

# Investment in Gulf of Mexico Shrimp Vessels, 1965-77

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## Introduction

Major capital inputs in the Gulf of Mexico shrimp fishery are vessels and gear. Since the early 1900's, equipment and techniques used in shrimp fishing have changed dramatically. The early vessels were constructed of wood and used drag seines, cast nets, and traps to harvest shrimp. Today's shrimp vessels, built of wood, steel, or fiberglass, are larger and equipped with sophisticated trawling gear and electronics. In addition, the total number of Gulf shrimp vessels has steadily increased (Prochaska and Cato, 1981).

Fishermen, operating in an open-access common-property resource, will expand effort (usually by increasing the number of vessels) as long as excess profits to individual firms exist (Crutchfield and Zellner, 1962; Gordon, 1954; Scott, 1955; Smith, 1969; Turvey, 1964). This increased effort by individual fishermen imposes extra cost burdens on other fishermen and usually gives rise to overcapitalization<sup>1</sup> from an economic standpoint.

This study examines implications of investment patterns in the Gulf shrimp fishery. Historical trends in capital stock (in dollars) of vessels are estimated for 1965-77 for different types of vessels for use with landings and sales data. Specifically, annual trends in total and per-vessel shrimp landings and sales are examined. Shrimp landings and sales per dollar of investment in fishing vessels are evaluated.

<sup>1</sup>The fishing effort or number of firms beyond that necessary to harvest the maximum economic yield.

Table 1.—Total number of shrimp vessels in the Gulf of Mexico by vessel construction type<sup>1</sup>.

Year	Vessel construction						Total
	Wood		Steel		Fiberglass		
	No.	%	No.	%	No.	%	
1965	2,473	93.4	175	6.6			2,648
1966	2,576	90.7	265	9.3			2,841
1967	2,618	88.4	345	11.6			2,963
1968	2,683	83.1	544	16.9			3,227
1969	2,803	81.5	631	18.4	4	0.1	3,438
1970	2,650	80.4	639	19.4	5	0.2	3,294
1971	2,594	76.3	788	23.2	17	0.5	3,399
1972	2,597	74.9	851	24.6	17	0.5	3,465
1973	2,675	77.6	758	22.0	16	0.4	3,449
1974	2,582	69.9	1,074	29.1	37	1.0	3,693
1975	2,637	71.5	1,017	27.6	36	1.0	3,690
1976	2,771	69.0	1,198	29.8	45	1.1	4,014
1977	2,935	67.5	1,356	31.2	55	1.3	4,346

<sup>1</sup>Source: NMFS unpublished operating units files for shrimp vessels, 1965-77.

## Trends in Investments

### Characteristics of the Gulf Shrimp Fleet

Historically, wooden vessels dominated the Gulf shrimp fleet (Table 1). Of the 2,648 vessels reported fishing in the Gulf area in 1965, 93.3 percent were wood, and the rest were steel. There has since been a steady substitution of steel and fiberglass vessels for wooden ones. Steel vessels accounted for 13.2 percent of the Gulf fleet in 1977, while the percentage of wooden vessels dropped to 67.5 percent.

Four fiberglass vessels joined the fleet in 1969, and in 1977 there were 55 fiberglass vessels representing 1.3 per-

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cent of the Gulf fleet. In the 1970's, a few vessels built of concrete, aluminum, and metallic alloys were introduced, but they have made no significant change in the Gulf shrimp fleet. This study has thus been limited to the evaluation of wood, steel, and fiberglass vessels<sup>2</sup>.

The average length of vessels registered with the U.S. Coast Guard increased from 48 feet in 1965 to 59 feet in 1977 (Tables 2 and 3). In 1965, only 14.3 percent of the fleet was less than 5 years old, but the percentage increased to 33.7 by 1977. The average Gulf shrimp vessel became larger and newer between 1965 and 1977.

