotely operated underwater vehicle sea trials;
- Atlantic Marine Assessment Program for Protected Species turtle tagging project; and
- Tow time data logger deployment.

In addition, the contractor has helped develop an underwater camera system, develop trawl time data loggers, and become proficient in video editing and the utilization of video editing software. Finally, the contractor is responsible for the care and

maintenance of electronics as well as the NEFSC's assortment of sampling gear to help support the NEFSC's research projects.

Developments in Gear Technology Achieved
Due to the assistance of this contractor, the NEFSC has been able to accomplish more research and maintain better oversight its various projects.

Improvements and Reduction in Bycatch Associated with This Project
The BREP-funded contractor has been involved in some aspect of all of the NEFSC projects (projects are listed at: http://www.nefsc.noaa.gov/read/protspp/PR_gear_research/) that have addressed regional bycatch concerns.

Project Title
Monitoring Seabird Bycatch in Northeast Commercial Fisheries

BREP Funding Provided
$40,000

Location of Research
NMFS Northeast Fisheries Science Center

Resource Challenge
Observed seabird bycatch in commercial fishing trips is a rare event, which makes it difficult to observe and even more difficult to quantify. To help overcome these difficulties, observer coverage of fisheries in the Gulf of Maine area has increased in the last couple of years, and NMFS Northeast Fisheries Science Center (NEFSC) staff has developed analytical methods that can process the increased observer data. Thus, it is hoped that bycatch estimates will be able to be developed for seabird species, although some estimates will have to be at made a gross taxa level, e.g., shearwaters in gillnets.

Project Summary
The objective of this project was to develop methodologies for expansion of observed seabird takes to total takes by fishery and species, if possible. This project uses a generalized additive model/ generalized linear model (GAM/GLM) approach for estimating bycatch and identifying fishing practices, gear configurations and environmental factors that are associated with high bycatch rates. In 2011, the NEFSC used this project's funds to help hire a contracting firm that, among other things, will provide for the estimation of seabird bycatch in commercial gillnet and mid-water trawl fisheries.

Developments in Gear Technology Achieved
This project did not directly achieve any developments in gear technology.

Improvements and Reduction in Bycatch Associated with This Project
In 2011, the NEFSC leveraged this project's funds with additional funds from other sources to support a contractor for one year to estimate seabird bycatch in commercial fisheries along the northern U.S. Atlantic coast. However, bycatch estimates will not be available until the end of 2012. The NEFSC plans to use data from observed commercial gillnet and mid-water trawl trips to estimate bycatch for as many seabird species as the data support. These analyses will be used to identify fishing practices, gear configurations, and environmental factors that are associated with high bycatch rates. If identified, these factors could be used to develop future gear technologies or gear changes that could reduce the bycatch of seabirds.

Project Title
Assessing the Potential of the Tow Time Data Logger

BREP Funding Provided
$21,800

Location of Research
NMFS Northeast Fisheries Science Center

Resource Challenge
In the early part of this decade, NMFS recognized the need to address sea turtle bycatch in a more comprehensive manner. NMFS thus developed the Strategy for Sea Turtle Conservation and Recovery in Relation to Atlantic Ocean and Gulf of Mexico Fishery (Strategy). The Strategy addresses sea turtle bycatch by gear type rather than by target fishery and has identified trawl gear as the first gear type to be addressed. Trawling is a method of fishing that involves actively pushing or towing a net through the water where it may incidentally capture sea turtles and other species.

Turtle excluder devices (TEDs) have been proven an effective method to minimize adverse effects related to sea turtle bycatch in several trawl fisheries around the world. However, TEDs may not be feasible for some trawl fisheries given the size of the target catch or the configuration of the gear. In the event that TEDs are not feasible, other mitigation measures (e.g., tow time restrictions, time/area closures) may need to be considered.

At this time, the feasibility of using a data logger to monitor compliance and enforce tow times within a fishery is unknown. The NMFS Northeast Fisheries Science Center (NEFSC) has worked with Onset Computers (Bourne, Massachusetts) to develop tow time data loggers, an electronic device that automatically measures the tow duration of fishing trawls (see Figure 2). Prototype loggers have been installed on commercial vessels, and preliminary testing has been completed. These loggers are now being refined to address issues identified during the preliminary testing. Following the resolution of these issues, it will be necessary to test the data loggers in a more structured and comprehensive manner in an experimental fishery to ensure that the loggers can withstand the rigors of commercial fishing and to evaluate the feasibility of using the data loggers as a management tool. This ongoing research may result in another tool that could be considered in addressing sea turtle bycatch in trawl fisheries.

Project Summary
The goal of this work is to determine and document the effectiveness of a recently developed tow time data logger in a commercial bottom trawl fishery.

Developments in Gear Technology Achieved
During 2011 the modified filtered logger has been deployed aboard:

- One near-shore summer flounder trawl vessel – Woods Hole, Massachusetts
- One offshore squid vessel – Point Judith, Rhode Island

- One scallop trawl vessel – Barnegat Light, New Jersey
- One horseshoe crab trawl vessel - Ocean City, Maryland
- One horseshoe crab/croaker flynet trawl vessel – Ocean City, Maryland

As of the end of 2011, the loggers were being retrieved and the readouts compared to a haul log that was completed by the vessel Captain. Retrieval of all loggers and analysis of the results is anticipated to be complete by mid-2012.

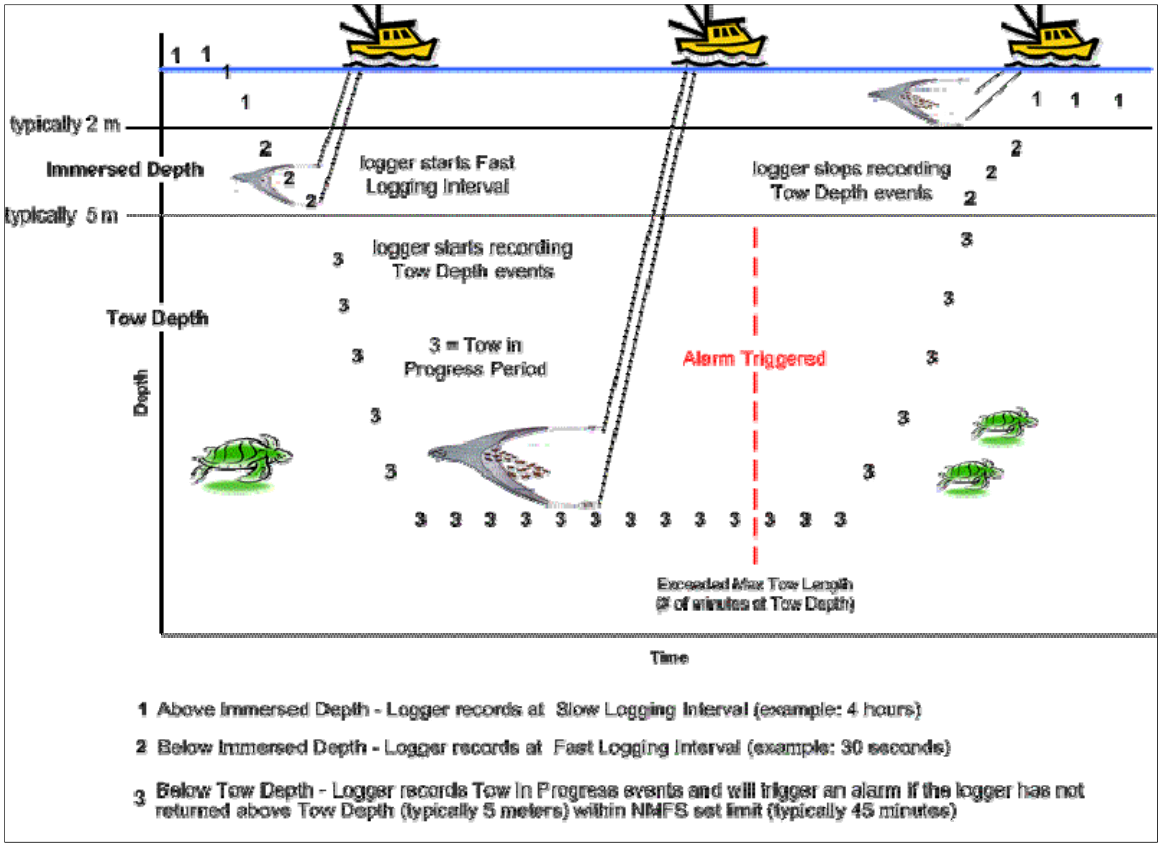


Figure 2. A schematic describing the operation of a tow time data logger.

Improvements and Reduction in Bycatch Associated with This Project

The NEFSC is in the process of demonstrating the logger as a viable management tool that could be used to reduce sea turtle mortalities.

Project Summaries—Southeast

Project Title
Turtle Excluder Device Technology: Evaluations and Fisher Outreach

BREP Funding Provided
$150,557

Location of Research
NMFS Southeast Fisheries Science Center

Resource Challenge
Sea turtle excluder devices (TEDs) are federally required equipment in most shrimp trawls fished in the Southeast Atlantic and Gulf of Mexico. The NMFS Southeast Fisheries Science Center (SEFSC) Harvesting Systems Unit conducts ongoing research to improve TED efficiency for sea turtle exclusion and target catch retention. Industry concepts directed at improving TED performance are evaluated through an annual TED testing project during which NOAA divers and TED specialists perform certification testing of new devices using captive-reared, juvenile sea turtles. Fishery-dependent testing of prototype TEDs to assess usability and target catch retention is also supported by the Harvesting Systems Unit.

NMFS is considering an expansion of the TED requirement to skimmer gear and the mid-Atlantic croaker fishery, which has prompted the development and testing of new TED designs for these fisheries. A flynet is a high-opening, two-seam bottom otter trawl typically used to catch sciaenids and other schooling species in the mid-Atlantic region of the United States. These trawls tend the bottom and open approximately 30 feet off the seafloor. This fishery primarily targets Atlantic croaker (*Micropogonias undulatus*) and may experience high-volume catches of greater than 100,000 lbs within a 30-minute tow. High catch rates and the use of net reels throughout the fishery have made implementing traditional TED technology troublesome (see Figure 3).

Figure 3. A net reel and a high-volume catch

Project Summary
This project included the following performance measures:

TED research and development:
- Development of improved TED designs through collaborative efforts with the fishing industry
- Candidate TED evaluation and certification testing offered on an annual basis to assess industry-based TED concepts
- New fishery TED development and usability assessments

Performance monitoring and reporting:
- Analyses and reporting of TED certification data
- Monitoring and evaluation of TED operational performance
- Technical recommendations and assistance in drafting language for rulemaking

Industry outreach:
- Technical training for net shops and fishers in TED construction and installation
- Development of instructional media to assist fishers

Enforcement training:
- Technical training and assistance for NMFS, U.S. Coast Guard, and State law enforcement agencies

Developments in Gear Technology Achieved
<u>Flynet TED development</u>
Net reels of various sizes and configurations are used on vessels operating in this fishery to deploy, retrieve, and store trawls. This poses significant structural and operational problems when it comes to traditional TED designs that are constructed of rigid frames. The industry requested the development of flexible prototypes that can be easily stored on net reels but are durable enough to withstand harsh commercial fishing conditions. Two prototypes were developed by NMFS SEFSC Fisheries Methods and Equipment Specialists. The TEDs were constructed almost entirely of cable, which provides for easy storage. Commercial trials were conducted with one of the designs to examine potential target catch loss and usability of the gear during the 2010-2011 season. Results of the trials were positive with catches of up to 90,000 lbs recorded with no structural damage to the TED observed. Observations of gear handling indicated that the cable TED design operated virtually hands-free. Both designs were tested for sea turtle exclusion using the NMFS small turtle testing protocol conducted in Panama City, Florida in June 2011. One design passed the certification test, while the other excluded all turtles introduced to the TED during a cursory trial.

<u>TED certification tests and diver evaluations</u>
New TED designs and modifications to approved TEDs were evaluated using the NMFS small turtle testing protocol (Federal Register, Vol. 55, No. 195) in Panama City, Florida

during June 2011. The protocol utilizes NMFS diver/gear specialists to conduct underwater observation and videotaping of controlled tests of candidate TED designs. The work was conducted from the *F/V Captain Wick*, as well as the *R/V Caretta*, operated by the SEFSC Mississippi Laboratories. TED designs evaluated during this project included:

- Flexible flatbar flynet TED (fish trawls)
- Hopkins 6-ft x 8-ft and 6-ft x 10-ft crimped cable TED (fish trawls)
- Lionel-James semi-cable TED (fish trawls)
- Double–shot cable flounder TED
- Australian TED with webbing ramp

Improvements and Reduction in Bycatch Associated with This Project

Flynet TED development

Both of the Hopkins crimped cable TEDs are slated for commercial trials during the 2011-2012 commercial season to further examine target catch retention and usability of the gears. Preliminary trials conducted with the cable TED during the 2010-2011 season indicate large reductions in spiny dogfish (*Squalus acanthias*) and clearnose skate (*Raja eglanteria*) bycatch. Comparative testing aboard a commercial trawler is slated for early 2012 to quantify the amount of bycatch reduction.

Fisher outreach

Outreach activities are essential in insuring that fishers are using regulated gear correctly and within the requirements of the law. Additionally, fisher outreach activities afford NMFS TED specialists an opportunity to provide the latest technical innovations for TEDs, which can improve TED performance for sea turtle exclusion and shrimp retention. During the spring of 2011, an unprecedented sea turtle stranding event occurred along the Mississippi Gulf Coast, prompting concern over fisher compliance with TED regulations. Working closely with NOAA's Office of Law Enforcement (OLE), the SEFSC Gear Monitoring Team (GMT) conducted TED dockside and at-sea outreach and compliance inspections throughout Alabama, Mississippi and Louisiana. From April through June 2011, the GMT assisted OLE Special Agents in conducting 146 vessel inspections for proper TED configuration. Chief among the problems noted with TEDs were steep installation angles and exit-hole dimensions that were less than the legal requirement. As the 2011 shrimp season progressed, continued inspections of the shrimp fleet by the GMT and OLE showed improved compliance with TED regulations. Enhanced dockside fisher outreach, including the distribution of a TED regulations "flip-book," is slated for the 2011-12 winter period.

Project Title
Shrimp Trawl Bycatch Reduction

BREP Funding Provided
$130,457

Location of Research
NMFS Southeast Fisheries Science Center

Resource Challenge
Federal regulations require the use of an approved bycatch reduction device (BRD) in all shrimp trawls fished in Gulf of Mexico federal waters and the Southeastern Atlantic Ocean. The new BRD certification criterion (February 2008) required a 30% reduction in finfish for both the eastern Gulf of Mexico and the U.S. South Atlantic. This action resulted in the certification and provisional certification of three additional BRD designs for use in the Gulf of Mexico; the Extended Funnel, the Modified Jones Davis, and the Composite Panel. Additional rulemaking in May 2009 changed the allowable configuration of the Fisheye BRD in the Gulf of Mexico in order to meet the new criterion. Additionally, there is a critical need to continue to develop improved bycatch reduction technologies to ensure red snapper management objectives are met in the shrimp fishery. These objectives, as stated in Amendments 14 to the Fishery Management Plan (FMP) for the Shrimp Fishery of the Gulf of Mexico and Amendment 27 to the FMP for the Reef Fish Resources of the Gulf of Mexico, include reducing bycatch discard mortality of juvenile red snapper to 74 percent below the 2001-2003 time period. This reduction can be modified in the future as red snapper rebuild. In order to address these objectives, the NMFS Southeast Fisheries Science Center (SEFSC) Harvesting Systems Unit conducts research to develop and evaluate shrimp trawl bycatch reduction technology.

Project Summary
In 2011, research conducted in cooperation with the Instituto Nacional de Pesca, Mexico (INP Mexico), involved a series of evaluations of commercial shrimp trawling gear. The objective was to use NOAA divers and gear specialists to evaluate the configuration and performance of a new trawl design developed by the INP for use in the Gulf of California. The prototype trawl design, named the Red Selectiva - Instituto Nacional de Pesca - Mexico (RS-INP-MEX) trawl, was developed to mitigate vaquita (*Phocoena sinus*) bycatch in the shrimp gillnet fishery (Figure 4). The vaquita is a rare species of porpoise

Figure 4. The Red Selectiva - Instituto Nacional de Pesca - Mexico (RS-INP-MEX) trawl

endemic to the northern part of the Gulf of California. Estimates of vaquita takes in the traditional gillnet shrimp fishery have raised concern that gillnet fisheries are impacting the potential recovery of the species. The INP is working cooperatively with international organizations and government agencies to transition gillnet fishermen to trawl fisheries. It is believed that trawl fisheries have little or no negative effects on the vaquita population.

The new trawl design incorporated a raised footrope that purportedly reduced the bycatch of finfish as compared to standard trawl gear (Figure 5). In 2009 and 2010, trawl diving operations were conducted by NOAA divers to document the fishing characteristics of the RS-INP-MEX trawl design. In May 2011, paired trawling evaluations were conducted in the Gulf of Mexico to compare the efficiency of the new trawl design to a typical Southeastern U.S. trawl design in terms of reduction of finfish bycatch and retention of targeted shrimp.

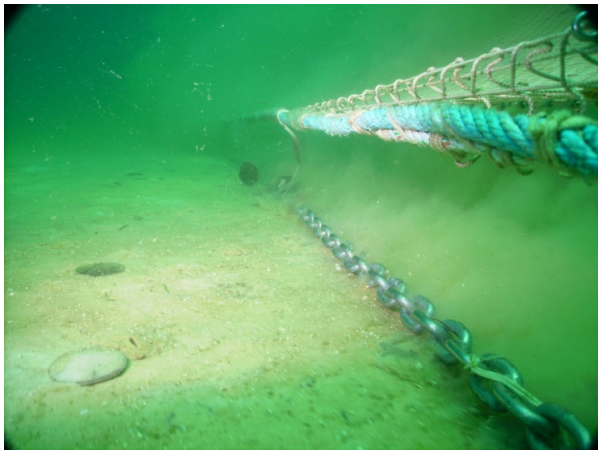


Figure 5. Raised footrope of the RS-INP-MEX trawl

Developments in Gear Technology Achieved

A total of 12 successful tows were completed comparing a 50-ft. RS-INP-MEX trawl to a 50-ft. Scorpion trawl, a typical southeastern United States design. A combination of gear problems and poor shrimping conditions as well as rough weather can be attributed to the low number of completed tows. The RS-IMP-MEX trawl demonstrated 40.77% reduction in total catch (p=0.002) and a 62.9% reduction in total shrimp (p=0.002) as compared to the Scorpion trawl, which were statistically significant. Shrimp reduction for white and brown shrimp was 52.8% and 71.6%, respectively, which were also significant. The estimated reduction of croaker (14.3%) was the only bycatch to show a statistically significant reduction with the RS-INP-MEX trawl. The ratios of fish to shrimp for the Scorpion and RS-INP-MEX trawl are 3.7 to 1 and 7.2 to 1 respectively.

Improvements and Reduction in Bycatch Associated with This Project

Comparative tows in the Gulf of Mexico indicate that the Scorpion trawl has a higher catch rate of both shrimp and bycatch than the Mexican trawl design. The Scorpion trawl also had a lower fish to shrimp ratio, which is generally accepted as a measure of ecological efficiency of a shrimp trawl. The difference in catch rate between the trawls may be attributed to several factors, first of which is the door weight used with the Mexican design. In the previous evaluation, NOAA divers observed that the doors of the RS-INP-MEX periodically lose contact with the bottom while towing and sometimes ride just above the bottom. The second factor that likely influences the difference in catch rates is the difference in the spread ratio between the trawl designs. The spread ratio is the width of the trawl as it sweeps along the sea floor, expressed as a percentage of the head rope length. The RS-INP-MEX trawl covers a swept area of bottom that is around

52% of the head rope length. Scorpion trawl spread ratios range from approximately 70% to 83% depending on the towing speed and the amount of flotation.

Continued collaboration with INP Mexico in this project is anticipated in 2012, during which catch comparisons between the RS-INP-MEX trawl and the Scorpion trawl may be conducted in the Gulf of California. The project symbolizes a long-standing collaboration between INP Mexico and the SEFSC with regard to the development of selective fishing gear. The development of more selective shrimp trawls will continue to be a common goal between the respective agencies.

Project Title
Green-Stick Gear Bycatch and Bycatch Mortality Characterization in the Northern Gulf of Mexico Atlantic Tuna Fishery

BREP Funding Provided
$74,000

Location of Research
NMFS Office of Sustainable Fisheries

Resource Challenge
Green-stick fishing gear has been touted among tuna fishermen in the Atlantic and Pacific because of high targeted-catch-to-bycatch ratios and, in some cases, the high quality of fish brought to the dock. Additional advantages of green-stick gear over some other fishing gears such as pelagic longline (PLL) may include reduced bycatch of unwanted species such as sea turtles or marine mammals and reduced bycatch mortality of undersized or prohibited species such as undersized bluefin tuna or billfish. Characterization of green-stick catch and post-release survival of discards, such as bluefin tuna and other species, will help in the assessment of green-stick fishing gear in the northern Gulf of Mexico (GOM) as a possible alternative to PLL in some areas. In the northern GOM, offshore oil and gas platforms can attract fish, including tunas, and may play a role in how green-stick gear is fished in the northern GOM. This project is designed in part to investigate that issue.

