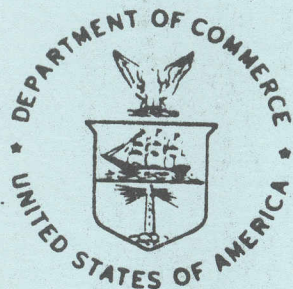


NOAA Technical Memorandum
NMFS-SEFC-99

Economic Status of the Offshore Shrimp Fishery
in the
Gulf of Mexico



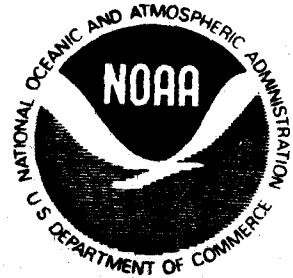
Presented at the
Gulf States Marine Fisheries Commission
Annual Spring Meeting
Biloxi, Mississippi

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Economic Status of the Offshore Shrimp
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Introduction

The shrimp fishery in the United States Gulf of Mexico has historically been one of the most valuable fisheries in the United States. The profitability of the fishermen in this fishery has not always maintained such elite status relative to other fisheries and in recent years the accounting ledgers for many vessels have been plagued with red ink. The reasons for these recently lean years of profitability are numerous and varied, but stock fluctuations, rising operating costs and generally lower ex-vessel prices account for much of the red ink. The purpose of this report is to present some basic indicators of the fishery which may provide some insight into the economic well-being or status of the shrimp fishery in the Gulf of Mexico during 1981. The indicators are restricted to data on the offshore fishery in the Gulf and apply primarily to the harvesting (or producing) sector of the fishery - i.e., the fishermen. A secondary purpose of the report is to present a general prognosis for the economic well-being of the fishery during 1982.

Since the paper is limited to the offshore shrimp fishery, it is necessary to, at least conceptually, describe this fishery. Although the Fishery Conservation and Management Act Section 3(9) defines the term "fishery resource" as any fishery, any stock of fish, any species of fish and any habitat of fish, it is intuitively obvious that fisheries' regulations ultimately only affect the human participants in the fishery directly. Thus, a fishery in the context of this report describes the people who are catching the fish and not the species they are harvesting. The offshore shrimp fishery then, is comprised of the fishermen catching shrimp seaward of the shoreline and not in the inland bays and estuaries along the Gulf of Mexico. A question of magnitude still remains because many fishermen have vessels which can effectively fish in both inshore and offshore areas depending on the locations of shrimp concentrations. For purposes of this report, a well-defined quantitative distinction between inshore and offshore fishermen is not required and the definition is fairly loose. However, a more rigorous definition could certainly be prescribed if the analysis required it.

The indicators presented in this report are in three general areas; prices, production, and vessel costs and revenue. The first section of the report presents monthly ex-vessel (dockside) prices for domestic shrimp landed in 1979, 1980 and 1981 for three geographical areas throughout the Gulf of Mexico. This section also discusses some of the major influential factors affecting the movement of ex-vessel shrimp prices. The second section presents data on offshore landed catch by month for 1979, 1980 and 1981 for three geographical areas of the Gulf. The ex-vessel values of these landings, as well as the average revenue per vessel, are also presented. Annual vessel costs and revenue estimates for both 1980 and 1981 are presented in the third section. These data are estimated from historical data and provide an indication of the fishery's average financial well-being during these two years. The paper is concluded with a prognosis for the fishery during 1982.

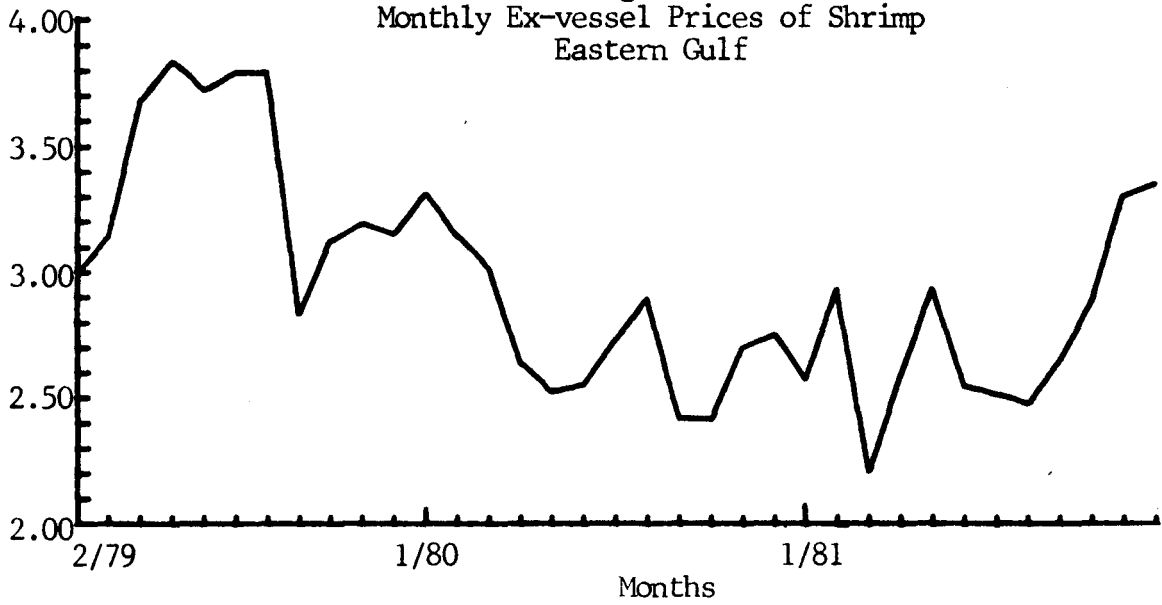
Ex-vessel Prices

The highly cyclical nature of shrimp prices causes part of the financial instability in the shrimp fisheries. Ex-vessel prices for the offshore catch landed at ports in the eastern (west coast of Florida), northern (Alabama, Mississippi, and Louisiana) and western (Texas) areas of the Gulf of Mexico for 1979, 1980, and 1981 are graphed in Figure 1. Ex-vessel prices in the northern and western Gulf moved in similar cycles during this three-year period with the peaks occurring mainly during the winter months (i.e., the off-season) and relatively lower prices during the summer months. The price series for the eastern Gulf (top panel of Figure 1) is counter-cyclical to the northwestern Gulf in 1979 and displays relatively low amplitudes for 1980 and most of 1981.

