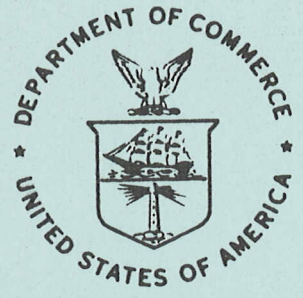

NOAA Technical Memorandum

NMFS-SEFC - 111

Estimated Impacts of Texas Closure Regulation on Ex-vessel Prices and Value, 1981 and 1982

John R. Poffenberger

U.S. Department of Commerce

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William G. Gordon, Assistant Administrator of Fisheries

Introduction and Methodology

The area seaward of the Territorial Sea off the Coast of Texas was closed to shrimp fishing concurrently with the closure by Texas of their Territorial Sea from May 25 through July 14, 1982. This is the second year that the Department of Commerce, National Marine Fisheries Service (NMFS) has mandated this concurrent closure. In addition to their regulatory responsibilities, the NMFS has also been requested by the Gulf of Mexico Fishery Management Council to thoroughly monitor and evaluate the effects of the Texas closure regulation. In December 1981, a report on the NMFS' monitoring of the shrimp fishery in the western Gulf of Mexico during May through August 1981 was presented to the Gulf Council. The NMFS also monitored various aspects of the closure regulation's effects during and immediately following the 1982 period and the purpose of this report is to present the analytical findings regarding the closure's effects on ex-vessel prices and value. The report also provides the estimated effects of the 1981 closure regulation for the twelve-month period beginning in May and ending in April 1982.

The theoretical rationale supporting this analysis is a straightforward result of shrimp being a "normal" good in which the demand for a product is inversely related to its prices. The demand for shrimp at the ex-vessel level is translated into the pounds landed and the price is assumed to be influenced (inversely) by the quantity of landings. Consequently, since the closure was anticipated to increase the amount of landings (the amounts of pounds landed, but not necessarily the number of shrimp), the ex-vessel price would be expected to decrease. The primary purpose of this research is to empirically estimate the magnitude of the price changes resulting from the estimated changes in landings due to the closure regulation. The estimated changes in prices are used to provide empirical estimates of the amount that the ex-vessel value has changed as a result of the regulation.

The same methodology was used in the 1981 report presented to the Gulf Council (Poffenberger, 1981 and 1982); however, only the direct effects of the Texas closure regulation on ex-vessel prices and value of brown shrimp were estimated. This report expands that analysis by estimating the indirect effects of the closure regulation on white and pink shrimp in the north central Gulf and also on all the commercial shrimp landed on the west coast of Florida. As a result of this analytical approach, 24 equations are required to estimate the effects of the change in brown shrimp landings on shrimp prices throughout the Gulf of Mexico. That is, there are three sets of equations - one for brown shrimp, one for pink and white and the third for Florida shrimp - and each set has eight equations that coincide with the eight marketing categories, which are based on the size of the shrimp.

The basic statistical relationship required for estimating net ex-vessel value is the relationship between price and landings. Multiple linear regression (ordinary least squares) was used to estimate the price-landings

relationship because this technique estimates the partial effects of a specific variable (in this analysis, landings) at the same time it includes the effects of other variables correlated with the dependent variable (i.e., ex-vessel price). The specific correlation with ex-vessel prices that is required for this analysis is the correlation with the brown shrimp landings variable. The coefficients of this variable in linear regression equation specifications provide empirical estimates of the absolute relationship between ex-vessel price and landings over the 1971-80 ten-year period. These estimated coefficients are the slope of the respective price-landings curve and are not estimates of the price flexibility of landings. The actual estimated changes in ex-vessel prices were made on a relative basis by multiplying the estimated regression coefficients times the ratios of the respective means of the price and landings data. These quantities are the price flexibilities estimated at the mean and are multiplied times the percentage change in brown shrimp landings to estimate the change in ex-vessel prices.

Including data on other factors besides landings is important for a complete specification of the regression equations. The literature on this subject provides a fairly well defined set of variables that can be tested and included if the respective relationship is justifiable statistically. This report does not discuss the relative merit of these variables, but previous research indicates that the following variables are the important ones; brown shrimp landings, landings of "other" sizes of shrimp depending on the specific equation, the quantity of fresh and frozen imports, the amount of inventories held in cold storage, real interest rates, real per capita spending at eating and drinking places, and real wholesale prices for the respective marketing categories.[1/] Not all of the regression equations, however, include each of these variables. A step-wise regression technique was used to estimate the equations and since this technique includes the variables one at a time depending on the relative statistical significance of the remaining variables, the "best" statistical fit for each equation was made when not all of the remaining variables were significantly correlated with the dependent variable.[2/] Consequently, the specification for each of the price landings' equations have, for the most part, different combinations of these seven independent variables. The specifications for each of the equations are listed in the Appendix (Table A.1).

For purposes of this analysis and to be consistent with other research reports prepared to evaluate various aspects of the closure regulation, price data are analyzed on a "biological" year basis. The biological year is defined as May through the following April. Thus, the analysis presented in this report is done for two time periods. First, the effects on prices and value are estimated for the twelve-month period beginning in May 1981 and ending in April 1982. The second time period is the four-month, May through August 1982. The analysis of the 1982 closure regulation is a preliminary one, and is provided as assistance to the Gulf Council in their decision to recommend continuation or repeal of the DOC/NMFS regulation.

Analytical Results

1981 Biological Year

The estimated effects of the Texas closure regulation on ex-vessel prices and value during May 1981 through April 1982 are presented in this section. The next section discusses these empirical results in more detail and provides a more in-depth interpretation of the estimates. Since 1981 was the first year that the regulation was in effect, a general question that should be considered initially is whether reported ex-vessel prices exhibited different patterns during the 1981-1982 twelve-month period than they exhibited historically. Shrimp prices (or prices in general) are difficult to evaluate over long periods of time with simple monthly averages. This difficulty is due primarily to the trends and cyclical fluctuations that prices usually exhibit. The trend components of the fluctations are caused by extraneous or non-market influences (inflation for example). Thus, numerical ten-year averages of shrimp prices for a particular month would not provide a good point of reference with which to make an evaluation about the movement of monthly shrimp prices during 1981 and 1982. In order to provide a more realistic point of comparison for monthly shrimp prices, the regression equations used to estimate the price flexibilities for the ex-vessel value calculations are used to predict 1981 and 1982 monthly shrimp prices.

Regression analysis is a reasonable approach because ordinary least squares provides the "best" linear fit of the average monthly prices by the respective independent variables. Thus, estimating 1981 and 1982 shrimp prices using the reported values for the independent variables (imports, wholesale prices, cold storage inventories, etc.) will provide best linear, unbiased, estimates of "average" shrimp prices given the conditions that occurred during 1981 and 1982. The actual reported prices and the predicted prices are plotted in Figures 1, 2, and 3 for the three sets of regression equations - i.e., the brown shrimp model, the white and pink shrimp model, and the Florida model respectively. Each figure has eight separate graphs for the eight marketing categories and in each of the graphs the solid line is the reported prices and the broken line is the predicted prices.[3/]

As the similarity of the two curves in each of the 24 plots indicates, the fit of the regression equation, in most cases, is quite good. This is not surprising since the statistical fits of the regression equations as indicated by the summary statistics (Appendix Table A.1) are excellent. The interpretation of these graphs, besides demonstrating the predictive quality of the equations, is to show whether the reported prices were similar in movement and magnitude to the predicted prices. If the estimated prices (i.e., the broken lines) are less than the reported prices, than the market did not react "as much as" it could have on the average given the magnitude of the independent parameters reported during 1981 and 1982. On the other hand, if the solid line is below the broken line, then the market reacted more than the least squares average. The graphs in Figures 1 through 3 display examples of both greater and lesser reactions of the shrimp market to the conditions in 1981 and 1982. There are no clear indications that monthly shrimp prices displayed any unexpected patterns during or after the Texas closure regulation in June and July, 1981.

