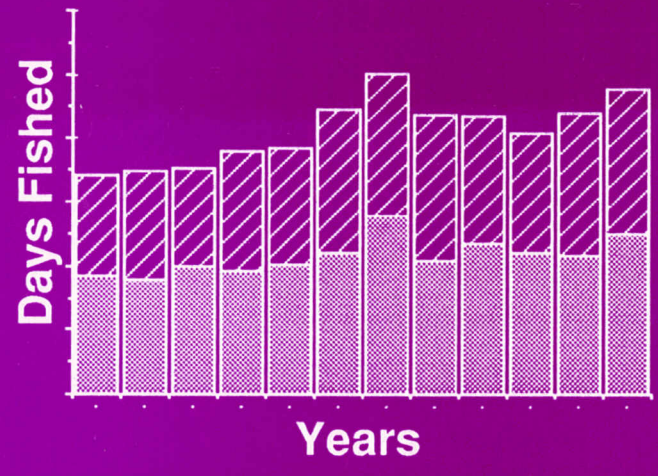
NOAA Technical Memorandum
NMFS - SEFSC - 337

Effort Trends for the Gulf of Mexico Shrimp Fishery



Effort = Landings / CPUE

GALVESTON LABORATORY
SOUTHEAST FISHERIES SCIENCE CENTER
NATIONAL MARINE FISHERIES SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
DEPARTMENT OF COMMERCE

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Effort Trends for the Gulf of Mexico Shrimp Fishery

by

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NOTICE:

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Introduction

This report provides a description of the data and data collection procedures used to collect statistics from the shrimp fisheries in the Gulf of Mexico and discusses recent trends in fishing effort. By providing these descriptions, it is intended that those who use the data will have a better understanding of the shrimp databases and can assist in efforts to improve the estimates.

The Southeast Fisheries Science Center (SEFSC) maintains shrimp databases from the commercial harvesting sector. These statistics do not include shrimp caught by recreational shrimpers for personal or family consumption. Similarly, the SEFSC databases do not include catch by commercial fishermen that is sold through non-dealer channels. In addition, the program does not include data on catch of shrimp discarded at sea.

Although the Gulf shrimp data base is complex, the procedures that are used to collect these data are, at least conceptually, straightforward. The data collection procedures are described below in the section entitled "Data Collection Procedures", and a detailed description of the data files follows entitled "Data File Descriptions".

Shrimp Data Files

Data Collection Procedures

Shrimp statistics for commercial fisheries are collected by port agents located in coastal ports around the Gulf. Currently, there are about 20 port agents employed by state or Federal agencies participating in the SEFSC Gulf shrimp program.

Port agents collect shrimp statistics from two sources, seafood dealers and fishermen. Data on the amount and value of the shrimp that are unloaded or landed at the dealers are collected by the port agents from dealer records. In 1992 there were a total of 457 active dealers in the Gulf of Mexico. For discussion purposes, these data are referred to as "dealer data" in the landings file. The second type of data includes detailed information on fishing effort and location for an individual trip and is collected by interviewing either the captain or a member of the crew. These data are referred to as "interview data" in the landings file.

Because a port agent is responsible for a specific geographical area, the same person collects the landings statistics, as well as interviews the fishermen for effort and location information. Consequently, it is the port agent's responsibility to assure that the right effort and location information are associated with the landings data from the same trip. This procedure guards against the possibility of double counting fishing activity that could occur if

more than one individual were responsible for collecting data in the same geographic area.

Because the fishing trip is the basic sampling unit, the fundamental principle of the data collection procedures is to collect both the landings and interview data on a trip-by-trip basis. However, because the number of fishing trips that occur in the Gulf shrimp fishery is so large (i.e., 291,954 total trips in 1992), it is impossible for a record to be made of every fishing trip. Consequently, data collection procedures include two modifications to this principle.

The first modification is that the port agents are only required to record landing statistics for fishing trips made by documented vessels (fishing craft registered with the U.S. Coast Guard) that fish nearshore and offshore (seaward of the COLREG line). The port agents combine the landings statistics and record only monthly totals for the pounds, value and number of trips that are made by boats (state licensed fishing craft) in these nearshore offshore areas. In contrast, the port agents combine the landings statistics and record only monthly totals for the pounds, value and number of trips that are made by both boats and vessels that fish in inshore areas (inside the COLREG line). Consolidation of data also is used for trips that are made in nearshore and offshore areas, but the vessel that made the trip could not be identified from the dealer's records. In 1992, out of a total of 45,109 nearshore and offshore trips by vessels, 2,861 (6.3%) were consolidated because the vessel could not be identified from the dealer's records.

The second modification is that port agents only conduct interviews from a sample of the vessels that fish nearshore and offshore. The intent of this protocol is to select a few individuals that are representative of the total population and collect information from the sample rather than the entire population. The logistics of fishing, however, make it impossible for the port agents to perform interviews that are selected randomly from the vessel population. Most of the time port agents do not know where and when vessels are going to land, so specific vessels cannot be targeted in advance for selection. As a result, the port agents are instructed to regularly visit the docks in their areas and interview vessel captains as opportunity arises. If there are more vessels in port than can be interviewed, the agents are instructed to select the vessels by "random" process, thus trying to avoid systematic bias, i.e., always interviewing the same vessels, at the same port, etc.

In summary, the port agents visit all the shrimp dealers in their assigned area at least once per month, and collect landings statistics for individual fishing trips for all the vessels fishing nearshore and offshore that can be identified. From a sample of these trips, the port agents interview a crew member to collect fishing effort and catch location information. For nearshore and

offshore trips made by boats, and inshore trips made by both boats and vessels, the port agents combine the landings statistics for all of the trips made each month.

Data File Descriptions

The port agents record the landings and interview data on a standard collection form. If landings statistics alone are collected, only part of the form is completed. If both landings and interview data are collected for the same trip, the entire form is completed. The individual data elements for the landings and interview portions of the data base are listed below. The data elements that are collected from the dealer's sales receipts or pack-out sheets are listed under the column titled "Landings Information", and the elements that are recorded from interviews with the captains are listed under the column titled "Interview Information". All of the data is put into a file which is termed the "Shrimp Landings File".

Landings Information	Interview Information
Port	Days Fished
Vessel Name	Size of Trawls
Official Documentation Number	Port of Departure
Date of Unloading	Departure Date
Number of Trips	Number of Trawls
Grading	Hours Fished During Day / Night
Dealer Number	Condition (heads on or off)
Species	Area
Size	Depth
Pounds	Number of Crew
Area	
Depth	
Price per Pound	

These data elements are, for the most part, self-explanatory; however, there are several that should be explained in more detail.

The term "Days Fished" is used to record the number of 24-hour days that the trawls were in the water fishing. For example, if a vessel fished 10 hours one day, 12 hours the next, and 12 hours the third day, the number of days fished would be 1.4, i.e., (10 hr +12 hr +12 hr)/24 hr = 1.4 days.

In order to assign fishing activity to a geographical location, the continental shelf of the Gulf has been divided into 21 statistical area or grids (Figure 2). These areas are further subdivided into 5 fathom increments for the shoreline out to 50 fathoms. The data elements, "Area" and "Depth", refer to these

statistical and depth subdivisions. Note, these data elements appear in both the "Landings" and "Interview" lists, but they are collected following slightly different procedures. The area and depth information that is recorded when only landings data are collected, and no interview is conducted, is "assigned" by the port agent. To assign the landings data to a specific area and depth the port agents usually use information obtained from the dealer, or in a few cases assign the fishing location based on their knowledge of the fleet's activity. In contrast, the area and depth information for an interview is actually provided by the fishermen.

The port agents attempt to identify the species of shrimp as accurately as possible. The major commercial species, white, brown, and pink (i.e., Penaeus setiferus, P. aztecus and P. duorarum) are familiar to most seafood dealers and properly identified by them. However, in Texas, many of the dealers include pink shrimp and brown shrimp together as brown shrimp landings.

In addition, the port agents record all of the landings statistics by market category or size of shrimp as the dealers have recorded them on their pack-out or sales receipts. Also, the port agents record whether the shrimp have been purchased as headed or whole (i.e., heads on). This identification is important because all of the statistics need to be converted to the same weight (i.e., heads on or heads off) when they are reported.

As discussion in the section on data collection procedures, the distinction between a vessel and a boat is important for the Gulf shrimp data. This distinction is based on the size and registration of the fishing craft. Vessels are defined as 5 net tons or greater and registered with the U.S. Coast Guard (USCG). The USCG issues a unique six-digit documentation number to each vessel, and this number is the "Official Documentation Number" that is recorded on the shrimp data collection form. Boats, on the other hand, are defined as all fishing craft that are not registered by the USCG, but are registered with the state in which they operate. Some of these boats may be 5 net tons or greater.

The count of unique vessel numbers in the Shrimp Landings File, gives a good estimate of the number of active nearshore and offshore vessels. Obviously, a particular vessel has to be active in a give year to have its number associated with landings at a dealer. However, the vessel count does not include all active vessels, since some vessels may only fish inshore, or a particular vessel number may not be recorded on a dealer's pack-out records.

The SEFSC also maintains a file known as the Vessel Operating Units File (VOUF). The intent of this file is to have a list, with associated vessel characteristic information (i.e., length, age, horsepower, etc.), for all active shrimp vessels during a particular year. During each year the port agents

keep a list of all the vessels landing or seen with shrimp gear at a particular port. These lists include all vessels, whether they fish nearshore, offshore or inshore. In some areas a port agent may suspect that a particular vessel is in the area and may include that vessel on the active list. Port agents are reluctant to take vessels off the VOUF since it is used by many investigators to get vessel characteristic data. This list of vessels is sent to the SEFSC at the end of each year so that the VOUF can be updated. Thus, the VOUF contains a list of all vessels found in the Shrimp Landings File, vessels fishing in the inshore areas, and vessels suspected to still be active in the fishery. Trends seen in the VOUF may lag trends observed in other files. The VOUF may overestimate the actual number of vessels in the fishery. The intent of the file is not to have an accurate count of the vessels, but to have vessel characteristic information available for research if these data are needed for a particular vessel.

Data Analysis for Nearshore and Offshore Gulf of Mexico

The intent of this section of the report is to outline recent trends with regards to shrimping effort in the Gulf of Mexico. The goal of any estimation of effort is to approximate the instantaneous rate of fishing morality (F). Effort may be defined by a variety of different methods, each with advantages and disadvantages associated with them. Various measures of effort include number of vessels, number of fishing trips, and time fished. The more analytical the estimation method, the better the relationship with F. But with this better relationship comes with detailed calculations and the need for more precise data. The more simple the estimation method, the most distant the relationship with F. But with this poorer relationship comes very simple calculations.