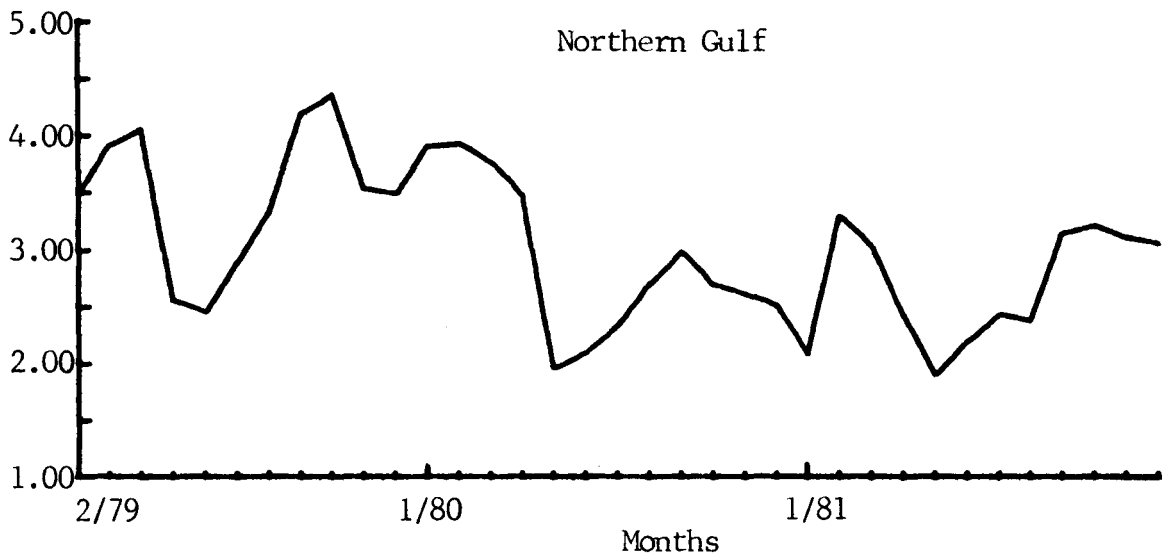
The most noticeable characteristics of this three-year price series are the sharp dips prices took during the summer months of 1980 and 1981. As will be discussed in more detail later in this section, ex-vessel prices are influenced mainly by two factors - domestic landings and cold storage inventories. The landed offshore catch in 1980 was about the same as the catch during the first part of 1979; however, the amount of shrimp in cold storage (inventories) increased 48 percent for the first six months of 1980 relative to 1979. As the graph in Figure 2 indicates, monthly cold storage holdings of shrimp during the first part of 1980 were above the ten-year averages (1971-1980) for these months. In 1981, domestic landings of offshore catches were above previous years and cold storage inventories were below 1979 by 7 percent for the first half of the year and were down 12.5 percent from the 1980 six-month inventories. These factors combined to yield slightly higher ex-vessel prices in 1981 compared to 1980 but lower prices relative to 1979 for the May, June, July and August period.

These comparisons of ex-vessel prices and shrimp inventories provide some intuitive indications of why ex-vessel shrimp prices fluctuate in such a cyclical pattern; however, for management purposes, empirical estimates of the relationship between shrimp prices and the factors influencing their movements are more useful. In a forthcoming issue of *Marine Fisheries Review* (MFR), I use simple and multiple regression analyses to estimate the empirical relationship between ex-vessel brown shrimp prices and some of the major factors affecting the movement of these prices. The model utilized in this article is an inverse demand function (Intriligator, 1978 and Fox 1953) in which monthly ex-vessel prices for the eight marketing categories of brown shrimp were regressed on landings, imports, cold storage holdings, per capita spending at eating and drinking places and the producer price index for meat, poultry and fish. The independent variables were specified in a multiplicative power function which can be transformed into a linear equation by taking the natural logarithm of the equation. The estimated coefficients in this specification provide a relative (unitless) measure of the effect on ex-vessel prices of the respective independent variables. The estimated coefficient on the landings variable,

