

# THE RED TIDE (*KARENIA BREVIS*) BLOOM OF 2000

Winston Denton and Cindy Contreras

Resource Protection Division

Texas Parks and Wildlife Department

4200 Smith School Road

Austin, Texas 78744

June 2004



Water Quality Technical Series WQTS-2004-01

## TABLE OF CONTENTS

Executive Summary

References and Acknowledgements

Appendix A. Pollution Response and Species Mortality (PRISM) fish kill and pollution investigation database report. Source: Texas Parks and Wildlife Department.

Appendix B. 2000 Red-Tide Event and Impacts on Texas Shellfish Growing Areas. Source: Texas Department of Health.

Appendix C. Cell count information from Dr. Tracy Villareal, University of Texas Marine Science Institute, Port Aransas, Texas.

Appendix D. Cell counts from Dr. Tony Reisinger, Sea Grant, and Dr. Don Hockaday, Univ. of Texas Pan American.

## EXECUTIVE SUMMARY

Texas experienced a widespread red tide in 2000 which affected almost every part of the state's coast. Although many harmful algae species are found in Texas waters and can cause toxic blooms, the term "red tide" is usually reserved for blooms of *Karenia brevis* (formerly *Gymnodinium breve*). These blooms can kill millions of fish and other aquatic organisms, contaminate shellfish, discolor coastal waters and cause respiratory irritation in beachgoers. Not surprisingly, this can also affect coastal economies which depend on shellfish harvesting, water-based recreation, and tourism. Economic impacts in the Galveston County area alone from the 2000 red tide approached \$18 million (Jones and Evans 2000).

Researchers and natural resource managers in Texas recognize the damaging effects of red tides. A red tide outbreak, like most harmful algal blooms, is revealed primarily through investigation of mortalities of fish or other aquatic organisms. Such investigations are the responsibility of Texas Parks and Wildlife Department. Determination and management of response to a red tide event is also a State responsibility. The Texas Department of Health has the primary role of protecting human health during a red tide. TDH staff collects and analyzes samples in oyster areas to determine if and when shellfish harvest must be closed to protect human health. Following the effects of a red tide, TDH will reopen shellfish harvest based upon the results of additional sampling. Important information currently being collected during red tides includes the locations of blooms, cell counts of the harmful algae in the water, and numbers and types of fish killed. Although Texas has experienced red tides for centuries, much remains unknown concerning the origin and development of red tides and how to minimize their harmful effects. It is hoped that bringing together information about the 2000 bloom into one document will provide a useful reference for those trying to study red tides.



Photo micrograph courtesy of Dr. Tracy A. Villareal, University of Texas Marine Science Institute

## REFERENCES

Jones, Lonnie and Garen Evans. 2001. Economic impact of the 2000 Red Tide on Galveston County, Texas, A Case Study. Final report under TPWD contract number 666226. Available on the web at <http://www.tpwd.state.tx.us/hab/redtide/pdf/report/economicimpact.pdf>

## ACKNOWLEDGMENTS

This report would not have possible without the support of the Texas Harmful Algal Bloom Work Group, a subcommittee of the Texas Toxic Substances Coordinating Committee. Special thanks go to committee members Dr. Tracy A. Villareal, Dr. Kirk Wiles, David Buzan, and Michael Weeks for providing content, reviewing the manuscript and providing comments.

**Appendix A. Pollution Response and Species Mortality (PRISM)  
investigation report. Source: Texas Parks and Wildlife Department.**

**Texas Parks and Wildlife Department  
Resource Protection Division - Kills and Spills Team  
Fish Kill/Pollution Complaint Detailed Report**

**General Description:**

<b>Event ID :</b>	20004B4703	<b>Estimated Killed :</b>	6,667,953
<b>Type of Event :</b>	Fish Kill	<b>Sum of Count Value :</b>	\$3,981,553.86
<b>Start Date :</b>	August 12, 2000	<b>Sum of Additional Value :</b>	\$0.00
<b>End Date :</b>	November 20, 2000	<b>Grand Total Value :</b>	\$3,981,553.86
<b>Region :</b>	04	<b>Fiscal Year :</b>	2000
<b>Record Status :</b>	Draft - Sent	<b>Calendar Year :</b>	2000
<b>Old Event ID :</b>			

**County(s):**

Jefferson	Galveston	Brazoria	Matagorda
Calhoun	Aransas	Nueces	Cameron
Kleberg	Kenedy	San Patricio	

**Event Description:**

Texas has historically recorded red tide events along coastal waters. The frequency of documented red tide events has increased since 1986. The 1986 red tide caused more documented impacts to fisheries resources than subsequently reported incidents. The 2000 red tide has been more extensive in areal coverage than previously reported incidents. Texas has experienced red tide along the nearshore coastal areas during four of the past five years, including 1996, 1997, 1999 and 2000. The areas affected vary from year to year from a single event in a ship channel in 1990 to the entire coastline in 2000. The most common location for the occurrence of red tide is the Brownsville/Port Isabel area. Corpus Christi and Padre Island National Seashore have had three red tide events since 1996. The 1996 red tide extended from Matagorda Island to Brownsville Ship Channel and Port Isabel. Beginning in early August of 2000, red tide was reported in an area offshore of Port Arthur, Texas, east to Calcasieu Pass, Louisiana. The Freeport, Texas, area began to have red tide fish kills a week later, which progressed northward in the nearshore Gulf of Mexico to Lower Galveston Bay, Dickinson Bay, West Galveston Bay, Surfside and southward to the Brazos and San Bernard Rivers. By September, the areas of red tide had progressed across the upper and mid-coastal areas from High Island to Port O'Connor. On September 13 a large fish kill occurred at Matagorda, east to Mitchell's Cut off Sargent Beach and in the Intracoastal Waterway (ICWW). By October areas of red tide had progressed down the coast to Padre Island National Seashore affecting East Matagorda Bay, Matagorda Bay, Corpus Christi Bay, Aransas Bay, San Antonio Bay. By November all bay systems, except the Laguna Madre, from Galveston Bay to Port Isabel; including large linear distances of the near shore Gulf had been affected by red tide blooms and associated fish kills.

Red tide refers to the reddish or tea-colored marine waters that are caused by a rapidly growing bloom of single celled microscopic algae. There are many species of algae that cause a discoloration of the water that are not harmful to marine life or humans. The Texas red tide refers to a species of marine dinoflagellate called *Karenia brevis* found in warm tropical and subtropical oceans. Red tide blooms off Texas are believed to originate from spin-offs of warm water currents that transport the red tide cells near-shore where nutrients carried to the sea by freshwater inflows provide optimal conditions for growth. When a growing population of red tide cells reaches a concentration of 100 to 200 cells per milliliter of water, enough toxin known as brevetoxin is produced to begin killing fish. When concentrations are 10,000 cells per milliliter or greater the red tide bloom is visible as reddish stained seawater. Brevetoxin produced by the bloom is distributed into the water column and can cause fish kills distances away from the actual bloom area.

Brevetoxin is a neurotoxin that can accumulate in the tissue of bivalves and when consumed by people, causes neurotoxic shellfish poisoning. Symptoms of neurotoxic shellfish poisoning are abdominal pain, nausea, vomiting and diarrhea. These symptoms can persist for several days before recovering. There have been no deaths attributed to neurotoxic shellfish poisoning. Brevetoxin can become airborne as an aerosol and cause respiratory and eye irritation.

Brevetoxin from red tide blooms has been documented to affect millions of fish and shellfish in Texas coastal waters. State resource agencies and health departments monitor the location, duration and effects on coastal resources. Texas Parks and Wildlife monitors red tide bloom events by aerial surveys, personal observations, collection of water column samples for cell counts and determines an estimate for the number of fish killed. The

red tide blooms and associated fish kills persisted within Texas Territorial Seas for over three months. Many Upper Texas coast beaches and bays were affected by red tide blooms for weeks causing multiple fish kills in these areas. Estimates of fish killed were determined by delineating shoreline sample areas within the kill zone, characterizing and enumerating all organisms within the sample areas and applying the organisms accounted for in the sample areas to an expansion factor. The expansion factor is calculated by dividing the total area of a kill by the area surveyed. It is likely that many of the dead fish in the Gulf of Mexico never washed ashore and are therefore not accounted for in the fish kill estimate. Predicted fish kill estimates were used to account for fish kills that occurred on multiple dates in the same general location. The predicted estimates for these areas were calculated by using shoreline samples collected in the same area for one event and expanding those counts for other dates when fish kills were known to have occurred. These areas that experienced red tide blooms for extended periods include Lower Galveston Bay, Galveston Island and San Luis Pass, Surfside, Bryan Beach, Intracoastal Waterway from Freeport to Sargent, Sargent Beach and East Matagorda Bay.

**Source and Cause:**

above normal salinities along coastal Texas following drought period contributed to the red tide blooms

Cause : Biotoxin (C)

Specific Cause : Karenia brevis (C)

Active Compound : 0 Not Applicable of See Specific Cause

Source : Natural Processes (C)

Action : Natural processes (C)

Specific Source : Algal bloom (C)

**Habitat(s):**

50 Mile(s) of Intercoastal Waterway

400 Mile(s) of Gulf of Mexico

200 Square Mile(s) of Estuary

**Water Segment(s):**

- 2461 - Espiritu Santo Bay, Bays and Estuaries Basin
- 2423 - East Bay, Bays and Estuaries Basin
- 2424 - West Bay, Bays and Estuaries Basin
- 2433 - Bastrop Bay/Oyster Lake, Bays and Estuaries Basin
- 2434 - Christmas Bay, Bays and Estuaries Basin
- 2439 - Lower Galveston Bay, Bays and Estuaries Basin
- 1301 - San Bernard River Tidal, Brazos-Colorado Coastal Basin
- 2451 - Matagorda Bay/Powderhorn Lake, Bays and Estuaries Basin
- 2501 - Gulf of Mexico, Gulf of Mexico Basin
- 2462 - San Antonio Bay/Hynes Bay/Guadalupe Bay, Bays and Estuaries Basin
- 2471 - Aransas Bay, Bays and Estuaries Basin
- 2481 - Corpus Christi Bay, Bays and Estuaries Basin
- 2482 - Nueces Bay, Bays and Estuaries Basin
- 2485 - Oso Bay, Bays and Estuaries Basin
- 2494 - Brownsville Ship Channel, Bays and Estuaries Basin
- 2441 - East Matagorda Bay, Bays and Estuaries Basin

**Location:**

	<u>Latitude</u>	<u>Longitude</u>
Starting Lat/Long : 29°38'5" / -93°49'15"	Start Lat/Long Decimal : 29.63472176	/ -93.82083130
Ending Lat/Long : 25°58'0" / -97°8'0"	End Lat/Long Decimal : 25.96666718	/ -97.13333130
Exact Location : Coastal Texas from Jefferson County to Cameron County		
Comments :		

**Notification Information:**

Date Notified : August 12, 2000	Investigator Name : KAST
Comments : TPWD Coastal Fisheries, TPWD Law Enforcement, Texas Department of Health, Galveston County Pollution Control, University of Texas Marine Science Institute, Texas A&M University- Galveston, assisted with the investigation.	Notified By : Public

**Alleged Party Information:**

Name : n/a

Contact :

Title :

Address :

Phone :

Fax :

City, State :

Zip Code :

**Audit Information:**

Keyed By : winston denton

Edited By :

Last User: Cindy Contreras

Prepared By : Winston Denton

Comments :

Date Keyed : 10/25/00 10:53:20 AM

Date Edited :

Last Update : 5/24/04 10:02:23 AM





Texas Parks and Wildlife Department  
Resource Protection Division - Kills and Spills Team  
Fish Kill/Pollution Complaint Detailed Counts Report

Event ID: 20004B4703

Count Type: Estimated

Report Header: Coastal Texas from Jefferson County to Cameron County (Jefferson County) organism data from 08/12/2000. Field and expanded counts for organisms counted by species and inch class. Expansion Factor is 176. Fish listed as 1 inch long were not measured.

Segment Number: 1

Expansion Factor: 176.00

Unit of Measure: 10 Mile(s)

Note: unidentified fish are flatfish that include hogchoker and bay whiff. Segment 1 was conducted on Bolivar Beach beginning .25 mile east of Retilon Rd. on September 11. The kill area was from Bolivar Flats east 10 miles and include Crystal Beach.

Site: 1 Unit of Measure: 100 Yard(s)

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
* Unidentified Fish		1	15	2,640
Atlantic Bumper	Chloroscombrus chrysurus	4	25	4,400
Atlantic Croaker	Micropogonias undulatus	5	140	24,640
Banded Drum	Larimus fasciatus	4	22	3,872
Conger Eel	Conger oceanicus	10	235	41,360
Gafftopsail Catfish	Bagre marinus	6	4	704
Gulf Menhaden	Brevoortia patronus	4	218	38,368
Hardhead Catfish	Arius felis	6	18	3,168
Harvestfish	Peprilus alepidotus	4	5	880
Ladyfish	Elops saurus	10	5	880
Pigfish	Orthopristis chrysoptera	5	4	704
Red Drum	Sciaenops ocellatus	36	1	176
Remora	Remora remora	12	1	176
Sand Seatrout	Cynoscion arenarius	1	10	1,760
Silver Perch	Bairdiella chrysoura	4	12	2,112
Southern Flounder	Paralichthys lethostigma	1	1	176
Southern Kingfish	Menticirrhus americanus	6	9	1,584
Southern Stargazer	Astroscopus y-graecum	5	13	2,288
Spot	Leiostomus xanthurus	4	13	2,288
Spotted Seatrout	Cynoscion nebulosus	8	2	352
		12	3	528
		15	1	176
		16	1	176
		18	2	352
Star Drum	Stellifer lanceolatus	2	15	2,640
Striped Mullet	Mugil cephalus	6	20	3,520
		10	15	2,640
Threadfin Shad	Dorosoma petenense	4	8	1,408

Site Totals: 818 143,968

Segment Totals: 818 143,968

Segment Number: 2

Expansion Factor: 281.60

Unit of Measure: 8 Mile(s)

Note: Segment 2 was collected a Surfside beach. The kill area was from the Quintana jetty east 5 miles. The segment was collected on October 5, 2000.

Site: 1 Unit of Measure: 50 Yard(s)

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
Atlantic Croaker	Micropogonias undulatus	1	118	33,229
Conger Eel	Conger oceanicus	1	2	563
Gulf Menhaden	Brevoortia patronus	1	40	11,264
Hardhead Catfish	Arius felis	1	3	845
Harvestfish	Peprilus alepidotus	1	1	282
Hogchoker	Trinectes maculatus	1	2	563
Ladyfish	Elops saurus	1	10	2,816
Pigfish	Orthopristis chrysoptera	1	26	7,322
Pinfish	Lagodon rhomboides	1	11	3,098
Red Drum	Sciaenops ocellatus	15 40	1 1	282 282
Sand Seatrout	Cynoscion arenarius	1	3	845
Silver Perch	Bairdiella chrysoura	1	10	2,816
Southern Kingfish	Menticirrhus americanus	1	30	8,448
Southern Stargazer	Astroscopus y-graecum	1	2	563
Spot	Leiostomus xanthurus	1	10	2,816
Spotted Seatrout	Cynoscion nebulosus	14	1	282
Star Drum	Stellifer lanceolatus	1	99	27,878
Striped Mullet	Mugil cephalus	1	24	6,758
<b>Site Totals:</b>			394	110,952
<b>Segment Totals:</b>			394	110,952

Segment Number: 3

Expansion Factor: 96.80

Unit of Measure: 11 Mile(s)

Note: Segment 3 was collected on October 12, 2000 at St. Joseph Island. Six one hundred foot sites were sampled. Site one is fish data collected in those six 100 ft. sample areas. Unidentified fish is a species of sea bass. The kill was about five days old.

Site: 1 Unit of Measure: 600 Feet

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
* Unidentified Fish		1	1	97
Atlantic Bumper	Chloroscombrus chrysurus	1	1	97
Atlantic Croaker	Micropogonias undulatus	1	92	8,906
Blackcheek Tonguefish	Symphurus plagiusa	1	1	97
Conger Eel	Conger oceanicus	1	24	2,323
Gafftopsail Catfish	Bagre marinus	1	1	97
Gulf Kingfish (whiting)	Menticirrhus littoralis	1	18	1,742
Gulf Menhaden	Brevoortia patronus	1	1	97
Hardhead Catfish	Arius felis	1	14	1,355
Pigfish	Orthopristis chrysoptera	1	29	2,807
Pinfish	Lagodon rhomboides	1	75	7,260
Red Drum	Sciaenops ocellatus	1	1	97

Spanish Mackerel	Scomberomorus maculatus	1	2	194
Spot	Leiostomus xanthurus	1	92	8,906
Spotted Seatrout	Cynoscion nebulosus	1	1	97
Striped Mullet	Mugil cephalus	1	270	26,136

<b>Site Totals:</b>	623	60,308
---------------------	-----	--------

<b>Segment Totals:</b>	623	60,308
------------------------	-----	--------

**Segment Number:** 4

**Expansion Factor:** 1,044.00

**Unit of Measure:** 43.5 Mile(s)

**Note:** segment 4 north and south of Bob Hall Pier on 10/9/2000. Site 1 and site 2 were collected north of Bob Hall Pier. Site 3 and 4 was collected south of Bob Hall pier. Counts expanded to Kleberg and Nueces County shoreline.

**Site: 1**      **Unit of Measure:** 20 Feet

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
Gulf Menhaden	Brevoortia patronus	6	13	13,572
		7	28	29,232
		8	8	8,352
		9	4	4,176
		10	1	1,044
Pigfish	Orthopristis chrysoptera	6	1	1,044
		7	2	2,088

<b>Site Totals:</b>	57	59,508
---------------------	----	--------

**Site: 2**      **Unit of Measure:** 100 Feet

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
Atlantic Needlefish	Strongylura marina	15	1	1,044
Hardhead Catfish	Arius felis	6	3	3,132
		7	1	1,044
		8	1	1,044
Spanish Mackerel	Scomberomorus maculatus	18	1	1,044
Spot	Leiostomus xanthurus	10	1	1,044
Striped Mullet	Mugil cephalus	9	1	1,044

<b>Site Totals:</b>	9	9,396
---------------------	---	-------

**Site: 3**      **Unit of Measure:** 100 Feet

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
Atlantic Bumper	Chloroscombrus chrysurus	6	26	27,144
		7	40	41,760
		8	1	1,044
Gulf Menhaden	Brevoortia patronus	5	3	3,132
		6	60	62,640
		7	69	72,036
		8	51	53,244
		9	8	8,352
Hardhead Catfish	Arius felis	6	2	2,088
		7	1	1,044
Pigfish	Orthopristis chrysoptera	5	2	2,088
		6	26	27,144

Pigfish	Orthopristis chrysoptera	7	56	58,464
		8	4	4,176
Pinfish	Lagodon rhomboides	5	4	4,176
		6	11	11,484
Southern Stargazer	Astroscopus y-graecum	15	1	1,044
		16	1	1,044
Striped Mullet	Mugil cephalus	8	1	1,044
		9	1	1,044
		11	1	1,044

<b>Site Totals:</b>	369	385,236
---------------------	-----	---------

<b>Segment Totals:</b>	435	454,140
------------------------	-----	---------

**Segment Number:** 5

**Expansion Factor:** 266.67

**Unit of Measure:** 30 Mile(s)

**Note:** Segment 5 Site 1 and Site 2 were collected along Bolivar Peninsula from Gilchrist to Bolivar Flats. Site 3,4, and 5 were collected from the West shoreline of lower Galveston Bay that include the Texas City Dike and Levee, and Dickinson Bay shorelines.

