

# FLORIDA SEA GRANT PROGRAM

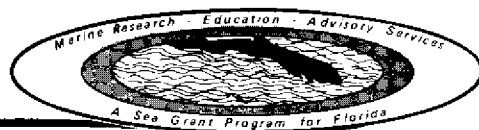
## THE FLORIDA SPINY LOBSTER FISHERY: LANDINGS, PRICES, AND RESOURCE PRODUCTIVITY

by

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## INTRODUCTION

Florida's spiny lobster industry achieved tremendous growth during the past two decades and is presently the second most important fishery in the state in terms of dockside value of landings. This substantial growth has caused much concern in the industry regarding the possibility of exploitation of the lobster resource. Both state and federal government and university personnel are responding with numerous research projects in the biological, physical and social sciences designed to address the exploitation question. The Food and Resource Economics Department has initiated a lobster management study designed to analyze fishery management alternatives for this industry. This report includes much of the background information currently in existence and is being reported prior to the completion of the study in order to aid other researchers, industry members and governmental agencies in their evaluation and understanding of trends and events in the lobster industry. Additional necessary data collected from a sample survey of the industry is also currently being analyzed.

This report has four sections. Section one is an analysis of the trends in the quality and value of spiny lobster landings in Florida. In section two trends in resource inputs (fishermen, fishing craft and gear) employed are analyzed. The third section combines the analysis of landings and resources used in spiny lobster production in order to determine productivity trends. The final section is a summary.

### Points of Clarification

Boats are defined as craft maintaining a capacity of less than five tons. The criteria for specifying this measurement are determined

by the U. S. Coast Guard. Vessels are defined as craft equal to or greater than five tons. Tonnage is measured in terms of volume of carrying capacity not strictly the actual weight of the craft. The reader is referred to recent annuals of the data source, Fishery Statistics of the U. S., for a concise definition of boats and vessels.

A firm is defined as a single operating unit including captain, crew and gear. The number of firms is computed by aggregating the number of boats and number of vessels. No distinction between the size (net tonnage) of the craft is made by the term "firm." It is assumed that each firm have one and only one captain regardless of ownership.

Unless otherwise specified, "price" is interpreted as average price. No significant change in the technology of the trap (design, size, etc.) has occurred during the period analyzed. "West coast" and "east coast" as used in the text refer only to the west coast of Florida and the east coast of Florida, never to the coastal areas of the U. S. The reader will note that in many cases the authors have intentionally not committed themselves to positive conclusions regarding the data. Results derived from the final analysis of the total management study are expected to alleviate this moderation.

The Data. With few exceptions, the data and computations presented in this publication are from the National Marine Fisheries Service [1, 2]. The primary data are published in a series of annual reports containing detailed statistics, analytic textual reviews and graphic presentation on the commercial fisheries of the U. S. The data were collected in cooperation with the various states and tabulated by the staff of the Statistics and Market News Division, National Marine Fisheries Service, U. S. Department of Commerce. Readers



interested in the statistical procedure are referred to the section in each annual report entitled "Statistical Survey Procedure" where the survey procedure followed has been outlined in moderate detail to document the source of figures and methods for their collection.

Based on interviews with enumeration of the data, it has been indicated that the number of traps recorded tends to underestimate actual number of traps in the industry. The opinion is that the average size fisherman uses approximately 850 traps initially. After a few years in the business, he increases the number of traps to approximately 1000 and many fishermen use over 2000 traps. Although interviews with fish house dealers at the beginning and end of the season are conducted, the data do not reflect the opinions of the enumerators.

Data in the annuals are classified according to fisheries based on water bodies. Florida fishery statistics are separated into the South Atlantic fisheries (east coast) and the Gulf fisheries (west coast) since Florida is bordered by both bodies of water. Some of the input data for the east and west coasts were not currently available beyond 1971. Although the Monroe County fishery encompasses both the Atlantic and Gulf waters, statistics for Monroe County are classified under the Gulf fishery (west coast) due to administrative decision of the National Marine Fisheries Service. In this report, separate analyses were carried out of the state as a whole and each coast because the data as presented indicated differences between each coast. Realizing that differences may occur within each fishery as classified, further analyses on a county basis are presently in process.

## TRENDS IN LANDINGS, VALUES AND PRICES

Landings are measured in whole weight of the lobster at dockside. An analysis of trends in landings can be helpful in assessing the influence of fishing effort on landings as well as other influences such as the environment and biology of the spiny lobster. Dockside price is the average price per pound received by the fishermen and total value is the total quantity of whole spiny lobsters landed times the dockside price. Analyzing trends in total value of landings and dockside prices are helpful in providing insights into the market for spiny lobster. Price trends also contribute to the analysis of entry and exit of fishing effort over time.

### Florida

Landings. Florida spiny lobster landings have increased at a greater percentage rate each year over the past twenty-two years. This increase began from a low of 1.6 million pounds in 1952 to over 11 million pounds currently (Table 1). U. S. spiny lobster landings outside the state of Florida have been a stable one-half million pounds per year. Consequently, total U. S. and total Florida landings exhibit similar trends (Figure 1). Florida's share of U. S. landings increased from 67 percent in 1952 to over 90 percent currently. Trends in the

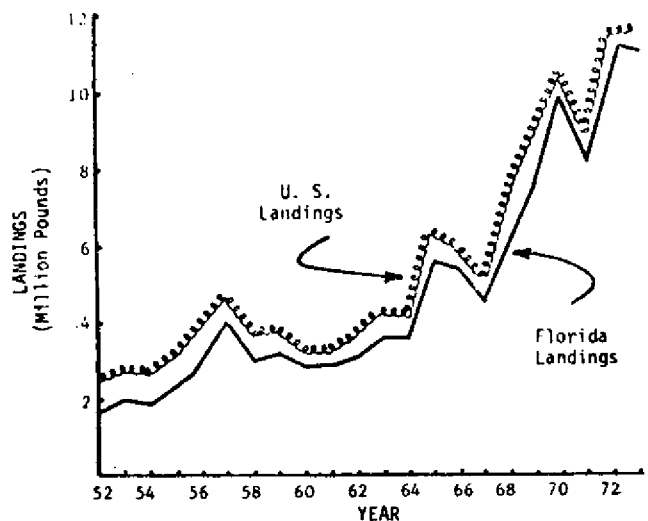


Figure 1. Total spiny lobster landings, U. S. and Florida, 1952-73.

relative value of landings show similar patterns, however, Florida's percentage of total U. S. value of landings is slightly smaller (Table 1). This reflects the relatively higher price for California spiny lobsters. California lands a smaller amount of lobsters in a relatively good market area. California and Georgia account for the majority of spiny lobster landings in the U. S. outside of Florida.

Based on the trend line estimated for Florida spiny lobster landings, some variability has occurred in landings from year to year (Figure 2, Equation 1)<sup>1</sup>.

Years with exceptional variation are 1957, 1965, 1970 and 1972. These extremes are likely explained by biological phenomena as well as economic factors. Biological factors that affect landings from year to year are migrations of lobsters to the area, changes in water temperature and salinity, and/or overall good weather conditons for the season. This report will only analyze economic factors' influence on the spiny lobster industry.

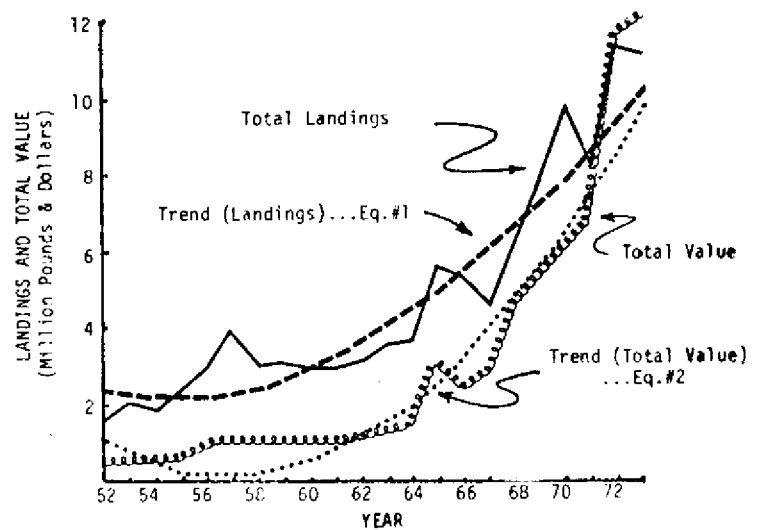


Figure 2. Total spiny lobster landings and total value, Florida, 1952-73.

<sup>1</sup>Trend lines in this report were estimated using ordinary least squares (OLS) regression analysis. For a detailed explanation of this technique the reader is referred to J. Johnston, *Econometric Methods*, 2nd Ed., New York, McGraw-Hill, 1972. All regression equations are presented in Appendix A and hereafter will be referenced by equation number only.

Table 1. Spiny lobster landings and dollar value, Florida and U.S., 1952-73.<sup>a</sup>

Year	U.S.			Florida				
	1,000 Pounds	1,000 Dollars	Average Cents Pound	Pounds	Dollars	Average Cents Pounds	Percent of U.S.	
							Pounds	Dollars
1952	2,419	740	30.6	1,612,400	403,100	25.0	67	55
1953	2,745	752	27.4	1,995,000	399,000	20.0	73	53
1954	2,849	837	29.4	1,947,300	428,406	22.0	68	51
1955	3,154	962	30.1	2,295,400	527,942	23.0	73	55
1956	3,849	1,210	31.4	3,113,000	825,056	26.5	81	68
1957	4,687	1,500	32.0	4,039,800	1,123,545	27.8	86	75
1958	3,588	1,226	34.2	2,954,307	836,651	28.3	82	68
1959	3,698	1,268	34.3	3,180,733	954,605	30.0	86	75
1960	3,210	1,344	41.9	2,848,540	1,100,284	38.6	89	82
1961	3,235	1,263	39.0	2,803,439	969,303	34.6	87	77
1962	3,664	1,561	42.6	3,107,000	1,187,127	38.2	35	76
1963	4,180	1,798	43.0	3,585,194	1,407,746	39.3	86	78
1964	4,088	1,880	46.0	3,631,130	1,562,163	43.0	89	83
1965	6,237	3,626	58.1	5,714,093	3,219,241	56.3	92	89
1966	5,844	2,882	49.3	5,350,266	2,468,969	46.1	92	86
1967	4,868	3,125	64.2	4,413,567	2,732,724	61.9	91	88
1968	7,476	5,367	71.8	6,155,036	4,408,569	71.6	82	82
1969	8,781	6,310	71.9	7,581,133	5,257,542	69.4	86	83
1970	10,345	6,332	61.2	9,869,462	5,918,479	60.0	95	94
1971	8,439	7,907	93.7	8,205,803	7,056,538	86.0	97	89
1972	11,024	11,388	103.3	10,633,808	10,986,294	103.3	95	96
1972 <sup>b</sup>	11,807	12,173 <sup>c</sup>	103.1	11,416,782	11,771,425	103.1	97	97
1973	9,872	10,567	107.0	9,667,228 <sup>b</sup>	10,221,242	105.7	98	97
1973 <sup>b</sup>	11,376	12,007	105.5	11,171,708 <sup>b</sup>	11,661,141	104.4	98	97

<sup>a</sup>From personal interviews with staff of the Statistics and Market News Division, NMFS, USDC it was indicated that approximately 80-90 percent of actual landings are documented. For example, in 1973 it is estimated that two million pounds of unrecorded spiny lobster landings from Florida were marketed in Georgia. These are based on personal opinions of statistical analysts collecting and analyzing the data and are not documented facts.

<sup>b</sup>Out of season landings included for 1972 and 1973 were 782,974 and 1,504,480, respectively. These are landings in Florida ports from foreign waters during the closed season in Florida allowed due to new 1972 legislation.

The following data for out of season landings was obtained from Fisheries Statistics, Southeastern Fisheries Center, U.S.D.C, NOAA, NMFS, Miami, Florida.

Year	East Coast		West Coast		Florida Total		Cents lb.
	Q	\$	Q	\$	Q	\$	
1972	530,734	532,907	252,240	252,224	782,974	785,131	100.3
1973	1,250,351	1,190,551	245,129	249,348	1,504,480	1,439,889	95.7

<sup>c</sup>Estimated by 11,807 x \$1.031 = 12,173.017

Source: National Marine Fisheries Service, Fishery Statistics of the United States (formerly Bureau of Commercial Fisheries), U. S. Government Printing Office, Washington, D.C. Annual Issues, 1952-71.

National Marine Fisheries Service, Florida Landings (formerly Bureau of Commercial Fisheries), U. S. Government Printing Office, Washington, D.C. Monthly and annual issues, 1971-73.