Project Summary
NMFS is partnering with the Louisiana Department of Wildlife and Fisheries to conduct this study through a contract beginning in September 2011 and continuing through September 2013. The study will characterize the catch and bycatch of green-stick fishing gear when used to target tunas in the northern GOM. A general comparison of species caught and/or retained with green-stick gear will be made against PLL gear using summaries of NMFS PLL logbook/observer data. This study is designed to collect data and report on features that contribute to the gear's success (or lack thereof) in catching target tuna species, incidentally kept species, and bycatch. The characteristics of areas where green-stick gear is used successfully for Atlantic tunas will be described, and information will be gathered on the operational requirements of green-stick gear such as fuel consumption, size of vessel, size of crew, and cost of gear.

Developments in Gear Technology Achieved
This project is currently underway and scheduled for completion in September 2013.

Improvements and Reduction in Bycatch Associated with This Project
This project is currently underway and scheduled for completion in September 2013.

Project Title
Skimmer Trawl TED Testing in North Carolina Inshore Waters

BREP Funding Provided
$49,000

Location of Research
NMFS Southeast Fisheries Science Center

Resource Challenge
On June 24, 2011, NMFS published a notice of intent to prepare an environmental impact statement and hold scoping meetings to address incidental bycatch and mortality of sea turtles in the southeastern shrimp fishery (76 FR 37050). One management option presented at the scoping meetings was the implementation of turtle excluder devices (TEDs) in commercial skimmer trawls (see Figure 6).

To determine the feasibility of TED use in skimmer trawls, comparative testing was conducted in Mississippi, Alabama, and North Carolina (NC) between 2008 and 2010. These studies assessed the functionality of TEDs, compared catch rates between TEDs and naked nets (no TED), and obtained commercial input on TED use. Further testing was conducted in NC during 2011 and is slated to continue in Louisiana and NC in future research projects. Collectively, this research will help the shrimp industry prepare for possible new TED requirements and allow development of optimum TED configurations for this fishery.

Figure 6. Example of a skimmer trawl vessel in the Gulf of Mexico

Project Summary
Results from 2010 TED testing in NC aboard six commercial skimmer trawl vessels with four different TED configurations indicated that a standard, mid-size grid (33" x 40") top opening with a double-cover flap functioned well. This TED configuration showed an approximate 11% reduction ($p < 0.001$) in shrimp catch and was chosen to serve as a control TED in this 2011 NC study.

In 2011, three commercial skimmer trawl vessels were contracted to conduct 10 trips, each operating with the control TED on one side, while an experimental TED configuration was installed on the other side of the vessel (Figure 7). A total of 30 trips and 157 comparative tows were completed during the study. All trips were observed, and data were recorded by the NMFS Southeast Fisheries Science Center (SEFSC) observer program based in Galveston, Texas.

Shrimp reductions in experimental TED configurations, compared to the control TED (double-cover, top opening) ranged from an increase of 24% ($p = 0.0021$, single-cover, bottom opening), to a reduction of 6.5% ($p = 0.1984$, single-cover, top opening). The other TED configuration tested (double-cover, bottom opening) showed an increase in shrimp of nearly 5% ($p = 0.2998$).

Bycatch (total catch – shrimp) reductions ranged from an increase of 1% ($p = 0.8839$, single-cover, bottom opening) to a reduction of 5.5% ($p = 0.7093$, single-cover, top opening). Bycatch was increased (5%) in the double-cover, bottom-opening TED. Analyses of total catch, bycatch, and shrimp all show similar trends among the three vessels during the 2011 NC study. The single-cover, top-opening TED and double-cover, bottom-opening TED showed non-significant catch differences compared to the control TED. Shrimp catches with the use of a single-cover, bottom-opening TED were increased significantly relative to the control TED. However, this may be attributed to potential side-bias associated with this fishery and the relatively low shrimp catches experienced during testing. Shrimp catch per tow with this vessel ranged from 0 kg to 3.7 kg in the control TED, with a mean of 1.6 kg per tow. Shrimp catches on the side with the experimental TED ranged from 0.2 kg to 5.2 kg, with a mean of 2.0 kg per tow.

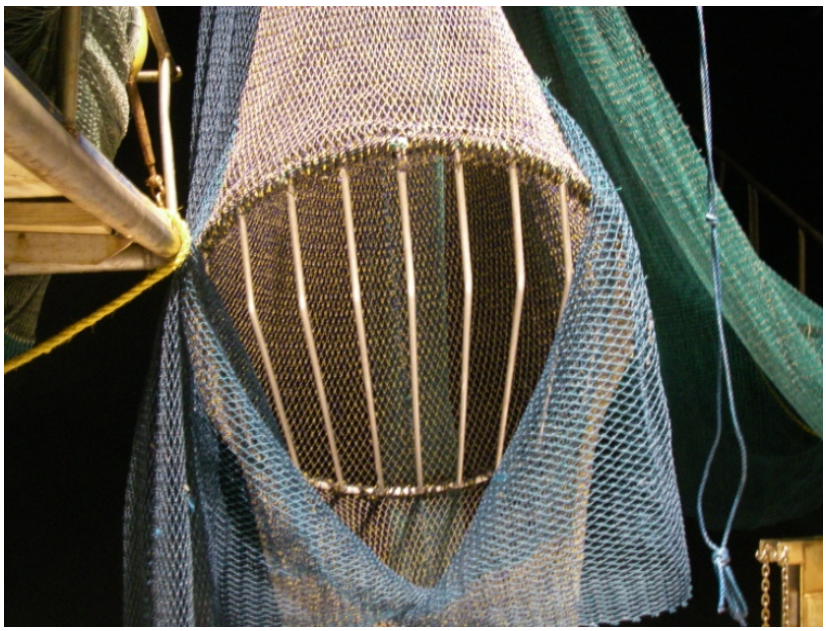


Figure 7. Picture of the TED used in NC skimmer trawl testing

Developments in Gear Technology Achieved
The 2011 NC skimmer trawl TED research was successful in identifying various TED configurations that could be used in commercial operations in NC. This technology can also be expanded to other regions in the southeastern Atlantic and Gulf of Mexico where commercial skimmer trawling occurs. Combined with the 2008 – 2010 studies, it appears that TEDs can function effectively in skimmer trawl operations with a relatively minimal (~5%) shrimp loss compared to nets without TEDs installed. However, due to different vessel size, varying water depths, seasonal debris in the water and inconsistent shrimp concentrations, it remains critical for the SEFSC and the commercial skimmer trawl industry to work collectively to develop the optimal TED configuration for each region.

During the course of these studies, commercial industry participants and representatives expressed concerns about the use of TEDs in skimmer operations. These included the potential increased drag associated with the use of TEDs, the increased weight, and the relative size of the standard mid-size TED installed in the small skimmer nets. To address this concern a smaller prototype "D-shaped" TED was constructed and slated to be tested in Louisiana skimmer operations by the end of 2012. This TED is 33" x 33" and is constructed of ½" aluminum rod. The decreased size and the D-shape may allow the TED to function more effectively by reducing potential drag and allowing the flat part of the D frame to tow more efficiently in these shallow-water operations.

Improvements and Reduction in Bycatch Associated with This Project
During the 2010 study, 341 successful comparative tows were made aboard six vessels testing experimental TEDs against naked net controls (no TEDs installed). There were three interactions with live Kemp's ridley sea turtles in this research, and these turtles were captured in control nets. During this 2011 NC study, TEDs were installed on both sides of the operation. A total of 157 tows were made in this study, and there was one interaction with a live Kemp's ridley sea turtle in a net equipped with a TED. This interaction occurred while the vessel had slowed and was making a turn. It is likely that this turtle would have escaped through the TED opening when the nets straightened and vessel-speed increased. In addition to significantly reducing the potential for sea turtle interactions in skimmer trawl operations, the use of a TED appears to significantly reduce the amount of unwanted/unmarketable finfish bycatch. In this 2011 study, bycatch reductions between TED types were statistically non-significant. However, amounts of bycatch reported by the fishermen conducting the study were much less when compared to operations in the study area working without TEDs installed.

Further testing is necessary in order to continue refining the TED configuration and handling techniques for the skimmer trawl fishery. Future studies will be designed to develop TEDs that will maximize target catch, decrease unwanted bycatch, eliminate protected species captures, and facilitate TED acceptance by the industry.

Project Title
Examining the Efficacy of Modified Circle Hooks in Reducing the Bycatch of Undersized Lutjanid and Serranid Fishes

BREP Funding Provided
$37,000

Location of Research
NMFS Southeast Fisheries Science Center

Resource Challenge
Of the fishes commonly caught off the southern portion of the east coast of the United States, fish within the snapper-grouper complex are among the most sought-after by recreational fishermen. Although management measures are in place to reduce the number of undersized fishes retained by anglers, size limits alone could be inadequate due to high post-release mortality of these fishes. While a number of factors negatively impact post-release survival, such as depth of capture, hook type, water temperature at location of capture, handling time, fight duration, and choice of bait, anatomical location of hooking is considered the most important factor related to post-release mortality. Circle hooks, when compared to J hooks, have been shown across a number of fish taxa to have shallower hooking depths within the buccal cavity and alimentary canal of fishes, resulting in fewer injuries to vital organs. However, circle hooks are not considered a panacea as deep-hooking still occurs with circle hooks, albeit at a lower rate.

To examine the potential for reduction of post-release mortality of undersized snapper and groupers caught with circle hooks, the NMFS Southeast Fisheries Science Center (SEFSC) is testing the efficacy of modified circle hooks (Figure 8) in further reducing incidences of gut hooking. The modified circle hook, hereafter referred to as an AP circle hook, incorporates a 40-mm wire extension (also referred to as an appendage) from the hook's eye, thereby increasing the diameter of the hook while negligibly impacting its effective size and weight.

Figure 8. Appendaged circle hook used in study

Project Summary

Fifteen fishing days were conducted on two headboats off the east coast of Florida between June 16, 2011 and October 12, 2011. Due to extremely low catch of red snapper off the east coast of Florida (possibly resulting from avoidance of this species by headboat operators), six additional sampling trips were conducted on a NOAA research vessel in the northern Gulf of Mexico, which resulted in the capture of 96% of all red snapper collected during this study. During each fishing day, two experienced anglers were selected to participate in the study. Each angler was provided a standardized rod and reel and experimental rigs. Each rig was constructed of leader material (100 lb. test mono), one swivel, one weight (8-16oz bank sinker), one standard circle hook (Mustad model #3997710D 10/0), and one AP circle hook (Mustad model number AP39960D 10/0). The dimensions of the control and treatment hooks are identical with the exception of the appendage. The position (top or bottom) of the standard and AP circle hooks was randomly assigned during the construction of the rigs. Rigs were changed daily or more frequently to remove bias resulting from degradation or damage. All captured fishes were identified and measured to the nearest mm by a trained observer.

Developments in Gear Technology Achieved

As of the end of 2011, 1,286 fishes had been captured, representing 21 genera and at least 27 species. Black sea bass, red snapper, and vermillion snapper dominated the catch, constituting 48.5, 24.0 and 9.5% of landings, respectively. There was no evidence of size-related selectivity (e.g. Kolmogorov-Smirnov test statistic = 0.75, $p = 0.62$ for black sea bass, or reduced efficiency (50.04% captured with circle hooks and 49.96% captured on AP circle hooks for all fishes collected) between the two hook types, regardless of species (Figures 9-10). Of the fishes that were captured, 97% were lip hooked regardless of hook type. When comparing hooking location by hook type, over 95% of all fishes captured were hooked in the jaw; however, 98.75% of fishes captured on appendaged hooks were hooked in the jaw, compared to 95.79% of fishes captured on circle hooks. Of the 17 fishes hooked in the throat or alimentary canal, only one of these occurrences was on an appendaged hook.

Improvements and Reduction in Bycatch Associated with This Project

Data will continue to be collected through spring 2012, with efforts focusing on increasing sample sizes of other recreationally important species such as vermillion snapper. Once data collection is completed, a full data analysis will be conducted.

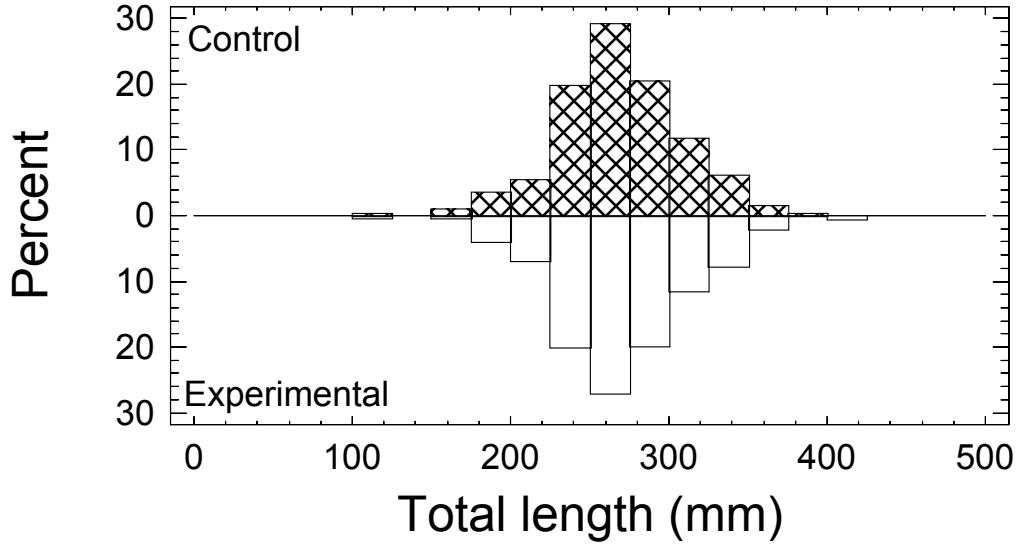


Figure 9. Relative length frequency of black sea bass, *Centroprisits striata*, captured using control and experimental hooks during this study

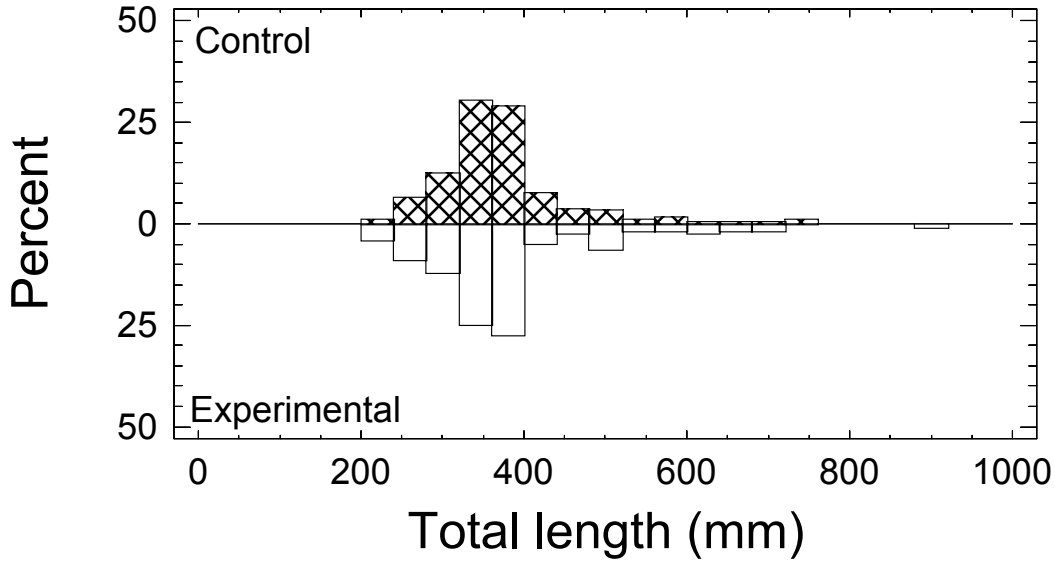


Figure 10. Relative length frequency of red snapper, *Lutjanus campechanus*, captured using control and experimental hooks during this study

Project Title
Reducing Bycatch in the Penaeid Shrimp Fishery Utilizing TEDs with Two-Inch Bar Spacing

BREP Funding Provided
$33,372

Location of Research
NMFS Southeast Fisheries Science Center

Resource Challenge
Measures to reduce finfish bycatch in the southeastern U.S. shrimp fishery (Figure 11) have led to the development of bycatch reduction devices (BRDs). Currently approved BRDs rely on the swimming behavior of fish to affect escapement through the device and out of the trawl. Due to differences in the swimming behavior of bycaught finfish and elasmobranches, current BRD designs do not effectively exclude all species. The turtle excluder device (TED), a required component of most shrimp trawls fished in the southeastern United States, is effective in eliminating larger fish from the catch. However, exclusion may be enhanced with reduced deflector bar spacing. Species of concern that may benefit from TEDs with reduced bar spacing include juvenile sharks such as the blacknose shark (*Carcharhinus acronotus*) and sturgeon (Acipenseridae**).** Recently, high fish-bycatch-to-shrimp ratios during late summer and fall fishing periods in the Gulf of Mexico have spurred interest from fishers to evaluate TEDs with reduced bar spacing as a means of excluding fish from the catch.

Figure 11. Gulf of Mexico shrimp vessel

Project Summary
This overall project was initiated in 2010 as a fishery-dependent study to assess differences in catch rates of shrimp and bycatch between standard 4-inch TEDs and TEDs with 2-inch bar spacing. Data were collected by NMFS observers according to established protocols for the fishery. Tows were conducted in nearshore and inshore waters of Louisiana, Mississippi and Alabama.

In 2011, this BREP focused on further assessing the efficacy of 2-inch TEDs in reducing bycatch. In an effort to improve shrimp retention with the 2-inch TED, the NMFS Southeast Fisheries Science Center (SEFSC) will conduct catch comparisons between a 4-inch TED and a 2-inch "staggered bar" TED. The 2-inch staggered bar TED features alternating offset deflector bars designed to reduce the deflection of shrimp out of the

TED opening. A commercial shrimp trawler has been contracted to perform this work. However, due to a delay in receiving BREP funds in 2011, testing of the staggered bar 2-inch TED is scheduled to begin in early 2012.

Developments in Gear Technology Achieved

Four-inch bar spacing is the maximum spacing allowed by federal law in order to prevent small sea turtles from passing through the TED deflector bars and into the shrimp trawl codend. Once TEDs were required in the southeast U.S. shrimp fishery, fishers became aware that the TED helped to reduce the capture of unwanted bycatch species and debris by working as an effective sorting device in the trawl. TEDs with bar spacing of less than four inches are not commonly used in the fishery, and this is largely an untested TED modification in the United States. The 2011 continuation of this study aims to reduce observed shrimp loss with the 2-inch TED by testing a staggered bar design. A staggered bar TED design has been used in an Australia shrimp fishery and has been shown to reduce bycatch while maintaining acceptable shrimp catch rates.

Improvements and Reduction in Bycatch Associated with This Project

The 2010 results from 40 paired tows conducted in the nearshore waters of Louisiana and Mississippi showed that the experimental 2-inch TED reduced shark and ray bycatch 78.0% and 80.6% by weight, respectively. With regard to fish bycatch, the experimental TED reduced Atlantic croaker (*Micropogonias undulates*) 37.5% by weight and trout species *(Cynoscion sp.)* 35.7% by weight. Shrimp loss for the experimental TED was 6.3% by weight. Based on the results of a paired t-test, this loss was statistically significant with a p value of <0.042, and a power 51.5%.

Project Title
Commercial Longline Sea Turtle Mitigation

BREP Funding Provided
$25,900

Location of Research
NMFS Southeast Fisheries Science Center

Resource Challenge
The NMFS Southeast Fisheries Science Center (SEFSC) continues to work toward the development of solutions to prevent the incidental capture and mortality of sea turtles in the southeastern U.S commercial longline fishery. NOAA has promulgated regulations requiring the use of circle hooks and careful release and handling methods for sea turtles by the longline industry. Fisherman outreach regarding the use of sea turtle handling equipment is paramount to the success of mortality reduction in hook-and-line fisheries. As such, outreach usually is incorporated into biological opinions required by the Endangered Species Act for different hook-and-line fisheries. To ensure best-use practices of these technologies, regular industry outreach activities are conducted by the SEFSC.

Project Summary
As a component of this project, the SEFSC has developed a Gear Monitoring Team (GMT) whose purpose is to provide direct training to fishers and marine law enforcement on the technical requirements of federally required fishing gear in the Southeast region. In 2011, the GMT conducted commercial fisher outreach at the ports of Port Isabel, Texas (TX); Port Mansfield, TX; Port Aransas, TX; Port Lavaca, TX; DuLac, Louisiana (LA); Venice, LA; Panama City, Florida (FL); and Madeira Beach, FL. Training for recreational fishermen was conducted in Port Isabel, TX; Port Mansfield, TX; Port Aransas, TX; Port Lavaca, TX; Biloxi, Mississippi; Dauphin Island, Alabama; Pensacola FL; Destin, FL; and Panama City, FL. Waterproof copies (50) of NOAA Technical Memorandum NMFS-SEFSC-528 on sea turtle biology and conservation were printed and distributed to fishers at ports as well and at Gulf of Mexico Fishery Management Council meetings. Although it is important to train commercial and recreational fishermen, it is just as important to train fishery enforcement professionals. The GMT in 2011 completed law enforcement training with marine law enforcement officers from the Florida Fish and Wildlife Commission training facility (2 classes), the United States Coast Guard Gulf Region Training Center training facility, and Texas Department of Parks and Wildlife.

