Dockside Price Analysis in the Florida Mullet Fishery

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INTRODUCTION

Commodity prices are affected by a large number of forces. Mullet prices are no exception. The seasonal quantities of mullet landed, volumes going into short-term storage, location of landings relative to the market, and consumers' incomes, tastes, and preferences all affect mullet prices. Policies and programs of regulatory agencies affect prices through their influence on supply and demand factors. Marketing and market development programs also often create new consumer demand for mullet which can result in both higher prices and production.

This paper is a discussion of the factors which affect Florida mullet prices and their relative importance. To accomplish this objective annual dockside prices since 1952 and monthly dockside prices since January of 1970 are discussed from both a total fishing standpoint and from price differences within the fishery at different locations of production.

ANNUAL PRICES

Florida mullet landings varied during the 1952-73 period from a low of 23.5 million pounds in 1968 to a high of 39.9 million pounds in 1966 (Fig. 1). This constitutes about 80 percent of annual U.S. landings. Annual prices moved in an opposite direction with a low of 5.25 cents reported in 1963 and a high of 11.03 cents in 1973. Annual prices were obviously responsive to the quantity of mullet landed. That is, the larger the quantity of mullet available the lower the price per pound received. All mullet price and quantity data were obtained from National Marine Fisheries Service publications (National Marine Fisheries Service, 1970-74a, b). During the past several years mullet prices in current dollars have been above average for the entire period and in fact reached the all-time high in 1973. However, in terms of real dollars (or a measure of the purchasing power of money received by fishers for their catch) prices have been relatively stable. The average producer has made no real gain in terms of gross purchasing power, unless of course the real cost of production decreased substantially.

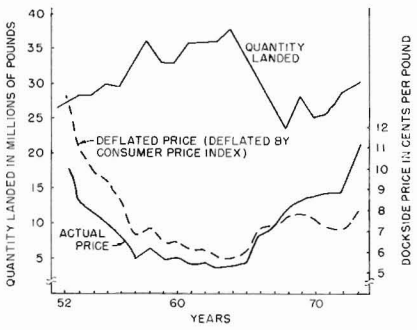

Figure 1.—Annual mullet landings in Florida and annual average prices in Florida in actual dollars, and dollars deflated by the consumer price index, 1952-73.

Estimated Price Functions

An estimated price response equation for mullet using annual data is given in Table 1. Regression coefficients give information concerning the effects of the quantity of mullet, other finfish landed, and personal incomes on the dockside price of mullet. The coefficient −0.29 means

Table 1.—Regression equation for annual dockside mullet prices, Florida, 1952-1973[1].

Dependent variable	Constant	Independent variable [3]			R^2	Durbin-Watson statistic
		Q_t	QF_t	IF_t		
P_t	15.9017	−0.2922 (4.70)	−0.0006 (.42)	.0439 (1.50)	0.65	0.83

[1]Number of observations is 22. The *t* statistic for each regression coefficient is shown in parentheses. The usual formula for computing the standard errors of regression coefficients are based upon the assumption that successive observations are random. In actual practice, the unexplained residuals for successive years may be significantly correlated. In such cases, the usual formula underestimates the standard errors of regression coefficients, thus overestimating the *t* values. The Durbin-Watson statistic for the equations indicate there may be some serial correlation.

[2]Dependent variable is:

P_t = Annual average price in cents per pound in year *t*.

[3]Independent variables are:

Q_t = Annual quantity landed in Florida in year *t* in millions of pounds.

QF_t = Annual quantity of all other finfish landed in year *t* in Florida in millions of pounds.

IF_t = Total personal income in Florida in year *t* in billions of dollars.

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that for each one million-pound increase in the annual quantity of mullet landed, a decline of 0.29 cents per pound can be expected in annual mullet prices with the values of other variables affecting mullet prices held constant. Stated in another manner, a increase of 3.42 million pounds will cause a one cent decline in annual prices. Florida total personal income was used to determine the effect of income changes on mullet prices. Although mullet are consumed primarily in the total Southeast, essentially no difference was determined by using total Southeast income. Quantities landed of all other finfish in Florida did not seem important in influencing mullet prices. The estimated price-quantity relationship given in Table 1 is plotted in Figure 2 with the remaining variables held at their mean values.

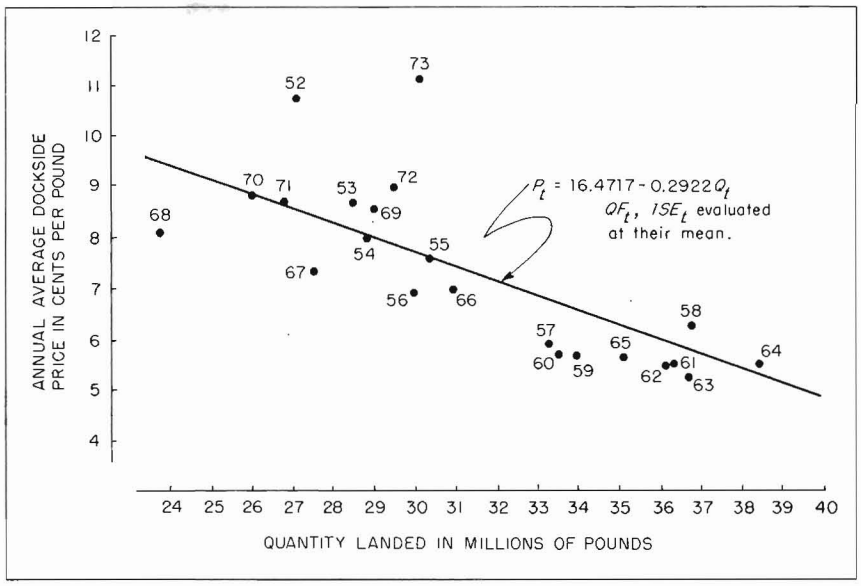


Figure 2.—Annual dockside mullet prices and quantities landed in Florida from 1952 to 1973 and estimated price function for mullet using equation in Table 1.

Price Differentials

Prices paid to fishers vary significantly with area of catch. Price differentials among five production areas in Florida demonstrated that in some years there was as much as 3 cents per pound difference between the lowest and highest price areas (Fig. 3). The five production areas selected for analysis included ten counties with two contiguous counties making up each of the five areas. Lee and Collier counties together produced 27 percent of total mullet landings in Florida in 1971-73, more than any other two counties. The five areas combined landed 64 percent of Florida's total for 1971-73 with Sarasota-Manatee, Franklin-Wakulla, Citrus-Levy, and Brevard-Volusia contributing 16.7, 8.5, 6.3, and 5.3 percent, respectively.

