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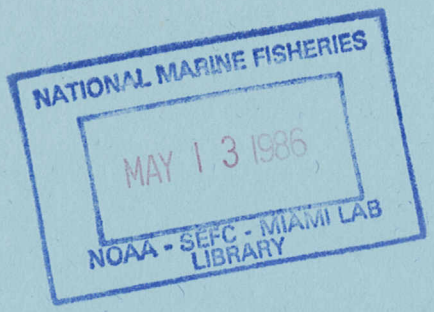

ESTIMATED IMPACTS OF TEXAS CLOSURE REGULATION ON EX-VESSEL PRICES AND VALUE OF SHRIMP, 1983 and 1984

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February 1986

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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NATIONAL MARINE FISHERIES SERVICE
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ABSTRACT

The Fishery Conservation Zone (FCZ) off the coast of Texas has been closed to shrimping since 1981 (from mid-May to mid-July) to coincide with the closure of the Texas territorial sea. These areas were closed to increase the size of commercially harvested brown shrimp. The econometric analysis of brown shrimp supply-demand relationships for three shrimp sizes (small - more than 67 tails per pound; medium - 31 to 67 tails per pound; and large - less than 31 tails per pound) estimated the changes in ex-vessel prices associated with simulated changes in landings. The estimated 0.4 million pound increase in landings due to the FCZ closure resulted in an increase in revenue of $6.7 million for May 1983 through April 1984. Preliminary estimates of the closure effect for May-August 1984 show a decrease in landings of 0.8 million pounds with an increase in revenue of $5.8 million. Changes in landings and value are due to the estimated decrease in catch of lower-valued small shrimp with an increase in higher-valued medium and large shrimp. The combined closure of the Texas territorial sea and the Texas FCZ in 1983 was estimated to have increased brown shrimp landings by 3.5 million pounds, with a resulting increase in revenue of $31.7 million for May 1983 through April 1984.

INTRODUCTION

Beginning in 1981, shrimp trawl fishing has been prohibited in the 200 mile Fishery Conservation Zone (FCZ) off Texas for a 45-60 day period in May, June, and July, coinciding with the closure of the State of Texas territorial sea (0-9 nautical miles from the coast). The Texas FCZ has been closed each year since then to implement part of the "Fishery Management Plan for the Shrimp Fishery in the Gulf of Mexico," developed by the Gulf of Mexico Fishery Management Council. The main objective of the "Texas Closure" regulation was to improve both the quantity and value of the commercial shrimp catch from the western Gulf by allowing newly recruited brown shrimp, Penaeus aztecus, to grow larger before harvest. Brown shrimp were the primary species affected by the closure due to their temporal and spatial distribution. As they migrate offshore from the estuarine areas and bays in spring and early summer, they increase relatively rapidly in weight. By delaying fishing during this rapid growth period, there is potential for yielding significant increases in both quantity landed and revenue received by shrimp fishermen.

The Texas Closure regulation includes two areas in the Gulf of Mexico that are regulated under separate authorities: the territorial sea is under the jurisdiction of the state of Texas and the Fishery Conservation Zone is under federal jurisdiction. Both of these areas are closed during the same time period, and the question has been raised regarding the effects of opening the two areas respectively. For that reason, Nichols (1985) has estimated the effects of (1) closing only the territorial sea, i.e., opening the FCZ to shrimp fishing, and (2) closing both the territorial sea and the FCZ.

The effect of the closure on the brown shrimp fishery in the western Gulf has been assessed each year since 1981. The Southeast Fisheries Center (SEFC) has presented reports to the Gulf Fishery Management Council (Nichols 1983, 1985; Poffenberger 1982, 1984), evaluating changes in landings and revenue from the 1981 and 1982 FCZ closures and preliminary estimates for the 1983 FCZ closure along with the effect of the combined closures of the FCZ and the Texas territorial sea. This report covers the effects on ex-vessel prices and value of the two closure scenarios - the FCZ closure and the combined closures of the FCZ and the Texas territorial sea - for two time periods - the 12-month season from May 1983 to April 1984 and the 4-month period from May through August 1984.

