

**Southeast Region Current Bycatch Priorities and Implementation Plan  
FY04 and FY05**

[NOTE: This is a public, working document that will be revised in the future as additional bycatch minimization opportunities occur.]



## Summary

This summary contains only brief highlights of the Southeast Region's activities. More detailed and additional information can be found in the Southeast Region's Bycatch Implementation Plan.

### Monitoring

#### *Priorities FY04*

- Enhance observer programs in the Gulf of Mexico shrimp trawl fishery.
- Continue/increase funding for FIN, MRFSS, ACCSP, and the Southeast Region.

#### *Priorities FY05*

- Enhance observer programs in the Gulf of Mexico bottom longline reef fish fishery.
- Continue/increase funding for FIN, MRFSS, ACCSP, and the Southeast Region.

### Research

#### *Priorities FY04*

- Provide better bycatch estimates for red snapper and other species with respect to season, depth and location.

#### *Priorities FY05*

- Investigate the use of technology in enhancing the collection of bycatch information that could decrease the need for observers.

### Management

#### *Priorities FY04*

- Reduce capacity in the shrimp fishery.

#### *Priorities FY05*

- Continue the use of time/area closures for fisheries that have high bycatch of fishes, marine mammals, and sea turtles.

### Education/Outreach

#### *Priorities FY04*

- Update and maintain regional lists of organizations that have a need or interest in bycatch information.
- Continue partnership with fishermen and industry groups to research and develop effective bycatch reduction techniques.

#### *Priorities FY05*

- Continue to update and maintain regional lists of organizations that have a need or interest in bycatch information.
- Post bycatch databases and research on the internet.
- Develop regional "media kits," including a glossary of terms, pertinent laws and regulations, visual aids, NMFS contacts, and World Wide Web sites to publicize recent efforts to reduce bycatch.

# SOUTHEAST REGION IMPLEMENTATION PLAN

## I. Introduction

The National Marine Fisheries Service (NOAA Fisheries), Southeast Region is responsible for the conservation, management, and protection of marine resources and their habitat in the Exclusive Economic Zone (EEZ) of the Southeastern United States. The Southeast Region works cooperatively with three regional fishery management councils: the South Atlantic Fishery Management Council (from North Carolina to eastern Florida including the Atlantic side of the Florida Keys), the Gulf of Mexico Fishery Management Council (from Texas to western Florida including the Gulf side of the Florida Keys), and the Caribbean Fishery Management Council (including Puerto Rico and the U.S. Virgin Islands). In combination, these Councils and NOAA Fisheries currently have 18 different fishery management plans, many of which manage diverse species complexes such as reef fish or corals as a unit. In essence, hundreds of species are being managed by the three Councils and NOAA Fisheries. The diversity of stocks and fishing methods, combined with the fact that many fishing methods catch multiple species simultaneously, can lead to overfishing, habitat impacts, and user conflicts.

Among many other legal mandates, NOAA Fisheries and the Councils are required to address bycatch, which is defined as “fishery discards, retained incidental catch, and unobserved mortalities resulting from direct encounter with fishing gear” (NOAA 1998a). The Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires that fisheries have standardized reporting methodologies and minimize bycatch to the extent practicable. Other laws protect specific types of marine plants and animals. The Endangered Species Act (ESA) requires that federal agencies ensure that their actions and authorization or funding of activities by others do not jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of their habitat. There are a number of ESA-listed species in the Southeast Region, including five species of sea turtles, whales, two species of sturgeon, and one species of seagrass. Marine mammals receive additional protection through the Marine Mammal Protection Act (MMPA), which requires that marine mammal bycatch is limited to levels that do not jeopardize their ability to achieve an optimum sustainable population. Sea birds also receive protections through the Migratory Bird Treaty Act (MBTA).

There are a variety of types of, and reasons for, bycatch. In some cases, bycatch results from prohibitions intended to reduce or eliminate directed fishing pressure on vulnerable stocks or species. This type of bycatch applies to depleted stocks of marine mammals, sea birds, five species of sea turtles, fishes that are slow growing and late to mature, as well as species listed under the ESA. In other cases, bycatch results from regulations (regulatory discards) such as size limits designed to protect spawning individuals or those that have not yet had a chance to grow to marketable size and/or spawn. These regulations and prohibitions on catch are designed to remove the incentive for people to target particular types of fishes. When there are limits to the size or number of fishes that can be retained, there will be incentives for fishers to keep the highest value items in a catch and discard the lower value

items. Trip limits are often imposed to spread out fishing opportunities throughout the year or among fishermen. If an individual catches more than their trip limit, they are required to discard the excess.

Fisheries in the Southeast generate about one billion dollars in ex-vessel revenue each year (NOAA 2001). These fisheries reflect the diverse fauna of the region, with relatively few large fisheries and many small fisheries. Catches occur from more than 300 stocks of fishes and fishery resources. The shrimp and menhaden fisheries dominate landings economically. The shrimp trawl fishery accounts for the largest revenue regionally, and sometimes nationally. The Gulf of Mexico shrimp fishery represents about 75% of the entire U.S. wild shrimp production. Total landings in the Southeast Region are dominated by the menhaden purse seine fishery with annual landings approaching 2 billion pounds (NOAA 2003a). Approximately 60% of the menhaden landings are from the Gulf of Mexico and 40% from the South Atlantic. Other than shrimp and menhaden, about half the commercial value of fisheries come from blue crabs, oysters, and other invertebrates that are generally harvested from state waters, and managed by the states. The remainder of the commercial harvest consists of finfish from many stocks; including reef fishes (e.g., red snapper, red grouper, gag, scamp, vermilion snapper); coastal pelagic fishes (e.g., king and Spanish mackerel); and highly migratory species (e.g., sharks, swordfish, and tunas).

Recreational fishing is a substantial part of the harvest in the Southeast Region. Participation in recreational fishing is much greater in the Southeast than other regions in the U.S. For example, over 50% of landings along the east coast of Florida are from recreational catches, which is the highest in the nation. Each year in the Southeast, approximately 4-6 million individuals partake in 30-40 million fishing trips. The bulk of fishes harvested by recreational fishermen consists of small sciaenids (croakers and seatrouts), but many commercially important species of great economic value (e.g., red snapper, black sea bass, gag, king mackerel, and Spanish mackerel) are also targeted by recreational fishermen.

Partnerships with other fishery management agencies and non-governmental organizations, including state fishery management agencies, interstate marine fisheries commissions, state Sea Grant College programs, and the Gulf and South Atlantic Fisheries Foundation have been crucial to addressing bycatch issues in the Southeast Region. In 1990, efforts began to address finfish bycatch in the shrimp trawl fishery, culminating in a strategic research document focused on this important issue (NOAA 2003a). Previously, gear research had focused on turtle excluder devices (TEDs). This bycatch strategic document led to implementation of a formal Regional Research Program that was coordinated by the Gulf and South Atlantic Fisheries Foundation. The major components of the research program were observer programs to quantify bycatch mortality, as well as gear technology research and development to reduce finfish bycatch. A four-phase development program has been successfully used to develop several bycatch reduction devices (BRDs) for use in shrimp trawls. Research and development of candidate devices have been carried out independently by NOAA Fisheries, Sea Grant, state agencies, universities, and industry, drawing on a variety of funding sources, primarily the

Saltonstall-Kennedy (S-K) and MARFIN (Marine Fisheries Initiative) grants programs. Bycatch characterization and reduction research have been conducted for other fisheries in the Southeast Region, though not through the same type of cooperative program structure as for the shrimp fishery. Pelagic longline fisheries for tuna, swordfish, and sharks have had mandatory observer programs in place since 1992. The primary goal of the programs is to collect catch and effort data on highly migratory species in the U.S. pelagic longline fleet. Information is also collected on bycatch of protected species (mammals, sea turtles, and seabirds). Actual coverage levels achieved from 1992-2002 have ranged from 2-6% depending on quarter and year. In 2002, the required observer program coverage was increased to 8%.

The directed shark gillnet fishery developed off the east coast of Florida and Georgia in the late 1980s. It is classified as a Category II fishery under the MMPA due to occasional interaction with, or capture of, marine mammals. There is also a concern about interaction with sea turtles. Between five and eleven vessels operated in this fishery from 1993-98 and four to six vessels are currently operating. An observer program for this fishery was in place during 1993-1995 and 1998-2002 to obtain estimates of catch, bycatch, and bycatch mortality rates of protected species (sea turtles and marine mammals), juvenile sharks, and other fish species caught in the southeast U.S. coastal shark gillnet fishery. Catch and bycatch estimates are gathered each year to meet the mandates of the Atlantic Large Whale Take Reduction Plan and the Biological Opinion issued under requirements of the Fishery Management Plan for Highly Migratory Species.

MARFIN and S-K grants have funded research on bycatch in the menhaden purse-seine fisheries of the Gulf and Atlantic coasts. The menhaden industry has previously developed some gear innovations to release bycatch alive during harvest. Bycatch is considered to be minimal in this fishery.

Estimates of fishes caught, but not retained, in recreational fisheries are made through the national Marine Recreational Fisheries Statistics Survey (MRFSS) program for much of the Southeast Region. There have been S-K awards for short-duration projects assessing recreational bycatch in some geographic areas not covered by MRFSS. A number of MARFIN and S-K grants have been awarded to examine mortality of hooked and released fish. In addition, a tagging program conducted by the NOAA-funded Marine Resources Monitoring Assessment and Prediction Program (MARMAP) program has estimated depth-related mortality of fishes captured with commercial hook-and-line gear. Species addressed include red snapper, red grouper, black sea bass, vermilion snapper, gag, greater amberjack, king and Spanish mackerel, and sharks.