Beginning in 1965, definite price differentials emerged[1]. The Franklin-Wakulla area now consistently has the largest price differential from Lee-Collier, which was used as the base for comparison. This differential normally ranges between one and two cents per pound. The Citrus-Levy area, for the last 5 years, also yielded higher prices than the Lee-Collier area by as much as 1.5 cents. Between 1964 and 1969 the Citrus-Levy area fluctuated with prices for 3 years higher than the base and prices for 2 years lower than the base. In the Sarasota-Manatee area prices were higher than in the Lee-Collier area between 1966 and 1969 (usually less than 0.5 cent higher) but since 1970 average prices were as much as 1.2 cents below the Lee-Collier average. The Brevard-Volusia area continues to fall below the base price in a range of from 1.0 cents to 1.5 cents per pound.

Since 1970, mullet landings in all five areas except Sarasota-Manatee trended slightly upward, with average prices also trending upward. Relative quantities landed in the five areas and production differences give no indication that production differences have

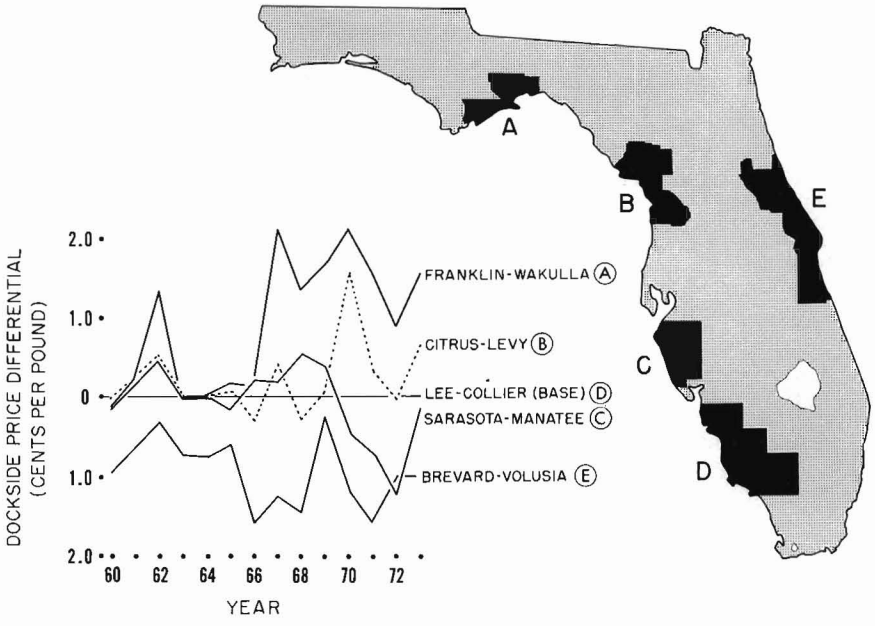
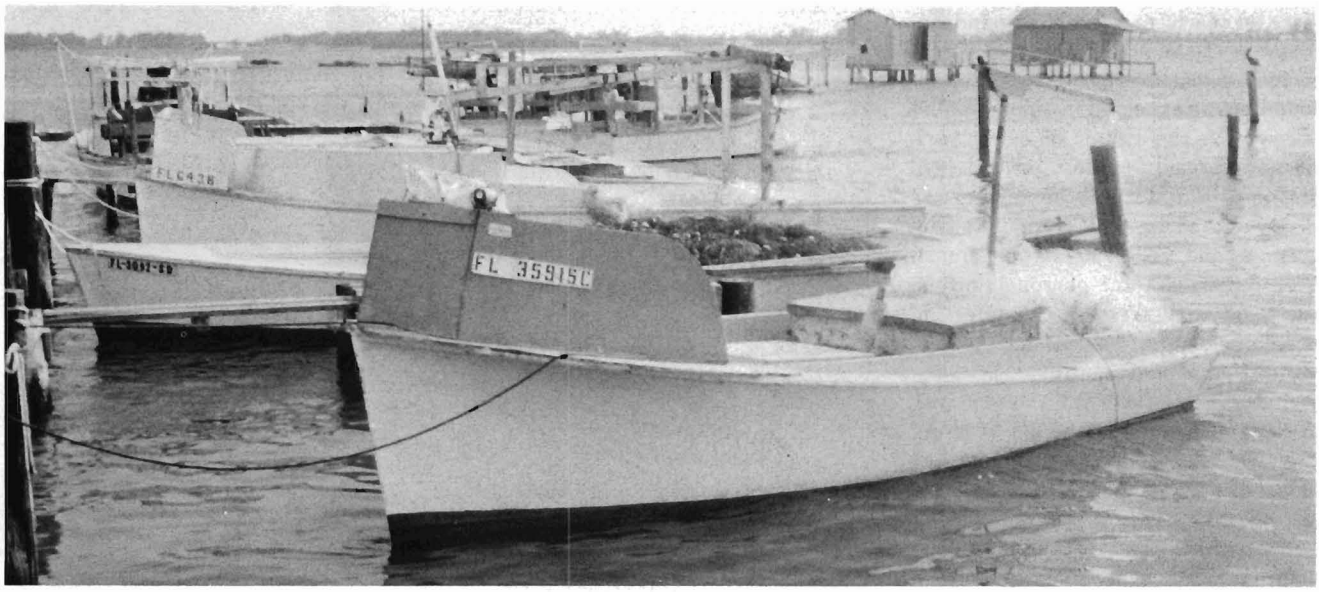
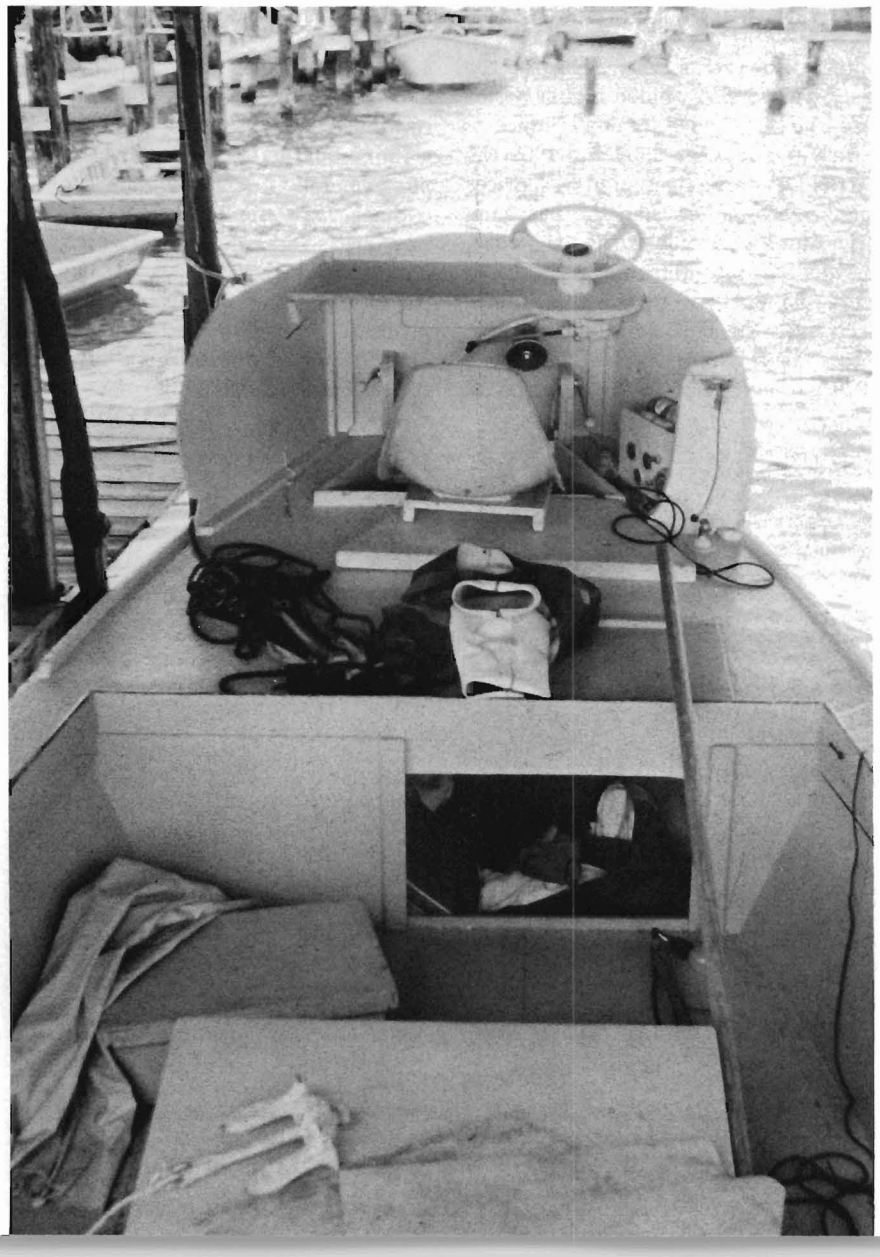