Economic factors on which data are available offer some explanation. In 1957 an approximate 50 percent increase in the number of fishermen (Economic Factor 1) occurred over the previous two-year average which may explain the exceptionally high landings in 1957. Price (Economic Factor 2) may offer partial explanation of the exceptional landings in 1965. The average price per pound for the five years prior to 1965 was 40 cents compared to 56 cents in 1965. Relatively high landings in 1970 may be a result of the number of traps (Economic Factor 3) which increased approximately 30 percent over the previous year. In addition, 1970 season average landings per trap (Economic Factor 4) were 45 pounds. With the exception of 1969, this was the highest number of pounds landed per trap since 1961. Landings in 1972 may be in part explained by both price and number of traps. In 1972 the number of traps hit a record high and average price increased to over \$1 per pound for the first time in history.

A substantial drop in landings occurred in 1967. Economic data do not offer any apparent explanation. The quantity of capital and labor inputs did not change substantially for this year. Factors other than those factors related to the economic system must have influenced the drop in landings.

Total Value. Total value of the Florida spiny lobster industry increased at a faster rate than total landings due to increasing prices per pound. Price increased from 20 cents per pound in 1952 to over \$1 per pound in 1973. As a result of increases in both landings and price, total value of landings increased from \$403,100 in 1952 to over \$12 million in 1973 (Table 1). Annual variation in total value of landings and total quantity landed was substantial in some years (Figure 2, Equation 2). However, as should be expected the variation in total

value is less than the variation in quantity landed from year to year because of general offsetting effects of price changes. For example, as the quantity landed in a given year increases substantially, the average dockside price decreases relative to landings. The net result is a significant change in landings over the previous years, but total value of landings remained relatively the same over the previous year since the price decreased proportionate to the increase in landings. Therefore, the change in price offsets the change in quantity landed creating very little variation in the total value of landings relative to the previous years.

Note that deviations from the trend lines of total value and total landings (Figure 2) occur in the same years. These deviations occur for hypothesized explanations previously discussed. Value of landings for the 1971-73 period appears to be substantially higher than the trend compared to the previous years. This can partially be explained by considerable price increases due in part to the rapid inflation experienced in the economy since 1971. This upward trend in prices and total value may be in part attributable to increasing consumer demand for spiny lobsters. The difference in value and quantity changes indicates the relative price changes over these years. To summarize, a definite positive trend in the total value of the landings occurred in the Florida spiny lobster fishery. Since 1971 an even more pronounced upward trend in total value has been indicated. This supports recent findings that per capita demand for lobster meat (all species) is significantly affected by consumer income.<sup>2</sup>

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<sup>2</sup>A demand equation was estimated for per capita U. S. consumption of all lobsters for 1947-72. The own price elasticity estimated =  $-.647$  and the income elasticity estimated =  $1.953$ . Source: Basic Economic Indicators: "American and Spiny Lobsters, 1947-73." U. S. Department of Commerce, NOAA, NMFS, Current Fisheries Statistics No. 6272, August 1974, p. 28.

### East and West Coasts

Landings. When the data are compared between the east and west coasts of Florida, significant differences are evident. Until recently, west coast landings exceeded those on the east coast (Table 2). Increased east coast landings may be partially explained by the increased fishing effort employed in foreign waters -- especially the Bahamian lobster fishery. Whereas total landings on the west coast are increasing at the same proportion each year, east coast landings are increasing a greater percentage each year. However, from 1972 to 1973 west coast landings increased approximately 8 percent while east coast landings showed an approximate 25 percent decrease (Figure 3). In 1972 east coast total landings exceeded total landings of the west coast for the first time in 18 years. West coast prices exceeded \$1 per pound for the first time in 1972 while east coast prices lagged below the \$1 mark until 1973 (Table 2).

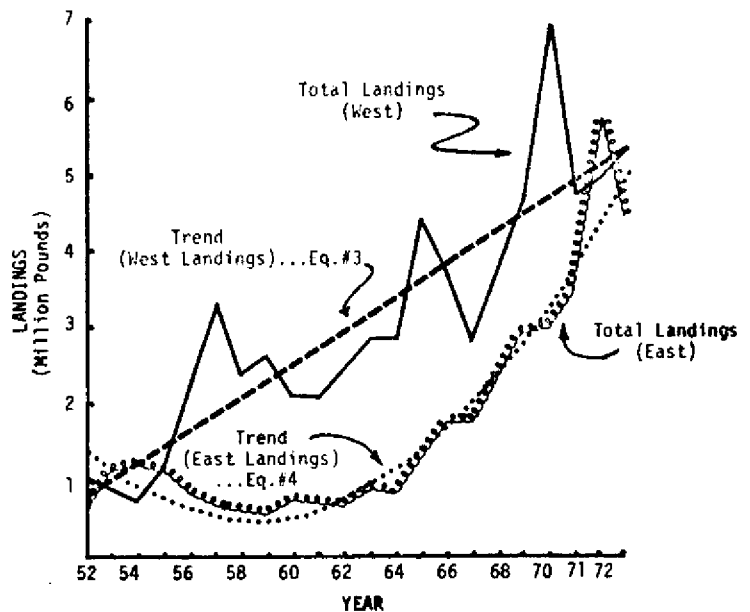


Figure 3. Total spiny lobster landings, Florida east and west coasts, 1952-73.

Due to relatively wide variation in annual west coast landings, the estimated trend is less stable (greater deviation between actual landings and estimated landings) than the trend on the east coast (Figure 3, Equation 3). Total landings on the west coast is increasing by 215,975 pounds per

Table 2. Spiny lobster landings and dollar values, Florida east and west coasts and Monroe County, 1952-73.

	FLORIDA										MONROE COUNTY						
	EAST COAST					WEST COAST											
	Pounds	Dollars	¢/lb.	Pounds	Dollars	¢/lb.	Pounds	Dollars	¢/lb.	lbs.	\$	% West Coast	Dollars	¢/lb.	lbs.	\$	
1952	1,612,400	403,100	25.0	655,700	163,925	25.0	956,700	239,175	25.0	59	59	447,396	NA	NA	NA	47	NA
1953	1,995,000	399,000	20.0	1,121,200	224,240	20.0	873,800	174,760	20.0	44	44	573,847	NA	NA	NA	66	NA
1954	1,947,300	428,406	22.0	1,223,300	269,126	22.0	724,000	159,280	22.0	37	37	722,444	NA	NA	NA	100	NA
1955	2,295,400	527,942	23.0	1,079,400	248,262	23.0	1,216,000	279,680	23.0	53	53	1,210,109	NA	NA	NA	100	NA
1956	3,113,000	825,056	26.5	798,800	227,818	28.5	2,314,200	597,238	25.8	74	72	2,308,836	NA	NA	NA	100	NA
1957	4,039,800	1,123,545	27.8	651,300	200,112	30.7	3,388,500	923,433	27.3	84	82	3,383,541	NA	NA	NA	100	NA
1958	2,954,307	836,651	28.3	622,787	183,722	29.5	2,331,520	652,929	28.0	79	78	2,328,406	NA	NA	NA	100	NA
1959	3,180,733	954,605	30.0	542,979	176,468	32.5	2,637,754	778,137	29.5	83	82	2,635,118	NA	NA	NA	100	NA
1960	2,848,540	1,100,284	38.6	719,344	280,544	39.0	2,129,196	819,740	38.5	75	75	2,126,349	818,664	38.5	100	100	100
1961	2,803,439	969,303	34.6	702,041	248,523	35.4	2,101,398	720,780	34.3	75	74	2,099,829	720,241	34.3	100	100	100
1962	3,107,000	1,187,127	38.2	672,400	259,546	38.6	2,434,600	927,581	38.1	78	78	2,434,148	929,845	38.2	100	100	100
1963	3,585,194	1,407,746	39.3	814,604	327,377	40.2	2,770,590	1,080,369	39.0	77	77	2,770,100	1,080,339	39.0	100	100	100
1964	3,631,130	1,562,163	43.0	785,718	350,587	44.6	2,845,412	1,211,576	42.6	78	78	2,843,888	1,210,928	42.6	100	100	100
1965	5,714,093	3,219,241	56.3	1,328,998	751,851	56.6	4,385,095	2,467,390	56.3	77	77	4,379,496	2,464,780	56.3	100	100	100
1966	5,350,266	2,468,969	46.1	1,686,138	809,852	48.0	3,664,128	1,659,117	45.3	68	67	3,650,142	1,654,460	45.3	100	100	100
1967	4,413,567	2,732,724	61.9	1,676,595	1,058,000	63.1	2,736,972	1,674,724	61.2	62	61	2,719,178	1,668,216	61.4	99	100	100
1968	6,155,036	4,408,569	71.6	2,234,177	1,580,386	70.7	3,920,859	2,828,183	72.1	64	64	3,891,736	2,813,336	72.3	99	99	99
1969	7,581,133	5,257,542	69.4	2,928,569	1,932,852	66.0	4,652,564	3,324,690	71.5	61	63	4,620,766	3,309,855	71.6	99	100	100
1970	9,869,462	5,918,479	60.0	3,017,745	1,830,199	60.6	6,851,717	4,008,280	59.7	69	69	5,235,225	3,125,429	59.7	76	76	76
1971	8,205,803	7,056,538	86.0	3,417,767	2,932,268	85.8	4,788,036	4,124,270	86.1	58	58	4,653,187	4,017,561	86.3	97	97	97
1972	10,633,808	10,986,294	103.3	5,736,746	5,721,281	99.7	4,897,062	5,265,013	107.5	46	48	NA	NA	NA	NA	NA	NA
1973	9,667,228	10,221,242	105.7	4,371,285	4,556,980	104.2	5,295,943	5,664,262	107.0	55	55	NA	NA	NA	NA	NA	NA
1972 <sup>a</sup>	11,416,782	11,771,425	103.1	6,267,480	6,254,188	99.8	5,149,302	5,517,237	107.1	45	47	4,814,013	5,176,026	107.5	93	94	94
1973 <sup>a</sup>	11,171,708	11,661,141	104.4	5,621,636	5,747,531	102.2	5,550,072	5,913,610	106.6	50	51	5,247,409	NA	NA	NA	95	95

<sup>a</sup>Includes out of season landings. See footnote a, Table 1.



year. Yearly variation in value of landings (Figure 4, Equation 5) was less than yearly variation in pounds landed (Figure 3, Equation 3). Value of west coast landings over time has been increasing at an increasing rate (Figure 4, Equation 5). For most years the actual value of landings is close to the estimated trend. West coast landings increased less than total value which implies that price per pound increased faster than landings.

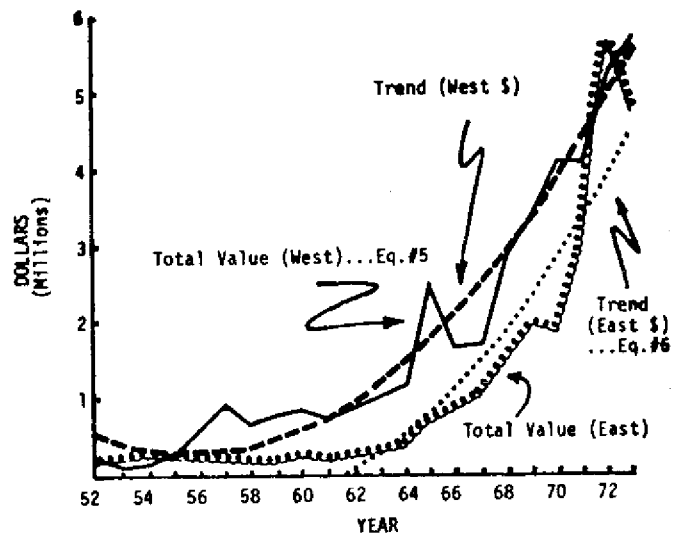


Figure 4. Total spiny lobster value, Florida east and west coasts, 1952-73. (Excluding out of season landings.)

East coast landings remained relatively stable between 1952 and 1964 (Figure 3, Equation 4). However, since 1964 landings increased significantly. For the 1952-73 period, landings increased at an increasing rate. A large proportion of the recent increase is due to increased landings from foreign waters (Table 3). Over the past ten years the percentage of total lobster landings from foreign waters increased approximately 600 percent and accounts for over 50 percent of Florida landings. A large portion of these foreign landings are attributable to landings from the Bahamian fishery and for the most part were landed on Florida's east coast.

Table 3. Spiny lobster landings in Florida ports caught in foreign waters, 1964-73.