**Site:** 1 **Unit of Measure:** 49 Yard(s)

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
Atlantic Croaker	Micropogonias undulatus	3	464	123,733
Atlantic Midshipman	Porichthys plectrodon	3	33	8,800
Atlantic Spadefish	Chaetodipterus faber	1	11	2,933
Striped Mullet	Mugil cephalus	4	38	10,133

<b>Site Totals:</b>	546	145,599
---------------------	-----	---------

**Site:** 2 **Unit of Measure:** 67 Yard(s)

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
* Mixed Species		1	16	4,267
* Unidentified Fish		1	1	267
Conger Eel	Conger oceanicus	1	19	5,067
Gulf Menhaden	Brevoortia patronus	1	2	533
Hardhead Catfish	Arius felis	1	1	267
Striped Mullet	Mugil cephalus	1	4	1,067

<b>Site Totals:</b>	43	11,468
---------------------	----	--------

**Site:** 3 **Unit of Measure:** 33 Yard(s)

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
* Unidentified Fish		1	2	533
Atlantic Midshipman	Porichthys plectrodon	1	1	267
Atlantic Needlefish	Strongylura marina	1	1	267
Gulf Menhaden	Brevoortia patronus	1	1	267
Pigfish	Orthopristis chrysoptera	1	2	533
Pinfish	Lagodon rhomboides	1	1	267
Striped Mullet	Mugil cephalus	1	1	267

<b>Site Totals:</b>	9	2,401
---------------------	---	-------

**Site:** 4 **Unit of Measure:** 49 Yard(s)

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
* Unidentified Fish		1	58	15,467
Atlantic Croaker	Micropogonias undulatus	1	65	17,333
Atlantic Spadefish	Chaetodipterus faber	1	1	267
Bay Whiff	Citharichthys spilopterus	1	7	1,867
Conger Eel	Conger oceanicus	1	318	84,800
Gafftopsail Catfish	Bagre marinus	1	3	800
Gulf Menhaden	Brevoortia patronus	1	21	5,600
Gulf Toadfish	Opsanus beta	1	11	2,933
Hogchoker	Trinectes maculatus	1	1	267
Inshore Lizardfish	Synodus foetens	1	7	1,867
Least Puffer	Sphoeroides parvus	1	1	267
Pigfish	Orthopristis chrysoptera	1	186	49,600
Pinfish	Lagodon rhomboides	1	85	22,667
Southern Flounder	Paralichthys lethostigma	1	11	2,933
Southern Stargazer	Astroscopus y-graecum	1	17	4,533
Spanish Mackerel	Scomberomorus maculatus	1	16	4,267
Spot	Leiostomus xanthurus	1	2	533
Spotted Seatrout	Cynoscion nebulosus	1	1	267
Striped Mullet	Mugil cephalus	1	25	6,667

<b>Site Totals:</b>	836	222,935
<b>Segment Totals:</b>	1,434	382,403

**Segment Number:** 6

**Expansion Factor:** 1,148.40

**Unit of Measure:** 43.5 Mile(s)

**Note:** Segment 6 collected on 10/25/01 on Padre Island National Seashore in Kleberg County. Fish kill counts expanded to all of Nueces and Kleberg County Gulf beach shoreline. Mixed species represents family Sciaenidae.

**Site:** 1 **Unit of Measure:** 100 Feet

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
* Mixed Species		6	11	12,632
Atlantic Bumper	Chloroscombrus chrysurus	4	1	1,148
		6	1	1,148
Conger Eel	Conger oceanicus	1	9	10,336
Gulf Kingfish (whiting)	Menticirthus littoralis	6	1	1,148
		7	6	6,890
		8	3	3,445
		10	2	2,297
		11	1	1,148
Gulf Menhaden	Brevoortia patronus	4	1	1,148
		6	1	1,148
Hardhead Catfish	Arius felis	1	433	497,257
Pigfish	Orthopristis chrysoptera	6	5	5,742
		7	1	1,148
Pinfish	Lagodon rhomboides	6	11	12,632
		7	3	3,445
Striped Mullet	Mugil cephalus	1	146	167,666

<b>Site Totals:</b>	636	730,378
---------------------	-----	---------

**Site:** 2 **Unit of Measure:** 100 Feet

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
* Mixed Species		6	1	1,148
Conger Eel	Conger oceanicus	1	11	12,632
Gulf Kingfish (whiting)	Menticirrhus littoralis	8	2	2,297
Gulf Menhaden	Brevoortia patronus	6	2	2,297
		7	2	2,297
Hardhead Catfish	Arius felis	1	75	86,130
Pigfish	Orthopristis chrysoptera	3	1	1,148
		6	1	1,148
		7	5	5,742
		8	1	1,148
Pinfish	Lagodon rhomboides	1	5	5,742
Striped Mullet	Mugil cephalus	1	31	35,600
<b>Site Totals:</b>			137	157,329
<b>Segment Totals:</b>			773	887,707

**Segment Number:** 7

**Expansion Factor:** 4.40

**Unit of Measure:** 22 Mile(s)

**Note:** segment 7 collected on 10/5/00 driving down the beach on the Padre Island National Seashore, counts expanded to Kleberg County shoreline.

**Site:** 1 **Unit of Measure:** 5 Mile(s)

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
Striped Mullet	Mugil cephalus	10	20	88
		11	18	79
<b>Site Totals:</b>			38	167
<b>Segment Totals:</b>			38	167

**Segment Number:** 8

**Expansion Factor:** 3.14

**Unit of Measure:** 22 Mile(s)

**Note:** Segment 8 collected on 10/25/01 driving down the beach on the Padre Island National Seashore, counts expanded to include Kleberg County shoreline.

**Site:** 1 **Unit of Measure:** 7 Mile(s)

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
Red Drum	Sciaenops ocellatus	1	63	198
<b>Site Totals:</b>			63	198
<b>Segment Totals:</b>			63	198

Segment Number: 9

Expansion Factor: 2,112.00

Unit of Measure: 60 Mile(s)

Note: Segment 9 represents assumed fish kill counts from Brazoria County areas on 3 separate dates 8/30, 9/13/ 920 where red tide fish kills occurred. Species numbers were obtained from one sample on 10-5-2001 near Surfside. Each event extended at least 20 mi

Site: 1 Unit of Measure: 150 Feet

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
Atlantic Croaker	Micropogonias undulatus	1	118	249,216
Conger Eel	Conger oceanicus	1	2	4,224
Gulf Menhaden	Brevoortia patronus	1	40	84,480
Hardhead Catfish	Arius felis	1	3	6,336
Harvestfish	Pepritus alepidotus	1	1	2,112
Hogchoker	Trinectes maculatus	1	2	4,224
Ladyfish	Elops saurus	1	10	21,120
Pigfish	Orthopristis chrysoptera	1	26	54,912
Pinfish	Lagodon rhomboides	1	11	23,232
Red Drum	Sciaenops ocellatus	15 40	1 1	2,112 2,112
Sand Seatrout	Cynoscion arenarius	1	3	6,336
Silver Perch	Bairdiella chrysoura	1	10	21,120
Southern Kingfish	Menticirrhus americanus	1	30	63,360
Southern Stargazer	Astroscopus y-graecum	1	2	4,224
Spot	Leiostomus xanthurus	1	10	21,120
Spotted Seatrout	Cynoscion nebulosus	14	1	2,112
Star Drum	Stellifer lanceolatus	1	99	209,088
Striped Mullet	Mugil cephalus	1	24	50,688
<b>Site Totals:</b>			394	832,128
<b>Segment Totals:</b>			394	832,128

Segment Number: 10

Expansion Factor: 545.60

Unit of Measure: 31 Mile(s)

Note: Segment 10 represents assumed fish kill counts for Galveston Island. A red tide fish kill occurred in Galveston County affecting Galveston Island from the jetty to San Luis Pass. Species count obtained from Bolivar Peninsula, Galveston County on 9-11-00.

Site: 1 Unit of Measure: 100 Yard(s)

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
Atlantic Bumper	Chloroscombrus chrysurus	4	25	13,640
Atlantic Croaker	Micropogonias undulatus	5	140	76,384
Banded Drum	Larimus fasciatus	4	22	12,003
Conger Eel	Conger oceanicus	10	235	128,216
Gafftopsail Catfish	Bagre marinus	6	4	2,182
Gulf Menhaden	Brevoortia patronus	4	218	118,941
Hardhead Catfish	Arius felis	6	18	9,821
Harvestfish	Peprilus alepidotus	4	5	2,728
Hogchoker	Trinectes maculatus	1	15	8,184
Ladyfish	Elops saurus	10	5	2,728
Pigfish	Orthopristis chrysoptera	5	4	2,182

Red Drum	Sciaenops ocellatus	36	1	546
Remora	Remora remora	12	1	546
Sand Seatrout	Cynoscion arenarius	1	10	5,456
Silver Perch	Bairdiella chrysoura	4	12	6,547
Southern Flounder	Paralichthys lethostigma	1	1	546
Southern Kingfish	Menticirrhus americanus	6	9	4,910
Southern Stargazer	Astroscopus y-graecum	5	13	7,093
Spot	Leiostomus xanthurus	4	13	7,093
Spotted Seatrout	Cynoscion nebulosus	8	2	1,091
		12	3	1,637
		15	1	546
		16	1	546
		18	2	1,091
Star Drum	Stellifer lanceolatus	2	15	8,184
Striped Mullet	Mugil cephalus	6	20	10,912
		10	15	8,184
Threadfin Shad	Dorosoma petenense	4	8	4,365
<b>Site Totals:</b>			818	446,302
<b>Segment Totals:</b>			818	446,302

**Segment Number:** 11

**Expansion Factor:** 1.00

**Unit of Measure:** 20 Mile(s)

**Note:** Segment 11 collected on 9-13-00 from Sargent to mouth of San Bernard River. Counts obtained from 2 randomly selected sites on the Gulf shoreline. Mixed species include sciaenids, stargazers, eels, whiting, mullet, pigfish, ladyfish and mojarra.

**Site:** 1 **Unit of Measure:** 20 Mile(s)

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
* Mixed Species		1	159,560	159,560
Gulf Menhaden	Brevoortia patronus	1	1,435,104	1,435,104
<b>Site Totals:</b>			1,594,664	1,594,664
<b>Segment Totals:</b>			1,594,664	1,594,664

**Segment Number:** 12

**Expansion Factor:** 1.00

**Unit of Measure:** 20 Mile(s)

**Note:** Segment 12 represents assumed fish kill counts from Mitchell's Cut south to Matagorda jettys based on dead fish reports in the area. Count data expanded from data collected near Sargent beach on 9-13-00. Mixed species include sciaenids, whiting, eels,

**Site:** 1 **Unit of Measure:** 20 Mile(s)

<u>Common Name</u>	<u>Scientific Name</u>	<u>Length</u>	<u>Actual Count</u>	<u>Expanded Count</u>
* Mixed Species		1	159,456	159,456
Gulf Menhaden	Brevoortia patronus	1	1,595,560	1,595,560
<b>Site Totals:</b>			1,755,016	1,755,016
<b>Segment Totals:</b>			1,755,016	1,755,016



Event Total Killed:

3,355,470

6,667,953

**Appendix B. 2000 Red-Tide Event and Impacts on  
Texas Shellfish Growing Areas. Source: Texas Department of Health.**

**Attachment 1:**

**2000 RED-TIDE EVENT AND IMPACTS  
ON TEXAS SHELLFISH GROWING AREAS**

**TEXAS DEPARTMENT OF HEALTH**

**March 13, 2001**

## INTRODUCTION

There are several toxic algae species that occur in offshore waters in the Gulf of Mexico. Most of these toxic algae are dinoflagellates. The toxic alga that has the greatest impact in Texas coastal waters is *Gymnodinium breve*. Under normal conditions these algae occur in low numbers, less than five organisms per ml of seawater. If a water sample was taken offshore, it would be common to find *G. breve* along with several other algae species all mixed together. Although not well understood, under certain conditions, this species can "bloom" out. When this happens, *G. breve* out-competes all other algae in the water and samples will show a monotypic makeup of *G. breve* cells. When cell counts reach about one thousand cells per ml, the water begins to take on a brick-red color, thus the term red-tide is used to describe these events.

If these blooms remain offshore, there is little impact to humans. However, if near shore currents transport these blooms along the Gulf beaches and potentially through the Gulf passes into the bay system, humans can be affected directly or indirectly. If the bloom appears along the surf zone of the beaches, the action of the waves begins to break the cells apart, releasing toxin. This toxin can then get mixed in the aerosol spray that occurs when the waves crash into the beach. Persons that are in the area of a bloom may experience respiratory, eye, nose and throat irritation. In addition, the toxins in the surf zone can kill large numbers of fish that cannot escape because of the shallow water. When these fish wash ashore they can cause serious sanitation problems in the affected area. The most serious problem with red tides is the consumption of oysters, clams or mussels that become contaminated with the toxins if the bloom enters into a bay. Because these shellfish are filter feeders, the toxin level can become concentrated in the tissue. Consumption of these shellfish can cause neurotoxic shellfish poisoning, or NSP. Although NSP is not known to be fatal, its symptoms include nausea, dizziness, tingling sensations in the extremities, dilated pupils and alternately hot and cold body temperatures. The Texas Department of Health (TDH) has a document titled *Contingency Plan For The Control Of Marine Biotoxins* that outlines the procedures to be followed by TDH to protect the public from contaminated shellfish (Appendix A). Protocols for opening and closing bays are contained in the Contingency Plan. Once an area has been impacted by cell counts greater than five per ml, the area is closed to harvesting, and active water sampling begins and continues until cell counts fall below five per ml. Once the cell counts fall below five per ml, then active shellfish tissue sampling begins for mouse bioassays to determine if the toxins are present in the meats. When results indicate that no toxin is present in the tissue, then the areas can be reopened to harvesting.

## CHRONOLOGY OF EVENTS

On June 29, 2000, a possible fish kill and discolored water were reported in Brazos Santiago Pass. Although investigated, there was no evidence to confirm the report.

Several days later on July 3, there were dead menhaden and complaints of respiratory irritation on South Padre Island, both of which are consistent with red tide. (pers. comm., Cindy Contreras and Dave Buzan)

No other reports surfaced until August 14, when a Texas Parks and Wildlife Department (TPWD) overflight noted discolored water and thousands of dead fish over an 87,000-acre area in the Gulf of Mexico South Southeast of Sabine Pass. On August 17, TDH personnel confirmed this bloom, and noted that it was moving eastward into Louisiana waters. Within a few days, *G. breve* was also confirmed by TPWD at the mouth of the San Bernard River and the Intracoastal Waterway (ICWW) at Surfside. (pers. comm., Cindy Contreras and Dave Buzan). Water samples were collected by TDH staff on August 24 and 29 from Galveston Bay at Bolivar Roads, the North Jetty, and the Boat Cut. Cell counts were conducted and revealed no organisms present (Table 1).

On August 31, a *G. breve* bloom was confirmed in West Galveston Bay, when a sample taken one mile inside of San Luis Pass revealed 208.3 cells per ml (Table 2). The following day the Galveston County Health District issued a press release warning area residents and visitors of the presence of the organism and of the potential harmful effects caused when the toxins produced by the organism are aerosolized (Galv. Co. Health Dist., 2000). By September 3, the bloom had moved into Galveston Bay proper where results revealed 30 cells per ml at the end of the Seawall in the Galveston Channel and 12.6 cells per ml at the South Jetty in the Galveston Channel (Table 1). On September 4, Marine Order Number 792 was issued closing the Central and East approved areas of Galveston Bay, as well as Conditionally Approved Area 1 of Galveston Bay. These closures were based on cell counts greater than five cells per ml as outlined in the *Contingency Plan For The Control Of Marine Biotoxins* (Attachment 1). Cell counts within Galveston Bay continued to be above five cells per ml for several weeks. Counts peaked around mid-September when a station at Houston Ship Channel Marker 45 reached 17,956 cells per ml (Table 1).

On September 14, *G. breve* was confirmed in East Matagorda Bay. Station EMB 97 (near shellfish marker J) contained 4,644 cells per ml, and station EMB 83 (between marker J and EMB 10) was reported as "too numerous to count." Cells continued to be identified in samples from East Matagorda Bay until early November (Table 3). Discolored water continued to be noted further down the coast toward Port O' Connor. On September 18, cells were found at the "Little Jetty" in Matagorda Bay with 311 cells per ml. By September 21 counts from the Dolphin Point Marina in Port O' Connor reached 8,656 cells per ml. During this time, a water sample was also collected offshore of the mouth of Powderhorn Lake. However, no cells were identified in the sample. Cells continued to be identified in samples collected in Matagorda Bay until early November when levels dropped below the five cells per ml criteria (Table 3).

On September 26, *G. breve* was confirmed at the University of Texas Marine Science Institute (UTMSI) in Port Aransas. There was also respiratory irritation noted. (pers. comm., Tracy Villareal)

A sampling trip into San Antonio and Mesquite Bays on September 28, showed cells in one Mesquite Bay sample. The sample was at Cedar Bayou, and was enumerated at 13.3 cells per ml. No cell counts were identified in any other samples from either Mesquite or San Antonio Bay. Cells continued to be identified in Mesquite Bay through early October. Finally, on November 9, TDH staff verified that no cells were identified in Mesquite Bay samples (Table 4).

On October 2, TDH staff confirmed the presence of *G. breve* in Aransas, Corpus Christi, Nueces, and Redfish Bays. Water samples continued to show cells throughout most of October. Sampling conducted by Mr. Tracy Villareal at the UTMSI Pier revealed that cell counts dropped below five cells per ml on November 19, and never increased again. Sampling conducted by TDH personnel further up in the estuaries showed cell counts remained elevated until November 7, when all samples were enumerated at zero cells per ml. Of special interest, Copano Bay cell counts never revealed the presence of *G. breve*. However, Copano Bay is hydrologically linked together with Aransas Bay and cells potentially entered the bay at some point. Cell counts for Aransas and Copano Bays are listed in Table 5. Corpus Christi, Nueces, and Redfish Bays results are listed in Table 6.

On October 3, cells were found in Lavaca Bay at station LAV 26. The levels were enumerated at 70.4 cells per ml (Table 7). At the same time, 4.4 cells per ml were counted from a station located at the mouth of Powderhorn Lake (Table 3). Sampling in both Lavaca Bay and Powderhorn Lake continued into late October, and on October 27, levels went below five cells per ml (Tables 7 and 3, respectively).

Sampling also continued in San Antonio Bay even after initial samples showed no cells. On October 6, TDH staff reported a sample at Panther Point with 2.2 cells per ml. The cell counts in San Antonio Bay exceeded the level of concern on October 13, when levels at Charlie's "The Lane" were 2,022 cells per ml (Table 4).

On October 13, citizens on South Padre Island were complaining of respiratory irritations. The following day, October 14, dead and dying fish were reported on Boca Chica beach. These events delayed the opening of the commercial oyster season (November 1 - April 30) for the Lower Laguna Madre from Port Mansfield all the way down to the Rio Grande.

After October 10, no cells were found in any samples from Galveston Bay proper (Table 1). Since the cell counts had fallen below 5 cells per ml, active shellfish tissue sampling began for mouse bioassays to determine if the toxins were present in the meats. Results of these bioassays are reported in Mouse Units per 100 grams (MU/100 g) of tissue, which gives a relative toxicity. By definition, one mouse unit is that amount of crude toxic residue that, on average, will kill 50% of the test animals in 930 minutes. Procedures for bioassay for shellfish toxins are outlined in *Recommended Procedures for the Examination of Seawater and Shellfish, 4<sup>th</sup> Edition*, (APHA, 1970). The mouse bioassay can detect if toxins are present (>20 MU/100 g) at the six-hour time mark. The bioassays are conducted at the TDH Laboratory in Austin, where the lab capacity is currently 10 samples per week. This laboratory capacity determined the sampling

strategy for the Seafood Safety Division (SSD) when reopening shellfish growing areas. Therefore, ten sample stations were chosen throughout Galveston Bay. Four were located in Conditionally Approved Area 1 (CAA 1), which included Dollar Reef, Todd's Dump, Redfish 63 South, and Eagle Point Reef. Three sample sites were located in the central approved area. These included South Redfish Reef, Bart's Pass, and Sheldon Reef. The final three samples were collected in the east approved area, and included Frenchy's Reef, Middle Reef, and Hanna's Reef. A first set of samples were collected from all ten of these sites on October 11. Mouse bioassays were completed on November 25. These results showed only two of the 10 samples with toxins present. These stations were Dollar Reef and Redfish 63 South, both of which are located in CAA 1. The Dollar Reef sample recorded 57 MU/100g of brevetoxin, and the Redfish 63 South had 24 MU/100g of brevetoxin (Table 8). Since no toxins were found in the samples from the Central or East Approved Areas, both were reopened on October 26. However, CAA 1 remained closed.

Seven additional oyster samples from Galveston Bay were collected on October 17. These samples were from the North Approved Area (NAA), Conditionally Approved Area 2 (CAA 2), and Conditionally Approved Area 3 (CAA 3). Sample stations located in NAA were located at Shuttle Reef and Reef 64. CAA 2 samples were collected from Lost Reef and Fisher Reef. The final three samples were collected from CAA 3, at Roundtable Reef, Hodges Reef, and Little Pipeline Reef. Of these seven samples only one came back with toxins present. This was the Reef 64 sample from the North Approved Area at 23 MU/100g (Table 8). Therefore, the North Approved Area remained closed to harvesting. CAA 2 and CAA 3 opened on November 1 with the issuance of the classification maps by Marine Order Number 795.

The Texas Department of Health issued a news release on October 31, warning that even though the commercial oyster season officially opened the following day, all Texas coastal waters, except parts of Galveston Bay, would remain closed due to the lingering effects of red tide.