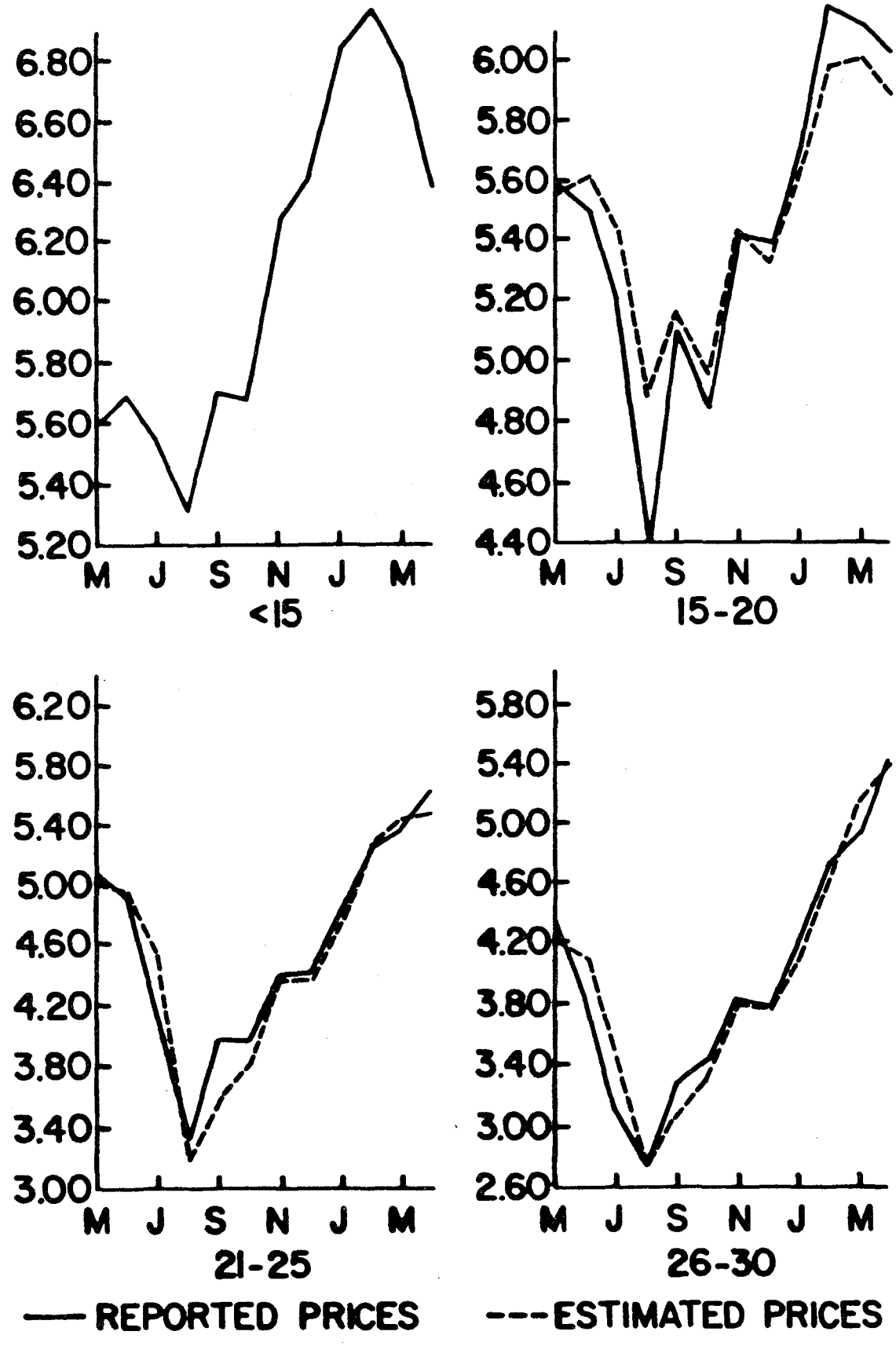

FIG. 1a - BROWN SHRIMP PRICES
MAY 1981 THRU APRIL 1982

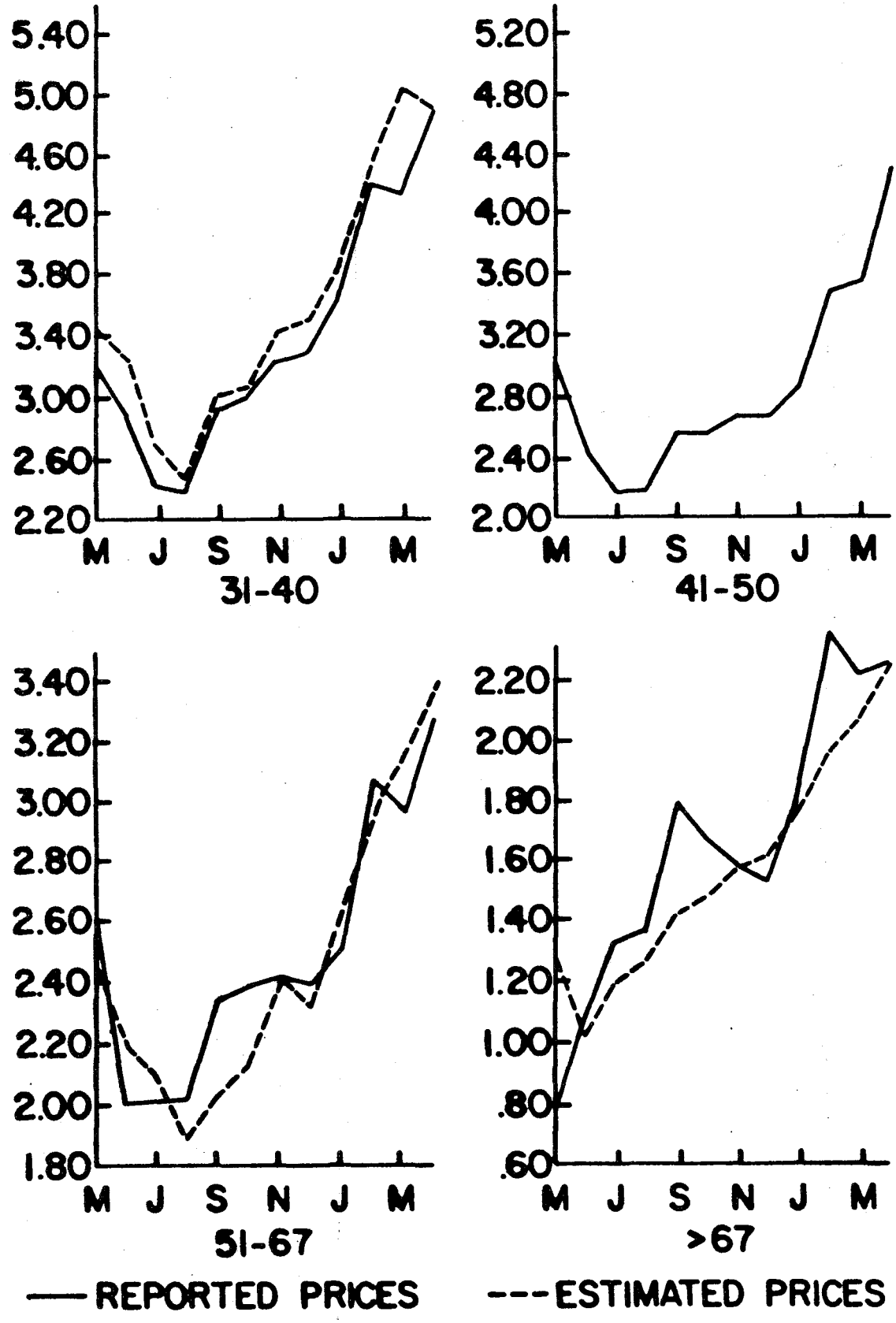

FIG. 1b - BROWN SHRIMP PRICES
MAY 1981 THRU APRIL 1982

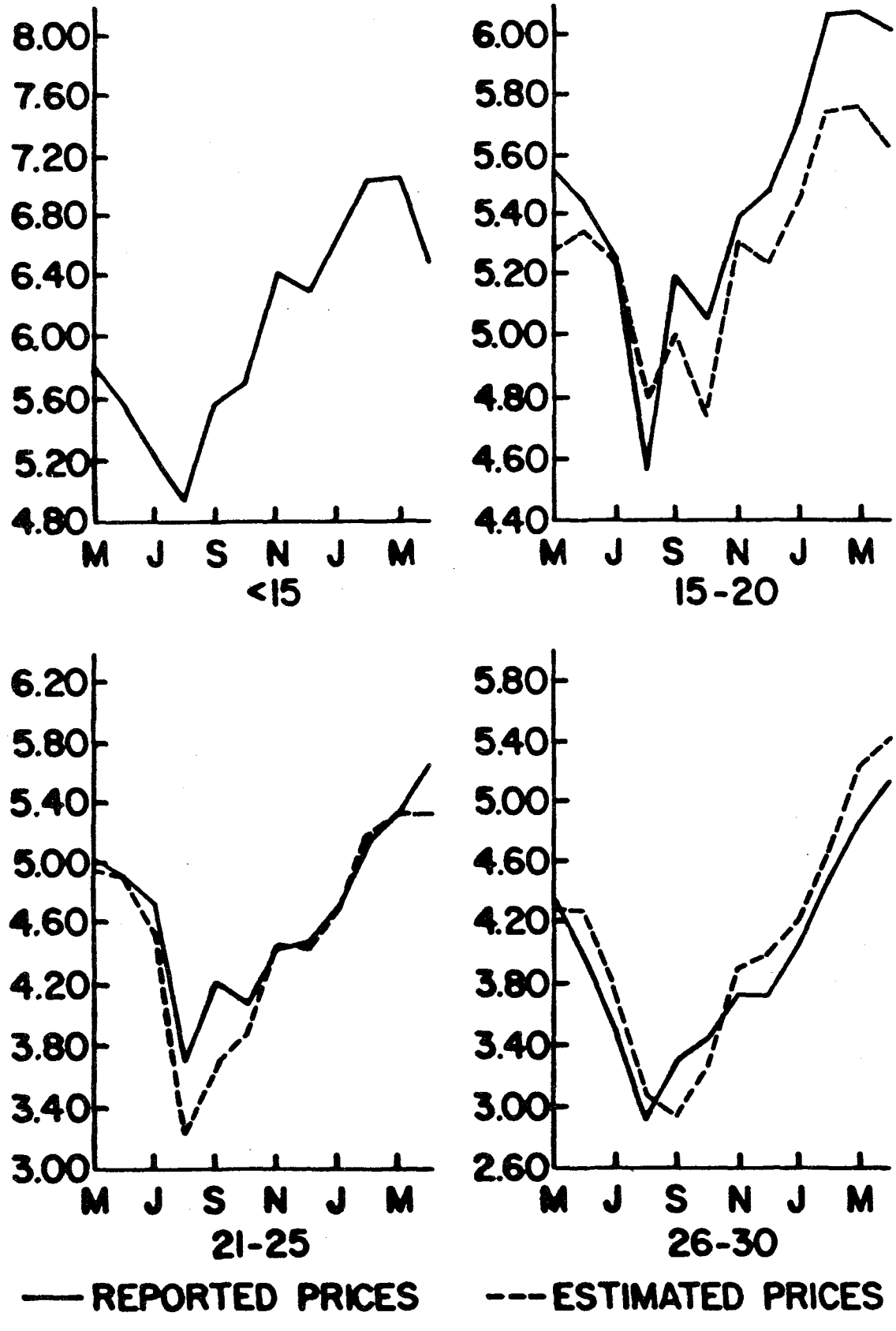

FIG. 2a - PINK AND WHITE SHRIMP PRICES
MAY 1981 THRU APRIL 1982

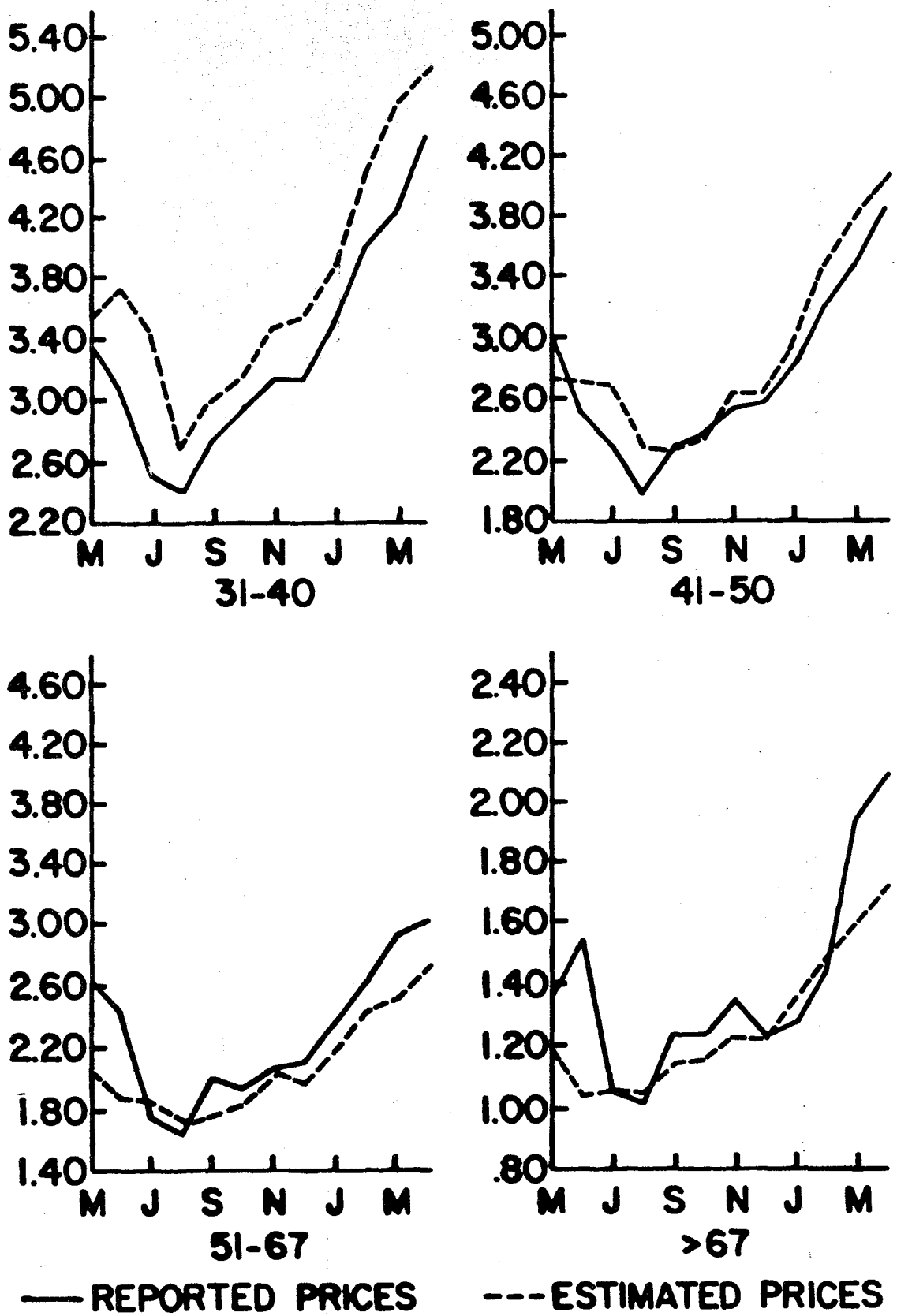

FIG. 2b - PINK AND WHITE SHRIMP PRICES
MAY 1981 THRU APRIL 1982

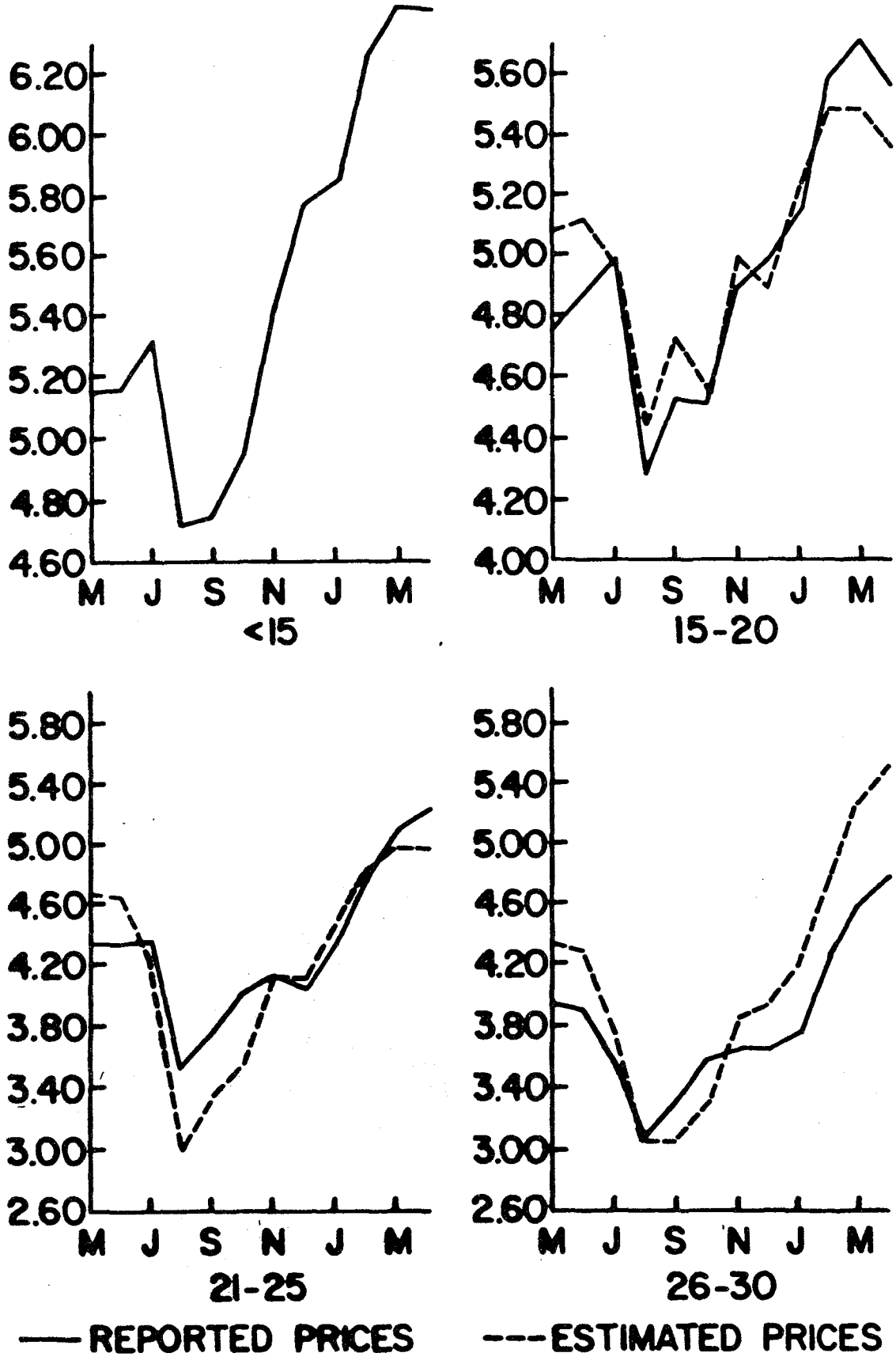

FIG. 3a - FLORIDA SHRIMP PRICES (ALL SPECIES) MAY 1981 THRU APRIL 1982

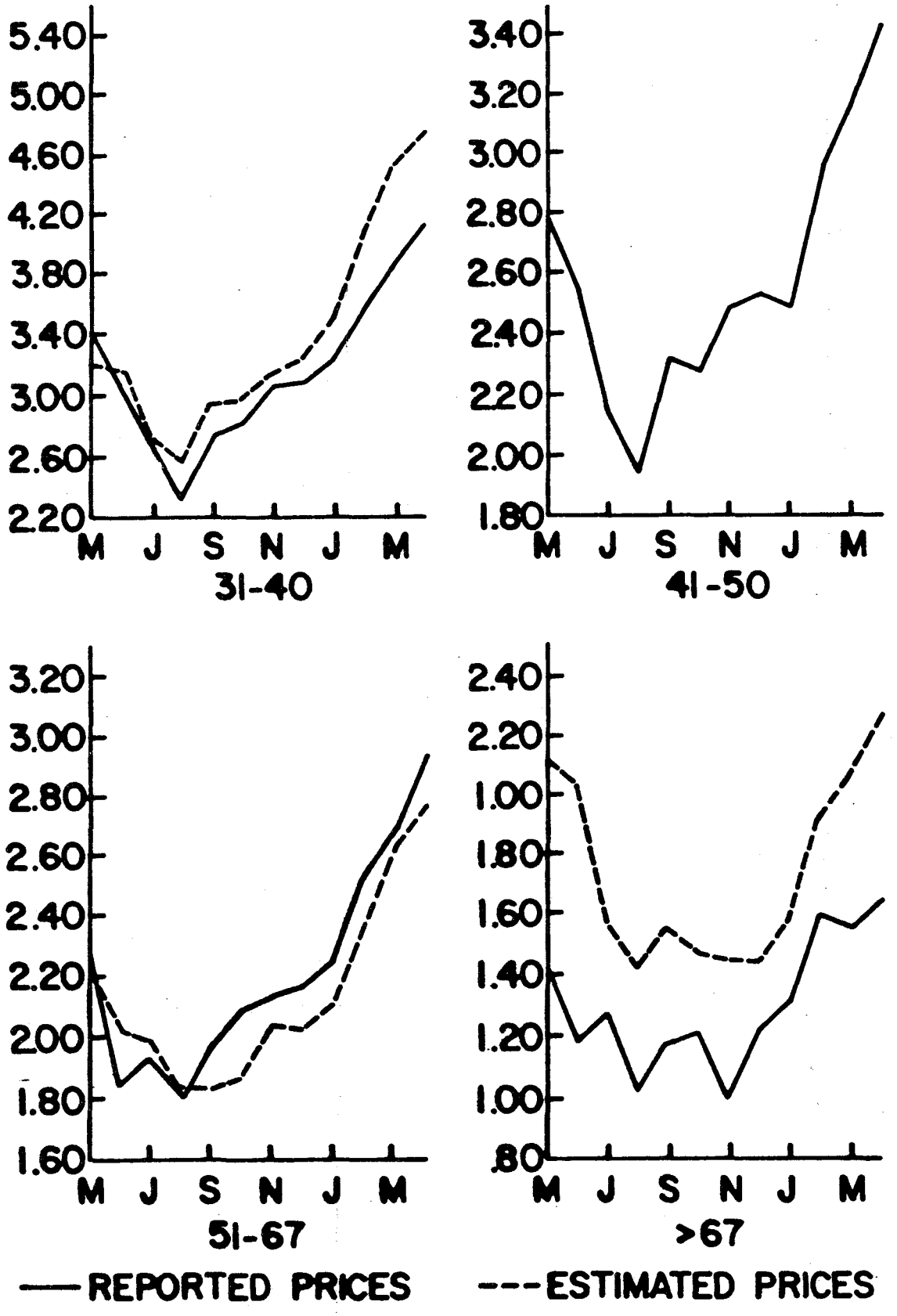

FIG. 3b - FLORIDA SHRIMP PRICES (ALL SPECIES) MAY 1981 THRU APRIL 1982

Since the same regression equations were used to estimate the respective price flexibilities for the eight size categories for each of the three models, and these equations provided a good representation of prices during 1981 and 1982, these models are considered quite reliable. The individual equations in this set of 24 equations were developed to estimate the respective changes in ex-vessel prices as a function of the (partial) effects of a change in brown shrimp landings with the effects of other factors statistically correlated with ex-vessel prices included in the regression equations, but held constant. The changes in brown shrimp landings were estimated assuming the closed area was open to fishing during the May 22 to July 15 period (Nichols, 1982). The differences in monthly landings between the reported and estimated landings are provided in Table 1. The absolute differences are listed in the top portion of the table and the relative or percentage differences are presented in the lower portion. In both portions of this table a negative sign indicates that the estimated landings are greater than the reported landings statistics. As would be anticipated, the estimated landings during May and June (i.e., the main part of the closure) were greater than the reported landings; but by July the reported landings were greater than the estimated landings. At the end of August, the estimated increase in landings due to the closure regulation was 3.3 million pounds. The total increase in landings for the 1981 biological year was estimated at 3.9 million pounds (Nichols, 1982).