Figure 1
Monthly Ex-vessel Prices of Shrimp
Eastern Gulf



Northern Gulf



Western Gulf

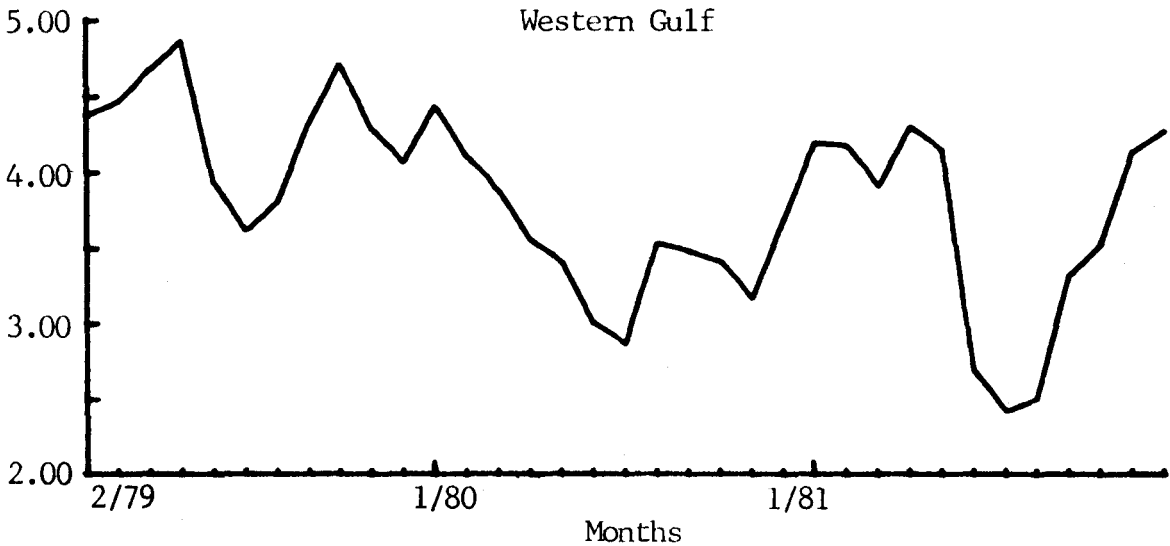
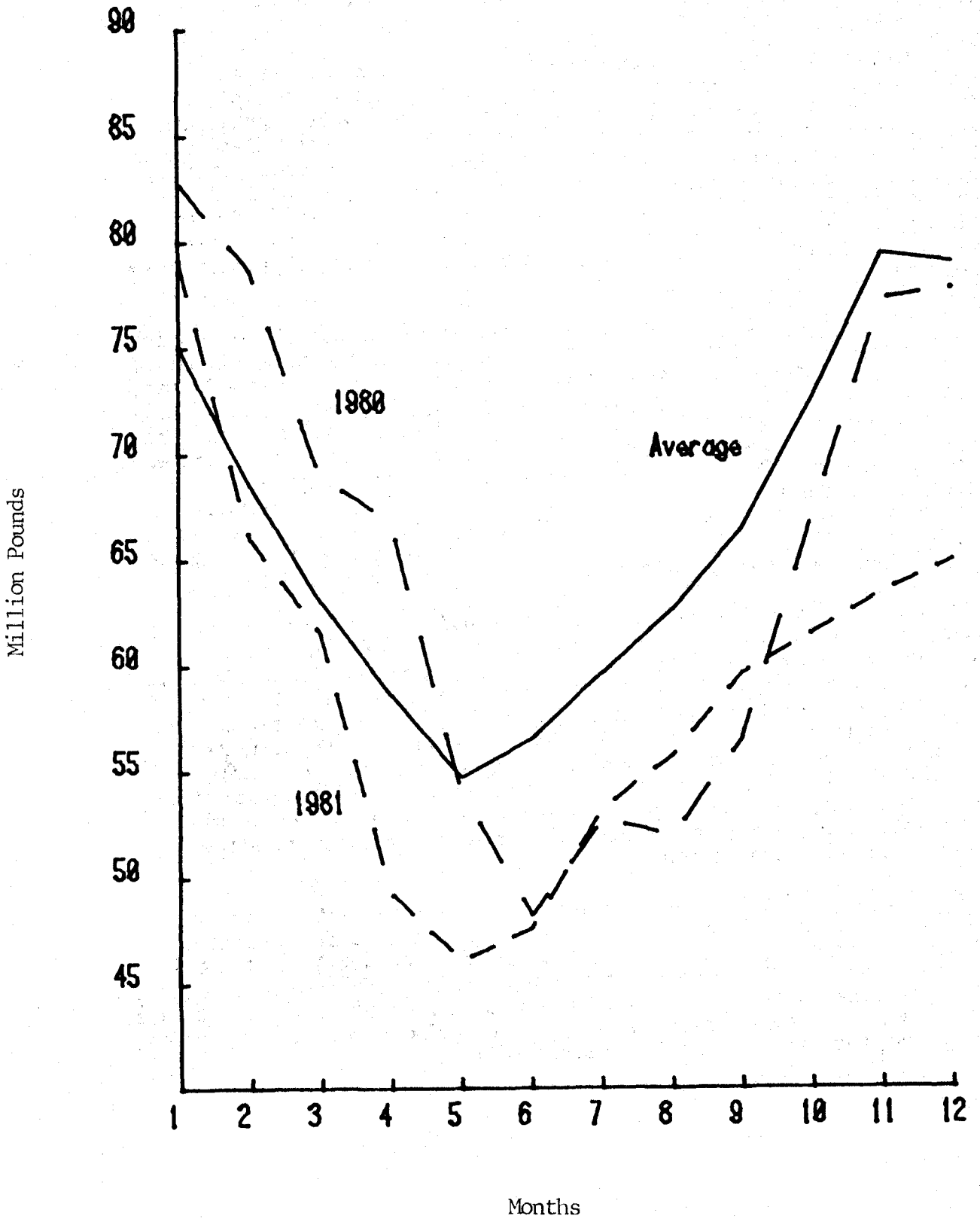


Figure 2

End of Month Cold Storage Holdings
(Product Weight)



for example, provides the percentage change in ex-vessel prices if the amount of landings changes by one percent and is referred to as the price flexibility of landings. The range of price flexibility estimates for brown shrimp landed at ports in the northwestern Gulf of Mexico is -0.04 to -0.11 depending on the size class of shrimp and the exact model specification.

The regression analyses presented in the MFR article also indicate several interesting interpretations with respect to the other explanatory variables. The coefficients for cold storage holdings were significantly different than zero ($\alpha = 0.05$) only for the 31-40, 41-50, and 51-67 size classes of shrimp indicating that the very large and very small shrimp probably are not held in storage but enter other processing channels directly. The estimated coefficients for this variable are close to -0.45 for the three significant size classes. This estimate implies that an increase of 10 percent in inventories would cause a decrease of about $4\frac{1}{2}$ percent in ex-vessel prices, ceteris paribus.

Data on fresh and frozen imports provided estimated coefficients which were significantly different than zero ($\alpha = 0.05$) only for size classes of 31-40 count and larger. The most interesting aspect of this variable was the positive sign estimated for the coefficients. The positive sign indicates that ex-vessel prices change in the same direction as imports. That is, if the amount of imports increases by 10 percent, prices would increase by about 3 percent. This reaction of ex-vessel prices is theoretically incorrect if prices are assumed to be influenced by foreign imports. Therefore, the positive sign probably indicates that changes in ex-vessel prices are the influential factor in determining the magnitude of foreign imports rather than imports affecting changes in ex-vessel prices.

The monthly per capita spending at eating and drinking places and the producer price index for meat, poultry and fish are variables that help account for shifts in the demand curve due to fundamental changes in demand or inflationary pressure. Both of these variables were significantly different than zero ($\alpha = 0.05$) and the producer price index data series dominated the summary statistics.¹ An interesting aspect of the estimated coefficient for the per capita spending variable is that, for the most part, the magnitude of the coefficient increases as the size of shrimp decreases which implies that a percentage change in (real) per capita spending would cause a larger percentage change in small shrimp prices relative to larger shrimp prices.

A final result of the regression analysis in the MFR article was that the 21-25, 41-50, and 51-67 size classes were the statistically dominant categories. In other words, these categories were the significant categories when they were included as independent variables in the regression equations of other size categories. The useful aspect of these results are that these three size categories would provide the most reasonable proxies for large, medium and small shrimp respectively.

Production

Although shrimp are landed throughout the year, definite seasonal patterns are obvious from the data and certainly well known to fishermen. As would be expected for a commodity in a relatively competitive market, the cyclical patterns of shrimp prices (Figure 1) and landings (Figure 3) are similar, albeit in an inverse direction. Large fluctuations in (offshore) landings are evident from the three years of data graphed in Figure 3, especially for the northern and western Gulf. The ex-vessel values (or gross revenue) from the offshore catch landed in these three geographical areas are also presented in Figure 3. The cyclical patterns of ex-vessel value follow those of the landed catch closely, except for the exaggerations during the peak summer months (especially for the northern and western areas).

An interesting observation from Figure 3 is the characteristics of the peaks for the ex-vessel value in the northern Gulf area was larger in 1979 than the two subsequent years; whereas the peaks in value of the offshore fishery in the western Gulf have increased in both 1980 and 1981 over the immediately preceding years. These characteristics are probably due in part to the relatively greater role the inshore fishery plays in the northern Gulf and in part to the influence of the Texas closure regulation in providing increased offshore catches and consequently more total revenue in the western Gulf area during 1981.