Short-duration observer programs have been conducted in some areas in the Gulf of Mexico to examine bycatch of the commercial hook-and-line fishery for reef fishes. Short-term research has also been conducted on bycatch in trap fisheries for finfish and crustaceans, with most projects focused on developing escape structures for unwanted or prohibited catch, and for reduction of ghost fishing by lost traps.

The impacts of bycatch on fish stocks are included in traditional stock assessments whenever estimates of bycatch are available. For example, the effects of bycatch by the shrimp fishery has been included in a red snapper stock assessment (Schirripa and Legault 1999). Incorporation of bycatch information from other fisheries in stock assessments is often less adequate due to lack of time series estimates for bycatch.

There does not appear to be a significant bycatch issue in the Caribbean since there are few regulations that would introduce regulatory discards. Jimenez (1993) estimated, based on fishery-independent data from the Southeast Area Monitoring and Assessment Program (SEAMAP)-Caribbean program collected off the west coast of Puerto Rico, that about 14% by number and 17% by weight of the fish caught in the commercial hook and line fishery are species with low market value, including squirrel fishes, butterfly fishes, doctor fishes, puffers, filefish, and scorpion fish. Regulatory discards may potentially include Nassau grouper, goliath grouper, butterfly fishes, sub-adult yellowtail snapper and sub-adult and berried spiny lobster. The extent of these regulatory discards is unknown since there are few data on commercial and recreational bycatch in the U.S. Caribbean region. The regulatory requirements forcing fishermen to discard these species are difficult to enforce because regulations are generally less restrictive in Territorial waters. Anecdotal information suggests that the vast majority of fish harvested in the U.S. Caribbean are retained for the market or for personal use including species with low market value. With the exception of species that are commonly believed to be ciguatoxic, economic discards in this region appear to be minimal.

The purpose of this Bycatch Implementation Plan is to identify methods that can be used to better quantify bycatch, as well as determine techniques that can be employed to reduce bycatch in fisheries of the Southeast Region. In particular, the goals are to: (1) prioritize fisheries in the Southeast Region that have potential for bycatch and describe how bycatch reporting methodologies can be enhanced; (2) prioritize top research needs to better monitor and reduce bycatch; (3) identify new management measures that can be taken to reduce bycatch in various fisheries; and (4) discuss ways to enhance education and outreach through better communication about bycatch to the public. This is a working document that will be revised in the future as additional bycatch minimization opportunities arise.

## **II. Standardization and enhancement of bycatch reporting methodologies, including data collection and monitoring**

The Preliminary Bycatch Assessment Report for the Southeast Region identified a number of NOAA Fisheries studies that had been conducted to evaluate the quality, quantity, and utility of data available on bycatch mortality. However, the report stated that bycatch reporting methodologies need to be standardized and enhanced for most fisheries. A number of methods are currently being used to monitor and estimate bycatch. The reliability associated with each method varies and is dependent on many factors that will be discussed below. It is critical to have credible estimates of the type, rate, and level of bycatch currently occurring, as well as information on the fishing practices and other factors that may contribute to bycatch. At-sea observation (in its various forms), fishery-independent data collection, and fishery-dependent data collection are all being used in the Southeast Region to obtain bycatch estimates. Alternative methods for monitoring and estimating bycatch including video cameras, digital scanning devices, remote monitoring, and stranding networks are also used to a limited extent in the Southeast Region.

### At-sea observation

Data collected from at-sea observer programs are the most reliable method for estimating bycatch if coverage is adequate to avoid large sampling errors and the observer effect (where fishing operations are altered in the presence of an observer). Combined with reliable estimates of total fishing effort or landed catch, bycatch rates from observer data can be used to estimate total bycatch levels in a fishery.

NOAA Fisheries has been using fishery observers to collect catch data from U.S. commercial fishing and processing vessels since 1972. However, observer data are limited or are almost non-existent for some animals such as sea birds in the Southeast Region. NOAA Fisheries (2003a) estimates that 48% of the fisheries in the Southeast are monitored by observer programs annually. There are several distinct levels in the evolution of an at-sea sampling program (Table 1).

Table 1. Developmental stages for observation programs (from: National Marine Fisheries Service. 2003a. Evaluating Bycatch: A National Approach to Standardized Bycatch Monitoring Programs. NOAA, NMFS, Silver Spring, MD. 64 p.).

Observer Program Level	Definition
None	No <i>systematic</i> program exists for bycatch data collection
Baseline	An initial effort including at-sea monitoring to assess whether a systematic program is needed to estimate bycatch is completed.
Pilot	An initial at-sea monitoring program that obtains information from relevant strata (time, area, gear) for design of a systematic program to estimate bycatch with the ability to calculate variance estimates has been done.
Developing	A program in which an established stratification design has been implemented and alternative allocation schemes are being evaluated to optimize sample allocations by strata to achieve the recommended goals of precision of bycatch estimates for the major species of concern.
Mature	A program in which some form of an optimal sampling allocation scheme has been implemented. The program is flexible enough to achieve the recommended goals of precision of bycatch estimates for the major species of concern considering changes in the fishery over time.

In a report that evaluates bycatch monitoring programs, NOAA (2003a) provided information on current observer level, number of trips or sea days to advance to the next observer level, cost to advance to the next level, and the magnitude of concern over bycatch of fish, marine mammals, and other protected species (i.e., ESA-listed species, seabirds) throughout the United States. To better prioritize observer needs and estimated related costs, information provided by NOAA (2003a) for the Southeast Region was entered into an Excel spreadsheet and sorted according to the potential for non-marine mammal, ESA, and seabird bycatch; fish bycatch; and marine mammal bycatch (Table 2).

On the basis of the potential for bycatch, observer programs are needed most for the pelagic longline fishery and the Gulf of Mexico shrimp trawl fishery. The pelagic longline fishery is considered to have high bycatch potential in all three categories (ESA/seabirds; fishes; marine mammals). NOAA (2003a) considers the observer program for the pelagic longline fishery to be at the “developing” level and it is estimated that \$3 million per year is needed to bring the monitoring program to the “mature” observer level. The Gulf of Mexico shrimp trawl fishery is considered to be high in bycatch potential for ESA-listed species such as sea turtles, and is arguably the most significant cause of bycatch of fishes in this region. The observer program used to quantify bycatch in the shrimp trawl fishery is considered to be at the “pilot” observer level. The estimated cost to bring the monitoring program to the next observer level (“developing”) is \$8 million per year. However, this cost does not take into consideration a possible 30-50% reduction in the number of fishing vessels that may occur. Under current economic conditions, it has been projected that many fishermen will be leaving the Gulf of Mexico shrimp trawl

industry because of an inability to make a profit. In addition, other technologies (i.e., video) that are less expensive could be also be used in conjunction with observers.

Other fisheries that have high potential for bycatch in at least one of the categories include the North Carolina coastal gillnet, inshore gillnet, North Carolina pound net, Gulf of Mexico bottom longline, South Atlantic snapper-grouper bottom longline, Gulf of Mexico reef fish hook-and-line, South Atlantic snapper-grouper hook-and-line, South Atlantic shrimp trawl, recreational charter boat, recreational headboat, and recreational private boat. The observer program level is considered to be “baseline” or “none” for North Carolina pound net, Gulf of Mexico bottom longline, South Atlantic snapper-grouper bottom longline, Gulf of Mexico reef fish hook-and-line, South Atlantic snapper-grouper hook-and-line, recreational charter boat, recreational headboat, and recreational private boat. Of the fisheries that have high potential for bycatch in one of the three categories, the expense to increase observer coverage to the next level was high (>\$1 million per year) for the South Atlantic snapper-grouper hook-and-line fishery (\$2,319,000 per year), and Gulf of Mexico reef fish hook-and-line fishery (\$2,016,000 per year).

In summary, observer programs are a reliable method for estimating bycatch. There is concern whether limited coverage observer programs will provide good measures of bycatch since fishermen may fish differently when observers are present. However, observer programs need to be enhanced or developed for many of the fisheries in the Southeast Region that have a significant bycatch potential. Unfortunately, observer programs are one of the most expensive programs available for estimating bycatch. NOAA (2003a) estimates that \$14.1 million dollars is necessary to develop baseline or pilot programs for fisheries in the Southeast Region and this does not include costs to improve observer programs for the pelagic longline fishery and Gulf of Mexico shrimp trawl fishery that are at more advanced observer levels.

Table 2. Fishery, gear, current observer level, number of sea days or trips required to advance to next observer level, cost to advance to next level, bycatch potential of fishery to non-marine mammal, ESA, and seabird bycatch, potential (3 = high potential) of fishery to fish bycatch, and potential of fishery to marine mammal bycatch. Fisheries sorted according to the potential for non-marine mammal, ESA, and seabird bycatch; fish bycatch; and marine mammal bycatch (NOAA 2003a).

