Observer Coverage of the US Gulf of Mexico and Southeastern Atlantic Shrimp Fishery, February 1992 – December 2003 - Methods[1]
Report to SEDAR

Elizabeth Scott-Denton
NOAA Fisheries
Southeast Fisheries Science Center
4700 Avenue U
Galveston, Texas 77551

Introduction

Significant declines in landings of several species of finfish in the US Gulf of Mexico and southeastern Atlantic in the mid-1980's brought about federal management measures to identify reasons for decline and expedite necessary actions to rebuild affected stocks. Shrimp trawl bycatch (or discarded non-target catch) was identified as a significant source of mortality on both commercial and recreational species. National Marine Fisheries Service (NOAA Fisheries) in cooperation with the Gulf and South Atlantic Fisheries Foundation, Inc. (Foundation) and the Gulf of Mexico and South Atlantic Fishery Management Councils initiated a large-scale observer program in February 1992. The two primary objectives of this research effort were (1) to estimate catch rates during commercial shrimping operations for both target and non-target species by area, season and depth, and (2) to evaluate bycatch reduction devices (BRDs) designed to eliminate or significantly reduce non-targeted catch, particularly red snapper, *Lutjanus campechanus*.

Since the program's implementation, more than 150 bycatch reduction device and turtle excluder device (TED) combinations have been evaluated. Currently five BRDs and 20 TED designs are certified for use in the US Gulf of Mexico and southeastern Atlantic shrimp fishery. Since 1992, data from more than 21,000 tows (Figure 1) have been collected during 1,310 trips (12,749 sea days).

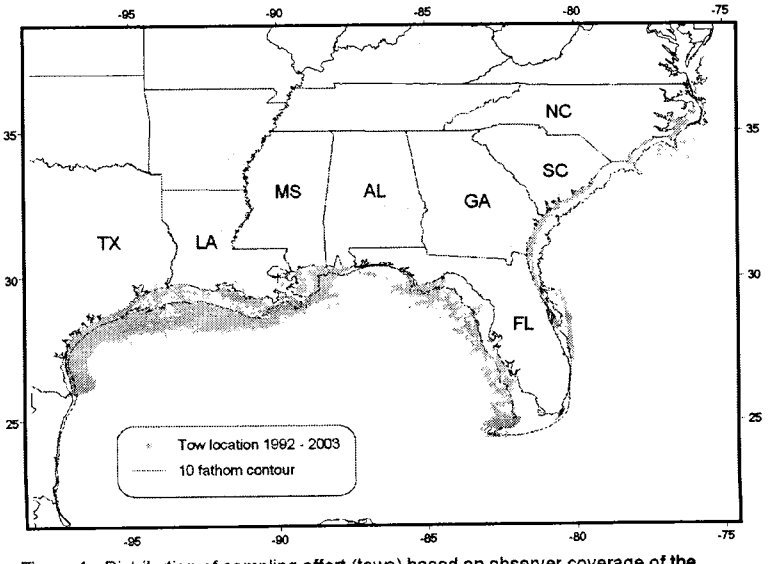

Figure 1. Distribution of sampling effort (tows) based on observer coverage of the US Gulf of Mexico and southeastern Atlantic shrimp fishery from February 1992 through December 2003.

NOAA Fisheries and the Foundation provided the greatest levels of observer coverage (i.e., sea days of observations) during the study period. Texas Shrimp Association, North Carolina Division of Marine Fisheries, and Georgia Department of Natural Resources also collected data from commercial shrimp vessels and contributed to the Southeast Regional shrimp trawl database. The resulting database, housed and managed at NOAA Fisheries Galveston Laboratory, continues to be used extensively by NOAA Fisheries scientists, Fishery Management Councils, universities and state resource agencies for stock assessment, ecosystem-based modeling, and as a foundation for many fishery management decisions.

The primary focus of this report addresses program data collection methods for bycatch characterization and BRD evaluation and certification efforts in the US Gulf of Mexico and southeastern Atlantic shrimp fishery. Trip, tow and sea day statistics are given by region (i.e., Gulf of Mexico - Texas, Louisiana, Alabama/Mississippi and West Florida; and east coast - North Carolina, South Carolina, Georgia, and East Florida). Species-specific catch-per-unit-effort estimations from bycatch characterization data collected in the Gulf of Mexico by area, season and depth will be presented in a subsequent report. A concurrent report, prepared by NOAA Fisheries Pascagoula Laboratory, will also be presented that includes finfish percent reduction values relative to BRD evaluation and certification efforts in the Gulf of Mexico.