Sampling of oysters for brevetoxin continued in Galveston Bay as SSD staff collected samples again on November 1. Once again, 10 samples were collected from around the bay. This time, eight samples were collected from CAA 1 and 2 were collected from the NAA. The CAA 1 sites were Levee Reef, Dollar Reef, Reef 51, Reef 57, Reef 63, Reef 69, North Reef 63, and at Shellfish Marker "S." The NAA sites were Reef 64 and Reef 60. Only one sample revealed the presence of toxins. This was the Dollar Reef sample, from CAA 1. The level of toxin was reported at 18 MU/100g (Table 8). CAA 1 once again remained closed due to toxins. Because a shellfish marker delineating the NAA and CAA2 was missing, NAA was not able to open until November 24, after the shellfish marker was replaced.

While Galveston Bay was mostly free of *G. breve* cells and areas were beginning to open, other parts of the coast were still showing signs of bloom. On November 1, *G. breve* was confirmed in Tres Palacios Bay. The levels were only 2.2 cells per ml, but surrounding areas had higher levels, and salinities were high enough to warrant closing the bay. Carancahua Bay was also closed for the same reasons as Tres Palacios Bay (Table 3).

By November 10, San Antonio Bay was the only mid-coast bay with cell levels above 5 per ml. Therefore, TDH personnel began collecting meat samples from mid-coast area bays. The first samples were collected from San Antonio Bay on November 10. Stations SAN 132 and SAN 100 both samples revealed the presence of *G. breve* toxins (Table 9).

On November 14, sampling resumed in the Galveston Bay Complex and along the middle coast. One sample was collected from Dollar Reef, which is located in CAA 1 of Galveston Bay, and once again the sample showed the presence of toxins. The result was 19 MU/100g (Table 8). Samples were also collected in Tres Palacios and Matagorda Bays. Two sites were chosen in Tres Palacios Bay and two in Matagorda Bay. The Tres Palacios sites were TRP 310 and TRP 314, which is offshore of Tripod Reef. The Matagorda Bay samples were from MAT 259 and MAT 271. The sample MAT 259 was not analyzed because there was insufficient meat to perform the analysis. All of the other three samples showed no toxins present (Table 10). The following day another sample was taken from a different location on Dollar Reef. This sample showed no toxins present (Table 8). However, CAA 1 of Galveston Bay remained closed. This same day samples were taken from both West Galveston Bay at North Deer Island and in the Freeport -area bays (Christmas and Bastrop Bays). Both of these samples showed no toxins present (Table 11). Samples were also collected in East Matagorda Bay at stations EMB 77 and EMB 75. The results of these samples showed brevetoxins present at a level of 20 MU/100g and 26 MU/100g, respectively (Table 10). At this time TDH personnel in Corpus Christi also began collecting meat samples. The first sample was taken from Aransas Bay at Long Reef. No toxins were detected in this sample (Table 12). However, the following day a sample collected from Mud Island, in Aransas Bay revealed toxins at a level of 26 MU/100g (Table 12). This same day two samples were also collected from Carancahua Bay, the first at state land tract 296 and the second at the southern end of Port Alto. Both samples came back showing the presence of toxins (Table 10). A final sample was also collected in West Galveston Bay at San Luis Pass, which revealed no toxins present (Table 11). Marine Order Number 799 was issued for opening West Galveston Bay on December 3, while Marine Order Number 800 was issued to open Christmas and Bastrop Bays on December 4.

Sampling began in Lavaca Bay on November 17, when two samples were collected. One sample was located in Cox Bay at LAV 41, and the second was at LAV 12. LAV 12 showed no toxins. However, LAV 41 in Cox Bay had levels at 24 MU/100g (Table 13). Due to the presence of toxins, Lavaca Bay remained closed to harvesting.

On November 28, two additional samples were taken from Dollar Reef in the CAA 1 of Galveston Bay. Both sets of results came back with no toxins present (Table 8). Marine Order Number 801 was issued to open CAA 1 of Galveston Bay. Samples were also taken in San Antonio and Mesquite Bays. Three sites were located in the approved area of San Antonio Bay and two were in Mesquite Bay. The San Antonio Bay sites included Panther Reef, Chickenfoot Reef, and Ayres Dugout. The Mesquite Bay sites were at Cedar Dugout and Bray's Cove. All five samples showed no toxins present (Table 9). Water samples were also collected in conjunction with the oyster tissue samples. All samples showed no cells present (Table 4).



Two bays were sampled again on November 29. These were Espiritu Santo Bay and Copano Bay. The site chosen in Espiritu Santo Bay was Josephine's Reef, and no toxins were found in the sample (Table 9). Once again TDH personnel sampled water for the presence of *G. breve*, but no cells were found (Table 4). The Copano Bay samples were taken from Lap Reef and Copano Causeway. These samples also showed no toxins present (Table 12).

San Antonio Bay continued to show no signs of *G. breve* bloom when TDH personnel collected two water samples on December 5. One sample was taken from SAN 106, and the other from SAN 73. Both samples showed no cells present (Table 4).

On December 6, crews sampled water at two stations in Caranchua Bay. One of the stations was at Port Alto and the other at Houston Point. Both contained no cells (Table 3). Three samples were also collected in Lavaca Bay. The stations were located in Keller Bay, Cox Bay, and Chicken Foot Reef. None of the samples contained cells (Table 7). The last water sample from Lavaca Bay was collected on December 7, and the results revealed no cells (Table 7).

Brevetoxin testing was conducted on December 8, and all samples showed no toxins present. Therefore, Marine Order Number 802 was issued opening Tres Palacios Bay, Matagorda Bay, Powderhorn Lake, Espiritu Santo Bay, Mesquite Bay, Copano Bay, and the approved area of San Antonio Bay.

Sampling continued in all bays which had previously reported high toxin levels. On December 4, samples were collected from Aransas Bay near Mud Island. When the results were finalized, no toxins were present (Table 12). The following day, Corpus Christi field staff collected two oyster meat samples from Corpus Christi Bay. One sample was from Shamrock Cove, the other from Island Moorings. Both samples indicated that no toxins were present (Table 14).

Just as lower coast bays were beginning to show signs of improvement, so were bays located along the middle coast. Stations from San Antonio Bay were once again sampled on December 5. The samples were taken from SAN 106 and SAN 73, which is south of Grassy Point. Both stations showed no toxins present (Table 9).

Five more samples were collected from Carancahua and Lavaca Bays on December 6. The two samples collected from Carancahua Bay were at CAR 214, near Port Alto, and CAR 296 at Houston Point. Both samples revealed that no toxins were present (Table 10). The remaining three samples were collected from Lavaca Bay. The stations were LAV 61 at Keller Bay, LAV 41 at Cox Bay, and LAV 12 at Chickenfoot Reef. All three samples showed no toxins present (Table 13). On December 7, a final sample was taken from Lavaca Bay at LAV 33 near Indian Point. This sample also showed no toxins present (Table 13).

Marine Order Number 803, issued on December 16, opened all of Lavaca Bay, Aransas Bay, St. Charles Bay and Corpus Christi Bay to harvesting. The following day, December 17, Marine Order 804 was issued opening Carancahua Bay. Although samples from the conditionally

approved area of San Antonio Bay showed no toxins present, the area did not open. This area remained closed due to exceedance of management plan criteria established for the area.

On January 3, 2001, two water and oyster meat samples were collected from East Matagorda Bay. Cell counts revealed no organisms (Table 3), and the oyster meat samples showed no toxins present (Table 10). Marine Order Number 810 was issued on January 14, which opened the approved area of East Matagorda Bay. However, the conditionally approved area remained closed due to an exceedance of the management plan criteria established for the area.

The final bay system to be sampled was the Lower Laguna Madre and South Bay. On January 8, both water and oyster meat samples were collected from this area. Water samples showed no organisms, and meats showed no toxins present (Tables 15 and 16). Therefore, on January 20, 2001, Marine Order Number 813 opened the Lower Laguna Madre and South Bay to the harvesting of shellfish.

## DISCUSSION

The spring and summer of 2000 were characterized by lower than average rainfall, which contributed to higher salinities in the estuaries along the Texas coast. One example of this was the Galveston Bay estuary. Salinities in the middle portion of Galveston Bay reached into the low 30 ppt range, much higher than salinities during a normal year. These higher salinities allowed the intrusion of *G. breve* into the estuary, which is typically shielded by lower salinities than the organism prefers. Salinities along the entire coast remained higher than normal throughout the period covered by this report.

The only major bay on the Texas coast in which *G. breve* was not identified was Copano Bay. The reasons for this are unclear, especially since all other bays in the area were affected. It is possible that a larger number of samples were needed in order to find any blooms.

An area where this event differed from past events was the presence of other *Gymnodinium* species. Many samples taken along the middle and lower coast had a large number of additional *Gymnodinium* species which had to be carefully differentiated from *G. breve*.

During this event, several samples were collected from the middle coast bays and sent to Dr. Pat Tester with the National Marine Fisheries Service, Beaufort Lab. At the time this report was completed, no results had been made available.

## CONCLUSIONS

The red tide event of 2000-2001 resulted in the closure of all bays along the Texas coast. With lower than normal rainfall resulting in higher than normal salinities, the perfect conditions were

created to harbor *G. breve*. It has become apparent that it is very important to have an adequate "Red Tide Contingency Plan" in place for future red tide events. Increased monitoring of the coastal bays has been implemented and will continue as long as conditions are adequate to support blooms.

Table 1. *G. breve* cell counts for Galveston Bay collected from August 24, 2000 to October 13, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
8/24/00	Bolivar Roads # 18	29° 21' 20" N 94° 46' 23" W	35.9	86°	0.0
8/24/00	Boat Cut (Jetties)	29° 22' 01" N 94° 42' 38" W	36.1	86°	0.0
8/24/00	End of North Jetty	29° 30' 51" N 94° 40' 35" W	36.5	86°	0.0
8/29/00	Bolivar Roads # 18	29° 21' 20" N 94° 46' 23" W	34.2	90°	0.8
8/29/00	End of Galveston North Jetty	29° 30' 51" N 94° 40' 35" W	36.1	88°	0.42
8/31/00	HSC Marker # 17	29° 20' 55" N 94° 47' 06" W	32.8	88°	0.0
08/31/00	End of South Jetty	29° 19' 50" N 94° 43' 29" W	36.5	88°	0.0
08/31/00	HSC Marker # 57	29° 31' 31" N 94° 53' 16" W	27.1	87°	0.0
08/31/00	HSC Marker # 37	29° 25' 48" N 94° 49' 57" W	30.8	88°	0.0
9/1/00	Bolivar Roads	29° 21' 20" N 94° 46' 23" W	34.4	87°	0.0
9/1/00	End of Texas City Dike # 1	29° 22' 09" N 94° 48' 33" W	33.5	87°	0.0
9/1/00	End of Texas City Dike # 2	29° 22' 09" N 94° 48' 33" W	33.5	87°	0.0
9/2/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W			164.0
9/2/00	East end of Seawall Galveston Channel	29° 20' 20" N 94° 45' 08" W			0.0
9/2/00	Galveston Yacht Club	29° 19' 23" N 94° 46' 30" W			0.0
9/2/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W			0.0
9/2/00	45 <sup>th</sup> Street Galveston Island (Gulf)	29° 16' 32" N 94° 48' 39" W			177
9/3/00	End of Seawall Galveston Channel	29° 20' 20" N 94° 45' 08" W			30
9/3/00	South Jetty Galveston Channel	29° 19' 50" N 94° 43' 29" W			12.6

Table 1 (cont). *G. breve* cell counts for Galveston Bay collected from August 24, 2000 to October 13, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
9/3/00	Galveston Yacht Basin	29° 19' 23" N 94° 46' 30" W			0.0
9/3/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W			0.0
9/3/00	45 <sup>th</sup> Street Galveston Island (Gulf)	29° 16' 32" N 94° 48' 39" W			10.4
9/3/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W			21.1
9/4/00	East end of Seawall Galveston Channel	29° 20' 20" N 94° 45' 08" W			20.0
9/4/00	South Jetty Galveston Channel	29° 19' 50" N 94° 43' 29" W			4.4
9/4/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W			7.7
9/4/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W			100.0
9/4/00	East Beach(Base of Galveston Jetties)	29° 19' 51" N 94° 44' 12" W			102.2
9/4/00	45 <sup>th</sup> Street Galveston Island (Gulf)	29° 16' 32" N 94° 48' 39" W			151.1
9/4/00	Galveston Yacht Basin	29° 19' 23" N 94° 46' 30" W			11.1
9/5/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W			6.7
9/5/00	47 <sup>th</sup> Street Galveston (Gulf)	29° 15' 57" N 94° 49' 27" W			12.2
9/5/00	East End of the Seawall	29° 20' 20" N 94° 45' 08" W	36.1	88°	25.6
9/5/00	Galveston Yacht Basin	29° 19' 23" N 94° 46' 30" W	35.0	89°	27.7
9/5/00	HSC Marker # 57	29° 31' 31" N 94° 53' 16" W	28.3	89°	14.4
9/5/00	HSC Marker # 37	29° 25' 48" N 94° 49' 57" W	34.1	87°	31.1
9/5/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W	35.2	88°	21.1

Table 1 (cont). *G. breve* cell counts for Galveston Bay collected from August 24, 2000 to October 13, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
9/8/00	HSC Marker # 57	29° 31' 31" N 94° 53' 16" W	32.2	84°	138.9
9/8/00	HSC Marker # 37	29° 25' 48" N 94° 49' 57" W	35.0	84°	777.8
9/8/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W	36.6	84°	160.0
9/8/00	End of Seawall Galveston Channel	29° 20' 20" N 94° 45' 08" W	36.6	85°	416.0
9/8/00	Galveston Yacht Basin	29° 19' 23" N 94° 46' 30" W	35.6	84°	43.1
9/8/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W			38.9
9/8/00	45 <sup>th</sup> Street Galveston Island (Gulf)	29° 16' 32" N 94° 48' 39" W			30.0
9/11/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W	34.9	85°	29.0
9/11/00	East End of Seawall Galveston Channel	29° 20' 20" N 94° 45' 08" W	35.8	85°	339.0
9/11/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W			440.0
9/11/00	47 <sup>th</sup> Street Galveston (Gulf)	29° 15' 57" N 94° 49' 27" W			1189.0
9/11/00	Bermuda Beach Galveston	29° 12' 03" N 94° 54' 40" W			1778.0
9/11/00	Galveston Yacht Basin	29° 19' 23" N 94° 46' 30" W			944.0
9/11/00	Dickinson Bayou	29° 28' 05" N 94° 57' 13" W			202.0
9/11/00	HSC Marker # 57	29° 31' 31" N 94° 53' 16" W	28.5	84°	79.0
9/11/00	HSC Marker # 37	29° 25' 48" N 94° 49' 57" W	32.5	85°	101.0
9/13/00	Galveston Yacht Basin	29° 19' 23" N 94° 46' 30" W	31.6	80°	35.6
9/13/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W	35.7	78°	0.0
9/13/00	45 <sup>th</sup> Street Galveston (Gulf)	29° 16' 32" N 94° 48' 39" W	34.8	78°	38.9

Table 1 (cont). *G. breve* cell counts for Galveston Bay collected from August 24, 2000 to October 13, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
9/13/00	East End of the Seawall	29° 20' 20" N 94° 45' 08" W	33.0	78°	5.5
9/13/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W	34.6	80°	0.0
9/13/00	Eagle Point	29° 29' 49" N 94° 54' 37" W	25.2	76°	0.0
9/13/00	Dollar Point Marina	29° 25' 21" N 94° 53' 23" W	30.5	80°	0.0
9/13/00	Offatts Bayou	29° 17' 47" N 94° 50' 07" W	36.3	80°	0.0
9/18/00	HSC Marker # 57	29° 31' 31" N 94° 53' 16" W	27.8	80°	945.0
9/18/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W			274.0
9/18/00	45 <sup>th</sup> Street Galveston Island (Gulf)	29° 16' 32" N 94° 48' 39" W			728.0
9/18/00	HSC Marker # 37	29° 25' 48" N 94° 49' 57" W	29.5	80°	4200.0
9/18/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W	30.6	80°	4323.0
9/18/00	End of Seawall Galveston Channel	29° 20' 20" N 94° 45' 08" W	31.0	82°	4844.0
9/18/00	Galveston Yacht Basin	29° 19' 23" N 94° 46' 30" W	31.2	82°	8011.0
9/18/00	HSC Marker # 45	29° 27' 34" N 94° 51' 02" W	30.0	80°	17,956.0
9/18/00	Redfish Reef	29° 30' 54" N 94° 54' 11" W	27.8	80°	4722.0
9/18/00	Dickinson Bayou	29° 28' 05" N 94° 57' 13" W	17.6	77°	0.0
9/20/00	HSC Marker # 73	29° 35' 46" N 94° 56' 44" W	24.2	82°	40.0
9/20/00	HSC Marker # 57	29° 31' 31" N 94° 53' 16" W	26.1	82°	10.0
9/20/00	HSC Marker # 37	29° 25' 48" N 94° 49' 57" W	29.9	82°	644.0
9/20/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W	30.1	82°	347.0

Table 1 (cont). *G. breve* cell counts for Galveston Bay collected from August 24, 2000 to October 13, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
9/20/00	East End of the Seawall Blvd.	29° 20' 20" N 94° 45' 08" W	30.2	82°	3.3
9/20/00	Galveston Yacht Basin	29° 19' 23" N 94° 46' 30" W	30.1	82°	2422.0
9/20/00	Siever's Cut East Galveston Bay	29° 26' 03" N 94° 42' 37" W	26.9	82°	103.0
9/20/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W			289.0
9/20/00	45 <sup>th</sup> Street Galveston Island (Gulf)	29° 16' 32" N 94° 48' 39" W			487.0
9/25/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W			0.0
9/25/00	45 <sup>th</sup> Street Galveston Island (Gulf)	29° 16' 32" N 94° 48' 39" W			0.0
9/25/00	East End of the Seawall Blvd.	29° 20' 20" N 94° 45' 08" W			14.4
9/25/00	Galveston Yacht Basin	29° 19' 23" N 94° 46' 30" W			73.3
9/25/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W	27.3	81°	0.0
9/25/00	Dollar Pt. Marina	29° 25' 21" N 94° 53' 23" W	27.0	78°	0.0
9/25/00	Eagle Pt. Marina	29° 29' 49" N 94° 54' 37" W	23.4	78°	0.0
9/27/00	HSC Marker # 57	29° 31' 31" N 94° 53' 16" W	28.8	75°	0.0
9/27/00	HSC Marker # 37	29° 25' 48" N 94° 49' 57" W	31.3	75°	7.0
9/27/00	End of Texas City Dike (Boat)	29° 22' 09" N 94° 48' 33" W	32.7	77°	8.0
9/27/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W			0.0
9/27/00	45 <sup>th</sup> Street Galveston Island (Gulf)	29° 16' 32" N 94° 48' 39" W			0.0
9/27/00	East End of the Seawall Blvd.	29° 20' 20" N 94° 45' 08" W			4.0
9/27/00	Galveston Yacht Basin	29° 19' 23" N 94° 46' 30" W			5.0



Table 1 (cont). *G. breve* cell counts for Galveston Bay collected from August 24, 2000 to October 13, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
9/27/00	Texas City Dike (Base)	29° 23' 23" N 94° 52' 51" W			0.0
9/27/00	Dollar Pt. Marina	29° 25' 21" N 94° 53' 23" W			0.0
9/27/00	Eagle Point Marina	29° 29' 49" N 94° 54' 37" W			0.0
9/27/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W			0.0
9/29/00	HSC Marker # 57	29° 31' 31" N 94° 53' 16" W	29.7	74°	27.0
9/29/00	HSC Marker # 37	29° 25' 48" N 94° 49' 57" W	31.4	74°	57.0
9/29/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W	32.9	75°	39.0
9/29/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W			3.0
9/29/00	45 <sup>th</sup> Street Galveston Island (Gulf)	29° 16' 32" N 94° 48' 39" W			64.0
9/29/00	East End of the Seawall Blvd.	29° 20' 20" N 94° 45' 08" W	33.3	76°	0.0
9/29/00	Galveston Yacht Basin	29° 19' 23" N 94° 46' 30" W	32.6	76°	0.0
9/29/00	Moses Lake	29° 26' 30" N 94° 55' 13" W	23.5	72°	0.0
9/29/00	Moses Lake Floodgate	29° 26' 55" N 94° 55' 01" W	25.0	72°	0.0
9/29/00	Dickinson Bayou	29° 28' 05" N 94° 57' 13" W	25.4	72°	0.0
10/2/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W			2.2
10/2/00	45 <sup>th</sup> Street Galveston Island (Gulf)	29° 16' 32" N 94° 48' 39" W			15.6
10/2/00	East End of the Seawall Blvd.	29° 20' 20" N 94° 45' 08" W	31.4	78°	6.7
10/2/00	Galveston Yacht Basin	29° 19' 23" N 94° 46' 30" W	31.5	78°	235.5
10/2/00	Galveston Bay Lease 301	29° 27' 57" N 94° 42' 03" W	26.7	78°	0.0

