

## Shrimp Fleet Mobility in Relation to the 1981 Texas Closure

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### Introduction

The Gulf of Mexico shrimp fleet consists of approximately 5,000 boats (craft less than 5 net tons) and 3,500 vessels (craft over 5 net tons) (NOAA, 1980). Boats generally fish in inside waters, and their fishing activities and landing ports are limited geographically. Vessels, however, generally fish offshore and have considerably greater mobility. Many (but not all) vessels in the course of a year will fish and land their catch in widely different parts of the Gulf. Operators change fishing grounds in response to the unique seasonal abundance patterns of shrimp in different areas and change landing ports to maintain an acceptable ratio between fishing time and transit time to and from the fishing grounds.

In 1981, state and federally managed waters off Texas were closed to brown shrimp fishing from 22 May through 15 July. Because coastal waters offshore of other states along the Gulf of Mexico were not closed to fishing at this time, concern was expressed that vessels normally fishing off Texas during this period would fish in these other areas. It was feared that this fishing might adversely affect catch rates or overload shoreside processing facilities in these areas.

This study was undertaken to provide information on the seasonal fishing activities of the Gulf shrimp fleet. The study describes the mobility of western Gulf shrimp vessels, compares fleet mobility in 1981 with that in earlier years, and relates the results to the 1981 closure of the Texas brown shrimp fishery. Companion studies in this series address the effect of this

fishing activity on catch rates and utilization of shoreside facilities.

### Methods

Categories to describe the mobility of the shrimp fleet were established based on geographical range of operations of the vessels, and the amount of activity in these categories was enumerated.

Data on the Gulf of Mexico shrimp fishery have been collected by the National Marine Fisheries Service (NMFS) since the late 1950's. Statistical agents obtain information from dealer records or by interview with vessel captains. Vessel identification, date of landing, port of landing, pounds landed, and statistical area fished are recorded for most vessel trips. Records for some smaller ports visited less frequently by agents and records obtained from secondary dealers and processors are generally consolidated and may not contain information on individual vessels or individual trips. Consequently, NMFS data, although not a total census of all the landed catch, provide an excellent description of the general shrimp fishing patterns in the Gulf.

Records utilized in this study were those containing a vessel identification number and recorded as landed at ports in Alabama, Mississippi, Louisiana, and Texas in May through August 1981 and June through August 1980 and 1970-74. Only landings by

identified vessels making their catches in offshore statistical areas were included, thus excluding landings by boats and catches made in bays and inside waters.

The fishing patterns portrayed by these landings records were assembled and compared between months and years. The data were arrayed by year, month, location of landing, and location of catch for May, June, July, August, and June-August 1981; June, July, August, and June-August 1980; and June-August 1970-74. Landing location was summarized geographically by category: Alabama/Mississippi (AL/MS), Louisiana (LA), Texas (TX), and combinations (indicated by hyphenated categories) of these states. Alabama and Mississippi were combined in one category because of their relatively short coastlines. Landings of vessels at Florida ports were not included in the analysis because data for 1980 were not available. Catch location was summarized by the following statistical areas: Areas 1-9 (off Florida), areas 10-12 (off Alabama, Mississippi, and Louisiana east of the Mississippi River), areas 13-16 (off Louisiana west of the Mississippi River), area 17 (an area divided by the seaward extension of the Louisiana-Texas border), and areas 18-21 (off Texas). Areas 18-21 and the Texas portion of area 17 were included in the 22 May-15 July closure. Each vessel was categorized according to its landing locations (in one state or in a combination of states) during a given time period. For example, vessels were grouped together that landed only in Texas, only in Louisiana, in both Louisiana and Texas (designated Louisiana-Texas),

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etc. These categories were considered more useful in describing vessel mobility than either home port (i.e., port of registration) or "home" designations. Home port designations were not used because 1) some vessels had home ports not in the Gulf of Mexico geographical area, 2) vessels do not necessarily spend a major portion of their fishing time in waters adjacent to their home port, and 3) home port designations were unavailable for some vessels. "Home" designations were not used to categorize vessels because there is no generally accepted definition of what constitutes the "home" of a vessel. For example, a "Texas" vessel may be defined variously as a vessel that lands only in Texas, that lands at any time in Texas, or that lands a designated proportion of its trips in Texas.