Number of vessels in the fishery is a very simple measure of effort. Some vessels within a particular port may be very active and fish intensively during the entire season. Other vessels may only fish during a particular month or season, while still other vessels may not fish at all. The number of vessels in the shrimp fishery can be obtained in both the landings file and the VOUF. As mentioned above the number of unique vessels in the landings file may be an underestimate of the actual number, while the number of unique vessels in the VOUF may be an overestimate of the actual number.

Number of trips represents an effort value that is more directly related to F since each trip is applying fishing pressure on the stock. Number of trips is obtained from the shrimp landings file and is not an estimated number. However, trip length is highly variable and may range from 1 to over 60 days in length.

Time fished represents an effort value that is the best with its relation to F. Currently we calculate nominal days fished, but research is presently under

way to calculate standardized days fished. This value is even in a closer relationship with F. This present nominal days fished unit of effort is calculated from data obtained by the port agents. Catch per unit effort (CPUE) is obtained from the equation: CPUE = Landings / Effort and can be calculated for each interviewed trip, since both landing and effort are known. Total effort for a given location (statistical area and depth zone) during a particular month can be obtained using the equation: Effort = Landings / CPUE. The total landings value for that catch location and time is obtained through the dealer canvass by the port agents and represents a non-estimated value of all pounds caught from that location. The average CPUE value for that catch location and time is obtained through the interview process and is calculated from the sample of all possible trips into that location. Thus, a total effort value is obtained for each location every month. Total monthly effort is obtained by summing effort values from all location cells in a particular month. Annual effort is obtained by summing effort values from all location cells in all months.

This method of effort calculation was reviewed and approved by a group of scientists at an effort estimation workshop held at the NMFS Galveston Laboratory during June 1992. The group included Jim Nance (NMFS Galveston Laboratory), Scott Nichols (NMFS Pascagoula Laboratory), Phil Goodyear (NMFS Miami Laboratory), John Hoey (National Fishery Institute), Wade Griffin (Texas A&M University), Arvind Shah (University of South Alabama), Robert Francis (University of Washington), and Terry Quinn (University of Alaska).

Vessel Interview Analysis

A total of 19,681 interviews were conducted during 1981. This number has dropped each year, with only 5,431 interviews conducted during 1992 (72% decrease). This number has declined for several reasons including: 1) additional agents were hired during the summer months in the early 1980's to collect interview data during the initial Texas Closure events, 2) as more and more fisheries have come under management plans the agents are required to collect data for each of these fisheries, 3) each interview takes longer to conduct, and 4) high interview refusal rate in some ports.

Historically, most of the interviews have been conducted in Texas (Figure 1). Most of the decline in interviews have occurred in Louisiana. Although most of interviews are taking place in Texas, these interviewed vessels have fished in a variety of locations as seen by number of interviews in different statistical subareas (Figure 2).

Although there has been a decrease in the number of interviews, the average size of the interviewed vessel has not changed to a great extent in most of the states (Figure 3). In other words, the same vessel sizes that were

interviewed in 1981 are still being interviewed in 1992. Only in Mississippi can a drop in average interviewed vessel size be observed in recent years.

Average Days Fished per Trip Analysis

The average days fished during a trip (time with trawls in the water), as determined only from interview data, has increased over the past twelve years (Figure 4). Although this increase is apparent as a yearly composite, it is not true for all statistical subareas (Figure 5). Area 10-12 has experienced the largest increase in days fished per trip in recent years. Also, many of the different port groups in the Gulf of Mexico show very different trends. Vessels interviewed in the Fort Myers area experience the most days fished per trip compared to other Florida ports (Figure 6). Days fished per trip has remained very stable in the Key West area, while an increase has been noted in vessels interviewed from the northern Florida area.

Days fished per trip has increase the most in the Gulf Shores area of Alabama (Figure 7). This increase has been noted during the last two years. All other ports in the Alabama - Mississippi area have vessels that average around 5 days fished per trip.

Days fished per trip in the Louisiana ports is usually around 3 to 4 (Figure 8). The increases noted in the Galliano area in 1990 and in the New Orleans area in 1991 and 1992 should be noted with caution. The number of interviews collected to obtain these values was very low (<20).

The ports of Port Author, Galveston and Freeport have usually lower days fished per trip values when compared with values from Aransas, Port Isabel and Brownsville (Figure 9). Increases where noted in Galveston and Freeport during the 1992 season.

Interviewed CPUE Analysis

Catch per unit effort (CPUE) from the interview data is important since it is used in the calculation to obtain total effort. Although the calculations to obtain effort is done on an individual location and month bases, it is interesting to view average CPUE trends on larger temporal and spatial scales. On the average, CPUE was greatest in 1981, moderate in 1984, 1985, 1986, and 1991, and low in 1982, 1983, 1987, 1988 and 1992 (Figure 10).

On the average, CPUE by area fished has been greatest in area 18-21 during the past few years (Figure 11). A general decrease in CPUE is apparent in both area 1-9 and area 10-12 from 1983 through 1992. When nearshore and offshore CPUE (seaward of the COLREG line) is examined by its two components (nearshore ≤10fm, and offshore >10fm) a difference in trend by

area is apparent. In the nearshore component CPUE has increased in both area 13-17 and area 18-21 in recent years, while CPUE in area 10-12 and area 1-9 has remained quite stable (Figure 12). On the other hand, CPUE in the offshore component shows different trends (Figure 13). All four areas have shown general decreased CPUE values when 1982 values are compared to 1992 values. CPUE values in area 18-21 have remained the most stable through the period, with a high in 1991 (excluding 1981) and a low in 1992. CPUE values in area 13-17 were highest in 1986 (excluding 1981), and then decreasing until 1988. Since that time they have remained quite stable. CPUE values in area 1-9 were also highest in 1986 (excluding 1981), and showed a decreasing trend until 1989. They have remained at about the same level for the past four years.

Calculated Days Fished Analysis

As discussed above, effort is a function of both landings and CPUE from a given location during a particular month. Overall seasonal or annual trends are created through the summation effort values in various locations and months. Effort in the nearshore and offshore zones (seaward of the COLREG line) peaked in 1987 and has remained below that level for the past five years (Figure 14). A general increase has been observed in effort over the past three years. The increase in effort from 1990 to 1991 came from an increase in effort in the offshore component, while the increase in effort from 1991 to 1992 came from an increase in the effort in the nearshore component. Most of the effort in the nearshore component is from area 13-17 (Figure 15). Effort levels in this area during 1992 were almost back to the levels experienced during 1987. Most of the effort in the offshore component is in area 18-21 (Figure 16). Effort in this area peaked in 1987 and has since remained below this level. Area 13-17 has experienced the next highest level in this offshore component, with a downward trend from 1986 through 1990, but an upward trend during the past two years.

Seasonal patterns show that effort in the September through December period is usually around 80,000 days (Figure 17). However, during both 1987 and 1992 the values were above average.

Boat and Vessel Fishing Trip Analysis

Number of trips by vessels and boats in the nearshore and offshore area (seaward of the COLREG line) is shown in Figure 18. The maximum number of trips for both fishing craft types occurred in 1987. Number of trips for vessels have declined since that time, while number of trips for boats have remained at about the same level for the past four year. The greatest number of nearshore and offshore boat trips are in area 13-17, with an increase being noted in area 18-21 during the past few years (Figure 19). The greatest number of nearshore and offshore vessel trips are in area 13-17,

with area 18-21 close behind (Figure 20). Numbers of vessel trips in area 18-21 have shown a slight but steady decline since 1987, while vessel trips in area 13-17 decreased from 1987 to 1990, but have shown a slight increase during the last two years.

Number of nearshore and offshore trips by vessels is quite variable when examined for different ports. When ports from Florida through Mississippi are viewed it can be seen that the greatest number of trips use to be from the Key West area (Figure 21). Trips in this port have declined sharply since that time. An increase in trips was noted in the Pascagoula area in 1990, but has since declined. All six of the port show about the same number of trips in 1992.

Number of nearshore and offshore trips by vessels is greatest in the Louisiana ports (Figure 22). The Houma area has historically had the greatest number of vessel trips, while most of the other ports have very similar numbers, especially in recent years.

Number of vessel trips are plotted in Figure 23 for most of the Texas ports. Port Author has usually had the greatest number, while Aransas has increased to number two in recent years, although both have declined compared to values in 1988. Freeport have shown the greatest decline in number of trips, while Port Isabel, Brownsville and Galveston have remained at near level values for the past few years.

Vessel Data Analysis

The current number of active vessels is between the high value contained in the VOUF and the low number obtained in the landings file. The differences in number of vessels shown in the two files is shown in Figure 24. It is interesting to note the decline in vessels from the VOUF in recent years, while the number in the landings file have remained quite stable.

Number of unique vessels landings at various ports around the Gulf of Mexico have many different patterns. When ports from Florida through Mississippi are viewed, it is apparent that Pascagoula has the largest number of unique vessels (Figure 25). Bayou LaBatre had the greatest number through the early 1980's, but has decreased to second during the last few years.

With regards to ports in Louisiana, Houma has the greatest number (Figure 26). Houma has remained the highest since 1983, while the Vermillion area is second. Increases in recent years are shown in the Plaquemines area, and Cameron.

Two different levels of vessel active can be seen in the six graphed Texas ports (Figure 27). The number of vessels landing in the ports of Galveston, Port Isabel, and Brownsville is low (about 200), but has remained quite stable for many years. The number of vessels landing in the ports of Aransas, Port Author and Freeport, is at the 400 vessel level, and has also remained quite stable in recent years.

Summary

Each of the indicators of effort mentioned above generally show the same trends with regards to overall effort in the nearshore and offshore shrimp fishery in the Gulf of Mexico. Days fished (actual period of time with trawls in the water) is the indicator of shrimp effort most closely related to F, since it depicts pressure on the stocks. This effort value peaked in 1987, dropped in 1988, but has shown a slight increase each of the past three years. This overall increase has not occurred everywhere, but the decreases in some areas are simply less than the increases experienced in other areas. The interviewed CPUE values, with their overall decreasing trend, lend support to the estimated days fished value.

The total number of nearshore and offshore trips peaked in 1987, dropped in 1988, and has remained near or slightly below that same level of the past several years. Although the trips have remained at nearly the same level, the average interviewed value of days fishing per trip has shown an increase. This increase has not occurred at all ports, but most show the increased trend. This increase in days fishing per trip, with the nearly stable level in total number of trips also lends support to the estimated days fished value. There is no indication, that even with the decrease in total number of interviews, that a different type of vessel is being interviewed presently than was interviewed in the early 1980's. Average length of interviewed vessels have not shown any major shifts (i.e., different sized vessels being interviewed in 1981 than in 1992).

Even number of vessels in the fishery, which is the least complex method to calculate effort, shows number have dropped in the VOUF, but have remained more stable in the landings file.