Year	Total Florida Landings	Florida Landings From Domestic Waters	Florida Landings From Foreign Waters	
	Quantity (Pounds)	Quantity (Pounds)	Quantity (Pounds)	Percent of Total Florida Landings
1964	3,631,100	2,632,547	998,553	27.5
1965	5,714,100	4,719,847	994,253	17.4
1966	5,350,000	3,151,150	2,198,850	41.1
1967	4,414,000	1,915,676	2,498,324	56.6
1968	6,155,000	2,880,540	3,274,460	53.2
1969	7,582,000	4,086,698	3,495,302	46.1
1970	9,862,462	6,745,924	3,116,538	31.6
1971	8,205,803	4,669,102	3,536,701	43.1
1972	11,986,221 <sup>a</sup>	5,488,338	6,497,883 <sup>a</sup>	54.2
1973	12,676,188 <sup>a</sup>	6,621,122	6,055,066 <sup>a</sup>	47.8

<sup>a</sup>Out of season landings included for 1972 and 1973 were 782,974 pounds and 1,504,480 pounds, respectively. These are landed in Florida from foreign waters during the Florida closed season.

Source: Foreign water landings obtained from unpublished data collected by the Statistical Reporting Service in the National Marine Fisheries Service, Miami, Florida.

Total Value. The trend in total value of landings (Figure 4, Equation 6) closely parallels the trend in total landings (Figure 3, Equation 4) for the east coast because of the relative stability of price compared to volume landed. East coast landings and total value of landings are increasing at a greater percentage each year in both total lobster landings and total value of landings.

In summary, the increase in total landings for Florida is largely due to the recent increase in landings on the east coast. This was generally due to foreign catch being landed in Florida. To substantiate this fact, the trend for total Florida landings was estimated with the landings from foreign waters deleted (Figure 5, Equation 7). The estimated trend of landings for Florida from domestic waters lies far below actual total Florida landings which include foreign landings (Figure 5, Equation 1). Also, the gradual trend implies

that domestic water landings are not increasing as fast as Florida landings from foreign waters.

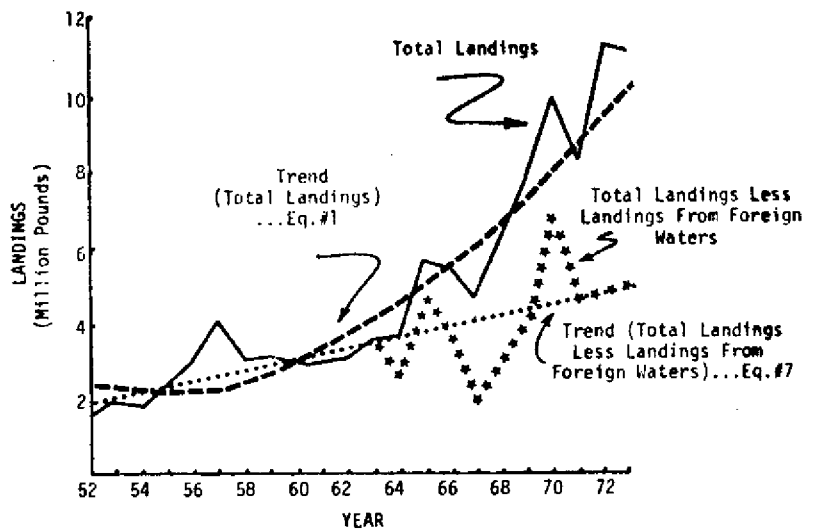


Figure 5. Total Florida landings, 1952-73, and total Florida landings less landings from foreign waters, 1964-73.<sup>a</sup> (Excluding out of season landings.)

<sup>a</sup>From personal interviews with staff of the Statistics and Market News Division, NMFS, USDC it was indicated that approximately 80 percent of the foreign water landings are caught in the Bahamian fishery. Also in 1972 a significant (larger than recorded) amount of foreign water lobsters were landed on the west coast of Florida. Again this is not documented but calculated speculation by reliable sources. Prior to 1964 data on Florida landings from foreign waters is not available.

## LABOR AND CAPITAL TRENDS

This section analyzes changes over time in labor and capital inputs employed in the Florida spiny lobster industry. The analysis is conducted for the state and then divided into the east and west coasts for further explanation of state trends. Capital refers to gear, boats and vessels. Labor is measured by the number of fishermen on boats, shore and vessels. Labor is further classified by casual and regular fishermen. Casual fishermen are those earning less than fifty percent of their income from fishing, whereas regular fishermen earn more than half of their income from fishing. The number of firms in the industry are analyzed to study the trend in aggregate inputs into the industry. Firms, as previously defined, are the number of boats and vessels in the industry during any year. Tonnage represents the total tonnage of only the total number of vessels in the industry for a given year. Data on boat tonnage is not available.

### Florida

Firms. The number of firms lobstering in Florida has increased at an increasing rate since 1952 (Figure 6, Equation 8, Appendix Table B). Comparing the 1952-54 period with the 1969-71 period the number of firms increased by 260 percent. The peak number of firms occurred in 1967 when 528 firms operated from Florida ports.

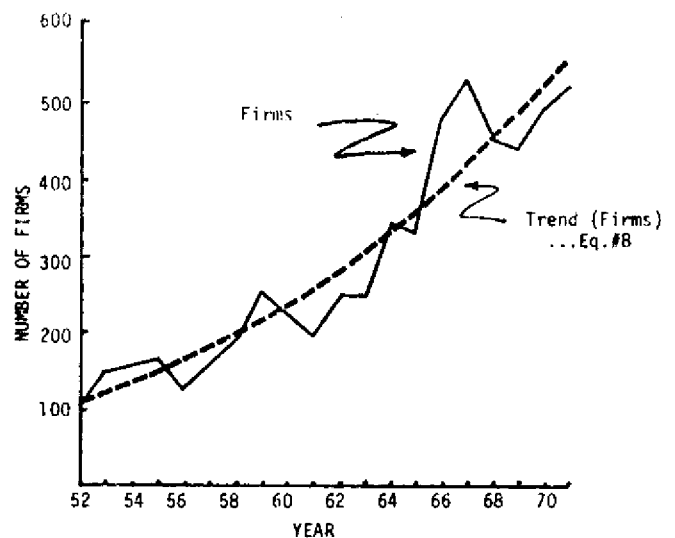


Figure 6. Number of spiny lobster firms, Florida, 1952-71.

The number of firms represents the number of lobster fishing units and may be regarded as a crude measure of fishing effort.<sup>3</sup> Economic theory of supply suggests producers will respond to price increases (decreases) by offering a greater (smaller) quantity of goods for sale, holding other factors constant. However, the producer often has only a limited amount of control over production because of random factors such as environmental and biological conditions. In these cases, the supply response to changes in prices are measured by a proxy which expresses intended responses. An increase in price theoretically can be expected to encourage new firms to enter (along with their associated fishermen, gear, etc.).

In Figure 7, corresponding prices and number of firms in the industry are plotted for each year for the period 1952-72. The line plotted through the points in Figure 7 (Equation 9) represents a highly significant (meaning little variation of the actual data from the estimated line) statistical relationship between the number of firms

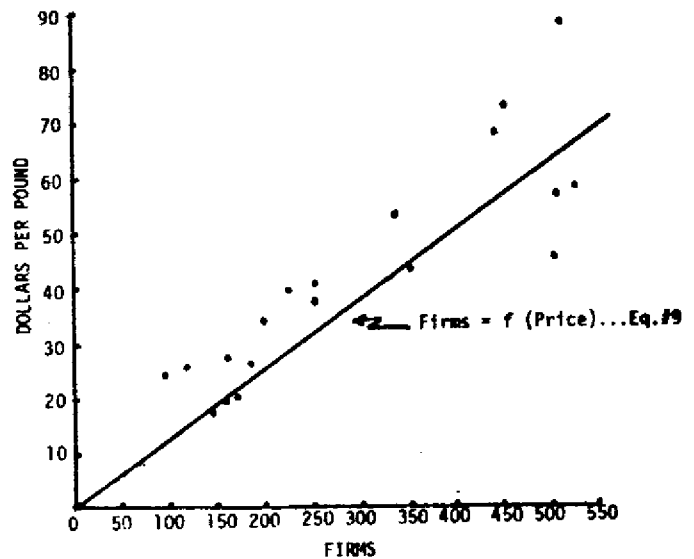


Figure 7. Relationship between number of spiny lobster firms and spiny lobster average dockside price, Florida, 1952-71.

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<sup>3</sup>The authors are currently developing an index of fishing effort. The index will take into account factors such as vessel size and gear along with the number of firms in order to develop a more accurate measure of effort.

in the industry and the average dockside price of lobster.<sup>4</sup> This relationship suggests that during the past two decades each 10 cent per pound increase in lobster prices has brought an additional sixty-nine firms or fishing units into the industry. Implications can also be drawn from this relationship explaining some of the increased use of other inputs which are discussed in the following sections.

Fishermen. The total number of fishermen landing their catch in Florida increased substantially since 1952 with the most pronounced increase since 1962 (Figure 8, Equation 10, Appendix Table B).

The number of fishermen on vessels increased to a maximum of 746 in 1971. This increase in the number of fishermen on vessels accounts for all of the increase in lobstermen since 1967.

Regular fishermen on boats and shore increased to a maximum of 621 in 1967 but then declined to 358 in 1971. Casual fishermen on boats and shore reached a maximum of 118 in 1964 but declined to 20 in 1970. As was the case with firms, it is expected that total number of fishermen is highly correlated with the price of lobster (Figure 7, Equation 9).

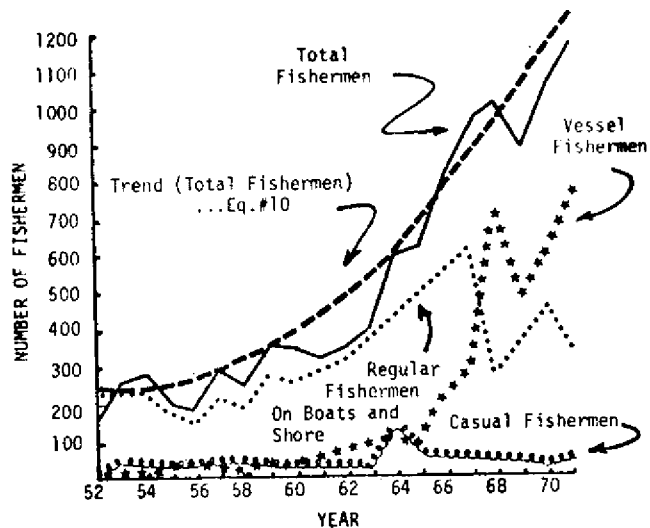


Figure 8. Number of spiny lobster fishermen, Florida, 1952-71.

<sup>4</sup>The statistical relationship for Equation 9 is:  $F = -2.96695 + 691.90322 P$ . Where: F represents number of firms and P represents price of lobsters expressed in dollars per pound.

Boats and Vessels. Number of boats increased from 102 in 1952 to a maximum of 388 in 1967 and thereafter declined to 250 in 1971 (Figure 9, Appendix Table B). Number of vessels, on the other hand, maintained a steady increase over time. The increase in the number of vessels was not noticeably significant until 1966

when vessels totaled 112. By 1968 there were 265 vessels and 189 boats. Since 1967 the number of vessels increased by 89 percent compared to a 49 percent decrease in the number of boats. However, number of boats increased 112 percent and number of vessels increased over 2,000 percent from the 1952-57 period to the 1966-71 period.

The trend in number of boats is positive and constant for the total period whereas the number of vessels has been increasing at an increasing rate (Equations 11 and 12, respectively). Much less variation is experienced in vessel numbers from year to year than in the number of boats. This may be partially explained by the fact that once a fisherman invests in a vessel, he will probably fish full time from year to year in order to recover his relatively large investment. Consequently, a smaller number of vessel fishermen exit soon after entering the industry.

Gross tonnage. Vessel tonnage in Appendix Table B and

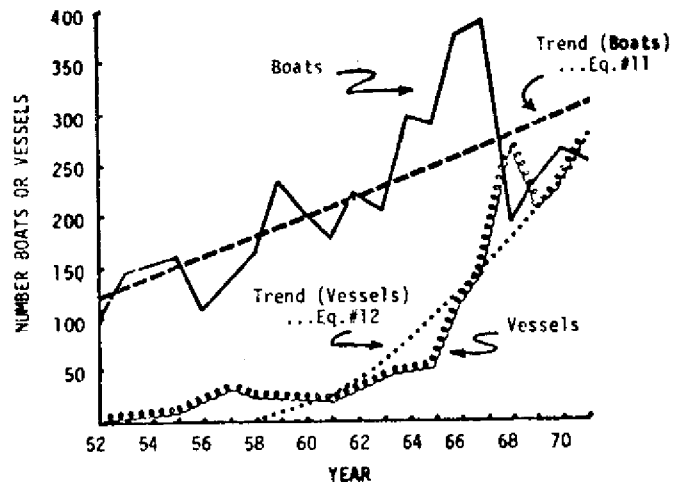


Figure 9. Number of spiny lobster boats and vessels, Florida, 1952-71.