METHODOLOGY

The federal regulation prohibiting offshore shrimp fishing was designed to affect brown shrimp landings in Texas and therefore would be expected to affect ex-vessel prices in response to the

change in supply. The estimation of the change in total revenue for the brown shrimp fishery due to the closure requires a measure of the difference between reported landings and what would have been landed with no closure. Changes in brown shrimp landings in the western Gulf of Mexico were estimated through a simulation of Gulf-wide fishing and the resulting yields that would have been expected had the FCZ been open. The simulations are based on a virtual population analysis of historical brown shrimp landings developed by Nichols (1985). The analysis of the effect of the combined closure of the FCZ and Texas waters uses a similar simulation of fishing effort without closure, i.e., what the landings would have been with both areas open to shrimp fishing during the spring and summer. An economic analysis of the results of the simulation model provides estimates of the expected ex-vessel value of the brown shrimp fishery for two conditions: (1) no closure of the FCZ to shrimping and (2) no closure of either the FCZ or the Texas territorial sea to shrimping. The difference in brown shrimp landings between the observed (FCZ closed) and simulated (FCZ open) conditions is used to estimate the effect of the regulation on ex-vessel prices and value of brown shrimp.

Ex-vessel prices and landings for eight shrimp marketing categories are reported by the National Marine Fisheries Service (NMFS). Previous analyses (Poffenberger, 1982 and 1984) of the effect of the Texas Closure on ex-vessel prices have examined the effect on each of the eight market size categories (where size refers to the number of tails per pound). However, since the closure was designed to increase the availability of larger shrimp, it was found that little accuracy was lost by aggregating the data into three size categories of small, medium, and large shrimp (Poffenberger, 1984). Therefore, for analytical purposes, weighted average prices are calculated (reported revenue/reported pounds) for the following size categories: small shrimp - those market categories of more than 67 tails per pound; medium shrimp - market categories of 31 to 67 tails per pound; and large shrimp - market categories of less than 31 tails per pound. These prices are then used in the econometric analysis of the effects of the Texas closure.

The methodology used for estimating the effect of the Texas Closure regulation on the value of the brown shrimp fishery is similar to that used in previous years. An econometric analysis of the supply-demand relationship between ex-vessel price and landings for small, medium, and large shrimp was conducted using regression equations developed by Poffenberger (1984). A multiple linear regression estimated the price-quantity relationship for the three size categories based on monthly data for the period January 1971-April 1982. The estimated regression coefficients provide a measure of the absolute relationship between ex-vessel price and shrimp landings, assuming all other variables are held constant, and is used in calculating the price flexibility. Price flexibility is an indication of the responsiveness of the price of one size category to changes in landings of that size category.

Price flexibilities derived from the regression equations are calculated at the means of the price and landings data for each size category. The percentage change in landings is combined with the estimated price flexibility and the product provides the percentage change in price. A predicted price for the simulated landings is calculated by multiplying the percentage change in price by the reported monthly prices for May through August 1983. The ex-vessel prices estimated from the simulated changes in landings are used to calculate the "simulated" ex-vessel value of the brown shrimp fishery, i.e., what the prices would have been if the FCZ were open to shrimping. The difference between the reported brown shrimp value (reported price x reported pounds) and the simulated value (estimated price x simulated pounds) is the effect of the closure on the total revenue to the fishery. These empirical results are presented in the next section.

Because the price flexibility estimates are calculated in relative terms (i.e., percentage change instead of absolute change), the effects on shrimp prices and total revenue can be estimated for the combined closure of the FCZ and the Texas territorial sea using the price flexibilities from the regression equations for the three size categories and the simulated landings for the combined area.

RESULTS

The regression equations and summary statistics are presented in the Appendix. As in previous years, the Durbin-Watson (DW) test statistic (a test for the presence of serial-correlation among the error terms) indicates that there is positive serial-correlation for the ordinary least squares (OLS) estimations. Although the OLS estimators are unbiased and consistent, the variances about those estimators are biased, and the t and F statistics are suspect and, therefore, unreliable. The confidence interval for the estimators will be narrower than it should be because there is a positive correlation. The Cochrane-Orcutt iterative technique is an analytical method that adjusts for first order serial correlation. The OLS and the Cochrane-Orcutt estimated regression equations are presented in the Appendix. The adjusted regression coefficients estimated from the Cochrane-Orcutt procedure are used to estimate the price flexibilities and are shown in Table 1 along with the OLS estimators.