It should be remembered that when shrimp effort data is used in direct population or impact analysis, effort is partitioned into different components and not used as an overall annual number. For example, when the brown shrimp stock assessment is under taken, only the brown shrimp component of effort in the various location cells is used in the calculations.

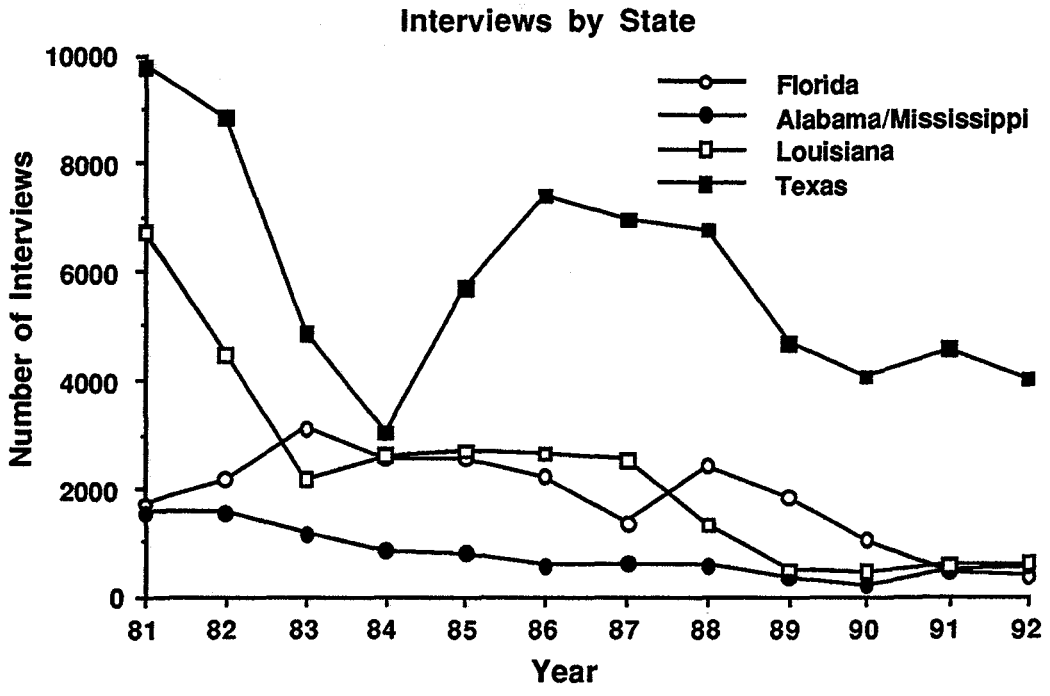

Figure 1. Number of dockside interviews grouped by state.

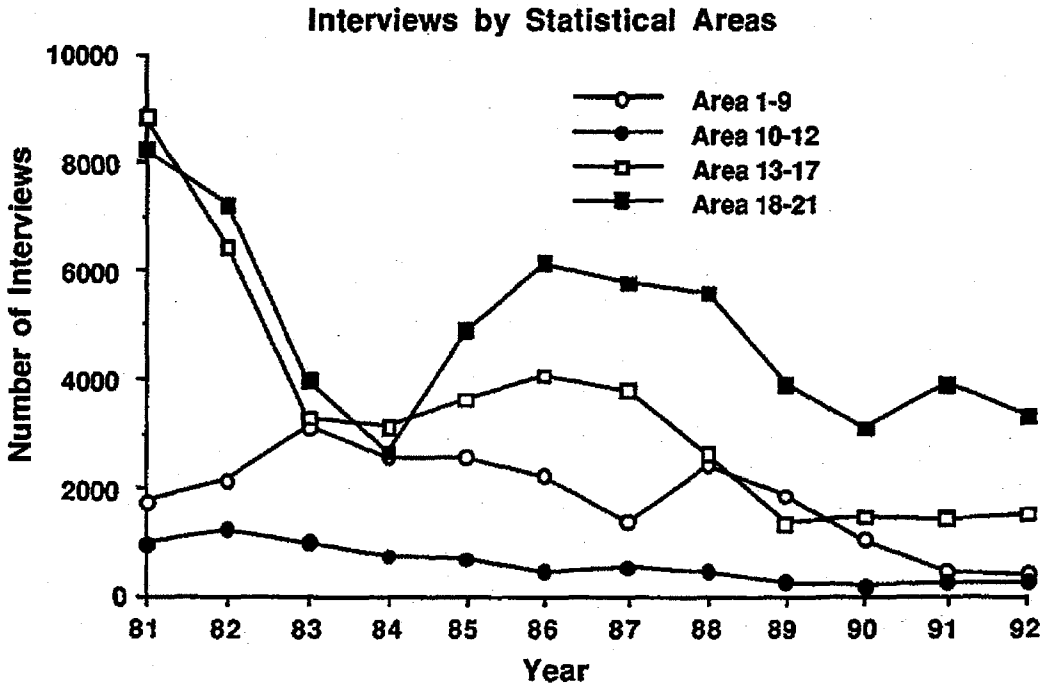

Figure 2. Number of dockside interviews grouped by area fished.

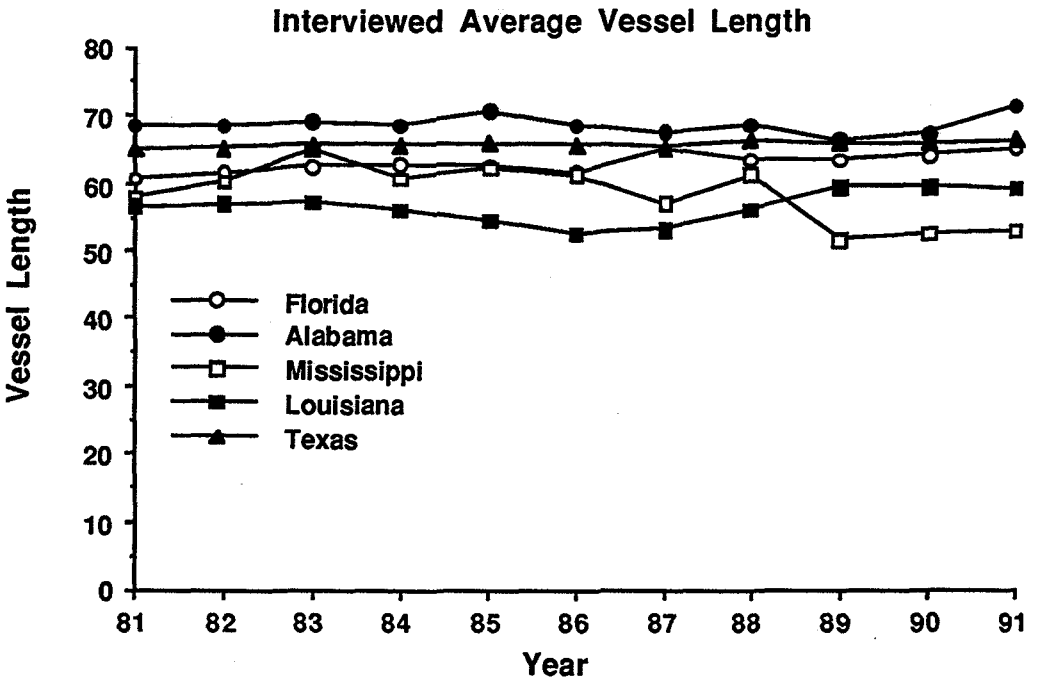

Figure 3. Average length of vessels used during dockside interviews.

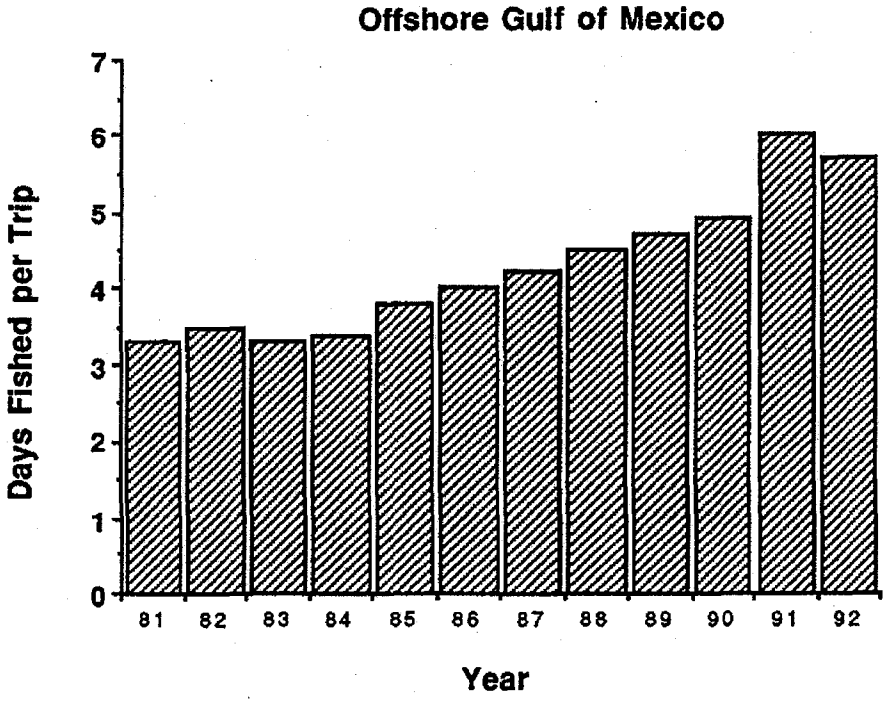

Figure 4. Average days fished per trip in offshore waters.

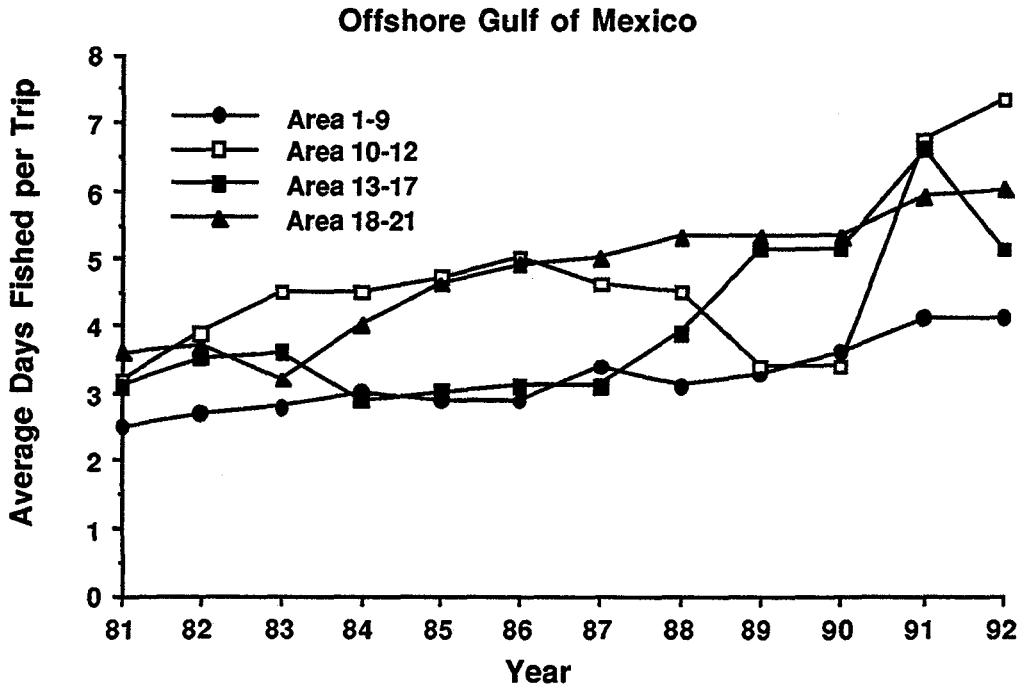

Figure 5. Average days fished per trip grouped by statistical areas.

