

## CHAPTER 10

# COMMERCIAL AND RECREATIONAL FISHERIES OF THE GULF OF MEXICO

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### 10.1 INTRODUCTION

The users of the Gulf of Mexico living marine resources are as diverse as the species and habitats. Depicting the economic components both annually and over time generally is based on agency-collected data primarily focused on landings. The revenue element of use being well documented serves commercial industry analyses partially and leaves a void that confronts recreational industry researchers. Missing critical elements for depicting economic conditions include, but are not limited to, production costs, expenditures by anglers, site-specific data, marketing and processing prices, and margins. Research at universities, by consultants, and within agencies on various economic issues occurs on a project basis. Project studies do not occur consistently enough over time on any species, much less a large enough component of Gulf of Mexico species, to be relied upon for the increasingly complex mix of decisions faced by agencies. Agencies in turn must be responsive to harvesters and increasingly strong regional and national nongovernmental organizations (NGOs). Agencies, users groups, and NGOs face decisions that include habitat protection, avoidance of indirect impacts of harvest gear, access, determining initial catch shares, allocations, law enforcement, and juxtaposition with other agency regulations. The existing data reporting system relied on for this chapter cannot be expected to adequately serve economic researchers addressing the range of inquiries associated with commerce in fisheries. Special projects of short duration from various funding sources most likely will be necessary to meet the needs of participants in the decision-making process. This chapter makes use of the data reporting systems maintained by agencies. State agencies in the Gulf of Mexico are generally unified in their reporting via agreements founded by the Gulf States Marine Fisheries Commission (GSMFC). This congressionally authorized commission has an increasing presence in organizing fisheries data and providing Internet access in a timely manner. Of particular interest is the GSMFC's role in specific analyses focused to fill special needs. The most recent example is commitment to a multiyear economic study of the inshore commercial shrimping sector. This economic analysis fills a void and has added value as it can be coupled with findings of National Oceanic and Atmospheric Administration (NOAA) Fisheries' research. Beginning in 2006, NOAA Fisheries began an annual economic survey of federal Gulf of Mexico shrimp permit holders that provides valuable insight over time of the region's largest commercial fishery. Essentially all other economic perspective of Gulf of Mexico commercial fisheries must be ascertained from annual NOAA and GSMFC reports interspersed with irregularly funded special projects.

When addressing the complexities of the angler harvest of Gulf of Mexico species, economists are no richer in terms of data sources. The core source of most reports is the Marine Recreational Fisheries Statistics Survey (MRFSS), which was later renamed the

Marine Recreational Information Program (MRIP). Established in 1979, the MRFSS evolved over the years into a system reflective of the difficulties associated with estimating (1) catch by species, (2) participants, (3) fishing by location, (4) target species, (5) fishing mode, and (6) expenditures by anglers. The use of the database was undertaken with knowledge of changes made over time to improve not only the representativeness of the data but also access. It is noteworthy that the state of Texas does not participate in the annual MRFSS/MRIP survey. Consequently, all discussion of catch by species, participation, and trips made by anglers are exclusive of Texas. However, there is Texas data on angler expenditures and related multipliers included from other sources to make that section as complete as possible. The recreational fisheries are addressed on the basis of economic activities associated with the pursuit of fish. Expenditures and associated indirect impacts springing from multiplier effects must serve as both the cost of angling and the base from which gross benefits can be estimated.

This chapter deals with the complexity of angling with attention to the Gulf of Mexico and state levels inclusive of species-specific findings to give the best possible descriptive background of the marine recreational fisheries. With the understanding that the commercial harvest of Gulf of Mexico fish species is a capture and sale process, there can be minimal comparability with the pursuit of recreational fisheries in terms of economics. Decisions on the use of Gulf of Mexico marine fish species will remain an interesting public process as data improves and economic analyses become more numerous with attention to both descriptive and analytical needs. Beginning with a review of federal, regional, and state management, a review of the commercial and recreational fishing industry in the Gulf of Mexico will be presented in general and for specific, commercially and recreationally important marine species. With respect to the commercial sector, emphasis is given to analysis of the shrimp, crab, menhaden (*Brevoortia patronus*), oyster, and reef fish industries. Recreationally important marine species for which special emphasis is given include spotted seatrout (*Cynoscion nebulosus*), red drum (*Sciaenops ocellatus*), groupers, snappers, and coastal pelagics. This review also includes estimates of expenditure and cost multipliers associated with input-output analyses. This assessment will focus first on the commercial fishing industry followed by the recreational angler-based industry. The chapter ends with a review of the Florida, Mississippi, Alabama, and Louisiana harvests since they represent major recreational fishing foci. A summary of the results of this review is presented in the final section of this chapter.

## 10.2 THE MANAGEMENT PROCESS AT ITS BASE

The mobility of most living marine resources pursued for harvest results in three levels of public entities—federal, state, and regional—being involved in management for the sustainable flow of benefits. Federal, state, and regional responsibilities established by law are approached by entities with similar but not uniform authorizations. Often, agencies charged with the management of fisheries resources in the Gulf of Mexico evolve with expanded abilities to influence the use of marine species. Criteria for guiding the public use of fishery resources can be found in legislation but more frequently in regulations promulgated by agencies. It is beyond the needs of this document to detail the regulations and authority by which agencies act to move resources toward sustainability. Agency websites can be searched for insight to the origin of authorizing legislation and current status of species-specific management activities.

### 10.2.1 Federal Oversight: National Oceanic and Atmospheric Administration

Of the agencies, the federal level is the most subject to change. Passage of the Fishery Conservation and Management Act (FCMA) in 1976 began an increased level of oversight at the federal level. The passage was associated with many prior years of numerous nations extending fisheries oversight to 200 miles (mi) (322 kilometers [km]). Fishery management councils were authorized around the nation. The membership of the Gulf of Mexico Fishery Management Council (GMFMC) included (1) state fishery agency representatives from Florida, Alabama, Mississippi, Louisiana, and Texas, (2) citizens appointed by the U.S. Secretary of Commerce from nominations by the region's governors, and (3) NOAA Fisheries' regional director. GMFMC develops fishery management plans for species common to the federal Exclusive Economic Zone (EEZ). Plan development evolves from guidelines established by federal legislation with frequent amendments necessary due to changing (1) use patterns, (2) technologies of fish harvesting, (3) legislation, (4) data, and (5) analysis methodologies. NOAA has final authority to approve, modify, or deny any amendment to a fishery management plan emanating from the GMFMC.

### 10.2.2 State Agency Management

The five states with Gulf coastal borders have authority to manage fishery resources on the basis of their preferred regulatory approaches to achieving goals. All have similar goals regarding conserving living resources for sustainable use over time. Though the focus is on state waters, there is the need for substantial interaction and cooperation with other states and the GMFMC. The movement of many species at critical life phases to waters of other Gulf States and waters seaward of state coastal boundaries necessitates formal working relationships to assure oversight throughout the various habitats. Seaward coastal boundaries vary from 9 mi (14.5 km) in Texas and the west coast of Florida to the traditional 3 mi (4.8 km) for the other three states on the Gulf. State agencies have designees on the GMFMC to convey local regulatory perspectives in the federal fishery plan development process. When species are totally within state waters or move laterally along the coast, coastal state regional coordination is authorized through the GSMFC.

The shrimp fisheries exemplify complexity for the management structure in the Gulf. The shrimp industry in Louisiana waters produces the Gulf's largest landings in pounds. Agency management approaches involve a large inshore fishery and harvest of smaller shrimp sizes (i.e., a larger number of shrimp to the pound at harvest). The management from Texas' state agency, Texas Parks and Wildlife, is for a lessened inshore catch and cooperative management with the GMFMC for larger-sized shrimp (i.e., fewer shrimp to the harvested pound).

Texas is unique among the states in that it has a voluntary commercial fishing license buyback program. The license buyback programs for bay shrimp, blue crab (*Callinectes sapidus*), and finfish seek to stabilize fishing efforts through time in order to promote healthy fisheries stocks. Funds for the buyback come from a surcharge on related commercial fishing licenses and a saltwater fishing stamp endorsement to recreational licenses.

### 10.2.3 Gulf States Marine Fisheries Commission

Acknowledging the joint interest of coastal states to achieve multiple goals for management of mobile fishery resources, Congress authorized the formation of multistate commissions in 1949. Utilization of fishery resources to meet food, employment, economic, and

recreation needs of citizens was reasoned to be facilitated by use based on conservation and a multistate oversight. The GSMFC includes 15 commissioners to oversee the implementation and evaluation of efforts to coordinate management among Gulf States. Each governor appoints a commissioner and each state legislature appoints one as well. The other five commissioners are the state fishery agency directors.

Though the GSMFC does not have direct regulatory authority, it clearly has been successful in stimulating deliberations leading to cooperative planning, data programs, and research. An understanding of the key role that fishery data improvement plays in goal achievement for the Gulf has been a visible part of GSMFC actions. While there are many GSMFC programs, the creation of fishery-independent and fishery-dependent data collection programs serve to prove the value of regional cooperation. The former is termed the Southeast Area Monitoring and Assessment Program (SEAMAP). The latter comprises two elements: (1) Commercial Fisheries Information Network (ComFIN) and (2) Recreational Fisheries Information Network (RecFIN). A common element of both the ComFIN and RecFIN programs is an emerging program to administer collection of economic information on Gulf fisheries.

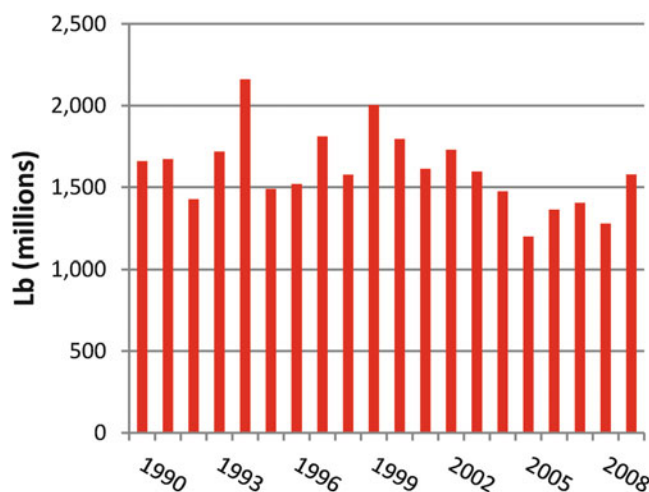
Following the active hurricane year of 2005, Congress assigned the GSMFC a leadership role in recovery programming. A 5-year program began in 2006 to oversee rehabilitation and recovery efforts. This emergency assistance to Gulf States established a format for action that resulted in valuable experience on enabling fisheries agencies to respond with coordinated programs.

## **10.3 GULF OF MEXICO COMMERCIAL FISHERIES IN AGGREGATE**

### **10.3.1 Gulf of Mexico Landings**

The capture of free ranging marine species for commercial use occurs from a large area subject to both within-year and between-year variability in environmental and economic conditions. Environmental conditions including water temperature, salinity, and turbidity—in conjunction with the life cycles of many of the species that inhabit the Gulf—all contribute to availability. Species availability, in conjunction with those economic conditions that determine whether a trip will be profitable, including the price received for the harvested product and the cost of inputs used in the harvesting process, provide signals to the harvesting units as to whether a trip will be financially viable. This viability along with the multitude of regulations that can also govern fishing patterns influences fishing effort, and ultimately the catch. Considering this, landings of a specific year cannot be descriptive of Gulf fisheries from either a biological or economic viewpoint. For this chapter, the 20-year period from 1990 to 2009 was chosen as inclusive of (1) pre- and post-management agency changes, (2) active tropical storm periods, (3) challenging production cost situations, and (4) high and low points in the national economy. This approach acknowledges that a species' stock level and economic conditions of inputs and demand play roles in landings levels. This perspective conveys a need to avoid reference to beginning-year and end-year comparisons. Rather, a 3-year average was used to depict landings and associated value as the beginning and end focus of comments. There is a distinction between location of landings and location of catch. This is particularly the case for the shrimp fisheries and most finfish. Location of catch is best documented for Gulf shrimp fisheries by offshore zones east to west across the Gulf and by inshore versus offshore. When data are available to differentiate landings from catch, that data is reported in the sections dealing with key species. Data by state are also reported in the key species sections.





**Figure 10.1. Gulf of Mexico commercial fishery landings, 1990–2009 (NMFS FSD; data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).**

In the latest 3-year period, 2007–2009, landings of all species combined were 1.4 billion pounds (Figure 10.1). This was 10 % lower than the initial 3-year period (1990–1992). With respect to the nation’s total fisheries, Gulf landings were near a 16 % share at the start and end of the 20-year period. Both U.S. and Gulf landings fell over the 20-year period to leave the Gulf shares essentially unchanged.

The Gulf landings share for the key species—menhaden, brown shrimp, white shrimp, blue crab, and oysters—demonstrate the national significance of the region’s fisheries. These key species accounted for 94 % of Gulf landings in the latest 3-year period. While other species, primarily finfish, are harvested, their trends do not convey overall change in Gulf landings.

### 10.3.1.1 Menhaden Landings



Gulf Menhaden

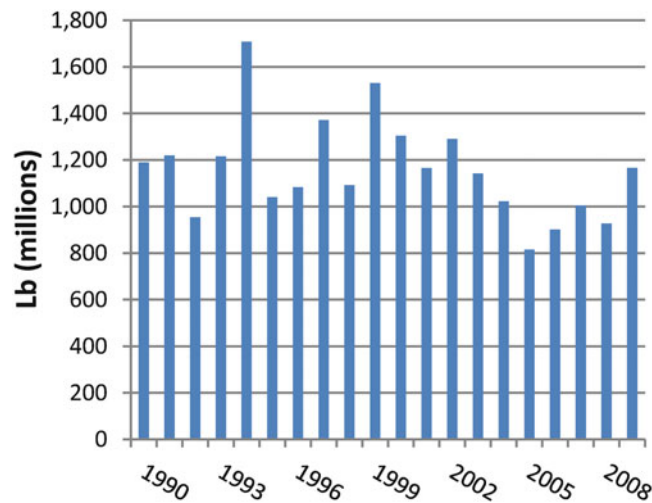
The menhaden fishery landings for the 20-year period ranged from a high of 1.7 billion pounds in 1994 to a low of 0.8 billion pounds in 2005 (Figure 10.2). The average was a 21 % decrease for the nation. The resulting Gulf share of national landings was 69 %. Essentially all menhaden landings occur in Louisiana (80 %) and Mississippi (19 %) for the industrial production of fish meal and oils. However, this is a case where there is some divergence due to catch location. Some Louisiana landings occasionally are caught off Texas. Mississippi landings can originate from Louisiana and vice versa.

### 10.3.1.2 Brown Shrimp Landings

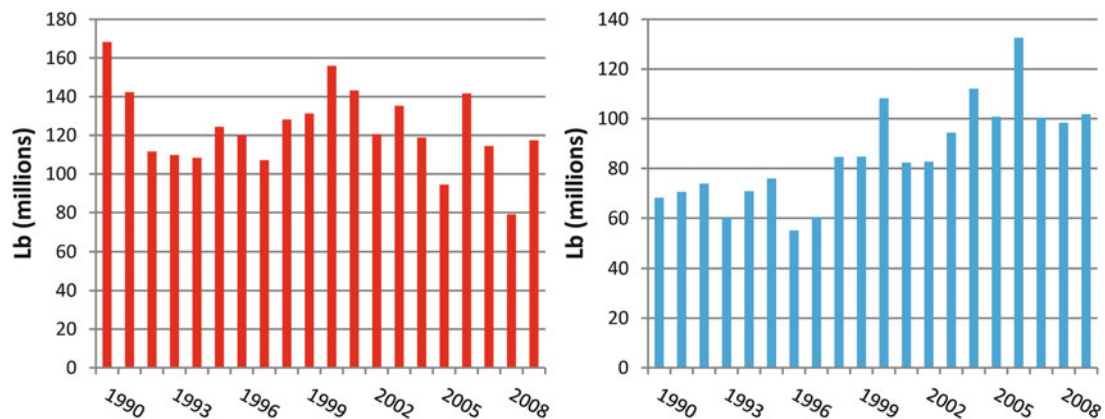


Brown Shrimp

Landings of brown shrimp (whole weight) ranged from a high of 168 million pounds in 1990 to the period low of 79 million pounds in 2008 (Figure 10.3, left panel). The average landings on



**Figure 10.2.** Gulf of Mexico commercial menhaden landings, 1990–2009 (NMFS FSD; data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).



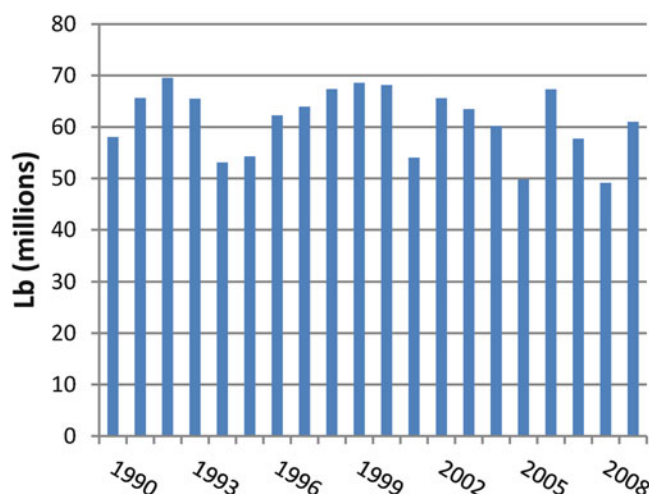
**Figure 10.3.** Gulf of Mexico brown shrimp (*left panel*) and white shrimp (*right panel*) landings, 1990–2009 (NMFS FSD; data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).

the basis of the 3-year groupings decreased 27 %. With Gulf landings accounting for 95 % of U.S. production, national landings were then down 27 %.

### 10.3.1.3 White Shrimp Landings



Annual white shrimp landings ranged from the period high of 132 million pounds in 2006 to the period low of 55 million pounds in 1996 (Figure 10.3, right panel). The average annual landings, on the basis of the 3-year groupings, increased 41 %. U.S. landings showed a smaller increase (30 %) when the non-Gulf landings decrease (20 %) was included. The Gulf's increased white shrimp production for the period almost negated the lower production from the brown shrimp fishery, which left total shrimp landings essentially unchanged.



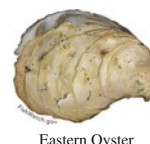
**Figure 10.4.** Gulf of Mexico commercial blue crab landings, 1990–2009 (NMFS FSD; data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).

#### 10.3.1.4 Blue Crab Landings



Statistics are reported for three blue crab products: (1) hard blue crab, (2) peeler crab, and (3) soft crab. Hard blue crab is, by far, the target of harvesters. Peeler is a designation for a crab in molt stage that results in a soft crab that can be marketed. Only hard blue crab landings are addressed herein, because it is the largest commodity form and also would reflect changes in levels of the other forms (Figure 10.4). The Gulf crab fishery accounts for 35 % of domestic landings with the remaining landings from Chesapeake and South Atlantic areas. Gulf landings, examined in 3-year intervals, began the period of analysis at almost 65 million pounds (i.e., 1990–1992 average) and ended the period at 56 million pounds (i.e., 2007–2009 average) for a 14 % decrease (Figure 10.4). National landings fared worse with a 26 % decrease.

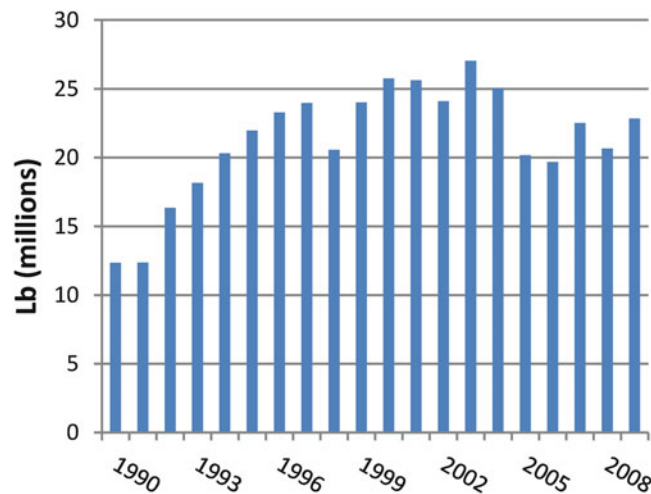
#### 10.3.1.5 Oyster Landings



U.S. landings of eastern oysters (*Crassostrea virginica*) were essentially unchanged for the period at 24 million pounds of meat. The initial 3-year average was 23.9 million pounds of meat, and the final 3-year period average was 24.4 million pounds of meat. Gulf oyster harvesters produced 13.7 million pounds in the initial period but the average for the final 3-year period rose to 22 million pounds (61 % increase) (Figure 10.5). The 22-million-pound level for the Gulf represents 90 % of the country's eastern oyster landings.

#### 10.3.1.6 Landings of All Other Species

Dozens of species have not been covered in the aggregate discussion of the Gulf. Although comprising approximately 6 % of total landings, many of the species are the focus of GMFMC

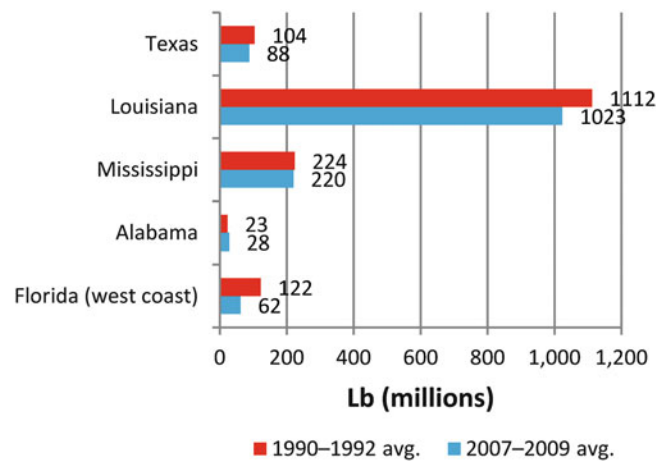


**Figure 10.5. Gulf of Mexico commercial oyster landings, 1990–2009 (NMFS FSD; data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).**

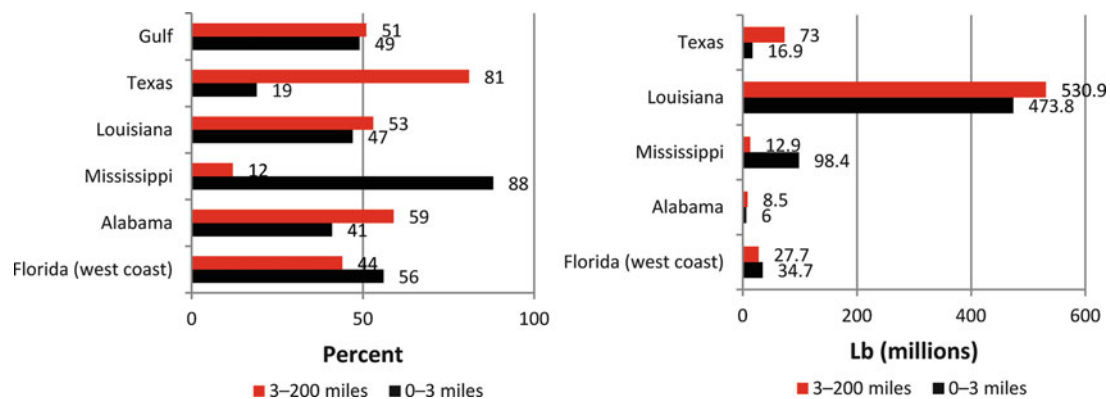
regulations. The reef fish complex of species includes many that are subject to technically defined designations of “subject to overfishing” and/or “overfished.” As of 2009, gag grouper (*Mycteroperca microlepis*), gray triggerfish (*Balistes capricus*), greater amberjack (*Seriola dumerili*), and red snapper (*Lutjanus campechanus*) were being managed so designated. Given the overfishing or overfished designation associated with these species, landings are constrained by regulation and significant changes in landings of these species are unlikely in the absence of a change in regulation. Changes in regulations generally reflect updated stock assessments indicating improvements/deteriorations in the health of the stock. Reef fish complex species generally entail involvement of commercial and recreational harvesters. This adds a complexity to the understanding of Gulf fisheries not present in the previously presented key species. There are small recreational harvests of oysters, blue crab, and shrimp in relation to commercial landings that are not problematic. Anglers for Gulf reef fish species are major participants in quota sharing and likely have a wider distribution throughout the Gulf landing sites than the far smaller number of commercial harvesters. More detailed discussions of the commercial harvest of reef fish species and the recreational harvest of reef fish and other species are given in subsequent sections of this chapter.

### 10.3.2 Aggregate Landings by State

The finfish and shellfish landings attributed to the states fluctuate as expected, yet the ranking of the states within the Gulf does not change much (Figure 10.6). Louisiana ranks first due to landings in five major species: (1) menhaden, (2) brown shrimp, (3) white shrimp, (4) blue crab, and (5) oysters. Landings are commonly above a billion pounds with menhaden accounting for 80 %. Mississippi attains the second highest landings also fueled by the menhaden fishery with a 94 % component. Most recently the west coast of Florida ranks fourth after historically holding the third spot. Landings in Texas placed third at the end of the 1990–2009 period. Alabama began and ended the period in fifth place. Differences by species among the states are presented in the sections dealing with individual key species.



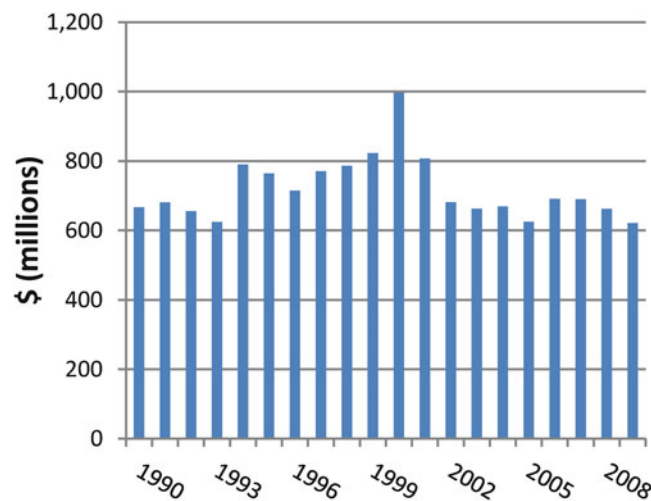
**Figure 10.6.** Average annual landings by state, 1990–1992 and 2007–2009 (NMFS FSD; data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).



**Figure 10.7.** Gulf of Mexico commercial catch by distance from shore, by state, in percentage (*left panel*) and pounds (*right panel*), 1990–2009 (NMFS, Fisheries Statistics Division with percentage calculations by authors; data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).

### 10.3.3 Catch by Distance from Shore

The diversity of species in the Gulf subject to commercial harvest results in many being caught either totally or partially in state waters. State waters is reported in the NOAA Fisheries as 0–3 mi (0–4.8 km) offshore even though Florida has a 9 mi (14.5 km) state limit on its west coast as does Texas throughout its Gulf border. Total catch for the Gulf can be portrayed as near a 50 %–50 % split between state and federal waters (Figure 10.7). Mississippi receives the highest level of state water catch at 88 %. At the other extreme, Texas receives 81 % from the 3–200-mi (4.8–322-km) zone, largely because of a large offshore shrimp component. Louisiana, Alabama, and Florida (west coast) were nearer to receiving equal shares from state waters and offshore zones. The Gulf's large menhaden fishery generally conveys a shallow water image consistent with state waters. This accurately fits for Mississippi with 88 % of the state's catch coming from state waters. The situation is not so described in neighboring Louisiana even



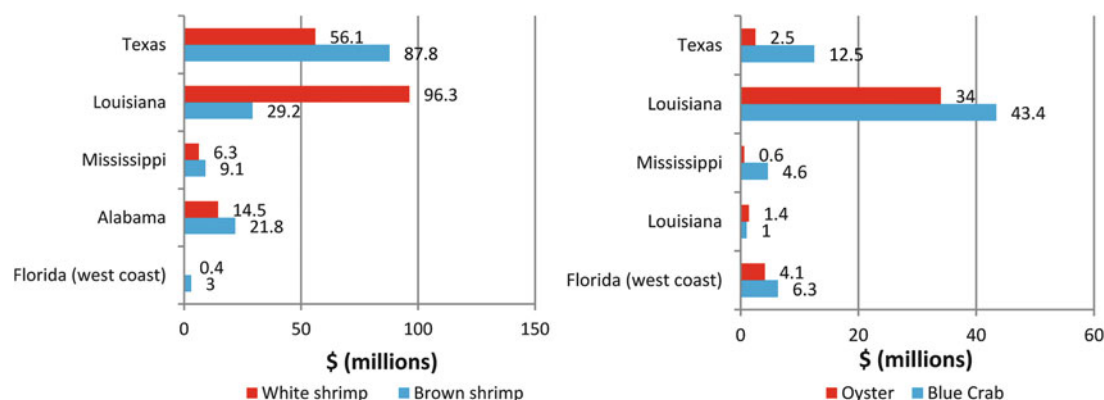
**Figure 10.8. Gulf of Mexico dockside value of commercial landings, 1990–2009 (NMFS FSD; data accessed 2012—see Appendix A).**

though the harvest methods are the same. Louisiana, with 53 % of total catch from federal waters, can only attain such a level if menhaden comprises a large part of the catch.

### 10.3.4 Dockside Value of Landings

Gulf fisheries brought in \$658 million (i.e., dockside value), on average, for the last 3 years of the 1990–2009 study period. The first 3-year average for the period was \$568 million for an 18 % increase in nominal terms. The high single year was 2000 with value at \$997 million (Figure 10.8). The last year of the period had value at its lowest over the 20 years. Value increased while landings decreased 10 %. Key species values were mixed: (1) oyster value increased 89 % under increased supplies of 61 %, (2) blue crab landings were 14 % lower with a value increase response of 59 %, (3) menhaden landed value was 15 % higher on 9 % lower landings, (4) white shrimp value was up 24 % on much higher landings of 41 %, and (5) brown shrimp was 37 % lower on a drop of 27 % in landings. Recall that these are for 3-year averages at the start and end of the 1990–2009 period.

NOAA Fisheries maintains an ex-vessel price series with 1982 as the base year (i.e., 1982 = 100). The ex-vessel price indexes for blue crab, oysters, menhaden, and Gulf and South Atlantic shrimp are good descriptors for the Gulf. However, none of the edible finfish from the Gulf have price indexes. The substitute index used herein is that of total edible finfish in the country. Edible finfish ex-vessel prices in 1990 had an index of 130 but ended at 117 in 2009. The interpretation is that overall finfish ex-vessel prices were 30 % higher in 1990 compared to 1982 but only 17 % higher by 2009. The index for blue crab was at 152 in 1990 with a large increase to 383 by 2009. Oyster harvesters were successful marketing in 1990 at prices that put the index at 228, the highest index for the key species. By 2009, the oyster index reflected more favorable conditions with an index of 273. Ex-vessel prices in the vertically integrated menhaden industry are estimated from a small number of firms. The index levels in 1990 and 2009 were 128 and 154, respectively. The situation for shrimp necessitated that all warm water shrimp be used in the calculation, not just the brown and white shrimp noted previously in this chapter. Brown and white shrimp commonly comprise over 95 % of landings. For 1990, the index was 79 signaling a 21 % decrease from the 1982 base. Although there were



**Figure 10.9.** Value of commercial landings by state and species (shrimp, *left panel*; oysters and blue crab, *right panel*), (2007–2009 average) (NMFS FSD; data accessed 2012—see Appendix A).

occasional exceptions for the 20-year period, the index reflected poor ex-vessel shrimp prices. Economic conditions by 2009 were not favorable, resulting in an index of 65 (i.e., price was 35 % below 1982).

When examined at the state level, the dockside value of all landings is highly concentrated in Louisiana and Texas with shares of 43 % and 26 %, respectively. The other state achieving a double-digit contribution is Florida (west coast) at 19 %. Alabama and Mississippi range from 6 to 7 % of Gulf value. Species components of the state values are widely different. Louisiana value of individual fisheries for white shrimp, blue crab, oysters, and menhaden leads among the states. For example, the commercial dockside value of Louisiana's white shrimp landings averaged \$96.3 million annually during 2007–2009, which exceeded the combined values for all other states (Figure 10.9 left panel). Similarly, the 2007–2009 annual average commercial value of Louisiana's blue crab landings (\$34 million) and oyster landings (\$43.4 million) exceeded the combined landings from all other Gulf states (Figure 10.9 right panel). The remaining key species, brown shrimp, is dominated by Texas landings (with an average dockside value of \$87.8 million during 2007–2009), followed by Louisiana (\$29.2 million) and Alabama (\$21.8 million) (Figure 10.9 left panel). Key species designation of the five species fits well for all but Florida (west coast). At 19 % of total Gulf value, the area only receives 11 % of its landed value from key species. Edible finfish such as groupers and snapper bring high finfish dockside prices. These species and highly valued spiny lobster (*Panulirus argus*) and stone crab (*Menippe mercenaria*) claws push the west coast's share in the Gulf (19 %) past that depicted by key species alone (3 %).

### 10.3.5 Processing Plants and Related Employment

The after-landings activities necessary to convert marine shellfish and finfish into marketable consumer products in varied locations around the country are substantial. A consumer product can be as basic as one in whole form that has been washed, graded, and temperature safe to labeled frozen product at retail. With the majority of seafood consumption occurring away from home, the product processing can result in an intermediate form that allows chefs final value-added opportunities in restaurants. Estimation of total employment in such a marketing chain when imported products as well as fresh seafood imports account for large shares of supply is not attempted on a times series basis. A substitute is the use of an input/output model that accounts for activity created throughout the economy as a result of an initial



sale. The next section describes economic impacts of sales, income, jobs, and value added based on an input/output model developed for NOAA.

There are minimal data available annually on the domestic processing industry. NOAA's annual report *Fisheries of the United States* includes the number of processing and wholesale plants with direct employment estimates. Indirect and induced employment estimates are not included. The state of Florida data are reported without differentiation of east and west coasts. Therefore, data to be discussed are for the non-Florida Gulf. For the 2007–2009 period, Gulf States averaged 163 processing plants and 231 wholesaling plants. The range for processing plants during the 3 years was small at 160–165 indicating stability in the near term. As expected, wholesaling plants were more numerous, in part due to the lower capital cost. The range for wholesaling plants during the 3 years was smaller at 229–232. There likely was more entry and exit in the wholesaling sector than the narrow range suggests due to the lower capital entry costs. Louisiana was home to both the largest number of processors and wholesalers (72 and 176, respectively). Mississippi had the lowest number of plants. However, in terms of employment, Mississippi led the Gulf States. Approximately one-third of the region's employment can be identified as Mississippi based. Average plant employment in Mississippi amounted to three times the level of the next highest Gulf state, Texas.

### 10.3.6 Economic Impact of Gulf of Mexico Commercial Fishing

Economic impacts to be portrayed include those of sales, income, and value added originating from landings and imports. The initial use of the National Marine Fisheries Service (NMFS) Fishing Industry Input/Output Model was applied to 2006. Annual analyses followed with a value-added calculation made in 2009. Thus, there are findings for the 2007–2009 period previously used to depict near term conditions with respect to landings. Separate information for the Florida west coast versus Florida east coast was not available. The Gulf economic impacts of landings had to be reported for Alabama, Mississippi, Louisiana, and Texas to avoid inconsistencies with the prior sections dealing with landings and this impact, with and without the inclusion of imports, is presented in Figure 10.10 for 2009. This represents the first year in which NMFS segmented imports from domestic product in the calculation of economic impacts.

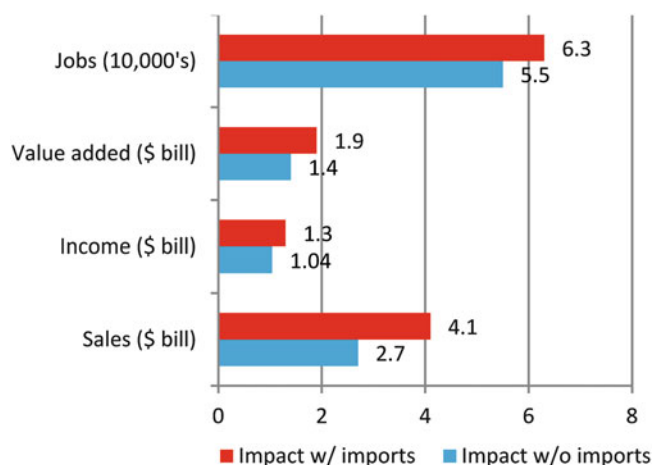
#### 10.3.6.1 Sales Impacts

An input/output model measures the impacts of an economic impetus, in this case the value of landings, on other sectors in a defined economy or region. Impacts estimated include the effects of domestic landings, imported seafood, wholesaling, processing, and retail on an economy. In this case the impact generated \$4.6 billion from Alabama, Mississippi, Louisiana, and Texas. For the 2007–2009 period, average annual sales impacts by state, including both domestic and imported product, were (1) Alabama, \$441 million; (2) Mississippi, \$348 million; (3) Louisiana, \$1.9 billion; and (4) Texas, \$1.9 billion.<sup>1</sup> All four states experienced a sales impact decrease from 2007 to 2009. Using the 3-year period, landed value average results in a higher impact estimate for sales than if 2009 alone was calculated. Importers accounted for 41 % of the seafood industry's Texas sales impact. Louisiana importers had 21 % of the impact. Mississippi and Alabama seafood economy had minimal importer roles.

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<sup>1</sup> The 2009 sales impact for Florida, including the east coast, equaled \$13 billion. Of this total, \$9.5 billion was generated by importers.





**Figure 10.10. Gulf of Mexico commercial seafood industry economic impact, 2009 (U.S. Department of Commerce 2011).**

### 10.3.6.2 Income Impacts

Income impacts are a component of sales in an economy. The income impacts for the four states associated with the use of both domestic and imported product amounted to \$1.3 billion. Louisiana (\$574 million) leads the Gulf and Mississippi was lowest in income generated at \$113 million. Texas at \$474 million was near the top and Alabama ranked third at \$148 million. Each of the states experienced a reduction of income impacts from 2007 to 2009 with no change in rankings. Specifically, income impacts for the four states in 2007 were as follows: Louisiana, \$1.1 billion; Mississippi, \$184 million; Texas, \$959 million; and Alabama, \$268 million.<sup>2</sup>

### 10.3.6.3 Employment Impacts

Direct jobs in the commercial harvesting sector spur actions among companies supplying inputs and for those adding value to landings and imported product ultimately used by consumers. The four states Gulf economy averaged 92,000 seafood industry jobs during 2007–2009. Employment decreased each year from 109,000 in 2007 to the period low of 63,000 in 2009. Texas job contraction was largest at –56 % followed by –38 % in Louisiana. Alabama and Mississippi had the lower decreases with each approximately –20 %. Seafood industry jobs in 2009 were (1) Louisiana, 29,200; (2) Texas, 18,900; (3) Alabama, 8,800; and (4) Mississippi, 6,400.<sup>3</sup> Jobs in the retail sector comprised approximately half of the jobs over the period. As to be expected, when employment decreased the retail sector experienced the largest problems. The nation's economy began a period of slowdown that could have led to the result. However, the input/output model result of a Gulf retail sector experiencing a 60 % reduction between 2007 and 2009 is problematic in spite of Gulf landings falling 10 %.

<sup>2</sup> The income impact for Florida, including its east coast, equaled \$2.4 billion in 2009 compared to \$2.8 billion in 2007.

<sup>3</sup> The 2009 number of Florida jobs, including the east coast, equaled 64,700. The import sector accounted for more than one-half of this total.

In addition to these employment estimates from the U.S. Department of Commerce, NOAA's annual publication *Fisheries Economics of the United States* and NOAA's report *Fisheries of the United States* (FUS) include employment estimates. The later report lists employment from seafood wholesale and processing plants by state and region. With the exception of the input/output model indicating lower employment for Mississippi than the FUS report, the employment estimates are close between the reports. This closeness warrants caution because an input/output model accounts for direct employment and jobs arising from the induced effects of direct employment. So the employment estimate from the model should be higher than the direct employment in FUS.

#### **10.3.6.4 Value Added**

The value-added measure from an input/output model addresses a net concept to an industry's economic impact. Gross sales reflect that costs are associated to produce the product sold. When the transfer payments of costs for goods and services used to produce the product sold are subtracted from gross sales, a net value image emerges. Referred to as value added, the estimate yields a descriptor useful for measuring a firm's or sector's net contribution to an economy. This section continues with the Alabama, Mississippi, Louisiana, and Texas designation for the Gulf because the input/output model does not report for the Florida west coast separately. The landed value and import value of the four-state Gulf in 2009 resulted in a value added of \$1.4 billion. Louisiana's post dockside firms accounted for 47 % of the total. Texas was second at a 31 % contribution to the total. Alabama at 13 % and Mississippi at 9 % had the smaller roles. There was no means by which to measure change between 2007 and 2009 because 2009 marked the first year of estimation.

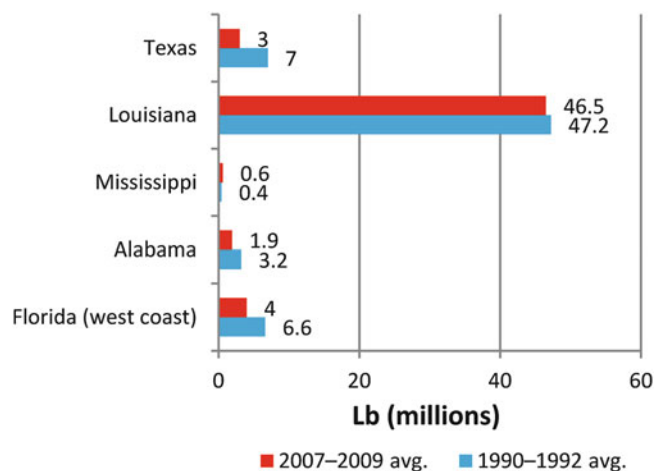
#### **10.3.6.5 Imports and Sales, Income, Employment, and Value Added Impacts**

Use of imported seafood in Gulf post dockside economic endeavors can be significant to a firm's success. The *Fisheries Economics of the United States* report for 2009 includes a treatment of imports as supply that leads to economic impacts. The four economic impact measures indicate double-digit contributions by imported product: (1) 33 % of sales, (2) 21 % of income, (3) 13 % of jobs, and (4) 25 % of value added (Figure 10.10). Among states Texas' sales were 98 % higher than would have been experienced with state landings alone. Mississippi incorporated imports the least at 6 % of sales. Louisiana and Alabama used imports to gain 34 % and 16 % higher seafood industry sales, respectively.

### **10.3.7 Commercial Fisheries of State Managed Species**

#### **10.3.7.1 The Blue Crab Fishery**

Essentially all of the nation's catch of blue crab occur in state waters. Harvesting units are small and make daily trips. These characteristics apply throughout the Chesapeake Bay, South Atlantic, and Gulf assuring that landings by state mimic catch by state. Management of the elements contributory to population levels and harvests consequently fall to state agencies. Regional cooperation via GSMFC adds another level of contribution to states achieving their goals. Gulf landings fell 14 % from the 1990–1992 base period to the end period of 2007–2009. However, the region's share of national landings increased in the comparison periods because national landings with Gulf removed fell by 32 %. Nationally, the increasing ex-vessel price for blue crab pushed dockside value up 90 %. The non-Gulf component increased over 100 %, while the Gulf increase neared only 59 %.

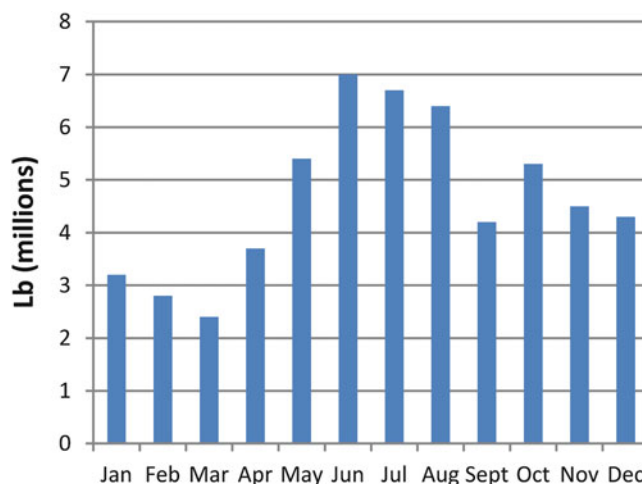


**Figure 10.11. Gulf of Mexico commercial blue crab landings by state for selected periods (NMFS FSD; data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).**

Within the downward landings results for the 1990–1992 period versus the 2007–2009 period, there was divergence among states. Texas (–57 %), Florida west coast (–40 %), and Alabama (–38 %) all experienced significantly lower landings (Figure 10.11). The Gulf’s largest producer, Louisiana, by comparison experienced only a 2 % decline in production while the region’s smallest producer, Mississippi, experienced an increase in production (Figure 10.11). Given that the Gulf blue crab production is dominated by Louisiana, the reduction in Gulf blue crab landings between 1990–1992 and 2007–2009 was minimal and largely mimicked that observed for Louisiana. These were among the lower producing states in the Gulf, but the impact with the largest producer, Louisiana, up only 2 % resulted in a decrease for the Gulf in total. Lowest producer, Mississippi, had a large percentage increase, but production approached only 500,000 lb. An important aspect of the Gulf blue crab fishery relates to the value of landings. Previously cited was the ex-vessel price performance being the best of species comprising Gulf landings. With 1982 serving as the base year for NOAA Fisheries’ ex-vessel price index, the blue crab index reached 383 in 2009. In 1990, the index stood at 152 suggesting that most of the large price increase occurred from 1990 to 2009. The end period had U.S. average ex-vessel price in a small range of \$0.75–\$0.81 per pound with the low occurring in 2009. Gulf end-period average prices were similar at \$0.73–\$0.80 per pound. The national recession in 2009 must have played a role as most Gulf species attained period low levels. Exceptions were oysters and stone crab claws.

Seasonality was less of an issue with blue crab production than other species. Closed seasons were not a management approach in major producing areas. Louisiana’s fishery accounts for 83 % of Gulf landings. Therefore, the occasional crab trap free periods based in avoiding gear conflicts or the facilitation of abandoned trap removal do not result in production shifts. May–September landings account for 53 % of annual landings (Figure 10.12). Winter months are lowest. Crabbers still put 4.3 million pounds on docks in the lowest month, March.

Blue crab can be graded by size with larger crabs going to live resale. Those not reaching the live resale size limit, the majority, are processed to remove the meat. However, the meat is not a uniform product; processed product is differentiated for sale as crab fingers, claw meat, white, backfin, lump, and jumbo lump. Multiple products of varied value for the human market represent perhaps the most complex of the Gulf’s processing industries. Blue crab processing occurred in all five Gulf states until 2005 which marked the stoppage in Mississippi from 2006



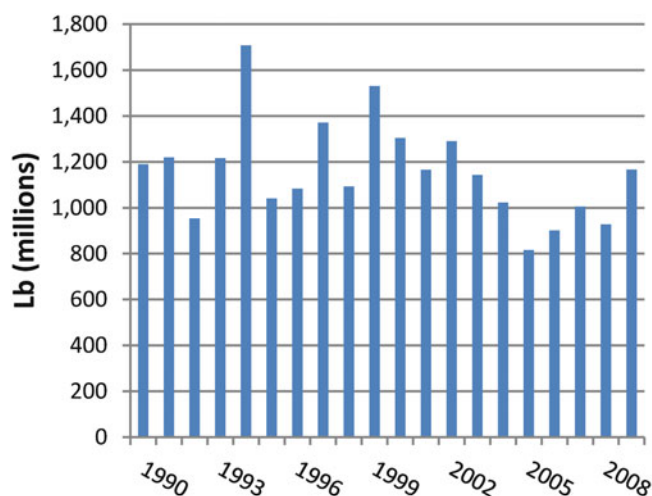
**Figure 10.12. Gulf of Mexico commercial blue crab landings by month, 2007–2009 average (NMFS FSD; data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).**

to the end of period used herein, 2009 (personal communication, Melissa Yencho-NOAA Fisheries). Texas processing was at the level with such a small number of firms that reporting it separately would divulge confidential data. From 2006 forward, the Texas data had to be combined with the Louisiana data to maintain confidentiality. Gulf blue crab processing data exists for Alabama, Louisiana/Texas, and Florida west coast. The 2007–2009 average Alabama processed production was six times larger than the next largest, Louisiana/Texas. Recalling the level of landings in Alabama being a 3-year average of approximately ten million pounds, points to significant cross state movement of live blue crab. The 4 % of average Gulf landings clearly would not support the Alabama processing industry's 4.2 million pounds of blue crab meat. It is an inescapable conclusion that Louisiana was the only state that could have supplied sufficient live crabs for Alabama to attain such a high processed volume.

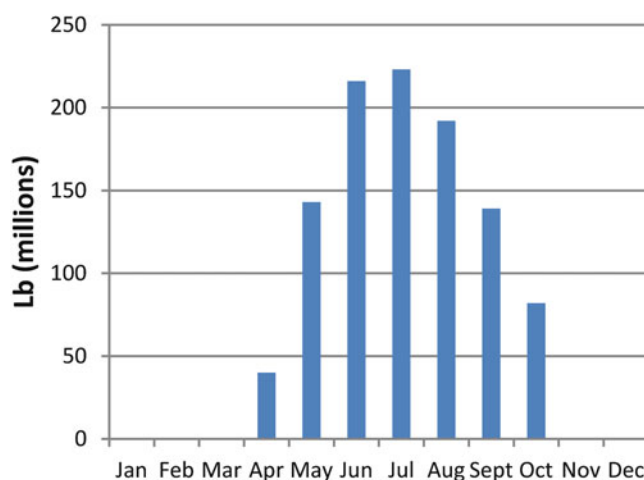
### 10.3.7.2 The Menhaden Fishery

Menhaden are a small oily finfish caught in nearshore fisheries from Chesapeake Bay to the Gulf. The vast majority of landings come from catch in the 0–3 mi (0–4.8 km) coastal area. Occasionally substantial catch is from the 3–200 mi (4.8–322 km) offshore area. The prospect of offshore harvest necessitates a closer tie between state agencies and NOAA Fisheries than would be thought for a clearly nearshore focused species. The decreasing number of firms in what is a large fishery for a species used in domestic and international markets encourages close cooperation among agencies and firms. Menhaden processing results in three products: (1) fish meal for use in animal feeds, primarily poultry; (2) fish oil for mostly export markets inclusive of human food uses; and (3) soluble, which often can be an additive to the meal.

The menhaden industry is noted as vertically integrated. Processors own vessels that fish under corporate direction. Crews are compensated on the basis of shares. Reported ex-vessel price under a vertically integrated structure with a small number of firms can be expected to differ from other Gulf fisheries. The other fisheries are characterized by large numbers of harvesters operating as owner operators throughout the Gulf at all times of a year. The companies and NOAA Fisheries do generate a price so that dockside value can be reported. The index of ex-vessel price for menhaden in 1990 and 2009 was at 128 and 154, respectively. At the end of the analysis period menhaden prices were \$0.06–\$0.07 per pound.



**Figure 10.13.** Gulf of Mexico annual menhaden landings, 1990–2009 (NMFS FSD; data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).



**Figure 10.14.** Gulf of Mexico menhaden landings by month, 2007–2009 average (NMFS FSD; data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).

Gulf landings were two-thirds of the U.S. total. On only four occasions from 1990 to 2009 did Gulf landings not reach at least one billion pounds and on only two occasions did landings exceed 1.5 billion pounds (Figure 10.13). Based on the first and last 3-year averages for the period, landings exhibited stability. Landings over the period fell only slightly with value increasing by 15 %. The number of firms over time decreased; evidently making for an increase in average landings per firm. The industrial firms are located in Mississippi and Louisiana. Much smaller firms in Florida (west coast) and Alabama focus on menhaden as bait for other fisheries such as blue crab and some recreational uses. These states land less than 1 % of the Gulf production. Landings for the industrial fishery start minimally in April, steadily increase to a peak in July, and end by October (Figure 10.14). Firms in Mississippi and Louisiana essentially fish the same times of the year.

### 10.3.7.3 Other State-Managed Species

The species selected as key species by the authors provide the insight needed regarding general conditions in the Gulf. Menhaden, brown shrimp, white shrimp, oysters, and blue crab combined accounted for 94 % of landings in the 2007–2009 period. NOAA Fisheries in its annual publication *Fisheries Economics of the United States* identifies Gulf key species additionally as crawfish, groupers, red snapper, mullets, stone crab, and tunas. The focus of this chapter being the northern Gulf (i.e., Alabama, Mississippi, and Louisiana) means there was no need to include crawfish and stone crab claws. The former is a freshwater species of wild and aquaculture origins found in Louisiana. The latter is overwhelmingly a Florida fishery. Like stone crab, the vast majority of Gulf striped mullet (*Mugil cephalus*) catch is Florida based; representing over 70 % of the Gulf total. Alabama and Louisiana basically account for the remainder with Alabama the larger. Total Gulf landings averaged ten million pounds of striped mullets in the most recent period. This was down from the initial 1990–1992 period average of 26 million pounds. Dockside value fell from the initial period's level of \$26.4 million to \$5.7 million.

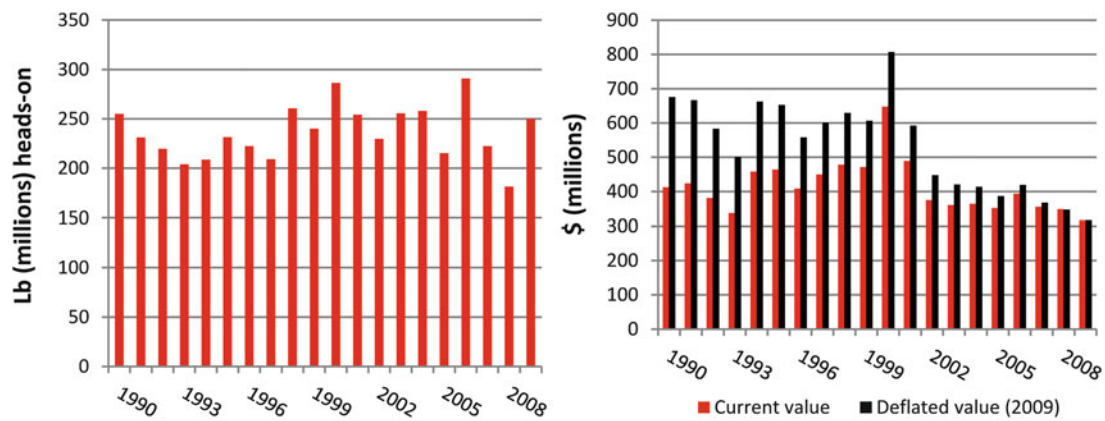
Yellowfin tuna (*Thunnus albacares*) landings in the Gulf for 2007–2009 increased to 35 % of the United States. The increase did not result from increased landings compared to elsewhere in the country. Rather, Gulf landings decreased (69 %) but landings other than the Gulf fell 78 %. Prices were favorable during 1990–2009 by almost doubling nationally. Gulf yellowfin prices followed the increase by the lesser amount of 50 %. The distribution of Gulf landings was very narrow. Louisiana received 77 % of the catch in 2007–2009, which represents an increase from the 46 % share in 1990–1992.

The harvest of red snapper and grouper are subject to increasingly constraining catch regulations of the GMFMC and cooperating states. Management of commercial effort by seasonal, gear, area protections and quotas with share assignment has the near-term effect of constraining catch. Additionally, these key species have been highly prized by anglers throughout the Gulf. Commercial red snapper average landings were essentially unchanged on the basis of an initial-period versus end-period measure at 2.6 million pounds. The 1995–2006 period average was 4.5 million pounds.

Location of landings changed among the states between initial and end periods. Northern Gulf states of Alabama, Louisiana, and Mississippi experienced a 50 % decrease. Texas and Florida west coast benefitted with the 1990–1992 average of 1.2 million pounds, increasing to 1.9 million pounds by 2007–2009. Gag (*Mycteroperca microlepis*), red (*Epinephelus morio*), and warsaw grouper (*Epinephelus nigritus*) landings have consistently been attributable to Florida west coast ports. Thus, there are landings of some groupers in the northern Gulf, but these cannot be considered important compared to previously reviewed species.

### 10.3.8 Additional Detail on Key Commercial Species

An overview of the Gulf of Mexico commercial seafood industry, including a brief discussion of some of the key species, was provided in the previous section of this chapter. This section provides additional detail on some of these key species including shrimp, oysters, and reef fish. Shrimp is given more discussion because it is by far the largest contributor, by value, to the Gulf of Mexico seafood industry. Oysters are given additional treatment because the nature of the industry involves leasing activities, with emphasis being given to Louisiana. Reef fish species comprise a sizeable portion of commercial finfish landings and are the subject of considerable management, including recently enacted catch share programs, and are given additional consideration on this basis.



**Figure 10.15. Gulf of Mexico shrimp landings (left panel) and value (right panel), 1990–2009 (NMFS FSD, data accessed 2012, with deflated values calculated by authors—see Appendix A) (Note: 1 lb = 0.454 kg).**

### 10.3.8.1 The Shrimp Fishery

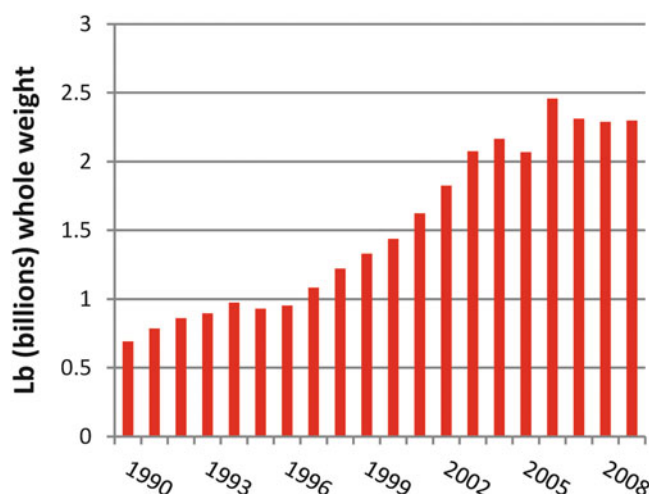
#### 10.3.8.1.1 Gulf Shrimp Landings and the Relation to Imports

With a 2009 dockside value of \$314 million, the shrimp fishery is the largest contributor to the \$615 million (2009) Gulf of Mexico commercial fishing sector. Since it is by far the largest component of the Gulf of Mexico commercial seafood industry, it is covered in additional detail in this section.

Annual Gulf shrimp production (heads-on weight) during 1990–2009 is provided in Figure 10.15 (left panel). While exhibiting a significant amount of annual variation, the yearly changes tend to follow a random-walk process and, over time, production returns to its long-run average (while not shown in the graph, long-run production of gulf shrimp has been stable since at least the 1970s). These observed random walks are primarily the result of changes in environmental conditions that influence recruitment and growth. Since the primary species of shrimp landed in the Gulf—brown and white—are short-lived animals, with maximum age of about 1 year, any short-run deviations from the long-term average will be temporary in nature assuming environmental conditions return to normal and there is a sufficient amount of effort to harvest the available crop. Overall, annual harvest of Gulf shrimp during 1990–2009 averaged 236 million pounds with a range from 181 million pounds in 2008 to 290 million pounds in 2006. While the effort needed to harvest the aggregate shrimp crop has historically been sufficient, as addressed in subsequent sections of this chapter, changes in profitability have led to a significant decline in industry effort in recent years and an increasing concern that with further declines in effort, a portion of the annual shrimp crop may not be harvested.

While the long-run production of Gulf shrimp, in pounds, has remained stable over time, the same cannot be said about the value of landed product; especially when the influence of inflation is removed. As indicated in Figure 10.15 (right panel), the long-run dockside value of the Gulf shrimp harvest has, overall, been declining, whether considered on a current or deflated basis. This decline has been particularly pronounced since 2001. On a current dollar basis, the value of Gulf production fell from an average of just over \$400 million annually during 1990–1994 to about \$350 million annually during 2005–2009. After adjusting for inflation, the decline was approximately 40 %, from \$617 million to \$367 million (expressed in 2009 dollars).





**Figure 10.16. U.S. shrimp imports (whole weight), 1990–2009 (NMFS FSD, data accessed 2012, with weight conversions calculated by authors—see Appendix A) (Note: 1 lb = 0.454 kg).**

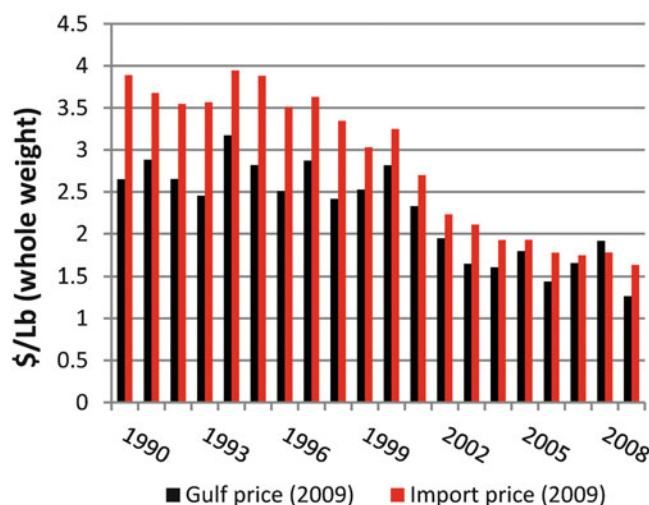
While there are several reasons for the sharp decline in the Gulf dockside shrimp price beginning in 2001, the overriding one is that of increasing imports. The source of these imports is from more than 40 countries throughout the world with Asian countries dominating the field. As indicated by the information in Figure 10.16, import growth has been large during the considered timeframe with total imports (heads-on equivalent weight<sup>4</sup>) advancing from an average of 850 million pounds annually during 1990–1994 to 2.3 billion pounds annually during the 2005–2009 period. Furthermore, as indicated, much of this increase has occurred post 2000. Given the strong U.S. economy throughout the later portion of the 1990s and the concomitant increase in demand for shrimp, the increase in imports during the 1990s did not lead to any sharp decline in the Gulf of Mexico dockside value (or price). However, the large increase in imports post 2000 combined with a number of other factors, including a recession that officially began in the third quarter of 2001, resulted in a sharp and prolonged decrease in the Gulf of Mexico dockside value (via a change in price). A detailed examination of possible factors influencing this price decline can be found in Keithly and Poudel (2008).

