# Annual Report to Congress on the Bycatch Reduction Engineering Program

NOAA

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

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
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2010 REPORT ON THE BYCATCH REDUCTION ENGINEERING PROGRAM PURSUANT TO SECTION 316(d) OF THE MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

## Introduction

Section 316(a) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) states, "Not later than 1 year after the date of enactment of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006, the Secretary, in cooperation with the Councils and other affected interests, and based upon the best scientific information available, shall establish a bycatch reduction program, including grants, to develop technological devices and other conservation engineering changes designed to minimize bycatch, seabird interactions, bycatch mortality, and post-release mortality in federally managed fisheries." The Department of Commerce's 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;
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.

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 2009

Funding to implement the BREP totaled $1,602,485 in 2009. This funding came from a NOAA budget line item entitled Reducing Bycatch. Table 1 lists the projects funded to implement the BREP in 2009. 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 6-80. It is important to note that several 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.

**Table 1. Projects funded to implement the BREP in 2009**

| *Project Title* | *Funding Provided* | *Recipient* |
|---|---|---|
| World Wildlife Fund's Smart Gear Initiative | $182,000 | World Wildlife Fund |
| Trawl Modifications to Reduce Fish Bycatch and Habitat Impacts from Mobile Fishing | $172,582 | NMFS Northwest Fisheries Science Center |
| Fishing Technology and Conservation Engineering to Reduce Trawl Bycatch in Alaskan Fisheries | $159,642 | NMFS Alaska Fisheries Science Center |
| Shrimp Trawl Bycatch Reduction | $156,106 | NMFS Southeast Fisheries Science Center |
| Gear Modifications to Reduce Harbor Porpoise Interactions in Commercial Gillnet Fisheries | $138,000 | NMFS Northeast Fisheries Science Center |
| NMFS National Seabird Program | $115,411 | NMFS Alaska Regional Office; NMFS Office of Protected Resources |
| Gear Research Studies and Research to Understand Sea Turtle Behavior in Areas Frequented by Scallop Dredge Fishing | $93,081 | NMFS Northeast Fisheries Science Center |
| NMFS Southeast Fisheries Science Center Bycatch Reduction Program | $80,451 | NMFS Southeast Fisheries Science Center |
| Sea Turtle Excluder Device Technology; Evaluations and Fisher Outreach | $50,500 | NMFS Southeast Fisheries Science Center |
| The Effects of Neodymium/Praseodymium (NdPr) Alloys on Shark Bycatch | $49,500 | NMFS Pacific Islands Fisheries Science Center |
| Incidental Take and Post-Release Mortality of Blue Sharks in the U.S. West Coast Drift Gillnet and Longline Fisheries for Swordfish | $46,615 | NMFS Southwest Fisheries Science Center |
| NMFS National Seabird Workshop | $41,959 | NMFS Alaska Regional Office |
| Reducing Bycatch in the Southeast U.S. Penaeid Shrimp Fishery: A Pilot Study to Assess Catch Rates of Shrimp and Finfish Catch Bycatch using TEDs with Reduced Bar Spacing | $41,800 | NMFS Southeast Fisheries Science Center |
| Green Stick Gear Bycatch and Bycatch Mortality Characterization in the Atlantic Tuna Fishery | $39,000 | NMFS Office of Sustainable Fisheries |

| | | |
|---|---|---|
| Pilot Program to Investigate Seabird Interactions with Alaskan Groundfish Trawl Paravanes and Develop First-Generation Mitigation Measures | $31,900 | NMFS Alaska Fisheries Science Center |
| Collaborative Research in Reducing Post-Release Mortality for Common Thresher Sharks Captured in the Southern California Recreational Fishery | $31,000 | NMFS Southwest Fisheries Science Center |
| Testing Footrope Modifications Designed to Reduce the Bycatch of Demersal Groundfish and Megafaunal Invertebrates, and Reduce Physical Impacts on Invertebrates in the Ocean Shrimp (*Pandalus jordani*) Trawl Fishery | $28,234 | NMFS Northwest Fisheries Science Center |
| Commercial Longline Sea Turtle Mitigation | $25,900 | NMFS Southeast Fisheries Science Center |
| Evaluation of Hook Guards, Larger Circle Hooks, and Non-offset Hooks in Preventing Interactions with Sea Turtles in the Gulf of Mexico Bottom Longline Fishery | $22,634 | NMFS Southeast Fisheries Science Center |
| Use of Photoluminescent Technology to Reduce Incidental Capture of Sea Turtles in Gillnet Fisheries | $16,170 | NMFS Pacific Islands Fisheries Science Center |
| Free Streamer Line Distribution Project | $15,000 | NMFS Alaska Regional Office |
| Uncharted Waters: The First Flights of Fledgling Albatrosses | $14,000 | University of California Santa Cruz |
| Seabirds in the Western North Atlantic and Interactions with Fisheries | $10,000 | NMFS Southeast Fisheries Science Center |
| Alaska Fisheries Science Center Coordinated Seabird Studies | $10,000 | NMFS Alaska Fisheries Science Center |
| Estimation of Seabird Bycatch in Northeast Commercial Fisheries | $10,000 | NMFS Northeast Fisheries Science Center |
| Gulf of Mexico Pelagic Longline Bluefin Tuna Bycatch Mitigation (Pilot) | $9,000 | NMFS Southeast Fisheries Science Center |
| Southwest Fisheries Science Center Contribution to World Seabird Conference | $5,000 | NMFS Southwest Fisheries Science Center |
| Coastal Observation and Seabird Study Team (COASST) | $4,000 | University of Washington |
| Monitoring of Seabird Bycatch in Peru: Assessment and Mitigation Measures | $3,000 | Pro Delphinus Peru |
| **Total** | $1,602,485 | |

## Project Summaries

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

*BREP Funding Provided*
$182,000

*Location of Research*
WWF, Palo Alto, California

*Resource Challenge*
Bycatch is among the most problematic aspects of modern fishing from a biodiversity conservation perspective. In addition to the sheer volume of bycatch globally, unselective fishing poses an extinction threat to numerous species of ocean wildlife and threatens the commercial viability of a number of mainstream fisheries. In recent years, improvements to fishing gears have played an important role in reducing bycatch, as modifications have increased the chances for non-target species to escape or avoid capture altogether. In many cases, these modifications have been simple and inexpensive, with the best innovations usually originating with the fishers themselves.

*Project Summary*
Launched in 2004, World Wildlife Fund's (WWF) 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 $50,000. To date, it has attracted more than 200 entries from more than 35 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 (DFO Canada).

The 2009 International Smart Gear Competition was launched in January 2009 (Figure 1). This competition attracted 71 entries from 27 different countries. Many of the competition judges commented on the high overall standard of the entries. This competition also featured an East African Regional Prize, a concept designed to focus attention on bycatch issues in regions around the world identified by WWF as being areas of particular biological significance. As a result, the Judges Workshop was held in Dar es Salaam in Tanzania, and 16 entries were received from East Africa. The winners were announced at the World Fishing Exhibition in Vigo, Spain in September.


**Figure 1. Promotional material for 2009 International Smart Gear Competition.**

*Developments in Gear Technology Achieved*

The grand prize winning idea, submitted by a team of Australian inventors, was the Underwater Baited Hook, a concept developed to address the bycatch problem associated with seabirds and pelagic longlining (Figure 2). This type of longlining features long and widely spaced branch lines, which are lines that hang down from the main longline with baited hooks at the end of each branch line. This stern-mounted, hydraulically driven device delivers baited hooks underwater, below vessel propeller turbulence, in a method much different from setting baits on the waters surface.

**Figure 2. The Underwater Baited Hook design team with the device.**

The device operates by placing a baited hook inside a capsule chamber that is attached to a hydraulic system. The capsule is propelled to a pre-set depth, and the system then reverses the hydraulics, flushing the baited hook from the capsule through a spring-

loaded door. The capsule then returns to the docking station to be set again. The system shields the bait from the eyes of scavenging seabirds like albatross, as well as putting it out of the range of diving seabirds such as shearwaters and petrels. Trials of the device have been extremely successful, and this winning idea has the potential to dramatically decrease the bycatch of seabirds on longlines around the world.

The first runner-up winner, developed by a team from Belgium, was a device called the Hovercran. This device was developed by a team from the Institute for Agricultural and Fisheries Research in Belgium and uses lightweight electrodes to catch shrimp and reduce bycatch. Its unique design eliminates the need for a bobbin rope, substantially reducing habitat impact. The low-intensity electric field provokes a startle response in shrimp. This electric field, combined with an elevated footrope, reduces bycatch volume by 35% while reducing bottom contact by 75%.

The second runner-up winner, designed by an Australian scientist, was the Batwing Otter Board. This radical design reduces bottom contact of otter boards by more than 90% while still maintaining the spread of trawl nets, and reducing fuel consumption. Instead of towing a large door at a 40-degree angle across the bottom, a heavy contact shoe is aligned with the direction of tow in a straight line. This eliminates the scraping action of the board, substantially reducing benthic impact and benthic bycatch. The Batwing Otter Board achieves the required net spread by mounting a sail-like device above the contact shoe that is comprised of materials designed to withstand the rigors of commercial trawling.

*Improvements and Reduction in Bycatch Associated with This Project*
The potential for improvements and reduction in bycatch associated with these ideas are 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 Underwater Baited Hook represents a major step forward in the search for a solution. When this device is commercially available, it should present the most viable and successful solution to this problem.

The Hovercran and the Batwing Otter Board also present opportunities for substantial reductions in bycatch in shrimp and bottom trawl fisheries. The Hovercran is scheduled to be tested on a number of commercial Dutch shrimp vessels during the spring of 2010, and the results of this extensive testing will be utilized in the design's advancement. The Batwing Otter Board is scheduled to undergo commercial trials on a number of small river trawlers in early 2010. Development of a larger-scale product for use on open-water trawlers will require some flume tank testing during 2010 to allow for optimization of the design under these conditions.

The 2007 grand prize winning idea, the Ruhle Trawl (formerly the Eliminator), continues to gain acceptance in appropriate fisheries. In 2009 the Ruhle Trawl was mandated by the European Union as a mitigation measure for vessels fishing in Norwegian waters, and is moving through the regulatory process for use in the United Kingdom.

*Project Title*
**Trawl Modifications to Reduce Fish Bycatch and Habitat Impacts from Mobile Fishing**

*BREP Funding Provided*
$172,582

*Location of Research*
Northwest Fisheries Science Center

*Resource Challenge*
The Pacific Coast groundfish fishery is subject to bycatch reduction requirements under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and Endangered Species Act (ESA). Species that have been identified as overfished (depleted) under the MSA must be rebuilt. Because Pacific Coast groundfish species are so intermixed, the harvest of healthy stocks has been constrained in order to reduce the total catch of depleted stocks that co-occur with healthy stocks. These catch reductions have placed an economic hardship on fishers and fishing communities. NMFS has also identified concerns about potential bycatch of ESA-listed endangered or threatened salmon in the Pacific whiting fishery and bottom trawl fisheries.

*Project Summary*
The Northwest Fisheries Science Center (NWFSC) sought funding to support staffing for a fishing gear technician in the NWFSC's Habitat and Conservation Engineering (H&CE) group within the NWFSC's Fishery Resource Analysis and Monitoring Division. Working with our fisheries research partner, the Pacific States Marine Fisheries Commission (PSMFC), the NWFSC hired a gear technician who is stationed at the NWFSC's field station in Newport, Oregon. This technician focuses on gear research, assists the group coordinator in the continued development of the NWFSC's bycatch reduction research, and collaborates with other NMFS and regional gear researchers. The FY09 funding allowed the H&CE group to continue to employ the gear technician into 2009. Continued funding has ensured support for a series of pilot projects to test several new promising trawl modifications to reduce fish bycatch and habitat impacts from mobile fishing. These projects are described below and on page 49.

In FY09, the NWFSC and PSMFC developed and began field testing of an open escape window bycatch reduction device (BRD) to reduce ESA-listed Chinook salmon and rockfish (genus *Sebastes*) bycatch (e.g., darkblotched, canary, and widow) in the Pacific whiting fishery (Figure 3). The development of this BRD benefited from extensive interactions with scientists, especially those from the Alaska Fisheries Science Center; commercial fishermen; and gear manufacturers working in the Pacific Northwest and Alaska. This BRD design consists of two mesh panels, positioned near the codend of a midwater trawl, which direct actively swimming fish toward an open escape window on the top and upper sides of the net. This BRD is designed so that fish displaying strong

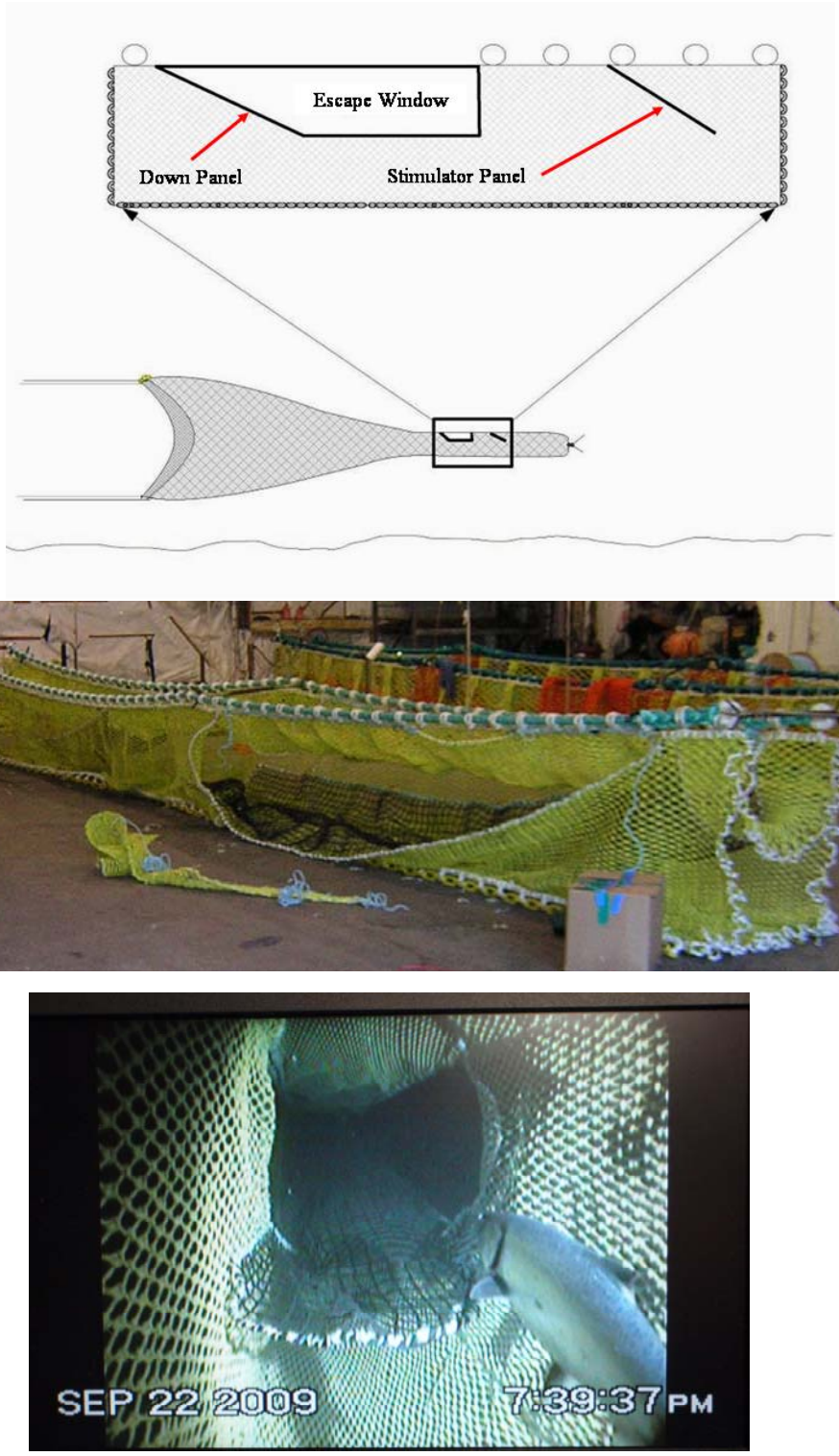


**Figure 3. Schematic view of midwater trawl and open escape window bycatch reduction device (BRD) (top); completed BRD in net loft in Newport, Oregon (starboard escape panel removed) (middle); Chinook salmon (ca. 80 cm) approaching BRD's escape window (bottom).**

swimming abilities (e.g., salmonids and rockfishes) can escape through the open windows, whereas fish exhibiting weak swimming abilities (e.g., Pacific whiting) will pass into the codend. During September 2009, the HC&E group conducted a five-day research cruise aboard a trawler engaged in the Pacific whiting fishery. Chinook salmon behavior within the BRD was documented with an autonomous video camera. A total of eight salmon were observed, with five salmon (> 62%) escaping via the BRD. Because trawling was conducted with an open codend and the video camera system could not record the total duration of every tow, we were unable to determine whether the remaining three salmon escaped using the BRD. Planning is currently underway to conduct further development and testing of the open escape window BRD concept in the Pacific whiting midwater trawl fishery as well as other west coast trawl fisheries.

In addition to the above work on flexible sorting grids, the NWFSC has continued work on two ongoing bycatch reduction research projects. The first ongoing project is in collaboration with the gear research group at the Oregon Department of Fish and Wildlife (ODFW), and is focused on observations of fish behavior in the vicinity of the footrope of the bycatch-reducing selective flatfish trawl, using a dual-frequency identification sonar (DIDSON) ultrasonic camera. Reducing bycatch in commercial fishing gear requires an understanding of the behavior of fish interacting with the gear. The use of lights may confound observations of fish behavior in the proximity of fishing gear. The DIDSON uses ultrasound to form images of fish, as well as the gear, surrounding structures, and the seafloor. The DIDSON was used to examine diel behavior differences in roundfish along a 12-meter section of the footrope on the starboard wing of the flatfish trawl. During FY09, data extraction was completed for individual fish tracks from all of the archived DIDSON data collected in 2006 and 2007. Movements of individual roundfish were tracked, providing a continuous measurement of distance from the footrope. Analysis of fish tracks revealed that during the day, roundfish remained farther from the footrope, maintained a relatively constant distance, and showed less variation in direction. At night, fish approached the footrope at a sharper angle and displayed a more abrupt change in speed and direction. These behavioral differences suggest that herding efficiency and gear selectivity is different between day and night fishing.

In FY09, the NWFSC continued a pilot project to integrate seabed classification with commercial fishing activities to investigate whether this type of information would be useful in reducing bycatch in west coast groundfish fisheries. This project is being conducted in the vicinity of Morro Bay, California as a collaboration between the NWFSC's HC&E group and West Coast Groundfish Observer Program, the Nature Conservancy, and Oregon State University's Active Tectonics and Seafloor Mapping Lab. The goal of the project is to capture bottom type using a Quester Tangent QTC VIEW simultaneously with bottom trawling. This project will consider questions such as: can high-quality data be collected during normal fishing operations to inform NMFS about bottom type with minimal impact on fishing operations; and will patterns in bycatch relate to specific seafloor classifications? Building on work completed in FY08, this project entered a second phase of field work in September 2009, employing a newly installed dual frequency echosounder matched to a Quester Tangent QTC View 5.5 system.