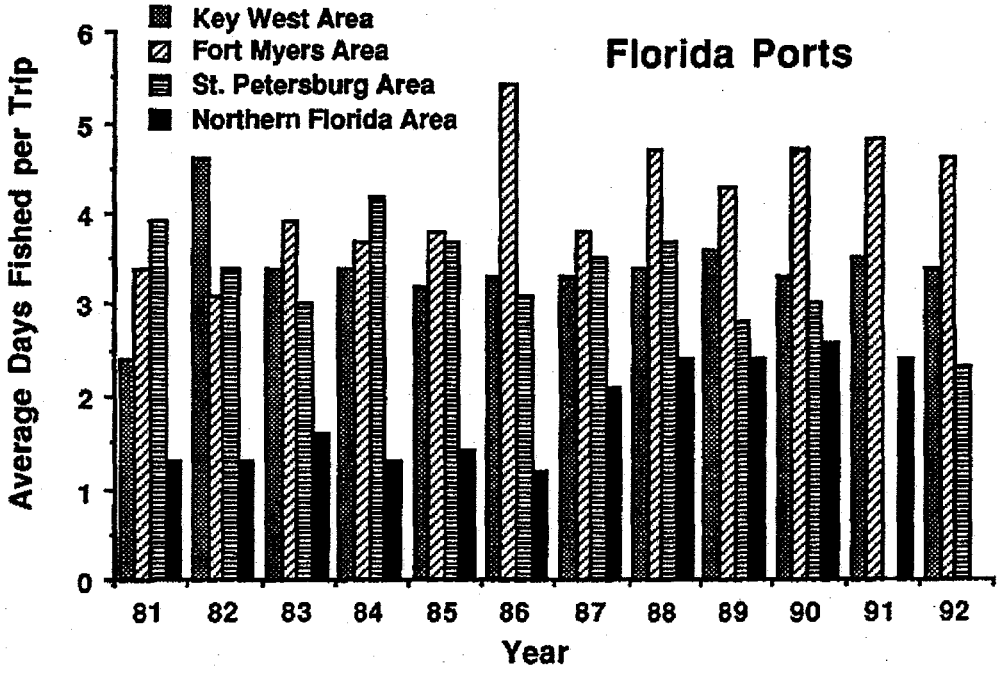

Figure 6. Average days fished per trip grouped by port of landing.

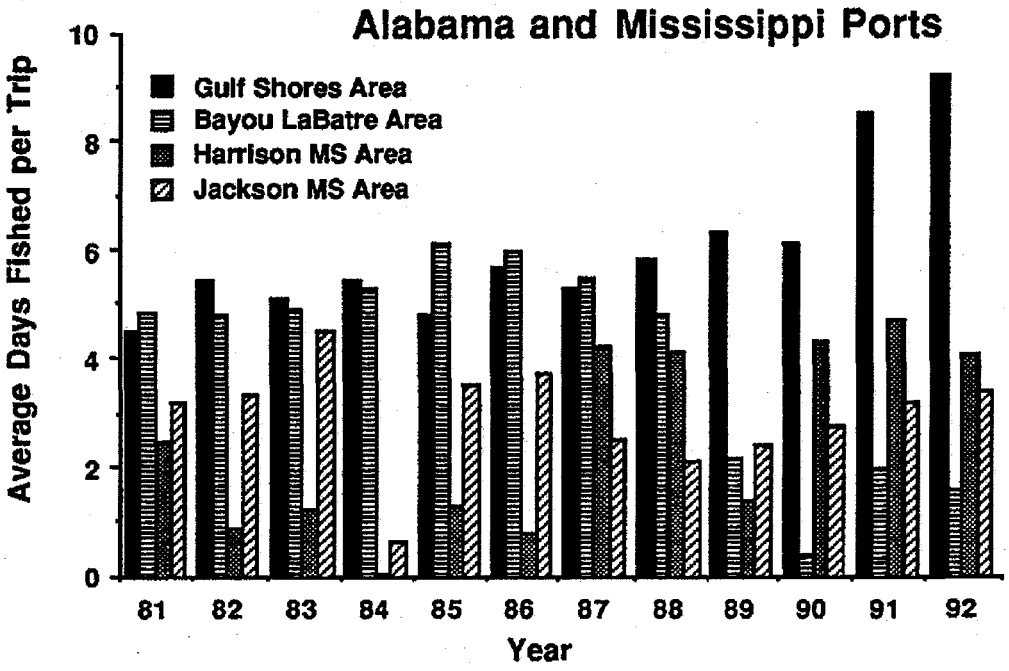

Figure 7. Average days fished per trip grouped by port of landing.

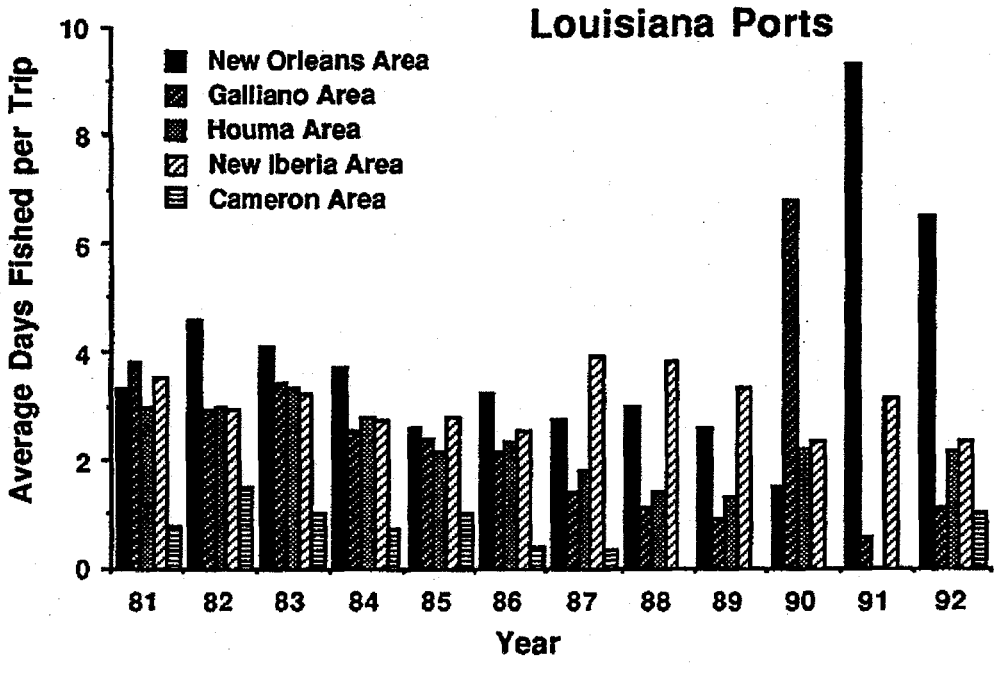

Figure 8. Average days fished per trip grouped by port of landing.

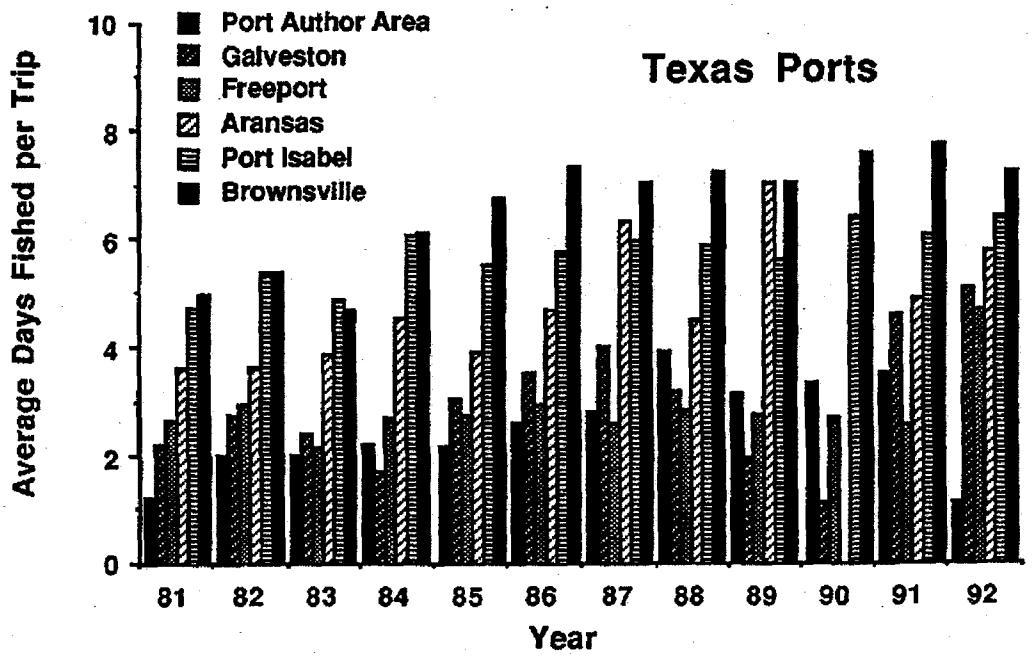

Figure 9. Average days fished per trip grouped by port of landing.

