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Review of the 1987 Texas Closure for the Shrimp Fishery Off Texas and Louisiana

U. S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

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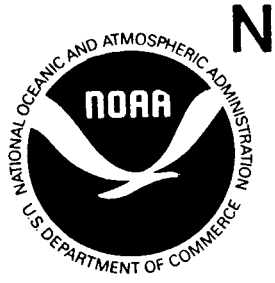

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1987 TEXAS CLOSURE REPORT

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INTRODUCTION

The implementation of the Gulf of Mexico Shrimp Fishery Management Plan (FMP) in May 1981 permitted, for the first time, closure of the brown shrimp fishery from the coastline to 200 nautical miles off the Texas coast. The objectives of the Texas Closure Management Measure were to increase the yield of shrimp and to eliminate waste caused by discard of undersized shrimp in the exclusive economic zone (EEZ). According to the FMP, shrimp yield would be increased by protecting brown shrimp from fishing during the period when they were predominantly small and were rapidly growing. Discards would be reduced by eliminating the count restriction in order to allow all shrimp caught to be landed. For the past six years the Gulf of Mexico Fishery Management Council (GMFMC) has agreed to continue this seasonal closure of the brown shrimp fishery off the Texas coast. The 1987 Texas closure was implemented from 1 June to 15 July 1987, and like 1986, but unlike the other five years, the area closed was only from the coastline to 15 nautical miles off the Texas coast. It was determined by the Council that this type of closure would still allow small brown shrimp to be protected from harvest but would also allow the taking of larger brown shrimp by fishermen in deeper waters.

The Texas Parks and Wildlife Department sets the closing and opening dates for the fishery by assessing abundance, size, and growth rate of shrimp in Texas waters during April and June (Bryan, 1985). Prior to the FMP, Texas law closed the territorial sea from the shoreline out 9 nautical miles for 45 days during mid-May to mid-July 1960-1980 (60 days in 1976). Texas's objective was to insure that a substantial proportion ($\geq$50%) of shrimp in Gulf waters had reached 65 tails/lb or 112 mm total length by season's opening. With the present FMP, the regulated portion of the EEZ is closed and opened in conjunction with the Texas territorial sea closure. The 1981-1986 closures have all exceeded the historical 45-day closure by 5-10 days, but the 1987 closure was only 45 days in length (Table 1).

The purposes of this report are to provide information to determine how well the objectives of the Texas Closure Regulation were

achieved in 1986 and 1987 and to determine if a 15 nautical mile closure meets all the objectives of the Closure Regulation as effectively as a 200 nautical mile closure. This report reviews and analyzes the characteristics of the Texas and Louisiana fisheries west of the Mississippi River and describes the catch, fishing effort, relative abundance and recruitment to the offshore fishery from May 1986 to August 1987. The report also discusses the social and economic impacts experienced by not only the shrimp fishermen, but the shrimp industry in general along the Gulf of Mexico coasts during the closure period.

MATERIALS AND METHODS

Fisheries Statistics

A collection of detailed catch statistics describing the U.S. Gulf of Mexico shrimp fishery (since 1956) is compiled by and available from the Southeast Fisheries Center (SEFC), Economics and Statistics Office (ESO). The procedures used to collect them are described by Klima (1980). The statistics consist of catch, recorded as pounds of shrimp (heads-off); fishing effort, recorded as either 24 hours of actual fishing time or numbers of trips; and size composition of catch, expressed in eight "count" or size categories representing number of shrimp tails per pound (<15, 15-20, 21-25, 26-30, 31-40, 41-50, 51-67 and ≥68). Starting in May 1982, ESO recorded pounds caught in size categories larger than 68 count as follows: 68-80, 81-100, 101-115 and ≥116 count.

To analyze the effects of the Texas closure, only commercial catch statistics from areas west of the Mississippi River (statistical subareas 13-21) were examined (Fig. 1). These data were used to compute catch per unit effort (CPUE) as pounds per 24 hours of fishing or as pounds per trip. The number of shrimp caught was estimated by multiplying the pounds caught in each size category by the mid-point of the size category, and in the case of <15 and ≥116 categories, by 15 and 116, respectively. Margo Hightower[1] and Tom Dawley[2] provided specific information concerning the Texas and Louisiana inshore and offshore shrimp fisheries relative to fleet activities, changes in the fleet, number of trips, discards and specifics of catch and effort for

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the fishing area during 1986 and 1987.

Statistical Treatment

Catch data frequently follow skewed distributions, show heteroscedasticity and have non-additive components. Transformations applied to the original data are often able to alleviate these problems and permit valid statistical analyses of the data employing t-tests and 2-way analysis of variance (ANOVA) (Sokal and Rohlf, 1969). Taylor's (1961) test analyzing relationships between means and variances was applied to the brown shrimp fishing data. It showed that catch data should be transformed to their logarithms, fishing effort data did not need to be transformed, and CPUE data should be transformed to their square roots. The analyses of these transformed data provided statistical support to what the untransformed data showed. The summaries are presented in this report using untransformed data.

The commercial catch data were grouped into biological years May-April since brown shrimp are recruited to the fishery in May of each year. The first and last biological years identified are May 1960-April 1961 (biological year 1960) and May 1986-April 1987 (biological year 1986).

Historical mean monthly catch, mean monthly fishing effort and mean monthly CPUE for the 1960-1985 period[3] were compared with the May 1986-April 1987 monthly data via 2-way ANOVA using paired observations. Additional comparisons between the May-August monthly means of the fisheries data for statistical subareas 13-17 and 18-21 for the historical time series (1960-1985) were compared with the 1987 monthly data from May-August, using paired observations in a 2-way ANOVA and in t-tests. The shrimp size distributions for each month in 1986 and 1987 were compared with the historical data set. Unless otherwise stated, tests of significance were performed at the 95% level ($P = 0.05$).

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[3]Does not include 1980 data because this data file has not been reconciled at this time.

Social Survey

To determine the social impact of the Texas closure on the shrimp industry in the Gulf of Mexico and to provide a comparison set of information to the data gathered last year, interviews of shrimp vessel captains were again conducted by NMFS port agents. Attempts were made to interview at least thirty captains from each of 13 port areas along the coast during the last week of July and the first week of August. The selected port areas included six Texas areas (Port Isabel, Brownsville, Port Aransas, Freeport, Galveston/Bolivar and Sabine/Port Arthur), three Louisiana areas (Cameron, Delcambre and Houma), one Mississippi port (Pascagoula), one Alabama port (Bayou LaBatre), and two Florida ports (Fort Myers and Key West). Interviews were conducted with the first thirty captains who would talk to the port agent. Questions were asked (read) directly from the form (Table 2), and the captains' responses were written exactly as stated. These open ended questions allowed for great flexibility in the responses offered to the port agents.

Similar questions were also asked to vessel owners at the same 13 ports and their responses were recorded. No set number of interviews was assigned, but interviews were conducted only during the same 2 week period when the captains were interviewed. A vessel owner was defined as a person who owned two or more shrimp vessels.

RESULTS - BACKGROUND

Biological Year Comparisons

Louisiana

Brown Shrimp Inshore Fishery

The inshore Louisiana brown shrimp fishery averaged 11.2 million pounds ± 3.9 million pounds standard deviation from 1960-1986 (Fig. 2). Peak production in Louisiana appears to be cyclic, with low production from 1960 to 1966 and above average production in all other years except 1973 to 1975 and 1979 to 1980. Historically, the Louisiana inshore fishery is active from May through August, with peak production in May and June.

During biological year 1986, the inshore Louisiana brown shrimp fishery had a total production of 14.4 million pounds, with 14.0 million pounds (98%) being taken in the May through June period. Thus, the inshore fishery experienced an above average year with regards to pounds caught, but it was not significantly above the historical average. Unlike the below average catch experienced during 1985, the 1986 production was comparable to other closure years.

Brown Shrimp Offshore Fishery

Annual production of brown shrimp from May to April in Louisiana offshore waters averaged 16.0 million pounds ± 8.3 million pounds standard deviation from 1960 to 1986. Annual yield was low in the early 1960's, increased to about 18 million pounds by 1967 and remained near this level through 1972 (Fig. 3). Yield dropped to about 10 million pounds from 1973 through 1975. Thereafter, yield has been in most cases above the historical average of 16.0 million pounds, with yields exceeding 30 million pounds in 1977 and 1978.

In biological year 1986, the Louisiana offshore brown shrimp fishery produced 29.6 million pounds of shrimp. This production level represents an extreme above average catch when compared to the 27 year

average (1960-1986), and is the third greatest catch recorded for this area.

The monthly pattern of shrimp production in Louisiana for biological year 1986 and the first four months of biological year 1987 was compared with the historical monthly average pattern (Fig. 4). Only January and April exhibited catch values that were below average. Yet, of those that showed above average catch, only May 1986 was significantly greater (= 0.01) than its historical counterpart. Like 1985, most fall and winter months (October-April) in 1986 showed above average production for brown shrimp. This is easily observed when monthly comparisons were made between comparable months during the 1974-1987 period (Table 3). Peak production months were, as in the past, still May-August in both 1986 and 1987.

Biological year 1986 also exhibited an above average amount of effort (days fished). During the year about 42,900 days of fishing were recorded for the brown shrimp fishery in Louisiana. This is nearly twice the historical average of 23,900 days fished.

The monthly pattern of effort during biological year 1986 and the first 4 months of biological year 1987 was compared with the historical monthly average pattern (Fig. 5). All months had greater than average effort values, but only May 1986, May 1987 and June 1987 were significantly different from their historical counterparts. When monthly comparisons were made between comparable months and periods, effort values during the 16 month period under investigation (May 1986-August 1987) were either the greatest or near the greatest value observed during the 1974-1987 period (Table 3).

An average CPUE value of 691 pounds per day was observed in biological year 1986. This value is near the historical average for the offshore waters of Louisiana. Yet, it was the early summer months in 1986 that kept the overall average close to the historical level. Only the May-August period in 1986 had above average CPUE during biological year 1986 and only May has had an above average CPUE value thus far in biological year 1987 (Fig. 6). Even with the above

average landings experienced during the 16 month period, the record levels of effort exerted in the offshore fishery produced lower than average CPUE values for most months. Pounds landed in 1987 biological year thus far appear to be above average, but fisherman will probably perceive it as a poor year because of the low CPUE values.

Texas

Brown Shrimp Inshore Fishery

Landings for the Texas inshore brown shrimp fishery have increased for the past several years. The average catch over the 27 year period (1960-1986) was 2.5 million pounds $\pm$ 2.1 million ponds standard deviation (Fig. 7). The catch during biological year 1986 was 5.6 million pounds, which is above the historical average, but less than occurred during each of the three previous years (1983-1985).

The Texas inshore brown shrimp fishery takes place from late April through August. Peak production usually occurs in May and June. In biological year 1986, 78% for the total catch occurred during May and June.

Brown Shrimp Offshore Fishery

The average annual brown shrimp yield from May to April in Texas offshore waters from 1960 to 1986 was 26.9 million pounds $\pm$ 7.4 million pounds standard deviation. Peak production occurred in 1967 and 1981 with a yield of 48 and 41 million pounds, respectively (Fig. 8). Annual production during biological year 1986 was 27.2 million pounds. This production value was above average, but not significantly greater than the historical mean. This level of catch was similar to the 27.7 million pounds taken during biological year 1985, and is the third largest catch since the closure started.

The monthly pattern of shrimp production off Texas for biological year 1986 and the first four months of biological year 1987 was compared with the historical monthly average pattern (Fig. 9). During biological year 1986 an atypical trend in landings occurred. Both May and June experienced above average catches. This was the first June

since the combined Texas closure began that had near normal landings. This catch level occurred because the EEZ was opened to brown shrimp fishing beyond the 15 nautical mile line. The entire regulated area was opened to fishing on July 2, 1986. Below average landings occurred from July through October. During other closure years, this period usually experiences better than average landings. Landings then increased during the winter, when traditionally only low levels of production are taking place. The months from November through April all had better than average landings. This is the second year that winter production levels have been above average (Table 3). However, none of the values were significantly greater than average this year.

An annual effort value of about 45,100 fishing days was expended off the Texas coast during biological year 1986. Monthly effort values followed the same trends as those shown for landings (Fig. 10). Winter months had greater than average levels of effort, while the summer months of 1986 experienced reduced effort. It should be recalled that record production was occurring off Louisiana during this summer period and some of the effort normally expended off Texas was shifted to Louisiana. None of the effort values experienced during this 16 month period were significantly different from their historical averages.

An average CPUE value of 602 pounds per day was experienced during biological year 1986. When monthly averages were compared to historical averages, only May 1986 and November 1986 had CPUE values that were above average (Fig. 11). None of the values during the 16 month period were significantly different from their historical counterparts.

Overview of 1986 Season

Biological year 1986 had greater than average landings for brown shrimp for the entire area from west of the Mississippi River Delta to the Texas-Mexico border. Total brown shrimp production (inshore and offshore) in Louisiana was 44.0 million pounds (14.4 inshore and 29.6 offshore), while in Texas landings totaled 32.8 million pounds (5.6 inshore and 27.2 offshore). This produced a total of 76.8 million pounds (20.0 inshore and 56.8 offshore). This value represents the largest brown shrimp catch since the record landings in 1981 (89.7 million pounds) and is much greater than the 67.1 million pound historical average for the area.

1987 Closure Period

In 1987, the territorial sea of the state of Texas and a six nautical mile wide band of the EEZ adjacent to those territorial seas were closed to all shrimp fishing from June 1 to July 15, except for a daytime nearshore fishery directed at white shrimp. This section of the report represents an analysis of the shrimp statistics taken during the MayAugust period of 1987 from statistical subareas 13-21, inclusive.

Louisiana

Brown Shrimp Inshore Fishery

The May through August 1987 catch in Louisiana for inshore waters amounted to 12.4 million pounds, with 90% of the total catch in May and June. This year's inshore production was higher than the 9.3 million pounds produced during the 1985 May through August period, but lower than most other years since 1981. Inshore production was 14.0, 14.9, 12.1, 15.1 and 15.2 million pounds for 1986, 1984, 1983, 1982 and 1981, respectively. Thus, the 1987 inshore catch was lower than all years since 1981, except 1983 and 1985.

In 1987, May inshore production was 4.5 million pounds with June production at 6.7 million pounds. Catch values dropped quickly after June, with a July catch of 1.0 million pounds and an August catch of

only 0.24 million pounds. Similar to last year, there were no early migration of small brown shrimp from inshore waters to offshore waters.

The proportion of the catch in the 116 and greater count size group was greatly reduced this year. In the past, large numbers of very small shrimp have been caught in the May through June period, thus causing a high percentage of the total catch to be in the greater than 116 count size group. This year only 41% of the shrimp landed were in the smallest size group (Table 4). However, as in other years, the greater than 68 count size group accounted for 95% of the shrimp landed in the inshore fishery.

Brown Shrimp Offshore Fishery

In May 1987, the fishery off Louisiana produced only 4.9 million pounds of brown shrimp, with over 7,900 days of fishing effort, for an average CPUE value of only 618 pounds per day. While the effort value represents one of the highest levels achieved off Louisiana since at least 1974, the catch is only slightly above average (Table 3). The catch level is below 1985 and 1986 values, but above or comparable to other historical May values. The CPUE value is the lowest since the 1983 season (Table 3). Unlike past years, most of the catch (61%) and effort (52%) occurred only in the shallow waters of statistical subarea 13 and not 13 and 14 (Fig. 12). This year the catch in statistical subarea 14 was only 0.7 million pounds with an effort of 888 days. CPUE values in subareas 13 and 14 were comparable with 744 pounds per day in subarea 13 and 770 pounds per day in subarea 14. Statistical subarea 15 had moderate levels of production with 1.0 million pounds caught from 2100 days of fishing. This is an above average level of effort, but it produced a CPUE of only 461 pounds per day. In May very little catch or effort was experienced in either statistical subarea 16 or 17.

In June, the fishery off Louisiana produced 6.6 million pounds of brown shrimp with a fishing effort of over 11,000 days. The average CPUE was 595 pounds per day. This June effort was the highest

experienced since 1974, with the catch being the second largest (second only to 1981) (Table 3). With the record amount of effort exerted, the CPUE value of 595 pounds per day was near the bottom of the range of June values (Table 3). As in past years, over 95% of the production took place within 15 fm of water in each of the five statistical subareas (13-17). CPUE values were quite good (800 pounds per day) in statistical subareas 14, 16 and 17, but only moderate (500 pounds per day) in subareas 13 and 15. This is similar to what occurred last year, but unusual when compared to most other years. Subarea 13 usually has CPUE values much higher than those of 15, 16 and 17.

The July offshore fishery in statistical subareas 13-17 produced 6.0 million pounds of brown shrimp with an effort of over 10,000 days of fishing. Average CPUE was 595 pounds per day. Again, this effort value was unusually high, with the catch level also being near the upper range of values experienced over the years (Table 3). CPUE values were near mid-range of other values during the 14 year period (Table 3). CPUE values were lowest in subareas 13 and increases progressively with the highest in subarea 17 (Fig. 14). Effort and catch were greatest in subareas 13 and 15. Most of the catch was in water shallower than 15 fm. Even subarea 17, which usually has a large catch in deeper waters, had most of the catch within the 15 fm contour line.

In August, the Louisiana offshore fishery produced approximately 3.3 million pounds of brown shrimp with an effort of about 5,750 days. Average CPUE was only 577 pounds per day. Both the catch and effort values were the greatest since the Texas Closure began in 1981, but CPUE was about average (Table 3). Highest CPUE values were found in statistical subareas 14 and 15 (Fig. 15). Greatest catches were from subarea 15, while effort was similar in all subareas, except subarea 14 which was extremely low.

Thus, during the May-August 1987 period, 20.8 million pounds of brown shrimp were landed from the offshore fishery. Since 1979, only 1981 (23.1 million pounds) and 1986 (22.8 million pounds) have

exceeded this value (Table 3). Yet, this catch came from a near record expenditure of effort. A total of nearly 34,800 days of fishing occurred during this four month period off Louisiana. Since 1974, only the effort exerted in the May-August 1979 period (42,300 days) exceeds this 1987 value (Table 3). With this high level of effort, CPUE values during this period averaged only 598 pounds per day. This is the lowest average CPUE value since the Texas Closure began, with the exception of the 1983 average (435 pounds per day) (Table 3).

Texas

Brown Shrimp Inshore Fishery

Thus far in biological year 1987, 7.6 million pounds of brown shrimp have been landed from Texas bays. This is the greatest catch ever recorded from Texas inshore waters. Monthly catches during 1987 were greatest in May and June with 2.9 million pounds in May and 3.5 million pounds in June. These two months accounted for 84% of the catch during the four month period. Landings were still quite high in July with 1.2 million pounds landed, but dropped off quickly in August with only about 23 thousand pounds landed.

This year Matagorda Bay again had the greatest inshore production during the May-August period with a catch level of 2.1 million pounds. This is a 41% increase over last year's catch for the bay system. Galveston Bay recorded a catch of 2.0 million pounds (nearly a 2 fold increase over last year), while Aransas bay had 1.8 million pounds of brown shrimp landed. This year San Antonio Bay had catches exceeding the million pound level (1.1 million pounds), while Corpus Christi Bay only experienced 0.6 million pounds landed. Most of the increases in landings this year occurred during the June period in all bay systems. As in past years, only Galveston Bay had any inshore production in August. This year only about 11 thousand pounds were landed. This represents an 89% decrease over last year's value.

The size composition of the inshore catch during the 1987 season was different than all previous years since the time ESO agents began

to collect data on the specific size categories larger than 68-count (Table 5). Last year only 32% of the total inshore catch during the May-June period was in the greater than 116 count size group. This year over 73% of the catch during the same two month period was in this size group. Last year only 30% of the entire May-August catch was composed of shrimp larger than 116 count, while this year the figure was 64% (Table 5).

Brown Shrimp Offshore Fishery

The 1987 offshore production from May through August amounted to 17.5 million pounds with 14.2 million pound (81%) of the catch produced in the July through August period. This is similar to last year's July through August percentage (76% in 1986), but markedly different than most other years since 1981, with 97% of the May through August total being taken in the July through August period. The four month catch total experienced this year was the largest since the record catch noted in 1981 (25.3 million pounds) (Table 3).

In May 1987, a little over 0.9 million pounds of brown shrimp were landed with an effort of around 3,100 days fished. This produced a CPUE value of only 300 pounds per day. This is an above average catch, associated with the greatest effort observed since 1979 (Table 3). Most of the landings were in statistical subareas 19-21, while subarea 19 had the largest CPUE.

With the EEZ open beyond 15 nautical miles, June production (2.4 million pounds) was similar to last year's value of 2.3 million pounds. Although this production level was the highest since the Closure began, it was comparable to other June levels during pre-closure years (Table 3). Effort increased over last years value of 3,700 days fished with a value of about 4,600 days fished. This effort value was the greatest ever recorded for the month of June (Table 3). Average CPUE was only 519 pounds per day this year. Catch and effort were both moderate to low in statistical subareas 18, 20 and 21, with higher levels in subarea 19 (Fig. 16). The greatest CPUE was in subarea 18 with over 700 pounds per day, while all other

Texas subareas were in the 500-400 pounds per day range (Fig. 13).

Total catch in July was 8.9 million pounds with over 9,900 days fished. This is the largest catch recorded for the month of July, with the exception of the 10.4 million pounds landed in 1981 (Table 3). The effort value is the greatest since at least 1974 (Table 3). About 3.6 million pounds (40% of the total) were caught before the closure opened on July 15th, with 4,900 days fished (49% of the total). Thus, closure and post-closure periods in July seemed to have nearly equal amounts of total effort, but landings were higher following the opening of the closure. CPUE during the closure period averaged 738 pounds per day, while during the post-closure period it averaged 1,035 pounds per day. Both catch and effort were high in subareas 18 and 19 and low in subareas 20 and 21 (Fig. 14). CPUE values were highest in subareas 20 and 21 (Fig. 14).

In August, the offshore Texas catch was 5.3 million pounds of brown shrimp with an effort of about 8,200 days of fishing. CPUE was around 653 pounds per day. All three values were mid-range when compared to other August values (Table 3). As in years past, most production was concentrated in subarea 19, but all subareas off Texas experienced similar CPUE values (Fig. 15).

Texas-Louisiana Comparisons

Size of Shrimp

Unlike most years, smaller sized shrimp were caught in Texas inshore waters when compared to inshore Louisiana waters during each month during the May through August period (Table 6). The average size count in May was 130 and 116 shrimp per pound in Texas and Louisiana, respectively, whereas in June the counts were 125 and 114 shrimp per pound. Count size dropped in both states in July, with an average of 94 shrimp per pound in Texas and 90 shrimp per pound in Louisiana. In August values were 71 and 63 shrimp per pound for Texas and Louisiana, respectively. These are the smallest average sized shrimp in Texas in many years, but were about average for Louisiana.

The size composition of the commercial offshore catch of brown shrimp from statistical subareas 13-17 from May to August 1987 was dominated by greater than 116-count shrimp in May and greater than 51 count shrimp in June and July (Fig. 16). In August, the catch was more uniformly distributed among the size groups ranging from 21-25 count to 51-67 count shrimp (Fig. 16).

In statistical subareas 18-21 the commercial offshore catch from May to August 1987 was distributed equally over all size categories in May, but was bimodal around 51-67 count and greater than 116-count in June (Fig. 17). In July, the 31-67 count group range was the predominant modal group, with large numbers of medium shrimp landed (Fig. 17). The dominant modal group in August was 31-40 count with secondary peaks in the 21-30 count range and 41-67 count range. Count sizes experienced this July and August were similar to previous years.

In comparing the mean number of shrimp per pound from offshore waters in Texas and Louisiana, Texas always had larger sized shrimp landed (Table 7). Both Texas and Louisiana had smaller shrimp landed this year compared to last year (Klima et al., 1987).

Number of Shrimp

In addition to describing the pounds landed by size count, we have converted the size category information into estimated numbers of shrimp caught in Texas and Louisiana, both for offshore and inshore waters. Large numbers of shrimp were caught in Louisiana waters in May and June (about equal amounts inshore and offshore), with numbers decreasing drastically in July and August (Table 8). Overall, Louisiana caught over 3 billion shrimp in the four month period, with 79% being caught in the first 2 months.

Texas had around 400-600 million shrimp caught from its waters each month during the May through July period. During the first 2 months, 80% were caught from inshore waters, while during July, 78% of the shrimp were taken from offshore waters. During August, numbers

dropped off markedly compared to July, but again most (99%) of the shrimp were from offshore waters.

Total Catch

May through August catches in 1987 were compared in Louisiana and Texas over the last 8 years (Table 9). Both offshore Louisiana and Texas had above average catches, with Texas experiencing the best catch since the record year of 1981. Inshore catches were below the average in Louisiana during the period (only 12.4 million pounds), while inshore Texas had the largest inshore catch ever recorded at 7.6 million pounds. Overall, Texas had a total of 25.1 million pounds for the four month period which was second only to the 29.5 million pounds in 1981. Louisiana also had a good catch with only 1986 and 1981 experiencing better catches.

RESULTS - ANALYSIS

Impact of Closure

Catch per Unit Effort Analysis

Changes in CPUE over several years before and after closure incorporate both recruitment variation and possible closure effects. However, as a first approximation, a "good year" in one area tends to be a "good year" throughout the Gulf. Therefore, examining the ratio of CPUE off Texas versus CPUE elsewhere will eliminate some of the effects of variation due to recruitment. In July the CPUE ratio has been near the mean value of 1.3 during most years, with the exception of the early 1970's and the initial closure years (Fig. 18). During the 200 nautical mile EEZ closure period (1981-1985) the increase in CPUE (biomass build up with closure) was an advantage to those individuals fishing in Texas offshore waters. This Texas advantage with higher than average CPUE, lasted until September in 1981, but only until August in most other 200 nautical mile closure years. This indicated a more rapid utilization of the stock build-up in later years. With the opening of the EEZ from 200 nautical miles to 15 nautical miles in 1986 and 1987, the Texas advantage (biomass build up because of the closure) was lost (Fig. 18). This was also evident when August CPUE ratios were calculated (Fig. 19). Both 1986 and 1987 values were very near the pre-closure average of 1.1 during the August period. Thus, the potential increase in harvests of larger shrimp has been exchanged for access to offshore waters in May and June during the last two seasons.

Gulf-Wide Yields - EEZ Closure

During 1986 and 1987 the EEZ was closed only out to 15 nautical miles. For all analysis purposes, we have treated both years as if the entire EEZ was opened (i.e., only state waters closed). June catch and effort data from both years support this assumption, since these values are similar to other June values during pre-closure years (Table 3).

The major difficulty in evaluating the effect of the Closure of the EEZ on the fishery is due to variations in recruitment from year to year. The most direct and effective way to account for variation in recruitment is to estimate recruitment strength via virtual population analysis (VPA). Once this has been done the estimated recruitment can be fished through computer simulation as if the 200 nautical mile closure was in effect and these results compared with yields with the EEZ opened to fishing.

The underlying VPA assessment (Nance and Nichols, 1987) was updated through August 1987. Procedures for estimating "starting F" were identical to those used in previous analysis. The same procedures used last year for assessing what fishing mortality would have been with a total closure of the EEZ was repeated (Nichols, 1987). The only exception was that the July effort was used as the maximum available effort estimate in a given year when compared to baseline years. It has become apparent over the last few years that maximum Gulf effort has shifted from August to July in the brown shrimp fishery.

For the 1986 biological year, a baseline of 1984-1985 was used and average fishing mortality rates were multiplied by the July multiplier of 1.036 (ratio of July effort in 1986 compared to 1984-1985 average). Fishing mortality off Louisiana was not held constant, since both baseline and current years had similar fishing pattern in the 5 fathom area near the Mississippi River (Klima et al., 1986). Effort during winter months in 1986 was much greater than the average effort during 1984 and 1985, so the simulation was run with and without adjustment to the winter fishery. Both simulations were computed for comparative purposes with historical data. Since the closure was not in effect in 1986, the increase in winter fishing pressure appears not to be a result of biomass build-up as was speculated during the 1985 closure when a similar winter increase was noted, but is probably a reflection of reduced economic pressures.

The simulation without winter adjustment indicated that 1.79 million pounds of small shrimp (>67 count) would be passed up if the EEZ would have been closed out to 200 nautical miles (Fig. 20). A catch increase of .83 million pounds of medium shrimp (31-67 count) would have occurred, but a decrease of .40 million pounds of large shrimp ($\leq$30 count) would have resulted during the winter period (Fig. 29). A net loss of 1.37 million pounds would occur with this closure situation.

The simulation with the winter adjustment showed similar trends in small and medium shrimp to the unadjusted situation. However, with the Closure a loss of only 1.68 million pounds of small shrimp (>67 count) would have occurred, with a gain of 1.70 million pounds realized in the 31-67 count group (Fig. 21). The increase in winter fishing pressure would pick up the large shrimp ($\leq$30 count) and a gain of 1.08 million pounds would be the result. A net gain of 1.1 million pounds would occur with this situation.

To determine the effect of a 200 nautical mile EEZ closure during the 1987 biological year, a 1984 baseline was chosen to simulate the fishing mortality rates during the closure period. This baseline year had similar effort and recruitment when compared to the current year. Starting F values in 1984 were adjusted by a July multiplier of 1.046. Analysis indicated that in the May-August period 3.36 million pounds of small shrimp (>67 count) would be passed up with the closure, but a gain of 2.32 million pounds of medium shrimp (31-67 count) and a gain of 1.88 million pounds of large shrimp ($\leq$30 count) would occur (Fig. 22). Thus, an increase of .82 million pounds would result in the May-August period with the total closure. Projections for the May-April period are shown in Figure 23. An increase of 2.18 million pounds is the indicated gain with a complete closure of the EEZ. A loss of 3.36 million of small shrimp (>67 count) would happen, but all other count groups would experience gains.

Effort Displacement

The Texas share of the June offshore effort fell to all time low levels during the 200 nautical mile EEZ closure (1981-1985), but this basically continued a decreasing trend that began several years before (Fig. 24). Effort off Texas averaged only 23% of the Gulf-wide June effort from 1976-1980. Quite likely then, 23% of the Gulf-wide effort was subject to displacement by the EEZ closure. With reopening of the EEZ beyond 15 nautical miles in 1986 and 1987, the fraction of effort off Texas has rebounded to levels above the 1976-1980 average.

In years past it has been assumed that the offshore effort exerted during August indexed the total amount of offshore effort available for a year. As mentioned earlier, July presently seems to be the month where maximum total available Gulf-wide effort occurs. In any case, the ratio of total June effort versus maximum Gulf effort (July effort in this case) can help identify the fate of the fleet formerly fishing off Texas during the June period. The idea behind this analysis was that if the June-July ratio remained constant after enactment of the closure, effort formerly off Texas probably moved to other areas. If on the other hand, June-July ratio dropped, the displaced vessels probably tied up and did not fish. Historically, the June-July ratio has been erratic, but generally increasing, probably reflecting faster growth of the nearshore fleet compared to more offshore components (Fig. 25). There was a slight dip in the ratio during the 1983 and 1984 seasons, but the effort ratio was back to average values in both 1986 and 1987. June effort compared to August effort showed this same trend, but more pronounced (Fig. 26). Effort in June was lost during the total closure of the EEZ, but has rebounded during the last two years. This suggests that the effort tied up during the 1981-1985 seasons has again returned to the fishery.

Vessel Mobility/Activity

State Landings

Commercial shrimp statistics are recorded with a given state and can be traced to the location of capture. We have utilized these data to depict the percent of each state's landings and its location of capture from June through August 1987 (Table 10).

Shrimp landings in the state of Texas that were from offshore production totaled 4.1 million pounds in June, 10.0 million pounds in July and 6.4 million pounds in August. In the June period 64% of the shrimp landed in Texas were caught off Texas, with 36% of the shrimp being caught off Louisiana. A greater percentage was caught off Texas this year when compared to last year (only 53% off Texas in 1986) (Klima et al., 1987). During both July and August about 85% of the shrimp landed in Texas were from Texas waters and only 15% were from Louisiana waters. Again, percentages off Louisiana were reduced from last year.

Percentage of 1987 Texas landings caught off each state was compared to 1985 data. During 1985, when the total EEZ was closed off Texas, only a small percentage of the brown shrimp landed in Texas were from Texas waters (Klima et al., 1987). Most of the landings for Texas in June were from Louisiana waters. In June 1987, a larger percentage of the shrimp landed in Texas were from Texas waters, but even with most of the EEZ off Texas opened to fishing, a large proportion of the shrimp landed were still from Louisiana waters. However, these values were still smaller than those in 1986 (Klima et al., 1987). During both July and August, the percentage of Texas landings caught off Texas were quite high during both years, with catches from Louisiana waters being moderate.

Shrimp landings in the state of Louisiana that were from offshore production totaled 7.4 million pounds in June, 6.1 million pounds in July, and 6.0 million pounds in August (Table 10). During June and August over 97% of the shrimp landed in Louisiana was caught in Louisiana waters. Only during July did the percent of Louisiana landings caught off Louisiana decrease to about 90%.

When 1987 Louisiana landing values were compared to 1985 and 1986 values, no detectable differences were seen. During both periods most of the shrimp landed in Louisiana were caught from Louisiana waters.

Shrimp landings in Mississippi from offshore production were mainly caught off Mississippi (Table 10). Shrimp landings in Alabama, on the other hand, were caught in greatest numbers off both Mississippi and Louisiana. Few shrimp were caught in Texas waters in June, but percentages rose to about 20% by August (Table 10). Florida landings were similar to those shown for Mississippi. Most of the shrimp landed in Florida during the June-August period were caught off Florida.

Home Port

We have further been able to identify the home port of most vessels from each of the Gulf coast states and have made a determination of the percent and pounds landed from June 1 through August 31, 1987 by each selected group (Texas, Louisiana and other) (Table 11). The unknown category is a conglomerate of information from consolidated schedules and, as a result, most probably comprises catches from boats fishing in their respective states.

During June 1987, about 84% of the 4.09 million pounds of shrimp landed in Texas were caught by vessels with Texas home ports. About 56% of the catch came from Texas waters, while 28% came from Louisiana waters. On the other hand, only 44% of the 7.41 million pounds of shrimp landed in Louisiana were caught by Louisiana home port vessels. The "unknown" category accounted for 47% of the catch. This category was rather large this year, but is most likely composed mainly of Louisiana vessels and maybe a few from states other than Texas. If true, then around 91% of the catch landed in Louisiana was from Louisiana home port vessels. This is consistent with data from most other years.

Landings of shrimp increased in Texas during July with 10 million pounds landed. This was a 24% increase over landings last year. Only 75% of the shrimp landed in Texas were from Texas vessels, while 4% were from Louisiana vessels and 11% from vessels from other Gulf states.

In Louisiana during July, about 6 million pounds of shrimp were landed,

which was only 3% below last years July value. Texas vessels accounted for 6% of the catch, while Louisiana vessels probably accounted for 92% (47% unknown). Other Gulf state vessels only landed about 1% of the months landings.

