

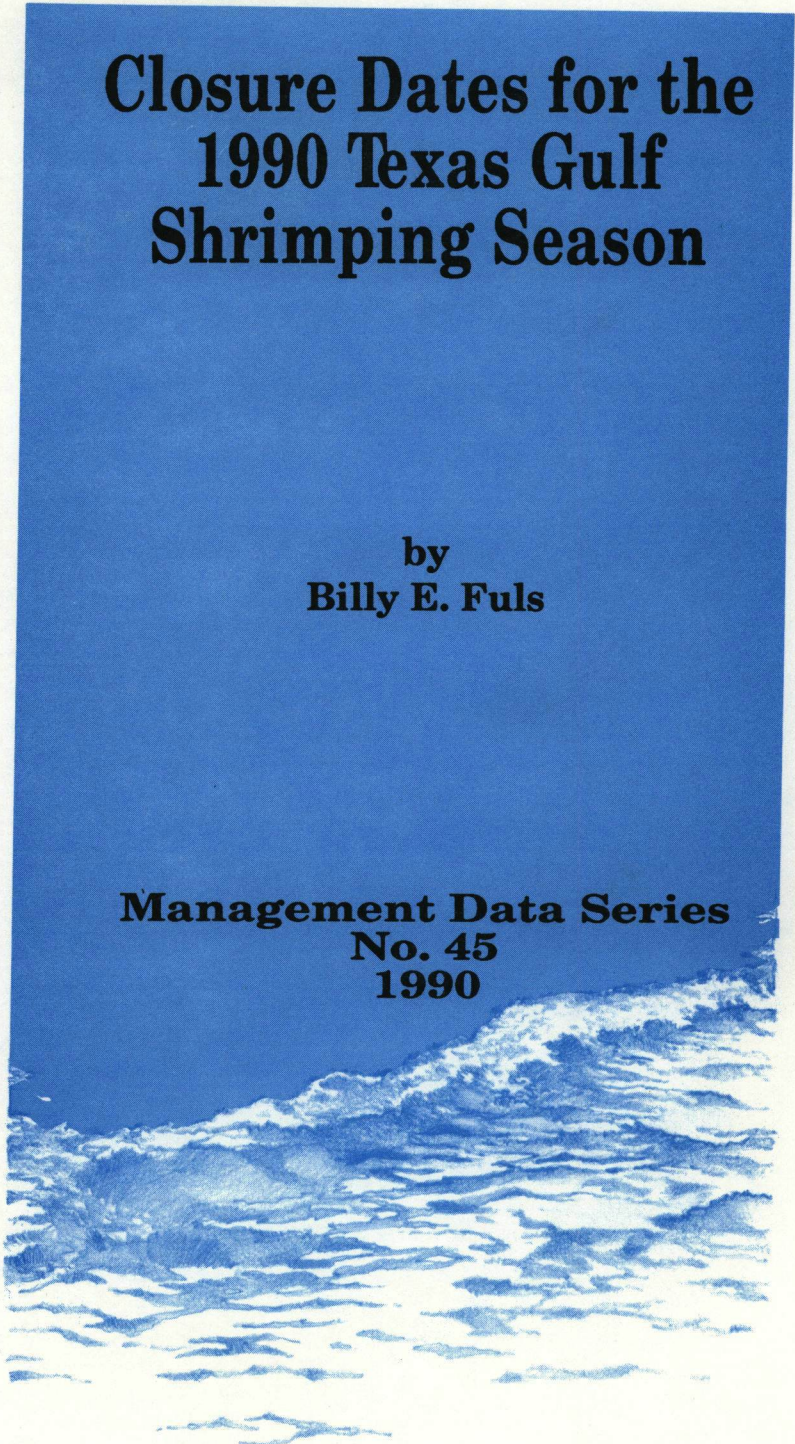
Closure Dates for the 1990 Texas Gulf Shrimping Season

