

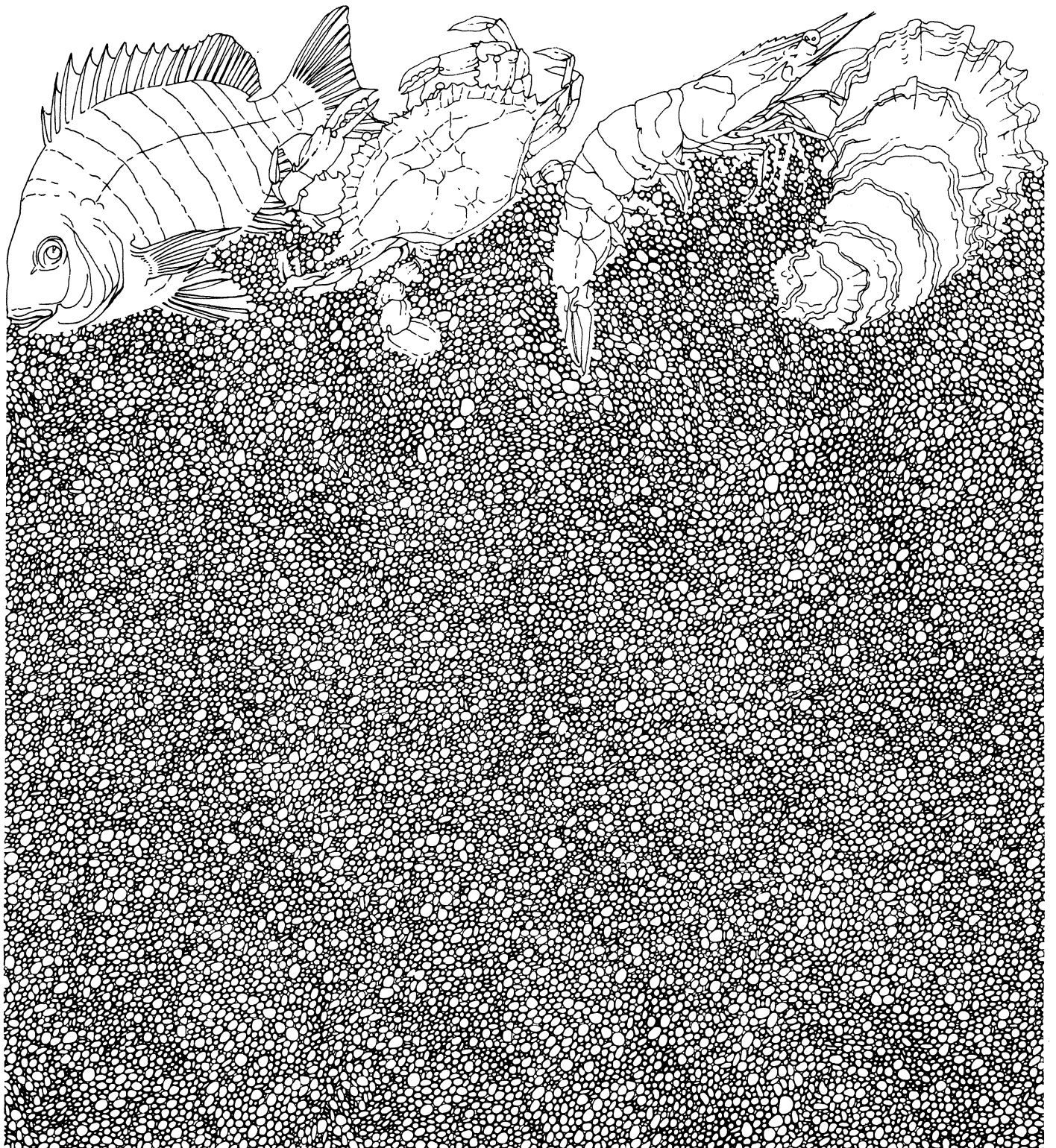
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# Trends in the Galveston Bay Oyster Fishery, 1979-1984

by: R.P. Hofstetter

Management Data Series Number 125  
1988

Texas Parks and Wildlife Department  
Coastal Fisheries Branch



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## ABSTRACT

Spring floods of the Trinity River destroyed Eastern oyster (Crassostrea virginica) populations on 217 ha of Trinity Bay reefs and damaged populations on an additional 100-120 ha in 1979. Heavy rainfall from summer tropical storms in 1979 caused further flooding that inhibited spawning and slowed oyster growth. The 1979-80 season was delayed 45 days by the Texas Parks and Wildlife Commission (TPWC) to allow oysters to increase in size and to improve in condition. Substantial spat set during 1980 was enhanced by the planting of oyster shell over 313 ha of public reefs in central Galveston Bay. The 1980 year class dominated the population structure through 1983 and provided a record oyster harvest (~2.7 million kg) during the 1982-83 season. Poor spat set in both 1982 and 1983 resulted in decreased market oyster abundance. Fishing pressure remained high during the 1983-84 season and market oyster abundance dropped to such a low level the TPWC closed the season 30 days early on 30 March 1984. A moderate spat set in 1984 indicated that market oyster abundance should increase in later years.

## INTRODUCTION

About 70% of the 1977-1984 Texas mean annual Eastern oyster (*Crassostrea virginica*) meat landings (3.1 million kg worth \$4.1 million) was harvested from the Galveston Bay system (Osburn et al. 1985). Forty-seven private oyster leases (1012 ha) produced over 306,000 kg (worth \$1.1 million) of these landings.

The oyster fishery is regulated by season, size limit, gear and cargo restrictions. The normal fishing season is from 1 November through 30 April. The Texas Parks and Wildlife Commission (TPWC) has the authority to close an area to the taking of oysters if the area is being overworked or damaged (State of Texas 1985). The Texas Parks and Wildlife Department (TPWD) has monitored population abundance and size of oysters on selected reefs in the Galveston Bay system since the early 1950's (Hofstetter 1977). These studies have been used to determine the status of oyster populations and to recommend closures.

The objectives of this study were to:

- 1) Monitor the population structure and size of oysters on selected public reefs in Trinity, Galveston, East and West Bays during January 1979-September 1984 and,
- 2) Monitor the number of commercial oyster boats.

## MATERIALS AND METHODS

Fixed oyster sample sites were established on public oyster reefs in the Galveston Bay system. Sites were sampled quarterly but the number varied among years: 33 during both 1979 and 1980, 34 during 1981, 35 during 1982, 38 during 1983 and 41 during 1984. These sites were grouped by area: Central, East Bay, Trinity Bay, West Shore and West Bay (Figures 1 and 2; Table 1). Oyster samples were collected with an eight-tooth Louisiana style oyster dredge (45 cm wide; 25 cm high) with a capacity of approximately 35 liters (1 standard bushel). The dredge was pulled across each reef site as many times as required to fill a 35-liter box with uncultured oysters and shell. All live oysters were measured (nearest mm) with dividers along the antero-posterior axis of the right valve. Oysters were grouped into: spat ( $\leq 25$  mm), small oysters (26-75 mm) and market oysters ( $\geq 76$  mm). Individual area means for each group were obtained by dividing the total number of oysters in each group by the number of sites within each bay area.

Pre-season oyster samples were collected at 10 central bay sites (Redfish Bar) during September or October each year and at several other stations during 1981-1984 with the same dredge used in quarterly sampling. The dredge was pulled five times for 1 minute each at each site. Market oysters were culled, counted and the mean

no./5 minute drag was obtained by dividing the total number caught by the number of sites sampled.

Three sites in the central bay area (Todd's Dump, North Redfish Reef and Bart's Pass) have been monitored since 1956. Oyster data from these sites were averaged to obtain quarterly and annual mean numbers of spat, small and market oysters.

Oyster boats dredging on public reefs (except in West Bay) were counted periodically throughout each oyster season. Texas boats were distinguished from out-of-state boats when possible. The total number of Texas and out-of-state boats observed each month was divided by the number of observations to obtain a monthly mean.

Bottom water samples were collected at each site. Salinity was determined (nearest o/oo) using a refractometer (Appendix A) and temperature (nearest C) was determined with a mercury thermometer (Appendix B).

## RESULTS

### Oyster Relative Abundance, 1979-1984.

During 1979, Trinity River flooding (8.9 billion m<sup>3</sup> discharged from Livingston Reservoir) caused 100% mortality among oysters on 217 ha of oyster reefs and partial mortality on 100-120 ha of additional reefs (Hofstetter 1981). Heavy local rainfall associated with tropical storms caused severe flooding on the west side of Galveston Bay and most tributaries entering West Bay during July and September (Benefield and Baker 1980). Low spring and summer salinities (Appendix A) inhibited spat setting throughout the bay. Summer 1979 sets averaged 10-50 spat/35 liters (Table 2). Small oysters from an excellent 1978 spat set (Hofstetter 1983) were abundant at Central and West Shore stations, averaging 131-201 oysters/35 liters. Small oyster abundance did not increase in East Bay or Trinity Bay even though the 1978 set had ranged upwards to 95 and 247 spat/35 liters, respectively. Market oysters increased in fall samples (averaging 15-50 oysters/35 liters) except in Trinity Bay where losses had occurred at upper bay stations because of the Trinity River flooding.