Landings dropped off in both states during August. In Texas only 6.4 million pounds of shrimp were landed. This represented a 14% decrease over landings from last August. About 80% of the landings came from Texas vessels, with 68% from Texas waters and 12% from Louisiana waters. Louisiana vessels accounted for only 2% of the Texas landings and other Gulf state vessels landed about 9% of the total. In Louisiana a little under 6 million pounds were landed, with Texas vessels landing around 16% of the total. Louisiana vessels probably accounted for 92% of the landings (50% unknown), with other Gulf states landing about 2% of the total.

Percentage data from the June-August 1987 period was similar to 1986 data in most cases. One difference was that Texas vessels took less of their Texas landings form Louisiana waters this year compared to last year (June, 5% less; July, 6% less; August, 5% less). This was probably due to the fact that Louisiana did not have as good of season offshore this year as was experienced last year, so Texas vessels fished closer to home.

Social Survey

Vessel Captain Interviews

A total of 277 vessel captains were interviewed this year with the following break down by home port: 19 from Key West, 10 from Fort Myers (29 total from Florida), 28 from Alabama, 24 from Mississippi, 44 from the Houma area, 17 from the Delcambre area, 12 from Cameron (73 from Louisiana), 28 from the Sabine area, 11 from Galveston, 5 from Freeport (44 from upper Texas coast), 7 from Port Aransas area, 35 from Port Isabel, 30 from Brownsville (72 from lower Texas coast) and 7 from east coast areas.

Chi-squared analysis revealed that responses to questions about the EEZ closure were independent of the date the survey was conducted. Thus, from each port no detectable difference was found when responses from the first week were compared to responses from the second week.

Captains were first asked what they thought was the purpose of the federal closure off Texas. Answers were summarized into broad categories, so interpretation of the results would be possible. Four categories had percentages large enough for inclusion in analysis. These categories were: 1) no opinion, 2) I don't know, 3) shrimp growth, and 4) political. When compared on an area by areas bases, some interesting trends were noted (Fig. 27). Overall, most captains seemed to know that the purpose of the closure was to allow small shrimp to grow (56%). Yet, when analyzed by area only Florida, Alabama, Mississippi and lower Texas ports had over 50% of their captains respond in this manner to the question. Answers from Louisiana were divided between shrimp growth (42%) and no opinion (23%), while responses from upper Texas ports were split into three categories: shrimp growth (34%), I don't know (30%) and political (18%).

The reason why many captains from the upper Texas coast ports answered that they did not know what the purpose of the closure was could be explained from the fact that 31% of the captains interviewed were Asian. When interviewed captains were split into their ethnic groups, the majority of those that did not know the reason for the closure (56%) or that had no opinion about the closure (28%) were of Asian descent (Fig. 28). All other ethnic groups seemed to be informed about the purpose of the closure.

Opinions about whether or not to have a closure of the EEZ of Texas were solicited from the vessel captains. Alabama and lower Texas ports had the most captains in favor of a closure (85% and 83%, respectively), with most (75%) of the Alabama captains in favor of a closure wanting a 15 mile closure and most (68%) of the lower Texas port captains in favor of the 200 mile closure (Fig. 29). Florida captains also showed a majority in favor of the closure (52% for the closure, 34% against), with 47% of them who wanted a closure favoring a 200 mile closure (20% had no opinion on distance). Mississippi captains were equally split with regards to opinion

about the closure (38% for and 38% against) (Fig. 29). Most (78%) did not select a closure distance, but those who did select, selected the 200 mile closure distance. Similar to last year, captains from Louisiana and upper Texas ports were against the closure of EEZ waters off Texas (58% in Louisiana and 64% in Texas) (Fig. 29). Of the small percentages in favor of the closure, most selected the 15 mile closure as the one they preferred.

Captains were categorized into their different ethnic groups and their type of vessel (ice or freezer). Hispanic captains showed the strongest (86%) support of a closure off Texas with most (65%) favoring as 200 mile closure (Fig. 30). White captains were almost equally divided between having a closure (48%) and not having a closure (43%). Those captains that were Asian or Louisiana-French were not in favor of a closure (40% and 57%, respectively) (Fig. 30). Captains of freezer boats were mostly (76%) in favor of a closure, with most (64%) favoring a 200 mile closure (Fig. 31). A great majority of the freezer boats were from the lower Texas coast (Fig. 32). Captains from ice boats were almost equally split between not having a closure (44%) and having a closure (45%) (Fig. 31). Those favoring the closure were more in favor of the 15 mile closure (40%) than the 200 mile closure (36%).

Captains were then asked why they responded in favor of or against a closure of the EEZ off Texas. Answers were placed into several general categories from which five had percentages high enough for analysis. The five categories were: 1) no opinion of closure, 2) too many boats in my state because of closure, 3) closure just isn't working, 4) closure to help conserve shrimp and allow them to grow, and 5) closure needed to enforce management efforts. Most of the captains from Alabama (71%), Florida (52%) and lower Texas ports (50%) wanted a closure because of conservation reasons (Fig. 33). Some lower Texas port captains (24%) also liked the closure because it helped with enforcement of management regulations. They stated that the closure (mainly 200 mile) protected the shrimp from poachers and allowed everyone equal chance after the opening day.

Louisiana captains were split between no opinion about the closure (26%), not having the closure because it wasn't working (26%) and because too many boats fished in Louisiana during the closure (22%) (Fig. 33). The majority (39%) of upper Texas coast port captains said they didn't want the closure because it just wasn't working.

The last two questions asked of the captains were what they felt was the biggest advantage of the closure and the biggest disadvantage of the closure. Answers about advantages were placed into categories with 4 having percentages high enough to consider in the analysis (Fig. 34). The categories included: 1) no opinion, 2) better catches, 3) no advantage, and 4) better enforcement of management regulation. Captains from Florida (41%), Alabama (79%), Mississippi (54%) and lower Texas ports (64%) stated that better catches or catch rates were the greatest advantage they experienced because of the closure. Captains from Louisiana (53%) and upper Texas ports (66%) said there was no advantage to the closure.

Disadvantages of the closure had 6 categories that were selected for analysis (Fig. 35). These included: 1) no opinion, 2) pulse fishing, 3) too many vessels in home state, 4) no disadvantage, 5) not making money because of closure, and 6) no enforcement of closure. Captains from Mississippi were split between the categories of no opinion (33%) and too many vessels in my state (33%). The category that answers from captains along the upper Texas coast most often fit into was pulse fishing (32%), while captains from Louisiana (44%) said that too many out of state vessels came to their state because of the closure. Captains along the lower Texas coast said enforcement was the worst problem (31%), with less money because of closure being the next highest selected category (22%).

Vessel Owners Interviews

A total of 51 vessel owners were interviewed, with 28 from the lower Texas coast, 8 from Florida, 6 from the upper Texas coast, 5 from Alabama, and 2 each from Louisiana and Mississippi. The majority (47%) owned ice boats, while 33% owned freezer boats and 20% had both types within their fleet.

Most (86%) of the vessel owners knew the purpose of the EEZ closure was to allow small shrimp to grow to a larger size before capture. None of the other categories that responses were placed in had percentages above 3%.

The majority (69%) of the vessel owners were in favor of having a closure in the EEZ, while 30% stated that they did not want any type of closure in federal waters (Fig. 36). Of those that wanted a closure, 45% wanted the 15 nautical mile closure, while only 18% wanted a 200 mile closure. All the owners who wanted the closure out to 200 miles were from lower Texas coast ports.

Owners were then asked why they responded in favor of or against a closure of the EEZ off Texas. Most of the owners that favored the closure stated they wanted a closure to protect the small brown shrimp and allow them to grow. Those who did not want a closure were split almost equally between two responses. One group stated the EEZ closure just was not working, while the other half was opposed because they didn't feel small brown shrimp were in federal waters.

The last two questions asked the owners were what they felt was the biggest advantage of the closure and the biggest disadvantage of the closure. Answers about the advantages of the closure were split into three different categories. Most (63%) owners felt the biggest advantage from the closure were larger shrimp, while others (24%) thought there was no advantage to having the closure. A small group (8%) felt the closure's only advantage was to protect state waters.

Disadvantages of the closure had four major categories that were selected for analysis (Fig. 37). One minor group (8%) stated that there were no disadvantages to a closure of the EEZ off Texas. Most (31%) of the owners felt that the closure caused them to lose money, either from dropped prices or increased travel for the vessels. Owners from Florida and Alabama (12% of total group) stated that the closure caused too many Texas boats to fish off their states, while 18% of the total (all from Texas) stated the greatest disadvantage was that pulse fishing occurred on opening. Some owners (18%) stated that the biggest disadvantage was because the EEZ closure was not enforced and many boats fished illegally in the closed waters.

Discards

Offshore Shrimp Sizes

SEAMAP surveys by NMFS provided fishery-independent estimates of shrimp sizes during the closure (Table 12). NMFS surveys in 5-50 fm waters during June 16-29 found undersized brown shrimp in subareas 19 and 21 and undersized pink shrimp in subareas 20 and 21. Commercial catch and discard of undersized shrimp was thus possible.

Estimation of Discarding from Interviews

For the purposes of the following discussion, catch is defined as landings plus discards. NMFS port agents in Texas collected information on shrimp discards along with landings for the period June 1-August 31, 1987, since fishing was allowed outside of the 15 nautical mile limit of closed waters. There were three types of fishing trip records among the 10,604 trips reported during this period (Table 13): 1) 1,093 complete interviews, in which captains reported both landings and discards, even if discards equalled zero; 2) 1,058 incomplete interviews, in which captains reported only landings (either captains were not asked about discards or comments on discarding were not recorded), for a total of 2,151 interviews; and 3) 8,453 dealer records in which captains were not interviewed at all. Total interview coverage was thus 20.3% of all trips, while discard information was collected after 10.3% of all trips during the reporting period (Table 13). Interview coverage of trips to subarea 21 was high (79%) compared with trips to subareas 18-20 elsewhere (9-36%). Recording of discard information was higher in subareas 20-21 than in subareas 18-19 (66-68% vs. 26-30%, respectively).

Biweekly brown shrimp landings and discard by statistical subarea and depth zone are presented in Tables 14-18. With the exception of the first two weeks of this survey (June 1-15), discarding generally occurred in all weeks of the season. In subarea 18 (Table 14), discarding was low throughout the study period - only 430 lbs were discarded from landings of 368,022 lbs (0.1%). Most of this (300 lbs) was discarded by vessels fishing in

1-10 fm prior to or just after the season opened on July 15. In subarea 19 (Table 15), discarded weight as 20 times higher than in subarea 18 (9,076 lbs) but was still only 1% of the landed shrimp weight. Maximum discards (6,120 lbs or 26% of the biweekly catch) occurred in 1-10 fm prior to June 30. In subarea 20 (Table 16), discarded shrimp weights again increased to 15,247 lbs, but this was still only 1.3% of the total catch. Discards were not reported until the July 1-15 period, and discarding continued through the rest of the survey. Discarding was heaviest in depth zone 5 (21-25 fm) during July 1-15, then moved into depth zones 3-4 (11-20 fm) for the last six weeks surveyed. In subarea 21 (Table 17), discarding occurred primarily in the four weeks after the season opened (8,405 lbs; 0.4% of total catch). Most discards came from depth zones 3 and 4 (11-20 fm) but over 10% of the discards were recorded from depth zone 6 (26-30 fm). Over the whole Texas coast (Table 18), discarding was recorded for most of the season with proportionally highest discarding in relation to landings (22%) recorded from depth zones 1+2 (1-10 fm) but highest discard weights coming from depth zone 3 (11-15 fm; 10,317 lbs) and depth zone 4 (16-20 fm; 11,696 lbs).

Biweekly and cumulative summaries of landings and discards are presented in Table 19. These data include an additional 37 interviews (for a total of 1,130 interviews) that reported landings and discard data but contained erroneous or missing information relating to vessel characteristics or shrimp size classes. Discards were proportionally highest during June 16-30 unloading dates (19.2% of total catch in subarea 19; 2.9% over all subareas), whereas the maximum discard weight (11,733 lb over all subareas) was noted during July 16-31 unloading dates. Discard weight was highest in subarea 20, followed by subareas 19 and 21, and was almost nil in subarea 18. This trend follows the SEAMAP size analysis which indicated largest shrimp in subarea 18 and smaller shrimp elsewhere. For the whole period, landings were 4.7 million lbs with 33,158 lbs discarded (0.7% of catch).

Biweekly and cumulative landings from incomplete interviews (no record of being questioned on discarding) and from dealer records (no interviews) are summarized in Tables 20 and 21. There were 1,058 trips during the survey period that were interviewed without collecting discard information and that landed 755,731 lbs of shrimp, mostly from subareas 18 and 19. Highest biweekly landings were reported during July 16-31. An additional 8,453 trips were recorded by dealers, again mostly in subareas 18 and 19, that landed another 9.1 million lbs. Again, highest biweekly landings were reported immediately after the season opened. Total shrimp landings for June 1-August 31, 1987 were than nearly 14.6 million lbs.

The total discard by shrimp vessels fishing off Texas and landing in Texas ports can be estimated from these data. Assuming that the 1,093 trip interviews reporting discards reflect a random sample of all 10,604 trips, the discard rate of 0.7% from those interviews applied to total landings of 14.6 million lbs (99.3% of total catch) yields an estimated discard of 103,000 lbs. At 65 tails/lb (the old Texas legal size limit of 112 mm), this biomass represented a possible discard of 6.7 million shrimp.

Compared with 1985 and 1986 (Klima et al. 1987), proportional discarding in 1987 was again on the low side (9.9% in 1985, 0.2% in 1986), but nearly 5 times as much biomass was discarded in 1987 as in 1986 (103,000 lbs vs. 22,400 lbs, respectively). An estimated 1.1 million lbs was discarded in 1985.

DISCUSSION

The current FMP lists four criteria that are to be considered by the GMFMC in reaching a decision about whether or not to recommend an EEZ closure in cooperation with the closure of state waters off Texas. These criteria are:

1. Benefits in increased pounds of shrimp caught and/or gross and/or net ex-vessel value to the industry resulting from the closure.

2. Adverse effects from an increase in fishing pressure as a result of the closure which causes a decrease in catch per unit effort.

3. Adverse effects from stress on support facilities for the shrimp fleet because of fleet migration resulting from the closure.

4. Any other information determined by the Regional Director to be relevant.

The discussion of results in this report will be formatted in such a way that relevant material will be placed under sub-areas which in most cases correspond to each of the listed criteria.

Historical Perspective

The abundance of brown shrimp differed in 1986 and 1987. The Louisiana brown shrimp catch from May-August 1986 for the inshore and offshore areas was 37.1 million pounds (14.3 inshore, 22.8 offshore), whereas in 1986 the total catch of brown shrimp for the same period was 33.2 million pounds (12.4 inshore, 20.8 offshore). In Texas during the May-August 1986 period only 19.1 million pounds (5.1 inshore, 14.0 offshore) were taken, while in the same period in 1987 about 25.1 million pounds (7.6 inshore, 17.5 offshore) were caught. Thus, in 1986 almost 9 million pounds of shrimp more were caught offshore Louisiana when compared to offshore Texas,

whereas in 1987 the offshore difference was only about 3 million pounds. This similarity in 1987 abundance between the two states should be remembered during the discussion of other results.

Effort in the brown shrimp offshore fishery this year (1987) far exceeded levels usually experienced during the summer period (Table 22). Yet, it was not the closure that caused the increase, since both offshore Louisiana and offshore Texas experienced a similar increase. A steady increase in fishing effort has been observed in the brown shrimp fishery for several years (Nance and Nichols, 1987). This increase in effort has greatly impacted the benefits of the Texas closure regulations. This is easily observed when CPUE values were computed for the offshore brown shrimp fisheries in Louisiana and Texas (Table 22). Note the reduction in CPUE experienced this year, even with the average to above average shrimp landings. Also, notice the decrease in CPUE off Texas in July with the closure at 15 nautical miles (1986 and 1987) instead of the 200 nautical mile closure (1981-1985) (Table 22). An average catch of brown shrimp was predicted this season off Texas (Table 23), but CPUE values will probably be very low, because of the increased fishing effort.

The average size of shrimp taken in the offshore waters of both Texas and Louisiana during the May-August 1987 period was smaller than shrimp taken during the same period in 1986. In Texas during May and June 1986, the average size was 40 count and 52 count respectively, whereas in 1987, the average size was 55 count in May and 66 count in June. In July and August 1987 average sizes were 45 count and 38 count respectively, which was not much different from 1986.

Although there was a considerable amount of small shrimp in the fishery during May and June, discards were estimated to be minimal. Discards amounted to only 103,00 pounds in 1987. This is between the low value experienced last year at 23,000 pounds and the high value of over 1.1 million pounds estimated in 1985. We feel that there was not as much economic incentive this year to discard shrimp because of the high prices being paid for small shrimp. This price structure will be discussed in greater detail later in the report.

Catch from inshore waters were near average in Louisiana at 12.4 million pounds, but were high in Texas at 7.6 million pounds. This is the largest catch of brown shrimp ever experienced in the Texas inshore fishery.

Size of shrimp caught in Texas inshore waters were much smaller in 1987 when compared to 1986. During May 1987 average size was 130 count, whereas last year it was 116 count. June, July and August also had similar results with 125 count, 94 count and 71 count respectively in 1987, and 96 count, 88 count and 48 count respectively in 1986. Louisiana sizes were all similar to last year, with larger sizes than Texas during every month (Table 6). This is the first time Louisiana inshore fishermen have caught larger sized shrimp than Texas inshore fishermen.

Benefits of Closure

Impacts of the closure analyses this year showed no build up of biomass off Texas in 1986 or 1987 with the 15 nautical mile closure when compared to the build up experienced during the 200 nautical mile closure (Figs. 18 and 19). Thus, the potential increase in harvest of larger shrimp has been exchanged for access to offshore waters in May and June during the last two seasons.

Simulation of fishing mortality with a 200 nautical mile closure in 1986 was undertaken with and without adjustment for the increase in effort seen in the winter of biological year 1986. Without adjustment, the model showed a net loss of 1.37 million pounds, mainly in the larger size categories (Fig. 20). With an adjustment for the winter fishing increase, a net gain of 1.1 million pounds would occur (Fig. 21). The adjustment for winter fishing seems to be the better simulation, not because of the net gain, but because the increase did occur and many larger sized shrimp were caught during this period than in previous years. The increase in the winter effort on brown shrimp is most likely not an effect of the closure (remember there was no closure in 1986), but most likely a response to better fuel prices and or a return to brown shrimp fishing following a brief lay off to fish for white shrimp in the fall and early winter. The white shrimp catch has been increasing steadily for the past several

years (Nance and Nichols, 1987).

An increase of around 0.82 million pounds would have resulted in the May-August 1987 period with a total closure of the EEZ off Texas (Fig. 22). Projections for the May-April period show an increase of around 2.18 million pounds with a total closure (Fig. 23). There is no indication that there will be a winter fishery for brown shrimp this year. All preliminary reports of catch data show a significant reduction after the August 1987 period.

Every year an increase in pounds has been estimated because of the closure (Klima, et al., 1987). This has been true for all years even though shrimp abundance has varied tremendously between years. The volatile fluctuations in catch are caused primarily by changes in the recruitment to the adult stock. Since brown shrimp recruit from the inshore areas to the offshore fisheries from late May to mid-July, and can be taken at this subadult stage when growth is extremely rapid, the resulting protection by the Texas Closure, which prohibits fishing on these juveniles, is well acknowledged to increase biomass, even at the mortality rates experienced for this species (Nichols, 1982).

In essence, there is little the manager can do to alter the abundance of shrimp between years, and the only option available is to take advantage of this rapid growth by restricting fishing and thus increasing pounds and eventually increasing dollars paid to the fishermen. It is well acknowledged that there will be an increase in pounds for a given year class because the accelerated growth far exceeds the natural mortality of the species. The manager is then faced with the decision of either partially protecting the stock with a prohibition of fishing out to 15 nautical miles or completely protecting the stock by prohibiting fishing out to 200 nautical miles.

In regards to the Texas Closure, a complete closure out to 200 nautical miles has been effective in curtailing fishing on this stock during the June-July recruitment phase (Klima, 1981). Another option implemented in 1986 was to partially close the zone and only prohibit trawling out to 15 nautical miles in conjunction with the state of Texas. This resulted in

substantial catches of small juvenile brown shrimp and increased the fishing mortality on the overall stock. However, in some cases taking small shrimp in large numbers may be more profitable than waiting and taking medium sized shrmp in moderate numbers because one factor that enters into the equation for determining the profitability to the fishermen is the price per pound paid to the fishermen. During 1986, the price structure was such that there were large differences in price between size categories, the lowest price being paid for the smallest shrimp and the highest price being paid for the largest shrimp, but with relatively steep gradation in the price paid between size categories (Fig. 38). In 1987, the price structure was relatively flat with little difference in price paid for 70 count shrimp to a size of approximately 30 count heads off (Fig. 39).

We have examined the relationship between different abundance levels, completely closed season versus partially closed season, and two price structures. We selected three levels of abundance (high, medium and low) with the high exemplifying the 1981 season, medium exemplifying the 1987 season, and the 1983 season as an example of the low. We have applied the two price structures (1986 and 1987) and calculated the yield in pounds and then dollars for both an open and closed situation.

Price was calculated as a monthly average for a given size group and then applied to any change noted in a particular group. These increases and decreases were summed for the entire four month period (May-August) and differences between opened and closed seasons noted.

In an above average year, both price structures cause an increase with a total closure (Fig. 40). The 1986 price structure causing a 5.15 million dollar increase over the 1987 price structure situation. In a poor season, it seems better to leave the closure opened (Fig. 41). Both price structures showed a negative impact on overall price if the total closure was in effect. During an average year, a total closure gives better overall value to the shrimp harvest with both price structures (Fig. 42). Thus, only during a poor season does it seem economically beneficial to have a partial closure of the EEZ off Texas. This points to the need for accurate

predictions of the upcoming shrimp season, so better management of shrimp can occur.

Adverse Effects of Closure

All analyses show that effort has increased Gulf wide, with an overall decrease in CPUE. This change has occurred not because of the combined closure off Texas, but in response to the increase in vessels fishing the offshore waters. Thus, it seems that no adverse effects on CPUE or effort have occurred because of closure regulations.

Analysis of vessel mobility show that offshore vessels are starting to fish to a greater extent in home state waters each year. Percentage of catch from Louisiana waters by Texas vessels was lower this year than in either 1985 or 1986 (Fig. 43). Levels in 1986 were higher than 1985 because of the higher catch rates off Louisiana compared to Texas. Many Texas vessels fished in Louisiana last year to take advantage of this situation (Klima et al., 1987).

Shrimp catch in Texas waters from non-Texas vessels has decreased steady each year (Fig. 44). The very low level in June 1985 was because the entire EEZ was closed off Texas during this period. It appears as though the 15 nautical closure has decreased the take of shrimp from non-Texas vessels from waters off the state of Texas. This occurred even with the large influx of Florida vessels this year, because of the poor season experienced off their state this past winter and spring.

Other Relevant Information

Responses of captains about the EEZ closure off Texas were very similar to last year. Greatest negative responses to a closure were again from captains in Louisiana and ports along the upper Texas coast (Fig. 45), while greatest positive responses were from captains in Florida, Alabama and ports along the lower coast of Texas (Fig. 46). Mississippi increased in both positive and negative categories this year because fewer no opinion responses were given to the NMFS agents.

Farther indepth analysis this year showed that the more freezer boats

an area had, the greater the positive response to the closure and the more captains that selected a 200 mile closure over a 15 mile closure. Captains indicated that it was for better enforcement of the closure that the 200 nautical mile limit was selected.

Asian fishermen present a complex problem to the management of the fishery. This group of captains had little idea about the purpose of the closure and no expressed opinions about the fishery regulations. Special attention must be focused on this segment of the population.

Enforcement efforts were greatly enhanced this year. Over 40 vessels were apprenhended while fishing within the closed portion of the EEZ. Yet, Coast Guard reports indicate there were many vessels in violation of the closed waters this year that were not seized. It is virtually impossible for any agency to mount a significant effort to prevent people from crossing an imaginary line unless the industry is solidly behind this type of regulation and are willing to commit and to follow through by volunteering information for apprehending violators.

SUMMARY

The 1986 Fishery

Brown shrimp offshore production in statistical subareas 18-21 from May 1986 to April 1987 amounted to 27.2 million pounds. Over 10.7 million pounds were produced in July-August alone. Moderate catches and moderate levels of relative abundance occurred off the Texas coast in July and August. A peak in CPUE of almost 896 pounds/day occurred in July, but dropped to 799 pounds/day in August. Production of brown shrimp from September to December 1986 amounted to 10.5 million pounds with an average CPUE of around 625 pounds/day. These were the highest catch and CPUE values recorded since 1974, with the exception of 1981. In the January-April 1987 period, production amounted to only 2.7 million pounds with the CPUE falling to an average of approximately 287 pounds/day, but these were again nearly the highest levels recorded since 1974.

The offshore brown shrimp catch from statistical subareas 13-17 from May 1986 to April 1987 amounted to 29.6 million pounds. The 9.6 million pound brown shrimp catch in Louisiana offshore waters during the July-August 1986 period was similar to the 10.7 million pounds produced in Texas waters. The CPUE averaged 813 pounds/day. The September-December Louisiana offshore catch amounted to 4.8 million pounds, which was higher than all other closure years. During this time period the overall CPUE of 600 pounds/day was about the same as was occurring in Texas offshore waters. The catch in January-April 1987 amounted to 2.0 million pounds with an average CPUE of 274 pounds/day, which was also similar to Texas.

In comparing the catch, fishing effort and CPUE with their associated historical values, for Texas and Louisiana offshore waters from May 1986 to April 1987, we found no significant differences in monthly catch off Texas, but significant difference in the monthly catch off Louisiana. Fishing effort was greater than the historical fishing effort off Louisiana, but not off Texas. Much of the effort normally expended off Texas was diverted to Louisiana because of perceived higher than normal shrimp abundance.

Recruitment to the Texas brown shrimp fishery in 1986 was slightly

below average. Our predicted annual production of 25.3 million pounds from July 1986-June 1987 was close to the actual catch of 27.1 million pounds and was slightly above the average 26.9 million pounds for offshore production covering the past 26 years.

A net gain of 1.1 million pounds of shrimp would have occurred with a complete closure of the EEZ off Texas. This gain was, however, from an extremely good winter fishery.

The 1987 Fishery

Recruitment to areas 18-21 in 1987 appeared to be slightly below average. We estimated an annual yield of 25.7 million pounds for Texas offshore waters. The offshore catch in July-August 1987 from subareas 18-21 amounted to 14.2 million pounds or an estimated annual yield of 23.6 or 30.2 million pounds using historical percent of total caught during July-August.

Louisiana Department of Wildlife and Fisheries predicted that brown shrimp recruitment to Louisiana fisheries would be higher in 1987 than in most years. The NMFS forecasted an above average catch for Louisiana of up to 32.9 million pounds (average = 27.0 million pounds).

In 1987, the total Louisiana May-August catch was 33.2 million pounds compared to 25.1 million pounds in Texas. Recruitment levels were only slightly different between areas 13-17 and 18-21. This similarity in both recruitment and production set the tone for the summer offshore fishery.

Fishing effort was much greater off both Louisiana and Texas this year compared to all other years. This increase in effort with only average to slightly above average abundance produced poorer than normal CPUE values in both areas.

The catch off Texas in July-August 1987 amounted to 14.2 million pounds. This is one of the largest catches experienced during this period. The average CPUE for this period was only 789 pounds/day. A rather low value when compared to other years.

The July-August catch off Louisiana amounted to 9.3 million pounds with an average CPUE of 589 pounds/day. The July-August 1986 Texas offshore

brown shrimp CPUE were almost identical to Louisiana offshore CPUE for the same time period. In all other closure years including 1987, the CPUE off Texas has been at least 1.5-2.0 times greater than off Louisiana.

The average size of shrimp in July and August off Louisiana was 69 and 43 per pound, respectively, whereas off Texas the average count was 45 in July and 38 in August 1986.

Home port information indicated that during the June 1 though August 31 period Louisiana vessels predominantly landed in Louisiana and very few Texas vessels landed in Louisiana. Likewise, Texas vessels predominantly caught the majority of shrimp landed in Texas. Louisiana vessels rarely landed in Texas. Overall probably 80% of the offshore landings in Louisiana were caught by Louisiana vessels and between 80-90% of the Texas landings were caught by Texas vessels.

An increase of around 0.82 million pounds would have resulted in the May-August 1987 period with a total closure of the EEZ off Texas. Projections for the May-August period show an increase of around 2.18 million pounds with a total closure.

Responses from interviewed vessel captains, about the EEZ closure, were similar to those received last year. Greatest negative responses to a closure were again from captains in Louisiana and ports along the upper Texas coast, while greatest positive responses were from captains in Florida, Alabama and ports along the lower coast of Texas.

Analysis of the EEZ closure each year has shown a positive benefit in pounds with a total closure. Additional studies this year indicate that all years, except very poor abundance years, would show an increase in ex-vessel prices paid for shrimp with a complete closure, with most price structures. Thus, from this analysis it seems that a complete closure would in most cases only enhance the fishery and not hinder it.

Thus, the goals of the FMP were only partially achieved in 1987 with the 15 nautical mile closure. The closure did allow the capture of large shrimp in deeper waters, but problems were encountered in enforcement again this year. A lot of vessel captains complained about the poaching of small in the social survey conducted this year. If the management plan is to be effective, compliance to the regulations must be observed by all involved.

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Table 1. Comparison of Texas closure dates.

Closure Year	Dates Closed	Length in Days
1981	May 22-July 15	55
1982	May 25-July 14	51
1983	May 27-July 15	50
1984	May 16-July 6	52
1985	May 20-July 8	50
1986	May 10-July 2	54
1987	June 1-July 15	45

Table 2. Copy of the sociological survey interview form used during the 1987 fishing season.

1987 OFFSHORE SOCIAL SURVEY
VESSEL CAPTAINS

INTERVIEW DATE _____ INTERVIEW PORT _____
VESSEL NAME _____ OFFICIAL NUMBER _____
VESSEL LENGTH _____ VESSEL TYPE (ICE OR FREEZER) _____
VESSEL HOME PORT _____ CAPTAIN'S ETHNIC GROUP (CIRCLE ONE)
(WHITE, HISPANIC, BLACK, ASIAN,
AMERICAN INDIAN, LA-FRENCH

1. HOW MANY YEARS HAVE YOU BEEN A COMMERCIAL FISHERMAN? _____
   A. HOW MANY YEARS HAVE YOU BEEN A SHRIMP FISHERMAN? _____
2. HOW OLD ARE YOU? _____
3. HOW MANY YEARS OF FORMAL EDUCATION DO YOU HAVE? _____
   (i.e., 1) not completed H.S., 2) completed H.S., 3) some college, 4) completed college, 5) graduate work)
4. ANNUAL NET INCOME IN 1986 _____ (i.e., 1) less than $10,000; 2) $10,000-$25,000; 3) $25,000-$50,000; 4) greater than $50,000)
5. IN YOUR OPINION, WHAT IS THE PURPOSE OF THE CLOSURE OF FEDERAL WATERS OFF TEXAS?
   _____
   _____
6. SHOULD THESE FEDERAL WATERS BE CLOSED? _____
   WHY? _____
   _____
   IF YES, WHAT DISTANCE? _____
7. BEFORE THE CLOSURE OF FEDERAL WATERS OFF TEXAS IN 1981, WHERE DID YOU TRAWL DURING JUNE _____
   JULY _____
   AUG _____
8. DID THE CLOSING OF FEDERAL WATERS OFF TEXAS THIS YEAR CAUSE YOU TO ALTER YOUR FISHING HABITS DURING JUNE _____/_____
   JULY _____/_____
   AUG _____/_____
9. HOW DID YOU MAKE THE DECISION TO FISH A PARTICULAR AREA THIS YEAR?
   a. During closure _____
   b. After closure _____
10. WHAT DO YOU SEE AS THE ONE BIGGEST ADVANTAGE OF THE FEDERAL WATER CLOSURE OFF TEXAS?
    _____
    _____
11. WHAT DO YOU SEE AS THE ONE BIGGEST DISADVANTAGE OF THE FEDERAL WATER CLOSURE OFF TEXAS?
    _____
    _____
12. HOW HAS THE FEDERAL WATER CLOSURE AFFECTED YOU PERSONALLY?
    _____
    _____
    _____

Table 3. Total offshore brown shrimp landings in millions of pounds, total fishing effort in 1000's of days and CPUE in lbs/day for Louisiana statistical subareas 13-17, and Texas statistical subareas 18-21 for 1974-1987 (1980 not included).

	Totals and Averages for Jan-Apr.		Totals and Averages for May-June		Totals and Averages for July-Aug.		Totals and Averages for Sept.-Dec.	
Area	13-17	18-21	13-17	18-21	13-17	18-21	13-17	18-21
1974								
Catch	1.4	2.6	1.9	2.4	4.0	13.0	3.5	8.4
Effort	3.5	6.6	4.5	6.8	6.3	18.1	4.8	13.5
CPUE	387	396	427	337	633	732	807	575
1975								
Catch	1.4	1.8	1.7	3.2	2.9	11.5	3.1	8.3
Effort	3.2	4.5	2.8	5.6	4.3	15.0	4.1	16.5
CPUE	461	257	627	503	671	771	940	497
1976								
Catch	2.3	2.0	5.2	2.0	7.9	11.5	5.7	10.7
Effort	4.9	7.1	8.2	5.6	9.0	16.5	9.6	19.1
CPUE	452	286	613	372	873	723	590	504
1977								
Catch	1.8	0.8	10.0	2.6	11.8	16.7	5.8	12.6
Effort	7.0	4.1	12.0	6.5	12.6	16.5	8.1	20.7
CPUE	263	177	837	461	939	1019	765	586
1978								
Catch	3.9	1.8	10.9	3.4	13.6	11.7	4.1	10.9
Effort	7.8	5.8	15.7	7.6	16.2	13.9	8.9	24.4
CPUE	555	286	697	447	827	864	451	436
1979								
Catch	3.1	2.2	9.8	2.8	9.5	7.4	4.1	6.4
Effort	8.2	8.3	18.0	6.5	24.3	11.9	11.2	15.0
CPUE	393	277	545	427	420	617	387	420
1981								
Catch	0.6	0.5	12.6	0.4	10.5	25.0	4.3	14.1
Effort	1.8	1.9	14.8	1.1	11.9	14.8	6.6	21.1
CPUE	308	269	852	308	863	1895	654	648
1982								
Catch	1.7	1.6	8.6	0.8	5.1	13.1	2.8	7.3
Effort	3.9	4.7	14.2	2.6	9.8	15.7	6.2	18.0
CPUE	412	330	607	295	524	922	447	403
1983								
Catch	1.4	0.8	3.9	0.7	4.9	9.9	2.5	6.6
Effort	4.3	3.3	9.1	2.3	11.2	10.3	4.7	14.6
CPUE	326	242	430	310	439	962	526	452
1984								
Catch	1.3	0.9	7.1	0.8	6.6	15.3	2.7	5.2
Effort	3.4	3.9	9.8	2.4	11.2	18.6	4.7	14.2
CPUE	395	224	718	295	587	819	575	366
1985								
Catch	2.0	1.4	10.9	0.6	6.1	14.0	3.4	9.7
Effort	4.4	3.8	11.1	1.5	9.7	15.2	5.3	15.5
CPUE	459	353	982	389	625	918	642	626
1986								
Catch	3.6	3.3	13.2	3.3	9.6	10.7	4.8	10.5
Effort	7.5	8.4	15.9	6.3	11.8	12.5	8.0	16.8
CPUE	480	393	830	524	813	856	600	625
1987								
Catch	2.0	2.7	11.5	3.3	9.3	14.2	-	-
Effort	7.3	9.4	19.0	7.7	15.8	18.1	-	-
CPUE	274	287	605	429	589	789	-	-

Table 3. cont. Total summary of total offshore brown shrimp landings in millions of pounds, total fishing effort in 1000's of days and average CPUE in lbs/day for Louisiana statistical subareas 13-17, and Texas statistical subareas 18-21 for 1974-1987 (1980 not included).