Table 1 (cont). *G. breve* cell counts for Galveston Bay collected from August 24, 2000 to October 13, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
10/2/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W	30.4	78°	2.2
10/4/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W			5.6
10/4/00	45 <sup>th</sup> Street Galveston Island (Gulf)	29° 16' 32" N 94° 48' 39" W			0.0
10/4/00	East End of the Seawall Blvd.	29° 20' 20" N 94° 45' 08" W			0.0
10/4/00	Galveston Yacht Basin	29° 19' 23" N 94° 46' 30" W			7.7
10/4/00	Dickinson Bayou	29° 28' 05" N 94° 57' 13" W			2,322.0
10/4/00	HSC Marker # 57	29° 31' 31" N 94° 53' 16" W	27.1	79°	11.1
10/4/00	HSC Marker # 37	29° 25' 48" N 94° 49' 57" W	30.6	78°	0.0
10/4/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W	30.8	79°	0.0
10/6/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W			0.0
10/6/00	45 <sup>th</sup> Street Galveston Island (Gulf)	29° 16' 32" N 94° 48' 39" W			0.0
10/6/00	East End of the Seawall Blvd.	29° 20' 20" N 94° 45' 08" W	30.8	82°	12.2
10/6/00	Galveston Yacht Basin	29° 19' 23" N 94° 46' 30" W	30.4	81°	46.7
10/6/00	Offatts Bayou	29° 17' 47" N 94° 50' 07" W	32.4	83°	0.0
10/6/00	Eagle Pt. Marina	29° 29' 49" N 94° 54' 37" W	26.6	83°	0.0
10/6/00	Dollar Pt. Marina	29° 25' 21" N 94° 53' 23" W	29.1	83°	3.3
10/6/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W	30.6	82°	3.3
10/10/00	HSC Marker # 57	29° 25' 48" N 94° 49' 57" W	29.2	64°	0.0
10/10/00	HSC Marker # 37	29° 22' 09" N 94° 48' 33" W	30.8	68°	0.0

Table 1 (cont). *G. breve* cell counts for Galveston Bay collected from August 24, 2000 to October 13, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
10/10/00	End of Texas City Dike	29° 22' 09" N 94° 48' 33" W	30.5	69°	0.0
10/10/00	East End of the Seawall Blvd.	29° 20' 20" N 94° 45' 08" W	30.2	70°	0.0
10/10/00	Galveston Yacht Basin	29° 19' 23" N 94° 46' 30" W	29.6	66°	0.0
10/10/00	East Bay Station 170	29° 31' 52" N 94° 36' 54" W	24.5	57°	0.0
10/10/00	East Bay Station 191	29° 31' 41" N 94° 31' 10" W	24.9	57°	0.0
10/10/00	East Bay Station 239	29° 28' 28" N 94° 44' 35" W	27.0	59°	0.0
10/13/00	14 <sup>th</sup> Street Rock Groin (Galveston)	29° 17' 47" N 94° 46' 47" W			0.0
10/13/00	45 <sup>th</sup> Street Galveston Island (Gulf)	29° 16' 32" N 94° 48' 39" W			0.0
10/13/00	HSC Marker # 57	29° 31' 30" N 94° 53' 17" W	26.6	64°	0.0
10/13/00	HSC Marker # 37 @ 1 ft.	29° 25' 46" N 94° 49' 55" W	27.8	67°	0.0
10/13/00	HSC Marker # 37 @ 25 ft.	29° 25' 46" N 94° 49' 55" W	28.5	66°	0.0
10/13/00	Texas City Dike @ 1 ft.	29° 25' 46" N 94° 49' 55" W	28.9	68°	0.0
10/13/00	Texas City Dike @ 17 ft.	29° 25' 46" N 94° 49' 55" W	28.7	66°	0.0
10/13/00	East End of Seawall	29° 20' 23" N 94° 44' 58" W			0.0
10/13/00	Galveston Yacht Basin @ 1 ft.	29° 19' 22" N 94° 46' 31" W	29.4	68°	0.0
10/13/00	Galveston Yacht Basin @ 5 ft.	29° 19' 22" N 94° 46' 31" W	29.4	66°	0.0
11/28/00	Dollar reef #1-SLT #349	29° 26' 21" N 94° 52' 47" W	14.9	60°	0.0
11/28/00	Dollar reef #2-SLT #349	29° 26' 01" N 94° 52' 59" W	15.5	61°	0.0

Table 2. *G. breve* cell counts for West Galveston Bay and the Freeport Area from August 25, 2000 to December 15, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cell Counts
08/25/00	ICWW @ Bastrop Bay	29° 05' 58" N 95° 12' 12" W	37.9	87°	0.0
08/25/00	San Luis Pass (WES)	29° 05' 39" N 95° 07' 28" W	36.8	87°	0.0
08/25/00	ICWW @ Surfside	28° 58' 50" N 95° 17' 39" W	36.7	87°	0.0
08/31/00	Galveston Causeway by Payco Marine(WES)	29° 17' 42" N 94° 53' 12" W	38.4	88°	0.0
08/31/00	Shellfish Marker (WES)	29° 16' 47" N 94° 54' 56" W	38.7	88°	0.0
08/31/00	Sea Isle (WES)	29° 08' 55" N 95° 02' 57" W	37.1	87°	0.0
08/31/00	San Luis Pass (WES)	29° 05' 39" N 95° 07' 28" W	37.2	88°	208.0
10/20/00	Pirate's Cove (WES) 1&2	29° 12' 48" N 94° 57' 02" W			0.0
10/20/00	Christmas Bay (Sy's Bait Camp)	29° 02' 13" N 95° 11' 32" W			0.0
10/20/00	Isle Del Sol (WES)	29° 08' 32" N 95° 03' 28" W			0.0
10/27/00	Sea Isle (WES)	29° 08' 55" N 95° 02' 57" W			0.0
10/27/00	WES A52	29° 14' 29" N 95° 00' 52" W			0.0
10/27/00	WES 83A	29° 17' 17" N 94° 54' 59" W			0.0
10/27/00	FRE 14 (Christmas Bay)	29° 04' 46" N 95° 10' 15" W			0.0
10/27/00	FRE 25 (Drum Bay)	28° 59' 45" N 95° 14' 05" W			0.0
11/15/00	Christmas Bay (Sy's Bait Camp)	29° 02' 13" N 95° 11' 32" W		62°	0.0
11/15/00	Treasure Island (WES)	29° 04' 45" N 95° 08' 11" W		64°	0.0
11/15/00	Isle Del Sol (WES)	29° 08' 55" N 95° 02' 57" W		62°	0.0
11/15/00	Spanish Land Grant (WES)	29° 12' 53" N 94° 56' 55" W		62°	0.0
11/15/00	Tiki Island (WES)	29° 18' 01" N 94° 54' 15" W		62°	0.0

Table 2 (cont.). *G. breve* cell counts for West Galveston Bay and the Freeport Area from August 25, 2000 to December 15, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
12/15/00	FRE 10A (Christmas Bay)	29° 02' 14" N 95° 11' 47" W	23.0	52°	0.0
12/15/00	FRE 15 (Bastrop Bay)	29° 05' 33" N 95° 10' 43" W	22.8	51°	0.0
12/15/00	FRE 25 (Drum Bay)	28° 59' 45" N 95° 14' 05" W	22.2	50°	0.0

Table 3. *G. breve* Cell Counts for the Matagorda Bay Complex from August 28, 2000 to January 3, 2001.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
08/28/00	Gulf of Mexico 1 - End of Matagorda Ship Channel Jetty	28° 24' 44" N 96° 19' 04" W	35.1	87°	0.0
08/28/00	Gulf of Mexico 2 - Pass Cavallo	28° 22' 47" N 96° 21' 33" W	34.7	87°	0.0
08/28/00	Gulf of Mexico 3 - 3/4 mile offshore of Colorado River	28° 34' 41" N 95° 59' 04" W	34.8	87°	7.4
09/14/00	MAT 271 - Offshore Mad Island Reef	28° 37' 15" N 96° 05' 46" W	31.9	82°	0.0
09/14/00	EMB 100 - Oyster Farm	28° 41' 44" N 95° 48' 33" W	36.4	82°	0.0
09/14/00	EMB 97 - Near Shellfish Marker J	28° 42' 57" N 95° 45' 31" W	35.6	82°	4,644
09/14/00	EMB 83 - Btwn. Marker J and EMB 10	28° 43' 52" N 95° 44' 03" W	34.2	82°	0.0
09/14/00	TRP 309 - Near Oliver Point	28° 38' 25" N 96° 14' 22" W	31.6	82°	0.0
09/18/00	MAT 113 - Little Jetty	28° 26' 44" N 96° 23' 41" W	35.1	82°	311
09/18/00	Gulf of Mexico 1 - End of Matagorda Ship Channel Jetty	28° 24' 44" N 96° 19' 04" W	35.2	82°	148
09/18/00	PWH 67 - Mouth of Powderhorn Lake	28° 30' 38" N 96° 29' 06" W	34.5	81°	0.0
09/21/00	MAT 113 - Dolphin Point Marina	28° 26' 44" N 96° 23' 41" W	34.2	81°	8,656
10/03/00	MAT 54 - Sand Point	28° 34' 06" N 96° 30' 22" W	34.1	79°	185
10/03/00	CAR 279 - CAR 1	28° 37' 37" N 96° 22' 14" W	34.0	79°	0.0
10/03/00	TRP 291 - TRP 9	28° 38' 53" N 96° 17' 56" W	33.9	79°	0.0
10/03/00	TRP 303 - Channel Marker 30	28° 37' 13" N 96° 16' 06" W	34.1	79°	0.0
10/03/00	MAT 214 - Near Palacios Point	28° 34' 54" N 96° 14' 27" W	34.1	79°	0.0
10/03/00	MAT 230 - ICWW Channel Marker 27	28° 33' 13" N 96° 12' 41" W	34.0	79°	0.0

Table 3 (cont). *G. breve* Cell Counts for the Matagorda Bay Complex from August 28, 2000 to January 3, 2001.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
10/03/00	MAT 208 - Offshore of Greens Bayou	28° 30' 17" N 96° 14' 43" W	34.6	79°	0.0
10/03/00	Gulf of Mexico 1 - End of Matagorda Ship Channel Jetty	28° 24' 44" N 96° 19' 04" W	33.3	79°	2,789
10/03/00	MAT 630 - Pass Cavallo	28° 23' 02" N 96° 23' 18" W	33.4	79°	711
10/03/00	ESP 240 - Saluria @ Mitchell Cut	28° 24' 02" N 96° 25' 03" W	33.4	79°	396
10/03/00	MAT 113 - Little Jetty	28° 26' 44" N 96° 23' 41" W	33.3	79°	3,567
10/03/00	MAT 67 - Offshore of Powderhorn Lake	28° 30' 45" N 96° 28' 50" W	33.4	79°	4.4
10/11/00	TRP 24	28° 41' 47" N 96° 13' 34" W	34.6	61°	0.0
10/11/00	TRP 17	28° 39' 27" N 96° 14' 50" W	34.3	57°	0.0
10/11/00	TRP 7	28° 36' 47" N 96° 15' 17" W	34.8	57°	0.0
10/11/00	MAT 10	28° 34' 32" N 96° 13' 46" W	34.1	57°	0.0
10/11/00	MAT R5	28° 37' 11" N 96° 02' 56" W	33.7	57°	0.0
10/11/00	EMB 3	28° 39' 20" N 95° 55' 20" W	37.2	57°	0.0
10/11/00	EMB 8	28° 43' 55" N 95° 46' 29" W	31.4	57°	152
10/11/00	EMB 12	28° 45' 46" N 95° 39' 13" W	28.8	57°	133
10/11/00	EMB 6	28° 43' 53" N 95° 49' 35" W	35.7	57°	259
10/11/00	Palacios Harbor	28° 41' 47" N 96° 13' 34" W	34.6	57°	0.0
10/11/00	Btwn. EMB Shellfish Markers C & D	28° 43' 26" N 95° 46' 00" W	31.3	57°	589
10/12/00	MAT 6	28° 36' 35" N 96° 23' 09" W	34.2	59°	15.6

Table 3 (cont). *G. breve* Cell Counts for the Matagorda Bay Complex from August 28, 2000 to January 3, 2001.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
10/12/00	CAR 2	28° 42' 21" N 96° 12' 10" W	33.6	59°	0.0
10/12/00	POC Big Jetty	28° 24' 23" N 96° 18' 14" W	30.4	59°	0.0
10/12/00	Pass Cavallo @ Saluria	28° 24' 02" N 96° 23' 18" W	30.9	59°	226
10/12/00	POC Little Jetty	28° 26' 44" N 96° 23' 41" W	30.8	59°	174
10/12/00	Channel Marker 31	28° 29' 10" N 96° 24' 44" W	31.2	59°	78
10/12/00	MAT 3	28° 30' 43" N 96° 29' 00" W	31.9	59°	59
10/12/00	PWH 2	28° 30' 22" N 96° 29' 19" W	32.6	59°	41
10/12/00	Offshore of Powderhorn Lake	28° 30' 58" N 96° 28' 59" W	31.4	59°	3,189
10/27/00	ICWW at Oyster Lake (MAT)	28° 35' 24" N 96° 11' 04" W	29.3	77°	0.0
10/27/00	MAT 6	28° 36' 36" N 96° 23' 09" W	33.5	77°	0.0
10/27/00	MAT 7	28° 38' 28" N 96° 18' 35" W	32.5	77°	0.0
10/27/00	MAT 3	28° 30' 43" N 96° 29' 00" W	30.7	77°	0.0
10/27/00	SE of Sand Point (MAT)	28° 33' 21" N 96° 30' 24" W	32.5	77°	0.0
10/27/00	PWH 2	28° 30' 22" N 96° 29' 19" W	32.2	77°	2.2
10/27/00	Ship Channel offshore of Boggy Bayou	28° 29' 10" N 96° 13' 46" W	30.9	77°	7.4
10/27/00	MAT 10	28° 34' 32" N 96° 13' 46" W	30.3	77°	2.2
10/27/00	MAT R5	28° 37' 11" N 96° 02' 56" W	32.8	77°	0.0
10/27/00	TRP 7	28° 36' 47" N 96° 15' 17" W	31.6	77°	0.0
10/27/00	TRP 17	28° 39' 27" N 96° 14' 50" W	32.7	77°	0.0



Table 3 (cont). *G. breve* Cell Counts for the Matagorda Bay Complex from August 28, 2000 to January 3, 2001.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
10/27/00	TRP 24	28° 41' 47" N 96° 13' 34" W	32.9	77°	0.0
10/27/00	CAR 2	28° 42' 21" N 96° 12' 10" W	33.2	77°	0.0
10/31/00	EMB 3	28° 39' 20" N 95° 55' 20" W	35.9	77°	22.0
10/31/00	EMB 8	28° 43' 54" N 95° 46' 28" W	33.2	77°	0.0
10/31/00	EMB 12	28° 45' 46" N 95° 39' 13" W	28.9	77°	0.0
10/31/00	EMB 6	28° 43' 53" N 95° 49' 35" W	31.8	77°	7.4
10/31/00	SE of Bird Island (EMB)	28° 43' 29" N 95° 44' 53" W	35.4	77°	0.0
11/01/00	TRP 24	28° 41' 47" N 96° 13' 34" W	30.9	79°	0.0
11/01/00	TRP 17	28° 39' 27" N 96° 14' 50" W	31.7	79°	2.2
11/01/00	TRP 7	28° 36' 47" N 96° 15' 17" W	31.6	79°	0.0
11/01/00	MAT 10	28° 34' 32" N 96° 13' 46" W	30.6	79°	0.0
11/01/00	MAT R5	28° 37' 11" N 96° 02' 56" W	32.4	79°	0.0
11/01/00	MAT 6	28° 36' 36" N 96° 23' 09" W	32.2	79°	4.4
11/01/00	MAT 7	28° 38' 28" N 96° 18' 35" W	31.3	79°	0.0
11/01/00	CAR 2	28° 42' 21" N 96° 12' 10" W	30.9	79°	2.2
11/08/00	EMB 3	28° 39' 20" N 95° 55' 20" W	36.4	69°	0.0
11/08/00	EMB 8	28° 43' 54" N 95° 46' 28" W	28.6	69°	0.0
11/08/00	EMB 12	28° 45' 46" N 95° 39' 13" W	16.0	69°	0.0
11/08/00	EMB 6	28° 43' 53" N 95° 49' 35" W	26.4	69°	0.0
11/09/00	MAT 113 - Little Jetties (POC)	28° 26' 32" N 96° 24' 04" W	31.0	63°	0.0

Table 3 (cont). *G. breve* Cell Counts for the Matagorda Bay Complex from August 28, 2000 to January 3, 2001.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
11/14/00	TRP 7	28° 36' 47" N 96° 15' 17" W	18.0	58°	0.0
11/14/00	MAT R5	28° 37' 11" N 96° 02' 56" W	14.9	58°	0.0
11/14/00	TRP 310 - Tres Palacios Channel Reef	28° 39' 35" N 96° 14' 43" W	18.5	58°	0.0
11/14/00	TRP 24	28° 41' 47" N 96° 13' 34" W	18.0	58°	0.0
11/14/00	MAT 259 - Corp reefs	28° 36' 03" N 96° 08' 23" W	14.9	58°	0.0
11/14/00	MAT 271 - Mad Island Reef	28° 37' 23" N 96° 06' 13" W	14.0	54°	0.0
11/14/00	MAT 314 - Tripod S of Hotel Pt.	28° 35' 27" N 96° 14' 07" W	17.2	57°	0.0
11/15/00	EMB 6	28° 43' 53" N 95° 49' 35" W	13.5	56°	0.0
11/15/00	EMB 8	28° 43' 55" N 95° 46' 29" W	11.1	56°	0.0
11/15/00	EMB 3	28° 39' 20" N 95° 55' 20" W	20.4	56°	0.0
11/15/00	EMB 12	28° 45' 46" N 95° 39' 13" W	10.0	56°	0.0
11/16/00	MAT 3	28° 30' 43" N 96° 29' 00" W	31.1	61°	0.0
11/16/00	PWH 2	28° 30' 22" N 96° 29' 19" W	31.0	61°	0.0
11/16/00	MAT 6	28° 36' 36" N 96° 23' 09" W	31.4	61°	0.0
11/16/00	S end of Port Alto CAR SLT #214	28° 38' 33" N 96° 25' 02" W	31.2	58°	0.0
11/16/00	CAR 3 SLT #296	28° 39' 46" N 96° 22' 34" W	31.6	61°	0.0
12/6/00	CAR 214 (Port Alto)	28° 38' 31" N 96° 25' 01" W	24.1	54°	0.0
12/6/00	CAR 296 (Houston Point)	28° 39' 48" N 96° 22' 34" W	24.0	64°	0.0
01/3/01	EMB 93 at station EMB 5	28° 42' 22" N 95° 49' 40" W	23.2	41°	0.0
01/3/01	EMB 77 at station EMB 8	28° 43' 54" N 95° 46' 21" W	15.3	41°	0.0

Table 4. *G. breve* Cell Counts for San Antonio, Espiritu Santo and Mesquite Bays from September 20, 2000 to December 5, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
09/20/00	San Antonio Bay - Turnstake	28° 15' 27" N 96° 40' 16" W	35.1	82°	0.0
09/20/00	San Antonio Bay - Steamboat	28° 18' 54" N 96° 37' 37" W	35.5	82°	0.0
09/20/00	Espiritu Santo Bay - South Pass	28° 17' 53" N 96° 37' 12" W	35.5	82°	0.0
09/20/00	San Antonio Bay - Offshore Pats Bay	28° 16' 30" N 96° 38' 30" W	35.4	82°	0.0
09/22/00	Espiritu Santo Bay - Charlie's Boat ramp	28° 21' 53" N 96° 34' 50" W	35.4	84°	0.0
09/22/00	Espiritu Santo Bay - Shoalwater Bay	28° 20' 03" N 96° 37' 26" W	34.6	84°	0.0
09/22/00	San Antonio Bay - Turnstake	28° 15' 27" N 96° 40' 16" W	34.6	84°	0.0
09/28/00	San Antonio Bay - Steamboat	28° 18' 54" N 96° 37' 37" W	36.0	72°	0.0
09/28/00	San Antonio Bay - South Pass	28° 17' 49" N 96° 37' 18" W	36.1	72°	0.0
09/28/00	San Antonio Bay - Panther Reef Point	28° 13' 16" N 96° 42' 04" W	36.4	73°	0.0
09/28/00	San Antonio Bay - Ayres Bay	28° 12' 29" N 96° 47' 26" W	33.7	73°	0.0
09/28/00	Mesquite Bay - Mouth of Cedar Bayou	28° 06' 04" N 96° 49' 50" W	37.1	72°	13.3
09/28/00	Mesquite Bay - ICWW at Mesquite	28° 10' 38" N 96° 51' 40" W	31.8	72°	0.0
09/28/00	San Antonio Bay - Turnstake	28° 15' 27" N 96° 40' 16" W	35.7	72°	0.0
10/03/00	Espiritu Santo Bay - Sahrria @Mitchell Cut	28° 24' 02" N 96° 25' 03" W	33.4	79°	396
10/06/00	Espiritu Santo Bay - Charlie's Boat ramp	28° 21' 53" N 96° 34' 50" W	34.6	83°	24.4
10/06/00	ESP 3	28° 23' 59" N 96° 28' 54" W	33.5	83°	2,900
10/06/00	ESP 5	28° 20' 13" N 96° 33' 48" W	33.6	83°	5,278
10/06/00	SAN 5	28° 17' 41" N 96° 37' 31" W	35.4	83°	0.0

