

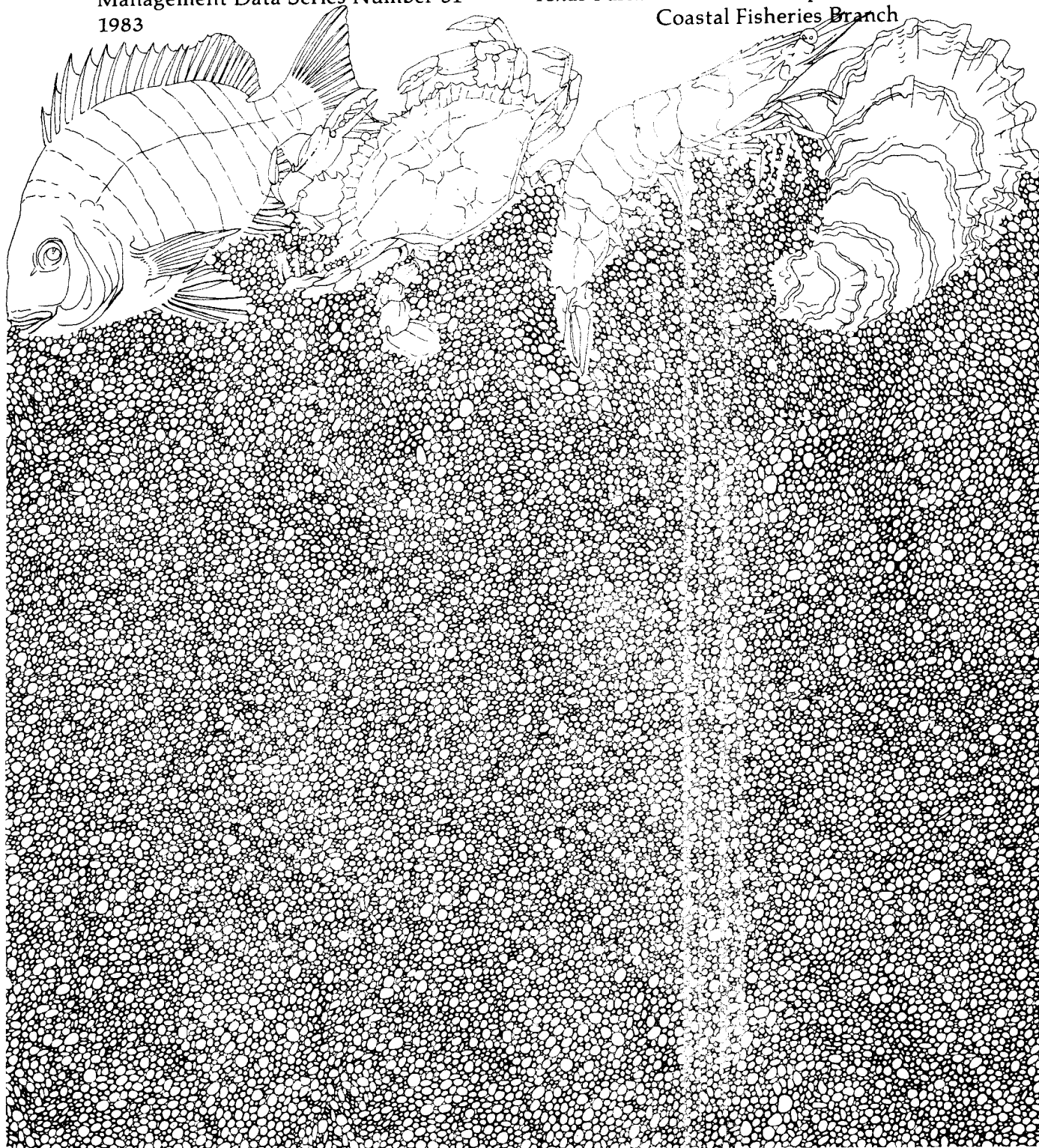
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OYSTER POPULATION TRENDS IN GALVESTON BAY 1973-1978

by R. P. Hofstetter

Management Data Series Number 51
1983

Texas Parks and Wildlife Department
Coastal Fisheries Branch



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ABSTRACT

Severe flooding on the Trinity River in 1973 destroyed oyster (*Crassostrea virginica*) populations in Trinity Bay and damaged those in the major harvest areas in central Galveston Bay. Recovery was slow. Poor reproduction during 1975, 1976 and 1977 caused near depletion of oyster populations by spring 1978. However, abundant spat setting during 1978 resulted in an increase in small (seed) oysters in fall. Because market size oysters were scarce and seed oysters vulnerable to damage from oyster dredging, oystering in Galveston Bay was prohibited by proclamation of the Texas Parks and Wildlife Department (TPWD) effective 15 December 1978.