*Improvements and Reduction in Bycatch Associated with This Project*
With the addition of a temporary gear technician, the NWFSC has been able to initiate a new and significant project aimed at reducing bycatch of ESA salmon and rockfish in the Pacific whiting midwater trawl fishery, while continuing ongoing collaborative studies with ODFW on the behavior of fish interacting with gear, using video and ultrasonic cameras. Results from 2009 demonstrated the capability of the open escape window BRD to release Chinook salmon before capture. More extensive testing of the BRD under varied fishing conditions with successful results would be the first step in applying this bycatch reduction concept in the Pacific whiting fishery.

One recent fishing industry collaborative effort grew out of the NWFSC's interactions with the conservation engineering group at the Alaska Fisheries Science Center and regional net lofts in the Pacific Northwest. These interactions resulted in the development of a variation on the BRD for the Pacific hake fishery by a Seattle net loft. Results from tests during 2009 and lessons learned are currently being exchanged between Pacific coast and Bering Sea gear technologists and will be applied in gear development for next year's field season. Work with ODFW is providing for the discovery of behavioral differences (e.g., in herding efficiency and escapement) that can be mined for gear designs that will reduce bycatch in west coast groundfish fisheries. Data from this project are currently being used by ODFW to consider potential modifications to the selective flatfish trawl (and other trawl types) to improve its capability to reduce bycatch. In a separate project, the NWFSC has moved into phase II of a pilot project to evaluate the efficacy of integrating seabed classification with commercial fishing activities to investigate whether this type of information would be useful in reducing bycatch. The field work for the phase II portion of the project will continue through February 2010.

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

*BREP Funding Provided*
$159,642

*Location of Research*
Alaska Fisheries Science Center

*Resource Challenge*
Research funded by the BREP at the Alaska Fisheries Science Center (AFSC) addressed three 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. Low return of Chinook salmon to Yukon River drainages has greatly increased pressure on the fishery to reduce its salmon bycatch.
2) Habitat impacts of trawling in the Bering Sea.
3) Incidental crab mortality due to trawling in the Bering Sea.

*Project Summary*
Salmon Excluders: In March and August of 2009, two cruises were conducted under exempted fishing permits to test improved excluder devices. Due to concerns over clogging in the excluders, the versions tested in 2009 used a panel that blocks escape portals during regular towing and opens them during scheduled periods of slower towing ("flapper excluders"). Many of these devices are currently being used in the fishery, but the most recent version provided by a major net manufacturer had not been tested for effectiveness. A September 2009 test used that version, which places the excluder just ahead of the codend, further back in the net than previous excluders. NMFS cameras and sonars were provided for both cruises, and we participated in all planning and several outreach workshops. We also funded one day of a workshop at the flume tank in St. Johns, Newfoundland for October 2009.

Reduce trawl damage to seafloor invertebrates: In October 2009, the North Pacific Fishery Management Council (NPFMC) was set to make a final decision to implement regulations requiring modified sweeps for Bering Sea flatfish fisheries. Work in this area in 2009 focused on providing research results to the NPFMC and other stakeholders as they decide whether to require these trawl sweep modifications for the Bering Sea flatfish fisheries. We also conducted research to explore variations of the sweep modifications that would help fishermen transition to their use. A nine-day research cruise in June tested whether smaller-diameter sweep cables, which would alleviate handling problems associated with the modifications, would still effectively herd flatfish.

Crab mortalitity rates after trawl encounters: From August 8 - 24, scientists aboard the F/V *Pacific Explorer* from the Conservation Engineering and Shellfish groups of the AFSC's Resource Assessment and Conservation Engineering Division collected data to estimate the mortality rates of red king crab (*Paralithodes camtsactcus*) after passage

under the groundgear of commercial bottom trawls. This followed the methods of similar research on Tanner and snow crabs in 2008. Crabs were recaptured after passing under the central and side sections of a trawl footrope, as well as after contacting the sweeps ahead of the trawl. Crabs were also assessed after capture by a similar net fished ahead of the trawl, to estimate and account for the effect of capture and handling. Finally, we evaluated the effectiveness of modifications to sweeps and footrope that were expected to reduce crab mortality. More than 3,700 crabs from 73 trawl hauls were assessed for reflex impairments, while more than 738 were assessed and then held in onboard tanks to establish the association between these impairments and the probability of mortality. This research was primarily supported by a grant from the North Pacific Research Board, but BREP funds were used for some of the supplemental field pay (overtime), equipment, supplies, and shipping.

*Developments in Gear Technology Achieved*

1. Salmon escape measurements for the flapper-style excluder indicated substantially reduced exclusion rates when escape portals were only available during slow-down events. We identified ways to achieve continuous availability by modifying the location and weighting of mesh panels. As many vessels were poised to implement the earlier version, we avoided widespread use of ineffective excluders.
2. Outreach and follow-up research on the modified sweeps is preparing the flatfish fleet for implementation, as the NPFMC decided at its October 2009 meeting to require Bering Sea flatfish trawlers to use modified sweeps beginning in 2011.
3. Estimates of crab mortality rates after trawl encounters were generated for all major Bering Sea crab species. Sweep modification reduced all of those rates.

*Improvements and Reduction in Bycatch Associated with This Project*

More of the pollock fleet is using salmon excluders, and our research is ensuring that these excluders are as effective as possible. Significant reductions in damage to sessile epifauna in the Bering Sea are expected when the sweep modification regulations are implemented. The same sweep modifications are expected to reduce unobserved crab mortalities from bottom trawling. We also provided key information needed to estimate the magnitude of such mortalities.

*Project Title*
**Shrimp Trawl Bycatch Reduction**

*BREP Funding Provided*
$156,106

*Location of Research*
Southeast Fisheries Science Center

*Resource Challenge*
Federal regulations require the use of an approved bycatch reduction device (BRD) in all shrimp trawls fished in Federal waters in the Gulf of Mexico and the Southeastern Atlantic Ocean. The new BRD certification criterion implemented by NMFS in February 2008 matched the existing criterion for the eastern Gulf of Mexico and the U.S. South Atlantic, i.e., a 30% reduction in finfish. This action resulted in the certification and provisional certification of three additional BRD designs for use in the Gulf of Mexico: the Extended Funnel, 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. There is a critical need to continue to develop improved bycatch reduction technologies to ensure red snapper management objectives, including the rebuilding of the red snapper stock, are met. In order to address this ongoing challenge, the Southeast Fisheries Science Center Harvesting Systems Unit conducts research to develop and evaluate shrimp trawl bycatch reduction technology.

*Project Summary*
The project consists of the following performance measures:

<u>BRD Research and Development</u>
- Fish behavioral modification studies
- Development of improved BRD designs through collaborative efforts with industry
- Assistance in conducting new BRD certification testing

<u>Performance Monitoring and Reporting</u>
- Analyses and reporting of BRD certification data
- Monitoring and evaluation of BRD operational performance
- Technical recommendations and assistance in drafting language for rulemaking

<u>Industry Outreach</u>
- Technical training for net shops and fishers in BRD construction and installation
- Development of instructional media to assist fishers

<u>Enforcement Training</u>
- Technical training and assistance for NMFS, U.S. Coast Guard, and State law enforcement agencies

*Developments in Gear Technology Achieved*
Through fishery independent and dependent research, BRD designs such as the Composite-Panel BRD and the Square Mesh Panels BRD have been evaluated for

efficacy of finfish bycatch reduction in the shrimp fishery. After completion of the additional testing, we plan to submit the optimal configuration of these BRDs for certification as an allowable shrimp trawl bycatch reduction mitigation measure for use in the southeast United States shrimp fisheries.

*Improvements and Reduction in Bycatch Associated with This Project*

The Composite-Panel BRD (Figure 4), a design provisionally certified for use in the Gulf of Mexico and the U.S. South Atlantic shrimp trawl fisheries, has shown an overall finfish bycatch reduction rate of 25.3% in the Gulf of Mexico shrimp fishery. In an attempt to increase the finfish reduction rate associated with the Composite-Panel BRD, a fisheries-dependent certification test was conducted with a combination of the Composite–Panel BRD and a Square Mesh Panel BRD. A total of 102 tows have been completed. The observed finfish reduction rate with this BRD combination is 36% by weight, with a shrimp reduction rate of 4%. The reduction in finfish observed during the experiment exceeds the minimum BRD certification criteria of 30% reduction in total finfish weight. Additional testing is being conducted aboard commercial vessels to evaluate the effect of the square mesh panel size and placement and codend construction materials on the performance of this BRD combination.

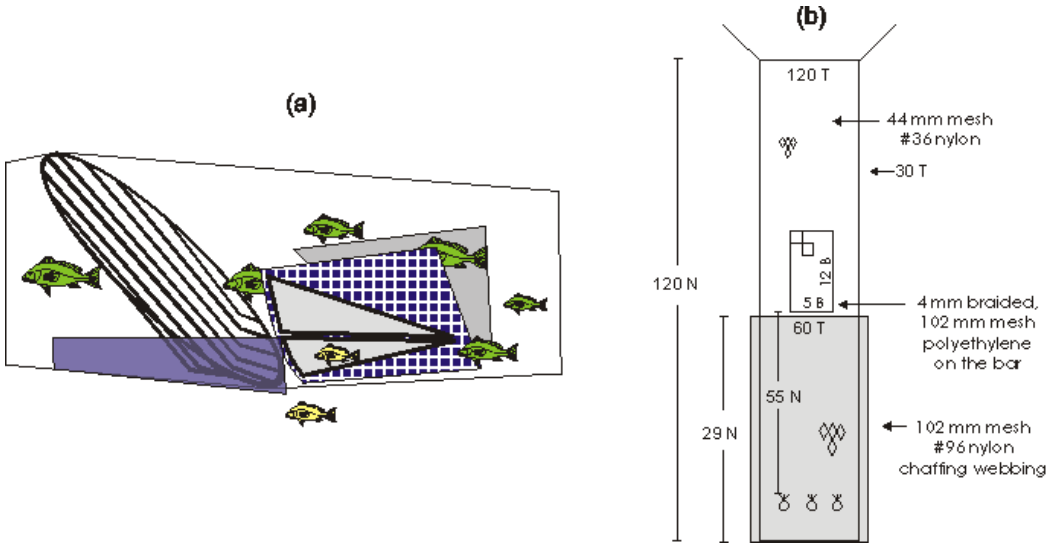


**Figure 4. Schematic diagram of two BRD types used in combination during a certification test: (a) Composite-Panel BRD, and (b) a codend with 102 mm (4-inch) square mesh panel (T = transversals, N = normals, and B = bar).**

*Project Title*
**Gear Modifications to Reduce Harbor Porpoise Interactions in Commercial Gillnet Fisheries**

*BREP Funding Provided*
$138,000

*Location of Research*
Northeast Fisheries Science Center

*Resource Challenge*
The Harbor Porpoise Take Reduction Plan has been in effect since December of 1998 and requires gillnet gear to be modified during certain times and in certain areas of the Gulf of Maine, southern New England, and the Mid-Atlantic when harbor porpoises are present to reduce interactions with commercial gillnet gear. In the New England area, pingers (i.e., acoustic deterrents) are required on gear at various times of year in six management areas; in contrast, in the Mid-Atlantic, gear modification requirements have been implemented during the winter months of January through April in lieu of pinger requirements.

*Project Summary*
Initially this project was designed to test the effectiveness of gillnets infused with 10% barium sulfate (BaSO4) to reduce harbor porpoise bycatch. This project was revised after it became apparent that it was difficult to ensure that gillnets were infused with the correct percentage of BaSO4. This problem became apparent when testing revealed that gillnets used in previous projects all had different percentages of BaSO4 than originally reported. The project was subsequently changed to test the conservation benefits of two different hanging ratios (0.5 vs. 0.33) in the sink gillnet fishery in the area south of the Cape Cod South Management Area.

The hanging ratio study started with both treatments placed randomly within each string of gillnets. Once testing started, it appeared that gillnets hung with both treatments were catching disproportionately more marine mammals compared to gillnets all hung with the same mesh configuration. Additionally, since gillnets are typically hung with one hanging ratio in the commercial fishery, there was a concern that the experimental protocols were not mimicking what occurs in the commercial fishery. Because of these issues, it was determined early in the experiment to switch the study design to test both treatments in strings of gillnets all hung with the same hanging ratio, but fished in close proximity, keeping all other variables (e.g., soak time, gear configuration) as similar as possible.

As of the end of FY09, half of the testing (79 out of 160 hauls) had been completed. This was not sufficient to determine whether there was a different catch rate of harbor porpoise between the two hanging ratios. The latter half of testing is scheduled to start in February 2010. Twenty-eight marine mammals were incidentally caught during the first phase of this study. Most of these encounters occurred in the gillnet panels hung with

both treatments, which we determined were not catching similarly to gillnets hung with only one treatment. In short, we have successfully collected comparative data, resolved issues surrounding the feasibility of implementing BaSO4 gillnets as a mitigation strategy, and engaged the fishing industry in discussions concerning this bycatch problem and potential remedies beyond hanging ratio that might be explored to mitigate harbor porpoise bycatch.

*Developments in Gear Technology Achieved*
Our initial testing identified problems with the experimental approach of using both treatments in one gillnet string. This approach was quickly abandoned after 19 hauls, and the remaining 60 hauls were conducted using the single treatment approach. Data on the catch rates of finfish and marine mammals have been collected, and an interim report has been received from the contractor tasked with collecting the field data. The most positive development achieved based on this project is the understanding that marine mammals appear to react differently to panels hung with different hanging ratios.

*Improvements and Reduction in Bycatch Associated with This Project*
This project has not been completed, and we anticipate that once it has been completed, we will have data to ascertain whether there is a difference in harbor porpoise bycatch when gillnets are hung on the third (0.33) as compared to those hung on the half (0.5). The most beneficial result of this work is the dialogue that has been established with members of the gillnet fishing community who are eager to address this problem and have expressed interest in this project. We anticipate that this project will form the nexus to advance research ideas and industry involvement, which may provide solutions beyond hanging ratios that have not yet been considered.

*Project Title*
**NMFS National Seabird Program**

*BREP Funding Provided*
$115,411

*Location of Research*
Alaska Regional Office, Headquarters Office of Protected Resources

*Resource Challenge*
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. Prior to 2001, NMFS' engagement on seabird projects reflected its focus on ocean resources and various regional interests and needs. Some examples of this seabird work include seabird surveys on NOAA research and stock assessment cruises in both the Pacific and Atlantic Oceans, collaborations on research and development of seabird bycatch reduction methods, and collection of seabird data by fishery observers.

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. NMFS regions are at various stages of NPOA implementation, with the Alaska and Pacific Islands regions having the most fully completed NPOA-Seabird assessments. This likely reflects the fact that at various times, the highest levels of documented seabird interactions was with NMFS fisheries in these two regions.

Seabirds are considered to be important indicators of ecosystem health, and are an obvious element of interest and study by NOAA 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. Our 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 in 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"; and
- 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 to 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 and 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). In addition to government staff, the work and collaborative input by multiple partners (Sea Grant, universities, fishing industry associations, and environmental groups) has been essential to addressing the seabird-fishery issues.

In FY09, 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 development of a national workshop to address NMFS's seabird responsibilities and initiating 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 new seabird language in section 116 of the MSA and making a presentation at the first annual BREP meeting at the NMFS Northeast Fisheries Science Center in August 2009;
- Participating on an inter-agency team to support a U.S. position for possible accession to ACAP;
- Leading a U.S. team at ACAP's 3rd Meeting of the Parties in Bergen, Norway, in April 2009, where U.S. efforts resulted in the adoption of the three North Pacific albatross species under ACAP's Annex 1;
- Co-convening the Commission for the Conservation of Antarctic Marine Living Resources' (CCAMLR) annual Scientific Committee working group on Incidental Mortality Associated with Longline Fisheries in Hobart, Australia, in October 2008;
- Participating on a steering committee for the NMFS National Bycatch Report and coordinating with USFWS experts and other seabird experts for input on seabird bycatch species for the Report;
- Monitoring status of a petition to 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 Western & Central Pacific Fisheries Commission annual meeting in December 2008; and
- Making presentations at Seabird Technical Meeting for Inter-American Tropical Tuna Commission (IATTC) in May 2009.

NSP travel supported by FY09 BREP funds included attendance at CCAMLR meetings to co-convene a seabird bycatch working group, participation at the annual Pacific Seabird Group meeting and an associated meeting of the North Pacific Albatross Working Group, participation and presentation of U.S. positions on seabird bycatch at the IATTC Seabird Technical Working Group, participation and lead of the U.S. team at the 3rd Meeting of the Parties of ACAP where three North Pacific albatross species were listed by ACAP, participation at the first annual BREP meeting.

*Developments in Gear Technology Achieved*
Developments from individual NSP projects are described on pages 37-38, 61-70, and 74-79.

*Improvements and Reduction in Bycatch Associated with This Project*
Improvements and reductions from individual NSP projects are described on pages 37-38, 61-70, and 74-79.

*Project Title*
**Gear Research Studies and Research to Understand Sea Turtle Behavior in Areas Frequented by Scallop Dredge Fishing**

*BREP Funding Provided*
$93,081

*Location of Research*
Northeast Fisheries Science Center

*Resource Challenge*
NMFS' Northeast Fisheries Science Center (NEFSC) has one full-time employee (FTE) who is dedicated to gear research activities related to protected species and other bycatch concerns. The NEFSC bycatch reduction efforts have resulted in several successful collaborations with the scallop, flounder, pound net, gillnet, and other fishing industries that have benefited both the fishing industries and the affected bycatch species. As the NEFSC has become more involved in gear research to develop strategies to mitigate bycatch, this effort has resulted in a greater need to expand the conservation engineering program at the NEFSC. This project funded a contractor to help the NEFSC and its one FTE grow the NEFSC's conservation engineering program and meet some regional research requirements.

*Project Summary*
In the past year, the Bycatch Reduction Engineering Program (BREP)-funded contractor has assisted with several NEFSC gear-related projects. These include:

- A study to assess the ability of a scallop dredge to cause turtles to go over the dredge;
- A squid trawl mesh selectivity study that compared the ability of different codend mesh sizes to reduce butterfish bycatch;
- A scallop dredge comparison and video research trip aboard a scallop dredge vessel comparing a modified turtle dredge to a standard New Bedford-style scallop dredge (underwater video was taken from mounted housings on the standard dredge to capture potential turtle encounters);
- Summer flounder trawl turtle excluder device (TED) testing and scallop trawl TED testing to ascertain the effect of TEDs on the catch of targeted species;
- Capture and tagging of two loggerhead sea turtles to attain a better understanding of their behaviors with the goal of using this information to mitigate and sea turtle bycatch; and
- A project to assess the effectiveness of different hanging ratios in reducing harbor porpoise bycatch.

