U.S. SOUTHEASTERN SHRIMP AND REEF FISH RESOURCES AND THEIR MANAGEMENT

A Dissertation

by

ELIZABETH SCOTT-DENTON

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2007

Major Subject: Wildlife and Fisheries Sciences

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ABSTRACT

U.S. Southeastern Shrimp and Reef Fish Resources and Their Management.

(May 2007)

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Catch rates of target and non-target species from commercial shrimp and reef fish fisheries operating in the U.S. southeastern region and associated fishing practices are provided in relation to an environmentally sound and economically driven approach to resource conservation. Beginning in 1992, fishery observers were placed aboard commercial vessels in the southeastern shrimp fishery. From 1993 through 1995 the program expanded to include reef fish vessels in the Gulf of Mexico (Gulf), and during 2004 and 2005 skimmer trawl vessels in coastal Louisiana.

Data from 27,868 tows were collected aboard shrimp vessels. Total catch rates in kilograms per hour were 30.8 in the Gulf, and 27.7 in the southeastern Atlantic. In the Gulf, finfish comprised 65% of the total weight, with penaeid shrimp at 16%, non-penaeid shrimp crustaceans at 13%, non-crustacean invertebrates at 4%, and debris at 1%. In the southeastern Atlantic, finfish accounted for 47%, with penaeid shrimp at 24%, invertebrates at 18%, crustaceans at 8%, and debris at 3%.

In the Gulf, finfish catch rates by weight were significantly higher in Alabama/Mississippi and Louisiana as compared with Texas and Florida. Shrimp catch-per-unit-effort (CPUE) was significantly higher off Texas. For all states areas, higher shrimp catch rates occurred in nearshore waters. Red snapper (*Lutjanus campechanus*) CPUE was significantly higher off Texas in offshore waters during September through December.

Assessment of the directed commercial reef fish fishery revealed relatively low release mortality. Based on surface release observations of under-sized target and unwanted species, the majority of fish were released alive with release mortality ranging from approximately 2% to 5% for all gear types.

Five hundred forty-eight sea turtle captures were documented aboard commercial shrimp vessels from 1992 through 2005. Ratio estimation reflected higher catch rates in nets not equipped with turtle excluder devices (TEDs). Two alternative methods, logistic regression and conceptual modeling, revealed reduced take levels in TED-equipped nets.

Data from 307 tows were collected aboard skimmer trawl vessels. Penaeid shrimp accounted for 66% of the total catch, followed by finfish at 19%, crustaceans at 7%, discarded penaeid shrimp at 6%, and debris at 3%.

ACKNOWLEDGEMENTS

I first commend the outstanding efforts given by the fishery observers involved in this research effort and the commercial fishing industry members, seeking to make a difference in the management of the resource, by allowing observers onboard. I could write multiple volumes relative to our successes and experiences over the years. I sincerely thank Mr. Dennis Koi for all the help he has provided on the data entry system and summarization of data files. Dr. James Nance has been instrumental and very supportive relative to my research efforts for many years, and my gratitude is beyond quantification. Ms. Jo Anne Williams must be commended for her computer skills and great talent for graphical representation. Relative to data collection, Mr. Mike Harrelson has been my right hand for many years, first as an observer and now as an observer coordinator. Also, acknowledgement goes to Mr. Pat Cryer, once an observer, and now an observer coordinator. Mr. Dennis Emilani has provided invaluable advice relative to species-specific data collection methods and support. For data entry, Mrs. Estella Garcia has been there from the onset of this research effort and devoted many long hours of outstanding work. Mrs. Becky Smith, Ms. Judy Gocke and Mr. Frank Patella must also be acknowledged for the contributions relative to data entry and support. Dr. Roger Zimmerman has given invaluable advice relative to program execution, funding strategies and editorial review. Drs. James Matis, Rick Hart and William Grant were instrumental in providing statistical and ecological modeling counsel. Finally, I sincerely thank my Committee members for their years of support, direction and patience, Drs. Thomas Linton, William Evans, Wyndylyn von Zharen and James Nance. I cannot close without thanking my husband and children who have been my greatest source of inspiration. My sincerest gratitude goes to all of you. Thank you.

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NOMENCLATURE

ABC	Allowable Biological Catch
$B_{CURRENT}$	Biomass at Current Level
B_{MSY}	Biomass at Maximum Sustainable Yield
BRD	Bycatch Reduction Device
CalCOFI	California Cooperative Oceanic Fisheries Investigation
CBD	Convention of Biological Diversity
CCA	Coastal Conservation Association
CCAMLR	Convention for the Conservation of Antarctic Marine Living Resources
CITES	Convention of International Trade in Endangered Species of Wild Fauna and Flora
CPUE	Catch-per-unit-effort
CRA	California Resources Agency
CRM	Corporate Risk Management
CV	Coefficient of Variation
DOE	Department of Energy
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EMS	Environmental Management System
EPA	Environmental Protection Agency
EPAP	Ecosystem Principles Advisory Panel
ESA	Endangered Species Act
FAO	Food and Agriculture Organization of the United Nations
$F_{CURRENT}$	Fishing Mortality at Current Rate
FEP	Fisheries Ecosystem Plan
FL	Fork Length
FMP	Fishery Management Plan

F_{MSY}	Fishing Mortality at Maximum Sustainable Yield
FR	Federal Register
GMFMC	Gulf of Mexico Fishery Management Council
HMS	Highly Migratory Species
IBQ	Individual Bycatch Quota
IC	Industry Canada
ICCAT	International Convention for the Conservation of Atlantic Tunas
IFQ	Individual Fishing Quota
IMO	International Maritime Organization
IPL	Institute of Public Law
ISO	International Organization for Standardization
ITQ	Individual Transferable Quota
IWC	International Whaling Commission
LOA	Letter of Authorization
LOC	Library of Congress
MFMT	Maximum Fishing Mortality Threshold
MMC	Marine Mammal Commission
MRAG	Marine Resources Assessment Group
MSC	Marine Stewardship Council
MSST	Minimum Stock Size Threshold
MSY	Maximum Sustainable Yield
NAS	National Academy of Science
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NSGs	National Standard Guidelines
OMB	Office of Management and Budget
OY	Optimum Yield
POC	Pew Oceans Commission

RA	Regional Administrator
RRA	Russell Research Associates
SDC	Status Determination Criteria
SEDAR	Southeast Data, Assessment, and Review
SEFSC	Southeast Fisheries Science Center
SERO	Southeast Regional Office
SFA	Sustainable Fisheries Act
SL	Standard Length
SPR	Spawning Potential Ratio
SSA	Southern Shrimp Alliance
SSC	Scientific and Statistical Committee
TAC	Total Allowable Catch
TED	Turtle Excluder Device
TL	Total Length
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
USC	United States Code
USCG	United States Coast Guard
USCOP	U.S. Commission on Ocean Policy
VMS	Vessel Monitoring System
WRI	World Resource Institute

CHAPTER I

INTRODUCTION

This dissertation contains analyses of catch rates of target and non-target species of commercial shrimp and reef fish fisheries operating in the U.S. southeastern region; additionally, the history and current management regimes for each fishery are examined. Each chapter represents an independent, stand-alone document focused on a unique, yet interrelated research effort. The common objective among all chapters is to provide a better understanding of commercial fishery operations with the ultimate goal directed toward an environmentally sound and economically driven management scheme.

Since the 1980's, research proposals for the execution of domestic offshore fishery observer programs to assess species-specific catch rates of target and non-target species of commercial fisheries have been federally funded nation-wide (NMFS 2004). Among the several programs in the U.S. southeastern region, the majority of effort, based on the need to gain a greater understanding of the composition and magnitude of bycatch associated with fishing operations, was focused on shrimp and reef fish fisheries operating in the U.S. Gulf of Mexico and southeastern Atlantic. Sampling designs and onboard data collection protocols, fishery observer training methods, and outreach programs for industry involvement were developed. Analyses of the data collected and regulatory actions proposed by Fishery Management Councils and promulgated by the National Marine Fisheries Service (NOAA Fisheries) to manage these fisheries were reviewed.

Chapter II provides an overview of the shrimp and reef fish fisheries operating in the Gulf of Mexico and southeastern Atlantic. Catch rates by category and species were given for the individual fisheries. Red snapper (*Lutjanus campechanus*), distribution

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This dissertation follows the style of North American Journal of Fisheries Management.

throughout the U.S. southeastern region and associated size class structure are given for the shrimp fishery. In addition, the condition of organisms discarded overboard and the fate relative to predation are presented. Catch rates by species were depicted for the reef fish fisheries by gear type as well as the associated fate of discarded organisms.

Chapter III details catch rates of penaeid shrimp and associated bycatch in the Gulf of Mexico shrimp fishery. Tests to detect significant differences in total finfish (excluding red snapper), penaeid shrimp, and red snapper catch-per-unit-effort (CPUE) among state areas, depths and seasons were conducted. Catch rates by weight and number for fourteen species of commercial, recreational and ecological importance were examined for each year of the study. CPUE by weight for these species, as well as penaeid shrimp, non-penaeid shrimp crustaceans, fish, and non-crustacean invertebrates were further examined by year, state, depth and season.

Chapter IV involves the analyses of the incidental capture of sea turtles in the shrimp fishery operating in the Gulf of Mexico and southeastern Atlantic. Catch and variance rates were given. Review of observer data obtained from a pilot study involving the assessment of turtle excluder device (TED) versus non-TED equipped trawls from 1992 through 2002 was reported. Ratio estimation, a logistic regression and a conceptual model were used for the analyses.

Chapter V assesses an alternative method of shrimp capture through the use of skimmer trawls. This effort involved placing observers aboard skimmer trawl vessels operating in Louisiana’s coastal waters. Catch rates of penaeid shrimp and associated bycatch by year and season were given.

Chapter VI summarizes current management regimes for the fisheries described above. The complexity of the current system is detailed in great length. An alternative holistic approach, one that is environmentally sound and economically driven was presented. This method seeks to enhance marine ecosystem health through personal and economic incentives shared by all stakeholders.

CHAPTER II

BYCATCH IN THE U.S. SOUTHEASTERN SHRIMP AND REEF FISH FISHERIES

INTRODUCTION

Bycatch, as defined by the National Marine Fisheries Service (NOAA Fisheries), is the discarded catch, including unobserved mortality, of any living marine organism resulting from a direct encounter with fishing gear (NMFS 2004). The impact resulting from large removals of bycatch can adversely influence the population size and age composition of affected species, reduce resource availability to other fishing sectors, and alter ecosystem structure and dynamics.

Advances in navigation and gear technology throughout the years have enabled commercial and recreational fishing sectors to maximize harvests, thus placing a substantial amount of pressure on many stocks. Global fish production has increased from 19.3 million tons in 1950 to 134.3 million tons in 2002, with 63% (84.4 million tons) derived from wild stock capture in oceans, 30% from aquaculture, and 7% from inland waters (FAO 2005). The recognition that coastal and marine resources can be removed or disrupted at greater levels than can be sustained by the environment, and continued conflict among user groups over allocation levels, elevated bycatch reduction to both national and international attention.

Alverson et al. (1994) initially estimated annual global discards (catch returned to the ocean) at 27 million tons; a revised estimate in 1998 reported a lower level at 20 million tons (FAO 1999). A more recent assessment conducted by Kelleher (2005), based on discards as a function of landings of a commercial fishery, extrapolated global discards to 7.3 million tons, noting that not all countries were fully represented. Both Alverson et al. (1994) and Kelleher (2005) concluded that bottom trawl fisheries ranked highest among gear types relevant to discards. Kelleher (2005) reported that bottom trawl fisheries accounted for more that 50% of the discards with a corresponding landings estimate of 22%.

The decline of global discards since the 1990's has been attributed to several factors. Kelleher (2005) reported an increase in the use of non-targeted species in developing countries, a decrease in effort and alternate target species in major trawl fisheries, and regulatory actions prohibiting, or restricting the take of discards. Moreover, international efforts have emphasized the need to reduce bycatch. The adoption in 1982 of the United Nations Convention on the Law of the Sea (UNCLOS III; UN 1982) provided the framework to promote responsible management of fishery resources, specifically, fishery management within a coastal States' Exclusive Economic Zone (EEZ). The growing threat on long-term fishery sustainability as a result of over exploitation, habitat modification, ecosystem alteration, economic loss and international conflicts prompted the 1991 Committee on Fisheries of the Food and Agricultural Organization (FAO) to request the FAO to develop an International Code of Conduct for Responsible Fisheries. The 1995 Code of Conduct for Responsible Fisheries is a non-binding, voluntary agreement (FAO 1995). However, it contains sections that are contained within two other binding agreements, the Compliance Agreement (FAO 1993), and the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling and Highly Migratory Fish Stocks (Straddling Stocks Agreement; UN 1995; von Zharen 1998). The critical elements of responsible resource management contained in the Straddling Stocks Agreement and in the Code of Conduct for Responsible Fisheries include a focus on the entire fishery process, or complex, as the management unit, taking into account social and economic factors. This approach not only considers the fishing industry and the target species, but also the continued existence of associated fauna, quality habitat, and consumer safety (von Zharen 1998).

Bycatch of non-target species occurs in most commercial and recreational fisheries. Gear selectivity for targeted species is rarely 100% effective, and varies both seasonally and temporally. Moreover, the gear used to capture target and non-target species can have detrimental effects on both communities and habitat. Trawling can indirectly disrupt the food web, alter organic matter decomposition rates, and the recycling of nutrients through resuspension of bottom sediment; repeated trawling can result in a shift in community structure (NRC 2002). Greenstreet and Rogers (2000) detected notable trends relative to species composition in groundfish assemblages in the Georges Bank region. Sharks, skates and rays expanded to dominate the groundfish assemblage over a time series. The authors attributed this to these species having a high probability of surviving capture and subsequent discarding.

Kelleher (2005) reported that the tropical shrimp trawl fisheries accounted for 27% of global discards. Harrington et al. (2005) estimated that 1.06 million tons of marine fish were discarded in U.S. fisheries in 2002, making the nation one of the highest worldwide relative to discard rates. From review of overall landings and discards in 27 fisheries in the U.S., the authors ranked the Gulf of Mexico and southeastern Atlantic shrimp fisheries the highest, with discard to landing ratios of 4.56 and 2.95, respectively. This was substantially higher than the Gulf of Mexico reef fish fishery with discards to landings ratio of 0.41 (Harrington et al. 2005).

Size restrictions and quotas, take prohibitions for certain species, and non-economical incentives to retain are among the reasons that bycatch is discarded. It is not economically feasible, for the most part, to retain most bycatch products. In the shrimp fishery, for example, bycatch is typically of lower value, 15 times less valuable than shrimp (NMFS 1998), and cold-storage capacity is generally limited. Pascoe (2000) examined incentives to discard in an open access fishery and under an individual transferable quota (ITQ) system. In an open access fishery, if a profit cannot be made relative to species or species size, the incentive to discard is high. The incentive is increased if there is limited hold capacity. Under an ITQ system, the incentive to discard, while variable among fisheries, may be lower based on increased planning and more selective harvesting strategies (Kaiser 2000).

Bycatch reduction through gear modifications and fishing practices has been devised for many fisheries. From review of 27 U.S. fisheries, Harrington et al. (2005) reported three methods of reducing bycatch. Modifications of fishing methods through gear modifications, including location, timing and through the use of bycatch reduction devices (BRDs) as demonstrated in New England, Gulf of Mexico and southeastern Atlantic. The second method discussed by the authors included changing gear types as exemplified by changing from drift gill nets to trolling for tunas, and from trawls to traps for groundfish. The last method reviewed by Harrington et al. (2005), involved reducing directed effort as demonstrated in New England and Alaska groundfish fisheries. Murawski et al. (2000) assessed reducing effort in the form of large-scale closures in the Georges Bank and southern New England areas. The authors concluded that while large year-round closures substantially improved the conservation of depleted groundfish stocks, future consideration relative to closed areas should also seek to improve overall levels of recruitment by protecting areas of optimal larval transport and critical nursery habitat.

Kelleher (2005) examined global discard rates relative to the use of turtle excluder devices (TEDs) and BRDs. The author concluded that there was not a substantial reduction in discards in shrimp fisheries using TED-equipped nets versus non-TED equipped nets. BRD reduction rates were more variable. Kelleher (2005) noted that a time series is required to more accurately assess gear modifications and that varying levels of enforcement may also account for the variability.

In the 1980's in the U.S. southeastern region, concerns over incidental take of endangered and threatened sea turtles in the shrimp trawl fishery escalated; in later years all fishery species impacted by trawling gear were brought to the forefront. Implementation of TED requirements and subsequent revisions of existing regulations have substantially reduced sea turtle take (NMFS 2002b). There still remains a considerable amount of progress to be made on BRD development relative to finfish removal and mortality (NMFS 2006a). Moreover, implications of BRD devices to reduce more organisms (e.g., shrimp predators) into the habitat may actually result in decreased shrimp stocks (Martinez et al. 1996; NMFS 1998). Chopin and Arimoto

(1995) further concluded that improvements in gear through modifications may be of little consequence if damage or stress incurred by juvenile fish persisted.

Using an energy-flow ecosystem model that incorporated 12 compartments linked by trophic relationships, the cycling of nitrogen and other essential primary production minerals, simulated the implications of bycatch reduction on shrimp biomass in the Gulf of Mexico (Sheridan et al. 1984; NMFS 1995). The authors stated that theoretically a 25% reduction of shrimp biomass would occur if 50% of the discards were retained (i.e., not discarded). However, the model revealed an 8% decline in shrimp biomass if discards were reduced through the use of BRDs or similar methods (assuming a 50% reduction and no subsequent predation by bottomfish). The authors concluded that the use of these modifications would result in no long-term effect on shrimp stocks or shrimp harvests.

Findings from past and current stock assessments have indicated low population levels of several commercial and recreational finfish species, most notably weakfish (*Cynoscion regalis*), in the southeastern Atlantic and red snapper (*Lutjanus campechanus)*, in the Gulf of Mexico. Population declines have been attributed to directed fishing as well as shrimp trawl bycatch. Based on a red snapper quantitative assessment in 1980's, 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 the Gulf of Mexico red snapper stock (Goodyear and Phares 1990).

Age 0 and Age 1 red snapper have been documented in shrimp trawl bycatch, predominantly in the Gulf of Mexico (Goodyear 1995). Age 0 red snapper measure to a standard length (SL) of to up 124 mm (Szedlmayer and Conti 1998; Allman et al. 2004). Gallaway and Cole (1999) assigned red snapper caught between January and June as age 1, under the assumption that these fish were recruited in the previous year. From July and August, based on bimodal size distribution, Gallaway and Cole (1999) assigned fish of less than 90 mm fork length (FL) to age 0, with larger fish to age 1. Similarly, from September through December, the proportion of age 1 fish was based on the percent of catch larger than 150 mm FL. More recently, using a Bayesian approach to estimate red snapper bycatch, Nichols (2004) discussed methods relative to the age 0:1 boundary, assigning fish under 300 mm to age 1.

Red snapper have been reported in shallow muddy waters absent of vertical relief, and are therefore subject to capture by trawls (Schirripa and Legault 1999; Wilson and Nieland 2001). From review of the literature, Gallaway and Cole (1999) documented juvenile red snapper in bottom trawls during fishery-independent surveys with recruitment beginning in June and July, and increasing through September. It has been suggested that age 1 red snapper gradually move from shallow muddy grounds to areas of vertical relief (e.g., oil and gas platforms) for refuge (Schirripa and Legault 1999; Wilson and Nieland 2001). Initial estimates for red snapper generation time ranged from 13 to 54 years; in a more recent aging assessment this was extended to 57 years (SEDAR 2005).

While scientific data related to life history characteristics has increased substantially in recent years, the multi-decadal debate over reef fish, particularly red snapper, and shrimp management continues, encompassing economics, politics, biological, cultural and emotional aspects. At present, uncertainly relative to economic viability of the shrimp and reef fish fisheries due to increasing energy costs, imports, and natural disasters defines one component. Biological uncertainties related to stock size, allocations and undefined mortality estimates describe other aspects. While gear technology to reduce finfish bycatch has improved to some degree, desirable levels of finfish mortality reduction have not been achieved (NMFS 2006a). Resolution as to allocation of resources among user groupers, specifically effort reduction in the shrimp fishery and individual fishing quotas (IFQs) in the red snapper fishery, continues to be debated. Environmentally sound incentives related to the supply and demand of fishery products, and the examination of harvest strategies and management from a holistic approach constitutes a management challenge that still remains unsolved.

To address one aspect of this multifaceted challenge, Congress through Fishery Conservation Amendments of 1990 (Public Law 101-627) to the Magnuson Fishery

Conservation and Management Act (Magnuson Act; 16 USC 1801) required the Secretary of Commerce to conduct a large-scale research program to estimate the magnitude and extent of bycatch resulting from shrimp trawling activity in the U.S. Gulf of Mexico and southeastern Atlantic. As directed by the Secretary, NOAA Fisheries implemented such a program in 1992. In October 1996, the Sustainable Fisheries Act (SFA; Public Law 104-297) reauthorized and amended the Magnuson Act and became the Magnuson-Stevens Conservation and Management Act (Magnuson-Stevens Act). This legislation required the Secretary to submit reports to Congress assessing research efforts on shrimp trawl bycatch (Nance et al. 1997; NMFS 1998; NMFS 2006a).

Scientific protocols for sampling aboard commercial shrimp trawlers for the purposes of characterizing bycatch and evaluating gear options to reduce bycatch, as well as assessing other management strategies to reduce or eliminate bycatch, were developed and subsequently published in a document entitled "Shrimp Trawl Bycatch Research Requirements" (NMFS 1991). Moreover, due to the complexity of the bycatch issue and the numerous stakeholders involved, NOAA Fisheries through cooperative agreements with the Gulf and South Atlantic Fisheries Foundation, Inc. (Foundation) organized a 34-member Finfish Steering Committee to address virtually all aspects of the bycatch research plan (NMFS 1998). The Steering Committee included representatives from both state and federal marine resource agencies, commercial and recreational fishing organizations, universities, and non-governmental organizations. In addition, Technical and Gear Review Panels were organized to advise the Steering Committee. The product of this cooperative effort was published in the document entitled "A Research Plan Addressing Finfish in the Gulf of Mexico and South Atlantic Fisheries" (Hoar et al. 1992).

Clearly, shrimp trawl bycatch represents only one source of fishery-related mortality. Currently there are 1,051 reef fish permit holders in the Gulf of Mexico (SERO 2006a). The primary gears used in this fishery include longline, bandit reels (i.e., electric reels, vertical line) and hand lines. Fish traps, while once used in the Gulf of Mexico, were phased out in February 2007 due to enforcement issues (GMFMC 1997).

Although numerous reef fish species are retained, the predominant targets of these fisheries are groupers and snappers. In the directed commercial fishery, longliners off the coast of Florida generally fish for red grouper (*Epinephelus morio*), yellowedge grouper (*E. flavolimbatus*), blueline tilefish (*Caulolatilus microps*) and sharks in deeper waters. Bandit-rigged (i.e., vertical line, electric reel) vessel operators also target red grouper and may seek yellowedge grouper and vermilion snapper (*Rhomboplites aurorubens*). Historically, based on effort data, most commercial fishing effort using bandit gear for red snapper occurs off Louisiana (Goodyear 1996).

Federal regulations have restricted size and landings of several reef fish species. Areas (designated as stressed areas for reef fish) have been closed or restricted based on gear type (GMFMC 2005a). In the Gulf of Mexico longline gear is prohibited inside the 50-fathom contour west and 20-fathom contour east, and south of Cape San Blas, Florida. Federal waters of the Tortugas North, Tortugas South, Madison and Swanson, and Steamboat Lumps off the west central Florida coast are also closed areas (GMFMC 2005a).

Currently, commercial landings for both shallow-water and deep-water groupers are regulated by poundage quotas, with 8.8 million pounds for shallow-water groupers and 1.02 million pounds for deep-water groupers (GMFMC 2005a). In January 1998, a permanent two-tier red snapper license limitation was established and allows for 2,000 and 200-pound trip limits (GMFMC 1993). The current total allowable catch (TAC) is 9.12 million pounds, divided between the commercial and recreational fishing sectors.

Both resource managers and industry members have questioned the effectiveness of quota systems, size limits, and area closures as management tools. Once the red snapper quota is reached, for example, the directed fishery targets other reef fish and red snapper becomes a bycatch species. The mortality rates of both discarded (undersize) target species and non-target species caught on the various gear types remains a pressing concern. Findings from mark-release mortality studies (Gitschlag and Renaud 1994;

Schirripa and Legault 1999) indicate variable rates of mortality based on depth and method of capture.

In December 1993, in cooperation with the commercial fishing industry and the Gulf of Mexico Fishery Management Council (Gulf Council), NOAA Fisheries implemented a scientific observer program to characterize the fish trap, bottom longline and bandit reel fisheries in the U.S. Gulf of Mexico. The primary objective was to quantify and document release mortality and bycatch levels aboard commercial reef fish vessels. Catch and effort data for targeted and bycatch species were collected and analyzed by area, season and gear type. Mortality rates of discarded species were determined by depth, size, and method of capture. Vessel and gear characteristics, operational costs, fishing locations, and environmental conditions were analyzed. Initial and subsequent findings of this research were reported to the Gulf Council (Scott-Denton and Harper 1995; Scott-Denton 1996).

Stock assessments for both shrimp and reef fish have historically been used to assess stock strength. Stock assessments are used both nationally and globally to provide quantifiable levels of allowable take from a single-species or species-complex fishery. All sources of mortality, including total directed fishing pressure on a stock, bycatch estimates from observed fisheries and impacts from non-fishery activities resulting in fishery mortality (e.g., urban development, industrial expansion, flood control measures, eutrophication, point and non-point pollution, hydroelectric power operations, oil and gas exploration and development) are required in stock assessment models (NMFS 1998). Moreover, fish population declines resulting from climatic change, and predator-prey interactions are all critical components for assessing fishery stock strength. These data are generally not available due to the lack of limited range and time series data for affected species (NMFS 1998). In short, mortality rates (i.e., quantity of fish removed from the population) are generally estimated, or not incorporated in stock assessment models. As such, overestimation may result in overly restrictive management measures; underestimation can result in measures that fail to adequately protect fishery stocks (NMFS 1998). Sharp et al. (2004) elaborated further to state that stock assessments do not consider several of many factors including the influence of climatic and environmental fluctuations, seismic events, habitat destruction, predation by migrant species, marine pollution, and invasive species. The authors also report that there is currently a failure to recognize that most fishing, even in the most sustainable and precautionary manner, has structural consequences in marine ecosystems including the composition of fish assemblages. Stock assessment refinement and ecosystem-based model enhancement required for a holistic approach to management is gained through many avenues including, but not limited to, the addition of new information on species-specific catch rates and distribution, improved gear efficiencies, as well as, the acquisition of knowledge on the many considerations listed by Sharp et al. (2004).

In this light, based on current management strategies, both the shrimp and reef fish fisheries are potential candidates for economic extinction if status quo is maintained (i.e., 9.12 TAC, and stock assessments with 40% reduction rate of red snapper from the shrimp fishery). Both fisheries are closely related from a management standpoint so that the concepts of ecosystem-based management with strong economic incentives could have reduced much of the crisis management going on today.

To illustrate, the Gulf Council implemented a Fishery Management Plan (FMP) for shrimp and reef fish resources in the Gulf of Mexico in 1981 (GMFMC 1981) and 1984 (GMFMC 1984), respectively. The reef fish FMP included a minimum size restriction of 13 inches in total length for red snapper and data reporting requirements. Further legislation involved the complete closure of the directed commercial fishery for red snapper in 1991 when a quota of 2.04 million pounds was reached, established a 7-fish bag limit (1.96 million pounds) for the recreational sector, and required 50% reduction of red snapper by the commercial shrimp fleet operating in the EEZ. From 1993 through 1995, the commercial quota was set at 3.06 million pounds with the recreational quota at 2.94 million pounds. The minimum size requirement of red snapper landed increased to 14 inches and 15 inches in total length in 1994 and 1996, respectively. Through regulatory amendments in 1996, the commercial quota was increased to 4.65 million pounds to be landed during two seasons, February and September. This legislation also increased the recreational quota to 4.47 million pounds (bag limit of 5 fish at 15 inches in total length). Collectively, this set the TAC at 9.12 million pounds. In January 1998, the minimum size requirement of red snapper landed was to increase to 16 inches in total length. This was canceled through a November 1997 regulatory amendment, and a 15-inch total length minimum was retained both for the commercial and recreational fisheries. In 2000, the 16-inch total length minimum became effective for the recreational sector only. In January 1998, a permanent two-tier red snapper license limitation was established to replace the temporary red snapper endorsement system. This system allows for basically the same as the endorsement system (i.e., 2,000 and 200 pound trip limits based on historical landings and income derived between 1990 and 1992). As of today, commercial red snapper annual quota of 4.65 million pounds is divided into a spring and fall season. The recreational season runs from April 21 through October 31, with a quota of 4.47 million pounds, with 4-fish/person bag limits at a 16-inch minimum size limit. Based on the 2005 red snapper stock assessment (SEDAR 2005), a reduction in the current quota is anticipated.

The most publicized actions resulting from the 1996 reauthorization of the Magnuson-Stevens Act relative to the Gulf of Mexico red snapper stock involved (1) empowering the NMFS Southeast Regional Administrator (RA) to close the recreational fishery in the EEZ when the quota was reached (first closure in 1997); (2) defining what constituted "Essential Fish Habitat"; and (3) mandating the Secretary of Commerce (and tasked to NOAA Fisheries) to respond to recommendations set forth by an independent red snapper peer review panel.

The congressionally-mandated independent red snapper peer review panel recommended improved data collection and stock assessment methods in order to improve the current science and management of red snapper in the Gulf of Mexico (MRAG Americas 1999). These included 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. The panel concluded that fishery observers were needed on all vessels involved with the fishery to quantify catch and associated bycatch, and release mortality.

One such observer program, a component of the large-scale program that was implemented in 1992, was conducted in the summer of 1998 regarding the Gulf Council's recommendation of maintaining the 1998 TAC of 9.12 million pounds. This TAC was higher than the allowable biological catch range (ABC) of 3 to 6 million recommended by the Gulf Council's Reef Fish Stock Assessment Panel and the independent peer review panel (MRAG Americas 1999). According to the authors, the Gulf Council based this decision on the 1998 proposed legislation that mandatory BRDs in the shrimp fishery would reduce red snapper mortality by 60%. Given this reduction, the Gulf Council concluded that a 9.12 million pound TAC would best balance the biological, social and economics of the fishery while providing optimum benefits to the nation (MRAG Americas 1999). NOAA Fisheries agreed to keep the 9.12 million TAC, based on a BRD efficiency rate of between 50% and 60%; thus, 6.0 million pounds would be released during the first season, and the remaining 3.12 million pounds would be released if NOAA Fisheries could validate a reduction of 50%-60% of juvenile snapper mortality in shrimp fishery (MRAG Americas 1999). In response, NOAA Fisheries instituted mandatory BRDs, observers, logbooks and vessel monitoring systems (VMS) units for the Gulf of Mexico shrimp fishery in April 1998. 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 observer safety concerns and the lack of an enforcement mechanism for a non-permitted fishery, the mandatory program became a voluntary charter program.

The combined BRD efficiency reduction rate derived from the non-random observer effort did not show the 50% to 60% reduction needed to release the remaining 3.12 million pounds TAC (MRAG Americas 1999). The remaining TAC, however, was released based on the recommendation made by NOAA Fisheries that the BRD reduction criterion could be achieved within two years (MRAG Americas 1999).

The shrimp trawl observer program continues through today. Observers are placed on commercial shrimp vessels through a voluntary mechanism. Based on these data, five BRD designs are currently certified for 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. The majority (>99%) of the Gulf fleet uses the Gulf fisheye.

Using 2001-2003 BRD evaluation data from this program, two assessments of BRD effectiveness were conducted by NOAA Fisheries (NMFS 2006a). Results from both of these assessments revealed much lower reduction rates. The 2004 assessment revealed that the red snapper reduction rate was 11.7%, substantially lower than the mandate (NMFS 2006a).

Throughout the years, bycatch reduction in the shrimp fishery has remained a contentious issue. In light of the 1998 management decisions, the Texas Shrimp Association filed suit against the Secretary of Commerce on May 8, 1998, challenging (1) NOAA Fisheries final BRD regulations; (2) TAC of 9.12 million pounds; (3) observer and logbook requirements; and (4) release of the remaining TAC allocation of 3.12 million pounds that NOAA Fisheries summer 1998 research concluded that BRDs did not meet the established red snapper mortality reduction criterion. Other lawsuits have since been filed over the current shrimp and red snapper management systems including Florida Wildlife Federation against the Department of Commerce challenging why NOAA Fisheries did not require BRDs in the EEZ off Florida (BRDs are now required). Most recently, on March 29, 2005, the Coastal Conservation Association (CCA), based on the 11.7% reduction findings, filed a petition to stop overfishing of red snapper by the commercial shrimp trawl fishery (CCA 2005). The Ocean Conservancy and Gulf Restoration Network have filed similar suits (SERO 2006b).

Based on the number of operating units, the commercial shrimp industry is the largest and most valuable fishery in the U.S. 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.

Both the shrimp and reef fish industry have experienced economic hardship. Relative to the shrimp fishery, global imports have flooded the U.S. market with low-cost, pond-reared shrimp. This in turn has significantly decreased the price of domestic trawl-caught shrimp to a record low. Combined with increased diesel and insurance prices, natural disasters, maintenance and more stringent regulations for TEDs and BRDs, numerous vessels have been sold, repossessed, or tied to the dock. The combination of these effects has lowered effort, but there remains a question as to how much more shrimping reduction is required to meet an acceptable rate of red snapper fishing mortality.

In response to these initial and subsequent concerns, NOAA Fisheries developed and implemented observer programs from 1992 and continuing through the present to quantify species-specific fishery catch rates, including sea turtles, by area and season from the commercial shrimp and reef fish fisheries. Further, the development and commercial evaluation of BRDs in the shrimp fishery remains a paramount objective.

METHODS

Observer Coverage

Fishery observers were placed aboard commercial shrimp and reef fish vessels operating in the U.S. southeastern region, from the Carolinas through Texas. Sampling effort allocation was based on current effort trends for all areas. The target species of the shrimp fishery are penaeid shrimp, with peak effort occurring from May through December. The predominant target species of the reef fish fisheries are groupers and snappers. The allocation of sampling by area for reef fish vessels was based on availability of vessels and current effort trends.

Fishery Data Collection

Vessel length, hull construction material, gross tonnage, engine horsepower and crew size were obtained for each vessel. For each trawl haul or set (the location of gear placement at a defined time) the type, number and construction material of the fishing gear was recorded.

Latitude, longitude, depth, and environmental parameters were recorded at the start of each tow or set. The time the gear remained in the water (soak or fishing time) was calculated.

For the shrimp fishery, observers collected data for bycatch characterization and for the evaluation of specific BRD designs. Onboard data collection for the purpose of bycatch characterization consisted of sampling trawl catches taken from shrimp vessels during commercial operations. Characterization projects involved collecting fishery-specific data from one randomly selected net for each tow. Nets trailing behind the try net (a small net used to intermittently test for concentrations of shrimp) were not sampled. 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, shoveled into baskets, and a total weight obtained. A subsample (approximately 20% of the total catch weight from the selected net) was processed for species composition. Species weight and number were obtained from the subsample. For BRD evaluation trials, observations were conducted aboard cooperative shrimp vessels during commercial operation in areas and seasons primarily of known juvenile red snapper abundance. 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 from starboard to port outboard nets to reduce net and side biases. Detailed measurement and written description of BRD, TED, and net type, construction, installation, webbing, and other associated gear characteristics were recorded at the start and end of each trip, or when adjustments were made. The total catch weight, counts and weights of shrimp and red snapper were obtained from each net. A subsample of approximately 32 kg from each net (experimental and control) was processed for a modified bycatch characterization, time permitting. A modified characterization consisted of processing selected species (or taxa) of finfish with the remaining subsample grouped into one of the following categories: non-penaeid shrimp crustaceans, fish, non-crustacean invertebrates, and debris (e.g., rocks, logs, trash). For all sampled tows, red snapper FL measurements were recorded.

The condition and fate of fish and invertebrates were observed and recorded in generalized categories (more than 50% alive, or more than 50% dead). Predators observed in the area upon discard were documented as sharks, dolphins, seabirds and other fish.

For the commercial reef fish vessels (i.e., fish trap, bottom longline and bandit reel), fishery-specific data were obtained from each set. Non-target and undersized target species were processed first, recording length, weight and fate prior to release (alive, dead, or unknown). A fish was determined to be alive if it swam, dead if it floated, and unknown if the fate could not be determined (i.e., erratic swimming). Beginning in 1995, the condition of the fish when brought onboard was recorded and includes the following categories: (1) live - normal appearance with no air expansion; (2) live - air bladder expansion; (3) live - eyes protruding; (4) live - with both air bladder expansion and eyes protruding; (5) dead when brought onboard; or (6) unknown or not recorded. Air bladders of live fish were punctured in the same manner as demonstrated by the captain and crew. Retained species were processed, recording length and weight.

For all projects, sightings or capture of sea turtles were documented in accordance with the Cooperative Marine Turtle Tagging Program protocol (SEFSC 2006). Sea turtle species, date, location, method of capture, status, carapace measurements and tag numbers placed on specimens were recorded.

Statistical Treatment and Analysis

For the shrimp fishery, overall catch rates, or catch-per-unit effort (CPUE), are presented for all years, areas, seasons and depths. Species total weights and numbers were extrapolated from subsample weight to the total catch weight, and are also based on one net per tow. Total weight and number extrapolation were derived by multiplying the sample weight (or number) of the species of interest by the total weight of the sampled net, divided by the subsample weight. For rare species, all specimens were removed from the net, and no extrapolation was required. In the absence of a weight or number for a given species the entire tow was set aside from the analysis.

Unique species, family, taxa, etc. (now referred to as species) were recorded. Specimens were identified to the species level for bycatch characterization efforts. For BRD trials species were placed into the following categories: penaeid shrimp, non-penaeid shrimp crustaceans, grouped fish, non-crustacean invertebrates, and debris (e.g., rocks, logs, trash).

For the reef fish fishery, no extrapolations were done. Release mortality was assessed based on all sampled fish.

Biological measurements were recorded in metric units. Vessel, gear and depth measurements followed current standards for the fisheries as related to relevant regulatory mandates (i.e., U.S. system equivalents).

RESULTS

Southeastern Shrimp Fishery

In February 1992, NOAA Fisheries in cooperation with the Foundation and the Gulf of Mexico and South Atlantic Fishery Management Councils initiated the large-scale observer program for the southeastern shrimp fishery. Since the program's implementation, more than 150 BRD and TED combinations have been evaluated. Currently five BRDs and 20 TED designs are certified for use in the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery based on data collected from this program. From 1992 through 2005, data from approximately 27,868 tows (Figure 1) were collected during 1,591 trips (15,585 sea days), with more than 130,000 hours of trawling observed.

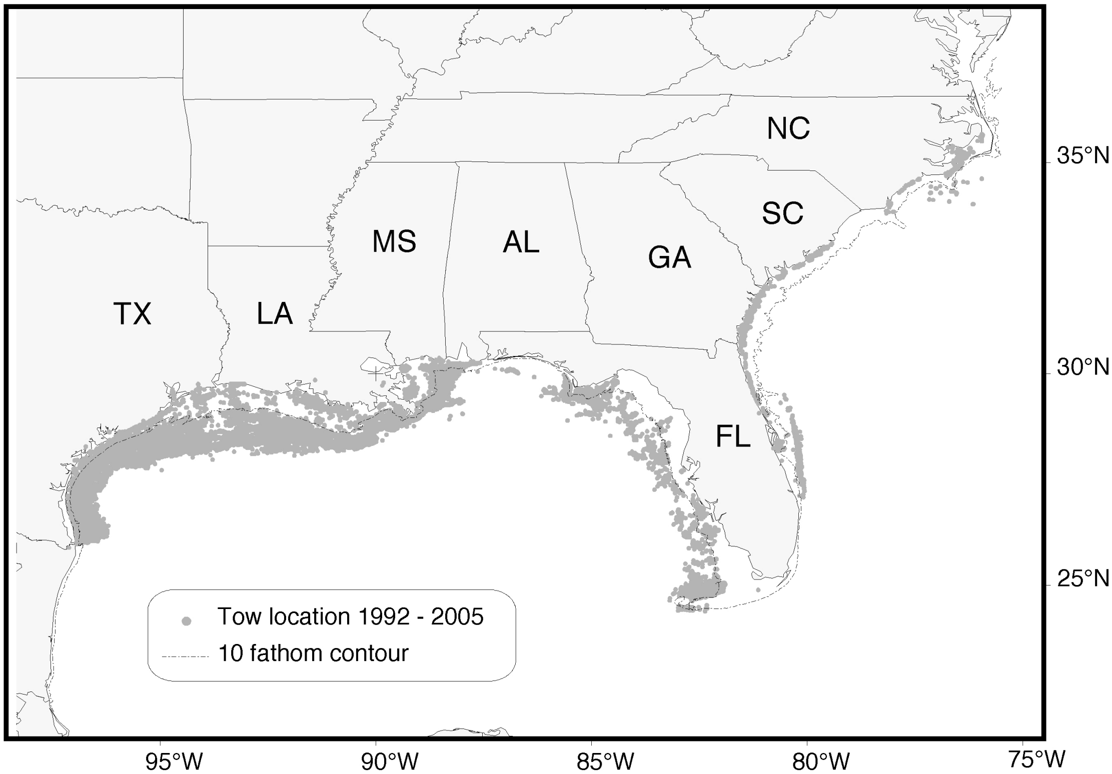

Figure 1. Distribution of sampling effort (tows) in the U.S. southeastern region. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

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 shrimp trawl bycatch database.

Sampling Effort by Trips and Sea Days

From computerized trip report data, 1,591 trips were completed in the U.S. Gulf of Mexico and southeastern Atlantic from February 1992 through December 2005 during 15,585 sea days of observations. Eight hundred-sixty trips (13,924 sea days) operated in the Gulf of Mexico, with an average trip length of 18.1 days. Seven hundred-eleven trips (1,661 sea days) occurred off the east coast, with average trip length of 2.8 days.

Annual observer coverage levels were less than 1% of the total shrimp effort in all years with the exception of 2002. The number of sea days varied from 1992 through 2005 (Figure 2), and was directly related to the amount of funding received. Coverage levels were highest in 2002 with 3,101 sea days, followed by 1998 with 1,472 sea days. In 2003 and 2004, approximately 1,410 and 1,328 days, respectively, were observed. 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 1,000 sea days. The lowest coverage occurred in 1996 with 300 sea days.

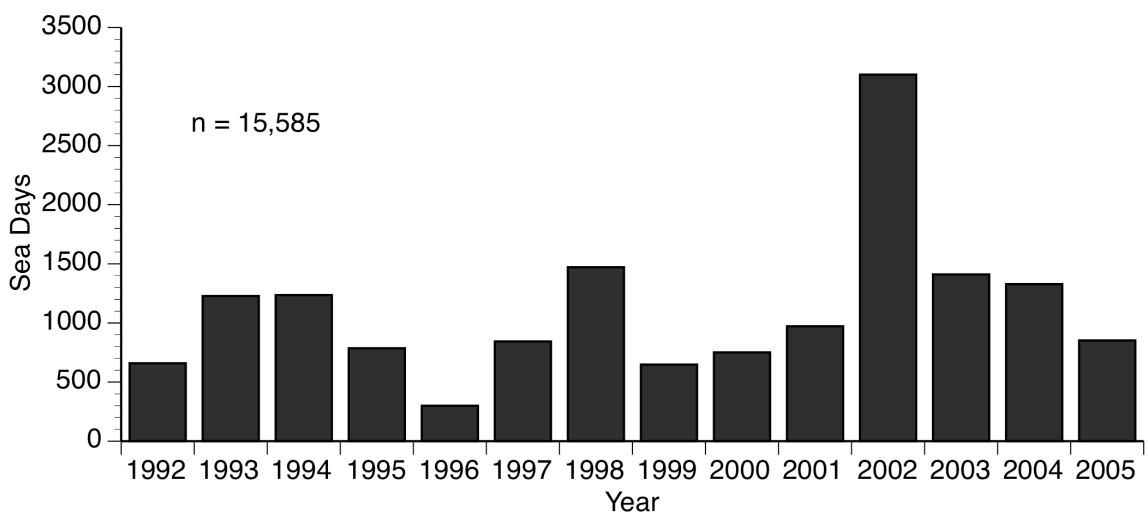

Figure 2. Number of sea days completed by year for the Gulf of Mexico and southeastern Atlantic. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

Sea day coverage in the Gulf of Mexico was substantially higher (note y-axis values when comparing figures) than for waters off the southeastern Atlantic. A total of 13,924 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 with 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 (typically in effect from May 15 through July 15 in each year).

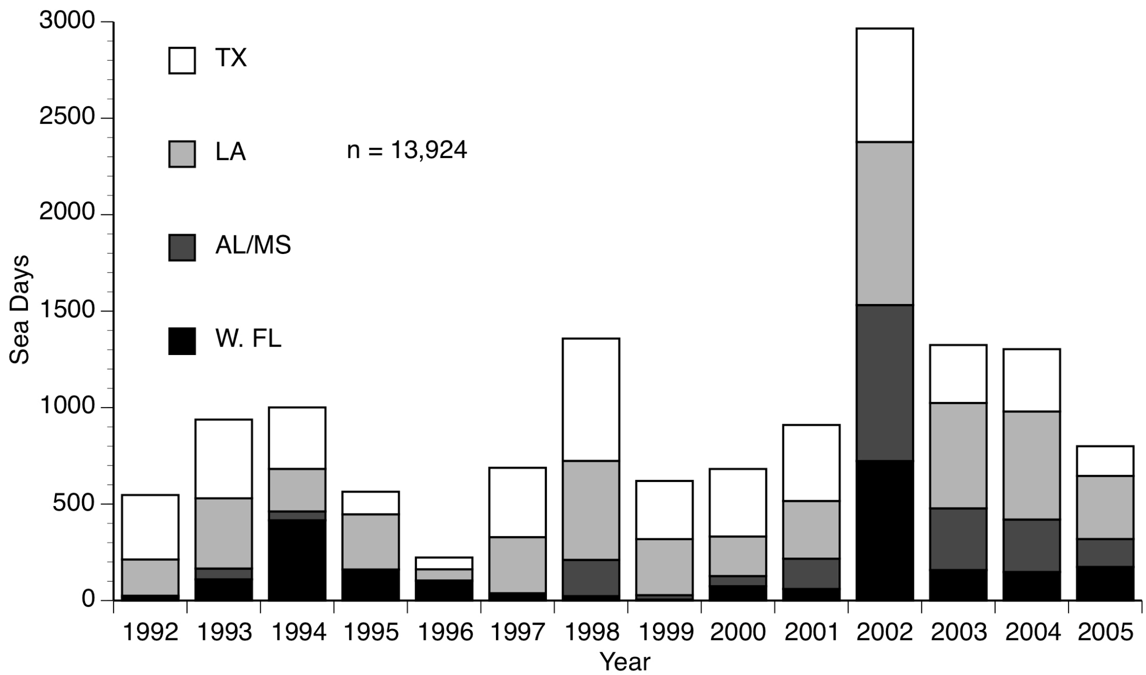

Figure 3. Sea days completed by year and state in the Gulf of Mexico. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

A total of 1,661 sea days of observations was completed in waters off the southeastern Atlantic (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 that also retained penaeid shrimp.

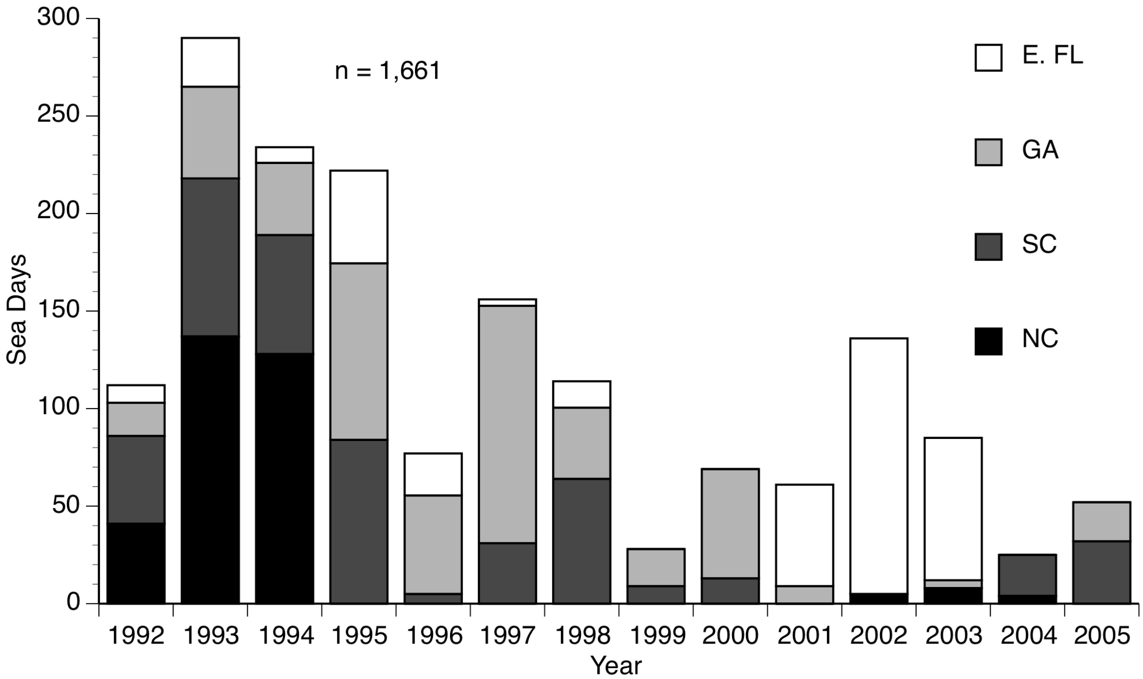

Figure 4. Sea days completed by year and state in waters off the southeastern Atlantic. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

Collectively, based on the number of sea days, coverage was greatest off Louisiana at 32%, followed by Texas at 30%, west coast of Florida at 14%, Alabama/Mississippi at 13%, Georgia and South Carolina at 3% each, and the east coast of Florida and North Carolina each at 2%. The number of sampled tows by state followed a similar pattern.

Sampling Effort by Tows

For the Gulf of Mexico, 23,718 tows were sampled from 1992 through 2005 (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.

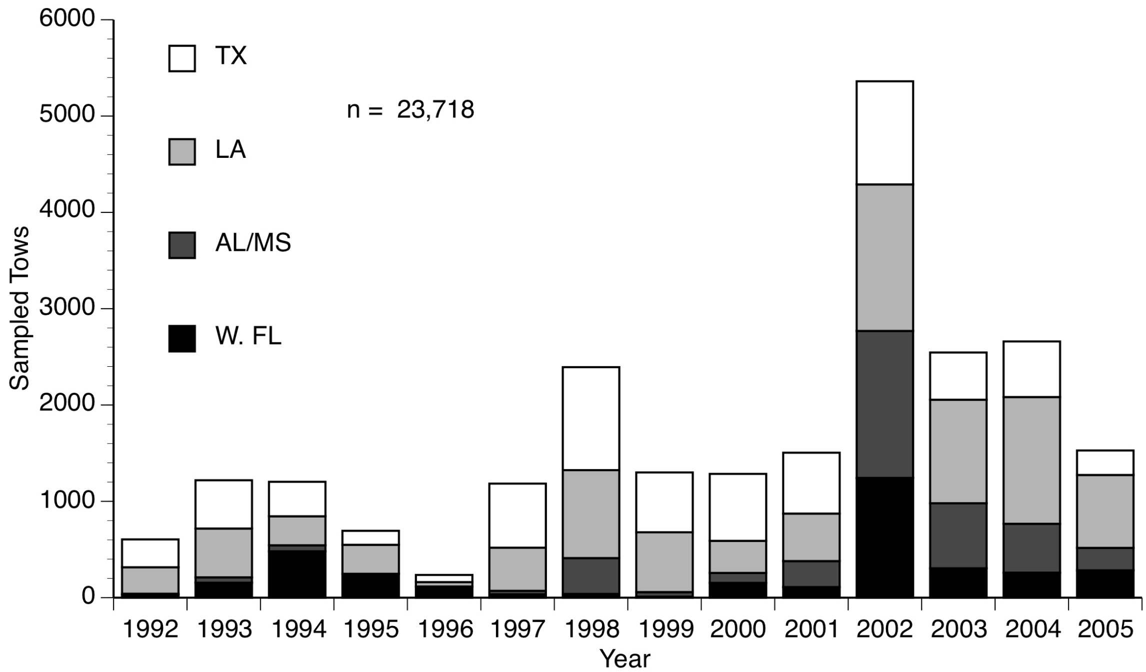

Figure 5. Number of tows sampled by year and state in the Gulf of Mexico. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

A total of 3,533 tows was sampled off the east coast during the study period (Figure 6). North Carolina had the highest number of tows processed during 1992 through 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 exceptions of 1999, 2000, 2004, and 2005.

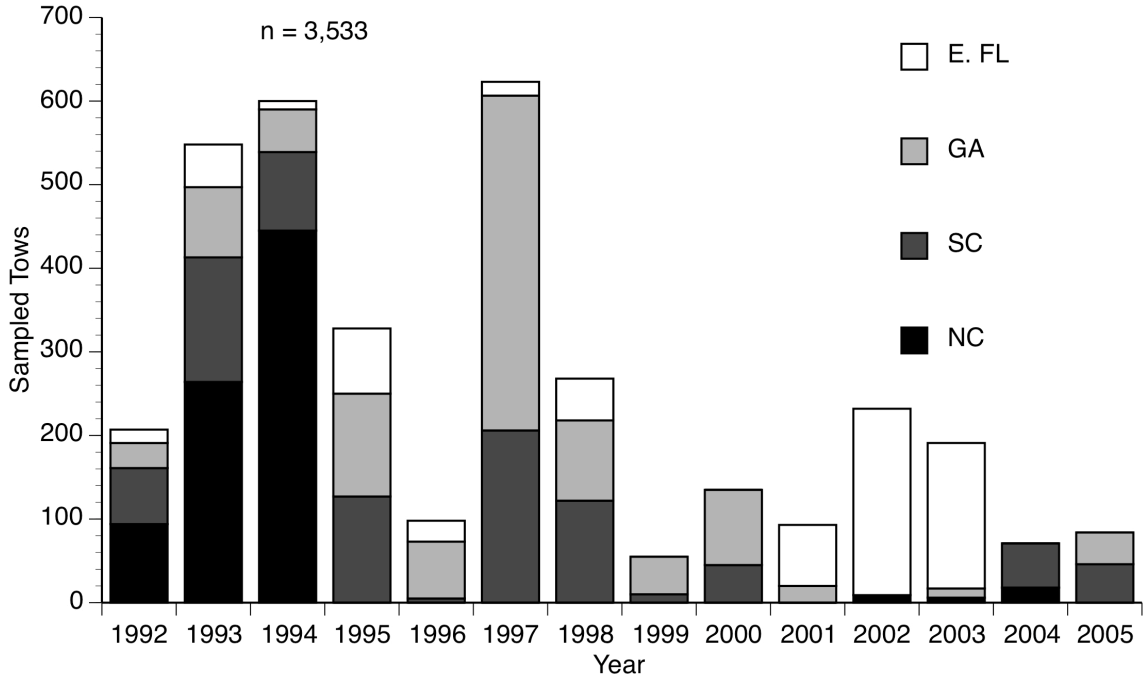

Figure 6. Number of tows sampled by year and state off the southeastern Atlantic. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

Vessels, Gear and Tow Characteristics

Two hundred sixty-two vessels participated in the study. Overall vessel length ranged from 36 to 98 feet (74.4 ± 10.0 s.d.). One hundred forty-six vessels contained ice holds, 106 had some freezer capacity, and 10 had unidentified cold storage. The majority of vessels (139) were steel hulls, followed by 87 of wood, 31 of fiberglass, 4 of wood and fiberglass, and one of aluminum. Engines averaged 414.0 hp. Crew size, including the captain, ranged from 1 to 5 individuals.

The number of nets pulled per tow varied from 1 to 4 nets (3.6 ± 0.8 s.d.). More nets per vessel were pulled in Gulf of Mexico (3.8 ± 0.5 s.d.) than off the southeastern Atlantic (2.9 ± 1.0 s.d.). For both areas, headrope length, on a per net basis, ranged from 15.3 to 85.0 feet with an average of approximately 48.3 feet (± 8.9 s.d.). In the Gulf of Mexico, headrope length ranged from 20.3 to 77.3 feet (48.1 ± 7.9 s.d). Off the southeastern Atlantic, headrope length ranged from 15.3 to 85.0 feet (49.6 ± 13.9 s.d).

Among all projects, tow time ranged from 0.1 to 20.5 hours (4.8 $\pm$ 2.4 s.d.). Tow times were longer in the Gulf of Mexico (5.2 $\pm$ 2.3 s.d.) than off the southeastern Atlantic (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 5.3 hours ($\pm$ 2.2 s.d.) for all projects and areas.

Based on starting latitude and longitude coordinates, 29% of tows occurred in waters of $\leq$ 10 fathoms, with 71% of tows in offshore waters > 10 fathoms. For all projects combined, tow depth ranged from 0.3 to 73.2 fathoms (18.1 $\pm$ 12.3 s.d.).

Extrapolated Species Composition – Percent and CPUE by Categories

Weight extrapolations from species composition samples by category for bycatch characterization and BRD/TED evaluation projects for all years, seasons, and depths for the Gulf of Mexico and southeastern Atlantic are presented in Figure 7. Approximately 2.9 million kilograms of total catch were obtained from 16,908 nets during 94,117 hours of trawling in the Gulf of Mexico. In the southeastern Atlantic, more than 214.4 thousand kilograms of catch were recorded from 3,145 nets during 7,749 hours of observations. Catch rates were higher in the Gulf of Mexico (30.8 kg/hr) as compared with the southeastern Atlantic (27.7 kg/hr). Discards to landings ratios were 5.18 and 3.20 for the Gulf of Mexico and southeastern Atlantic, respectively.

In the Gulf of Mexico, fish species dominated the catch by weight at 65%, followed by penaeid shrimp at 16%, non-penaeid shrimp crustaceans at 13%, non-crustacean invertebrates at 4%, and debris at 1%. CPUE in kilograms per hour by category was 20.1 for fish, 5.0 for penaeid shrimp, 4.1 for crustaceans, 1.2 for invertebrates, and 0.4 for debris.

Similarly, in the southeastern Atlantic, fish species dominated the catch by weight at 47%, followed by penaeid shrimp at 24%, invertebrates at 18%, crustaceans at 8%, and debris at 3%. CPUE in kilograms per hour by category was 13.0 for fish, 6.6 for penaeid shrimp, 5.1 for invertebrates, 2.1 for crustaceans, and 0.8 for debris.

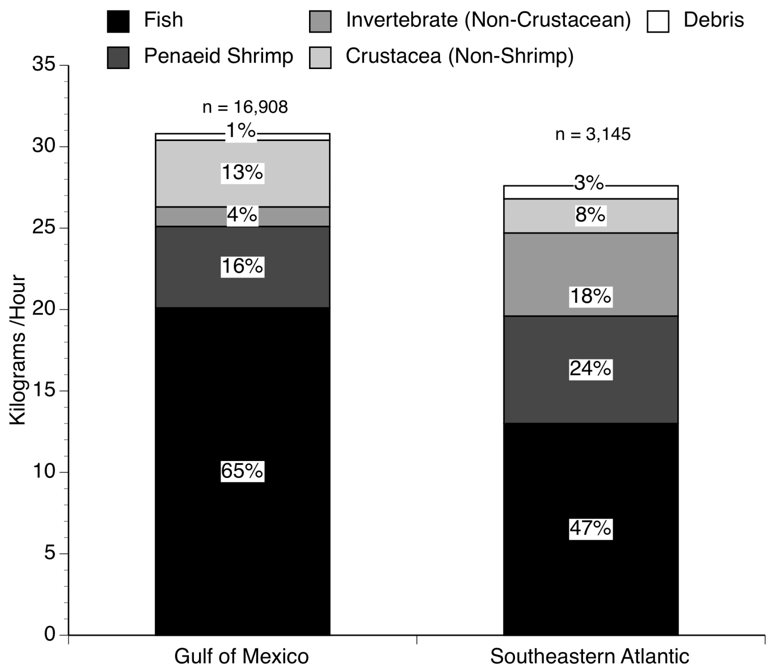

Figure 7. Percent species composition by weight and category for the Gulf of Mexico and southeastern Atlantic. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005, n = nets sampled.

<u>Extrapolated Species Composition – Percent and CPUE by Weight</u>

Weight extrapolations for bycatch characterization efforts for all years, seasons, and depths for the Gulf of Mexico and southeastern Atlantic are presented for dominant species. Percent and CPUE for 651 species collected in the Gulf of Mexico, and 391 species obtained in southeastern Atlantic are given in Appendix A, Tables A1 and A2, respectively.

Based on a per net basis, approximately 227.4 thousand kilograms were caught from 1,482 tows during 7,697 hours of trawling in the Gulf of Mexico. The majority of tows occurred in Florida at 50%, followed by Louisiana at 24%, Texas at 23% and Alabama/Mississippi at 3%. In the southeastern Atlantic, more than 48.6 thousand kilograms were obtained from 445 tows during 1,249 hours of observations. South Carolina collections comprised the majority of tows at 33%, followed by North Carolina at 30%, Georgia at 28% and the east coast of Florida at 9%.

Weight extrapolations for dominant species (> 0.6 kg/hr) in the Gulf of Mexico from bycatch characterization samples for all years, areas, seasons and depths are presented in Figure 8. Longspine porgy (*Stenotomus caprinus*) comprised approximately 9% of the total catch, followed by Atlantic croaker (*Micropogonias undulatus*), pink shrimp (*Farfantepenaeus duorarum*), and brown shrimp (*Farfantepenaeus aztecus*) each at 7%, inshore lizardfish (*Synodus foetens*) at 6%, iridescent swimming crab (*Portunus gibbesii*) at 4%, and lesser blue crab (*Callinectes similis*), blotched swimming crab (*Portunus spinimanus*), and Gulf butterfish (*Peprilus burti*) each at 2%. All other species (642) combined comprised 54% of the total weight. CPUE in kilograms per hour by dominant species was 2.8 for longspine porgy, 2.1 for Atlantic croaker and pink and brown shrimp, 1.6 for inshore lizardfish, 1.0 for iridescent swimming crab, and 0.6 each for lesser blue crab, blotched swimming crab, and Gulf butterfish.

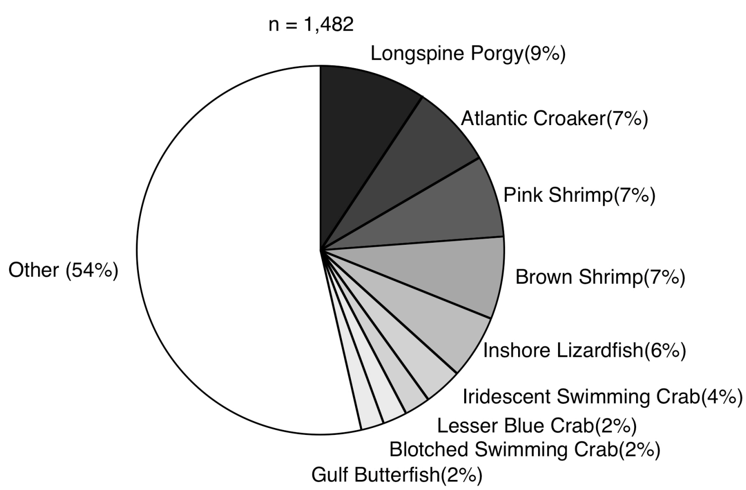

Figure 8. Percent species composition by weight for the Gulf of Mexico. Based on observer coverage of the U.S. Gulf of Mexico shrimp fishery from 1992 through 2005; n = tows.

Figure 9 depicts weight extrapolations for dominant species (> 1.5 kg/hr) for the southeastern Atlantic. Atlantic croaker, spot (*Leiostomus xanthurus*), and cannonball jellyfish (*Stomolophus meleagris*) accounted for approximately 9% each of the total catch, followed by white shrimp (*Litopenaeus setiferus*) and debris each at 7%, brown shrimp at 6%, jellyfish (Class Scyphozoa) at 5%, and star drum (*Stellifer lanceolatus*) and Atlantic menhaden (*Brevoortia tyrannus*) each at 4%. Approximately 310 species combined comprised the remaining 41% of the total weight. Overall, weakfish comprised approximately 1% of the total catch in the southeastern Atlantic. CPUE in kilograms per hour by species was 3.6 for Atlantic croaker, 3.4 for spot, 3.3 for cannonball jellyfish, 2.8 for white shrimp, 2.6 for debris, 2.2 for brown shrimp, 2.8 for jellyfish class, 1.6 for star drum, and 1.5 for Atlantic menhaden.

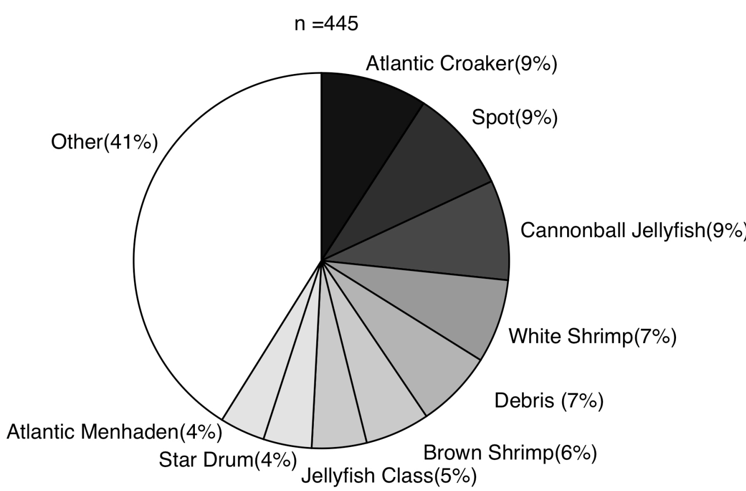

Figure 9. Percent species composition by weight for the southeastern Atlantic. Based on observer coverage of the U.S. southeastern Atlantic shrimp fishery from 1992 through 2005; n = tows.

Extrapolated Species Composition – Percent and CPUE by Number

Extrapolated numbers as related to the total weight for bycatch characterization efforts for all years, seasons, and depths for the Gulf of Mexico and southeastern Atlantic are given for dominant species. As previously mentioned, tows where no counts were obtained for a given species were set aside for the purpose of this analysis. Similarly, debris counts were entered as a default of one and accounted for less than 1%

based on one unit of debris for each tow where present. Approximately 7.5 million organisms were caught in 957 tows during 5,176 hours of trawling in the Gulf of Mexico. In the southeastern Atlantic, more than 780.0 thousand organisms were obtained from 229 tows during 566 hours of observations.

Number extrapolations for dominant species (> 40 no/hr) collected in the Gulf of Mexico (Figure 10) indicate that longspine porgy comprised 14% of the total catch, followed by brown shrimp at 9%, sugar shrimp (*Trachypenaeus sp*.), pink shrimp and iridescent swimming crab each at 6%, Atlantic croaker and longspine swimming crab (*Portunus spinicarpus*) each at 5%, and lesser blue crab and mantis shrimp (*Squilla sp*.), each at 3%. All other species combined comprised 44% of the total number. CPUE in numbers per hour were 197 for longspine porgy, 129 for brown shrimp, 90 for sugar shrimp, 82 for pink shrimp, 80 for iridescent swimming crab, 74 for Atlantic croaker, 67 for longspine swimming crab, 49 for lesser blue crab, and 42 for mantis shrimp.

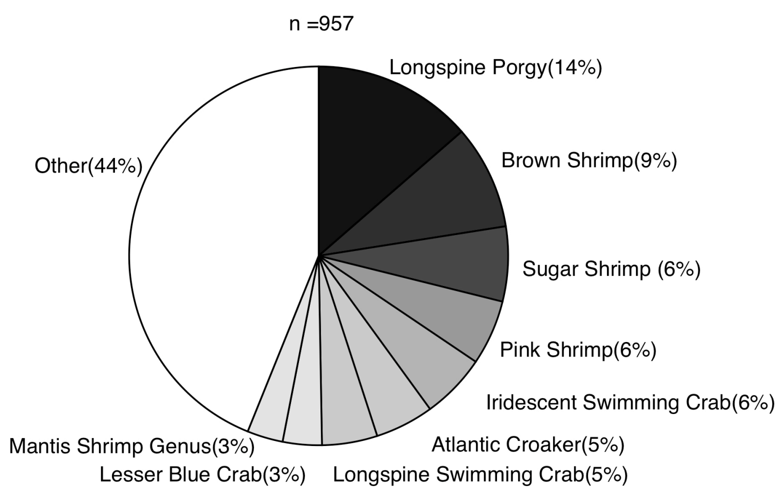

Figure 10. Percent species composition by number for the Gulf of Mexico. Based on observer coverage of the U.S. Gulf of Mexico shrimp fishery from 1992 through 2005; n = tows.

Figure 11 denotes number extrapolations for dominant species (> 35 no/hr) for the southeastern Atlantic. By number, spot accounted for approximately 13% of the total catch, followed by brown shrimp at 11%, white shrimp at 9%, Atlantic croaker at 8%, cannonball jellyfish at 6%, pink shrimp and star drum both at 5%, jellyfish at 4%, and blue crab (*Callinectes sapidus*) at 3%. Other species accounted for 34% of the total catch. Corresponding CPUE in numbers per hour by species were 184 for spot, 156 for brown shrimp, 131 for white shrimp, 108 for Atlantic croaker, 85 for cannonball jellyfish, 76 for pink shrimp, 67 for star drum, 62 for jellyfish, and 37 for blue crab.

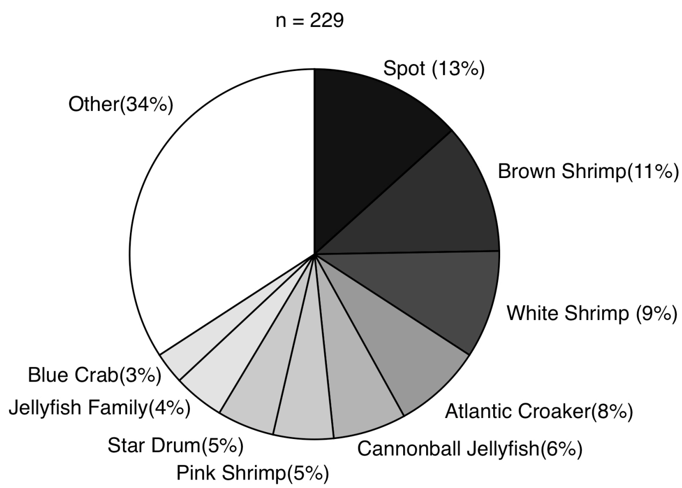

Figure 11. Percent species composition by number for the southeastern Atlantic. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005; n = tows.

Sample size used for extrapolation purposes is different between weight and number. Thus comparison of weight and number estimates was not possible.

Gulf of Mexico Species Composition by State – Percent and CPUE

Weight extrapolations for dominant species in the Gulf of Mexico by state area from bycatch characterization samples for all years, seasons and depths were assessed.

The number of sampled tows varied, as well as the number of unique species captured in each state area.

Approximately 57.4 thousand kilograms were caught in 337 tows during 2,051 hours of trawling off Texas. Three hundred-six unique species were identified. By weight, longspine porgy accounted for approximately 16% of the total catch, followed by brown shrimp at 15%, Atlantic croaker at 12%, inshore lizardfish at 6%, lesser blue crab at 5%, Gulf butterfish at 4%, spot at 3%, and sugar shrimp and brown rock shrimp (*Sicyonia brevirostris*) each at 2%. Other species accounted for 36% of the total catch. Corresponding CPUE in kilograms per hour by dominant species was 4.6 for longspine porgy, 4.1 for brown shrimp, 3.3 for Atlantic croaker, 1.7 for inshore lizardfish, 1.4 for lesser blue crab, 1.0 for Gulf butterfish, 0.7 for spot, and 0.6 for both sugar shrimp and brown rock shrimp.

Off the coast of Louisiana more than 72.3 kilograms were caught in 360 tows during 2,267 hours of trawling. Two hundred ninety-five species were documented. Longspine porgy comprised 15% of the total catch by weight, followed by Atlantic croaker at 12%, brown shrimp at 10%, inshore lizardfish at 8%, sand seatrout (*Cynoscion arenarius*), gulf butterfish, and hardhead catfish (*Arius felis*) each at 3%, and lesser blue crab and white shrimp each at 2%. Other species accounted for 43% of the remaining catch. CPUE for longspine porgy was 4.7, followed by Atlantic croaker at 3.8, brown shrimp at 3.1, inshore lizardfish at 2.5, sand seatrout at 1.1, Gulf butterfish, hardhead catfish and lesser blue crab at 0.8, and white shrimp at 0.7.

Off the coasts of Alabama/Mississippi approximately 10.4 thousand kilograms were caught from 47 tows during 200 hours of trawling. Two hundred-three unique species were recorded. Longspine porgy and Atlantic croaker accounted for 11% each of the total catch, followed by inshore lizardfish at 5%, sand seatrout, mantis shrimp, brown shrimp and lesser blue crab each at 4%, and bigeye searobin (*Prionotus longispionosus*) and longspine swimming crab each at 3%. Other species comprised 50% of the remaining catch. Corresponding CPUE in kilograms per hour for dominant species was 5.9 for longspine porgy, 5.6 for Atlantic croaker, 2.5 for inshore lizardfish, 2.3 for sand seatrout, 2.2 each for mantis shrimp and brown shrimp, 1.9 for lesser blue crab, 1.8 for bigeye searobin, and 1.5 for longspine swimming crab.

Approximately 87.3 thousand kilograms of catch from 738 tows during 3,178 hours of trawling were obtained waters off the west coast of Florida. Five hundred forty-five unique species were identified. By weight, pink shrimp accounted for 18% of the total catch, followed by iridescent swimming crab at 8%, blotched swimming crab at 5%, sand perch (*Diplectrum formosum*), sponge phylum (Porifera), and inshore lizardfish each at 4%, and dusky flounder (*Syacium papillosum*), pinfish (*Lagodon rhomboides*), and leopard searobin (*Prionotus scitulus*) each at 3%. All other species combined accounted for 49% of the total catch. CPUE was 4.9 for pink shrimp, 2.2 for iridescent swimming crab, 1.4 for blotched swimming crab, 1.2 for sand perch, 1.1 for sponge, 1.0 for inshore lizardfish, 0.8 each for both dusky flounder and pinfish, and 0.7 for leopard searobin.

<u>Southeastern Atlantic Species Composition by State – Percent and CPUE</u>

Weight extrapolations for dominant species in the southeastern Atlantic by state from bycatch characterization samples for all years, seasons and depths were examined. Again, the number of tows off each state was variable, ranging from 38 off the east coast of Florida to 149 off South Carolina.

Off the east coast of Florida approximately 9.2 thousand kilograms were caught in 38 tows during 174 hours of trawling. One hundred sixty-two unique species were identified. Atlantic croaker accounted for 23% of the total catch, followed by spot at 9%, silver seatrout (*Cynoscion nothus*) and southern kingfish (*Menticirrhus americanus*) each at 7%, white shrimp at 5%, iridescent swimming crab at 4%, jellyfish (Class) at 3%, and inshore lizardfish and Spanish mackerel (*Scomberomorus maculatus*) each at 2%. Other species accounted for 37% of the remaining catch. CPUE in kilograms per hour for dominant species was 12.1 for Atlantic croaker, 5.0 for spot, 3.9 for silver seatrout, 3.7 for southern kingfish, 2.8 for white shrimp, 1.9 for iridescent swimming crab, 1.7 for jellyfish, 1.2 for inshore lizardfish, and 1.1 for Spanish mackerel.

Approximately 14.1 thousand kilograms were caught in 125 tows during 395 hours of trawling off Georgia. One hundred seventy-seven unique species were documented. By weight, debris comprised 15% of the total catch, followed by white shrimp at 10%, Atlantic menhaden at 9%, spot and star drum each at 8%, Atlantic croaker at 6%, and jellyfish (Class), penaeid shrimp and southern kingfish each at 4%. Other species accounted for 32% of the total catch. Corresponding CPUE in kilograms per hour was 5.3 for debris, 3.6 for white shrimp, 3.2 for Atlantic menhaden, 2.8 for spot and star drum, 2.1 for Atlantic croaker, 1.6 for jellyfish and penaeid shrimp, and 1.4 for southern kingfish.

Off the coast of South Carolina more than 21.0 thousand kilograms were caught in 149 tows during 466 hours of trawling. One hundred sixty-four unique species were recorded. Cannonball jellyfish accounted for 20% of the total catch, followed by brown shrimp at 10%, jellyfish (Family) at 9%, spot, white shrimp and jellyfish (Class) each at 7%, Atlantic croaker and debris each at 5%, and star drum at 4%. Other species combined comprised 28% of the total catch. CPUE in kilograms per hour for dominant species was 8.9 for cannonball jellyfish, 4.3 for brown shrimp, 3.9 for jellyfish (Family), 3.3 for spot, 3.2 for white shrimp, 2.9 for jellyfish (Class), 2.3 for Atlantic croaker, 2.1 for debris, and 1.7 for star drum.

Approximately 4.4 thousand kilograms were caught in 133 tows during 213.4 hours of trawling off the coast of North Carolina. One hundred twenty-eight unique species were identified. Blue crab dominated at 17%, followed by spot at 16%, pink shrimp, Atlantic croaker, and brown shrimp at 11% each, pinfish at 7%, white shrimp and pigfish (*Orthopristis chrysoptera*) both at 3% each, and inshore lizardfish at 1%. Other species accounted for 20% of the remaining catch. CPUE in kilograms per hour by dominant species was 3.4 for blue crab, 3.3 for spot, 2.3 for pink shrimp, Atlantic croaker and brown shrimp, 1.4 for pinfish, 0.6 for both white shrimp and pigfish, and 0.2 for inshore lizardfish.

Red Snapper Size and Capture Location

Fishery observers, for the most part, measured all red snapper present from the nets selected for sampling. From 1992 through 2005, approximately 313,470 red snapper were processed. The majority of captures occurred in the Gulf of Mexico with only a small fraction (<0.01%) being recorded in the southeastern Atlantic (Figure 12). Approximately 62% of red snapper based on length frequency data were off Texas, followed by Louisiana at 27%, and Alabama at 10%. All other states combined represented less than 1%. There was unequal sampling between areas and states that may account for the percent differences observed (i.e., more red snapper counted where sampling was greater).

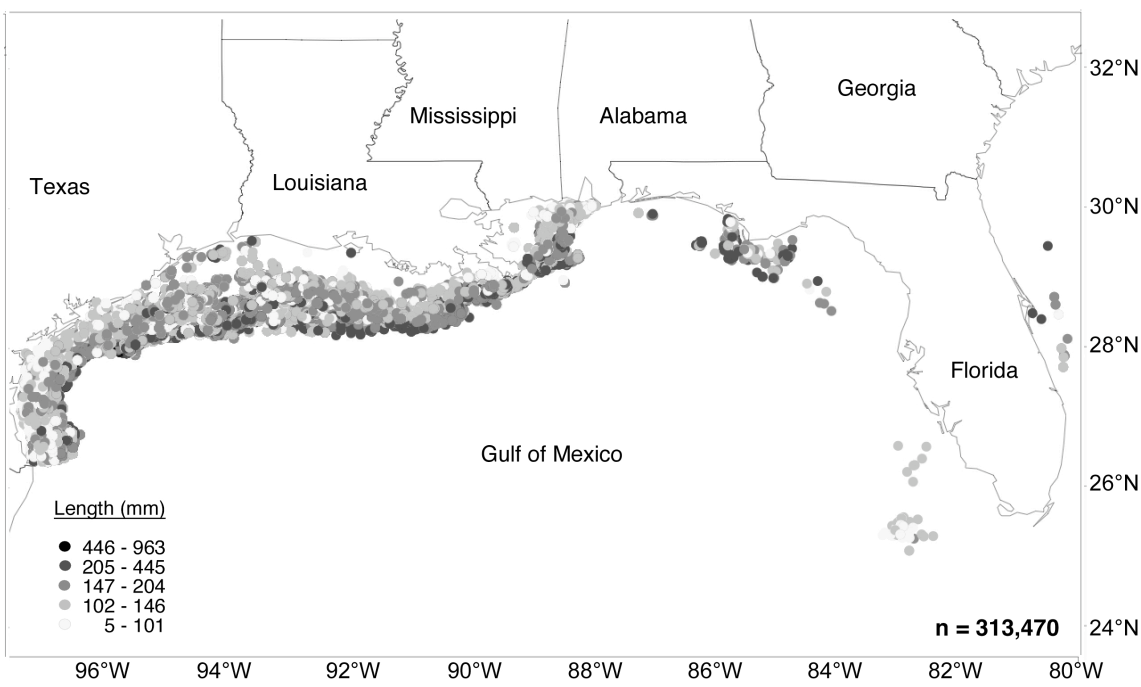

Figure 12. Location and size classes based on red snapper length frequency data. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005; n = individuals.

Based on FL measurements of 313,470 red snapper (Figure 13), the mean length was 127.5 mm (± 48.2 s.d.), and ranged from 5 to 963 mm (127.5 ± 48.2 s.d). The median length was 118 mm. The size class with the greatest number recorded was 105 - 125 mm at 21%, followed by 85 - 105 mm at 19%, 125 – 145 mm at 15%, 65 - 85 mm at 12%, 145 -165 mm at 9%, 165 - 185 mm at 7%, and 185 - 205 mm at 6%. All other size classes contained less than 5% by number.

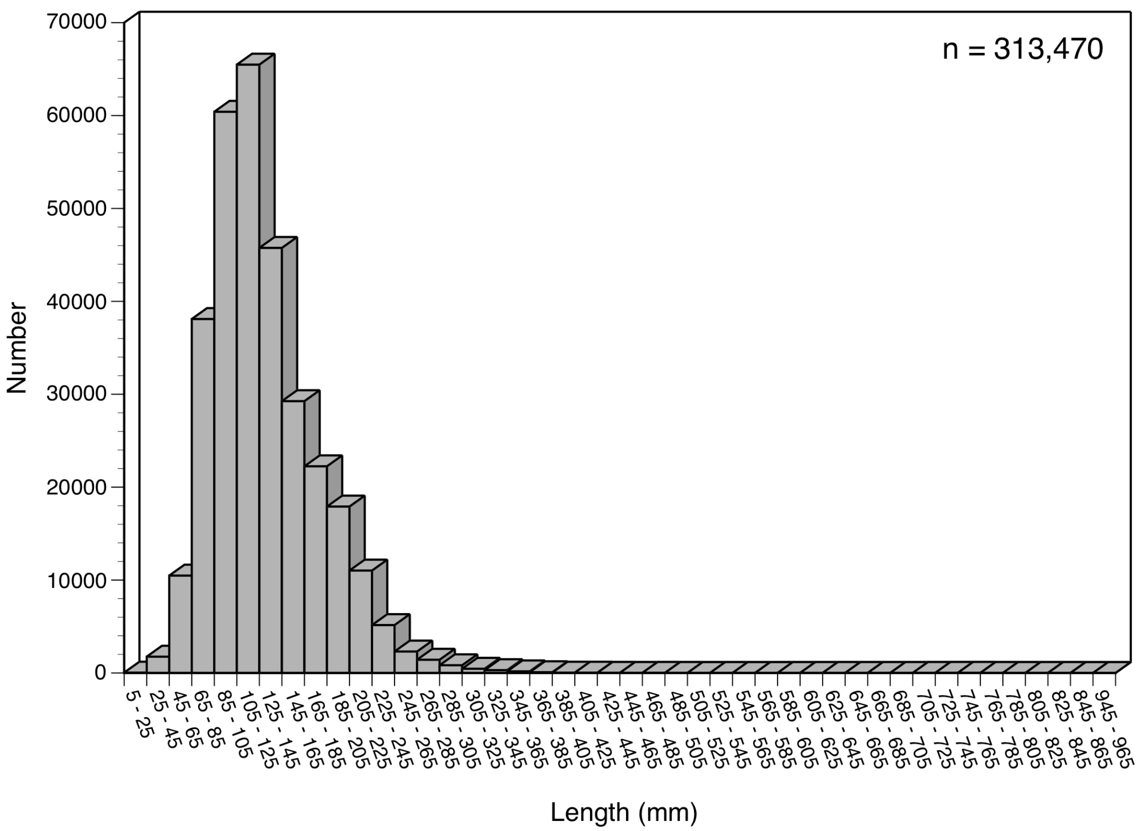

Figure 13. Frequency distribution of red snapper by size class. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005; n = individuals.

The frequency distribution of red snapper by month is depicted in Figure 14. Based on total number, notable recruitment of red snapper to the shrimp fishery started in August (17%), increased progressively through September (19%) and October (19%), with a decline evident in November (13%) and December (6%). From January through June, occurrence by month was low (<5%).

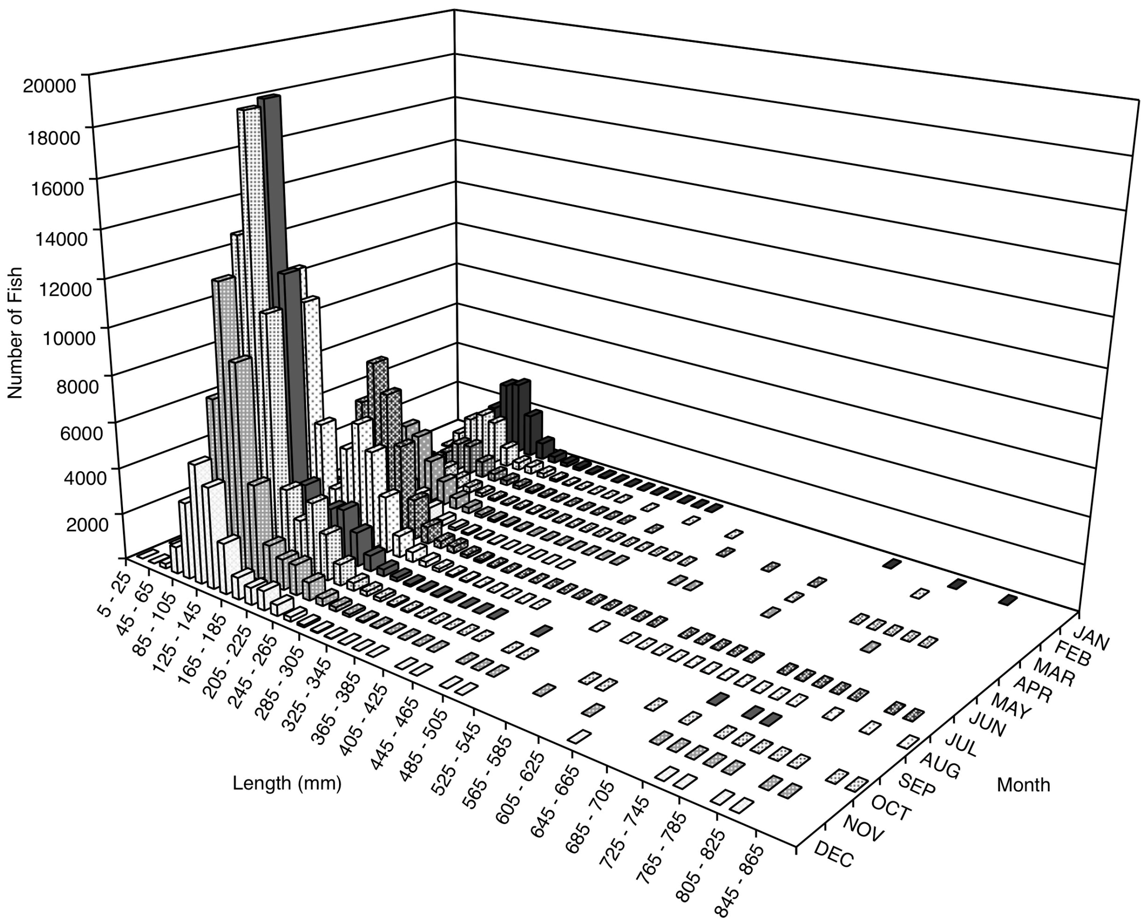

Figure 14. Frequency distribution of red snapper by size class and month. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

Among all seasons, the greatest concentration of red snapper by depth, based on length measurements, occurred between 10 and 40 fathoms (Figure 15). Approximately

43% of red snapper were between 10 and 20 fathoms, followed by 37% between 20 and 30 fathoms, and 15% between 30 to 40 fathoms.

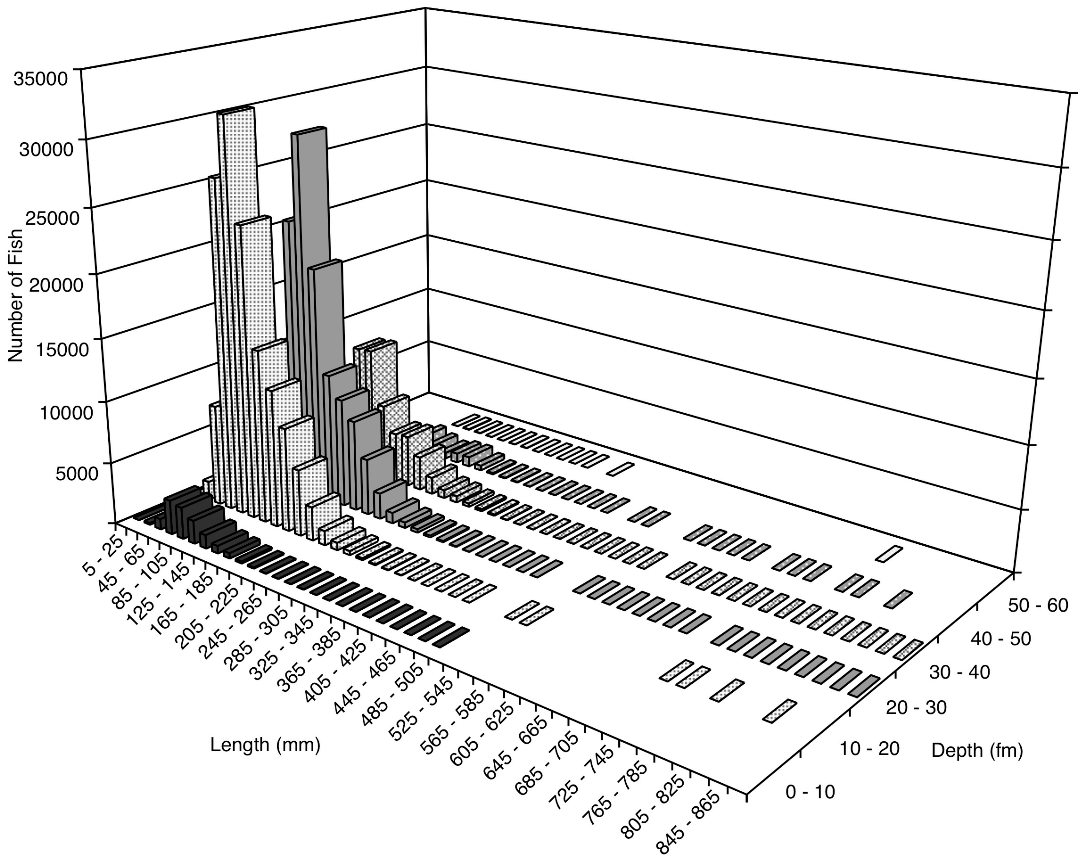

Figure 15. Frequency distribution of red snapper by size class and depth. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

Average length by 10-fathom depth and area strata is presented in Figure 16. Average lengths in millimeters were grouped in class intervals of 66 –120, 120 –140, 140-165, 165-219, and 219-297. All classes were represented in all states; however, the number of observations in each cell was highly variable. The general trend observed was smaller red snapper in shallower waters with larger individuals occurring in deeper areas.

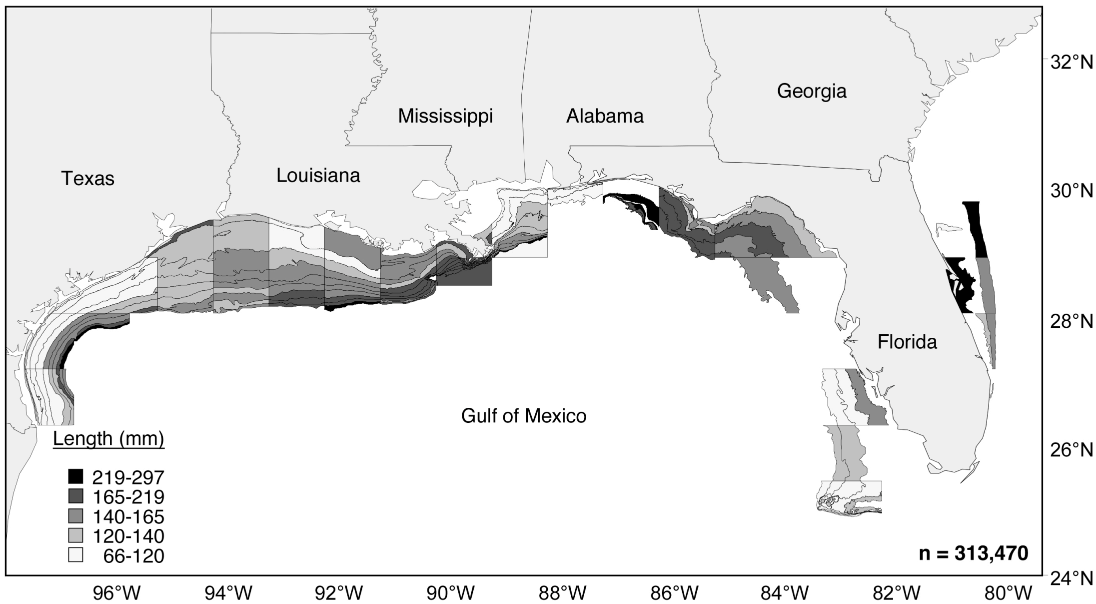

Figure 16. Average lengths of red snapper by 10-fathom depth and area strata. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

Condition and Fate of Organisms Discarded

The condition and fate of fish and invertebrates observed from 1997 through 2005 from the Gulf of Mexico and southeastern Atlantic were recorded in generalized categories (i.e., more than 50% alive, or more than 50% dead); organisms observed feeding on discarded catch were documented as sharks, dolphins, seabirds and other fish. Visual observations were recorded prior to discarding the bycatch. The majority (96%) of net observations occurred in the Gulf of Mexico.

Percentages and number of observations for fish and invertebrates by alive versus dead categories are depicted in Figure 17. The number of observations varied for fish and invertebrates.

Based on observed estimates, 11% of fish species were documented in the alive category. Tow times ranged from 0.1 to 15.0 hours (4.8 $\pm$ 2.0 s.d.). Approximately 73% of these observations were in offshore waters, with the greatest percentage (38%) occurring in September through December. Conversely, 89% of fish were reported in the dead category. Tow times ranged from 0.1 to 20.5 (5.3 ± 1.9). The majority (48%) of these observations occurred between May and August in offshore waters (78%).

Approximately 52% of invertebrate species were classified as alive. The mean tow time was 5.1 (± 1.9 s.d) and ranged from 0.1 to 15.0 hours. The majority (41%) of the observations occurred from May to August in offshore waters (79%). For those observations (48%) with invertebrates reported in the dead category, tow times ranged from 0.1 to 20.5 (5.3 ± 2.0 s.d.), with the greatest concentration of effort from May to August (53%) in offshore waters (76%).

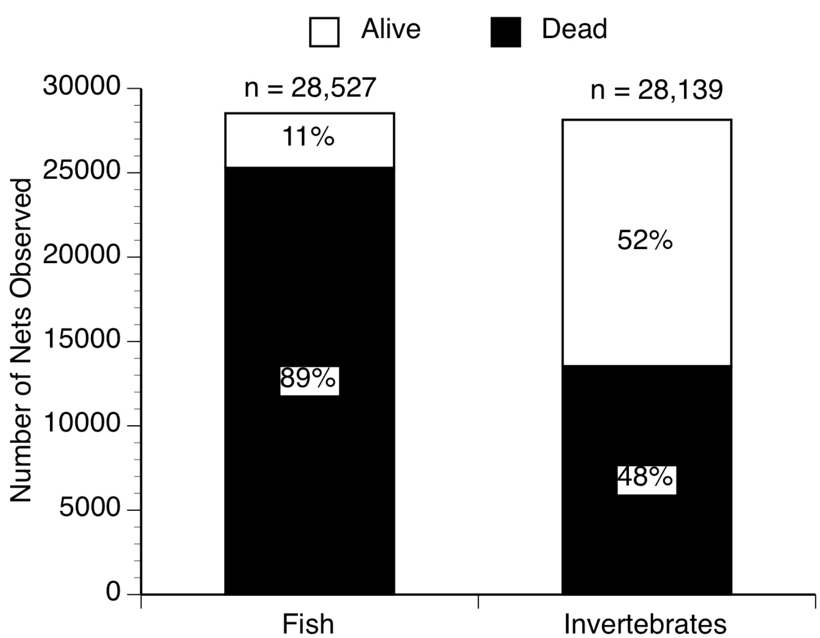

Figure 17. Condition of organisms prior to discard from shrimp vessels under commercial operation in the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

The absence or presence of organisms feeding on discarded bycatch is denoted in Figure 18. As above, the number of observations varied. Within each category, seabirds were reported most frequently (49%), followed by dolphins (34%), other fish (20%) and sharks (12%).

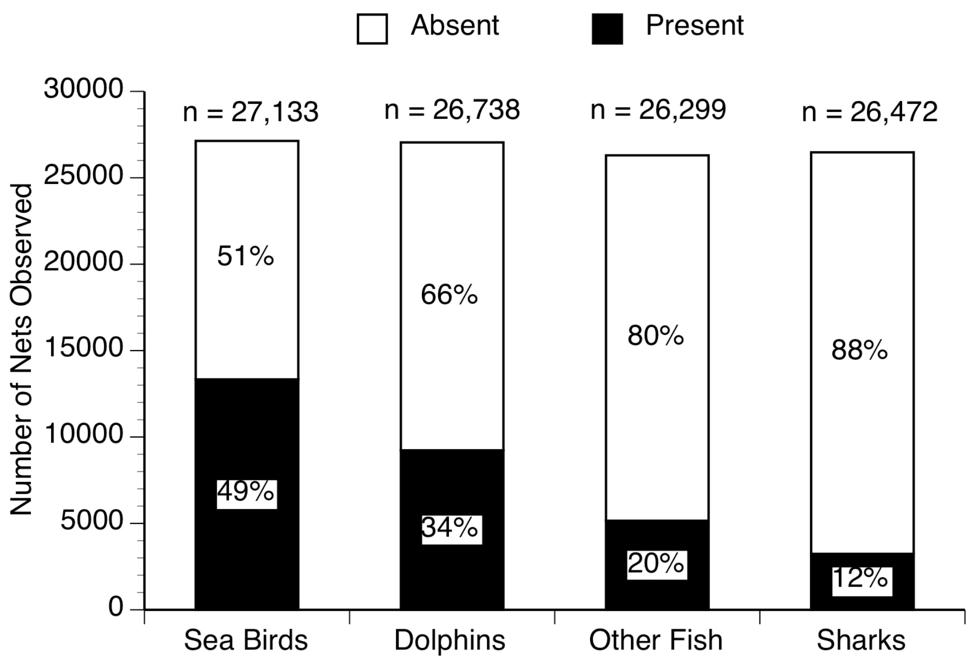

Figure 18. Predators observed feeding on bycatch discards from shrimp vessels under commercial operation in the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

Commercial Reef Fish Fishery

Observer coverage of the commercial reef fish fishery operating primarily off the west coast of Florida, and to a lesser extent off Louisiana was conducted between 1993 through 1995, during 289 days at sea. NOAA Fisheries observers (10) collected data from 576 sets aboard fish trap vessels, 317 sets from bottom longline, and 580 sets from bandit reel vessels. Initial and subsequent findings were presented to the Gulf Council for regulatory-making decisions (Scott-Denton and Harper 1995; Scott-Denton 1995).

Fish Trap

Thirteen trips were made aboard six fish trap vessels between December 1993 and February 1995. Five hundred seventy-six sets were sampled during 96 sea days of observations off the west coast of Florida.

Overall vessel length was 43.7 feet, ranging between 32 and 53 feet. All vessels were of fiberglass construction. Engine power ranged from 175 to 670 horsepower, with 483.2 the average. The number of crew, not including the captain, consisted of 1 or 2 individuals.

Trap dimensions ranged from 10.6 cubic feet to 16 cubic feet, with 14 cubic feet being used most often on a per trip basis. The mesh of the traps was constructed of plastic-coated wire, with mesh sizes of 1.0" x 1.0", 1.5" x 1.5", or 1" x 2" being used most often. Traps with 1.0" x 1.0" had larger mesh in the trap doors. All traps had biodegradable blow-out panels and escape windows.

The number of traps set at a location, based on 11 trips, varied from 6 to 37, with 20.6 traps the average (± 5.5 s.d.). All traps were set individually at depths ranging from 10 to 22.7 fathoms, with 17.1 the average (± 2.8 s.d.). Average soak time was 10.0 (± 8.3 s.d.) hours and ranged from 0.8 to 88.9 hours. Three sets with soak times greater than 76 hours were the result of engine problems. The majority of traps were set, tended and retrieved during daylight hours. Trip length ranged from 3 to 12 days with the average being 6.8 days.

The majority of sets (87%) occurred in 0 to 2 foot seas, with the remaining sets occurring in 3 to 5 foot seas. Water clarity ranged from 33 feet to greater than 66 feet, with 29% in waters of greater than 66-foot visibility. Bottom type descriptions were obtained from the vessel operator. The majority of sets occurred over shell bottom (47%). Rock (19%), sponge (16%), sand (14%), unknown (3%), and mud (1%) comprised the remaining. A combination of shell and sand occurred, but only the dominant material was recorded.

From 11,999 traps set, 36% were sampled. A total of 16,943 fish of 64 species was recorded (Appendix A, Table A3). Approximately 58% of the individuals were released alive, 34% were kept, 2% were released dead, 7% retained for bait, and < 1% were released with an unknown fate. Approximately 5,133 red grouper were measured. Lengths in millimeters ranged from 203 to 965 in total length (TL) with the 305 mm category having the highest percentage (14%) of individuals.

The dominant species were red grouper at 35%, followed by lane snapper (*Lutjanus synagris*) at 18%, white grunt (*Haemulon plumieri*) at 9%, sand perch at 7%, tomtate (*H. aurolineatum*) at 6%, black seabass (*Centropristis striata*) at 5%, littlehead porgy (*Calamus proridens*) and pinfish each at 4%, and knobbed porgy (*C. nodosus*) at 3%. Other species (55) comprised 9% of the remaining sampled catch.

Bottom Longline

Twelve trips were made aboard nine bottom longline vessels from April 1994 through May 1995. Three hundred-seventeen sets were sampled during 112 days of sea day observations. Two hundred forty-two sets targeted red grouper with remaining 75 sets seeking yellowedge grouper and blueline tilefish in deeper waters.

Longline vessels averaged 49.3 feet, ranging from 38 to 62 feet. Six vessels were fiberglass, and one was wood. Engine horsepower ranged from 185 to 671 horsepower, with 271 the average. The number of crew, excluding the captain, consisted of 1 to 3 individuals.

Mainline material was composed of cable or monofilament, with the test or strength of the mainline ranging from 900 to 2,000 pounds, based on 11 trips. The average test was 1,281. The amount of mainline set at a location ranged from 0.9 to 9.0 nautical miles, averaging 2.4 nautical miles. Gangion material was monofilament with length ranging from 1.5 to 6.3 feet, with an average of 2.6 feet. Barbed-circle hooks were used for all sets, with both offset and straight hooks used. Hooks averaged 2.2 inches in shaft length, and 0.8 inches from the point to the shaft.

The average number of hooks set a location was 731.9 (± 378.0 s.d.), varying from 75 to 2,100 hooks. The average depth of sets was 47.8 (± 27.3 s.d.), with a range of 18 to 129. The sets targeting red grouper averaged 34.1 fathoms. Fishing time ranged from 0.3 to 24.7 hours, with 3.0 hours the average (± 2.7 s.d.). The majority of fishing occurred during daylight hours. Trip length ranged from 2 to 18 days; the average was 9.5 days.

The majority of sets (64%) occurred in 0 to 2 foot seas, with 32% in 3 to 5 foot seas, and 4% in 6 to 8 foot seas. Water clarity was greater than 66 feet for all sets. The majority of sets occurred over rock bottom at 41%, followed by shell and coral both at 21%, unknown at 14%, pothole depression at 3%, and mud at less than 1%.

From the 229,467 hooks processed (100%), a total of 5,224 fish of 89 species were caught (Appendix A, Table A4). Approximately 56% of the individuals were kept, 28% released alive, 5% released dead, 10% retained for bait, and 2% released with an unknown fate. Approximately 2,958 red grouper were measured and ranged from 254 to 991 mm TL. The 457 mm category had the highest percentage of the individuals.

Dominant species caught on longline gear included red grouper at 59%, followed by yellowedge grouper at 12%, blueline tilefish at 5%, gag (*Mycteroperca microlepis*) at 3%, scamp (*M. phenax*) at 2%, and southern hake (*Urophycis floridana*), clearnose skate (*Raja eglanteria*), sandbar shark (*Carcharhinus plumbeus*) and leopard toadfish (*Opsanus pardus*) each at 1%. All other species (80) accounted for 14% of the catch.

Bandit Reel

Sixteen trips were made aboard bandit-rigged vessels during 81 sea days of observations (580 sets) from January through July 1995. Nine trips targeted red grouper and vermilion snapper off Florida and seven trips were for red snapper off Louisiana.

Bandit-rigged vessels averaged 48.9 feet, ranging from 34 to 70 feet. Nine vessels were fiberglass, and two were wood. Engine horsepower ranged from 90 to 450 horsepower, with 242.8 the average. The number of crew, excluding the captain, consisted of 0 to 5 individuals.

The average number of hooks set a location was 123.7 (± 543.7 s.d.), varying from 1 to 8,000 hooks. The average depth of sets was 24.1 (± 9.2 s.d.), with a range of 8 to 56 fathoms. Fishing time ranged from less than 0.1 to 20.6 hours, with 1.0 hour the average (± 2.3 s.d.). The majority of fishing occurred during daylight hours. Trips averaged 4.6 days, and ranged from 2 to 14 days in length.

The majority of sets (61%) occurred in 0 to 2 foot seas, with 27% in 3 to 5 foot seas, and 11% in 6 to 8 foot seas, and 1% in greater than 8-foot seas. The majority of sets (> 99%) occurred over unknown substrate.

A total of 2,806 fish (45 species) was processed off Florida (Appendix A, Table A5). Of these, 55% were kept, 37% were released alive, 2% were released dead, 7% retained for bait, and < 1% released with an unknown fate.

The dominant species caught on bandit-rigged vessels off Florida were vermilion snapper at 43%, followed by red grouper at 38%, gag and bank seabass (*Centropristis ocyurus*) each at 3%, red porgy (*Pagrus pagrus*), tomtate and whitebone porgy (*Calamus leucosteus*) each at 2%, and gray snapper (*Lutjanus griseus*) and scamp each at 1%. Other species (36) comprised 5% of the remaining catch sampled.

Off Louisiana, a total of 716 fish comprised of 16 species was sampled during March 1995 (Appendix A, Table A6). Of these, 46% of the individuals were kept, 47% were released alive, 2% each were released dead, retained for bait, or released with an unknown fate.

The dominant species on bandit gear off Louisiana included red snapper at 86%, followed by gray triggerfish (*Balisties capriscus*) and vermilion snapper each at 4%, blue runner (*Caranx crysos*), guaguanche (*Sphyraena guachancho*), tomtate, silver seatrout (*Cynoscion nothus*), and greater amberjack (*Seriola dumerili*) each at 1%. Little tunny (*Euthynnus alletteratus*) comprised less than 1%. All other species (7) accounted for 2% of the sampled catch.

The condition of fish when brought on board the vessel is depicted in Appendix A, Table A7. A large percentage (74%) of the fish exhibited signs of stress (i.e., air expansion).

A parallel research effort, conducted by Russell Research Associates, Inc. (RRA), was completed in 1995 aboard bandit-rigged vessels off Louisiana. RRA observers collected data during 6 trips (21 sea days of observations). Off Louisiana, a total of 607 fish comprised of 29 species was sampled during March 1995. Of these, 80% of the individuals were kept, 18% were released alive, 1% retained for bait, and less than 1% each were released dead, or returned with an unknown fate. Red snapper was the dominant species comprising 62% of the catch.

DISCUSSION

Based on findings from the current study, estimated overall CPUE for the shrimp fishery was similar compared to earlier assessments (NMFS 1995; Scott-Denton and Nance 1996; Nance and Scott-Denton 1997; Nance et al. 1997; NMFS 1998). From data collected during the 1992 through 1996 period (NMFS 1998), overall catch rates were 28.0 kg/hr in the Gulf of Mexico, and 27.0 kg/hr in the southeastern Atlantic. In the current study, catch rates from 1992 through 2005 period, were 30.8 kg/hr in the Gulf of Mexico, and 27.7 kg/hr in the southeastern Atlantic. Discards to landings ratios were 5.18 and 3.20 for the Gulf of Mexico and southeastern Atlantic, respectively; higher than the landing ratio estimates of 4.56 and 2.95 reported by Harrington et al. (2005) for the 1992 through 1996 period for the same areas.

Percent composition by species categories was similar in the 1992 through 1996 assessment (NMFS 1998), and in the current study. In the former review, the shrimp category comprised all commercial shrimp species (i.e., penaeid shrimp, seabob (*Xiphopenaeus kroyeri*), sugar and rock shrimp (*Sicyonia sp*.); in the current study only penaeid shrimp were placed in the shrimp category, with other shrimp species placed in the non-penaeid shrimp crustacean category. The change in grouping methodology was due to a revision in data collection procedures in the latter years of the current study. Additionally, a debris category was included.

In the 1992 through 1996 assessment, percentages by weight for the Gulf of Mexico were 67% for finfish, followed by 16% for commercial shrimp species, 13% non-commercial shrimp crustaceans, and 4% non-crustacean invertebrates (NMFS 1998). In the current study (i.e., 1992 through 2005) for the same region, finfish species dominated the catch at 65%, followed by penaeid shrimp at 16%, non-penaeid shrimp crustaceans at 13%, non-crustacean invertebrates at 4%, and debris at 1%. CPUE in kilograms per hour by category was 20.1 for finfish, 5.0 for penaeid shrimp, 4.1 for crustaceans, 1.2 for invertebrates, and 0.4 for debris.

In the 1992 through 1996 assessment (NMFS 1998), percentage composition for the southeastern Atlantic was 51% for finfish, 18% for commercial shrimp species, 13% for non-commercial shrimp crustaceans, and 18% for non-crustaceans invertebrates. In the current study, finfish species dominated the catch at 47%, followed by penaeid shrimp at 24%, invertebrates at 18%, crustaceans at 8%, and debris at 3%. CPUE in kilograms per hour by category was 13.0 for fish, 6.6 for penaeid shrimp, 5.1 for invertebrates, 2.1 for crustaceans, and 0.8 for debris.

Based on species characterization efforts, for both studies, the dominants by weight remained consistent. In the Gulf of Mexico, Atlantic croaker and longspine porgy comprised the largest percentage of the overall catch. Atlantic croaker and spot dominated the catch in the southeastern Atlantic. In the current study, the two dominants by number in the Gulf of Mexico were longspine porgy and brown shrimp, however, it should be noted that sampling effort was not equally distributed among states. For the southeastern Atlantic, spot and brown shrimp were the two top ranking species by number.

Analysis of species composition on an individual state level for the current study revealed, to some extent, a similar trend relative to weight estimates in the Gulf of Mexico. Off Texas, longspine porgy and brown shrimp dominated. Longspine porgy and Atlantic croaker comprised the two highest percentages off both Louisiana and Alabama/Mississippi. The top two species off Florida were pink shrimp and iridescent swimming crab, with Florida having the highest number of unique species among Gulf of Mexico states.

In the southeastern Atlantic, at the individual state level, the dominant species were more diverse as compared with the overall assessment. Off the east coast of Florida, Atlantic croaker and spot ranked as the top two. Debris and white shrimp ranked highest by weight off Georgia, with cannonball jellyfish and brown shrimp off

South Carolina, and blue crab and spot off North Carolina. Georgia had the highest number unique species.

While considered as one of the most high profile finfish species of concern, red snapper comprised approximately 0.3% of the total catch by weight in the Gulf of Mexico, and less than 0.01% in the southeastern Atlantic based on bycatch characterization efforts. Based on length frequency data of more than a quarter of a million red snapper, the highest concentration occurred off Texas, followed by Louisiana and Alabama/Mississippi. All other states combined, including the southeastern Atlantic states, comprised less than 1%. These estimates were based on actual numbers; it is reasonable to assume that more red snapper were counted where sampling intensity was highest.

Age 0 and 1 fish dominated the catch with the 105 to 125 mm FL size class comprising the highest number of individuals. Notable recruitment to the fishery began in August increased progressively from September through October with a decline evident in November. Both the size and timing of recruitment and peak are consistent with other research findings (Goodyear 1995; Gallaway and Cole 1999).

The highest concentration of red snapper by depth, based on length frequency data, occurred between 10 and 20 fathoms. The general trend observed was smaller red snapper in shallower waters with larger individuals occurring in deeper depths. Schirripa and Legault (1999) noted a similar trend pattern, but further scrutiny of the data, revealed that this was the result of comparative scarcity of larger snapper at shallower depths, noting that smaller individuals are found throughout the depth ranges observed.

Based on visual observations made by observers, more than 50% of finfish species were reported as dead prior to discarding in 89% of observations documented. In 52% of the observations, invertebrates were classified as alive (more than 50%) prior to discarding. Relative to predation on the discarded catch, seabirds were reported most frequently, followed by dolphins, other fish and sharks.

Assessment of the reef fish fishery through observer coverage revealed relatively low release mortality. Based on surface release observations of under-sized target and unwanted species, the majority of fish were released alive with release mortality ranging from approximately 2% to 5% for all gear types. In a parallel research effort, conducted by RRA aboard bandit-rigged vessels targeting red snapper off Louisiana, red snapper mortality was also low. It should be noted that these findings were based on sink or swim. Notably stressed fish status (i.e., air bladder expansion, protruding eyes) was not recorded for all gear types, but clearly would be expected to affect longer-term survival. In a more recent study aboard commercial bandit vessels (Wilson and Nieland 2001), red snapper release mortality was substantially higher at 69% based on the discards inability to re-submerge.

From review of the literature, Shirripa and Legault (1999) reported significant mortality of caught and released red snapper, noting that mortality increased with increasing depths. The authors used mortality estimates of 20% for recreational sector and 33% for the commercial reef fish fishery in their assessments. However, based on mark and recapture studies of red snapper, the authors cited multiple recaptures of the same fish, concluding that red snapper could survive catch and release.

Further, SERO (2006b) released higher discard mortality rates for the commercial and recreational red snapper sectors. Reported values ranged from 71% to 82% for the directed commercial fishery, and 15% to 40% for the recreational component. Moreover, the authors noted that while the commercial fishery had higher discard mortality, the recreational fishery discarded a substantially higher number of red snapper than the commercial sector.

Clearly, removal of species from the marine ecosystem can influence population size and composition of affected species and subsequently alter ecosystem structure and dynamics. Alverson et al. (1994) inferred that declines in Atlantic croaker, red snapper, and weakfish were related directly to the shrimp trawling activities. Moreover, the authors cite many examples of changes in species assemblages occurring after the introduction of trawling operations in various parts of the world. Conversely, the authors cite that not all effects of trawling are negative. Redistribution of bottom organic material to the surface and water column provides a food source for many species, including but not limited to, birds, sharks and marine mammals.