[1]Adapted from E. Scott-Denton (in preparation). Gulf of Mexico shrimp and red snapper fishery resources and their management. Ph.D. Dissertation, Texas A&M University, College Station, Texas.

Background

The Gulf of Mexico Fishery Management Council (Gulf Council) implemented a Fishery Management Plan (FMP) for the shrimp fishery in May 1981 in an effort to increase shrimp yield and value through measures designed to allow for optimal shrimp growth. Three commercially important penaeid shrimp species, brown shrimp *(Farfantepenaues aztecus),* white shrimp *(Litopenaeus setiferus)* and pink shrimp *(Farfantepenaeus duorarum)* historically comprise the majority of shrimp landed in the Gulf of Mexico. In 2002, these three species accounted for 96 percent of annual shrimp landed in the Gulf of Mexico, approximately 137 million pounds (heads-off), valued at 364 million dollars.

Since 1981, the shrimp FMP has been amended twelve times with several regulatory mandates enacted in the Gulf of Mexico shrimp fishery. Following a red snapper quantitative assessment in 1988, NOAA Fisheries concluded that the directed fisheries for red snapper (both commercial and recreational) as well as incidental take of juvenile red snapper by shrimp trawlers were responsible for annual declines in red snapper stock (Goodyear, 1988; Goodyear and Phares, 1990).

Growing concerns over bycatch prompted Congressional amendments in 1990 to the Magnuson Fishery Conservation and Management Act (Magnuson Act), and in 1996 to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). These legislative mandates required the Secretary of Commerce, and consequently NOAA Fisheries, to conduct a multi-year shrimp trawl bycatch research program to identify and minimize the impacts of shrimp trawling on federally-managed species in the US Gulf of Mexico and southeastern Atlantic.

One component of the multi-year research program involved the deployment of fishery observers on commercial shrimp vessels. Through a cooperative effort and a voluntary observer program, NOAA Fisheries and the Foundation began placing observers on commercial shrimp vessels in February 1992 to collect fishery-specific catch and BRD evaluation data. Other organizations including Texas Shrimp Association, North Carolina Division of Marine Fisheries, and Georgia Department of Natural Resources also placed observers. From 1992 through 1996, sixteen BRD designs were evaluated during commercial shrimp operations (Watson, et al. 1999). From these data, five designs were identified for potential use in federal waters in the Gulf of Mexico and southeastern Atlantic including the fisheye, expanded mesh, extended funnel, Gulf fisheye and the Jones-Davis. Based on red snapper reduction rates, the Gulf fisheye and the Jones-Davis were proposed for the western Gulf of Mexico (Cape San Blas, Florida to the Texas/Mexico border).

The Gulf fisheye and Jones-Davis BRD designs were certified by interim rule May 19, 1998, for the western Gulf of Mexico. These regulations followed the 1997 Congressionally-mandated independent red snapper peer review panel's recommendations pertaining to data collection and stock assessment methods for red snapper in the Gulf of Mexico. Improvement in data to assess bycatch in the shrimp fishery, better shrimp effort estimates, statistically designed data collection programs to avoid opportunistic samplings, and non-reported landings were specifically identified. The panel concluded that observers were needed on all vessels involved with the fishery to quantify catch and associated bycatch, and release mortality of red snapper (MRAG Americas, 1997).

In May 1998, the NOAA Fisheries component of the regional observer program intensified coverage of the shrimp fishery operating in the western Gulf of Mexico. This increased effort was in response to Gulf Council's recommendation to maintain the 1998 red snapper TAC of 9.12 million pounds. The Gulf Council based this decision on the 1998 proposed legislation that mandatory BRDs in the shrimp fishery should reduce red snapper mortality by 60%. Through legislative measures in May 1998, mandatory BRDs (Amendment 9 to Gulf shrimp FMP), observers, logbooks and vessel monitoring systems (VMS) units were required for the western Gulf of Mexico shrimp fishery. Efforts to place observers, logbooks and VMS units on randomly-selected shrimp vessels were met with a high refusal rate from the fishing industry. Based on safety concerns and the lack of an enforcement mechanism for a non-permitted fishery, the mandatory observer program became a voluntary charter program. The mandatory BRD requirement remained in effect, and later became permanent with the final rule for the Gulf BRD protocol in 1999.

Based on the number of operating units, the commercial shrimp industry is the largest and most valuable fishery in the US southeast region, and until recently, one of only a few commercial fisheries not required to have a federal permit. Amendment 11 to the Gulf shrimp FMP required all commercial shrimp vessels operating in federal waters of the Gulf of Mexico to obtain a renewable federal permit. That permit requirement became effective December 5, 2002.