Developments in Gear Technology Achieved
New sea turtle mitigation techniques for the bottom-longline reef-fish fishery were trialed under a BREP-funded study in 2010. This study aimed to characterize the species-specific relationships between catch rates and soak times for target and bycatch species in the bottom-longline reef-fish fishery as a means to promote shorter soak times and reduce sea turtle mortality in the fishery. The SEFSC hopes to acquire additional BREP funding

to continue the study in 2012 to further evaluate the seasonal effect and bait type on capture times of target and bycatch species.

Improvements and Reduction in Bycatch Associated with This Project
To ensure fishery compliance and best-use practice of turtle mitigation gear and techniques in the longline fishery, efforts related to this project focused on outreach and training.

Project Title
Seabird Bycatch in the Western North Atlantic Fisheries

BREP Funding Provided
$24,000

Location of Research
NMFS Southeast Fisheries Science Center

Resource Challenge
The three big challenges regarding seabird bycatch are (1) correct and precise identification of species by observers; (2) the low proportion of positive catches, which affects analysis of the data; and (3) the number of relatively rare pelagic seabird species known to forage in the time-space footprint of the pelagic observer effort. This combination makes it important to improve the precision and accuracy of seabird identifications and the reliability of bycatch estimates. As understanding of factors that influence seabird bycatch increases, the potential for reducing seabird bycatch and the potential jeopardy for rare species improves as well.

Project Summary
This project conducted an analysis of seabird bycatch in relation to hook type and hook size, with results presented at the First International Circle Hook Symposium (Symposium) in Miami in May 2011. This analysis has resulted in a manuscript for inclusion in an issue of Bulletin of Marine Science that will contain other papers from the symposium. For the first analysis prepared for the symposium, the study prepared 10 delta models (i.e., combination generalized linear and binary models). These models differed mainly in specific predictor variables when one or more choices were available (e.g., pelagic fishing area vs. latitude and longitude combination), or the analysis used only one of two or more highly correlated variables in the same model. For example, hook type or hook size was excluded from some of the models because the two variables were correlated. The analysis for the manuscript focused on the three fishing areas that contain most of the U.S. Atlantic seabird bycatch (Northeast Coastal (NEC), Mid-Atlantic Bight (MAB), and South Atlantic Bight (SAB)) and reduced to three the number of alternative models. This methodology increased almost four-fold the percent of total longline sets that resulted in seabird bycatch. This project supported further analysis of the data and a report that contains updated estimates of seabird bycatch through 2009. This project also supported preparation of a section of the U.S. National Report to the International Commission for the Conservation of Atlantic Tunas based on these results, as well as a Bird Identification Training for Pelagic Observer Program observers at the NMFS Southeast Fisheries Science Center in March 2011.

Developments in Gear Technology Achieved
This project did not directly achieve any developments in gear technology.

Improvements and Reduction in Bycatch Associated with This Project
The analysis for the Symposium involved the development of two generalized linear models to examine the effects of hook type (J hooks and circle hooks) and hook size (8/0 and 9/0 J hooks, and 16/0 and 18/0 circle hooks) on (1) the probability of catching one or more seabirds on a set, and (2) the positive catch rate (i.e., number of seabirds per 1,000 hooks in a longline set with seabirds caught). This analysis was confined to the three areas of the pelagic longline fishery where most of the seabirds are caught. This increased almost four-fold the proportion of observed seabird sets having seabird bycatch, which was intended to reduce any possible negative influence of rarity on the analysis. The paired models (delta approach) showed that both hook type and hook size significantly influenced seabird bycatch in the U.S. Atlantic pelagic longline fishery. Compared to hook size, hook type played a lesser role in the probability of catching a seabird but played a more important role on the positive catch rate. Use of the 8/0 J hook led to the highest probability of catching a seabird and the highest positive catch rate. Results suggest that use of the circle hook could significantly reduce seabird bycatch in the U.S. Atlantic pelagic longline fishery, although its effectiveness might be unrecognized because of other influences on seabird bycatch, such as location, season, target species, and associated fishing tactics.

This project estimated seabird bycatch in the U.S. Atlantic pelagic longline fishery during 1992-2010 by applying 21 candidate models (M1-M21) and extrapolating from the observed seabird bycatch to the estimated seabird bycatch. The NMFS Pelagic Observer Program (POP) observed 12,004 longline sets from 1992 to 2010, with a total of 133 seabirds captured on 67 sets. The overall nominal catch rate was 0.011 birds per set or 0.015 birds per 1,000 hooks. Among those specified seabirds, gulls (Laridae *spp.*) were the most frequently captured, followed by shearwaters (Procellariidae *spp.*, especially greater shearwaters *Puffinus gravis*) and northern gannet (*Morus bassanus*). In the pelagic longline fishery, a total of 211,879 longline sets was used for extrapolation, and the overall coverage proportion by the POP effort was 5.7%. We estimated a total of 1,432-3,345 seabirds captured on average in the U.S. Atlantic pelagic longline fishery from 1992 to 2010, with the highest annual estimate in 1995 according to models M1-M3, M5, and M18-M21, in 1999 according to model M4, and in 1997 according to models M6-M17. The highest estimate of seabird bycatch occurred in the MAB area, followed by the NEC area. The estimates of seabird bycatch in the SAB and GOM areas were also relatively high. Longline fishing during summer through winter produced higher estimates of seabird bycatch than fishing during other times of the year.

For this project, analysts introduced new modeling approaches, both refinements of delta models and new models such as tree-ensemble models (Adaboost and random forest models) and the Tweedie Distribution Model. The other major innovation in these 2011 analyses was to focus on pelagic observer data from the three main areas where seabirds are caught in trying to distinguish differences in seabird catch rates as a function of different aspects of fishing gear and strategy (such as circle hooks vs. J-hooks and target species). This project found that the highest seabird catch rates were on sets that targeted dolphinfish. Information from the observer program indicated that special fishing tactics

involving the arrangement of hooks relative to floats in this fishery may have been responsible for higher catch rates on these sets.

Project Title
Evaluation of Weaker Circle Hooks to Release Bluefin Tuna in the Yellowfin Tuna Longline Fishery

BREP Funding Provided
$12,700

Location of Research
NMFS Southeast Fisheries Science Center

Resource Challenge
Pelagic longline fisheries for tuna and swordfish catch several non-target species such as blue and white marlin, sharks, and bluefin tuna, which are managed under international rebuilding plans and are experiencing overfishing. The bycatch of these species by pelagic longline fisheries is of concern to management agencies, and the United States has implemented several time/area closures in an effort to reduce bycatch mortality of these species in U.S. fisheries. The Gulf of Mexico is a spawning area for the western Atlantic bluefin tuna stock and has become an area of concern due to bycatch mortality of spawning bluefin tuna. NMFS is evaluating additional time/area closures in the Gulf of Mexico to mitigate the bycatch mortality of spawning bluefin tuna. Modifying fishing gear and/or fishing practices to reduce the mortality of bluefin tuna, while maintaining catches of yellowfin tuna in the Gulf of Mexico directed yellowfin tuna fishery, is being investigated as an alternative to additional time/area closures.

Project Summary
Mitigation research focuses on utilizing the difference in the size and relative strengths of bluefin tuna as compared to the targeted yellowfin tuna to reduce bluefin takes. Anecdotal information from fishers indicates spawning bluefin tuna, which are much larger than yellowfin tuna, are capable of straightening some types of hooks used in the yellowfin tuna fishery.

During year one of the research (2007), fishery-independent experiments were conducted to collect data on the relative force exerted by bluefin and yellowfin tuna when captured on pelagic longline gear. Treatments of three different breaking strengths of monofilament leader (140, 200, and 250 lbs.) were tested to determine which would effectively release bluefin tuna yet retain yellowfin tuna. Based on the data collected, 140-lb. and 200-lb. monofilament leader were determined to be capable of releasing bluefin tuna of the sizes of fish captured. Starting in 2008, a fishery-dependent experiment was initiated to investigate the potential of a newly designed hook as a potential mitigation measure for reducing bluefin tuna capture on pelagic longlines. The objective of the experiment was to evaluate the efficacy of a weaker 16/0 circle hook (3.65 mm wire diameter) in reducing the bycatch of bluefin tuna by comparing it to a standard 16/0 circle hook (4.0 mm wire diameter) used in the pelagic longline fishery (see Figure 12). The experimental hook retains the dimensions of a 16/0 hook but has less tensile strength, causing it to bend or straighten at loads that would not bend a conventional 16/0 hook (see Figure 13).

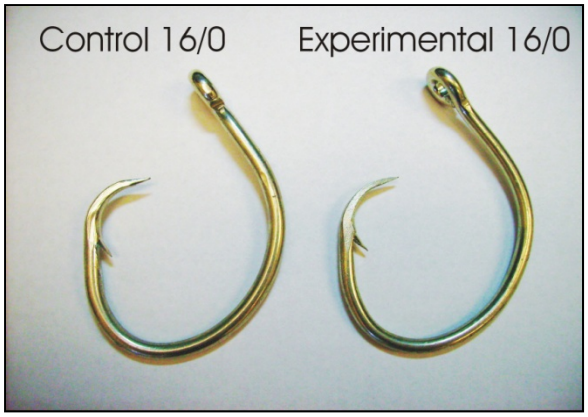


Figure 12. Standard (control) and experimental 16/0 circle hooks

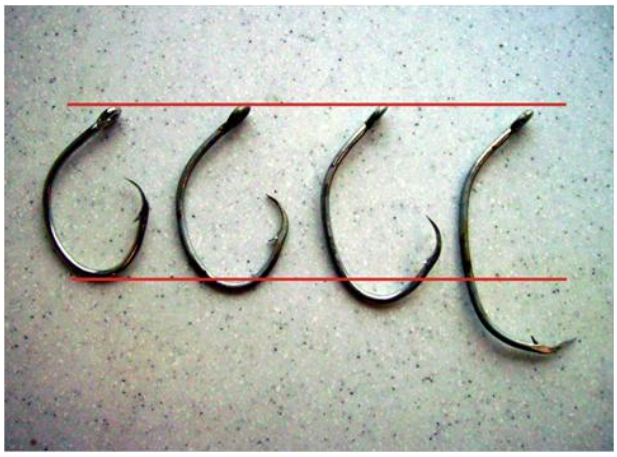


Figure 13. Bent and straightened hooks

Developments in Gear Technology Achieved
Research was conducted from 2008 to 2010 by the Engineering and Harvesting Branch of the NMFS Southeast Fisheries Science Center (SEFSC), Mississippi Laboratories, to evaluate the efficacy of a new 16/0 "weak" circle hook design in reducing the bycatch of bluefin tuna in the Gulf of Mexico yellowfin tuna fishery. Six commercial vessels completed 311 pelagic longline sets. Experimental hooks and standard 16/0 circle hooks were alternated on the longline with a total of 198,606 hooks set. A total of 33 bluefin were caught during the experiment, of which 10 were caught on the experimental hook (56.5% reduction). The difference in bluefin catch was statistically significant. Vessels landed a total of 2,065 yellowfin tuna. The difference in the yellowfin catch rate for standard and experimental hooks was not significant.

Improvements and Reduction in Bycatch Associated with This Project
The estimated takes of spawning-size bluefin tuna by the Gulf of Mexico (GOM) pelagic longline fishery have raised concerns that this fishery may be impacting efforts to recover the western Atlantic bluefin tuna stocks. As a result of this research, a final rule was published in April 2011 requiring all vessels fishing for highly migratory species in the GOM with pelagic longline gear onboard to possess, use, and deploy only circle

hooks that are described at Title 50 of the U.S. Code of Federal Regulation (CFR) § 635.21(c), and that are constructed of corrodible round wire stock that is no larger than 3.65 mm in diameter.

The SEFSC used 2011 BREP funding to produce and distribute weak hooks for outreach efforts to the fishing industry. The SEFSC also used 2011 BREP funds to construct hook inspection gauges and train law enforcement agencies. These activities have helped to expedite implementation of the weak hook technology.

Project Summaries—Southwest

Project Title
Ability of Southern California Deepwater Rockfish to Survive Barotrauma Following in-situ Recompression

BREP Funding Provided
$104,290

Location of Research
NMFS Southwest Fisheries Science Center

Resource Challenges
Pacific rockfish experience high discard mortality rates from a condition called barotrauma (see Figure 14), which is caused by the change in pressure during capture. Excessive buoyancy from barotrauma makes it difficult for many rockfish species to submerge under their own power. Discarded rockfish are often left floating on the surface where they can succumb to thermal shock, suffocation, and/or predation. Currently seven species of rockfish are listed as "depleted" by the Pacific Fishery Management Council, and several other populations are in decline. Understanding how barotrauma affects different species of rockfish is important in order to properly manage discard mortality. Research supported by the NOAA Saltonstall-Kennedy Grant Program, California Sea Grant, and the Coastside Fishing Club (San Francisco) have shown that recompressing excessively buoyant rockfish immediately after capture results in high survival rates for shallow-water rockfish species. However, little is known about the ability of deepwater rockfish species to survive barotrauma if recompressed. Five of the seven rockfish species currently listed as depleted are commonly found at depths greater than 150 m: Bocaccio *Sebastes paucispinis*, Darkblotched *S.crameri*, Cowcod *S. levis*, Pacific Ocean Perch *S. alutus*, and Widow rockfish *S. entomelas*.

Figure 14. Sunset rockfish with barotrauma tagged externally with a V9AP transmitter

Project Summary

The goal of this study is to determine the survival rate of deepwater rockfish species captured from depths greater than 150 m and subsequently recompressed using weighted cages. Researchers at the NMFS Southwest Fisheries Science Center (SWFSC) tagged four different species of rockfish captured from 150 m to 180 m depths off the coast of Southern California. Rockfish were externally tagged with V9AP accelerometer pressure transmitter tags from Vemco (see Figure 9). Species included sunset rockfish *S. crocotulus*, bocaccio *S. paucispinis,* starry rockfish *S. constellatus*, and bank rockfish *S. rufus*. Tag life is 122 days. Immediately after the tags were attached, rockfish were recompressed to depths between 40 m to 50 m using a weighted cage. It was determined that rockfish captured from depths greater than 150 m needed to be recompressed to a minimum depth of 45 m. The release cage used was equipped with a video camera and a pneumatic opening door that could be controlled from the boat. With this "cage cam," the SWFSC was able to monitor rockfish as they were recompressed and determine the depth needed for recompression. Temporary moorings attached to VR2W acoustic receivers were deployed in the vicinity of the fishing/tagging site in order to monitor the tagged fish. The receivers will be deployed for up to four months in order to monitor for potential delayed mortality.

Additionally, a subset of rockfish was collected for an analysis of internal injury and long-term survival potential. Rockfish from the most commonly encountered species by the southern California fishery were dissected to evaluate internal injury as a result of barotrauma (i.e., swimbladder rupture, hemorrhaging), and heart, head, kidney, and rete mirabile samples were removed for further histological examination. On survey trips in 2012, researchers will recompress ~15-30 fish in on-board recompression chambers and then slowly decompress them under controlled conditions. Following decompression, these fish will be maintained and monitored in the SWFSC Experimental Aquarium for two months where they will be non-lethally sampled for blood from a caudal-venipuncture at two time points, once rockfish are brought to surface pressure and at the end of the two month observation period. The SWFSC will extract total ribonucleic acid (RNA) from the red and white blood cells and measure the expression of immune genes that respond to barotrauma. This will be another valuable indicator of recovery potential and overall health.

Developments in Gear Technology Achieved

As of this writing, the SWFSC has deployed the temporary moorings with the VR2W acoustic receivers attached and initiated tagging rockfish at the 43 fathom bank off the coast of San Diego. The SWFSC also has initiated collecting rockfish tissues for analysis of internal injury. The researchers have determined that rockfish captured from depths greater than 150 m need to be recompressed to a minimum depth of 45 m. Development of minimum release depths to achieve successful releases is key to developing the technology and protocols to properly implement recompression technology in a large-scale manner.

Improvements and Reduction in Bycatch Associated with This Project
The SWFSC should finish tagging all rockfish by the end of January 2012. Receivers will be downloaded twice during the four-month lifespan of the tags. The SWFSC anticipates the data collection from the acoustic tags will be completed by the end of May 2012. The SWFSC anticipates collection of rockfish using pressure chambers in January and February 2012 as well, with rockfish being held in the SWFSC Experimental Aquarium until April 2012. Gene expression analyses are planned to be conducted May-June 2012. The SWFSC anticipates data analysis completion by the end of summer 2012. Results from this project will be disseminated to fishery managers immediately after completion to help inform decisions about discard mortality in deepwater rockfish species.

Project Title
Determining Post-Release Survivorship using Alternative Angling Techniques in the Recreational Fishery for Common Thresher Sharks

BREP Funding Provided
$78,265

Location of Research
NMFS Southwest Regional Office

Resource Challenge
In southern California, the recreational fishery for common thresher sharks (*Alopias vulpinus)* has grown considerably over the past 10 years, with catch-and-release techniques gaining popularity among anglers. In 2008, a BREP-funded project focused on assessing post-release survivorship using the primary techniques employed by southern California anglers. The BREP-funded common thresher studies have since focused on assessing survivorship using the different techniques currently employed by anglers in the California fishery. BREP funds provided in 2011 focused on the last phase of the thresher survivorship work, which assessed post-release mortality in sharks captured using mouth-based techniques (see Figure 15). Understanding the effects of capture using the different fishery techniques is necessary for an accurate assessment of harvest in the recreational fishery. This work provides anglers with information on the mortality of their released catch given particular fishing practices. With this new information, anglers will have an opportunity to change fishing techniques to reduce wasteful practices and embrace an ethical angling philosophy. This BREP-funded research tests the hypothesis that mouth-hooked common thresher sharks survive the acute effects of the angling event.

Specific objectives of this research were to:

1. Estimate survivorship rates associated with traditional mouth-hooking techniques in the southern California recreational fishery.
2. Provide highly migratory species managers with an overall hooking mortality estimate associated with all of the techniques currently used in the fishery, i.e., mouth-based (this project), caudal-based (2008 BREP project), as well as sharks lost with trailing gear (2010 BREP project).
3. Develop a multimedia outreach campaign that highlights practical conservation strategies and further raises angler awareness of the need for sustainable fishery practices.
4. Prepare and submit a scientific manuscript on project findings.

Project Summary
This project was designed to quantify hooking mortality rates associated with traditional mouth-based techniques in the southern California recreational fishery. Survivorship was determined using pop-off satellite archival tags (PSATs) deployed on sub-adult and adult common thresher sharks captured using standardized techniques. The BREP funds also

were used to launch a multimedia outreach campaign that highlights practical conservation strategies for the common thresher fishery.

Figure 15. Pfleger Institute of Environmental Research intern William Goldsmith tagging a mouth-hooked common thresher shark

All of the trailing gear PSATs used in the 2010 BREP project and five of the mouth-hooked PSATs used for this project have been deployed on common thresher sharks captured using fishery standard techniques. For the trailing gear study using BREP funds received in 2010, five of the sharks died within 36 hours of capture, two survived, and one remains at liberty. For the mouth-hooked individuals (2011 BREP funds), four of the five tagged sharks survived the acute effects of capture, and the NMFS Southwest Regional Office (SWR) has not yet received the data for the remaining shark. The final tag deployments are slated for spring 2012. The multi-media outreach campaign commenced filming in mid-November 2011, when the NOAA Ocean Media Center sent out a film crew and at-sea field activities were recorded. Additional footage will be filmed in spring 2012, at which time final editing and production of a DVD will take place. Scientific manuscript preparation will follow shortly after the data-collection period has ended.

Developments in Gear Technology Achieved

From the preliminary findings, it appears that sharks captured by the mouth may have the highest rate of survivorship. From the field studies, the project team has identified several techniques that may result in higher survival rates for mouth-hooked individuals. Among these are: (1) the use of non-offset circle hooks; (2) dead drifting; (3) drop-back

troll techniques, which involves trolling a teaser lure (without hooks) to first attract sharks to the boat, then dropping back a baited circle hook; and (4) drifting with baited artificial lures. Field studies in late 2011 and early 2112 will focus more specifically on developing a mouth-hooking protocol that can be promoted and shared through the multi-media outreach campaign.

The SWR has continued a strong public outreach campaign that promotes a more ethical angling approach geared to reduce post-release mortality in the common thresher shark fishery. Two project seminars were offered in 2011 that provided over 200 recreational fishers with a thorough review of the BREP-funded research and possible ways to improve current fishery practices. Seminars also focused on promoting the use of techniques that reduce trailing gear in sharks that are hooked in the tail but not landed (based on 2010 BREP findings). Increased accessibility to thresher specimens was made possible through the NMFS Southwest Fisheries Science Center juvenile thresher shark survey and through concurrent Pfleger Institute of Environmental Research projects funded through the George T. Pfleger Foundation. Current efforts are focused on filming a multimedia outreach message that highlights practical ethical angling and conservation strategies in the southern California thresher fishery. This video will be made available to local fishers and on the web.

Improvements and Reduction in Bycatch Associated with This Project
The primary objective of this BREP-funded project was to assess post-release survivorship in the southern California recreational fishery for common thresher sharks. Results to date have already had an impact on current fishing practices in southern California. The outreach efforts associated with the BREP work have been widely disseminated to recreational clubs and fishers in the region, with several tournaments now offering incentives for practicing mouth-hooked techniques. Additionally, these findings will be used by assessment scientists and managers to provide an additional estimate of removals in the recreational fishery.