Activity in the various categories was evaluated by calculating a percentage value for each category based on total number of vessels, total number of trips, or total number of pounds landed. These percentage values were then compared, either subjectively or statistically, as described in the next section, to interpret the impact of the closure regulation on vessel activity and fleet mobility.

### Results

Fishing activities of the western Gulf shrimp fleet during each month from May through August 1981 are shown in Figure 1. First, activity for each state category was expressed as a percentage of the total number of vessels participating in the fishery in each month. Thus, in May 1981, 17 percent of the vessels landed in Alabama/Mississippi, 51 percent landed in Louisiana, 30 percent landed in Texas, 0.5 percent landed in Louisiana and Alabama/Mississippi, 1.0 percent landed in Louisiana and Texas, and 0.2 percent landed in Texas and Alabama/Mississippi. Corresponding values for June, July, and August are also shown in Figure 1. These results indicate that in 1981 over 90 percent of the vessels landed in only one state during a month, fewer than 10 percent landed in two states in any month, and no vessels were recorded as landing in three states. The percent-

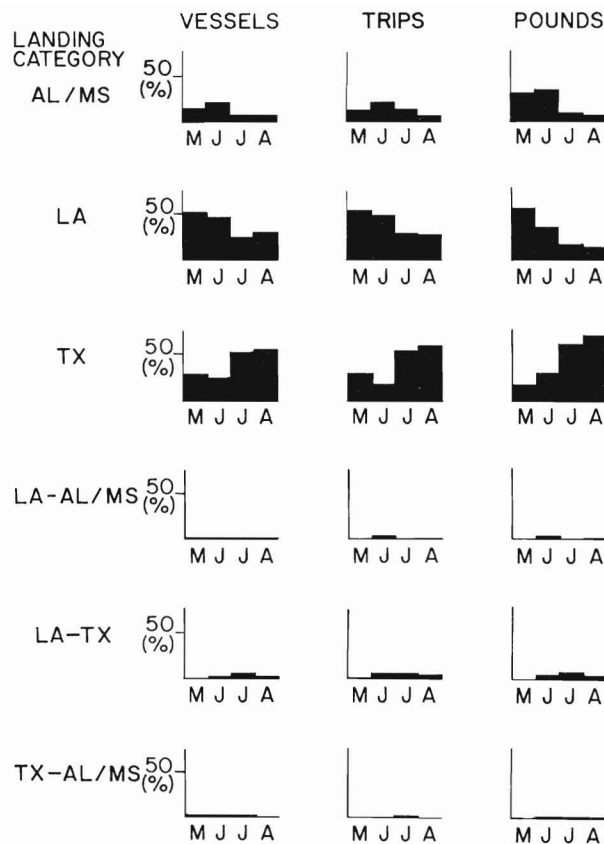


Figure 1.—Distribution of activity of shrimp vessels in the western Gulf of Mexico, May through August 1981, measured as number of vessels operating, number of trips made, and number of pounds landed. Monthly activity is shown for each area landing category (by state or states) as a percentage of total activity for that month.

ages of vessels landing in Alabama/Mississippi and in Louisiana were higher in May and June than in July and August. Conversely, the percentages of vessels landing in Texas were lower in May and June than in July and August. Of the vessels landing in two states in a single month, landings in Louisiana-Texas were most frequent (as high as 7 percent), landings in Louisiana-Alabama/Mississippi were next most frequent (as high as 2 percent), and landings in Texas-Alabama/Mississippi were least frequent (as high as 1.3 percent).

Second, activity was expressed as a percentage of the number of trips completed and the number of pounds land-

ed. These results for each state are also shown in Figure 1. Over 90 percent of the completed trips and over 90 percent of the pounds landed each month were by vessels landing in single states, and less than 10 percent were from vessels operating in two states. Activity at Alabama/Mississippi and Louisiana ports was generally higher in May and June than in July and August, whereas activity at Texas ports was lower in May and June than in July and August. Of the trips and pounds landed in two states in any single month, Louisiana-Texas was the most frequent category. Thus the three measures of activity patterns—vessel, trips, and pounds landed—are comparable.