Methods

Observers

Through a cooperative effort among several organizations, standardized observer training, sampling protocols and data forms were established in 1992. A detailed description of at-sea collection methods and data requirements are presented in NOAA Fisheries Galveston Laboratory's observer manual entitled "Characterization of the US Gulf of Mexico and Southeastern Atlantic Otter Trawl and Bottom Reef Fish Fisheries" May 2002.

Initially, all observers were trained at NOAA Fisheries Galveston Laboratory. Since the program's implementation, 132 observers have been trained and deployed from February 1992 through December 2003. NOAA Fisheries and the Foundation deployed the greatest number of observers. Other organizations, including Texas Shrimp Association, North Carolina Division of Marine Fisheries, and Georgia Department of Natural Resources, placed observers at some times during the study period.

The majority of observers held a Bachelor's degree in marine science or closely related field, and had previous at-sea experience. NOAA Fisheries contracted observers primarily through three contracting companies. Foundation observers contracted directly with the Foundation.

Projects

While the major emphasis from February 1992 through December 2003 was bycatch characterization and BRD evaluation aboard shrimp vessels operating in the US Gulf of Mexico and southeastern Atlantic shrimp fishery, several other projects evolved: TED evaluations, BRD certifications, rock shrimp characterization and BRD evaluations in the rock shrimp fishery. Projects contained in the data set were coded as follows:

B = BRD Evaluation
C = Bycatch Characterization
E = Effort
G = BRD Certification, Gulf of Mexico
M = Modified Bycatch Characterization
N = Naked Net (TED alternative)
R = Red Snapper Initiative
S = BRD Certification, South Atlantic
T = TED Evaluation
X = Rock Shrimp Characterization
Y = Rock Shrimp BRD Evaluation
Z = Soft TED Evaluation

Both the data and the methods of collection varied among projects. BRD evaluations (B) recorded catch data for shrimp and selected finfish from nets equipped with BRD/TED (experimental) versus nets with the same type of TED (control). BRDs used in these evaluation trials were non-certified; the majority of trials were prior to 1998. Bycatch characterization (C) identified all species in a subsample (approximately 20% of the total catch) from one randomly-selected net during a tow. During Effort (E) trips all shrimp and red snapper weights were recorded from all nets during a tow. BRD Certification, Gulf of Mexico (G) trips which occurred after 1998, were similar to BRD

evaluations relative to data collection methods, and designed to provide data to certify new BRDs based on specified criterion. Applicants seeking to certify BRDs were required in July 2001 to apply to NOAA Fisheries Southeast Regional Office (SERO) for a letter of authorization (LOA). Modified Bycatch Characterization (M) trips, similar to bycatch characterization, selected 20 species (or taxa) of finfish with the remaining organisms from the subsample grouped. Naked Net or Alternative to TED (N) obtained sea turtle catch data from TED-equipped nets versus non-TED equipped nets; limited tow time restrictions applied for nearshore waters. Red Snapper Initiative (R) compared data from nets equipped with certified BRDs/TED (experimental) versus nets equipped with a TED (control); all trials were conducted in the Gulf of Mexico. BRD Certification, South Atlantic (S) evaluations trials were the same as described for (G), but occurred off the southeastern Atlantic. TED Evaluation (T) were designed to evaluate new or modified TED designs; TED equipped nets versus modified or non-TED equipped nets were tested. Rock Shrimp Characterization (X) trips occurred primarily of the east coast and were similar to project (C), with rock shrimp the target species. Soft TED Evaluation (Z) trips were the same as described for project (T), and involved catch comparisons from nets equipped with soft TEDs versus modified or non-TED equipped nets.

Trip, sea day and tow summaries are based on computerized trip report data. Detailed collection methods presented below include (1) bycatch and modified bycatch characterization, and (2) BRD evaluation, red snapper initiative, and BRD certification efforts. The latter contained paired-tow data. For all projects, shrimping activities were observed under commercial operation. No direction was given by the Program relative to location or duration of shrimping activities other than for limited tow time restrictions for non-TED equipped nets.