Project Title
Pinniped Deterrence in Recreational and Commercial Fisheries

BREP Funding Provided
$25,000

Location of Research
NMFS Southwest Regional Office

Resource Challenge
Almost all coastal commercial and recreational fisheries along the coast of California interact with pinnipeds to varying degrees, primarily California sea lions (*Zalophus californianus*) and harbor seals (*Phoca vitulina*). These pinnipeds become entangled and/or are captured in fishing gear, damage fishing gear, and damage the target catch when trying to feed on fish caught in the gear (i.e., depredation). Fish that have been damaged by pinnipeds are often discarded at sea and are considered to be an economic discard, which is a form of bycatch. Additionally, successful acquisition of prey through depredation could result in pinniped dependence on human fishing activities, which may increase the risk of pinniped injury or mortality through interactions with fishing gear and increase the number of pinniped conflicts with frustrated fishermen. One commercial fishery in southern California that has been experiencing frequent pinniped depredation is the California halibut trawl fishery. In the spring of 2009, NMFS began working with local commercial fishermen to collaboratively develop and test solutions for what they described as significant pinniped depredation in this fishery (Figure 16), primarily from harbor seals that are locally abundant near some important fishing areas.

Figure 16. California halibut with pinniped bite and scratch marks

Project Summary
This project's objective was to evaluate the effectiveness and performance of modifying a trawl net using a smaller-mesh extension or "protection panel" (Figure 17) to reduce or prevent pinniped depredation on California halibut trawl gear, primarily from harbor seals, while also minimizing, or at least not increasing, bycatch of other species. The idea put forward by fishermen was that using a smaller-mesh extension might prevent pinnipeds from reaching through the net with their claws and mouths in an attempt to remove or damage fish from this area of the net. An experimental fishery protocol was

established to compare catch performance and depredation rate of the halibut trawl net using a 3-inch mesh size modification, compared to the performance of the $5^{1/2}$-inch mesh size trawl net extension normally used in the fishery. Additionally, an underwater video camera system was used to document the behavioral response of pinnipeds during these experiments (Figure 18).

Figure 17. Small mesh protection panel

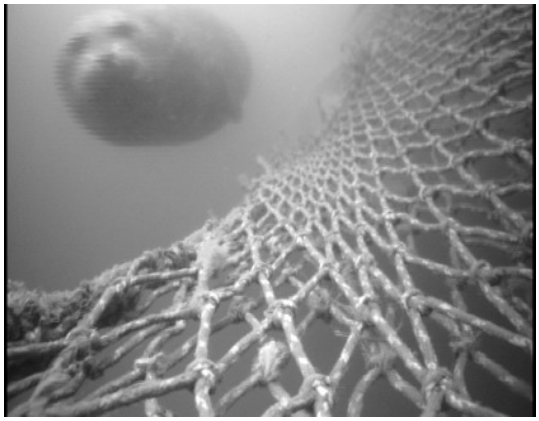


Figure 18. Harbor seal patrolling the net

Table 2 shows that overall halibut catch rates and evidence of pinniped depredation was less than expected during most of the study, although fishing and pinniped activity during the second half of the experiment was considered more representative of typical conditions, according to the fishermen.

Table 2. Results from 34 paired comparative tows conducted aboard the *F/V Cecelia* in the coastal waters near Santa Barbara and Oxnard, California, from August 2010 through February 2011

Catch Performance	control	small mesh		control	small mesh	
	count	count	p-value	weight (kg)	weight (kg)	p-value
Total halibut catch per tow	2.36	3.22	0.024	10.86	14.55	0.098
Total bycatch	134.26	184.95	0.001	49.09	46.81	0.605
Depredation	**All tows**			**Last 19 paired tows**		
Halibut caught	80	109		53	56	
Halibut damaged	10	9	0.53	10	5	0.30
% damaged	13	8		19	9	

Findings included the following:

- More halibut was caught using the small-mesh extension, although catch was low overall.
- There was a significant increase in the bycatch of small fish that did not affect the total weight of catch.
- There were inconclusive results on the numbers of fish observed damaged.
- There also were observations of fish being pulled out of net by pinnipeds during haulback.

Based on these results, a new design to minimize the bycatch of small fish is under development and will be evaluated in 2012. Instead of including the small-mesh extension directly in front of the codend in the trawl net, a small mesh "protective tube" will be constructed to surround the normal extension and codend in a way that will allow the net to sort out small fish as usual while providing an improved barrier for pinnipeds attempting to depredate during fishing operations. Continued progress on the underwater video system based on lessons learned will be incorporated in this next round of experimental research.

Developments in Gear Technology Achieved

Indications are that the small mesh extension in the initial configuration testing contributed to increased retention of small fish. The next design will attempt to resolve this by creating a protective barrier around a select portion of the net as opposed to being directly part of the net funnel.

Improvements and Reduction in Bycatch Associated with This Project

Reduction in pinniped depredation of halibut following this line of research appears to have potential but cannot be firmly established by results so far.

Project Title
Temporal Variation in Seabird Distribution and Density in the Eastern Tropical Pacific

BREP Funding Provided
$20,000

Location of Research
NMFS Southwest Fisheries Science Center

Resource Challenge
Understanding distribution and abundance of seabirds at sea and changes over time is an integral part of mitigating seabird bycatch. The ability to investigate the degree of overlap in space and time between seabirds that are vulnerable to bycatch and fisheries operations is an important piece of this mitigation. NMFS assessment cruises provide baseline data to proceed with these types of analyses.

Project Summary
A growing concern exists over the long-term ecosystem effects of seabird bycatch in fisheries throughout the world's oceans. NMFS conducts a number of projects and programs to address this concern, including development and maintenance of seabird avoidance regulations, mitigation research (often in conjunction with the fishing industry), observer training, preparation and dissemination of education and outreach materials for fishermen and the public, and participation in international efforts at regional fishery management organizations (RFMOs), bilateral meetings, fishers' fora, and various fisheries observer and scientific conferences.

In addition to these concerns and associated activities, NMFS is contributing to seabird assessments in RFMOs in order to address other seabird—fishery interactions, both direct and indirect. These efforts are especially supported through the seabird component of the marine mammal and ecosystem assessment cruises conducted by the NMFS Southwest Fisheries Science Center since 1988. Data from these cruises regarding seabird distribution and abundance allow for investigation of overlap between seabird species and fisheries of all kinds. This 2011 project is a continuation of these efforts.

The geographic region for this project was initially proposed to be the eastern tropical Pacific but was changed to the central tropical Pacific due to unanticipated changes in NOAA research vessel allocation subsequent to submission of the project proposal. However, the project objectives, methods, and implications remain consistent with the initial project proposed.

Seabird survey data for this project were collected aboard the NOAA *R/V Sette* in the U.S. exclusive economic zone regions of the main Hawaiian islands and Palmyra Atoll. This region was surveyed in 2005, so the 2011 survey was a repeat of this area. Standard 300-m strip transect methods were used in conjunction with a data entry and edit program run from a laptop computer. Seabird identification, numbers, behavior, and interspecific

associations were recorded in real time during all daylight hours, weather permitting. The protocols, equipment, and software for this project have been a part of the SWFSC ecosystem cruises since 1988.

Developments in Gear Technology Achieved
This project did not directly achieve any developments in gear technology.

Improvements and Reduction in Bycatch Associated with This Project
The research cruise began in October 2011 and ended in November 2011. Extremely high seabird diversity (21 species on each of 2 days) was observed early in the cruise. Prior to the cruise, seabird observers were contracted and briefed regarding field protocols and project objectives. The field manual and data entry and edit programs were modified from previous versions to fit this particular cruise. Equipment was shipped, and the seabird component of the cruise was staged. Post-cruise accomplishments will include equipment de-staging, personnel de-brief, data edit and archive, and data analysis and comparison with the 2005 cruise.

Project Title
Continued Funding for a Fishing Gear Technician at the Northwest Fisheries Science Center

BREP Funding Provided
$107,830

Location of Research
NMFS Northwest Fisheries Science Center

Resource Challenge
Starting in 2011, the west coast limited entry groundfish trawl fishery began management under the West Coast Groundfish Trawl Catch Share Program (implemented through Amendments 20 and 21 to the Pacific Coast Groundfish Fishery Management Plan). This new program established annual catch limits and individual fishing quotas along with individual bycatch quotas. These complex fishery management measures have created increased demand for bycatch solutions in the groundfish trawl fishery. Currently, there is no dedicated staff or permanent funding at the NMFS Northwest Fisheries Science Center (NWFSC) to conduct bycatch research, which places severe limits on the NWFSC's ability to pursue conservation engineering projects relevant to reducing bycatch and habitat impacts from fishing gear in the groundfish trawl fishery.

Project Summary
In 2011, the NWFSC sought funding for continuation of a fishing gear technician to work with the NWFSC Habitat and Conservation Engineering (HCE) group. Since December 2008, with BREP funding, the NWFSC was able to hire and maintain a Pacific States Marine Fisheries Commission (PSMFC) fishing gear technician to focus on gear research, assist the HCE group coordinator in the continued development of the NWFSC bycatch reduction research, and collaborate with other NMFS and regional gear researchers and the fishing industry. Through contracting of a PSMFC staff member, the NWFSC has been able to pursue a wide-ranging array of conservation engineering projects relevant to reducing bycatch in the groundfish trawl fishery.

Developments in Gear Technology Achieved
With continued support for a fishing gear technician, several developments have been achieved. Since 2009 the NWFSC has iteratively developed and tested an open escape window bycatch reduction device (BRD) to reduce Chinook salmon and overfished or rebuilding rockfish species (e.g., darkblotched, canary, and widow) bycatch in the Pacific hake fishery. In 2011, this BRD was tested using a recapture net to quantify fish escapement rates under normal commercial fishing operations. Of particular interest was the gear's performance under high-volume catches of Pacific hake. Results from this study showed reductions in Chinook salmon, yellowtail rockfish, and widow rockfish bycatch by 21.4%, 8.3%, and 8.3%, respectively. Escapement of Pacific hake, the target species, was 1.2%. Project details appear on page 29.

In a second project the NWFSC tested a flexible sorting grate excluder designed to reduce Pacific halibut bycatch in the groundfish bottom trawl fishery. The BRD reduced Pacific halibut bycatch numerically by 57% and by 62% by weight. The loss of target species ranged from 9% to 22%. Results from this work are currently being drafted into a manuscript. Project details appear on page 42.

The gear technician funded under this project helped provide direct observation video camera systems to fishermen for their use in evaluating industry-designed BRDs. These camera systems have been used over 20 times across the Pacific hake midwater trawl fishery, groundfish bottom trawl fishery, and the pink shrimp trawl fishery. Project details appear on page 49.

Finally, the NWFSC has begun planning for the development of flexible sorting grate excluders designed to reduce overfished or rebuilding rockfish bycatch in the bottom and midwater trawl components of the groundfish fishery. This work is in response to the fishing industry's increasing concerns about individual bycatch quotas of overfished or rebuilding rockfish species allocated under the Groundfish Trawl Rationalization Catch Share Program.

Improvements and Reduction in Bycatch Associated with This Project
With the addition of a temporary gear technician, the NWFSC has been able to initiate projects aimed at reducing bycatch of Chinook salmon, rockfishes, and Pacific halibut in the groundfish trawl fishery, and subadult groundfishes and ESA-listed eulachon in the pink shrimp trawl fishery. Variations on the design of the open escape window BRD are increasingly deployed in the Pacific hake fishery. Results from 2011 have demonstrated that Pacific halibut bycatch (a prohibited take species with the potential to constrain the fishery) can be significantly reduced using flexible sorting grate excluders. The loaner video camera systems are becoming an essential tool in the development of industry-designed BRDs in several fisheries.

Project Title
Developing, Testing, and Demonstrating Bycatch Reduction Devices in West Coast Trawl Fisheries

BREP Funding Provided
$93,670

Location of Research
NMFS Northwest Fisheries Science Center

Resource Challenge
In previous years, the Pacific hake (*Merluccius productus*) fishery had established bycatch limits for Chinook salmon, darkblotched rockfish (*Sebastes crameri*), widow rockfish (*S. entomelas*), and canary rockfish (*S. pinniger*). When bycatch limits for any of these species were reached or projected to be reached, the fishery was spatially altered or closed. Beginning in 2011, however, the Pacific coast groundfish trawl fishery has been managed under a catch shares program adopted by the Pacific Fishery Management Council and NMFS. This new program, the West Coast Groundfish Trawl Catch Share Program, established annual catch limits and individual fishing quotas along with individual bycatch quotas. These complex fishery management measures have created increased demand for reducing bycatch in the Pacific hake fishery.

Project Summary
Since 2009, the NMFS Northwest Fisheries Science Center (NWFSC), in collaboration with the Pacific States Marine Fisheries Commission (PSMFC), has field-tested a bycatch reduction device (BRD) to reduce Chinook salmon and overfished or rebuilding rockfish (e.g., darkblotched, canary, and widow) bycatch in the Pacific hake fishery. This BRD is built around a four-seam tube of netting that is inserted in the trawl between the last tapered section of the net and the beginning of the intermediate section. The key component of this BRD design consists of two inclined square mesh ramps that are laced inside the BRD tube, creating large escape windows on each side of the net. In previous work, fish behavior and gear performance were observed using video cameras and artificial light. Although measuring the escapement of Chinook salmon and rockfishes was possible using the video cameras, the video cameras were not effective at enumerating the escapement of the more numerous Pacific hake. In 2011, this study focused on incorporating a recapture net in the BRD design to quantify the escapement of Pacific hake and bycatch species under regular fishing activities and under conditions of high-volume catches.

Developments in Gear Technology Achieved
During this study, a recapture net was designed and deployed that allowed for quantifying the escapement rates of target and non-target species (Figures 19-23). Results showed Chinook salmon, yellowtail rockfish, and widow rockfish bycatch was reduced by 21.4%, 8.3%, and 8.3%, respectively (Table 3). Escapement of Pacific hake, the target species, was 1.2%. Earlier studies conducted on the same BRD employed artificial illumination, whereas escapement rates measured with the recapture net were made in the absence of artificial illumination.

Improvements and Reduction in Bycatch Associated with This Project
Interactions between researchers and the fishing industry along the Pacific coast and Alaska have resulted in a technology transfer whereby variations of this BRD design are being used as rockfish excluders in the Pacific hake trawl fishery and as Chinook salmon excluders in the Bering Sea walleye pollock (*Theragra chalcogramma*) trawl fishery. Results from these tests and lessons learned are continuously being exchanged and are stimulating discussions within the industry that have expanded out into other fisheries (e.g., applying BRDs to reduce Pacific halibut and rockfish bycatch in bottom trawls). Collaborations with conservation engineers at the NMFS Alaska Fisheries Science Center (notably Dr. Craig Rose) have provided NWFSC and PSMFC researchers with valuable information that has helped with the development of this project.

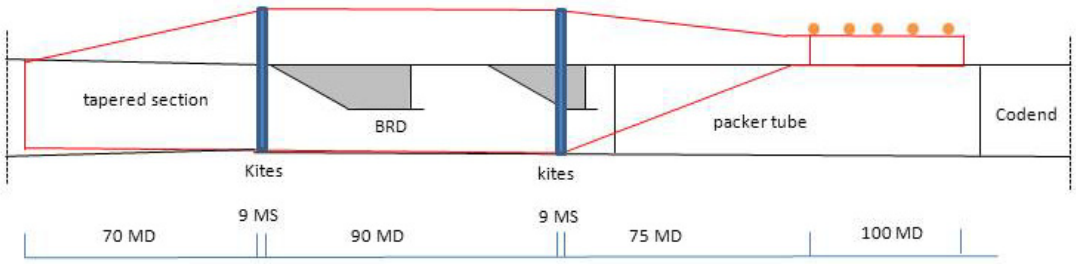


Figure 19. Schematic design of the recapture net incorporated into the open escape window bycatch reduction device used during the current study

Figure 20. Recapture net under construction, and integration with bycatch reduction device in a net loft in Newport, Oregon

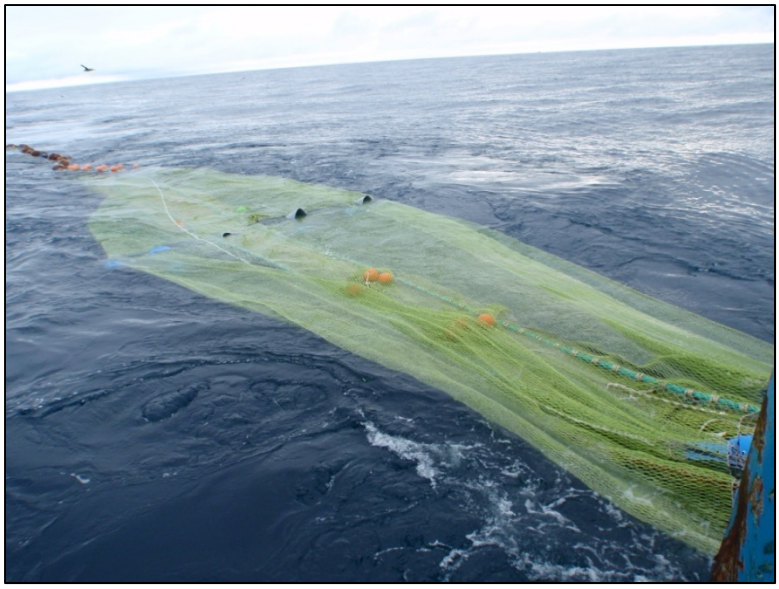


Figure 21. Bycatch reduction device and recapture net being deployed aboard a commercial fishing vessel off Washington during July 2011

Figure 22. Bycatch reduction device and recapture net being deployed aboard a commercial fishing vessel off Washington during July 2011. Blue objects encircling the recapture net are kites used to hydrodynamically open the net.

Figure 23. Video frame grabs showing Chinook salmon (left image) and widow rockfish with Pacific hake (right image) swimming inside the recapture net surrounding the BRD

Table 3. Escapement rates of Pacific hake and non-target species during 2011

Species	Trawl net (kg)	Recapture net (kg)	% Escapement
Pacific hake	786,218	9,484	1.2
Yellowtail rockfish	10,169	923	8.3
Widow rockfish	1,261	114	8.3
American shad	226	547	70.9
Jack mackerel	114	59	33.1
Chinook Salmon (# of fish)	11	3	21.4

Project Title
Improving the Selectivity of Bottom Trawls to Reduce Bycatch of Pacific Halibut in the West Coast Groundfish Trawl Fishery

BREP Funding Provided
$76,250

Location of Research
NMFS Northwest Fisheries Science Center

Resource Challenge
Starting in 2011, the west coast limited entry groundfish trawl fishery began management under the West Coast Groundfish Trawl Catch Share Program (implemented through Amendments 20 and 21 to the Pacific Coast Groundfish Fishery Management Plan). This new program established annual catch limits and individual fishing quotas along with individual bycatch quotas. These complex fishery management measures have created increased demand for bycatch solutions in the groundfish trawl fishery. Currently, bycatch of overfished species in the west coast groundfish trawl fishery constrains the fishery such that a substantial portion of available harvest is left in the ocean. For many bottom trawl fishermen participating in this new program a major bycatch species of concern is Pacific halibut (*Hippoglossus stenolepis*), which is a prohibited-take species with potential to constrain the fishery.

Project Summary
In response to fishermen's concern for Pacific halibut bycatch, the NMFS Northwest Fisheries Science Center (NWFSC), in collaboration with the Pacific States Marine Fisheries Commission (PSMFC) and the fishing industry, tested the efficacy of a flexible sorting grate bycatch reduction device (BRD) designed to reduce Pacific halibut bycatch. The BRD is built around a four-seam tube of netting that is inserted between the trawl's intermediate and codend and includes two vertical panels (7.5" mesh) and an exit ramp (5.5" mesh) constructed of AQUAPEX® (cross-linked polyethylene tubing). The flexible grate sorts fish by size as they move toward the codend (see Figure 24, bottom left photo). The concept of the design is that fish smaller than the sorting grate openings will be retained, whereas fish greater than the sorting grate openings will be excluded from the trawl via the exit ramp (see Figure 24, bottom right photo).

For this project, a recapture net was used to quantify the escapement rates of target and non-target species. Results showed that Pacific halibut bycatch was reduced numerically by 57% and by 62% by weight (Table 4 and Figure 25). A significant difference in mean total length also was noted between Pacific halibut caught in the trawl codend and the recapture net codend; with larger fish occurring in the recapture net. Target species loss ranged from 9% to 22%.

Developments in Gear Technology Achieved
During this study, a Pacific halibut BRD was tested for application in the groundfish bottom trawl fishery. This study is one of the first projects in the west coast groundfish

bottom trawl fishery to quantify the efficacy of a flexible sorting grate excluder designed to reduce Pacific halibut bycatch. In addition, the project employed a novel circular ring system that is attached to the outside of the BRD and ensures that the BRD is held open laterally and vertically while fishing. This technology was developed in Sweden and transferred to the United States through a regional net loft in Seattle.

Improvements and Reduction in Bycatch Associated with This Project
Results demonstrated the capability of a flexible sorting grate excluder to reduce Pacific halibut bycatch in the groundfish bottom trawl fishery. As expected, the BRD also reduced the bycatch of larger Pacific halibut (Table 4 and Figure 25). This finding is important because under the West Coast Groundfish Trawl Catch Share Program, fishermen are allocated Pacific halibut bycatch quota by weight rather than numbers of fish. During August 2011 there was a major collaboration between this project and a parallel Pacific halibut bycatch reduction project conducted by the Environmental Defense Fund and Gauvin and Associates (funded by National Fish and Wildlife Foundation). The results of these two projects were presented at a bycatch reduction workshop held at the Pacific Fisheries Management Council Meeting in Costa Mesa, California in November 2011.