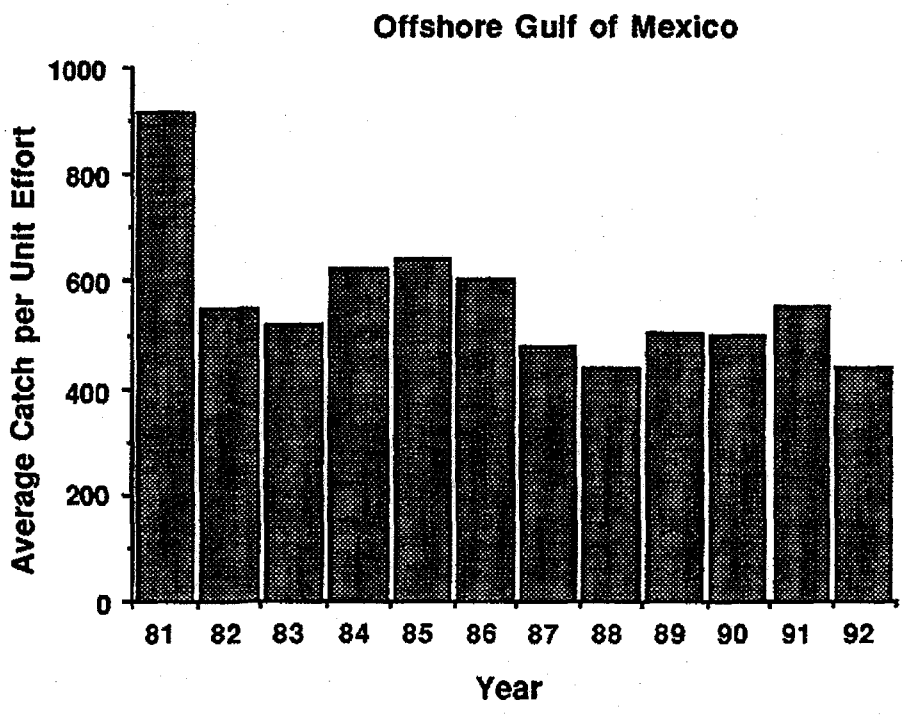

Figure 10. Average catch per unit effort in offshore waters.

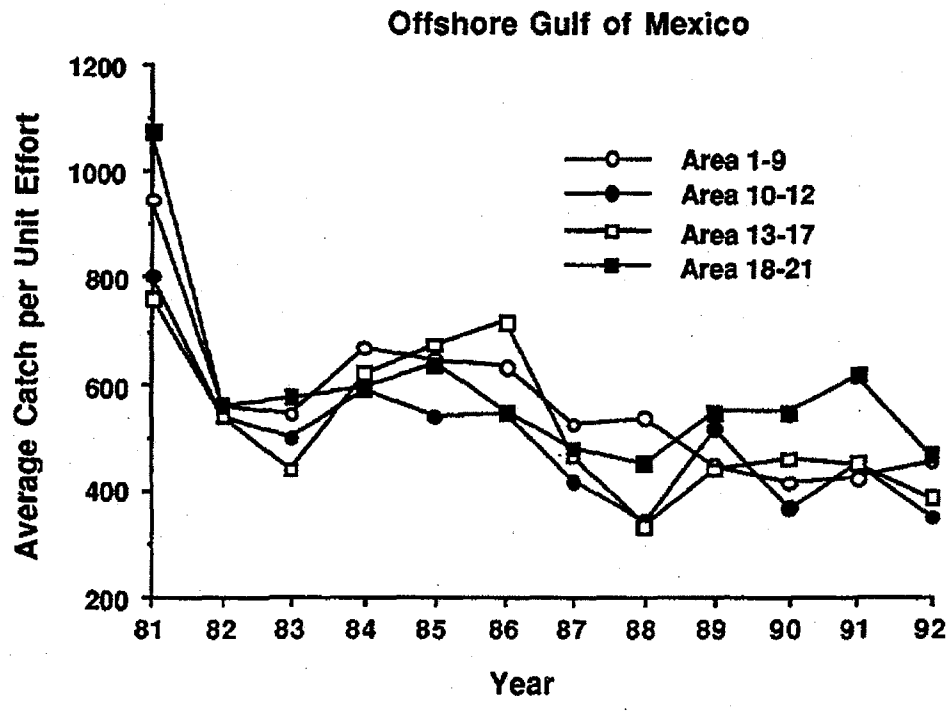

Figure 11. Average catch per unit effort grouped by statistical areas.

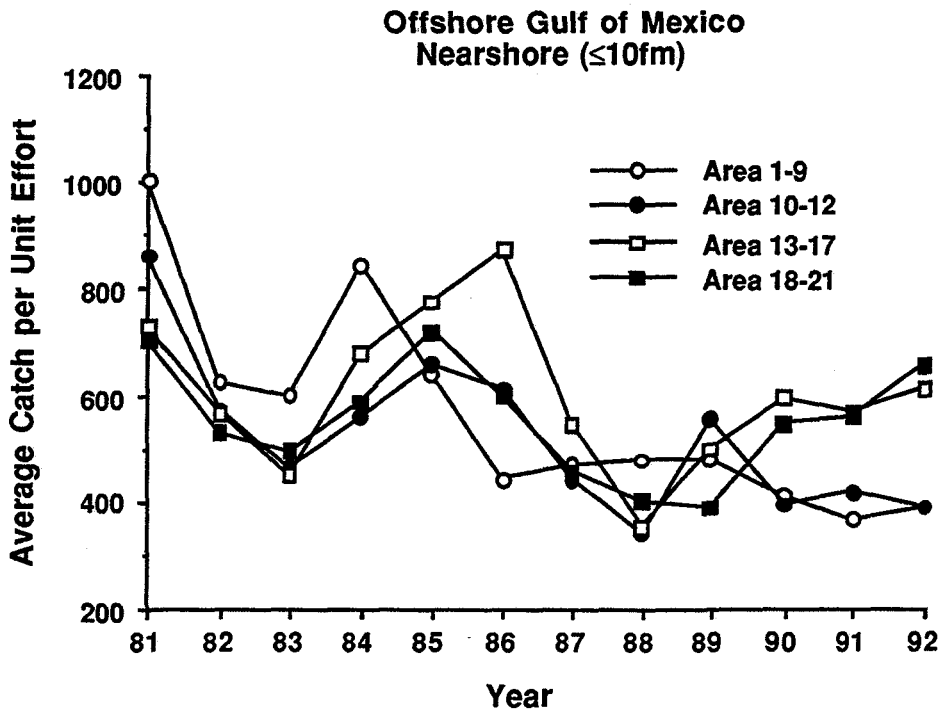

Figure 12. Average catch per unit effort grouped by nearshore zone in statistical areas.

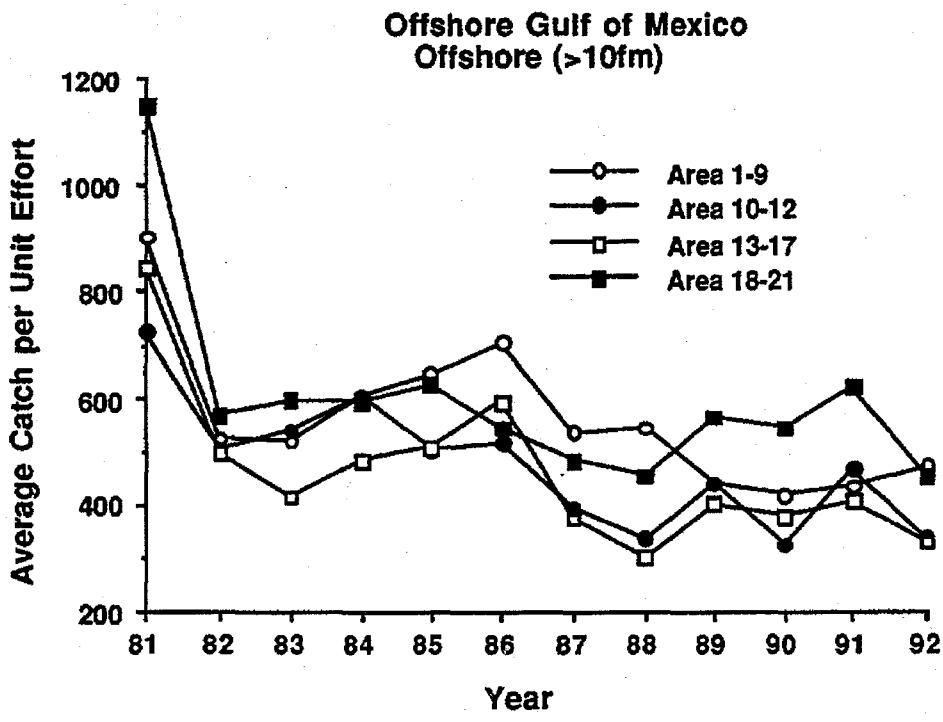

Figure 13. Average catch per unit effort grouped by offshore zone in statistical areas.

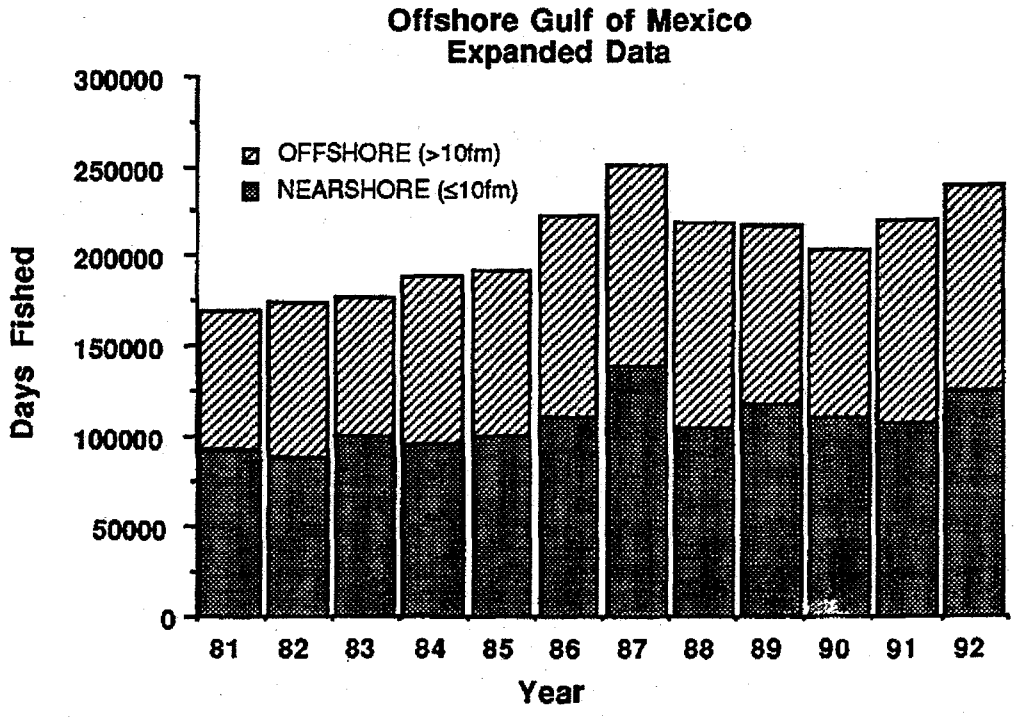

Figure 14. Nearshore (≤10fm) and offshore (>10fm) shrimping effort in Gulf of Mexico.