Vessel Selection

NOAA Fisheries-approved observers were placed year round on cooperating shrimp vessels. Placement intensity was based on vessel availability and current commercial effort trends by area and season. From February 1992 through May 1998 vessel operators were solicited to participate through phone and mail correspondence, port agents, and the Foundation. In May 1998, the NOAA Fisheries component of the program became mandatory following federal requirements for mandatory observer coverage, BRDs and VMS units in the Gulf of Mexico. Federal regulations in June 17, 1998, required vessels to have a current US Coast Guard (USCG) Safety Decal prior to taking an observer. Under the mandatory selection process, vessels were randomly selected based on the previous complete year of effort (i.e., 1996) stratified by statistical area, depth and season. These data were derived from NOAA Fisheries shrimp landings file and cross-referenced with USCG documentation records. This yielded a list of active vessels with owner names and addresses. Port agents, when possible, obtained the contact information (e.g., owner phone numbers) for selected vessels; the Internet was also used. Efforts to place observers randomly, through mandatory measures, were met with a high rate of refusal from industry. Observer safety, inadequate sleeping facilities, liability insurance concerns, combined with the lack of an enforcement mechanism for a non-permitted fishery, ultimately resulted in the program becoming a voluntary charter program in June 1998. Since that time, efforts to randomize the selection of charter vessels have been based on selecting vessels from the previous complete year of shrimp effort as described above. Similarly, port agents, when possible, provided owner contact information. In May 2003, a portion of the shrimp permit file (vessel name, documentation number, vessel owner's name and phone number) was obtained from SERO, and used to facilitate contacting selected vessels. Vessel operators who

volunteered to participate were used if vessels, selected under the randomized process, were not available.

From the available vessel contact information, efforts were made to quantify and categorize recorded responses related to the random selection for the NOAA Fisheries component for Gulf of Mexico vessels from 1998 through 2003. Using recorded attempts, ten categories were established. From a list of approximately 315 randomly selected vessels, 21% were contacted by phone and a message was left; 18% did not have a phone, did not answer, reported a wrong phone number, or had a disconnected phone number; 17% did not have a federal shrimp permit as of May 2003; 13% expressed interest, but did not return the information package; 13% responded positively and took an observer; 6% used other types of gear or fished in non-federal waters; 5% each expressed no interest or could not speak English; and 1% each hung up, or had non-functional vessels. Collectively, throughout the study period (1992 through 2003), the majority of vessel operators volunteered to participate; vessel selection, for the most part, was non-random.

Vessel owners (or operators) were compensated a flat rate for the observer's food and lodging while aboard the vessel, and for potential shrimp loss when gear modifications occurred. Compensation rates varied among organizations and projects, and were dependent on annual funding levels. Effective October 2003, vessel owner/operators participating in the NOAA Fisheries component of the program were required to complete vendor profiles, register online with the Central Contractor Registration (CCR), and obtain a D-U-N-S number in order to be compensated by the federal government.

At-Sea Data Collection Methods

Vessel and Gear Characteristics

For all projects specific data relative to vessel and gear characteristics were recorded. Vessel length, hull construction material, gross tonnage, engine horsepower and crew size information were obtained for each vessel. Characteristics related to BRD, TED, net type and other associated gear were recorded at the start of each trip, or when changes were made. For each tow, bottom time, vessel speed and operational aspects relative to each net were documented.

Bycatch Characterization

Onboard data collection for the purpose of bycatch characterization consisted of sampling trawl catches taken from commercial shrimp vessels operating in the US Gulf of Mexico and southeastern Atlantic. The first characterization trips occurred in April 1992 in the Gulf of Mexico, and in June 1992 off the east coast. Fishery-specific data were collected from one randomly-selected net for each tow. Nets trailing behind the try net were not selected for sampling. The catch from the selected net was placed into a partitioned area (e.g., separated from the catch from the remaining nets). The catch was then mixed to ensure randomness, shoveled into baskets, and a total weight obtained. A subsample (approximately 20% of the total catch weight) was processed for species composition. Species weight and number were obtained from the subsample. Length frequencies for 30 specimens were recorded for selected species.

Bycatch characterization efforts involved identifying all species in the subsample to species level. During modified characterization trips, 20 selected species (or taxa) of finfish were processed with the remaining subsample grouped into one of the following categories: non-shrimp crustaceans, fish, other non-crustacean invertebrates, or debris (e.g., rocks, logs, trash).

All sea turtles were identified to species, measured, tagged, photographed and released. Sea turtles were handled and released according to the Cooperative Marine Turtle Tagging Program protocol.

BRD Evaluation, Red Snapper Initiative and BRD Certification

BRD evaluations began in the Gulf of Mexico in February 1992 and off the east coast in July 1992. NOAA Fisheries-approved observers collected data for the evaluation of specific BRD designs. Comparisons of catch data for nets equipped with BRD/TED gear combinations (experimental) versus nets with the same type of TED (control) were conducted. Experimental and control nets were alternated, typically mid-trip, from starboard to port outboard nets to reduce net and side biases. Generally, only the two outboard nets were sampled. The total catch and shrimp weights were obtained from the experimental and control nets. A subsample of approximately 32 kg (70 pounds) from each net (experimental and control) was processed for a modified bycatch characterization. When time permitted, all red snapper from the subsamples were counted and weighed.