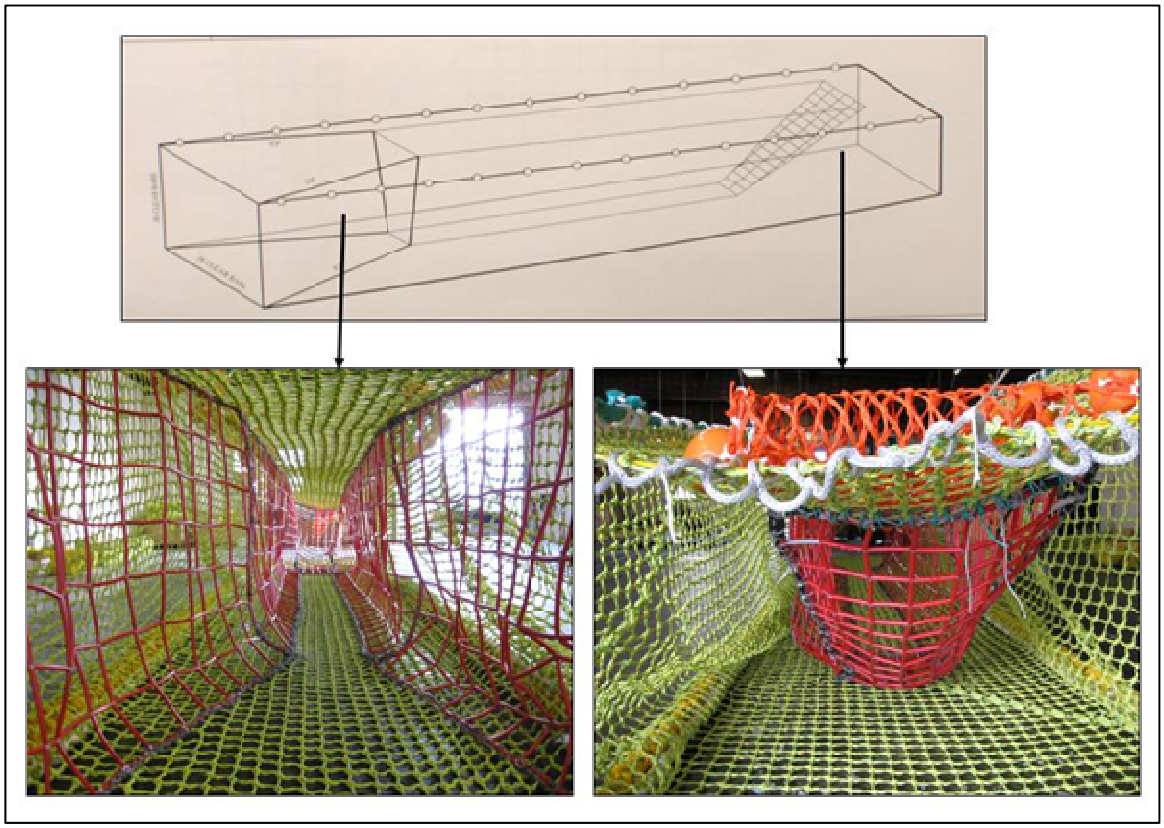


Figure 24. Schematic 3D view of a Pacific halibut flexible sorting grate excluder (top); aft- looking view of the forward portion of the excluder where fish enter and encounter the device (bottom left); forward view of the aft end of the excluder where fish larger than the sorting grate openings would be guided and excluded from the trawl out an exit ramp (bottom right). Image and design is courtesy of Dantrawl, Inc., Seattle, WA.

Table 4. Summary of Pacific halibut bycatch reduction

Pacific halibut	Recapture net	Trawl net	Result
Number of fish	69	52	57%
Weight (kg)	308	192	62%
Mean total length (cm)	74.4	70.0	P<0.001

Figure 25. Comparison of fish caught between the trawl codend and recapture codend during one tow

Project Title

Providing Direct Observation Video Camera Systems to Fishermen for Their Use in Evaluating Industry-Designed Bycatch Reduction Devices – Year 2

BREP Funding Provided

$40,710

Location of Research

NMFS Northwest Fisheries Science Center

Resource Challenge

Starting in 2011, the west coast limited entry groundfish trawl fishery began management under the West Coast Groundfish Trawl Catch Share Program (implemented through Amendments 20 and 21 to the Pacific Coast Groundfish Fishery Management Plan). This new program established annual catch limits and individual fishing quotas along with individual bycatch quotas (IBQ). These complex fishery management measures have created increased demand for bycatch solutions in the groundfish trawl fishery. For many fishermen participating in this new program, major bycatch species of concern are Pacific halibut and Chinook salmon (which are prohibited-take species), and overfished or rebuilding rockfish species (i.e., darkblotched, widow, canary, and yelloweye rockfish). The fishermen's concern is that they will reach an IBQ before reaching their catch share quota.

Project Summary

The NMFS Northwest Fisheries Science Center (NWFSC), in collaboration with the Pacific States Marine Fisheries Commission and fishing industry, initiated a video system loaner program that provides commercial fishermen and other sectors of the industry access to in situ video imaging systems for their use in evaluating industry-designed bycatch reduction devices (BRDs) (Figure 26). This program, which began in November 2010 with two video camera systems, is now in process of expanding to five camera systems.

Developments in Gear Technology Achieved

Since the NWFSC implemented the video loaner program, the camera systems have been checked out 20 times. Length of use per check-out has ranged from one day to over two months. These systems are being used to examine salmon and rockfish excluders in the Pacific hake midwater trawl fishery, Pacific halibut excluders in the groundfish bottom trawl fishery (see Figure 27), and groundfish and eulachon (an ESA-listed species) behavior in the pink shrimp trawl fishery. For several fishermen using these systems, modifications to their BRDs have occurred after initial use because their devices were not performing as envisioned.

Improvements and Reduction in Bycatch Associated with This Project

The video loaner program has provided fishermen and manufacturers of fishing gear the opportunity to examine and improve the efficacy of their BRDs. With this program, fishermen have been able to develop BRDs that are effective at reducing bycatch while

still retaining satisfactory levels of their target species. As this project expands, it is highly anticipated that fishermen will further develop BRDs across all sectors of the groundfish trawl fishery that will help reduce bycatch.

Figure 26. One of the loaner video camera systems developed at the NWFSC with BREP funding.

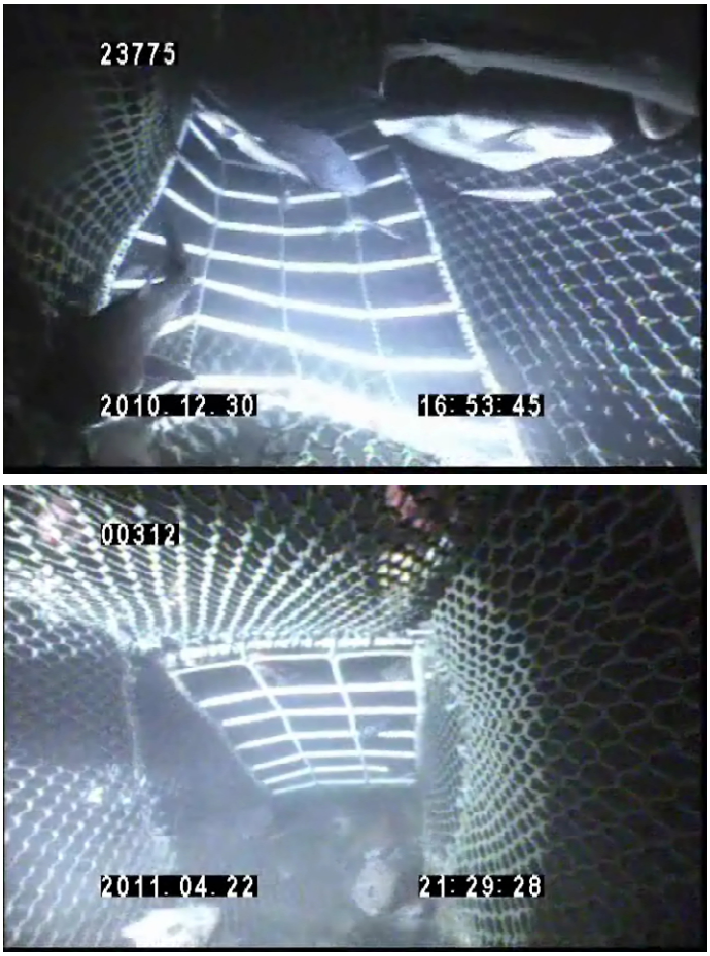


Figure 27. Video frame grabs showing flexible sorting grates developed by the fishing industry to reduce Pacific halibut bycatch in the groundfish bottom trawl fishery. Information gained from the videos was used to improve the performance of the grates.

Project Title
Coastal Observation and Seabird Survey Team

BREP Funding Provided
$7,491

Location of Research
University of Washington

Resource Challenge
Along the West Coast of North America (California north to Alaska), nearly 100 marine bird species utilize coastal waters for feeding, breeding, and migration. Cumulatively, over 100 million birds are found throughout these waters. Coastal systems pose a variety of threats to resident and migrant birds, most notably including food stress due to climate and ecosystem shifts; disease; predation from native and introduced predators; pollution and toxins from natural (e.g., harmful algal blooms) and manmade (e.g., oil spills, floating debris) sources; and fishery bycatch. In the latter category, different fishery sectors affect different functional groups. For instance, longline fisheries often affect open-ocean species that forage on the surface (e.g., albatross, fulmars, petrels, shearwaters) whereas gillnets affect diving species (e.g., murres, puffins, auklets, loons, shearwaters).

Beached bird surveys offer one method for documenting bycatch incidents in the Pacific Northwest and Alaska without costs associated with at-sea work. In areas in which sampling is adequate in space and time, data collected can provide estimates of mortality from bycatch and other sources, estimates of sensitivity to bycatch by entanglement type, and information on the distribution of bycatch-sensitive species.

The Coastal Observation and Seabird Survey Team (COASST) is a geographically diverse (northern California to Alaska) beached bird survey in which volunteers assess taxon-specific encounter rates on a monthly basis. In 2010-11, over 700 trained volunteers collected data on beached birds at more than 330 sites throughout the Pacific Northwest and Alaska. “Normal” or background data collected in the COASST program can be used as a baseline against which fishery-associated mortality events can be contrasted, both in species composition and in overall intensity and severity.

Project Summary
The COASST project collects data on seabird mortality patterns in the Pacific Northwest and Alaska, including information on species sensitive to fisheries bycatch. 2011 BREP funds supported the expansion of data collection efforts, supplies, and materials for documentation of entangled seabirds across over 550 kilometers of coastline and aboard fishing vessels along the West Coast.

Developments in Gear Technology Achieved
This project did not directly achieve any developments in gear technology.

Improvements and Reduction in Bycatch Associated with This Project
Within this reporting period (July 10-September 11), 579 volunteers cumulatively conducted 4,120 surveys and contributed more than 11,951 hours (5,848 survey hours, 6,103 travel hours) to the program. Participants found 1,090 carcasses of 98 different species.

COASST is the largest program of its kind in the world and the only program to photograph and individually mark carcasses, allowing quantification of persistence and scavenging rates, as well as confirmation of species identification and incidents of fisheries bycatch from recreational and commercial gear. From July 2010 to September 2011, COASST volunteers recorded information on 1,588 species of longline and trawl bycatch importance, including: 3 Laysan albatross; 15 black-footed albatross; 284 sooty shearwaters (1 line entanglement, 1 hook entanglement); 27 short-tailed shearwaters; 6 pink-footed shearwaters; and 1,253 northern fulmars. In addition, data were recorded on 780 common murres (3 line entanglements, 1 net entanglement); 247 rhinoceros auklets; and 46 loons, for a total of 1,073 species commonly found entangled in coastal gillnets.

Project Title
Fisheries-Independent Marine Bird Surveys at the Northwest Fisheries Science Center

BREP Funding Provided
$7,000

Location of Research
NMFS Northwest Fisheries Science Center

Resource Challenge
Seabird bycatch reduction gear in the West Coast fishing fleet is now being tested during voluntary deployments and sea trials. Spatially explicit data concerning the spatial and temporal overlap between fisheries and seabird species at sea will be required to target bycatch reduction actions such as gear design or designating times and places for fishery openings/closures. Documentation by West Coast fisheries observers in the summer of 2011 of lethal take of ESA-protected seabird species highlights the need for ongoing fisheries-independent information on seabird distributions in the Pacific Northwest. 2011 BREP funding provided to NMFS Northwest Fisheries Science Center (NWFSC) is being used to grow the capital equipment pool necessary to collect quantitative, fisheries-independent seabird data. Data will be used to generate maps of overlap between the West Coast fishing fleet and seabirds most vulnerable to conflict with fishing gear (e.g., albatrosses and petrels). These maps can then be used to guide gear development and management actions for fisheries where bycatch concerns exist and overlap is identified.

Project Summary
This project built on a 2010 BREP proof-of-concept project for the Pacific Northwest. 2011 BREP funds were used to purchase one complete set of equipment necessary to collect geo-referenced data on fisheries-independent seabird distributions. Fisheries-independent data are in demand for seabird bycatch reduction projects already funded by the BREP through Washington Sea Grant. These studies are fulfilling proactive bycatch reduction mandates for Pacific Northwest regional bycatch strategies and implementation plans by examining the degree of overlap between birds and West Coast fisheries (e.g. http://www.wsg.washington.edu/mas/resources/seabird.html).

Funding from BREP is an important first step toward growing the pool of dedicated equipment necessary for NWFSC research operations between 2011 and 2014. In the past, NWFSC researchers have had to borrow equipment from other projects to conduct at-sea surveys. Sometimes equipment is unavailable because it is deployed on other projects. Dedicated capital equipment builds NMFS long-term capacity to quantify seabird distributions off the coasts of Oregon and Washington, and it allows NWFSC to fill data gaps in both seasonal (e.g., winter) and geographical (e.g., southern Oregon) coverage.

This project also has helped to secure three berths for trained observers during the upcoming February 2012 NOAA *R/V Shimada* Southern Resident Killer Whale survey.

This survey will be the first deployment for this dedicated equipment. Subsequent deployments on other surveys during 2012-2014 will take place as observer berths and observer time become available. Past experience (2005-2010) indicates that if observers are available, a dedicated equipment pool would allow NWFSC to staff 1-3 cruises per year that would otherwise not collect information on seabird distributions.

Developments in Gear Technology Achieved
This project did not directly achieve any developments in gear technology.

Improvements and Reduction in Bycatch Associated with This Project
Fisheries-independent seabird data are presently being used to evaluate overlap between seabirds and West Coast fisheries in the Pacific Northwest. Information collected by the NWFSC is feeding directly into the Pacific Fishery Management Council process; for example, see the draft document "Risk Assessment of US West Coast Groundfish Fisheries to Threatened and Endangered Seabirds" (available for download - http://www.pcouncil.org/wp-content/uploads/G1a_ATT6_RISK_ASMNT_SEPT2011BB.pdf).

New data collected in 2012-2014 also should feed into this process when map updates are required.

Project Title
Gained in Translation: Accessing Seabird Bycatch in Russian and Japanese Gillnet Fisheries

BREP Funding Provided
$2,500

Location of Research
NMFS Northwest Fisheries Science Center

Resource Challenge
The NMFS Northwest Fisheries Science Center (NWFSC) recently initiated a risk assessment of U.S. West Coast groundfish fisheries to threatened and endangered marine species including three species of marine birds (short-tailed albatross, marbled murrelet, California least tern). Summarizing bycatch in U.S. fisheries and elsewhere was part of this effort, particularly for short-tailed albatross and marbled murrelet. A missing piece of such assessments is often poorly understood or inaccessible bycatch levels outside of the purview of U.S. fisheries management. Accessing the data available in the seabird portion of a new Russian book on bycatch will be invaluable to further efforts to understand overall bycatch risks for protected species upon which NMFS must consult.

This book describes gillnet fishery methods in the Russian exclusive economic zone and the monitoring effort by commercial Japanese and scientific Russian fleets. Marine bird and mammal bycatch data collected during the large-scale salmon fishery from the 1990s through the early 2000s are summarized in detail. Species composition and seasonal, interannual and geographic variation in bycatch mortality are analyzed. Estimates of bird and mammal mortality in gillnets are presented, and the potential effect of the fishery on populations is discussed. Global measures to mitigate gillnet bycatch are presented, as is the potential of implementing some of these measures in Russian waters.

Project Summary
The objective of this project was to access seabird bycatch data and analyses from Russian and Japanese gillnet fisheries prosecuted in Russian waters by translating a groundbreaking new publication written in Russian. The seabird portion of this book (Y. Artukhin, V.N. Burkanov, and V.S. Nikulin V. S. 2010. Accidental bycatch of marine birds and mammals in the salmon gillnet fishery in the northwestern Pacific Ocean. Moscow: Skorost' Tsveta. 264 p.) summarizes and analyzes seabird bycatch by Russian and Japanese drift gillnet fisheries prosecuted in the Russian EEZ. A freelance Russian translator/M.S.-level biologist in Seattle was contracted to translate the document. The contractor is of Russian descent and is fluent in Russian.

Developments in Gear Technology Achieved
This project did not directly achieve any developments in gear technology.

Improvements and Reduction in Bycatch Associated with This Project
BREP funds supported the final product from this project, which will be an English translation/summary of the seabird portion of "Accidental bycatch of marine birds and mammals in the salmon gillnet fishery in the northwestern Pacific Ocean" by Yuri Artukhin, V. N. Burkanov, and V. S. Nikulin.

This document, which is expected to be finalized in early 2012, will include sections covering: current and historical condition of the salmon fishing industry in the Northwest Pacific Ocean, bycatch of marine birds by the salmon fishing industry in the Northwest Pacific Ocean, and an assessment of losses/ damage to marine bird and mammal populations in the Russian EEZ, including translations and summaries of all data tables and figures.

Project Title
Fishing Technology and Conservation Engineering to Reduce Trawl Bycatch in Alaskan Fisheries

BREP Funding Provided
$141,000

Location of Research
NMFS Alaska Fisheries Science Center

Resource Challenge
Research funded in 2011 by the BREP at the Alaska Fisheries Science Center (AFSC) addressed two main resource challenges:

1) Bycatch of salmon in the Alaska pollock fishery has been a critical challenge for what is consistently among the largest and most valuable fisheries in the United States. Salmon bycatch is a concern to NMFS because of the potential negative impacts of bycatch on salmon stocks in general, and on western Alaska salmon stocks in particular. Newly instituted hard caps on salmon bycatch are a significant constraint on full exploitation of pollock stocks.
2) Overall crab mortality due to trawling in the Bering Sea and Gulf of Alaska, including both mortality of captured and discarded crabs and mortality of crabs after escape from trawls on the seafloor, is also an important challenge.

Project Summary
Salmon excluders: AFSC Conservation Engineering (CE) scientists participated in tests and refinement of salmon excluder designs in February and March 2011. CE scientists provided and operated underwater video and sonar equipment to directly observe gear, assuring effective tuning of devices. Chinook salmon escape rates were between 25—40%, while chum salmon escape rates remained in the 10 – 15% range. Pollock escape was insignificant at less than 1%. The North Pacific Fisheries Research Foundation placed a technician aboard Gulf of Alaska vessels to demonstrate correct tuning and operation of the new excluder design to promote transfer of this technology to that fleet. The AFSC provided the camera systems used by this technician from our CE "loaner pool." BREP funding was also used for travel to a Fall 2011 workshop at the fishing gear testing facility in St. Johns, Newfoundland to develop new designs to improve escape rates for both salmon species.

Development and evaluation of trawl groundgears that produce less damage to crabs in soft-bottom areas: In June 2011, CE scientists conducted two weeks of tests of alternative footrope designs for flatfish capture efficiency and crab bycatch rates aboard the catcher/processor *Cape Horn*. The vessel's twin trawling and catch handling systems allowed direct comparisons of catch rates on each tow. Preliminary results indicate that a conventional disk footrope (Figure 28) had much lower crab bycatch rates than a comparable roller gear footrope (a result expected by fishermen), but very similar flatfish

catch rates (an unexpected result). In a second test, CE scientists found that widening disk spacing, and hence reducing ground contact and potential for crab damage, had little effect on flatfish catch rates.

Figure 28. Bottom trawl with a disk footrope coming aboard the *F/V Cape Horn*. This trawl had been fished side-by-side with a matching trawl with a roller footrope, the catch from which was already aboard, behind the other net reel. (Photo: Carwyn Hammond)

In August 2011, the same footrope designs were used in tests to determine the mortality rate of crabs passing under each of these footropes. Reflex scans were conducted on recaptured crabs and converted to mortality rates using a relationship between reflex loss and delayed mortality (called reflect action mortality predictor, or RAMP) that had been developed in prior years. Analysis of those results was not yet complete as of the end of 2011. During that cruise, CE scientists also conducted experiments to address concerns raised by fishermen regarding the experimental methods for estimating escape mortality rates of crabs. The fishermen were concerned that exposure to suspended sediment during recapture behind the footropes could be causing additional mortality.
CE scientists developed a way to expose crabs to the sediment and recapture process without having to also contact a footrope. This process provided a better control condition for the mortality estimates, improving their scientific validity as well as their understanding and acceptance by affected fishermen.