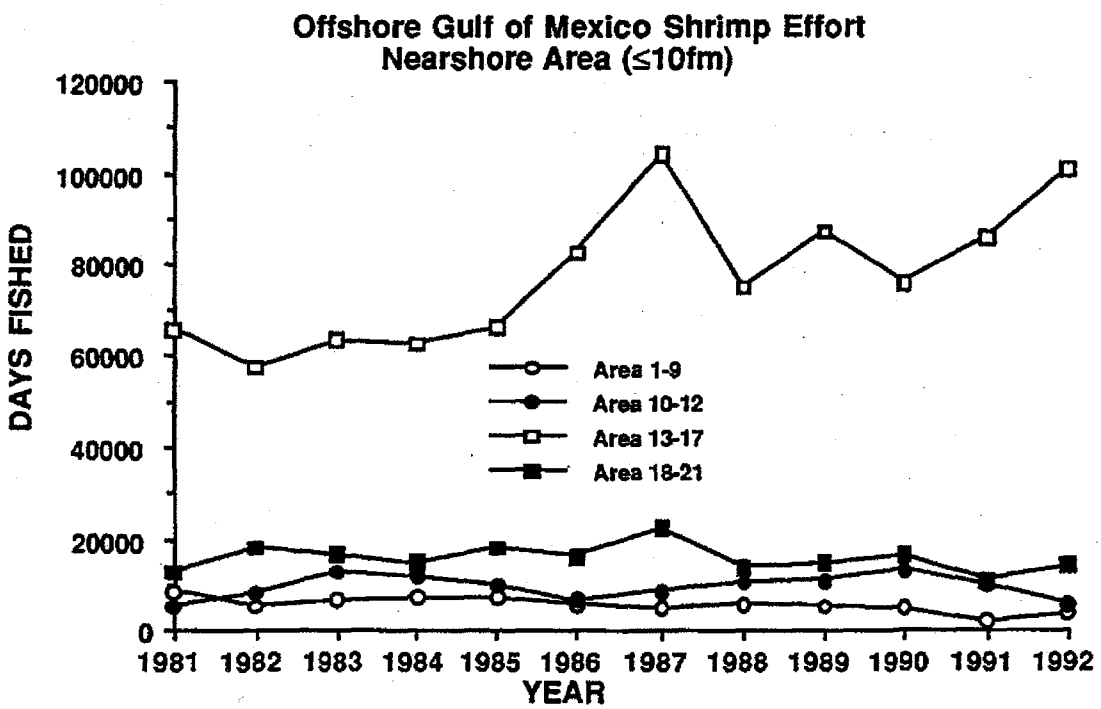

Figure 15. Nearshore (≤10fm) shrimping effort grouped by statistical areas.

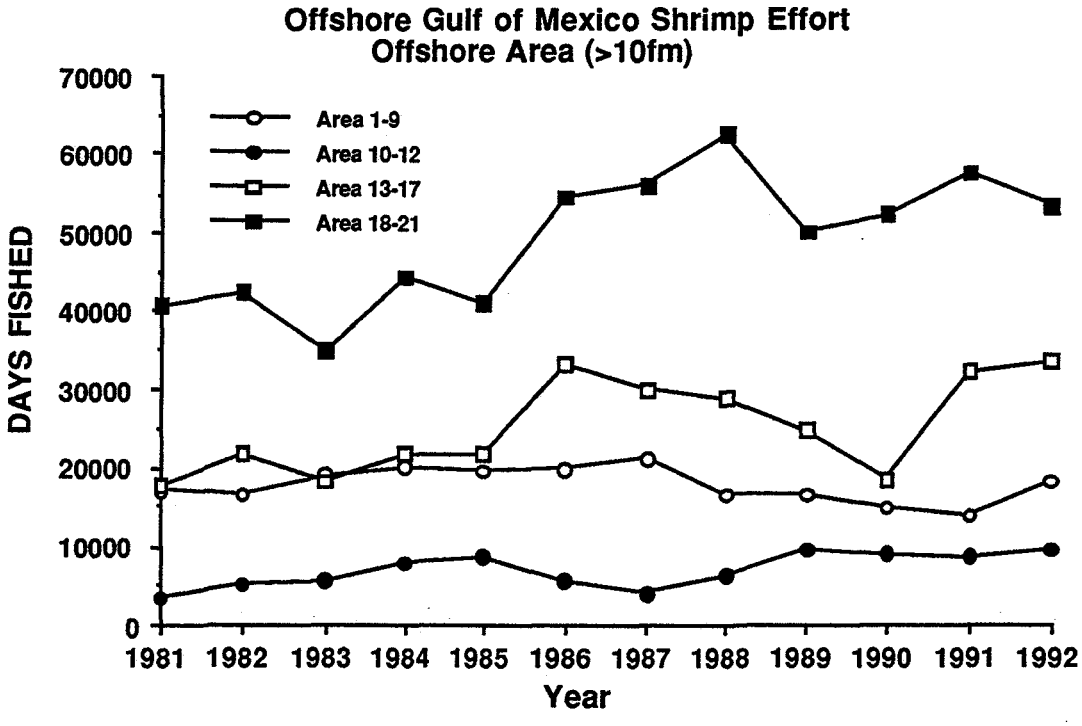

Figure 16. Offshore (≤10fm) shrimping effort grouped by statistical areas.

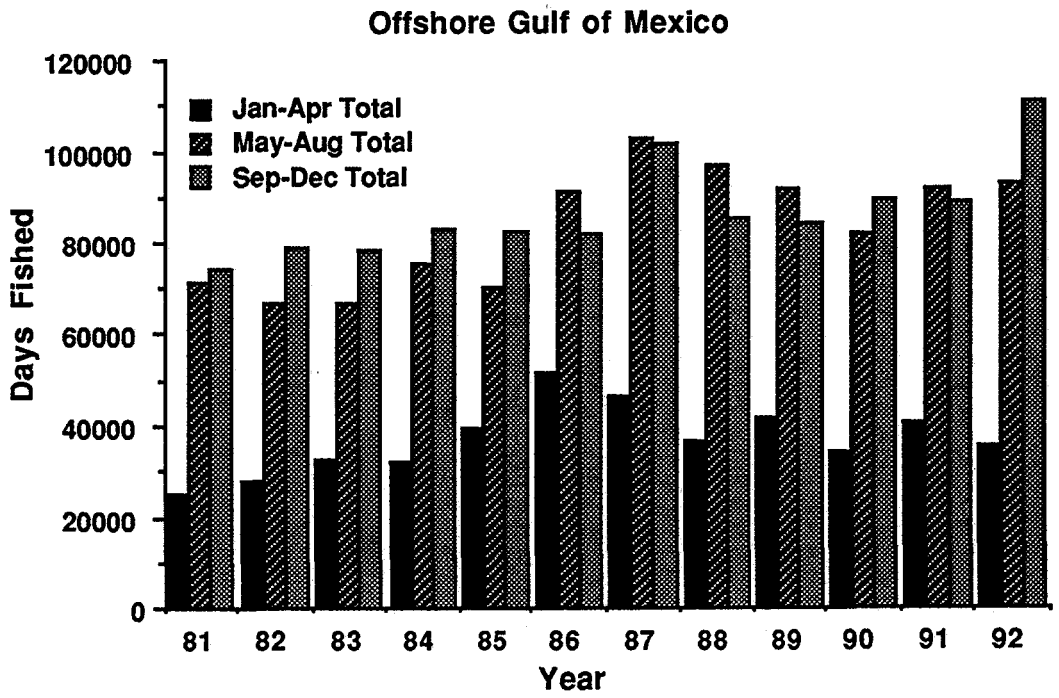

Figure 17. Nearshore (≤10fm) and offshore (>10fm) shrimping effort grouped by season.

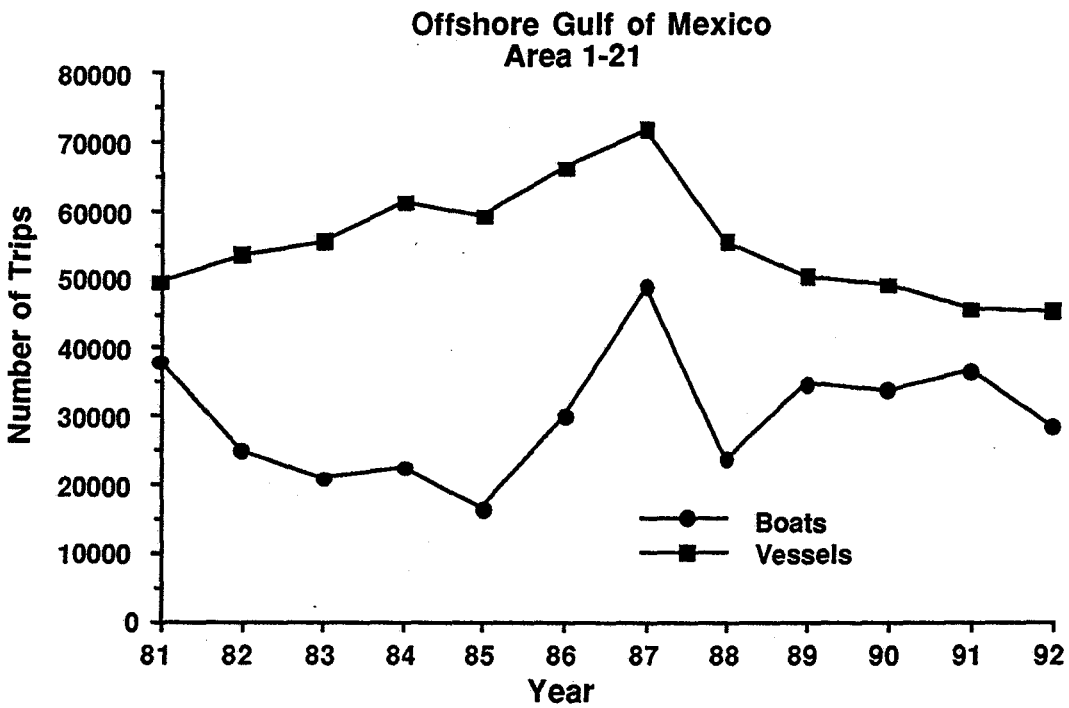

Figure 18. Number of offshore trips by boats and vessels in Gulf of Mexico.