Simply increasing the availability of shrimp may not represent more revenue to the individual fishermen if the number of vessels (and fishermen) increases. Statistics on the reported number of vessels (i.e., crafts greater than 5 gross tons and documented with the U.S. Coast Guard) in the Gulf of Mexico shrimp fishery indicate that their number has been increasing steadily except for modest declines during 1974 and 1975 (Table 1). Comprehensive data are only available through 1977, but preliminary estimates for 1981 indicate that the increasing trend has been continuing.

The catch statistics which are routinely collected by the National Marine Fisheries Service can be summarized by vessel and the number of trips a vessel was reported to have made during a specific year. A summary of these data are presented in Table 2 by the following groups - fewer than 10 trips, 10 to 50 trips, and more than 50 trips per year. The method of reporting the shrimp landings data was changed for 1976 through 1980 and a summary by vessel (such as the summary presented in Table 2) cannot be made for those years. Several years prior to 1976 are also presented in Table 2 as a comparison to the preliminary 1981 data. It is reasonable to assume based on the distribution of catch by area (last column in Table 2) that most of the 10-50 trip per year vessels do mostly offshore fishing. A comparison with earlier years indicates that 1981 was a very good year based on both the average catch per vessel and the concomitant average gross revenue per vessel. The distribution of the catch for the 10-50 trip vessels is interesting because it is divided nearly equally between the small, medium and large size categories. The distribution of catch by size

Figure 3

Total Landings and Ex-vessel Value of Shrimp by Geographical Area

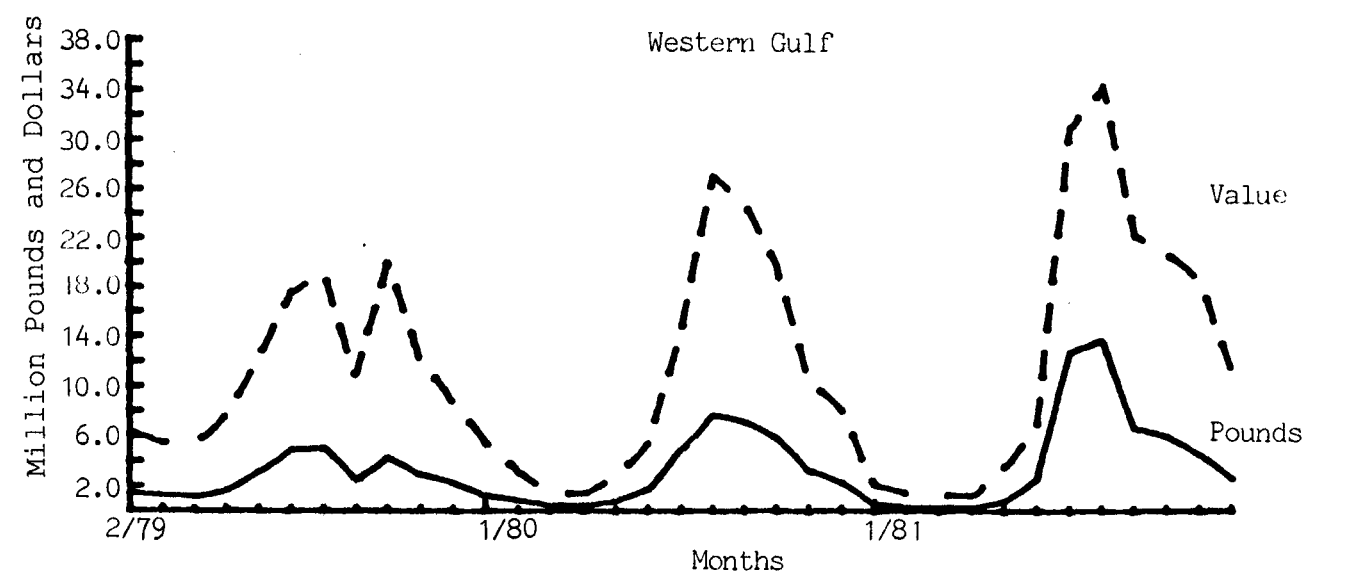
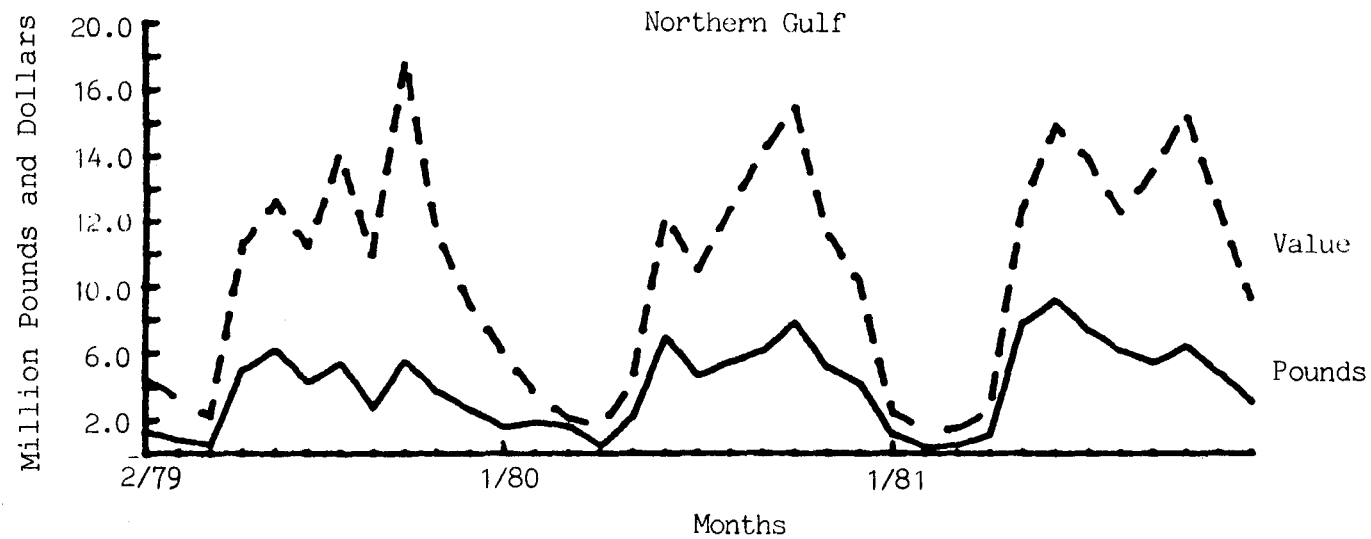
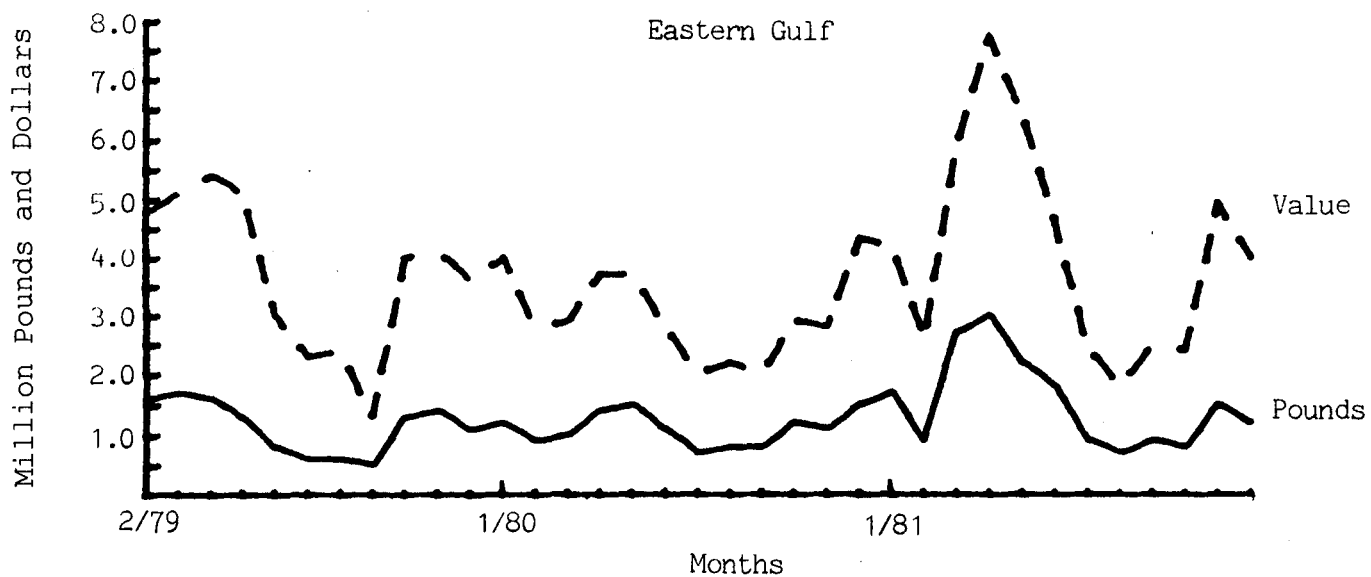