Mortality rates for crab bycatch in Gulf of Alaska trawls and applicability of sweep modifications to reduce crab morality: CE scientists also evaluated Tanner crabs caught by commercial trawl vessels in the Gulf of Alaska to estimate crab bycatch mortality rates and applicability of mortality estimation methods from previous studies. A sample of the assessed crabs were held in both onboard and laboratory tanks to test how the RAMP relationship for bycatch crabs compared to the RAMP developed for escaping crabs after encountering trawls on the seafloor. In combination with similar observations for Tanner and snow crabs during the Bering Sea cruise on the *Cape Horn*, described above, this provided the observations and validation tests to generate estimates of trawl bycatch mortality rates. Preliminary analyses confirm how such mortalities are related to handling time aboard the capture vessel. CE scientists also worked with captains to assess the implementation of trawl sweep modifications to the Gulf of Alaska fleet to reduce crab mortality on the seafloor. These improved estimates of crab bycatch mortality rates and information on applicability of sweep modifications will inform considerations of crab protection actions by the North Pacific Fishery Management Council.

Developments in Gear Technology Achieved and Improvements and Reduction in Bycatch Associated with This Project
The following developments/reductions were achieved:

1. Improved estimates of crab bycatch mortality rates for both Bering Sea and Gulf of Alaska bottom trawl fisheries.
2. Confirmation of 25-40% escapement rates for Chinook salmon in the Alaska pollock fishery and continued transfer of excluder technology to the Bering Sea and Gulf of Alaska fleets. Excluder use in the Bering Sea is extensive and increasing, and it also is developing rapidly in the Gulf of Alaska.
3. Direct comparisons of flatfish and crab capture rates for three bottom trawl footropes, two conventional and one experimental. Mortality rates of escaping crabs were also estimated. CE scientists provided these results to fleet captains at a workshop in November 2011, which should allow informed selection to reduce crab mortality and a launch pad for development and testing of improved footropes in 2012.

Project Title
Alaska Fisheries Science Center Coordinated Seabird Studies

BREP Funding Provided
$40,000

Location of Research
NMFS Alaska Fisheries Science Center

Resource Challenge
The NMFS Alaska Fisheries Science Center (AFSC) attempts to address two primary resource challenges with regard to seabirds. The first involves a suite of issues relative to seabird interactions with commercial fisheries. Basic challenges are how to monitor and provide viable estimates of seabird bycatch; reduce seabird bycatch; address Endangered Species Act (ESA)–related fishery interaction issues (e.g., with short-tailed albatross, (*Phoebastria albatrus*)); and address the linkage between seabirds and food provided by the commercial fisheries in the form of offal and discards. The second resource challenge is how to best make use of seabirds as a valuable tool for an improved understanding of marine ecosystem processes and changes brought about by annual variation in or potential long-term effects from climate change.

Project Summary
The AFSC operates the Coordinated Seabird Studies Program (CSSP) and leverages a variety of funding sources and limited resources to complete work on seabird interactions with fisheries in collaboration with other NMFS offices, academia, Sea Grant, nongovernmental organizations (environmental and fishing industry), and other federal agencies (U.S. Fish & Wildlife Service (USFWS) and U.S. Geological Survey) or states. Current work includes collaborating with the fishing industry to focus on vessel-specific aspects of seabird bycatch, improving coordination of seabird training for groundfish fishery observers between NMFS and the USFWS, and gathering data from bycaught birds that will provide demographic information that can improve our understanding of the overall impact of bycatch on seabird populations.

Developments in Gear Technology Achieved
This project did not directly achieve any developments in gear technology.

Improvements and Reduction in Bycatch Associated with This Project
No direct bycatch reduction was achieved as part of these activities. However, this project did provide the foundation for future bycatch reduction work and effective measures. By focusing on observer training, the CSSP ensures that high-quality data are coming from the fishery. By focusing on bycaught marine birds, the CSSP improves understanding of the overall impact of bycatch on seabird populations. The CSSP also uses seabirds as "marine samplers" to gather data on trophic interactions and ocean plastics. Components of the CSSP's work in 2011 complemented previous seabird bycatch activities that have led to 80% and greater reductions in seabird bycatch in the Alaskan demersal longline fleets.

Project Title
Estimating Snow Crab Mortality as a Function of Weather Conditions during the Eastern Bering Sea Snow Crab Fishery

BREP Funding Provided
$20,410

Location of Research
NMFS Alaska Fisheries Science Center

Resource Challenge
The estimate of discard mortality in the snow crab (*Chionoecetes opilio*) fishery in the Bering Sea is currently set at a rate of 50%, but it is widely acknowledged that further work is needed on both refining this estimate and reducing bycatch losses.

Project Summary
The objectives of this project were to determine the effect of wind chill and exposure time on the survival of discarded snow crab and to determine potential long-term effects of cold weather exposure on crab survival. Previous work on the fishing grounds found that the predicted mortality of discarded crabs was less than 6% when the wind chill at the sorting table was > 5 degrees C. Mortality increased dramatically, up to ~30%, when the wind chill fell to -15 degrees C. The model fit was poor, however, because of limited sampling at the colder wind chills. This project included two components to meet the basic objective of improving discard mortality rate estimates. An at-sea study placed observers on commercial snow crab vessels during the January 2011 fishing season in an attempt to increase extreme cold observations. The observers, however, encountered relatively mild conditions, which hampered their efforts to collect the needed data. This project also had a laboratory component that simulated cold exposure at the seawater facility at the Alaska Fisheries Science Center, Kodiak Laboratory. The ability to hold and observe crab in the laboratory after simulated cold exposures allowed us to accurately determine the associated short-term mortality rates. In addition, samples of crab tissues and hemolymph were collected to determine changes to glucose and trehelose levels, which allow inferences about the long-term viability of cold-stressed crab. It has previously been shown that the crab eyestalk is very vulnerable to freezing, and also it is the center of the crab's endocrine and nervous systems.

Developments in Gear Technology Achieved
Associated with the simulated cold exposures in the laboratory, a micro-thermocouple was adapted for use in monitoring the freezing levels of the eyestalks caused by various temperature treatments (Figure 29).

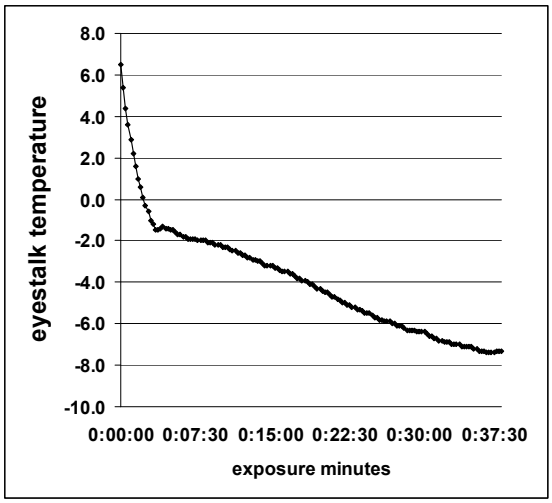


Figure 29. The temperature in the interior of the crab eyestalk when exposed to -20 degrees C

Improvements and Reduction in Bycatch Associated with This Project

This project provided additional evidence that extreme cold exposure results in increased mortality in snow crab. When combined with data from previous studies, these results will allow for a more accurate determination of the mortality rate of snow crab discarded during the Bering Sea fishery. The University of Alaska-Southeast has been contracted to analyze and interpret the changes in glucose and trehelose levels of the hemolymph and tissue samples collected for this study with a contract completion date of June 30, 2012. It is anticipated that changes to these hemolymph sugar levels will explain the actual mechanisms that induce short-term mortalities and also reduce the long-term vitality of those crab that survive the cold exposure. The overall result of this study will be to provide fishery managers with a more accurate estimate of the mortality rate of snow crab discarded during the Bering Sea fishery. The discard mortality rate is an important parameter used to determine the allowable harvest levels, so a more accurate estimate will positively impact the ability of managers to sustainably manage this resource.

Project Title
Acoustically Observing False Killer Whales in the Hawaii-Based Tuna Longline Fishery

BREP Funding Provided
$87,770

Location of Research
NMFS Pacific Islands Fisheries Science Center

Resource Challenge
Direct interactions between cetaceans and fishing gear pose a substantial threat to the viability of cetacean populations and can lead to significant financial losses to fishermen. Cetaceans may approach fishing lines to procure bait or catch, which can lead to entanglement or hooking of the animal, resulting in serious injury or death. False killer whales have been found to interact with the Hawaii-based deep-set, tuna-target longline fishery, resulting in bycatch removal rates that exceed sustainable levels. This issue has prompted the development of new acoustic technology that will be used with the cooperation of fisherman from the Hawaii Longline Association to record the sounds associated with setting, soaking, and hauling gear, as well as sounds produced by false killer whales that may interact with fishing gear.

Project Summary
The goal of this research is to acoustically monitor the Hawaii-based longline fishery to gain a better understanding of false killer whale interactions with fishing gear. According to the project's design, acoustic recorders were to be used to detect the occurrence of such interactions, based on sounds produced by the animals as well as sounds associated with setting, soaking, and hauling the gear. Data collection was to focus on completing the following objectives:

1. Develop a methodology for attaching and deploying autonomous acoustic recorders onto longline fishing gear.
2. Generally analyze acoustic data to obtain information on the presence of false killer whales in the vicinity of fishing vessels, and the frequency of interactions.
3. Conduct a specific analysis on changes in the acoustic behavior of a false killer whale during an interaction, and determine the presence of any possible acoustic cues produced by the vessel that may attract an animal and lead to an interaction.
4. Recommend modifications in the design of fishing gear and/or fishing techniques that may help to reduce the frequency of interactions.

In conjunction with fishing operations, the nature of interactions between an animal and a vessel's gear can be determined through analysis of acoustic data. A better understanding of these interactions should be obtained through this project, providing insight into appropriate management measures that should be implemented for protection of the

Hawaiian population of false killer whales and a reduction in depredation of catch from the longline fishery.

Developments in Gear Technology Achieved

BREP funds in 2011 were used to purchase a total of three High-frequency Acoustic Recording Packages (HARPs) developed by engineers at the Scripps Institution of Oceanography. These instruments are specifically designed for ease of use within the fishery and will be used to detect the occurrence and nature of false killer whale interactions. The hard drive and internal 'guts' of the recorder have been condensed to fit in a small pressure case so that it may be easily and quickly deployed from a fishing vessel without slowing down the fishing process (Figure 30). Additionally, a saltwater switch has been developed to enable data acquisition to begin immediately when the recorder enters the water.

The first recorder prototype has been received and is currently being tested on the captive false killer whale and bottlenose dolphin at the Hawaii Institute of Marine Biology in Kaneohe, Hawaii (Figure 31). The first fishing trip deployment for this instrument occurred in early-December, 2011. At the time of the writing of this report, the instrument was still at-sea, so no assessment of data quality or the occurrence of false killer whale interaction was available. Fishermen are testing various attachment and deployment methods to determine the best configuration for future trips.

Figure 30. Pressure case of HARP, with black plastic housing

Figure 31. BJ the bottlenose dolphin with HARP, Hawaii institute of Marine Biology

Improvements and Reduction in Bycatch Associated with This Project
Although this new technology has just begun to be used in the field, the potential for bycatch reduction as a result of the information obtained during the project is great. Once the full set of nine recorders is available (with combined BREP and Marine Mammal Commission funding), the NMFS Pacific Islands Fisheries Science Center (PIFSC) will have the ability to monitor multiple fishing trips at once to gain good spatial coverage of the fishing area. Analysis of the acoustic data acquired may help the PIFSC to better understand these interactions and how to progress with mitigation measures.

Project Title

Evaluating the Physiological Status of Large Pacific Blue Marlin Captured in the Pacific Longline Fisheries: Implications for Post-Release Survival and Biochemical Correlates of Morbidity and Mortality

BREP Funding Provided

$30,000

Location of Research

NMFS Pacific Islands Fisheries Science Center

Resource Challenge

Management strategies for mitigating effects on the bycatch of large-scale commercial fisheries require accurate estimates of post-release survival in captured teleosts, elasmobranchs, and sea turtles. High mortality from industrial fishing has the potential to reduce parental biomass and ultimately the ability of a stock to rebound. The uncertainty about post-release survival in many pelagic species is challenging for management, but this information is absolutely critical to develop conservation measures.

Project Summary

This project is integrated with the BREP-funded project entitled: Evaluating the Post-Release Survival of Large Pacific Blue Marlin Captured in the Pacific Longline Fisheries: I. PSAT Studies (described in the 2011 BREP Report to Congress).

This project's objective is to determine the post-release survival of large Pacific blue marlin (*Makaira nigricans*) and striped marlin (*Kajikia audax*) released from pelagic longline gear using biochemical correlates of morbidity and mortality from tissue plugs and blood. This will enable the development of biochemical techniques that are portable and applicable to the rapid analyses of post-release survivorship in many pelagic species. Analysis of the first biochemical samples has commenced at Queens University (Ontario, Canada). The tissue samples will be assayed for biochemical correlates of stress and morbidity. Plasma samples will be analyzed for ion concentrations (Mg^{2+}, Ca^{2+}, K^{+}); metabolite levels (such as lactate); and hormone levels (cortisol). For the molecular analysis of muscle samples, consensus primers for genes that are a measure of stress response (members of the heat shock protein (hsp) family) were designed and will be used to generate species-specific primers. These in turn will be used to measure relative mRNA levels in target animals.

Our study will provide key estimates on the post-release mortality of blue and striped marlin captured in the Hawaii-based commercial longline fishery using a combination of pop-up satellite archival tags (PSATs) and biochemical correlates of morbidity and mortality. Specifically, the study will strive to tag and collect samples from larger individuals where estimates on post-release survival are lacking. To achieve statistical power, our goal is to acquire between 200 and 400 biochemical samples of marlin screened for biochemical marker with ~20 samples tagged with PSATs. To date, we have only acquired appreciable sample numbers (~n=80) on striped marlin for some

diagnostic markers. Due to availability and catchability, however, billfish sampling has been limited for shortbill spearfish (*Tetrapturus angustirostris*) (~n=25) and blue marlin (< n=10). Shortbill spearfish was added to serve as a comparison group in the biochemical analyses to aid in marker interpretation. Unforeseen failure of cryogenic liquid nitrogen storage dewars occurred at sea and thus compromised about one-third of the biochemical samples. The dewars were replaced in 2011. Additional biochemical samples are expected to be acquired in 2012.

This study on billfish is currently evaluating to profiles of more than 100 fish comprising 3 species (blue and striped marlin and shortbill spearfish). These animals have been sampled for multiple tissues and subjected to a complex suite of analyses to establish condition. Some conclusions are consistent with expectations based upon our previous studies, but others appear novel or at least different from the situation seen in sharks. The primary goal of this study is to establish profiles, but the next phase of the work will be to determine whether profiles can be used to distinguish between fish that will (or will not) survive upon release from commercial fishing gear. This requires fish to be both sampled and tagged. We have successfully tagged and sampled seven fish, but at this point these individuals have not been subjected to biochemical analyses. However, we can gain much insight into the utility of specific parameters to be used as predictors of survival.

There were a number of parameters that vary so little among fish that they are unlikely to have diagnostic value. Plasma levels of Na^{+}, Ca^{2+}, Cl^{-}, phosphate each show little variation between species (SD are less than 10% of means). Mg is more variable, with several individual fish having levels as much as 10-times above baseline. In a previous shark study conducted by the NMFS Pacific Islands Fisheries Science Center, Mg levels were one of the strongest predictors of post-release survival. If this is the case for billfish, then it is informative that 25% of spearfish, 25% of blue marlin, and 0% of striped marlin showed elevations in Mg, more than 4-times baseline levels. This suggests that capture stress was lowest for striped marlin, but that approximately ¾ of blue marlin and spearfish experienced significant stress.

Indices of muscle damage show that captured fish have experienced a considerable degree of muscle damage. Enzymes normally found in the muscle (LDH, CPK) are released with muscle damage, appearing in the plasma. These two enzymes correlate with each other in all species. The extent of muscle damage was greater in striped marlin than blue marlin and spearfish (average values for both LDH and CPK in striped marlin were more than twice the values for the other billfish). The range of values was impressive, varying almost 2,000-fold between individuals (see Figure 32).

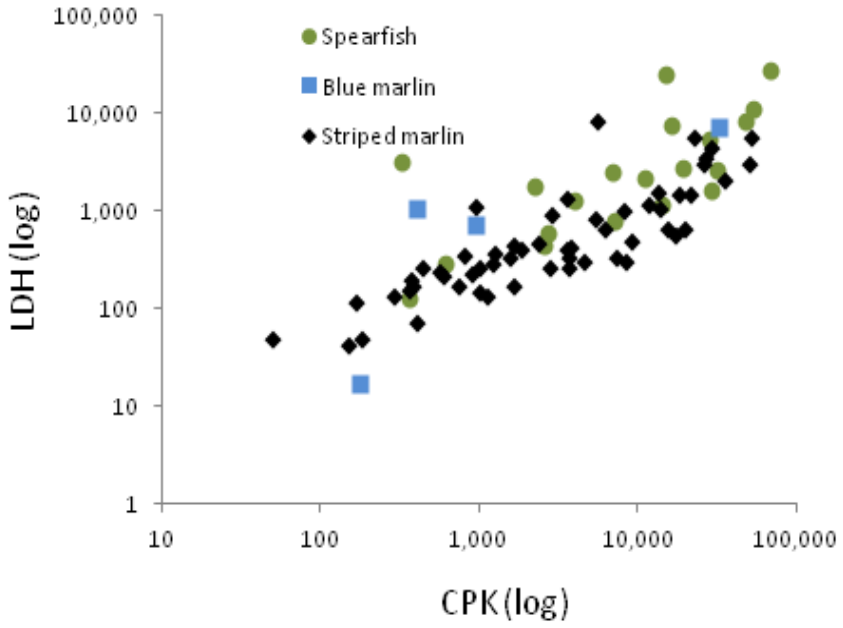


Figure 32. LDH and CPK values for spearfish, blue marlin, and striped marlin

This project also has measured the stress hormone cortisol in each animal. As with the indices of muscle damage, striped marlin stand out as the species that shows the greatest signs of stress arising from capture. The average cortisol level in striped marlin was more than twice that of the other two species (see Figure 33).

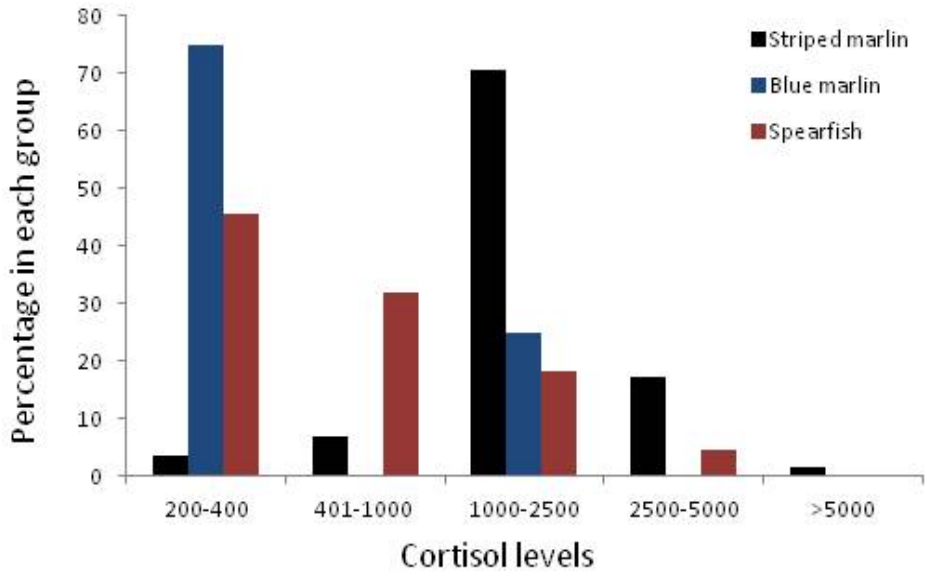


Figure 33. Cortisol levels for striped marlin, blue marlin, and spearfish

One manifestation of metabolic stress is departure from normal levels of glucose and lactate. Glucose levels can increase under stress in an effort to provide fuel for various tissues. However, if that glucose is used for energy production, then glucose levels can decline. Lactate will accumulate under stressful conditions, arising when produced by working muscle. One might expect strenuous muscle activity to result in both muscle damage and lactate production. However, there is little correlation (R^2=0.15). In previous modeling of blue sharks, lactate production was one of the strongest predictors of post-release mortality. In this study, lactate rose to remarkable levels in the blood. As with other parameters, spearfish showed the greatest perturbations. However, lactate levels were much higher in billfish than blue sharks.

One of the most powerful parameters for predicting post-release survival in sharks is the expression of a gene involved in the cellular stress response, hsp70. The multiple regression analyses suggested that this parameter was as important as Mg, but that it identified a different type of stress. In billfish, a significant fraction of animals had hsp70 levels that were elevated more than 10-times above baseline: 26% of spearfish, 25% of blue marlin, and 8% of striped marlin. Interestingly, several individual fish showed elevated levels of hsp70, as well as either Mg or lactate. However, most fish with elevations in one parameter were closer to normal in the others.