Figure 3.—Annual average mullet price differentials for five major production areas in Florida using Lee and Collier County price as base price, 1960-73.

[1]Examination of price data for species other than mullet indicate that several species showed quite similar prices in all areas of the state during 1963 and 1964. County price data were determined by dividing the county values of landings by pounds landed. During 1963 and 1964 it is possible that the data reporting technique used was to derive an average statewide price and use this price to estimate county landings values. This would have resulted in similar prices for all counties.





Boats (above and left) used in the mullet fishery are normally no longer than 24 feet. These two basic types are inboard boats with the controls located in the extreme front portion of the boat. This leaves room for an icebox and adequate working area.

caused the divergences appearing in 1964, 1965, and 1966. However, two of the lower production areas, Franklin-Wakulla and Citrus-Levy, do have higher prices than the other areas. Lower landings, combined with the locational advantage of being closer to southeastern markets such as Atlanta, may explain the higher price.

MONTHLY PRICES

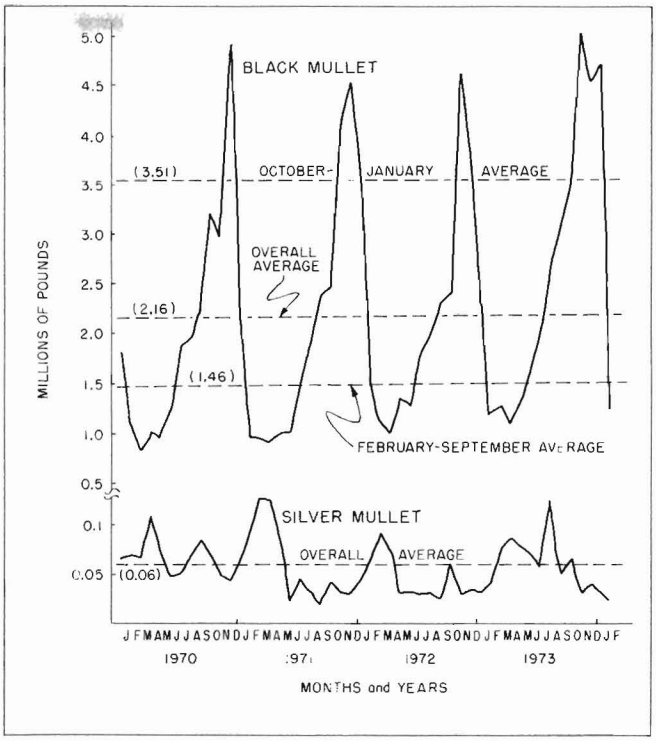
Seasonal and monthly variations in prices occur for a number of reasons. These include weather, social customs, holidays, and changes in the amount of mullet caught. For example, if the same amount of mullet were available each month, prices might vary due to holidays and seasonal consumption patterns. If the demand for mullet is the same each month, the amount caught would determine the price.

Black or striped mullet dominates the Florida mullet catch with four other species known to exist (Futch, 1966). Black mullet, *Mugil cephalus* Linnaeus, and silver mullet, *Mugil curema* Valenciennes, are reported as commercial catches in Florida.

Price-Quantity Relationships

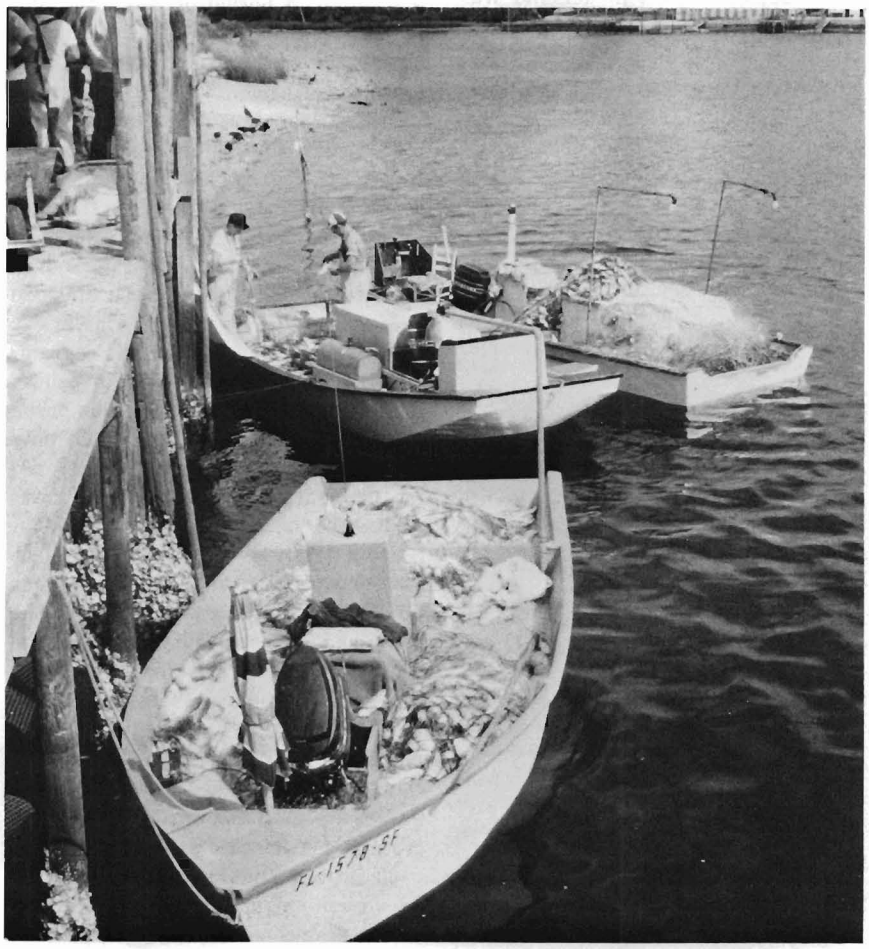
Black mullet spawn principally from November through January. Before