The percentage change in landings is the basis for estimating the change in ex-vessel prices and consequently value. The percentages listed in the bottom portion of Table 1 are combined with the estimated coefficients from the regression equations and the product provides the percentage change in prices or the price flexibility estimates calculated at the mean (Appendix Table A.2). The estimated prices for brown shrimp landed in the north central Gulf of Mexico are provided in the bottom portion of Table 2 and the reported (weighted average) ex-vessel prices for brown shrimp are presented in the top portion of this table. For two of the columns in this table, the estimated prices are identical to the reported prices. This is due to the specification of the regression equations for the ≤15 and 41-50 size categories. Ex-vessel prices were not correlated with brown shrimp landings for either of these two size categories; thus, prices were assumed to remain the same whether the regulated area was opened or closed. Estimated ex-vessel prices for white and pink shrimp in the north central Gulf and all commercial species landed on the west coast of Florida are presented in Tables 3 and 4 respectively. As in Table 2, the upper portions of Tables 3 and 4 provide the reported prices for the respective months and size categories and the lower portions provide the estimated prices.

The calculation of ex-vessel value is, of course, simply the product of price times the amount of pounds landed. The estimated changes in monthly ex-vessel value for the three models are presented in Table 5. Brown shrimp is the only species whose landings are directly affected by the areal closure; however, since all shrimp prices are interrelated, it is reasonable to anticipate some indirect effects on other shrimp prices. Thus, two models (or groups of equations) were developed to measure the indirect or spillover

Table 1.

Difference in Brown Shrimp Landings if Regulated Area is Closed or Opened - by Size

Absolute Difference

		<15	15-20	21-25	26-30	31-40	41-50	51-67	>67
1981	May	-32552.	-111613.	-93063.	-101753.	-81136.	-14491.	-23426.	362532.
	Jun	-16611.	-49649.	-79405.	-69650.	-200641.	-442799.	-524336.	806528.
	Jul	6943.	62973.	244597.	576422.	1569303.	-424810.	-439871.	-338062.
	Aug	16727.	239364.	377734.	483039.	1026062.	194086.	226987.	189058.
	Sep	31005.	58590.	-239660.	-15045.	129904.	84348.	221329.	70741.
	Oct	-12074.	-198177.	-136760.	189856.	87594.	83862.	98933.	2582.
	Nov	-45934.	-243897.	-250253.	-79421.	-140845.	-31350.	-19094.	4166.
	Dec	-16224.	14412.	-96651.	-26764.	-66977.	-17873.	-10615.	942.
	Jan	31427.	168182.	186489.	67850.	83098.	7825.	6746.	1295.
	Feb	85248.	215123.	94401.	97308.	70842.	12375.	7396.	419.
	Mar	-3323.	29755.	-20883.	-1737.	-14646.	-2601.	-2196.	5520.
	Apr	-14114.	25935.	-12261.	-1965.	-8043.	-6160.	-5689.	-295.

Percentage Difference

		<15	15-20	21-25	26-30	31-40	41-50	51-67	>67
1981	May	-1.719	-1.731	-1.175	-1.015	-0.373	-0.064	-0.054	0.027
	Jun	-1.328	-0.660	-0.782	-0.436	-0.209	-0.239	-0.110	0.050
	Jul	0.293	0.402	0.411	0.378	0.211	-0.100	-0.119	-0.079
	Aug	0.273	0.452	0.225	0.163	0.128	0.094	0.099	0.180
	Sep	0.365	0.106	-0.119	-0.008	0.067	0.175	0.354	0.621
	Oct	-0.248	-0.308	-0.085	0.189	0.115	0.274	0.384	0.092
	Nov	-0.598	-0.221	-0.222	-0.160	-0.217	-0.165	-0.157	0.106
	Dec	-0.193	0.014	-0.130	-0.082	-0.118	-0.163	-0.127	0.037
1982	Jan	0.451	0.462	0.477	0.443	0.457	0.407	0.401	0.435
	Feb	0.606	0.473	0.356	0.462	0.391	0.365	0.358	0.203
	Mar	-0.045	0.111	-0.134	-0.021	-0.197	-0.392	-0.306	0.441
	Apr	-0.663	0.140	-0.133	-0.039	-0.117	-0.280	-0.235	-0.008

Table 2.

Reported and Estimated Prices for Brown Shrimp by Size

Reported Prices

	<15	15-20	21-25	26-30	31-40	41-50	51-67	>67
1981 May	5.593	5.477	5.092	4.288	3.304	3.022	2.597	0.790
Jun	5.694	5.399	4.939	3.848	2.837	2.426	2.001	1.060
Jul	5.549	5.097	4.117	3.149	2.432	2.178	2.005	1.321
Aug	5.317	4.401	3.338	2.789	2.387	2.167	2.015	1.377
Sep	5.704	4.995	3.890	3.290	2.920	2.530	2.359	1.775
Oct	5.675	4.754	3.880	3.423	3.006	2.537	2.385	1.657
Nov	6.267	5.304	4.401	3.828	3.234	2.645	2.407	1.576
Dec	6.433	5.281	4.413	3.778	3.307	2.650	2.389	1.534
1982 Jan	6.838	5.611	4.705	4.207	3.643	2.838	2.506	1.803
Feb	6.967	6.073	5.212	4.736	4.405	3.468	3.058	2.342
Mar	6.787	6.020	5.366	4.943	4.344	3.565	2.947	2.195
Apr	6.392	5.906	5.599	5.413	5.304	4.229	3.267	2.227

Estimated Prices

	<15	15-20	21-25	26-30	31-40	41-50	51-67	>67
1981 May	5.593	5.380	4.959	4.210	3.302	3.022	2.599	0.790
Jun	5.694	5.335	4.853	3.811	2.830	2.426	2.011	1.060
Jul	5.549	5.129	4.215	3.170	2.420	2.178	2.006	1.321
Aug	5.317	4.416	3.354	2.798	2.389	2.167	2.013	1.379
Sep	5.704	4.986	3.880	3.286	2.925	2.530	2.362	1.780
Oct	5.675	4.748	3.872	3.425	3.014	2.537	2.382	1.658
Nov	6.267	5.286	4.379	3.815	3.228	2.645	2.412	1.577
Dec	6.433	5.271	4.400	3.771	3.302	2.650	2.394	1.535
1982 Jan	6.836	5.651	4.755	4.240	3.658	2.838	2.494	1.808
Feb	6.967	6.106	5.253	4.769	4.421	3.468	3.045	2.344
Mar	6.787	6.008	5.350	4.935	4.328	3.565	2.964	2.200
Apr	6.392	5.894	5.582	5.404	5.290	4.229	3.280	2.227

Table 3.

Reported and Estimated Prices for Pink and White Shrimp by Size

Reported Prices

	<15	15-20	21-25	26-30	31-40	41-50	51-67	>67
1981 May	5.703	5.536	5.033	4.183	3.351	3.008	2.628	1.366
Jun	5.567	5.442	4.952	3.978	3.047	2.534	2.061	1.549
Jul	5.228	2.265	4.752	3.506	2.533	2.331	1.763	1.071
Aug	4.947	4.551	3.719	2.935	2.400	1.986	1.625	1.029
Sep	5.568	5.202	4.225	3.282	2.728	2.302	2.003	1.236
Oct	5.712	5.058	4.088	3.433	2.949	2.366	1.935	1.239
Nov	6.407	5.380	4.433	3.758	3.146	2.531	2.075	1.351
Dec	6.317	5.484	4.471	3.739	3.144	2.578	2.119	1.254
1982 Jan	6.634	5.703	4.766	4.054	3.483	2.808	2.378	1.291
Feb	6.930	6.064	5.152	4.485	3.997	3.202	2.653	1.455
Mar	6.947	6.065	5.359	4.846	4.211	3.493	2.927	1.937
Apr	6.495	6.003	5.544	5.148	4.727	3.850	3.019	2.092

Estimated Prices

	<15	15-20	21-25	26-30	31-40	41-50	51-67	>67
1981 May	5.703	5.489	4.967	4.303	3.385	3.015	2.169	1.367
Jun	5.567	5.411	4.909	3.984	3.030	2.555	1.757	1.551
Jul	5.228	5.281	4.773	3.466	2.500	2.339	1.765	1.068
Aug	4.947	4.558	3.729	3.117	2.401	1.979	1.765	1.034
Sep	5.568	5.197	4.219	3.130	2.748	2.288	2.011	1.258
Oct	5.712	5.055	4.084	3.337	2.981	2.343	2.017	1.242
Nov	6.407	5.371	4.422	3.916	3.142	2.546	2.029	1.355
Dec	6.317	5.479	4.465	3.990	3.130	2.593	2.012	1.256
1982 Jan	6.634	5.723	4.792	4.305	3.504	2.768	2.098	1.307
Feb	6.930	6.079	5.173	4.702	4.021	3.161	2.483	1.464
Mar	6.947	6.059	5.351	5.011	4.150	3.542	2.424	1.962
Apr	6.495	5.997	5.535	5.430	4.674	3.888	2.644	2.091

Table 4.