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ABSTRACT

Brown shrimp (Penaeus aztecus) were collected with bag seines along shorelines and with trawls in deeper (≥ 1 m) Texas bay and gulf waters to determine closing and opening dates of the 1990 shrimping season in the Texas Territorial Sea. The purpose of the closed season was to protect small brown shrimp from fishing pressure until they reached a larger, more valuable size and to minimize waste caused by discarding smaller shrimp during gulf harvest. The Texas Parks and Wildlife Commission rules which became effective 14 May 1990 set the closed season to begin at 30 minutes after sunset on 15 May 1990. Bay and gulf samples collected in June indicated substantial numbers of brown shrimp would be ≥ 112 mm by 1 July. Longer tidal durations, when major movements of shrimp from the bays to gulf occur, were predicted for 2-8 July. In order to allow small shrimp emigrating during their period to disperse from passes, the recommended opening date was 30 minutes after sunset on 8 July. This complied with the 45-60 day closure mandated by the Shrimp Conservation Act of 1959.

ACKNOWLEDGEMENTS

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INTRODUCTION

Second to salmon landings, shrimp have the highest total ex-vessel value of all seafood products landed in the United States. Reported shrimp landings were 161.6 million kg (heads-on) with an ex-vessel value of \$475 million in 1989 (U. S. Department of Commerce 1990). Texas shrimp landings in 1989 amounted to 35.0 million kg valued at \$144 million (Johns In press). This is 22% of the weight and 30% of the value of the U. S. shrimp fishery. Shrimp are the most important commercial seafood product in Texas, annually accounting for over 90% of the value and 80% of the weight of all seafood landings. Brown shrimp (Penaeus aztecus) is the most economically valuable species, comprising about 84% of the weight and 94% of the value of the annual reported landings.

Brown shrimp spawn in the Gulf of Mexico, go through several larval stages and enter bays during February-April as post-larvae (Baxter and Renfro 1967, King 1971). They initially seek shallow nursery areas in the bays where they grow rapidly, migrate to the deeper portions of bays and then return to the gulf in late May or early June at a mean size of about 90 mm TL (Copeland 1965, Trent 1967, Parker 1970, King 1971). Movement to the gulf through passes occurs mainly at night near the surface in association with ebb tides during the period of maximum tide duration (Copeland 1965, King 1971). Movement ceases during daylight and during flood tides, with shrimp remaining on the bottom until the next nocturnal ebb tide. Diurnal tides are mixed, with one low and one high per 24-h period of maximum range and two highs and two lows per 24-h period with a minimum range (Collier and Hedgpeth 1950). During the period of maximum range, tides are at maximum duration.

Brown shrimp management in Texas is designed to accommodate all users (bait, small food shrimp and large food shrimp fishermen) while protecting the resource and minimizing waste. The supply of large shrimp is ensured by regulating harvest in bays and simultaneously delaying harvest in the gulf until emigrants reach a larger, more valuable size. Prior to 14 May 1990 shrimp were managed by the Texas Legislature through the Shrimp Conservation Act of 1959 (State of Texas 1989). This Act established a 45 day closed season in the Texas Territorial Sea (TTS) waters (≤ 16.7 km from shore) from 1 June-15 July each year. In 1975 the Texas Legislature authorized the Texas Parks and Wildlife Commission (TPWC) to adjust closing and opening dates as long as the total closure was ≥ 45 days but ≤ 60 days. In April 1978 the TPWC delegated this authority to the TPWD Executive Director. On 2 November 1989 the Texas Shrimp Fishery Management Plan was adopted by the TPWC. Chapter 77, TPWD Code, provided the TPWC with the authority to regulate the catching, possession, purchase, and sale of shrimp (1st sales transaction) after a Shrimp Fishery Management Plan developed by the TPWD was approved by the TPWC. Effective 14 May 1990 the TPWC amended Texas Parks and Wildlife Code, Chapter 77, Section 77.061(a)(1), 77.065, and 77.067 to mandate a closure of the TTS beginning 30 minutes after sunset on 15 May to 30 minutes after sunset on 15 July. However, the opening date of 15 July could still be altered by the Executive Director using sound biological data.