In the U.S. southeast region, bycatch from the commercial shrimp fishery still remains relatively higher than compared with other commercial fisheries. Early estimates from Alverson et al. (1994) calculated a discard to landing ratio in kilograms of 10.30 and 8.00 for the Gulf of Mexico and southeastern Atlantic shrimp fisheries, respectively. While calculation methods varied, more recent estimates (Harrington et al. 2005; Kelleher 2005) as well as the current study reveal lower ratios for these regions indicative of a decline. These estimates, however, still reflect substantial discarding. Moreover, while several species listed as overfished, notably red snapper, did not comprise a large component by weight of the bycatch, the number of individuals discarded combined with the amount of annual fishing effort exerted is reason for considerable concern. Similarly, long-term survival of undersized target and non-target species released by recreational and commercial reef fish fisheries warrants further investigation.

The twenty-year deliberation over reef fish and shrimp management continues primarily through the council systems. At present, uncertainty relative to economic viability of the shrimp and reef fish fisheries due to increasing energy costs, imports, and natural disasters and biological uncertainties relative to stock size, allocations and undefined mortality estimates identify major challenges. While gear technology to reduce finfish bycatch has improved, desirable levels related to finfish mortality estimates have not been achieved (NMFS 2006a). Resolution as to allocation of resources among user groupers, specifically effort allocation in the shrimp fishery and IFQs in the red snapper fishery has been slow forthcoming. Environmentally sound incentives related to the supply and demand of fishery products, and the examination of harvest strategies and management from a holistic approach constitutes a management challenge that has not been met, and remains a problem.

An economy-driven Environmental Management System (EMS) through an ISO 14001 framework should be considered as alternative to, or in collaboration with, the current management regime. This concept is discussed at length in Chapter VI. ISO 14001 certification demonstrates that an organization has made a commitment to the environment through ensuring the needs of the present are met without compromising the needs of future generations (von Zharen 2001). Through unified efforts of shareholders, a series of organizational standards are developed that become part of a system to which an organization must adhere. Decreased operational costs, lower liability, and a competitive advantage in the global market result in increased economic returns, and are among the many tangible benefits documented by major corporations and companies (von Zharen 2001). The key components of an EMS include committed shareholders, identification of an activity and its impact to the environment, establishing objectives and targets with some type of dispute resolution mechanism employed to achieve consensus among shareholders, developing and implementing an action plan, and an adaptive monitoring system that continually targets improvement.

While used by corporations and other organizations globally, this approach could most assuredly be applicable to the commercial fishing industry. The current study of bycatch in the southeastern shrimp and reef fisheries as related to species-specific catch rates and fishing practices, combined with in-depth assessment of BRD effectiveness (NMFS 2006a) can be used not only to enhance stock assessment and ecologically-based models for regulatory purposes, but also to assist in the development and implementation plan required for an effective EMS.

CHAPTER III

U.S. GULF OF MEXICO SHRIMP FISHERY, FEBRUARY 1992 THROUGH DECEMBER 2005

INTRODUCTION

Significant declines in landings of several species of finfish in the U.S. 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. 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 BRD and turtle excluder device (TED) combinations have been evaluated in the southeastern shrimp fishery. Currently two BRDs, the Gulf fisheye and Jones-Davis designs, are certified for use in the U.S. Gulf of Mexico based on data collected from this program. From 1992 through 2005, data from approximately 23,718 tows have been collected during 860 trips (13,924 sea days), with more than 122,727 hours of trawling observed in the Gulf of Mexico.

The commercial penaeid shrimp fishery began in the late 1800's through the use of seines in shallow waters (NMFS 1999). The otter trawl, used currently in the fishery, was invented in 1915, and enabled vessels to pull one large trawl in deeper waters (NMFS 1999). Through time the number of nets has increased from one to four.

Three commercially important penaeid shrimp species, brown shrimp (*Farfantepenaeus aztecus*), white shrimp (*Litopenaeus setiferus*), and pink shrimp (*Farfantepenaeus duorarum*) historically comprise the majority of shrimp landed. In 2002, these three species accounted for 96% of annual shrimp landed in the Gulf of Mexico, approximately 62,142 mt (heads-off), valued at 364 million dollars (NMFS 2003).

The majority of brown shrimp are caught at depths between 20 and 40 fathoms; white shrimp are typically taken in 10 fathoms or less, with pink shrimp captured in waters of approximately 30 fathoms. The majority of brown shrimp are harvested off the coasts of Texas and Louisiana with pink shrimp catch occurring predominantly off Florida (NMFS 1999).

While shrimp are harvested at maximum levels (NMFS 1999), recruitment overfishing has not been apparent in Gulf of Mexico shrimp stocks (Nance 2006). According to Nance (1993) more boats and gear exist in the fishery than are needed, and reducing fishing effort would not significantly reduce shrimp catch.

This is evident based on examination of catch, effort and ex-vessel (dockside) price statistics (NMFS 2006b) as depicted in Figure 19. While catch has remained relatively stable through time, effort and the dockside price of shrimp have declined since the beginning of the decade. A combination of factors are responsible for the decline, including but not limited to, imports, diesel costs and natural disasters.

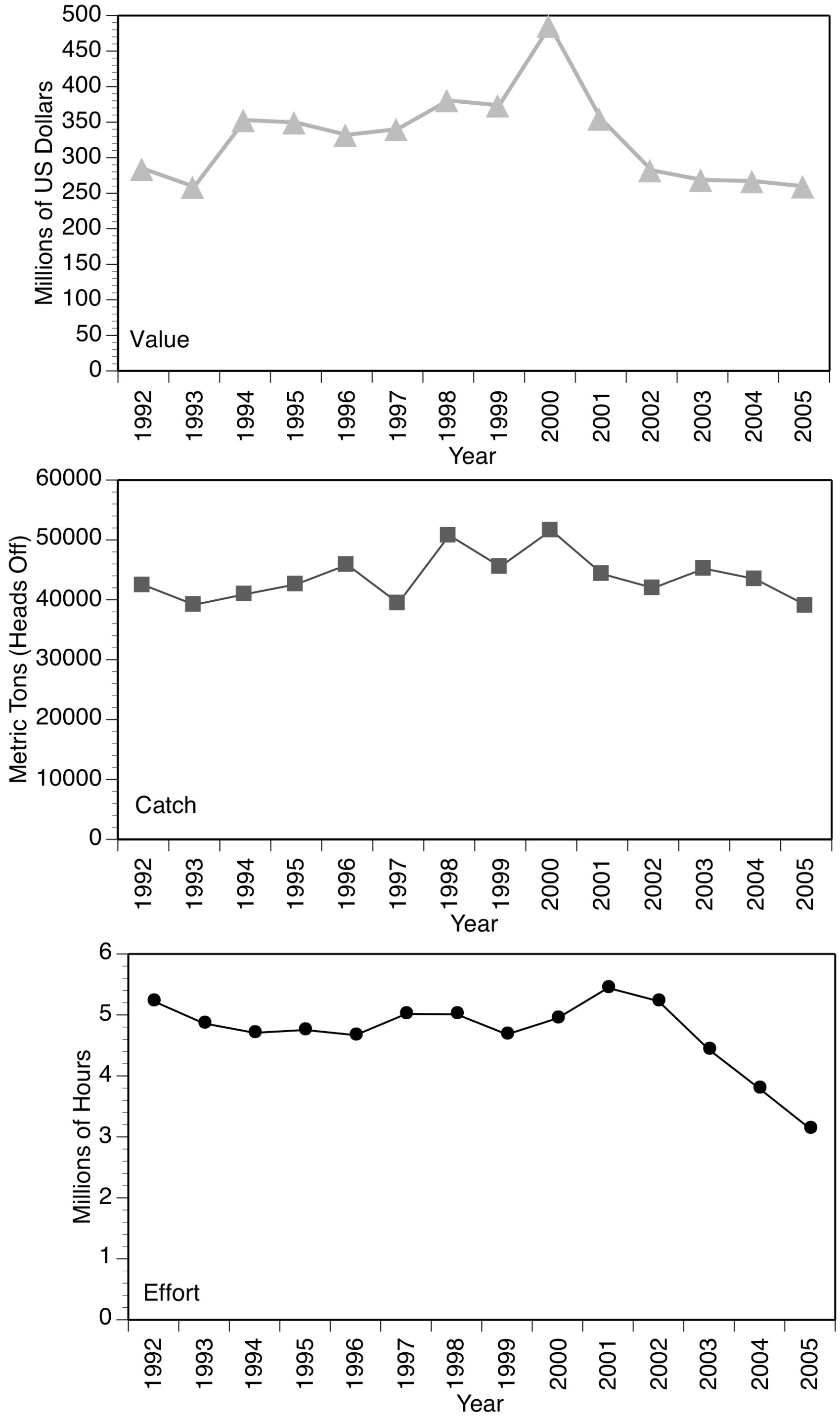

Figure 19. Penaeid shrimp statistics for the Gulf of Mexico from 1992 through 2005. Value is in million of U.S. dollars, catch in millions of pounds, with effort in millions of hours. Source: NMFS, 2006b.

Relative to the federal management of the commercial shrimp fishery, 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 (GMFMC 1981). There are currently seasonal closures off Texas and Florida to allow for increased shrimp growth and subsequent increased yield and value.

Since 1981, the shrimp FMP has been amended thirteen times with several regulatory mandates enacted in the Gulf of Mexico shrimp fishery. Following a red snapper quantitative assessment in 1980's, 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 and Phares 1990).

Growing concerns over bycatch prompted Congressional amendments in 1990 to the Magnuson Fishery Conservation and Management Act (Magnuson Act; 16 USC 1801), and in 1996 to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act; SFA; Public Law 104-297). These legislative mandates required the Secretary of Commerce, and subsequently 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 U.S. 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 (Branstetter 1997; Watson et al. 1999). From these observer 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 1999).

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 the 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 (64 FR 36782, July 8, 1999).

As prescribed in the Gulf BRD protocol, BRD certification criterion required a minimum of 30 successful tows (i.e., no operation problems); the test was between a potential BRD design (experimental) and a control. In the Gulf of Mexico, if a BRD-equipped net (experimental) could significantly demonstrate overall red snapper reduction as compared to a control net, further estimates were calculated to determine reduction in fishing mortality by 20 mm length classes, with natural mortality at age 0 of 0.4 to 2 per year (NMFS 2006a).

In the Gulf of Mexico, two BRD designs met the 44% red snapper reduction fishing mortality criterion in 1998, the fisheye and Jones Davis. After extensive testing of these devices aboard commercial vessels in the 1998 observer effort, overall red snapper reduction for Gulf fisheye was lower than in previous years (NMFS 2006a). Possible reasons for this loss were primarily associated with BRD placement and operational problems (Foster and Scott-Denton 2004; NMFS 2006a). From recent assessments of the Gulf fisheye design, the estimated overall red snapper fishing mortality reduction was 11.7%, with a 95% confidence interval of 4.3-19.1% (NMFS 2006a). From this analysis it was noted that approximately 75% of the vessels had the fisheye in an illegal position in the net. However, the red snapper reduction rate was the same at 11.7%; the 95% confidence interval varied.

NOAA Fisheries and the Foundation have continued working with industry members on new BRD designs through subsequent certification trials. Twenty new designs were evaluated from 1999 through 2003 (NMFS 2006a). Six designs met certification criterion (i.e., minimum tow and red snapper requirements); of these designs one exceeded the 44% red snapper reduction fishing mortality criterion, the Jones-Davis with Double Hoop (NMFS 2006a).

More recently, the Gulf Council reviewed the Gulf of Mexico BRD certification criterion for federal waters west of Cape San Blas, Florida requiring a minimum reduction of 44% in age 0 and 1 red snapper mortality from the average during the 1984 through 1989 baseline period (GMFMC 2006). The authors concluded that the current standards were outdated and no longer met the required outcome as established in the red snapper rebuilding plan. Proposed alternatives presented under the shrimp FMP framework included (1) maintain current standards, (2) base BRD performance on a reduction of CPUE on age 0 and 1 at 12%, 20%, and 30% minimum thresholds, and (3) use percentage reductions in total finfish by weight based on 10% increments ranging from 10% to 40%. The preferred alternative selected by the Gulf Council was a minimum reduction of 30% in weight of total finfish; this according to the Gulf Council, would allow for greater flexibility in certification procedures, promote innovation, be consistent with standards in place for the eastern Gulf of Mexico, and ultimately result in a greater number of more efficient and cost effective BRD designs.

Continued efforts to gain greater understanding of the gear modification have been accomplished by scientists and gear specialists with the Harvesting Systems and Engineering Division of NOAA Fisheries Mississippi Laboratories, through observations of fish behavior, underwater video documentation of trawling operations, and water flow patterns and measurement associated with various BRD designs (Engaas et al. 1999; NMFS 2006a). More recently, infrared light technology has enabled these researchers to further observe fish behavior under commercial shrimping operations (NMFS 2006a).

Based on the number of operating units, the commercial shrimp industry is the largest and most valuable fishery in the U.S. 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. There are currently 2,373 federally-permitted vessels operating in the Gulf of Mexico (SERO 2006a).

The primary focus of this chapter addresses a description of the Gulf of Mexico commercial shrimp fishery, project objectives and methods, and species-specific catch rates estimations by area, season and depth from bycatch characterization and TED/BRD evaluation and certification efforts in the U.S. Gulf of Mexico. Trip, tow and sea day statistics are given by region (i.e., Gulf of Mexico - Texas, Louisiana, Alabama/Mississippi and West Florida). Initial findings and a detailed review of BRD designs and effectiveness were presented in a Report to Congress submitted in 2006 (Foster and Scott-Denton 2004; NMFS 2006a).

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. Vessel selection, for the most part, was opportunistic, and may not be representative of the commercial shrimp fleet as a whole.

The resulting database, housed and managed at NOAA Fisheries Galveston Laboratory, contains a wealth of information on species-specific catch rates and BRD effectiveness. Collectively, these data can used 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, including an Environmental Management System (EMS).

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 U.S. Gulf of Mexico and Southeastern Atlantic Otter Trawl and Bottom Reef Fish Fisheries" (NMFS 2002a).

Initially, all observers were trained at NOAA Fisheries Galveston Laboratory. Since the program's implementation, 144 observers have been trained and deployed from February 1992 through December 2005. 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 2005 was bycatch characterization and BRD evaluation aboard shrimp vessels operating in the U.S. Gulf of Mexico shrimp fishery, other projects evolved, notably TED evaluations and BRD certifications. Projects contained in the data set were coded as follows: B for BRD evaluation, C for bycatch characterization, E for effort, G for BRD certification in the Gulf of Mexico, M for modified bycatch characterization, N for naked net (TED alternative), R for red snapper initiative, T for TED evaluation, X for rock shrimp characterization, and Z for 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 in the Gulf of Mexico (G) 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. TED evaluations (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 were similar to project (C), with rock shrimp the target species; however, all tows contained penaeid shrimp. 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 relative to location or duration of shrimping activities other than for limited tow time restrictions for non-TED equipped nets.

For all projects the condition and fate of organisms by category (i.e., fish and invertebrates) were recorded once the catch was decked, prior to discarding. Condition codes were as follows: more than 50% of catch alive, more than 50% of catch dead, not determined, or not observed. Predators observed feeding on the discarded catch were recorded and categorized as sharks, dolphins, seabirds or other fish. When visible, the number of organisms exiting the BRD during net retrieval was estimated.

All sea turtles were identified to species, measured, tagged, photographed and released. Sea turtles were handled and released according to the NOAA Fisheries Cooperative Marine Turtle Tagging Program protocol (SEFSC 2006).

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, NOAA Fisheries 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 U.S. 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, owner name and phone number) was obtained from NOAA Fisheries' 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 2005. Mandatory selection was consistently low, less than 1%. Collectively, throughout the study period (1992 through 2005), the majority of vessel operators volunteered to participate; thus, vessel selection, for the most part, was opportunistic.

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 in order to be compensated by the federal government.

At Sea Data Collection Methods

Vessel and Gear Characteristics

For all projects 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 U.S. Gulf of Mexico. The first characterization trips occurred in April 1992. Fishery-specific data were collected from one randomly selected net for each tow. Nets trailing behind the try net (a small net used to intermittently test for concentrations of shrimp) 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, time permitting.

BRD Evaluation, Red Snapper Initiative and BRD Certification

BRD evaluations began in the Gulf of Mexico in February 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 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 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.

Typically from the last tow of the night, a subsample was processed for a modified bycatch characterization.

BRD pre-certification and certification procedures are described at length in the 1999 document entitled "Gulf of Mexico Bycatch Reduction Device Testing Protocol Manual" (NMFS 1999). 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 for BRD certification.

Statistical Treatment and Analysis

Data collected throughout the study period were entered into three different data sets. 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. Additionally, corrections were made to the analysis files (not to the archive data sets) based on review of the source data against computerized data. Outliers were set aside.

Only data that were computerized at the time of the analyses were included. Again, the data were housed within three data sets, early years (1992-1997), BRD project (1998), and recent years (1997-2005). In general, for all years, red snapper were selected and processed from the entire sampled net, and no extrapolation was required. Shrimp extrapolations were required for the first data set, based on formatting errors related to retained shrimp weights. In 1998, the data structures and collection methods were modified for the BRD project, and no shrimp extrapolations were conducted for that project. Extrapolations for shrimp estimates were preformed on recent year data. A summary of all tows from 1997 through 2005 relative to non-extrapolated shrimp, red snapper and total bycatch catch rates were examined. The data were further categorized by species and species grouping through an extrapolation process using characterization and modified characterization (TED/BRD evaluation and certification trials) data from all projects except effort and rock shrimp characterization. An analysis of catch rates by area and season based on rock shrimp characterization during 2003 and 2004 were presented to the South Atlantic Fishery Management Council (Scott-Denton 2004).

Data Partitioning

Catch rate estimates were examined by year, area, season and depth. Shrimp statistical zones (Figure 20; Patella 1975) were used to delineate area designations. Statistical subareas 1 – 9 represented the west coast of Florida, 10 – 12 delineated Alabama/Mississippi, 13 - 17 depicted Louisiana, and 18 – 21 represented Texas. Seasonal categories were as follows: January through April; May through August; and September through December. Depth strata included nearshore (≤ 10 fathoms) and offshore (> 10 fathoms) waters.

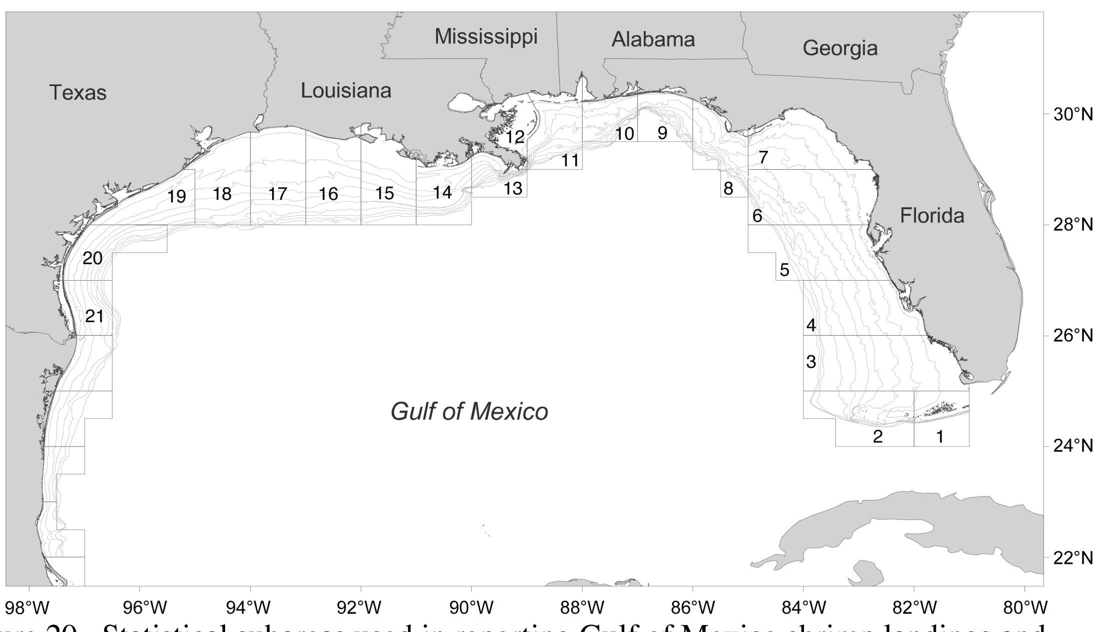

Figure 20. Statistical subareas used in reporting Gulf of Mexico shrimp landings and effort. Adapted from Patella (1975).

Unique species, family, and taxa (now referred to as species) were recorded. For the extrapolated species composition by category analysis, species were placed into the following categories: penaeid shrimp, non-penaeid shrimp crustaceans, fish, non-crustacean invertebrates, and debris (e.g., rocks, logs, trash).

An assessment of total finfish (excluding red snapper), penaeid shrimp and red snapper was conducted. CPUE in kilograms per hour is reported by state, depth and season.

Fourteen other species of commercial, recreational and ecological importance, including Atlantic croaker (*Micropogonias undulatus*), black drum (*Pogonias cromis*), cobia (*Rachycentron canadum*), king mackerel (*Scomberomorus cavalla*), lane snapper (*Lutjanus synagris*), longspine porgy (*Stenotomus caprinus*), red drum (*Sciaenops ocellatus*), seatrout (*Cynoscion sp.*), other snapper (*Lutjanus sp.*), grouped sharks, southern flounder (*Paralichthys lethostigma*), Spanish mackerel (*Scomberomorus maculatus*), and vermilion snapper (*Rhomboplites aurorubens*) were recorded for all tows. CPUE by weight and number was estimated by year for the Gulf of Mexico. CPUE for these species, penaeid shrimp, non-penaeid shrimp crustaceans, fish, and non-crustacean invertebrates were further examined by year, state, depth and season.

<u>Statistical Analyses</u>

Species total weights and numbers were extrapolated from subsample weight to the total catch weight, and are based on one net per tow for all analyses except the overall estimation by category, when all nets were used. The nets used in the subsequent analyses were consistent with current BRD regulations at that time (not required or required). Total weight and number extrapolation were derived by multiplying the sample weight (or number) of the species of interest by the total weight of the sampled net, divided by the subsample weight for that net. For rare species, all specimens were removed from the net, and no extrapolation was required. In the absence of a weight or number for a given species the entire tow as set aside from the analysis.

Subsample weights were record to the hundredth decimal place. In some years, shrimp and red snapper weights were recorded to the tenth decimal. For consistency all weights were reported to the tenth decimal place.

Biological measurements were recorded in metric units. Vessel, gear and depth measurements followed current standards for the fisheries (i.e., U.S. system equivalents) as related to relevant regulatory mandates.

Ratio estimation and testing procedures were used for statistical analyses to determine specific catch rates. As described by Snedecor and Cochran (1967), the ratio estimation in equation (1) was used as the sample estimate of the mean.

$$(1)\ R = \frac{\sum Y}{\sum X}$$

Where:

R = ratio estimate

Y = extrapolated kilograms for species of interest for selected strata

X = hours towed for selected strata

The estimated standard error of the estimate is given in equation (2).

$$(2)\ s(R) = \frac{1}{\bar{x}}\sqrt{\frac{\sum (Y - RX)^2}{n(n-1)}}$$

Where:

$\bar{x}$ = mean of hours towed for selected strata

n = number of tows occurring in selected strata

The null hypothesis was that independent variables of area, depth and season did not affect CPUE, with the alternative hypothesis being that CPUE was affected by area, depth and season. The software program CONTRAST, a program designed for analysis of rate estimates, was used for this purpose (Hines and Sauer 2000). P-values for each chi-square test and comparison of CPUE were adjusted with a sequential Bonnferoni correction (Rice 1990) to maintain an overall error rate of 0.05. Multiple comparisons were conducted between all state areas, depth zones (near and off), and seasons (Appendix B, Tables B2 and B3); selected state and depth results are presented below.

To standardize bycatch estimates as prescribed in Evaluating Bycatch: A National Approach to Standardized Bycatch Monitoring Programs (NMFS 2004), the coefficient of variation (CV) was calculated by year for selected species.

CV estimates were calculated by dividing the estimated standard error by the estimate of the mean for selected species. CV values were derived for total finfish, penaeid shrimp, non-penaeid shrimp crustaceans, invertebrates, and fourteen selected species. A linear regression was used to assess trends in CPUE over the time series.

RESULTS

Sampling Effort

Trips and Sea Days

A total of 860 trips was completed in the U.S. Gulf of from February 1992 through December 2005 during 13,924 sea days of observations. More than 122,727 hours of trawling were observed. Trip length ranged from 1 to 62 days, and averaged 18.1 days.

In all years, except for 2002, annual observer coverage levels were less than 1% of the total shrimp effort. The number of sea days varied from 1992 through 2005, and was directly related to the amount of funding received. Coverage levels were highest in 2002 with 2,965 sea days, followed by 1998 with 1,358 sea days. In 2003 and 2004, coverage levels were 1,325 and 1,303 sea days, respectively. In 1994, a total of 1,001 days was completed. In all other years during the study period, coverage was less than 1,000 sea days. The lowest coverage occurred in 1996 with 223 sea days.

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.

<u>Tows</u>

In the Gulf of Mexico, 23,718 tows were sampled from February 1992 through December 2005. Samples were processed from each state area in all years, with the exception of 1995, when no samples were obtained off Alabama/Mississippi. A summation of tows by year, state and season and associated catch data are given in Appendix B, Table B1 for tows where characterization or modified characterization data were available.

<u>Projects</u>

During the study period 13,924 sea days completed in the Gulf of Mexico were categorized by project type (Figure 21). Red snapper initiative comprised 34% of the effort, followed by BRD evaluation at 21%, bycatch characterization at 13%, Gulf certification at 10%, effort at 9%, TED evaluation at 6%, naked net or alternative to TEDs at 5%, modified characterization at 2%, and soft TED evaluation and rock shrimp characterization at less than 1% each.

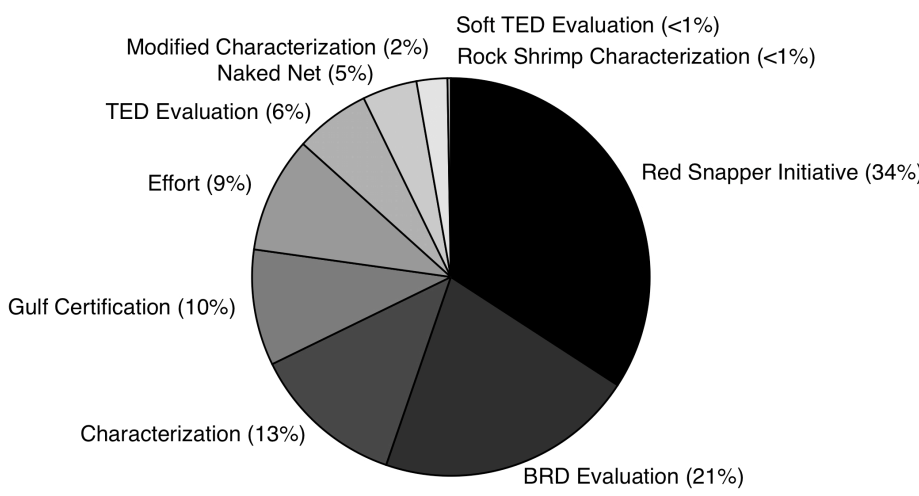

Figure 21. Percentage of sea days by project in the Gulf of Mexico. Based on observer coverage of the U.S. Gulf of Mexico shrimp fishery from February 1992 through December 2005.

Tows allocated to each project are shown in Figure 22. Approximately 38% of tows sampled were dedicated to red snapper initiative. BRD evaluation trials accounted for 18%, followed by the effort project at 11%, bycatch characterization at 10%, Gulf certification at 9%, TED evaluation at 6%, naked net at 5%, modified bycatch characterization at 2%, and soft TED evaluation and rock shrimp characterization at less than 1% each.

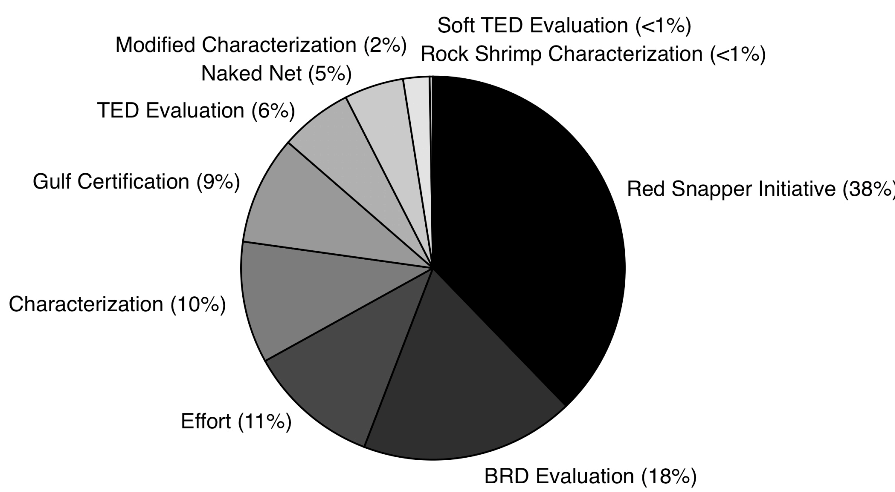

Figure 22. Percentage of tows by project in the Gulf of Mexico. Based on observer coverage of the U.S. Gulf of Mexico shrimp fishery from February 1992 through December 2005.

Vessel, Gear and Fishing Characteristics

One hundred seventy-one vessels participated in the study. Overall vessel length ranged from 36 to 98 feet (74.3 ± 9.6 s.d.). Ninety-eight vessels had freezer capacity, 65 contained ice holds, and 8 had unidentified cold storage. The majority of vessels (132) were steel hulls, followed by 20 of wood, 15 of fiberglass, 3 of wood and fiberglass, and one of aluminum. Engines averaged 449.3 hp. Crew size, including the captain, ranged from 1 to 4 individuals.

The number of nets pulled per tow varied from 1 to 4, with 3.8 nets the average. Headrope length, on a per net basis, ranged from 20.3 to 77.3 feet with an average of approximately 48.1 feet (± 7.9 s.d.). Towing speed ranged from 1.0 to 5.6 knots, and averaged 2.8 knots (± 0.3 s.d.).

Among all projects, tow time ranged from 0.1 to 20.5 hours (5.2 ± 2.3 s.d.). Based on starting latitude and longitude coordinates, 21% of tows occurred in waters of ≤ 10 fathoms, with 79% of tows in offshore waters > 10 fathoms. All projects combined, tow depth ranged from 0.3 to 69.0 fathoms (19.8 ± 11.8 s.d.).

Non-Extrapolated CPUE – Total Catch, Shrimp and Red Snapper

Using data from all projects, including those where no characterization subsamples were taken, non-extrapolated total catch, shrimp and red snapper weights from both experimental and control nets from 1997 through 2005 were obtained. Based on 16,344 nets (88,964 hours) penaeid shrimp comprised 16% of the total catch, with other species accounting for 84%. Total catch, shrimp and red snapper CPUE in kilograms per hour was 33.1, 5.4 and 0.1, respectively. Approximately 2 red snapper were caught per hour per net. From 8,471 nets (45,790 hours) consistent with current BRD regulations catch rates for total catch, shrimp and red snapper were 31.3, 5.4, and 0.1, respectively. As with all nets, approximately 2 red snapper were caught per hour per net.

Extrapolated Species Composition by Categories – Percent and CPUE – All Nets

Weight extrapolations from species composition samples for all sampled nets by category for all projects, years, seasons, and depths for the Gulf of Mexico are presented in Figure 23. Approximately 2.9 million kilograms of total catch were obtained from 16,908 nets during 94,117 hours of trawling in the Gulf of Mexico (30.8 kg/hr). The discard to landing ratio was 5.2.

Fish species dominated the catch at 65%, followed by penaeid shrimp at 16%, non-penaeid shrimp crustaceans at 13%, non-crustacean invertebrates at 4%, and debris at 1%. CPUE in kilograms per hour by category was 20.1 for fish, 5.0 for penaeid shrimp, 4.1 for crustaceans, 1.2 for invertebrates, and 0.4 for debris.

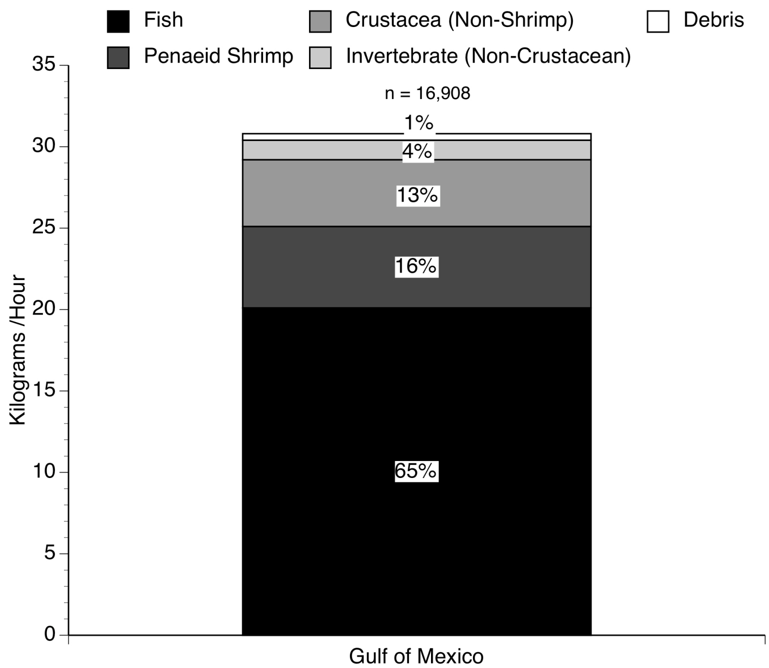

Figure 23. Percent species composition by weight and category in the Gulf of Mexico. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005, n = nets sampled.

Extrapolated Species Composition by Categories – Percent and CPUE – Selected Nets

Similarly, weight extrapolations from species composition samples on a per net basis by category for all projects, years, seasons, and depths for the Gulf of Mexico are presented in Figure 24. Estimates were on a per net basis and consistent with current BRD regulations. Approximately 1.6 million kilograms of total catch were obtained from 9,509 tows during 52,494 hours of trawling in the Gulf of Mexico (30.1 kg/hr). The discard to landing ratio, as with all nets, was 5.2.

Fish species comprised the majority of the catch at 64%, followed by penaeid shrimp at 16%, non-penaeid shrimp crustaceans at 14%, non-crustacean invertebrates at 4%, and debris at 1%. CPUE in kilograms per hour by category was 19.5 for fish, 4.9 for penaeid shrimp, 4.2 for crustaceans, 1.3 for invertebrates, and 0.4 for debris.

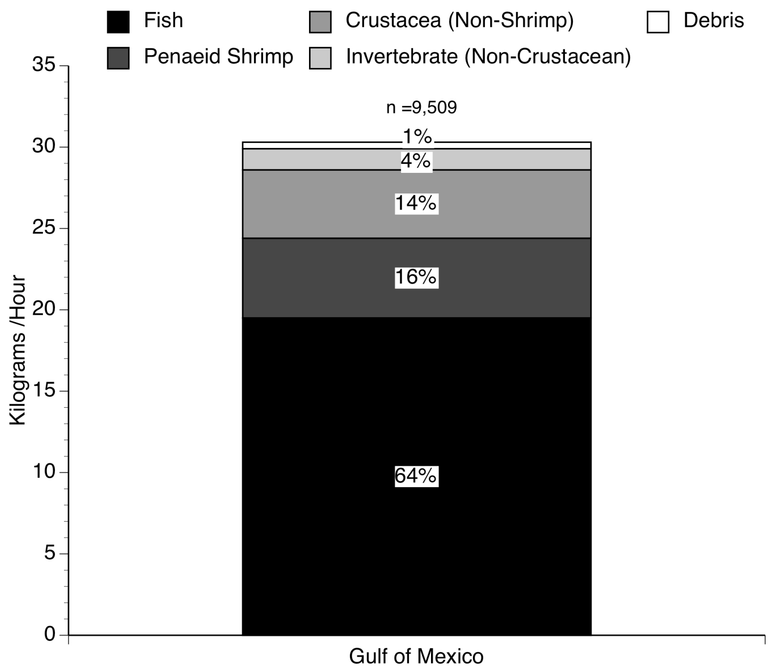

Figure 24. Percent species composition by weight and category in the Gulf of Mexico for selected nets. Nets are consistent with BRD regulations. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005, n = nets sampled.

Extrapolated Species Composition by Categories, State and Depth – Percent and CPUE

Weight extrapolations from species composition samples for categories by state and depth for all projects, years, and seasons for the Gulf of Mexico are presented in Figure 25. Again, estimates were on a per net basis and consistent with current BRD regulations.

Total catch values for all years combined by state and depth were variable. Louisiana nearshore waters had the highest CPUE in kilograms per hour at 44.3 followed by Alabama/Mississippi offshore at 35.4, Florida nearshore at 32.4, Texas nearshore at 32.3, Louisiana offshore at 30.6, Alabama/Mississippi nearshore at 27.7, Florida offshore at 26.9, and Texas offshore at 25.9.

Finfish catch rate estimates in kilograms per hour followed a similar trend as compared with total catch values. Louisiana nearshore waters had the highest finfish

CPUE at 30.7, followed by Alabama/Mississippi offshore at 25.2, Louisiana offshore at 21.7, Texas nearshore at 20.6, Alabama/Mississippi nearshore at 17.9, Florida nearshore at 15.3, Florida offshore at 15.0, and Texas offshore at 14.6.

Penaeid shrimp catch rate estimates in kilograms per hour were also variable. Again, the Louisiana nearshore area had the highest CPUE at 9.3, followed by Texas nearshore at 6.6, Florida nearshore at 5.8, Texas offshore at 5.6, Florida offshore at 4.6, Alabama/Mississippi nearshore at 4.1, Louisiana offshore at 4.0, and Alabama/Mississippi offshore at 3.8.

Invertebrate CPUE in kilograms per hour was 2.3 for both Florida near and offshore waters. Nearshore Louisiana water had the next higher CPUE value at 1.8, followed by Texas nearshore at 1.5, Alabama/Mississippi nearshore at 1.4, Texas offshore and Alabama/Mississippi offshore both at 1.1, and Louisiana offshore at 0.9.

Non-penaeid shrimp crustacean mean catch rates in kilograms per hour were highest in Florida nearshore waters at 8.4, followed by Alabama/Mississippi offshore at 4.8, Florida offshore at 4.5, Texas offshore at 4.4, Louisiana offshore at 3.7, and Texas nearshore at 3.0. CPUE in Alabama/Mississippi nearshore waters was 2.6, with the lowest catch rate value occurring in Louisiana nearshore at 2.0.

Debris CPUE in kilograms per hour were highest in Alabama/Mississippi nearshore waters at 1.8. Louisiana and Florida nearshore waters had debris catch rates at 0.6 each. Alabama/Mississippi offshore, Florida offshore and Texas nearshore each had debris CPUE at 0.5. Louisiana and Texas offshore waters had debris catch rates levels of 0.3 and 0.1, respectively.

Based on the ratio of shrimp to total catch within each state and depth grouping, shrimp comprised 22% of the total catch in Texas offshore waters. Similarly, in Louisiana nearshore waters penaeid shrimp accounted for 21% of the total catch. In the Texas nearshore area, shrimp comprised 20% of the total catch. In all other state-depth groupings, shrimp accounted for less than or equal to 18%.

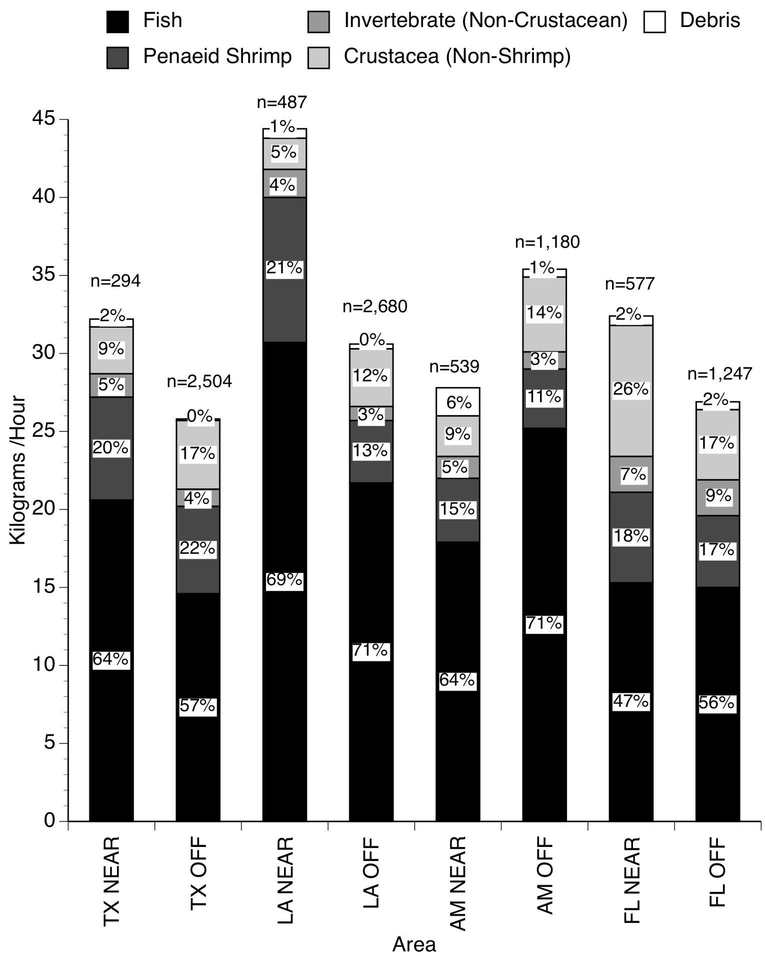

Figure 25. Percent species composition by weight and category in the Gulf of Mexico by state and depth. Nets are consistent with BRD regulations. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005, n = nets sampled.

Extrapolated Finfish, Shrimp and Red Snapper – CPUE

CPUE in kilograms per hour for total finfish (excluding red snapper), shrimp and red snapper were examined for all years combined by state, depth and season. Catch rates were further analyzed by year, state, depth and season. Tests for significance between mean catch rates were performed with all state components presented below. Depth and seasonal comparisons were discussed, with primary divisions highlighted. Depth and seasonal comparisons for all years combined are presented in Appendix B, Tables B2 and B3

Finfish CPUE All Years Combined by State

For all years combined, finfish CPUE in kilograms per hour was 23.2 (± 0.4 SE) for Alabama/Mississippi, 22.7 (± 0.3 SE) for Louisiana, 15.1 (± 0.3 SE) for Florida, and 14.9 (± 0.2 SE) for Texas. There was no significant difference in mean catch rates between Alabama/Mississippi and Louisiana ($\chi 2 = 1.19$, $P > 0.008$), and Florida and Texas ($\chi 2 = 0.32$, $P > 0.008$). Significant differences were detected between the following comparisons: Florida and Alabama/Mississippi ($\chi 2 = 248.84$, $P < 0.008$), Texas and Alabama/Mississippi ($\chi 2 = 312.96$, $P < 0.008$), Louisiana and Florida ($\chi 2 = 379.06$, $P < 0.008$), and Texas and Louisiana ($\chi 2 = 560.84$, $P < 0.008$). CV estimates were 0.0 for all state areas.

Finfish CPUE by Year and State

CPUE for total finfish by year and state is presented in Figure 26. State areas not discussed in the narrative for a given year indicate no data were collected. While variable, a general trend of catch rates evolved. Finfish catch rates were significantly higher in Alabama/Mississippi and Louisiana compared with CPUE off Texas and Florida. In most years, catch rate estimates in Alabama/Mississippi and Louisiana were not significantly different. Similarly, CPUE was not significantly different between Texas and Florida in the majority of years.

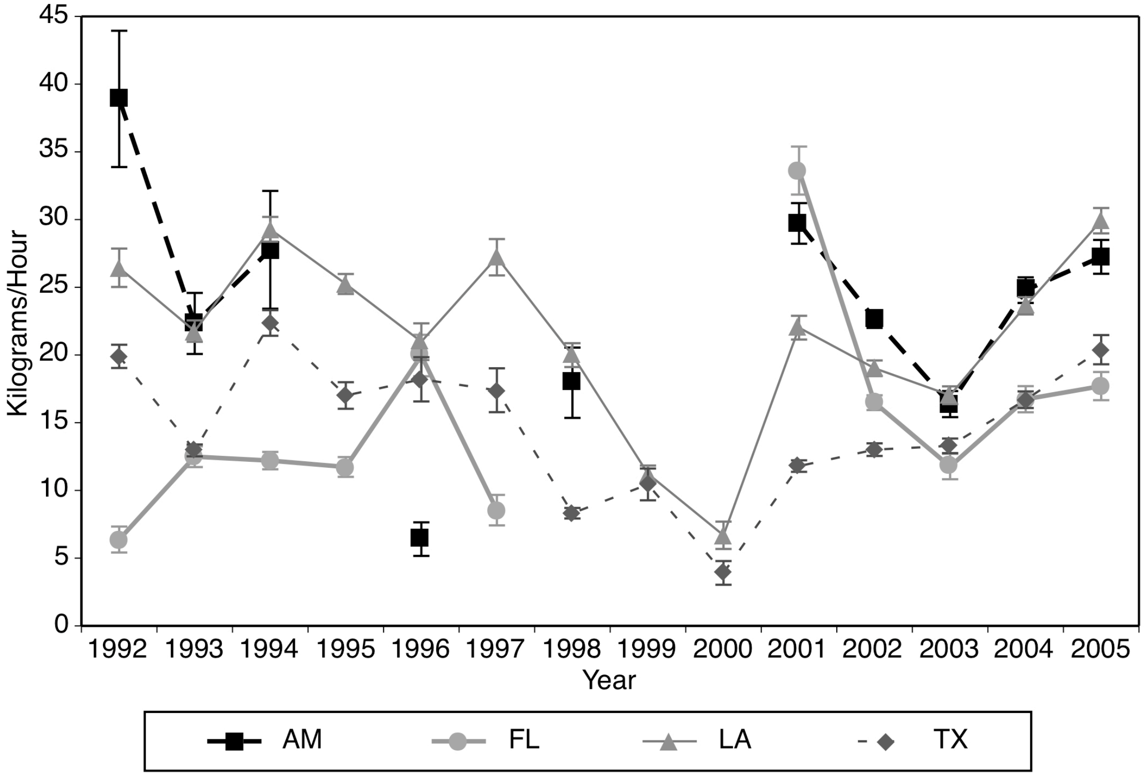

Figure 26. Finfish CPUE in kilograms per hour by year and state for nets consistent with BRD regulations. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

In 1992, CPUE in kilograms per hour was 38.9 (± 5.0 SE) for Alabama/Mississippi, 26.4 (± 1.4 SE) for Louisiana, 19.9 (± 0.9 SE) for Texas, and 6.4 (± 1.0 SE) for Florida. There was no significant difference of mean catch rates between Alabama/Mississippi and Louisiana ($\chi2 = 5.69$, $P > 0.008$). Significant differences were detected between the following comparisons: Florida and Alabama/Mississippi ($\chi2 = 40.35$, $P < 0.008$), Texas and Alabama/Mississippi ($\chi2 = 13.87$, $P < 0.008$), Louisiana and Florida ($\chi2 = 137.53$, $P < 0.008$), Texas and Florida ($\chi2 = 110.51$, $P < 0.008$), and Texas and Louisiana ($\chi2 = 15.58$, $P < 0.008$). CV estimates for were lowest for Texas at 0.0, followed by Alabama/Mississippi and Louisiana at 0.1 each, and Florida at 0.2.

A similar pattern was also observed in 1993 relative to estimated finfish catch rates. CPUE in kilograms per hour was 22.3 (± 2.3 SE) for Alabama/Mississippi, 21.8

(± 0.8 SE) for Louisiana, 13.0 (± 0.4 SE) for Texas, and 12.5 (± 0.8 SE) for Florida. There was no significant difference of mean catch rates between Alabama/Mississippi and Louisiana ($\chi 2 = 0.06$, $P > 0.008$), or between Texas and Florida ($\chi 2 = 0.27$, $P > 0.008$). Significant differences were detected between the following comparisons: Florida and Alabama/Mississippi ($\chi 2 = 17.06$, $P < 0.008$), Texas and Alabama/Mississippi ($\chi 2 = 16.67$, $P < 0.008$), Louisiana and Florida ($\chi 2 = 70.74$, $P < 0.008$), and Texas and Louisiana ($\chi 2 = 95.11$, $P < 0.008$). CV estimates were 0.0 for Louisiana and Texas, and 0.1 for Alabama/Mississippi and Florida.

In 1994, finfish catch rates in kilograms per hour were 29.3 (± 0.9 SE) for Louisiana, 27.8 (± 4.3 SE) for Alabama/Mississippi, 22.4 (± 0.9 SE) for Texas, and 12.2 (± 0.6 SE) for Florida. There was no significant difference of mean catch rates between Alabama/Mississippi and Louisiana ($\chi 2 = 0.12$, $P > 0.008$), or between Alabama/Mississippi and Texas ($\chi 2 = 1.47$, $P > 0.008$). Significant differences in mean catch rates were detected in the following contrasts: Florida and Alabama/Mississippi ($\chi 2 = 12.54$, $P < 0.008$), Louisiana and Florida ($\chi 2 = 234.35$, $P < 0.008$), Texas and Louisiana ($\chi 2 = 27.74$, $P < 0.008$), and Texas and Florida ($\chi 2 = 79.21$, $P < 0.008$). CV estimates were 0.0 for Texas and Louisiana, 0.1 for Florida, and 0.2 for Alabama/Mississippi.

CPUE in kilograms per hour in 1995 was 25.2 (± 0.7 SE) for Louisiana, 17.0 (± 1.0 SE) for Texas, and 11.7 (± 0.7 SE) for Florida. Significant differences in mean catch rates were detected between all comparisons: Texas and Florida ($\chi 2 = 18.59$, $P < 0.016$), Louisiana and Florida ($\chi 2 = 169.27$, $P < 0.016$), and Texas and Louisiana ($\chi 2 = 44.97$, $P < 0.016$). CV values were 0.0 for Louisiana, and 0.1 for Texas and Florida.

In 1996, finfish catch rates in kilograms per hour were 21.0 (± 1.4 SE) for Louisiana, 20.0 (± 1.5 SE) for Florida, 18.2 (± 1.6 SE) for Texas, and 6.4 (± 1.2 SE) for Alabama/Mississippi. There was no significant difference of mean catch rates between Florida and Texas ($\chi 2 = 0.62$, $P > 0.008$), Louisiana and Texas ($\chi 2 = 1.71$, $P > 0.008$), or between Louisiana and Florida ($\chi 2 = 0.25$, $P > 0.008$). Significant differences in mean catch rates were detected in the following comparisons: Florida and

Alabama/Mississippi ($\chi 2 = 47.41$, $P < 0.008$), Louisiana and Alabama/Mississippi ($\chi 2 = 63.04$, $P < 0.008$), and Texas and Alabama/Mississippi ($\chi 2 = 33.12$, $P < 0.008$). CV estimates were 0.1 for all states, with the exception of Alabama/Mississippi with a value of 0.2.

Finfish catch rate estimates in kilograms per hour in 1997 were 27.2 (± 1.3 SE) for Louisiana, 17.4 (± 1.6 SE) for Texas, and 8.5 (± 1.1 SE) for Florida. Significant differences in mean catch rates were detected between all comparisons: Texas and Florida ($\chi 2 = 20.16$, $P < 0.016$), Louisiana and Florida ($\chi 2 = 113.64$, $P < 0.016$), and Texas and Louisiana ($\chi 2 = 21.81$, $P < 0.016$). CV values were 0.0 for Louisiana, and 0.1 for Texas and Florida.

In 1998, finfish CPUE was 20.0 (± 0.9 SE) for Louisiana, 18.0 (± 2.6 SE) for Alabama/Mississippi, and 8.3 (± 0.4 SE) for Texas. There was no significant difference of mean catch rates between Alabama/Mississippi and Louisiana ($\chi 2 = 0.55$, $P > 0.016$). Significant differences in mean catch rates were detected between the following contrasts: Texas and Louisiana ($\chi 2 = 147.06$, $P < 0.016$), and Texas and Alabama/Mississippi ($\chi 2 = 13.45$, $P < 0.016$). CV estimates were 0.0 for all states, with the exception of Alabama/Mississippi, with a value of 0.1.

Finfish CPUE in kilograms per hour in 1999 was 11.2 (± 0.6 SE) for Louisiana, and 10.4 (± 1.2 SE) for Texas. There was no significant difference of mean catch rates between Louisiana and Texas ($\chi 2 = 0.36$, $P > 0.05$). CV values were 0.1 for both states.

Finfish catch rate estimates in kilograms per hour in 2000 were 6.7 (± 1.0 SE) for Louisiana, and 3.9 (± 0.9 SE) for Texas. There was a significant difference of mean catch rates between Louisiana and Texas ($\chi 2 = 4.32$, $P < 0.05$). CV values were 0.2 for both areas.

In 2001, finfish CPUE in kilograms per hour was 33.6 (± 1.8 SE) for Florida, 29.7 (± 1.5 SE) for Alabama/Mississippi, 22.0 (± 0.9 SE) for Louisiana, and 11.8 (± 0.4 SE) for Texas. There was no significant difference of mean catch rates between Alabama/Mississippi and Florida ($\chi 2 = 2.83$, $P > 0.008$). Significant differences were detected between the following comparisons: Louisiana and Alabama/Mississippi ($\chi 2 =$

19.67, $P < 0.008$), Texas and Alabama/Mississippi ($\chi2 = 132.39$, $P < 0.008$), Louisiana and Florida ($\chi2 = 34.43$, $P < 0.008$), Texas and Florida ($\chi2 = 143.42$, $P < 0.008$), and Texas and Louisiana ($\chi2 = 109.98$, $P < 0.008$). CV estimates were 0.0 for Louisiana and Texas, and 0.1 for Alabama/Mississippi and Florida.

Finfish catch rates in kilograms per hour in 2002 were 22.6 (± 0.7 SE) for Alabama/Mississippi, 19.0 (± 0.6 SE) for Louisiana, 16.5 (± 0.5 SE) for Florida, and 13.0 (± 0.5 SE) for Texas. Significant differences were detected between the following comparisons: Florida and Alabama/Mississippi ($\chi2 = 52.65$, $P < 0.008$), Louisiana and Alabama/Mississippi ($\chi2 = 17.41$, $P < 0.008$), Texas and Alabama/Mississippi ($\chi2 = 144.96$, $P < 0.008$), Louisiana and Florida ($\chi2 = 10.23$, $P < 0.008$), Texas and Louisiana ($\chi2 = 65.77$, $P < 0.008$), and Texas and Florida ($\chi2 = 23.29$, $P < 0.008$). CV estimates were 0.0 for all states.

In 2003, finfish catch rates in kilograms per hour were 17.0 (± 0.7 SE) for Louisiana, 16.4 (± 1.0 SE) for Alabama/Mississippi, 13.3 (± 0.5 SE) for Texas, and 11.8 (± 0.9 SE) for Florida. There was no significant difference of mean catch rates between Louisiana and Alabama/Mississippi ($\chi2 = 0.31$, $P > 0.008$), or between Texas and Florida ($\chi2 = 1.99$, $P > 0.008$). Significant differences in mean catch rates were detected in the following comparisons: Florida and Alabama/Mississippi ($\chi2 = 11.73$, $P < 0.008$), Texas and Alabama/Mississippi ($\chi2 = 7.80$, $P < 0.008$), Louisiana and Florida ($\chi2 = 21.07$, $P < 0.008$), and Texas and Louisiana ($\chi2 = 19.36$, $P < 0.008$). CV estimates were 0.0 for Louisiana and Texas, and 0.1 for Alabama/Mississippi and Florida.

Finfish catch rate estimates in kilograms per hour in 2004 were 24.8 (± 0.9 SE) for Alabama/Mississippi, 23.6 (± 0.6 SE) for Louisiana, 16.7 (± 1.0 SE) for Florida, and 16.7 (± 0.6 SE) for Texas. There was no significant difference of mean catch rates between Alabama/Mississippi and Louisiana ($\chi2 = 1.02$, $P > 0.008$), or between Florida and Texas ($\chi2 = 0.00$, $P > 0.008$). Significant differences in mean catch rates were detected in the following contrasts: Florida and Alabama/Mississippi ($\chi2 = 35.51$, $P < 0.008$), Louisiana and Florida ($\chi2 = 35.50$, $P < 0.008$), Texas and Louisiana ($\chi2 = 61.13$, P < 0.008), and Texas and Alabama/Mississippi ($\chi 2 = 51.43$, $P < 0.008$). CV estimates were 0.0 for all states, with the exception of Florida, with a value of 0.1.

In 2005, finfish catch rates in kilograms per hour were 29.9 ($\pm$ 0.9 SE) for Louisiana, 27.2 ($\pm$ 1.2 SE) for Alabama/Mississippi, 20.4 ($\pm$ 1.1 SE) for Texas, and 17.7 ($\pm$ 1.0 SE) for Florida. As in previous years, there was no significant difference of mean catch rates between Louisiana and Alabama/Mississippi ($\chi 2 = 2.92$, $P > 0.008$), or between Texas and Florida ($\chi 2 = 3.22$, $P > 0.008$). Significant differences in mean catch rates were detected in the following comparisons: Florida and Alabama/Mississippi ($\chi 2 = 34.46$, $P < 0.008$), Texas and Alabama/Mississippi ($\chi 2 = 17.24$, $P < 0.008$), Louisiana and Florida ($\chi 2 = 76.18$, $P < 0.008$), and Texas and Louisiana ($\chi 2 = 44.48$, $P < 0.008$). CV estimates were 0.0 for Louisiana and Alabama/Mississippi, and 0.1 for Texas and Florida.

Finfish CPUE All Years Combined by State and Depth

For all years combined, finfish catch rates in kilograms per hour for Texas waters were 20.5 ($\pm$ 1.0 SE) in the nearshore area, and 14.4 ($\pm$ 0.2 SE) in offshore waters. There was a significant difference in mean catch rates between depth zones ($\chi 2 = 36.08$, $P < 0.002$). CPUE for Louisiana was 30.7 ($\pm$ 0.8 SE) for the nearshore area, and 21.6 ($\pm$ 0.3 SE) for offshore waters. A significant difference was detected between mean catch rates in the two depth zones ($\chi 2 = 112.66$, $P < 0.002$). In Alabama/Mississippi waters catch rates were 17.8 ($\pm$ 0.8 SE) in the nearshore zone, and 25.2 ($\pm$ 0.5 SE) in offshore waters. There was a significant difference in finfish catch rates between the two zones ($\chi 2 = 64.94$, $P < 0.002$). For Florida, finfish catch rates were 15.3 ($\pm$ 0.5 SE) for the nearshore zone, and 15.0 ($\pm$ 0.4 SE) for offshore waters. There was not a significant difference in mean catch rates between the two depth zones ($\chi 2 = 0.15$ $P > 0.002$). CV estimates for all state areas and depth strata were 0.0.

Finfish CPUE by Year, State and Depth

Catch rates for total finfish by year, state and depth is presented in Figure 27. While variable, general trends of catch rates evolved. While not significantly different in all years, mean catch rates where higher in nearshore areas of Texas and Louisiana than in the offshore waters of each state in the majority of years. Conversely, in Alabama/Mississippi waters mean catch rates were more variable with higher catch rates observed in the offshore zone in most years. Off Florida, catch rates were higher in offshore waters in the majority of years; however, no significant difference was detected between the two depth strata in all years sampled, with the exception of 1994.

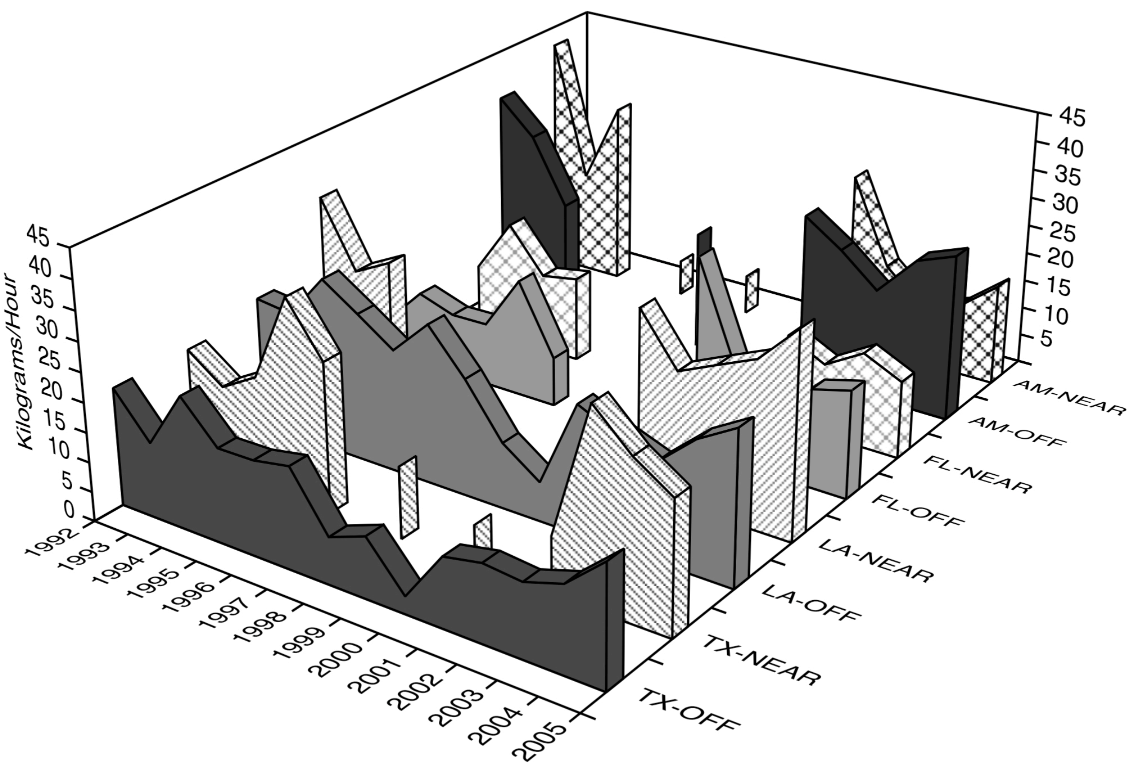

Figure 27. Finfish CPUE in kilograms per hour in the Gulf of Mexico by year, state and depth. Nets are consistent with BRD regulations. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

In 1992, finfish CPUE in kilograms per hour off Texas was 19.8 (± 1.9 SE) for nearshore waters, and 19.9 (± 0.9 SE) for offshore waters. There was no significant difference of mean catch rates between the two depth strata ($\chi2 = 0.00$, $P > 0.002$). CV estimates for Texas were 0.1 and 0.0 in near and offshore depths, respectively. Off the coast of Louisiana catch rates were higher in nearshore waters 34.2 (± 1.7 SE) as compared with offshore waters 22.4 (± 1.7 SE). There was a significant difference of mean catch rates between Louisiana near and offshore waters ($\chi2 = 23.17$, $P < 0.002$). CV values for Louisiana were 0.1 for both depth zones. CPUE in kilograms per hour off Alabama/Mississippi was 41.5 (± 8.8 SE) for nearshore waters, and 36.4 (± 5.3 SE) for offshore waters. There was not a significant difference of mean catch rates between the two depth strata ($\chi2 = 0.25$, $P > 0.002$). CV estimates for Alabama/Mississippi were 0.2 and 0.1 in near and offshore depths, respectively. Off Florida finfish CPUE was 6.4 (± 1.0 SE) for offshore waters. For the Florida offshore zone, the CV estimate was 0.2.

In 1993, finfish catch rates in kilograms per hour off Texas were 15.4 (± 2.3 SE) for nearshore waters, and 12.7 (± 0.4 SE) for the offshore strata. There was no significant difference of mean catch rates between the two depth zones ($\chi2 = 1.34$, $P > 0.002$). CV estimates were 0.1 and 0.0 for Texas near and offshore areas, respectively. Off Louisiana catch rates were 22.9 (± 2.6 SE) in the nearshore area, and 21.6 (± 0.8 SE) in offshore waters. There was no significant difference of mean catch rates between Louisiana near and offshore waters ($\chi2 = 0.22$, $P > 0.002$). CV values for Louisiana were 0.1 for the nearshore zone, and 0.0 for offshore waters. Off the coast of Alabama/Mississippi finfish CPUE was 18.0 (± 1.8 SE) for nearshore waters, and 30.7 (± 5.8 SE) for offshore waters. There was not a significant difference of mean catch rates between the two depth strata ($\chi2 = 4.38$, $P > 0.002$). CV estimates were 0.1 and 0.2 in Alabama/Mississippi near and offshore depths, respectively. Off Florida catch rates were 12.0 (± 1.0 SE) for the nearshore zone, and 12.9 (± 1.2 SE) for offshore waters. There was no significant difference of mean catch rates between the two depth zones ($\chi2 = 0.34$ $P > 0.002$). CV estimates for Florida waters were 0.1 for both depth strata.

Finfish catch rate estimates in kilograms per hour in 1994 for Texas were 19.1 ($\pm$ 5.1 SE) for nearshore waters, and 22.6 ($\pm$ 0.9 SE) for the offshore zone. There was no significant difference of mean catch rates between the two depth strata ($\chi 2 = 0.46$, $P > 0.002$). CV estimates for Texas were 0.3 for nearshore, and 0.0 for offshore waters. Off Louisiana CPUE was 26.2 ($\pm$ 2.4 SE) in the nearshore area, and 29.3 ($\pm$ 0.9 SE) in offshore waters. No significant difference was detected between the two depth zones ($\chi 2 = 1.56$, $P > 0.002$). CV estimates for Louisiana were 0.1 and 0.0 in the near and offshore depths, respectively. CPUE in kilograms per hour off Alabama/Mississippi was 32.2 ($\pm$ 6.0 SE) for nearshore waters, and 19.4 ($\pm$ 5.1 SE) for offshore waters. There was not a significant difference of mean catch rates between the two depth strata ($\chi 2 = 2.67$, $P > 0.002$). CV values for Alabama/Mississippi waters were 0.2 for the nearshore zone, and 0.3 for offshore waters. For Florida, finfish catch rates were 21.4 ($\pm$ 1.9 SE) for the nearshore zone, and 10.8 ($\pm$ 0.6 SE) for offshore waters. There was a significant difference of mean catch rates between the two depth zones ($\chi 2 = 28.08$, $P < 0.002$). CV estimates for Florida were 0.1 for both depth strata.

In 1995, catch rates for finfish off Texas were 34.3 ($\pm$ 8.8 SE) in the nearshore area, and 16.1 ($\pm$ 0.9 SE) in offshore waters. No significant difference was detected between the two depth zones ($\chi 2 = 4.24$, $P > 0.005$). CV estimates were 0.3 and 0.1 in Texas near and offshore depths, respectively. CPUE in the Louisiana offshore strata was 25.2 ($\pm$ 0.7 SE) with a CV of 0.0. Off Florida, catch rates were 13.7 ($\pm$ 1.7 SE) for the nearshore zone, and 10.9 ($\pm$ 0.8 SE) for offshore waters. There was not a significant difference of mean catch rates between the two depth zones ($\chi 2 = 2.25$, $P > 0.005$). CV estimates for Florida were 0.1 for both depth strata.

Finfish CPUE in 1996 off Texas was 25.5 ($\pm$ 3.3 SE) for nearshore, and 16.2 ($\pm$ 1.6 SE) for offshore waters. There was no significant difference between near and offshore waters ($\chi 2 = 6.43$, $P > 0.003$). CV estimates for Texas were 0.1 for both depth strata. CPUE for the Louisiana offshore zone was 21.0 ($\pm$ 1.4 SE); the CV was 0.1. In Alabama/Mississippi nearshore waters, CPUE was 6.4 ($\pm$ 1.2 SE), with a CV of 0.2. For Florida, catch rates were 14.9 ($\pm$ 2.4 SE) in the nearshore area, and 20.5 ($\pm$ 1.7 SE) in offshore waters. No significant difference was detected between the two depth zones ($\chi 2 = 3.74$, $P > 0.003$). CV estimates were 0.2 and 0.1 in near and offshore depths, respectively.

In 1997, CPUE for in the Texas offshore zone was 17.4 (± 1.6 SE). The CV estimate was 0.1. The catch rate in Louisiana offshore waters was 27.2 (± 1.3 SE), with a CV of 0.0. In Florida offshore waters, the CPUE was 8.5 (± 1.1 SE), with a CV value of 0.1.

Finfish catch rate estimates in kilograms per hour in 1998 for Texas were 12.3 (± 2.1 SE) for nearshore waters, and 8.0 (± 0.4 SE) for the offshore zone. There was no significant difference of mean catch rates between the two depth strata ($\chi 2 = 4.08$, $P > 0.005$). CV estimates for Texas were 0.2 for nearshore, and 0.0 for offshore waters. CPUE for the Louisiana offshore zone was 20.0 (± 0.9 SE), with a CV of 0.0. Catch rates in kilograms per hour off Alabama/Mississippi were 7.0 (± 2.8 SE) for nearshore waters, and 20.7 (± 2.9 SE) for offshore waters. There was a significant difference of mean catch rates between the two depth strata ($\chi 2 = 11.31$, $P < 0.005$). CV values for Alabama/Mississippi were 0.4 for the nearshore zone, and 0.1 for offshore waters.

Finfish CPUE in kilograms per hour for Texas offshore waters in 1999 was 10.4 (± 1.2 SE), with a CV 0.1. For the Louisiana zone, the catch rate estimate was 11.2 (± 0.6 SE). The CV estimate was 0.1.

Finfish catch rate estimates in kilograms per hour in 2000 for Texas were 6.9 (± 0.2 SE) for nearshore waters, and 3.0 (± 0.8 SE) for the offshore zone. There was no significant difference of mean catch rates between the two depth zones ($\chi 2 = 23.08$, $P > 0.017$). CV estimates for Texas were 0.0 for nearshore, and 0.3 for offshore waters. Louisiana offshore CPUE was 6.7 (± 1.0 SE), with a CV of 0.2.

In Texas offshore waters in 2001 finfish CPUE in kilograms per hour was 11.8 (± 0.4 SE); the CV was 0.0. Off Louisiana, CPUE was 31.2 (± 4.6 SE) in the nearshore area, and 21.8 (± 0.9 SE) in offshore waters. No significant difference was detected between the two depth zones ($\chi 2 = 3.95$, $P > 0.003$). CV estimates for Louisiana waters were 0.1 and 0.0 in near and offshore depths, respectively. CPUE in kilograms per hour off Alabama/Mississippi was 30.5 ($\pm$ 2.4 SE) for nearshore waters, and 29.1 ($\pm$ 1.9 SE) for offshore waters. There was not a significant difference of mean catch rates between the two depth strata ($\chi2 = 0.21$, $P > 0.003$). CV estimates for Alabama/Mississippi were 0.1 for both depth zones. Florida offshore finfish CPUE was 33.6 ($\pm$ 1.8 SE); the CV was 0.1.

In 2002, finfish CPUE in kilograms per hour off Texas was 9.7 ($\pm$ 2.6 SE) for nearshore waters, and 13.1 ($\pm$ 0.5 SE) for offshore waters. There was no significant difference of mean catch rates between the two depth strata ($\chi2 = 1.73$, $P > 0.002$). CV estimates for Texas were 0.3 and 0.0 in near and offshore depths, respectively. Off Louisiana CPUE was 22.6 ($\pm$ 3.4 SE) in the nearshore area, and 18.9 ($\pm$ 0.6 SE) in offshore waters. No significant difference was detected between the two depth zones ($\chi2 = 1.10$, $P > 0.002$). CV values for Louisiana were 0.2 for nearshore, and 0.0 for offshore waters. CPUE in kilograms per hour off Alabama/Mississippi was 16.0 ($\pm$ 1.1 SE) for nearshore waters, and 24.8 ($\pm$ 0.8 SE) for offshore waters. There was a significant difference of mean catch rates between the two depth zones ($\chi2 = 45.01$, $P < 0.002$). CV estimates for Alabama/Mississippi were 0.1 and 0.0 in near and offshore depths, respectively. For Florida, catch rates were 15.7 ($\pm$ 0.7 SE) in the nearshore area, and 17.1 ($\pm$ 0.8 SE) in offshore waters. No significant difference was detected between the two depth zones ($\chi2 = 1.54$, $P > 0.002$). CV estimates were 0.0 for both Florida depth strata.

Finfish catch rate estimates in kilograms per hour in 2003 for Texas were 32.9 ($\pm$ 3.2 SE) for nearshore waters, and 12.5 ($\pm$ 0.5 SE) for the offshore zone. There was a significant difference of mean catch rates between the two depth strata ($\chi2 = 39.96$, $P < 0.002$). CV estimates for Texas were 0.1 for nearshore, and 0.0 for offshore waters. Off Louisiana, CPUE was 25.6 ($\pm$ 3.1 SE) in the nearshore area, and 16.4 ($\pm$ 0.7 SE) in offshore waters. No significant difference was detected between the two depth zones ($\chi2 = 8.31$, $P > 0.002$). CV estimates for Louisiana waters were 0.1 and 0.0 in near and offshore depths, respectively. CPUE in kilograms per hour off Alabama/Mississippi was 10.3 ($\pm$ 1.1 SE) for nearshore waters, and 19.4 ($\pm$ 1.3 SE) for offshore waters. A significant difference of mean catch rates was detected between the two depth strata ($\chi 2 = 29.83$, $P < 0.002$). CV values for Alabama/Mississippi were 0.1 for both depth zones. For Florida, finfish catch rates were 12.5 ($\pm$ 1.1 SE) for the nearshore zone, and 10.4 ($\pm$ 1.7 SE) for offshore waters. There was not a significant difference of mean catch rates between the two depth zones ($\chi 2 = 1.09$ $P > 0.002$). CV estimates for Florida were 0.1 and 0.2 in near and offshore depths, respectively.

In 2004, catch rates for finfish off Texas were 26.7 ($\pm$ 1.4 SE) in the nearshore area, and 14.5 ($\pm$ 0.6 SE) in offshore waters. A significant difference was detected between the two depth zones ($\chi 2 = 66.79$, $P < 0.002$). CV estimates for Texas were 0.1 and 0.0 in near and offshore depths, respectively. Off Louisiana, CPUE was 28.5 ($\pm$ 1.5 SE) in the nearshore area, and 22.3 ($\pm$ 0.7 SE) in offshore waters. A significant difference was detected between the two depth zones ($\chi 2 = 14.06$, $P < 0.002$). For Louisiana, CV values were 0.1 for nearshore, and 0.0 for offshore waters. For Alabama/Mississippi finfish catch rates were 12.3 ($\pm$ 1.7 SE) in the nearshore area, and 26.4 ($\pm$ 1.0 SE) in offshore waters. Again, there was a significant difference between depth zones ($\chi 2 = 49.37$, $P < 0.002$). CV estimates were 0.1 and 0.0 in near and offshore depths, respectively. For Florida waters, catch rates were 16.5 ($\pm$ 1.9 SE) in the nearshore area, and 16.9 ($\pm$ 1.1 SE) in offshore waters. No significant difference was detected between the two depth zones ($\chi 2 = 0.03$, $P > 0.002$). CV estimates for Florida were 0.1 in both depth strata.

Catch rates in kilograms per hour in 2005 for Texas waters were 22.4 ($\pm$ 9.6 SE) in the nearshore area, and 20.4 ($\pm$ 1.1 SE) in offshore waters. There was no significant difference in mean catch rates between depth zones ($\chi 2 = 0.04$, $P > 0.002$). CV values in Texas waters were 0.4 for nearshore, and 0.1 for offshore waters. CPUE for Louisiana was 35.3 ($\pm$ 1.5 SE) for the nearshore area, and 26.2 ($\pm$ 1.2 SE) for offshore waters. A significant difference was detected between mean catch rates in the two depth zones ($\chi 2 = 23.39$, $P < 0.002$). CV values for Louisiana were 0.0 for both depth strata. In Alabama/Mississippi waters catch rates were 17.6 ($\pm$ 2.7 SE) in the nearshore zone, and 28.9 ($\pm$ 1.4 SE) in offshore waters. There was a significant difference relative to mean finfish catch rates between the two zones ($\chi 2 = 14.37$, $P < 0.002$). CV calculations were 0.2 for nearshore waters, and 0.0 for the offshore zone. For Florida, finfish catch rates were 13.4 (± 1.4 SE) for the nearshore zone, and 18.6 (± 1.2 SE) for offshore waters. There was not a significant difference of mean catch rates between the two depth strata ($\chi 2 = 8.21$ $P > 0.002$). CV estimates for Florida were 0.1 in both depth strata, respectively.

Finfish CPUE All Years Combined by State, Depth and Season

For all years combined, finfish catch rate estimates for Texas nearshore waters were 11.1 (± 1.1 SE) in January through April, 26.8 (± 1.3 SE) in May through August, and 11.1 (± 2.6 SE) in September through December. There was a significant difference between January through April and May through August ($\chi 2 = 84.90$, $P < 0.0002$), and May through August and September through December ($\chi 2 = 29.66$, $P < 0.0002$). There was no significant difference between January and April and September through December ($\chi 2 = 0.00$, $P > 0.0002$). CPUE in Texas offshore waters was 8.0 (± 0.3 SE) in January through April, 15.0 (± 0.3 SE) in May through August, and 15.8 (± 0.4 SE) in September through December. There was a significant difference between January through April and May through August ($\chi 2 = 330.95$, $P < 0.0002$), and January through April and September through December ($\chi 2 = 270.74$, $P < 0.0002$). There was no significant difference between May through August and September through December ($\chi 2 = 3.25$, $P > 0.0002$). In Louisiana nearshore waters catch rate estimates were 18.4 (± 1.9 SE) in January through April, 32.8 (± 1.0 SE) in May through August, and 27.3 (± 1.7 SE) in September through December. There was no significant difference in mean catch rates between May through August and September through December ($\chi 2 = 8.00$, $P > 0.0002$), and January through April and September through December ($\chi 2 = 12.07$, $P > 0.0002$). There was a significant difference between January through April and May through August ($\chi 2 = 87.32$, $P < 0.0002$). For Louisiana offshore waters CPUE was 18.7 (± 0.3 SE) in January through April, 25.0 (± 0.6 SE) in May through August, and 22.7 (± 0.4 SE) in September through December. There was a significant difference in mean catch rates between January through April and May through August ($\chi 2 = 87.32$, $P < 0.0002$), and January through April and September through December ($\chi 2 = 53.87$, $P < 0.0002$). There was no significant difference between May through August and September through December ($\chi 2 = 9.93$, $P > 0.0002$). In Alabama/Mississippi nearshore waters CPUE was 7.8 ($\pm$ 0.5 SE) in January through April, 14.7 ($\pm$ 0.9 SE) in May through August, and 26.8 ($\pm$ 1.5 SE) in September through December. There was a significant difference for the following comparisons: January through April and May through August ($\chi 2 = 45.75$, $P < 0.0002$), January through April and September through December ($\chi 2 = 145.66$, $P < 0.0002$), and May through August and September through December ($\chi 2 = 48.82$, $P < 0.0002$). For Alabama/Mississippi offshore waters CPUE was 27.3 ($\pm$ 0.9 SE) in January through April, 19.7 ($\pm$ 0.7 SE) in May through August, and 30.5 ($\pm$ 1.0 SE) in September through December. There was a significant difference between January through April and May through August ($\chi 2 = 46.44$, $P < 0.0002$), and May through August and September through December ($\chi 2 = 84.40$, $P < 0.0002$). There was no significant difference between January through April and September through December ($\chi 2 = 5.79$, $P > 0.0002$). For Florida nearshore waters CPUE was 14.9 ($\pm$ 0.6 SE) in January through April, 14.6 ($\pm$ 0.8 SE) in May through August, and 22.6 ($\pm$ 2.4 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi 2 = 0.04$, $P > 0.0002$), January through April and September through December ($\chi 2 = 9.80$, $P > 0.0002$), and May through August and September through December ($\chi 2 = 9.80$, $P > 0.0002$). In Florida offshore waters catch rates were 12.8 ($\pm$ 0.4 SE) in January through April, 14.3 ($\pm$ 0.7 SE) in May through August, and 24.9 ($\pm$ 1.2 SE) in September through December. There was a significant difference between January through April and

September through December ($\chi 2$ = 95.83, P < 0.0002), and May through August and September through December ($\chi 2$ = 61.26, P < 0.0002). There was no significant difference between January through April and May through August ($\chi 2$ = 3.61, P > 0.0002). For all state areas, depths and seasons, CV values ranged from 0.0 to 0.2.

Finfish CPUE by Year, State, Depth and Season

CPUE for finfish by year, state, depth and season is presented in Figure 28. A general seasonal trend was observed relative to CPUE. In Texas nearshore waters catch rates were higher in May through August in most years, although not significantly higher in all years. For the offshore zone, May through August yielded higher finfish CPUE in the majority of years, followed by the September through December period. In Louisiana nearshore waters higher catch rates occurred in May through August and September through December, with no significant difference detected between the two seasons in all years with the exception of 1992. In Louisiana offshore waters, the May through August period yielded higher finfish catch rates, although CPUE was not significantly different than the September through December period in most years. In Alabama/Mississippi near and offshore waters, CPUE was higher in September through December in the majority of years. For Florida nearshore waters, catch rates were relatively consistent between seasons, with the Florida offshore zone experiencing higher catch rates in September through December, followed by the May through August period.

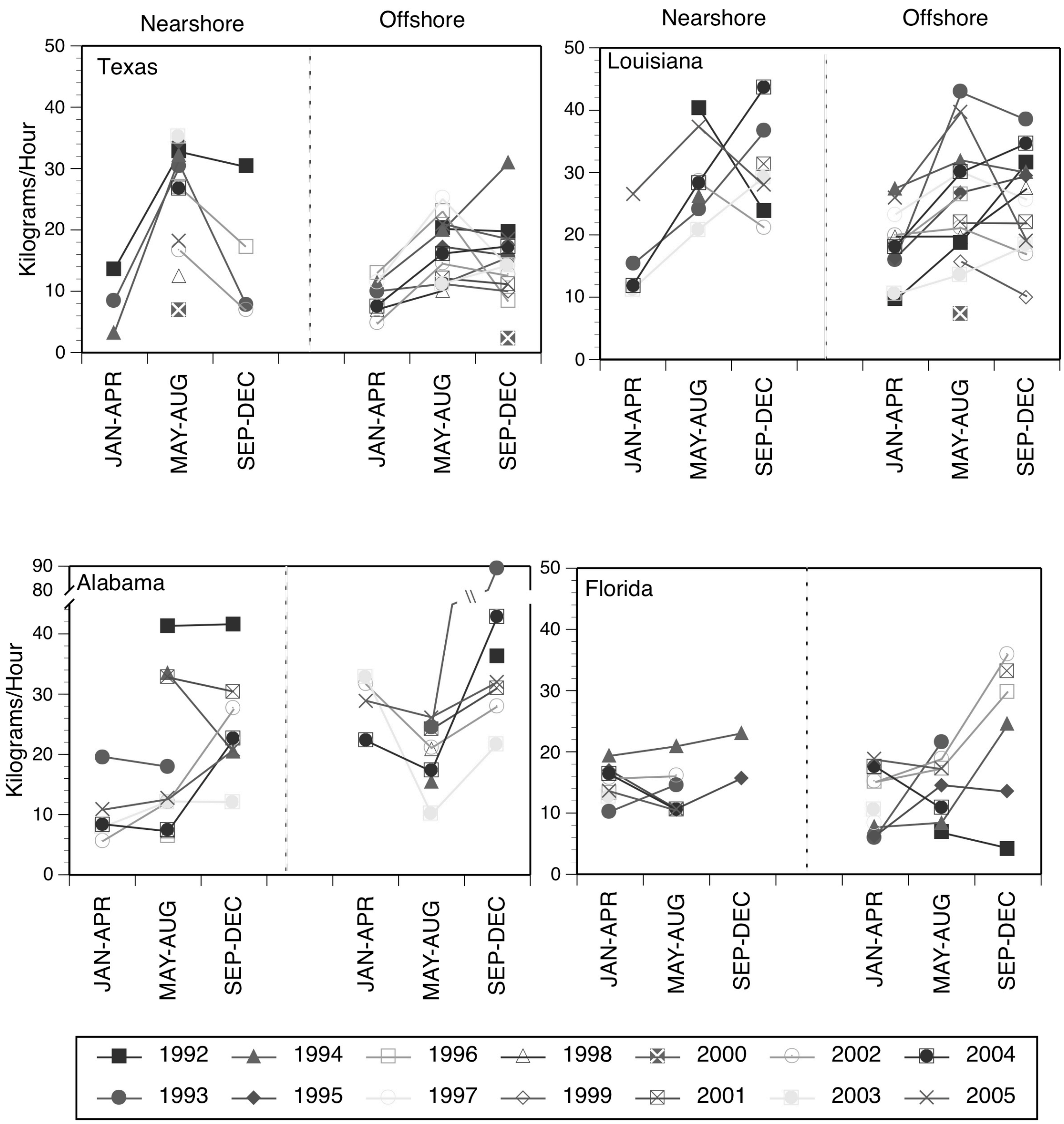

Figure 28. Finfish CPUE in kilograms per hour in the Gulf of Mexico by year, state, depth and season. Nets are consistent with BRD regulations. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

In 1992, finfish CPUE in kilograms per hour off Texas nearshore waters was 13.6 (± 1.6 SE) in January through April, 32.7 (± 4.6 SE) in May through August, and 30.3 (± 15.7 SE) for September through December. There was a significant difference of mean catch rates between January through April and May through August ($\chi2$ = 15.61, P < 0.0005). No significant difference was detected between the following comparisons: January through April and September through December ($\chi2$ = 1.11, P > 0.0005), and May through August and September through December ($\chi2$ = 0.02, P > 0.0005). In Texas offshore waters catch rates were 20.2 (± 1.5 SE) in May through August, and 19.8 (± 1.2 SE) for September through December. There was no significant difference between the two seasons ($\chi2$ = 0.05, P > 0.0005). In Louisiana nearshore waters CPUE was 40.4 (± 2.3 SE) in May through August, and 23.7 (± 2.1 SE) for September through December. There was a significant difference between the two periods ($\chi2$ = 29.49, P < 0.0005). For Louisiana offshore waters CPUE was 9.6 (± 0.8 SE) in January through April, 18.8 (± 2.3 SE) in May through August, and 31.6 (± 2.3 SE) for September through December. There was a significant difference between the following comparisons: January through April and May through August ($\chi2$ = 14.64, P < 0.0005), January through April and September through December ($\chi2$ = 84.49, P < 0.0005), and May through August and September through December ($\chi2$ = 15.82, P < 0.0005). In Alabama/Mississippi nearshore waters, CPUE was 41.3 (± 16.2 SE) in May through August, and 41.6 (± 11.4 SE) for September through December. There was no significant difference between the two seasons ($\chi2$ = 0.00, P > 0.0005). In Florida offshore waters CPUE was 6.8 (± 1.1 SE) in May through August, and 4.3 (± 0.8 SE) in September through December. There was no significant difference between the two time periods ($\chi2$ = 3.21, P > 0.0005). CV estimates were variable, and ranged from 0.1 to 0.5

Finfish CPUE in 1993 in Texas nearshore waters was 8.5 (± 1.0 SE) in January through April, 30.4 (± 6.1 SE) in May through August, and 7.9 (± 3.0 SE) for September through December. There was no significant difference for the following comparisons: January through April and May through August ($\chi2$ = 12.64, P > 0.0003), January through April and September through December ($\chi2$ = 0.86, P > 0.0003), and May through August and September through December ($\chi2$ = 11.04, P > 0.0003). In Texas offshore waters catch rate estimates were 10.0 (± 0.5 SE) in January through April, 11.2

($\pm$ 0.5 SE) in May through August, and 15.5 ($\pm$ 0.8 SE) for September through December. There was a significant difference between January through April and September through December ($\chi2$ = 33.15, $P < 0.0003$), and May through August and September through December ($\chi2$ = 19.07, $P < 0.0003$). There was no significant difference between January through April and May through August ($\chi2$ = 2.99, $P > 0.0003$). For Louisiana nearshore waters CPUE was 15.3 ($\pm$ 2.8 SE) in January through April, 24.0 ($\pm$ 3.4 SE) in May through August, and 36.5 ($\pm$ 10.6 SE) for September through December. There was no significant difference for the following comparisons: January through April and May through August ($\chi2$ = 3.97, $P > 0.0003$), January through April and September through December ($\chi2$ = 3.78, $P > 0.0003$), and May through August and September through December ($\chi2$ = 1.29, $P > 0.0003$). For Louisiana offshore waters CPUE was 16.1 ($\pm$ 0.5 SE) in January through April, 42.8 ($\pm$ 4.4 SE) in May through August, and 38.4 ($\pm$ 2.0 SE) in September through December. There was a significant difference between January through April and May through August ($\chi2$ = 36.47, $P < 0.0003$), and January through April and September through December ($\chi2$ = 117.52, $P < 0.0003$). There was no significant difference between May through August and September through December ($\chi2$ = 0.84, $P > 0.0003$). In Alabama/Mississippi nearshore waters catch rate estimates were 19.6 ($\pm$ 3.4 SE) in January through April, and 17.9 ($\pm$ 1.9 SE) in May through August. There was no significant difference between the two seasons ($\chi2$ = 0.19, $P > 0.0003$). For Alabama/Mississippi offshore waters CPUE was 24.5 ($\pm$ 4.7 SE) in May through August, and 89.3 ($\pm$ 8.6 SE) in September through December. There was a significant difference between the two periods ($\chi2$ = 43.49, $P < 0.0003$). In Florida nearshore waters catch rate estimates were 10.3 ($\pm$ 1.4 SE) in January through April, and 14.6 ($\pm$ 1.0 SE) in May through August. There was no significant difference between the two seasons ($\chi2$ = 6.37, $P > 0.0003$). For Florida offshore waters CPUE was 6.0 ($\pm$ 0.6 SE) in January through April, and 21.6 ($\pm$ 1.4 SE) in May through August. There was a significant difference between the two periods ($\chi2$ = 102.36, $P < 0.0003$). CV estimates were relatively low, and ranged from 0.1 to 0.3

During 1994, finfish catch rates for Texas nearshore waters were 3.3 (± 2.5 SE) in January through April, and 32.0 (± 5.0 SE) in May through August. There was a significant difference between the two seasons ($\chi2 = 26.53$, $P < 0.0003$). In Texas offshore waters CPUE was 11.4 (± 1.7 SE) in January through April, 19.9 (± 1.0 SE) in May through August, and 30.8 (± 2.0 SE) for September through December. There was a significant difference for the following comparisons: January through April and May through August ($\chi2 = 18.53$, $P < 0.0003$), January through April and September through December ($\chi2 = 54.75$, $P < 0.0003$), and May through August and September through December ($\chi2 = 24.04$, $P < 0.0003$). For Louisiana offshore waters CPUE was 27.5 (± 1.2 SE) in January through April, 32.0 (± 1.9 SE) in May through August, and 30.0 (± 2.0 SE) in September through December. There was no significant difference for the following comparisons: January through April and May through August ($\chi2 = 4.03$, $P > 0.0003$), January through April and September through December ($\chi2 = 1.15$, $P > 0.0003$), and May through August and September through December ($\chi2 = 0.53$, $P > 0.0003$). For Alabama/Mississippi nearshore waters CPUE was 33.4 (± 6.5 SE) in May through August, and 20.3 (± 2.0 SE) in September through December. There was not a significant difference between the two periods ($\chi2 = 3.66$, $P > 0.0003$). For Florida nearshore waters CPUE was 19.4 (± 3.3 SE) in January through April, 20.9 (± 0.9 SE) in May through August, and 23.1 (± 2.6 SE) for September through December. There was no significant difference between the following comparisons: January through April and May through August ($\chi2 = 0.20$, $P > 0.0003$), January through April and September through December ($\chi2 = 0.76$, $P > 0.0003$), and May through August and September through December ($\chi2 = 0.69$, $P > 0.0003$). For Florida offshore waters catch rates were 7.7 (± 0.5 SE) in January through April, 8.4 (± 0.6 SE) in May through August, and 24.5 (± 2.6 SE) in September through December. There was a significant difference between January through April and September through December ($\chi2 = 40.28$, $P < 0.0003$), and May through August and September through December ($\chi2 = 36.32$, $P < 0.0003$). There was no significant difference between January through April and May through August ($\chi2 = 1.00$, $P > 0.0003$). CV estimates were moderate, and ranged from 0.1 to 0.8.

For Texas offshore waters in 1995 finfish catch rate estimates were 17.3 (± 2.0 SE) in May through August, and 15.8 (± 1.0 SE) in September through December. There was not a significant difference between the two seasons ($\chi2 = 0.40$, $P > 0.001$). For Louisiana offshore waters CPUE was 16.3 (± 0.7 SE) in January through April, 26.8 (± 1.2 SE) in May through August, and 29.4 (± 1.0 SE) in September through December. There was a significant difference detected between January through April and September through December ($\chi2 = 119.10$, $P < 0.001$), and January and April and May through August ($\chi2 = 52.60$, $P < 0.001$). There was no significant difference between May and August and September through December ($\chi2 = 2.90$, $P > 0.001$). In Florida nearshore waters catch rate estimates were 17.0 (± 3.3 SE) in January through April, 10.7 (± 1.7 SE) in May through August, and 15.8 (± 7.6 SE) for September through December. There was a significant difference for the following comparisons: January through April and May through August ($\chi2 = 2.90$, $P < 0.001$), January through April and September through December ($\chi2 = 0.02$, $P < 0.001$), and May through August and September through December ($\chi2 = 0.43$, $P < 0.001$). In Florida offshore waters CPUE was 6.3 (± 0.7 SE) in January through April, 14.6 (± 1.4 SE) in May through August, and 13.5 (± 1.5 SE) in September through December. There was a significant difference between January through April and September through December ($\chi2 = 19.25$, $P < 0.001$), and January through April and May through August ($\chi2 = 28.44$, $P < 0.001$). There was no significant difference between May through August and September through December ($\chi2 = 0.29$, $P > 0.001$). CV estimates ranged from 0.0 to 0.5.

During 1996, finfish CPUE in Texas nearshore waters was 26.9 (± 3.7 SE) in May through August, and 17.3 (± 2.9 SE) in September through December. There was not a significant difference between the two seasons ($\chi2 = 4.26$, $P > 0.001$). In Texas offshore waters CPUE was 13.0 (± 4.1 SE) in January through April, 23.0 (± 2.3 SE) in May through August, and 8.3 (± 0.9 SE) for September through December. There was not a significant difference between January through April and May through August ($\chi2 = 4.47$, $P > 0.001$), and January through April and September through December ($\chi2 = 1.20$, $P > 0.001$). There was a significant difference between May through August and

September through December ($\chi2 = 33.98$, $P < 0.001$). In Louisiana offshore waters catch rates were 18.4 (± 1.1 SE) in January through April, and 26.3 (± 3.2 SE) in May through August. There was not a significant difference between the two periods ($\chi2 = 5.67$, $P > 0.001$). In Florida offshore waters CPUE was 15.1 (± 1.3 SE) in January through April, 17.2 (± 4.6 SE) in May through August, and 29.9 (± 3.2 SE) in September through December. There was a significant difference between January through April and September through December ($\chi2 = 18.13$, $P < 0.001$). There was no significant difference between and January through April and May through August ($\chi2 = 0.21$, $P > 0.001$), and between May through August and September through December ($\chi2 = 5.11$, $P > 0.001$). CV estimates were low, and ranged from 0.1 to 0.3.

CPUE in Texas offshore waters in 1997 was 11.4 (± 2.2 SE) in January through April, 25.0 (± 3.3 SE) in May through August, and 14.1 (± 1.6 SE) in September through December. There was a significant difference between January through April and May through August ($\chi2 = 11.70$, $P < 0.002$). There was no significant difference detected between and January through April and September through December ($\chi2 = 0.94$, $P > 0.002$), and between May through August and September through December ($\chi2 = 8.85$, $P > 0.002$). In Louisiana offshore waters catch rate estimates were 23.3 (± 10.3 SE) in January through April, 30.1 (± 2.2 SE) in May through August, and 25.6 (± 1.7 SE) for September through December. There was not a significant difference between the following comparisons: January through April and May through August ($\chi2 = 0.42$, $P > 0.002$), January through April and September through December ($\chi2 = 0.05$, $P > 0.002$), and May through August and September through December ($\chi2 = 2.60$, $P > 0.002$). CV estimates ranged from 0.1 to 0.4.

During 1998, catch rate estimates for finfish in Texas offshore waters were 7.0 (± 0.3 SE) in January through April, and 10.1 (± 0.8 SE) in May through August. There was a significant difference between the two seasons ($\chi2 = 12.49$, $P < 0.002$). In Louisiana offshore waters catch rate estimates were 19.7 (± 0.9 SE) in January through April, 19.7 (± 2.5 SE) in May through August, and 27.4 (± 3.4 SE) in September through December. There was not a significant difference between the following comparisons:

January through April and May through August ($\chi2 = 0.00$, $P > 0.002$), January through April and September through December ($\chi2 = 4.87$, $P > 0.002$), and May through August and September through December ($\chi2 = 3.34$, $P > 0.002$). CV estimates ranged from 0.0 to 0.4.

Finfish catch rates in 1999 for Texas offshore waters were 11.2 ($\pm$ 0.9 SE) in May through August, and 10.0 ($\pm$ 1.8 SE) in September through December. There was not a significant difference between the two seasons ($\chi2 = 0.37$, $P > 0.008$). CPUE for Louisiana offshore waters was 15.7 ($\pm$ 0.7 SE) in May through August, and 10.1 ($\pm$ 0.6 SE) in September through December. There was a significant difference detected between the two time periods ($\chi2 = 35.77$, $P < 0.008$). CV values were low, and ranged from 0.0 to 0.2.

In 2001, finfish CPUE for Texas offshore waters was 12.1 ($\pm$ 0.5 SE) in May through August, and 11.1 ($\pm$ 0.7 SE) in September through December. There was not a significant difference between the two seasons ($\chi2 = 1.16$, $P > 0.001$). Similarly, catch rate estimates for Louisiana offshore waters were 21.9 ($\pm$ 1.4 SE) in May through August, and 21.8 ($\pm$ 1.1 SE) in September through December. A significant difference was not detected between the two time periods ($\chi2 = 0.00$, $P > 0.001$). For Alabama/Mississippi nearshore waters CPUE was 32.8 ($\pm$ 7.0 SE) in May through August, and 30.4 ($\pm$ 2.5 SE) in September through December. Again, there was no significant difference between the two seasons ($\chi2 = 0.10$, $P > 0.001$). In Alabama/Mississippi offshore waters, CPUE was 24.1 ($\pm$ 1.3 SE) in May through August, and 31.0 ($\pm$ 2.5 SE) in September through December. There was not a significant difference between the two seasons ($\chi2 = 5.71$, $P > 0.001$). CV values were low, ranging from 0.0 to 0.2.

Catch rate estimates during 2002 Texas nearshore waters were 16.6 ($\pm$ 8.6 SE) in May through August, and 6.9 ($\pm$ 0.9 SE) in September through December. There was not a significant difference between the two seasons ($\chi2 = 1.28$, $P > 0.0002$). CPUE in Texas offshore waters was 4.7 ($\pm$ 0.5 SE) in January through April, 14.5 ($\pm$ 0.6 SE) in May through August, and 12.5 ($\pm$ 0.8 SE) in September through December. There was a significant difference between January through April and May through August ($\chi 2$ = 164.86, P < 0.0002), and January through April and September through December ($\chi 2$ = 68.78, P < 0.0002). There was no significant difference between May through August and September through December ($\chi 2$ = 3.77, P > 0.0002). In Louisiana nearshore waters catch rate estimates were 28.4 ($\pm$ 10.6 SE) in May through August, and 16.8 ($\pm$ 0.8 SE) in September through December. There was not a significant difference between the two seasons ($\chi 2$ = 0.43, P > 0.0002). For Louisiana offshore waters CPUE was 20.0 ($\pm$ 1.2 SE) in January through April, 21.1 ($\pm$ 0.9 SE) in May through August, and 16.8 ($\pm$ 0.8 SE) in September through December. There was no significant difference detected for the following comparisons: January through April and May through August ($\chi 2$ = 0.50, P > 0.0002), January through April and September through December ($\chi 2$ = 4.62, P > 0.0002), and May through August and September through December ($\chi 2$ = 12.07, P > 0.0002). In Alabama/Mississippi nearshore waters CPUE was 5.6 ($\pm$ 0.8 SE) in January through April, 12.1 ($\pm$ 0.8 SE) in May through August, and 27.5 ($\pm$ 2.4 SE) in September through December. There was a significant difference for the following comparisons: January through April and May through August ($\chi 2$ = 33.22, P < 0.0002), January through April and September through December ($\chi 2$ = 73.65, P < 0.0002), and May through August and September through December ($\chi 2$ = 35.51, P < 0.0002). For Alabama/Mississippi offshore waters CPUE was 31.7 ($\pm$ 2.1 SE) in January through April, 21.0 ($\pm$ 0.9 SE) in May through August, and 27.9 ($\pm$ 1.5 SE) in September through December. There was a significant difference between January through April and May through August ($\chi 2$ = 21.53, P < 0.0002), and May through August and September through December ($\chi 2$ = 15.89, P < 0.0002). There was no significant difference between January through April and September through December ($\chi 2$ = 2.12, P > 0.0002). For Florida nearshore waters CPUE was 15.6 ($\pm$ 0.8 SE) in January through April, and 16.0 ($\pm$ 1.3 SE) in May through August. There was not a significant difference between the two periods ($\chi 2$ = 0.06, P > 0.0002). In Florida offshore waters catch rates were 15.1 ($\pm$ 0.9 SE) in January through April, 18.8 ($\pm$ 1.6 SE) in May through August, and 35.9 ($\pm$ 3.2 SE) in September through December.

There was a significant difference between January through April and September through December ($\chi2 = 38.68$, $P < 0.0002$), and May through August and September through December ($\chi2 = 22.48$, $P < 0.0002$). There was no significant difference between January through April and May through August ($\chi2 = 4.06$, $P > 0.0002$). CV values ranged from 0.0 to 0.5.

During 2003, CPUE for finfish in Texas offshore waters was 11.3 ($\pm$ 0.6 SE) in May through August, and 14.2 ($\pm$ 0.7 SE) in September through December. There was not a significant difference between the two seasons ($\chi2 = 9.77$, $P > 0.0004$). Catch rate estimates for Louisiana nearshore waters were 11.3 ($\pm$ 2.5 SE) in January through April, 20.9 ($\pm$ 3.0 SE) in May through August, and 29.3 ($\pm$ 4.0 SE) in September through December. There was not a significant difference between January through April and May through August ($\chi2 = 5.90$, $P > 0.0004$), and May through August and September through December ($\chi2 = 2.88$, $P > 0.0004$). There was a significant difference detected between January through April and September through December ($\chi2 = 14.57$, $P < 0.0004$). CPUE in Louisiana offshore waters was 10.5 ($\pm$ 0.8 SE) in January through April, 13.6 ($\pm$ 0.9 SE) in May through August, and 18.3 ($\pm$ 0.9 SE) in September through December. There was a significant difference noted between January through April and September through December ($\chi2 = 45.55$, $P < 0.0004$), and May through August and September through December ($\chi2 = 13.62$, $P < 0.0004$). There was no significant difference between January through April and May through August ($\chi2 = 7.29$, $P > 0.0004$). Catch rate estimates for Alabama/Mississippi nearshore waters were 7.9 ($\pm$ 0.7 SE) in January through April, 12.2 ($\pm$ 2.1 SE) in May through August, and 12.0 ($\pm$ 3.9 SE) in September through December. There was not a significant difference detected for the following comparisons: January through April and May through August ($\chi2 = 3.66$, $P > 0.0004$), January through April and September through December ($\chi2 = 1.12$, $P > 0.0004$), and May through August and September through December ($\chi2 = 0.00$, $P > 0.0004$). CPUE in Alabama/Mississippi offshore waters was 33.0 ($\pm$ 4.0 SE) in January through April, 10.0 ($\pm$ 1.0 SE) in May through August, and 21.7 ($\pm$ 1.6 SE) in September through December. There was a significant difference between January through April and May through August ($\chi2 = 30.94$, $P < 0.0004$), and May through August and September through December ($\chi2 = 38.24$, $P < 0.0004$). There was no significant difference detected between January through April and September through December ($\chi2 = 6.88$, $P > 0.0004$). CV estimates were low, and ranged from 0.1 to 0.3.

In 2004, finfish mean catch rate estimates for Texas offshore waters were 7.6 (± 0.6 SE) in January through April, 16.1 (± 0.6 SE) in May through August, and 17.3 (± 1.3 SE) in September through December. There was a significant difference between January through April and May through August ($\chi2 = 91.38$, $P < 0.0003$), and January through April and September through December ($\chi2 = 43.37$, $P < 0.0003$). There was no significant difference between May and August and September through December ($\chi2 = 0.63$, $P > 0.0003$). CPUE for Louisiana nearshore waters was 11.9 (± 3.8 SE) in January through April, 28.4 (± 1.5 SE) in May through August, and 43.6 (± 8.5 SE) in September through December. There was no significant difference detected between January through April and September through December ($\chi2 = 11.64$, $P > 0.0003$), and May through August and September through December ($\chi2 = 3.14$, $P > 0.0003$). There was a significant difference between January and April and May through August ($\chi2 = 16.02$, $P < 0.0003$). In Louisiana offshore waters catch rates were 18.2 (± 0.6 SE) in January through April, 30.0 (± 1.8 SE) in May through August, and 34.7 (± 2.7 SE) in September through December. There was a significant difference detected between January through April and September through December ($\chi2 = 36.15$, $P < 0.0003$), and January through April and May through August ($\chi2 = 40.79$, $P < 0.0003$). There was no significant difference between May through August and September through December ($\chi2 = 2.09$, $P > 0.0003$). In Alabama/Mississippi nearshore waters catch rates were 8.4 (± 0.9 SE) in January through April, 7.2 (± 1.0 SE) in May through August, and 22.6 (± 3.8 SE) in September through December. There was not a significant difference between January through April and May through August ($\chi2 = 0.78$, $P > 0.0003$), and January through April and September through December ($\chi2 = 13.19$, $P > 0.0003$). There was a significant difference detected between May and August and September through December ($\chi2 = 15.15$, $P < 0.0003$). In Alabama/Mississippi offshore waters

CPUE was 22.3 (± 0.9 SE) in January through April, 17.2 (± 2.2 SE) in May through August, and 42.8 (± 2.3 SE) in September through December. There was a significant difference between January through April and September through December ($\chi 2$ = 71.98, $P < 0.0003$), and May through August and September through December ($\chi 2$ = 65.73, $P < 0.0003$). There was not a significant difference detected between January through April and May and August ($\chi 2 = 4.69$, $P > 0.0003$). For Florida nearshore waters catch rate estimates were 16.3 (± 2.7 SE) in January through April, and 10.5 (± 3.6 SE) in May through August. There was not a significant difference between the two seasons ($\chi 2 = 1.98$, $P > 0.0003$). For Florida offshore waters CPUE was 17.6 (± 1.2 SE) in January through April, and 10.7 (± 1.2 SE) in May through August. There was a significant difference between the two seasons ($\chi 2 = 15.91$, $P < 0.0003$). CV estimates were low, and ranged from 0.0 to 0.3.

In 2005 finfish catch rates in Texas offshore waters were 21.0 (± 1.3 SE) in May through August, and 18.5 (± 1.9 SE) in September through December. There was not a significant difference between the two seasons ($\chi 2 = 1.20$, $P > 0.0003$). In Louisiana nearshore waters CPUE was 26.6 (± 2.1 SE) in January through April, 37.4 (± 1.6 SE) in May through August, and 27.9 (± 4.2 SE) in September through December. There was no significant difference detected between May through August and September through December ($\chi 2 = 4.51$, $P > 0.0003$), and January through April and September through December ($\chi 2 = 0.08$, $P > 0.0003$). There was a significant difference between January and April and May through August ($\chi 2 = 16.68$, $P < 0.0003$). In Louisiana offshore waters catch rates were 26.0 (± 1.5 SE) in January through April, 39.7 (± 3.5 SE) in May through August, and 19.0 (± 1.0 SE) in September through December. There was a significant difference detected between May through August and September through December ($\chi 2 = 33.32$, $P < 0.0003$), and January through April and September through December ($\chi 2 = 15.76$, $P < 0.0003$). There was no significant difference between January and April and May through August ($\chi 2 = 13.37$, $P > 0.0003$). Catch rate estimates for Alabama/Mississippi nearshore waters were 10.8 (± 1.2 SE) in January through April, 12.5 (± 1.9 SE) in May through August, and 20.8 (± 3.7 SE) in September through December. There was not a significant difference detected for the following comparisons: January through April and May through August ($\chi 2 = 0.60$, $P > 0.0003$), January through April and September through December ($\chi 2 = 6.69$, $P > 0.0003$), and May through August and September through December ($\chi 2 = 3.92$, $P > 0.0003$). Similarly, CPUE for Alabama/Mississippi offshore waters was 28.9 (± 1.9 SE) in January through April, 26.1 (± 2.6 SE) in May through August, and 32.0 (± 3.0 SE) in September through December. There was not a significant difference detected for the following comparisons: January through April and May through August ($\chi 2 = 0.77$, $P > 0.0003$), January through April and September through December ($\chi 2 = 0.77$, $P > 0.0003$), and May through August and September through December ($\chi 2 = 2.23$, $P > 0.0003$). For Florida nearshore waters catch rate estimates were 13.5 (± 1.5 SE) in January through April, and 10.4 (± 0.2 SE) in May through August. There was not a significant difference between the two seasons ($\chi 2 = 4.27$, $P > 0.0003$). For Florida offshore waters CPUE was 18.7 (± 1.3 SE) in January through April, and 17.2 (± 2.2 SE) in May through August. There was no significant difference between the two time periods ($\chi 2 = 0.37$, $P > 0.0003$). CV estimates ranged from 0.0 to 0.8.

Shrimp CPUE All Years Combined by State

For all years combined, shrimp CPUE in kilograms per hour was 5.7 (± 0.1 SE) for Texas, 5.0 (± 0.9 SE) for Florida, 4.6 (± 0.1 SE) for Louisiana, and 3.9 (± 0.1 SE) for Alabama/Mississippi. Significant differences were detected between the following comparisons: Florida and Alabama/Mississippi ($\chi 2 = 96.77$, $P < 0.008$), Louisiana and Alabama/Mississippi ($\chi 2 = 52.45$, $P < 0.008$), Texas and Alabama/Mississippi ($\chi 2 = 273.36$, $P < 0.008$), Louisiana and Florida ($\chi 2 = 9.91$, $P < 0.008$), Texas and Florida ($\chi 2 = 36.76$, $P < 0.008$), and Texas and Louisiana ($\chi 2 = 93.92$, $P < 0.008$). CV estimates were 0.0 for all state areas, except Florida with a CV of 0.2.

<u>Shrimp CPUE by Year and State</u>

CPUE for shrimp by year and state is presented in Figure 29. As compared with other state areas, Texas yielded higher CPUE in the majority years.

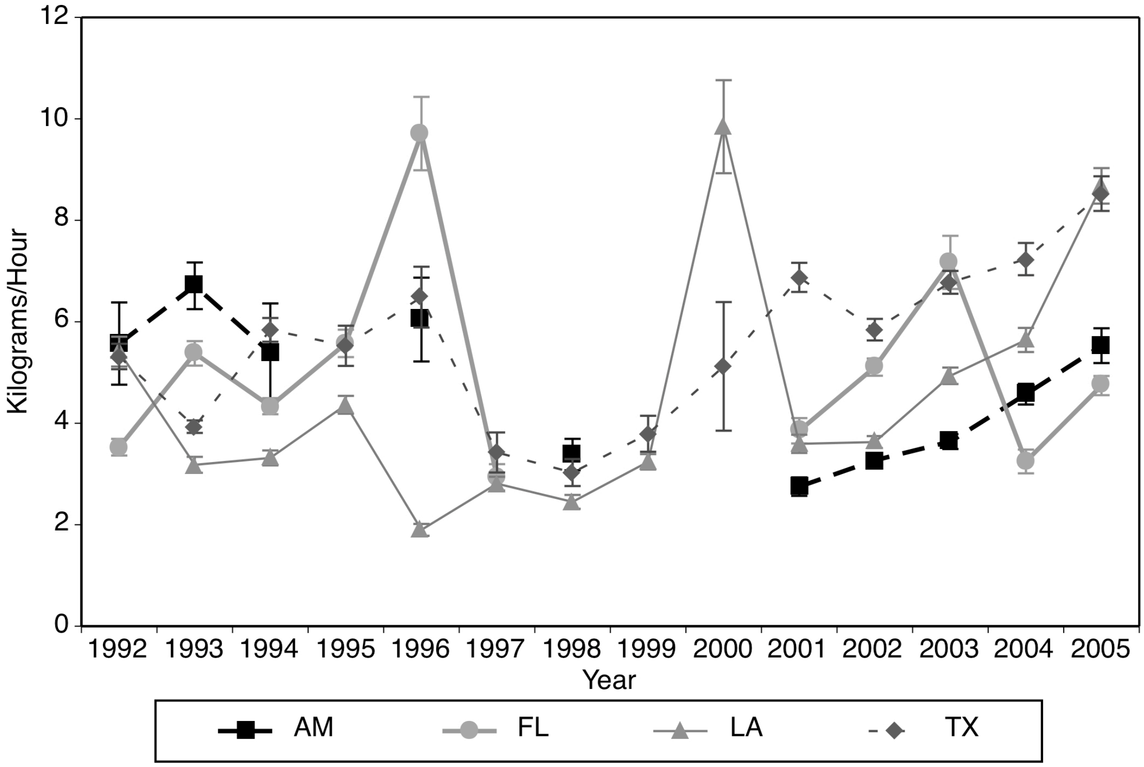

Figure 29. Penaeid shrimp CPUE in kilograms per hour by year and state for nets consistent with BRD regulations. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

In 1992, penaeid shrimp catch rates in kilograms per hour were 5.6 (± 0.8 SE) for Alabama/Mississippi, 5.4 (± 0.3 SE) for Louisiana, 5.3 (± 0.3 SE) for Texas, and 3.5 (± 0.2 SE) for Florida. There was no significant difference of mean catch rates between Alabama/Mississippi and Florida ($\chi2 = 6.10$, $P > 0.008$), Louisiana and Alabama/Mississippi ($\chi2 = 0.03$, $P > 0.008$), Texas and Alabama/Mississippi ($\chi2 = 0.09$, $P > 0.008$), and Louisiana and Texas ($\chi2 = 0.06$, $P > 0.008$). Significant differences in mean catch rates were detected in the following contrasts: Louisiana and Florida ($\chi2$ =

31.32, $P < 0.008$), and Texas and Florida ($\chi2 = 35.63$, $P < 0.008$). CV estimates were 0.0 for Texas and Florida, and 0.1 for Louisiana and Alabama/Mississippi.

Shrimp catch rates in kilograms per hour in 1993 were 6.7 ($\pm$ 0.5 SE) for Alabama/Mississippi, 5.4 ($\pm$ 0.2 SE) for Florida, 3.9 ($\pm$ 0.1 SE) for Texas, and 3.2 ($\pm$ 0.2 SE) for Louisiana. There was no significant difference of mean catch rates between Alabama/Mississippi and Florida ($\chi2 = 6.57$, $P > 0.008$). Significant differences were detected between the following comparisons: Texas and Louisiana ($\chi2 = 14.13$, $P < 0.008$), Louisiana and Florida ($\chi2 = 58.07$, $P < 0.008$), Louisiana and Alabama/Mississippi ($\chi2 = 52.65$, $P < 0.008$), Texas and Florida ($\chi2 = 28.39$, $P < 0.008$), and Texas and Alabama/Mississippi ($\chi2 = 33.98$, $P < 0.008$). CV estimates were 0.0 for all states, except for Alabama/Mississippi, with a CV estimate of 0.1.