### Estimated Investment

The capital stock in dollars of vessels fishing for shrimp in the Gulf of Mexico was estimated as follows:

$$KT_t = \sum_t \sum_c \sum_l P_{lct} N_{lct}$$

where  $KT_t$  = total real capital stock of vessels built in year  $t$ ;

$P_{lct}$  = cost of a vessel of length  $l$ , constructed of material  $c$ , and built in year  $t$ ;

$N_{lct}$  = number of vessels of length  $l$ , constructed of material  $c$ , and built in year  $t$ ;

<sup>2</sup>Vessels are fishing craft of 5 net tons or more in cubic capacity. They are either enrolled or documented by the U.S. Coast Guard and have an official number assigned by that agency. Boats have a capacity of less than 5 net tons. There are more boats than vessels fishing for shrimp in the Gulf of Mexico, but they account for less of the catch, about 25 percent in 1976.

**Table 2.—Number of shrimp fishing vessels by length and construction year in the Gulf of Mexico shrimp fishery, 1965<sup>1</sup>.**

Year of construction	Length (feet)														Total
	0-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76-80	81-85	86-90	91-95	96-100	
1910	6	7	3	6	2	2	0	0	0	0	0	0	0	0	26
1920	6	6	2	0	0	1	0	0	0	0	0	0	0	0	15
1930	21	23	13	5	2	1	0	0	1	0	0	0	0	0	66
1940	20	59	49	49	8	2	3	0	0	0	0	0	0	0	190
1950	83	85	130	149	150	51	29	3	2	1	0	0	0	0	683
1960	109	64	81	182	208	244	275	20	4	1	0	0	0	0	1,188
1965	54	57	43	32	36	36	160	60	1	0	1	0	0	0	480
Total	299	301	321	423	406	337	467	83	8	2	1	0	0	0	2,648

<sup>1</sup>Source: NMFS unpublished operating units files for shrimp vessels, 1965-77.

**Table 3.—Number of shrimp fishing vessels by length and construction year in the Gulf of Mexico shrimp fishery, 1977<sup>1</sup>.**

Year of construction	Length (feet)														Total
	0-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76-80	81-85	86-90	91-95	96-100	
1910	1	1	2	5	0	2	0	0	0	0	0	0	0	0	11
1920	3	5	2	1	0	1	0	0	0	0	0	0	0	0	12
1930	16	16	11	4	1	0	0	0	0	0	0	0	0	0	48
1940	11	46	37	34	6	2	1	0	1	0	0	0	0	0	138
1950	50	66	71	91	95	35	15	3	2	0	0	0	0	0	428
1960	50	46	54	101	110	103	131	7	2	1	0	0	0	0	605
1965	55	44	46	18	23	22	92	33	3	0	0	0	0	0	336
1966	13	15	12	9	14	12	30	43	20	0	1	0	0	0	169
1967	17	15	14	2	5	11	31	72	28	5	0	0	0	0	200
1968	25	19	10	7	6	12	34	75	40	9	1	1	0	0	239
1969	16	16	15	1	6	7	30	58	18	9	0	0	0	0	176
1970	14	12	15	7	3	7	17	53	5	6	0	0	0	0	139
1971	15	16	19	9	5	11	28	49	12	8	0	0	0	0	172
1972	18	16	14	8	8	12	35	66	20	9	0	0	0	0	206
1973	11	13	9	9	11	14	46	67	26	0	1	0	0	0	207
1974	16	10	11	6	11	19	49	80	31	6	2	0	1	0	242
1975	18	13	7	8	8	12	58	84	55	18	2	0	0	0	283
1976	9	10	26	20	17	5	9	56	155	67	32	1	0	0	407
1977	14	14	30	32	14	18	8	62	56	56	22	1	0	1	328
Total	372	393	405	372	343	305	614	808	474	194	61	3	1	1	4,346

<sup>1</sup>Source: NMFS unpublished operating units files for shrimp vessels, 1965-77.

$l$  = length of vessel (0-35 feet, 36-40 feet, . . . . . 96-100 feet);  
 $c$  = material of which vessel is constructed (wood, steel, fiberglass), and  
 $t$  = year in which vessel is built (1900-10, 1911-20, . . . . . 1977).

$$P_{lct} = a(L)^b e^{d_i c} e^{d_j t}$$

where  $a$  and  $b$  are estimated coefficients and  $d_i$  and  $d_j$  are estimated coefficients of dummy variables. The productive decay pattern which underlines capacity depreciation in vessels was ignored in deriving the real capital stock due to insufficient data.