Figure 10 is recorded as net tonnage prior to 1958 and recorded as gross tonnage since that time. The reader is referred to [1] for a complete explanation of net and gross tonnage. Tonnage in the industry has increased steadily throughout the 1952-72 period. The most

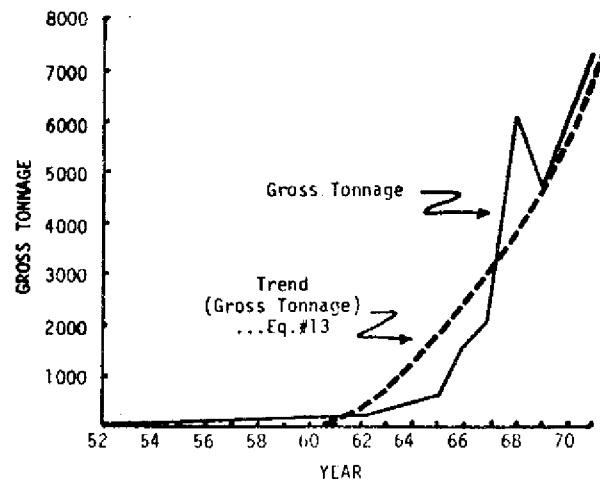


Figure 10. Total gross tonnage of spiny lobster vessels, Florida, 1952-71.

significant increases have occurred since 1962. Vessel tonnage is highly correlated with the number of vessels since tonnage refers to vessels only. A comparison of trends in number of vessels and trends in gross tonnage (Figures 9 and 10, respectively) shows the average size of vessels increasing over time. Vessel tonnage and number of vessels are highly correlated with lobster prices over time suggesting the number and size of vessels in the industry increase in response to increases in price.<sup>5</sup>

Traps. The number of traps in the Florida spiny lobster fishery increased from 14,850 in 1952 to an estimated 279,504 in 1973 (Appendix B). The number of traps have increased at a greater percentage each year for the period 1952-73 (Figure 11, Equation 14). In recent years the rate of increase has been more substantial.

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<sup>5</sup>The simple correlation coefficient between price and gross tonnage and vessel number are .89 and .92, respectively.



The change in the number of traps over time is obviously related to the number of fishermen, fishing craft and firms in the industry. But in addition, traps per firm or fisherman increased over time which is an intensification of effort. This intensification is possibly a function of the anticipated profitability or it

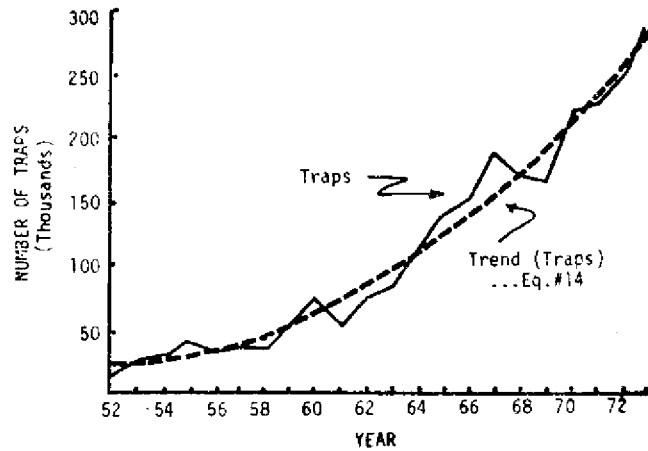


Figure 11. Number of spiny lobster traps, Florida, 1952-73.

could be related to some change in technology, i.e., shift from boats to vessels. A study of the relationship between the price fishermen received for lobsters and the number of traps employed in the industry shows that each 10 cent change in price was associated with a change of 34,309 traps during the past two decades.<sup>6</sup>

### East and West Coasts

Firms. In the west coast fishery there exists a substantial movement into and out of the fishery from year to year. But the number of firms entering (or re-entering) exceeds the number leaving and thus creates a net increase of approximately 16 firms a year (Figure 12, Equation 16, Appendix Table C).

The number of firms entering the east coast fishery is less stable than the number on the west coast (Figure 13, Equation 17).

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<sup>6</sup>Equation 15 regressing number of traps (T) on lobster price (P) is:  $T = -49.79 + 343.09 P$  where T is expressed per 1000 traps and P is expressed as dollars per pound.

The estimated trend shows the number of firms increasing at a much faster rate in the 1960's than in the 1950's. A possible explanation previously mentioned of this increase in the number of firms is the trend of increasing dockside prices of lobster. Number of firms in the east coast fishery vary considerably from year to year. The most significant increase took place in 1966 and 1967. Between 1967 and 1970 the number of firms steadily declined but have experienced an upward trend since 1970.

Fishermen. Since 1952 the number of fishermen on both coasts steadily increased (Figure 14, Equations 18 and 19, Appendix Table C) with trends approximately the same for both coasts. Prior to 1956 the number of fishermen on the east coast was greater than on the west coast. Currently, the number of lobster fishermen on both coasts are at record highs as exhibited by the greater percentage increase in

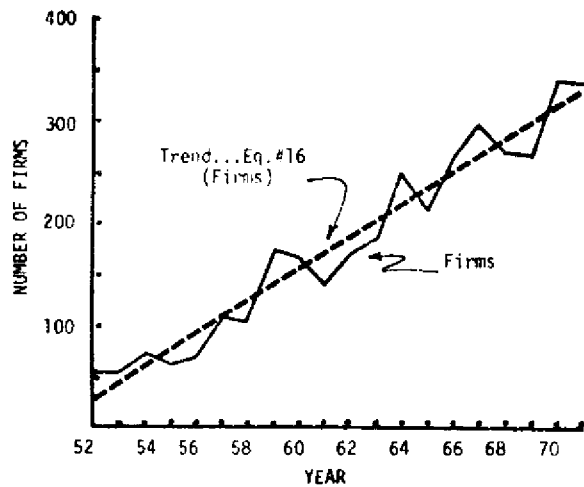


Figure 12. Number of spiny lobster firms, Florida west coast, 1952-71.

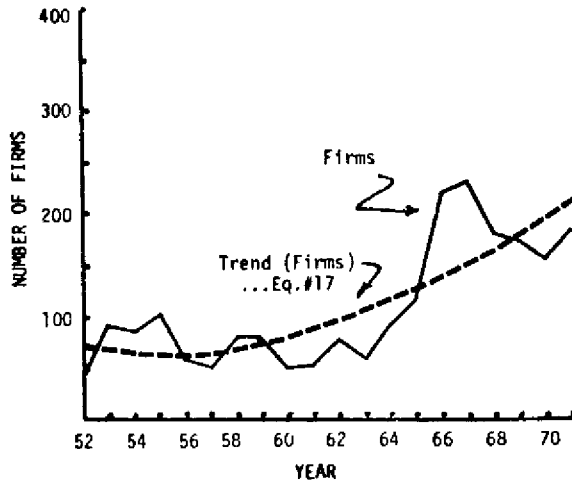


Figure 13. Number of spiny lobster firms, Florida east coast, 1952-71.

number of fishermen each year. Since 1968 the number of fishermen on vessels on the east coast exceeded the number on the west coast. The number of fishermen on boats, as compared to vessels, consistently has been greater on the west coast. Distribution of fishermen between vessels and boats between coasts probably is influenced by the more distant fishing grounds on the east coast.

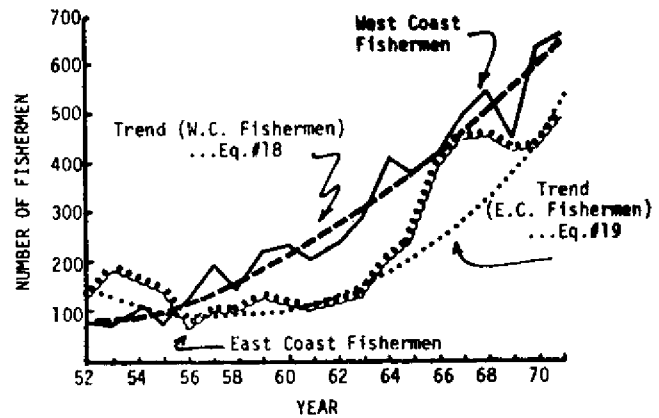


Figure 14. Number of spiny lobster fishermen, Florida east and west coasts, 1952-71.

The increases in the number of fishermen on the east coast since 1965 has come almost totally from the increase in the number of Cuban fishermen. This statement is the opinion of enumerators and statistical analysts that collect U. S. statistical data on spiny lobsters.

Boats and Vessels.

Number of boats on the west coast experienced an upward trend (Figure 15, Equation 20) over the years but is presently approaching a plateau. No significant trend for the east coast is evident. Both the east

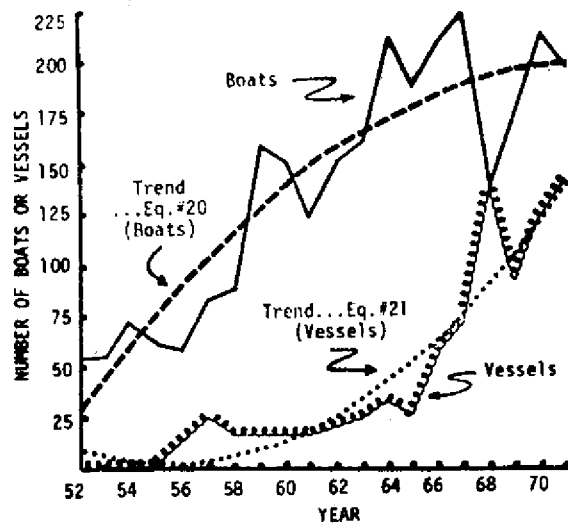


Figure 15. Number of spiny lobster boats and vessels, Florida west coast, 1952-71.

and west coasts experienced a significant decrease in the number of boats in 1968. Accompanying this decrease in boats was an increase in the number of vessels on both coasts. This substitution of fishing craft (boats for vessels) or increase in size of operating units indicates that economies of size may exist in the industry. A portion of the expansion in vessel numbers may have been induced by high prices received during that period. The west coast experienced an increase in the number of vessels earlier than did the east coast (Figures 15 and 16).

The long term trends estimated for each coast were very similar (Equations 21 and 22).

The west coast experienced some growth in the number of vessels in the mid 1950's, but then number of vessels remained relatively stable until the mid 1960's when the number of vessels increased significantly on both east and west coasts.

Gross Tonnage.

Gross tonnage followed

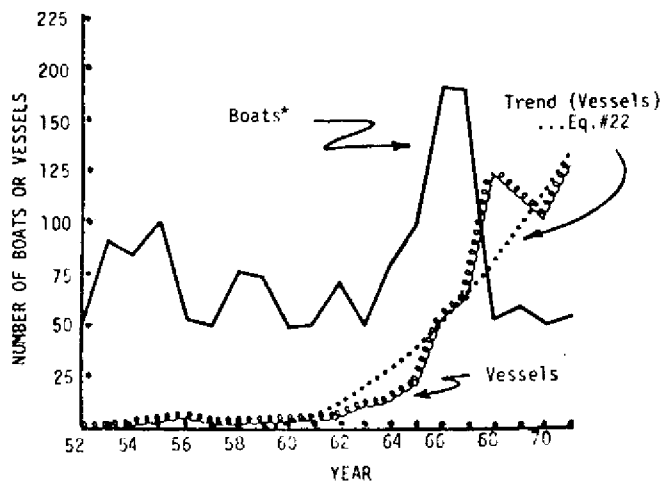


Figure 16. Number of spiny lobster boats and vessels, Florida east coast, 1952-71.

the same pattern as the number of vessels on each coast (Figures 17 and 18). The most pronounced increase in gross tonnage came in 1968. Gross tonnage on both coasts is increasing at increasing rates (Equations 23 and 24). Demand for larger and faster vessels may be highly influenced by the availability of lobsters on offshore fishing grounds. Fishermen are fishing farther out each year. This very often requires staying out for several days or employing faster boats for daily trips. Since 1970 the west coast has maintained substantially more gross tonnage than the east coast.