In addition, the contractor has assisted the NEFSC by researching high frequency pingers and gillnet gear characteristics; performing data pulls and geographic information system (GIS) mapping for sturgeon catches, the Atlantic Large Whale Take Reduction Plan, and GIS mapping only for a gillnet hanging ratio study; providing storage and maintenance of

turtle test carcasses and gillnets; and assisting with preparations for the 2009 annual BREP meeting.

Finally, the contractor has attained training in Alaska Marine Safety Education Association Survival Trainer and Drills Conductor Certificates, intensive TED building and design training, CPR and first aid, digital video editing, sea turtle tagging, and deployment and use of a tow-time data logger.

*Developments in Gear Technology Achieved*
During FY09 the contractor assisted the NEFSC by helping to:

- Develop and test a tow time data logger;
- Test gillnets hung with two different hanging ratios to ascertain an effect on harbor porpoise bycatch;
- Assist with satellite tagging of sea turtles;
- Assist with studies to determine the effect on catch rates of bottom trawls outfitted with TEDs in the summer flounder and scallop fishery;
- Assist with research to assess gear selectivity related to squid, butterfish, and other bycaught species in the loligo squid fishery;
- Assist with a study to determine the effectiveness of a modified dredge to cause turtles to go over the dredge frame as opposed to under the frame, where injury is assumed to be much greater; and
- Perform data pulls and analysis in several fisheries and gear types to help answer bycatch questions.

*Improvements and Reduction in Bycatch Associated with This Project*
In the last year, the contractor has been involved in projects that have provided quantitative data on:

- The impact of TEDs in the summer flounder and scallop trawl fishery;
- The impact of mesh size on the bycatch of harbor porpoise in the sink gillnet fishery targeting monkfish;
- The development of an improved scallop dredge frame design that reduces potential injury and mortality resulting from benthic interactions of sea turtles to scallop dredges;
- The development of a tow time data logger that may provide an alternative to TEDs in fisheries where catch loss is high; and
- Factors leading to the entanglement of whales in vertical lines in both the trap and gillnet fisheries.

*Project Title*
**NMFS Southeast Fisheries Science Center Bycatch Reduction Program**

*BREP Funding Provided*
$80,451

*Location of Research*
Southeast Fisheries Science Center

*Resource Challenge*
This program develops gear and techniques to prevent or reduce the incidental capture of protected and non-target species (bycatch) in commercial marine fisheries of the Southeast Region. The program promotes best-use practices of bycatch reduction technology by fishers through dedicated outreach activities (workshops and dockside visits) and publication of technical manuals and instructional videos. It also provides training and assistance to fishers to promote best use practices. In addition, the program provides training to marine law enforcement agencies to further their capacity in conducting compliance inspections of federally required bycatch reduction gear.

*Project Summary*
A mission of NMFS' Southeast Fisheries Science Center (SEFSC) Harvesting Systems Unit (Unit) is to develop, evaluate and implement new gear and techniques to address critical marine fisheries bycatch issues from North Carolina to Texas. Current research includes:

- Developing gear and techniques to reduce finfish bycatch in the shrimp fishery;
- Developing and testing new turtle excluder device (TED) designs for the shrimp fishery and for fisheries that may have a future TED requirement;
- Testing the efficacy of "weak hooks" designed to release bluefin tuna while retaining yellowfin tuna in the Gulf of Mexico pelagic longline fishery; and
- Reducing the incidental capture of sea turtles in gillnet fisheries.

Additionally, the Unit provides outreach and training in bycatch reduction technology to fishers and marine law enforcement agencies through a dedicated "Gear Monitoring Team." The Unit also works extensively with international gear researchers, working collaboratively to address bycatch issues that are held in common.

*Developments in Gear Technology Achieved*
During FY09, the SEFSC bycatch reduction program conducted testing of new TED designs for the shrimp and flynet fisheries. The new TED designs were tested for sea turtle exclusion efficacy, and, pending regulatory publication, the "Big Boy" TED will be available for use in the Southeast shrimp fishery, and the "Flexible-flat bar TED" will be approved for use in the mid-Atlantic croaker fishery. Additionally, a new, triangular TED opening design will be approved, which will offer added strength to the TED system, particularly for TEDs used in large fish trawls.

*Improvements and Reduction in Bycatch Associated with This Project*
The project continued the collection of data from the Gulf of Mexico pelagic longline fishery in testing weak hook technology for the reduction of bluefin tuna bycatch. Results from FY09 testing supported FY08 research showing that the experimental hooks may reduce blufin tuna bycatch by as much as 75%.

Collaborative work with international gear researchers in Trinidad, French Guiana, and Mexico furthered the SEFSC's understanding of bycatch reduction technologies and potential application in U.S. fisheries. Results from tests using modified gillnets to reduce leatherback sea turtle entanglements in Trinidad indicated that the experimental, low-profile nets (Figure 5) captured 45% fewer turtles than the control, with less than 20% loss of target catch. Also, experimental net damage attributed to sea turtle interactions was less than half than the controls. SEFSC diver-gear specialists conducted evaluations of the Red Selectiva, a shrimp trawl designed by the Instituto Nacional de Pesca, Mexico, for improved fuel efficiency and bycatch reduction. SEFSC collaboration with gear researchers in French Guiana has resulted in the adoption of TED technology by the French Guiana industrial shrimping fleet. Testing of a TED with two-inch bar spacing in French Guiana has shown promise for finfish bycatch reduction and has spurred interest in this TED modification by U.S. fishers. The SEFSC is currently evaluating a two-inch modified TED in the Gulf of Mexico shrimp fishery.

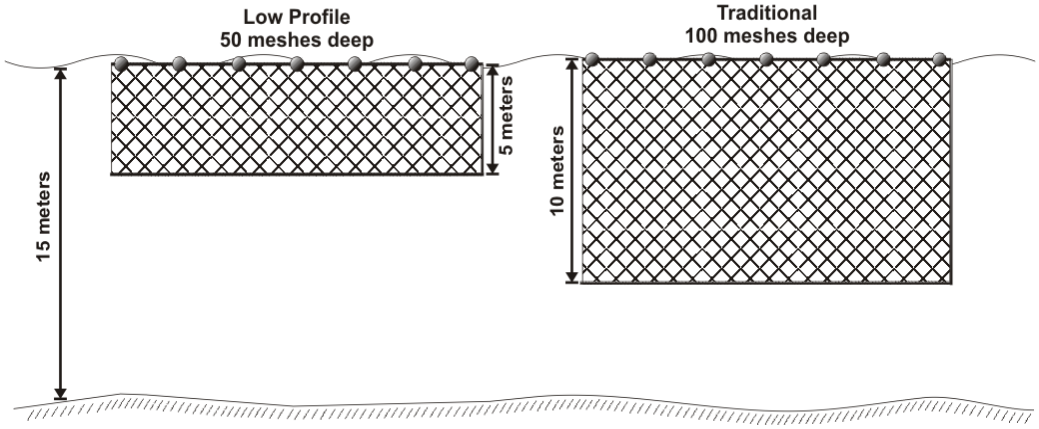


**Figure 5. Traditional and low-profile gillnets tested in Trinidad in 2007 and 2009.**

An important component of the bycatch reduction program is the dedicated effort to conduct fisher outreach and training in bycatch reduction technologies and techniques. Such activities are essential during all phases of bycatch reduction technology development, including prototype development, proof of concept testing, usability testing, and post-regulatory monitoring of device performance. Mechanisms to obtain fisher feedback on the performance of bycatch reduction measures are equally important. To facilitate this feedback, the Unit has developed the Gear Monitoring Team (GMT), a mobile sub-unit interfacing with fishers through dockside visits and workshops. The GMT also provides training to marine law enforcement to improve their understanding of regulated gear. At-sea training is conducted using the GMT's own 26-foot rigid-hull inflatable boat, the GMT1 (Figure 6).

**Figure 6. SEFSC Gear Monitoring Team outreach and training boat GMT1.**

*Project Title*
**Sea Turtle Excluder Device Technology; Evaluations and Fisher Outreach**

*BREP Funding Provided*
$50,500

*Location of Research*
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 SEFSC Harvesting Systems Unit (Unit) conducts ongoing research to improve TED efficiency for sea turtle exclusion and shrimp retention. Industry concepts directed at improving TED performance are evaluated through an annual TED testing project during which NMFS' diver-TED specialists perform certification testing of new devices using captive-reared juvenile sea turtles. Fishery-dependent testing of candidate TEDs to assess target catch retention is also supported by the Unit. The potential expansion of the TED requirement to other fisheries (skimmer gear and the mid-Atlantic croaker fishery) has prompted the development and testing of new TED designs.

*Project Summary*
The project consists of the following performance measures:

<u>TED Research and Development</u>
- Development of improved TED designs through collaborative efforts with 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.

<u>Performance Monitoring and Reporting</u>
- Analyses and reporting of TED certification data.
- Monitoring and evaluation of TED operational performance.
- Technical recommendations and assistance in drafting language for rulemaking.

<u>Industry Outreach</u>
- Technical training for net shops and fishers in TED construction and installation.
- Development of instructional media to assist fishers.

<u>Enforcement Training</u>
- Technical training and assistance for NMFS, U.S. Coast Guard, and State law enforcement agencies.

*Developments in Gear Technology Achieved*
Alternative techniques were required to conduct TED catch retention testing in the flynet fishery because of the high volume of catches and vessels rigged to tow single nets. High between-tow variability prevented the use of traditional techniques such as "alternate haul" or "two-vessel paired tows." The trouser trawl technique was selected as the most

cost-effective way to determine catch loss associated with TED use in the flynet fishery. A traditional 85-foot flynet was modified with a dividing panel and two separate codends. Testing was conducted during the 2008 and 2009 fishing seasons on a prototype TED that is capable of flexing during storage on net reels, which are common in the fishery, and remaining straight when towed (Figure 7).

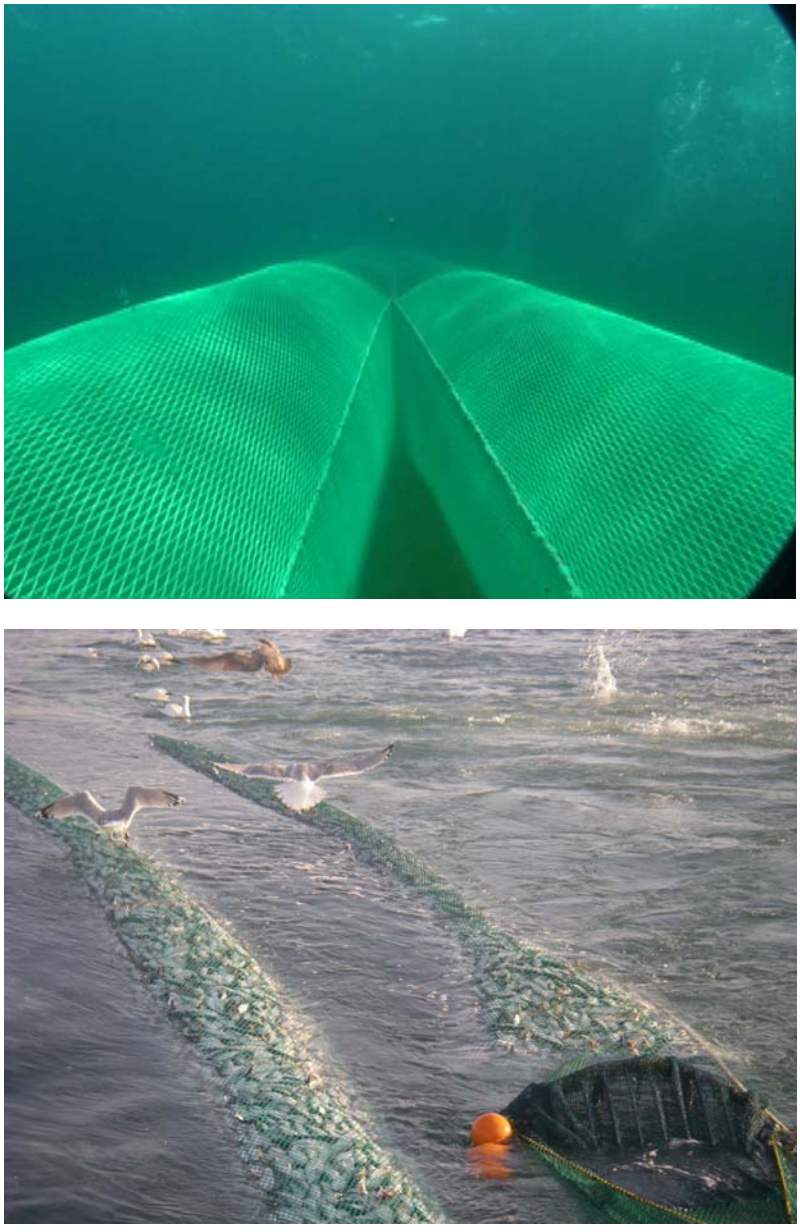

**Figure 7. Flynet trouser trawl turtle excluder device (TED) catch retention testing.**

*Improvements and Reduction in Bycatch Associated with This Project*
The TED developed for use in the flynet fishery was constructed of aluminum flat bar with a center section composed of stainless steel cable, which allows it to flex. Target catch loss for this TED was 6.7% (95%CI -28.0% to 14.6%). In addition, unwanted catch of spiny dogfish (*Squalus acanthias*) and clearnose skates (*Raja eglanteria*) were reduced by 40% and 63%, respectively. During usability testing aboard commercial vessels, handling of the TED was relatively easy with a small learning curve required to prevent gear damage. The TED was also tested for turtle exclusion utilizing the standard small turtle test required for all TEDs certified for use in U.S. fisheries. The flynet TED passed in a top-opening configuration, excluding 24 out of 25 turtles. The TED will undergo additional usability testing prior to implementation into the fishery.

At-sea inspections of gear by NMFS gear specialists and well-trained marine law enforcement personnel continue to be the most effective means of sustaining compliance with TED regulations. This effort also is most effective in reaching the fishing industry with information on regulated gear requirements and best-use methods. As a component of this project, a Gear Monitoring Team (GMT) has been developed to provide direct training to fishers and marine law enforcement on the technical requirements of TEDs and bycatch reduction devices. During 2009, the GMT conducted 69 at-sea boardings on commercial vessels operating in the Gulf of Mexico and South Atlantic. A total of 31 training sessions have been conducted by the GMT for commercial fishermen and federal and state law enforcement groups throughout the Gulf of Mexico and the South Atlantic.

*Project Title*
**The Effects of Neodymium/Praseodymium (NdPr) Alloys on Shark Bycatch**

*BREP Funding Provided*
$49,500

*Location of Research*
Pacific Islands Fisheries Science Center

*Resource Challenge*
The incidental capture of sharks is estimated at over 300,000 metric tons annually, and often comprises a large proportion of total catch. For example, sharks comprise > 25% of the total catch in Australian and Fijian tuna longline fisheries and comprise ~15% of the total catch in the Hawaii-based longline fisheries, with substantial catches (>50% of total catch) in the swordfish longline sector prior to 2002. Because sharks are among the top predators in marine ecosystems, the continued depletion of their populations could result in detrimental cascading effects for marine biodiversity.

*Project Summary*
Highlights:

1. Conducted coastal longline trials examining the effects of Nd/Pr alloys on scalloped hammerhead sharks. (Hawaii)
2. Conducted longline trials examining the effects of Nd/Pr alloys on blue and mako sharks. (California)
3. Conducted a pilot study in an Eastern Tropical Pacific (ETP) longline fishery examining effects of alloys on mixed shark species. (Ecuador)
4. Conducting behavioral studies examining feeding behaviors of captive sharks in relation to Nd/Pr alloys. (Hawaii)

Summaries:
*1. Conducted coastal longline trials examining the effects of Nd/Pr alloys on scalloped hammerhead sharks.* In cooperation with the Hawaii Institute of Marine Biology (HIMB, University of Hawaii) located in Kaneohe Bay, Oahu, we conducted fishing experiments with bottom-set longline gear targeting juvenile scalloped hammerhead sharks (*Sphyrna lewini).* Bottom-set longline gear contained branchlines that alternated between control 45g lead weight and 45g Nd-Pr weight. Results from 19 bottom longlines yielded a total of 59 scalloped hammerhead sharks, with 18 sharks caught on hooks with Nd-Pr metal weights and 41 sharks caught on hooks with control lead weights. The mean catch rate of control branchlines was 0.019 CPUE (sharks/hook-hour) versus 0.008 CPUE on branchlines with NdPr metal (Figure 8), which represents a 58% decrease in catch rate. Analysis with the Wilcoxon Matched-Pairs signed ranks test indicates a significant decrease in shark catch on NdPr branchlines (n=19, P-value = 0.013).

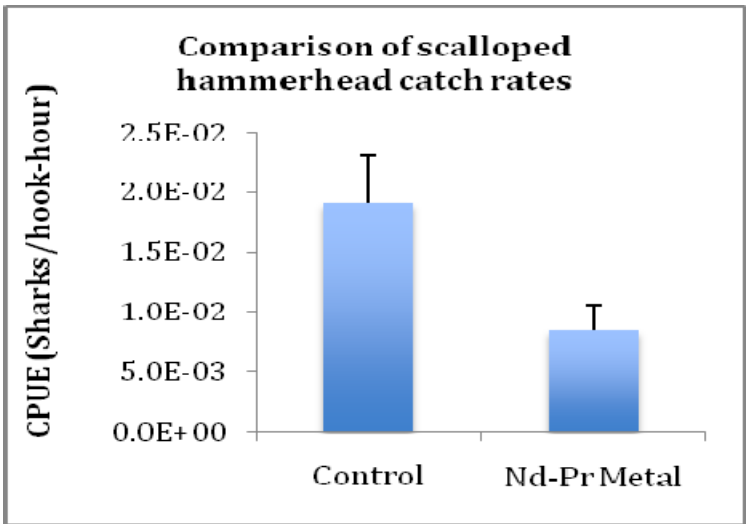


**Figure 8. Comparison of scalloped hammerhead catch rates.**

*2. Conducted longline trials examining the effects of Nd/Pr alloys on blue and mako sharks.* In collaboration with HIMB and NMFS' Southwest Fisheries Science Center, we were able to conduct longline trials off the coast of Southern California with the commercial longliner F/V Southern Horizon. Longlines were composed of 200 branchlines in which branchlines with lead weight were alternated with branchlines with Nd/Pr metal weight. The number of floats was adjusted so that there were four branchlines between floats. A total of 25 longlines were set. The catch was composed of primarily mako sharks (*Isurus oxyrinchus*, n=117 caught) and blue sharks (*Prionace glauca*, n=37 caught) (Table 2). Analysis of catch data is ongoing, though initial analysis indicates no difference in the catch rates of blue and mako sharks between control branchlines with and without Nd/Pr metals.