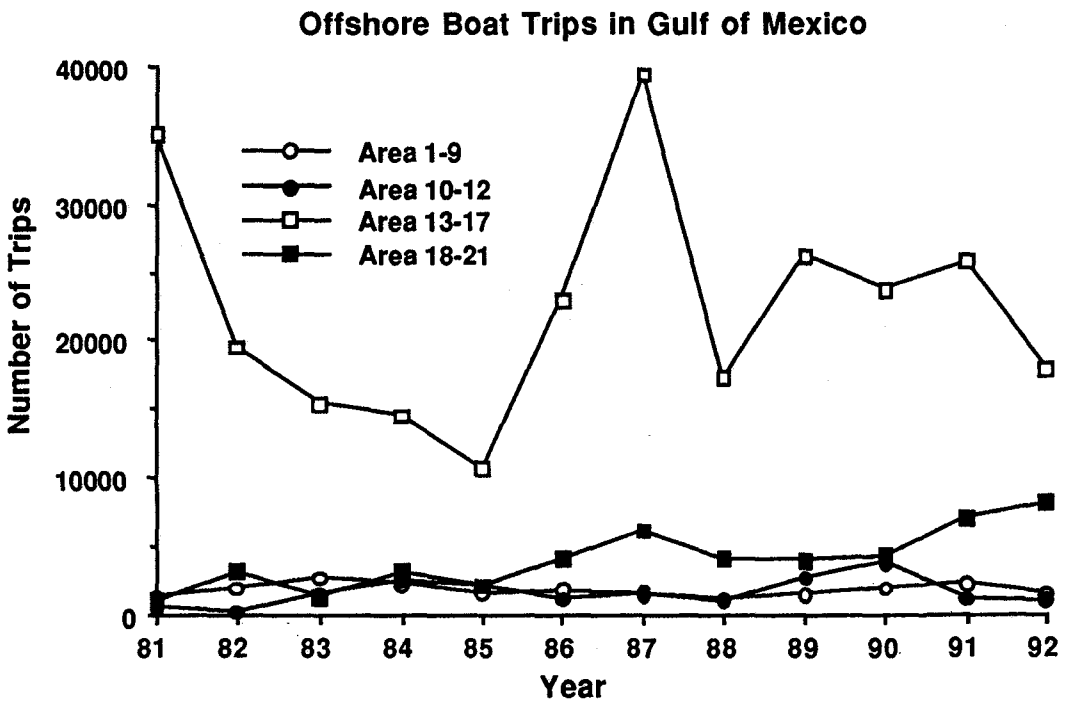

Figure 19. Number of offshore trips by boats grouped by subarea.

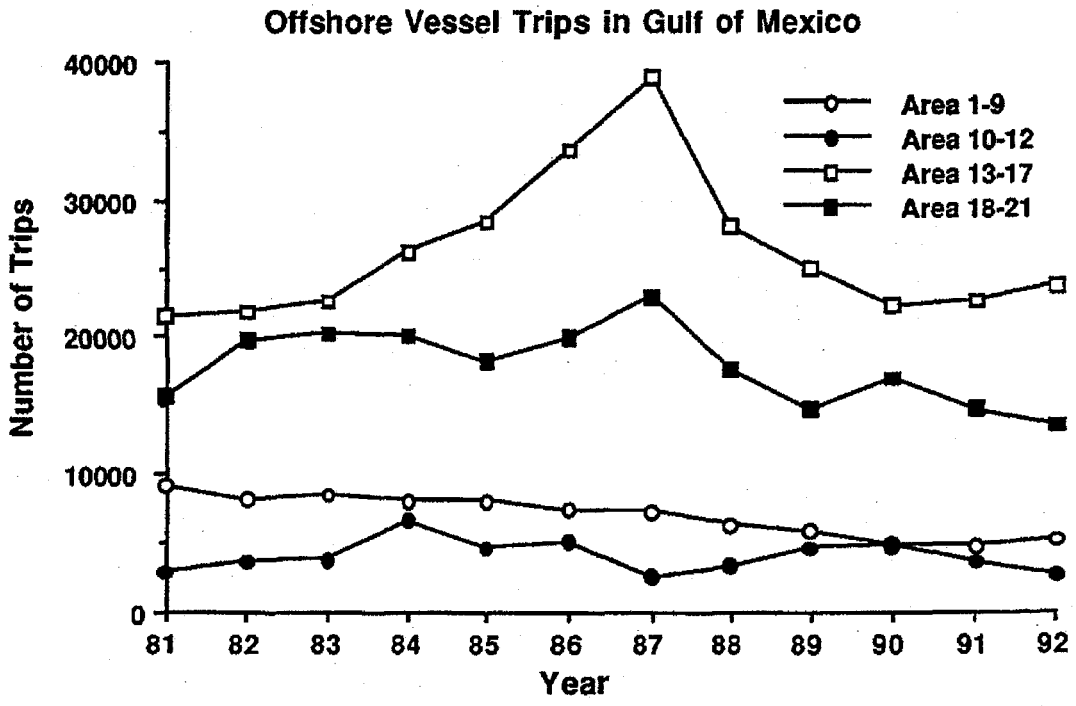

Figure 20. Number of offshore trips by vessels grouped by subarea.

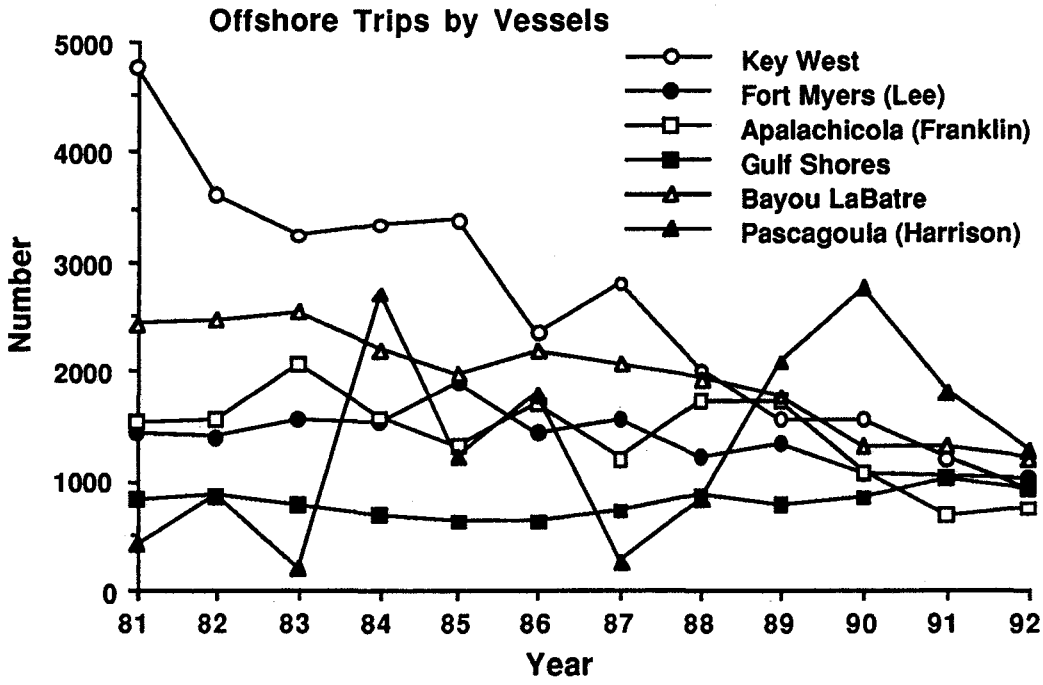

Figure 21. Number of offshore trips by vessels grouped by port of landing.

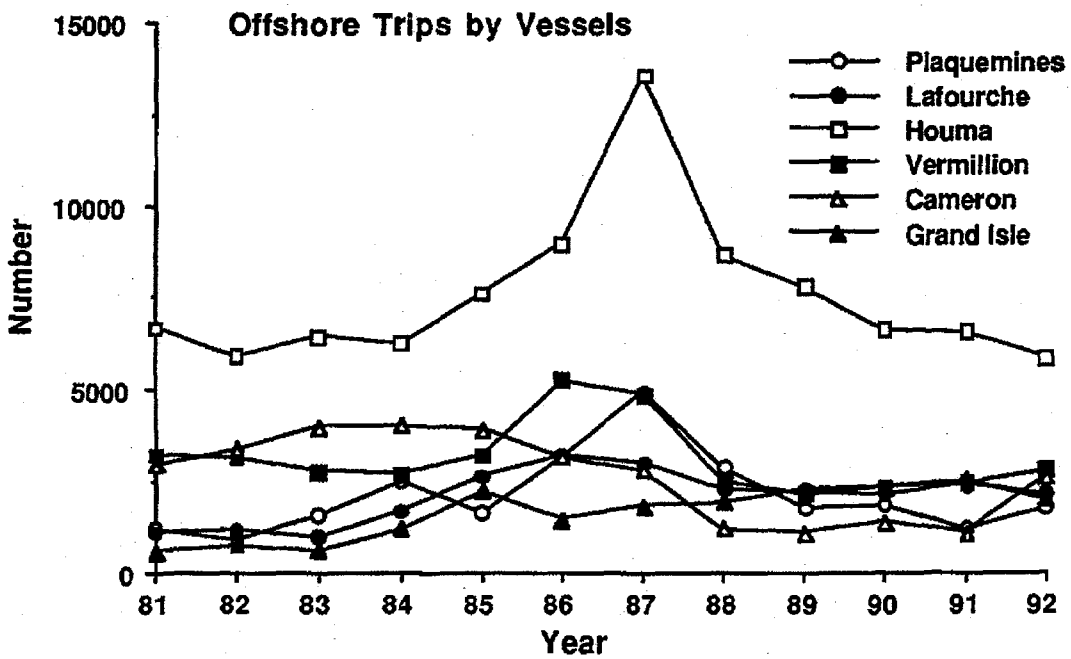

Figure 22. Number of offshore trips by vessels grouped by port of landing.

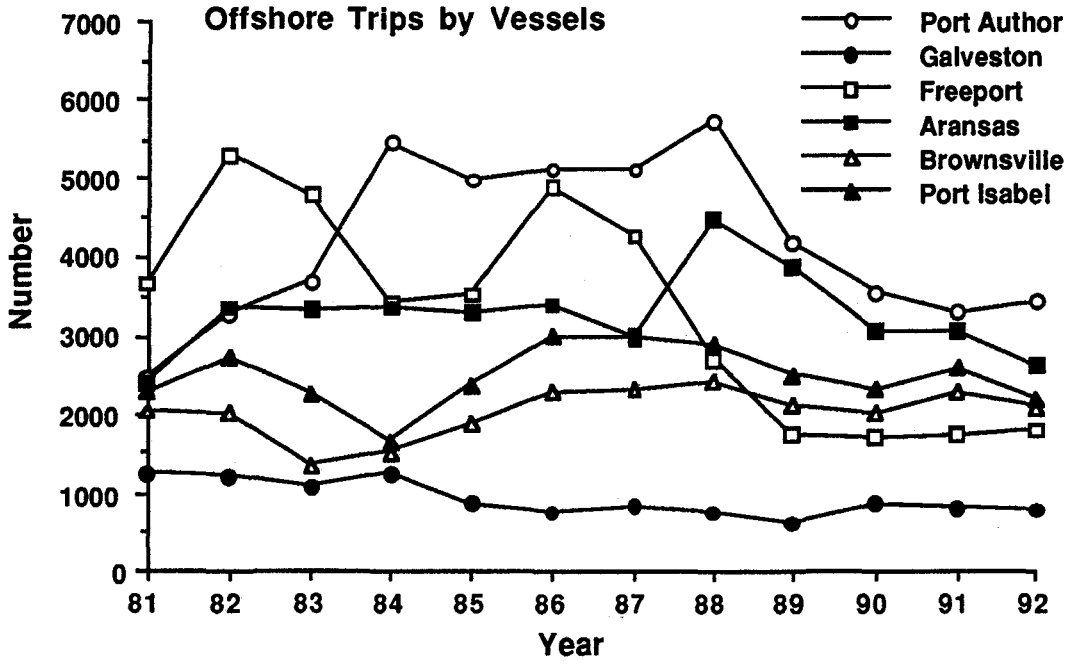

Figure 23. Number of offshore trips by vessels grouped by port of landing.