At this point it is premature to make many conclusions about post-release survival. This study has produced a large number of samples that need to be processed, and the results must be analyzed in conjunction with tagging results. Preliminary findings suggest that striped marlin are able to undertake much more strenuous activity, incur much greater activity muscle damage and metabolic stress, and yet tolerate these conditions with relatively less perturbation in Mg homeostasis. Conversely, blue marlin (and spearfish) appear on the surface to be less affected than striped marlin, but they show greater perturbation in Mg homeostasis and hsp70 expression. The analyses to date suggest that striped marlin may show evidence of incurring a greater perturbation in metabolism, but they may be less affected by the disturbance (i.e., they are less stressed, and possibly more likely to survive).

Investigators on this project have nearly completed the processing of samples from the previous BREP-funded project, including the first samples from fish that have been PSAT tagged. In early 2012, the costs of analyses will exceed the level of funding provided for this BREP project. In any event, the investigators will try to analyze as many samples as possible.

Developments in Gear Technology Achieved
This project is developing the necessary tools and methodology to estimate post-release mortality of istiophorid billfish released from commercial longline fishing gear.

Improvements and Reduction in Bycatch Associated with This Project
This project will provide estimates of post-release mortality of istiophorid billfish released from commercial longline fishing gear in the Hawaii-based commercial longline fishery. Although PSATs can provide unequivocal results on the fate of released

animals, cost precludes their widespread application in survival studies. A biochemical approach reduces experimental bias and increases sample size. To achieve sufficient sample sizes, it is imperative to conduct biochemical studies in parallel with PSAT deployment studies.

Project Title
World Wildlife Fund's (WWF) Smart Gear Initiative

BREP Funding Provided
$150,000

Location of Research
WWF, Palo Alto, California

Resource Challenge
The problem of bycatch is widely acknowledged by the fishing industry and management agencies as one of the most difficult challenges in maintaining sustainable fishery resources. Modifications to gears or development of innovative solutions can help solve particular bycatch problems within specific fisheries. These improvements can often be applied to other fisheries on a broader scale, but a lack of transfer mechanisms and even the knowledge that particular solutions exist can limit the spread of bycatch solutions.

Project Summary
Launched in 2004, the WWF's International Smart Gear Competition identifies and rewards the most promising technological developments for reducing bycatch. The competition invites submissions of practical, cost-effective solutions to reduce fisheries bycatch and offers cash prizes totaling $57,500. To date, it has attracted more than 270 entries from 45 different countries around the world. The competition also serves as a cornerstone for cross-sector collaborations between non-governmental organizations and industry partners, including the National Fisheries Institute from the United States and Sealord Group Ltd. from New Zealand; the scientific community, including the American Fisheries Society, Memorial University, and the Consortium for Wildlife Bycatch Reduction; and governments and governmental entities including NOAA and Canada's Department of Fisheries and Oceans.

The 2011 International Smart Gear Competition was launched in March 2011 (Figure 34) and was the fifth time that the competition has been held. To date, 40% of the winning entries are now being utilized in commercial fisheries, and WWF continues to work to advance other winners to this stage of adoption.

The 2011 competition attracted 74 entries from 31 different countries. This competition featured a Special Tuna Prize sponsored by International Seafood Sustainability Fund, which was designed to attract entries aimed at addressing particular bycatch issues in tuna fisheries. The competition closed on August 31st, and the Steering and Judges Workshops were held in the WWF offices in Washington D.C. in September and October. The Judges Workshop featured a panel of 12 internationally recognized gear experts who reviewed the entries over a period of two days and selected the winning entries.

Figure 34. Promotional material for the 2011 International Smart Gear Competition

Developments in Gear Technology Achieved

The judges awarded the Grand Prize and the Special Tuna Prize to an entry called the Yamazaki double-weight branchline (Figure 35). This device is designed to reduce seabird bycatch in pelagic longline fisheries when used in combination with tori lines and in some cases night-setting. The double-weight configuration is designed to (1) sink pelagic longline hooks beyond the range of seabird attacks within the aerial extent of a tori line during line setting, and (2) reduce injuries to crew should a hook come free while under tension in the landing process and recoil back at the vessel.

The Yamazaki double-weight configuration consists of two leads, or weights, placed at either end of a 1 to 1.5 m section of wire or wire trace. This weighted section is inserted into a branchline 2 meters above the hook. The weight nearest the hook is free to slide along the branchline while the second lead is fixed. The double weight reduces the danger of weight recoil injury by:

1. Spreading the mass of the weights (two smaller weights are better than one) across the wire trace,
2. Including a sliding weight that dampens the speed at which the weight can recoil,
3. Including a 1.0- to 1.5-meter section of stretch resistant line (wire) that serves to also reduce recoil energy, and
4. Positioning the larger of the two weights in or near the hands of a crewman as the line is under maximum tension as it approaches the sea door.

The double-weight system is also easier to handle on deck than a single weighted swivel because it is easier to coil and prevents jackknifing (i.e., the lead leading the baited hook into the water) as it is thrown into the water in line-setting.

In research conducted off the coast of South Africa in 2009, researchers introduced line weighting in order to force branchlines to sink closer to the stern where the sinking hooks could be protected by bird-scaring lines with an aerial extent of 100 meters. The safe leads successfully sank baits closer to the stern. However, fishing masters on these vessels rejected this method of line weighting as dangerous, impractical (hard to coil and jackknifing on setting), and unreliable (they broke in large numbers when the "O" rings failed). Prototype safe leads were also expensive at US$ 2.00 each.

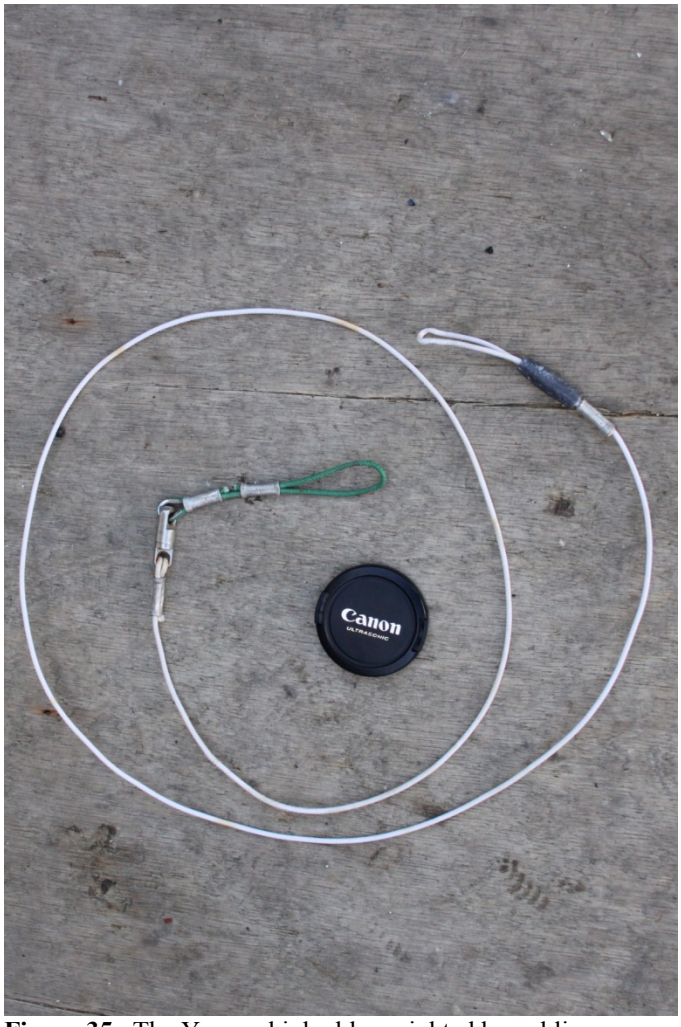


Figure 35. The Yamazaki double-weighted branchline

The double-weight system was conceived in reaction to the need to weight branchlines in a way that was safe and acceptable to Japanese fishing masters. In 2010, over 95,000 branchlines with the double-weight system were hauled with no injuries. The double-weight configuration also reduced seabird bycatch compared to un-weighted branchlines by 89% with no effect on fish catch rates.

The first runner-up winner was a device called the SeaQualizer. The SeaQualizer is a noninvasive, pressure-activated fish recompression tool that is capable of releasing fish at

targeted depths. Designed primarily for the recreational fishing industry, this device increases the survival rate of fish that are experiencing barotrauma symptoms by releasing them after they have been returned to depth and sufficiently recompressed. The SeaQualizer works by noninvasively securing articulating jaws to a fish's lower lip. The reverse end of the mechanism is fastened to a weighted fishing line, via a long-line clip, which is then returned to a depth that provides adequate recompression so that when released, the fish can swim away on its own with minimal buoyant force acting against it.

With high fishing pressure, many coastal areas around the United States are experiencing an increase in closed seasons and closed areas. By utilizing an effective release practice that reduces post-release mortality, some of these closed seasons and areas could possibly be reopened, thereby creating more opportunities for fishermen who depend on these grounds for recreation or to make a living. The SeaQualizer should increase the survival rate of fish that usually die, giving more fish the opportunity to reach maturity and reproduce. It is a well-designed and effective idea that is simple to use and can be readily applied to fisheries with this post-release mortality issue all over the world.

The second runner-up winner was a device designed to reduce the bycatch of sea turtles in gillnets and is a solution that could have global implications. Called Turtle Lights for Gillnets, the device uses widely available fishing lights (LED or chemical lightsticks) to illuminate gillnets (see Figure 36). Trials have reduced green turtle interactions by 60% without affecting target catch rates or catch value.

Experiments with illuminated nets to prove this concept were conducted in Baja California, but this device can be adapted in any coastal gillnet fishery. The team that developed this device hypothesized that illuminating nets creates a visual cue to alert sea turtles to the presence of a barrier, allowing them to avoid it. Anecdotal evidence suggests that sea turtles swim up to an illuminated net and move along side it until they turn away.

Figure 36. Fishermen attaching LEDs to a gillnet

Improvements and Reduction in Bycatch Associated with This Project
WWF is excited about the ideas that were selected as winners of this competition. The potential for improvements and reduction in bycatch associated with these ideas is significant. The bycatch of seabirds during longline fishing is an issue that management agencies around the world have struggled to address for a long period of time. The Yamazaki double-weighted branchline is a simple innovation that can be readily implemented, and there are indications that the Japanese longlining fleet, one of the largest in the Pacific, will adopted it by the end of 2012. The Japanese Tuna Association has indicated that they will petition the tuna regional fishery management organizations to have the branchline adopted by longlining vessels around the world.

The SeaQualizer and Turtle Lights for Gillnets also present opportunities for substantial reductions in bycatch in recreational and gillnet fisheries. The SeaQualizer represents the first time the competition has had a winning entry from the recreational fishing sector. This device is already developed to the stage where it can be manufactured on a commercial scale. The problem of barotrauma in the recreational fishing industry is a significant issue particularly in the U.S. West Coast and in the Gulf of Mexico. Studies have suggested that fish survival rates greater than 50% are possible using the SeaQualizer, depending on the species and the depth from which they are raised. Species such as rockfish are usually caught in less than 200 feet of water, and when recompressed these species have shown survival rates of up to 90%. Publicity from the SeaQualizer's win in the International Smart Gear Competition should assist in the uptake of this simple but effective tool.

Turtle Lights for Gillnets and their ability to reduce the bycatch of turtles has the potential to be an effective device for turtle conservation all over the world. Coastal gillnet fisheries are one of the most common forms of fishing throughout the world and are often problematic because of their non-selective nature. In particular, gillnet fisheries have been associated with significant sea turtle bycatch rates. For example, the coastal gillnet fishery based in Lopez Mateo, Baja California, Mexico interacts with up to 800 loggerhead turtles (*Caretta caretta*) per year, while gillnet fisheries off the coast of northern Peru catch over 300 green sea turtles (*Chelonia mydas*) per year.

The use of lightsticks to illuminate gillnets in order to reduce sea turtle bycatch has not been widely tested in gillnet fisheries prior to this research and is a creative use of a widely available product. The experimental work for this project was undertaken in Baja California in an area with high concentrations of green turtles. Future work will incorporate testing in Brazil and Peru, as well as testing on additional species including loggerhead and leatherback sea turtles. This future work also will test additional light spectra, based on preliminary trials that have suggested ultraviolet spectra also may selectively alert sea turtles.

Project Title
NMFS National Seabird Program

BREP Funding Provided
$88,068

Location of Research
NMFS Alaska Regional Office; NMFS Office of Science and Technology

Resource Challenge
The NMFS National Seabird Program (NSP) was formed in 2001 when the United States finalized its National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries (NPOA-Seabirds). The NSP is led by a National Coordinator and implemented regionally through seabird contacts at each NMFS Regional Office, Science Center, and Headquarters Office.

Although seabirds may be impacted by both direct (e.g., incidental catch, gear entanglement, bycatch) and indirect (e.g., prey availability, ecosystem interactions) effects, the primary focus of the NPOA-Seabirds and thus of the NSP to date has been to address the direct impacts of fisheries on seabirds. The NPOA-Seabirds addresses both domestic and international fishery issues. The NPOA-Seabirds calls for assessments of longline fisheries to determine whether seabird bycatch is a problem. If a problem exists, then it is addressed through a variety of efforts including gear research, requirements for mitigation measures, outreach, and continued monitoring and estimation of bycatch. Seabirds are considered to be important indicators of ecosystem health and are an area of interest to and study by NMFS scientists and managers. NMFS continues to be concerned about the long-term ecosystem effects of seabird bycatch in NMFS-managed fisheries and in fisheries conducted in many areas of the world's oceans. Additionally, seabird abundance and distribution can inform scientists about oceanic prey abundance, climate change, and contaminants.

Seabird connections to NMFS range from survey scientists observing them at-sea on research and stock assessment survey cruises that are a regular part of NMFS practice, to fishery observers recording them as incidental catch in the samples they observe onboard fishing vessels. Whereas the primary trust responsibilities for seabirds rests with the U.S. Department of Interior and its U.S. Fish & Wildlife Service (USFWS), NMFS plays a significant role and has responsibilities through various statutory authorities and agency policies. NMFS's role in seabird monitoring and reduction of seabird bycatch is guided by the following:

- Magnuson-Stevens Fishery Conservation and Management Act (MSA) (e.g., Bycatch Reduction Engineering Program (BREP) and seabird language at Section 316)
- Endangered Species Act (ESA)
- National Environmental Policy Act (e.g., assessing impacts/effects of fishery actions on the seabird component of the marine environment)

- NPOA-Seabirds
- United Nations' Food & Agriculture Organization's Best Practice Technical Guidelines for IPOA/NPOA-Seabirds (March 2009)
- NMFS Strategic Plan—FY2005 to FY2010
- NMFS Strategic Plan for Fisheries Research (2010)
- NMFS National Bycatch Strategy and National Bycatch Report
- Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds"
- USFWS List of Birds of Conservation Concern

Project Summary
The NSP budget funds approximately half of the NSP National Coordinator's salary and funds National Coordinator and invitational travel (domestic and international). Project funds allocated through the NSP are described in later sections of this report. The NSP continues to support both the domestic and international implementation of the NPOA-Seabirds and works directly with the BREP to collaboratively implement new seabird language in Section 116 of MSA. All NMFS Regions have worked with the NSP to address NPOA-Seabirds implementation and seabird bycatch reduction. Numerous activities have been undertaken, including seabird avoidance regulations, fishery management plan development addressing seabird mitigation, cooperative mitigation research with the longline industry, fisheries observer training, education and outreach materials for fishermen and the public, and international efforts at regional fishery management organizations, bilateral fisheries meetings, fisheries observer conferences, albatross and seabird conferences, and the Agreement for Conservation of Albatrosses and Petrels (ACAP). Collaborative contributions by multiple partners, including Sea Grant, universities, fishing industry associations, and environmental groups, have been essential to addressing seabird—fishery issues.

In FY11, the National Seabird Coordinator carried out the functions of the NSP by:

- Managing the NSP annual budget and acting as the contracting technical representative on all projects funded by NSP/BREP funds;
- Leading a NMFS Steering Committee on the development of a NMFS Strategic Plan on Seabirds;
- Working with NMFS Regional Offices, Science Centers, and Headquarters Offices to continue to support both the domestic and international implementation of NPOA Seabirds;
- Working directly with the BREP to implement Section 116 of the MSA;
- Participating on an inter-agency team to support a U.S. position for possible accession to ACAP;
- Leading a U.S. team to the 6th Meeting of the Advisory Committee of ACAP in Guayaquil, Ecuador, in August 2011;
- Participating on a steering committee for the NMFS National Bycatch Report (NBR) and coordinating with USFWS experts and other seabird experts for input on seabird bycatch species for the NBR;

- Monitoring the status of a petition to the USFWS to list the black-footed albatross under the ESA;
- Coordinating with U.S. delegations to prepare briefings, presentations, and documents for meetings of working groups of regional fishery management organizations including the International Commission on the Conservation of Atlantic Tunas annual meeting in November 2010; and
- Participating as a seabird expert at the NMFS International Affairs Bycatch Workshop in Silver Spring, Maryland, in September 2011.

NSP travel supported by FY11 BREP funds included attendance at the ACAP Advisory Committee meeting in Ecuador.

Developments in Gear Technology Achieved
Developments from individual NSP projects are described on pages 12, 32-34, 47-48, 60-65, and 69.

Improvements and Reduction in Bycatch Associated with This Project
Improvements and reduction in bycatch from individual NSP projects are described on pages 12, 32-34, 47-48, 60-65, and 69.

Proposals to Address Bycatch or Seabird Interaction Problems

NMFS has undertaken a bycatch reduction strategic planning effort to identify bycatch or seabird interaction problems that should be addressed by NMFS through 2017. These identified bycatch or seabird interaction problems are described by NMFS Regions and Programs below.

Northeast Region
The NMFS Northeast Region and Northeast Fisheries Science Center have identified the following proposals:

- Seabird bycatch reduction through completing gillnet seabird bycatch estimation analysis (2012-2014)
- Seabird bycatch reduction through completing seabird bycatch estimation analysis for gear type(s) other than gillnets (2012-2014)
- Reduction of cusk bycatch in New England fisheries (2012-2015)
- Reduction of fish and turtle bycatch, as well as marine mammal interactions, in gillnet fisheries (2012-2016)
- Turtle bycatch reduction in non-scallop trawl fisheries (2012-2017)
- Continuation of the estimation of bycatch of turtles and marine mammals in northwest Atlantic trawl, gillnet, pot, dredge and longline fisheries (2012-2017)
- Atlantic large whale take reduction in fisheries that entangle whales, through the development of gear modifications and other technologies to reduce takes (2012-2017)

Southeast Region
The NMFS Southeast Region and Southeast Fisheries Science Center have identified the following proposals:

- Turtle bycatch reduction in the Gulf of Mexico bottom longline fishery (2012-2017)
- Development of fishing methods that mitigate the effects of barotrauma for recreationally caught reef fish (2012-2017)
- Seabird bycatch reduction through enhanced observer coverage to assess potential protected species interactions with fisheries in the Atlantic (2012-2017)
- Turtle bycatch reduction in non-shrimp trawl fisheries (Atlantic flynet fishery, Atlantic whelk trawl fishery, Gulf butterfish fishery (2012-2017)
- Turtle excluder device and bycatch reduction device refinement in shrimp trawl fishery (2012-2017)
- Turtle bycatch reduction in various Atlantic and Gulf of Mexico gillnet fisheries (2012-2017)

Atlantic Highly Migratory Species (HMS)
The Atlantic HMS Management Division in the NMFS Office of Sustainable Fisheries has identified the following proposals:

- Billfish, bluefin tuna, and sea turtle bycatch reduction in Gulf of Mexico longline fisheries through investigation and characterization of green-stick gear (2012-2014)
- Development of a weak hook for Atlantic bluefin tuna bycatch reduction in the Atlantic pelagic longline fishery (2012-2014)
- Examination of size selectivity of circle hooks commonly used in the commercial shark longline fishery off the southeastern United States (2012-2014)

Southwest Region
The NMFS Southwest Region and Southwest Fisheries Science Center have identified the following proposals:

- Rockfish mortality reduction through the use of recompression cages and devices (2012-2013)
- Shark bycatch and bycatch mortality reduction in drift gillnet and pelagic longline fisheries (2012-2017)
- Seabird bycatch reduction through enhanced collection of seabird distribution and abundance data on cetacean and ecosystem assessment cruises, action at international regional fishery management organizations, and information and outreach to fishery participants (2012-2017)
- Green sturgeon bycatch and mortality reduction in hook-and-line, gillnet, and trawl fisheries (2012-2017)
- Reduction in whale entanglements from fixed-gear fisheries along the U.S. west coast (2012-2017)
- Pinniped depredation reduction in commercial and recreational fisheries (2012-2017)
- Development and use of genetic stock identification information in fisheries management to avoid weak or ESA-listed salmon stocks in the ocean salmon fishery (2012-2017)

Northwest Region
The NMFS Northwest Region and Northwest Fisheries Science Center have identified the following proposals:

