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Indexing the Economic Health of the U.S. Fishing Industry's Harvesting Sector

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PREFACE

A version of this paper was presented originally at the Eighth Annual Seminar of The Center for Oceans Law and Policy, University of Virginia, held at Cancun, Mexico in January 1984. The dual purpose of the paper was to develop a simplified but credible means to gauge the economic health of the U.S. commercial fish harvesting industry and to apply the methodology to a cross section of major U.S. fisheries. With regard to methodology, the authors recognize limitations imposed by availability of data and various technical assumptions that underlie indexing procedures used in the analysis. Nonetheless, they wish to emphasize the critical need for analyses of this sort to guide fisheries policy and fisheries investment decisions and they encourage further attempts to refine both the data and methodology presented in this paper.

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NATIONAL TRENDS IN FISHERIES

The United States traditionally has been among the world leaders in commercial fishing and currently ranks fourth in volume produced behind Japan, the USSR and China. In terms of contribution to the world catch, the U.S. accounts for approximately five percent of the world total, about the same as in 1965 (Figure 1). During the late 1960's and early 1970's the U.S. share dropped below four percent. This was a period when traditional domestic fishing grounds were being exploited by foreign distant water fleets. Since the late 1970's, however, the U.S. share of the total has been increasing (Figure 2).

The fisheries for edible species as well as those used for industrial purposes have shared in the recent growth in the U.S. catch (Figure 3). In 1982 landings totaled 2.9 million metric tons divided approximately equally between edible and industrial species (Appendix Tables A-1 and A-2). The dockside value of landings was $2.4 billion, of which edible species accounted for over 90 percent (Figures 4 and 5).

There has been more than a five fold increase in the value of the U.S. catch since 1965 (Figure 6). Some of this increased value is due to inflation in the national economy and the general rise in all prices. However, the rate of growth in prices received by fishermen has outpaced the increase in the general price level (Figure 7). This growth in the "real" value of fish and shellfish landings reflects a strong U.S. consumer demand for fish products and, in some cases, a decrease in the market quantities available.

Per capita consumption of commercially marketed fish products in the U.S. has remained between 5.5 and 6.0 kilograms during the past decade, up slightly over the 1965 level of 4.9 kilograms (Figure 8). This reflects an increase in per capita consumption of fresh and frozen products such as fillets, steaks, sticks and portions and certain shellfish such as shrimp. These product forms are popular in the institutional (restaurants, etc.) markets where high prices are less of an inhibiting influence on consumption. Currently, over half of U.S. fish consumption takes place away from home.[1]

Periodic declines in the market availability of certain species such as king crab, scallops and surf clams have resulted in rapidly escalating prices for products from these species. This, along with the strong consumer demand for fresh and frozen fish products is reflected in a rate of increase in the price of fish well above that for meat and poultry. The average price of fish and shellfish was up about 300 percent between

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1. Demand for raw fish at the dock is derived from consumer demand, and the relative strength of demand for fresh and frozen products is reflected in exvessel price differentials. Tuna, for example, is processed almost exclusively as a canned product, and exvessel tuna prices show a 332% increase between 1965 and 1982. During the same period the average dockside price of shrimp, which is distributed mostly in the fresh and frozen form, increased 458%.

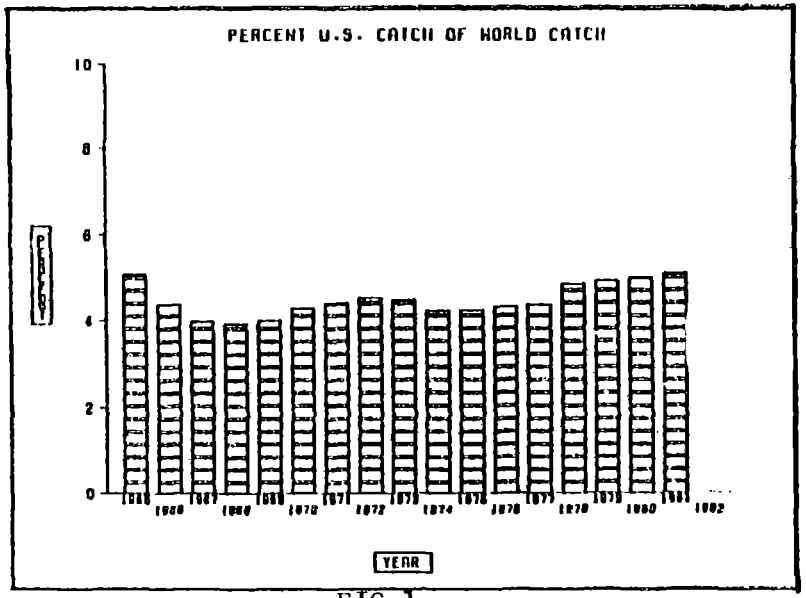
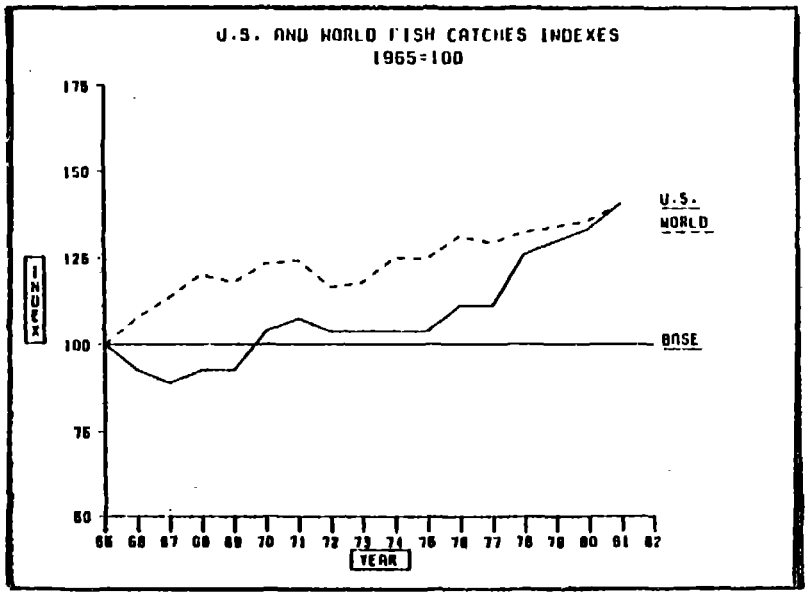


FIG. 1



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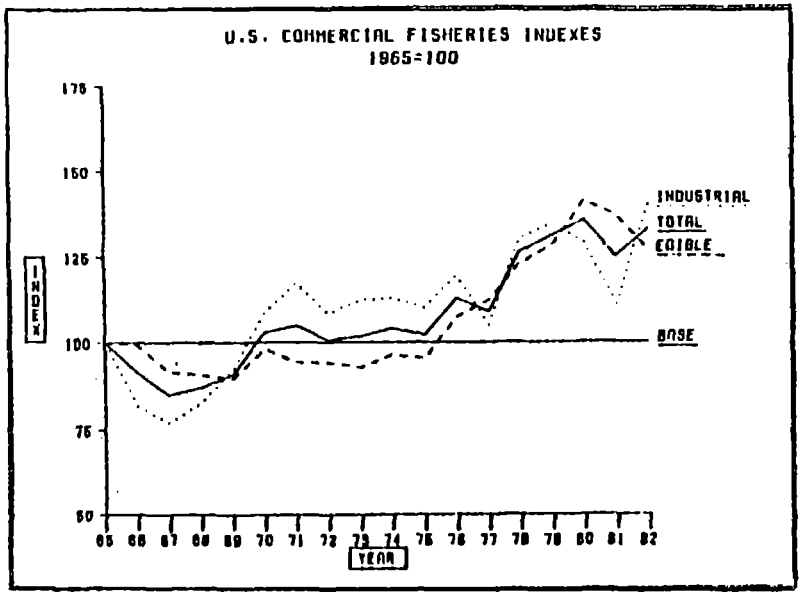

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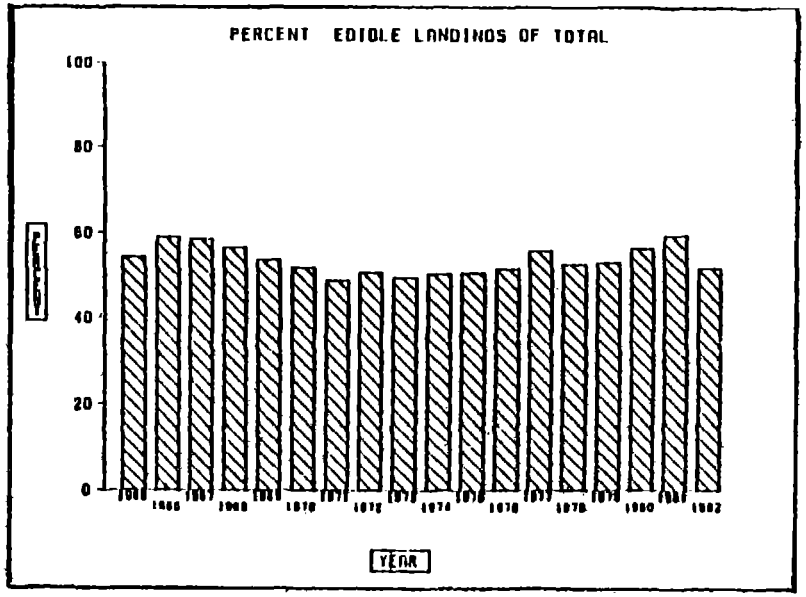

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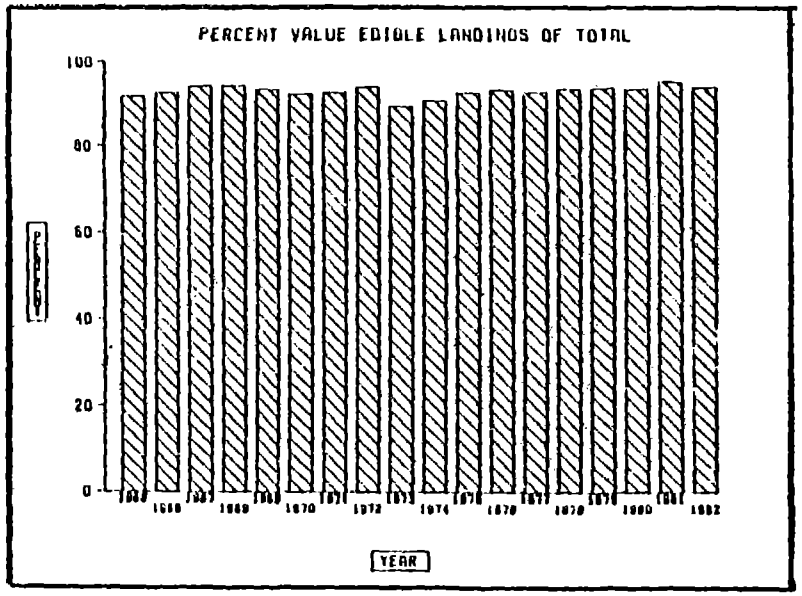

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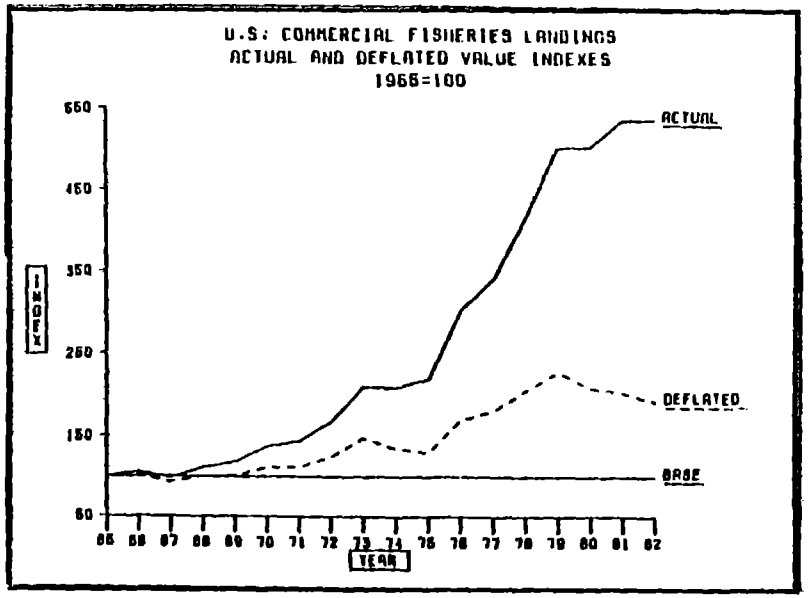
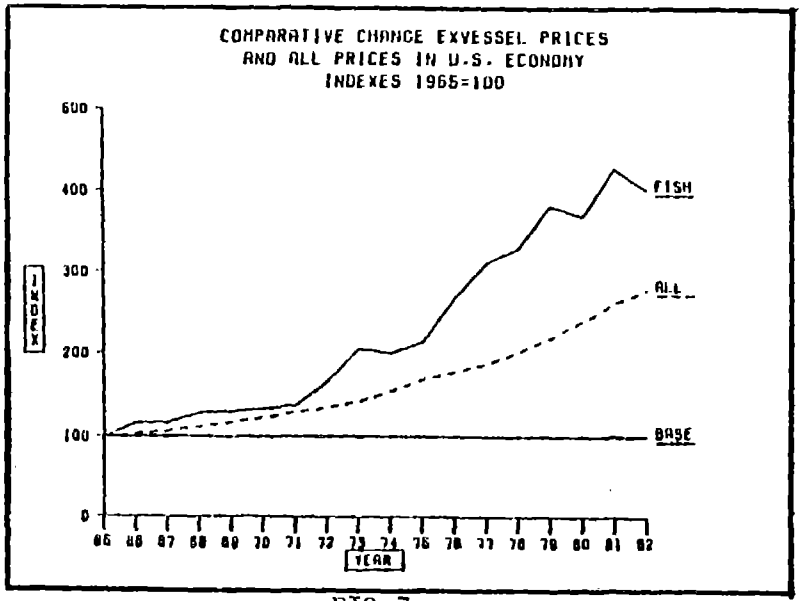


FIG.6



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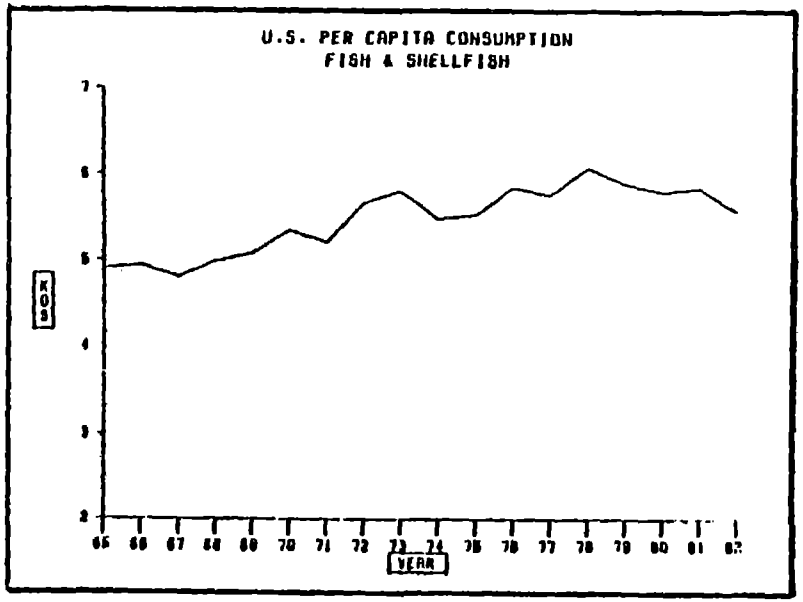

FIG.8

1965 and 1982. During the same period beef and veal prices increased by almost 200 percent, and poultry prices advanced by less than 100 percent (Figure 9). Considering these relative price changes, it is not surprising that the per capita consumption of fish has increased only slightly while the growth in poultry consumption has been considerable.

The relatively small increase in per capita consumption of fish, however, when combined with the population growth that has taken place in the U.S. during the past two decades, has resulted in a significant increase in total consumption. Because domestic landings have not kept pace with consumption, the U.S. is a leading importer of fish products, outranked in this respect only by Japan. U.S. landings of edible species, for example, accounted for only 41 percent of total edible supplies in 1982 (Figure 10 and Appendix Table A-3). This is below the domestic industry's share of the market in 1965. U.S. producers of industrial species fare somewhat better with 76 percent of the market, or about double their 1965 share (Figure 11). The rise in the domestic industrial fish share occurred as a result of the sharp drop in U.S. imports of fish meal following the failure of the Peruvian anchovy fishery in the early 1970's. Overall, 53 percent of U.S. fishery product supplies by volume are from domestic landings, and 47 percent are from imports (Appendix Table A-4).

The U.S. exports a portion of its fishery production, but the volume of exports remains well below imports. There has been a growing deficit in the U.S. balance of trade in fishery products. In 1982, imports of fishery products were valued at $4.5 billion and exports at $1.1 billion, for a trade deficit of about $3.4 billion. The deficit in 1965 was approximately $0.5 billion (Figure 12 and Appendix Table A-5). It should be noted that a portion of the imports is made up of jewelry. This contributes to the trade deficit.

THE CONCEPTUAL FRAMEWORK

Changes in landings, value, prices and consumption as discussed above are useful indicators of the general status of the commercial fishing industry in terms of overall relative growth. However, these changes do not necessarily give insight into the economic health of the industry which is determined by both costs and revenue. If appropriate data were available industry health could be expressed as net profit or through other measures such as rate of return on investment. Cost information is essential because it is possible to have a declining net profit even if total revenue and landings increase over a period. This could occur if costs increase at a faster rate than revenue. Similarly, if revenue and landings in a fishery were declining, net profit could be increasing if costs were declining faster than revenue.