Table 1

Number of shrimp otter trawl boats and vessels
in the Gulf of Mexico, 1960-1980*

Year	Boats	Vessels	Total Craft
1960	3,089	2,941	6,030
1961	2,987	2,686	5,673
1962	3,927	2,600	6,527
1963	4,481	2,697	7,178
1964	4,360	2,782	7,142
1965	4,785	2,849	7,634
1966	4,797	2,942	7,739
1967	4,983	3,146	8,129
1968	5,109	3,430	8,539
1969	4,817	3,569	8,386
1970	4,495	3,579	8,074
1971	4,828	3,487	8,315
1972	4,848	3,683	8,531
1973	4,723	4,091	8,814
1974	4,589	3,785	8,374
1975	5,054	3,690	8,744
1976	5,116	4,177	9,293
1977	5,190	4,355	9,545

Source: Fishery Statistics of the United States, N.M.F.S., U.S.
Department of Commerce, annual issues and preliminary data.

*Number of boats and vessels are exclusive of duplication of reporting for individual states.

Table 2

Comparison of Catch Statistics per Vessel by Number of Trips

1981

Vessels Reporting	No. of ^{1/} Vessels	Avg Trips Per Vessel	Avg Lbs. Per Vessel	Avg Value Per Vessel	Dist. of Catch ^{2/}			Dist. of Catch	
					SM	MD	LG	OFFSH	INSH
◀ 10 Trips	2378	3.9	11706.8	33545.6	0.25	0.37	0.38	0.96	0.04
10-50 Trips	1914	16.5	37787.3	106367.2	0.28	0.35	0.37	0.95	0.05
▶ 50 Trips	37	73.2	23519.4	47156.1	0.52	0.27	0.22	0.64	0.36

1975

◀ 10 Trips	1492	3.9	6163.3	10712.3	0.22	0.25	0.54	0.89	0.11
10-50 Trips	1098	18.1	28618.3	51846.4	0.31	0.30	0.39	0.95	0.05
▶ 50 Trips	34	85.1	16167.4	18881.9	0.78	0.11	0.12	0.27	0.73

1974

◀ 10 Trips	1071	4.4	7158.1	10004.1	0.23	0.29	0.49	0.90	0.10
10-50 Trips	2076	20.0	33735.9	46874.6	0.18	0.32	0.50	0.96	0.04
▶ 50 Trips	100	84.8	21952.1	18119.0	0.63	0.17	0.20	0.46	0.54

1973

◀ 10 Trips	942	4.3	6385.3	10705.0	0.23	0.34	0.42	0.92	0.08
10-50 Trips	2399	20.7	30354.2	52286.6	0.22	0.36	0.41	0.97	0.03
▶ 50 Trips	111	81.8	22136.3	23891	0.61	0.21	0.18	0.51	0.49

^{1/} The number of vessels in this summary is 71% of the total (see Table 1) for 1975, 62% in 1974 and 84% in 1973.

^{2/} Small shrimp are 51 count and smaller, medium shrimp are 31 to 50 count and large are ◀15 to 30 count.

category was about the same in earlier years with the exception of 1974 in which large shrimp comprised a greater percentage relative to the distribution of these percentages for other years.

In summary, the offshore shrimp fishery produced more ex-vessel landings and value in 1981 than they did in 1980. In addition to increased landings and value being reported in the three geographical areas separately, the total offshore fishery in the Gulf produced 28 percent more landings and 21 percent more gross revenue in 1981 relative to 1980. Although 1980 catch data cannot be summarized by vessel, one would anticipate that the catch and revenue per vessel would also show improvement in 1981 over 1980.

Costs

The amount of shrimp that vessels catch and land is certainly important to their economic well-being, but equally important are the costs incurred in catching those shrimp. This has become painfully obvious in the last five or six years since the cost of fuel has escalated at unprecedented rates. This report does not provide a detailed investigation of the changes in operating costs over the past few years; however, estimates of costs and revenues are presented for 1980 and 1981 (Table 3).