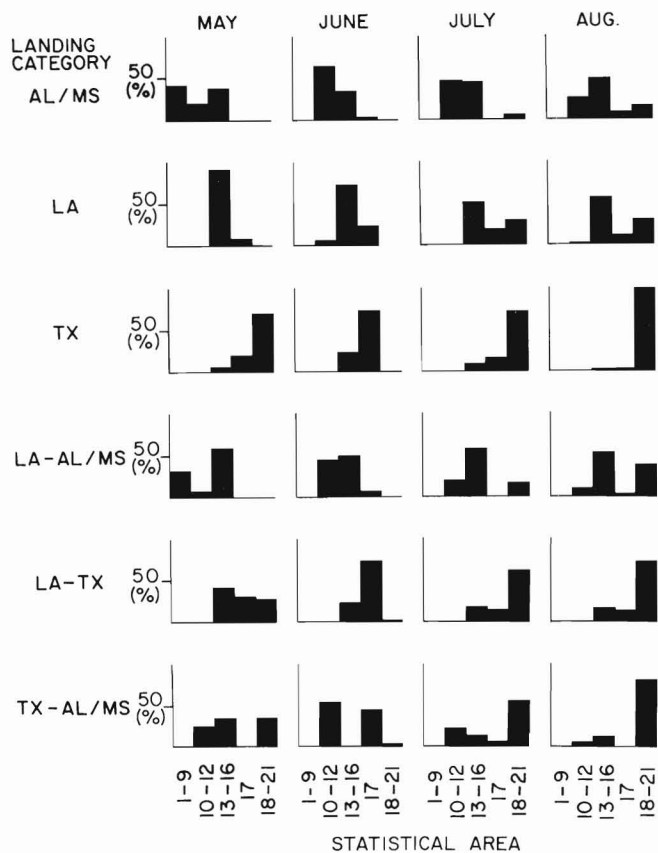


Figure 2.—Distribution of activity of shrimp vessels in the western Gulf of Mexico, May through August 1981, as measured by location of the catch within each area landing category. Activity is shown as catch taken in statistical areas 1-9 (off Florida), 10-12 (off Alabama, Mississippi, and Louisiana east of the Mississippi River), 13-16 (off Louisiana west of the Mississippi River), 17 (off Louisiana-Texas), and 18-21 (off Texas) as a percentage of total catch for that month and area landing category.

Fishing activity patterns in 1981 were further described by comparing the locations of capture with the location of landing (Fig. 2). Vessels landing in Alabama/Mississippi, Louisiana, or Texas fished primarily in the offshore areas of the respective state where they landed and secondarily off an adjacent state. Vessels landing in Alabama/Mississippi fished off Florida (areas 1-9) and Louisiana (areas 13-16) in May, as well as off their own state areas. In later months the fishing activity of vessels landing in Alabama/Mississippi shifted to the west. Vessels landing in Louisiana fished mainly off

that state. They seldom fished off Alabama/Mississippi (areas 10-12), but fished to a greater extent off Texas (areas 18-21) in July and August. Vessels landing in Texas fished mainly off that state in May, to a major extent off Louisiana (areas 13-16) in June and July, but again almost entirely off Texas in August.

Another aspect of fishing activity patterns, month-to-month variation, was examined by comparing 1981 patterns with those in 1980 (Fig. 3). Similarities as well as differences in the two years were apparent. The majority (96-98 percent) of vessels landing in