Figure 4.--Monthly landings of black mullet and silver mullet in Florida, 1970-73.



spawning, mullet form large schools and migrate from their typical estuarine habitat into offshore water (Futch, 1966). Formation of large schools and concentration in estuarine areas before going offshore causes mullet harvesting to increase drastically from September through January when they "run" and are more easily caught. Catch weights are also increased since most of the catch consists of mature spawning adults. Roe has always been a valuable by-product of the mullet catch but recently has become more important. See Futch (1966) for a detailed description of the black mullet and Smith (1972) for an indication of the importance of mullet roe.

Monthly landings of black mullet range from a low of slightly less than 1 million pounds in February through April to highs of between 4.5 and 5 million in December (Fig. 4). The October-January average since 1970 is 3.51 million pounds, the February-September average is 1.46 million, and the overall monthly average is 2.16 million pounds. Monthly average landings of silver mullet was about 60 thousand pounds. Silver mullet landings peak a little later than black mullet with high production months usually February and March.



This type of boat is called a "well" boat and is powered by an inboard motor mounted through an opening in the hull.

Average monthly statewide price of mullet received at dockside shows an inverse relationship with the quantity caught. When the amount of mullet produced by fishers is at a peak, the price received is usually the lowest (Fig. 5). Largest quantities landed normally occur in December and lowest prices received occur in December and January. Conversely, lowest quantities landed are normally in March and April, with highest prices received in May and June.

Prices received on the Florida West Coast where the major production occurs are normally higher than on the East Coast—in fact, in only 4 months of the 50 months covered in this study were average East Coast prices greater.

Estimated Price Function

Price and landings data from January 1970 through February 1974 were

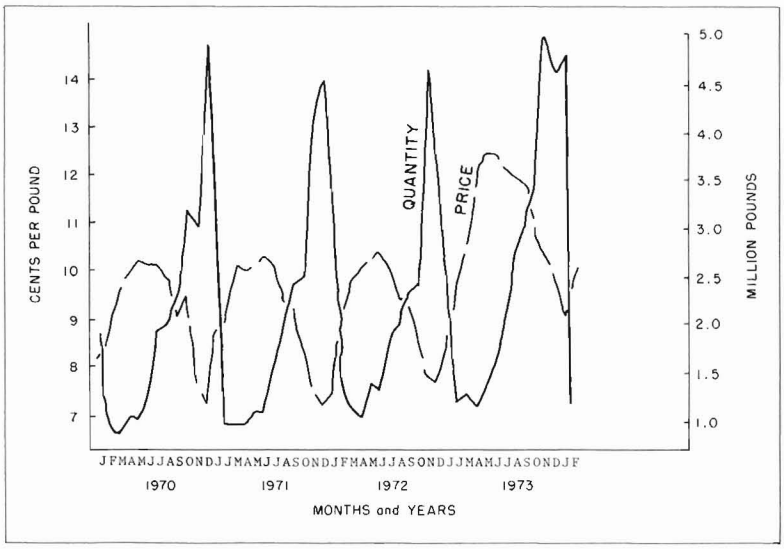


Figure 5.—Monthly landings and dockside prices of mullet in Florida, 1970-73.

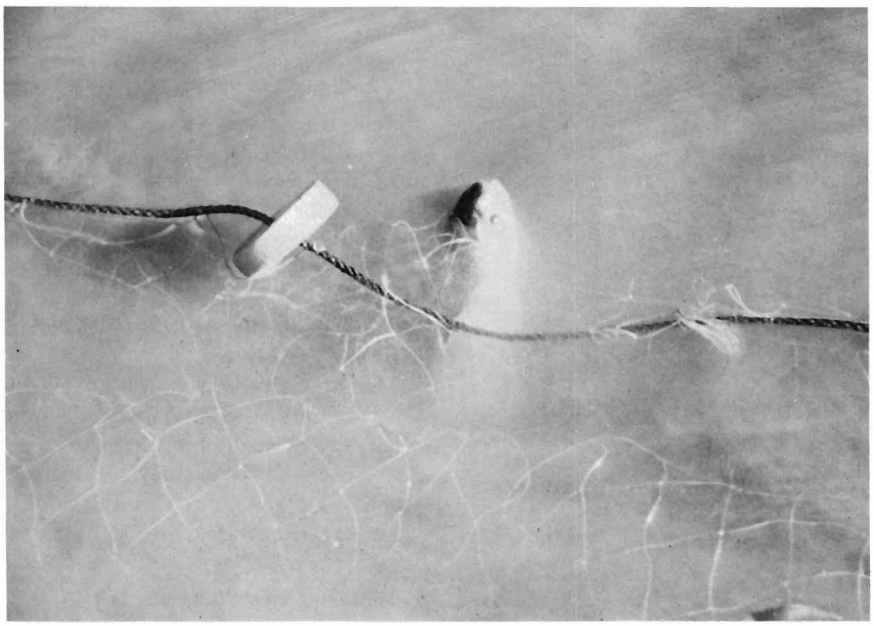
used to estimate a price response equation based on monthly observations. The data used and plotted in Figure 6 require some initial discussion. Dots on the figure represent the monthly price-quantity observation for the months of February through September of each year. This shows that higher prices were received during the months when quantities landed were relatively low. Monthly price-quantity relationships during the "run" months when larger quantities are landed are indicated by the X's and show that lower prices are received when quantities landed are highest. Circled observations indicate the plotted price-quantity relationships for April through December 1973.