Comparison of the information in Figure 10.15 (left panel) and Figure 10.16 clearly highlights how small Gulf landings are relative to imports. Given this and the fact that differentiation of Gulf shrimp from the imported product is minimal, one would expect changes in the Gulf and import prices to follow a similar pattern. This relationship is evident in the information in Figure 10.17. While the import price, expressed on a whole weight equivalent basis, generally exceeded the Gulf dockside price by a considerable margin during the early 1990s, this margin gradually lessened over time and had largely disappeared by the mid-2000s.<sup>5</sup> Furthermore, given the large share of total U.S. supply (i.e., domestic and imported product) provided by imports, along with their apparent close substitutability, one would expect that changes in

<sup>4</sup> The terms “live-weight” and “whole weight” are used interchangeably in this section.

<sup>5</sup> The import price, while converted to a whole weight equivalent basis, consists of different product forms and different shrimp sizes. Both of these factors will, to some extent, likely explain a portion of the price differential between import and domestic product prices. Overall, the correlation between these two price series was 0.94 during the study period.





**Figure 10.17.** Deflated Gulf dockside shrimp price and import price (whole weight), 1990–2009 (NMFS FSD, data accessed 2012, with weight conversions and deflated prices calculated by authors—see Appendix A) (Note: 1 lb = 0.454 kg).

Gulf landings would have little or no influence on its own price. This is examined in greater detail in a subsequent section.

#### 10.3.8.1.2 A Closer Look at Imports

As noted, a large number of countries export shrimp to the United States. Asian countries have accounted for the majority of U.S. shrimp imports since at least the early 1990s and in 2009 accounted for more than 70 % of the total (based on product weight). Thailand dominated exports to the United States in 2009 accounting for almost one-half of the Asian exports and more than one-third of total exports. Other countries of significance include Indonesia (17 % of Asian exports and 13 % of total exports to the United States), Ecuador (70 % of South American exports and 11 % of total exports to the United States), China and Vietnam (each accounting for approximately 10 % of Asian exports to the United States and 8 % of total exports to the United States), and Mexico (accounting for about 67 % of Central American exports to the United States and 7.5 % of total exports to the United States).

Employing monthly data covering the 1995–2005 period, Jones et al. (2008) examines the U.S. demand for shrimp by source in relation to prices from the sources. The analysis includes seven import sources—Mexico, Ecuador, India, Thailand, Vietnam, China, and Rest of World—and domestic (i.e., U.S.) source. Own-price elasticities for all sources were negative, as suggested by theory, and statistically significant.<sup>6</sup> Furthermore, the own-price elasticities were inelastic (less than  $-1$ ) for all sources implying that a 1 % increase (decrease) in price from any given source would result in a less than proportionate decrease (increase) in quantity demanded for shrimp from that source in the U.S. market. The scale elasticities, which measure the influence of a change in overall U.S. shrimp demand on the demand from the individual sources, were positive and statistically significant for all sources and ranged from a low of 0.30

<sup>6</sup> An own-price elasticity, with respect to demand, measures the change in quantity demanded of a good that will be forthcoming with respect to a 1 % change in its own price. Similarly, a cross-price elasticity measures the change in demand for a given good associated with a 1 % change in the price of a substitute (or complement) good.

(Ecuador) to a high of 1.74 (India). The scale elasticity for the U.S. production with an estimate of 0.90 indicates that the demand for U.S. produced shrimp increases by 9 % for each 10 % increase in total U.S. shrimp demand. Finally, the researchers note that “[f]or the most part, cross elasticities were negative, implying that shrimp demand exhibited a complementary relationship between countries.” This finding is not easily explainable.

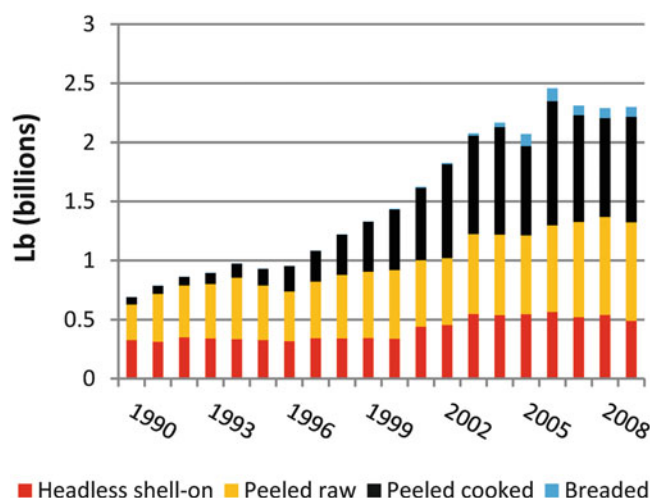
The large increase in U.S. shrimp imports and the resultant decline in Gulf dockside price resulted in a coalition of Southeast U.S. shrimp harvesters and processors (Gulf and South Atlantic) petitioning the U.S. International Trade Administration and the U.S. International Trade Commission for relief in the form of antidumping duties. These petitions, filed on December 31, 2003, charged six countries—China, Thailand, Vietnam, India, Ecuador, and Brazil—with unfair trade practices. These six countries exported 822 million pounds of shrimp (product weight) to the United States in 2003, which represented almost three-quarters of the total U.S. shrimp imports for that year. After an exhaustive investigation, the finding of dumping and injury was found, and duties were imposed on subject merchandise from these six countries. Details on the investigation and factors leading to the investigation are provided by Keithly and Poudel (2008) who, after analysis of the situation, conclude that these duties had only a marginal impact on limiting shrimp exports to the United States because of trade diversion effects (essentially increased shrimp imports from countries not named or merchandise not named that offset any reduction in imports from countries and merchandise named). Thus, the duties likely had only a marginal, if any, effect on increasing the price received by the domestic shrimpers for their harvested product. Furthermore, the conclusion by Keithly and Poudel (2008) would suggest that the recent stability in imports was not the result of the duties imposed on named countries and merchandise. Instead, the stability likely reflects a decline in demand in 2008 as the United States entered a deep and protracted recession. While the antidumping duties imposed on the six named countries may have had little influence on increasing the U.S. Gulf shrimp dockside price, the domestic industry did benefit significantly via funds collected from the duties and negotiated settlements to rescind reviews. Specifically, the Continued Dumping and Subsidy Offset Act of 2000 (i.e., the Byrd Amendment) provided for the annual disbursement of funds collected under the Act to the injured party (i.e., the petitioners). This disbursement totaled hundreds of millions of dollars before the Act was repealed.

As noted, Southeast U.S. processors also petitioned for relief from the growing import base. This reflected the fact that not only was the total import base increasing but the composition of the import base was also changing with value-added products comprising an increasing share of the total (Figure 10.18). Imports of peeled raw product, for example, increased from about 300 million pounds (whole weight basis) in 1990 to more than 800 million pounds in the late 2000s. Peeled cooked imports increased from about 60 million pounds (whole weight equivalent) to more than 800 million pounds. Imports of headless shell-on shrimp, by comparison, exhibited a much more modest increase—from about 325 million pounds (whole weight basis) in 1990 to 500–550 million pounds by the late 2000s.

#### 10.3.8.1.3 A Closer Look at the Gulf Shrimp Fishery



Gulf shrimp fishermen target four species of shrimp, including brown (*Farfantepenaeus aztecus*), white (*Litopenaeus setiferus*), pink (*Farfantepenaeus duorarum*), and royal red (*Pleoticus robustus* or *Hymenopenaeus robustus*). Other species of related organisms, such as seabobs (*Xiphopenaeus kroyeri*) and rock shrimp (*Sicyonia brevirostris*), are incidentally harvested. Of the main shrimp species, brown shrimp is the most important to offshore



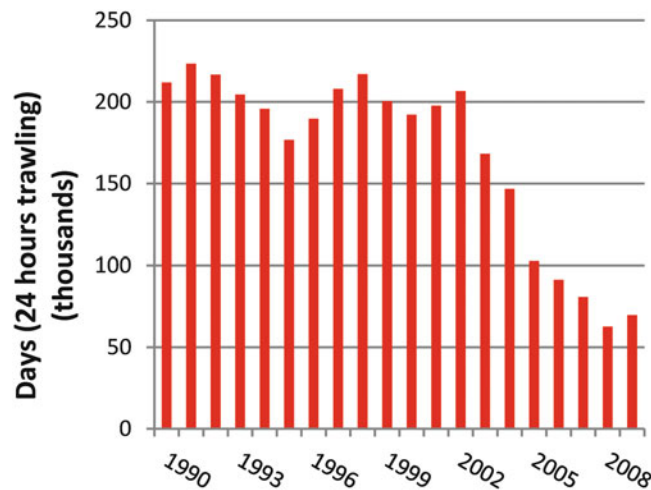
**Figure 10.18. U.S. shrimp imports by product form (whole weight equivalent basis), 1990–2009 (NMFS FSD, data accessed 2012, with weight conversions calculated by authors—see Appendix A) (Note: 1 lb = 0.454 kg).**

harvesters and is primarily caught in waters up to 40 fathoms (73.2 m) from June through October of each year. The white shrimp fishery, which approaches the importance of brown shrimp in terms of catch, typically peaks in the months of August through December. Geographically, however, white shrimp are primarily harvested from nearshore, state waters up to 20 fathoms (36.6 m), thus generally making them the target of smaller vessels. Of the remaining shrimp species, pink shrimp are primarily harvested as a distinct species off of Florida's west coast and in the Florida Keys in waters up to 30 fathoms (54.9 m). Outside Florida waters, pink shrimp are less abundant; if harvested, they tend to be caught while harvesting brown shrimp and are typically included as part of the brown shrimp harvest. Royal red shrimp, a species harvested in waters 140–275 fathoms (256–503 m) deep, are a minor component of the Gulf shrimp fishery. Unlike other shrimp species, which are relatively short-lived and thus considered to be an annual crop, royal reds have a multiple-year life span. While brown, white, and pink shrimp are all subject to capture in state and EEZ waters (depending on the time of year), royal reds are harvested exclusively in the EEZ.

Technologically, the Gulf shrimp fleet employs a wide range of both gear and vessels depending on the species and fishing area being exploited. In terms of gear, harvesters have been known to use cast nets, haul seines, stationary butterfly nets, wing nets, skimmer nets, traps, beam trawls, and otter trawls, with the otter trawl being the primary gear used in offshore and EEZ waters.

### *Shrimp Effort*

Given the large decline in the Gulf of Mexico dockside shrimp price in conjunction with rising fuel prices, shrimp fishermen have been experiencing a cost-price squeeze for some time now. This squeeze was exacerbated in late 2001 when the dockside price fell sharply and this decline lasted for a protracted period of time (see Keithly and Poudel 2008 for additional details). Given this cost-price squeeze, it should come as no surprise that effort in the fishery has fallen. The decline in offshore effort (defined as outside the Collision Regulation [COL-REG] lines), measured in terms of 24-h days fished, is given in Figure 10.19 for the 1990–2009



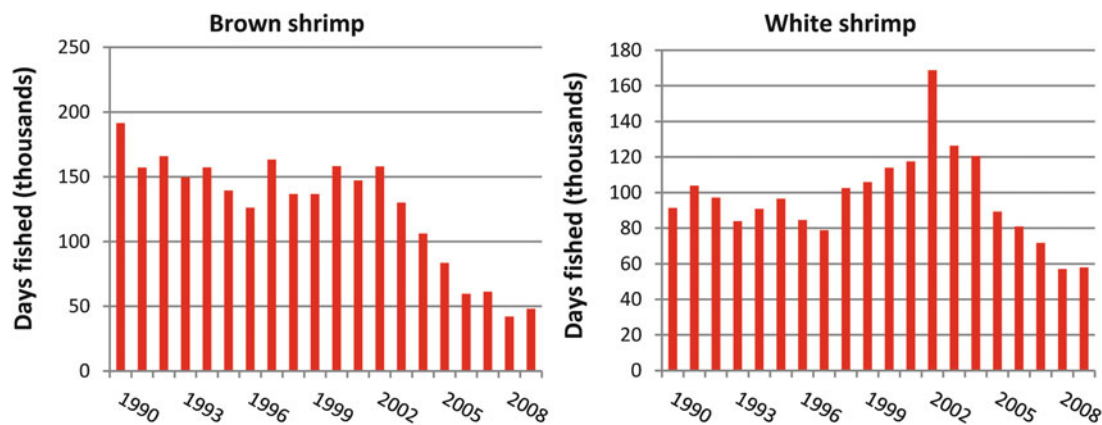
**Figure 10.19. Estimated offshore effort (24-h days fished) by the Gulf of Mexico offshore shrimp fleet, 1990–2009 (NMFS Galveston Laboratory, personal communication, 2012—see Appendix A).**

period. As indicated, total offshore effort approached or exceeded 200,000 days fished per year throughout the 1990s. Since 2003, however, effort has fallen sharply and in recent years, has been less than 70,000 days per year. Overall, effort in recent years has only been about one-third to one-half of the observed effort throughout the 1990s. Analysis by Nance et al. (2006) examines the relationship between catch and effort in the offshore component of the Gulf of Mexico shrimp fishery and if their analysis is valid, one can conclude that the current level of effort associated with the offshore component of the fishery is significantly less than what is required to harvest maximum yield. This conclusion, however, needs to be tempered because the treated relationship between offshore yield and effort in their analysis was considered independently of inshore shrimping activities. As the case with respect to offshore effort, inshore effort has also fallen sharply in recent years. Reduction in effort in the inshore component of the fishery would, one might hypothesize, result in increased escapement of the small shrimp to offshore waters and, hence, an increasing abundance of shrimp in the offshore waters. This increased abundance translates into a higher catch per unit of effort in the offshore waters.

A more detailed examination of effort in the two main northern Gulf of Mexico shrimp fisheries—the brown shrimp fishery and the white shrimp fishery—can be made with the aid of Figure 10.20. As indicated, total estimated effort (i.e., inshore and offshore) in the brown shrimp fishery (Grids 7–21)<sup>7</sup> fell from almost 200,000 days annually in the early 1990s to about 160,000 days by the late 1990s/early 2000s (effort is assumed to be directed at a particular species if at least 90 % of that trip's catch comprises that particular species). Thereafter, in association with the sharp decline in shrimp price and increasing fuel costs, effort fell precipitously to less than 50,000 days in recent years.

A somewhat different picture emerges when one examines total effort (i.e., inshore and offshore) white shrimp effort (Figure 10.20, right panel). As indicated, effort associated with this fishery showed a large increase in the mid-1990s to early 2000s with an abnormally high number of days fished being reported in 2002 (169,000 days). Thereafter, however, effort fell sharply to about 60,000 days in recent years. This decline in effort coincided with a period of increasing white shrimp harvest indicating a significant increase in the catch per unit effort.

<sup>7</sup> See Figure 10.29 for a listing of grids.



**Figure 10.20.** Directed shrimping effort on brown (*left panel*) and white shrimp (*right panel*) fisheries (grids 7–21), 1990–2009 (NMFS Galveston Laboratory, personal communication, 2012—see Appendix A).

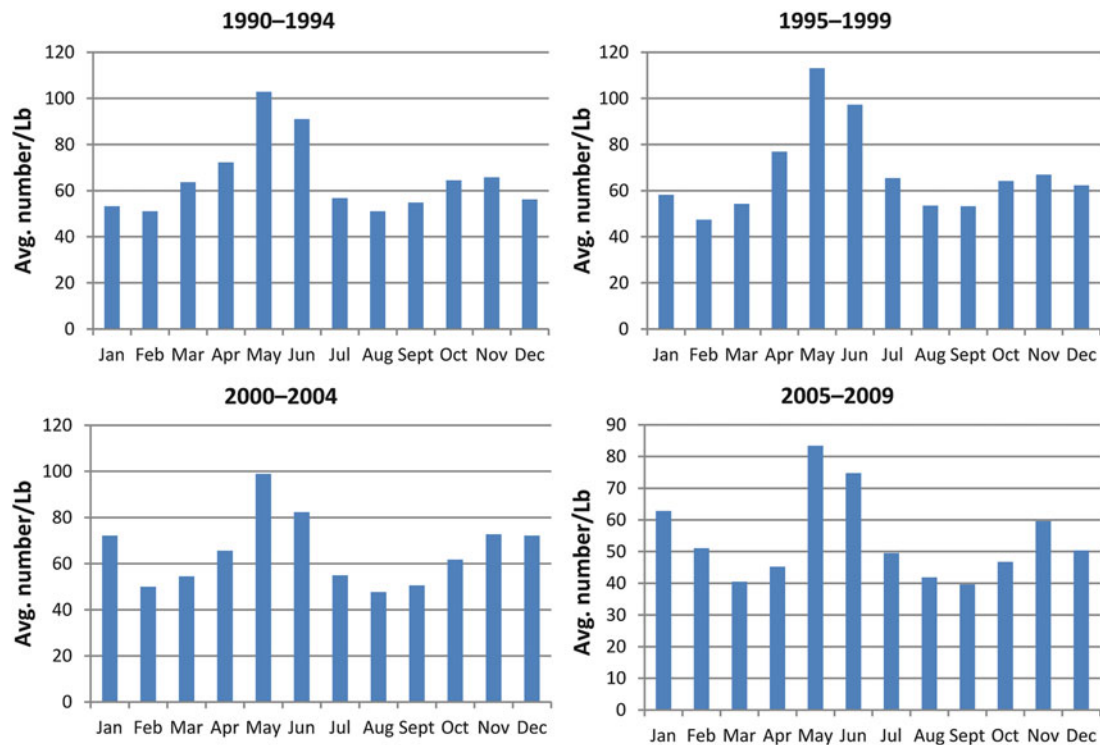
As noted by Liese and Travis (2010), vessels fishing for *Penaeid* shrimp in the federal waters of the Gulf of Mexico were required to have a permit as of December 5, 2002. Subsequently, a moratorium was placed on the issuance of new permits and, according to unpublished NMFS records, a total of 1,907 vessels were permitted under the Gulf shrimp moratorium permit in 2009 (i.e., the upper-bound estimate of the number of vessels that would be legally allowed to shrimp in the federal waters of the Gulf of Mexico). Of this total, 693 of the vessels, or more than one-third of the total, were home-ported in Texas. Louisiana ranked second (545 permits; 29 %), followed by Florida (278 permits; 15 %), Mississippi (164 permits), and Alabama (149 permits). While the number of permits equaled about 1,900 in 2009, Liese and Travis (2010) report that only about 1,215 of these actively harvested shrimp in 2009.

In addition to those vessels holding a Gulf shrimp moratorium permit, which is required for shrimping in federal waters, a large number of boats shrimp only in the state waters. Based on state license sales, Miller and Isaacs (2011) estimate that the population of inshore shrimpers, excluding those that had a Gulf shrimp moratorium permit, approximated 3,765 in 2009. About 60 % of the licenses were issued in Louisiana while another 14 % and 12 % were issued in the states of Texas and Alabama, respectively.

#### *Shrimp Size at Harvest*

The size of shrimp at harvest varies significantly throughout the year and can vary over time as a result of environmental factors, dates associated with opening inshore waters, the amount of fishing pressure, where the fishing pressure is centered, or some amalgam. Cold weather, for example, can retard the growth of brown shrimp, which may yield a smaller size at harvest, all other factors being equal. Similarly, declining fishing pressure may provide the shrimp additional time to grow which would yield a larger average size at harvest (assuming all other factors are the same). The estimated average size of shrimp for four time periods—1990–1994, 1995–1999, 2000–2004, and 2005–2009—by month is given in Figure 10.21. As indicated, shrimp size is consistently smallest in May (i.e., a larger number of shrimp to the pound), associated with movement of brown shrimp from the estuaries and the opening of the inshore fishery in the northern Gulf States. The average size then increases (as the brown shrimp grows and moves offshore) until September/October when white shrimp show up in significant quantities.

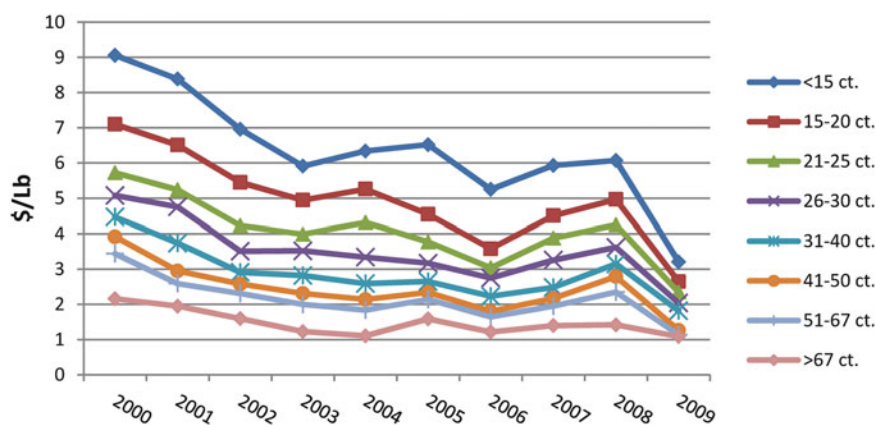




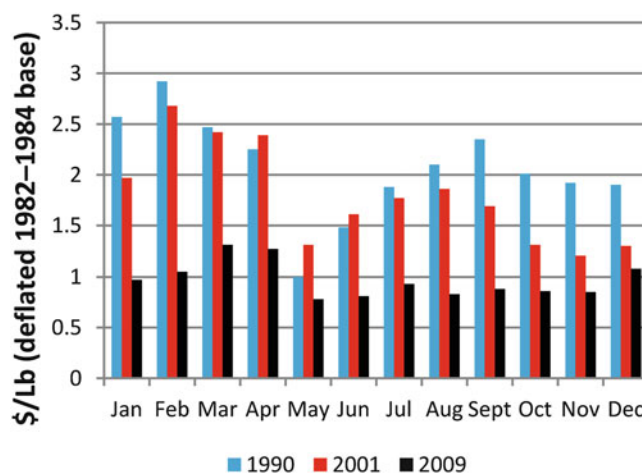
**Figure 10.21. Estimated average size of shrimp at harvest (headless), by month, selected 5-year periods (NMFS Galveston Laboratory, personal communication, 2012, with calculations by authors—see Appendix A) (Note: 1 lb = 0.454 kg).**

The apparent increase in average shrimp size (i.e., fewer shrimp to the pound), particularly after the 1995–1999 period is of interest as well. For example, the estimated average number of shrimp to the pound (headless) in May during 1990–1994 was estimated to equal 102 and increased to 113 during 1995–1999. During the May 2000–2004 period, the average declined to 98 and declined again to 85 during the 2005–2009 period. For September (roughly when white shrimp begin to move), the averages for the four 5-year periods are 55, 53, 50, and 40, respectively. The increasing shrimp size (i.e., fewer shrimp to the pound) has been particularly pronounced during the most recent 5-year period when the monthly trend held for all months but February. While not formally tested, one plausible explanation for the changing shrimp size over the period of analysis is the large reduction in effort during recent years (Figs. 10.19 and 10.20).

Size of shrimp at harvest is an important consideration for at least two reasons. First, the price the shrimper receives for his harvested product is directly related to the harvested size with smaller shrimp commanding a lower price. Second, an increase in the average shrimp size at harvest (i.e., fewer shrimp to the pound) can translate into increased harvest in the aggregate assuming natural mortality is low relative to the gains in weight that could be achieved by allowing the shrimp to grow to a larger size prior to harvest. The relationship between size of shrimp and price received on an annual basis for the 2000–2009 period is given in Figure 10.22. As is illustrated by the information in the figure, prices (undeflated) of all shrimp sizes fell during the 2000–2009 period. Furthermore, the price declines are particularly pronounced (in terms of the absolute dollar decline) for the larger-sized shrimp (i.e., smaller count to the pound). With respect to the under 15 count (i.e., less than 15 shrimp to the pound),



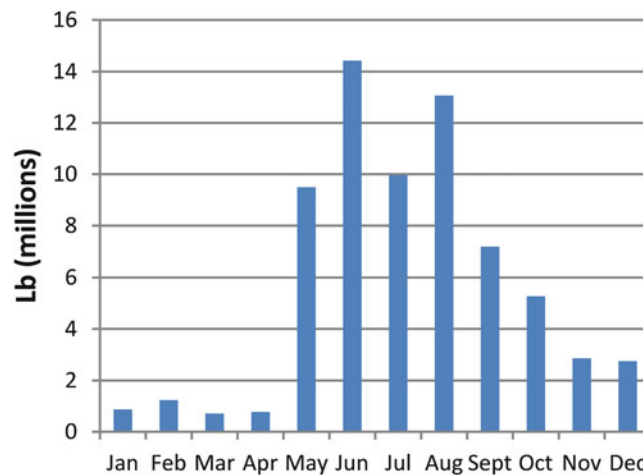
**Figure 10.22.** Average annual shrimp prices per pound (current) by size category (NMFS Galveston Laboratory, personal communication, 2012–see Appendix A) (Note: 1 lb = 0.454 kg).



**Figure 10.23.** Gulf dockside price by month for selected years (prices deflated based on 1982–1984 Consumer Price Index [CPI]) (NMFS Galveston Laboratory, personal communication, 2012, with price calculations by authors—see Appendix A) (Note: 1 lb = 0.454 kg).

the unadjusted price fell from about \$9.00 per pound to \$4.00 per pound, or by about \$5.00 per pound. The 51–67 count size price, by comparison, fell by only \$1.75 per pound from \$3.44 in 2000 to \$1.69 in 2009. In all size categories, overall, the price decline between 2000 and 2009 ranged from about 45 to 55 %.

With a change in average size of shrimp harvested throughout the year comes a change in price. This is illustrated in Figure 10.23 for selected years. As indicated, price is consistently lowest in May when the average size of shrimp is smallest (see Figure 10.21) and inland waters are opened. As the brown shrimp grow and move offshore, the average price tends to increase through August. Associated with the opening of the inshore waters to white shrimp in late August, the price of shrimp begins to decline. The relatively high prices in months prior to the opening of the inshore waters to brown shrimp fishing in May (i.e., January through April) to a large extent represent the harvest of large, overwintering white shrimp.



**Figure 10.24. Gulf of Mexico brown shrimp harvest by month, 2005–2009 average (NMFS Galveston Laboratory, personal communication, 2012, with calculations by authors—see Appendix A) (Note: 1 lb = 0.454 kg).**

The information in Figure 10.23 also points to some other price features meriting discussion. First, note that the sharp differential between the 2001 monthly prices and the 1990 monthly prices beginning in September and continuing throughout the remainder of the year. This sudden and sharp price differential reflects the terrorist attack of September 11, 2001 and subsequent recession. Second, the 2009 monthly prices are well below either the 1990 or 2001 deflated prices. Finally, as indicated, there is considerably less price variation by month in the 2009 prices than in either the 1990 or 2001 prices; consistent with a narrowing of the price differential between the large and small shrimp as observed in Figure 10.22.

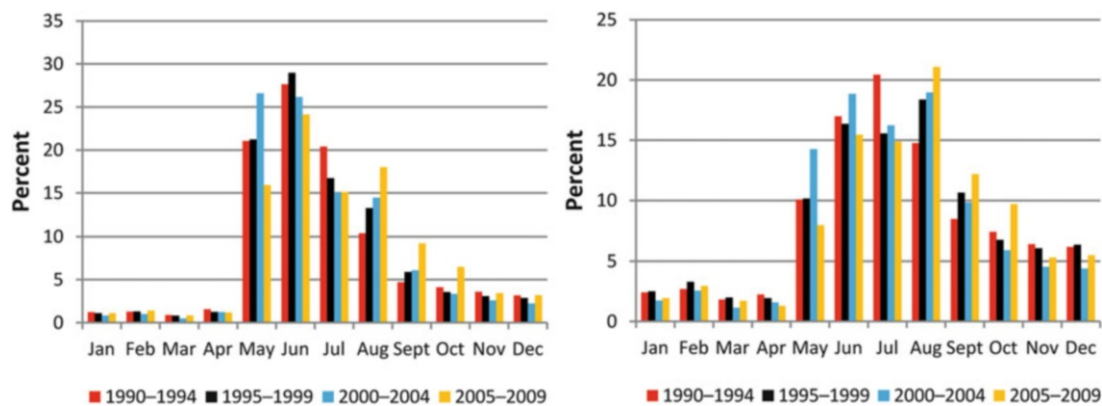
#### *Harvested Species*

Two species, brown shrimp and white shrimp, as noted, dominate the commercial harvest of shrimp. This is particularly true in the northern and western Gulf. Both of these species tend to be seasonal in nature, and harvest is directly related to their growth and migration patterns. The seasonal nature of harvest of brown shrimp, based on the 2005–2009 period, is illustrated in Figure 10.24. Harvest tends to be small until May, which coincides with emigration of the brown shrimp from the estuaries to deeper waters and the opening of the inshore waters in the northern Gulf States. On average, 9.3 million pounds of brown shrimp were harvested in the month of May during 2005–2009, and this increased to 14 million pounds in June. Coinciding with the opening of Texas waters to shrimping, brown shrimp catch, in pounds, increased once again in August and then fell through the remainder of the year.<sup>8</sup>

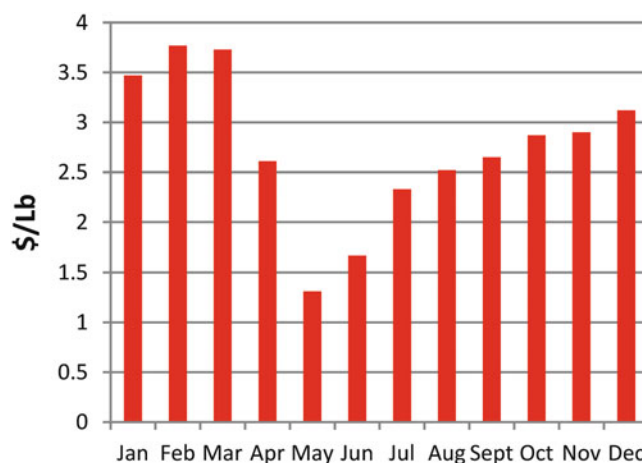
Production (pounds) of brown shrimp by month for selected time periods during 1990–2009, expressed on a percentage basis, is given in Figure 10.25 (left panel). In general, the monthly production pattern is relatively consistent across the four 5-year time periods considered. One significant difference, however, is observed in the most recent 5-year period (2005–2009).

<sup>8</sup> In an effort to protect juvenile brown shrimp and thereby increasing shrimp yield, waters off the Texas coast and seaward to 200 mi (322 km) are closed each year from approximately May 15 to July 15.





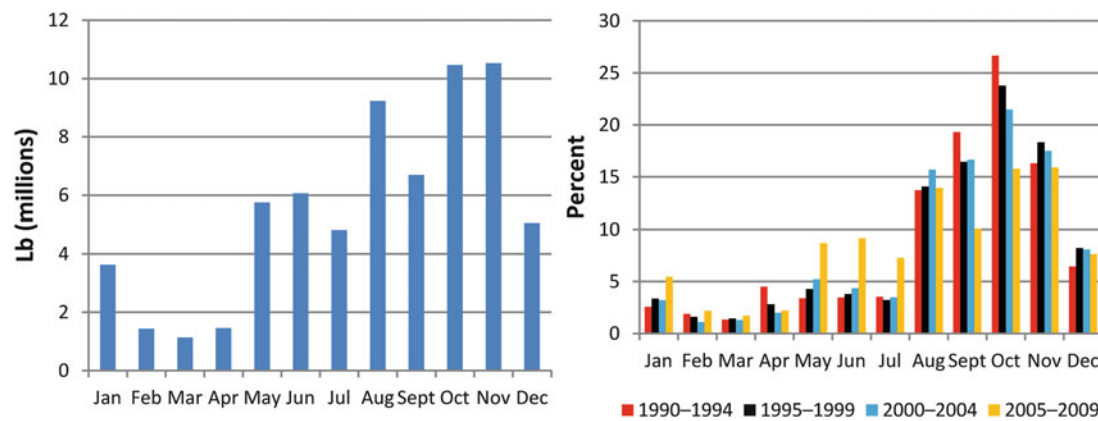
**Figure 10.25.** Gulf of Mexico brown shrimp harvest by month (pounds, *left panel*; value, *right panel*) expressed on a percentage basis for selected time periods, 1990–2009 (NMFS, Galveston Laboratory with calculations by authors; data 2012—see Appendix A).



**Figure 10.26.** Gulf of Mexico brown shrimp price by month, 2005–2009 average (NMFS Galveston Laboratory, personal communication, 2012, with calculations by authors—see Appendix A) (Note: 1 lb = 0.454 kg).

In this period, the harvest of brown shrimp appears, to some extent, to be delayed. For example, May harvest, expressed on a percentage basis, was significantly lower than in other 5-year periods while harvests in the later months (August through October) were higher than in other periods. This delayed harvest may reflect the declining effort on the stock (Figure 10.20, left panel), which provides the brown shrimp stock additional time to grow.

While May and June tend to be the peak months in terms of poundage of brown shrimp harvest, peak value from the harvest tends to be in July and August (Figure 10.25, right panel). The observed difference in monthly poundage and value patterns is the result of larger brown shrimp being harvested in the later months and the increased price per pound for the harvested product. This price pattern is presented in Figure 10.26 for the 2005–2009 period. As indicated, the May brown shrimp price during 2005–2009 averaged less than \$1.50 per pound. Coinciding with an increased size at harvest, the brown shrimp price increased rapidly reaching \$3.00 per pound by the end of the year.



**Figure 10.27. Gulf of Mexico average monthly white shrimp production for 2005–2009 (left panel) and production by month, expressed on a percentage basis, selected periods (right panel) (NMFS Galveston Laboratory, personal communication, 2012, with calculations by authors—see Appendix A) (Note: 1 lb = 0.454 kg).**

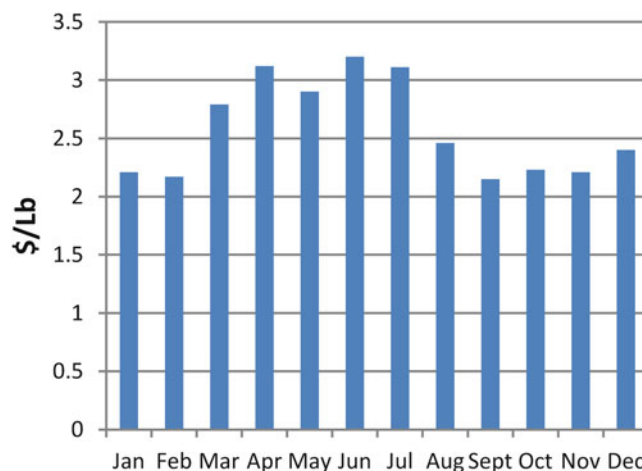
The U.S. Gulf of Mexico white shrimp harvest has, overall, been increasing during the 1990–2009 period. For example, in 1990–1994, annual production of white shrimp averaged about 40 million pounds (heads off). By 1995–1999, the average had increased again to 42 million pounds and increased sharply to 58 million pounds in 2000–2004. Annual production of white shrimp in 2005–2009, averaging 66 million pounds, exceeded that of 1990–1994 by about 65 %.

While not as distinct as for brown shrimp, there is also a seasonal pattern to the Gulf white shrimp harvest. During 2005–2009, for example, Gulf landings of white shrimp averaged 66 million pounds (heads off). While brown shrimp catch is predominant in the 3-month period ending in August, the Gulf white shrimp catch tends to be highest in the months of August through November (Figure 10.27, left panel). This pattern is relatively consistent back to the 1990–1994 period, although the most recent 5-year period indicates a higher proportion being harvested in the May–July period at the expense of later months.

The higher proportion of white shrimp catch in the earlier months (May through July) may well reflect the increased catch of overwintering white shrimp. Specifically, with significantly less white shrimp fishing effort in recent years, an increasing proportion of the shrimp stock produced in a given year escapes catch in that year and is available for harvest in the subsequent year. This hypothesis is, to some extent, supported by examination of monthly white shrimp dockside prices (Figure 10.28). Specifically, the monthly white shrimp dockside prices tend to be relatively high in the earlier months suggesting larger shrimp that escaped harvest in the previous year. While one might argue that this price effect may be the result of low quantities being harvested in these earlier months, this argument is likely fallacious for two reasons. First, there are large quantities of brown shrimp landed in the May–July period that represent a close substitute for the white shrimp product. Second, as discussed later in this chapter, large changes in Gulf landings appear to have little influence on the Gulf dockside price due, largely, to the large import base.

#### *Harvest by Depth and Movement of the Fleet*

There are two general classes of shrimp vessels in the Gulf of Mexico—those that fish primarily in the inshore waters and those that fish primarily in the offshore waters. Smaller

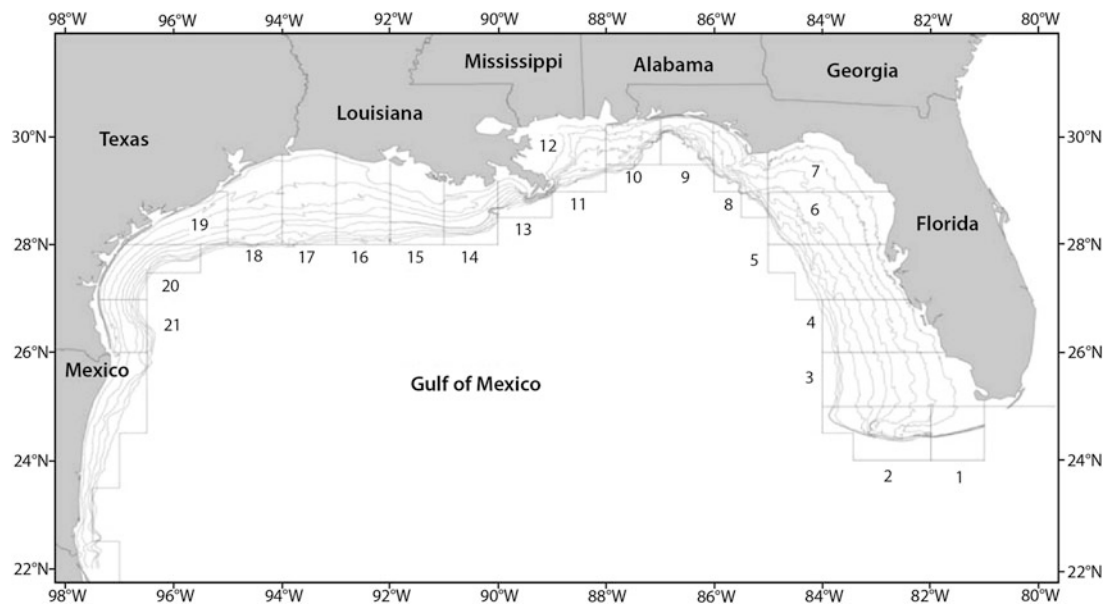


**Figure 10.28.** Gulf of Mexico average monthly dockside white shrimp price, 2005–2009 average (NMFS Galveston Laboratory, personal communication, 2012, with price calculations by authors—see Appendix A) (Note: 1 lb = 0.454 kg).

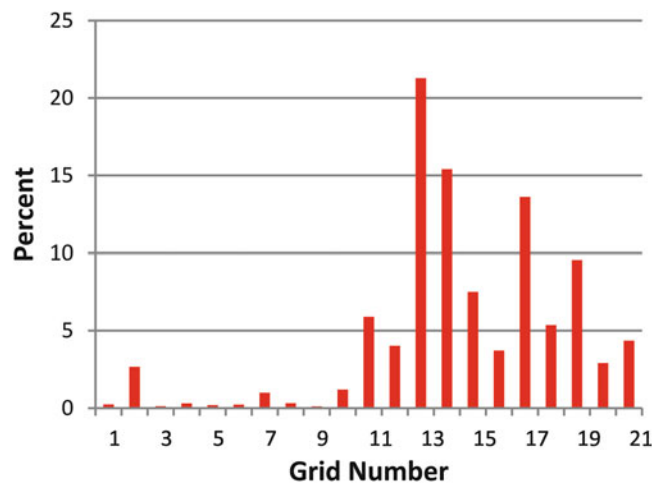
vessels, as one would expect, tend to shrimp primarily inshore while large vessels shrimp primarily offshore. The larger, offshore vessels are required to have a moratorium permit to shrimp in federal waters. According to Liese and Travis (2010), this segment of the harvesting sector accounted for two-thirds of the poundage harvested, and with the larger-sized shrimp harvested offshore, over three-quarters of the dockside revenue was generated in the fishery.

Geographical information covering the spatial distribution of catch, effort, and other critical variables for the management of the shrimp fishery are collected by the NMFS. This geographical information has three major components: a harvesting location defined on a statistical grid of longitude and latitude, a harvesting depth based on the fathom zone where harvesting was reported, and a record that identifies the port where the harvest was landed. The statistical grids are roughly defined as 1° longitudinal or latitudinal areas that project from shore out to 50 fathoms (91.4 m). Twenty-one of these grids occur in the U.S. Gulf of Mexico territorial waters. The fathom zones are defined as intervals of water depth in 5-fathom (9.1-m) increments from the U.S. shoreline out to 50 fathoms (91.4 m). Given the bathymetry of the continental shelf in the northern Gulf of Mexico, the overlap of these two measures generates a maximum of 210 statistical subareas to which harvesting activity, and thus landings, are assigned during data collection (Figure 10.29).

Because the larger Gulf shrimp vessels can traverse a large geographic area in the harvesting of shrimp, the area where shrimp is caught does not necessarily reflect where it is eventually landed and thus, while landings by state were considered earlier in this chapter, it is also useful to consider catch by area. The estimated 2005–2009 annual catch by grid, expressed on a percentage basis, is given in Figure 10.30. Relatively little catch occurs along the Florida coast with the exception of grid 2 which represents the primary fishing grounds for pink shrimp. More than one-third of the total Gulf shrimp catch, by comparison, is estimated to be derived from two grids off of the coast of Louisiana (13 and 14) where both brown and white shrimp dominate the catch. All of the grids off the coast of Louisiana (13–17) account for about 60 % of the total shrimp catch, in pounds, during the 2005–2009 period. This catch, in percentage terms of the Gulf total, is about twice as high as the percentage of 2009 active shrimp moratorium permits registered to Louisiana home-ported vessels. While more than one-third



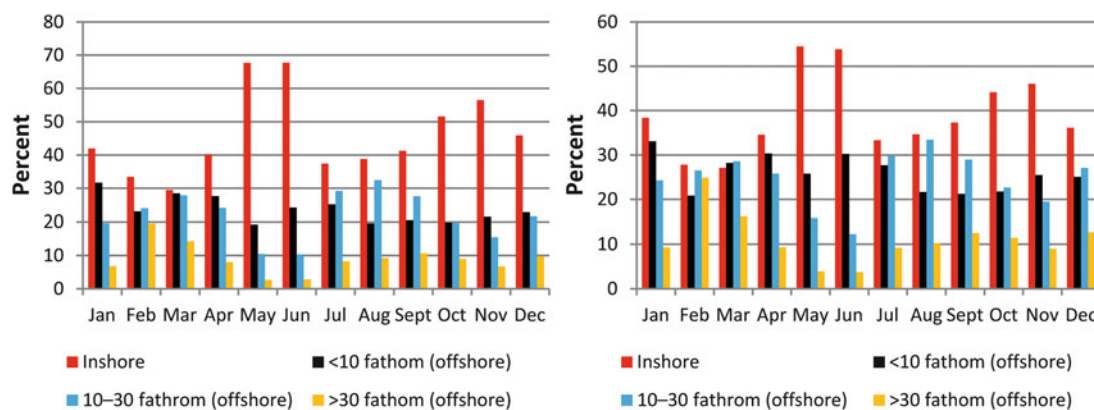
**Figure 10.29. Relationship of 1° longitude/latitude statistical grids with fathom zones in the northern U.S. Gulf of Mexico (Nance et al. 2006).**



**Figure 10.30. Estimated shrimp catch by grid, 2005–2009 average (NMFS Galveston Laboratory, personal communication, 2012, with calculations by authors—see Appendix A).**

of the 2009 active shrimp moratorium permits were associated with vessels home-ported in Texas, catch in the grids associated with waters off the coast of Texas (grids 18–21) represented just 22 % of the total shrimp catch, in pounds, during 2005–2009.

There are several explanations as to why there is relatively high shrimp catch off the Louisiana coast, in pounds, relative to active shrimp moratorium permits issued to vessels home-ported in the state and conversely, why there is a relatively high number of active shrimp moratorium permits issued to Texas-based vessels relative to catch off of the Texas coast. The first explanation is that Texas vessels tend to be larger than Louisiana vessels and travel greater

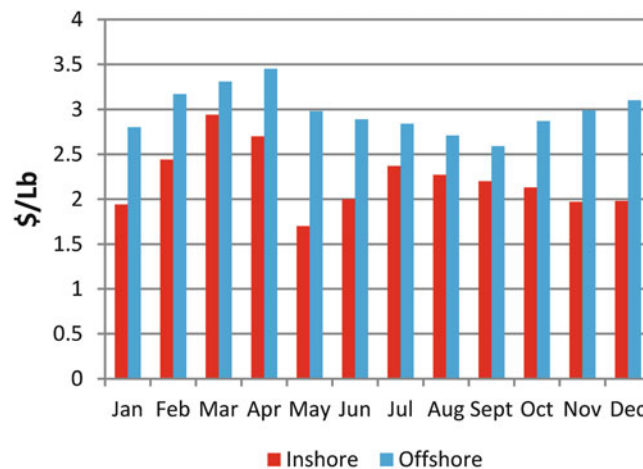


**Figure 10.31. Average monthly percentage of Gulf shrimp catch from inshore and offshore waters on the basis of pounds (*left panel*) and value (*right panel*), 2005–2009 (NMFS Galveston Laboratory, personal communication, 2012, with percentage calculations by authors—see Appendix A).**

distances. Ran et al. (2008) report that most of the vessels home-ported in Texas had statistical grids 14–21 as their harvesting destination, which of course includes Louisiana waters. However, according to Ran et al. (2008), Louisiana vessels only infrequently fish in the waters off the Texas coast. A second explanation is that while the catch from waters off the Texas coast, expressed in pounds, equaled only 22 % of the Gulf total catch during 2005–2009, Texas manages for a larger-sized shrimp than Louisiana which, as such, commands a price premium. Estimated catch off the Texas coast during 2005–2009, expressed on a value basis, was in excess of one-quarter of the Gulf total. Finally, while Louisiana's offshore fleet is smaller than that of Texas, in terms of the number of permitted vessels, Louisiana has a much larger inshore fleet that harvests a large amount of shrimp from its inshore waters.

Average monthly catch by depth, expressed on a poundage basis, is given for the 2005–2009 period and provided in Figure 10.31 (left panel). Similar information, expressed on a value of catch basis, is given in Figure 10.31 (right panel). As indicated, catch from inshore waters consistently represents the largest proportion of catch during each month and, in general, catch decreases with depth. Furthermore, the proportion of catch from inshore waters is directly related to the opening of the bays in association with the growth and movement of brown and white shrimp. For example, catch from inshore waters, in pounds, tends to be 40 % or less and then increases to almost 70 % in May associated with the opening of the spring season (i.e., brown shrimp season) in the northern Gulf States. As the brown shrimp grow and migrate to deeper waters, catch from inshore waters declines until the inshore waters open again in the fall for white shrimp season. By comparison, monthly shrimp catches in the less-than-10-fathom (18.3-m) offshore zone consistently fell in the narrow range of 20–30 %. Finally, with the exception of February and March, catch outside the 30-fathom (54.9-m) zone generally equaled 10 % or less.

A similar pattern to that observed for pounds emerges when one considers monthly values of catch by depth (Figure 10.31, right panel). However, the dominance of the inshore catch is lessened because the average size of shrimp caught from inshore waters tends to be smaller than that caught from offshore and, as such, commands a lower price. A comparison of inshore and offshore average monthly prices, based on 2005–2009 catches, is presented in Figure 10.32. As indicated, the May price differential (\$1.28 per pound) is the largest, reflecting the opening of the inshore waters in Louisiana (which accounts for the largest proportion of the inshore catch) and the targeting of very small brown shrimp in the local bays and estuaries. The price



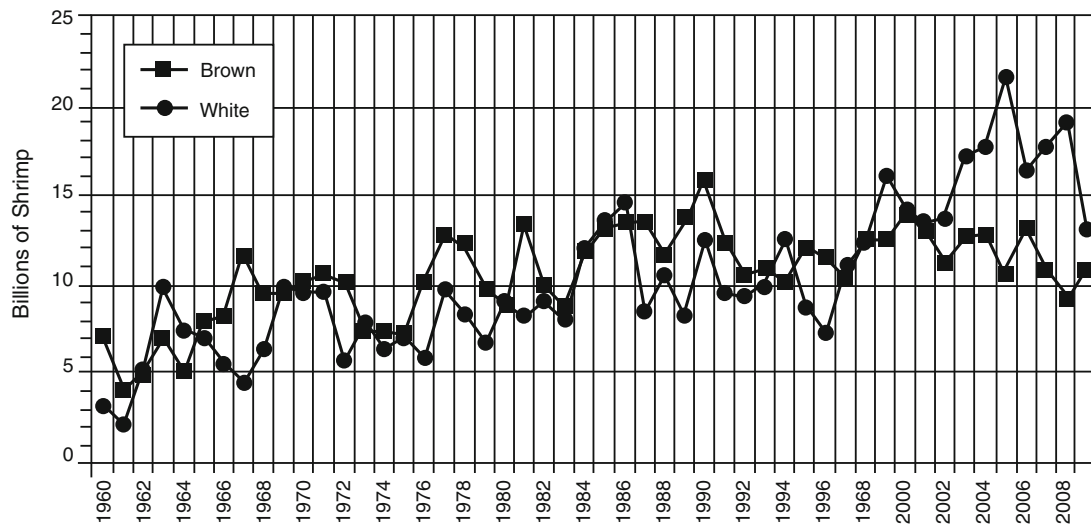
**Figure 10.32.** Average monthly shrimp prices for catch from inshore and offshore waters, 2005–2009 average (NMFS Galveston Laboratory, personal communication, 2012, with price calculations by authors—see Appendix A) (Note: 1 lb = 0.454 kg).

differential then decreases again through September after which it increases to more than \$1.00 per pound by November.

Because of the diversified product (size category) mixes that bring very different market prices, shrimp harvesters can be considered as multiproduct firms. As such, one might expect the harvesters to be responsive to market signals subject to their technological and resource abundance constraints. Ran et al. (2008) examine this issue by determining to what extent harvesting effort and shrimp harvests by size category change in response to changing relative prices, while at the same time controlling for various seasonal influences that might affect the size distribution of shrimp stocks. Their analysis indicates that shrimp harvesters apparently have some ability to allocate effort across shrimp size categories in response to relative market prices, and harvesting effort is statistically targeted at low-count (large) shrimp size categories both due to their own-price and because of changing relationships with the price of other size categories. In addition, the majority of middle-sized shrimp appear to be harvested as a residual in the overall pursuit of large and small shrimp. While the harvest of these shrimp is dependent on the effort expended, the supply-response to effort changes tends to be lower than that observed for large- and small-sized shrimp. Ran et al. (2008) also found there to be some discernible differences between the supply elasticities of the nearshore waters and the deeper, offshore water fishery, with the supply generated by the deeper, offshore water fleet being more responsive to changes in effort, particularly with respect to the largest and smallest size categories.

Ran et al. (2011) examine those factors that influence location choice by vessels in the offshore fleet during two 5-year periods: 1995–1999 and 2000–2004. Factors found to influence location choice include expected revenues, attitudes towards risk, and fuel costs. The most important factor, however, is past experiences among the shrimpers at specific harvesting locations. Specifically, as noted by Ran et al. (2011) “. . .the behavioral inertia associated with changing fishing sites, perhaps due to lack of information or habit persistence, made harvester reluctant to change fishing location from one trip to the next (p. 41).” The authors conclude that because of changing economic conditions in the fishery (i.e., the deterioration of profits), behavior of the fleet has changed with some of the shrimpers becoming more risk averse.





**Figure 10.33.** Estimated annual recruitment of brown and white shrimp into the Gulf of Mexico shrimp fishery, 1960–2009 (Nance 2011).

#### *Variability in Shrimp Populations and Harvests*

It is well known that fish populations and, to a lesser extent, subsequent harvests can vary significantly from one year to the next and that much of this variation is the result of environmental factors. Year-to-year variations can be particularly pronounced for species supported by a relatively few year classes since variations in recruitment are not *smoothed out* by older year classes. Given the short life span of brown and white shrimp, it should come as no surprise that annual populations and harvests vary substantially from year to year.

Fish populations are not directly observed which makes determination of populations difficult. One method is to estimate populations based on fishery-independent sampling of the population. Another method, which has historically been employed by the NMFS to estimate recruitment and adult shrimp populations, is based on virtual population analysis (VPA), details of which are provided by Nichols (1986). Based on this analysis, estimated Gulf of Mexico brown and white shrimp recruitment for the 1960–2009 period is given in Figure 10.33. After generally increasing from 1960 to 1990, brown shrimp recruitment fell during the next several years with the 2000 value of 14 billion recruits approximating those numbers estimated for the late 1980s. The 2009 estimated recruitment of 10.7 billion brown shrimp was approximately 15 % above the 2008 estimated recruitment of 9.25 billion shrimp. While no discernible long-term trend in estimated brown shrimp recruitment has been observed since the late 1980s, annual variation is shown to be large with year-over-year changes of 15–20 % not being uncommon.

Like brown shrimp, estimated recruitment of white shrimp showed significant variation over time with a range from 7.3 billion shrimp in 1996 to 21.5 billion shrimp in 2005. Estimated recruitment in 2008 of 19 billion shrimp exceeded the 2009 estimated recruitment of 13.1 billion shrimp by 45 %. Overall, estimated annual recruitment since the mid-1990s appears to be significantly higher than the long-term average though, as indicated, annual variation is also large.

Given the large annual variation in estimated recruitment of brown and white shrimp, it is no surprise that large variations are also observed in estimated (via VPA) parent populations

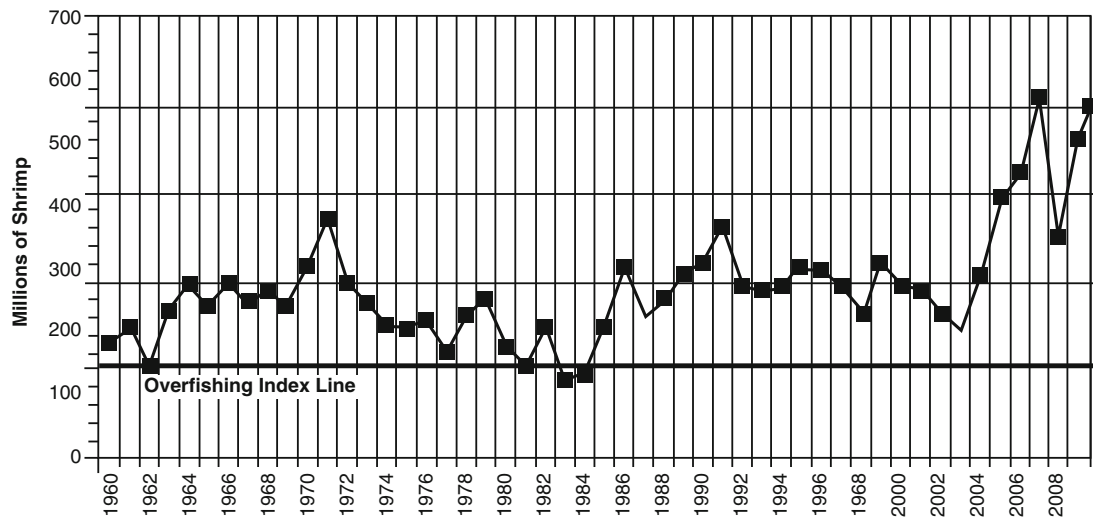


Figure 10.34. Estimated Gulf of Mexico brown shrimp parent population, 1960–2009 (Nance 2011).

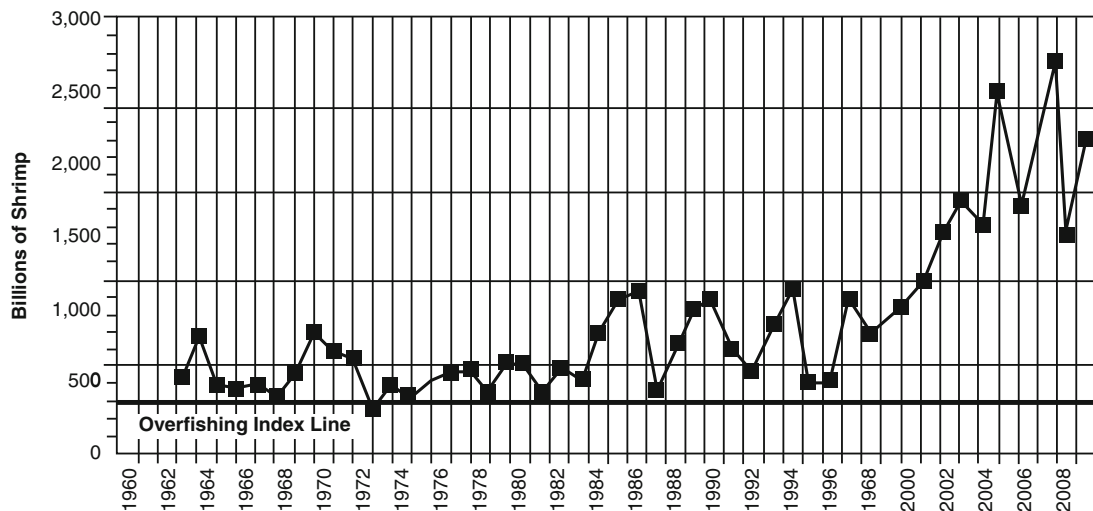


Figure 10.35. Estimated Gulf of Mexico white shrimp parent population, 1960–2009 (Nance 2011).

(Figs. 10.34 [brown shrimp] and 10.35 [white shrimp]). As indicated, the estimated brown shrimp parent population (defined as over 7 months of age during November–February) increased significantly in recent years but with large annual variations. For example, the estimated parent population in 2005 (approximately 400 million shrimp) exceeded the 2004 estimate (approximately 300 million shrimp) by 33 %. Similarly, the 2007 estimate (approximately 500 million) exceeded the 2008 estimate (approximately 350 million) by about 50 % with the 2009 estimate (approximately 500 million) exceeding the 2008 estimate by about 150 million shrimp.

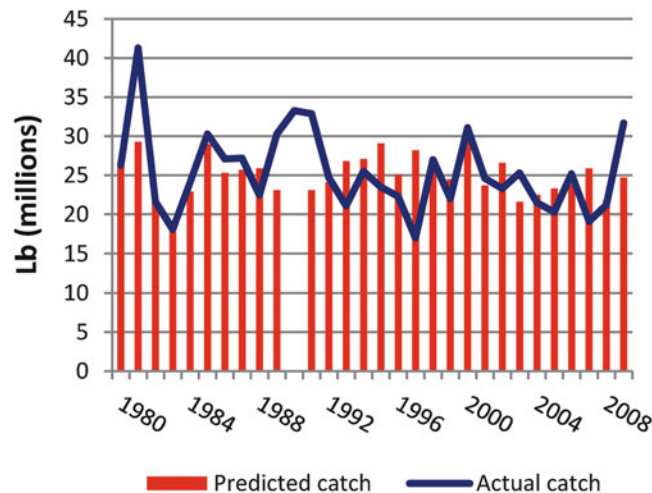
The estimated white shrimp parent population clearly showed an increasing trend since the late 1990s. Nance (2011) hypothesizes that this is related to an increase in the number of overwintering white shrimp (while not stated by Nance, this is likely the result of a decline in white shrimp effort; see Figure 10.20). Like brown shrimp, the estimated population of white shrimp parents can vary substantially from one year to the next with percentage changes of



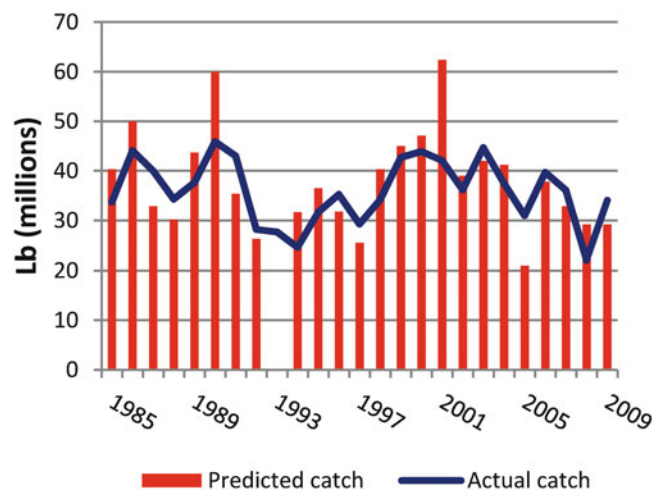
more than 20 % not being uncommon, particularly in later years. For example, the estimated white shrimp parent population increased from about 1.6 billion in 2005 to more than 2.5 billion in 2006, or by more than 50 %, before falling to about 1.7 billion the following year. Similarly the change between 2008 and 2009 (from approximately 2.1–2.7 billion) represents a nearly 30 % increase.