In 1994, shrimp catch rates in kilograms per hour were 5.8 ($\pm$ 0.2 SE) for Texas, 5.4 ($\pm$ 1.0 SE) for Alabama/Mississippi, 4.3 ($\pm$ 0.2 SE) for Florida, and 3.3 ($\pm$ 0.1 SE) for Louisiana. There was no significant difference of mean catch rates between Louisiana and Alabama/Mississippi ($\chi2 = 4.44$, $P > 0.008$), Texas and Alabama/Mississippi ($\chi2 = 0.20$, $P > 0.008$), and Florida and Alabama/Mississippi ($\chi2 = 1.14$, $P > 0.008$). Significant differences in mean catch rates were detected in the following comparisons: Louisiana and Florida ($\chi2 = 22.21$, $P < 0.008$), Texas and Louisiana ($\chi2 = 83.38$, $P < 0.008$), and Texas and Florida ($\chi2 = 28.35$, $P < 0.008$). CV values were 0.0 for all states, except for Alabama/Mississippi, with a CV estimate of 0.2.

Shrimp catch rate estimates in kilograms per hour in 1995 were 5.6 ($\pm$ 0.3 SE) for Florida, 5.5 ($\pm$ 0.4 SE) for Texas, and 4.4 ($\pm$ 0.2 SE) for Louisiana. There was no significant difference of mean catch rates between Florida and Texas ($\chi2 = 0.01$, $P > 0.016$). Significant differences in mean catch rates were detected in the following contrasts: Louisiana and Florida ($\chi2 = 14.10$, $P < 0.016$), and Texas and Louisiana ($\chi2 = 7.20$, $P < 0.016$). CV estimates were 0.0 for all states, with the exception of Texas, with a value of 0.1.

In 1996, shrimp catch rates in kilograms per hour were 9.7 ($\pm$ 0.7 SE) for Florida, 6.5 ($\pm$ 0.6 SE) for Texas, 6.0 ($\pm$ 0.8 SE) for Alabama/Mississippi, and 1.9 ($\pm$ 0.1 SE) for

Louisiana. There was no significant difference of mean catch rates between Texas and Alabama/Mississippi ($\chi 2 = 0.19$, $P > 0.008$). Significant differences in mean catch rates were detected in the following comparisons: Louisiana and Alabama/Mississippi ($\chi 2 = 24.70$, $P < 0.008$), Florida and Alabama/Mississippi ($\chi 2 = 11.15$, $P < 0.008$), Florida and Texas ($\chi 2 = 11.77$, $P < 0.008$), Louisiana and Florida ($\chi 2 = 113.63$, $P < 0.008$), and Texas and Louisiana ($\chi 2 = 56.38$, $P < 0.008$). CV estimates were 0.1 for all states.

Shrimp catch rate estimates in kilograms per hour in 1997 were 3.4 ($\pm$ 0.4 SE) for Texas, 2.9 ($\pm$ 0.3 SE) for Florida, and 2.8 ($\pm$ 0.1 SE) for Louisiana. No significant differences in mean catch rates were detected between the following comparisons: Texas and Florida ($\chi 2 = 1.08$, $P > .016$), Louisiana and Florida ($\chi 2 = 0.17$, $P > 0.016$), and Texas and Louisiana ($\chi 2 = 2.17$, $P > 0.016$). CV values were 0.0 for Louisiana, and 0.1 for Texas and Florida.

In 1998, shrimp CPUE was 3.4 ($\pm$ 0.3 SE) for Alabama/Mississippi, 3.0 ($\pm$ 0.3 SE) for Texas, and 2.5 ($\pm$ 0.1 SE) for Louisiana. There was no significant difference of mean catch rates between Texas and Louisiana ($\chi 2 = 3.73$, $P > 0.016$), or between Alabama/Mississippi and Texas ($\chi 2 = 0.76$, $P > 0.016$). There was a significant difference between Alabama/Mississippi and Louisiana ($\chi 2 = 7.60$, $P < 0.016$). CV estimates were 0.1 for all states.

Shrimp catch rate estimates in kilograms per hour in 1999 were 3.8 ($\pm$ 0.4 SE) for Texas, and 3.2 ($\pm$ 0.2 SE) for Louisiana. There was no significant difference of mean catch rates between Texas and Louisiana ($\chi 2 = 2.05$, $P > 0.05$). CV values were 0.0 for Louisiana, and 0.1 for Texas.

In 2000, shrimp CPUE in kilograms per hour was 9.8 ($\pm$ 0.9 SE) for Louisiana, and 5.1 ($\pm$ 1.3 SE) for Texas. There was a significant difference of mean catch rates between Louisiana and Texas ($\chi 2 = 9.12$, $P < 0.05$). CV values 0.1 and 0.2 for Louisiana and Texas, respectively.

Shrimp catch rate estimates in kilograms per hour in 2001 were 6.9 ($\pm$ 0.3 SE) for Texas, 3.9 ($\pm$ 0.3 SE) for Florida, 3.6 ($\pm$ 0.2 SE) for Louisiana, and 2.8 ($\pm$ 0.2 SE) for Alabama/Mississippi. There was no significant difference of mean catch rates between

Florida and Louisiana ($\chi2 = 0.70$, $P > 0.008$). Significant differences were detected between the following comparisons: Louisiana and Alabama/Mississippi ($\chi2 = 10.88$, $P < 0.008$), Florida and Alabama/Mississippi ($\chi2 = 12.66$, $P < 0.008$), Texas and Alabama/Mississippi ($\chi2 = 147.30$, $P < 0.008$), Alabama/Mississippi and Florida ($\chi2 = 10.89$, $P < 0.008$), Texas and Florida ($\chi2 = 63.11$, $P < 0.008$), and Texas and Louisiana ($\chi2 = 93.97$, $P < 0.008$). CV estimates were 0.0 for Louisiana and Texas, and 0.1 for Alabama/Mississippi and Florida.

In 2002, mean shrimp catch in kilograms per hour were 5.8 ($\pm$ 0.2 SE) for Texas, 5.1 ($\pm$ 0.2 SE) for Florida, 3.6 ($\pm$ 0.1 SE) for Louisiana, and 3.3 ($\pm$ 0.1 SE) for Alabama/Mississippi. There was no significant difference between Louisiana and Alabama/Mississippi ($\chi2 = 6.18$, $P > 0.008$). Significant differences were detected between the following comparisons: Florida and Alabama/Mississippi ($\chi2 = 93.88$, $P < 0.008$), Texas and Alabama/Mississippi ($\chi2 = 127.15$, $P < 0.008$), Louisiana and Florida ($\chi2 = 51.08$, $P < 0.008$), Texas and Louisiana ($\chi2 = 83.30$, $P < 0.008$), and Texas and Florida ($\chi2 = 7.38$, $P < 0.008$). CV estimates were 0.0 for all states.

Shrimp catch rates in kilograms per hour in 2003 were 7.2 ($\pm$ 0.5 SE) for Florida, 6.8 ($\pm$ 0.2 SE) for Texas, 4.9 ($\pm$ 0.2 SE) for Louisiana, and 3.6 ($\pm$ 0.1 SE) for Alabama/Mississippi. There was no significant difference of mean catch rates between Florida and Texas ($\chi2 = 0.48$, $P > 0.008$). Significant differences in mean catch rates were detected in the following comparisons: Florida and Alabama/Mississippi ($\chi2 = 42.17$, $P < 0.008$), Louisiana and Alabama/Mississippi ($\chi2 = 35.09$, $P < 0.008$), Texas and Alabama/Mississippi ($\chi2 = 136.14$, $P < 0.008$), Louisiana and Florida ($\chi2 = 16.62$, $P < 0.008$) and Texas and Louisiana ($\chi2 = 43.97$, $P < 0.008$). CV estimates were 0.0 for all states, except for Florida, with a CV of 0.1.

In 2004, shrimp CPUE in kilograms per hour was 7.2 ($\pm$ 0.3 SE) for Texas, 5.6 ($\pm$ 0.2 SE) for Louisiana, 4.6 ($\pm$ 0.2 SE) for Alabama/Mississippi, and 3.2 ($\pm$ 0.2 SE) for Florida. Significant differences in mean catch rates were detected in the following contrasts: Alabama/Mississippi and Louisiana ($\chi2 = 11.63$, $P < 0.008$), Florida and Texas ($\chi2 = 102.32$, $P < 0.008$), Florida and Alabama/Mississippi ($\chi2 = 18.28$, $P <$

0.008), Louisiana and Florida ($\chi2 = 51.61$, $P < 0.008$), Texas and Louisiana ($\chi2 = 16.14$, $P < 0.008$), and Texas and Alabama/Mississippi ($\chi2 = 49.74$, $P < 0.008$). CV estimates were 0.0 for all states, with the exception of Florida, with a value of 0.1.

Shrimp catch rates in kilograms per hour in 2005 were 8.7 ($\pm$ 0.3 SE) for Louisiana, 8.5 ($\pm$ 0.3 SE) for Texas, 5.5 ($\pm$ 0.3 SE) for Alabama/Mississippi, and 4.7 ($\pm$ 0.2 SE) for Florida. There was no significant difference of mean catch rates between Texas and Louisiana ($\chi2 = 0.10$, $P > 0.008$), or between Alabama/Mississippi and Florida ($\chi2 = 4.04$, $P > 0.008$). Significant differences in mean catch rates were detected between the following comparisons: Louisiana and Alabama/Mississippi ($\chi2 = 41.34$, $P < 0.008$), Texas and Alabama/Mississippi ($\chi2 = 38.35$, $P < 0.008$), Louisiana and Florida ($\chi2 = 97.93$, $P < 0.008$), and Texas and Florida ($\chi2 = 93.94$, $P < 0.008$). CV estimates were 0.0 for all states, except for Alabama/Mississippi, with a CV of 0.1.

Shrimp CPUE All Years Combined by State and Depth

For all years combined, shrimp catch rates in kilograms per hour for Texas waters were 6.6 ($\pm$ 0.3 SE) in the nearshore area, and 5.6 ($\pm$ 0.1 SE) in offshore waters. There was a significant difference in mean catch rates between depth zones ($\chi2 = 9.89$, $P < 0.002$). CPUE for Louisiana was 9.3 ($\pm$ 0.3 SE) for the nearshore area, and 4.0 ($\pm$ 0.1 SE) for offshore waters. A significant difference was detected between mean catch rates in the two depth zones ($\chi2 = 243.54$, $P < 0.002$). In Alabama/Mississippi waters catch rates were 4.1 ($\pm$ 0.1 SE) in the nearshore zone, and 3.8 ($\pm$ 0.1 SE) in offshore waters. There was not a significant difference in shrimp catch rates between the two zones ($\chi2 = 3.35$, $P > 0.002$). For Florida, shrimp catch rates were 5.8 ($\pm$ 0.2 SE) for the nearshore zone, and 4.6 ($\pm$ 0.1 SE) for offshore waters. There was a significant difference in mean catch rates between the two depth zones ($\chi2 = 40.14$ $P < 0.002$). CV estimates for all state areas and depth strata were 0.0.

Shrimp CPUE by Year, State and Depth

Catch rate estimates for penaeid shrimp by year, state and depth is presented in Figure 30. For all state areas, CPUE was higher in nearshore areas compared with offshore strata in the majority of years sampled, although not significantly different in all years.

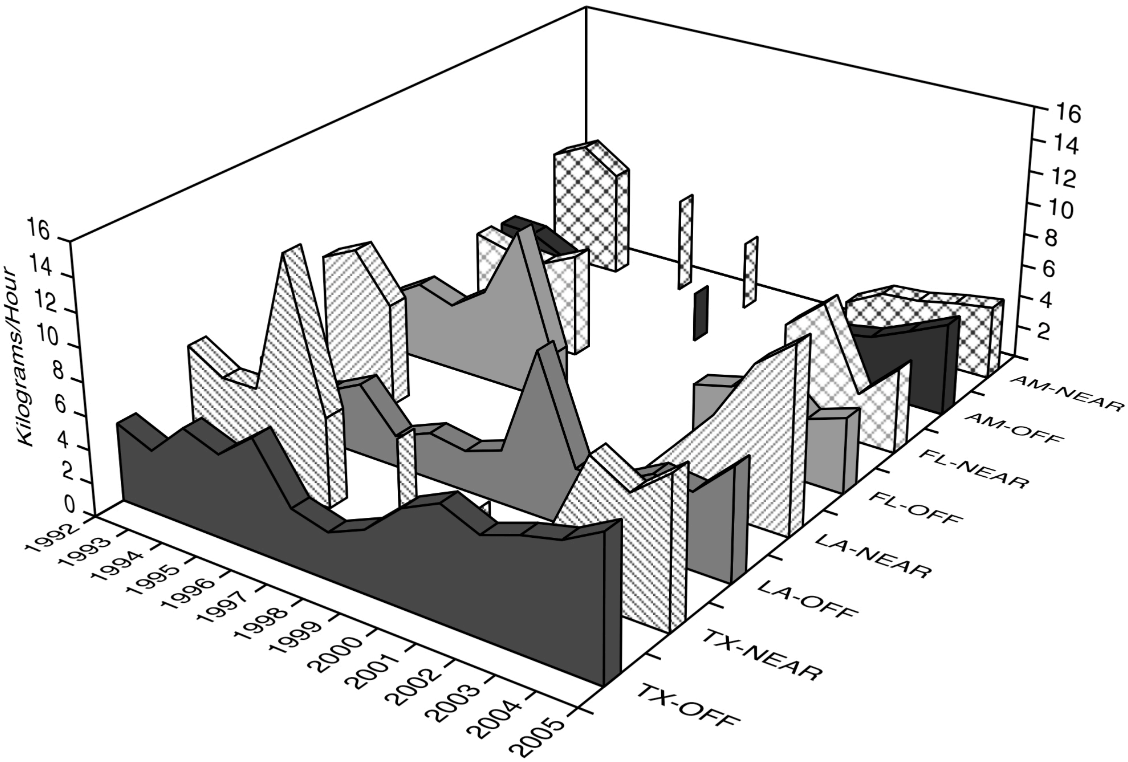

Figure 30. Penaeid shrimp CPUE in kilograms per hour in the Gulf of Mexico by year, state and depth. Nets are consistent with BRD regulations. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

In 1992, shrimp catch rates in kilograms per hour off Texas were 7.0 ($\pm$ 0.6 SE) for nearshore waters, and 4.7 ($\pm$ 0.2 SE) for offshore waters. There was no significant difference of mean catch rates between the two depth strata ($\chi 2 = 11.34$, $P > 0.002$). CV estimates for Texas were 0.1 for both near and offshore depths. Off the coast of Louisiana catch rates were higher in nearshore waters 8.1 ($\pm$ 0.5 SE) as compared with offshore waters 4.0 ($\pm$ 0.3 SE). There was a significant difference of mean catch rates between Louisiana near and offshore waters ($\chi 2 = 49.98$, $P < 0.002$). CV values for

Louisiana were 0.1 for both depth zones. CPUE in kilograms per hour off Alabama/Mississippi was 7.0 ($\pm$ 1.5 SE) for nearshore waters, and 4.2 ($\pm$ 0.7 SE) for offshore waters. There was not a significant difference of mean catch rates between the two depth strata ($\chi 2 = 2.96$, $P > 0.002$). CV estimates for Alabama/Mississippi were 0.2 for both near and offshore zones. Off Florida shrimp CPUE was 3.5 ($\pm$ 0.2 SE) for offshore waters. The CV value was 0.0.

Shrimp CPUE in kilograms per hour in 1993 off Texas was 5.7 ($\pm$ 0.6 SE) for nearshore waters, and 3.8 ($\pm$ 0.1 SE) for the offshore strata. There was a significant difference of mean catch rates between the two depth zones ($\chi 2 = 11.74$, $P < 0.002$). CV estimates for Texas were 0.1 and 0.0 for near and offshore areas, respectively. Off Louisiana, catch rates were 9.2 ($\pm$ 1.2 SE) in the nearshore area, and 2.5 ($\pm$ 0.1 SE) in offshore waters. There was a significant difference of mean catch rates between Louisiana near and offshore waters ($\chi 2 = 31.60$, $P < 0.002$). CV values for Louisiana waters were 0.1 for the nearshore zone, and 0.0 for offshore waters. Off the coast of Alabama/Mississippi shrimp CPUE was 8.1 ($\pm$ 0.6 SE) for nearshore waters, and 4.1 ($\pm$ 0.5 SE) for offshore waters. There was a significant difference of mean catch rates between the two depth strata ($\chi 2 = 29.25$, $P < 0.002$). CV estimates for Alabama/Mississippi were 0.1 in both the near and offshore depths. Off Florida, catch rates were 6.1 ($\pm$ 0.4 SE) for the nearshore zone, and 4.9 ($\pm$ 0.3 SE) for offshore waters. There was no significant difference of mean catch rates between the two depth zones ($\chi 2 = 6.28$ $P > 0.002$). CV estimates for Florida were 0.1 for both depth strata.

In 1994, Texas shrimp catch rates in kilograms per hour were 5.8 ($\pm$ 1.3 SE) for nearshore waters, and 5.8 ($\pm$ 0.2 SE) for the offshore zone. There was no significant difference of mean catch rates between the two depth strata ($\chi 2 = 0.00$, $P > 0.002$). CV estimates for Texas were 0.2 for nearshore, and 0.0 for offshore waters. Off Louisiana, CPUE was 6.3 ($\pm$ 1.3 SE) in the nearshore area, and 3.3 ($\pm$ 0.1 SE) in offshore waters. No significant difference was detected between the two depth zones ($\chi 2 = 5.32$, $P > 0.002$). CV estimates for Louisiana were 0.2 and 0.0 in near and offshore depths, respectively. CPUE in kilograms per hour off Alabama/Mississippi was 6.6 ($\pm$ 1.5 SE) for nearshore waters, and 3.0 (± 0.2 SE) for offshore waters. There was not a significant difference of mean catch rates between the two depth strata ($\chi 2 = 5.91$, $P > 0.002$). CV values for Alabama/Mississippi were 0.2 for the nearshore zone, and 0.1 for offshore waters. For Florida, shrimp catch rates were 5.6 (± 0.5 SE) for the nearshore zone, and 4.1 (± 0.2 SE) for offshore waters. There was not a significant difference of mean catch rates between the two depth zones ($\chi 2 = 6.64$, $P > 0.002$). CV estimates for Florida were 0.1 in the nearshore, and 0.0 for offshore.

Catch rates for shrimp off Texas in 1995 were 14.4 (± 3.6 SE) in the nearshore area, and 5.1 (± 0.3 SE) in offshore waters. No significant difference was detected between the two depth zones ($\chi 2 = 6.48$, $P > 0.005$). CV estimates for Texas waters were 0.1 and 0.3 in near and offshore depths, respectively. CPUE the Louisiana offshore strata was 4.4 (± 0.2 SE), with a CV of 0.0. Off Florida, catch rates were 5.4 (± 0.5 SE) for the nearshore zone, and 5.7 (± 0.3 SE) for offshore waters. There was not a significant difference of mean catch rates between the two depth zones ($\chi 2 = 0.22$, $P > 0.005$). CV estimates for Florida were 0.1 for both depth strata.

In 1996, shrimp catch rate estimates off Texas were 5.4 (± 0.4 SE) for nearshore, and 6.8 (± 0.8 SE) for offshore waters. There was no significant difference between near and offshore waters ($\chi 2 = 2.40$, $P > 0.003$). CV estimates for Texas were 0.1 for both depth strata. CPUE for the Louisiana offshore zone was 1.9 (± 0.1 SE); the CV was 0.1. The catch rate estimate for Alabama/Mississippi nearshore waters was 6.0 (± 0.8 SE), with a CV of 0.1. For Florida, catch rates were 6.4 (± 1.3 SE) in the nearshore area, and 10.1 (± 0.8 SE) in offshore waters. No significant difference was detected between the two depth zones ($\chi 2 = 5.84$, $P > 0.003$). CV estimates for Florida were 0.2 and 0.1 in near and offshore depths, respectively.

In Texas offshore waters in 1997 the catch rate estimate was 3.4 (± 0.4 SE), with a CV of 0.1. CPUE for Louisiana offshore waters was 2.8 (± 0.1 SE), with a CV of 0.0. In Florida offshore waters the CPUE was 2.9 (± 0.3 SE), with a CV of 0.1.

Shrimp catch rate estimates in kilograms per hour in 1998 for Texas were 5.7 (± 0.4 SE) for nearshore waters, and 2.8 (± 0.3 SE) for the offshore zone. There was a significant difference of mean catch rates between the two depth strata ($\chi2 = 37.16$, $P < 0.005$). CV estimates were 0.1 for near and offshore waters. CPUE for the Louisiana offshore zone was 2.5 (± 0.1 SE), with a CV of 0.1. Catch rates in kilograms per hour off Alabama/Mississippi were 4.4 (± 1.0 SE) for nearshore waters, and 3.1 (± 0.3 SE) for offshore waters. There was no significant difference of mean catch rates between the two depth strata ($\chi2 = 1.33$, $P > 0.005$). CV values for Alabama/Mississippi were 0.2 for the nearshore zone, and 0.1 for offshore waters.

Shrimp CPUE for Texas offshore waters in 1999 was 3.8 (± 0.4 SE), with a CV 0.1. For the Louisiana offshore zone, the catch rate estimate was 3.2 (± 0.2 SE), with the CV estimate equal to 0.0.

Shrimp catch rate estimates in kilograms per hour in 2000 for Texas were 2.9 (± 0.1 SE) for nearshore waters, and 5.8 (± 1.6 SE) for the offshore zone. There was no significant difference of mean catch rates between the two depth zones ($\chi2 = 3.41$, $P > 0.017$). CV estimates were 0.0 for nearshore, and 0.3 for offshore waters. In Louisiana offshore waters CPUE was 9.8 (± 0.9 SE), with a CV of 0.1.

For Texas offshore waters in 2001 the CPUE in kilograms per hour was 6.9 (± 0.3 SE); the CV was 0.0. Off Louisiana CPUE was 0.7 (± 0.1 SE) in the nearshore area, and 3.6 (± 0.2 SE) in offshore waters. There was a significant difference detected between the two depth zones ($\chi2 = 220.41$, $P < 0.003$). CV estimates for Louisiana were 0.1 and 0.0 in near and offshore depths, respectively. CPUE in kilograms per hour off Alabama/Mississippi was 2.3 (± 0.2 SE) for nearshore waters, and 3.0 (± 0.3 SE) for offshore waters. There was not a significant difference of mean catch rates between the two depth strata ($\chi2 = 4.35$, $P > 0.003$). CV values for Alabama/Mississippi estimates were 0.1 for both depth zones. In the Florida offshore zone shrimp CPUE was 3.9 (± 0.3 SE); the CV was 0.1.

In 2002, shrimp CPUE in kilograms per hour off Texas was 3.5 (± 0.7 SE) for nearshore waters, and 5.9 (± 0.2 SE) for offshore waters. There was a significant difference of mean catch rates between the two depth strata ($\chi2 = 12.09$, $P < 0.002$). CV estimates were 0.2 and 0.0 in near and offshore depths, respectively. Off Louisiana, CPUE was 3.3 ($\pm$ 0.3 SE) in the nearshore area, and 3.6 ($\pm$ 0.1 SE) in offshore waters. No significant difference was detected between the two depth zones ($\chi2 = 1.11$, $P > 0.002$). CV values were 0.1 for nearshore waters, and 0.0 in the offshore zone. CPUE in kilograms per hour off Alabama/Mississippi was 3.6 ($\pm$ 0.2 SE) for nearshore waters, and 3.2 ($\pm$ 0.1 SE) for offshore waters. There was no significant difference of mean catch rates between the two depth zones ($\chi2 = 2.84$, $P > 0.002$). CV estimates were 0.1 and 0.0 in near and offshore depths, respectively. For Florida, catch rates were 5.9 ($\pm$ 0.3 SE) in the nearshore area, and 4.4 ($\pm$ 0.2 SE) in offshore waters. There was significant difference detected between the two depth zones ($\chi2 = 20.11$, $P < 0.002$). CV estimates were 0.0 for both depth strata.

In 2003, shrimp catch rate estimates in kilograms per hour for Texas were 8.5 ($\pm$ 1.0 SE) for nearshore waters, and 6.7 ($\pm$ 0.2 SE) for the offshore zone. There was no significant difference of mean catch rates between the two depth strata ($\chi2 = 3.31$, $P > 0.002$). CV estimates for Texas were 0.1 for the nearshore zone, and 0.0 for offshore waters. Off Louisiana, CPUE was 5.8 ($\pm$ 1.2 SE) in the nearshore area, and 4.9 ($\pm$ 0.2 SE) in offshore waters. No significant difference was detected between the two depth zones ($\chi2 = 0.66$, $P > 0.002$). CV estimates for Louisiana were 0.2 and 0.0 in near and offshore depths, respectively. CPUE in kilograms per hour off Alabama/Mississippi was 3.7 ($\pm$ 0.3 SE) for nearshore waters, and 3.6 ($\pm$ 0.2 SE) for offshore waters. There was no significant difference of mean catch rates between the two depth strata ($\chi2 = 0.14$, $P > 0.002$). CV values for Alabama/Mississippi were 0.1 for the nearshore area, and 0.0 for offshore waters. For Florida, shrimp catch rates were 7.9 ($\pm$ 0.5 SE) for the nearshore zone, and 5.9 ($\pm$ 1.1 SE) for offshore waters. There was not a significant difference of mean catch rates between the two depth zones ($\chi2 = 2.99$ $P > 0.002$). CV estimates were 0.1 and 0.2 in near and offshore depths, respectively.

Catch rates for shrimp in 2004 off Texas were 7.2 ($\pm$ 0.7 SE) in the nearshore area, and 7.2 ($\pm$ 0.4 SE) in offshore waters. There was no significant difference detected between the two depth zones ($\chi2 = 0.00$, $P > 0.002$). CV estimates were 0.1 and 0.0 in near and offshore depths, respectively. Off Louisiana, CPUE was 9.5 ($\pm$ 0.6 SE) in the nearshore area, and 4.6 ($\pm$ 0.2 SE) in offshore waters. A significant difference was detected between the two depth zones ($\chi2 = 61.88$, $P < 0.002$). For Louisiana CV values were 0.1 for both near and offshore waters. For Alabama/Mississippi shrimp catch rates were 4.2 ($\pm$ 0.5 SE) in the nearshore area, and 4.6 ($\pm$ 0.2 SE) in offshore waters. There was no significant difference between depth zones ($\chi2 = 0.64$, $P > 0.002$). CV estimates were 0.1 and 0.0 in near and offshore depths, respectively. For Florida waters, catch rates were 3.0 ($\pm$ 0.3 SE) in the nearshore area, and 3.9 ($\pm$ 0.4 SE) in offshore waters. No significant difference was detected between the two depth zones ($\chi2 = 3.79$, $P > 0.002$). CV estimates were 0.1 in both depth strata.

Shrimp catch rates in kilograms per hour in 2005 in Texas waters were 9.0 ($\pm$ 0.4 SE) in the nearshore area, and 8.5 ($\pm$ 0.3 SE) in offshore waters. There was no significant difference in mean catch rates between depth zones ($\chi2 = 1.04$, $P > 0.002$). CV values for Texas were 0.0 for both near and offshore waters. CPUE for Louisiana was 11.3 ($\pm$ 0.6 SE) for the nearshore area, and 6.8 ($\pm$ 0.4 SE) for offshore waters. A significant difference was detected between mean catch rates in the two depth zones ($\chi2 = 39.73$, $P < 0.002$). CV values for Louisiana were 0.1 for both depth strata. In Alabama/Mississippi waters catch rates were 4.6 ($\pm$ 0.7 SE) in the nearshore zone, and 5.7 ($\pm$ 0.4 SE) in offshore waters. There was no significant difference relative to mean finfish catch rates between the two zones ($\chi2 = 1.96$, $P > 0.002$). CV calculations were 0.2 for nearshore, and 0.1 for offshore. In Florida, shrimp catch rates were 5.2 ($\pm$ 0.3 SE) for the nearshore zone, and 4.6 ($\pm$ 0.2 SE) for offshore waters. There was not a significant difference of mean catch rates between the two depth strata ($\chi2 = 2.21$ $P > 0.002$). CV estimates were 0.2 and 0.1 in near and offshore depths, respectively.

Shrimp CPUE All Years Combined by State, Depth and Season

For all years combined, shrimp catch rate estimates for Texas nearshore waters were 6.2 ($\pm$ 0.5 SE) in January through April, 7.3 ($\pm$ 0.4 SE) in May through August, and 3.8 ($\pm$ 0.6 SE) in September through December. There was not a significant difference between January through April and May through August ($\chi2 = 2.75$, $P > 0.0002$), and

January through April and September through December ($\chi2 = 8.84$, $P > 0.0002$). There was a significant difference between May through August and September through December ($\chi2 = 21.68$, $P < 0.0002$). CPUE in Texas offshore waters was 1.8 (± 0.1 SE) in January through April, 7.6 (± 0.1 SE) in May through August, and 3.9 (± 0.1 SE) in September through December. There was a significant difference for the following comparisons: January through April and May through August ($\chi2 = 1478.86$, $P < 0.0002$), January through April and September through December ($\chi2 = 417.15$, $P < 0.0002$), and May through August and September through December ($\chi2 = 668.05$, $P < 0.0002$). In Louisiana nearshore waters catch rate estimates were 3.0 (± 0.4 SE) in January through April, 10.7 (± 0.4 SE) in May through August, and 6.7 (± 0.5 SE) in September through December. There was a significant difference for the following comparisons: January through April and May through August ($\chi2 = 201.34$, $P < 0.0002$), January through April and September through December ($\chi2 = 34.62$, $P < 0.0002$), and May through August and September through December ($\chi2 = 37.06$, $P < 0.0002$). For Louisiana offshore waters CPUE was 2.4 (± 0.0 SE) in January through April, 5.9 (± 0.2 SE) in May through August, and 4.6 (± 0.1 SE) in September through December. There was a significant difference for the following comparisons: January through April and May through August ($\chi2 = 308.62$, $P < 0.0002$), January through April and September through December ($\chi2 = 544.75$, $P < 0.0002$), and May through August and September through December ($\chi2 = 35.17$, $P < 0.0002$). In Alabama/Mississippi nearshore waters CPUE was 2.1 (± 0.2 SE) in January through April, 5.5 (± 0.2 SE) in May through August, and 3.2 (± 0.2 SE) in September through December. There was a significant difference for the following comparisons: January through April and May through August ($\chi2 = 136.66$, $P < 0.0002$), January through April and September through December ($\chi2 = 16.17$, $P < 0.0002$), and May through August and September through December ($\chi2 = 54.52$, $P < 0.0002$). For Alabama/Mississippi offshore waters CPUE was 2.5 (± 0.1 SE) in January through April, 4.3 (± 0.1 SE) in May through August, and 4.4 (± 0.2 SE) in September through December. There was a significant difference between January through April and May through August ($\chi2$ = 137.81, P < 0.0002), and January through April and September through December ($\chi2$ = 96.37, P < 0.0002). There was no significant difference between May through August and September through December ($\chi2$ = 0.11, P > 0.0002). For Florida nearshore waters CPUE was 6.0 ($\pm$ 0.2 SE) in January through April, 5.3 ($\pm$ 0.3 SE) in May through August, and 6.4 ($\pm$ 0.6 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi2$ = 3.25, P > 0.0002), January through April and September through December ($\chi2$ = 0.50, P > 0.0002), and May through August and September through December ($\chi2$ = 2.84, P > 0.0002). In Florida offshore waters catch rates were 4.4 ($\pm$ 0.1 SE) in January through April, 4.6 ($\pm$ 0.2 SE) in May through August, and 5.7 ($\pm$ 0.2 SE) in September through December. There was not a significant difference between January through April and May through August ($\chi2$ = 0.54, P > 0.0002), and May through August and September through December ($\chi2$ = 11.80, P > 0.0002). There was a significant difference between January through April and September through December ($\chi2$ = 25.10, P < 0.0002). For all state areas, depths and seasons, CV values ranged from 0.0 to 0.2.

Shrimp CPUE by Year, State, Depth and Season

CPUE for shrimp by year, state, depth and season is depicted in Figure 31. A strong seasonal trend was observed relative to shrimp catch rates from 1992 through 2005 period. In Texas nearshore waters the May through August period yielded higher shrimp CPUE in most years. For Texas offshore waters, the May through August period was significantly higher in all years. Similarly, in Louisiana near and offshore areas the May through August period yielded higher CPUE, followed by the September through December period. This trend was also observed in Alabama/Mississippi. In Florida nearshore and offshore waters, catch rates were fairly consistent, with the September through December yielding higher CPUE during years when all seasons were sampled.

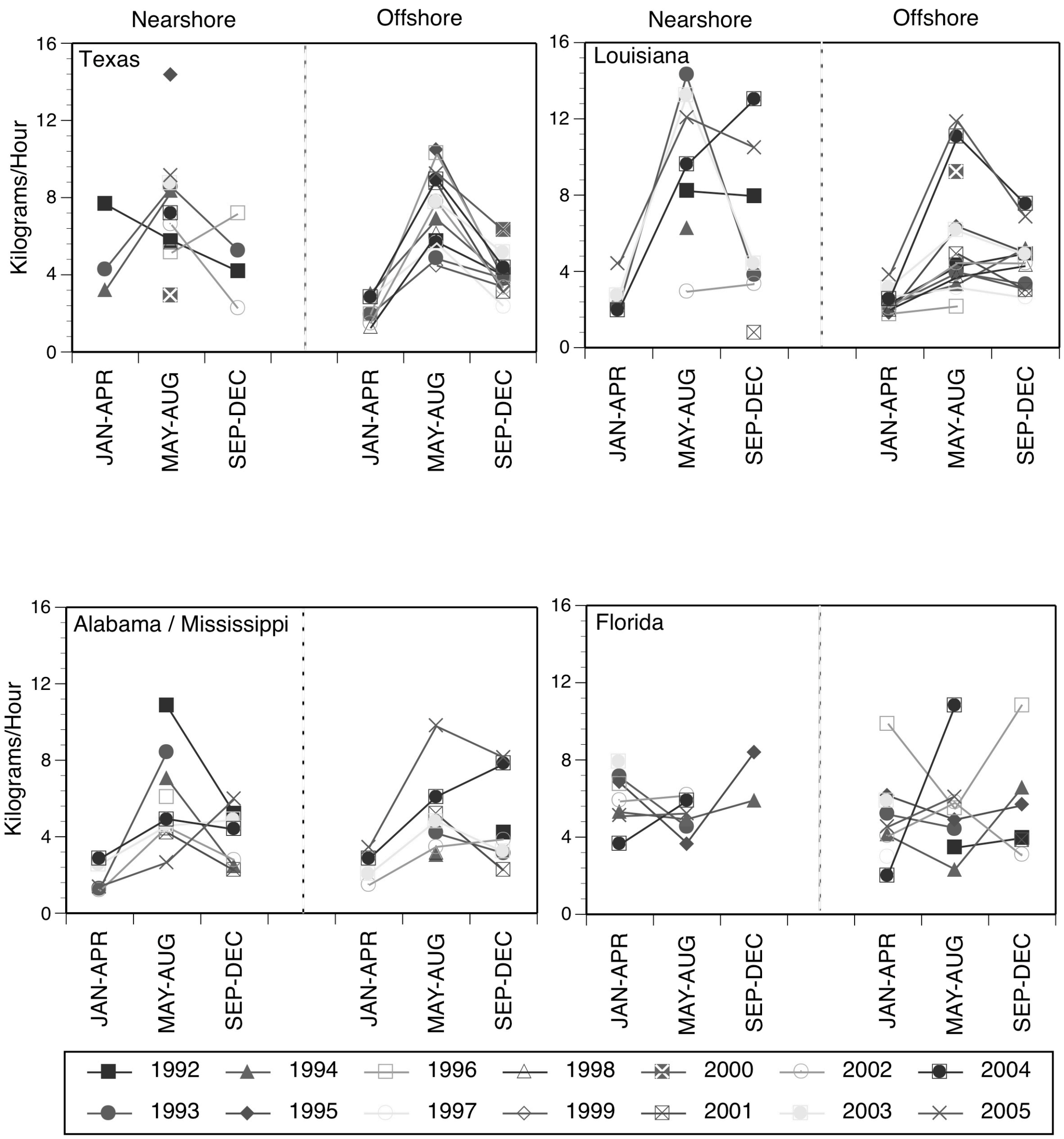

Figure 31. Penaeid shrimp CPUE in kilograms per hour in the Gulf of Mexico by year, state, depth and season. Nets are consistent with BRD regulations. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

Shrimp CPUE in kilograms per hour in 1992 off Texas nearshore waters was 7.7 (± 0.8 SE) in January through April, 5.8 (± 1.3 SE) in May through August, and 4.2 (± 0.6 SE) for September through December. There was a significant difference of mean catch rates between January through April and September through December ($\chi2$ = 13.62, P < 0.0002). No significant differences were detected between the following comparisons: January through April and May through August ($\chi2$ = 1.49, P > 0.0002), and May through August and September through December ($\chi2$ = 1.19, P > 0.0002). In Texas offshore waters catch rates were 5.7 (± 0.4 SE) in May through August, and 4.0 (± 0.3 SE) in September through December. There was a significant difference between the two seasons ($\chi2$ = 13.39, P < 0.0002). In Louisiana nearshore waters CPUE was 8.2 (± 0.7 SE) in May through August, and 7.9 (± 0.7 SE) for September through December. There was no significant difference between the two periods ($\chi2$ = 0.07, P > 0.0002). For Louisiana offshore waters CPUE was 2.3 (± 0.3 SE) in January through April, 4.3 (± 0.6 SE) in May through August, and 4.9 (± 0.3 SE) for September through December. There was a significant difference detected between January through April and September through December ($\chi2$ = 34.48, P < 0.0002). There were no significant differences for the following comparisons: January through April and May through August ($\chi2$ = 7.52, P > 0.0002), and May through August and September through December ($\chi2$ = 0.90, P > 0.0002). In Alabama/Mississippi nearshore waters CPUE was 10.8 (± 2.6 SE) in May through August, and 5.2 (± 1.3 SE) for September through December. There was no significant difference between the two seasons ($\chi2$ = 3.83, P > 0.0002). In Florida offshore waters CPUE was 3.4 (± 0.2 SE) in May through August, and 3.9 (± 0.5 SE) in September through December. There was no significant difference between the two seasons ($\chi2$ = 0.86, P > 0.0002). CV estimates were low, and ranged from 0.1 to 0.2.

Shrimp CPUE in 1993 in Texas nearshore waters was 4.3 (± 0.6 SE) in January through April, 8.5 (± 1.2 SE) in May through August, and 5.3 (± 1.4 SE) for September through December. There was no significant difference for the following comparisons: January through April and May through August ($\chi2$ = 10.44, P > 0.0003), January through April and September through December ($\chi2$ = 0.45, P > 0.0003), and May through August and September through December ($\chi2$ = 3.20, P > 0.0003). In Texas offshore waters catch rate estimates were 1.9 (± 0.1 SE) in January through April, 4.8 (±

0.3 SE) in May through August, and 3.8 (± 0.1 SE) for September through December. There was a significant difference between the following comparisons: January through April and May through August ($\chi2 = 112.98$, $P < 0.0003$), January through April and September through December ($\chi2 = 147.43$, $P < 0.0003$), and May through August and September through December ($\chi2 = 13.54$, $P < 0.0003$). For Louisiana nearshore waters CPUE was 2.1 (± 0.5 SE) in January through April, 14.3 (± 1.6 SE) in May through August, and 3.8 (± 0.8 SE) for September through December. There was no significant difference detected between January through April and September through December ($\chi2 = 2.95$, $P > 0.0003$). There was a significant difference detected for the following comparisons: January through April and May through August ($\chi2 = 53.62$, $P < 0.0003$), and May through August and September through December ($\chi2 = 34.98$, $P < 0.0003$). For Louisiana offshore waters CPUE was 2.2 (± 0.1 SE) in January through April, 3.9 (± 0.6 SE) in May through August, and 3.3 (± 0.2 SE) in September through December. There was no significant difference between January through April and May through August ($\chi2 = 7.72$, $P > 0.0003$), and May through August and September through December ($\chi2 = 0.89$, $P > 0.0003$). There was a significant difference between January through April and September through December ($\chi2 = 31.95$, $P < 0.0003$). In Alabama/Mississippi nearshore waters catch rate estimates were 1.3 (± 0.1 SE) in January through April, and 8.4 (± 0.5 SE) in May through August. There was a significant difference between the two seasons ($\chi2 = 180.90$, $P < 0.0003$). For Alabama/Mississippi offshore waters CPUE was 4.2 (± 0.5 SE) in May through August, and 3.1 (± 1.1 SE) in September through December. There was no significant difference between the two periods ($\chi2 = 0.71$, $P > 0.0003$). In Florida nearshore waters catch rate estimates were 7.1 (± 0.5 SE) in January through April, and 4.5 (± 0.5 SE) in May through August. There was no significant difference between the two seasons ($\chi2 = 12.77$, $P > 0.0003$). For Florida offshore waters CPUE was 5.2 (± 0.4 SE) in January through April, and 4.5 (± 0.4 SE) in May through August. There was not significant difference between the two periods ($\chi2 = 1.62$, $P > 0.0003$). CV estimates were relatively low, and ranged from 0.0 to 0.4

During 1994, shrimp catch rates for Texas nearshore waters were 3.2 ($\pm$ 0.6 SE) in January through April, and 8.3 ($\pm$ 1.9 SE) in May through August. There was no significant difference between the two seasons ($\chi2 = 6.95$, $P > 0.0003$). In Texas offshore waters CPUE was 3.0 ($\pm$ 0.7 SE) in January through April, 6.9 ($\pm$ 0.3 SE) in May through August, and 3.9 ($\pm$ 0.2 SE) for September through December. There was a significant difference between January through April and May through August ($\chi2 = 27.24$, $P < 0.0003$), and May through August and September through December ($\chi2 = 70.37$, $P < 0.0003$). There was no significant difference between January through April and September through December ($\chi2 = 1.67$, $P > 0.0003$). For Louisiana offshore waters CPUE was 2.3 ($\pm$ 0.1 SE) in January through April, 3.3 ($\pm$ 0.3 SE) in May through August, and 5.2 ($\pm$ 0.3 SE) in September through December. There was a significant difference between January through April and September through December ($\chi2 = 71.11$, $P < 0.0003$), and May through August and September through December ($\chi2 = 17.46$, $P < 0.0003$). There was no significant difference between January through April and May through August ($\chi2 = 9.45$, $P > 0.0003$). For Alabama/Mississippi nearshore waters CPUE was 7.0 ($\pm$ 1.6 SE) in May through August, and 2.4 ($\pm$ 0.5 SE) in September through December. There was not a significant difference between the two periods ($\chi2 = 7.62$, $P > 0.0003$). For Florida nearshore waters CPUE was 5.3 ($\pm$ 1.0 SE) in January through April, 4.9 ($\pm$ 1.4 SE) in May through August, and 5.9 ($\pm$ 0.6 SE) for September through December. There was no significant difference between the following comparisons: January through April and May through August ($\chi2 = 0.05$, $P > 0.0003$), January through April and September through December ($\chi2 = 0.26$, $P > 0.0003$), and May through August and September through December ($\chi2 = 0.43$, $P > 0.0003$). For Florida offshore waters CPUE was 4.1 ($\pm$ 0.2 SE) in January through April, 2.3 ($\pm$ 0.1 SE) in May through August, and 6.6 ($\pm$ 0.3 SE) in September through December. There was a significant difference between the following comparisons: January through April and May through August ($\chi2 = 56.64$, $P < 0.0003$), January through April and September through December ($\chi2 = 43.56$, $P < 0.0003$), and May through August and September through December ($\chi 2 = 153.97$, $P < 0.0003$). CV estimates were generally low, and ranged from 0.1 to 0.3.

For Texas offshore waters in 1995 shrimp catch rate estimates were 10.5 (± 1.4 SE) in May through August, and 3.8 (± 0.2 SE) in September through December. There was a significant difference between the two seasons ($\chi 2 = 23.58$, $P < 0.001$). For Louisiana offshore waters CPUE was 1.8 (± 0.1 SE) in January through April, 6.3 (± 0.3 SE) in May through August, and 5.0 (± 0.2 SE) in September through December. There was a significant difference between the following comparisons: January through April and May through August ($\chi 2 = 235.91$, $P < 0.001$), January through April and September through December ($\chi 2 = 229.56$, $P < 0.001$), and May through August and September through December ($\chi 2 = 16.50$, $P < 0.001$). In Florida nearshore waters catch rate estimates were 6.8 (± 1.0 SE) in January through April, 3.7 (± 0.5 SE) in May through August, and 8.4 (± 2.0 SE) for September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi 2 = 7.96$, $P > 0.001$), January through April and September through December ($\chi 2 = 0.51$, $P > 0.001$), and May through August and September through December ($\chi 2 = 5.35$, $P > 0.001$). Similarly, in Florida offshore waters CPUE was 6.1 (± 0.6 SE) in January through April, 4.9 (± 0.6 SE) in May through August, and 5.6 (± 0.4 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi 2 = 2.15$, $P > 0.001$), January through April and September through December ($\chi 2 = 0.49$, $P > 0.001$), and May through August and September through December ($\chi 2 = 1.06$, $P > 0.001$). CV estimates ranged from 0.0 to 0.3.

During 1996, shrimp CPUE in Texas nearshore waters was 5.1 (± 0.4 SE) in May through August, and 7.2 (± 0.7 SE) in September through December. There was not a significant difference between the two seasons ($\chi 2 = 5.65$, $P > 0.001$). In Texas offshore waters CPUE was 1.9 (± 0.7 SE) in January through April, 10.3 (± 0.9 SE) in May through August, and 4.0 (± 0.3 SE) for September through December. There was a significant difference between January through April and May through August ($\chi 2 =$

51.05, $P < 0.001$), and May through August and September through December ($\chi2$ = 41.57, $P < 0.001$). There was not a significant difference detected between January through April and September through December ($\chi2 = 7.84$, $P > 0.001$). In Louisiana offshore waters catch rates were 1.8 ($\pm$ 0.1 SE) in January through April, and 2.2 ($\pm$ 0.3 SE) in May through August. There was not a significant difference between the two periods ($\chi2 = 1.68$, $P > 0.001$). In Florida offshore waters CPUE was 9.9 ($\pm$ 1.0 SE) in January through April, 5.5 ($\pm$ 2.0 SE) in May through August, and 10.9 ($\pm$ 1.3 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi2 = 3.77$, $P > 0.001$), January through April and September through December ($\chi2 = 0.35$, $P > 0.001$), and May through August and September through December ($\chi2 = 5.01$, $P > 0.001$). CV estimates ranged from 0.1 to 0.4.

Shrimp CPUE in Texas offshore waters in 1997 was 2.8 ($\pm$ 0.1 SE) in January through April, 5.6 ($\pm$ 1.1 SE) in May through August, and 2.4 ($\pm$ 0.2 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi2 = 6.91$, $P > 0.002$), January through April and September through December ($\chi2 = 5.91$, $P > 0.002$), and May through August and September through December ($\chi2 = 8.91$, $P > 0.002$). In Louisiana offshore waters catch rate estimates were 2.6 ($\pm$ 0.6 SE) in January through April, 3.1 ($\pm$ 0.3 SE) in May through August, and 2.6 ($\pm$ 0.2 SE) for September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi2 = 0.63$, $P > 0.002$), January through April and September through December ($\chi2 = 0.00$, $P > 0.002$), and May through August and September through December ($\chi2 = 3.03$, $P > 0.002$). CV estimates ranged from 0.1 to 0.2.

During 1998, catch rate estimates for shrimp in Texas offshore waters were 1.2 ($\pm$ 0.0 SE) in January through April, and 6.1 ($\pm$ 0.7 SE) in May through August. There was a significant difference between the two seasons ($\chi2 = 44.25$, $P < 0.002$). In Louisiana offshore waters catch rate estimates were 2.0 ($\pm$ 0.1 SE) in January through

April, 3.7 (± 0.4 SE) in May through August, and 4.3 (± 1.0 SE) for September through December. There was no significant difference between January through April and September through December ($\chi2 = 5.66$, $P > 0.002$), and May through August and September through December ($\chi2 = 0.31$, $P > 0.002$). There was a significant difference between January through April and May through August ($\chi2 = 16.58$, $P < 0.002$). CV estimates ranged from 0.0 to 0.2.

Shrimp catch rates in 1999 for Texas offshore waters were 4.5 (± 0.3 SE) in May through August, and 3.4 (± 0.5 SE) in September through December. There was not a significant difference between the two seasons ($\chi2 = 3.64$, $P > 0.008$). CPUE for Louisiana offshore waters was 4.0 (± 0.1 SE) in May through August, and 3.1 (± 0.2 SE) in September through December. There was a significant difference detected between the two time periods ($\chi2 = 16.23$, $P < 0.008$). CV values were low, and ranged from 0.0 to 0.2.

In 2001, shrimp CPUE for Texas offshore waters was 8.7 (± 0.4 SE) in May through August, and 3.1 (± 0.1 SE) in September through December. There was a significant difference between the two seasons ($\chi2 = 205.77$, $P < 0.001$). Similarly, catch rate estimates for Louisiana offshore waters were 4.9 (± 0.4 SE) in May through August, and 3.0 (± 0.2 SE) in September through December. A significant difference was detected between the two time periods ($\chi2 = 19.40$, $P < 0.001$). For Alabama/Mississippi nearshore waters CPUE was 4.2 (± 0.2 SE) in May through August, and 2.2 (± 0.2 SE) in September through December. Again, there was a significant difference between the two seasons ($\chi2 = 47.95$, $P < 0.001$). In Alabama/Mississippi offshore waters, CPUE was 5.2 (± 0.7 SE) in May through August, and 2.2 (± 0.3 SE) in September through December. There was a significant difference between the two seasons ($\chi2 = 17.78$, $P < 0.001$). CV values were low, ranging from 0.0 to 0.1.

Catch rate estimates during 2002 Texas nearshore waters were 6.6 (± 0.5 SE) in May through August, and 2.3 (± 0.3 SE) in September through December. There was a significant difference between the two seasons ($\chi2 = 58.05$, $P < 0.0002$). CPUE in

Texas offshore waters was 1.5 ($\pm$ 0.2 SE) in January through April, 7.8 ($\pm$ 0.3 SE) in May through August, and 3.3 ($\pm$ 0.1 SE) in September through December. There was a significant difference for the following comparisons: January through April and May through August ($\chi 2$ = 361.05, $P < 0.0002$), January through April and September through December ($\chi 2$ = 70.29, $P < 0.0002$), and May through August and September through December ($\chi 2$ = 207.97, $P < 0.0002$). In Louisiana nearshore waters catch rate estimates were 2.9 ($\pm$ 0.6 SE) in May through August, and 3.3 ($\pm$ 0.4 SE) in September through December. There was not a significant difference between the two seasons ($\chi 2$ = 0.34, $P > 0.0002$). For Louisiana offshore waters CPUE was 2.1 ($\pm$ 0.1 SE) in January through April, 4.4 ($\pm$ 0.2 SE) in May through August, and 4.4 ($\pm$ 0.2 SE) in September through December. There was a significant difference between January through April and May through August ($\chi 2$ = 122.80, $P < 0.0002$), and January through April and September through December ($\chi 2$ = 92.66, $P < 0.0002$). There was not a significant difference detected between May through August and September through December ($\chi 2$ = 0.01, $P > 0.0002$). In Alabama/Mississippi nearshore waters CPUE was 1.2 ($\pm$ 0.2 SE) in January through April, 4.5 ($\pm$ 0.3 SE) in May through August, and 2.8 ($\pm$ 0.2 SE) in September through December. There was a significant difference for the following comparisons: January through April and May through August ($\chi 2$ = 98.28, $P < 0.0002$), January through April and September through December ($\chi 2$ = 27.88, $P < 0.0002$), and May through August and September through December ($\chi 2$ = 24.01, $P < 0.0002$). For Alabama/Mississippi offshore waters CPUE was 1.5 ($\pm$ 0.1 SE) in January through April, 3.5 ($\pm$ 0.1 SE) in May through August, and 3.9 ($\pm$ 0.2 SE) in September through December. There was a significant difference between January through April and May through August ($\chi 2$ = 229.95, $P < 0.0002$), and January through April and September through December ($\chi 2$ = 112.77, $P < 0.0002$). There was no significant difference between May through August and September through December ($\chi 2$ = 2.74, $P > 0.0002$). For Florida nearshore waters CPUE was 5.8 ($\pm$ 0.3 SE) in January through April, and 6.1 ($\pm$ 0.5 SE) in May through August. There was not a significant difference between the two periods ($\chi 2$ = 0.25, $P > 0.0002$). In Florida offshore waters catch rates were 4.0 (± 0.2 SE) in January through April, 5.8 (± 0.6 SE) in May through August, and 3.0 (± 0.4 SE) in September through December. There was not a significant difference between January through April and May through August ($\chi2 = 7.39$, $P > 0.0002$), and January through April and September through December ($\chi2 = 4.67$, $P > 0.0002$). There was a significant difference between May through August and September through December ($\chi2 = 14.30$, $P < 0.0002$). CV values ranged from 0.0 to 0.2.

During 2003, CPUE for shrimp in Texas offshore waters was 7.8 (± 0.3 SE) in May through August, and 5.1 (± 0.3 SE) in September through December. There was a significant difference between the two seasons ($\chi2 = 43.97$, $P < 0.0004$). Catch rate estimates for Louisiana nearshore waters were 2.7 (± 0.3 SE) in January through April, 13.2 (± 4.3 SE) in May through August, and 4.4 (± 1.1 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi2 = 5.88$, $P > 0.0004$), January through April and September through December ($\chi2 = 1.88$, $P > 0.0004$), and May through August and September through December ($\chi2 = 3.95$, $P > 0.0004$). CPUE in Louisiana offshore waters was 3.2 (± 0.3 SE) in January through April, 6.1 (± 0.4 SE) in May through August, and 4.8 (± 0.2 SE) in September through December. There was a significant difference between January through April and September through December ($\chi2 = 28.56$, $P < 0.0004$), and January through April and May through August ($\chi2 = 35.70$, $P < 0.0004$). There was no significant difference between May through August and September through December ($\chi2 = 7.74$, $P > 0.0004$). Catch rate estimates for Alabama/Mississippi nearshore waters were 2.5 (± 0.2 SE) in January through April, 4.6 (± 0.4 SE) in May through August, and 4.9 (± 1.6 SE) in September through December. There was not a significant difference between January through April and September through December ($\chi2 = 2.09$, $P > 0.0004$), and May through August and September through December ($\chi2 = 0.04$, $P > 0.0004$). There was a significant difference between January through April and May through August ($\chi2 = 22.99$, $P < 0.0004$). CPUE in Alabama/Mississippi offshore waters was 2.0 (± 0.2 SE) in January through April, 4.8 (± 0.3 SE) in May through August, and 3.2 (± 0.2 SE) in September through December.

There was a significant difference detected for the following comparisons: January through April and May through August ($\chi 2 = 77.75$, $P < 0.0004$), January through April and September through December ($\chi 2 = 19.40$, $P < 0.0004$), and May through August and September through December ($\chi 2 = 26.63$, $P < 0.0004$). CV estimates were low, and ranged from 0.0 to 0.3.

In 2004, shrimp catch rate estimates for Texas offshore waters were 2.8 (± 0.4 SE) in January through April, 9.0 (± 0.4 SE) in May through August, and 4.4 (± 0.3 SE) in September through December. There was a significant difference between January through April and May through August ($\chi 2 = 121.86$, $P < 0.0003$), and May through August and September through December ($\chi 2 = 75.27$, $P < 0.0003$). There was no significant difference between January through April and September through December ($\chi 2 = 10.10$, $P > 0.0003$). CPUE for Louisiana nearshore waters was 1.9 (± 0.5 SE) in January through April, 9.6 (± 0.6 SE) in May through August, and 13.0 (± 3.3 SE) in September through December. There was no significant difference detected between January through April and September through December ($\chi 2 = 11.23$, $P > 0.0003$), and May through August and September through December ($\chi 2 = 1.07$, $P > 0.0003$). There was a significant difference between January and April and May through August ($\chi 2 = 100.55$, $P < 0.0003$). In Louisiana offshore waters catch rates were 2.6 (± 0.1 SE) in January through April, 11.1 (± 0.9 SE) in May through August, and 7.5 (± 0.6 SE) in September through December. There was a significant difference detected between January through April and September through December ($\chi 2 = 74.51$, $P < 0.0003$), and January through April and May through August ($\chi 2 = 94.25$, $P < 0.0003$). There was no significant difference between May through August and September through December ($\chi 2 = 11.64$, $P > 0.0003$). In Alabama/Mississippi nearshore waters catch rates were 2.8 (± 1.1 SE) in January through April, 4.9 (± 0.5 SE) in May through August, and 4.4 (± 0.8 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi 2 = 3.24$, $P > 0.0003$), January through April and September through December ($\chi 2 = 1.31$, $P > 0.0003$), and May through August and September through December ($\chi 2 = 0.32$, $P >$

0.0003). In Alabama/Mississippi offshore waters CPUE was 2.8 (± 0.1 SE) in January through April, 6.1 (± 0.7 SE) in May through August, and 7.8 (± 0.5 SE) in September through December. There was a significant difference between January through April and September through December ($\chi 2 = 97.60$, $P < 0.0003$), and January through April and May through August ($\chi 2 = 22.18$, $P < 0.0003$). There was not a significant difference detected between May through August and September through December ($\chi 2 = 4.14$, $P > 0.0003$). For Florida nearshore waters catch rate estimates were 3.6 (± 0.4 SE) in January through April, and 5.9 (± 1.0 SE) in May through August. There was not a significant difference between the two seasons ($\chi 2 = 4.52$, $P > 0.0003$). For Florida offshore waters CPUE was 2.0 (± 0.1 SE) in January through April, and 10.8 (± 1.6 SE) in May through August. There was a significant difference between the two seasons ($\chi 2 = 29.95$, $P < 0.0003$). CV estimates were relatively low, and ranged from 0.0 to 0.4.

In 2005 shrimp catch rates in Texas offshore waters were 9.3 (± 0.4 SE) in May through August, and 6.3 (± 0.4 SE) in September through December. There was a significant difference between the two seasons ($\chi 2 = 24.71$, $P < 0.0003$). In Louisiana nearshore waters CPUE was 4.4 (± 0.6 SE) in January through April, 12.1 (± 0.7 SE) in May through August, and 10.5 (± 0.9 SE) in September through December. There was a significant difference detected between January through April and May through August ($\chi 2 = 68.70$, $P < 0.0003$), and January through April and September through December ($\chi 2 = 33.30$, $P < 0.0003$). There was no significant difference between May through August and September through December ($\chi 2 = 1.86$, $P > 0.0003$). In Louisiana offshore waters catch rates were 3.8 (± 0.2 SE) in January through April, 11.9 (± 1.1 SE) in May through August, and 6.8 (± 0.3 SE) in September through December. There was a significant difference for the following comparisons: January through April and May through August ($\chi 2 = 57.35$, $P < 0.0003$), January through April and September through December ($\chi 2 = 66.66$, $P < 0.0003$), and May through August and September through December ($\chi 2 = 20.86$, $P < 0.0003$). Catch rate estimates for Alabama/Mississippi nearshore waters were 1.4 (± 0.1 SE) in January through April, 2.7 (± 0.3 SE) in May through August, and 6.0 (± 0.8 SE) in September through December. There was a significant difference for the following comparisons: January through April and May through August ($\chi 2 = 19.11$, $P < 0.0003$), January through April and September through December ($\chi 2 = 29.52$, $P < 0.0003$), and May through August and September through December ($\chi 2 = 14.46$, $P < 0.0003$). CPUE for Alabama/Mississippi offshore waters was 3.4 ($\pm$ 0.2 SE) in January through April, 9.8 ($\pm$ 1.1 SE) in May through August, and 8.1 ($\pm$ 0.8 SE) in September through December. There was a significant difference detected between January through April and May through August ($\chi 2 = 33.26$, $P < 0.0003$), and January through April and September through December ($\chi 2 = 32.08$, $P < 0.0003$). There was no significant difference between May through August and September through December ($\chi 2 = 1.44$, $P > 0.0003$). For Florida nearshore waters catch rate estimates were 5.1 ($\pm$ 0.3 SE) in January through April, and 5.2 ($\pm$ 1.2 SE) in May through August. There was not a significant difference between the two seasons ($\chi 2 = 0.01$, $P > 0.0003$). For Florida offshore waters CPUE was 4.5 ($\pm$ 0.2 SE) in January through April, and 6.1 ($\pm$ 0.7 SE) in May through August. There was no significant difference between the two time periods ($\chi 2 = 4.87$, $P > 0.0003$). CV estimates ranged from 0.0 to 0.4.

Red Snapper CPUE All Years Combined by State

For all years combined, red snapper catch rates in kilograms per hour were 0.2 ($\pm$ 0.0 SE) for Texas, 0.1 ($\pm$ 0.0 SE) for Louisiana, 0.0 ($\pm$ 0.0 SE) for Alabama/Mississippi, and 0.0 ($\pm$ 0.0 SE) Florida. Significant differences were detected between the following comparisons: Florida and Alabama/Mississippi ($\chi 2 = 189.05$, $P < 0.008$), Louisiana and Alabama/Mississippi ($\chi 2 = 72.37$, $P < 0.008$), Texas and Alabama/Mississippi ($\chi 2 = 417.47$, $P < 0.008$), Louisiana and Florida ($\chi 2 = 425.78$, $P < 0.008$), Texas and Florida ($\chi 2 = 871.57$, $P < 0.008$), and Texas and Louisiana ($\chi 2 = 170.43$, $P < 0.008$). CV estimates were ranged from 0.0 to 0.9.

Red Snapper CPUE by Year and State

Approximately 5,127.9 kilograms of red snapper were obtained from 9,509 tows during 52,494 hours of trawling in the Gulf of Mexico from 1992 through 2005. Collectively, for all years and state areas red snapper CPUE was 0.1. CPUE in kilograms per hour for red snapper by year and state is presented in Figure 32. Texas, followed by Louisiana, experienced higher CPUE for red snapper. Red snapper were caught in most years and states; however, the values were low and less than 0.1 in most instances. For this reason, the sections below focused on catch rates primarily in Texas and Louisiana, and Alabama/Mississippi in years when catch rates were ≥ 0.1.

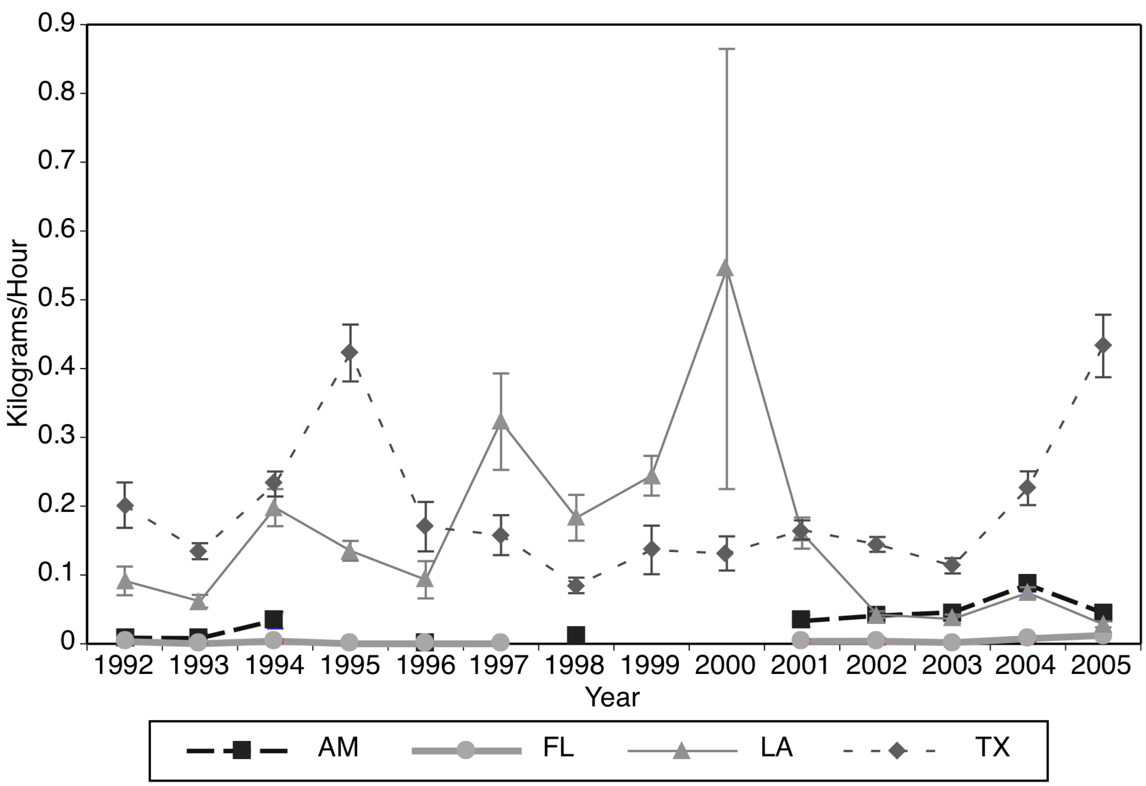

Figure 32. Red snapper CPUE in kilograms per hour by year and state for nets consistent with BRD regulations. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

In 1992, red snapper CPUE in kilograms per hour was 0.2 ($\pm$ 0.0 SE) for Texas, and 0.1 ($\pm$ 0.0 SE) for Louisiana. There was a significant difference of mean catch rates between Texas and Louisiana ($\chi 2 = 7.95$, $P < 0.008$). CV estimates for were 0.2 for both states.

A similar pattern was observed in 1993 relative to estimated red snapper catch rates. CPUE in kilograms per hour was 0.1 ($\pm$ 0.0 SE) for Texas, and 0.1 ($\pm$ 0.0 SE) for Louisiana. Again, there was a significant difference of mean catch rates detected between Texas and Louisiana ($\chi 2 = 23.90$, $P < 0.008$). CV estimates were 0.1 for Texas, and 0.2 for Louisiana.

In 1994, red snapper catch rates in kilograms per hour were 0.2 ($\pm$ 0.0 SE) for Texas and 0.2 ($\pm$ 0.0 SE) for Louisiana. There was no significant difference of mean catch rates between Texas and Louisiana ($\chi 2 = 1.12$, $P > 0.008$). CV estimates were 0.1 for both states.

Red snapper CPUE in kilograms per hour in 1995 was 0.4 ($\pm$ 0.0 SE) for Texas, and 0.1 for Louisiana ($\pm$ 0.0 SE). There was a significant difference in mean catch rates detected between Texas and Louisiana ($\chi 2 = 43.14$, $P < 0.016$). CV values were 0.1 for both Texas and Louisiana.

In 1996, red snapper catch rates in kilograms per hour were 0.2 ($\pm$ 0.0 SE) for Texas, and 0.1 for Louisiana ($\pm$ 0.0 SE). There was no significant difference in mean catch rates between Texas and Louisiana ($\chi 2 = 2.95$, $P > 0.008$). CV values were 0.2 for Texas and 0.3 for Louisiana.

Red snapper catch rate estimates in kilograms per hour in 1997 were 0.3 ($\pm$ 0.1 SE) for Louisiana, and 0.2 ($\pm$ 0.0 SE) for Texas. No significant difference in red snapper mean catch rates was detected between Louisiana and Texas ($\chi 2 = 4.73$, $P > 0.016$). CV values were 0.2 for both areas.

In 1998, red snapper CPUE was 0.2 ($\pm$ 0.0 SE) for Louisiana, and 0.1 ($\pm$ 0.0 SE) for Texas. There was a significant difference of mean catch rates between Louisiana and Texas ($\chi 2 = 7.82$, $P < 0.016$). CV estimates were 0.2 for Louisiana, and 0.1 for Texas.

Red snapper CPUE in kilograms per hour in 1999 was 0.2 ($\pm$ 0.0 SE) for Louisiana, and 0.1 ($\pm$ 0.0 SE) for Texas. There was a significant difference of red snapper mean catch rates between Louisiana and Texas ($\chi2 = 5.60$, $P < 0.05$). CV values were 0.1 for Louisiana, and 0.3 for Texas.

Red snapper catch rate estimates in kilograms per hour in 2000 were 0.5 ($\pm$ 0.3 SE) for Louisiana, and 0.1 ($\pm$ 0.0 SE) for Texas. There was not a significant difference of mean catch rates between Louisiana and Texas ($\chi2 = 1.66$, $P > 0.05$). CV values were 0.6 for Louisiana, and 0.2 for Texas.

In 2001, red snapper CPUE in kilograms per hour was 0.2 ($\pm$ 0.0 SE) for Louisiana, and 0.2 ($\pm$ 0.0 SE) for Texas. There was no significant difference of mean catch rates between Louisiana and Texas ($\chi2 = 0.03$, $P > 0.008$). CV estimates were 0.1 for both states.

Red snapper catch rates in kilograms per hour in 2002 were 0.1 ($\pm$ 0.0 SE) for Texas, and 0.0 ($\pm$ 0.0 SE) for Louisiana. There was a significant difference detected between the Texas and Louisiana ($\chi2 = 75.07$, $P < 0.008$). CV estimates were 0.1 for both states.

As in 2002, red snapper catch rates in kilograms per hour in 2003 were 0.1 ($\pm$ 0.0 SE) for Texas, and 0.0 ($\pm$ 0.0 SE) for Louisiana. There was a significant difference between the Texas and Louisiana ($\chi2 = 36.41$, $P < 0.008$). CV estimates were 0.1 for Texas, and 0.2 for Louisiana.

Red snapper catch rate estimates in kilograms per hour in 2004 were 0.2 ($\pm$ 0.0 SE) for Texas, 0.1 ($\pm$ 0.0 SE) for Louisiana, and 0.1 ($\pm$ 0.0 SE) for Alabama/Mississippi. There was no significant difference between the Louisiana and Alabama/Mississippi ($\chi2 = 0.86$, $P > 0.008$). There was a significant difference in mean catch rates between Texas and Louisiana ($\chi2 = 34.69$, $P < 0.008$), and between Texas and Alabama/Mississippi ($\chi2 = 27.96$, $P < 0.008$). CV estimates were 0.1 for all areas.

In 2005, red snapper catch rates in kilograms per hour were 0.4 ($\pm$ 0.9 SE) for Texas, and 0.0 ($\pm$ 0.0 SE) for Louisiana. There was a significant difference in mean catch rates detected between Texas and Louisiana ($\chi 2 = 78.61$, $P < 0.008$). CV estimates were 0.1 for Texas and 0.2 for Louisiana.

Red Snapper All Years Combined by State and Depth

For all years combined, red snapper CPUE in kilograms per hour for Texas waters were 0.1 ($\pm$ 0.0 SE) in the nearshore area, and 0.2 ($\pm$ 0.0 SE) in offshore waters. There was a significant difference in mean catch rates between depth zones ($\chi 2 = 62.46$, $P < 0.002$). CPUE for Louisiana was 0.0 ($\pm$ 0.0 SE) for the nearshore area, and 0.1 ($\pm$ 0.0 SE) for offshore waters. A significant difference was detected between mean catch rates in the two depth zones ($\chi 2 = 442.73$, $P < 0.002$). In Alabama/Mississippi waters catch rates were 0.0 ($\pm$ 0.0 SE) in the nearshore zone, and 0.1 ($\pm$ 0.0 SE) in offshore waters. There was a significant difference in red snapper catch rates between the two zones ($\chi 2 = 102.04$, $P < 0.002$). For Florida, red snapper catch rates were 0.0 ($\pm$ 0.0 SE) for the nearshore zone, and 0.0 ($\pm$ 0.0 SE) for offshore waters. There was a significant difference in mean catch rates between the two depth zones ($\chi 2 = 22.55$ $P < 0.002$). CV estimates for all state areas and depth strata ranged from 0.0 to 1.0.

Red Snapper CPUE by Year, State and Depth

Catch rates for red snapper by year, state and depth is presented in Figure 33. In all years and for all state areas, offshore waters consistently yielded higher catch rate values compared with nearshore strata; CPUE was significantly higher in most years. Differences in catch rates in near and offshore waters by year and state for Texas and Louisiana (and for Alabama/Mississippi in years with CPUE $\geq$ 0.1) are presented below. Florida near and offshore catch rates were below 0.1.

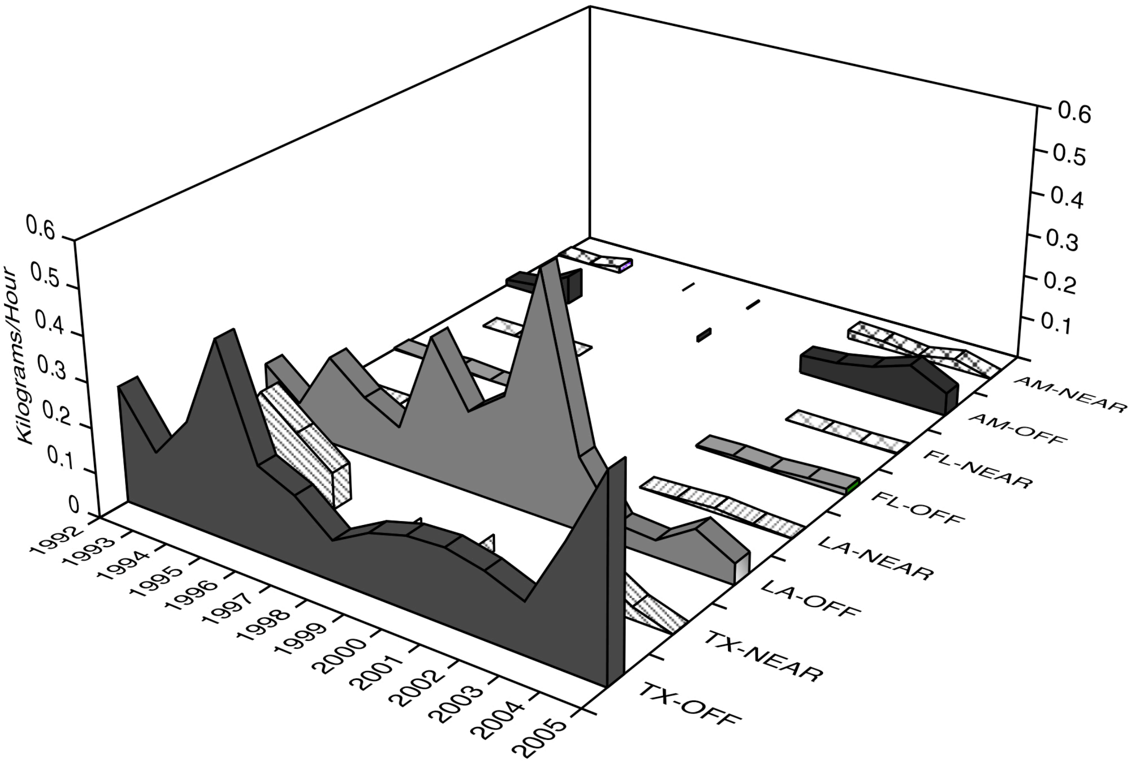

Figure 33. Red snapper CPUE in kilograms per hour in the Gulf of Mexico by year, state and depth. Nets are consistent with BRD regulations. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

Red snapper CPUE in kilograms per hour in 1992 off Texas was 0.1 (± 0.0 SE) for nearshore waters, and 0.3 (± 0.0 SE) for offshore waters. There was a significant difference of mean catch rates between the two depth strata ($\chi 2 = 12.26$, $P < 0.002$). CV estimates were 0.7 and 0.2 in near and offshore depths, respectively. Off the coast of Louisiana catch rates in nearshore waters were 0.0 (± 0.0 SE) as compared with offshore waters 0.1 (± 0.0 SE). There was a significant difference of mean catch rates between Louisiana near and offshore waters ($\chi 2 = 15.71$, $P < 0.002$). CV values were 0.4 in nearshore waters, and 0.2 in the offshore zone.

In 1993, red snapper catch rates in kilograms per hour off Texas were 0.1 (± 0.0 SE) for nearshore waters, and 0.1 (± 0.0 SE) for the offshore strata. There was no significant difference of mean catch rates between the two depth zones ($\chi 2 = 1.92$, P >

0.002). CV estimates were 0.4 and 0.1 for near and offshore areas, respectively. Off Louisiana catch rates were 0.0 ($\pm$ 0.0 SE) in the nearshore area, and 0.1 ($\pm$ 0.0 SE) in offshore waters. There was a significant difference of mean catch rates between Louisiana near and offshore waters ($\chi2 = 43.65$, $P < 0.002$). CV values were 1.0 for the nearshore zone, and 0.2 for offshore waters.

Red snapper catch rate estimates in kilograms per hour in 1994 for Texas were 0.2 ($\pm$ 0.1 SE) for nearshore waters, and 0.2 ($\pm$ 0.0 SE) for the offshore zone. There was no significant difference of mean catch rates between the two depth strata ($\chi2 = 0.06$, $P > 0.002$). CV estimates were 0.4 for nearshore, and 0.1 for offshore waters. Off Louisiana, CPUE was 0.0 ($\pm$ 0.0 SE) in the nearshore area, and 0.2 ($\pm$ 0.0 SE) in offshore waters. There was a significant difference detected between the two depth zones ($\chi2 = 53.77$, $P < 0.002$). CV estimates could not be calculated in nearshore waters because there was no variance; in offshore depths the CV was 0.1. In Alabama/Mississippi waters catch rates were 0.0 ($\pm$ 0.0 SE) in the nearshore zone, and 0.1 ($\pm$ 0.0 SE) in offshore waters. There was not a significant difference relative to mean red snapper catch rates between the two zones ($\chi2 = 2.62$, $P > 0.002$). CV calculations were 0.4 for nearshore, and 0.5 for offshore waters.

In 1995, catch rates for red snapper off Texas were 0.1 ($\pm$ 0.0 SE) in the nearshore area, and 0.4 ($\pm$ 0.0 SE) in offshore waters. There was a significant difference detected between the two depth zones ($\chi2 = 20.93$, $P < 0.005$). CV estimates were 0.3 and 0.1 in near and offshore depths, respectively. CPUE in the Louisiana offshore strata was 0.1 ($\pm$ 0.0 SE), with a CV of 0.1.

Red snapper CPUE in 1996 off Texas was 0.1 ($\pm$ 0.0 SE) for nearshore and 0.2 ($\pm$ 0.0 SE) for offshore waters. There was no significant difference between near and offshore waters ($\chi2 = 3.69$, $P > 0.003$). CV estimates were 0.5 in nearshore waters, and 0.2 in the offshore strata. CPUE for the Louisiana offshore zone was 0.1 ($\pm$ 0.0 SE); the CV was 0.3.

CPUE for the Texas offshore zone in 1997 was 0.2 (± 0.0 SE), with a CV of 0.2. The catch rate estimate for Louisiana offshore waters was 0.3 (± 0.1 SE); the CV value was 0.2.

Red Snapper catch rate estimates in kilograms per hour in 1998 for Texas were 0.0 (± 0.0 SE) for nearshore waters, and 0.1 (± 0.0 SE) for the offshore zone. There was a significant difference of mean catch rates between the two depth strata ($\chi 2 = 31.74$, $P < 0.005$). CV estimates were 0.4 for nearshore, and 0.1 for offshore waters. Red snapper CPUE for the Louisiana offshore zone was 0.2 (± 0.0 SE), with a CV of 0.2.

CPUE for Texas offshore waters in 1999 was 0.1 (± 0.0 SE), with a CV 0.3. For the Louisiana offshore area, the catch rate estimate was 0.2 (± 0.0 SE), with the CV estimate equal to 0.0.

Red snapper catch rate estimates in kilograms per hour in 2000 for Texas were 0.0 (± 0.0 SE) for nearshore waters, and 0.2 (± 0.0 SE) for the offshore zone. There was a significant difference of mean catch rates between the two depth zones ($\chi 2 = 20.76$, $P < 0.017$). CV estimates were 0.5 for the nearshore zone, and 0.1 for offshore waters. In Louisiana offshore waters CPUE was 0.5 (± 0.3 SE), with a CV of 0.6.

In 2001 in Texas offshore waters, the CPUE in kilograms per hour was 0.2 (± 0.0 SE); the CV was 0.1. Off Louisiana, CPUE was 0.0 (± 0.0 SE) in the nearshore area, and 0.2 (± 0.0 SE) in offshore waters. There was a significant difference detected between the two depth zones ($\chi 2 = 50.81$, $P < 0.003$). CV estimates could not be calculated for nearshore waters due to no recorded catch; in the offshore strata, the CV was and 0.1.

In 2002, red snapper in kilograms per hour off Texas was 0.0 (± 0.0 SE) for nearshore waters, and 0.1 (± 0.0 SE) for offshore waters. There was a significant difference of mean catch rates between the two depth strata ($\chi 2 = 32.87$, $P < 0.002$). CV estimates were 0.8 and 0.1 in near and offshore depths, respectively. Off Louisiana, CPUE was 0.0 (± 0.0 SE) in the nearshore area, and 0.0 (± 0.0 SE) in offshore waters. There was a significant difference detected between the two depth zones ($\chi 2 = 40.09$, $P < 0.002$). CV values were 0.8 for nearshore, and 0.1 for offshore waters.

Red snapper catch rate estimates in kilograms per hour in 2003 for Texas were 0.1 ($\pm$ 0.0 SE) for nearshore waters, and 0.1 ($\pm$ 0.0 SE) for the offshore zone. There was not a significant difference of mean catch rates between the two depth strata ($\chi 2 = 3.64$, $P > 0.002$). CV estimates were 0.2 for the nearshore area, and 0.1 for offshore waters. Off Louisiana, CPUE was 0.0 ($\pm$ 0.0 SE) in the nearshore area, and 0.0 ($\pm$ 0.0 SE) in offshore waters. There was a significant difference detected between the two depth zones ($\chi 2 = 12.22$, $P < 0.002$). CV estimates were 0.4 and 0.2 in near and offshore depths, respectively. CPUE in kilograms per hour off Alabama/Mississippi was 0.0 ($\pm$ 0.0 SE) for nearshore waters, and 0.1 ($\pm$ 0.0 SE) for offshore waters. A significant difference of mean catch rates was detected between the two depth strata ($\chi 2 = 12.53$, $P < 0.002$). CV values were 0.4 for nearshore waters, and 0.3 in the offshore strata.

In 2004, catch rates for red snapper off Texas were 0.0 ($\pm$ 0.0 SE) in the nearshore area, and 0.3 ($\pm$ 0.0 SE) in offshore waters. A significant difference was detected between the two depth zones ($\chi 2 = 54.44$, $P < 0.002$). CV estimates were 0.5 and 0.1 in near and offshore depths, respectively. Off Louisiana, CPUE was 0.0 ($\pm$ 0.0 SE) in the nearshore area, and 0.1 ($\pm$ 0.0 SE) in offshore waters. A significant difference was detected between the two depth zones ($\chi 2 = 77.85$, $P < 0.002$). CV values were 0.4 for near, and 0.1 for offshore waters. For Alabama/Mississippi finfish catch rates were 0.0 ($\pm$ 0.0 SE) in the nearshore area, and 0.1 ($\pm$ 0.0 SE) in offshore waters. Again, there was a significant difference between depth zones ($\chi 2 = 30.58$, $P < 0.002$). CV estimates were 0.3 and 0.1 in near and offshore depths, respectively.

Red snapper catch rates in kilograms per hour for 2005 for Texas waters were 0.0 ($\pm$ 0.0 SE) in the nearshore area, and 0.4 ($\pm$ 0.0 SE) in offshore waters. There was a significant difference in mean catch rates between depth zones ($\chi 2 = 91.29$, $P < 0.002$). CV values were 1.0 for the nearshore zone, and 0.1 for offshore waters. CPUE for Louisiana was 0.0 ($\pm$ 0.0 SE) for the nearshore area, and 0.0 ($\pm$ 0.0 SE) for offshore waters. A significant difference was detected between mean catch rates in the two depth zones ($\chi 2 = 42.04$, $P < 0.002$). CV values were 0.6 in nearshore waters and 0.2 in the offshore strata. In Alabama/Mississippi waters catch rates were 0.0 ($\pm$ 0.0 SE) in the nearshore zone, and 0.1 ($\pm$ 0.0 SE) in offshore waters. There was a significant difference relative to mean red snapper catch rates between the two zones ($\chi 2 = 44.76$, $P < 0.002$). CV calculations were 1.0 for nearshore, and 0.1 for offshore waters.

Red Snapper All Years Combined by State, Depth and Season

For all years combined, red snapper catch rate estimates for Texas nearshore waters were 0.0 ($\pm$ 0.0 SE) in January through April, 0.1 ($\pm$ 0.0 SE) in May through August, and 0.0 ($\pm$ 0.0 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi 2 = 7.28$, $P > 0.0002$), January through April and September through December ($\chi 2 = 0.17$, $P > 0.0002$), and May through August and September through December ($\chi 2 = 11.04$, $P > 0.0002$). CPUE in Texas offshore waters was 0.1 ($\pm$ 0.0 SE) in January through April, 0.2 ($\pm$ 0.0 SE) in May through August, and 0.3 ($\pm$ 0.0 SE) in September through December. There was a significant difference detected between the following comparisons: January through April and May through August ($\chi 2 = 30.80$, $P < 0.0002$), January through April and September through December ($\chi 2 = 135.47$, $P < 0.0002$), and May through August and September through December ($\chi 2 = 53.12$, $P < 0.0002$). In Louisiana nearshore waters catch rate estimates were 0.0 ($\pm$ 0.0 SE) in January through April, 0.0 ($\pm$ 0.0 SE) in May through August, and 0.0 ($\pm$ 0.0 SE) in September through December. There was no significant difference between the following comparisons: January through April and May through August ($\chi 2 = 0.49$, $P > 0.0002$), January through April and September through December ($\chi 2 = 0.45$, $P > 0.0002$), and May through August and September through December ($\chi 2 = 0.00$, $P > 0.0002$). For Louisiana offshore waters CPUE was 0.1 ($\pm$ 0.0 SE) in January through April, 0.1 ($\pm$ 0.0 SE) in May through August, and 0.2 ($\pm$ 0.0 SE) in September through December. There was a significant difference between January through April and September through December ($\chi 2 = 97.30$, $P < 0.0002$), and May through August and September through December ($\chi 2 = 25.97$, $P < 0.0002$). There was no significant difference between January through April and May through August ($\chi 2 = 5.81$, $P >$

0.0002). In Alabama/Mississippi nearshore waters CPUE was 0.0 (± 0.0 SE) in January through April, 0.0 (± 0.0 SE) in May through August, and 0.0 (± 0.0 SE) in September through December. There was not a significant difference between the following comparisons: January through April and May through August ($\chi 2 = 3.76$, $P > 0.0002$), January through April and September through December ($\chi 2 = 2.94$, $P > 0.0002$), and May through August and September through December ($\chi 2 = 0.30$, $P > 0.0002$). For Alabama/Mississippi offshore waters CPUE was 0.1 (± 0.0 SE) in January through April, 0.0 (± 0.0 SE) in May through August, and 0.1 (± 0.0 SE) in September through December. There was not a significant difference between January through April and May through August ($\chi 2 = 1.64$, $P > 0.0002$), and January through April and September through December ($\chi 2 = 8.73$, $P > 0.0002$). There was a significant difference between May through August and September through December ($\chi 2 = 33.05$, $P < 0.0002$). For Florida nearshore waters CPUE was 0.0 (± 0.0 SE) in January through April, 0.0 (± 0.0 SE) in May through August, and 0.0 (± 0.0 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi 2 = 2.58$, $P > 0.0002$), January through April and September through December ($\chi 2 = 3.85$, $P > 0.0002$), and May through August and September through December ($\chi 2 = 2.02$, $P > 0.0002$). In Florida offshore waters catch rates were 0.0 (± 0.0 SE) in January through April, 0.0 (± 0.0 SE) in May through August, and 0.0 (± 0.0 SE) in September through December. As in the nearshore waters, there was not a significant difference between the following comparisons: January through April and May through August ($\chi 2 = 0.42$, $P > 0.0002$), January through April and September through December ($\chi 2 = 0.68$, $P > 0.0002$), and May through August and September through December ($\chi 2 = 0.03$, $P > 0.0002$). For all state areas, depths and seasons, CV values ranged from 0.0 to 0.4.

Red Snapper CPUE by Year, State, Depth and Season

CPUE for red snapper by year, state, depth and season is denoted in Figure 34. In the Texas nearshore area, CPUE was higher in May through August. In Texas offshore waters, the September through December yielded higher CPUE in the majority of years. A similar trend was observed in Louisiana near and offshore waters.

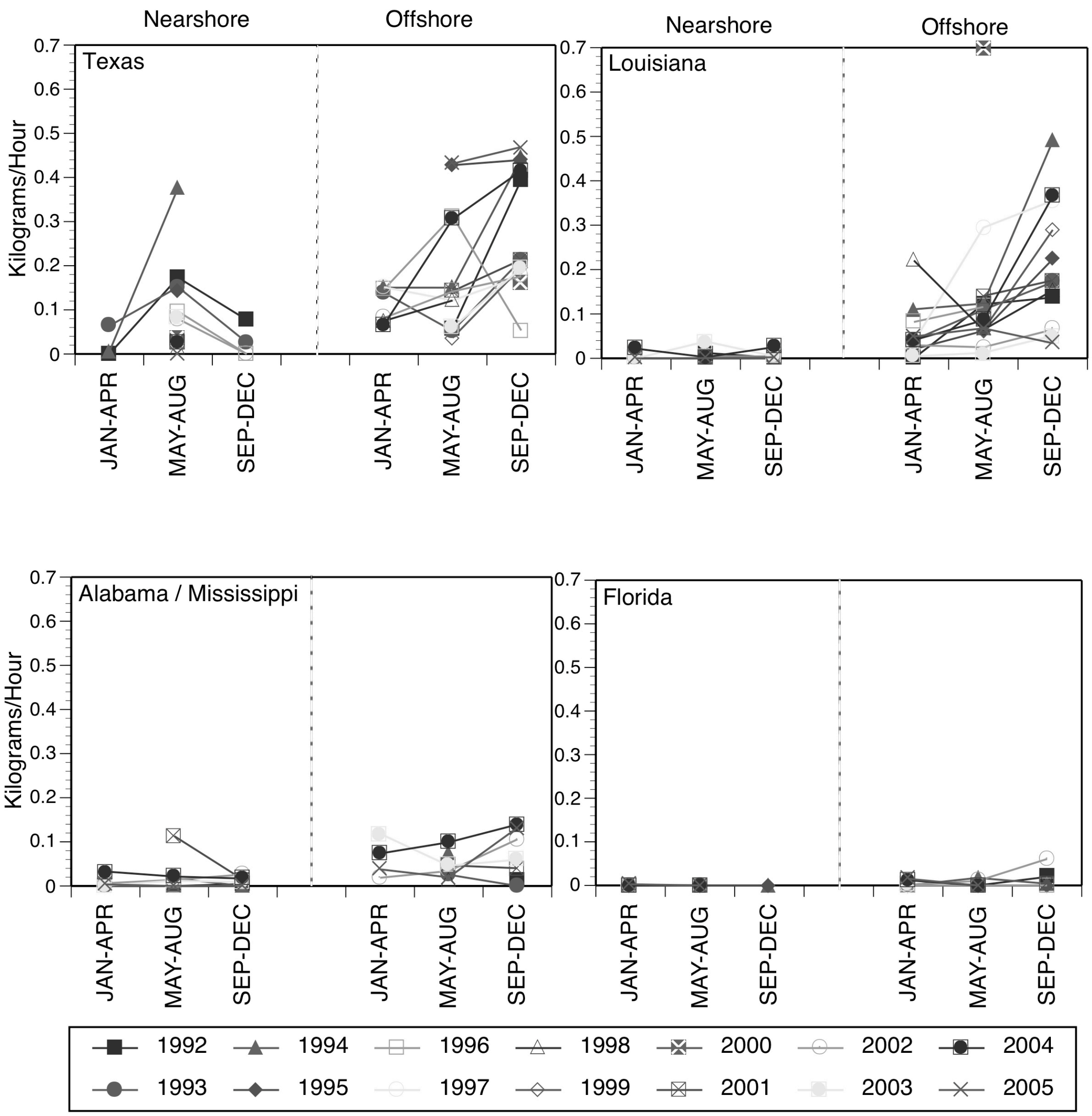

Figure 34. Red snapper CPUE in kilograms per hour in the Gulf of Mexico by year, state, depth and season. Nets are consistent with BRD regulations. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

Red snapper CPUE in kilograms per hour in 1992 off Texas nearshore waters was 0.0 (± 0.0 SE) in January through April, 0.2 (± 0.1 SE) in May through August, and 0.1 (± 0.0 SE) for September through December. There was not a significant difference in mean catch rates between the following comparisons: January through April and September through December ($\chi2 = 3.57$, $P > 0.0005$), January through April and May through August ($\chi2 = 1.79$, $P > 0.0005$), and May through August and September through December ($\chi2 = 0.50$, $P > 0.0005$). In Texas offshore waters catch rates were 0.1 (± 0.0 SE) in May through August, and 0.4 (± 0.1 SE) in September through December. There was a significant difference detected between the two seasons ($\chi2 = 23.78$, $P < 0.0005$). In Louisiana nearshore waters CPUE was 0.0 (± 0.0 SE) in May through August, and 0.0 (± 0.0 SE) for September through December. There was no significant difference between the two periods ($\chi2 = 3.56$, $P > 0.0005$). For Louisiana offshore waters CPUE was 0.0 (± 0.0 SE) in January through April, 0.1 (± 0.1 SE) in May through August, and 0.1 (± 0.0 SE) for September through December. There was a significant difference detected between January through April and September through December ($\chi2 = 42.07$, $P < 0.0005$). There were no significant differences between the following comparisons: January through April and May through August ($\chi2 = 4.72$, $P > 0.0005$), and May through August and September through December ($\chi2 = 0.07$, $P > 0.0005$). CV estimates were relatively high, and ranged from 0.2 to 1.0.

Red snapper CPUE in 1993 in Texas nearshore waters was 0.1 (± 0.0 SE) in January through April, 0.2 (± 0.1 SE) in May through August, and 0.0 (± 0.0 SE) for September through December. There was no significant difference for the following comparisons: January through April and May through August ($\chi2 = 1.08$, $P > 0.0003$), January through April and September through December ($\chi2 = 0.63$, $P > 0.0003$), and May through August and September through December ($\chi2 = 2.85$, $P > 0.0003$). In Texas offshore waters catch rate estimates were 0.1 (± 0.0 SE) in January through April, 0.1 (± 0.0 SE) in May through August, and 0.2 (± 0.0 SE) in September through December. There was a significant difference between January through April and May through August ($\chi2 = 14.92$, $P < 0.0003$), and May through August and September through December ($\chi2 = 37.59$, $P < 0.0003$). There was no significant difference between January through April and September through December ($\chi2 = 5.79$, $P > 0.0003$). For Louisiana nearshore waters CPUE was 0.0 ($\pm$ 0.0 SE) in January through April, 0.0 ($\pm$ 0.0 SE) in May through August, and 0.0 ($\pm$ 0.0 SE) for September through December. There was no significant difference detected between January through April and May through August ($\chi2 = 0.98$, $P > 0.0003$), and May through August and September through December ($\chi2 = 0.98$, $P > 0.0003$). For Louisiana offshore waters CPUE was 0.0 ($\pm$ 0.0 SE) in January through April, 0.1 ($\pm$ 0.1 SE) in May through August, and 0.2 ($\pm$ 0.0 SE) in September through December. There was no significant difference in mean catch rates for the following comparisons: January through April and May through August ($\chi2 = 0.88$, $P > 0.0003$), January through April and September through December ($\chi2 = 10.81$, $P > 0.0003$), and May through August and September through December ($\chi2 = 0.58$, $P > 0.0003$). CV estimates were ranged from 0.1 to 1.0.

During 1994, red snapper catch rates for Texas nearshore waters were 0.0 ($\pm$ 0.0 SE) in January through April, and 0.4 ($\pm$ 0.1 SE) in May through August. There was no significant difference between the two seasons ($\chi2 = 7.53$, $P > 0.0003$). In Texas offshore waters CPUE was 0.2 ($\pm$ 0.1 SE) in January through April, 0.2 ($\pm$ 0.0 SE) in May through August, and 0.4 ($\pm$ 0.0 SE) for September through December. There was not a significant difference between January through April and May through August ($\chi2 = 0.00$, $P > 0.0003$), and January through April and September through December ($\chi2 = 10.50$, $P > 0.0003$). There was a significant difference between May through August and September through December ($\chi2 = 53.69$, $P < 0.0003$). For Louisiana offshore waters CPUE was 0.1 ($\pm$ 0.0 SE) in January through April, 0.1 ($\pm$ 0.0 SE) in May through August, and 0.5 ($\pm$ 0.1 SE) in September through December. There was a significant difference between January through April and September through December ($\chi2 = 14.91$, $P < 0.0003$), and May through August and September through December ($\chi2 = 13.67$, $P < 0.0003$). There was no significant difference between January through April and May through August ($\chi2 = 0.13$, $P > 0.0003$). CV estimates ranged from 0.1 to 0.9.

For Texas offshore waters in 1995 shrimp catch rate estimates were 0.4 (± 0.1 SE) in May through August, and 0.4 (± 0.0 SE) in September through December. There was not a significant difference detected between the two seasons ($\chi 2 = 0.01$, $P > 0.001$). For Louisiana offshore waters CPUE was 0.0 (± 0.0 SE) in January through April, 0.1 (± 0.0 SE) in May through August, and 0.2 (± 0.0 SE) in September through December. There was a significant difference between January through April and September through December ($\chi 2 = 71.19$, $P < 0.001$), and May through August and September through December ($\chi 2 = 25.59$, $P < 0.001$). There was no significant difference in mean catch rates between January through April and May through August ($\chi 2 = 3.33$, $P > 0.001$). CV estimates ranged from 0.1 to 0.4.

During 1996, red snapper CPUE in Texas nearshore waters was 0.1 (± 0.0 SE) in May through August, and 0.0 (± 0.0 SE) in September through December. There was not a significant difference detected between the two seasons ($\chi 2 = 4.67$, $P > 0.001$). In Texas offshore waters CPUE was 0.1 (± 0.0 SE) in January through April, 0.3 (± 0.1 SE) in May through August, and 0.1 (± 0.0 SE) for September through December. There was not a significant difference between January through April and May through August ($\chi 2 = 3.91$, $P > 0.001$), and May through August and September through December ($\chi 2 = 9.80$, $P > 0.001$). There was a significant difference detected between January through April and September through December ($\chi 2 = 15.77$, $P < 0.001$). In Louisiana offshore waters catch rates were 0.1 (± 0.0 SE) in January through April, and 0.1 (± 0.1 SE) in May through August. There was not a significant difference between the two periods ($\chi 2 = 0.26$, $P > 0.001$). CV estimates ranged from 0.1 to 0.5.

Red snapper CPUE in Texas offshore waters in 1997 was 0.2 (± 0.0 SE) in January through April, 0.1 (± 0.0 SE) in May through August, and 0.2 (± 0.0 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi 2 = 0.70$, $P > 0.002$), January through April and September through December ($\chi 2 = 0.33$, $P > 0.002$), and May through August and September through December ($\chi 2 = 1.00$, $P > 0.002$). In Louisiana offshore waters catch rate estimates were 0.0 (± 0.0 SE) in January through

April, 0.3 (± 0.1 SE) in May through August, and 0.4 (± 0.1 SE) for September through December. There was not a significant difference between January through April and May through August ($\chi2 = 3.20$, $P > 0.002$), and May through August and September through December ($\chi2 = 0.14$, $P > 0.002$). There was a significant difference detected between January through April and September through December ($\chi2 = 12.29$, $P < 0.001$). CV estimates ranged from 0.1 to 0.5.

During 1998, catch rate estimates for red snapper in Texas offshore waters were 0.1 (± 0.0 SE) in January through April, and 0.1 (± 0.0 SE) in May through August. There was not a significant difference detected between the two seasons ($\chi2 = 2.55$, $P > 0.002$). In Louisiana offshore waters catch rate estimates were 0.2 (± 0.0 SE) in January through April, 0.1 (± 0.0 SE) in May through August, and 0.0 (± 0.1 SE) for September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi2 = 9.18$, $P > 0.002$), January through April and September through December ($\chi2 = 0.50$, $P > 0.002$), and May through August and September through December ($\chi2 = 1.00$, $P > 0.002$). CV estimates ranged from 0.2 to 0.6.

Red snapper catch rates in 1999 for Texas offshore waters were 0.0 (± 0.0 SE) in May through August, and 0.2 (± 0.0 SE) in September through December. There was a significant difference between the two seasons ($\chi2 = 9.96$, $P < 0.008$). CPUE for Louisiana offshore waters was 0.1 (± 0.0 SE) in May through August, and 0.3 (± 0.0 SE) in September through December. There was a significant difference detected between the two time periods ($\chi2 = 40.20$, $P < 0.008$). CV values were moderate, and ranged from 0.1 to 0.4.

In 2001, red snapper CPUE for Texas offshore waters was 0.1 (± 0.0 SE) in May through August, and 0.2 (± 0.0 SE) in September through December. There was not a significant difference between the two seasons ($\chi2 = 6.52$, $P > 0.001$). Similarly, catch rate estimates for Louisiana offshore waters were 0.1 (± 0.1 SE) in May through August, and 0.2 (± 0.0 SE) in September through December. A significant difference was not detected between the two time periods ($\chi2 = 0.39$, $P > 0.001$). CV values ranged from 0.1 to 0.4.

Catch rate estimates during 2002 Texas nearshore waters were 0.1 (± 0.1 SE) in May through August, and 0.0 (± 0.0 SE) in September through December. There was not a significant difference between the two seasons ($\chi2 = 1.64$, $P > 0.0002$). CPUE in Texas offshore waters was 0.1 (± 0.0 SE) in January through April, 0.1 (± 0.0 SE) in May through August, and 0.2 (± 0.0 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi2 = 5.37$, $P > 0.0002$), January through April and September through December ($\chi2 = 11.29$, $P > 0.0002$), and May through August and September through December ($\chi2 = 2.05$, $P > 0.0002$). In Louisiana nearshore waters catch rate estimates were 0.0 (± 0.0 SE) in May through August, and 0.0 (± 0.0 SE) in September through December. There was not a significant difference between the two seasons ($\chi2 = 0.00$, $P > 0.0002$). For Louisiana offshore waters CPUE was 0.0 (± 0.0 SE) in January through April, 0.0 (± 0.0 SE) in May through August, and 0.1 (± 0.0 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi2 = 0.25$, $P > 0.0002$), January through April and September through December ($\chi2 = 10.13$, $P > 0.0002$), and May through August and September through December ($\chi2 = 10.57$, $P > 0.0002$). For Alabama/Mississippi offshore waters CPUE was 0.0 (± 0.0 SE) in January through April, 0.0 (± 0.0 SE) in May through August, and 0.1 (± 0.0 SE) in September through December. There was a significant difference between January through April and September through December ($\chi2 = 47.63$, $P < 0.0002$), and May through August and September through December ($\chi2 = 31.20$, $P < 0.0002$). There was no significant difference between January through April and May through August ($\chi2 = 6.90$, $P > 0.0002$). In Florida offshore waters catch rates were 0.0 (± 0.0 SE) in January through April, 0.0 (± 0.0 SE) in May through August, and 0.1 (± 0.0 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi2 = 0.01$, $P > 0.0002$), January through April and September through December ($\chi2 = 6.16$, $P > 0.0002$), and May through August and September through December ($\chi2 = 0.27$, $P > 0.0002$). CV values ranged from 0.1 to 1.0.

During 2003, CPUE for red snapper in Texas offshore waters was 0.1 ($\pm$ 0.0 SE) in May through August, and 0.2 ($\pm$ 0.0 SE) in September through December. There was a significant difference between the two seasons ($\chi2 = 40.40$, $P < 0.0004$). Catch rate estimates for Louisiana nearshore waters were 0.0 ($\pm$ 0.0 SE) in January through April, 0.0 ($\pm$ 0.0 SE) in May through August, and 0.0 ($\pm$ 0.0 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi2 = 3.83$, $P > 0.0004$), January through April and September through December ($\chi2 = 4.16$, $P > 0.0004$), and May through August and September through December ($\chi2 = 3.00$, $P > 0.0004$). CPUE in Louisiana offshore waters was 0.0 ($\pm$ 0.0 SE) in January through April, 6.1 ($\pm$ 0.4 SE) in May through August, and 0.1 ($\pm$ 0.0 SE) in September through December. There was not a significant difference between May through August and September through December ($\chi2 = 11.66$, $P > 0.0004$), and January through April and May through August ($\chi2 = 2.03$, $P > 0.0004$). There was a significant difference between January through April and September through December ($\chi2 = 21.39$, $P < 0.0004$). Catch rates in Alabama/Mississippi offshore waters were 0.1 ($\pm$ 0.1 SE) in January through April, 0.0 ($\pm$ 0.0 SE) in May through August, and 0.1 ($\pm$ 0.0 SE) in September through December. There was not a significant difference detected for the following comparisons: January through April and May through August ($\chi2 = 0.82$, $P > 0.0004$), January through April and September through December ($\chi2 = 0.57$, $P > 0.0004$), and May through August and September through December ($\chi2 = 0.37$, $P > 0.0004$). CV estimates ranged from 0.1 to 1.0.

In 2004 red snapper catch rate estimates for Texas offshore waters were 0.1 ($\pm$ 0.0 SE) in January through April, 0.3 ($\pm$ 0.0 SE) in May through August, and 0.4 ($\pm$ 0.1 SE) in September through December. There was a significant difference detected between January through April and May through August ($\chi2 = 33.26$, $P < 0.0003$), and

January through April and September through December ($\chi 2 = 35.61$, $P < 0.0003$). There was no significant difference between May through August and September through December ($\chi 2 = 2.54$, $P > 0.0003$). CPUE for Louisiana nearshore waters was 0.0 ($\pm$ 0.0 SE) in January through April, 0.0 ($\pm$ 0.0 SE) in May through August, and 0.0 ($\pm$ 0.0 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi 2 = 0.75$, $P > 0.0003$), January through April and September through December ($\chi 2 = 0.01$, $P > 0.0003$), and May through August and September through December ($\chi 2 = 0.62$, $P > 0.0003$). In Louisiana offshore waters catch rates were 0.0 ($\pm$ 0.0 SE) in January through April, 0.1 ($\pm$ 0.0 SE) in May through August, and 0.4 ($\pm$ 0.0 SE) in September through December. There was a significant difference detected between January through April and September through December ($\chi 2 = 37.02$, $P < 0.0003$), and May through August and September through December ($\chi 2 = 24.74$, $P < 0.0003$). There was no significant difference in mean catch rates between January through April and May through August ($\chi 2 = 5.62$, $P > 0.0003$). In Alabama/Mississippi offshore waters CPUE was 0.1 ($\pm$ 0.0 SE) in January through April, 0.1 ($\pm$ 0.0 SE) in May through August, and 0.1 ($\pm$ 0.0 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi 2 = 0.52$, $P > 0.0003$), January through April and September through December ($\chi 2 = 9.35$, $P > 0.0003$), and May through August and September through December ($\chi 2 = 1.20$, $P > 0.0003$). CV estimates were ranged from 0.1 to 1.0.

In 2005 red snapper catch rates in Texas offshore waters were 0.4 ($\pm$ 0.1 SE) in May through August, and 0.5 ($\pm$ 0.1 SE) in September through December. There was no significant difference between the two seasons ($\chi 2 = 0.13$, $P > 0.0003$). In Louisiana nearshore waters CPUE was 0.0 ($\pm$ 0.0 SE) in January through April, 0.0 ($\pm$ 0.0 SE) in May through August, and 0.0 ($\pm$ 0.0 SE) in September through December. There was not a significant difference detected between the following comparisons: January through April and May through August ($\chi 2 = 1.07$, $P > 0.0003$), January through April and September through December ($\chi 2 = 2.00$, $P > 0.0003$), and May through August and

September through December ($\chi2 = 1.21$, $P > 0.0003$). In Louisiana offshore waters catch rates were 0.0 ($\pm$ 0.0 SE) in January through April, 0.1 ($\pm$ 0.0 SE) in May through August, and 0.0 ($\pm$ 0.0 SE) in September through December. There was not a significant difference for the following comparisons: January through April and May through August ($\chi2 = 0.73$, $P > 0.0003$), January through April and September through December ($\chi2 = 0.86$, $P > 0.0003$), and May through August and September through December ($\chi2 = 3.96$, $P > 0.0003$). CPUE for Alabama/Mississippi offshore waters was 0.0 ($\pm$ 0.0 SE) in January through April, 0.0 ($\pm$ 0.0 SE) in May through August, and 0.1 ($\pm$ 0.0 SE) in September through December. There was not a significant difference detected between January through April and September through December ($\chi2 = 12.97$, $P > 0.0003$), and January through April and May through August ($\chi2 = 3.10$, $P > 0.0003$). There was a significant difference in mean catch rates between May through August and September through December ($\chi2 = 19.12$, $P < 0.0003$). CV estimates ranged from 0.1 to 1.0.

Extrapolated Percent and CPUE by Weight All Years– Selected Species

Approximately 1.6 million kilograms of catch was recorded from 1992 through 2005 from 9,509 tows (52,494 hours) from nets consistent with current BRD requirements. For all years combined, grouped finfish (excluding the species listed below) comprised 38% of the catch, followed by penaeid shrimp at 16%, non-penaeid shrimp crustaceans at 14%, Atlantic croaker and longspine porgy each at 9%, seatrout at 6%, invertebrates at 4%, and debris and grouped sharks each at 1%. Red snapper, southern flounder, lane snapper, Spanish mackerel, vermilion snapper, red drum, king mackerel, snapper, cobia, and black drum, each accounted for less than 1%.

CPUE in kilograms per hour was 11.5 for grouped finfish, 4.9 for penaeid shrimp, 4.2 for crustaceans, 2.8 for Atlantic croaker, 2.7 for longspine porgy, 1.8 for seatrout, 1.3 for invertebrates, 0.4 for debris, and 0.2 for grouped sharks. Red snapper, southern flounder, lane snapper, and Spanish mackerel each had estimated catch rates of 0.1. Vermilion snapper, red drum, king mackerel, snapper, cobia, and black drum CPUE was each less than 0.1.

Extrapolated CPUE by Year, Weight and Number – Selected Species

Weight and number extrapolations for selected species by year for all projects, and seasons for the Gulf of Mexico were examined. Estimates were on a per net basis and consistent with current BRD regulations. The number of observations varied between weight and number extrapolations, so a direct comparison was not possible.

Extrapolated CPUE by Year and Weight – Selected Species

CPUE in kilograms per hour by species and year is depicted in Figure 35. The y-axis is scaled according to species abundance, and varies among the species presented graphically. CPUE is presented from highest to lowest for each species in the narrative below. The number of observations (i.e., number of tows sampled) was variable by year. Appendix B, Table B1 lists the number of observations by year. Sample size ranged from 2,116 tows in 2002 to 13 in 2000. In all years, except 1999 and 2000, sample size was more than 100.

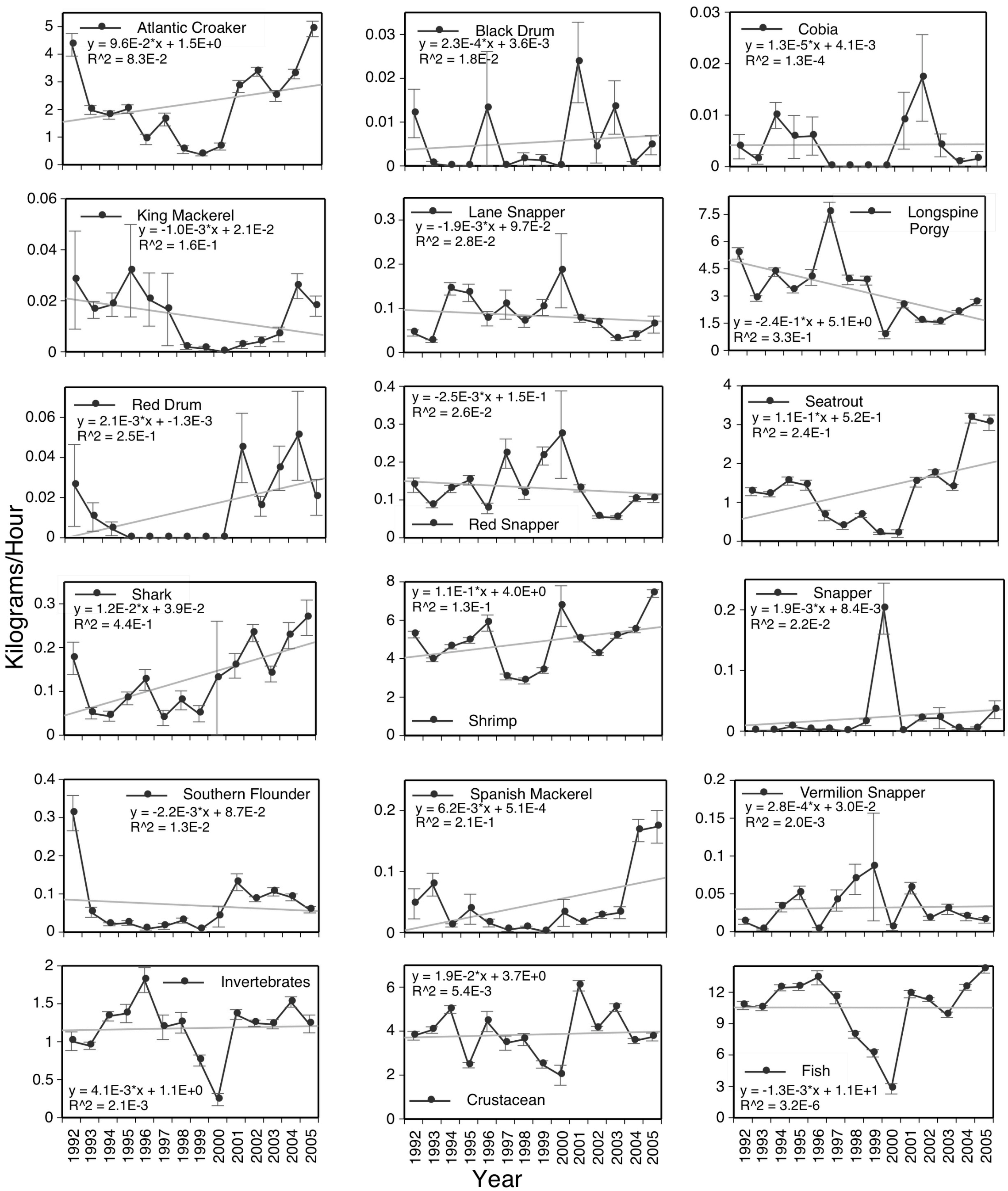

Figure 35. Selected species CPUE in kilograms per hour in the Gulf of Mexico by year. Nets are consistent with BRD regulations. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

Atlantic croaker occurred in all years, with a positive increase in CPUE detected over the time series. The highest estimated CPUE in kilograms per hour occurred in 2005, with a value of 4.9 (± 0.3 SE). CPUE in both 1992 and 2002 was 4.3 (± 0.4 SE) and 3.4 (± 0.2 SE), respectively. Catch rate estimates were 3.3 (± 0.2 SE) in 2004, followed by 2.8 (± 0.2 SE) in 2001, 2.5 (± 0.2 SE) in 2003, 2.0 (± 0.2 SE) in both 1995 and 1993. The remaining years had CPUE values less than 2.0. In 1994 and 1997 catch rates were 1.8 (± 0.3 SE) and 1.6 (± 0.2 SE), respectively. CPUE in 1996 was 0.9 (± 0.2 SE), followed by 0.7 (± 0.1 SE) in 2000, and 0.5 (± 0.1 SE) in 1998. The lowest CPUE during the 1992 through 2005 period occurred in 1999 with a value of 0.4 (± 0.0 SE). CV estimates for all years were low, ranging from 0.0 to 0.3, with 0.1 observed in most years.