Reported and Estimated Prices of Shrimp Landed on Florida West Coast by Size

Reported Prices

	<15	15-20	21-25	26-30	31-40	41-50	51-67	>67
1981 May	5.150	4.758	4.364	3.952	3.388	2.774	2.290	1.415
Jun	5.160	4.870	4.351	3.912	3.138	2.530	1.837	1.190
Jul	5.306	4.990	4.383	3.578	2.663	2.160	1.915	1.270
Aug	4.709	4.280	3.543	3.097	2.331	1.945	1.804	1.031
Sep	4.751	4.517	3.775	3.307	2.714	2.307	1.961	1.180
Oct	4.951	4.502	4.000	3.573	2.799	2.269	2.092	1.208
Nov	5.421	4.882	4.144	3.641	3.047	2.469	2.121	1.003
Dec	5.772	4.967	4.060	3.641	3.091	2.250	2.165	1.229
1982 Jan	5.850	5.141	4.340	3.764	3.221	2.482	2.251	1.322
Feb	6.267	5.591	4.767	4.222	3.555	2.941	2.523	1.600
Mar	6.425	5.702	5.075	4.567	3.852	3.151	2.694	1.570
Apr	6.404	5.558	5.208	4.774	4.155	3.407	2.963	1.653

Estimated Prices

	<15	15-20	21-25	26-30	31-40	41-50	51-67	>67
1981 May	5.150	4.995	4.596	4.314	3.094	2.774	2.348	1.414
Jun	5.160	4.942	4.501	3.971	2.819	2.530	1.926	1.188
Jul	5.306	4.749	3.924	3.425	2.487	2.160	1.936	1.274
Aug	4.709	4.095	3.138	3.077	2.451	1.945	1.895	1.025
Sep	4.751	4.641	3.580	3.227	2.866	2.307	2.001	1.152
Oct	4.951	4.425	3.618	3.376	2.945	2.269	2.013	1.204
Nov	5.421	4.944	4.116	3.853	2.970	2.469	2.062	0.999
Dec	5.772	4.935	4.118	3.929	3.045	2.520	2.071	1.228
1982 Jan	5.850	5.297	4.419	4.279	3.301	2.482	2.041	1.301
Feb	6.267	5.702	4.807	4.779	3.959	2.941	2.407	1.588
Mar	6.425	5.582	4.923	5.051	3.948	3.151	2.542	1.545
Apr	6.404	5.472	5.113	5.509	4.762	3.407	2.733	1.654

Table 5.

Monthly Totals of Estimated Changes in Ex-Vessel Value

For the Respective Species and Area*

Year	Month	Brown Shrimp	Other Species	Florida
1981	May	-1,735,926	4,090	-49,663
	Jun	-2,877,850	56,418	-14,556
	Jul	4,718,201	-10,044	87,568
	Aug	7,277,734	-149,650	10,694
	Sep	752,256	190,222	19,822
	Oct	-163,095	25,185	56,749
	Nov	-3,499,677	-65,759	-18,374
	Dec	-821,892	4,708	-28,440
1982	Jan	2,643,347	-6,811	-160,574
	Feb	3,211,696	-5,015	-93,241
	Mar	-23,603	56,166	48,699
	Apr	99,445	31,385	-165,344
Annual Total		9,381,746	130,892	-346,304

* Negative values indicate that the prices estimated assuming that the closure area was open are greater than the reported prices.

effects of the closure regulation on pink and white shrimp prices and Florida prices.[4] The estimated spillover effects of the Texas closure regulation are shown in the last two columns of Table 5.

The direct and largest monetary effects of the closure regulation were on the brown shrimp catches off the coast of Texas; however, it is reasonable to expect the brown shrimp prices in Louisiana, Mississippi, and Alabama would also be affected. The analytical constraints of the biological simulations (Nichols, 1982), however, do not provide a state-by-state breakdown of landings estimated under the assumption that the closed area had been opened. Consequently, measuring the effects on brown shrimp prices in these three states is difficult without estimates of the changes in brown shrimp landings on a state-by-state basis. As an approximation it is assumed that all of the changes in landings occurred in Texas and that the effects on ex-vessel prices in Louisiana, Mississippi, and Alabama are a result of the changes in Texas brown shrimp prices.[5] The estimated changes in brown shrimp prices are multiplied by the reported landings of brown shrimp in three states to get the change in ex-vessel value resulting from the closure regulation. These estimates are presented in the lower portion of Table 6 and the estimates of changes in ex-vessel value for the estimated changes in Texas landings are presented in the top portion the the table. The empirical results of the model estimating the effects on the ex-vessel value of landings in Louisiana, Mississippi, and Alabama do not follow an anticipated pattern, which would be opposite to that exhibited by the ex-vessel value estimates made for Texas landings. The interpretation of these empirical estimates will be discussed further in the Discussion section.

1982 Preliminary Estimates

The areal closure off the coast of Texas during May 25 through July 14, 1982 is analyzed similar to that just described for the closure during 1981. However, since the data for May through August 1982 are preliminary, two scenarios have been estimated for the landings under the assumption that the area was opened to fishing. For brevity, only the monthly totals (summarized over all size categories) for the two scenarios are presented. One scenario was estimated employing the pattern of fishing effort exhibited during 1979 and these estimates are presented in Table 7. An alternative pattern of fishing effort was used to estimate the second scenario and the landings and ex-vessel value resulting from this scenario are presented in Table 8.

The 1979 fishing effort patterns resulted in changes in the estimated amount of landings that are slightly different than the first four months of the 1981 biological year. As shown in Table 7, landings are estimated to be slightly negative in May, positive in June and July, and negative again in August. The net change for these four months is a decrease of 1.3 million pounds, which results in a loss of 7.5 million dollars. The estimated changes in ex-vessel value for pink and white shrimp and all species landed in Florida do not totally follow a pattern opposite to the changes in brown shrimp landings; but the total for the four-month period is an estimated 0.7 and 1.4 million dollar increase for the two models respectively.

Table 6.

Estimated Changes in Ex-Vessel Value of Brown Shrimp Landings by Size

Texas Landings

	<15	15-20	21-25	26-30	31-40	41-50	51-67	>67	Monthly Total
1981 May	-183268.	-594613.	-467486.	-420253.	-266089.	-44864.	-60450.	226346.	-1,770,677
Jun	-98835.	-257797.	-384598.	-263342.	-519726.	-1030715.	-995008.	682902.	-2,857,119
Jul	40408.	319028.	988272.	1729290.	3657323.	-900631.	-845586.	-387420.	4,600,684
Aug	93504.	1058695.	1234337.	1298041.	2381837.	427286.	449378.	286979.	7,230,057
Sep	180759.	297058.	-915093.	-47636.	382520.	217699.	519528.	136297.	711,132
Oct	-68580.	-932612.	-523829.	632722.	258873.	213191.	231708.	4127.	-801,400
Nov	-290762.	-1263191.	-1078946.	-296894.	-454476.	-83916.	-44359.	5858.	-3,506,686
Dec	-107403.	85035.	-418294.	-99012.	-224450.	-49264.	-25406.	1307.	-837,497
1982 Jan	221560.	931139.	868942.	285301.	308383.	23650.	18467.	2295.	2,659,737
Feb	603556.	1304927.	491281.	462997.	316809.	44554.	22892.	950.	3,247,966
Mar	-22065.	181535.	-112095.	-8473.	-63589.	-9464.	-6129.	11574.	28,706
Apr	-88918.	154525.	-68342.	-10454.	-42797.	-26038.	-17268.	643.	99,935
									8,670,556

Louisiana, Mississippi and Alabama Landings

	<15	15-20	21-25	26-30	31-40	41-50	51-67	>67	Monthly Total
1981 May	0.	1152.	4820.	7040.	-151.	-203.	806.	-9579.	3,885
Jun	0.	2070.	5310.	8971.	261596.	-4377.	13427.	-28080.	285,917
Jul	0.	-3178.	-11703.	-25904.	607979.	-2197.	6456.	12193.	583,646
Aug	0.	-3453.	-7355.	-14398.	543396.	761.	-1681.	-5580.	511,690
Sep	0.	1562.	3262.	3091.	61104.	310.	-1039.	-1862.	66,428
Oct	0.	626.	1496.	-1765.	4433.	124.	-349.	-40.	4,525
Nov	0.	3731.	2765.	3073.	11063.	-162.	243.	-69.	20,644
Dec	0.	2397.	1213.	1495.	-3186.	-127.	181.	-7.	1,966
1982 Jan	0.	-2719.	-2774.	-3130.	-1910.	82.	-219.	-40.	-10,710
Feb	0.	-3816.	-2656.	-3971.	-10111.	62.	-84.	-6.	-20,582
Mar	0.	905.	1205.	286.	6713.	-20.	29.	-9.	9,109
Apr	0.	715.	613.	227.	-224.	-11.	44.	2.	816
									1,430,334

Table 7.

Estimated Monthly Changes in Landings and Ex-Vessel Value Based on 1979 Fishing Effort Patterns*

Months 1982	Change in Brown Shrimp Landings	Change in Ex-vessel Value		
		Brown Shrimp	Other Species	Florida
May	-876,014	-4,000,656	228,656	277,959
Jun	1,320,795	-6,630,543	277,291	765,564
Jul	1,873,499	6,621,697	16,543	212,406
Aug	-997,987	-3,188,911	216,233	153,995
Total	-1,321,297	-7,498,413	738,723	1,409,292

* Negative values indicate that the estimated ex-vessel value assuming the closure area is greater than the reported ex-vessel value.

The estimated monthly changes that were a result of the alternative scenario of fishing effort (Table 8) also display patterns different than the same four months in 1981. For this alternative, the difference between the reported landings and the baseline landings estimated under the assumption that the area was open to fishing are immeasurable for May and June. In July, the estimated change was a positive 1.3 million pounds but in August, the change was a negative 0.9 million pounds. The net change, therefore, was an increase in brown shrimp landings of 0.5 million pounds to the fishery. This net increase in landings, however, resulted in a net decrease in ex-vessel value to the fishery of 1.9 million dollars. The negative difference in landings estimated for August and the higher prices estimated for this month caused the net loss for this four-month period.

Discussion

In the previous sections, the regression models and the empirical estimates resulting from those models were presented for the 1981 biological year (May through April of the following year) and preliminary estimates were made for the first four months in the 1982 biological year. This section further discusses these empirical estimates by interpreting them from a comparative, as well as a logical perspective.