A comparison of the information in Figure 10.33 with that in Figs. 10.34 and 10.35 gives an indication of the high shrimp natural (and/or harvest) mortality from time of recruitment until parent stage. For example, while the estimated recruitment of brown shrimp generally exceeded 10 billion shrimp in recent years (Figure 10.33), the parent population has generally fallen in the 200–500 million range (Figure 10.34). While a portion of the decline can be explained by the harvest of juvenile shrimp, the majority is undoubtedly the result of high natural mortality.

While there is no routine sampling of harvestable shrimp to determine population, the NMFS (Galveston Laboratory) forecasts western Gulf of Mexico brown shrimp production for the upcoming year (July–June) via two methods. The first method, referred to as the Baxter Bait Index, is based on the monitoring of the Galveston Bay bait shrimp fishery from late April to mid-June. The second method, referred to as The Environmental Model, uses a suite of variables (Galveston air temperature during mid-April, rainfall during early March, and bay water height during late April/early May) to predict brown shrimp production from Texas waters. The Baxter Bait Index is considered to be the more reliable of the two forecasts. Figure 10.36 shows a comparison of predicted annual harvests (July–June) based on the Baxter Bait Index and actual annual harvests for the 1980–2009 period. The correlation between the predicted and actual values (excluding 1990 for which no prediction was made) is a relatively low, 0.37. As indicated, the predicted harvest ranged from below 20 million pounds (1983) to 30 million pounds (2000) while the actual harvest ranged from less than 20 million pounds (2007) to more than 40 million pounds (1982). The average predicted harvest averaged 25 million pounds, which was also the average annual harvest during the considered period. The relatively low correlation between predicted harvest and actual harvest is likely largely driven by unpredictable changes in natural mortality and growth of the shrimp between the time of



**Figure 10.36.** Texas offshore brown shrimp catch predictions (July–June) based on Galveston Bay bait index values in relation to actual catch, 1980–2009 [NMFS (Galveston Laboratory) 2012] (Note: 1 lb = 0.454 kg).



**Figure 10.37. Louisiana inshore and offshore brown shrimp catch predictions (May–April) based on May catch index value and actual catch, 1985–2009 [NMFS (Galveston Laboratory) 2012] (Note: 1 lb = 0.454 kg).**

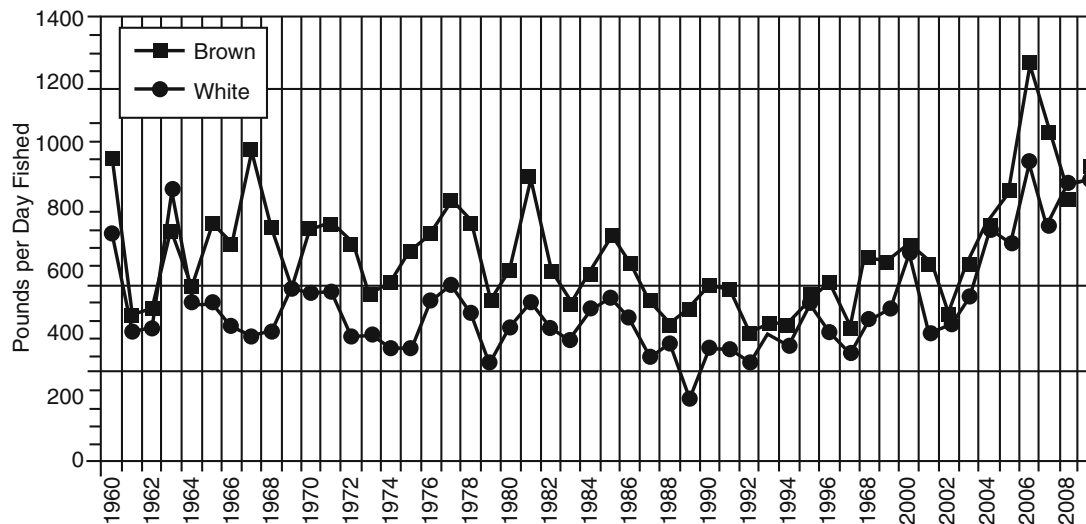
monitoring in the bays (late April to mid-June) and the time that the shrimp move offshore and become susceptible to harvest by the Texas fleet.

Louisiana's brown shrimp catch (inshore and offshore) is also predicted for the biological year (May–April) based on catch information from Louisiana's inshore and offshore fisheries in May. These predictions for 1985–2009 along with subsequent harvests are presented in Figure 10.37. As indicated, the use of May's catch to forecast the biological year's catch is, with some notable exceptions, relatively accurate (correlation 0.72) with most turning points being correctly predicted. Thus, one can conclude that a single month's catch early in the season can provide meaningful information that can be used in predicting catch for the biological year (May–April). Finally, as indicated, there is considerable year-to-year variation in both the predicted and actual Louisiana brown shrimp catch.

The large annual fluctuations in brown and white juvenile shrimp can, of course, translate into large annual variations in harvests. However, the mapping of shrimp from the juvenile stage to either the adult stage or harvest is less than monotonic because of the large number of environmental factors that can influence the survival and growth of shrimp throughout their successive life stages. These environmental factors have been examined by a large number of researchers (see, for example, Haas et al. 2001 for brown shrimp and Diop et al. 2007 for white shrimp and references contained therein). Annual variations in harvest for the two species are clearly identified in Figure 10.38.

#### *Catch per Unit Effort*

Large variations in year-to-year and long-term shrimp abundance (Figures 10.33, 10.34, and 10.35) and long-run changes in effort (Figure 10.20) translate into short-run and long-run changes in catch per unit effort (CPUE). Annual CPUE estimates for the brown and white shrimp fisheries are presented in Figure 10.38 for the 1960–2009 period. As indicated, following abundance patterns, CPUE can vary considerably from one year to the next and has increased significantly since the early 2000s. The increased CPUE in recent years reflects, at least in part, the sharp reduction in effort (days fished) that then translates into increased shrimp availability (given the fixed short-run stock) for those trips being made.



**Figure 10.38. Catch per unit effort (day fished) in the Gulf of Mexico brown and white shrimp fisheries, 1960–2009 (Nance 2011) (Note: 1 lb = 0.454 kg).**

With respect to white shrimp, CPUE was a record 931 lb per day fished in 2006 before falling to less than 750 lb per day fished in 2007. In 2008, CPUE increased again to 875 lb and equaled 882 lb in 2009. Since 2004, the CPUE associated with the white shrimp fishery has consistently been higher than in any year dating back to the 1960s. This, of course, reflects both the relatively high abundance in recent years (Figs. 10.33 and 10.35) and the relatively low level of effort targeting the species (Figure 10.20). Before the early 2000s, CPUE of less than 400 lb per day fished was not an uncommon occurrence in the white shrimp fishery.

The average CPUE for brown shrimp since 1960 has approximated 640 lb per day fished with the 2006 estimate of 1,244 lb per day fished being approximately twice the long-run average. The CPUE declined in the successive 2 years to 1,027 lb per day fished in 2007 and 821 lb per day fished in 2008 before increasing to 932 lb per day fished in 2009. Unlike the white shrimp fishery, however, CPUE associated with the brown shrimp fishery rarely (if ever) fell below 400 lb per day fished during the considered period of analysis.

#### *Financial Condition of the Fleet*

Prior to the year 2001, the U.S. shrimp industry was relatively healthy from an economic perspective. The average annual rate of return for the harvesting fleet was 12.5 % during the 1965–1995 period, even though fluctuating stocks (due to year-to-year changes in environmental conditions) led to substantial inter-year variability, including some years in which profitability was near zero or negative (Funk et al. 1998). While it is not surprising to find that profitability varies by vessel size, small vessels on average had higher rates of return, suggesting that there are decreasing returns to scale in the harvesting industry. This may be a function of ownership patterns in the industry, where smaller vessels tend to be operated by their owners and only participate in the shrimp fishery on a part-time basis when revenue and/or profit per unit of effort are high (Funk et al. 1998). For larger vessels, relatively high fixed costs and vertical integration with processors often force owners to continue harvesting regardless of the economic conditions. Over time, this leads to lower than average rates of return even though large vessels can be highly profitable when nominal dockside prices are stable and real input cost are low (as they were from

1998–2000)<sup>9</sup> (Travis and Griffin 2004). In the years since 2000, however, market forces have exerted tremendous economic pressure on individuals who depend on the harvesting of seafood as their primary source of income. As the largest sector of that industry by value, the shrimp fleet of the U.S. Gulf of Mexico is also the most threatened by those market forces.

The most recent analysis of financial conditions in the offshore shrimp fishery is provided by Liese and Travis (2010), while that for the inshore fleet is given by Miller and Isaacs (2011). As succinctly stated by Miller and Isaacs “overall, the financial situation in 2008 was economically unsustainable for the average active inshore shrimp harvesting business.” The authors further indicate that “[t]hese results parallel similar research about the economic performance of the offshore fleet. Increasing fuel costs, increases in imported shrimp volume—which places downward pressure on domestic prices—as well as recent natural and manmade disasters continue to erode the economic vitality of the Gulf shrimp harvesting fleet.” With respect to the inshore fleet, Miller and Isaacs (2011) found the net cash flow to owners of active boats in the Gulf of Mexico inshore shrimp fishery, which represents the difference between total revenues from all sources (average \$45,684) and financial outlays (\$39,850), to equal approximately \$6,000 per fisherman, on average, in 2008. When considering all expenses, including the opportunity cost of time, profits to active owners of boats in the Gulf of Mexico inshore shrimp fishery were, on average, slightly negative in 2008. Almost 50 % of the active boat owners were found to have a negative net cash flow in 2008, and less than 10 % reported net cash flow in excess of \$33,000.

With respect to the federally permitted vessels (i.e., those vessels legally allowed to shrimp in the Gulf of Mexico EEZ), Liese and Travis (2011) report that net cash flow among this segment of the shrimp harvesting sector averaged about \$8,300 per active owner in 2009 based on revenues from all sources (from the sale of shrimp, disaster payments, etc.) averaging \$212,000 (revenues from landed shrimp accounted for 89 % of this total) and costs averaging about \$208,000. The average economic return, calculated by dividing operating revenue by the value of the vessel assets, equaled 0.3 %. This estimate stands in stark contrast to the 12.5 % return on investment reported by Funk et al. (1998) for the 1965–1995 period.

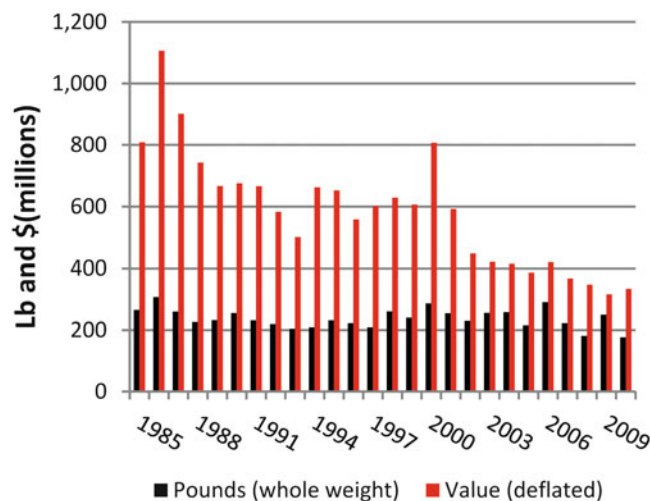
#### 10.3.8.1.4 The Gulf of Mexico Shrimp Processing Sector

Analyses by Keithly and Roberts (1994) and Keithly et al. (2006) indicate that virtually all shrimp landed in the U.S. Gulf is processed in that region. The two primary products produced from the domestic landings, as noted by Keithly and Roberts (1994) and Keithly et al. (2006), are a headless shell-on product and a peeled-raw product. The production of these two product forms (converted to a whole weight basis) and deflated value (2009 Consumer Price Index [CPI] used as the base) are presented in Figure 10.39. Mirroring the dockside price, the price of the processed product has fallen sharply, particularly after 2000. This decline in deflated value has transpired despite long-run stability in processed poundage (the result of virtually all harvest being used in the processing sector and long-run stability in harvest; see Figure 10.15).

Comparison of the processed shrimp price (headless shell-on and peeled-raw) with the Gulf dockside shrimp price indicates that the marketing margin has significantly fallen over time

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<sup>9</sup> Historically, many of the larger processors maintained their own fleets. This vertical integration was employed as a means of ensuring adequate supply of raw material for use in processing activities. These vertical integrated facilities could (and often would) absorb losses in the harvesting component of their operations in the profits generated in processing. As profitability in the processing sector eroded over time, due to competition with imported product, the ability to absorb losses in the harvesting component of the business declined. As such, vertical integration is probably not as prevalent today as in the 1980s. Unfortunately, there is little data that could be used to examine changes in vertical integration.

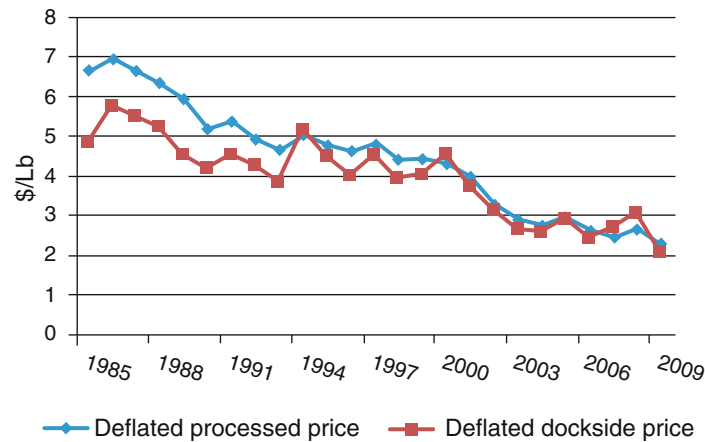


**Figure 10.39. Gulf processed pounds (headless shell-on and peeled-raw products) and deflated value of processed product, 1985–2009 (NMFS Southeast Regional Office, personal communication, 2011, with deflated values calculated by authors—see Appendix A) (Note: 1 lb = 0.454 kg).**

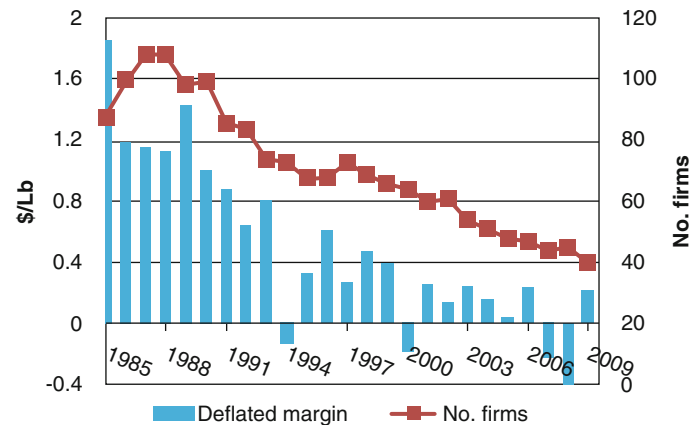
(Figure 10.40), particularly since 2001 and the associated rapid rise in imports of peeled-raw product (Figure 10.18). Given the reduction in margin and, one would hypothesize, associated profit per unit of output, a large proportion of the processing establishments have exited the industry while others have coped with the declining per unit profitability by increasing output.<sup>10</sup> The decline in number of firms in association with the declining marketing margin is given in Figure 10.41 while the increase output per firm is considered in Figure 10.42. As indicated, in association with the declining marketing margin the number of firms fell from almost 100 in the early 1990s to the mid-40s by the late 2000s. Production per firm, however, has increased, thereby mitigating, at least to some extent, the declining profitability per unit of output. Given that the long-run domestic shrimp harvest has been stable, along with the fact that existing processors use virtually all of the landings, it is apparent that the increased output per firm is the result of a reduction in the number of firms.

In general, the price received by Gulf processors for the two primary products, headless shell-on and peeled-raw, closely mirrors the import prices associated with these two products. With respect to the headless shell-on product, there are generally only small deviations between the Gulf price and import price (Figure 10.43, left panel). With respect to the peeled-raw product, the Gulf price generally exceeded the import price during the mid-1980s to early 1990s but since then the import price has consistently exceeded the domestic price (Figure 10.43, right panel). While the reason for this change is not known with certainty, it coincides with that period during which U.S. imports of farm-raised shrimp from Asian countries expanded rapidly. As such, one might hypothesize that beginning in the early 1990s, there was an increased use of this farm-raised shrimp (which is desired because of its uniform size and

<sup>10</sup> The marketing margin, by definition, reflects the difference between the processed price and the dockside price or, stated somewhat differently, the cost of inputs (including normal returns to capital and labor) to transform the product. If costs of these inputs did not significantly decline, one could state with certainty that the profit per unit output has also fallen.



**Figure 10.40. Relationship between deflated processed and dockside prices (2009 base), 1985–2009 [NMFS Southeast Regional Office (processing data), personal communication, 2011; NMFS FSD (dockside data), data accessed 2011, with deflated prices calculated by authors—see Appendix A] (Note: 1 lb = 0.454 kg).**



**Figure 10.41. Change in number of Gulf shrimp processors in relation to change in marketing margin, 1985–2009 (NMFS Southeast Regional Office, personal communication, 2011, with deflated margins calculated by authors—see Appendix A). (Note: 1 lb = 0.454 kg).**

year-round availability) in the raw-peeled product exported to the U.S. market. Given its desirability, a premium was likely attached to the product.

Finally, a comparison of the domestic headless shell-on price (Figure 10.43, left panel) and the domestic peeled-raw price (Figure 10.43, right panel) shows that the price received for the headless shell-on product consistently exceeds the price received for the peeled-raw product but that the price differential has been narrowing in recent years. The higher price associated with the headless shell-on product is the result of a larger-sized shrimp generally being used in the production of the headless shell-on product *vis-à-vis* the peeled-raw product. Roberts and Keithly (1991), however, document the significantly greater overall economic contribution associated with the peeled-raw product resulting from additional value-added activities.



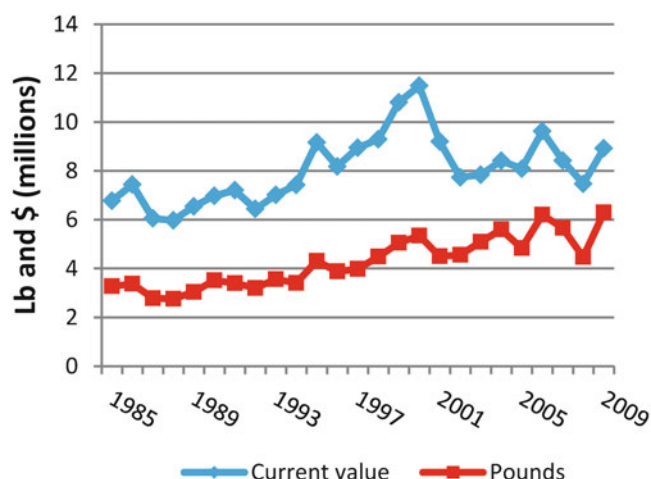


Figure 10.42. Average output per firm (headless shell-on and peeled-raw products) and current value of output per firm, 1985–2009 (NMFS Southeast Regional Office, personal communication, 2011, with calculations by authors—see Appendix A). (Note: 1 lb = 0.454 kg).

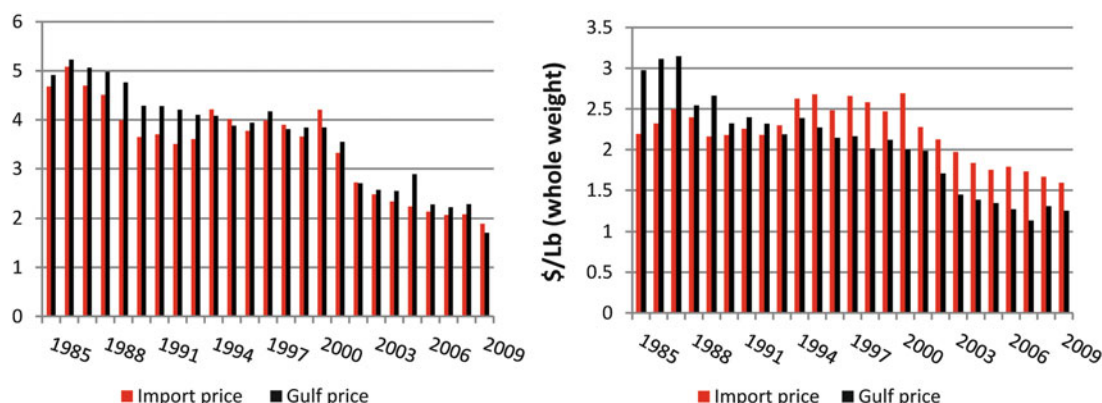


Figure 10.43. Relationship between the domestic processed price and import price for headless shell-on product (*left panel*) and peeled-raw product (*right panel*), 1985–2009 [NMFS Southeast Regional Office (processing data), personal communication, 2011; NMFS FSD (dockside price data), data accessed 2011, with calculations by authors—see Appendix A] (Note: 1 lb = 0.454 kg).

#### 10.3.8.1.5 Impact of Gulf Shrimp Landings on Dockside Price

Arguably, the most comprehensive analysis of the impact of Gulf shrimp landings on the Gulf shrimp dockside price is that of Poudel (2008). Based on a large-scale econometric model of the world shrimp market U.S. market, the European Union [EU] market, and the Japanese market), Poudel (2008) analyzes the impacts of increased shrimp production in different regions of the world (Asia, Central America, and South America) on the Gulf of Mexico dockside price as well as the influence of changes in own landings (i.e., Gulf landings) on the dockside price. The analysis was based on quarterly data from 1990 to 2004. Overall, Poudel (2008) found the dockside price to be relatively invariant to large changes in landings with a 10 % increase (decrease) in Gulf landings resulting in a 1.7 % decline (increase) in dockside price, holding all other factors constant. The small response in price to a change in landings is not unexpected given that the U.S. shrimp supply is dominated by imports. Furthermore, given



the increase in imports since 2004, one might expect that the influence of own landings on price has lessened in more recent years.

Based on monthly data from 1990 to 2008, Asche et al. (2012) use a co-integration approach to examine the relationship between the shrimp import price and the Gulf dockside price. The authors found a high degree of market integration between the imported product and domestic product and, based on this finding, conclude that large changes in Gulf of Mexico landings will lead to little change in the Gulf dockside price. Rather, imports will increase to meet domestic demand.

Together, these two studies indicate that large changes in Gulf shrimp production will result in little change in the dockside price. This finding should come as little surprise given (1) imports represent the vast majority of U.S. supply (i.e., domestic landings plus imports) and (2) there is little to differentiate the domestic product from the imported product, particularly after it enters the restaurant trade where a high percentage of the shrimp product is consumed.

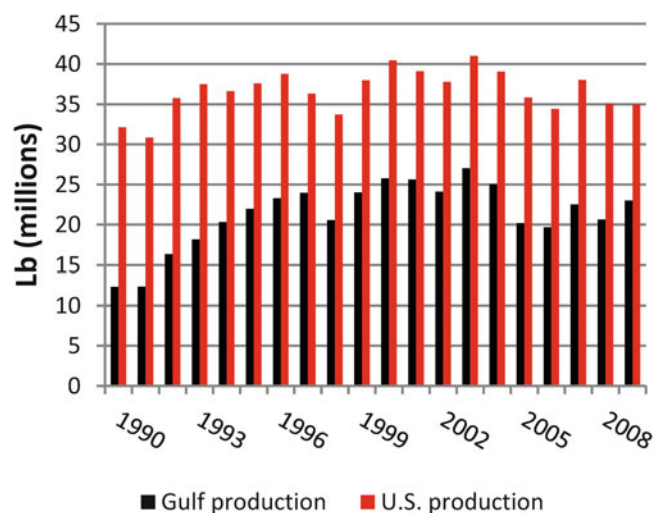
### **10.3.8.2 The Oyster Industry**

Unlike most species harvested in the Gulf of Mexico, the oyster is a sessile creature. As such, the harvesting sector can be developed around leasing operations. All Gulf States, with the exception of Alabama, maintain leases on state-regulated water bottoms, though only Louisiana and Texas maintain large-scale active leasing systems. Long-run aspects of these two leasing systems, along with the leasing systems in other Gulf States, are discussed in the recently completed Oyster Management Plan developed by GSMFC (OTTF 2012). Given the importance of Louisiana and Texas to Gulf oyster production, the leasing systems in these two states are examined in some detail after a brief review of the Gulf oyster industry. Detail given to the Louisiana segment of the industry is warranted due to its large size relative to other Gulf States and its complexity. While the lease system in Texas is somewhat less complex than that of Louisiana's, attention is also given to this system because it contributes significantly to the state's oyster production. After reviewing the production side of the Gulf oyster industry, attention is turned to examining the processing sector and the influence of harvest on dockside prices.

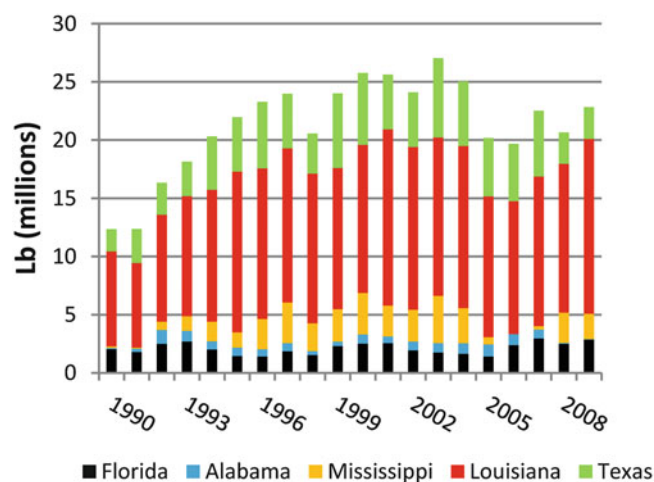
#### **10.3.8.2.1 The Production Side**

##### *Gulf Production in Relation to U.S. Total*

On average, the production of oysters from the Gulf of Mexico (the United States) averaged 21.3 million pounds (meat weight) annually during 1990–2009, which represented almost 60 % of the nation's 36.6 million-pound annual average production over the period. Given the large share of U.S. oyster production attributable to the Gulf region, any large changes in annual Gulf production also significantly influence U.S. production (Figure 10.44). As indicated, Gulf production, which averaged 19.3 million pounds annually during the 1990s, generally increased during much of the period with production from the region approximately doubling from the early 1990s to the late 1990s. By 2000, Gulf production reached the 25 million-pound mark, and during the decade beginning in 2000, annual production from the region averaged 23.3 million pounds. The increased Gulf production in the most recent decade has translated into an increased share of U.S. production attributable to the Gulf. Specifically, during the 1990s, the Gulf share of U.S. production equaled 54 %, and since 2000, the Gulf share of the nation's production has equaled 62 %. The Gulf has approached or exceeded the 65 % mark in most years since 2000 with the exception of the 3-year period ending in 2008 when the Gulf share fell below 60 % in each of the 3 years. Overall, U.S. production among states outside the Gulf region has averaged about 14.2 million since 2000.



**Figure 10.44. U.S. and Gulf of Mexico annual oyster production, 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).**



**Figure 10.45. Gulf oyster production by state, 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).**

#### *Gulf Production by State*

Annual oyster production for each of the five Gulf States from 1990 to 2009 is presented in Figure 10.45. As indicated, the region's production is dominated by Louisiana, which accounted for 57 % of the total during the period of analysis based on annual average production of 12.2 million pounds. Texas, with average annual production approaching 4.5 million pounds accounted for an additional 20 % of the region's total output during 1990–2009. Florida and Mississippi each contributed about 10 % to the region's total while Alabama's contribution was negligible.

Annual oyster harvest in any given state, or throughout the region, can vary significantly from one year to the next due largely to environmental perturbations. As indicated by the

information in Figure 10.45, Gulf production during the 20-year period ending in 2009 fluctuated from less than 13 million pounds (1990 and 1991) to more than 25 million pounds (2000, 2001, 2003, and 2004). Abnormally low production in 1990 was most likely the result of drought conditions throughout Louisiana, which lasted for several years beginning in the mid-1980s. This drought came to an abrupt end in 1991 with a record rainfall. While initially resulting in high oyster mortality as a result of low salinity conditions throughout the state's estuary systems, the pulse of fresh water was, in the long run, beneficial to the oyster population. Gulf production was also relatively low in 2005 and 2006 due, primarily, to a reduction in harvests in Mississippi and Louisiana. This decline can be directly related to Hurricane Katrina (and to a lesser extent Hurricane Rita), which made landfall around the Mississippi/Louisiana border in August of 2005 (Mississippi was forced to close its state waters to all oyster harvesting in 2006). Similarly, when Hurricane Ike entered around Galveston Bay in 2008, there was a significant loss of infrastructure that resulted in a reduction in Texas production in that year and in 2009. This had a significant impact on production from Texas given the fact that about 80 % of the Texas production is generally taken from this one water body.

Despite some significant year-to-year variations in state annual production, each state's relative share of the region's overall total has remained extremely stable when considered in 10-year increments (Table 10.1). For example, Louisiana's share of the region's production remained at 57 % during both 10-year periods while Texas's share remained at about 21 %.

*A Closer Look at the Louisiana Oyster Harvesting System:* Louisiana's large annual oyster harvest is derived from a combination of production from leases and public seed grounds. By providing a stable environment through its leasing policy, the state has encouraged industry investment and has provided an impetus for the preservation, rehabilitation, and expansion of existing leases. Overall, Louisiana's leased acreage has expanded approximately fivefold since the early 1960s, from about 75,000 acres (30,350 ha) to about 400,000 acres (161,875 ha) (OTTF 2012). Despite this increase in acreage, long-run production from this leased acreage has remained relatively constant at about eight million pounds per year. Increasing leased acreage in conjunction with relatively constant long-run production from the leased acreage implies, of course, declining productivity per acre. This may be the result of several factors including (1) the recently added acreage is not as productive as the older acreage, (2) older leases are no longer as productive as in past years, (3) the average productivity of all leased acreage is declining, and (4) some amalgam of these factors. One argument that has been advanced to explain the increased leased acreage in conjunction with the relatively stable long-run production is that the increased acreage being leased is in response to wetland degradation and increasing rapid fluctuations in salinity regimes. Specifically, with the increasing exposure of

**Table 10.1. 10-Year Average Annual Oyster Production in Pounds for Each Gulf State and Its Share (%) of Gulf of Mexico Production**

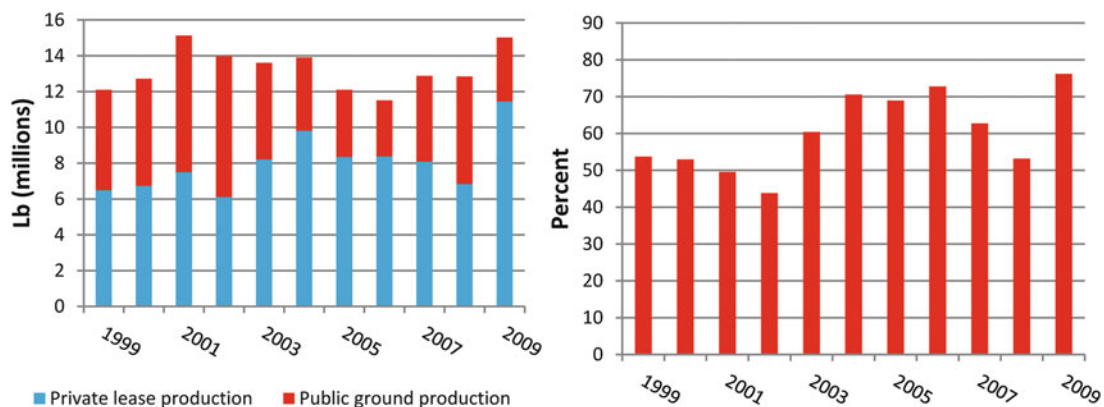
	Florida	Alabama	Mississippi	Louisiana	Texas
1990–1999 avg.	1,964,000 (10.2 %)	594,137 (3.1 %)	1,652,250 (8.5 %)	11,118,537 (57.5 %)	4,002,534 (20.7 %)
2000–2009 avg.	2,256,747 (9.7 %)	669,528 (2.9 %)	2,172,242 (9.3 %)	13,349,786 (57.2 %)	4,895,472 (21.0 %)
1990–2009 avg.	2,110,374 (9.9 %)	631,833 (3.0 %)	1,912,246 (9.0 %)	12,234,162 (57.3 %)	4,449,003 (20.9 %)

Source: NMFS FSD, data accessed 2012—see Appendix A. Note: 1 lb=0.454 kg.

oyster leases to open water (due to marsh deterioration), short-term changes in the proximate reef area have become more common and with a higher magnitude of change. Hence, acreage that is productive one year may not be productive the next. As such, leaseholders may be increasingly diversifying their individual lease portfolios as a means of protecting themselves against the vagaries associated with any single lease or group of leases subject to environmental perturbations. Keithly and Kazmierczak (2006) suggest that speculation may have also contributed to the observed increase in leased acreage since the 1960s. Specifically, oil and gas activities are common in coastal Louisiana and often overlap oyster leases on a geographical basis. The researchers found that compensation for oil and gas activities is negotiated with affected lessees and may or may not be based on lease productivity. Hence, the researchers argue that considerable acreage of water-bottom is leased for the main purpose of receiving compensation rather than for the production of oysters.

Leasing activities do not operate in isolation but, instead, are intricately tied to the public grounds. Specifically, these public grounds serve as a source of seed oyster that can be transplanted to the private leases which is particularly important in those areas where natural oyster production (i.e., spat set) is limited and, as such, production from leases in these areas would be very limited in the absence of transplanting activities. An examination of Louisiana's oyster leasing activities, in recent years, and the relation between these activities and the public grounds is presented in this section.

*Private Leases:* Since 1999, production from private grounds has averaged eight million pounds (meats) annually (Figure 10.46, left panel). Highest observed production from private leases during the 11-year period of analysis ending in 2009 occurred in that year and equaled 11.5 million pounds. The relatively high production in the latest year may reflect, in part, the influence of the Private Oyster Lease Rehabilitation Program (POLR), which was initiated to assist leaseholders in recovery efforts after Hurricanes Katrina and Rita. Specifically, the program partially reimbursed leaseholders for (1) movement of seed from public grounds to individual leases, (2) sediment/debris removal, (3) cultch deposition, and (4) other activities. During the life of the program, which expired at the end of 2009, leaseholders were partially reimbursed for the bedding of more than 800,000 barrels of seed oysters (one barrel is equivalent to two sacks where a sack, according to the Oyster Technical Task Force (OTTF 2012), has a dimension of 1.87 cubic feet (ft<sup>3</sup>) and supports approximately 100 lb of shell and



**Figure 10.46.** Annual oyster production from private leases and public grounds (*left panel*) and annual private lease production as a percentage of the total (*right panel*), 1999–2009 (unpublished data provided to Walter Keithly by the LDWF for years covering 1999–2008); 2009 data derived from LDWF (2010) with percentage calculations by authors; (Note: 1 lb = 0.454 kg).

meats on approximately 60,000 acres (24,281 ha). The bedding of these seed oysters represented approximately 40 % of the total POLR expenditures with another 40 % being paid for sediment/debris removal from private grounds. The lowest observed annual production during the 11-year period of analysis, equal to 6.2 million pounds, occurred in 2002.

Expressed on a percentage basis, production from leases as a percent of total production (i.e., leases and public grounds) equaled 60 % during the period of analysis. As indicated in Figure 10.46 (right panel), the range has been from just over 40 % (2002) to approaching 80 % (2009). As of September 21, 2010, there was a total of 384,951 acres (155,784 ha) of water bottoms being leased (personal communication with Patrick Banks, LDWF). This represents about a 5 % decline from the January 1999 leased acreage totaling 403,141 acres (163,145 ha) and about an 8 % decline from the 419,900 acres (169,928 ha) being leased in February 2001.<sup>11</sup> As noted by Keithly and Kazmierczak (2006), the declining acreage likely reflects a combination of the moratorium on the leasing of new acreage (this moratorium was established March 7, 2002, but excluded pending applications as of that date) and the purchase of leases by the state in furtherance of its restoration activities. Of the 392,000 acres (158,636 ha) being leased as of February 2006, more than one-third of the total (140,485 acres [56,852 ha]) was in Plaquemines Parish while an additional one-quarter of the total (91,890 acres [37,187 ha]) was Terrebonne Parish based. Other parishes contributing to the total include St. Bernard (88,139 acres [35,669 ha]), Lafourche (23,448 acres [9,489 ha]), Iberia (18,312 acres [7,411 ha]), Jefferson (18,093 acres [7,322 ha]), Vermillion (5,404 acres [2,187 ha]), and St. Mary (14 acres [5.7 ha]). In addition, some leases transverse parish borders. These include Jefferson/Lafourche (1,088 acres [440 ha]), Jefferson/Plaquemines (1,804 acres [730 ha]), Lafourche/Terrebonne (381 acres [154 ha]), Plaquemine/St. Bernard (327 acres [132 ha]), Terrebonne/St. Mary (177 acres [72 ha]), and Iberia/Vermillion (2,432 acres [984 ha]). Annual leased acreage of approximately 400,000 acres [161,874 ha] for the 11-year period ending in 2009 in conjunction with production from leased grounds during that period (averaging eight million pounds per year) yields an average annual production per acre of 20 lb. This equates to three sacks per acre based on the conversion factor of 6.47 lb of meats per sack.

While oyster yield per acre from private leases has averaged about 20 lb (meats) per year in recent years, one should recognize that all acreage is not as equally productive and some acreage is not capable of supporting oysters. With respect to the ability to support oysters, Keithly and Kazmierczak (2006), in an analysis of leasing activities, reported that 56 % of the leases considered in their study were unproductive (defined for purposes of the study as having no standing crop capable of harvest at the time the pre-impact assessment of the lease was made<sup>12</sup>). While some leases may have no standing crop in any given year, under more conducive environmental conditions the lease may be productive in other years. While not provided in the report, an analysis of the pre-impact assessment information collected by the researchers indicate that about 20 % of the leases had no hard bottom or shell (indicating that the lease could not support an oyster crop) while another 38 % had less than 5 % hard bottom and/or shell.

Keithly and Kazmierczak (2006) suggest that one plausible explanation for the leasing of nonproductive grounds is that of speculation. Specifically, the authors argue that the

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<sup>11</sup> Detailed information on leased acreage, number of leaseholders, and number of leases for selected time periods can be obtained at <http://204.196.151.247/oyster/>.

<sup>12</sup> Much of the proposed work in the coastal region requires a Coastal Use Permit. As a part of the process in obtaining this permit, a pre-impact assessment in that area potentially impacted by the work must be conducted. This includes an assessment of oyster leases and reefs if they are located in the area of the proposed work.

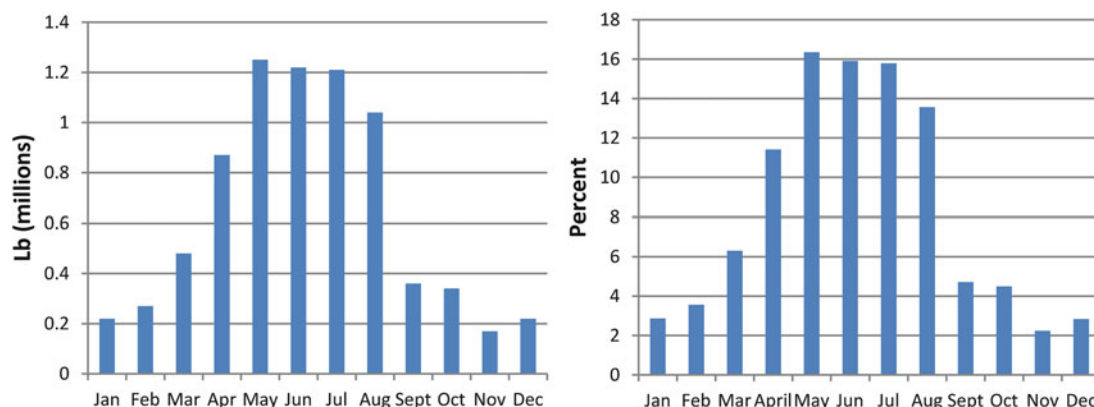


juxtaposition of water-bottom leasing and oil and gas activities along the coast has likely encouraged leasing of nonproductive grounds in the expectation that compensation will be received for oil and gas activities in proximity to the lease. The authors estimated that the 2004–2005 harvesting cost per sack equaled \$7.84 while the dockside price per sack equaled \$16.37 yielding a profit margin of \$8.53 per sack. In conjunction with average productivity per acre and number of acres, net income associated with harvesting from private leases was estimated to equal approximately \$12 million in total or roughly \$31 on a per acre basis. Payments to lease holders from oil and gas activities during 2004–2005, by comparison, were estimated by the authors to equal \$26 to \$36 per acre. Hence, the authors conclude that compensation to leaseholders from oil and gas activities equals or exceeds income derived from harvesting activities.

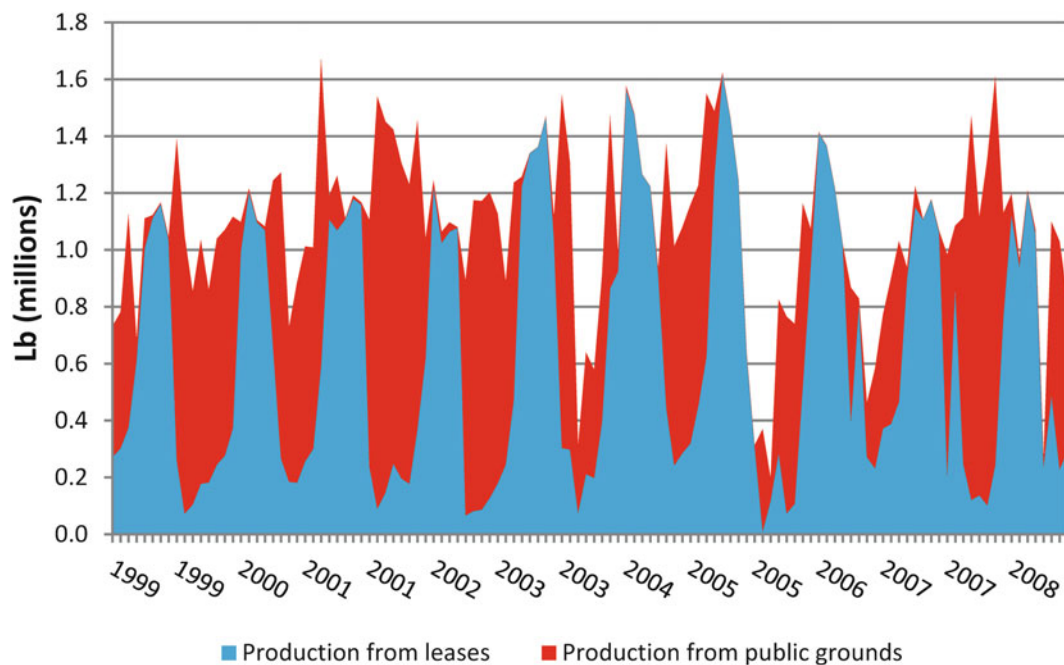
Other acreage, while capable of supporting a standing oyster crop, may be closed to the harvest for direct marketing on a seasonal or permanent basis as a result of health concerns. As suggested by Diagne et al. (2004), relaying of oysters from leases in harvest-limited waters to leases in approved waters, while permitted, is practiced infrequently in Louisiana with the level of activity being a function of the dockside price, availability of oysters on the public seed grounds, and the availability of oysters on private leases.

Average monthly oyster landings from private leases for the 10-year period ending in 2008 (i.e., 1999–2008) are presented in Figure 10.47 (left panel) and the same information presented on a percentage basis is given in the right panel. As indicated, production from private grounds is highest in the summer months with the 4-month period ending in August accounting for about 60 % of the total. By comparison, production during the 4-month period ending in February accounted for only about 11 % of the total production from private grounds during the 1999–2008 period.

One explanation for higher production during summer months is that the public grounds are closed throughout the summer months. The relationship between production from private leases and public grounds is illustrated in Figure 10.48. As indicated, decreases (increases) in production from the private leases can generally be associated with increases (decreases) in production from the public ground with the correlation between the two being equal to  $-0.795$  (based on the monthly data from 1999 to 2008).



**Figure 10.47.** Average monthly oyster production from private leases on a poundage basis (*left panel*) and on a percentage basis (*right panel*), 1999–2008 (calculated from unpublished data provided to Walter Keithly by LDWF with percentage calculations by authors) (Note: 1 lb = 0.454 kg).



**Figure 10.48. Monthly oyster production from private leases and public grounds, 1999–2008 (calculated from unpublished data provided to Walter Keithly by the LDWF) (Note: 1 lb = 0.454 kg).**

The annual value of production derived from private leases increased from about \$13 million in 1999 to almost \$40 million in 2009 (Figure 10.49, left panel). The relatively high dockside value from private leases in 2009 represents a combination of two factors. First, as noted, production from leases was uncharacteristically high in 2009. Second, the 2009 dockside price for oysters (meat weight) taken from private leases equaled \$3.38 per pound (Figure 10.49, right panel). This price exceeded the reported dockside price in most other years by a significant margin with the 2006 and 2007 reported prices being about 8 % below the 2009 price. Using the 2006–2009 average annual dockside price (unweighted) in conjunction with the recent productivity of 20 lb per acre, annual gross oyster revenues from leasing are estimated to equal about \$65 per acre.

Kazmierczak and Keithly (2005) examined per trip harvesting costs on private leases. Their analysis, based on a harvesting cost survey of Louisiana oystermen which was conducted during the July through August 2003 and June through August 2004 periods, found that the most important variables contributing to per trip variable costs were the number of sacks harvested, fuel price, captain's wage, miscellaneous costs, and crew wages (in decreasing order of impact on variable costs).

*Public Grounds:* The public oyster grounds, as indicated in Figure 10.50, are scattered throughout the coast. While encompassing nearly 1.7 million acres (687,966 ha), known reef bottom (about 38,000 acres [15,378 ha] though this should be considered as the lower-bound of the actual amount of reef because all public water bottoms have not been surveyed) equals only a fraction of the total water bottom (LDWF 2010). These grounds, in general, serve as both a source of seed oyster (less than three inches) and oysters for direct market (three inches or greater). They are generally open for harvest in September/October and close the following March/April.



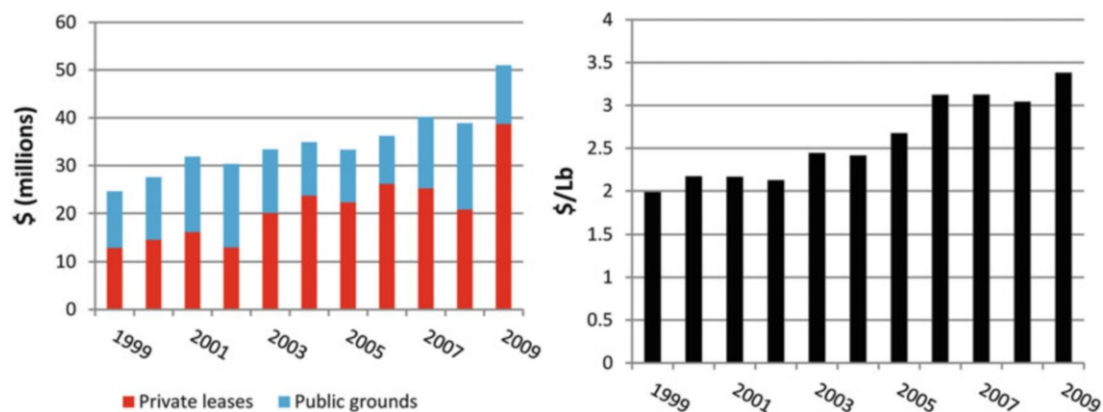


Figure 10.49. Current value of oyster production from private leases and public grounds (*left panel*) and annual dockside price for oysters taken from private leases (*right panel*), 1999–2009 (unpublished data provided to Walter Keithly by the LDWF for years covering 1999–2008 with 2009 data derived from LDWF (2010) with price calculations by authors).

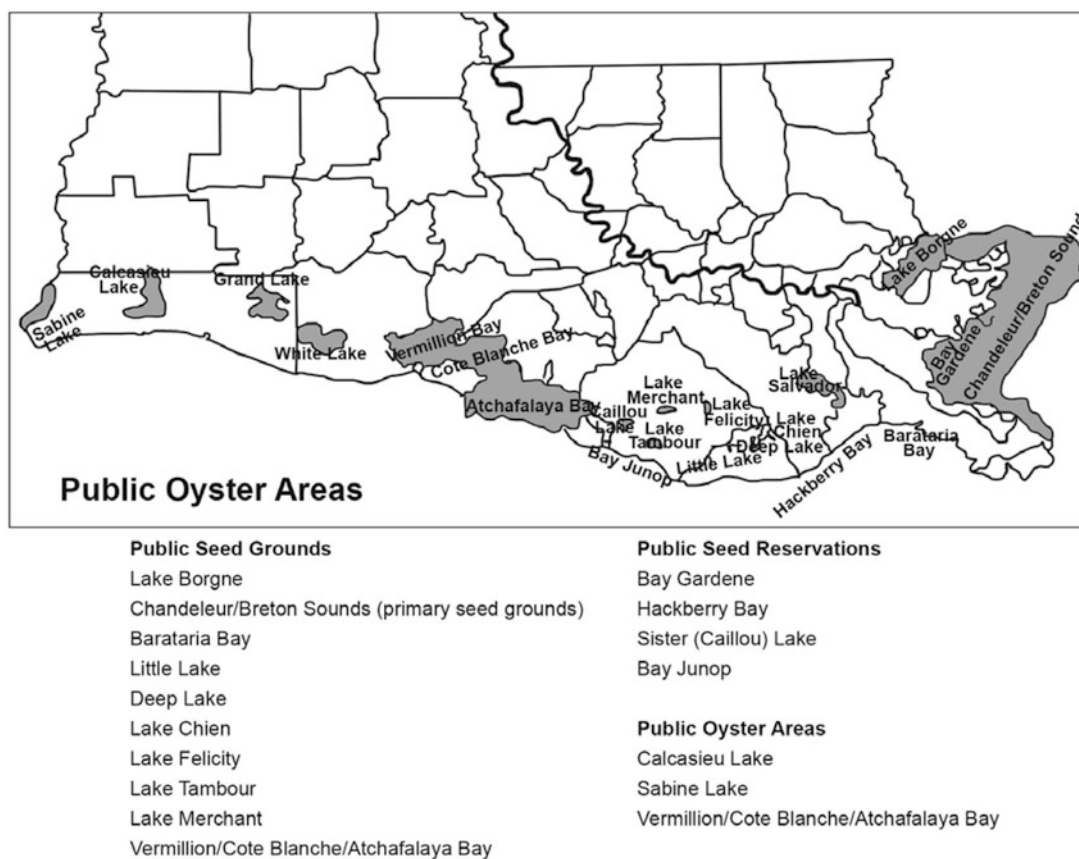
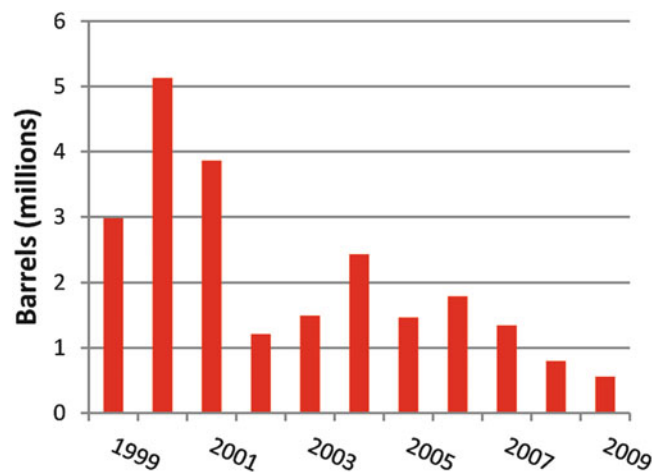


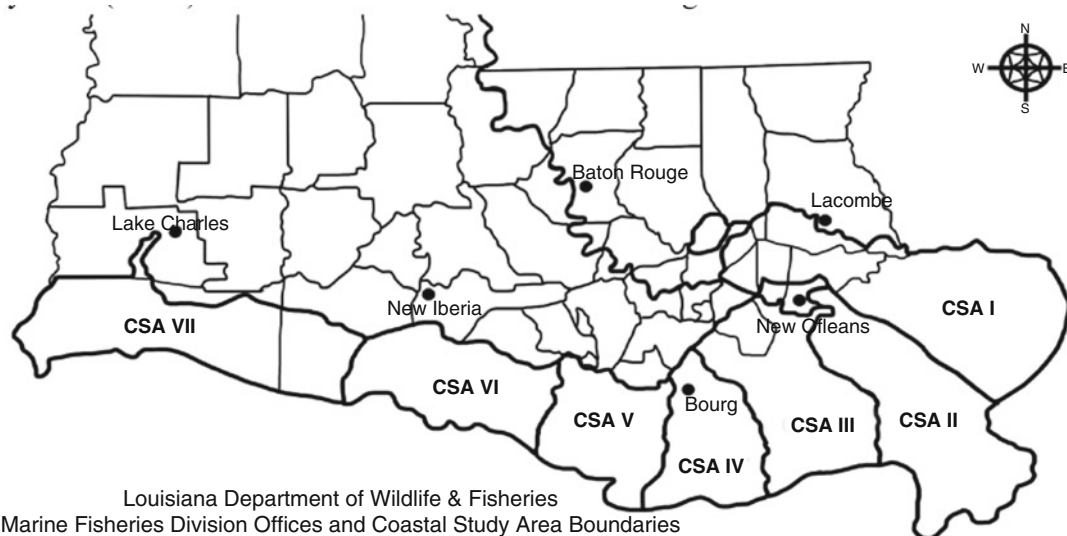
Figure 10.50. Map of public oyster grounds in Louisiana (LDWF 2009).

Seed oyster, while not permitted to be directly marketed, may be moved from the public grounds to private leases where the transplanted product can later be harvested for market. Since 1999, estimated barrels of seed oyster have averaged 2.1 million annually, with a range from over five million barrels (2000) to less than 600,000 barrels (2009; Figure 10.51). The declining seed oyster availability in recent years may be the result of changing environmental conditions, the effects of numerous storms and hurricanes, high fishing pressure relative to the ability of the stock to replenish itself, or some amalgam. While the change in estimated seed oyster availability on the public grounds (Figure 10.51) appears large, estimates of natural mortality among subadult and adult oysters populations are large and can exceed 50–95 % (OTTF 2012). One would expect natural mortality of seed oysters to be at least this large.

For sampling and management purposes, the coastal region is divided into seven areas, known as coastal study areas (CSAs). These seven areas are illustrated in Figure 10.52.



**Figure 10.51. Estimated seed oyster availability on public grounds, 1999–2009 (email from Patrick Banks, LDWF, to Walter Keithly, December 29, 2009).**



**Figure 10.52. Map illustrating coastal study areas in the Louisiana (LDWF 2010).**

- CSA I consists of approximately 690,000 acres (279,233 ha) of water bottoms, all east of the Mississippi River and north of the Mississippi River Gulf Outlet, of which approximately 21,000 acres (8,498 ha) represent reef.
- CSA II, which consists of approximately 17,000 acres (6,880 ha) of reefs, is characterized by 300,000 acres (121,406 ha) of water bottoms east of the Mississippi River (and south of the Mississippi River Gulf Outlet).
- CSA III represents the Barataria Bay system and consists of approximately 140 acres (57 ha) of reef.
- CSA IV includes the Terrebonne/Timbalier Basin.
- CSA V, which includes three water bodies in Terrebonne Parish (Sister Lake, Bay Junop, and Lake Merchant), consists of approximately 13,000 acres (5,261 ha) of water bottoms of which approximately 2,500 acres (1,012 ha) is reef.
- CSA VI, found in the Vermilion/Cote Blanche/Atchafalaya Bay System, consists of about 542,000 acres (219,340 ha) of water bottoms, and the reef is an unknown portion of this total.
- CSA VII includes Calcasieu Lake and Sabine Lake; Calcasieu Lake consists of 58,290 acres (23,590 ha) of water bottoms of which 1,691 acres (684 ha) is reef.<sup>13</sup>

Estimated seed and sack availability from these CSAs associated with the four most recent stock assessments are presented in Table 10.2. As indicated, estimated seed variability from one year to the next in any CSA can be large. As just one example, estimated seed oyster availability in CSA I fell by more than two-thirds, from 305,000 barrels in 2008 to 83,000 barrels in 2009. While the variability from one year to the next in any CSA is important to recognize, it is also important to recognize that the direction of change across CSAs is not always consistent, even among contiguous CSAs. For example, while there was a large decline in estimated seed availability in CSA I between 2008 and 2009, estimated availability in CSA II more than doubled. The fact that the direction of change across contiguous CSAs is not consistent is not unexpected; different CSAs represent different bay systems and all are subject to their own environmental perturbations. Given the high annual natural mortality rate associated with subadult and adult oysters (i.e., 50–95 %), the high year-to-year seed oyster variability within a given CSA should come as no surprise.

The estimated harvest of seed oysters, by CSA, for the most recent 4 years is provided in Table 10.3. It is useful to consider the information in Table 10.2 in conjunction with that in Table 10.3. Estimates of seed oyster availability are generally made in July of each year and can be used to help establish what might be available for harvest in that season. Thus, the 2008 seed availability can be used to establish the seed harvest potential for the 2008–2009 public ground season. For example, estimated seed availability in CSA I for 2008 was 305,000 barrels. About 87,000 barrels of seed were subsequently transplanted to private leases during the 2008–2009 public ground harvesting season. As indicated, no transplanting from CSA VII occurs even though there is generally a significant amount of seed in that region. This is because of the long distance to leases that are primarily located in the eastern portion of the state. In examining these numbers, one should also keep in mind the incentives to transplant seed offered by the POLR program. These incentives likely increased transplanting activities during the period considered in these tables.

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<sup>13</sup> Summation of total reef area by CSA exceeds the 38,000 acres (15,378 ha) previously cited. The reason(s) for this discrepancy is unknown.

**Table 10.2. Estimated Seed and Market (Sack) Oyster Availability in Barrels by Coastal Study Area, 2007–2010<sup>a</sup>**

CSA	Seed	Sack	Total	CSA	Seed	Sack	Total
2007				2008			
I	293,219	139,136	432,355	I	305,256	750,526	1,055,782
II	451,034	309,562	760,596	II	110,751	124,393	235,144
III	10,584	2,424	13,008	III	2,036	2,949	4,985
IV	2,131	847	2,978	IV	2,277	2,267	4,544
V	96,891	127,127	224,018	V	46,863	52,237	98,100
VI	N/A <sup>b</sup>	N/A	N/A	VI	N/A	N/A	N/A
VII				VII	331,102	447,131	778,233
2009				2010			
I	82,867	178,097	265,964	I	120,188	94,833	215,021
II	241,762	78,450	320,212	II	105,836	39,739	145,575
III	11,402	141	11,543	III	5,020	1,207	6,227
IV	2,236	270	2,506	IV	2,021	499	2,520
V	89,602	43,387	132,989	V	154,340	36,971	191,311
VI	N/A	N/A	N/A	VI	N/A	N/A	N/A
VII	126,047	310,503	436,550	VII	307,265	356,458	663,723

<sup>a</sup>There are two sacks to one barrel. Convert barrels to pounds of meat by multiplying sacks (barrels times two) by 6.47. Seed oyster availability cannot be converted to meat weight.

<sup>b</sup>No estimates (N/A) are given for seed and sack in CSA VI because the amount of reef area has not been determined  
Source: Derived from LDWF (2007), LDWF (2008), LDWF (2009), and LDWF (2010).

Estimated statewide market oyster availability on the public grounds for the 1999–2009 period is provided in Figure 10.53. As with seed oyster availability (Figure 10.51), the estimated market oyster availability has, in general, been declining since the early 2000s. During the 11-year period ending in 2009, the average estimated market oyster availability on public grounds equaled 1.7 million barrels (3.4 million sacks) and ranged from 4.3 million barrels in 2001 to 375,000 barrels in 2006 (likely influenced in part by Hurricanes Katrina and Rita). The correlation between seed and market oyster harvests during the period of analysis equaled 0.69.

The estimated market oyster availability on public grounds by CSA is given in Table 10.2. As with seed availability, market oyster availability (i.e., sack) in any CSA can vary significantly from one year to the next. For example, estimated market availability in CSA I fell from approximately 750,000 barrels in 2008 to less than 200,000 barrels in 2009 and fell again to 95,000 barrels in 2010. Inter-year variation likely reflects a combination of changing environmental conditions that lead to changes in natural mortality and harvesting pressure.

Annual statewide harvest of market oysters from the public grounds is given in Figure 10.46 and as a percent of total production in Figure 10.54.<sup>14</sup> Overall, during 1999–2009, market oyster production from the public grounds averaged 5.3 million pounds, with a low of 3.1 million pounds being harvested in 2006 and a high of 7.8 million pounds being harvested in 2002.

<sup>14</sup>Landings data associated with production from the public grounds are based on trip ticket data provided by the fishermen/dealers. Information provided includes area fished. Specified areas associated with the public grounds are provided in the two figures at the end of this section.