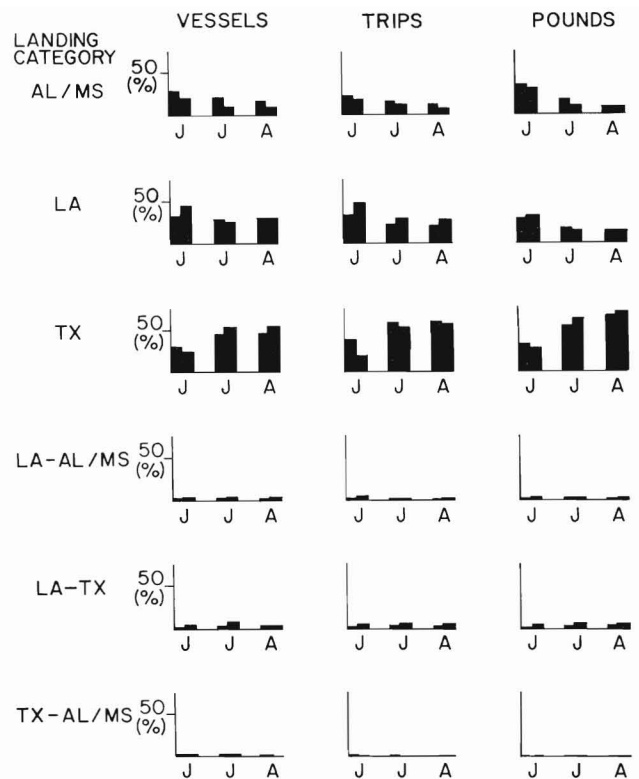


Figure 3.—Distribution of activity of shrimp vessels in the western Gulf of Mexico, June through August 1980 (left bar) and 1981 (right bar), measured as number of vessels operating, number of trips made, and number of pounds landed. Monthly activity is shown for each area landing category (by state or states) as a percentage of total activity for that month.

June, July, or August in both 1980 and 1981 landed in only a single state. Fewer than 5 percent of the vessels landed in more than one state in any month. The percentage of vessels landing in Alabama/Mississippi in 1980 decreased from June to August, although less so than in 1981, and the percentage of vessels landing in Texas increased, but not as much as in 1981. The percentages of vessels landing in more than one state in 1980 (2.2 percent in June, 4.2 percent in July, and 3.5 percent in August) were less than in 1981 (5.5 percent, 9.4 percent, and 4.2 percent, respectively). In both July and

Table 1.—Activity by state(s) of landing of selected shrimp vessels in the western Gulf of Mexico in June through August 1981, 1980, and 1970-74. State categories included were Alabama/Mississippi, Louisiana, and Texas and their combinations. Percentage of vessels landing in the state, percentage of trips, and percentage of pounds landed are shown. Selected vessels are those identified by vessel documentation number; thus, percentages in the table are based on only the identified vessel portion of total fleet operations.

State of operation	1981	1980	1974	1973	1972	1971	1970
	<i>Percentage of vessels</i>						
AL/MS	12.4	19.3	12.9	13.5	14.2	15.8	16.8
LA	30.7	30.5	21.8	19.6	24.1	23.4	23.4
TX	41.4	41.0	47.6	51.6	47.1	40.5	39.5
LA-AL/MS	3.6	3.7	4.8	2.3	3.3	4.3	4.7
LA-TX	9.7	4.4	12.1	10.4	9.2	1.1	12.9
TX-AL/MS	1.8	0.9	1.0	1.9	1.5	1.9	1.5
TX-LA-AL/MS	0.6	0.2	0.5	0.8	0.6	0.8	1.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	<i>Percentage of trips</i>						
AL/MS	10.0	14.5	10.2	13.6	14.2	16.0	15.8
LA	25.9	23.5	14.8	11.8	18.0	17.8	15.6
TX	43.0	50.5	55.7	59.0	52.1	43.3	33.0
LA-AL/MS	4.1	4.0	2.1	2.3	3.4	5.0	11.6
LA-TX	14.0	6.3	12.9	10.2	9.7	14.2	11.6
TX-AL/MS	2.1	0.9	1.8	2.1	1.9	2.7	1.8
TX-LA-AL/MS	0.9	0.3	0.7	1.0	0.6	1.0	1.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	<i>Percentage of pounds landed</i>						
AL/MS	10.5	16.0	12.5	10.5	12.6	15.5	13.9
LA	15.7	17.7	12.2	9.8	15.0	17.4	16.7
TX	53.1	54.0	54.9	62.8	55.9	40.4	42.7
LA-AL/MS	4.4	4.9	4.7	2.3	3.9	6.2	5.9
LA-TX	13.5	5.4	13.4	11.2	10.0	16.2	16.7
TX-AL/MS	2.0	1.5	1.4	2.4	1.9	3.1	2.2
TX-LA-AL/MS	0.8	0.4	0.9	0.9	0.8	1.1	2.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 2.—Comparison of activity by state(s) of landing of selected shrimp vessels in the Gulf of Mexico in June through August 1980-81. Average logarithm of the percentage distribution ( $\ln P$ ), standard deviation ( $\hat{\sigma}$ ), and pooled standard deviation ( $\tilde{\sigma}$ ) for vessels, trips, and pounds are shown for 1970-74. Percentage values for 1981 and 1980 ( $P_{81}/P_{80}$ ), and the normalized variable  $z$  are discussed in the text.