As Figures 1, 2, and 3 indicated, the statistical regression equations provided a good representation of 1981 prices for the respective size and species of shrimp landed in the Gulf of Mexico. Recall that the purpose of this report, and hence the model specification, was to estimate the effects of a regulation that caused changes in brown shrimp landings on ex-vessel prices and value reported at ports throughout the Gulf of Mexico. The analysis was extended to measure the spillover (or indirect) effects on ex-vessel prices and value of other commercial species of shrimp landed throughout the Gulf. It is quite possible that the empirical requirements of the analysis have decreased the "statistical quality" of this model (or models) relative to other potential model specifications; however, specifications of other models would not have permitted the measurement of the regulation's effects on the desired ex-vessel values.

One of the most severe statistical constraints in analyzing the effects of the closure regulation was the large amount of correlation between shrimp prices for the three commercial species reported at different geographical areas throughout the Gulf of Mexico. Measuring the direct effect of changes in brown shrimp landings on prices was the primary analytical consideration; however, this close correlation between brown shrimp prices and the prices of pink and white shrimp could also result in an indirect effect on non-brown shrimp prices. Specifying some of the models to account for this potential indirect effect, as well as the arithmetic involved in calculating the estimated changes in ex-vessel value (i.e., the landings in size class could be large one year relative to the landings during the 1971-1980 data analysis period and therefore, provide an over-representation of that size class in the weighted average), raised some concerns about the empirical estimates generated by the regression equations.

Table 8.

Estimated Monthly Changes in Landings and Ex-Vessel Value Based on Different Fishing Effort Patterns*

Months 1982	Change in Brown Shrimp Landings	Change in Ex-vessel Value		
		Brown Shrimp	Other Species	Florida
May	-	-	176,705	250,587
Jun	-	-	216,129	741,210
Jul	1,333,450	2,314,707	21,417	215,064
Aug	-871,382	-4,186,906	237,617	158,564
Total	462,068	-1,872,199	651,868	1,365,425

* Negative values indicate that the estimated ex-vessel value assuming the closure area is greater than the reported ex-vessel value.

The evaluation of empirical results is always difficult, but as an initial test the estimated results should follow the direction of the price changes suggested by economic theory. Comparisons of the estimated signs or the regression coefficients are provided in Table 9 for the estimated changes in brown shrimp landings, ex-vessel value, prices, ex-vessel value of white and pink shrimp and the ex-vessel value of landings reported in Florida. Only the signs of the estimated empirical values for the 1981 data are presented in this table and the signs listed in the last four columns should be compared to the signs in the first column. The reason for these comparison are, of course, that the fundamental changes of the closure regulation are on brown shrimp landings and all the other changes are a direct or indirect (spillover) effect of the change in landings.

The change in ex-vessel value of brown shrimp due to a change in landings can be separated into two components that are opposite in effect. If landings increase, prices should decrease; but the change in ex-vessel value will be the net effect of the landings increase and the price decrease. Thus, the sign of the brown shrimp price effect (column 3) should be opposite the sign of the change in brown shrimp landings and depending on the magnitude of the price flexibility estimates, the sign of the ex-vessel value of brown shrimp could be either positive or negative. Reviewing the third column in Table 9 indicates that the signs of the monthly totals for June, September and October are opposite the theoretically anticipated signs. The annual summation of these estimates, however, has a negative sign, as would be expected.[6/]

The signs of the estimated effects on the ex-vessel value of pink and white shrimp are presented in the fourth column. Three months, September, October and November, have signs that are theoretically unanticipated and the empirical magnitudes of these coefficients are sufficient to cause the sign of the annual summation of these monthly estimates to be positive instead of an anticipated negative one.

The signs of the monthly estimates for the Florida model are presented in the last column of Table 9. Only four of the twelve monthly estimates have the anticipated signs; however, the annual summation for this model does have a negative sign as theory would suggest. This result is caused by the relatively large landings reported during November, December, January and February (the major seasonal period for the Tortugas fishery) and the negative signs estimated for the change in prices during these four months. In other words, the negative quantity estimated for the annual sum is caused by the arithmetic of the estimates and not the adequacy of the model.

The implications that are suggested from the comparisons in Table 9 are somewhat interesting. For the white and pink shrimp models, the landings in September and October for the 26-30 size categories dominated the other size categories and thus, the seasonal increases of white shrimp landings during these months accounted for positive change in the ex-vessel value for 1981. Similarly, large amounts of landings during the winter months resulted in the annual negative changes in ex-vessel value for the commercial species landed

Table 9.

Comparisons of the Signs of the Estimated Changes in the Respective Landings and Ex-Vessel Values

	Brown Shrimp Landings	Brown Shrimp Value	Brown Shrimp Prices	Other Species Value	Florida Value (8)
May	-	-	+	+	-
Jun	-	-	-(2)	+	-
Jul	+	+	-	-	+
Aug	+	+	-	-	+
Sep	+	+	+(3)	+(5)	-
Oct	+	-(1)	+(4)	+(6)	+
Nov	-	-	+	-(7)	-
Dec	-	-	+	+	-
Jan	+	+	-	-	-
Feb	+	+	-	-	-
Mar	-	-	+	+	+
Apr	-	-	+	+	-
Total	+	+	-	+	-

1) The unanticipated sign is caused by the relatively larger change in prices for the 15-20 and 21-25 size categories compared to the 26-30, 51-67 and >67 size categories.

2) 51-67 size shrimp are a positive function of 41-50 size landings and a negative function of 51-67 size landings. For June, the landings of 41-50 size shrimp dominate the direction of the price change; therefore, estimated prices decrease instead of increasing as the decrease in brown shrimp landings suggests.

3) Size categories 15-20 and 51-67 are a function of 21-25 size and 41-50 count shrimp, respectively. Since the 21-25 and 41-50 categories have price changes opposite the anticipated changes in the 15-20 and 51-67 size categories and the relative magnitude of 21-25 size category dominates the landings, these two categories (15-20 and 51-67) have opposite signs and they cause the monthly total to have a positive sign instead of a negative one.

4) Size class 21-25 dominates the monthly total and the sign of that value is positive.

5) The amount of landings in the 26-30 size class dominated this monthly total and since the price change is brown shrimp was positive, the change estimated change in the other shrimp prices was positive also.

6) The sign on the 26-30 size category was positive instead of an anticipated negative sign; furthermore, the relative magnitude of landings (white and

pink) were large which caused the monthly totals to be positive. So in #4 above, the price of 26-30 count is estimated as a function of brown shrimp prices and the change in this price was positive yielding a positive change in the white and pink shrimp prices.

7) Again, the 26-30 size category has an unexpected negative sign and the estimated change in ex-vessel value dominates the monthly total.

8) The majority of the signs are different from the anticipated sign based on the change in landings - i.e., column one. The unanticipated signs are due to the model specifications for the Florida prices which is a result of the insignificant relationships between Florida prices and brown shrimp landings. The negative sign on the annual total is the anticipated sign, but this is due to the large landings in December, January, February and March and not due to the theoretically correct pattern of signs.

in Florida. Therefore, as a general conclusion regarding the two models estimated to measure the spillover effects, the estimates (summarized annually) are dominated by the seasonal landings for the respective models more so than the effects that changes in brown shrimp landings (caused by the closure regulation) had on them.

The other attempt to measure indirect (or spillover) effects from the regulation were the effects on brown shrimp prices reported in Louisiana, Mississippi, and Alabama. These results for May 1981 through April 1982 were presented in Table 6. Reviewing these estimates by size categories, it is obvious that the ex-vessel values estimated for June, July and August for the 31-40 size category dominate the monthly and consequently the annual changes in ex-vessel value for the three state model (lower portion of Table 6). The results of a model that are dominated by a few monthly changes in a single size category provide reason for some question. There are two reasons that the model specification measuring these brown shrimp spillover effects is inappropriate. First, Nichols (1982) considers the brown shrimp stock to be continuous throughout the north central Gulf and therefore, simulation estimates for changes in landings are not available on a state-by-state basis. As an approximation, it is assumed that all of the changes in landings are made in Texas and that the effects on the ex-vessel value of brown shrimp landed in Louisiana, Mississippi and Alabama are a result of changes in prices.

The second reason is due to the close statistical correlation in brown shrimp prices between those reported for Texas and the other three states. The statistical analyses done in search of an adequate model clearly demonstrated that ex-vessel prices for separate states are, for the most part, not significantly correlated with the landings reported in the respective states. Prices on a state-by-state basis are, however, significantly correlated with total brown shrimp landings in the north central Gulf. Thus the market for brown shrimp appears to be determined by landings throughout the north central Gulf and a state-by-state estimate is inappropriate.

The interpretations of the empirical estimates made by the models specified to measure the indirect (or spillover) effects of the closure regulation probably should be considered with caution. Furthermore, the magnitudes of these estimates are fairly small relative to the estimated increases in landings and ex-vessel value of brown shrimp. The most important results of these analyses are the estimated effects on ex-vessel brown shrimp prices and value. Referring back to Table 5, the estimated increase in brown shrimp landings as a result of the regulation was 3.9 million pounds, which resulted in an increase in gross revenue to the fishery of 9.4 million dollars during the May through April 1981 biological year.

For comparative purposes, the empirical results for the first four months of 1981 and 1982 are compared. The increase in brown shrimp landings during May through August 1981 was estimated to be 3.3 million pounds or an increase in ex-vessel value of 7.5 million dollars. During the same four months in 1982, the estimated change in landings was a negative 1.3 million pounds with

an ex-vessel value of 7.5 million dollars (the 1979 based fishing pattern scenario presented in Table 7). The same estimated ex-vessel values (but for different amount of landings) between 1981 and 1982, albeit opposite in direction, is due to the difference in ex-vessel prices. Although a detailed analysis of these price trends is beyond the scope of this paper, several potential causes can be easily cited. First, domestic landings were much lower in 1982 than in 1981. In addition, dealers and processors maintained inventories well below the 1971-1980 ten year monthly averages (Figure 4), in part because of the high interest rates. Another possible contributing factor was the inability of foreign imports to supplement the poor domestic harvests. Although foreign imports were about the same as the monthly ten-year averages, (Figure 5), substantial increases in imports would have been expected in response to the higher U.S. prices and low domestic supply. Thus, it is reasonable to presume that the combination of these three factors resulted in the inability of the quantity supplied to meet the quantity demanded, thus, forcing the ex-vessel price to increase.