CPUE for black drum was less than 0.1 in all years, with a positive increase in CPUE observed. Catch rates were calculated based on the limited catches yielding a rounded value of 0.0 (± 0.0 SE). CPUE was highest in 2001, followed by 2003, 1996, 1992, 2005, 2002, 1998, 1999, 1993, 2004, and 1994. No red drum were recorded in the remaining years, 1995, 1997, or 2000. CV estimates ranged from 0.4 and 1.0, with 1.0 occurring in most years.

As with black drum, cobia CPUE was less than 0.1 in all years. A positive trend in CPUE was observed over the study period. The highest CPUE value was in 2002, followed by 1994, 2001, 1996, 1995, 2003, 1992, 2005, 1993, and 2004. For all other years (1997, 1998, 1999, and 2000), no catch was reported. CV values were high, ranging from 0.3 to 0.9.

Similarly, king mackerel abundance was low by weight in sampled nets, with CPUE less than 0.1 in all years. A negative trend in CPUE was noted. Catch rates were highest in 1995, followed by 1992, 2004, 1996, 1994, 2005, 1997, 1993, 2003, 2002, 2001, 1998, and 1999. In 2000, no catch was reported. CV estimates were relatively high, ranging from 0.2 to 0.9.

A negative trend in lane snapper CPUE was evident over the time series. CPUE in kilograms per hour was highest in 2000 with a value of 0.2 (± 0.1 SE). CPUE was 0.1

(± 0.0) in 1994, 1995, 1997, 1999, 2001, 1996, 1998, 2002, and 2005. Catch rate estimates were 0.0 (± 0.0) in 1992, 2004, 2003, and 1993. CV values by year were moderate and ranged from 0.1 to 0.5.

Longspine porgy occurred in all years, with a negative trend noted relative to CPUE. Highest CPUE in kilograms per hour was in 1997 with a value of 7.6 (± 0.5 SE). CPUE in 1992 and 1994 was 5.4 (± 0.3 SE) and 4.3 (± 0.2 SE), respectively. Catch rate estimates were 4.0 (± 0.4 SE) in 1996, followed by 3.9 (± 0.3 SE) in 1998, 3.9 (± 0.2 SE) in 1999, and 3.3 (± 0.2 SE) in 1995. The remaining years had CPUE values less than 3.0. CPUE in 1993 was 2.9 (± 0.2 SE), followed by 2.6 (± 0.2 SE) in 2005, 2.5 (± 0.1 SE) in 2001, 2.1 (± 0.1 SE) in 2004, and 1.6 (± 0.1 SE) in both 2002 and 2003. The lowest CPUE for longspine porgy from 1992 through 2005 occurred in 2000, with a value of 0.8 (± 0.2 SE). CV estimates for all years were low, ranging from 0.0 to 0.2, with 0.1 observed in most years.

A positive slope relative to CPUE was observed for red drum over the study period. Catch rate estimates for red drum were less than 0.1 in all years except for 2004 when the highest CPUE in kilograms per hour was reached at 0.1 (± 0.0 SE). For the remaining years (2001, 2003, 1992, 2005, 2002, 1993, and 1994), and ranked in terms of CPUE from highest to lowest, CPUE was 0.0 (± 0.0 SE). There was no catch reported from 1995 through 2000. CV values were moderate to high ranging from 0.3 to 0.8.

Red snapper were captured in all years, with a negative slope in CPUE observed over the time series. The highest estimated CPUE in kilograms per hour occurred in 2000 with a value of 0.3 (± 0.1 SE). CPUE in 1997, 1999, and 1995 was 0.2 (± 0.0 SE). For the remaining years (1992, 2001, 1994, 1998, 2005, 2004, 1993, 1996, 2002, and 2003), CPUE was 0.1 (± 0.0 SE). CV estimates were low to moderate ranging from 0.1 to 0.4.

Seatrout were sampled in all years, with a positive trend in CPUE detected. CPUE was highest in 2004, with a value of 3.2 (± 0.1 SE). CPUE in 2005 was 3.1 (± 0.2 SE). Catch rate estimates were 1.7 (± 0.1 SE) in 2002, followed by 1.5 (± 0.1 SE) in both 1994 and 2001, 1.4 (± 0.1 SE) in both 1995 and 2003, 1.3 (± 0.1 SE) in 1992, and

1.2 (± 0.1 SE) in 1993. The remaining years had CPUE values less than 1.0. In 1998 and 1996, catch rates were 0.7 (± 0.1 SE). CPUE in 1994 was 0.4 (± 0.1 SE), followed by 0.2 (± 0.0 SE) in 1999. CPUE was 0.2 (± 0.1 SE) in 2000. CV estimates for all years were generally low, ranging from 0.0 to 0.5, with 0.1 observed in most years.

Sharks were documented in every year of the project, with an upward trend in CPUE observed. Highest CPUE in kilograms per hour occurred in 2005 with a value of 0.3 (± 0.0 SE). CPUE in 2002, 2004, 1992, and 2001 was 0.2 (± 0.0 SE). The catch rate estimate was 0.1 (± 0.0 SE) in 2003. CPUE in 2000 was 0.1 (± 0.1 SE). Estimated catch rates were 0.1 (± 0.0 SE) in 1996, 1995, 1998, and 1993. For the remaining years (1999, 1994, and 1997), CPUE was 0.0 (± 0.0 SE). CV values by year were variable, ranging from 0.1 to 1.0.

A positive trend in CPUE was observed for penaeid shrimp over the time series. The highest estimated CPUE in kilograms per hour for penaeid shrimp occurred in 2005 with a value of 7.4 (± 0.2 SE). CPUE in 2000 and 1996 was 6.7 (± 1.1 SE) and 5.9 (± 0.4 SE), respectively. Catch rate estimates were 5.5 (± 0.1 SE) in 2004, followed by 5.3 (± 0.2 SE) in 1992, 5.2 (± 0.1 SE) in 2003, and 5.0 (± 0.2 SE) in 2001. The remaining years had CPUE values less than 5.0. In 1995 and 1994 catch rates were 4.9 (± 0.1 SE) and 4.6 (± 0.1 SE), respectively. CPUE in 2002 was 4.2 (± 0.1 SE), followed by 3.9 (± 0.1 SE) in 1993, 3.4 (± 0.1 SE) in 1999, and 3.0 (± 0.2 SE) in 1997. The lowest CPUE during the 1992 through 2005 period occurred in 1998 with a value of 2.8 (± 0.2 SE). CV estimates for all years were low, ranging from 0.0 to 0.2, with 0.0 observed in most years.

An upward trend was detected for snapper relative to CPUE. Snapper CPUE in kilograms per hour was highest in 1999, with a value of 0.2 (± 0.0 SE). In most other years (2005, 2002, 2001, 1998, 1994, 2003, 2004, 1995, 1996, 1993, and 1992), and ranked by CPUE from highest to lowest, catch rate estimates were 0.0 (± 0.0 SE). There was no recorded catch in 1997 and 2000. CV estimates were variable, ranging from 0.2 to 0.9.

Southern flounder were sampled in all years, with a negative trend relative to CPUE observed. The highest estimated CPUE in kilograms per hour occurred in 1992, with a value of 0.3 (± 0.0 SE). CPUE in 2001, 2003, 2004, 2002, 2005, and 1993 was 0.1 (± 0.0 SE). For the remaining years (2000, 1998, 1995, 1994, 1997, 1996 and 1999), CPUE was 0.0 (± 0.0 SE). CV estimates were moderate, ranging from 0.1 to 0.8.

Similarly, Spanish mackerel occurred in all years of the project, with a positive trend detected in terms of CPUE. The highest estimated CPUE in kilograms per hour occurred in 2005 and 2004, with values of 0.2 (± 0.0 SE). CPUE in 1993 was 0.1 (± 0.0 SE). For the remaining years (1992, 1995, 2003, 2000, 2002, 2001, 1996, 1994, 1998, 1997, and 1999), CPUE was 0.0 (± 0.0 SE). CV estimates were highly variable ranging from 0.1 to 1.0.

A positive slope relative to CPUE was observed for vermilion snapper. CPUE for vermilion snapper was highest in 1999, with a value of 0.1 (± 0.1 SE). Catch rate estimates were 0.1 (± 0.0 SE) in 1998, 2001, and 1995. In the remaining years (1997, 1994, 2003, 2004, 2002, 2005, 1992, 2000, 1996, and 1993), CPUE values were 0.0 (± 0.0 SE). CV estimates for all years were variable, ranging from 0.1 to 0.8.

Extrapolated CPUE by Year and Number – Selected Species

CPUE in numbers of individuals per hour by species and year is depicted in Figure 36. The y-axis is scaled according to species abundance relative to number. CPUE is presented from highest to lowest for each species in the narrative.

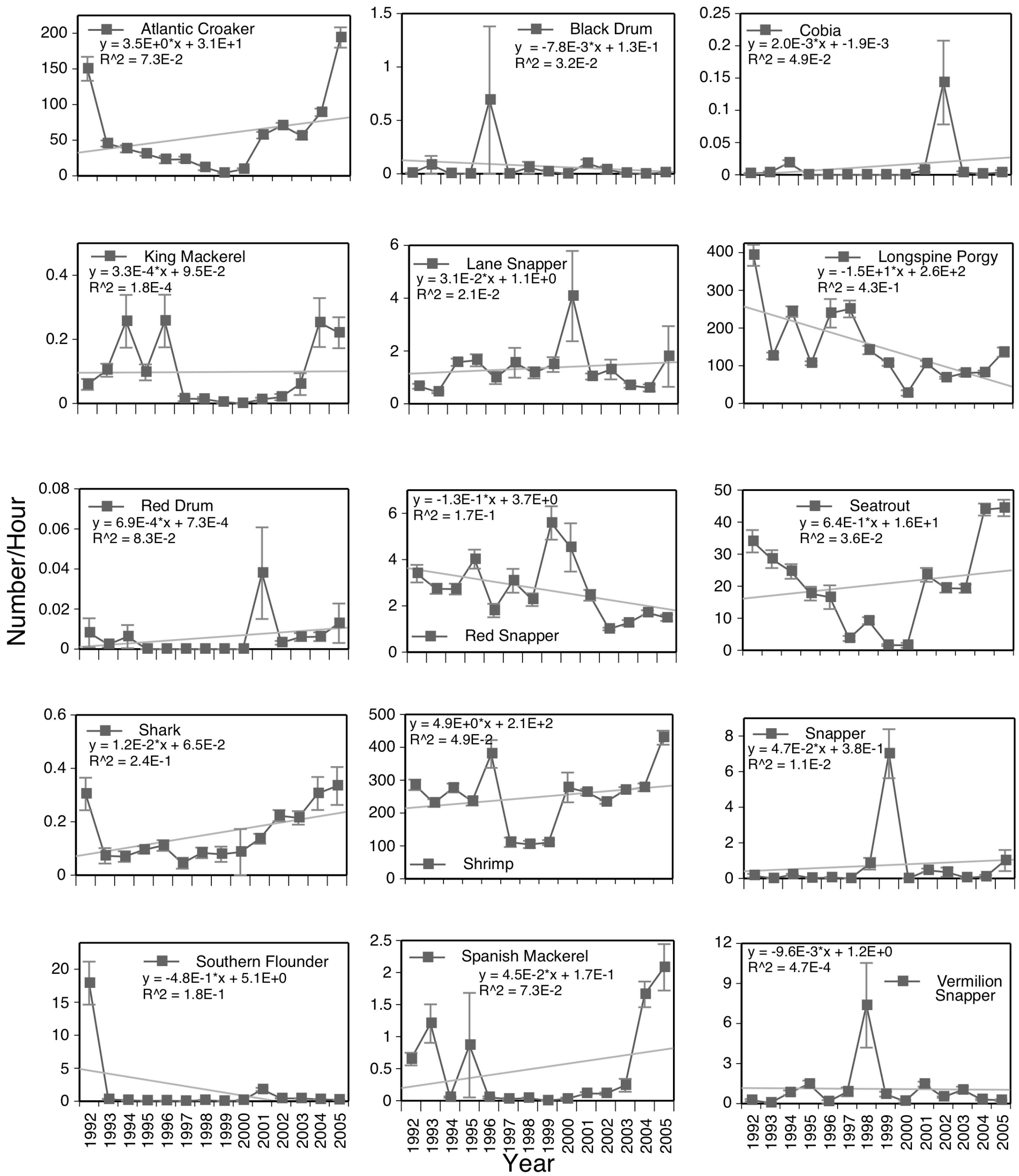

Figure 36. Selected species CPUE in numbers per hour in the Gulf of Mexico by year. Nets are consistent with BRD regulations. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

A positive trend relative to CPUE was detected for Atlantic croaker over the time series. The highest CPUE in numbers per hour occurred in 2005, with a value of 194.0

(± 14.3 SE). CPUE in 1992 and 2004 was 150.1 (± 16.8 SE) and 89.0 (± 5.2 SE), respectively. Catch rate estimates were 70.6 (± 3.7 SE) in 2002, followed by 57.0 (± 4.6 SE) in 2001, and 56.0 (± 5.0 SE) in 2003. The remaining years had CPUE values less than 50.0 individuals per hour. In 1993 and 1994, catch rates were 45.4 (± 4.2 SE) and 37.9 (± 5.0 SE), respectively. CPUE in 1995 was 30.7 (± 2.5 SE), followed by 23.1 (± 3.8 SE) in 1997, 22.8 (± 5.2 SE) in 1996, 11.8 (± 4.0 SE) in 1998, and 9.1 (± 1.5 SE) in 2000. The lowest CPUE from 1992 through 2005 occurred in 1999, with a value of 4.1 (± 0.5 SE). CV estimates for all years were low, ranging from 0.0 to 0.3, with 0.1 observed in most years.

Black drum catch rates relative to number of individuals caught per hour were low, with a negative slope noted in terms of CPUE. The highest CPUE was in 1996 with a value of 0.7 (± 0.7 SE). Catch rates in 2001 were 0.1 (± 0.0 SE). Estimated CPUE was 0.1 (± 0.1 SE) in 1993 and 1998. In other years (2002, 1999, 2005, 1992, 2003, 1994, and 2004), catch rates were 0.0 (± 0.0 SE). There was no catch recorded in 1995, 1997, or 2000. CV estimates were high ranging from 0.4 to 1.0, with 1.0 in most years.

Similarly, cobia CPUE in numbers per hour was low; however, a positive trend was detected over the study period. The highest catch rate occurred in 2002, with a value of 0.1 (± 0.1 SE). CPUE was 0.0 (± 0.0 SE) in 1994, 2001, 2005, 2003, 1993, 1992, and 2004. No catch was recorded in 1995, 1996, 1997, 1998, 1999, and 2000. CV values were relatively high, ranging from 0.2 to 0.9.

An upward trend in CPUE was observed for king mackerel. King mackerel catch rates relative to individuals per hour were 0.3 (± 0.1 SE) in 1996, 1994, and 2004. CPUE was 0.2 (± 0.0 SE) in 2005. In 1993, 1995, 2003, and 1992, CPUE was 0.1 (± 0.0 SE). Catch rates were estimated at 0.0 (± 0.0 SE) in 2002, 1997, 1998, 2001, and 1999. No catch was observed in 2000. CV estimates were variable, ranging from 0.2 to 0.7.

Lane snapper occurred in all years, with a positive trend in CPUE detected. The highest CPUE in numbers per hour was in 2000, with a value of 4.1 (± 1.7 SE). CPUE was 1.8 (± 1.1 SE) in 2005. CPUE was 1.6 (± 0.2 SE) in 1995, followed by 1.6 (± 0.1 SE) in 1994, and 1.6 (± 0.6 SE) in 1997. Catch rates were 1.5 (± 0.3 SE) in 1999, followed by 1.3 (± 0.4 SE) in 2002, 1.2 (± 0.2 SE) in 1998, 1.0 (± 0.1 SE) in 2001, and 1.0 (± 0.2 SE) in 1996. CPUE was below 1.0 for the remaining years. In 2003 and 1992, catch rate values were 0.7 (± 1.0 SE). CPUE was 0.6 (± 0.1 SE) in 2004. The lowest catch rate estimate occurred in 1993, with a value of 0.4 (± 0.0 SE). CV values were moderate, ranging from 0.1 to 0.6

A negative slope was observed in terms of CPUE over the time series for longspine porgy. The highest CPUE in number per hour occurred in 1992 with a value of 392.9 (± 28.1 SE). CPUE in 1997 and 1994 was 250.5 (± 22.4 SE) and 243.6 (± 13.9 SE), respectively. Catch rate estimates were 239.1 (± 37.9 SE) in 1996, followed by 141.5 (± 11.1 SE) in 1998, 136.0 (± 12.3 SE) in 2005, 126.2 (± 8.8 SE) in 1993, and 106.7 (± 7.1 SE) in 1999. In 1995 and 2001 catch rates were 106.5 (± 5.3 SE) and 105.7 (± 7.3 SE), respectively. The remaining years had CPUE values less than 100 individuals per hour. CPUE in 2004 was 82.2 (± 5.0 SE), followed by 80.9 (± 8.9 SE) in 2003, and 68.1 (± 2.9 SE) in 2002. The lowest CPUE from 1992 through 2005 occurred in 2000, with a value of 27.6 (± 7.2 SE). CV estimates for all years were low, ranging from 0.0 to 0.3, with 0.1 observed in most years.

While red drum CPUE in numbers per hour was low in all years, a positive trend was detected in terms of CPUE. Estimated CPUE values were 0.0 (± 0.0 SE) in 2001, 2005, 1992, 1994, 2004, 2003, 2002, and 1993. No catch was recorded in 1995, 1996, 1997, 1998, 1999, and 2000. CV estimates were high in most years, and ranged from 0.3 to 0.9.

The trend in CPUE over the time series for red snapper was declining. Red snapper CPUE in numbers per hour was highest in 1999 with a value of 5.6 (± 0.7 SE). Catch rate estimates in 2000 and 1995 were 4.5 (± 1.0 SE) and 4.0 (± 0.4 SE), respectively. Catch rate estimates were 3.4 (± 0.4 SE) in 1992, followed by 3.1 (± 0.5 SE) in 1997, 2.7 (± 0.2 SE) in both 1993 and 1994, 2.5 (± 0.2 SE) in 2001, and 2.3 (± 0.3 SE) in 1998. The remaining years had CPUE values less than 2 individuals per hour. In 1996 and 2004 catch rates were 1.8 (± 0.3 SE) and 1.7 (± 0.1 SE), respectively. CPUE in 2005 was 1.5 (± 0.1 SE), and 1.3 (± 0.1 SE) in 2003. The lowest CPUE from 1992 through 2005 occurred in 2002, with a value of 1.0 (± 0.1 SE). CV estimates for all years were low, ranging from 0.1 to 0.2, with 0.1 observed in most years.

A positive trend in CPUE was detected for seatrout. The highest CPUE in numbers per hour occurred in 2005, with a value of 44.4 (± 2.6 SE). CPUE in 2004 and 1992 was 43.9 (± 1.9 SE) and 34.0 (± 3.5 SE), respectively. Catch rate estimates were 28.4 (± 2.8 SE) in 1993, followed by 24.6 (± 2.3 SE) in 1994, and 23.5 (± 2.2 SE) in 2001. The remaining years had CPUE values less than 20.0 individuals per hour. In 2002 and 2003, catch rates were 19.4 (± 1.4 SE) and 19.2 (± 1.3 SE), respectively. CPUE in 1995 was 17.7 (± 2.2 SE), followed by 16.6 (± 3.7 SE) in 1996, 9.2 (± 1.1 SE) in 1998, 3.7 (± 0.8 SE) in 1997, and 1.6 (± 0.3 SE) in 1999. The lowest CPUE from 1992 through 2005 occurred in 2000, with a value of 1.6 (± 0.8 SE). CV estimates for all years were relatively low, ranging from 0.0 to 0.5, with 0.1 observed in most years.

A positive trend in shark CPUE was evident over the study period. Shark catch rates relative to individuals per hour were 0.3 (± 0.1 SE) in 2005, 2004, and 1992. CPUE in 2002 and 2003 was 0.2 (± 0.0 SE). CPUE was 0.1 (± 0.1 SE) in 2001, 1996, and 1995. Similarly, CPUE was 0.1 (± 0.1 SE) in 2000. Catch rates were estimated at 0.1 (± 0.0 SE) in 1998, 1999, 1993, and 1994. The lowest CPUE from occurred in 2000 with a value of 0.0 (± 0.0 SE). CV estimates were highly variable, ranging from 0.1 to 1.0.

Penaeid shrimp CPUE in individuals per hour was relatively high as compared with other species, with a positive trend detected in terms of CPUE. The highest CPUE in number per hour occurred in 2005, with a value of 429.2 (± 21.3 SE). CPUE in 1996 and 1992 was 379.7 (± 42.3 SE) and 285.7 (± 16.0 SE), respectively. Catch rate estimates were 278.1 (± 11.7 SE) in 2004, followed by 277.8 (± 45.3 SE) in 2000, 276.1 (± 13.5 SE) in 1994, 269.6 (± 9.3 SE) in 2003, and 263.6 (± 9.9 SE) in 2001. In 1995 and 2002 catch rates were 235.5 (± 12.8 SE) and 233.3 (± 5.5 SE), respectively. CPUE in 1993 was 230.3 (± 11.7 SE), followed by 110.9 (± 14.2 SE) in 1997, and 110.2 (± 7.4 SE) in 1999. The lowest CPUE from 1992 through 2005 occurred in 1998, with a value of 104.4 (± 11.0 SE). CV estimates for all years were low, ranging from 0.0 to 0.2, with 0.1 observed in most years.

Although snapper catch rate estimates in numbers per hour were low, a positive trend in CPUE was observed over the time series. The highest CPUE was in 1999 with a value of 7.0 (± 1.4 SE). The catch rate estimate was 1.0 (± 0.6 SE) in 2005. CPUE was 0.8 (± 0.3 SE) in 1998, followed by 0.5 (± 0.1 SE) in 2001, and 0.3 (± 0.3 SE) in 2002. During 1994 and 1992 catch rates were 0.2 (± 0.1 SE). CPUE was 0.1 (± 0.1 SE) in 2004. CPUE was below 0.1 for the remaining years. Catch rate estimates were 0.0 (± 0.0 SE) in 1996, 2003, 1995, and 1993. No catch was recorded in 1997, or in 2000. CV values were relatively high, ranging from 0.2 to 1.0.

A negative trend in CPUE was detected for southern flounder. Southern flounder catch rate estimates were low in all years except 1992, when CPUE in numbers per hour reached 17.9 (± 3.3 SE). CPUE was 1.8 (± 0.2 SE) in 2001. Catch rate estimates in 2002 and 2003 were 0.4 (± 0.0 SE). CPUE was 0.3 (± 0.1 SE) in 1993, and 0.3 (± 0.0 SE) in 2004. Catch rate estimates in 2005 and 1998 were 0.2 (± 0.0 SE). Similarly, CPUE in 1994 and 2000 was 0.1 (± 0.1 SE). In 1996 and 1995, CPUE was 0.1 (± 0.0 SE). In 1997 and 1999, catch rate estimates were 0.0 (± 0.0 SE). CV values were variable, ranging from 0.1 to 0.7.

Spanish mackerel occurred in all years, with a positive trend in CPUE detected. The highest CPUE in numbers per hour was in 2005, with a value of 2.1 (± 0.4 SE). CPUE was 1.7 (± 0.2 SE) in 2004. CPUE was 1.2 (± 0.3 SE) in 1993, followed by 0.9 (± 0.8 SE) in 1995, and 0.6 (± 0.1 SE) in 1992. Catch rates were 0.2 (± 0.1 SE) in 2003. In 2001, 2002, 1994, and 1996, catch rate estimates were 0.1 (± 0.0 SE). During 1998, 2000, 1997, and 1999, CPUE was 0.0 (± 0.0 SE). CV values were moderate to high, ranging from 0.1 to 1.0

Vermilion snapper occurred in all years. A negative trend in CPUE was observed. The highest CPUE in numbers per hour was in 1998, with a value of 7.4 (± 3.2 SE). The catch rate estimate was 1.5 (± 0.3 SE) in 1995. CPUE was 1.5 (± 0.2 SE) in 2001, followed by 1.0 (± 0.2 SE) in 2003, and 0.9 (± 0.3 SE) in 1997. Catch rates were 0.8 (± 0.2 SE) in 1994, followed by 0.7 (± 0.2 SE) in 1999, and 0.5 (± 0.1 SE) in 2002. CPUE was below 0.5 for the remaining years. In 2004, 2005, and 1992, catch rate values were 0.3 (± 0.1 SE). CPUE was 0.2 (± 0.1 SE) in 2000. Catch rates were 0.1 (± 0.1 SE) in 1996. The lowest catch rate estimate occurred in 1993, with a value of 0.1 (± 0.0 SE). CV values were moderate, ranging from 0.1 to 0.8.

Extrapolated CPUE by Weight, Year, State, Depth and Season – Selected Species

Further refinement of CPUE in kilograms per hour for selected species spatially and temporally is presented below. CPUE varied considerably as less effort was applied to refined strata. Further, CPUE by each stratum are not cumulative. For consistency, catch rates were given first for Texas, followed by Louisiana, Alabama/Mississippi and Florida. Within each state stratum, CPUE was presented from highest to lowest.

At the individual state level no data were collected off Alabama/Mississippi in 1995, 1997, 1999, or 2000. Off Florida no sampling occurred from 1998 through 2000. By the year, state and depth division no data were obtained in the Texas nearshore strata in 1997, 1999, or 2001. Similarly, for the Louisiana nearshore area no data were recorded from 1995 through 2000. In the Alabama/Mississippi nearshore strata no sampling occurred in 1995, 1997, 1999, or 2000. In the offshore zone off Alabama/Mississippi no observations were conducted during 1995, 1996, 1997, 1999, or 2000. No data were recorded in 1992, and from 1997 through 2001 within Florida nearshore strata, or during 1998 through 2000 in the offshore area. At the year, state, depth and season level no data were collected in the following strata: Texas nearshore waters during January through April from 1995 through 2005; Texas offshore zone from January through April from in 1992, 1993, 1995, 1999 through 2003, and 2005; Texas nearshore waters from May through August in 1997, 1999, and 2001; Texas offshore zone during May through August in 2000; Texas nearshore waters during September through December in 1994, 1995, 1997 through 2001, and during 2003 through 2005; Texas offshore waters from September through December in 1998; Louisiana nearshore waters during January through April in 1992, and from 1994 through 2002; Louisiana offshore zone from January through April during 1999 through 2001; Louisiana nearshore waters from May through August from 1995 through 2001; Louisiana nearshore waters during September through December from 1994 through 2000; Louisiana offshore waters from September through December in 1996, and in 2000; Alabama/Mississippi nearshore waters during January through April in 1992, and from 1994 through 2001; Alabama/Mississippi offshore waters during January through April in 1992 through 2001; Alabama nearshore zone during May through August in 1995, 1997, 1999, and 2000; Alabama/Mississippi offshore waters from May through August in 1992, 1995, 1996, 1997, 1999, and 2000; Alabama/Mississippi nearshore waters in September through December in 1993, and from 1995 through 2000; Alabama/Mississippi offshore zone from September through December from 1994 through 2000; Florida nearshore waters from January through April in 1992, and from 1997 through 2001; Florida offshore zone from January through April in 1992, and from 1998 through 2001; Florida nearshore waters in May through August in 1992, from 1996 through 2001, and in 2003; Florida offshore waters from May through August during 1997 through 2001, and in 2003; Florida nearshore zone during September through December in 1992, 1993, and from 1996 through 2005; and Florida offshore waters during September through December in 1993, from 1997 through 2000, and during 2003 through 2005.

The number of observations and effort for each individual stratum are presented in Appendix B, Table B1. There were substantially lower sample sizes in 1999 and 2000 compared with other years.

Atlantic Croaker

Atlantic croaker CPUE in kilograms per hour by year and state was examined. Overall, Atlantic croaker catch rates were highest in Alabama/Mississippi, followed by Louisiana, Texas and Florida.

CPUE for Atlantic croaker off Texas was highest in 2005, with a value of 2.8. CPUE was 2.4 in 1992 and 1995. Catch rates were 1.9 and 1.7 in 1996 and 1993, respectively. CPUE in 1994 was 1.6, followed by 1.5 in 2004, and 1.1 in both 2002 and 2003. For the remaining years catch rates were below 1.0. CPUE was 0.7 in both 2001 and 1997. CPUE was 0.6 in 2000, followed by 0.4 in 1999, and 0.1 in 1998.

CPUE off Louisiana was highest in 2005, with a value of 7.6. CPUE was 6.6 in 1992, followed by 5.0 in 2004, 4.1 in 2002, 3.7 in 2001, and 3.4 in 2003. Catch rates in 1994 and 1995 were 3.2 and 3.0, respectively. CPUE was 2.8 in 1993, followed by 2.7 in 1997, and 1.1 in 1998. For the remaining years, catch rates were below 1.0. CPUE was 0.8 in 1996, followed by 0.7 in 2000, and 0.4 in 1999.

Off Alabama/Mississippi Atlantic croaker catch rates were highest in 1992, with a value of 14.1. CPUE was 8.7 in 1994, followed by 7.7 in 2001, and 5.7 in 2002. Catch rates in 2005 and 2004 were 4.7 and 3.0, respectively. CPUE was 2.7 in 2003, followed by 2.6 in 1993, 2.5 in 1996, and 0.7 in 1998.

Florida experienced the lowest catch rates for Atlantic croaker, with highest CPUE occurring in 2002, with a value of 0.6. CPUE was 0.5 in 2005, followed by 0.4 in 1994, 0.3 in 2001, and 0.2 in 2004. Estimated catch rates were 0.0 in 1996, 1995, 1992, 1993, 1997, and 2003.

Atlantic croaker catch rate estimates in kilograms per hour by year, state and depth were assessed. Nearshore areas yielded higher catch rates of Atlantic croaker as compared with offshore strata.

In the Texas nearshore strata, Atlantic croaker CPUE was highest in 2005, with a value of 8.3. CPUE was 6.5 in 2004, followed by 4.7 in 1996, and 2.2 in both 1993 and 1995. Similarly, catch rates were 1.9 in both 1998 and 1992. CPUE was 1.1 in 2002, followed by 1.0 in 2000, 0.5 in 1994, and 0.3 in 2003.

For Texas offshore waters, CPUE was also highest in 2005, with a value of 2.7. Catch rates in 1992 and 1995 were 2.6 and 2.4, respectively. CPUE was 1.7 in both 1994 and 1993. Similarly, catch rate estimates in were 1.2 in both 1996 and 2003. CPUE was 1.1 in 2002. For the remaining years, catch rates were below 1.0. CPUE was 0.7 in both 2001 and 1997. CPUE was 0.5 in 2000, followed by 0.4 in both 2004 and 1999. The lowest CPUE was 0.0 in 1998.

In the Louisiana nearshore area, Atlantic croaker CPUE was highest in 2001, with a value of 16.7. Catch rate estimates were 12.0 and 10.1 in 2002 and 1992, respectively. CPUE was 9.3 in 1994, followed by 8.5 in 2005, 8.3 in 2003, 7.2 in 2004, and 6.6 in 1993.

For Louisiana offshore waters, the highest catch rate estimate occurred in 2005, with a value of 7.0. CPUE was 4.7 in 1992, followed by 4.4 in 2004, 3.8 in 2002, and 3.5 in 2001. Catch rate estimates were 3.2 and 3.1 in 1994 and 2003, respectively. CPUE was 3.0 in 1995, followed by 2.7 in 1997, 2.3 in 1993, and 1.1 in 1998. For the remaining years, catch rate estimates were below 1.0. CPUE was 0.8 in 1996, followed by 0.7 in 2000, and 0.4 in 1999.

For Alabama/Mississippi nearshore strata, CPUE was highest in 1992, with a value of 23.3. Catch rate estimates were 14.8 and 12.6 for 2001 and 1994, respectively. CPUE was 9.7 in 2005, followed by 4.5 in 2002, 3.8 in 1993, and 3.1 in 2004. Catch rate estimates were 2.5 in both 1996 and 1998. The lowest CPUE occurred in 2003, with a value of 1.4.

In the Alabama/Mississippi offshore zone, CPUE was highest at 6.1 in 2002. Catch rate values were 5.2 and 3.8 in 1992 and 2005, respectively. CPUE was 3.4 in 2003, followed by 2.9 in 2004, 2.6 in 2001, and 1.2 in 1994. Catch rate estimates were 0.3 in both 1993 and 1998.

In Florida nearshore waters, Atlantic croaker CPUE was highest in 1994, with a value of 1.4. CPUE was 1.1 in 2002, followed by 1.0 in 2005, 0.3 in 2004, and 0.1 in 1995. Catch rate estimates were 0.0 in 1993, 1996, and 2003.

In the Florida offshore zone, CPUE was highest at 0.4 in 2005. Catch rate estimates were 0.3 in both 2001 and 1994. CPUE was 0.2 in 2002. Catch rate estimates were 0.1 in both 2004 and 1996. CPUE was estimated at 0.0 in 1992 1993, 1995, 1997, and 2003.

Atlantic croaker catch rates in kilograms per hour by year, state, depth and season were analyzed. As noted before, Atlantic croaker CPUE was generally highest in Alabama/Mississippi, followed by Louisiana, Texas and Florida. Seasonal distribution was variable, with Atlantic croaker occurring in all seasons. September through December and May through August yielded higher catch rates in most years.

In Texas nearshore waters during January through April, Atlantic croaker CPUE was highest at 0.6 in 1992. In 1994 and 1993 catch rate estimates were 0.5 and 0.2, respectively.

For the Texas offshore zone during the same period (January through April), CPUE was highest in 1997, with a value of 0.7. CPUE was 0.5 in 1996, followed by 0.2 in 2004, and 0.1 in 1994. Estimated catch rate estimates were 0.0 in both 2002 and 1998.

In Texas nearshore waters from May through August, highest CPUE for Atlantic croaker occurred in 2005, with a value of 7.7. Catch rate estimates were 6.5 and 6.3 in 2004 and 1993, respectively. CPUE was 5.5 in 1996, followed by 4.9 in 1992, 3.1 in 2002, and 2.2 in 1995. Catch rates for the remaining years was below 2.0. CPUE was 1.9 in 1998, followed by 1.0 in 2000, 0.6 in 1994, and 0.2 in 2003.

During May through August in the Texas offshore zone, highest CPUE was reported in 2005, with a value of 2.0. CPUE in 1996 was 1.5, and 1.1 in 1992. The remaining years had catch rates of less than 1.0. CPUE was 0.9 in 2002, followed by 0.6 in both 1997 and 2001, and 0.4 in both 1994 and 1999. The catch rate estimate was 0.3 in 1995. CPUE was 0.2 in 2003, 2004, and 1993. The lowest estimated catch estimate was 0.0 in 1998.

Atlantic croaker CPUE in Texas nearshore waters during September through December was highest at 2.0 in 1992. Catch rate estimates for the remaining years were relatively low. CPUE was 0.8 in 1993, followed by 0.4 in 1996, and 0.2 in 2002.

For Texas offshore waters during the same time frame (September through December), CPUE was highest in 1994, with a value of 5.0. Catch rate estimates in 2005 and 1992 were 4.9 and 3.7, respectively. CPUE in 1993 was 3.6, followed by 2.8 in 1995, 2.5 in 2003, 2.3 in 2004, and 1.9 in 2002. Estimated catch rates were 0.9 in both 2001 and 1996. CPUE was 0.7 in 1997, followed by 0.5 in 1999, and 0.4 in 2000.

In Louisiana nearshore waters during January through April, CPUE for Atlantic croaker was highest in 2003, with a value of 2.8. CPUE was 0.3 in 2004, followed by 0.2 in 1993, and 0.0 in 2005.

During January through April in the Louisiana offshore zone, highest CPUE was 9.5 in 2005. CPUE was 4.1 in 1997, followed by 3.6 in 2004, 3.4 in 2002, and 2.2 in 1994. Catch rate estimates in 2003 and 1993 were 1.7 and 1.2, respectively. For the remaining years, CPUE was less than 1.0. In 1998, CPUE was 0.7, followed by 0.6 in 1996, 0.3 in 1992, and 0.1 in 1995.

In May through August in Louisiana nearshore waters, CPUE was highest in 2004, with a value of 14.3. CPUE was 12.5 in 1992, followed by 10.0 in 2005, 9.3 in 1994, 7.7 in 1993, and 6.9 in 2004. The lowest catch rate estimate was 3.7 in 2003.

Data were collected in all years from May through August in Louisiana offshore waters. The highest CPUE for Atlantic croaker occurred in 2005, with a value of 10.7. Catch rate estimates in 2004 and 2002 were 4.2 and 4.1, respectively. CPUE in 1994 was 3.0. Estimated catch rates in 1997, 2003, and 2001, were 2.3. CPUE in 1998 was 2.1, followed by 1.4 in 1993, 1.1 in both 1996 and 1992, and 0.6 in 2000. The lowest CPUE of Atlantic croaker was observed in 1999, with a value of 0.2.

In Louisiana nearshore waters during the September through December period, highest CPUE was 22.2 in 2004. Catch rate estimates in 1993 and 2001 were 17.2 and 16.7, respectively. CPUE was 11.4 in 2002, followed by 10.5 in 2003, 6.0 in 1992, and 4.1 in 2005.

In Louisiana offshore waters during this same time period (September through December), CPUE was highest in 2004, with a value of 8.8. A similar catch estimate of 8.7 was observed in 1992. CPUE was 7.1 in 1993, followed by 5.2 in 1994, 5.0 in 1995, 4.1 in 2002, and 4.0 in 2002. Catch rate estimates for the remaining years were below 4.0. CPUE was 3.6 in 1998, followed by 3.5 in 2003, 2.8 in 1997, and 2.7 in 2005. The lowest CPUE was exhibited in 1999, with a value of 0.4.

In Alabama/Mississippi nearshore waters during January through April the highest CPUE occurred in 2002, with a value of 0.5. CPUE was 0.2 in 2003. In 1993 and 2005, estimated catch rates were 0.1. The lowest CPUE was 0.0 in 2004.

During this same period (January through April) in Alabama/Mississippi offshore waters, CPUE for Atlantic croaker was highest at 11.5 in 2003. CPUE was 10.8 in 2002, followed by 3.4 in 2005, and 1.4 in 2004.

During May through August in the Alabama/Mississippi nearshore zone, the highest CPUE was 24.4 in 1992. Catch rate values were 13.1 and 6.5 in 1994 and 2001, respectively. CPUE was 6.5 in 2001, followed by 5.1 in 2005, and 4.0 in 1993. Catch rate estimates were 2.5 in both 1996 and 1998. CPUE in 2003 was 2.2, followed by 1.3 in 2002, and 0.2 in 2004.

In Alabama/Mississippi offshore waters from May through August, highest CPUE occurred in 2002, with a value of 4.7. CPUE was 1.7 in 2005, followed by 1.0 in 2001, 0.8 in 1994, 0.6 in 2003, and 0.3 in 1998. Catch rate estimates were 0.2 and 0.1 in 1993 and 2004, respectively.

During September through December in Alabama/Mississippi nearshore waters, highest Atlantic croaker CPUE was 22.9 in 1992. Catch rate estimates were 15.4 and 13.8 in 2001 and 2005, respectively. CPUE was 12.0 in 2002, followed by 9.7 in 2004, 7.4 in 1994, and 3.0 in 2003.

During the same time period from September through December, the highest CPUE in Alabama/Mississippi offshore zone occurred in 2004, with a value of 8.7. The catch rate estimate was 7.4 in 2005. CPUE was 5.7 in 2002, followed by 5.2 in 1992, 3.2 in 2001, 2.4 in 2003, and 0.8 in 1993.

In Florida nearshore waters from January through April, CPUE was highest in 2002 at 1.6. CPUE was 1.0 in 2005, and 0.2 in 1994. Estimated catch rates were 0.0 for 2004, 1993, 1995, 1996, and 2003.

During January through April in the Florida offshore zone, Atlantic croaker CPUE was highest in 2005, with a value of 0.4. Catch rate estimates were 0.1 in both

2004 and 2002. Similarly, estimated CPUE was 0.0 from 1993 through 1997, and in 2003.

From May through August for Florida nearshore waters, CPUE was highest at 0.6 in 2005. Estimated catch rates were 0.2 in both 1995 and 1994. CPUE was 0.0 in 1993, 2002, and 2004. For Florida offshore waters from May through August, CPUE was 0.1 in both 2005 and 2002. Estimated catch rate values were 0.0 in 1994, 1992, 1993, 1995, 1996, and 2004.

In the Florida nearshore zone during September through December, Atlantic croaker CPUE was highest at 2.6 in 1994. The estimated catch rate was 0.0 in 1995.

For Florida offshore waters during the same time period (September through December), Atlantic croaker CPUE was highest in 2002, with a value of 3.1. CPUE was 1.5 in 1994, followed by 0.2 in 2001, and 0.1 in 1996. Catch rate estimates were 0.0 in both 1992 and 1995.

<u>Black Drum</u>

CPUE for black drum was low in all years for all state areas combined. At the individual state level, CPUE was 0.1 off Alabama in both 1992 and 2001, and 0.1 in Texas waters in 1996. Catch rate estimates were 0.0 in all other years and states. At the most refined level, by state, depth and season, CPUE was 0.8 in Texas nearshore waters in May and August in 2005, followed by 0.4 in Louisiana nearshore waters in September through December in 2003. CPUE was 0.3 in Texas nearshore waters during May through August in 1996, and 0.2 in Alabama/Mississippi offshore waters during September through December in 1992. CPUE was 0.1 in the following states, depths and seasons: Alabama/Mississippi nearshore waters in September through December in 2001, Louisiana nearshore waters in September through December in 1992, Alabama near and offshore waters in January through April in 2003, Florida nearshore waters in January through April in 2002, and Alabama offshore waters in September through December in 2001. CPUE was 0.0 in all other areas, depths and seasons.

Cobia

Similarly, cobia CPUE was less than 0.1 in all years for all areas combined. On the state level, CPUE was 0.1 off Florida in 1992. At the state, depth and season level, CPUE was 0.9 in Louisiana nearshore waters during September through December in 2001. The catch rate estimate was 0.3 in Alabama/Mississippi offshore waters during January through April in 2002. CPUE was 0.1 in the following: Alabama/Mississippi nearshore waters from September through December in 2003, Florida offshore waters during the May through August period in 1992, Louisiana nearshore waters from September through December in 1993, and Florida offshore waters during September through December in 1995. For all other areas, depths and seasons cobia CPUE was estimated at 0.0.

King Mackerel

As with black drum and cobia, king mackerel abundance was low by weight in sampled nets; CPUE was less than 0.1 in all years for all areas combined. By state, CPUE was estimated at 0.1 off Texas in 1995, in Florida in 1997, off Alabama/Mississippi in 1996, and off Texas in 1992. At the state, depth and season level, CPUE was 0.7 in Louisiana nearshore waters during September through December in 1993. Catch rate estimates were 0.3 in Texas nearshore waters from September through December in 1992. CPUE was 0.2 in Texas nearshore waters from May through August in 1995, in Louisiana nearshore waters during September through December in 2003, and in the Texas offshore zone from May through August in 1992. Catch rate estimates were 0.1 in following stratum: Texas offshore waters from September through December in 1995, Texas offshore waters from January through April in 1997, Louisiana offshore waters during May through August in 2004, Louisiana nearshore waters from May through August in 2002, Texas nearshore zone in May through August in 1993, Florida offshore waters from January through April in 1997, Texas nearshore zone in May through August in 2004, Florida offshore waters in May through August in 2002, Texas offshore waters from May through August in 1994, Louisiana nearshore waters from May through August in 2004, and Alabama/Mississippi nearshore waters from May through August in 1996. CPUE was 0.0 in all other areas, depths and seasons.

Lane Snapper

Lane snapper CPUE in kilograms per hour by year and state was assessed. While low, overall lane snapper catch rates were higher in Florida as compared with other state areas. Texas and Louisiana experienced similar catch rates, with CPUE off Texas slightly higher. Alabama/Mississippi had the lowest CPUE.

In Texas CPUE for lane snapper was highest in 2000, with a value of 0.3. Catch rate estimates were 0.1 in 2001, 1997, 1995, 2005, 1999, and 1992. Estimated CPUE values were 0.0 for the remaining years, namely, 2004, 1994, 2003, 1996, 1993, 2002, and 1998.

Lane snapper CPUE off Louisiana was highest at 0.2 in 1998. Estimated catch rate were 0.1 in 1996, 1997, 1999, 1994, 2001, and 2005. CPUE was 0.0 for 1995, 1992, 1993, 2004, 2002, 2003, and 2000.

Off Alabama/Mississippi lane snapper catch rates were 0.0 for all sampled years. These included 2002, 1993, 2003, 1994, 2001, 2005, 2004, 1992, 1996, and 1998.

Florida experienced the highest catch rates for lane snapper. CPUE was 0.3 in both 1995 and 1994. Catch rate estimates were 0.2 in both 2002 and 2003. CPUE was 0.1 during 2004, 2005, and 1996. Catch rates were estimated at 0.0 for 1993, 1997, 1992, and 2001.

Lane snapper catch rate estimates in kilograms per hour by year, state and depth strata were examined. Again, catch rates were highest in Florida, with similar trends observed in both the near and offshore areas. In the remaining states areas CPUE was higher in the offshore strata as compared with the nearshore zones in most years.

CPUE for lane snapper in the Texas nearshore strata was highest in 2000, with a value of 0.1. Catch rate estimates were 0.0 for 2002, 1992, 1994, 2004, 1993, 2003, 1995, 1996, 1998, and 2005.

For Texas offshore waters, CPUE was highest at 0.3 in 2000. Estimated catch rates were 0.1 in 2001, 1995, 1997, 2005, 1999, 1992, and 2004. Similarly, CPUE was 0.0 in 1994, 2003, 1996, 1993, 2002, and 1998.

In the Louisiana nearshore area, lane snapper CPUE was highest in 2001, with a value of 0.1. Estimated catch rates were 0.0 in 1992, 2003, 1993, 2004, 2002, 1994, and 2001.

For Louisiana offshore waters, the highest catch rate estimate occurred in 2005, with a value of 0.2. CPUE was 0.1 in 1996, 1997, 1999, 1994, 2001, 2005, and 1992. Catch rates were 0.0 in 1995, 1993, 2004, 2002, 2003, and 2000.

For Alabama/Mississippi nearshore strata, CPUE was 0.0 for all years sampled. These included 2002, 2003, 2001, 1993, 1992, 1994, 1996, 1998, 2004, and 2005.

In the Alabama/Mississippi offshore zone, CPUE was highest in 1993, with a value of 0.1. The remaining years, 2002, 1994, 2003, 2001, 2005, 2004, 1992, and 1998, had estimated catch rates of 0.0.

In Florida nearshore waters, lane snapper CPUE was highest in 1995, with a value of 0.5. CPUE was 0.4 in 2004, followed by 0.3 in 2003, 0.2 in both 2002 and 1994, and 0.1 in 1996. Catch rate estimates were 0.0 in both 2005 and 1993.

In the Florida offshore zone, CPUE was 0.3 in both 1994 and 1995. Catch rates were 0.2 in 2002. Estimated CPUE was 0.1 in 2003, 2005, and 1996. Catch rate estimates were 0.0 in 1993, 2004, 1997, 1992, and 2001.

Lane Snapper CPUE in kilograms per hour by year, state, depth and season was analyzed. Florida had the highest CPUE, with occurrence in all seasons. In the nearshore area off Florida, the January through April period yielded higher CPUE as compared with other seasons. CPUE in Florida offshore waters was more variable among seasons. The remaining states had relatively lower catch rates, with occurrence in all seasons.

Lane snapper CPUE in Texas nearshore waters during January through April was not detectable. Catch rate estimates were 0.0 in 1993, 1992, and 1994.

For the Texas offshore zone during the same period (January through April), CPUE was 0.1 in 2004 and 1994. Estimated catch rate estimates were 0.0 for 1996, 2002, 1998, and 1997.

In Texas nearshore waters from May through August, lane snapper CPUE was 0.1 in 1992 and 2000. Catch rate estimates were 0.0 in 1994, 2004, 1993, 1995, 1996, 1998, 2002, 2003, and 2005.

Similarly, during May through August in the Texas offshore zone, CPUE was 0.1 in both 2001 and 1992. Catch rate estimates were 0.0 in 1997, 2005, 1995, 1996, 1994, 1998, 2004, 2002, 2003, 1993, and 1999.

Lane snapper CPUE in Texas nearshore waters during September through December CPUE was 0.1 in both 2002 and 1992. Catch rate estimates were 0.0 for 1993 and 1996.

For Texas offshore waters during the same time frame (September through December), CPUE was 0.3 in 2004 and 2005. CPUE was 0.2 in 2000. Catch rate estimates were 0.1 for 1999, 1997, 1995, 2001, 2003, 1994, and 1992. CPUE was 0.0 in 2002, 1993, and 1996.

In Louisiana nearshore waters during January through April, CPUE for lane snapper was not detectable. Catch rate estimates were 0.0 in 1993, 2003, 2004, and 2005.

During January through April in the Louisiana offshore zone, CPUE was 0.2 in 1998 and 1996. Catch rate estimates were 0.0 in 1995, 1994, 1993, 2002, 2004, 2005, 2003, 1992, and 1997.

In May through August in Louisiana nearshore waters, lane snapper CPUE was highest in 2005, with a value of 0.1. Catch rate estimates were 0.0 in 1992, 2004, 1993, 1994, 2002, and 2003.

From May through August in Louisiana offshore waters, CPUE was highest at 0.2 in 2005. Catch rate estimates were 0.1 in 1996, 2001, and 1992. CPUE was 0.0 in 1998, 1995, 1994, 2004, 2002, 1993, 2003, 1997, 1999, and 2000.

In Louisiana nearshore waters during the September through December period, CPUE was 0.0 in all years when sampling occurred. These include 1993, 1992, 2003, 2004, 2002, 2005, and 2001.

In Louisiana offshore waters during this same time period (September through December), lane snapper CPUE was highest in 1994, with a value of 0.3. In 1997, the catch estimate was 0.2. CPUE was 0.1 in 2004, 1999, 2001, 1992, 1993, and 1995. Catch rates were 0.0 in 2002, 2005, 2003, and 1998.

In Alabama/Mississippi nearshore waters during January through April, lane snapper CPUE was 0.0 in all years sampled. These include 1993, 2002, 2003, 2004, and 2005.

During this same period (January through April) in Alabama/Mississippi offshore waters, the highest CPUE for lane snapper was 0.1 in 2002. Catch rate estimates were 0.0 for 2004, 2005, and 2003.

During May through August in the Alabama/Mississippi nearshore zone, the highest CPUE was 0.1 in 2001. Catch rate estimates were 0.0 in 2003, 2002, 1993, 1992, 1994, 1996, 1998, 2004, and 2005.

In Alabama/Mississippi offshore waters from May through August, highest CPUE occurred in 1993, with a value of 0.1. Catch rate estimates were 0.0 in 2001, 1994, 2004, 2002, 2003, 1998, and 2005.

During September through December in Alabama/Mississippi nearshore waters, CPUE was not detectable. Catch rate estimates were 0.0 in 2002, 2003, 2001, 1992, 1994, 2004, and 2005.

During the same time period from September through December, the highest CPUE in Alabama/Mississippi offshore zone occurred in 2002, with a value of 0.1. Catch rate estimates were 0.0 in 2005, 2003, 2004, 2001, 1992, and 1993.

In Florida nearshore waters from January through April, CPUE was highest in 1995 at 1.1, the highest among all strata. CPUE was 0.5 in 1994, followed by 0.4 in 2004, 0.3 in 2003, 0.2 in 2002, and 0.1 in 1996. Catch rate estimates were 0.0 in both 1993 and 2005.

During January through April in the Florida offshore zone, lane snapper CPUE was 0.3 in both 1995 and 1994. The catch rate estimate was 0.2 in 2002. Similarly, estimated CPUE was 0.1 in 2003, 1996, 2005, and 1993. Catch rate estimates were 0.0 in both 2004 and 1997.

From May through August for Florida nearshore waters, CPUE was 0.2 in both 2002 and 1994. Estimated catch rates were 0.0 in 1995, 1993, 2004, and 2005.

For Florida offshore waters from May through August, the highest CPUE occurred in 1994, with a value of 0.5. Catch rates were 0.4 and 0.2 in 2002 and 1995, respectively. Estimated catch rate values were 0.0 in 1993, 2004, 1992, 1996, and 2005.

In the Florida nearshore zone during September through December, CPUE was not detectable. Catch rate estimates were 0.0 in both 1994 and 1995.

For Florida offshore waters during the same time period (September through December), lane snapper CPUE was highest in 1995, with a value of 0.2. Catch rate estimates were 0.0 in 2002, 1992, 1994, 2001, and 1996.

Longspine Porgy

CPUE in kilograms per hour by year and state for longspine porgy was examined. Overall, longspine porgy catch rates were higher in Louisiana and Texas, with both states experiencing similar catch rates in most years. Lower CPUE was observed in Alabama/Mississippi and Florida.

CPUE off Texas for longspine porgy was highest in 1997, with a value of 6.6. Catch rates were 6.5 and 6.4 in 2005 and 1994, respectively. CPUE was 6.4 in 1992, followed by 6.2 in 1992, and 5.5 in 1996. For the remaining years catch rates were below 5.0. CPUE was 4.9 in 2004, followed by 4.0 in 2003, 3.5 in 1999, 3.1 in 1995, and 2.6 in 2001. CPUE was 2.3 in both 1998 and 2002. CPUE was 1.7 in 1993. The lowest catch rate estimate occurred in 2000, with a value of 0.7.

CPUE off Louisiana was highest at 10.3 in 1997. CPUE was 7.2 in 1996, followed by 7.1 in 1994, 6.5 in 1998, and 5.4 in 1992. Catch rates in 1995 and 1993 were 5.3 and 4.8, respectively. CPUE was 4.0 in 1999, followed by 2.5 in 2001, and 2.0

in 2005. For the remaining years, catch rates were below 2.0. CPUE was 1.4 in 2002, followed by 1.2 in both 2004 and 2000, and 1.0 in 2003.

Off Alabama/Mississippi longspine porgy catch rate was highest in 1993, with a value of 3.8. CPUE was 2.7 in 2005, followed by 2.6 in 2001, and 2.5 in 1998. Catch rates in 2002 and 2004 were 2.3 and 2.2, respectively. CPUE was 2.0 in 1994, followed by 0.9 in 2003, 0.7 in 1992, and 0.0 in 1996.

Florida experienced the lowest catch rates for longspine porgy; the highest CPUE occurred in 2001, with a value of 1.1. CPUE was 0.9 in 1994, followed by 0.4 in 2005, 0.2 in 2002, and 0.1 in 1993. Estimated catch rates were 0.0 in 2004, 1995, 1996, 1992, 1997, and 2003.

Longspine porgy catch rate estimates in kilograms per hour by year, state and depth strata were assessed. Offshore areas yielded higher catch rates of longspine porgy as compared with nearshore strata.

In the Texas nearshore zone, longspine porgy CPUE was highest in 2003, with a value of 22.4. Catch rates dropped substantially in the remaining years. CPUE was 4.0 in 1994, followed by 3.3 in 1996, and 1.6 in both 1998 and 1992. CPUE was 1.2 in 1993, followed by 0.8 in 2000, 0.5 in both 2002 and 2004, and 0.1 in 1995. The lowest catch rate was 0.0 observed in 2005.

For Texas offshore waters, CPUE was highest in 1992, with a value of 8.0. Catch rate estimates were 6.6 in 2005, 1997, and 1994. CPUE in 1996 and 2004 were 6.1 and 5.9, respectively. CPUE was 3.5 in 1999, followed by 3.3 in 1995, and 3.2 in 2003. For the remaining years, catch rates were below 3.0. CPUE was 2.6 in 2001, followed by 2.4 in 1998, 2.3 in 2002, and 1.8 in 1993. The lowest catch rate estimate was 0.6 in 2000.

In the Louisiana nearshore area, CPUE was highest at 3.9 in 1992. The catch rate estimate was 3.1 in 2003. CPUE was 0.1 in both 2004 and 1993. Similarly, catch rates were 0.0 in 2005, 2002, 1994, and 2001.

For Louisiana offshore waters, the highest catch rate estimate occurred in 1997, with a value of 10.3. CPUE was 7.2 in both 1994 and 1996. CPUE was 6.5 in 1998, followed by 6.2 in 1992, 5.4 in 1993, and 5.3 in 1995. Catch rate estimates were 4.0 and 3.3 in 1999 and 2005, respectively. CPUE was 2.6 in 2001, followed by 1.5 in 2004, 1.4 in 2002, and 1.2 in 2000. The lowest longspine porgy catch rate estimate was 0.9 in 2003.

For Alabama/Mississippi nearshore strata, CPUE was highest at 1.5 in 2001. Catch rate estimates were 0.8 and 0.5 for 2002 and 1994, respectively. CPUE was 0.4 in 1998, followed by 0.3 in 2003, and 0.2 in both 2004 and 1993. Catch rate estimates were 0.0 in 2005, 1992, and 1996.

In the Alabama/Mississippi offshore zone, CPUE was highest at 10.9 in 1993. Catch rates values were 4.8 and 3.4 in 1994 and 2001, respectively. CPUE was 3.2 in 2005, followed by 3.1 in 1998, 2.7 in 2002, and 2.5 in 2004. Catch rate estimates were 1.4 in 1992, and 1.2 in 2003.

In Florida nearshore waters, longspine CPUE was highest in 1994, with a value of 0.6. CPUE was 0.2 in 1993, and 0.1 in 2005. Catch rate estimates were 0.0 in 2004, 2002, 1996, 1995, and 2003.

In the Florida offshore zone, CPUE was highest at 1.1 in 2001. CPUE was 1.0 in 1994. Catch rate estimates were 0.4 and 0.3 in 2005 and 2002, respectively. CPUE was estimated at 0.0 in 1995, 1993, 1996, 2004, 1992, 1997, and 2003.

Longspine porgy catch rates in kilograms per hour by year, state, depth and season were examined. Seasonal distribution was variable, with longspine porgy occurring in all seasons. The May through August period typically yielded higher catch rates, followed by September through December.

In Texas nearshore waters during January through April, longspine porgy CPUE was 0.0 in all years sampled. These years were 1993, 1994, and 1992.

For the Texas offshore zone during the same period (January through April), longspine porgy CPUE was highest in 1994, with a value of 3.0. CPUE was 2.4 in 1996, followed by 2.0 in 1997, and 1.9 in 1998. Estimated catch rates were 1.5 in 2002, and 1.3 in 2004.

In Texas nearshore waters from May through August, highest CPUE for longspine porgy occurred in 2003, with a value of 25.1. Rates declined substantially in the remaining years. Catch rate estimates were 7.3 and 4.6 in 1994 and 1992, respectively. CPUE was 3.8 in 1993 and 1996, followed by 1.8 in 2002, 1.6 in 1998, 0.8 in 2000, 0.5 in 2004, and 0.1 in 1995. The lowest catch rate among years was 0.0 in 2005.

During May through August in the Texas offshore zone, highest CPUE was recorded in 1996, with a value of 10.4. The catch rate estimate was 9.1 in 1997, and 8.3 in 1992. CPUE was 7.0 in 2004, followed by 6.8 in 2005, 5.0 in 1995, and 4.9 in 1994. Catch rate estimates were 3.3 in 1998, and 3.1 in 1999. The remaining years had catch rates of less than 3.0. CPUE was 2.2 in 2003, followed by 1.9 in 2002, and 1.7 in both 1993 and 2001.

Longspine porgy CPUE in Texas nearshore waters during September through December was highest at 8.1 in 1992. Catch rate estimates were 0.0 in 1993, 1996, and 2002.

For Texas offshore waters during the same time period (September through December), CPUE was highest in 1994, with a value of 11.2. Catch rate estimates in 1992 and 2004 were 7.8 and 6.8, respectively. CPUE was 6.3 in 2005, followed by 5.7 in 1997, 4.6 in 2003, 4.4 in 2001, and 3.8 in 1999. Estimated catch rates were 3.5 in 2002, and 2.9 in 1995. CPUE was 1.8 in 1996, followed by 1.2 in 1993, and 0.6 in 2000.

In Louisiana nearshore waters during January through April, CPUE for longspine porgy was highest in 2003, with a value of 1.2. Catch rate estimates were 0.0 during 1993, 2004, and 2005.

During January through April in the Louisiana offshore zone, CPUE was 7.7 in both 1994 and 1998. CPUE was 5.3 in 1996, followed by 4.9 in 1997, 4.5 in 1993, and 3.8 in 1995. Catch rate estimates in 1992 and 2002 were 2.2 and 1.9, respectively. CPUE was 1.2 in 2003, followed by 1.0 in 2004, and 0.4 in 2005.

In May through August in Louisiana nearshore waters, CPUE was highest in 2004, with a value of 8.9. CPUE was 6.1 in 1992, followed by 0.1 in both 2004 and 1993, and 0.0 in 2002, 2005, and 1994.

Data were collected in all years from May through August in Louisiana offshore waters. The highest CPUE occurred in 1993, with a value of 11.6. Catch rate estimates in 1996 and 2005 were 11.0 and 10.0, respectively. CPUE in 1992 was 9.4, followed by 8.9 in 1995, 8.7 in 1997, 4.8 in 1999, and 4.4 in 1994. The remaining years had catch rates less than 4.0. CPUE was 3.3 in 1998, followed by 3.1 in 2001, 2.3 in 2004, 2.0 in 2002, and 1.5 in 2000. The lowest CPUE was observed in 2003, with a value of 0.4.

In Louisiana nearshore waters during the September through December period, highest CPUE was 1.9 in 2003. Catch rate estimates in both 1992 and 1993 were 0.1. Estimated CPUE was 0.0 in 2004, 2005, 2002, and 2001.

In Louisiana offshore waters during this same time period (September through December), CPUE was highest in 1997, with a value of 11.5. A catch estimate of 9.5 was observed in 1994. CPUE was 7.7 in 1992, followed by 7.4 in 1993, 4.8 in 1995, 3.7 in 1999, and 3.2 in both 1998 and 2004. Catch rate estimates were 2.3 in both 2001 and 2005. CPUE was 0.9 in 2003. The lowest CPUE was exhibited in 2002, with a value of 0.7.

In Alabama/Mississippi nearshore waters during January through April the highest longspine porgy CPUE occurred in 1993, with a value of 1.2. CPUE was 0.3 in 2002, followed by 0.0 in 2003, 2004, and 2005.

During this same period (January through April) in Alabama/Mississippi offshore waters, the highest CPUE for longspine porgy was 3.0 in 2002. Catch rate estimates were 1.7 in both 2005 and 2004. CPUE was 0.7 in 2003.

During May through August in the Alabama/Mississippi nearshore zone, the highest CPUE was 11.1 in 2001. The catch rate was 1.3 in 2002. CPUE was 0.5 in both 1994 and 2004. Similarly, catch rate estimates were 0.4 in both 2003 and 1998. CPUE was 0.1 in 1993. Catch rate estimates were 0.0 in 1992, 1996, and 2005.

In Alabama/Mississippi offshore waters from May through August, highest longspine porgy CPUE occurred in 1993, with a value of 6.7. CPUE was 4.6 in 2005, followed by 3.4 in 2004, 3.3 in 1994, 3.2 in 2001, and 3.1 in 1998. Catch rate estimates were 2.4 in 2002, and 0.6 in 2003.

During September through December in Alabama/Mississippi nearshore waters, highest CPUE was 0.9 in 2001. Catch rate estimates were 0.8 and 0.1 in 2003 and 2002, respectively. CPUE was 0.0 in 2004, 1994, 2005, and 1992.

During the same time period from September through December, highest CPUE in Alabama/Mississippi offshore zone occurred in 1993, with a value of 51.3. This rate dropped substantially in the remaining years. The catch rate estimate was 5.9 in 2005. CPUE was 3.6 in 2004, followed by 3.5 in 2001, 3.4 in 2002, 1.9 in 2003, and 1.4 in 1992.

In Florida nearshore waters from January through April, longspine porgy CPUE was highest in 2005 at 0.1. Estimated catch rates were 0.0 for 2002, 1993, 1994, 1995, 1996, 2003, and 2004.

During January through April in the Florida offshore zone, longspine porgy CPUE was highest in 2005, with a value of 0.4. The catch rate estimate was 0.1 in 2002. Similarly, estimated CPUE was 0.0 was 1993, 2004, 1994, 1995, 1996, 1997, and 2003.

From May through August for Florida nearshore waters, CPUE was highest at 0.6 in 2004. Catch rate estimates were 0.5 and 0.4 in 1993 and 2005, respectively. CPUE was 0.0 in 2002, 1994, and 1995.

For Florida offshore waters from May through August, CPUE was 0.1 in 2002. Estimated catch rate values were 0.4 in 2005, and 0.1 in 1995. CPUE was 0.0 in 2004, 1993, 1994, 1992, and 1996.

In the Florida nearshore zone during September through December, longspine CPUE was highest at 1.2 in 1994. In 1995, the estimated catch rate was 0.0.

For Florida offshore waters during the same time period (September through December), longspine porgy CPUE was highest in 1994, with a value of 5.7. CPUE was 0.9 in 2001, followed by 0.1 in 2002, and 0.0 in 1996, 1992, and 1995.

Red Drum

CPUE for red drum was less than 0.1 in all years, except 2004, for all state areas combined. On the individual state level, red drum CPUE was 0.2 in Alabama/Mississippi in 2001. Catch rate estimates were 0.1 in Alabama/Mississippi in 2003, and off Louisiana in both 2004 and 1992. Examination of CPUE by state, depth and season, yielded a value of 0.8 off Louisiana nearshore waters from September through December in 2001. Similarly, the catch rate estimate was 0.8 in Alabama/Mississippi nearshore waters during the same season in 2004. CPUE was 0.5 in Louisiana nearshore waters in January through April in 1993, in Louisiana nearshore waters from September through December in 2003, and in Alabama/Mississippi nearshore waters from September through December in 2003. Catch rate estimates were 0.4 in Alabama/Mississippi nearshore waters during September through December in both 2001 and 2002. CPUE was 0.3 in Louisiana offshore waters from May through August in 2004, in Alabama/Mississippi offshore waters from January through April in 2003, in Louisiana nearshore waters during September through December in 2005, in Louisiana nearshore waters from May through August in 2004, and in Alabama/Mississippi nearshore waters during January through April in 2002. Catch rates were 0.2 in Florida nearshore waters from May through August in 2005, and in Alabama/Mississippi nearshore waters during January through April in 2003. CPUE was 0.1 for the following: Louisiana offshore waters in September through December in 1992, Florida nearshore waters in September through December in 1994, Alabama/Mississippi nearshore waters during January through April in 2005, Alabama/Mississippi offshore waters from September through December in 2001, Alabama/Mississippi nearshore waters from May through August in 2003, Louisiana nearshore waters during September through December in 1992, and Louisiana nearshore waters from May through August in 2005. CPUE was 0.0 in all other areas, depths and seasons.

Red Snapper

Red snapper CPUE in kilograms per hour by year and state was examined. As previously reported, red snapper catch rates were higher in Texas and Louisiana. CPUE was significantly lower off Alabama and Florida.

Red snapper CPUE off Texas was ≥ 0.1 in all years. CPUE for red snapper was 0.4 in both 2005 and 1995. Catch rate estimates were 0.2 in 1994, 2004, 1992, 1996, 2001, and 1997. Estimated CPUE was 0.1 for the remaining years. These include 2002, 1999, 1993, 2000, 2003, and 1998.

CPUE off Louisiana was highest in 2000, with a value of 0.5. The catch rate estimate in 1997 was 0.3. CPUE was 0.2 in 1999, 1994, 1998, and 2001. Catch rate estimates were 0.1 in 1995, 1996, 1992, 2004, and 1993. CPUE was 0.0 in 2002, 2003, and 2005.

Off Alabama/Mississippi red snapper CPUE was highest in 2004, with a value of 0.1. Estimated CPUE was 0.0 in 2003, 2005, 2002, 1994, 2001, 1998, 1992, 1993, and 1996.

Florida experienced the lowest catch rates for red snapper, with estimated CPUE at 0.0 in all sampled years. These included 2005, 2004, 1994, 2002, 2001, 1992, 2003, 1993, 1995, 1996, and 1997.

Red snapper catch rate estimates in kilograms per hour by year, state and depth strata are presented below. Offshore areas of Texas and Louisiana yielded higher catch rates of red snapper as compared with the nearshore strata.

In the Texas nearshore strata, red snapper CPUE was highest in 1994, with a value of 0.2. Catch rate estimates were 0.1 in 1995, 1993, 1996, 2003, and 1992. CPUE was 0.0 in 2000, 2004, 2002, 1998, and 2005.

For Texas offshore waters, CPUE was 0.4 in both 2005 and 1995. Catch rates were 0.3 in both 2004 and 1992. Similarly, CPUE was 0.2 in 1994, 1996, 2001, 2000, and 1997. Estimated values of CPUE were 0.1 in 2002, 1993, 1999, 2003, and 1998.

In the Louisiana nearshore area, CPUE was 0.0 in all years sampled. These included 2003, 1992, 2002, 2004, 2005, 1993, 1994, and 2001.

For Louisiana offshore waters, the highest catch rate estimate occurred in 2000, with a value of 0.5. CPUE was 0.3 in 1997. Catch rate estimates were 0.2 in 1999, 1994, 1998, and 2001. CPUE was 0.1 in 1992, 1995, 2004, 1996, and 1993. Catch rates were estimated at 0.0 in 2005, 2002, and 2003.

For Alabama/Mississippi nearshore strata, CPUE was estimated at 0.0 for all years when sampling occurred. These included 2004, 2001, 2002, 1994, 2003, 1998, 1992, 2005, 1993, and 1996.

In the Alabama/Mississippi offshore zone, CPUE was 0.1 in 2004, 1994, 2003, and 2005. Estimated catch rates values were 0.0 in 2002, 2001, 1993, 1992, and 1998.

In Florida nearshore waters, red snapper catch rates were estimated at 0.0 for all sampled years. These included 2005, 2004, 2002, 1993, 1994, 1995, 1996, and 2003.

Similarly, in the Florida offshore zone, CPUE was not detectable. Catch rate estimates were 0.0 in 2005, 2004, 2002, 1994, 2003, 2001, 1992, 1993, 1995, 1996, and 1997.

Red snapper catch rate values in kilograms per hour by year, state, depth and season were assessed. Red snapper CPUE was highest off Texas and Louisiana in offshore waters in September through December.

In Texas nearshore waters during January through April, red snapper CPUE was highest at 0.1 in 1993. In 1994 and 1992 catch rate estimates were 0.0.

For the Texas offshore zone during the same period (January through April), CPUE was highest in 0.2 in both 1997 and 1994. Estimated catch rate estimates were 0.1 in 1996, 2002, 1998, and 2004.

In Texas nearshore waters from May through August, highest CPUE for red snapper occurred in 1994, with a value of 0.4. In 1992 and 1993, catch rate estimates were 0.2. CPUE was 0.1 in 1995, 1996, 2003, and 2002. Catch rates were 0.0 for 2000, 2004, 1998, and 2005.

During May through August in the Texas offshore zone, highest CPUE was 0.4 in both 2005 and 1995. CPUE in both 1996 and 2004 was 0.3. The catch rate estimate in 1994 was 0.2. CPUE was 0.1 in 2001, 2002, 1997, 1998, 2003, 1992, and 1993. The lowest estimated catch rate was 0.0 in 1999.

Red snapper CPUE in Texas nearshore waters during September through December was highest at 0.1 in 1992. Catch rate estimates were 0.0 in 1993, 1996, and 2002.

For Texas offshore waters during the same time frame (September through December), CPUE was highest in 2005, with a value of 0.5. Catch rate estimates were 0.4 in 1994, 1995, 2004, and 1992. CPUE was 0.2 in 2001, 1993, 1999, 2003, 1997, 2002, and 2000. The estimated catch rate was 0.1 in 1996.

In Louisiana nearshore waters during January through April, CPUE for red snapper was 0.0 in all years sampled. These included 2004, 1993, 2003, and 2005.

During January through April in the Louisiana offshore zone, highest CPUE was 0.2 in 1998. Catch rate estimates in 1994 and 1996 were 0.1. CPUE was 0.0 in 2005, 1993, 2004, 1997, 2002, 1995, 2003, and 1992.

In May through August in Louisiana nearshore waters, CPUE was 0.0 in all years when sampling occurred. These included 2003, 1992, 2002, 2004, 1993, 2005, and 1994.

From May through August in Louisiana offshore waters, the highest CPUE occurred in 2000, with a value of 0.7. The catch rate estimate in 1997 was 0.3. CPUE was 0.1 in 2001, 1994, 1992, 1996, 1993, 2004, 2005, 1998, 1999, and 1995. Estimated catch rates were 0.0 in 2002 and 2003.

In Louisiana nearshore waters during the September through December period, CPUE was not detectable. Red snapper catch rate estimates were 0.0 in 2004, 2002, 2003, 2005, 1992, 1993, and 2001.

In Louisiana offshore waters during this same time period (September through December), CPUE was highest in 1994, with a value of 0.5. Catch rate estimates were 0.4 in both 2004 and 1997. CPUE was 0.3 in 1999. Catch rate estimates were 0.2 in 1992, 1995, 2001, 1993, and 1998. CPUE was 0.1 in both 2002 and 2003. The lowest CPUE was exhibited in 2005, with a value of 0.0.

In Alabama/Mississippi nearshore waters during January through April, CPUE was 0.0 in all years sampled. These years were 2004, 2002, 2005, 2003, and 1993.

During this same period (January through April) in Alabama/Mississippi offshore waters, CPUE was 0.1 in both 2003 and 2004. Catch rate estimates were 0.0 in 2005 and 2002.

During May through August in the Alabama/Mississippi nearshore zone, CPUE was 0.1 in 2001. Catch rate estimates were 0.0 in 2004, 1994, 2002, 2003, 1998, 1993, 1992, 1996, and 2005.

In Alabama/Mississippi offshore waters from May through August, red snapper CPUE was 0.1 in both 2004 and 1994. Catch rate estimates were 0.0 in 2001, 2003, 2002, 1993, 2005, and 1998.

During September through December in Alabama/Mississippi nearshore waters, red snapper CPUE was 0.0 in all years when sampling occurred. These included 2002, 2004, 2001, 2003, 1992, 1994, and 2005.

During the same time period (September through December), CPUE in Alabama/Mississippi offshore zone was 0.1 in 2004, 2005, and 2002. Catch rate estimates were 0.0 in 2001, 1992, and 1993.

In Florida nearshore waters from January through April, CPUE was not detectable. Red snapper catch rate estimates were 0.0 in 2005, 1993, 1994, 1995, 1996, 2002, 2003, and 2004.

Similarly, during January through April in the Florida offshore zone, red snapper CPUE was 0.0 in all years sampled. These included 2005, 2004, 2003, 2002, 1994, 1993, 1995, 1996, and 1997.

Again, from May through August for Florida nearshore waters, CPUE was 0.0 in all years when observations were conducted. These included 2004, 2002, 1993, 1994, 1995, and 2005.

For Florida offshore waters from May through August, CPUE was 0.0 in sampled years. These years were 1994, 2002, 1992, 1993, 1995, 1996, 2004, and 2005.

In the Florida nearshore zone during September through December, CPUE was 0.0 in the two years sampled. These were 1994 and 1995.

For Florida offshore waters during the same time period (September through December), red snapper CPUE was highest in 2002, with a value of 0.1. Catch rate estimates were 0.0 in 1992, 1994, 2001, 1995, and 1996.

Seatrout

CPUE in kilograms per hour by year and state was analyzed. Overall, catch rates were generally higher in Alabama/Mississippi, followed by Louisiana, Texas and Florida.

CPUE off Texas for seatrout was highest in 1995, with a value of 1.7. Catch rates in 1996 and 2004 were 1.6 and 1.1, respectively. CPUE in both 1992 and 1994 was 1.0, followed by 0.9 in both 1993 and 2005. CPUE was 0.6 in 2001, 2002, and 1998. Similarly, catch rate estimates were 0.3 in 1997, 2003, and 2000. The lowest CPUE experienced was 0.1 in 1999.

CPUE off Louisiana was 4.4 in both 1994 and 2004. CPUE was 3.8 in 2005, followed by 3.4 in 2002, 2.2 in 1995, and 1.8 in both 1993 and 2003. Catch rates in 2001 and 1992 were 1.6 and 1.4, respectively. CPUE in 1998 was 0.8, followed by 0.5 in both 1997 and 1996. For the remaining years, catch rates were below 0.5. CPUE was 0.2 in 1999, and 0.1 in 2000.

Off Alabama/Mississippi seatrout CPUE was highest in 2005, with a value of 6.3. Catch rate estimates in 1992 were 5.3, followed by 4.1 in both 2004 and 2001. During 1994, CPUE was 2.6, followed by 2.0 in both 2002 and 2003. Catch rate estimates were 1.3 in 1993, followed by 0.6 in 1998, and 0.5 in 1996.

Florida experienced the lowest CPUE for seatrout. Catch rates were 0.2 in both 2005 and 2004. Catch rate estimates were 0.1 in 1996, 2002, 1993, 1994, and 2003. Similarly, CPUE was 0.0 in 1995, 1992, 1997, and 2001.

Seatrout catch rate estimates in kilograms per hour by year, state and depth strata are presented below. CPUE relative to depth was variable. Off Texas, catch rates were higher in nearshore waters. Off Louisiana, CPUE was similar between the near and offshore strata. Off Alabama/Mississippi, catch rates were higher in offshore waters as compared with the nearshore strata. Florida nearshore waters experienced higher CPUE than the offshore zone.

In the Texas nearshore strata, seatrout CPUE was highest at 9.1 in 1995. Catch rate estimates were 4.3 in 1996, followed by 3.8 in 2004, 3.7 in 1998, and 3.6 in 1994. Catch rates were 2.3 and 1.9 in 1992 and 2005, respectively. CPUE was 1.4 in 1993, followed by 1.0 in 2002, 0.7 in 2000, and 0.6 in 2003.

For Texas offshore waters, CPUE was highest in 1995, with a value of 1.3. Catch rate estimates were 0.9 in 2005, 1993, and 1996. Similarly, catch rate estimates in 1994 were 0.8, followed by 0.6 in 2001, 2002, and 1992. For the remaining years, catch rates were below 0.6. CPUE in 2004 was 0.5. CPUE was 0.4 in 1998, followed by 0.3 in both 1997 and 2003. Catch rate estimates were 0.1 in both 2000 and 1999.

In the Louisiana nearshore area, CPUE was highest at 3.2 in 2004. In 2003 and 2005, catch rate estimates were 3.0 and 2.9, respectively. CPUE was 2.6 in 1993, 1992, and 1994. Catch rates were 1.8 in 2001, and 1.5 in 2002.

For Louisiana offshore waters, the highest catch rate estimate occurred in 2004, with a value of 4.7. CPUE was 4.5 in both 2005 and 1994. Catch rate estimates were 3.4 in 2002, followed by 2.2 in 1995, 1.8 in 1993, 1.7 in 2003, and 1.6 in 2001. CPUE was 0.8 in both 1998 and 1992. Similarly, the catch rate estimates were 0.5 in both 1997 and 1996. For the remaining years, catch rate estimates were below 0.3. CPUE was 0.2 in 1999, and 0.1 in 2000.

For Alabama/Mississippi nearshore strata, CPUE was highest at 4.5 in 1992. In 1994 and 1993, catch rates values were 3.2 and 1.7, respectively. CPUE was 1.4 in both 2004 and 2003. Catch rate estimates were 1.2 in 2005, followed by 1.1 in 2002, 1.0 in 2001, and 0.5 in 1996. The lowest CPUE for seatrout was at 0.3 in 1998.

In the Alabama/Mississippi offshore zone, CPUE was highest in 2005, with a value of 7.1. In 2001 and 1992, catch rates values were 6.4 and 6.1, respectively. CPUE was 4.5 in 2004. CPUE was 2.3 in both 2002 and 2003. Catch rate estimates were 1.4 in 1994, followed by 0.7 in 1998, and 0.5 in 1993.

In Florida nearshore waters, seatrout CPUE was highest at 1.0 in 1996. Catch rate estimates were 0.6 in 1994, followed by 0.5 in 2005, 0.3 in 2004, and 0.2 in both 1993 and 2002. CPUE was 0.1 in 1995, and 0.0 in 2003.

In the Florida offshore zone, CPUE was highest in 2005, with a value of 0.2. Catch rate estimates were 0.1 in 2004, 2003, and 2002. CPUE was 0.0 in 1996, 1994, 1993, 1992, 1995, 1997, and 2001.

Seatrout CPUE in kilograms per hour by year, state, depth and season was examined. Seatrout occurred in all seasons with variable catch rates. Higher CPUE in the nearshore waters typically occurred in May through August period, most notably off Texas. Relative to the offshore strata, higher catch rate estimates were observed in January through April, followed by September to December. This was particularly evident in offshore waters off Louisiana and Alabama/Mississippi.

In Texas nearshore waters during January through April, seatrout CPUE was highest at 1.8 in 1992. Catch rate estimates were 0.4 in both 1994 and 1993.

For the Texas offshore zone during the same period (January through April), CPUE was highest in 2004, with a value of 1.0. CPUE was 0.8 in 1994, followed by 0.7 in 1997, and 0.5 in both 1998 and 1996. The lowest CPUE was 0.3 in 2002.

In Texas nearshore waters from May through August, highest CPUE for seatrout was 9.1 in 1995. Catch rate estimates were 6.1 and 4.6 in 1994 and 1996, respectively. CPUE was 3.8 in 2004, followed by 3.7 in 1998, 3.5 in 1993, 3.4 in 1992, and 2.2 in 2005. Catch rates for the remaining years was below 1.0. CPUE was 0.7 in both 2002 and 2000. The lowest CPUE was 0.2 in 2003.

During May through August in the Texas offshore zone, highest CPUE was observed in 2005, with a value of 1.1. CPUE was 0.8 in 1995, and 0.7 in both 2001 and 1996. Catch rate estimates were 0.6 in 1994, followed by 0.5 in 2002, and 0.3 in 2004, 1992, and 1993. Similarly CPUE was 0.2 in both 1998 and 2003. Catch rate estimates were 0.1 in 1997, and 0.0 in 1999.

Seatrout CPUE in Texas nearshore waters during September through December was highest at 2.6 in 1996. Catch rate estimates were 2.3 in 1992, followed by 1.2 in both 1993 and 2002.

For Texas offshore waters during the same time frame (September through December), CPUE was highest in 1993, with a value of 1.7. Catch rate estimates in 1995 and 1996 were 1.4 and 1.3, respectively. CPUE was 1.1 in 1994, followed 0.8 in both 2002 and 1992. Estimated catch rates were 0.5 in both 2004 and 2003. Seatrout catch rates were 0.4 in 1997, and 0.3 in both 2001 and 2005. CPUE was 0.1 in 1999, and 0.0 in 2000.

In Louisiana nearshore waters during January through April, CPUE for seatrout was highest in 1993, with a value of 3.6. Catch rate estimates were 2.9 in both 2004 and 2003. The lowest CPUE was 1.0 in 2005.

During January through April in the Louisiana offshore zone, highest CPUE was 7.8 in 2005. CPUE was 6.0 in 2002, followed by 5.2 in 1994, 5.0 in 2004, and 4.4 in 1997. Catch rate estimates in 2003 and 1993 were 2.9 and 1.4, respectively. For the remaining years, CPUE was less than 1.0. CPUE was 0.9 in 1998, followed by 0.6 in 1996, 0.5 in 1995, and 0.2 in 1992.

In May through August in Louisiana nearshore waters, seatrout CPUE was highest in 2004, with a value of 3.2. Catch rates were 2.8 in both 1992 and 2005. CPUE was 2.6 in 1994, followed by 2.3 in 1993, 1.9 in 2002, and 0.7 in 2003.

During May through August in Louisiana offshore waters, highest CPUE for seatrout was 5.8 in 1994. Catch rate estimates in 2004 and 2005 were 4.4 and 2.7, respectively. CPUE in 1992 was 1.4. Estimated catch rates were 1.3 in 2002, and 0.9 in 2003. CPUE was 0.8 in both 1993 and 2001, followed by 0.5 in 1998, 0.4 in 1996, and 0.3 in both 1995 and 1997. The catch rate estimate in 1999 was 0.1. The lowest CPUE of seatrout was 0.0 in 2000.

In Louisiana nearshore waters during the September through December period, highest CPUE was 4.0 in 2005. Catch rate estimates in 2003 and 2004 were 3.6 and 2.6, respectively. CPUE was 2.3 in 1992, followed by 1.8 in 2001, 1.6 in 1993, and 1.4 in 2002.

In Louisiana offshore waters during this same time period (September through December), CPUE was highest in 1995, with a value of 3.7. Similar catch rate estimates were 3.6 in 1993, and 3.5 in 2004. CPUE was 2.6 in 2002, followed by 2.4 in 2005, 2.1 in 2001, 1.7 in 2003, and 1.5 in 1998. Catch rate estimates for the remaining years were below 1.5. CPUE was 1.3 in 1994, followed by 1.0 in 1992, 0.4 in 1997, and 0.3 in 1999.

In Alabama/Mississippi nearshore waters during January through April the highest CPUE occurred in 1993, with a value of 2.6. CPUE in 2004 was 2.1. Estimated catch rates were 1.2 in both 2003 and 2002. The lowest CPUE was 0.6 in 2005.

During this same period (January through April), seatrout CPUE in Alabama/Mississippi offshore waters was 11.0 in 2005. CPUE was 6.3 in 2004, followed by 5.9 in 2002, and 5.3 in 2003.

During May through August in the Alabama/Mississippi nearshore zone, the highest seatrout CPUE was 6.8 in 1992. Catch rate values were 3.1 and 1.7 in 1994 and 1993, respectively. CPUE was 1.6 in 2005, followed by 1.3 in 2003, and 1.0 in 2001. Catch rate estimates were 0.8 in 2002, followed by 0.7 in 2004, and 0.5 in 1996. The lowest CPUE was 0.3 in 1998.

In Alabama/Mississippi offshore waters from May through August, highest CPUE occurred in 2004, with a value of 1.4. CPUE in 2003 was 1.2, followed by 1.0 in 2005, 0.9 in 2002, 0.7 in 1998, and 0.5 in 1994. Catch rate estimates were 0.4 in both 1993 and 2001.

During September through December in Alabama/Mississippi nearshore waters, highest seatrout CPUE was 4.4 in 1994. Catch rate estimates were 3.4 and 2.2 in 1992 and 2003, respectively. CPUE was 1.8 in 2004, followed by 1.6 in 2002, 1.3 in 2005, and 1.0 in 2001.

During the same time period from September through December, the highest seatrout CPUE in Alabama/Mississippi offshore zone occurred in 2001, with a value of

8.6. The catch rate estimate was 6.1 in 1992. CPUE was 2.6 in 2002, followed by 2.5 in 2004, 2.2 in 2005, 2.0 in 2003, and 1.0 in 1993.

In Florida nearshore waters from January through April, CPUE was highest in 2005 at 0.5. CPUE was 0.3 in 2004, and 0.2 in both 2002 and 1994. Estimated catch rates were 0.0 for 2003, 1993, 1995, and 1996.

During January through April in the Florida offshore zone, seatrout CPUE was 0.2 in 2005 and 2004. Catch rate estimates were 0.1 for both 2003 and 2002. Similarly, estimated CPUE was 0.0 in 1994, 1993, 1995, 1996, and 1997.

From May through August for Florida nearshore waters, seatrout CPUE was highest at 0.9 in 2005. Estimated catch rates were 0.6 in 1993. CPUE was 0.3 in 1994, followed by 0.2 in 2004, 0.1 in 1995, and 0.0 in 2002.

For Florida offshore waters from May through August, CPUE was 0.1 in 2005. Estimated catch rate values were 0.0 in 2004, 2002, 1993, 1992, 1994, 1995, and 1996.

In the Florida nearshore zone during September through December, seatrout CPUE was highest at 0.9 in 1994. The estimated catch rate was 0.0 in 1995.

For Florida offshore waters during the same time period (September through December), seatrout CPUE was 0.1 in both 1996 and 1994. Catch rate estimates were 0.0 in 2002, 1992, 1995, and 2001.

Sharks

Grouped shark CPUE in kilograms per hour by year and state was assessed. Shark catch occurred in all states with variable distribution among states. Overall, catch rates were slightly higher in Louisiana as compared with Alabama/Mississippi and Texas. CPUE in Florida was lower. Catch rates were notably higher in the latter part of the project.

Off Texas, shark CPUE was 0.2 in both 2000 and 2005. Estimated catch rates were 0.1 in 1992, 1996, 1999, 2002, 1995, 2003, 2004, 1998, and 2001. CPUE was 0.0 in 1997, 1994, and 1993.

CPUE off Louisiana was 0.4 in 2004, 2005, and 2002. Similarly, catch rates were 0.3 in both 1992 and 1996. CPUE was 0.2 in 2001. For the remaining years estimated catch rates were < 0.2. CPUE was 0.1 in 2003, 1995, 1998, 1993, and 1997. Catch rates were 0.0 in 1994, 1999, and 2000.

Off Alabama/Mississippi shark catch rates were 0.3 in both 2001 and 2002. CPUE was 0.2 in 2005. Catch rates were 0.1 in 2003, 2004, 1992, and 1994. CPUE was 0.0 in 1993, 1998, and 1996.

Florida experienced lower catch rates for grouped sharks. CPUE was 0.3 in 2003. The catch rate value in 2005 was 0.2. CPUE was 0.1 in 2002, 2004, and 1994. CPUE was estimated at 0.0 in all other years sampled. These include 2001, 1995, 1993, 1992, 1996, and 1997.

Grouped shark catch rate estimates in kilograms per hour by year, state and depth strata are presented below. CPUE in near and offshore zones was variable among all states. Texas and Louisiana nearshore waters typically yielded higher rates as compared with the offshore zones. In Alabama/Mississippi and Florida offshore areas reflected higher catch rates than the nearshore strata.

In the Texas nearshore waters, shark CPUE was highest in 2000, with a value of 0.8. CPUE was 0.7 in 2005, followed by 0.4 in 2003, and 0.3 in 1992. Estimated catch rates were 1.0 in both 2004 and 1998. CPUE was 0.0 in 2002, 1993, 1994, 1995, and 1996.

For the Texas offshore zone, CPUE was highest at 0.2 in 2005. Catch rates were 0.0 in 1996, 1999, 2002, 1995, 2003, 2004, 1998, and 2001. CPUE was 0.0 for the remaining years. These included 1997, 1992, 1994, 1993, and 2000.

In the Louisiana nearshore area, CPUE was 0.6 in both 2004 and 2005. Catch rate estimates were 0.4 in 1992, followed by 0.2 in 1993, and 0.1 in 2003. CPUE was 0.0 in 1994, 2001, and 2002.

For Louisiana offshore waters, the highest catch rate estimate occurred in 2002, with a value of 4.0. CPUE was 0.3 in both 2004 and 1996. Similarly, catch rate estimates were 0.2 in 1992, 2001, and 2005. For the remaining years, CPUE was < 0.1.

Catch rate estimates were 0.1 in 2003, 1995, 1998, 1993, and 1997. CPUE was 0.0 in 1994, 1999, and 2000.

For Alabama/Mississippi nearshore strata, CPUE was highest in 1992, with a value of 0.2. Catch rate estimates were 0.1 in 2002, 2001, 2004, 1994, and 1998. CPUE was 0.0 for 1993, 2005, 1992, and 1996.

In the Alabama/Mississippi offshore zone, CPUE was highest in 2002, with a value of 0.5. Catch rates values were 0.3 and 0.2 in 2002 and 2005, respectively. CPUE was 0.1 in 1992, 2003, and 1994. Catch rate estimates were 0.0 in both 1993 and 1998.

In Florida nearshore waters, shark CPUE was 0.2 in both 1994 and 2003. CPUE was 0.1 in both 2005 and 2002. Catch rate estimates were 0.0 in 2004, 1995, 1993, and 1996.

In the Florida offshore zone, CPUE was highest at 0.5 in 2003. Catch rate estimates were 0.2 in 2005, 2002, and 2004. CPUE was estimated at 0.0 in 1994, 2001, 1995, 1993, 1992, 1996, and 1997.

Grouped shark CPUE in kilograms per hour by year, state, depth and season was assessed. Seasonal distribution was variable. In Texas and Louisiana nearshore waters no detectable catch rates were evident in the January through April period, and thus limited to May through August and September through December. In offshore waters of these two states, catch was recorded in all seasons. Similarly, catch rates were documented in all seasons and depth strata for Alabama/Mississippi and Florida waters.

In Texas nearshore waters during January through April, shark CPUE was 0.0 in all years sampled. These included 1992, 1993, and 1994.

For the Texas offshore zone during the same period (January through April), CPUE was highest in 1996, with a value of 0.4. CPUE was 0.2 in 2002. Catch rates were 0.1 in both 2004 and 1998. Estimated CPUE was 0.0 in both 1994 and 1997.

In Texas nearshore waters from May through August, highest shark CPUE occurred in 1992, with a value of 1.0. Catch rate estimates were 0.8 and 0.4 in 2000 and 2003, respectively. CPUE was 0.1 in 2004, 2002, and 1998. Catch rates were 0.0 for 1993, 1994, 1995, 1996, and 2005.

During May through August in the Texas offshore zone, CPUE was 0.2 in 2005, 1999, and 1996. Catch rates were 0.1 in 1998, 2002, 2004, 1995, and 2003. Estimated CPUE was 0.0 in 2001, 1994, 1992, 1993, and 1997.

Shark CPUE in Texas nearshore waters during September through December was highest at 1.6 in 1992. Catch rate estimates declined substantially in the remaining years. CPUE was 0.1 in 1993, and 0.0 in both 1996 and 2002.

For Texas offshore waters during the same time frame (September through December), CPUE was 0.1 in 2001, 2002, 1995, 2003, 1999, and 1997. Catch rate estimates were 0.0 in 1992, 1993, 1994, 1996, 2000, 2004, and 2005.

In Louisiana nearshore waters during January through April, shark CPUE was 0.0 in all years observed. These included 1993, 2003, 2004, and 2005.

During January through April in the Louisiana offshore zone, estimated shark catch rates were 0.4 in 1992, 2004, and 2003. CPUE was 0.3 in both 2002 and 1996. Catch rate estimates in 2005 and 1995 were 0.2. CPUE was 0.1 in both 1998 and 1993. Estimated catch rates were 0.0 in 1994 and 1997.

In May through August in Louisiana nearshore waters, CPUE was highest in 2004, with a value of 0.7. CPUE was 0.6 in 1992, followed by 0.5 in 2005, 0.4 in 2003, and 0.3 in 1993. The catch rate estimate were 0.0 in both 1994 and 2002.

Data were collected in all years from May through August in Louisiana offshore waters. CPUE was 0.3 in 2002 and 1992. Catch rate estimates were 0.2 in both 2004 and 1998. CPUE was 0.1 in 2003, 2001, 1996, 2005, and 1993. Catch rate estimates for the remaining years were 0.0. These years included 1995, 1994, 1997, 1999, and 2000.

In Louisiana nearshore waters during the September through December period, highest CPUE was 1.4 in 2005. The catch rate estimate in 2004 was 0.2. CPUE was 0.0 in 1992, 1993, 2001, 2002, and 2003.

In Louisiana offshore waters during this same time period (September through December), shark CPUE was highest in 2002, with a value of 0.4. The catch rate estimates were 0.3 in both 2001 and 2005. Similarly, CPUE was 0.2 in both 1993 and

2004. Catch rate estimates were 0.1 in 1995, 2003, 1992, and 1997. CPUE was 0.0 in 1999, 1994, and 1998.

In Alabama/Mississippi nearshore waters during January through April the highest CPUE occurred in 2003, with a value of 0.2. CPUE was 0.0 in 1993, 2002, 2004, and 2005.

During this same period (January through April) in Alabama/Mississippi offshore waters, the highest shark CPUE was 0.5 in 2002. CPUE was 0.3 in 2005, followed by 0.2 in 2003, and 0.1 in 2004.

During May through August in the Alabama/Mississippi nearshore zone, the highest CPUE was 0.2 in 2003. Catch rate estimates were 0.1 in 2002, 1994, and 1998. CPUE was 0.0 in 1993, 2004, 1992, 1996, 2001, and 2005.

In Alabama/Mississippi offshore waters from May through August, shark CPUE was 0.2 in 2001 and 2002. Catch rate estimates were 0.1 in 2003, 2005, and 1994. CPUE was 0.0 in 2004, 1993, and 1998.

During September through December in Alabama/Mississippi nearshore waters, CPUE was 0.2 in both 2004 and 2002. The catch rate estimate was 0.1 in 2001. CPUE was 0.0 in 2003, 2005, 1992, and 1994.

During the same time period (September through December), the highest shark CPUE in Alabama/Mississippi offshore zone occurred in 2001, with a value of 0.6. The catch rate estimates were 0.4 and 0.2 in 2002 and 2005, respectively. CPUE was 0.1 in 1992, 2003, and 2004. The catch rate estimate was 0.0 in 1993.

In Florida nearshore waters from January through April, CPUE was highest in 2003 at 0.2. CPUE was 0.1 in 2005, 1994, and 2002. Catch rate estimates were 0.0 in 2004, 1995, 1993, and 1996.

During January through April in the Florida offshore zone, shark CPUE was highest in 2003, with a value of 0.5. Catch rate estimates were 0.2 for both 2005 and 2004. Similarly, estimated CPUE was 0.1 in 2002. Catch rate estimates were 0.0 in 1994, 1995, 1993, 1996, and 1997.

From May through August for Florida nearshore waters, CPUE was highest at 0.2 in 2005. Estimated catch rates were 0.1 for both 2002 and 1995. CPUE was 0.0 in 1993, 1994, and 2004.

For Florida offshore waters from May through August, CPUE was 0.2 in both 1994 and 2002. The estimated catch rate value was 0.1 in 2004. CPUE was 0.0 in 1992, 1993, 1995, 1996, and 2005.

In the Florida nearshore zone during September through December, CPUE was highest at 0.3 in 1994. The estimated catch rate was 0.0 in 1995.

For Florida offshore waters during the same time period (September through December), shark CPUE was highest in 2002, with a value of 1.0. Catch rate estimates were 0.0 in 2001, 1992, 1994, 1995, and 1996.

Shrimp

Penaeid shrimp CPUE in kilograms per hour by year and state are presented below. Shrimp catch rates were variable among states and years, with Texas experiencing higher CPUE in the majority of years.

For Texas, CPUE for shrimp was highest in 2005 with a value of 8.5. Catch rates in 2004 and 2001 were 7.2 and 6.9, respectively. CPUE was 6.8 in 2003, followed by 6.5 in 1996, and 5.8 in both 2002 and 1994. Catch rates were 5.5 in 1995, followed by 5.3 in 1992, and 5.1 in 2000. In the remaining years, catch rates were below 5.0. CPUE was 3.9 in 1993, followed by 3.8 in 1999, and 3.4 in 1997. The lowest CPUE occurred in 1998, with a value of 3.0.

CPUE off Louisiana was highest in 2000, with a value of 9.8. CPUE was 8.7 in 2005, followed by 5.6 in 2004, 5.4 in 1992, 4.9 in 2003, and 4.4 in 1995. Catch rates in 2002 and 2001 were similar, with a value of 3.6. CPUE in 1994 was 3.3. Catch rates were 3.2 in both 1999 and 1993. CPUE was 2.8 and 2.5 in 1997 and 1998, respectively. The lowest catch rate occurred in 1996, with a value of 1.9.

Off Alabama/Mississippi shrimp catch rates were highest in 1993, with a value of 6.7. CPUE was 6.0 in 1996, followed by 5.6 in 1992, and 5.5 in 2005. Catch rates in

1994 and 2004 were 5.4 and 4.6, respectively. CPUE was 3.6 in 2003, followed by 3.4 in 1998, 3.3 in 2002, and 2.8 in 2001.

The highest CPUE off Florida occurred in 1996, with a value of 9.7. CPUE was 7.2 in 2003, followed by 5.6 in 1995, and 5.4 in 1993. Catch rates in 2002 and 2005 were 5.1 and 4.7, respectively. CPUE was 4.3 in 1994, followed by 3.9 in 2001, 3.5 in 1992, and 3.2 in 2004. The lowest catch rate was observed in 1997, with a value of 2.9.

Shrimp catch rate estimates in kilograms per hour by year, state and depth strata were examined. Nearshore areas typically yielded higher catch rates of shrimp as compared with offshore strata.

In the Texas nearshore strata, shrimp CPUE was highest in 1995, with a value of 14.4. CPUE was 9.0 in 2005, followed by 8.5 in 2003, and 7.2 in 2004. Catch rates in 1992 and 1998 were 7.0 and 6.8, respectively. CPUE was 5.8 in 1994, followed by 5.7 in 1993, 5.4 in 1996, and 3.5 in 2002. The lowest catch rate experience was 2.9 in 2000.

For Texas offshore waters, CPUE was highest at 8.5 in 2005. Catch rates in 2004 and 2001 were 7.2 and 6.9, respectively. CPUE was 6.8 in 1996. Catch rates were 6.7 in 2003, followed by 5.9 in 2002, and 5.8 in both 1994 and 2000. CPUE was 5.1 in 1995, followed by 4.7 in 1992, 3.8 in both 1999 and 1993, and 3.4 in 1997. The lowest catch rate observed was 2.8 in 1998.

In the Louisiana nearshore area, CPUE was highest in 2005 having a value of 11.3. Estimated catch rates were 9.5 in 2004, followed by 9.2 in 1993, 8.1 in 1992, 6.3 in 1994, 5.8 in 2003, and 3.3 in 2002. The lowest catch estimate, based on four tows, was 0.7 in 2001.

For Louisiana offshore waters, the highest catch rate estimate occurred in 2000, with a value of 9.8. CPUE was 6.8 in 2005, followed by 4.9 in 2003, 4.6 in 2004, 4.4 in 1995 and 4.0 in 1992. Catch rate estimates were 3.6 in both 2001 and 2002. CPUE was 3.3 in 1994, followed by 3.2 in 1999, 2.8 in 1997, and 2.5 in both 1993 and 1998. The lowest catch estimate was 1.9 in 1996.

For Alabama/Mississippi nearshore strata, CPUE was highest in 1993, with a value of 8.1. Catch rate estimates were 7.0 and 6.6 in 1992 and 1994, respectively.

CPUE was 6.0 in 1996, followed by 4.6 in 2005, 4.4 in 1998, and 4.2 in 2004. Catch rate estimates were below 4.0 for the remaining sampled years. CPUE was 3.7 in 2003, followed by 3.6 in 2002, and 2.3 in 2001.

In the Alabama/Mississippi offshore zone, shrimp CPUE was highest at 5.7 in 2005. Catch rates values were 4.6 and 4.2 in 2004 and 1992, respectively. CPUE was 4.1 in 1993, followed by 3.6 in 2003, 3.2 in 2002, and 3.1 in 1998. Catch rate estimates were 3.0 in both 1994 and 2001.

In the Florida nearshore zone, CPUE was highest at 7.9 in 2003. Catch rate estimates were 6.4 in 1996, and 6.1 in 1993. CPUE was 5.9 in 2002. Catch rate estimates were 5.6 in 1994, followed by 5.4 in 1995, 5.2 in 2005, and 3.9 in 2004.

In Florida offshore waters, shrimp CPUE was highest in 1996, with a value of 10.1. CPUE was 5.9 in 2003, followed by 5.7 in 1995, 4.9 in 1993, and 4.6 in 2005. Catch rates values were 4.4 and 4.1 in 2002 and 1994, respectively. CPUE was 3.9 in 2001, followed by 3.5 in 1992, 3.0 in 2004, and 2.9 in 1997.

Shrimp CPUE in kilograms per hour by year, state, depth and season was analyzed. CPUE was higher during May through August in Texas, Louisiana, and Alabama/Mississippi in most years. In Florida, catch occurred in all seasons with higher CPUE observed in September through December.

In Texas nearshore waters from January through April, shrimp CPUE was highest at 7.7 in 1992. Catch rate estimates were 4.3 and 3.2 in 1993 and 1994, respectively.

For the Texas offshore zone during the same period (January through April), CPUE was highest in 1994, with a value of 3.0. CPUE was 2.8 in both 2004 and 1997. Catch rate estimates were 1.9 in 1996, followed by 1.5 in 2002, and 1.2 in 1998.

In Texas nearshore waters from May through August, highest CPUE for shrimp occurred in 1995, with a value of 14.4. Catch rate estimates were 9.1 and 8.7 in 2005 and 2003, respectively. CPUE was 8.5 in 1993, followed by 8.3 in 1994, 7.2 in 2004, 6.8 in 1998, and 6.6 in 2002. Catch rates for the remaining years were below 6.0. CPUE was 5.8 in 1992, followed by 5.1 in 1996, and 2.9 in 2000.

During May through August in the Texas offshore zone, highest CPUE was reported in 1995, with a value of 10.5. Similarly, CPUE in 1996 was 10.3. CPUE was 9.3 in 2005, followed by 9.0 in 2004, 8.7 in 2001, and 7.8 in both 2003 and 2002. Catch rate estimates for the remaining years were below 7.0. CPUE was 6.9 in 1994, followed by 6.1 in 1998, 5.7 in 1992, 5.6 in 1997, and 4.8 in 1993. The lowest estimated catch rate was 4.5 in 1999.

Shrimp CPUE in Texas nearshore waters during September through December was 7.2 in 1996. Catch rate estimates in 1993 were 5.3, followed by 4.2 in 1992, and 2.3 in 2002.

For Texas offshore waters during the same time frame (September through December), CPUE was 6.3 in both 2005 and 2000. Catch rate estimates in 2003 and 2004 were 5.1 and 4.4, respectively. CPUE was 4.0 in both 1996 and 1992, followed by 3.9 in 1994, 3.8 in both 1995 and 1993, 3.4 in 1999, and 3.3 in 2002. Estimated catch rates were 3.1 in 2001, and 2.4 in 1997.

In Louisiana nearshore waters during January through April, CPUE for shrimp was highest in 2005, with a value of 4.4. CPUE was 2.7 in 2003, followed by 2.1 in 1993, and 1.9 in 2004.

During January through April in the Louisiana offshore zone, highest CPUE was 3.8 in 2005. CPUE was 3.2 in 2003, followed by 2.6 in both 1997 and 2004, and 2.3 in both 1994 and 1992. Catch rate estimates in 1993 and 2002 were 2.2 and 2.1, respectively. CPUE was 2.0 in 1998. Catch rate estimates were 1.8 in both 1995 and 1996.

In May through August in Louisiana nearshore waters, CPUE was highest in 1993, with a value of 14.3. CPUE was 13.2 in 2003, followed by 12.1 in 2005, 9.6 in 2004, 8.2 in 1992, and 6.3 in 1994. The lowest catch rate estimate was 2.9 in 2002.

From May through August in Louisiana offshore waters, the highest CPUE occurred in 2005, with a value of 11.9. Catch rate estimates in 2004 and 2000 were 11.1 and 9.2, respectively. CPUE in 1995 was 6.3, followed by 6.1 in 2003, 4.9 in 2001, 4.4

in 2002, and 4.3 in 1992. Estimated catch rates in 1999 were 4.0, and 3.9 in 1993. CPUE was 3.7 in 1998, followed by 3.3 in 1994, 3.1 in 1997, and 2.2 in 1996.

In Louisiana nearshore waters during the September through December period, highest CPUE was 13.0 in 2004. Catch rate estimates in 2005 and 1992 were 10.5 and 7.9, respectively. CPUE was 4.4 in 2003, followed by 3.8 in 1993, 3.3 in 2002, and 0.7 in 2001.

In Louisiana offshore waters during this same time period (September through December), shrimp CPUE was highest in 2004, with a value of 7.5. A catch rate estimate of 6.8 was observed in 2005. CPUE was 5.2 in 1994, followed by 5.0 in 1995, 4.9 in 1992, 4.8 in 2003, and 4.4 in 2002. Catch rate estimates for the remaining years were below 4.5. CPUE was 4.3 in 1998, followed by 3.3 in 1993, 3.1 in 1999, and 3.0 in 2001. The lowest CPUE was exhibited in 1997, with a value of 2.6.

In Alabama/Mississippi nearshore waters during January through April the highest shrimp CPUE occurred in 2004, with a value of 2.8. CPUE was 2.5 in 2003. The estimated catch rates were 1.4 in 2005, and 1.3 in 1993. The lowest CPUE was 1.2 in 2002.

During this same period (January through April) in Alabama/Mississippi offshore waters, the highest CPUE for shrimp was 3.4 in 2005. CPUE was 2.8 in 2004, followed by 2.0 in 2003, and 1.5 in 2002.

During May through August in the Alabama/Mississippi nearshore zone, the highest CPUE was 10.8 in 1992. Catch rate values were 8.4 and 7.0 in 1993 and 1994, respectively. CPUE was 6.0 in 1996, followed by 4.9 in 2004, and 4.6 in 2003. Catch rate estimates were 4.5 in 2002, and 4.4 in 1998. CPUE in 2001 was 4.2, followed by 2.7 in 2005.

In Alabama/Mississippi offshore waters from May through August, highest CPUE occurred in 2005, with a value of 9.8. CPUE in 2004 was 6.1, followed by 5.2 in 2001, 4.8 in 2003, 4.2 in 1993, and 3.5 in 2002. Catch rate estimates were 3.1 in both 1998 and 1994.

During September through December in Alabama/Mississippi nearshore waters, highest CPUE was 6.0 in 2005. Catch rate estimates were 5.2 and 4.9 in 1992 and 2003, respectively. CPUE was 4.4 in 2004, followed by 2.8 in 2002, 2.4 in 1994, and 2.2 in 2001.

During the same time period from September through December, the highest CPUE in Alabama/Mississippi offshore zone occurred in 2005, with a value of 8.1. The catch rate estimate was 7.8 in 2004. CPUE was 4.2 in 1992, followed by 3.9 in 2002, 3.2 in 2003, 3.1 in 1993, and 2.2 in 2001.

In Florida nearshore waters from January through April, CPUE was highest in 2003 at 7.9. CPUE was 7.1 in 1993, followed by 6.8 in both 1995 and 1996, 5.8 in 2002, 5.3 in 1994, and 5.1 in 2005. The lowest estimated CPUE occurred in 2004, with a value of 3.6.

During January through April in the Florida offshore zone, shrimp CPUE was highest at 9.9 in 1996. Catch rate values were 6.1 and 5.9 in 1995 and 2003, respectively. Catch rate estimates were 5.2 in 1993, followed by 4.5 in 2005, 4.1 in 1994, 4.0 in 2002, and 2.9 in 1997. The lowest estimated CPUE occurred in 2004, with a value of 2.0.

From May through August for Florida nearshore waters, CPUE was highest at 6.1 in 2002. Estimated catch rates were 5.9 in 2004, and 5.2 in 2005. CPUE was 4.9 in 1994, followed by 4.5 in 1993, and 3.7 in 1995.

For Florida offshore waters from May through August, CPUE was highest in 2004, with a value of 10.8 Estimated catch rates were 6.1 in 2005, and 5.8 in 2002. CPUE was 5.5 in 1996, followed by 4.9 in 1995, 4.5 in 1993, and 3.4 in 1992. The lowest catch rate estimate was 2.3 in 1994.

In the Florida nearshore zone during September through December, CPUE was highest at 8.4 in 1995. The estimated catch rate was 5.9 in 1994.

For Florida offshore waters during the same time period (September through December), shrimp CPUE was highest in 1996, with a value of 10.9. CPUE was 6.6 in

1994, followed by 5.6 in 1995, and 3.9 in both 1992 and 2001. The lowest CPUE was 3.0 in 2002.

Snapper

Snapper CPUE in kilograms per hour was below 0.1 in all years for all state areas combined, except for 1999 when the value was 0.2. At the individual state level, CPUE was 0.3 off Louisiana in 1999, and 0.1 in both 2005 and 2002, also off the coast of Louisiana. At the most refined level, by state, depth and season, CPUE was 0.9 in Louisiana offshore waters during May through August in 1999. Catch rates were 0.2 in Louisiana offshore waters in January through April in 2002, and in May through August in both 2005 and 1998. CPUE was 0.1 in the following: Louisiana nearshore waters in May through August in 2005, Texas offshore waters during May through August in 1999, Louisiana offshore waters from September through December in 1999, Louisiana offshore waters from May through August in 2001, and Louisiana offshore waters during May through August in 1994. CPUE was 0.0 in all other state areas, depths and seasons.

Southern Flounder

Southern flounder CPUE in kilograms per hour by year and state was assessed. All states experienced similar catch rates, with CPUE off Alabama/Mississippi slightly higher.

In Texas waters CPUE for southern flounder was highest in 1992, with a value of 0.5. Catch rate estimates were 0.1 in 2001, 2003, and 2000. Estimated CPUE values were 0.0 for the remaining years. These years included 2002, 1996, 1994, 2004, 1993, 1998, 2005, 1997, 1995, and 1999.

Southern flounder CPUE off Louisiana was 0.1 in 2001, 2003, 1993, 2002, and 2004. Estimated catch rate were 0.0 in 2005, 1992, 1995, 1998, 1994, 1997, 1999, 1996, and 2000.

Off Alabama/Mississippi southern flounder CPUE was highest in 1992, with a value of 0.4. Catch rate estimates were 0.2 in both 2001 and 2004. CPUE was 0.1 in 2003, 1998, 2002, 1993, and 1996. Catch rate estimates were 0.0 in both 2005 and 1994.

Off Florida, CPUE was highest in 2001 at 0.2. Catch rate estimates were 0.1 in 2002, 2005, 2004, and 1992. CPUE was 0.0 during 2003, 1993, 1994, 1995, 1996, and 1997.

Southern flounder catch rate estimates in kilograms per hour by year, state and depth strata are presented below. Catch rates were higher in offshore strata for most years and states.

CPUE for southern flounder in the Texas nearshore strata was 0.1 in 2000, 1992, 1994, 2005, and 1996. Catch rate estimates were 0.0 for 1993, 2004, 1995, 1998, 2002, and 2003.

For Texas offshore waters, CPUE was highest at 0.7 in 1992. Estimated catch rates were 0.1 in both 2001 and 2003. Similarly, CPUE was 0.0 in 2000, 2002, 1998, 2004, 1993, 1997, 2005, 1994, 1996, 1995, and 1999.

In the Louisiana nearshore area, southern flounder CPUE was 0.1 in 1992, 2003, and 2002. Estimated catch rates were 0.0 in 2004, 2005, 1993, 1994, and 2001.

For Louisiana offshore waters, estimated CPUE was 0.1 in 2001, 2003, 1993, 2004, 2002, and 2005. Catch rates were 0.0 in 1995, 1998, 1992, 1994, 1997, 1999, 1996, and 2000.

For Alabama/Mississippi nearshore strata, CPUE was highest in 1992 at 0.4. Catch rate estimates were 0.1 in 2003, 2005, 2001, 2002, 1996, and 2004. CPUE was 0.0 in 1993, 1998, and 1994.

In the Alabama/Mississippi offshore zone, CPUE was 0.3 in both 2001 and 1992. In 2004, 2003, and 1993, estimated catch rates were 0.2. CPUE was 0.1 in both 1998 and 2002. Similarly, CPUE was 0.0 in both 2005 and 1994.

In Florida nearshore waters, southern flounder CPUE was 0.1 in 2004, 2002, 2005, and 1994. Catch rate estimates were 0.0 in 1995, 1993, 1996, and 2003.

In the Florida offshore zone, catch rates were 0.2 in 2001, 2002, and 2005. Estimated CPUE was 0.1 in 2004, 1992, and 2003. Catch rate estimates were 0.0 in 1993, 1994, 1995, 1996, and 1997.

Southern flounder CPUE in kilograms per hour by year, state, depth and season was assessed. Southern flounder occurred in all seasons in most states and depths with variable rates.

Southern flounder CPUE in Texas nearshore waters during January through April was 0.1 in both 1993 and 1992. The catch estimate in 1994 was 0.0.

For the Texas offshore zone during the same period (January through April), CPUE was 0.0 in all years. These included 2004, 1998, 2002, 1994, 1996, and 1997.