Traps. Number of traps in the west coast fishery is increasing at a greater percentage each year (Figure 19, Equation 25). Number of traps on the west coast has increased from a minimum of 4,500 in 1952 to over 150,000 by 1970 (Appendix Table C). Number of traps on the east coast is also increasing at a higher rate each year, however,

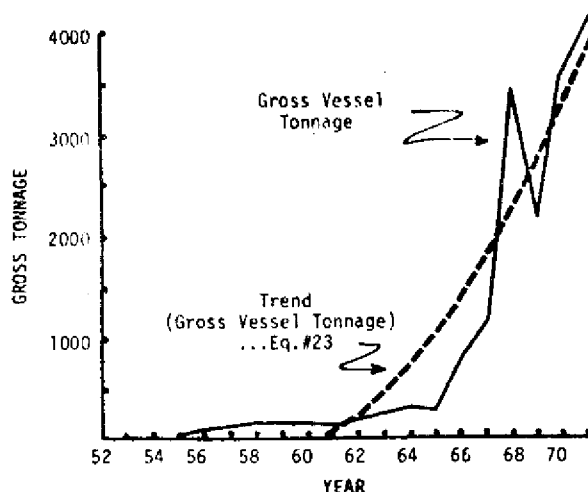


Figure 17. Gross spiny lobster vessel tonnage, Florida west coast, 1952-71.

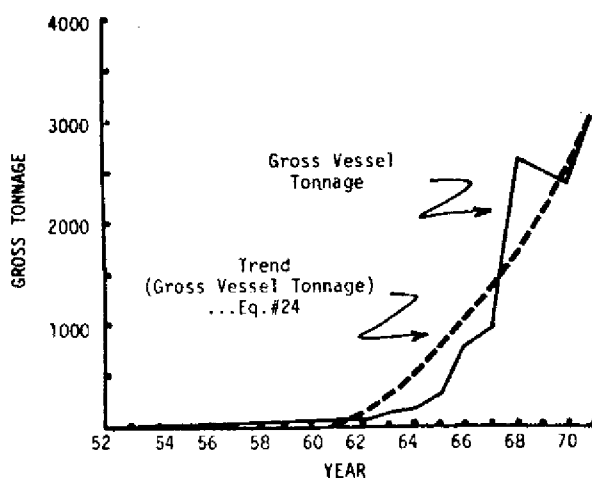


Figure 18. Gross spiny lobster vessel tonnage, Florida east coast, 1952-71.

the rate of increase on the east coast (Figure 20, Equation 26) is not as great as the rate of increase on the west coast. The east coast appears to have larger variations about the trend line in the number of traps from year to year than does the west coast.

The minimum number of traps employed on the east coast was 10,350 in 1952 while the maximum number employed was approximately 79,000 in 1971. This increasing number of traps for the east coast may in part be due to expansion into the Bahamian fishing grounds during this period.

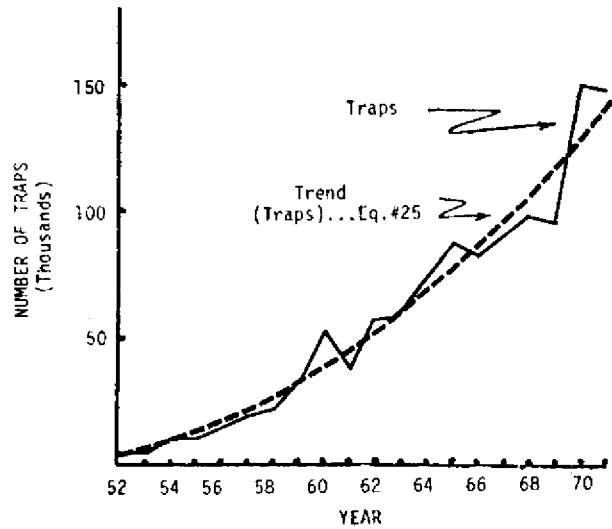


Figure 19. Number of spiny lobster traps, Florida west coast, 1952-71.

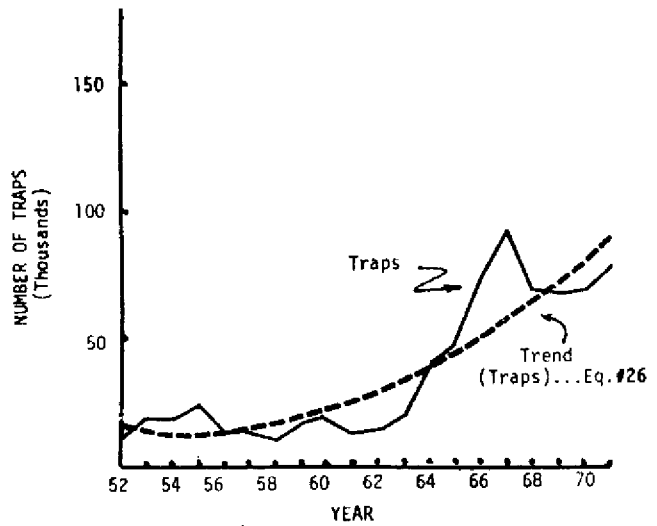


Figure 20. Number of spiny lobster traps, Florida east coast, 1952-71.

## PRODUCTIVITY TRENDS

This section surveys landings and dockside value of landings per unit of labor and capital inputs. The first section discusses these for Florida while the latter section compares these input-output relationships between the east and west coasts. Landings are pounds of whole lobster landed and dollars are total dockside value of landings.

### Florida

Landings and Dollars Per Firm. Lobster landings per firm have varied quite substantially from year to year during the past twenty years (Figure 21, Appendix Table D).

As a result of this variation, no trend for landings per firm could be estimated. Landings per firm were extremely high in 1956 and 1957. These years were the first in which both the number and size of vessels increased considerably (Appendix Table C). Landings per firm were at a low in 1967 when total landings in the industry were down from levels for years immediately prior to and after 1967 (Table 1).

Dollars per firm also

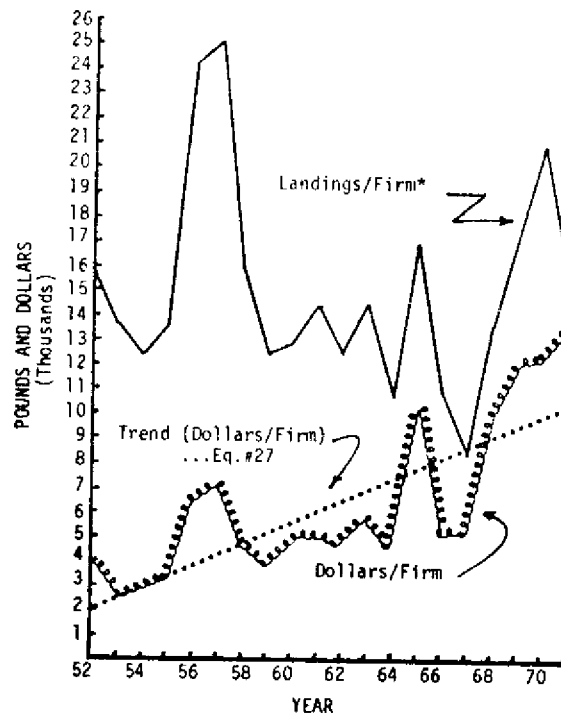


Figure 21. Spiny lobster landings and dollars per firm, Florida, 1952-71.

\*No statistically significant trend could be estimated for pounds per firm.

exhibited considerable variation from year to year. Generally this variation was consistent with landings per firm but somewhat less extreme because of the normal inverse relation of price and quantity landed. There has been an overall constant upward trend in dollars per firm due mainly to price increases (Figure 21, Equation 27).

Landings and Dollars Per Trap. Number of pounds per trap varied widely, ranging from a high of 110 pounds in 1957 to approximately 24 pounds in 1967 (Appendix Table D). The state average pounds per trap for the early period, 1952 to 1962, is 37.9 compared to an average of 80.5 pounds per trap for the latter period, 1963 to 1973. The estimated trend (Figure 22, Equation 28)

is decreasing but with great variation from year to year. From 1956 to 1959 pounds per trap were above the estimated trend with a maximum of 110 pounds per trap in 1957. After 1957 pounds per trap began decreasing and remained below the estimated trend line until 1968 with a minimum of 23 pounds per trap in 1967. Since 1968 pounds per trap have been moderately increasing to 45 pounds in 1970 and leveling off in the upper thirties in recent years.

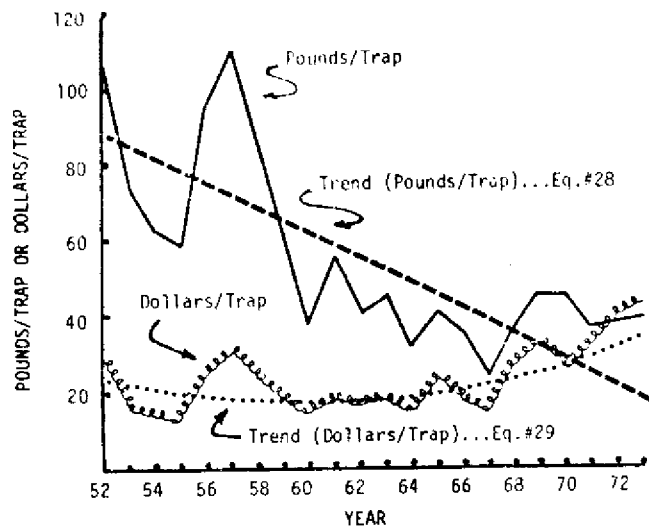


Figure 22. Pounds and dollars of spiny lobsters per trap, Florida, 1952-73.

Dollars per trap reached an all time high in 1973 at \$41.83 per trap from a minimum in 1955 at \$13.52 per trap (Appendix Table D).



The average dollars per trap for the period from 1952 to 1962 was \$19.85 compared to \$25.63 per trap for 1963-1973 period. It should be noted that this reflects substantial changes in price per pound over this period, since pounds per trap decreased over the period. In order for dollars per trap to remain relatively stable from year to year, price per pound had to vary significantly to offset the large inverse variation in pounds per trap over this same period.

A gradual increase in dollars per trap has been experienced in spite of the overall decrease in pounds per trap (Figure 22, Equation 29). During the 1950's and early 1960's the trend in dollars per trap decreased but since that time substantial price increases have offset the decline in landings.

In 1957 dollars per trap exhibited the largest variation from the estimated trend (which in the same year pounds per trap were at an extreme). As mentioned above, a viable economic explanation is that a substantial increase in vessels was responsible for the increase in pounds per trap landed. It is hypothesized that a trap on a vessel is more productive than a similar trap on a boat. Note that the two estimated trend lines, dollars per trap and pounds per trap, intersect between 1971 and 1972 (Figure 22, Equations 28 and 29). This reflects the fact that price exceeded \$1 per pound for the first time in 1972.

Landings and Dollars Per Fisherman. Pounds per fisherman over time have followed similar patterns as pounds per trap (Appendix Table D). Pounds landed per fisherman ranged from a high of over

16,129 pounds in 1956 to a low of over 4,660 pounds in 1967.<sup>7</sup> The average number of pounds landed per fisherman for the earlier period, 1952-62, was 10,217 compared to 7,382 for the latter period, 1963-71. This is an approximate 28 percent decrease in pounds landed per fisherman when comparing averages

of the first 11 years of the 1952-71 period to the last nine years. The overall trend was downward; however, there have been substantial yearly variations (Figure 23, Equation 30). This yearly variation in landings per

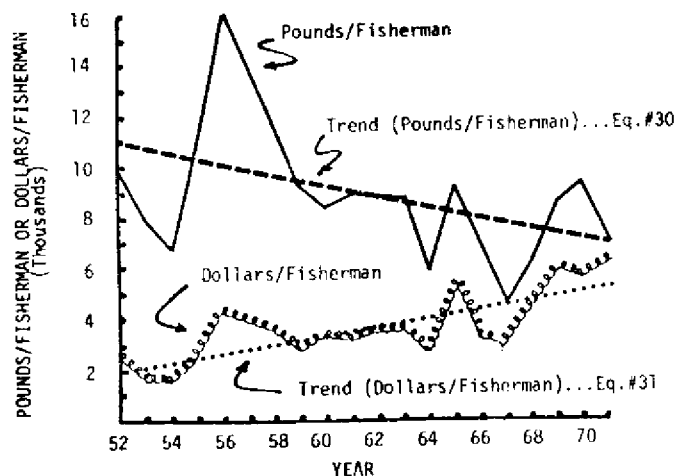


Figure 23. Pounds and dollars of spiny lobsters per fisherman, Florida, 1952-71.

fisherman as in the case of landings per trap, is closely associated with yearly changes

in number of vessels. For example, from 1952 to 1955 the variation in landings per fisherman was below the estimated trend and then advanced far above the trend until 1959 (Appendix Table D). The average landings per fisherman for 1952-55 was 7,000 compared to 12,500 pounds per fisherman for the 1956-59 period. During this same time period, vessel numbers increased substantially. Six vessels were recorded in 1955 while only two were recorded in 1954 and 1953 (Appendix Table B). The

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<sup>7</sup>It should be emphasized that pounds per fisherman does not represent the total catch of a lobster firm, boat or vessel since often two or more fishermen are employed by some firms. These trends show returns to one input, labor. This is of particular importance in fisheries since crewmen often work on a share basis.

number of vessels increased to 18 in 1956 and to 28 in 1957 after which the number leveled off at 21 by 1959. This 300 percent increase in number of vessels in 1956 followed by another 56 percent increase in 1957 are feasible economic factors that may have influenced landings per fisherman during the period 1955 to 1959. This is to imply that during this period new firms were entering the market with larger investments of capital and labor which possibly led to increased marginal productivity.