During summer and fall 1980 a substantial spat set, averaging 164-263 spat/35 liters, was found in all areas (Table 2). Small oysters had also increased in fall samples, averaging 200-292 oysters/35 liters. Sample abundance of small oysters in Trinity Bay and East Bay equalled that of other areas. Market oysters were most abundant in Central summer samples (48/35 liters) and West Shore winter samples (64/35 liters) as the 1978 year class was recruited. Numbers also increased in East Bay and Trinity Bay samples, averaging 18-20 market oysters/35 liters.

The 1981 set averaged 64-120 spat/35 liters with peak setting noted during spring (Table 2). Small oysters, recruited from the 1980 year class, were abundant everywhere, averaging 130-346/35 liters. However, sample abundance decreased in Trinity Bay after a spring mean of 223 oysters/35 liters was recorded. Market oyster abundance ranged from a low of 18/35 liters in East Bay summer samples to a high of 63/35 liters in West Shore winter samples.

During summer and fall 1982, light sets averaging 10-37 spat/35 liters were found (Table 2). Small oysters were most abundant in winter samples, averaging 140-283 oysters/35 liters. Market oysters increased in all areas from the 1980 year class, and averaged 44-87 oyster/35 liters in fall samples.

The 1983 set averaged 10-81 spat/35 liters in summer samples (Table 2). Small sets were noted at Trinity Bay and West Shore stations. Most spat (584) were collected in July at Carancahua Reef in West Bay (Appendix C). Increased spat set was found at some stations on Redfish Bar after Hurricane Alicia came ashore near San Luis Pass on 18 August 1983 (Appendix C). No damage to oyster populations was detected after hurricane passage. Small oysters decreased in abundance, averaging 55-78/35 liters in fall samples, except in Trinity Bay where the mean was 91 oysters/35 liters. Market oyster populations declined in Central and West Shore samples by fall but changed little in Trinity Bay, averaging 33-36 oysters/35 liters. Although some oysters near shore were killed during a freeze in late December 1983, oysters in deeper waters did not appear to be affected.

Spat set during 1984 averaged 44-233 spat/35 liters in summer samples (Table 2). The distribution was uneven; Central stations west of the Houston Ship Channel received relatively light sets (39-80 spat/35 liters) while moderate to heavy sets (168-246 spat/35 liters) were noted on reefs off Smith Point (Appendix C). Bayview and Dollar Reefs along the west shore received very light sets (2-3 spat/35 liters). The heaviest set (456 spat/35 liters) was found at Dry Hole Reef in Trinity Bay (Appendix C). Market oysters became less abundant, averaging 24-31/35 liters in Central, East Bay and Trinity Bay samples during the three quarters sampled. In West Bay, the number of market oysters in three summer samples ranged from 11 to 46 (Appendix B). West shore samples contained the most market oysters, averaging 43-74/35 liters (Table 2).

#### Oyster Population Trends, 1956-1984

There was a general decline in spat and small oysters from 1956 to a low point from 1973 through 1977 (Figure 3; Table 3). After 3 years (1975-1977) of very poor recruitment the 1978 spat set approached that of 1971. In 1980 and 1981 the spat set was the heaviest since 1967. Small oyster abundance, resulting from increased spat set which began in 1978, reached a record high in 1981 and remained high through 1982. Market oysters became most abundant

in 1982 and market oyster populations remained high through 1983. By 1984 market oysters became less abundant, but did not decrease to the low level recorded in 1978.

Although the mean annual spat sets recorded during 1979-1984 did not equal those found during the late 1950's, small oyster abundance was similar to that observed during 1956-1964 (Figure 4; Table 3) and reached record levels during 1981 and 1982. As these oysters were recruited, market oyster abundance increased, reaching a record high during fall 1982 (Figure 5; Table 3). The mean annual number of market oysters in 1982 was the highest ever recorded followed by the second highest number in 1983.

#### Pre-season Abundance of Market Oysters, 1976-1984

The pre-season abundance (no./5 minute drag) of market oysters collected at Redfish Bar sites fell from an average of 127/drag in 1976 to a low of 24/drag in 1978 (Table 4). By 1979 the number of market oysters increased to 61/drag and abundance continued to increase to a record high of 190/drag in 1982. East Bay samples averaged 234/drag while Trinity Bay samples averaged 109/drag. Abundance dropped sharply in 1983, ranging from 62/drag in Trinity Bay to 82/drag in East Bay and 91/drag at Redfish Bar. West Bay samples contained the largest number, averaging 108/drag. By 1984 the average number had dropped to 51/drag at Redfish Bar and 21/drag in West Bay.

#### Trends in Fishing Pressure, 1979-1984

Because market oysters were scarce, the TPWC closed Galveston Bay to oystering effective 15 December 1978. The opening of the 1979-1980 season was delayed until 15 December 1979 to allow more spat to reach cullable size (>19 mm) and to allow market oysters, which were in poor condition due to local flooding, to improve in quality. Fishing pressure was light, ranging from 15 to 28 boats/day with few (4-9) out-of-state boats participating (Figure 6; Table 5). During the 1980-1981 season the number of out-of-state boats averaged 14-34/day and Texas boats averaged 13-34/day. Few out-of-state boats returned during the 1981-1982 season (1-3/day) but the number of Texas boats increased to 36-68/day. More boats were observed working in February 1982 than in any other month. The number of Texas boats continued to increase during the 1982-1983 season, averaging 72-109/day. Out-of-state boats were scarce (3-6/day). At the beginning of the 1983-1984 season out-of-state boats were common, averaging 23/day during November, but the number dropped to 6-14/day, thereafter. Texas boats averaged 47-85/day with the highest number observed in February.

To prevent oysters from reaching the low levels experienced in 1978, the TPWC requested that the Galveston Bay system be closed to oystering when the mean number of market oysters dropped to 30 in

timed samples across Redfish Bar. This level was reached in March and the bay was closed 30 March 1984.

#### DISCUSSION

During summer and early fall 1979, oysters were in poor condition due to low salinity caused by spring and summer flooding. Oyster growth was slowed. By October 1979 the modal size of oysters in central Galveston Bay was 58 mm and 16% of the population was of legal, harvestable size (76 mm). The TPWC delayed the opening of the 1979-1980 harvest season until 15 December 1979 to allow time for oysters to increase in size and improve in condition. By delaying the season for 45 days, more (22%) of the oysters reached legal size in improved condition and the percentage of oysters under legal culling size decreased from 8% in October to 2% in December.

Spreading of oyster shell across 313 ha of public oyster reefs in central Galveston Bay during June-July 1980 enhanced the spat set in that area (Hofstetter 1981). Plantings had originally been scheduled for summer 1979 but were postponed due to low salinity. If plantings had been made, the resulting spat set, based upon sets observed at central bay stations, would have been only 13% of that observed during summer 1980.

Abundant setting and excellent survival of the 1980 year class throughout Galveston Bay led to a record harvest of 2.7 million kg of oyster meats during the 1982-1983 season. This was accomplished with a higher than normal number of oyster boats working reefs in Trinity, East, West and Bastrop Bays as well as central Galveston Bay. The number of oyster boats remained high during the 1983-1984 season even though the quantity of market oysters decreased.

It is probable that fishing pressure on public reefs in the Galveston Bay system will continue to be high in future seasons. Monitoring of oyster populations throughout the bay system will be necessary to insure that populations remain healthy. In October 1984 a new sampling program was initiated to provide more frequent and broader coverage of the Galveston Bay system (Benefield et al. 1986).



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Table 1. Oyster sampling sites in the Galveston Bay system during 1979-1984.  
 Q = stations sampled quarterly. T = pre-season timed samples.