In Texas nearshore waters from May through August, CPUE was highest in 1992 at 0.3. Catch rate estimates were 0.2 and 0.1 in 1994 and 1995, respectively. CPUE was 0.0 in 2004, 1995, 1996, 1993, 1998, 2002, 2003, and 2005.

Similarly, during May through August in the Texas offshore zone, southern flounder CPUE was relatively high at 1.6 in 1992. Catch rate estimates were 0.1 in both 2001 and 2003. Catch rate estimates were 0.0 in 2002, 1998, 1997, 1994, 1996, 2005, 2004, 1993, 1995, and 1999.

Southern flounder CPUE in Texas nearshore waters during September through December was 0.4 in 1996. Catch rate estimates were 0.0 for 1992, 1993, and 2002.

For Texas offshore waters during the same time frame (September through December), CPUE was 0.1 in both 2003 and 1992. Catch rate estimates were 0.0 for 2000, 2004, 2002, 1993, 1997, 1996, 1994, 2005, 2001, 1995, and 1999.

In Louisiana nearshore waters during January through April, CPUE for southern flounder was 0.5 in 2004. Catch rate estimates were 0.0 in 1993, 2003, and 2005.

During January through April in the Louisiana offshore zone, CPUE was 0.1 in both 2004 and 2002. Catch rate estimates were 0.0 in 2005, 1994, 1998, 1993, 1992, 1995, 1996, 1997, and 2003.

In May through August in Louisiana nearshore waters, CPUE was 0.0 in all years sampled. These included 2003, 1992, 2004, 2005, 1993, 1994, and 2002.

From May through August in Louisiana offshore waters, CPUE was highest at 0.8 in 1993. Catch rate estimates were 0.1 in 2005, 1998, 2004, 2002, 2003, and 1997. CPUE was 0.0 in 1992, 1994, 2001, 1995, 1996, 1999, and 2000.

In Louisiana nearshore waters during the September through December period, southern flounder CPUE was 0.2 in 1992. Catch rate estimates were 0.1 in 2003, 2002, and 1993. CPUE was 0.0 in 2005, 2001, and 2004.

In Louisiana offshore waters during this same time period (September through December), CPUE was highest in 1993, with a value of 0.3. In 2001 and 2004, the catch estimate of 0.2 was observed in both years. CPUE was 0.1 in 2003, 2002, 1995, and 2005. CPUE was 0.0 in 1992, 1999, 1994, 1997, and 1998.

In Alabama/Mississippi nearshore waters during January through April, CPUE was 0.1 in 2003. Catch rate estimates were 0.0 in 2004, 1993, 2002, and 2005.

During this same period (January through April) in Alabama/Mississippi offshore waters, CPUE for southern flounder was 0.1 in both 2003 and 2004. Catch rate estimates were 0.0 in 2005 and 2002.

During May through August in the Alabama/Mississippi nearshore zone, CPUE was 0.1 in both 2003 and 1996. Catch rate estimates were 0.0 in 2004, 2002, 1993, 1998, 1994, 1992, 2001, and 2005.

In Alabama/Mississippi offshore waters from May through August, highest CPUE for southern flounder occurred in 2001, with a value of 0.6. In 1993, the catch rate value was 0.2. CPUE was 0.1 in 2004, 1998, 2005, and 2002. CPUE was 0.0 in both 2003 and 1994.

During September through December in Alabama/Mississippi nearshore waters, highest CPUE occurred in 1992, with a value of 0.6. In 2003, the catch rate value was 0.3. CPUE was 0.2 in both 2002 and 2005. Catch rate values were 0.1 in both 2001 and 2004. CPUE was lowest at 0.0 in 1994.

During the same time period (September through December), the highest CPUE in Alabama/Mississippi offshore zone occurred in 2004, with a value of 0.5. Catch rate estimates were 0.3 in both 2003 and 1992. CPUE was 0.2 in both 2001 and 2002. Similarly, catch rate were 0.0 in both 1993 and 2005.

In Florida nearshore waters from January through April, CPUE was highest in 2002 at 0.2. In 2004 and 2005, CPUE was 0.1. Catch rate estimates were 0.0 in 1993, 1994, 1995, 1996, and 2003.

During January through April in the Florida offshore zone, southern flounder CPUE was 0.2 in 2002, 2005, and 2004. The catch rate estimate was 0.1 in 2003. Similarly, estimated CPUE was 0.0 for 1993, 1994, 1995, 1996, and 1997.

From May through August for Florida nearshore waters, CPUE was 0.2 in 1994. Estimated catch rates were 0.1 in both 1995 and 1993. CPUE was 0.0 in 2002, 2004, and 2005.

For Florida offshore waters from May through August, the highest CPUE occurred in 1992, with a value of 0.1. Estimated catch rate values were 0.0 in 1993, 2005, 1994, 1995, 1996, 2002, and 2004.

In the Florida nearshore zone during September through December, CPUE was at 0.1 in 1994. The catch rate estimate was 0.0 in 1995.

For Florida offshore waters during the same time period (September through December), southern flounder CPUE was highest in 2003, with a value of 0.3. Catch rate estimates were 0.2 in 2001. CPUE was 0.0 in 1994, 1992, 1995, and 1996.

Spanish Mackerel

Spanish mackerel CPUE in kilograms per hour by year and state was examined. While low, overall Spanish mackerel catch rates were higher off Louisiana and Texas. Alabama experienced slightly lower catch rates. The lowest CPUE occurred off Florida.

In Texas CPUE for Spanish mackerel was highest in 2004, with a value of 0.3. Catch rate estimates were 0.1 in both 2005 and 1993. Estimated CPUE values were 0.0 for the remaining years. These years included 2000, 1996, 1995, 2001, 1992, 1994, 2003, 2002, 1999, 1997, and 1998.

Spanish mackerel CPUE off Louisiana was highest at 0.3 in 2005. The estimated catch rate was 0.2 in 2004. CPUE was 0.1 in 1993, 1992, and 1995. The catch rate estimate was 0.0 in 2003, 2002, 1998, 1994, 2001, 1997, 1996, 1999, and 2000.

Off Alabama/Mississippi Spanish mackerel CPUE was 0.2 in 1993. The catch rate estimate was 0.1 in 1994. CPUE was 0.0 in 1992, 2002, 2001, 2003, 2004, 2005, 1996, and 1998.

Florida experienced the lowest catch rates for Spanish mackerel. Estimated CPUE was 0.0 in all sampled years. These included 2004, 1996, 2005, 2002, 1995, 1992, 1994, 1993, 1997, 2001, and 2003.

Spanish mackerel catch rate estimates in kilograms per hour by year, state and depth strata are given below. Catch rates were higher in nearshore areas as compared with offshore strata for all state areas.

CPUE for Spanish mackerel in the Texas nearshore strata was highest in 2004, with a value of 1.4. The catch rate estimate was 0.2 in 2003. CPUE was 0.1 in 2000, 1995, 1996, 2005, 1993, 1994, 2002, 1992, and 1998.

For Texas offshore waters, CPUE was 0.1 in both 2005 and 1993. Similarly, CPUE was 0.0 in 1996, 2000, 2004, 2001, 1995, 1992, 2002, 1994, 1999, 1997, 2003, and 1998.

In the Louisiana nearshore area, Spanish mackerel CPUE was highest in 1993, with a value of 0.8. CPUE was 0.7 in 2005, followed by 0.6 in both 2004 and 2003, 0.4 in 2002, and 0.3 in 1992. Catch rate estimates were 0.0 in both 1994 and 2001.

For Louisiana offshore waters, CPUE was 0.1 in 2004, 1995, and 2005. Catch rates were 0.0 in 1993, 2002, 1998, 1994, 1992, 2001, 2003, 1997, 1996, 1999, and 2000.

For Alabama/Mississippi nearshore strata, CPUE was highest in 1993, with a value of 0.3. Catch rate estimates were 0.1 in 2002, 1992, 1994, 2001, and 2003. Similarly, CPUE was 0.0 in 2005, 2004, 1996, and 1998.

In the Alabama/Mississippi offshore zone, CPUE was 0.0 in all years when sampling occurred. These include 1994, 2004, 2003, 2002, 2005, 2001, 1992, 1993, and 1998.

In Florida nearshore waters, Spanish mackerel CPUE was highest in 2004, with a value of 0.2. Catch rate estimates were 0.0 in 2005, 1994, 2002, 1993, 1995, 1996, and 2003.

In the Florida offshore zone, CPUE was 0.0 in all years when observations were conducted. These included 1996, 1995, 1992, 2005, 1994, 2002, 1993, 1997, 2001, 2003, and 2004.

Spanish mackerel CPUE in kilograms per hour by year, state, depth and season was examined. Catch rates were generally higher in the May through August and September through December periods in nearshore waters for most states. In the offshore strata, lower CPUE was experienced during all seasons.

Spanish mackerel estimated CPUE in Texas nearshore waters during January through April was 0.0 in all years sampled. These included 1992, 1993, and 1994.

For the Texas offshore zone during the same period (January through April), CPUE was not detectable. Catch rate estimates were 0.0 in 2004, 1998, 1994, 1996, 1997, and 2002.

In Texas nearshore waters from May through August, CPUE was 1.4 in 2004. Estimated catch rate estimates were 0.2 in both 2003 and 1993. Similarly, CPUE was 0.1 in 2000, 1994, 1995, and 1996. Catch rates were 0.0 in 1992, 1998, 2002, and 2005.

During May through August in the Texas offshore zone, CPUE was 0.1 in 2005. Catch rate estimates were 0.0 in 1996, 2004, 1999, 1995, 2001, 1992, 1994, 1993, 2002, 1997, 1998, and 2003.

Spanish mackerel CPUE in Texas nearshore waters during September through December CPUE was 0.1 in both 1992 and 1993. Catch rate estimates were 0.0 in both 2002 and 1996.

For Texas offshore waters during the same time frame (September through December), CPUE was 0.1 in 1993. Catch rate estimates were 0.0 in 2000, 1996, 2002, 1995, 2003, 1997, 2001, 1992, 1994, 1999, 2004, and 2005.

In Louisiana nearshore waters during January through April, CPUE for Spanish mackerel was highest in 2004, with a value of 2.6. Catch rate estimates were 0.0 in 1993, 2003, and 2005.

During January through April in the Louisiana offshore zone, CPUE was 0.2 in 1995. Catch rate estimates were 0.1 in 2005, 1997, 2004, and 2002. CPUE was 0.0 in 1993, 1998, 1994, 1992, 1996, and 2003.

In May through August in Louisiana nearshore waters, CPUE was highest at 1.7 in 2002. CPUE was 1.2 in 1993, followed by 0.8 in 2005, 0.6 in 2004, and 0.3 in 1992. Catch rate estimates were 0.0 in both 1994 and 2003.

From May through August in Louisiana offshore waters, CPUE was highest at 0.4 in 2004. CPUE was 1.0 in 1992. Catch rate estimates were 0.0 in 2005, 1994, 1998, 2002, 1993, 1995, 1996, 1997, 1999, 2000, 2001, and 2003.

In Louisiana nearshore waters during the September through December period, CPUE was 0.8 in 2003. Catch rate estimates were 0.7 in both 2005 and 1993. CPUE was 0.2 and 0.1 in 1992 and 2004, respectively. Catch rates were 0.0 in both 2002 and 2001.

In Louisiana offshore waters during this same time period (September through December), Spanish mackerel CPUE was 0.0 in all years when sampling occurred. These years include 1995, 1993, 2001, 2003, 2005, 1997, 1992, 2002, 1994, 1998, 1999, and 2004.

In Alabama/Mississippi nearshore waters during January through April, CPUE was 0.0 in all years sampled. These included 2005, 2002, 1993, 2003, and 2004.

During this same period (January through April) in Alabama/Mississippi offshore waters, the highest CPUE for Spanish mackerel was 0.1 in 2002. Catch rate estimates were 0.0 for 2004, 2005, and 2003.

During May through August in the Alabama/Mississippi nearshore zone, CPUE was 0.3 in both 1993 and 1992. Catch rate estimates were 0.1 in both 2002 and 2003. CPUE was 0.0 in 1994, 1996, 1998, 2001, 2004, and 2005.

In Alabama/Mississippi offshore waters from May through August, catch rate estimates were 0.0 in all years sampled. These included 1994, 2004, 2003, 2002, 1993, 1998, 2001, and 2005.

During September through December in Alabama/Mississippi nearshore waters, CPUE was highest at 0.7 in 1994. Catch rates were 0.3 in 2003, followed by 0.2 in 2002, 0.1 in 2001, and 0.0 in 2004, 2005, and 1992.

During the same time period (September through December), CPUE for Spanish mackerel in Alabama/Mississippi offshore waters was 0.0 for all years when observations were conducted. These included 2003, 2005, 2001, 2004, 1992, 1993, and 2002.

In Florida nearshore waters from January through April, CPUE was highest in 2004 at 0.2. Catch rate estimates were 0.0 in 2002, 1993, 1994, 1995, 1996, 2003, and 2005.

During January through April in the Florida offshore zone, Spanish mackerel CPUE was not detectable. Catch rate estimates were 0.0 in 1996, 1995, 2005, 1994, 2002, 1993, 1997, 2003, and 2004.

From May through August for Florida nearshore waters, CPUE was 0.4 in 2005. Estimated catch rates were 0.0 in 2002, 1993, 1994, 1995, and 2004.

For Florida offshore waters from May through August, CPUE was 0.0 in all years when data were obtained. These included 1992, 1993, 1994, 1995, 1996, 2002, 2004, and 2005.

In the Florida nearshore zone during September through December, CPUE was at 0.1 in 1994. The catch rate estimate was 0.0 in 1995.

For Florida offshore waters during the same time period (September through December), Spanish mackerel CPUE was 0.0 in all years assessed. These included 1992, 1994, 1995, 1996, 2001, and 2002.

<u>Vermilion Snapper</u>

Vermilion snapper CPUE in kilograms per hour by year and state was low. While low, this species occurred in each state area in at least one year.

CPUE off Texas for vermilion snapper was 0.1 in 2003, 2001, 1994, and 1995. Catch rate estimates were 0.0 in 1998, 2005, 2002, 1999, 1997, 1992, 2004, 1993, 1996, and 2000.

Similarly, CPUE off Louisiana was 0.1 in 1999, 1997, 1995, and 1998. CPUE was 0.0 in 2002, 2004, 1992, 2001, 2005, 2000, 1994, 2003, 1993, and 1996.

Off Alabama/Mississippi vermilion snapper CPUE was highest at 0.4 in 1998. For the remaining years, CPUE was 0.0. These years included 2001, 2002, 2004, 2003, 1992, 1993, 1994, 1996, and 2005.

In Florida waters CPUE was 0.2 in 2001. Catch rates were estimated at 0.0 in 1995, 2004, 1994, 1993, 2002, 1996, 2005, 1997, 1992, and 2003.

Vermilion snapper catch rate estimates in kilograms per hour by year, state and depth strata were assessed. Detectable CPUE, while low, occurred exclusively in the offshore zones of all state areas.

CPUE for vermilion snapper in the Texas nearshore strata was 0.0 in all years. These included 1992, 1993, 1994, 1995, 1996, 1998, 2000, 2002, 2003, 2004, and 2005.

For Texas offshore waters, CPUE was 0.1 in 2003, 2001, 1994, and 1995. Catch rate estimates were 0.0 in 1998, 2005, 2002, 1999, 1992, 1997, 2004, 1993, 1996, and 2000.

In the Louisiana nearshore area, vermilion snapper CPUE was 0.0 in all years when sampling occurred. These included 2003, 1992, 1993, 1994, 2001, 2002, 2004, and 2005.

In Louisiana offshore waters, catch rate estimates were 0.1 in 1999, 1997, 1995, and 1998. CPUE was 0.0 in 2004, 1992, 2005, 2002, 2001, 2000, 1994, 2003, 1993, and 1996.

For Alabama/Mississippi nearshore strata, CPUE was 0.0 for all years when sampling occurred. These years included 1992 through 1994, 1996, 1998, and 2001 through 2005.

In the Alabama/Mississippi offshore zone, CPUE was highest in 1998, with a value of 0.5. The remaining years had estimated catch rates of 0.0. These years included 2001, 2002, 2004, 2003, 1992, 1993, 1994, and 2005.

In Florida nearshore waters, vermilion snapper CPUE was 0.0 in all years sampled. These included 2002, from 1993 through 1996, and during 2003 through 2005.

In the Florida offshore zone, CPUE was highest at 0.2 in 2001. Catch rates were 0.0 in 2004, 1995, 1994, 1993, 2002, 1996, 2005, 1997, 1992, and 2003.

Vermilion snapper CPUE in kilograms per hour by year, state, depth and season was examined. The May through August and September through December periods experienced higher catch rates as compared with January through April. Again, no detectable CPUE was observed in nearshore strata.

Estimated CPUE for vermilion snapper in Texas nearshore waters during January through April was 0.0 in years when sampling occurred. These included 1992, 1993, and 1994.

Similarly, for the Texas offshore zone during the same period (January through April), CPUE was not detectable. Catch rate estimates were 0.0 in 2002, 1998, 2004, 1997, 1994, and 1996.

In Texas nearshore waters from May through August, catch rate estimates were also 0.0 in all years assessed. These included 1992 through 1996, 1998, 2000, and 2002 through 2005.

During May through August in the Texas offshore zone, CPUE was 0.3 in 1995, and 0.2 in 2003. Catch rate estimates were 0.1 in 2001, 1994, and 1998. CPUE was 0.0 in 2002, 1993, 2004, 1992, 1996, 1997, 1999, and 2005.

Vermilion snapper CPUE in Texas nearshore waters during September through December CPUE was 0.0 in all years sampled. These years were 1992, 1993, 1996, and 2002.

For Texas offshore waters during the same time frame (September through December), CPUE was 0.1 in 2005. Catch rate estimates were 0.0 for 2003, 2002, 1999, 1992, 1997, 1995, 1994, 2001, 1993, 1996, 2000, and 2004.

In Louisiana nearshore waters during January through April, CPUE for vermilion snapper was 0.0 in all years when sampling occurred. These included 1993, 2003, 2004, and 2005.

During January through April in the Louisiana offshore zone, CPUE was 0.1 in both 1992 and 2004. Catch rate estimates were 0.0 in 1997, 2002, 1998, 1994, 1993, 2003, 1995, 1996, and 2005.

In May through August in Louisiana nearshore waters, CPUE was not detectable. Catch rate estimates were 0.0 in 1992 through 1994, and from 2002 through 2005.

From May through August in Louisiana offshore waters, CPUE was 0.3 in both 1995 and 1998. The catch rate estimate was 0.1 in 2002. CPUE was 0.0 in 2001, 2000, 2003, 1999, 1992, 1993, 1994, 1996, 1997, 2004, and 2005.

In Louisiana nearshore waters during the September through December period, CPUE was 0.0 in all years were sampling occurred. These included 2003, 1992, 1993, 2001, 2002, 2004, and 2005.

In Louisiana offshore waters during this same time period (September through December), CPUE was 0.1 in 1999, 1997, and 2005. Catch rate estimates were 0.0 in 2002, 1994, 2004, 2001, 1992, 2003, 1993, 1995, and 1998.

In Alabama/Mississippi nearshore waters during January through April, CPUE was 0.0 in all years when observations were made. These included 1993, 2002, 2003, 2004, and 2005.

Similarly, in Alabama/Mississippi offshore waters during January through April, CPUE for vermilion snapper was not detectable. Catch rate estimates were 0.0 in 2003, 2004, 2002, and 2005.

During May through August in the Alabama/Mississippi nearshore zone, CPUE was 0.0 in all years assessed. These included 1992 through 1994, 1996, 1998, and 2001 through 2005.

In Alabama/Mississippi offshore waters from May through August, highest CPUE occurred in 1998, with a value of 0.5. Catch rate estimates were 0.0 in 2002, 1993, 1994, 2001, 2003, 2004, and 2005.

During September through December in Alabama/Mississippi nearshore waters, vermilion snapper CPUE was 0.0 in all years sampled. These included 1992, 1994, 2001, 2002, 2003, 2004, and 2005.

Similarly, during the same time period from September through December, catch rate estimates were 0.0 for all years when observations occurred. These included 2002, 2001, 2004, 2003, 1992, 1993, and 2005.

In Florida nearshore waters from January through April, CPUE was not detectable. Catch rate estimates were 0.0 in 2002, 1993, 1994, 1995, 1996, 2003, 2004, and 2005.

As above, during January through April in the Florida offshore zone, vermilion snapper CPUE was 0.0 in all years sampled. These included 2004, 1994, 2005, 1995, 1997, 2002, 1996, 1993, and 2003.

From May through August for Florida nearshore waters, estimated catch rates were 0.0 in all years when observation occurred. The years were 2002, 1993, 1994, 1995, 2004, and 2005.

For Florida offshore waters from May through August, CPUE was 0.1 in both 1995 and 1993. Catch rates were 0.0 in 2002, 1992, 1994, 1996, 2004, and 2005.

In the Florida nearshore zone during September through December, CPUE was 0.0 in both years sampled. These included 1994 and 1995.

For Florida offshore waters during the same time period (September through December), vermilion snapper CPUE was 0.2 in both 2002 and 2001. Catch rate estimates were 0.0 in 1995, 1996, 1994, and 1992.

Invertebrates

Non-crustacean invertebrate CPUE in kilograms per hour by year and state was analyzed. Generally, catch rates were higher in Florida and Alabama/Mississippi as compared with Texas and Louisiana.

Invertebrate CPUE off Texas was highest at 1.9 in 2003. The catch rate value in 2001 was 1.6. CPUE was 1.5 in 1994, 2004, and 1996. Catch rates in 2002 and 2005 were 1.1 and 1.0, respectively. CPUE in both 1995 and 1998 was 0.9, followed by 0.6 in 1992, 1997, and 1993. Catch rate estimates were 0.4 in 1999, and 0.3 in 2000.

CPUE off Louisiana was highest in 2005, with a value of 1.6. CPUE was 1.5 in 2001, followed by 1.3 in 1998, 1.2 in 1995, and 1.0 in both 1992 and 1996. Catch rate estimates were 0.9 in 2003, 2004, and 1999. CPUE was 0.8 in 1993, followed by 0.7 in 1997, 2002, and 1994. The lowest estimated catch rate was 0.2 in 2000.

Off Alabama/Mississippi invertebrate CPUE was highest in 1998, with a value of 4.2. Catch rates were 2.5 in 1992, followed by 1.9 in 1994, 1.8 in 1993, and 1.7 in 2004. Catch rates in 2003 and 2002 were 1.1 and 1.0, respectively. For the remaining years catch rates were below 1.0. CPUE was 0.5 in 2001, followed by 0.2 in both 2005 and 1996.

Florida experienced higher invertebrate catch rates, with highest CPUE occurring in 1997, with a value of 4.3. CPUE was 3.7 in 2004, followed by 3.3 in 1992, 3.2 in 1996, and 2.8 in 1993. Estimated catch rates were 2.6 in 2002, followed by 2.0 in 1995, and 1.6 in both 2005 and 1994. CPUE was 1.4 in 2003, and 1.2 in 2001.

Invertebrate catch rate estimates in kilograms per hour by year, state and depth strata are presented below. Generally, catch rates were higher in nearshore waters off Texas and Louisiana as compared with offshore strata. Off Alabama/Mississippi and Florida, CPUE was similar between near and offshore zones.

In the Texas nearshore strata, invertebrate CPUE was highest in 2005, with a value of 7.6. CPUE in 1998 was 4.8, followed by 2.7 in 1996, and 2.2 in 1994. Similarly, catch rates were 1.8 in both 1995 and 2003. CPUE was 1.4 in 1993, followed by 1.3 in 2002, 1.2 in 2004, and 0.7 in both 2000 and 1992.

For Texas offshore waters, CPUE was highest in 2003, with a value of 2.0. Catch rates in both 2001 and 2004 were 1.6. CPUE was 1.5 in 1994, followed by 1.1 in both 1996 and 2002, 0.9 in 2005, and 0.8 in 1995. Similarly, catch rate estimates were 0.6 in 1992, 1998, and 1997. CPUE was 0.5 in 1993, and 0.4 in 1999. The lowest CPUE was 0.1 in 2000.

In the Louisiana nearshore area, CPUE was highest at 2.9 in 2005. Catch rate estimates were 2.5 and 2.3 in 1994 and 1993, respectively. CPUE was 1.1 in 2004, followed by 1.0 in 2001, 0.9 in 1992, 0.8 in 2003, and 0.6 in 2002.

For Louisiana offshore waters, the highest invertebrate catch rate occurred in 2001, with a value of 1.5. CPUE was 1.3 in 1998, followed by 1.2 in 1995, and 1.0 in 1992, 1996 and 2003. For the remaining years, catch rate estimates were below 1.0. CPUE was 0.9 in both 2004 and 1999. Catch rate estimates were 0.7 in 1997, 2002, and 2005. Similarly, CPUE was 0.6 in both 1994 and 1993. The lowest catch rate value was 0.2 in 2000.

For Alabama/Mississippi nearshore strata, CPUE was highest at 3.5 in 1998. Catch rate estimates were 2.8 and 2.2 in 1992 and 1994, respectively. CPUE was 2.1 in 2004, followed by 1.7 in 2002, 1.3 in 2003, and 0.6 in 1993. The catch rate value was 0.5 in 2001. CPUE was 0.2 in both 2005 and 1996.

In the Alabama/Mississippi offshore zone, CPUE was highest in 1998, with a value of 4.3. Catch rate estimates were 4.1 in 1993, and 2.1 in 1992. CPUE was 2.1 in 1992, followed by 1.7 in 2004, 1.4 in 1994, and 1.0 in 2003. For the remaining years, CPUE was less than 1.0. Catch rate estimates were 0.8 in 2002, followed by 0.5 in 2001, and 0.2 in 2005.

In Florida nearshore waters, invertebrate CPUE was highest at 4.0 in 1996. CPUE was 3.9 in 2004, followed by 3.6 in 1994, 3.5 in 1993, and 2.0 in 2002. Catch rate estimates were 1.4 in 1995, and 1.2 in 2003. The lowest CPUE was 1.1 in 2005.

In the Florida offshore zone, CPUE was highest at 4.3 in 1997. Catch rate estimates were 3.6 in 2004, followed by 3.3 in 1992, and 3.1 in both 1996 and 2002.

CPUE was estimated at 2.4 in 1993, followed by 2.3 in 1995, 1.8 in 2003, 1.7 in 2005, and 1.3 in 1994. The lowest catch rate estimate was 1.2 in 2001.

Invertebrate CPUE in kilograms per hour by year, state, depth and season was examined. CPUE was typically higher in May through August, followed by September through December. Florida had higher CPUE in the January through April period as compared with other state areas.

In Texas nearshore waters during January through April, invertebrate CPUE was highest at 1.2 in 1993. Catch rate estimates were 0.5 and 0.3 in 1992 and 1994, respectively.

For the Texas offshore zone during the same period (January through April), CPUE was highest in 2004, with a value of 0.9. CPUE was 0.8 in 1996, followed by 0.7 in 1994, 0.5 in 2002, and 0.4 in 1998. The lowest estimated catch rate was 0.3 in 1997.

In Texas nearshore waters from May through August, highest invertebrate CPUE was at 4.8 in 1998. Catch rate estimates were 3.7 and 2.8 in 1994 and 2002, respectively. CPUE was 2.0 in 1993, followed by 1.9 in 2003, 1.8 in 1995, 1.6 in 2005, and 1.2 in both 1996 and 2004. Catch rates for the remaining years were below 1.0. CPUE was 0.9 in 1992, and 0.7 in 2000.

During May through August in the Texas offshore zone, highest CPUE was observed in 2003, with a value of 2.6. CPUE was 2.3 in 2001. Catch rate estimates were 2.0 in both 1994 and 1995. Similarly, CPUE was 1.8 in both 2004 and 1996. CPUE was 1.5 in 2002, followed by 1.4 in 1997, and 1.0 in both 1998 and 1992. The remaining years had catch rates of less than 1.0. CPUE was 0.9 in 2005, followed by 0.7 in 1993, and 0.5 in 1999.

Invertebrate CPUE in Texas nearshore waters during September through December was highest at 11.9 in 1996. Catch rate estimates for the remaining years were relatively low. CPUE was 2.0 in 1992, followed by 0.8 in 2002, and 0.6 in 1993.

For Texas offshore waters during the same time frame (September through December), CPUE was 1.0 in both 2004 and 2003. Catch rate estimates were 0.6 in both

2005 and 1995. CPUE was 0.4 in 1996, 1993, 1992, and 2002. CPUE was 0.3 in 1994, 1999, and 2001. Catch rate estimates were 0.2 and 0.1 in 1997 and 2000, respectively.

In Louisiana nearshore waters during January through April, invertebrate CPUE was highest in 1993, with a value of 1.4. CPUE was 0.8 in 2004, followed by 0.3 in 2003, and 0.1 in 2005.

During January through April in the Louisiana offshore zone, highest CPUE was 0.7 in 1996. CPUE was 0.5 in 1993, 2004, and 2002. Similarly, catch rate estimates were 0.4 in 1994, 2003, 1998, and 2005. CPUE was 0.3 in 1997, followed by 0.2 in 1992, and 0.1 in 1995.

In May through August in Louisiana nearshore waters, CPUE was highest in 1994, with a value of 2.5. CPUE was 2.4 in 1993, followed by 1.6 in both 2005 and 2003, 1.0 in 2004, and 0.5 in 1992. The lowest catch rate estimate was 0.3 in 2002.

From May through August in Louisiana offshore waters, the highest invertebrate CPUE occurred in 1998, with a value of 4.3. Catch rate estimates were 2.4 and 2.0 in 2003 and 2001, respectively. CPUE was 1.7 in 1999, and 1.6 in 2004. Estimated catch rates were 1.4 in 1996, 1993, and 2002. CPUE was 1.2 in both 1995 and 1994, followed by 1.1 in 2005, 0.6 in 1997, and 0.2 in 2000. The lowest invertebrate CPUE was observed in 1992, with a value of 0.1.

In Louisiana nearshore waters during the September through December period, highest CPUE was 10.7 in 2005. Catch rate estimates in 2004 and 1993 were 6.5 and 3.7, respectively. CPUE was 1.7 in 1992, followed by 1.0 in 2001, and 0.7 in both 2002 and 2003.

In Louisiana offshore waters during this same time period (September through December), CPUE was highest in 2004, with a value of 2.2. CPUE was 1.9 in 1992, followed by 1.7 in 1995, 1.2 in 2001, and 1.0 in 1998. Catch rate estimates of 0.8 were observed in both 1997 and 1993. Similarly, CPUE was 0.7 in 1999, 2003, and 2005. Catch rate estimates were 0.5 in 2002, and 0.4 in 1994.

In Alabama/Mississippi nearshore waters during January through April, the highest CPUE occurred in 2004, with a value of 3.1. Catch rate estimates were 1.1 in both 2003 and 2002. CPUE in 2005 was 0.3. The lowest CPUE was 0.2 in 1993.

During this same period (January through April) in Alabama/Mississippi offshore waters, the highest invertebrate CPUE was 1.4 in 2003. CPUE was 0.8 in 2002, followed by 0.7 in 2004, and 0.2 in 2005.

During May through August in the Alabama/Mississippi nearshore zone, the highest invertebrate CPUE was 5.2 in 1992. Catch rate values were 3.5 and 2.5 in 1998 and 2004, respectively. CPUE was 2.4 in 2002, followed by 2.3 in 1994, 1.4 in 2001, and 1.3 in 2003. Catch rate estimates were 0.6 in 1993, followed by 0.4 in 2005, and 0.2 in 1996.

In Alabama/Mississippi offshore waters from May through August, highest CPUE occurred in 2004, with a value of 6.3. CPUE was 4.5 in 1993, followed by 4.3 in 1998, 1.4 in 1994, 1.3 in 2003, and 1.1 in 2002. Catch rate estimates were 1.0 and 0.4 in 2001 and 2005, respectively.

During September through December in Alabama/Mississippi nearshore waters, highest CPUE was 1.7 in 1992. Catch rate estimates were 1.6 in 2003, followed by 0.8 in 2002, and 0.6 in both 2004 and 1994. CPUE was 0.5 in 2001, and 0.2 in 2005.

During the same time period from September through December, the highest CPUE in Alabama/Mississippi offshore zone occurred in 1992, with a value of 2.1. The catch rate estimate was 0.7 in 2004. CPUE was 0.5 in both 1993 and 2003, followed by 0.4 in 2001, 0.3 in 2002, and 0.2 in 2005.

In Florida nearshore waters from January through April, CPUE was highest in 2004 at 4.0. CPUE was 3.8 and 1.9 in 1996 and 1995, respectively. The estimated catch rate was 1.8 in 2002. Similarly, CPUE was 1.2 in 2003, 1993, and 2005. The lowest catch rate was 1.0 in 1994.

During January through April in the Florida offshore zone, invertebrate CPUE was highest in 1997 at 4.3. CPUE was 3.8 in 2004, and 3.2 in 2002. Estimated catch rates were 3.0 in 1996, followed by1.8 in 2003, 1.6 in both 2005 and 1993, 1.5 in 1995, and 1.3 in 1994.

From May through August for Florida nearshore waters, CPUE was highest at 7.3 in 1993. Estimated catch rates were 5.8 in 1994, followed by 3.5 in 2004, 2.4 in 2002, and 1.1 in 2005. The lowest CPUE was 0.9 in 1995.

For Florida offshore waters from May through August, CPUE was 6.0 in 1995. Estimated catch rate values were 3.4 in 1993, followed by 3.0 in 2002, 2.7 in 2005, 2.2 in 1996, and 2.0 in 2004. For the remaining years, CPUE was less than 1.0. Catch rate estimates were 0.8 in 1994, and 0.3 in 1992.

In the Florida nearshore zone during September through December, CPUE was highest at 5.2 in 1994. The estimated catch rate was 1.1 in 1995.

For Florida offshore waters during the same time period (September through December), invertebrate CPUE was highest in 1992, with a value of 18.5. Catch rate estimates were relatively low for the remaining years. CPUE was 3.4 in 1996, followed by 1.7 in 1994, 1.2 in 2001, 0.8 in 1995, and 0.5 in 2002.

<u>Crustaceans</u>

Non-penaeid shrimp crustacean CPUE in kilograms per hour by year and state was assessed. Catch rates were higher in Florida and Alabama/Mississippi as compared with Texas and Louisiana.

CPUE off Texas was highest at 7.6 in 1996. Catch rate estimates were 6.7 and 5.6 in 2001 and 1994, respectively. CPUE was 5.0 in 2003, followed by 4.1 in 1993, 3.6 in 2005, and 3.5 in 2002. For the remaining years catch rates were below 3.5. CPUE was 3.4 in 2004, followed by 3.2 in 1992, 2.9 in 1997, and 2.8 in 1995. Catch rate estimates were 2.6 in both 1999 and 1998. The lowest CPUE was 1.2 in 2000.

CPUE off Louisiana was highest in 1994, with a value of 7.1. CPUE was 6.9 in 2001, followed by 4.8 in 2003, 3.4 in both 2000 and 1992, and 3.3 in 1993. Catch rates were 3.1 in 2004, 1998, and 2002. CPUE was 2.4 in 1999, followed by 2.3 in 1997, and

2.1 in 2005. For the remaining years, catch rates were below 2.0. CPUE was 1.6 in 1995, and 1.5 in 1996.

Off Alabama/Mississippi crustacean CPUE was highest at 14.6 in 1998. Catch rate estimates were 9.3 in 1992, followed by 5.9 in 1994, 5.4 in 1993, and 4.9 in 2003. Catch rates were 4.5 and 4.2 in 2004 and 2001, respectively. CPUE was 3.4 in 2002, and 3.1 in 2005. The lowest catch rate was 1.3 in 1996.

Florida experienced slightly higher catch rates, with highest CPUE occurring in 1997, with a value of 9.3. CPUE was 8.8 in 1992, followed by 8.5 in 2005, 7.8 in 2003, and 7.5 in 2002. Estimated catch rates were 5.7 in 1993, followed by 5.6 in 1996, 3.8 in 2004, and 3.6 in 1995. CPUE was 3.0 in 1994, and 2.6 in 2001.

Crustacean catch rate estimates in kilograms per hour by year, state and depth strata are presented below. Higher catch rates were typically observed in the offshore zone for Texas, Louisiana and Alabama/Mississippi. For Florida, the nearshore zones had higher CPUE as compared with the offshore strata during most years.

In the Texas nearshore strata, crustacean CPUE was highest in 1996, with a value of 10.9. Catch rate estimates were 5.5 in 1993, followed by 5.3 in 1994, 4.3 in 1998, 4.2 in 1995, and 3.3 in 2003. CPUE was 3.1 in 2005, followed by 2.6 in 2000, 1.4 in 1992 and 1.0 in 2004. The lowest estimated catch rate was 0.8 in 2002.

For Texas offshore waters, CPUE was estimated at 6.7 in both 2001 and 1996. Catch rates in 1994 and 2003 were 5.6 and 5.1, respectively. CPUE was 4.0 in 1993, followed by 3.9 in both 2004 and 1992, 3.7 in 2005, and 3.6 in 2002. For the remaining years, catch rates were below 3.0. CPUE was 2.9 in 1997, followed by 2.7 in 1995, 2.6 in 1999, 2.5 in 1998, and 0.8 in 2000.

In the Louisiana nearshore area, CPUE was highest in 1992, with a value of 4.4. Catch rate estimates were 3.9 in 1993, and 3.7 in 1994. Catch rates were 1.4 in 2004, followed by 1.2 in 2005, 1.0 in both 2003 and 2002. The lowest CPUE was 0.7 in 2001.

For Louisiana offshore waters, the highest catch rate estimate occurred in 1994, with a value of 7.1. CPUE was 7.0 in 2001, followed by 5.0 in 2003, 3.6 in 2004, and 3.4 in 2000. Catch rate estimates were 3.2 in 1993, and 3.1 in both 2002 and 1998.

Similarly, CPUE was 2.8 in both 1992 and 2005. Catch rate estimates were 2.4 in 1999, followed by 2.3 in 1997, 1.6 in 1995, and 1.5 in 1996.

For Alabama/Mississippi nearshore strata, crustacean CPUE was highest in 1992, with a value of 11.3. Catch rate estimates were 5.7 and 4.1 in 1998 and 1994, respectively. CPUE was 3.6 in 2004, followed by 2.8 in 2002, 2.4 in 2003, and 2.0 in 1993. Catch rate estimates were 1.4 in 2001, and 1.3 in 1996. The lowest CPUE was 0.7 in 2005.

In the Alabama/Mississippi offshore zone, CPUE was highest at 16.8 in 1998. Catch rates values were 12.0 in 1993, and 9.3 in 1994. CPUE was 7.4 in 1992, followed by 6.1 in both 2001 and 2003, 4.6 in 2004, and 3.6 in 2002. The lowest catch rate occurred in 2005, with a value of 3.5.

In Florida nearshore waters, crustacean CPUE was highest at 14.6 in 2005. CPUE was 11.0 in 2003, followed by 10.8 in 2002, 7.4 in 1993, and 4.6 in 1996. Catch rate estimates were 4.0 in 1995, and 2.9 in 2004. Lowest CPUE was observed in 1994, with a value of 2.8.

In the Florida offshore zone, CPUE was highest at 9.3 in 1997. Catch rate estimates were 8.8 and 7.2 in 1992 and 2005, respectively. CPUE was 5.7 in 1996, followed by 4.8 in 2002, 4.6 in 1993, 4.2 in 2004, and 3.5 in 1995. Catch rate estimates were 3.1 in 1994, and 2.6 in 2003. The lowest CPUE was 2.3 in 2003.

Crustacean CPUE in kilograms per hour by year, state, depth and season was examined. Higher CPUE was observed in May through August and from September through December in Texas, Louisiana and Alabama/Mississippi in both near and offshore zones. In Florida nearshore water higher CPUE in January through April was observed. In offshore waters, detectable CPUE (≥ 0.1) was prevalent in all seasons.

In Texas nearshore waters during January through April, crustacean CPUE was highest at 5.3 in 1993. Catch rate estimates were 2.9 and 0.9 in 1994 and 1992, respectively.

For the Texas offshore zone during the same period (January through April), CPUE was highest in 2004, with a value of 2.4. CPUE was 2.3 in 1996, followed by 2.2 in 1994, 1.4 in 1998, and 1.3 in 1997. The lowest estimated catch rate was 0.5 in 2002.

In Texas nearshore waters from May through August, highest crustacean CPUE occurred in 1996, with a value of 12.6. Catch rate estimates were 7.7 and 7.0 in 1994 and 1993, respectively. CPUE was 4.7 in 2005, followed by 4.3 in 1998, 4.2 in 1995, 3.4 in 2003, 2.6 in 2000, and 2.2 in 1992. Catch rates were 1.8 in 2002, and 1.0 in 2004.

During May through August in the Texas offshore zone, highest CPUE was reported in 1996, with a value of 9.7. CPUE in 2001 was 9.4, and 7.1 in both 2003 and 1994. Catch rate estimates were 5.6 in both 1997 and 1995. Similarly, estimated catch rates were 5.1 in 2002 and 1993. CPUE was 4.8 in 1998, followed by 4.7 in 2004, 4.3 in 2005, 4.1 in 1992, and 3.5 in 1999.

Crustacean CPUE in Texas nearshore waters during September through December was highest at 3.3 in 1992. Catch rate estimates for the remaining years were relatively low. CPUE was 1.4 in 1993, followed by 1.0 in 1996, and 0.4 in 2002.

For Texas offshore waters during the same time frame (September through December), CPUE was highest in 1996, with a value of 4.4. Catch rate estimates were 4.0 and 3.7 in 1993 and 1992, respectively. CPUE was 2.8 in 1994, followed by 2.3 in 2003, 2.1 in both 1999 and 1995, 1.9 in 2005, and 1.7 in 1997. Catch rate estimates were 1.3 in 2002, followed by 1.2 in 2001, and 1.1 in 2004. The lowest CPUE was 0.7 in 2000.

In Louisiana nearshore waters during January through April, crustacean CPUE was highest at 2.9 in 1993. CPUE was 1.3 in 2005, followed by 0.8 in 2004, and 0.5 in 2003.

During January through April in the Louisiana offshore zone, highest CPUE was 8.1 in 1994. CPUE was 2.4 in both 1993 and 2004, followed by 2.0 in 1998, 1.5 in 2002, and 1.3 in 2005. The catch rate estimate was 1.2 in 1997. CPUE was 0.4 in both 1996 and 1995. Catch rate estimates were 0.3 and 0.0 in 2003 and 1992, respectively.

In May through August in Louisiana nearshore waters, CPUE was highest in 1993, with a value of 5.4. CPUE was 3.7 in both 1992 and 1994, followed by 2.1 in 2003, and 1.7 in 2002. Estimated catch rate values were 1.5 in both 2004 and 2005.

During May through August in Louisiana offshore waters, the highest crustacean CPUE was 14.0 in 2001. Similarly, the catch rate estimate was 11.1 in 1993. Catch rate estimates were 9.3 and 9.2 in 1994 and 2003, respectively. CPUE was 6.9 in 2005, followed by 6.4 in 1998, and 6.3 in 2004. In the remaining years, CPUE was less than 5.0. Catch rate estimates were 4.9 in 2002, followed by 4.0 in 1995, 3.9 in 1996, and 3.3 in 1997. CPUE was 3.1 in both 2000 and 1999. The lowest catch rate value observed was 2.1 in 1992.

In Louisiana nearshore waters during the September through December period, highest CPUE was 5.7 in 1992. Catch rate estimates were 0.8 in both 2002 and 2003. CPUE was 0.7 in 2001, followed by 0.4 in 2004, and 0.2 in 1993 and 2005.

In Louisiana offshore waters during this same time period (September through December), CPUE was highest in 2004, with a value of 6.8. A catch rate estimate of 5.9 was observed in 1998. CPUE was 4.8 in 2003, followed by 4.7 in 1992, 4.1 in 1993, and 3.5 in both in 2001 and 2002. Catch rate estimates were 2.3 in both 1999 and 1994. CPUE was 1.8 in 2005, and 1.7 in 1997. The lowest CPUE was exhibited in 1995, with a value of 1.4.

In Alabama/Mississippi nearshore waters during January through April the highest CPUE occurred in 1993, with a value of 2.9. CPUE was 1.9 in 2002, and 1.5 in 2004. Estimated catch rates were 1.4 in 2005, and 1.2 in 2003.

During this same period (January through April) in Alabama/Mississippi offshore waters, the highest crustacean CPUE was 3.0 in 2004. Catch rate estimates were 1.9 in 2005, followed by 1.8 in 2003, and 1.5 in 2002.

During May through August in the Alabama/Mississippi nearshore zone, the highest CPUE was 12.9 in 1992. Catch rates were relatively lower in the remaining years. In 2004 and 1998, catch rate values were 5.8 and 5.7, respectively. CPUE was

5.0 in 2001, followed by 4.3 in 1994, and 4.1 in 2003. Catch rate estimates were 4.0 in 2002, and 2.1 in 2005. CPUE was 1.9 in 1993, and 1.3 in 1996.

In Alabama/Mississippi offshore waters from May through August, highest CPUE occurred in 1998, with a value of 16.8. CPUE was 12.1 in 1993, followed by 9.8 in 2003, 9.6 in 2001, 9.1 in 2004, and 8.2 in 1994. Catch rate estimates were 5.6 and 4.5 in 2005 and 2002, respectively.

During September through December in Alabama/Mississippi nearshore waters, the highest crustacean catch rate was 10.6 in 1992. CPUE was 2.3 in 2004, followed by 1.8 in 1994, 1.5 in 2003, and 1.2 in 2001. Catch rate estimates were 0.9 in 2002, and 0.2 in 2005.

During the same time period (September through December) in Alabama/Mississippi offshore waters, highest CPUE was 11.3 in 1993. Catch rate estimates were 7.4 in 1992, followed by 6.1 in 2005, 5.2 in 2004, and 4.8 in 2001. CPUE was 4.7 in 2003, and 3.2 in 2002.

In Florida nearshore waters from January through April, CPUE was highest in 2005 at 14.8. Similarly, catch rate estimates were 12.2 and 11.0 in 2002 and 2003, respectively. CPUE was 7.4 in 1993, followed by 5.2 in 1995, 4.8 in 1996, 2.8 in 2004, and 2.5 in 1994.

During January through April in the Florida offshore zone, crustacean CPUE was highest in 1997, with a value of 9.3. Catch rate estimates were 6.3 in 2005, and 4.5 in 1996. CPUE was 4.5 in 1996, followed by 4.2 in 2004, 4.1 in 1993, 3.8 in 2002, 3.5 in 1994, and 3.1 in 1995. The lowest observed CPUE was 2.3 in 2003.

From May through August for Florida nearshore waters, CPUE was highest at 17.2 in 2005. Estimated catch rates were 7.9 in 2002, followed by 7.4 in 1993, 5.2 in 1994, 3.4 in 2004, and 3.3 in 1995.

For Florida offshore waters from May through August, the catch rate estimate was highest at 18.7 in 2005. CPUE was 9.9 and 7.4 in 1992 and 2002, respectively. Catch rates were 5.2 in 1993, followed by 3.7 in 2004, 2.6 in 1995, and 2.4 in 1994. The lowest CPUE was experienced in 1996 at 1.9.

In the Florida nearshore zone during September through December, CPUE was highest at 2.5 in 1994. The estimated catch rate was 1.5 in 1995.

For Florida offshore waters during the same time period (September through December), crustacean CPUE was highest in 1996, with a value of 8.2. Catch rates were 5.6 in 2002, followed by 4.5 in 1995, 3.5 in 1992, 2.6 in 1994, and 2.5 in 2001.

Other Grouped Finfish

CPUE for other finfish species (excluding Atlantic croaker, black drum, cobia, king mackerel, lane snapper, longspine porgy, red drum, red snapper, seatrout, shark, snapper, southern flounder, Spanish mackerel, and vermilion snapper) was examined. While similar among state areas, higher CPUE generally occurred off Florida and Alabama/Mississippi as compared with Louisiana and Texas in most years. For Florida it is interesting to note that dominant species (e.g., Atlantic croaker, longspine porgy and seatrout) occurring in the other state areas were relatively lower in Florida waters, implying different finfish species dominated. Based on characterization data these species include sand perch (*Diplectrum formosum*), inshore lizardfish (*Synodus foetens*), and dusky flounder, (*Syacium papillosum*).

Finfish CPUE off Texas was highest in 1994, with a value of 13.1. Catch rate estimates were 9.8 in 2005, followed by 9.6 in 1997, and 9.4 in both 1995 and 1992. CPUE was 8.9 and 8.8 in 1996 and 2002, respectively. Catch rates were estimated at 8.7 in 2004, followed by 8.5 in 1993, and 7.5 in both 2003 and 2001. For the remaining years catch rates were below 7.0. CPUE was 6.1 in 1999, and 5.1 in 1998. The lowest CPUE was 1.8 in 2000.

CPUE off Louisiana was highest at 15.5 in 2005. Estimated catch rates were 14.4 in both 1995 and 1994, followed by 13.6 in 2001, 13.5 in 1997, and 12.5 in 1992. CPUE was 12.1 in both 2004 and 1996. Catch rates were 11.9 in 1993, followed by 11.1 in 1998, 10.5 in 1993, 9.6 in 2002, and 6.2 in 1999. The lowest CPUE was in 2000, with a value of 4.7.

Off Alabama/Mississippi catch rates were highest in 1992, with a value of 18.2. CPUE was 15.2 in 2004, followed by 14.4 in 1994, and 14.3 in both 2001 and 1993. Catch rates were 13.6 and 13.3 in 1998 and 2005, respectively. CPUE was 12.1 in 2002, and 10.3 in 2003. The lowest catch rate value was 3.4 in 1996.

Florida experienced the highest CPUE in 2001, with a value of 31.9. Catch rate estimates were 19.6 in 1996, followed by 16.2 in 2005, 15.9 in 2004, 15.0 in 2002, and 12.2 in 1993. CPUE was 11.3 in 1995, and 11.1 in 2003. Catch rates were estimated at 10.4 in 1994, 8.4 in 1997, and 6.2 in 1992.

Other grouped fish catch rate estimates in kilograms per hour by year, state, and depth were assessed. CPUE was generally higher in the nearshore zones off Texas and Louisiana. Conversely, catch rates were higher in the offshore areas in Alabama/Mississippi and Florida.

In the Texas nearshore strata, CPUE was highest in 1995, with a value of 22.6. Catch rate estimates were 14.2 in 2004, followed by 13.5 in 1992, 12.8 in 1996, and 10.8 in both 2005 and 1994. Similarly, CPUE was 10.4 in 1993. In the remaining years, catch rates were less than 10.0. CPUE was 9.0 in 2003, followed by 7.5 in 1998, 6.9 in 2002, and 3.3 in 2000.

For Texas offshore waters, CPUE was highest at 13.3 in 1994. Catch rates were 9.7 and 9.6 in 2005 and 1997, respectively. CPUE was 8.9 in 2002, followed by 8.7 in 1995, 8.3 in 1993, and 7.8 in both 1996 and 1992. Catch rate estimates were 7.6 in 2004, and 7.5 in both 2001 and 2003. CPUE was 6.1 in 1999, and 5.1 in 1998. The lowest catch rate experienced in offshore waters was at 1.3 in 2000.

In the Louisiana nearshore area, grouped finfish CPUE was highest in 2005, with a value of 22.2. Catch rates were 16.8 in 1992, followed by 16.3 in 2004, 14.3 in 1994, 12.4 in 1993, and 11.0 in 2001. CPUE was 9.7 in 2003, and 8.6 in 2002.

For Louisiana offshore waters, CPUE was 14.4 in both 1995 and 1994. Catch rates were 13.7 and 13.5 in 2001 and 1997, respectively. CPUE was 12.1 in 1996, followed by 11.9 in 1993, 11.1 in 1998, and 11.0 in 2004. Catch rate estimates were

10.9 in 2005, and 10.6 in 2003. CPUE was 10.2 in 1992, followed by 9.6 in 2002, 6.2 in 1999, and 4.7 in 2000.

For Alabama/Mississippi nearshore strata, CPUE was highest in 1994, with a value of 15.8. Catch rate estimates were 13.2 in 1992, and 12.4 in 2001. CPUE was 12.0 in 1993, followed by 9.1 in 2002, 7.2 in 2004, and 6.6 in 2005. Catch rate estimates were 6.5 in 2003, and 3.8 in 1996. The lowest CPUE was 3.4 in 1996.

In the Alabama/Mississippi offshore zone, CPUE was highest in at 23.1 in 1992. Catch rate values were 18.7 and 16.2 in 1993 and 2004, respectively. CPUE was 16.0 in 1998, followed by 15.7 in 2001, 14.5 in 2005, and 13.1 in 2002. Catch rate estimates were 12.1 in 2003, and 11.9 in 1994.

In Florida nearshore waters, other grouped fish CPUE was highest in 1994, with a value of 18.3. CPUE was 15.0 in 2004, followed by 13.9 in 2002, 13.8 in 1996, and 13.0 in 1995. Catch rate estimates were 12.1 in 2003, and 11.5 in 2005. The lowest catch rate was 11.4 in 1993.

In the Florida offshore zone, CPUE was highest at 31.9 in 2001. Catch rate estimates were 20.3 in 1996, followed by 17.2 in 2005, 16.3 in 2004, 15.9 in 2002, 12.7 in 1993, and 10.6 in 1995. For the remaining years, CPUE was less than 10.0. Catch rate estimates were 9.5 in 2003, 9.2 in 1994, 8.4 in 1997, and 6.2 in 1992.

For other grouped finfish, CPUE in kilograms per hour by year, state, depth and season was analyzed. In Texas near and offshore waters higher CPUE typically occurred in the May through August period. For all other state areas and depth zones, CPUE was comparable among all seasons.

In Texas nearshore waters during January through April, other grouped fish CPUE was highest at 11.2 in 1992. Catch rate estimates were 7.8 and 2.4 in 1993 and 1994, respectively.

For the Texas offshore zone during the same period (January through April), CPUE was highest in 1996, with a value of 9.1. CPUE was 7.9 in 1997, followed by 7.4 in 1994, 4.9 in 2004, and 4.5 in 1998. The lowest estimated catch rate was 2.6 in 2002. In Texas nearshore waters from May through August, highest CPUE occurred in 1995, with a value of 22.6. Catch rate estimates were 18.4 and 17.7 in 1992 and 1994, respectively. CPUE was 16.4 in 1993, followed by 14.2 in 2004, 12.7 in 1996, 10.9 in 2002, and 9.0 in 2003. Catch rates for the remaining years were below 9.0. CPUE was 7.5 in both 1998 and 2005. The lowest catch rate value was 3.3 in 2000.

During May through August in the Texas offshore zone, highest grouped finfish CPUE was recorded at 15.2 in 1997. CPUE was 13.7 in 1994, followed by 11.1 in 2002, 10.8 in both 1995 and 2005, and 10.0 in 1996. Catch rate estimates were 8.6 in both 1992 and 2001. Similarly, CPUE was 8.4 in 2004, followed by 8.2 in 2003, 7.4 in 1999, and 6.2 in 1998.

CPUE in Texas nearshore waters during September through December was highest at 15.8 in 1992. Catch rates were estimated at 13.9 in 1996, followed by 5.7 in 1993, and 5.4 in 2002

For Texas offshore waters during the same time frame (September through December), CPUE was highest in 1994, with a value of 13.4. Catch rate estimates in 1993 and 1995 were 8.7 and 8.2, respectively. CPUE in was 7.4 in 2004, followed by 7.3 in 1992, 7.0 in 1997, 6.6 in 2005, and 6.4 in 2003. Estimated catch rates were 6.1 in 2002, and 5.4 in 1999. CPUE was 5.3 in 2001, followed by 4.3 in 1996, and 1.0 in 2000.

In Louisiana nearshore waters during January through April, highest CPUE was 25.6 in 2005. CPUE was 11.0 in 1993, followed by 5.6 in 2004, and 4.4 in 2003.

During January through April in the Louisiana offshore zone, highest grouped finfish CPUE was 12.2 in 1994. CPUE was 11.5 in 1995, followed by 11.3 in 1996, 10.1 in 1998, 9.8 in 1997 and 8.8 in 1993. Catch rate estimates were 7.9 in both 2002 and 2004. For the remaining years, CPUE was 7.8 in 2005, followed by 6.3 in 1992, and 4.3 in 2003.

In May through August in Louisiana nearshore waters, CPUE was highest in 2005, with a value of 22.9. CPUE was 18.0 in 1992, followed by 16.5 in 2004, 14.3 in 1994, 12.3 in 1993, and 10.4 in 2002. The lowest catch rate estimate was 7.1 in 2003.

Data were collected in all years from May through August in Louisiana offshore waters. The highest CPUE occurred was 28.1 in 1993. Catch rate estimates in 1997 and

1994 were 18.7 and 18.6, respectively. CPUE was 18.1 in 2004, followed by 15.6 in 2005, 15.5 in 2001, 15.1 in 1995, 13.6 in 1996, 13.2 in 2002, and 13.1 in 1998. For the remaining years, estimated catch rates were less than 10.0. CPUE was 9.8 in 2003, followed by 9.7 in 1999, 6.5 in 1992, and 4.9 in 2000.

In Louisiana nearshore waters during the September through December period, highest CPUE was 18.6 in 2004. Catch rate estimates were 17.3 in 2005, followed by 16.1 in 1993, 14.7 in 1992, 11.3 in 2003, and 11.0 in 2001. The lowest CPUE was 8.2 in 2002.

In Louisiana offshore waters during this same time period (September through December), CPUE for other grouped finfish was highest in 1993, with a value of 19.7. A similar catch estimate of 19.0 was observed in 1998. CPUE was 18.7 in 2004, followed by 15.7 in 1995, 13.8 in 1992, 13.5 in 1994, 12.8 in 2001, and 12.0 in 2003. Catch rate estimates for the remaining years was below 12.0. CPUE was 11.1 in 2005, followed by 10.4 in 1997, 9.0 in 2002, and 5.3 in 1999.

In Alabama/Mississippi nearshore waters during January through April the highest CPUE occurred in 1993, with a value of 15.7. CPUE was 10.0 in 2005, followed by 6.2 in 2004, 5.9 in 2003, and 3.3 in 2002.

During this same period (January through April) in Alabama/Mississippi offshore waters, the highest CPUE was 14.8 in 2003. CPUE was 12.8 in 2004, followed by 12.4 in 2005, and 11.0 in 2002.

During May through August in the Alabama/Mississippi nearshore zone, the highest CPUE for other grouped finfish was 16.6 in 1994. Catch rate values were 14.1 and 11.8 in 2001 and 1993, respectively. CPUE was 9.9 in 1992, followed by 8.4 in 2002, 7.8 in 2003, and 5.9 in both 2005 and 2004. Catch rate estimates were 3.8 in 1998, and 3.4 in 1996.

In Alabama/Mississippi offshore waters from May through August, CPUE was 18.6 in both 2001 and 2005. Catch rate values were estimated at 16.9 in 1993, followed by 16.0 in 1998, 12.7 in 2002, 12.1 in 2004, and 10.8 in 1994. The lowest CPUE was 7.5 in 2003.

During September through December in Alabama/Mississippi nearshore waters, highest CPUE was 14.7 in 1992. Catch rate estimates were 12.8 and 12.3 in 2002 and 2001, respectively. CPUE was 10.0 in 2004, followed by 7.8 in 1994, 5.4 in 2005, and 4.7 in 2003.

During the same time period from September through December, the highest CPUE in Alabama/Mississippi offshore zone occurred in 1993, with a value of 36.1. The catch rate estimate was 27.3 in 2004. CPUE was 23.1 in 1992, followed by 16.3 in 2005, 15.5 in 2002, 14.9 in 2003, and 14.6 in 2001.

In Florida nearshore waters from January through April, CPUE was highest at 18.5 in 1994. CPUE was 15.8 in 1995, and 15.2 in 2004. Estimated catch rates were 13.1 in both 1996 and 2002, followed by 12.1 in 2003, 11.7 in 2005, and 10.1 in 1993.

During January through April in the Florida offshore zone, other grouped fish CPUE was highest in 2005, with a value of 17.3. Catch rate estimates were 16.9 and 14.9 in 2004 and 1996, respectively. Similarly, estimated CPUE was 14.3 in 2002. Catch rate estimates were 9.5 in 2003, followed by 8.4 in 1997, 7.3 in 1994, and 5.9 in both 1993 and 1995.

From May through August for Florida nearshore waters, CPUE was highest at 20.1 in 1994. Estimated catch rates were 15.5 in 2002, followed by 13.5 in 1993, 10.2 in 1995, 9.7 in 2004, and 7.7 in 2005.

For Florida offshore waters from May through August, CPUE was highest in 1993, with a value of 21.4. Catch rate values were 17.2 in 1996, followed by 17.0 in 2002, 16.5 in 2005, 14.2 in 1995, and 10.6 in 2004. CPUE was 7.8 in 1994, and 6.6 in 1992.

In the Florida nearshore zone during September through December, CPUE was highest at 17.9 in 1994. In 1995, the estimated catch rate was 15.7.

For Florida offshore waters during the same time period (September through December), grouped finfish CPUE was highest in 2001, with a value of 31.6. CPUE was 31.3 in 2002, followed by 29.5 in 1996, 17.2 in 1994, and 13.1 in 1995. The lowest catch rate value was 4.2 in 1992

DISCUSSION

From February 1992 through December 2005, data from approximately 23,718 tows were collected during 860 trips (13,924 sea days), with more than 122,727 hours of trawling observed in the Gulf of Mexico. Vessel and fishing characteristics for all projects combined were documented. Overall vessel length was 74.3 feet. Most vessels were of steel hull construction, and had freezer capacity. The average number of nets pulled behind the vessel was 3.8, with an average headrope length of approximately 48.1 feet. Tow time in the Gulf of Mexico averaged 5.2 hours. The average fishing depth was 19.8 fathoms, with a mean towing speed of 2.8 knots.

Based on 16,908 nets that contained species characterization data, approximately 2.9 million kilograms of total catch were documented. Examination by species categories was similar to earlier assessments (Scott-Denton 1996; Nance et al. 1997; NMFS 1998). Fish species comprised the majority of catch at 65%, followed by penaeid shrimp at 16%, non-penaeid shrimp crustaceans at 13%, non-crustacean invertebrates at 4%, and debris at 1%. From an earlier 1992 through 1996 assessment, the values were 67% for finfish, followed by 16% for commercial shrimp species, 13% non-commercial shrimp crustaceans, and 4% non-crustacean invertebrates (NMFS 1998).

In the current study, CPUE in kilograms per hour by category was 20.1 for fish, 5.0 for penaeid shrimp, 4.1 for crustaceans, 1.2 for invertebrates, and 0.4 for debris. From non-extrapolated data from 1997 through 2005, CPUE was 5.4 for penaeid shrimp, suggesting that subsamples yielded a relatively close estimate of the actual value.

To be reflective of the fishery at a particular time, data from nets consistent with current BRD regulations (required or not required) were examined. Approximately 1.6 million kilograms of total catch were obtained from 9,509 tows during 52,494 hours of trawling in the Gulf of Mexico yielding a discard to landing ratio of 5.2. Percentages and CPUE were similar as above for all nets with finfish dominating at 64%, followed by penaeid shrimp at 16%, non-penaeid shrimp crustaceans at 14%, other non-crustacean invertebrates at 4%, and debris at 1%. CPUE in kilograms per hour by category was

19.5 for fish, 4.9 for penaeid shrimp, 4.2 for crustaceans, 1.3 for invertebrates, and 0.4 for debris.

Examination of CPUE in kilograms per hour by state and depth for all years indicated that the Louisiana nearshore area had the highest CPUE for total catch, finfish and penaeid shrimp. CPUE for total catch in this area was 44.3. The Texas offshore zone had the lowest estimated total catch CPUE at 25.9. Similarly, the Louisiana nearshore area produced the highest finfish rate with a CPUE of 30.7, with the Texas offshore area yielding the lowest estimated CPUE at 14.6. Penaeid shrimp CPUE estimates were also highest in the Louisiana nearshore area at 9.3; Alabama/Mississippi offshore had the lowest CPUE at 3.8. Catch rate estimates for invertebrates were highest in both Florida near and offshore waters at 2.3, with the lowest CPUE in Louisiana offshore waters at 0.9. Crustacean CPUE was highest in Florida nearshore waters at 8.4. In contrast, the lowest crustacean CPUE was observed in Louisiana nearshore area at 2.0. Debris catch rate estimates were highest in the Alabama/Mississippi nearshore area at 1.8, and lowest in Texas offshore waters at 0.1.

Based on the ratio of shrimp to total catch, shrimp comprised 22% of the total catch in Texas offshore waters, followed by 21% in Louisiana nearshore waters, and 20% in Texas nearshore waters. In all other state and depth strata, shrimp accounted for less than or equal to 18% of the total catch.

Based on multiple comparison tests for all years combined for total finfish (excluding red snapper), finfish CPUE was significantly higher in Alabama/Mississippi and Louisiana as compared with catch rates off Florida and Texas. No significant difference was detected in mean catch rates between Alabama/Mississippi and Louisiana. Similarly, no significant difference in CPUE was evident between Florida and Texas. Finfish catch rates were significantly higher in the nearshore areas off Texas and Louisiana as compared with the offshore zones of the two states. Conversely, the Alabama/Mississippi offshore strata yielded significantly higher finfish catch in the offshore area. In Florida, for all years combined, the nearshore area yielded higher CPUE, although catch rates were not significantly different between the two depth strata.

In Texas nearshore waters finfish CPUE was significantly higher in May through August. In Texas offshore waters CPUE was higher in September through December, although there was no significant difference between this period and May through August. In both Louisiana near and offshore waters, the May through August and September through December period were not significantly different and yielded higher CPUE than the January through April period. For Alabama/Mississippi nearshore waters there was a significant difference detected between all seasons, with the September through December period yielding significantly higher CPUE. Similarly, in Alabama/Mississippi offshore strata, CPUE in the September through December and January through April periods were not significantly different and higher than in May through August. For Florida nearshore waters, there was no significant difference in mean catch rates between seasons. In Florida offshore waters significantly higher CPUE was observed in September through December as compared with other seasons.

CPUE for total finfish (excluding red snapper) by year and state depicted a similar trend. In most years, catch rates off Alabama/Mississippi and Louisiana were similar and higher than observed off Texas and Florida. There was no significant difference in finfish mean catch rates between Alabama/Mississippi and Louisiana, or between Texas and Florida in most years. Examination by state and depth revealed higher CPUE of finfish in the nearshore areas compared with offshore waters for both Texas and Louisiana in the majority of years. Conversely, Alabama/Mississippi exhibited significantly higher finfish CPUE in the offshore area compared with inshore zone in most years. Off Florida, catch rates were more comparable with no significant difference detected between the near and offshore strata in all years sampled, except in 1994. CV estimates for finfish were low, and less than 0.2 in all years and areas. In Texas nearshore waters catch rates were higher in May through August in all years, although not significantly higher in all years. For the offshore zone, May through August yielded higher finfish CPUE in the majority of years, followed by the September through December period. In Louisiana nearshore waters higher catch rates occurred in May through August and September through December, with no significant difference detected between the two seasons in the majority of years. In Louisiana offshore waters, the May through August period yielded higher finfish catch rates, although CPUE was not significantly different than the September through December period in most years. In Alabama/Mississippi near and offshore waters, CPUE was higher in September through December in the majority of years. For Florida nearshore waters, catch rates were relatively consistent between seasons, with the Florida offshore zone experiencing higher catch rates in September through December, followed by the May through August period.

For all years combined, shrimp CPUE was significantly different between all state areas comparisons, with Texas yielding the highest catch rate. While Louisiana is a large contributor to overall commercial shrimp catch in the Gulf of Mexico, a large percentage of this production comes from inland waters, and as such, not reflected in this study. Relative to depth strata, in Texas, Louisiana and Florida, shrimp CPUE was significantly higher in the nearshore areas as compared with the offshore strata. While higher in the nearshore area of Alabama/Mississippi, CPUE was not significantly different than in the offshore zone. In Texas nearshore waters the highest CPUE for shrimp occurred in May through August, and while not significantly different than the January through April period, it was significantly higher than September through December. Similarly, shrimp CPUE in Texas offshore waters was significantly higher in May through August as compared with the other two seasons. In both Louisiana near and offshore waters and in the Alabama/Mississippi nearshore zone, the same seasonal trend was evident; May through August yielded significantly higher CPUE. For Alabama/Mississippi offshore waters, catch rates were higher in September through December, but not significantly different than CPUE observed in May through August. For Florida nearshore waters the highest CPUE was observed in September through December. This was also evident for the Florida offshore area.

When examined by year, as compared with other state areas, Texas yielded higher CPUE for shrimp in the majority of years. Relative to state by depth, while not significantly different in all years, nearshore areas yielded higher catch rate estimates as compared with offshore zones. This was observed for all state areas in most years. As with total finfish, CV values were low (< 0.3) in all years. A strong seasonal trend was observed relative to shrimp catch rates from 1992 through 2005 period. In Texas nearshore waters the May through August period yielded higher shrimp CPUE in most years. For Texas offshore waters, the May through August period was significantly higher in all years. Similarly, in Louisiana near and offshore areas the May through August period yielded higher CPUE, followed by the September through December period. A similar trend was observed in Alabama/Mississippi. In Florida nearshore and offshore waters, catch rates were relatively more consistent between seasons, with the September through December yielding higher CPUE during years when all seasons were sampled.

For all years combined, red snapper mean catch rates were significantly different between all state areas comparisons. Texas yielded the highest CPUE. Relative to depth, CPUE was significantly higher in offshore waters of all state areas compared with the nearshore zones. In Texas nearshore waters the highest catch rate for red snapper occurred in May through August, although it was not significantly different compared with other seasons. CPUE was significantly higher in Texas offshore waters from September through December than in other seasons. For nearshore waters in Louisiana, Alabama/Mississippi and for Florida near and offshore waters, CPUE for red snapper was less than 0.1 kg/hr. As in Texas offshore waters, CPUE in Louisiana offshore waters was significantly higher in September through December as compared with other seasons. In Alabama/Mississippi offshore waters, catch rates were highest in September through December, although not significantly different than January through April.

When examined by individual years, detectable rates of CPUE for red snapper (i.e., CPUE $\geq$ 0.1) were for the most part restricted to Texas and Louisiana. CPUE was higher in Texas compared with Louisiana in the majority of years. In all years and state areas, offshore waters consistently yielded higher catch rate values compared with nearshore strata; CPUE was significantly higher in most years. CV estimates were variable and higher than those observed for total finfish and penaeid shrimp, ranging from 0.1 to 1.0. In the Texas nearshore area, CPUE was higher in May through August, although not significantly different as compared with the other two seasons. For the remaining states in the nearshore zones, CPUE was low, and relatively consistent among seasons. For all state areas, CPUE was higher in September through December in the offshore strata.

Within the finfish category discussed above, fourteen species of commercial, recreational and ecological importance were examined. For all years combined, grouped finfish (other than the 14 species immediately following) comprised 38% of the catch by weight, followed by Atlantic croaker and longspine porgy each at 9%, seatrout at 6%, and grouped sharks at 1%. Red snapper, southern flounder, lane snapper, Spanish mackerel, vermilion snapper, red drum, king mackerel, snapper, cobia, and black drum, each accounted for less than 1%. Corresponding catch rate estimates in kilograms per hour were 11.5 for grouped finfish, 2.8 for Atlantic croaker, 2.7 for longspine porgy, 1.8 for seatrout, and 0.2 for grouped sharks. Red snapper, southern flounder, lane snapper, and Spanish mackerel each had catch rate estimates of 0.1. Vermilion snapper, red drum, king mackerel, snapper, cobia, and black drum CPUE was each less than 0.1.

Catch rate estimates by weight for selected species were examined by year. Clearly, year-to-year variations by species were evident, and often cyclic in nature. Positive trends in CPUE throughout the time series were observed for Atlantic croaker, black drum, cobia, red drum, seatrout, shark, shrimp, snapper, Spanish mackerel, vermilion snapper, invertebrates and crustaceans. In contrast, negative trends were evident for king mackerel, lane snapper, longspine porgy, red snapper, southern flounder, and grouped finfish (excluding the species referenced above).

Similarly, while using a smaller sample size than for weight, CPUE by number for selected species was calculated. Positive slopes were observed for Atlantic croaker, cobia, king mackerel, lane snapper, red drum, seatrout, shark, shrimp, snapper, and Spanish mackerel. Negative trends were apparent for black drum, longspine porgy, red snapper, southern flounder, and vermilion snapper.

Nichols et al. (1987, 1990) using data from three sources of observer data and resource surveys provided annual estimates from 1972 through 1989 for selected species of finfish bycatch in the Gulf of Mexico commercial shrimp trawl fishery. These species reported in numbers of fish included croaker, spot, seatrout (sand and silver), longspine porgy, bumper (*Chloroscombrus chrysurus*), butterfish (*Peprilus burti*), cutlassfish (*Trichiurus lepturus*), hardhead catfish (*Arius felis*), red snapper, vermilion snapper, king mackerel, Spanish mackerel, and red drum. Total finfish and sharks were reported in pounds. CPUE estimates derived from a general linear model were multiplied by shrimp effort to produce annual estimates of bycatch (assuming two nets were trawled). From visual interpretation of the graphs presented in the document, shrimp effort in 24-hour days fish depicted an upward trend from 1972 through 1989. Increasing trends were observed for longspine porgy, vermilion snapper, king mackerel, Spanish mackerel, red drum, sharks, and shrimp. Decreases throughout the time series were evident for total finfish, Atlantic croaker, seatrout, and red snapper. The authors concluded that while the magnitude of species common in shrimp trawl bycatch was not surprising, the projected estimate of less frequently encountered species of red snapper, king mackerel, and Spanish mackerel was comparable to, or exceeded the recreational harvest. In a more recent assessment (Nichols and Pellegrin 1992) similar trends were observed for the species above; in addition, an increasing trend was noted for cobia.

In the current study, CPUE by weight for selected species was examined by year, state, depth and season. It is important to re-emphasize that CPUE varied considerably as less effort was applied to refined strata. In addition, sample size was variable among years, and most notably lower in 1999 and 2000.

Atlantic croaker CPUE was generally higher off Alabama/Mississippi, followed by Louisiana, Texas and Florida; nearshore areas yielded higher catch rates compared with the offshore areas. Seasonally, CPUE was typically higher in September through December and May through August.

While low, overall lane snapper CPUE was higher in Florida compared with other state areas. Texas and Louisiana experienced similar catch rates, with CPUE off

Texas slightly higher. CPUE in Alabama/Mississippi was less than 0.1. Relative to depth, similar trends in CPUE were observed in both the near and offshore areas of Florida. In the remaining states, CPUE, while low, was higher in the offshore strata as compared with the nearshore zones in most years. In the nearshore area off Florida, the January through April period yielded higher CPUE compared with other seasons. CPUE in Florida offshore waters was more variable among seasons. The remaining states had relatively lower catch rates, with occurrence in all seasons.

Overall, longspine porgy catch rates were higher in Louisiana and Texas, with both states experiencing similar catch rates in most years. Lower CPUE was observed in Alabama/Mississippi and Florida. The offshore areas yielded higher catch rates of longspine porgy compared with nearshore strata for all state areas. Seasonal distribution was variable, with longspine porgy occurring in all seasons. May through August typically yielded higher catch rates, followed by September through December.

Shark catch occurred in all states with variable distribution among states. Overall, catch rates were slightly higher in Louisiana as compared with Alabama/Mississippi and Texas. CPUE in Florida was lower. Catch rates were notably higher in the latter part of the project (i.e., 2001 through 2005). CPUE in near and offshore zones was variable among all states. Texas and Louisiana nearshore waters typically yielded higher catch rates as compared with offshore zones. In Alabama/Mississippi and Florida offshore areas reflected higher catch rates than nearshore strata. In Texas and Louisiana nearshore waters no detectable catch rates were evident in the January through April period, and thus limited to May through August and September through December. In offshore waters of these two states, catch was recorded in all seasons. Similarly, catch rates were documented in all seasons and depth strata for Alabama/Mississippi and Florida waters.

Southern flounder CPUE was similar among states, with catch rates off Alabama/Mississippi slightly higher. CPUE was generally higher in offshore strata compared with nearshore zones for most years and states. Southern flounder occurred in all seasons and in most states and depths with variable rates; no detectable trend was established.

Spanish mackerel CPUE, while low, was typically higher off Louisiana and Texas. Alabama/Mississippi experienced slightly lower CPUE; no detectable rate of catch was observed off Florida at the state level. CPUE was clearly higher in nearshore strata as compared with the offshore zones for all states. Seasonally, higher rates of catch occurred in May through August and September through December in nearshore waters of most states.

Seatrout, as with Atlantic croaker showed similar patterns in terms of CPUE. Overall catch rates were highest off Alabama/Mississippi, followed by Louisiana, Texas and Florida. CPUE relative to depth was variable. Off Texas, catch rates were higher in nearshore waters. Off Louisiana, CPUE was similar between the near and offshore strata. Off Alabama/Mississippi, catch rates were higher in offshore waters as compared with the nearshore strata. While relatively undetectable, Florida nearshore waters experienced higher CPUE than the offshore zone. Seatrout occurred in all seasons with variable catch rates. Higher CPUE in the nearshore waters typically occurred in May through August period, most notably off Texas. Relative to the offshore strata, higher catch rate estimates were observed in January through April, followed by September through December. This was particularly evident in offshore waters off Louisiana and Alabama/Mississippi.

Catch rates for vermilion snapper were low. While low, this species occurred in at least one state in at least one year, exclusively in offshore waters. While limited, the May through August and September through December periods experienced higher catch rates compared with January through April.

For invertebrates, CPUE was higher in Florida and Alabama/Mississippi as compared with Texas and Louisiana. Relative to depth, catch rates were typically higher in nearshore waters off Texas and Louisiana. Off Florida and Alabama/Mississippi, catch rates were similar between the near and offshore zones. Invertebrate CPUE occurred in all seasons and depth zones. CPUE was typically higher in May through

August, and September through December. Florida had higher CPUE in the January through April period as compared with other state areas.

As with invertebrates, crustacean category CPUE was higher in Florida and Alabama/Mississippi than in Texas and Louisiana. Similarly, higher catch rates were observed in the offshore zone for Texas, Louisiana and Alabama/Mississippi. For Florida, the nearshore zone had higher CPUE as compared with the offshore strata during several years. Higher CPUE was observed from May through August, followed by September through December in Texas, Louisiana and Alabama/Mississippi in both near and offshore zones. In Florida nearshore waters, higher CPUE in January through April was observed. In offshore waters, CPUE was prevalent in all seasons.

CPUE for grouped finfish species (excluding Atlantic croaker, black drum, cobia, king mackerel, lane snapper, longspine porgy, red drum, red snapper, shark, snapper, southern flounder, Spanish mackerel, seatrout, and vermilion snapper) was examined. While similar among state areas, higher CPUE occurred off Florida and Alabama/Mississippi as compared with Louisiana and Texas in most years. For Florida it is interesting to note that the more dominant species (e.g., Atlantic croaker, longspine porgy and seatrout) occurring in the other state areas, were relatively low in Florida waters. This implies that other finfish species dominated. Based on species characterization efforts these species include sand perch, inshore lizardfish, and dusky flounder. CPUE was generally higher in the nearshore zones off Texas and Louisiana. Conversely, catch rates were typically higher in the offshore areas in Alabama/Mississippi and Florida. In Texas near and offshore waters, higher CPUE typically occurred in the May through August period. For all other state areas and depth zones, CPUE was comparable among all seasons.

For all years based on weight, CV estimates for finfish, penaeid shrimp, crustaceans, invertebrates, longspine porgy, and Atlantic croaker were low (< 0.2). CV values for other finfish species of commercially and/or recreational importance, including red snapper and king mackerel, were variable, and in some instances equal to 1.0.

Catch rates from 1992 through 2005 period contained within this study were 30.8 kg/hr in the Gulf of Mexico. Discards to landings ratios were 5.18, higher than the landing ratio estimates of 4.56 reported by Harrington et al. (2005) for the 1992 through 1996 period. This is indicative that substantial discarding continues to present a challenge unresolved. Moreover, while several species listed as overfished, notably red snapper, did not comprise a large component by weight of the bycatch, the number of individuals discarded combined with the amount of annual shrimp effort exerted is reason for considerable concern. Similarly, long-term effects of continued discarding and habitat and community altercations from numerous sources, both biotic and abiotic, warrant further investigation.

Collectively, species-specific catch rates by area, season and depth and associated operational aspects of the commercial shrimp fishery contained within this chapter, combined with findings of BRD evaluation trails, can be used to enhance stock assessments and further ecological-modeling efforts. Moreover, these data can be used in the formulation of an environmentally based and economically driven plan for the fishery that seeks to continually improve practices for the benefit the environment. This type of plan, or Environmental Management System (EMS), holds great potential relative to the direction and management of these resources.

CHAPTER IV

INCIDENTAL CAPTURE OF SEA TURTLES IN THE U.S. SOUTHEASTERN SHRIMP TRAWL FISHERY

INTRODUCTION

There are five species of sea turtles, Kemp's Ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*), and green (*Chelonia mydas*) that inhabit waters of the U.S. Gulf of Mexico and southeastern Atlantic. All of these species are currently listed as threatened or endangered. Following the passage of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1536 et seq.), the National Marine Fisheries Service (NOAA Fisheries) prepared several ESA section 7 consultations relative to the effects of federal activities, including federally-permitted fisheries, on threatened or endangered species. The resulting consultations sought to develop methods to minimize adverse effects on threatened or endangered species, inclusive of the species habitat.

Using data from nets not equipped with turtle excluder devices (TEDs) from three shrimp trawl observer programs in the U.S. Gulf of Mexico (16,771 net hours) and southeastern Atlantic (9,943 net hours) sea turtle catch rates and mortality were estimated from 1973 to 1984 (Henwood and Stunz 1987). Mortality estimates in numbers per year for loggerhead sea turtles were 3,129 $\pm$ 1,001 in the Gulf of Mexico, and 6,745 $\pm$ 577 in the southeastern Atlantic. Kemp's Ridley mortality rates were estimated at 501 $\pm$ 501 and 266 $\pm$ 119 in the Gulf of Mexico and southeastern Atlantic, respectively. Mortality estimates for green sea turtles were 125 $\pm$ 250 in the Gulf of Mexico and 104 $\pm$ 44 in the Atlantic. These authors also detected a strong statistically significant ($r = 0.98$; $P < 0.001$) relationship of dependence of mortality on tow time (i.e., longer tow times, higher mortality).

Magnuson et al. (1990) conducted a qualitative ranking of mortality sources on sea turtles. Among the factors ranked in order of importance from juveniles to adults were shrimp trawling, other fisheries, non-human predators, weather, beach development, disease, dredging, entanglement, oil-platform removal, boat collisions, direct take, entrainment, recreational fishing, beach vehicles, beach lighting, beach replenishment, toxins, and ingestion of plastics. The authors concluded that sea turtle mortality resulting from trawling operations in the southeastern shrimp fishery was the major source of man-induced mortality on loggerhead and Kemp's Ridley sea turtles, causing more deaths than all other fisheries combined. The authors estimated mortality for loggerheads to range from 5,000 to 50,000 sea turtles per year; for Kemp's Ridley sea turtles, the estimated range was 500 to 5,000 per year.

Thompson et al. (1991) reported on the spatial and seasonal distribution of sea turtles in the Gulf of Mexico. Based on aerial surveys and shrimp trawling effort distribution, sub-adult and adult turtles abundance was typically higher in the eastern Gulf of Mexico, from the Mississippi River Delta to Key West, Florida. Seasonally, loggerhead concentrations were higher in the spring and lower in the winter. From a historical perspective, green sea turtles were more abundant in Texas; Kemp's Ridley sea turtles were traditionally assumed to be more concentrated in Louisiana. Based on the author's findings, both Kemp's Ridley and green sea turtles were present throughout the Gulf of Mexico, with higher concentrations in the northern and western Gulf of Mexico.

Renaud et al. (1997), based on data collected from two shrimp trawl observer programs, estimated catch rates of sea turtles in shrimp trawls with and with out TEDs in the southeastern shrimp fishery. Try nets (a small net used intermittently to test for concentrations of shrimp) were not used when calculating catch-per-unit-effort (CPUE). From March 1998 through 1990, during 6,478 hours of trawling, 63 turtles were captured in non-TED equipped nets, 6 in try nets, and 3 in TED-equipped nets. CPUE in numbers per hour and standardized to a 100-foot headrope was 0.00022 in the Gulf of Mexico and 0.00185 in the southeastern Atlantic for TED-equipped nets. In the second assessment, based on data from the early years of the current study (April 1992 through October 1995; 18,631 hours of trawling), 24 sea turtles were captured in TED-equipped nets, and 19 in try nets. CPUE was 0.00016 in the Gulf of Mexico and 0.00047 in the southeastern Atlantic for TED-equipped nets.

Significant statistical relations between monthly sea turtle stranding rates and monthly shrimp effort during 1986 through 1989 in depth intervals varying from 0 to 15 fathoms in two areas of the northwestern Gulf of Mexico have been documented (Caillouet et al. 1991). Moreover, following TED implementation in the shrimp fishery, Caillouet et al. (1996), assessed monthly sea turtle standings and shrimp effort from 1990 and 1993, and detected significant positive correlations as in 1986 to 1989. In addition, the 15 to 20 fathom depth interval had a significant positive correlation. The authors, in an attempt to explain the continued statistical association between sea turtle strandings and shrimp effort, hypothesized the following: legally-installed TEDs were not effective in excluding sea turtles; sea turtles were subject to repeated captures resulting in increased stress and subsequent mortality; sea turtles were captured in try nets; illegally-installed or altered TEDs resulted in captures; and other non-shrimp related sources of mortality were in synchrony with shrimp effort. The authors reported that there was little evidence to support most of the hypotheses above, with the exception of try nets and illegal TEDs.

In June 1987, Federal law required the use of TEDs in shrimp trawls to protect endangered and threatened sea turtles (52 FR 24247, June 28, 1987). At that time various TED exemptions were allowed based on vessel size, season and area fished. By December 1994, the use of TEDs was mandatory for virtually the entire U.S. shrimp otter-trawl fishery regardless of season or area. In December 1996, subsequent regulatory measures protecting sea turtles included restrictions on soft TEDs, TED requirements for try nets, and other gear modifications in nearshore shrimping areas designated as Shrimp Fishery Sea Turtle Conservation Areas (60 FR 44780, August 29, 1995). Despite strong evidence of sea turtle mortality resulting from shrimp trawling in the U.S. Gulf of Mexico and southeastern Atlantic, various shrimp industry associations continued to voice concerns regarding the required use of TEDs. Indicative of these concerns, in the July 19, 1995, Committee Report to accompany H.R. 2076 (LOC 1995), Congress directed NOAA Fisheries to provide additional resources for "conducting independent research, through academic institutions and with the participation of the shrimp fishing industry, into alternative methods, other than the use of turtle excluder devices, for reducing the incidental capture of sea turtle in shrimp trawls". The Omnibus Consolidated Appropriations Act for Fiscal Year 1997 (Public Law 104-208) was signed by President Clinton on October 1, 1996. The Conference Report accompanying the Act (H. R. 104-863; LOC 1996), directed NOAA Fisheries to provide funds "...to enable an independent entity to collect and assess data on catch effort and by-catch in the shrimp fishery. This independent effort shall provide site-to-site and long-term information regarding the relative abundance of sea turtles, and NMFS may use its authority to collect shrimp trawl by-catch data in non-turtle excluder device equipped trawls..."

In response to these congressional directives, a study of alternatives to TEDs and sea turtle bycatch in the southeastern U.S. commercial shrimping fleet was initiated in 1997. The study, conducted by an independent entity, the Gulf and South Atlantic Fisheries Foundation, Inc. (Foundation) through contract with NOAA Fisheries, placed observers aboard participating shrimping vessels to collect sea turtle data. The Foundation was responsible for administering the major portion of the alternative to TEDs and sea turtle bycatch program (GSAFDF 1998, Jamir 1999). NOAA Fisheries Southeast Fisheries Science Center (SEFSC) Galveston Laboratory Observer Program validated the Foundation's alternatives to TEDs study through simultaneous observer coverage.

The alternative to TED study was a subset of a much larger program that began in February 1992, through a joint government/commercial research cooperative agreement between NOAA Fisheries and the Foundation to collect species-specific bycatch data from the U.S. Gulf of Mexico and southeastern Atlantic commercial shrimp fisheries. Catch rates of bycatch species, including sea turtles, taken by shrimp trawlers continue to be collected by area and season, and devices to reduce finfish bycatch, particularly red snapper (*Lutjanus campechanus*), evaluated. The Texas Shrimp Association, North Carolina Division of Marine Fisheries, and the Georgia Department of Natural Resources have also collected data from commercial shrimp vessels and contributed to the shrimp trawl database.

METHODS

Onboard Sampling

From 1992 through 2005, fishery observers monitored sea turtle take levels aboard commercial shrimp vessels in nearshore and offshore waters in the U.S. Gulf of Mexico and southeastern Atlantic through a voluntary program. Allocation of sampling effort aboard vessels followed seasonal trends. By area and season, sampling occurred in waters primarily off Louisiana and Texas in summer and fall, and off southwest Florida in winter and spring. In the southeastern Atlantic (east coast) coverage occurred primarily in summer months. Net type and size, try net and other associated gear characteristics were measured. TED type, installation, size of opening, flotation, webbing, bar spacing, and funnel measurements were recorded at the start and end of each trip, or when adjustments were made by the vessel operator. For each tow, environmental parameters, bottom time and operational aspects relative to each net were documented. Total catch and shrimp weight from the one randomly selected net were obtained, with a subsample of approximately 32 kg processed for bycatch characterization. Methods for recording, tagging and releasing captured sea turtles followed procedures set forth in the May 14, 1997, Biological Opinion (NMFS 1994). All sea turtles were identified to species, measured, tagged, photographed and released. Sea turtles that were actively moving were tagged according to the NOAA Fisheries Miami Laboratory tagging protocol, released off the vessel's stern when the engine gears are in neutral, during times when the trawls are out of the water, and in areas where recapture is not expected. Unconscious sea turtles were resuscitated, retained for up to 24 hours, and released. Dead sea turtles (determined by no movement for 24 hours) were tagged and released.

Alternative to TEDS

The subset project, termed alternative to TEDs, followed similar procedures as for onboard sampling described in the preceding paragraph, with slight modification to minimize injury or death to sea turtles captured in non-TED equipped nets. Sea turtle take aboard shrimp vessels trawling with TED and non-TED equipped nets in nearshore (COLREGS line to 15-fathom depth contour) and offshore waters were monitored. Vessel operators trawling within the 15-fathom contour with non-TED equipped nets were limited to 55 minute tow times from April 1 through October 31, and to 75 minutes from November 1 through March 31. Tow time was measured from the time the doors enter the water until they are removed. No tow time restrictions applied in waters beyond the 15-fathom contour.

Statistical Treatment and Analyses

Sea Turtle Captures from 1992 through 2005

Sea turtle take by species, method of capture and location from 1992 through 2005 were assessed for the Gulf of Mexico and southeastern Atlantic. Five captures did not have associated latitude and longitude coordinates, however, a state location was given for all captures.

Ratio estimation and testing procedures were used for statistical purposes to determine specific catch rates by tow hour, with no adjustment for number of nets, or headrope length. Tows that had an unknown gear type (TED or no TED), and tows were no effort values were set aside from the analyses. Moreover, CPUE estimates for sea turtles caught by try nets assumed that a try net was pulled during all tows, and that the net was pulled continuously during a tow.

As described by Snedecor and Cochran (1967), the ratio estimation in equation (1) was used as the sample estimate of the mean.

$$(1)\ R = \frac{\sum Y}{\sum X}$$

Where:

R = ratio estimate

Y = number of species of interest for selected strata

X = hours towed for selected strata

The estimated standard error of the estimate is given in equation (2).

$$(2)\ s(R) = \frac{1}{\bar{x}}\sqrt{\frac{\sum(Y-RX)^2}{n(n-1)}}$$

Where:

$\bar{x}$ = mean of hours towed for selected strata

n = number of tows occurring in selected strata

To standardize bycatch estimates as prescribed in Evaluating Bycatch: A National Approach to Standardized Bycatch Monitoring Programs (NMFS 2004), the coefficient of variation (CV) was calculated by year for the Gulf of Mexico and southeastern Atlantic. CV estimates were calculated by dividing the estimated standard error by the estimate of the mean.

Sea Turtle Captures (1992-2002) Following Alternative to TED Project

Data from 1992 through 2002, following the alternative to TED project, were analyzed through use of a logistic regression and through conceptual ecological modeling. These two approaches were recommended and reviewed by gradate faculty at Texas A&M University. The intent was to examine alternative methods for sea turtle assessment; there was a relatively large degree of uncertainty relative input variables (e.g., mortality estimates, shrimp effort).

Statistical subareas were used to delineate state areas (Patella 1975). For the Gulf of Mexico, statistical subareas 1 – 9 represented the west coast of Florida, 10 – 12 delineated Alabama/Mississippi, 13 - 17 depicted Louisiana, and 18 – 22 represented Texas. Based on latitude degrees north in the southeastern Atlantic, subareas 28 and 29 denoted the east coast of Florida, 30 and 31 depicted Georgia, 32 and 33 represented South Carolina, and 34 and 35 delineated North Carolina.

Using Statsoft software (Statistica 2001), a logistic regression was used to estimate the probability of sea turtle capture in nets equipped with TEDs versus nets without TEDs. Effort (hours towed) was standardized to a 100-foot headrope length by multiplying the number of nets by headrope length divided by 100 feet multiplied by hours towed. The independent variable was effort (hours towed per 100 feet of headrope) with the dependent variable being dichotomous (i.e., success or failure of a sea turtle capture), denoted 0 for no turtle capture, and 1 for turtle captures.

Conceptual model formulation is illustrated through use of a conceptual model for predicting sea turtle populations (Figure 37). The primary objective of the model was to access the effectiveness of TEDs on sea turtle populations in the U.S. southeastern shrimp fishery. In order to facilitate bounding the system of interest, the null hypothesis was that the capture rates of sea turtles in TED and non-TED equipped nets were equal, with the alternative hypothesis being that capture rates were not equal. Points of material accumulation, represented by state variables, are in the units of numbers of individuals. The three state variables depicted are EGGS, JUVENILES, and ADULTS. Associated with each state variable is a material transfer representing units leaving via mortality (MORT). Mortality estimates have been combined to incorporate both natural and man-influenced factors, with the adult population being exposed to an additional source of mortality, shrimp effort. The driving variable, MONTH, will affect shrimping effort. Shrimping effort with and without TEDs, denoted as EFFORT TEDS and EFFORT NO TEDS, and an associated CPUE for each are given in the units sea turtles per hour of trawling. An auxiliary variable, PERCENT NESTERS, is used to represent the percentage of the adult population expected to nest. A constant variable represents the average number of eggs per female, EGGS PER FEMALE, with MONTH used as a counter. Collectively, the latter three components, determine natality (NATALITY).

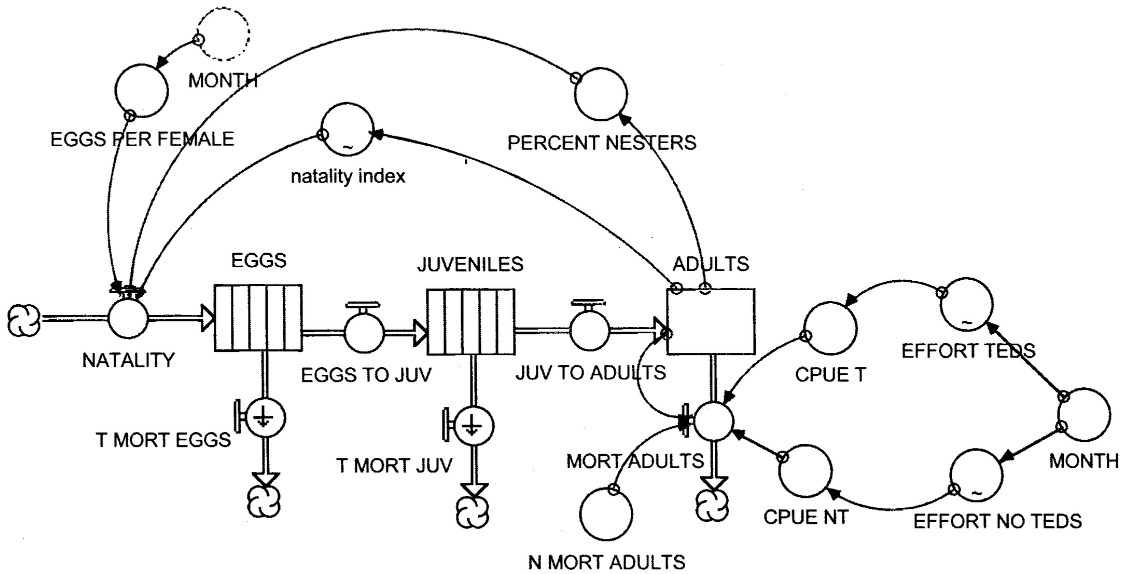

Figure 37. Conceptual model to predict sea turtle populations as related to turtle excluder device effectiveness in the U.S. southeastern shrimp fishery.

Relative to model quantification and simulations, the model (Figure 37) is a deterministic, compartment model based on difference equations with 1-month time unit. STELLA Research 6.0 software (High Performance Systems, Inc., 2000) was used for simulations.

Conveyors with transit times of 2 (egg incubation period) and 180 (hatchlings to reach sexual maturity) months are used EGGS and JUVENILES, respectively, with initial values set at 0. The initial value of 4,539,100 for ADULTS was derived from extrapolation of the number of annual nest counts, by species, along the southeastern U.S. (ESA, Section 7 Consultation, Biological Opinion, 2002). To parameterize the model, natural mortality estimates of 0.05000, 0.06000 and 0.00005 were used for EGGS, JUVENILES and ADULTS, respectively, in both the baseline and exploratory simulations. To address the primary question of fishing induced mortality on the adult population, shrimp effort by month for the Gulf of Mexico for 2001 by was obtained from NOAA Fisheries port agents. The units are hours fished. For the east coast, effort data were obtained from annual trip data (Epperly et al. 2002). Trip data were used to estimate hours fished and proportioned by month using Gulf of Mexico effort allocations. Three percent of the total effort was attributed to EFFORT NO TED, to represent a non-compliance factor. CPUE was obtained using observer data from 1992 through 2002. At this time more than 69,000 hours of shrimp trawling had been observed. Interactions that resulted in the death of a sea turtle and those of an unknown release status (e.g., comatose) were used to derive CPUE estimates for nets equipped with and without TEDs. Based on these observer data, 0.00038 and 0.0028 turtles per hour were derived for CPUE T and CPUE NT, respectively. Thus for total mortality on adults the equation is (ADULTS*N MORT ADULTS)+(CPUE T+CPUE NT). An equal ratio of male to females was assumed, with the value of ADULTS*0.50 given to PERCENT NESTERS; this also assumes that all females reproduce. Nesting for all species may occur yearly or range to several years between nesting events, with each female producing approximately 400 eggs per year (ESA, Section 7 Consultation, Biological Opinion, 2002). Nesting occurs in summer months. The value of 133 eggs for each month (June, July and August) constitutes the EGGS PER FEMALES component of the model. EGGS PER FEMALES* PERCENT NESTERS yield the NATALITY estimate.

RESULTS

Spatial and Temporal Distribution - Sea Turtle Captures from 1992 through 2005

From 1992 through 2005, based on data recorded from 27, 005 tows, 548 sea turtle captures were documented during commercial shrimp operations. Approximately 56% of the sea turtle takes were captured in nets not equipped with TEDs (Figure 38). Try nets accounted for 19% of the captures; 13% of the sea turtles slid out of TED-nets upon retrieval, with 8% captured in TED-equipped nets (typically before the TED). Similarly, 3% of the sea turtles slid out of non-TED equipped nets upon retrieval. Less than 1% each of the captures resulted from sea turtles sliding out of the try net upon retrieval, or the method of capture was not documented.

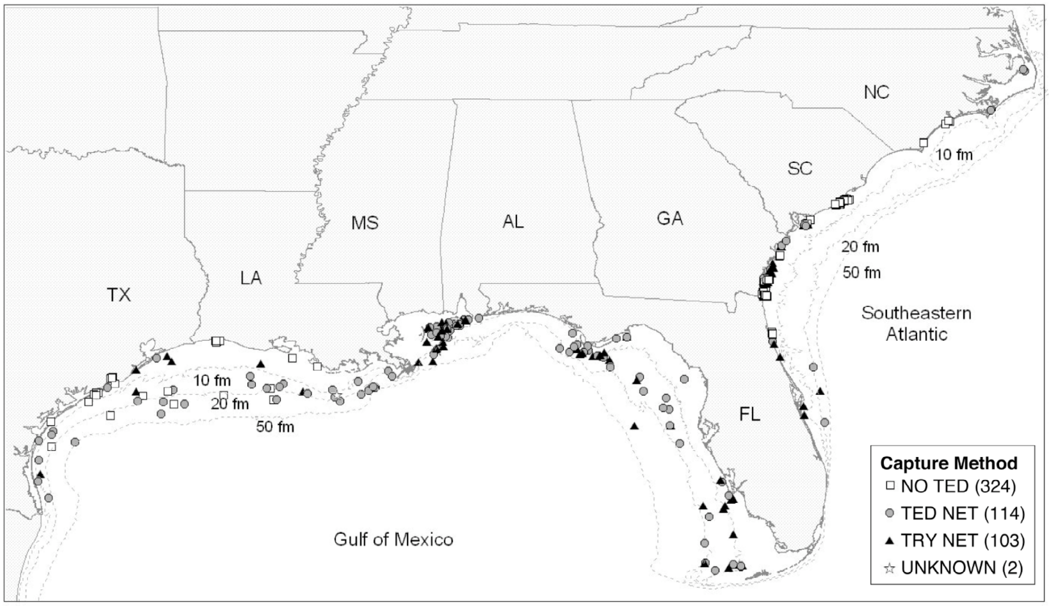

Figure 38. Sea turtle takes by method of capture from the U.S. southeastern shrimp fishery from 1992 through 2005. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

The status and condition of the captured sea turtles were documented. Approximately 85% of the sea turtles were released alive and conscious. For 7% of the captures, the status was unknown. Fresh dead and alive/unconscious sea turtles accounted for 3% each of the takes. Less than 1% each were decomposed, or released alive with an unknown fate (i.e., conscious or unconscious).

Four sea turtle species were documented during from 1992 through 2005 (Figure 39). By species, 68% were loggerhead, 21% Kemp's Ridley, 4% green, and 2% leatherback. Approximately 5% of the captures were not identified.

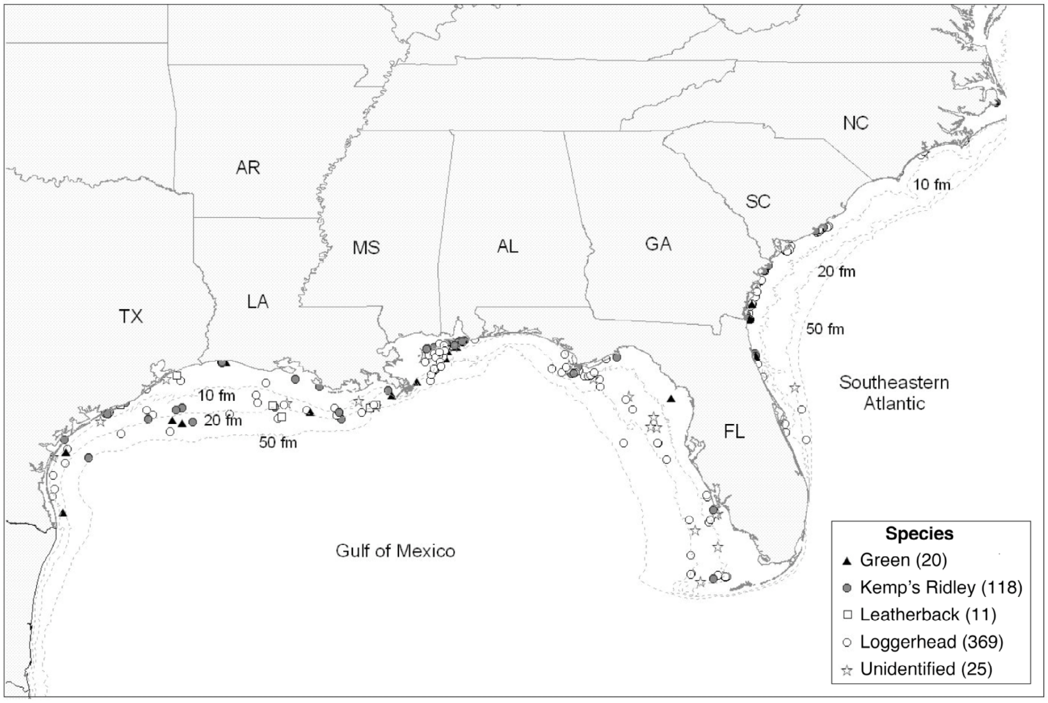

Figure 39. Sea turtles by species captured from the U.S. southeastern shrimp fishery from 1992 through 2005. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

While sampling intensity varied by location, Georgia had the highest percentage of captures at 29%. South Carolina accounted for 20% of the takes. Off the east coast of Florida the percentage was 16%, followed by the west coast of Florida at 11%, Texas and Louisiana each at 7%, Alabama at 6%, and Mississippi and North Carolina each at 2%.

Relative to species by location, off Georgia, loggerhead sea turtles accounted for the majority of individuals at 124, followed by Kemp's Ridley at 32, green at 4, and unidentified at 1. By number off South Carolina, loggerhead sea turtles comprised the majority at 101, followed by Kemp's Ridley at 5, and leatherback at 1. Off the east coast of Florida, loggerhead accounted for 47 captures, followed by Kemp's Ridley at 35, and green and unidentified each at 2. Off the west coast of Florida, loggerhead sea turtles comprised the majority of individuals at 37, followed by unidentified at 13, Kemp's Ridley at 11, and green at 1. In Texas waters, both loggerhead and Kemp's Ridley accounted for 16 captures each, followed by green at 4, unidentified at 3, and leatherback at 2. Similarly, off Louisiana, loggerhead sea turtles comprised the majority at 16, followed by Kemp's Ridley at 11, leatherback and green each at 4, and unidentified at 3. In waters off Alabama, the dominant sea turtle species was loggerhead accounting for 16 captures, followed by Kemp's Ridley at 5, leatherback and green each at 4, and unidentified at 3. Off Mississippi, 9 loggerhead and 2 Kemp's Ridley sea turtles were captured. In North Carolina waters, loggerhead sea turtles accounted for 7 captures, followed by green and Kemp's Ridley each at 1.

Sea turtle captures by month are depicted in Figure 40. By month, the greatest majority of sea turtle were taken in summer months. In June 19% of the captures occurred, followed by July and March each at 18%, April and May each at 8%, August and September each at 6%, November and October each at 5%, January and December each at 3%, and February at 1%.

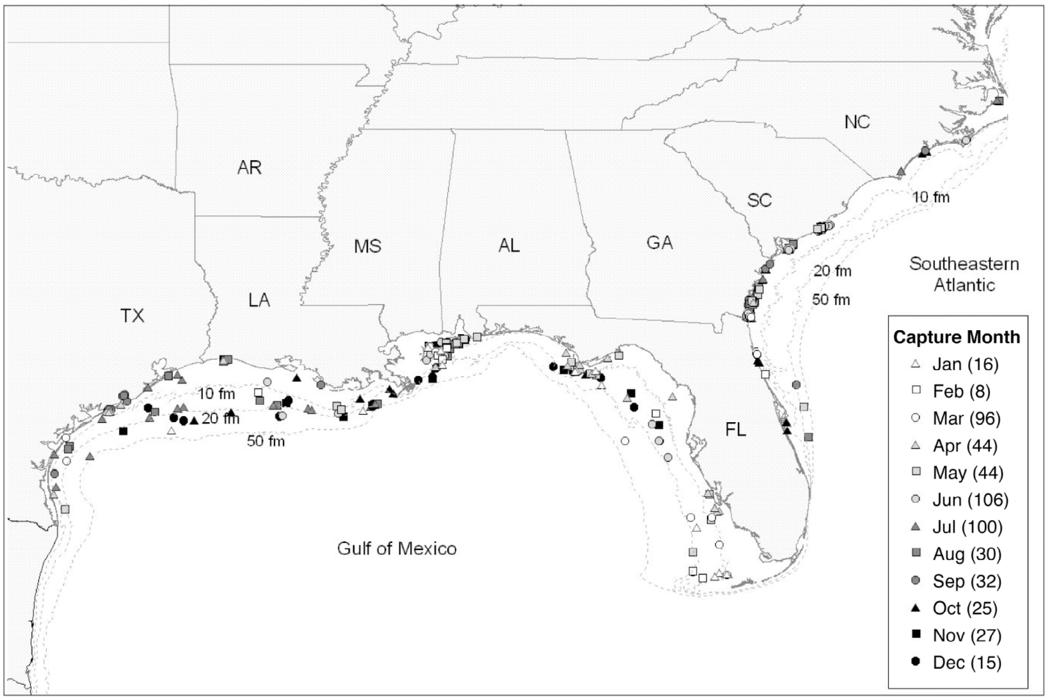

Figure 40. Sea turtles by month captured from the U.S. southeastern shrimp fishery from 1992 through 2005. Based on observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

Ratio Estimation – Sea Turtle Captures 1992 through 2005

Catch rate estimates in numbers per hour towed for the various methods of captures from 1992 through 2005 are depicted in Figure 41. While sampling intensity varied among years and methods, non-equipped TED nets exhibited the highest CPUE compared with other methods.

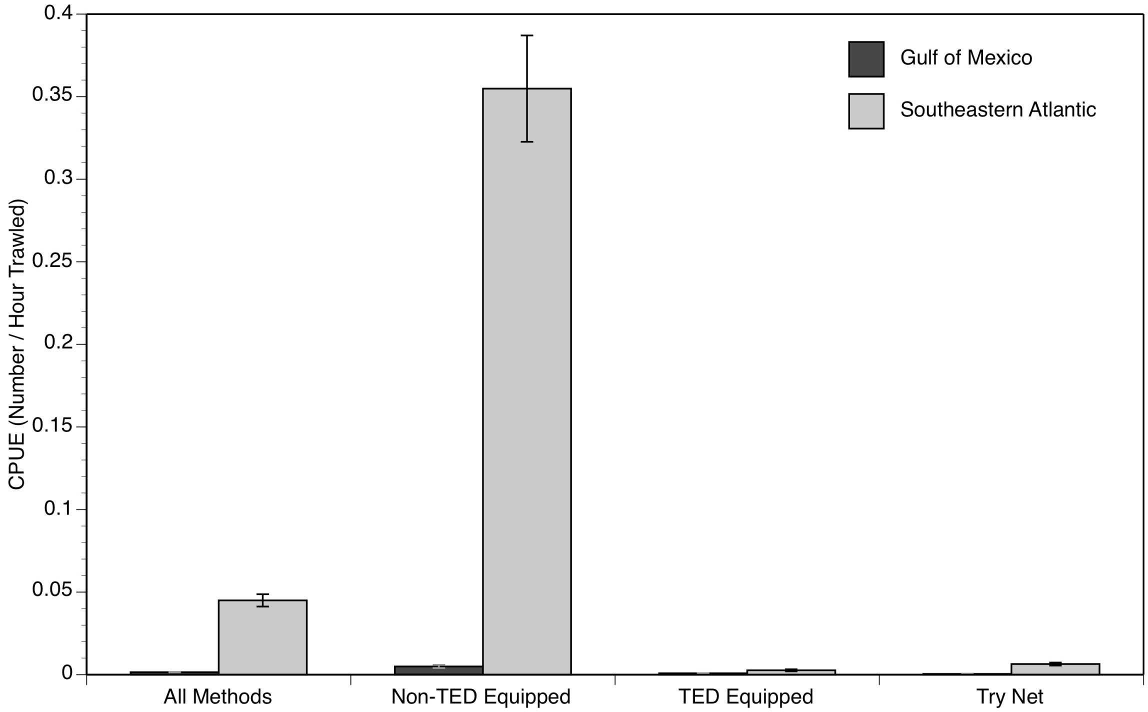

Figure 41. CPUE of sea turtles by method of capture. Derived from observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005. CPUE represents numbers of sea turtles per trawl hour.

CPUE in numbers per tow hour for all methods of capture from 1992 through 2005 was 0.00419 (SE $\pm$ 0.00025) based on 130,815.4 hours of trawling. CPUE estimates were 0.00150 (SE $\pm$ 0.00012) for the Gulf of Mexico (122,721.0 hours of trawling; 184 captures), and 0.04497 (SE $\pm$ 0.00373) for the southeastern Atlantic (8,094.4 hours of trawling; 364 captures).

CV estimates for all methods by year and area relative to sampling intensity (tows sampled) are depicted in Figure 42. Sampling effort was substantially lower and in the southeastern Atlantic compared with the Gulf of Mexico. CV estimates for the Gulf of Mexico ranged from 0.1 in 2002 to 0.6 in 1996, and were below 0.5 in all years except 1996. CV values were higher for the southeastern Atlantic, and ranged from 0.1 in 1997 to 0.7 in 1995. CV estimates were equal to or more than 0.4 in most years.

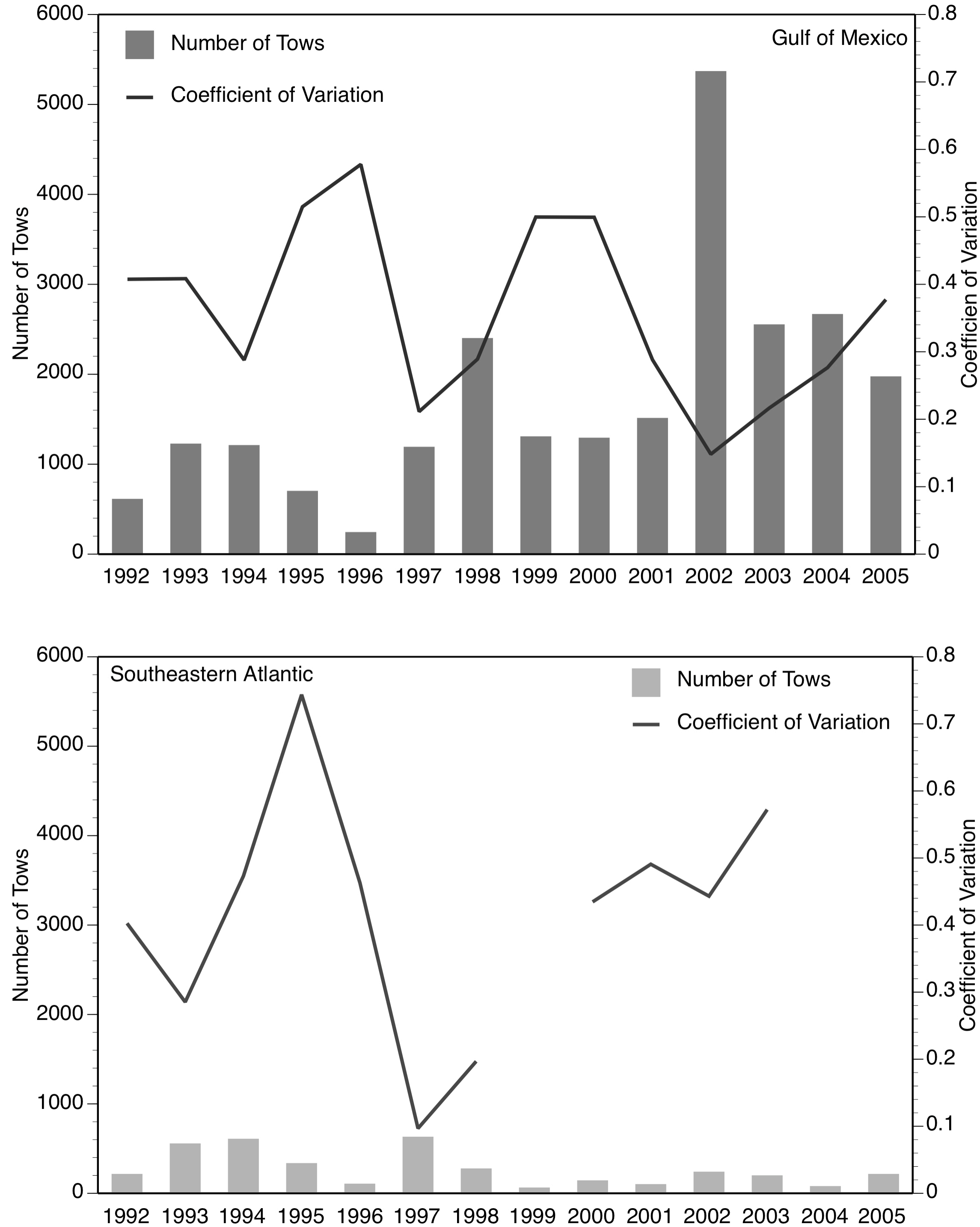

Figure 42. Coefficient of variation estimates by region for sea turtles. Based observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005.