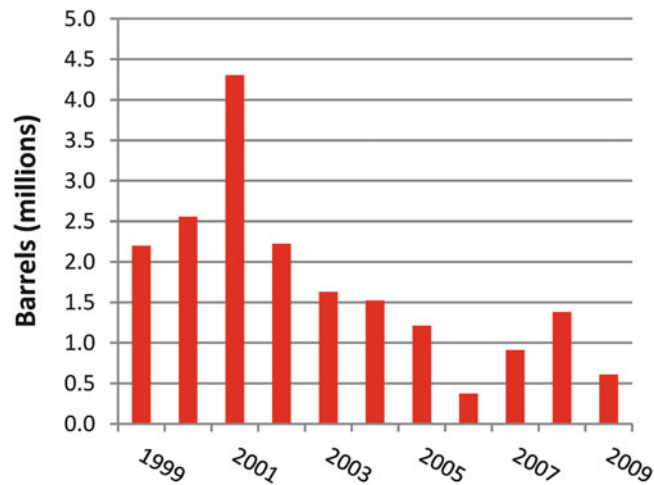
**Table 10.3. Estimated Harvests of Seed Oysters and Market Oysters in Barrels by Coastal Study Area, 2007–2010<sup>a</sup>**

CSA	Seed	Market	Total	CSA	Seed	Market	Total
2006–2007				2007–2008			
I	61,635	25,536	87,171	I	157,085	136,568	293,653
II	110,567	91,678	202,245	II	173,285	139,290	312,575
III	12,190	3,046	15,236	III	13,345	167	13,512
IV	1,940	0	1,940	IV	2,627	3,635	6,262
V	10	4,956	4,966	V	39,115	47,562	86,677
VI	60,390	8,884	69,274	VI	45,121	2,197	47,318
VII	0	14,171	14,171	VII	0	39,823	39,823
<b>Total</b>	<b>246,732<sup>b</sup></b>	<b>148,271</b>	<b>395,003</b>	<b>Total</b>	<b>430,578</b>	<b>369,241</b>	<b>799,819</b>
2008–2009				2009–2010			
I	87,180	85,094	172,274	I	57,055	79,014	136,069
II	77,003	132,791	209,794	II	82,688	83,807	166,495
III	1,985	1,860	3,845	III	7,885	252	8,137
IV	205	9	214	IV	0	0	0
V	600	3,502	4,102	V	4,610	6,838	11,448
VI	0	0	0	VI	0	0	0
VII	0	34,742	34,742	VII	0	68,537	68,537
<b>Total</b>	<b>166,973</b>	<b>257,998</b>	<b>424,746</b>	<b>Total</b>	<b>152,238</b>	<b>238,448</b>	<b>390,686</b>

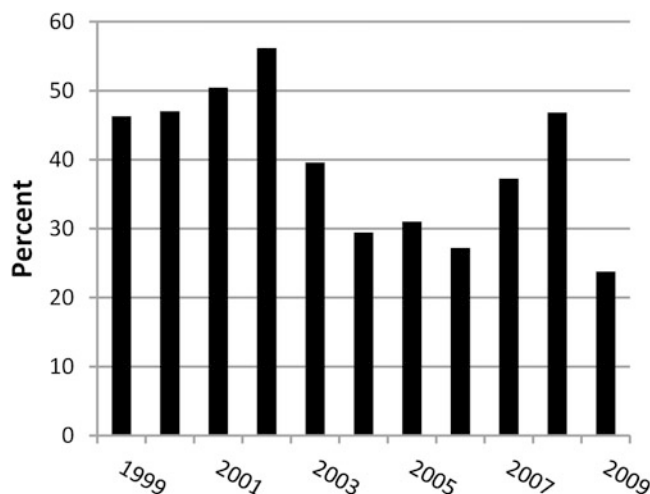
<sup>a</sup>There are two sacks to one barrel. Convert market oysters in barrels to pounds of meat by multiplying sacks (barrels times two) by 6.47. Seed oyster availability cannot be converted to meat weight.

<sup>b</sup>Does not include relocation project.

Source: Derived from LDWF (2007), LDWF (2008), LDWF (2009), and LDWF (2010).



**Figure 10.53. Estimated state wide market oyster availability in barrels on the state's public seed grounds, 1999–2009 (email from Patrick Banks, LDWF, to Walter Keithly, December 29, 2009).**



**Figure 10.54. Percentage of annual harvest derived from public grounds, 1999–2009 (unpublished data provided to Walter Keithly by the LDWF for years covering 1999–2008 with 2009 data derived from LDWF (2010) with percentage calculations by authors).**

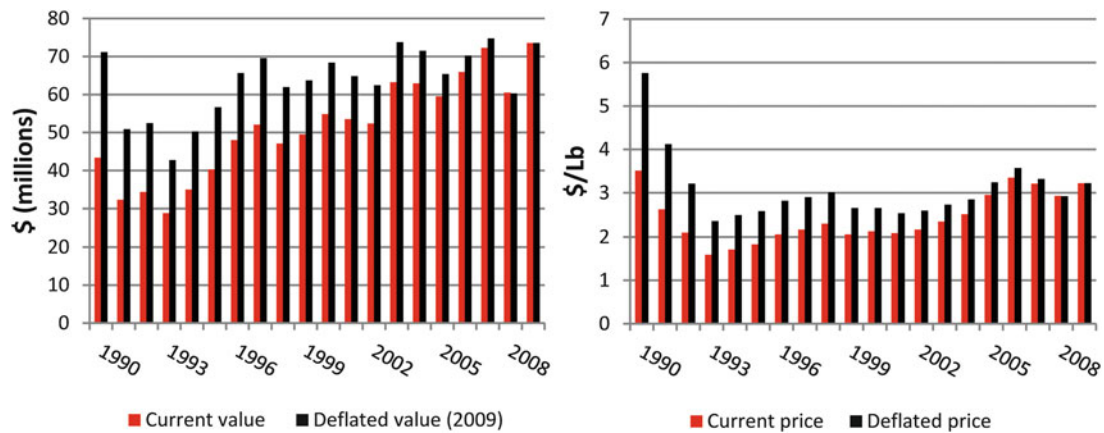
On a percentage basis of the total harvest (i.e., harvest from leases and harvest of market oysters from public grounds), production from public grounds ranged from less than 30 % to more than 50 %. In general, years of high public ground production tends to correlate with low private lease production.

Estimated harvest of market oysters from the public grounds by CSA for the four most recent years is given in Table 10.3. For CSA I, although estimated 2008 market oyster availability equaled 750,000 barrels, the estimated 2008–2009 harvests equaled only 85,000 barrels. Similarly, though the 2009 market oyster availability for the region equaled 178,000 barrels, estimated 2009–2010 harvests equaled 79,000 barrels. By comparison, the 2008 estimated market oyster availability for CSA II in 2008 equaled 124,000 barrels and the 2008–2009 estimated harvest from the region equaled 133,000 barrels. Similarly, the 2009 estimated market oyster availability equaled 788,000 barrels and subsequent harvest equaled 84,000 barrels.

*A Closer Look at the Texas Oyster Harvesting System:* As noted by the information in Table 10.1, Texas represents the second largest oyster producing state in the Gulf of Mexico with annual production since 1990 averaging close to 4.5 million pounds. Like Louisiana, a sizeable share of the Texas oyster production is derived from leasing activities. However, leases are much more limited in Texas totaling 43 and comprising 2,321 acres (939 ha) (OTTF 2012). Furthermore, all are in Galveston Bay. As stated in OTTF (2012), “[t]he original goal of the Texas oyster lease program was to create new self-sustaining oyster producing areas under private ownership but is currently being used exclusively as depuration sites for oysters transplanted from restricted waters (pp. 8–37).” Furthermore, given that the management goals associated with the current program are currently being met, there is a moratorium on the issuance of new leases.

Given that the current leases are used exclusively for depuration sites for oysters transplanted from restricted waters, relaying of oysters from public grounds restricted waters to private beds represents the primary source of oysters that are subsequently harvested from leases. There is currently a spring (May) transplanting season and a fall (September) transplanting season with each lasting, on average, 9 days in recent years.





**Figure 10.55. Current and deflated value of Gulf oyster production (left panel) and current and deflated price (right panel), 1990–2009 (NMFS FSD, data accessed 2012, with deflated prices calculated by authors—see Appendix A) (Note: 1 lb = 0.454 kg).**

Since the early 1990s, production from the private leases as a percentage of total state production has fallen in the 15–30 % range annually with absolute production from the leases ranging from less than 600,000 lb in many years to close to two million pounds. The 2008 lease-based harvest equaled 535,000 lb which represented the lowest take from leases since 1993 (OTTF 2012).

#### *Dockside Value and Price*

In general, the current dockside value of Gulf oyster production, as indicated by the information in Figure 10.55 (left panel), trended upward during the 1990–2009 period. During 1990–1994, for instance, total annual Gulf value averaged about \$35 million. By 2005–2009, the current value had increased to \$66 million annually (or by about 90 %). Much of this increase is, of course, the result of inflation. After adjusting for inflation (expressed in 2009 dollars), the increase was much more moderate; from \$54 million annually during 1990–1994 to \$69 million annually during 2005–2009 (Figure 10.55, left panel). This 28 % increase in deflated value matches well with the 33 % increase in production between these two periods—15.9 million pounds to 21.2 million pounds—suggesting no long-run increase in the deflated dockside price.

The long-run constancy in deflated dockside price (meat weight) can be examined with the aid of the information in Figure 10.55 (right panel). While the 1990 deflated price was, as indicated, significantly higher than any other yearly price during the 20-year period of analysis, the deflated price fell sharply in the following three succeeding years even though the Gulf production in pounds increased after 1991 (Keithly and Diop 2001). Subsequently, Dedah et al. (2011) attribute the significant decline in price to (1) media which drew attention to the health risks associated with the consumption of raw oysters and (2) mandated labeling requirements for establishments selling raw oysters. These mandated labeling requirements were initiated in an attempt to better inform the public of the health risks associated with the consumption of raw oysters and other shellfish.



#### 10.3.8.2.2 The Gulf Oyster Processing Industry

The Gulf of Mexico oyster processing industry is considered in detail in OTTF (2012) and thus only some highlights are presented here. The study suggests that, in general, Gulf processors shuck a minimum of 60 % of the Gulf harvested product, and the quantity of processed product closely mirrors landings in the region with increased landings implying increased processing activities.

The report also indicates that the value of Gulf oyster processing activities increased from about \$30 million in 1980 to more than \$60 million during 2000–2008. However, much of that increase is inflationary based and after removing inflationary effects, no growth in the value of Gulf processing activities is observed. This is consistent with the relatively long-term constancy in the deflated dockside value of the harvested product (Figure 10.55, left panel).

During the early-to-mid 1990s, the number of Gulf firms engaged in oyster processing activities averaged about 100 per year. The number gradually declined over time with less than 70 being reported since 2006. Given the long-term stability in Gulf oyster landings in conjunction with the quantity of processed product closely mirroring the Gulf landings, a declining number of firms suggests increased output per processing establishment. Overall, production per firm since 1994 has consistently exceeded 100,000 lb of oyster meats and since 2004 has exceeded 175,000 lb of meats. On average, revenues from oyster processing activities exceeded \$1 million per firm for the first time in 2006, with 2007 and 2008 figures also around the \$1 million figure.

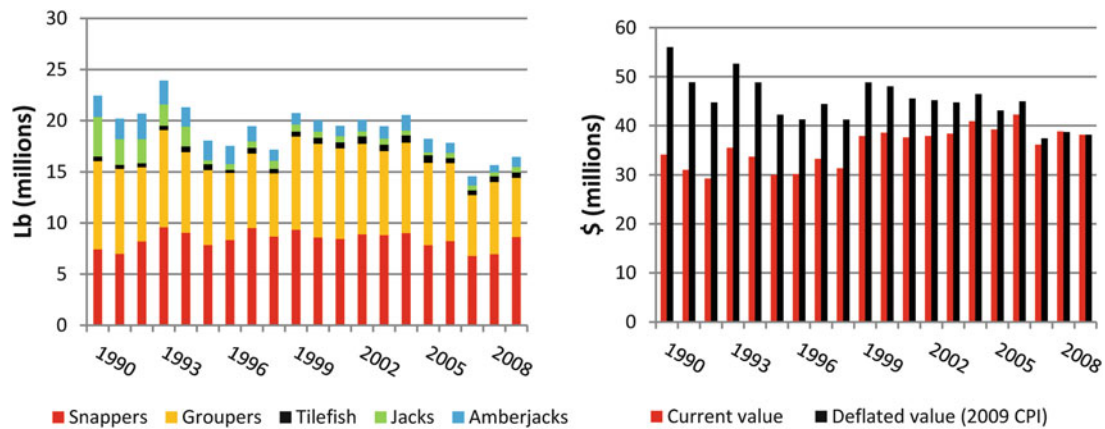
#### 10.3.8.2.3 Impact of Oyster Landings on Dockside Price

Dedah et al. (2011) is the most current and detailed analysis examining the influence of production in different regions of the United States and imports on the Gulf of Mexico dockside. The study employed a complete demand system using quarterly data covering the first quarter 1985 through the fourth quarter of 2008. Included in the analysis was Gulf oyster production. The authors found that a 10 % increase (decrease) in Gulf harvest (at its mean value) resulted in a 6.4 % decrease (increase) in the Gulf dockside oyster price. Dedah et al. (2011) also indicate that Gulf dockside price is significantly influenced by production in other regions and imports. Specifically, a 10 % increase (decrease) in Pacific production was found to result in an inverse reduction or increase in the Gulf price by 1.6 %. Finally, the authors found that a 10 % increase in all supply sources (Gulf, Chesapeake, Pacific, and imports), evaluated at the 1985–2008 mean values for all variables, results in a 9.8 % decrease in the Gulf dockside price.

#### 10.3.8.3 The Commercial Reef Fish Sector

The Gulf of Mexico is host to a large number of reef fish species, many of which represent income generators to the commercial fishing sector. Given the susceptibility of many of the species to overfishing in conjunction with their popularity by the commercial and recreational sectors, the GMFMC is considerably involved in the management of reef fish species. Management of reef fish species with respect to the commercial sector has historically included sector quotas, size and trip limits, closed seasons, limited entry, and, more recently, the introduction of catch shares (previously called individual fishing quotas). The introduction of catch shares, as discussed in more detail below, constitutes a major shift in management regime and one that is likely to become more prevalent over time.

Following the *Gulf of Mexico Reef Fish Fishery Management Plan* (GMFMC 1981) and related amendments, Gulf of Mexico reef fish can be broadly classified into six groups: snappers, groupers, tilefish, jacks, amberjacks, and triggerfish. Annual commercial landings of these species



**Figure 10.56. Gulf of Mexico commercial reef fish landings in pounds (*left panel*) and value (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012, with deflated values calculated by authors—see Appendix A) (Note: 1 lb = 0.454 kg).**

groups, excluding triggerfish, are presented in Figure 10.41 (left panel) for the 1990–2009 period (Note: commercial landings of triggerfish are minor, totaling less than 1 million pounds since 1990). Two of these species groups—snappers and groupers—dominate commercial reef fish landings with respective shares both in excess of 40 %. Overall, the total commercial landings of reef fish species declined from about 20 million pounds annually in the early to mid-1990s to about 16 million pounds annually in the later years of analysis (Figure 10.56, left panel).

The current dockside value of the commercial reef fish landings, as indicated by the information in Figure 10.56 (right panel), showed little growth during the period of analysis, and on a deflated basis (with 2009 being designated as the base year for the CPI), the value has clearly been declining. There are a number of potential reasons for this decline. First, reef fish landings have fallen marginally during the period of analysis. Second, management measures, particularly with respect to the red snapper fishery, may have contributed to lower prices than would otherwise be the case (in short, derby fishing conditions that led to market gluts). Finally, and of significant importance, imports of snappers and groupers are large; generally nearing or exceeding domestic production of these species. During 2005–2009, for example, imports of snapper averaged eight million pounds (product weight) annually, while imports of grouper averaged ten million pounds (product weight). These imports have been increasing over time and, being close substitutes for the domestic product, likely exerted downward pressure on the Gulf snapper and grouper dockside prices.

Examining snapper separately, landings have averaged about 8.4 million pounds annually since 1990 with no apparent long-run trend (Figure 10.57, left panel). While the current value of snapper landings increased from approximately \$15 million per year in the early 1990s to about \$20 million per year, on average, in the later years, the deflated value of Gulf of Mexico snapper landings illustrated no increase (Figure 10.57, right panel). The long-run stability in commercial snapper landings and the concomitant stability in deflated value of the landings imply, of course, long-run stability in the deflated per pound price. While the deflated dockside price exceeded \$3.00 per pound in 1990 and 1991, the deflated dockside price since 1992 has fallen in the relatively narrow range of \$2.40–\$2.80 per pound (based on the 2009 CPI). Waters (2001) ascribes much of the decline in snapper price beginning in 1992 to management measures imposed to protect and rebuild the red snapper stock. Also, as noted, imports of snappers are large and have been increasing over time.

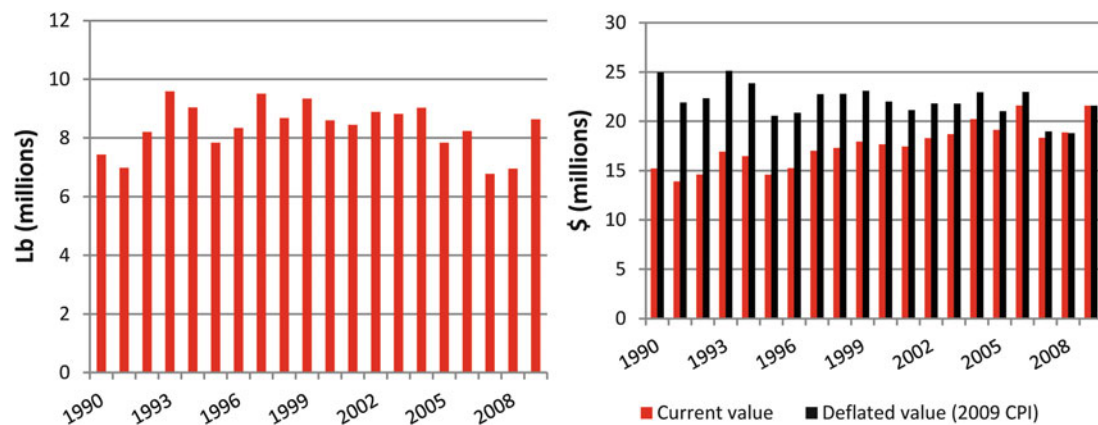


Figure 10.57. Gulf of Mexico commercial snapper landings in pounds (*left panel*) and value (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012, with deflated values calculated by authors—see Appendix A) (Note: 1 lb = 0.454 kg).

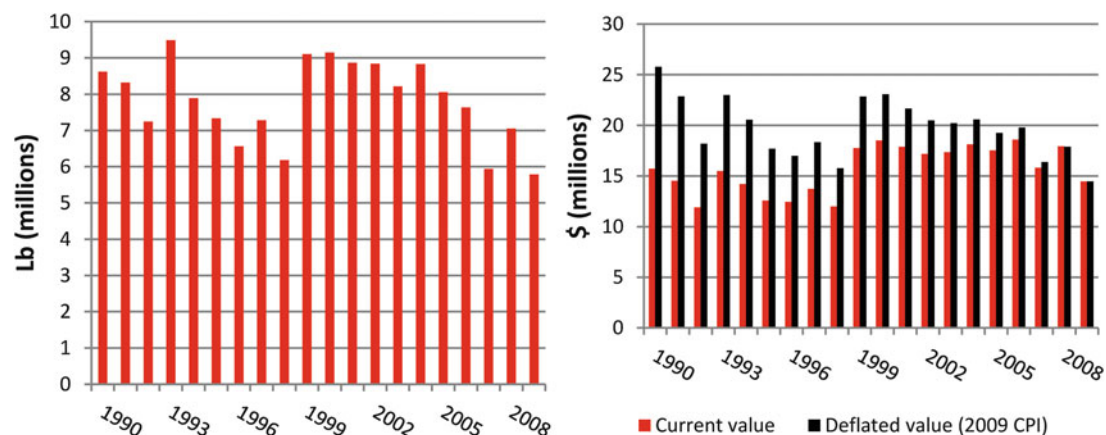


Figure 10.58. Gulf of Mexico commercial grouper landings in pounds (*left panel*) and value (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012, with deflated values calculated by authors—see Appendix A) (Note: 1 lb = 0.454 kg).

Gulf of Mexico annual commercial grouper landings (Figure 10.58, left panel) indicate production from a low of less than six million pounds to a high of more than nine million pounds. Since 2005, landings have averaged about seven million pounds annually or about one million pounds below the eight million pound long-run average. This decline is, at least in part, the result of more stringent quotas being placed on the commercial sector in response to recent stock assessments suggesting that some species in the grouper complex are experiencing overfishing conditions. Furthermore, as was the situation with red snapper, the value of grouper landings has trended downwards (Figure 10.58, right panel) when inflationary effects are removed (based on the 2009 CPI). This is largely the result of a decline in landings in recent years given that the deflated per pound price has historically fallen in the relatively narrow range of about \$2.40–\$2.70 per pound with few exceptions and no apparent trend.

Two reef fish species—red snapper and vermilion snapper (*Rhomboplites aurorubens*)—represent the primary species targeted by commercial fishermen in the northern Gulf of

Mexico. In the eastern Gulf, grouper dominates commercial harvest. Management of all of these species is under the purview of the GMFMC. Management measures implemented over the years to protect these stocks are numerous including minimum size restrictions, vessel quotas, closed seasons, and most recently, catch share programs for the red snapper fishery (implemented in 2007) and the grouper and tilefish fisheries (implemented in 2010). These catch share programs give harvesting rights to individuals with each individual's harvesting rights based on the total quota for the fishery and each individual's share of the total (shares will sum to 100 % of the quota). Given overall industry quotas for all of these species, landings are constrained and will expand only as the respective stocks expand.

As mentioned, the red snapper fishery is one of the two most important reef fish species targeted by the commercial sector in the northern Gulf of Mexico, and it was the first of the Gulf reef fish species to be managed under a catch share program. While originally scheduled for implementation in the mid-1990s, congressional actions delayed implementation until 2007 (see Keithly (2001) for information on the original program and congressional actions that delayed implementation). When implemented on January 1, 2007, the commercial quota was set at 2.55 million pounds (whole weight) with a quota increase of 765,000 lb later in the year (NMFS 2010). The 2007 ending quota of 3.315 million pounds was reduced to 2.550 million pounds for both 2008 and 2009. The commercial quota is of particular importance because it provides an upper boundary for commercial harvest assuming no illegal catch. In fact, the reported commercial harvest since 2007 and through 2009 has been from 96 to 97 % of the quota allocated to the sector (NMFS 2011).

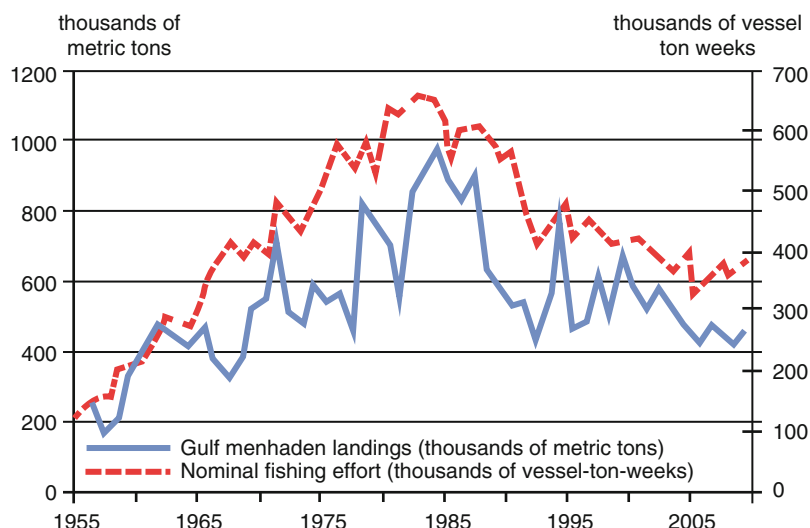
Shares in the red snapper fishery can be either sold or leased.<sup>15</sup> As noted by Gauvin et al. (1994), if fishermen embrace the future of the catch share program and expect the program to last in perpetuity, then shares can be considered an asset worth the equivalent of the discounted stream on net income derived from that asset. According to the NMFS (2010), the mean transfer price per one-pound equivalent of shares approximated \$14 in 2009, while the median price was approximately \$18. The allocation price (lease price to harvest one pound in 2009) was \$3.02. However, as stated in the report, the large number of transactions without reliable price information suggests that these figures should be viewed with some caution.

#### 10.3.8.4 Menhaden

The Gulf of Mexico menhaden fishery was briefly considered in Section 10.3.1.1. The species is relatively short lived and in 2009 age-2 fish comprised an estimated 73 % of the fleet harvest and age-1 fish comprised 13 % of the harvest (NMFS, Sustainable Fisheries Branch, Beaufort, NC, 2010). Overall, the percentage of age-2 fish comprising harvest has increased over time with reasons for this increase not clearly identified. Hypotheses include (1) contraction of the fishery over time from the extremes of the species range, Florida through Texas, where smaller fish were more abundant in Mississippi and Louisiana waters and (2) a redistribution of age-1 fish to more inside waters due to deterioration of wetlands (GSMFC meeting, Orange Beach, Alabama, 2010). Given that the majority of harvest comprises only a couple of year classes, environmental factors that influence recruitment significantly influence subsequent harvest. Citing Christmas et al. (1982) and Guillory et al. (1983), Deegan (1990) suggests that low winter temperatures, high salinities, and low turbidity during the period when the menhaden are in the estuaries are correlated with poor year-classes because of their

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<sup>15</sup> Details of the red snapper catch share program, including issues of transferability and leasing, can be found in Amendment 26 to the Gulf of Mexico Reef Fish Fishery Management Plan (GMFMC 2006) which is available at: [http://sero.nmfs.noaa.gov/sf/pdfs/Amend\\_26\\_031606\\_FINAL.pdf](http://sero.nmfs.noaa.gov/sf/pdfs/Amend_26_031606_FINAL.pdf).



**Figure 10.59. Gulf of Mexico menhaden landings and nominal effort, 1955–2009 (NMFS (Sustainable Fisheries Branch) 2010) (Note: 1 metric ton is equal to 2,204.6 pounds).**

influence on growth and mortality rates of young-of-the-year fish. Louisiana, in fact, forecasts menhaden catch each year using a suite of factors including water temperature (off Grand Isle, Louisiana), salinity, Mississippi River discharge, juvenile menhaden catch in fishery-independent trawl samples, and expected effort.<sup>16</sup> Given that the fishery is largely dependent upon only 2 year classes, changes in environmental factors that influence recruitment of juveniles can significantly influence menhaden availability from one year to the next.

While environmental factors may largely drive menhaden availability, catch is determined by both environmental factors and effort employed to harvest available menhaden. The NMFS (Beaufort Laboratory) has been forecasting annual Gulf menhaden harvests based on estimates of expected fishing effort for the upcoming year (via discussion with industry). Gulf forecasts over the 1973–2009 period have differed from actual catch by an average of 15 % per year (NMFS, Beaufort Laboratory, 2010). The relationship between effort and harvest is clearly illustrated for the 1955–2009 period in Figure 10.59. While the relationship is clear, it is also apparent that annual variations in harvest are large relative to annual variations in effort. This fact is likely explained by the influence of environmental factors on the populations of the few year classes dominating harvest.

### 10.3.9 Additional Detail on Processing and Wholesaling

In general, there are two sources of data by which one can examine the seafood processing industry. The first source is generally referred to as *the voluntary end-of-the year processor survey*, and the data used in this survey is collected and maintained by NMFS. Data collected include detailed information (by plant) on species processed and output by product form, the value of the output, and employment. The database is very rich, and it was this database that was employed in the analysis of Gulf shrimp and oyster processing activities in this chapter. The other data source represents information collected by the U.S. Bureau of Census, and this

<sup>16</sup> <http://menhaden.gsmfc.org/pdf/March%202008%20MAC%20minutes.pdf>.



data source was the basis for discussion in Section 10.3.5. Both data sources have their advantages. The primary advantage of the NMFS data source is that it provides detailed information on processing activities by species and associated output value. The primary disadvantage of this source is that although detailed information by species is collected, it is not routinely published, and for reasons of confidentiality, the information is not easily accessible by the general public. The primary advantage of the data collected by the U.S. Bureau of Census is that differentiation is made between nonemployer processing firms (defined as firms that have no paid employees and are subject to federal income taxes), which tend to be small in scale, and employer establishments (which have paid employees and may, in some instances, consist of more than one firm in one or more states). In addition, payrolls are given for employer establishments. One primary limitation to this data source is the absence of detailed information on processed species and value of output (though the value of output is apparently provided for nonemployer establishments). A second limitation is that data for Florida are not differentiated between the Gulf and South Atlantic. The NMFS uses this database in describing processing activities by state in its annual *Fisheries Economics of the United States* reports, and it is this data source used in this section. All seafood wholesaling information also comes from the U.S. Bureau of Census.

Annual seafood sales and processing information for each of the five Gulf of Mexico states (which includes the east coast of Florida) for the 2000–2008 period is presented in Tables 10.4, 10.5, 10.6, 10.7, and 10.8, and 2008 information for the Gulf, in aggregate, is provided in Table 10.9. While a detailed discussion of the information in each table is beyond the scope of this chapter, a discussion of some of the primary findings is informative.

Examination of the individual state tables leads to the conclusion that there is little or no growth in the number of employer-based seafood processing establishments, and some states (particularly Florida and Mississippi) are experiencing a significant contraction in the number of establishments. Those states experiencing the largest contraction in number of establishments (on a percentage basis) also experienced a large decline in number of employees suggesting that contraction goes beyond simple consolidation, with the caveat that payroll does not appear to have fallen as much as employment.

A second noteworthy finding is that Mississippi consistently led Gulf States in terms of the number of employees among employer-based processing establishments during the period of analysis with a generally higher commensurate payroll. Given the limited commercial landings in Mississippi, it is clear that other sources of raw product, including product from other states and imports, are being used by Mississippi processors.

As shown in the tables, employer-based establishments tend to be substantially larger than the nonemployer-based firms. Specifically, payrolls among employer-based establishments in each of the Gulf States tended to exceed receipts by the nonemployer firms even though the number of employer-based establishments by state, with the exception of Mississippi, tended to be significantly less than the number of nonemployer based firms and payroll comprises only a fraction of receipts (assuming profitability).

The information in the respective tables also indicates that Florida (including east coast) and Louisiana experienced sizable increases in the number of nonemployer processing firms during the period of study with the number in Florida approximately doubling. Furthermore, receipts from the sale of prepared and packaged seafood among nonemployer firms can be highly variable from one year to the next and does not appear to strongly track changes in the number of firms.

Finally, comparing payroll from employer-based seafood wholesaling by state to seafood processing indicates that seafood wholesaling represents a major activity with payroll often exceeding that of processing (i.e., Florida and Texas). The primary exception to this finding is

Table 10.4. Florida (Including East Coast) Annual Seafood Processing and Wholesaling Activities, 2000–2008

	Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Seafood sales and processing—nonemployer firms										
Seafood product prep. and packaging	Firms	102	104	116	142	177	164	174	173	202
	Receipts (\$1000's)	8,330	6,350	5,064	8,047	8,652	8,756	10,184	10,497	11,065
Seafood sales and processing—employer establishments										
Seafood product prep. and packaging	Firms	41	43	33	27	24	25	22	20	23
	Employees	2,188	2,033	2,359	2,084	2,193	1,616	1,704	1,748	1,637
	Payroll (\$1000's)	58,821	58,977	65,914	61,452	65,881	47,529	62,801	58,233	53,455
Seafood sales, wholesale	Firms	329	323	314	293	261	258	259	267	229
	Employees	2,915	2,670	2,395	1,835	1,948	1,883	2,091	2,308	1,913
	Payroll (\$1000's)	76,363	76,717	78,160	55,874	63,276	65,339	73,897	85,019	75,203

Source: U.S. Department of Commerce (2011)



**Table 10.5. Alabama Annual Seafood Processing and Wholesaling Activities, 2000–2008**

	Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Seafood sales and processing—nonemployer firms										
Seafood product prep. and packaging	Firms	46	39	44	36	43	40	34	47	33
	Receipts (\$1000's)	3,677	2,711	3,603	1,168	3,413	3,414	1,558	1,547	1,894
Seafood sales and processing—employer establishments										
Seafood product prep. and packaging	Firms	17	21	22	24	23	26	24	23	23
	Employees	1,725	1,880	1,951	2,057	2,037	1,925	1,629	1,510	1,450
	Payroll (\$1000's)	33,811	32,692	36,198	36,766	36,130	38,229	34,703	32,774	29,277
Seafood sale; wholesale	Firms	47	45	36	33	31	26	26	31	29
	Employees	887	692	547	611	588	607	395	395	494
	Payroll (\$1000's)	10,252	9,597	7,062	6,148	6,752	6,345	6,195	6,202	8,751

Source: U.S. Department of Commerce (2011)

Table 10.6. Mississippi Annual Seafood Processing and Wholesaling Activities, 2000–2008

	Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Seafood sales and processing—nonemployer firms										
Seafood product prep. and packaging	Firms	10	13	15	23	18	12	22	0	17
	Receipts (\$1000's)	1,300	1,186	915	1,561	1,056	1,045	1,537	ND	1,055
Seafood sales and processing—employer establishments										
Seafood product prep. and packaging	Firms	37	33	34	37	33	28	24	22	20
	Employees	4,339	4,053	3,675	4,438	3,728	3,637	3,353	3,022	3,062
	Payroll (\$1000's)	73,350	65,237	70,792	80,229	66,047	63,957	60,510	60,633	61,723
Seafood sales, wholesale	Firms	30	28	29	26	29	30	23	25	18
	Employees	232	2,226	226	176	166	145	58	106	61
	Payroll (\$1000's)	3,716	4,056	3,791	3,067	3,631	1,822	2,063	3,285	3,088

Source: U.S. Department of Commerce (2011)

Table 10.7. Louisiana Annual Seafood Processing and Wholesaling Activities, 2000–2008

	Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Seafood sales and processing—nonemployer firms										
Seafood product prep. and packaging	Firms	39	58	66	73	75	76	99	85	77
	Receipts (\$'1000's)	3,466	2,918	3,006	4,678	10,097	8,513	8,179	6,253	7,365
Seafood sales, retail	Firms	172	170	185	208	204	156	181	196	182
	Receipts (\$'1000's)	11,806	12,586	15,201	22,637	18,148	14,585	20,046	20,932	25,900
Seafood sales and processing—employer establishments										
Seafood product prep. and packaging	Firms	56	50	50	54	54	50	40	41	36
	Employees	1,282	1,141	1,185	1,693	1,519	1,556	1,506	1,253	991
	Payroll (\$'1000's)	45,285	48,331	52,861	56,562	47,016	43,801	45,439	41,391	32,382
Seafood sales, wholesale	Firms	162	164	152	134	133	128	112	119	98
	Employees	1,187	1,245	1,270	1,001	975	1,037	807	954	739
	Payroll (\$'1000's)	21,717	23,053	22,363	19,539	19,639	17,649	21,243	21,604	18,858

Source: U.S. Department of Commerce (2011)

Table 10.8. Texas Annual Seafood Processing and Wholesaling Activities, 2000–2008

Year		2000	2001	2002	2003	2004	2005	2006	2007	2008
Seafood sales and processing—nonemployer firms										
Seafood product prep. and packaging	Firms	85	108	104	99	100	108	109	94	85
	Receipts (\$1000's)	5,596	5,575	3,901	5,234	1,981	2,228	2,974	5,386	3,466
Seafood sales and processing—employer establishments										
Seafood product prep. and packaging	Firms	31	29	27	23	24	23	21	26	27
	Employees	1,305	1,506	1,453	1,274	1,177	1,288	1,155	1,207	1,169
	Payroll (\$1000's)	24,374	24,507	25,772	25,426	24,394	23,842	24,302	27,813	27,045
Seafood sales, wholesale	Firms	113	129	115	99	103	97	92	104	69
	Employees	1,187	1,102	999	1,057	1,009	1,001	897	970	734
	Payroll (\$1000's)	32,857	33,552	29,430	27,016	27,730	26,408	28,586	51,597	24,498

Source: U.S. Department of Commerce (2011)

**Table 10.9. Gulf of Mexico (Including Florida East Coast) Seafood Processing and Wholesaling Activities, 2008**

	State	Florida	Alabama	Mississippi	Louisiana	Texas
Seafood sales and processing—nonemployer firms						
Seafood product prep. and packaging	Firms	202	33	17	77	85
	Receipts (\$1000's)	11,065	1,894	1,055	7,365	3,466
Seafood sales and processing—employer establishments						
Seafood product prep. and packaging	Firms	23	23	20	36	27
	Employees	1,637	1,450	3,062	991	1,169
	Payroll (\$1000's)	53,455	29,277	61,723	32,382	27,045
Seafood sales, wholesale	Firms	229	29	18	98	69
	Employees	1,913	494	61	739	734
	Payroll (\$1000's)	75,203	8,751	3,088	15,858	24,498

Source: U.S. Department of Commerce (2011)

Mississippi (and to a lesser extent Alabama) where payroll from wholesaling is a small fraction of that associated with processing.

## 10.4 THE GULF OF MEXICO RECREATIONAL SECTOR

A review of the Gulf of Mexico recreational fishing sector is provided in this section. Issues to be considered include participation, number of trips, catches of various species, and expenditures and multiplier effects. Much of the information reported here is derived from MRFSS/MRIP implemented by the NMFS in 1979.<sup>17</sup> Collection of reliable statistics on recreational activities is notoriously elusive and, as stated by a panel convened to review the validity of the MRFSS/MRIP protocol, “[r]ecreational angling provides formidable challenges in estimating catch, effort, and economic expenditures by anglers, either regionally or nationally, due to the diversity of sites and modes of fishing available to the anglers” (National Research Council 2006).

With this in mind, it is instructive to first examine the methodology employed to collect data that are used in MRFSS/MRIP estimates of effort, participation, and catch rates. There are two independent but complementary surveys used to collect the raw data—a telephone survey and a dockside intercept survey. The telephone survey is used to determine the number of participants and trips, and the dockside intercept is used primarily for determining species caught and associated quantities.

Determining species caught and quantities are problematic for at least three reasons. First, and foremost, for reasons discussed later in this section, much of the catch is released and, as such, is not observed by the port sampler. Second, if catch by an individual is large, the port sampler may not have time to measure all fish or the angler may refuse to show all fish to the

<sup>17</sup>In early 2012, changes were made in the MRFSS estimation procedure regarding the extrapolation from the sample to the population with respect to catch. Participation estimates were not changed. Changes were made from 2004 forward. The name of the program was also changed from the Marine Recreational Fisheries Statistics Survey to the Marine Recreational Information Program. In general, changes appear in most cases to be minor. Details regarding changes, including a comparison of the MRFSS to MRIP data, is available at: <http://www.countmyfish.noaa.gov/index.html>.

port sampler. Finally, given limited budgets and time, port samplers are only able to interview a small proportion of anglers. As such, estimates of total catch and weight are made based on a relatively small sample and there will be imprecision in these estimates. Furthermore, the magnitude of the impression, as a percentage of the estimate, is likely to be compounded when considering infrequently caught species or when estimates are generated for a geographic region more narrowly defined than the Gulf of Mexico (e.g., state or county/parish). This later observation reflects the fact that the MRFSS/MRIP was originally designed in a manner that would yield reliable estimates of catch and effort for the Gulf of Mexico in total, but estimates at the state level would be less reliable. However, a number of states now contribute to the MRFSS/MRIP federal budget to ensure greater reliability of estimates at the state level. Other limitations associated with the MRFSS/MRIP are discussed in the National Research Council report (2006).

Given that much of the ensuing discussion regarding recreational catch (in numbers of fish) and harvest (pounds landed or released dead) is based on the MRFSS/MRIP, the reader should be cognizant that the figures given are merely estimates, and there are likely to be some errors associated with these estimates. Also, Texas is not included in the MRFSS/MRIP, and as such, all discussion of catch, harvest, trips, and participation is exclusive of Texas (though Texas is included in the Expenditures and Multipliers section of the chapter).<sup>18</sup> Finally more emphasis tends to be given to Louisiana and, to a lesser extent, Florida. This reflects the fact that Florida has, by far, the largest recreational fishery in the Gulf (of the four states considered) and there is currently a special interest in the Louisiana recreational fishery. In some instances, comparisons are made between the MRFSS/MRIP data and other available information, particularly regarding Louisiana.

For purposes of notation, the MRFSS/MRIP system designates fish brought into the dock and observed by the port sampler (trained interviewers) as *A*. Fish that are used for bait, released dead, or filleted (i.e., they are killed but identification is by individual anglers) are designated as *B1* (i.e., fish that are considered harvested but not seen or identified by interviewer). Finally fish claimed to be released alive by the angler (identified by individual anglers) are designated as *B2*. Given these designations, total catch is defined as  $A + B1 + B2$ . Total harvest, or removals from the stock, is defined as  $A + B1$ . Total catch (i.e.,  $A + B1 + B2$ ) is given only in numbers of fish because *B2* is unobserved by the trained port samplers. The harvest ( $A + B1$ ) is given in terms of both numbers of fish and weight.<sup>19</sup> These designations are used throughout the report. For purposes of this chapter, with few exceptions, analysis of catch includes fish released alive (i.e., *B2*). Thus, unless otherwise noted, catch will refer to the total number of fish caught, whether released or kept. Harvest ( $A + B1$ ), however, is only examined in terms of pounds of fish. In general, we have attempted to provide detail on catch in a manner that the reader can also ascertain harvest ( $A + B1$ ) in terms of numbers of fish.

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<sup>18</sup> In addition, catch by headboats are not included in the MRFSS/MRIP data. Catch by this sector tends to be relatively limited for most species and would rarely exceed 10 % of the total estimated recreational catch of any species. Furthermore, most of the catch by this sector would be that associated with offshore species (primarily snappers and groupers).

<sup>19</sup> Additional detail on the sampling process can be found at <http://www.st.nmfs.noaa.gov/st/recreational/queries/glossary.html>.



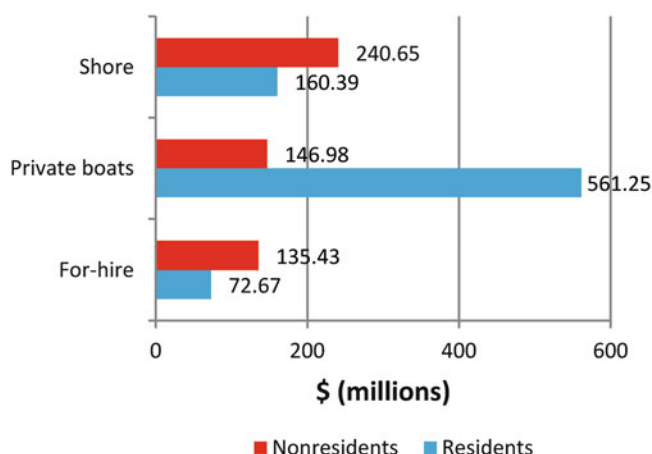


Figure 10.60. Estimated marine recreational angling trip expenditures, 2009 (NMFS 2010).

#### 10.4.1 Expenditures and Multipliers

Each year, millions of individuals, both Gulf and non-Gulf residents, enjoy marine recreational fishing in the Gulf of Mexico. In pursuing this activity, expenditures are incurred. These expenditures can be broadly classified as either trip expenditures or durable expenditures. Furthermore, these expenditures can be incurred in association of shore-based fishing activities, private boat fishing activities, or for-hire fishing activities. The estimated 2009 trip expenditures associated with each of these activities are presented in Figure 10.60. As indicated, greatest trip expenditures were incurred in private/rental boat fishing activities, which totaled \$708 million. The vast majority of this total (approximately 80 %), as might be expected, was incurred by Gulf residents. With respect to for-hire (charter) activities, by comparison, the majority of total estimated expenditures (\$208 million) were incurred by nonresidents who accounted for 65 % of the total. Similarly, about 60 % of the \$401 million spent on shore-based fishing activities in 2009 was incurred by nonresidents.

Expenditures incurred in the pursuit of recreational fishing activities generate jobs, sales, value added, and income in the state where these initial expenditures were incurred. NMFS has estimated economic multipliers associated with these expenditures; details of these multipliers and assumptions are given by Gentner and Steinback (2008). Focusing initially on the 2009 impacts, recreational fishing activities were estimated to generate, at a minimum, 92,000 jobs throughout the Gulf States when including indirect and induced effects associated with the initial expenditures (Table 10.10). Value added, which represents the contribution of recreational fishing to the gross domestic product of the state (region), was estimated to equal \$3.3 billion. Sales, which represent the total dollar sales resulting from the initial expenditures, totaled an estimated \$9.9 billion. Finally, income, which represents wages, salaries, benefits, and proprietary income resulting from the initial angler expenditures, totaled more than \$5 billion.

Florida (west coast) accounted for about 50 % of the total number of generated jobs and value-added activities in 2009. Texas accounted for about 25 % of the generated jobs and value-added activities. Louisiana, though having a small population relative to Texas, accounted for about 20 % of the generated jobs and more than 15 % of the value-added activities.

**Table 10.10 Economic Impacts Associated with Gulf of Mexico Angling Activities, 2006–2009**

	<b>Jobs</b>	<b>Sales (\$1000 s)</b>	<b>Value Added (\$1000 s)</b>	<b>Income (\$1000 s)</b>
<b>2006</b>				
Florida (West Coast)	75,257	7,823,752	4,235,087	NA
Alabama	6,572	630,181	325,523	NA
Mississippi	3,731	490,501	189,450	NA
Louisiana	26,612	2,382,034	1,199,333	NA
Texas	34,175	4,197,011	2,154,891	NA
<b>Total</b>	<b>146,347</b>	<b>15,523,479</b>	<b>8,104,284</b>	<b>NA</b>
<b>2007</b>				
Florida (West Coast)	65,799	6,829,434	3,704,818	NA
Alabama	6,759	654,353	337,493	NA
Mississippi	4,707	616,930	239,021	NA
Louisiana	27,446	2,453,392	1,234,449	NA
Texas	23,382	3,004,862	1,514,791	NA
<b>Total<sup>a</sup></b>	<b>128,093</b>	<b>13,558,971</b>	<b>7,030,572</b>	<b>NA</b>
<b>2008</b>				
Florida (West Coast)	54,589	5,650,068	3,075,710	NA
Alabama	4,719	455,093	235,481	NA
Mississippi	2,930	382,778	148,837	NA
Louisiana	25,590	2,297,078	1,156,796	NA
Texas	25,544	3,288,135	1,656,545	NA
<b>Total<sup>a</sup></b>	<b>113,372</b>	<b>12,073,152</b>	<b>6,273,369</b>	<b>NA</b>
<b>2009</b>				
Florida (West Coast)	42,314	4,369,022	1,532,821	2,385,738
Alabama	4,924	474,746	155,663	245,437
Mississippi	3,188	417,080	105,472	162,099
Louisiana	19,688	1,774,692	578,767	894,123
Texas	22,127	2,846,858	910,011	1,434,733
<b>Total<sup>a</sup></b>	<b>92,241</b>	<b>9,900,398</b>	<b>3,282,734</b>	<b>5,122,130</b>

<sup>a</sup>Note: The TOTAL figures should be considered a minimum since they do not account for any trade among individual Gulf States (estimated by authors). NA not available. Source: U.S. Department of Commerce (various issues): ([http://www.st.nmfs.noaa.gov/st5/publication/fisheries\\_economics\\_2009.html#](http://www.st.nmfs.noaa.gov/st5/publication/fisheries_economics_2009.html#)).

Comparison of economic impacts across years indicates a distinct reduction in jobs, sales, and value-added activities from 2006 to 2009. For instance, while the total number of estimated jobs generated from Gulf recreational fishing activities equaled 146,000 in 2006, by 2009 the total number of estimated jobs had fallen to 92,000. Similarly, value-added activities fell from an estimated \$8.1 billion in 2006 to just \$3.3 billion in 2009. Much if not most of this decline can be tied to the downturn in the U.S. economy that began in 2007 and continued into 2009. Furthermore, as indicated, a large proportion of the decline can be tied to Florida (west coast), which, among the Gulf States, was particularly impacted by the most recent recession.

## 10.4.2 Gulf of Mexico Fishing Activities

Various issues related to the Gulf of Mexico recreational fishing sector are considered in this section of the report including an analysis of trips taken and catch (number of fish) and harvest (pounds kept). Catch and harvest are evaluated at the aggregate level and for some of the primary species groups and individual species. Missing from this section is a discussion of the number of recreational participants. This is because the MRFSS/MRIP does not provide this information at the aggregate Gulf level (in particular, estimates of nonresidents are not given because of potential *double counting* of Gulf residents fishing in more than one state). However, participation in the individual Gulf States is considered when states are evaluated on an individual basis.

### 10.4.2.1 Number of Angler Trips

Before considering angler trips, a definition is in order. The MRFSS/MRIP defines a single angler on a fishing trip as an angler trip. Hence, if a party of four goes out on a private/rental boat, this is considered to be four angler trips. Based on this definition, the number of saltwater angler trips, according to MRFSS/MRIP estimates, averaged just over 20 million annually during the 1990–2009 period (Figure 10.61). Throughout the 1990s, the estimated number of annual angler trips never exceeded 20 million, and the 10-year average was 17 million. Beginning in 2000, the estimated annual number of trips increased sharply with the average in the most recent decade equaling 23.1 million. During this most recent 10-year period the number of annual trips fell below 20 million only in 2002 when the total equaled 19.7 million. The maximum number of trips during the 20-year period of analysis occurred in 2004 with the estimated total exceeding 26 million.

The reason for the large increase in number of angler trips beginning in 2000 is difficult to identify. While real per capita income did rise during the late 1990s and through much of the 2000s, the increase is likely not sufficient to explain the sharp increase in estimated trips. Similarly, while population throughout the Gulf region was gradually increasing during the period of analysis, which might explain the gradual overall increase in estimated trips, there was no abrupt change in the late 1990s/early 2000s that would correlate with the large increase in trips. Similarly, after being at near-record lows (adjusted for inflation) during the 1990s, gasoline prices rose rapidly beginning around 2000 and, hence, a decline in the cost of a

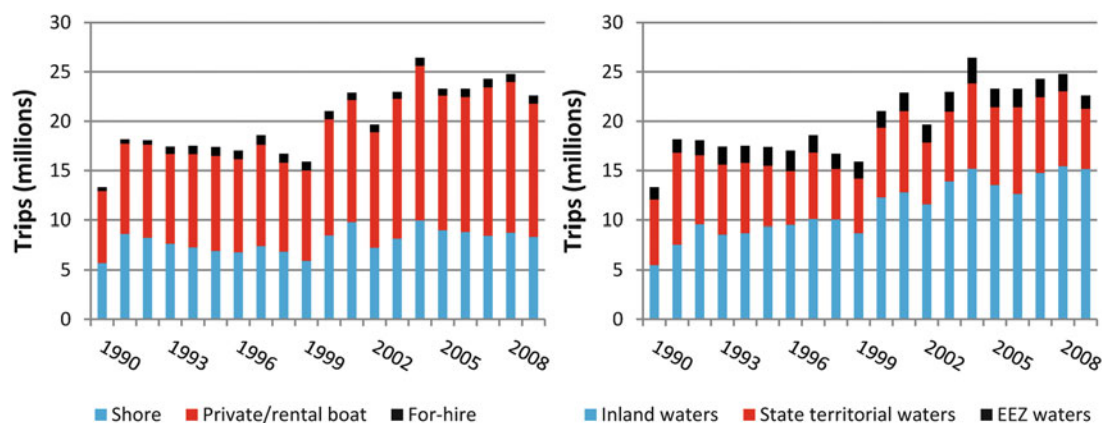


Figure 10.61. Gulf of Mexico angler trips by mode (*left panel*) and by area fished (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A).

recreational fishing trip does not appear to explain the observed increase in Gulf-wide recreational fishing trips. As discussed in some detail in a subsequent section, a similar trend is apparent in the number of Florida visitors (i.e., a sudden and significant increase in 2000). While it is tempting to suggest that this increase contributed to the large increase in the 2000 estimated fishing trips, one would think that increased visitation would manifest itself via an increase in for-hire trips. However, this mode did not show an appreciable increase in trips.

#### **10.4.2.1.1 Angler Trips by Mode**

Trips in the MRIP database are reported on a mode basis. Three types of modes are considered: shore-based marine fishing trips, private/rental boat-based fishing trips, and charter-based trips. The overwhelming majority of the trips, as indicated by the information in Figure 10.61 (left panel), represent shore-based fishing or fishing from private/rental boats with the former representing about 35–40 % in recent years and the latter representing 55–60 %. Furthermore, virtually all growth in the total estimated number of marine angler trips during 1990–2009 was the result of increasing private/rental boat-based trips. During 1990–1999, the number of private/rental boat-based angler trips averaged 9.1 million annually, and this mode of fishing constituted 54 % of the estimated total number of trips during the period. During the most recent 10-year period of analysis, the estimated number of angler trips associated with the private/rental boat mode increased to 13.6 million annually, and its share of the total advanced to almost 60 %.

Shore-based angler trips averaged 7.9 million during 1990–2009, with a maximum estimate of 10 million being reported in 2004. During the 1990s, shore-based angler trips constituted a 42 % share of the total number based on an annual average of 7.1 million. With the large increase in private/rental boat angler trips since 2000, the share of total trips represented by the shore mode fell to 38 % based on an average of 8.7 million shore-based trips.

For-hire-based marine fishing trips in the Gulf (excluding Texas) represent a very small share of the total number of angler trips. Specifically, during the 20-year period ending in 2009, less than 4 % of the total angler trips were represented by the for-hire sector. In absolute numbers, for-hire trips peaked at just below one million in 1997, and since 2000, have averaged 786,000 annually. In a recently completed analysis, Savolainen et al. (2012) estimated that the population of for-hire operators was 3,315 in 2009. Of this total, 189 were classified as head boats operations (defined as a firm whose primary vessel carries more than six passengers on the average trip), 789 were classified as charter operations (defined as a firm whose primary vessel carries six or fewer passengers, on average, per trip), and 2,337 guide boats (defined as a firm whose primary vessel carries six or fewer passengers per trip, is approximately 28 ft in length or less, and fishes inshore on more than 75 % of the trips). Savolainen et al. (2012) report that revenues (primarily fees and tips) associated with the Gulf of Mexico for-hire sector equaled \$215 million in 2009, with about one-half of the total being derived by the guide operations. The estimated revenues given by Savolainen et al. (2012) compare favorably with those reported by NMFS for 2009 (i.e., \$208 million).

#### **10.4.2.1.2 Angler Trips by Area Fished**

The MRFSS/MRIP segments trips into three fishing areas: (1) inland waters (e.g., bays), (2) state territorial waters, and (3) EEZ waters, where the EEZ for Florida (west coast) is seaward of 9 nautical mi (16.7 km) and for Alabama, Mississippi, and Louisiana is seaward of 3 nautical mi (5.6 km). As indicated by the information in Figure 10.61 (right panel), the vast majority of angler trips occur in state waters (either inland or state territorial). Since 1990, 56 % of the annual total number of trips (20.1 million annual average) occurred in inland waters while an additional 35 % occurred in the state territorial waters. Angler trips in the EEZ, averaging 1.8

million annually during 1990–2009, accounted for less than 10 % of the total annual number of angler trips.

In general, a significant increase in the number of inland angler trips was apparent in the estimates while little increase was observed in either the number of territorial water trips or trips in the EEZ. For example, during 1990–1995, the number of angler trips in inland waters averaged 8.0 million annually. By 2005–2009, this number had increased to 14.3 million (about 75 %). During the same time frames, by comparison, angler trips in state territorial waters increased by less than 5 % (from an average of 7.4 million to an average of 7.6 million) while angler trips in federal waters increased by less than 15 % (from an annual average of 1.5 million to an annual average of 1.7 million). Furthermore, virtually all of the long-run increase in total angler trips, beginning in 2000, as discussed in the previous section of this chapter, appears to be attributable to an increase in number of trips being reported in inland waters.

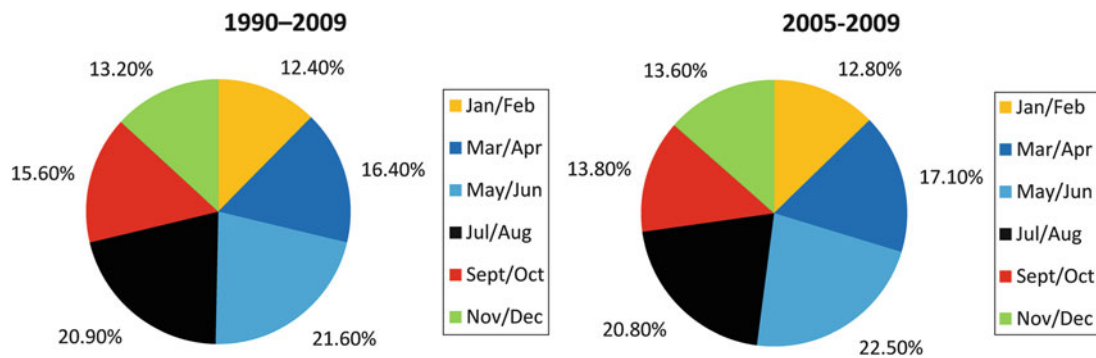
In 2009, total Gulf of Mexico angler trips in EEZ waters (excluding Texas) equaled 1.33 million. This total represented the lowest reported figure since the early 1990s and about a 30 % decrease from the 1.87 million trips reported as recently as 2006. Similarly, angler trips in state territorial waters have fallen sharply since 2006 with the 2009 number (6.1 million) representing more than a 40 % decline when compared to the 2006 figure of 8.8 million trips. These reductions likely reflect, in part, recessionary conditions throughout the country and among Gulf States (particularly Florida, subsequently discussed, which represents the majority of recreational Gulf fishing activities, excluding Texas). Throughout the United States, per capita personal income fell from \$40,900 in 2008 to \$38,800 in 2009. In Florida, the decline was from \$40,000 to \$37,300. While angler trips in Gulf state territorial waters and federal waters have fallen in recent years, angler trips in inland waters have increased—12.6 million in 2006 and 15.2 million in 2009. It is likely that given the reduction in income and high fuel prices, some anglers substituted the less expensive fishing in inland and state territorial waters for the more expensive fishing in federal waters.

#### 10.4.2.1.3 Angler Trips by Wave

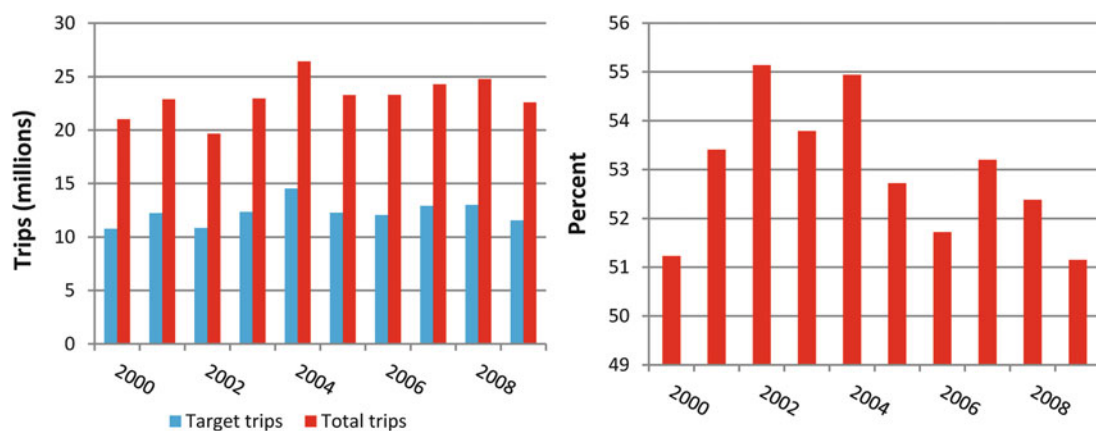
The year-round temperate climate in the Gulf region is conducive to year-round fishing. The MRFSS/MRIP provides information on fishing activities (and catch) in 2-month increments: January/February, March/April, May/June, July/August, September/October, and November/December. While some seasonal fishing patterns in the Gulf are apparent, these patterns, as indicated by the information in Figure 10.46, are moderate in nature. Slightly more than 40 % of the reported trips during the 1990–2009 period occurred during the 4-month summer period ending in August while about 25 % of the angler trips occurred during the 4-month winter period ending in February (Figure 10.62, left panel). Furthermore, little change in seasonality pattern was evident when considering shorter time periods, such as the 2005–2009 period (Figure 10.62, right panel).

#### 10.4.2.1.4 Angler Targeting Behavior

There are a large number of species harvested by recreational anglers in the Gulf of Mexico. When anglers are intercepted at the conclusion of a fishing trip and asked to respond to a series of questions as part of MRFSS/MRIP, one question asked as part of the survey is species targeted on that trip. The angler is allowed to list up to two individual species. Three caveats are in order when evaluating targeting activities. First, many trips contain multiple participants and only the *leader* may be interviewed. It is assumed that the *followers* are targeting the same species. Second, the interviewees may not specify (or may not have) targeted species. Hence, targeting behavior associated with any individual species represents a minimum value of all targeting behavior. Finally, interviews occur at the completion of a trip. As such,



**Figure 10.62.** Gulf of Mexico angler trips by wave for 1990–2009 (*left panel*) and 2005–2009 (*right panel*) (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A).