Seasonal oyster harvests from public reefs in Galveston Bay ranged from 1.1 million kg (2.4 million lb) during 1976-77 to 8.7 thousand kg (19.2 thousand lb) during the abbreviated (45 day) 1978-79 seasons. As market oysters became scarce in Galveston Bay, oystering increased in mid-central bays. During the 1978-79 season, San Antonio Bay became the leading oyster producing area. The harvest of 359.5 thousand kg (792.7 thousand lb) established a record for that bay system. Private oyster lease production (confined to Galveston Bay) set a new record of 5861 m³ (7666.2 yd³) During 1976 only to be broken in 1977 when 7261 m³ (9497.4 yd³) were reported.

Over a 23-year period, a decline in sample abundance of spat and small oysters has been observed although market oyster stocks remained relatively constant. A relationship between spring salinity values and spat setting was noted. Best spat sets usually occurred when salinity ranged 17-24 o/oo during spring. When salinity fell below 8 o/oo substantial spat sets did not occur.

INTRODUCTION

For many years Galveston Bay has supplied at least three-quarters of the total oyster (Crassostrea virginica) harvest from public reefs in Texas. (Hofstetter 1977). Fishermen from other bays, and from out-of-state, have regularly participated in the harvest. The bay has also provided all of the harvest from private oyster leases.

Over the past 10 years reefs in Trinity Bay and East Bay have become marginally productive and the oyster harvest has become generally confined to central Galveston Bay. At the same time, oyster lease activities, through the transplanting program, have placed increasing pressure on oyster populations in closed waters. Erratic spat sets have led to decreased productivity in both open and closed areas, affecting the availability of market oysters for public reef fishermen and oyster lease holders alike. Under such conditions monitoring oyster populations throughout the bay is a necessity for proper management.

Studies of oyster populations have been conducted since the early 1950's, and information on population trends has been reported (Hofstetter 1977). The oyster project was terminated in 1973 and not resumed until 1976. Unfortunately this was a period when the recent decline in oyster populations began. However, it is believed that the limited sampling during 1973-75 provided adequate trend data for those years.

This report summarizes oyster population data obtained in 1973-78 and continues the analysis of population trends in the Redfish Bar Reef Complex.

METHODS

Oyster sample stations were established on public reefs in Trinity Bay, central Galveston Bay, East Bay and along the west shore (Table 1 and Figure 1). There were 20-22 stations in 1973-75 and 32-36 stations in 1976-78. All reefs along the west shore, and most of those in Trinity Bay, were closed to oystering by the State Health Department because of pollution. Central Galveston and East Bay stations were in approved water.

Samples, consisting of 0.035 m³ (0.458 yd³) (1 standard bushel) of unculled oysters, were collected quarterly (but with less regularity in 1973-75). The sample gear in 1973-75 was an eleven-tooth, "Texas style" oyster dredge. In 1976-78, an eight-tooth, "Biloxi style" (or Louisiana) dredge was used. Each dredge had a capacity of 0.035 m³ (0.458 yd³).

Bottom water samples were collected at each station visit; temperature was read to the nearest degree Celsius, salinity was determined by refractometer (± 1.0 o/oo). Unusual occurrences such as high mortality, heavy fouling and increased predation were noted.

Live oysters were culled from the sample and were measured along the dorso-ventral axis of the right valve. Measurements were grouped into 25 mm classes designated as Spat (≤ 25 mm), Seed (26-50 mm), Sub-market (51-75 mm), Small Market (76-100 mm), Medium Market (101-125 mm) and Large Market (126-150 mm). In this report three groupings were used: Spat (to 25 mm), Small Oysters (26-75 mm) and Market Oysters (76 mm and over).