	May		June		July		Aug.	
Area	13-17	18-21	13-17	18-21	13-17	18-21	13-17	18-21
1974								
Catch	0.8	0.6	1.1	1.8	2.1	5.9	1.9	7.1
Effort	2.2	2.9	2.3	3.9	3.3	7.3	3.0	10.8
CPUE	374	219	480	455	628	806	637	657
1975								
Catch	1.0	0.5	0.7	2.7	1.5	6.1	1.4	5.4
Effort	1.4	2.2	1.4	3.4	2.0	6.8	2.3	8.2
CPUE	724	208	529	797	723	891	620	651
1976								
Catch	1.4	0.8	3.8	1.2	4.8	6.2	3.1	5.3
Effort	3.2	3.1	5.0	2.5	5.4	7.4	3.6	8.8
CPUE	456	246	770	497	880	839	866	607
1977								
Catch	3.6	0.5	6.4	2.1	5.9	8.6	5.9	8.1
Effort	4.3	3.6	7.7	2.8	6.3	7.5	6.3	9.0
CPUE	839	150	835	771	935	1147	943	891
1978								
Catch	5.3	0.8	5.6	2.6	8.5	5.4	5.1	6.3
Effort	7.7	3.8	8.0	3.8	9.0	5.5	7.2	8.4
CPUE	685	217	708	677	941	982	713	746
1979								
Catch	4.1	0.9	5.7	1.9	4.2	3.9	5.3	3.5
Effort	7.6	3.2	10.4	3.3	14.7	5.6	9.6	6.3
CPUE	536	271	554	582	285	685	555	548
1981								
Catch	5.0	0.4	7.6	-	7.5	10.4	3.0	14.6
Effort	5.8	1.1	9.0	-	8.1	4.4	3.8	10.4
CPUE	861	308	842	-	927	2382	799	1408
1982								
Catch	3.3	0.8	5.3	-	3.3	6.6	1.8	6.4
Effort	5.4	2.6	8.8	-	6.4	5.2	3.4	10.2
CPUE	609	295	604	-	525	1279	522	629
1983								
Catch	1.0	0.5	2.9	0.2	2.6	5.2	2.3	4.8
Effort	2.5	1.8	6.6	0.5	4.2	3.7	4.9	6.7
CPUE	417	294	441	163	415	1414	470	714
1984								
Catch	2.6	0.6	4.5	0.2	3.8	8.8	2.7	6.5
Effort	3.3	2.1	6.5	0.3	6.4	8.2	4.7	9.0
CPUE	769	275	691	748	598	1074	573	723
1985								
Catch	6.9	0.6	4.0	0.0	3.0	8.2	2.5	5.6
Effort	5.7	1.5	5.4	0.0	4.9	6.8	3.7	8.4
CPUE	1221	391	732	0	612	1223	682	672
1986								
Catch	7.8	1.0	5.4	2.3	6.3	5.7	3.3	5.0
Effort	8.0	2.6	7.9	3.7	7.5	6.3	4.3	6.2
CPUE	978	390	691	628	840	896	773	799
1987								
Catch	4.9	0.9	6.6	2.4	6.0	8.9	3.3	5.3
Effort	7.9	3.1	11.1	4.6	10.0	9.9	5.8	8.2
CPUE	618	300	595	519	595	905	577	653

Table 3. Total offshore brown shrimp landings in millions of pounds, total fishing effort in 1000's of days and CPUE in lbs/day, for Louisiana statistical subareas 13-17, and Texas statistical subareas 18-21 for 1974-1987 (1980 not included).

	Jan.		Feb.		Mar.		Apr.	
Area	13-17	18-21	13-17	18-21	13-17	18-21	13-17	18-21
1974								
Catch	0.5	1.1	0.4	0.6	0.3	0.5	0.2	0.4
Effort	1.1	1.7	1.0	1.5	0.8	1.5	0.6	1.9
CPUE	448	653	408	427	385	301	308	202
1975								
Catch	0.4	0.7	0.4	0.6	0.4	0.3	0.2	0.2
Effort	0.5	1.8	1.1	1.7	1.0	1.0	0.6	0.0
CPUE	754	407	376	327	388	293	324	0.0
1976								
Catch	0.8	0.5	0.6	0.6	0.4	0.4	0.5	0.5
Effort	1.4	1.3	1.3	2.0	1.0	1.7	1.2	2.1
CPUE	534	384	501	289	401	245	370	227
1977								
Catch	0.5	0.2	0.4	0.2	0.5	0.1	0.4	0.3
Effort	1.8	1.0	1.6	0.9	1.8	0.7	1.8	1.5
CPUE	296	193	249	163	274	149	232	201
1978								
Catch	0.9	0.7	1.1	0.5	1.4	1.2	0.5	0.4
Effort	1.1	2.0	2.1	1.3	3.4	0.9	1.2	1.6
CPUE	836	353	531	371	413	174	438	247
1979								
Catch	0.7	0.7	1.0	0.6	0.8	0.5	0.6	0.4
Effort	1.9	2.3	2.0	2.4	2.3	2.1	2.0	1.5
CPUE	374	312	524	266	361	235	312	293
1981								
Catch	0.2	0.3	0.1	0.1	0.2	0.06	0.08	0.06
Effort	0.6	1.0	0.4	0.4	0.4	0.3	.04	0.2
CPUE	319	253	329	296	387	228	195	301
1982								
Catch	0.5	0.6	0.6	0.6	0.4	0.2	0.2	0.2
Effort	0.9	1.4	1.2	1.9	1.1	0.6	0.7	0.8
CPUE	549	454	446	317	370	276	281	271
1983								
Catch	0.4	0.3	0.3	0.2	0.4	0.1	0.3	0.2
Effort	1.2	1.0	1.2	1.0	1.1	0.5	0.8	0.8
CPUE	373	261	281	206	331	255	346	215
1984								
Catch	0.4	0.2	0.4	0.2	0.3	0.1	0.3	0.3
Effort	0.8	1.2	0.9	0.9	0.8	0.6	0.8	1.2
CPUE	502	196	382	236	326	227	366	74
1985								
Catch	0.6	0.4	0.5	0.3	0.4	0.2	0.4	0.4
Effort	0.8	1.1	1.3	0.9	1.4	0.9	0.9	0.9
CPUE	734	357	405	326	298	267	519	464
1986								
Catch	1.4	0.9	1.0	1.0	0.8	0.6	0.4	0.8
Effort	2.9	1.6	2.1	2.5	1.5	1.9	0.9	2.2
CPUE	478	547	508	387	497	330	470	349
1987								
Catch	0.5	1.0	0.6	0.8	0.6	0.4	0.3	0.5
Effort	1.1	2.8	2.1	2.6	2.7	2.1	1.4	1.9
CPUE	459	347	308	304	239	199	189	248

Table 4. Louisiana inshore brown shrimp catch 1987, in 1,000 pounds - Mississippi River to Texas. Does not include pieces.

Size Count	May	June	July	August	Total
<15	-	-	0.1	0.3	0.4
16-20	-	-	-	0.7	0.7
21-25	0.1	0.4	0.1	1.3	1.9
26-30	-	0.3	0.7	12.1	13.1
31-40	1.0	4.4	6.7	31.8	43.9
41-50	2.2	15.2	24.4	40.9	82.7
51-67	12.2	205.0	149.7	67.7	434.6
68-80	490.0	809.3	353.9	30.9	1 684.1
81-100	693.7	1,352.2	161.0	11.1	2,218.0
101-115	1,220.9	1,369.6	100.8	8.2	2,699.5
>116	2,016.9	2,768.2	153.4	15.1	4,953.6
Total	4,437.0	6,524.6	950.8	220.1	12,132.5

Table 5. Texas inshore brown shrimp catch 1987, in 1,000 pounds.

Size Count	May	June	July	August	Total
<15	-	-	0.1	-	0.1
16-20	-	0.1	0.5	-	0.6
21-25	0.3	0.2	1.3	0.6	2.4
26-30	0.3	0.3	0.7	-	1.3
31-40	17.2	6.7	12.3	1.7	37.9
41-50	33.3	15.3	19.0	4.6	72.2
51-67	79.2	40.7	70.1	1.5	191.5
68-80	90.4	85.7	316.1	4.2	496.4
81-100	141.5	316.0	286.7	9.7	753.9
101-115	354.1	554.9	240.7	0.7	1,150.4
116- >	2,200.1	2,445.1	254.7	0.3	4,900.2
Total	2,916.4	3,465.0	1,202.2	23.3	7,606.9

Table 6. Mean number of shrimp per pound from inshore waters in 1987.

State	May	June	July	August
LA	116	114	90	63
TX	130	125	94	71

Table 7. Mean number of shrimp per pound from offshore waters (1987).

State	May	June	July	August
LA	112	88	69	43
TX	55	66	45	38

Table 8. Numbers of shrimp caught in Texas and Louisiana from May-August 1987 (numbers in millions of shrimp).

State	May	June	July	August	Total
LA					
Inshore	516.5	744.8	86.2	13.9	1,361.4
Offshore	542.9	571.0	409.0	140.2	1,653.1
Total	1,059.4	1,315.8	495.2	154.1	3,024.5
TX					
Inshore	380.5	434.8	113.3	1.6	930.2
Offshore	51.3	153.8	396.8	197.7	799.6
Total	431.8	588.6	510.1	199.3	1,729.8

Table 9. May-August catch of brown shrimp in millions of pounds from inshore and offshore Louisiana waters in statistical subareas 13-17 and in Texas waters in statistical subareas 18-21.

	Years							
Area	1987	1986	1985	1984	1983	1982	1981	1980
Louisiana:								
Inshore	12.4	14.3	8.9	14.9	12.1	15.1	15.2	7.3
Offshore	20.8	22.8	16.9	13.6	8.8	13.7	23.1	11.7
Total	33.2	37.1	25.7	28.5	20.9	28.8	38.3	19.0
Texas:								
Inshore	7.6	5.1	5.4	7.1	5.9	4.1	4.2	4.5
Offshore	17.5	14.0	14.5	16.1	10.5	13.9	25.3	12.6
Total	25.1	19.1	19.9	23.5	16.4	18.0	29.5	17.1

Table 10. Percent of offshore Texas, Louisiana, Mississippi, Alabama and Florida landings caught off each state in 1987.

Percent of Texas Landings caught off each state offshore.

State Caught	June 1-30	July 1-31	August 1-31
TX	63.8	87.9	84.0
LA	36.2	12.1	16.0
MS	0.0	0.0	0.0
AL	0.0	0.1	0.0
FL	0.0	0.0	0.0
Thousand Pounds	4,085.9	10,026.6	6,438.0

Percent of Louisiana landings caught off each state offshore.

State Caught	June 1-30	July 1-31	August 1-31
TX	0.0	7.4	2.6
LA	99.9	90.5	96.9
MS	0.1	2.2	0.4
AL	0.0	0.0	0.0
FL	0.0	0.0	0.0
Thousand Pounds	7,443.7	6,096.4	5,951.1

Percent of Mississippi landings caught off each state offshore.

State Caught	June 1-30	July 1-31	August 1-31
TX	0.0	0.0	0.0
LA	0.0	3.8	8.6
MS	100.0	96.2	91.4
AL	0.0	0.0	0.0
FL	0.3	0.0	0.0
Thousand Pounds	231.5	54.0	37.8

Percent of Alabama landings caught off each state offshore.

State Caught	June 1-30	July 1-31	August 1-31
TX	0.0	14.9	19.4
LA	48.6	35.9	42.4
MS	35.7	43.2	37.0
AL	14.9	5.7	1.2
FL	0.8	0.4	0.0
Thousand Pounds	1,057.2	902.7	1,001.3

Table 10. continued.

Percent of Florida landings caught off each state offshore.

State Caught	June 1-30	July 1-31	August 1-31
TX	0.0	0.0	3.8
LA	2.5	0.3	0.4
MS	1.2	0.3	0.0
AL	2.1	0.1	0.0
FL	94.3	99.2	95.7
Thousand Pounds	915.8	499.7	645.9

Table 11. Percent and total pounds landed in millions of pounds (offshore only) by vessels and boats from Gulf States from June through August 1986.

Home Port	Area Landed	Area Fished	Pounds Landed	Total Landings in States	% of Total Pounds
			June 1-30		
LA	LA	LA	3.26	7.41	43.9
TX	LA	LA	0.54	7.41	7.2
Other*	LA	LA	0.11	7.41	1.5
Unknown**	LA	LA	3.51	7.41	47.3
LA	LA	TX	0.00	7.41	0.0
TX	LA	TX	0.00	7.41	0.0
Other	LA	TX	0.00	7.41	0.0
Unknown	LA	TX	0.00	7.41	0.0
LA	TX	LA	0.04	4.09	1.1
TX	TX	LA	1.15	4.09	28.2
Other	TX	LA	0.09	4.09	2.1
Unknown	TX	LA	0.19	4.09	4.7
LA	TX	TX	0.04	4.09	0.9
TX	TX	TX	2.27	4.09	55.6
Other	TX	TX	0.18	4.09	4.4
Unknown	TX	TX	0.12	4.09	3.0
			July 1-31		
LA	LA	LA	2.46	5.95	41.3
TX	LA	LA	0.28	5.95	4.6
Other	LA	LA	0.05	5.95	0.8
Unknown	LA	LA	2.72	5.95	45.7
LA	LA	TX	0.10	5.95	1.7
TX	LA	TX	0.06	5.95	1.0
Other	LA	TX	0.02	5.95	0.3
Unknown	LA	TX	0.27	5.95	4.6
LA	TX	LA	0.03	10.03	0.3
TX	TX	LA	0.94	10.03	9.4
Other	TX	LA	0.07	10.03	0.7
Unknown	TX	LA	0.17	10.03	1.7
LA	TX	TX	0.32	10.03	3.2
TX	TX	TX	6.60	10.03	65.8
Other	TX	TX	1.06	10.03	10.5
Unknown	TX	TX	0.85	10.03	8.4

Table 11. continued.

Home Port	Area Landed	Area Fished	Pounds Landed	Total Landings in States	% of Total Pounds
			August 1-31		
LA	LA	LA	2.45	5.88	41.7
TX	LA	LA	0.24	5.88	4.0
Other	LA	LA	0.09	5.88	1.5
Unknown	LA	LA	2.94	5.88	50.0
LA	LA	TX	0.10	5.88	1.7
TX	LA	TX	0.01	5.88	0.2
Other	LA	TX	0.00	5.88	0.0
Unknown	LA	TX	0.04	5.88	0.8
LA	TX	LA	0.02	6.44	0.3
TX	TX	LA	0.78	6.44	12.2
Other	TX	LA	0.06	6.44	1.0
Unknown	TX	LA	0.16	6.44	2.5
LA	TX	TX	0.10	6.44	1.6
TX	TX	TX	4.35	6.44	67.5
Other	TX	TX	0.48	6.44	7.5
Unknown	TX	TX	0.48	6.44	7.5

*Home port vessels from other states (i.e., Florida, Mississippi and Alabama).

**Unknown consolidated vessels and boats, mostly inshore boats.

Table 12. Fishery-independent SEAMAP determinations of brown shrimp and pink shrimp lengths during the 1986 Texas Closure (June 1-July 15, 1986). n = number measured; mm = mean mm total length; ±CI = 95% confidence interval of the mean length.

Vessel	Sampling Dates	Statistical Subareas	Depth (fm)	Brown Shrimp			Pink Shrimp		
				n	mm	±CI	n	mm	±CI
OREGON II	6/16-21	18	5-50	813	117	2.1	79	141	3.9
	6/18-24	19	5-50	2,961	106	0.9	35	164	9.9
	6/24-29	20	5-50	2,973	113	0.9	443	110	1.7
	6/27-28	21	6-18	584	100	1.5	293	110	1.7
	6/16-29	18-21	5-50	7,331	110	0.6	850	115	1.4

Table 13. Interview coverage of fishing trips off Texas during June 1-August 31, 1987 and interviews containing discard information. Only trips landing in Texas ports are included since discard data were collected only by Texas port agents.

Fishing Subarea	Total Trips (T)	Trips Interviewed (I)		Interviews with Discard Data		
		Number	%T	Number	%I	%T
18	2,742	368	13.4	83	25.6	3.0
19	5,655	506	9.0	150	29.6	2.7
20	1,087	392	36.1	260	66.3	23.9
21	1,120	885	79.0	600	67.8	53.6
18-21	10,604	2,151	20.3	1,093	50.8	10.3

Table 14. Biweekly brown shrimp landings (L), discard (D), and percent discarded (%D = D/(L+D)) in statistical subarea 18 during June 1-August 31, 1987 by unloading dates and depth zones (in 5-fm increments, where zone 1 = 1-5 fm, 2 = 6-10 fm, etc.). Landings and discards (lbs of tails) are from 83 interviews.

		Depth Zones							
Unloading Dates	Data	1 & 2	3	4	5	6	7	8	9 & 10
6/1-15	L	1,556	446	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0
	%D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6/16-30	L	47,956	7,695	10,569	0	0	0	0	0
	D	50	0	0	0	0	0	0	0
	%D	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/1-15	L	44,371	78,946	44,176	5,700	4,835	0	0	0
	D	300	10	0	0	0	0	0	0
	%D	0.7	<0.1	0.0	0.0	0.0	0.0	0.0	0.0
7/16-31	L	14,137	19,817	6,081	10,076	0	0	0	0
	D	70	0	0	0	0	0	0	0
	%D	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8/1-15	L	0	0	20,078	0	1,300	0	0	0
	D	0	0	0	0	0	0	0	0
	%D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8/16-31	L	38,550	7,310	4,423	0	0	0	0	0
	D	0	0	0	0	0	0	0	0
	%D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6/1-8/31	L	146,570	114,214	85,327	15,776	6,135	0	0	0
	D	420	10	0	0	0	0	0	0
	%D	0.3	<0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 15. Biweekly brown shrimp landings (L), discard (D), and percent discarded (%D = D/(L+D)) in statistical subarea 19 during June 1-August 31, 1987 by unloading dates and depth zones (in 5-fm increments, where zone 1 = 1-5 fm, 2 = 6-10 fm, etc.). Landings and discards (lbs of tails) are from 150 interviews.

Unloading Dates	Data	Depth Zones							
		1 & 2	3	4	5	6	7	8	9 & 10
6/1-15	L	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0
	%D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6/16-30	L	17,460	5,740	2,565	0	0	0	0	0
	D	6,120	0	0	0	0	0	0	0
	%D	26.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/1-15	L	0	116,608	38,969	7,235	0	1,229	0	0
	D	0	1,220	10	0	0	10	0	0
	%D	0.0	1.0	<0.1	0.0	0.0	0.8	0.0	0.0
7/16-31	L	1,500	46,521	63,713	37,570	0	0	0	0
	D	0	0	316	800	0	0	0	0
	%D	0.0	0.0	0.5	1.9	0.0	0.0	0.0	0.0
8/1-15	L	118	33,892	102,496	39,124	0	2,140	0	0
	D	0	0	200	0	0	0	0	0
	%D	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
8/16-31	L	4,490	89,023	140,084	59,079	7,453	0	0	0
	D	0	0	400	0	0	0	0	0
	%D	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
6/1-8/31	L	23,568	291,784	347,827	143,008	7,453	3,369	0	0
	D	6,120	1,220	926	800	0	10	0	0
	%D	20.6	0.4	0.3	0.6	0.0	0.3	0.0	0.0

Table 16. Biweekly brown shrimp landings (L), discard (D), and percent discarded (%D = D/(L+D)) in statistical subarea 20 during June 1-August 31, 1987 by unloading dates and depth zones (in 5-fm increments, where zone 1 = 1-5 fm, 2 = 6-10 fm, etc.). Landings and discards (lbs of tails) are from 260 interviews.

Unloading Dates	Data	Depth Zones							
		1 & 2	3	4	5	6	7	8	9 & 10
6/1-15	L	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0
	%D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6/16-30	L	0	0	40,975	5,855	1,720	0	0	0
	D	0	0	0	0	0	0	0	0
	%D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/1-15	L	0	23,987	71,717	36,750	3,310	731	0	0
	D	0	75	1,740	1,750	0	0	0	0
	%D	0.0	0.3	2.4	4.5	0.0	0.0	0.0	0.0
7/16-31	L	23,259	161,963	119,779	34,713	3,583	310	0	0
	D	0	3,372	2,470	410	0	0	0	0
	%D	0.0	2.0	2.0	1.2	0.0	0.0	0.0	0.0
8/1-15	L	155	103,605	69,898	24,657	12,335	4,042	0	0
	D	0	1,300	560	0	0	0	0	0
	%D	0.0	1.2	0.8	0.0	0.0	0.0	0.0	0.0
8/16-31	L	18,645	181,528	162,850	57,647	195	3,020	0	0
	D	0	1,720	1,850	0	0	0	0	0
	%D	0.0	0.9	1.1	0.0	0.0	0.0	0.0	0.0
6/1-8/31	L	42,059	471,083	465,219	159,622	21,143	8,103	0	0
	D	0	6,467	6,620	2,160	0	0	0	0
	%D	0.0	1.4	1.4	1.3	0.0	0.0	0.0	0.0

Table 17. Biweekly brown shrimp landings (L), discard (D), and percent discarded (%D = D/(L+D)) in statistical subarea 21 during June 1-August 31, 1987 by unloading dates and depth zones (in 5-fm increments, where zone 1 = 1-5 fm, 2 = 6-10 fm, etc.). Landings and discards (lbs of tails) are from 600 interviews.

Unloading Dates	Data	Depth Zones							
		1 & 2	3	4	5	6	7	8	9 & 10
6/1-15	L	0	2,905	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0
	%D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6/16-30	L	0	0	36,115	34,270	0	0	0	0
	D	0	0	50	0	0	0	0	0
	%D	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
7/1-15	L	0	2,585	36,210	55,500	14,920	0	0	0
	D	0	00	430	30	0	0	0	0
	%D	0.0	0.0	1.2	0.1	0.0	0.0	0.0	0.0
7/16-31	L	45,460	419,328	437,430	75,415	6,395	0	0	0
	D	30	1,070	2,645	350	200	0	0	0
	%D	0.1	0.3	0.6	0.5	3.0	0.0	0.0	0.0
8/1-15	L	23,650	190,145	395,615	159,115	44,985	3,585	0	0
	D	25	1,550	780	0	800	0	0	0
	%D	0.1	0.8	0.2	0.0	1.7	0.0	0.0	0.0
8/16-31	L	10,078	151,995	138,095	65,634	6,460	3,945	0	0
	D	0	0	245	200	0	0	0	0
	%D	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.0
6/1-8/31	L	79,188	766,958	1,043,465	389,934	72,760	7,530	0	0
	D	55	2,620	4,150	580	1,000	0	0	0
	%D	0.1	0.3	0.4	0.1	1.4	0.0	0.0	0.0

Table 18. Biweekly brown shrimp landings (L), discard (D), and percent discarded (%D = D/(L+D)) in statistical subarea 18-21 during June 1-August 31, 1987 by unloading dates and depth zones (in 5-fm increments, where zone 1 = 1-5 fm, 2 = 6-10 fm, etc.). Landings and discards (lbs of tails) are from 1,093 interviews.

Unloading Dates	Data	Depth Zones							
		1 & 2	3	4	5	6	7	8	9 & 10
6/1-15	L	1,556	3,351	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0
	%D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6/16-30	L	65,416	13,435	90,224	40,125	1,720	0	0	0
	D	6,170	0	50	0	0	0	0	0
	%D	8.6	0.0	0.1	0.0	0.0	0.0	0.0	0.0
7/1-15	L	44,371	222,126	191,072	105,185	23,065	1,960	0	0
	D	300	1,305	2,180	1,780	0	10	0	0
	%D	0.7	0.6	1.1	1.7	0.0	0.5	0.0	0.0
7/16-31	L	84,356	647,629	627,003	157,774	9,978	310	0	0
	D	100	4,442	5,431	1,560	200	0	0	0
	%D	0.1	0.7	0.9	1.0	2.0	0.0	0.0	0.0
8/1-15	L	23,923	327,642	588,087	222,896	58,620	9,767	0	0
	D	25	2,850	1,540	0	800	0	0	0
	%D	0.1	0.9	0.3	0.0	1.3	0.0	0.0	0.0
8/16-31	L	71,763	429,856	445,452	182,360	14,108	6,965	0	0
	D	0	1,720	2,495	200	0	0	0	0
	%D	0.0	0.4	0.6	0.1	0.0	0.0	0.0	0.0
6/1-8/31	L	291,385	1,644,039	1,941,838	708,340	107,491	19,002	0	0
	D	6,595	10,317	11,696	3,540	1,000	10	0	0
	%D	2.2	0.6	0.6	0.5	0.9	0.1	0.0	0.0

Table 19. Summary of Texas brown shrimp landings and discard (lbs of tails) by unloading date and statistical subarea of fishing, as derived from trip interviews during June 1-August 31, 1987.

Unloading Dates	Subarea	Biweekly				Cumulative			
		Trips	Landings	Discard	%Discard	Trips	Landings	Discard	%Discard
6/1-15	18	3	2,002	0	0.0	3	2,002	0	0.0
	19	0	0	0	0.0	0	0	0	0.0
	20	0	0	0	0.0	0	0	0	0.0
	21	1	2,905	0	0.0	1	2,905	0	0.0
	18-21	4	4,907	0	0.0	4	4,907	0	0.0
6/16-30	18	23	66,220	50	<0.1	26	68,222	50	<0.1
	19	6	25,765	6,120	19.2	6	25,765	6,120	19.2
	20	11	48,550	0	0.0	11	48,550	0	0.0
	21	40	70,385	50	0.1	41	73,290	50	0.1
	18-21	80	210,920	6,220	2.9	84	215,827	6,220	2.9
7/1-15	18	32	178,028	310	0.2	58	246,250	360	0.1
	19	32	164,041	1,240	0.8	38	189,806	7,360	3.7
	20	48	136,495	3,565	2.5	59	185,045	3,565	1.9
	21	56	109,215	460	0.4	97	182,505	510	0.3
	18-21	168	587,779	5,575	0.9	252	803,606	11,795	1.4
7/16-31	18	21	50,111	70	0.1	79	296,361	430	0.1
	19	43	149,304	1,116	0.7	81	339,110	8,476	2.4
	20	98	343,607	6,252	1.8	157	528,652	9,817	1.9
	21	219	984,028	4,295	0.4	316	1,166,533	4,805	0.4
	18-21	381	1,527,050	11,733	0.8	633	2,330,656	23,528	1.0
8/1-15	18	6	21,378	0	0.0	85	317,739	430	0.1
	19	39	177,770	200	0.1	120	516,880	8,676	1.7
	20	50	214,692	1,860	0.9	207	743,344	11,677	1.6
	21	180	817,095	3,155	0.4	496	1,983,628	7,960	0.4
	18-21	275	1,230,935	5,215	0.4	908	3,561,591	28,743	0.8
8/16-31	18	4	50,283	0	0.0	89	368,022	430	0.1
	19	44	300,129	400	0.1	164	817,009	9,076	1.1
	20	63	423,885	3,570	0.8	270	1,167,229	15,247	1.3
	21	111	376,207	445	0.1	607	2,359,835	8,405	0.4
	18-21	222	1,150,504	4,415	0.4	1,130	4,712,095	33,158	0.7

Table 20. Biweekly and cumulative brown shrimp landings (lb, tails) for trips unloading during June 1-August 31, 1987 that were interviewed without collecting discard data.

Unloading Dates	Subarea	Biweekly Trips	Biweekly Landings	Cumulative Trips	Cumulative Landings
6/1-15	18	19	6,061	19	6,061
	19	43	7,446	43	7,446
	20	24	10,855	24	10,855
	21	129	13,675	129	13,675
	18-21	215	38,037	215	38,037
6/16-30	18	36	21,841	55	27,902
	19	24	19,496	67	26,942
	20	29	28,049	53	38,904
	21	50	11,105	179	24,780
	18-21	139	80,491	354	118,528
7/1-15	18	68	63,607	123	91,509
	19	100	82,633	167	109,575
	20	19	12,208	72	51,112
	21	76	12,415	255	37,195
	18-21	263	170,863	617	289,391
7/16-31	18	62	68,379	185	159,888
	19	83	98,506	250	208,081
	20	49	56,822	121	107,934
	21	16	18,254	271	55,449
	18-21	210	241,961	827	531,352
8/1-15	18	50	35,911	235	195,799
	19	49	40,522	299	248,603
	20	7	10,312	128	118,246
	21	5	385	276	55,834
	18-21	111	87,130	938	618,482
8/16-31	18	41	49,728	276	245,527
	19	64	67,148	363	315,751
	20	12	19,032	140	137,278
	21	3	1,341	279	57,175
	18-21	120	137,249	1,058	755,731

Table 21. Biweekly and cumulative brown shrimp catch (lbs of tails) for trips unloading during June 1-August 31, 1987 that were recorded by dealers but not interviewed.

Unloading Dates	Subarea	Biweekly Trips	Biweekly Landings	Cumulative Trips	Cumulative Landings
6/1-15	18	100	107,599	100	107,599
	19	76	92,400	76	92,400
	20	17	21,568	17	21,568
	21	22	16,500	22	16,500
	18-21	215	238,067	215	238,067
6/16-30	18	441	432,956	541	540,555
	19	2,591	769,662	2,667	862,062
	20	107	174,304	124	195,872
	21	37	35,410	59	51,910
	18-21	3,176	1,412,332	3,391	1,650,399
7/1-15	18	602	845,873	1,143	1,386,428
	19	303	815,685	2,970	1,677,747
	20	128	330,606	252	526,478
	21	73	121,805	132	173,715
	18-21	1,106	2,113,969	4,497	3,764,368
7/16-31	18	702	855,159	1,845	2,241,587
	19	1,314	1,600,768	4,284	3,278,515
	20	348	243,717	600	770,195
	21	40	87,870	172	261,585
	18-21	2,404	2,787,514	6,901	6,551,882
8/1-15	18	291	414,161	2,136	2,655,748
	19	325	779,882	4,609	4,058,397
	20	57	178,334	657	948,529
	21	35	52,365	207	313,950
	18-21	708	1,424,742	7,609	7,976,624
8/16-31	18	238	390,263	2,374	3,046,011
	19	540	638,501	5,149	4,696,898
	20	38	51,573	695	1,000,102
	21	28	41,130	235	355,080
	18-21	844	1,121,467	8,453	9,098,091

Table 22. Summary of fishing effort and CPUE for Louisiana (13-17) and Texas (18-21).