Fishery	Gear	Level	Sea Days or Trips	Cost to Enhance	Bycatch Potential for Non-Marine Mammal, ESA Bycatch and Seabirds	Potential for Fish Bycatch	Potential for Marine Mammal Bycatch
Pelagic Longline	Surface Longline	Developing	2 days for each set	\$3,000,000	3	3	3
Gulf of Mexico Shrimp Trawl NC Coastal Gillnet	Trawl	Pilot	8,000 days	\$8,000,000	3	3	1
	Gillnet	Pilot	117 trips		3	2	3
Inshore Gillnet	Gillnet	Pilot	820 trips		3	2	2
NC Pound Net Gulf of Mexico Reef Fish	Pound Net	Baseline	66 trips	\$80,000	3	1	2
	Bottom Longline	Baseline	17-35 trips	\$588,000	2	3	1
South Atlantic Snapper-Grouper	Bottom Longline	Baseline	4-8 trips	\$135,000	2	3	1
Gulf of Mexico Reef Fish South Atlantic Snapper-Grouper	Hook and Line	Baseline	60-120 trips	\$2,016,000	2	3	1
	Hook and Line	Baseline	79-138 trips	\$2,319,000	2	3	1
South Atlantic Shrimp Trawl	Trawl	Pilot	4,000 days		2	3	1
Recreational Charter boat	Hook and Line, Speargun	None	1,121-2,242 trips		2	3	1
Recreational Headboat	Hook and Line, Speargun	Baseline	260-500 trips	\$624,000	2	3	1
Recreational Private Boat	Hook and Line, Speargun, Castnet, etc.	None (MRFSS)	177,325-354,650 trips		2	3	1
Directed Shark Gillnet	Drift Gillnet	Mature	100% Coverage		2	2	2
NC Haul/Beach Seine	Seine	Baseline	6-12 trips	\$15,000	2	2	2
NC Long-Haul Seine	Seine	Baseline	4-8 trips	\$10,000	2	2	2
NC Stop Nets	Seine	Baseline	100 days	\$120,000	2	2	2
Southeastern Atlantic Flynet	Trawl	Baseline	2-5 trips	\$42,000	2	2	1
Winter Fluke (Flounder) Trawls	Trawl	Baseline	7-13 trips	\$190,000	2	2	1

Fishery	Gear	Level	Sea Days or Trips	Cost to Enhance	Bycatch Potential for Non-Marine Mammal, ESA Bycatch and Seabirds	Potential for Fish Bycatch	Potential for Marine Mammal Bycatch
Migratory Coastal Pelagic - Gulf of Mexico	Trolling	None	6-12 trips	\$202,000	2	1	1
Migratory Coastal Pelagic - South Atlantic	Trolling	None	45-90 trips	\$1,512,000	2	1	1
Surface Trawl (Jellyfish)	Trawl	None	1 trip	\$8,000	2	1	1
Gulf of Mexico Reef Fish	Trap	Baseline	Fishery Being Phased Out		1	3	1
Black Sea Bass Pot Fishery	Pot/Traps	Baseline	50 days	\$60,000	1	2	2
Crab Trap/Pot (Blue Crabs) - Gulf of Mexico	Pot	None	1,250-2,500 trips	\$3,000,000	1	1	2
Crab Trap/Pot (Blue Crabs) - South Atlantic	Pot	None	600-1,200 trips	\$1,440,000	1	1	2
Gulf Menhaden Purse Seine	Purse Seine	Baseline	226-451 sets	\$271,000	1	1	2
Crab Trap/Pot (Stone Crab)	Pot	None	175-350 trips	\$420,000	1	1	1
Crab Trap/Pot - Golden Crab	Pot	None	1-2 Trips	\$17,000	1	1	1
Lobster Trap	Pot	None	115-230 trips	\$276,000	1	1	1
Fish Trawl (Paired/Single)	Trawl	None	50 days	\$60,000	1	1	1
Atlantic Menhaden Purse Seine	Purse Seine	None	25-50 sets	\$30,000	1	1	1
Gulf of Mexico Cast Net	Cast Net	None	0 days		1	1	1
South Atlantic Cast Net	Cast Net	None	0 days		1	1	1
Gulf of Mexico Beam Trawl	Beam Trawl	Baseline	75 trips	\$90,000	1	1	1
Gulf of Mexico Skimmer Trawl	Skimmer Trawl	None	219-438 trips	\$526,000	1	1	1
South Atlantic Skimmer Trawl	Skimmer Trawl	None	18-36 trips	\$43,000	1	1	1
Gulf of Mexico Butterfly Nets	Butterfly net	None	25-51 trips	\$61,000	1	1	1
South Atlantic Butterfly Nets	Butterfly net	None	3-6 trips	\$7,000	1	1	1

### Fishery-independent data collection

In the Southeast Region, NOAA Fisheries conducts a variety of fishery-independent surveys (i.e., MARMAP and SEAMAP) during specific seasons in both offshore and inshore waters, using both NOAA and chartered vessels. Surveys vary according to the habitats or areas sampled, the availability of vessels, and weather conditions. The primary objective of fishery-independent research surveys is typically to measure year-to-year variation in abundance for species of interest. Secondary goals may include spatial and temporal distribution patterns, size and age composition, size/age at sexual maturity and sexual transition, fecundity measurements, and environmental monitoring. Simultaneous abundance levels and life history information are gathered for as many species as possible. In some cases, these may include species of concern for bycatch monitoring. For example, the fishery-independent MARMAP program has conducted a cooperative data collection program with commercial fishermen and processors for over 30 years. In addition to monitoring reef fish abundance and conducting life history studies on fishes, the MARMAP program conducts a tagging program that has provided information on depth-related mortality of various reef fish species. Information on topics such as bycatch in the shark gillnet fishery, release mortality in the hook-and-line fishery, bycatch in the shrimp fishery and survival of bycatch in the pelagic longline fishery have also been obtained by other fishery-independent NOAA funded studies (MARFIN, S-K, Cooperative Research Program).

Fishery-independent surveys often do not use commercial gear or do not fish gear in the same manner as commercial fishermen. Inferences can be made regarding what commercial catches might be, if there are values that can be used to convert fishery-independent bycatch rates to commercial catches. Fishery-independent surveys may be useful in estimating total bycatch for fisheries in which observer data are discontinuous and where fishery-dependent CPUE estimates are available. However, fishery-independent surveys are expensive (up to \$10,000 per day for vessel costs), and are subject to annual changes in appropriations.

### Fishery-dependent data collection

#### *Logbooks*

Most fishers keep logbooks of their catches, including information on timing and location. One option for reporting bycatch is to mandate the use of standardized logbooks by each participant in a fishery. Logbooks may include information on type of gear used, date, time of day, location of fishing activity, weather conditions, method by which gear was deployed (e.g., tow length, and number of hooks set), and catch of non-target species. Federally managed fisheries that currently have mandatory logbook and bycatch reporting requirements for the Southeast Region include pelagic highly migratory species (HMS), snapper/grouper/wreckfish, reef fish, coastal migratory pelagic species, golden crab, coastal sharks, and the headboat/charter boat fishery (Table 3).

Table 3. Federally managed fisheries with mandatory logbook and bycatch reporting requirements for the Southeast Region (NOAA 2003a).

Fishery/FMP Gear Type(s)	Species of Bycatch Required to be Reported
Pelagic Highly Migratory Species – Swordfish/Tuna/Shark (Longline, Hand Line, Harpoon, Purse Seine, Bandit Rig, Rod and Reel)	All discards, including protected species
Snapper/Grouper/Wreckfish (Bottom Longline, Trap)	All discards, including protected species
Coastal Migratory – Mackerel, Dolphin and Cobia (Gillnet, Handline, Troll)	All discards, including protected species
Gulf of Mexico/South Atlantic Reef Fish (Bottom Longline, Trap)	All discards, including protected species
Golden Crab (Trap/Pot)	All discards, including protected species
Coastal Sharks (Bottom Longline)	All discards, including protected species
Headboat/Charter Boat (Rod and Reel)	None

Logbook data are most useful in estimating bycatch when reporting is mandatory, because a key advantage of logbooks is the ability to use them to cover all fishing activity relatively inexpensively. Many logbook programs do not require, or do not place a strong emphasis on accurate reporting of bycatch. Furthermore, some of the fisheries that have the greatest potential for bycatch (Table 2) do not have mandatory logbook and bycatch reporting requirements. In some fisheries, such as the Gulf of Mexico shrimp trawl fishery, logbook reporting of bycatch is not practicable, but logbooks could enhance effort data needed to expand bycatch composition from observer programs.

The Marine Mammal Authorization Program (MMAP) has as its primary focus the self-reporting of marine mammal bycatch. The MMAP requires that any fisherman participating in a state or federal fishery that operates in U.S. waters report all injuries and mortalities of marine mammals associated with fishing operations to NOAA Fisheries within 48 hours of returning to port. However, the MMAP purportedly has not succeeded in obtaining reliable marine mammal bycatch data. Despite fairly good outreach and distribution of reporting forms to all state and federally-permitted fishermen each year, compliance with the reporting requirement is thought to be very low (NOAA 2003a).

Poffenberger (2003) provided a report on discard data that is based on the Southeast Fisheries Science Center (SEFSC) logbook program for snapper-grouper, reef fishes, king mackerel, Spanish mackerel, and shark fisheries. However, in the absence of any observer data, there are concerns about the accuracy of logbook data from these and other fisheries. Biases associated with logbooks primarily result from inaccuracy in reporting of species that are caught in large numbers or are of little economic interest (particularly of bycatch species) and low compliance rates. Many fishermen may perceive that

accurate reporting will result in restricted fishing effort or access. This results in a disincentive for reporting accurate bycatch data, and an incentive to under-report or not report (NOAA 2003a).