The 1980 cost and revenue data presented in Table 3 are estimated based on annual data collected from vessel owners and captains since the early 1970s (Wade Griffin, pers. com.). The historical cost and revenue data were collected from vessels landing, at least some of their annual catch, at Texas ports and are used as a proxy for cost and revenue estimates of offshore vessels in the entire Gulf of Mexico. The 1980 estimates in Table 3 indicate that it was a financially poor year for the average vessel represented by these data. Although these estimates may not be totally representative of all the offshore vessels in the Gulf and do not provide any indication of the distribution around this mean estimate, it is clear that the indication of a financially bad year is reliable.

Estimated cost and revenue figures for 1981 are also presented in Table 3. These estimates are based on the 1980 figures but adjusted for known cost increases between 1980 and 1981. For example, the cost of ice increased by about 10% in the northwestern Gulf areas and the cost of diesel fuel rose from about \$0.92 per gallon to \$1.15. The cost of supplies was assumed to increase about 8 percent based on a sub-component of the consumer price index. The wages paid to crew members were assumed to drop from about 33 percent of gross revenue to about 28 percent. This drop was used because the crew on many vessels have had to pay part of the vessel's fuel expenses in 1981. The final assumption underlying these estimates is that fixed costs did not change between 1980 and 1981. In addition to costs, gross revenue had to be estimated in a way consistent with the 1980 estimates presented in Table 3. The change in vessel revenue was estimated by applying the same percentage increase in the ex-vessel value of the offshore catch between 1980 and 1981 to the 1980 estimate of

Table 3

Cost and Revenue Estimates for 1980 and 1981

	1980 ^{1/}	1981 ^{2/}
Gross Revenue	144,145	174,593
Costs		
Variable Costs		
Ice	4,029	4,432
Fuel	52,852	65,536
Supplies	35,750	38,610
Crew's Wages	<u>46,776</u>	<u>49,297</u>
Total Variable	139,401	157,875
Total Fixed Cost	<u>42,631</u>	42,631
Total Cost	<u>182,032</u>	<u>200,506</u>
Net Revenue	- 36,887	- 25,913

^{1/} The cost and revenue estimates for 1980 were provided by Dr. Wade Griffin, Texas A&M University from his computer simulation model which is derived from data collected historically on a sample of vessels landing their offshore catch in Texas. The 1980 estimates are unpublished, but are part of a contract between Texas A&M University and the National Marine Fisheries Service.

^{2/} The cost and revenue estimates for 1981 are calculated from the 1980 estimates using the following adjustment:

- gross revenue was increased by 21%, the increase in offshore value between 1980 and 1981;
- ice was increased 10%;
- fuel was increased 24%, based on observations by NMFS port agents;
- supplies were increased 8% based on increases of sub-component of the consumer price index, and
- crew's wages were calculated at 28% of gross revenue.

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gross revenue. Adding all the adjusted 1981 cost estimates and subtracting them from the estimated gross revenue yields a negative net revenue estimate for 1981.

Providing a negative net revenue estimate for the offshore fishery during 1981 seems inappropriate for several reasons. First, the landed offshore catch increased by 28 percent and ex-vessel value increased by 21 percent. A second reason could be the apparent change in fishing concentration in 1981 compared to 1980. The number of offshore trips which the fishermen made in 1981 was about 12 percent lower than in 1980 (97,814, in 1980 to 85,705 in 1981). In addition, these fewer trips provided 21 percent more revenue to the fishery or an average of \$3,952 per trip in 1981 compared to \$2,859 per trip in 1980. An even more striking comparison is the average revenue per trip between 1980 and 1981 for the western Gulf. In 1980, the average revenue per trip was \$4,543 and in 1981 the average revenue per trip increased to \$7,511. The reduction in the number of trips would also indicate that the fishing vessels probably used less fuel during 1981 and even though the price per gallon was about 24 percent greater, their total fuel expenditure could have been less. Since the number of trips per vessel comprising the 1980 estimated cost and revenues was not known, an adjustment in the average amount of fuel consumed for the 1981 estimates could not be made.