The purpose of the annual closure is to protect small shrimp from fishing pressure until they reach a larger, more valuable size (≥ 112 mm mean TL) and to minimize waste caused by discarding smaller shrimp during gulf harvest.

Texas has closed the TTS for 30 years; the statutory 1 June-15 July season has been adjusted nine times (Table 1). The rationale for adjusting closure dates was detailed by Moffett (1967, 1972), Johnson (1976), Bryan (1983, 1985, 1986 and 1988), and Procarione and Fuls (1990). Small shrimp were protected in the TTS by closures prior to 1981, but large numbers of small shrimp were still captured and discarded in waters beyond Texas' jurisdiction (Berry and Benton 1969, Baxter 1973, Bryan et al. 1982).

The Gulf of Mexico Fishery Management Council Shrimp Fishery Management Plan was adopted in 1980 and implemented in 1981 (Center for Wetland Resources 1980). Among other options, the plan called for closure of U. S. waters (≥ 16.7 to 370.6 km) off Texas to complement the traditional Texas closed season. However, during the 1986, 1987, and 1988 closure U. S. waters were closed out to only 27.8 km. During 1989 and 1990 U. S. waters were again closed out to 370.6 km. The combined closure of Texas and U. S. waters has resulted in an increased yield of brown shrimp off Texas during every closure year from 1981-89 (Nichols 1990). However, the July-August catch per unit of effort (CPUE) off Texas was greater (except for 1984) when U. S. waters were closed to 370.6 km during 1981-85 (371-860 kg/d) than during 1986-88 (310-388 kg/d) when waters were closed to only 27.8 km (Klima et al. 1990). When U.S. waters were again closed to 370.6 km during the 1989 closure, the July-August CPUE (466 kg/d) again rose above the 1986-88 CPUE. The present report documents procedures used to determine the 1990 dates of closing and opening the TTS to shrimping.

MATERIALS AND METHODS

Shoreline samples were collected with bag seines to capture post-larval and juvenile shrimp as they were first recruited to the gear. Otter trawls were used in deeper (≥ 1 m) portions of bays and in the Gulf of Mexico to determine the time and at what sizes shrimp emigrated from the bays.

Samples were collected with bag seines (18.3 m long and 1.8 m deep with 19-mm stretched mesh in the wings and 13-mm stretched mesh in the bag) in the Sabine Lake, Galveston, East Matagorda, Matagorda, San Antonio, Aransas and Corpus Christi Bays and upper and lower Laguna Madre systems. Sixteen different shoreline stations were sampled each month in each bay system. Detailed descriptions of sample stations and procedures are reported by Bryan (1988).

Samples were collected with trawls (6.1 m wide at mouth with 3.8-cm stretched mesh) in the same bay systems listed for bag seines. Detailed descriptions of sample stations, frequency and procedures are reported by Dailey et al. (In press).

Trawls, identical to those used in the bays, were used in the TTS during June in five gulf areas: 24.1 km either side of each of the Sabine Pass jetties (Sabine), Galveston jetties (Galveston), Matagorda jetties (Port O'Connor), and Aransas Pass jetties (Port Aransas), and 48.2 km north from the Texas-Mexico border (Port Isabel). Detailed descriptions of sample stations, frequency and procedures are reported by Dailey et al. (In press). Gulf trawl

samples during June were in conjunction with the National Marine Fisheries Service (NMFS) Southeast Area Monitoring and Assessment Program (SEAMAP).

For all gears, the sampling week extended from 1/2 h before sunrise Monday through 1/2 h after sunset the following Sunday; all samples were collected during daylight hours. All brown shrimp captured in a sample were counted. Total length (mm; tip of rostrum to tip of telson) was obtained from up to 19 shrimp in bag seine samples and up to 50 in trawl samples.