Following the certification of the Gulf fisheye and Jones-Davis designs in 1998, an intensive effort was made to evaluate the effectiveness of these BRD designs under commercial operation in the western Gulf of Mexico. This project, identified as the red snapper initiative, involved the use of certified BRDs (i.e., Gulf fisheye and Jones-Davis). Evaluation efforts followed the guidelines set forth in to the bycatch reduction criterion proposed for the Gulf of Mexico as presented in the Federal Register, July 2, 1997. The onboard sampling methods were similar to the BRD evaluation described above, with minor exceptions. The control net had a closed BRD; the experimental net was equipped with the Gulf fisheye or Jones-Davis BRD design. The gear was alternated every third day. Total shrimp weights and red snapper counts and weights were obtained from each net (experimental and control), with all red snapper measured. If time permitted, typically the last tow of the night, a subsample was processed for a modified bycatch characterization.

BRD precertification and certification procedures are described at length in the 1999 document entitled "Gulf of Mexico Bycatch Reduction Device Testing Protocol Manual". Onboard data collection procedures are similar to those described above. A minimum of 30 successful tows, a specific number of red snapper caught, and consistent tow times are among some of the testing requirements required for BRD certification.

Results and Discussion

Sampling Effort

Trips and Sea Days

A total of 1, 310 trips was completed in the US Gulf of Mexico and southeastern Atlantic from February 1992 through December 2003 during 12,749 sea days of observations. More than 117,000 hours of trawling were observed. Six hundred thirty-seven trips (11,147 sea days) operated in the Gulf of Mexico, with an average trip length of 17.5 days. Six hundred sixty-eight trips (1,475 sea days) occurred off the east coast, with average trip length of 2.2 days. Five trips (127 sea days) targeted waters off both the east coast and in the Gulf of Mexico, and averaged 25.4 days.

Annual observer coverage levels were less than 1% of the total shrimp effort. The number of sea days varied from 1992 through 2003 (Figure 2), and were directly correlated to the amount of funding received. Coverage levels were highest in 2002 with 3,063 sea days, followed by 1998 with 1,472 sea days. In 1994 and 1993, coverage levels were 1,235 and 1,228 sea days, respectively. In all other years during the study period, coverage was less than 1000 sea days. The lowest coverage occurred in 1996 with 300 sea days.

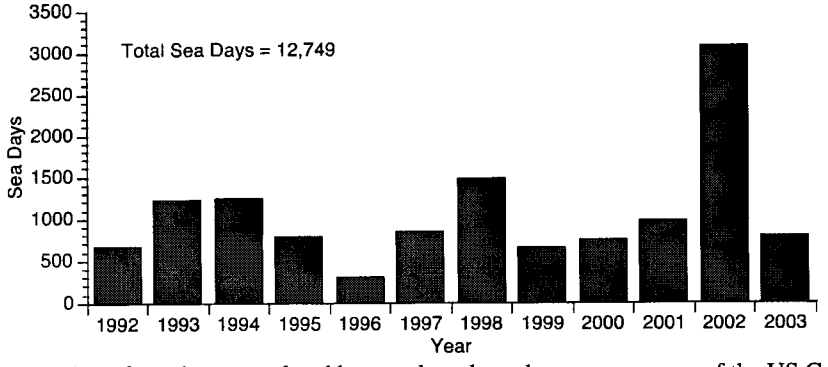

Figure 2. Number of sea days completed by year based on observer coverage of the US Gulf of Mexico and southeastern Atlantic shrimp fishery from February 1992 through December 2003.

Sea day coverage in the Gulf of Mexico was substantially higher (note y-axis values when comparing figures) than for waters off the east coast. A total of 11,220 sea days was completed during the study period (Figure 3). Observer coverage occurred off Texas, Louisiana and off the west coast of Florida in all years. Typically, Alabama/Mississippi coverage was lower, except in 2002, and more variable as compared to the other states. An annual trend was evident and involved higher coverage off Texas and Louisiana in summer and fall, and off southwest Florida in winter and early spring. In addition, the greatest concentrated effort occurred annually off Texas after the opening of the Texas Closure in July.