Area site	Latitude	Longitude	No. samples/year											
			1979		1980		1981		1982		1983		1984 <sup>a</sup>	
			Q	T	Q	T	Q	T	Q	T	Q	T	Q	T
<b>Central</b>														
1. Beacon 63	29-32-45	94-54-45	4	0	4	0	4	0	4	0	4	0	3	0
2. Beacon 59	29-31-40	94-53-55	4	0	4	0	4	0	4	0	4	0	3	0
3. Eagle Point	29-30-40	95-54-40	4	1	4	1	4	1	4	1	4	1	3	1
4. Todd's Dump	29-30-15	94-53-10	4	1	4	1	4	1	4	1	4	1	3	1
5. Switchover	29-30-40	94-53-05	4	1	4	1	4	1	4	1	4	1	3	1
6. Experimental	29-29-30	94-53-10	4	1	4	1	4	1	4	1	4	1	3	1
7. North Redfish	20-30-10	94-51-35	4	1	4	1	4	1	4	1	4	1	3	1
8. South Redfish	29-29-30	94-51-05	4	1	4	1	4	1	4	1	4	1	3	1
9. Central Redfish	29-29-45	94-49-50	4	1	4	1	4	1	4	1	4	1	3	1
10. East Redfish	29-30-35	94-49-15	4	1	4	1	4	1	4	1	4	1	3	1
11. Bart's Pass	29-31-55	94-49-30	4	1	4	1	4	1	4	1	4	1	3	1
12. Gaspice	29-31-20	94-47-30	4	1	4	1	4	1	4	1	4	1	3	1
<b>East Bay</b>														
13. Catfish	29-30-45	94-44-55	0	0	0	0	0	0	0	0	4	0	3	0
14. Moody	29-32-05	94-39-55	4	0	4	0	4	0	4	0	4	0	3	0
15. Cowshed	29-32-20	94-38-20	0	0	0	0	0	0	0	0	4	0	3	0
16. Frenchy	29-31-25	94-36-15	4	0	4	0	4	0	4	0	4	0	3	0
17. Hanna	29-28-50	94-42-50	0	0	0	0	0	0	4	1	4	0	3	0
18. Deep Hanna	29-29-40	94-43-55	4	0	4	0	4	1	4	1	4	0	3	0
19. Bull Hill	29-28-45	94-44-35	4	0	4	0	4	1	4	1	4	0	3	0
<b>Trinity Bay</b>														
20. Dow	29-38-45	94-54-20	4	0	4	0	4	0	4	0	4	0	3	0
21. Beezley	20-39-20	94-52-45	4	0	4	0	4	0	4	0	4	0	3	0
22. Vingtone	29-33-40	94-46-55	4	0	4	0	4	0	4	0	4	0	3	0
23. Spoonbill	29-33-15	94-47-36	4	0	4	0	4	0	4	0	4	0	3	0
24. Lonesome	29-35-35	94-48-55	4	0	4	0	4	0	4	0	4	0	3	0
25. Tern	29-36-25	94-51-00	4	0	4	0	4	0	4	0	4	1	3	0
26. Dry Hole	29-35-55	94-51-35	4	0	4	0	4	0	4	1	4	1	3	0
27. Lost	29-36-40	94-52-30	4	0	4	0	4	0	4	1	4	1	3	0
<b>West Shore</b>														
28. Morgan's Point	29-40-05	94-58-45	0	0	0	0	0	0	0	0	0	0	2	0
29. Yacht Club	29-37-10	94-59-35	4	0	4	0	4	0	4	0	4	0	3	0
30. Red Bluff	29-36-30	94-58-20	4	0	4	0	4	0	4	0	4	0	3	0
31. Bent Pipe	29-35-50	94-58-25	4	0	4	0	4	0	4	0	4	0	3	0
32. Scott	20-34-35	94-59-30	4	0	4	0	4	0	4	0	4	0	3	0
33. Bayview	29-31-30	94-59-15	0	0	0	0	2	0	4	0	4	0	3	0
34. San Leon	29-30-30	94-56-35	4	0	4	0	4	0	4	0	4	0	3	0
35. April Fool	29-28-50	94-54-55	4	0	4	0	4	0	4	0	4	0	3	0
36. Dickinson	29-27-50	94-55-25	4	0	4	0	4	0	4	0	4	0	3	0
37. Levee	29-26-25	94-53-55	4	0	4	0	4	0	4	0	4	0	3	0
38. Dollar	29-26-20	94-52-50	4	0	4	0	4	0	4	0	4	0	3	0
<b>West Bay</b>														
39. Confederate	29-15-40	94-56-35	0	0	0	0	0	0	0	0	0	0	1	1
40. Green's Cut	29-15-15	94-58-55	0	0	0	0	0	0	0	0	0	0	1	1
41. Carancahua	29-13-05	95-00-30	0	0	0	0	0	0	0	0	2	0	2	1

<sup>a</sup>Quarterly sampling discontinued October 1984

Table 2. Mean number of spat (Sp), small (Sm) oysters and market (Mkt) oysters in 35 1 oyster dredge samples collected quarterly, by area, during January 1979-September 1984.

Year	Quarter	Central			East Bay			Trinity Bay			West Shore			Mean		
		Sp	Sm	Mkt	Sp	Sm	Mkt	Sp	Sm	Mkt	Sp	Sm	Mkt	Sp	Sm	Mkt
1979	Jan-Mar	25	201	20	28	92	13	6	53	23	27	184	37	21	147	24
	Apr-Jun	5	163	22	6	51	10	2	46	27	9	157	34	6	120	25
	Jul-Sep	22	142	30	19	25	8	50	16	1	10	150	50	24	99	26
	Oct-Dec	8	150	40	5	52	15	9	50	1	7	131	50	8	109	30
1980	Jan-Mar	5	125	45	4	41	16	10	61	2	3	112	52	5	96	33
	Apr-Jun	1	103	41	3	33	12	2	59	2	1	71	57	2	75	32
	Jul-Sep	164	130	48	263	59	16	219	81	3	167	151	59	190	115	36
	Oct-Dec	164	273	40	129	200	20	73	266	18	144	292	64	132	270	40
1981	Jan-Mar	90	286	40	83	201	26	26	220	22	80	288	63	71	262	40
	Apr-Jun	97	307	31	66	280	19	97	223	26	120	266	49	100	275	34
	Jul-Sep	104	297	24	64	232	18	24	130	23	58	246	42	67	241	28
	Oct-Dec.	39	346	39	19	230	28	20	178	31	18	265	40	26	269	36
1982	Jan-Mar	15	283	49	9	200	62	8	140	33	13	231	55	12	224	49
	Apr-Jun	5	205	55	3	156	50	4	131	34	2	139	62	4	162	52
	Jul-Sep	31	158	66	12	107	54	10	58	24	17	124	64	20	118	54
	Oct-Dec	31	133	85	19	72	87	27	86	44	37	110	75	30	107	73
1983	Jan-Mar	10	94	65	8	89	56	11	66	35	12	98	92	10	88	64
	Apr-Jun	8	78	60	5	56	45	9	65	33	11	72	93	8	70	60
	Jul-Sep	81	70	54	53	53	73	14	72	34	10	68	79	42	66	58
	Oct-Dec	19	78	34	6	55	59	15	91	36	10	62	71	13	72	49
1984	Jan-Mar	8	81	31	2	46	30	7	70	25	4	51	74	6	64	41
	Apr-Jun	5	90	26	2	48	30	2	77	27	4	63	61	3	72	37
	Jul-Sep	119	137	24	234	89	28	185	140	28	44	124	43	132	125	31

Table 3. Mean number of oyster spat (Sp), small (SM) oysters and market (Mkt) oysters in 35 1 oyster dredge samples collected quarterly at three Redfish Bar sites in central Galveston Bay during 1956-1984. ND = no data.

Year	Jan-Mar			Apr-Jun			Jul-Sep			Oct-Dec			Annual mean		
	Sp	Sm	Mkt	Sp	Sm	Mkt	Sp	Sm	Mkt	Sp	Sm	Mkt	Sp	Sm	Mkt
1956	ND	ND	ND	12	77	41	162	212	36	108	257	34	94	182	37
1957	44	160	25	24	164	33	122	193	20	730	111	14	230	157	23
1958	646	203	24	212	223	29	76	229	24	42	334	22	244	247	25
1959	20	324	32	79	311	18	60	163	26	12	122	26	42	230	25
1960	8	113	37	44	94	46	579	223	48	135	244	37	191	168	42
1961	4	150	42	42	165	34	514	191	32	94	201	37	164	177	36
1962	14	126	27	55	137	23	159	208	40	105	332	55	83	201	36
1963	26	232	47	89	230	42	112	210	52	36	159	57	66	208	50
1964	15	113	48	58	69	42	126	122	38	35	135	37	58	109	41
1965	14	131	36	46	88	37	129	100	32	41	120	39	58	110	36
1966	1	76	32	3	76	28	20	65	34	65	83	30	22	75	31
1967	23	110	23	442	90	24	141	221	33	13	161	37	155	146	29
1968	6	141	32	2	114	27	45	64	17	17	107	27	18	107	26
1969	5	105	26	3	81	25	82	100	25	26	123	29	29	102	26
1970	12	141	24	9	111	30	114	93	36	22	85	46	39	108	34
1971	9	105	39	107	83	41	122	218	43	17	274	35	64	170	40
1972	13	206	30	8	147	33	19	130	54	9	72	49	12	139	42
1973	3	58	45	3	48	30	4	32	20	38	42	30	12	45	31
1974	ND	ND	ND	2	50	14	68	76	25	52	87	21	41	71	20
1975	2	84	24	2	48	13	ND	ND	ND	9	54	38	5	62	25
1976	1	29	28	12	20	37	8	26	44	15	26	41	9	25	38
1977	3	21	28	1	28	28	2	17	25	6	14	25	3	20	26
1978	3	15	20	81	17	11	103	31	12	34	110	20	55	43	16
1979	25	114	16	6	121	22	11	75	35	6	126	40	12	109	28
1980	4	112	29	1	97	40	160	115	45	161	260	31	82	146	36
1981	89	261	34	86	325	26	106	276	19	24	312	41	76	294	30
1982	9	242	44	2	179	47	29	142	82	32	109	100	18	168	68
1983	7	98	66	4	76	64	89	74	55	14	102	32	28	88	54
1984	6	68	25	1	58	22	147	140	28	ND	ND	ND	51	89	25

Table 4. Mean number of market oysters collected with a 35 l oyster dredge in September-November timed samples (five 1-minute drags) on select reef areas during 1976-1984. ND = no data.