Catch was expressed as no./ha (bag seines) and no./h (trawls). The coastwide mean catch (number and length) in bag seines was weighted by the shoreline distance in each bay system (Matlock and Ferguson 1982). Bay trawl data were weighted according to the percentage each bay system's surface area in water ≥ 1 m deep contributed to the coastwide area. Gulf trawl data were weighted by the number of grids within each gulf sampling area. Mean shrimp lengths were weighted by the total number caught in each sample. Projected growth rates for combined bays were based on the von Bertalanffy model from Parrack (1979). Sexes were assumed equal since shrimp sex was not determined.

Prior to May 1990 the following criteria were used to recommend the 1990 closing of the TTS:

1. Mean number of brown shrimp/ha (transformed to Log_{10}) captured in bag seines during April 1990 was compared to the combined mean number (+ 2 mean SE) caught during 1978-80 and 1987-89 when the season was closed 1 June. Relatively large numbers of shrimp captured in April were interpreted as indicating good survival and/or early recruitment of post-larvae and, therefore, a probable earlier than 1 June emigration from bays to the gulf.
2. Percentage of samples in which brown shrimp occurred was compared to that observed in previous years. A relatively high percentage of samples containing shrimp was interpreted to mean that shrimp were well distributed along the coast.
3. Mean length of shrimp collected during April was determined. When the number of shrimp in samples indicated early emigration, the von Bertalanffy growth model from Parrack (1979) was used to estimate the date shrimp captured in April would reach a mean length of 90 mm. Growth rate was calculated from 15 April.
4. Periods of maximum duration of ebb tides were determined from NOAA nautical charts for Galveston Bay. The date of the period nearest to the date shrimp were projected to reach 90 mm was recommended as the closure date.

The following criteria were used to recommend the 1990 opening of the TTS to shrimping:

1. Mean number of shrimp/ha (transformed to Log_{10}) caught in bag seines during June 1990 was compared to previous years' means. The season could be set for the 60 days authorized if substantial numbers [a

mean 2 SE (SD = SE since yearly means are used) greater than average since 1979] of small shrimp were still found along shorelines. This would indicate additional recruitment of small shrimp into the bays, thus later movement towards the gulf. The season could be shortened if the mean number of shrimp was 2 SE less than average for 1979-89. This would indicate less recruitment of small shrimp into the bays, thus earlier movement towards the gulf.

2. Mean number of shrimp/h (transformed to Log_{10}) caught with trawls in the deeper (≥ 1 m) portion of bays in June was compared to previous years' means. These samples reflect those shrimp that will most likely move to the gulf during June-July. If catch rates are similar to or greater than in past years, the date when shrimp are projected to reach a mean length of 112 mm (calculated from 15 June) is recommended to be the reopening date.
3. Samples in the Gulf of Mexico within the TTS during June were collected to determine if recruitment into the gulf shrimping grounds had occurred. If recruitment to the gulf shrimping grounds has occurred, mean lengths are obtained and growth rates projected to determine the recommendation for the opening date. The criterion is that a substantial portion of brown shrimp on the fishing grounds average ≥ 112 mm when the season opened (Center for Wetland Resources 1980).

RESULTS

Closing Date

Rules adopted by the TPWC during May 1990 set future gulf closure dates to 30 minutes after sunset on 15 May 1990. Prior to the 14 May effective date for this change, mean catch rates and sizes of shrimp from bag seines during April indicated an early emigration of brown shrimp to the Gulf of Mexico was probable in 1990. Mean number (1.8/ha) of shrimp captured in April bag seines was similar to 1981-86 and greater than the average +2 mean SE (1.4/ha) during 1978-80 and 1987-89 (Table 2). Percentage of samples containing shrimp in 1990 was 63% compared to a six year mean of 33% for 1978-80 and 1987-89 (when a normal closure date of 1 June was set), and a six year mean of 62% for 1981-86 (when closure dates were set earlier than 1 June), indicating that shrimp exhibited a wide distribution along the Texas coast.

Mean length of shrimp from bag seines was 53 ± 2 mm in April 1990 (Table 2). Growth calculated from 15 April indicated mean length would be 90 mm on 15 May 1990. Periods of maximum ebb tide duration for Galveston Bay were 10-16 May, 25-28 May and 5-13 June.