Closure of the Fishery Conservation Zone.

Estimates for May 1983-April 1984.

The estimated effects of the Texas Closure regulation are based on monthly simulations of brown shrimp landings for the Gulf of Mexico fishery had the FCZ been open in May-July 1983. A comparison of observed with simulated landings for the three aggregated size categories indicates that the closure regulation caused a short-term

decrease in brown shrimp landings of 1 percent or 0.5 million pounds over the May-August 1983 period but an overall annual increase of 1 percent or 0.4 million pounds for the entire 1983-1984 season (May through April). The estimated change in ex-vessel value due to the changes in landings was a short-term increase of $2.1 million or a 2 percent increase in revenue for May-August 1983, and an annual increase of $6.7 million or a 3 percent gain for the entire season (Tables 2 and 3).

The increase in yield due to the closure of the FCZ results from a shift in the shrimp size composition of the catch. There is an overall increase in the catch of medium and large shrimp, 1.8 million pounds and 0.6 million pounds, respectively, with a corresponding decrease in the small shrimp catch of 1.8 million pounds. The change in size composition has the desired affect on revenue, a decrease of $2.8 million for small shrimp and an increase of $6.3 million and $3.2 million, respectively, for medium and large shrimp (Table 3).

Estimates for May-August 1984.

Preliminary estimates of the effects of the closure for 1984 cover only the 4 month period, May through August, and are presented in Table 4. The estimated change in catch due to the closure of the FCZ is an overall decrease of 1 percent or 0.8 million pounds of brown shrimp. The results of the 1984 closure for May-August are a shift in the size composition of the catch with a decrease in small shrimp landings of 3.9 million pounds and an increase of only 3.1 million pounds for medium and large shrimp. Although there is a decrease in brown shrimp landings, the shift away from the smaller to the larger and more valuable shrimp causes an overall increase in revenue. Therefore, due to the FCZ closure there is an increase in total ex-vessel value for May-August of 4 percent or $5.8 million. The change in revenue over the short term shows a decrease in the value of small shrimp, $4.0 million, with increases in values of medium shrimp, $5.0 million, and large shrimp, $5.0 million. These are preliminary estimates, however, and may change as data for the entire year are included in the simulations.

Closure of the FCZ and the Territorial Sea.

Estimates for May 1983-April 1984.

The effects of closing both the Texas territorial sea and FCZ were estimated for the 1983-1984 season (Tables 5 and 6). The general effects are similar to those for the analysis above but of a larger magnitude, reflecting the increased area included by the combined closures. A comparison of the reported landings and the simulated landings indicates that during the 4 month period, May-August, there was an increase in brown shrimp landings of 0.7 million pounds, valued at $17.4 million due to the combined closures

of the FCZ and the Texas territorial sea. The estimated change in landings over the annual period, May 1983-April 1984, shows that due to the closures, brown shrimp landings increased by 3.5 million pounds, with a corresponding increase in value of $31.7 million. An examination of the size composition of the 1983-1984 brown shrimp catch reveals a decrease in small shrimp landings of 5.7 million pounds and an increase of over 9 million pounds in landings of the larger shrimp. The change in revenue due to the closures was a decrease in value of $8.6 million for small shrimp and an increase of over $40 million for the larger shrimp (Table 6). As these estimates indicate, if the two areas had been open to shrimping there would have been a larger percentage of the small but lower valued shrimp caught, with a lower percentage of catch in the higher valued medium and large size categories.

SUMMARY

The 1983 Texas Closure regulation resulted in an estimated increase in brown shrimp landings of 0.4 million pounds and a $6.7 million increase in ex-vessel value for the 1983-1984 season. The brown shrimp fishery had reported landings of 61.47 million pounds valued at $194.7 million during this 12 month period; without the closure the annual revenue would have been $188 million. The preliminary estimates for May through August 1984 indicate a decrease in total landings of 0.8 million pounds, but an increase in ex-vessel value of $5.8 million, as a result of closing the FCZ to shrimping.