For this reason, it is useful to have indicators that reflect the changes in revenue over time relative to changes in cost. Conclusions regarding trends in industry health can be drawn from detailed profit and loss statements for firms in a fishery. There are, however, certain problems associated with accounting profit and loss statements (P-LS). A major consideration is that such statements are generally not available

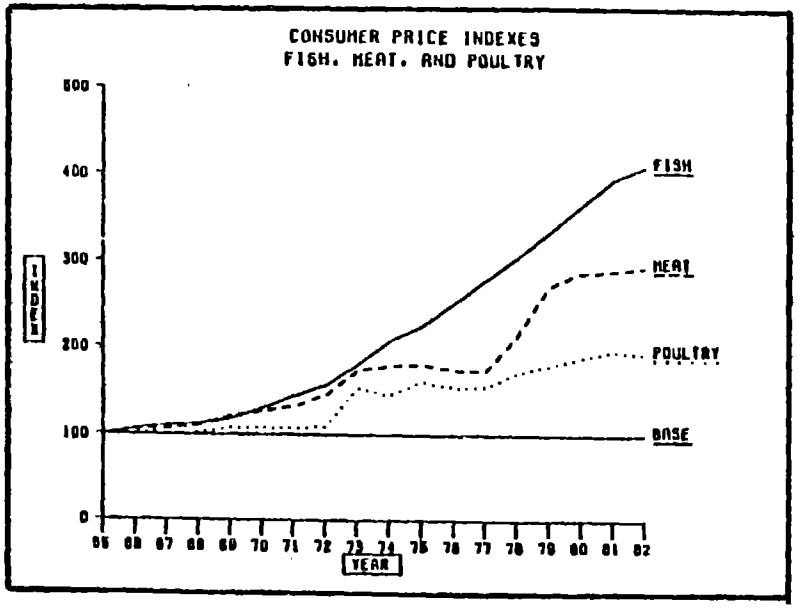

FIG.9

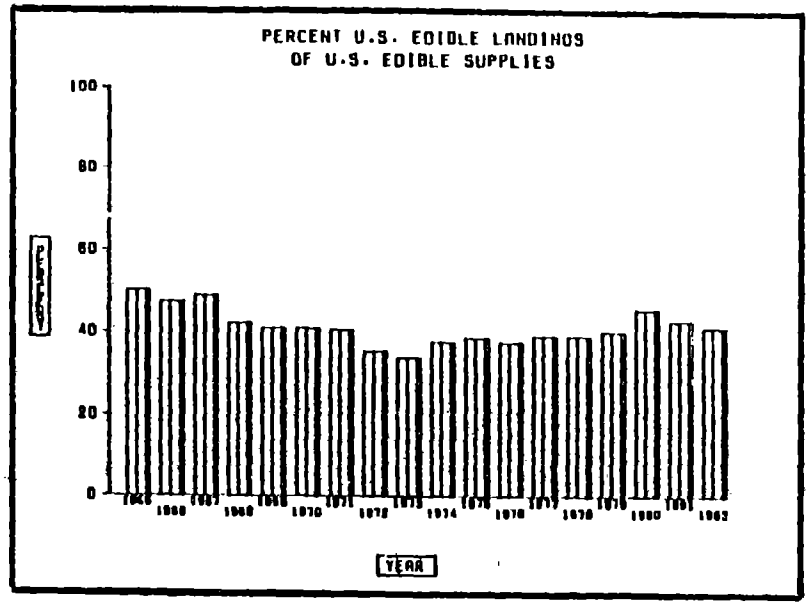

FIG.10

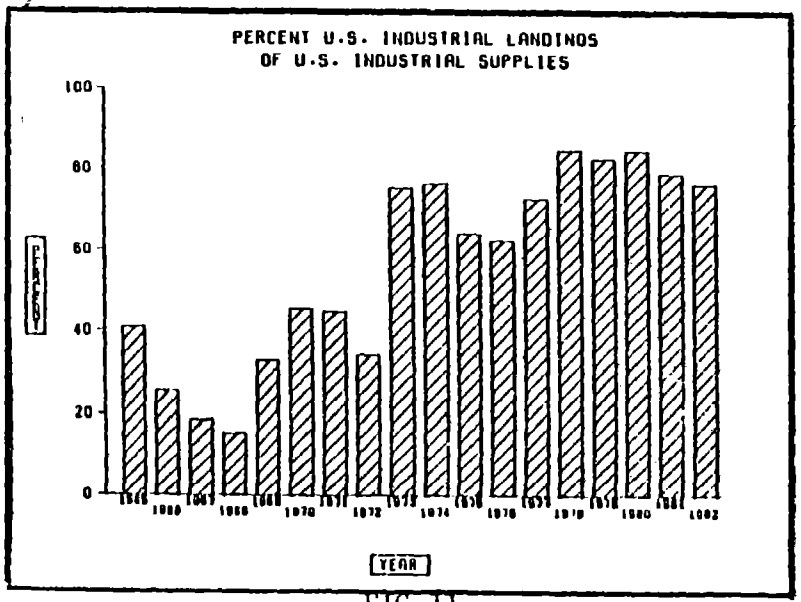

FIG.11

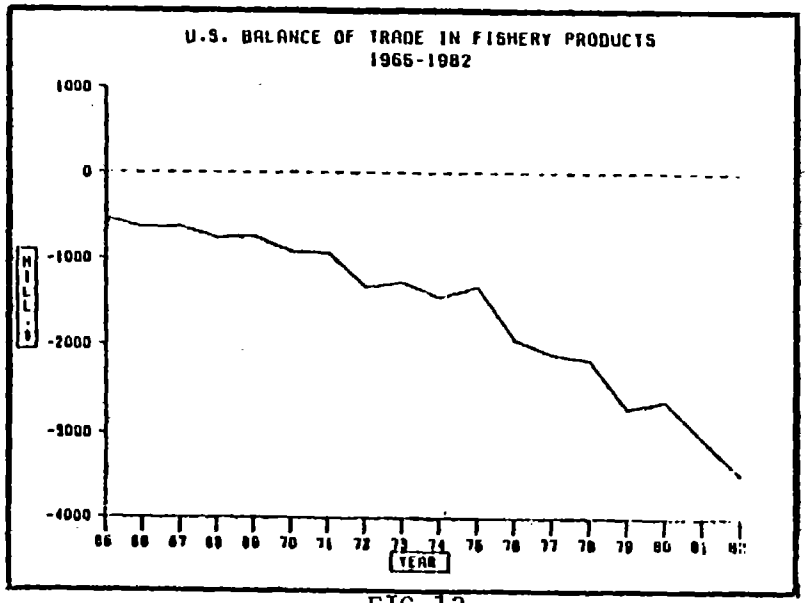

FIG.12

for most fisheries. During the period 1964-1972 a number of cost and earnings analyses were conducted by economists with the Bureau of Commercial Fisheries and NMFS. This work was not continued and efforts since then have been of an ad-hoc nature and not appropriate for examining changes over time.

Even if P-LS were available, care is required in interpreting the results. For example, "lay" systems (arrangements for dividing costs and revenues among vessel owners and crews) in some fisheries have been altered during the past decade due to the changing nature of the fishery or in response to input price changes. Under these circumstances, returns to owners may not reflect the actual conditions in the fishery. That is, a crew could be absorbing more of the costs with a resultant decrease in net crew share while the returns to the owner remain constant. Thus, the P-LS of the owner would not reflect the overall health of the industry.[2] Also, P-LS may be misleading when comparing across firms or over time because of different accounting procedures. For firms that are vertically integrated, it is difficult to allocate costs to particular levels of their operations, and firms may allocate these costs differently.

Therefore, while P-LS are helpful in evaluating the effects of certain management or regulatory actions, they may not always give a complete picture of what is occurring relative to the long term economic health of the industry. For this reason, the authors developed a set of indexes for examining relative changes in industry costs and revenues over time. These indexes can be used to supplement information from P-LS if they are available and, in the absence of P-LS, can provide an indication of industry economic health relative to a given base period.

The indexes developed for this paper are based on the principal that the profit or loss situation of a firm or set of firms is dependent on three components of the business operation. These components are:

1. Price of the output (ex-vessel price);
2. Price of inputs (cost of fuel, repairs, etc.); and
3. Productivity of inputs (catch per day at sea, catch per trap lift, etc.).

Changes in any or all of these components will be reflected by a shift in net profit or loss of the firms involved in a fishery. For example, if in a particular fishery over a period of years input prices and catch per day at sea remained constant but ex-vessel price (output price) increased, the firms' financial situation at the end of the time period would be improved relative to that at the beginning of the time period.

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2. If, for example, one would examine the owner's P-LS for certain airlines or automobile manufacturers, the "bottom line" of these statements would not directly reflect the fact that workers in these firms have given up benefits or even taken wage cuts. Thus, a P-LS for such firms would underestimate the actual decline in overall industry health.

However, if ex-vessel price and catch per day at sea remained the same but fuel and repair costs (input prices) increased, the firms' economic health would deteriorate during the period. Similarly, if input and output prices remained constant but productivity (catch per day at sea) diminished, the financial status of the firm would decline.

In preparing this paper, five basic indexes were established. These are designed to reflect the following:

1. Changes in per unit output price;
2. Changes in input prices;
3. Changes in productivity;
4. How (2) and (3) combine to determine changes in cost per unit of output; and
5. How (1)and (4) combine to determine the change in the economic health of the firms in the industry.

Output Price Index

The Output Price Index is given by:

$$I_{R_{ti}} = OP_{ti}/OP_{oi} \quad ; \qquad (1)$$

Where,

$I_{R_{ti}}$ is the output price or per unit revenue index for species i in year t,

OP_{ti} is output price for species i in year t, and

OP_{oi} is output price for species i in the base year.

Input Cost Index

The aggregated Input Cost Index is calculated by appropriately weighting the cost indexes of the factors of production. That is:

$$I_{C_{ti}} = \sum_{j} K_{ji} I_{C_{jt}} \quad ; \qquad (2)$$

Where,

$I_{C_{ti}}$ is the aggregated cost index in year t for firms harvesting species i,

K_{ji} is the proportion of total costs of harvesting species i contributed by input j, and

$I_{C_{jt}}$ is the index of input costs for input j in year t and is calculated as

$$I_{C_{jt}} = C_{jt}/C_{jo} .$$

Here, C_{jt} and C_{jo} are respectively the prices paid per unit of input in year t and year o, the base year.

Thus, $I_{C_{ti}} = \sum_j K_{ji}(C_{jt}/C_{jo}) = C_{ti}/C_{oi}$;

Where,

C_{ti} and C_{oi} are the aggregated cost per unit of effort for species i in year t and the base year.

Productivity Index

The Productivity Index is designed to reflect the relative changes in output per unit of input over the time period considered. In words, the Productivity Index is an index of catch per unit of effort in the fishery and is calculated as:[3]

$$I_{P_{ti}} = (L_{ti}/E_{ti})/(L_{oi}/E_{oi}) \quad ; \tag{3}$$

Where,

$I_{P_{ti}}$ is the Productivity Index for species i in year t,

L_{ti} and L_{oi} are landing in year t and year o of species i, and

E_{ti} and E_{oi} are the amount of effort on species i in year t and year o.

Unit Output Cost Index

For an individual vessel, the change in cost per unit landed (Unit Output Cost) of a particular species i over the time period from the base year o, to the year t is represented as:

$$I_{CU_{ti}} = I_{C_{ti}}/I_{P_{ti}} \quad ; \tag{4}$$

Where,

$I_{CU_{ti}}$ is the Per Unit Cost Index of a species i in year t, and $I_{C_{ti}}$ and $I_{P_{ti}}$ are as defined above.

The logic of the index $I_{CU_{ti}}$ can be seen through the derivation of this index. That is,

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3. The authors recognize the difficulty in measuring fishing effort and therefore catch per unit of effort. Measures used for this study were selected from available data and involve the assumption that changes in effort will be accompanied by changes in costs. It should be noted that the effort measures used herein are not necessarily those measures preferred by fishery biologists for modeling and analyzing fisheries population dynamics and stock assessments.

$$I_{CU_{ti}} = (C_{ti}/C_{oi}/[(L_{ti}/E_{ti})/(L_{oi}/E_{oi})] \quad (4a)$$

This can be rewritten as

$$I_{CU_{ti}} = (C_{ti}/C_{oi})/[(E_{oi}/L_{oi})(L_{ti}/E_{ti})] \quad (4b)$$

or $$I_{CU_{ti}} = (C_{ti}/C_{oi})(L_{oi}/L_{ti})(E_{ti}/E_{oi}) \quad (4c)$$

Equation (4c) shows that for species i:

1. If effort and landings remain the same in year t as in the base year but input costs in year t are higher that in year o (the base year), cost per unit of output will be higher in year t than in the base year.

2. If input cost and landings remain the same in year t as in the base year but effort in year t increases relative to that in year o, the cost per unit of output in year t will increase relative to cost per unit of output in the base year.

3. If input cost and effort in year t are the same as in the base year but landings in year t are higher than in year o, the cost per unit of fish landed will decrease.

An alternative way of examining the Unit Output Cost Index is by rewriting equation (4a) as:

$$I_{CU_{ti}} = (C_{ti}E_{ti}/L_{ti})/(C_{oi}E_{oi}/L_{oi}) \; . \quad (4d)$$

Since C_{ti} is cost per unit of effort on species i and E_{ti} is the total effort on species i, $(C_{ti} E_{ti})$ = total cost of harvesting species i in year t. Dividing $(C_{ti} E_{ti})$ by L_{ti}, where L_{ti} is, for example, pounds of species i landed in year t, gives the cost per pound landed of species i in year t. The right hand side of equation (4d) then, is simply the ratio of cost per pound landed in year t to cost per pound landed in the base year.

Industry Health Index

The Industry Health Index is designed to identify for a given year the ratio of per unit output prices and costs as compared to the ratio of these measures in the base year. It is calculated as:

$$I_{H_{ti}} = I_{R_{ti}} / I_{CU_{ti}} \; , \quad (5)$$

where the right hand terms are those defined in equation (1) and equation (4).

Examination of the various components of equations (1), (2), (3) and (4) shows that equation (5) can be rewritten as:

$$I_{H_{ti}} = (OP_{ti}/OP_{oi})(C_{oi}/C_{ti})(E_{oi}/E_{ti})(L_{ti}/L_{oi}) \quad (5a)$$

The logic of the Industry Health Index as an expression of how the profit or loss situation for firms in that industry may have changed in year t relative to the situation in the base year can be seen by examining equation (5a). Insight is provided by observing which right hand elements are in the numerator and which are in the denominator. If output price, input cost, effort and landings in year t are each the same as in year o, the fractions on the right hand side equal one and the value of I_{Hti} is 1.0. This would indicate that the industry is in the same profit or loss situation in year t as it was in year o.

Other interpretations are:

1. If input cost, effort and landings in year t are the same as in the base year and output price in year t is greater than in the base year, equation (5a) indicates that (because OP_{ti} is in the numerator) the Health Index would be greater than 1.0. That is, the industry profit or loss situation is improved in year t relative to that in the base year;
2. If output price, effort and landings in year t are the same as in the base year but input costs are greater in year t than in the base year, the Health Index will be less than 1.0 (because C_{ti} is in the denominator). This would indicate that the industry profit or loss condition is less favorable than in the base year;
3. If output price, input cost and landings in year t are the same as in year o, and effort in year t is greater than in the base year, the Health Index will be less than 1.0 and the profit or loss situation will be less favorable than in the base year; and
4. If output price, input price and effort in year t are the same as in the base year and landings in year t are larger than in the base year, the Health Index will be greater than 1.0 and the industry profit or loss picture will be improved over the base year situation.

There are two key points that must be kept in mind in using this Health Index. The first is that the value of the Health Index in any given year t does not directly show whether or not the firms in the industry are making a profit in year t. For example, assume that the Health Index is 1.2. This implies only that the industry is doing better than it did in the base year. Thus, if the firms in the industry were just breaking even in year o, a Health Index of 1.2 for year t would mean the industry has moved to a profit making situation. However, if the firms in the industry were generally operating at a loss in the base year, a Health Index of 1.2 could indicate:

a. the firms are earning a profit in year t;
b. the firms are just breaking even in year t; or
c. the firms are continuing to operate at a loss in year t -- albeit not as great as the loss in the base year.

Likewise, if $I_{Hti} < 1.0$, it does not necessarily follow that the firms are operating at a loss, merely that they are not doing as well as in the base year. If they were making a profit in the base year, a Health Index value of less than one in year t could mean they are making less profit in year t -- or they are breaking even, or -- they have moved into a loss situation. The possible situations in year t given alternative financial standings in the base year and alternative values for the Health Index are summarized in Table 1.

The second point relative to interpretation of the Health Index is that the absolute value of the index in any year t will be affected by the choice of the base year. This is a common problem of any index designed for comparisons over time. For that reason, the primary use of the Health Index over the period of time under consideration should be to evaluate tendencies or general trends. For example, if $I_{Hti} > I_{Ht+1,i}$, the choice of any other base year will result in the relationship between the Health Indices for years t and t+1 continuing to be $I_{Hti} > I_{Ht+1,i}$. The difference between I_{Hti} and $I_{Ht+1,i}$ will vary as alternative base years are selected. However, the selection of alternative base years will not change the direction of the inequality. This point also means that absolute values of the Health Index should not be used to directly compare across fisheries for a given year.

EMPIRICAL DATA

In the time available for the preparation of this paper, it was not possible to assemble the data required to analyze the economic health of all U.S. fisheries. The authors therefore attempted to obtain the necessary information for evaluating a cross section of some of the major fisheries. The analyses contained in this paper cover the following species or categories of species: sea scallops landed in New England by the scallop dredge fleet; New England groundfish (cod, haddock, red and white hake, whiting, redfish, and flounders caught by otter trawl on vessels over five gross registered tons; Northern lobster landed in Maine; West Coast tuna (excluding albacore); Gulf of Mexico shrimp; Gulf of Mexico menhaden; surf clams, and Alaskan king and tanner crab. These eight fisheries account for almost one half of the value of U.S. landings (Table 2). The most important species in terms of value excluded from the analysis is salmon which makes up about one fifth of the total U.S. landings value. Salmon is excluded because the authors were unable, in the time available, to obtain appropriate data on this fishery.

The Base Year

The selection of the period of time covered in the analysis was, as is the case with most indexing analyses, somewhat arbitrary. The primary criterion was to select a period of time for analysis covering as many years as possible while at the same time having available data for all fisheries to be covered. This required data on quantity and value of landings and fishing effort. It is, of course, the latter factor that is most limiting and the authors recognize the complex and difficult considerations involved in developing a measure of fishing effort. In

TABLE 1 POSSIBLE FINANCIAL SITUATIONS IN YEAR t UNDER ALTERNATIVE ASSUMED BASE YEAR FINANCIAL STANDINGS AND HEALTH INDEX VALUES

Financial Standing in Base Year	Health Index in Year t	Is it Possible for the Firms in the Industry in Year t To Be Operating at:		
		Profit	Breakeven	Loss
Profit	Less than 1.0	yes	yes	yes
Break even		no	no	yes
Loss		no	no	yes
Profit	Equal to 1.0	yes	no	no
Break even		no	yes	no
Loss		no	no	yes
Profit	Greater than 1.0	yes	no	no
Break even		yes	no	no
Loss		yes	yes	yes

TABLE 2 COMPARATIVE LANDINGS VALUE OF FISHERIES ANALYZED IN HARVESTING SECTOR HEALTH STUDY

Fishery	Value of Landings		Percent of Total	
	1981	1982	1981	1982
	Million Dollars		Percent	
New England otter trawl	129.0	151.2	5.4	6.3
New England scallop dredge	71.0	55.6	3.0	2.3
Maine lobster	44.4	47.3	1.9	2.0
Gulf shrimp	401.4	425.7	16.8	17.8
Gulf menhaden	47.7	72.7	2.0	3.0
Tuna (excl. albacore)	179.4	135.2	7.5	5.7
King & tanner crab	205.6	186.2	8.6	7.8
Surf clam	23.5	26.0	1.0	1.1
Sub-total	1102.0	1099.9	46.2	46.0
All Species	2387.7	2390.0	100.0	100.0

considering these limitations, the authors selected for analysis the period 1965 through 1982.

Output Price Index

The calculation of the Output Price Index for each species was relatively straight forward. Total dollar value of landings for each fishery for each year was divided by total landings (metric tons) for that year. This gave a weighted average annual price per metric ton for each fishery. The 1965 price was then divided into the price for each of the years in the period of analysis and the result multiplied by 100. Thus, the Output Price Index for each species was established with a base year (1965) value of 100 and each other year's price was calculated as a percent of the base year price.

Input Cost Index

The components of cost for any firm can be classified as either variable or fixed. Variable costs are those that change with output. In fishing, these are likely to be costs associated with fishing time such as days at sea. These would include expenditures for labor, food, fuel, engine repairs, etc. Fixed costs are those that do not change with output and include items such as hull insurance, interest on loans, rental on dock space, interest on investment and depreciation.

In examining the change in costs during the period of analysis the authors determined that the rate of increase for all costs except fuel, labor and interest rates could be represented by the Bureau of Labor Statistics' Index of Producers Prices for Industrial Commodities. The change in interest rate paid by fishermen was considered to be best represented by the Index of the Prime Rate for Short Term Business Loans. (Although short term rates are higher than long term rates, they both increased at approximately the same rate during the period of analysis.) Fuel price changes were represented by the Index of Producers Prices for Petroleum Products.

The wage rate for fishermen was somewhat more complicated. Over the long run, it would be expected that crewmen be paid their opportunity cost (what they could earn in their best employment alternative) as represented, for example, by the wage rate in manufacturing. However, in fisheries since 1965, two factors may have prevented wages from increasing as fast as the manufacturing wage rate. These factors are:

1. Fishermen in most fisheries are paid on a "lay" or share system. In many fisheries the catch rate has declined over time and this could represent downward pressure on fishermen wages earned per unit of time; and

2. In several fisheries all or part of the fuel costs are deducted from the crew share. The rapidly increasing fuel costs since 1973 have probably diminished net crew share.

These negative effects on fishermen earnings have in some cases been partially offset by decreases in number of crewmen per vessel. However, in the opinion of the authors, fishermen net earnings have not increased as rapidly as manufacturing wages since 1965. Because of the authors' judgment that the change in manufacturing wages would overestimate fishermen earnings, the Index of Producer Prices for Industrial Commodities (which increased at a slightly slower rate than the Index of Hourly Manufacturing Wages) was selected to represent the rate of increase in fishermen earnings.