Year	Trinity Bay	Redfish Bar	East Bay	West Bay
1976	ND	127	ND	ND
1977	ND	81	ND	ND
1978	ND	24	ND	ND
1979	ND	61	ND	ND
1980	ND	82	ND	ND
1981	133	103	42	ND
1982	109	190	234	ND
1983	69	91	82	108
1984	ND	51	ND	21

Table 5. Mean number/day of Texas (Tex) and Out-of-State (OS) oyster boats observed dredging on public reefs in Galveston Bay (excluding West Bay) during each month of the 1962-1963 through the 1983-1984 oyster seasons (Nov-Apr). ND = no data.

Season	November		December		January		February		March		April			
	Tex	OS	Tex	OS	Tex	OS	Tex	OS	Tex	OS	Tex	OS		
1962-63 <sup>a</sup>	ND	15	ND	18	ND	20	ND	38	ND	ND	32	Closed		
1963-64 <sup>a</sup>	ND	61	ND	6	ND	87	ND	99	ND	ND	37	Closed		
1964-65 <sup>a</sup>	ND	47	ND	60	ND	74	ND	53	ND	ND	47	Closed		
1965-66 <sup>a</sup>	37	41	66	41	76	41	41	47	54	12	66	Closed		
1966-67	21	59	33	59	41	53	33	17	34	17	51	22	15	37
1967-68	25	37	32	42	35	21	52	25	34	25	59	20	15	35
1968-69	12	48	32	39	27	32	32	32	20	13	33	ND	ND	ND
1969-70	24	54	21	54	36	45	24	29	23	20	43	7	9	16
1970-71	23	85	43	62	38	34	30	32	35	35	70	19	13	32
1971-72	40	23	55	30	44	20	ND	ND	ND	ND	ND	ND	ND	ND
1972-73	39	30	21	32	59	20	20	18	ND	ND	ND	ND	ND	ND
1973-74	15	52	12	20	ND	ND	ND	ND	11	3	14	ND	ND	ND
1974-75	16	9	23	8	18	12	ND	ND	12	6	8	ND	ND	ND
1975-76	21	9	22	7	ND	ND	27	0	36	1	37	20	4	24
1976-77	43	28	74	19	33	7	36	8	18	6	24	11	9	20
1977-78 <sup>b</sup>	21	9	45	11	43	6	13	6	22	6	28	10	4	14
1978-79 <sup>b</sup>	7	3	4	0	Closed		Closed		Closed			Closed		
1979-80 <sup>c</sup>	Closed		23	4	19	9	16	7	11	9	20	10	5	15
1980-81	21	33	34	34	26	13	22	13	ND	ND	ND	13	14	27
1981-82	39	2	40	2	48	3	68	2	36	1	37	ND	ND	ND
1982-83	79	3	91	6	109	4	109	5	72	5	77	ND	ND	ND
1983-84 <sup>d</sup>	48	23	49	6	56	11	85	10	47	14	61	Closed		

<sup>a</sup>Season closed 31 March

<sup>b</sup>Bay closed by TPW Commission on 15 December 1978

<sup>c</sup>Bay opened 15 December 1979

<sup>d</sup>Bay closed by TPW Commission on 30 March 1984

Figure 1. Oyster reefs in Trinity, Galveston and East Bays sampled during 1979-1984.

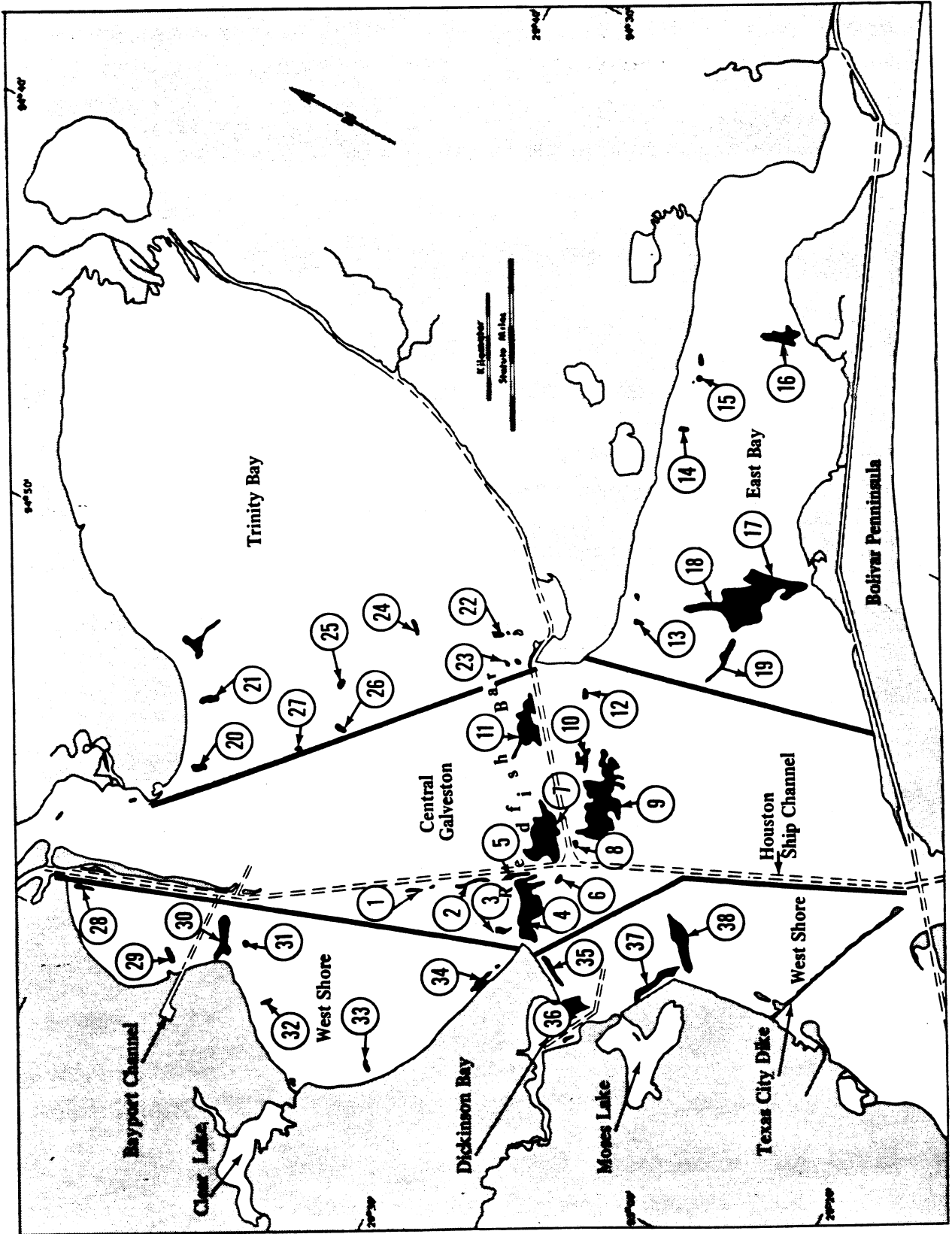




Figure 2. Oyster reefs in West Bay sampled during 1979-1984.