One objective of the closure was to allow for an increase in the size of brown shrimp commercially harvested off the Texas coast. The simulation analysis by Nichols (1985) indicated a shift in the size composition of the 1983-1984 catch into the larger size categories. This shift resulted in increases in the total revenue of the catch; thus, the main purpose of the closure to increase both the quantity and value of the Texas brown shrimp fishery was realized.

The Texas FCZ has been closed to shrimp fishing for 4 years during the mid-May through mid-July period. Comparisons of previous seasons' landings and revenue are presented in Table 7. Revised estimates of the gain in pounds and value due to the FCZ closure are: 1981, 4.2 million pounds and $9.8 million; 1982, 1.4 million pounds and $6.0 million; and for 1983, 0.4 million pounds and $6.7 million. Annual reported yields and revenue show a consistent increase over the estimated yields and revenue if the closure had not been in effect. The general indication is that the closure policy has been beneficial to the brown shrimp fishery.

The combined closure of the Texas FCZ and the Texas territorial sea resulted in a 6 percent or 3.5 million pound increase in the landings of brown shrimp. The increase in revenue is estimated at $31.7 million or 16 percent over what would have been received if

both the FCZ and the territorial sea had been open to shrimping. A comparison with landings and revenue reported in previous seasons is presented in Table 8. The combined closures of the Texas FCZ and territorial sea were estimated to have consistently produced increases in pounds landed: 1981, 9.8 million pounds and $59 million; 1982, 4.9 million pounds and $43.2 million; and 1983, 3.5 million pounds and $31.7 million. The relative magnitudes of the revenue estimates support the management objectives for the closures, i.e., to protect smaller shrimp while they grow into larger, more valuable size categories.

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Table 1. Comparison of ordinary least squares (OLS) and Cochrane-Orcutt regression and price flexibility estimates for brown shrimp prices.

Size categories	Pounds* landed	Ex-vessel* prices	OLS** $\frac{dRP}{dLB}$	OLS** m	Cochrane-Orcutt** $\frac{dRP}{dLB}$	Cochrane-Orcutt** m
<30	$1.786(10^6)$	1.79	$-5.24(10^{-8})$	-.052	$-5.29(10^{-8})$	-.053
31-67	$2.514(10^6)$	1.20	$-1.08(10^{-8})$	-.022	$-1.05(10^{-9})$	-.0022
>67	$1.938(10^6)$	0.59	$-2.30(10^{-8})$	-.075	$-2.09(10^{-8})$	-.069

* The pounds landed and ex-vessel prices are averages of the monthly 1971 through 1982 data set. Ex-vessel prices are in real dollars, i.e., adjusted by the Consumer Price Index.

** The regression coefficients (dRP/dLB) were estimated using multiple regression analysis. The results of these regressions are presented in the Appendix. The price flexibility estimates (m) were calculated at the means of the 1971-1982 data set.

Table 2. Reported and simulated landings and revenue for May-August 1983 due to the closure of the Fishery Conservation Zone.*

Size categories	Pounds			Revenue ($)		
	Reported	Simulated	Difference	Reported	Simulated	Difference
<30	3,019.7	3,136.8	-117.1	17,319.3	17,987.5	-688.1
31-67	15,701.7	14,297.1	1,404.6	60,329.6	54,726.2	5,567.3
>67	29,441.5	31,229.8	-1,788.3	52,449.2	55,205.1	-2,755.8
TOTAL	48,162.9	48,633.7	-500.8	130,098.1	127,954.8	2,143.3

*Values are in thousands.

Table 3. Reported and simulated landings and revenue for May 1983-April 1984 due to the closure of the Fishery Conservation Zone.*

Size categories	Pounds			Revenue ($)		
	Reported	Simulated	Difference	Reported	Simulated	Difference
<30	11,291.5	10,679.6	611.9	61,671.1	58,432.6	3,238.5
31-67	20,447.3	18,872.3	1,575.0	80,056.2	73,797.3	6,258.9
>67	29,728.6	31,540.0	-1,812.4	52,977.2	55,777.9	-2,800.7
TOTAL	61,467.3	61,092.8	374.5	194,704.5	188,077.8	6,696.7

*Values are in thousands.