For tows not equipped with TEDs, the catch rate estimate was 0.04581 (SE ± 0.00426) based on 7073.0 hours of trawling. Estimated CPUE was 0.00496 (SE ± 0.00095) for the Gulf of Mexico (6,247.3 hours of trawling; 31 captures), and 0.35485 (SE ± 0.03220) for the southeastern Atlantic (825.7 hours of trawling; 293 captures).

For try net captures, estimated CPUE was 0.00083 (SE ± 0.00008) based on 130,815.4 hours of trawling. Catch rate estimates were 0.00046 (SE ± 0.00006) for the Gulf of Mexico (122,721.0 hours of trawling; 56 captures), and 0.00642 (SE ± 0.00091) for the southeastern Atlantic (8,094.4 hours of trawling; 52 captures).

CPUE for TED-equipped nets was 0.00095 (SE ± 0.00009) based on 121,156.4 hours of trawling. Catch rate estimates were 0.00084 (SE ± 0.00009) for the Gulf of Mexico (113,945.2 hours of trawling; 96 captures), and 0.00263 (SE ± 0.00063) for the southeastern Atlantic (7,211.1 hours of trawling; 19 captures).

For TED-equipped nets, CPUE by year for all species of sea turtles combined was, in most years, lower in the Gulf of Mexico compared with the southeastern Atlantic (Figure 43). In the Gulf of Mexico, CPUE was highest at 0.00178 (SE ± 0.00126) in 1996, followed by 0.00153 (SE ± 0.00051) in 1994, 0.00150 (SE ± 0.00035) in 2003, 0.00137 (SE ± 0.00073) in 1995, 0.00133 (SE ± 0.00040) in 2001, and 0.00120 (SE ± 0.00084) in 1992. For the remaining years, CPUE was less than 0.00100. Catch rate estimates were 0.00099 (SE ± 0.00020) and 0.00075 (SE ± 0.00033) in 2002 and 1993, respectively. CPUE was 0.00066 (SE ± 0.00033) in 1999, followed by 0.00046 (SE ± 0.00027) in 2000, 0.00031 (SE ± 0.00016) in 2004, 0.00023 (SE ± 0.00016) in 2005, 0.00019 (SE ± 0.00013) in 1998, and 0.00000 (SE ± 0.00000) in 1997. In the southeastern Atlantic, as in the Gulf, CPUE was highest in 1996, with a value of 0.01246 (SE ± 0.00760). The catch rate estimate was 0.00790 (SE ± 0.00560) in 1997, followed by 0.00571 (SE ± 0.00404) in 1992, 0.00465 (SE ± 0.00325) in 1998. CPUE was similar at 0.00417 (SE ± 0.00186) and 0.00414 (SE ± 0.00413) in 1993 and 2001, respectively. The catch rate estimate was 0.00255 (SE ± 0.00255) in 2003, followed by 0.00097 (SE ± 0.00097) in 2002, and 0.00090 (SE ± 0.00090) in 1995. CPUE was 0.00000 (SE ± 0.00000) in 1994, 1999, 2000, 2004, and 2005.

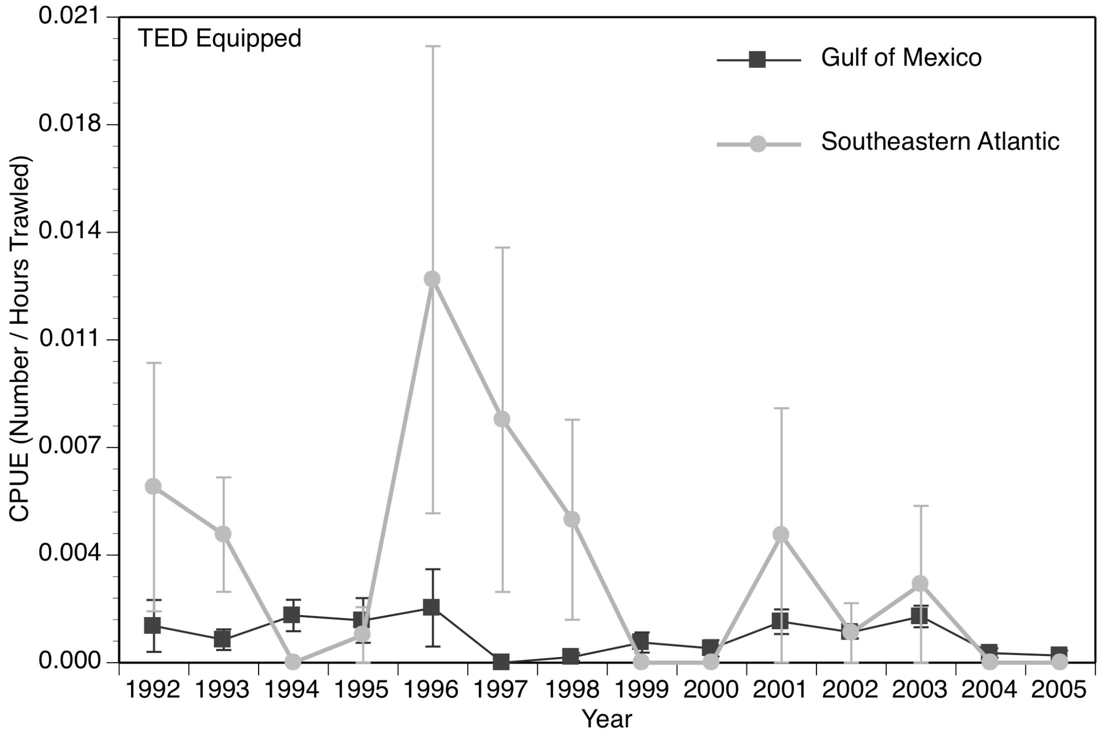

Figure 43. Sea turtle CPUE by year for TED-equipped nets in the Gulf of Mexico and southeastern Atlantic. Based observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005. CPUE represents numbers of sea turtles per trawl hour.

CPUE by month for TED-equipped nets is depicted in Figure 44. In the Gulf of Mexico, the highest catch rate estimate was observed in May, with a value of 0.00212 (SE $\pm$ 0.00054). CPUE was 0.00173 (SE $\pm$ 0.00050) in June, followed by 0.00147 (SE $\pm$ 0.00052) in January, 0.00126 (SE $\pm$ 0.00040) in April, 0.00089 in December (SE $\pm$ 0.00036), and 0.00078 (SE $\pm$ 0.00026) in November. Catch rate estimates were 0.00072 (SE $\pm$ 0.00038) and 0.00063 (SE $\pm$ 0.00024) in March and October, respectively. CPUE was 0.00062 (SE $\pm$ 0.00020) in August, followed by 0.00038 (SE $\pm$ 0.00016) in July, 0.00025 (SE $\pm$ 0.00018) in February, and 0.00013 (SE $\pm$ 0.00013) in September. For the southeastern Atlantic, a bimodal distribution relative to sea turtle CPUE by month was observed from April through July and August through November in the southeastern Atlantic (Figure 44). CPUE was 0.00946 (SE $\pm$ 0.00700) in May, followed by 0.00753

(SE ± 0.00375) in June, 0.00499 (SE ± 0.00249) in September, 0.00275 (SE ± 0.00137) in October, 0.00262 (SE ± 0.00185) in July, and 0.00203 (SE ± 0.00143) in August. CPUE was 0.00000 (SE ± 0.00000) for the remaining months.

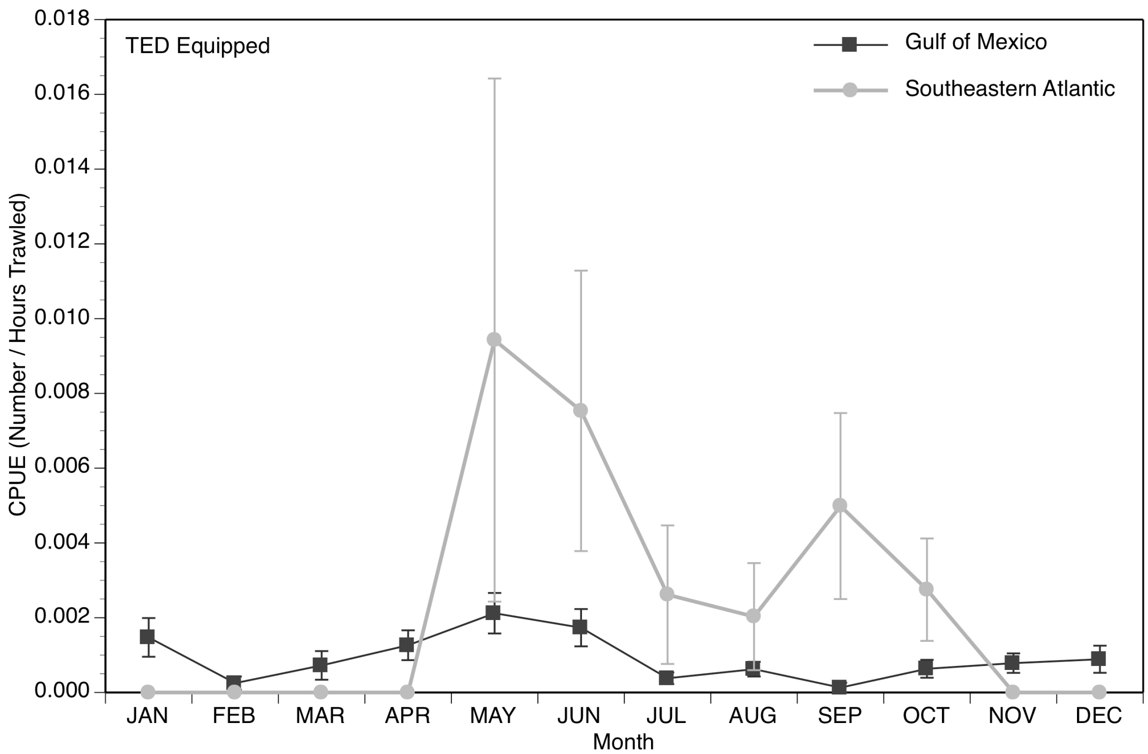

Figure 44. Sea turtle CPUE by month for TED-equipped nets in the Gulf of Mexico and southeastern Atlantic. Based observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2005. CPUE represents numbers of sea turtles per trawl hour.

Logistic Regression

From 1992 through 2002, more than 67,000 hours of shrimp trawling were observed; the majority of observed shrimping effort for both the TED and non-TED equipped nets, occurred in statistical zones 15-21, off the coast of Louisiana and Texas (Figure 45). Highest CPUE of sea turtles (sea turtles per hour per 100-foot headrope) was in statistical zones 29-32, off the east coast in non-equipped nets (Figure 45).

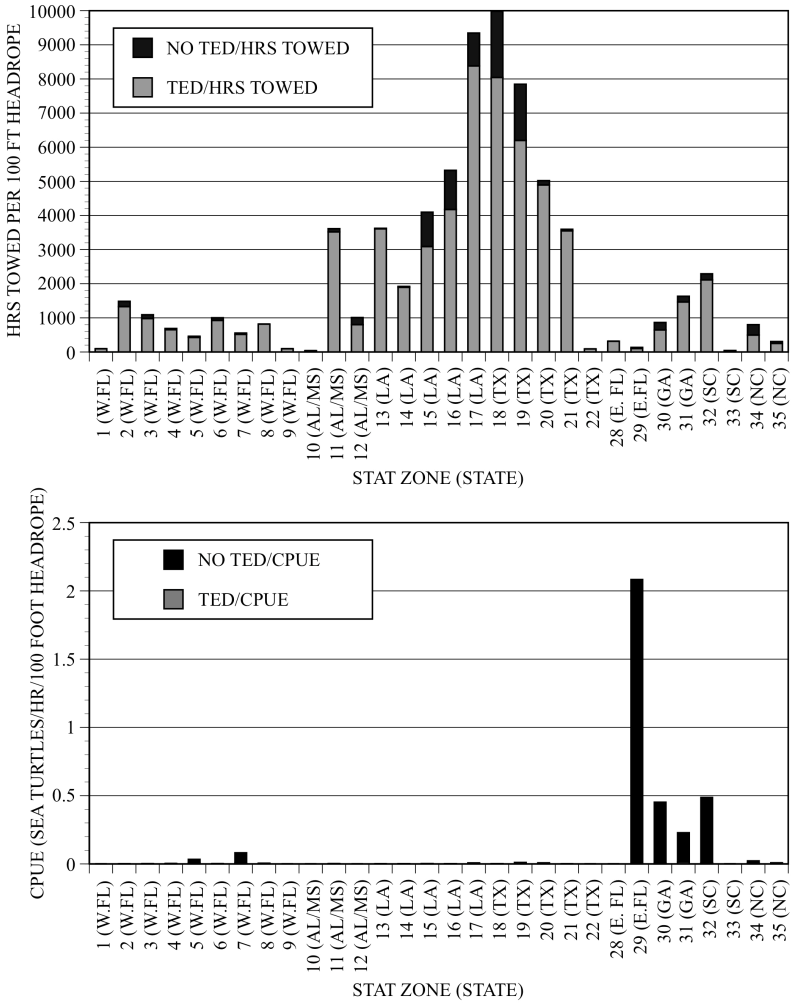

Figure 45. Standardized shrimp effort and CPUE by state for TED and non-TED equipped nets in the Gulf of Mexico and southeastern Atlantic. Based observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2002. CPUE represents numbers of sea turtles per trawl hour per 100 foot of headrope.

The logistic regression used to estimate the probability of sea turtle capture in nets equipped with TEDs versus nets without TEDs is presented in Figure 46. The chi-square values for df = 1 for the TED and no-TED were 13.8 and 207.6, respectively.

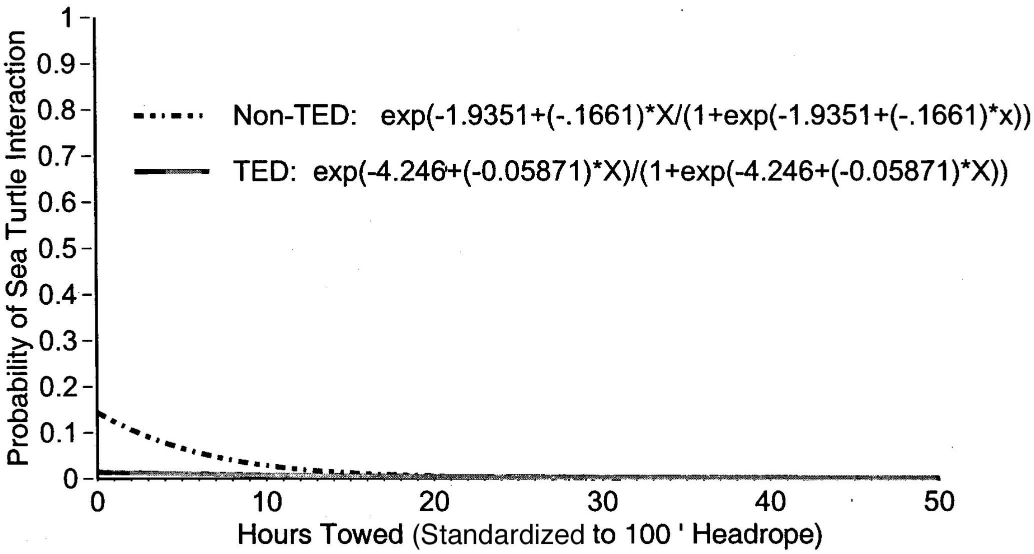

Figure 46. Logistic regression used to estimate the probability of sea turtle capture in TED and non-TED equipped nets. Based observer coverage of the U.S. Gulf of Mexico and southeastern Atlantic shrimp fishery from 1992 through 2002. Hours towed is standardized to a 100 foot headrope.

Conceptual Model

Using the parameter estimates discussed in the previous section, a baseline simulation was executed and is shown in Figure 47. This, as parameterized above, represents the current management scheme used by NOAA Fisheries and shows the long-term trend (over the next 500 years). This management regime involves mandatory TED use for all shrimp vessels for all seasons and areas, assuming a 97% compliance rate.

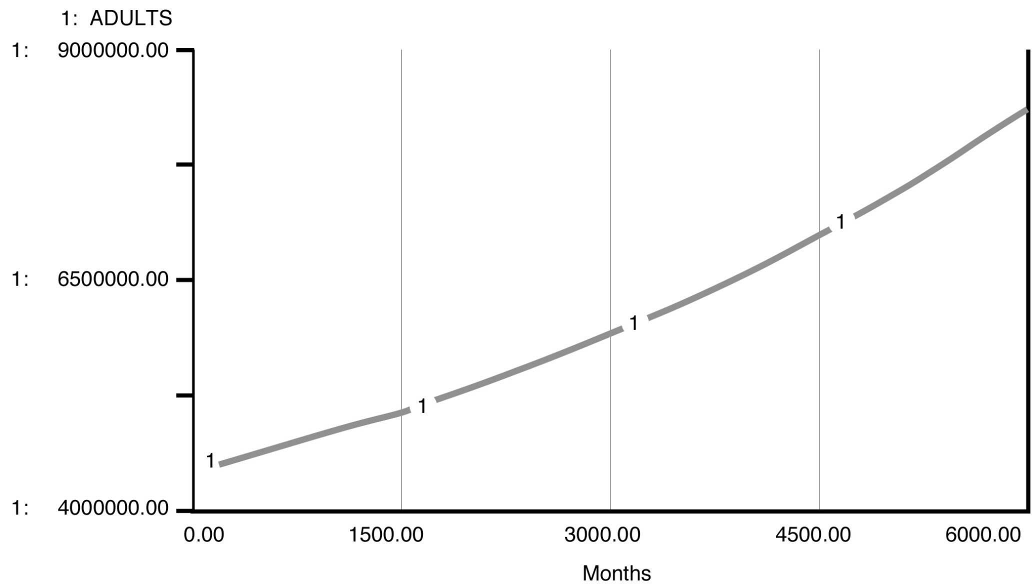

Figure 47. Baseline simulation representing mandatory TED use in the U.S. southeastern shrimp fishery.

Relative to the exploratory simulation, Figure 48 represents a simulation that involves using the CPUE for non-TED equipped nets for the total shrimp effort (i.e., no TEDs used). This strategy would depict repealing TED requirement in U.S. southeastern shrimp fishery.

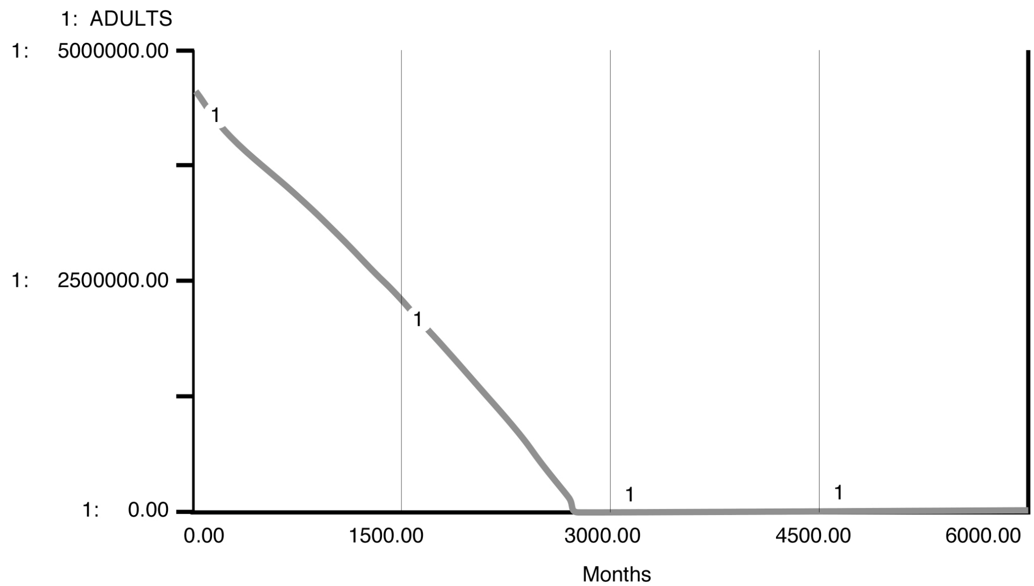

Figure 48. Exploratory simulation representing non-TED equipped nets in the U.S. southeastern shrimp fishery.

Relative to the sensitivity analysis, quantifying natural mortality and shrimp effort presented the greatest challenge and brought forth a great amount of uncertainty relative to these estimates. Using the baseline simulation, and holding all parameter estimates constant, changing T MORT JUV from 0.06 to 0.07 changed the adult population trend from a positive to negative slope. Similarly, increasing N MORT ADULTS from 0.00005 to 0.00014 an increasing trend was evident; 0.00015 reversed this trend. Thus, these results lead to the conclusion that the adult population prediction is highly sensitive to juvenile and adult natural mortality changes. Changing estimates of T MORT EGGS had little effect.

DISCUSSION

At-sea observer programs continue to provide one of the best data sources required to assess sea turtle capture and mortality rates associated with various commercial fishing gears. From 1992 through 2005, based on observer data recorded from more than 130,000 hours of trawling in the U.S. Gulf of Mexico and southeastern Atlantic, 548 sea turtle captures were documented during commercial shrimp operations.

The majority of captures (59%) were in non-TED equipped nets as part of an alternative to TEDs project. TED-equipped nets accounted for 21% of the captures; try nets represented 20% of the total takes. Most sea turtles (85%) were released alive and conscious. Four species of sea turtles were documented from 1992 through 2005, with loggerhead sea turtles the most numerous, followed by Kemp's Ridley, green and leatherback. While sampling intensity varied among areas, Georgia had the highest occurrence of sea turtles, followed by South Carolina, the east and west coasts of Florida, Texas, Louisiana, Alabama, Mississippi and North Carolina. The majority of sea turtle captures were in summer.

Ratio estimation and testing procedures reflected higher CPUE in non-TED equipped nets, followed by TED equipped nets and try nets for both regions combined for the 1992 through 2005 period, assuming that the try net was pulled continuously. In the Gulf of Mexico, the same pattern relative to CPUE by gear type was exhibited. For the southeastern Atlantic, CPUE was higher in non-TED equipped nets, followed by try nets and TED-equipped nets. Higher sea turtle CPUE was evident off the east coast compared with the Gulf of Mexico, regardless of method of capture.

CPUE by year for TED-equipped nets was highest for both regions in 1996; high variability indicative of low sampling intensity was evident in the Gulf of Mexico in this year, and to a greater degree off the east coast for multiple years, including 1996. Lower sea turtle CPUE was detected in 2004 and 2005 for both regions, possibly the result of regulatory changes requiring larger TED openings. By month, highest CPUE occurred in May and June for both regions. A second peak relative to CPUE was observed in September for the east coast; however, a relatively high standard error was noted as in other months.

Two alternative methods, logistic regression and conceptual modeling, were used to assess sea turtles captures in TED and non-TED equipped nets. Based on the large degree of uncertainty in input variables, notably mortality estimates and shrimp effort, the results are not definitive. These models do, however, provide a direction and a foundation for further model development and refinement. Moreover, other species of concern, improvements in bycatch reduction device (BRD) technology, predator-prey relations, and other environmental parameters have the potential for inclusion.

Based on the logistic regression analysis for the current assessment, the chi-square values for df = 1 for the TED and no-TED were 13.8 and 207.6, respectively. This would suggest that the fitted lines are significant in explaining the relationship between hours towed and turtle capture. One would expect more sea turtle captures with longer tow or bottom times. This was perhaps affected by tow time restrictions (i.e., resulting in shorter tows), or may be explained by the fact that the net is in the water column more possibly increasing encounter incident. In addition, statistical areas 29 through 32, with non-TED equipped nets had the highest CPUE overall, thus suggesting high sea turtle abundance in the area, and that TEDs were effective. Examination of the number of tows by time intervals and should be examined more thoroughly, and a multiple logistic regression is suggested to examine for further significance (i.e., to test the significance of the TED effect).

Based on the results of the baseline simulation, the current management scheme (mandatory TEDs) would ensure an upward adult population trend for the long-term recovery of sea turtle populations. Conversely, elimination of TED requirements for the southeastern U.S. shrimp fishery would lead to the collapse of the sea turtle population. This model has the potential to be an extremely useful straightforward management tool for not only resource managers, but also for industry members and the general public; different management alternatives as well as more holistic approaches (i.e., more variables) could be incorporated. Further, a logistic regression discussed earlier to estimate the probability of sea turtle capture in nets equipped with TEDs versus nets without TEDs could be used in conjunction with this model to facilitate information transfer to industry members and other shareholders.

All methods examined yielded higher sea turtle CPUE in non-TED equipped nets, consistent with findings from previous studies (Henwood and Stuntz 1987; Renaud et al. 1997; Epperly et al. 2002). Moreover, recent regulatory changes (68 FR 8456, February 21, 2003), based on stranding data of large sea turtles (Epperly and Teas 2002), required increased dimensions of TED openings, thus allowing for greater survival of sea turtle populations, notably leatherback, loggerhead and green sea turtles. These regulatory changes could possibly explain the lower CPUE detected in 2004 and 2005. Based on the most recent Biological Opinion dated December 2, 2002, the commercial shrimp industry in the U.S. Gulf of Mexico and southeastern Atlantic would not jeopardize the continued existence of any sea turtle species, provided that the proposed regulatory change relative to larger TED openings were enacted (68 FR 8456, February 21, 2003).

Clearly, substantial progress has been made in TED technology since the 1980's. In an effort to continually improve operational aspects and to gain a better understanding of all factors related to sea turtle abundance, distribution and biotic and abiotic interactions, additional investigation is warranted. Refinement of the models presented in the current study, or similar methods, provide a baseline that can be used to further the goal of a holistic approach to ocean stewardship.

CHAPTER V

ALTERNATIVE TO GEAR MODIFICATIONS: THE SKIMMER TRAWL FISHERY IN COASTAL LOUISIANA

INTRODUCTION

The majority of penaeid shrimp harvested in the Gulf of Mexico and southeastern Atlantic is through use of bottom-otter trawls. One alternative method for shrimp capture with non-traditional gear includes skimmer trawls. Skimmer trawls are paired-framed nets typically used in inshore waters to harvest penaeid shrimp. The gear is passive and relies on tidal currents to move shrimp into the nets, or more commonly, the vessel pushes the nets through the water column. Once the nets are lowered into the water, only the bags (cod ends) of the nets are picked up and the catch removed; the mouths of the nets are continually fishing.

Skimmer trawls have been documented in both Louisiana and in North Carolina, and more recently in other coastal states in the Gulf of Mexico (Epperly et al. 2002). In 1992, the number of skimmer trawl licenses acquired in Louisiana was 1836; by 2000, the number approximately doubled to 3,655 (Epperly et al. 2002). In North Carolina, skimmer trawls target white shrimp in late summer through fall in Pamlico and Core Sounds. Approximately 3,587 trips occurred in 2002 in North Carolina using skimmer trawl gear, with trips typically being less than 24-hours in length (Daniel 2004).

Hein and Meier (1995) reported on the history and use of skimmer trawls in coastal Louisiana. As reflected by increased license sales and based on dockside interviews, the advantages of skimmer trawls over the traditional otter trawl were presented. Increased efficiency relative to gear retrieval, better survivability and condition of both target and non-target species, greater and more effective coverage of fishing areas, and improved safety are among some of the advantages given by the authors. Disadvantages included restricted fishing depth; greater care required at night relative to obstructions, bottom damage resulting from improperly tuned gear, and vessel instability when underway.

Coale et al. (1994), using a skimmer trawl designed by a Louisiana commercial shrimp industry member, compared catch rates between skimmer and otter trawls in the inshore waters of North Carolina. The authors reported that the skimmer trawl caught less bycatch, had a lower bycatch rates and a lower fish-to shrimp ratio (1.38) compared with the otter trawl during the peak white shrimp season. Moreover, white shrimp comprised 23.3% of the total weight in the skimmer trawl. In the otter trawl, white shrimp accounted for 5.1% of the total biomass. Conversely, brown shrimp constituted 6.1% of the total catch in the skimmer trawl, compared with 16.8% of total biomass in the otter trawl. The authors also observed survivability of associated bycatch; they reported greater survivability of organisms captured in the skimmer trawl than those obtained in the otter trawl.

The performance of the standard high profile versus low-profile skimmer trawls in North Carolina was examined by Hines et al. (1999). Catch rates for penaeid shrimp, including penaeid discards, were significantly lower in the low-profile net compared with the high-profile net. By species, brown shrimp catches were less by 39.1%; no significant difference was detected between the two net designs relative to pink shrimp. The authors attributed this to low pink shrimp abundance. No white shrimp were present during the study. Total finfish by weight was similar between the two net designs, with finfish comprising 67.5% in the low-profile net, and 62.0% in the high-profile net.

Rudershausen and Weeks (1999) discussed the advantages of skimmers trawls over conventional otter trawls used in North Carolina. These included reducing bycatch, minimizing disturbance to the benthic habitat, and increasing bycatch survivability. The authors compared steel and aluminum skimmer trawl frames to determine if fuel efficiency would increase with the lighter, yet more expensive, aluminum construction. There was no significant difference between materials relative to fuel efficiency (Rudershausen and Weeks 1999).

Currently, there are no turtle excluder device (TED) or bycatch reduction device (BRD) requirements for skimmer trawls; however, limited tow time restrictions apply due to the potential of sea turtle interactions. Tow times are established by individual states. Prior to this research effort, very limited historical and no known current data relative to catch composition, directed effort or operational aspects for the Gulf of Mexico skimmer trawl fishery were available.

In September 2004, NOAA Fisheries Southeast Fisheries Science Center's Galveston Laboratory in cooperation with the shrimp industry initiated observer coverage of the skimmer trawl fishery operating in the U.S. Gulf of Mexico, exclusively within coastal waters of Louisiana. The primary objectives of this research effort were to estimate catch rates of target and non-target species, including sea turtles, by area and season during commercial shrimping operations.

Ninety-six skimmer trawl trips were observed from September 2004 through June 2005. A total of 307 tows during 114 sea days of observations (Figure 49) was completed during the study period.

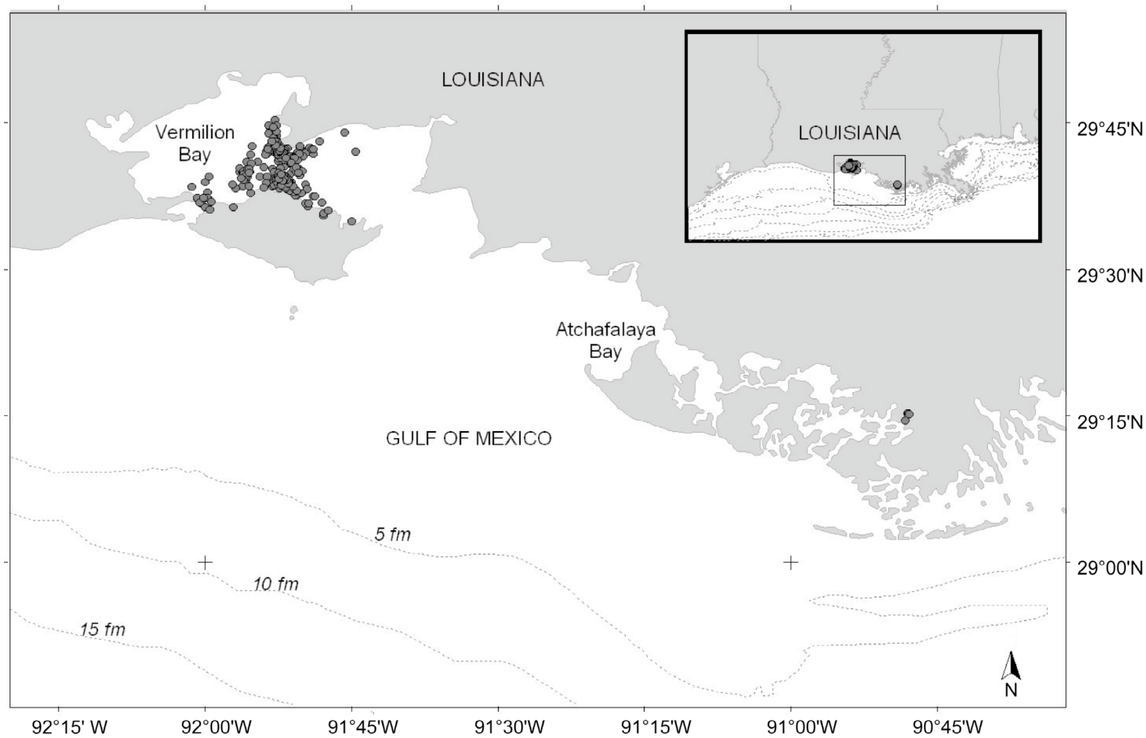

Figure 49. Distribution of sampling effort (tows) aboard skimmer trawl vessels. Based on observer coverage of the skimmer trawl fishery in coastal Louisiana from September 2004 through June 2005.

METHODS

NOAA Fisheries-approved observers were placed on cooperating skimmer trawl vessels targeting penaeid shrimp. No attempt was made to direct fishing location or modify normal commercial operations. Effort allocation was based on vessel availability and current commercial effort trends by area and season.

Vessel length, hull construction material, gross tonnage, engine horsepower and crew size information were obtained for each vessel. Characteristics related to 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.

Fishery-specific data were collected from one randomly selected net from each tow. Total catch and shrimp weights were recorded (i.e., not extrapolated and based on one net per tow). A subsample (approximately 20% of the total catch weight) was processed for species composition. Species weight and number were obtained from the subsample. A detailed description of the sampling procedures is contained in the NOAA Fisheries Characterization of the U.S. Gulf of Mexico and Southeastern Atlantic Otter-trawl and Bottom Reef Fish Fisheries – Observer Training Manual (NMFS 2002a).

Species total weights and numbers were extrapolated from subsample weight to the total catch weight, and are also based on one net per tow. In the absence of a weight or number for a given species the entire tow was set aside from the analysis.

Unique species, family, taxa, etc. (now referred to as species) were recorded. Species were placed into the following categories: penaeid shrimp, non-penaeid shrimp crustaceans, fish, non-crustacean invertebrates, and debris (e.g., rocks, logs, trash). Debris counts, where present, were entered as a default of one and accounted for less than 1% based on one unit of debris for each tow.

Overall catch rates were presented for all years, areas, seasons, and depths. Catch rate estimates were also examined by year and season. Seasonal categories are as follows: January through April; May through August; and September through December.

Biological measurements were recorded in metric units. Vessel, gear and depth measurements followed current standards for the fisheries (i.e., U.S. system equivalents) as related to relevant regulatory mandates.

For graphing purposes, percent values were rounded to the nearest whole number. The order of the categories presented in the graphs varied. Moreover, sample size used for extrapolation purposes varied by weight and number.

All data were entered into the southeast regional shrimp trawl bycatch data base that has been developed since 1992 though a southeast regional program conducted by NOAA Fisheries in cooperation with commercial fishing organizations and interests, state fishery management agencies and universities. This database is housed and managed at NOAA Fisheries Southeast Fisheries Science Center's Galveston Laboratory were final data sets are archived. Summarized data (i.e., individual identifiers removed) are available for use by all interested stakeholders

RESULTS

Overview

Three observers collected data from 307 tows from ninety-six trips in coastal waters of Louisiana from September 2004 to June 2005. Based on these 307 tows (517.0 hours), 16,965.7 kilograms of total catch were recorded based on one net from each tow. Retained shrimp species comprised 10,423.2 kilograms (heads-on), or 61.4% of the total weight. Catch-per unit-effort (CPUE) for shrimp was 20.2 kilograms per hour.

Three hundred-four tows contained species characterization data. Penaeid shrimp percent composition extrapolated from these subsamples was 66.1%. Extrapolated CPUE for shrimp based on subsamples was 21.6 kilograms per hour.

A total of sixty-three unique species was collected. There were 56 species of fish, and 4 of penaeid shrimp. Crustaceans and invertebrates had one unique species each. Logs, rocks, etc. were placed in miscellaneous debris.

Vessels, Gear and Tow Characteristics

Three unique vessels participated in the study. Overall vessel length ranged from 34 to 42 feet with 39.7 feet the average ($\pm$ 4.0 s.d.). All vessels were of fiberglass construction, and had ice storage capacity.

Based on a per tow basis, headrope length was 16.0 feet ($\pm$ 0.0 s.d). Two nets were pulled on each tow. Nets were not equipped with TEDs or BRDs. Towing speed ranged from 0.9 to 3.0 knots, and averaged 1.8 knots ($\pm$ 0.3 s.d.).

Tow depth averaged 1.3 fathoms ($\pm$ 0.2 s.d), and ranged from 0.8 to 2.3 fathoms. Tow time ranged from 0.2 to 4.3 hours, with an average tow time of 1.7 hours ($\pm$ 0.4 s.d). The majority of tows occurred between dawn and late afternoon; average trip length was one day.

Extrapolated Species Composition by Categories – Percent and CPUE

Based on weight extrapolations from species composition samples by category for both years, all areas, seasons, and depths (Figure 50), penaeid shrimp dominated the catch at 66%, followed by fish species at 19%, non-penaeid shrimp crustaceans at 7%, discarded penaeid shrimp at 6%, and debris at 3%. Non-crustacean invertebrates comprised less than 1%. CPUE in kilograms per hour by category was 21.6 for penaeid shrimp, 6.2 for fish, 2.2 for crustaceans, 1.8 for discarded penaeid shrimp, and 0.9 for debris.

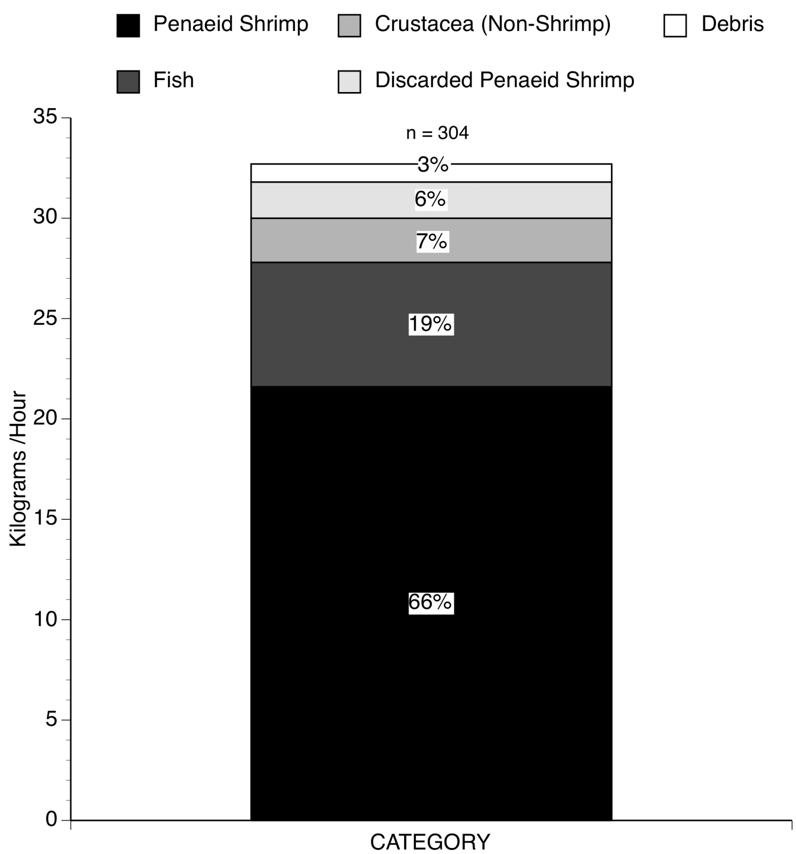

Figure 50. CPUE and percent species composition by weight and category from skimmer trawl tows. Based on observer coverage of the skimmer trawl fishery in coastal Louisiana from September 2004 through June 2005.

Extrapolated numbers from species composition samples by category for all years, areas, seasons, and depths are presented in Figure 51. Penaeid shrimp were dominant by number at 89%, followed by fish at 8%, discarded penaeid shrimp at 2%, penaeid shrimp, and crustaceans each at 1%. As previously mentioned, tows where no counts were obtained (75) for a given species were set aside for the purpose of this analysis. CPUE estimates in numbers per hour for the category components were 6,498 for penaeid shrimp, 595 for fish, 118 for discarded penaeid shrimp, and 66 for crustaceans.

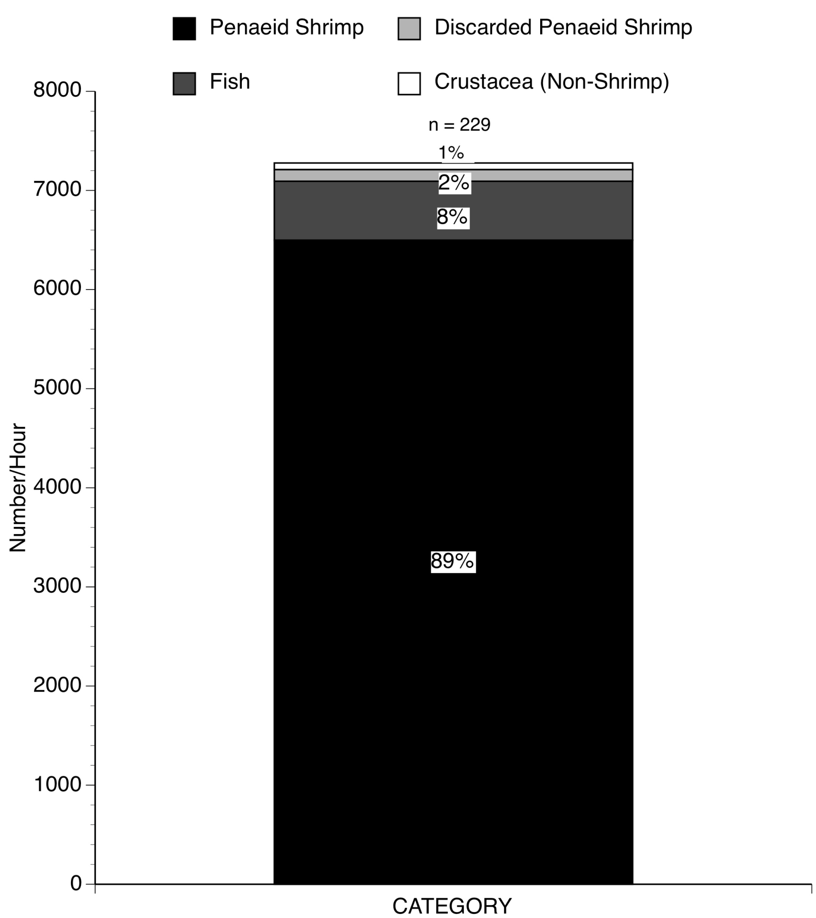

Figure 51. Percent species composition by number and category from skimmer trawl tows. Based on observer coverage of the skimmer trawl fishery in coastal Louisiana from September 2004 through June 2005.

Extrapolated Species Composition by Species – Percent and CPUE

Weight extrapolations from the species composition samples for both years, all areas, seasons and depths (Figure 52) indicate that white shrimp (*Litopenaeus setiferus*) comprised 49% of the total catch, followed by penaeid shrimp at 17%, Gulf menhaden (*Brevoortia patronus*) at 8%, blue crab (*Callinectes sapidus*) at 7%, discarded penaeid shrimp at 6%, debris at 3%, Atlantic croaker (*Micropogonias undulatus*) and threadfin shad (*Dorosoma petenense*) each at 2%, and blue catfish (*Ictalurus furcatus*) at 1%. All other species (54) comprised 5% of the total weight. Corresponding CPUE in kilograms per hour were 16.1 for white shrimp, 5.4 for penaeid shrimp, 2.7 for Gulf menhaden, 2.2 for blue crab, 1.8 for discarded penaeid shrimp, 0.9 for debris, 0.7 for Atlantic croaker, 0.6 for threadfin shad, and 0.4 for blue catfish.

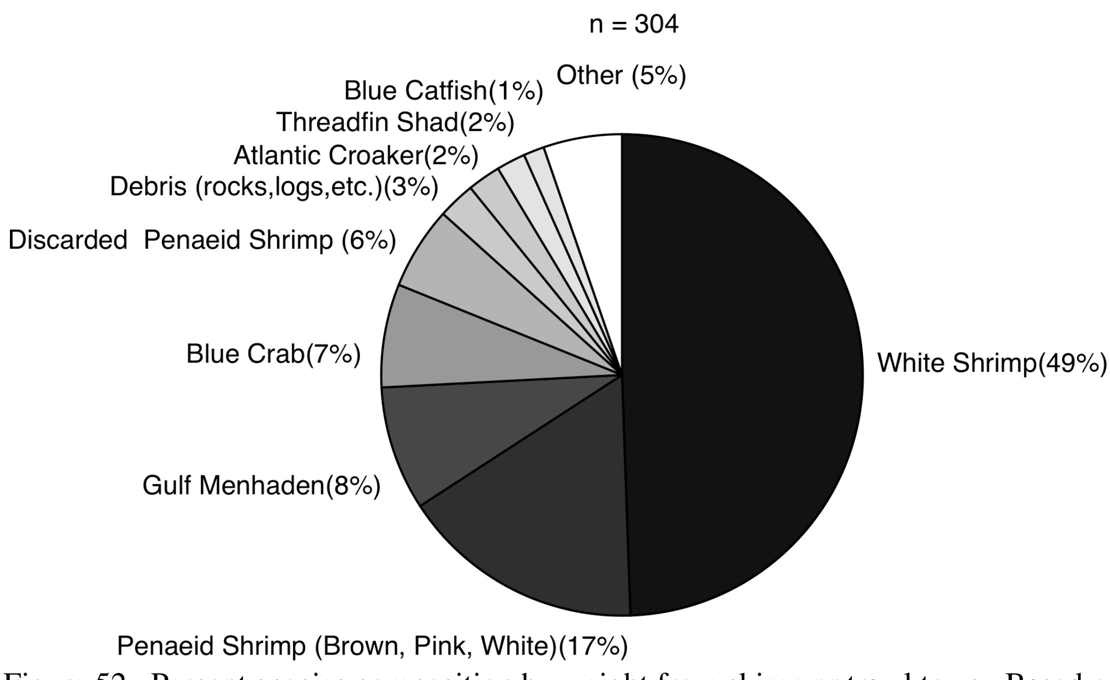

Figure 52. Percent species composition by weight from skimmer trawl tows. Based on observer coverage of skimmer trawl fishery in coastal Louisiana from September 2004 through June 2005.

From number extrapolations, species composition samples for both years, all areas, seasons and depths (Figure 53) denote that white shrimp comprised 61% of the total catch, followed by penaeid shrimp at 28%, Gulf menhaden at 4%, and discarded penaeid shrimp and Atlantic croaker each at 2%. Debris counts, accounted for less than 1% based on one unit of debris for each tow. All other species (57) comprised 4% of the total number. CPUE in number per hour were 4,475 for white shrimp, 2,016 for penaeid shrimp, 291 for Gulf menhaden, 118 for discarded penaeid shrimp, and 112 for Atlantic croaker.

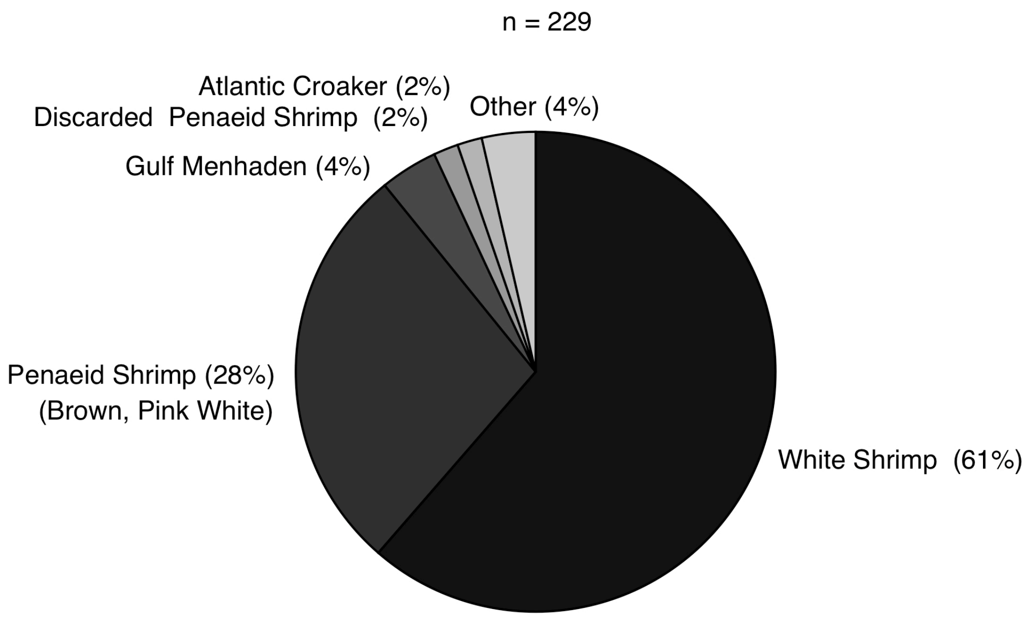

Figure 53. Percent species composition by number from skimmer trawl tows. Based on observer coverage of the skimmer trawl fishery in coastal Louisiana from September 2004 through June 2005.

Estimated CPUE by Year and Season

Figure 54 depicts CPUE estimates in kilograms per hour by season and year. Catch rates of penaeid shrimp were higher compared with other species categories for both years and seasons. The highest estimated catch rate of penaeid shrimp was observed in May through August 2005 (23.6 kg/hr); CPUE was lower in September through December 2004 (21.0 kg/hr). Fish CPUE was higher in September through December 2004 (6.5 kg/hr) as compared with May through August 2005 (5.1 kg/hr). Non-penaeid shrimp crustacean catch rate was the highest in May through August 2005 (3.3 kg/hr), followed by September through December 2004 (1.9 kg/hr). Debris estimated CPUE was similar between years and seasons with highest rate in May through August (1.0 kg/hr) followed by September through December 2004 (0.8 kg/hr). The catch rate of discarded penaeid shrimp was highest in September through December 2004 (2.1 kg/hr) as compared with May through August 2005 (0.8 kg/hr). Non-crustacean invertebrate CPUE was less than 1.0 kilogram per hour for both seasons.

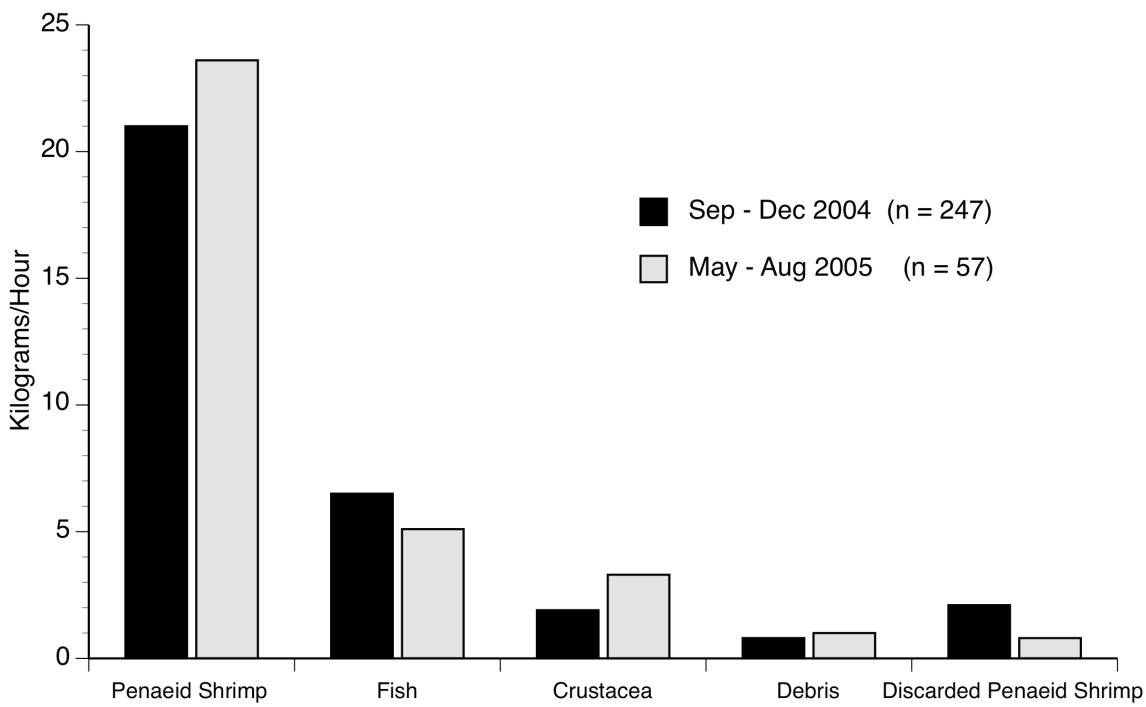

Figure 54. CPUE in kilograms per hour by year, season, weight, and category from skimmer trawl tows. Based on observer coverage of the skimmer trawl fishery in coastal Louisiana from September 2004 through June 2005.

Sea Turtle Interactions

Restricted tow times are established by individual states based on the potential for sea turtle interactions. During the study period, no sea turtles were captured.

DISCUSSION

From September 2004 through June 2005, data from approximately 307 tows were collected during 97 trips (114 sea days) aboard three skimmer trawl vessels in coastal Louisiana. Vessel and fishing characteristics were documented. Overall vessel length averaged 39.7 feet. All vessels were of fiberglass construction, and had ice hold capacity. Two nets were pulled on each vessel, each with a headrope length of 16 feet. Tow time averaged 1.7 hours. The average fishing depth was 1.3 fathoms, with a mean towing speed of 1.8 knots.

Vessel selection was opportunistic, and may not be representative of the entire fleet. Moreover, as reported by Hein and Meier (1995), the use of skimmer trawls is prevalent throughout coastal Louisiana. The current study was restricted to two generalized areas in Louisiana.

From non-extrapolated data, penaeid shrimp (heads-on) constituted 61% of the total weight; corresponding CPUE in kilograms per hour was 20.2. Extrapolated data from species composition samples yielded slightly higher estimates. Penaeid shrimp accounted for 66% of the total catch; CPUE in kilograms per hour was 21.6.

Similarly, based on extrapolated data, finfish accounted for 19% of the total weight, followed by crustaceans at 7%, discarded penaeid shrimp at 6%, and debris at 3%. Corresponding CPUE in kilograms per hour was 6.2 for finfish, 2.2 for crustaceans, 1.8 for discarded penaeid shrimp, and 0.9 for debris.

Compared with previous studies conducted in North Carolina (Coale et al. 1994; Hines et al. 1999), the current study yield substantially higher penaeid shrimp and lower finfish CPUE. This may be attributed to higher shrimp production in Louisiana than in North Carolina, alternate gear designs, variable fishing practices, or a combination of all these factors.

The discards to landings ratio was 0.63 for the skimmer trawl fishery in the current study. This was notably less than the ratio of 4.56 reported by Harrington et al. 2005 for the Gulf of Mexico otter trawl fishery.

In the current study, the dominant species by both weight and number was white shrimp, followed grouped penaeid shrimp, and Gulf menhaden. By weight, the fourth dominant species was blue crab, followed by discarded penaeid shrimp, debris, Atlantic croaker, threadfin shad, and blue catfish. By number, the next fourth dominant was discarded penaeid shrimp, and Atlantic croaker.

Seasonally, higher penaeid shrimp CPUE occurred in May through August 2005 compared with September through December 2004. This pattern was also observed for non-penaeid shrimp crustacean and debris. For finfish and discarded penaeid shrimp, CPUE was higher in September through December 2004 compared with May through August 2005.

In conclusion, bycatch rates in this study were substantially lower in skimmer trawls compared with historical and current estimates of bycatch associated with capture from otter trawls. Based on these findings and previous studies (Coale et al. 1994; Hines et al. 1999) skimmer trawls provide an alternative to conventional otter trawls for harvesting penaeid shrimp. The tangible benefits include, but not limited to, reducing finfish bycatch, lessening bottom habitat disruption, and decreasing fuel consumption. Subsequent shrimp yield based on size (i.e., growth overfishing), potential sea turtle interactions and other abiotic and biotic interactions warrant further investigation, and should be considered when assessing the optimal holistic approach to resource management.

CHAPTER VI

CONCLUSIONS: CURRENT MANAGEMENT AND FUTURE CONSIDERATIONS

MANAGEMENT STRATEGIES

In chapters II – V, some of the most recent issues facing the shrimp and reef fish fisheries operating in the U.S. southeastern were examined. In this chapter, current management regimes and polices are presented in length, primarily to emphasize the critical need for improvement. Findings of the previous chapters are highlighted in relation to future management considerations.

The recognition that coastal and marine resources can be removed or disrupted at greater levels than can be sustained by the environment poses a significant challenge for this generation and generations henceforth. Thirty years ago, Congress passed the first federal fishery statue, one of several environmental laws passed in the 1970's, to remedy mistakes of the past and promote sustainable use in the future. While the intent of these measures is commendable, the complexity of existing management regimes and their interpretation combined with the variability and dynamic nature of fishing issues have often impeded progress towards the overall goal of a holistic approach to ocean governance.

Magnuson-Stevens Conservation and Management Act

The Magnuson Fishery Conservation and Management Act (Magnuson Act; 16 USC 1801), the primary federal fisheries statue, was enacted in 1976. Passage was based on concerns over the past and current management of coastal fisheries resources and that countries other than the U.S., most notably European distant-water fleets, were gaining the greatest economic benefit from these resources (Ross 1997). The Magnuson Act extended U.S. territorial seas from 12 nautical miles (nm) to 200 nm, and domestically authorized U.S. federal jurisdiction over all fishery resources from distances greater than 3 nm (or 9 nm off Texas and west coast of Florida) to 200 nm. The area, beyond individual U.S. state's jurisdiction (3 or 9 nm), now comprises the Exclusive Economic Zone (EEZ). The actual mechanism for this expansion of 3.4 billion square miles was through a 1983 proclamation by President Reagan, Proclamation No. 5030, stating "the United States now asserts jurisdiction over the living and non-living resources within the exclusive economic zone" (CRA 1995; Evans 1998). The area of the EEZ is 1.25 times larger than the landmass of the U.S. and its territorial possessions. The Magnuson Act also established eight regional fishery management councils to develop fishery management plans (FMPs) for fishery resources in their federal geographic region.

In October 1996, the Sustainable Fisheries Act (SFA; Public Law 94-265) reauthorized and amended the Magnuson Act and became the Magnuson-Stevens Conservation and Management Act (Magnuson-Stevens Act). With passage of the SFA, substantial changes in requirements relative to defining and preventing overfishing, rebuilding overfished stocks, minimizing bycatch and conserving fishery habitat were promulgated, with three new National Standards (8 through 10) added (NMFS 1996). Provisions in SFA required improved fishery monitoring and research, consideration of fishing communities, identification of essential fish habitat (EFH), formation of constituent advisory panels and fishing capacity assessments (NMFS 1996; Musgrave et al. 1998; Goble and Freyfogle 2002)

National Standards contained within the Magnuson-Stevens Act (Section 301) dictate how fishery conservation and management programs are developed and reviewed. FMPs must comply with these Standards and take into account the biological, social, and economic factors associated with the management of fishery resources (Wallace and Fletcher 2004). As mandated by the Magnuson-Stevens Act, National Standard Guidelines (NSGs; 63 FR 24211, May 1, 1998) do not have the effect of law, but instead are used to assist in FMP development as related to National Standards. NSGs are designed to provide guidance to reduce overfishing without delay, rebuild overfished stocks within a specified time, prevent bycatch and reduce mortality of unavoidable bycatch to the maximum extent possible. Councils are to examine existing FMPs and future management actions to ensure that they comply with the National Standards, and amend FMPs not in compliance (63 FR 24211, May 1, 1998).

National Standard 1 prescribes for conservation and management measures to prevent overfishing while achieving, on a continuing basis, optimum yield (OY; NMFS 1996; NOAA 1997). FMPs must define overfishing, establish options to prevent overfishing, and if overfished, must take action to rebuild affected stocks within a specified time period. According to the authors, rebuilding provisions, as revised by SFA, require that overfished stocks be rebuilt to levels consistent with producing maximum sustainable yield (MSY) as soon as possible, or no more than ten years unless the biology of the stock, environmental parameters or international agreements preclude this action.

National Standard 1 has received a great deal of attention based on its complexity. In an attempt to simplify the context of National Standard 1, various literature sources were examined (NOAA 1994; NMFS 1996; NOAA 1997; 63 FR 24211, May 1, 1998; Restrepo et al. 1998; GMFMC 2004; Wallace and Fletcher 2004). The following include highlights: MSY is the largest long-term average catch or yield that can be taken on a continuous basis (sustained) from a stock or stock complex under prevailing ecological and environmental conditions. OY equates to MSY reduced by economic, social, and ecological factors (although not required to be reduced). The National Environmental Policy Act of 1969 (Public Law 91-190, 42 USC 4371 et seq.) requires an Environmental Impact Statement (EIS), inclusive of socioeconomic impact statements, if the action of a federal agency has the potential to impact the quality of the human environment. Relative to this Standard, if limited access to a fishery is required to achieve OY, then the Secretary of Commerce and regional fishery management councils must consider social and economic impacts of such action. MSY and OY control rules, or harvest strategies are mandatory requirements in FMPs, and must contain reference points in terms of MSY (limit reference point) and OY (target reference point) as well as status determination criteria (SDC) to identify when a stock is overfished or undergoing overfishing. The parameters of minimum stock size threshold (MSST) and maximum fishing mortality threshold (MFMT) are used to monitor the current level of biomass ($B_{CURRENT}$) and current rate of fishing mortality ($F_{CURRENT}$) relative to biomass at MSY (B_{MSY}) and fishing mortality at MSY (F_{MSY}). MSST is the threshold biomass level below a stock would not be capable of rebuilding to B_{MSY} within a specified time frame (10 years) if exploited at MFMT. A stock with biomass below MSST ($B_{CURRENT}$<MSST) is deemed overfished, and thus triggers a rebuilding plan required to rebuild the stock to B_{MSY}. MFMT is the maximum level of fishing mortality a stock can endure while still producing MSY on continuing basis. A fishery mortality rate greater than MFMT ($F_{CURRENT}$>MFMT) is undergoing overfishing. According to the authors, when MSY cannot be estimated directly (i.e., insufficient data) proxies of MSY may be used that typically include various reference points defined in terms of relative spawning potential.

National Standards 2 through 7 were not significantly altered by SFA (NMFS 1996; NOAA 1997). National Standard 2 dictates that conservation and management must be based on the best scientific data. National Standard 3 defines stock structure, with an individual stock managed throughout its geographic range. National Standard 4 prescribes for the fair and equitable allocation of fishing privileges, with allocations calculated in such a manner to ensure conversation, and not allotted in such a way to allow for one entity to have an access share. National Standard 5 dictates for conservation and management to consider the efficient use of resources other than for solely economic reasons. National Standard 6 mandates that measures should allow for variations among fisheries, resources and catch. National Standard 7 concerns minimization of costs and avoidance of duplication.

National Standard 8 requires conservation and management measures to take into account the importance of fishery resources to fishing communities, provide for the continued participation of such communities and, to the "extent practicable", minimize adverse economic impacts on such fishing communities (NMFS 1996, NOAA 1997). It is pointed out by the authors that any action must be consistent with SFA requirements “including the prevention of overfishing and rebuilding of overfishing stocks."

National Standard 9 requires that measures, to the extent practicable, minimize bycatch or if unavoidable, minimize the mortality of such bycatch (NMFS 1996; NOAA 1997). The term “extent practicable” translates to reasonable efforts to be taken by regional fishery management councils that do not favor one user group over another, nor place an unreasonable economic burden on one or more sectors of the fishery (NOAA 1997). Based on the legislative history (NOAA 1997), the House version of National Standard 9 originally was worded:"...shall, to the maximum extent practicable, minimize bycatch." Acknowledging that some level of bycatch is unavoidable in most fisheries, the House was directing councils to seek innovative ways to reduce bycatch and mortality (NOAA 1997). According to floor statements (NOAA 1997) from Alaska Congressman Don Young (Merchant Marine and Fisheries Committee) "to the extent practicable" was intentionally selected. Councils were to make “reasonable efforts,” adding that it was not the intent of Congress to ban a type of fishing gear in order to comply with this standard. In addition, “practicable” requires a cost analysis of a management action, and the intent of Congress is not to allocate among particular gear types, or to impose costs on the commercial fishing industry that cannot be reasonably met (NOAA 1997). NSGs (63 FR 24211, May 1, 1998) state that the term practicable is not the same as possible, because not all reductions that are possible are practicable. They conclude that it may not be practicable to eliminate all bycatch and bycatch mortality in some fisheries. However, bycatch that cannot be avoided must, to the extent practicable, be released alive. Any management action that does not give priority to avoiding bycatch must be supported by an analysis as to why. Councils must consider the net benefit to the nation through an evaluation that includes, at minimum, adverse affects to directed and non-directed stocks, economics, recreational and environmental considerations, and non-market values of bycatch species (63 FR 24211, May 1, 1998).

The terminology and quantification of this Standard has brought about considerable debate and litigation (NOAA 1997; Goble and Freyfogle 2002). Recommendations have been made to remove the second phrase (minimize mortality), or reword to include unobserved mortality. Section 303 of the Magnuson-Stevens Act (NMFS 1996; NOAA 1997), directs for bycatch minimization and establishment of a standardized reporting methodology for FMPs.

National Standard 10 requires measures, to the extent practicable, to promote the safety of human life at sea (NMFS 1996; Musgrave et al. 1998). IFQ proponents have used this Standard as justification to prevent or manage the dangers associated with derby fisheries (NOAA 1997). The Senate, however, stated that this Standard was not intended to promote one management system over another (NOAA 1997).

Relative to council structure, the Magnuson-Stevens Act established eight regional fishery management councils to manage fishery resources within specific geographic regions (NMFS 1996; Evans 1998; Wallace and Fletcher 2004). Council membership is intended to reflect fishery expertise and the interests of each of the regional states, and includes commercial, recreational and charter-boat representation. Voting members (or their designees) include (1) the director of each state's marine fishery resources department as designated by the Governor; (2) the NOAA Fisheries Regional Administrator (RA) for the area concerned; (3) one person from each state, nominated by the Governor and selected by the Secretary of Commerce from a list of at three; and (4) at-large members from any of the states who are nominated by the governor and selected by the Secretary. Non-voting members include: (1) the regional or area director of the U.S. Fish and Wildlife Service; (2) the commander of the Coast Guard district for the area; (3) the Executive Director of Marine Fisheries Commission; and (4) a representative from the Department of State. Each council has an executive director and staff who coordinate council activities. Much concern has been afforded to council composition most notably, fair representation of commercial, recreational and other interests, as well as conflict of interest relative to council action.

The councils are required to establish and maintain scientific and statistical committees (SSC) for the status and assessment of fishery stocks (i.e., stock assessment and fishery evaluation) and related economic and social implications in the development of FMPs (NMFS 1996, NOAA 1997). An advisory panel consisting of commercial and recreational fishing, and other interests in the region of concern is required to provide information and recommendations relative to FMP development.

Councils are to prepare and submit FMPs and related amendments to the Secretary of Commerce for fishery stocks requiring conservation and management (NMFS 1996, NOAA 1997). Prior to final action, councils must announce the proposed rule change (through the Federal Register and media); conduct public hearings at appropriate times and locations to ensure the interests of individuals are heard; and provide for open public access to regular and emergency meetings where final action is scheduled. Proposed rule changes are submitted to the Secretary for review and approval prior to implementation (GMFMC, 2006).

The contents of a FMP are provided in Section 303 of Magnuson-Stevens Act. Requirements fall within two categories, mandatory and discretionary (NMFS 1996; NOAA 1997).

Mandatory requirements for FMPs developed by councils must contain mechanisms to protect and sustain fishery resources, be consistent with the National Standards, and with international agreements (NMFS 1996; NOAA 1997; 63 FR 24211, May 1, 1998). A description of the fishery including, but not limited to, characteristics as to number of vessels, user groups (commercial, recreational and charter), gear type, landings, species involved and any costs associated with fishery management must be identified. MSY and OY must be defined with supporting data, and the extent and capacity that fishing vessels will harvest OY estimated annually. EFH, efforts to minimize adverse effects caused by fishing gear, and measures to solicit conservation of such habitat must be identified. FMPs must include fishery impact statements relating to the effects on fishing communities from conservation and management actions. Criterion relative to defining when a stock is overfished must be determined and be based on the reproductive potential of the affected stocks. Actions relative to when a stock is approaching an overfished state, or is in an overfished condition must be met with management measures to end overfishing and rebuild the affected stock equitably among user groups. Standardized bycatch reporting methodologies are now required for assessment purposes as well as measures, to the extent practicable, to minimize bycatch and the mortality of unavoidable bycatch. According to the authors, a similar assessment is required for the recreational sector and related to minimizing mortality of released catch.

Discretionary, or non-mandatory, provisions of the Magnuson-Steven Act include, but are not limited to, requiring permits and fees, designating closure areas, and limiting the catch, sale and shipment of fishery resources (NMFS 1996; NOAA 1997; Musgrave et al. 1998). Restrictions on the type and amount of gear are permitted as well as provisions to require observers and vessel monitoring systems (VMS). Conservation efforts can incorporate comparable management actions enacted by individual state plans. Establishment of limited-entry systems are permitted but must consider the historical and current participation in the fishery, economics, alternative fisheries to offset loss, cultural and social implications and any other related consideration. Catch incentives as a means to reduce bycatch and mortality may be enacted.

IFQs are addressed in Magnuson-Stevens Act (NMFS 1996; NOAA 1997, Musgrave et al. 1998), for the achievement of OY, and are defined as federal permits under a limited access system to harvest (expressed by units) a percentage of the TAC. IFQs came about in response to the lack of adequate regulations to prevent over harvesting (NAS 1999). After passage of the SFA, councils were prohibited from submitting or approving any new IFQ programs until October 1, 2000 (NMFS 1996; NOAA 1997). IFQ programs approved on or after January 4, 1995, would be repealed (e.g., Gulf of Mexico red snapper IFQs). Councils can, however, terminate or limit, without compensation to holders, any type of limited access permits including IFQs (i.e., no right or title to a fish before it is caught). Further, councils are permitted to modify, through amendments, existing IFQ programs. In addition, a council may allocate 25%

of fees collected from these fisheries to purchase IFQs for small vessels and entry-level fishing participants (NMFS 1996; NOAA 1997). After October 2001, councils and the Secretary of Commerce were directed to consider recommendations by the National Academy of Science (NAS) report (NAS 1999). Any new IFQ programs must provide for procedures for review and revision, enforcement, including observer coverage, and equitable allocation of IFQs that prevent excessive share allotment. In addition, the Secretary can collect 0.5% of the value of the permit upon registration or transfer of the permit to fund the registration, and to collect a fee of up to 3% of the ex-vessel (dockside) price to cover for the costs of enforcement and management (NAS 1999). Based on the legislative history (NOAA 1997) both the House and Senate were unreceptive or, at minimum, suspicious of an IFQ system. In addition, controversy over privatizing a public resource is a problematic barrier for some constituents.

The timeline for approval of council actions varies depending on the particular management measure: FMP implementation, FMP amendment, notice actions, regulatory amendments, emergency action, interim rules, or secretarial plans. Evans (1998) and Wallace and Fletcher (2004) provide an overview of these processes. Once a council determines a fishery is at risk, assessments are conducted relative to the biological, environmental, social and economic components of the fishery. A draft FMP (or amendment to an existing FMP) is then compiled. When the draft is completed, notice of a 45-day public comment period begins that includes meetings and written comments. After this, the council responds to comments. The FMP is then submitted to the Secretary of Commerce for formal review; this starts day one of the process. On day 15, NOAA Fisheries announces a 45-day public hearing for comment on the proposed rule. On day 95, a final decision is made by the Secretary. If approved, the rule is forwarded to OMB (Office of Management and Budget) for review. On day 110, the final rule is published in the Federal Register, and by day 140, the final regulation becomes effective.

An FMP may contain measures for immediate management changes (notice actions). NOAA Fisheries must first approve, then the council must notify participants through NOAA Fisheries. FMPs may also contain provisions for modifying regulations; as such, the council can adopt a regulatory amendment after approval is received from the NOAA Fisheries RA and after a public comment period.

Emergency action can be taken by a council (majority rule), if such a situation exists. The council decision is forwarded to the NOAA Fisheries RA, who after review, submits to the Secretary for approval and publication in the Federal Register, at which time the proposed rule becomes regulation. Emergency regulations remain in effect for 90 days, and can be extended for an additional 90 days. Similarly, interim rules can be implemented to prevent overfishing, remain in effect for 180 days, and extended for an additional 180 days. The Secretary can also develop FMPs for the management of highly migratory species (HMS), or when a council is unable to accomplish the requirements of a council within a given time period.

Understanding the complexity involved, the time it takes from recognition of a problem (fishery at risk) to submission of a draft FMP or amendment to the Secretary is a lengthy process. The terminology and interpretation of proposed mandates have resulted in extensive litigation (Goble and Freyfogle 2002). Moreover, interest-based decisions and lack of consensus among council members has further delayed progress. Clearly, a more straightforward and transparent method is warranted to streamline the process and create greater collaboration among all shareholders. This point is further illustrated by the U.S. Commission on Ocean Policy's (USCOP; USCOP 2004) inference that social, economic, and political considerations have often impeded the use of the best available scientific information relative to the fishery management process. The authors stress that regional fishery management councils should rely on SSC findings, and that SSC membership should adhere to stringent scientific and conflict of interest requirements (USCOP 2004). Further, the authors acknowledge the need for scientific findings to be translated into practical information and products that can be used by decision makers as well as the general public.

Maximum Sustainable Yield (MSY)

The concept of MSY, or "limit reference", has opened the door to a large degree of interpretation. Fluctuations in fisheries abundance are typically attributed to density dependence and the effects of harvesting, with environmental factors treated as random factors (Sakuramoto 2005). Density dependence results from resource limitations that lead to within species competition. Characteristics include reduction in mean fitness where the contribution that individuals attribute is declining, less survivorship and less fecundity (Winemiller 2001). The stock surplus production relationship (e.g., logistic model) and the stock recruit relationship (e.g., Ricker or Beverton and Holt) are two categories of density dependent models (Sakuramoto 2005).

The surplus production theory dictates that in an unfished population, the biomass (total weight) of fish in a habitat will approach carrying capacity (k), or the maximum amount of fish that can be supported in that habitat (Wallace and Fletcher 2004). In an unfished stock, older fish predominant and prevent younger fish from surviving based on competition for resources (Wallace and Fletcher 2004). Once a population at k has been reduced by an initial harvest, a subsequent sustainable yield can be calculated as a fraction of the reduced size. Mathematically, MSY is the density at half 1/2 k; however, maximum yield from some populations may occur at densities higher than 50% (Goble and Freyfogle 2002).

The S-shaped logistic curve was proposed in 1849 by Verhulst Pearl to illustrate population growth from an initial size to k (Winemiller 2001; Goble and Freyfogle 2002). Controlled experiments (environmental and food supply constant) on bacteria and some insects were conducted demonstrating growth according to Verhulst Pearl's logistic equation. The concept is that populations are stable, abundance will remain constant forever unless disturbed, and once disturbed (above or below k), the population will return to the same abundance. Several parameters must be precisely estimated; the population has an exact and single k, growth must follow the logistic curve, k and present population size must be known (Goble and Freyfogle 2002). Sakuramoto (2005) concluded that while the logistic model has led to the MSY theory, an important concept in fisheries science, very few species are managed under the concept of MSY.

According to Goble and Freyfogle (2002), for the MSY concept to be successful, not only are precise estimates of both k and current population size required, but also, it is imperative to obtain complete cooperation from harvesters to ensure the exact amount is harvested each year. The authors conclude that the MSY concept is based on the premise that nature undisturbed by humans remains constant indefinitely, and if disturbed, nature rebounds back to the original state.

Using the Verhulst Pearl's logistic growth model to explain density dependence allows Ro (net replacement rate, offspring that survive to maturity), or r (instantaneous rate of change of population size per individual) to change with N (population size; Winemiller 2001). For a population at k (some value of the population density), Ro = 1 (population is stable and not declining or growing with each individual exactly replacing itself), and r = 0 (births equal deaths, slope = 0), then the instantaneous rate of change of N over time equals rN(k-N/k) and yields the sigmodal growth curve (Winemiller 2001). There are several assumptions with this model. All individuals in the population are equal, the value of r assumes optimal growth conditions, and there are no time lags.

Using a conceptual stock – recruit model under the assumption that net replacement is 1 to 1 (each individual leaves behind one successful recruit), then adding density dependence (resource limited), the stock density will experience positive growth when below k (Figure 55; Winemiller 2001). When population growth reaches k, it stabilizes. When fishing begins the removal of biomass below k, triggers a phenomenon (density compensation) that enables the population to exhibit a positive growth mode to compensate for the fact that it is under the value of k (Winemiller 2001).

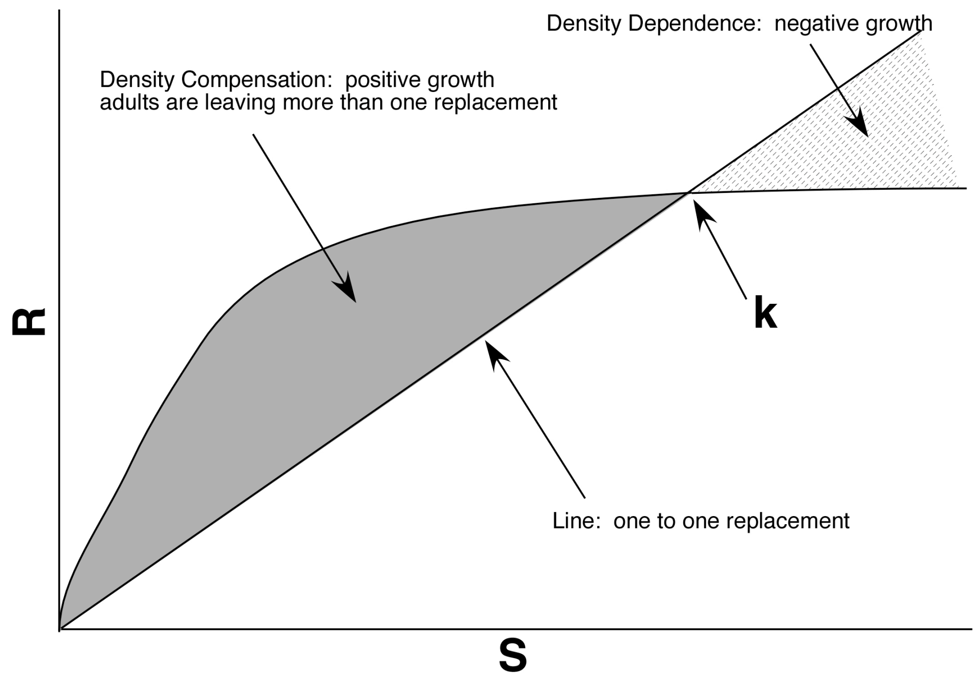

Figure 55. Stock-recruit conceptual model illustrating density compensation and density dependence. S and R denote stock and recruit, respectively. Adapted from Winemiller 2001.

Stock and recruit densities fit to a curve as a model of stock-recruit relationship are commonly used in fisheries management (Winemiller 2001). At the point where the curve is at the maximum height (steepest interval) represents a population density where the population growth is at the maximum. The basic theory is to harvest at this point because of density compensation; the population should be sustained because of a natural mechanism that will compensate for the mortality represented by harvest.

Stock and recruitment data incorporated into stock recruit models reflecting density dependence (e.g., Ricker and Beverton and Holt) are commonly used in an effort to obtain the best fitting curve (Winemiller 2001). The problem arises when there is substantial scatter (low r^2), reflective of a large degree of unexplained variability associated with how well the data fit the curve. Often, the curve is not explaining 80-85% of the variation in the data, indicative that other factors are setting the recruitment density, and as such, not strongly dependent on stock density, but on other variables (e.g., climate, currents, larval predation). Hence, often a large degree of stochastic and density independent elements often drive the population dynamics (Winemiller 2001).

MSY and F_{MSY} are generally based on historical catch and effort data based on the assumption that each year's catch and effort represent an equilibrium with the population where catch equals surplus production at the level of fishing effort (Jennings et al. 2001). CPUE regressed against effort over a time series yields a negative relationship where higher fishing effort yields lower CPUE; this in turn is used to determine MSY. Jennings et al. (2001) state that changes in CPUE are rarely density dependent, but instead are the result of fishing technology, abiotic and biotic factors. To illustrate, the authors examined the Peruvian anchovy fishery. In 1970, this fishery accounted for 25% of global marine landings. Approximately 11 million tons were taken annually since the mid 1960's. In 1972, low recruitment combined with the effects of EL Nino, concentrated the adults resulting in mass harvest. This led to overcapitalization in the fishery and abiotic factors resulted in disequilibrium between catch and effort (Jennings et al. 2001). The authors conclude that over time MSY is variable due to changes in productivity and abiotic factors, and as such should never be exploited at MSY (i.e., exceed surplus production).

Control rules or harvest strategies typically define a reference fishing mortality rate as a function of stock size (63 FR 24211, May 1, 1998). According to technical guidelines, OY is the target with the limit being less than or equal to MSY (Restrepo et al. 1998). In the Magnuson-Stevens Act, limit reference points imply that F_{MSY} is the upper bound on fishing mortality (Restrepo et al. 1998). The authors conclude that the target reference point (OY) should not be exceeded more than 50% of the time.

NSGs (63 FR 24211, May 1, 1998) state that in any MSY control rule, a given stock size is associated with a given fishing mortality and a given level of potential harvest. NSGs provide guidance as to the method of selecting the MSY control rule in each year as to maximize the resulting long-term average; these include removing a constant catch from a stock size that exceeds a lower bound; removing a constant fraction of the biomass; allowing for a constant level of escapement (percentage of fish that escape inshore and move offshore and eventually spawn); or varying the fishing mortality rate as a continuous function of stock size (63 FR 24211, May 1, 1998). F_{MSY} denotes the management reference point of MSY. When MSY cannot be estimated directly (i.e., insufficient data), then other measures related to reproductive capacity can serve as proxies of MSY that include various reference points defined in terms of relative spawning potential (63 FR 24211, May 1, 1998).

For the management of shrimp resources as related to MSY, abiotic factors play an important role. Shrimp are a short-lived species that depend on optimal environmental conditions for growth and survival. Previously, MSY for the shrimp FMP was based on the Schaefer surplus-production model (GMFMC 2005). This model uses trends in CPUE, designed for multiyear species, and provides an average long-term yield and not a maximum, and assumes environmental conditions are constant. However, it was determined inadequate. For this reason, the Gulf of Mexico Fishery Management Council (Gulf Council) seeks to define MSY by the lowest and highest landings (pound of tails) taken annually from 1990-2000 and does not result in recruitment overfishing (GMFMC 2005). MSY can be exceeded for several years without damage to stock productivity, harvest below MSY may occur during years of low recruitment based on environmental factors, and that sufficient spawning stock is a more appropriate measure than comparing catches to uncertain MSY values (GMFMC 2005b).

Often, as in the case of red snapper (*Lutjanus campechanus*), given the lack of or inadequate understanding of recruitment at stock sizes greater than what has been observed makes estimating stock level that would produce MSY difficult (GMFMC 2004). Estimates, therefore, are highly uncertain, based on the fact that they are required to predict beyond a range of data upon which they are based. In addition, changes in gear selectivity may affect assessment outputs (GMFMC 2004).

From review of Amendment 22 to the reef fish FMP (GMFMC 2004) within the context of the NSGs (63 FR 24211, May 1, 1998) and Restrepo et al. (1998), red snapper are overfished and undergoing overfishing. According to the authors, prior to this

Amendment, the stock was under a rebuilding plan established in 1996 through a regulatory amendment to achieve 20% SPR (spawning potential ratio) by 2019, the minimum level projected that prevents further decline. Because this plan was not consistent with the NSGs, Amendment 22 seeks to develop a more conservative rebuilding plan to end overfishing and restore the stock to the biomass capable of producing MSY on a continuous basis. It was estimated to take 12 years with no fishing pressure (including shrimp bycatch) for the stock to rebuild plus the generation time 19.6 years as specified in the NSGs; thus the Council submitted a recovery plan for a target date of 2032 or earlier. NOAA Fisheries returned the plan with a mandate to explore realistic alternatives through a supplemental EIS. Based on a 1999 age-structured assessment program, point estimates for MSY were produced and defined by two parameters: steepness (number of recruits produced annually per mature adult when a population is low and no competition), and estimated maximum recruitment (maximum recruitment that could be achieved by a large population). These two parameters, according to the authors, shape the Beverton and Holt stock recruitment relationship. Using the low (0.90) and high (0.95) range of steepness, and maximum (1972) and minimum (1972-76) recruitment levels from fishery independent groundfish surveys in the model, a range of point estimates for MSY, B_{MSY} and F_{MSY} were derived. The most conservative estimates (i.e., low steepness, low recruitment) yielded the following: MSY (million of pounds) = 41.13; B_{MSY} (millions of pounds) = 2,726; F_{1999} = 0.259; and F_{MSY} = 0.092 (GMFMC 2004).

These translate to 32 to 36% SPR; currently, the stock is not likely to be near the level that would produce MSY (GMFMC 2004). According to the authors, $B_{CURRENT}$ in the 1999 stock assessment was approximately 7% of B_{MSY}. Thus, the preferred alternative using low steepness (0.90) and low maximum recruitment (1972-76) for MSY equals the yield associated with F_{MSY}, or 41.13 million pounds whole weight. Based on Restrepo et al. (1998) guidance, MSST shall equal $(1-M)*B_{MSY}$ = 2,453 million pounds with B_{MSY}=2,726 million pounds and M=0.1. Again, based on guidance Restrepo et al. (1998), after recovery, OY for red snapper should correspond to

$F_{OY}=0.75*F_{MSY}=0.069$. The preferred alternative to end overfishing and rebuild the stock is to maintain the TAC at 9.12, end overfishing between 2009 and 2010, and rebuild red snapper by 2032, adjusting as necessary through periodic assessments. These projections are assuming 40% red snapper reduction from the shrimp fleet. Recent estimates indicate an 11.7% reduction in red snapper, instead of the assumed 40% (NMFS 2006a). Based on this, the Coastal Conservation Association (CCA) filed a petition on March 29, 2005, to stop overfishing on red snapper by the commercial shrimp trawl fishery (CCA 2005). The Ocean Conservancy and Gulf Restoration Network have filed similar suits (SERO 2006b).

Based on public comments of National Standard 1 (63 FR 24211, May 1, 1998) reasons for not using MSY included the lack of flexibility of MSY, and the difficulty of estimating MSY. NSGs conclude that some degree of flexibility in application of the National Standards was intended by Congress to manage the nation's fisheries as long as the stocks can be rebuilt and their productivity sustained consistent with provisions in the Magnuson-Stevens Act. NSGs response outlined that MSY is essential because it: (1) constitutes an upper limit on OY, (2) establishes the initial target for rebuilding an overfished stock or stock complex, and (3) provides the foundation for overfishing definitions. In addition, MSY is defined in numerous international agreements, most notably in the establishment of precautionary approaches to fishery management. NSGs stress that MSY is the largest long-term average catch across all possible management regimes (i.e., global), not solely a single management regime.

While the MSY theory is an important concept in that it promotes sustainable use and mandates limits, lessons learned in the past illustrate that (1) MSY of a fish stock can often not be determined without over exploiting it, and (2) once past MSY, reducing effort is difficult because of overcapitalization and increased fishing pressure (Evans 1998). Throughout history, our nation’s legislative system has often facilitated overcapitalization. In the 1980 the American Fisheries Promotion Act increased grants to the fishing industry for fishery development programs and funds to allow boat and facilities owners to avoid defaulting on private loans (Ross 1997). In 2003, Congress passed the Consolidated Appropriations Resolution (Public Law 108-7). This, in part, awarded $35 million in disaster assistance to the U.S. shrimp industry due to a substantial decline in U.S. wild-caught shrimp prices resulting from global shrimp imports.

Because of its existing foundation combined with the move toward international standardization embracing the precautionary approach as related to a limit concept and the need to stay within those limits, deviation from the MSY concept is not expected in the near future. As such, deriving MSY should clearly depend on species life history characteristics with other practical considerations, notably abiotic and biotic interactions that incorporate cumulative effects of man-induced environmental alterations (e.g., urban and industrial development, invasive species, eutrophication).

Individual Fishing Quotas (IFQs)

Most U.S. fisheries have been open-access fisheries, with the long-term trend resulting in more effort and investment than a resource can support (Wallace and Fletcher 2004). Placing a quota on the take of fishery resources typically results in derby fishing that creates periodic flooding of the market, and thus lowers prices. Two limited entry systems that are becoming more prominent include license (or permit) limitations and IFQs. IFQs have been used since the 1970's worldwide predominantly in Canada, New Zealand and Iceland and in the U.S.'s North Pacific halibut and sablefish, South Atlantic wreckfish, and Mid-Atlantic surf clam and ocean and mahogany quahog fisheries (NAS 1999). IFQ programs typically allocate a percentage share of the TAC to fishing participants. Since the TAC can change from year to year, the IFQ is typically a percentage of the TAC. Most IFQ programs allow for buying, selling or leasing provisions. Major concern over unfair allocation and profits that shareholders receive upon sale has been common (NAS 1999). Most IFQ programs allot from 0.5% to 20% of the TAC to be held by one entity (Wallace and Fletcher 2004).

Sharp et al. (2004) stated that, as a rule, IFQs, or marketable quota systems, favor the financially strongest and often displace small scale or individually owned fishing ventures. Based on largely ineffective legislative attempts to restrict economic dominance, the authors stress that managers introducing such systems into small scale or mixed fisheries take into account the socioeconomic and political consequences of such actions.

IFQs, according to the NAS (1999), were created despite of a long history over limited access and privatization of a common resource, and introduced to fisheries on the basis of the roles of markets and increased recognition of economic factors in protecting the environment (i.e., globalization and integration of markets). The concept of markets denotes that they are a source of economic growth with well-defined property rights being a primary component (NAS 1999).

NAS (1999) provided a history of IFQs beginning with the Alaska's halibut fishery pre-IFQ, where the season was repeatedly shortened to maintain acceptable levels of catch. The fishing industry responded by adding more gear. Moreover, considerable concern was expressed relative to human safety and increased gear loss due to dangerous weather during the shortened seasons. After IFQs, these problems, according to the NAS (1999), have been eliminated, and have, as intended, reduced the number of participants.

IFQs for both the commercial red snapper and shrimp fisheries in the Gulf of Mexico have been proposed by Leal et al. (2004). For red snapper, the authors describe the current overfished state of red snapper and attribute one reason for the decline as mortality from discarded fish. Size limits, trip limits, and a shorter seasons (derby fishing) have led to ever increasing mortality rates of discarded fish. The authors estimated two million pounds per year were discarded with most thrown back dead. In the shrimp fishery, overcapacity and the associated increase in bycatch and habitat alteration is cited by Leal et al. (2004) as the primary reasons for IFQs in this fishery. They point out that in all managed fisheries, TACs should be set for the targeted species.

Based on the NAS (1999), IFQs provide a limited entry system to reduce overcapitalization and waste, with the major intent to increase incentives for vessel owners to decrease the labor and capitol. Additional advantages are improved safety at sea, better fishing and handling practices that in turn lower bycatch and allow for higher quality products for a longer period of time. Disadvantages include fairness in the initial distribution of IFQs, the effects on processors, increased costs to gain entry into a IFQ program, too many shares acquired by one entity, effects of leasing, and the issue of the allocating a public owned resource (NAS 1999).

Overcapacity in the shrimp fishery is a growing concern, notably as it relates to trawl caught bycatch. Leal et al. (2004), using NOAA Fisheries data, report that the shrimp industry landed 130 million pounds in 185 thousand fishing days in 1967; in 2001, approximately 150 million pounds were landed in 310 thousand fishing days. The authors concluded that with improved technology, 45% more effort in 2001 than in 1967 resulted in catch of about the same amount of shrimp. Currently, there are approximately 2,600 active shrimp permits in the Gulf of Mexico shrimp fishery; this number is expected to further decline until 2012 due to the economic climate of the fishery (GMFMC 2005b). Attributing to the decline are recent changes in the global shrimp industry that have flooded the U.S. with low-cost, pond-reared shrimp imports. This in turn has significantly decreased the price of domestic trawl-caught shrimp to a record low in a 37-year period. This combined with increased diesel and insurance prices and more stringent regulations, has led to overcapitalization of the fishery.

IFQs for the red snapper fishery would be a viable option provided allocations are fair and equitable, and all specifications are clearly defined including percentage values to administer and enforce this type of program. Improved safety, a reduction in labor and capitol, lower bycatch, and higher quality as reported by NAS (1999) would most probably be similar. In addition, the fishery has an established TAC that is monitored and adjusted periodically through stock assessments and council action. This is consistent with recommendations NAS (1999) in that IFQs are allocations of quota and are best suited for fisheries managed by a TAC (typically set annually by applying target exploitation rate to an estimate for current stock size). In addition, year-to-year fluctuations in recruitment due to environmental conditions could be assessed because of the longer-lived nature of this stock (Restrepo et al. 1998)

While IFQs would most likely result in the same benefits to the shrimp industry as those listed for red snapper, the shrimp stock is not experiencing (recruitment) overfishing. As stated previously, MSY is difficult to assess for shrimp based on the annual life cycle and dependence on optimal environmental conditions for growth and survival. Establishing a TAC would be difficult, based on the assumption of under optimizing shrimp yield. Future allocation attempts may not be based on shrimp catch, but instead on shrimp bycatch quotas and effort reduction measures.

Precautionary Approach

Precautionary approach (although not defined in the Magnuson-Stevens Act) as related to fisheries is based on the scientific uncertainty that exists when assessing the status of fishery stocks and prescribes for conservative management actions to harvest less than the theoretical maximum (Restrepo et al. 1998). The FAO's Code for Responsible Fisheries defines precautionary approach as a set of measures and actions, that include future courses of action and foresight, to reduce or avoid risk to the resource, environment, and people, and that take into account existing uncertainties and the potential consequences of being wrong (FAO 1995). von Zharen (1998) explains this approach as lowering the burden of proof required for taking action against activities that have the potential to have long-term affects, or scientific uncertainty relative to future harm. Many fisheries have collapsed because of an inability to implement timely conservation measures based on sound scientific proof. Hence, the precautionary approach allows for conservation actions in the absence of proof of overfishing (Restrepo et al. 1998). Within this context, NSGs (63 FR 24211, May 1, 1998) for the Magnuson-Stevens Act, provide direction relative to reference points with target reference point (OY) set below limit reference point (MSY). Moreover, the authors concluded that the criteria to set target catch levels should be risk adverse: the greater the uncertainty, the greater the caution (63 FR 24211, May 1, 1998).

An account of the international environmental history reflects the inception and rationale for the precautionary principle. In the late 1800's, Gifford Pinchot, Head of

Agriculture Forestry Division and responsible for the formation of U.S. Forest Service, promoted conservation, or the wise use of resources to yield the greatest good to the greatest number of people over time (von Zharen 2001). At the end of the 1800's, John Muir, one founder of the Sierra Club, promoted the concept of preservation, or the land ethic, and proclaimed the land's inherent worth; the concept that followed was to preserve nature for its own sake, rather than merely conserving for human use (von Zharen 2001). Early international law sought to conserve natural resources for human consumptive purposes only; in the 1970s and 1980s a move towards conservation and sustainability for other uses began to evolve, and by the early 1990s, notably in 1992 with the Earth Summit (UN 1997), a predominant shift relative to considering natural resources beyond simply human consumptive uses occurred. The shift, for the most part, incorporates the concept of precautionary principals (limits and uncertainty) within a holistic approach. Clearly, there has been a transition of major international law relevant to natural resources, reflecting the "environmental climate" in which they were conceived.

In 1948, the UN created the Inter-Governmental Maritime Consultative Organization; in 1982, the name was changed to the International Maritime Organization (IMO; IMO 2006). IMO, an agency of the UN is tasked with the creation of international legal regimes relative to trade, safety, efficiency, and marine pollution control to which the maritime industry adhere (von Zharen 2005). The concern over marine pollution was exemplified by Torrey Canyon disaster of 1967 involving an oil spill of 120,000 tons. In response, IMO promulgated the International Convention for the Prevention of Pollution from Ships of 1973, as modified by the Protocol of 1978, termed MARPOL 73/78. MARPOL 73/78 and its appendices pertain to oil, chemicals, garbage, sewage and air pollution (von Zharen 1998; IMO 2006).

In 1946, the International Convention for the Regulation of Whaling brought marine mammals to an international attention with interested nations seeking to optimize whale harvest, or MSY, on a solely economic-driven basis. It established an International Whaling Commission (IWC) comprised of one vote per signatory nation

(IWC 2006). The IWC was charged with adopting regulations (Schedule) relative to the conservation and use of whales stocks that include, but not limited to, assessing protection status, specifying area and seasonal closures, setting size and catch limits, and describing methods of harvest (Aron 2000). The Schedule, in effect, sets quotas. Fourteen nations, all whaling nations, signed the Convention in 1946; today, 71 nations (IWC 2006) mostly non-whaling, are members. IWC has met annually to amend the Schedule, requiring a 3/4th majority vote. However, a nation may file an objection within 90 days, thereby exempting them from compliance. Signatory nations can take any number of whales (as they determine) for scientific purposes, but must transmit research results to the IWC (Aron 2000). Until 1972, the Schedule was based not on a particular species or number, but instead, the blue whale oil equivalency or Blue Whale Units (Aron 2000). This enabled the IWC to control whale oil production. Prior to the 1970s, overcapitalization and severely depleted stocks prevailed.

Meanwhile, in the 1970's, marine mammal and endangered species protection came to the forefront, creating new agencies charged with the protection of these species (e.g., NOAA; Marine Mammal Commission). In 1972, at the UN's Conference on the Human Environment in Stockholm (global discussion on development and environmental issues, Stockholm, Sweden) the U.S. proposed a 10-year moratorium on whaling that subsequently did not pass in IWC. Increased public perception, primarily of the cruelty associated with whaling methods, brought about increased membership to the IWC resulting in a majority vote on a whaling moratorium in 1982 (effective 1985; Aron, 2000). Conversely, Iceland assumed Japan's traditional stand and proposed the scientific take of 250 whales (minke, fin and sei); the IWC's Scientific Committee discredited the research, but Iceland initiated the program regardless, and by August 2003 had taken 36 minke whales (Aron 2000; MMC 2005).

President Truman in 1945, due to domestic oil concerns, extended U.S. claim to all resources on the U.S. continental shelf. Other nations soon followed with similar actions. Moreover, based on depleted fish stocks, jurisdictional conflicts, increased marine pollution, and other concerns the UN's Convention on the Law of the Sea

(UNCLOS) in 1958 directed for a unified approach for international regulation of all aspects of the ocean and its use (UN 2006). The 1958 UNCLOS adopted four conventions that included the territorial sea and contiguous zone, high seas, continental shelf and fishing, and resource conservation in the high seas. In the mid 1960's, increasing conflicts over resources, increased technology and scientific advancements, growing concerns over resource use and determent, seabed mining, nuclear weapons and the Stockholm Conference on Human Environment provided the foundation for UNCLOS III. In 1982, UNCLOS III (UN 1982) was signed by 119 nations; the U.S. signed but did not ratify. The Convention entered into force in November 1994 (in 2005 -157 member states; UN 2006). Relevant provisions of the Convention (320 article and 9 annexes) include, but are not limited to, coastal states 200 nautical mile jurisdiction, and conservation and research of marine resources (high seas, territorial seas, marine mammals and sedentary species) and their environment. von Zharen's (1998) review concludes that while this is a positive step forward in international marine conservation, the provisions contained are not specific; enforcement mechanisms are lacking; and a holistic approach to management is not considered.

While the U.S. did not ratify UNCLOS III, the U.S. did ratify other agreements including the Agreement for the implementation of the provisions of the United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (in force December 2001), that was adopted by UN's Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks and termed the 1995 UN Fish Stock Agreement, or Straddling Stocks Agreement (UN 1995). The U.S. ratified the Agreement in 1996. This Agreement provided for the conservation and management of those fish stocks based on the precautionary approach and the best available scientific data.

Relative to the Straddling Stock Agreement, Restrepo et al. (1998) highlight the determination of stock specific target and limit point references, the need to take action if exceeded, and the need to account for uncertainness and impacts on non-target species.

In addition, precautionary guidelines for new fisheries and emergency management actions when resources are severely threatened due to environmental of fishing levels are provided. According to von Zharen (1998, 2005) this Agreement follows through on part of the conceptual framework from UNCLOS, and also and contains three essential components: specific boarding enforcement and sanction mechanisms, dispute resolution methods, and protection of non-targeted species, or bycatch. The drawbacks are that the principles apply to high seas (i.e., not to a nation's EEZ); and it does not address overcapitalization of the world fleets, a major cause of stock decline (von Zharen 1998).

UNCLOS provided several avenues to address responsible management of marine fisheries based on the precautionary approach (Restrepo et al. 1998). In 1991, FAO's Committee on Fisheries requested the agency to develop an International Code of Conduct for Fisheries. While not a binding international agreement, the Code for Responsible Fisheries promotes responsible fishing and optimal sustainable use in accordance with international law and calls for the precautionary approach to management (FAO 1995). The Code for Responsible Fisheries is the first international response related to food and economic productivity that addresses all aspects involved with sustainable development of living resources and directs for conservation for all species and components within the ocean ecosystem (von Zharen 1998). Again, while not binding, the precautionary principles of the Code for Responsible Fisheries are incorporated in both the Compliance Agreement and the Straddling Stock Agreement. Annex II of the latter provides for precautionary reference points (limit and target; Restrepo et al. 1998). Language directs for fishery management to ensure the risk of exceeding limit reference points will be low, and that targeted reference points should not be exceeded on average. Further, a fishing mortality rate that yields MSY should be the minimum standard for limit reference points (Restrepo et al. 1998). This marked a turning point in global environmental management approaches relative to setting standards. Delegated responsibilities are given to flag and port states, provisions for safety and internationally-agreed to standards for monitoring and control of fishing activities and potential conflicts are detailed, with the decision-making process encompassing views from all stakeholders (FAO 1995; von Zharen 1998).

In May 1992, FAO and the Mexican government held an International Conference on Responsible Fishing in Cancun, and formulated resolutions that were presented at the UN's Conference on Environment and Development (UNCED; Earth Submit) in Rio de Janeiro, Brazil in June 1992. Agenda 21 and the Rio Declaration on Environment and Development were adopted by the Conference (von Zharen 1998; OceanLaw 2006).

Agenda 21 specifies actions covering all areas of the environment, with Chapter 17 devoted to fisheries and describes the marine environment as "an essential component of the global life-support system and a positive asset that presents opportunities for sustainable development" (OceanLaw 2006). Provisions set forth include integrated management and sustainable development of coastal areas and EEZs, sustainable use and conservation of marine living resources of the high seas, and increased international coordination. Chapter 17 addressed concerns over inadequacy of current management regimes and for marine resources and high seas fisheries, with the latter encompassing unregulated fishing, overcapilization, reflagging, questionable data and lack of cooperation (OceanLaw 2006).

The Rio Declaration (or "Rio Principles") contains a set of 27 principles on the environment and development, and is designed to promote sustainable development internationally (OceanLaw 2006). While not addressing fisheries directly, Principle 15, according to the authors, states that the precautionary approach shall be used to protect the environment, and as such, lack of full scientific certainty shall not be used as a reason for delaying preventive actions against environmental degradation.

The Convention of Biological Diversity (CBD) also came out of the Rio Conference. The Convention's aim is to conserve biological diversity, promote the sustainability of ecosystem components, and encourage sharing of genetic resources (OceanLaw 2006). Nation states are required to cooperate in preserving biological diversity globally. The Convention applies to all biological diversity, marine and terrestrial. Fisheries are not specifically addressed but recognized in the Convention in the Jakarta Mandate of the Ministerial Statement on the implementation of the Convention on Biological Diversity relative to fishing effort and sustainable use of marine biodiversity (OceanLaw 2006). Fishing is listed as one of the five most important and potential threats to marine and coastal biological diversity. Parties are directed to address conservation and sustainable use of marine and coastal biological diversity (OceanLaw 2006).

The Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessel on the High Seas (Compliance Agreement) was adopted by the FAO in 1993. The Compliance Agreement was the first stage of FAO's Code of Conduct for Responsible Fisheries, and placed requirements on flag States to take measures to ensure that vessels (>24 m) flying their flags did not engage in any activity that undermines the effectiveness of international conservation and management measures, and sought to limit the freedom of vessels that have a poor compliance record to "shop around" for new flags (OceanLaw 2006). It reinforces UNCLOS, and expands rights of states whose vessels fish on the high seas. Member states must implement a license program with license authorization granted only if the state can effectively monitor and provide records to the FAO for use in the global registry of high seas fishing vessels (OceanLaw 2006). If another nation state is fishing inappropriately, it must be reported to that state, and maybe reported to the FAO (von Zharen 1998). The Compliance Agreement, fundamental to the Code, was domestically enacted through the High Seas Fishing Compliance Act of 1995.

Another binding major natural resource international instrument that illustrates a progression to the precautionary principle includes the International Convention for the Conservation of Atlantic Tunas. The agreement was signed in 1966 and established the International Commission for the Conservation of Atlantic Tunas (ICCAT; ICCAT 2006). ICCAT conducts stock assessments on Atlantic tunas, swordfish, and billfish, with member nations establishing quotas and management recommendations designed to rebuild overfished stocks and allow for sustainable harvest throughout the Atlantic

(Mediterranean Sea, the Caribbean Sea, and the Gulf of Mexico). Recommendations adopted by ICCAT are implemented domestically under the Atlantic Tunas Convention Act of 1975, and address the conservation of Atlantic tunas and codifies the obligations of the U.S. under the Convention (IPL 2006).

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) of 1973 (152 member 2001) seeks to protect endangered species of wild fauna and flora (terrestrial, avian and marine) by restricting international trade of such species (OceanLaw 2006). Species subject to CITES are listed in one of three appendices (I – lists those threatened with extinction; II lists trade that must be controlled; and III identifies by any party as protected in its jurisdiction). Import and export authorizations are granted by Management Authorities and Scientific Authorities, to which every member state is required to appoint (OceanLaw 2006). Cetaceans (whales and dolphins) are in Appendices I (gray, blue, humpback, bowhead and right whales), or II (all others); other protected species include sea otter, walrus, dugong, manatee, sea lions and sea turtles (von Zharen 1998).

Convention for the Conservation of Antarctic Marine Living Resources, 1980, 1982, (CCAMLR) promotes and sustains marine diversity within populations of fish, mollusks, crustaceans and all other species of living organisms, including birds, found south of the Antarctic Convergence (OceanLaw 2006). It provides for a holistic ecological approach to conservation, mandates measures consistent with MSY, and directs a reduction in bycatch (von Zharen 1998).

Based upon the FAO's Technical Guidelines for the Precautionary Approach three categories - fisheries management, research and technology - are defined (Restrepo et al. 1998). The authors conclude that biological reference points and control rules comprise just one component in the precautionary approach framework. Other components that warrant inclusion are access control systems, alternative management systems, improved data collection and enforcement efforts, more selective and less harmful gear, and education. The authors further state that decisions in stock assessments made by scientists relative to model choice, estimation techniques and parameter selection should be straightforward, objective, and transparent and are critical elements required for successful collaboration and progress.

The time required for implementation of international environmental laws and subsequent action is lengthy, primary because each sovereign state seeks control and optimization over its own resources, as well as those in the high seas, often disregarding long-term detrimental effects of over-utilization and waste. A great deal of diplomacy and compromise must be used in resource protection and allocation. On the domestic level, a vast array of diverse cultural, social, political and personal values impede the process. Applying these factors on a global level for common consensus on environmental issues translates into time lost and further degradation of natural resources. This is exemplified by the U.S. non-ratification of UNCLOS III. Progress is being made relative to domestic and global environmental issues, but it has taken decades to evolve. To illustrate the slow evolutionary process, in the 1960's UN delegate Pardo recognized that ocean resources were interrelated, and as such, the ocean should as be assessed as one unit (UN 2006); in 1972, the first global discussion on the environmental in Stockholm Conference on Human Environment in 1972, and twenty years later the Conference on Environment and Development (UNCED; Earth Submit). While recent efforts to address limit constraints, risk, and more holistic approaches to environmental governance into the management process have slowly been evolving, most of these lack effective enforcement mechanisms.

Ecosystems Management

An ecosystem, simply defined, is a system formed by the interactions of organisms with their environment. An ecosystem-based approach to fishery management considers all interactions that a directed fish stock has with predators, competitors, and prey species; effects of climate and weather relative to biology and ecology; interactions of stocks and their habitats; the impact of fishing effort on fish and their habitats; and all anthropogenic and natural stressors (EPAP 1999). Evans (1998) adds more to this concept and includes economics and the global market. von Zharen

(2001) points out two important concepts related to the ecosystem approach: (1) a realization that sustaining an ecosystem requires a holistic approach in which every component in the environment is interrelated and mutually dependent; and (2) recognition that ecosystem-based management must be considered not only on a local, but also, within a global context.

The underlying principles of ecosystem management have a long history. During the 1800's, the first half of the century was marked with the depletion and loss of fish stocks in the northeast U.S. (overfishing and habitat degradation though deforestation and agriculture, industrial land use and dams; Ross 1997). These conditions subsequently brought about the creation of first conservation agency in the U.S. in 1871, the U.S. Office of Commissioner of Fish and Fisheries (Ross 1997; Evans 1998). Spencer Baird, Assistant Secretary of the Smithsonian, served as the first Commissioner and realized fish depletion was not only related to harvest, but to other biotic and abiotic components within the ocean ecosystem (Ross 1997; Evans 1998; EPAP 1999). In 1945, approximately 555,000 metric tons (mt) of sardines were harvested off California and 24 canneries established (CalCOFI 2006). Two years later, sardine harvest dropped to 100,000 mt; industry imposed taxes on catch and supported the California Cooperative Oceanic Fisheries Investigation (CalCOFI) to research the reason for the collapse. Findings by CalCOFI, reported a 2 degrees C increase in ocean waters off California that were correlated with anomalies in precipitation, plankton and fisheries abundance levels (CalCOFI 2006). By 1958, CalCOFI researchers concluded that fluctuations in fishery abundance were best understood by studying the entire ocean-atmosphere relationship. In 1969, core samples revealed that sardines follow a cycle of decline and recovery approximately every 80 years, and by 1982, CalCOFI had linked the El Nino phenomena to fluctuations in temperature and biomass (Evans 1998; CalCOFI 2006).

In 1986, NOAA Administrator Evans proposed the concept of ecosystem-based management of fishery resources to Congress (Evans 1998). However, only recently, has the concept of ecosystem-based management been explored in local and international fisheries regimes. In the interim (and prevalent today), numerous stocks have been categorized as overfished or undergoing overfishing. One notable "economic" versus biological collapse occurred in the cod fishery in the early 1990s in the North Atlantic (Evans, 1998; Sharp et al. 2004, IC 2006). A number of factors were attributed to the collapse and include, but not limited to, unrealistically high TAC allocations based on single-species stock assessments, sharing of transboundary stocks in sections of the Newfoundland's Grand Banks with no record keeping, failure to control increased fishing effort, overcapacity, failure to minimize impacts of fishing gear, failure to consider ecological changes including temperature and salinity patterns, shifting predator-prey relationships, and politics (IC 1996; Evans 1998). Through increased technology, the 1990's experienced global market development for fishery resources that coincided with an increased demand for seafood with consumers willing to pay considerable amounts (Evans 1998). Exploitation of fishery stocks increased more than two fold between the 1980-90's, with 4.5 mt harvested by the U.S. consisting primarily of pollock and menhaden (EPAP 1999). At present, of the approximately 242 species under a FMP, 45 are overfished or undergoing overfishing (NMFS 2006c).

As mandated by SFA and administered by NOAA Fisheries, a multi-stakeholder Ecosystem Principles Advisory Panel (EPAP) was convened and a subsequent Report to Congress entitled "Ecosystem-Based Fishery Management" was submitted in 1999 (EPAP 1999). EPAP (1999) provided a conceptual model of the ecosystem theory as it relates to fisheries, assessed current ecosystem practices, and recommended how to incorporate ecosystem principles (e.g., exhaustibility, uncertainty and the role of humans) and management policies with the ultimate goal of maintaining healthy and sustainable ecosystems.

EPAP (1999) proposes that regional fishery management councils should continue to use single species (or species complex) FMPs as amended to incorporate ecosystem approaches as specified under a national Fisheries Ecosystem Plan (FEP). According to the authors, each council would develop an FEP that identifies and zones the ecosystem by taking into account (1) hydrography, bathymetry, productively and trophic structure; (2) how climate influences the physical, chemical and biological components within ecosystem; and (3) how these (1 and 2) affect the food web dynamics. EPAP (1999) stresses that the Department of Commerce prepare guidelines, encourage FEP demonstration models, and enact FEP through the current reauthorization of the Magnuson-Act with enforcement through oversight and timelines.

Consistent with the philosophy of ecosystem management as it applies to fisheries, NOAA's Strategic Plan FY2003-FY2008 and Beyond (NOAA 2006) addresses the protection, restoration and managed use of coastal and ocean resources through ecosystem management approaches. Investment to improve ecosystem understanding, identification of FEPs, development of health indices as well as new methods to ensure full implementation of an ecosystem-based management approach is the goal-wide ecosystem strategy defined by NOAA (NOAA 2006).

Over three decades ago, the Stratton Commission conducted a U.S. ocean policy comprehensive assessment (USCOP 2004). The Oceans Act of 2000 (Public Law 106-256) emphasized the great importance of this nation's oceans, coasts and marine resources, and prompted the President to develop and appoint a 16-member U.S. Commission on Ocean Policy (USCOP). USCOP's charge was to develop recommendations for a new national ocean policy. Based on testimony from a diverse array of 445 experts (e.g., scientists, industry, environmentalists, citizens), and consultation with its Science Advisory Panel, USCOP released in September 2004, a comprehensive Final Report to the President and Congress entitled: "An Ocean Blueprint for the 21st Century" (USCOP 2004). USCOP expired in December 2004 as required in the Oceans Act of 2000. The resulting document of the Administration's response to COP recommendations is the U.S. Ocean Action Plan of December 2004.

The Pew Oceans Commission (POC) released its own final report to Congress and the nation in June 2003 entitled: "America's Living Oceans: Charting a Course for Sea Change" (POC 2003). This report as well dictated the need for ecosystem approach to management.

Collectively, NOAA, USCOP and POC stress the need for an ecosystem approach to management. In response to these directives, 2006 efforts related to the reauthorization of the Magnuson-Stevens Act direct that regional fishery management councils create fishery ecosystem plans inclusive of Habitat Areas of Particular Concern (NMFS 2005). These plans, as such, are intended to direct fisheries management towards an ecosystem approach. Faced with these challenges, this reemphasizes the need for regional fishery management councils to rely more heavily on the best available science and adhere to conflict of interest requirements as recommended by U.S. Commission on Ocean Policy (USCOP 2004). In a November 2006 meeting of regional fishery management council representatives, Commerce Department Deputy Secretary Sampson concluded that reauthorization would bring about new challenges in fishery management, stating that councils must change the "business as usual" attitude perceived by many outside the process associate with the council system (NMFS 2006d).