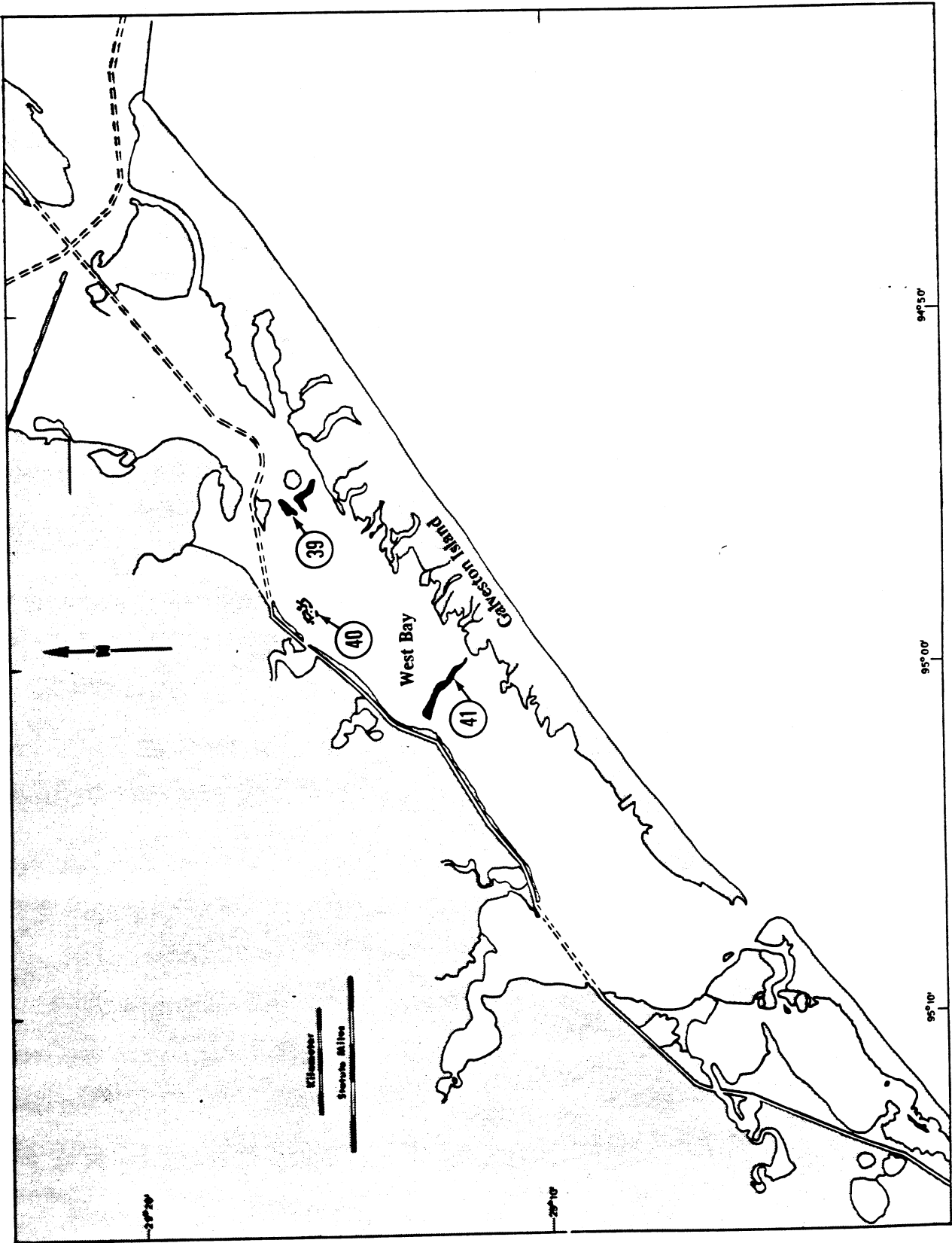


Figure 3. Annual mean number of oyster spat in 35-liter samples collected quarterly at three Redfish Bar sites in central Galveston Bay during 1956-1984.

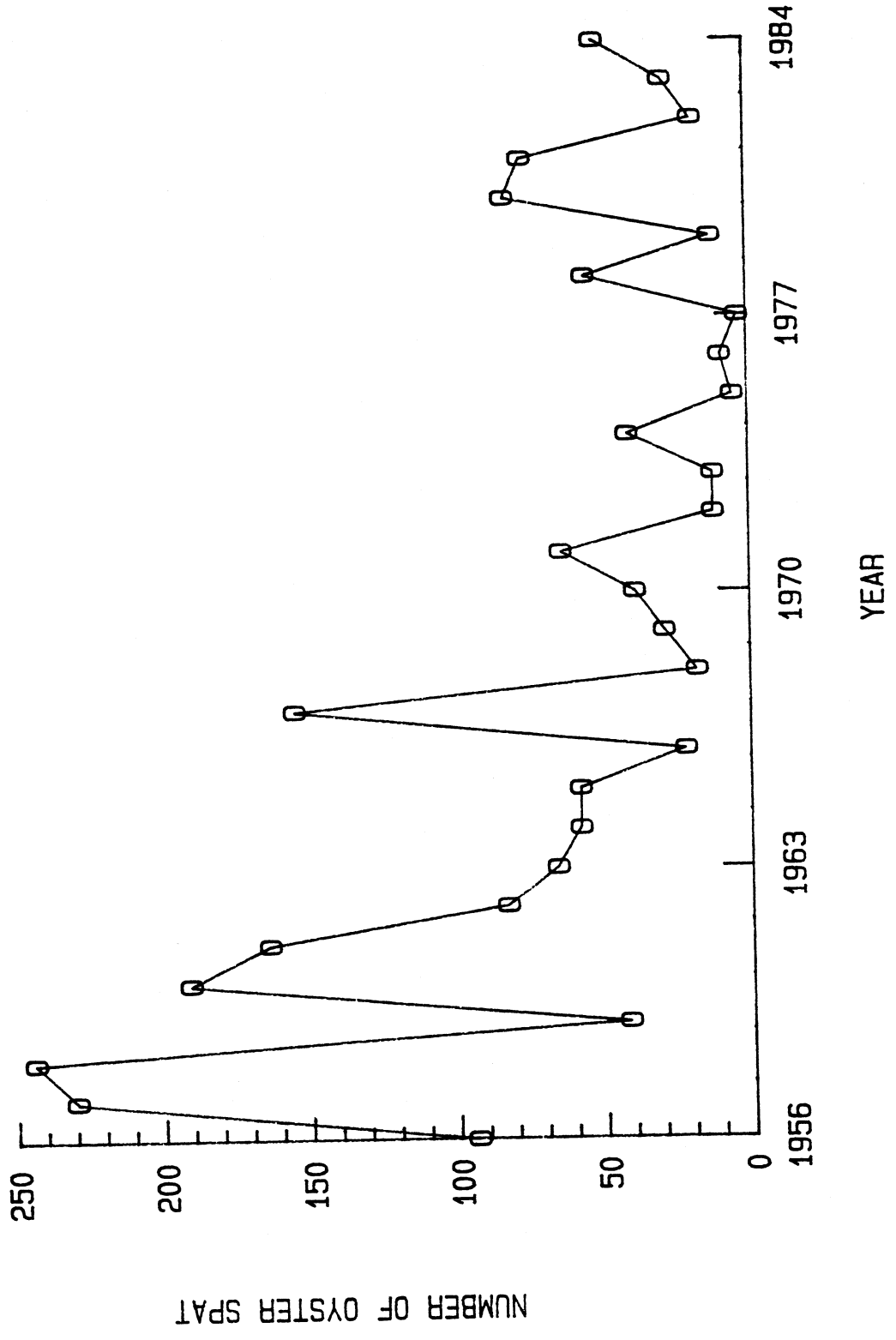


Figure 4. Annual mean number of small oysters in 35-liter oyster dredge samples collected quarterly at three Redfish Bar sites in central Galveston Bay during 1956-1984.