Fishing Effort (1000 Day)

Year	Areas 13-17			Areas 18-21		
	May-June	July	August	May-June	July	August
1981	14.8	8.1	3.8	1.1	4.4	10.4
1982	14.2	6.4	3.4	2.6	5.2	10.2
1983	9.1	4.2	4.9	2.3	3.7	6.7
1984	9.8	6.4	4.7	2.4	8.2	9.0
1985	11.1	6.0	3.7	1.5	6.8	8.4
1986	15.9	7.5	4.3	6.3	6.3	6.2
1987	19.0	10.0	5.8	7.7	9.8	8.2
Average (81-85)	11.8	6.2	4.1	2.0	5.7	8.9

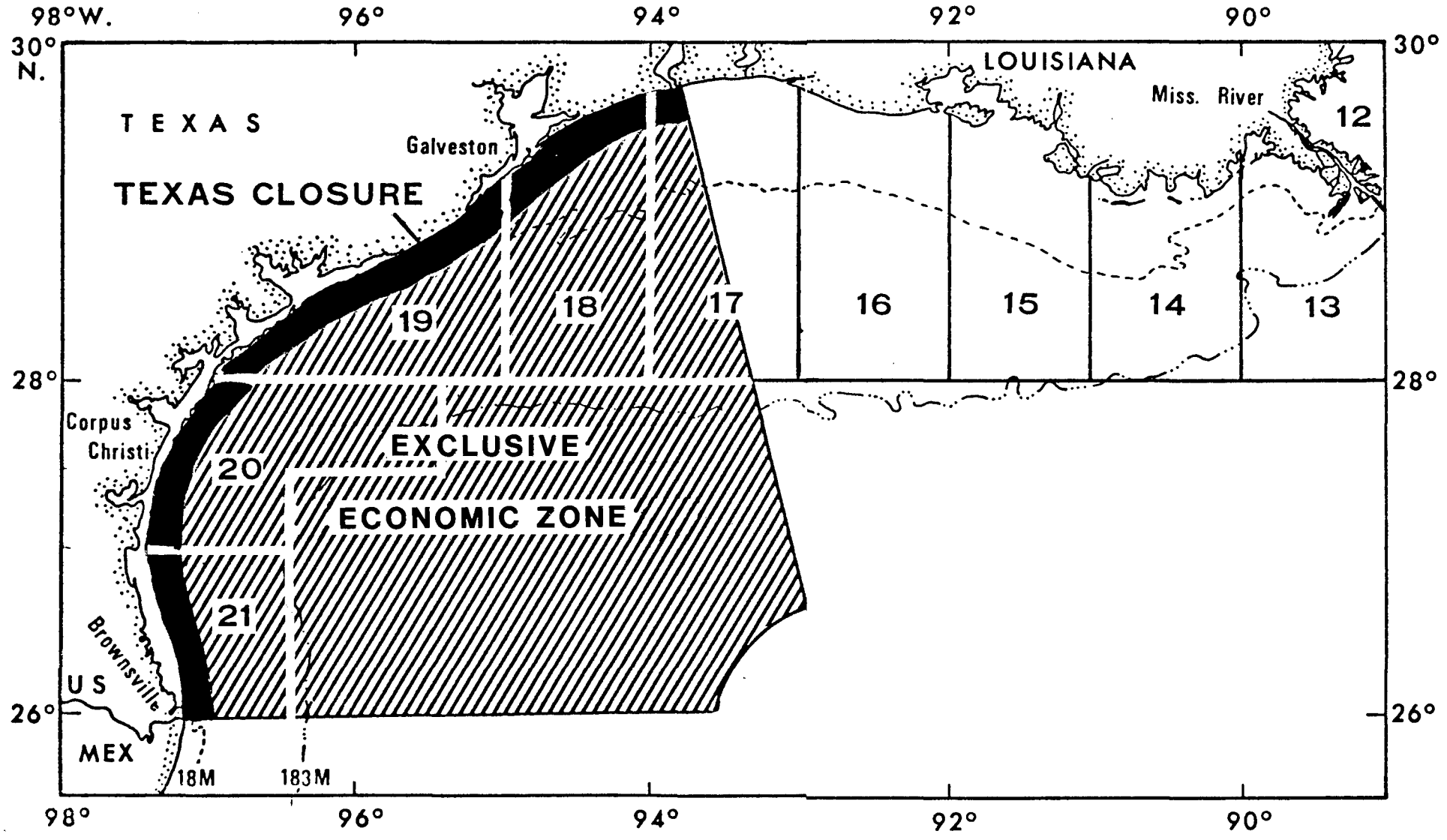
CPUE (lbs/fishing day)

Year	Areas 13-17			Areas 18-21		
	May-June	July	August	May-June	July	August
1981	852	927	799	308	2,382	1,408
1982	607	525	522	295	1,279	629
1983	430	415	470	310	1,414	714
1984	718	598	573	295	1,074	723
1985	982	612	682	389	1,223	672
1986	830	840	773	524	896	799
1987	605	595	577	429	905	653
Average (81-85)	718	615	609	319	1,474	829

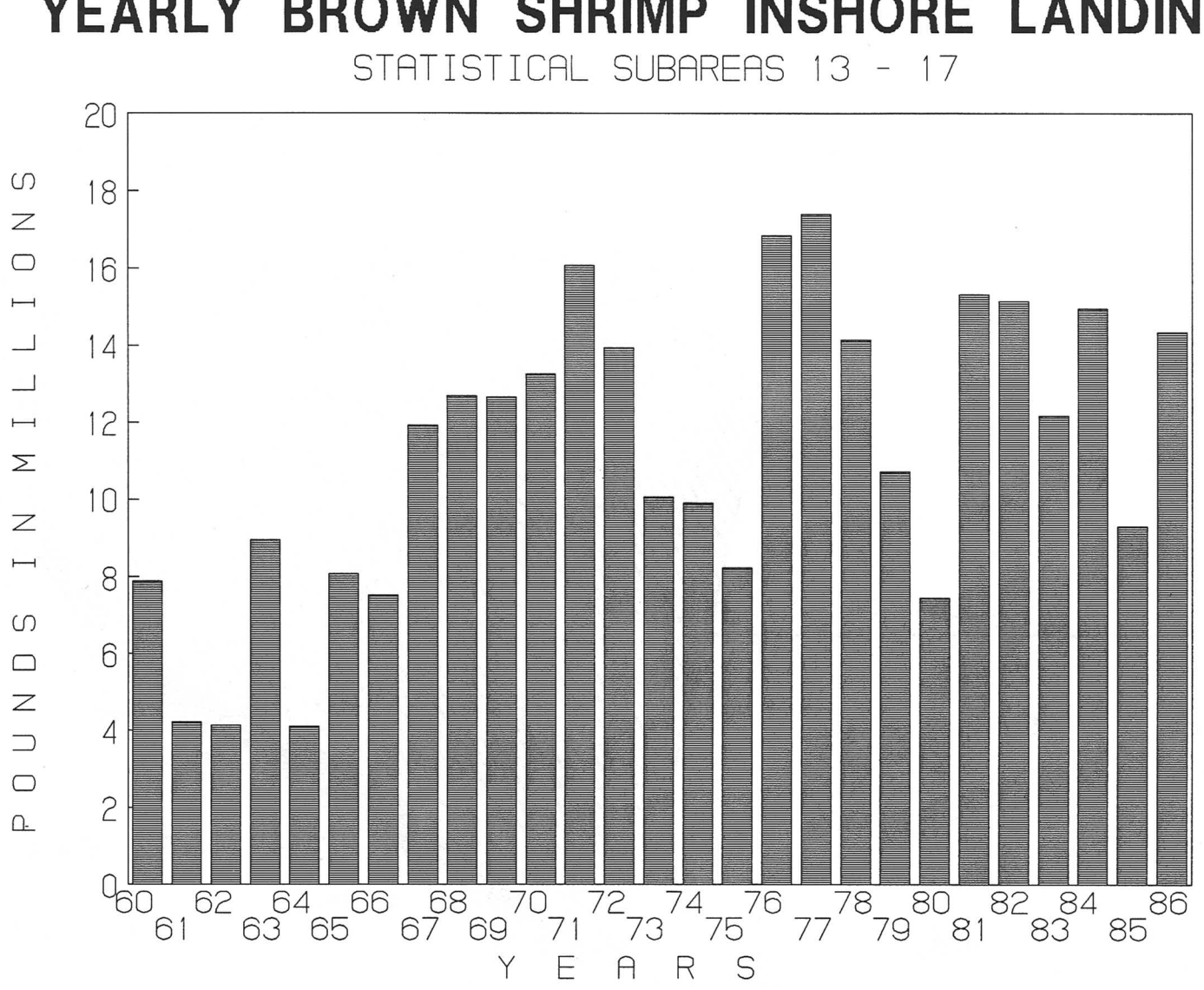
Table 23. Galveston Bay Bait shrimp index values from 1960-1986 (average catch = 26.9 million pounds.

Year	Bait index	Predicted catch in millions of pounds	Actual catch in millions of pounds	Difference in millions of pounds
1960	53.6	29.1	34.5	+5.4
1961	20.8	20.0	13.2	-6.8
1962	26.1	21.5	17.3	-4.2
1963	53.0	29.0	24.6	-4.4
1964	30.2	22.6	18.6	-3.9
1965	41.0	25.6	26.5	+0.9
1966	-	-	31.5	-
1967	89.4	39.0	42.7	+3.7
1968	28.0	22.0	27.9	+5.9
1969	43.5	26.3	24.7	-1.6
1970	70.0	33.7	30.7	-3.0
1971	82.3	37.1	34.5	-2.6
1972	85.6	38.0	35.5	-2.5
1973	18.7	19.4	23.3	+3.9
1974	34.3	23.8	26.4	+2.6
1975	-	-	23.7	-
1976	34.1	23.8	25.7	+1.9
1977	58.1	30.5	34.4	+3.9
1978	40.5	25.5	27.7	+2.2
1979	-	-	16.5	-
1980	45.0	26.7	25.7	-1.0
1981	54.3	29.3	40.0	+10.7
1982	26.3	21.5	21.8	+0.3
1983	12.7	17.8	18.2	+0.4
1984	31.2	22.9	24.1	+1.2
1985	44.9*	29.0	30.4	+1.4
1986	37.2	25.3	27.1	+1.8
1987	38.6	25.7	NA	NA

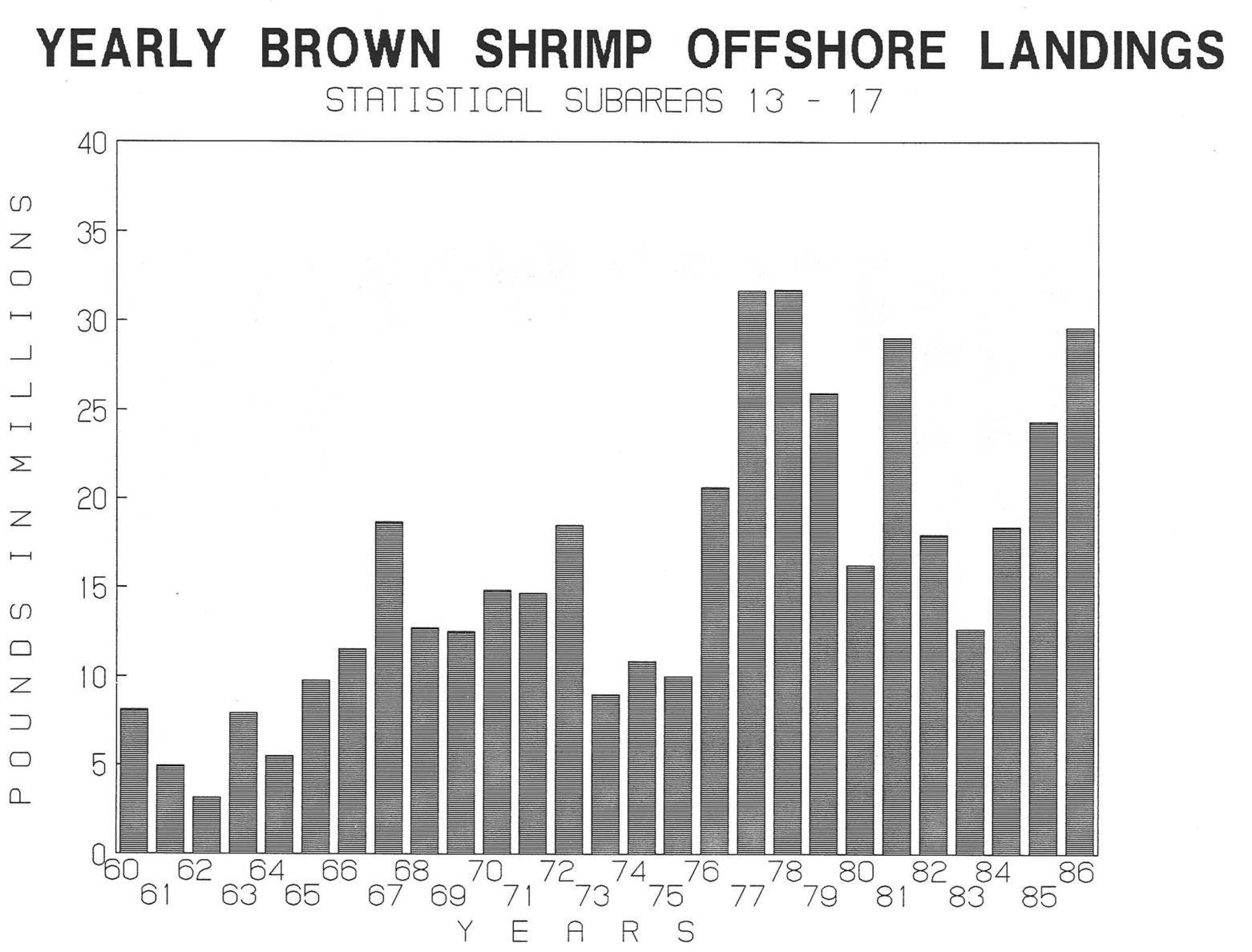
*Modified bait index model used.



1. Location of statistical subareas and the federal exclusive economic zone.



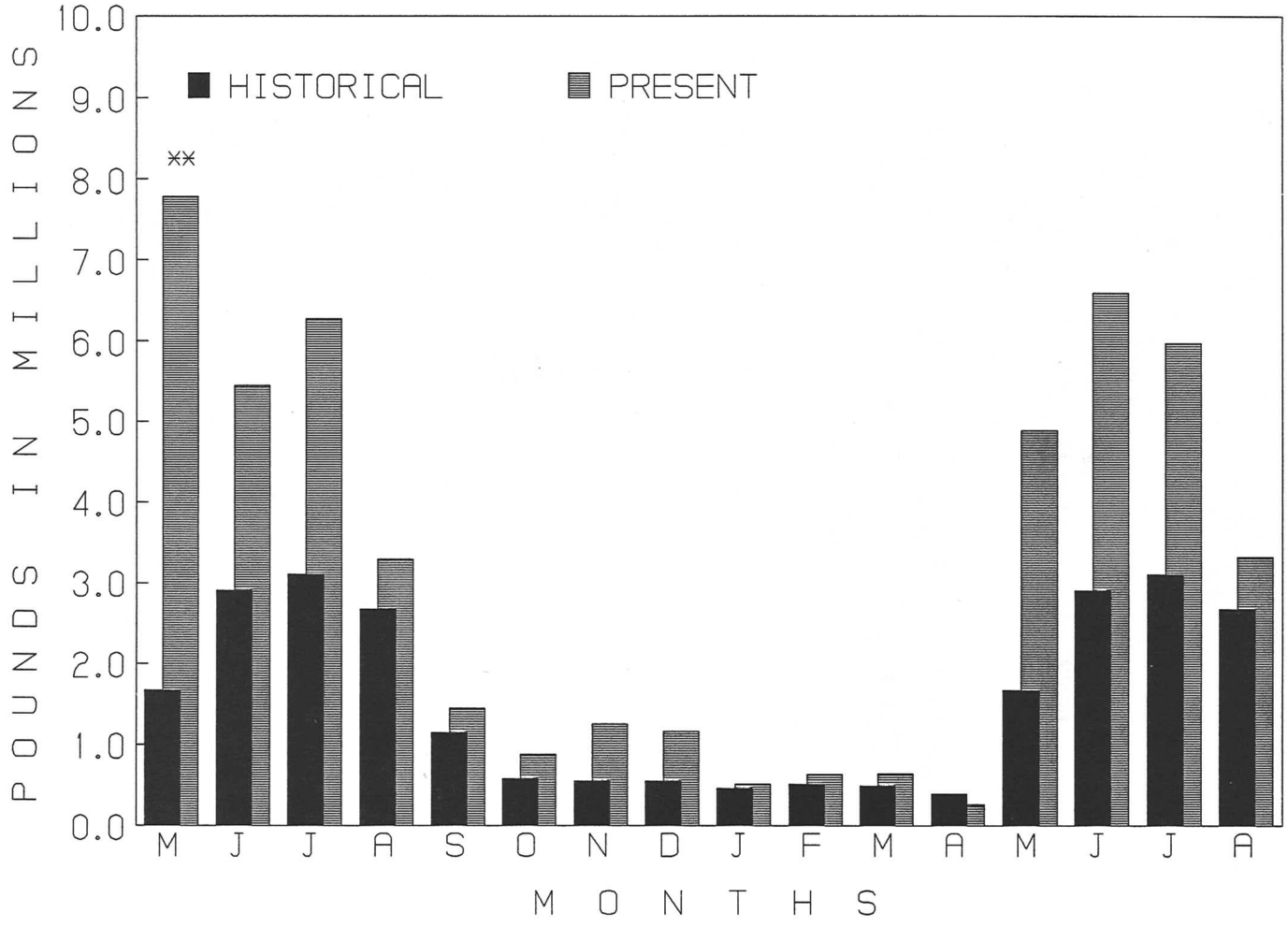
2. Annual inshore brown shrimp landings in Louisiana west of the Mississippi River.



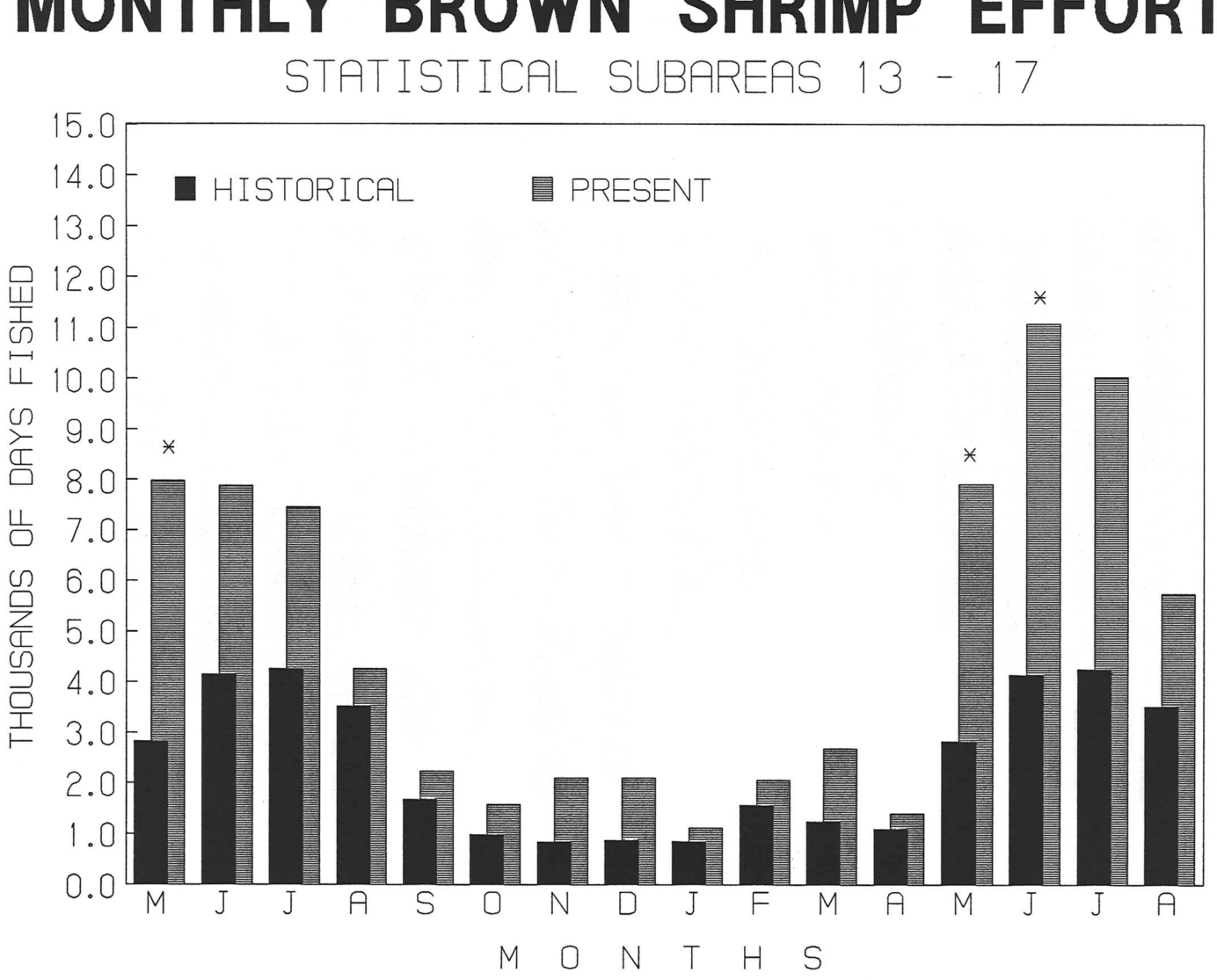
3. Annual offshore brown shrimp landings in Louisiana west of the Mississippi River.

MONTHLY BROWN SHRIMP LANDINGS

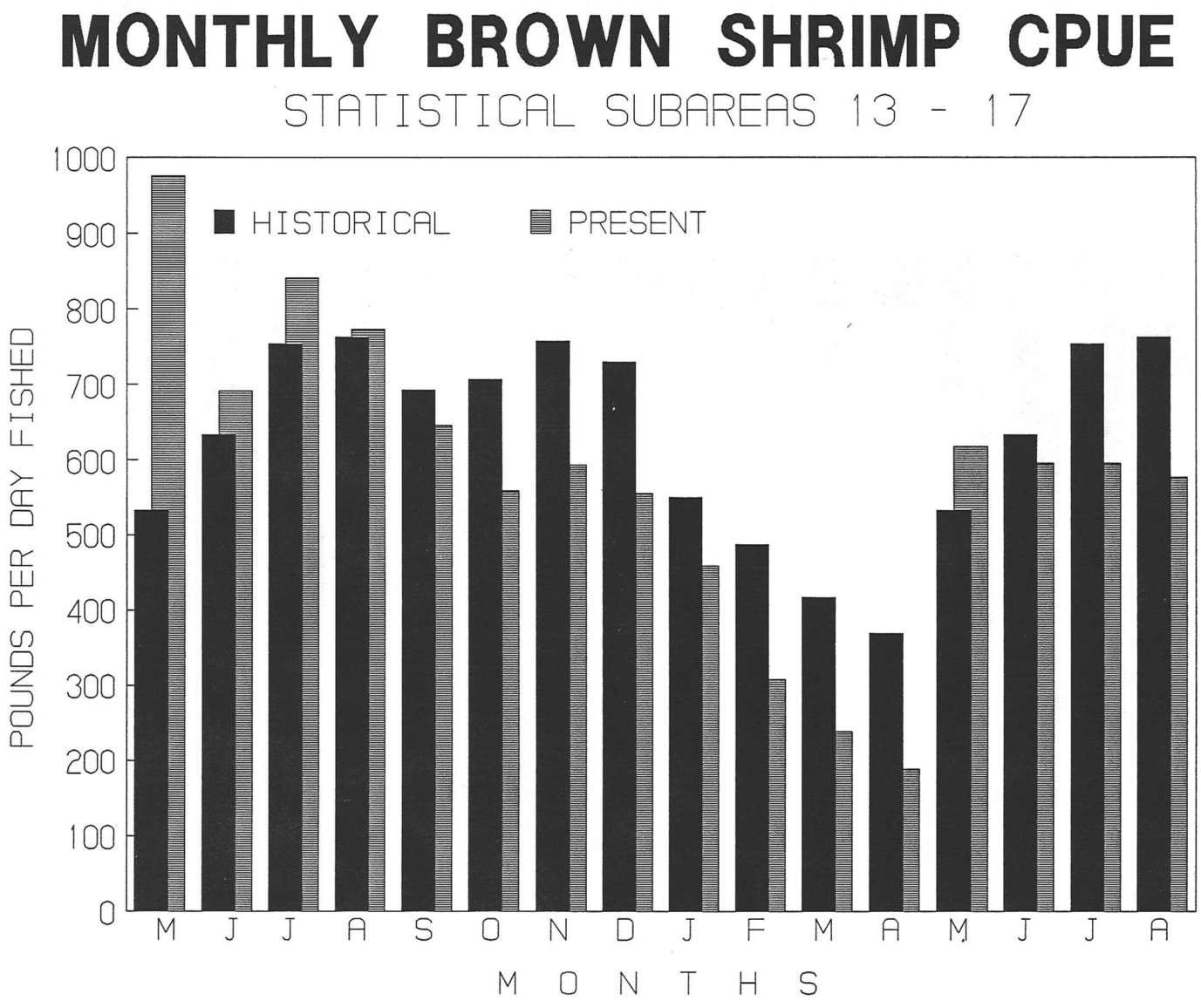
STATISTICAL SUBAREAS 13 - 17



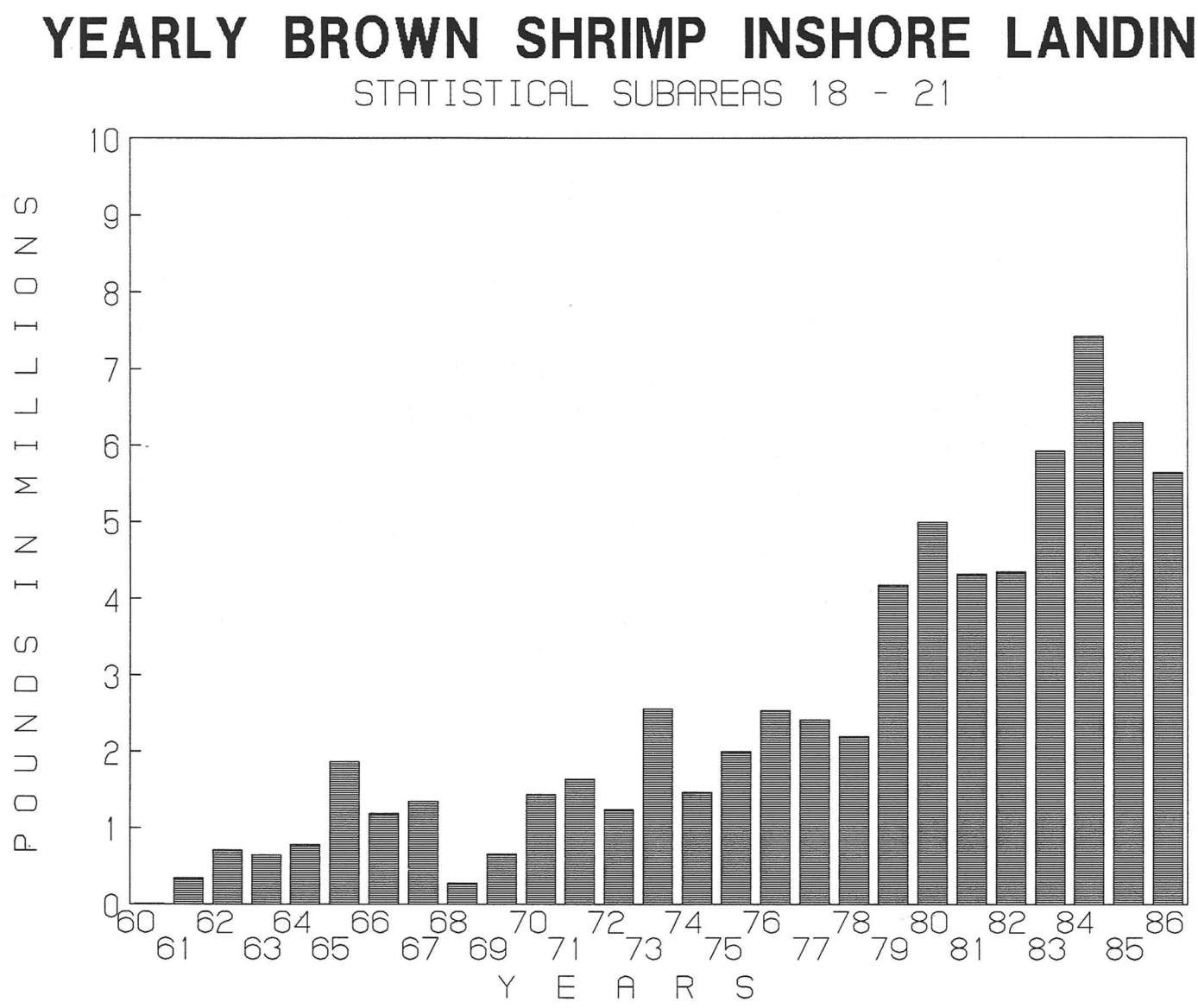
4. Average monthly historical catch compared to monthly catch values during biological year 1986 and the first four months of biological year 1987. (**significant at alpha = .01 level)



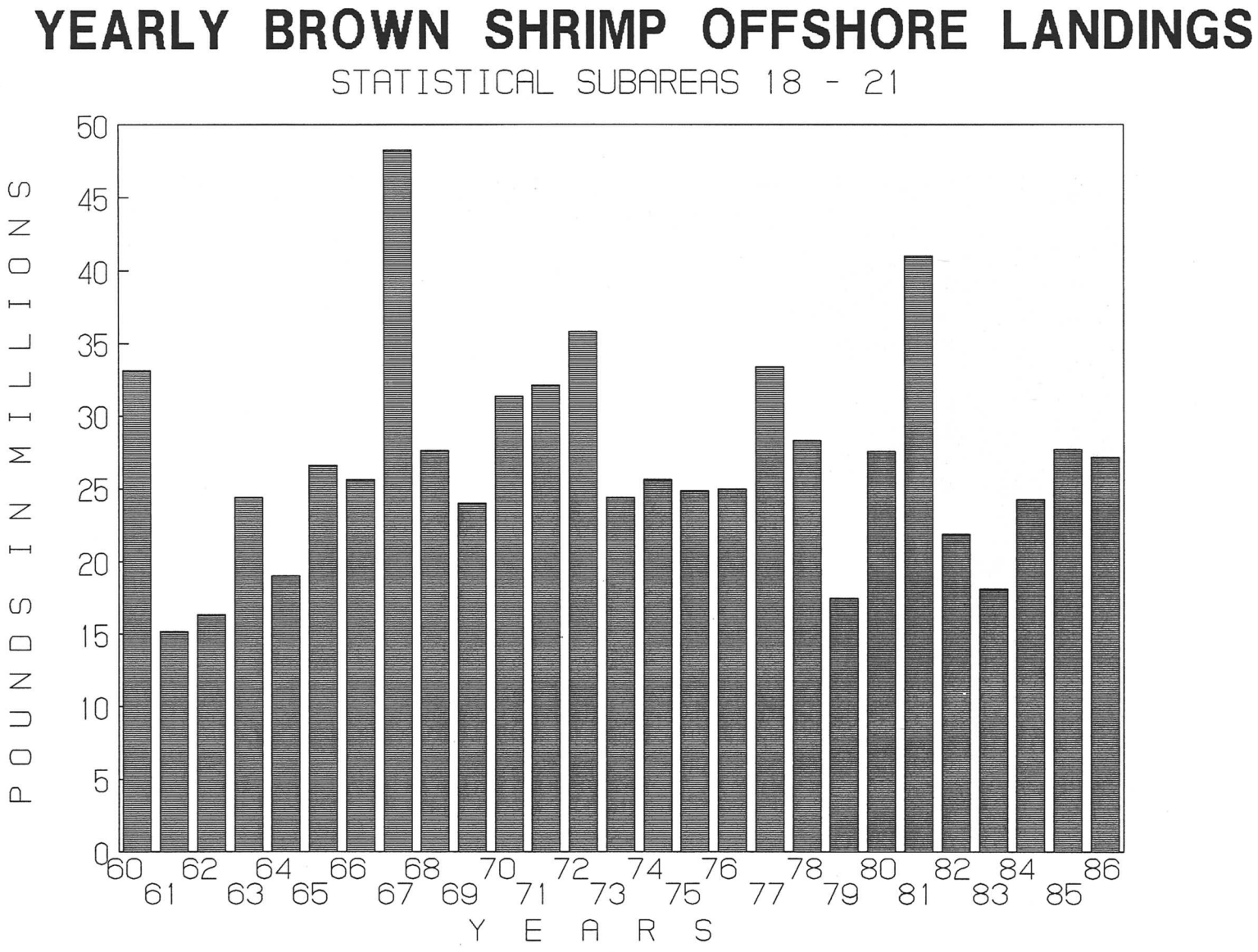
5. Average monthly historical effort compared to monthly effort values during biological year 1986 and the first four months of biological year 1987. (*significant at alpha = .05 level)



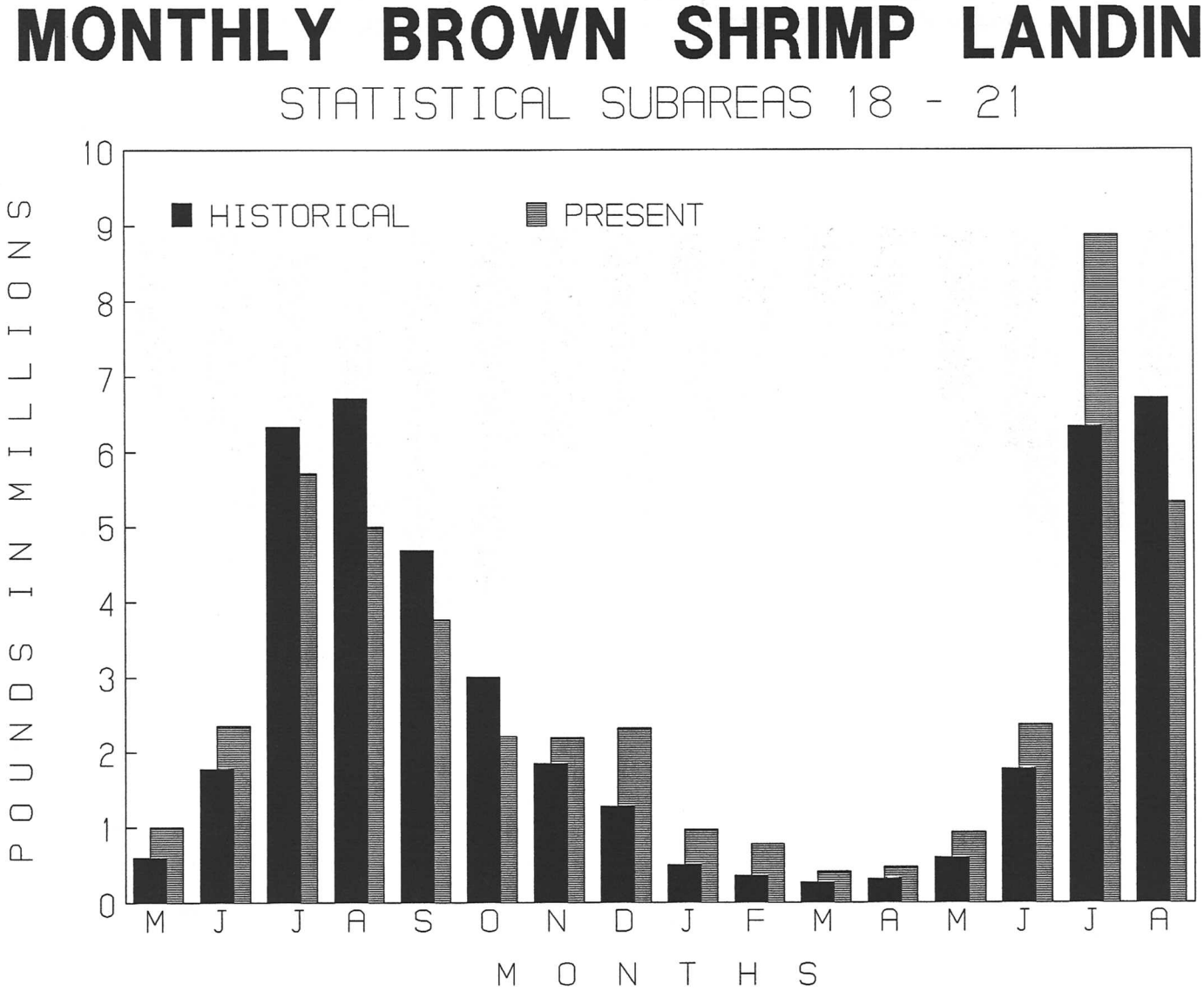
6. Average monthly historical CPUE compared to monthly effort values during biological year 1986 and the first four months of biological year 1987.