Table 4 (cont). *G. breve* Cell Counts for San Antonio, Espiritu Santo and Mesquite Bays from September 20, 2000 to December 5, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
10/06/00	SAN 6	28° 13' 40" N 96° 42' 25" W	36.3	83°	2.2
10/06/00	SAN 8	28° 14' 47" N 96° 46' 09" W	31.7	83°	0.0
10/06/00	SAN 7	28° 11' 55" N 96° 49' 49" W	33.3	83°	0.0
10/06/00	MES 2	28° 08' 05" N 96° 49' 46" W	35.6	83°	0.0
10/06/00	Cedar Bayou	28° 06' 50" N 96° 49' 52" W	34.1	83°	237.0
10/06/00	SAN 100	28° 21' 55" N 96° 45' 46" W	22.8	83°	0.0
10/06/00	SAN 1	28° 24' 19" N 96° 42' 43" W	25.0	83°	0.0
10/06/00	SAN 3	28° 21' 15" N 96° 42' 43" W	33.5	83°	0.0
10/06/00	SAN 4	28° 18' 41" N 96° 40' 47" W	35.5	83°	0.0
10/06/00	Ayres Dugout	28° 10' 06" N 96° 49' 56" W	35.3	83°	0.0
10/13/00	Espiritu Santo Bay - Charlie's Boat Ramp	28° 21' 53" N 96° 34' 50" W	34.1	64°	56.0
10/13/00	ESP 5	28° 20' 13" N 96° 33' 48" W	32.3	64°	822.0
10/13/00	SAN 5	28° 17' 41" N 96° 37' 31" W	33.1	64°	444.0
10/13/00	SAN 6	28° 13' 40" N 96° 42' 25" W	34.2	64°	2,022.0
10/13/00	SAN 8	28° 14' 47" N 96° 46' 09" W	24.8	64°	0.0
10/13/00	SAN 7	28° 11' 55" N 96° 49' 49" W	28.9	64°	0.0
10/13/00	MES 2	28° 08' 05" N 96° 49' 46" W	33.6	64°	0.0
10/13/00	Cedar Bayou (MES)	28° 06' 04" N 96° 49' 50" W	31.7	64°	29.0
10/13/00	SAN 100	28° 21' 55" N 96° 45' 46" W	29.8	64°	0.0

Table 4 (cont). *G. breve* Cell Counts for San Antonio, Espiritu Santo and Mesquite Bays from September 20, 2000 to December 5, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
10/13/00	SAN 1	28° 24' 19" N 96° 42' 43" W	32.5	64°	0.0
10/13/00	SAN 3	28° 21' 15" N 96° 42' 43" W	34.1	64°	20.0
10/13/00	SAN 4	28° 18' 41" N 96° 40' 47" W	33.4	64°	16.0
10/13/00	Fulgram's Cut (ESP)	28° 21' 29" N 96° 34' 20" W	31.7	64°	1,322.0
10/13/00	ESP bloom area	28° 19' 01" N 96° 35' 04" W	32.8	64°	4,822.0
10/13/00	SAN bloom area	28° 17' 34" N 96° 38' 16" W	33.2	64°	37,733.0
10/13/00	Bloom offshore of Twin Lakes (SAN)	28° 15' 58" N 96° 40' 11" W	33.3	64°	Too numerous to count
10/30/00	ESP 3	28° 23' 59" N 96° 28' 54" W	30.3	79°	2.2
10/30/00	SAN 4	28° 18' 41" N 96° 40' 47" W	31.7	79°	2.2
10/30/00	SAN 1	28° 24' 19" N 96° 42' 43" W	16.4	79°	0.0
10/30/00	SAN 17	28° 23' 48" N 96° 46' 35" W	17.8	79°	26.0
10/30/00	SAN 100	28° 21' 55" N 96° 45' 46" W	23.4	79°	119.0
10/30/00	V-reef (SAN)	28° 16' 08" N 96° 45' 55" W	32.4	79°	3,356.0
10/30/00	Dolphin Pt. Marina (ESP)	28° 26' 25" N 96° 24' 47" W	30.1	79°	0.0
10/30/00	0.5 miles SE of half moon reef (SAN)	28° 20' 00" N 96° 45' 49" W	29.2	79°	2,678.0
10/30/00	Charlie's Boat Ramp (ESP)	28° 21' 53" N 96° 34' 50" W	31.9	79°	18.5
11/09/00	ESP 5	28° 20' 13" N 96° 33' 48" W	33.0	61°	4.4
11/09/00	ESP 3	28° 23' 59" N 96° 28' 54" W	30.7	63°	0.0
11/09/00	Charlie's Boat Ramp (ESP)	28° 21' 53" N 96° 34' 50" W	30.8	61°	0.0

Table 4 (cont). *G. breve* Cell Counts for San Antonio, Espiritu Santo and Mesquite Bays from September 20, 2000 to December 5, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
11/09/00	MES 2	28° 08' 05" N 96° 49' 46" W	32.6	61°	0.0
11/09/00	Cedar Bayou (MES)	28° 06' 04" N 96° 49' 50" W	31.4	61°	0.0
11/09/00	SAN 1	28° 24' 19" N 96° 42' 43" W	33.0	61°	0.0
11/09/00	SAN 3	28° 21' 15" N 96° 42' 43" W	12.8	59°	0.0
11/09/00	SAN 4	28° 18' 41" N 96° 40' 47" W	25.4	59°	0.0
11/09/00	SAN 5	28° 17' 41" N 96° 37' 31" W	31.3	61°	0.0
11/09/00	SAN 6	28° 13' 40" N 96° 42' 25" W	33.3	61°	0.0
11/09/00	SAN 7	28° 11' 55" N 96° 49' 49" W	31.3	61°	0.0
11/09/00	SAN 8	28° 14' 47" N 96° 46' 09" W	31.9	61°	6.7
11/09/00	SAN 100	28° 21' 55" N 96° 45' 46" W	20.4	61°	0.0
11/28/00	MES 9 (Cedar Dugout)	28° 09' 09" N 96° 52' 19" W	24.5	64°	0.0
11/28/00	MES 23 (Ayres Dugout)	28° 10' 00" N 96° 50' 01" W	23.7	65°	0.0
11/28/00	MES 26 (Near Bray's Cove)	28° 08' 31" N 96° 49' 24" W	25.3	64°	0.0
11/28/00	SAN 114 (Panther Reef)	28° 15' 25" N 96° 43' 01" W	18.7	64°	0.0
11/28/00	SAN 54 (Chicken foot)	28° 13' 02" N 96° 47' 09" W	18.9	64°	0.0
11/29/00	ESP 205 (Josephine Reef)	28° 20' 04" N 96° 31' 18" W	29.7	64°	0.0
12/5/00	SAN 106 (Near station 15)	28° 22' 04" N 96° 43' 18" W	6.6	52°	0.0
12/5/00	SAN 73 (South of Grassy Point)	28° 23' 07" N 96° 45' 41" W	1.1	53°	0.0

Table 5. *G. breve* Cell Counts for Arausas and Copano Bays from October 2, 2000 to November 16, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
10/02/00	Sea Gun Boat Ramp	28° 08' 07" N 97° 00' 25" W	35.8	77°	0.0
10/02/00	Goose Island Boat Ramp	28° 07' 42" N 96° 59' 08" W	36.0	77°	0.0
10/02/00	Copano Fishing Pier	28° 08' 08" N 97° 00' 37" W	31.4	77°	0.0
10/02/00	Fulton Harbor	28° 03' 37" N 97° 02' 00" W	37.2	77°	244.0
10/02/00	Rockport Harbor	28° 01' 22" N 97° 02' 48" W	38.0	77°	7.0
10/05/00	Sea Gun Boat Ramp	28° 08' 07" N 97° 00' 25" W	35.5	82°	0.0
10/05/00	Copano Fishing Pier	28° 08' 08" N 97° 00' 37" W	33.2	82°	0.0
10/05/00	Fulton Harbor	28° 03' 37" N 97° 02' 00" W	37.4	82°	98.0
10/05/00	Rockport Harbor	28° 01' 22" N 97° 02' 48" W	38.0	82°	24.0
10/26/00	Sea Gun Boat Ramp	28° 08' 07" N 97° 00' 25" W	33.0	73°	4.0
10/26/00	Copano Boat Ramp	28° 06' 50" N 97° 01' 33" W	33.1	73°	0.0
10/26/00	Copano Fishing Pier	28° 08' 08" N 97° 00' 37" W	33.1	73°	0.0
10/26/00	Fulton Harbor	28° 03' 37" N 97° 02' 00" W	32.4	73°	13.0
10/26/00	Rockport Harbor	28° 01' 22" N 97° 02' 48" W	32.8	73°	93.0
11/07/00	Copano Fishing Pier	28° 08' 08" N 97° 00' 37" W	29.6	73°	0.0
11/07/00	Fulton Harbor	28° 03' 37" N 97° 02' 00" W	30.5	73°	0.0
11/07/00	Rockport Harbor	28° 01' 22" N 97° 02' 48" W	30.6	73°	0.0
11/10/00	Rockport Harbor	28° 01' 22" N 97° 02' 48" W	30.8	72°	0.0
11/10/00	Fulton Harbor	28° 03' 37" N 97° 02' 00" W	30.7	72°	0.0

Table 5 (cont). *G. breye* Cell Counts for Aransas and Copano Bays from October 2, 2000 to November 16, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
11/10/00	Sea Gun Boat Ramp	28° 08' 07" N 97° 00' 25" W	31.5	72°	0.0
11/10/00	Copano Fishing Pier	28° 08' 08" N 97° 00' 37" W	30.0	72°	0.0
11/15/00	Aransas Bay - Long Reef SLT #131	28° 04' 00" N 96° 57' 04" W	30.0	59°	0.0
11/16/00	Aransas Bay - Mud Island SLT #235	27° 56' 17" N 97° 00' 07" W	31.9	60°	0.0



Table 6. *G. breve* Cell Counts for Corpus Christi and Redfish Bays from October 10, 2000 to November 10, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
10/02/00	Oso Bay Boat Launch	27° 42' 41" N 97° 18' 44" W	41.0	77°	106.0
10/02/00	Cole Park	27° 46' 21" N 97° 23' 18" W	40.1	77°	139.0
10/02/00	Cooper's Alley Boat Ramp	27° 47' 25" N 97° 23' 23" W	40.1	77°	25,000.0
10/02/00	Port of Corpus Christi Jetty	27° 48' 27" N 97° 23' 27" W	41.0	77°	6,056.0
10/02/00	Nueces Bay Boat Ramp	27° 50' 16" N 97° 22' 52" W	40.2	77°	7.0
10/4/00	RDF 7	27° 53' 48" N 97° 08' 06" W	36.4	77°	13.0
10/4/00	RDF 16	27° 50' 02" N 97° 06' 24" W	33.3	77°	2.0
10/4/00	Island Mooring Subdivision	27° 48' 43" N 97° 05' 38" W	33.3	77°	4.0
10/4/00	Port Aransas Jetty - South	27° 50' 09" N 97° 02' 26" W	33.3	77°	2.0
10/4/00	RDF 9	27° 50' 50" N 97° 03' 30" W	33.5	77°	4.0
10/4/00	RDF 8	27° 53' 29" N 97° 06' 32" W	34.6	77°	19.0
10/4/00	RDF 14	27° 59' 34" N 97° 04' 23" W	38.2	77°	15.0
10/05/00	Cole Park	27° 46' 21" N 97° 23' 18" W	40.2	82°	22.0
10/05/00	Cooper's Alley Boat Ramp	27° 47' 25" N 97° 23' 23" W	38.6	82°	198.0
10/05/00	Oso Bay Boat Launch	27° 42' 41" N 97° 18' 44" W	41.0	82°	83.0
10/26/00	Oso Bay Boat Launch	27° 42' 41" N 97° 18' 44" W	36.1	73°	6.0
10/26/00	Cole Park	27° 46' 21" N 97° 23' 18" W	36.0	73°	9.0
10/26/00	Cooper's Alley Boat Ramp	27° 47' 25" N 97° 23' 23" W	36.3	73°	107.0
11/07/00	Oso Bay Boat Launch	27° 42' 41" N 97° 18' 44" W	31.5	73°	0.0

Table 6 (cont). *G. breve* Cell Counts for Corpus Christi and Redfish Bays from October 10, 2000 to November 10, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
11/07/00	Cole Park	27° 46' 21" N 97° 23' 18" W	31.4	73°	0.0
11/07/00	Cooper's Alley Boat Ramp	27° 47' 25" N 97° 23' 23" W	30.6	73°	0.0
11/10/00	Oso Bay Boat Launch	27° 42' 41" N 97° 18' 44" W	33.1	72°	0.0
11/10/00	Cole Park	27° 46' 21" N 97° 23' 18" W	32.9	72°	0.0
11/10/00	Cooper's Alley Boat Ramp	27° 47' 25" N 97° 23' 23" W	32.9	72°	0.0

Table 7. *G. breve* Cell Counts for Lavaca Bay from October 3, 2000 to December 7, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
10/03/00	Lavaca 26 - Ship Channel	28° 33' 57" N 96° 31' 17" W	32.5	79°	70.4
10/12/00	LAV 7	28° 38' 42" N 96° 36' 06" W	31.4	59°	0.0
10/12/00	Harbor of Refuge (Port Lavaca)	28° 35' 41" N 96° 36' 40" W	28.8	59°	0.0
10/12/00	Lavaca Bay - Marker # 66	28° 35' 44" N 96° 33' 54" W	31.5	59°	0.0
10/12/00	LAV 35	28° 36' 12" N 96° 28' 57" W	33.3	59°	0.0
10/12/00	LAV 34	28° 34' 16" N 96° 29' 35" W	33.8	59°	33
10/12/00	Harbor of Refuge (Lavaca Bay)	28° 35' 41" N 96° 36' 40" W	28.8	59°	0.0
10/27/00	LAV 7	28° 38' 42" N 96° 36' 06" W	29.4	77°	0.0
10/27/00	Lavaca Bay - Marker #66	28° 35' 44" N 96° 33' 54" W	30.9	77°	0.0
10/27/00	LAV 35	28° 36' 12" N 96° 28' 57" W	32.9	77°	0.0
10/27/00	LAV 34	28° 34' 16" N 96° 29' 35" W	32.3	77°	0.0
11/02/00	LAV 7	28° 38' 42" N 96° 36' 06" W	26.7	77°	0.0
11/02/00	Lavaca Bay - Marker #66	28° 35' 44" N 96° 33' 54" W	27.8	77°	0.0
11/02/00	LAV 35	28° 36' 12" N 96° 28' 57" W	27.6	77°	2.2
11/02/00	LAV 34	28° 34' 16" N 96° 29' 35" W	31.4	77°	0.0
11/02/00	Marker #52 (bottom sample)	28° 33' 11" N 96° 30' 15" W	31.5	77°	0.0
11/07/00	LAV 7	28° 38' 42" N 96° 36' 06" W	28.1	72°	0.0
11/07/00	LAV 16A	28° 41' 05" N 96° 36' 58" W	27.1	72°	0.0
11/07/00	LAV F1	28° 40' 53" N 96° 34' 57" W	26.0	72°	0.0
11/07/00	LAV 35	28° 36' 12" N 96° 28' 57" W	31.0	72°	0.0

Table 7 (cont). *G. breve* Cell Counts for Lavaca Bay from October 3, 2000 to December 7, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
11/07/00	LAV 34	28° 34' 16" N 96° 29' 35" W	31.3	72°	0.0
11/07/00	City Port (Port Lavaca)	28° 38' 34" N 96° 33' 07" W	30.2	72°	0.0
11/07/00	Lavaca Bay - Marker #66	28° 35' 44 " N 96° 33' 54" W	29.9	72°	0.0
12/6/00	LAV 61 (Keller Bay)	28° 36' 26" N 96° 28' 59" W	21.9	54°	0.0
12/6/00	LAV 41 (Cox Bay)	28° 37' 58" N 96° 30' 25" W	22.9	53°	0.0
12/6/00	LAV 12 (Chicken foot)	28° 38' 45" N 96° 36' 00 W	16.7	54°	0.0
12/7/00	LAV 33 (Indian Point)	28° 33' 22" N 96° 31' 14" W	20.2	53°	0.0

Table 8. Chronology of oyster brevetoxin results for Galveston Bay from October 11, 2000 to November 28, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Results MU/100g
10/11/00	Dollar Reef SLT#349	29° 26' 21" N 94° 52' 47" W	26.9	60°	57 MU/100g
10/11/00	South Redfish Reef SLT #266	29° 29' 43" N 94° 51' 03" W	26.8	63°	<20 MU/100g
10/11/00	Todd's Dump SLT #286	29° 30' 19" N 94° 53' 26" W	26.6	63°	<20 MU/100g
10/11/00	South Reef Marker #63 (SLT # 262)	29° 31' 49" N 94° 53' 49" W	26.0	62°	24 MU/100g
10/11/00	Eagle Pt. Reef SLT #307	29° 30' 48" N 94° 54' 35" W	26.5	64°	<20MU/100g
10/12/00	Bart's Pass SLT #200	29° 32' 10" N 94° 48' 54" W	23.4	61°	<20 MU/100g
10/12/00	Sheldon Reef SLT #197	29° 31' 39" N 94° 46' 50" W	24.0	63°	<20MU/100g
10/12/00	Frenchy's Reef SLT #174	29° 31' 59" N 94° 36' 17" W	24.8	61°	<20 MU/100g
10/12/00	Middle Reef SLT #161	29° 30' 48" N 94° 39' 44" W	25.2	62°	<20 MU/100g
10/12/00	Hanna's Reef SLT #192	29° 28' 32" N 94° 42' 10" W	25.5	62°	<20 MU/100g
10/17/00	Shuttle Reef SLT #248	29° 32' 12" N 94° 53' 36" W	26.4	71°	<20 MU/100g
10/17/00	Reef Marker #64 SLT #250	29° 33' 19" N 94° 54' 28" W	26.1	72°	23 MU/100g
10/17/00	Lost Reef SLT #114	29° 36' 47" N 94° 52' 27" W	25.1	72°	<20 MU/100g
10/17/00	Fisher Reef SLT #68	29° 39' 46" N 94° 50' 17" W	23.9	75°	<20 MU/100g
10/17/00	Roundtable Reef SLT #106	29° 33' 54" N 94° 46' 41" W	24.5	73°	<20 MU/100g
10/17/00	Hodges Reef SLT #80	29° 35' 21" N 94° 44' 15" W	24.2	76°	<20 MU/100g
10/17/00	Little Pipeline Reef SLT #41	29° 37' 02" N 94° 42' 56" W	24.0	77°	<20 MU/100g
11/1/00	Levee Reef SLT 350	29° 26' 36" N 94° 53' 22" W	28.6	77°	<20 MU/100g
11/1/00	Dollar Pt. Reef SLT #349	29° 26' 21" N 94° 52' 47" W	28.6	77°	18 MU/100g