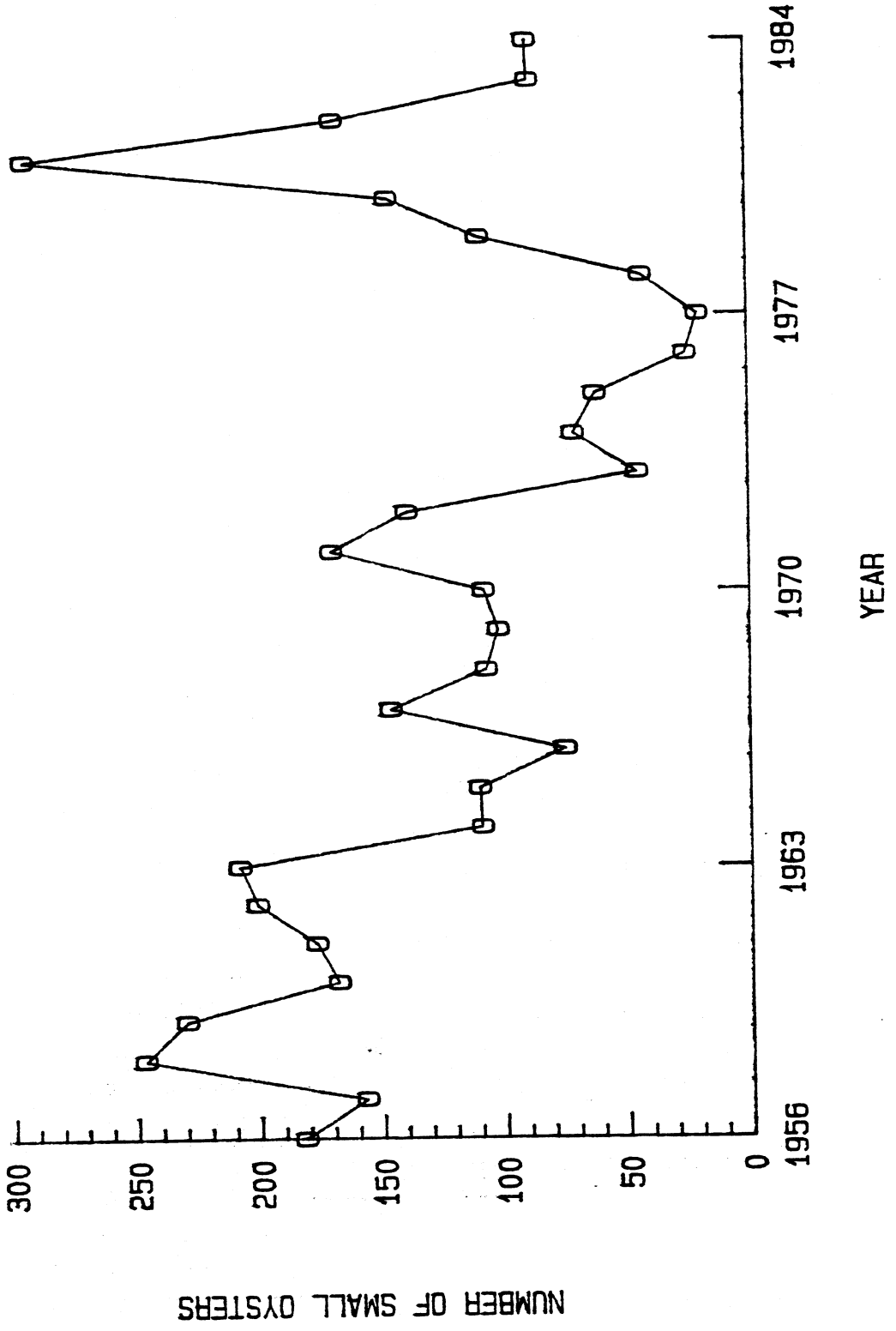


Figure 5. Annual mean number of market oysters in 35-liter oyster dredge samples collected quarterly at three Redfish Bar sites in central Galveston Bay during 1956-1984.

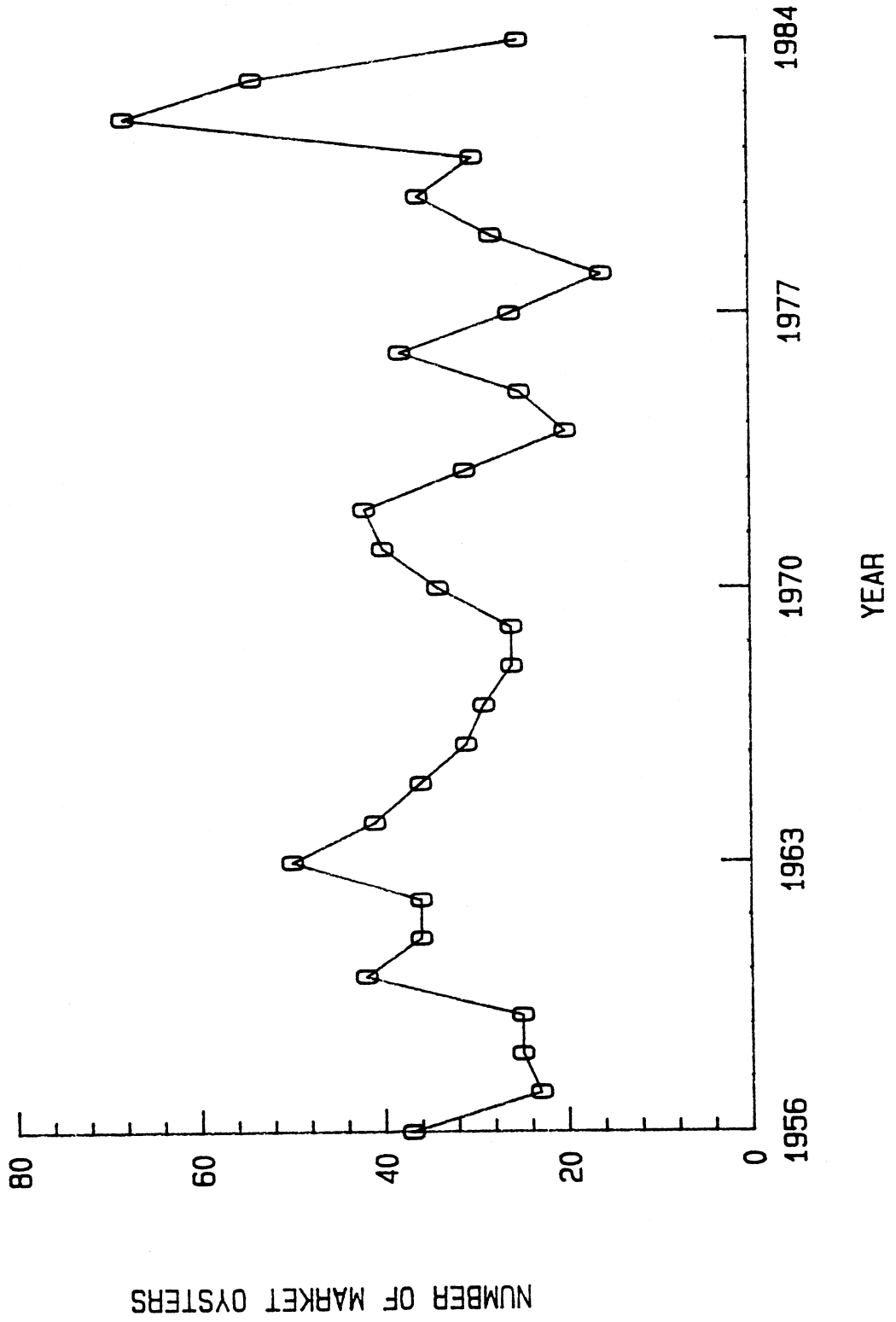
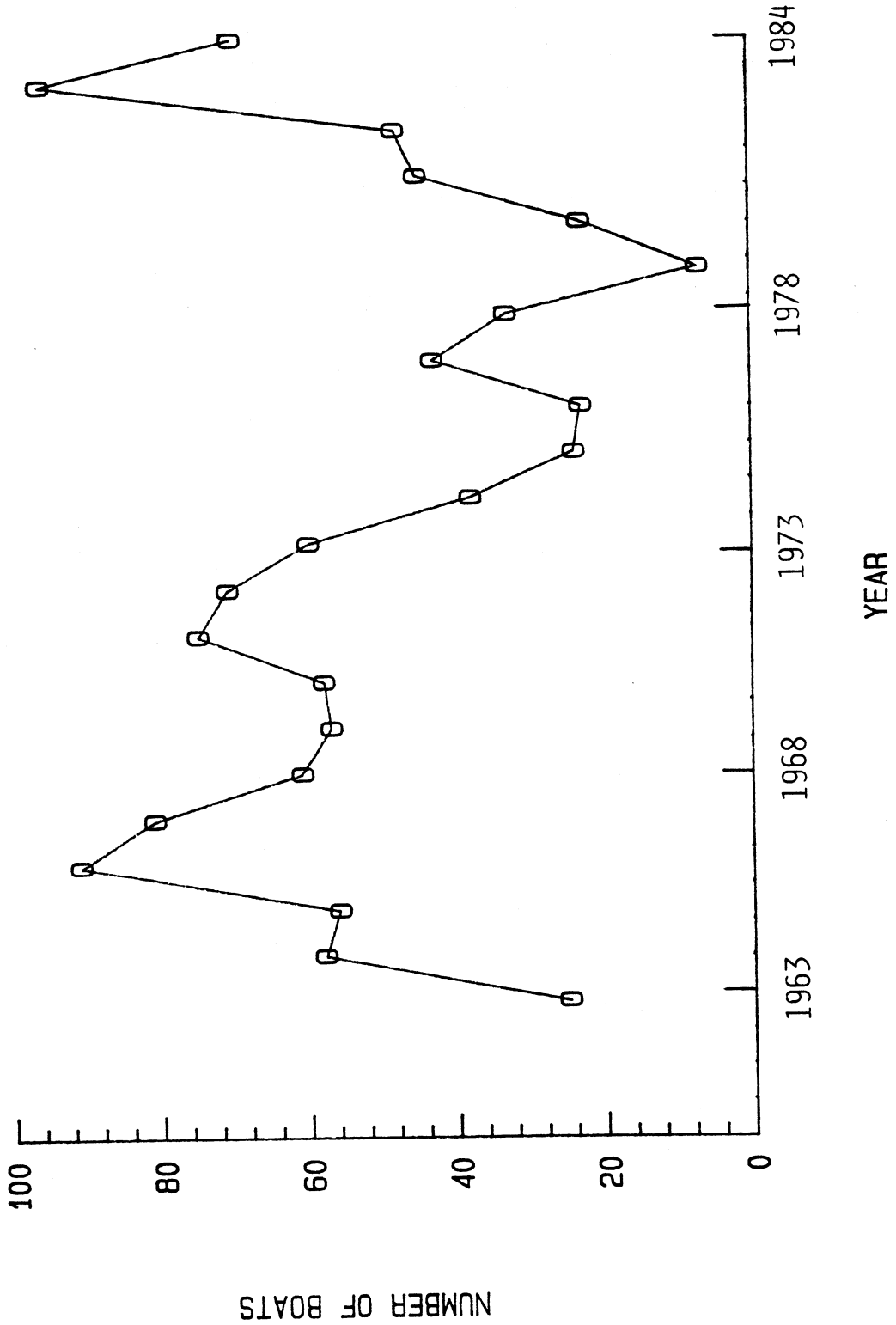




Figure 6. Total mean number of oyster boats observed dredging on public reefs in Galveston Bay (excluding West Bay) during the 1962-1963 (1963) through 1983-1984 (1984) oyster seasons.