Future Management Considerations

Previous and current management and conservation measures have been largely ineffective due a single-species, crisis response management system, and lack of a comprehensive approach to viewing the marine ecosystem as an interrelated system (Evans 1998). von Zharen (1998) describes this in terms of legislative mandates in response to human-induced threats (over harvesting of the oceans, ecosystem disruption from pollution, and uncontrolled development).

Sharp et al. (2004) postulated the way to transform single-species management regimes into true ecosystems management, requires a re-ordering of the interactions of fishing communities, managers, scientists, politicians and all other stakeholders. The authors concluded that the primary difference between (1) how fisheries problems are conceptualized currently, and (2) how they really operate is that ecosystems are dynamic, from primary producer level to the top of the food chain. The bottom line in both approaches is that during periods of low fish abundance, the problem becomes one of too many people and too few fish, further intensified by the expansion from local and regional markets to the global arena (Sharp et al. 2004).

Improving current management strategies requires clearly defined objectives and processes and greater collaboration from all sectors. Sharp et al. (2004) suggest that the only solution for the world's fisheries crisis is to redefine the problem, with the problem not being about sustaining fish, but rather sustaining fishing people. The authors stress that success in the latter implies success in the former. Indirectly, this illustrates an important point: to allow industry and other shareholders to become much more involved in, and become part of, resource management. Hawken (1993) in his national bestseller entitled: "The Ecology of Commerce: A Declaration of Sustainability" further concluded that the role of government is to assume those functions that cannot be accomplished by citizens or private institutions. The author recognizes a critical need for change that involves new ways to introduce and discuss ecological principles in a manner that draws people together, noting that confusion or ignorance of these ecological principles will not provide protection from their implications.

Involving the fishing industry to a greater degree in fishery management processes that are straightforward and transparent has proven beneficial in several areas. Johnson and Childers (1999) described the stewardship ethic of the Alaskan fishing industry. The authors cite an Alaskan fishing industry participant "As fishermen, we benefit from the resource. Taking responsibility for conservation is how we give something back." Moreover, Sharp et al. (2004) reported that by carefully integrating information provided by the fishing industry with government research and surveys, optimal management strategies are obtained. The authors provide several examples of such types of collaboration including New Zealand's trawl fishery, South Africa's Benguela Ecology Program, and Canada's Sentinel Fishery effort in the North Atlantic. Kaiser (2000) reviewed the need to support a Code of Responsible Fisheries. The overall assessment concluded that fishing practices, price competition and lack of participation by the fishing industry relative to management decisions often led to situations where bycatch occurred. Changes to the current management regime, altering fishing practices, and increased consumer awareness relative to sustainability were deemed necessary for these fisheries to remain stable (Kaiser 2000).

As one of the world's largest buyers of fish, Unilever, has focused on increased consumer awareness as part of its sustainability initiative (Unilever 2003). Through a cooperative effort between Unilever and the World Wildlife Federation, an independent certification organization, the Marine Stewardship Council (MSC), was established. According to the authors, MSC developed Principles and Criteria (Standard) for sustainable fisheries, to which a fishery can become certified and carry the MSC logo. Unilever has encouraged their fish suppliers to seek certification to the MSC standard to promote consumer choice and reward sustainable fisheries. New Zealand hoki, U.S. Alaskan pollock, Chilean hake and South African hake are among the fisheries certified, or undergoing certification (Unilever 2003).

Efforts have been progressing towards a holistic approach to the conservation and management relative to all aspects of the ocean ecosystem. In addition to the Code of Responsible Fisheries (FAO 1995), von Zharen (1998) discusses other conservation measures that include the 1998 Ocean Charter, and ISO 14001. The 1998 Ocean Charter, a cooperative effort between the Cousteau Society and the UN, encourages individuals to join an international effort to protect the ocean ecosystem (von Zharen 1998). The underlying principles of the Ocean Charter are to empower those who sign the agreement to influence ocean policy within and among countries, and prescribe for a commitment to protect the ocean. Similar to the MSC standard discussed above, the ISO's (International Organization for Standardization; ISO Greek translation is "equal") system standard, ISO 14001, addresses environmental management on a global scale, but with local application.

ISO is a non-governmental worldwide alliance of national standards institutes currently comprising 148 members (ISO 2006). The objective of ISO is to promote the development of standardization and related activities in the world with a view to facilitating international exchange of goods and services, and to developing cooperation in scientific, technological and economic activity; the results of ISO technical work are published as International Standards (ISO 2006).

The ISO 14000 series is a set of international applicable standards that provides guidance to any organizational unit that seeks to improve operations, services and/or products through use of an Environmental Management System (EMS; von Zharen 2001). An EMS is a set of processes and practices developed by an organization that allow for a reduction in environmental impacts and increased operating efficiency (EPA 2006). The underlying principles are that if individual organizations commit to the environment through an EMS, the collective result will benefit the environment as a whole. Several key components of an EMS include: motivated employees (or shareholders), identification of an activity and its impact to the environment, establishing objectives and targets, developing an action plan, and a continuous and adaptive monitoring system that always targets improvement (von Zharen 1996). In 2000, President Clinton signed Executive Order 13148 requiring all federal agencies to adopt an EMS by December 2005. Moreover, the White House Office of Management and Budget and the White House Council on Environmental Quality have offered clear direction that all agencies are required to use EMS for an effective management and stewardship relative to in their policies, practices, and budgets (DOE 2003).

The inception of ISO 14000 series resulted from efforts at the Earth Summit in 1992. The series of international standards for environmental management are collectively called ISO 14000 with all but one of the series, ISO 14001, providing guidance. The ISO 14001 standard is the specification document that denotes the requirement of an EMS (von Zharen 2001). It is the standard to which an organization can be certified (BSI 2002). The certification or registration of an EMS delineates that the EMS conforms to the requirements of the ISO 14001 standard (von Zharen 2001).

The underlying principals of ISO 14001 are the commitment to improve environmental performance, increase public awareness of an organization's commitment to improve the environment, and at the same time reduce operational costs and/or decrease liability exposure (von Zharen 1996; von Zharen 2001). An organization's efforts as related to this may be as simple as to reduce heating and cooling temperatures and water use in offices to as complex as reducing air emissions from marine activities. The key components to ISO 14001 certification are to identify all environmental impacts resulting from an activity, product, or services; seek to eliminate or reduce negative impacts; and finally, continually look for avenues for improvement. Each phase of the certification process requires documentation. The overall bottom line is a reduction in negative impacts to the environment, cost savings to the organization, improved employee morale, and increased public awareness of an organization's commitment to protect the environment (von Zharen 1996; von Zharen 2001).

According to von Zharen (2001), specific elements of an ISO 14001-based EMS include the following steps: develop an environmental policy statement that incorporates the organization's commitment to protect the environment; identify activities, services, or products that have the potential to significantly impact the environment; develop a system to access applicable law pertaining to organizational activities; establish objectives and targets to reduce environmental impacts; develop an action plan to meet objectives and targets; identify roles and responsibilities for each step of the plan; train employees on their EMS responsibilities; facilitate communication both internally and externally related to the EMS; record and document EMS-related material; establish operational activities related to the policy statement, objectives and targets inclusive of emergency prevention and response; establish procedures for tracking performance and corrective actions related to the EMS non-compliance; and periodically audit and review the EMS relative to operational aspects, and to ensure it is continually improved (von Zharen 2001).

As our younger generation becomes increasing more knowledgeable in conservation issues and implications, more companies are making an environmental commitment, and benefiting from increased recognition and profits (von Zharen 2001). As of 2002, the number of ISO 14001 companies globally was 49,462, with U.S. companies numbering 2,620 (WRI 2006). In January 2006, the number of ISO certified companies increased worldwide to 103,593, with the U.S. accounting for 5,100 companies (CRM 2006).

Sustaining natural resources for current and future use is the ultimate goal of all management regimes. Sustainability, according to von Zharen (2001), is a management philosophy that shares the same objectives as business, namely increased revenues, profits and assists with a corporate commitment to safeguarding and renewing resources, both natural and human.

While used by corporations and other companies globally, ISO 14001 certification has the potential to become a viable business strategy for the fishing industry. Unification of shareholders relative to a common goal is required. This concept has been successfully demonstrated by the commercial shrimp industry as illustrated by the Southern Shrimp Alliance (SSA). SSA represents shrimp fishermen and processors nationally and organized in response to global trade practices and the subsequent decline in domestic shrimp prices (SSA 2006). One of the many objectives of SSA involves lobbying for more stringent controls and testing of banned chemicals, notably, chloramphenical and nitrofurans used historically by some shrimp importing countries to treat disease and ultimately grow pond-reared shrimp faster. SSA is also involved with developing marketing plans for domestic shrimp. ISO 14001 certification would be a viable business option for SSA and other fishing organizations to consider.

Another key element of ISO 14001 certification is a commitment and involvement from management. This commitment could originate at the regional fishery management council level. Collectively, establishing objectives and targets with a dispute resolution mechanism employed to achieve consensus, the development and implementation of a dynamic action plan, could be executed as it relates to reducing environmental impacts and increasing profits.

Moreover, ISO 14001 certification with industry taking the initiative to derive environmentally sound practices has the potential, and the Magnuson-Steven's discretionary authority as related bycatch reduction, to be interconnected with IFQs and license limitation programs through incentive-based applications. These could be addressed through percentage levels and other avenues to promote continual improvement. NAS (1999) elaborated on the use of individual bycatch quotas (IBQs), and concluded that IBQs have the potential to reduce both the rate and quantity of bycatch.

Based on their experience and knowledge of the resource empowering the fishing industry to take the led in identifying processes that have or have the potential to result in negative environmental impacts relative to fishing operations, combined with straightforward and transparent science that incorporates an ever increasing wider array of biotic and abiotic interactions, an effective EMS is inevitable. Once identified, a plan may consist of various objectives and targets that include changes in fishing behaviors relative to avoidance of high bycatch areas, modifications to gear to reduce bycatch, cooperative efforts to close areas during particular seasons of high bycatch, alternative fuels for vessels and transport of seafood.

As presented in chapters II and III of this dissertation, bycatch in the southeastern shrimp and reef fisheries as related to species-specific catch rates and fishing practices, combined with in-depth assessment of BRD effectiveness (NMFS 2006a) can be used to in many ways. These include, but are not limited to, the enhancement of stock assessments and ecologically based models, and in the development and implementation plan required for an effective EMS, within an ISO 14001 framework. Specifically, area and seasonal closures associated with high concentrations of bycatch could be one consideration in EMS planning and implementation. On a more refined level, federally managed species and other species of commercial, recreational and ecological importance, taken in the commercial shrimp fishery over a fourteen-year period as presented in chapter III, may be considered in relation to bycatch reduction device development as well as area and seasonal closures.

As demonstrated in chapter IV, substantial progress has been made in turtle excluder device (TED) technology since the 1980's. In an effort to continually improve operational aspects and to gain a better understanding of all factors related to sea turtle abundance, distribution and biotic and abiotic interactions, additional investigation and further refinement of the models presented in the chapter IV could be a component relative to EMS planning and execution.

Examination of non-conventional methods for harvesting penaeid shrimp, as demonstrated in Chapter V, offers increased opportunities in relation to reducing environmental harm. The tangible benefits, as exemplified with the skimmer trawl fishery, include reducing finfish bycatch, lessening bottom habitat disruption, and decreasing fuel consumption.

In summary, an EMS for the fishing industry provides an environmentally sound and economically driven approach to ocean stewardship. This method seeks to enhance marine ecosystem health globally, through local application, and is designed to involve, motivate and empower all shareholders to devise methods to improve operational processes to continually benefit the environment.

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APPENDIX A

SPECIES COMPOSITION TABLES

Table A1. Species (or equivalent), CPUE and percent of the total weight of organisms captured in shrimp trawls in the Gulf of Mexico. Based on observer coverage of the U.S. Gulf of Mexico shrimp fishery from February 1992 through December 2005.

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Longspine Porgy	*Stenotomus caprinus*	2.8	9.5
Atlantic Croaker	*Micropogonias undulatus*	2.1	7.3
Pink Shrimp	*Farfantepenaeus duorarum*	2.1	7.2
Brown Shrimp	*Farfantepenaeus aztecus*	2.1	7.1
Inshore Lizardfish	*Synodus foetens*	1.6	5.6
Iridescent Swimming Crab	*Portunus gibbesii*	1.0	3.5
Lesser Blue Crab	*Callinectes similis*	0.6	2.2
Blotched Swimming Crab	*Portunus spinimanus*	0.6	2.0
Gulf Butterfish	*Peprilus burti*	0.6	1.9
Sand Seatrout	*Cynoscion arenarius*	0.5	1.8
Sand Perch	*Diplectrum formosum*	0.5	1.7
Sponge Phylum	Porifera	0.5	1.6
Pinfish	*Lagodon rhomboides*	0.4	1.4
Mantis Shrimp Genus	*Squilla sp.*	0.4	1.4
Spot (Flat Croaker)	*Leiostomus xanthurus*	0.4	1.4
Longspine Swimming Crab	*Portunus spinicarpus*	0.4	1.3
Brown Rock Shrimp	*Sicyonia brevirostris*	0.4	1.3
Debris (rocks, logs, etc.)	Debris	0.4	1.3
Dusky Flounder	*Syacium papillosum*	0.4	1.2
Sugar/Blood Shrimp Genus	*Trachypenaeus sp.*	0.4	1.2
Shoal Flounder	*Syacium gunteri*	0.3	1.2
Rock Seabass	*Centropristis philadelphica*	0.3	1.1
White Shrimp	*Litopenaeus setiferus*	0.3	1.1
Bigeye(Blackfin) Searobin	*Prionotus longispinosus*	0.3	1.0
Leopard Searobin	*Prionotus scitulus*	0.3	1.0
Atlantic Cutlassfish	*Trichiurus lepturus*	0.3	1.0
Silver Jenny	*Eucinostomus gula*	0.3	1.0
Hardhead Catfish	*Arius felis*	0.3	1.0
Swimming Crab Family	Portunidae	0.3	0.9
Longfin Squid	*Loligo pealeii*	0.3	0.9
Bluespotted Searobin	*Prionotus roseus*	0.2	0.8
Spotfin Mojarra	*Eucinostomus argenteus*	0.2	0.7
Gulf Menhaden	*Brevoortia patronus*	0.2	0.7

Table A1. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Seatrout Genus	*Cynoscion sp.*	0.2	0.7
Mantis Shrimp	*Squilla empusa*	0.2	0.6
Scrawled Cowfish	*Lactophrys quadricornis*	0.2	0.6
Pigfish	*Orthopristis chrysoptera*	0.2	0.6
Dwarf Sand Perch	*Diplectrum bivittatum*	0.2	0.6
Silver Seatrout	*Cynoscion nothus*	0.2	0.5
Dwarf Goatfish	*Upeneus parvus*	0.2	0.5
Blackedge Cusk-eel	*Lepophidium brevibarbe*	0.2	0.5
Lane Snapper	*Lutjanus synagris*	0.2	0.5
Blue Crab	*Callinectes sapidus*	0.1	0.5
Atlantic Brief Squid	*Lolliguncula brevis*	0.1	0.5
Tomtate	*Haemulon aurolineatum*	0.1	0.5
Orange Filefish	*Aluterus schoepfi*	0.1	0.4
Clearnose Skate	*Raja eglanteria*	0.1	0.4
Spotted Whiff	*Citharichthys macrops*	0.1	0.4
Swimming Crab Genus	*Portunus sp.*	0.1	0.4
Atlantic Bumper	*Chloroscombrus chrysurus*	0.1	0.4
Blackwing Searobin	*Prionotus rubio*	0.1	0.4
Fringed Flounder	*Etropus crossotus*	0.1	0.4
Southern Kingfish	*Menticirrhus americanus*	0.1	0.4
Southern Flounder	*Paralichthys lethostigma*	0.1	0.4
Atlantic Midshipman	*Porichthys plectrodon*	0.1	0.4
Rock Shrimp Genus	*Sicyonia sp.*	0.1	0.3
Red Snapper	*Lutjanus campechanus*	0.1	0.3
Rough Scad	*Trachurus lathami*	0.1	0.3
Sea Bob Shrimp	*Xiphopenaeus kroyeri*	0.1	0.3
Southern Hake	*Urophycis floridana*	0.1	0.3
Smoothead Scorpionfish	*Scorpaena calcarata*	0.1	0.3
Polkadot Batfish	*Ogcocephalus radiatus*	0.1	0.3
Mexican Flounder	*Cyclopsetta chittendeni*	0.1	0.3
Blackear Bass	*Serranus atrobranchus*	0.1	0.3
Bandtail Puffer	*Sphoeroides spengleri*	0.1	0.3
Jellyfish Class	Scyphozoa	0.1	0.3
Bay Whiff	*Citharichthys spilopterus*	0.1	0.2
Wenchman	*Pristipomoides aquilonaris*	0.1	0.2
Ocellated Flounder	*Ancylopsetta quadrocellata*	0.1	0.2
Sponge Class	Demospongiae	0.1	0.2
Lesser Rock Shrimp	*Sicyonia dorsalis*	0.1	0.2
Roundel Skate	*Raja texana*	0.1	0.2
Unknown Crustacean	Unknown Crustacean	0.1	0.2
Blackcheek Tonguefish	*Symphurus plagiusa*	0.1	0.2
Striped Burrfish	*Chilomycterus schoepfi*	0.1	0.2

Table A1. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Yellow Box Crab	*Calappa sulcata*	0.1	0.2
Moon Jellyfish	*Aurelia aurita*	0.1	0.2
Mojarra Genus	*Eucinostomus sp.*	0.0	0.2
Sardine, Scaled	*Harengula jaguana*	0.0	0.2
Mexican Searobin	*Prionotus paralatus*	0.0	0.2
Lefteye Flounder Genus	*Etropus sp.*	0.0	0.1
Gafftopsail Catfish	*Bagre marinus*	0.0	0.1
White Grunt	*Haemulon plumieri*	0.0	0.1
Round Herring	*Etrumeus teres*	0.0	0.1
Largescale Lizardfish	*Saurida brasiliensis*	0.0	0.1
Threadfin Shad	*Dorosoma petenense*	0.0	0.1
Red Goatfish	*Mullus auratus*	0.0	0.1
Barbfish	*Scorpaena brasiliensis*	0.0	0.1
Spanish Sardine	*Sardinella aurita*	0.0	0.1
Southern Puffer	*Sphoeroides nephelus*	0.0	0.1
Bank Cusk-eel	*Ophidion holbrooki*	0.0	0.1
Atlantic Spadefish	*Chaetodipterus faber*	0.0	0.1
Spanish Mackerel	*Scomberomorus maculatus*	0.0	0.1
Offshore Lizardfish	*Synodus poeyi*	0.0	0.1
Smooth Pufferfish	*Lagocephalus laevigatus*	0.0	0.1
Humpback Shrimp Genus	*Solenocera sp.*	0.0	0.1
Atlantic Thread Herring	*Opisthonema oglinum*	0.0	0.1
Scup	*Stenotomus chrysops*	0.0	0.1
Big Eye Mojarra	*Eucinostomus havana*	0.0	0.1
Atlantic Sharpnose Shark	*Rhizoprionodon terraenovae*	0.0	0.1
Squid and Octopus Class	Cephalopoda	0.0	0.1
Paper Scallop	*Amusium papyraceus*	0.0	0.1
Squid Genus	*Loligo sp.*	0.0	0.1
Banded Croaker	*Larimus fasciatus*	0.0	0.1
Squid Family	Loliginidae	0.0	0.1
Crustacean Order	Decapoda	0.0	0.1
Shortwing Searobin	*Prionotus stearnsi*	0.0	0.1
Flatface Swimming crab	*Portunus depressifrons*	0.0	0.1
Horned Searobin	*Bellator militaris*	0.0	0.1
Flame Box Crab	*Calappa flammea*	0.0	0.1
Planehead Filefish	*Monacanthus hispidus*	0.0	0.1
Jellyfish Family	Carybdeidae	0.0	0.1
Gray Triggerfish	*Balistes capriscus*	0.0	0.1
Bearded Brotula	*Brotula barbata*	0.0	0.1
Pancake Batfish	*Halieutichthys aculeatus*	0.0	0.1
Star Drum	*Stellifer lanceolatus*	0.0	0.1
Least Puffer	*Sphoeroides parvus*	0.0	0.1

Table A1. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Gulf Flounder	*Paralichthys albigutta*	0.0	0.1
Harvestfish	*Peprilus alepidotus*	0.0	0.1
Lefteye Flounder Genus	*Bothus sp.*	0.0	0.1
Round Scad	*Decapterus punctatus*	0.0	0.1
Cownose Ray	*Rhinoptera bonasus*	0.0	0.1
Yellow Conger	*Hildebrandia flava*	0.0	0.1
Striped Anchovy	*Anchoa hepsetus*	0.0	0.1
Ravenel Scallop	*Pecten raveneli*	0.0	0.1
Spotfin Flounder	*Cyclopsetta fimbriata*	0.0	0.1
Spinycheek Scorpionfish	*Neomerinthe hemingwayi*	0.0	0.1
Sea Cucumber Class	Holothuroidea	0.0	0.1
King Mackerel	*Scomberomorus cavalla*	0.0	0.1
Bighead Searobin	*Prionotus tribulus*	0.0	0.1
Snakefish	*Trachinocephalus myops*	0.0	0.1
Seabass Genus	*Diplectrum sp.*	0.0	0.1
Lefteye Flounder Genus	*Syacium sp.*	0.0	0.1
Squid Order	Teuthoidea	0.0	0.1
Northern Kingfish	*Menticirrhus saxatilis*	0.0	0.1
Scorpionfish Genus	*Scorpaena sp.*	0.0	0.1
Lady Crab Genus	*Ovalipes sp.*	0.0	0.1
Twospot Flounder	*Bothus robinsi*	0.0	0.1
Bluestriped Grunt	*Haemulon sciurus*	0.0	0.1
Spottail Tonguefish	*Symphurus urospilus*	0.0	0.1
Seabream	*Archosargus rhomboidalis*	0.0	0.1
Echinoderm Class	Echinoidea	0.0	0.1
Red Drum	*Sciaenops ocellatus*	0.0	0.1
Smooth Butterfly Ray	*Gymnura micrura*	0.0	0.1
Bank Seabass	*Centropristis ocyurus*	0.0	0.1
Sheepshead	*Archosargus probatocephalus*	0.0	0.0
Atlantic Moonfish	*Selene setapinnis*	0.0	0.0
Fringed Filefish	*Monacanthus ciliatus*	0.0	0.0
Southern Stingray	*Dasyatis americana*	0.0	0.0
Requiem Shark Genus	*Carcharhinus sp.*	0.0	0.0
Calico Box Crab	*Hepatus epheliticus*	0.0	0.0
Keyhole Urchin (sanddollar)	*Mellita quinquiesperforata*	0.0	0.0
Marbled Puffer	*Sphoeroides dorsalis*	0.0	0.0
Notched Sand Dollar	*Encope emarginata*	0.0	0.0
Ridged Slipper Lobster	*Scyllarides nodifer*	0.0	0.0
Portly Spider Crab	*Libinia emarginata*	0.0	0.0
Honeycomb Moray	*Gymnothorax saxicola*	0.0	0.0
Atlantic Guitarfish	*Rhinobatos lentiginosus*	0.0	0.0
Atlantic Threadfin	*Polydactylus octonemus*	0.0	0.0

Table A1. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Vermillion Snapper	*Rhomboplites aurorubens*	0.0	0.0
Whitebone Porgy	*Calamus leucosteus*	0.0	0.0
Blue Runner	*Caranx crysos*	0.0	0.0
Florida Lady Crab	*Ovalipes floridanus*	0.0	0.0
Starfish Subclass	Asteroidea	0.0	0.0
Horseshoe Crab	*Limulus polyphemus*	0.0	0.0
Fringed Sole	*Gymnachirus texae*	0.0	0.0
Spotted Batfish	*Ogcocephalus pantostictus*	0.0	0.0
Bigeye Scad	*Selar crumenophthalmus*	0.0	0.0
Unknown Invertebrate	Unknown Invertebrate	0.0	0.0
Lady Crab (w/o spots)	*Ovalipes guadulpensis*	0.0	0.0
Michelin's Sand Dollar	*Encope michelini*	0.0	0.0
Atlantic Stingray	*Dasyatis sabina*	0.0	0.0
Knobbed Porgy	*Calamus nodosus*	0.0	0.0
Spottedfin Tonguefish	*Symphurus diomedianus*	0.0	0.0
Bigeye	*Priacanthus arenatus*	0.0	0.0
Guaguanche	*Sphyraena guachancho*	0.0	0.0
Blacknose Shark	*Carcharhinus acronotus*	0.0	0.0
Searobin Genus	*Prionotus sp.*	0.0	0.0
Mottled Cusk-eel	*Lepophidium jeannae*	0.0	0.0
Scad Mackerel	*Decapterus macarellus*	0.0	0.0
Pisces (Grouped Fish)	Pisces	0.0	0.0
Sand Diver	*Synodus intermedius*	0.0	0.0
Searobin Family	Triglidae	0.0	0.0
Speckled Swimming Crab	*Arenaeus cribrarius*	0.0	0.0
Tunicate Phylum	Urochordata	0.0	0.0
Finger Sponge	*Haliclona oculata*	0.0	0.0
Bonnethead Shark	*Sphyrna tiburo*	0.0	0.0
Invertebrate	Invertebrate	0.0	0.0
Gulf Hake	*Urophycis cirrata*	0.0	0.0
Bandtail Searobin	*Prionotus ophryas*	0.0	0.0
Lancer Stargazer	*Kathetostoma albigutta*	0.0	0.0
Sash Flounder	*Trichopsetta ventralis*	0.0	0.0
Sharksucker	*Echeneis naucrates*	0.0	0.0
Emerald Parrotfish	*Nicholsina usta*	0.0	0.0
Singlespot Frogfish	*Antennarius radiosus*	0.0	0.0
Gulf Bar-Eyed Tilefish	*Caulolatilus intermedius*	0.0	0.0
Dotterel Filefish	*Aluterus heudeloti*	0.0	0.0
Spanish Slipper Lobster	*Scyllarides aequinoctialis*	0.0	0.0
Atlantic Figsnail	*Ficus communis*	0.0	0.0
Pigmy Filefish	*Monacanthus setifer*	0.0	0.0
Bluefish	*Pomatomus saltatrix*	0.0	0.0

Table A1. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Jolthead Porgy	*Calamus bajonado*	0.0	0.0
Flat Sea Biscuit	*Clypeas subdepresus*	0.0	0.0
Silver Conger	*Hoplunnis macrurus*	0.0	0.0
Gulf Kingfish	*Menticirrhus littoralis*	0.0	0.0
Cushion Starfish (reticulated)	*Oreaster reticulatus*	0.0	0.0
Blueback Herring	*Alosa aestivalis*	0.0	0.0
Offshore Tonguefish	*Symphurus civitatus*	0.0	0.0
Arthropod Subphylum	Crustacea	0.0	0.0
Littlehead Porgy	*Calamus proridens*	0.0	0.0
Spotted Hake	*Urophycis regia*	0.0	0.0
Blackedge Moray	*Gymnothorax nigromarginatus*	0.0	0.0
Hogchoker	*Trinectes maculatus*	0.0	0.0
Marlin-spike	*Nezumia bairdi*	0.0	0.0
Shrimp Eel	*Ophichthus gomesi*	0.0	0.0
Sea Hare Genus	*Aplysia sp.*	0.0	0.0
Polyps and Medusae	Cnidaria	0.0	0.0
Cobia (Ling)	*Rachycentron canadum*	0.0	0.0
Orangespotted Filef	*Cantherhines pullus*	0.0	0.0
Mottled Seahare	*Aplysia brasiliana*	0.0	0.0
Swordtail Jawfish	*Lonchopisthus micrognathus*	0.0	0.0
Sandollar Genus	*Encope sp.*	0.0	0.0
Blotched Cusk-eel	*Ophidion grayi*	0.0	0.0
Conger Eel	*Conger oceanicus*	0.0	0.0
Silver Perch	*Bairdiella chrysoura*	0.0	0.0
Whelk Genus	*Busycon sp.*	0.0	0.0
Three Eyed Flounder	*Ancylopsetta dilecta*	0.0	0.0
Unknown Fish	Unknown Fish	0.0	0.0
Black Drum	*Pogonias cromis*	0.0	0.0
Lined Sole	*Achirus lineatus*	0.0	0.0
White Fin Sharksucker	*Echeneis neucratoides*	0.0	0.0
Jackknife-fish	*Equetus lanceolatus*	0.0	0.0
Lesser Electric Ray	*Narcine brasiliensis*	0.0	0.0
Sea Pansy	*Renilla sp.*	0.0	0.0
Jack Family	Carangidae	0.0	0.0
Slantbrow Batfish	*Ogcocephalus declivirostris*	0.0	0.0
Coarsehand Lady Crab	*Ovalipes stephensoni*	0.0	0.0
False Pilchard	*Harengula clupeola*	0.0	0.0
Smooth Dogfish Shark	*Mustelus canis*	0.0	0.0
Shortnose Batfish	*Ogcocephalus nasutus*	0.0	0.0
Ray Genus	*Gymnura sp.*	0.0	0.0
Remora	*Remora remora*	0.0	0.0
Cubbyu	*Equetus umbrosus*	0.0	0.0

Table A1. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Ocean Triggerfish	*Canthidermis sufflamen*	0.0	0.0
Bluntnose Stingray	*Dasyatis say*	0.0	0.0
Spreadfin Skate	*Raja olseni*	0.0	0.0
Lobed Moon Shell	*Polinices duplicatus*	0.0	0.0
Common Crevalle Jack	*Caranx hippos*	0.0	0.0
Box Crab Family	Calappidae	0.0	0.0
Blacktip Shark	*Carcharhinus limbatus*	0.0	0.0
Broad Flounder	*Paralichthys squamilentus*	0.0	0.0
Knobbed Whelk	*Busycon carica*	0.0	0.0
Caribbean Spiny Lobster	*Panulirus argus*	0.0	0.0
Spiny Butterfly Ray	*Gymnura altavela*	0.0	0.0
Sand Whiff	*Citharichthys arenaceus*	0.0	0.0
Box Crab Genus	*Calappa sp.*	0.0	0.0
Longnose Spider Crab	*Libinia dubia*	0.0	0.0
Lemon Shark	*Negaprion brevirostris*	0.0	0.0
Bay Anchovy	*Anchoa mitchilli*	0.0	0.0
Sand Dollar Order	*Cylpeasteroida*	0.0	0.0
Chub Mackerel	*Scomber japonicus*	0.0	0.0
Lady (w/specks) Crab	*Ovalipes ocellatus*	0.0	0.0
Roughback Batfish	*Ogcocephalus parvus*	0.0	0.0
Unicorn Filefish	*Aluterus monoceros*	0.0	0.0
Crested Cusk-eel	*Ophidion welshi*	0.0	0.0
Florida Smoothhound	*Mustelus norrisi*	0.0	0.0
Atlantic Purple Sea Urchin	*Arbacia punctulata*	0.0	0.0
Longnose Batfish	*Ogcocephalus corniger*	0.0	0.0
Ragged Goby	*Bollmannia communis*	0.0	0.0
Spotted Spoonnose Eel	*Echiophis intertinctus*	0.0	0.0
Snail Class	Gastropoda	0.0	0.0
Black Seabass	*Centropristis striata*	0.0	0.0
Gray Flounder	*Etropus rimosus*	0.0	0.0
Seabass Genus	*Centropristis sp.*	0.0	0.0
Pear Whelk	*Busycotypus spiratus*	0.0	0.0
Grass Porgy	*Calamus arctifrons*	0.0	0.0
Horned Whiff	*Citharichthys cornutus*	0.0	0.0
Orange Spot Sardine	*Sardinella brasiliensis*	0.0	0.0
Variable Urchin	*Lytechinus variegatus*	0.0	0.0
Bluntnose Jack	*Hemicaranx amblyrhynchus*	0.0	0.0
Florida Stone Crab	*Menippe mercenaria*	0.0	0.0
Spiny Flounder	*Engyophrys senta*	0.0	0.0
Gray Snapper	*Lutjanus griseus*	0.0	0.0
Red Lizardfish	*Synodus synodus*	0.0	0.0
Northern Searobin	*Prionotus carolinus*	0.0	0.0

Table A1. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Spotted Scorpionfish	*Scorpaena plumieri*	0.0	0.0
Scrawled Filefish	*Aluterus scriptus*	0.0	0.0
Palmate Sponge Genus	*Isodictya sp.*	0.0	0.0
Red Porgy	*Pagrus pagrus*	0.0	0.0
Gizzard Shad	*Dorosoma cepedianum*	0.0	0.0
Conger Eel Family	Congridae	0.0	0.0
Stilt Spider Crab	*Anasimus latus*	0.0	0.0
Northern Shortfin Squid	*Illex illecebrosus*	0.0	0.0
Giant Tun	*Tonna galea*	0.0	0.0
Finescale Menhaden	*Brevoortia gunteri*	0.0	0.0
Sailor's choice	*Haemulon parra*	0.0	0.0
Slipper Lobster Genus	*Scyllarides sp.*	0.0	0.0
Spider Crab Genus	*Libinia sp.*	0.0	0.0
Common Octopus	*Octopus vulgaris*	0.0	0.0
Pygmy Sea Bass	*Serraniculus pumilio*	0.0	0.0
Yellow Stingray	*Urobatis jamaicensis*	0.0	0.0
Calico Scallop	*Argopecten gibbus*	0.0	0.0
Sea Urchin Genus	*Arbacia sp.*	0.0	0.0
Tonguefish Genus	*Symphurus sp.*	0.0	0.0
Yellowedge Grouper	*Epinephelus flavolimbatus*	0.0	0.0
Forbes Asterias Sea Star	*Asterias forbesi*	0.0	0.0
Whitespotted Filefish	*Cantherhines macrocerus*	0.0	0.0
Tripletail	*Lobotes surinamensis*	0.0	0.0
Red Hogfish	*Decodon puellaris*	0.0	0.0
Southern Stargazer	*Astroscopus y-graecum*	0.0	0.0
Furcate Spider Crab	*Stenocionops furcatus*	0.0	0.0
Octopus Genus	*Octopus sp.*	0.0	0.0
Leopard Toadfish	*Opsanus pardus*	0.0	0.0
Queen Parrotfish	*Scarus vetula*	0.0	0.0
Tube Sponge	*Callyspongia vaginalis*	0.0	0.0
Lefteye Flounder Family	Bothidae	0.0	0.0
Bucktooth Parrotfish	*Sparisoma radians*	0.0	0.0
Unknown Matter	Unknown Matter	0.0	0.0
Deep Sea Scallop	*Placopecten magellanicus*	0.0	0.0
Vase Sponge	*Ircinia campana*	0.0	0.0
Eyed Flounder	*Bothus ocellatus*	0.0	0.0
Spinner Shark	*Carcharhinus brevipinna*	0.0	0.0
Naked Sole	*Gymnachirus melas*	0.0	0.0
Southern Sennet	*Sphyraena picudilla*	0.0	0.0
Bivalve Class	Bivalvia	0.0	0.0
Banded Rudderfish	*Seriola zonata*	0.0	0.0
Florida Pompano	*Trachinotus carolinus*	0.0	0.0

Table A1. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Lefteye Flounder Genus	*Cyclopsetta sp.*	0.0	0.0
Lookdown	*Selene vomer*	0.0	0.0
Porgy Genus	*Calamus sp.*	0.0	0.0
Giant Hermit Crab	*Petrochirus diogenes*	0.0	0.0
Hairy Sponge Crab	*Dromidia antillensis*	0.0	0.0
Short Bigeye	*Pristigenys alta*	0.0	0.0
White Eyed Goby	*Bollmannia boqueronensis*	0.0	0.0
Mottled Mojarra	*Eucinostomus lefroy*	0.0	0.0
Shrimp Eel Genus	*Ophichthus sp.*	0.0	0.0
Sponge Crab Genus	*Dromidia sp.*	0.0	0.0
Pike-Conger Eel	*Hoplunnis sp.*	0.0	0.0
Butter Hamlet	*Hypoplectrus unicolor*	0.0	0.0
Right-Handed Hermit Crab Family	Paguridae	0.0	0.0
Kinglet Rock Shrimp	*Sicyonia typica*	0.0	0.0
Blackfin Grenadier	*Caelorinchus caribbaeus*	0.0	0.0
Batfish Genus	*Ogcocephalus sp.*	0.0	0.0
Sea Nettle	*Chrysaora quinquecirrha*	0.0	0.0
Margintail Conger	*Paraconger caudilimbatus*	0.0	0.0
Scallop Family	Pectinidae	0.0	0.0
Shrimp Flounder	*Gastropsetta frontalis*	0.0	0.0
Sculptured Slipper Lobster	*Parribacus antarcticus*	0.0	0.0
Whitespotted Soapfish	*Rypticus maculatus*	0.0	0.0
Gulf Frog Crab	*Raninoides louisianensis*	0.0	0.0
Pearly Razorfish	*Hemipternotus novacula*	0.0	0.0
Goldface Tilefish	*Caulolatilus chrysops*	0.0	0.0
Sea Squirt Class	Ascidiacea	0.0	0.0
Spotted Seatrout	*Cynoscion nebulosus*	0.0	0.0
Yellowfin Menhaden	*Brevoortia smithi*	0.0	0.0
Slender Sea Star	*Luidia clathrata*	0.0	0.0
Rough Silverside	*Membras martinica*	0.0	0.0
Pen Shell Genus	*Atrina sp.*	0.0	0.0
Solenocerid Shrimp	Solenoceridae	0.0	0.0
Spotted Snake Eel	*Ophichthus ophis*	0.0	0.0
Greater Amberjack	*Seriola dumerili*	0.0	0.0
Painted Wrasse	*Halichoeres caudalis*	0.0	0.0
Puddingwife	*Halichoeres radiatus*	0.0	0.0
Parrotfish Family	Scaridae	0.0	0.0
Reef Scorpionfish	*Scorpaenodes caribbaeus*	0.0	0.0
Atlantic Manta	*Manta birostris*	0.0	0.0
Smallmouth Flounder	*Etropus microstomus*	0.0	0.0
Cusk-eel Family	Ophidiidae	0.0	0.0
French Angelfish	*Pomacanthus paru*	0.0	0.0

Table A1. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Brittle Star Subclass	Ophiuroidea	0.0	0.0
Hunchback Scorpionfish	*Scorpaena dispar*	0.0	0.0
Yellow Goatfish	*Mulloidichthys martinicus*	0.0	0.0
Sawtoothed Elbow Crab	*Parthenope serrata*	0.0	0.0
Cake Sponge	*Ircinia strobilina*	0.0	0.0
Mottled Purse Crab	*Persephona mediterranea*	0.0	0.0
Sheepshead Porgy	*Calamus penna*	0.0	0.0
Purse Crab	*Iliacantha liodactylus*	0.0	0.0
Heart Urchin	*Moira atropos*	0.0	0.0
Jack Genus	*Caranx sp.*	0.0	0.0
Plumed Hairy Crab	*Pilumnus floridanus*	0.0	0.0
King Snake Eel	*Ophicthus rex*	0.0	0.0
African Pompano	*Alectis ciliaris*	0.0	0.0
Snake Eel Genus	*Echiophis sp.*	0.0	0.0
Web Burrfish	*Chilimycterus antillarum*	0.0	0.0
Mantis Shrimp Order	Stomatopoda	0.0	0.0
Trunkfish	*Lactophrys trigonus*	0.0	0.0
Mollusk Phyllum	Mollusca	0.0	0.0
Pear Whelk	*Busycon spiratum*	0.0	0.0
Northern Sennet	*Sphyraena borealis*	0.0	0.0
Yellowline Arrow Crab	*Stenorhynchus seticornis*	0.0	0.0
Striped Grunt	*Haemulon striatum*	0.0	0.0
Spotfin Butterflyfish	*Chaetodon ocellatus*	0.0	0.0
Flagfin Mojarra	*Eucinostomus melanopterus*	0.0	0.0
Saw-tooth Pen Shell	*Atrina serrata*	0.0	0.0
Tidewater Mojarra	*Eucinostomus harengulus*	0.0	0.0
Comb Jellyfish Phylum	Ctenophora	0.0	0.0
Snowy Grouper	*Epinephelus niveatus*	0.0	0.0
Ladyfish	*Elops saurus*	0.0	0.0
Snapper Eel	*Echiophis punctifer*	0.0	0.0
Lined Seahorse	*Hippocampus erectus*	0.0	0.0
Wrasse Genus	*Halichoeres sp.*	0.0	0.0
Spotfin Jawfish	*Opistognathus sp.*	0.0	0.0
Ocellated Frogfish	*Antennarius ocellatus*	0.0	0.0
Shortjaw Lizardfish	*Saurida normani*	0.0	0.0
Red Grouper	*Epinephelus morio*	0.0	0.0
Reticulate Goosefish	*Lophiodes reticulatus*	0.0	0.0
Striped Searobin	*Prionotus evolans*	0.0	0.0
Swimming Crab Genus	*Callinectes sp.*	0.0	0.0
Caribbean Tonguefish	*Symphurus arawak*	0.0	0.0
Florida Fighting Conch	*Strombus alatus*	0.0	0.0
Chip Crab	*Heterocrypta granulata*	0.0	0.0

Table A1. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Soft Coral Subclass	Octocoralia	0.0	0.0
Striated Frogfish	*Antennarius striatus*	0.0	0.0
Saucereye Porgy	*Calamus calamus*	0.0	0.0
Pencil Urchin	*Eucidaris tribuloides*	0.0	0.0
Heart Urchin Order	Spatangoida	0.0	0.0
Angel Shark	*Squatina dumeril*	0.0	0.0
Triggerfish/Filefish Family	Balistidae	0.0	0.0
Spider Crab Family	Majidae	0.0	0.0
Turret-shell Genus	*Turritella sp.*	0.0	0.0
Starfish Family	Asteriidae	0.0	0.0
Gulf Oyster Drill	*Urosalpinx perrugata*	0.0	0.0
Xanthid Crab Family	Xanthidae	0.0	0.0
Spiny Rock Shrimp	*Sicyonia burkenroadi*	0.0	0.0
Blue Croaker	*Bairdiella batabana*	0.0	0.0
Gulf Toadfish	*Opsanus beta*	0.0	0.0
Yellowtail Snapper	*Ocyurus chrysurus*	0.0	0.0
Snake Eel Family	Ophichthidae	0.0	0.0
Slender Searobin	*Peristidion gracile*	0.0	0.0
Hogfish	*Lachnolaimus maximus*	0.0	0.0
Basket Star Family	Gorgonocephalidae	0.0	0.0
Beaded Sea Star	*Astropecten articulatus*	0.0	0.0
Pale Spotted Eel	*Ophichthus puncticeps*	0.0	0.0
Cannonball Jellyfish	*Stomolophus meleagris*	0.0	0.0
Longtail Tonguefish	*Symphurus pelicanus*	0.0	0.0
Goby Genus	*Bollmannia sp.*	0.0	0.0
Spiny Spider Crab	*Mithrax spinosissimus*	0.0	0.0
Dusky Anchovy	*Anchoa lyolepis*	0.0	0.0
Channelnose Spider	*Coelocerus spinosus*	0.0	0.0
Conch Genus	*Strombus sp.*	0.0	0.0
Flying Gurnard	*Dactylopterus volitans*	0.0	0.0
Blue Angelfish	*Holacanthus bermudensis*	0.0	0.0
Honeycomb Cowfish	*Lactophrys polygonia*	0.0	0.0
Sharphorn Clinging Crab	*Mithrax acuticornis*	0.0	0.0
Purse Crab	*Persephona punctata*	0.0	0.0
Spotted Driftfish	*Ariomma regulus*	0.0	0.0
Mud Star	*Ctenodiscus crispatus*	0.0	0.0
Blue Spotted Coronetfish	*Fistularia tabacaria*	0.0	0.0
Cake Urchin	*Meoma ventricosa*	0.0	0.0
Left-Handed Hermit Crab Genus	*Petrochirus sp.*	0.0	0.0
Striped Mullet	*Mugil cephalus*	0.0	0.0
Goby Family	Gobiidae	0.0	0.0
Moray Genus	*Gymnothorax sp.*	0.0	0.0

Table A1. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Squirrelfish	*Holocentrus adscensionis*	0.0	0.0
Blue Catfish	*Ictalurus furcatus*	0.0	0.0
Olive-Pit Porcelain Crab	*Euceramus praelongus*	0.0	0.0
Shelligs Crab	*Callinectes ornatus*	0.0	0.0
Lesser Amberjack	*Seriola fasciata*	0.0	0.0
Sea Anemone Class	Anthozoa	0.0	0.0
Spiny Jewelbox	*Arcinella cornuta*	0.0	0.0
Longnose Anchovy	*Anchoa nasuta*	0.0	0.0
Silverside Family	Atherinidae	0.0	0.0
Gastropod Class Eggcase	Gastropoda eggcase	0.0	0.0
Hardshell Clam Family	Veneridae	0.0	0.0
Herring Family	Clupeidae	0.0	0.0
Spider Crab Genus	*Mithrax sp.*	0.0	0.0
Scrawled Sole	*Trinectes inscriptus*	0.0	0.0
Lefteye Flounder Genus	*Paralichthys sp.*	0.0	0.0
Spotted Goatfish	*Pseudupeneus maculatus*	0.0	0.0
Grunt Family	Haemulidae	0.0	0.0
Sargassum Crab	*Portunus sayi*	0.0	0.0
Gulf Killifish	*Fundulus grandis*	0.0	0.0
Key Worm Eel	*Ahlia egmontis*	0.0	0.0
Ghost Crab	*Callianassa marginata*	0.0	0.0
Soft Coral Genus	*Leptogorgia sp.*	0.0	0.0
Sea Egg (Urchin)	*Tripneustes ventricosus*	0.0	0.0
Flat Claw Hermit Crab	*Pagurus pollicaris*	0.0	0.0
Brown Spiny Sea Star	*Echinaster spinulosus*	0.0	0.0
Rock Shell Genus	*Murex sp.*	0.0	0.0
Pink Purse Crab	*Persephona crinita*	0.0	0.0
Mantis Shrimp	*Squilla neglecta*	0.0	0.0
Spottail Pinfish	*Diplodus holbrooki*	0.0	0.0
Atlantic Distorsio	*Distorsio clathrata*	0.0	0.0
Irish Pompano	*Diaperus auratus*	0.0	0.0
Ridgeback Mud Crab	*Panopeus turgidus*	0.0	0.0
Lightning Whelk	*Busycon sinistrum*	0.0	0.0
Cone Shell Genus	*Conus sp.*	0.0	0.0
Mud Crab Genus	*Panopeus sp.*	0.0	0.0
Penaeid Shrimp Family	Penaeidae	0.0	0.0
Bryosoan Genus	*Schizoporella sp.*	0.0	0.0
Longspine Scorpionfish	*Pontinus longispinis*	0.0	0.0
Porgy Family	Sparidae	0.0	0.0
Limp or Weak Sea Star	*Luidia alternata*	0.0	0.0
False Arrow Crab	*Metoporhapis calcarata*	0.0	0.0
Finetooth Shark	*Carcharhinus isodon*	0.0	0.0

Table A1. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Black Snapper	*Apsilus dentatus*	0.0	0.0
Pygmy Tonguefish	*Symphurus parvus*	0.0	0.0
Sargassum Triggerfish	*Xanthichths ringens*	0.0	0.0
Barred Cusk-eel	*Lepophidium staurophor*	0.0	0.0
Mooneye Cusk-eel	*Ophidion selenops*	0.0	0.0
Schwengel Pitar (Clam)	*Pitar cordatus*	0.0	0.0
Seahorse Genus	*Hippocampus sp.*	0.0	0.0
Oyster Toadfish	*Opsanus tau*	0.0	0.0
Florida Lobsterette	*Nephropsis aculeata*	0.0	0.0
9-armed Seastar	*Luidia senegalensis*	0.0	0.0
Short Tail Snake Eel	*Callechelys guiniensis*	0.0	0.0
Snapper Genus	*Lutjanus sp.*	0.0	0.0
Royal Bonnet	*Sconsia striata*	0.0	0.0
Blackbar Drum	*Equetus iwanotoi*	0.0	0.0
Bay Scallop	*Argopecten irradians*	0.0	0.0
Antenna Codlet	*Bregmaceros atlanticus*	0.0	0.0
Hunter's Banded Tulip Shell Subspecies	*Fasciolaria lilium hunteria*	0.0	0.0
White Elbow Crab	*Leiolambrus nitidus*	0.0	0.0
White Giant-turris	*Polystira albida*	0.0	0.0
Measled Cowry	*Cypraea zebra*	0.0	0.0
Pleated Sea Squirt	*Styela plicata*	0.0	0.0
Striped Hermit Crab	*Clibanarius vittatus*	0.0	0.0
Sponge Crab	*Dromia erythropus*	0.0	0.0
Stiff Pen Shell	*Atrina rigida*	0.0	0.0
Spring Tailed Mantis Shrimp	*Lysosquilla scabricauda*	0.0	0.0
Decorator Crab	*Microphrys bicornutus*	0.0	0.0
Windowpane	*Scophthalmus aquosus*	0.0	0.0
Bobtail Squid Family	Sepiolidae	0.0	0.0
Spotted Drum	*Equetus punctatus*	0.0	0.0
Atlantic Silverside	*Menidia menidia*	0.0	0.0
Drum Genus	*Equetus sp.*	0.0	0.0
Bivalve Family	Leptonidae	0.0	0.0
Porcelain Crab Genus	*Porcellana sp.*	0.0	0.0
Transverse Ark	*Anadara transversa*	0.0	0.0
Sea Bass Genus	*Serranus sp.*	0.0	0.0
Queen Angelfish	*Holacanthus ciliaris*	0.0	0.0
Shortfinger Neck Crab	*Podochela sidneyi*	0.0	0.0
Scotch Bonnet	*Phalium granulatum*	0.0	0.0
Tilefish Genus	*Caulolatilus sp.*	0.0	0.0
Sea Urchin Subclass	Euechinoidea	0.0	0.0
Armored Searobin	*Peristedion miniatum*	0.0	0.0
Wrasse Family	Labridae	0.0	0.0

Table A1. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Quahog (Hard-shelled) Clam Genus	*Mercenaria sp.*	0.0	0.0
Two Spot Cardinalfish	*Apogon pseudomaculatus*	0.0	0.0
Common Blunt Armed Sea Star	*Asterina folium*	0.0	0.0
Red Brown Ark	*Barbatia cancellaria*	0.0	0.0
Cardinalfish Genus	Apogon	0.0	0.0
White Mullet	*Mugil curema*	0.0	0.0
Warty Sea Anemone	*Bunodosoma cavernata*	0.0	0.0
Hairy Mud Crab Genus	*Pilumnus sp.*	0.0	0.0
Pipefish Family	Syngnathidae	0.0	0.0
Anchovy Genus	*Anchoa sp.*	0.0	0.0
Silk Snapper	*Lutjanus vivanus*	0.0	0.0
Chace Slipper Lobster	*Scyllarus chacei*	0.0	0.0
Slender Inshore Squid	*Loligo pleii*	0.0	0.0
Heart Urchin	*Lovenia cordiformis*	0.0	0.0
Dusky Cardinalfish	*Phaeoptyx pigmentaria*	0.0	0.0
Atlantic Deepsea Lobster	*Acanthacaris caeca*	0.0	0.0
Sea Star Genus	*Astropecten sp.*	0.0	0.0
Silver Porgy	*Diplodus argenteus*	0.0	0.0
Cartilaginous Fish Class Eggpouch	Elasmobranchiomorphi eggpouch	0.0	0.0
Banded Tulip Shell	*Fasciolaria lilium*	0.0	0.0
Violet Goby	*Gobioides broussoneti*	0.0	0.0
Reef Croaker	*Odontoscion dentex*	0.0	0.0
Texas Venus Clam	*Agriopoma texasianum*	0.0	0.0
Oyster Crab	*Pinnotheres ostreum*	0.0	0.0
Chain Pipefish	*Syngnathus louisianae*	0.0	0.0
Atlantic Batfish	*Dibranchus atlanticus*	0.0	0.0
Goosefish Genus	*Lophiodes sp.*	0.0	0.0
Schoolmaster	*Lutjanus apodus*	0.0	0.0
Pea Crab	*Pinnotheres sp.*	0.0	0.0
Balloonfish	*Diodon holocanthus*	0.0	0.0
Peppermint Shrimp	*Lysmata wurdemanni*	0.0	0.0
Spinous Elbow Crab	*Parthenope pourtalesii*	0.0	0.0
Flatfish Order	*Pleuronectiformes*	0.0	0.0
Gray Angelfish	*Pomacanthus arcuatus*	0.0	0.0
Smallscale Lizardfish	*Saurida caribbaea*	0.0	0.0
Highfin Goby	*Gobionellus oceanicus*	0.0	0.0
Grapsid Crab Family	Grapsidae	0.0	0.0
Goatfish Family	Mullidae	0.0	0.0
Beaded Hairy Crab	*Pilumnus pannosus*	0.0	0.0
Northern Pipefish	*Syngnathus fuscus*	0.0	0.0
Luminous Hake	*Steindachneria argentea*	0.0	0.0
Fat Sleeper Goby	*Dormitator maculatus*	0.0	0.0

Table A1. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Spotted Trunkfish	*Lactophrys bicaudalis*	0.0	0.0
Sea Whip	*Leptogorgia virgulata*	0.0	0.0
Spotted Porcelain Crab	*Porcellana sayana*	0.0	0.0
Mole Crab Family	Albuneidae	0.0	0.0
Reef Butterflyfish	*Chaetodon sedentarius*	0.0	0.0
Zigzag Scallop	*Euvola ziczac*	0.0	0.0
Pilotfish	*Naucrates ductor*	0.0	0.0
Angel Wing Clam	*Cyrtopleura costata*	0.0	0.0
Sculptured Mud Crab	*Micropanope sculptipes*	0.0	0.0
School Bass	*Schultzea beta*	0.0	0.0
Starfish Class	Stelleroidea	0.0	0.0
Channeled Whelk	*Busycotypus canaliculatus*	0.0	0.0
Mole Crab	*Emerita talpoida*	0.0	0.0
Bivalve Genus	*Macoma sp.*	0.0	0.0
Sponge Cardinalfish	*Phaeoptyx xenus*	0.0	0.0
Ark Shell Family	Arcidae	0.0	0.0
Menhaden (Herring) Genus	*Brevoortia sp.*	0.0	0.0
Cusk-eel Genus	*Lepophidium sp.*	0.0	0.0
Spotted Soapfish	*Rypticus subbifrenatus*	0.0	0.0
Slipper Lobster Family	Scyllaridae	0.0	0.0
Skipjack Herring	*Alosa chrysochloris*	0.0	0.0
Axiid Family Crab	Axiidae	0.0	0.0
Codlet Family	*Bregmacerotidae*	0.0	0.0
Lucinid Shell Family	Lucinidae	0.0	0.0
Wharf Crab	*Pachygrapsus gracilis*	0.0	0.0
Elbow Crab Family	Parthenopidae	0.0	0.0
Smooth Skate	*Raja senta*	0.0	0.0
Gulf Squareback Crab	*Speocarcinus lobatus*	0.0	0.0
Smooth Mud Crab	*Hexapanopeus angustifrons*	0.0	0.0
Longsnout Seahorse	*Hippocampus reidi*	0.0	0.0
Spongy Decorator Crab	*Macrocoeloma trispinosum*	0.0	0.0
Atlantic Oval Squid	*Sepioteuthis sepioidea*	0.0	0.0
Sea Star Family	Astropectinidea	0.0	0.0
Prickly Lobsterette	*Nephropsis agassizii*	0.0	0.0
Polka-dot Cusk-eel	*Otophidium omostigmum*	0.0	0.0
Banded Porcelain Crab	*Petrolisthes galathina*	0.0	0.0
Striped Porcelain Crab	*Porcellana sigsbeiana*	0.0	0.0
Glasseye Snapper	*Priacanthus cruentatus*	0.0	0.0
Bluntnose Flyingfish	*Prognichthys gibbifrons*	0.0	0.0
Herring Genus	*Sardinella sp.*	0.0	0.0
Common Baby's Ear	*Sinum perspectivum*	0.0	0.0
Spindle Shell Sub-Family	Fusininae	0.0	0.0

Table A1. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Drum Genus	*Menticirrhus sp.*	0.0	0.0
Leatherjacket	*Oligoplites saurus*	0.0	0.0
Brown Hairy Wharf Crab	*Pilumnus dasypodus*	0.0	0.0
Atlantic Mackerel	*Scomber scombrus*	0.0	0.0
Eared Ark	*Anadara notabilis*	0.0	0.0
Longlure Frogfish	*Antennarius multiocellatus*	0.0	0.0
Nucleus Scallop	*Argopecten nucleus*	0.0	0.0
Spiny Beaded Sea Star	*Astropecten duplicatus*	0.0	0.0
Needlefish Family	Belonidae	0.0	0.0
Clench Venus Clam	*Chione clenchi*	0.0	0.0
Sponge Crab Family	Dromiidae	0.0	0.0
Yucatan Spindle	*Fusinus couei*	0.0	0.0
Dusky Squirrelfish	*Holocentrus vexillarius*	0.0	0.0
Red-Ridged Clinging Crab	*Mithrax forceps*	0.0	0.0
Scallop Genus	*Argopecten sp.*	0.0	0.0
Horse-eye Jack	*Caranx latus*	0.0	0.0
Pearlfish	*Carapus bermudensis*	0.0	0.0
Florida Blenny	*Chasmodes saburrae*	0.0	0.0
Purse Shell Genus	*Isognomon sp.*	0.0	0.0
Slender Filefish	*Monacanthus tuckeri*	0.0	0.0
Daisy Brittle Star	*Ophiopholis aculeata*	0.0	0.0
Rimspine Searobin	*Peristedion thompsoni*	0.0	0.0
Beach Mole Crab	*Albunea paretii*	0.0	0.0
Bronze Cardinalfish	*Astrapogon alutus*	0.0	0.0
Blackfin Cardinalfish	*Astrapogon puncticulatus*	0.0	0.0
White Perch	*Morone americana*	0.0	0.0
Spiny Searobin	*Prionotus alatus*	0.0	0.0
Coastal Mud Shrimp	*Upogebia affinis*	0.0	0.0
Atlantic Needlefish	*Strongylura marina*	0.0	0.0

Table A2. Species, CPUE and percent of the total weight of organisms captured in shrimp trawls in the southeastern Atlantic. Based on observer coverage of the U.S. Gulf of Mexico shrimp fishery from February 1992 through December 2005.

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Atlantic Croaker	*Micropogonias undulatus*	3.6	9.2
Spot (Flat Croaker)	*Leiostomus xanthurus*	3.4	8.7
Cannonball Jellyfish	*Stomolophus meleagris*	3.3	8.6
White Shrimp	*Litopenaeus setiferus*	2.8	7.3
Debris (rocks, logs, etc.)	Debris	2.6	6.6
Brown Shrimp	*Farfantepenaeus aztecus*	2.2	5.6
Jellyfish Class	Scyphozoa	1.8	4.7
Star Drum	*Stellifer lanceolatus*	1.6	4.1
Atlantic Menhaden	*Brevoortia tyrannus*	1.5	3.9
Southern Kingfish	*Menticirrhus americanus*	1.5	3.8
Jellyfish Family	Carybdeidae	1.5	3.7
Blue Crab	*Callinectes sapidus*	0.7	1.9
Silver Seatrout	*Cynoscion nothus*	0.7	1.7
Banded Croaker	*Larimus fasciatus*	0.6	1.6
Pink Shrimp	*Farfantepenaeus duorarum*	0.5	1.4
Penaeid Shrimp Genus	*Penaeus sp.*	0.5	1.3
Atlantic Cutlassfish	*Trichiurus lepturus*	0.5	1.2
Seatrout Genus	*Cynoscion sp.*	0.4	1.1
Weakfish	*Cynoscion regalis*	0.4	0.9
Spanish Mackerel	*Scomberomorus maculatus*	0.4	0.9
Pinfish	*Lagodon rhomboides*	0.3	0.8
Irridescent Swimming Crab	*Portunus gibbesii*	0.3	0.8
Inshore Lizardfish	*Synodus foetens*	0.3	0.7
Gafftopsail Catfish	*Bagre marinus*	0.3	0.6
Atlantic Sharpnose Shark	*Rhizoprionodon terraenovae*	0.2	0.6
Lesser Blue Crab	*Callinectes similis*	0.2	0.6
Sand Seatrout	*Cynoscion arenarius*	0.2	0.6
Northern Searobin	*Prionotus carolinus*	0.2	0.6
Atlantic Brief Squid	*Lolliguncula brevis*	0.2	0.5
Hardhead Catfish	*Arius felis*	0.2	0.5
Searobin Genus	*Prionotus sp.*	0.2	0.5
Southern Flounder	*Paralichthys lethostigma*	0.2	0.5
Mantis Shrimp	*Squilla empusa*	0.2	0.4
Atlantic Thread Herring	*Opisthonema oglinum*	0.2	0.4
Starfish Subclass	*Asteroidea*	0.2	0.4
Lady Crab (w/specks)	*Ovalipes ocellatus*	0.1	0.4
Mantis Shrimp Genus	*Squilla sp.*	0.1	0.4
Unknown Invertebrate	Unknown Invertebrate	0.1	0.4
Hogchoker	*Trinectes maculatus*	0.1	0.3
Swimming Crab Genus	*Callinectes sp.*	0.1	0.3
Bonnethead Shark	*Sphyrna tiburo*	0.1	0.3
Fringed Flounder	*Etropus crossotus*	0.1	0.3

Table A2. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Smooth Butterfly Ray	*Gymnura micrura*	0.1	0.3
Harvestfish	*Peprilus alepidotus*	0.1	0.3
Blacktip Shark	*Carcharhinus limbatus*	0.1	0.3
Rock Seabass	*Centropristis philadelphica*	0.1	0.3
Threadfin Shad	*Dorosoma petenense*	0.1	0.3
Pigfish	*Orthopristis chrysoptera*	0.1	0.3
Moon Jellyfish	*Aurelia aurita*	0.1	0.2
Atlantic Spadefish	*Chaetodipterus faber*	0.1	0.2
Silver Perch	*Bairdiella chrysoura*	0.1	0.2
Dusky Flounder	*Syacium papillosum*	0.1	0.2
Summer Flounder	*Paralichthys dentatus*	0.1	0.2
Yellowfin Menhaden	*Brevoortia smithi*	0.1	0.2
Striped Anchovy	*Anchoa hepsetus*	0.1	0.2
Bluefish	*Pomatomus saltatrix*	0.1	0.2
Ocellated Flounder	*Ancylopsetta quadrocellata*	0.1	0.2
Flatface Swimming Crab	*Portunus depressifrons*	0.1	0.2
Atlantic Stingray	*Dasyatis sabina*	0.1	0.2
Sea Cucumber Class	Holothuroidea	0.1	0.2
Portly Spider Crab	*Libinia emarginata*	0.1	0.2
Finetooth Shark	*Carcharhinus isodon*	0.1	0.2
Slender Sea Star	*Luidia clathrata*	0.1	0.2
Atlantic Bumper	*Chloroscombrus chrysurus*	0.1	0.2
Clearnose Skate	*Raja eglanteria*	0.1	0.2
Blackcheek Tonguefish	*Symphurus plagiusa*	0.1	0.1
Unknown Crustacean	Unknown Crustacean	0.1	0.1
Channeled Whelk	*Busycotypus canaliculatus*	0.1	0.1
Calico Box Crab	*Hepatus epheliticus*	0.1	0.1
Cownose Ray	*Rhinoptera bonasus*	0.0	0.1
Bluntnose Stingray	*Dasyatis say*	0.0	0.1
Striped Searobin	*Prionotus evolans*	0.0	0.1
Spotted Hake	*Urophycis regia*	0.0	0.1
Tunicate Phylum	Urochordata	0.0	0.1
Unknown Fish	Unknown Fish	0.0	0.1
Sand Perch	*Diplectrum formosum*	0.0	0.1
Bay Whiff	*Citharichthys spilopterus*	0.0	0.1
Horned Searobin	*Bellator militaris*	0.0	0.1
Atlantic Moonfish	*Selene setapinnis*	0.0	0.1
Scalloped Hammerhead Shark	*Sphyrna lewini*	0.0	0.1
Leopard Searobin	*Prionotus scitulus*	0.0	0.1
Horseshoe Crab	*Limulus polyphemus*	0.0	0.1
Brown Rock Shrimp	*Sicyonia brevirostris*	0.0	0.1
Striped Burrfish	*Chilomycterus schoepfi*	0.0	0.1

Table A2. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Spotfin Mojarra	*Eucinostomus argenteus*	0.0	0.1
Bullnose Ray	*Myliobatis freminvillei*	0.0	0.1
Keyhole Urchin (sanddollar)	*Mellita quinquiesperforata*	0.0	0.1
Knobbed Whelk	*Busycon carica*	0.0	0.1
Squid Order	Teuthoidea	0.0	0.1
Southern Eagle Ray	*Myliobatis goodei*	0.0	0.1
Longnose Spider Crab	*Libinia dubia*	0.0	0.1
Starfish Class	Stelleroidea	0.0	0.1
Southern Hake	*Urophycis floridana*	0.0	0.1
Sea Bob Shrimp	*Xiphopenaeus kroyeri*	0.0	0.1
Bighead Searobin	*Prionotus tribulus*	0.0	0.1
Cobia (Ling)	*Rachycentron canadum*	0.0	0.1
Southern Stingray	*Dasyatis americana*	0.0	0.1
Red Goatfish	*Mullus auratus*	0.0	0.1
Atlantic Butterfish	*Peprilus triacanthus*	0.0	0.1
Lobed Moon Shell	*Polinices duplicatus*	0.0	0.1
Smooth Dogfish Shark	*Mustelus canis*	0.0	0.1
Speckled Swimming Crab	*Arenaeus cribrarius*	0.0	0.1
Spotted Whiff	*Citharichthys macrops*	0.0	0.1
Tidewater Silverside	*Menidia peninsulae*	0.0	0.1
Spotfin Flounder	*Cyclopsetta fimbriata*	0.0	0.1
Lefteye Flounder Family	Bothidae	0.0	0.1
Flat Claw Hermit Crab	*Pagurus pollicaris*	0.0	0.1
Gulf Butterfish	*Peprilus burti*	0.0	0.1
Knobbed Porgy	*Calamus nodosus*	0.0	0.0
Florida Pompano	*Trachinotus carolinus*	0.0	0.0
Silky Shark	*Carcharhinus falciformis*	0.0	0.0
Naked Sole	*Gymnachirus melas*	0.0	0.0
Coarsehand Lady Crab	*Ovalipes stephensoni*	0.0	0.0
Red Drum	*Sciaenops ocellatus*	0.0	0.0
Spinycheek Scorpionfish	*Neomerinthe hemingwayi*	0.0	0.0
Windowpane	*Scophthalmus aquosus*	0.0	0.0
Sea Urchin Genus	*Arbacia sp.*	0.0	0.0
Bivalve Class	Bivalvia	0.0	0.0
Swimming Crab Genus	*Portunus sp.*	0.0	0.0
Blotched Swimming Crab	*Portunus spinimanus*	0.0	0.0
Flame Box Crab	*Calappa flammea*	0.0	0.0
Blue Runner	*Caranx crysos*	0.0	0.0
Requiem Shark Genus	*Carcharhinus sp.*	0.0	0.0
Lesser Electric Ray	*Narcine brasiliensis*	0.0	0.0
Notched Sand Dollar	*Encope emarginata*	0.0	0.0
Invertebrate	Invertebrate	0.0	0.0

Table A2. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Hogfish	*Lachnolaimus maximus*	0.0	0.0
Gulf Menhaden	*Brevoortia patronus*	0.0	0.0
Spotted Seatrout	*Cynoscion nebulosus*	0.0	0.0
Lookdown	*Selene vomer*	0.0	0.0
Spiny Butterfly Ray	*Gymnura altavela*	0.0	0.0
Pleated Sea Squirt	*Styela plicata*	0.0	0.0
Gulf Flounder	*Paralichthys albigutta*	0.0	0.0
Mottled Cusk-eel	*Lepophidium jeannae*	0.0	0.0
Sugar/Blood Shrimp	*Trachypenaeus sp.*	0.0	0.0
Spottail Pinfish	*Diplodus holbrooki*	0.0	0.0
Spotted Eagle Ray	*Aetobatis narinari*	0.0	0.0
Longfin Squid	*Loligo pealeii*	0.0	0.0
Shrimp Eel	*Ophichthus gomesi*	0.0	0.0
Rough Scad	*Trachurus lathami*	0.0	0.0
Bigeye	*Priacanthus arenatus*	0.0	0.0
Least Puffer	*Sphoeroides parvus*	0.0	0.0
Bay Anchovy	*Anchoa mitchilli*	0.0	0.0
Rock Shrimp Genus	*Sicyonia sp.*	0.0	0.0
Sharks Grouped	General Sharks	0.0	0.0
Planehead Filefish	*Monacanthus hispidus*	0.0	0.0
Mottled Purse Crab	*Persephona mediterranea*	0.0	0.0
Marbled Puffer	*Sphoeroides dorsalis*	0.0	0.0
Atlantic Guitarfish	*Rhinobatos lentiginosus*	0.0	0.0
Florida Stone Crab	*Menippe mercenaria*	0.0	0.0
Whelk Genus Eggcase	Busycon Eggcase	0.0	0.0
Variable Urchin	*Lytechinus variegatus*	0.0	0.0
Spottedfin Tonguefish	*Symphurus diomedianus*	0.0	0.0
Squid and Octopus Class	Cephalopoda	0.0	0.0
Northern Puffer	*Sphoeroides maculatus*	0.0	0.0
Forbes Asterias Sea Star	*Asterias forbesi*	0.0	0.0
Tonguefish Genus	*Symphurus sp.*	0.0	0.0
Quahog (Hard-shelled) Clam Genus	*Mercenaria sp.*	0.0	0.0
Lightning Whelk	*Busycon sinistrum*	0.0	0.0
Wenchman	*Pristipomoides aquilonaris*	0.0	0.0
Fringed Sole	*Gymnachirus texae*	0.0	0.0
Spinner Shark	*Carcharhinus brevipinna*	0.0	0.0
Northern Kingfish	*Menticirrhus saxatilis*	0.0	0.0
King Mackerel	*Scomberomorus cavalla*	0.0	0.0
Queen Conch	*Strombus gigas*	0.0	0.0
Dogfish Shark Genus	*Mustelu sp.*	0.0	0.0
American Eel	*Anguilla rostrata*	0.0	0.0
Gray Triggerfish	*Balistes capriscus*	0.0	0.0

Table A2. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Anchovy Genus	*Anchoa sp.*	0.0	0.0
Blackwing Searobin	*Prionotus rubio*	0.0	0.0
Southern Puffer	*Sphoeroides nephelus*	0.0	0.0
Twospot Flounder	*Bothus robinsi*	0.0	0.0
Florida Smoothhound	*Mustelus norrisi*	0.0	0.0
Smooth Skate	*Raja senta*	0.0	0.0
Guaguanche	*Sphyraena guachancho*	0.0	0.0
Gulf Kingfish	*Menticirrhus littoralis*	0.0	0.0
Southern Stargazer	*Astroscopus y-graecum*	0.0	0.0
Drum Genus	*Menticirrhus sp.*	0.0	0.0
Striped Mullet	*Mugil cephalus*	0.0	0.0
Black Seabass	*Centropristis striata*	0.0	0.0
Tripletail	*Lobotes surinamensis*	0.0	0.0
Atlantic Purple Sea Urchin	*Arbacia punctulata*	0.0	0.0
Right-handed Hermit Crab Genus	*Pagurus sp.*	0.0	0.0
Yellow Box Crab	*Calappa sulcata*	0.0	0.0
Horse-eye Jack	*Caranx latus*	0.0	0.0
Longtail Tonguefish	*Symphurus pelicanus*	0.0	0.0
Longspine Porgy	*Stenotomus caprinus*	0.0	0.0
Conger Eel	*Conger oceanicus*	0.0	0.0
Sardine, Scaled	*Harengula jaguana*	0.0	0.0
Atlantic Rock Crab	*Cancer irroratus*	0.0	0.0
Heart Urchin	*Moira atropos*	0.0	0.0
Silver Jenny	*Eucinostomus gula*	0.0	0.0
Spiny Spider Crab	*Mithrax spinosissimus*	0.0	0.0
Striped Cusk-eel	*Ophidion marginatum*	0.0	0.0
Gag	*Mycteroperca microlepis*	0.0	0.0
Longspine Swimming Crab	*Portunus spinicarpus*	0.0	0.0
Unknown Matter	Unknown Matter	0.0	0.0
Oyster Toadfish	*Opsanus tau*	0.0	0.0
9-armed Seastar	*Luidia senegalensis*	0.0	0.0
Finescale Menhaden	*Brevoortia gunteri*	0.0	0.0
Dwarf Sand Perch	*Diplectrum bivittatum*	0.0	0.0
Ladyfish	*Elops saurus*	0.0	0.0
Atlantic Sturgeon	*Acipenser oxyrhynchus*	0.0	0.0
Red Snapper	*Lutjanus campechanus*	0.0	0.0
Sponge Phylum	Porifera	0.0	0.0
Scad Mackerel	*Decapterus macarellus*	0.0	0.0
Octopus Genus	*Octopus sp.*	0.0	0.0
Polyps and Medusae	Cnidaria	0.0	0.0
White Grunt	*Haemulon plumieri*	0.0	0.0
Rough Silverside	*Membras martinica*	0.0	0.0

Table A2. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Three Eyed Flounder	*Ancylopsetta dilecta*	0.0	0.0
Scrawled Cowfish	*Lactophrys quadricornis*	0.0	0.0
Purse Crab	*Persephona punctata*	0.0	0.0
Hake Genus	*Urophycis sp.*	0.0	0.0
Saw-tooth Pen Shell	*Atrina serrata*	0.0	0.0
Violet Goby	*Gobioides broussoneti*	0.0	0.0
Hardshell Clam Family	Venerida*e*	0.0	0.0
Sheepshead	*Archosargus probatocephalus*	0.0	0.0
Black Grouper	*Mycteroperca bonaci*	0.0	0.0
Sharksucker	*Echeneis naucrates*	0.0	0.0
Round Herring	*Etrumeus teres*	0.0	0.0
Dotterel Filefish	*Aluterus heudeloti*	0.0	0.0
Blotched Cusk-eel	*Ophidion grayi*	0.0	0.0
Spider Crab Genus	*Mithrax sp.*	0.0	0.0
Beach Mole Crab	*Albunea paretii*	0.0	0.0
Unicorn Filefish	*Aluterus monoceros*	0.0	0.0
Puffer Family	Tetraodontidae	0.0	0.0
Stripped Sea Cucumber	*Thyonella gemmata*	0.0	0.0
Tomtate	*Haemulon aurolineatum*	0.0	0.0
Silverside Genus	*Menidia sp.*	0.0	0.0
Mojarra Genus	*Eucinostomus sp.*	0.0	0.0
Snook Genus	*Centropomsus sp.*	0.0	0.0
Gizzard Shad	*Dorosoma cepedianum*	0.0	0.0
Sea Star Family	Astropectinidea	0.0	0.0
Common Crevalle Jack	*Caranx hippos*	0.0	0.0
White Mullet	*Mugil curema*	0.0	0.0
Leatherjacket	*Oligoplites saurus*	0.0	0.0
Dwarf Goatfish	*Upeneus parvus*	0.0	0.0
Mexican Searobin	*Prionotus paralatus*	0.0	0.0
Shortwing Searobin	*Prionotus stearnsi*	0.0	0.0
Pen Shell Genus	*Atrina sp.*	0.0	0.0
Cut-Ribbed Ark	*Anadara floridana*	0.0	0.0
Brown Spiny Sea Star	*Echinaster spinulosus*	0.0	0.0
Lefteye Flounder Genus	*Paralichthys sp.*	0.0	0.0
Roughback Batfish	*Ogcocephalus parvus*	0.0	0.0
Honeycomb Moray	*Gymnothorax saxicola*	0.0	0.0
Blackbelly Rosefish	*Helicolenus dactylopterus*	0.0	0.0
Herring Family	Clupeidae	0.0	0.0
Southern Sennet	*Sphyraena picudilla*	0.0	0.0
Stilt Spider Crab	*Anasimus latus*	0.0	0.0
Purse Crab	*Iliacantha liodactylus*	0.0	0.0
Black Drum	*Pogonias cromis*	0.0	0.0

Table A2. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Carolina Hake	*Urophycis earlli*	0.0	0.0
Northern Sennet	*Sphyraena borealis*	0.0	0.0
Blueback Herring	*Alosa aestivalis*	0.0	0.0
Bigeye Scad	*Selar crumenophthalmus*	0.0	0.0
Starfish Family	Asteriidae	0.0	0.0
Beaded Sea Star	*Astropecten articulatus*	0.0	0.0
Bearded Brotula	*Brotula barbata*	0.0	0.0
Ray Genus	*Gymnura sp.*	0.0	0.0
Whelk Genus	*Busycon sp.*	0.0	0.0
Atlantic Midshipman	*Porichthys plectrodon*	0.0	0.0
Round Scad	*Decapterus punctatus*	0.0	0.0
Silverside Family	Atherinidae	0.0	0.0
Jack Genus	*Caranx sp.*	0.0	0.0
Smooth Pufferfish	*Lagocephalus laevigatus*	0.0	0.0
Snapper Genus	*Lutjanus sp.*	0.0	0.0
Mackerel Family	Scombridae	0.0	0.0
Broken Back Shrimp Family	Hippolytidae	0.0	0.0
Triggerfish/Filefish Family	Balistidae	0.0	0.0
Brittle Star Subclass	Ophiuroidea	0.0	0.0
Bigeye(Blackfin) Searobin	*Prionotus longispinosus*	0.0	0.0
Calico Scallop	*Argopecten gibbus*	0.0	0.0
Bank Cusk-eel	*Ophidion holbrooki*	0.0	0.0
Right-Handed Hermit Crab Family	Paguridae	0.0	0.0
Striped Mojarra	*Diapterus plumieri*	0.0	0.0
Sand Stargazer	*Dactyloscopus tridigitatus*	0.0	0.0
Pancake Batfish	*Halieutichthys aculeatus*	0.0	0.0
Smoothead Scorpionfish	*Scorpaena calcarata*	0.0	0.0
Banded Rudderfish	*Seriola zonata*	0.0	0.0
Spider Crab Genus	*Libinia sp.*	0.0	0.0
Bandtail Searobin	*Prionotus ophryas*	0.0	0.0
African Pompano	*Alectis ciliaris*	0.0	0.0
Blackedge Cusk-eel	*Lepophidium brevibarbe*	0.0	0.0
Longnose Batfish	*Ogcocephalus corniger*	0.0	0.0
Molly Miller	*Scartella cristata*	0.0	0.0
Pea Crab	*Pinnotheres sp.*	0.0	0.0
Orange Filefish	*Aluterus schoepfi*	0.0	0.0
Skilletfish	*Gobiesox strumosus*	0.0	0.0
Ballyhoo	*Hemiramphus brasiliensis*	0.0	0.0
French Angelfish	*Pomacanthus paru*	0.0	0.0
Highfin Goby	*Gobionellus oceanicus*	0.0	0.0
Mullet Genus	*Mugil sp.*	0.0	0.0
Ponderosa Ark Shell	*Neotia ponderosa*	0.0	0.0

Table A2. Continued

COMMON NAME	GENUS SPECIES	KG/HR	PERCENT
Angel Wing Clam	*Cyrtopleura costata*	0.0	0.0
Crested Blenny	*Hypleurochilus geminatus*	0.0	0.0
Lady Crab Genus	*Ovalipes sp.*	0.0	0.0
Atlantic Threadfin	*Polydactylus octonemus*	0.0	0.0
Redleg Humpback Shrimp	*Exhippolysmata oplophoroides*	0.0	0.0
Tulip Shell Genus	*Fasciolaria sp.*	0.0	0.0
Yellow Conger	*Hildebrandia flava*	0.0	0.0
Sea Pill Bug	*Sphaeroma quadridentatum*	0.0	0.0
Sea Star Genus	*Leptasterias sp.*	0.0	0.0
Schoolmaster	*Lutjanus apodus*	0.0	0.0
Gray Snapper	*Lutjanus griseus*	0.0	0.0
Toadfish Genus	*Opsanus sp.*	0.0	0.0
Discarded Penaeid Shrimp	*Penaeus sp.*	0.0	0.0
Blenny Family	Blenniidae	0.0	0.0
Goby Family	Gobiidae	0.0	0.0
Lined Seahorse	*Hippocampus erectus*	0.0	0.0
Dog Snapper	*Lutjanus jocu*	0.0	0.0
Stout Tagel	*Tagelus plebeius*	0.0	0.0
Margate	*Haemulon album*	0.0	0.0
Scrawled Filefish	*Aluterus scriptus*	0.0	0.0
Arthropod Subphylum	Crustacea	0.0	0.0
Oyster Blenny	*Hypleurochilus aequipinnis*	0.0	0.0
Pigmy Filefish	*Monacanthus setifer*	0.0	0.0
Mud Dog Whelk	*Nassarius obsoletus*	0.0	0.0
Mud Crab Genus	*Panopeus sp.*	0.0	0.0

Table A3. Number and fate by species of fish caught in fish traps from December 1993 through February 1995. Based on observer coverage of the reef fish fishery. UNK denotes unknown fate.

COMMON NAME	GENUS SPECIES	TOTAL	KEPT	ALIVE	DEAD	BAIT	UNK
Red Grouper	*Epinephelus morio*	5901	1308	4419	140		34
Lane Snapper	*Lutjanus synagris*	3093	2012	854	33	175	19
White Grunt	*Haemulon plumieri*	1597	736	823	16	22	
Sand Perch	*Diplectrum formosum*	1261	2	1045	9	205	
Tomtate	*Haemulon aurolineatum*	996	8	656	1	331	
Black Seabass	*Centropristis striata*	770	666	104			
Littlehead Porgy	*Calamus proridens*	729	463	252		14	
Pinfish	*Lagodon rhomboides*	652		570	1	81	
Knobbed Porgy	*Calamus nodosus*	488	164	201		123	
Gray Triggerfish	*Balistes capriscus*	268	118	147	3		
Vermilion Snapper	*Rhomboplites aurorubens*	148	34	33		81	
Southern Puffer	*Sphoeroides nephelus*	143	32	106		5	
Planehead Filefish	*Monacanthus hispidus*	115	3	110	2		
Red Porgy	*Pagrus pagrus*	113	113				
Spottail Pinfish	*Diplodus holbrooki*	100		20	4	76	
Jackknife-fish	*Equetus lanceolatus*	87		51	35		1
Gray Snapper	*Lutjanus griseus*	52	14	37	1		
Whitebone Porgy	*Calamus leucosteus*	46	13	33			
Pigfish	*Orthopristis chrysoptera*	41		28	2	11	
Gag	*Mycteroperca microlepis*	37	4	31	1		1
Fringed Filefish	*Monacanthus ciliatus*	34		34			
Spotfin Butterflyfish	*Chaetodon ocellatus*	30		27	3		
Bandtail Puffer	*Sphoeroides spengleri*	27	11	12	4		
Yellowtail Snapper	*Ocyurus chrysurus*	21	10	10	1		
Blue Angelfish	*Holacanthus bermudensis*	19		15	4		
Spotted Moray	*Gymnothorax moringa*	19	1	18			
Orange Filefish	*Aluterus schoepfi*	17		11	6		
Bank Seabass	*Centropristis ocyurus*	17	2	9	1	5	
Cubbyu	*Equetus umbrosus*	14		3	11		
Nurse Shark	*Ginglymostoma cirratum*	14		14			
Margate	*Haemulon album*	14		14			
Sand Diver	*Synodus intermedius*	11		10	1		
Black Grouper	*Mycteroperca bonaci*	6	1	5			
Sharksucker	*Echeneis naucrates*	6		6			
Triggerfish/Filefish	Balistidae	4		4			
Ocean Triggerfish	*Canthidermis sufflamen*	4		4			
Gray Angelfish	*Pomacanthus arcuatus*	4		3	1		
Reef Butterflyfish	*Chaetodon sedentarius*	3		3			
Leopard Toadfish	*Opsanus pardus*	3		3			
Remora	*Remora remora*	3		3			
Bucktooth Parrotfish	*Sparisoma radians*	3		3			

Table A3. Continued

COMMON NAME	GENUS SPECIES	TOTAL	KEPT	ALIVE	DEAD	BAIT	UNK
Least Puffer	*Sphoeroides parvus*	3		3			
Hardhead Catfish	*Arius felis*	2		2			
Blue Runner	*Caranx crysos*	2		1		1	
Red Hogfish	*Decodon puellaris*	2		1	1		
Scamp	*Mycteroperca phenax*	2	2				
Gulf Toadfish	*Opsanus beta*	2		2			
Short Bigeye	*Pristigenys alta*	2	2				
Greater Amberjack	*Seriola dumerili*	2		2			
Inshore Lizardfish	*Synodus foetens*	2		2			
Whitefin Sharksucker	*Echeneis neucratoides*	1		1			
Ocellated Frogfish	*Antennarius ocellatus*	1		1			
Grass Porgy	*Calamus arctifrons*	1		1			
Jolthead Porgy	*Calamus bajonado*	1		1			
Sheepshead Porgy	*Calamus penna*	1		1			
Atlantic Spadefish	*Chaetodipterus faber*	1		1			
Tiger Shark	*Galeocerdo cuvier*	1		1			
Cottonwick	*Haemulon melanurum*	1		1			
Scrawled Cowfish	*Lactophrys quadricornis*	1		1			
Mutton Snapper	*Lutjanus analis*	1	1				
Red Goatfish	*Mullus auratus*	1		1			
Southern Flounder	*Paralichthys lethostigma*	1		1			
Lesser Amberjack	*Seriola fasciata*	1		1			
Redband Parrotfish	*Sparisoma aurofrenatum*	1		1			
	TOTALS	16943	5720	9757	281	1130	55
	PERCENTAGES	100%	33.8%	57.6%	1.7%	6.7%	0.3%

Table A4. Number and fate by species of fish caught on longline gear from April 1994 through May 1995. Based on observer coverage of the reef fish fishery. UNK denotes unknown fate.

COMMON NAME	GENUS SPECIES	TOTAL	KEPT	ALIVE	DEAD	BAIT	UNK
Red Grouper	*Epinephelus morio*	3080	1446	1322	202	22	88
Yellowedge Grouper	*Epinephelus flavolimbatus*	623	616	1	1	5	
Blueline Tilefish	*Caulolatilus microps*	268	160			108	
Gag	*Mycteroperca microlepis*	176	176				
Scamp	*Mycteroperca phenax*	109	104	5			
Southern Hake	*Urophycis floridana*	66				66	
Clearnose Skate	*Raja eglanteria*	62	12	38		12	
Sandbar Shark	*Carcharhinus plumbeus*	52	49	1		1	1
Leopard Toadfish	*Opsanus pardus*	48	2	22	11	13	
Speckled Hind	*Epinephelus drummondhayi*	47	45	2			
Great Barracuda	*Sphyraena barracuda*	45	6		4	33	2
Greater Amberjack	*Seriola dumerili*	39	17			22	
Nurse Shark	*Ginglymostoma cirratum*	37		37			
Honeycomb Moray	*Gymnothorax saxicola*	37				37	
Blacktip Shark	*Carcharhinus limbatus*	36	34		1	1	
Red Porgy	*Pagrus pagrus*	32	29			3	
Atlantic Sharpnose Shark	*Rhizoprionodon terraenovae*	31	10			21	
Bonito	*Euthynnus alletteratus*	30	8		1	21	
Snowy Grouper	*Epinephelus niveatus*	28	28				
Smooth Dogfish Shark	*Mustelus canis*	24	8			16	
Reticulate Moray	*Muraena retifera*	23	1	5	8	9	
Red Snapper	*Lutjanus campechanus*	21	21				
Inshore Lizardfish	*Synodus foetens*	21	1	1		19	
Tiger Shark	*Galeocerdo cuvier*	19		3		16	
Blacknose Shark	*Carcharhinus acronotus*	18				17	1
Spinner Shark	*Carcharhinus brevipinna*	18	15			3	
Whitebone Porgy	*Calamus leucosteus*	17	9			8	
Mutton Snapper	*Lutjanus analis*	16	16				
Almaco Jack	*Seriola rivoliana*	15	15				
Banded Rudderfish	*Seriola zonata*	12	12				
Dusky Shark	*Carcharhinus obscurus*	9	9				
Carolina Hake	*Urophycis earlli*	9				9	
Silky Shark	*Carcharhinus falciformis*	7	3			4	
Vermilion Snapper	*Rhomboplites aurorubens*	7	1			6	
Jolthead Porgy	*Calamus bajonado*	6	3			3	
Night Shark	*Carcharhinus signatus*	6				6	
Queen Snapper	*Etelis Oculatus*	6	6				
Spotted Moray	*Gymnothorax moringa*	6		2	4		
Silk Snapper	*Lutjanus vivanus*	6	5			1	

Table A4. Continued

COMMON NAME	GENUS SPECIES	TOTAL	KEPT	ALIVE	DEAD	BAIT	UNK
Black Grouper	*Mycteroperca bonaci*	6	6				
Pale Spotted Eel	*Ophichthus puncticeps*	6	4		1	1	
Blackfin Tuna	*Thunnus atlanticus*	6	3			3	
Bank Seabass	*Centropristis ocyurus*	5	3	2			
Warsaw Grouper	*Epinephelus nigritus*	5	5				
Bigeye Sixgill Shark	*Hexanchus vitulus*	5	1			4	
Great Hammerhead Shark	*Sphyrna mokarran*	5				5	
Margate	*Haemulon album*	4	4				
Blackfin Snapper	*Lutjanus buccanella*	4	4				
Gulf Toadfish	*Opsanus beta*	4				4	
Snakefish	*Trachinocephalus myops*	4	1			3	
Sharksucker	*Echeneis naucrates*	3		3			
Lemon Shark	*Negaprion brevirostris*	3	3				
Spinycheek Scorpionfish	*Neomerinthe hemingwayi*	3		2	1		
Cobia (Ling)	*Rachycentron canadum*	3	3				
King Mackerel	*Scomberomorus cavalla*	3	2			1	
Yellow Jack	*Caranx bartholomaei*	2	2				
Common Crevalle Jack	*Caranx hippos*	2	1			1	
Bignose Shark	*Carcharhinus altimus*	2	2				
Dolphin	*Coryphaena hippurus*	2	1			1	
Sand Perch	*Diplectrum formosum*	2		1		1	
Tilefish	*Lopholatius chamaeleonticeps*	2	2				
Cubera Snapper	*Lutjanus cyanopterus*	2	2				
Lane Snapper	*Lutjanus synagris*	2	2				
Red Drum	*Sciaenops ocellatus*	2	1		1		
Wahoo	*Acanthocybium solandri*	1	1				
Spotted Eagle Ray	*Aetobatus narinari*	1		1			
Bearded Brotula	*Brotula barbata*	1	1				
Saucereye Porgy	*Calamus calamus*	1	1				
Bar Jack	*Caranx ruber*	1	1				
Requiem Shark	*Carcharhinidae*	1	1				
Ocean Triggerfish	*Cathidermis sufflamen*	1	1				
Conger Eel	*Conger oceanicus*	1				1	
Blacktail Moray	*Gymnothorax kolpos*	1	1				
Spiny Butterfly Ray	*Gymnura altavela*	1				1	
Bluestriped Grunt	*Haemulon sciurus*	1				1	
Longspine Squirrelfish	*Holocentrus rufus*	1		1			
Sailfish	*Istiophorus platypterus*	1				1	
Gray Snapper	*Lutjanus griseus*	1	1				

Table A4. Continued

COMMON NAME	GENUS SPECIES	TOTAL	KEPT	ALIVE	DEAD	BAIT	UNK
Snapper	*Lutjanus sp.*	1			1		
Ocean Sunfish	*Mola mola*	1		1			
Florida Smoothhound Shark	*Mustelus norrisi*	1		1			
Sand Tiger Shark	*Odontaspis taurus*	1				1	
Margintail Conger	*Paraconger caudilimbatus*	1		1			
Wenchman	*Pristipomoides aquilonaris*	1				1	
Remora	*Remora remora*	1	1				
Chub Mackerel	*Scomber japonicus*	1				1	
Chain Dogfish	*Scyliorhinus retifer*	1		1			
Shoal Flounder	*Syacium gunteri*	1				1	
Swordfish	*Xiphias gladius*	1	1				
	TOTALS	5224	2929	1453	236	514	92
	PERCENTAGES	100%	56.1%	27.8%	4.5%	9.8%	1.8%

Table A5. Number and fate by species of fish caught on bandit reels off Florida from January through July 1995. Based on observer coverage of the reef fish fishery. UNK denotes unknown fate.

COMMON NAME	GENUS SPECIES	TOTAL	KEPT	ALIVE	DEAD	BAIT	UNK
Vermilion Snapper	*Rhomboplites aurorubens*	1195	868	239		88	
Red Grouper	*Epinephelus morio*	1077	433	593	44		7
Gag	*Mycteroperca microlepis*	87	57	28	2		
Bank Seabass	*Centropristis ocyurus*	78		69	6	3	
Red Porgy	*Pagrus pagrus*	59	2	1		56	
Tomtate	*Haemulon aurolineatum*	56		50		6	
Whitebone Porgy	*Calamus leucosteus*	44	43	1			
Gray Snapper	*Lutjanus griseus*	41	36	5			
Scamp	*Mycteroperca phenax*	25	22	3			
Lane Snapper	*Lutjanus synagris*	21	17	1		3	
Creole-fish	*Paranthias furcifer*	21	21				
Banded Rudderfish	*Seriola zonata*	17		1		16	
Tattler	*Serranus phoebe*	9		9			
Clearnose Skate	*Raja eglanteria*	8		8			
Gray Triggerfish	*Balistes capriscus*	7	6	1			
King Mackerel	*Scomberomorus cavalla*	7	7				
Little Tunny	*Euthynnus alletteratus*	6		4		2	
Leopard Toadfish	*Opsanus pardus*	6		5	1		
Sand Diver	*Synodus intermedius*	5		4		1	
Spotted Moray	*Gymnothorax moringa*	3		3			
Atlantic Sharpnose Shark	*Rhizoprionodon terraenovae*	3	2	1			
Knobbed Porgy	*Calamus nodosus*	2	1			1	
Blacknose Shark	*Carcharhinus acronotus*	2	2				
Sand Perch	*Diplectrum formosum*	2				1	1
Jewfish	*Epinephelus itajara*	2		2			
Mutton Snapper	*Lutjanus analis*	2	2				
Red Snapper	*Lutjanus campechanus*	2	2				
Black Grouper	*Mycteroperca bonaci*	2	2				
Jolthead Porgy	*Calamus bajonado*	1	1				
Littlehead Porgy	*Calamus proridens*	1				1	
Blue Runner	*Caranx crysos*	1		1			
Silky Shark	*Carcharhinus falciformis*	1	1				
Black Seabass	*Centropristis striata*	1	1				
Red Hogfish	*Decodon puellaris*	1		1			
Tiger Shark	*Galeocerdo cuvier*	1		1			
Nurse Shark	*Ginglymostoma cirratum*	1		1			

Table A5. Continued

COMMON NAME	GENUS SPECIES	TOTAL	KEPT	ALIVE	DEAD	BAIT	UNK
White Grunt	*Haemulon plumieri*	1				1	
Pinfish	*Lagodon rhomboides*	1				1	
Reticulate Moray	*Muraena retifera*	1			1		
Smooth Dogfish Shark	*Mustelus canis*	1	1				
Yellowtail Snapper	*Ocyurus chrysurus*	1	1				
Porgy	Sparidae	1				1	
Spanish Hogfish	*Bodianus rufus*	1	1				
Round Scad	*Decapterus punctatus*	1				1	
Hake	*Urophycis sp.*	1		1			
	TOTALS	2806	1529	1033	54	182	8
	PERCENTAGES	100.0%	54.5%	36.8%	1.9%	6.5%	0.3%

Table A6. Number and fate by species of fish caught on bandit reels off Louisiana in March 1995. Based on observer coverage of the reef fish fishery. UNK denotes unknown fate.

COMMON NAME	GENUS SPECIES	TOTAL	KEPT	ALIVE	DEAD	BAIT	UNK
Red Snapper	*Lutjanus campechanus*	614	274	329	8		3
Gray Triggerfish	*Balisties capriscus*	29	24	1			4
Vermilion Snapper	*Rhomboplites aurorubens*	27	25	1			1
Blue Runner	*Caranx crysos*	8				8	
Guaguanche	*Sphyraena guachancho*	8			6	2	
Tomtate	*Haemulon aurolineatus*	6		2		3	1
Silver Seatrout	*Cynoscion nothus*	5		2	3		
Greater Amberjack	*Seriola dumerili*	4		2			2
Little Tunny	*Euthynnus alletteratus*	3				2	1
Pinfish	*Lagodon rhomboides*	3		1		2	
Knobbed Porgy	*Calamus nodosus*	2	2				
Cubera Snapper	*Lutjanus cyanopterus*	2	2				
Cobia	*Rachycentron canadum*	2	2				
Sheepshead	*Archosargus probatocephalus*	1		1			
Shortfin Mako	*Isurus oxyrinchus*	1	1				
Lane Snapper	*Lutjanus synagris*	1	1				
	TOTALS	716	331	339	17	17	12
	PERCENTAGES	100%	46.2%	47.3%	2.4%	2.4%	1.7%

Table A7. Fate and condition (when brought on board) of fish caught on bandit reels off Louisiana in March 1995. Based on observer coverage of the reef fish fishery. UNK denotes unknown fate.

COMMON NAME	GENUS SPECIES	KEPT: Live/Normal Appearance	KEPT: Live/Air Bladder Expansion	KEPT: Unknown or No Data	ALIVE: Live/Normal Appearance	ALIVE: Live/Air Bladder Expansion	ALIVE: Unknown or No Data	DEAD: Live/Normal Appearance	DEAD: Live/Air Bladder Expansion	DEAD: Unknown or No Data	BAIT: Live/Normal Appearance	UNK: Unknown or No Data
Red Snapper	*Lutjanus campechanus*	34	231	9	32	288	9		6	2		3
Gray Triggerfish	*Balisties capriscus*	23	1		1							4
Vermilion Snapper	*Rhomboplites aurorubens*	24	1		1							1
Blue Runner	*Caranx crysos*										8	
Guaguanche	*Sphyraena guachancho*							6			2	
Tomtate	*Haemulon aurolineatus*				2						3	1
Silver Seatrout	*Cynoscion nothus*				2			3				
Greater Amberjack	*Seriola dumerili*				2							2
Little Tunny	*Euthynnus alletteratus*										2	1
Pinfish	*Lagodon rhomboides*				1						2	
Knobbed Porgy	*Calamus nodosus*	2										
Cubera Snapper	*Lutjanus cyanopterus*		2									
Cobia	*Rachycentron canadum*	2										
Sheepshead	*Archosargus probatocephalus*					1						
Shortfin Mako	*Isurus oxyrinchus*	1										
Lane Snapper	*Lutjanus synagris*		1									
	TOTALS	86	236	9	41	289	9	9	6	2	17	12

APPENDIX B

SPATIAL AND TEMPORAL STATISTICS

Table B1. Tow information by year, area, depth and season. Based observer coverage of the U.S. Gulf of Mexico shrimp fishery from February 1992 through December 2005. Area designations are as follows: G – Gulf wide, TX – Texas, LA – Louisiana, AM – Alabama/Mississippi, and FL – Florida. Depth designations are: N – nearshore (≤ 10 fathoms), and O – offshore (> 10 fathoms). Seasonal categories are denoted as follows: J-A - January through April, M-A - May through August, and S-D - September through December. Sample size (n) represents tows, with one net sampled per tow. Total weight is in kilograms. Catch-per-unit-effort (CPUE) is kilograms per hour. Tow time mean is in hours. VS denotes vessel speed in knots. Blank cells indicate no data were collected.