Vessel costs, expressed in 1977 dollars, were estimated from cost data provided by vessel builders and owners. Griffin et al. (1978) have shown that vessel length, material of construction, and year of purchase were the most significant factors determining the cost of a vessel, and the relationship is of a log linear form

The resulting estimated real capital stock (in 1977 dollars) of fishing vessels almost tripled from 1965 to 1977 (Table 4), although fluctuation occurred. The capital stock of wooden vessels increased moderately (43 percent) over the study period from \$116 million in 1965 to \$167 million in 1977. Steel vessels increased 1,200 percent from \$15 million in 1965 to \$195 million in 1977.

**Table 4.—Real capital stock of Gulf of Mexico shrimp vessels by vessel construction type (1977 dollars).**

Year	Vessel stock (million dollars)			
	Wood	Steel	Fiberglass	Total
1965	116.7	15.0		131.7
1966	123.6	23.9		147.5
1967	127.3	32.4		159.7
1968	131.8	63.3		195.1
1969	140.1	76.4	0.4	216.9
1970	133.6	67.5	0.4	201.5
1971	135.9	94.3	1.5	231.7
1972	136.7	104.8	1.8	243.3
1973	141.7	92.7	1.6	236.0
1974	140.2	142.9	3.6	286.7
1975	141.7	123.1	3.7	268.5
1976	153.0	164.0	4.7	321.7
1977	167.0	195.2	5.8	368.0

Source: NMFS unpublished operating units files for shrimp vessels, 1965-77.

During the 1970's, steel vessels began to exceed wooden vessels in real capital stock, though not in numbers, landings,

or value of landings (Tables 1, 4, 6, and 7). This may be attributed in part to the high costs associated with steel vessels. Fiberglass vessels increased 1,450 percent from \$0.4 million in 1969 to \$5.8 million in 1977.

Negative real net investment<sup>3</sup> (a decline in real capital stock) was observed in 1970, 1973, and 1975 (Table 5). This follows a decline in vessel stocks as a consequence of poor yields as well as unfavorable economic conditions. Real net investment is highly responsive to certain economic factors facing the Gulf shrimp fishery. National economic downturns occurred in 1970, 1974-75, and 1979-80, reducing the demand and prices for shrimp. Fuel costs have become significant to the shrimp industry, especially when prices jumped in 1973-74 and 1979-80. During the period of this study, returns above cost from shrimping declined from 1973 through the middle of 1975 due to a combination of economic factors, including increased fuel costs, lower shrimp prices during part of the time, and poor landings (Warren and Griffin, 1980). This led to negative real net investment in vessels in 1973 and 1975. Conditions began to improve in the middle of 1975, bringing record real net investments in 1976-77 (Table 5).

### Total Landings, Sales, and Capital Stock

Over the 14-year period, Gulf shrimp landings varied significantly with vessel construction (Table 6). An increase in the total number of vessels employed does not necessarily lead to an increase in the total amount of shrimp caught as indicated in Tables 1 and 6. Specifically, the vessel-to-shrimp landings correlation coefficient (0.54) is unusually low because landings are at or near the

<sup>3</sup>The NMFS data on vessels represent the number of vessels actually fishing. However, even in "bad years" all vessels fish at least once so they are counted as part of the fleet. Therefore, negative net investment is not occurring because a vessel may remain idle one year and positive net investment is not occurring because they start fishing the next "good year." Rather, negative real net investment is experienced in the current period whenever real capital stock in the previous year exceeds that of the current year. By description, real net investment is  $KT_t - KT_{t-1}$ .

Table 5.—Real net investment in Gulf of Mexico shrimp vessels by vessel construction type (1977 dollars).

Year	Real net investment <sup>1</sup> (million dollars)			
	Wood	Steel	Fiberglass	Total
1966	6.9	9.0		15.9
1967	3.7	8.5		12.2
1968	4.5	30.9		35.4
1969	8.9	13.0		21.3
1970	-6.5	-9.0	-0.1	-15.5
1971	2.2	26.9	1.2	29.3
1972	0.8	10.5	0.2	11.5
1973	5.0	-12.2	-0.2	-7.0
1974	-1.6	50.2	2.0	50.8
1975	1.5	-19.8	0.1	-18.2
1976	11.3	40.9	0.9	53.1
1977	14.0	31.2	1.0	46.3

<sup>1</sup>Real net investment is computed as the year-to-year change in real capital stock from Table 4. Source: NMFS unpublished operating units files for shrimp vessels, 1965-77.

maximum sustainable yield. Total Gulf landings appear to have fluctuated about a mean since the mid-1950's when growth subsided (Prochaska and Cato, 1981).