Quarterly trends in oyster population levels were based upon average numbers of oysters of each size group collected from stations within each bay area. In 1973-75 these areas included Trinity, central Galveston, and East Bays. In 1976-78 the west shore area was added.

Long-term population trends were based upon data from three stations in the Redfish Bar Reef Complex, sampled since 1956. These were: Todd's Dump, west of the Houston Ship Channel; North Redfish Reef, 1.6 k east of the Houston Ship Channel; and Bart's Pass, 1.6 k west of Smith Point. These data were also used to prepare 5-year trends in Redfish Bar oyster populations.

RESULTS

Effects of the 1973 Flood

Trinity Bay discharge (Romayor gage) during 1973 was 13,610 cubic hectometers (11,040,000 acre-feet) or almost 2.5 times the average annual flow (Hofstetter 1977). Fifty-three percent of the discharge was recorded in March-June. Heavy local rainfall, particularly in June, flooded the smaller watersheds on the west side of the bay (Dickinson Bayou and Clear Creek).

In May, salinities ranged 0-2 o/oo in Trinity Bay and did not exceed 6 o/oo in other areas. Low salinities remained through June.

Oyster mortality at Trinity Bay stations in May ranged 1-15% (Table 2). By the end of June death rates increased to 16-17% among small oysters and 21-78% among market size oysters. In mid-July no live oysters were found at five stations within 21 km (13 miles) of the Trinity River mouth. At the sixth station (Dry Hole Reef) 18% of the small oysters and 10% of the market oysters survived.

June death rates among oysters at central Galveston stations ranged 8-19%. More dead oysters were found at Todd's Dump (18-19%) than at Bart's Pass (8-17%) even though Bart's Pass was more exposed to Trinity River flood waters. By July, however, mortality at Bart's Pass approached 100%. Oysters at Gaspipeline and East Redfish stations suffered less mortality even though salinity values ranged only slightly above those at Bart's Pass. At Redfish stations farther west mortality rates ranged 14-37%.

In East Bay death rates during July were higher at mid-bay stations (37-40%) than in the lower bay (14%), reflecting the influence of Trinity flood waters rather than local runoff. Along the west shore in Galveston Bay mortality rates ranged from 15% at Halfway Reef (influenced by Clear Creek) to 37% at Dickinson Reef (influenced by Dickinson Bayou).

Trends in Oyster Abundance

Average numbers of spat, small oysters and market oysters in quarterly collections within each bay area are shown in Table 3. Data from each station, upon which these averages are based, are given in Appendix A. Salinity values obtained at each station visit are shown in Appendix B.

Spatfall

The peak spat set in 1973 did not occur until fall. Setting (expressed as the average number per 0.035 m³) (0.458 yd³) ranged from scarce (2) in East Bay to light (25-42) in Trinity and central Galveston Bays. The maximum set (88) was found at Dry Hole Reef in mid-Trinity Bay.

Setting in 1974 was first observed in summer and continued into fall. Moderate sets (124) occurred in central Galveston Bay, light to moderate sets (82) in East Bay and light sets (18) in Trinity Bay. The heaviest set (715) occurred at Dollar Reef in the fall.

Although no samples were collected in summer 1975, spatfall, judged by the number of seed oysters in fall samples, was scarce. Fall sets in central Galveston and East Bays were light (23-28). The heaviest set (60) was found at East Redfish Reef.

Poor setting continued in 1976. Light sets (22-28) were found from spring through fall in central Galveston Bay, with a slight peak in spring. Light sets (36-41) were also observed along the west shore and in East Bay during summer. Spatfall in Trinity Bay was scarce. Maximum sets of 80-88 spat per sample were found in summer from Dollar and Dickinson Reefs.

The 1977 spat set was very low. Summer and fall sets in Trinity, central Galveston and East Bays were very light (3-13). Light setting (up to 25) occurred in the west shore area. The heaviest set (126 spat per sample) occurred at Levee Reef in the fall. Many of these spat had set inside the shells of old oysters which had been killed by oyster drills (Thais haemastoma).