Year	Area	Depth	Season	n	Hours	Total Weight	CPUE	Tow Time Mean	Tow Time s.d.	VS Mean	VS s.d.
1992	G	ALL	ALL	487	2345.4	76885.4	32.8	4.8	2.8	2.7	0.5
1992	G	N	ALL								
1992	G	O	ALL								
1992	TX	ALL	ALL	243	1178.6	34476.9	29.3	4.9	2.6	2.7	0.6
1992	TX	N	ALL	110	326.9	9452.6	28.9	3.0	1.5	2.2	0.5
1992	TX	N	J-A	81	219.1	4966.9	22.7	2.7	1.5	2.1	0.3
1992	TX	N	M-A	26	98.1	4099.5	41.8	3.8	1.1	2.5	0.7
1992	TX	N	S-D	3	9.7	386.2	39.8	3.2	0.8	2.6	0.0
1992	TX	O	ALL	133	851.7	25024.3	29.4	6.4	2.3	3.1	0.4
1992	TX	O	J-A								
1992	TX	O	M-A	62	344.6	10688.7	31.0	5.6	1.3	3.2	0.4
1992	TX	O	S-D	71	507.1	14335.6	28.3	7.1	2.6	3.0	0.3
1992	LA	ALL	ALL	184	949.5	34888.7	36.7	5.2	3.1	2.8	0.4
1992	LA	N	ALL	94	328.1	15980.6	48.7	3.5	1.3	2.5	0.3
1992	LA	N	J-A								
1992	LA	N	M-A	56	206.0	11017.4	53.5	3.7	1.3	2.7	0.3
1992	LA	N	S-D	38	122.1	4963.2	40.6	3.2	1.2	2.3	0.3
1992	LA	O	ALL	90	621.4	18908.1	30.4	6.9	3.5	3.0	0.4
1992	LA	O	J-A	15	197.1	2397.4	12.2	13.1	1.0	3.5	0.8
1992	LA	O	M-A	17	109.1	2785.6	25.5	6.4	3.4	3.0	0.1
1992	LA	O	S-D	58	315.2	13725.1	43.5	5.4	1.7	2.9	0.2
1992	AM	ALL	ALL	18	77.4	4437.8	57.3	4.3	1.5	2.6	0.3
1992	AM	N	ALL	10	38.0	2404.3	63.3	3.8	1.6	2.5	0.4

Table B1. Continued

Year	Area	Depth	Season	n	Hours	Total Weight	CPUE	Tow Time Mean	Tow Time s.d.	VS Mean	VS s.d.
1992	AM	N	J-A								
1992	AM	N	M-A	4	12.1	850.6	70.3	3.0	0.4	2.5	0.5
1992	AM	N	S-D	6	25.9	1553.7	60.0	4.3	2.0	2.5	0.4
1992	AM	O	ALL	8	39.4	2033.5	51.6	4.9	1.1	2.6	0.1
1992	AM	O	J-A								
1992	AM	O	M-A								
1992	AM	O	S-D	8	39.4	2033.5	51.6	4.9	1.1	2.6	0.1
1992	FL	ALL	ALL	42	139.9	3081.9	22.0	3.3	1.8	2.3	0.1
1992	FL	N	ALL								
1992	FL	N	J-A								
1992	FL	N	M-A								
1992	FL	N	S-D								
1992	FL	O	ALL	42	139.9	3081.9	22.0	3.3	1.8	2.3	0.1
1992	FL	O	J-A								
1992	FL	O	M-A	25	116.8	2384.6	20.4	4.7	0.6	2.3	0.0
1992	FL	O	S-D	17	23.1	697.4	30.2	1.4	0.9	2.3	0.1
1993	G	ALL	ALL	995	5647.4	146749.8	26.0	5.7	3.3	2.8	0.3
1993	G	N	ALL	296	871.5	27456.3	31.5	2.9	1.9	2.5	0.4
1993	G	O	ALL	699	4775.9	119293.5	25.0	6.8	3.0	2.9	0.2
1993	TX	ALL	ALL	404	2587.1	56518.3	21.8	6.4	2.7	2.9	0.2
1993	TX	N	ALL	55	207.5	6015.5	29.0	3.8	1.4	2.7	0.3
1993	TX	N	J-A	34	122.9	2540.9	20.7	3.6	1.3	2.7	0.2
1993	TX	N	M-A	18	65.9	3187.8	48.4	3.7	1.3	2.7	0.3
1993	TX	N	S-D	3	18.7	286.8	15.3	6.2	1.3	3.0	0.0
1993	TX	O	ALL	349	2379.6	50502.9	21.2	6.8	2.6	3.0	0.2
1993	TX	O	J-A	54	518.9	7636.4	14.7	9.6	4.0	2.9	0.4
1993	TX	O	M-A	141	866.2	19018.2	22.0	6.1	2.0	3.0	0.1
1993	TX	O	S-D	154	994.5	23848.2	24.0	6.5	1.7	3.0	0.1
1993	LA	ALL	ALL	308	2172.3	63757.6	29.4	7.1	3.7	2.7	0.3
1993	LA	N	ALL	61	223.6	8700.7	38.9	3.7	1.8	2.3	0.3
1993	LA	N	J-A	11	69.0	1516.9	22.0	6.3	1.2	2.6	0.2
1993	LA	N	M-A	44	125.5	5893.9	47.0	2.9	1.3	2.1	0.3
1993	LA	N	S-D	6	29.1	1290.0	44.3	4.9	0.5	2.4	0.1
1993	LA	O	ALL	247	1948.7	55056.9	28.3	7.9	3.5	2.9	0.2
1993	LA	O	J-A	159	1486.7	31829.8	21.4	9.4	3.5	2.9	0.3
1993	LA	O	M-A	27	108.9	6477.6	59.5	4.0	1.5	2.9	0.1
1993	LA	O	S-D	61	353.1	16749.5	47.4	5.8	1.2	2.8	0.1
1993	AM	ALL	ALL	152	295.6	10762.8	36.4	1.9	1.5	2.6	0.5
1993	AM	N	ALL	128	195.1	5604.4	28.7	1.5	1.2	2.5	0.5
1993	AM	N	J-A	2	10.1	247.4	24.5	5.0	1.6	3.0	0.0
1993	AM	N	M-A	126	185.0	5357.0	29.0	1.5	1.1	2.5	0.5
1993	AM	N	S-D								

Table B1. Continued

Year	Area	Depth	Season	n	Hours	Total Weight	CPUE	Tow Time Mean	Tow Time s.d.	VS Mean	VS s.d.
1993	AM	O	ALL	24	100.5	5158.5	51.3	4.2	1.0	2.8	0.1
1993	AM	O	J-A								
1993	AM	O	M-A	21	90.9	4151.1	45.7	4.3	1.0	2.8	0.1
1993	AM	O	S-D	3	9.6	1007.4	104.9	3.2	0.1	2.8	0.1
1993	FL	ALL	ALL	131	592.4	15711.0	26.5	4.5	1.1	2.7	0.3
1993	FL	N	ALL	52	245.3	7135.8	29.1	4.7	0.9	2.6	0.2
1993	FL	N	J-A	31	150.4	3900.7	25.9	4.9	1.0	2.5	0.1
1993	FL	N	M-A	21	94.9	3235.0	34.1	4.5	0.6	2.8	0.2
1993	FL	N	S-D								
1993	FL	O	ALL	79	347.1	8575.3	24.7	4.4	1.2	2.7	0.3
1993	FL	O	J-A	39	194.4	3282.3	16.9	5.0	1.0	2.4	0.2
1993	FL	O	M-A	40	152.7	5292.9	34.7	3.8	1.2	3.0	0.1
1993	FL	O	S-D								
1994	G	ALL	ALL	860	4339.9	137747.2	31.7	5.0	1.9	2.7	0.2
1994	G	N	ALL	99	431.5	15928.5	36.9	4.4	2.0	2.6	0.2
1994	G	O	ALL	761	3908.4	121818.7	31.2	5.1	1.8	2.7	0.2
1994	TX	ALL	ALL	293	1440.0	51390.9	35.7	4.9	1.9	2.7	0.2
1994	TX	N	ALL	18	95.5	3114.2	32.6	5.3	3.4	2.7	0.2
1994	TX	N	J-A	3	29.0	284.3	9.8	9.7	3.4	2.9	0.1
1994	TX	N	M-A	14	52.8	2753.9	52.2	3.8	1.2	2.7	0.2
1994	TX	N	S-D	1	13.7	76.0					
1994	TX	O	ALL	275	1344.5	48276.7	35.9	4.9	1.8	2.7	0.2
1994	TX	O	J-A	6	64.7	1146.2	17.7	10.8	3.0	2.9	0.1
1994	TX	O	M-A	198	897.0	32428.9	36.2	4.5	1.3	2.7	0.2
1994	TX	O	S-D	71	382.8	14701.6	38.4	5.4	1.7	2.9	0.1
1994	LA	ALL	ALL	206	1078.6	43941.7	40.7	5.2	2.1	2.8	0.2
1994	LA	N	ALL	7	16.0	618.2	38.6	2.3	0.9	2.5	0.1
1994	LA	N	J-A								
1994	LA	N	M-A	7	16.0	618.2	38.6	2.3	0.9	2.5	0.1
1994	LA	N	S-D								
1994	LA	O	ALL	199	1062.6	43323.5	40.8	5.3	2.0	2.8	0.2
1994	LA	O	J-A	75	514.2	19864.3	38.6	6.9	2.2	3.0	0.0
1994	LA	O	M-A	72	305.4	14031.7	45.9	4.2	1.3	2.6	0.1
1994	LA	O	S-D	52	243.0	9427.6	38.8	4.7	1.2	2.8	0.2
1994	AM	ALL	ALL	38	151.3	6275.1	41.5	4.0	1.2	2.6	0.2
1994	AM	N	ALL	26	99.0	4504.3	45.5	3.8	1.2	2.5	0.1
1994	AM	N	J-A								
1994	AM	N	M-A	24	90.2	4256.0	47.2	3.8	1.1	2.5	0.1
1994	AM	N	S-D	2	8.8	248.3	28.2	4.4	1.8	2.4	0.1
1994	AM	O	ALL	12	52.3	1770.8	33.9	4.4	1.1	2.8	0.1
1994	AM	O	J-A								
1994	AM	O	M-A	11	49.4	1430.0	28.9	4.5	1.1	2.8	0.1

Table B1. Continued

Year	Area	Depth	Season	n	Hours	Total Weight	CPUE	Tow Time Mean	Tow Time s.d.	VS Mean	VS s.d.
1994	AM	O	S-D	1	2.9	340.8					
1994	FL	ALL	ALL	323	1670.0	36139.6	21.6	5.2	1.7	2.6	0.2
1994	FL	N	ALL	48	221.0	7691.8	34.8	4.6	1.4	2.5	0.2
1994	FL	N	J-A	20	88.1	2743.1	31.1	4.4	1.9	2.5	0.2
1994	FL	N	M-A	6	20.5	790.4	38.6	3.4	0.8	2.7	0.1
1994	FL	N	S-D	22	112.4	4158.3	37.0	5.1	0.7	2.5	0.1
1994	FL	O	ALL	275	1449.0	28447.7	19.6	5.3	1.7	2.6	0.2
1994	FL	O	J-A	179	881.3	14718.4	16.7	4.9	1.2	2.6	0.3
1994	FL	O	M-A	46	312.3	4641.9	14.9	6.8	2.8	2.8	0.1
1994	FL	O	S-D	50	255.4	9087.5	35.6	5.1	1.4	2.6	0.1
1995	G	ALL	ALL	579	3033.1	87175.8	28.7	5.2	2.8	2.8	0.3
1995	G	N	ALL	71	280.9	7799.8	27.8	4.0	1.2	2.6	0.2
1995	G	O	ALL	508	2752.2	79376.0	28.8	5.4	2.9	2.8	0.3
1995	TX	ALL	ALL	136	595.8	15929.2	26.7	4.4	2.5	2.9	0.2
1995	TX	N	ALL	8	30.3	1661.3	54.8	3.8	1.4	2.8	0.0
1995	TX	N	J-A								
1995	TX	N	M-A	8	30.3	1661.3	54.8	3.8	1.4	2.8	0.0
1995	TX	N	S-D								
1995	TX	O	ALL	128	565.5	14267.9	25.2	4.4	2.6	2.9	0.2
1995	TX	O	J-A								
1995	TX	O	M-A	26	102.8	3679.5	35.8	4.0	1.2	2.9	0.2
1995	TX	O	S-D	102	462.7	10588.4	22.9	4.5	2.8	2.9	0.2
1995	LA	ALL	ALL	251	1546.5	50741.2	32.8	6.2	3.4	2.9	0.3
1995	LA	N	ALL								
1995	LA	N	J-A								
1995	LA	N	M-A								
1995	LA	N	S-D								
1995	LA	O	ALL	251	1546.5	50741.2	32.8	6.2	3.4	2.9	0.3
1995	LA	O	J-A	34	433.3	8232.4	19.0	12.7	1.7	2.9	0.0
1995	LA	O	M-A	52	301.0	11628.1	38.6	5.8	0.7	3.3	0.3
1995	LA	O	S-D	165	812.2	30880.7	38.0	4.9	2.4	2.7	0.2
1995	AM	ALL	ALL								
1995	AM	N	ALL								
1995	AM	N	J-A								
1995	AM	N	M-A								
1995	AM	N	S-D								
1995	AM	O	ALL								
1995	AM	O	J-A								
1995	AM	O	M-A								
1995	AM	O	S-D								
1995	FL	ALL	ALL	192	890.8	20505.4	23.0	4.6	1.3	2.7	0.2
1995	FL	N	ALL	63	250.6	6138.5	24.5	4.0	1.2	2.6	0.2

Table B1. Continued

Year	Area	Depth	Season	n	Hours	Total Weight	CPUE	Tow Time Mean	Tow Time s.d.	VS Mean	VS s.d.
1995	FL	N	J-A	24	108.5	3351.4	30.9	4.5	1.2	2.6	0.2
1995	FL	N	M-A	35	124.9	2326.7	18.6	3.6	1.1	2.6	0.2
1995	FL	N	S-D	4	17.2	460.4	26.8	4.3	0.1	2.8	0.0
1995	FL	O	ALL	129	640.2	14366.9	22.4	5.0	1.3	2.7	0.2
1995	FL	O	J-A	52	248.3	4221.5	17.0	4.8	1.1	2.6	0.2
1995	FL	O	M-A	34	155.6	4369.2	28.1	4.6	1.5	2.8	0.0
1995	FL	O	S-D	43	236.2	5776.2	24.5	5.5	1.2	2.8	0.0
1996	G	ALL	ALL	174	882.7	27861.3	31.6	5.1	3.0	2.8	0.3
1996	G	N	ALL	32	118.4	3641.7	30.8	3.7	1.2	2.4	0.4
1996	G	O	ALL	142	764.3	24219.6	31.7	5.4	3.2	2.9	0.3
1996	TX	ALL	ALL	54	224.8	7684.8	34.2	4.2	2.0	2.8	0.3
1996	TX	N	ALL	12	48.2	2190.3	45.4	4.0	1.6	2.6	0.2
1996	TX	N	J-A								
1996	TX	N	M-A	9	41.2	1926.3	46.8	4.6	1.4	2.5	0.1
1996	TX	N	S-D	3	7.0	264.0	37.7	2.3	0.4	2.8	0.3
1996	TX	O	ALL	42	176.6	5494.4	31.1	4.2	2.1	2.9	0.3
1996	TX	O	J-A	3	25.7	466.0	18.1	8.6	4.4	3.3	0.1
1996	TX	O	M-A	28	86.8	3925.3	45.2	3.1	0.8	2.6	0.2
1996	TX	O	S-D	11	64.1	1103.2	17.2	5.8	0.8	3.3	0.0
1996	LA	ALL	ALL	33	323.8	8287.5	25.6	9.8	3.4	3.0	0.2
1996	LA	N	ALL								
1996	LA	N	J-A								
1996	LA	N	M-A								
1996	LA	N	S-D								
1996	LA	O	ALL	33	323.8	8287.5	25.6	9.8	3.4	3.0	0.2
1996	LA	O	J-A	20	217.7	4680.7	21.5	10.9	2.9	3.1	0.1
1996	LA	O	M-A	13	106.1	3606.8	34.0	8.2	3.6	3.0	0.3
1996	LA	O	S-D								
1996	AM	ALL	ALL	11	40.8	571.4	14.0	3.7	0.8	2.0	0.1
1996	AM	N	ALL	11	40.8	571.4	14.0	3.7	0.8	2.0	0.1
1996	AM	N	J-A								
1996	AM	N	M-A	11	40.8	571.4	14.0	3.7	0.8	2.0	0.1
1996	AM	N	S-D								
1996	AM	O	ALL								
1996	AM	O	J-A								
1996	AM	O	M-A								
1996	AM	O	S-D								
1996	FL	ALL	ALL	76	293.3	11317.7	38.6	3.9	0.9	2.9	0.2
1996	FL	N	ALL	9	29.4	880.0	29.9	3.3	0.9	2.8	0.2
1996	FL	N	J-A	8	25.0	716.1	28.6	3.1	0.9	2.8	0.2
1996	FL	N	M-A	1	4.4	163.9	37.3				
1996	FL	N	S-D								

Table B1. Continued

Year	Area	Depth	Season	n	Hours	Total Weight	CPUE	Tow Time Mean	Tow Time s.d.	VS Mean	VS s.d.
1996	FL	O	ALL	67	263.9	10437.6	39.6	3.9	0.9	2.9	0.2
1996	FL	O	J-A	40	158.2	5147.0	32.5	4.0	1.0	2.8	0.2
1996	FL	O	M-A	3	9.5	254.9	26.8	3.2	1.6	2.9	0.1
1996	FL	O	S-D	24	96.2	5035.8	52.3	4.0	0.6	2.9	0.2
1997	G	ALL	ALL	123	873.7	25610.7	29.3	7.1	2.8	3.0	0.2
1997	G	N	ALL								
1997	G	O	ALL	123	873.7	25610.7	29.3	7.1	2.8	3.0	0.2
1997	TX	ALL	ALL	41	292.6	7184.4	24.6	7.1	2.8	2.9	0.2
1997	TX	N	ALL								
1997	TX	N	J-A								
1997	TX	N	M-A								
1997	TX	N	S-D								
1997	TX	O	ALL	41	292.6	7184.4	24.6	7.1	2.8	2.9	0.2
1997	TX	O	J-A	2	13.2	211.8	16.0	6.6	0.0	3.0	0.1
1997	TX	O	M-A	17	91.8	3502.2	38.2	5.4	1.7	2.9	0.1
1997	TX	O	S-D	22	187.6	3470.4	18.5	8.5	2.8	2.9	0.2
1997	LA	ALL	ALL	62	457.9	15259.2	33.3	7.4	3.2	3.0	0.1
1997	LA	N	ALL								
1997	LA	N	J-A								
1997	LA	N	M-A								
1997	LA	N	S-D								
1997	LA	O	ALL	62	457.9	15259.2	33.3	7.4	3.2	3.0	0.1
1997	LA	O	J-A	2	14.5	398.9	27.5	7.3	0.8	3.1	0.2
1997	LA	O	M-A	28	168.9	6315.3	37.4	6.0	2.5	3.0	0.0
1997	LA	O	S-D	32	274.5	8545.0	31.1	8.6	3.5	3.0	0.1
1997	AM	ALL	ALL	1	5.5	221.2	40.2				
1997	AM	N	ALL								
1997	AM	N	J-A								
1997	AM	N	M-A								
1997	AM	N	S-D								
1997	AM	O	ALL	1	5.5	221.2	40.2				
1997	AM	O	J-A								
1997	AM	O	M-A								
1997	AM	O	S-D								
1997	FL	ALL	ALL	19	117.7	2945.9	25.0	6.2	0.4	2.8	0.2
1997	FL	N	ALL								
1997	FL	N	J-A								
1997	FL	N	M-A								
1997	FL	N	S-D								
1997	FL	O	ALL	19	117.7	2945.9	25.0	6.2	0.4	2.8	0.2
1997	FL	O	J-A	19	117.7	2945.9	25.0	6.2	0.4	2.8	0.2
1997	FL	O	M-A								

Table B1. Continued

Year	Area	Depth	Season	n	Hours	Total Weight	CPUE	Tow Time Mean	Tow Time s.d.	VS Mean	VS s.d.
1997	FL	O	S-D								
1998	G	ALL	ALL	269	2037.0	43455.8	21.3	7.6	4.1	2.8	0.3
1998	G	N	ALL	32	108.5	2676.7	24.7	3.4	0.9	2.5	0.3
1998	G	O	ALL	237	1928.5	40779.1	21.1	8.1	4.0	2.9	0.3
1998	TX	ALL	ALL	139	1142.9	17090.9	15.0	8.2	4.5	2.8	0.4
1998	TX	N	ALL	26	79.4	2044.8	25.8	3.1	0.3	2.4	0.3
1998	TX	N	J-A								
1998	TX	N	M-A	26	79.4	2044.8	25.8	3.1	0.3	2.4	0.3
1998	TX	N	S-D								
1998	TX	O	ALL	113	1063.5	15046.2	14.1	9.4	4.2	2.9	0.3
1998	TX	O	J-A	55	713.6	7298.2	10.2	13.0	1.1	3.1	0.2
1998	TX	O	M-A	58	349.9	7747.9	22.1	6.0	3.1	2.7	0.3
1998	TX	O	S-D								
1998	LA	ALL	ALL	98	749.5	20487.7	27.3	7.6	3.5	2.9	0.3
1998	LA	N	ALL								
1998	LA	N	J-A								
1998	LA	N	M-A								
1998	LA	N	S-D								
1998	LA	O	ALL	98	749.5	20487.7	27.3	7.6	3.5	2.9	0.3
1998	LA	O	J-A	61	555.7	13701.2	24.7	9.1	3.7	3.0	0.2
1998	LA	O	M-A	32	166.9	5742.8	34.4	5.2	1.3	2.8	0.3
1998	LA	O	S-D	5	26.9	1043.7	38.8	5.4	1.1	2.9	0.1
1998	AM	ALL	ALL	32	144.6	5877.1	40.6	4.5	1.1	2.7	0.3
1998	AM	N	ALL	6	29.1	631.9	21.7	4.9	1.0	2.7	0.1
1998	AM	N	J-A								
1998	AM	N	M-A	6	29.1	631.9	21.7	4.9	1.0	2.7	0.1
1998	AM	N	S-D								
1998	AM	O	ALL	26	115.5	5245.2	45.4	4.4	1.1	2.7	0.3
1998	AM	O	J-A								
1998	AM	O	M-A	26	115.5	5245.2	45.4	4.4	1.1	2.7	0.3
1998	AM	O	S-D								
1998	FL	ALL	ALL								
1998	FL	N	ALL								
1998	FL	N	J-A								
1998	FL	N	M-A								
1998	FL	N	S-D								
1998	FL	O	ALL								
1998	FL	O	J-A								
1998	FL	O	M-A								
1998	FL	O	S-D								
1999	G	ALL	ALL	73	447.2	8095.5	18.1	6.1	0.8	3.0	0.0
1999	G	N	ALL								

Table B1. Continued

Year	Area	Depth	Season	n	Hours	Total Weight	CPUE	Tow Time Mean	Tow Time s.d.	VS Mean	VS s.d.
1999	G	O	ALL	73	447.2	8095.5	18.1	6.1	0.8	3.0	0.0
1999	TX	ALL	ALL	20	117.4	2047.5	17.4	5.9	0.8	3.0	0.0
1999	TX	N	ALL								
1999	TX	N	J-A								
1999	TX	N	M-A								
1999	TX	N	S-D								
1999	TX	O	ALL	20	117.4	2047.5	17.4	5.9	0.8	3.0	0.0
1999	TX	O	J-A								
1999	TX	O	M-A	8	44.0	866.4	19.7	5.5	0.3	3.0	0.0
1999	TX	O	S-D	12	73.3	1181.1	16.1	6.1	0.9	3.0	0.0
1999	LA	ALL	ALL	53	329.8	6048.0	18.3	6.2	0.8	3.0	0.0
1999	LA	N	ALL								
1999	LA	N	J-A								
1999	LA	N	M-A								
1999	LA	N	S-D								
1999	LA	O	ALL	53	329.8	6048.0	18.3	6.2	0.8	3.0	0.0
1999	LA	O	J-A								
1999	LA	O	M-A	12	66.0	1631.2	24.7	5.5	0.2	3.0	0.0
1999	LA	O	S-D	41	263.8	4416.8	16.7	6.4	0.8	3.0	0.0
1999	AM	ALL	ALL								
1999	AM	N	ALL								
1999	AM	N	J-A								
1999	AM	N	M-A								
1999	AM	N	S-D								
1999	AM	O	ALL								
1999	AM	O	J-A								
1999	AM	O	M-A								
1999	AM	O	S-D								
1999	FL	ALL	ALL								
1999	FL	N	ALL								
1999	FL	N	J-A								
1999	FL	N	M-A								
1999	FL	N	S-D								
1999	FL	O	ALL								
1999	FL	O	J-A								
1999	FL	O	M-A								
1999	FL	O	S-D								
2000	G	ALL	ALL	13	69.4	1008.8	14.5	5.3	0.7	2.9	0.1
2000	G	N	ALL	2	10.8	146.7	13.6	5.4	0.1	2.8	0.0
2000	G	O	ALL	11	58.6	862.1	14.7	5.3	0.8	2.9	0.1
2000	TX	ALL	ALL	8	45.7	497.3	10.9	5.7	0.5	2.9	0.1
2000	TX	N	ALL	2	10.8	146.7	13.6	5.4	0.1	2.8	0.0

Table B1. Continued

Year	Area	Depth	Season	n	Hours	Total Weight	CPUE	Tow Time Mean	Tow Time s.d.	VS Mean	VS s.d.
2000	TX	N	J-A								
2000	TX	N	M-A	2							
2000	TX	N	S-D								
2000	TX	O	ALL	6	34.9	350.6	10.0	5.8	0.5	2.9	0.1
2000	TX	O	J-A								
2000	TX	O	M-A	1	5.0	60.4	12.1				
2000	TX	O	S-D	5	29.9	290.2	9.7	6.0	0.3	2.9	0.1
2000	LA	ALL	ALL	5	23.7	511.5	21.6	4.7	0.7	3.0	0.0
2000	LA	N	ALL								
2000	LA	N	J-A								
2000	LA	N	M-A								
2000	LA	N	S-D								
2000	LA	O	ALL	5							
2000	LA	O	J-A								
2000	LA	O	M-A	4	18.5	390.5	21.1	4.6	0.8	3.0	0.0
2000	LA	O	S-D	1	5.2	121.0	23.3				
2000	AM	ALL	ALL								
2000	AM	N	ALL								
2000	AM	N	J-A								
2000	AM	N	M-A								
2000	AM	N	S-D								
2000	AM	O	ALL								
2000	AM	O	J-A								
2000	AM	O	M-A								
2000	AM	O	S-D								
2000	FL	ALL	ALL								
2000	FL	N	ALL								
2000	FL	N	J-A								
2000	FL	N	M-A								
2000	FL	N	S-D								
2000	FL	O	ALL								
2000	FL	O	J-A								
2000	FL	O	M-A								
2000	FL	O	S-D								
2001	G	ALL	ALL	842	4616.9	148177.0	32.1	5.5	2.0	2.9	0.3
2001	G	N	ALL	64	385.6	14119.6	36.6	6.0	1.5	2.9	0.2
2001	G	O	ALL	778	4231.3	134057.4	31.7	5.4	2.1	2.9	0.3
2001	TX	ALL	ALL	412	2215.6	60621.5	27.4	5.4	2.4	3.0	0.2
2001	TX	N	ALL	1	3.9	121.2	31.1				
2001	TX	N	J-A								
2001	TX	N	M-A	1	3.9	121.2	31.1				
2001	TX	N	S-D								

Table B1. Continued

Year	Area	Depth	Season	n	Hours	Total Weight	CPUE	Tow Time Mean	Tow Time s.d.	VS Mean	VS s.d.
2001	TX	O	ALL	411	2211.7	60500.3	27.4	5.4	2.4	3.0	0.2
2001	TX	O	J-A								
2001	TX	O	M-A	320	1482.4	48835.5	32.9	4.6	1.3	3.0	0.2
2001	TX	O	S-D	91	729.3	11664.8	16.0	8.0	3.3	3.1	0.1
2001	LA	ALL	ALL	216	1283.3	44079.7	34.3	5.9	1.5	2.9	0.3
2001	LA	N	ALL	4	23.8	808.8	34.0	6.0	0.5	2.8	0.1
2001	LA	N	J-A								
2001	LA	N	M-A								
2001	LA	N	S-D	4	23.8	808.8	34.0	6.0	0.5	2.8	0.1
2001	LA	O	ALL	212	1259.5	43270.9	34.4	5.9	1.5	2.9	0.3
2001	LA	O	J-A								
2001	LA	O	M-A	81	419.8	18225.1	43.4	5.2	0.8	2.8	0.4
2001	LA	O	S-D	131	839.7	25045.7	29.8	6.4	1.6	2.9	0.2
2001	AM	ALL	ALL	144	860.0	32828.6	38.2	6.0	1.5	2.9	0.2
2001	AM	N	ALL	59	357.9	13189.6	36.9	6.1	1.5	2.9	0.2
2001	AM	N	J-A								
2001	AM	N	M-A	4	21.3	930.5	43.7	5.3	0.4	2.9	0.4
2001	AM	N	S-D	55	336.6	12259.1	36.4	6.1	1.5	2.9	0.2
2001	AM	O	ALL	85	502.1	19639.0	39.1	5.9	1.5	3.0	0.2
2001	AM	O	J-A								
2001	AM	O	M-A	25	136.6	5530.4	40.5	5.5	1.7	3.1	0.2
2001	AM	O	S-D	60	365.5	14108.6	38.6	6.1	1.4	2.9	0.2
2001	FL	ALL	ALL	70	258.0	10647.3	41.3	3.7	0.8	2.5	0.1
2001	FL	N	ALL								
2001	FL	N	J-A								
2001	FL	N	M-A								
2001	FL	N	S-D								
2001	FL	O	ALL	70	258.0	10647.3	41.3	3.7	0.8	2.5	0.1
2001	FL	O	J-A								
2001	FL	O	M-A	1	3.8	326.5	85.9				
2001	FL	O	S-D	69	254.2	10320.8	40.6	3.7	0.8	2.5	0.1
2002	G	ALL	ALL	2116	11475.0	327504.9	28.5	5.4	1.9	2.8	0.2
2002	G	N	ALL	463	2071.5	61653.2	29.8	4.5	1.7	2.7	0.2
2002	G	O	ALL	1653	9403.5	265851.8	28.3	5.7	1.9	2.9	0.2
2002	TX	ALL	ALL	396	2296.2	54507.9	23.7	5.8	2.2	2.9	0.1
2002	TX	N	ALL	10	57.9	891.9	15.4	5.8	1.6	2.8	0.3
2002	TX	N	J-A								
2002	TX	N	M-A	4	16.6	462.3	27.8	4.2	0.8	3.0	0.1
2002	TX	N	S-D	6	41.3	429.6	10.4	6.9	0.9	2.7	0.3
2002	TX	O	ALL	386	2238.3	53616.0	24.0	5.8	2.2	2.9	0.1
2002	TX	O	J-A	23	175.3	1270.7	7.2	7.6	2.7	3.0	0.1
2002	TX	O	M-A	264	1367.6	39966.7	29.2	5.2	1.6	2.9	0.1

Table B1. Continued

Year	Area	Depth	Season	n	Hours	Total Weight	CPUE	Tow Time Mean	Tow Time s.d.	VS Mean	VS s.d.
2002	TX	O	S-D	99	695.4	12378.6	17.8	7.0	2.7	3.0	0.1
2002	LA	ALL	ALL	504	3228.2	86430.7	26.8	6.4	1.9	2.9	0.2
2002	LA	N	ALL	20	110.0	3040.9	27.6	5.5	0.8	2.7	0.2
2002	LA	N	J-A								
2002	LA	N	M-A	4	21.2	715.8	33.8	5.3	0.7	2.8	0.1
2002	LA	N	S-D	16	88.8	2325.1	26.2	5.6	0.8	2.7	0.2
2002	LA	O	ALL	484	3118.2	83389.8	26.7	6.4	1.9	2.9	0.2
2002	LA	O	J-A	136	1034.3	25089.6	24.3	7.6	2.2	2.9	0.2
2002	LA	O	M-A	131	736.5	23595.3	32.0	5.6	1.5	2.9	0.2
2002	LA	O	S-D	217	1347.4	34705.0	25.8	6.2	1.5	2.8	0.2
2002	AM	ALL	ALL	678	3738.2	115442.9	30.9	5.5	1.5	2.8	0.2
2002	AM	N	ALL	168	909.4	22971.7	25.3	5.4	1.9	2.8	0.1
2002	AM	N	J-A	12	115.1	1174.1	10.2	9.6	3.1	2.7	0.1
2002	AM	N	M-A	101	516.7	12135.1	23.5	5.1	1.2	2.8	0.1
2002	AM	N	S-D	55	277.6	9662.6	34.8	5.0	1.6	2.8	0.1
2002	AM	O	ALL	510	2828.8	92471.2	32.7	5.5	1.4	2.8	0.2
2002	AM	O	J-A	78	544.1	19275.5	35.4	7.0	1.8	2.8	0.2
2002	AM	O	M-A	298	1590.5	48325.3	30.4	5.3	1.0	2.8	0.2
2002	AM	O	S-D	134	694.2	24870.4	35.8	5.2	1.4	2.8	0.1
2002	FL	ALL	ALL	538	2212.4	71123.4	32.1	4.1	1.4	2.7	0.3
2002	FL	N	ALL	265	994.2	34748.7	35.0	3.8	1.3	2.7	0.2
2002	FL	N	J-A	180	675.8	24226.8	35.8	3.8	1.2	2.6	0.2
2002	FL	N	M-A	85	318.3	10521.8	33.1	3.7	1.3	2.8	0.2
2002	FL	N	S-D								
2002	FL	O	ALL	273	1218.2	36374.7	29.9	4.5	1.4	2.8	0.2
2002	FL	O	J-A	190	851.6	22602.3	26.5	4.5	1.4	2.7	0.3
2002	FL	O	M-A	68	303.9	10883.7	35.8	4.5	1.5	2.8	0.2
2002	FL	O	S-D	15	62.7	2888.8	46.1	4.2	1.2	2.8	0.2
2003	G	ALL	ALL	929	5340.0	148337.9	27.8	5.7	1.6	2.9	0.2
2003	G	N	ALL	173	894.4	24759.2	27.7	5.2	1.6	2.8	0.1
2003	G	O	ALL	756	4446.0	123578.7	27.8	5.9	1.5	2.9	0.2
2003	TX	ALL	ALL	209	1176.0	32055.0	27.3	5.6	0.9	3.0	0.2
2003	TX	N	ALL	9	47.2	2196.0	46.5	5.2	0.4	2.6	0.1
2003	TX	N	J-A								
2003	TX	N	M-A	8	41.5	2051.0	49.4	5.2	0.4	2.6	0.0
2003	TX	N	S-D	1	5.7	145.0	25.4				
2003	TX	O	ALL	200	1129.0	29858.9	26.4	5.6	1.0	3.0	0.2
2003	TX	O	J-A								
2003	TX	O	M-A	123	664.2	19228.6	29.0	5.4	0.9	3.0	0.3
2003	TX	O	S-D	77	464.8	10630.3	22.9	6.0	0.9	3.0	0.1
2003	LA	ALL	ALL	389	2417.5	67885.8	28.1	6.2	1.8	2.9	0.2
2003	LA	N	ALL	24	155.3	5203.4	33.5	6.5	1.7	2.9	0.1

Table B1. Continued

Year	Area	Depth	Season	n	Hours	Total Weight	CPUE	Tow Time Mean	Tow Time s.d.	VS Mean	VS s.d.
2003	LA	N	J-A	3	18.5	287.2	15.5	6.2	0.5	2.7	0.0
2003	LA	N	M-A	6	29.2	1121.3	38.4	4.9	2.4	2.9	0.1
2003	LA	N	S-D	15	107.6	3794.9	35.3	7.2	1.0	2.9	0.1
2003	LA	O	ALL	365	2262.2	62682.3	27.7	6.2	1.8	2.9	0.2
2003	LA	O	J-A	41	287.2	4158.2	14.5	7.0	0.7	2.9	0.1
2003	LA	O	M-A	79	421.2	13486.4	32.0	5.3	1.0	2.9	0.1
2003	LA	O	S-D	245	1553.8	45037.7	29.0	6.3	2.0	2.9	0.2
2003	AM	ALL	ALL	235	1373.4	37449.0	27.3	5.8	1.1	2.8	0.2
2003	AM	N	ALL	77	454.2	9295.6	20.5	5.9	1.1	2.8	0.1
2003	AM	N	J-A	31	200.0	3603.4	18.0	6.5	0.8	2.8	0.1
2003	AM	N	M-A	34	184.4	4141.3	22.5	5.4	1.1	2.8	0.1
2003	AM	N	S-D	12	69.8	1550.8	22.2	5.8	0.8	2.7	0.1
2003	AM	O	ALL	158	919.2	28153.4	30.6	5.8	1.2	2.8	0.2
2003	AM	O	J-A	27	164.8	6406.8	38.9	6.1	1.0	2.9	0.2
2003	AM	O	M-A	63	342.2	9052.6	26.5	5.4	0.8	2.9	0.1
2003	AM	O	S-D	68	412.2	12694.1	30.8	6.1	1.4	2.7	0.1
2003	FL	ALL	ALL	96	372.9	10948.2	29.4	3.9	1.2	2.7	0.1
2003	FL	N	ALL	63	237.7	8064.1	33.9	3.8	1.0	2.7	0.1
2003	FL	N	J-A	63	237.7	8064.1	33.9	3.8	1.0	2.7	0.1
2003	FL	N	M-A								
2003	FL	N	S-D								
2003	FL	O	ALL	33	135.2	2884.1	21.3	4.1	1.4	2.7	0.1
2003	FL	O	J-A	33	135.2	2884.1	21.3	4.1	1.4	2.7	0.1
2003	FL	O	M-A								
2003	FL	O	S-D								
2004	G	ALL	ALL	1217	6972.0	229603.6	32.9	5.7	1.8	2.9	0.2
2004	G	N	ALL	239	1346.3	48315.3	35.9	5.6	1.3	2.9	0.2
2004	G	O	ALL	978	5625.7	181288.2	32.2	5.8	1.9	2.9	0.2
2004	TX	ALL	ALL	276	1499.6	43932.1	29.3	5.4	1.9	3.0	0.2
2004	TX	N	ALL	41	265.0	9775.2	36.9	6.5	1.1	3.0	0.1
2004	TX	N	J-A								
2004	TX	N	M-A	41	265.0	9775.2	36.9				
2004	TX	N	S-D								
2004	TX	O	ALL	235	1234.6	34156.9	27.7	5.3	2.0	3.0	0.2
2004	TX	O	J-A	31	248.8	3485.6	14.0	8.0	3.3	2.9	0.2
2004	TX	O	M-A	182	857.0	27533.5	32.1	4.7	1.2	3.0	0.2
2004	TX	O	S-D	22	128.8	3137.8	24.4	5.9	0.6	3.0	0.1
2004	LA	ALL	ALL	505	3194.7	108292.8	33.9	6.3	1.7	2.9	0.2
2004	LA	N	ALL	119	677.8	27777.6	41.0	5.7	1.3	2.9	0.2
2004	LA	N	J-A	2	13.8	214.9	15.6	6.9	0.1	3.0	0.1
2004	LA	N	M-A	111	644.4	26291.0	40.8	5.8	1.1	2.9	0.2
2004	LA	N	S-D	6	19.6	1271.7	64.9	3.3	1.6	2.9	0.1

Table B1. Continued

Year	Area	Depth	Season	n	Hours	Total Weight	CPUE	Tow Time Mean	Tow Time s.d.	VS Mean	VS s.d.
2004	LA	O	ALL	386	2516.9	80515.2	32.0	6.5	1.8	2.9	0.2
2004	LA	O	J-A	243	1768.8	42661.9	24.1	7.3	1.6	2.9	0.2
2004	LA	O	M-A	71	399.1	19729.9	49.4	5.6	1.1	3.0	0.2
2004	LA	O	S-D	72	349.0	18123.3	51.9	4.8	1.3	3.1	0.1
2004	AM	ALL	ALL	267	1525.1	56375.6	37.0	5.7	1.4	2.9	0.2
2004	AM	N	ALL	31	174.8	4471.2	25.6	5.6	1.5	2.8	0.2
2004	AM	N	J-A	6	45.8	799.6	17.5	7.6	1.9	2.8	0.1
2004	AM	N	M-A	14	75.2	1646.4	21.9	5.4	0.4	2.7	0.2
2004	AM	N	S-D	11	53.8	2025.2	37.6	4.9	1.1	3.0	0.2
2004	AM	O	ALL	236	1350.3	51904.5	38.4	5.7	1.4	2.9	0.2
2004	AM	O	J-A	120	783.6	22760.4	29.0	6.5	1.1	2.9	0.2
2004	AM	O	M-A	45	237.3	9312.3	39.2	5.3	1.1	2.8	0.1
2004	AM	O	S-D	71	329.4	19831.8	60.2	4.6	0.9	3.0	0.1
2004	FL	ALL	ALL	169	752.6	21003.0	27.9	4.5	1.4	2.8	0.2
2004	FL	N	ALL	48	228.7	6291.3	27.5	4.8	1.1	2.8	0.2
2004	FL	N	J-A	43	207.1	5623.0	27.2	4.8	1.1	2.8	0.2
2004	FL	N	M-A	4	15.6	367.3	23.5	3.9	0.8	2.7	0.1
2004	FL	N	S-D	1	6.0	301.0	50.2				
2004	FL	O	ALL	121	523.9	14711.7	28.1	4.3	1.5	2.8	0.2
2004	FL	O	J-A	101	467.7	13151.2	28.1	4.6	1.4	2.8	0.2
2004	FL	O	M-A	20	56.2	1560.5	27.8	2.8	1.0	2.8	0.1
2004	FL	O	S-D								
2005	G	ALL	ALL	833	4419.6	171536.1	38.8	5.3	1.4	2.9	0.2
2005	G	N	ALL	213	1098.1	51585.2	47.0	5.2	1.1	2.9	0.2
2005	G	O	ALL	620	3321.5	119950.8	36.1	5.4	1.4	2.9	0.2
2005	TX	ALL	ALL	168	818.5	28106.8	34.3	4.9	1.1	3.0	0.2
2005	TX	N	ALL	3	14.8	717.5	48.5	4.9	0.3	3.0	0.2
2005	TX	N	J-A								
2005	TX	N	M-A	2	9.6	413.8	43.1	4.8	0.3	3.1	0.2
2005	TX	N	S-D	1	5.2	303.7	58.4				
2005	TX	O	ALL	165	803.7	27389.3	34.1	4.9	1.1	3.0	0.2
2005	TX	O	J-A								
2005	TX	O	M-A	125	600.7	21709.8	36.1	4.8	1.1	3.0	0.2
2005	TX	O	S-D	40	203.0	5679.6	28.0	5.1	1.2	3.0	0.1
2005	LA	ALL	ALL	353	2032.4	87096.1	42.9	5.8	1.3	2.9	0.2
2005	LA	N	ALL	158	829.8	42653.7	51.4	5.3	1.1	2.9	0.2
2005	LA	N	J-A	9	53.8	1773.1	33.0	6.0	0.5	3.0	0.4
2005	LA	N	M-A	126	649.6	34595.0	53.3	5.2	7.6	2.9	0.2
2005	LA	N	S-D	23	126.4	6285.7	49.7	5.5	1.2	2.9	0.1
2005	LA	O	ALL	195	1202.6	44442.4	37.0	6.2	1.4	2.9	0.2
2005	LA	O	J-A	67	452.3	14393.8	31.8	6.8	1.4	2.9	0.1
2005	LA	O	M-A	49	268.0	16155.4	60.3	5.5	0.7	3.0	0.2

Table B1. Continued

Year	Area	Depth	Season	n	Hours	Total Weight	CPUE	Tow Time Mean	Tow Time s.d.	VS Mean	VS s.d.
2005	LA	O	S-D	79	482.3	13893.3	28.8	6.1	1.4	2.9	0.2
2005	AM	ALL	ALL	144	763.5	28693.8	37.6	5.3	1.6	2.9	0.3
2005	AM	N	ALL	23	114.0	3236.5	28.4	5.0	1.0	2.9	0.3
2005	AM	N	J-A	5	28.3	733.8	25.9	5.6	0.9	2.9	0.2
2005	AM	N	M-A	2	9.3	166.6	17.9	4.6	1.2	3.4	0.5
2005	AM	N	S-D	16	76.4	2336.1	30.6	4.8	0.9	2.8	0.3
2005	AM	O	ALL	121	649.6	25457.3	39.2	5.4	1.7	2.9	0.3
2005	AM	O	J-A	60	383.5	13336.2	34.8	6.4	1.6	2.8	0.1
2005	AM	O	M-A	32	138.0	5933.9	43.0	4.3	1.1	3.2	0.4
2005	AM	O	S-D	29	128.0	6187.2	48.3	4.4	1.1	2.7	0.2
2005	FL	ALL	ALL	168	805.2	27639.3	34.3	4.8	1.1	2.9	0.2
2005	FL	N	ALL	29	139.5	4977.5	35.7	4.8	1.0	2.8	0.2
2005	FL	N	J-A	25	125.7	4521.0	36.0	5.0	0.8	2.8	0.2
2005	FL	N	M-A	3	10.0	346.6	34.7	3.3	1.3	2.8	0.2
2005	FL	N	S-D	1	3.8	110.0	28.9				
2005	FL	O	ALL	139	665.7	22661.8	34.0	4.8	1.1	2.9	0.2
2005	FL	O	J-A	126	619.0	20536.0	33.2	4.9	1.0	2.9	0.2
2005	FL	O	M-A	13	46.7	2125.8	45.5	3.6	0.8	2.5	0.1
2005	FL	O	S-D								

Table B2. Chi-square statistics calculation and multiple comparison test results for total fish (excluding red snapper), shrimp and red snapper by area and depth. Area designations are as follows: TX – Texas, LA – Louisiana, AM – Alabama/Mississippi, and FL – Florida. Depth designations are: NR – nearshore (≤ 10 fathoms), and OFF – offshore (> 10 fathoms). Bolded cells denote significance.

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Species
1992-2005	**AM OFF**	**AM NR**	**64.94**	**0.0000**	**Fish**
1992-2005	**FL NR**	**AM OFF**	**211.58**	**0.0000**	**Fish**
1992-2005	FL NR	AM NR	8.21	0.0042	Fish
1992-2005	**FL OFF**	**AM OFF**	**275.89**	**0.0000**	**Fish**
1992-2005	**FL OFF**	**AM NR**	**11.00**	**0.0009**	**Fish**
1992-2005	FL OFF	FL NR	0.15	0.6968	Fish
1992-2005	**LA NR**	**AM NR**	**130.99**	**0.0000**	**Fish**
1992-2005	**LA NR**	**AM OFF**	**33.48**	**0.0000**	**Fish**
1992-2005	**LA NR**	**FL NR**	**265.38**	**0.0000**	**Fish**
1992-2005	**LA NR**	**FL OFF**	**304.44**	**0.0000**	**Fish**
1992-2005	**LA OFF**	**AM NR**	**21.27**	**0.0000**	**Fish**
1992-2005	**LA OFF**	**AM OFF**	**42.47**	**0.0000**	**Fish**
1992-2005	**LA OFF**	**FL NR**	**136.55**	**0.0000**	**Fish**
1992-2005	**LA OFF**	**FL OFF**	**213.49**	**0.0000**	**Fish**
1992-2005	**LA OFF**	**LA NR**	**112.66**	**0.0000**	**Fish**
1992-2005	**TX NR**	**AM OFF**	**17.31**	**0.0000**	**Fish**
1992-2005	**TX NR**	**FL NR**	**22.88**	**0.0000**	**Fish**
1992-2005	**TX NR**	**FL OFF**	**26.96**	**0.0000**	**Fish**
1992-2005	**TX NR**	**LA NR**	**61.68**	**0.0000**	**Fish**
1992-2005	TX NR	AM NR	4.61	0.0318	Fish
1992-2005	TX NR	LA OFF	1.00	0.3185	Fish
1992-2005	**TX OFF**	**AM NR**	**18.55**	**0.0000**	**Fish**
1992-2005	**TX OFF**	**AM OFF**	**410.74**	**0.0000**	**Fish**
1992-2005	**TX OFF**	**LA NR**	**370.52**	**0.0000**	**Fish**
1992-2005	**TX OFF**	**LA OFF**	**468.96**	**0.0000**	**Fish**
1992-2005	**TX OFF**	**TX NR**	**36.08**	**0.0000**	**Fish**
1992-2005	TX OFF	FL NR	2.59	0.1075	Fish
1992-2005	TX OFF	FL OFF	2.03	0.1542	Fish
1992-2005	AM OFF	AM NR	3.35	0.0674	Shrimp
1992-2005	**FL NR**	**AM NR**	**62.52**	**0.0000**	**Shrimp**
1992-2005	**FL NR**	**AM OFF**	**128.84**	**0.0000**	**Shrimp**
1992-2005	**FL OFF**	**AM OFF**	**41.90**	**0.0000**	**Shrimp**
1992-2005	**FL OFF**	**FL NR**	**40.14**	**0.0000**	**Shrimp**
1992-2005	FL OFF	AM NR	8.64	0.0033	Shrimp
1992-2005	**LA NR**	**AM NR**	**201.28**	**0.0000**	**Shrimp**
1992-2005	**LA NR**	**AM OFF**	**255.54**	**0.0000**	**Shrimp**
1992-2005	**LA NR**	**FL NR**	**87.36**	**0.0000**	**Shrimp**
1992-2005	**LA NR**	**FL OFF**	**178.24**	**0.0000**	**Shrimp**
1992-2005	**LA OFF**	**FL NR**	**115.30**	**0.0000**	**Shrimp**
1992-2005	**LA OFF**	**FL OFF**	**29.64**	**0.0000**	**Shrimp**

Table B2. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Species
1992-2005	**LA OFF**	**LA NR**	**243.54**	**0.0000**	**Shrimp**
1992-2005	LA OFF	AM OFF	3.54	0.0597	Shrimp
1992-2005	LA OFF	AM NR	0.53	0.4661	Shrimp
1992-2005	**TX NR**	**AM NR**	**55.07**	**0.0000**	**Shrimp**
1992-2005	**TX NR**	**AM OFF**	**79.82**	**0.0000**	**Shrimp**
1992-2005	**TX NR**	**FL OFF**	**38.47**	**0.0000**	**Shrimp**
1992-2005	**TX NR**	**LA NR**	**33.89**	**0.0000**	**Shrimp**
1992-2005	**TX NR**	**LA OFF**	**71.32**	**0.0000**	**Shrimp**
1992-2005	TX NR	FL NR	5.51	0.0189	Shrimp
1992-2005	**TX OFF**	**AM NR**	**78.77**	**0.0000**	**Shrimp**
1992-2005	**TX OFF**	**AM OFF**	**236.90**	**0.0000**	**Shrimp**
1992-2005	**TX OFF**	**FL OFF**	**56.25**	**0.0000**	**Shrimp**
1992-2005	**TX OFF**	**LA NR**	**111.90**	**0.0000**	**Shrimp**
1992-2005	**TX OFF**	**LA OFF**	**233.91**	**0.0000**	**Shrimp**
1992-2005	**TX OFF**	**TX NR**	**9.89**	**0.0017**	**Shrimp**
1992-2005	TX OFF	FL NR	1.12	0.2895	Shrimp
1992-2005	**AM OFF**	**AM NR**	**102.04**	**0.0000**	**Red Snapper**
1992-2005	**FL NR**	**AM NR**	**33.17**	**0.0000**	**Red Snapper**
1992-2005	**FL NR**	**AM OFF**	**220.22**	**0.0000**	**Red Snapper**
1992-2005	**FL OFF**	**AM OFF**	**168.14**	**0.0000**	**Red Snapper**
1992-2005	**FL OFF**	**FL NR**	**22.55**	**0.0000**	**Red Snapper**
1992-2005	FL OFF	AM NR	8.95	0.0028	Red Snapper
1992-2005	**LA NR**	**AM NR**	**16.94**	**0.0000**	**Red Snapper**
1992-2005	**LA NR**	**AM OFF**	**190.55**	**0.0000**	**Red Snapper**
1992-2005	**LA NR**	**FL NR**	**19.05**	**0.0000**	**Red Snapper**
1992-2005	LA NR	FL OFF	2.63	0.1047	Red Snapper
1992-2005	**LA OFF**	**AM NR**	**298.30**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF**	**AM OFF**	**48.65**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF**	**FL NR**	**483.85**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF**	**FL OFF**	**409.11**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF**	**LA NR**	**442.73**	**0.0000**	**Red Snapper**
1992-2005	**TX NR**	**FL NR**	**19.18**	**0.0000**	**Red Snapper**
1992-2005	**TX NR**	**LA NR**	**17.32**	**0.0000**	**Red Snapper**
1992-2005	**TX NR**	**FL OFF**	**16.08**	**0.0001**	**Red Snapper**
1992-2005	**TX NR**	**AM NR**	**12.14**	**0.0005**	**Red Snapper**
1992-2005	TX NR	LA OFF	5.09	0.0241	Red Snapper
1992-2005	TX NR	AM OFF	0.20	0.6558	Red Snapper
1992-2005	**TX OFF**	**AM NR**	**711.89**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF**	**AM OFF**	**323.27**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF**	**FL NR**	**914.06**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF**	**FL OFF**	**838.56**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF**	**LA NR**	**873.24**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF**	**LA OFF**	**140.02**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF**	**TX NR**	**62.46**	**0.0000**	**Red Snapper**

Table B3. Chi-square statistics calculation and multiple comparison test results for total finfish (excluding red snapper), shrimp and red snapper by area, depth and season. Area designations are as follows: TX – Texas, LA – Louisiana, AM – Alabama/Mississippi, and FL – Florida. Depth designations are: NR – nearshore (≤ 10 fathoms), and OFF – offshore (> 10 fathoms). Seasonal categories are denoted as follows: J-A - January through April, M-A - May through August, and S-D - September through December. Bolded cells denote significance.

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	**AM NR M-A**	**AM NR J-A**	**45.75**	**0.0000**	**Fish**
1992-2005	**AM NR S-D**	**AM NR J-A**	**145.66**	**0.0000**	**Fish**
1992-2005	**AM NR S-D**	**AM NR M-A**	**48.82**	**0.0000**	**Fish**
1992-2005	**AM OFF J-A**	**AM NR J-A**	**352.12**	**0.0000**	**Fish**
1992-2005	**AM OFF J-A**	**AM NR M-A**	**99.77**	**0.0000**	**Fish**
1992-2005	**AM OFF J-A**	**AM OFF M-A**	**46.44**	**0.0000**	**Fish**
1992-2005	AM OFF J-A	AM NR S-D	0.08	0.7797	Fish
1992-2005	**AM OFF M-A**	**AM NR J-A**	**199.82**	**0.0000**	**Fish**
1992-2005	**AM OFF M-A**	**AM NR M-A**	**20.48**	**0.0000**	**Fish**
1992-2005	**AM OFF M-A**	**AM NR S-D**	**19.04**	**0.0000**	**Fish**
1992-2005	**AM OFF S-D**	**AM NR J-A**	**423.81**	**0.0000**	**Fish**
1992-2005	**AM OFF S-D**	**AM NR M-A**	**144.40**	**0.0000**	**Fish**
1992-2005	**AM OFF S-D**	**AM OFF M-A**	**84.40**	**0.0000**	**Fish**
1992-2005	AM OFF S-D	AM OFF J-A	5.79	0.0161	Fish
1992-2005	AM OFF S-D	AM NR S-D	4.26	0.0391	Fish
1992-2005	**FL NR J-A**	**AM NR J-A**	**82.00**	**0.0000**	**Fish**
1992-2005	**FL NR J-A**	**AM NR S-D**	**56.41**	**0.0000**	**Fish**
1992-2005	**FL NR J-A**	**AM OFF M-A**	**31.09**	**0.0000**	**Fish**
1992-2005	**FL NR J-A**	**AM OFF J-A**	**136.92**	**0.0000**	**Fish**
1992-2005	**FL NR J-A**	**AM OFF S-D**	**192.94**	**0.0000**	**Fish**
1992-2005	FL NR J-A	FL NR M-A	0.04	0.8363	Fish
1992-2005	FL NR J-A	AM NR M-A	0.01	0.9160	Fish
1992-2005	**FL NR M-A**	**AM NR J-A**	**50.41**	**0.0000**	**Fish**
1992-2005	**FL NR M-A**	**AM NR S-D**	**51.72**	**0.0000**	**Fish**
1992-2005	**FL NR M-A**	**AM OFF M-A**	**23.67**	**0.0000**	**Fish**
1992-2005	**FL NR M-A**	**AM OFF J-A**	**109.87**	**0.0000**	**Fish**
1992-2005	**FL NR M-A**	**AM OFF S-D**	**157.50**	**0.0000**	**Fish**
1992-2005	FL NR M-A	AM NR M-A	0.01	0.9374	Fish
1992-2005	**FL NR S-D**	**AM NR J-A**	**36.21**	**0.0000**	**Fish**
1992-2005	FL NR S-D	FL NR M-A	9.80	0.0017	Fish
1992-2005	FL NR S-D	FL NR J-A	9.80	0.0017	Fish
1992-2005	FL NR S-D	AM NR M-A	9.39	0.0022	Fish
1992-2005	FL NR S-D	AM OFF S-D	9.28	0.0023	Fish
1992-2005	FL NR S-D	AM OFF J-A	3.38	0.0658	Fish
1992-2005	FL NR S-D	AM NR S-D	2.24	0.1342	Fish
1992-2005	FL NR S-D	AM OFF M-A	1.32	0.2511	Fish

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	**FL OFF J-A**	**AM NR J-A**	**56.12**	**0.0000**	**Fish**
1992-2005	**FL OFF J-A**	**AM NR S-D**	**83.07**	**0.0000**	**Fish**
1992-2005	**FL OFF J-A**	**AM OFF M-A**	**80.61**	**0.0000**	**Fish**
1992-2005	**FL OFF J-A**	**AM OFF J-A**	**218.15**	**0.0000**	**Fish**
1992-2005	**FL OFF J-A**	**AM OFF S-D**	**284.72**	**0.0000**	**Fish**
1992-2005	**FL OFF J-A**	**FL NR S-D**	**16.20**	**0.0001**	**Fish**
1992-2005	FL OFF J-A	FL NR J-A	8.70	0.0032	Fish
1992-2005	FL OFF J-A	FL NR M-A	4.26	0.0390	Fish
1992-2005	FL OFF J-A	AM NR M-A	4.09	0.0433	Fish
1992-2005	**FL OFF M-A**	**AM NR J-A**	**56.77**	**0.0000**	**Fish**
1992-2005	**FL OFF M-A**	**AM NR S-D**	**58.71**	**0.0000**	**Fish**
1992-2005	**FL OFF M-A**	**AM OFF M-A**	**32.87**	**0.0000**	**Fish**
1992-2005	**FL OFF M-A**	**AM OFF J-A**	**133.58**	**0.0000**	**Fish**
1992-2005	**FL OFF M-A**	**AM OFF S-D**	**187.04**	**0.0000**	**Fish**
1992-2005	FL OFF M-A	FL NR S-D	11.03	0.0009	Fish
1992-2005	FL OFF M-A	FL OFF J-A	3.61	0.0573	Fish
1992-2005	FL OFF M-A	FL NR J-A	0.40	0.5265	Fish
1992-2005	FL OFF M-A	AM NR M-A	0.17	0.6841	Fish
1992-2005	FL OFF M-A	FL NR M-A	0.12	0.7339	Fish
1992-2005	**FL OFF S-D**	**AM NR J-A**	**178.06**	**0.0000**	**Fish**
1992-2005	**FL OFF S-D**	**AM NR M-A**	**47.88**	**0.0000**	**Fish**
1992-2005	**FL OFF S-D**	**FL NR M-A**	**51.77**	**0.0000**	**Fish**
1992-2005	**FL OFF S-D**	**FL NR J-A**	**59.31**	**0.0000**	**Fish**
1992-2005	**FL OFF S-D**	**FL OFF J-A**	**95.83**	**0.0000**	**Fish**
1992-2005	**FL OFF S-D**	**FL OFF M-A**	**61.26**	**0.0000**	**Fish**
1992-2005	**FL OFF S-D**	**AM OFF M-A**	**14.69**	**0.0001**	**Fish**
1992-2005	FL OFF S-D	AM OFF S-D	13.77	0.0002	Fish
1992-2005	FL OFF S-D	AM OFF J-A	2.77	0.0959	Fish
1992-2005	FL OFF S-D	AM NR S-D	1.08	0.2989	Fish
1992-2005	FL OFF S-D	FL NR S-D	0.72	0.3952	Fish
1992-2005	**LA NR J-A**	**AM NR J-A**	**29.48**	**0.0000**	**Fish**
1992-2005	**LA NR J-A**	**AM OFF J-A**	**18.05**	**0.0000**	**Fish**
1992-2005	**LA NR J-A**	**AM OFF S-D**	**32.28**	**0.0000**	**Fish**
1992-2005	LA NR J-A	AM NR S-D	12.20	0.0005	Fish
1992-2005	LA NR J-A	FL OFF J-A	8.55	0.0034	Fish
1992-2005	LA NR J-A	FL OFF S-D	8.40	0.0037	Fish
1992-2005	LA NR J-A	FL OFF M-A	4.25	0.0393	Fish
1992-2005	LA NR J-A	FL NR M-A	3.38	0.0659	Fish
1992-2005	LA NR J-A	FL NR J-A	3.28	0.0702	Fish
1992-2005	LA NR J-A	AM NR M-A	3.12	0.0771	Fish
1992-2005	LA NR J-A	FL NR S-D	1.85	0.1734	Fish
1992-2005	LA NR J-A	AM OFF M-A	0.42	0.5153	Fish
1992-2005	**LA NR M-A**	**AM NR J-A**	**511.15**	**0.0000**	**Fish**
1992-2005	**LA NR M-A**	**AM NR M-A**	**189.15**	**0.0000**	**Fish**

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	**LA NR M-A**	**AM OFF M-A**	**123.97**	**0.0000**	**Fish**
1992-2005	**LA NR M-A**	**AM OFF J-A**	**17.28**	**0.0000**	**Fish**
1992-2005	**LA NR M-A**	**FL NR M-A**	**205.92**	**0.0000**	**Fish**
1992-2005	**LA NR M-A**	**FL NR J-A**	**252.73**	**0.0000**	**Fish**
1992-2005	**LA NR M-A**	**FL OFF J-A**	**361.34**	**0.0000**	**Fish**
1992-2005	**LA NR M-A**	**FL OFF M-A**	**242.96**	**0.0000**	**Fish**
1992-2005	**LA NR M-A**	**FL OFF S-D**	**27.40**	**0.0000**	**Fish**
1992-2005	**LA NR M-A**	**LA NR J-A**	**45.82**	**0.0000**	**Fish**
1992-2005	**LA NR M-A**	**FL NR S-D**	**15.52**	**0.0001**	**Fish**
1992-2005	LA NR M-A	AM NR S-D	11.34	0.0008	Fish
1992-2005	LA NR M-A	LA NR S-D	8.00	0.0047	Fish
1992-2005	LA NR M-A	AM OFF S-D	2.87	0.0904	Fish
1992-2005	**LA NR S-D**	**AM NR J-A**	**119.47**	**0.0000**	**Fish**
1992-2005	**LA NR S-D**	**AM NR M-A**	**42.62**	**0.0000**	**Fish**
1992-2005	**LA NR S-D**	**AM OFF M-A**	**17.03**	**0.0000**	**Fish**
1992-2005	**LA NR S-D**	**FL NR M-A**	**44.77**	**0.0000**	**Fish**
1992-2005	**LA NR S-D**	**FL NR J-A**	**47.70**	**0.0000**	**Fish**
1992-2005	**LA NR S-D**	**FL OFF J-A**	**68.51**	**0.0000**	**Fish**
1992-2005	**LA NR S-D**	**FL OFF M-A**	**50.04**	**0.0000**	**Fish**
1992-2005	LA NR S-D	LA NR J-A	12.07	0.0005	Fish
1992-2005	LA NR S-D	AM OFF S-D	2.71	0.0997	Fish
1992-2005	LA NR S-D	FL NR S-D	2.51	0.1128	Fish
1992-2005	LA NR S-D	FL OFF S-D	1.35	0.2448	Fish
1992-2005	LA NR S-D	AM NR S-D	0.04	0.8466	Fish
1992-2005	LA NR S-D	AM OFF J-A	0.00	1.0000	Fish
1992-2005	**LA OFF J-A**	**AM NR J-A**	**300.52**	**0.0000**	**Fish**
1992-2005	**LA OFF J-A**	**AM NR M-A**	**17.12**	**0.0000**	**Fish**
1992-2005	**LA OFF J-A**	**AM NR S-D**	**28.74**	**0.0000**	**Fish**
1992-2005	**LA OFF J-A**	**AM OFF J-A**	**81.81**	**0.0000**	**Fish**
1992-2005	**LA OFF J-A**	**AM OFF S-D**	**133.42**	**0.0000**	**Fish**
1992-2005	**LA OFF J-A**	**FL NR M-A**	**20.85**	**0.0000**	**Fish**
1992-2005	**LA OFF J-A**	**FL NR J-A**	**32.56**	**0.0000**	**Fish**
1992-2005	**LA OFF J-A**	**FL OFF J-A**	**124.10**	**0.0000**	**Fish**
1992-2005	**LA OFF J-A**	**FL OFF M-A**	**32.88**	**0.0000**	**Fish**
1992-2005	**LA OFF J-A**	**FL OFF S-D**	**26.19**	**0.0000**	**Fish**
1992-2005	**LA OFF J-A**	**LA NR S-D**	**24.62**	**0.0000**	**Fish**
1992-2005	**LA OFF J-A**	**LA NR M-A**	**189.31**	**0.0000**	**Fish**
1992-2005	LA OFF J-A	FL NR S-D	2.63	0.1048	Fish
1992-2005	LA OFF J-A	AM OFF M-A	2.12	0.1458	Fish
1992-2005	LA OFF J-A	LA NR J-A	0.01	0.9066	Fish
1992-2005	**LA OFF M-A**	**AM NR J-A**	**470.97**	**0.0000**	**Fish**
1992-2005	**LA OFF M-A**	**AM NR M-A**	**93.40**	**0.0000**	**Fish**
1992-2005	**LA OFF M-A**	**AM OFF M-A**	**35.64**	**0.0000**	**Fish**
1992-2005	**LA OFF M-A**	**AM OFF S-D**	**23.21**	**0.0000**	**Fish**

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	**LA OFF M-A**	**FL NR M-A**	**106.83**	**0.0000**	**Fish**
1992-2005	**LA OFF M-A**	**FL NR J-A**	**151.76**	**0.0000**	**Fish**
1992-2005	**LA OFF M-A**	**FL OFF J-A**	**290.53**	**0.0000**	**Fish**
1992-2005	**LA OFF M-A**	**FL OFF M-A**	**140.94**	**0.0000**	**Fish**
1992-2005	**LA OFF M-A**	**LA NR M-A**	**46.80**	**0.0000**	**Fish**
1992-2005	**LA OFF M-A**	**LA OFF J-A**	**87.32**	**0.0000**	**Fish**
1992-2005	LA OFF M-A	LA NR J-A	11.09	0.0009	Fish
1992-2005	LA OFF M-A	LA OFF S-D	9.93	0.0016	Fish
1992-2005	LA OFF M-A	AM OFF J-A	4.55	0.0329	Fish
1992-2005	LA OFF M-A	LA NR S-D	1.55	0.2134	Fish
1992-2005	LA OFF M-A	AM NR S-D	1.27	0.2593	Fish
1992-2005	LA OFF M-A	FL NR S-D	0.96	0.3266	Fish
1992-2005	LA OFF M-A	FL OFF S-D	0.01	0.9044	Fish
1992-2005	**LA OFF S-D**	**AM NR J-A**	**472.31**	**0.0000**	**Fish**
1992-2005	**LA OFF S-D**	**AM NR M-A**	**65.22**	**0.0000**	**Fish**
1992-2005	**LA OFF S-D**	**AM OFF J-A**	**21.38**	**0.0000**	**Fish**
1992-2005	**LA OFF S-D**	**AM OFF S-D**	**53.76**	**0.0000**	**Fish**
1992-2005	**LA OFF S-D**	**FL NR M-A**	**76.54**	**0.0000**	**Fish**
1992-2005	**LA OFF S-D**	**FL NR J-A**	**118.13**	**0.0000**	**Fish**
1992-2005	**LA OFF S-D**	**FL OFF J-A**	**276.50**	**0.0000**	**Fish**
1992-2005	**LA OFF S-D**	**FL OFF M-A**	**107.65**	**0.0000**	**Fish**
1992-2005	**LA OFF S-D**	**LA NR M-A**	**89.90**	**0.0000**	**Fish**
1992-2005	**LA OFF S-D**	**LA OFF J-A**	**53.87**	**0.0000**	**Fish**
1992-2005	LA OFF S-D	AM OFF M-A	14.11	0.0002	Fish
1992-2005	LA OFF S-D	AM NR S-D	7.08	0.0078	Fish
1992-2005	LA OFF S-D	LA NR S-D	6.74	0.0094	Fish
1992-2005	LA OFF S-D	LA NR J-A	4.86	0.0275	Fish
1992-2005	LA OFF S-D	FL OFF S-D	3.02	0.0825	Fish
1992-2005	LA OFF S-D	FL NR S-D	0.00	0.9641	Fish
1992-2005	**TX NR J-A**	**AM NR S-D**	**70.08**	**0.0000**	**Fish**
1992-2005	**TX NR J-A**	**AM OFF M-A**	**42.51**	**0.0000**	**Fish**
1992-2005	**TX NR J-A**	**AM OFF J-A**	**124.07**	**0.0000**	**Fish**
1992-2005	**TX NR J-A**	**AM OFF S-D**	**166.96**	**0.0000**	**Fish**
1992-2005	**TX NR J-A**	**FL NR S-D**	**18.57**	**0.0000**	**Fish**
1992-2005	**TX NR J-A**	**FL OFF S-D**	**70.78**	**0.0000**	**Fish**
1992-2005	**TX NR J-A**	**LA NR S-D**	**61.95**	**0.0000**	**Fish**
1992-2005	**TX NR J-A**	**LA NR M-A**	**208.57**	**0.0000**	**Fish**
1992-2005	**TX NR J-A**	**LA OFF J-A**	**39.89**	**0.0000**	**Fish**
1992-2005	**TX NR J-A**	**LA OFF S-D**	**89.36**	**0.0000**	**Fish**
1992-2005	**TX NR J-A**	**LA OFF M-A**	**116.35**	**0.0000**	**Fish**
1992-2005	TX NR J-A	LA NR J-A	10.96	0.0009	Fish
1992-2005	TX NR J-A	FL NR J-A	8.51	0.0035	Fish
1992-2005	TX NR J-A	AM NR J-A	7.01	0.0081	Fish
1992-2005	TX NR J-A	FL NR M-A	6.34	0.0118	Fish

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	TX NR J-A	AM NR M-A	6.29	0.0122	Fish
1992-2005	TX NR J-A	FL OFF M-A	5.66	0.0174	Fish
1992-2005	TX NR J-A	FL OFF J-A	1.87	0.1717	Fish
1992-2005	**TX NR M-A**	**AM NR J-A**	**194.63**	**0.0000**	**Fish**
1992-2005	**TX NR M-A**	**AM NR M-A**	**61.41**	**0.0000**	**Fish**
1992-2005	**TX NR M-A**	**AM OFF M-A**	**24.63**	**0.0000**	**Fish**
1992-2005	**TX NR M-A**	**FL NR M-A**	**65.85**	**0.0000**	**Fish**
1992-2005	**TX NR M-A**	**FL NR J-A**	**74.55**	**0.0000**	**Fish**
1992-2005	**TX NR M-A**	**FL OFF J-A**	**112.60**	**0.0000**	**Fish**
1992-2005	**TX NR M-A**	**FL OFF M-A**	**76.33**	**0.0000**	**Fish**
1992-2005	**TX NR M-A**	**LA OFF J-A**	**39.01**	**0.0000**	**Fish**
1992-2005	**TX NR M-A**	**TX NR J-A**	**84.90**	**0.0000**	**Fish**
1992-2005	**TX NR M-A**	**TX NR S-D**	**29.66**	**0.0000**	**Fish**
1992-2005	**TX NR M-A**	**LA NR M-A**	**14.56**	**0.0001**	**Fish**
1992-2005	TX NR M-A	LA NR J-A	13.50	0.0002	Fish
1992-2005	TX NR M-A	LA OFF S-D	9.34	0.0022	Fish
1992-2005	TX NR M-A	AM OFF S-D	5.55	0.0185	Fish
1992-2005	TX NR M-A	FL NR S-D	2.36	0.1244	Fish
1992-2005	TX NR M-A	LA OFF M-A	1.57	0.2101	Fish
1992-2005	TX NR M-A	FL OFF S-D	1.22	0.2684	Fish
1992-2005	TX NR M-A	AM OFF J-A	0.13	0.7191	Fish
1992-2005	TX NR M-A	LA NR S-D	0.06	0.8110	Fish
1992-2005	TX NR M-A	AM NR S-D	0.00	1.0000	Fish
1992-2005	**TX NR S-D**	**AM NR S-D**	**27.76**	**0.0000**	**Fish**
1992-2005	**TX NR S-D**	**AM OFF J-A**	**35.06**	**0.0000**	**Fish**
1992-2005	**TX NR S-D**	**AM OFF S-D**	**49.29**	**0.0000**	**Fish**
1992-2005	**TX NR S-D**	**FL OFF S-D**	**23.51**	**0.0000**	**Fish**
1992-2005	**TX NR S-D**	**LA NR S-D**	**27.22**	**0.0000**	**Fish**
1992-2005	**TX NR S-D**	**LA NR M-A**	**61.75**	**0.0000**	**Fish**
1992-2005	**TX NR S-D**	**LA OFF S-D**	**19.54**	**0.0000**	**Fish**
1992-2005	**TX NR S-D**	**LA OFF M-A**	**27.51**	**0.0000**	**Fish**
1992-2005	TX NR S-D	AM OFF M-A	10.42	0.0012	Fish
1992-2005	TX NR S-D	FL NR S-D	10.56	0.0012	Fish
1992-2005	TX NR S-D	LA OFF J-A	8.36	0.0038	Fish
1992-2005	TX NR S-D	LA NR J-A	5.21	0.0224	Fish
1992-2005	TX NR S-D	FL NR J-A	1.99	0.1586	Fish
1992-2005	TX NR S-D	AM NR M-A	1.76	0.1849	Fish
1992-2005	TX NR S-D	FL NR M-A	1.70	0.1929	Fish
1992-2005	TX NR S-D	AM NR J-A	1.61	0.2041	Fish
1992-2005	TX NR S-D	FL OFF M-A	1.40	0.2362	Fish
1992-2005	TX NR S-D	FL OFF J-A	0.40	0.5271	Fish
1992-2005	TX NR S-D	TX NR J-A	0.00	1.0000	Fish
1992-2005	**TX OFF J-A**	**AM NR M-A**	**52.67**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**AM NR S-D**	**154.54**	**0.0000**	**Fish**

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	**TX OFF J-A**	**AM OFF M-A**	**268.70**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**AM OFF J-A**	**423.36**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**AM OFF S-D**	**498.66**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**FL NR M-A**	**59.89**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**FL NR J-A**	**114.89**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**FL NR S-D**	**36.20**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**FL OFF J-A**	**93.87**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**FL OFF M-A**	**72.32**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**FL OFF S-D**	**197.57**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**LA NR J-A**	**29.67**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**LA NR S-D**	**124.42**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**LA NR M-A**	**601.79**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**LA OFF J-A**	**600.51**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**LA OFF S-D**	**809.57**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**LA OFF M-A**	**678.20**	**0.0000**	**Fish**
1992-2005	**TX OFF J-A**	**TX NR M-A**	**213.12**	**0.0000**	**Fish**
1992-2005	TX OFF J-A	TX NR J-A	6.87	0.0088	Fish
1992-2005	TX OFF J-A	TX NR S-D	1.42	0.2338	Fish
1992-2005	TX OFF J-A	AM NR J-A	0.18	0.6677	Fish
1992-2005	**TX OFF M-A**	**AM NR J-A**	**147.73**	**0.0000**	**Fish**
1992-2005	**TX OFF M-A**	**AM NR S-D**	**61.41**	**0.0000**	**Fish**
1992-2005	**TX OFF M-A**	**AM OFF M-A**	**44.45**	**0.0000**	**Fish**
1992-2005	**TX OFF M-A**	**AM OFF J-A**	**173.65**	**0.0000**	**Fish**
1992-2005	**TX OFF M-A**	**AM OFF S-D**	**238.36**	**0.0000**	**Fish**
1992-2005	**TX OFF M-A**	**FL OFF J-A**	**20.65**	**0.0000**	**Fish**
1992-2005	**TX OFF M-A**	**FL OFF S-D**	**68.18**	**0.0000**	**Fish**
1992-2005	**TX OFF M-A**	**LA NR S-D**	**50.75**	**0.0000**	**Fish**
1992-2005	**TX OFF M-A**	**LA NR M-A**	**312.36**	**0.0000**	**Fish**
1992-2005	**TX OFF M-A**	**LA OFF J-A**	**72.82**	**0.0000**	**Fish**
1992-2005	**TX OFF M-A**	**LA OFF S-D**	**226.69**	**0.0000**	**Fish**
1992-2005	**TX OFF M-A**	**LA OFF M-A**	**238.40**	**0.0000**	**Fish**
1992-2005	**TX OFF M-A**	**TX NR M-A**	**84.37**	**0.0000**	**Fish**
1992-2005	**TX OFF M-A**	**TX OFF J-A**	**330.95**	**0.0000**	**Fish**
1992-2005	TX OFF M-A	TX NR J-A	10.84	0.0010	Fish
1992-2005	TX OFF M-A	FL NR S-D	9.88	0.0017	Fish
1992-2005	TX OFF M-A	LA NR J-A	3.25	0.0713	Fish
1992-2005	TX OFF M-A	TX NR S-D	2.21	0.1368	Fish
1992-2005	TX OFF M-A	FL OFF M-A	0.91	0.3404	Fish
1992-2005	TX OFF M-A	FL NR M-A	0.16	0.6911	Fish
1992-2005	TX OFF M-A	AM NR M-A	0.07	0.7907	Fish
1992-2005	TX OFF M-A	FL NR J-A	0.04	0.8328	Fish
1992-2005	**TX OFF S-D**	**AM NR J-A**	**150.80**	**0.0000**	**Fish**
1992-2005	**TX OFF S-D**	**AM NR S-D**	**51.16**	**0.0000**	**Fish**
1992-2005	**TX OFF S-D**	**AM OFF M-A**	**25.93**	**0.0000**	**Fish**

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	**TX OFF S-D**	**AM OFF J-A**	**138.13**	**0.0000**	**Fish**
1992-2005	**TX OFF S-D**	**AM OFF S-D**	**197.54**	**0.0000**	**Fish**
1992-2005	**TX OFF S-D**	**FL OFF J-A**	**29.67**	**0.0000**	**Fish**
1992-2005	**TX OFF S-D**	**FL OFF S-D**	**53.99**	**0.0000**	**Fish**
1992-2005	**TX OFF S-D**	**LA NR S-D**	**42.84**	**0.0000**	**Fish**
1992-2005	**TX OFF S-D**	**LA NR M-A**	**262.96**	**0.0000**	**Fish**
1992-2005	**TX OFF S-D**	**LA OFF J-A**	**30.15**	**0.0000**	**Fish**
1992-2005	**TX OFF S-D**	**LA OFF S-D**	**138.13**	**0.0000**	**Fish**
1992-2005	**TX OFF S-D**	**LA OFF M-A**	**168.38**	**0.0000**	**Fish**
1992-2005	**TX OFF S-D**	**TX NR M-A**	**69.32**	**0.0000**	**Fish**
1992-2005	**TX OFF S-D**	**TX OFF J-A**	**270.74**	**0.0000**	**Fish**
1992-2005	**TX OFF S-D**	**TX NR J-A**	**15.24**	**0.0001**	**Fish**
1992-2005	TX OFF S-D	FL NR S-D	7.69	0.0055	Fish
1992-2005	TX OFF S-D	FL OFF M-A	3.88	0.0487	Fish
1992-2005	TX OFF S-D	TX NR S-D	3.26	0.0712	Fish
1992-2005	TX OFF S-D	TX OFF M-A	3.25	0.0715	Fish
1992-2005	TX OFF S-D	FL NR J-A	2.01	0.1565	Fish
1992-2005	TX OFF S-D	LA NR J-A	1.81	0.1788	Fish
1992-2005	TX OFF S-D	FL NR M-A	1.75	0.1861	Fish
1992-2005	TX OFF S-D	AM NR M-A	1.28	0.2570	Fish
1992-2005	**AM NR M-A**	**AM NR J-A**	**136.66**	**0.0000**	**Shrimp**
1992-2005	**AM NR M-A**	**AM NR S-D**	**54.52**	**0.0000**	**Shrimp**
1992-2005	**AM NR S-D**	**AM NR J-A**	**16.17**	**0.0001**	**Shrimp**
1992-2005	**AM OFF J-A**	**AM NR M-A**	**154.19**	**0.0000**	**Shrimp**
1992-2005	AM OFF J-A	AM NR S-D	9.66	0.0019	Shrimp
1992-2005	AM OFF J-A	AM NR J-A	4.31	0.0380	Shrimp
1992-2005	**AM OFF M-A**	**AM NR J-A**	**97.61**	**0.0000**	**Shrimp**
1992-2005	**AM OFF M-A**	**AM NR S-D**	**19.74**	**0.0000**	**Shrimp**
1992-2005	**AM OFF M-A**	**AM NR M-A**	**20.78**	**0.0000**	**Shrimp**
1992-2005	**AM OFF M-A**	**AM OFF J-A**	**137.81**	**0.0000**	**Shrimp**
1992-2005	**AM OFF S-D**	**AM NR J-A**	**82.90**	**0.0000**	**Shrimp**
1992-2005	**AM OFF S-D**	**AM NR S-D**	**18.45**	**0.0000**	**Shrimp**
1992-2005	**AM OFF S-D**	**AM OFF J-A**	**96.37**	**0.0000**	**Shrimp**
1992-2005	**AM OFF S-D**	**AM NR M-A**	**15.45**	**0.0001**	**Shrimp**
1992-2005	AM OFF S-D	AM OFF M-A	0.11	0.7449	Shrimp
1992-2005	**FL NR J-A**	**AM NR J-A**	**214.79**	**0.0000**	**Shrimp**
1992-2005	**FL NR J-A**	**AM NR S-D**	**95.24**	**0.0000**	**Shrimp**
1992-2005	**FL NR J-A**	**AM OFF J-A**	**275.75**	**0.0000**	**Shrimp**
1992-2005	**FL NR J-A**	**AM OFF M-A**	**53.43**	**0.0000**	**Shrimp**
1992-2005	**FL NR J-A**	**AM OFF S-D**	**39.65**	**0.0000**	**Shrimp**
1992-2005	FL NR J-A	FL NR M-A	3.25	0.0715	Shrimp
1992-2005	FL NR J-A	AM NR M-A	2.99	0.0839	Shrimp
1992-2005	**FL NR M-A**	**AM NR J-A**	**73.81**	**0.0000**	**Shrimp**
1992-2005	**FL NR M-A**	**AM NR S-D**	**29.16**	**0.0000**	**Shrimp**

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	**FL NR M-A**	**AM OFF J-A**	**69.01**	**0.0000**	**Shrimp**
1992-2005	FL NR M-A	AM OFF M-A	8.20	0.0042	Shrimp
1992-2005	FL NR M-A	AM OFF S-D	6.44	0.0112	Shrimp
1992-2005	FL NR M-A	AM NR M-A	0.19	0.6632	Shrimp
1992-2005	**FL NR S-D**	**AM NR J-A**	**52.54**	**0.0000**	**Shrimp**
1992-2005	**FL NR S-D**	**AM NR S-D**	**27.97**	**0.0000**	**Shrimp**
1992-2005	**FL NR S-D**	**AM OFF J-A**	**46.31**	**0.0000**	**Shrimp**
1992-2005	FL NR S-D	AM OFF M-A	13.13	0.0003	Shrimp
1992-2005	FL NR S-D	AM OFF S-D	11.83	0.0006	Shrimp
1992-2005	FL NR S-D	FL NR M-A	2.84	0.0917	Shrimp
1992-2005	FL NR S-D	AM NR M-A	2.33	0.1268	Shrimp
1992-2005	FL NR S-D	FL NR J-A	0.50	0.4817	Shrimp
1992-2005	**FL OFF J-A**	**AM NR J-A**	**108.18**	**0.0000**	**Shrimp**
1992-2005	**FL OFF J-A**	**AM NR S-D**	**23.41**	**0.0000**	**Shrimp**
1992-2005	**FL OFF J-A**	**AM NR M-A**	**18.36**	**0.0000**	**Shrimp**
1992-2005	**FL OFF J-A**	**AM OFF J-A**	**160.87**	**0.0000**	**Shrimp**
1992-2005	**FL OFF J-A**	**FL NR J-A**	**49.68**	**0.0000**	**Shrimp**
1992-2005	FL OFF J-A	FL NR S-D	12.17	0.0005	Shrimp
1992-2005	FL OFF J-A	FL NR M-A	6.98	0.0082	Shrimp
1992-2005	FL OFF J-A	AM OFF M-A	0.22	0.6391	Shrimp
1992-2005	FL OFF J-A	AM OFF S-D	0.00	0.9486	Shrimp
1992-2005	**FL OFF M-A**	**FL NR J-A**	**21.18**	**0.0000**	**Shrimp**
1992-2005	**FL OFF M-A**	**AM NR J-A**	**68.91**	**0.0000**	**Shrimp**
1992-2005	**FL OFF M-A**	**AM NR S-D**	**18.72**	**0.0000**	**Shrimp**
1992-2005	**FL OFF M-A**	**AM OFF J-A**	**67.84**	**0.0000**	**Shrimp**
1992-2005	FL OFF M-A	FL NR S-D	8.83	0.0030	Shrimp
1992-2005	FL OFF M-A	AM NR M-A	7.53	0.0061	Shrimp
1992-2005	FL OFF M-A	FL NR M-A	3.21	0.0731	Shrimp
1992-2005	FL OFF M-A	AM OFF M-A	1.08	0.2996	Shrimp
1992-2005	FL OFF M-A	FL OFF J-A	0.54	0.4606	Shrimp
1992-2005	FL OFF M-A	AM OFF S-D	0.52	0.4715	Shrimp
1992-2005	**FL OFF S-D**	**AM NR J-A**	**143.63**	**0.0000**	**Shrimp**
1992-2005	**FL OFF S-D**	**AM NR S-D**	**62.30**	**0.0000**	**Shrimp**
1992-2005	**FL OFF S-D**	**AM OFF J-A**	**158.04**	**0.0000**	**Shrimp**
1992-2005	**FL OFF S-D**	**AM OFF M-A**	**27.69**	**0.0000**	**Shrimp**
1992-2005	**FL OFF S-D**	**AM OFF S-D**	**21.51**	**0.0000**	**Shrimp**
1992-2005	**FL OFF S-D**	**FL OFF J-A**	**25.10**	**0.0000**	**Shrimp**
1992-2005	FL OFF S-D	FL OFF M-A	11.80	0.0006	Shrimp
1992-2005	FL OFF S-D	FL NR M-A	1.20	0.2734	Shrimp
1992-2005	FL OFF S-D	FL NR S-D	1.13	0.2871	Shrimp
1992-2005	FL OFF S-D	AM NR M-A	0.68	0.4083	Shrimp
1992-2005	FL OFF S-D	FL NR J-A	0.58	0.4472	Shrimp
1992-2005	**LA NR J-A**	**AM NR M-A**	**35.19**	**0.0000**	**Shrimp**
1992-2005	**LA NR J-A**	**FL NR M-A**	**23.14**	**0.0000**	**Shrimp**

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	**LA NR J-A**	**FL NR J-A**	**55.18**	**0.0000**	**Shrimp**
1992-2005	**LA NR J-A**	**FL NR S-D**	**26.18**	**0.0000**	**Shrimp**
1992-2005	**LA NR J-A**	**FL OFF S-D**	**41.15**	**0.0000**	**Shrimp**
1992-2005	LA NR J-A	FL OFF J-A	13.90	0.0002	Shrimp
1992-2005	LA NR J-A	FL OFF M-A	13.97	0.0002	Shrimp
1992-2005	LA NR J-A	AM OFF S-D	12.39	0.0004	Shrimp
1992-2005	LA NR J-A	AM OFF M-A	12.18	0.0005	Shrimp
1992-2005	LA NR J-A	AM NR J-A	4.99	0.0255	Shrimp
1992-2005	LA NR J-A	AM OFF J-A	1.68	0.1944	Shrimp
1992-2005	LA NR J-A	AM NR S-D	0.31	0.5805	Shrimp
1992-2005	**LA NR M-A**	**FL NR M-A**	**105.53**	**0.0000**	**Shrimp**
1992-2005	**LA NR M-A**	**FL NR J-A**	**107.81**	**0.0000**	**Shrimp**
1992-2005	**LA NR M-A**	**FL NR S-D**	**37.35**	**0.0000**	**Shrimp**
1992-2005	**LA NR M-A**	**FL OFF S-D**	**107.05**	**0.0000**	**Shrimp**
1992-2005	**LA NR M-A**	**LA NR S-D**	**37.06**	**0.0000**	**Shrimp**
1992-2005	**LA NR M-A**	**AM NR J-A**	**366.34**	**0.0000**	**Shrimp**
1992-2005	**LA NR M-A**	**AM NR S-D**	**263.59**	**0.0000**	**Shrimp**
1992-2005	**LA NR M-A**	**AM NR M-A**	**124.40**	**0.0000**	**Shrimp**
1992-2005	**LA NR M-A**	**AM OFF J-A**	**382.39**	**0.0000**	**Shrimp**
1992-2005	**LA NR M-A**	**AM OFF M-A**	**221.25**	**0.0000**	**Shrimp**
1992-2005	**LA NR M-A**	**AM OFF S-D**	**202.51**	**0.0000**	**Shrimp**
1992-2005	**LA NR M-A**	**FL OFF J-A**	**217.27**	**0.0000**	**Shrimp**
1992-2005	**LA NR M-A**	**FL OFF M-A**	**166.10**	**0.0000**	**Shrimp**
1992-2005	**LA NR M-A**	**LA NR J-A**	**201.34**	**0.0000**	**Shrimp**
1992-2005	**LA NR S-D**	**FL OFF J-A**	**18.59**	**0.0000**	**Shrimp**
1992-2005	**LA NR S-D**	**AM NR J-A**	**69.98**	**0.0000**	**Shrimp**
1992-2005	**LA NR S-D**	**AM NR S-D**	**38.58**	**0.0000**	**Shrimp**
1992-2005	**LA NR S-D**	**AM OFF J-A**	**63.41**	**0.0000**	**Shrimp**
1992-2005	**LA NR S-D**	**AM OFF M-A**	**19.86**	**0.0000**	**Shrimp**
1992-2005	**LA NR S-D**	**AM OFF S-D**	**17.91**	**0.0000**	**Shrimp**
1992-2005	**LA NR S-D**	**LA NR J-A**	**34.62**	**0.0000**	**Shrimp**
1992-2005	LA NR S-D	FL OFF M-A	13.53	0.0002	Shrimp
1992-2005	LA NR S-D	FL NR M-A	5.01	0.0252	Shrimp
1992-2005	LA NR S-D	AM NR M-A	4.51	0.0337	Shrimp
1992-2005	LA NR S-D	FL OFF S-D	2.60	0.1068	Shrimp
1992-2005	LA NR S-D	FL NR J-A	1.55	0.2136	Shrimp
1992-2005	LA NR S-D	FL NR S-D	0.12	0.7309	Shrimp
1992-2005	**LA OFF J-A**	**FL NR M-A**	**78.30**	**0.0000**	**Shrimp**
1992-2005	**LA OFF J-A**	**FL NR J-A**	**335.19**	**0.0000**	**Shrimp**
1992-2005	**LA OFF J-A**	**FL NR S-D**	**49.79**	**0.0000**	**Shrimp**
1992-2005	**LA OFF J-A**	**FL OFF J-A**	**240.17**	**0.0000**	**Shrimp**
1992-2005	**LA OFF J-A**	**FL OFF M-A**	**82.31**	**0.0000**	**Shrimp**
1992-2005	**LA OFF J-A**	**FL OFF S-D**	**184.04**	**0.0000**	**Shrimp**
1992-2005	**LA OFF J-A**	**LA NR S-D**	**68.16**	**0.0000**	**Shrimp**

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	**LA OFF J-A**	**AM NR M-A**	**183.33**	**0.0000**	**Shrimp**
1992-2005	**LA OFF J-A**	**AM OFF M-A**	**202.57**	**0.0000**	**Shrimp**
1992-2005	**LA OFF J-A**	**AM OFF S-D**	**127.38**	**0.0000**	**Shrimp**
1992-2005	**LA OFF J-A**	**LA NR M-A**	**405.42**	**0.0000**	**Shrimp**
1992-2005	**LA OFF J-A**	**AM NR S-D**	**14.46**	**0.0001**	**Shrimp**
1992-2005	LA OFF J-A	AM NR J-A	2.71	0.0995	Shrimp
1992-2005	LA OFF J-A	LA NR J-A	2.66	0.1028	Shrimp
1992-2005	LA OFF J-A	AM OFF J-A	1.38	0.2397	Shrimp
1992-2005	**LA OFF M-A**	**AM NR J-A**	**201.62**	**0.0000**	**Shrimp**
1992-2005	**LA OFF M-A**	**AM NR S-D**	**88.00**	**0.0000**	**Shrimp**
1992-2005	**LA OFF M-A**	**AM OFF J-A**	**254.56**	**0.0000**	**Shrimp**
1992-2005	**LA OFF M-A**	**AM OFF M-A**	**46.92**	**0.0000**	**Shrimp**
1992-2005	**LA OFF M-A**	**AM OFF S-D**	**34.83**	**0.0000**	**Shrimp**
1992-2005	**LA OFF M-A**	**FL OFF J-A**	**43.36**	**0.0000**	**Shrimp**
1992-2005	**LA OFF M-A**	**FL OFF M-A**	**18.40**	**0.0000**	**Shrimp**
1992-2005	**LA OFF M-A**	**LA NR J-A**	**51.64**	**0.0000**	**Shrimp**
1992-2005	**LA OFF M-A**	**LA NR M-A**	**111.09**	**0.0000**	**Shrimp**
1992-2005	**LA OFF M-A**	**LA OFF J-A**	**308.62**	**0.0000**	**Shrimp**
1992-2005	**LA OFF M-A**	**LA OFF S-D**	**35.17**	**0.0000**	**Shrimp**
1992-2005	LA OFF M-A	FL NR M-A	2.46	0.1171	Shrimp
1992-2005	LA OFF M-A	AM NR M-A	2.03	0.1540	Shrimp
1992-2005	LA OFF M-A	LA NR S-D	1.95	0.1624	Shrimp
1992-2005	LA OFF M-A	FL NR S-D	0.72	0.3976	Shrimp
1992-2005	LA OFF M-A	FL OFF S-D	0.23	0.6319	Shrimp
1992-2005	LA OFF M-A	FL NR J-A	0.10	0.7530	Shrimp
1992-2005	**LA OFF S-D**	**FL NR J-A**	**41.32**	**0.0000**	**Shrimp**
1992-2005	**LA OFF S-D**	**FL OFF S-D**	**18.65**	**0.0000**	**Shrimp**
1992-2005	**LA OFF S-D**	**AM NR J-A**	**156.01**	**0.0000**	**Shrimp**
1992-2005	**LA OFF S-D**	**AM NR S-D**	**39.16**	**0.0000**	**Shrimp**
1992-2005	**LA OFF S-D**	**AM OFF J-A**	**308.53**	**0.0000**	**Shrimp**
1992-2005	**LA OFF S-D**	**LA NR J-A**	**20.28**	**0.0000**	**Shrimp**
1992-2005	**LA OFF S-D**	**LA NR M-A**	**208.84**	**0.0000**	**Shrimp**
1992-2005	**LA OFF S-D**	**LA OFF J-A**	**544.75**	**0.0000**	**Shrimp**
1992-2005	**LA OFF S-D**	**LA NR S-D**	**15.17**	**0.0001**	**Shrimp**
1992-2005	LA OFF S-D	AM NR M-A	12.36	0.0004	Shrimp
1992-2005	LA OFF S-D	FL NR S-D	9.58	0.0020	Shrimp
1992-2005	LA OFF S-D	AM OFF M-A	4.58	0.0323	Shrimp
1992-2005	LA OFF S-D	FL NR M-A	3.97	0.0464	Shrimp
1992-2005	LA OFF S-D	FL OFF J-A	2.74	0.0977	Shrimp
1992-2005	LA OFF S-D	AM OFF S-D	1.87	0.1717	Shrimp
1992-2005	LA OFF S-D	FL OFF M-A	0.04	0.8405	Shrimp
1992-2005	**TX NR J-A**	**LA NR J-A**	**27.39**	**0.0000**	**Shrimp**
1992-2005	**TX NR J-A**	**AM NR J-A**	**59.16**	**0.0000**	**Shrimp**
1992-2005	**TX NR J-A**	**AM NR S-D**	**30.23**	**0.0000**	**Shrimp**

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	**TX NR J-A**	**AM OFF J-A**	**52.63**	**0.0000**	**Shrimp**
1992-2005	**TX NR J-A**	**LA NR M-A**	**47.54**	**0.0000**	**Shrimp**
1992-2005	**TX NR J-A**	**LA OFF J-A**	**56.99**	**0.0000**	**Shrimp**
1992-2005	TX NR J-A	AM OFF M-A	13.48	0.0002	Shrimp
1992-2005	TX NR J-A	FL OFF J-A	12.41	0.0004	Shrimp
1992-2005	TX NR J-A	AM OFF S-D	11.96	0.0005	Shrimp
1992-2005	TX NR J-A	LA OFF S-D	9.52	0.0020	Shrimp
1992-2005	TX NR J-A	TX NR S-D	8.84	0.0030	Shrimp
1992-2005	TX NR J-A	FL OFF M-A	8.55	0.0035	Shrimp
1992-2005	TX NR J-A	FL NR M-A	2.27	0.1317	Shrimp
1992-2005	TX NR J-A	AM NR M-A	1.76	0.1841	Shrimp
1992-2005	TX NR J-A	FL OFF S-D	0.67	0.4130	Shrimp
1992-2005	TX NR J-A	LA NR S-D	0.41	0.5208	Shrimp
1992-2005	TX NR J-A	LA OFF M-A	0.33	0.5682	Shrimp
1992-2005	TX NR J-A	FL NR J-A	0.17	0.6803	Shrimp
1992-2005	TX NR J-A	FL NR S-D	0.07	0.7927	Shrimp
1992-2005	**TX NR M-A**	**AM NR J-A**	**134.15**	**0.0000**	**Shrimp**
1992-2005	**TX NR M-A**	**AM NR S-D**	**78.47**	**0.0000**	**Shrimp**
1992-2005	**TX NR M-A**	**AM OFF J-A**	**130.80**	**0.0000**	**Shrimp**
1992-2005	**TX NR M-A**	**AM OFF M-A**	**48.41**	**0.0000**	**Shrimp**
1992-2005	**TX NR M-A**	**AM OFF S-D**	**43.21**	**0.0000**	**Shrimp**
1992-2005	**TX NR M-A**	**FL OFF J-A**	**46.13**	**0.0000**	**Shrimp**
1992-2005	**TX NR M-A**	**FL OFF M-A**	**32.64**	**0.0000**	**Shrimp**
1992-2005	**TX NR M-A**	**LA NR J-A**	**62.92**	**0.0000**	**Shrimp**
1992-2005	**TX NR M-A**	**LA NR M-A**	**34.46**	**0.0000**	**Shrimp**
1992-2005	**TX NR M-A**	**LA OFF J-A**	**141.31**	**0.0000**	**Shrimp**
1992-2005	**TX NR M-A**	**LA OFF S-D**	**40.19**	**0.0000**	**Shrimp**
1992-2005	**TX NR M-A**	**TX NR S-D**	**21.68**	**0.0000**	**Shrimp**
1992-2005	**TX NR M-A**	**AM NR M-A**	**15.01**	**0.0001**	**Shrimp**
1992-2005	TX NR M-A	FL NR M-A	14.31	0.0002	Shrimp
1992-2005	TX NR M-A	FL OFF S-D	10.36	0.0013	Shrimp
1992-2005	TX NR M-A	LA OFF M-A	9.32	0.0023	Shrimp
1992-2005	TX NR M-A	FL NR J-A	8.24	0.0041	Shrimp
1992-2005	TX NR M-A	TX NR J-A	2.75	0.0973	Shrimp
1992-2005	TX NR M-A	FL NR S-D	1.57	0.2101	Shrimp
1992-2005	TX NR M-A	LA NR S-D	0.87	0.3523	Shrimp
1992-2005	**TX NR S-D**	**LA NR M-A**	**85.75**	**0.0000**	**Shrimp**
1992-2005	TX NR S-D	LA NR S-D	12.39	0.0004	Shrimp
1992-2005	TX NR S-D	FL NR J-A	11.05	0.0009	Shrimp
1992-2005	TX NR S-D	LA OFF M-A	10.14	0.0014	Shrimp
1992-2005	TX NR S-D	FL NR S-D	9.38	0.0022	Shrimp
1992-2005	TX NR S-D	FL OFF S-D	8.29	0.0040	Shrimp
1992-2005	TX NR S-D	AM NR J-A	7.56	0.0060	Shrimp
1992-2005	TX NR S-D	AM NR M-A	6.21	0.0127	Shrimp

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	TX NR S-D	LA OFF J-A	5.57	0.0183	Shrimp
1992-2005	TX NR S-D	AM OFF J-A	4.69	0.0303	Shrimp
1992-2005	TX NR S-D	FL NR M-A	4.39	0.0362	Shrimp
1992-2005	TX NR S-D	LA OFF S-D	1.60	0.2062	Shrimp
1992-2005	TX NR S-D	LA NR J-A	1.49	0.2218	Shrimp
1992-2005	TX NR S-D	FL OFF M-A	1.24	0.2655	Shrimp
1992-2005	TX NR S-D	AM NR S-D	0.97	0.3250	Shrimp
1992-2005	TX NR S-D	FL OFF J-A	0.73	0.3917	Shrimp
1992-2005	TX NR S-D	AM OFF S-D	0.67	0.4120	Shrimp
1992-2005	TX NR S-D	AM OFF M-A	0.52	0.4697	Shrimp
1992-2005	**TX OFF J-A**	**AM OFF S-D**	**188.46**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**FL NR M-A**	**109.42**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**FL NR J-A**	**408.01**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**FL NR S-D**	**64.93**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**FL OFF J-A**	**318.28**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**AM NR S-D**	**39.78**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**AM NR M-A**	**240.53**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**AM OFF J-A**	**38.00**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**AM OFF M-A**	**278.91**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**FL OFF M-A**	**124.05**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**FL OFF S-D**	**238.06**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**LA NR S-D**	**0.87**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**LA NR M-A**	**454.10**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**LA OFF J-A**	**46.09**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**LA OFF S-D**	**583.61**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**LA OFF M-A**	**379.69**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**TX NR J-A**	**75.07**	**0.0000**	**Shrimp**
1992-2005	**TX OFF J-A**	**TX NR M-A**	**173.54**	**0.0000**	**Shrimp**
1992-2005	TX OFF J-A	TX NR S-D	11.01	0.0009	Shrimp
1992-2005	TX OFF J-A	LA NR J-A	10.59	0.0011	Shrimp
1992-2005	TX OFF J-A	AM NR J-A	2.11	0.1466	Shrimp
1992-2005	**TX OFF M-A**	**AM OFF S-D**	**232.99**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**FL NR J-A**	**50.87**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**FL OFF J-A**	**334.27**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**FL OFF S-D**	**46.70**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**AM NR J-A**	**606.22**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**AM NR S-D**	**321.72**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**AM NR M-A**	**69.79**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**AM OFF J-A**	**1100.07**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**AM OFF M-A**	**335.96**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**FL NR M-A**	**44.23**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**FL OFF M-A**	**127.66**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**LA NR J-A**	**150.97**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**LA NR M-A**	**50.19**	**0.0000**	**Shrimp**

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	**TX OFF M-A**	**LA OFF J-A**	**1487.65**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**LA OFF S-D**	**370.41**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**LA OFF M-A**	**54.95**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**TX NR S-D**	**36.49**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**TX OFF J-A**	**1478.86**	**0.0000**	**Shrimp**
1992-2005	**TX OFF M-A**	**TX OFF S-D**	**668.05**	**0.0000**	**Shrimp**
1992-2005	TX OFF M-A	TX NR J-A	7.57	0.0059	Shrimp
1992-2005	TX OFF M-A	FL NR S-D	4.48	0.0343	Shrimp
1992-2005	TX OFF M-A	LA NR S-D	3.30	0.0691	Shrimp
1992-2005	TX OFF M-A	TX NR M-A	0.68	0.4085	Shrimp
1992-2005	**TX OFF S-D**	**FL NR J-A**	**107.49**	**0.0000**	**Shrimp**
1992-2005	**TX OFF S-D**	**AM NR J-A**	**84.69**	**0.0000**	**Shrimp**
1992-2005	**TX OFF S-D**	**AM NR M-A**	**46.57**	**0.0000**	**Shrimp**
1992-2005	**TX OFF S-D**	**AM OFF J-A**	**167.86**	**0.0000**	**Shrimp**
1992-2005	**TX OFF S-D**	**FL NR M-A**	**18.20**	**0.0000**	**Shrimp**
1992-2005	**TX OFF S-D**	**FL NR S-D**	**19.53**	**0.0000**	**Shrimp**
1992-2005	**TX OFF S-D**	**FL OFF S-D**	**54.57**	**0.0000**	**Shrimp**
1992-2005	**TX OFF S-D**	**LA NR S-D**	**28.67**	**0.0000**	**Shrimp**
1992-2005	**TX OFF S-D**	**LA NR M-A**	**268.66**	**0.0000**	**Shrimp**
1992-2005	**TX OFF S-D**	**LA OFF J-A**	**378.41**	**0.0000**	**Shrimp**
1992-2005	**TX OFF S-D**	**LA OFF S-D**	**47.30**	**0.0000**	**Shrimp**
1992-2005	**TX OFF S-D**	**LA OFF M-A**	**95.75**	**0.0000**	**Shrimp**
1992-2005	**TX OFF S-D**	**TX NR J-A**	**20.95**	**0.0000**	**Shrimp**
1992-2005	**TX OFF S-D**	**TX NR M-A**	**67.28**	**0.0000**	**Shrimp**
1992-2005	**TX OFF S-D**	**TX OFF J-A**	**417.15**	**0.0000**	**Shrimp**
1992-2005	TX OFF S-D	FL OFF J-A	13.06	0.0003	Shrimp
1992-2005	TX OFF S-D	AM NR S-D	9.44	0.0021	Shrimp
1992-2005	TX OFF S-D	AM OFF M-A	8.44	0.0037	Shrimp
1992-2005	TX OFF S-D	FL OFF M-A	7.99	0.0047	Shrimp
1992-2005	TX OFF S-D	AM OFF S-D	7.09	0.0077	Shrimp
1992-2005	TX OFF S-D	LA NR J-A	6.24	0.0125	Shrimp
1992-2005	TX OFF S-D	TX NR S-D	0.00	0.9520	Shrimp
1992-2005	AM NR M-A	AM NR J-A	3.76	0.0525	Red Snapper
1992-2005	AM NR S-D	AM NR J-A	2.94	0.0862	Red Snapper
1992-2005	AM NR S-D	AM NR M-A	0.30	0.5831	Red Snapper
1992-2005	**AM OFF J-A**	**AM NR J-A**	**24.09**	**0.0000**	**Red Snapper**
1992-2005	**AM OFF J-A**	**AM NR M-A**	**17.75**	**0.0000**	**Red Snapper**
1992-2005	AM OFF J-A	AM NR S-D	12.36	0.0004	Red Snapper
1992-2005	AM OFF J-A	AM OFF M-A	1.64	0.1997	Red Snapper
1992-2005	**AM OFF M-A**	**AM NR J-A**	**40.55**	**0.0000**	**Red Snapper**
1992-2005	**AM OFF M-A**	**AM NR M-A**	**25.94**	**0.0000**	**Red Snapper**
1992-2005	AM OFF M-A	AM NR S-D	11.76	0.0006	Red Snapper
1992-2005	**AM OFF S-D**	**AM NR J-A**	**128.84**	**0.0000**	**Red Snapper**
1992-2005	**AM OFF S-D**	**AM NR M-A**	**108.06**	**0.0000**	**Red Snapper**

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	**AM OFF S-D**	**AM NR S-D**	**70.74**	**0.0000**	**Red Snapper**
1992-2005	**AM OFF S-D**	**AM OFF M-A**	**33.05**	**0.0000**	**Red Snapper**
1992-2005	AM OFF S-D	AM OFF J-A	8.73	0.0031	Red Snapper
1992-2005	**FL NR J-A**	**AM NR M-A**	**26.62**	**0.0000**	**Red Snapper**
1992-2005	**FL NR J-A**	**AM OFF M-A**	**70.44**	**0.0000**	**Red Snapper**
1992-2005	**FL NR J-A**	**AM OFF J-A**	**32.61**	**0.0000**	**Red Snapper**
1992-2005	**FL NR J-A**	**AM OFF S-D**	**167.17**	**0.0000**	**Red Snapper**
1992-2005	FL NR J-A	AM NR S-D	9.32	0.0023	Red Snapper
1992-2005	FL NR J-A	AM NR J-A	6.32	0.0119	Red Snapper
1992-2005	FL NR J-A	FL NR S-D	3.85	0.0497	Red Snapper
1992-2005	FL NR J-A	FL NR M-A	2.58	0.1084	Red Snapper
1992-2005	**FL NR M-A**	**AM NR M-A**	**27.40**	**0.0000**	**Red Snapper**
1992-2005	**FL NR M-A**	**AM OFF M-A**	**71.09**	**0.0000**	**Red Snapper**
1992-2005	**FL NR M-A**	**AM OFF J-A**	**32.83**	**0.0000**	**Red Snapper**
1992-2005	**FL NR M-A**	**AM OFF S-D**	**167.88**	**0.0000**	**Red Snapper**
1992-2005	FL NR M-A	AM NR S-D	9.53	0.0020	Red Snapper
1992-2005	FL NR M-A	AM NR J-A	6.71	0.0096	Red Snapper
1992-2005	FL NR M-A	FL NR S-D	2.02	0.1550	Red Snapper
1992-2005	**FL NR S-D**	**AM NR M-A**	**27.55**	**0.0000**	**Red Snapper**
1992-2005	**FL NR S-D**	**AM OFF M-A**	**71.21**	**0.0000**	**Red Snapper**
1992-2005	**FL NR S-D**	**AM OFF J-A**	**32.87**	**0.0000**	**Red Snapper**
1992-2005	**FL NR S-D**	**AM OFF S-D**	**168.01**	**0.0000**	**Red Snapper**
1992-2005	FL NR S-D	AM NR S-D	9.57	0.0020	Red Snapper
1992-2005	FL NR S-D	AM NR J-A	6.78	0.0092	Red Snapper
1992-2005	**FL OFF J-A**	**AM OFF M-A**	**52.88**	**0.0000**	**Red Snapper**
1992-2005	**FL OFF J-A**	**AM OFF J-A**	**27.06**	**0.0000**	**Red Snapper**
1992-2005	**FL OFF J-A**	**AM OFF S-D**	**146.82**	**0.0000**	**Red Snapper**
1992-2005	**FL OFF J-A**	**FL NR S-D**	**17.42**	**0.0000**	**Red Snapper**
1992-2005	**FL OFF J-A**	**FL NR M-A**	**17.16**	**0.0000**	**Red Snapper**
1992-2005	**FL OFF J-A**	**FL NR J-A**	**15.75**	**0.0001**	**Red Snapper**
1992-2005	FL OFF J-A	AM NR M-A	9.40	0.0022	Red Snapper
1992-2005	FL OFF J-A	AM NR S-D	4.63	0.0314	Red Snapper
1992-2005	FL OFF J-A	AM NR J-A	0.37	0.5420	Red Snapper
1992-2005	**FL OFF M-A**	**AM OFF M-A**	**27.99**	**0.0000**	**Red Snapper**
1992-2005	**FL OFF M-A**	**AM OFF J-A**	**20.75**	**0.0000**	**Red Snapper**
1992-2005	**FL OFF M-A**	**AM OFF S-D**	**104.78**	**0.0000**	**Red Snapper**
1992-2005	FL OFF M-A	FL NR S-D	3.35	0.0670	Red Snapper
1992-2005	FL OFF M-A	FL NR M-A	3.32	0.0683	Red Snapper
1992-2005	FL OFF M-A	FL NR J-A	3.16	0.0753	Red Snapper
1992-2005	FL OFF M-A	AM NR S-D	1.78	0.1822	Red Snapper
1992-2005	FL OFF M-A	AM NR M-A	1.42	0.2338	Red Snapper
1992-2005	FL OFF M-A	FL OFF J-A	0.42	0.5174	Red Snapper
1992-2005	FL OFF M-A	AM NR J-A	0.05	0.8179	Red Snapper
1992-2005	FL OFF M-A	FL OFF S-D	0.03	0.8707	Red Snapper

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	**FL OFF S-D**	**AM OFF M-A**	**41.79**	**0.0000**	**Red Snapper**
1992-2005	**FL OFF S-D**	**AM OFF J-A**	**24.11**	**0.0000**	**Red Snapper**
1992-2005	**FL OFF S-D**	**AM OFF S-D**	**131.32**	**0.0000**	**Red Snapper**
1992-2005	FL OFF S-D	FL NR S-D	9.95	0.0016	Red Snapper
1992-2005	FL OFF S-D	FL NR M-A	9.85	0.0017	Red Snapper
1992-2005	FL OFF S-D	FL NR J-A	9.31	0.0023	Red Snapper
1992-2005	FL OFF S-D	AM NR M-A	3.84	0.0500	Red Snapper
1992-2005	FL OFF S-D	AM NR S-D	2.87	0.0904	Red Snapper
1992-2005	FL OFF S-D	FL OFF J-A	0.68	0.4092	Red Snapper
1992-2005	FL OFF S-D	AM NR J-A	0.01	0.9151	Red Snapper
1992-2005	**LA NR J-A**	**AM OFF M-A**	**55.68**	**0.0000**	**Red Snapper**
1992-2005	**LA NR J-A**	**AM OFF J-A**	**29.35**	**0.0000**	**Red Snapper**
1992-2005	**LA NR J-A**	**AM OFF S-D**	**148.97**	**0.0000**	**Red Snapper**
1992-2005	LA NR J-A	AM NR M-A	12.47	0.0004	Red Snapper
1992-2005	LA NR J-A	AM NR S-D	6.54	0.0105	Red Snapper
1992-2005	LA NR J-A	FL OFF S-D	2.73	0.0985	Red Snapper
1992-2005	LA NR J-A	AM NR J-A	2.00	0.1575	Red Snapper
1992-2005	LA NR J-A	FL OFF J-A	1.52	0.2178	Red Snapper
1992-2005	LA NR J-A	FL OFF M-A	1.49	0.2222	Red Snapper
1992-2005	LA NR J-A	FL NR S-D	1.01	0.3156	Red Snapper
1992-2005	LA NR J-A	FL NR M-A	0.97	0.3242	Red Snapper
1992-2005	LA NR J-A	FL NR J-A	0.80	0.3717	Red Snapper
1992-2005	**LA NR M-A**	**AM OFF M-A**	**57.64**	**0.0000**	**Red Snapper**
1992-2005	**LA NR M-A**	**AM OFF J-A**	**28.58**	**0.0000**	**Red Snapper**
1992-2005	**LA NR M-A**	**AM OFF S-D**	**152.58**	**0.0000**	**Red Snapper**
1992-2005	LA NR M-A	FL NR S-D	14.22	0.0002	Red Snapper
1992-2005	LA NR M-A	FL NR M-A	13.93	0.0002	Red Snapper
1992-2005	LA NR M-A	AM NR M-A	13.19	0.0003	Red Snapper
1992-2005	LA NR M-A	FL NR J-A	12.36	0.0004	Red Snapper
1992-2005	LA NR M-A	AM NR S-D	5.78	0.0162	Red Snapper
1992-2005	LA NR M-A	FL OFF S-D	1.97	0.1607	Red Snapper
1992-2005	LA NR M-A	AM NR J-A	1.24	0.2661	Red Snapper
1992-2005	LA NR M-A	FL OFF M-A	0.92	0.3383	Red Snapper
1992-2005	LA NR M-A	FL OFF J-A	0.75	0.3867	Red Snapper
1992-2005	LA NR M-A	LA NR J-A	0.49	0.4823	Red Snapper
1992-2005	**LA NR S-D**	**AM OFF M-A**	**54.67**	**0.0000**	**Red Snapper**
1992-2005	**LA NR S-D**	**AM OFF J-A**	**28.10**	**0.0000**	**Red Snapper**
1992-2005	**LA NR S-D**	**AM OFF S-D**	**148.60**	**0.0000**	**Red Snapper**
1992-2005	LA NR S-D	AM NR M-A	11.06	0.0009	Red Snapper
1992-2005	LA NR S-D	FL NR S-D	6.34	0.0118	Red Snapper
1992-2005	LA NR S-D	FL NR M-A	6.22	0.0127	Red Snapper
1992-2005	LA NR S-D	FL NR J-A	58.58	0.0182	Red Snapper
1992-2005	LA NR S-D	AM NR S-D	5.46	0.0195	Red Snapper
1992-2005	LA NR S-D	FL OFF S-D	1.51	0.2198	Red Snapper

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	LA NR S-D	AM NR J-A	0.98	0.3233	Red Snapper
1992-2005	LA NR S-D	FL OFF M-A	0.81	0.3676	Red Snapper
1992-2005	LA NR S-D	LA NR J-A	0.45	0.5003	Red Snapper
1992-2005	LA NR S-D	FL OFF J-A	0.04	0.5266	Red Snapper
1992-2005	LA NR S-D	LA NR M-A	0.00	0.9472	Red Snapper
1992-2005	**LA OFF J-A**	**AM NR J-A**	**83.17**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF J-A**	**AM NR M-A**	**61.84**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF J-A**	**AM NR S-D**	**31.42**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF J-A**	**FL NR S-D**	**130.37**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF J-A**	**FL NR M-A**	**130.21**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF J-A**	**FL NR J-A**	**129.34**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF J-A**	**FL OFF J-A**	**104.40**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF J-A**	**FL OFF S-D**	**86.06**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF J-A**	**FL OFF M-A**	**59.36**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF J-A**	**LA NR J-A**	**105.71**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF J-A**	**LA NR M-A**	**111.33**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF J-A**	**LA NR S-D**	**106.08**	**0.0000**	**Red Snapper**
1992-2005	LA OFF J-A	AM OFF S-D	14.37	0.0002	Red Snapper
1992-2005	LA OFF J-A	AM OFF M-A	5.39	0.0202	Red Snapper
1992-2005	LA OFF J-A	AM OFF J-A	0.05	0.8187	Red Snapper
1992-2005	**LA OFF M-A**	**AM NR J-A**	**51.56**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF M-A**	**AM NR M-A**	**43.03**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF M-A**	**AM NR S-D**	**33.42**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF M-A**	**FL NR S-D**	**63.22**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF M-A**	**FL NR M-A**	**63.17**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF M-A**	**FL NR J-A**	**62.90**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF M-A**	**FL OFF J-A**	**55.85**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF M-A**	**FL OFF S-D**	**51.72**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF M-A**	**FL OFF M-A**	**46.16**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF M-A**	**LA NR J-A**	**58.49**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF M-A**	**LA NR M-A**	**57.81**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF M-A**	**LA NR S-D**	**57.08**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF M-A**	**AM OFF M-A**	**14.37**	**0.0001**	**Red Snapper**
1992-2005	LA OFF M-A	LA OFF J-A	5.81	0.0159	Red Snapper
1992-2005	LA OFF M-A	AM OFF J-A	4.68	0.0306	Red Snapper
1992-2005	LA OFF M-A	AM OFF S-D	0.08	0.7765	Red Snapper
1992-2005	**LA OFF S-D**	**AM NR J-A**	**273.19**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF S-D**	**AM NR M-A**	**248.19**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF S-D**	**AM NR S-D**	**188.12**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF S-D**	**AM OFF M-A**	**133.50**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF S-D**	**AM OFF J-A**	**62.03**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF S-D**	**AM OFF S-D**	**36.31**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF S-D**	**FL NR S-D**	**319.87**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF S-D**	**FL NR M-A**	**319.73**	**0.0000**	**Red Snapper**

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	**LA OFF S-D**	**FL NR J-A**	**318.96**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF S-D**	**FL OFF J-A**	**295.96**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF S-D**	**FL OFF S-D**	**276.79**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF S-D**	**FL OFF M-A**	**238.68**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF S-D**	**LA NR J-A**	**297.35**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF S-D**	**LA NR M-A**	**302.59**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF S-D**	**LA NR S-D**	**297.66**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF S-D**	**LA OFF J-A**	**97.30**	**0.0000**	**Red Snapper**
1992-2005	**LA OFF S-D**	**LA OFF M-A**	**25.97**	**0.0000**	**Red Snapper**
1992-2005	**TX NR J-A**	**AM OFF S-D**	**17.28**	**0.0000**	**Red Snapper**
1992-2005	**TX NR J-A**	**LA OFF S-D**	**61.79**	**0.0000**	**Red Snapper**
1992-2005	TX NR J-A	LA OFF M-A	12.29	0.0005	Red Snapper
1992-2005	TX NR J-A	LA OFF J-A	5.17	0.0230	Red Snapper
1992-2005	TX NR J-A	AM OFF J-A	3.52	0.0607	Red Snapper
1992-2005	TX NR J-A	FL NR S-D	2.16	0.1417	Red Snapper
1992-2005	TX NR J-A	FL NR M-A	2.15	0.1423	Red Snapper
1992-2005	TX NR J-A	FL NR J-A	2.12	0.1456	Red Snapper
1992-2005	TX NR J-A	LA NR J-A	1.76	0.1848	Red Snapper
1992-2005	TX NR J-A	AM OFF M-A	1.53	0.2154	Red Snapper
1992-2005	TX NR J-A	LA NR M-A	1.52	0.2176	Red Snapper
1992-2005	TX NR J-A	LA NR S-D	1.49	0.2216	Red Snapper
1992-2005	TX NR J-A	FL OFF J-A	1.32	0.2515	Red Snapper
1992-2005	TX NR J-A	AM NR J-A	1.05	0.3053	Red Snapper
1992-2005	TX NR J-A	FL OFF S-D	1.01	0.3148	Red Snapper
1992-2005	TX NR J-A	FL OFF M-A	0.87	0.3522	Red Snapper
1992-2005	TX NR J-A	AM NR M-A	0.33	0.5676	Red Snapper
1992-2005	TX NR J-A	TX NR S-D	0.17	0.6781	Red Snapper
1992-2005	TX NR J-A	AM NR S-D	0.12	0.7329	Red Snapper
1992-2005	**TX NR M-A**	**FL NR S-D**	**16.74**	**0.0000**	**Red Snapper**
1992-2005	**TX NR M-A**	**FL NR M-A**	**16.73**	**0.0000**	**Red Snapper**
1992-2005	**TX NR M-A**	**FL NR J-A**	**16.67**	**0.0000**	**Red Snapper**
1992-2005	**TX NR M-A**	**AM NR J-A**	**14.46**	**0.0001**	**Red Snapper**
1992-2005	**TX NR M-A**	**FL OFF J-A**	**15.12**	**0.0001**	**Red Snapper**
1992-2005	**TX NR M-A**	**FL OFF S-D**	**14.39**	**0.0001**	**Red Snapper**
1992-2005	**TX NR M-A**	**LA NR J-A**	**15.97**	**0.0001**	**Red Snapper**
1992-2005	**TX NR M-A**	**LA NR M-A**	**15.54**	**0.0001**	**Red Snapper**
1992-2005	**TX NR M-A**	**LA NR S-D**	**15.47**	**0.0001**	**Red Snapper**
1992-2005	TX NR M-A	FL OFF M-A	13.86	0.0002	Red Snapper
1992-2005	TX NR M-A	AM NR M-A	12.38	0.0004	Red Snapper
1992-2005	TX NR M-A	AM NR S-D	11.03	0.0009	Red Snapper
1992-2005	TX NR M-A	TX NR S-D	11.04	0.0009	Red Snapper
1992-2005	TX NR M-A	TX NR J-A	7.28	0.0070	Red Snapper
1992-2005	TX NR M-A	LA OFF S-D	5.55	0.0185	Red Snapper
1992-2005	TX NR M-A	AM OFF M-A	5.37	0.0205	Red Snapper

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	TX NR M-A	AM OFF J-A	2.75	0.0973	Red Snapper
1992-2005	TX NR M-A	LA OFF J-A	2.71	0.0996	Red Snapper
1992-2005	TX NR M-A	LA OFF M-A	0.19	0.6658	Red Snapper
1992-2005	TX NR M-A	AM OFF S-D	0.10	0.7577	Red Snapper
1992-2005	**TX NR S-D**	**AM OFF S-D**	**57.93**	**0.0000**	**Red Snapper**
1992-2005	**TX NR S-D**	**LA OFF J-A**	**24.31**	**0.0000**	**Red Snapper**
1992-2005	**TX NR S-D**	**LA OFF M-A**	**30.50**	**0.0000**	**Red Snapper**
1992-2005	**TX NR S-D**	**LA OFF S-D**	**160.71**	**0.0000**	**Red Snapper**
1992-2005	TX NR S-D	AM OFF J-A	11.35	0.0008	Red Snapper
1992-2005	TX NR S-D	AM OFF M-A	9.43	0.0021	Red Snapper
1992-2005	TX NR S-D	FL NR S-D	4.62	0.0317	Red Snapper
1992-2005	TX NR S-D	FL NR M-A	4.59	0.0321	Red Snapper
1992-2005	TX NR S-D	FL NR J-A	4.48	0.0342	Red Snapper
1992-2005	TX NR S-D	LA NR J-A	3.24	0.0720	Red Snapper
1992-2005	TX NR S-D	LA NR M-A	2.68	0.1017	Red Snapper
1992-2005	TX NR S-D	LA NR S-D	2.57	0.1092	Red Snapper
1992-2005	TX NR S-D	FL OFF J-A	2.10	0.1470	Red Snapper
1992-2005	TX NR S-D	AM NR J-A	1.35	0.2447	Red Snapper
1992-2005	TX NR S-D	FL OFF S-D	1.28	0.2578	Red Snapper
1992-2005	TX NR S-D	FL OFF M-A	0.86	0.3532	Red Snapper
1992-2005	TX NR S-D	AM NR M-A	0.06	0.8088	Red Snapper
1992-2005	TX NR S-D	AM NR S-D	0.03	0.8705	Red Snapper
1992-2005	**TX OFF J-A**	**AM NR J-A**	**94.80**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**AM NR M-A**	**81.05**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**AM NR S-D**	**60.41**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**AM OFF M-A**	**30.78**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**FL NR S-D**	**116.15**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**FL NR M-A**	**116.07**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**FL NR J-A**	**115.63**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**FL OFF J-A**	**103.67**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**FL OFF S-D**	**95.64**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**FL OFF M-A**	**82.72**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**LA NR J-A**	**106.74**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**LA NR M-A**	**107.04**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**LA NR S-D**	**105.32**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**LA OFF S-D**	**21.35**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**TX NR S-D**	**52.85**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**TX NR J-A**	**19.46**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF J-A**	**LA OFF J-A**	**15.62**	**0.0001**	**Red Snapper**
1992-2005	TX OFF J-A	AM OFF J-A	10.91	0.0010	Red Snapper
1992-2005	TX OFF J-A	LA OFF M-A	0.77	0.3792	Red Snapper
1992-2005	TX OFF J-A	AM OFF S-D	0.59	0.4423	Red Snapper
1992-2005	TX OFF J-A	TX NR M-A	0.00	0.9635	Red Snapper
1992-2005	**TX OFF M-A**	**AM NR J-A**	**327.23**	**0.0000**	**Red Snapper**

Table B3. Continued

Years	Area 1 Depth 1	Area 2 Depth 2	Chi-Square	Probability	Category
1992-2005	**TX OFF M-A**	**AM NR M-A**	**299.17**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**AM NR S-D**	**225.68**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**AM OFF M-A**	**165.39**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**AM OFF J-A**	**77.65**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**AM OFF S-D**	**50.51**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**FL NR S-D**	**382.18**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**FL NR M-A**	**382.02**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**FL NR J-A**	**381.16**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**FL OFF J-A**	**354.82**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**FL OFF S-D**	**331.88**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**FL OFF M-A**	**284.90**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**LA NR J-A**	**355.15**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**LA NR M-A**	**362.44**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**LA NR S-D**	**356.35**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**LA OFF J-A**	**123.93**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**LA OFF M-A**	**35.27**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**TX NR S-D**	**191.56**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**TX NR J-A**	**73.11**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF M-A**	**TX OFF J-A**	**30.80**	**0.0000**	**Red Snapper**
1992-2005	TX OFF M-A	TX NR M-A	7.84	0.0051	Red Snapper
1992-2005	TX OFF M-A	LA OFF S-D	0.81	0.3672	Red Snapper
1992-2005	**TX OFF S-D**	**AM NR J-A**	**457.21**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**AM NR M-A**	**433.86**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**AM NR S-D**	**373.40**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**AM OFF M-A**	**313.96**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**AM OFF J-A**	**202.44**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**AM OFF S-D**	**175.07**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**FL NR S-D**	**497.24**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**FL NR M-A**	**497.11**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**FL NR J-A**	**496.44**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**FL OFF J-A**	**476.59**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**FL OFF S-D**	**460.18**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**FL OFF M-A**	**425.62**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**LA NR J-A**	**478.68**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**LA NR M-A**	**482.34**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**LA NR S-D**	**478.37**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**LA OFF J-A**	**270.28**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**LA OFF M-A**	**135.82**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**LA OFF S-D**	**63.44**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**TX NR S-D**	**339.78**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**TX NR J-A**	**175.91**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**TX NR M-A**	**45.56**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**TX OFF J-A**	**135.47**	**0.0000**	**Red Snapper**
1992-2005	**TX OFF S-D**	**TX OFF M-A**	**53.12**	**0.0000**	**Red Snapper**

VITA

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M.S., Rangeland Ecology & Management, Texas A&M University, 1998
Ph.D., Wildlife &Fisheries Science, Texas A&M University, 2007

Employment: Fishery Biologist (Research), NOAA Fisheries Southeast Fisheries Science Center (SEFSC), 1984- present. Directs and coordinates major offshore bycatch observer programs in the U.S. Gulf of Mexico and southeastern Atlantic. Researched shrimp movement and life history characteristics.

Publications: 24 publications and reports

Presentations: 21 scientific presentations

Activities: SEFSC Factor IV Committee – 2005
Source Evaluation Board Member – November 2005
National Observer Program Safety Committee, 2003 – present
2000 Chair, Federal Women's Program Council, 1987 - present
Cerebral Palsy's High-Tech/High School Program, 1995 - 2004
Expanding Your Horizons, Clear Lake City, Texas, 1998, 2001

Honors: Department of Commerce Silver Medal Award, 2006
NOAA Fisheries Employee of Month, 2005
Outstanding Woman of Galveston Laboratory, 2002
Outstanding Work Performance Awards, 1996, 1989, 1991, 1993-1997
Marine Fisheries Review, Best Publication, 1998