Table 8 (cont). Chronology of oyster brevetoxin results for Galveston Bay from October 11, 2000 to November 28, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Results MU/100g
11/1/00	Reef Marker #51 SLT#285	29° 29' 39" N 94° 52' 13" W			<20 MU/100g
11/1/00	Reef Marker #57 SLT #266	29° 31' 22" N 94° 53' 29" W			<20 MU/100g
11/1/00	South Reef Marker #63 (SLT # 262)	29° 31' 49" N 94° 53' 49" W			<20 MU/100g
11/1/00	Reef Marker # 69 SLT #252	29° 34' 33" N 94° 55' 55" W			<20 MU/100g
11/2/00	North Reef Marker #63 SLT #250	29° 33' 08" N 94° 54' 37" W	25.1	77°	<20MU/100g
11/2/00	Reef Marker #64 SLT #250	29° 33' 19" N 94° 54' 28" W	25.1	76°	<20 MU/100g
11/2/00	Reef Marker #60 SLT #249	29° 33' 21" N 94° 53' 48" W	24.4	77°	<20MU/100g
11/2/00	Shellfish Marker S Reef SLT #330	29° 29' 14" N 94° 54' 06" W	25.4	76°	<20 MU/100g
11/14/00	Dollar Pt. Reef SLT #349	29° 26' 21" N 94° 52' 47" W	20.5	57°	19 MU/100g
11/15/00	Dollar Pt. Reef #2 SLT #334	29° 26' 33" N 94° 52' 28" W	20.7	57°	<20 MU/100g
11/28/00	Dollar Pt. Reef #1 SLT #349	29° 26' 21" N 94° 52' 47" W	14.9	60°	<20 MU/100g
11/28/00	Dollar Pt. Reef #2 SLT #349	29° 26' 01" N 94° 52' 59" W	15.5	61°	<20 MU/100g

Table 9. Chronology of oyster brevetoxin results for San Antonio, Espiritu Santo, and Mesquite Bays from November 10, 2000 to December 5, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Results MU/100g
11/10/00	1.2 miles N SAN 100 SLT #73	28° 22' 56" N 96° 45' 41" W	12.4	63°	32 MU/100g
11/10/00	Swan Point SAN SLT #132	28° 22' 54" N 96° 42' 55" W	22.3	63°	32 MU/100g
11/28/00	SAN SLT #114 - Panther Reef	28° 15' 25" N 96° 43' 01" W	18.7	64°	<20 MU/100g
11/28/00	SAN SLT #54 - Chickenfoot Reef	28° 13' 02" N 96° 47' 09" W	18.9	64°	<20 MU/100g
11/28/00	AP SAN SLT #23 - Ayres Dugout	28° 10' 00" N 96° 50' 01" W	23.7	65°	<20 MU/100g
11/28/00	MES SLT #9 - Cedar Dugout	28° 09' 09" N 96° 52' 19" W	24.5	64°	<20 MU/100g
11/28/00	MES SLT #26 - Bray's Cove	28° 08' 31" N 96° 49' 24" W	25.3	64°	<20 MU/100g
11/29/00	ESP SLT #205 - Josephine Reef	28° 20' 04" N 96° 31' 18" W	29.7	64°	<20 MU/100g
12/5/00	SAN SLT #106 - Near station 15	28° 22' 04" N 96° 43' 18" W	6.6	52°	<20 MU/100g
12/5/00	SAN SLT #73 - South of Grassy Point	28° 23' 07" N 96° 45' 41" W	1.1	53°	<20 MU/100g

Table 10. Chronology of oyster brevetoxin results for the Matagorda Bay Complex from November 14, 2000 to January 3, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Results MU/100g
11/14/00	SE of Mad Island Cut SLT #271	28° 37' 23" N 96° 06' 13" W	14.0	54°	<20 MU/100g
11/14/00	Reef near Hotel Pt. TRP SLT #314	28° 35' 27" N 96° 14' 07" W	17.2	57°	<20 MU/100g
11/14/00	Between Stations 17 - 19 TRP SLT # 310	28° 39' 35" N 96° 14' 43" W	18.5	58°	<20 MU/100g
11/15/00	EMB 8 SLT #77	28° 43' 54" N 95° 46' 21" W	11.1	56°	20 MU/100g
11/15/00	EMB 6 SLT #75	28° 44' 06" N 95° 49' 46" W	13.5	56°	26 MU/100g
11/16/00	CAR SLT #214 - Port Alto	28° 38' 33" N 96° 25' 02" W	31.2	58°	30 MU/100g
11/16/00	CAR SLT #296	28° 39' 46" N 96° 22' 34" W	31.6	61°	22 MU/100g
12/6/00	CAR SLT#214 - Port Alto	28° 38' 31" N 96° 25' 01" W	24.1	54°	<20 MU/100g
12/6/00	CAR SLT #296 - Houston Point	28° 39' 48" N 96° 22' 30" W	24.0	54°	<20 MU/100g
01/3/01	EMB 93 at station EMB 5	28° 42' 22" N 95° 49' 50" W	23.2	41°	<20 MU/100g
01/3/01	EMB 77 at station EMB 8	28° 43' 54" N 95° 46' 21" W	15.3	41°	<20 MU/100g



**Table 11. Chronology of oyster brevetoxin results for West Galveston Bay and the Freeport Area from October 24, 2000 to November 16, 2000.**

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Results MU/100g
10/24/00	Christmas Bay (Sy's Bait Camp)	29° 02' 56" N 94° 09' 55" W	31.4	76°	28 MU/100g
10/25/00	Pirate's Cove SLT #67	29° 12' 48" N 94° 57' 02" W	30.5	76°	<20 MU/100g
11/15/00	North Deer Island SLT #79A (WES)	29° 16' 56" N 94° 55' 54" W	27.2	57°	<20 MU/100g
11/15/00	Christmas Bay (Sy's Bait Camp)	29° 02' 13" N 94° 11' 32" W	24.8	62°	<20 MU/100g
11/16/00	San Luis Pass SLT # 28 (WES)	29° 05' 40" N 95° 06' 45" W	26.2	64°	<20 MU/100g

Table 12. Chronology of oyster brevetoxin results for Aransas and Copano Bays from November 15, 2000 to December 4, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Results MU/100g
11/15/00	ARA SLT #131 - Long Reef	28° 04' 00" N 96° 57' 04" W	30.0	59°	<20 MU/100g
11/16/00	ARA SLT #235 - Mud Island	27° 56' 17" N 97° 00' 07" W	31.9	60°	26 MU/100g
11/29/00	COP SLT #38 - Copano Causeway	28° 07' 50" N 97° 00' 47" W	26.1	68°	<20 MU/100g
11/29/00	COP SLT #34 - Lap Reef	28° 09' 05" N 97° 02' 10" W	26.1	68°	<20 MU/100g
12/4/00	ARA SLT #235- Mud Island	27° 56' 17" N 97° 00' 07" W	30.0	60°	<20 MU/100g

Table 13. Chronology of oyster brevetoxin results for Lavaca Bay from November 17, 2000 to December 7, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Results MU/100g
11/17/00	LAV 12 - Chickenfoot Reef	28° 38' 44" N 96° 36' 02" W	27.1	57°	<20 MU/100g
11/17/00	LAV 41 - Cox Bay	28° 37' 56" N 96° 30' 26" W	30.7	57°	24 MU/100g
12/6/00	LAV 61 - Keller Bay	28° 36' 26" N 96° 28' 59" W	21.9	54°	<20 MU/100g
12/6/00	LAV 41 - Cox Bay	28° 37' 58" N 96° 30' 25" W	22.9	53°	<20 MU/100g
12/6/00	LAV 12 - Chickenfoot Reef	28° 38' 45" N 96° 36' 00" W	16.7	54°	<20 MU/100g
12/7/00	LAV 33 - Indian Point	28° 33' 22" N 96° 31' 14" W	20.2	53°	<20 MU/100g

Table 14. Oyster brevetoxin results for Corpus Christi Bay for December 5, 2000.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Results MU/100g
12/5/00	Shamrock Cove	27° 46' 25" N 97° 08' 27" W	30.0	60°	<20 MU/100g
12/5/00	Island Moorings	27° 48' 55" N 97° 05' 48" W	31.0	60°	24 MU/100g

Table 15. *G. breve* Cell Counts for South Bay on January 8, 2001.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Cells per ml
01/8/01	Lower Laguna Madre-Station 6A	26° 00.860 N 97° 10.623 W			0.0
01/8/01	Lower Laguna Madre-LT #748	26° 04.607 N 97° 09.890 W			0.0

Table 16. Oyster brevetoxin results for South Bay for January 8, 2001.

Date	Location/Description	Lat. / Long.	Salinity (ppt)	Water Temp °F	Results MU/100g
01/8/01	Lower Laguna Madre-Station 6A	26° 00.860 N 97° 10.623 W			<20 MU/100g
01/8/01	Lower Laguna Madre-LT #748	26° 04.607 N 97° 09.890 W			<20 MU/100g

**Appendix D. Red tide cell counts from Dr. Tony Reisinger, Sea Grant,  
and Dr. Don Hockaday, University of Texas Pan American.**

Date	Location	Cell Count (cells/ml)
12-Oct-00	Mansfield Pass	222
12-Oct-00	5 miles s. of Mansfield Pass	525
12-Oct-00	10 miles s. of Mansfield Pass	794
12-Oct-00	15 miles s. of Mansfield Pass	1051
12-Oct-00	20 miles s. of Mansfield Pass	55
12-Oct-00	25 miles s. of Mansfield Pass	153
12-Oct-00	28.5 miles s. of Mansfield Pass (Access #5)	106
12-Oct-00	Queen's Point	0
12-Oct-00	Children's Beach	present (no count)
12-Oct-00	Channel at Ted's Restaurant	0
12-Oct-00	Radisson Hotel	0
15-Oct-00	West end of Queen Isabella Cswy.	0
15-Oct-00	Isla Blanca Park	28
15-Oct-00	8.4 miles n. of Access #5	94
15-Oct-00	12 miles n. of Access #5	53
15-Oct-00	Mansfield Jetties	96
16-Oct-00	Access #5	33
16-Oct-00	5 miles n. of Access #5	27
16-Oct-00	10 miles n. of Access #5	17
16-Oct-00	15 miles n. of Access #5	<10
16-Oct-00	20 miles n. of Access #5	<10
16-Oct-00	25 miles n. of Access #5	<10
19-Oct-00	Access #5	<10
19-Oct-00	5 miles n. of Access #5	<10
19-Oct-00	10 miles n. of Access #5	<10



Figure 1. Red Tide Closures for Galveston Bay.

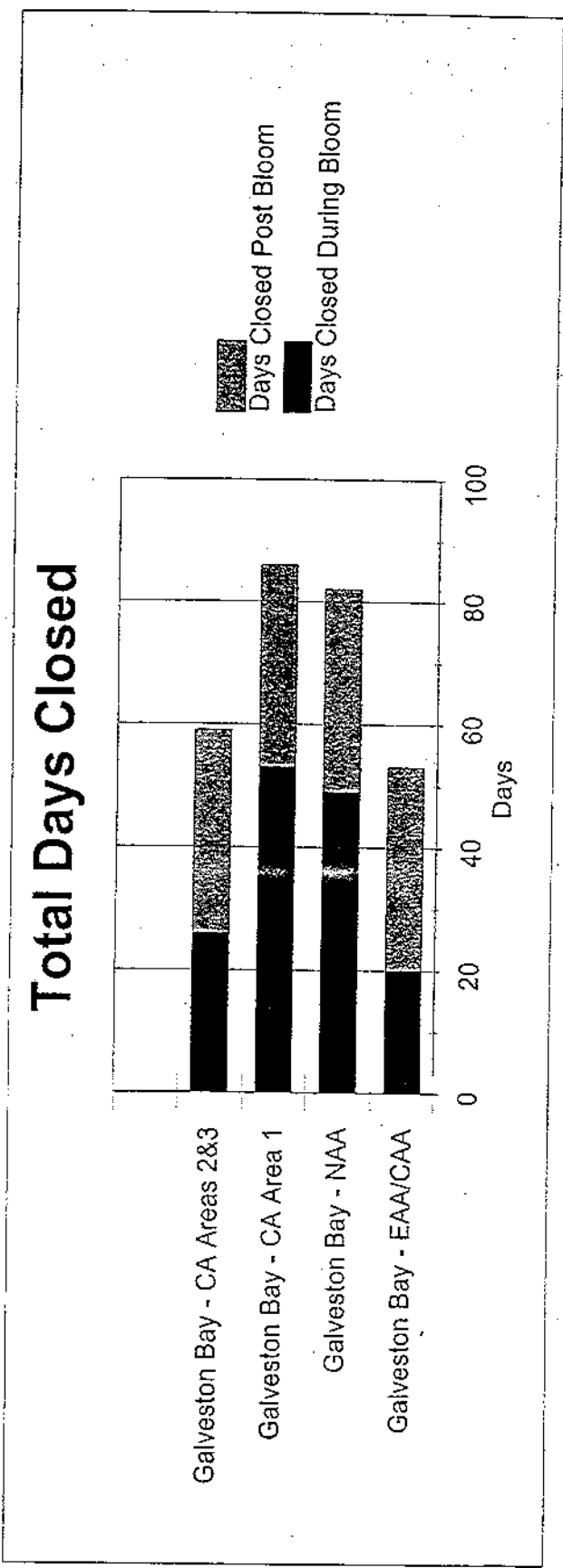
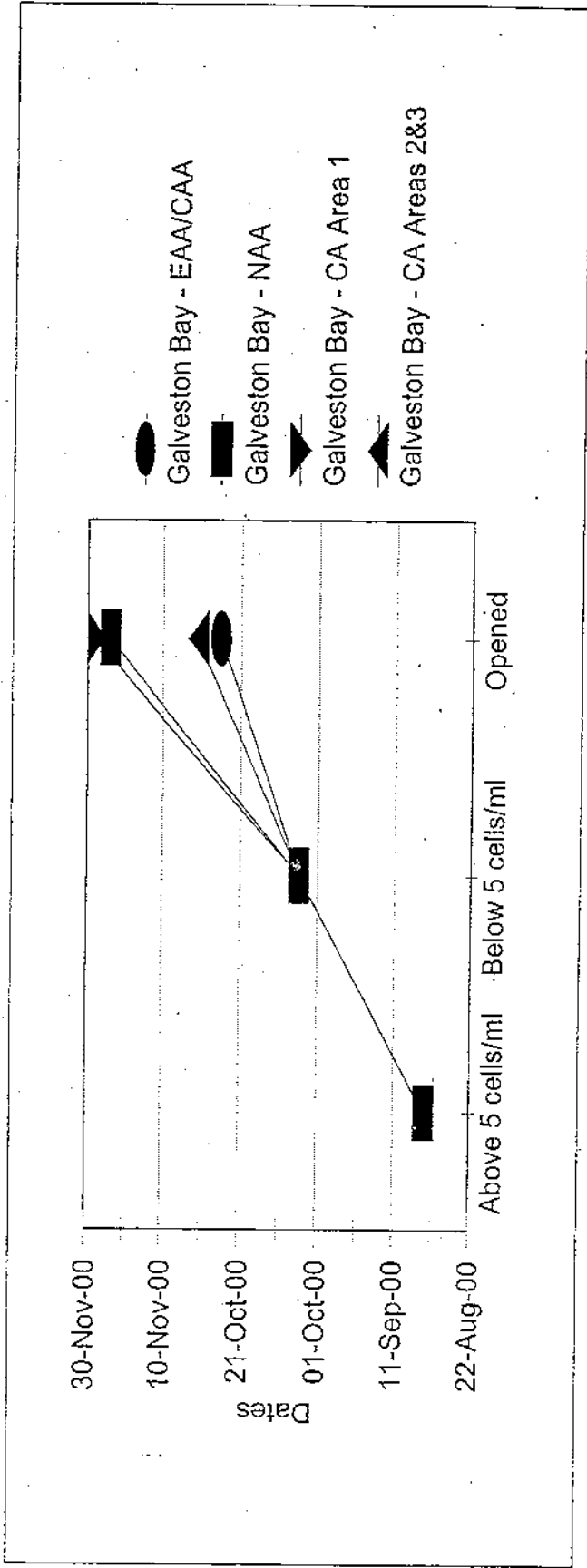


Figure 2. Red Tide Closures for West Galveston, Christmas and Bastrop Bays.

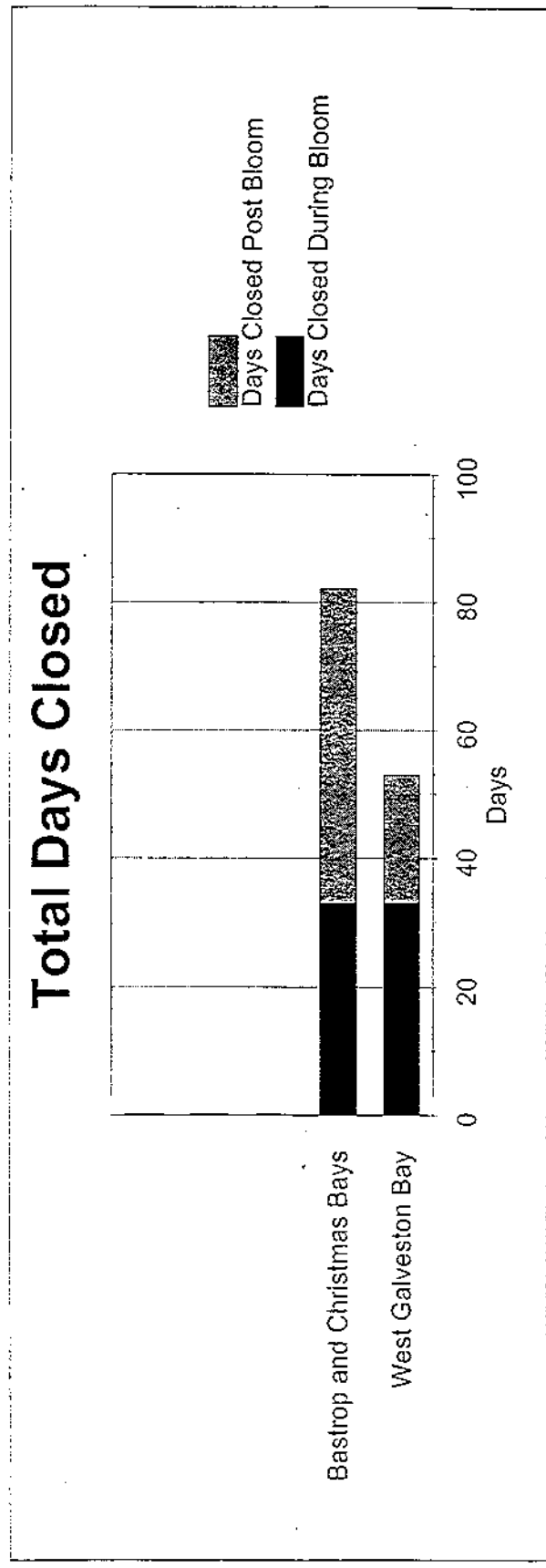
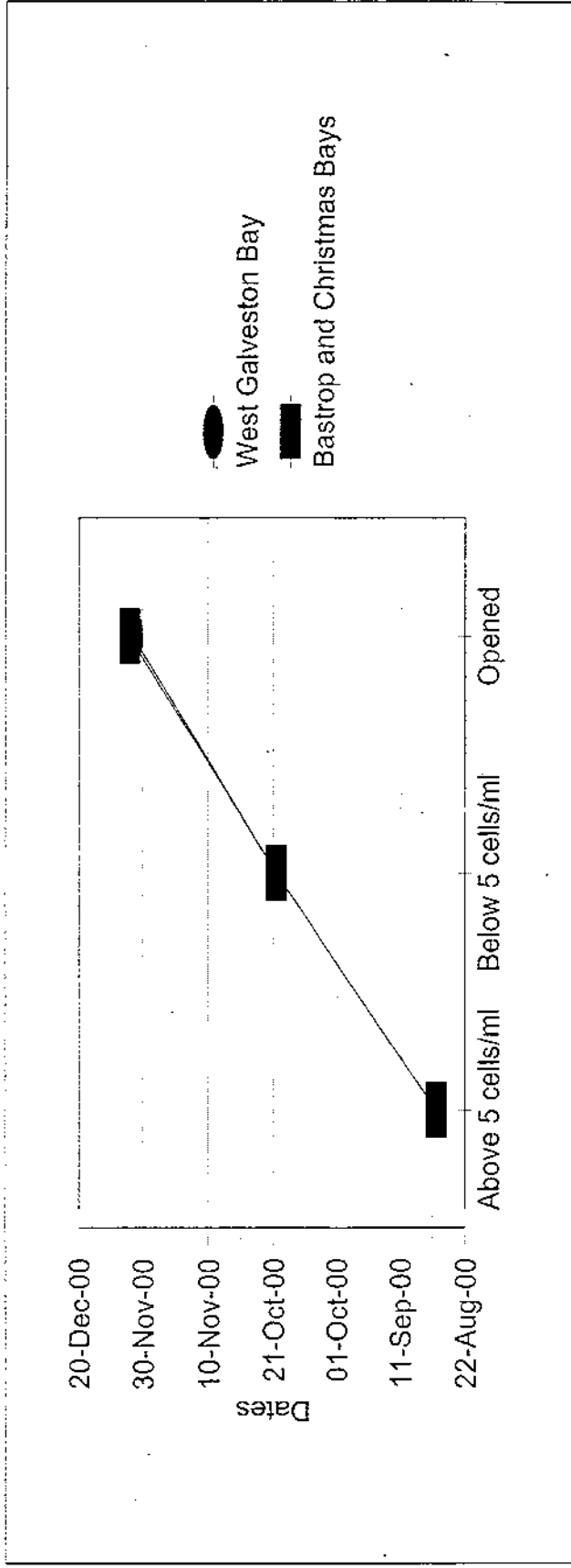


Figure 3. Red Tide Closures for East Matagorda, Matagorda, Tres Palacios and Carancahua Bays.