Thus, the separate cost components and the index selected to represent the change in price of that component over the period 1965-1982 are:

Fuel - Index of Producers Prices for Processed Petroleum Products;

Interest - Index of Prime Rate Charged for Short Term Business Loans; and

Repairs, wages, capital and other costs - Index of Producers Prices for Industrial Commodities.

In order to calculate an appropriate aggregated input cost index, it was necessary to determine the proportion of total costs represented by each of the above cost components for each fishery. Information from cost and earnings studies made during the late 1960's and early 1970's formed the basis for this cost allocation. It was determined that during the base year for the surf clam, groundfish, scallop, lobster and king and tanner crab fisheries the breakdown would be: fuel, 10 percent; interest, 10 percent; and other costs, 80 percent.

For the shrimp fishery for 1965 the allocation was: fuel, 15 percent; interest, 10 percent; and other costs, 75 percent.

The breakdown for the tuna fleet in 1965 was: fuel, 12 percent; interest, 10 percent; and other costs, 78 percent.

For menhaden the cost allocation among the three categories was: fuel, 7 percent; interest, 10 percent; and other costs, 83 percent.

Although the above allocations were specified for 1965, the different rate of change in the three cost categories resulted, by 1982, in a significantly different allocation of costs. For example, in the groundfish fleet fuel made up 10 percent of the 1965 cost but 19.0 percent of the 1982 costs. The change in allocation was even more striking for the shrimp fleet where in 1965, 15 percent of the costs were for fuel while in 1982 this had increased to 27.1 percent. The pattern of this change was similar for all fisheries considered in this paper.

Productivity Index

The measure of fishing effort used in this study differs by fishery. Data availability constraints and variations in fishing operations across fisheries make it impossible and in some cases undesirable to construct a uniform effort measure. The aim in this analysis was to use measures that are reasonably associated with parallel changes in the use of inputs.

Given below is the measure of fishing effort used to calculate catch per unit of effort or productivity for each fishery. The productivity was calculated for each fishery for each year during the period 1965-1982. The result for 1965 was then divided into the result for each other year and multiplied by 100. Thus, the index for each year for each fishery is expressed as a percent of the 1965 catch per unit of effort in that fishery.

The effort measures used and sources of information are:

Scallops	Scallop dredge vessel days at sea (NMFS);
Groundfish	Otter trawl vessel days at sea (NMFS);
Lobster	Number of trap hauls (Maine Dept. of Marine Resources);
Menhaden	Vessel ton weeks (The sum, over all weeks, of registered net tonnage of vessels that landed menhaden at least once during the week.) (NMFS);
Surf clams	Weighted effort index of three size classes of vessels. (Class I, less than 50 GRT; Class II, 51 to 100 GRT; Class III, greater than 100 GRT.) (The weights are: Class I, 1; Class II, 1.47; Class III, 4.71.) (Mid-Atlantic Regional Fisheries Management Council);
King crab	Ton trips (Average GRT times number of trips) (NMFS);
Shrimp	Ton trips (Average GRT times number of trips) (NMFS); and
Tuna	Total carrying capacity of vessels (IATTC Annual Reports).

RESULTS OF EMPIRICAL ANALYSIS

Scallops

There has been a significant change in landings by the scallop dredge fleet in New England since 1965. Landings in 1982, at 51,000 metric tons (MT) were slightly higher than in 1965 but four times higher than in the early 1970's (Table 3). The value of landings in 1982 was nearly 600 percent above the 1965 level. Even deflated value more than doubled (Figure 13). Since the mid 1970's there has been an expansion in number of scallop vessels and days at sea for the fleet. Vessel numbers have almost tripled while days at sea have slightly more than doubled (Table 3). This means that the average days at sea per vessel has declined in recent years.[4] Although days at sea more than doubled during the period, landings in 1982 were only 10 percent higher than in 1965.

The result of the changes in landings and in vessel days at sea is that landings per unit of effort have diminished especially since 1978 (Figure 14). This recent decline in landings per day absent appears to be following a pattern similar to what occurred in the late 1960's. The drop in that period was attributed to a decline in abundance of sea scallops on George's Bank and the Middle Atlantic grounds. The recovery of the catch rate in the mid 1970's was due to increased fishing activity in the Middle Atlantic grounds off New Jersey where the fishing season was extended from six to ten months.

Ex-vessel prices for scallops were up substantially during the 1965-82 period, despite downward pressures on prices from an active Canadian fishery and relatively large quantities of scallops imported from Canada.

The Health Index given in Table 4 and Figure 15 indicates that cost-price relationships in the scallop fleet have been relatively favorable as compared to the 1965 situation. In 11 of the 18 years during the 1965-82 period, the Health Index was greater than 1.0. The fleet did especially well during the years 1976-1978. A primary reason for the improvement was a substantial increase in catch per day at sea. This increase in catch per unit of effort helped to offset the rapid rise in input costs. This can be seen more clearly in Figure 16 where the Unit Output Cost Index is shown to be below the Input Cost Index for those three years. It was only in recent years (since 1979) when the catch rate again began to decline that the Unit Output Cost Index increased substantially. The combination of a rapid increase in input costs and the declining catch rate moved the Unit Output Cost Index near, and in 1982 above the Output Price Index, indicating that for the first time since 1971 the industry was not doing as well as it did in 1965.

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4. Many of the vessels are capable of facilitating other gear. Some vessel owners may have exercized this option to a greater extent in recent years. This could result in a decrease of days at sea for scallops but not necessarily in total days at sea.

TABLE 3 NEW ENGLAND SCALLOP DREDGE: VESSELS, EFFORT, LANDINGS, AND VALUE OF LANDINGS

1965-1982

1) VSL_SD NUMBER OF VESSELS, NEW ENG. SCALLOP DREDGE
2) EFRT_SD VESSEL DAYS ABSENT, NEW ENG. SCALLOP DREDGE
3) LAN_SD LANDINGS, NEW ENG. SCALLOP DREDGE (THOUS. METRIC TONS LIVE WT.)
4) VAL_SD VALUE OF LANDINGS, NEW ENG. SCALLOP DREDGE ($MILLION)
5) VALD_SD DEFLATED VALUE OF NEW ENG. SCALLOP DREDGE LANDINGS (MILLION 1965 DOLLARS)
6) LAN_SD_X LANDINGS INDEX, NEW ENG. SCALLOP DREDGE, 1965=100
7) VAL_SD_X VALUE OF LANDINGS INDEX, NEW ENG. SCALLOP DREDGE, 1965=100
8) VALD_SD_X DEFLATED VALUE OF LANDINGS INDEX, NEW ENG. SCALLOP DREDGE, 1965=100

Date	VSL_SD	EFRT_SD	LAN_SD	VAL_SD	VALD_SD	LAN_SD_X	VAL_SD_X	VALD_SD_X
1965	60.00	8200.00	45.90	8.23	8.19	100.00	100.00	100.00
1966	49.00	7100.00	41.40	5.40	5.20	90.20	65.61	63.56
1967	42.00	5900.00	25.90	5.30	4.96	56.43	64.39	60.57
1968	69.00	7500.00	29.20	8.64	7.75	63.62	105.06	94.65
1969	60.00	6300.00	18.60	5.44	4.63	40.52	66.08	56.50
1970	45.00	5000.00	16.00	5.76	4.66	34.86	69.99	56.91
1971	44.00	4600.00	14.80	5.79	4.46	32.24	70.36	54.50
1972	43.00	4700.00	12.90	6.86	5.07	28.10	83.36	61.98
1973	44.00	3800.00	11.80	5.55	3.88	25.71	67.46	47.43
1974	32.00	3500.00	15.60	6.42	4.13	33.99	78.08	50.45
1975	43.00	4100.00	20.20	10.11	5.95	44.01	122.95	72.68
1976	84.00	6400.00	38.90	19.21	10.74	84.75	233.52	131.21
1977	154.00	9300.00	58.90	25.78	13.62	128.32	313.41	166.41
1978	133.00	9900.00	60.10	40.59	19.97	130.94	493.40	243.91
1979	199.00	13000.00	57.10	51.51	23.33	124.40	626.22	284.95
1980	266.00	18200.00	58.20	59.04	24.46	126.80	717.68	298.74
1981	258.00	19700.00	67.20	71.02	26.88	146.41	863.41	328.39
1982	175.00	17800.00	50.80	55.61	19.88	110.68	676.00	242.84

TABLE 4 NEW ENGLAND SCALLOP DREDGE: INDEXES OF EFFORT, PRODUCTIVITY, PRICES, COSTS, AND HARVESTING SECTOR HEALTH, 1965-1982

1) EFRT_SD_X VESSEL DAYS ABSENT INDEX, NEW ENG. SCALLOP DREDGE, 1965=100
2) CPUE_SD_X LANDINGS PER DAY ABSENT INDEX, NEW ENG. SCALLOP DREDGE, 1965=100
3) ICST_SD_X INPUT PRICES INDEX, NEW ENG. SCALLOP DREDGE, 1965=100
4) OCST_SD_X OUTPUT COST INDEX(COST/UNIT OF LNDGS.),NEW ENG. SCALLOP DREDGE, 1965=100
5) PRI_SD_X EXVESSEL PRICE INDEX, NEW ENG. SCALLOP DREDGE, 1965=100
6) HLTX_SD N.E. SCALLOP DREDGE HARVESTING SECTOR HEALTH INDEX (PRICE/COST RATIO), BASE 1965=1.0

Date	EFRT_SD_X	CPUE_SD_X	ICST_SD_X	OCST_SD_X	PRI_SD_X	HLTX_SD
1965	100.00	100.00	100.00	100.00	100.00	1.00
1966	86.59	104.16	104.20	100.03	72.74	0.73
1967	71.95	78.43	105.90	135.03	114.12	0.85
1968	91.46	69.56	109.50	157.41	165.14	1.05
1969	76.83	52.76	115.60	219.10	163.07	0.74
1970	60.98	57.18	119.40	208.80	200.77	0.96
1971	56.10	57.49	118.80	206.63	218.21	1.06
1972	57.32	49.05	121.40	247.49	296.59	1.20
1973	46.34	55.49	135.20	243.64	262.39	1.08
1974	42.68	79.63	166.60	209.21	229.73	1.10
1975	50.00	88.02	177.20	201.32	279.37	1.39
1976	78.05	108.58	184.80	170.20	275.53	1.62
1977	113.41	113.14	196.00	173.24	244.23	1.41
1978	120.73	108.45	214.30	197.61	376.81	1.91
1979	158.54	78.47	246.10	313.61	503.38	1.61
1980	221.95	57.14	287.60	503.29	565.99	1.12
1981	240.24	60.95	321.90	528.11	589.72	1.12
1982	217.07	51.04	319.80	626.57	611.24	0.98

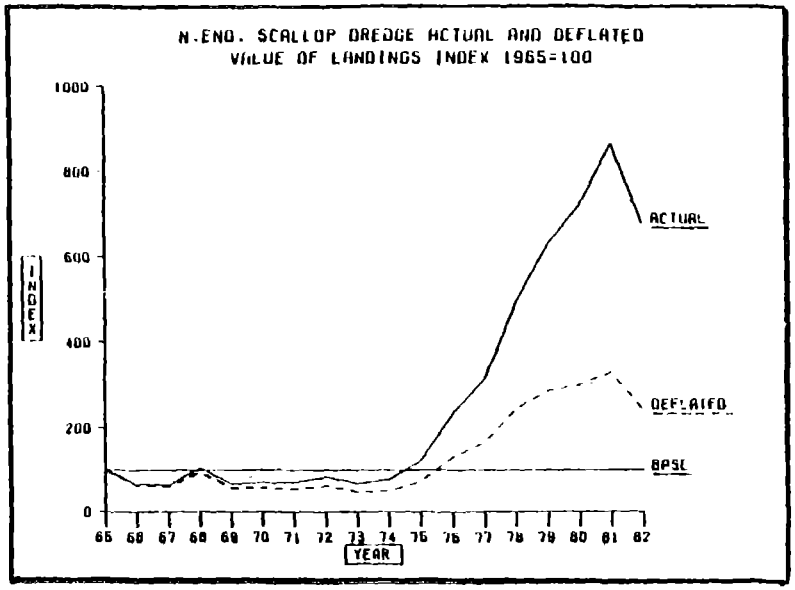

FIG.13

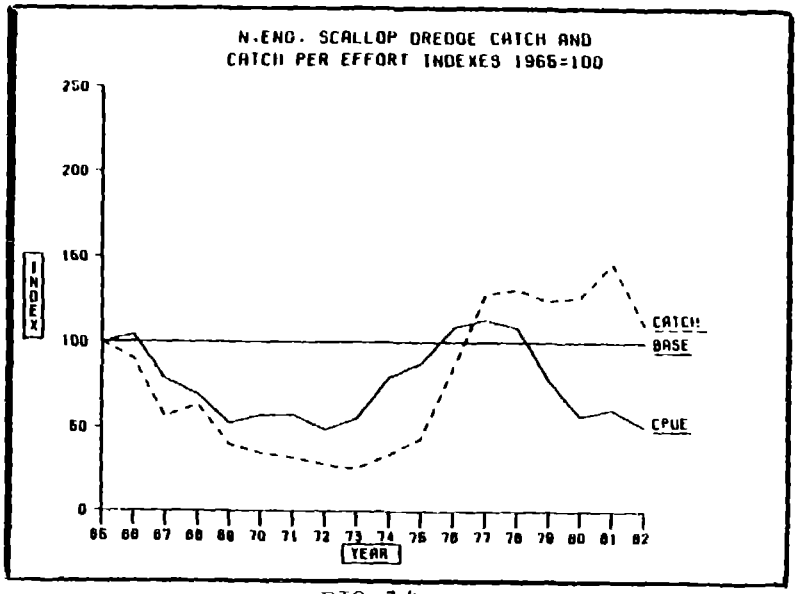

FIG.14

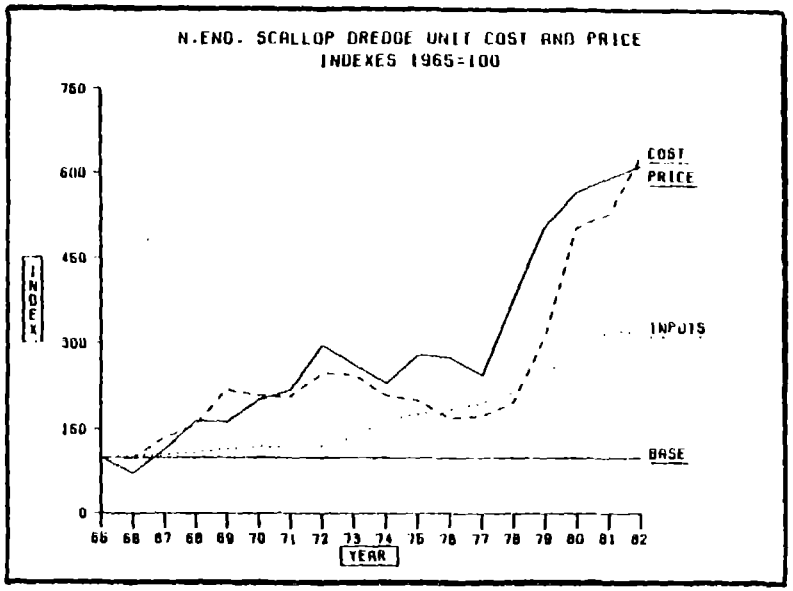

FIG.15

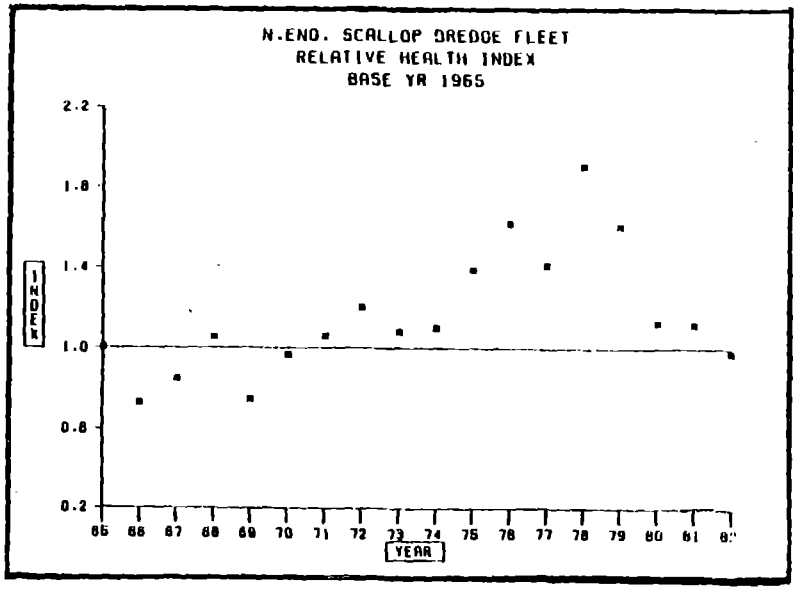

FIG.16

Maine Lobsters

Landings of Maine lobsters, which account for over half of the total catch of northern lobsters, were about 20 percent higher in 1982 than in 1965. The value of landings was up by more than 300 percent during the period. The deflated value of landings increased at about the same rate as landings, indicating that the deflated price per pound in 1982 was almost the same as in 1965 (Table 5 and Figure 17).

The number of trap hauls expanded slightly during the period but because landings also increased, the catch per haul showed no clear trend (Figure 18). For most of the years during the period of analysis the catch per haul was within 10 percent of the 1965 rate (Table 6).

The Health Index indicates that for a majority of years between 1965 and 1982 the Maine lobster harvesting industry was not doing as well as it did in 1965 (Figure 20). This is in large part because of the slow rate of change in price due to consumer resistance to what was already in 1965 a relatively high priced item. It is also related to the flow of imports from Canada which tend to have a price depressing effect on U.S. caught lobsters.

As can be seen from Figure 19, most of the cost increase for lobsters occurred because of inflationary pressures on input prices rather than a decline in productivity. The Health Index may underestimate the actual industry health because some vessels have, in recent years, carried more traps, which would tend to reduce cost per trap haul.

New England Otter Trawl

The New England otter trawl fleet lands a mix of species, most of which are groundfish. The fleet during the 1960's and early 1970's labored under the dual pressures of heavy foreign fishing on George's Bank and a steady stream of imported competitive products from Canada. There were serious declines in the abundance and availability of haddock, cod and ocean perch and by the time the U.S. Congress enacted the Magnuson Fishery Conservation and Management Act, the otter trawl catch had diminished to less than half of the 1965 level. In 1967 the haddock fishery was dependent almost entirely on the 1963 year class and even with the quotas set by agreement within the International Commission for Northwest Atlantic Fisheries (ICNAF), the fishery was unable to recover. By 1970 the catch and value of otter trawl landings were well below 1965 levels (Table 7). Although landings continued to decline, value did rise in the early 1970's. However, deflated value did not reach the 1965 level again until 1976 (Figure 21).