Appendix A. Salinity (o/oo) at quarterly oyster sample sites in Galveston Bay during 1979-1984.



Table A.1. (Cont'd.)

Area site	1982				1983				1984			
	W	SP	S	F	W	SP	S	F	W	SP	S	F <sup>a</sup>
<b>Central</b>												
Beacon 63	15	10	19	16	12	14	ND	16	15	20	22	ND
Beacon 59	15	8	23	16	14	15	ND	16	15	20	23	ND
Eagle Point	14	8	16	19	11	15	6	16	18	20	21	ND
Todd's Dump	13	9	16	18	11	15	6	13	18	20	21	ND
Switchover	14	4	16	18	11	15	6	15	18	20	21	ND
Experimental	15	10	16	18	14	15	10	14	18	21	26	ND
North Redfish	11	8	14	18	9	9	12	11	18	20	25	ND
South Redfish	12	8	17	18	9	9	12	13	18	20	25	ND
Cent. Redfish	10	3	16	18	9	10	6	8	16	22	23	ND
East Redfish	10	1	16	16	9	10	6	10	15	20	21	ND
Bart's Pass	10	1	15	14	8	9	5	12	14	18	21	ND
Gaspipe	11	1	17	14	7	11	5	12	15	21	20	ND
<b>East Bay</b>												
Catfish	ND	ND	ND	ND	2	15	8	10	15	21	22	ND
Moody	16	5	12	12	2	15	4	10	15	20	18	ND
Cowshed	ND	ND	ND	ND	0	16	4	ND	14	18	18	ND
Frenchy	16	9	13	14	2	15	2	ND	14	20	20	ND
Hanna	18	6	21	16	4	18	6	15	16	24	24	ND
Deep Hanna	18	5	18	14	3	15	8	12	16	23	25	ND
Bull Hill	18	4	20	12	4	15	10	12	16	23	25	ND
<b>Trinity Bay</b>												
Dow	6	8	6	12	0	15	6	10	14	14	20	ND
Beezley	5	3	4	11	0	12	6	9	13	13	18	ND
Vingtune	8	4	3	14	2	10	5	6	12	16	19	ND
Spoonbill	7	4	5	14	3	12	5	7	12	16	21	ND
Lonesome	10	5	ND	14	0	14	6	6	12	17	20	ND
Tern	6	6	ND	16	1	11	9	11	12	17	21	ND
Dry Hole	7	8	ND	16	3	12	9	9	14	17	21	ND
Lost	7	8	ND	16	0	12	9	10	12	16	21	ND
<b>West Shore</b>												
Morgan's Point	ND	ND	ND	ND	ND	ND	ND	ND	ND	16	20	ND
Yacht Club	14	8	14	15	13	12	8	12	14	16	20	ND
Red Bluff	14	8	16	15	13	12	9	12	15	17	21	ND
Bent Pipe	15	8	12	18	12	12	11	12	15	16	22	ND
Scott	14	8	13	20	12	14	10	12	15	19	22	ND
Bayview	10	8	18	17	10	13	6	14	15	19	24	ND
San Leon	9	8	17	18	10	13	7	15	15	21	22	ND
April Fool	17	5	17	19	11	15	9	18	15	21	22	ND
Dickinson	17	7	17	17	12	19	10	16	16	23	24	ND
Levee	17	7	18	18	12	20	9	19	18	23	25	ND
Dollar	19	5	20	18	12	20	8	18	16	23	26	ND
<b>West Bay</b>												
Carancahua	ND	ND	ND	ND	ND	25	ND	ND	15	ND	30	ND

<sup>a</sup> sampling discontinued

Appendix B. Water temperature (C) at quarterly oyster sample sites  
in Galveston Bay during 1979-1984.



Table B.1. (Cont'd)

Area site	1982				1983				1984			
	W	SP	S	F	W	SP	S	F	W	SP	S	F <sup>a</sup>
<b>Central</b>												
Beacon 63	9	24	31	18	12	23	30	17	16	27	30	ND
Beacon 59	9	24	31	18	13	23	31	17	16	26	30	ND
Eagle Point	8	24	31	20	11	24	29	18	12	27	30	ND
Todd's Dump	9	28	31	20	11	24	29	18	12	27	30	ND
Switchover	9	27	31	20	12	24	29	18	12	26	30	ND
Experimental	10	28	31	20	11	24	29	18	12	27	30	ND
North Redfish	18	27	31	19	15	26	29	17	11	27	30	ND
South Redfish	18	27	30	19	15	26	29	17	12	26	30	ND
Cent. Redfish	18	27	30	19	15	26	27	17	12	26	30	ND
East Redfish	18	27	30	19	15	26	27	17	12	26	30	ND
Bart's Pass	18	27	30	19	15	26	27	17	12	26	30	ND
Gaspise	18	27	30	19	15	26	27	16	11	26	29	ND
<b>East Bay</b>												
Catfish	ND	ND	ND	ND	16	26	28	23	18	26	29	ND
Moody	20	29	30	18	17	27	28	22	18	26	29	ND
Cowshed	ND	ND	ND	18	16	27	28	22	18	26	29	ND
Frenchy	22	29	30	18	17	26	28	22	18	26	29	ND
Hanna	19	28	31	18	18	26	28	22	21	26	29	ND
Deep Hanna	19	28	31	19	18	27	28	22	21	26	29	ND
Bull Hill	19	28	31	19	18	26	29	22	21	26	29	ND
<b>Trinity Bay</b>												
Dow	15	25	31	15	18	23	31	15	12	26	30	ND
Beezley	15	27	31	14	18	23	31	15	12	26	30	ND
Vingtune	13	26	30	14	19	22	29	14	17	26	29	ND
Spoonbill	15	27	30	14	18	22	29	15	18	26	30	ND
Lonesome	14	26	ND	15	19	23	30	15	17	26	30	ND
Tern	13	27	ND	18	17	24	30	15	17	26	30	ND
Dry Hole	13	27	ND	18	17	24	30	15	17	26	29	ND
Lost	13	27	ND	18	17	24	31	15	17	26	29	ND
<b>West Shore</b>												
Morgan's Point	ND	ND	ND	ND	ND	ND	ND	ND	ND	25	30	ND
Yacht Club	8	24	30	21	13	24	30	18	12	24	30	ND
Red Bluff	9	24	31	21	12	23	30	18	11	24	30	ND
Bent Pipe	9	24	31	21	12	23	31	18	11	24	30	ND
Scott	8	24	31	21	12	24	30	18	11	24	30	ND
Bayview	9	24	31	21	13	24	31	18	17	25	30	ND
San Leon	13	24	32	21	12	24	31	18	19	25	31	ND
April Fool	12	27	31	17	14	23	31	9	17	28	29	ND
Dickinson	13	27	31	17	14	23	31	10	17	27	29	ND
Levee	12	27	31	17	14	23	31	9	17	27	29	ND
Dollar	11	27	31	17	14	23	30	9	17	27	29	ND
<b>West Bay</b>												
Carancahua	ND	ND	ND	ND	ND	31	ND	ND	13	ND	30	ND

<sup>a</sup> sampling discontinued



Appendix C. Number of spat, small, and market oysters in quarterly 35-liter oyster dredge samples from public reefs in Galveston Bay during 1979-1984.



Table C.1. (Cont'd.).