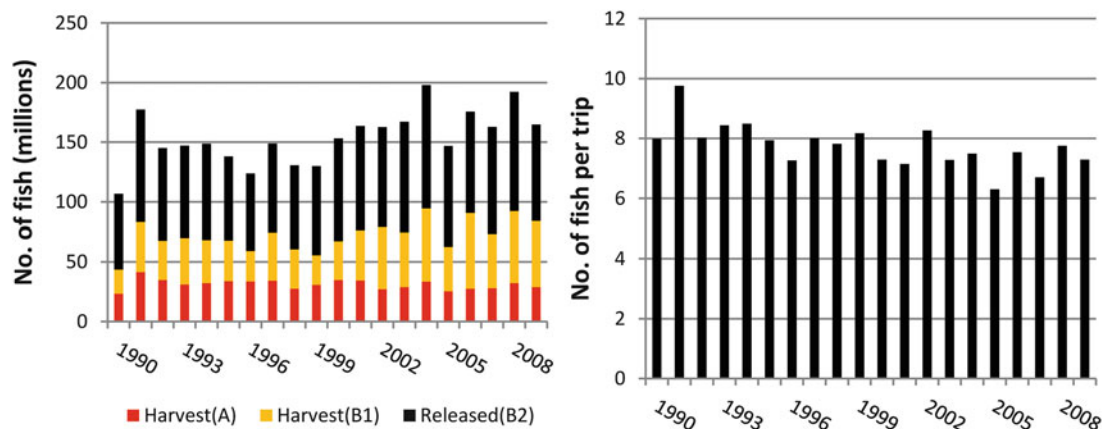


**Figure 10.63.** Gulf of Mexico recreational targeted trips in relation to total trips (*left panel*) and as a percentage of total trips (*right panel*) (NMFS FSD, data accessed 2012, with targeting estimates and percentages calculated by authors—see Appendix A).

there is some debate as to whether the actual catch influences how one responds to questions regarding targeting behavior.

With these caveats in mind, reported targeted angler trips in relation to total angler trips and the targeted angler trips as a percentage of total trips are illustrated in Figure 10.63. As indicated, the proportion of interviewees who list targeted species tends to be limited; ranging from about 51 to 55 % during the 10-year time period being considered (Figure 10.63, right panel). The reason(s) behind the large percentage of, and stability in, unspecified target trips is unknown but to some extent may reflect the large number of species available to recreational anglers with many of the species susceptible to harvest using the same gear. Thus, the primary purpose of a trip becomes one more of catching fish rather than catching specific species. Furthermore, one might speculate that the inability to specify targeted species may be heightened in the offshore fisheries that are largely managed by GMFMC. As discussed in a subsequent section, many of the federally managed species are subject to seasonal closures, and there may be a reluctance to indicate one is targeting a species that would need to be released during a closure of that fishery.





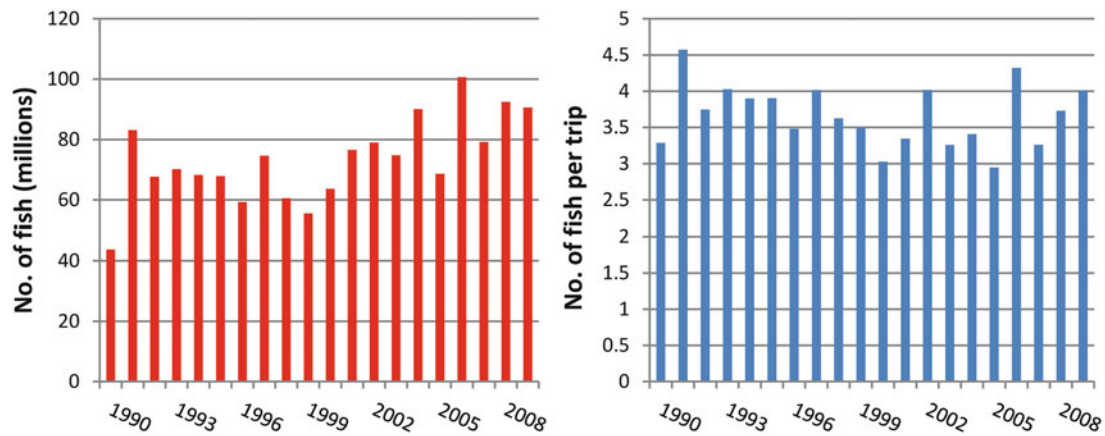
**Figure 10.64.** Catch in numbers of fish by recreational anglers (*left panel*) and number of fish caught per trip (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A).

#### 10.4.2.1.5 Aggregate Gulf of Mexico Recreational Catch/Harvest

The estimated annual number of fish caught ( $A + B1 + B2$ ) throughout the Gulf (excluding Texas) for the 1990–2009 period is given in Figure 10.64 (left panel). The total catch (by all anglers and modes) generally ranged from about 130 million fish per year to 190 million fish per year and averaged about 155 million fish per year during the 20-year period of analysis. While exhibiting considerable year-to-year variation, there is little or no long-run discernible trend in annual catch estimates in number of fish, with a possible exception of an upward and permanent shift beginning in the late 1990s. This upward shift largely corresponds with the upward movement in number of trips (see Figure 10.61).

The information in Figure 10.64 (left panel) also indicates that a large proportion of the number of fish caught is released either alive or dead. Since 1990, more than one-half of the catch in numbers of fish has been released alive (B2) with no apparent long-run trend. The high release rate is the result of a number of factors. Factors include, but are not limited to, (1) many species caught are generally considered to be undesirable (e.g., saltwater catfish), (2) most desirable species now have minimum (and sometimes maximum) size limits with catch at size below (above) that limit required to be returned to the water, (3) there are seasons for many of the desirable species and catch of that species outside the designated season must be released, and (4) retention of some species considered to be severely overfished (e.g., goliath grouper) is prohibited. While there appears to have been an upward and permanent shift in the number of fish caught beginning in the late 1990s (Figure 10.64, left panel), there appears to be no corresponding increase in the number of fish caught per trip (Figure 10.64, right panel). This is because the increased catch beginning in the late 1990s coincided with an increase in the number of angler trips. Hence, the estimated catch per angler trip remained virtually constant.

Focusing only on harvest ( $A + B1$ ), the Gulf of Mexico recreational harvest (excluding Texas) averaged 73 million fish per year during the 20-year period ending in 2009 with a range from less than 50 million in 1990 to 100 million in 2006 (Figure 10.65, left panel). During the decade of the 1990s, the estimated annual harvest equaled 65 million fish per year with the figure increasing to 82 million fish per year during the most recent decade (2000–2009). With few exceptions, the number of fish harvested per trip consistently fell in the relatively narrow range of three fish to four fish with no observable trend (Figure 10.65, right panel). This would



**Figure 10.65.** Harvest (in numbers of fish) by recreational anglers (*left panel*) and number of fish harvested per trip (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A).

suggest that the increasing harvest, expressed in terms of number of fish, during the most recent decade is the result of an increase in number of trips which, as noted, averaged 23 million annually during the most recent decade compared to 17 million annually during the 1990s.

Considering either catch ( $A + B1 + B2$ ) or harvest ( $A + B1$ ) in the aggregate has only limited value because many of the species most frequently caught are done so with the express purpose of using the catch for bait in catching more desirable species. This is clearly illustrated with the help of the information in Tables 10.11, 10.12, 10.13, 10.14, and 10.15 where each table provides the 25 most commonly caught ( $A + B1 + B2$ ) and harvested ( $A + B1$ ) species for a given year (1990, 1995, 2000, 2005, and 2009). As indicated, many of the species either caught ( $A + B1 + B2$ ) or harvested ( $A + B1$ ) tend to be used primarily as bait or released because they are not considered edible. In 1990, for example, three of the four most commonly recreationally caught species in the Gulf of Mexico (scaled sardine [*Harengula jaguana*], gizzard shad [*Dorosoma cepedianum*], and pinfish [*Lagodon rhomboids*]) represent species primarily used for bait as too are Spanish sardine (*Sardinella aurita*) and Gulf menhaden. Many other species—including hardhead catfish (*Arius felis*), gafftopsail catfish (*Bagre marinus*), and ladyfish (*Elops saurus*)—are rarely kept because they are considered *trash fish* by a large proportion of the recreational fishing population. Similarly, many of the more commonly harvested species ( $A + B1$ ) in 1990 are used for bait including the three listed under the most commonly caught species. The average weight of the harvested baitfish species, as indicated, tends to be low relative to non-bait species (e.g., the average weight of scaled sardines equaled 0.0266 lb). The total estimated catch by Gulf of Mexico anglers in 1990 equaled 106 million fish (Figure 10.64, left panel). Of this total, 22.5 million, or about 20 %, represented species that would normally be used for bait. Similarly, the number of fish harvested ( $A + B1$ ) in 1990 was estimated to equal 44 million (Figure 10.65, left panel). Of this total, 13.3 million, or almost 30 %, represented species primarily used for bait.

As also indicated by the information in Table 10.11, some of the species caught ( $A + B1 + B2$ ) in 1990 were generally harvested (i.e., either retained or released dead) while for other species the catch and harvest figures can vary substantially. For example, an estimated 7.9 million scaled sardines were caught by recreational anglers in 1990, of which 7.4 million were harvested. By comparison, while an estimated 11.8 million spotted seatrout were caught by recreational anglers in 1990, about two-thirds of this total were released alive based on an

**Table 10.11 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species by Gulf of Mexico Recreational Anglers, 1990**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Spotted Seatrout	11,782,266	Scaled Sardine	7,406,277	0.027
Scaled Sardine	7,865,548	Spotted Seatrout	3,791,206	1.297
Gizzard Shad	6,781,324	Sand Seatrout	2,785,120	0.652
Pinfish	5,758,476	Pinfish	2,352,044	0.229
Hardhead Catfish	5,335,865	White Grunt	1,961,626	0.709
Sand Seatrout	4,386,361	Atlantic Croaker	1,615,793	0.500
Atlantic Croaker	3,792,456	Spanish Mackerel	1,524,575	1.657
Spanish Mackerel	3,641,476	Sheepshead	1,363,611	2.066
Black Sea Bass	3,242,468	Striped Mullet	1,116,400	1.272
White Grunt	3,192,857	Spanish Sardine	1,046,086	0.044
Red Drum	2,267,628	Gray Triggerfish	945,723	2.372
Striped Mullet	2,253,036	Gizzard Shad	937,038	0.220
Sheepshead	2,043,894	Gulf Menhaden	890,584	0.588
Gray Snapper	1,838,071	Black Sea Bass	879,359	0.669
Gafftopsail Catfish	1,678,791	Gray Snapper	869,753	1.570
Ladyfish	1,559,712	Red Drum	813,517	6.403
Red Grouper	1,501,984	Hardhead Catfish	748,224	1.066
Sand Perch	1,270,975	Yellowtail Snapper	714,397	1.424
Spanish Sardine	1,217,217	Silver Seatrout	696,586	0.584
Southern Flounder	1,162,179	Atlantic Thread Herring	682,254	0.122
Gulf Menhaden	1,135,902	Southern Flounder	614,575	1.382
Yellowtail Snapper	1,098,766	Vermilion Snapper	549,003	0.984
Silver Seatrout	1,087,375	Dolphin	512,500	8.857
Gray Triggerfish	1,082,116	Pigfish	436,867	0.472
Blue Runner	994,028	Sand Perch	435,769	0.436

Source: (NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg)

estimated harvest figure of 3.8 million fish. Since scaled sardines are used primarily for bait, those not used on the trip are likely discarded dead. The large percentage of live-release of spotted seatrout, as discussed in greater detail later in this chapter, reflects the considerable management measures, including size limits and bag limits, implemented to protect the populations of this species throughout the Gulf of Mexico. Finally, as indicated by the information in Table 10.11, some species commonly caught by recreational anglers in the Gulf of Mexico, such as hardhead catfish, are rarely retained or released dead (A + B1). While the estimated catch of hardhead catfish in 1990 totaled 5.3 million fish which led to its 5th place ranking, hardhead catfish ranks only 17th among most commonly harvested species indicating that the vast majority of this species is reported to be released alive. Because there are virtually

**Table 10.12 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species by Gulf of Mexico Recreational Anglers, 1995**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Spotted Seatrout	20,803,580	Spanish Sardine	890,074	NA
Scaled Sardine	19,570,826	Pinfish	855,943	0.220
Pinfish	12,297,105	Sand Seatrout	817,751	0.530
Red Drum	6,987,029	White Grunt	752,203	0.699
Hardhead Catfish	6,466,956	Vermilion Snapper	699,398	1.041
White Grunt	5,409,872	Southern Flounder	662,142	1.144
Sand Seatrout	4,449,631	Striped Anchovy	660,456	0.020
Sheepshead	3,573,270	Atlantic Thread Herring	637,242	0.060
Atlantic Thread Herring	3,287,447	Sand Perch	616,149	0.326
Gray Snapper	3,264,432	Southern Kingfish	612,129	0.605
Atlantic Croaker	2,409,813	Scaled Sardine	607,327	0.043
Gag	2,264,393	Pigfish	583,308	0.397
Black Sea Bass	2,168,769	Gray Triggerfish	541,630	1.893
Red Grouper	1,951,612	King Mackerel	484,248	9.199
Crevalle Jack	1,865,996	Black Sea Bass	479,187	0.591
Pigfish	1,632,945	Gulf Menhaden	456,781	0.220
Spanish Mackerel	1,572,507	Seatrout Genus	421,376	NA
Gafftopsail Catfish	1,561,431	Silver Perch	406,875	0.177
Red Snapper	1,491,284	Sheepshead	373,012	2.078
Striped Mullet	1,268,225	Yellowtail Snapper	351,082	1.212
Silver Perch	1,259,430	Hardhead Catfish	343,923	0.976
Sand Perch	1,176,826	Round Scad	327,235	NA
Blue Runner	1,108,328	Mullet Genus	294,853	NA
Black Drum	1,030,209	Bluefish	243,192	2.072
Yellowtail Snapper	966,760	Lane Snapper	228,787	1.476

Source: (NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb=0.454 kg.)

no regulations requiring the return of hardhead catfish (e.g., size limits or bag limits), the large difference between catch (A + B1 + B2) of hardhead catfish and harvest of the species (A + B1) reflects the fact that much of the recreation public considers this species to be a trash fish.

In 2009, three of the five most commonly caught species (scaled sardine, pinfish, and Atlantic thread herring [*Opisthonema oglinum*]) represent species primarily used for bait (Table 10.15). Similar findings apply if one considers harvested species. Comparison of the information in Tables 10.11 and 10.15 (as well as other selected years provided in Tables 10.12, 10.13, and 10.14) suggests that, in general, the catch and harvest of many species—such as

**Table 10.13 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species by Gulf of Mexico Recreational Anglers, 2000**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Spotted Seatrout	26,859,790	Scaled Sardine	14,714,424	0.022
Scaled Sardine	17,584,629	Pinfish	5,180,685	0.401
Pinfish	9,534,737	Sand Seatrout	4,376,247	0.631
Red Drum	8,201,553	Red Drum	2,981,011	5.651
Atlantic Croaker	5,911,239	Atlantic Thread Herring	2,316,911	0.082
Sand Seatrout	5,902,934	Atlantic Croaker	1,772,120	0.456
Hardhead Catfish	4,523,357	White Grunt	1,739,314	0.875
White Grunt	4,179,199	Spanish Mackerel	1,501,056	1.986
Gray Snapper	3,907,599	Striped Mullet	1,478,051	1.145
Black Sea Bass	3,382,680	Blue Runner	1,323,223	1.097
Ladyfish	3,038,159	Sheepshead	1,258,531	2.669
Spanish Mackerel	2,897,142	Southern Kingfish	1,253,472	0.603
Sheepshead	2,837,075	Black Drum	821,396	3.342
Blue Runner	2,796,861	Spanish Sardine	816,465	0.019
Atlantic Thread Herring	2,727,189	Round Scad	775,122	NA
Gafftopsail Catfish	2,124,884	Gulf Menhaden	758,747	0.215
Crevalle Jack	2,063,277	Gray Snapper	694,916	1.612
Black Drum	1,994,186	Spotted Seatrout	660,962	1.641
Red Grouper	1,862,001	Black Sea Bass	548,872	0.815
Striped Mullet	1,841,982	Southern Flounder	546,769	1.452
Gag	1,798,006	Gag	540,122	6.820
Southern Kingfish	1,551,570	Pigfish	435,936	0.319
Pigfish	1,060,531	White Mullet	373,823	0.696
Red Snapper	998,453	Gulf Kingfish	370,069	0.663
Gulf Menhaden	950,030	Red Snapper	340,077	4.284

Source: (NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.)

spotted seatrout, red drum, and scaled sardines—increased significantly between 1990 and 2009. Changes in catches/harvests of the more desired species over time are examined in greater detail later in this chapter.

The information in Tables 10.11, 10.12, 10.13, 10.14, and 10.15 leads to the conclusion that aggregate catch (A + B1 + B2) and harvest (A + B1) estimates, when analyzed in terms of numbers of fish, are significantly skewed by the inclusion of baitfish species. Given the relatively low average weight associated with the baitfish species, inclusion of these species will have little influence on aggregate poundage estimates. The large amount of catch that is released dead or otherwise not seen or identified by the interviewer (B1) is illustrated in

**Table 10.14 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species by Gulf of Mexico Recreational Anglers, 2005**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Spotted Seatrout	30,194,309	Scaled Sardine	17,338,752	0.052
Scaled Sardine	18,058,990	Spotted Seatrout	10,027,333	1.470
Pinfish	9,468,582	Pinfish	5,954,236	0.281
Red Drum	8,313,858	Atlantic Thread Herring	3,915,545	0.016
Hardhead Catfish	6,103,615	Red Drum	2,316,967	6.957
Gray Snapper	5,557,647	Sheepshead	2,002,107	2.850
Sheepshead	4,341,937	Sand Seatrout	1,916,453	0.573
Atlantic Thread Herring	4,070,662	White Grunt	1,687,555	0.860
Ladyfish	3,894,394	Spanish Mackerel	1,191,652	1.729
White Grunt	3,372,101	Striped Mullet	1,080,239	1.176
Atlantic Croaker	3,344,904	Southern Kingfish	1,060,265	0.592
Gag	2,789,268	Gray Snapper	1,054,134	2.396
Red Snapper	2,738,566	Red Snapper	835,166	4.027
Sand Seatrout	2,588,201	Atlantic Croaker	770,890	0.411
Spanish Mackerel	2,497,044	White Mullet	743,687	0.665
Gafftopsail Catfish	2,163,933	Gulf Menhaden	577,043	NA
Southern Kingfish	1,643,147	Southern Flounder	541,916	1.219
Black Sea Bass	1,612,855	Gag	517,374	6.666
Red Grouper	1,460,939	Sand Perch	460,961	0.431
Common Snook	1,362,106	Black Drum	449,895	5.269
Crevalle Jack	1,346,097	Blue Runner	449,314	0.924
Black Drum	1,285,579	Menhaden Genus	390,512	NA
Striped Mullet	1,228,363	Gulf Kingfish	366,168	0.731
Blue Runner	1,047,689	Lane Snapper	349,043	1.141
Sand Perch	836,435	Round Scad	336,453	NA

Source: (NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.)

Figure 10.64 (left panel). A large proportion of this total reflects the harvest of many small fish subsequently used for bait (e.g., scaled sardines and pinfish). For example, the total estimated catch in 2009 equaled 172 million fish. More than 25 % of this total number was represented by species generally used as baitfish. Similarly, about 20 % of the estimated 106 million fish caught in 1990 represent baitfish. With respect to harvested fish (A + B1), the 1990 estimate equaled 44 million (Figure 10.65, left panel). Of this total, 13.3 million, or about 30 %, represented species primarily used for bait. Likewise, about 50 % of the estimated 90 million fish harvested in 2009 represent species primarily used as baitfish.



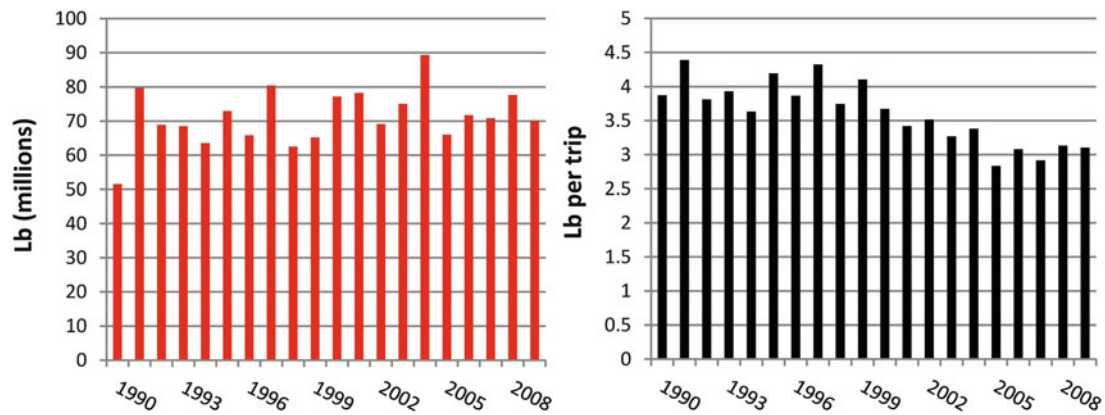
**Table 10.15 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species by Gulf of Mexico Recreational Anglers, 2009**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Scaled Sardine	31,431,676	Scaled Sardine	29,939,131	0.029
Spotted Seatrout	30,689,392	Spotted Seatrout	13,336,326	1.510
Pinfish	9,792,148	Atlantic Thread Herring	6,804,819	0.108
Red Drum	8,009,540	Pinfish	5,448,281	0.132
Atlantic Thread Herring	7,472,772	Sand Seatrout	4,200,054	0.561
Sand Seatrout	6,617,915	Red Drum	2,608,080	6.146
Hardhead Catfish	5,279,557	Sheepshead	1,573,049	2.658
Atlantic Croaker	4,897,441	Spanish Mackerel	1,503,195	1.697
Gray Snapper	4,172,791	Gray Snapper	1,300,627	1.711
Ladyfish	3,387,942	White Grunt	1,206,086	0.909
Spanish Mackerel	3,132,709	Atlantic Croaker	1,173,610	0.388
Sheepshead	2,871,863	Round Scad	1,096,334	NA
Gag	2,750,328	Ballyhoo	1,087,375	NA
Red Snapper	2,568,716	Southern Kingfish	979,390	0.575
Red Grouper	2,472,120	Red Snapper	795,585	4.885
White Grunt	2,241,227	Striped Mullet	741,904	1.172
Black Drum	1,747,954	Blue Runner	696,892	0.951
Blue Runner	1,490,693	Black Drum	664,917	5.248
Gafftopsail Catfish	1,426,345	Herring Family	647,389	NA
Southern Kingfish	1,388,023	Southern Flounder	643,630	1.358
Crevalle Jack	1,309,758	King Mackerel	509,489	8.039
Round Scad	1,128,681	Vermilion Snapper	407,787	1.030
Ballyhoo	1,088,172	Gulf Menhaden	391,449	NA
Black Sea Bass	977,919	Dolphin	341,574	08.162
Striped Mullet	957,806	Unidentified Fish	271,498	NA

Source: (NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.)

The estimated annual harvest of fish, given on a weight basis (A + B1), for the Gulf (excluding Texas) from 1990 to 2009 is given in Figure 10.66 (left panel). As indicated, pounds harvested have historically fluctuated from about 60 million to 80 million on an annual basis with no long-run trend.

While the total harvest during the 20-year period ending in 2009 appears to be stable, there does appear to be a decline in pounds harvested (A + B1) per angler trip (Figure 10.66, right panel). During the 1990s, pounds harvested (A + B1) averaged four pounds per angler trip. During the most recent decade (2000–2009), pounds harvested had fallen by about



**Figure 10.66.** Gulf of Mexico recreational harvest in pounds (*left panel*) and harvest per trip (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A) (*Note:* 1 lb = 0.454 kg).

0.25–3.25 lb per angler trip, on average. This decline largely parallels the increase in angler trips in the early 2000s.

When examined by mode, fishing from private/rental boats accounted for an average of 65 % of Gulf (excluding Texas) harvest (A + B1), in pounds, during the 1990–2009 period with an annual range generally fluctuating from 60 to 70 %. The for-hire mode accounted for about 20 % of the total pounds while shore-based angling accounted for the remaining 15 %. No long-term trends were apparent in any of the three modes.

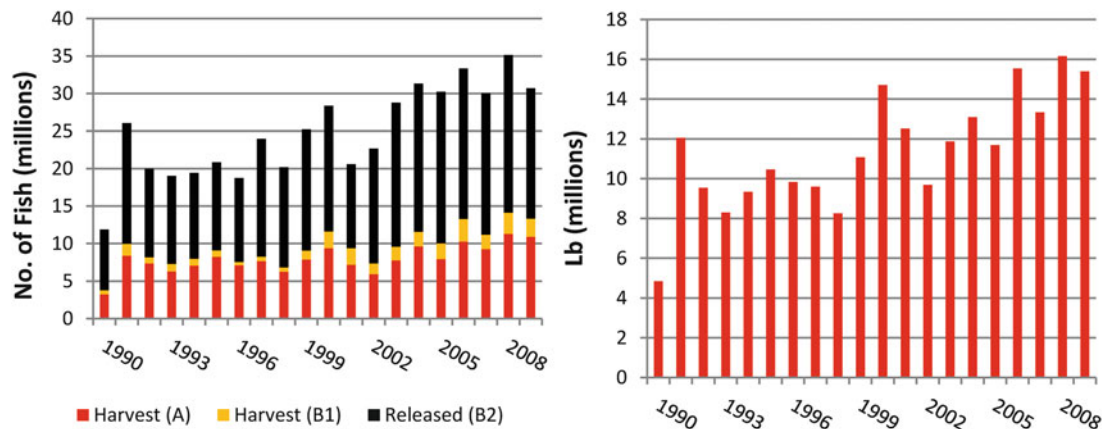
#### 10.4.2.2 Gulf of Mexico Recreational Catch/Harvest by Species/Group

A large and diverse group of species are targeted and harvested by Gulf of Mexico recreational anglers. The species (groups) targeted and caught in the inshore waters tend to differ from those targeted and caught offshore. Analyses of primary species associated with inshore and offshore fishing activities at the Gulf level, angler trips taken in the pursuit of the catch/harvest of these species (groups), and targeting behavior are examined below.

##### 10.4.2.2.1 Inshore Species

Two species, spotted (speckled) seatrout and red drum, dominate marine recreational angling activities in the inland and nearshore waters of the Gulf of Mexico. These two species are the preferred target of anglers throughout the Gulf and are given gamefish status in many of the Gulf States.

Spotted seatrout is managed by the individual Gulf States, and size restrictions and bag/possession limits are also determined by the individual states. These can vary significantly among the states. For example, Florida limits spotted seatrout harvest to four per harvester per day in the South region and five per harvester per day in the Northwest region. For Louisiana, the limit on spotted seatrout is 25 per person per day. VanderKooy (2010) provides a detailed listing of all laws and regulations pertaining to the recreational sector by state, and information on spotted seatrout regulations can be found in the report. While the individual Gulf States also manage red drum, management of the fishery in federal waters is under the purview of GMFMC. Since 1988, the harvest and possession of red drum from federal waters has been prohibited. By state, Florida has the most restrictive red drum bag limit (one per harvester per day) while Louisiana has the most liberal (five daily per person).



**Figure 10.67.** Gulf of Mexico recreational spotted sea trout catch (*left panel*) and pounds harvested (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A) (*Note: 1 lb = 0.454 kg*).

### *Spotted Seatrout*

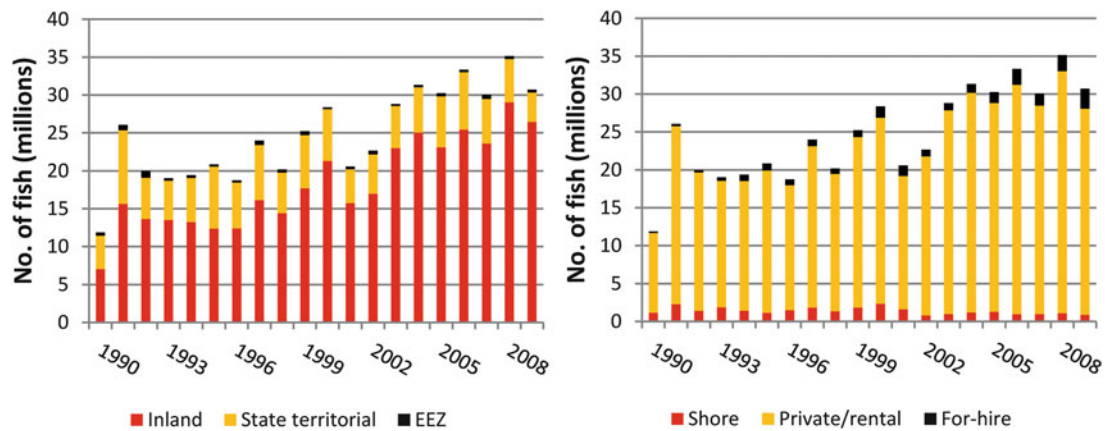


Estimated Gulf of Mexico catch of spotted seatrout (excluding Texas) in numbers of fish is given in Figure 10.67 (left panel) for the 1990–2009 period. In general, after falling from more than 28 million fish in 1999 to about 20 million fish in 2000, the estimated catch of spotted seatrout gradually increased during the remainder of the decade peaking at 35 million fish in 2008 and equaled 31 million in 2009. On average, approximately 60 % of the total catch is reported to be released alive (B2), and there has been no apparent trend in this average since 1990. The information in Figure 10.67 (left panel) also highlights that harvest (dead) not seen or identified by interviewer (B1) is relatively limited when considering a species not used as bait.

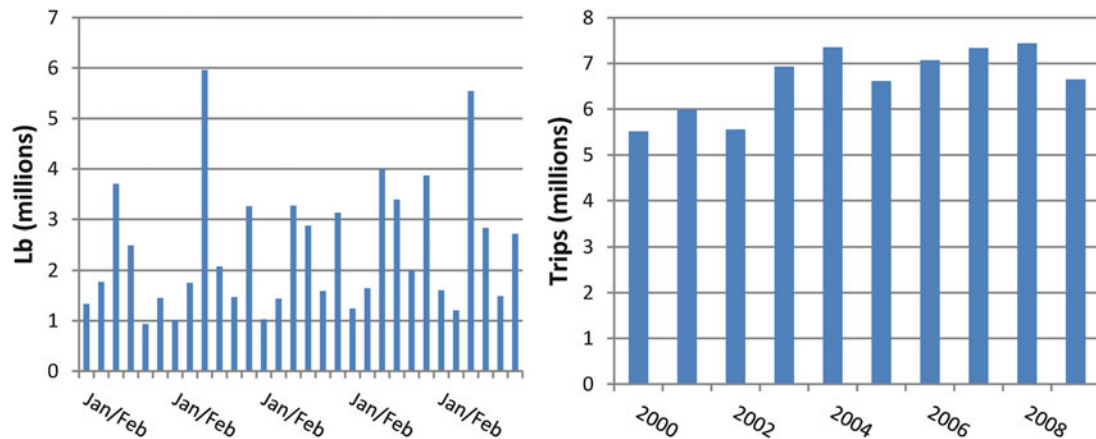
The estimated harvest of spotted seatrout, in pounds (A + B1), also has been gradually increasing since the 1990s with the average during the most recent 10-year period at 13.4 million pounds annually, exceeding the 1990–1999 average of 9.3 million pounds annually by about 45 % (Figure 10.67, right panel). In general, the increased spotted seatrout catch (in either number of fish or pounds landed) correlates well with the increasing number of inshore trips (see Figure 10.61, right panel). In both instances, the correlation approached or exceeded 0.80.

The role of the inshore waters to spotted seatrout catch in numbers of fish (A + B1 + B2) is clearly illustrated in Figure 10.68 (left panel). During the 1990s, about 65 % of the spotted seatrout catch (excluding Texas) was in inland waters, with the proportion increasing to more than 80 % since 2000 (the years 1990 and 1991 appear to be unexplained anomalies with respect to the percentage of spotted seatrout derived from the inshore waters). The 2009 proportion of 87 % was the highest on record. With some notable exceptions, particularly in the earlier years, less than 5 % of the catch in numbers is taken from federal waters.

Being primarily an inshore fishery, it should come as no surprise that the vast majority of recreational spotted seatrout catch comes from private/rental boats. Since 1990, the percentage of catch in numbers of fish coming from this mode (excluding Texas) has consistently equaled about 80–90 % of the total with no apparent trend (Figure 10.68, right panel). The share of



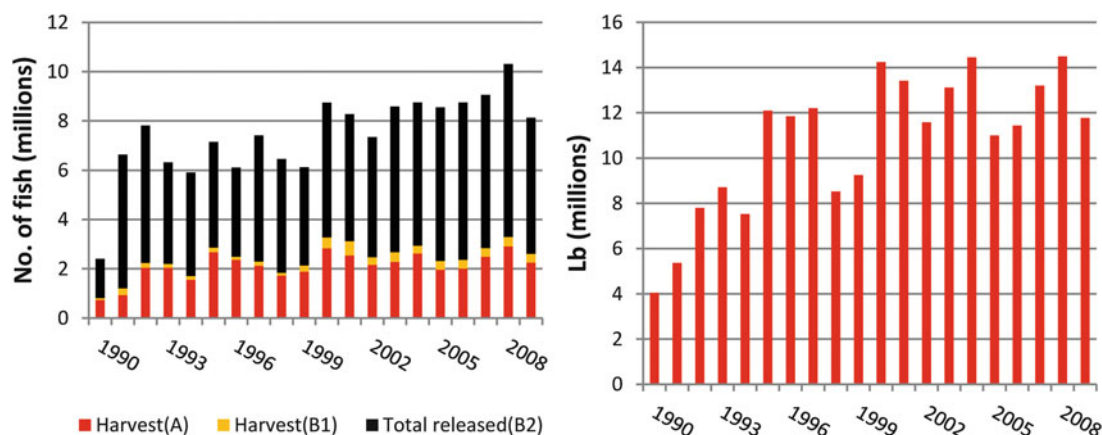
**Figure 10.68.** Gulf of Mexico recreational spotted seatrout catch by area fished (*left panel*) and mode (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A).



**Figure 10.69.** Gulf of Mexico recreational spotted seatrout harvest by wave 2005–2009 (*left panel*) and trips where spotted seatrout was caught, 2000–2009 (NMFS FSD, data accessed 2012—see Appendix A) (*Note:* 1 lb = 0.454 kg).

harvest represented by the for-hire sector has, on the other hand, been increasing particularly in recent years with the 2009 share (15 %) representing the highest on record. The recent increase in the for-hire share has come largely at the expense of the shore mode with its 2009 share (1.7 %) being the lowest on record (the shore mode represented an unweighted average of 6.5 % during the period of study).

The Gulf of Mexico recreational spotted seatrout fishery is seasonal in nature with a couple of distinct periods when examining harvest (A + B1 in pounds) in 2 month waves. Beginning in January/February, harvest tends to increase, reaching a peak in May/June of each year. It then falls but generally increases sharply again in November/December. Since 2005, nearly 33 % of the spotted seatrout harvest (A + B1), in pounds, has occurred in the May/June period with an additional 20 % being reported in both the July/August and November/December periods (Figure 10.69, left panel).



**Figure 10.70.** Gulf of Mexico recreational red drum catch (*left panel*) and harvested pounds (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A) (*Note:* 1 lb = 0.454 kg).

Gulf of Mexico (excluding Texas) angling trips resulting in the catch of spotted seatrout (A + B1 + B2) is given in Figure 10.69 (right panel) for the 2000–2009 period. As indicated, the annual number of trips reporting the catch of spotted seatrout has, in recent years, fluctuated in the 5.5–7.5 million range.

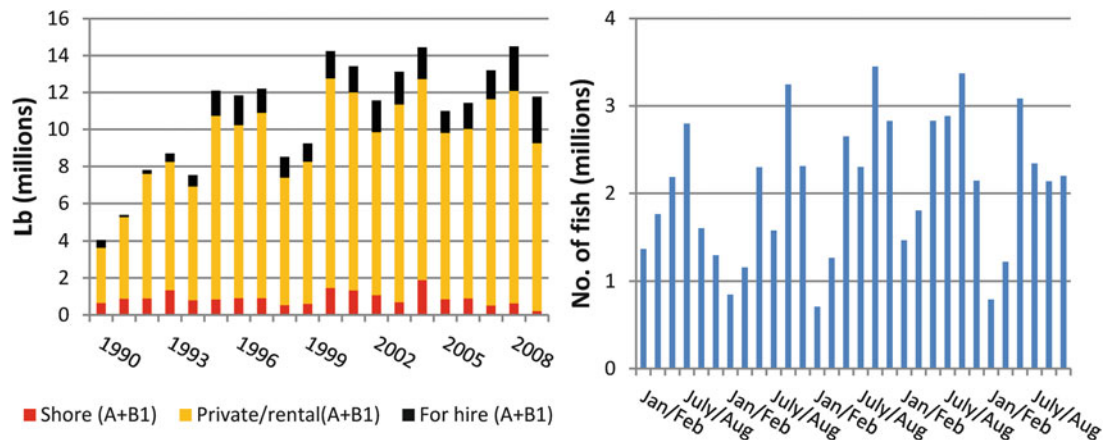
### Red Drum



Red drum is the other popular species among inshore fishermen. Gulf of Mexico recreational anglers have caught, on average, an estimated 7.4 million red drum per year (A1 + B1 + B2) since 1990 with annual catches trending up in recent years (Figure 10.70, left panel). For example, during 1990–1994, estimated red drum catch per year averaged 5.8 million fish, while during the 1990s the average estimated catch equaled 6.2 million fish per year. Since 2000, average catch, in numbers, has equaled an estimated 8.7 million fish per year. In no year prior to 2000 did the annual estimated catch exceed eight million fish, but since 2000, annual estimated catch has not fallen below eight million fish. The impact of severe weather conditions on red drum stocks is evident in the abnormally low 1990 red drum catch (2.4 million fish) which was likely the direct result of a very hard freeze in 1989 that resulted in a high mortality in the Louisiana red drum stock. Historically, about two-thirds of the red drum catch, in numbers, have been released alive (B2) and there is no long-run apparent change to this figure. Release of this high percentage of red drum reflects, at least in part, the management measures established to protect the species from overfished conditions, particularly size limits and daily bag limits.

Similar to catch, the red drum harvest (A + B1) expressed on a weight basis increased during the mid-to-late 1990s, but since that time there has been no apparent increasing long-run trend (Figure 10.70, right panel). Since 2000, an estimated 12.9 million pounds of red drum have been harvested annually by recreational anglers throughout the Gulf of Mexico (excluding Texas). Similar to spotted seatrout, the correlation between total number of inshore trips (Figure 10.61, right panel) and total annual estimated red drum catch in numbers during the 1990–2009 period was high (0.88), as was the correlation between total number of inshore trips and the estimated harvest (A + B1) in pounds (0.83). Since 2000, no less than 80 % of the red





**Figure 10.71.** Gulf of Mexico recreational red drum harvest by mode 1990–2009 (*left panel*) and wave 2005–2009 (*right panel*) 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A).

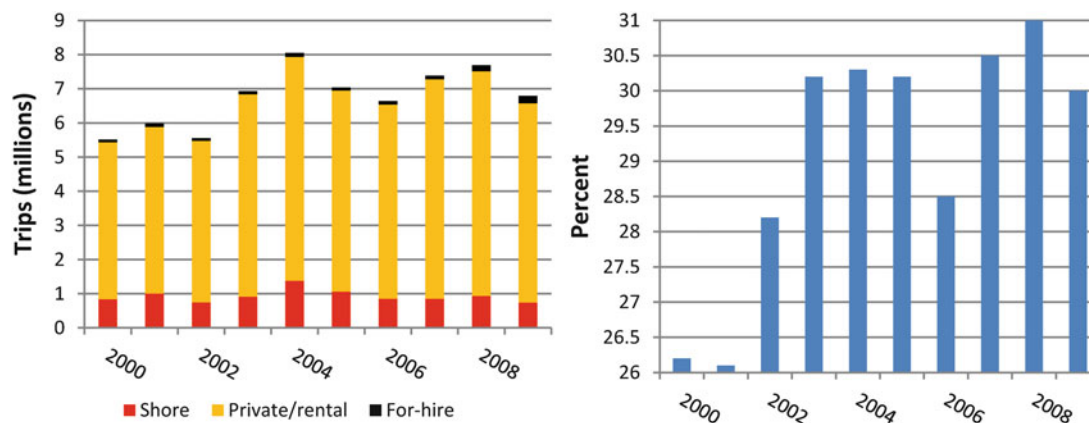
drum harvest (A + B1) in pounds has been taken from inshore waters with the total exceeding 90 % in both 2008 and 2009. Furthermore, in no year prior to 1999 did the share of red drum harvest taken from inland waters exceed 80 %, and in no year after 1999 did the share fall under 80 %.

Similar to spotted seatrout, the overwhelming majority of red drum harvest in pounds is taken from the private/rental mode with yearly estimates generally ranging from about 75 % to slightly more than 80 % (Figure 10.71, left panel) with no apparent trend. The share taken by the for-hire mode, on the other hand, has increased, especially after the mid-1990s, with the share in 2008 (16.6 %) and 2009 (21.3 %) being the largest on record. The share attributable to shore-based fishing has ranged from 16 % to less than 2 % and has averaged about 8 % during the period of analysis.

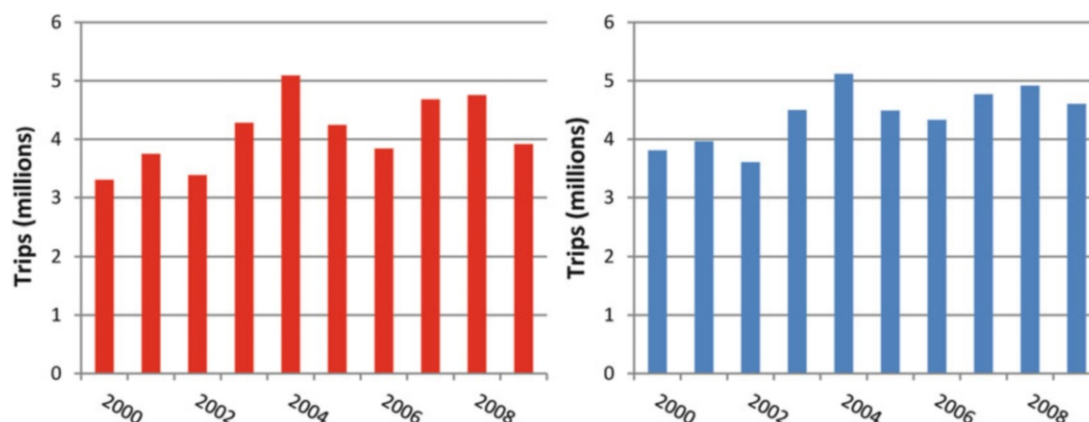
Like spotted seatrout, there is a seasonal pattern to red drum harvest with yield being lowest in January/February and gradually increasing to May/June or July/August (Figure 10.71, right panel). As with spotted seatrout, significant harvests occur in the November/December period. Spotted seatrout and red drum are often targeted on the same trip. Hence, targeting behavior for these two species combined is considered herein. During the 2000–2009 period, the number of angler trips wherein the angler reported targeting behavior for either red drum or spotted seatrout averaged 6.6 million annually with the annual estimates ranging from 5.5 million in 2000 to 8.1 million in 2004 (Figure 10.72, left panel). As a proportion of total Gulf trips, which averaged 23.1 million during 2000–2009, trips targeting red drum or spotted seatrout averaged about 30 % (Figure 10.72, right panel). This figure becomes more relevant when one considers that only about 50 % of the MRFSS/MRIP interviewees report any targeting behavior (Figure 10.63, right panel).

As indicated, the vast majority of targeting behavior for either spotted seatrout or red drum was in relation to the private/rental boat mode (Figure 10.72, left panel). In general, more than 40 % of the private/rental boat mode angler trips reported targeting either spotted seatrout or red drum with the figure consistently approximating 43 % since 2005. By comparison, only about 10 % of the anglers fishing from shore reported targeting spotted seatrout or red drum with little interyear variation. With respect to the for-hire mode, the percentage of angler trips reporting red drum/spotted trout targeting behavior ranged from about 10 % (2000) to 25 % (2009) and averaged about 15 % during the 10-year period of analysis (2000–2009).





**Figure 10.72. Angler trips targeting either spotted seatrout or red drum (*left panel*) and targeting percentage (*right panel*), 2000–2009 (NMFS FSD, data accessed 2012, with targeting estimates and percentages calculated by authors—see Appendix A).**

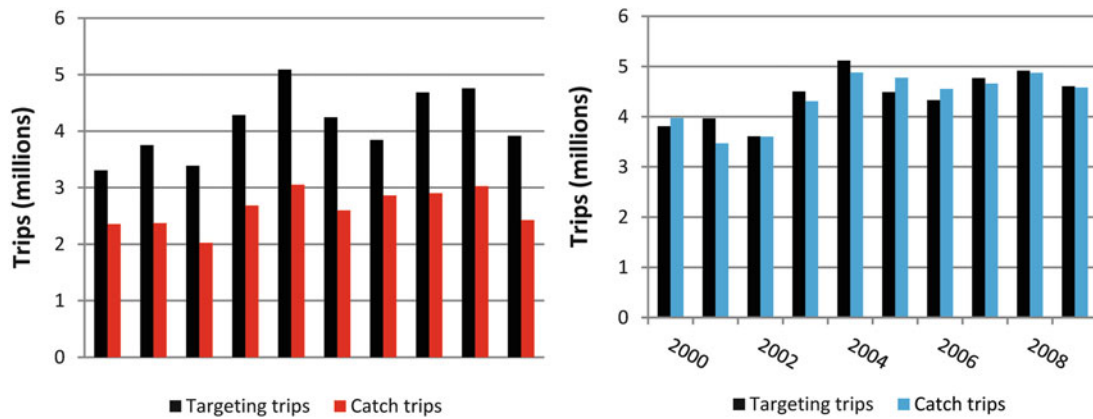


**Figure 10.73. Gulf of Mexico angler trips targeting red drum (*left panel*) and Gulf of Mexico angler trips targeting spotted seatrout, 2000–2009 (NMFS FSD, data accessed 2012, with targeting estimates calculated by authors—see Appendix A).**

Considering the two species separately, the number of Gulf angler trips reporting the targeting of red drum on an annual basis ranged from about 3.3 million (2000) to 5.1 million (2004) and averaged 4.1 million annually during the 10-year period of analysis (Figure 10.73, left panel). This represents about 18 % of the total 23.2 million angler trips conducted yearly, on average, throughout the Gulf (excluding Texas) during the 10-year period and almost 20 % of the 21.3 million annual trips taken in state (inland and territorial) waters.

The annual number of spotted seatrout targeting trips generally ranged from about 4 million to 5 million and averaged 4.4 million during the 10-year period ending in 2009 (Figure 10.73, right panel). This 10-year average constituted 19 % of the annual average of 23.2 million trips taken in the Gulf of Mexico (excluding Texas).

One might notice that the total targeting trips for red drum and spotted seatrout, evaluated separately (Figure 10.73), exceeds the total when combined (i.e., targeting either red drum or spotted seatrout) by a significant margin. For example, targeted red drum trips totaled 3.9



**Figure 10.74. Relationship between red drum catch trips and targeting trips (left panel) and spotted seatrout catch trips and targeting trips (right panel), 2000–2009 (NMFS FSD, data accessed 2012, with targeting estimates calculated by authors—see Appendix A).**

million in 2009 while targeted spotted seatrout trips totaled 4.6 million. Trips targeting either red drum or spotted seatrout, by comparison, totaled only 6.8 million in 2009. The difference is the result of the MRFSS/MRIP allowing interviewees to list up to two targeted species when answering the survey.

Targeting trips for a given species do not necessarily equal the number of trips for which that species was caught. This is because while a species may be targeted on a given trip, that species may not be caught and a given species may be caught on a given trip even though that species was not targeted. As indicated in Figure 10.74 (left panel), the annual number of trips where red drum was a targeted species exceeded the number of trips in which red drum was caught by a wide margin. During the 2000–2009 period, only about 65 % of the red drum targeting trips resulted in a positive catch of red drum with the annual range from less than 50 % to more than 70 % (Figure 10.74, left panel).

With respect to spotted seatrout, the relationship between targeting trips and catch trips is much more direct. Rarely did targeting trips exceed catch trips by a significant margin, and in many years, the number of catch trips equaled or slightly exceeded the number of targeting trips (Figure 10.74, right panel).

#### 10.4.2.2.2 Offshore Species

##### *Aggregate Reef Fish*

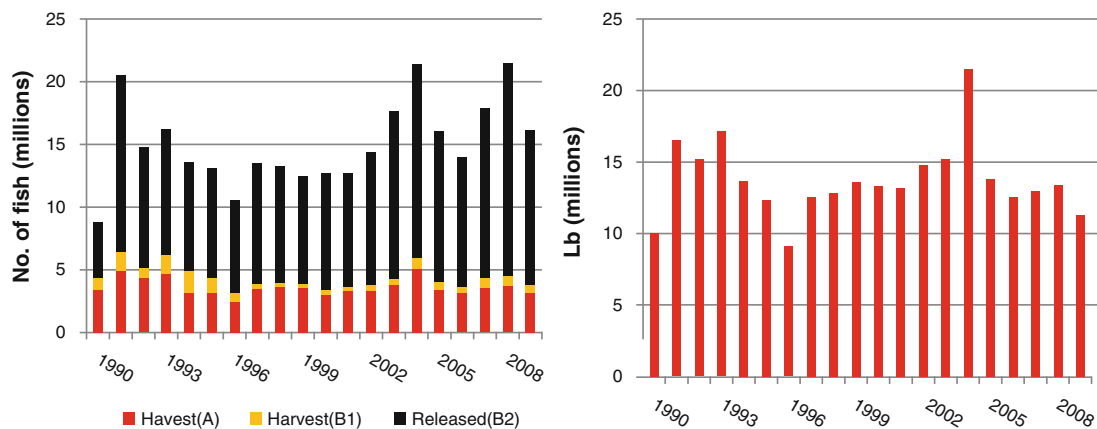


Greater Amberjack

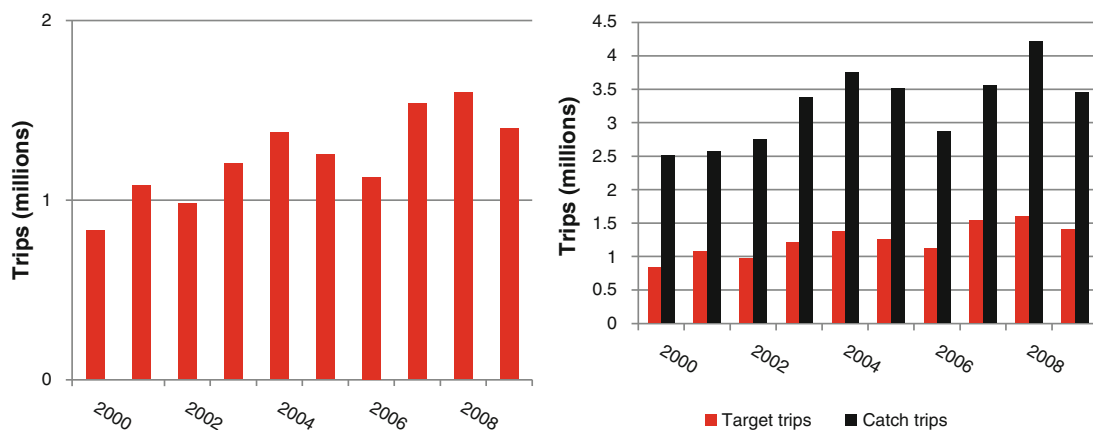


Gray Triggerfish

The Gulf of Mexico Reef Fish Fishery Management Plan includes six species groups in its management unit: triggerfishes, Jacks, wrasses, snappers, tilefish, and groupers. Based on this designation, estimated total catch of reef fish species for 1990–2009 in numbers of fish is presented in Figure 10.75 (left panel). As indicated, the total number of fish caught ( $A + B1 + B2$ ) ranged from less than ten million in 1990 to more than 20 million in 1991, 2004, and 2008, with an average catch during the period equaling 15 million. While catch in numbers can exceed 20 million, the majority of this catch is released alive ( $B2$ ); though much of it is subject to subsequent mortality (from hook and handling trauma or predation before the fish can recover). Since 1990, on average, almost 70 % of the reef fish catch is reportedly released alive with the figure exceeding 75 % since 2005. There are a number of reasons for the



**Figure 10.75.** Gulf of Mexico recreational aggregate reef fish catch (*left panel*) and harvest (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).



**Figure 10.76.** Gulf of Mexico recreational reef fish targeting trips (*left panel*) and reef fish targeting trips in relation to reef fish catch trips, 2000–2009 (NMFS FSD, data accessed 2012, with targeting estimates calculated by authors—see Appendix A).

high reef fish discard rates including regulations pertaining to minimum sizes and bag limits. Some of these regulations will be considered in more detail when considering snappers and groupers—the two primarily targeted recreational species groups within the reef fish complex.

Estimated total recreational reef fish harvest (A + B1) expressed on a weight basis is given in Figure 10.75 (right panel) for the 1990–2009 period. The aggregate harvest of reef fish averaged 13.4 million pounds during the period of analysis and ranged from about nine million pounds (1996) to more than 20 million pounds (2004). Since 2004, the annual aggregate reef fish harvest has fallen and, as discussed in the next section, much of this decline is the result of a decline in grouper harvest.

Though a considerable amount of effort is expended on the management of reef fish species by GMFMC and the regulations of managing recreational effort and take are numerous (bag limits, size limits, seasonal closures, mandatory use of circle hooks, etc.), only a small percentage of trips taken by marine anglers are in pursuit of any specific reef fish species. Since 2005, about 1.4 million trips annually (or about 6 % of the total estimated Gulf of Mexico trips) indicated a given reef fish species to be a targeted species (Figure 10.76, left panel). While a

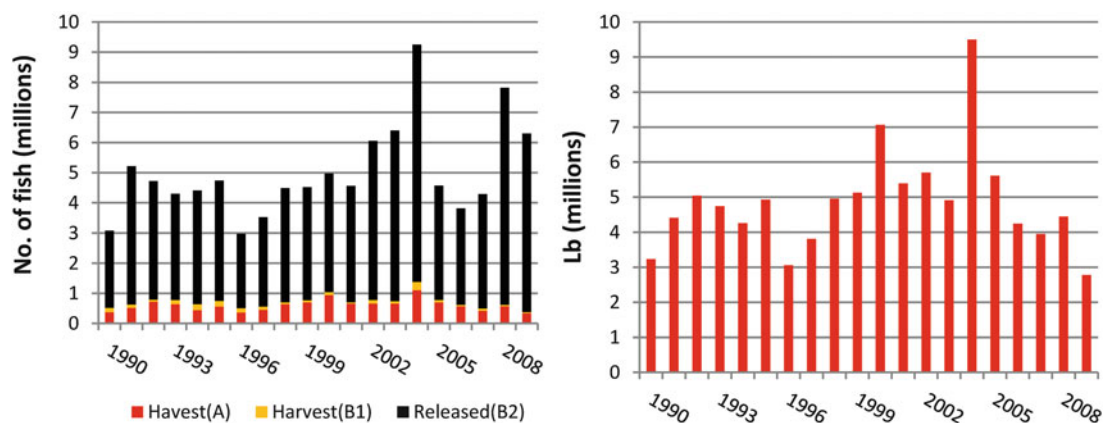
seemingly small percentage of Gulf trips target reef fish, most reef fish are caught in federal waters or state territorial waters (particularly in Florida and Texas where the state waters extend out 9 nautical mi [16.7 km]). When considering just the state territorial and EEZ waters, the proportion increases to about 15 %.

Though the number of angler trips in which a specific reef fish species is listed as being targeted is relatively limited (an average of 1.4 million trips annually during 2000–2009), the number of angler trips where a given reef fish species is caught is much more prevalent (Figure 10.76, right panel). On average, reef fish were reported caught on about 3.3 million angler trips annually during the 2000–2009 period. This represents almost 15 % of the total Gulf angler trips during the period. This of course raises the question, why is the estimated number of reef fish catch trips significantly higher than the number of reef fish targeting trips? There are at least three plausible answers to this question. First, no specific reef fish species may be targeted on a given trip even if the intent of the trip is to catch reef fish (specifically, since the MRFSS/MRIP asks for targeting behavior on specific species, one could still target reef fish without any specific species in mind). Second, many of the reef fish species, particularly red snapper, are subject to long seasonal closures, and these species may be caught in conjunction with targeting non-reef fish species. Finally, given long closed seasons, some anglers may target a given species during the closed season with the intent of releasing any catch of that species. In such a situation, the angler (the interviewee) may be hesitant to report his targeting behavior.

#### Individual Reef Fish Species (Groups)



**Grouper:** The grouper family, as defined in the Gulf of Mexico Reef Fish Fishery Management Plan (GMFMC 1981), includes nine species: speckled hind (*Epinephelus drummondhayi*), Yellowedge grouper (*Epinephelus flavolimbatus*), Warsaw grouper, Snowy grouper (*Epinephelus niveatus*), Black grouper (*Mycteroperca bonaci*), Yellowmouth grouper (*Mycteroperca interstitialis*), Gag grouper, Scamp (*Mycteroperca phenax*), and Yellowfin grouper (*Mycteroperca venenosa*). Based on this categorization, the annual aggregate grouper catch (A + B1 + B2) by Gulf of Mexico recreational anglers in numbers of fish during the 1990–2009 period is presented in Figure 10.77 (left panel). As shown, aggregate catch



**Figure 10.77.** Gulf of Mexico recreational aggregate grouper catch (*left panel*) and harvest (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A) (*Note:* 1 lb = 0.454 kg).

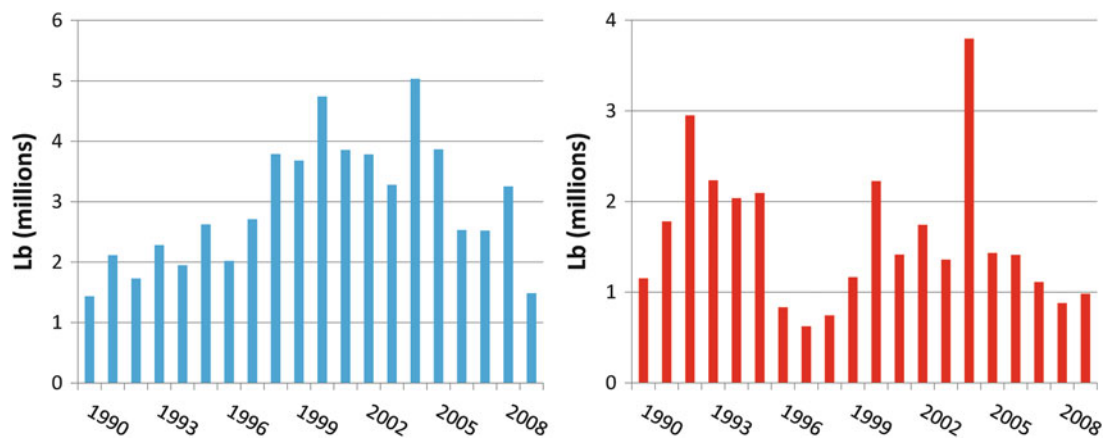
(A + B1 + B2) increased rapidly after the mid-1990s peaking at about nine million fish in 2004 after which catch declined sharply. This decline, however, was transitory in nature and by 2008 the total catch in numbers of fish had again approached the eight million mark. The reasons for the precipitous decline in landings after 2004 are explored in more detail when catch of individual grouper species is considered.

On average, less than 15 % of the aggregate grouper catch by recreational anglers in the Gulf in number of fish was harvested (A + B1); the remaining (approximately) 85 % was released alive (Figure 10.77, left panel). This percentage remained extremely consistent during the period of analysis (generally 83–89 % range) with the exception of the last 2 years when the percentage exceeded 90 %. The high release rate during the period reflects aggregate bag limits, minimum size restrictions, and closed seasons (Carter et al. 2008).

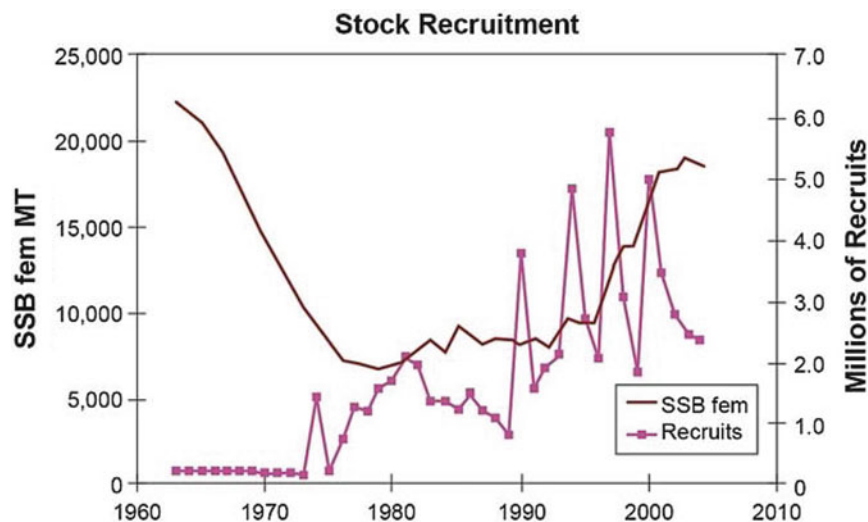
Estimated aggregate harvest (A + B1) of grouper, expressed on a weight basis, is provided in Figure 10.77 (right panel) for the 1990–2009 period. As indicated, the annual harvest has fluctuated widely, ranging from less than three million pounds to more than eight million pounds. While some of the fluctuation can be explained by management actions (see individual species discussion), much of the variation likely simply reflects large annual recruitment variation. As a result of numerous environmental factors (most of which remain unknown), year-class size can vary by an order of magnitude and, as such, recruitment into the legal fishery (i.e., minimum legal size at harvest) can also vary substantially. Because of a high amount of pressure on the grouper stocks, a high percentage of the recreational grouper catch occurs shortly after the minimum legal size is reached.