From 1965 through 1975 there was a continuous decline in landings per day at sea and it was not until 1976 that productivity increased. At least some of the improvement likely came about because of less foreign fishing effort and a recovery of certain stocks due to natural conditions or perhaps, actions taken under ICNAF. There were moderate increases in

TABLE 5 MAINE LOBSTER: EFFORT, LANDINGS, AND VALUE OF LANDINGS 1965-1982

1) EFRT_ML NUMBER OF TRAP HAULS (IN THOUSANDS), MAINE LOBSTER FISHERY
2) LAN_ML LANDINGS OF MAINE LOBSTER (THOUS. METRIC TONS, LIVE WT.)
3) VAL_ML VALUE OF MAINE LOBSTER LANDINGS ($MILLION)
4) VALD_ML DEFLATED VALUE OF MAINE LOBSTER LANDINGS (MILLION 1965 DOLLARS)
5) LAN_ML_X LANDINGS INDEX, MAINE LOBSTER, 1965=100
6) VAL_ML_X VALUE OF LANDINGS INDEX, MAINE LOBSTER, 1965=100
7) VALD_ML_X DEFLATED VALUE OF LANDINGS INDEX, MAINE LOBSTER, 1965=100

Date	EFRT_ML	LAN_ML	VAL_ML	VALD_ML	LAN_ML_X	VAL_ML_X	VALD_ML_X
1965	29245.00	8.56	14.18	14.11	100.00	100.00	100.00
1966	29524.00	9.03	14.90	14.37	105.59	105.13	101.84
1967	27031.00	7.48	13.36	12.50	87.42	94.21	88.61
1968	34170.00	9.30	14.76	13.23	108.70	104.12	93.80
1969	32516.00	9.00	16.07	13.67	105.16	113.32	96.89
1970	30800.00	8.24	16.90	13.68	96.35	119.21	96.93
1971	32515.00	7.96	17.21	13.26	93.09	121.37	94.00
1972	26220.00	7.37	16.74	12.39	86.19	118.11	87.82
1973	31647.00	7.75	21.87	15.31	90.60	154.29	108.49
1974	26980.00	7.47	22.71	14.60	87.26	160.20	103.52
1975	34035.00	7.72	27.45	16.15	90.22	193.60	114.45
1976	30647.00	8.62	27.94	15.62	100.74	197.10	110.75
1977	34881.00	8.39	28.89	15.26	98.02	203.75	108.18
1978	32984.00	8.68	33.56	16.51	101.43	236.74	117.03
1979	35699.00	10.04	40.99	18.56	117.35	289.11	131.55
1980	33816.00	9.97	37.90	15.70	116.54	267.32	111.27
1981	32331.00	10.27	44.38	16.80	119.99	313.01	119.05
1982	33979.00	10.21	47.30	16.91	119.29	333.64	119.85

TABLE 6 MAINE LOBSTER: INDEXES OF EFFORT, PRODUCTIVITY, PRICES, COSTS, AND HARVESTING SECTOR HEALTH, 1965-1982

1) EFRT_ML_X LANDINGS PER TRAP HAUL INDEX, MAINE LOBSTER, 1965=100
2) CPUE_ML_X LANDINGS PER TRAP HAUL INDEX, MAINE LOBSTER, 1965=100
3) ICST_ML_X INPUT PRICES INDEX, MAINE LOBSTER, 1965=100
4) OCST_ML_X OUTPUT COST INDEX (COST/UNIT OF LNDGS.), MAINE LOBSTER, 1965=100
5) PRI_ML_X EXVESSEL PRICE INDEX, MAINE LOBSTER, 1965=100
6) HLTX_ML MAINE LOBSTER HARVESTING SECTOR HEALTH INDEX (PRICE/COST RATIO), BASE 1965=1.0

Date	EFRT_ML_X	CPUE_ML_X	ICST_ML_X	OCST_ML_X	PRI_ML_X	HLTX_ML
1965	100.00	100.00	100.00	100.00	100.00	1.00
1966	100.95	104.59	104.20	99.63	99.56	1.00
1967	92.43	94.58	105.90	111.96	107.76	0.96
1968	116.84	93.03	109.50	117.71	95.79	0.81
1969	111.18	94.59	115.60	122.22	107.76	0.88
1970	105.32	91.48	119.40	130.52	123.73	0.95
1971	111.18	83.73	118.80	141.89	130.38	0.92
1972	89.66	96.13	121.40	126.28	137.03	1.09
1973	108.21	83.73	135.20	161.47	170.29	1.05
1974	92.26	94.59	166.60	176.14	183.59	1.04
1975	116.38	77.53	177.20	228.57	214.58	0.94
1976	104.79	96.13	184.80	192.23	195.65	1.02
1977	119.27	82.18	196.00	238.50	207.87	0.87
1978	112.79	89.93	214.30	238.30	233.41	0.98
1979	122.07	96.13	246.10	256.00	246.37	0.96
1980	115.63	100.79	287.60	285.35	229.38	0.80
1981	110.55	108.54	321.90	296.57	260.85	0.88
1982	116.19	102.67	319.80	311.47	279.68	0.90

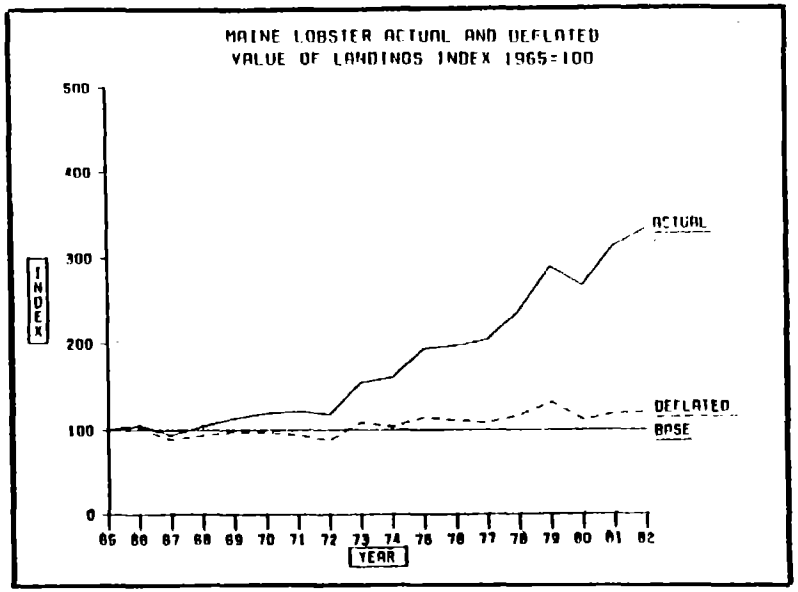

FIG.17

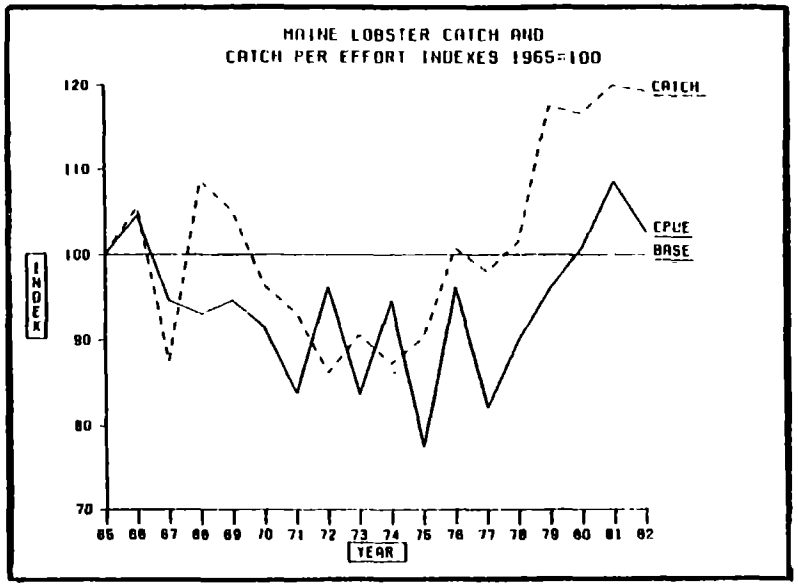

FIG.18

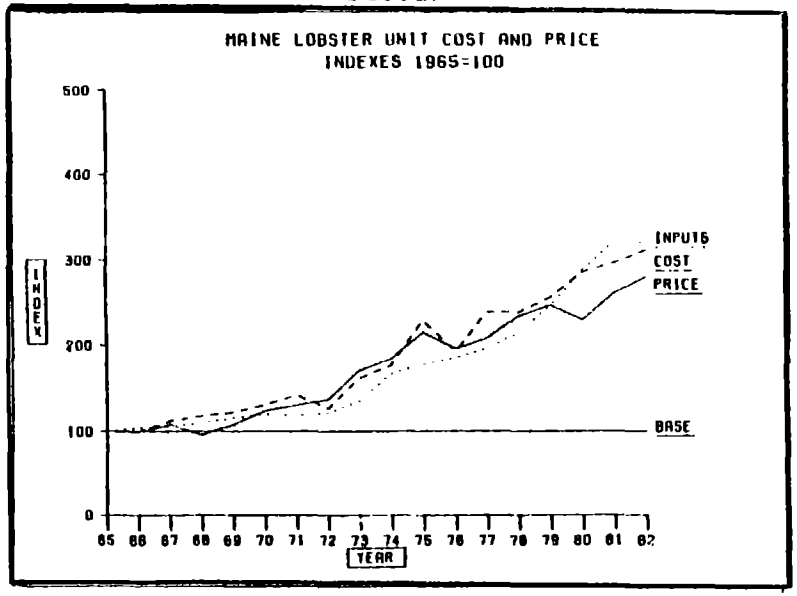

FIG.19

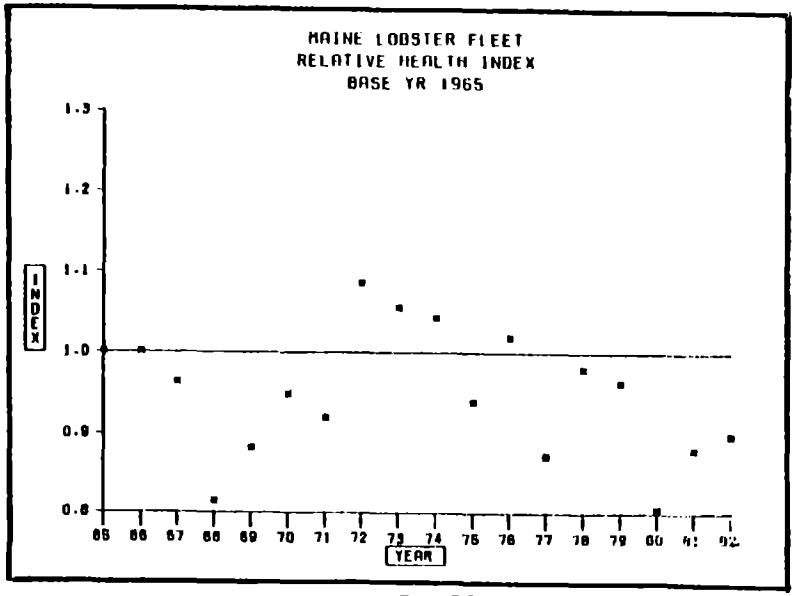

FIG.20

TABLE 7 NEW ENGLAND OTTER TRAWL: VESSELS, EFFORT, LANDINGS, AND VALUE OF LANDINGS 1965-1982

1) VSL_OT NUMBER OF VESSELS, NEW ENG. OTTER TRAWL
2) EFRT_OT VESSEL DAYS ABSENT, NEW ENG. OTTER TRAWL
3) LAN_OT LANDINGS, NEW ENG. OTTER TRAWL,(THOUS.METRIC TONS, LIVE WT.)
4) VAL_OT VALUE OF LANDINGS, NEW ENG. OTTER TRAWL, ($MILLION)
5) VALD_OT DEFLATED VALUE OF NEW ENG. OTTER TRAWL LANDINGS (MILLION 1965 DOLLARS)
6) LAN_OT_X LANDINGS INDEX, NEW ENG. OTTER TRAWL, 1965=100
7) VAL_OT_X VALUE OF LANDINGS INDEX, NEW ENG. OTTER TRAWL, 1965=100
8) VALD_OT_X DEFLATED VALUE OF LANDINGS INDEX, NEW ENG. OTTER TRAWL, 1965=100

Date	VSL_OT	EFRT_OT	LAN_OT	VAL_OT	VALD_OT	LAN_OT_X	VAL_OT_X	VALD_OT_X
1965	512.00	63878.00	243.00	36.56	36.38	100.00	100.00	100.00
1966	545.00	62101.00	231.00	38.51	37.13	95.06	105.34	102.05
1967	559.00	62219.00	209.00	33.68	31.53	86.01	92.14	86.66
1968	538.00	57757.00	203.00	33.72	30.23	83.54	92.24	83.10
1969	550.00	56732.00	186.00	37.59	31.98	76.54	102.82	87.91
1970	562.00	60253.00	172.00	41.45	33.54	70.78	113.37	92.18
1971	566.00	57299.00	155.00	38.42	29.61	63.79	105.08	81.38
1972	565.00	57506.00	135.00	42.11	31.16	55.56	115.19	85.65
1973	553.00	54814.00	134.00	46.12	32.27	55.14	126.14	88.70
1974	575.00	56568.00	123.00	48.31	31.06	50.62	132.13	85.38
1975	587.00	60727.00	115.00	57.28	33.69	47.33	156.66	92.61
1976	590.00	58363.00	118.00	64.69	36.17	48.56	176.95	99.43
1977	594.00	56782.00	135.00	74.93	39.59	55.56	204.95	108.82
1978	643.00	61497.00	145.00	92.58	45.55	59.67	253.24	125.19
1979	768.00	69508.00	153.00	106.93	48.42	62.96	292.48	133.08
1980	896.00	75923.00	166.00	115.93	48.02	68.31	317.10	132.00
1981	914.00	72519.00	161.00	128.96	48.81	66.26	352.72	134.15
1982	975.00	82887.00	169.00	151.24	54.07	69.55	413.67	148.60

TABLE 8 NEW ENGLAND OTTER TRAWL: INDEXES OF EFFORT, PRODUCTIVITY, PRICES, COSTS AND HARVESTING SECTOR HEALTH, 1965-1982

1) EFRT_OT_X VESSEL DAYS ABSENT INDEX, NEW ENG. OTTER TRAWL, 1965=100
2) CPUE_OT_X LANDINGS PER DAY ABSENT INDEX, NEW ENG. OTTER TRAWL, 1965=100
3) ICST_OT_X INPUT PRICES INDEX, NEW ENG. OTTER TRAWL, 1965=100
4) OCST_OT_X OUTPUT COST INDEX (COST/UNIT OF LNDGS.), NEW ENG. OTTER TRAWL, 1965=100
5) PRI_OT_X AVER. EXVESSEL PRICE INDEX, NEW ENG. OTTER TRAWL, 1965=100
6) HLTX_OT N.E. OTTER TRAWL HARVESTING SECTOR HEALTH INDEX (PRICE/COST RATIO), BASE 1965=1.0

Date	EFRT_OT_X	CPUE_OT_X	ICST_OT_X	OCST_OT_X	PRI_OT_X	HLTX_OT
1965	100.00	100.00	100.00	100.00	100.00	1.00
1966	97.22	97.78	104.20	106.56	110.82	1.04
1967	97.40	88.30	105.90	119.93	107.13	0.89
1968	90.42	92.39	109.50	118.52	110.42	0.93
1969	88.81	86.18	115.60	134.13	134.33	1.00
1970	94.33	75.04	119.40	159.11	160.17	1.01
1971	89.70	71.11	118.80	167.07	164.74	0.99
1972	90.02	61.71	121.40	196.72	207.34	1.05
1973	85.81	64.26	135.20	210.39	228.75	1.09
1974	88.56	57.16	166.60	291.47	261.05	0.90
1975	95.07	49.78	177.20	355.96	331.04	0.93
1976	91.37	53.15	184.80	347.71	364.41	1.05
1977	88.89	62.50	196.00	313.61	368.92	1.18
1978	96.27	61.98	214.30	345.75	424.40	1.23
1979	108.81	57.86	246.10	425.31	464.53	1.09
1980	118.86	57.48	287.60	500.39	464.20	0.93
1981	113.53	58.36	321.90	551.57	532.38	0.97
1982	129.76	53.60	319.80	596.67	594.81	1.00

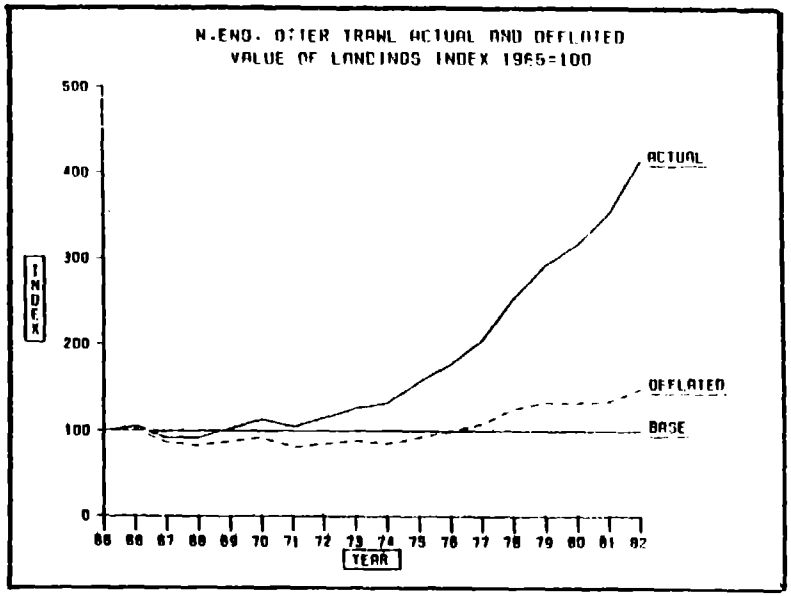

FIG.21

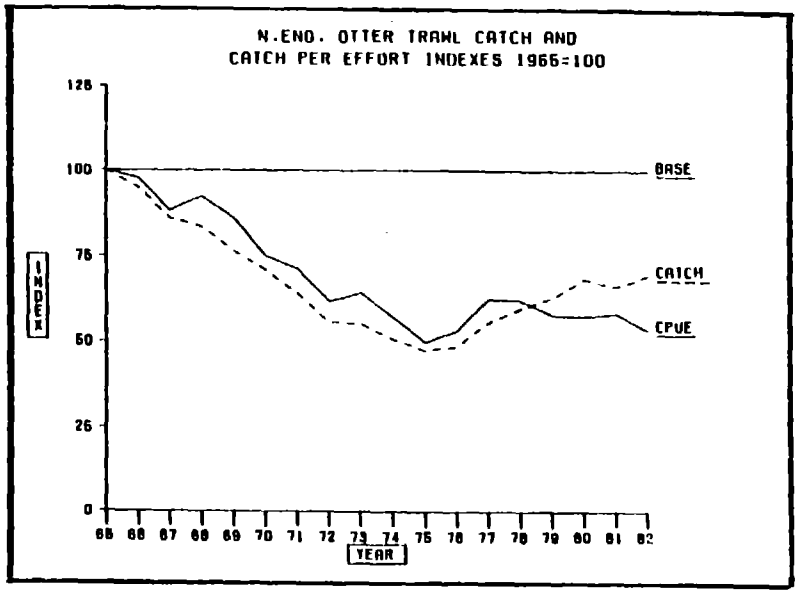

FIG.22

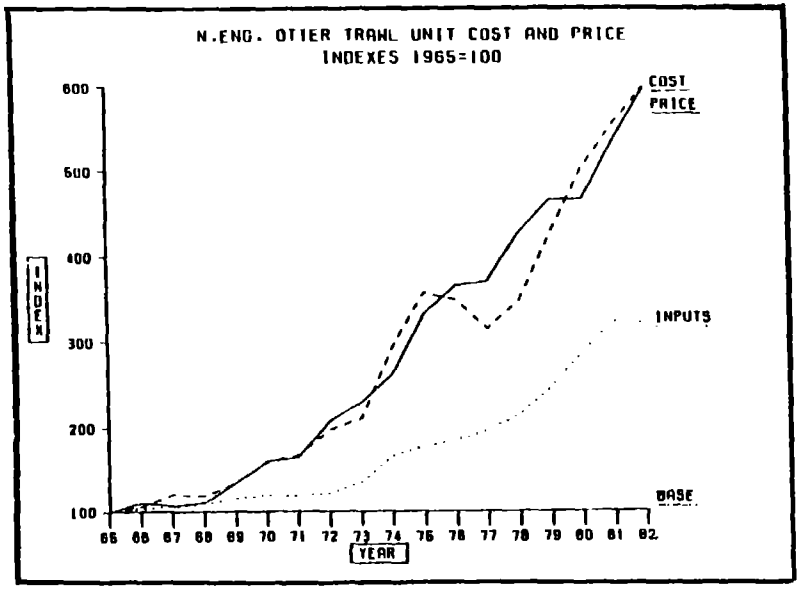

FIG.23

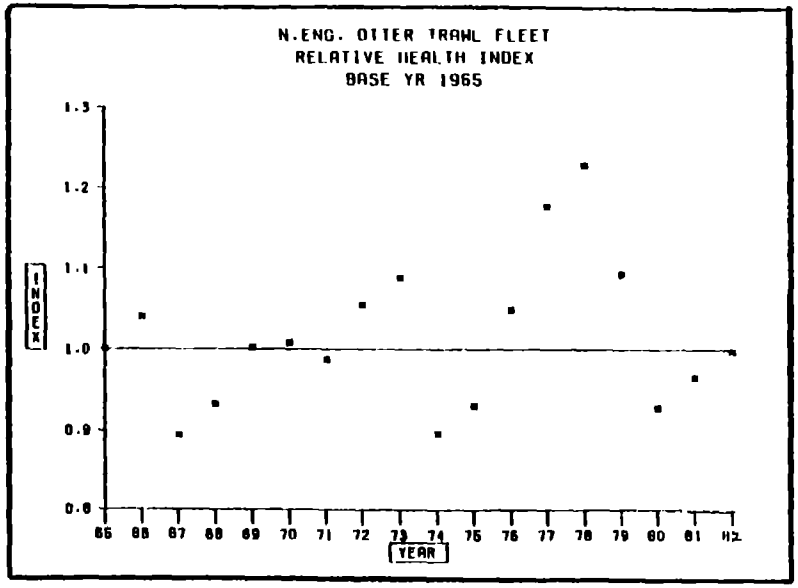

FIG.24

landings and catch per unit of effort between 1976 and 1978 (Figure 22). The partial recovery in catch rates along with relatively large price increases helped to move the Industry Health Index above 1.0 in 1976, 1977 and 1978 (Table 8 and Figure 24). However, in the following years a number of vessels were added to this fleet (Table 7). This contributed to a significant increase in total days at sea by the fleet, and catch per unit of effort diminished with a sizeable drop taking place in 1982 (Table 8). The decline in catch rate along with the effects of increased fuel and other costs caused a reversal of the Health Index which dropped to below 1.0 in 1980 but gradually climbed back to 1.0 by 1982 (Figure 24). Sharp price increases in 1981 and 1982 and relatively stable input costs in 1982 helped to restore the Health Index to the 1965 level (Figure 23).