This apparent shift in demand was primarily the result of increased activity in the roe market. Expectations were high that the demand for roe in Japan and France would be much greater than in the past and buyers were willing to pay a higher price than before. Efforts in late 1972 and early 1973 to develop roe markets were probably instrumental in causing this shift in demand. See Smith (1972) for a complete discussion of this marketing program by the National Marine Fisheries Service. January and February prices in 1974 fell back closer to their normal pattern but from March until August 1974, the latest data becoming available since the analysis was completed, prices have ranged from 12 to 14 cents per pound and demonstrated a price-quantity relationship consistent with the April-December 1973 demand level. The effect on price in any given month was estimated for changes in quantity landed, income, quantity of other finfish landed, and a demand shifter for the April-December 1973 period.

Often with a particular species the quantities landed in one or more previous months affect the current month's price in a similar manner as the current month's landings. When fish can be frozen and/or stored for any period of time this is likely to be the case. Wholesalers might buy a sufficient quantity of fish to satisfy their market for a period of 2 months and then be less willing to purchase mullet during the current month except at a much lower price.

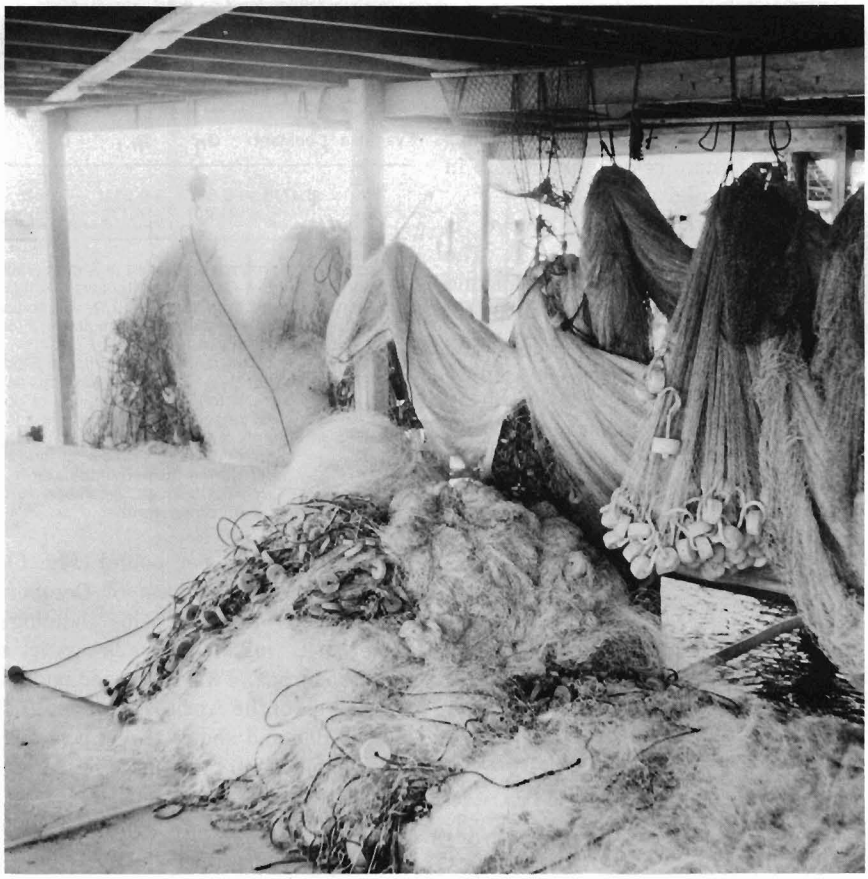
Mullet cannot usually be stored for more than a 60- to 90-day period unless frozen in the round. Two primary reasons exist for this. First, mullet flesh after any processing tends to become unstable during storage due to the susceptibility of the flesh lipids to oxidative rancidity (State University System of Florida Sea Grant Program, 1974). This technical problem causes most mullet to be consumed in fresh form or after storage periods of only several months' duration, unless stored in the round. Second, storage costs relative to the value of mullet are high. Since a dealer or wholesaler can place lobster or shrimp with a much higher ($2.00 to $4.00 per pound) value in the same cold storage facility as mullet and at the same storage cost, it is not generally economically feasible to store mullet because storage costs alone might exceed half the dockside value of the mullet stored. However, some mullet are placed in frozen storage for certain specialized markets.

Quantities landed beyond the third or fourth month past the current month would not be expected to have an appreciable effect on price in the current month. Inclusion of monthly



Mullet are caught primarily with gill nets. Mullet fishers also catch other species such as trout, redfish, Spanish mackerel, pompano, and bluefish.

Mullet fishers maintain a substantial investment in nets—possibly as high as $15,000. Net size may range from 3-inch mesh nets to 4¾-inch mesh with several net sizes in between.



storage inventories in this analysis was not possible since these data are not available. Also, since storage inventories of mullet are likely to be small, a distributed lag model was used to analyze the effect of mullet landings on price.

The price response equation estimated using a first degree polynomial distributed lag model[2] is shown in Table 2. This model assumes that quantities in the current month have the greatest effect on the price with quantities in prior months becoming less important each month until the effect on price approaches zero. The effect on price of a one million pound increase in current month landings was 0.53 of one cent decrease[3]. A one million pound increase in the month prior to the current month caused 0.36 of one cent decrease. Third month landings prior to the current month had minimal price effects. Lags of 4 months and second degree polynomials were also examined. The estimated equation shown in Table 2 was selected as the "best"[4].

Changes in personal income and the 1973 demand shift dummy variable were also important. The shift in demand occurring during April-December 1973 caused a price difference of 2.33 cents to be paid for any given

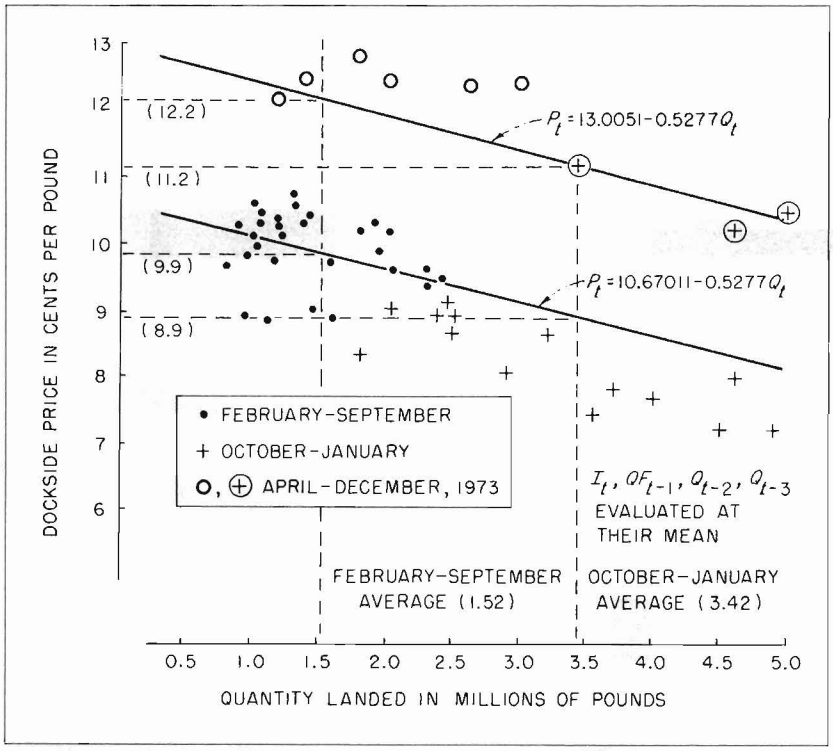


Figure 6.—Monthly quantity landed and dockside price of mullet in Florida from January 1970 to February 1974, and estimated price function for mullet using equation in Table 2.