Table 6 shows a general upward trend in shrimp landings from 1965 to 1972 for steel and fiberglass vessels. Considerable fluctuations, however, were observed for both vessel types after 1972. There is a downward trend in shrimp landings from 1965 to 1972, with fluctuation beyond 1972 for wooden vessels. The variability in shrimp landings may be attributed to biological and economic factors and to pushing the fishery to its maximum production capacity. If the shrimp population is low, for example, landings would be less; and if the economy is depressed, shrimpers would shrimp less. Evidently, as the number of vessels increases, reaction to these conditions becomes more diverse causing greater variation in landings.

Steel vessels generally have a larger share of catch relative to the number of vessels than wooden and fiberglass vessels, but the respective shares of catch and catch value are roughly proportional to capital stock. In 1977, steel vessels accounted for only 31 percent of the entire Gulf fleet but represented about 45 percent of the quantity and value of landings and 53 percent of the capital stock (Tables 1, 4, 6, and 7). Wooden vessels constituted 68 percent of the Gulf fleet, accounted for 54 percent of the quantity and value of landings, and had 45 percent of the value of capital stock.

Table 6.—Total shrimp landings from the Gulf of Mexico by vessel construction type.

Year	Landings <sup>1</sup> (million pounds)			
	Wood	Steel	Fiberglass	Total
1965	84.0	13.9		97.9
1966	76.4	12.5		88.9
1967	89.7	20.0		109.7
1968	79.4	22.7		97.6
1969	62.2	27.3	0.1	89.6
1970	64.1	30.7	0.1	94.9
1971	62.4	34.9	0.7	98.0
1972	60.1	41.8	0.7	102.6
1973	50.3	30.0	0.4	80.7
1974	43.1	34.2	1.1	78.4
1975	41.1	30.7	0.8	72.6
1976	55.7	42.5	0.9	99.1
1977	61.6	50.6	1.2	113.4

<sup>1</sup>Landings are determined on head-off basis and exclude catch by boats. Source: NMFS unpublished Gulf of Mexico shrimp landings data files, 1965-77.

Table 7.—Total shrimp landings value from the Gulf of Mexico by vessel construction type (1977 dollars).

Year	Shrimp value (million dollars)			
	Wood	Steel	Fiberglass	Total
1965	91.9	15.3		107.2
1966	104.6	17.2		121.8
1967	102.5	22.8		125.3
1968	96.9	29.3		126.2
1969	81.6	35.7	0.2	117.5
1970	72.9	34.9	0.2	108.0
1971	87.2	48.8	1.0	137.0
1972	95.6	66.5	1.1	163.2
1973	99.9	59.6	0.8	160.3
1974	61.4	48.8	1.6	111.8
1975	75.3	56.4	1.4	133.1
1976	121.9	93.0	2.0	216.9
1977	111.5	91.6	2.2	205.3

Source: NMFS unpublished Gulf of Mexico shrimp landings data files, 1965-77.

The value of landings increased steadily from \$107.2 million in 1965 to \$205.3 million in 1977 with much of the recent growth being from real increases in shrimp price (Tables 6 and 7). While the correlation between the number of vessels and catch is low, there is a statistical relationship between fleet expansion and shrimp price (Prochaska and Cato, 1981). It seems unlikely that this relationship will continue because the inflationary trend which began in 1973 affected not only prices received but prices paid by fishermen (Tettey et al., In press). Fuel prices jumped in 1973-74 and again in 1979-80. Apparently, the relationship between shrimp prices and fleet expansion was held during the period for which data were available for this study because there were tremendous increases in total value of catch (in