Table 4. Reported and simulated landings and revenue for May-August 1984 due to the closure of the Fishery Conservation Zone.*

Size categories	Pounds			Revenue ($)		
	Reported	Simulated	Difference	Reported	Simulated	Difference
<30	7,444.4	6,102.0	1,342.4	33,720.5	28,773.0	4,947.5
31-67	25,649.0	23,936.1	1,712.9	68,917.8	64,008.2	4,909.6
>67	34,330.5	38,213.7	-3,883.2	41,934.5	45,967.4	-4,032.9
TOTAL	67,423.9	68,251.8	-827.9	144,572.8	138,748.6	5,824.2

*Values are in thousands.

Table 5. Reported and simulated landings and revenue for May-August 1983 due to the closure of both the Fishery Conservation Zone and the Texas Territorial Sea.*

Size categories	Pounds			Revenue ($)		
	Reported	Simulated	Difference	Reported	Simulated	Difference
<30	3,097.7	2,015.7	1,004.0	17,319.3	11,764.2	5,555.1
31-67	15,701.7	10,481.9	5,219.8	60,329.6	40,163.0	20,166.6
>67	29,441.5	34,929.0	-5,487.5	52,449.2	60,724.6	-8,275.4
TOTAL	48,162.9	47,426.6	736.3	130,098.1	112,651.8	17,446.3

*Values are in thousands.

Table 6. Reported and simulated landings and revenue for May 1983-April 1984 due to the closure of the Fishery Conservation Zone and the Texas Territorial Sea.*

Size categories	Pounds			Revenue ($)		
	Reported	Simulated	Difference	Reported	Simulated	Difference
<30	11,291.5	7,720.7	3,570.8	61,671.1	42,937.3	18,733.8
31-67	20,447.3	14,871.3	5,576.0	80,056.2	58,500.1	21,556.1
>67	29,728.5	35,415.6	-5,687.1	52,977.2	61,552.6	-8,575.4
TOTAL	61,467.3	58,007.6	3,459.7	194,704.5	162,990.0	31,714.5

*Values are in thousands.

Table 7. Comparison of estimated differences in landings and revenue in the brown shrimp fishery due to the closure of the Fishery Conservation Zone.*

Year	Pounds			Revenue ($)		
	Reported	Simulated	Difference	Reported	Simulated	Difference
12-month totals, May through April						
1981-82	102,246	98,001	4,245(4%)	236,020	226,309	9,711(4%)
1982-83	74,063	72,667	1,396(2%)	226,799	220,822	5,977(3%)
1983-84	61,467	61,093	374(1%)	194,704	188,008	6,696(3%)
4-month totals, May through August						
1981	79,329	74,331	3,998(5%)	144,723	134,328	10,395(7%)
1982	60,193	59,451	742(1%)	155,880	150,568	5,312(3%)
1983	48,163	48,663	-500(-1%)	130,098	127,955	2,143(2%)
1984	67,424	68,251	-827(-1%)	144,572	138,748	5,824(4%)

*Values are in thousands.

Table 8. Comparison of estimated differences in landings and revenue in the brown shrimp fishery due to the closure of the Fishery Conservation Zone and the Texas Territorial Sea.*

Year	Pounds			Revenue ($)		
	Reported	Simulated	Difference	Reported	Simulated	Difference
12-month totals, May through April						
1981-82	102,246	92,455	9,791(10%)	236,020	176,522	59,498(25%)
1982-83	74,063	69,209	4,854(7%)	226,799	183,578	43,221(19%)
1983-84	61,467	58,007	3,460(6%)	194,704	162,990	31,714(16%)
4-month totals, May through August						
1981	79,329	76,632	2,697(3%)	144,723	113,764	30,959(21%)
1982	60,193	59,241	952(2%)	155,880	131,817	24,063(15%)
1983	48,162	47,426	736(2%)	130,098	112,652	17,446(13%)

*Values are in thousands.

APPENDIX

Using the model developed by Poffenberger (1984), Linear regression estimates for brown shrimp prices reported in the north central Gulf of Mexico are presented here. These estimates were made using monthly data from January 1971 through April 1982 (136 observations). Both the OLS (ordinary least squares) estimates and the estimates derived from the Cochrane-Orcutt correction for serial correlation are presented.