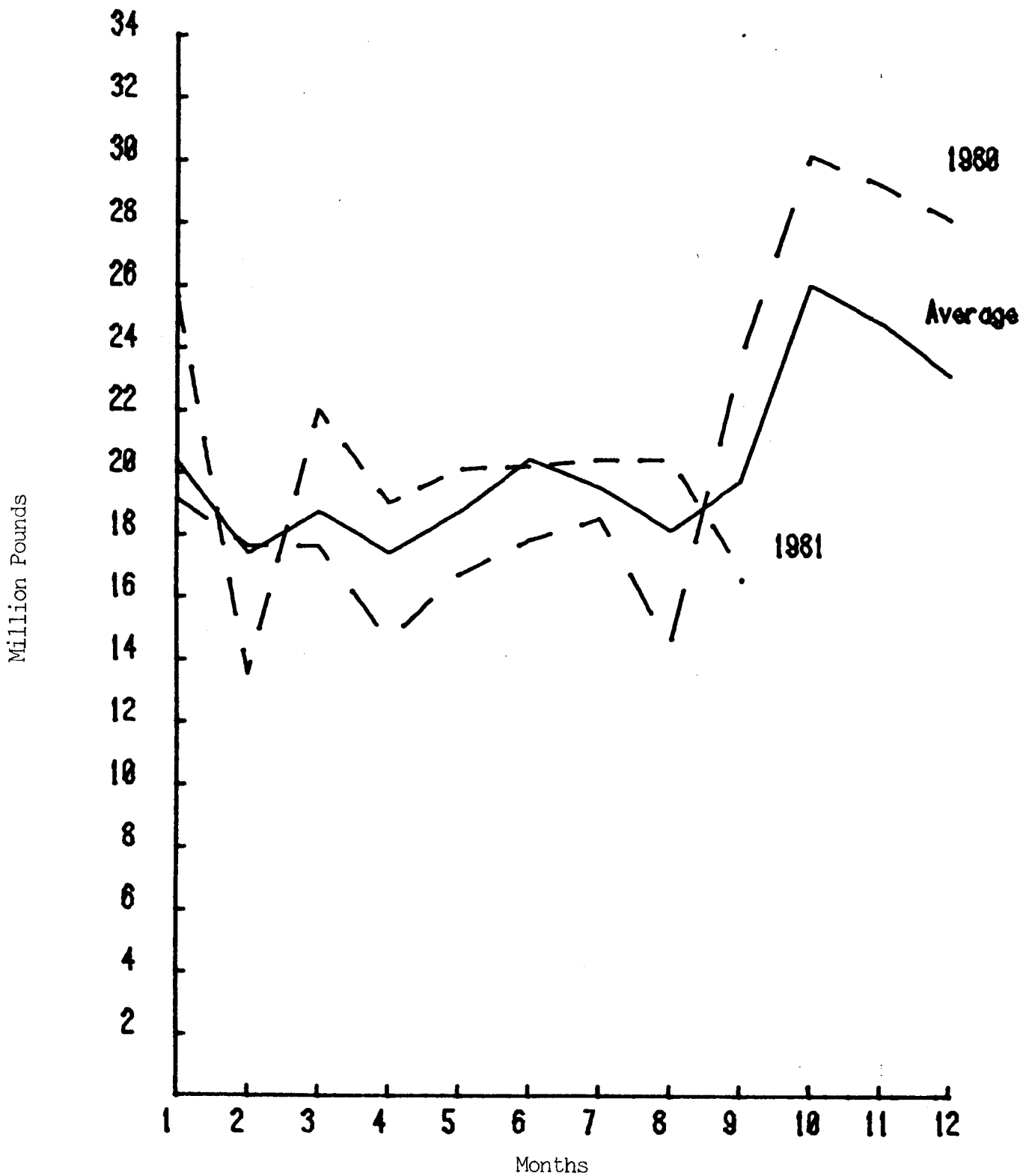
Summary and Prognosis

This report has provided some important economic indicators of the offshore shrimp fishery in the Gulf of Mexico as a description of the status of this fishery during 1981. Ex-vessel prices began to reach 1979 levels after the poor year in 1980. It appears as though this price recovery was due largely to the lower volume of cold storage inventories and the resulting increased demand by the processing sector. The higher ex-vessel prices during 1981 also influenced foreign imports which were higher during the first half of the year than both the 1980 and the (1971-1980) ten-year monthly average (Figure 4). In addition to prices, both landings and ex-vessel value were at record heights in 1981. Landings were 28 percent higher than 1980 and ex-vessel value was 21 percent greater. Even larger increases in landings and value were reported in the western Gulf area with landings increasing 40 percent and ex-vessel value increasing 25 percent relative to 1980.

The report also presented some estimates on the expenditure side of the ledger; however, these estimates are less certain than the regularly reported NMFS landings data. Negative revenues were estimated (Table 3) for an average vessel in 1981, but these estimates were based on 1980 estimates and several reasons were discussed which suggest that these estimates may not be plausible. The primary, underlying reason for the questionable cost estimates in Table 3 is the increased efficiency of the offshore fishery in 1981 compared to 1980. Therefore, in summary, the economic indicators suggest that 1981 was not only an extremely improved season over 1980, but an above average year relative to the years in the past decade.

Figure 4

Imports of Fresh and Frozen Shrimp
(Heads off Weight)



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A secondary purpose in preparing this report was to provide at least a naive prediction or prognosis of the fishery's economic status during 1982. From a production perspective, it is difficult to predict how well the fishery will do in 1982 because no well-established stock-recruitment relationship exists. Therefore, this aspect of the fishery, albeit an important one, remains an unknown until recruitment indices are measured in the inland bays and estuaries in the early spring. However, other aspects of the fishery can be reviewed and suggestions made on their magnitudes during 1982.

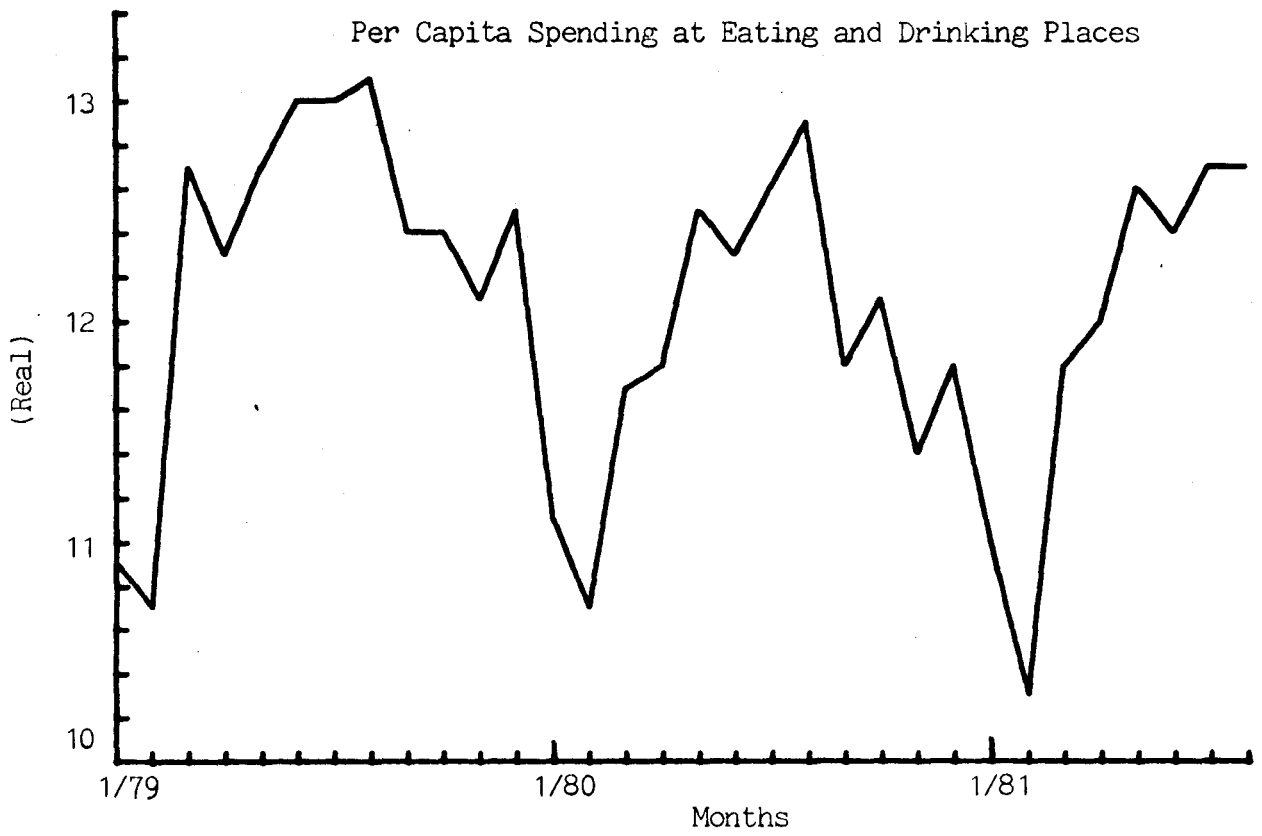
Operating costs do not appear headed for unusual increases in 1982. The world oil supply remains high and the OPEC member nations do not appear to have much control over the current downward trend in crude oil prices. Interest rates (including short-term rates) will probably remain high in light of the Federal Reserve's continued tight monetary policy. Furthermore, the demand for short-term capital will also remain high, especially since the federal government will be financing a growing budgetary deficit. Thus, vessel owners will face increased costs if they have to borrow money to finance their early 1982 operations.