**Table 2. Catch numbers from longlines set off the coast of California.**

| | Caught on Nd/Pr | Caught on Control | Total Caught |
|---|---|---|---|
| Mako Shark | 61 | 56 | 117 |
| Blue Shark | 17 | 21 | 37 |
| Common Thresher | 0 | 1 | 1 |
| Dorado | 0 | 1 | 1 |
| Hammerhead Shark | 1 | 0 | 1 |
| Mackerel | 3 | 2 | 5 |
| Mola Mola | 1 | 0 | 1 |
| Pelagic Stingray | 8 | 5 | 13 |
| Spiny Dogfish | 1 | 0 | 1 |

3. *Conducted a pilot study in an Ecuadorian longline fishery examining effects of* Nd/Pr metals *on mixed shark species*. In collaboration with the Ecuadorian Subsecretaria de Recursos Pesqueros del Ecuador and the NMFS Southwest Regional Office, we initiated a pilot study in the Ecuadorian artisanal longline fisheries targeting tunas, billfish, and sharks. In this study we conducted longline trials in an area to the Northwest of Manta,

Ecuador. Longlines were composed of 300 branchlines, and, as in the other longline trials, we alternated branchlines that had lead control weights with branchlines that had Nd/Pr metal weights. Three sets were deployed over three days of fishing. Catch was low due to poor conditions and competition from other longline fishing boats in the area. Nonetheless, we caught pelagic thresher sharks (*Alopias pelagicus*), silky sharks (*Carcharhinus falciformis*), and scalloped hammerhead sharks (*Sphyrna lewini*) (Table 3). In addition, we developed excellent research collaboration with Ecuadorian fisheries researchers and a working relationship with Ecuadorian fishers interested in developing sustainable fishing strategies. We also developed a much better understanding of the operational requirements in this artisanal fishery.

**Table 3. Catch numbers from longlines set off the coast of Ecuador.**

| | Caught on Metal | Caught on Control | Total Caught |
|---|---|---|---|
| Pelagic thresher | 3 | 5 | 8 |
| Silky shark | 2 | 1 | 3 |
| Scalloped hammerhead | 1 | 1 | 2 |
| Mahi Mahi | 2 | 2 | 4 |

*4. Conducting behavioral studies examining feeding behaviors of captive sharks in relation to Nd/Pr alloys.* In collaboration with HIMB, we are currently conducting behavioral experiments with juvenile scalloped hammerhead sharks to examine feeding and swimming behaviors in response to electropositive metals, electric fields generated by electrodes, hydrogen gas bubbles, and small amounts of Nd and Pr oxides. Protocols have been developed utilizing eight hammerhead pups in 114 feeding and swimming observations.

*Developments in Gear Technology Achieved*

In conducting these experiments, we have developed a system of assays that can used to test a variety of potential shark bycatch deterrents and determine their usefulness in commercial fisheries. The Nd/Pr alloy is one such deterrent that may be useful in reducing shark interactions with pelagic longline gear. However, experiments with pelagic shark species suggest that there will be species-specific effects. A next step to develop this bycatch reduction technology is to examine the effects of this metal on a variety of shark species and target fish in a pelagic longline fishery. Our pilot study in Ecuador provides us with an ideal location to field test innovative gear technologies.

*Improvements and Reduction in Bycatch Associated with This Project*

We are in the process of developing a shark bycatch reduction strategy that may significantly reduce some species of shark interactions with pelagic longline gear. This project has supported the following publication and symposium abstract:

Brill, R., P. Bushnell, L. Smith, C. Speaks, M. Sundaram, E. Stroud, and J.H. Wang. 2009. The repulsive and feeding deterrent effects of electropositive metals on juvenile sandbar sharks (*Carcharhinus plumbeus*). *Fish. Bull.* 107: 298-307.

Wang, J.H., M. Hutchinson, L. McNaughton, K. Holland, and Y. Swimmer. 2009. Use of electropositive metals to reduce shark feeding behavior. 60th Tuna Conference, Lake Arrowhead, CA.

*Project Title*
**Incidental Take and Post-Release Mortality of Blue Sharks in the U.S. West Coast Drift Gillnet and Longline Fisheries for Swordfish**

*BREP Funding Provided*
$46,615

*Location of Research*
Southern California Bight and Southwest Fisheries Science Center

*Resource Challenge*
This project focuses on blue shark bycatch and mortality in the California- and Oregon–based drift gillnet (DGN) and the Hawaii- and former California-based shallow-set longline (LL) swordfish fisheries. Shark fishery interaction rates and population status have received recent national and international attention. Because of their vulnerable life history characteristics, sharks are particularly susceptible to overfishing. Blue sharks were ranked first in number for bycatch species in the LL fishery and are ranked second in number in the DGN fishery, yet the majority of sharks that are caught are returned to sea. Roughly 35 percent of all blue sharks caught in the DGN fishery are returned to sea alive, but their post-release survivorship is unknown, making it impossible to estimate the fishery mortality as needed to develop sound population assessments. We will determine the post-release survivorship of blue sharks released alive from the DGN fishery and examine the spatial and temporal distribution of blue shark bycatch with respect to environmental factors and fishery dynamics. Through comparative analyses of blue shark bycatch with respect to swordfish catch in the two fisheries, we will identify times, areas, and gear configurations that optimize swordfish catch while minimizing blue shark bycatch.

*Project Summary*
The goals of this project are to:

1. Complete a study of blue shark post-release survival in the DGN fishery.
2. Conduct quantitative analyses to compare the ecological footprint and economic characteristics of the swordfish DGN and LL fisheries.
3. Design a robust experiment that will examine the ecological footprint and economic potential for a proposed LL fishery that would operate in the same general time and area as the current DGN fishery.
4. Design a series of robust experiments that will test gear modifications to reduce blue shark bycatch in the DGN and LL fisheries.

In order to study the survival rates of blue sharks released from the DGN fishery, 10 pop-off satellite archival tags have been deployed by observers in the fishery since 2006. In addition, a new data collection protocol has been developed to obtain more detailed data on the condition of all blue sharks released alive in the fishery. Using the new data collection protocol during the 2007 and 2008 seasons, we determined that 72% of blue

sharks released alive were in good or fair condition, whereas 28% sustained major injury or stress. The 10 tagged blue sharks released were in good or fair condition, and none suffered a post-release mortality. These preliminary results allow for estimation of the post-release survival of blue sharks from this fishery, enabling the use of better fishery mortality estimates in stock assessments and to guide management of this fishery. An additional eight tags purchased in part with Bycatch Reduction Engineering Program funding have been given to observers to deploy during the 2009 fishing season on smaller sharks and on some in poor condition so that this study can better address survival of sharks of the sizes and conditions represented in the catch.

In order to examine bycatch of blue sharks in the west coast-based swordfish fisheries, fishery logbook and observer data from the California/Oregon DGN fishery and the former California-based LL fishery have been incorporated into a spatial analytical platform developed by colleagues at the University of Southern California (Figure 9). We have contracted a biologist/fishery data analyst to develop a probability density model of blue shark habitat based on physical and biological oceanographic data. Data from the Hawaii-based swordfish LL fishery are forthcoming and will help refine the model. Investigators have developed a preliminary design of a side-by-side comparison study using LL and DGN gear and employing a suite of potential shark deterrents.

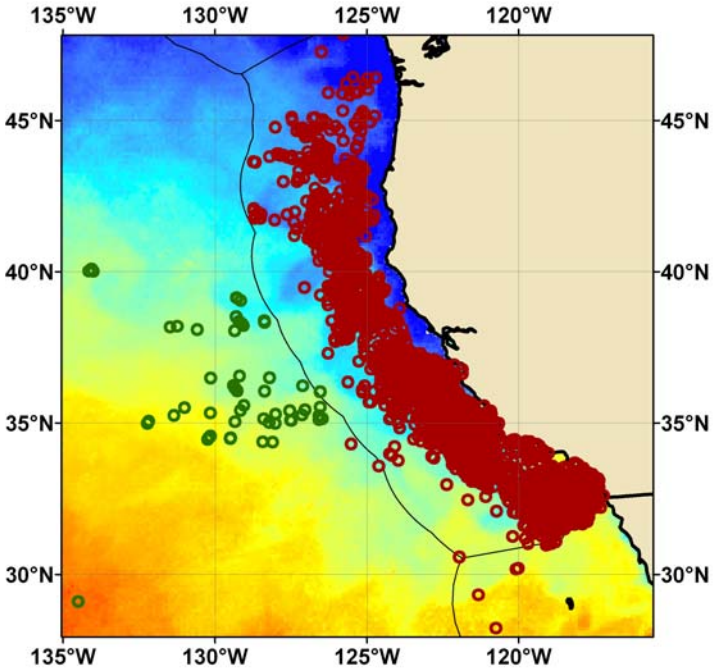


**Figure 9. Distribution of blue shark catch with respect to sea surface temperature in the DGN (red) and LL (green) fisheries.**

In order to study the survival rates of blue sharks released from the DGN fishery, 10 pop-off satellite archival tags have been deployed by observers in the fishery since 2006. In addition, a new data collection protocol has been developed to obtain more detailed data

on the condition of all blue sharks released alive in the fishery. Using the new data collection protocol during the 2007 and 2008 seasons, we have determined that 72% of blue sharks released alive are in good or fair condition, whereas 28% have sustained major injury or stress. The 10 tagged blue sharks released were in good or fair condition, and none suffered a post-release mortality. These preliminary results allow for estimation of the post-release survival of blue sharks from this fishery, enabling the use of better fishery mortality estimates in stock assessments and to guide management of this fishery. An additional eight tags purchased in part with Bycatch Reduction Engineering Program funding have been given to observers to deploy on smaller sharks and some in poor condition during the 2009 fishing season so that this study can better address survival of sharks of the sizes and conditions represented in the catch.

*Developments in Gear Technology Achieved*

New developments in gear technology have yet to be achieved. Analysis of the historical fishery data will help identify whether LL gear should be proposed as either a complement or as an alternative to DGN gear for targeting swordfish in order to minimize bycatch of blue sharks and other vulnerable non-target species. Investigators plan to test gear modifications, including the use of potential shark deterrents, and compare LL and DGN target and non-target catch rates off the California coast in 2010.

*Improvements and Reduction in Bycatch Associated with This Project*

No improvements or reductions have been achieved yet. Once the previously described analyses have been completed, a habitat-based model will be developed to identify areas in time and space where the catch of swordfish relative to blue sharks and other key bycatch species is optimal. The model will also incorporate comparative fishery economics data in order to design an economically viable alternative to current fishing practices.

*Project Title*
**NMFS National Seabird Workshop**

*BREP Funding Provided*
$41,959

*Location of Research*
Alaska Regional Office

*Resource Challenge*
Although seabirds may be impacted by both direct (e.g., incidental catch, gear entanglement, bycatch) and indirect (e.g., prey availability, ecosystem interactions) effects, to date the primary focus of the National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries (NPOA-Seabirds), and thus of the National Seabird Program, 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, it will be addressed through a variety of efforts: gear research; requirements for mitigation measures; outreach; continued monitoring and estimation of bycatch. NMFS Regions are at various stages of NPOA-Seabirds implementation. Recent guidance from the United Nations' Food & Agriculture Organization's Committee on Fisheries called on nations to also address seabird impacts from other relevant fishing gears, including trawls and gillnets.

An overarching strategic plan is needed to guide NMFS in addressing its responsibilities for seabirds, which interact with fisheries in the marine environment and act as indicators of ecosystem health. In September 2009, a National Seabird Workshop (Workshop) was held in Seattle, Washington, at the NMFS Alaska Fisheries Science Center, to develop such a strategic plan.

*Project Summary*
The Workshop's primary objective was to initiate the development of a seabird implementation plan at both the national and regional levels that could be used to:

- Describe and provide insights regarding NMFS seabird activities and important partnerships with management entities including the U.S. Fish and Wildlife Service;
- Guide NMFS management and science; and
- Provide input to the NMFS long-term planning and budget process.

Within this context, other objectives addressed at the Workshop included:

- Networking among NMFS seabird contacts;
- Becoming informed about NMFS regional seabird activities;
- Identifying regional and national seabird priorities and resource gaps;

- Addressing how to implement Magnuson-Stevens Fishery Conservation and Management Act section 316 requirements, regionally and nationally; and
- Developing seabird-related performance measures.

*Developments in Gear Technology Achieved*
No developments in gear technology were achieved with this project, but the long-term results of the Workshop should lead to increased NMFS support for gear technology to reduce seabird—fisheries interactions.

*Improvements and Reduction in Bycatch Associated with This Project*
All Workshop objectives were achieved. A NMFS Seabird Strategic Plan is being developed and will be used to guide NMFS management and science with respect to the seabird component of the marine ecosystem. The Workshop report and the Seabird Strategic Plan will be available in 2010.

*Project Title*

**Reducing Bycatch in the Southeast U.S. Penaeid Shrimp Fishery: A Pilot Study to Assess Catch Rates of Shrimp and Finfish Catch and Bycatch using TEDs with Reduced Bar Spacing**

*BREP Funding Provided*

$41,800

*Location of Research*

Southeast Fisheries Science Center

*Resource Challenge*

Measures to reduce finfish bycatch in the Southeastern U.S. shrimp fishery have led to the development of bycatch reduction devices (BRDs). Currently approved BRDs rely on the swimming behavior of fish to escape 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 shrimp-to-fish bycatch ratios during late summer and fall fishing periods in the Gulf of Mexico spurred interest from fishers in evaluating TEDs with reduced bar spacing as a means of excluding fish from the catch.

*Project Summary*

The project is designed to conduct comparison tows between a TED with two-inch deflector bar spacing and a traditional TED with four-inch bar spacing as a means of assessing differences in bycatch and shrimp catch rates. This study focuses on the offshore fishing areas of Texas and inshore areas of Mississippi and Alabama during the fall-winter fishing period. Two commercial shrimp trawlers from Alabama and Texas have been contracted for the study, and comparative testing has begun.

*Developments in Gear Technology Achieved*

Due to a delay in the processing of project funding and contract procurements, the project was not started until early October 2009. Comparison tows with commercial trawlers are underway in Alabama and Texas and will continue through December 2009.

*Improvements and Reduction in Bycatch Associated with This Project*

Although results from this study are not yet available, the evaluation of TEDs with reduced bar spacing as a means of improving bycatch reduction is being pursued by other fisheries researchers including those at the Georgia Marine Extension Service. International studies have shown as much as a 30% reduction in finfish bycatch with two-inch TEDs when compared to four-inch TEDs, with no difference in catches of shrimp.

*Project Title*
**Green Stick Gear Bycatch and Bycatch Mortality Characterization in the Atlantic Tuna Fishery**

*BREP Funding Provided*
$39,000

*Location of Research*
Office of Sustainable Fisheries

*Resource Challenge*
Bycatch and bycatch mortality associated with certain gears such as pelagic longline (PLL) in Atlantic highly migratory species fisheries continue to be a source of ongoing concern. Efforts to reduce bycatch and bycatch mortality of undersized fish and prohibited species in the PLL fishery through the implementation of circle hook requirements, required bait types, and closed areas have been successful, but at a high cost to fishermen. Continued exploration of other technology and fishing practices may aid in reducing bycatch and bycatch mortality and provide additional management options.

Green-stick fishing gear is used to catch Atlantic tunas, with yellowfin tuna accounting for approximately 82% (by weight and number) of the catches made with the gear. Green-stick gear is trolled and consists of a 35-to-45-foot fiberglass pole and a 400-to-800-foot mainline that is elevated or suspended above the water (Figure 10). Tension on the mainline is maintained by towing a device called a "bird," which is a three-to-four-foot sled made of wood and/or fiberglass. From the mainline, up to 10 hooks or gangions extend down to the water's surface. Baits may be natural or artificial and skip across the surface of the water as the gear is trolled. The gear often has a power haul-back capability that reduces the fight time of caught fish.

Green-stick gear has been touted among tuna fishermen because of high catch ratios, high quality of the fish brought to the dock, low bycatch, and low bycatch mortality of undersized fish or prohibited species. There is a lack of reliable data to support these claims, however. If these characteristics prove true, green-stick gear may be a management option with reduced bycatch and bycatch mortality compared to some other fishing gears.

*Project Summary*
The purpose of this project was to determine whether green-stick gear used in the Atlantic tuna fishery has lower bycatch and bycatch mortality than PLL gear, particularly for bluefin tuna, Atlantic billfish, and other species. This project also was designed to determine what differences exist in operational requirements between green-stick and PLL gears (i.e., fuel consumption, proximity to tuna fishing grounds) and implications for vessel revenues.

**Figure 10. Green-stick fishing vessel. (Photo credit: National Marine Fisheries Service)**

The objectives of this project were to:

- Characterize the bycatch and bycatch mortality of green-stick gear used to target yellowfin tuna in the U.S. Atlantic Ocean;
- Characterize the areas where green-stick gear is used successfully for yellowfin tuna; and
- Compare the operational requirements of green-stick gear and PLL such as fuel consumption, size of vessel, size of crew, and cost of gear.

Because most green-stick gear fishing in the United States occurs in the mid-Atlantic area, NMFS partnered with the North Carolina Division of Marine Fisheries Observer Program and commercial fishermen in North Carolina. Observers were placed on board vessels that fished as they normally would with green-stick gear. Information was collected on catch, effort, how the gear was fished, area where the gear was fished, vessel size, crew size, and economic information such as fuel and gear costs. Project funds were used to cover the cost of sea time for participating vessels, train and place observers, and purchase the necessary supplies and equipment to appropriately monitor green-stick fishing gear aboard selected vessels.

*Developments in Gear Technology Achieved*
Data collection began in July 2009 and will continue possibly into 2010 depending on the frequency of fishing trips conducted by tuna fishermen participating in the study.

*Improvements and Reduction in Bycatch Associated with This Project*
Preliminary data have been collected from four fishing trips of one to three days in length. The catch during those trips included yellowfin tuna, skipjack tuna, blackfin tuna,

and dolphin fish. Bycatch during the trips included one undersized bluefin tuna and one sailfish, both of which were released alive and in good condition. Data collection is ongoing. These preliminary results are insufficient to draw any statistically significant conclusions regarding bycatch or bycatch mortality. Completion of the research project is needed to answer the research objectives outlined above.