Increases in ex-vessel prices were also responsible for the net loss in ex-vessel value at the end of the May through August period for the second scenario in the 1982 analysis (Table 8). Even though there was a net increase in landings (about 0.5 million pounds), the ex-vessel price weighted over all size categories was $4.81 per pound in August, which was a $3.07 per pound increase over the $1.74 per pound average for July. This increase in price was 64 percent in 1982 whereas the July to August increase in 1981 was only 12 percent. Much of the 1982 July to August price increase was not, however, caused by a general increase in year-to-year prices, but by a change in the size distribution of the landings. In July 1982, about 90 percent of the difference in landings (i.e., the difference between the reported landings with the area closed and the simulated landings assuming the area was opened) was in the two smallest size categories, 51-67 and >67 categories. The distribution in August, however, had changed so that about 60 percent of the difference was in the medium size categories, 21-25 to 31-40 categories. Consequently, the net loss estimated for the second scenario was due largely to a shift in the distribution of the size of shrimp to larger, more costly sizes.

In conclusion this report should be able to provide answers to the following two questions — does the analysis provided reasonable estimates of the direct and indirect effects on ex-vessel prices and value of landings in the Gulf of Mexico and if so, what are the magnitudes of those effects? Attempts were made to measure the effects of the closure regulation on pink and white shrimp prices in the north central Gulf and the regulation's effect on shrimp prices in Florida. The regression results from these analyses indicate that landings during the peak months in these two areas dominated the calculations of ex-vessel value. Furthermore, the magnitude of these estimates were generally small relative to the changes in landings and ex-vessel value of brown shrimp. Similarily, regression analysis was used to measure the spillover effects of the closure regulation on brown shrimp prices reported in Louisiana, Mississippi, and Alabama. The results of these analyses indicated that the models used were inappropriate and did not adequately measure these effects.

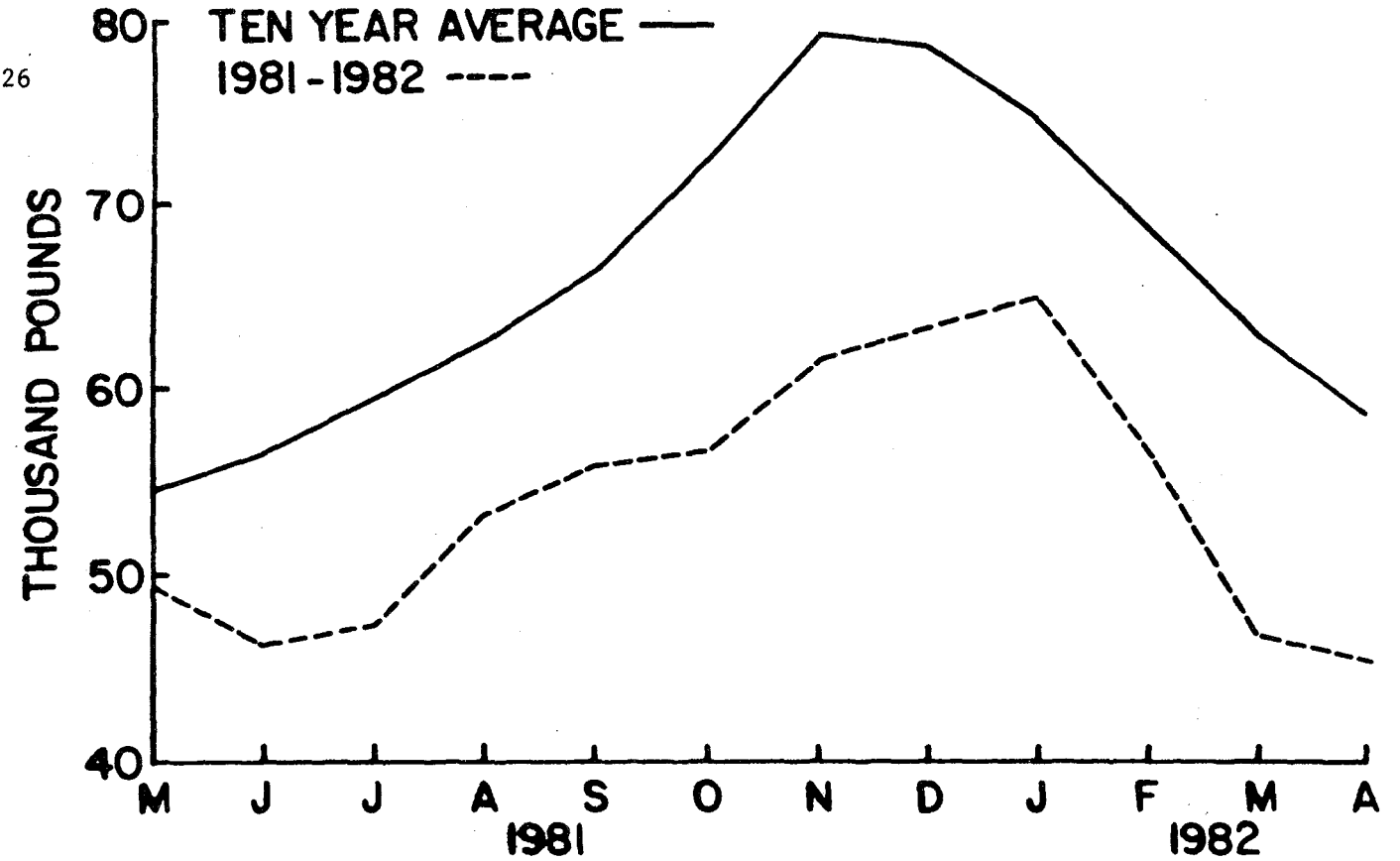

FIG.4-COLD STORAGE HOLDING (PRODUCT WEIGHT)

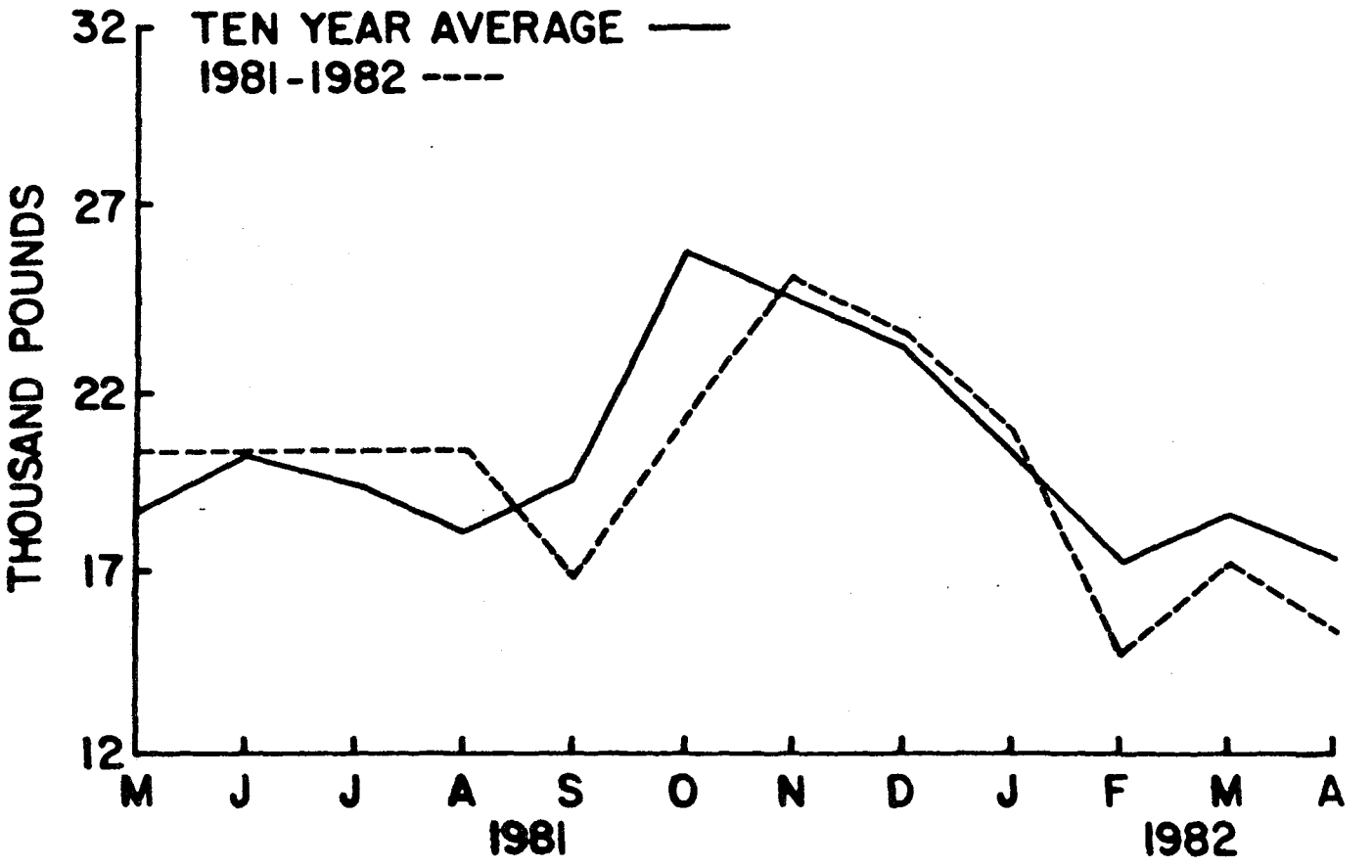

FIG.5-FRESH AND FROZEN IMPORTS

The brown shrimp model, on the other hand, provides quite reasonable results for both the 1981 and 1982 time periods. For the first four months of the 1981 biological year, the estimated increase in brown shrimp landings was 3.3 million pounds with a combination of increases and decreases in the other eight months resulting in a net increase for the year of 3.9 million pounds. The estimated increase in ex-vessel value for the first four months was 7.5 million dollars and the total increase for the year was an additional 1.9 million dollars or an annual total of 9.4 million dollars. Estimates of the preliminary data on brown shrimp landings for 1982 indicate a different pattern from the changes than were estimated for the May through August period in 1981. Consequently, two scenarios were estimated using alternative patterns of fishing effort in an attempt to more clearly analyze these inter-year differences. The estimated changes in landings for the two scenarios were a decrease of 1.3 million pounds and an increase of 0.5 million pounds. The respective changes in ex-vessel value for the two scenarios were decreases of 7.5 and 1.9 million dollars.