Ex-vessel prices depend mainly on two things - domestic landings and cold storage inventories. As mentioned previously, a prediction of the status of the stocks for 1982 cannot be made with any certainty. The latest figures on inventories are for January 1982 (preliminary) and they indicate that inventories are considerably below the levels in previous years (Figure 2). Lower inventories could be a result of currently high interest rates, but more importantly they suggest that the dockside demand by processors will probably be strong in the early part of the shrimp season in the northwestern Gulf and consequently ex-vessel prices should remain relatively high.

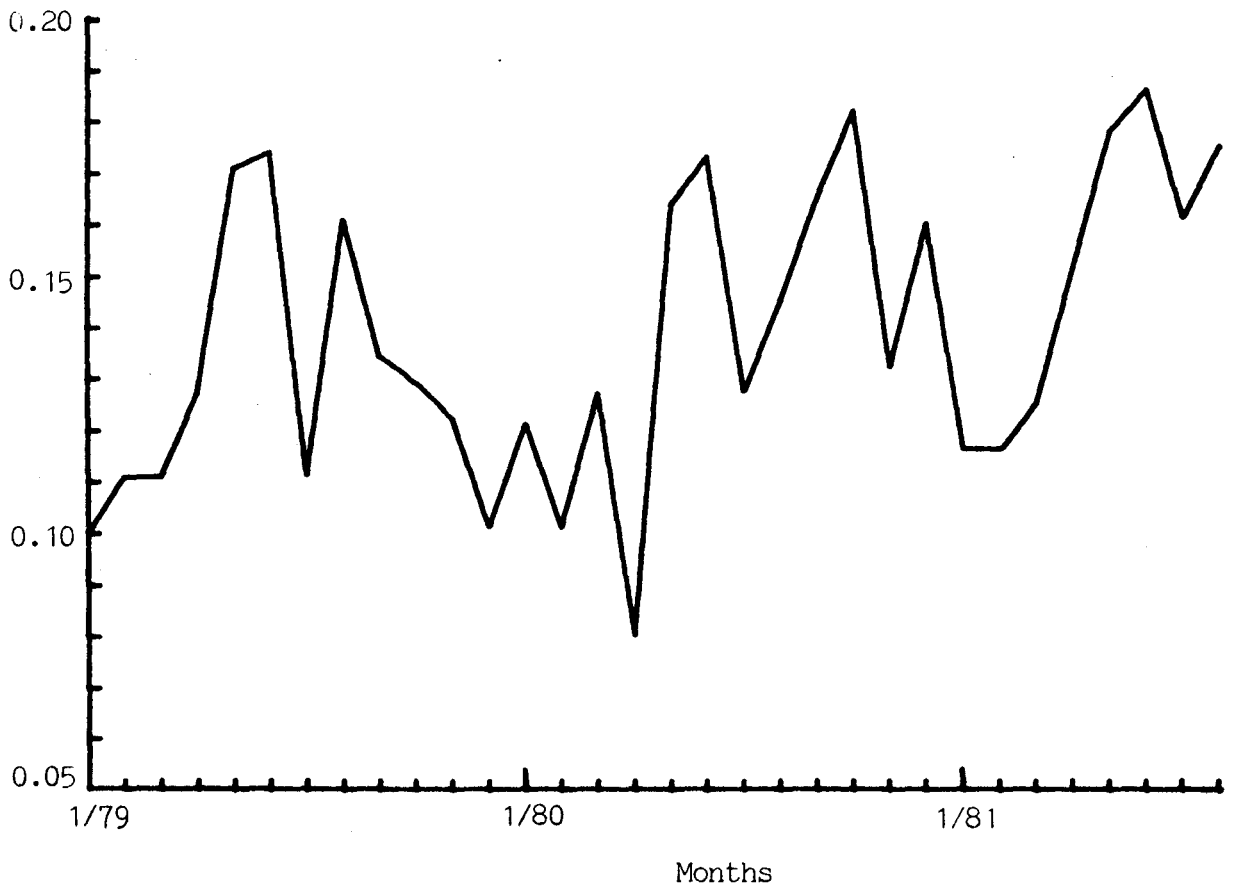
Previous reports on the economic condition of the Gulf shrimp fisheries (Miller, 1975 and Miller and Greenfield, 1975), suggested that consumer demand and the state of the national economy were important to shrimp demand at the docks. The National Marine Fishery Service provides a time series referred to as "apparent consumption" which could be as a proxy for consumer demand.^{2/} However, this series is really a better measure of the shrimp available for consumption and hence the name "apparent". The monthly "apparent consumption" of shrimp for 1979, 1980 and part of 1981 are plotted in the bottom panel of Figure 5. Another factor important to shrimp demand is the state of the national economy which is often measured by the performance of the gross national product. However, a data series collected by the Bureau of Census, per capita spending at eating and drinking establishments deflated by a sub-component of the consumer price index, was used in the previously discussed regression analyses as a measure of the portion of the national economy spent on food consumption (Poffenberger, forthcoming). The per capita spending series was statistically significant with prices of all eight marketing classes of shrimp. Monthly data for this series are graphed in the top panel of Figure 5 for 1979, 1980 and part of 1981. The most recent data for both "apparent

Figure 5

Per Capita Spending at Eating and Drinking Places



Per Capita Apparent Consumption of Shrimp



consumption" and per capita spending that are plotted in Figure 5 show that consumer demand and the shrimp available to them are remaining fairly strong.

In conclusion, the indications are that the offshore shrimp fishery had a relatively good year in 1981. Furthermore, the early indications for 1982 are that both prices and demand should be strong for the spring shrimp season. Thus, if the environmental conditions are not too unfavorable for the growth and maturation of the shrimp larvae and sub-adults in the inshore bays and estuaries, the offshore fishery should have a relatively good year economically in 1982.

Footnotes

- 1/ In the MFR article, two multiple regression models were specified, an adjusted and an unadjusted model. For the adjusted model, ex-vessel prices were deflated (divided) by the producer price index for meat, poultry and fish to adjust for the inflationary rises in prices over the ten-year period. The regression results reported in the article show that the magnitude of the estimated coefficients were almost identical for either model.
- 2/ Apparent consumption is calculated as the sum of domestic landings, foreign imports and the difference between beginning and ending cold storage inventories and from this summation total exports from the U.S. are subtracted. This series is provided in the Shellfish Market News, a National Marine Fisheries Service publication.

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