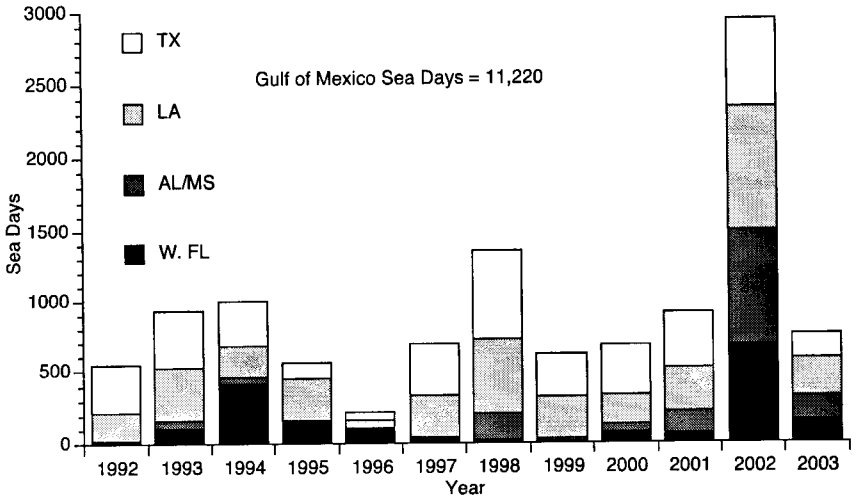

Figure 3. Sea days completed by year and state in the Gulf of Mexico based on observer coverage of the US Gulf of Mexico and southeastern Atlantic shrimp fishery from February 1992 through December 2003.

A total of 1,529 sea days of observations was completed in waters off the east coast (Figure 4). Highest coverage for North Carolina occurred from 1992 through 1994. Coverage off South Carolina and Georgia was fairly consistent through 2000. Increased coverage off the east coast of Florida occurred from 2001 through 2003, with increased monitoring of the rock shrimp fishery.

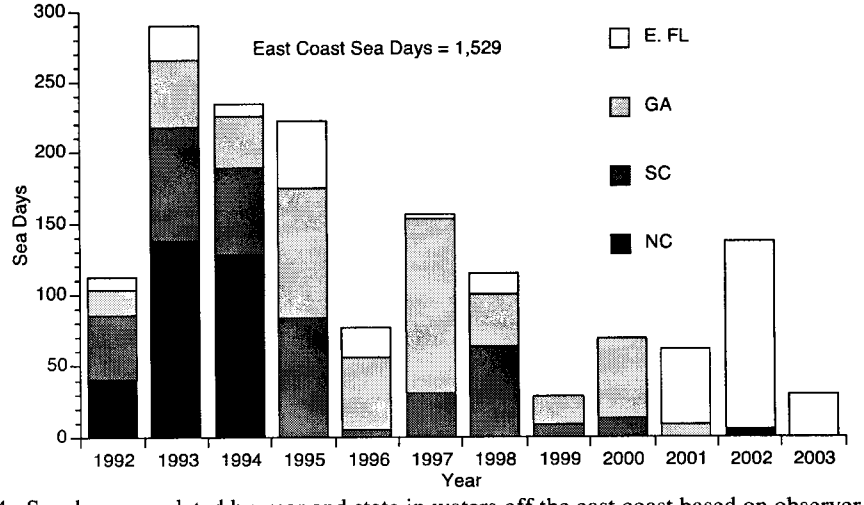

Figure 4. Sea days completed by year and state in waters off the east coast based on observer coverage of the US Gulf of Mexico and southeastern Atlantic shrimp fishery from February 1992 through December 2003.

Collectively, based on the number of sea days, coverage was greatest off Texas at 32%, followed by Louisiana at 30%, west coast of Florida at 14%, Alabama/Mississippi at 12%, Georgia at 4%, South Carolina and the east coast of Florida at 3% each, and North Carolina at 2%. The number of sampled tows by state followed a similar pattern.

Tows

For the Gulf of Mexico, 18,355 tows were sampled from February 1992 through December 2003 (Figure 5). Samples were processed from each Gulf State in all years, with the exception of 1995, when no samples were obtained off Alabama/Mississippi.