[2]These models are often referred to as Almon lag models (Almon, 1965).

[3]The effect of a change in any particular variable on price is discussed with the effects of all other variables remaining constant. For example, interpretation of the – 0.53 coefficient means that for a 1 million pound increase in landings in the current month price will decrease by 0.53 of 1 cent, with all other variables remaining constant.

[4]One difficulty in using a polynomial lag model is that the degree of the polynomial and the length of the lag must be specified at the time of model formulation. Normally, familiarity of the data and industry will provide insight into the most appropriate degree and length of lag. Variations of degrees and lag lengths can then be tested until the contribution of the additional lagged variables to the regression sum of squares is no longer statistically significant. Another possibility is to choose the length of lag which results in the highest value for the coefficient of determination corrected for degrees of freedom. Finally, these criteria in concert with the knowledge of the data will result in a "best" lag and polynomial degree being chosen. Nonlag models examined did not appear to give as satisfactory results as the distributed lag model presented in this paper.

quantity[5]. The direction of price changes was also consistent with those expected. For example, increases in income were associated with positive changes in price. Landings of other finfish did not seem important in influencing mullet prices.

The estimated demand curve is shown graphically in Figure 6. The lower curve represents the demand curve traced out excluding the price-quantity data from April through December 1973. The upper curve represents the demand curve during the 1973 period. For the approximately 4-year period studied, the average monthly quantity landed during February-September was 1.52 million pounds. Using the estimated demand curve this would result in a dockside price of 9.9 cents per pound (Fig. 6). During the "run" season of October-January, average monthly landings were 3.42 million pounds with a resultant price of 8.9 cents per pound.

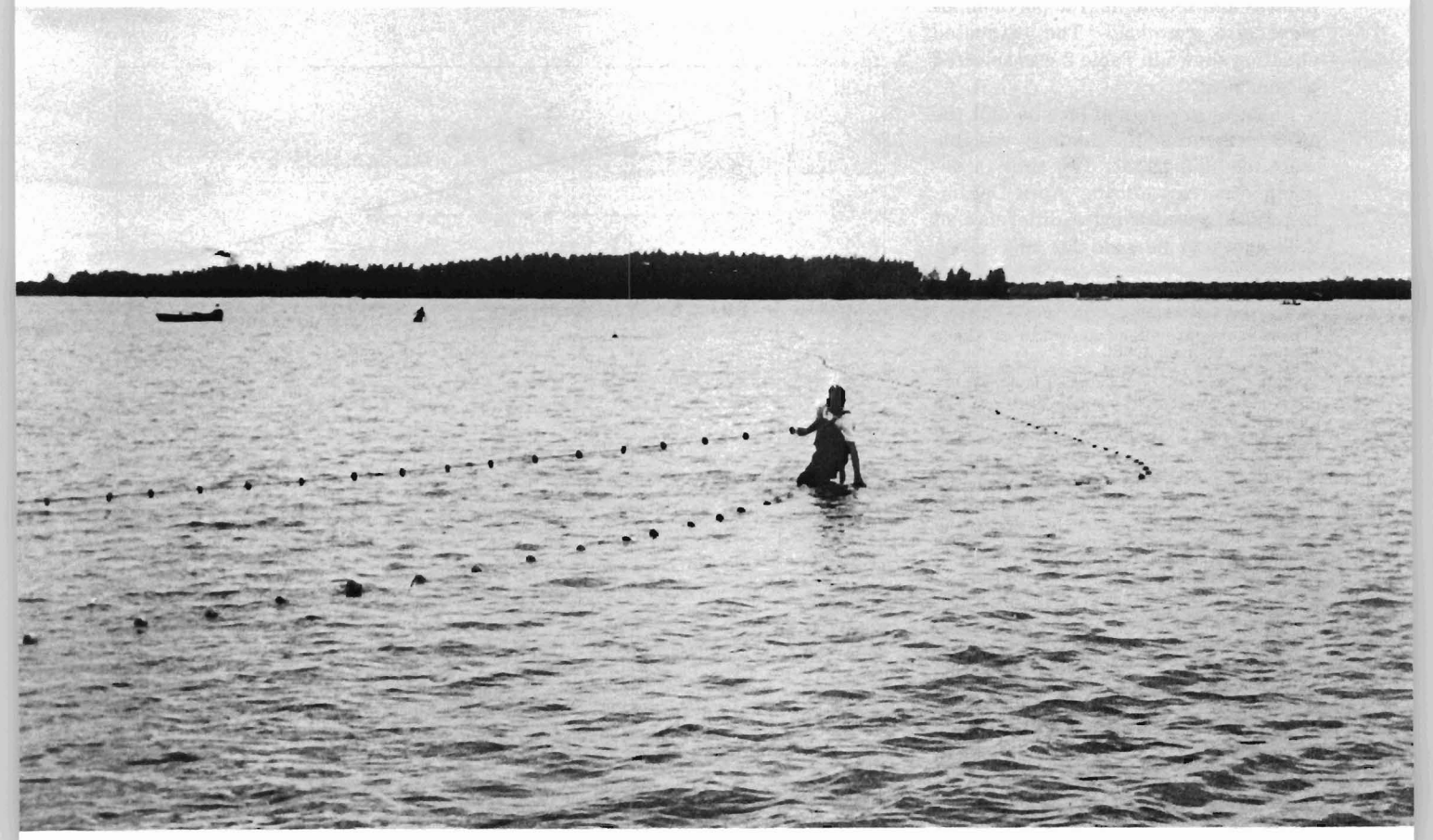
Analysis of the April-December 1973 shift in demand shows the importance of demand shifts in price determination. As remarked earlier, anticipation during this time was high for a new roe market, particularly in Japan. Market anticipation encouraged buyers to pay higher prices than had been paid in the past. Those buyers bidding price upward for the roe market then caused other buyers to pay higher prices to retain their relative market shares. Inclusion of the demand shifter (D) for

[5]Dummy variables to measure differences in the intercept and slope of the demand curve during the "run" season were also examined. Low t values were associated with slope shifter parameter estimates so it was not included in the model. A model including the intercept shifter did indicate a significant difference in the intercept of demand curve during the "run" season. A complete examination of this model can be made in a forthcoming report on the Florida mullet industry to be published by the Florida Sea Grant Program.