*Project Title*
**Pilot Program to Investigate Seabird Interactions with Alaskan Groundfish Trawl Paravanes and Develop First-Generation Mitigation Measures**

*BREP Funding Provided*
$31,900

*Location of Research*
Alaska Fisheries Science Center

*Resource Challenge*
The short-tailed albatross (*Phobastria albatrus*) is an endangered species with habitat overlapping the groundfish fisheries in Alaska. There have been six observed takes of the short-tailed albatross in Alaskan longline fisheries. Although no known takes have occurred in the groundfish trawl fisheries, those fisheries were included in the 2003 Biological Opinion (BiOp), and the fisheries were allowed a take of two birds over the life of the BiOp, which was expected to be five years. The trawl fishery was included in this BiOp largely due to a report received from a scientist aboard a commercial groundfish trawl vessel that had deployed a paravane. A paravane is a device that trawl operators use to obtain signals from net monitoring equipment. The paravane receives acoustic signals as it is deployed at five or more fathoms deep via a boom alongside the vessel (Figure 11). Because seabirds attend vessels to take advantage of fish discharge, they may come into contact with this gear. In the report cited above, numerous interactions were observed in a short time period. This report and other information led to a Likely to Adversely Affect Determination for short-tailed albatross interactions with the Alaskan trawl fleet.

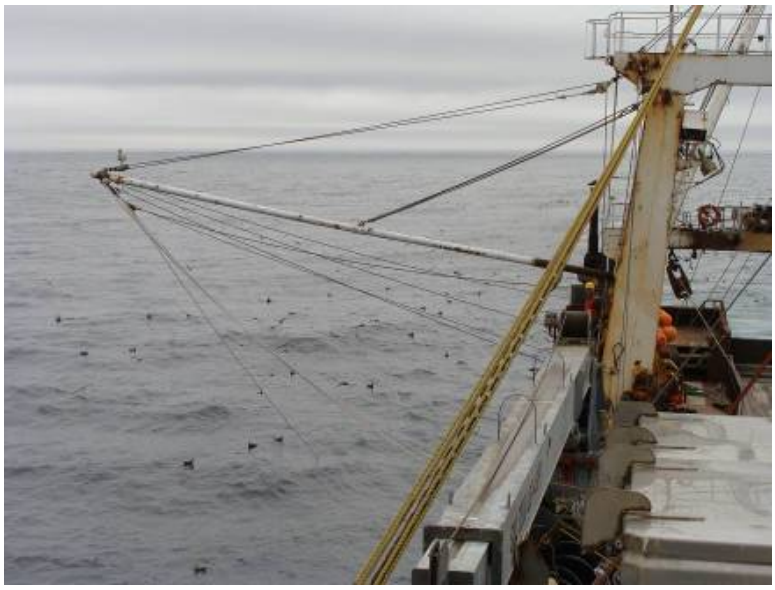

**Figure 11. A seabird/paravane interaction session. The paravane cable runs down into the water from near the end of the boom (and back to the vessel under the boom). All other lines control the boom or are used to deploy and retrieve the block used to deploy the paravane. (Photo credit: Todd Loomis, Cascade Fishing)**

*Project Summary*
With funding from the Bycatch Reduction Engineering Program and the National Cooperative Research Program, the AFSC conducted a pilot study on seabird interactions with paravanes in August 2009. This is the first study in the North Pacific on seabird—paravane interactions. The goals of this project were to learn about the basic usage of paravane gear, obtain baseline information on seabird interactions with the paravane gear, and attempt to develop and deploy at least three different types of mitigation measures. Industry partners included the North Pacific Fisheries Foundation and Cascade Fishing, Inc., owners of the fishing trawler *Seafisher*.

A biologist experienced with seabird mitigation was deployed to the trawler *Seafisher* for one trip, August 8 through 16. During this period we were able to achieve all the stated goals of the pilot project, including observation sessions of seabird—paravane interactions without mitigation measures and with several different mitigation measures. The crew and biologist cooperatively tested six different types of mitigation measures. There were no seabird mortalities or injuries associated with the paravane during this trip. Interaction rates varied from 0 to 138 per 15-minute observation session. Nearly all interactions were by Northern Fulmars (*Fulmaris glacialis*) and were with the paravane cable itself rather than the various lines supporting or controlling the paravane boom.

*Developments in Gear Technology Achieved*
This pilot project was able to test several "first generation" mitigation measures (Figure 12), and project investigators learned a great deal about which types of measures might prove effective while also not interfering with a vessel's ability to deploy paravane gear and ensure crew safety is maintained. This work will form the basis of future testing through a more rigorous scientific approach.

**Figure 12. Mitigation measure using streamers similar to those deployed in the longline fishery, where seabird bycatch has been reduced by 65% (and albatross bycatch reduced by 90%). The paravane cable is on far right, angling down into the water. (Photo credit: Jeff Pesta, NMFS Alaska Fisheries Science Center)**

*Improvements and Reduction in Bycatch Associated with This Project*
Field work was completed in August 2009, and data analysis and reporting will be completed in early 2010. Several mitigation measures appeared to be effective in reducing seabird interactions with the paravane cable, and we learned that there were few interactions with the actual boom or various lines controlling the boom itself.

*Project Title*
**Collaborative Research on Reducing Post-Release Mortality for Common Thresher Sharks Captured in the Southern California Recreational Fishery**

*BREP Funding Provided*
$31,000

*Location of Research*
Southwest Fisheries Science Center, Southern California Bight

*Resource Challenge*
The common thresher shark (*Alopias vulpinus)* is the target of a popular and expanding recreational fishery in Southern California. The large size of the sharks, their high food-value, and the proximity of fishing operations to local ports has collectively led to the recent expansion of the fishery. Although long-term comprehensive landings data are lacking for the recreational fishery, direct observations, fishing tackle sales, and weigh-station records all suggest a dramatic increase in fishing catch and effort over the past six years. The primary techniques employed in the recreational thresher shark fishery entail trolling heavy baited lures with large J-type hooks through well-known spawning and feeding aggregation areas (e.g., canyon heads and nearshore banks) in the Southern California Bight. Because thresher sharks utilize their elongate upper caudal fin to stun live prey before it is consumed, >90% of sharks are foul-hooked and subsequently hauled in backwards during the fight. Like most pelagic species, common thresher sharks must move forward to effectively extract oxygen from the water. Recent trends in the fishery suggest a conservation movement toward catch-and-release fishing, a tactic that can only be effective if the released sharks survive the fight. The high incidence of tail-hooking and the unknown fate of released sharks further complicate the design of an effective management strategy for this valuable resource. The goals of this research plan were to assess post-release mortality rates in the southern California fishery and investigate alternative fishing techniques that may increase survivorship in released sharks.

*Project Summary*
This project quantified post-release mortality for common thresher sharks captured in the recreational fishery off Southern California. The project also focused on the development of alternative fishing gear types that may increase post-release survivorship in this growing fishery. The post-release mortality assessment was conducted using pop-off satellite archival tags (PSATs) deployed on sub-adult and adult common thresher sharks. The PSATs were deployed from March 2007 through May 2009 on thresher sharks caught using Southern California fishery standard techniques (Figure 13). Concurrent investigations of the physiological indicators of capture stress for tail-hooked sharks (i.e., blood biochemistry, stress proteins) were also performed to compare with mouth-hooked individuals (Figure 14). This work couples laboratory and field investigations to further understand post-release survivorship in this popular fishery.

**Figure 13. An exhausted female thresher shark (180 cm fork length) is tagged and released following a 55-minute tail-hooked fight. (Photo by Richard Herrmann)**

**Figure 14. Extracting a blood sample from a juvenile mouth-hooked thresher shark prior to release (blood was not taken from tagged individuals).**

Increased accessibility to thresher sharks for tagging and blood biochemistry samples was made possible due to concurrent National Science Foundation (NSF)-funded research (NSF grant # IOS -0617384) aimed at investigating the muscle physiology of the common thresher shark.

Specific objectives of this project were to:

1. Determine a catch-and-release mortality estimate for the recreational fishery and disseminate the results to managers for use in determining annual removals and improving stock assessment parameters.
2. Evaluate the capture stress response by comparing the blood chemistry and stress-induced response from mouth- and tail-hooked thresher sharks.
3. Investigate the use of alternative gear types to reduce post-release mortality.
4. Develop a public outreach and educational program directed at reducing post-release mortality and promoting sustainable practices in the recreational fishery.

*Results*

PSATs were deployed on 19 sub-adult and adult thresher sharks (160 to 230 cm fork length (FL)) captured using fishery standard techniques. Fight times ranged from 45 to 140 minutes, with the longer periods typically resulting in slower, more lethargic boat-side behavior. From the PSAT records it was determined that all individuals with fight times less than 75 minutes survived the acute effects of catch and release. Immediate post-release mortality was observed in all five common threshers (205-230 cm FL, 3 female: 2 male) that fought on the line for periods >85 minutes. The post-release mortality estimate obtained in this study was 26%. These results suggest a relatively high mortality rate for tail-hooked common thresher sharks released in the southern California fishery. Because mortality was only observed in the largest individuals with fight times >85 min, encouraging the use of gear and methods that reduce fight times may be a plausible avenue for reducing mortality in this fishery. Initial findings from the blood analyses suggest a marked difference in the molecular stress response of the red blood cells and the plasma ionic content from sharks captured by the mouth and by the caudal fin. The final biochemical analyses will be combined with results from the field tagging trials and prepared for publication in 2010.

*Developments in Gear Technology Achieved*

Experimental gear trials were conducted in 2009 during efforts to capture mouth-hooked thresher sharks for the blood biochemistry experiments. Field trials were primarily based on replacing the J-hooks currently used in the fishery with circle hooks. Six of the ten individuals caught using these alternative techniques were hooked in the mouth. However, the use of circle hooks did not eliminate the incidence of foul-hooking. Although the initial gear trials indicated that the use of circle hooks may reduce the number of foul-hooked sharks captured in the recreational fishery, additional field trials are necessary to determine the effectiveness of this gear modification.

*Improvements and Reduction in Bycatch Associated with This Project*
A strong public outreach component was incorporated into this project to encourage active participants in the fishery to assist in the development of alternative fishing methods that reduce foul-hooking and increase mouth-hooking. These public forums were also used to disseminate information on best fishery practices and methods aimed at safe release.

Over 500 recreational fishermen attended the 6 seminars offered in 2008 and 2009, with over a dozen dedicated anglers willing to participate in the additional gear trials. The project team participated in numerous fishing radio shows and submitted informative articles to popular recreational fishing magazines and newsletters to provide additional outlets for informing stakeholders of the project.

*Project Title*

**Testing Footrope Modifications Designed to Reduce the Bycatch of Demersal Groundfish and Megafaunal Invertebrates, and Reduce Physical Impacts on Invertebrates in the Ocean Shrimp (*Pandalus jordani*) Trawl Fishery**

*BREP Funding Provided*

$28,234

*Location of Research*

Northwest Fisheries Science Center and Oregon Department of Fish and Wildlife

*Resource Challenge*

The mandatory use of bycatch reduction devices (BRDs) and voluntary industry-led changes in footrope configuration have reduced groundfish bycatch in the ocean shrimp (*Pandalus jordani*) trawl fishery by between 66-88% from historical levels (Hannah and Jones 2000, Hannah and Jones 2007). However, the remaining bycatch includes the juveniles of some commercially important groundfish species, including darkblotched rockfish (*Sebastes crameri*) and Pacific ocean perch (*S. alutus*) (Hannah and Jones 2005). These two species are currently considered overfished, and fishery yields are now limited by long-term federal rebuilding plans for these species. The presence of these two groundfish species within the residual bycatch of the shrimp trawl fishery argues for additional bycatch reduction in this fishery, if it is technically feasible.

Research to date on shrimp trawl footropes suggests that it may be possible to develop efficient shrimp trawls with footrope designs that reduce both impacts on megafaunal invertebrates and the bycatch of small demersal fishes (Hannah and Jones 2000, Hannah and Jones 2003). Specifically, shrimp trawls that use chain droppers but lack a continuous groundline may be feasible. This type of trawl footrope has been used in the past by a few Oregon vessel operators with good results. However, to be implemented as a fishery management measure, trawls without continuous groundlines need to be evaluated more robustly to determine how they can be constructed to reliably reduce the bycatch of small demersal fish and to determine how much they reduce impacts on megafaunal invertebrates.

*Project Summary*

During the May/June 2010 timeframe, a single three-day cruise will be used to evaluate the effect of the footrope configurations on benthic megafaunal invertebrates. Investigators will mount a remote underwater video system on the footrope of each net and record interactions between macroinvertebrates and the two footropes. In 2009, a new cantelivered frame was developed at the Oregon Department of Fish and Wildlife to position a video camera forward of the shrimp trawl's footrope. Investigators will analyze videotapes, and encounters between the footrope and invertebrates will be enumerated, scored, and compared between the two footrope configurations.

To determine how the lack of a continuous groundline influences the bycatch of small demersal groundfish, we will compare catches between port and starboard nets on a

double-rigged shrimp trawler, with each net utilizing a different footrope configuration. One net will use a footrope configuration in which the chain or cable groundline has been removed and heavy drop chains added so that they attach to the fishing line and hang directly down toward the seafloor. The number and gauge of the drop chains will be adjusted to achieve identical fishing line height between the two nets so that the effect of the footrope configuration on catches can be isolated. Fishing line height will be measured using a recording inclinometer developed from NMFS bottom contact sensor technology (Hannah and Jones 2003). On the other net, a conventional footrope incorporating "ladder chains" that form a continuous groundline will serve as a control. Five days of testing is planned for June/July 2010 to evaluate the effect of footrope configuration on bycatch. Differences in shrimp catch and bycatch between the two nets will be evaluated (haul and footrope as main effects without interaction).

*Developments in Gear Technology Achieved*
During FY09 all of the gear development with regard to the shrimp trawls and in situ video camera systems was completed in preparation for spring 2010 field work. Field work was originally planned for late summer/early fall 2009, but contracting and permitting delays and unanticipated changes in the dynamics of the ocean shrimp fishery delayed the field portion of this project.

*Improvements and Reduction in Bycatch Associated with This Project*
Results from field work conducted in 2010 may lead to the development and use of shrimp trawl footrope designs that reduce both bottom impacts and the entrainment (bycatch and bycatch mortality) of small demersal fishes, including juvenile rockfishes.

*References*
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*Project Title*
**Commercial Longline Sea Turtle Mitigation**

*BREP Funding Provided*
$25,900

*Location of Research*
Southeast Fisheries Science Center

*Resource Challenge*
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. Federal regulations requiring the use of circle hooks, and careful release and handling methods for sea turtles have been adopted by the longline industry. To ensure best-use practices of these technologies, the SEFSC conducts regular industry outreach activities.

*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 gear in the Southeast region. During FY09, GMT personnel conducted multiple outreach events and dockside visits at primary Southeastern fishing ports as a means of promoting turtle-safe gear and handling techniques. Instruction focused on proper use of turtle de-hooking gear, as well as how-to information on gear fabrication. SEFSC gear specialists held workshops for Federal (U.S. Coast Guard) and State marine enforcement agencies to provide information on the technical aspects of the gear requirements, and tips on inspecting vessels for compliance.

*Developments in Gear Technology Achieved*
New sea turtle mitigation techniques for the bottom longline reef fish fishery were trialed under a Bycatch Reduction Engineering Program-funded study reported on the next page.

*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, FY09 efforts were focused on outreach and training. During FY09, the GMT conducted 8 training workshops for marine law enforcement as well as 16 dockside visits and workshops for fishers participating in the reef fish bottom longline and pelagic longline fisheries throughout the Southeast region.

*Project Title*
**Evaluation of Hook Guards, Larger Circle Hooks, and Non-offset Hooks in Preventing Interactions with Sea Turtles in the Gulf of Mexico Bottom Longline Fishery**

*BREP Funding Provided*
$22,634

*Location of Research*
Southeast Fisheries Science Center

*Resource Challenge*
A recent NMFS review of sea turtle interactions in the Gulf of Mexico reef fish fishery determined that the number of loggerhead sea turtle takes authorized in the 2005 Biological Opinion for the fishery has been exceeded. In response to this finding, NMFS has implemented an interim rule prohibiting bottom longlining for Gulf of Mexico reef fish inshore of the 35-fathom depth curve along the East Florida shelf. Pending approval of Amendment 31 to the Fishery Management Plan for Reef Fish Resources in the Gulf of Mexico, further regulatory actions will occur, including gear restrictions, seasonal area closures, and endorsement requirements for participating fishers. The expected economic impacts of these regulatory measures indicate that harvests, revenues, and expenditures will be negatively affected. The fishery represents the single largest source of commercially caught and marketed grouper in the United States and contributes significantly to many local and State economies, particularly along the west coast of Florida.

*Project Summary*
Industry groups have proposed to test several gear modifications that they feel may have potential in reducing sea turtle takes, including eliminating squid bait, reducing gangion length, increasing hook size, and using hook guards. During FY09, the NMFS Southeast Fisheries Science Center (SEFSC) Harvesting Systems Unit conducted a preliminary evaluation of bottom-set longline gear using NOAA diver-gear specialists. Underwater video was used to document the action of the mainline as it contacts the bottom as well as the fishing configuration of differing gangion lengths and prototype hook guards. Because a statistically robust, fishery-dependent evaluation of a single mitigation measure would require significant effort (100% observer coverage of more than 1,300 trips), other mitigation research is being considered. Some fishers feel that limiting bait soak time through shorter sets may reduce turtle interactions with no effect on target catch rates. A fishery-dependent experiment to test this concept has been proposed and submitted to the Bycatch Reduction Engineering Program for FY10 funding. The study will characterize the catch rates of target species as a function of bait soak time through the use of hook timers alternated throughout a longline set. New gear requirements for the fishery allow only 750 hooks to be fished at one time. Therefore, shorter soak times and more frequent hauls may be necessary in order for the fishery to remain cost-effective and competitive.

*Developments in Gear Technology Achieved*

The SEFSC obtained a better understanding of the fishing configuration of reef fish bottom longline gear during NMFS diver-gear specialist evaluations in Panama City, Florida. The SEFSC chartered a commercial longline vessel for three days, and the vessel made multiple sets of gear to evaluate various hook guard designs and gangion lengths (Figure 15). Divers observed that the 1/8 inch (3 mm) stainless steel mainline laid flat on the bottom and became buried in the sand/shell substrate in a relatively short period of time. A comparison of the fishing configuration of short vs. longer gangions (4.5 ft [1.3 m] vs. 12 ft [3.6 m]) showed little difference in the position of the bait on the bottom relative to the mainline. The SEFSC also evaluated different hook guards designed to shield bait during gear deployment and retrieval. However, only four of the eight designs evaluated performed as designed, i.e., separating from the hook/bait once it contacted bottom (Figure 16). Factors affecting hook guard performance included buoyancy of the guard and size of the hook in relation to the guard (smaller hooks may become wedged in the guard, thus preventing the guard from separating from the bait at depth). Additional work is needed to fully assess the feasibility of hook guards as a mitigation measure for the fishery, including in-situ observations of guards and gangions at typical fishing depths using tethered cameras or remotely operated vehicles.