Although the empirical estimates for the difference in ex-vessel value resulting from the 1982 closure regulation indicate a fairly substantial net decrease for May to August, an important qualification should be emphasized regarding these estimates. The general conclusion reached by Nichols (1982) from all analytical techniques was that the differences or changes in brown shrimp landings in 1982 due to the regulation were below the detectable range (i.e., essentially unmeasurable) by these techniques. The concomitant estimates for the difference in ex-vessel value, however, are more complex since the estimated differences in ex-vessel values are a direct result of two factors. The first factor is a general increase in ex-vessel prices between 1981 and 1982. More importantly, however, the relative magnitudes of the estimated "net losses" in 1982 unlike the gain in 1981 are more affected by the size distribution of shrimp in the monthly differences between the reported brown shrimp landings and the VPA simulation estimates, which assume the closed area was opened to fishing. The estimated empirical difference in ex-vessel value due to the closure regulation during 1982 is a result of the relatively large ex-vessel prices associated with the simulated differences in landings rather than the differences in landings themselves. Therefore, the magnitudes of the estimated change in ex-vessel value for the 1982 closure should be considered with less confidence than the 1981 estimates.[7] Since the estimated changes in brown shrimp landings in 1982 are below a detectable range, the estimated differences in ex-vessel values, which use the estimated changes in landings as their empirical basis, can be no more precise and therefore should also be considered in an undetectable range.

From a decision-making perspective, the estimated economic effects of the closure regulation during 1981 are definitely positive and the empirical estimates are realistic. The estimates for 1982, on the other hand, should be considered less reliable empirically. Qualitatively, however, the analysis of the 1982 closure strongly indicates a very small or perhaps even a slightly negative impact on the shrimp fishery in the north western Gulf of Mexico.

Footnotes

1. Several recent reports that discuss the types of factors influencing the movement of ex-vessel shrimp prices are: Blomo, 1979, Chiu, 1980; Poffenberger, 1981 and Thompson and Roberts, 1982.

2. For a discussion of this technique see Statistical Package for the Social Sciences, Version VI.

3. Several of the individual graphs in Figures 1, 2, and 3 only have solid lines. The regression equations used to estimate the monthly prices for these size categories did not have a statistical relationship between ex-vessel prices and brown shrimp landings. Thus, the estimated prices are the same as the reported prices and only one line is required.

4. Several of the regression equations that were used to measure the indirect effects were specified with ex-vessel brown shrimp prices as an independent variable. Appendix Table A.1 presents the equation specifications for all the models.

5. As with the pink and white shrimp model and the Florida model, the regression specifications to measure the spillover price effects on Louisiana, Mississippi, and Alabama brown shrimp prices also included Texas brown shrimp prices as an independent variable (See footnote 4).

6. The footnotes, identified by the numbers in parenthesis, in Table 9 describe the effects that have caused the estimates to have the signs listed in this table.

7. This does not imply that the analytical techniques used to make these empirical estimates are suspect. It should be clearly understood that stating the 1982 empirical estimates of change in ex-vessel value should be considered with less confidence than the 1981 estimates does not imply that there is less confidence in the ability of the analytical techniques to measure a difference in landings. We have considerable confidence in the estimates; the confidence is, however, that the estimated change in landings as a result of the 1982 closure is very small and hardly detectable.

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Appendix Table A.1

Regression Equations with Summary Statistics

Description of variables:

PB = price of brown shrimp landed in north central Gulf of Mexico;

LB = landings (in 100,000 pounds) of brown shrimp in north central Gulf of Mexico;

PO = price of pink and white shrimp landed in north central Gulf of Mexico;

LO = landings (100,000 pounds) of pink and white shrimp in north central Gulf of Mexico;

PF = price of the three commercial species of shrimp landed on the west coast of Florida;

LF = landings (100,000 pounds) of the three commercial species of shrimp landed on the west coast of Florida;

WP = wholesale prices reported by the Fulton Fish Market in New York - NMFS, Market News, New York office;

DVS = dummy variable for seasonality - 1 for the months May through October and zero elsewhere;

ST = cold storage holdings as reported at the end of the month in product weight (100,000 pounds);

PCS = per capita spending at eating and drinking places;

SIR = short-term interest rate charged to prime lending customers;

I = fresh and frozen imports reported in product weight (100,000 pounds); and

DVF = dummy variable for seasonality - 0 for months June through October and 1 elsewhere.

Note: - all prices are deflated by a subcomponent of the producer price index, i.e., the component for meat, poultry and fish.

- the numerical post-scripts (i.e., 1, 2, ..., 8) identify the size category of shrimp. For example, PB1 is the price of brown shrimp that have fewer than 15 shrimp per pound.

Description of Summary Statistics:

R^2 = the coefficient of determination adjusted for the degrees of freedom;

DF = the number of degrees of freedom;

MSE = the mean square error; and

F-ratio = the statistic that measures the overall statistical significance of the equation

Note: - the t-statistics for the respective coefficients are presented in parantheses below the coefficients.

<15 (size category 1)

PB1 = .196 = .94 WP3 + .01 LO3 - .73 DVS
(22.9) (3.1) (2.1)
R^2 = .82 DF = 16 MSE = .034 F-ratio = 181.3

PO1 = -.091 + .77 WP3 + .012 LO3 + .047 PCS + .012 DVS
(14.3) (3.5) (2.9) (2.6)
R^2 = .81 DF = 115 MSE = .034 F-ratio = 118.8

PF1 = - .146 + .94 WP3 + .27 ST
(19.6) (2.0)
R^2 = .77 DF = 117 MSE = .043 F-ratio = 199.2

15-20 (size category 2)

PB2 = .08 + .86 WP2 - .0054 LB3 - .011 SIR + .0025 LO3
(90.2) (6.6) (3.3) (2.6)
R^2 = .99 DF = 114 MSE = .002 F-ratio = 2263.5

PO2 = .119 + .86 WP2 - .010 PCS - .012 SIR + .33I - .0019 LB3
(47.9) (1.9) (2.46) (2.3) (1.8)
R^2 = .98 DF = 113 MSE = .003 F-ratio = 950.9

PF2 = -.094 + .944 PB2 + .12 ST
(54.5) (2.4)
R^2 = .97 DF = 116 MSE = .005 F-ratio = 1609.2

21-25 (size category 3)

PB3 = .304 + .85 WP3 - .0054 LB3 - .011 SIR - .012 PCS - .08 ST
(54.0) (6.1) (2.5) (2.9) (2.2)
R^2 = .98 DF = 114 MSE = .003 F-ratio = 1106.3

PO3 = .145 + .87 WP3 - .019 PCS - .0027 LB3 + .34 I
(45.3) (3.8) (2.5) (2.3)
R^2 = .97 DF = 115 MSE = .004 F-ratio = 942.5

PF3 = -.105 + .93 PB3 +.34 I - .034 DVF + .09 ST
(48.3) (2.3) (2.3) (1.8)
R^2 = .96 DF = 115 MSE = .004 F-ratio = 747.5

26-30 (size category 4)

PB4 = .228 + .90 WP3 - .002 (LB2 + LB3) - .018 PCS - .10 ST
(55.5) (4.9) (4.3) (3.1)
R^2 = .98 DF = 114 MSE = .003 F-ratio = 1294.2

PO4 = -.243 + .93 PB4 + .03 PCS - .006 LO4
(22.7) (3.2) (1.9)
R^2 = .87 DF = 115 MSE = .018 F-ratio = 264.7

PF4 = .003 = .91 PB4 - .056 DVF + .26 I
(60.9) (5.4) (2.1)
R^2 = .97 DF = 115 MSE = .003 F-ratio = 1339.2

31-40 (size category 5)

PB5 = .263 + .91 WP5 - .012 PCS - .002 LB6 - .25 I - .046 DVS - .11 ST
(39.9) (2.4) (3.1) (1.9) (3.1) (2.4)
R^2 = .97 DF = 112 MSE = .003 F-ratio = 577.6

PO5 = .024 + .88 WPS + .011 LB6 - .003 LB5 - .072 DVS
(22.8) (4.6) (2.6) (2.3)
R^2 = .83 DF = 114 MSE = .020 F-ratio = 138.7

PF5 = .052 + .84 PB5 - .048 DVF + .011 PCS - .09 ST
(40.9) (3.7) (2.9) (2.1)
R^2 = .96 DF = 114 MSE = .003 F-ratio = 778.3

41-50 (size category 6)

PB6 = .227 + .90 WP6 - .019 PCS - .10 ST + .0036 LO5 - .25 DVS
(42.2) (4.8) (2.6) (2.1) (2.0)
R^2 = .97 DF = 113 MSE = .002 F-ratio = 701.6

PO6 = -.018 + .82 WP6 + .0055 LB6 - .077 VS
(15.1) (2.8) (2.1)
R^2 = .67 DF = 115 MSE = .028 F-ratio = 76.8

PF6 = .269 + .77 WP6 - .18 ST - .012 PCS - .014 LF6
(34.1) (4.7) (2.9) (2.6)
R^2 = .94 DF = 114 MSE = .003 F-ratio = 440.9

51-67 (size category 7)

PB7 = .265 + .83 WP7 - .027 PCS + .004 LO7 - 0.55 DVS + .0039 LB6 - .0018 LB7
(28.6) (5.4) (3.2) (4.4) (3.7) (2.3)
R^2 = .92 DF = 109 MSE = .003 F-ratio = 200.0

PO7 = .133 + .71 PB7
(11.6)
R^2 = .54 DF = 114 MSE = .016 F-ratio = 133.7

PF7 = .152 + .531 PB7 - .36 ST + .025 PCS + .052 DVF
(13.8) (7.3) (5.3) (3.3)
R^2 = .82 DF = 111 MSE = .005 F-ratio = 125.9

>67 (size category 8)

PB8 = -.125 + .52 WP8 - .0014 LB8 + .2 ST
(14.4) (5.8) (3.2)
R^2 = .70 DF = 113 MSE = .008 F-ratio = 87.6

PO8 = .061 + .36 WP8 - .006 LB8
(7.3) (2.0)
R^2 = .33 DF = 114 MSE = .015 F-ratio - 28.6

PF8 = -.228 + .50 WP8 + .048 SIR + .0008 LB8 - .55 I
(12.1) (6.0) (3.1) (2.3)
R^2 = .62 DF = 112 MSE = .011 F-ratio = 46.3

Appendix Table A.2

Price Flexibility Estimates at the Mean

By Model by Size Category

	Brown Shrimp Model	Other Species Model	Florida Model
<15	NA	NA	NA
15-20	-0.015	-0.007	IN
21-25	-0.022	-0.011	IN
26-30	-0.017	IN	IN
31-40	-0.010	-0.019	IN
41-50	NA	0.035	NA
51-67	-0.012	IN	IN
>67	-0.005	-0.028	0.037

NA - There was no significant correlation between price and landings

IN - The model was specificied with prices of species other than brown shrimp as a function of brown shrimp prices.