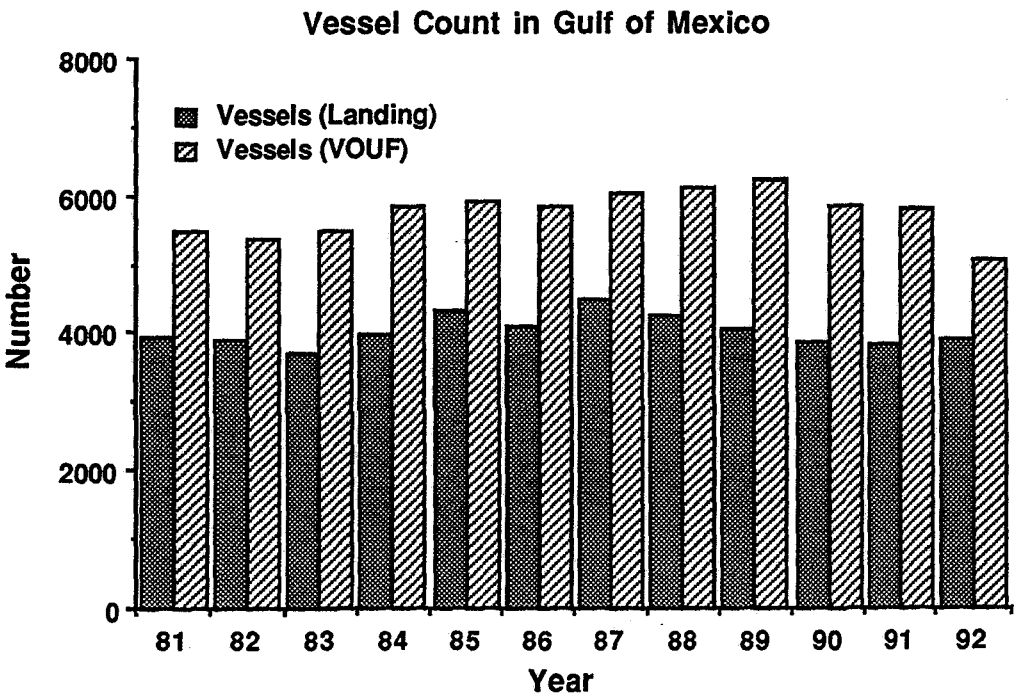

Figure 24. Vessel count in Gulf of Mexico by file type.

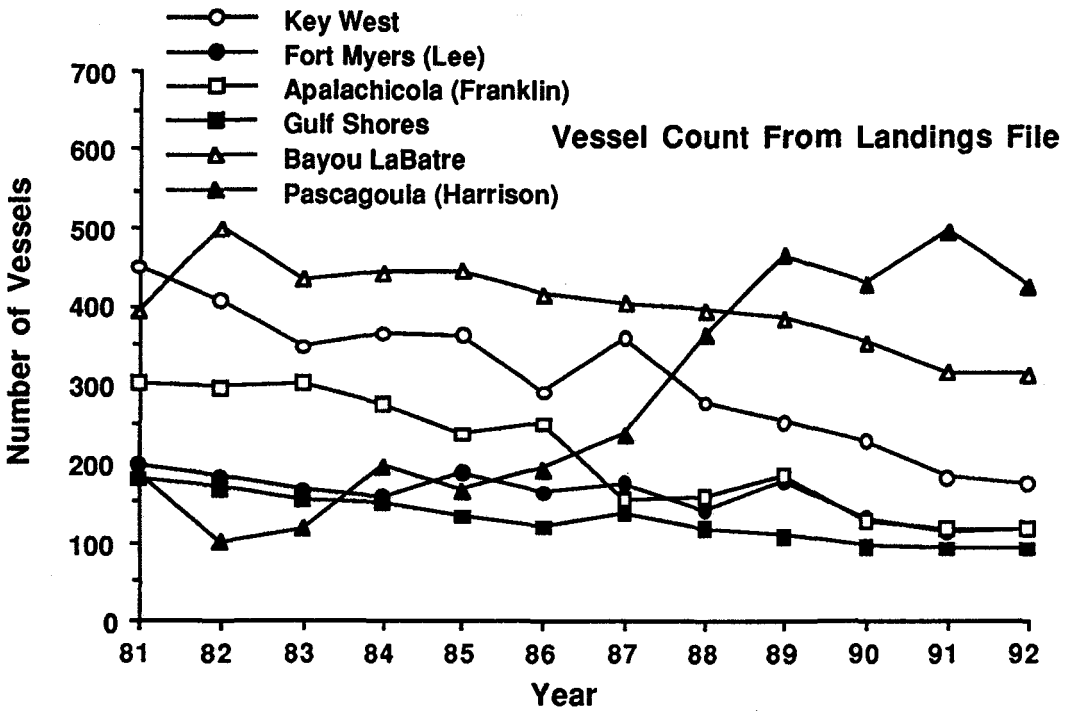

Figure 25. Vessel count in landings file grouped by port of landing.

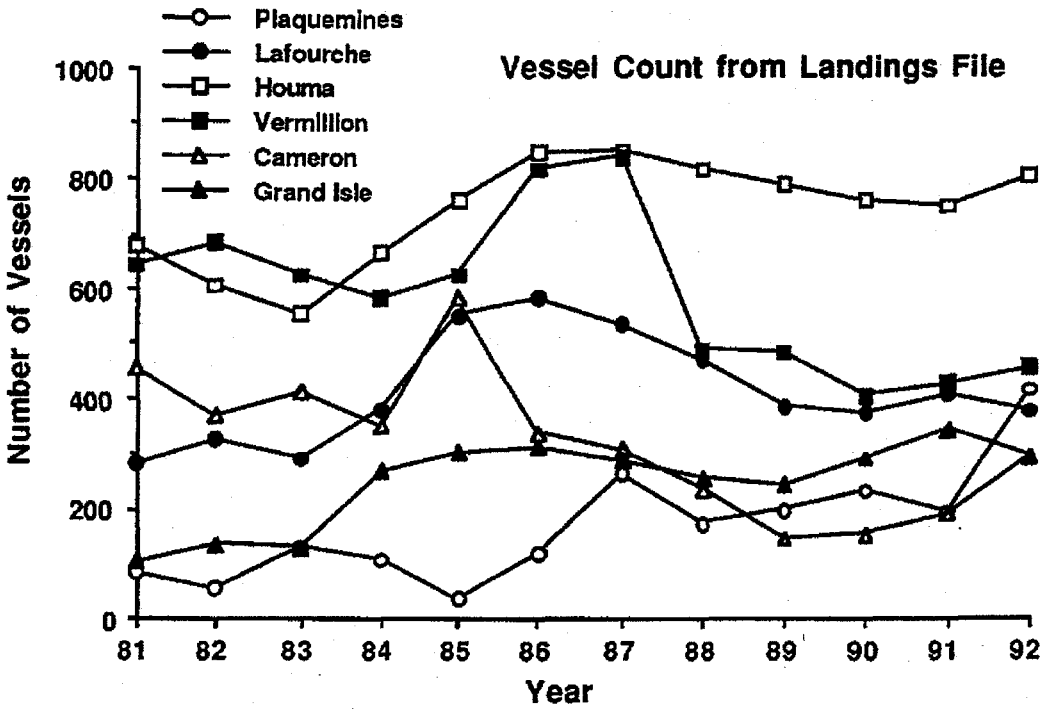

Figure 26. Vessel count in landings file grouped by port of landing.

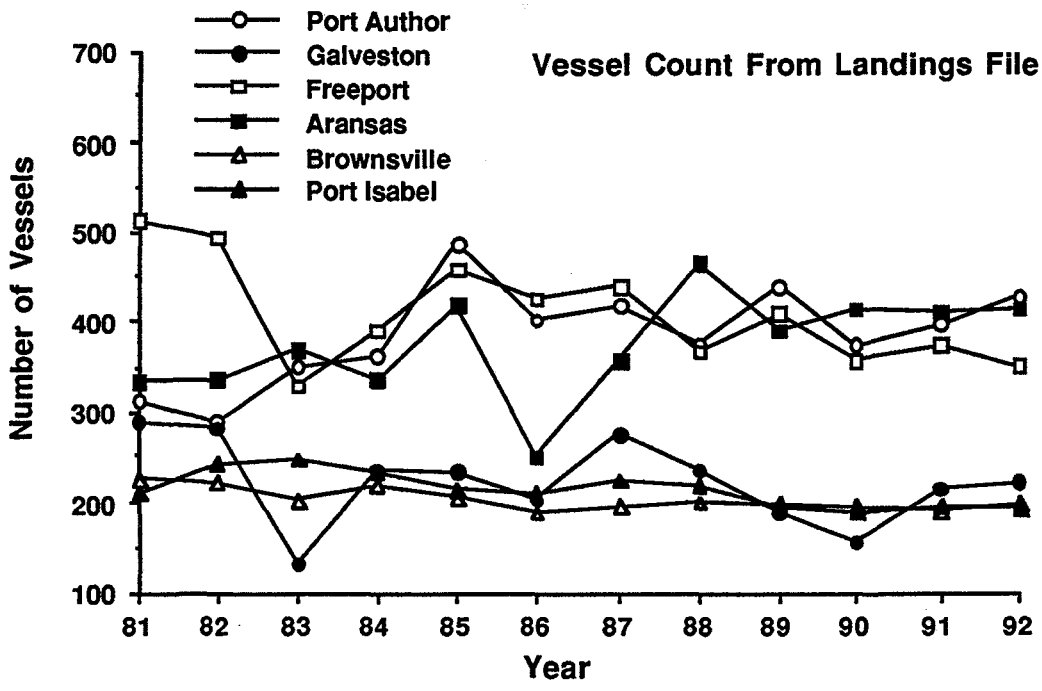

Figure 27. Vessel count in landings file grouped by port of landing.