Extreme lows in pounds per fisherman were reached in 1964 and 1967. These extremes are associated with increases in the number of fishermen for these years while total landings remained relatively stable over this period (Appendix Table B). Number of fishermen was 608 in 1964 compared to 405 in 1963 and in 1967 the number of fishermen was 947 compared to 801 in 1966. Pounds per fisherman began to increase after 1967 to a peak of 9,320 pounds in 1970. This peak was above the long run trend and may be partially due to the increased number of traps per fisherman over previous years in addition to the higher yield per trap for that year (Table 4). Number of fishermen increased to a maximum

Table 4. Spiny lobster traps per fisherman and pounds per trap, Florida, 1968-71.

<u>Year</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>
Traps/Fisherman	168	186	207	197
Pounds/Trap	37	46	45	36

Source: Computed from Table 1 and Appendix Table B.

of 1,149 by 1971 compared to 1,059 for 1970 and 885 for 1969 (Appendix Table B). This may have also influenced the downward pattern of pounds

per fisherman landed during this period. In summary, as more fishermen have entered the spiny lobster fishery, average landings per fisherman have declined. However, concurrently total lobster landings for the state have increased over time. This indicates that the additional increase in the number of fishermen more than offsets the decline in landings per fisherman.

Dollars per fisherman experienced an upward trend (Figure 23, Equation 31). There appears to be less variation from the trend for dollars per fisherman than for pounds per fisherman. The range of dollars per fisherman for the 1952-71 period is from a low \$1,508 in 1954 to a high \$6,107 in 1971 (Appendix Table D). The average dollars per fisherman for 1952 to 1962 was \$2,937 compared to \$4,356 for 1963 to 1971. This was an approximate 48 percent increase compared to a 28 percent decrease in pounds per fisherman for the same periods. The basic reason for this difference is that price received for lobster rose at a faster rate than landings decreased. The same extreme peaks are generally experienced in dollars per fisherman as in pounds per fisherman. The previous reasoning can be used to explain these yearly variations since pounds per fisherman in part determine dollars per fisherman. Differences that do occur in the two patterns may be explained by variations in price changes. For example, dollars per fisherman decreased in 1970 while pounds per fisherman increased. This is partially due to the lower price per pound received in 1970 compared to surrounding years (Table 5). Excluding 1970 the average price per pound received for 1968-73 was \$.88. As in the case of pounds per trap and dollars per trap, pounds per fisherman is exceeded by dollars per fisherman between 1971-72 due to price per pound exceeding \$1 for the first time (Table 5).

Table 5. Price per pound of spiny lobster, Florida, 1968-73.

<u>Year</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
Price/Pound (dol.)	.72	.69	.60	.86	1.03	1.08

East and West Coasts

The nature of the lobster fishery varies between the east and west coasts, i.e., Bahamian vs. Keys. The intent of this section is to compare input-output relationships of the east and west coast fisheries (Appendix Table E).

Landings and Dollars Per Firm.

There has been no significant trend in landings per firm on the west coast. Variations in yearly landings were extreme in 1956 and 1967 (Figure 24, Appendix Table E). The sharp increase in landings per firm on the west coast attributed to the peak landings for the state illustrated in Figure 21. Dollars per firm generally followed the same yearly pattern as landings per firm, however, there has been a slight constant upward trend in dollars per firm due to increasing prices (Figure 24, Equation 32).

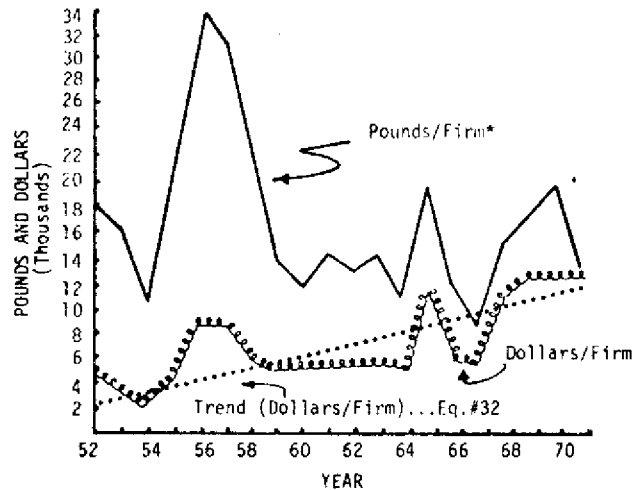


Figure 24. Pounds and dollars per spiny lobster firm, Florida west coast, 1952-71.

\*No statistically significant trend could be estimated for pounds per firm.

Landings per firm on the east coast varied considerably on a year-to-year basis (Figure 25, Equation 33). Landings per firm gradually trended downward until 1967 and since then increased considerably

due to landings caught in foreign waters. Dollars per firm on the east coast closely parallels landings per firm throughout the twenty year period (Figure 25, Equation 34). Since 1967 the east and west coasts have shown similar patterns in landings and dollars per firm. The increase in state landings since 1967 can be mostly attributed to increased landings on the east coast.

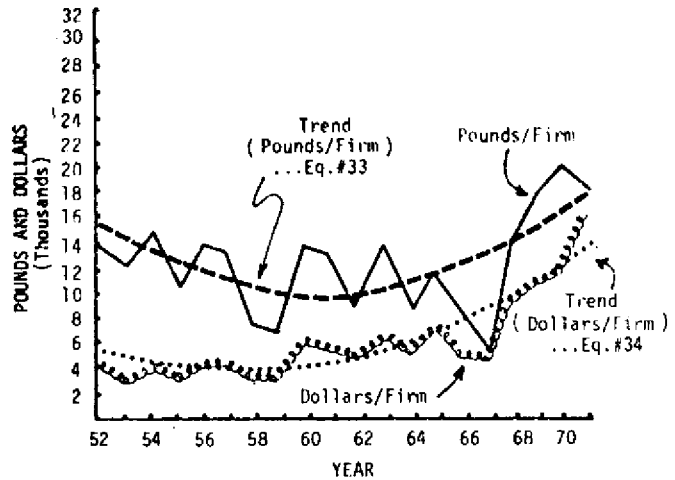


Figure 25. Pounds and dollars per spiny lobster firm, Florida east coast, 1952-71.

Landings and Dollars Per Trap. Pounds per trap for the east coast varied from a high of 65.2 pounds in 1954 to a low of 17.8 pounds in 1966 (Appendix Table E). The range on the west coast was between 212.6 pounds in 1952 to 29.8 pounds in 1967. The average pounds per trap for the period 1952-62 for the east coast was 48.97 compared to an average of 100.61 pounds per trap on the west coast. Average pounds per trap on the east coast was 32.10 for the 1962-71 period compared to 42.04 pounds per trap on the west coast.

One of the basic economic factors that influenced this output difference between the fisheries appears to be the use of vessels. Reference is made to Figures 13 and 14 which indicate that vessels were employed at an earlier date on the west coast than on the east coast. Gross vessel tonnage has always been greater on the west coast.

The trend in pounds per trap for both coasts are decreasing at a smaller percentage rate each year until 1968 after which the trends

Leveled out (Figure 26, Equations 35 and 36). This means that in earlier years the decline was more rapid than in years when pounds per trap tended to level out. Both trends indicate that a minimum level of pounds per trap was reached in the late 1960's. Minimum for the east coast was estimated during 1965 at approximately 32 pounds per

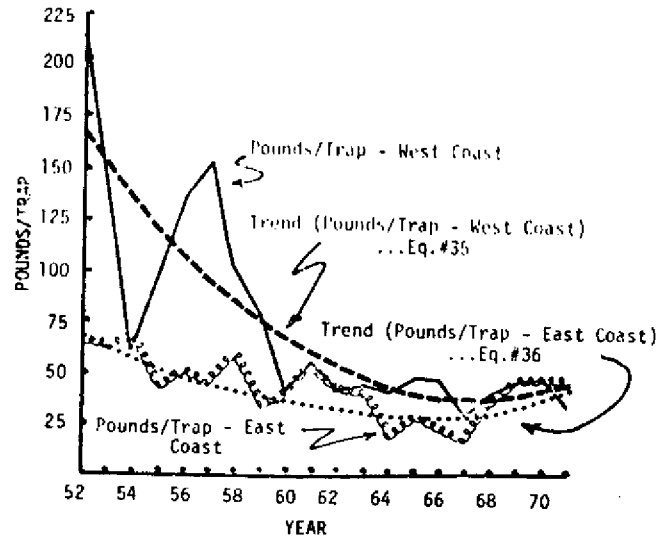


Figure 26. Pounds per spiny lobster trap, Florida east and west coasts, 1952-71.

trap. Minimum for the west coast was estimated during 1967 at approximately 36 pounds per trap. Pounds per trap have been gradually increasing on both coasts since 1965 and 1967. Such increases in production could be due to an introduction of new craft technology during such periods and/or the discovery of new fishing grounds. Prior to 1965, pounds per trap for the west coast were decreasing at a faster rate than for the east coast. Pounds per trap appear more stable from year to year on the east coast compared to the highs of 1952 and 1957 and lows of 1954 and 1960 on the west coast. At this time no adequate economic interpretation for the decrease in pounds per trap in 1954 can be provided. All of the inputs were increasing at a normal rate but total quantity landed was slightly below previous years. This decrease is most likely explained by biological or environmental incidents that occurred in 1954 and are not recorded in the data. The 1957 peak in pounds per trap on the west coast could be associated with an increase in the use of vessels for that year. Vessels on the west coast numbered 25 compared to a 10.4 average for the 1952-1962 period excluding 1957

(Appendix Table C). After 1957, pounds per trap on the west coast decreased to a low of approximately 38 pounds in 1960 and thereafter stabilized at 45 pounds with little variation. East coast landings per trap show a similar relationship but with less variation since 1952. In 1970 pounds per trap on the east coast increased above pounds per trap on the west coast for the first time since 1953.

Dollars per trap varied from a low of \$8.74 in 1964 to a high of \$35.40 in 1956 on the west coast (Appendix Table E). Average dollars per trap for the 1952-1962 period on the east coast was \$14.03 compared to \$26.65 on the west coast. Average dollars per trap during 1963-1971 on the east coast was \$19.64 compared to \$24.51 on the west coast. While on the east coast dollars per trap increased between the two periods, the west coast experienced a slight decrease. This decrease for the west coast was basically brought about by the same phenomena that caused pounds per trap to decrease by a greater percentage on the west coast than the decrease in pounds per trap on the east coast. That is that the rate of vessel employment has increased at a faster rate on the east coast than on the west coast for the 1963-71 period. Price per pound remained fairly equal for both coasts with a few exceptions.

Estimated trends for dollars per trap on the east and west coasts are very similar to trends estimated for pounds per trap on each coast (Figure 27, Equations 37 and 38). The only exception is the east coast trend for dollars per trap increased above the west coast trend after 1970. This was caused by the east coast landing more pounds per trap than the west coast after 1970 (Figure 26). As previously mentioned, this could be due to improved fishing in the Bahamian fishery off the east coast. Other than this difference, yearly data on dollars per



trap behaved in the same manner as did pounds per trap for the respective coast. This indicates that prices on each coast were fairly equal over time. Based on the estimated trends, dollars per trap for the east coast are increasing at an increasing rate. Dollars per trap for the west coast are also increasing at a greater percentage rate each year but not as rapidly as the east coast.

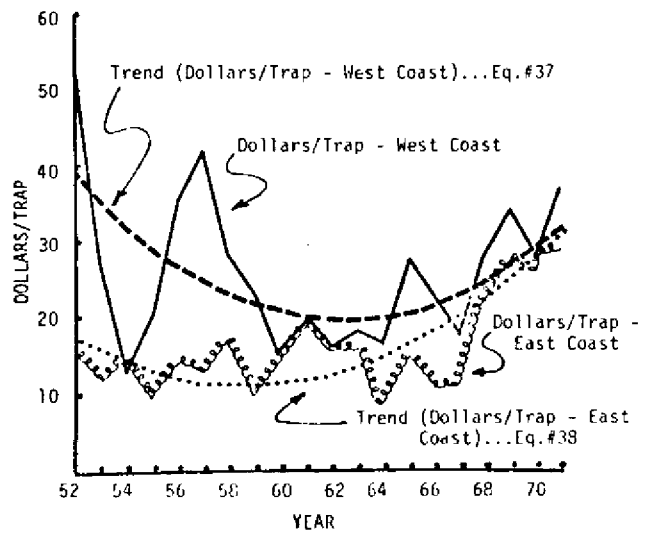


Figure 27. Dollars per spiny lobster trap, Florida east and west coasts, 1952-71.