The advantage of logbooks as compared to other sampling methods is that logbooks are usually required of all fishery participants and can provide good estimates of fishing effort. Reliable measures of effort are crucial for extrapolating observed bycatch rates to the fishery as a whole, to determine total bycatch levels. Another advantage is that logbook programs are much less expensive than observer programs. The costs usually include producing and distributing the logbooks, data entry, database maintenance, and analysis. As with fishery surveys, logbook programs are generally not implemented solely to collect information on bycatch. Therefore, the cost of collecting bycatch data via logbooks is marginal, and may be limited to costs associated with the entry and analysis of the bycatch data (NOAA 2003a).

In summary, there are a number of fisheries in the Southeast Region that have bycatch reporting methodologies (Table 3). However, bycatch reporting methodologies may be lacking for some fisheries where there is substantial potential for bycatch. Logbook programs do provide qualitative estimates in bycatch where bycatch is required to be reported; however, the accuracy of these data is of concern, particularly in the absence of any observer data. In many fisheries (e.g., Gulf of Mexico shrimp trawl fishery) logbook programs are more useful in providing estimates of total effort by area and season that can then be combined with observer data to estimate total bycatch.

#### *FIN, MRFSS, and ACCSP*

Collection of landings data and other fisheries-dependent data is conducted through the Fisheries Information Network (FIN), Atlantic Coastal Cooperative Statistics Program (ACCSP), and MRFSS. The Gulf States Marine Fisheries Commission (GSMFC) currently manages and coordinates the Southeast Fishery Information Network (FIN) of which RecFIN and ComFIN are the recreational and commercial components, respectively. The purpose of these state-federal cooperative programs is to collect, manage, and disseminate statistical data and information on the commercial and recreational fisheries of the Southeast Region. These programs combine efforts of program partners which include states and territories of the Southeast Region, NOAA Fisheries, the U.S. Fish and Wildlife Service, the National Park Service, and the GFMC and CFMC. Over time, all or most of the fishery-dependent data will be collected under the umbrella of FIN, which includes such state programs as the Florida, Alabama, and Louisiana trip ticket programs for the collection of commercial fishery statistics. Under the RecFIN program, the states are collecting all of the intercept data for MRFSS. The FIN also began the development of a bycatch module where data will be collected via at-sea sampling from priority fisheries.

Data on recreational fisheries have been collected by MRFSS since 1979 to establish a data base for estimating the impact of marine recreational fishing on marine resources. MRFSS data are collected by two independent, but complementary, surveys: a telephone survey of households in coastal counties, and an intercept (i.e., interview) survey of anglers at fishing access sites. Data from the two

independent surveys are combined to produce estimates of fishing effort, catch, and participation. Using the complemented surveys approach, marine recreational fishing estimates (not including shellfishing) are calculated for six two-month periods (waves) in each year. In addition to fish that are landed, MRFSS provides estimates of fish caught, but not retained. Total survey effort during a one-year period usually involves more than 76,000 intercept interviews and over 265,000 telephone interviews. MRFSS is conducted throughout the entire Southeast Region with the exception of Texas and states can augment sampling.

The ACCSP has developed a data collection program for the South Atlantic (Maine to Florida) that includes data for catch and effort, biological sampling, bycatch releases and protected species interactions, and socioeconomic data. The ACCSP commercial data collection program is a mandatory, trip-based system with all fishermen and dealers required to report standardized data elements. The bycatch, releases, and protected species interactions monitoring portion of ACCSP includes quantitative and qualitative data collection components. The quantitative component includes mandatory at-sea observers and mandatory and voluntary reporting of releases and discards through the catch and effort trip ticket systems. The qualitative data collection includes sea turtle and marine mammal stranding and entanglement reporting networks, beach bird surveys, and port sampling to verify reporting on fishermen trip reports.

Port samplers that collect data for these programs (FIN, MRFSS, ACCSP) are Federal, state government-employed or contracted biologists trained to collect fishery information and biological samples from fishermen and/or dealers, at or near the time of landing. Port samplers collect information primarily on catch, but also bycatch information on fishes or other species that are not landed. Bycatch data collected by port samplers are similar to logbook data in that there are significant concerns about the completeness and accuracy of the information. In addition, data from interviews with fishermen or dealers may not represent or reflect total catch.

An advantage over logbooks, though, is the timeliness of these reports and their usefulness in directing further sampling towards potential problem areas. Furthermore, port sampling is less expensive than the observer program in that it includes the salary of a port sampler to collect data as well as the cost of entering the data. NOAA (2003a) estimates that the cost of an observer program ranges \$350 to \$2,000 per sea day.

### *Caribbean*

Currently, there is no program in place in the U.S. Caribbean to collect bycatch data. The Caribbean Fishery Management Council (CFMC) is considering an alternative in an amendment to the Fishery Management Plans (FMPs) of the U.S. Caribbean to develop and implement a Federal permit system for commercial and charter boat fishermen participating in Council-managed fisheries, with an associated mandatory monthly reporting requirement. Under this alternative, permits would be implemented for each fishery (e.g., conch permit, spiny lobster permit, reef fish permit). Permit renewal would be dependent upon submission of monthly catch reports, similar to what is currently required of

U.S. Virgin Island fishery participants. Permits would be issued to specific vessels. Initially, there would be no specific eligibility criteria required, so as to encourage issuance of permits to all vessels fishing in the EEZ.

Another alternative in the amendment to the Fishery Management Plans of the U.S. Caribbean would require that bycatch data be collected through the current trip ticket systems, which are managed at the Territorial level. This amendment also provides an alternative that utilizes the MRFSS database to provide additional bycatch information on the recreational and subsistence sectors. This would provide fishery managers a means to monitor the bycatch of individual recreational anglers and subsistence fishermen.

### Alternative Methods

Various “alternative” methods of monitoring bycatch are currently being used and/or continue to be evaluated, to a limited extent, to monitor and estimate bycatch in the Southeast Region. The reliability and credibility associated with each method is dependent on many factors. Some of these methods may also be useful for developing techniques to reduce and/or monitor the effectiveness of such measures. Technology can be used to monitor fishing activities, assess species composition of organisms retained or discarded, and determine the condition of organisms that are released. In addition, technology may be useful in many of the fisheries in the Southeast Region that use small vessels that can not accommodate an observer, and where safety of observers is an issue. However, in some fisheries, the volume and diversity of bycatch may make the use of various technologies impractical since it will be difficult to identify species, or accurately estimate the number or weight of discarded fishes. There is a need to obtain information on the entire catch of commercial fishermen including individuals that are discarded. The use of video cameras and technology that will record species, length, and capture position could greatly enhance the collection of bycatch information and lessen the need for observers.

### *Video Cameras*

The employment of video cameras to monitor activities at sea is relatively new and has only been used in a few fisheries throughout the country. This technology has been applied on an experimental basis in at least two federally-managed fisheries: the Alaska halibut longline fishery and the Pacific whiting trawl fishery. In addition, video cameras have been determined to be a promising option for assessing bycatch of seabirds in the Pacific halibut fishery off Alaska (NOAA 2003a). They are also being used extensively in several Canadian fisheries. In the Southeast Region, video cameras have been used by the MARMAP program to monitor the tagging of reef fishes by commercial fishermen. During 1995-2000, selected fishermen were paid to tag and release gag and greater amberjack. However, part of the agreement was that the fishermen record data (length of fish, weight of fish, tag number, location) on paper and video. This provided scientists with a paper and a video record of tagging. In addition, information was obtained on the health of the fish when tagged as well as the disposition (float or swim away) of the fish when released.

There is also concern that protected species such as sea turtles may drop out of the gear before it is hauled on board and viewed by the camera. One methodology in the use of video cameras described by NOAA (2003a) involves mounting one or more tamper-proof digital video cameras in various areas on a fishing vessel's deck or hull, and recording all or a portion of the fishing activities. The cost of video monitoring includes the expense of the equipment (3-5 cameras per vessel and a CPU with a removable hard drive), installation of cameras on vessels, and post-cruise analysis of the video stream. The estimated cost to equip 10 vessels for 60 days, including analysis of video, is approximately \$90,000 (\$150 per vessel per day).

#### *Electronic Devices*

Digital observer technology takes the use of video cameras to monitor fishing activities one step further by using a digital scanner to record images of individual fish catch for electronic species identification and for length/frequency estimates. The scanner records several images of a fish as it passes through the scanner on a conveyor belt, and uses the best of these images to make its predictions and calculations. Digital observer technology has been developed for use in Alaska groundfish fisheries but has not been employed in the Southeast Region. Although this technology is still in a testing phase, and appears to be software and hardware intensive, it may have limited utility for specific fisheries and/or gear types.

Electronic fish measuring boards have been used in the Southeast Region on research vessels for the MARMAP program as well as in fish houses during port sampling. This technology provides another means of rapidly obtaining species identification and length frequency information. Electronic fish measuring boards cost about \$5,000 each and can be interfaced to a computer to store data and simplify data collection. The system will require an individual to download and analyze data that are collected at sea.

#### *Stranding Networks*

Stranding "networks" have been established throughout the country, including the Southeast Region, to monitor the rate of strandings of protected species on beaches. Only a small portion of the animals that strand can be linked to fishing interactions.