**Figure 15. West Florida commercical reef fish bottom longliner.**

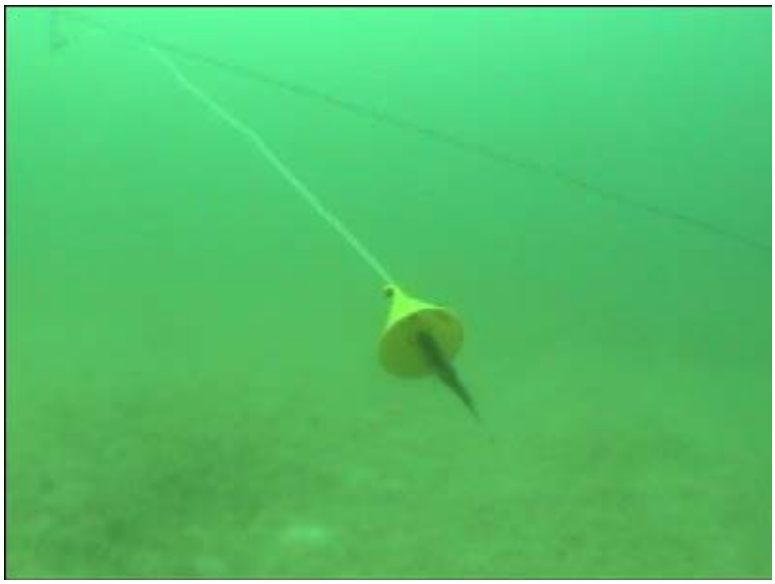

**Figure 16. Funnel-type hook guard shielding bait during deployment of a bottom longline.**

*Improvements and Reduction in Bycatch Associated with This Project*
Although the project did not provide a definitive measure for reducing sea turtle interactions in the reef fish bottom longline fishery, research conducted in FY09 provided promising clues as to next steps. We propose to further refine the concept of hook guards in collaboration with industry, focusing on a more reliable method of ensuring guard separation from the bait at depth. We also hope to characterize the relationship between bait soak time and target catch rates through a proposed FY10 BREP study. Should the proposed study not receive funding, a pilot study may be pursued using select fishers to record catch data utilizing hook timers purchased with FY09 project funds.

*Project Title*
**Use of Photoluminescent Technology to Reduce Incidental Capture of Sea Turtles in Gillnet Fisheries**

*BREP Funding Provided*
$16,170

*Location of Research*
Pacific Islands Fisheries Science Center
Baja California, Mexico (Punta Abreojos, Bahia de los Angeles)

*Resource Challenge*
Many nesting populations of Pacific leatherback, olive ridley, green, and loggerhead turtles have dramatically decreased. Incidental capture of sea turtles associated with pelagic longline fisheries and various gillnet fisheries have contributed to this decline in sea turtle populations. Recent studies suggest that small-scale coastal gillnet fisheries can have potentially high sea turtle interactions, equal to or in some cases exceeding sea turtle interactions with industrial-scale pelagic fisheries. Experiments examining visual cues on gillnets indicated that illuminating nets with battery-powered LED lightsticks reduces the catch rates of green sea turtles on turtle monitoring nets by 40%. In addition, illuminating nets used in a commercial bottom gillnet fishery targeting primarily elasmobranches and halibut species had no change in target fish catch rates.

*Project Summary*
Current photoluminescent technology is inadequate to provide illumination for gillnets soaked overnight. A potential alternative to illuminating gillnets with LED lightsticks is to use net materials that glow in the dark. By adding photoluminescent dyes to monofilament and nylon rope during the manufacturing process, net material becomes photoluminescent. However, despite working with several manufacturing companies based both in China and Australia (Allure Glow International, Lightleader Co., Skycore Group), we were not able to identify products that could easily be used to replace monofilament mesh or woven into nets such that a visual cue could be generated for more than two hours. Current photoluminescent technology is developing longer-lasting pigments that may be a useful in the future, but the technology has not yet reached that state. However, many of these pigments can be incorporated into paints at different densities resulting in longer illumination times. These paints could be applied gillnet floats and buoys, but not monofilament mesh. Future experimentation with photoluminescent dye concentrations in gel coat paint will examine optimum mixtures that be used to paint buoys used on float lines of gillnets.

Despite not being able to identify photoluminescent materials to illuminate gillnets, we examined the effects of using relatively inexpensive chemi-luminescent lightsticks (standard lightsticks used in the longline fishing industry ranging in price from 25 cents to $1.00) to illuminate gillnets. We conducted experiments to examine the effectiveness of reducing sea turtle catch rates using gillnets illuminated by common chemical lightsticks in Estero Coyote near Punta Abreojos, Baja California Sur, Mexico. We set

two monofilament nets near each other in areas with similar depth, bottom topography, and habitat. The experimental net had six-inch green chemical lightsticks placed every five meters, while the control net had non-activated lightsticks placed every five meters. We found a 60% reduction in sea turtle catch on illuminated gillnets (Figure 17). In all six paired trials, illuminated nets had lower green sea turtle catch per unit effort (CPUE). Analysis using the Wilcoxon Matched-Pairs Signed-Rank Test indicated a significant difference in CPUE ($n = 6$, $p = 0.016$). Combined with findings in 2008, these results provide compelling evidence that illuminating gillnets allows sea turtles to avoid being entangled and therefore can help in the reduction of their bycatch.

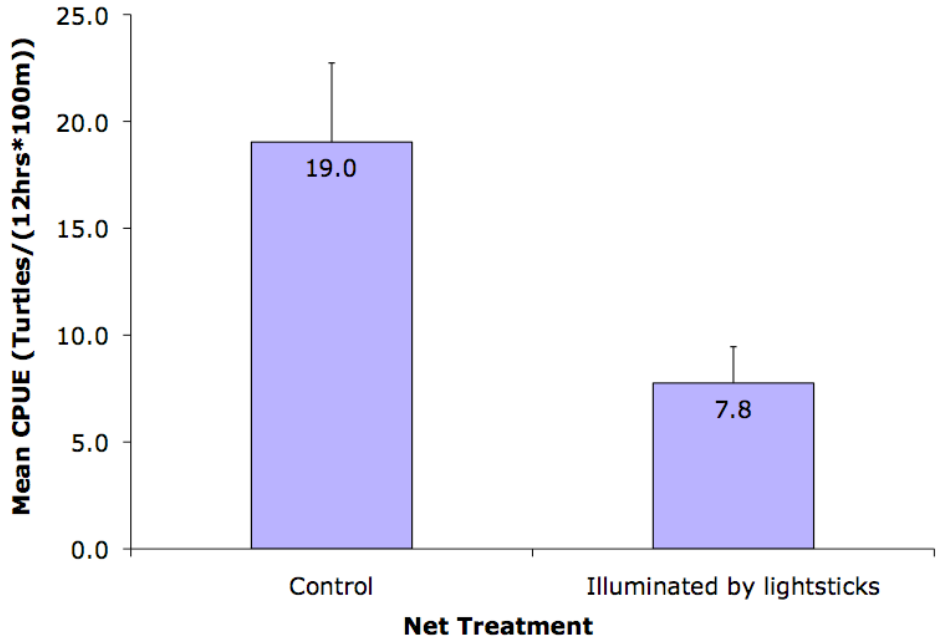


**Figure 17: Effects of chemical lightstick illumination on sea turtle catch in Punta Abreojos.**

We also conducted a study in Bahía de los Angeles, Baja California, Mexico in an existing small-scale gillnet fishery that targets guitarfish, rays, and California halibut. Two pairs of nets were set near each other in areas with similar depth, bottom topography, and habitat. The experimental net had six-inch green chemical lightsticks placed every five meters, while the control net had non-activated lightsticks placed every five meters. We recorded the number, species, and category (target species, bycatch species, and other species) of the catch, along with fish length. We also weighted the catch of each net and recorded market value based on the fish species and price per kilo. We found a slight decrease in catch in illuminated gillnets (Figure 18). In illuminated nets, the mean CPUE was 2.0% less than the mean CPUE in control nets. Of the 17 trials conducted, 6 trials had lower target fish CPUE in the experimental net. Analysis with the Wilcoxon Matched-Pairs Signed-Rank Test indicated that there was no significant difference in target fish CPUE ($n = 17$, $p = 0.61$) between net treatments. Combined with findings in 2008, these results suggest that illuminating gillnets does not negatively impact target catch.

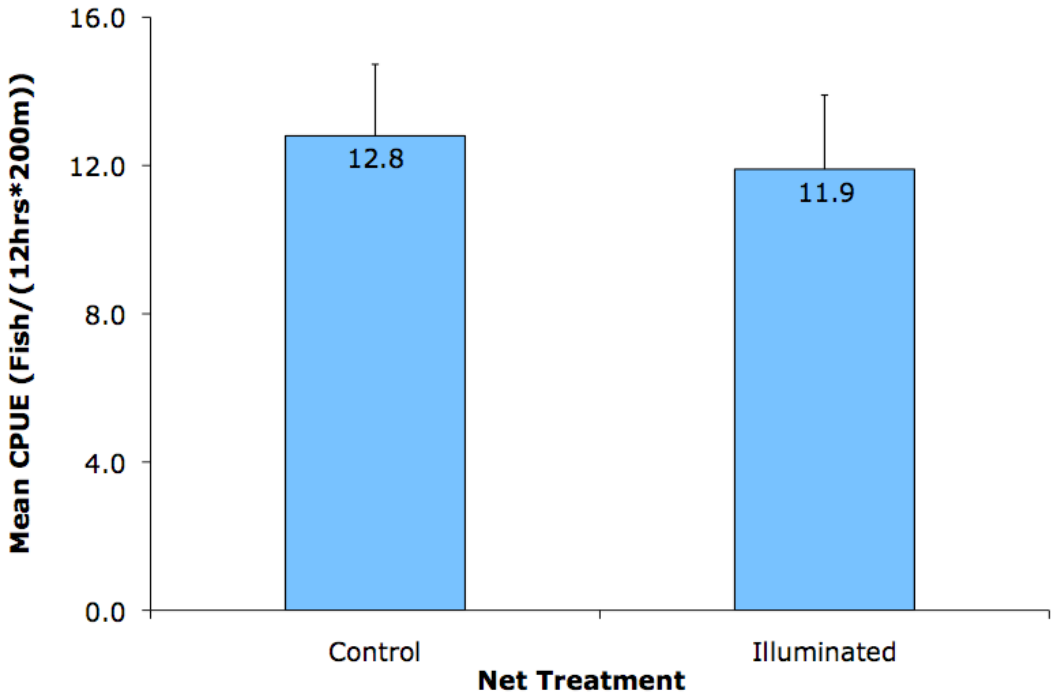


**Figure 18. Effects of lightstick illumination on target fish catch in Bahía de los Angeles.**

When testing the effect of lightstick illumination on target fish market value, we found a slight decrease on illuminated gillnets (Figure 19). Of the 17 trials conducted, 11 had lower market value in the experimental net. However, analysis using the Wilcoxon Matched-Pairs Signed-Rank Test indicated that there was no significant difference in market value ($n$ = 17, $p$ = 0.09) between net treatments. Combined with findings from 2008, these results suggest that illuminating gillnets does not negatively impact market value and will not impact fishermen earnings.

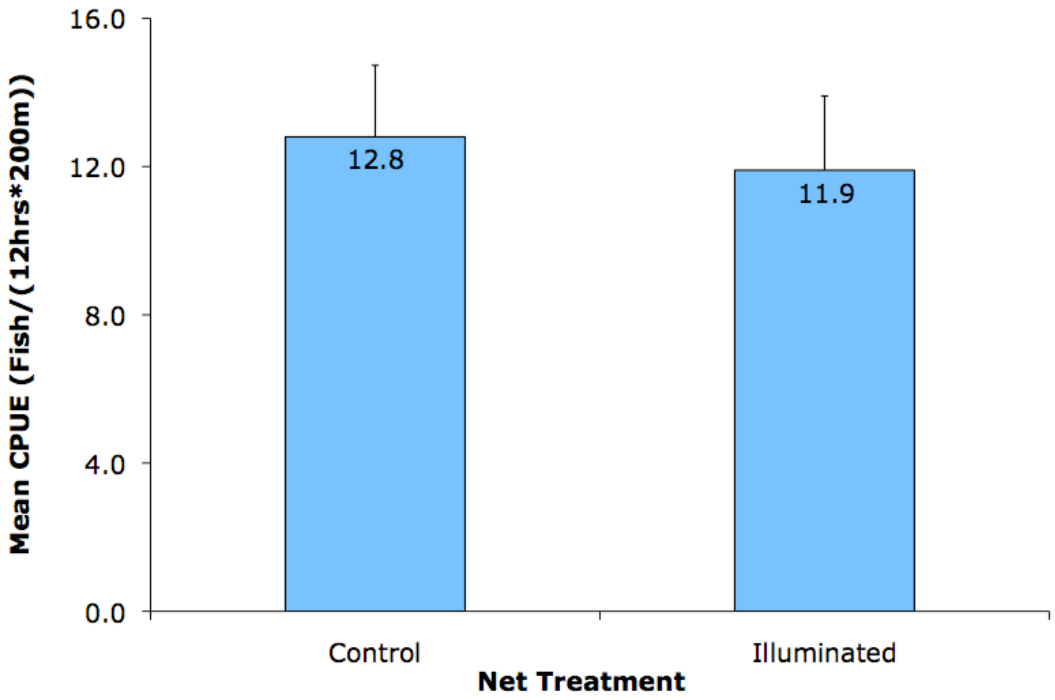


**Figure 19: Effects of lightstick illumination on market value in Bahía de los Angeles**

Students from an underserved community in San Diego, California had the opportunity to participate in all aspects of this research project. The students learned the importance of devising methods in order to address research objectives, how to carry out field research, how to analyze results, and how to present their research to various audiences. The students also developed a vast knowledge of sea turtle biology and conservation, in addition to fisheries ecology and management. Many students were on boats for the first time in their life, and all learned how to pull and set gillnets, identify fish species, and tag and measure sea turtles.

*Developments in Gear Technology Achieved*
In conducting these experiments, we have developed a system of assays that can be used to test a variety of potential sea turtle bycatch deterrents in gillnets and determine their usefulness in commercial fisheries.

*Improvements and Reduction in Bycatch Associated with This Project*
Our experiments in 2009 showed that using chemical lightsticks to illuminate nets may be a useful strategy in reducing sea turtle interactions with coastal gillnet gear. This project supported the following publications:

Gilman, E., J. Gearhart, B. Price, S. Eckert, H. Milliken, J. Wang, Y. Swimmer, D. Shiode, O. Abe, H. Peckham, M. Chaloupka, M. Hall, J. Mangel, J. Alfaro-Shigeto, P. Dalzell, and A. Ishizaki. 2009. Mitigating sea turtle by-catch in coastal passive net fisheries. *Fish and Fisheries*.

Wang, J.H., S. Fishler, and Y. Swimmer. In review. Developing visual deterrents to reduce sea turtle bycatch in gill net fisheries. *Marine Ecology Progress Series*.

*Project Title*
**Free Streamer Line Program**

*BREP Funding Provided*
$15,000

*Location of Research*
Pacific States Marine Fisheries Commission, Portland, Oregon

*Resource Challenge*
Longline fishermen in Alaska groundfish and halibut fisheries are required to use streamer lines to prevent seabirds from accessing baited hooks when the longlines are deployed. Although the streamer lines are not expensive, it is very important that they are constructed properly and meet certain construction standards. Distributing free ready-made streamer lines (built to specified standards) provides an incentive for fishermen to use effective seabird bycatch reduction gear and provides an opportunity for outreach and education to fishermen about the importance of seabirds in our marine ecosystem.

*Project Summary*
NMFS contracted with the Pacific States Marine Fisheries Commission (Commission) to achieve the following objectives:

- Build seabird avoidance gear (e.g., streamer lines) of specified construction and dimensions;
- Maintain an adequate inventory of the streamer lines to meet demand expressed by operators of longline vessels and streamer line distributors; and
- Distribute, at no cost to the recipient, streamer lines to established distributors in Alaska and Washington, and individuals requesting the free streamer lines.

*Developments in Gear Technology Achieved*
In consultation with NMFS, the Commission works closely with Washington Sea Grant researchers to ensure that the streamer lines being produced reflect the best scientific information available related to research conducted on streamer line efficacy and construction. In 2009, the Commission was able to offer a new model of lightweight streamer line that was better suited to the fishing gear deployment operations of smaller longline vessels.

*Improvements and Reduction in Bycatch Associated with This Project*
Free streamer lines provide an incentive for fishermen to use the best available seabird bycatch reduction gear. These streamer lines have experimentally been proven to reduce seabird bycatch by 80-100%.

*Project Title*
**Uncharted Waters: The First Flights of Fledgling Albatrosses**

*BREP Funding Provided*
$14,000

*Location of Research*
Midway Atoll, Northwest Hawaiian Islands and University of California Santa Cruz

*Resource Challenge*
Laysan and black-footed albatrosses clearly interact with longline fisheries (as evident from reported bycatch) because the birds forage in the same localities as the fishers. Information about the distribution of these top-level predators in relation to the location of commercial fishing operations is therefore important to determine the likelihood of potential interactions. Juvenile birds (i.e., fledglings or young of the year) are particularly vulnerable because of their naïveté, so it is likely that they experience greater negative interactions with fisheries than adults. However, we know very little about the movements and distribution of this age class in comparison to adults. The U.S. National Plan of Action on the Reduction of Seabird Incidental Catch in Longline Fisheries (NPOA-Seabirds) calls for outreach, education, and public awareness programs on seabird bycatch. Thus, this project is consistent with such activities under the NPOA-Seabirds.

*Project Summary*
This project was initially designed (and funded by the National Geographic Society) to equip 10 Laysan and/or 10 black-footed albatross fledglings with satellite transmitters at Midway Atoll National Wildlife Refuge to determine the initial dispersal, behavior, and home ranges during the first year of life at sea. However, through a combination of additional funds including NOAA support, the project has equipped a total of 30 fledglings since 2006, and another 5-8 will be equipped during summer 2010. We are now starting to obtain a much better resolution on the distribution of this age class. Moreover, the location data will help us evaluate the oceanographic properties of the habitats frequented by the fledglings (by comparing bird location with remotely sensed data) to determine the common and/or predictable features that influence fledgling distributions. The data also will help us compare fledgling distributions with fisheries effort data to define, describe, and evaluate the degree of overlap with specific fisheries operations and regional fishery management organizations (RFMOs).

Figure 20 shows the initial dispersal and end points (either from death or transmitter failure) of fledgling albatrosses tracked in 2006 and 2007. The duration of these deployments averaged 60 days, but a few birds were tracked for up to 125 days. Similar deployment durations were obtained in 2008. New insights from these data include the movements of fledglings toward the coast of Japan as well as the general latitudinal range of the birds, which overlaps with adult albatrosses at the northern extent of the range of the fledglings. One of the next steps will be to examine whether there are common oceanographic features of the birds that can be used to predict distribution based on

future observations (i.e., modeling effort). Additional analyses will include the focus on navigational cues that may direct the birds on their first flights.