Gulf Shrimp

The economic health of the Gulf shrimp fleet is particularly sensitive to the price of vessel engine fuel and the conditions in the national economy. Fuel costs make up a larger percent of total cost for this fleet than for most other fleets, and this is reflected in the Index of Input Prices. This Index moved up rapidly between 1972 and 1974 and between 1978 and 1980 when large increases in the price of petroleum products took place (Table 10 and Figure 27). Also, prices received by shrimp fishermen have been suppressed by declines in demand as a result of the economic recessions (1974-75 and 1980-81) and a steady flow of imports from numerous countries throughout the world. In spite of these events, total ton-trips by this fleet continued to increase and in 1982 were 65 percent greater than in 1965 (Table 9). The expanded fishing effort did not result in significantly increased landings (Figure 26 and Table 9), and catch per ton-trip in 1982 was only about two thirds of the 1965 level (Table 10).

During the period the Output Price Index increased at such a rapid rate that the Industry Health Index generally remained above 1.0 (Table 10, Figures 27 and 28). The Health Index may underestimate the industry financial situation in some years because certain U.S. shrimp vessels fished out of Trinidad, French Guiana and other Caribbean ports. Shrimp caught by these vessels were offloaded in these foreign ports and not reported as U.S. catch.

Menhaden

Gulf menhaden account for more than one third of the weight of finfish landed by U.S. fishermen. The value of this catch represents six percent of the value of all finfish. Menhaden landings in 1982 were at an all time high and were 55 percent above the 1981 level and 184 percent above the 1965 catch (Table 11 and Figure 30).

The demand for U.S. menhaden increased sharply in 1973. This is reflected in a rapid rise in price that year to a new level that was approximately maintained in subsequent years (Table 12 and Figure 31). Among the causes of the rapid price increase were the collapse of the

TABLE 9 GULF SHRIMP:EFFORT, LANDINGS, AND VALUE OF LANDINGS 1965-1982

1) EFRT_GS VESSEL TON TRIPS GULF SHRIMP
2) LAN_GS LANDINGS, GULF SHRIMP,(THOUS, METRIC TONS, LIVE WT.)
3) VAL_GS VALUE OF LANDINGS, GULF SHRIMP, ($MILLION)
4) VALD_GS DEFLATED VALUE OF LANDINGS, GULF SHRIMP (MILLION 1965 DOLLARS)
5) LAN_GS_X LANDINGS INDEX GULF SHRIMP, 1965=100
6) VAL_GS_X VALUE OF LANDINGS INDEX, GULF SHRIMP, 1965=100
7) VALD_GS_X DEFLATED VALUE OF LANDINGS INDEX, GULF SHRIMP,1965=100

Date	EFRT_GS	LAN_GS	VAL_GS	VALD_GS	LAN_GS_X	VAL_GS_X	VALD_GS_X
1965	252.00	88.54	70.90	70.56	100.00	100.00	100.00
1966	288.00	81.28	82.90	79.92	91.81	116.93	113.26
1967	309.00	102.38	90.60	84.80	115.63	127.79	120.18
1968	340.00	92.53	95.80	85.89	104.51	135.12	121.72
1969	337.00	90.90	101.10	86.02	102.67	142.60	121.91
1970	317.00	104.55	108.20	87.55	118.09	152.61	124.08
1971	309.00	103.15	136.30	105.05	116.50	192.24	148.89
1972	384.00	103.83	164.10	121.43	117.27	231.45	172.10
1973	405.00	82.65	171.80	120.22	93.34	242.31	170.38
1974	373.00	84.46	138.00	88.74	95.39	194.64	125.76
1975	333.00	77.16	178.30	104.89	87.14	251.48	148.65
1976	376.00	95.35	275.20	153.88	107.69	388.15	218.09
1977	347.00	120.61	296.80	156.82	136.22	418.62	222.26
1978	373.00	112.63	319.60	157.23	127.21	450.78	222.83
1979	393.00	93.71	377.60	170.99	105.84	532.58	242.33
1980	366.00	94.48	302.10	125.14	106.71	426.09	177.36
1981	412.00	121.65	401.40	151.93	137.40	566.15	215.32
1982	415.00	95.21	425.70	152.18	107.53	600.42	215.68

TABLE 10 GULF SHRIMP: INDEXES OF EFFORT, PRODUCTIVITY, PRICES, COSTS, AND HARVESTING SECTOR HEALTH

1) EFRT_GS_X VESSEL TON TRIPS INDEX. GULF SHRIMP. 1965=100
2) CPUE_GS_X LANDINGS PER TON TRIP INDEX, GULF SHRIMP, 1965=100
3) ICST_GS_X INPUT PRICES INDEX, GULF SHRIMP, 1965=100
4) OCST_GS_X OUTPUT COST INDEX (COST/UNIT LNDGS.) GULF SHRIMP,1965=100
5) PRI_GS_X AVERAGE EXVESSEL PRICE INDEX, GULF SHRIMP, 1965=100
6) HLTX_GS GULF SHRIMP HARVESTING SECTOR HEALTH INDEX (PRICE/COST RATIO) BASE 1965=1.0

Date	EFRT_GS_X	CPUE_GS_X	ICST_GS_X	OCST_GS_X	PRI_GS_X	HLTX_GS
1965	100.00	100.00	100.00	100.00	100.00	1.00
1966	114.29	80.33	104.20	129.72	127.36	0.98
1967	122.62	94.30	105.85	112.25	110.52	0.98
1968	134.92	77.46	109.15	140.91	129.29	0.92
1969	133.73	76.77	115.15	150.00	138.89	0.93
1970	125.79	93.87	119.10	126.88	129.24	1.02
1971	122.62	95.01	118.80	125.05	165.02	1.32
1972	152.38	76.95	121.40	157.76	197.38	1.25
1973	160.71	58.08	135.45	233.22	259.60	1.11
1974	148.02	64.44	169.15	262.47	204.05	0.78
1975	132.14	65.94	180.65	273.94	288.59	1.05
1976	149.21	72.17	188.65	261.39	360.45	1.38
1977	137.70	98.93	201.00	203.18	307.31	1.51
1978	148.02	85.94	219.20	255.07	354.37	1.39
1979	155.95	67.87	253.50	373.53	503.19	1.35
1980	145.24	73.47	300.75	409.34	399.30	0.98
1981	163.49	84.04	338.75	403.09	412.05	1.02
1982	164.68	65.30	336.00	514.58	558.37	1.09

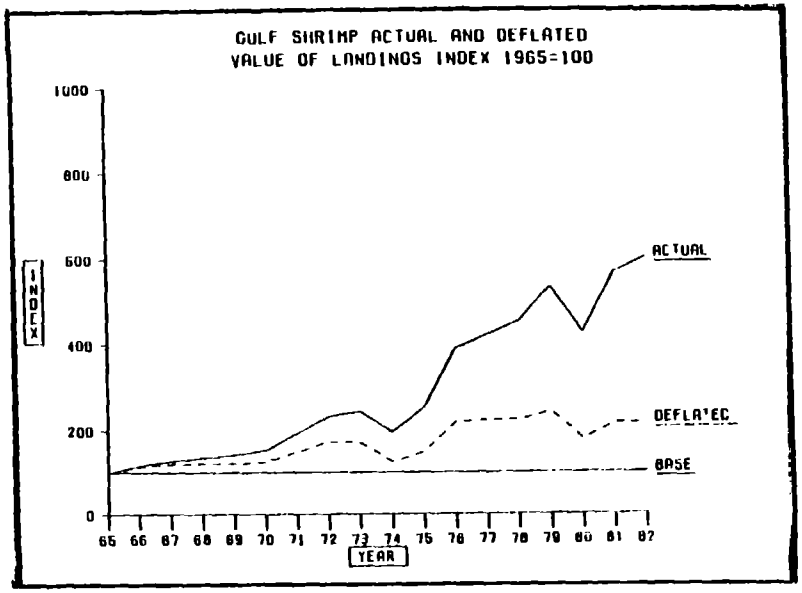

FIG.25

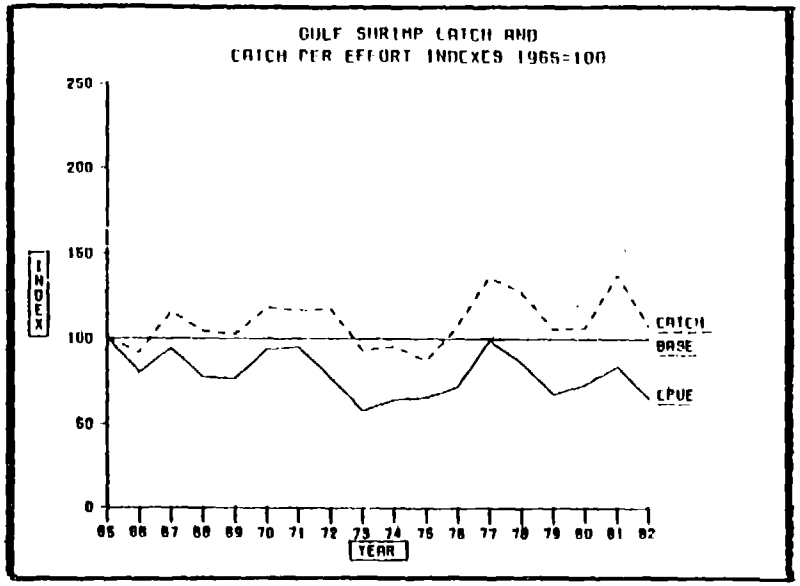

FIG.26

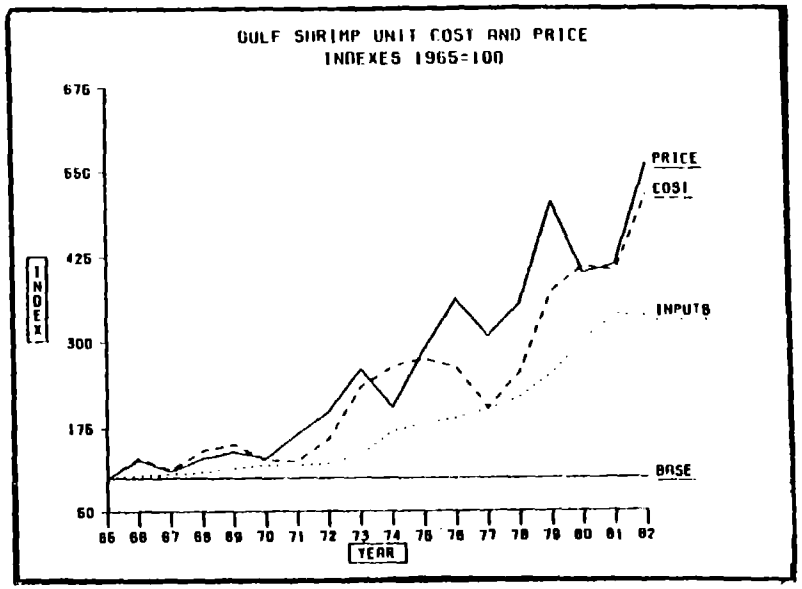

FIG.27

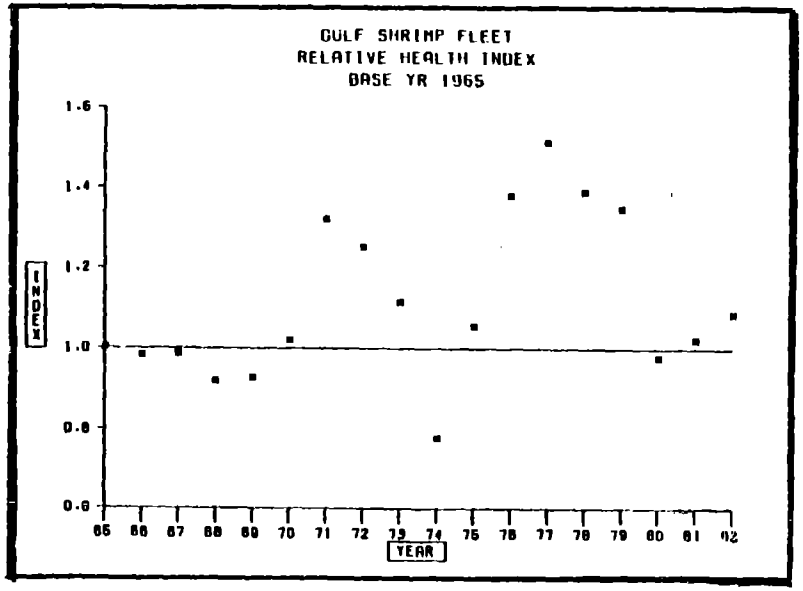

FIG.28

Peruvian Anchovy fishery and an increase in soybean prices -- both of which represent close competitors to menhaden fish meal. Prices were off slightly in 1981 and 1982 because of problems with marketing menhaden oil. The strong U.S. dollar also put downward pressure on exports and prices.

Table 12 and Figure 30 indicate that while catch rates were generally off from the 1965 level during the period, they increased substantially in 1987 and 1979, then dropped off, but in 1982 nearly reached the 1965 level.

The increased catch rate and level of landings in 1982 helped the industry partially recover from the 1980-81 situation. However, the Health Index for 1982 was still below the levels for 1965 and most of the 1970's (Table 12 and Figure 32). It is interesting to note the impact of the Peruvian anchovy fishery on the U.S. Gulf menhaden Industry Health Index. The Peruvian industry was fully developed and placing large quantities of fish meal in international markets especially in 1967, 1968 and 1969. This is reflected in a drop in menhaden price and a depressed Health Index for those years. The impact of the price drop was exacerbated by a simultaneous drop in catch rate in the Gulf fleet during these years. However, by 1973, U.S. prices were up and the catch rate had also partially recovered from the low level in the late 1960's. As a result, the Health Index in 1973 and 1974 and again in 1978 and 1979 was substantially above the 1965 level.

Surf Clams

Surf clam landings in 1982 were at approximately the same level as in 1965 but were only about one half of the amount that occurred in the mid 1970's (Table 14 and Figure 34). The value of surf clam landings was eight times higher in 1982 than in 1965 and deflated value increased by 300 percent (Table 13 and Figure 33). The increase in value is largely a result of substantially higher prices which in 1982 were seven times higher than the 1965 level (Table 14).

During the period, there were large fluctuations in catch rates, declining from the base of 100 in 1965 to 60 in 1971, then increasing to 108 in 1974 only to fall substantially by 1976. Catch rates since 1976 have remained at about one-fourth of the 1965 level (Table 14 and Figure 34). This drop in catch rate combined with increased input costs[5] resulted in cost per unit of output increases of up to 1200 percent in the late 1970's (Table 14 and Figure 35).

Therefore, although prices did move up rapidly during the period, they did not offset cost increases. The Health Index indicates that since 1977 the industry cost-revenue situation has deteriorated relative

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5. The cost index was adjusted to reflect the fact that vessels were operating fewer days each week after 1978. This reduced variable costs and the index was adjusted accordingly.

TABLE 11 GULF MENHADEN: LANDINGS AND VALUE OF LANDINGS, 1965-1982

1) LAN_GM LANDINGS, GULF MENHADEN,(THOUS, METRIC TONS,LIVE WT.)
2) VAL_GM VALUE OF LANDINGS GULF MENHADEN ($MILLION)
3) VALD_GM DEFLATED VALUE OF LANDINGS, GULF MENHADEN (MILLION 1965 DOLLARS)
4) LAN_GM_X LANDINGS INDEX, GULF MENHADEN,1965=100
5) VAL_GM_X VALUE OF LANDINGS INDEX, GULF MENHADEN ,1965=100
6) VALD_GM_X DEFLATED VALUE OF LANDINGS INDEX, GULF MENHADEN, 1965=100

Date	LAN_GM	VAL_GM	VALD_GM	LAN_GM_X	VAL_GM_X	VALD_GM_X
1965	463.58	16.90	16.82	100.00	100.00	100.00
1966	359.70	13.90	13.40	77.59	82.25	79.67
1967	317.52	8.50	7.96	68.49	50.30	47.30
1968	375.12	10.70	9.59	80.92	63.31	57.03
1969	523.90	17.20	14.63	113.01	101.78	87.01
1970	548.40	23.70	19.18	118.30	140.24	114.02
1971	728.93	26.20	20.19	157.24	155.03	120.06
1972	502.13	18.10	13.39	108.32	107.10	79.63
1973	487.16	46.00	32.19	105.09	272.19	191.37
1974	587.86	48.30	31.06	126.81	285.80	184.65
1975	542.96	35.50	20.88	117.12	210.06	124.16
1976	561.55	44.00	24.60	121.13	260.36	146.27
1977	447.25	39.20	20.71	96.48	231.95	123.14
1978	820.56	78.00	38.37	177.00	461.54	228.14
1979	779.28	73.40	33.24	168.10	434.32	197.60
1980	702.17	69.10	28.62	151.47	408.88	170.18
1981	552.48	47.70	18.05	119.18	282.25	107.34
1982	854.12	72.70	25.99	184.25	430.18	154.51

TABLE 12 GULF MENHADEN: INDEXES OF PRODUCTIVITY, PRICES, COSTS, AND HARVESTING SECTOR HEALTH 1965-1982

1) CPUE_GM_X LANDINGS PER TON WEEK INDEX, GULF MENHADEN, 1965=100
2) ICST_GM_X INPUT PRICES INDEX, GULF MENHADEN, 1965=100
3) OCST_GM_X OUTPUT COST INDEX (COST/UNIT OF LANDINGS) GULF MENHADEN,1965=100
4) PRI_GM_X AVERAGE EXVESSEL PRICE INDEX, GULF MENHADEN, 1965=100
5) HLTX_GM GULF MENHADEN HARVESTING SECTOR HEALTH INDEX (PRICE/COST RATIO) BASE 1965=1.0

Date	CPUE_GM_X	ICST_GM_X	OCST_GM_X	PRI_GM_X	HLTX_GM
1965	100.00	100.00	100.00	100.00	1.00
1966	69.00	104.20	151.01	106.01	0.70
1967	57.00	105.93	185.84	73.37	0.39
1968	71.00	109.71	154.52	78.19	0.51
1969	93.00	115.87	124.59	90.03	0.72
1970	99.00	119.58	120.79	118.59	0.98
1971	112.00	118.80	106.07	98.59	0.93
1972	82.00	121.40	148.05	98.87	0.67
1973	83.00	135.05	162.71	259.36	1.59
1974	87.00	165.07	189.74	225.65	1.19
1975	74.00	175.13	236.66	179.52	0.76
1976	71.00	182.49	257.03	215.18	0.84
1977	61.00	193.00	316.39	240.73	0.76
1978	104.00	211.36	203.23	261.10	1.28
1979	107.00	241.66	225.85	258.71	1.15
1980	82.00	279.71	341.11	270.31	0.79
1981	65.00	311.79	479.68	237.13	0.49
1982	96.00	310.08	323.00	233.77	0.72