## Summary

At-sea observation (in its various forms), fishery-independent data collection, logbooks, port samplers, video cameras and other technology can be used to obtain bycatch estimates. Each has specific advantages and disadvantages. At-sea observer programs are the most reliable method for estimating bycatch. They provide more accurate estimates of bycatch than either fishery-independent surveys or self-reporting. Combined with reliable estimates of total fishing effort or landed catch, bycatch rates from observer data can be used to estimate total bycatch levels in a fishery. Observer programs are developed for many fisheries in the Southeast Region, yet some still require enhancement to reach a level that will be more useful in assessing bycatch. Observer programs are very expensive, particularly for the fisheries that have the largest amount of bycatch. Funding to enhance existing observer programs is needed.

There are many fisheries (Table 3) in the Southeast Region that have bycatch reporting requirements. However, enhanced bycatch reporting is needed for some fisheries where bycatch may be substantial. Logbook programs provide qualitative estimates of bycatch (where bycatch is required to be reported); however, the accuracy of these data is of concern, particularly in the absence of any observer data. Logbook programs are useful in providing estimates of total effort by area and season that can be combined with observer data to estimate total bycatch. Logbooks can be a useful addition to at-sea observer programs, but should be subject to periodic ground-truthing. Typically, relying solely on self-reporting can result in questionable information on which to base management decisions.

The use of video cameras and technology that will record species, length, and capture position can enhance the collection of bycatch information and lessen the need for observers. It may also provide information on the entire catch in some fisheries, including catch that is discarded, at a cost that is substantially less than an observer program.

### **III. Prioritization of top research needs**

#### Obtain Better Estimate of Fish Bycatch in the Gulf of Mexico Shrimp Trawl Fishery

Bycatch mortality can decrease the sustainability of a fishery as well as the yield that can be generated from that fishery. Bycatch of red snapper varies by depth, season and location. A better measure of this variability could be obtained if the observer level in the Gulf of Mexico shrimp trawl fishery was enhanced. If bycatch is not monitored adequately, it increases the uncertainty concerning total fishing-related mortality, making it more difficult to assess the status of target organisms. Effort reporting in the logbook program should also be enhanced and ground-truthed to a better developed observer program. Reliable effort data from the logbook program combined with bycatch information from the observer program can be used to provide better estimates of bycatch and examine bycatch variability with respect to season, depth, and location.

#### Analyze the Effect of Time/Area Closures on Bycatch in the Pelagic Longline Fishery

NOAA Fisheries has implemented several time/area closures in the Atlantic Ocean and Gulf of Mexico to reduce discards and bycatch. Logbook data have been used to estimate the effect of closures on discarded species and total catch by comparing logbook data collected during 1999-2000 (prior to time/area closures) to data obtained during the 2001 fishing year when most of the closures were implemented (NOAA 2003b). This analysis has demonstrated that the closure probably has resulted in a decline in bycatch for a number of species. However, evaluation of time/area closures would be enhanced with an augmented observer program. In addition, the logbook data need to be ground-truthed to observer data to ensure that they accurately depict bycatch information.

#### Survival of Regulatory and Economic Discards

Estimates of depth-related release mortality and the depth distribution of fishing effort are needed for stock assessments. Many reef fishes captured at depths greater than ~ 20 m often have problems submerging when released. Further, fishes caught in water deeper than 40 m may experience anatomical traumas due to decompression that occurs with the rapid ascent during capture. Estimates of depth related release mortality are an important component when imposing size limits to rebuild stocks, protecting spawning individuals, or allowing for the survival of smaller, younger fishes that have not had the opportunity to spawn.

A number of studies have examined depth related mortality in reef fishes. Collins et al. (1999) examined the benefits of releasing air from the swim bladder of fish and the effect of depth on release mortality of black sea bass and vermilion snapper. Numerous cage studies have been used to hold discarded red snapper at various depths and for various periods of time to determine survival (Gitschlag and Renaud 1987; Render and Wilson 1994). MARFIN funded studies are currently being conducted to estimate discard rate and release mortality in red snapper, and to determine if red snapper are more susceptible to depth-induced mortality than red grouper (Roche and Brown 2003). Tagging data from the MARMAP have been used to estimate depth related survival of released gag in the South Atlantic (McGovern et al. In Review).

A well coordinated program that involves observers, fishermen participation, and/or electronic monitoring is needed to link depth related mortality rates of different fish species to distribution of fishing effort by depth.

#### Research on Use of Digital Video Cameras and Electronic Measuring Systems

If there was adequate funding for extensive coverage, at-sea observer programs would be the best approach to measure bycatch in many fisheries in the Southeast Region. However, observer programs are far more expensive than the use of video monitoring and other electronic technology. More research is needed on affordable and effective ways to set up the instrumentation, make it tamper-proof, record data, download data, interpret output and analyze information. Though these modern technologies have limitations, including difficulty of identifying species and amounts of bycatch, they have been used in other regions to supplement observer programs. In addition, an electronic logbook has been tested to a limited extent in the South Atlantic. However, it is unknown if technologies such as video can be successfully used in the Southeast Region to measure bycatch. Video cameras have been used to a limited extent by the MARMAP program to record fishermen tagging and measuring gag and greater amberjack as well as monitor post tagging survival. Studies need to be conducted in the Southeast Region to assess the efficacy of technology in identifying species, measuring the length of individual fish, and recording catch location as well as other physical attributes.

#### Conduct Research On Post-Release Mortality of Billfish, Tunas, and Sharks Caught by Commercial and Recreational Fishermen

Highly migratory species that are released alive by commercial and recreational fishermen may die due to trauma suffered during capture (i.e., hooking injuries, wrapped in gangion, stress experienced while out of water). Through the use of satellite tags, it has been determined that many fishes that are presumed to be in good shape when released do not survive. Research needs to be continued to provide a species specific estimate of post release mortality. These data can be used to augment observer and logbook data on dead discards.

#### Research to Reduce Mortality of Sea Turtles, HMS, and Marine Mammal in the Pelagic Longline Fishery

Research into developing effective ways to minimize the potential for harming or catching sea turtles in commercial longline fisheries should be continued. Scientists at NOAA Fisheries, Pascagoula Laboratory have completed a three-year research program in cooperation with the Bluewater Fishermen's Association on the Grand Banks in the Western North Atlantic. This research has indicated that longline fishermen can avoid unintentional catches of loggerhead sea turtles by reducing the time hooks are in the water during daylight hours. Sea turtle interaction was reduced and swordfish catch rates increased by using circle hooks with mackerel as bait instead of J hooks baited with squid. Most sea turtle deaths attributed to pelagic longline gear occur when the gear is not removed from the turtle, or removed improperly. NOAA Fisheries and commercial fishers have developed effective tools to remove hooks and line safely from sea turtles that were incidentally caught on longline gear.

Additional research should focus on methods to prevent turtle bycatch, such as the use of blue-dyed squid and the use of alternative colors for light sticks that are attached to gangions.

Additional research should be conducted to determine if bycatch of sea turtles and fish species can be reduced by altering the depth, area, and/or time of day fished in the Southeast Region. Work has been conducted by Berkeley and Edwards (1998) in the Gulf of Mexico, to determine times, depths, areas, and air and water temperatures associated with longline catches of target tuna species, as well as bycatch of undersized tunas, swordfish and other species. This work has also assessed the feasibility of lighter leaders to allow giant bluefin tuna to break free while still retaining target species.

#### **IV. Possible new bycatch management measures that should be considered for fisheries that have high potential for bycatch of marine mammals and other protected species**

##### Pelagic Longline Fishery

The pelagic longline fishery is considered to have high bycatch potential for fishes, marine mammals, and other protected species. NOAA (2002) indicates that Risso dolphin, long-finned and short-finned pilot whales have been impacted by pelagic longline gear, primarily between South Carolina and Cape Cod. New mitigation measures may be needed to reduce incidental mortality and serious injury of pilot whales in the pelagic longline fisheries. NOAA Fisheries plans to convene a take reduction team to address this issue in 2005.

The incidental bycatch of seabirds in various fisheries around the world has generated concern over the last two decades. In particular, there is considerable potential for interaction of seabirds with pelagic longline gear. The U.S. voluntarily developed a National Plan of Action for reducing the Incidental Catch of Seabirds in Longline Fisheries (NPOA-S) as requested in the International Plan of Action for Reducing the Incidental Catch of Seabirds in the Longline Fisheries (IPOA-S). There is little bycatch of any seabirds by pelagic longline gear in the Southeast Region. The brown pelican, one of two pelican species in North America, has been listed as endangered since 1970 in its entire range, except in Alabama and Florida where it is listed as recovered since 1985. Pelicans feed entirely upon fishes that they capture. However, they seldom occur more than 20 miles offshore and therefore are not found in the same areas where pelagic longline is deployed.

A number of actions has been taken to reduce bycatch in the pelagic longline fishery. Time/area closures (Charleston Bump, Florida east coast, Desoto Canyon) have been implemented and appear to have reduced bycatch of undersized swordfish, bluefin tuna, yellowfin tuna, large coastal sharks, wahoo, bigeye tuna, pelagic sharks, blue marlin, white marlin, sailfish, dolphin, and sea turtles (NOAA 2003b). Data are not currently sufficient to determine if time/area closure have reduced serious injury and/or mortality of marine mammals (NOAA 2002). These closures were enacted March 1, 2001, as part of Regulatory Amendment 1 to the Highly Migratory Species Fishery Management Plan (HMS FMP). Time/area closures should be continued with greater emphasis placed on an enhanced observer program tied to logbook data to quantify potential bycatch reduction and determine if additional time/closures are necessary.