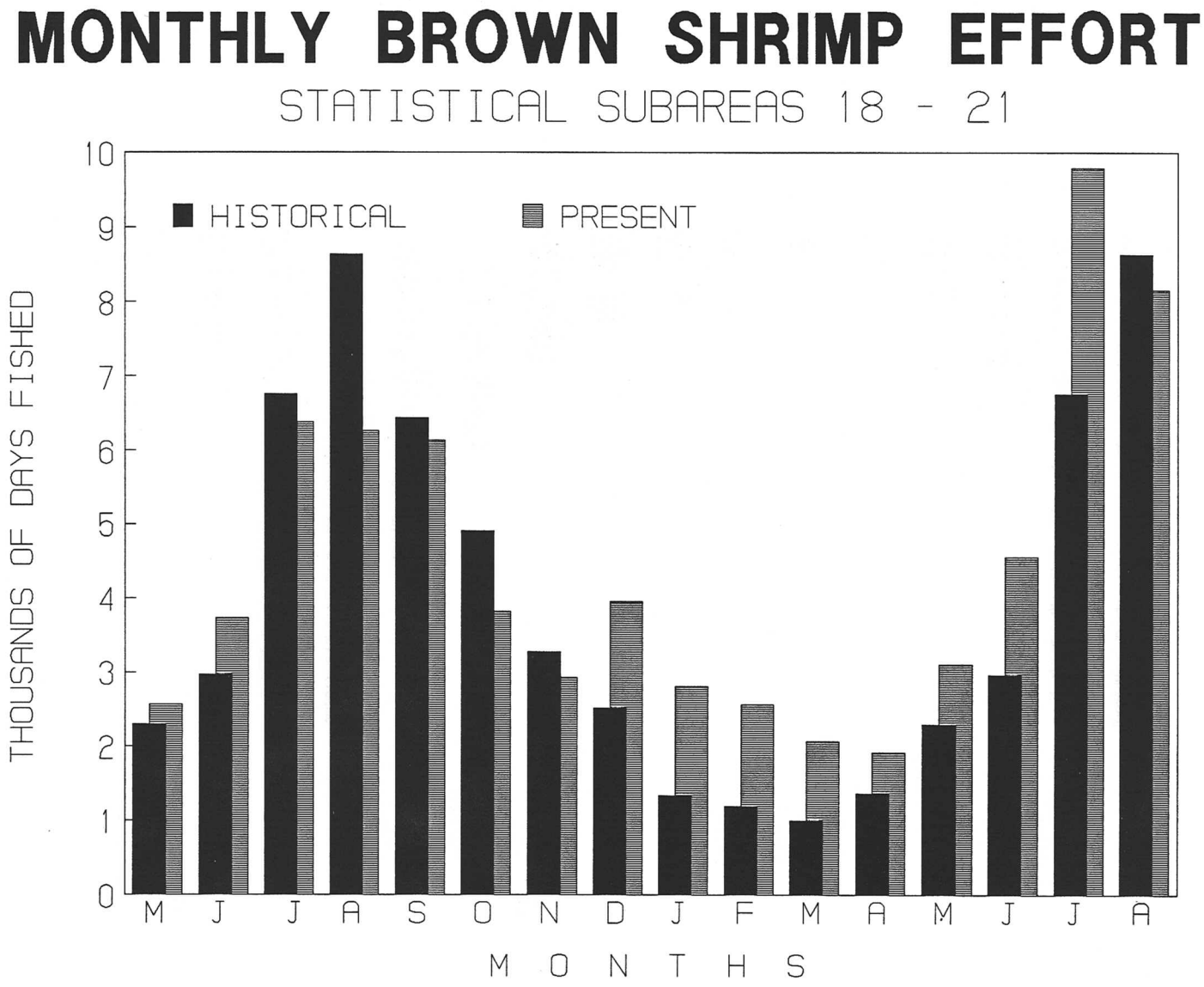
7. Annual inshore brown shrimp landings in Texas.



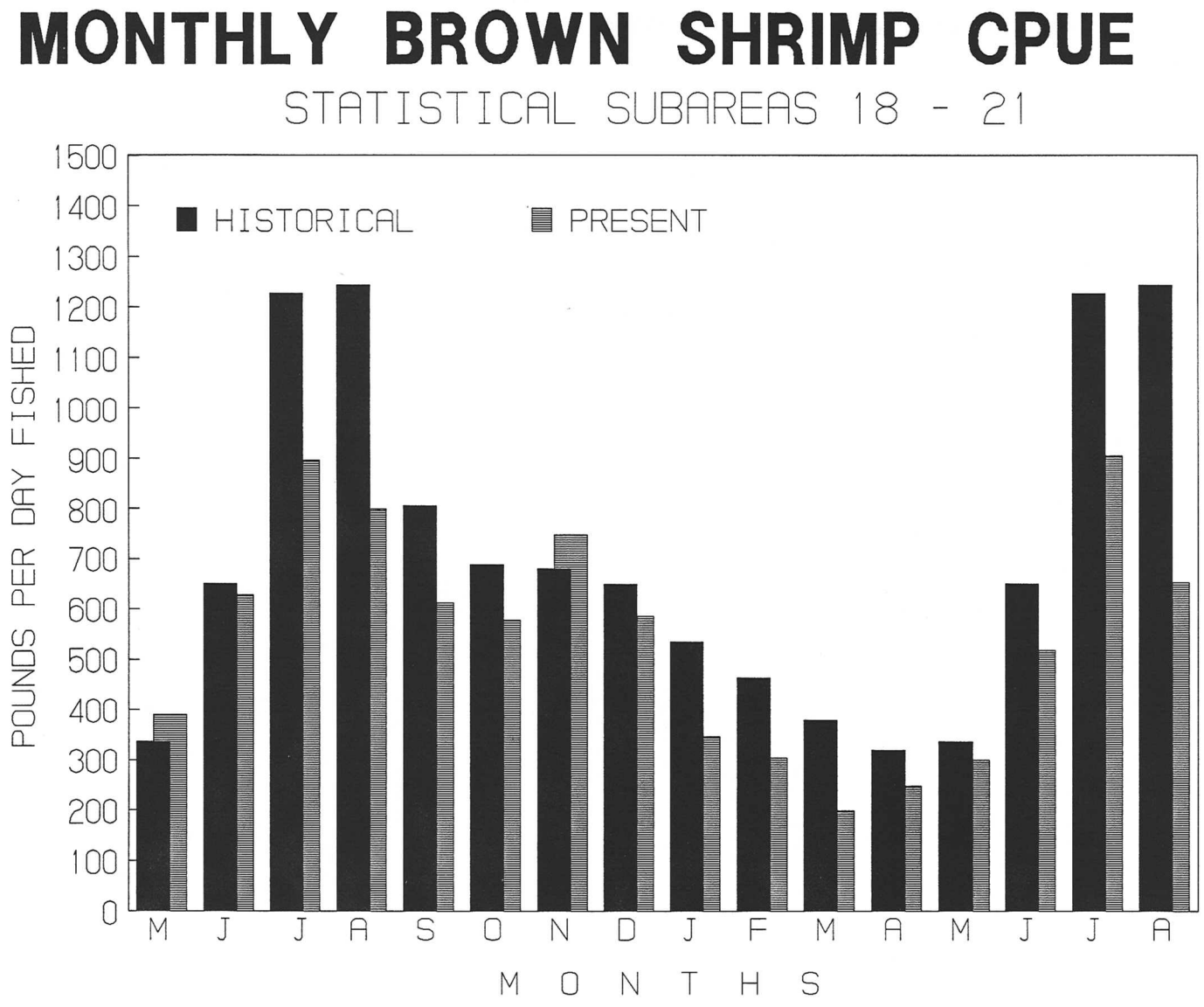
8. Annual offshore brown shrimp landings in Texas.



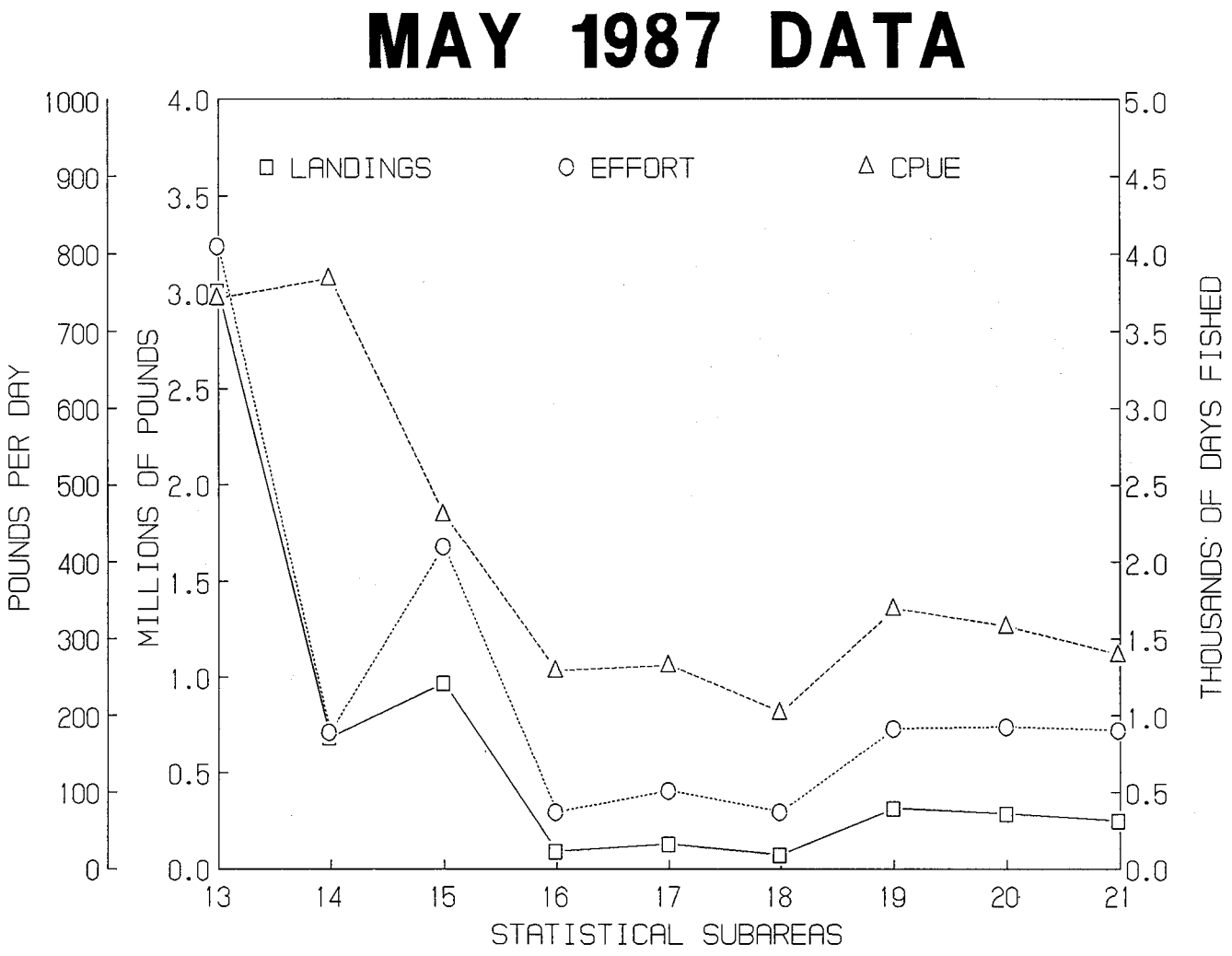
9. Average monthly historical catch compared to monthly catch values during biological year 1986 and the first four months of biological year 1987.



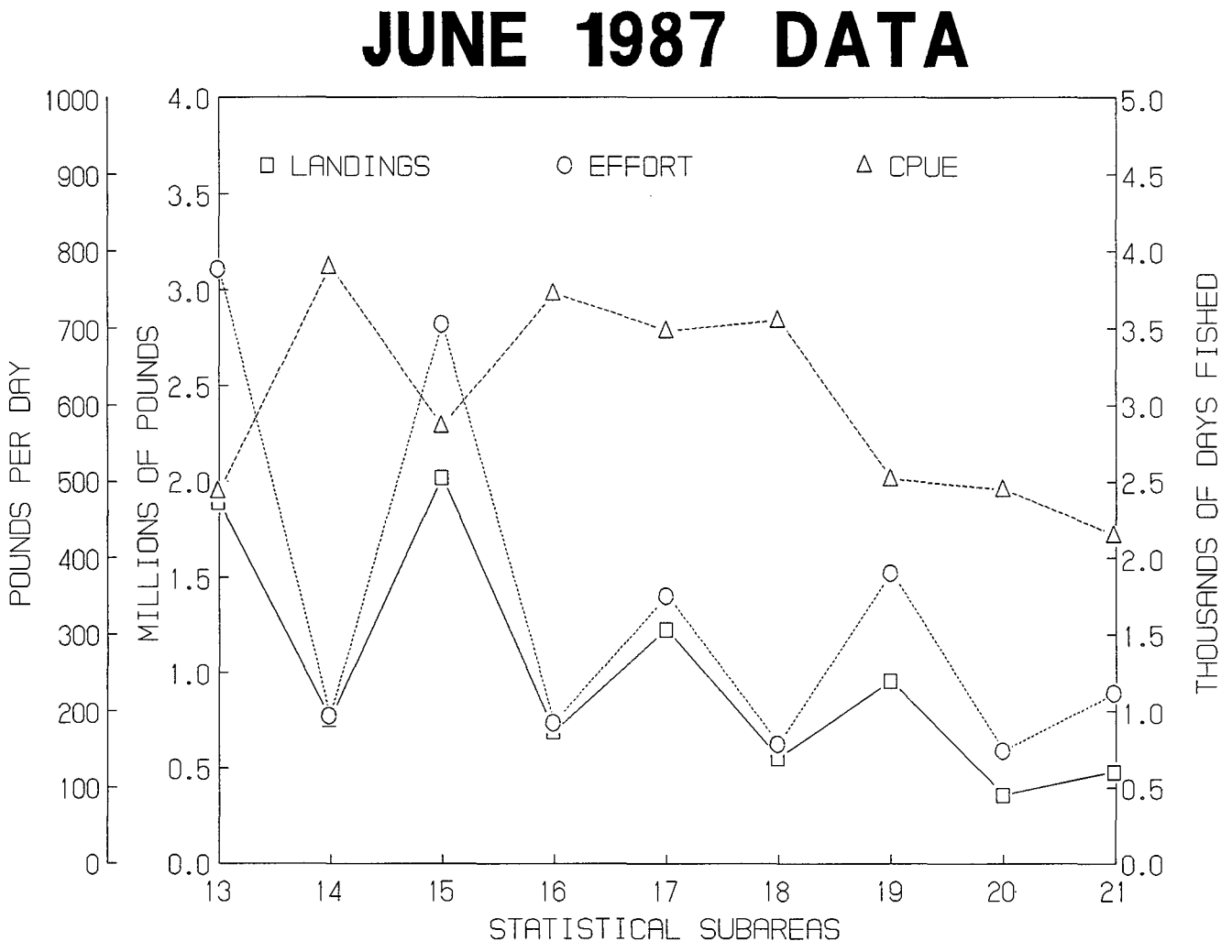
10. Average monthly historical effort compared to monthly effort values during biological year 1986 and the first four months of biological year 1987.



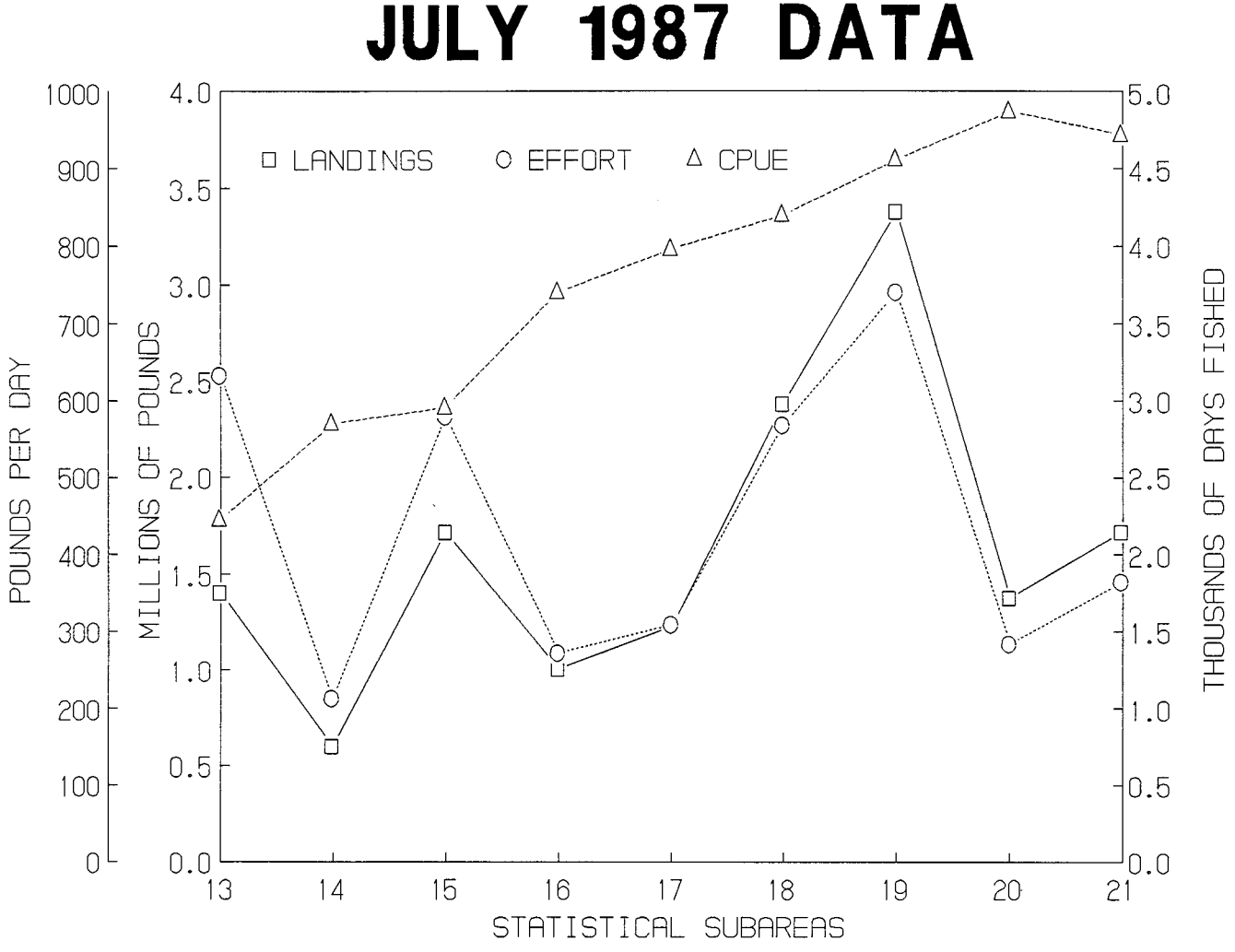
11. Average monthly historical CPUE compared to monthly CPUE values during biological year 1986 and the first four months of biological year 1987.



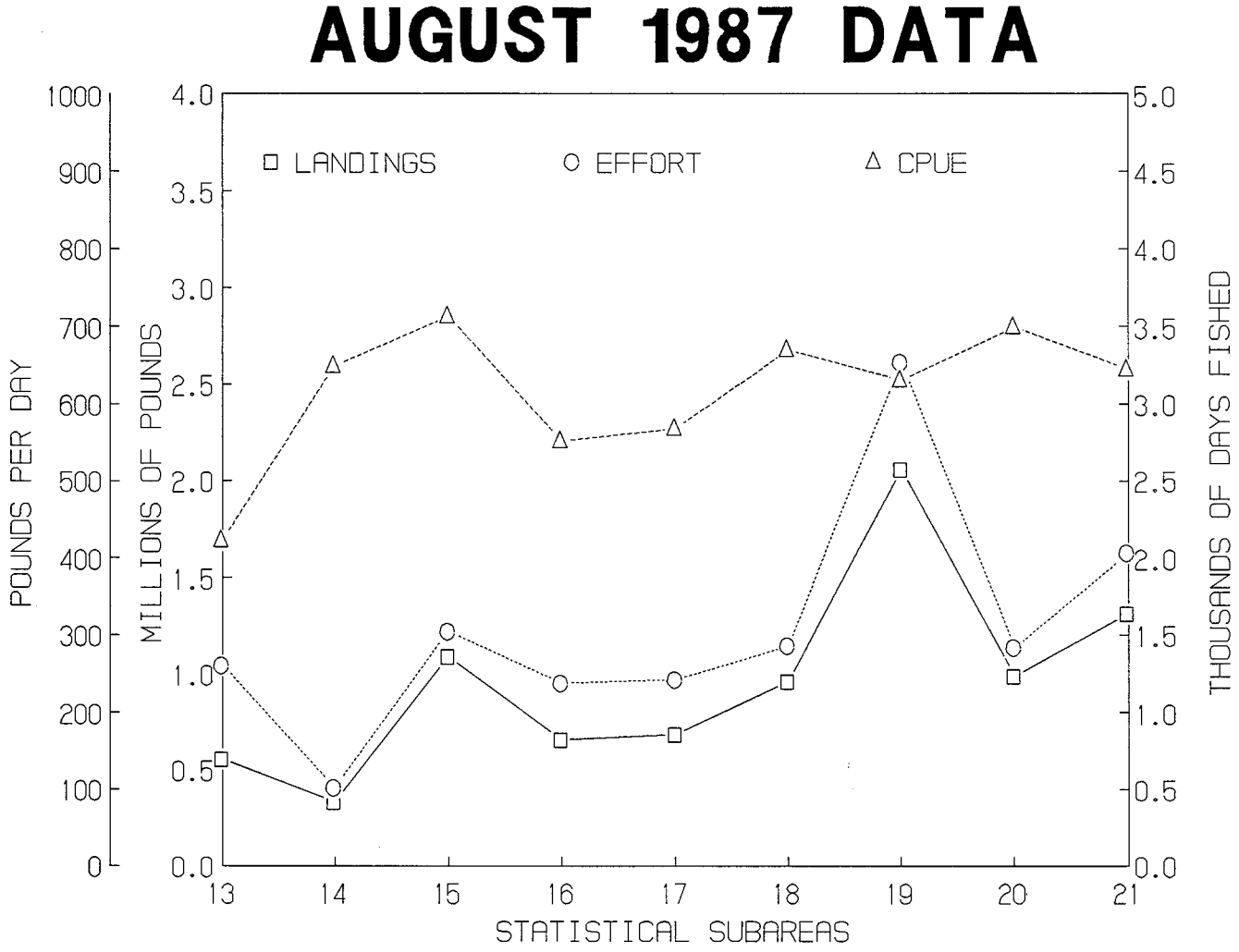
12. Offshore brown shrimp catch, fishing effort and CPUE from statistical subareas 13-21 in May 1987.



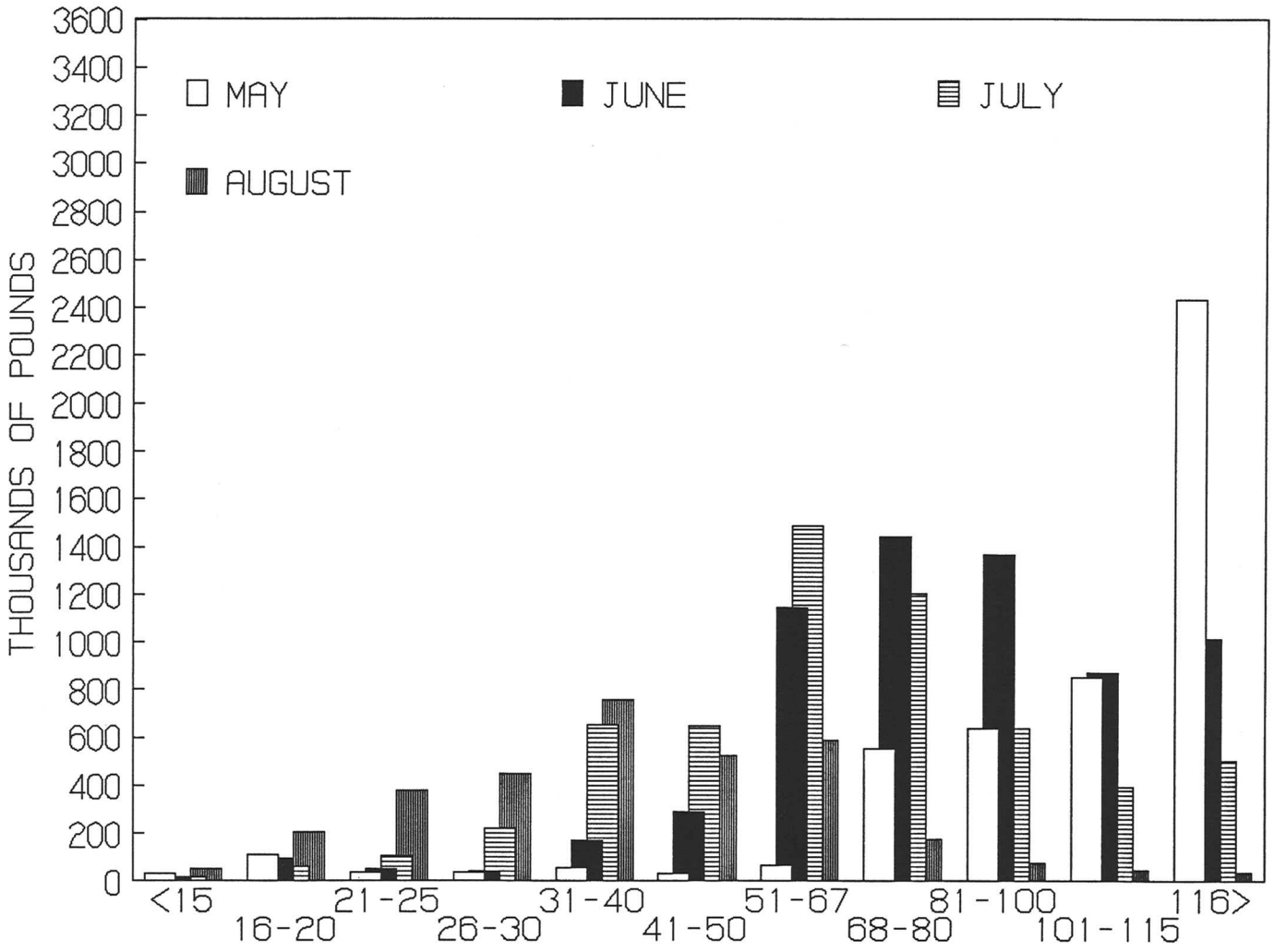
13. Offshore brown shrimp catch, fishing effort and CPUE from statistical subareas 13-21 in June 1987.



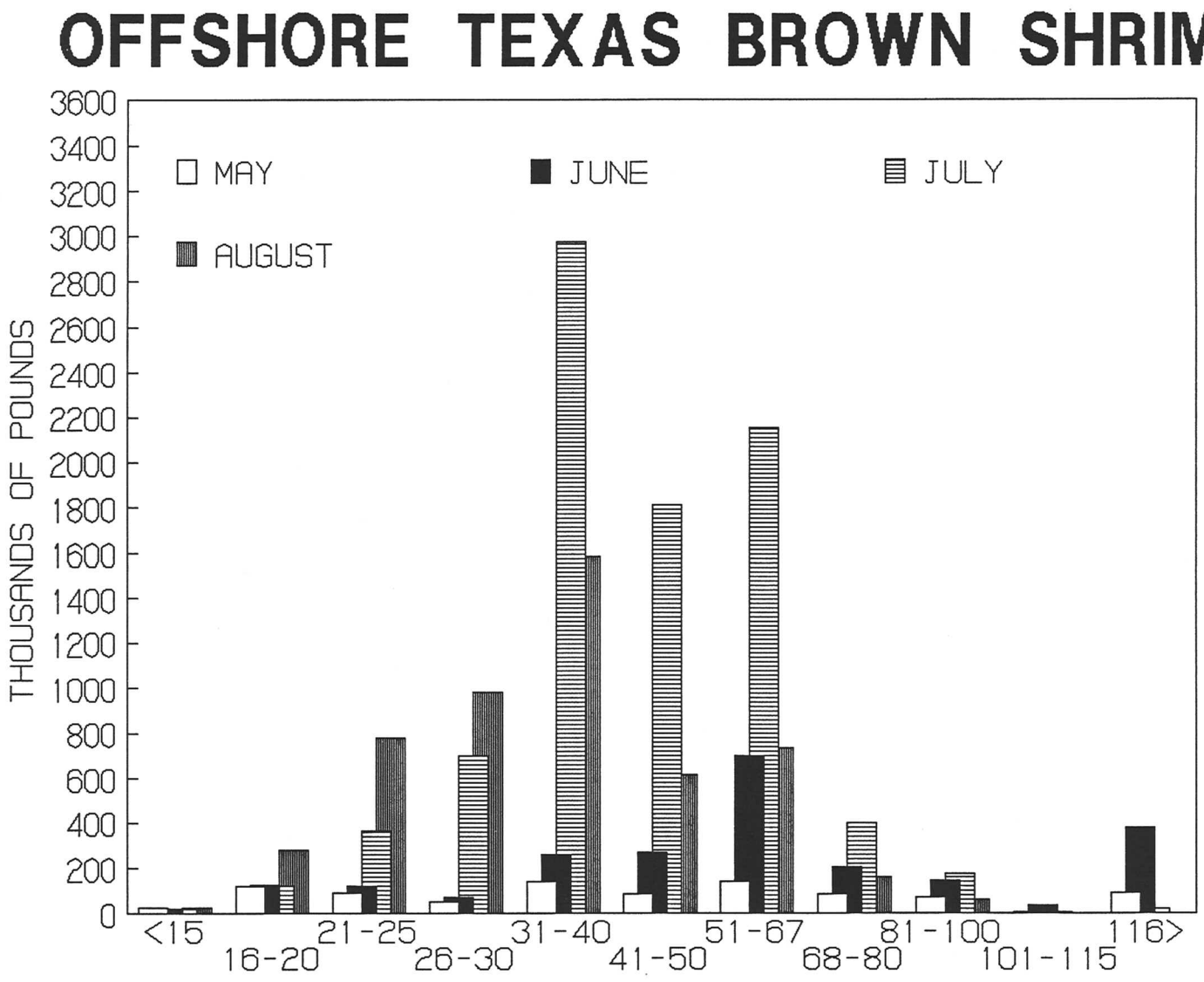
14. Offshore brown shrimp catch, fishing effort and CPUE from statistical subareas 31-21 in July 1987.



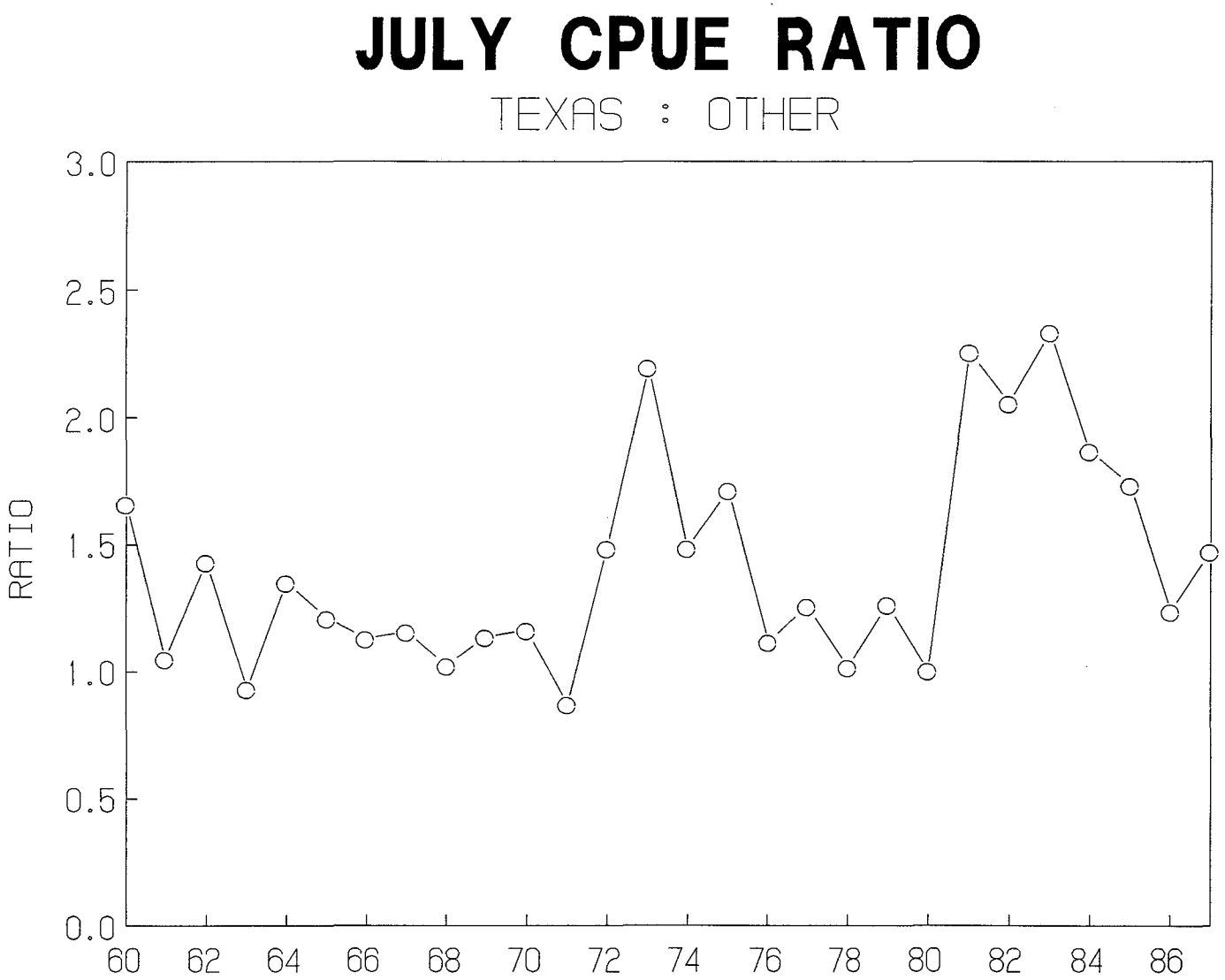
15. Offshore brown shrimp catch, fishing effort and CPUE from statistical subareas 13-21 in August 1987.



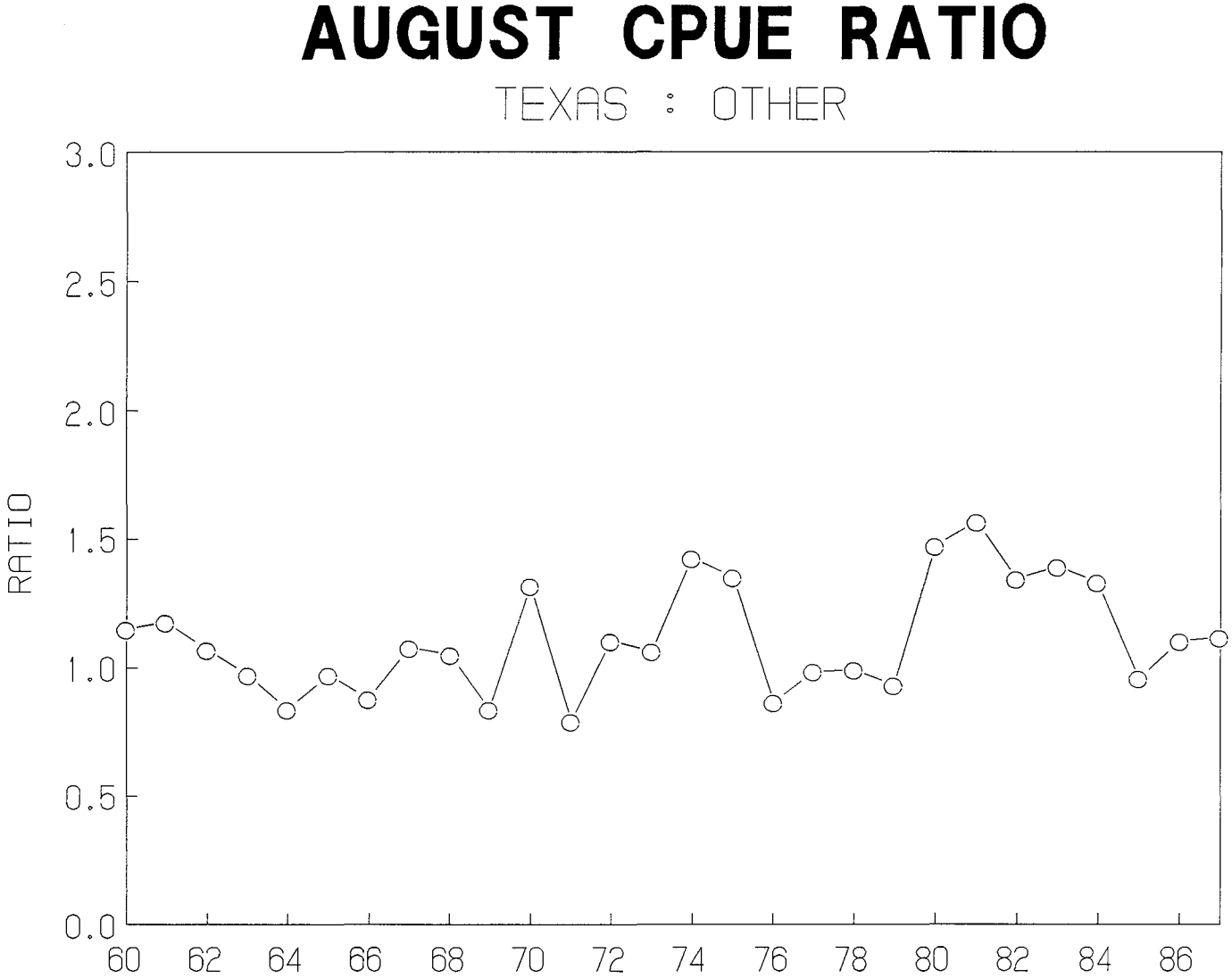
16. Size distribution of brown shrimp caught off Louisiana during the May-August 1987 period.