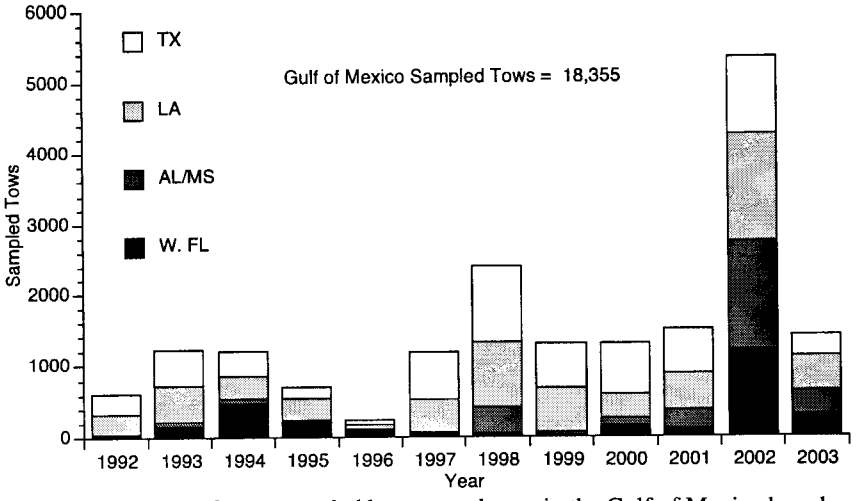

Figure 5. Number of tows sampled by year and state in the Gulf of Mexico based on observer coverage of the US Gulf of Mexico and southeastern Atlantic shrimp fishery from February 1992 through December 2003.

A total of 3,255 tows was sampled off the east coast during the study period (Figure 6). North Carolina had the highest number of tows processed during 1992 and 1994. Both Georgia and South Carolina had tows sampled in most years, with highest effort in 1997. East Florida had samples in all years, with the exception of 1999 and 2000.

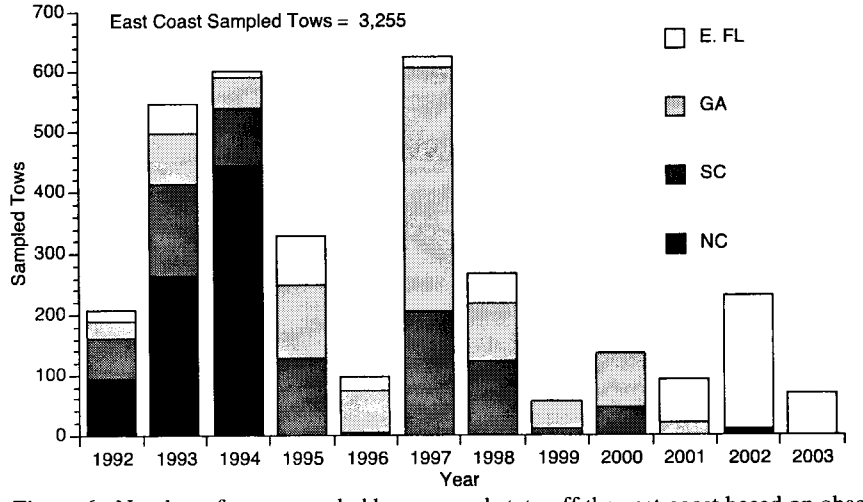

Figure 6. Number of tows sampled by year and state off the east coast based on observer coverage of the US Gulf of Mexico southeastern Atlantic shrimp fishery from February 1992 through December 2003.

Projects

During the study period 1,310 trips completed in the Gulf of Mexico and southeastern Atlantic were categorized by project type (Figure 7). BRD evaluation comprised 27% of trips, followed by bycatch characterization at 24%, red snapper initiative at 13%, naked net or alternative to TEDs at 11%, TED and soft TED evaluations at 6% each, effort at 5%, Gulf certification at 3%, south Atlantic (east coast) certification at 2%, and modified characterization and rock shrimp characterization at 1% each.

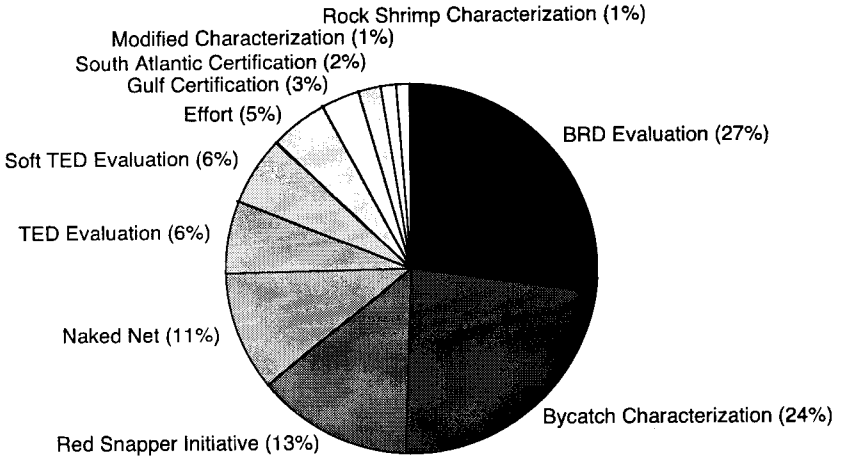

Figure 7. Percentage of 1,310 trips by project from observer coverage of the US Gulf of Mexico and southeastern Atlantic shrimp fishery from February 1992 through December 2003.