Regulatory Amendment 1 to the HMS FMP also prohibited the use of live bait, setting up a live well, or maintaining live baitfish on board a vessel with pelagic longline gear beginning September 1, 2000, in the Gulf of Mexico. The primary purpose of this prohibition was to reduce the bycatch of billfish (blue marlin, white marlin, and sailfish). Based on one year's data, time/area closures and live bait prohibition appear to have been successful in reducing bycatch in the HMS pelagic longline fishery.

Research has been conducted on new fishing techniques to reduce interactions with protected species, fishing mortality, and bycatch in the HMS fisheries. These include circle hook studies, educational

workshops for recreational and commercial fishermen on how to improve gear handling techniques to reduce mortality, distributing handling protocols for marine mammals and sea turtles, developing dipnet and line cutters to reduce injuries to sea turtles, live bait prohibitions in the Gulf of Mexico, satellite tagging of swordfish and billfish, and developing light-sticks that do not attract sea turtles.

Prince et al. (2002) have shown that circle hooks have the potential for reducing mortality of billfish captured in the directed fisheries for Atlantic HMS. Circle hooks can also reduce turtle bycatch when used with mackerel rather than squid for bait. Consideration of the mandatory use of circle hooks should include effectiveness as well as enforceability.

A maximum permissible soak time is also being considered for pelagic longline gear. The Charleston Bump research project has demonstrated that there is a greater survival rate of incidental catch and bycatch of highly migratory fish species with shorter soak times. Other NOAA funded studies have shown that shorter soak times are effective in reducing bycatch of sea turtles. However, most sea turtle deaths attributed to commercial fishing gear occur when the gear is not removed from the turtle, or removed improperly. NOAA Fisheries, private industry, and commercial fishers have developed effective tools to remove hooks and line safely from sea turtles that were accidentally caught on longline gear (NOAA 1998b). Proven tools to remove hooks and line safely from sea turtles and marine mammals should be required aboard all pelagic longline vessels.

Varying the part of the water column fished or time of day that the gear is fished in addition to shorter soak times may reduce bycatch in many species. Use of blue-dyed squid and light sticks that are a different color from the conventional yellow light stick may deter sea turtles from longline gear. These techniques require further research.

In 1996, NOAA Fisheries formed the Atlantic Offshore Cetacean Take Reduction Team (TRT) to reduce the incidental take of right whales, humpback whales, sperm whales, beaked whales, pilot whales, common dolphins, bottlenose dolphins, and spotted dolphins in the Atlantic pelagic driftnet, pelagic longline, and pair trawl fisheries. The TRT reached consensus on several strategies to reduce takes in each fishery and prepared a draft plan in November 1996. However, each of the three fisheries has had a major change since the team was originally convened. Two of the three fisheries no longer exist. The pair trawl fishery was inactive when the TRT was convened. The pelagic driftnet fishery was closed with respect to swordfish in a rule published on January 27, 1999. Also, on May 28, 1999, the HMS FMP prohibited the use of driftnet gear in targeting tuna in pelagic waters. Subsequently, the longline fishery has been modified to reduce bycatch of species other than marine mammals (such as billfish and sea turtles). Since the nature of the fisheries has changed tremendously since 1996 when the TRT was convened, NOAA Fisheries disbanded the TRT in August 2001 and will evaluate the need for a new TRT when the updated mortality and serious injury estimates are available in the next three years.

### Gulf of Mexico Shrimp Trawl Fishery

A 1998 report to Congress prepared by NOAA Fisheries provided detailed information on shrimp trawl bycatch in the southeastern United States. This study, which solicited input from fishery scientists, industry representatives and conservation groups, provided information on the magnitude of bycatch and quality of data used. From 1990 to 1996, fishery biologists and commercial fishermen tested 145 different designs for bycatch reduction devices (BRDs) intended to reduce the bycatch of finfish. Research indicated that without BRDs, shrimp trawl catches consisted of 67% finfish, 16% commercial shrimp, 13% non-commercial shrimp, and 4% other invertebrates by weight. Atlantic croaker was the dominant commercially-important finfish caught in shrimp trawls, while king mackerel, Spanish mackerel, and red snapper were also common. This effort also led to several effective shrimp trawl gear modifications. The western Gulf of Mexico shrimp trawl industry now uses a 12" x 5" fisheye BRD, while the South Atlantic industry uses an extended funnel BRD and an expanded mesh BRD in addition to the 12" x 5" fisheye BRD. It is estimated that usage of BRDs in the Gulf of Mexico has reduced bycatch of red snapper by 40%.

Despite the reduction in bycatch afforded by the BRDs, finfish bycatch is still a problem in the Gulf of Mexico shrimp trawl fishery. Additional BRD designs may help to reduce finfish bycatch to some degree, however, a reduction in shrimping effort may have the greatest impact in reducing finfish bycatch. Economic analysis indicates that the shrimp fishery has excess capacity. Under prevailing economic conditions it is projected that the number of vessels in the fishery may decrease as much as 30 to 50% without any management actions due to an inability to make a profit. Initial steps to manage fishing effort have already been taken (permit requirements and a control date of December 6, 2003) and the Gulf of Mexico Fishery Management Council (GMFMC) is considering limited entry.

Turtle bycatch has also been a problem in the shrimp trawl fishery. Currently, several different TED designs are approved for use; many of these were developed by the industry during cooperative research and evaluation with NOAA Fisheries. The overall compliance with TED regulations has been good, although there is room for improvement. The results of TED regulations have helped to increase turtle populations over the last decade. In 2002, the SEFSC completed an analysis of sea turtle bycatch in the shrimp trawl fishery (Epperly et al. 2002). This document was the basis for a portion of the Southeast Regions's sea turtle take estimates in its Biological Opinion (December 2002) that found that the continued operation of the shrimp fishery under the new TED regulations would not jeopardize any ESA listed species.

### North Carolina Coastal Gillnet Fishery

The North Carolina coastal gillnet fishery is considered to have high bycatch marine mammals and sea turtles. Fishes are considered to be at a moderate level of potential in this gear type.

Palka and Rossman (2001) indicated that bycatch of bottlenose dolphin off North Carolina during 1996-2000 was greatest for the medium mesh gillnet (5 to 7 inches) that targeted spiny dogfish in state and Federal waters. The small mesh gillnet (<= 5 inches) that caught Atlantic croaker, bluefish, and

weakfish had the second highest bycatch of bottlenose dolphin. Lowest bycatch rates of bottlenose dolphin were reported in large mesh gillnets ( $\geq 7$  inches) where striped bass dominated catches in state waters and monkfish comprised most of the landings in Federal waters.

In May, 2001, a workshop was held in Beaufort, North Carolina, to discuss modifications that could be made to gear to reduce the interaction and mortality of bottlenose dolphin ([http://www.nmfs.noaa.gov/prot\\_res/readingrm/SE\\_BDTRP/maymeetingsummary.pdf](http://www.nmfs.noaa.gov/prot_res/readingrm/SE_BDTRP/maymeetingsummary.pdf)). Bottlenose dolphin use echolocation to catch fishes and presumably, are unable to detect gillnets in shallow water. Nets can be modified to increase their reflectivity by using different density floats that are underwater. Furthermore, nets can be dyed to be more easily detected. These techniques require further research before implementation.

In May 2002, the Bottlenose Dolphin TRT recommended that studies be conducted to more fully investigate the nature of bottlenose dolphin takes and the efficacy of potential changes to fishing gear (Feldt and Neuhauser 2002). With respect to gillnets, the TRT recommended that research be funded to: (1) investigate bridle alterations to prevent collapsing of the net and examine the elimination of bridles on anchored gillnets; (2) investigate the behavior of anchored gillnets with regard to dolphin entanglement when panels are laced or not laced together; (3) investigate the effects of different string designs (e.g., shallower net depth, hung in different parts of the water column) to determine if the amount of webbing can be reduced without affecting catch for different fisheries; (4) determine if dolphins that appear to be attracted to nets or boats in North Carolina waters are interacting with gillnet gear; and (5) investigate the importance of time of day and time from set with respect to when dolphins are caught in the gear.

At the April, 2003 Bottlenose Dolphin TRT meeting (Feldt and Neuhauser 2003), it was recommended that fishers using gillnets provide trip initiation and termination reports to enforcement officers, provide gear markers specific to the fishery, continue the use of latitudinal boundaries and state waters/federal waters boundaries in lieu of longitude, distinguish each fishery with unique gear characteristics (e.g., range of mesh size), and haul gear once every 24 hours.

Beginning in 1995, sea turtle strandings along the coast of North Carolina suddenly and dramatically increased during April and May, and this pattern continued in subsequent years. The increase in strandings coincided with increasing effort in the monkfish gillnet fishery, which first began off North Carolina in 1995. As a result, NOAA Fisheries enacted seasonally adjusted gear restrictions by closing portions of the Mid-Atlantic EEZ waters to fishing with gillnets larger than 8-inch stretch mesh.

NOAA Fisheries limited restrictions to Federal waters since the monkfish fishery was not prosecuted in state waters. However, after these management measures were implemented, the monkfish fishery shifted effort into North Carolina state waters. Additional restrictions are being considered by NOAA Fisheries. A change in the mesh size from 8 inches to 7 inches is being evaluated since fisheries that use

smaller mesh nets may also impact sea turtles. NOAA Fisheries is considering extending mesh size restrictions into North Carolina state waters.