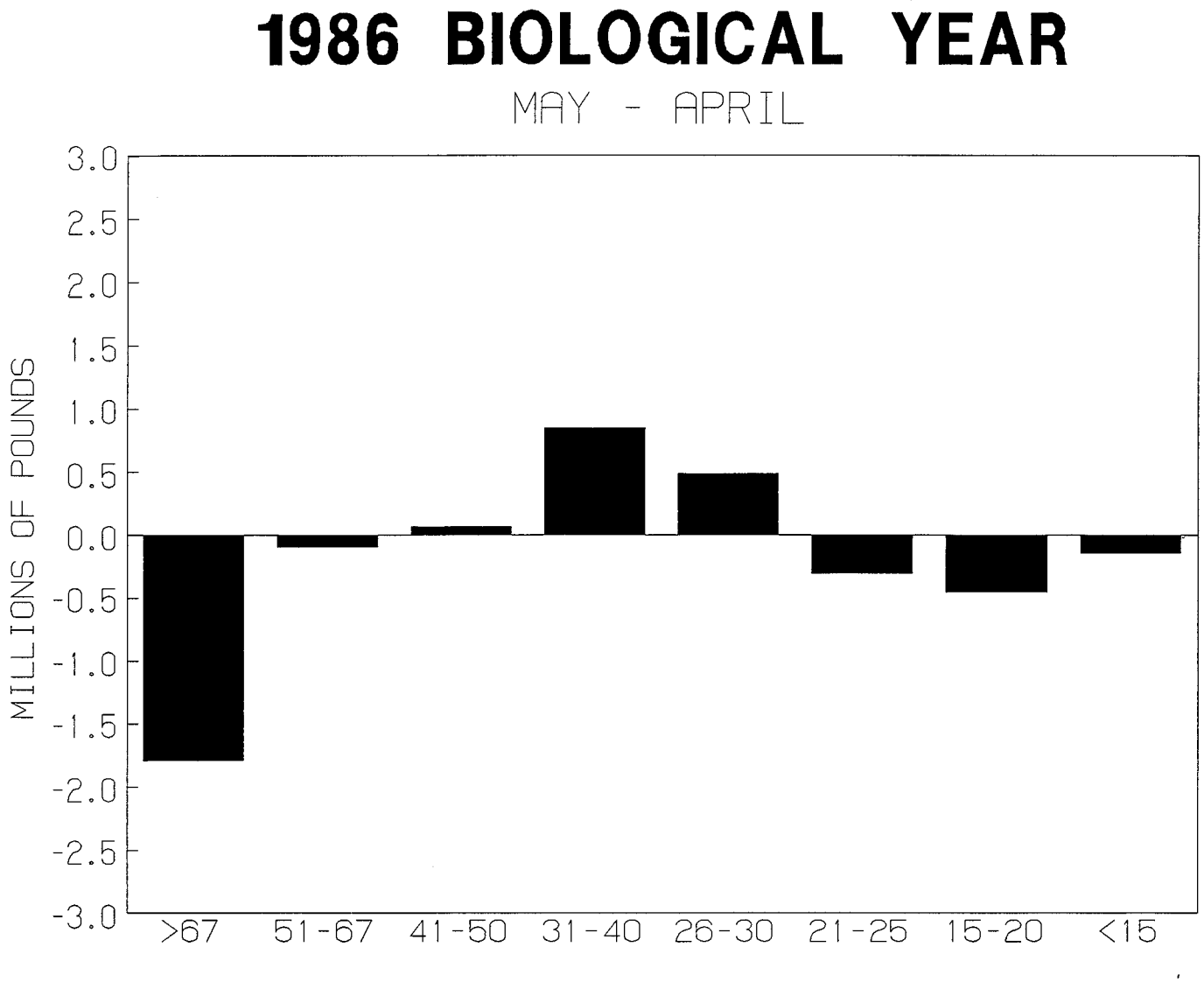
17. Size distribution of brown shrimp caught off Texas during the May-August 1987 period.



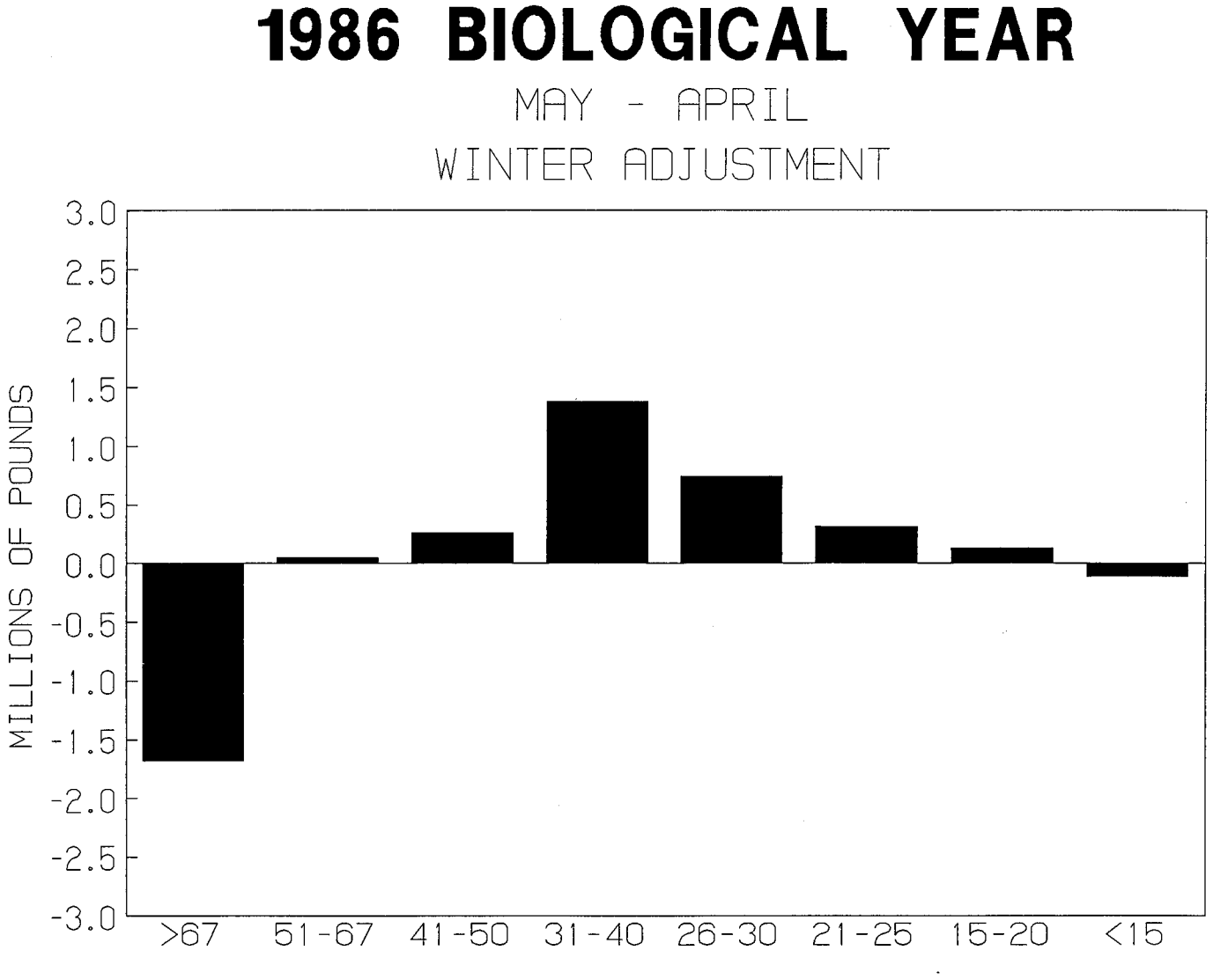
18. Analysis of July CPUE in Gulf of Mexico. Ratio is Texas verses elsewhere in Gulf.



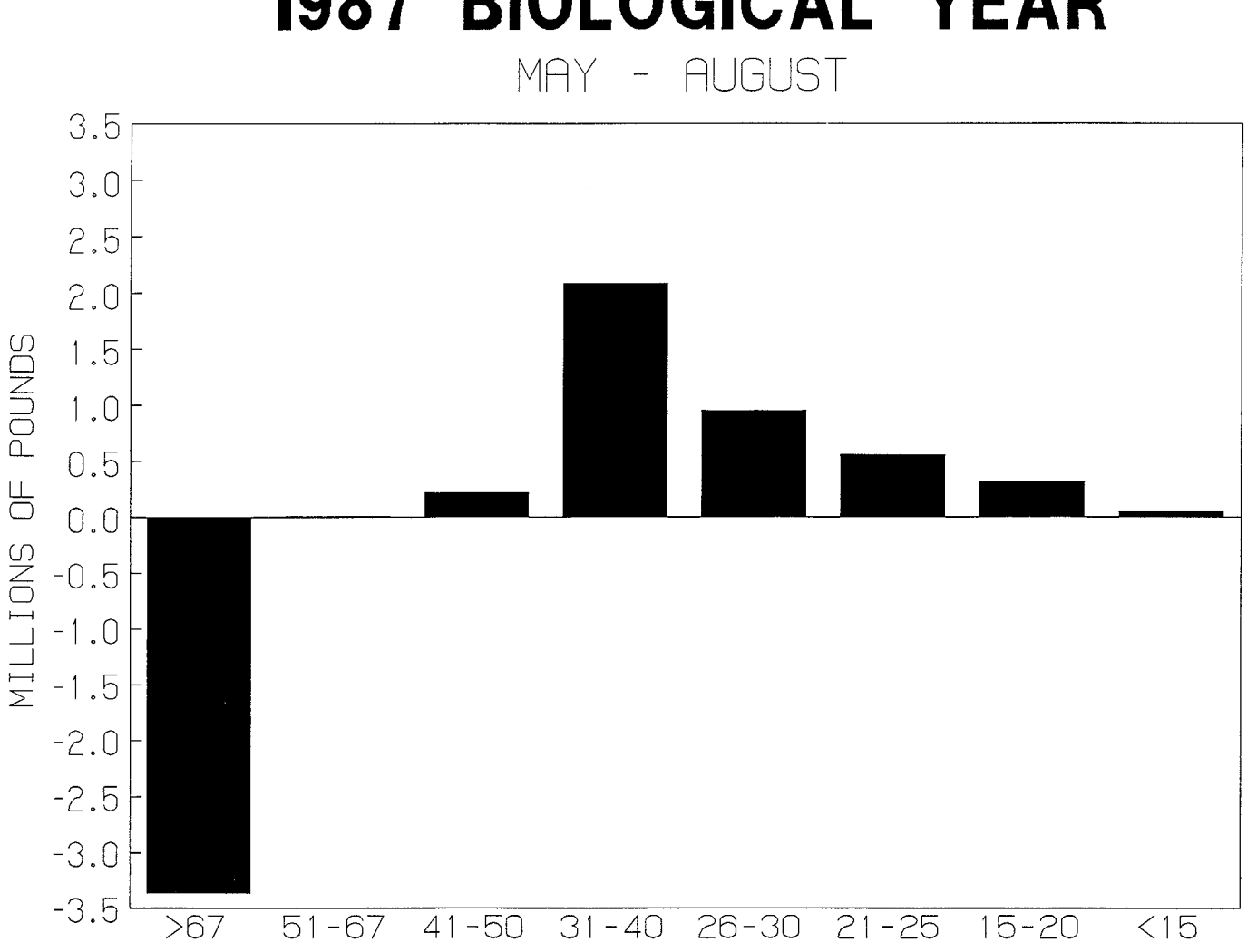
19. Analysis of August CPUE in Gulf of Mexico. Ratio is Texas verses elsewhere in Gulf.



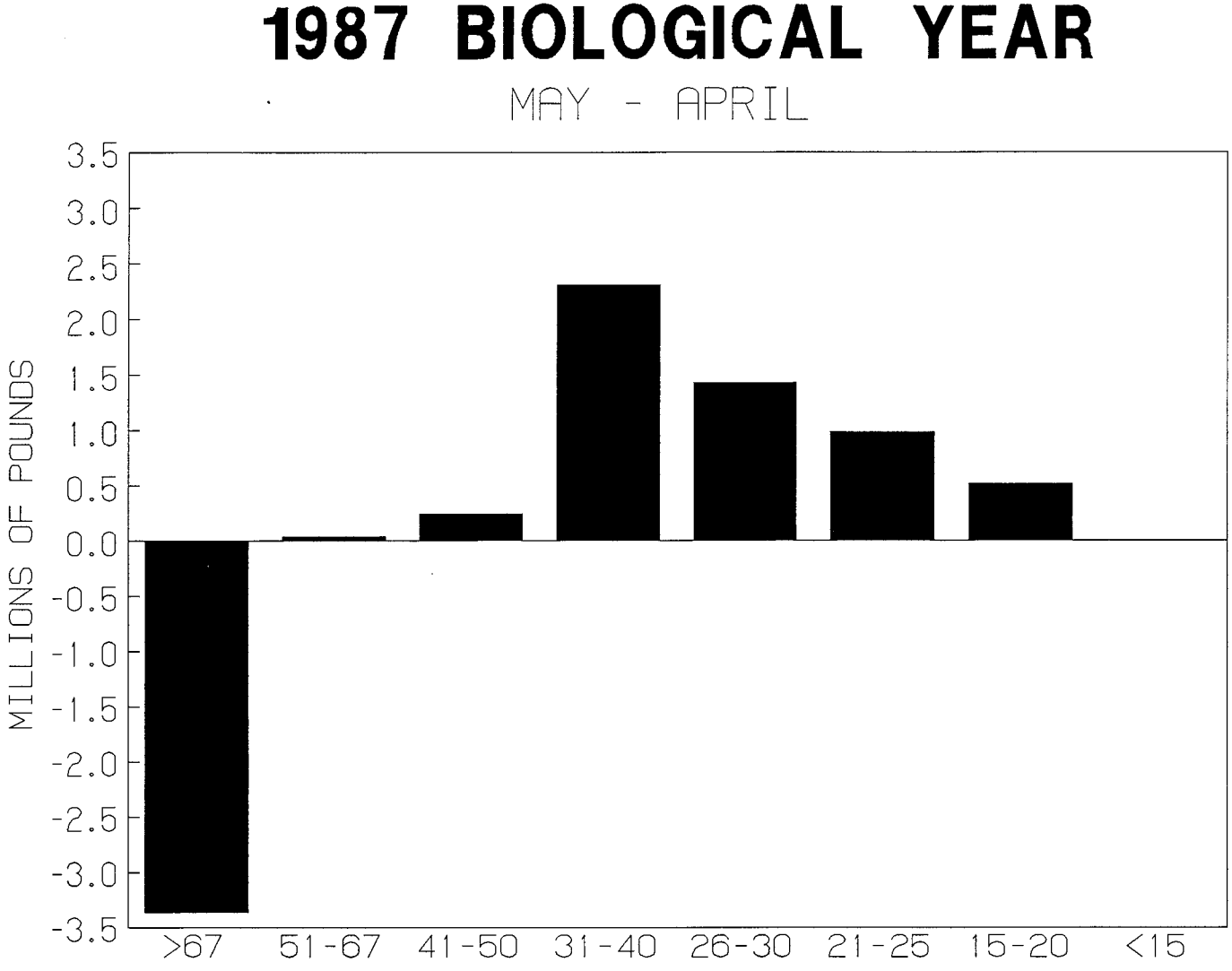
20. Estimated change in catch for various size groups with a 200 nautical mile closure during biological year 1986. No adjustments made for increased winter fishing effort this year.



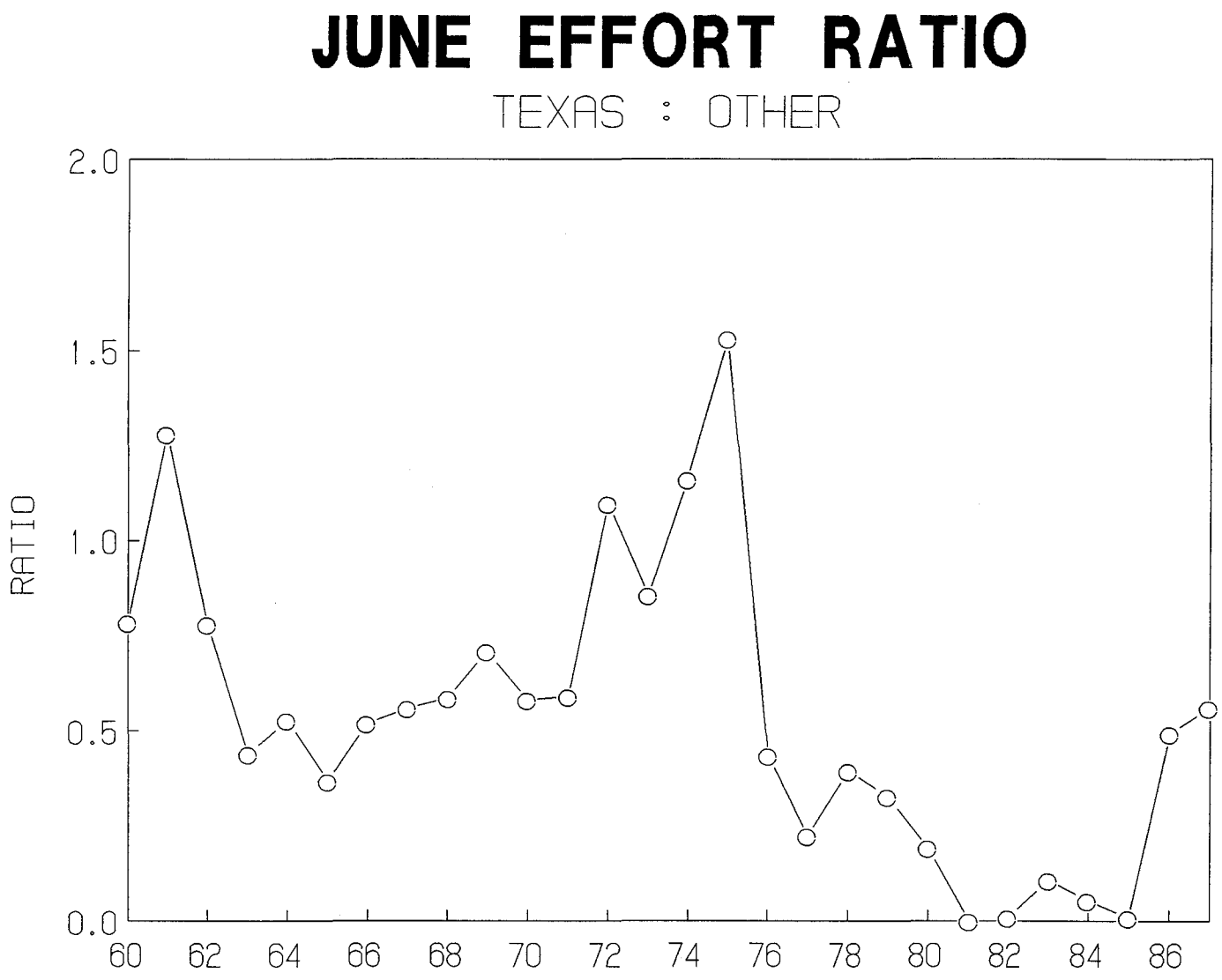
21. Estimated change in catch for various size groups with a 200 nautical mile closure during biological year 1986. Adjustments made for increased winter fishing effort this year.



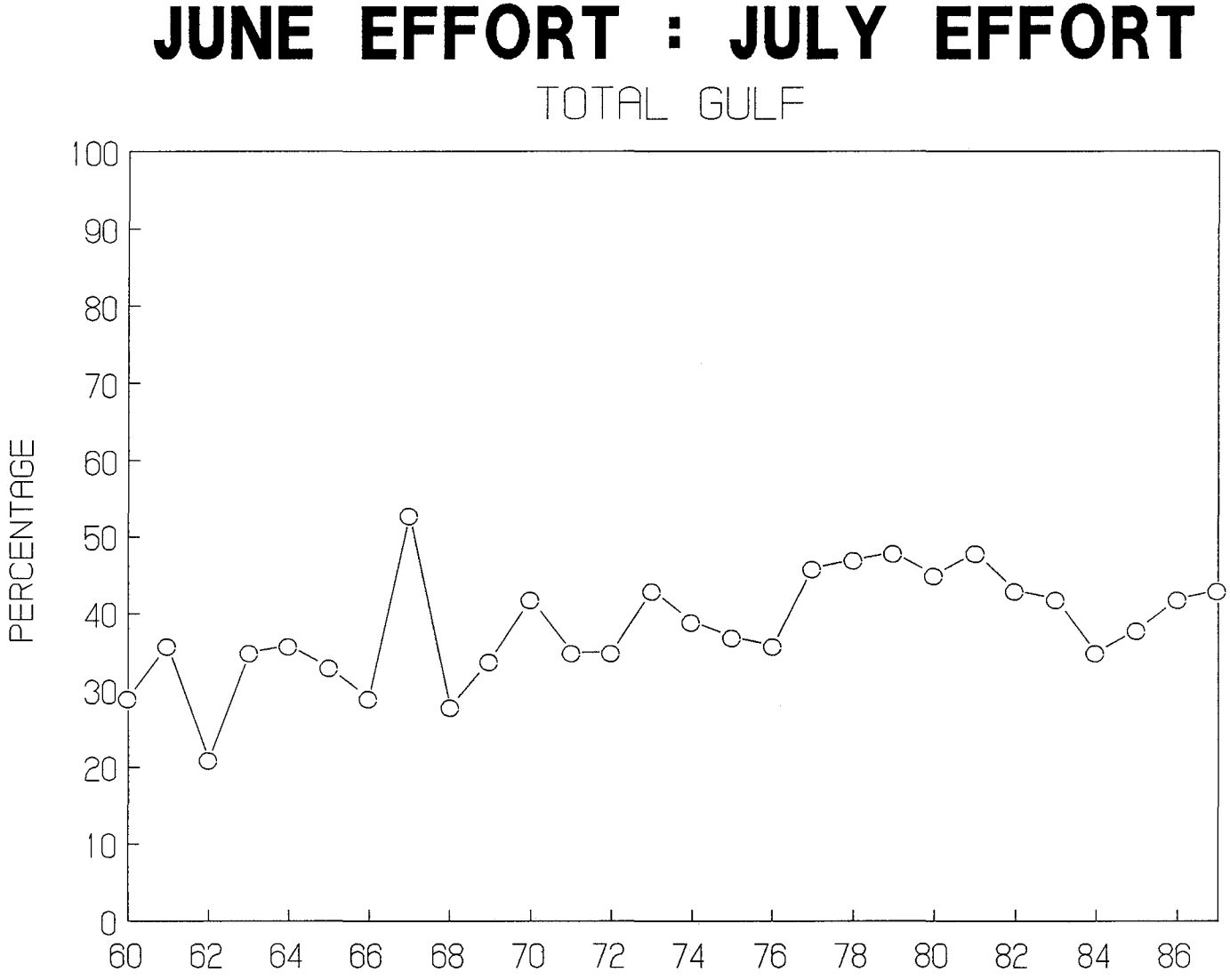
22. Estimated change in catch for various size groups with a 200 nautical mile closure during the first four months of biological year 1987.



23. Estimated change in catch for various size groups with a 200 nautical mile closure during biological year 1987.

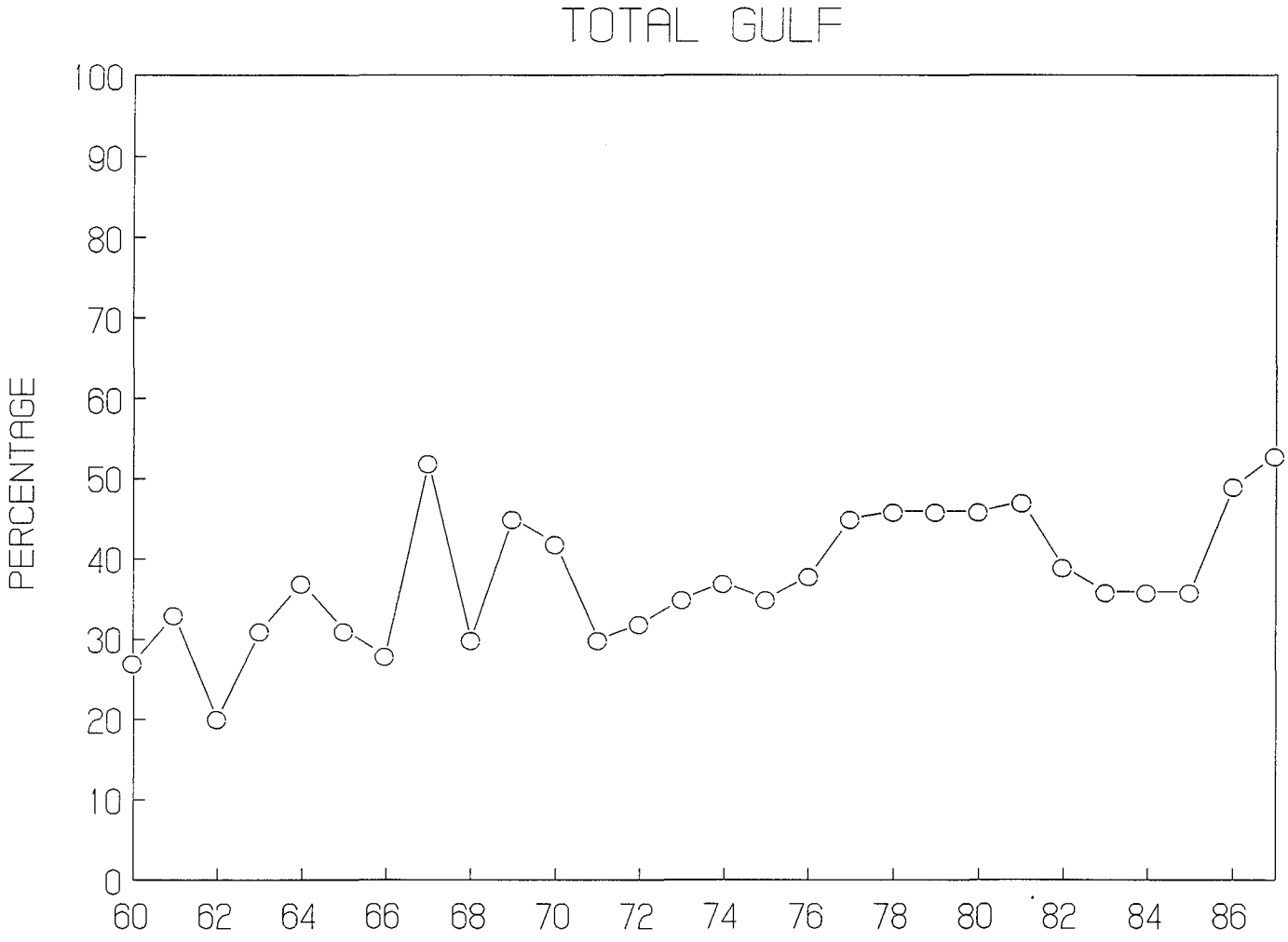


24. Analysis of June fishing effort. Ratio is Texas verses elsewhere in Gulf of Mexico.

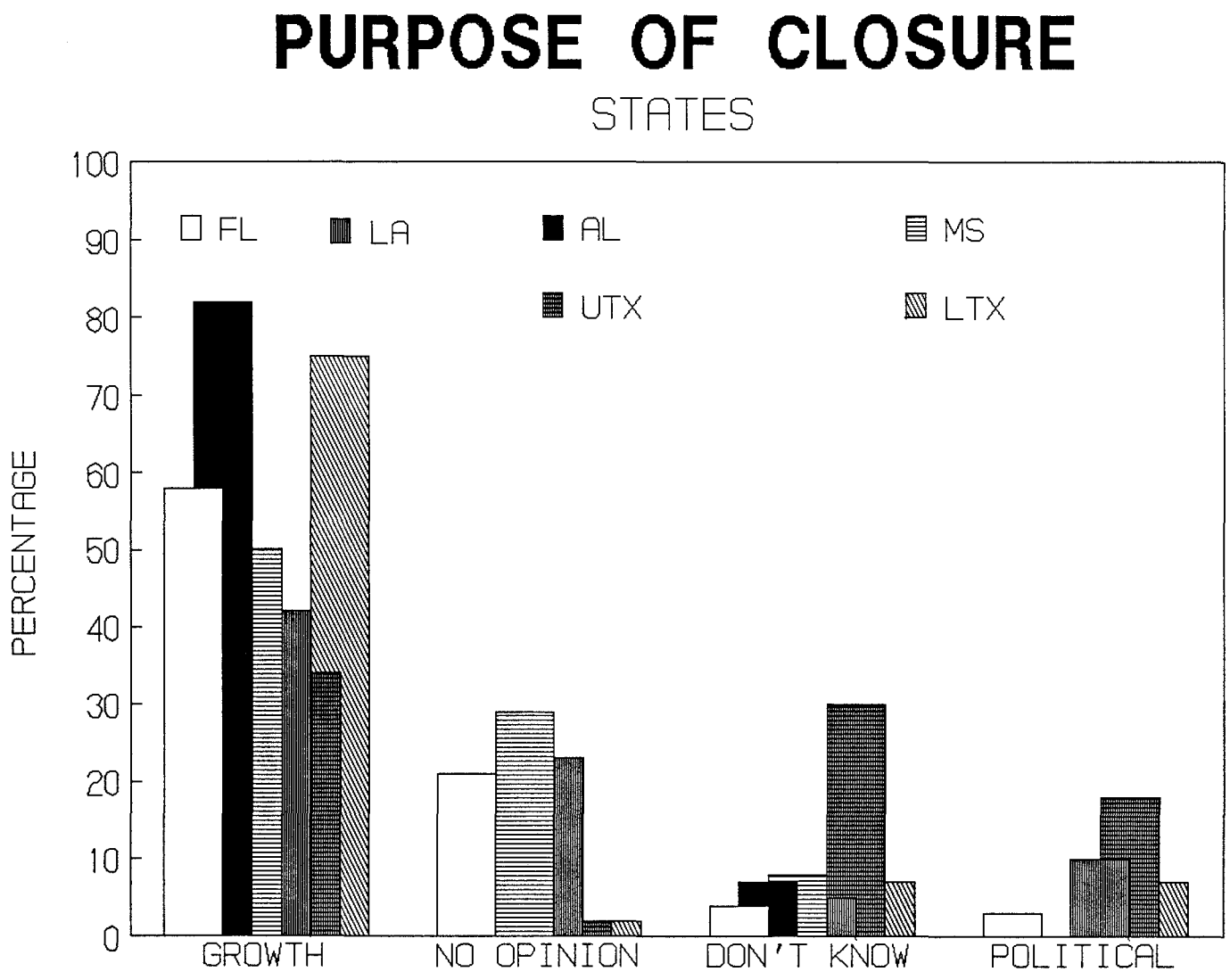


25. Percentage of total Gulf of Mexico June fishing effort to total Gulf of Mexico July fishing effort.

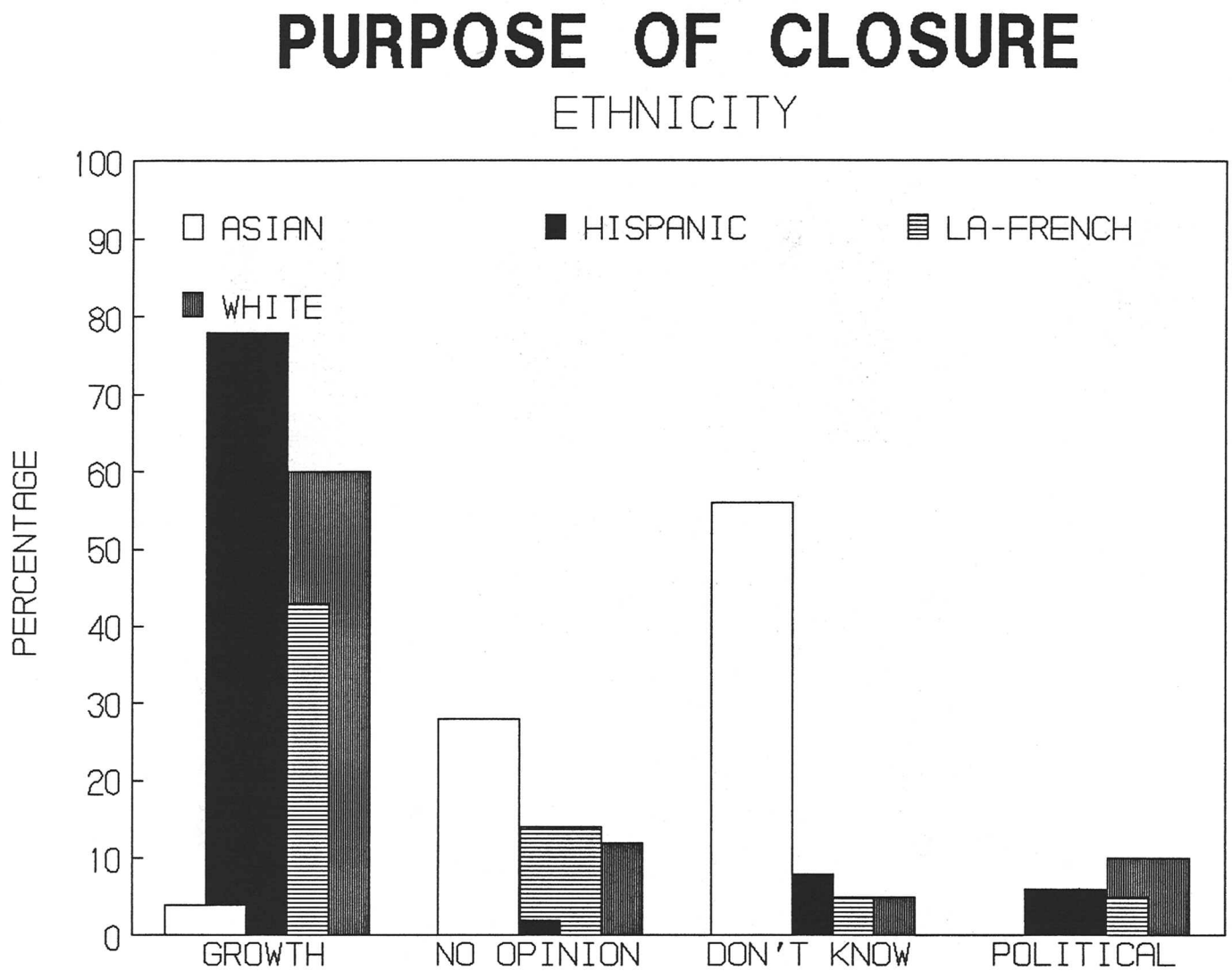
JUNE EFFORT : AUGUST EFFORT



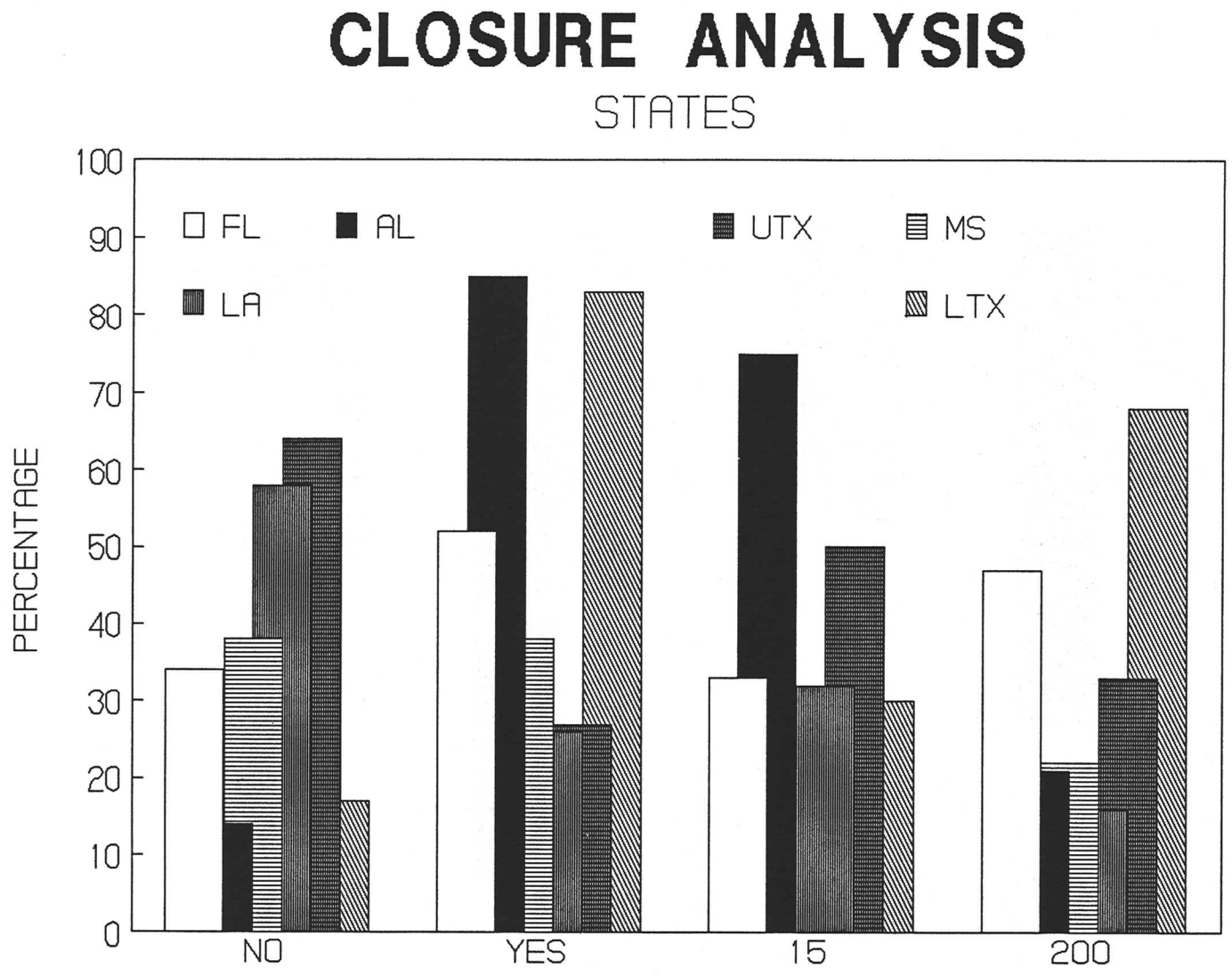
26. Percentage of total Gulf of Mexico June fishing effort to total Gulf of Mexico August fishing effort.