Area site	1982				1983				1984			
	W	SP	S	F	W	SP	S	F	W	SP	S	F <sup>a</sup>
<b>Central</b>												
Beacon 63	44	8	79	49	51	18	6	51	22	8	39	ND
Beacon 59	30	5	59	30	14	15	19	22	27	5	73	ND
Eagle Point	2	6	8	22	3	6	80	7	3	1	68	ND
Todd's Dump	3	1	4	35	9	3	23	21	5	3	77	ND
Switchover	8	0	6	33	2	1	31	11	1	12	47	ND
Experimental	2	4	25	33	14	6	121	11	10	10	80	ND
North Redfish	17	1	33	46	8	6	132	3	1	0	119	ND
South Redfish	16	9	13	63	8	17	152	28	6	5	91	ND
Cent. Redfish	25	1	19	17	0	5	117	7	4	5	175	ND
East Redfish	18	8	37	8	4	4	90	22	5	2	168	ND
Bart's Pass	8	4	50	14	5	3	111	17	11	1	246	ND
Gaspice	7	9	21	24	5	11	91	24	3	7	240	ND
<b>East Bay</b>												
Catfish	ND	ND	ND	ND	5	8	32	9	3	6	397	ND
Moody	2	2	11	11	4	1	11	6	0	0	278	ND
Cowshed	ND	ND	ND	ND	6	3	2	3	0	0	232	ND
Frenchy	2	0	3	5	11	3	1	3	0	0	29	ND
Hanna	10	3	14	27	12	4	29	2	2	2	272	ND
Deep Hanna	14	3	16	29	17	5	53	12	3	2	338	ND
Bull Hill	18	7	17	21	4	8	244	6	6	2	83	ND
<b>Trinity Bay</b>												
Dow	4	3	2	60	7	12	4	14	14	0	38	ND
Beezley	21	8	0	57	25	24	8	17	12	3	26	ND
Vingtune	1	1	0	2	2	6	10	0	2	2	75	ND
Spoonbill	4	0	4	3	0	1	21	9	3	1	73	ND
Lonesome	16	14	6	20	2	7	2	9	0	2	223	ND
Tern	10	0	28	22	20	8	15	11	5	1	213	ND
Dry Hole	4	2	20	14	16	8	35	27	8	3	456	ND
Lost	4	2	18	35	13	6	13	35	10	1	373	ND
<b>West Shore</b>												
Morgan's Point	ND	ND	ND	ND	ND	ND	ND	ND	ND	9	47	ND
Yacht Club	14	0	6	5	6	4	3	14	5	1	35	ND
Red Bluff	18	3	15	14	3	8	2	10	10	1	82	ND
Bent Pipe	7	1	20	3	3	3	0	26	3	0	69	ND
Scott	4	0	3	14	7	18	1	0	1	0	12	ND
Bayview	5	0	0	11	3	1	8	0	0	0	2	ND
San Leon	4	3	1	24	5	7	25	5	2	0	51	ND
April Fool	12	1	10	23	14	6	12	1	0	3	67	ND
Dickinson	10	0	5	36	20	9	20	2	0	8	76	ND
Levee	19	6	24	85	26	18	21	7	3	10	46	ND
Dollar	34	11	90	158	28	35	13	38	16	7	3	ND
<b>West Bay</b>												
Carancahua	ND	ND	ND	ND	ND	271	584	ND	47	ND	231	ND
Green's Cut	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	140	ND
Confederate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	35

<sup>a</sup> sampling discontinued



Table C.2. (Cont'd.)

Area site	1982				1983				1984				F <sup>a</sup>
	W	SP	S	F	W	SP	S	F	W	SP	S	F	
<b>Central</b>													
Beacon 63	362	202	177	174	252	145	176	106	150	151	209	ND	
Beacon 59	334	176	115	115	112	74	113	66	80	122	121	ND	
Eagle Point	189	184	183	91	58	53	102	103	129	133	209	ND	
Todd's Dump	210	177	138	87	75	59	67	154	82	82	165	ND	
Switchover	336	227	125	130	56	53	35	74	57	78	189	ND	
Experimental	260	168	138	92	70	72	34	27	71	63	50	ND	
North Redfish	286	156	159	82	87	78	62	37	60	46	123	ND	
South Redfish	265	255	204	151	72	88	16	63	60	67	84	ND	
Cent. Redfish	287	156	166	147	37	61	36	46	59	71	27	ND	
East Redfish	322	277	137	144	86	98	30	51	60	85	110	ND	
Bart's Pass	231	205	129	158	132	92	93	114	63	47	134	ND	
Gaspiper	318	277	230	220	94	64	73	95	99	139	220	ND	
<b>East Bay</b>													
Catfish	ND	ND	ND	ND	172	105	47	90	76	75	124	ND	
Moody	123	88	87	61	55	34	38	37	22	20	96	ND	
Cowshed	ND	ND	ND	ND	52	28	35	22	15	19	26	ND	
Frenchy	97	64	25	37	42	31	20	14	8	12	46	ND	
Hanna	194	154	114	61	80	44	27	20	31	27	70	ND	
Deep Hanna	232	206	136	86	108	63	49	56	51	29	37	ND	
Bull Hill	355	267	172	115	113	89	155	147	122	151	221	ND	
<b>Trinity Bay</b>													
Dow	150	92	18	89	53	102	88	94	77	71	100	ND	
Beezley	70	79	0	57	43	67	102	143	119	105	131	ND	
Vingtune	16	15	7	25	16	22	21	37	31	33	102	ND	
Spoonbill	135	92	66	46	45	56	58	73	47	84	126	ND	
Lonesome	62	113	0	37	44	33	40	51	42	34	112	ND	
Tern	224	275	102	158	149	96	117	77	83	81	132	ND	
Dry Hole	189	150	126	135	92	73	72	137	71	92	256	ND	
Lost	275	228	145	142	82	73	78	116	90	115	165	ND	
<b>West Shore</b>													
Morgan's Point	ND	ND	ND	ND	ND	ND	ND	ND	ND	138	197	ND	
Yacht Club	142	90	83	84	47	48	29	70	62	63	244	ND	
Red Bluff	161	108	99	118	126	73	70	72	89	70	167	ND	
Bent Pipe	104	99	68	85	99	42	35	63	58	109	188	ND	
Scott	104	101	36	37	66	82	67	64	51	49	101	ND	
Bayview	112	61	83	53	32	17	34	18	16	17	25	ND	
San Leon	355	241	169	97	97	72	90	96	60	65	138	ND	
April Fool	326	198	209	153	102	94	92	56	42	58	113	ND	
Dickinson	257	171	108	92	79	70	104	64	101	56	169	ND	
Levee	508	276	232	199	169	117	115	70	22	52	21	ND	
Dollar	243	46	152	187	159	107	42	44	12	15	0	ND	
<b>West Bay</b>													
Carancahua	ND	ND	ND	ND	ND	65	64	ND	134	ND	122	ND	
Green's Cut	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	204	ND	
Confederate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	82	ND	

<sup>a</sup> sampling discontinued



Table C.3. (Cont'd).

Area site	1982				1983				1984			
	W	SP	S	F	W	SP	S	F	W	SP	S	F <sup>a</sup>
<b>Central</b>												
Beacon 63	25	22	22	42	42	59	25	28	58	31	27	ND
Beacon 59	18	46	20	51	69	51	33	30	26	22	13	ND
Eagle Point	58	68	99	76	71	60	80	42	32	26	17	ND
Todd's Dump	43	57	96	99	60	45	40	28	18	27	28	ND
Switchover	52	37	46	82	64	51	63	23	41	29	35	ND
Experimental	52	63	76	78	63	62	64	23	19	21	13	ND
North Redfish	43	40	65	84	88	63	36	25	25	14	18	ND
South Redfish	58	55	40	53	61	45	33	47	35	27	12	ND
Cent. Redfish	83	85	115	114	89	82	44	45	21	15	13	ND
East Redfish	58	71	76	124	62	55	58	30	53	39	34	ND
Bart's Pass	47	45	84	116	51	83	90	42	31	26	39	ND
Gaspipe	48	56	53	101	55	67	82	46	19	35	35	ND
<b>East Bay</b>												
Catfish	ND	ND	ND	ND	72	74	94	67	45	36	45	ND
Moody	31	26	42	101	40	28	55	69	24	35	24	ND
Cowshed	ND	ND	ND	ND	57	42	107	67	35	25	21	ND
Frenchy	33	38	22	51	26	41	42	49	24	16	22	ND
Hanna	93	55	68	77	86	23	68	53	24	23	9	ND
Deep Hanna	53	60	63	83	56	53	71	50	26	37	33	ND
Bull Hill	102	71	77	122	58	57	72	60	33	41	42	ND
<b>Trinity Bay</b>												
Dow	55	89	14	44	72	58	62	61	53	55	44	ND
Beezley	22	18	0	0	1	0	0	0	1	10	18	ND
Vingtune	0	0	0	3	0	1	0	11	14	17	18	ND
Spoonbill	38	17	16	48	29	50	42	48	28	40	30	ND
Lonesome	0	1	0	0	0	0	0	3	2	4	8	ND
Tern	47	38	32	71	62	60	56	54	47	47	46	ND
Dry Hole	58	56	71	100	62	64	47	65	29	19	23	ND
Lost	41	56	59	91	51	33	67	49	24	23	37	ND
<b>West Shore</b>												
Morgan's Point	ND	ND	ND	ND	ND	ND	ND	ND	ND	73	52	ND
Yacht Club	70	74	84	72	97	97	71	62	64	43	42	ND
Red Bluff	57	59	76	66	85	95	81	90	81	71	48	ND
Bent Pipe	36	59	42	53	65	62	87	56	93	79	36	ND
Scott	84	77	85	77	83	79	71	76	63	57	40	ND
Bayview	69	84	83	77	93	95	59	81	100	79	81	ND
San Leon	65	72	66	92	111	110	104	84	85	71	40	ND
April Fool	55	62	48	60	83	93	96	77	71	60	48	ND
Dickinson	79	78	86	133	125	118	95	72	77	49	37	ND
Levee	26	51	48	72	82	96	62	81	68	65	25	ND
Dollar	9	0	21	44	95	83	66	31	39	22	23	ND
<b>West Bay</b>												
Carancahua	ND	ND	ND	ND	ND	72	36	ND	35	ND	11	ND
Green's Cut	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	46	ND
Confederate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	16	ND

<sup>a</sup> sampling discontinued

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PWD-RP-3400-260-5/89