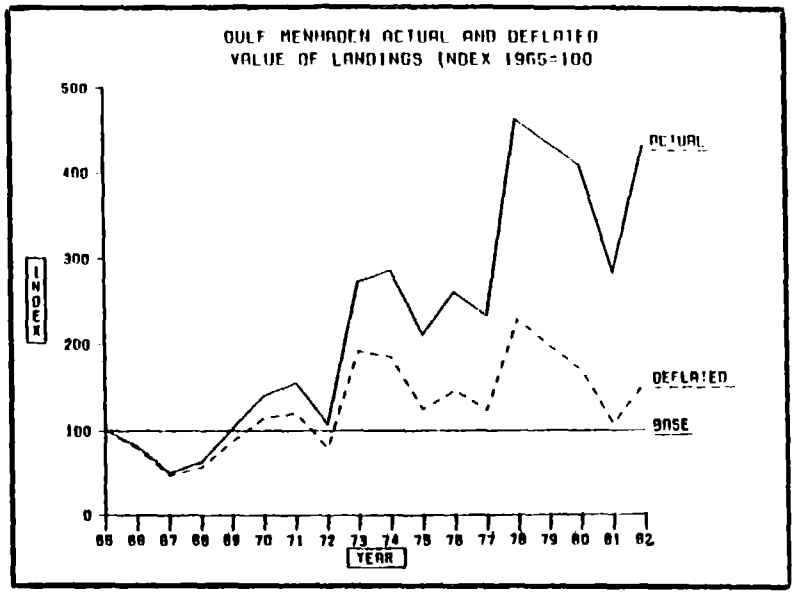

FIG.29

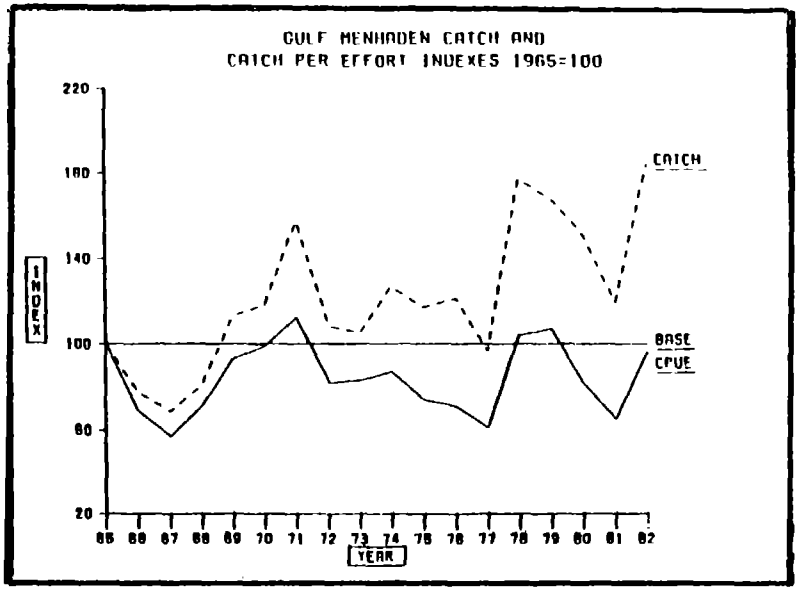

FIG.30

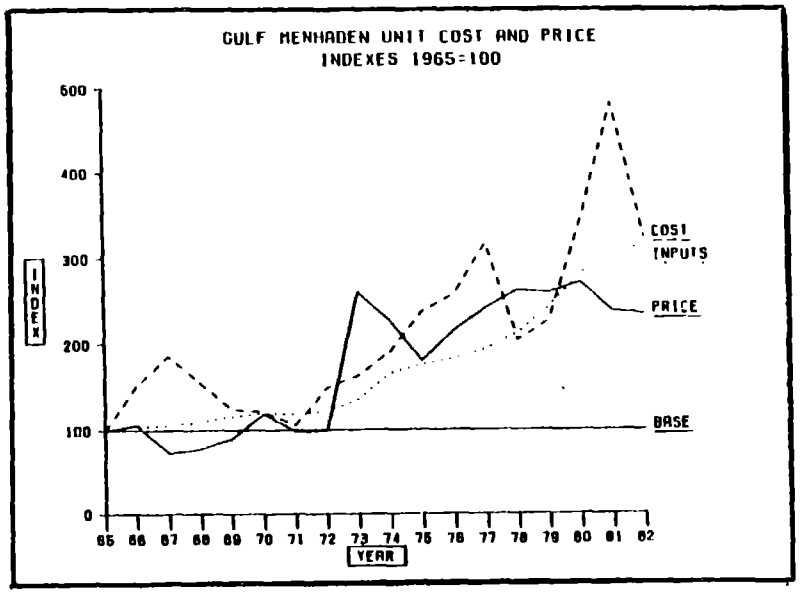

FIG.31

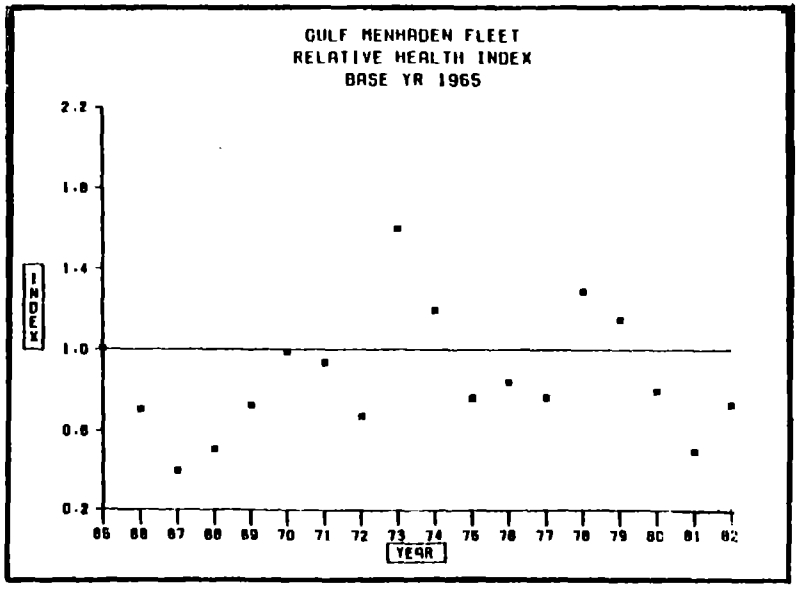

FIG.32

TABLE 13 SURF CLAM: EFFORT, LANDINGS, AND VALUE OF LANDINGS 1965-1982

1) EFRT_SC WEIGHTED EFFORT INDEX, SURF CLAM MIDDLE ATLANTIC
2) LAN_SC LANDINGS, SURF CLAM (THOUS. METRIC TONS MEAT WT.)
3) VAL_SC VALUE OF LANDINGS, SURF CLAM ($MILLION)
4) VALD_SC DEFLATED VALUE OF LANDINGS, SURF CLAM (MILLION 1965 DOLLARS)
5) LAN_SC_X LANDINGS INDEX, SURF CLAM, 1965=100
6) VAL_SC_X VALUE OF LANDINGS INDEX, SURF CLAM, 1965=100
7) VALD_SC_X DEFLATED VALUE OF LANDINGS INDEX, 1965=100

Date	EFRT_SC	LAN_SC	VAL_SC	VALD_SC	LAN_SC_X	VAL_SC_X	VALD_SC_X
1965	91.00	20.00	3.20	3.18	100.02	100.00	100.00
1966	112.00	20.46	3.90	3.76	102.29	121.88	118.23
1967	151.00	20.46	4.40	4.12	102.29	137.50	129.51
1968	128.00	18.10	4.10	3.68	90.49	128.13	115.59
1969	133.00	21.55	5.70	4.85	107.73	178.13	152.51
1970	176.00	30.53	7.70	6.23	152.64	240.63	195.93
1971	180.00	23.86	6.90	5.32	119.30	215.63	167.24
1972	174.00	28.76	7.90	5.85	143.79	246.88	183.84
1973	177.00	37.38	9.90	6.93	186.88	309.38	217.85
1974	183.00	43.59	12.20	7.84	217.95	381.25	246.70
1975	187.00	39.42	12.60	7.41	197.09	393.75	233.09
1976	274.00	22.27	23.30	13.03	111.36	728.13	409.70
1977	467.00	23.13	26.40	13.95	115.67	825.00	438.66
1978	474.00	17.78	20.90	10.28	88.91	653.13	323.33
1979	492.00	15.83	19.30	8.74	79.15	603.13	274.83
1980	399.00	17.10	19.10	7.91	85.50	596.88	248.81
1981	387.00	20.91	23.50	8.89	104.55	734.38	279.71
1982	403.00	22.54	26.00	9.29	112.72	812.50	292.29

TABLE 14 SURF CALM: INDEXES OF EFFORT, PRODUCTIVITY, PRICES, COSTS, AND HARVESTING SECTOR HEALTH 1965-1982

1) EFRT_SC_X INDEX OF SURF CLAM WEIGHTED EFFORT, 1965=100
2) CPUE_SC_X INDEX OF CATCH PER UNIT OF EFFORT, SURF CLAM, 1965=100
3) ICST_SC_X INPUT PRICES INDEX, SURF CLAM, 1965=100
4) OCST_SC_X OUTPUT PRICE INDEX, SURF CLAM, 1965=100
5) PRI_SC_X EXVESSEL PRICE INDEX, SURF CLAM, 1965=100
6) HLTX_SC SURF CLAM HARVESTING SECTOR HEALTH INDEX (PRICE/COST RATIO) BASE 1965=1.0

Date	EFRT_SC_X	CPUE_SC_X	ICST_SC_X	OCST_SC_X	PRI_SC_X	HLTX_SC
1965	100.00	100.00	100.00	100.00	100.00	1.00
1966	123.08	83.00	104.20	125.54	119.16	0.95
1967	165.93	62.00	105.90	170.81	134.43	0.79
1968	140.66	65.00	109.50	168.46	141.59	0.84
1969	146.15	77.00	115.60	150.13	165.34	1.10
1970	193.41	79.00	119.40	151.14	157.64	1.04
1971	197.80	60.00	118.80	198.00	180.74	0.91
1972	191.21	75.00	121.40	161.87	171.68	1.06
1973	194.51	96.00	135.20	140.83	165.54	1.18
1974	201.10	108.00	166.60	154.26	174.91	1.13
1975	205.49	97.00	177.20	182.68	199.77	1.09
1976	301.10	37.00	184.80	499.46	653.69	1.31
1977	513.19	23.00	196.00	852.17	713.06	0.84
1978	520.88	17.00	186.40	1096.47	734.43	0.67
1979	540.66	15.00	192.00	1280.00	761.77	0.60
1980	438.46	20.00	247.30	1236.50	697.89	0.56
1981	425.27	24.00	206.00	858.33	702.20	0.82
1982	442.86	26.00	227.10	873.46	720.63	0.83

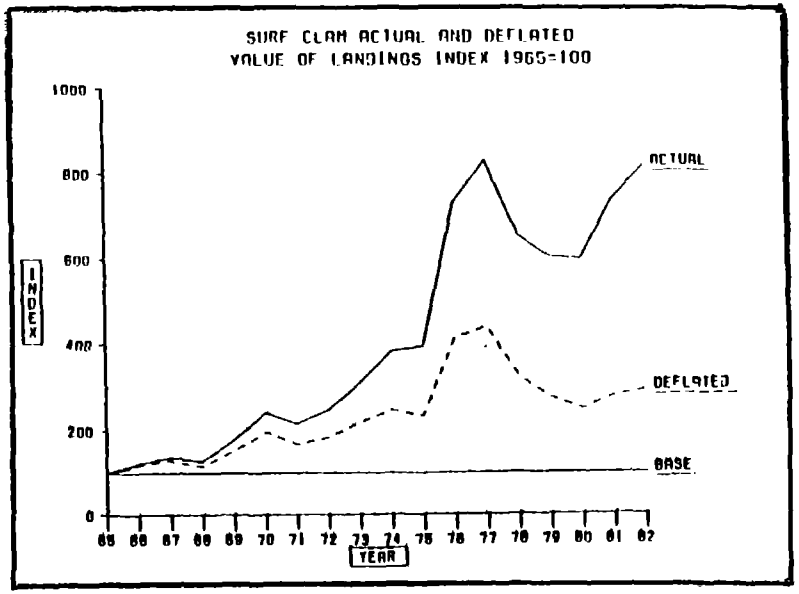

FIG.33

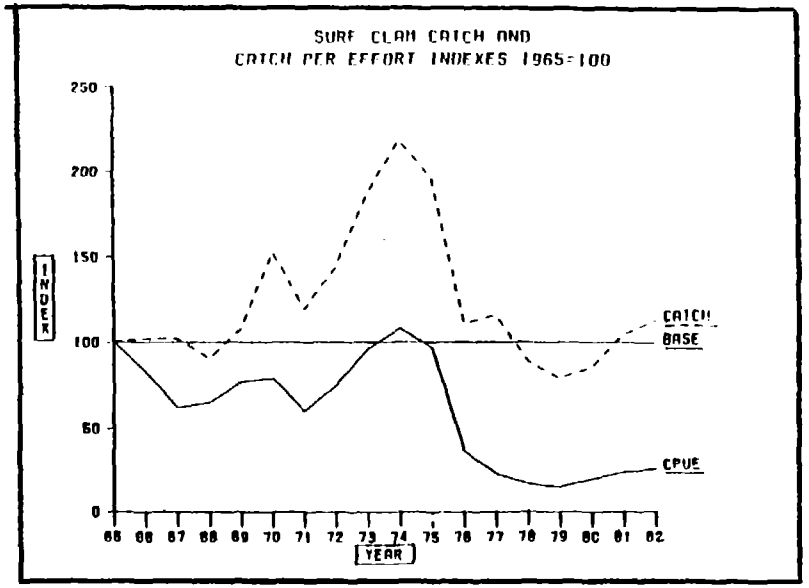

FIG.34

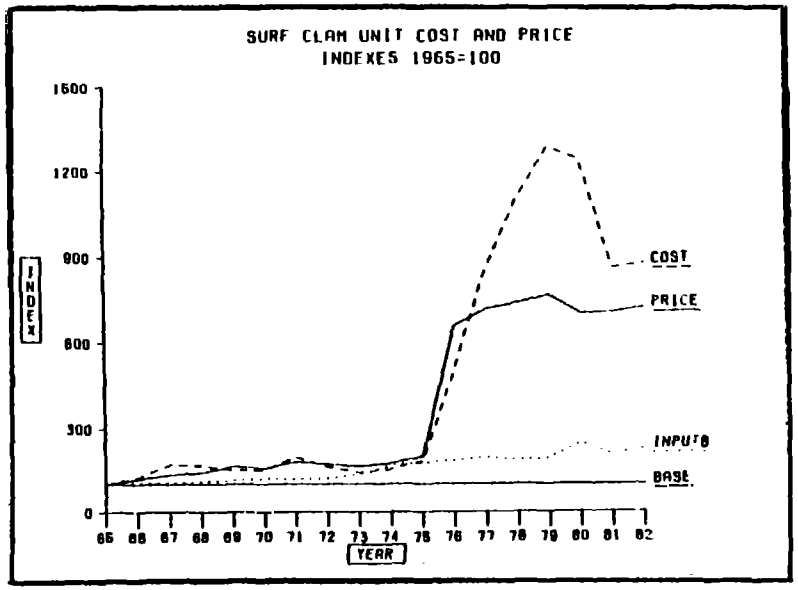

FIG.35

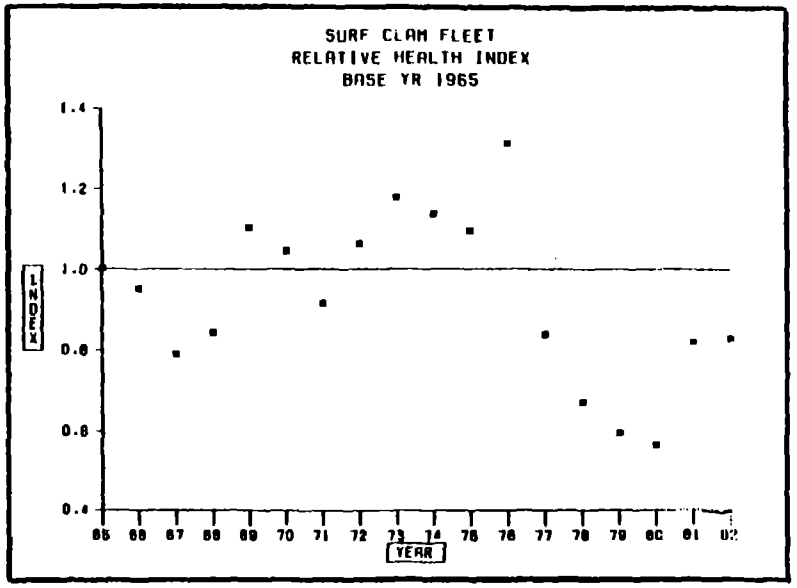

FIG.36

to the 1965 situation (Table 14 and Figure 31). The conditions in the late 1970's and 1980's were brought about in part by the relatively high Health Index that existed from 1969 to 1975 (Figure 36). By 1974 and 1975, considerable expansion plans had been made and when the additional effort was added to the fishery, it likely contributed to the decline in catch rates. The fishery is now heavily regulated and earnings are depressed as a result of excess capacity -- conditions that will continue unless stocks increase substantially. Unfortunately, there are few alternative fishing activities for these vessels.

Tuna

U.S. tuna landings (excluding albacore) were down in 1982 slightly below the 1965 level and about half of the 1976 landings. However, this decline in U.S. landings was partially offset by increased landings by the fleet in Puerto Rico. As a result, combined U.S. and Puerto Rico landings were almost one third higher than the 1965 level (Tables 15 and 16). During this period, there was a substantial expansion in effort and catch per unit of effort has declined to approximately one half the 1965 level (Table 16 and Figure 38).[6]. The data represent the operations of vessels from a number of countries which report their results to the Commission which maintains records of gear, flag, and tuna carrying capacity for most of the vessels that catch yellowfin, skipjack, or blue fin in the eastern tropical Pacific Ocean. U.S. vessels account for over half the number of vessels and carrying capacity. According to Commission records, carrying capacity increased substantially between 1965 and 1975 and has been relatively stable since.

The decline in productivity combined with increasing input costs resulted in unit output costs that moved up faster than the relatively moderate gains in price (Table 16 and Figure 39). As a consequence, there has been an almost steady decline in the tuna Industry Health Index. It should be noted, however, that this does not take into account revenues earned by this fleet from landings in ports other than the U.S. and Puerto Rico.

King and Tanner Crab

This fishery started in the early 1960's as the king crab fishery. It was late in the 1960's that exploitation of the tanner crab resource was initiated (Table 17). The combined catch of king and tanner crab per unit of effort (ton-trips) declined rapidly during the period 1966, 1967 and 1968 (Table 18 and Figure 41).