During 1996-2000, observer coverage of the North Carolina gillnet fishery ranged from 0.20-3.28 % (Palka and Rossman 2001). Additional observer data are needed to ensure that recent restrictions are sufficient to decrease bycatch of sea turtles and marine mammals.

#### North Carolina Inshore Gillnet Fishery

The inshore gillnet fishery is considered to have moderate potential for bycatch of fishes and marine mammals, and high potential for bycatch of sea turtles. The shallow-water fishery operates from April through December in areas next to the barrier islands in Pamlico Sound. Most fishing in these areas occurs in depths of less than 3 feet (0.9 m). The deep-water fishery operates from September through December with fishermen setting nets along the slope adjacent to the main basin of Pamlico Sound. Fishing depths in this area range from 10 to 20 feet (3.0 to 6.1 m). Fishermen in the deep-water fishery are target flounder migrating from estuarine waters to offshore locations for spawning.

In early November 1999, significant increases were noted in inshore sea turtle strandings in the southeastern portion of Pamlico Sound. During November and December, a total of 97 strandings occurred in the area. Kemp's ridley turtles accounted for 46 of the strandings; 31 of the strandings were loggerhead turtles; 19 of the strandings were green turtles; and one unidentified turtle. The deep-water, large-mesh gillnet fishery for flounder in southeastern Pamlico Sound was suspected of being responsible for a significant portion of the strandings. NOAA Fisheries enacted seasonal closures during September 15 to December 15 for inshore large-mesh greater than 4.25 inches in Pamlico Sound to protect migrating sea turtles.

Collection of observer data should continue in the inshore gillnet fishery to assess the interaction with sea turtles and marine mammals outside the closed season and with gillnets that have a mesh smaller than 4.25 inches during the closed season. Strandings of bottlenose dolphin have occurred in the recreational and commercial components of the inshore gillnet fishery as well as the trap/pot fisheries in the Southeast Region. Results from observer data will determine if current restrictions are sufficient or if seasonal closures need to be expanded in time and space; as well as whether a requirement for smaller mesh sizes in gillnets, which might increase finfish bycatch, is needed.

#### North Carolina Pound Net Fishery

Bycatch potential is considered to be moderate for fishes and marine mammals, and high for sea turtles. Mortalities of sea turtles have been reported for the large-mesh, pound net leaders in the Chesapeake Bay.

Sea turtles rarely become entangled in North Carolina pounds nets and are usually released alive (<http://www.ncsu.edu/seagrant/coastwatch/PoundNetting.htm>). However, there has been an increase in the number of applications for pound net sets, due primarily to the severe restrictions on the gill net fishery in Pamlico Sound ([http://www.ncdmf.net/mfc/MFC10\\_01.htm](http://www.ncdmf.net/mfc/MFC10_01.htm)). Collection of observer data

should be enhanced to quantify sea turtle interaction and mortality in North Carolina pound nets and ensure that regulations, similar to those imposed in the Virginia waters of the Chesapeake Bay, are not necessary.

In some areas escape panels are used in pound nets to reduce finfish bycatch. In North Carolina, the North Carolina Department of Marine Fisheries requires a 5.5 inch mesh escape panel in all flounder pound nets except those in western Albemarle Sound.

#### Gulf of Mexico Reef Fish Bottom Longline Fishery

The Gulf of Mexico reef fish bottom longline fishery is considered to have high bycatch potential for fishes, low potential for marine mammals, and moderate potential for sea turtles. In 1994 and 1995, observers made nine trips aboard bottom longline vessels in the Gulf of Mexico. Red grouper were targeted in 242 of the observed sets while the remaining 75 sets were in deeper water to catch yellowedge grouper and blueline tilefish (NOAA 1998a). A total of 5,224 animals representing 89 taxa were caught on 229,467 hooks. Approximately 56% of the fishes were retained. Bycatch mortality was reported to be low with 28% of the individuals released alive, 5% released dead, and 10% retained as bait and 2% unknown. However, when this study was conducted there were fewer regulations in place on minimum sizes and bag limits than currently exist. If this study were repeated, it is likely that bycatch mortality would be greater in the reef fish bottom longline fishery because of the increase in the number of regulatory discards. Current observer data are needed to determine the composition, abundance, and mortality with respect to depth of species that are released in the bottom longline fishery.

Survival of fishes that are released alive is related to depth of capture. Fishes caught in deep water often die due to anatomical trauma suffered from pressure changes during rapid ascent. In addition, many fishes caught in shallow water that could survive, may not be able to return to the bottom and remain floating at the surface due to expansion of air in the swim bladder. Probably none of the fishes caught and released in depths where yellowedge grouper and blueline tilefish are found would survive (McGovern et al. In Review). Survival of fishes in shallow water where red grouper are targeted can be enhanced by removing the air from the swim bladder with a hypodermic needle or a hollow canula (Collins et al. 1999).

One management strategy that might reduce bycatch mortality is the mandatory use of circle hooks by commercial and recreational fishermen. Research conducted by Prince et al. (2002) indicated that circle hooks had a higher hooking rate than J hooks, landing rates were similar between J and circle hooks, circle hooks were more likely to lodge in the mouth and were less likely than J hooks to be swallowed, and circle hooks tended to reduce bleeding in sailfish. Studies conducted with other species also show greater survival of fishes when circle hooks are used (<http://www.dnr.state.md.us/fisheries/fishingreport/crsb.html>). The GMFMC recommends that recreational and commercial fishermen use circle hooks when fishing for red snapper to reduce hooking mortality (<http://www.gulfcouncil.org/prrel/pr1999-28.htm>).

Other management measures that decrease fishing effort may be required to decrease bycatch mortality of reef fishes. These include some form of gear prohibition in the bottom longline fishery. Amendment 18 to the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico is currently being developed. It contains alternatives that would reduce the number of vessels using longline gear in shallow waters. Closed areas and seasons may also reduce bycatch mortality in the bottom longline fishery. The GMFMC has recommended, and NOAA Fisheries has implemented, MPAs to protect reef fish in the Dry Tortugas (Tortugas North and South), off west Florida (including the Madison-Swanson and Steamboat Lumps Marine Reserves), the Flower Gardens in the western Gulf, and the Tortugas Shrimp Sanctuary. Additional observer data are needed in the reef fish fishery to better estimate bycatch rates with respect to depth and location, as well as the disposition of fishes that are released (float or swim away). Observer data may also be useful in determining if time/area closures are reducing bycatch.

#### South Atlantic Snapper-Grouper Longline Fishery

The South Atlantic snapper-grouper longline fishery is considered to have high bycatch potential for fishes, low potential for marine mammals, and moderate potential for sea turtles. The fishery is prosecuted in water deeper than 92 m (50 fathoms). There are few observer data to document bycatch mortality in the fishery. However, research indicates that most fishes caught in water deeper than 92 m do not survive the changes in pressure that occur when bringing them to the surface (Collins et al. 1999; McGovern et al. In Review).

Management measures that may decrease bycatch mortality include time/area closures and MPAs. The South Atlantic Fishery Management Council (SAFMC) is proposing the use of MPAs in Amendment 14 to the South Atlantic Snapper-Grouper Fishery Management Plan. Spawning season closures have also been suggested for species in the deepwater grouper and tilefish complex (snowy grouper, yellowedge grouper, misty grouper, speckled hind, warsaw grouper, tilefish, and blueline tilefish). Observer data are needed to determine if the proposed management measures will have any effect on reducing bycatch or if effort will just be displaced to outside of the closed area.

#### Gulf of Mexico/South Atlantic Reef Fish Hook-and-Line Fishery

The Gulf of Mexico and South Atlantic reef fish hook-and-line fishery is considered to have high bycatch potential for fishes, low potential for marine mammals, and moderate potential for sea turtles. Mortality of bycatch species is directly related to depth of capture with fishes caught in shallow water having the greatest chance of release survival. Removing air from the swim bladder with a hypodermic needle or hollow canula will increase the survival of fishes caught and released in shallow water (Collins et al. 1999).

Management measures that may decrease bycatch mortality include time/area closures, MPAs, and mandatory use of circle hooks. MPAs have been established in the Gulf of Mexico. In the South Atlantic, MPAs are being proposed in Amendment 14 to the Snapper-Grouper Fishery Management Plan (FMP). Spawning season closures have also been implemented for certain species in the Gulf of

Mexico and South Atlantic (e.g., gag). Circle hooks have been shown to increase survival of fishes as they are less likely to be swallowed. An individual fishing quota system that has been proposed to reduce red snapper fishing mortality may also reduce bycatch mortality. Observer data are needed to determine if bycatch is reduced by these measures.

#### South Atlantic Shrimp Trawl Fishery

Bycatch potential for fishes is considered to be high in the South Atlantic shrimp trawl fishery. This fishery is considered to have low bycatch potential for marine mammals and moderate potential for sea turtles. NOAA 1998a indicated that without the use of BRDs, about 51% of the catch is composed of finfish, 18% commercial shrimp species, 13% non-commercial shrimp/crustaceans, and 18% non-crustacean invertebrates. Total fish reduction varies with BRD design, with significant reduction rates noted for Spanish mackerel, weakfish, croaker, and spot. For example, the 12"X5" (30 mesh) fisheye provided a reduction of 25% in weakfish, 53% for Spanish mackerel, and 36% for spot. Additional BRD designs may offer greater fish bycatch reduction. Observer data are needed to provide better estimates of the decrease in bycatch in this fishery with the use of BRDs.