Landings and Dollars Per Fisherman. Pounds per fisherman for the east coast ranged from a low of 3,726 pounds in 1967 to a high of 11,922 pounds in 1956 (Figure 28, Appendix Table E). The west coast ranged from 5,507 pounds per fisherman in 1967 to 18,262 pounds per fisherman in 1956. Average pounds per fisherman for the east coast during the 1952-62 period was 7,091 per fisherman compared to 12,715 pounds per fisherman for the west coast. Average pounds per fisherman during

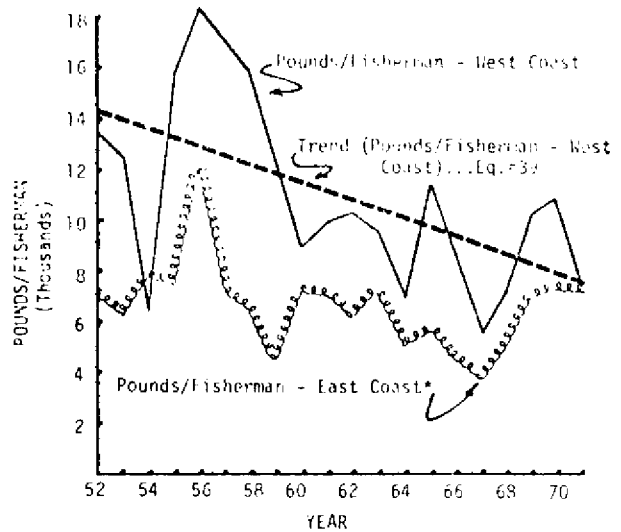


Figure 28. Pounds of spiny lobsters per fisherman, Florida east and west coasts, 1952-71.

\*No statistically significant trend could be estimated for pounds per fisherman on the east coast.

the 1963-71 period for the east coast was 5,621 pounds compared to 8,603 pounds for the west coast. Average pounds per fisherman during the 1963-71 period for the east coast was 5,621 compared to 8,603 pounds for the west coast. The east coast experienced a 21 percent decrease in pounds landed per fisherman between the two periods compared to a 32 percent decrease for the west coast.<sup>8</sup> Number of traps for the east coast during the 1963-71 period was 3.82 times greater than the number of traps during the 1952-62 period. The increase in number of traps for the west coast was 3.77 times greater for the 1963-71 period compared to the 1952-62 period. These changes occurred while the number of fishermen for each coast increased at approximately the same rate. Consequently, traps and fishermen do not account for all the differences between the trends in pounds landed for the east coast and the west coast.

Another possible explanation for this difference may be related to the rate at which each coast increased its use of vessels for these respective periods. Average number of vessels employed on the east coast for 1952-62 was 3.2 compared to 70.2 vessels employed for the 1963-71 period. Average number of vessels for the west coast during 1952-62 was 11.7 compared to 79.2 vessels for the 1963-71 period. The percentage increase for the east coast was approximately four times that for the west coast. The larger growth rate in vessel numbers probably explains part of the relatively smaller percentage decrease in pounds per fisherman for the east coast during the periods compared.

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<sup>8</sup>The decline in landings per fisherman is not inconsistent with the trend in landings per trap. If a linear relationship were estimated for landings per trap, the trend would have been negative.

Tonnage per vessel and gross tonnage appear to be highly correlated with total landings.

Due to the large variation in annual landings for the east coast, no significant trend could be estimated (Figure 28). A linear trend was estimated for the west coast, but with extreme variation of landings from year to year (Figure 28, Equation 39). Except for 1954, landings for each coast followed somewhat similar patterns.

With the exception of 1954, dollars per fisherman were lower for the east coast than west coast. Dollars per fisherman for the east coast ranged from a low of \$1,252.74 in 1953 to a high of \$6,004.22 in 1971 (Appendix Table E). The range for the west coast was from a low of \$1,381.98 in 1954 to a high of \$7,243.33 in 1969. Average dollars per fisherman for the east coast during 1952-1962 was \$2,070 compared to \$3,531 for the west coast during the same period. During 1963-71 average dollars per fisherman for the east coast was \$3,393 compared to \$5,051 for the west coast. An overall increase in landings has been experienced during the 1963-71 period for the west coast but with wide yearly variations which were consistent with landings per fisherman for that coast (Figure 29, Equation 40).

In recent years the trend in dollars per fisherman for the east coast was greater than the trend for the west coast (Figure 29, Equation 41).

Based on the estimated trend for the west coast, dollars per fisherman was increasing

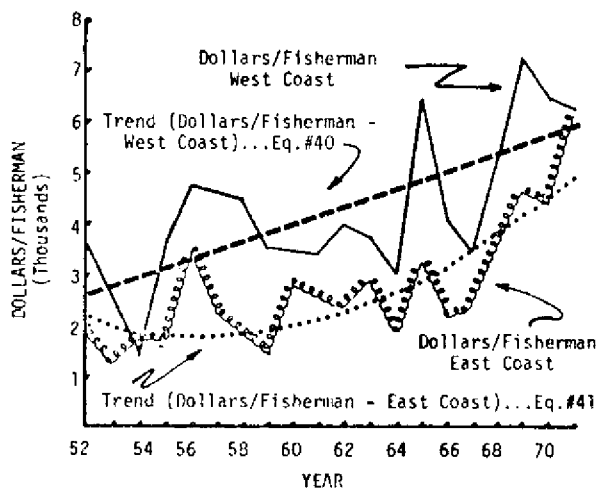


Figure 29. Dollars per fisherman received for spiny lobsters, Florida east and west coasts, 1952-71.

by approximately \$100 each year. Dollars per fisherman for the east coast was increasing at an increasing rate and if it continues will exceed the value of landings per fisherman for the west coast.

## SUMMARY

Spiny lobster landings in Florida increased over the 1952-73 period. The trend in total value of landings also increased but at a more rapid rate because of increasing prices over this period. Total spiny lobster landings for 1973 rose above 12 million pounds while price per pound averaged \$1.08. Total quantity of landings on both the west and east coasts increased. However, the trend in total landings on the east coast is increasing at a greater rate than on the west coast. Trends in total value of landings for the east and the west coasts are increasing at approximately the same increasing rate. Prices for both Florida coasts have also remained fairly equal for this period with only a few exceptions.

The recent increase in total Florida landings is primarily due to increased landings from foreign waters. Most of the foreign caught lobsters are landed on the east coast which explains the increase in east coast landings. However, when foreign landings are excluded, the trend in Florida landings is still increasing but at a much reduced rate.

Inputs into the Florida spiny lobster fishery have been substantially increased. Total number of fishermen and boats are increasing at a constant rate. The trend in the number of vessels is increasing at a greater rate than boats. Vessels are also increasing in size as indicated by a more rapid increase in gross vessel tonnage than in the number of vessels. The number of traps reached an estimated maximum of 279,504 in 1973 and is increasing at a greater percentage rate each year. Number of firms has also tended to trend upward at an increasing rate.

Both east and west coasts are increasing in numbers of fishermen. Number of boats entering the spiny lobster fishery on the west coast is increasing each year but at a decreasing rate implying the entry of new boats is decreasing each year. Number of vessels on the west coast trended upward at an increasing rate. Similar implications can be drawn from the number of vessels entering the lobster fishery on the east coast. Number of boats on the east coast is highly variable from year to year and no trend could be estimated. Gross vessel tonnage increased at an increasing rate for both coasts. Trap numbers also increased at an increasing rate on both the east and west coasts. However, up until recent years number of traps on the west coast has increased at a constant rate while on the east coast trap numbers have increased at a greater percentage rate each year.

The long-run trend in total landings was exceeded by trends in the various resources used, consequently, output per unit of input decreased. Pounds per trap for the state decreased at a constant rate each year with wide yearly variations. Dollars per trap showed a gradual upward trend because price increases exceeded declines in pounds per trap. Pounds landed per fisherman and dollars received per fisherman illustrate similar trends.

Trends in pounds per trap on both coasts have been decreasing at a decreasing rate indicating smaller declines in recent years compared to earlier declines. Pounds per trap appear to have increased on the east coast in recent years due to increased landings brought about by fishing the Bahamian grounds. Pounds per fisherman for both coasts have also trended downward while dollars per fisherman have exhibited an increasing trend on both coasts. Dollars received per fisherman is increasing at a faster rate on the east coast than on the west coast.

To reiterate, the trend in total Florida landings increased over the past 22 years. This increase is inflated due to the additional foreign water lobsters landed in Florida ports during the closed season as well as seasonal landings from the Bahamian fishery. Inputs into the fishery have generally increased at a faster rate than landings have increased, therefore, decreasing the output per unit of input (namely pounds per trap and pounds per fisherman). This decrease in productivity has been partially offset in recent years by increasing prices per pound.

Throughout this paper it appears that there exists a high correlation between higher productivity and increased employment of vessels as well as increased vessel size. A follow up to this study is currently underway to determine the production relationships in the spiny lobster fishery and maximum economic yield. The decline in catch per unit of input (fisherman and traps) shown in this bulletin does not necessarily imply the maximum sustainable yield has been reached. To determine the maximum sustainable yield with respect to resource use requires the additional analysis currently underway.

## DATA SOURCES

1. National Marine Fisheries Service, Fishery Statistics of the United States (formerly Bureau of Commercial Fisheries), U. S. Government Printing Office, Washington, D. C. Annual Issues, 1952-71.
2. National Marine Fisheries Service, Florida Landings (formerly Bureau of Commercial Fisheries), U. S. Government Printing Office, Washington, D. C. Monthly and annual issues, 1971-73.



APPENDIX

Appendix Table A. Regression equations and summary of results.

Estimated intercept and regression coefficients are presented for specified dependent variables regressed on years unless otherwise specified. Standard error of the estimates are presented in parentheses.

Equation Number	Figure Number	Dependent Variable	Estimated Intercept	Estimate Coefficients		R <sup>2</sup>
				Year	Year <sup>2</sup>	
1	2 & 5	Quantity (Florida)	2,423.10	21.85 (5.34)	-127.89 (126.55)	.8997
2	2	Value (Florida)	1,558.08	36.00 (4.54)	-427.33 (107.50)	.9416
3	3	Quantity (West Coast)	597.09	215.98 (25.62)		.7804
4	3	Quantity (East Coast)	1,660.37	-312.93 (61.21)	20.93 (2.58)	.9125
5	4	Value (West Coast)	669.61	-159.78 (52.42)	17.21 (2.21)	.9563
6	4	Value (East Coast)	1,059.88	-326.57 (79.39)	22.06 (3.35)	.8761
7	5	Quantity (Fla. excluding foreign)	1,627,000.00	160,500.00 (33,580.00)		.5332
8	6	Firms (Florida)	105.87	7.26 (7.88)	.7544 (.36)	.9019
9	7	Price (\$)/Pound (Florida)	0	Firms .001405 (.0000624)		.7750
10	8	Fishermen (Florida)	2,289.40	-162.00 (12.19)	32.40 (.56)	.9534
11	9	Boats (Florida)	112.90	9.70 (2.20)		.5293
12	9	Vessels (Florida)	34.70	-13.80 (4.80)	1.30 (.20)	.9088
13	10	Gross Tonnage (Florida)	1,263.60	-524.50 (129.20)	40.40 (6.00)	.9019
14	11	Traps (Florida)	20,480.97	-213.04 (2,298.12)	539.63 (106.30)	.9628
15	--	Traps (Florida)	-49.79	Price/Pound 343.09 (28.07)		.8925
16	12	Firms (West Coast)	15.10	15.78 (.87)		.9484

Appendix Table A. Continued.