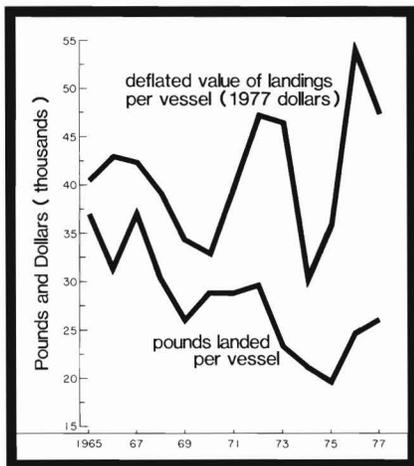


Figure 1.— Shrimp pounds and value landed per vessel in the Gulf of Mexico shrimp fishery, 1965-77.

constant 1977 dollars) and capital stock in vessels (in constant 1977 dollars) in 1976 (Tables 4 and 7).

#### Per Vessel Landings, Sales, and Capital Stock

Figure 1 indicates that the value of shrimp landings per vessel (in 1977 dollars) fluctuated considerably since 1965, with little if any sign of a rising trend. Revenue for shrimp landings per vessel increased only \$6,800 over the 12-year period. A low of \$30,300 per vessel was recorded in 1974 and a high of \$54,000 was recorded in 1976. The trend reflects, largely, the movement of ex-vessel prices for shrimp (deflated to 1977 dollars) over the years.

In contrast, shrimp landings per vessel have trended downward from 36,900 pounds in 1965 to 26,000 pounds in 1977. A high of 37,000 pounds was observed in 1967, and a low of 19,600 pounds was harvested in 1975. The decline in pounds per vessel is inevitable due to a tremendous increase in number of vessels exploiting a given stock of shrimp. Shrimp pounds landed per dollar invested in fishing vessels also declined sharply from 0.75 pounds in 1965 to 0.31 pounds in 1977 (Figure 2). There were some fluctuations in the shrimp

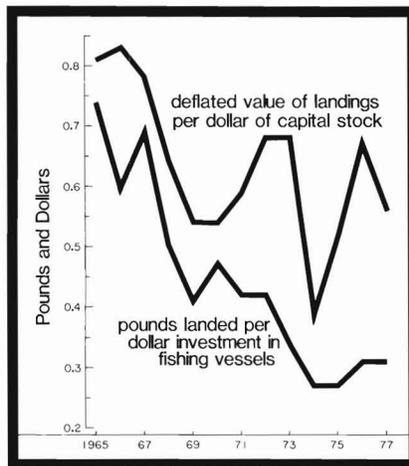


Figure 2.— Shrimp pounds and value landed per capital stock in vessels in the Gulf of Mexico shrimp fishery, 1965-77.

landings with a minimum of 0.27 pounds recorded in 1975.

The value of shrimp landings per dollar investment in vessels decreased from \$0.81 in 1965 to \$0.56 in 1977 (Figure 2). It is evident that capital productivity has generally trended downward in the Gulf shrimp fishery. For every dollar invested in fishing vessels, as much as \$0.83 worth of shrimp was landed in 1966 as against \$0.39 in 1974. As more vessels enter the fishery, the problems become more pronounced. In response to such a growing disparity between output per vessel and the amount of capital added to the fishery, shrimp fishermen appear to have cut back in fishing days. Landings per fisherman day have increased and the entire labor force in the Gulf shrimp fishery has become more efficient (Miller and Surdi, 1981).

#### Conclusions

The pounds of shrimp landed per vessel in the Gulf of Mexico decreased sharply over the study period. The estimated real capital stock of vessels (in 1977 dollars) almost tripled during 1965-77 to \$368 million, while pounds of shrimp landed per dollar invested in fishing vessels continued to decrease from 0.75 in 1965 to 0.31 in 1977. In

1977 dollars, the value of catch per dollar of investment also fell, dropping from \$0.81 in 1965 to \$0.56 in 1977.

Apparently, the perceived value of landings per vessel increased on average at a faster rate than production costs per vessel causing excess profit to exist. This created an incentive for investments, although there may be other reasons for stimulating investment. This expansion was interrupted only by poor economic conditions, such as in 1970, and 1973-75. Although data were not available to estimate real capital stock beyond 1977, other information suggests that substantial declines (large negative real investment) occurred in 1979-80.

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