Table 2.—Regression equation using first degree polynomial distributed lag model[1] for monthly dockside mullet prices in Florida[2].

Depend. Variable[3]	Constant	Independent variables[4] Q_t	Q_{t-1}	Q_{t-2}	Q_{t-3}	IF_t	QF_t	D	R^2	Durbin-Watson statistic
Pt	8.4718	−0.5277 (13.0)	−0.3551 (14.17)	−0.1825 (6.26)	−0.0098 (0.20)	0.1125 (3.88)	0.0013 (0.25)	2.3350 (9.50)	0.92	1.60

[1]Models of this type are discussed in Almon (1965); Nervlove (1968); and Kmenta, Jan. 1971. Distributed lag models: A survey. Unpubl. manuscr. Michigan State Univ.
[2]Observations were from January 1970, to February 1974. Numbers in parenthesis are t values.
[3]Monthly dockside average price of mullet in Florida in cents per pound in month (t).
[4]Independent variables are:
Q_t = Monthly landings of mullet in Florida in current month (t) in millions of pounds.
Q_{t-1} through Q_{t-3} = Monthly landings of mullet in Florida in months prior (t—1, t—2, t—3) to current month (t) in millions of pounds.
IF_t = Total personal income in Florida in month (t) in billions of dollars.
QF_t = Monthly landings of all other finfish in Florida in month (t) in millions of pounds.
D = Zero-one shifter variable for months of April through December 1973, to indicate a demand shift during these months.
1 = April through December 1973.
0 = All other months.



Fishing is sometimes done in water shallow enough to wade.

this period resulted in the upper demand curve in Figure 6 with resultant prices of 12.2 and 11.2 cents per pound, respectively, during the average "summer" and "run" seasons.

Significance of causing upward shifts in the demand for mullet becomes apparent. Upward demand shifts occur for several reasons in addition to the shifts caused by population, income, and changes in other products. One shifter is new markets for a product, as is evidenced by the effect of the roe market on total demand. Another shift might occur from market promotional activities to make consumers aware of a product or new uses of a product. Successful promotions can be expected to shift demand upward. A third, but related reason, would be a technological improvement that would allow new products to be produced from mullet. Solution of the rancidity problem allowing the more versatile use of mullet flesh in new and different products would undoubtedly cause an upward demand shift.

PRICE FLEXIBILITIES

Price-quantity flexibilities show the percent change in price resulting from a 1 percent change in quantity given that the effects of other variables affecting price remain constant[6]. The percentage effect of mullet quantities landed on mullet price are shown in Table 3.

[6]Price-quantity flexibility was computed as $\frac{\partial P_t}{\partial Q_t} \cdot \frac{Q_t}{P_t}$, where:

$\frac{\partial P_t}{\partial Q_t}$ = partial derivative of estimated mullet price response equations with respect to quantity of mullet landed, and

P_t, Q_t = arithmetic means of mullet price and quantity variables used to estimate equations.

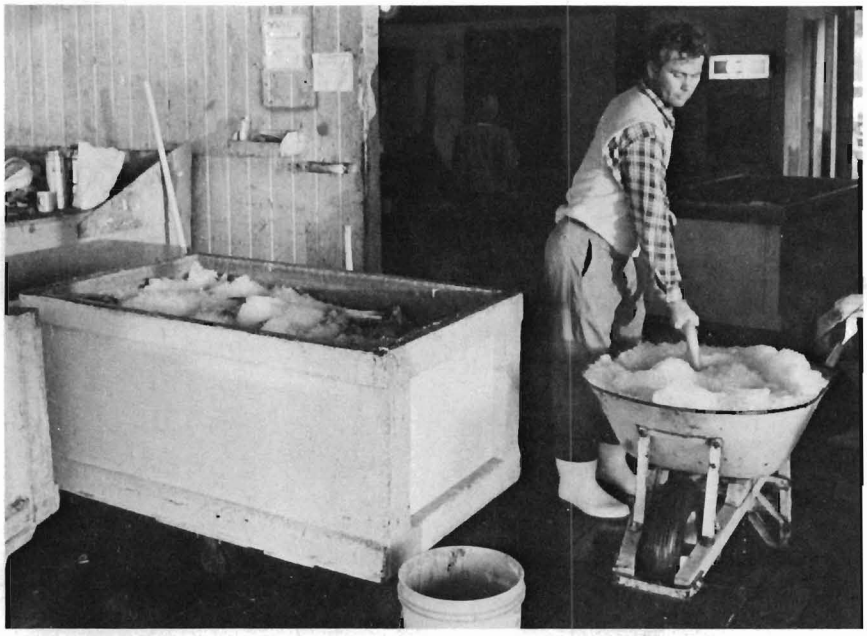
Table 3.—Price-quantity flexibilities for Florida mullet based on monthly, bimonthly, quarterly and annual data.

Equation used	Type of data	Price-quantity flexibility
From:		
Table 2	monthly	—0.123
Table [1]2	bimonthly	—0.129
Table [1]2	quarterly	—0.184
Table 1	annually	—1.251

[1]A model identical to that in Table 2 was used with monthly data transformed into quarterly and bimonthly observations, respectively.

The argument would normally be made that prices become more flexible as the time or period for price adjustment becomes longer, particularly when storage of any commodity is possible. For example, buyers will store mullet purchased at lower prices when possible to satisfy their needs in coming months. During these coming

Other fishing occurs in the bays with the entire operation handled from the boat.



Mullet are handled at the fish house by washing and placing on ice and under refrigeration.

months when supplies may be more limited purchases will not be necessary at the higher price since storage holdings are available.

The degree of responsiveness will in part depend on the length of time mullet can be stored. Since most mullet are consumed fresh and storage periods in general range from no longer than 3 to 4 months, less flexible prices with respect to quantities landed would be expected monthly than on a bi-monthly, quarterly, and annual basis. The shorter the time period under consideration, the more available are storage holdings and the less price responsive are buyers to changes in quantity.

Mullet dockside price-quantity flexibilities followed this pattern. The flexibility based on monthly data of -0.123 means that for a one percent increase in quantity of mullet landed there would be 0.123 percent decrease in price. Aggregation of the monthly data into bimonthly and quarterly observations and the resultant price response equation estimations led to price-quantity flexibility estimates of -0.129 and -0.184. The price response on the bimonthly basis was fairly similar to that on the monthly basis while the quarterly estimates yielded a somewhat more price flexible response. Beginning with the 3-month period buyers must become more price responsive to quantities landed since storage beyond that time period becomes less likely. On an annual basis, a one percent increase in quantity landed resulted in a 1.251 percent decrease in price. Storage over the period of one year is virtually non-existent. Buyers are then quite price responsive to changes in the quantities of landings.