Opening Date

The season was opened 30 minutes after sunset on 8 July because most shrimp on the fishing grounds would be ≥ 112 mm (65 tails/lb) or larger by that date. Bag seine catch rates of shrimp during June 1990 ($1.9 \pm 0.2/\text{ha}$) were not significantly different from the eleven year average ($2.1 \pm 0.3/\text{ha}$) of previous years (Table 2). Mean length (65 ± 2 mm) indicated shrimp along shorelines would not reach 112 mm until the end of July or much longer than the authorized closure period.

Mean number of shrimp in the deeper portion of bays in June 1989 ($1.2 \pm 0.2/\text{h}$) was not significantly different from the average during June 1982-89 ($1.4 \pm 0.1/\text{h}$) (Table 3). Mean length (97 mm) calculated from 15 June indicated they would be 112 mm on 1 July.

Catch rates and mean lengths of shrimp during June in the TTS indicated a substantial portion of the shrimp on the fishing grounds would average ≥ 112 mm when the season opened (Table 4).

Since brown shrimp remaining in the deeper portion of the bays would be 112 mm on 1 July and those already in the gulf would be 112 mm by the end of June, an earlier opening than the scheduled 15 July opening was indicated. Longer tidal durations, when major movement of shrimp from the bays to the gulf occur, were predicted for 2-8 July. In order to allow small shrimp emigrating during this time period to disperse from the passes, the recommended opening date was 30 minutes after sunset on 8 July 1990. This date complies with the minimum 45-60 day closure as mandated by the Shrimp Conservation Act of 1959.

DISCUSSION

Techniques used to establish a closed season should be simple because they must be employed in a timely manner. The last possible dates for collection of bag seine samples are 30 April and 30 June, respectively. Calculations must be made and results presented and approved by the TPWD Executive Director who has delegated authority by the TPWC to set season dates. The law requires 72 and 24 h, respectively, for public notice for closing and opening dates (State of Texas 1989). The approved season dates must be published in the Texas Register and public notice and news releases prepared. The NMFS is notified so that public notice can be provided concerning the closing and opening of U. S. waters. The NMFS must go through their in-house procedure which requires a minimum of three days notice prior to the effective opening/closing date.

Fishery managers do not always have the luxury of an extensive data analysis. The time lapse from the last day of data collection through approval and public notice is only a few days. Since sample data are often required to be transmitted by telephone to expedite analysis, there is a possibility of error. Data in the present report are considered preliminary and may change with up-dating of the data base.

This was the ninth year in which the described technique was used to determine season dates; data indicate it has been successful. Adjustments may be made to the technique as more data are collected and analyzed.

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Table 1. Modifications to the 1 June-15 July closed gulf shrimping season by year.

Year ^a	Date ^b		Duration (days)
	Closing	Opening	
1967	17 May	1 Jul	45
1972	17 May	1 Jul	45
1976	17 May	16 Jul	60
1981	22 May	16 Jul	55
1982	25 May	14 Jul	50
1983	27 May	15 Jul	49
1984	16 May	6 Jul	51
1985	20 May	8 Jul	49
1986	10 May	2 Jul	53

^aIn 1975 the maximum length of the closed season was increased from 45 to 60 days.

^bThrough 1981 the season closing and opening times were 12:01 a.m. During 1982-86 the closing and opening times were 30 minutes after sunset.

Table 2. Coastwide mean catch rate (no./ha + 1 transformed to $\log \pm 1SE$) and mean length (mm $\pm 1SE$) of brown shrimp collected with 18.3-m wide bag seines along shorelines in Sabine, Galveston, East Matagorda, Matagorda, San Antonio, Aransas and Corpus Christi Bays, and upper and lower Laguna Madre during April and June 1978-90. ND = no data.