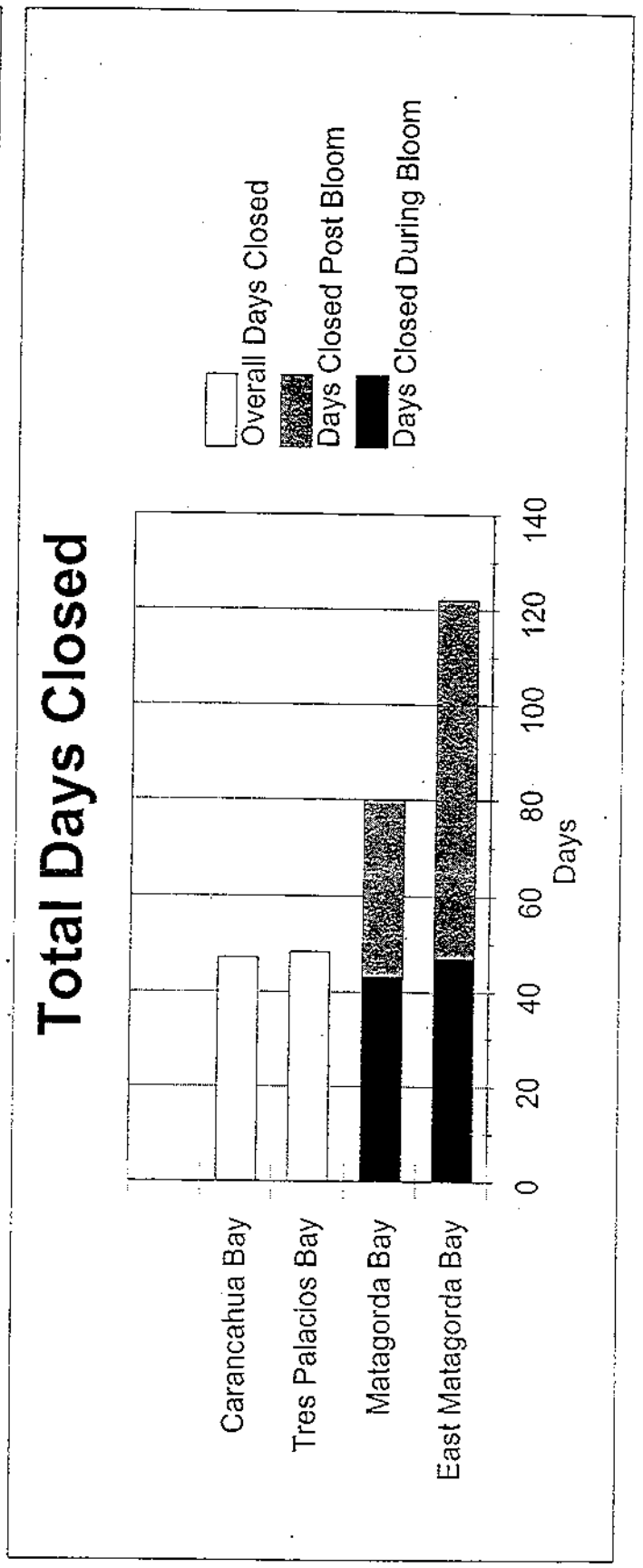
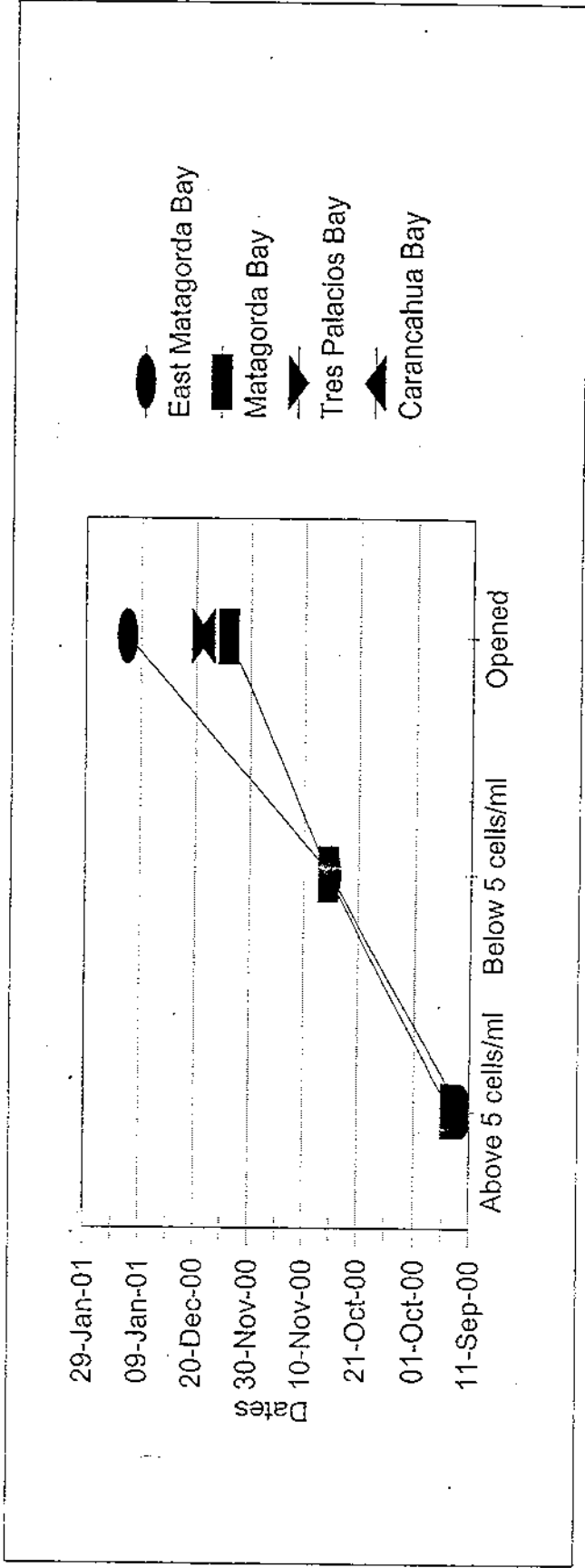


Figure 4. Red Tide Closures for Lavaca Bay and Powderhorn Lake.

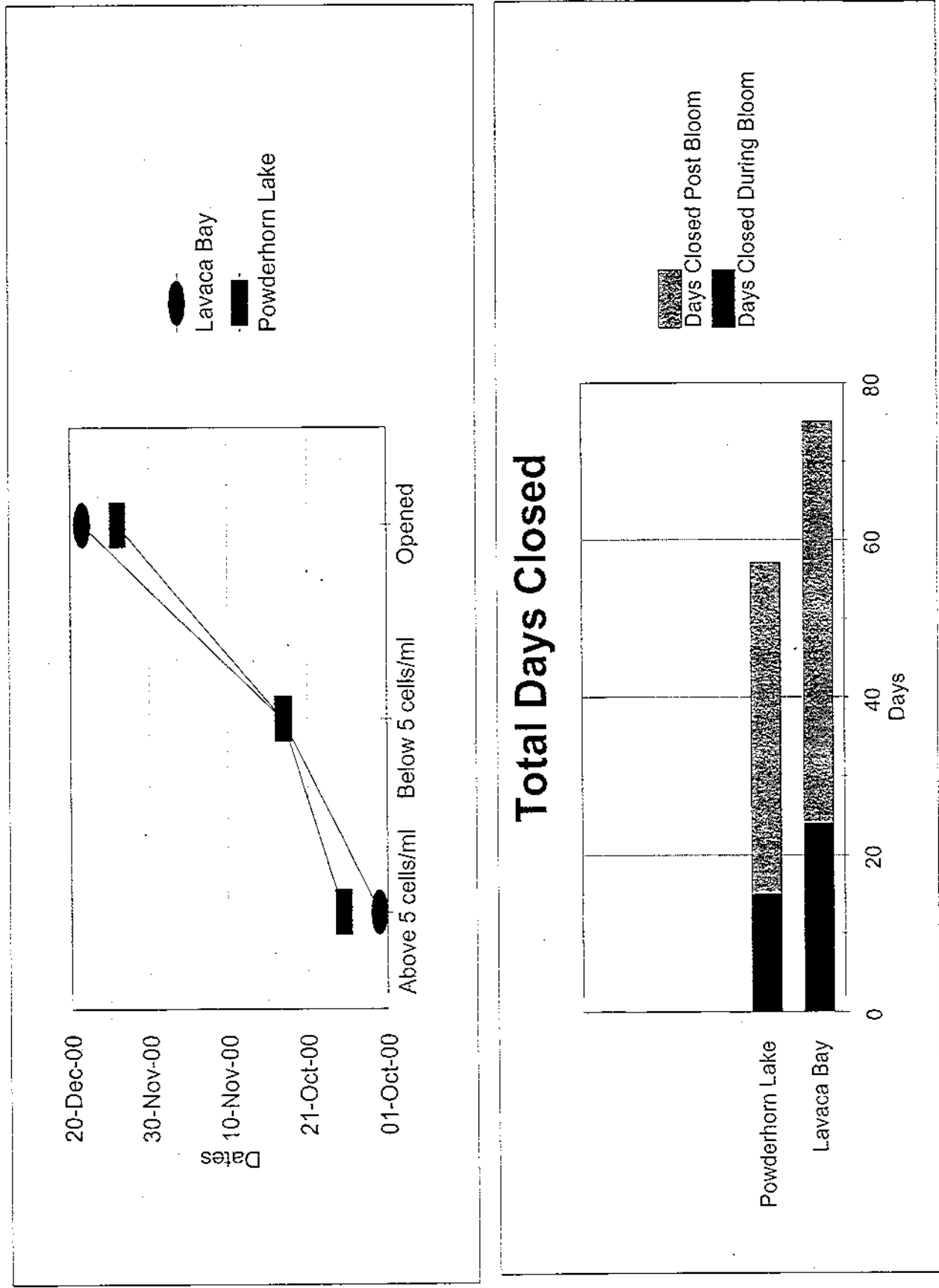


Figure 5. Red Tide Closures for Espiritu Santo, San Antonio and Mesquite Bays.

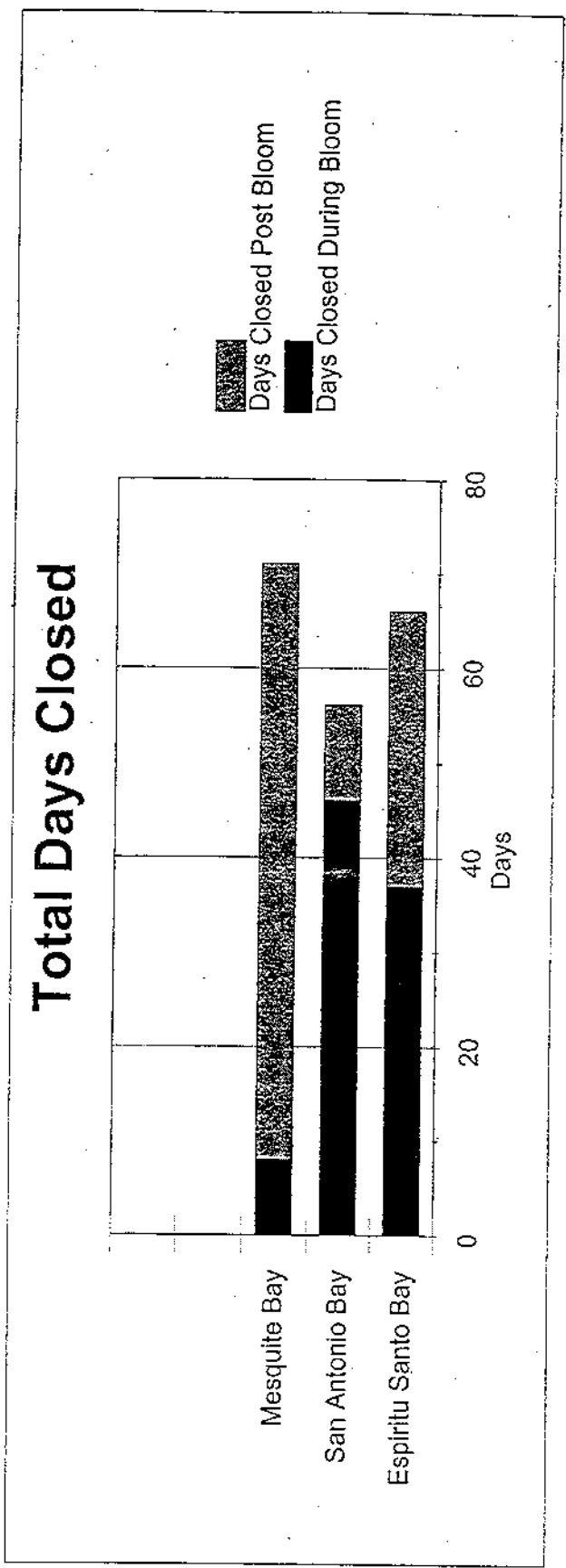
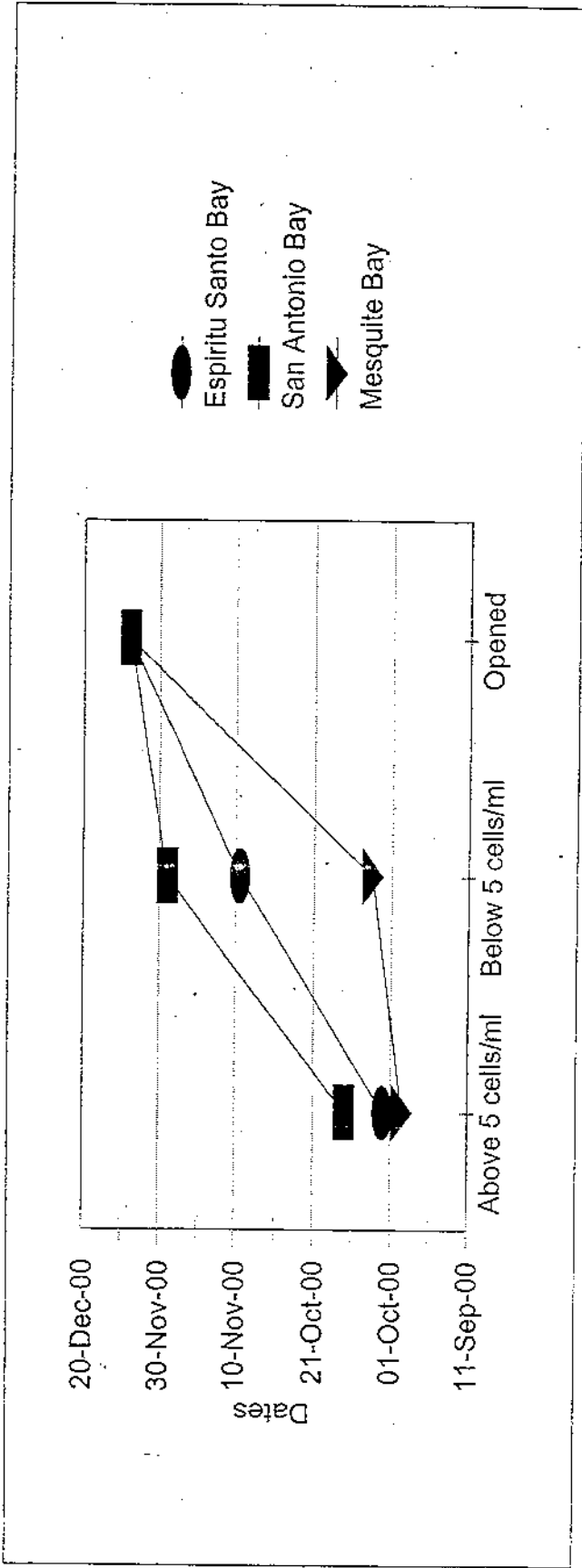
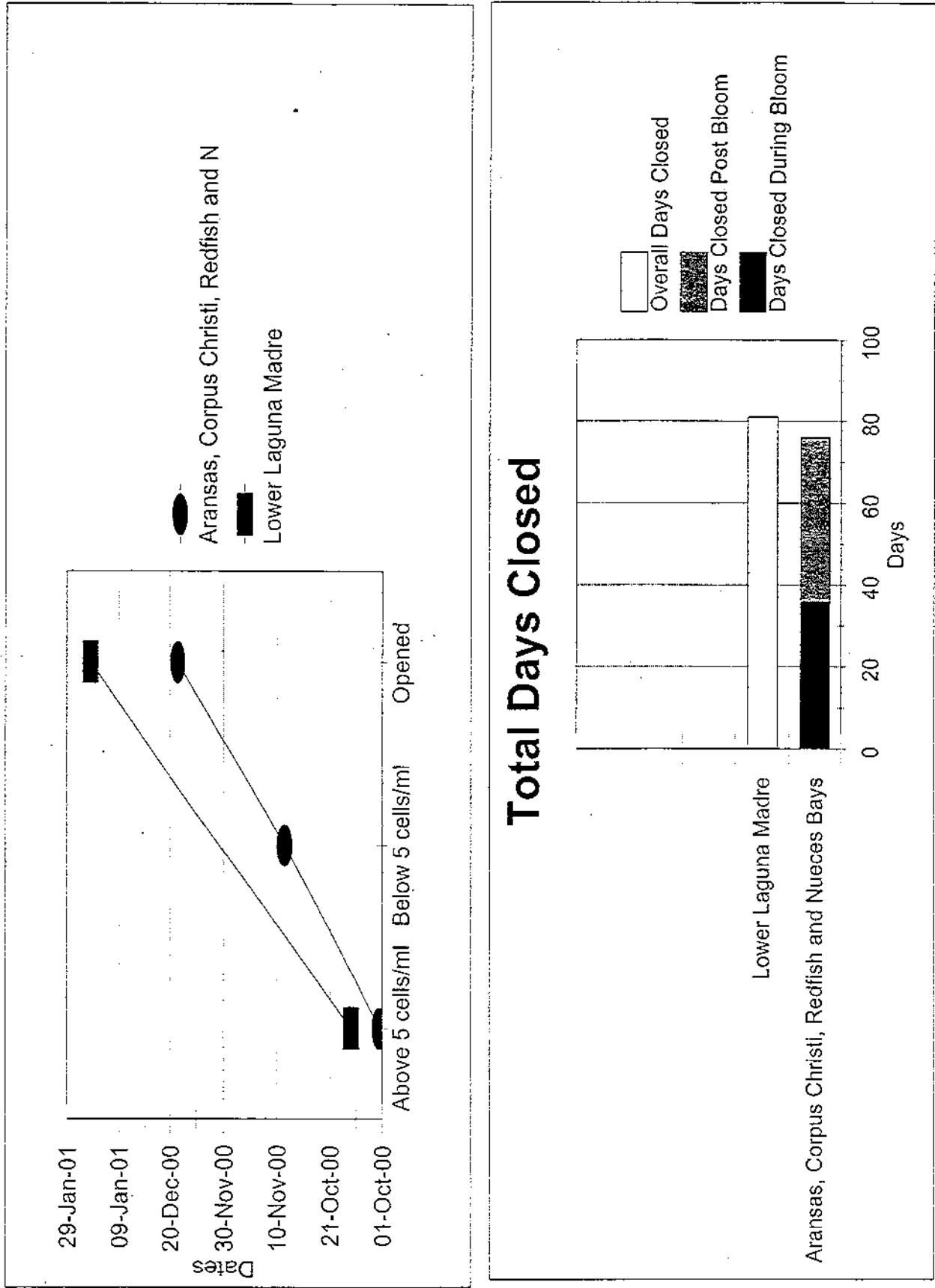


Figure 6. Red Tide Closures for Aransas, Corpus Christi, Redfish, Nueces and South Bays.