Approximation of price-elasticities from the price-quantity flexibilities also allow some comparisons of the effect on total revenues of production increases and decreases. Approximated price elasticities from the monthly, bimonthly, and quarterly price-quantity flexibilities are -8.13, -7.75, and -5.43, respectively[7]. Since the absolute values of these are greater than 1, fishers should be able to land more mullet in the short run and accept the lower price with resultant higher total revenues. This is predicted on the assumption that the fish are available and will be purchased.

Price-income flexibilities were computed on a monthly and annual basis. These estimates were 0.2616 and 0.0676, respectively, and indicate the percentage change in price resulting from a one percent increase in income, with all other variables affecting mullet prices remaining unchanged.

INDUSTRY IMPLICATIONS

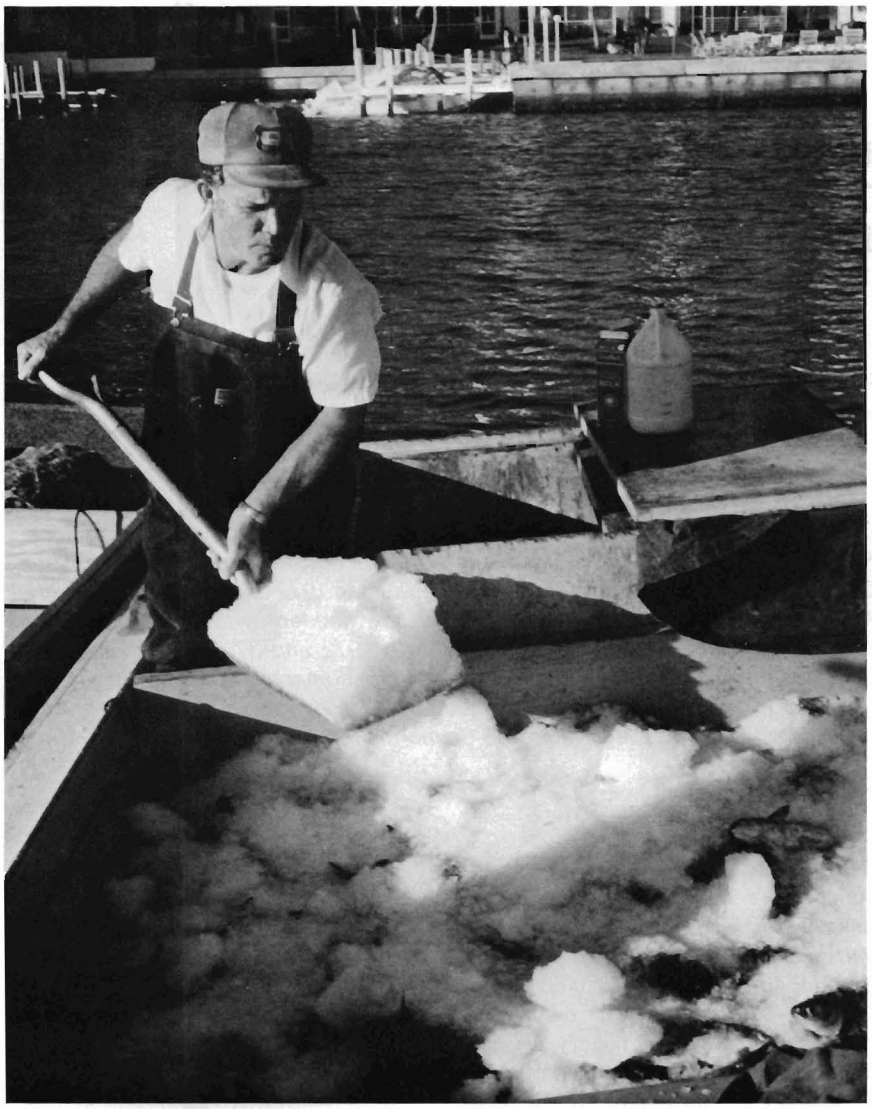
Fishers are perhaps more conscious of the prices received for the mullet they catch than any other segment of the industry. Each is a price-taker, and individually can do little to influence prices at the dockside level. Just as the consumer has the option of refusing to

[7]Computed by taking the inverse of price-quantity flexibility. This is not the true elasticity of demand but is an acceptable approximation for this use.

buy mullet if the price is too high, fishers have the choice of not fishing for mullet if the price they receive is too low to cover expenses and give a return for their labor and management. But, in the short run, bills must be paid and not fishing at all on an individual basis is not a very satisfactory alternative.

Therefore, to get higher dockside prices for mullet, two improvements are necessary. These are more markets and new products. This analysis showed the effect of a demand shift on dockside prices. Assuming that development of the roe market was instrumental in causing the demand shift as discussed in this paper, a resultant dockside price increase of 2.3 cents per pound was felt as a result of this market program. Continuation of this type effort to develop other markets and new uses for mullet will be necessary to further the improvement of dockside prices. New markets and products must be developed for mullet, and the technological problems of storage and rancidity must be solved to make this feasible.

New products, markets, and improvements in the storage capability will also contribute to the solution of the seasonality problem in the industry. Since major production occurs during a 4-month period when the market becomes glutted and prices are low, new products and markets would take the pressure off this over-supply, depressed price period and provide the producers with possibly higher and certainly more stable prices. Storability would also insure processors and manufacturers of new mullet products a constant month-to-month supply. Markets are hard to develop and maintain with nonstorable seasonable production. It will take an effort from all segments of the industry to implement these improvements and realize higher mullet prices.



Quality mullet are produced using ample ice. This fisherman stores his catch between layers of ice as it is taken from the net.

LITERATURE CITED

Almon, S. 1965. The distributed lag between capital appropriations and expenditure. Econometrica 33:178-196.

Futch, C. R. 1966. Lisa, the Florida black mullet. Fla. Board Conserv. Mar. Lab., Salt Water Fish. Leafl. 6, 6 p.

National Marine Fisheries Service. 1970-74a. Fishery Statistics of the United States. Curr. Fish. Stat., U. S. Gov. Print. Off. Washington, D.C.

National Marine Fisheries Service. 1970-74b. Florida landings. Curr. Fish. Stat., U.S. Gov. Print. Off., Washington, D.C.

Nervlove, M. 1968. Distributed lags and demand elasticities: Theoretical considerations. J. Farm Econ. 11:301-310.

Smith, E. M. 1972. Japan trade mission, provisional draft. U. S. Dep. Commer., Nat. Mar. Fish. Serv., Pascagoula, Miss.

State University System of Florida Sea Grant Program. 1974. Improved technology for the utilization and maintenance of the quality of mullet. Fish. Resour. Proj. R/RF-2, State Univ. Syst. Fla. Sea Grant Prog., Year '74 Proposal for Calendar Year 1975, Vol. II.

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