#### Recreational Charter Boat Fishery

The recreational charter boat fishery is considered to have high potential of bycatch for fishes, low potential for marine mammals, and moderate potential for sea turtles. Management measures that may decrease bycatch mortality include time/area closures as well as mandatory use of circle hooks. Bycatch has been monitored in the charter boat fishery through MRFSS since 1979. A combination of random telephone interviews and dockside surveys are used to estimate the catch by species. An increase in the number of telephone interviews and dockside surveys may provide more reliable estimates of bycatch in the MRFSS program. In addition, observer data would provide more reliable estimates of bycatch and help to ground-truth information from the MRFSS program.

#### Recreational Private Boat Fishery

The recreational private boat fishery is considered to have high bycatch potential for fishes, low potential for marine mammals, and moderate potential for sea turtles. Management measures that may decrease bycatch mortality include time/area closures as well as mandatory use of circle hooks. Bycatch has been monitored in the charter boat fishery through the MRFSS since 1979. A combination of random telephone interviews and dockside surveys are used to estimate the catch by species. An increase in the number of telephone interviews and dockside surveys may provide more reliable estimates of bycatch in the MRFSS program.

#### Gulf of Mexico/South Atlantic Blue Crab Trap/Pot Fishery

The Gulf of Mexico and South Atlantic blue crab trap/pot fishery is considered to have low bycatch potential for fishes, moderate potential for marine mammals, and low potential for sea turtles. Blue crab traps have been identified as a source of mortality of bottlenose dolphin in the Southeast Region. Bottlenose dolphin have been observed begging at boats, feeding on discarded bait fish, following fishermen from trap to trap, engaging in crab pot tipping behavior, and removing bait from traps

resulting in trap damage (<http://members.aol.com/adrcnet/1999/1999sp10.html>). In addition, bottlenose dolphin mortality from crab pot float line entanglement is known to have occurred.

In 2002, the Bottlenose Dolphin TRT recommended that a program be developed, implemented, and enforced to remove derelict blue crab pots and associated lines from all water bodies frequented by bottlenose dolphin. They recommended the use of a sinking or negatively buoyant line to minimize excess line floating at the surface or in loops suspended in the water column. The TRT also suggested that the scope of line be limited to the minimum length necessary to reduce the amount of line in the water. In situations where bottlenose dolphin are tipping traps and stealing bait, the TRT recommended that the bait wells be modified to alleviate bait stealing behavior.

Bycatch in commercial blue crab traps is believed to present a significant source of mortality for diamondback terrapins. Excluder devices have been developed that do not significantly affect the number of crabs captured when compared to traditional (no excluder) crab pots. The device does, however, appear to reduce the number of larger crabs captured (<http://www.state.nj.us/dep/fgw/diaback.htm>).

## **V. Enhancement of education and outreach efforts**

The mission of the NOAA Fisheries is stewardship of the Nation's living marine resources. Through conservation and wise use, these resources and their habitat can be managed to benefit the Nation without jeopardizing options for the future.

The Southeast Regional Office and the various science labs in the Southeast Region participate in a wide range of community outreach activities in their respective locations. These include, but are not limited to, presentations to middle schools and high schools about fisheries management, protected species issues, and research, and presentations on the use of circle hooks and the correct method to release air from swim bladders to local fishing clubs and civic groups.

The NOAA Fisheries Southeast Regional Office issues public announcements, Southeast Fishery Bulletins, or News Releases on different topics, including use of TEDs, BRDs, and other methods to reduce bycatch for the convenience of constituents in the southern United States. These are mailed out to various organizations, government entities, commercial interests and recreational groups. This information is also included in newsletters and publications that are produced by NOAA Fisheries and the various regional fishery management councils. Announcements and news released are also available on the internet (<http://caldera.sero.nmfs.gov/fishery/pannounc.gen/pa.htm>) and broadcasted over NOAA weather radio.

Education and outreach efforts, including technology transfer, have been an important component of bycatch reduction in a number of fisheries. For example, a series of workshops were held in North Carolina, South Carolina, Georgia, and Florida during 2002 with recreational and commercial fishermen to evaluate the effectiveness of MPAs that have been proposed in Amendment 14 to the Fishery Management Plan for the Snapper-Grouper Fishery of the South Atlantic. Information on handling techniques to reduce bycatch and bycatch mortality of species taken in the HMS fishery has been shared with recreational and commercial fishermen through brochures and workshops. Technology-transfer workshops have been conducted to introduce gear innovations and new fishing practices to reduce bycatch and bycatch mortality in the Southeast shrimp fishery, to industry associations, the Gulf and South Atlantic Fisheries Foundation, academic institutions, Sea Grant and Marine Extension Service offices, and private individuals. Results of this program are summarized in the 1998 report to Congress, "Southeastern United States Shrimp Trawl Bycatch Program" (NOAA 1998a). These data were instrumental in the development of bycatch reduction management regulation by the SAFMC and GMFMC for their respective shrimp fishery management plans.

The Protected Resources Division in the Southeast Region is responsible for the conservation, management, and protection of marine mammals and endangered and threatened species occurring in waters of the southeastern United States, Puerto Rico, and the U.S. Virgin Islands. This includes species of sea turtles and marine mammals under the jurisdiction of the NMFS, as well as shortnose and Gulf sturgeon, and Johnson's seagrass. The Protected Resources Division participates in numerous outreach activities including maintaining a web site (<http://caldera.sero.nmfs.gov/protect/protect.htm>).

The Division visits schools, fishing clubs, fishing associations, marinas, trade shows, fish houses, etc. and disseminates information by means of brochures, videos, placards, electronic presentations, public service announcements, newspapers, industry magazines, and newsletters on protected resources. These sources include information on the MMPA, protected species, best fishing practices, ghost fishery gear, interaction with marine mammals, and industry specific information (e.g., blue crab fishery).

The Protected Resources Division sponsors a “Protect Dolphins Campaign” where public service announcements and brochures regarding interaction with dolphins are provided to hotels, marinas, etc. in the Southeast Region ([http://www.nmfs.noaa.gov/prot\\_res/MMWatch/protectdolphcamp.html](http://www.nmfs.noaa.gov/prot_res/MMWatch/protectdolphcamp.html)). The Protected Resources Division conducts an “early warning system” for right whales. Aerial surveys are conducted and any sightings of right whale are reported to the Coast Guard who broadcast the information over marine radio. In addition, sightings are also broadcasted over NOAA weather radio. Entanglement of marine mammals in fishing gear is also broadcasted over NOAA weather radio.

Training is provided by the Protected Resources Division to familiarize individuals with laws and regulations regarding marine mammals, supply contact information and protocol for responding to a mammal stranding, and encourage the best fishing practices to minimize contact with marine mammals and sea turtles.

The NOAA Fisheries Southeast Region, State/Federal Liaison Office is responsible for facilitating the conservation, development and management of marine and estuarine resources in the U.S. Territorial Sea and the Exclusive Economic Zone (EEZ) through competitive and noncompetitive grants and cooperative financial assistance programs. Announcements regarding funding opportunities are mailed out to interested parties including various organizations, government entities, commercial fishermen, and recreational groups/fishermen. Information is also available on the internet (<http://caldera.sero.nmfs.gov/grants/grants.htm>) and is provided in newsletters disseminated by NOAA Fisheries and the regional fishery management councils.

The State/Federal Liaison Office encourages and sponsors research between scientists at academic and government institutions and the fishing industry. Information obtained from funding provided by the Southeast Region has become an essential component of information that is used to manage fishery resources and decrease bycatch in the southeastern United States. Results from studies funded by the State/Federal Liaison Office are provided to regional fishery management councils, and the fishing industry in the form of reports, presentations, and brochures. Some studies have been advocated by different groups and further disseminated to the public. For example, through funding provided by the State/Federal Liaison Office in the Southeast Region, Prince et al. (2002) indicated that circle hooks had a higher hooking rate than J hooks, landing rates were similar between J and circle hooks, circle hooks were more likely to lodge in the mouth and were less likely than J hooks to be swallowed, and circle hooks tended to reduce bleeding in sailfish. The GMFMC has recommended that recreational and commercial fishermen to use circle hooks when fishing for red snapper to reduce hooking mortality (<http://www.gulfcouncil.org/prrel/pr1999-28.htm>). Numerous fishing groups now advocate the use of

circle hooks for catch and release of fishes (<http://www.catchandreleasefound.org/fishstory6.html>, [http://www.buckeyeflyfishers.com/Articles/circle\\_hooks.htm](http://www.buckeyeflyfishers.com/Articles/circle_hooks.htm)).

In another study funded by the Southeast Region, Collins et al. (1999) determined that survival of black sea bass and vermilion snapper caught with hook-and-line gear and released could be enhanced if air was removed from the swim bladder with a hypodermic needle or a hollow canula. This method has also been supported by recreational fishermen and fishing clubs ([http://www.leadertec.com/Catch\\_release.html](http://www.leadertec.com/Catch_release.html)).

There is a need to further enhance communication on bycatch issues through public education and outreach. Lists of government, industry, conservation, professional, media, and other organizations that have an interest or need for bycatch information is being developed for the Southeast Region. It is critical that accurate and timely information on bycatch-related issues, regulations, and activities should be distributed in a friendly fashion among the different user groups.

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