Sea days allocated to each project are shown in Figure 8. Approximately 27% of sea days were dedicated to red snapper initiative, followed by BRD evaluation at 24%, bycatch characterization at 16%, effort at 10%, Gulf certification at 7%, naked net at 6%, TED evaluation at 5%, modified bycatch characterization at 3%, rock shrimp characterization at 2% and south Atlantic certification and soft TED evaluation at 1% each.

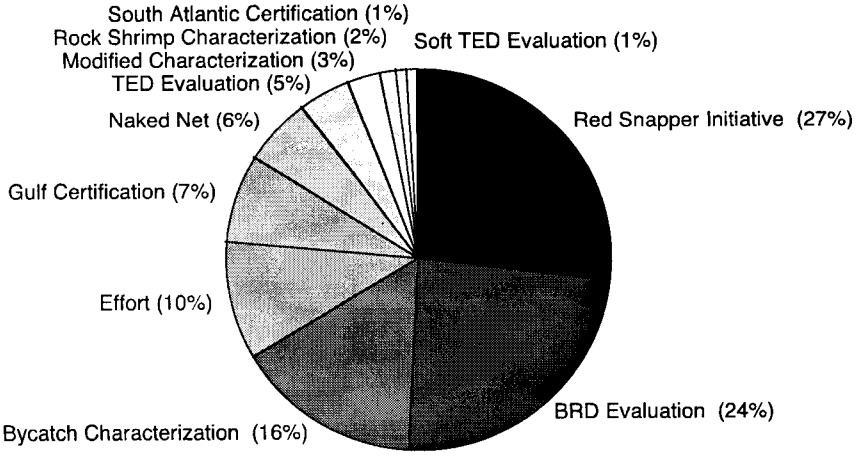

Figure 8. Percentage of 12,749 sea days by project from observer coverage of the US Gulf of Mexico and southeastern Atlantic shrimp fishery from February 1992 through December 2003.

All projects combined, trip duration ranged from 1 to 62 days. Trips were consistently longer in the Gulf of Mexico than on the east coast. By project, average trip length in days, was 21.7 for Gulf certification trips, followed by 20.2 for effort, 19.5 for red snapper initiative, 17.5 for modified characterization, 14.8 for rock shrimp, 8.6 for BRD evaluation, 6.9 for TED evaluation, 6.4 for bycatch characterization, 5.4 for naked net, 3.7 for south Atlantic certification, and 1.2 for soft TED evaluation.

Vessel, Gear and Fishing Characteristics

Two hundred forty-five vessels participated in the study. Overall vessel length ranged from 36 to 98 feet (74.5 $\pm$ 10.0 s.d.). One hundred forty vessels contained ice holds, 95 had some freezer capacity and 10 had unidentified cold storage. The majority of vessels (128) were steel hulls, followed by 85 of wood, 27 of fiberglass, 4 of wood and fiberglass, and one of aluminum. Engines averaged 406.2 hp. Crew size, including the captain, ranged from 1 to 5 individuals.

The number of nets pulled per tow varied from 1 to 4, with 3.7 nets the average. Headrope length, on a per net basis, ranged from 15 to 85 feet with an average of approximately 48 feet.

Among all projects, tow time ranged from 0.1 to 20.5 hours (4.8 $\pm$ 2.5 s.d.). Tow times were longer in the Gulf of Mexico (5.2 $\pm$ 2.4 s.d.) than off the east coast (2.4 $\pm$ 1.5 s.d.) Setting aside non-TED equipped nets towed in waters of $\leq$ 15 fathoms (i.e., tow time restricted), tow times averaged 5.0 hours ($\pm$ 2.4 s.d) for all projects and areas.

Based on starting latitude and longitude coordinates, 32% of tows occurred in waters of $\leq$ 10 fathoms, with 68% of tows in offshore waters > 10 fathoms. All projects combined, tow depth ranged from 0.3 to 73.2 fathoms (17.6 $\pm$ 12.0 s.d). Although rock shrimp tows took place in deeper water than those targeting penaeid shrimp exclusively; removing those trips from the analysis made no substantial difference in average depth (17.4 $\pm$ 11.9 s.d.).

Controversial Aspects

Vessel selection, for the most part, was opportunistic, and may not be representative of the commercial shrimp fleet as a whole. Data collected throughout the study period have been entered into three different data sets; creating files from all sets can be a lengthy process. And finally, data contributors were responsible for editing and proofing their own data and for providing hard copies of the source data. Archived data on the server were not changed or altered (e.g., keystroke errors or outliers) unless written permission was granted by the contributing organization.

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