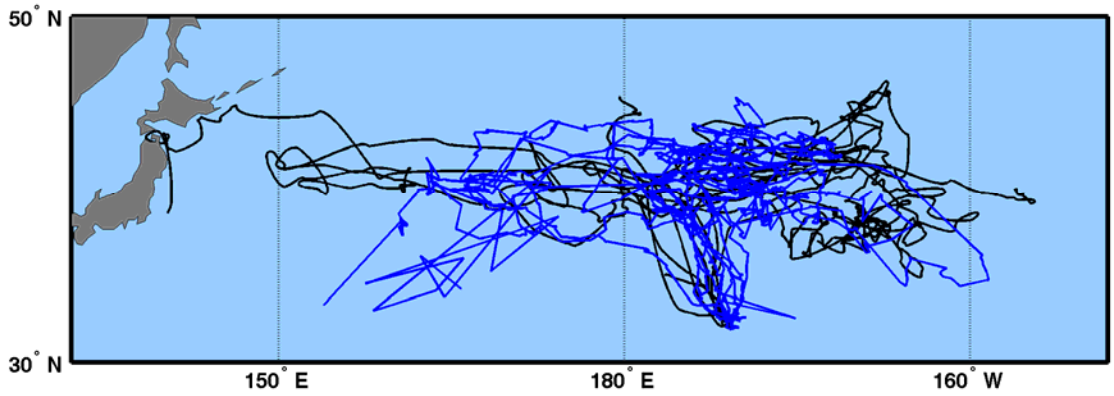


**Figure 20. Tracks representing the movements of black-footed and Laysan albatross fledglings (N = 17 birds) tracked in 2006 (blue) and 2007 (black). The one bird that made it to Japan was a Laysan albatross tracked for 120 days.**

*Developments in Gear Technology Achieved*
No developments in gear technology were achieved through this project.

*Improvements and Reduction in Bycatch Associated with This Project*
Data generated from this project have been used in at least four white paper reports presented at annual Inter-American Tropical Tuna Commission (IATTC) meetings. The specific aims of these reports have been to increase awareness of seabird bycatch within IATTC waters and to showcase the overlap between tracked bird distribution and international fisheries. In addition, all data have been archived in the BirdLife International Procellariiform database, and the data therein have been used to generate several reports to various RFMOs and non-governmental organizations (e.g., the International Union for Conservation of Nature). A separate but related project to the current effort on fledglings has produced a dynamic model that predicts the overlap between fisheries and albatross distribution. This modeling effort will be implemented in future analyses with the data collected from this project.

*Project Title*
**Seabirds in the Western North Atlantic and Interactions with Fisheries**

*BREP Funding Provided*
$10,000

*Location of Research*
Southeast Fisheries Science Center

*Resource Challenge*
A high diversity of seabird species, including species of very small population number, regularly occurs in an area of high U.S. pelagic longline fishing effort. At least 49 seabird species, including such species as the Bermuda petrel, the black-capped petrel, Fea's petrel, Audubon's shearwater, and the white-tailed tropicbird, have been documented in the area of the outer continental shelf off the North Carolina Outer Banks.

*Project Summary*
As a continuing project, this project has five elements:

1. Improve identification of seabirds by observers (from the generic "seabird" to the specific species and even the state of maturity in some cases);
2. Improve knowledge and appreciation of Western North Atlantic seabirds by observers and others;
3. Examine factors influencing seabird bycatch;
4. Estimate the total seabird bycatch of the Western North Atlantic U.S. pelagic longline fleet; and
5. Prepare the annual U.S. National Report on the Seabird Bycatch of the Western North Atlantic U.S. Pelagic Longline Fishery (Appendix 2.2.8 in the annual U.S. National Report to International Commission for the Conservation of Atlantic Tunas).

The Southeast Fisheries Science Center (SEFSC) has prepared a seabird bycatch report form that is in use by both pelagic and bottom longline observers. The data are input into a relational database. Seabird identification training, usually by a seabird expert and experienced natural resource educator, is provided to observers as training opportunities allow. Seabird photo quizzes are conducted with observers via email. The SEFSC has prepared an informative memorandum entitled "Species Profiles of Seabirds of the Western North Atlantic" to inform observers and others about this interesting group of birds, and to make observers more aware of their vulnerability to human disruption of all types and their place in the ocean ecosystem.

As part of this project, the SEFSC contracted with Virginia Polytechnic Institute to conduct an analysis of the observed seabird bycatch of the U.S. pelagic longline fleet operating in the Western North Atlantic. The main purpose of the analysis was to test alternative methodologies of using pelagic observer program (POP) data to estimate the seabird bycatch of the fleet. Certain extreme characteristics of the dataset (i.e., rare

events, clumped distributions) may influence the reliability of estimates of total fleet bird bycatch based on observed bird bycatch. Therefore, this project tested alternative methodologies for their ability to overcome the shortcomings of the data. The project produced annual estimates for the POP period of record using nine alternative methods, and the project examined model estimates and model statistics.

*Developments in Gear Technology Achieved*
Our analyses suggest that increasing weight on longlines decreases bird bycatch, probably because extra weight increases the longline sinking rate.

*Improvements and Reduction in Bycatch Associated with This Project*
This project has resulted in improved identification of observed seabird bycatch, identification of a "hot spot" where high seabird activity and high U.S. pelagic longline effort intersect, and improved estimation of the total seabird bycatch of the pelagic longline fleet.

*Project Title*
**Alaska Fisheries Science Center Coordinated Seabird Studies**

*BREP Funding Provided*
$10,000

*Location of Research*
Alaska Fisheries Science Center

*Resource Challenge*
Seabird attraction to fishing vessels occurs because seabirds take advantage of feeding opportunities around vessels. This can unfortunately bring birds into contact with fishing gear, and has created a situation where fisheries are considered the greatest threat to seabirds worldwide. Some of the worst cases of population decline are in the albatrosses and other large seabirds in southern oceans due to fishery bycatch. However, through collaborative work of many organizations in Alaska, seabird bycatch has been reduced in the longline fishery by over 60%, with a nearly 90% reduction in albatross bycatch. Despite these successes there are still challenges to reducing seabird bycatch and understanding seabird interactions with commercial fisheries in Alaska.

*Project Summary*
The Alaska Fisheries Science Center (AFSC) operates the Coordinated Seabird Studies Program and leverages a variety of funding sources and limited resources to complete work in collaboration with other NMFS Offices, academia, Sea Grant, non-governmental organizations such as environmental groups and fishing industry groups, and other federal agencies (U.S. Fish and Wildlife Service and U.S. Geological Survey) or states. The $10,000 received in 2009 was added to the grant that the AFSC has with the University of Washington Joint Institute for the Study of the Atmosphere and Ocean (JISAO). This funding provided about two months of staff time to assist with two important projects. The first project supported the logistics of the AFSC seabird carcass necropsy program (Figure 21). Incidentally caught seabirds are recovered by observers and returned to port. A scientific-based necropsy provides valuable and critical information on a suite of factors related to diet, population dynamics, ocean plastics, and other items. Funds from the Bycatch Reduction Engineering Program (BREP) in 2008 helped set up the lab to process birds, and matching funds were provided in 2009 by the NMFS Alaska Region and added to the contract by AFSC staff. FY09 BREP funds will assist with the logistics of handling these many and scientifically valuable specimens.

**Figure 21. Seabird carcass necropsy program. (Photos credit: OIKONOS/Marine Wildlife Veterinary Care and Research Center)**

Other JISAO work in 2009 includes analysis of observer special project data to investigate seabird attraction to fishery offal (Figure 22). This information is important as we investigate seabird—fleet interactions and is important for, among other things, incorporation into National Environmental Policy Act analysis and documents for various fishery management actions.

**Figure 22. Seabirds attracted to fishery offal. (Photo credit: Jeff Pesta, AFSC)**

*Developments in Gear Technology Achieved*

No additional gear technologies were developed, but improved understanding of seabird interactions with fisheries will result from this project. In addition, 2008 funds will provide valuable scientific information on demographics and other facets of seabird life. These data are being evaluated to determine whether they can be made available on the AFSC website, with proper Magnuson-Stevens Fishery Conservation and Management Act data confidentiality protections in place.

*Improvements and Reduction in Bycatch Associated with This Project*
Based on products from 2008 funding, where the AFSC contracted with an analyst to complete the longline vessel-specific bycatch analysis, meetings were held with the Freezer Longline Coalition (FLC). The FLC and the AFSC, with a consultant contracted using BREP funds, are working together to further reduce seabird bycatch. The industry group is using the data provided, along with a long-term internal and unique approach, to reduce seabird bycatch within their group using data reported by AFSC-certified fisheries observers in real time. We are working collaboratively to develop additional proposals for future funding. In addition, a draft AFSC Processed Report entitled "Analysis of 2004-2007 Vessel-Specific Seabird Bycatch Data in Alaska Demersal Longline Fisheries" by K.S. Dietrich and S.M. Fitzgerald will be available in 2010.

*Project Title*
**Estimation of Seabird Bycatch in Northeast Commercial Fisheries**

*BREP Funding Provided*
$10,000

*Location of Research*
Northeast Fisheries Science Center

*Resource Challenge*
Numerous commercial fisheries off the Northeast coast of the United States incidentally catch a variety of seabird species. The Northeast Fisheries Observer Program (NEFOP) documented 174 seabird takes in 2007 and 151 in 2008. The NEFOP has documented seabird bycatch in the following fisheries: gillnet; bottom trawl; mid-water trawl; bottom longline; beach seine; purse seine; and scallop dredge. Gillnets and trawls have had the largest numbers of observed seabird bycatch. Within these gear types, 14 species of seabird bycatch have been documented. Of these seabirds, the red-throated loon (*Gavia stellata*) is a species on the U.S. Fish and Wildlife Service's Birds of Conservation Concern list, and it is frequently caught in mid-Atlantic gillnets. Other frequently caught seabird species include the black scoter (*Melanitta nigra*), northern gannet (*Morus bassanus*), greater shearwater (*Puffinus gravis*), and common loon (*Gavia immer*).

The 2009 Bycatch Reduction Engineering Program (BREP) funds were used to partially fund a contractor who is estimating the total number of seabird takes in the various commercial fisheries. This is a challenge because there are four databases that must be utilized: the NEFOP database; Vessel Trip Report database; Commercial Fisheries database; and the North Carolina Division of Marine Fisheries database. Data from each of these databases must be downloaded, understood, processed, quality checked, and then applied in an appropriate manner to complement the fishing practices and natural history of the seabirds that interact with the fishery.

*Project Summary*
Because the gillnet fishery has the largest number of observed seabird takes, estimates of bycatch from this fishery were developed first. The BREP-funded contractor was instrumental in processing, understanding, and quality checking the gillnet NEFOP data, which led to a publication (Warden and Orphanides 2008). The BREP-funded contractor then used the 1996 – 2007 gillnet NEFOP data, along with data from the other databases, to develop bycatch estimates for the common and red-throated loons in the Northeast and Mid-Atlantic gillnets (Warden in review). Generalized linear models were used to estimate the average annual common loon mortality in 1996 - 2007 as 74 loons in the Northeast gillnet fishery (CV = 0.58, 95% CI = 26–213) and 477 in the Mid-Atlantic gillnet fishery (CV = 0.25, 95% CI = 294–773), while the average annual red-throated loon mortality in the Mid-Atlantic gillnet fishery was estimated at 897 loons (CV = 0.32, 95% CI = 486–1654). The BREP-funded contractor has started processing data from the bottom trawl fishery that will be used in seabird bycatch estimates.

*Developments in Gear Technology Achieved*
In an effort to find potential gear technologies that might be able to reduce seabird bycatch, the BREP-funded contractor explored what gillnet gear characteristics and fishing practices were most highly correlated to the bycatch of the common loon (Warden in review). The contractor found that in the Northeast gillnet fishery, the common loon bycatch rate for gillnet strings without spaces between the nets within the string was about 4.5 (95% CI=2.7-10.0) times higher than the bycatch rate for strings with spaces. In the Mid-Atlantic gillnet fishery, hauls closer to shore, especially those with long soak durations, had high common loon bycatch rates. These gear characteristics could possibly be explored in future conservation engineering experiments to evaluate whether they could reduce loon bycatch in gillnets.

*Improvements and Reduction in Bycatch Associated with This Project*
At this stage in this project, no experiments have been conducted to explore whether gear modifications could be used to reduce the bycatch of seabirds in gillnets. However, because of the processing and quality-checking of the NEFOP gillnet data performed in previous years (as well as in 2009) by the BREP-funded contractor, Palka *et al.* (2008) were able to document that pingers, when used properly, are able to reduce the bycatch of harbor porpoises (*Phocoena phocoena*) in the Northeast gillnet fishery.

*References*
Palka, D.L., M.C. Rossman, A.S. VanAtten, and C.D. Orphanides. 2008. Effect of pingers on harbour porpoise (*Phocoena phocoena*) bycatch in the US Northeast gillnet fishery. *J. Cetacean Res. Manage.* 10(3): 217-226.

Warden M.L., and C.D. Orphanides. 2008. Preparation of the Northeast Fisheries Observer Program gillnet data for use in bycatch analyses of protected species. *US Dept Commer, Northeast Fish Sci Cent Ref Doc.* 08-17; 44 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026 or http://www.nefsc.noaa.gov/publications/crd/crd0817/.

Warden, M.L. (in review). Bycatch of wintering common and red-throated loons in US Atlantic gillnets, 1996-2007. *Aquat. Biol.*

*Project Title*
**Gulf of Mexico Pelagic Longline Bluefin Tuna Bycatch Mitigation (Pilot)**

*BREP Funding Provided*
$9,000

*Location of Research*
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 Mexico is a spawning area for the western Atlantic bluefin tuna stock and has become an area of concern due to 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 management measures.

*Project Summary*
This research has focused on utilizing the difference in the size and relative strength 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. In year two of the project (2008), a fishery-dependant experiment was initiated to investigate the potential of a newly designed hook as a mitigation measure for reducing bluefin tuna capture on pelagic longlines. The objective of this 2009 experiment was to evaluate the efficacy of a weaker 16/0 circle hook (experimental) in reducing the bycatch of bluefin tuna by comparing it to a standard 16/0 circle hook (control) used in the pelagic longline fishery (Figure 23). 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.


**Figure 23. Control and experimental circle hooks.**

*Developments in Gear Technology Achieved*

Fishery-dependent data were collected in 2008 from two contracted pelagic longline yellowfin tuna vessels in the Gulf of Mexico. Vessels fished with industry standard gear utilizing the experimental hook on every other leader. Seventy-two sets were made, with a total of 36,766 hooks set in the experiment. A total of five bluefin tuna were caught (Figure 24). Four were caught on the control hook, and one was caught on the experimental gear. A total of 652 yellowfin tuna were caught, with the experimental hook having a 6% higher catch rate than the control hook.

**Figure 24. Size of bluefin tuna typically caught in the Gulf of Mexico yellowfin tuna pelagic longline fishery.**

Five vessels conducted 125 sets in 2009 with a total of 87,106 hooks set in the experiment. A total of 15 bluefin tuna were caught during the experiment. The experimental hook caught 75% fewer bluefin, with 12 being caught on the control hooks. A total of 921 yellowfin tuna were caught, with the experimental hook having a 13% lower catch rate than the control hook.

Cumulatively for the period 2008 to 2009, 5 vessels have made 20 trips. One hundred ninety-seven sets have been conducted with a total of 123,872 hooks set. A total of 20 bluefin tuna have been caught, of which 16 were caught on the control hook for a 75% observed reduction rate. A total of 1,573 yellowfin tuna have been caught. The observed reduction in yellowfin by count is 5.6% with the experimental hook. Based on these results, NMFS proposes to continue this research in 2010 in order to improve the statistical confidence of the experiment results.

*Improvements and Reduction in Bycatch Associated with This Project*
The results of year-three research are encouraging. With additional sampling effort, we hope to confirm that the weaker hooks are capable of releasing bluefin tuna while maintaining the target catch. Such results would be an asset in the transfer of the new hook technology to the tuna longline fishery in the United States and worldwide.

*Project Title*
**Southwest Fisheries Science Center Contribution to World Seabird Conference**

*BREP Funding Provided*
$5,000

*Location of Research*
Southwest Fisheries Science Center

*Resource Challenge*
The Pacific Seabird Group, with partnering support from over 25 professional seabird and research organizations from around the world, is hosting the first world conference to focus specifically on seabirds. This conference will be held September 7-11, 2010, in Victoria, British Columbia, Canada. Through a strong conference program, the goal of this conference is to put seabird management and conservation into a worldwide perspective. By bringing 500 - 600 participants from over 30 countries together, the conference will be able to comprehensively address the global issues and data needs for these species, most of which inhabit multiple countries and waters within their own ranges.

*Project Summary*
NOAA Fisheries is helping to support an international conference addressing global conservation and management issues relating to marine ecosystems and seabirds. Primary conference symposia feature the following themes:

- Climate Change and Seabirds: Comparative Ecosystem Dynamics of the World's Oceans
- Interactions between Seabirds and Fisheries: A Global Perspective
- Spatial Ecology At Sea: Opportunities and Challenges for Seabird Marine Protected Areas
- Seabird Colonies: Restoration and Engineering of Seabird Nesting Habitat

Special paper sessions include the following topics:

- Technological and Analytical Innovation in Seabird Research
- Marine Debris
- Interactive Effects of Chemical Contaminants, Parasites, and Stressors on Seabirds
- Energetics, Physiology, and Nutrition
- Seabird Demography
- Seabird Informatics, Databases, and Longterm Monitoring
- Seabird Phenotypic Plasticity and Microevolution
- Evolutionary and Conservation Genetics of Seabirds

*Developments in Gear Technology Achieved*
No developments in gear technology were achieved through this project.

*Improvements and Reduction in Bycatch Associated with This Project*
One of the primary symposia at this conference focuses on seabirds and fishery interactions. Experts from around the world will meet on this important topic and likely will report on the most recent advances in this field.

*Project Title*
**Coastal Observation and Seabird Study Team (COASST)**

*BREP Funding Provided*
$4,000

*Location of Research*
University of Washington and coast of northern California, Oregon, Washington, and Alaska

*Resource Challenge*
Thousands of seabirds are incidentally taken as fisheries bycatch each year. COASST beached bird surveys offer one method for documenting bycatch incidents in the Pacific Northwest and Alaska without costs associated with at-sea work. Data collected provide estimates of mortality from bycatch and other sources, sensitivity to bycatch by entanglement type, and information on the distribution of bycatch-sensitive species.

For example, COASST beached bird data were used as a baseline against which fishery-associated wrecks (mass beachings of bycatch-sensitive species where post mortem analyses of select carcasses indicated drowning and restraint) were compared (Hamel et al 2009). In this study of the potential impact of gillnet fisheries on seabirds, individual wreck events were two orders of magnitude higher in carcass deposition than background beaching rates; however, they were also rare in space and time. Therefore, when background rates were compared to wreck cumulatively (over the entire 39-year dataset and over all coastline in Puget Sound where beaching was possible), total baseline mortality exceeded total wreck mortality by two orders of magnitude.