Overall, about 33 % of the aggregate reef fish harvest (A + B1), expressed on a weight basis, was represented by grouper during the period of analysis. The share of aggregate reef fish harvest in pounds represented by grouper reached a maximum of 53 % in 2000 but was only about 25 % in 2009.

Grouper catch by recreational anglers consists primarily of two species—gag grouper and red grouper—which combined, account for about 95 % of the total recreational grouper harvest (A + B1) during 1990–2009. Annual harvests (A + B1) of these two species expressed on a weight basis are presented in Figure 10.78 (gag grouper, left panel; red grouper, right panel) for the 1990–2009 period. Gag grouper harvest, which accounted for about two-thirds of the total harvest of these two species, gradually increased through 2004 and declined sharply thereafter to a low of 1.5 million pounds in 2009. By comparison, recreational landings of red



**Figure 10.78.** Gulf of Mexico recreational harvest of gag grouper (*left panel*) and red grouper (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).



**Figure 10.79.** Estimated recruitment in the Gulf of Mexico gag grouper fishery (Ortiz 2006) (Note: SSB fem MT refers to the estimated spawning stock biomass of females).

grouper showed several cyclical trends. For example, landings during 1996–2000 were less than one-half of those during 1990–1995. After 2000, landings rose sharply, peaked in 2004, and then fell sharply. There are a couple of potential reasons why landings of both red and gag grouper fell sharply beginning in 2005 and have remained relatively low since that year. First, a large red tide event off the west coast of Florida occurred in 2005, which is believed to have led to large fish kills.<sup>20</sup> Furthermore, in June of 2005, an interim rule was established by GMFMC that established closed seasons for recreational grouper fishing and reduced the bag limit of red grouper to only one fish. Further restrictions were imposed in 2009 (GMFMC 2011).

Changes in recreational harvest of gag and red grouper from one year to the next or in the long run can be the result of several factors including annual variation in recruitment, long-term changes in biomass, and regulations. Changes in recruitment on subsequent harvest can be particularly pronounced in those fisheries that are heavily fished, since a large proportion of the fish that are kept are at the minimum size limit. Thus, annual variations in recruitment (year-0 fish) can have large impacts on harvest when that cohort reaches the minimum legal size at harvest. Estimated annual variation in recruitment of gag grouper is clearly demonstrated in Figure 10.79. This variation can easily translate into large annual variations in subsequent harvest at that time when that cohort reaches minimum harvest size.

The influence of a large-scale environmental perturbation on the gag grouper population can be examined with the aid of Figure 10.80. As mentioned, a large red tide event occurred off the Florida west coast in 2005. This red tide event resulted in a large reduction in the estimated gag grouper biomass which likely explains, in part, the reduction in harvest of gag grouper (as well as red grouper) beginning in that year (see Figure 10.78).

Consistent with the decline in grouper harvests (A + B1) beginning in 2005, the estimated number of targeted grouper (any species) angler trips fell by about one-half. The number of reported angler trips targeting grouper was highest in 2000, which is consistent with the above average catch in that year (Figure 10.81, left panel). Since 2005, the reported number of targeted

<sup>20</sup> See <http://www.sefsc.noaa.gov/sedar/download/SI2RD12%20FLred%20tide%20Dec2006.pdf?id=DOCUMENT> for information of the impact of this event.



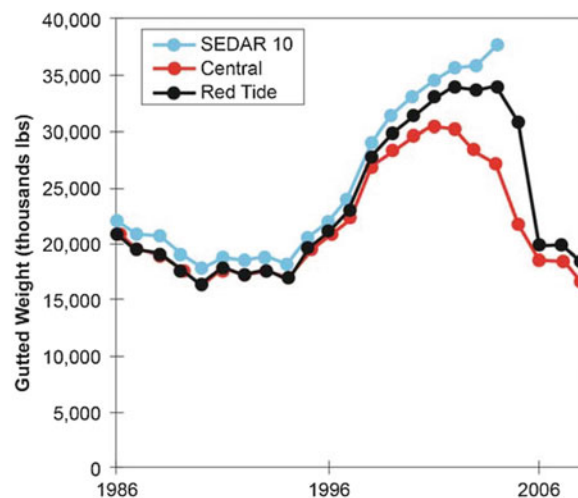


Figure 10.80. Estimated Gulf of Mexico gag grouper biomass (Anonymous 2009) (Note: 1 lb = 0.454 kg).

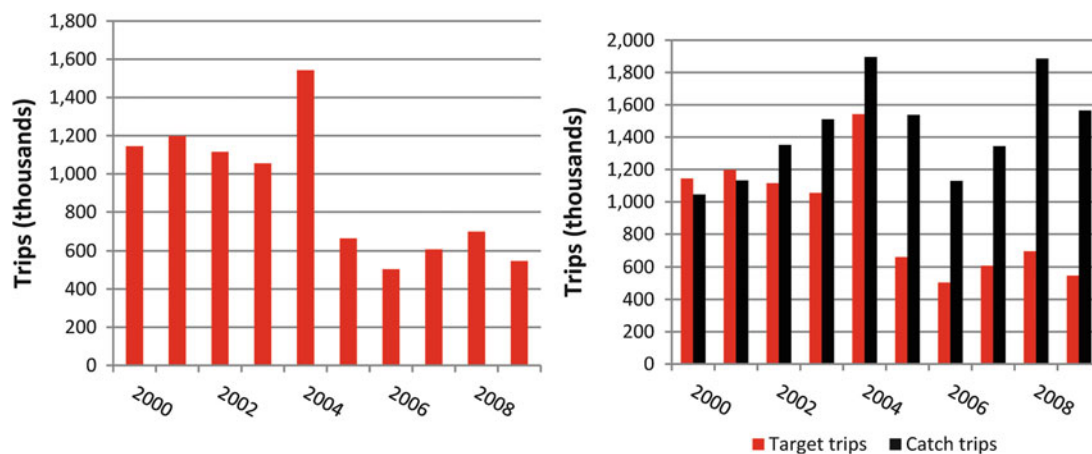
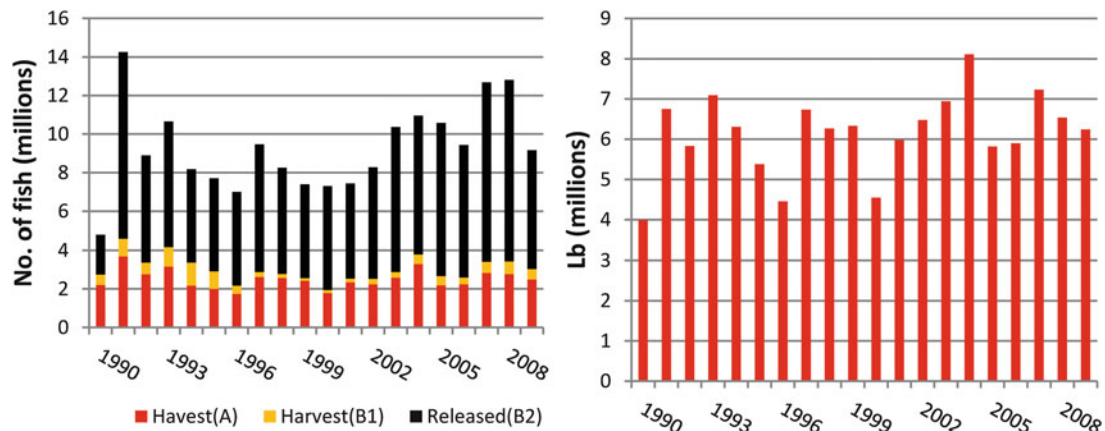


Figure 10.81. Recreational grouper targeting trips (*left panel*) and relationship between grouper catch trips and grouper targeting trips (*right panel*), 2000–2009 (NMFS FSD, data accessed 2012, with targeting estimates calculated by authors—see Appendix A).

grouper trips has averaged about 600,000 annually compared to an annual average of 1.2 million during 2000–2004. The decline in number of reported grouper targeting trips coincides with the red tide event that reportedly caused high grouper mortality (Anonymous 2009). While four named hurricanes hit Florida in 2004 (Charley, Frances, Ivan, and Jeanne), these hurricanes do not appear to have materially impacted Florida fishing trips or targeted grouper trips. In fact, some have hypothesized that the increased hurricane activity was the cause for the increased grouper catch in that year.

While the number of reported grouper angler targeting trips fell sharply beginning in 2005, the number of angler trips wherein grouper was caught fell for only a couple of years but increased sharply again in 2008 and 2009 (Figure 10.81, right panel). This is consistent with the increased grouper catches ( $A + B1 + B2$ ) in number of fish as illustrated in Figure 10.77 (left panel). As these fish reach minimum harvest size, one might see a commensurate increase in harvest in pounds.



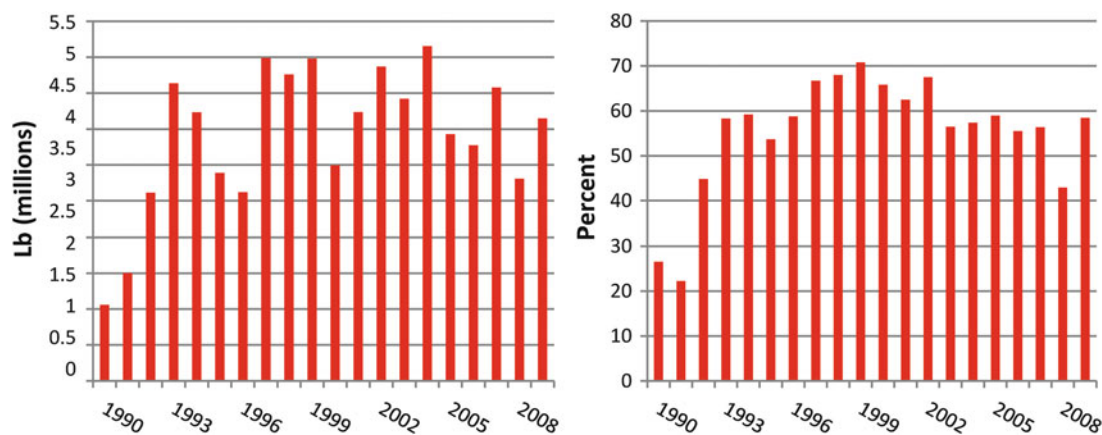
**Figure 10.82.** Gulf of Mexico recreational aggregate snapper catch (*left panel*) and harvest (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A) (*Note: 1 lb = 0.454 kg*).

### Snappers



The snapper family, as defined in the Gulf of Mexico Reef Fish Fishery Management Plan (GMFMC 1981) (with amendments), includes a large number of species: Queen snapper (*Etelis oculatus*), Mutton snapper (*Lutjanus analis*), Blackfin snapper (*Lutjanus buccanella*), Red snapper (*Lutjanus campechanus*), Cubera snapper (*Lutjanus cyanopterus*), Gray (mangrove) snapper (*Lutjanus griseus*), Lane snapper (*Lutjanus synagris*), Yellowtail snapper (*Ocyurus chrysurus*), Wenchman snapper (*Pristipomoides aquilonaris*), and Vermilion snapper (*Rhomboplites aurorubens*). Based on this classification, the estimated catch (A + B1 + B2) of snappers by recreational anglers in the Gulf of Mexico (excluding Texas) in number of fish averaged nine million annually during 1990–2009 (Figure 10.82, left panel). Overall, the estimated number of fish generally fell throughout the 1990s but increased throughout the 2000s approaching 13 million in 2007 and 2008 before falling to about nine million in 2009. The vast majority of snapper are released with the average approaching 70 % (with no apparent trend) during the 20-year period of analysis. The high snapper release percentage reflects the substantial regulations imposed on the primary recreational snapper species in the northern Gulf—the red snapper. These regulations include size limits, bag limits, and extended closed seasons.<sup>21</sup> Overall, annual snapper catch in number of fish as a proportion of aggregate reef fish catch in number of fish generally ranged from about 55 to 70 % during the 20-year period of analysis. Combined snapper and grouper catches (A + B1 + B2) consistently accounted for at least 90 % of the aggregate reef fish catch in numbers and in selected years the combined total approached or exceeded 99 % of the aggregate reef fish catch.

<sup>21</sup> A complete list of recreational red snapper size limits, bag limits, season lengths, and recreational allocation/quotas through 2005 is given by Hood et al. 2007. More recent information on recreational red snapper regulations (and other reef fish species) can be found on the Gulf of Mexico Fishery Management Council website at: [http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/Summaries\\_of\\_the\\_Provisions\\_of\\_FMPs.pdf](http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/Summaries_of_the_Provisions_of_FMPs.pdf)

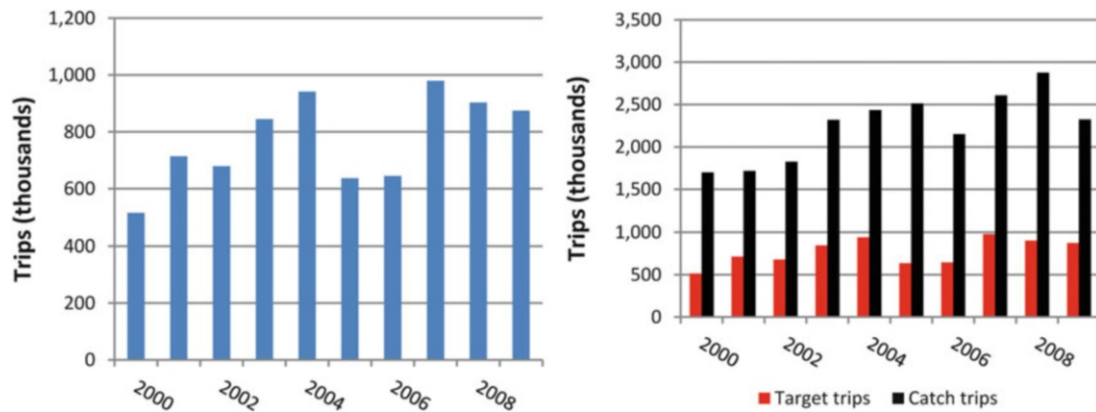


**Figure 10.83. Gulf of Mexico recreational red snapper harvest (left panel) and as a percent of total recreational snapper harvest (right panel), 1990–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A) (Note: 1 pound is equal to 0.454 kilograms).**

Aggregate snapper harvest by Gulf of Mexico recreational anglers (excluding Texas) in pounds (A + B1) is provided in Figure 10.82 (right panel). During the 20-year period ending in 2009, the estimated weight of aggregate snapper harvest averaged 6.1 million pounds annually with peak landings of over eight million pounds in 2004. As indicated, estimated harvest in pounds has been relatively stable since 2005.

Red snapper is by far the most popular recreational snapper species, particularly in the northern and western Gulf. Annual harvest of red snapper during 1990–2009, expressed on a weight basis, is given in Figure 10.83 (left panel), while red snapper landings in pounds as a percentage of total snapper landings are given in Figure 10.83 (right panel). As indicated, harvest of red snapper in pounds (A + B1) was very low in the early 1990s but increased from 1990 to 1993 at which point it equaled more than 4.5 million pounds. It declined again through 1996 but increased sharply in 1997. Much of the change in harvest during this period can be tied to changing regulations that are often tied to a changing red snapper population (as determined by stock assessments). Since the early 1990s, the red snapper fishery has been managed under a quota system with 51 % of the total quota given to the commercial sector and 49 % to the recreational sector. From 1996 to 2006, the recreational share of the quota equaled 4.5 million pounds a year. In 2007, the recreational quota was reduced to 3.2 million pounds and was reduced once again to 2.4 million pounds in 2008 where it remained in 2009. In an attempt to maintain the recreational harvest within its quota, GMFMC uses a combination of bag limits and fishing seasons though more often than not the final recreational harvest in a given year exceeds the quota. In 2009, for example, the recreational catch exceeded the quota by about 2.2 million pounds or almost 90 %.

Snapper angler targeting trips and snapper angler catch trips in relation to targeting trips are presented in Figure 10.84. Trips reporting the targeting of specific snapper species averaged 770,000 during the 10-year period of analysis (Figure 10.84, left panel). As was the case with grouper, snapper catch trips exceeded targeting trips by a wide margin during each of the 10 years considered (Figure 10.84, right panel). Overall, catch trips were generally about three times as large as target trips. Potential explanations for the large deviation between targeted snapper trips and catch trips were identified in the analysis of aggregate reef fish species.



**Figure 10.84. Gulf of Mexico recreational snapper targeting trips (left panel) and the relationship between catch trips and targeting trips (right panel), 2000–2009 (NMFS FSD, data accessed 2012, with targeting estimates calculated by authors—see Appendix A).**

### Coastal Pelagics

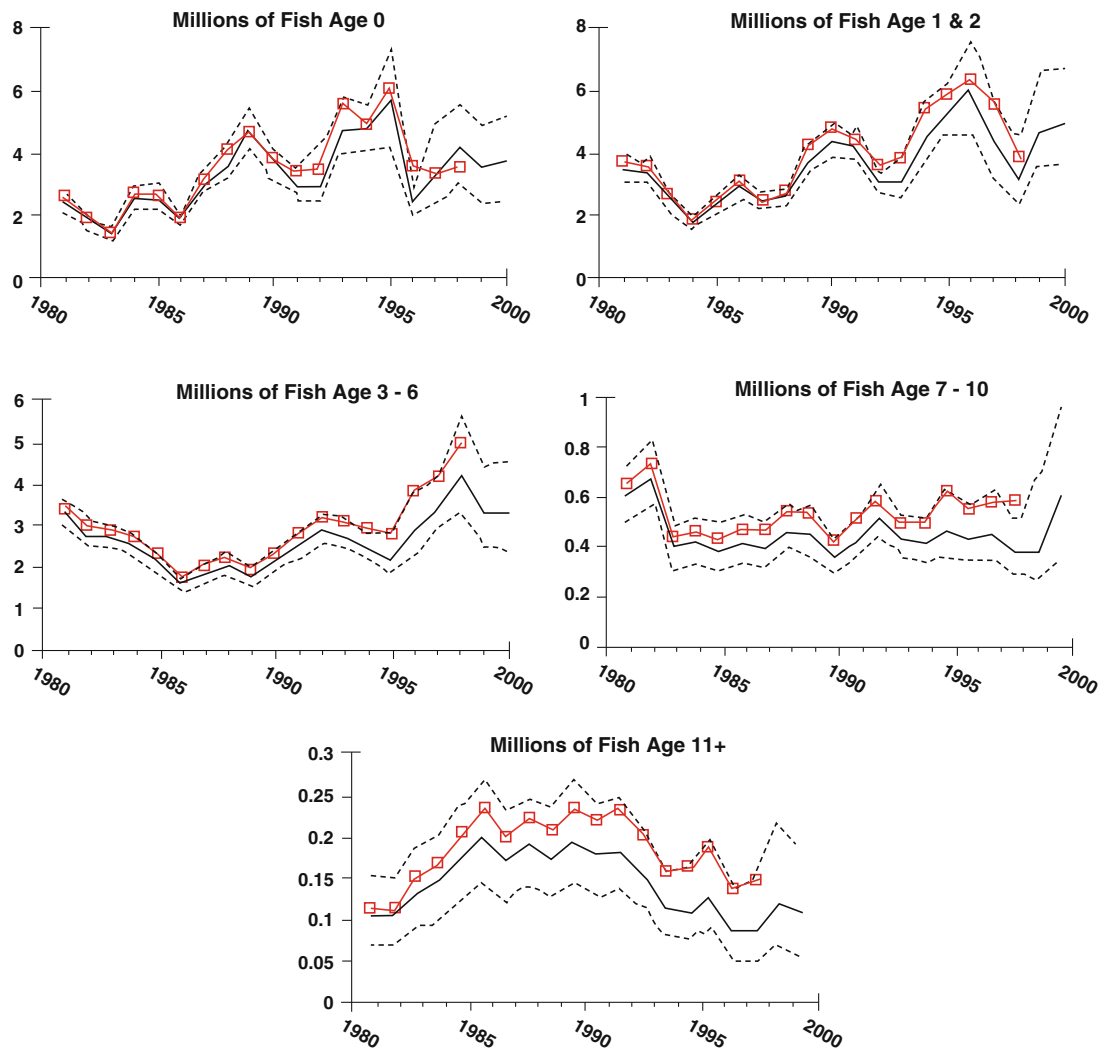


Another group of species of high recreational interest in the Gulf of Mexico is that of coastal pelagic. There are five primary coastal pelagic species: king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*Scomberomorus maculatus*), cobia (*Rachycentron canadum*), dolphinfish (*Coryphaena hippurus*), and wahoo (*Acanthocybium solandri*). Three of these species—king mackerel, Spanish mackerel, and cobia—are managed under the auspices of the GMFMC (cooperatively with the South Atlantic Management Council due to the migratory nature of the species). Recreational harvests of the other two species, while not subject to federal regulation in the Gulf, are subject to various state regulations.

*Coastal Pelagics Managed by Gulf Council:* Of the three coastal pelagic species managed by the GMFMC, king mackerel has historically received the most attention because it was considered to be heavily overfished. As such, the GMFMC established a total allowable catch (TAC) for the species for the 1986/1987 season (July 1 to June 30) equal to 2.9 million pounds of which 1.97 million pounds was allocated to the recreational sector.<sup>22</sup> With additional information and updated stock assessments, the TAC was subsequently increased to 4.25 million pounds for the 1990/1991 season (recreational allocation equal to 3.91 million pounds) and increased again to 7.8 million pounds for the 1992/1993 season (recreational allocation equal to 5.3 million pounds). In association with the recovery of the king mackerel stock, the TAC was increased again to 10.6 million pounds for the 1997/1998 season (7.2 million pound recreational quota) before being decreased marginally to 10.2 million pounds for the 2000/2001 season where it is currently maintained.

Estimated year-class strengths for the Gulf of Mexico king mackerel stock for the 1980–2000 period is presented in Figure 10.85 while the estimated biomass for the age 3+ proportion of the population (i.e., harvestable population) is given in Figure 10.86. While

<sup>22</sup>For a detailed description of historical rules and regulations, see: [http://www.gulfcouncil.org/fishery\\_management\\_plans/migratory\\_pelagics\\_management.php](http://www.gulfcouncil.org/fishery_management_plans/migratory_pelagics_management.php).



**Figure 10.85.** Estimated Gulf of Mexico king mackerel biomass trends, by cohort (Ortiz et al. 2002). *Note:* Solid black line represents population estimates, by age, based on analysis by Ortiz et al. (2002) while the hashed black lines represent the 80 % confidence interval around the population estimates. The red line represents population estimates, by age, provided in a previous assessment and provided by Ortiz et al. (2002) for purposes of comparison.

somewhat dated, the information presented in these figures clearly indicates a high amount of annual variability in recruitment, subsequent year-class strength, and harvestable biomass. As illustrated, years of strong recruitment (age 0 fish) map into larger year classes in subsequent years.

Large variations in year-class strengths and biomass, in conjunction with changing management measures, can result in large annual variations in recreational catches and harvests. This variation is evident in Figure 10.87, left panel (1990–2009 Gulf recreational catches in terms of numbers of fish) and Figure 10.87, right panel (annual recreational harvest in pounds). As indicated, the estimated Gulf recreational catch of king mackerel in numbers of fish has ranged from less than 400,000 in some years (2003, 2005, 2008) to more than 700,000 in other years (1991, 1996, 2006). Similarly, annual harvests (A + B1) have ranged from in excess of five

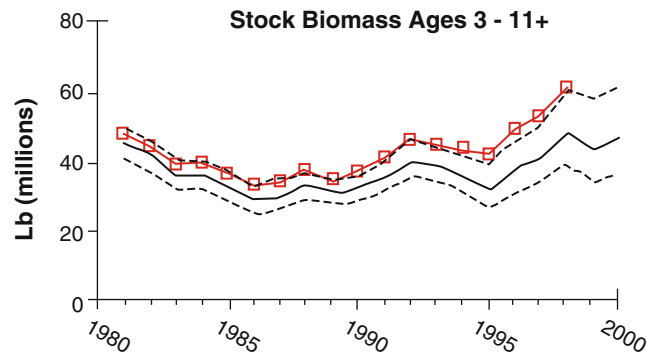


Figure 10.86. Estimated Gulf of Mexico king mackerel biomass trends, 3–11+ year cohorts (Ortiz et al. 2002). Note: Solid black line represents population estimates, by age, based on analysis by Ortiz et al. (2002) while the hashed black lines represent the 80 % confidence interval around the population estimates. The red line represents population estimates, by age, provided in a previous assessment and provided by Ortiz et al. (2002) for purposes of comparison. (1 lb = 0.454 kg).

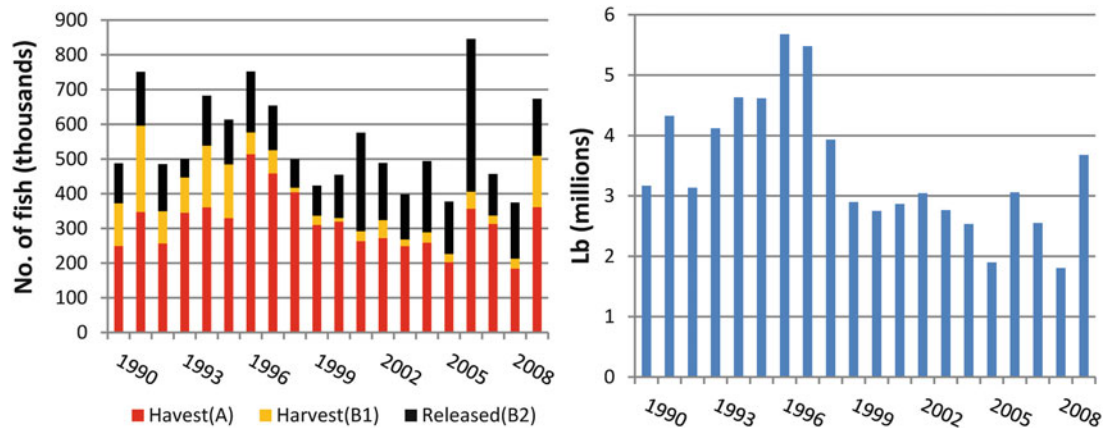
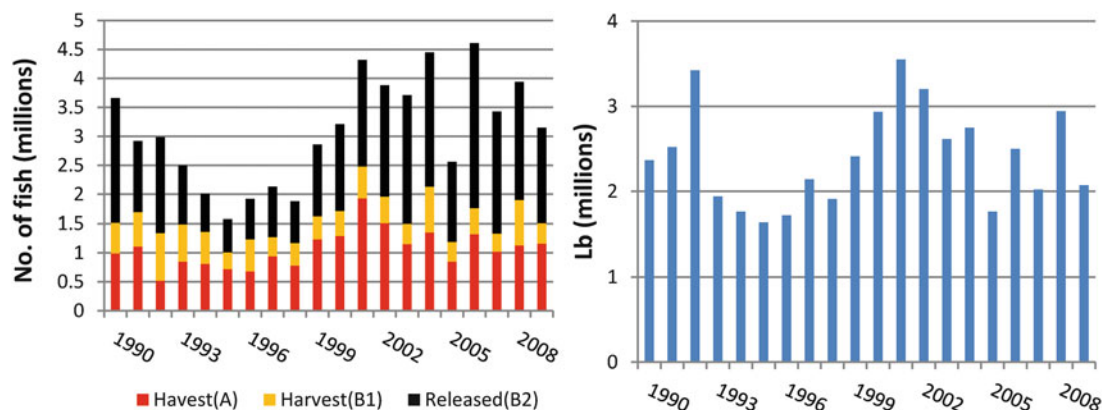


Figure 10.87. Gulf of Mexico recreational king mackerel catch (*left panel*) and harvest (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).

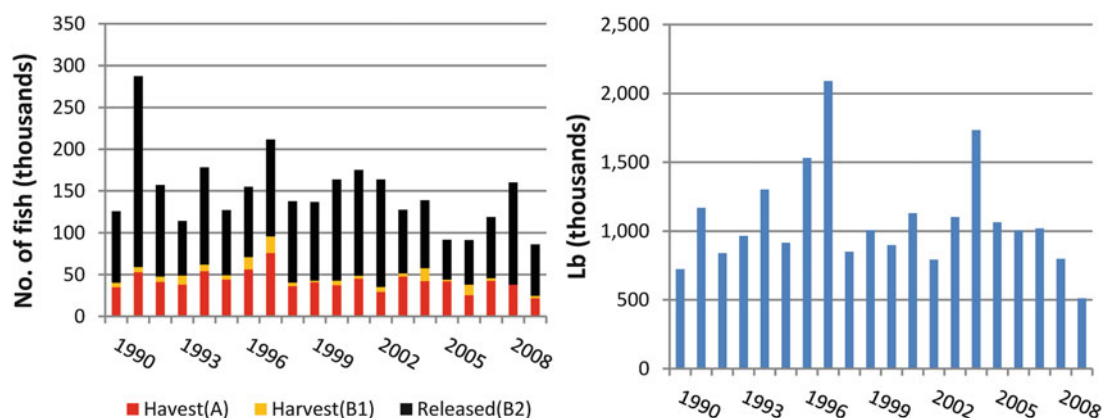
million pounds in some years (1996, 1997) to less than two million pounds in other years (2005, 2008). In recent years, the recreational harvest has fallen far short of the approximately seven million pound recreational allocation. Almost 30 % of the king mackerel catch (A + B1 + B2) over the 1990–2009 period was reportedly released alive (B2) with the proportion approaching or exceeding 50 % in some years (e.g., 2001 and 2006).

Like king mackerel, the GMFMC management of Spanish mackerel has changed over time. In the early 1990s (1991/1992 season), the TAC was set at 8.6 million pounds with 43 % of this total allocated to the recreational sector. Bag limits varied by state with a bag limit of three fish per person per day in Texas, a bag limit of five fish per person per day in Florida, and a bag limit of ten fish per person per day in the remaining Gulf States (i.e., Alabama, Mississippi, and Louisiana). The Gulf Spanish mackerel TAC was subsequently reduced to seven million pounds for the 1996/1997 fishing year with the percentage allocation to the recreational sector remaining constant. While the recreational share remained constant, the TAC for the 1999/2000 season was increased to 9.1 million pounds and the recreational bag limit was increased to 15 fish per person per day across all Gulf States.





**Figure 10.88.** Gulf of Mexico recreational Spanish mackerel catch (*left panel*) and harvest (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A) (*Note: 1 lb = 0.454 kg*).

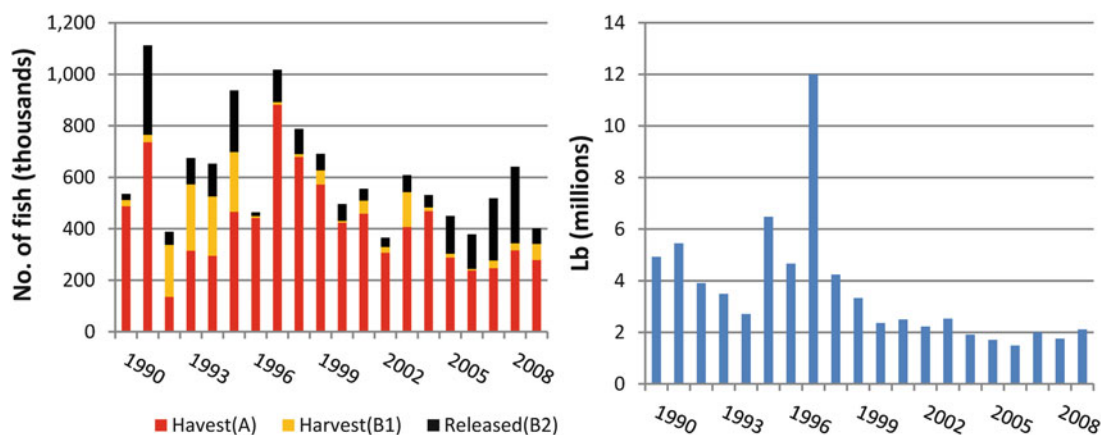


**Figure 10.89.** Gulf of Mexico recreational cobia catch (*left panel*) and harvest (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A) (*Note: 1 lb = 0.454 kg*).

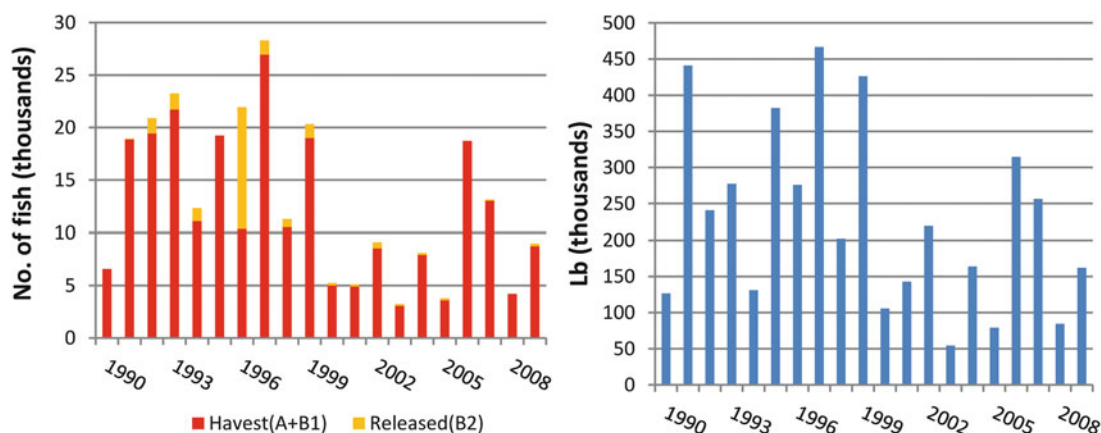
Annual Gulf of Mexico recreational catches (A + B1 + B2) and harvests (A + B1) of Spanish mackerel for the 20-year period ending in 2009 are presented in Figure 10.88. Annual catch in numbers of fish is highly variable with a range from less than two million fish to more than four million fish. Similarly, the annual Spanish mackerel harvest during the 20-year period ranged from less than two million pounds in many years to 3.5 million pounds in 2001.

Cobia, as noted, is the third coastal pelagic species under the purview of the GMFMC. Annual catches and harvests of this fish are relatively limited (Figure 10.89) and are recreationally managed under a bag limit of two fish per person.

*Coastal Pelagics Not Managed by Gulf Council:* As noted, there are two coastal pelagic species that are harvested by recreational fishermen that are not managed by GMFMC. The first of these species, dolphinfish, are high spawners and the growth rate of the fish is very high. As such, GMFMC sees no need to manage this species (though there are some state regulations, including a Florida regulation of ten fish per person per day bag limit, not to exceed 80 per vessel per day). As indicated by the information in Figure 10.90 (left panel), annual dolphinfish catches expressed in numbers of fish can vary widely. During the period of analysis, annual catch of dolphinfish ranged from less than 400,000 fish (1992, 2002, and 2006) to more than



**Figure 10.90.** Gulf of Mexico recreational dolphinfish catch (*left panel*) and harvest (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).



**Figure 10.91.** Gulf of Mexico recreational wahoo catch (*left panel*) and harvest (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012—see Appendix A).

one million fish (1991 and 1997). Recreational harvest varied from a high of 12 million pounds in 1997 to less than two million pounds in a number of years (Figure 10.90, right panel). Since 2004, however, annual harvest has fallen in the relatively narrow 1.5 million pound to two million pound range.

The second coastal pelagic species not managed by the GMFMC is wahoo. Annual catches and harvests of this species are quite limited as suggested by the information in Figure 10.91.

#### *Highly Migratory Pelagics*



A number of highly migratory species (HMS), including billfish, swordfish, tunas, and sharks, spend a portion of their respective life cycles in the Gulf of Mexico, and a high proportion of the trips targeting these species are in Florida. Estimating the recreational catch of these species is problematic for a number of reasons, and as stated in a recently

completed report by the MRIP, *Highly Migratory Species Work Group & Florida Fish & Wildlife Commission* (Florida Highly Migratory Species Private Angler Survey Final Report) (FFWCC 2010):

*Conducted by the state's Fish & Wildlife Research Institute for the past decade, the MRFSS has averaged 40,000 field intercepts annually. HMS-targeted trips comprise a small proportion of all recreational fishing trips combined, though, which makes them a 'rare event' in any survey that is not directly targeting this specific segment of the recreational fishery. As a result, catch estimates for nearly all HMS species are highly imprecise due to typically low MRFSS intercept sample size.*

It is not just the low sampling rate that yields imprecise (and likely biased) estimates of catch and effort associated with HMS species, including design limitations (e.g., when sampling takes place) and coverage biases, in the MRFSS. With respect to design limitations, MRFSS intercept surveys occur only during the daytime. Completed HMS trips, given the type of fishing and the larger boats used in the activity, often arrive home at night and thus would not be sampled. With respect to coverage biases, MRFSS intercept sampling occurs only at accessible docks. A sizeable proportion of the larger recreational vessels that will, on occasion, target HMS species do not dock at public access sites. Finally, tournament caught fish are not included in MRFSS estimates because MRFSS does conduct intercept surveys at tournament sites. With these caveats in mind, a few MRFSS catch statistics are provided in this section. However, one should recognize the uncertainty with these estimates and make use of them accordingly. In an attempt to reduce potential biases and level of uncertainty, only 10-year averages are presented along with high and low catches during that interval. Estimated Gulf (excluding Texas) catch of tunas during the 2000–2009 period averaged approximately 100,000 fish per year with a low of 27,000 fish and a high of 223,000 fish. About 70 % of the total catch (A + B1 + B2) during the period was harvested (A + B1) which equaled about 1.3 million pounds per year.

Just over one million sharks per year were estimated to be caught in the Gulf (excluding Texas) during 2000–2009 with a range from about 800,000 to 1.3 million. Among HMS species, sharks have the least annual variation in catch. Of the estimated annual catch of 1.3 million sharks, less than 10 % were harvested (A + B1). The estimated number of marlin (blue [*Makaira nigricans*] and white [*Tetrapturus albidus*]) caught each year, on average, during 2000–2009 was less than 10,000; virtually none of these were kept. Finally, estimated annual swordfish catches were negligible and equal to zero in many years (likely because no intercepted anglers had caught a swordfish).

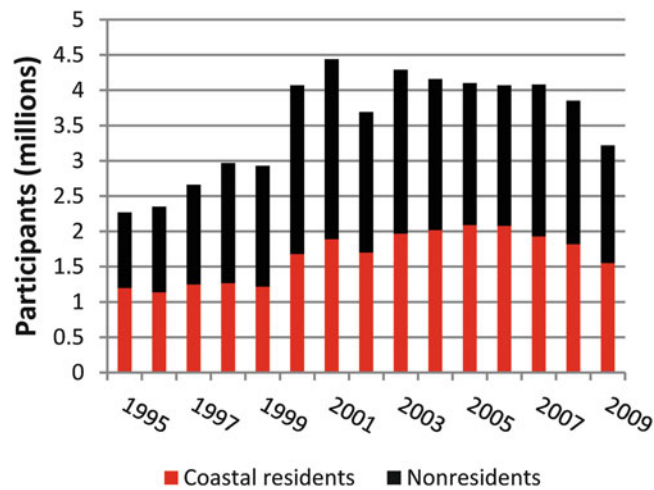
### 10.4.3 Recreational Activities at the State Level

#### 10.4.3.1 Participation by State

##### 10.4.3.1.1 Florida

The estimated annual number of marine anglers in Florida is, to a large extent, nonresident based (Figure 10.92). As discussed throughout the analysis by state, this factor alone tends to differentiate Florida from the other Gulf States. Overall, more than 50 % of the participants have historically been nonresidents with the proportion approaching 60 % during the late 1990s/early 2000s.

Furthermore, as indicated, west coast Florida participation, as measured by the number of marine anglers, increased significantly during the 1995–2009 period. Much of the growth occurred in 2000–2001 when the annual participants estimate increased to an average of about 4.2 million as compared to an average of about three million annually during



**Figure 10.92. Number of Florida (west coast) angler participants based on MRFSS, 1995–2009 (NMFS FSD, data accessed 2012—see Appendix A).**

1998–1999. Most of the increase was the result of an increase in the number of nonresident participants.

The sharp increase in nonresident participation in the early 2000s corresponds with a sharp increase in estimated Florida visitors during this period. Specifically, from 1996 to 1998, the annual number of Florida visitors (estimated) fell in the relatively narrow range of 45 million to 49 million. In 1999, the estimate increased to 59 million and increased again to 73 million in 2000. Thereafter, the number gradually grew to almost 85 million in 2007 and 2008. In 2009, the number fell to 81 million. Corresponding to the decline in estimated visitors in 2009, the number of nonresident anglers fishing Florida waters fell from about two million in 2008 to 1.7 million in 2009. The estimated number of resident participants increased from about 1.2 million annually during the mid-1990s to more than two million by 2004 (Figure 10.92). The estimated number fell after 2006, and by 2009 it equaled only 1.6 million.

#### 10.4.3.1.2 Alabama

The estimated number of marine angler participants in Alabama's waters is provided in Figure 10.93 for the 15-year period ending in 2009. As indicated, the total increased from less than 300,000 annually during the mid-1990s to more than 700,000 by the mid-2000s before falling to about 550,000 annually in 2008 and 2009 (the low participation rate in 2005 is undoubtedly the result of Hurricane Katrina and its impact on the marine-related infrastructure along the Alabama coast). With respect to residents (coastal and noncoastal), the estimated number of participants increased from about 180,000 annually during the mid-1990s to more than 400,000 during much of the 2000s before falling to 308,000 in 2008. The number increased to 357,000 in 2009. Overall, the average number of resident participants during 2005–2009, averaging 365,000 annually, was almost double the average number of resident participants in 1995–1999 (184,000). Coastal participants have represented about 60 % of total resident participants during the period of analysis.

The number of nonresident participants, who comprised roughly 40 % of the Alabama total during 1995–2009, grew from about 100,000 annually during the mid-1990s to 345,000 in 2004 but fell to only 160,000 in 2005, undoubtedly the influence of Hurricane Katrina. After recovering again to 320,000 in 2006, the number fell in each of the successive 3 years and

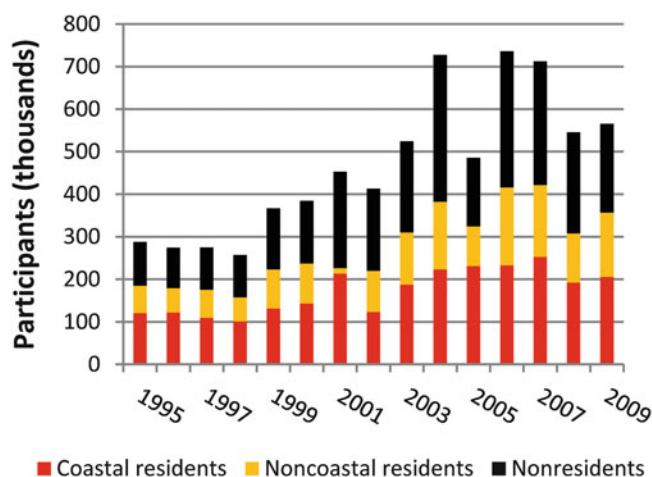


Figure 10.93. Number of Alabama angler participants based on MRFSS, 1995–2009 (NMFS FSD, data accessed 2012—see Appendix A).

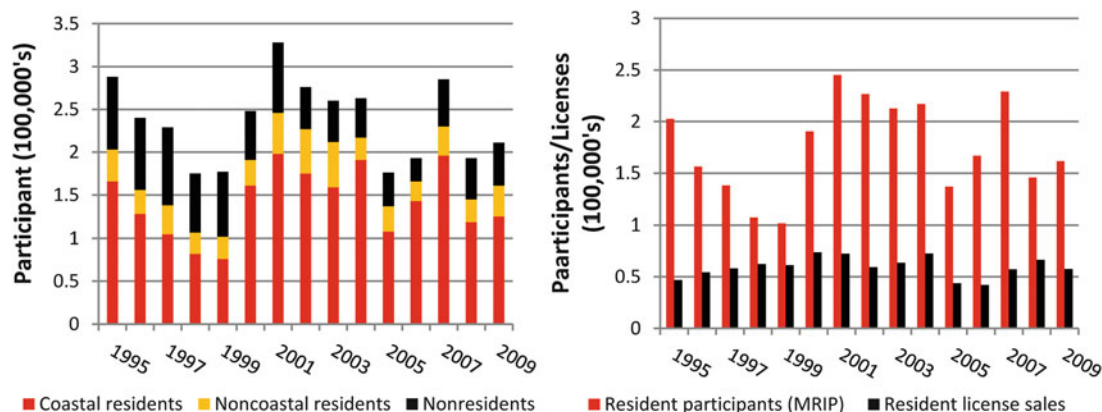
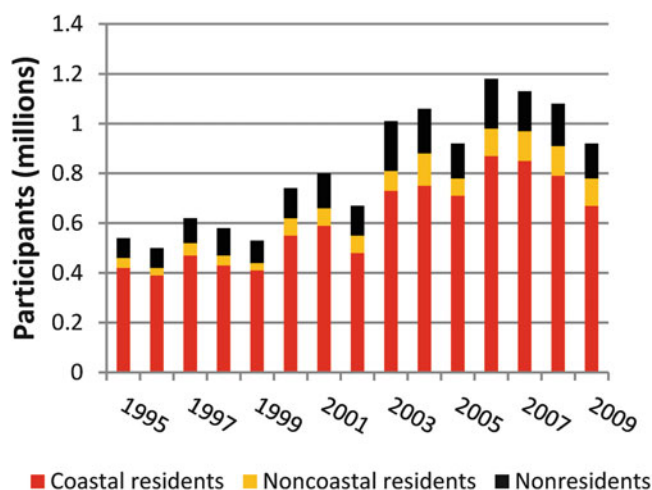


Figure 10.94. Number of Mississippi angler participants based on MRFSS (*left panel*) and comparison of MRFSS resident participants and resident license sales (*right panel*), 1995–2009 (NMFS FSD, data accessed 2012—see Appendix A; Mississippi Department of Marine Resources, data provided by Buck Buchanan).

equaled only 210,000 in 2009. This figure represents the fewest nonresident participants since 2002 (excluding the 2005 hurricane year).

#### 10.4.3.1.3 Mississippi

Among the Gulf States (excluding Texas), Mississippi had the fewest marine recreational participants with the estimated number over 1995–2009 averaging 235,000 annually. Unlike other Gulf States, Mississippi had no apparent growth in participation rate during the 15-year period being considered (Figure 10.94, left panel). Overall, the number of participants during 1995–1999, according to the MRFSS estimates, averaged about 220,000 compared to about 210,000 during 2005–2009. While some of the decline in recent years reflects the impact on infrastructure associated with Hurricane Katrina, the downward trend in participation rate appears to have been in motion prior to 2005, though the large annual variation in number of participants makes this statement tenuous.



**Figure 10.95. Number of Louisiana angler participants based on MRFSS, 1995–2009 (NMFS FSD, data accessed 2012—see Appendix A).**

The number of resident participants, which ranged from 102,000 (1999) to 245,000 (2001), represented three-quarters of the total number of participants during the 15-year period. The estimated number of nonresident participants never exceeded the 100,000 mark and has hovered around 50,000 annually since 2006.

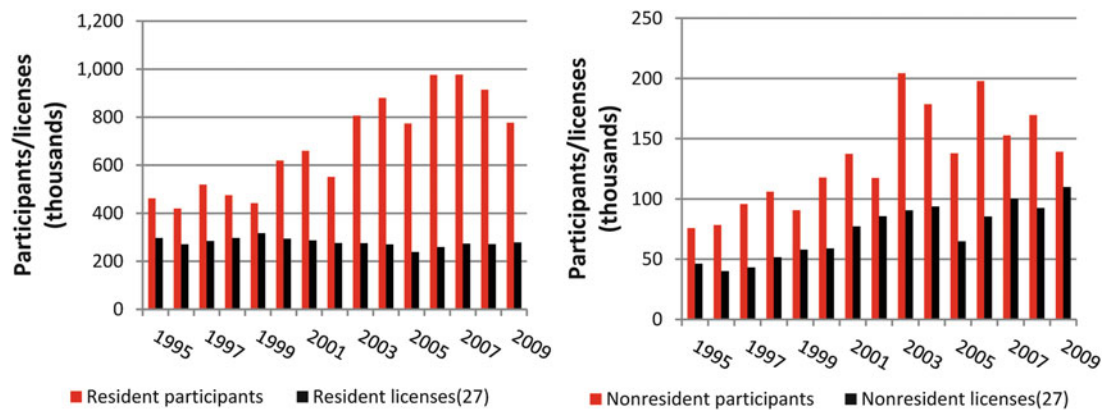
Information illustrating the relationship between the MRFSS annual resident participation estimates and the resident license sales is given in Figure 10.94 (right panel).<sup>23</sup> As indicated, the MRFSS estimates of resident participants exceed resident license sales by a wide margin with little or no apparent trend to this margin. There are a number of reasons that explain at least a portion of the differential. First, some residents are exempt from a license requirement (e.g., individuals under the age of 16; blind, paraplegic, or multiple amputee residents; member of the armed forces on active duty out of state on leave). Second, some residents required to have a license may risk fishing without it. Third, MRFSS estimates are given on a calendar year basis while license sales are given on a fiscal year basis. Finally, the MRFSS estimates are just that, estimates. As such, there is some amount of error associated with these estimates. While not illustrated, there is also a large differential between MRFSS estimates of nonresident participants and nonresident license sales. In 2009, for example, the MRFSS nonresident participation estimate was approximately 50,000 individuals compared to about 11,000 nonresident license sales (2009–2010 fiscal year).

#### 10.4.3.1.4 Louisiana

Based on MRFSS estimates, the reported number of recreational participants fishing in Louisiana's waters increased from an average of 553,000 annually during 1995–1999 to more than one million during 2005–2009 (Figure 10.95). Coastal residents consistently represented 70–80 % of the total participants while noncoastal Louisiana residents represented 7–12 % of the total. Out-of-state participants represented 14–20 % of the total. Despite two 2005 hurricanes (Katrina and Rita) that damaged or destroyed a sizeable amount of the coastal fishing infrastructure and resulted in the dislocation of a sizeable portion of Louisiana's coastal

<sup>23</sup> While MRFSS estimates are on a calendar basis, license sales are on a June/May basis. For purposes of analysis, license sales for 1995–1996 were treated as 1995.





**Figure 10.96. Comparison of MRFSS estimates of Louisiana participants and license sales to residents (left panel) and nonresidents (right panel), 1995–2009 (NMFS FSD, data accessed 2012—see Appendix A; LDWF, <http://www.wlf.louisiana.gov/licenses/statistics>).**

population, the 2006 MRFSS reported coastal participants (868,000) was the highest estimate during the 15-year period of analysis (ending in 2009) with the number subsequently falling in each of the 3 following years to about 670,000 in 2009. Similarly, the reported number of out-of-state participants totaled 198,000 in 2006 but then fell to 139,000 in 2009. In absolute terms, the 198,000 in 2006 ranked second only to the 204,000 (2003) reported out-of-state participants during the 15-year period of analysis ending in 2009. Combined, Louisiana coastal and noncoastal estimated number of resident participants peaked in 2006 and 2007 at about 977,000 and fell to 777,000 by 2009.

With a number of exceptions, a saltwater fishing license is required for fishing in Louisiana's waters. This requirement permits a comparison of MRFSS participation estimates with license sales. Some primary caveats are in order, however, before such a comparison is given. First, a saltwater fishing license is not required for individuals under the age of 16 or for senior citizens (currently, residents born prior to June 1, 1940, are exempt). Second, licenses expire on June 30 each year but can be purchased as early as June 1 of the previous year. Third, the MRFSS numbers are estimates extrapolated from a sample and there is likely to be some error associated with this extrapolation. Finally, the purchase of a license does not imply its use. With these caveats in mind, a comparison of annual resident saltwater licenses (privilege type 27) and MRFSS resident participation estimates is presented in Figure 10.96 (left panel). A similar comparison of nonresident saltwater license sales and MRFSS out-of-state participant estimates is given in Figure 10.96 (right panel). As indicated, without exception, the MRFSS estimates of resident participants exceed resident saltwater license sales by a wide margin, and this margin has tended to increase over time. Consistent with the significant differences in MRFSS resident (i.e., Louisiana) participant estimates and resident license sales, the correlation between the two time-series was negative and significant ( $-0.58$ ).

While license gear 27 (Resident Saltwater Fishing) is the most common license required for participating in saltwater fishing activities in Louisiana, there are, in addition to those previously noted (e.g., individuals under the age of 16), several exceptions. These include residents with disabilities, active military residents, and the resident 3-day charter to name just some of the more common exemptions. While these residents are exempt from purchasing the Resident Saltwater Fishing License (27), other respective licenses are required (in many instances, these licenses are hunting and fishing combination licenses). In addition to these licenses, there is also a Resident Lifetime License and Senior Hunting/Fishing License. Inclusion of these licenses

complicates analysis because some are issued only as hunting and fishing combinations and the number of Lifetime Licenses, by definition, will only increase over time. With these caveats noted, the Louisiana Department of Wildlife and Fisheries (LDWF) provides an estimate of all resident saltwater privileges. In 2009, this total was 395,000 (357,000 in 2007 and 383,000 in 2008). These numbers are still significantly below the MRFSS participation estimates.

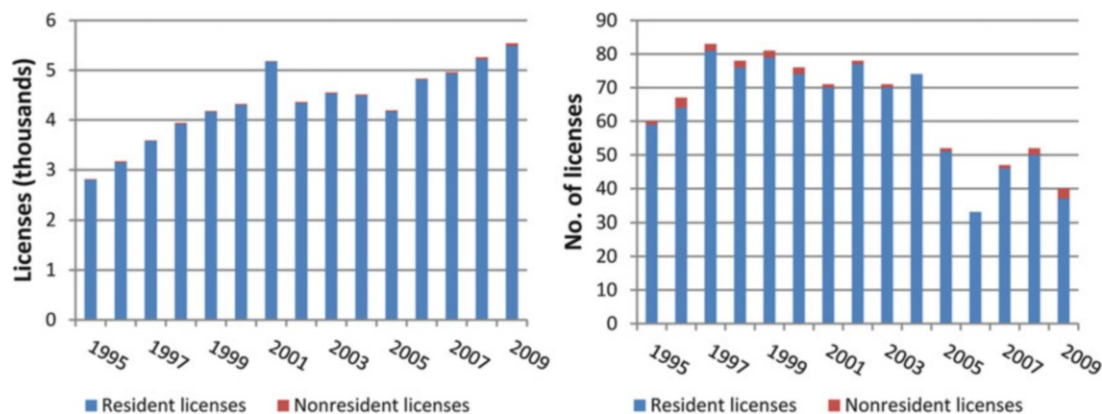
As was the case in the comparison of resident participants, MRFSS annual estimates of out-of-state participants consistently exceeded the nonresident saltwater license sales, often by a substantial amount (Figure 10.96, right panel). The difference between the two time series as a proportion of the MRFSS estimates ranged from a low of about 20 % in 2009 to more than 50 % in several years. Despite the observed annual differences, the correlation between the MRFSS estimates of out-of-state participants and nonresident saltwater license sales was a respectable 0.78.

Yet a third source for examining participation is the U.S. Fish and Wildlife Service (USFWS) *National Survey of Fishing, Hunting, and Wildlife-Associated Recreation* (U.S. Department of Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau (2008)). This survey is conducted every 5 years with the 2006 survey being the most recently available one. For that year, the estimated number of saltwater participants (both fishing and spearing activities) in Louisiana of age 16 or greater totaled 289,000. Of this total, 248,000 were Louisiana residents and 42,000 were nonresidents. The estimated number of 2006 nonresident saltwater fishermen, however, is based on a small sample size and is thus subject to the standard caveats.<sup>24</sup> Estimates of number of participants from the 2001 survey yield a total of 504,000 of which 386,000 were residents and 118,000 were nonresidents. The 1996 survey yielded estimates of 255,000 resident participants (16 years of age or greater) and 90,000 nonresidents (small sample size) for a total participation estimate of 346,000. As indicated by the three USFWS surveys covering an 11-year period spanning from 1996 to 2006, the total estimated number of saltwater participants (16 years of age or more) increased from 346,000 in 1996 to 504,000 in 2001 but then fell by about 40–289,000 in 2006. Resident participants as a percentage of the total ranged from 74 % in 1996 to 86 % in 2006.

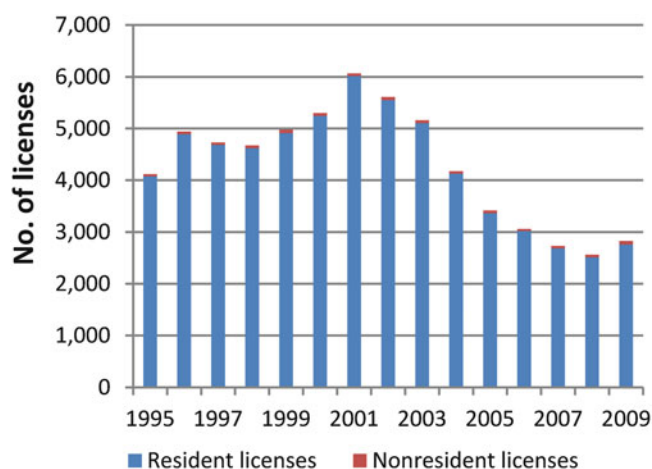
The MRFSS/MRIP survey captures only recreational finfish fishing activities and, as such, does not capture all recreational activities of potential relevance. Recreational shellfish/molluscan fishing activities also occur in Louisiana's waters. State license sales can assist in portraying these activities. One of the more common recreational shellfish fishing activities is that of crabbing. To participate in this activity, residents and nonresidents must purchase a crab trap license that allows them to employ up to 10 traps (license numbers 70/83 and 71/84). Annual sales of crab trap licenses for the period 1995–2009 are presented in Figure 10.97 (left panel). As indicated, total sales advanced from about 2800 in 1995 to more than 4,000 during each year of the 1990s and have exceeded 5,000 in 2001, 2008, and 2009. More recently, a lifetime crab trap license has been instituted by LDWF. Issuance of these licenses has increased from 1 in 2004 to 39 in 2009. Less than 1 % of the recreational crab trap licenses are issued to nonresidents.

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<sup>24</sup> While the survey used to conduct the 2006 *U.S. Fish and Wildlife Service Fishing, Hunting, and Wildlife-Associated Activities* did not elicit information on individuals less than 16 years of age, the screening phase of the survey, which was initiated in April 2006, did collect information on persons 6–15 years of age and their activities in 2005. While a number of caveats associated with these estimates are given—not the least of which being potential long-term recall bias and the household participant not being the 6–15-year-old participants—an estimate of 133,000 6–15-year-old resident fishing participants in 2006 was made. Note that this estimate includes both fresh-water and saltwater participants.



**Figure 10.97.** Louisiana recreational crab licenses (*left panel*) and recreational oyster licenses (*right panel*), 1995–2009 (Louisiana Department of Wildlife and Fisheries: <http://www.wlf.louisiana.gov/licenses/statistics>).



**Figure 10.98.** Louisiana recreational shrimp licenses (less than 16-foot trawl), 1995–2009 (LDWF: <http://www.wlf.louisiana.gov/licenses/statistics>).

Recreational oystering also requires a specific gear license (in addition, a basic fishing license and a saltwater fishing license is required for the recreational tonging of oysters). This license (74/89 for residents and 75/90 for nonresidents) allows one to use tongs for the recreational take of oysters. A separate tonging license is required for each tong being used, and harvesters are limited to two sacks per person per day. As indicated (Figure 10.97, right panel), the number of recreational gear licenses associated with the recreational harvest of oysters is relatively limited (never exceeding the low 80s).

Another Louisiana recreational shellfish fishing activity is that of shrimping. There are two primary gear licenses associated with this activity differing, primarily, on the size of allowable trawl and take/possession limits (in addition, the basic fishing license and saltwater fishing license are required for recreational shrimping). The first license (72/87 for residents and 73/88 for nonresidents) allows for a single trawl (up to 16 ft in length) and boat limit (not to exceed 100 lb per day heads on). As indicated by the information in Figure 10.98, sales of these licenses peaked at just over 6,000 in 2001 and thereafter declined to a low of about 2,600 in 2008 before

marginally increasing to about 2,800 in 2009. More recently, a lifetime resident trawl (less than 16 ft) license has been instituted by the state. Issuance of this license to residents is minor totaling zero in 2004, one in 2005, five in 2006, five in 2007, seven in 2008, and six in 2009. The overwhelming majority of licenses giving one the privilege of using a 16-foot trawl in conjunction with the 100 lb per day boat limit are to residents with nonresidents generally accounting for less than 2 % of the total.

The second primary recreational shrimping gear license allows for a trawl up to 25 ft in length and catch limits of 250 lb (heads on) per boat per day. This is a relatively new initiated license category, and annual issuance of this license has increased from 157 in 2004 to 520 in 2009. As was the case with the smaller trawl issuance of nonresident gear licenses for the recreational use of trawls in excess of 16 ft, the up to 25 ft in length trawl licenses tend to be very limited with a maximum of 8 being issued in 2008.