The decline was reversed as the tanner crab catch increased. However, in 1981 and especially in 1982 the combined catch rate fell

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6. Effort and catch-effort data used in this analysis is derived from information published by the Inter-American Tropical Tuna Commission (IATTC

TABLE 15 TUNA: VESSELS, LANDINGS, AND VALUE OF LANDINGS 1965-1982

1) VSL_TU NUMBER OF U.S. FLAG TUNA PURSE SEINE VESSELS
2) LAN_TU LANDINGS OF TUNA,U.S. MAINLAND AND PUERTO RICO,EXCL. ALBACORE (THOUS. MT. TONS,LIVE WT.)
3) VAL_TU VALUE OF TUNA LANDINGS, U.S. MAINLAND AND EST. PUERTO RICO ($MILLION)
4) VALD_TU DEFLATED VALUE OF TUNA LANDINGS (U.S. MAINILAND AND EST. PUERTO RICO - $MILLION)
5) LAN_TU_X LANDINGS INDEX, TUNA 1965=100
6) VAL_TU_X VALUE OF TUNA LANDINGS INDEX, 1965=100 (INCLUDES U.S. MAINLAND AND EST. P. RICO)
7) VALD_TU_X DEFLATED VALUE OF TUNA LANDINGS INDEX, 1965=100

Date	VSL_TU	LAN_TU	VAL_TU	VALD_TU	LAN_TU_X	VAL_TU_X	VALD_TU_X
1965	111.00	152.54	42.74	42.53	100.00	100.00	100.00
1966	102.00	134.67	48.59	46.84	88.29	113.68	110.14
1967	101.00	171.41	46.83	43.84	112.37	109.58	103.07
1968	104.00	156.76	52.44	47.02	102.77	122.70	110.55
1969	120.00	169.42	59.96	51.02	111.06	140.29	119.96
1970	121.00	191.51	74.95	60.65	125.55	175.37	142.61
1971	124.00	195.05	86.80	66.90	127.87	203.09	157.30
1972	127.00	216.14	105.50	78.07	141.69	246.85	183.57
1973	133.00	217.55	117.28	82.07	142.62	274.41	192.97
1974	135.00	227.80	145.95	93.85	149.34	341.49	220.67
1975	142.00	234.83	135.73	79.85	153.94	317.58	187.75
1976	155.00	282.59	182.72	102.17	185.26	427.52	240.23
1977	142.00	198.31	163.44	86.36	130.01	382.42	203.06
1978	140.00	239.68	219.41	107.94	157.13	513.36	253.80
1979	138.00	223.53	209.49	94.86	146.54	490.14	223.04
1980	126.00	219.59	278.22	115.25	143.95	650.95	270.98
1981	128.00	208.88	264.96	100.29	136.94	619.93	235.80
1982	123.00	192.42	232.95	83.28	126.14	545.04	195.81

TABLE 16 TUNA: INDEXES OF PRODUCTIVITY, PRICES, COSTS, AND HARVESTING SECTOR HEALTH 1965-1982

1) CPUE_TU_X CATCH PER TON CARRYING CAPACITY INDEX, TUNA, 1965=100
2) ICST_TU_X INPUT PRICES INDEX, TUNA 1965=100
3) OCST_TU_X OUTPUT COST INDEX (COST/UNIT OF LNDGS.), TUNA, 1965=100
4) PRI_TU_X EXVESSEL PRICE INDEX, TUNA, EXCLUDING ALBACORE, 1965=100
5) HLTX_TU TUNA HARVESTING SECTOR HEALTH INDEX(PRICE-COST RATIO) BASE 1965=1.0

Date	CPUE_TU_X	ICST_TU_X	OCST_TU_X	PRI_TU_X	HLTX_TU
1965	100.00	100.00	100.00	100.00	1.00
1966	104.00	104.20	100.19	128.77	1.29
1967	146.00	105.88	72.52	97.52	1.34
1968	106.00	109.36	103.17	119.40	1.16
1969	105.00	115.42	109.92	126.32	1.15
1970	104.00	119.28	114.69	139.70	1.22
1971	96.00	118.80	123.75	158.84	1.28
1972	75.00	121.40	161.87	174.22	1.08
1973	69.00	135.30	196.09	192.43	0.98
1974	67.00	167.62	250.18	228.69	0.91
1975	68.00	178.58	262.62	206.31	0.79
1976	69.00	186.34	270.06	230.79	0.85
1977	54.00	198.00	366.67	294.17	0.80
1978	64.00	216.26	337.91	326.74	0.97
1979	55.00	249.06	452.84	334.50	0.74
1980	51.00	292.86	574.24	452.22	0.79
1981	56.00	328.64	586.86	452.75	0.77
1982	45.00	326.28	725.07	432.11	0.60

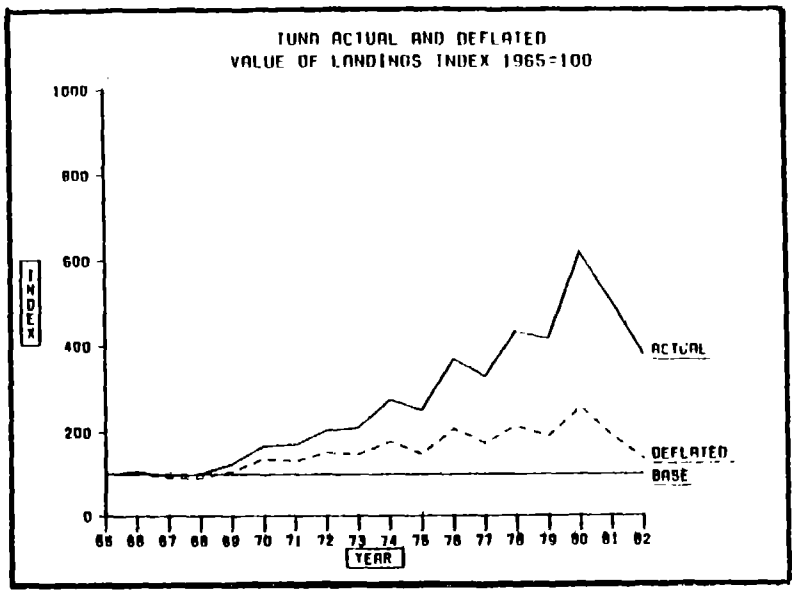

FIG.37

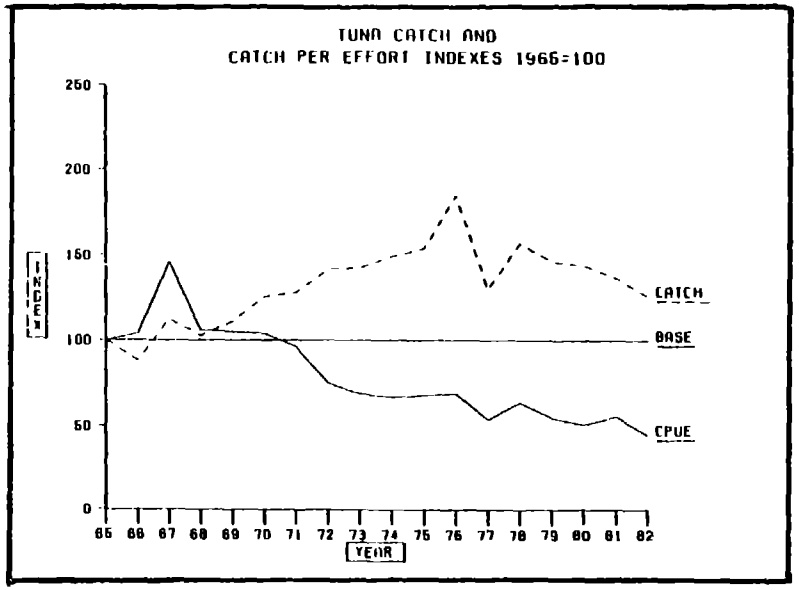

FIG.38

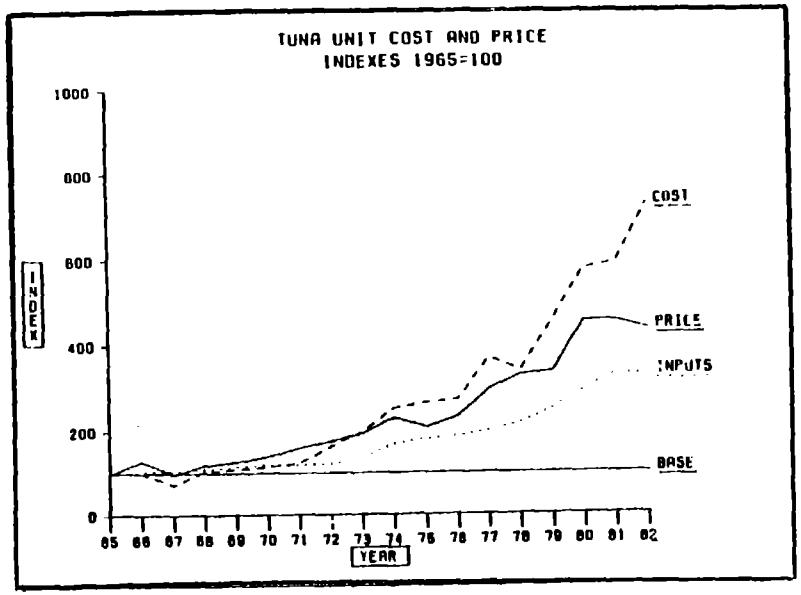

FIG.39

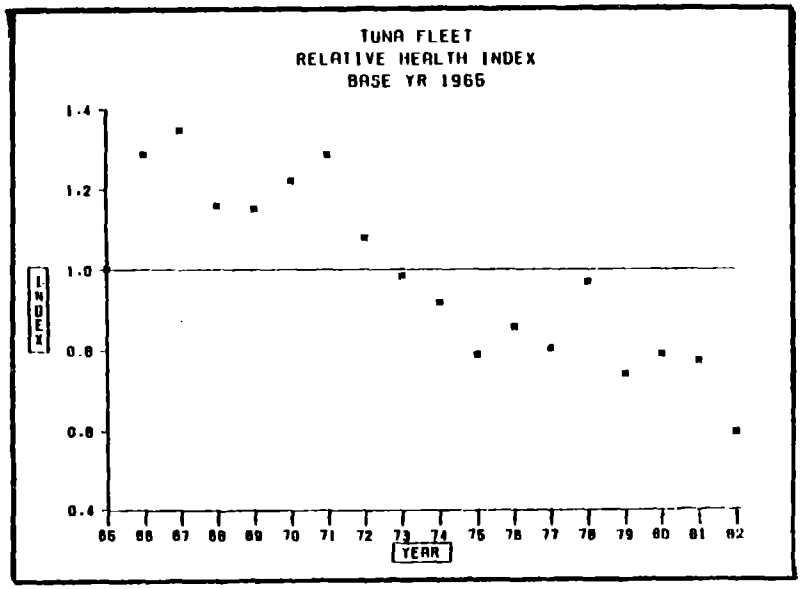

FIG.40

TABLE 17 KING & TANNER CRAB: VESSELS, EFFORT, LANDINGS AND VALUE OF LANDINGS 1965-1982

1) VSL_AC NUMBER OF VESSELS, KING AND TANNER CRAB (UNDUPLICATED)
2) EFRT_AC VESSEL TON-TRIPS, KING AND TANNER CRAB (THOUSANDS)
3) LAN_KC LANDINGS OF KING CRAB (THOUS. METRIC TONS)
4) LAN_TC LANDINGS OF TANNER CRAB (THOUS. METRIC TONS)
5) LAN_AC LANDINGS, KING & TANNER CRAB,(THOUS. METRIC TONS,LIVE WT.)
6) VAL_KC VALUE OF LANDINGS ,KING CRAB($MILLION)
7) VAL_TC VALUE OF LANDINGS ,TANNER CRAB ($MILLION)
8) VAL_AC VALUE OF LANDINGS ,KING & TANNER CRAB, ($MILLION)
9) VALD_AC DEFLATED VALUE OF LANDINGS , KING & TANNER CRAB(MILLION 1965 DOLLARS)

Date	VSL_AC	EFRT_AC	LAN_KC	LAN_TC	LAN_AC	VAL_KC	VAL_TC	VAL_AC	VALD_AC
1965	342.00	307.80	59.74	0.00	59.74	12.70	0.00	12.70	12.64
1966	424.00	387.96	72.21	0.00	72.21	15.70	0.00	15.70	15.14
1967	501.00	473.44	57.92	0.05	57.97	15.00	0.00	15.00	14.04
1968	462.00	450.45	37.10	1.45	38.60	21.80	0.30	22.10	19.81
1969	405.00	436.30	26.44	5.13	31.57	15.60	1.20	16.80	14.29
1970	345.00	365.15	23.63	6.58	30.16	13.20	1.40	14.60	11.81
1971	314.00	400.40	32.07	5.85	37.92	19.10	1.40	20.50	15.80
1972	368.00	563.16	33.66	13.65	47.31	20.50	3.70	24.20	17.91
1973	470.00	690.31	34.84	27.99	62.87	44.70	10.80	55.50	38.84
1974	528.00	698.06	43.82	29.03	72.85	39.30	13.10	52.30	33.63
1975	447.00	545.20	44.27	21.27	65.54	38.40	7.00	45.50	26.77
1976	492.00	637.76	48.08	36.65	84.78	67.90	16.00	83.90	46.91
1977	542.00	723.09	45.18	44.68	89.86	99.60	37.50	137.10	72.44
1978	679.00	960.13	55.61	58.88	114.62	155.90	50.90	206.80	101.74
1979	848.00	936.03	67.90	59.19	127.09	149.00	72.30	221.30	100.21
1980	834.00	923.64	84.23	55.38	139.61	191.70	60.10	251.80	104.31
1981	830.00	915.95	40.29	48.81	89.10	158.20	47.40	205.60	77.82
1982	830.00	935.86	17.46	30.62	48.08	114.80	71.40	186.20	66.56

TABLE 18 KING & TANNER CRAB: INDEXES OF EFFORT, PRODUCTIVITY, PRICES, COSTS, AND HARVESTING SECTOR HEALTH, 1965-1982

1) LAN_AC_X LANDINGS INDEX KING & TANNER CRAB 1965=100
2) VAL_AC_X VALUE OF LANDINGS INDEX., KING & TANNER CRAB, 1965=100
3) VALD_AC_X DEFLATED VALUE OF LANDINGS INDEX, KING & TANNER CRAB,1965=100
4) EFRT_AC_X VESSEL TON-TRIPS INDEX, KING & TANNER CRAB, 1965=100
5) CPUE_AC_X LANDINGS PER TON TRIP INDEX,KING & TANNER CRAB,1965=100
6) ICST_AC_X INPUT PRICES INDEX, KING & TANNER CRAB, 1965=100
7) OCST_AC_X OUTPUT COST INDEX (COST/UNIT OF LNDGS.), KING & TANNER CRAB, 1965=100
8) PRI_AC_X AVERAGE EXVESSEL PRICE INDEX, KING & TANNER CRAB, 1965=100
9) HLTX_AC KING & TANNER CRAB HARVESTING SECTOR HEALTH INDEX (PRICE/COST RATIO)BASE 1965=1.0

Date	LAN_AC_X	VAL_AC_X	VALD_AC_X	EFRT_AC_X	CPUE_AC_X	ICST_AC_X	OCST_AC_X	PRI_AC_X	HLTX_AC
1965	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	1.00
1966	120.88	123.62	119.74	126.04	95.91	104.20	108.65	102.27	0.94
1967	97.04	118.11	111.08	153.82	63.09	105.90	167.86	121.72	0.73
1968	64.62	174.02	156.75	146.35	44.15	109.50	247.99	269.31	1.09
1969	52.85	132.28	113.09	141.75	37.28	115.60	310.06	250.32	0.81
1970	50.49	114.96	93.47	118.63	42.56	119.40	280.52	227.68	0.81
1971	63.48	161.42	125.00	130.08	48.80	118.80	243.45	254.29	1.04
1972	79.19	190.55	141.68	182.96	43.29	121.40	280.46	240.61	0.86
1973	105.24	437.01	307.25	224.27	46.93	162.24	345.74	415.26	1.20
1974	121.94	411.81	266.06	226.79	53.77	199.92	371.80	337.71	0.91
1975	109.71	358.27	211.76	177.13	61.94	212.64	343.30	326.56	0.95
1976	141.91	660.63	371.16	207.20	68.49	221.76	323.77	465.52	1.44
1977	150.41	1079.53	573.11	234.92	64.03	274.40	428.55	717.70	1.67
1978	191.87	1628.35	804.88	311.93	61.51	299.60	487.06	848.66	1.74
1979	212.74	1742.52	792.79	304.10	69.96	393.76	562.85	819.08	1.46
1980	233.70	1982.68	825.20	300.08	77.88	460.16	590.85	848.39	1.44
1981	149.15	1618.90	615.66	297.58	50.12	515.04	1027.58	1085.43	1.06
1982	80.48	1466.14	526.62	304.05	26.47	511.68	1932.93	1821.63	0.94

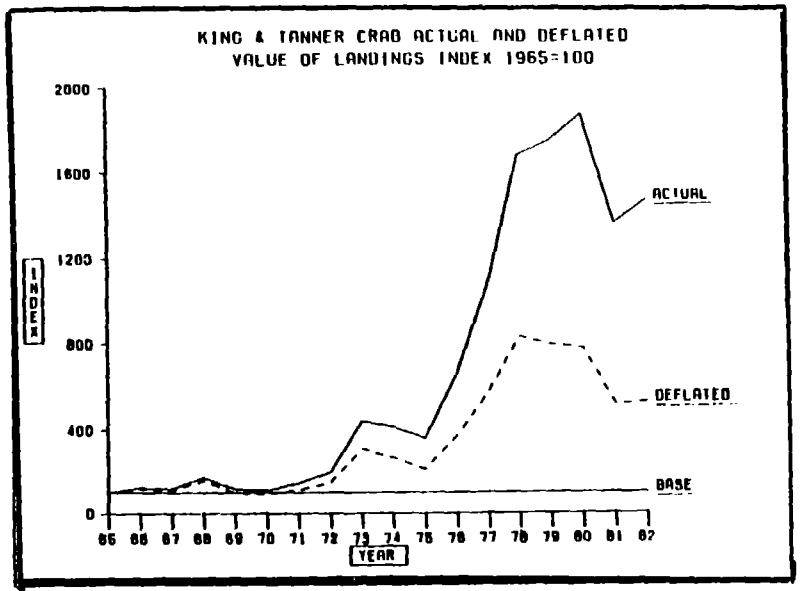

FIG.41

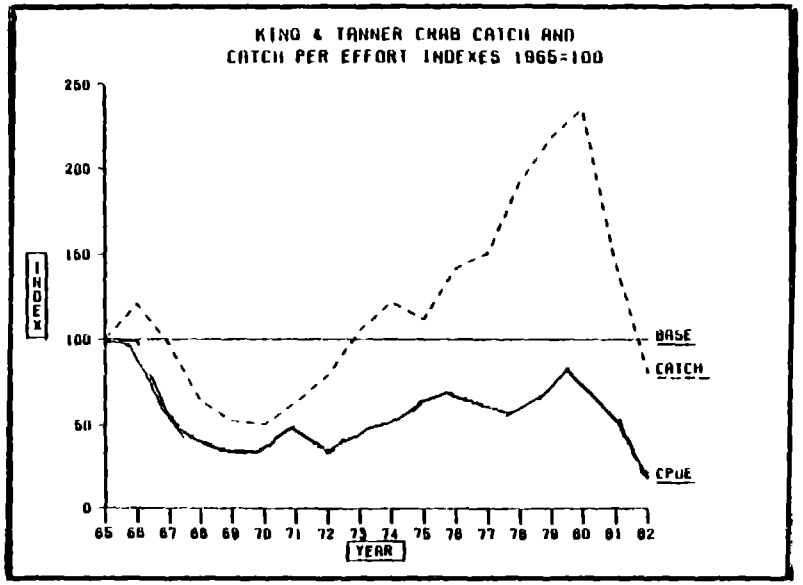

FIG.42

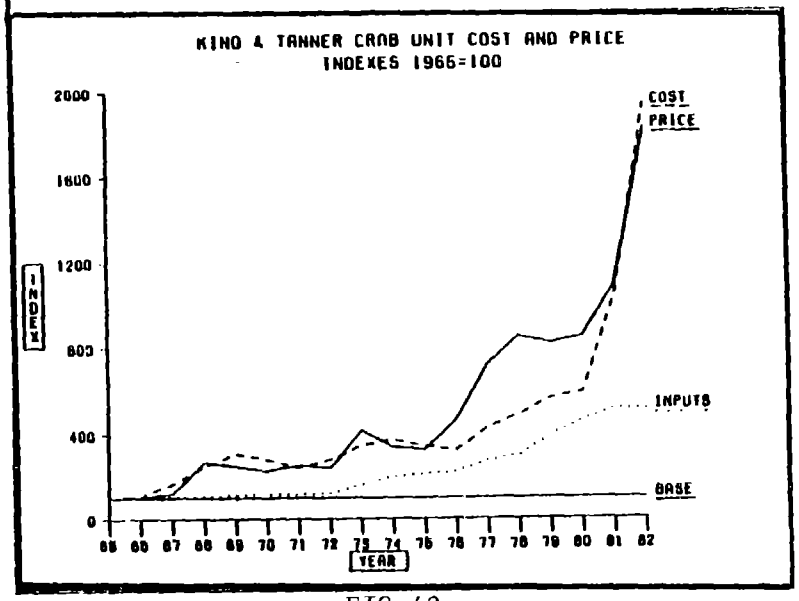

FIG.43

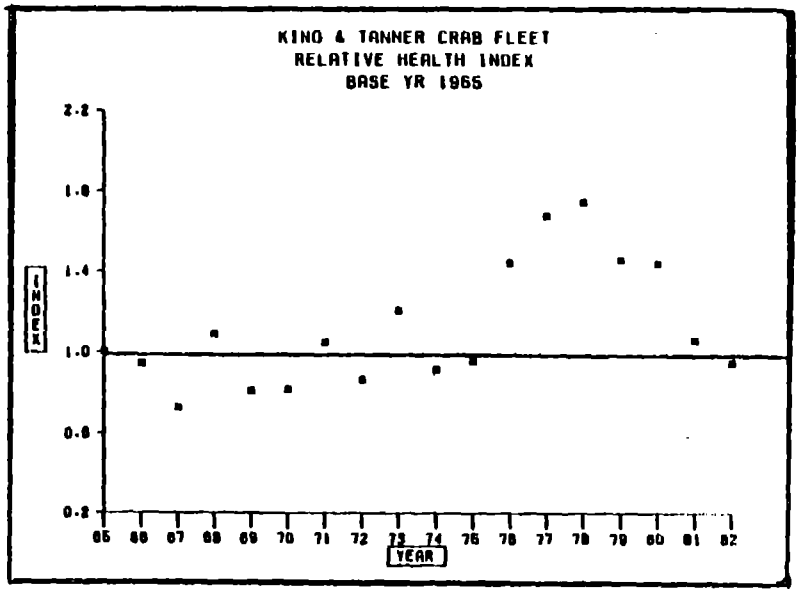

FIG.44

dramatically (Table 18 and Figure 41). This occurred after a period of rapid build up in the number and size of crab vessels and an expansion in the number of trips by these vessels. The build up in effort was partially a result of an unprecedented increase in value of landings which reflected increased landings and a rapidly increasing price from about 1970 to 1978 (Tables 17 and 18 and Figures 40, 41, and 42).