- Pacific coast roundfish bycatch reduction by improving performance of already proven bycatch reduction gear types, e.g., selective flatfish trawl to reduce rockfish bycatch in flatfish fishery (2012-2013)
- Endangered Species Act-listed salmon bycatch reduction, as well as rockfish bycatch reduction, through refinement and implementation of flexible sorting grids and other excluders in the Pacific hake fishery (2012-2013)
- Improving the selectivity of bottom trawls to reduce bycatch of Pacific halibut in the west coast groundfish trawl fishery (2012-2017)
- Providing direct observation video camera systems to fishermen for their use in evaluating industry-designed bycatch reduction devices (2012-2017)

- Seabird bycatch reduction through continuation of Seabird Bycatch Research Project to reduce potential fisheries interactions with short-tailed albatross and other seabird species (2012-2017)

Alaska Region
The NMFS Alaska Region and Alaska Fisheries Science Center have identified the following proposals:

- Salmon bycatch reduction in Alaska pollock fisheries through development of trawl modifications (2012-2017)
- Pacific halibut bycatch reduction in Gulf of Alaska and Eastern Bering Sea groundfish (cod, flatfish, pollock) trawl and longline fisheries through development of fisheries-specific bycatch reduction devices (2012-2017)
- Crab bycatch reduction in groundfish fisheries through development of gear modifications (2012-2017)
- Seafloor habitat and Essential Fish Habitat impact reduction by modifying trawls and trawling methods (2012-2017)
- Seabird bycatch reduction in Alaska trawl fisheries by further developing effective seabird mitigation gear, enhancing bycatch monitoring, exploring the role of vessel attraction and providing free seabird bycatch reduction gear (2012-2017).
- Seabird bycatch reduction in Alaska and Northwest longline fisheries by providing free streamer lines and cost-sharing on integrated weight lines (2012-2017)
- Reduction of unobserved crab mortality due to trawl encounters through development and implementation of modified trawl groundgear (2012-2017)

Pacific Islands Region
The NMFS Pacific Islands Region and Pacific Islands Fisheries Science Center have identified the following proposals:

- Prediction of post-release survival in large pelagic fish (2012-2015)
- Examining the feasibility of weak hooks to reduce longline bycatch (2012-2015)
- False killer whale take reduction in the Hawaii-based pelagic longline fishery (2012-2017)

National Seabird Program
The NMFS National Seabird Program has identified the following proposals:

- Seabird bycatch reduction through outreach related to a Seabird Carcass Collection Program that would coordinate information on seabird bycatch composition in fisheries (2012-2017)
- Seabird bycatch reduction through outreach to fishery participants regarding seabird species distribution on fishery survey cruises (2012-2017)
- Seabird bycatch reduction seabird interaction actions at regional fishery management organizations (2012-2017)
- Seabird bycatch reduction through research and data analysis on relationship of endangered short-tailed albatross distribution and potential fishery interactions off Alaska (2012-2017)

Appendix 1. NMFS Bycatch Reduction Engineering Program Policy Directive

Department of Commerce • National Oceanic & Atmospheric Administration • National Marine Fisheries Service

NATIONAL MARINE FISHERIES SERVICE POLICY DIRECTIVE POLICY DIRECTIVE 01-107 EFFECTIVE DATE
Fisheries Management
BYCATCH REDUCTION ENGINEERING PROGRAM
NOTICE: This publication is available at: http://www.nmfs.noaa.gov/directives/.
OPR: F/SF3 (Benaka) **Certified by:** F/SF (Risenhoover) **Type of Issuance:** Initial
SUMMARY OF REVISIONS:

Section 316 of the Magnuson-Stevens Fishery Conservation and Management Act, as amended through January 12, 2007 (MSA), requires the Secretary of Commerce (Secretary), in cooperation with the Councils and other affected interests, and based upon the best scientific information available, to establish a Bycatch Reduction Engineering Program (BREP), including grants, by mid-January 2008 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. According to the MSA, the BREP will:

1. be regionally based;
2. be coordinated with projects conducted under the cooperative research and management program established under MSA;
3. provide information and outreach to fishery participants that will encourage adoption and use of technologies developed under the BREP; and
4. provide for routine consultation with the Councils in order to maximize opportunities to incorporate results of the BREP in fishery management plans (FMPs) developed by the Councils.

Section 316 also:

- authorizes FMPs prepared by a Council or the Secretary to establish a system of incentives to reduce total bycatch and seabird interactions;
- authorizes the Secretary, in coordination with the Secretary of the Interior, to undertake projects in cooperation with industry to improve information and technology to reduce seabird interactions; and

- requires the Secretary to submit an annual report to Congress that describes funding provided to implement Section 316, developments in gear technology achieved under Section 316, and improvements and reduction in bycatch and seabird interactions associated with implementing Section 316.

This policy directive implements the BREP to carry out the objectives of Section 316 of the MSA, and national bycatch reduction coordination activities that have been carried out by the Office of Sustainable Fisheries over the past several years, including long-term planning and outreach and funding of bycatch research critical to management objectives. This policy directive establishes the following authorities and responsibilities for the BREP:

Provide National Coordination

- Provide guidance to ensure that the results of bycatch reduction engineering and post-release injury and mortality projects supported by NOAA are responsive to management needs and can be used to support management decisions.
- Solicit and review annual updates of action items and progress for Regional Bycatch Implementation Plans. The Regional Bycatch Implementation Plan updates have included, and will continue to include, action items related to not only bycatch reduction engineering and other research but also to monitoring, management (including international efforts), and education and outreach.
- Track results of projects funded by the BREP.
- Advocate, coordinate, and support, to the extent practicable, incentives to reduce bycatch of fish and protected species as well as bycatch mortality, including providing guidance on best practices for incentive programs as necessary.
- Ensure that appropriate bycatch reduction policies are incorporated into the NOAA Policy Directives System.
- Serve as a liaison to the National Observer Program for purposes of its National Bycatch Report.
- Collaborate with the Office of Habitat Conservation to implement the Deep Sea Coral Research and Technology Program required by Section 408 of the MSA.
- Provide a forum, as appropriate, to help develop solutions to regional and national bycatch issues.
- Serve as a point of contact among NOAA managers, the NMFS National Seabird Program, and regionally based bycatch reduction engineering programs.
- Ensure that BREP annual performance milestones are tracked and met consistently.

Allocate Funding

- Develop funding allocations for annual BREP spending plan, based on review of proposals submitted and the approved BREP spending plan process.
- Facilitate the timely distribution of national funds to enhance implementation of bycatch reduction engineering efforts.
- Coordinate long-term budgeting processes to ensure full funding for the BREP.
- Help ensure that programs affected by technologies developed through the BREP have sufficient resources to facilitate or accommodate their application.

Coordinate Planning and Policy Development

- As appropriate, conduct long-term strategic planning to identify regional and national bycatch reduction engineering priorities, develop incentive programs to reduce post-release mortality and injury, and provide assistance to the Regions in identifying fisheries for which gear technology may provide solutions and fisheries for which gear technology solutions may not be feasible.
- Ensure that fisheries of bycatch concern identified through the National Observer Program's National Bycatch Report receive bycatch reduction engineering resources as appropriate.
- Coordinate with Regional Administrators and Science Center Directors to brief Regional Fishery Management Councils on BREP work at least once a year and receive feedback from Councils on bycatch reduction concerns and priorities.
- Represent bycatch reduction efforts in NOAA and NMFS strategic planning activities.

Enhance Communication

- Compile, coordinate review of, and manage clearance of the annual BREP Report to Congress.
- Regularly brief NOAA leadership groups and stakeholder groups such as the Council Coordinating Committee, the Marine Fisheries Advisory Committee, and the Marine Fish Conservation Network on the successes of and challenges for the BREP and solicit feedback on bycatch reduction concerns.
- Respond to requests as appropriate from NOAA, the Department of Commerce, Congress, and other members of the public regarding bycatch reduction engineering, incentives to reduce post-release injury and mortality, and other bycatch reduction issues.
- Compile and distribute information on BREP activities to constituent groups, fishery managers and scientists, and other organizations with an interest in bycatch reduction through presentations at professional meetings and publication of articles in journals and NMFS publications such as the annual business report.

Conduct Outreach Activities

- Develop and enhance collaborative partnerships with other NOAA programs including the National Observer Program, National Cooperative Research Program, the National Sea Grant College Program (especially its fisheries extension agents), Regional Bycatch Committees and Action Teams[1], and the Offices of Protected Resources, International Affairs, Habitat Conservation, and Science and Technology (including the National Seabird Program), to leverage bycatch reduction engineering resources.
- Manage and regularly update the NMFS Bycatch Feature website.

1. When NMFS published its National Bycatch Strategy in the *Federal Register* on March 11, 2003, some Regions, including the Northeast Region, responded by creating Regional Bycatch Committees and Action Teams. Some of these teams and committees may still exist, even though they have been relatively inactive in recent years.

- Collaborate with the National Observer Program, the National Sea Grant College Program, and other NOAA bycatch stakeholders to ensure a consistent and effective message is provided to the public regarding NOAA's bycatch reduction engineering efforts and to encourage adoption and use of technologies developed through the BREP.
- Support and track, to the extent necessary, international technology transfer and capacity building efforts based on successful technologies developed through the BREP for federally managed fisheries.

The mission of the BREP is to develop technological solutions and investigate changes in fishing practices designed to minimize bycatch of fish (including sponges and deep sea and shallow, tropical corals) and protected species (including marine mammals, seabirds, and sea turtles) as well as minimize bycatch injury and mortality (including post-release injury and mortality).

Organization and Reporting:

The BREP will be administered by a National Coordinator in the NMFS Office of Sustainable Fisheries, in conjunction with a Science Lead and Management Lead. The Office of Sustainable Fisheries, in consultation with the Offices of Protected Resources, Science and Technology, and International Affairs, will provide policy oversight and overall coordination of activities through the National Coordinator. Coordination activities include providing staff support to the BREP, documenting BREP activities, managing the annual spending plan process, serving as primary point of contact for the annual BREP Report to Congress, and any other activity deemed necessary by the BREP or NMFS leadership.

The Science Lead and Management Lead will be identified by the BREP National Coordinator from among the six Regional representatives described below. The Leads will rotate on a regular basis. The Science Lead and Management Lead will work with the National Coordinator to help coordinate BREP activities and develop final BREP recommendations on spending plans, policy issues, and other topics. These Leads also will help ensure that the BREP focuses on Regional issues as it carries out its work. If all primary Regional representatives come from Science Centers, then the Management Lead may be selected from among alternate Regional representatives (see below).

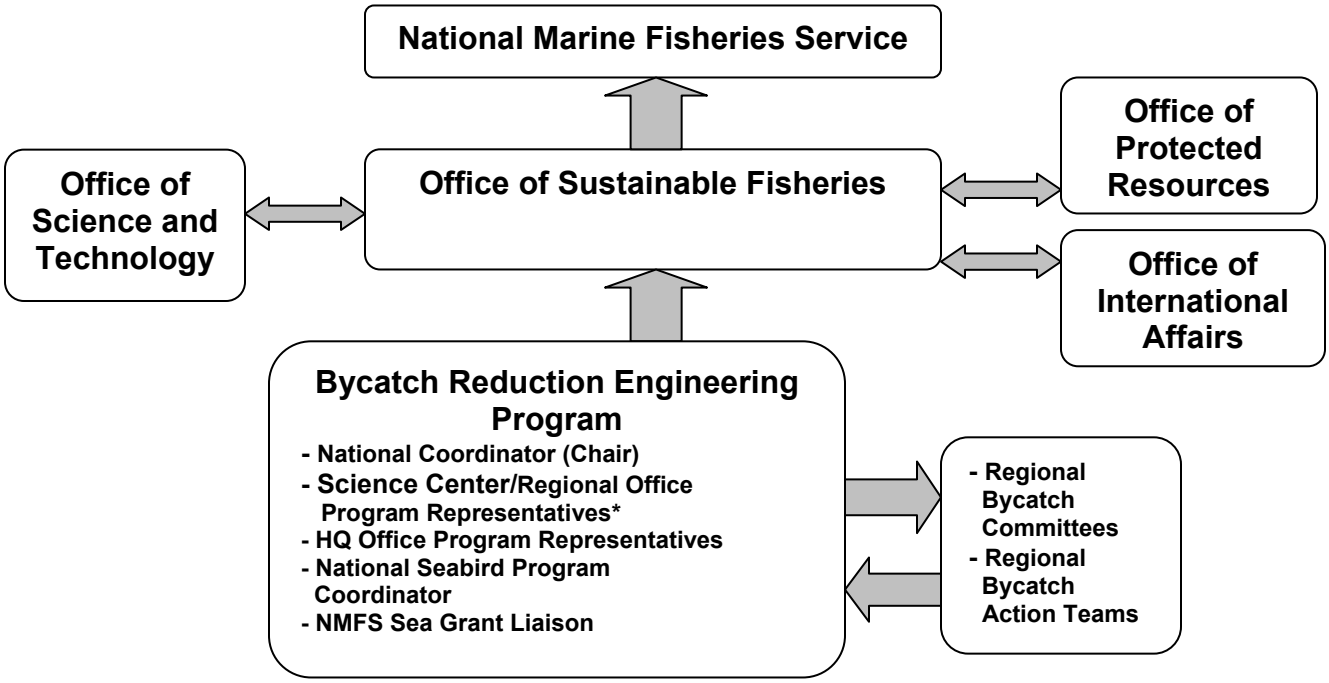
The BREP will include, along with the National Coordinator, the following program representatives:

- One representative with hands-on bycatch reduction engineering and post-release injury and mortality experience from each Regional Fisheries Science Center/Regional Office (i.e., six total Regional representatives);
- The NMFS Sea Grant Liaison (or other Sea Grant designee);
- The NMFS National Seabird Program Coordinator;
- One representative each from the headquarters Offices of Protected Resources, Science and Technology, Habitat Conservation, and International Affairs; and

- One representative from the Highly Migratory Species Management Division in the Office of Sustainable Fisheries.

Regional representatives will be responsible for representing their entire Region, rather than a Regional Office or Science Center perspective. The Regional Administrator and Science Center Director should not only nominate a primary Regional representative, but also an alternate representative. If the primary representative comes from a Science Center, then the alternate representative should come from a Regional Office. In addition, if the primary representative is someone who focuses mostly or exclusively on protected species or fisheries bycatch, then the alternate representative should be, to the extent practicable, someone who focuses on the other area (either protected species or fisheries). The Regional representatives should serve as liaisons between the BREP and already existing Regional Bycatch Committees and Action Teams, to the extent such Committees and Teams are active.

BREP organization and Line Office/Group oversight



*Two of these Program Representatives will be designated the BREP Science and Management Leads.

The Office of Sustainable Fisheries, in consultation with the Offices of Protected Resources, Science and Technology, and International Affairs, will designate a Science Lead and a Management Lead from among the Science Center/Regional Office Program Representatives.

The BREP should attempt to develop consensus recommendations whenever possible. The standard for reaching consensus is that all BREP members can accept the proposed recommendation. If the BREP cannot reach consensus, it may be necessary to vote in order to determine where differences of opinion exist. In the event voting is necessary, each member of the BREP shall have only one vote. The vote will be considered by the National Coordinator, Science Lead, and Management Lead, who will attempt to reach a consensus. If consensus cannot be reached, all perspectives will be forwarded to the Directors of the Offices of Sustainable Fisheries, Protected Resources, and Science and Technology for their advice.

The BREP shall periodically meet or have conference calls. When a member of the BREP cannot attend a meeting or conference call, it is his or her responsibility to either appoint an alternative to attend, or to communicate his or her views to other members of the BREP prior to the meeting. Minutes of all meetings and conference calls will be developed by the National Coordinator in coordination with Science and Management Leads.

No quorum is needed for the BREP to conduct business; however, every effort will be made to schedule meetings so that most members can attend. The BREP will meet via conference call whenever possible. Beginning in FY09, regular face-to-face meetings will be scheduled, possibly in conjunction with a National Observer Program Advisory Team (NOPAT) meeting or the National Cooperative Research Program's annual meeting. Agendas for all meetings will be developed by the National Coordinator in coordination with the BREP Science and Management Leads. Agendas will be distributed to BREP members for review and input prior to all meetings. Materials will be distributed prior to all meetings via the BREP intranet site whenever possible. Meetings of the BREP may include presentations of projects funded by the BREP, with feedback on the projects provided and discussions of how the results of these projects can meet management needs.

Funding Processes:

Currently the non-observer portion of the Reducing Bycatch line in the NOAA budget (i.e., ~$800K) will fund basic BREP operations in FY08. In the absence of additional BREP funding, the BREP will strive to leverage other sources of bycatch reduction engineering funding in NOAA to help achieve the mission of the BREP.

BREP funds are allocated on an annual basis based on technical review and recommendations from the BREP. The annual fund allocation process will include the following characteristics:

- The request for proposals will be sent by the BREP National Coordinator to the Regional Administrators, Science Center Directors, and HQ Office Directors in mid-September. Members of the BREP will be cc'ed on the request.
- The request for proposals will include several criteria, which may change from year to year, upon which the proposals will be evaluated, for example, the relation of the proposed project to current action items in a Regional Bycatch Implementation Plan, or whether the proposed project builds on results from a successful pilot project previously funded by the BREP or Reducing Bycatch budget line.
- Prioritized Regional proposals will be sent by Regional Administrators and Science Center Directors jointly, as well by as the Director, Office of Sustainable Fisheries (for Atlantic highly migratory species), to the BREP National Coordinator by the end of October.
- The BREP National Coordinator will preview proposals by mid-November to ensure no major required components are missing.
- The BREP will review proposals and finalize a draft spending plan by mid-January.
- The final spending plan will be approved by the Director, Office of Sustainable Fisheries.

The preceding schedule will be compressed if a NOAA budget was available soon after the beginning of the fiscal year. The request for proposals will require that:

- Proposals be no longer than five pages in length;
- Proposals address scalability and specify whether the proposal is for a multi-year project;
- Investigators for proposals that receive funding submit progress reports six months after receiving funding as well as final reports within a specified period of time after projects are completed; and
- Proposals primarily related to electronic monitoring or observer data analysis be submitted to NOPAT.

When the BREP becomes fully funded, a portion of BREP funding will be allocated as grants through existing national and regional NOAA grant programs, which could include Sea Grant, the Marine Fisheries Initiative, and the Cooperative Research Partners Program. The BREP will require prospective grantees to submit proposals, and the BREP will evaluate proposals based on conformance with the BREP mission and other criteria. The BREP will publicize grant opportunities through the Federal Register, the NMFS Bycatch Feature website, and other means. When fully funded, the BREP will distribute a significant portion of available BREP funding, including grant funding, among the Regions, which will develop Regional spending plans. However, spending plans will be subject to comment and/or approval by the BREP.

The duration of the BREP will be indefinite because the MSA does not indicate a limit to the BREP's duration.

This policy directive's objective will be attained when the above-listed responsibilities are carried out effectively on a routine basis. Additional performance measures will include number of bycatch reduction projects developed and number of new bycatch reduction technologies adopted by industry.

Procedural directives will be issued to implement this policy as needed.

John Oliver_____January 11, 2008_____
Assistant Administrator for Fisheries Date

Appendix 2. Section 316 of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006

H. R. 5946—31

SEC. 116. BYCATCH REDUCTION ENGINEERING PROGRAM.

(a) IN GENERAL.—Title III (16 U.S.C. 1851 et seq.), as amended by section 113 of this Act, is further amended by adding at the end the following:

''SEC. 316. BYCATCH REDUCTION ENGINEERING PROGRAM.

''(a) BYCATCH REDUCTION ENGINEERING PROGRAM.—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. The program shall—

''(1) be regionally based;

''(2) be coordinated with projects conducted under the cooperative research and management program established under this Act;

''(3) provide information and outreach to fishery participants that will encourage adoption and use of technologies developed under the program; and

''(4) provide for routine consultation with the Councils in order to maximize opportunities to incorporate results of the program in Council actions and provide incentives for adoption of methods developed under the program in fishery management plans developed by the Councils.

''(b) INCENTIVES.—Any fishery management plan prepared by a Council or by the Secretary may establish a system of incentives to reduce total bycatch and seabird interactions, amounts, bycatch rates, and post-release mortality in fisheries under the Council's or Secretary's jurisdiction, including—

''(1) measures to incorporate bycatch into quotas, including the establishment of collective or individual bycatch quotas;

''(2) measures to promote the use of gear with verifiable and monitored low bycatch and seabird interactions, rates; and

''(3) measures that, based on the best scientific information available, will reduce bycatch and seabird interactions, bycatch mortality, post-release mortality, or regulatory discards in the fishery.

''(c) COORDINATION ON SEABIRD INTERACTIONS.—The Secretary,

in coordination with the Secretary of Interior, is authorized to undertake projects in cooperation with industry to improve information and technology to reduce seabird bycatch, including—

‘‘(1) outreach to industry on new technologies and methods;

‘‘(2) projects to mitigate for seabird mortality; and

‘‘(3) actions at appropriate international fishery organizations to reduce seabird interactions in fisheries.

‘‘(d) REPORT.—The Secretary shall transmit an annual report to the Senate Committee on Commerce, Science, and Transportation and the House of Representatives Committee on Resources that—

‘‘(1) describes funding provided to implement this section;

‘‘(2) describes developments in gear technology achieved under this section; and

‘‘(3) describes improvements and reduction in bycatch and seabird interactions associated with implementing this section, as well as proposals to address remaining bycatch or seabird interaction problems.’’

Annual Report to Congress on the Bycatch Reduction Engineering Program

U.S. Secretary of Commerce
John E. Bryson

Administrator of National Oceanic and Atmospheric Administration
and Under Secretary of Commerce
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