#### 10.4.3.2 Angler Trips by State

Florida, as previously discussed, dominated Gulf of Mexico marine angler participation (excluding Texas). As such, one would expect a very high proportion of the angler trips to be Florida based. In fact, Florida accounted for more than 70 % of the total estimated angler trips throughout the Gulf of Mexico (excluding Texas) during 1995–2009 (Figure 10.99, left panel). Louisiana ranked second, similar to its participation ranking, accounting for 17 % of the angler trips. Alabama and Mississippi combined contributed 12 % of the total number of trips during 1995–2009.

##### 10.4.3.2.1 Florida (West Coast)

In association with the increasing number of participants, the estimated number of marine trips taken in Florida's waters (west coast) increased from an average of 12.3 million annually during 1995–1999 to 17 million during 2005–2009. In 2009, an estimated 15.2 million angler trips were made in Florida (west coast) waters, which represented about a 12 % decline from the 2004 peak of 17.8 million trips. Overall, the proportion of Gulf trips (excluding Texas) represented by Florida fell in the narrow range of 69–73 % with no apparent long-term trend. On average, 50 % of the Florida-based angler trips were in inland waters during 1995–2009 with

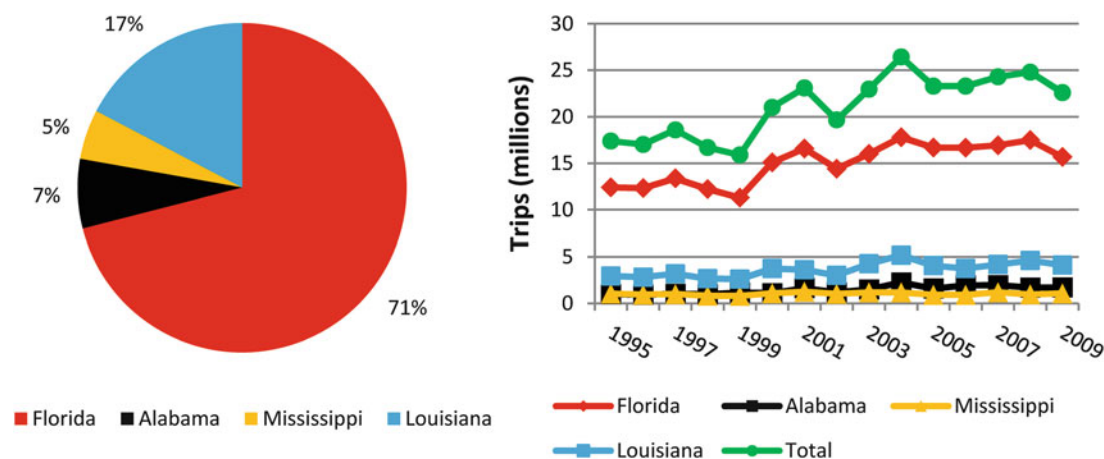
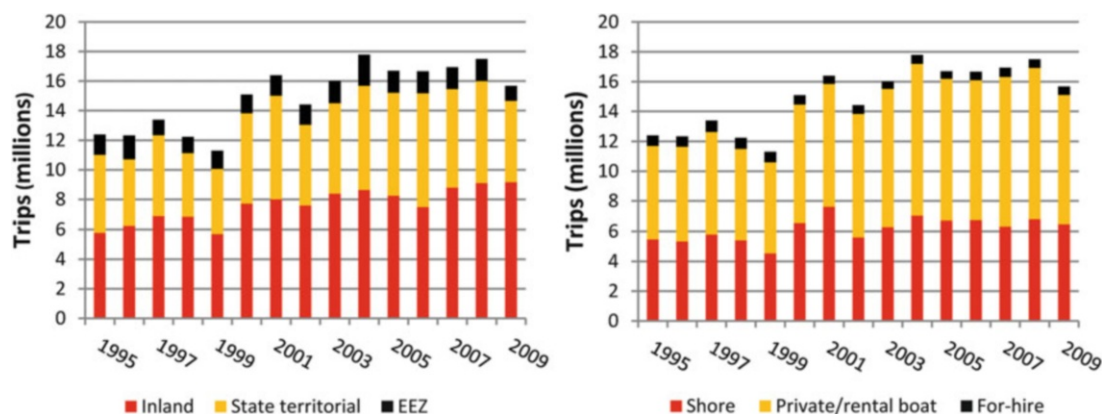


Figure 10.99. Percent angling trips by state (*left panel*) and number by state (*right panel*), 1995–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A).



**Figure 10.100. Recreational fishing trips in Florida waters by area fished (*left panel*) and by mode (*right panel*), 1995–2009 (NMFS FSD, data accessed 2012—see Appendix A).**

no discernible long-run change in this proportion (Figure 10.100, left panel). Another 40 % of the trips were in state territorial waters (out to 9 nautical mi [16.7 km] in the case of Florida). About 10 % of the trips occurred in the federal waters (outside 9 nautical mi [16.7 km]).

Overall, the private/rental boat mode represented 50–60 % of the total Florida-based angler trips during 1995–2009 while the shore-based mode generally represented 45–50 % of the total angler trips (Figure 10.100, right panel). The share of total trips attributable to the for-hire sector never exceeded 6 % and in some years was as low as 3 %. Savolainen et al. (2012) estimate that the 2009 number of for-hire operations in Florida (west coast) totaled 1372 and comprised 118 head boat operations, 473 charter operations, and 781 guide boat operations. The head boat operations made, on average, 115 trips in 2009 while the charter operations and guide operations made close to 100 each. Savolainen et al. (2012) further report that the average net income to the owner of head boat operations in Florida equaled \$65,000 with the owners of charter operations and guide operations netting \$21,000 and \$28,000, respectively.

#### 10.4.3.2.2 Alabama

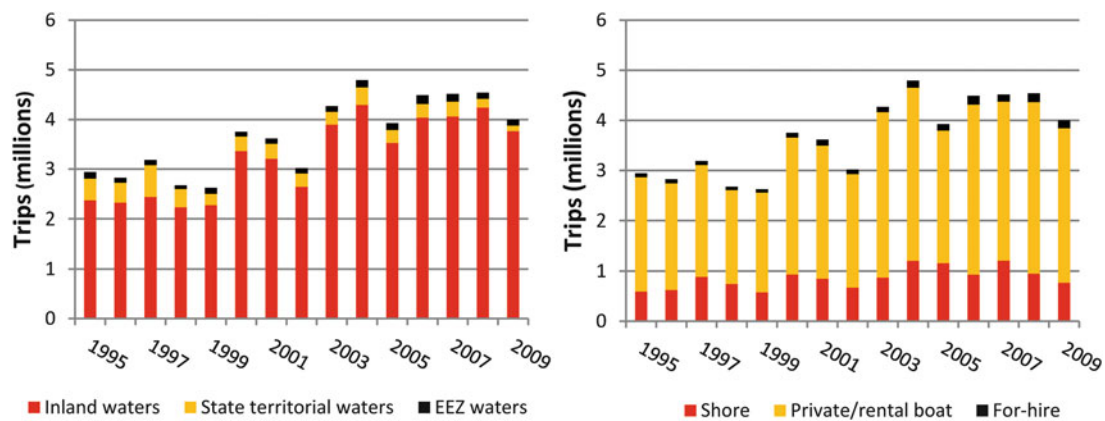
The number of marine angler trips in Alabama waters averaged 1.45 million annually during 1995–2009 and ranged from less than one million in several years (1995, 1996, 1998) to 2.3 million trips in 2004 (Figure 10.99, right panel). Since 2004, however, the estimated number of trips has fallen with the 2009 estimate equaling 1.7 million. Overall, the Gulf proportion of trips taken in Alabama waters increased during the period of analysis from 5 to 6 % during the mid-1990s to 7–8 % in more recent years.

During the mid-1990s, less than 30 % of the Alabama angler trips were in the inshore waters but by the late 2000s, this percentage had increased to more than 60 %. Conversely, whereas more than 30 % of the angler trips were in the EEZ waters in some years during the mid-1990s, this percentage has fallen sharply in later years and has averaged less than 10 % since 2006.

#### 10.4.3.2.3 Mississippi

Angler trips in Mississippi's waters, according to MRFSS data, averaged just over one million per year with no discernible long-term trend. In 1995–1999, for example, the number of trips averaged about 925,000 annually. This figure increased only marginally to about one million annually during 2005–2009. Among the four Gulf States considered in detail in this section, Mississippi is the only one where no change is evident.





**Figure 10.101. Recreational fishing trips in Louisiana waters by area fished (left panel) and by mode (right panel), 1995–2009 (NMFS FSD, data accessed 2012—see Appendix A).**

#### 10.4.3.2.4 Louisiana

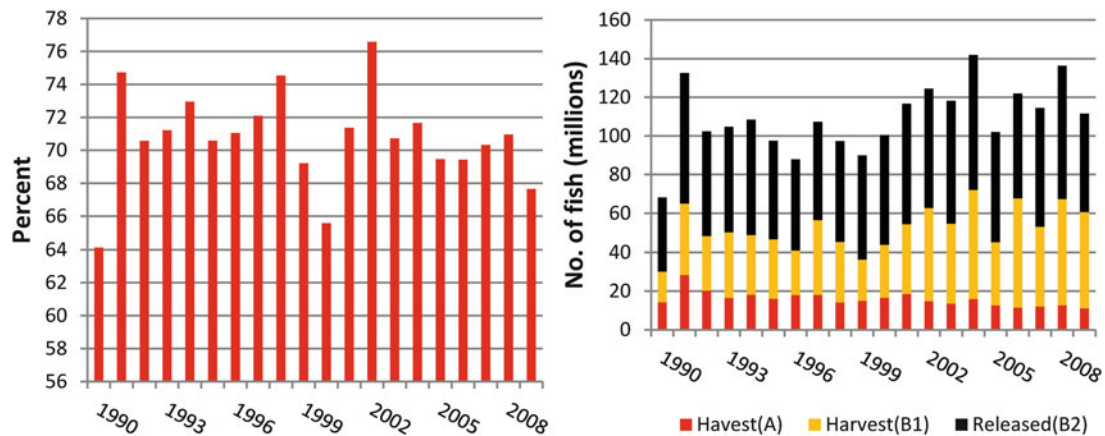
During the 15-year period ending in 2009, the reported annual number of trips in Louisiana (salt) waters has ranged from 2.6 million (1999) to 5.2 million (2004) and has averaged 3.7 million (Figure 10.99, right panel). While exhibiting significant interyear variation, the number of trips, in general, exhibited an upward trend during the period of analysis. Despite two hurricanes in 2005 (Katrina and Rita) that impacted a significant portion of Louisiana's coastal infrastructure, the reported number of trips in that year fell by only about 20 % when compared to 2004 (which was the record year), and by 2006, the number of trips approached that observed pre-hurricanes. The observed number of trips in 2009 equaled 4.1 million, which represented about a 10 % decline in relation to the previous year.

Louisiana's recreational fishery is overwhelmingly inland in nature. Since 1995, recreational trips in inland waters averaged 3.2 million annually—more than 85 % of the total number of recreational trips (Figure 10.101, left panel). The percentage of trips in state territorial waters averaged 312,000 annually during 1995–2009 and ranged from a high of 20 % in 1997 to less than 4 % (2008 and 2009). In general, the proportion of total trips occurring in territorial waters has fallen during the period of analysis with a concomitant increase in the percentage of trips occurring in inland waters. During the period of analyses, the reported number of recreational trips in federal waters averaged 120,000 annually representing approximately 3 % of the total number of trips.

As indicated by the information in Figure 10.101 (right panel), 20–30 % of the total annual trips are shore based. Another 2–4 % of the trips used for-hire services. The majority of the trips, almost 75 % of the total, represent use of private/rental boats.

With respect to the Louisiana for-hire sector, Savolainen et al. (2012) estimate that the population of for-hire boats (more specifically, captains) equaled 681 in 2009 and that the number has increased substantially since the 1990s. Of this total, 100 were charter boats, 575 were guide boats, and the remaining 6 were head boats. The average number of trips made by charter vessels equaled 75, and net income to owners from charter boat operations averaged \$40,000. Guide boat operations, by comparison, averaged 71 trips with net income accruing to the owner estimated at \$28,000 on average.





**Figure 10.102.** Florida's share of the Gulf aggregate recreational catch (*left panel*) and Florida aggregate recreational catch (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A).

### 10.4.3.3 Catch/Harvest by State

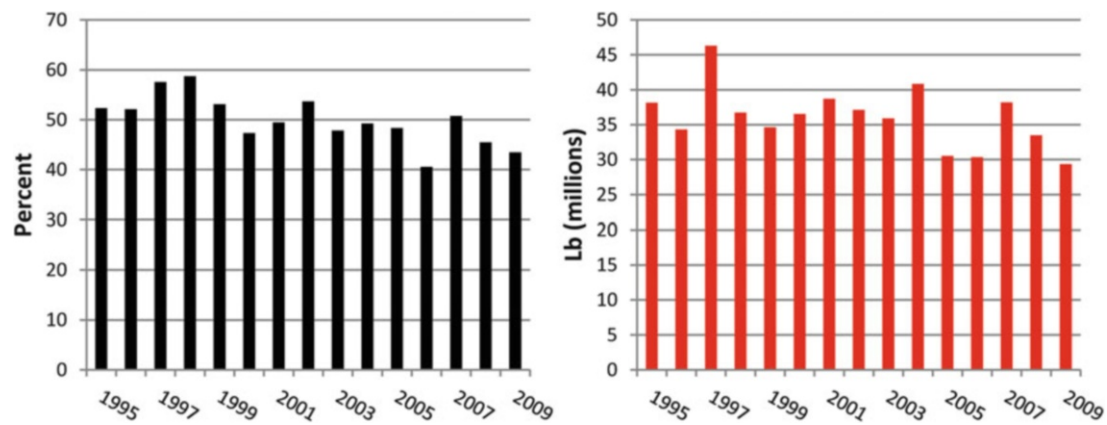
#### 10.4.3.3.1 Florida

##### *Aggregate Catch/Harvest*

Florida, as previously discussed, dominates the Gulf (excluding Texas) in terms of number of participants and trips. As such, it should come as no surprise that Florida also accounts for the majority of catch. Florida's share of Gulf catch in numbers of fish and harvest in pounds are given in Figure 10.102 (left panel) for the 1995–2009 period. Florida has continually maintained a 65–75 % share of Gulf catch in numbers of fish during the 15 years of analysis. This percentage of Gulf catch corresponds with the 70 % of Gulf trips (excluding Texas) taken in Florida waters. In absolute numbers, the estimated number of fish caught increased from an average of about 100 million annually during the mid-1990s to an average of about 120 million during the late 2000s, yielding a 15-year period average of about 110 million fish (Figure 10.102, right panel).

While Florida consistently accounted for about 70 % of the Gulf recreational catch in number of fish (Figure 10.102, left panel), its share, in terms of pounds harvested (A + B1), averaged only about 50 % of the Gulf total (1995–2009) during the 15-year analysis period, and its share appears to have fallen marginally since the late 1990s (Figure 10.103, left panel). In absolute numbers, Florida's annual landings in pounds of fish (A + B1), with few exceptions, have fallen in the 30–40 million pound range (Figure 10.103, right panel) with no apparent upward trend even though the number of fish caught does appear to have increased (Figure 10.102, right panel). This would suggest an increasing rate of releases or smaller fish being harvested and kept.

The reason that Florida's share of the total Gulf catch in terms of numbers exceeds its share of total Gulf harvest by weight is the inclusion of bait fish in the catch (A + B1 + B2) and harvest estimates (A + B1). Florida's catch (A + B1 + B2) and harvest (A + B1) of the top 25 species for selected years (1995, 2000, 2005, and 2009) in numbers of fish are given in Tables 10.16, 10.17, 10.18, and 10.19. As indicated, the overwhelming proportion of the state's catch/harvest in numbers of fish is represented by species generally used as baitfish. Comparison of the 2009 Florida catch/harvest estimates with those for the Gulf for the same year



**Figure 10.103. Florida's share of Gulf of Mexico recreational harvest (left panel) and pounds harvested (right panel), 1995–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A) (Note: 1 lb = 0.454 kg).**

(Tables 10.12, 10.13, 10.14, and 10.15) clearly points to the fact that virtually all of the reported Gulf of Mexico recreational baitfish catch/harvest is Florida based.

In general, there was a large amount of consistency between most commonly caught (A + B1 + B2) recreational species in Florida when comparing 1995 and 2009 (Tables 10.16 and 10.19), with no observed changes in ranking among the top five species. Furthermore, while large increases in the catches of scaled sardines and Atlantic thread herring were observed between the 2005 and 2009 periods, catches of the other three top five species (pinfish, spotted seatrout, and gray snapper) remained relatively constant. With respect to harvest (A + B1), four of the five most commonly harvested species in 1995 remained among the five most commonly harvested species in 2009 with only white grunt (*Haemulon plumieri*) falling out of the ranking and Spanish mackerel replacing it. This change in positioning reflects both a sharp decline in the estimated harvest of white grunt (from 2.8 million fish in 1995 to 1.2 million fish in 2009) and a doubling in the harvest of Spanish mackerel (from 658,000 fish to 1.4 million fish).

#### *Analysis by Inshore and Offshore Species*

**Inshore Species:** As in other Gulf States, the two most desirable species targeted by Florida participants in the inshore waters are spotted seatrout and red drum. Currently in Florida, the bag limit on spotted seatrout is five fish and the bag limit on red drum is one fish.

The estimated catch of spotted seatrout in Florida waters for the 1995–2009 period expressed in number of fish (A + B1 + B2) is given in Figure 10.104 (left panel), and harvest in pounds (A + B1) is given in Figure 10.104 (right panel). In terms of number of fish, catch often exceeds the ten million mark and in some years exceeds 12 million. While the number of spotted seatrout caught in Florida's waters is large, the vast majority of these fish are released alive (Figure 10.104, left panel). This finding is also confirmed by the information presented in Tables 10.16, 10.17, 10.18, and 10.19. Since 1995, approximately 85 % of the spotted seatrout caught in Florida waters has been released alive (i.e., B2) with no apparent long-run trend. Pounds harvested generally falls between two and three million pounds. The estimated weight associated with the Florida recreational spotted seatrout harvest remained virtually constant between 1995 and 2009 (with the exception of an increase in 2000) at an average of 1.45 lb per fish (Tables 10.16, 10.17, 10.18, and 10.19).

**Table 10.16 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species by Florida Recreational Anglers, 1995**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Scaled Sardine	19,218,450	Scaled Sardine	15,254,950	0.042
Pinfish	11,568,160	Pinfish	15,254,950	0.185
Spotted Seatrout	8,341,695	White Grunt	15,254,950	0.696
White Grunt	5,387,420	Atlantic Thread Herring	2,637,242	0.060
Atlantic Thread Herring	3,287,447	Spotted Seatrout	1,831,312	1.452
Gray Snapper	3,161,517	Sand Seatrout	1,240,362	0.535
Hardhead Catfish	2,745,700	Sheepshead	1,237,207	1.835
Gag	2,244,954	Spanish Sardine	890,074	NA
Black Sea Bass	2,168,769	Gray Snapper	757,900	1.264
Sheepshead	2,095,996	Striped Anchovy	660,456	0.020
Red Grouper	1,951,298	Spanish Mackerel	657,562	1.690
Crevalle Jack	1,848,913	Dolphin	650,211	8.522
Pigfish	1,612,672	Sand Perch	614,892	0.326
Red Drum	1,453,207	Pigfish	574,835	0.413
Gafftopsail Catfish	1,415,476	Blue Runner	524,440	0.948
Sand Seatrout	1,410,338	Black Sea Bass	479,187	0.591
Silver Perch	1,257,550	Striped Mullet	468,509	1.056
Sand Perch	1,175,568	Vermilion Snapper	452,154	0.762
Blue Runner	1,065,211	Silver Perch	404,995	0.178
Spanish Mackerel	1,010,330	King Mackerel	403,774	9.164
Yellowtail Snapper	966,760	Seatrout Genus	395,104	NA
Spanish Sardine	890,074	Gag	390,383	6.125
Dolphin	888,518	Southern Kingfish	382,604	0.601
Seatrout Genus	837,843	Yellowtail Snapper	351,082	1.212
Grunt Genus	785,373	Round Scad	320,876	0.436

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

The catch of red drum expressed in numbers of fish (A + B1 + B2) is given in Figure 10.105 (left panel) while pounds harvested is given in Figure 10.105 (right panel). As indicated, catch of red drum in Florida waters generally fluctuated between 1.5 and 2 million fish annually until 2003 at which point catch increased significantly. Release rate equaled about 1.9 million fish per year based on total catch of 2.2 million. This indicates a release proportion of 85 % that has not changed appreciably during the period of consideration.

*Offshore Species:* Florida's recreational reef fish catch is large, averaging an estimated 13 million fish per year from 1995 to 2009 (Figure 10.106, left panel). This represented about 85 % of the total Gulf recreational reef fish catch (excluding Texas) in numbers of fish with the annual

**Table 10.17 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species by Florida Recreational Anglers, 2000**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Scaled Sardine	17,583,932	Scaled Sardine	14,713,726	0.022
Spotted Seatrout	10,484,841	Pinfish	5,015,732	0.385
Pinfish	8,545,587	Atlantic Thread Herring	2,316,911	0.082
White Grunt	4,179,199	White Grunt	1,739,314	0.875
Gray Snapper	3,727,119	Sand Seatrout	1,620,390	0.546
Black Sea Bass	3,382,680	Spotted Seatrout	1,469,697	1.839
Ladyfish	2,758,987	Blue Runner	1,272,321	1.208
Atlantic Thread Herring	2,727,189	Spanish Mackerel	1,180,062	1.860
Spanish Mackerel	2,303,801	Striped Mullet	966,378	1.436
Blue Runner	2,262,193	Spanish Sardine	816,465	0.019
Sand Seatrout	2,189,286	Round Scad	775,122	NA
Hardhead Catfish	2,165,642	Sheepshead	697,513	2.090
Crevalle Jack	2,041,748	Gray Snapper	630,192	1.395
Sheepshead	1,938,982	Gulf Menhaden	579,657	0.223
Red Grouper	1,862,001	Black Sea Bass	548,872	0.815
Gag	1,768,555	Gag	527,939	6.732
Gafftopsail Catfish	1,741,746	Pigfish	432,774	0.314
Red Drum	1,633,350	Atlantic Croaker	404,930	0.484
Striped Mullet	1,064,127	Southern Kingfish	321,841	0.639
Pigfish	1,056,668	Silver Perch	315,476	0.199
Round Scad	915,464	Red Drum	310,044	4.614
Spanish Sardine	895,075	Striped Killifish	296,217	NA
Gulf Menhaden	702,632	White Mullet	250,926	0.729
Silver Perch	695,093	Menhaden Genus	219,017	NA
Common Snook	667,738	Red Grouper	217,853	7.179
Grunt Genus	785,373	Round Scad	320,876	0.436

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

proportion generally ranging from about 80 to 90 % (Figure 10.106, right panel). As indicated, reef fish catch in numbers of fish along Florida's west coast appears to have increased since the early 2000s. This increase closely mimics the increase in Gulf grouper catch (Figure 10.77), which is primarily a Florida fishery. Overall, the catch of reef fish species accounted for slightly more than 10 % of the total estimated angler catch (numbers of fish) of fish in Florida's waters during 1995–2009.

Estimated pounds of reef fish harvested from Florida's waters (A + B1) by recreational anglers generally ranged from about 8 to 11 million pounds, with exceptions, and averaged ten million pounds annually during the 15-year period of analysis (Figure 10.107, left panel). While variable on a year-to-year basis, no discernible trend in harvested pounds is evident. Overall,

**Table 10.18 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species by Florida Recreational Anglers, 2005**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Scaled Sardine	18,055,543	Scaled Sardine	17,335,305	0.052
Spotted Seatrout	13,694,784	Pinfish	5,645,022	0.295
Pinfish	8,764,639	Atlantic Thread Herring	3,915,545	0.016
Gray Snapper	5,360,548	Spotted Seatrout	1,980,357	1.549
Atlantic Thread Herring	4,070,662	White Grunt	1,687,555	0.860
Red Drum	3,590,782	Spanish Mackerel	1,100,222	1.857
White Grunt	3,372,101	Sheepshead	1,050,108	2.121
Ladyfish	3,285,880	Gray Snapper	931,242	1.451
Sheepshead	2,869,202	Striped Mullet	806,221	1.479
Gag	2,716,307	White Mullet	722,388	0.685
Spanish Mackerel	2,314,955	Gulf Menhaden	560,549	0.000
Hardhead Catfish	2,134,717	Red Drum	501,367	3.813
Red Snapper	1,665,642	Red Snapper	491,229	3.755
Black Sea Bass	1,612,855	Gag	490,192	6.818
Red Grouper	1,453,218	Sand Perch	460,951	0.431
Gafftopsail Catfish	1,388,348	Southern Kingfish	413,214	0.674
Common Snook	1,362,106	Menhaden Genus	390,512	0.000
Crevalle Jack	1,320,171	Sand Seatrout	370,992	0.634
Striped Mullet	919,147	Round Scad	336,453	0.000
Blue Runner	871,509	Blue Runner	333,292	1.055
Sand Perch	836,425	Lane Snapper	332,042	0.753
White Mullet	732,364	Dolphin	285,999	5.951
Gulf Menhaden	598,936	Black Sea Bass	285,543	0.804
Lane Snapper	582,930	Gulf Kingfish	273,497	0.764
Southern Kingfish	553,397	Spanish Sardine	228,028	0.220

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

Florida's share of the annual Gulf recreational reef fish harvest (excluding Texas) generally ranged from about 60 to 80 % when evaluated on a poundage basis, though during the latest 2 years of analysis, its share fell to about 50 % (Figure 10.107, right panel).

*Groupers:* Groupers are strongly identified with Florida. Overall, more than 95 % of the grouper catch in terms of either number of fish (A + B1 + B2) or pounds harvested (A + B1) occurs in Florida waters and, hence, the various figures provided for the Gulf are, for all intents and purposes, equivalent to what one would see for Florida. Overall, since 1995 groupers have represented about 40 % of the reef fish caught by recreational anglers in Florida's waters in terms of number of fish (A + B1 + B2) and almost 50 % in terms of pounds landed (A + B1).

**Table 10.19 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species by Florida Recreational Anglers, 2009**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Scaled Sardine	31,430,678	Scaled Sardine	29,938,133	0.028
Pinfish	9,413,639	Atlantic Thread Herring	6,804,819	0.108
Spotted Seatrout	9,032,362	Pinfish	5,384,932	0.106
Atlantic Thread Herring	7,472,772	Spanish Mackerel	1,392,399	1.620
Gray Snapper	3,998,388	Spotted Seatrout	1,370,634	1.488
Ladyfish	3,043,921	White Grunt	1,206,086	0.909
Spanish Mackerel	2,938,091	Gray Snapper	1,176,301	1.233
Gag	2,728,998	Round Scad	1,096,334	NA
Red Grouper	2,472,120	Ballyhoo	1,087,375	NA
White Grunt	2,241,227	Sand Seatrout	889,866	0.661
Hardhead Catfish	1,957,552	Blue Runner	687,199	0.948
Red Snapper	1,868,467	Sheepshead	681,263	2.193
Red Drum	1,566,251	Herring Family	647,389	NA
Sheepshead	1,466,501	Red Snapper	545,333	3.637
Blue Runner	1,446,946	Striped Mullet	490,298	1.492
Sand Seatrout	1,333,096	King Mackerel	452,892	7.101
Crevalle Jack	1,301,344	Vermilion Snapper	345,683	0.976
Round Scad	1,128,681	Gulf Menhaden	334,964	NA
Ballyhoo	1,088,172	Dolphin	334,374	7.304
Black Sea Bass	977,919	Unidentified Fish	271,498	NA
Gafftopsail Catfish	792,219	Pigfish	232,901	0.355
Pigfish	751,446	Red Drum	225,380	4.623
Common Snook	711,391	Gag	202,659	6.835
Bluefish	674,052	Ladyfish	200,634	1.208
Striped Mullet	674,022	Lane Snapper	192,094	0.882

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

### Snappers



Yellowtail Snapper

The catch of snappers in Florida waters by marine recreational anglers expressed in number of fish and as a percentage of Gulf total snapper catch (excluding Texas) is given in Figure 10.108. When examined on a yearly basis, catch consistently ranged from about 6 million to 7 million fish per year during the mid-1990s until 2003 when catch increased sharply. The average estimated catch since 2003 is nine million fish annually (left panel). On a share basis,



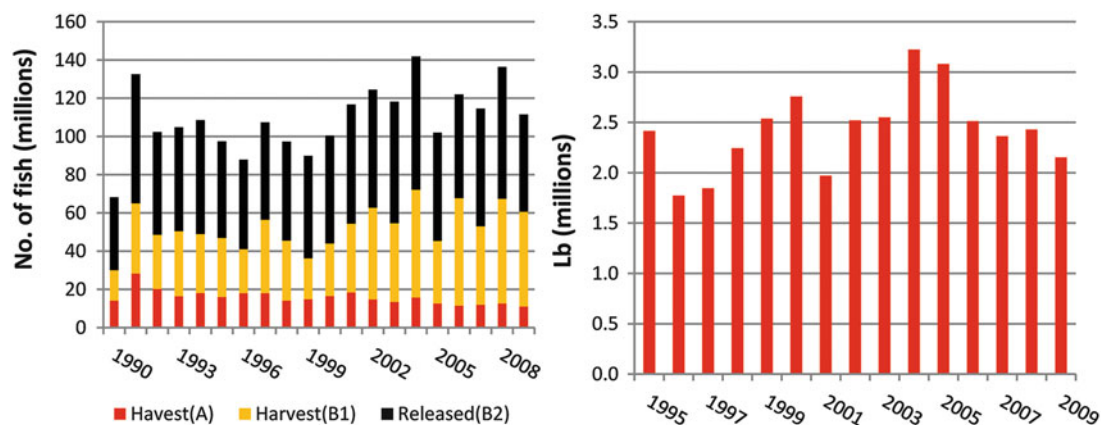


Figure 10.104. Florida recreational catch of spotted seatrout (*left panel*) and pounds harvested (*right panel*), 1995–2009 (NMFS FSD, data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).

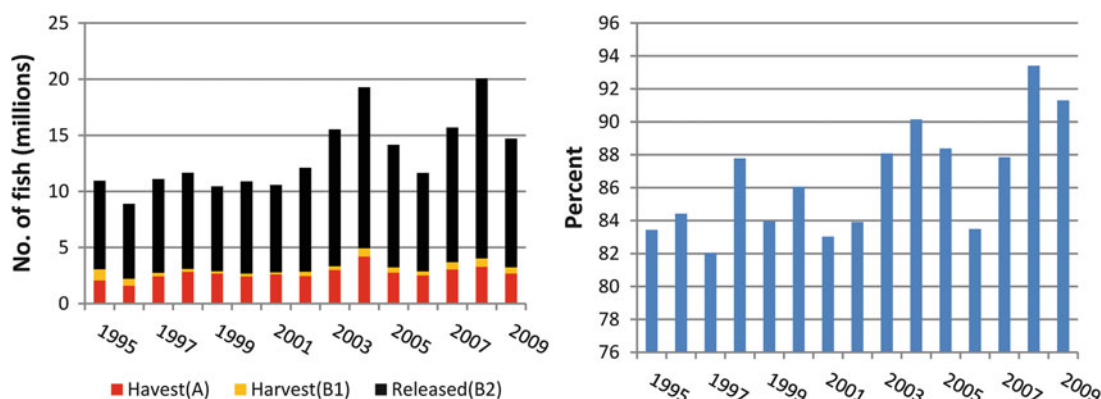


Figure 10.105. Florida recreational catch of red drum (*left panel*) and pounds harvested (*right panel*), 1995–2009 (NMFS FSD, data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).

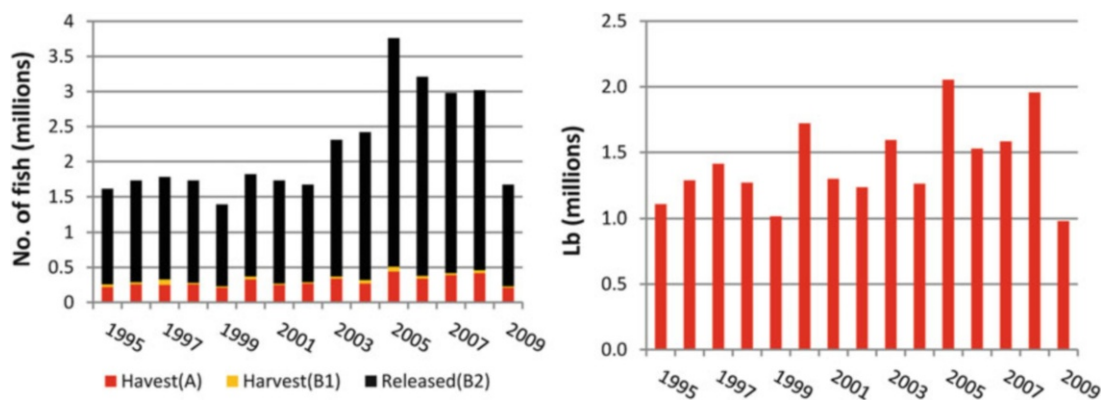
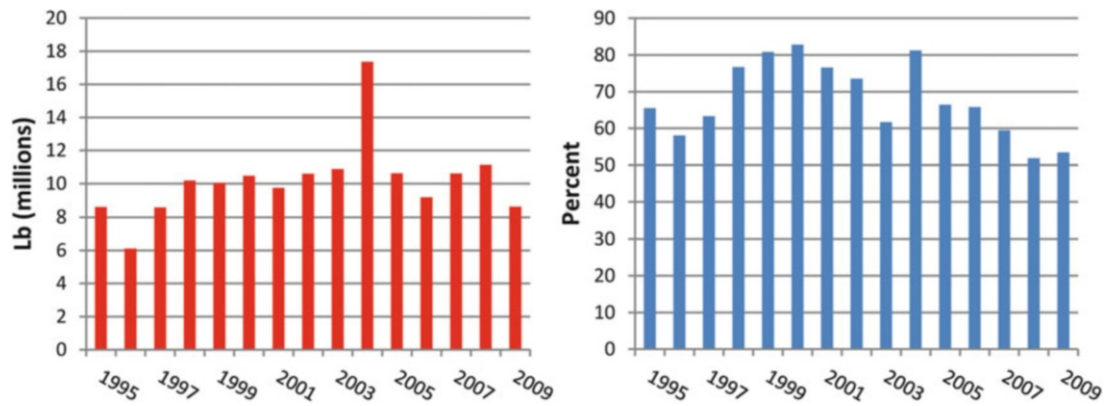
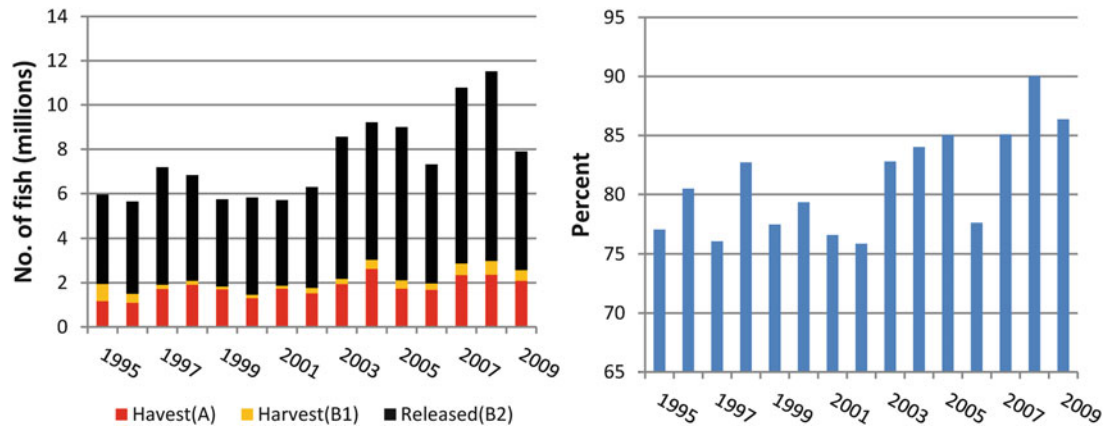


Figure 10.106. Florida's recreational catch of reef fish (*left panel*) and as a percentage of the Gulf of Mexico recreational reef fish catch, 1995–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A).



**Figure 10.107.** Florida's recreational harvest of reef fish (*left panel*) and percentage of the Gulf of Mexico recreational reef fish harvest (*right panel*), 1995–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A) (Note: 1 lb = 0.454 kg).



**Figure 10.108.** Florida's recreational catch of snappers (*left panel*) and as a percentage of the Gulf of Mexico recreational snapper catch, 1995–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A).

Florida generally accounted for between 75 and 85 % of the Gulf recreational catch (A + B1 + B2) expressed in numbers of fish during 1995–2009 (right panel).

The annual recreational harvest (A + B1) of snappers from Florida waters expressed in pounds and as a percentage of the Gulf harvest is presented in Figure 10.109. As indicated, harvested pounds have been highly variable on an annual basis with a range from less than 2.5 million pounds to more than 5.5 million pounds. Since 1995, pounds of snappers harvested from Florida waters have averaged 3.8 million annually which represented almost 60 % of the total Gulf recreational snapper harvest (excluding Texas). Furthermore, as indicated, Florida's share of the Gulf's total closely mimics the absolute Florida harvest in pounds.

There are a large number of snapper species caught in Florida, with red snapper contributing the largest share of the total harvested poundage (A + B1). There has been a significant increase in the harvest of this species since 1995 (Figure 10.110, left panel) and this increase is generally attributed to growth in the stock and expansion of the stock from the northern Gulf to the Florida panhandle and down through the eastern Gulf.

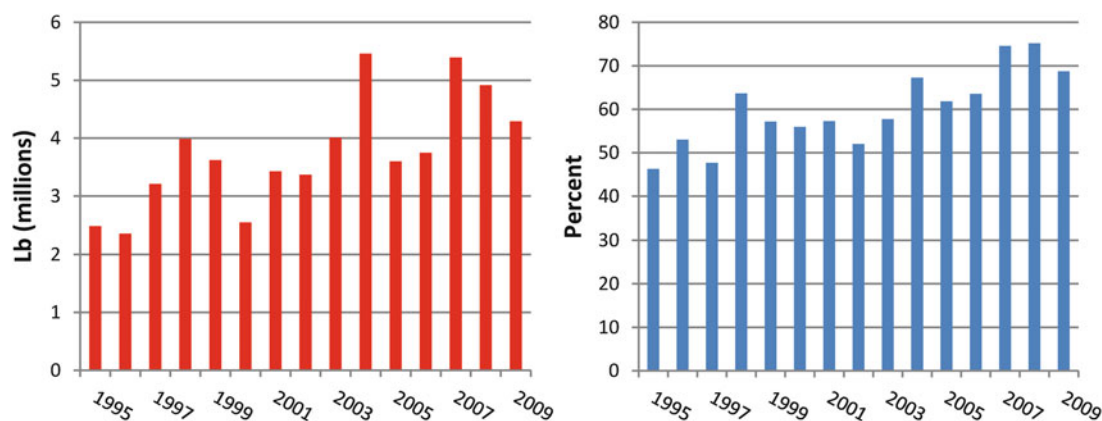


Figure 10.109. Florida's recreational harvest of snappers (*left panel*) and as a percentage of the Gulf of Mexico recreational snapper harvest, 1995–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A) (*Note: 1 lb = 0.454 kg*).

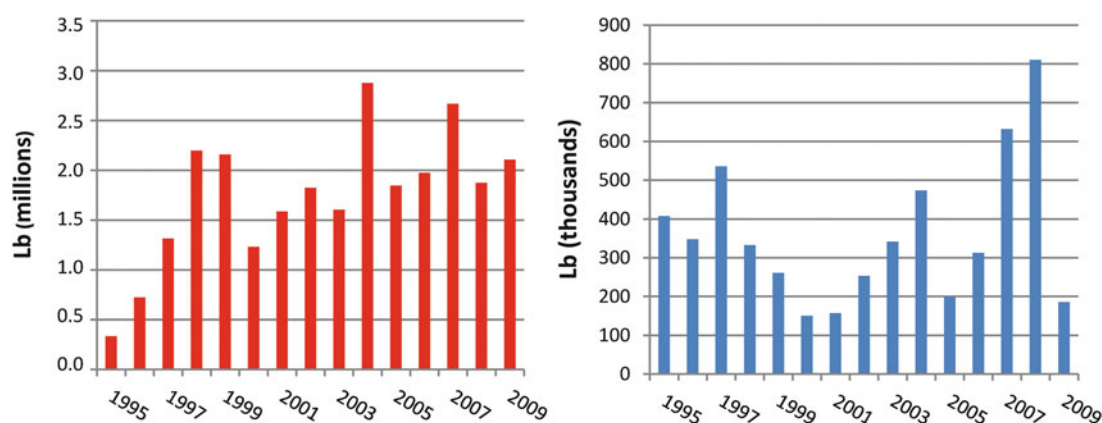


Figure 10.110. Florida's recreational harvest of red snapper (*left panel*) and yellowtail snapper (*right panel*), 1995–2009 (NMFS FSD, data accessed 2012—see Appendix A) (*Note: 1 lb = 0.454 kg*).

Yellowtail snapper is harvested largely in the Florida Keys. Recreational harvest of this species, as shown in Figure 10.110 (right panel), tends to be highly variable on a year-to-year basis with average annual landings during 1995–2009 equaling close to 400,000 lb.

#### 10.4.3.3.2 Louisiana

##### *Aggregate Catch*

Whereas Florida's most common catches (A + B1 + B2) and harvests (A + B1) in terms of numbers of fish were baitfish, a decidedly different picture emerges when one evaluates Louisiana's catches and harvests by species for selected years ranging from 1995 to 2009 (Tables 10.20, 10.21, 10.22, and 10.23). In terms of catch, spotted seatrout dominates all other species with an estimated 11.8 million (A + B1 + B2) and 18.5 million being caught in 1995 and 2009, respectively. Red drum ranks a distant second with the estimated 1995 catch equaling 5.2

**Table 10.20 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species by Louisiana Recreational Anglers, 1995**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Spotted Seatrout	11,772,695	Spotted Seatrout	6,884,427	1.177
Red Drum	5,217,781	Red Drum	2,449,022	5.920
Hardhead Catfish	3,457,519	Sand Seatrout	856,107	0.569
Sand Seatrout	1,116,463	Sheepshead	646,983	2.124
Atlantic Croaker	1,053,423	Largemouth Bass	427,546	1.178
Sheepshead	944,262	Atlantic Croaker	409,294	0.499
Black Drum	803,938	Red Snapper	288,484	4.245
Red Snapper	672,140	Southern Flounder	260,073	1.242
Largemouth Bass	651,826	Black Drum	230,479	4.3784
Southern Flounder	301,697	Gulf Menhaden	159,683	0.220
Pinfish	259,226	Striped Mullet	122,547	0.869
Gulf Menhaden	188,932	Hardhead Catfish	115,584	1.164
Striped Mullet	145,357	Threadfin Shad	108,903	NA
Gulf Kingfish	128,201	Silver Seatrout	99,118	1.285
Gafftopsail Catfish	114,887	Bluegill	83,914	0.205
Spot	114,332	Pinfish	78,540	0.296
Bluegill	112,658	Blue Catfish	72,358	1.332
Threadfin Shad	108,903	Gray Triggerfish	66,995	2.200
Gulf Killifish	105,952	Spot	65,346	0.364
Silver Seatrout	100,805	Gulf Killifish	64,840	NA
Blue Catfish	99,257	Sheepshead Minnow	59,909	NA
Gray Triggerfish	78,097	Gulf Kingfish	55,728	0.453
Sea Catfish Family	64,052	Dolphin	45,171	11.747
Sheepshead Minnow	59,909	Gafftopsail Catfish	42,971	2.638
Gray Snapper	52,700	Skipjack Herring	34,126	0.414

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

million fish and the 2009 catch equaling almost six million fish. Combined, these two species accounted for more than one-half of the total Louisiana recreational catch (A + B1 + B2) in 1995 and two-thirds of the state's estimated recreational catch in 2009. Overall, the ranking of the five most commonly caught species remained unchanged when comparing the information for 1995 and 2009.

Similar to the Louisiana catch statistics, two species—spotted seatrout and red drum—dominate the Louisiana recreational harvest (A + B1) statistics. These two species, combined, represented 66 % of the state's total estimated recreational harvest in 1995 and almost 80 % of the state's total 2009 harvest. Overall, the average weight of the harvested spotted seatrout

**Table 10.21 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species by Louisiana Recreational Anglers, 2000**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (1bs)
Spotted Seatrout	15,370,235	Spotted Seatrout	8,834,473	1.310
Red Drum	6,322,698	Sand Seatrout	1,230,837	0.928
Atlantic Croaker	3,906,464	Atlantic Croaker	957,736	0.522
Hardhead Catfish	2,201,793	Black Drum	665,273	4.008
Sand Seatrout	1,836,504	Red Drum	568,100	5.311
Black Drum	1,732,633	Sheepshead	386,000	2.696
Sheepshead	671,964	Southern Flounder	373,833	1.636
Southern Flounder	444,544	Spanish Mackerel	151,080	2.039
Striped Mullet	363,547	Southern Kingfish	142,531	0.812
Spanish Mackerel	360,313	Hardhead Catfish	133,085	0.934
Pinfish	348,617	Striped Mullet	109,685	0.890
Gafftopsail Catfish	316,989	Gafftopsail Catfish	99,703	2.315
Ladyfish	2,043,894	Gulf Menhaden	95,578	NA
Southern Kingfish	1,838,071	Red Snapper	81,065	5.543
Gulf Menhaden	1,678,791	Largemouth Bass	79,170	1.390
Red Snapper	1,559,712	Pinfish	62,861	0.619
Mullet Genus	1,501,984	Gray Triggerfish	51,058	2.619
Largemouth Bass	1,270,975	Seatrout Genus	48,325	NA
Blue Runner	1,217,217	Blue Catfish	41,551	1.557
Blue Catfish	1,162,179	Gulf Kingfish	33,994	0.655
Seatrout Genus	1,135,902	Gray Snapper	33,353	2.598
Atlantic Stingray	1,098,766	Atlantic Stingray	30,581	NA
Gray Triggerfish	1,087,375	Atlantic Spadefish	23,275	3.187
Gray Snapper	1,082,116	Blue Runner	14,299	1.301
Stingray Genus	994,028	Blacktip Shark	13,574	14.364

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

remained unchanged between the 2 years (1.17 lb per fish) while the average weight of the harvested red drum fell from almost 6 lb per fish in 1995 to about 5.6 lb in 2009.

While Louisiana's recreational catch of baitfish is but a fraction of that reported for Florida (259,000 pinfish and 189,000 Gulf menhaden in 1995), some undesirable species are often caught. For example, an estimated 3.5 million and 2.7 million hardhead catfish were caught in 1995 and 2009, respectively. Harvest (A + B1) of this species in 1995, however, equaled only 116,000 and in 2009 equaled 95,000, which for each year represents less than 5 % of the catch of this species. While there are no regulations governing the harvest of this species, it is usually returned to the water alive because it is considered inedible by the majority of the recreational fishing population.

The aggregate anglers catch in Louisiana's waters for the years 1995 to 2009 expressed as a percentage of the Gulf catch and in numbers of fish (A + B1 + B2) is presented in Figure 10.111

**Table 10.22 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species by Louisiana Recreational Anglers, 2005**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Spotted Seatrout	14,727,580	Spotted Seatrout	7,435,705	1.106
Red Drum	4,263,779	Red Drum	1,626,356	8.209
Hardhead Catfish	3,388,334	Sand Seatrout	973,661	0.593
Atlantic Croaker	1,333,069	Sheepshead	644,499	2.768
Sand Seatrout	1,226,313	Atlantic Croaker	442,583	0.412
Sheepshead	1,073,416	Black Drum	308,777	6.024
Black Drum	930,537	Southern Flounder	280,050	1.123
Gafftopsail Catfish	672,912	Southern Kingfish	239,777	0.538
Ladyfish	532,341	Pinfish	147,908	0.314
Southern Kingfish	410,882	Hardhead Catfish	125,832	1.11
Red Snapper	396,531	Red Snapper	110,503	4.966
Southern Flounder	355,791	Gray Snapper	107,688	4.486
Largemouth Bass	272,581	Largemouth Bass	102,857	0.986
Pinfish	232,477	Gafftopsail Catfish	86,621	3.307
Blue Catfish	189,002	Blue Catfish	78,580	1.293
Gray Snapper	155,251	Spanish Mackerel	38,785	2.133
Spanish Mackerel	75,771	Cobia	21,172	24.054
Atlantic Stingray	54,144	Channel Catfish	19,996	0.569
Bluefish	50,440	Bluegill	19,031	0.249
Blue Runner	45,997	Striped Mullet	18,046	0.595
Channel Catfish	45,894	Blackfin Tuna	15,582	22.818
Stingray Genus	35,501	Atlantic Spadefish	13,820	1.221
Atlantic Spadefish	28,914	Dolphin	13,246	3.771
Freshwater Drum	23,539	Seatrout Genus	12,446	NA
Cobia	22,362	Gulf Kingfish	11,837	0.551

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

(left panel) while the number of fish caught by anglers is given in Figure 10.111 (right panel). As indicated, the estimated annual number of fish being caught by recreational anglers, though highly variable on a year-to-year basis, increased during the period of analysis. From 1995 to 1999, the average catch expressed in number of fish equaled 27 million annually. By 2005–2009, this figure had increased to 36 million. Overall, Louisiana's share of the total Gulf catch (excluding Texas) expressed in numbers of fish averaged 21 % during the 15-year period of analysis and ranged from a low of 15 % in 2002 to a high of 26 % in 2000. As was found to be the case throughout the Gulf, a large proportion of the catch by anglers in Louisiana's waters is released with the annual estimate of 50–60 %. This high release rate reflects a combination of the catch of undesirable species (e.g., hardhead catfish) and regulations (particularly size limits and bag limits).



**Table 10.23 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species by Louisiana Recreational Anglers, 2009**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Spotted Seatrout	18,532,549	Spotted Seatrout	10,557,489	1.179
Red Drum	5,959,448	Red Drum	2,236,916	5.581
Hardhead Catfish	2,693,243	Sand Seatrout	879,031	0.554
Sand Seatrout	1,726,535	Sheepshead	703,498	3.153
Atlantic Croaker	1,563,809	Black Drum	518,989	5.370
Black Drum	1,482,978	Atlantic Croaker	470,537	0.373
Sheepshead	1,174,727	Southern Flounder	285,605	1.378
Gafftopsail Catfish	536,631	Southern Kingfish	103,044	0.548
Southern Flounder	336,019	Gray Snapper	98,829	2.481
Ladyfish	329,567	Striped Mullet	97,984	0.394
Red Snapper	214,713	Red Snapper	97,250	7.075
Southern Kingfish	152,493	Hardhead Catfish	95,201	1.414
Striped Mullet	110,011	Largemouth Bass	59,344	1.343
Gray Snapper	106,433	Gafftopsail Catfish	59,194	2.056
Atlantic Bumper	87,237	Blue Catfish	51,043	2.843
Largemouth Bass	77,727	Gulf Menhaden	50,650	NA
Blue Catfish	68,697	Blackfin Tuna	47,558	18.746
Blackfin Tuna	57,048	Seatrout Genus	44,144	NA
Gulf Menhaden	50,650	Atlantic Bumper	37,076	0.110
Seatrout Genus	44,144	Channel Catfish	19,709	1.740
Pinfish	41,213	Greater Amberjack	17,277	26.761
Atlantic Stingray	33,755	Tripletail	15,580	8.799
Spanish Mackerel	29,906	Striped Bass	14,353	0.701
Channel Catfish	25,374	Spanish Mackerel	12,511	1.9870
Greater Amberjack	23,140	Pinfish	11,273	0.107

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

As was the case with the number of fish landed, the aggregate pounds of fish harvested (A + B1) from Louisiana waters have been increasing (Figure 10.112). During 1995–1999, the estimated harvest averaged about 22 million pounds annually. By 2005–2009, this annual average increased to almost 30 million pounds and would likely have been higher if not for Hurricanes Katrina and Rita in 2005 that limited fishing activities and catch in that year. Interestingly, the recreational harvest (in pounds) in 2006 was the highest observed figure during the 15-year period of analysis and may reflect an increase in species populations in that year as a result of a reduction in 2005 effort. Overall, Louisiana's share of the Gulf recreational harvest in pounds averaged 37 % during the 1995–2009 period with an annual range from about 30 % to more than 45 %.

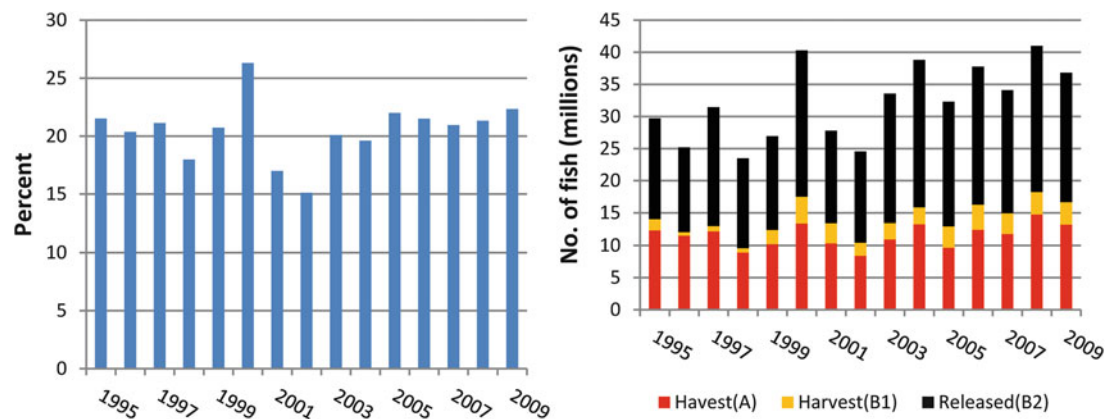


Figure 10.111. Louisiana's share of the Gulf aggregate recreational catch (*left panel*) and Louisiana recreational catch (*right panel*), 1990–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A).

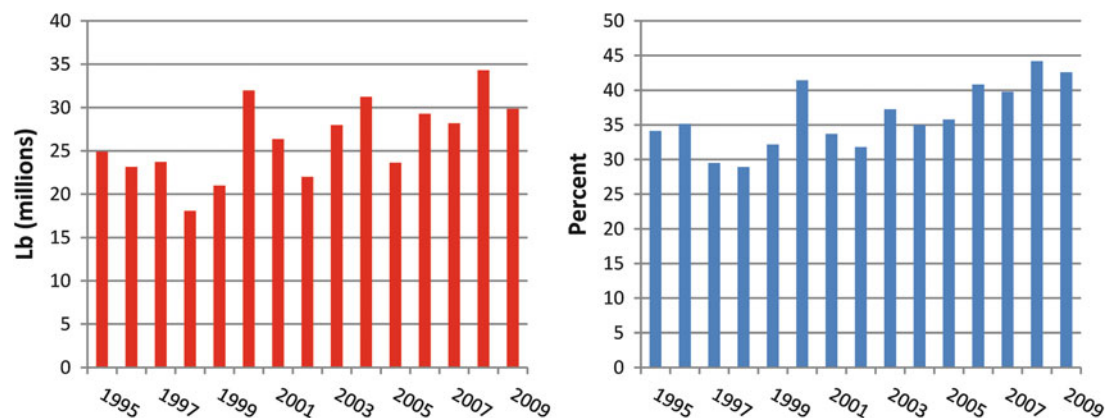


Figure 10.112. Louisiana's recreational aggregate harvest (*left panel*) and percentage of Gulf harvest (*right panel*), 1995–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A) (Note: 1 lb = 0.454 kg).

As was the case with the number of fish landed, the aggregate pounds of fish harvested (A + B1) from Louisiana waters have been increasing (Figure 10.112). During 1995–1999, the estimated harvest averaged about 22 million pounds annually. By 2005–2009, this annual average increased to almost 30 million pounds and would likely have been higher if not for Hurricanes Katrina and Rita in 2005 that limited fishing activities and catch in that year. Interestingly, the recreational harvest (in pounds) in 2006 was the highest observed figure during the 15-year period of analysis and may reflect an increase in species populations in that year as a result of a reduction in 2005 effort. Overall, Louisiana's share of the Gulf recreational harvest in pounds averaged 37 % during the 1995–2009 period with an annual range from about 30 % to more than 45 %.

*Inshore Species*

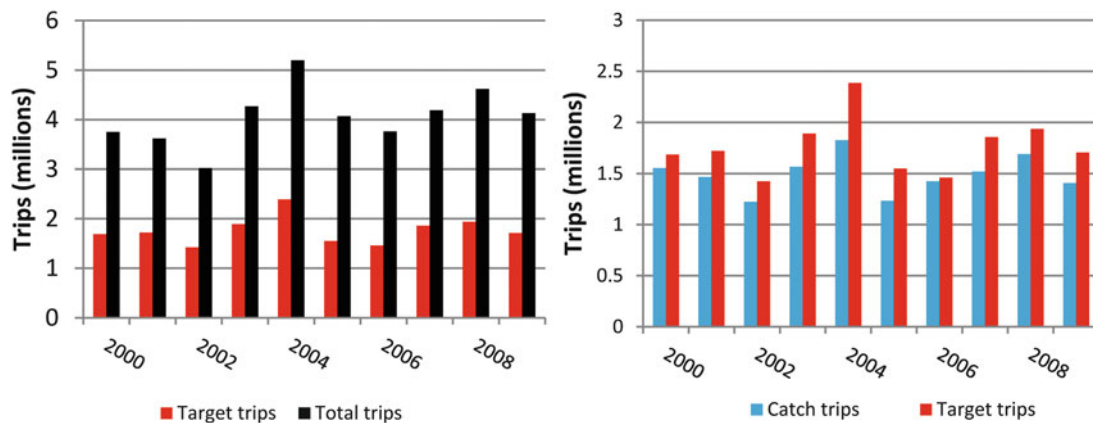
Louisiana is known for its inshore fishing and is often referred to as the *Redfish Capital*. This is not surprising since the five fish bag limit is the most liberal among Gulf States, and the Louisiana red drum catch rates tend to be high. Though possibly not as well known, the same claim can be made for spotted seatrout.

*Red Drum*

The popularity of red drum in Louisiana becomes clear when one looks at the percentage of fishermen targeting the species on any given trip. According to the MRIP survey data, since 2000, approximately 43 % of the Louisiana interviewed respondents, on average, reported that red drum was one of the two primary species targeted. In 2001, for example, there was an estimated 3.6 million angler trips. Of this total, an estimated 1.7 million (48 %) of the total, reported red drum as one of the two primary species being targeted (Figure 10.113, left panel). This year represents the highest red drum targeting behavior during the 10-year period of analysis. Conversely, the lowest reported red drum targeting behavior (on a percentage basis) was reported in 2005 and 2006 when 1.5 million of the approximately four million angler trips (38 %) indicated red drum as one of the two primary targeted species.

While an angler may specify that he or she is targeting red drum on any given trip, it does not necessarily imply that red drum will be caught. A comparison between red drum targeted trips and trips where the catch of red drum is reported is presented in Figure 10.113 (right panel). As indicated, targeted trips consistently exceeded catch trips though the correlation between the two was a respectable 0.88.

Since 1995, the estimated number of red drum caught expressed in numbers of fish ( $A + B1 + B2$ ) has averaged 5.4 million annually with an associated range of 4.1 million in 1996 to 6.6 million in 2000 (Figure 10.114). Louisiana's share of the Gulf red drum catch generally ranges from 60 % to almost 80 %. These fish can be either kept or released. As indicated, about 60 % of the red drum catch has historically been released alive with very little variation in the percentage when examined on a year-to-year basis. During the period of analysis, the correlation between the (estimated) annual number of red drum harvested ( $A + B1$ ) and the number of red drum released alive ( $B2$ ) was positive, equaling 0.54.



**Figure 10.113.** Louisiana red drum targeting trips in relation to total trips (*left panel*) and Louisiana red drum targeting trips in relation to catch trips (*right panel*), 2000–2009 (NMFS FSD, data accessed 2012, with targeting estimates calculated by authors—see Appendix A).

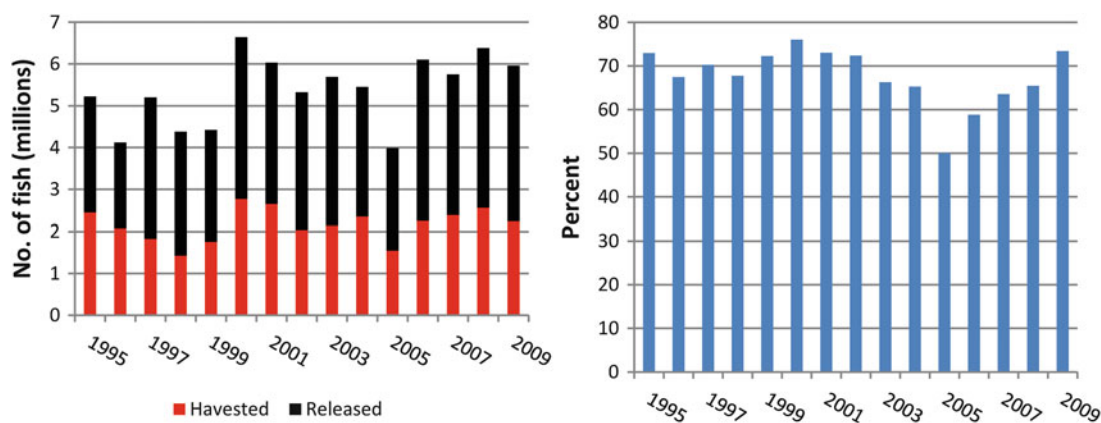


Figure 10.114. Louisiana recreational red drum catch (*left panel*) and Louisiana catch in relation to Gulf total (*right panel*), 1995–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A).