More generally, patterns of species-specific entanglement mortality have been assessed using COASST and other datasets (Moore et al 2009). It is important to note that entanglement in commercial gear is undersampled in beached bird programs because ghost gear often sinks, and carcasses, once removed from actively fishing gear, are difficult to ascribe to bycatch mortality without post mortem analyses.

*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. Funds have supported the expansion of data collection efforts, supplies, and materials for documentation of entangled seabirds across over 500 kilometers of coastline and aboard fishing vessels along the West Coast.

*Developments in Gear Technology Achieved*
No developments in gear technology were achieved through this project.

*Improvements and Reduction in Bycatch Associated with This Project*
COASST is a citizen-science project that utilizes a network of over 600 trained volunteers to collect data on beached birds at more than 400 sites throughout the Pacific

Northwest and Alaska, thereby creating a wealth of high-quality, verifiable data at a geographic scale that would not be possible using paid agency personnel. From June 2008 to May 2009, 603 volunteers cumulatively conducted 7,741 surveys, contributed more than 4,160 hours, and found more than 2,550 carcasses of 75 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. In 2009, COASST volunteers recorded information on 6 species of bycatch importance, including 2 Laysan Albatross, 21 Black-footed Albatross (1 hook entanglement), 65 Sooty Shearwaters, 8 Short-tailed Shearwaters, 7 Pink-footed Shearwaters, and 197 Northern Fulmars. Through public outreach events, ongoing workshops and refresher sessions, and a series of citizen-focused publications, COASST works to engage coastal communities, putting science, management, and seabird conservation into the hands of local stakeholders.

*References*

Hamel, N.J., A.E. Burger, K. Charleton, P. Davidson, S. Lee, D.F. Bertram, and J.K. Parrish. 2009. Bycatch and beached birds: Assessing mortality impacts in coastal net fisheries using marine bird strandings. *Marine Ornithology* 37:41-60.

Moore, E, S. Lyday, J. Roletto, K. Litle, J.K. Parrish, H. Nevins, J. Harvey, J. Mortenson, D. Greig, M. Pianna, A. Hermance, D. Lee, D. Adams, A. Allen, and S. Kell. 2009. Entanglements of marine mammals and seabirds in central California and the north-west coast of the United States 2001-2005. *Marine Pollution Bulletin* 58:1045-1051.

*Project Title*
**Monitoring of Seabird Bycatch in Peru: Assessment and Mitigation Measures**

*BREP Funding Provided*
$3,000

*Location of Research*
Pro Delphinus Peru

*Resource Challenge*
The artisanal fisheries in Peru, including gillnet and longline fisheries, have been shown to impact certain seabirds populations. The waved, Chatham, and black-browed albatrosses, together with pink-footed and sooty shearwaters, white-chinned petrels, Humboldt penguins, and cormorants, interact with these fisheries. This project is designed to assess the level of impact of these fisheries on seabirds and provide education and awareness on seabird conservation to fishing communities along the Peru coast.

Additionally, the waved albatross has been noted as a species of concern in various NMFS documents and reports submitted to the Inter-American Tropical Tuna Commission (IATTC). The waved albatross is listed under the Agreement on the Conservation of Albatrosses and Petrels (ACAP), and forages within the IATTC area. The waved albatross also is vulnerable to bycatch within longline fisheries, and it actually overlaps with such IATTC fisheries. Consistent with MSA section 316(c), which provides authority "to undertake projects in cooperation with industry to improve information and technology to reduce seabird bycatch, including… actions at appropriate international fishery organizations to reduce seabird interactions in fisheries," and with NMFS' implementation of the U.S. National Plan of Action on Reducing the Incidental Catch of Seabirds in Longline Fisheries, this Pro Delphinus project in Peru will advance our knowledge of the waved albatross and its potential for interaction with IATTC fisheries.

*Project Summary*
This multi-year project, with continued support from NMFS, has been able to document seabird bycatch by both longline and gillnet vessels, including many threatened and endangered species including albatrosses, petrels, and penguins (Figures 25). The critically endangered (according to the International Union for Conservation of Nature) waved albatross, in particular, was identified as being vulnerable not only to bycatch but also to targeted capture as a source of food for artisanal fishing crews. Since uplisting of the waved albatross, and with the support of NOAA, the ACAP, and the American Bird Conservancy, this project, through repeated workshops in fishing ports and creation and distribution of educational materials, has significantly raised awareness among fishers, and there has been an apparent decline in incidental captures (Figure 26). We are also currently working to improve the understanding of waved albatross behavior and at-sea distribution through continued onboard observer work. Additionally, during this year's project we addressed the targeted take of waved albatrosses by having an anthropologist

visit a fishing community in order to work directly with the community and provide further insights into the history of the issue and possible paths forward.

*Developments in Gear Technology Achieved*
In the coming year Pro Delphinus will be working with artisanal longline fishermen in select ports to introduce weighted swivels into the fleet. The use of weighted swivels could prove a cost and time savings to fishermen as well as increase branchline sink rates, thereby reducing seabird bycatch by reducing the time hooks are available for capture.

*Improvements and Reduction in Bycatch Associated with This Project*
Project activities have helped improve our understanding of the threats to seabirds posed by Peruvian artisanal fisheries and have succeeded in raising the awareness of these issues within fishing communities. Our continuing efforts indicate that seabird bycatch continues but suggests that the targeted take of waved albatrosses has declined. Continuing efforts, particularly with longline vessels, will seek to further reduce threats to seabirds by introducing weighted swivels and assessing the characteristics of the mechanization of the fleet.


**Figure 25. Waved albatrosses gathering around a gillnet vessel, awaiting offal discards (top), and fighting over fish discards from a gillnet vessel (bottom).**

**Figure 26. Fishermen in the port of Pucusana reading seabird factsheets.**

## 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 2015. 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:

- Turtle bycatch reduction in scallop trawls and dredges (2010).
- Harbor porpoise take reduction in bottom set gillnets (2010).
- Seabird bycatch reductions through completing gillnet seabird bycatch estimation analysis (2010).
- Atlantic sturgeon and harbor porpoise bycatch reduction in the monkfish fishery (2010-2011).
- Turtle bycatch reductions in non-scallop trawl fisheries (2010-2015).
- Continuation of the estimation of bycatch of turtles and marine mammals in northwest Atlantic trawl, gillnet, pot, dredge and longline fisheries (2010-2015).
- Finfish bycatch reduction in squid, herring, and Northeast multispecies trawl fisheries (2010-2015).
- Seabird bycatch reduction through completing seabird bycatch estimation analysis for gear type(s) other than gillnets (2011-2013).
- Atlantic large whale take reduction in fisheries that entangle whales, through the development of gear modifications and other technologies to reduce takes (2011-2015).

*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 reef fish fishery (2010-2012).
- Bluefin tuna bycatch reduction in the Gulf of Mexico yellowfin tuna fishery (2010-2012).
- Improve the information content of seabird bycatch reporting by observers in the Western North Atlantic (WNA) U.S. pelagic longline and bottom longline fleets, develop information materials about WNA seabirds, analyze the seabird bycatch, and estimate the total seabird bycatch of the U.S. pelagic longline fleet (2010-2015).
- Seabird bycatch reduction through enhanced observer coverage to assess potential protected species interactions with fisheries in the Atlantic (2010-2015).
- Turtle bycatch reduction in non-shrimp trawl fisheries (Atlantic flynet fishery, Atlantic whelk trawl fishery) (2010-2015).

- Turtle excluder device and bycatch reduction device refinement in shrimp trawl fishery (2010-2015).
- Turtle bycatch reduction in various Atlantic and Gulf of Mexico gillnet fisheries (2010-2015).
- Turtle entanglement/bycatch reduction through development of weak links for the vertical lines used for buoys in a variety of pot fisheries (2010-2015).
- Shrimp bycatch reduction through testing of Australian "hopper" gear for improved survivability of shrimp bycatch (2011-2015).

*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 (2010-2012).
- Buoy gear bycatch reduction in the swordfish handgear fishery through investigation and characterization of bycatch in that fishery (2010).
- Sea turtle bycatch reduction in Atlantic shallow-set longline using techniques developed in experiments in the Pacific Ocean (2010-2013).
- HMS rod and reel bycatch reduction through investigation and characterization of bycatch in that fishery (2012-2015).

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

- Shark bycatch and bycatch mortality reduction in drift gillnet and pelagic longline fisheries (2010-2011).
- Turtle bycatch reduction through development of predictive models of turtle distribution (2010-2011).
- 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 (2010-2011).
- Pinniped bycatch reduction through the transmission of sound to deter the animals from active fishing vessels (2010-2011).
- Evaluation of gear modifications to prevent marine mammal depredation in the California halibut trawl fishery in Southern California (2010-2011).
- Shark bycatch mortality reduction in recreational catch-and-release fishery (2010-2012).
- Ocean sunfish (*Mola mola*) bycatch reduction in drift gillnet fishery (2011-2013).

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

- West coast groundfish bycatch reduction by improving the performance of already proven bycatch reduction gear types, e.g., selective flatfish trawl to reduce rockfish bycatch in flatfish fishery (2010).
- Seabird bycatch reduction through continuation of Seabird Bycatch Research Project to reduce potential fisheries interactions with short-tailed albatross and other seabird species (2010-2012).
- Endangered Species Act-listed salmon bycatch reduction, as well as rockfish bycatch reduction, through refinement and implementation of flexible sorting grids in the west coast Pacific hake fishery (2010-2015).
- Habitat impact reduction through testing the linkage between observer derived estimates of bycatch with co-registered information on type of habitat swept (e.g., information derived from fishing vessel onboard acoustic seabed classification systems) (2010-2015).
- Seabird bycatch reduction in Alaska and Northwest longline fisheries by providing free streamer lines and cost-sharing on integrated weight lines (2010-2015).

*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 (2010-2012).
- 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 (2010-2015).
- Crab bycatch reduction in groundfish fisheries through development of gear modifications (although trawl bycatch is a higher volume issue, bycatch of blue king crab in cod pots (baited traps) has a higher priority due to concern over potential overfishing of that species) (2010-2015).
- Seafloor habitat and Essential Fish Habitat impact reduction by modifying trawls and trawling methods (2010-2015).
- 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 (2010-2015).
- Seabird bycatch reduction in Alaska and Northwest longline fisheries by providing free streamer lines and cost-sharing on integrated weight lines (2010-2015).
- Reduction of unobserved crab mortality due to trawl encounters through development and implementation of modified trawl groundgear (2010-2015).
- Development of a more efficient method for identifying incidentally caught Pacific halibut that are live-release candidates (i.e., high survival rate), and development of methods consistent with observer program protocols for sorting, accounting, and discarding halibut rapidly (2010 - 2015).

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

- False killer whale take reduction in the Hawaii-based pelagic longline fishery through evaluation of circle hook effects (2010).
- Seabird bycatch reduction and longline fishermen protection by developing and refining safe-lead weights and side-setting (2010).
- Shark bycatch reduction in the Hawaii-based pelagic longline fishery through continued testing of chemical (electropositive metals) deterrents (2010-2011).
- Marlin bycatch reduction in longline fisheries targeting tuna by continuing to develop operational alterations (depth, time, season, area) in the fleet (2010-2011).
- Evaluation of blue marlin post-release mortality in Pacific longline fisheries (2010-2011).
- Development of a California sea lion bycatch reduction strategy based on visual cues (2010-2011).
- Turtle bycatch reduction through development of measures to reduce interactions in gillnet fisheries (2010-2015).
- Turtle bycatch reduction through continued operation and analysis of "TurtleWatch," which provides fishing area advisory charts indicating turtle avoidance areas to Hawaii longliners (2010-2015).
- International sea turtle, shark, and gamefish bycatch reduction through testing and promoting longline bycatch mitigation methodologies including: (1) continued testing of circle hooks to reduce sea turtle bycatch and maintain target catch; (2) continued testing of stiffer lines to reduce turtle entanglements in longlines; (3) testing chemical methods of reducing shark bycatch (now under domestic development); and (4) testing of operational alterations to reduce marlin catches (2010-2015).
- Seabird bycatch reduction in longline fisheries by providing free safe-lead gear and cost-sharing for side-setting vessel conversions (2010-2015).

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

- National Seabird Program Strategic Planning Workshop (2010).
- Seabird bycatch reduction through outreach related to a Seabird Carcass Collection Program that would coordinate information on seabird bycatch composition in fisheries (2010-2015).
- Seabird bycatch reduction through continuing ongoing international projects for sharing of mitigation gear technology (e.g., with Russia and Peru) and seabird interaction actions at regional fishery management organizations (2010-2015)
- Seabird bycatch reduction through outreach to fishery participants regarding seabird species distribution on fishery survey cruises (2010-2015).

## Conclusion

Bycatch Reduction Engineering Program (BREP) funding increased by $766,313 from FY08 to FY09. A portion of this additional funding supported a substantial grant to the World Wildlife Fund to help foster innovative conservation engineering ideas from members of the fishing industry, environmental groups, government entities, academia, and other sources. With this additional funding, the BREP also was able to increase the human resources needed to develop conservation engineering solutions to bycatch challenges by funding two contactors, at NMFS' Northeast Fisheries Science Center and Northwest Fisheries Science Center, respectively.

BREP projects in 2009 built upon successful work in previous years, including improvements to devices to reduce trawl bycatch in Alaskan fisheries, as well as in Gulf of Mexico and South Atlantic shrimp trawls. Other projects that built on previous work included thresher shark post-release mortality research and study of the ability of electropositive metals to repel sharks from fishing gear. The BREP also broke new ground in 2009 by sponsoring the first NMFS National Seabird Workshop, characterizing bycatch related to green stick fishing gear, and evaluating hook guards to reduce sea turtle bycatch in the Gulf of Mexico bottom longline fishery.

The return on investment for conservation engineering research is becoming more and more apparent as important U.S. fisheries suffer significant financial losses due to bycatch. For example, the incidental take of sea turtles allowed under a 2005 Biological Opinion for the bottom longline component of the reef fish fishery in the Gulf of Mexico was determined to be exceeded in 2009, which has resulted in a prohibition on bottom longlining inshore of the 35-fathom depth curve along the East Florida shelf. A 2006 NMFS economic assessment reported that the ex-vessel value of product associated with this fishery was $25.8 million. With respect to Florida alone, the total 2006 impact of the commercial reef fish fishery on the Florida economy was estimated to be approximately $88.2 million, supporting an estimated 1,848 jobs.

Similar bycatch-related economic impacts are being felt in the Atlantic mackerel, squid, and butterfish fishery. The butterfish stock has been deemed overfished since 2005. There is no directed butterfish fishery, and the major source of butterfish mortality is discards, primarily in the offshore *Loligo pealeii* fishery. Amendment 10 to the Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan proposed to implement a butterfish mortality cap in 2011, which would close the *Loligo* fishery on a trimester basis if the cap is met. Economic analyses related to Amendment 10 indicate that the limited access *Loligo* fleet could lose up to $16 million as a result of the butterfish mortality cap. When the estimated multiplier effect is considered, total losses could be as high as $49 million.

Continued and increased investment in BREP conservation engineering research should offset some of these estimated losses. More selective fishing gear allows fishers to increase their fishing activities, protects endangered species, and enables overfished fish stocks to rebuild.

## Appendix 1. NMFS Bycatch Reduction Engineering Program Policy Directive

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

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| ***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)<br>**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 (including the National Seabird Program), International Affairs, Habitat Conservation, and Science and Technology, to leverage bycatch reduction engineering resources.
- Manage and regularly update the NMFS Bycatch Feature website.
- 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

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.

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.

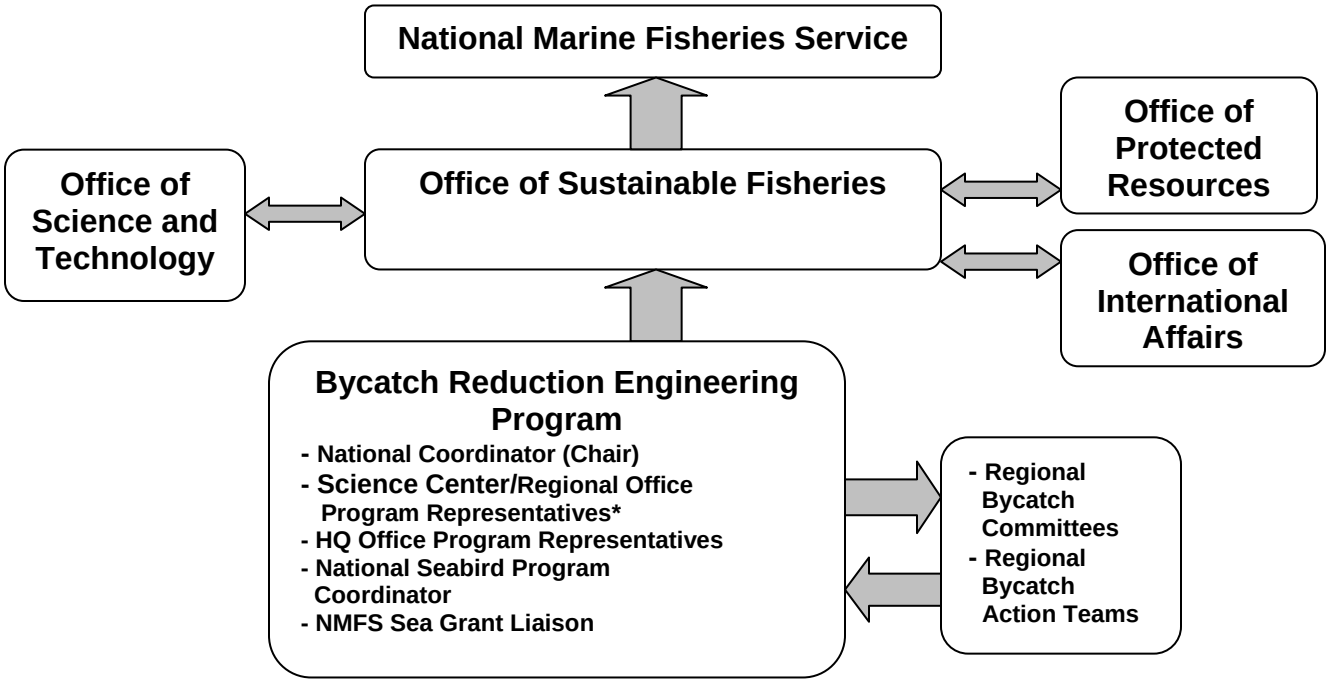
The Science Lead and Management Lead will be identified by the BREP National Coordinator from among the six Regional representatives described below. The Leads will rotate on a regular basis. The Science Lead and Management Lead will work with the National Coordinator to help coordinate BREP activities 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
Gary Locke

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and Undersecretary of Commerce
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