# Chronology of the 2000 Red Tide Bloom

Cindy Contreras  
Resource Protection Division  
Texas Parks and Wildlife Department

- 6/28 Dying menhaden and discolored water reported in Brazos Santiago Pass.
- 6/29 Tony Reisinger (Marine Extension Service) counted 49 *Gymnodinium* spp. cells per ml at Brazos Santiago Pass.
- 7/3 Perry Trial with Coastal Fisheries reported a small bloom (100 x 40 sq. ft.) at Brazos Santiago Pass near Isla Blanca Park and the Children's Beach. U.T. Pan American counted 130-140 cells/ml in water samples.
- 7/3 Dead menhaden reported on South Padre Island and respiratory irritation consistent with red tide.
- 8/11 Fishermen reported thousands of dead black drum in the Gulf SSE of Sabine Pass.
- 8/14 TPWD overflight noted discolored water and thousands of dead fish over an 87,000-acre patch of water in the Gulf SSE of Sabine Pass. Greg Fewell of Omega Protein estimated that 50,000 fish were involved. This number was reported in the press.
- 8/16 Jerry Mambretti with Coastal Fisheries reported obtaining a good water sample with the aid of Omega Protein spotter planes. Thousands of dead fish reported up to five miles off Sabine Pass jetties.
- 8/22 *Gymnodinium breve* confirmed in water samples from the mouth of the San Bernard River.
- 8/24 *G. breve* confirmed in the ICWW at Surfside. TPWD staff counted 181 fish in a 2.5-mile stretch of beach.
- 8/25 TDH reported a red tide in Bastrop Bayou at the ICWW.
- 8/28 Continuing reports of fish kill in Gulf SSE of Sabine Pass. Some reports mention sores on the fish. Red drum with fin and tail damage reported caught off the Sabine jetty.
- 8/28 A Mexican official reported discolored water consistent with red tide in the Playa Bagdad, which is east of Matamoros just south of the Texas/Mexico border.
- 8/28 Citizen Jack McCall reported 4-5 dozen bull red drum and some dead speckled seatrout from the jetties in Surfside on the beach for a distance of 5-6 miles south of Surfside.
- 8/28 Dead fish reported in the mouth of the San Bernard River extending two miles out into the Gulf.

8/30 TPWD overflight noted discolored water and/or dead fish at: San Luis Pass to Surfside, Quintana Jetties, Brazos Turning Basin, Old Brazos River, Dow intake canal, mouth of the Brazos River, and mouth of the San Bernard River.

8/30 Citizen John Rogers reported dying fish at Surfside including a lot of large speckled trout.

8/31 TDH confirmed bloom in West Galveston Bay.

8/31 Dead and dying fish and respiratory irritation reported in Ingleside Cove.

8/31 Citizen John Rogers reported dead mullet, trout (22-30 inches long), dogfish, eels, snook (10-12 inches long), and large red drum on the beach for about 2-3 miles south of San Luis Pass. He saw water transparency drop from 25 inches down to 5 inches while fishing. He saw fresh dead fish on Quintana Beach.

9/1 Citizen reports red tide at Surfside.

9/1 Dr. Bill Wardle with TAMU-Galveston reported concentrations of red tide at 225 per ml at Sea Isle, 35 per ml at the Sea Wall, and 275 per ml at Jamaica Beach from samples collected that morning. He saw dead fish at Sea Wolf Park and dying fish on the Texas City Dike.

9/3 TDH confirmed bloom in Galveston Bay.

9/6 Citizen L. Metcalf reported fish floundering about and swimming on their sides from six miles up the San Bernard River. Species observed included croaker, sand trout, and speckled trout. He made his observations after dark while fishing between 10:30 and 11:00 p.m., and thought it was during a low tide. He did not observe any unusual colors or odors.

9/12 Winston Denton with Resource Protection reported 17,000 cells per ml at the Texas City Dike, respiratory problems at Galveston Island State Park beach and visible red tide from the beach at this point east to the Galveston jetties. He saw a visible red tide from the beach at Quintana and a large bloom in East Bay near the Texas City Dike and in Dickinson Bay.

9/13 Fish kill at Sargent Beach. Coastal Fisheries staff estimated 1,595,560 dead fish.

9/13 Dave Buzan with Resource Protection collected water samples and made the following observations. At Galveston Beach at 61<sup>st</sup> Street (1741 hours) there was no red tide aerosol. Two-day old fish on the beach included striped mullet, speckled trout, stargazers, Atlantic spadefish in concentrations of about 50 dead fish per 150 meter of beach. At Galveston Island State Park (1813 hours) park staff reported beachgoers coughing and experiencing eye irritation all day. Dead fish had washed ashore beginning on Monday, 9/11. Fish were numerous and the species included menhaden, hardheads, speckled trout, stargazers, eels, Atlantic croakers, and pigfish. At San Luis Pass, Dave observed dead fish floating in the pass. At San Luis Pass County Park, he saw large numbers of dead fish, primarily Gulf menhaden, with some speckled trout and a few flounder. At San Luis Pass fishing pier, he saw high numbers of dead fish spread across the high tide line. The proprietor stated that dead fish began washing ashore Tuesday morning (9/12) around 0700 hours. Species included red drum, speckled trout, hardheads, mullet, and a few eels. Visitors reported coughing on and off for the past two days. At Gulf beach at Surfside, Dave saw very high numbers of dead fish on the beach. No eye irritation or coughing was noticed at that time. At the Gulf beach at Surfside jetty, surfers reported slight burning of the eyes and



coughing. They said it had been much worse on Saturday, 9/9, but did not see any dead fish that day. A few dead fish were observed on the beach. At Quintana Beach, Dave saw a few dead fish. No coughing or eye irritation was observed. Two beachgoers reported arriving on 9/11 and experiencing slight symptoms on Monday which became worse on Tuesday and diminished on Wednesday.

9/14 TDH confirmed bloom in East Matagorda Bay.

9/17 Wade Graham with TNRCC at Beaumont reported a few fresh dead fish at Crystal Beach. There were a lot of little brown eels. He experienced respiratory discomfort at the beach, and noticed other beachgoers coughing but staying on the beach. His child has asthma but did not have problems on the beach that day. There was a strong current running from east to west and an extremely high tide.

9/18 TDH and TPWD investigation and sampling revealed red tide in areas of Galveston Bay with "hundreds of thousands" of dead fish.

9/18 TDH confirmed bloom in Matagorda Bay.

9/19 Winston Denton reported visibly red water from east and west of San Luis Pass to Surfside. He reported red tide entering West Bay. Dead fish from San Luis Pass to Surfside were almost all menhaden with a red drum every 0.1 mile or so. He saw 23-24 species of fish dead on Crystal Beach.

9/19 Dave Buzan saw few dead fish and no problems with red tide aerosol on Galveston Beach at 2300 hours. Fishermen on the pier at 61<sup>st</sup> Street reported no luck catching fish.

9/20 Dave Buzan saw numerous old dead fish between the Galveston jetties. At Bolivar near the Audubon Sanctuary he saw numerous dead fish including some red snappers, but no fresh dead fish and no aerosol.

9/21 Red tide confirmed in Port O'Connor area.

9/21 Respiratory irritation and 60 dead fish noted on San Jose Island. Three reports of red tide in Cedar Bayou.

9/22 Red tide confirmed in Corpus Christi Bay.

9/22 Dead and dying fish in Port O'Connor back bays.

9/22 TPWD overflight noted discolored water in Corpus Christi Bay, Oso Bay, Port Aransas jetties, off San Jose Island, Mesquite Bay, Ayres Bay, the ICWW near Mesquite Bay, off Matagorda Island, and around Pass Cavallo, and the ICWW at the west end of Matagorda Bay. Dead fish were observed in Cedar Bayou and Pass Cavallo.

9/22 Coastal Fisheries estimated 10,983 dead fish in counts of three areas in the Galveston Bay system.

9/22-23 Big fish kills observed in East Bay near Rollover Pass, also in Dickinson Bay, Texas City, and the San Luis Pass area.

- 9/23 Galveston Beach Patrol reported persistent red tide problems along the Galveston beaches every day for the last two weeks.
- 9/26 Red tide confirmed at UTMSI in Port Aransas. Respiratory irritation noted.
- 9/28 TDH confirmed bloom in Mesquite Bay.
- 10/2 TDH confirmed bloom in Aransas Bay, Copano Bay, Corpus Christi Bay, and Redfish Bay.
- 10/3 TDH confirmed bloom in Powderhorn Lake and Lavaca Bay.
- 10/5 Reports of continuing respiratory irritation from Surfside and the Padre Island National Seashore.
- 10/5 Respiratory irritation reported in Cedar Bayou.
- 10/5 Smiley Nava with Resource Protection reported a dead mullet every couple of hundred feet along the Padre Island National Seashore, but very little respiratory irritation.
- 10/6 Jim Overman with Dow reported dead fish everywhere at Dow.
- 10/6 TDH confirmed bloom in San Antonio Bay.
- 10/6 Dead fish reported on Matagorda Beach.
- 10/6 Respiratory irritation and dying fish reported in Port O'Connor back bays.
- 10/6 Fish kill reported in Espiritu Santo Bay.
- 10/12 Fish kill continues in Port O'Connor back bays.
- 10/12 Dead and dying fish in Brazos Santiago Pass and respiratory irritation noted on South Padre Island.
- 10/12 Discolored water noted off Port Aransas.
- 10/12 Coastal Fisheries estimate 58,217 dead fish on San Jose Island (from a fish kill 5-6 days earlier).
- 10/13 Fish kill and discolored water reported extending from Panther Point in San Antonio Bay to the edge of Espiritu Santo Bay.
- 10/13 Severe respiratory irritation on South Padre Island reported by the public.
- 10/14 Fish kill and respiratory irritation reported on Boca Chica Beach.
- 10/16 TPWD overflight noted red tide in Nueces, Corpus Christi, Mesquite, and San Antonio Bays and in the Gulf off the Padre Island National Seashore. Dead fish observed in Nueces Bay.

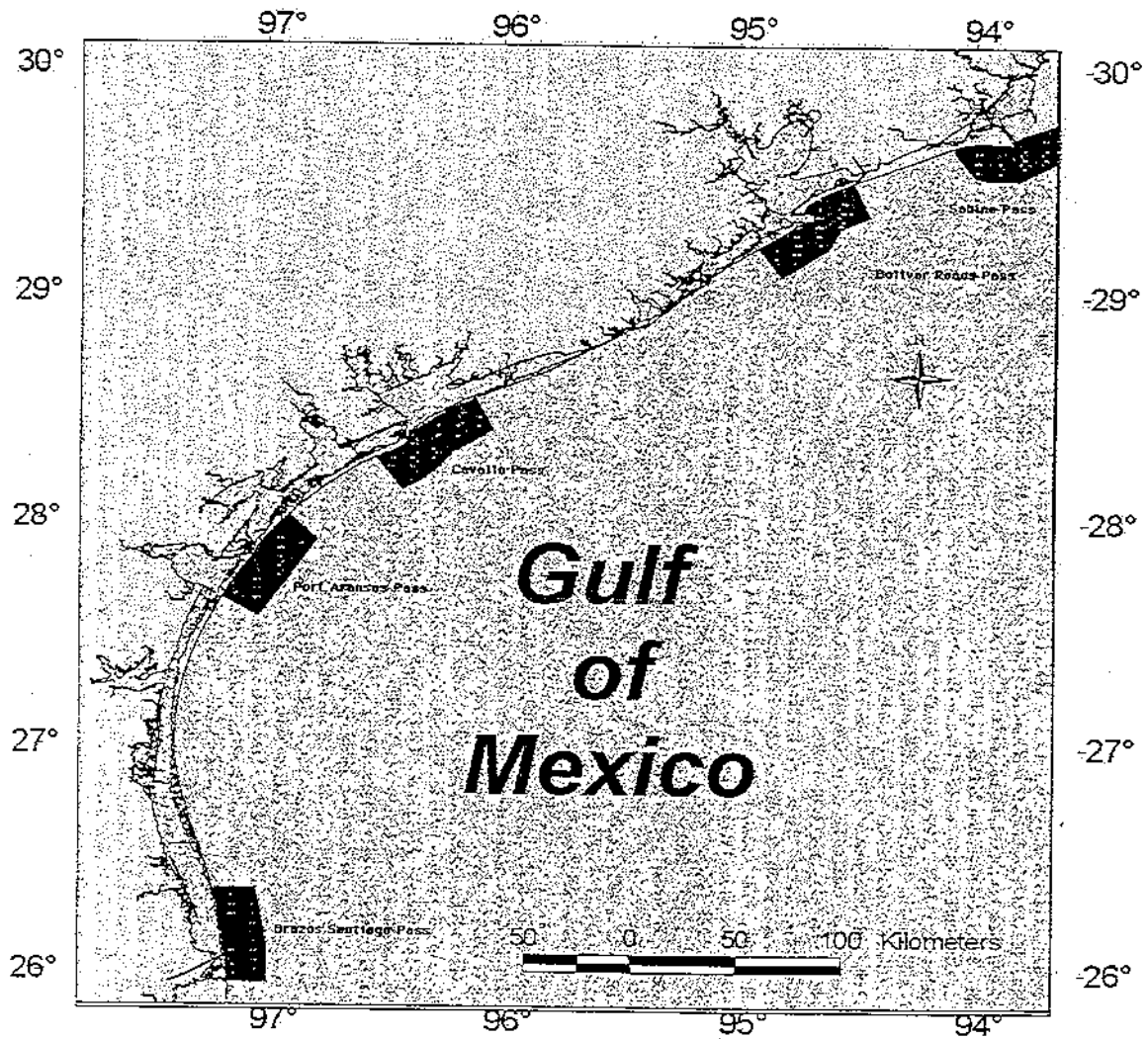
11/07/01

- 10/16 Report from Mexico that an estimated 1.5 tons of fish have died in Matamoros-San Fernando.
- 10/17 TPWD Communications received a call about three dead stingrays and a three-foot hammerhead shark in the Big Pocket area near Port O'Connor.
- 10/19 TPWD overflight noted discolored water in the west end of East Matagorda Bay, along the shore of Lavaca Bay, and in Espiritu Santo and Shoalwater Bays.
- 10/23 National Park Service staff report continuing effects of red tide along the Padre Island National Seashore.
- 10/24 A citizen reported red tide in Rockport Harbor and rumors that red tide was bad in San Antonio Bay.
- 10/25 Respiratory irritation reported at Boca Chica.
- 10/27 Red tide observed in Nueces Bay.
- 11/1 TDH confirmed bloom in Tres Palacios Bay.

**Appendix C. Cell count information from Dr. Tracy Villareal,  
University of Texas Marine Science Institute, Port Aransas, Texas.**

Fig. 1. Sampling sites for red tide monitoring program.

# Gulf Sample Sites



Date	Major area	Grid	chl a avg.	std error	K. breve	K. spp	K. mikimotoi
1/6/00	19	1582	0.100125	0.0025	0	0	0
1/6/00	20	2032	0.51375	0.095	0	0	0
1/10/00	21	3187	0.269125	0.1035	0	0	50
1/11/00	17	3492	1.52375	0.415	0	0	50
1/11/00	18	408	2.0425	0	0	0	0
1/17/00	17	3790	1.38125	0.475	18600	0	600
1/17/00	19	1676	0.27	0	0	0	100
1/17/00	20	2190					
1/25/00	18	650	1.675	0.2	7250	0	1500
1/25/00	20	2144	0.49125	0.085	0	0	0
1/31/00	21	3041	0.45125	0.495	150	0	0
2/6/00	19	1508	1.9225	0	0	0	0
2/7/00	21	3228	0.565	0.01	0	0	0
2/8/00	18	471	0.76125	0.215	50	0	0
2/8/00	20	2202	1.045	0.41	100	0	50
2/9/00	17	131	0.775	0.37	0	0	0
2/16/00	17	211	1.33125	0.375	0	0	50
2/16/00	19	1698	0.24875	0.105	0	0	0
2/22/00	20	2058	0.25375	0.115	0	0	0
2/28/00	21	3042	0.1145	0.204	0	16500	0
3/1/00	18	648	0.48875	0.105	0	0	0
3/1/00	20	2130	0.80875	0.395	0	0	0
3/8/00	19	1572	0.7425	1.01	0	0	0
3/9/00	17	3492	2.6375	0.55	0	0	0
3/9/00	21	3166	0.141	0.006	0	7500	0
3/13/00	18	457	1.08125	0.875	0	0	0
3/20/00	17	3753	3.45	1.2	0	0	0
3/24/00	18	674	3.7875	2.55	0	0	150
3/24/00	20	2118	0.74125	0.735	0	0	0
3/26/00	21	3095					
3/27/00	19	1714	0.74625	0.905	0	0	100
4/5/00	17	175	1.66875	2.345	0	0	0
4/5/00	18	542			0	2500	0
4/13/00	19	1466	0.1515	0.131	0	0	0
4/13/00	20	2083	0.45875	0.015	0	0	0
4/13/00	21	3217	0.4675	0.37	0	0	0
4/16/00	19	1760	0.17175	0.212	0	0	50
4/17/00	20	2188	0.245	0.04	0	0	0

Date	Major area	Grid	chl a avg.	std error	K. breve	K. spp	K. mikimotoi
4/18/00	17	3771	2.8875	1.15	0	0	0
4/18/00	21	3075	0.39375	0.385			
4/19/00	18	636	1.745	0	0	0	0
5/10/00	20	2237	0.2785	0.446	0	0	0
5/11/00	18	385	0.9775	2.01	0	0	0
5/11/00	21	3248	0.1425	0.083	0	0	0
5/16/00	17	99	3.525	0.1	0	0	0
5/16/00	19	1615	0.52125	0.835	0	0	50
5/16/00	21	3062	0.52625	0.375	150	0	50
5/21/00	19	1717	0.21	0.16	0	0	0
5/21/00	20	2046	0.273125	0.2075	0	0	0
5/22/00	17	211	9.25	9.2	0	0	0
5/22/00	18	711	0.545	0	0	0	0
6/1/00	17	206	1.74125	0.965	0	0	0
6/3/00	21	N/A					
6/6/00	20	2070	0.3975	0.04	0	0	0
6/13/00	18	436	2.31	2.36	0	200	0
6/13/00	19	1534	1.5625	0	0	0	0
6/13/00	21	3257	0.16	0.045	0	0	500
6/22/00	17	3491	1.77	0.92	0	0	0
6/26/00	21	3156	0.24175	0.083	0	0	0
6/27/00	19	1801	0.335	0.2	0	0	0
6/27/00	20	2131	0.078875	0.0935	0	0	0
6/29/00	21						
7/3/00	21	3119					
7/5/00	18	458	0.995	1.25	0	0	0
7/5/00	19	1583	0.18975	0.116	0	0	0
7/5/00	20	2055	0.265625	0.0675	0	0	0
7/5/00	21	3228	0.2095	0.071			
7/6/00	17	210	2.22375	0.845	0	0	0
7/10/00	21	2981					
7/17/00	17	212	2.0625	1.19			
7/17/00	18	692	0.5775	0.77	50	0	0
7/17/00	20	2155	0.1525	0.119	50	50	0
7/18/00	19	1782	0.12475	0.242	0	0	0
7/18/00	21	3085	0.106625	0.063	0	0	0
8/1/00	18	384					
8/2/00	20	2192	0.154	0.002			
8/3/00	17	172	1.1325	1.31			

Date	Major area	Grid	chl a avg.	std error	K. breve	K. spp	K. mikimotoi
8/4/00	21	3187	?	0.125	0	0	0
8/12/00	19	1552	0.33625	0.155	130	190	30
8/16/00	17	3731	4.925	0	138000	60000	0
8/16/00	17	3768					
8/16/00	19	1659	1.43	1.26	2000	740	0
8/21/00	18	693					
8/23/00	20	2102			0	40	0
8/28/00	21	3125	?	0.0155	0	0	0
9/5/00	18	670	0.39875	0.25			
9/5/00	20	2180	?	0.017	0	140	0
9/6/00	21	3197	0.183	0.338	0	0	0
9/9/00	19	1535	?	0.88	1120	140	0
9/11/00	17	3766	?	2.2	252000	0	0
9/11/00	17	3783	?	?	116000	0	0
9/18/00	17	N/A			373000	0	0
9/18/00	17	77			2000	0	0
9/18/00	17	175	?	3.716982143	250000	0	0
9/19/00	19	1801			100	100	0
9/27/00	18	468			8000	3000	0
9/27/00	18	468			5740	60	0
9/27/00	20	2045	?	0.17	4640	600	0
9/28/00	21	3094	?	?	0	80	0
10/2/00	19	1554	?	?	169760	5360	0
10/4/00	17	3491	?	?	0	40	0
10/12/00	18	411	?	?	0	0	0
10/13/00	20	2033	?	?	20040	4740	0
10/13/00	21	3188					
10/13/00	21	3247	?	?			
10/16/00	18	649	?	?			
10/16/00	21	3146	?	?	27000	32000	0
10/17/00	17	3779	?	?	0	120	0
10/18/00	19	1762	?	?	0	0	0
10/19/00	20	2226	?	?	0	10	0
11/10/00	17	107			0	0	0
11/10/00	19	1569	?	?	0	0	0
11/11/00	20	2179	?	?	0	40	0
11/15/00	18	328					