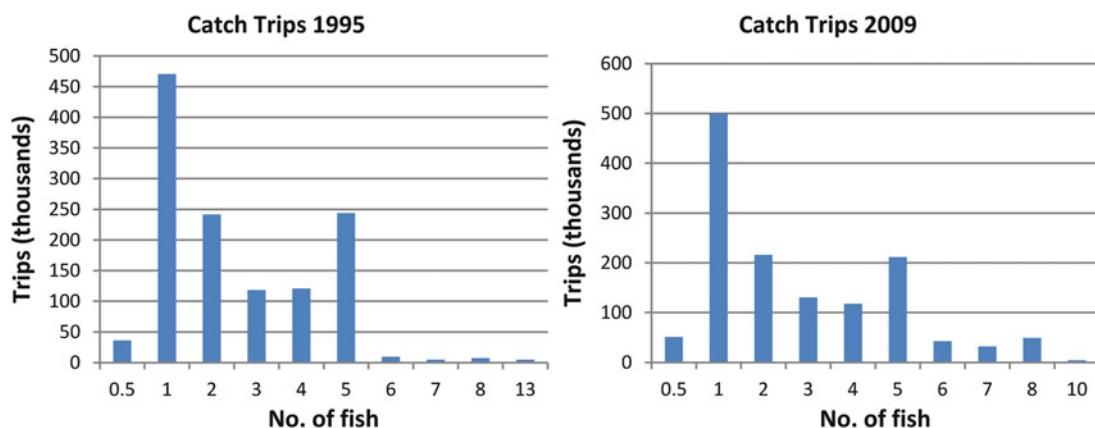
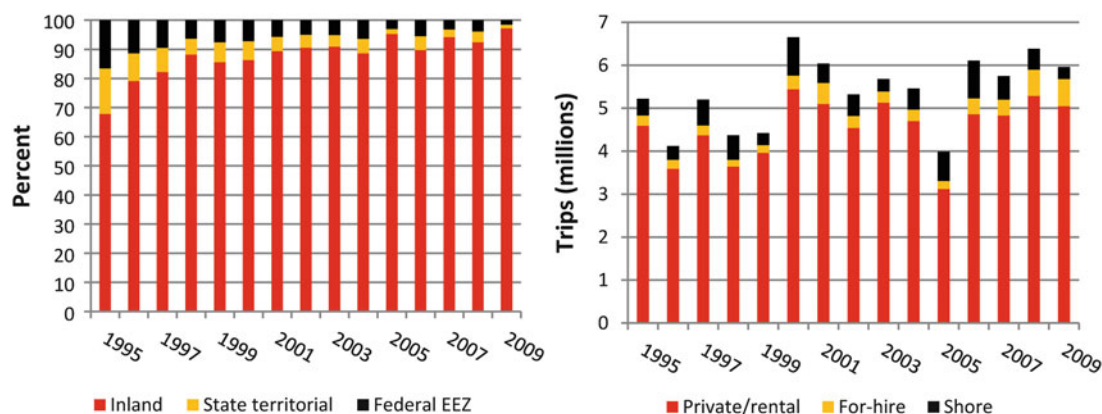


Figure 10.115. Red drum catch (number) per Louisiana angler among those trips where catch of red drum was positive, 1995 and 2009 (NMFS FSD, data accessed 2012, with estimations by authors—see Appendix A).

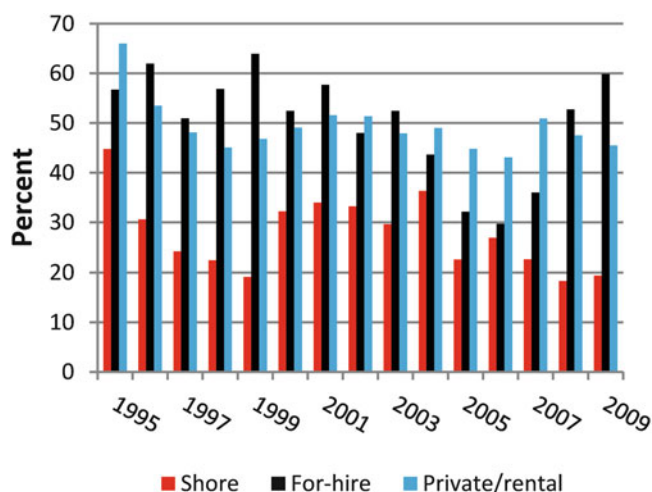
The catch of red drum per angler among those angler trips reporting red drum catches is provided for selected years (1995 and 2009) in Figure 10.115. As indicated, there has been little change in the distribution of the catch between the two periods with the average catch per angler exhibiting a bimodal distribution at one fish and five fish.<sup>25</sup> Furthermore, as shown, there are many trips where the red drum catch per angler exceeds five fish even though the bag limit is five fish per angler. The reason for this is that the catch can exceed bag limit with the excess being released.

Catch of red drum in Louisiana waters occurs overwhelmingly in inland waters (Figure 10.116). This is not unexpected given that the majority of total angler trips taken occur in inland waters and red drum is one of the most frequently targeted species. As indicated, there

<sup>25</sup> The 0.5 catch per angler is the result of parties with more than one angler and the division of the catch among the anglers.



**Figure 10.116.** Louisiana recreational red drum catch by area (*left panel*) and mode (*right panel*), 1995–2009 (Sour NMFS FSD, data accessed 2012—see Appendix A).



**Figure 10.117.** Louisiana recreational red drum targeting behavior by mode, 1995–2009 (NMFS FSD, data accessed 2012, with targeting estimates calculated by authors—see Appendix A).

has been a gradual increasing trend in the percentage of red drum catch in inland waters over the 15-year period of analysis with the inland catch representing 97 % of the total in 2009.

The overwhelming proportion of red drum catch occurs from private/rental boats with approximately 85 % of this species catch being taken by this mode since 1995 (Figure 10.116, right panel). Another 10 % of the catch has been taken from shore. In general, there was little observed change in the catch-by-mode trend during the 15-year period of analysis with the exception of the last several years when the proportion of red drum catch emanating from the for-hire mode increased at the expense of the shore mode.

In general, there is a considerable amount of red drum targeting behavior among all fishing modes (Figure 10.117). With respect to the shore-based mode, slightly less than 30 % of the angler trips reported the targeting of red drum during the 15-year period of analysis. This proportion increased to 50 % for the for-hire mode and the private/rental boat mode.

As noted, MRIP data are collected and analyzed in terms of *waves* wherein each wave represents a 2-month period. Estimated red drum catch by wave for selected periods during 1995–2009 is presented in Figure 10.118. As indicated, there is some seasonality to red drum

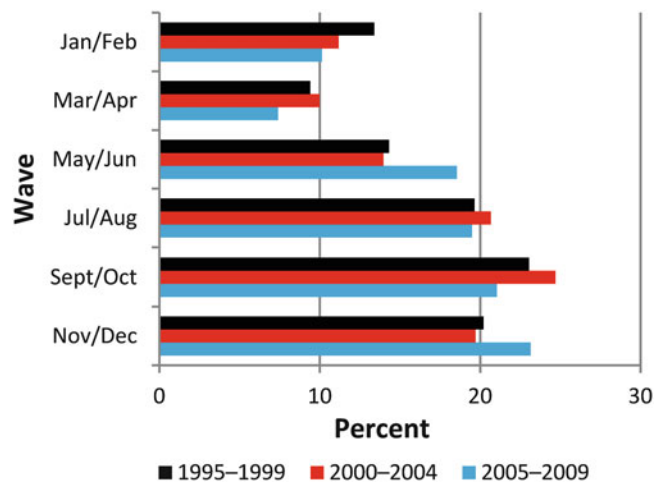


Figure 10.118. Louisiana recreational red drum catch by wave, 1995–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A).

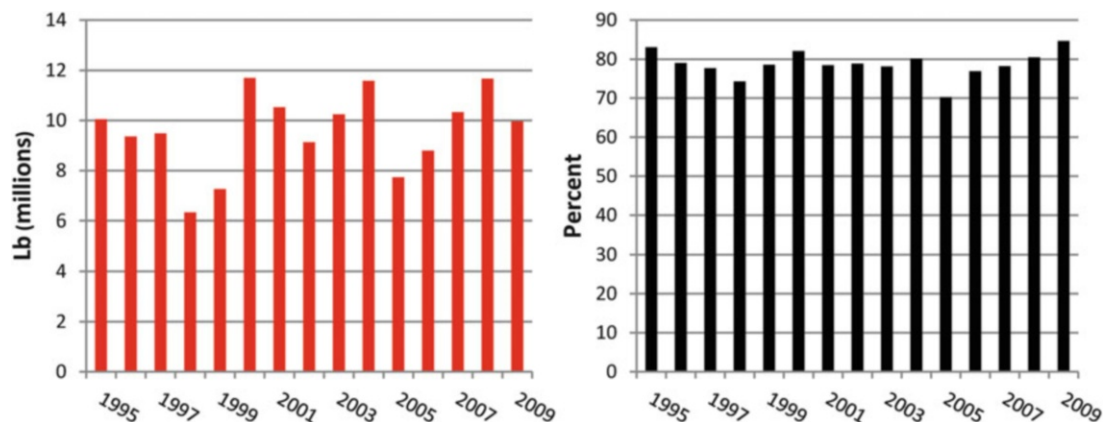


Figure 10.119. Louisiana recreational red drum harvest and Louisiana's harvest in relation to Gulf total, 1995–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A) (*Note:* 1 lb = 0.454 kg).

catch, and this seasonality mimics what was observed for the Gulf. This is expected given the large proportion of the Gulf catch in number of fish is represented by Louisiana.

As previously discussed, the catch of red drum by Louisiana's anglers in numbers of fish ( $A + B1 + B2$ ) accounts for the majority of the Gulf catch (excluding Texas). As such, it should come as no surprise that Louisiana's recreational harvest of red drum in pounds ( $A + B1$ ) dominates the Gulf (Figure 10.119). Overall, Louisiana's annual recreational red drum harvest in pounds generally ranges from about 8 million pounds to 11 million pounds, which represents about 80 % of the Gulf total (excluding Texas). The state's share of the Gulf total in pounds harvested is marginally higher than its share in number of fish reflecting primarily larger bag limits in Louisiana and a larger sized fish being harvested.<sup>26</sup>

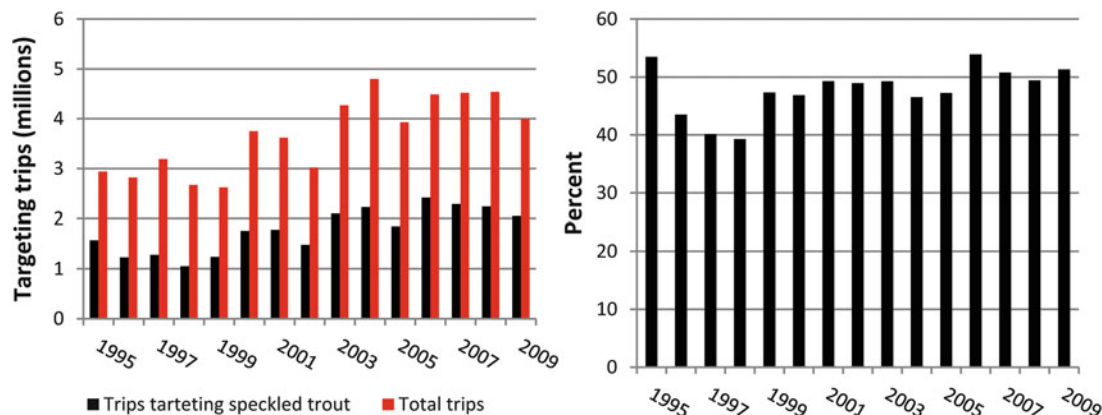
<sup>26</sup> As noted, the Gulf red drum harvest (excluding Texas) is dominated by Florida and Louisiana. In 1995, the average weight of red drum harvested in Florida equaled 4.3 lb per fish compared to 5.9 lb per fish in Louisiana. In 2009, the Florida recreationally harvested red drum averaged 1.49 lb per fish compared to 5.6 lb for fish harvested in Louisiana.



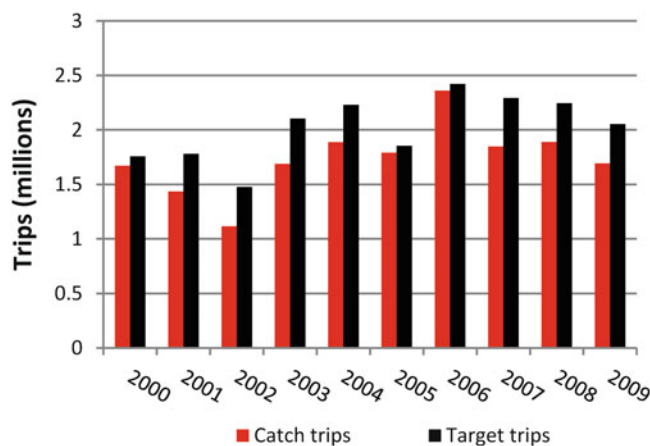
*Spotted Seatrout*

Along with red drum, spotted seatrout is the other species most often targeted in Louisiana. Since 1995, as indicated by the information in Figure 10.120, from about 40 % to more than 50 % of the annual trips report spotted seatrout as one of the two targeted species (average of 48 % over the 15-year period ending in 2009). The only year in which trips targeting spotted seatrout fell below 40 % was 1998 when it was marginally lower (39 %). As previously noted, the respondents to the MRIP dockside interview are allowed to state two targeting species. While not discussed here, about two-thirds of intercepted anglers in Louisiana consistently indicated that they targeted either red drum or spotted seatrout.

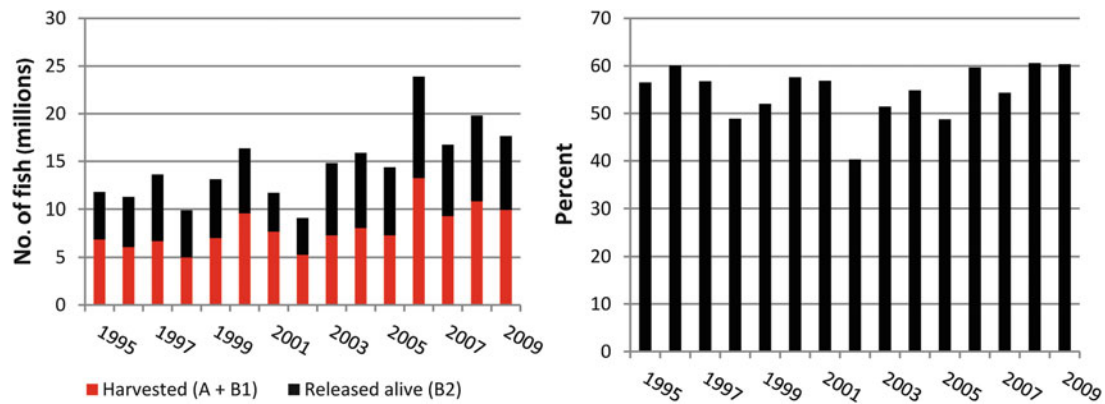
A close relationship exists between recreational spotted seatrout targeting trips and catch trips in Louisiana's waters (Figure 10.121). While this might suggest that the probability of



**Figure 10.120.** Louisiana spotted seatrout targeting trips in relation to total number of trips (*left panel*) and as a percent of total trips (*right panel*): 1995–2009 (NMFS FSD, data accessed 2012, with targeting estimates and percentages calculated by authors—see Appendix A).



**Figure 10.121.** Relationship between Louisiana spotted seatrout catch trips and spotted seatrout targeting trips, 2000–2009 (NMFS FSD, data accessed 2012, with targeting estimates calculated by authors—see Appendix A).



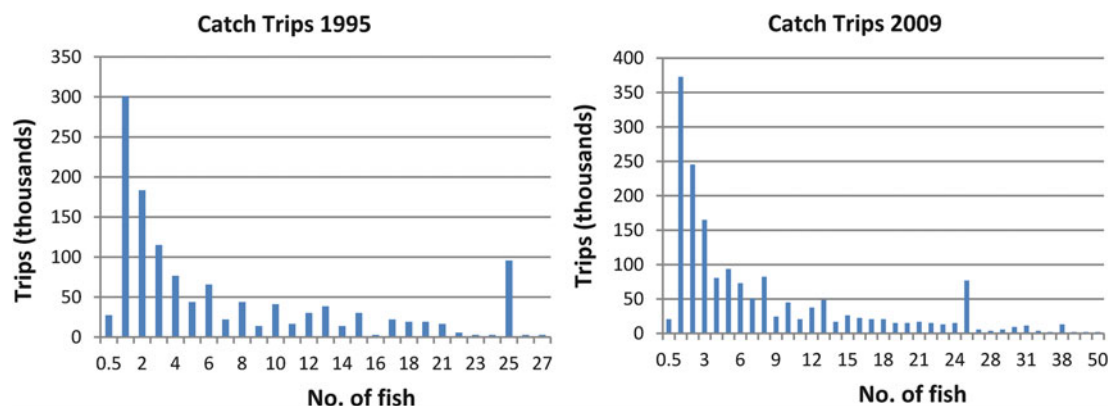
**Figure 10.122. Louisiana spotted seatrout catch (left panel), and percentage of Gulf spotted seatrout catch (right panel) (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A).**

catching spotted seatrout is high if it is a targeted species, some caution should be used in the interpretation of this relationship. First, some trips may result in the catch of spotted seatrout even if it is not a targeted species. Second, respondents to the MRIP dockside survey are asked about their targeting behavior after the trip is concluded. There is a body of evidence suggesting that what an angler catches on a trip can bias his post-trip responses to targeting behavior.

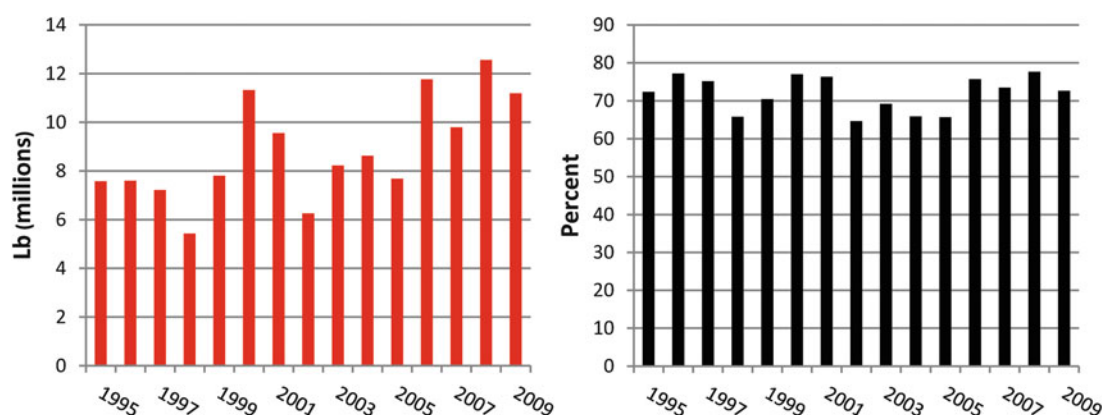
According to MRIP statistics, an average of 14.66 million spotted seatrout were caught (A + B1 + B2) per year in Louisiana waters during the 15-year period ending in 2009 (Figure 10.122, left panel). The number of fish caught reached a maximum in 2006 with reported total equaling almost 24 million. The minimum reported catch in numbers was in 2002 at just over nine million. As with all species, spotted seatrout can be harvested (A + B1) or released alive (B2). For the 15-year period ending in 2009, an average of 55 % of the spotted seatrout catch in numbers were harvested annually with a range from about 50 % in many years to about 65 % in 2002. During the period of analysis, the correlation between the (estimated) annual number of spotted seatrout harvested (A + B1) and the number of spotted seatrout released alive (B2) was positive, equaling 0.84. When examined on an annual basis, Louisiana's catch of spotted seatrout as a proportion of the Gulf's total (excluding Texas) consistently ranged from about 50 to 60 % with the exception of 2002 when it fell to about 40 %.

The catch of spotted seatrout per angler among those trips reporting spotted seatrout catches is provided for selected years (1995 and 2009) in Figure 10.123. As indicated, there has been little change in the distribution of the catch between the two considered years.

Like red drum, the overwhelming proportion of Louisiana's recreational spotted seatrout catch (A + B1 + B2) is derived from inland waters with the percentage in recent years approaching 95 % (average for the 1995–2009 equals 90 %). Also, like red drum, about 90 % of the recreational catch of spotted seatrout in Louisiana's waters is derived from the private/rental boat mode. Louisiana's recreational harvest of spotted seatrout in pounds (A + B1) for the 1995–2009 period is given in Figure 10.124. As indicated, annual landings have ranged from less than six million pounds to more than 12 million pounds and have averaged almost nine million pounds annually during the 15-year period of consideration. This average represents about 70 % of the Gulf total spotted seatrout landings in pounds during the period.



**Figure 10.123.** Catch of spotted seatrout per angler (in number of fish) among those trips where catch of spotted seatrout was positive, 1995 and 2009 (NMFS FSD, data accessed 2012, with estimations by authors—see Appendix A).

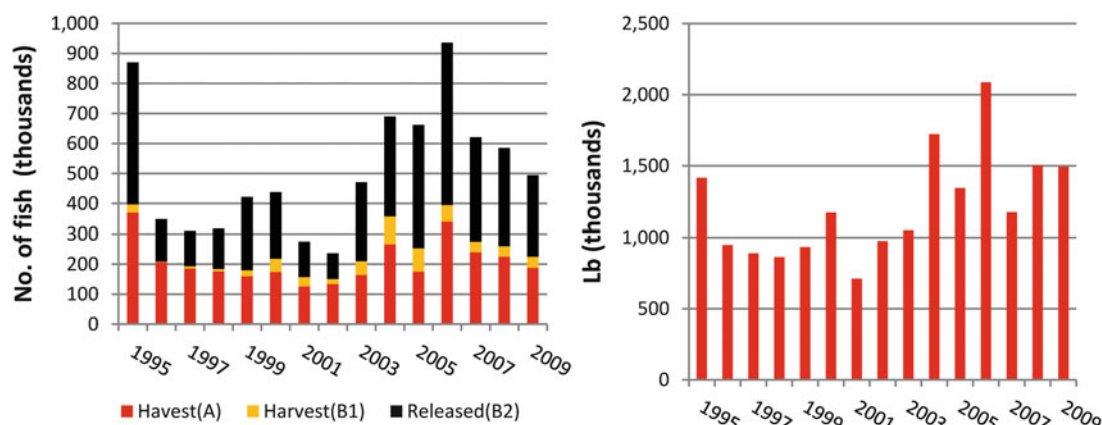


**Figure 10.124.** Louisiana recreational harvest of spotted seatrout (left panel) and percentage of Gulf total harvest (right panel), 1995–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A) (Note: 1 lb = 0.454 kg).

#### *Offshore Species*

*Aggregate Reef Fish:* As noted when examining trips by area, Louisiana is primarily an inshore fishery. As such, it is not surprising that catch of offshore species is limited. The aggregate catch of reef fish in numbers of fish (A + B1 + B2) generally tends to be less than one million fish per year and harvest in pounds (A + B1) is generally less than two million pounds per year (Figure 10.125). Among the primary species harvested are red snapper (average annual landings of 558,000 since 1995) and greater amberjack (average landings of 231,000 lb annually since 1995).

*Other Offshore Species:* Other than reef fish species, two offshore species highly desired by Louisiana anglers are yellowfin tuna and blackfin tuna (*Thunnus atlanticus*). These two species are highly migratory in nature and, as such, yearly landings can fluctuate widely. Reported harvest of yellowfin tuna averaged 365,000 lb annually during 1995–2009, and blackfin tuna landings averaged 300,000 lb. Large expenditures are incurred in the harvest of these species due to the far offshore distance one must travel to catch either yellowfin or blackfin tuna and, as such, the number of trips is limited. The limited number and nature of these trips suggests caution should be exercised when assessing the reliability of these figures.



**Figure 10.125. Louisiana recreational aggregate reef fish catch (left panel) and harvested pounds, 1995–2009 (NMFS FSD, data accessed 2012—see Appendix A) (Note: 1 lb = 0.454 kg).**

#### 10.4.3.3.3 Alabama and Mississippi

Given that Florida and Louisiana dominate Gulf recreational catch in both numbers of fish caught ( $A + B1 + B2$ ) and pounds of fish kept ( $A + B1$ ), analysis given to the recreational fisheries in Alabama and Mississippi is more limited. The 25 most frequently caught ( $A + B1 + B2$ ) and harvested ( $A + B1$ ) species from Alabama waters for selected years between 1995 and 2009 (1995, 2000, 2005, and 2009) are identified in Tables 10.24, 10.25, 10.26, and 10.27 while comparable figures for Mississippi are given in Tables 10.28, 10.29, 10.30, and 10.31. Without going into detail, a comparison of Alabama's and Mississippi's catches and harvests in numbers of fish with that of Louisiana's would suggest that Mississippi is closer to Louisiana in terms of species caught than is Alabama. For example, while spotted seatrout represents the most frequently harvested species in numbers in both Louisiana and Mississippi, it ranks only third in Alabama. Similarly, while red drum is ranked second in Louisiana and seventh in Mississippi, it is ranked tenth in Alabama. Such a finding is not unexpected given that the coastal wetlands in Alabama are considerably more limited than in Mississippi. By comparison, many of the species most frequently harvested in Alabama represent those most often associated with offshore fishing activities (e.g., king mackerel, vermilion snapper, and gray triggerfish). This finding is consistent with fishing practices across the states. Specifically, whereas approximately 95 % of the 2009 fishing trips in both Louisiana and Mississippi were conducted in inland waters, less than 65 % of the fishing trips in Alabama were conducted in inland waters.

As the information in Figure 10.126 (left panel) indicates, recreational anglers in Alabama have, in recent years, caught about 9–12 million fish per year. Since increasing in the late 1990s, little trend is evident in recreational catch from Alabama's waters. As a proportion of the Gulf catch, in numbers of fish, Alabama has contributed as little as about 3.5 % and never more than 7 % with the 1995–2009 average equaling 5.4 % (Figure 10.126, right panel). Overall, more than 50 % of the catch during 1995–2009 was released alive (B2) with the proportion exceeding 60 % in some years.

In terms of pounds landed ( $A + B1$ ), Alabama's share of the Gulf total has fallen in the relatively narrow range of 8–11 % in recent years (Figure 10.127, right panel) based on an absolute harvest that has remained stable during the 2005–2009 period ranging from about 5.7 million to 7 million pounds (Figure 10.127, left panel). As was the situation in terms of number

**Table 10.24 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species By Alabama Recreational Anglers, 1995**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Sand Seatrout	1,234,756	Sand Seatrout	1,078,925	0.559
Red Snapper	567,495	Scaled Sardine	352,376	0.055
Spanish Mackerel	427,074	Red Snapper	324,633	4.010
Atlantic Croaker	406,574	Sheepshead	273,670	2.409
Scaled Sardine	352,376	Spanish Mackerel	250,118	1.691
Pinfish	344,211	Vermilion Snapper	242,816	1.170
Sheepshead	295,479	Striped Mullet	215,248	0.685
Vermilion Snapper	287,047	Gray Triggerfish	188,386	1.977
Gray Triggerfish	222,571	Atlantic Croaker	166,017	0.405
Striped Mullet	216,156	Southern Kingfish	150,153	0.671
Atlantic Spadefish	199,938	Southern Flounder	112,973	1.183
Southern Kingfish	171,281	Atlantic Spadefish	105,743	1.677
Spotted Seatrout	153,573	Bluefish	105,533	2.076
Hardhead Catfish	141,301	Spotted Seatrout	93,232	1.133
Bluefish	140,848	Red Drum	74,409	6.102
Red Drum	126,209	King Mackerel	65,071	6.6031
Southern Flounder	120,208	Pinfish	48,191	0.264
King Mackerel	84,632	Lefteye Flounder Family	28,774	NA
Tomtate	40,717	White Mullet	28,749	0.555
Greater Amberjack	40,260	Seatrout Genus	26,271	NA
Lefteye Flounder Family	35,822	Gulf Kingfish	23,503	0.551
White Mullet	28,749	Black Drum	21,412	3.084
Gulf Kingfish	27,978	Hardhead Catfish	19,223	0.907
Seatrout Genus	26,271	Greater Amberjack	16,564	20.242
Black Drum	24,039	Gray Snapper	15,478	1.081

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

of fish caught ( $A + B1 + B2$ ), there was an apparent increase in pounds landed in the late 1990s though the reason for this increase is not obvious.

As with the number of participants and trips, Mississippi's estimated recreational catch is the lowest among the four Gulf States considered in this analysis (Figure 10.128). The observed maximum catch expressed in numbers of fish occurred in 2001 when an estimated eight million fish were caught. Anywhere from one-third to one-half of the total catch is generally released alive (B2). Overall, the recreational catch from Mississippi's waters did not exceed 5 % of the Gulf total in any of the 15 years of analysis and in some years fell as low as 2 %.

**Table 10.25 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species By Alabama Recreational Anglers, 2000**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Sand Seatrout	738,646	Sand Seatrout	554,172	0.507
Atlantic Croaker	738,218	Southern Kingfish	302,402	0.534
Red Snapper	461,098	Atlantic Croaker	225,056	0.399
Southern Kingfish	458,689	Striped Mullet	170,156	0.937
Pinfish	432,737	Spanish Mackerel	162,281	2.349
Blue Runner	430,801	Spotted Seatrout	140,197	1.674
Spotted Seatrout	382,089	Sheepshead	133,462	2.977
Spanish Mackerel	218,697	Red Snapper	127,346	4.010
Sheepshead	179,962	Gulf Kingfish	125,542	0.586
Striped Mullet	173,894	White Mullet	122,897	0.623
Atlantic Spadefish	152,835	Menhaden Genus	99,330	NA
White Mullet	151,838	King Mackerel	91,576	10.916
Gulf Kingfish	133,762	Mullet Genus	89,280	NA
Red Drum	124,407	Pinfish	85,125	0.303
Menhaden Genus	124,320	Southern Flounder	63,443	1.481
King Mackerel	123,636	Bluefish	58,056	2.408
Bluefish	103,625	Red Drum	53,734	6.045
Hardhead Catfish	90,637	Gulf Menhaden	52,745	0.203
Mullet Genus	89,280	Atlantic Spadefish	35,565	2.264
Gray Snapper	86,529	Blue Runner	34,701	0.717
Southern Flounder	74,359	Black Drum	26,846	2.896
Gulf Menhaden	53,744	Gray Snapper	22,622	1.400
Little Tunny	44,632	Gray Triggerfish	15,314	2.576
Requiem Shark Family	34,849	Florida Pompano	12,757	1.561
Black Drum	29,827	Searobin Genus	12,185	NA

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

In terms of pounds harvested (A + B1), Mississippi's share fell from about 6 % in the mid-1990s to less than 3 % from 2005 to 2008 before increasing to 5 % in 2009 (Figure 10.129, right panel). This is based on harvested poundage ranging from about 1.5 million to 4.5 million (Figure 10.129, left panel). Much of the observed decline in both catch (Figure 10.128) and harvest (Figure 10.129) during the mid-2000s was undoubtedly related to the destruction in infrastructure associated with Hurricane Katrina.



**Table 10.26 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species By Alabama Recreational Anglers, 2005**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Atlantic Croaker	1,683,014	Sand Seatrout	349,559	0.510
Red Snapper	650,305	Spotted Seatrout	294,437	1.860
Spotted Seatrout	617,079	Sheepshead	279,854	3.420
Sand Seatrout	612,421	Atlantic Croaker	233,043	0.428
Pinfish	467,484	Red Snapper	232,430	4.106
Southern Kingfish	409,075	Striped Mullet	221,943	0.919
Sheepshead	365,273	Southern Kingfish	191,183	0.560
Hardhead Catfish	349,698	Pinfish	158,298	0.233
Red Drum	327,984	Red Drum	153,822	7.861
Striped Mullet	254,510	Southern Flounder	150,458	1.258
Southern Flounder	230,554	Blue Runner	104,515	0.362
Blue Runner	129,795	Gray Triggerfish	82,494	2.249
Gulf Kingfish	108,247	Vermilion Snapper	74,899	1.105
Spanish Mackerel	96,234	Gulf Kingfish	71,938	0.565
Gray Triggerfish	89,455	Black Drum	68,699	8.199
Vermilion Snapper	82,812	Spanish Mackerel	45,032	1.500
Ladyfish	76,172	King Mackerel	41,509	8.108
Black Drum	75,331	Bluegill	37,084	0.388
Bluefish	72,364	Hardhead Catfish	33,459	0.750
Gafftopsail Catfish	69,927	Mullet Genus	25,055	NA
Gag	64,974	Gag	21,381	6.056
Bluegill	64,896	White Mullet	21,298	0.539
King Mackerel	54,814	Atlantic Spadefish	20,761	1.904
Atlantic Spadefish	53,477	Red Porgy	19,127	1.127
Gray Snapper	41,847	Ladyfish	16,195	1.262

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

## 10.5 SUMMARY

Given its diversity of species, the Gulf of Mexico offers ample opportunities to both commercial and recreational fishermen. The objective of this chapter is to provide a systematic examination of the Gulf of Mexico commercial and recreational fishing sectors focusing on a variety of topics. With respect to the commercial sector, some of the topics considered include trends in production of various species, the value of production associated with these various species, the impact of imports on dockside prices, and processing. Overall, long-term landings of most key commercial species appear to be stable and changes, where noted, appear to be tied to regulations to manage fish stocks. This is particularly true with respect to finfish stocks. Of the commercial fisheries examined, the shrimp fishery faces the greatest obstacles in terms

**Table 10.27 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species By Alabama Recreational Anglers, 2009**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Sand Seatrout	2,176,890	Sand Seatrout	1,428,030	0.580
Atlantic Croaker	2,035,394	Southern Kingfish	591,217	0.595
Spotted Seatrout	1,075,150	Spotted Seatrout	318,109	2.100
Southern Kingfish	837,218	Atlantic Croaker	249,833	0.367
Red Snapper	453,175	Sheepshead	165,809	2.735
Hardhead Catfish	439,071	Southern Flounder	138,841	1.445
Pinfish	298,775	Red Snapper	138,062	5.083
Sheepshead	202,989	Spanish Mackerel	75,605	1.854
Red Drum	163,178	Vermillion Snapper	61,969	0.893
Southern Flounder	160,787	Red Drum	61,808	6.771
Spanish Mackerel	135,188	King Mackerel	52,661	9.475
King Mackerel	76,575	Pinfish	8270	0.200
Vermillion Snapper	67,768	White Mullet	42,196	0.357
White Mullet	61,976	Striped Mullet	34,979	0.854
Gray Snapper	59,930	Gray Triggerfish	34,555	2.550
Gray Triggerfish	52,989	Black Drum	28,670	6.284
Striped Mullet	52,122	Hardhead Catfish	19,564	0.825
Bluefish	43,031	Gray Snapper	18,536	2.152
Pigfish	41,901	Atlantic Spadefish	17,386	1.105
Blue Runner	38,897	Bluefish	13,985	1.804
Black Drum	38,841	Silver Perch	12,069	0.203
Gulf Flounder	34,850	Gulf Flounder	11,120	1.718
Gafftopsail Catfish	34,422	Lane Snapper	10,138	1.285
Atlantic Spadefish	26,424	Red Pongy	8,616	0.834
Ladyfish	14,414	Blue Runner	7,158	1.256

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

of long-run viability. Increasing imports have led to a significant decline in the price shrimpers receive for the harvested product and, in turn, a reduction in profitability. This reduction has led to a substantial downsizing of the industry with current effort in the fishery (measured in days fished) being a fraction of what it was in the 1990s. This statement applies for both the brown and white shrimp, the two species of relevance in the northern Gulf of Mexico.

Like the harvesting sector, the Gulf shrimp-processing sector has not been immune to the increasing import base. A steadily eroding marketing margin and, presumably, profit has culminated in consolidation of this sector, and remaining firms are increasing output in an attempt to counterbalance the declining marketing margin per unit of output.

**Table 10.28 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species By Mississippi Recreational Anglers, 1995**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Sand Seatrout	688,074.36	Sand Seatrout	642,357.28	0.441
Atlantic Croaker	669,942.72	Striped Mullet	13,309.73	0.593
Spotted Seatrout	535,617.59	Atlantic Croaker	388,380.15	0.283
Striped Mullet	428,727.73	Southern Flounder	69,565.72	0.845
Southern Flounder	281,587.77	Spotted Seatrout	266,054.24	1.374
Sheepshead	237,534.23	Sheepshead	215,151.83	2.061
Red Drum	189,832.36	Gulf Menhaden	93,910.29	NA
Pigfish	125,507.84	Red Drum	81,965.38	7.853
Hardhead Catfish	122,435.30	Spanish Mackerel	79,882.90	1.792
Gulf Menhaden	93,910.29	Southern Kingfish	63,416.67	0.523
Spanish Mackerel	93,115.38	Red Snapper	37,535.93	3.573
Southern Kingfish	77,432.72	Atlantic Spadefish	35,548.97	1.480
Red Snapper	48,894.06	Atlantic Sharpnose Shark	32,997.40	6.070
Atlantic Sharpnose Shark	38,055.40	Pinfish	32,618.79	0.216
Atlantic Spadefish	35,548.97	Gray Snapper	22,444.24	0.809
Gafftopsail Catfish	28,706.12	Black Drum	21,236.04	3.208
Gray Snapper	27,776.59	Gafftopsail Catfish	20,001.63	3.535
Black Drum	23,725.02	Tripletail	19,618.58	9.467
Cobia	21,625.78	Hardhead Catfish	16,086.65	0.734
Tripletail	19,618.58	Blacktip Shark	13,504.86	10.149
Blacktip Shark	18,624.38	Gray Triggerfish	9,116.03	2.348
Bluefish	10,817.39	King Mackerel	7,689.57	9.574
Gray Triggerfish	10,227.84	Spot	5,040.37	0.296
King Mackerel	7,689.57	Lefteye Flounder Genus	5,039.00	NA
Requiem Shark Family	5,559.03	Bluefish	4,996.11	2.284

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

Direct jobs in the harvesting sector generate jobs elsewhere in the economy via companies supplying inputs and those adding value to the harvest product that is ultimately used by the consumer. For the four Gulf States considered in the analysis (Florida was excluded because the west coast could not be differentiated from the east coast), seafood industry jobs averaged 92,000 annually during 2007–2009. However, the four-state employment fell from 109,000 in 2007 to 63,000 in 2009. Income impacts for the four states equaled \$1.3 billion in 2009 compared to \$2.5 billion in 2007, a decline approaching 50 %.

**Table 10.29 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species By Mississippi Recreational Anglers, 2000**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Sand Seatrout	1,138,498	Sand Seatrout	970,848	0.439
Atlantic Croaker	659,068	Southern Kingfish	486,699	0.512
Spotted Seatrout	622,625	Striped Mullet	231,832	0.868
Southern Kingfish	514,030	Spotted Seatrout	216,596	1.762
Striped Mullet	240,413	Atlantic Croaker	184,398	0.421
Pinfish	207,796	Southern Flounder	93,031	1.251
Red Drum	121,097	Red Drum	49,133	7.505
Southern Flounder	113,023	Sheepshead	41,556	3.422
Hardhead Catfish	65,285	Gulf Menhaden	30,768	0.203
Sheepshead	46,167	Black Drum	27,479	3.263
Gafftopsail Catfish	36,392	Gafftopsail Catfish	22,347	2.973
Gulf Menhaden	30,768	Pinfish	16,967	0.400
Black Drum	28,862	Atlantic Sharpnose Shark	11,171	5.934
Gray Snapper	23,384	Gray Snapper	8,750	0.707
Spanish Mackerel	14,331	Spanish Mackerel	7,634	1.551
Atlantic Sharpnose Shark	11,171	Gulf Kingfish	7,429	0.683
Red Snapper	9,231	Hardhead Catfish	6,494	0.999
Cobia	7,464	Red Snapper	6,379	4.750
Gulf Kingfish	7,429	Cobia	3,096	32.356
Gag	3,694	Blacktip Shark	2,797	18.257
Blacktip Shark	2,797	Tripletail	2,768	5.123
Tripletail	2,768	King Mackerel	2,305	8.043
King Mackerel	2,305	Gag	2,238	6.225
Unidentified Eel	2,273	Blue Runner	1,901	0.728
Blue Runner	1,901	Atlantic Spadefish	1,901	0.998

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

With respect to the recreational sector, topics considered include expenditures and impact, angler participation, trips, and catch and harvest. The analysis was based almost exclusively on MRFSS/MRIP statistics, the most continual and long-term monitoring program on recreational fishing patterns. Texas opted out of the program and, hence, is largely excluded from this chapter with the exception of expenditures and impacts. At the top end in terms of economic impacts, about 42,000 jobs were generated in Florida in response to recreational fishing activities with an associated \$2.4 billion in income. At the bottom end, about 3,200 jobs were generated in Mississippi with additional income of \$162 million. Louisiana was in the middle with the generation of almost 20,000 jobs and almost \$1.0 billion in additional income.

**Table 10.30 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species By Mississippi Recreational Anglers, 2005**

Species Name	Number of Fish caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Spotted Seatrout	1,154,866	Spotted Seatrout	316,834	1.297
Sand Seatrout	329,859	Sand Seatrout	222,240	0.492
Southern Kingfish	269,793	Southern Kingfish	216,090	0.518
Atlantic Croaker	241,377	Southern Flounder	72,485	1.231
Hardhead Catfish	230,865	Atlantic Croaker	40,813	0.256
Red Drum	131,312	Red Drum	35,422	11.521
Southern Flounder	101,119	Striped Mullet	34,028	0.886
Sheepshead	34,045	Sheepshead	27,646	4.352
Striped Mullet	34,028	Hardhead Catfish	12,174	1.335
Gafftopsail Catfish	32,746	Gulf Kingfish	8,895	0.869
Red Snapper	26,087	Spanish Mackerel	7,612	1.041
Blacktip Shark	11,162	Black Drum	6,850	1.452
Black Drum	10,136	Atlantic Sharpnose Shark	4,960	7.47
Spanish Mackerel	10,085	King Mackerel	4,940	10.431
Gulf Kingfish	8,895	Blacktip Shark	4,047	29.43
Atlantic Sharpnose Shark	4,960	Gafftopsail Catfish	4,012	3.688
King Mackerel	4,940	Pinfish	3,008	0.165
Pinfish	3,983	Tripletail	2,254	4.123
Tripletail	2,254	Cobia	1,196	32.915
Crevalle Jack	2,102	Red Snapper	1,003	2.249
Cobia	1,196	Lane Snapper	1,003	2.822
Lane Snapper	1,003	Florida Pompano	993	1.268
Florida Pompano	993	Finetooth Shark	878	10.307
Finetooth Shark	878	Blue Runner	388	0.841
Blue Runner	388	Crevalle Jack	271	1.102

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

Overall, marine recreational participation in three of the four states increased significantly since the mid-1990s with Mississippi being the sole exception. While participation has increased substantially, much of the growth occurred prior to the mid-2000s. It is likely that the combination of high fuel prices in recent times combined with the downturn in the U.S. economy, including Florida, negatively influenced participation and the number of trips.

While MRFSS/MRIP represents the primary data source for tracking participation over time, state-issued marine fishing license sales can also be used to track changes, subject to a number of caveats. A comparison between MRFSS/MRIP participation estimates and license sales for both Louisiana and Mississippi was made to determine whether license sales track

**Table 10.31 25 Most Frequently Caught (Left Panel) and Harvested (Right Panel) Species By Mississippi Recreational Anglers, 2009**

Species Name	Number of Fish Caught (A + B1 + B2)	Species Name	Number of Fish Harvested (A + B1)	Mean Weight (lbs)
Spotted Seatrout	2,049,332	Spotted Seatrout	1,090,094	1.431
Sand Seatrout	1,381,393	Sand Seatrout	1,003,126	0.441
Atlantic Croaker	1,038,030	Atlantic Croaker	339,728	0.310
Southern Flounder	328,421	Southern Flounder	209,197	1.161
Red Drum	320,663	Southern Kingfish	125,724	0.487
Hardhead Catfish	189,692	Striped Mullet	118,642	0.846
Southern Kingfish	184,865	Red Drum	83,976	8.662
Striped Mullet	121,651	Black Drum	77,811	3.685
Black Drum	112,968	Spanish Mackerel	22,680	1.458
Gafftopsail Catfish	63,073	Sheepshead	22,479	2.833
Requiem Shark Family	40,093	Atlantic Spadefish	19,978	1.153
Pinfish	38,521	Sunfish Genus	19,750	NA
Red Snapper	32,360	Requiem Shark Family	18,527	NA
Spanish Mackerel	29,523	Red Snapper	14,939	4.184
Sheepshead	27,645	Gafftopsail Catfish	7,181	2.258
Atlantic Spadefish	20,353	Gray Snapper	6,960	4.515
Sunfish Genus	19,750	Gulf Menhaden	5,763	NA
Bluegill	14,350	Hardhead Catfish	5,274	0.827
Bluefish	14,134	Bluefish	4,885	2.168
Gray Snapper	8,039	Gag	4,464	5.313
Gag	5,903	Pinfish	3,805	0.157
Gulf Menhaden	5,763	Blue Catfish	3,363	0.320
Blue Runner	4,850	Tripletail	2,963	4.668
Blue Catfish	3,363	Bluegill	2,870	0.364
King Mackerel	3,128	King Mackerel	2,850	9.668

Source: NMFS FSD, data accessed 2012, with calculations by authors—see Appendix A. Note: 1 lb = 0.454 kg.

MRFS/MRIP estimates in a reasonable manner. Disturbingly, some significant differences were noted with MRFS/MRIP estimates exceeding license sales by a large margin. While there are explanations for these observed differences (e.g., a license is not required for saltwater fishing in Louisiana if one is under the age of 16), the differences are large enough to justify further examination of MRFS/MRIP participation data. The number of Gulf angler trips (excluding Texas) increased from about 17 million annually during the decade of the 1990s to 23 million annually during the most recent decade with a sharp increase in number of angler trips beginning in 2000. The explanation for this sharp increase in the number of angler trips is open to speculation but it coincides with a sharp increase in the number of nonresident



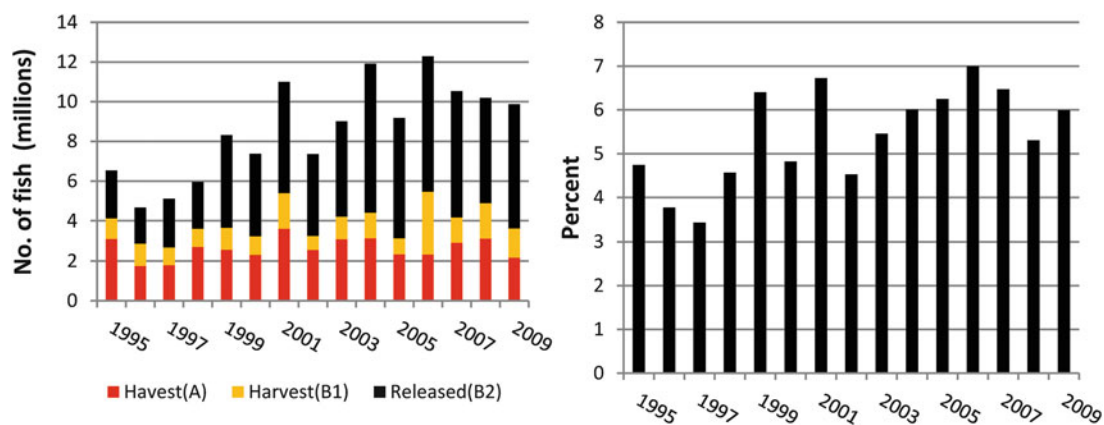


Figure 10.126. Alabama recreational catch and proportion of Gulf catch, 1995–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A).

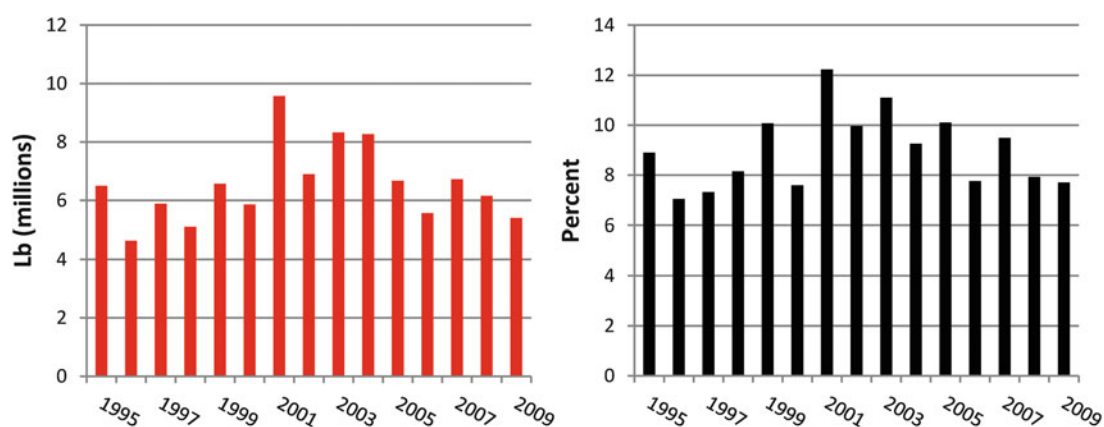


Figure 10.127. Alabama recreational harvest (*left panel*) and harvest in relation to the Gulf harvest (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A) (*Note*: 1 lb = 0.454 kg).

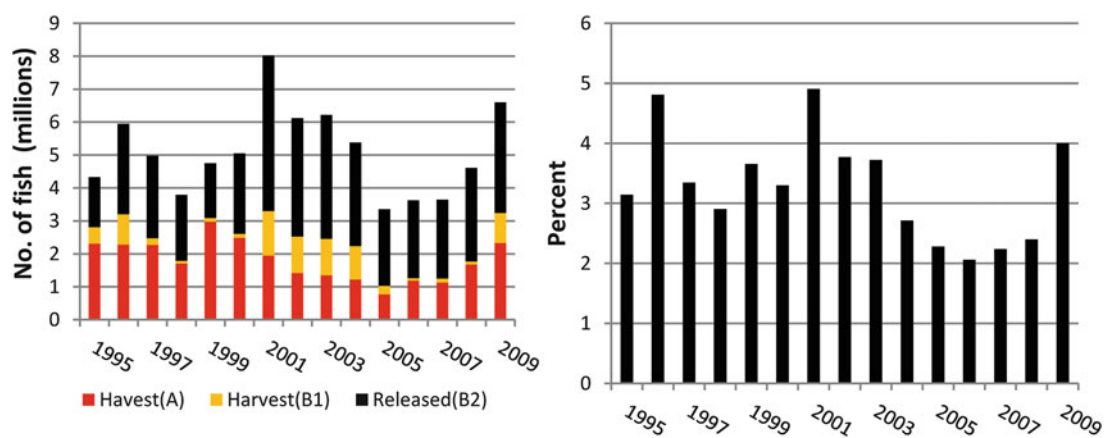
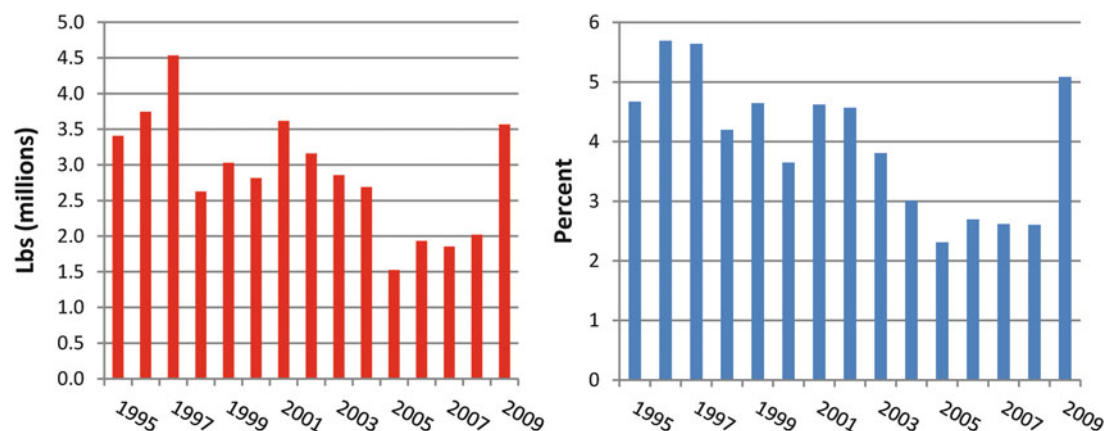


Figure 10.128. Mississippi recreational catch (*left panel*) and catch as a percent of Gulf total (*right panel*), 1995–2009 (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A).



**Figure 10.129. Mississippi recreational harvest (left panel) and Mississippi recreational harvest in relation to the Gulf harvest. (NMFS FSD, data accessed 2012, with percentage calculations by authors—see Appendix A) (Note: 1 lb = 0.454 kg).**

participants in Florida. Florida accounted for about 70 % of the total Gulf trips during the period of analysis and about 50 % of Florida-based trips were in inland waters. Louisiana accounted for another 17 % of the total, and about 85 % of the Louisiana-based trips were in inland waters.

Given that the vast majority of Louisiana's fishing activities take place in inshore waters, it comes as no surprise that targeting behavior and catch are also largely associated with those species using inshore habitat; the two primary species are red drum and spotted seatrout. A full 50 % of all Louisiana-based angling trips target spotted seatrout and with a catch averaging about 20 million fish per year, the state accounts for 60 % of the Gulf's total spotted seatrout catch in numbers of fish. Similarly, Louisiana accounts for about 80 % of the Gulf's red drum harvest in pounds.

While there is considerable red drum and spotted seatrout catch in Florida's waters, the state can also make claim to a large offshore fishery component and reef fish is generally the target of offshore activities.

## ACKNOWLEDGMENTS

BP sponsored the preparation of this chapter. This chapter has been peer reviewed by anonymous and independent reviewers with substantial experience in the subject matter. We thank the peer reviewers, as well as others, who provided assistance with research and the compilation of information, including the Fisheries Statistics Division and the Galveston Laboratory of the National Marine Fisheries Service and the Louisiana Department of Wildlife and Fisheries.

Small fish and shellfish images used throughout Chapter 10 are from GulfFINFO (<http://gulf.fishinfo.org/>) with the exception of the following: (1) Mangrove Snapper (© 1992, Diane Rome Peebles, used with permission); (2) Grey Triggerfish (FishWatch.gov; <http://www.fishwatch.gov/>); (3) Blue Marlin (Oceloti. 2014. Blue marlin fish illustration. iStockphoto, Calgary, Alberta, Canada. Available from <http://www.istockphoto.com/vector/blue-marlin-fish-gm505255597-44750310?clarity=false>. Accessed December 12, 2016); and (4) Black Grouper (THEPALMER. 2015. Black grouper engraving illustration. iStockphoto, Calgary, Alberta, Canada. Available from

<http://www.istockphoto.com/vector/black-grouper-engraving-gm475800654-66202355?clarity=false>. Accessed December 12, 2016).

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## APPENDIX A

The National Marine Fisheries Service (NMFS) maintains a large number of databases related to the catch of commercial and recreational marine species. Many of the more frequently used databases are available to the public on line and other databases are made available upon request to the appropriate unit within NMFS. With respect to commercial fishery statistics, landings data can be accessed by logging onto the website <http://www.st.nmfs.noaa.gov/commercial-fisheries/index> and following the link to “Commercial Landings.” Here, annual commercial landings can be downloaded by species (pounds and value) by state or region on either an annual or monthly basis. The annual databases for commercial landings extend back to 1950 while the monthly databases extend back to 1990. These databases served as



the primary source for much of the commercial landings information and figures presented in this chapter. For example, annual commercial data from the website was used to generate Figures 10.1, 10.2, and 10.13 while monthly commercial data from the website was used to generate Figures 10.12 and 10.14. In addition, this link also provides relevant information on landings by gear.

While this source provides considerable information on commercial landings by species, it is presented only at an aggregate species level and more detailed information can often be obtained via a request to the appropriate regional NMFS laboratory. For example, while shrimp landings by species (brown, white, etc.) can be downloaded from the <http://www.st.nmfs.noaa.gov/commercial-fisheries/index> website, many different shrimp sizes are landed and the price per pound can vary significantly depending upon size. Detailed information of this nature requires a request being made to the appropriate NMFS Laboratory, with the Galveston Laboratory maintaining the more detailed shrimp records. These records include landings by size count (e.g., Figure 10.21), harvest by area (e.g., Figure 10.30) and effort expressed in 24-h fishing days in total and by species (e.g., Figure 10.20).

When considering the U.S. commercial seafood industry, the role of imports (or exports) should be considered. Imports add to the total U.S. supply and U.S. consumption is a function of domestic landings and imports less any exports. The National Marine Fisheries Service maintains extensive databases on fishery product imports and exports differentiated by country of origin (for imports) and product forms. Data from these databases is provided on both an annual and monthly basis and can be downloaded by logging onto the website <http://www.st.nmfs.noaa.gov/commercial-fisheries/index> and following the link to “Foreign Trade.”

A final component that should be considered when examining the commercial fishing industry is the processing sector. Processing activities, by transforming the harvested product into product forms desired by consumers, adds value to the landed product via the marketing services it provides. As discussed in Section 10.3.9 of this chapter, there are two primary data sources related to processing activities. One is referred to as *the voluntary end-of-the year processor survey*; data used in this survey is collected and maintained by NMFS. Data collected and maintained under the auspices of this survey is detailed and includes for each processing establishment: (a) processed pounds, by product form, and value associated with each species being processed by that establishment, (b) the location of the processing establishment, and (c) monthly employment. This database, which includes the use of both domestic and imported raw product, was used to generate the figures associated with shrimp processing activities (i.e., the figures in Section 10.3.8.1.4). While detailed information associated with this annual survey (e.g., processing activities for individual species or by region) is not routinely published by NMFS, specific requests can be made by contacting the NMFS Office of Science and Technology Headquarters located in Silver Spring, Maryland, USA. The second data source of relevance to processing activities is contained in annual *Fisheries Economics of the United States* reports. Information given in these reports was discussed in Section 10.3.9 of this chapter and is not repeated here.

Given the increasing economic importance of recreational marine fishing activities and the relevancy of these fishing activities in the management process, NMFS also collects and analyzes these activities. Detailed information on recreational activities, such as that included in this chapter can be viewed by logging onto <http://www.st.nmfs.noaa.gov/recreational-fisheries/index> and then following the link to the “Access Data” site and then to the “Run a Query” site. From there, several “pull down menus” are presented including “Select a Catch Query,” “Select an Effort Query,” and “Select a Participation Query.” The “Select a Catch Query” menu provides the data to analyze recreational catch and harvest in aggregate, such as that presented in Figure 10.64 (left panel) and Figure 10.65 (left panel), as well as by individual species (such as,

Figure 10.67). Information can be generated in terms of either number of fish or pounds, given certain limitations, as well as by state or region. The “Select Effort Query” permits analysis of recreational activities in terms of number of trips such as that presented in Figure 10.61. Using this “pull down menu,” trips by mode and area fished, such as presented in Figure 10.61, can be examined.<sup>27</sup> Combining information generated from the “Select a Catch Query” menu and the “Select an Effort Query” allows examination of the catch (harvest) per trip such as that presented in Figure 10.64 (right panel). The data associated with both catch and effort are collected and maintained in 2-month waves (January/February, . . . , November/December) which also allows for seasonal analysis of both catch (e.g., Figure 10.69; left panel) and effort (e.g., Figure 10.62). Finally, the “Select a Participation” query gives the number of fishermen by state such as that presented in Section 10.4.3.1 of this chapter.

In addition to these “readymade” queries, more detailed data sets pertaining to MRFSS and MRIP can be downloaded from the “Access Data” site by selecting the “Download Data” option. This allows development of customized programming options and the examination of data in greater detail (e.g., county level). The data used to generate the tables reporting the 25 most commonly caught and harvested presented in this chapter, as well as targeted trips information, were derived from these databases. In addition, this site presents details regarding available information.

It is important to recognize, however, that when programs are customized for analysis, assumptions must be made at several steps of the analysis that can influence final results. One specific example related to the current analysis is that associated with targeted trip estimates given in this document. Specifically, when the document was being prepared, the website had no “readymade” query for targeted trips and the authors utilized a program originally developed by the NMFS, Southeast Regional Office (provided by Stephen Holiman) to generate the targeted trip estimates. An assumption was made in the development of this program that if, for example, only one person in a fishing party of four was interviewed and that person indicated targeting a given species than the other three members of that party would also be targeting the same species. This assumption is probably realistic in most cases but if this assumption is not made, targeted trip estimates will generally differ by a relatively small amount. Since completion of this chapter, the NMFS has added a “readymade” query for targeted trips and estimates from this query do differ (generally by a small amount) from those given.

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<sup>27</sup>Since the completion of this chapter an additional query has been added to the “Select an Effort Query” menu, that is the “Directed Trip” query. This query was not available at the time of the analysis but results presented in this paper should closely match the information given by using this query.

Habitats and Biota of the Gulf of Mexico: Before the  
Deepwater Horizon Oil Spill

Volume 2: Fish Resources, Fisheries, Sea Turtles, Avian  
Resources, Marine Mammals, Diseases and Mortalities

Ward, C.H. (Ed.)

2017, LXV, 891 p. 551 illus., 519 illus. in color.,

Hardcover

ISBN: 978-1-4939-3454-6