Equation Number	Figure Number	Dependent Variable	Estimated Intercept	Estimate Year	Coefficients Year <sup>2</sup>	R <sup>2</sup>
17	13	Firms (East Coast)	77.57	-4.89 (6.12)	.5807 (.2833)	.6332
18	14	Fishermen (West Coast)	59.21	8.50 (6.42)	1.06 (.30)	.9612
19	14	Fishermen (East Coast)	169.71	-24.69 (9.35)	2.17 (.43)	.8704
20	15	Boats (West Coast)	12.90	17.60 (4.50)	-.40 (.20)	.8142
21	15	Vessels (West Coast)	15.40	-5.40 (2.60)	.60 (.10)	.8982
--	16	Boats (East Coast)		---(NO TREND)---		
22	16	Vessels (East Coast)	19.30	-8.40 (2.50)	.70 (.10)	.9030
23	17	Gross Tonnage (West Coast)	717.50	-291.70 (79.60)	22.40 (3.70)	.8810
24	18	Gross Tonnage (East Coast)	541.90	-233.40 (56.10)	18.00 (2.60)	.9070
25	19	Traps (West Coast)	3,225.40	1,630.20 (1,612.00)	264.10 (74.60)	.9553
26	20	Traps (East Coast)	17,280.30	-1,844.20 (2,214.10)	275.50 (102.40)	.7884
--	21	Quantity/Firm (Florida)		---(NO TREND)---		
27	21	Dollars/Firm (Florida)	1,779.00	432.61 (81.25)		.6117
28	22	Pounds/Trap (Florida)	91.56	-3.31 (.67)		.5784
29	22	Dollars/Trap (Florida)	24.89	-1.65 (.9410)	.0936 (.0435)	.2812
30	23	Pounds/Fisherman (Florida)	11,230.79	-216.62 (93.83)		.2285
31	23	Dollars/Fisherman (Florida)	1,844.28	163.67 (35.75)		.5380
--	24	Pounds/Firm (West Coast)		---(NO TREND)---		
32	24	Dollars/Firm (West Coast)	2,778.00	393.70 (88.27)		.5249

Appendix Table A. Continued.

Equation Number	Figure Number	Dependent Variable	Estimated Intercept	Estimate Coefficients Year	Estimate Coefficients Year <sup>2</sup>	R <sup>2</sup>
33	25	Pounds/Firm (East Coast)	16,350.00	-1,426.00	74.97	.4431
34	25	Dollars/Firm (East Coast)	4,874.00	(472.10)	(21.84)	.8267
35	26	Pounds/Trap (West Coast)	182.98	(266.60)	(12.33)	.6917
36	26	Pounds/Trap (East Coast)	71.61	-17.72	.5392	.5622
37	27	Dollars/Trap (West Coast)	42.09	(4.75)	(.2198)	.3050
38	27	Dollars/Trap (East Coast)	18.20	-5.62	.2008	.6277
39	28	Pounds/Fisherman (West Coast)	14,579.11	(1.57)	(.0727)	.3249
--	28	Pounds/Fisherman (East Coast)		-353.74	(.1658)	
40	29	Dollars/Fisherman (West Coast)	2,469.91	(120.19)	(.0657)	.4476
41	29	Dollars/Fisherman (East Coast)	2,218.92	(.75)	.1207	.6655
				(.0347)		
				(NO TREND)		
				165.04		
				(43.63)		
				-154.18	14.38	
				(119.60)	(5.53)	

Appendix Table B. Spiny lobster capital and labor inputs, Florida, 1952-73.

Year	Fishermen		Boats and Shore		Total	Boats		Vessels		Traps		Firms <sup>b</sup>
	Vessels (Regular)	(Regular)	(Casual)	(Casual)		(Number)	(Number)	(Number)	(Tonnage) <sup>a</sup>	(Number)	(Number)	
1952	0	166	0	0	166	102	0	0	0	14,850	102	
1953	4	243	2	2	249	145	2	18	18	25,774	147	
1954	4	225	43	43	272	155	2	13	13	30,445	157	
1955	14	185	20	20	219	160	6	49	49	39,042	166	
1956	38	135	18	18	193	110	18	137	137	32,725	128	
1957	57	217	16	16	290	133	28	151 <sup>c</sup>	151 <sup>c</sup>	36,635	161	
1958	44	193	11	11	248	166	21	173	173	34,316	187	
1959	41	281	25	25	347	233	21	165	165	51,712	254	
1960	40	281	20	20	341	201	20	209	209	73,630	221	
1961	45	258	11	11	314	174	21	214	214	52,350	195	
1962	53	280	16	16	349	223	25	268	268	74,390	248	
1963	69	316	20	20	405	212	34	409	409	80,290	246	
1964	109	381	118	118	608	294	47	562	562	113,653	341	
1965	106	469	50	50	625	286	46	655	655	138,900	332	
1966	232	533	36	36	801	376	112	1,624	1,624	150,970	488	
1967	299	621	27	27	947	388	140	2,163	2,163	185,925	528	
1968	690	288	23	23	1,001	187	265	6,108	6,108	168,390	452	
1969	509	347	29	29	885	235	205	4,742	4,742	164,655	440	
1970	598	441	20	20	1,059	266	226	5,930	5,930	129,100	492	
1971	746	358	45	45	1,149	250	270	7,272	7,272	225,862	520	
1972					NA					248,448 <sup>d</sup>	NA	
1973					NA					279,504 <sup>d</sup>	NA	

<sup>a</sup>Prior to 1958 tonnage is reported as net tonnage. (See source for complete definition of net tonnage.)

<sup>b</sup>Firms are estimated as the sum of the number of vessels and boats.

<sup>c</sup>The original data source lists 51 gross tons for 1957. This was adjusted to 151 due to an obvious error in printing upon consultation with the Statistical Reporting Service of the National Marine Fisheries Service.

<sup>d</sup>Traps estimated as follows: 1972 = 10% of 1971 plus number of traps 1971  
 1973 = 12.5% of 1972 plus number of traps 1972  
 Percentages were based on preliminary unpublished statistics.

Source: Based on annual issues of [1].

Appendix Table C. Spiny lobster capital and labor inputs, Florida east and west coasts, 1952-71.

	Boats				Vessels				Traps				Firms				Fishermen				Total
	Number		Gross Tonnage		Number		Number		Number		Number		Vessel		Regular		Casual				
	East	West	East	West	East	West	East	West	East	West	East	West	East	West	East	West	East	West			
1952	48	54	0	0	10,350	0	0	4,500	54	48	54	0	0	95	71	24	0	119	71		
1953	90	55	2	0	19,274	0	18	6,500	55	92	55	4	0	173	70	2	0	179	70		
1954	84	71	0	2	18,755	13	0	11,690	84	84	73	0	4	142	83	15	28	157	115		
1955	99	61	4	2	26,342	14	35	12,700	103	103	63	10	4	124	61	10	10	144	75		
1956	53	57	4	14	16,150	104	33	16,775	57	57	71	10	28	57	80	0	18	67	126		
1957	50	83	3	25	14,915	126	25	21,720	53	53	108	8	49	79	138	6	10	93	197		
1958	78	88	4	17	11,095	142	31	23,221	82	82	105	11	33	87	106	3	8	101	147		
1959	74	159	4	17	18,100	134	31	33,612	78	78	176	11	30	107	174	5	20	123	224		
1960	49	152	4	16	18,990	171	38	54,640	53	53	168	11	29	89	182	2	18	102	239		
1961	50	124	5	16	13,360	166	48	38,990	55	55	140	13	32	88	170	0	11	101	213		
1962	72	151	5	20	16,140	212	56	58,250	77	77	171	13	40	88	192	9	7	110	239		
1963	50	162	10	24	20,240	261	148	60,050	60	60	186	25	44	83	233	8	12	116	289		
1964	80	214	13	34	40,100	358	204	73,553	93	93	248	41	68	143	238	14	104	198	410		
1965	98	188	18	28	49,200	308	347	89,700	116	116	216	50	56	163	306	26	24	239	386		
1966	166	210	54	58	76,420	824	800	74,550	220	220	268	128	104	233	300	24	12	385	416		
1967	164	224	65	75	94,125	1189	974	91,800	329	329	299	156	143	291	330	3	24	450	497		
1968	52	135	128	137	69,890	3433	2675	98,500	180	180	272	367	323	74	214	11	12	452	549		
1969	59	176	113	92	67,700	2185	2557	96,955	172	172	268	325	184	92	255	9	20	426	459		
1970	52	214	103	123	69,050	3534	2396	150,050	155	155	337	311	287	110	331	3	17	424	635		
1971	55	195	128	142	78,825	4184	3088	147,037	183	183	337	382	364	99	259	6	39	487	662		

Source: Based on annual issues of [1].

Appendix Table D. Dollars and pounds of spiny lobsters per trap and per fisherman, Florida, 1952-73.

Year	Pounds Per Trap	Pounds Per Fisherman	Pounds <sup>a</sup> Per Firm	Dollars Per Fisherman	Dollars Per Trap	Dollars <sup>b</sup> Per Firm
1952	109	9,713	15,808	2,428	27	3,952
1953	77	8,014	13,574	1,603	15	2,715
1954	64	6,857	12,403	1,503	14	2,729
1955	57	10,481	13,828	2,411	14	3,180
1956	95	16,130	24,320	4,275	25	6,446
1957	110	13,930	25,091	3,874	31	6,979
1958	86	11,913	15,750	3,734	24	4,474
1959	62	9,166	12,518	2,751	18	3,757
1960	39	8,353	12,889	3,227	15	4,979
1961	54	8,928	14,376	3,087	19	4,971
1962	42	8,903	12,528	3,407	16	4,787
1963	45	8,852	14,574	3,476	18	5,724
1964	32	5,972	10,596 (7,720)	2,369	14	4,581 (3,320)
1965	41	9,143	17,211 (14,216)	5,151	23	9,697 (8,004)
1966	35	6,679	10,963 (6,457)	3,082	16	5,059 (2,977)
1967	24	4,661	8,360 (3,628)	2,886	15	5,176 (2,246)
1968	37	6,149	13,617 (6,345)	4,404	26	9,752 (4,543)
1969	46	8,566	17,232 (9,267)	5,941	32	11,950 (6,431)
1970	45	9,320	20,060 (13,711)	5,589	27	12,029 (8,227)
1971	36	7,093	15,780 (8,979)	6,107	31	13,570 (7,722)
1972	37	N.A.	N.A.	N.A.	38	N.A.
1973	39	N.A.	N.A.	N.A.	42	N.A.

<sup>a</sup>Figures in parentheses are pounds of lobster landed in domestic waters per firm. See Table 3.

<sup>b</sup>Figures in parentheses are total value of landings per firm from domestic waters. Computed using average cents per pound, Florida, Table 1.

Source: Compiled from annual issues of [1, 2].

Appendix Table E. Spiny lobster input-output relationships, Florida east and west coasts, 1952-71.

Year	Pounds/Trap		Dollars/Trap		Pounds/Fisherman		Dollars/Fisherman		Pounds/Firm		Dollars/Firm	
	East	West	East	West	East	West	East	West	East	West	East	West
1952	63	213	16	53	6,902	13,475	1,726	3,369	13,660	17,717	3,415	4,429
1953	58	134	11	27	6,264	12,483	1,253	2,497	12,187	15,887	2,437	3,177
1954	65	62	14	14	7,792	6,282	1,714	1,382	14,563	9,896	3,204	2,177
1955	41	93	9	21	7,419	15,793	1,706	3,632	10,373	18,802	2,386	4,324
1956	49	137	14	35	11,922	18,262	3,400	4,712	14,014	32,408	3,997	8,363
1957	44	154	13	42	7,003	16,972	2,152	4,625	12,289	30,957	3,776	8,437
1958	56	100	17	28	6,166	15,861	1,819	4,442	7,595	22,205	2,241	6,218
1959	30	78	10	23	4,414	11,776	1,435	3,474	6,961	14,987	2,262	4,421
1960	38	39	15	15	7,052	8,909	2,750	3,430	13,573	12,674	5,293	4,879
1961	53	54	19	18	6,951	9,866	2,461	3,384	12,764	15,010	4,519	5,143
1962	42	42	16	16	6,112	10,187	2,358	3,889	8,731	14,238	3,368	5,436
1963	40	46	16	18	7,022	9,587	2,822	3,738	13,577	14,896	5,456	5,808
1964	20	39	9	16	3,968	6,940	1,771	2,955	8,449	11,473	3,770	4,885
1965	27	49	15	28	5,561	11,360	3,146	6,392	11,457	20,301	6,481	11,423
1966	22	49	11	22	4,380	8,808	2,104	3,988	7,664	13,672	3,681	6,191
1967	18	30	11	18	3,726	5,507	2,352	3,370	5,096	9,154	3,198	5,601
1968	32	40	23	29	4,943	7,142	3,496	5,152	12,412	14,415	8,780	10,398
1969	43	48	29	34	6,875	10,136	4,537	7,243	17,027	17,360	11,238	12,405
1970	44	46	26	27	7,117	10,790	4,307	6,438	19,469	20,332	11,808	12,131
1971	43	32	37	28	7,000	7,161	6,004	6,182	18,627	14,068	15,978	12,145

Source: Derived from (1).



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