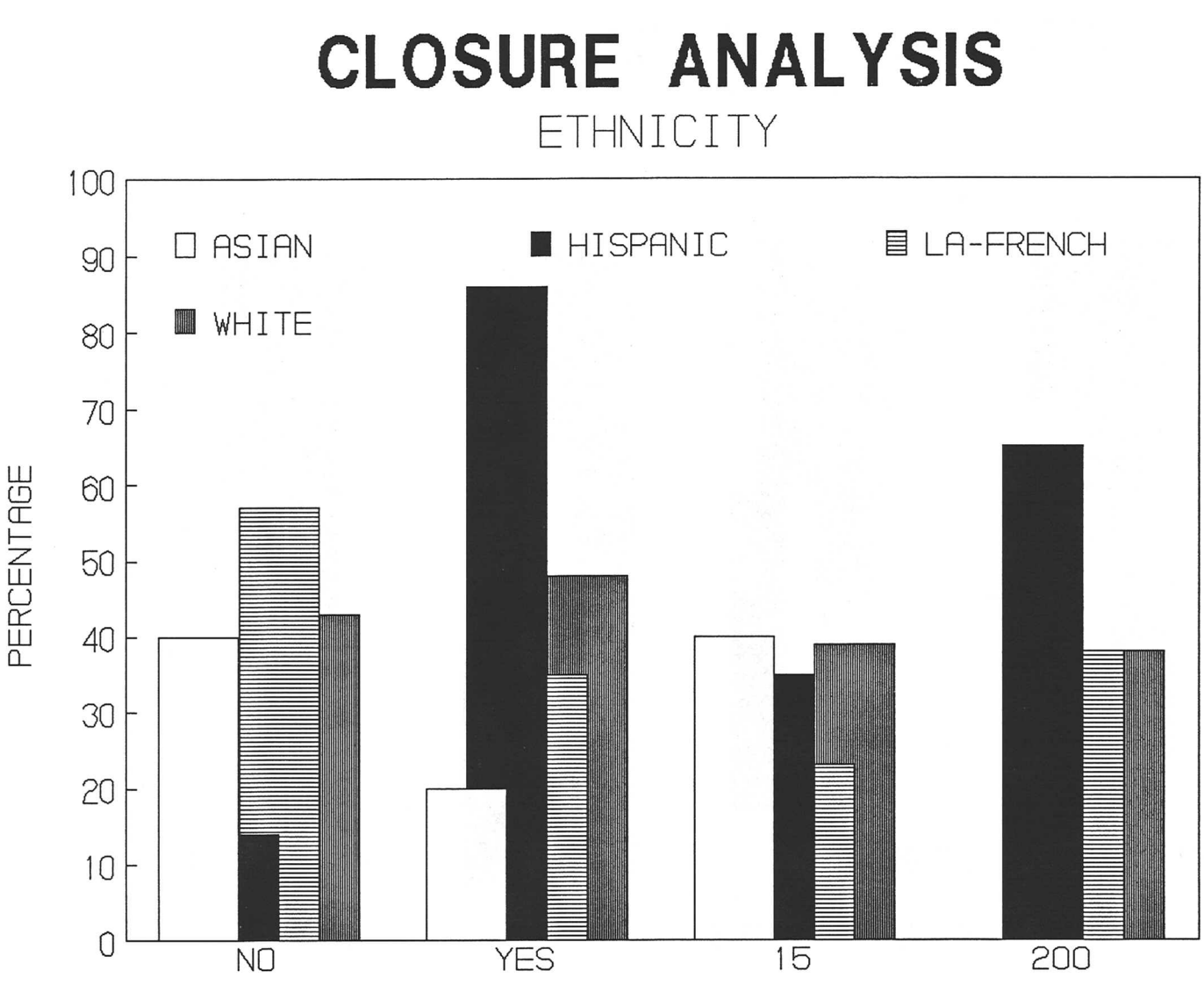
27. Percentage of interviewed captains from various states with expressed opinions about the purpose of the EEZ closure off Texas.



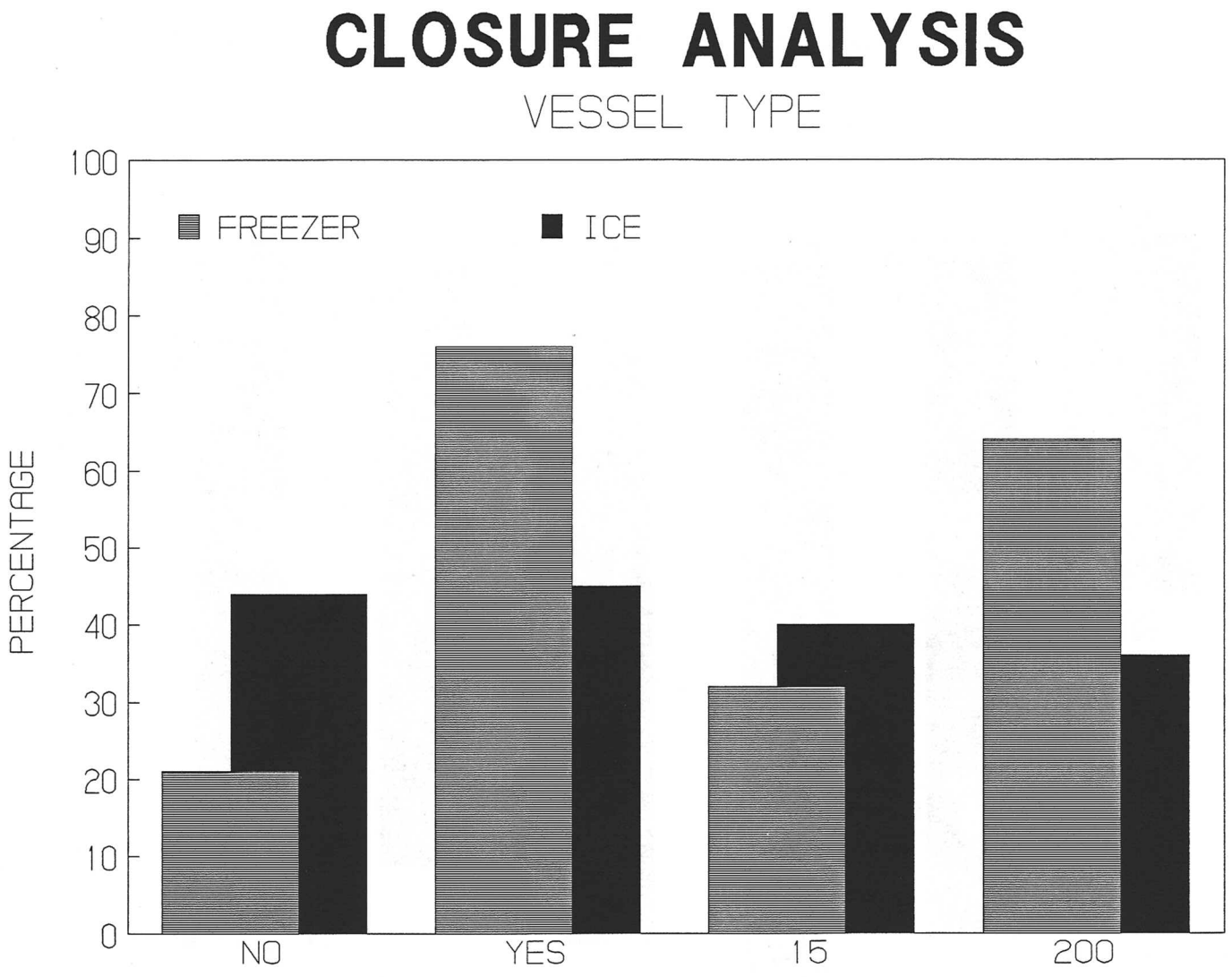
28. Percentage of interviewed captains from various ethnic groups with expressed opinions about the purpose of the EEZ closure off Texas.



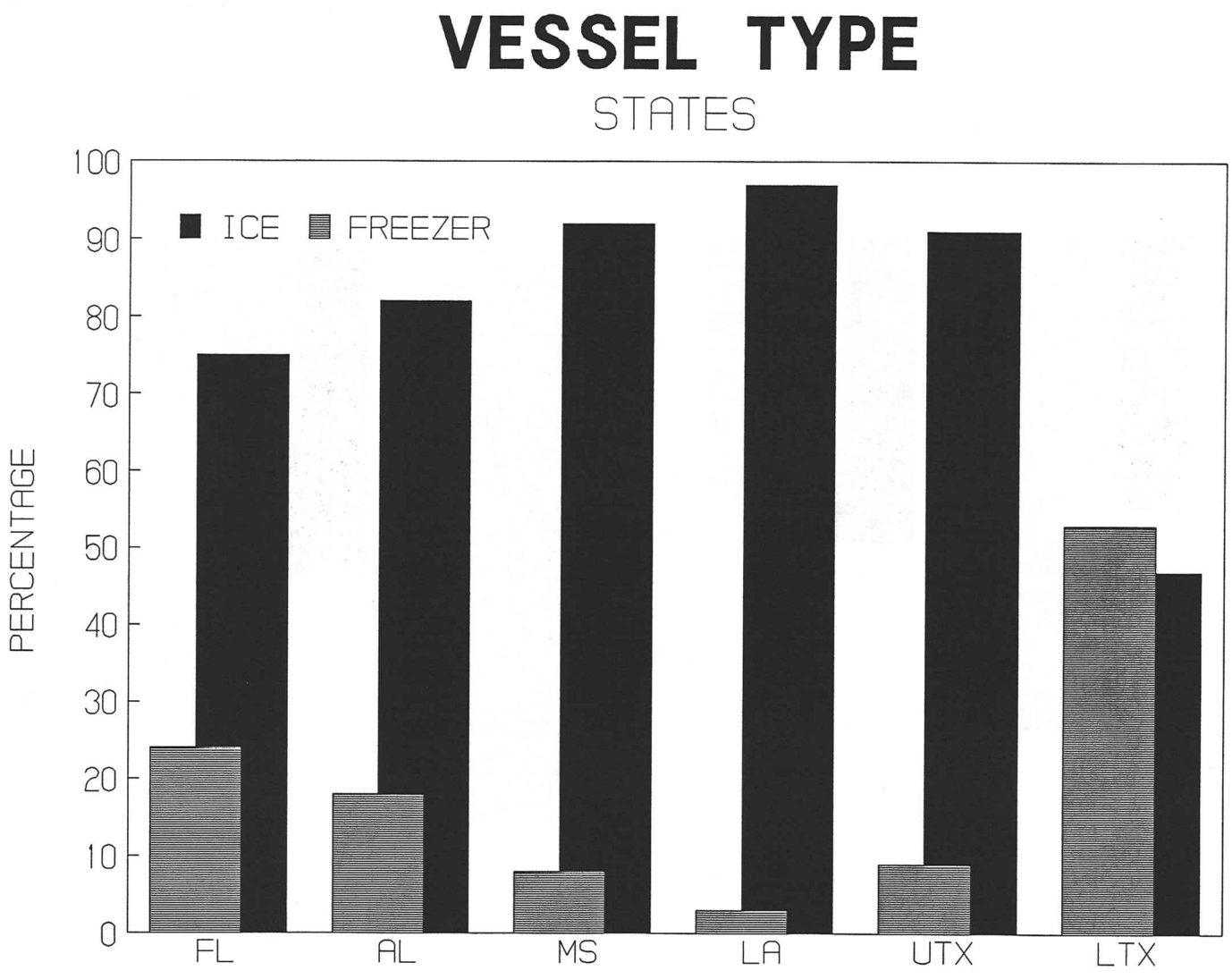
29. Percentage of interviewed captains from various states with expressed opinions about whether or not to have an EEZ closure off Texas, and if so, what distance.



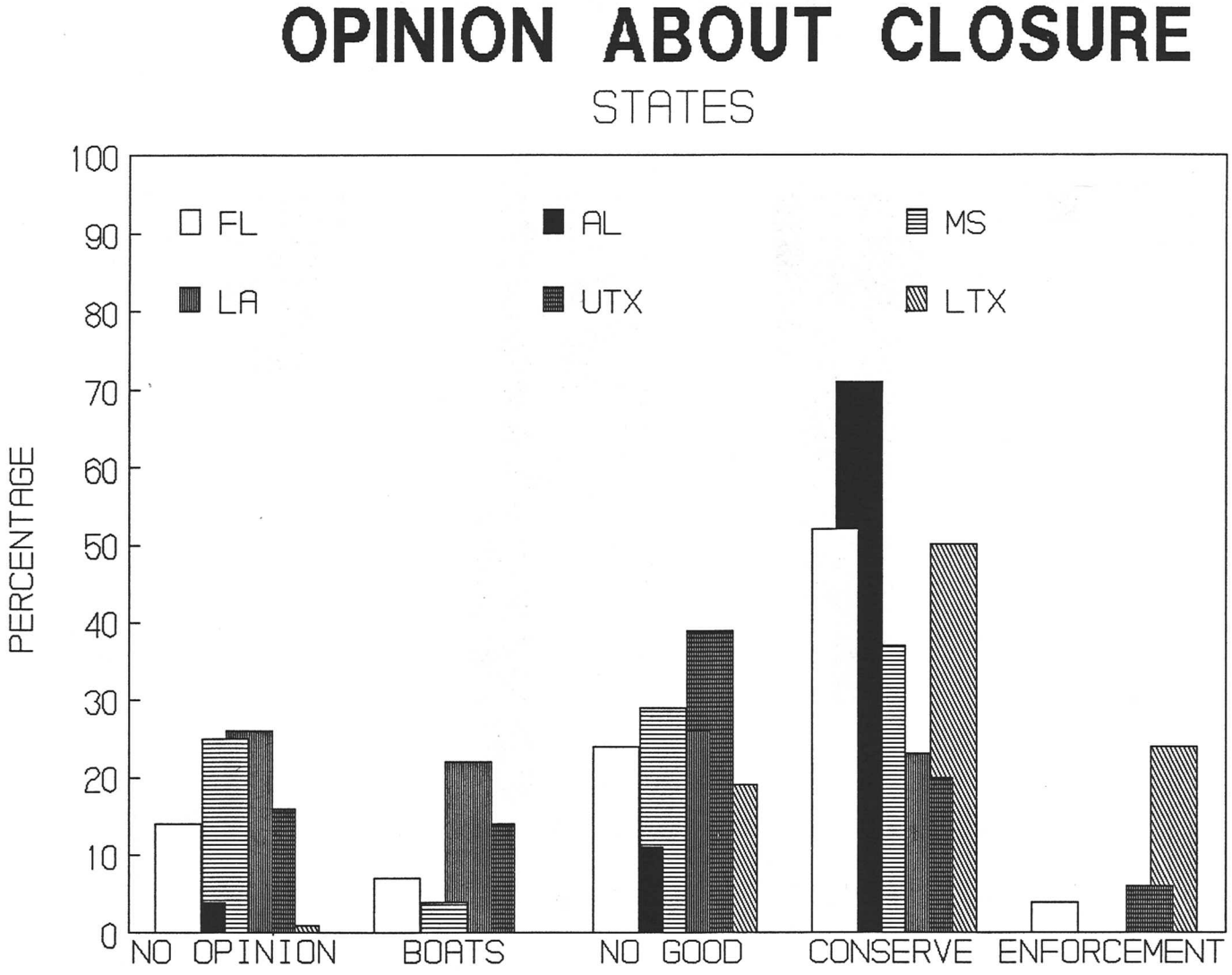
30. Percentage of interviewed captains from various ethnic groups with expressed opinions about whether or not to have an EEZ closure off Texas, and if so, what distance.



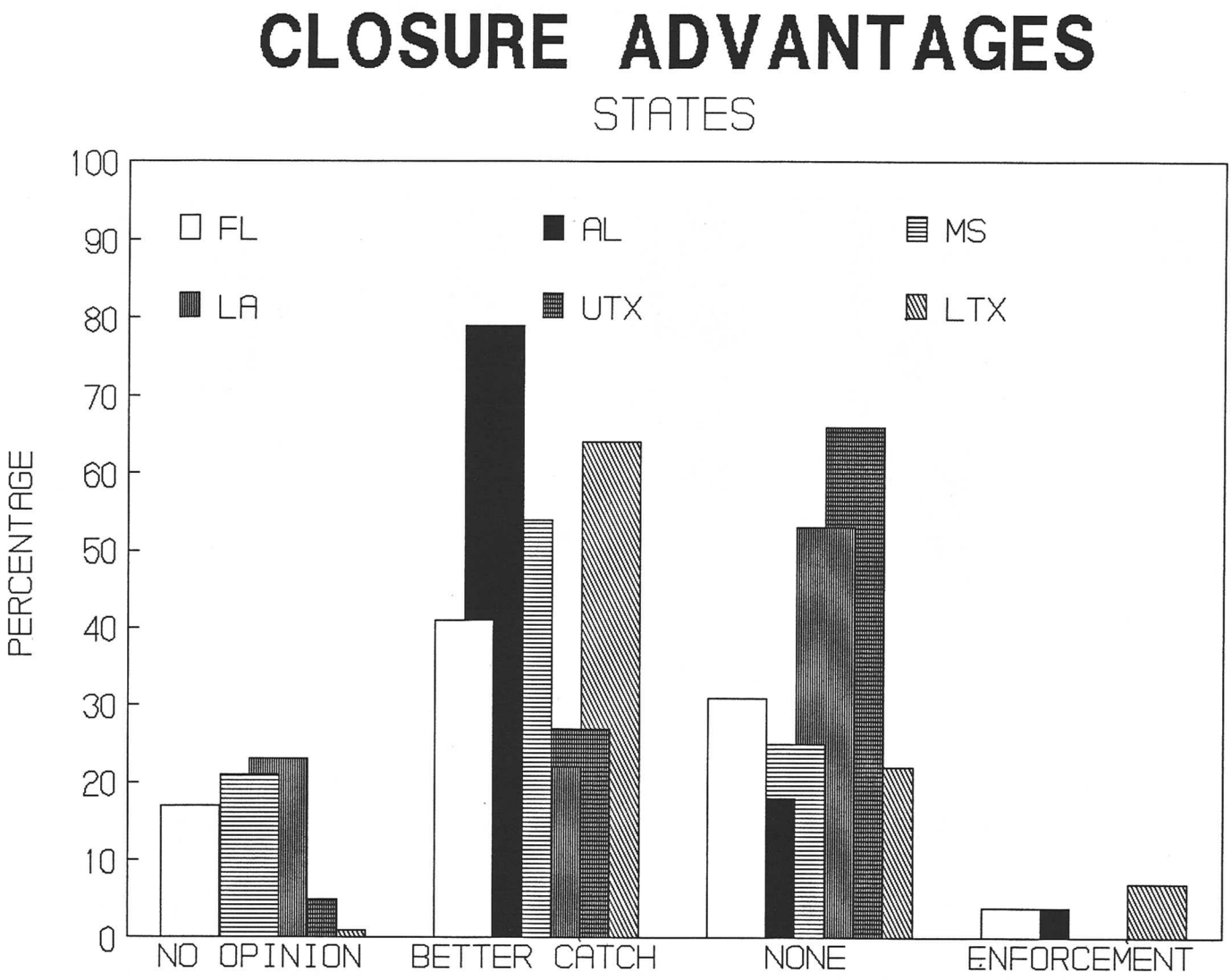
31. Percentage of interviewed captains from various vessel types with expressed opinions about whether or not to have an EEZ closure off Texas, and if so, what distance.



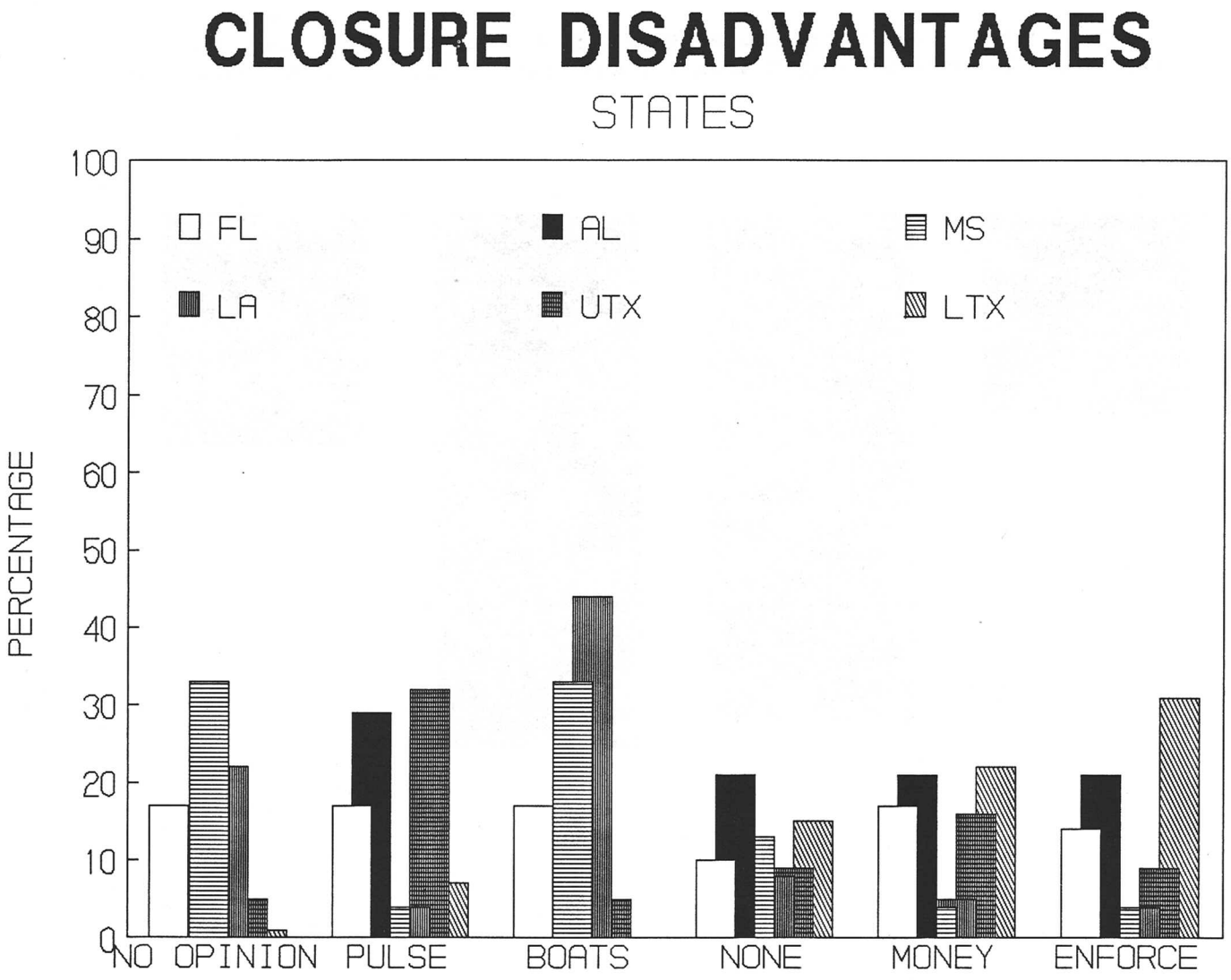
32. Percentage of each type of vessel from each state when interviews took place.



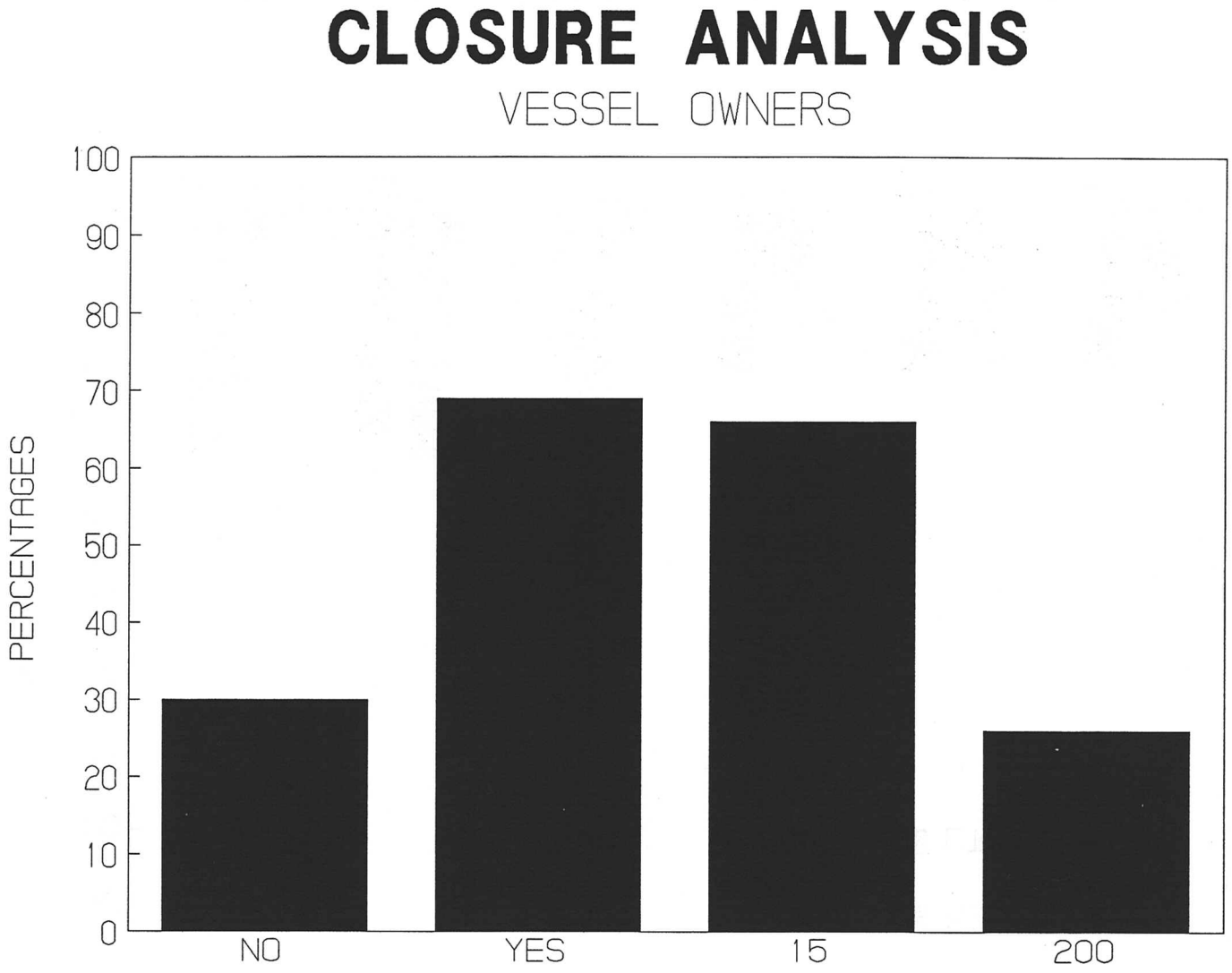
33. Percentage of interviewed captains from various states with expressed opinions about why they did or did not like the EEZ closure.



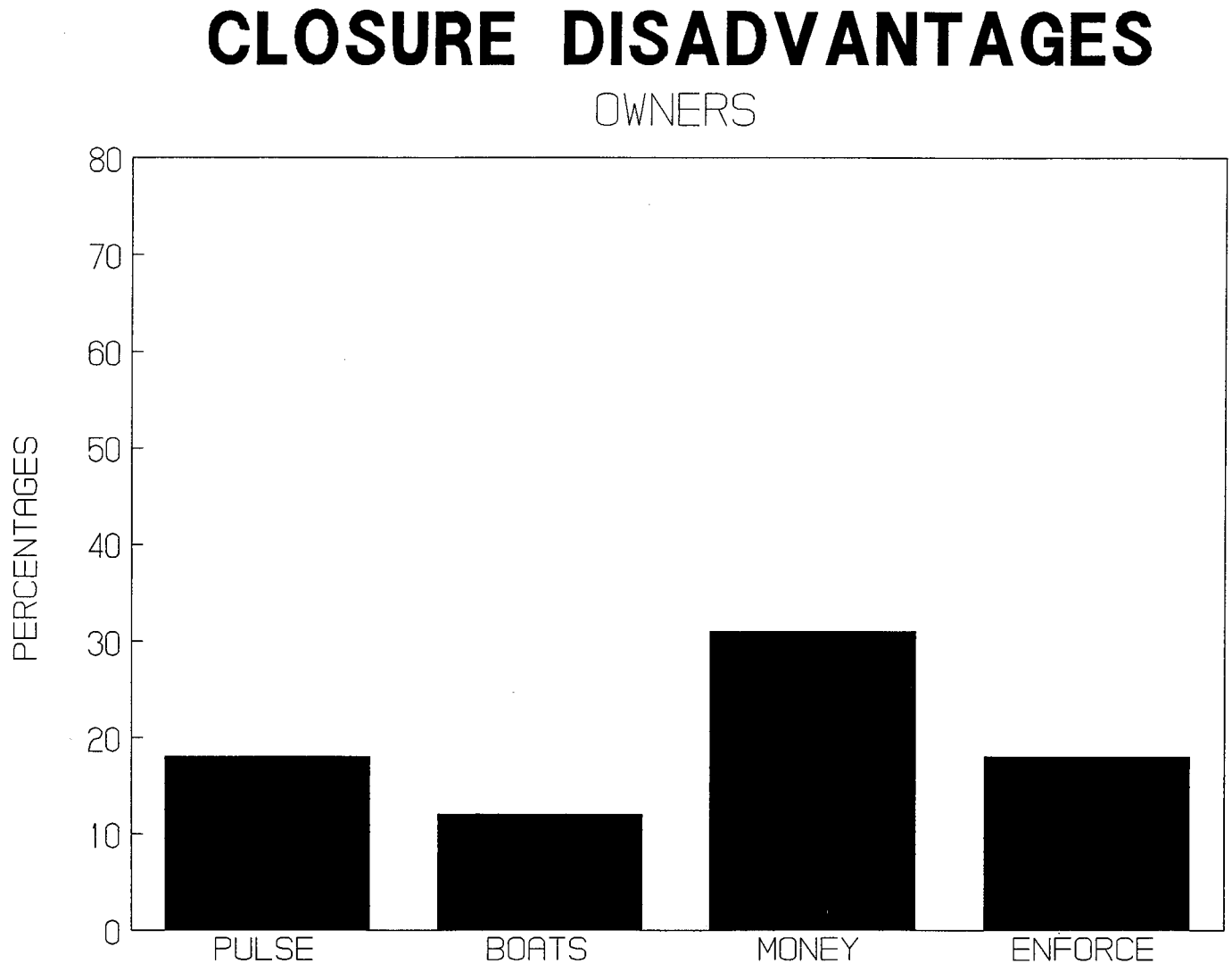
34. Percentage of interviewed captains from various states with expressed opinions about advantages of the EEZ closure off Texas.