The unusual factor in this fishery is the price increase that took place in recent years. This price increase tended to offset increasing costs and declining catch rates. The strong price in this fishery is a result of the well established export market and the domestic market orientation toward restaurant sales. The final result, however, was that by 1982 even a price of 20 times higher than the 1965 level could not offset the catch rate drop of 1982. Thus, the economic health of the industry as measured by the Health Index no longer compared favorably with even that of the beginning stages of the fishery in 1965.

SUMMARY

The purpose of this paper was two-fold: to develop a simplified but meaningful method of evaluating the economic health of the U.S. fish harvesting industry; and to utilize that method to depict the economic health of certain major fisheries. The measure of economic health is an Industry Health Index which includes three components.

1. Industry output price (ex-vessel price);
2. Industry input costs (cost of fuel, labor, repairs, etc.); and
3. Industry productivity (catch per unit of fishing effort).

Industry productivity is the quotient of landings and total fishing effort. Therefore, the Health Index for each fishery is an aggregation of ratios of outut price, input costs, landings, and fishing effort in the year of interest (1982 for example) to that in the base year (1965 for this study). Using this approach, when the Industry Health Index for a fishery in a particular year is greater than 1.0, the industry cost-revenue situation (taking into account all of the components listed above) is relatively better than it was in 1965, the base year. Similarly, when the Index value is less that 1.0, the industry cost-revenue situation is less favorable than it was in the base year.

An important aspect of the proposed approach is that the cause of changes in output costs can be quantitatively partitioned between input price fluctuations and variations in productivity. This is especially useful in evaluating fishery management policy decisions.

The method was applied to eight major fisheries. Table 19 gives the fisheries included and the calculated 1982 Industry Health Index for these fisheries. Relative to 1965, the cost-revenue situation in the Gulf shrimp fishery was improved in 1982, while that for the New England scallop and otter trawl fisheries was about the same. For the other

fisheries -- especially Gulf menhaden and tuna -- the 1982 cost-revenue conditions were less favorable than in 1965.

The authors believe the method outlined in this paper is a useful approach for tracking the economic health of the various fisheries in the U.S. and suggest that NMFS establish a regular procedure for calculating and publishing such indicators.

It is recognized by the authors that the indexes calculated for this paper have the limitations inherent in the landings and effort data for each fishery. Attempts should be made to improve and refine the data and the indexes. This will require interdisciplinary work, particularly relative to the Productivity Index. Also important is an expansion of on-going cost and earnings studies. The product of this work would be the establishment of a set of industry economic health indicators useful to policy makers, potential investors in the harvesting sector, financial institutions and others interested in the U.S. commercial fishing industry.

TABLE 19 INDUSTRY HEALTH INDEX/VALUES FOR 1982, BY FISHERY

Fishery	Index Value
New England sea scallops	0.98
Maine lobsters	0.90
New England otter trawl	1.00
Gulf of Mexico shrimp	1.09
Gulf of Mexico menhaden	0.72
Surf clams	0.83
West Coast tuna	0.60
King and tanner crab	0.94

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APPENDIX

TABLE A-1 EDIBLE VS. INDUSTRIAL: LANDINGS AND VALUE

1) LAN_ED LANDINGS, EDIBLE FISH & SHELLFISH (THOUS. METRIC TONS LIVE WT.)
2) LAN_IN LANDINGS, INDUSTRIAL FISH (THOUS. METRIC TONS LIVE WT.)
3) LAN_TO LANDINGS, TOTAL COMMERCIAL FISH & SHELLFISH (THOUS. METRIC TONS LIVE WT.)
4) LAN_ED_PC EDIBLE LANDINGS AS A PERCENT OF TOTAL LANDINGS
5) VAL_ED VALUE OF EDIBLE FISH & SHELLFISH LANDINGS ($MILLION)
6) VAL_IN VALUE OF INDUSTRIAL FISH LANDINGS ($MILLION)
7) VAL_TO VALUE OF U.S. LANDINGS COMMERCIAL FISH & SHELLFISH, ALL SPECIES ($MILLION)
8) VAL_ED_PC VALUE OF EDIBLE LANDINGS AS A PERCENT OF TOTAL LANDINGS VALUE
9) VALD_TO DEFLATED VALUE ALL U.S. COMM. LANDINGS FISH & SHELLFISH (MILLION $1972)

Date	LAN_ED	LAN_IN	LAN_TO	LAN_ED_PC	VAL_ED	VAL_IN	VAL_TO	VAL_ED_PC	VALD_TO
1965	1173.46	993.38	2166.83	54.16	409.00	37.00	446.00	91.70	599.78
1966	1167.11	813.30	1980.40	58.93	437.00	35.00	472.00	92.58	614.90
1967	1074.12	765.22	1839.34	58.40	414.00	26.00	440.00	94.09	556.54
1968	1064.59	822.37	1886.96	56.42	468.00	29.00	497.00	94.16	602.13
1969	1052.80	914.45	1967.25	53.52	492.00	35.00	527.00	93.36	605.96
1970	1150.78	1079.56	2230.34	51.60	565.00	48.00	613.00	92.17	670.31
1971	1107.23	1165.29	2272.52	48.72	595.00	48.00	643.00	92.53	669.72
1972	1104.51	1075.48	2179.99	50.67	702.00	46.00	748.00	93.85	748.00
1973	1087.73	1115.85	2203.57	49.36	836.00	101.00	937.00	89.22	886.05
1974	1132.18	1120.84	2253.02	50.25	844.00	88.00	932.00	90.56	809.87
1975	1118.12	1094.08	2212.19	50.54	904.00	73.00	977.00	92.53	776.69
1976	1258.73	1185.25	2443.98	51.50	1257.00	92.00	1349.00	93.18	1019.34
1977	1315.43	1042.37	2357.80	55.79	1404.00	111.00	1515.00	92.67	1081.76
1978	1441.08	1293.21	2734.28	52.70	1733.00	121.00	1854.00	93.47	1232.55
1979	1505.03	1337.66	2842.69	52.94	2093.00	141.00	2234.00	93.69	1367.03
1980	1657.44	1282.77	2940.22	56.37	2092.00	145.00	2237.00	93.52	1252.24
1981	1608.91	1102.24	2711.15	59.34	2277.00	111.00	2388.00	95.35	1221.42
1982	1490.07	1397.99	2888.05	51.59	2247.00	143.00	2390.00	94.02	1154.59

TABLE A-2 EDIBLE VS. INDUSTRIAL: LANDINGS AND VALUE OF LANDINGS INDEXES

1) LAN_ED_X LANDINGS INDEX, EDIBLE FISH & SHELLFISH, 1965=100
2) LAN_IN_X LANDINGS INDEX, INDUSTRIAL FISH, 1965=100
3) LAN_TO_X LANDINGS INDEX, ALL FISH & SHELLFISH, 1965=100
4) VAL_ED_X VALUE OF LANDINGS INDEX, EDIBLE FISH & SHELLFISH, 1965=100
5) VAL_IN_X VALUE OF LANDINGS INDEX, INDUSTRIAL FISH, 1965=100
6) VAL_TO_X VALUE OF LANDINGS INDEX, ALL FISH & SHELLFISH, 1965=100
7) VALD_TO_X DEFLATED VALUE OF LANDINGS INDEX, ALL FISH & SHELLFISH, 1965=100

Date	LAN_ED_X	LAN_IN_X	LAN_TO_X	VAL_ED_X	VAL_IN_X	VAL_TO_X	VALD_TO_X
1965	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1966	99.46	81.87	91.40	106.85	94.59	105.83	102.52
1967	91.53	77.03	84.89	101.22	70.27	98.65	92.79
1968	90.72	82.79	87.08	114.43	78.38	111.43	100.39
1969	89.72	92.05	90.79	120.29	94.59	118.16	101.03
1970	98.07	108.68	102.93	138.14	129.73	137.44	111.76
1971	94.36	117.31	104.88	145.48	129.73	144.17	111.66
1972	94.12	108.26	100.61	171.64	124.32	167.71	124.71
1973	92.69	112.33	101.70	204.40	272.97	210.09	147.73
1974	96.48	112.83	103.98	206.36	237.84	208.97	135.03
1975	95.28	110.14	102.09	221.03	197.30	219.06	129.50
1976	107.27	119.31	112.79	307.33	248.65	302.47	169.95
1977	112.10	104.93	108.81	343.28	300.00	339.69	180.36
1978	122.81	130.18	126.19	423.72	327.03	415.70	205.50
1979	128.26	134.66	131.19	511.74	381.08	500.90	227.92
1980	141.24	129.13	135.69	511.49	391.89	501.57	208.78
1981	137.11	110.96	125.12	556.72	300.00	535.43	203.64
1982	126.98	140.73	133.28	549.39	386.49	535.87	192.50

TABLE A-3 U.S. EDIBLE AND INDUSTRIAL SUPPLIES: QUANTITIES AND PERCENTAGES

1) SUP_ED U.S. SUPPLIES OF EDIBLE FISHERY PRODUCTS (LANDINGS & IMPORTS, MIL. LBS. LIVE WT.)
2) SUP_IN U.S. SUPPLIES OF INDUSTRIAL FISHERY PRODUCTS (LANDINGS & IMPORTS, MIL. LBS. LIVE WT.)
3) SUP_TO U.S. SUPPLIES OF ALL COMM. FISHERY PRODUCTS (LANDINGS & IMPORTS, MIL. LBS. LIVE WT.)
4) PCT_EDLAN DOMESTIC LANDINGS EDIBLE SPECIES AS A PERCENT OF TOTAL EDIBLE SUPPLIES
5) PCT_INLAN DOMESTIC LANDINGS INDUSTRIAL SPECIES AS A PERCENT OF TOTAL IND. SUPPLIES
6) PCAPCON U.S. ANNUAL PER CAPITA CONSUMPTION OF COMMERCIAL FISH & SHELLFISH (KGS. EDIBLE MEAT)

Date	SUP_ED	SUP_IN	SUP_TO	PCT_EDLAN	PCT_INLAN	PCAPCON
1965	5163.00	5372.00	10535.00	50.11	40.77	4.90
1966	5432.00	7037.00	12469.00	47.37	25.48	4.94
1967	4849.00	9142.00	13991.00	48.83	18.45	4.81
1968	5579.00	11802.00	17381.00	42.07	15.36	4.99
1969	5674.00	6173.00	11847.00	40.91	32.66	5.08
1970	6213.00	5261.00	11474.00	40.83	45.24	5.35
1971	6023.00	5773.00	11796.00	40.53	44.50	5.22
1972	6889.00	6960.00	13849.00	35.35	34.07	5.67
1973	7107.00	3271.00	10378.00	33.74	75.21	5.81
1974	6638.00	3237.00	9875.00	37.60	76.34	5.49
1975	6394.00	3770.00	10164.00	38.55	63.98	5.53
1976	7404.00	4189.00	11593.00	37.48	62.38	5.85
1977	7414.00	3165.00	10579.00	39.12	72.61	5.76
1978	8135.00	3374.00	11509.00	39.05	84.50	6.08
1979	8251.00	3580.00	11831.00	40.21	82.37	5.90
1980	8006.00	3351.00	11357.00	45.64	84.39	5.81
1981	8267.00	3086.00	11353.00	42.91	78.74	5.85
1982	7968.00	4043.00	12011.00	41.23	76.23	5.58

TABLE A-4 U.S. EDIBLE AND INDUSTRIAL SUPPLIES: QUANTITIES AND CONSUMER PRICE INDEXES

1) SUP_ED_X INDEX OF U.S. SUPPLIES OF EDIBLE FISHERY PRODUCTS, 1965=100
2) SUP_IN_X INDEX OF U.S. SUPPLIES OF INDUSTRIAL FISHERY PRODUCTS, 1965=100
3) SUP_TO_X INDEX U.S. SUPPLIES OF ALL COMMERCIAL FISHERY PRODUCTS, 1965=100
4) PCAPCON_X INDEX U.S. PER CAPITA CONSUMPTION OF COMM. FISHERY PRODUCTS, 1965=100
5) CPI_FISH CONSUMER PRICE INDEX - FISH & SHELLFISH, 1965=100
6) CPI_BFVL CONSUMER PRICE INDEX - BEEF & VEAL, 1965=100
7) CPI_POUL CONSUMER PRICE INDEX - POULTRY, 1965=100

Date	SUP_ED_X	SUP_IN_X	SUP_TO_X	PCAPCON_X	CPI_FISH	CPI_BFVL	CPI_POUL
1965	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1966	105.21	130.99	118.36	100.93	106.56	105.27	105.38
1967	93.92	170.18	132.80	98.15	110.18	105.89	98.70
1968	108.06	219.69	164.98	101.85	111.99	110.18	101.80
1969	109.90	114.91	112.45	103.70	118.11	121.25	107.56
1970	120.34	97.93	108.91	109.26	129.97	126.61	107.03
1971	116.66	107.46	111.97	106.48	143.45	132.26	107.65
1972	133.43	129.56	131.46	115.74	156.32	144.70	109.00
1973	137.65	60.89	98.51	118.52	179.38	173.44	152.88
1974	128.57	60.26	93.74	112.04	206.75	178.41	145.01
1975	123.84	70.18	96.48	112.96	223.92	180.04	160.32
1976	143.40	77.98	110.04	119.44	250.37	174.19	153.77
1977	143.60	58.92	100.42	117.59	277.16	173.26	154.74
1978	157.56	62.81	109.25	124.07	303.34	212.92	170.71
1979	159.81	66.64	112.30	120.37	333.04	270.89	179.22
1980	155.06	62.38	107.80	118.52	363.77	286.22	188.36
1981	160.12	57.45	107.76	119.44	394.03	288.70	196.08
1982	154.33	75.26	114.01	113.89	408.26	292.79	192.63

TABLE A-5 U.S. IMPORTS VS. EXPORTS: VALUES, BALANCES, INDEXES, AND RATIOS

1) IMP_VAL U.S. IMPORTS OF FISHERY PRODUCTS IN MILLIONS OF DOLLARS
2) EXP_VAL U.S. EXPORTS OF FISHERY PRODUCTS IN MILLIONS OF DOLLARS
3) BAL_FISH U.S. BALANCE OF TRADE IN FISHERY PRODUCTS ($MILLION)
4) IMP_VAL_X INDEX OF U.S. IMPORTS OF FISHERY PRODUCTS, 1965=100
5) EXP_VAL_X INDEX OF U.S. EXPORTS OF FISHERY PRODUCTS, 1965=100
6) IM_EX_RAT RATIO OF U.S. IMPORTS FISH. PROD. TO U.S. EXPORTS FISH. PROD.

Date	IMP_VAL	EXP_VAL	BAL_FISH	IMP_VAL_X	EXP_VAL_X	IM_EX_RAT
1965	600.90	69.50	-531.40	100.00	69.50	8.65
1966	719.70	84.80	-634.90	119.77	84.80	8.49
1967	707.90	82.20	-625.70	117.81	82.20	8.61
1968	822.70	67.80	-754.90	136.91	67.80	12.13
1969	844.30	104.50	-739.80	140.51	104.50	8.08
1970	1037.40	117.50	-919.90	172.64	117.50	8.83
1971	1074.20	139.20	-935.00	178.77	139.20	7.72
1972	1494.40	157.90	-1336.50	248.69	157.90	9.46
1973	1583.10	299.20	-1283.90	263.45	299.20	5.29
1974	1710.90	262.10	-1448.80	284.72	262.10	6.53
1975	1637.10	304.70	-1332.40	272.44	304.70	5.37
1976	2328.20	384.70	-1943.50	387.45	384.70	6.05
1977	2633.60	520.50	-2113.10	438.28	520.50	5.06
1978	3086.00	905.50	-2180.50	513.56	905.50	3.41
1979	3808.80	1084.50	-2724.30	633.85	1084.50	3.51
1980	3648.50	1006.20	-2642.30	607.17	1006.20	3.63
1981	4206.00	1157.00	-3049.00	699.95	1157.00	3.64
1982	4523.60	1058.90	-3464.70	752.80	1058.90	4.27

TABLE A-6 WORLD CATCH: LANDINGS, INDEXES AND PERCENTAGES

1) LAN_WO WORLD CATCH OF FISH & SHELLFISH IN MILLION METRIC TONS LIVE WEIGHT
2) LAN_WXP WORLD CATCH EXCLUDING PERUVIAN ANCHOVY IN MILLION METRIC TONS LIVE WEIGHT
3) LAN_WO_X INDEX OF WORLD CATCH FISH & SHELLFISH, 1965=100
4) LAN_WXP_X INDEX OF WORLD CATCH EXCLUDING PERUVIAN ANCHOVY, 1965=100
5) PCT_US U.S. CATCH FISH & SHELLFISH AS A PERCENT OF WORLD CATCH

Date	LAN_WO	LAN_WXP	LAN_WO_X	LAN_WXP_X	PCT_US
1965	53.20	45.50	100.00	100.00	5.08
1966	57.30	47.70	107.71	104.84	4.36
1967	60.40	49.90	113.53	109.67	3.97
1968	63.90	52.60	120.11	115.60	3.91
1969	62.70	53.00	117.86	116.48	3.99
1970	65.60	52.50	123.31	115.38	4.27
1971	66.10	54.90	124.25	120.66	4.39
1972	62.00	57.20	116.54	125.71	4.52
1973	62.70	61.00	117.86	134.07	4.47
1974	66.50	62.50	125.00	137.36	4.21
1975	66.40	63.10	124.81	138.68	4.22
1976	69.80	65.50	131.20	143.96	4.30
1977	68.90	68.10	129.51	149.67	4.35
1978	70.40	69.00	132.33	151.65	4.83
1979	71.30	69.90	134.02	153.63	4.91
1980	72.20	71.40	135.71	156.92	4.99
1981	74.80	73.30	140.60	161.10	5.08
1982	-	-	-	-	-