Large brown shrimp - < 30 count per pound:

$$RP = \underset{(4.46)}{0.391} + \underset{(39.4)}{0.808}\ RWP - \underset{(-5.9)}{0.524\ (10^{-7})}\ LB$$

$$- \underset{(-3.40)}{0.0077}\ INT - \underset{(-2.25)}{0.185(10^{-5})}\ STOR - \underset{(-3.20)}{0.081}\ DV$$

$\overline{R}^2 = 0.93$

$F_{5,130} = 345.88$

$DW = 1.54$

Medium brown shrimp - 31-67 count per pound:

$$RP = \underset{(-0.32)}{-0.0338} + \underset{(22.23)}{0.844}\ RWP - \underset{(-2.42)}{0.108(10^{-7})}\ LB$$

$$+ \underset{(1.73)}{0.167(10^{-5})}\ STOR - \underset{(-2.14)}{0.0703}\ DV$$

$\overline{R}^2 = 0.84$

$F_{4,131} = 174.11$

$DW = 0.966$

Small brown shrimp - > 67 count per pound:

$$RP = \underset{(1.23)}{0.114} + \underset{(8.47)}{0.340}\ RWP - \underset{(-8.37)}{0.230(10^{-7})}\ LB$$

$$+ \underset{(1.51)}{0.0143}\ RPCSP - \underset{(-3.11)}{0.009}\ MON$$

$\overline{R}^2 = 0.63$

$F_{4,131} = 57.91$

DW = 1.46

Because there was an indication of serial correlation, as evidenced by the values of the Durbin-Watson statistic, the price equations were re-estimated using a technique developed by Cochrane-Orcutt to correct for the serial correlation. Those results follow:

Large brown shrimp - < 30 count per pound:

$$RP = \underset{(4.30)}{0.497} + \underset{(24.03)}{0.758}\ RWP - \underset{(-5.37)}{0.529(10^{-7})}\ LB$$

$$- \underset{(-2.12)}{0.0066}\ INT - \underset{(-1.93)}{0.203(10^{-5})}\ STOR - \underset{(-2.62)}{0.072}\ DV$$

$\overline{R}^2 = 0.86$

$F_{5,129} = 165.103$

Medium brown shrimp - 31-67 count per pound:

$$RP = \underset{(-0.68)}{-0.120} + \underset{(11.85)}{0.835}\ RWP - \underset{(-0.26)}{0.105(10^{-8})}\ LB$$

$$+ \underset{(1.92)}{0.287(10^{-5})}\ STOR - \underset{(-2.79)}{0.0829}\ DV$$

$\overline{R}^2 = 0.60$

$F_{4,130} = 49.82$

Small brown shrimp - > 67 count per pound:

$$RP = \underset{(1.39)}{0.151} + \underset{(7.22)}{0.367}\ RWP - \underset{(-7.39)}{0.209(10^{-7})}\ LB$$

$$+ \underset{(0.69)}{0.0074}\ RPCSP - \underset{(-2.02)}{0.0066}\ MON$$

$\overline{R}^2 = 0.52$

$F_{4,130} = 36.07$

Definition of terms for regression equations:

RPB = ex-vessel prices by size deflated by the Consumer Price Index (CPI);

RWP = wholesale price by size reported by the New York Fulton Fish Market deflated by the CPI;

DV = a dummy variable measuring the seasonality of ex-vessel prices (DV = 1 for months between June and October and zero elsewhere);

LB = pounds of brown shrimp by size landed at ports in the north central Gulf of Mexico;

INT = short-term prime interest rate;

STOR = beginning of the month cold storage holdings in product weight;

RPCSP = per capita spending at eating and drinking places deflated by the CPI; and

MON = sequential index for months (i.e., MON = 1, 2,..., 12).

Summary statistics:

$\overline{R}^2$ = R-squared adjusted for the degrees of freedom;

F = F-statistic; and

DW = Durbin and Watson test statistic.

Note: The t-values are presented in parentheses below the respective regression coefficients.