State of operation	$\ln P$	$\hat{\sigma}$	$\tilde{\sigma}$	1981	1980	$P_{81}/P_{80}$	$z$
	<i>Number of vessels</i>						
AL/MS	2.6789	0.1097	0.1680	12.4	19.3	0.6425	-1.86*
LA	3.1090	0.0833	0.1833	30.7	30.5	1.0066	0.025
TX	3.8072	0.1144	0.1611	41.4	41.0	1.0098	0.043
LA-AL/MS	1.3203	0.3106	0.3847	3.6	3.7	0.9730	-0.050
LA-TX	2.4368	0.1521	0.1868	9.7	4.4	2.2045	2.99**
TX-AL/MS	0.4189	0.2633	0.2448	1.8	0.9	2.0000	2.00**
TX-LA-AL/MS	-0.2776	0.3621	0.3772	0.6	0.2	3.0000	2.06**
	<i>Total trips</i>						
AL/MS	2.6595	0.2276	0.1680	10.0	14.5	0.6896	-1.56
LA	2.7711	0.1915	0.1833	25.9	23.5	1.1021	0.375
TX	3.8982	0.1708	0.1611	43.0	50.5	0.8515	-0.706
LA-AL/MS	1.2189	0.4323	0.3847	4.1	4.0	1.0250	0.045
LA-TX	2.4859	0.1766	0.1868	14.0	6.3	2.2222	3.02**
TX-AL/MS	0.7506	0.1571	0.2448	2.1	0.9	2.3333	2.45**
TX-LA-AL/MS	0.0673	0.4022	0.3772	0.9	0.3	3.0000	2.06**
	<i>Pounds landed</i>						
AL/MS	2.5567	0.1442	0.1680	10.5	16.0	0.6562	-1.7732*
LA	2.6327	0.2393	0.1833	15.7	17.7	0.8870	-0.462
TX	3.9244	0.1889	0.1611	53.1	54.0	0.9833	-0.074
LA-AL/MS	1.4682	0.4008	0.3847	4.4	4.9	0.8980	-0.198
LA-TX	2.5828	0.2244	0.1868	13.5	5.4	2.5000	3.47**
TX-AL/MS	0.7547	0.2938	0.2448	2.0	1.5	1.3333	0.831
TX-LA-AL/MS	0.0709	0.3662	0.3772	0.8	0.4	2.0000	1.30

\*Significant at 0.10 level.

\*\*Significant at 0.05 level.

August 1980 a few vessels reported landings in three states (not shown in Figure 3), whereas in 1981 no vessel was reported to have landed in three states in any single month from June through August. Similarities and differences in fishing activity between 1980 and 1981 that were indicated by number of vessels reported were also indicated by trips completed and pounds landed.

A further comparison between 1981 and 1980 was made by combining records for June, July, and August for each of these years and for 1970-74 (Table 1). Records for 1975-79 were not collected in a manner suitable for this comparison and thus were not used. June, July, and August were chosen because they included two approximately equal time periods—a period of regulation (1 June through 15 July) and an unregulated period (16 July through 31 August). Thus, comparisons using a 3-month period of

observation allowed conclusions about shifts in fishing activity that encompassed a longer time than one month and that incorporated the effects of the closure regulation both during and immediately following the closure period.