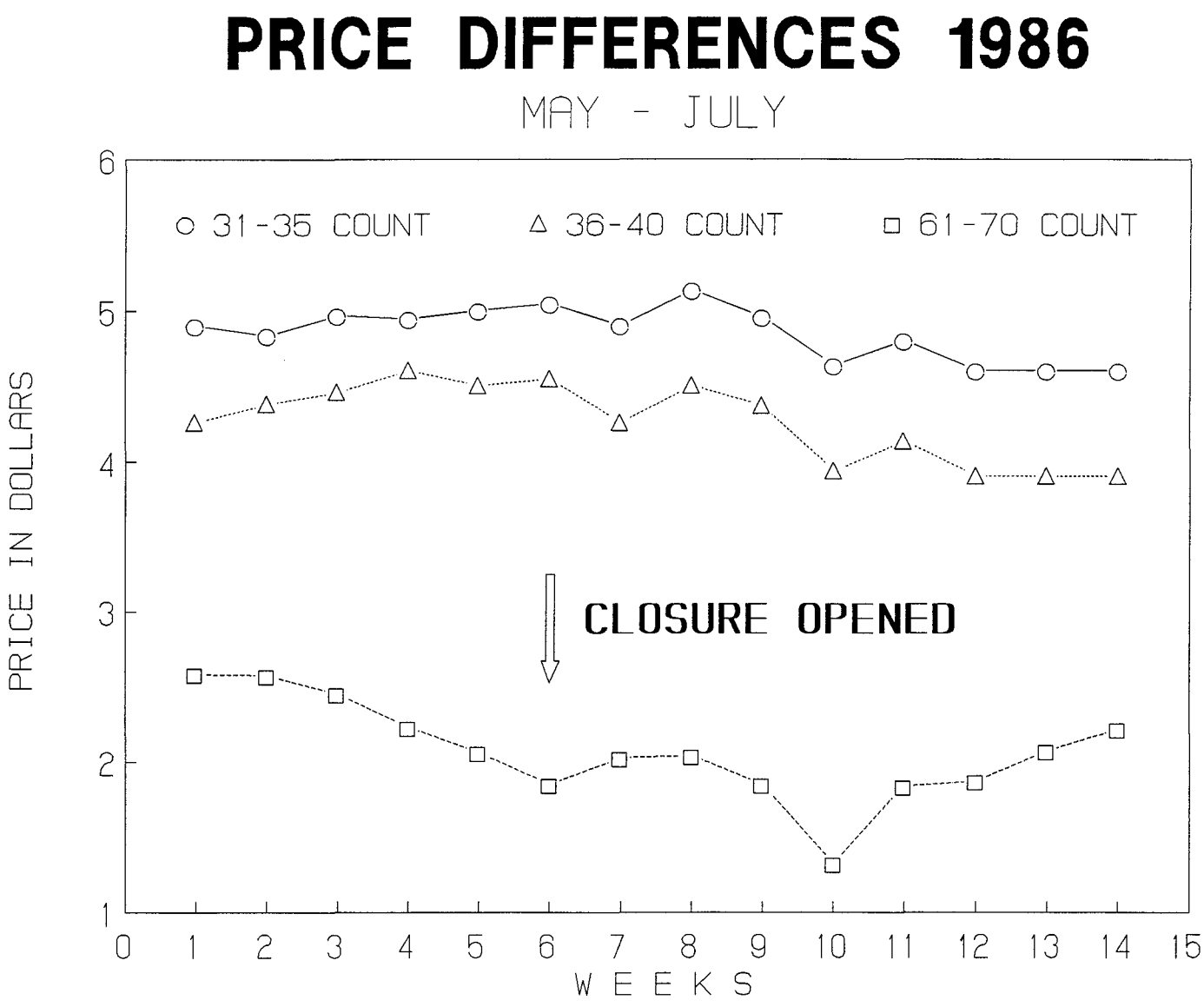
35. Percentage of interviewed captains from various states with expressed opinions about disadvantages of the EEZ closure off Texas.



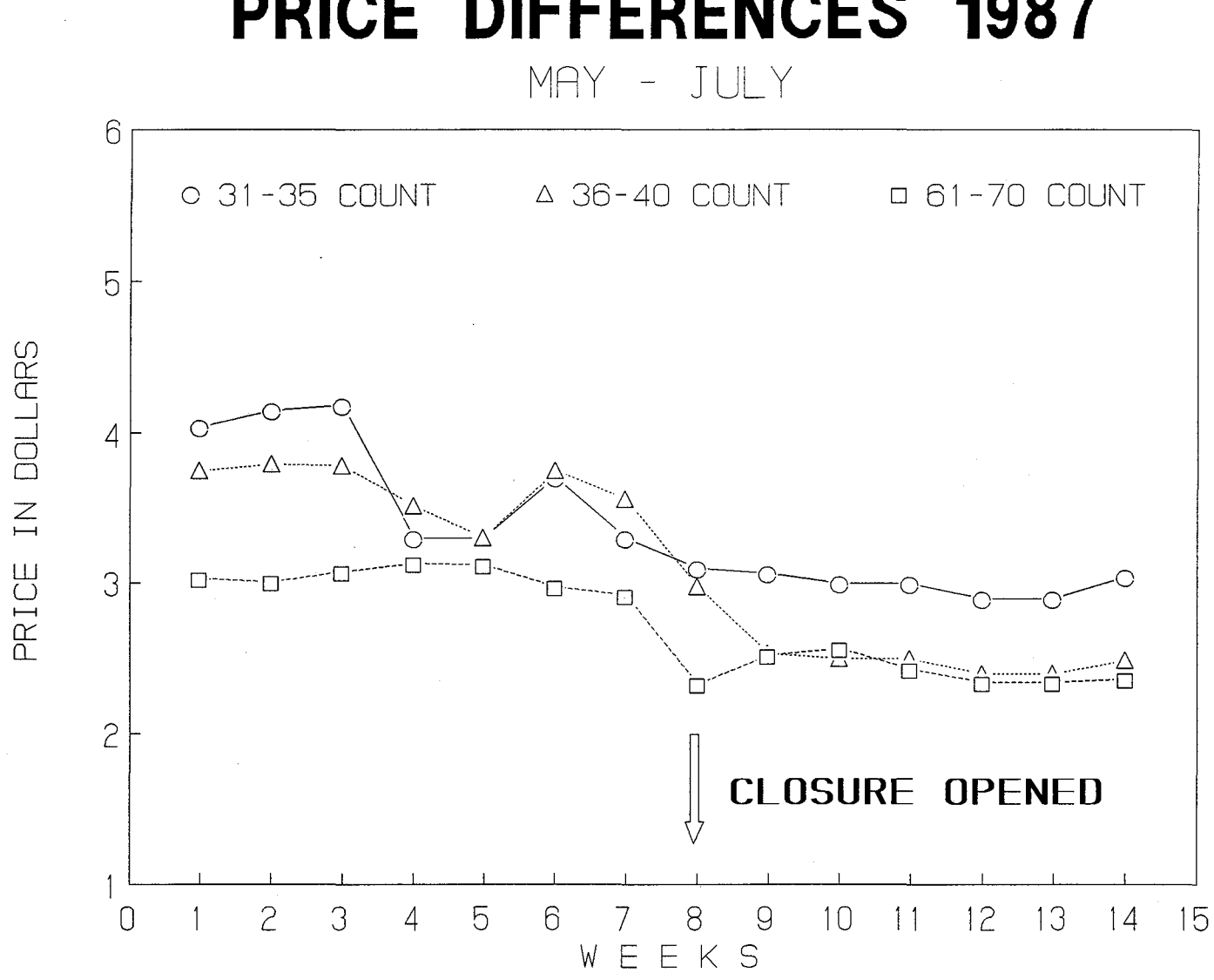
36. Percentage of interviewed vessel owners with expressed opinions about whether or not to have an EEZ closure off Texas, and if so, what distance.



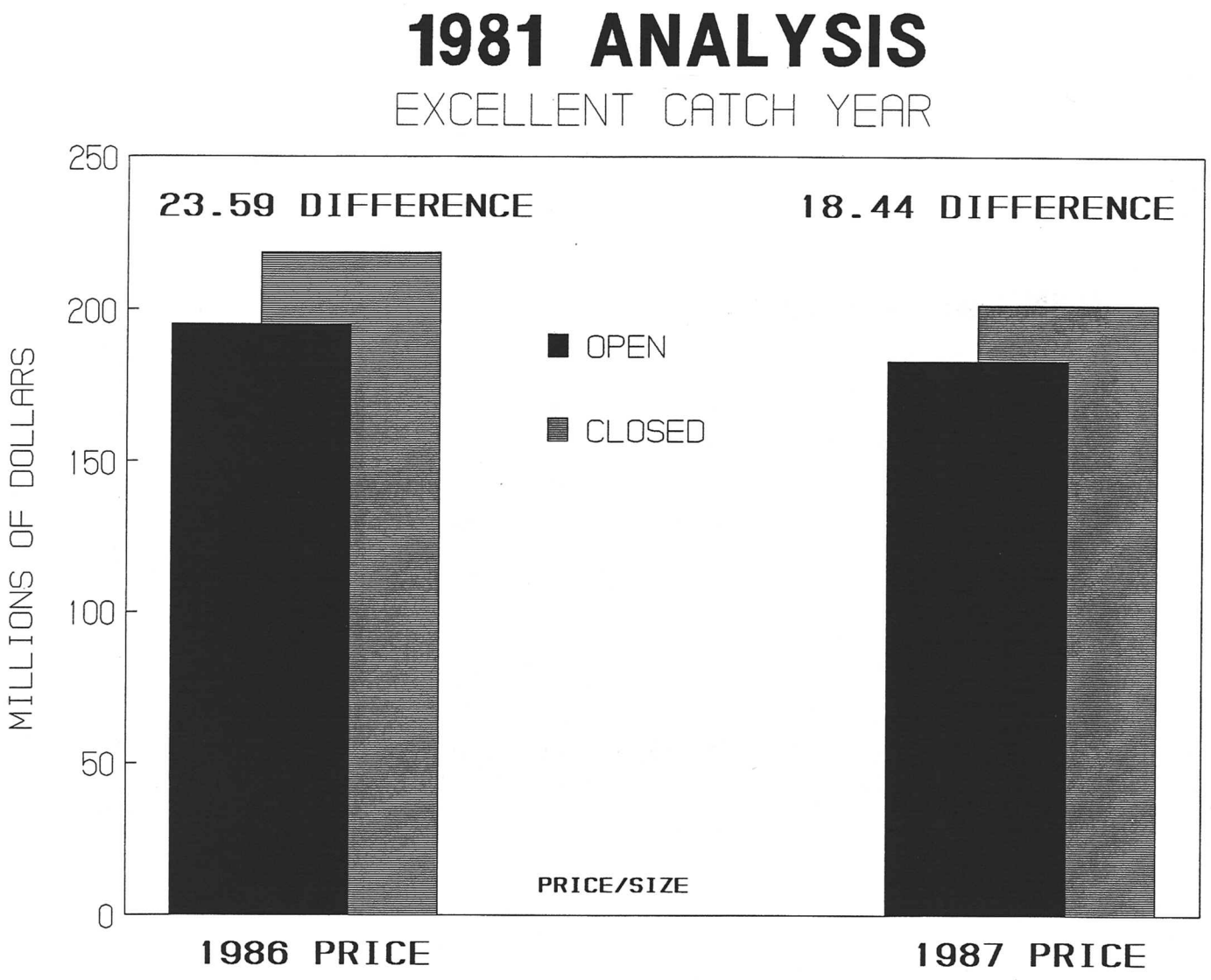
37. Percentage of interviewed vessel owners with expressed opinions about disadvantages of the EEZ closure off Texas.



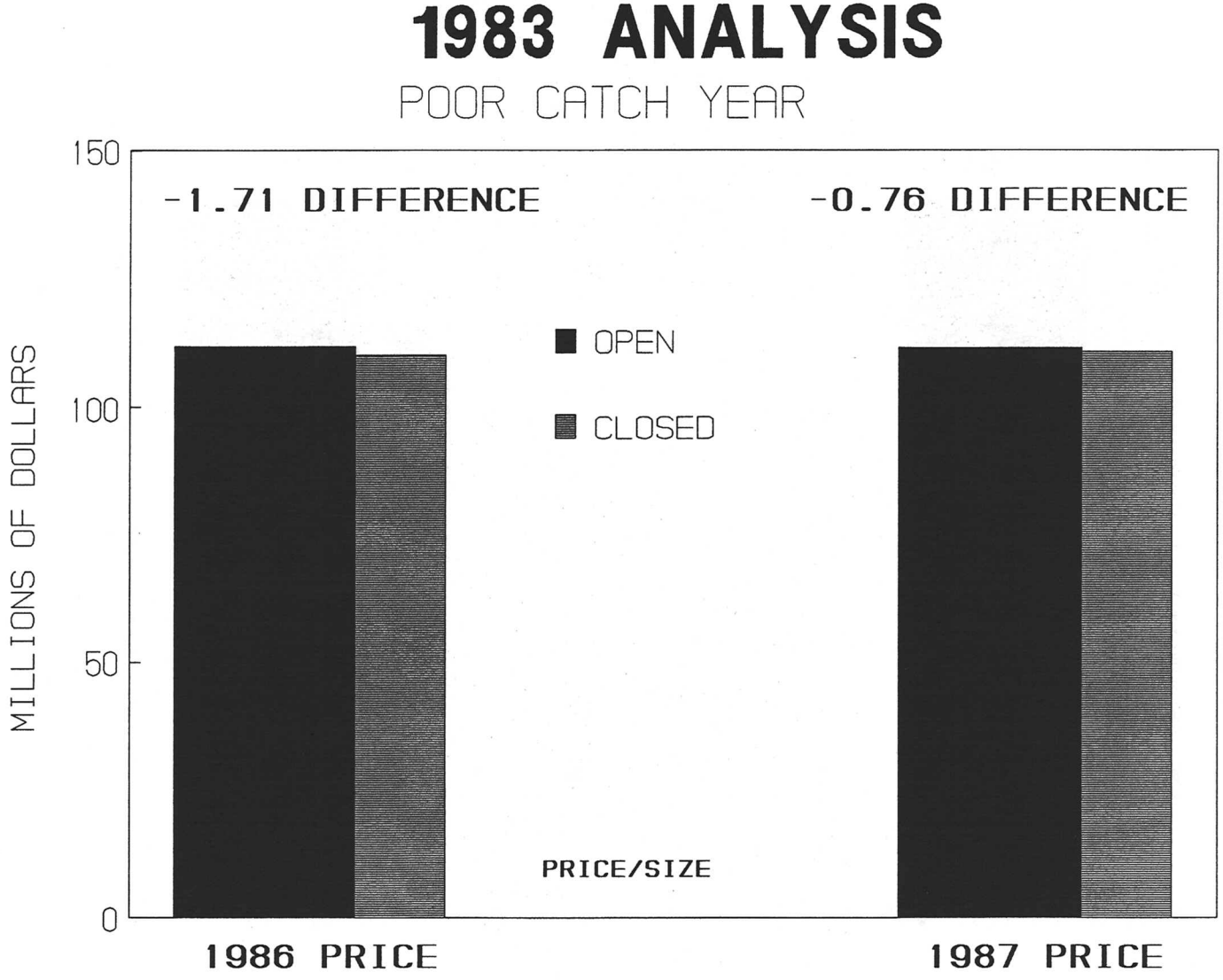
38. Average ex-vessel value for shrimp in Texas for May through July during 1986.



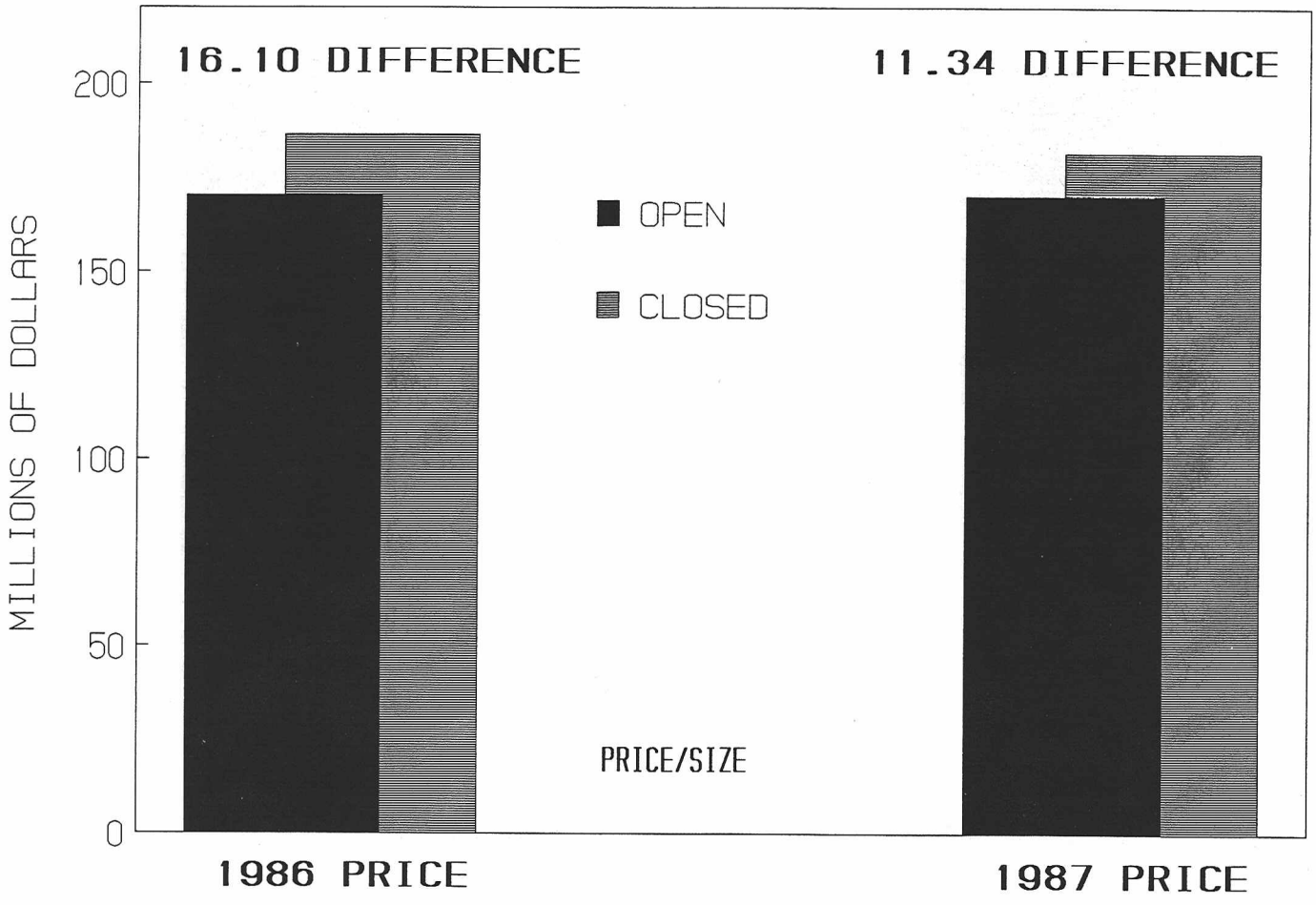
39. Average ex-vessel value for shrimp in Texas for May through July during 1987.



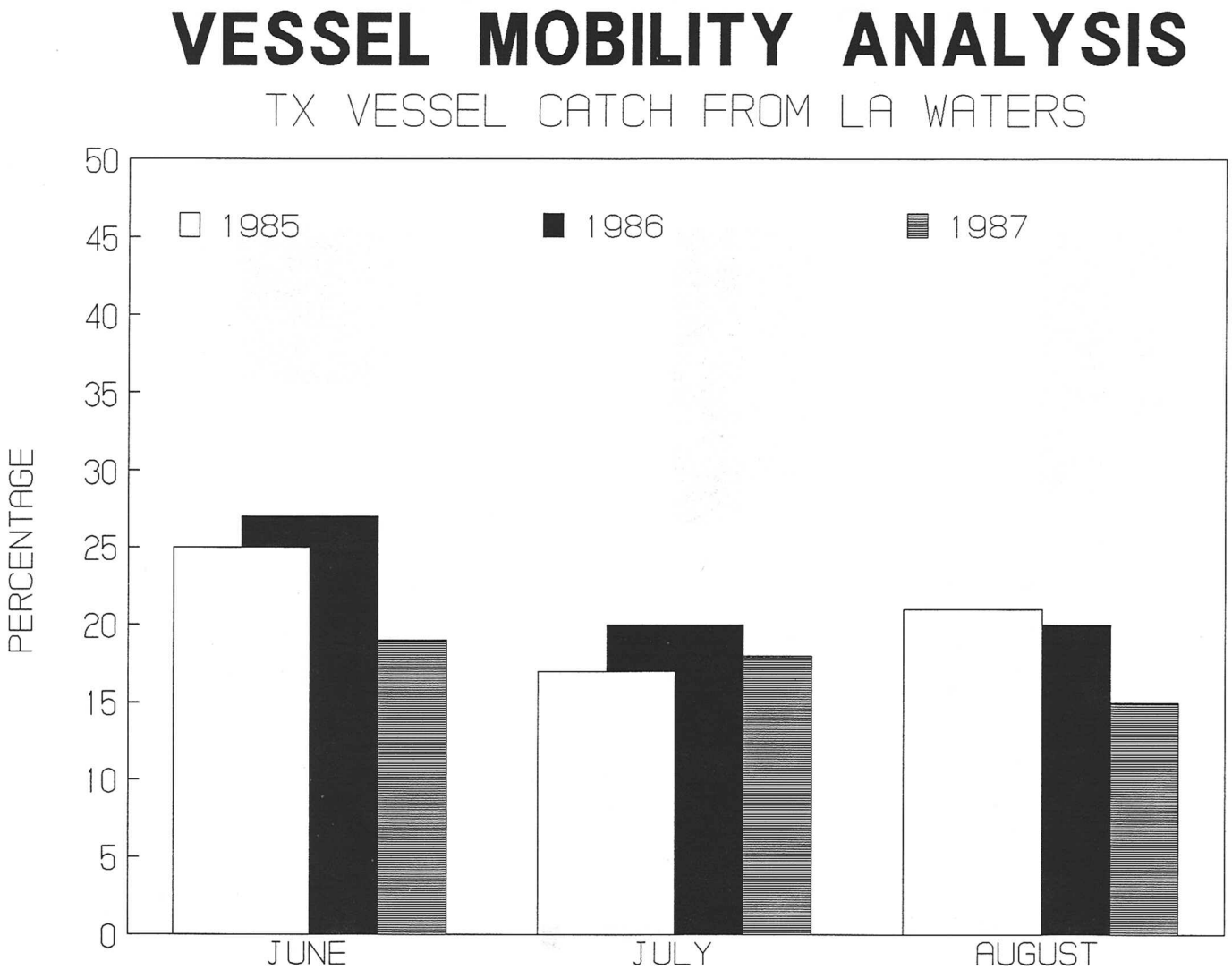
40. Estimated ex-vessel value of 1981 catch from May-August using 1986 and 1987 prices. Values shown are for EEZ opened or closed.



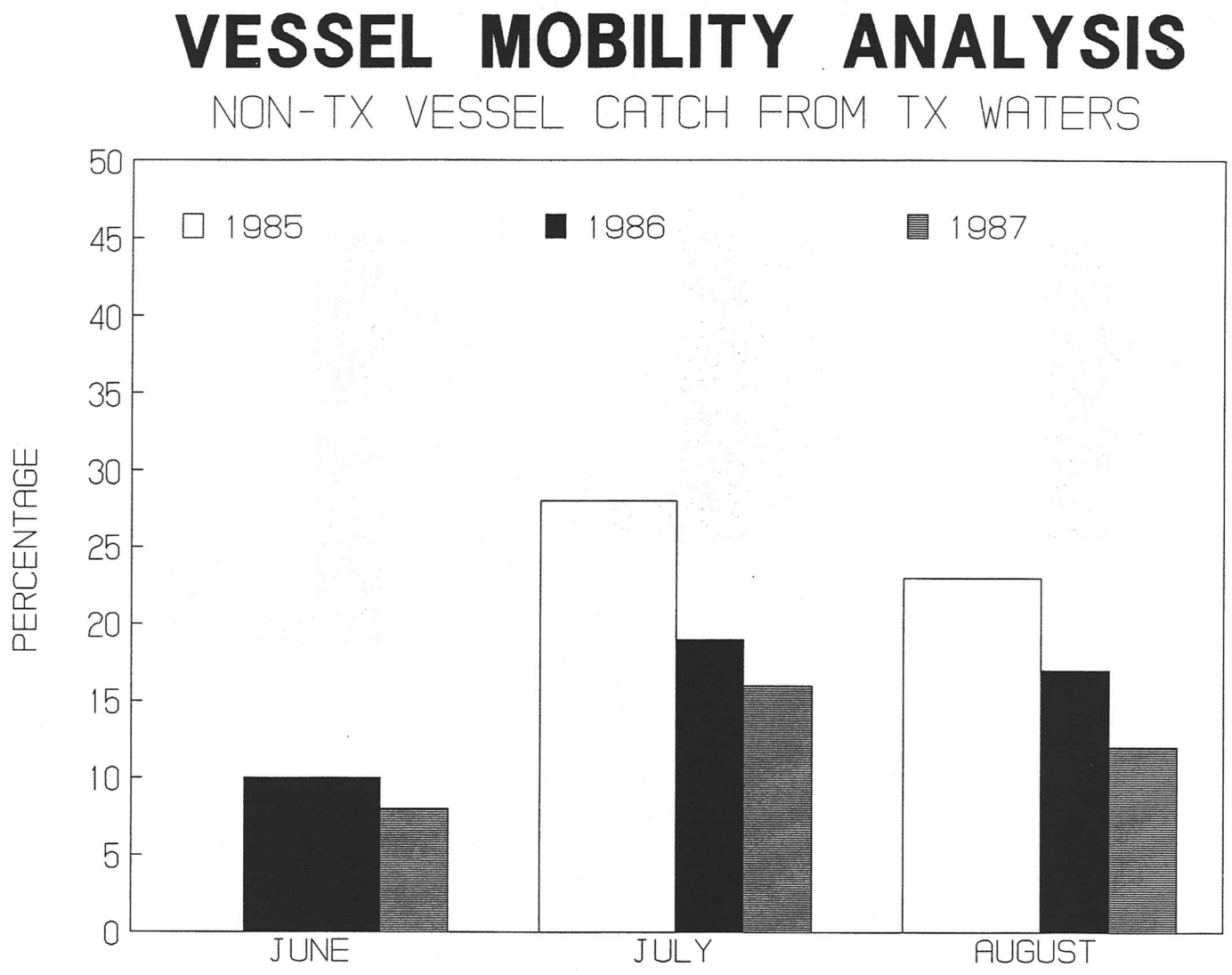
41. Estimated ex-vessel value of 1983 catch from May-August using 1986 and 1987 prices. Values shown are for EEZ opened or closed.



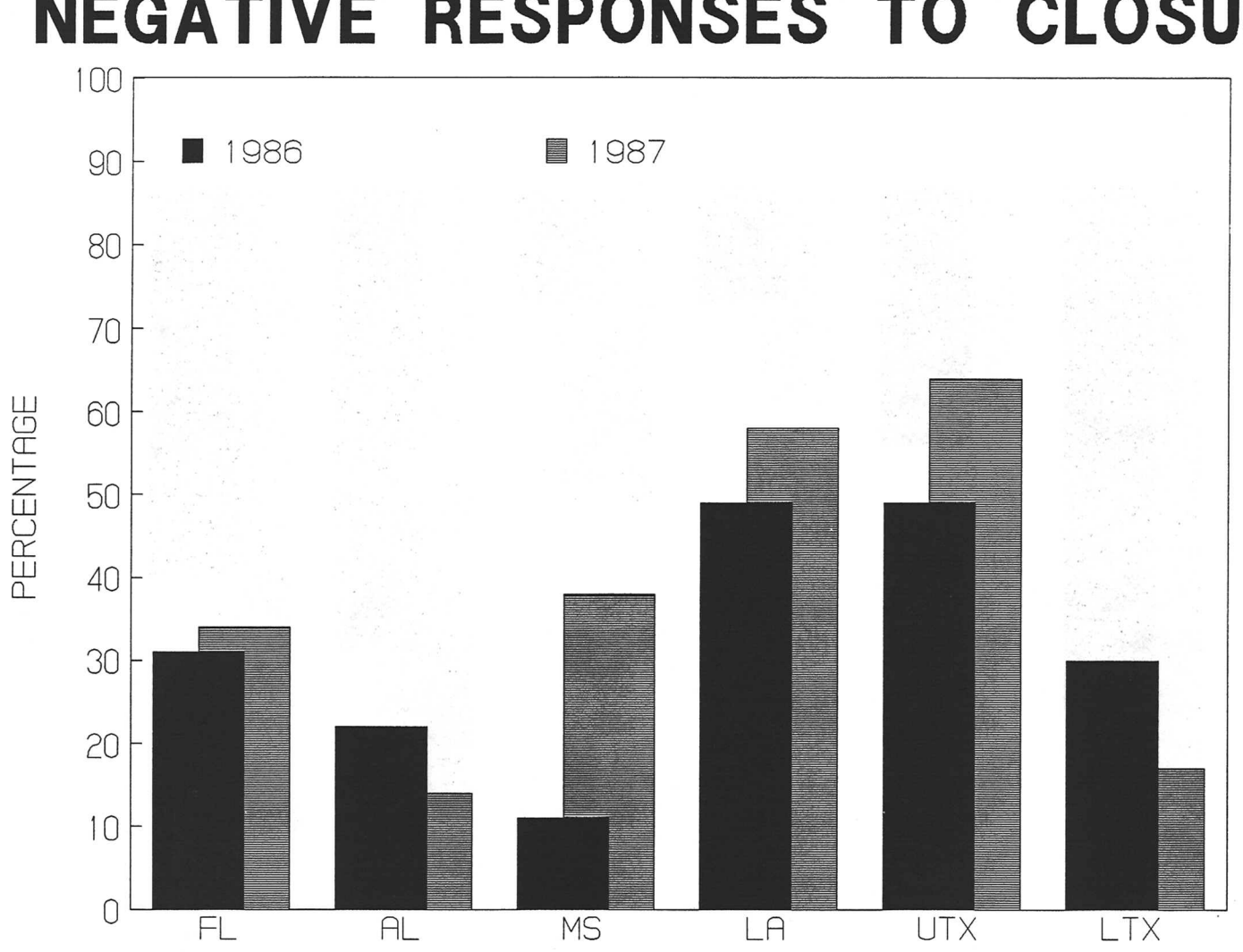
42. Estimated ex-vessel value of 1987 catch from May-August using 1986 and 1987 prices. Values shown are for EEZ opened or closed.



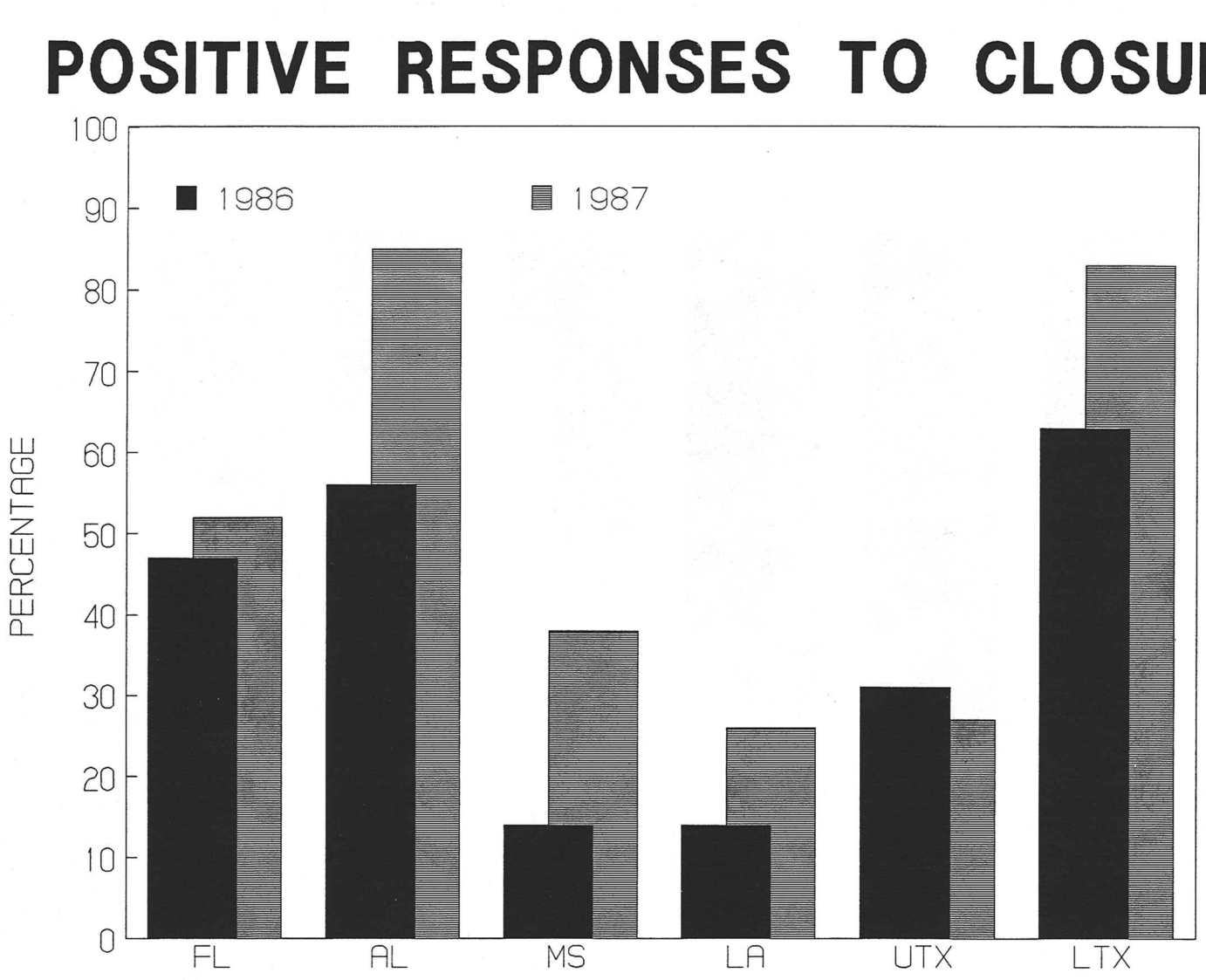
43. Percentage of shrimp taken from waters off Louisiana by vessels with a home port in Texas.



44. Percentage of shrimp taken from waters off Texas by vessels with a home port other than Texas.



45. Comparison of 1986 and 1987 social survey with regards to percentage of captains from a certain area against the EEZ closure off Texas.



46. Comparison of 1986 and 1987 social survey with regards to percentage of captains from a certain area in favor of the EEZ closure off Texas.