Year	April				June			
	Samples/mo	Mean catch rate (no./ha) ^b	Samples containing shrimp (%) ^c	Mean length	Mean catch rate (no./ha) ^d	Samples containing shrimp (%)	Mean length ^e	
1978	42	0.7 \pm 0.4	33	48 \pm 3	ND	ND	ND	
1979	42	0.5 \pm 0.4	31	48 \pm 2	2.0 \pm 0.6	74	62 \pm 4	
1980	42	0.4 \pm 0.2	21	49 \pm 3	2.4 \pm 0.3	83	63 \pm 3	
1981	42	2.0 \pm 0.5	76	54 \pm 3	1.9 \pm 0.4	69	60 \pm 3	
1982	70	1.8 \pm 0.3	64	52 \pm 2	2.3 \pm 0.4	79	68 \pm 3	
1983	80	1.4 \pm 0.4	56	43 \pm 2	2.3 \pm 0.3	82	63 \pm 4	
1984	80	1.7 \pm 0.4	66	57 \pm 4	2.2 \pm 0.4	81	69 \pm 3	
1985	80	1.4 \pm 0.5	44	52 \pm 2	2.4 \pm 0.4	84	64 \pm 3	
1986	90	2.0 \pm 0.2	67	58 \pm 3	1.6 \pm 0.4	66	69 \pm 5	
1987	90	1.1 \pm 0.3	36	47 \pm 3	1.7 \pm 0.4	71	65 \pm 3	
1988	108	0.9 \pm 0.2	36	47 \pm 4	2.1 \pm 0.4	78	71 \pm 2	
1989	108	1.0 \pm 0.2	38	46 \pm 3	2.4 \pm 0.2	81	59 \pm 2	
1990	144	1.8 \pm 0.3	63	53 \pm 2	1.9 \pm 0.2	72	65 \pm 2	

^a Differences in bag seine statistics in this report compared to previous reports are due to updating the data base.

^b Mean no./ha + 2SE for 1978-80 and 1987-89 = 1.4/ha

^c Percentage of samples containing shrimp 1978-80 and 1987-89 = 33

^d Mean no./ha \pm 1SE 1979-89 = 2.1 \pm 0.3

^e Mean length (mm) \pm 1SE 1979-89 = 65 \pm 4

Table 3. Mean catch rate (no./h + 1 transformed to $\log_{10} \pm 1\text{SE}$) and mean length (mm $\pm 1\text{SE}$) of brown shrimp collected with 6.1-m wide otter trawls in the deeper (≥ 1 m) water of Sabine, Galveston, East Matagorda, Matagorda, San Antonio, Aransas and Corpus Christi Bays and the upper and lower Laguna Madre during June 1982-90^a.

Year	No./h ^b	Mean length (mm)
1982	1.4 \pm 0.2	92 \pm 2
1983	1.3 \pm 0.2	96 \pm 2
1984	1.5 \pm 0.2	101 \pm 3
1985	1.4 \pm 0.2	91 \pm 2
1986	1.3 \pm 0.2	95 \pm 2
1987	1.5 \pm 0.2	90 \pm 4
1988	1.3 \pm 0.2	91 \pm 2
1989	1.4 \pm 0.2	86 \pm 2
1990	1.2 \pm 0.2	97 \pm 2

^aDifferences in bay trawl statistics in this report compared to previous reports are due to updating the data base.

^bMean no./h + 1SE 1982-89 = 1.4 \pm 0.1.

Table 4. Mean catch rate (no./h + 1 transformed to $\log_{10} \pm 1\text{SE}$) and mean length (mm $\pm 1\text{SE}$) of brown shrimp collected in five areas of the TTS in the Gulf of Mexico with 6.1 m trawls during June 1986-90^a.

Year	Mean no./h	Mean length (mm)	Mean length (mm) adjusted to 6/30
1986	0.7 \pm 0.2	107 \pm 3	120
1987	1.0 \pm 0.2	104 \pm 2	117
1988	1.3 \pm 0.2	105 \pm 3	119
1989	1.9 \pm 0.3	99 \pm 3	113
1990	1.0 \pm 0.2	108 \pm 2	120

^aDifferences in gulf trawl statistics in this report compared to previous reports are due to updating the data base.

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