The base year of 1980 was used for assessing changes resulting from the increased regulations in 1981. The percentages of vessels, trips, and landings for each of the four major categories or groupings (TX, LA, AL/MS, LA-TX) for 1981 were: TX (41, 43, 53, for vessels, trips, and landings, respectively), LA (31, 26, 16), AL/MS (12, 10, 10), and LA-TX (10, 14, 14). For 1980, the corresponding results were: TX (41, 50, 54), LA (30, 24, 18), AL/MS (19, 14, 16), and LA-TX (4, 6, 5). For 1970-74, the minimum and maximum values for each category were: TX (40-50, 33-59, 40-63), LA (20-24, 12-18, 10-17), AL/MS (13-17, 10-16, 10-16), and LA-TX (1-13, 10-14, 10-17). In general, 1980 results

fell midway between the minimum and maximum values for 1970-74. However, a consistent shift from the LA-TX category to the LA alone category occurred over this period. Results for all categories are shown in Table 1.

Additional comparisons between years (Table 2) were made for distributions of vessels, trips, and landings in the June-August period. The total number of identified vessels was generally stable within the two periods 1980-81 and 1970-74. The year-to-year variability (in percent) for vessels, trips, and landings for the period 1970-74 was used to assess the "significance" of the changes from 1980 to 1981. Means and variances ( $\ln P$  and  $\hat{\sigma}^2$ , respectively) of logarithms of percentage values for 1970-74 were calculated and used to make this assessment. As shown in Table 2, variance estimates calculated for the logarithms of the percentages were similar for vessels, trips, and pounds landed with-

same landing category. As expected, variability was less for vessels, trips, and landings for a single state and was greater for activities encompassing three states. A pooled estimate of variance  $\bar{\sigma}^2$  (calculated from vessels, trips, and pounds) for each landing area was used to determine whether changes from 1980 to 1981 should be considered usual or unusual. The statistic:

$$z = \ln(P_{81}/P_{80})/\sqrt{2\bar{\sigma}^2}$$

where  $z$  = normalized variable,  
 $P_y$  = percentage of activity (vessels, trips, or pounds) in a given landing area in year  $y$ , and  
 $\bar{\sigma}^2$  = pooled estimate of variance calculated for each landing area for vessels, trips, and pounds.

Significantly higher percentage frequencies in 1981 compared with 1980 occurred in the following categories: Louisiana-Texas, Texas-Alabama/Mississippi, and Texas-Louisiana-Alabama/Mississippi (Table 2). Percentage ratios between these two years

were outside the range expected from historical values. These categories included 3 percent of the identified vessels, 4 percent of their trips, and 3 percent of their landings in 1981, and thus represented only a minor portion of the total fleet activity in that year. The higher frequencies that occurred in the two- and three-state categories indicate an increase in vessel mobility in 1981 compared with 1980. This increase in vessel mobility is possibly due to the Texas closure. Furthermore, observations on fishing practices in 1981 are consistent with this conclusion. Many vessels fished off Louisiana in June and July and off Texas in July and August because of the closure, and these vessels probably contributed to the numbers in the two- or three-state landing categories.

#### Summary

The relationship between state(s) of landing and fishing activity of individually identified Gulf shrimp vessels, as measured by frequency of vessels, trips, and pounds landed for 1981, were examined in this study. The distribution of pounds landed by area of capture was also examined. Emphasis was on vessels operating in the western Gulf.

In June-August 1981, most vessels landed in only one western Gulf state,

but some vessels (15 percent) landed in more than one state, especially Louisiana-Texas. The data indicate that probably the majority of catch was taken offshore of the respective states of landing.

Fishing activity patterns in June-August indicated significantly more fleet movement in 1981 compared with 1980. More activity (as measured by percentage of vessels, trips, or pounds) was observed for landing categories encompassing two or more states. Less fleet activity was observed in 1981 than in 1980 in the Alabama/Mississippi category. Since the ratio of activities between 1981 and 1980 in these areas is outside the range of historical values, we concluded that this is likely to be due to imposition of the Texas closure in 1981. The change of mobility includes the shift to grounds away from Texas during the closure period and the shift to grounds off Texas after the closure ended. Although the difference between 1980 and 1981 was statistically significant, the majority of fishing activity in each year was by vessels that landed in only a single state during the June-August period.

#### Literature Cited

NOAA. 1980. Shrimp fishery of the Gulf of Mexico; plan approval and proposed regulations. Fed. Regist. 45(218); 74178-74308 (November 7, 1980).