Spatfall increased and was better distributed in 1978. Light to moderate setting (88) was first observed in central Galveston Bay during spring. By summer moderate to heavy sets (142-277) were found in central Galveston, East Bay and along the west shore. Setting in Trinity Bay was moderate (108). The heaviest set (829) was found in the summer sample at Levee Reef and sets of 400-600 spat per sample occurred at Switchover, Eagle Point, San Leon, East Redfish and Gaspie Reefs. The maximum set in Trinity Bay was 318 spat per sample at Tern Reef in the summer. Overall spatfall was much heavier than the 1974 set and almost equal to the 1971 set.

Small oysters

The number of small oysters dropped markedly in spring and summer samples in Trinity and East Bay during 1973 but changed little in central Galveston Bay. Stocks increased in all areas during 1974 and by summer

were generally more abundant than they had been before the 1973 flood, ranging upwards to 73 and 90 per 0.035 m³ (0.048 yd³) in Trinity and Galveston Bays. Although recovery was also noted in East Bay, small oysters averaged 23-29 per sample, about half that found prior to the flood.

Peak abundance of small oysters in central Galveston Bay occurred in winter 1975, averaging over 100 per sample. By spring, less than half remained. Those in East Bay were scarce in spring increasing slightly (to 1974 levels) by fall. Small oyster abundance in Trinity Bay diminished noticeably between winter 1975 and winter 1976 (from 50 to 5). Most of the loss probably occurred in spring 1975 due to fresh water.

Small oysters remained scarce in Trinity Bay in 1976 averaging 5-8/sample. Those at East Bay stations were never abundant, ranging 12-18/sample, similar to levels found in the previous two years. Stocks were less abundant in central Galveston Bay than in the previous year, reaching a high of only 44 in summer. At west shore stations, small oysters were more abundant in winter (51) and fall (42).

During 1977 small oyster abundance decreased in all areas except Trinity Bay. The decline was most noticeable in East Bay and west shore stations beginning in the spring but continued in all areas through spring 1978. The average number per 0.035 m³ (0.0458 yd³) at no time exceeded 35.

The relative abundant spat set in 1978 led to an increase in the abundance of small oysters beginning in summer 1978. Larger populations were found in all areas, but were most abundant in central Galveston Bay and along the west shore, averaging 121-218 in summer and fall samples. Around 500 per sample were collected from San Leon, Eagle Point and Dickinson Reefs. Numbers in Trinity and East Bays, although considerably lower (45-59), were the largest since 1972.

Market oysters

Market oysters were plentiful (49-90/sample) at Trinity and East Bay stations in winter 1973 prior to the flood. By fall none remained in Trinity Bay and East Bay stocks had been sharply reduced (to 21). In central Galveston Bay market oysters ranged 20-30 throughout the year showing limited damage from the flood.

Trinity Bay market oyster stocks remained at low levels (under 10) until fall 1978 when the average number rose to 21. Stocks in East Bay also remained low, averaging 12-25 through 1977, then dropping in 1978, to 5-7 through summer and 12 in the fall.

The central Galveston Bay market oysters began to increase in abundance during fall 1975, averaging 57/sample by summer 1976. By 1977 numbers averaged 27-35/sample, similar to levels found in 1973. The decline continued through summer 1978 to a low of 16. West shore stations contained many market oysters (62-81) in 1976 and 1977 with peak abundance in fall 1976. Abundance dropped steadily in 1978 to 27 in the fall.

The Public Oyster Fishery

Observations of the number of oyster dredge boats working the reefs are summarized in Table 4 as the average number per day during each month of the harvest season. The monthly harvest, in cubic meters (shell stock) and in kilograms (shucked meats), is shown in Table 5.

1973-74 Season: In spite of damage to oyster stocks from the 1973 flood, the 1973-74 fishery was relatively large, opening with an average of 67 dredge boats per day working in November. Most of these boats (78%) were from Louisiana. By December the average number of boats had dropped by about half and the number continued dropping throughout the season.

On 25 January 1974, the State Health Department closed the bay to oystering because of local flooding. The harvest areas were not reopened until 21 February 1974.

The season's harvest was reported at 5259 m³ (6878.8 yd³) (45,490 bbls) yielding 441,468 kg (973,272 lb) of shucked meat. Much of the harvest (43%) was taken in November.

1974-75 Season: Fewer dredge boats worked the reefs compared to the previous season; most of them (31/day) in December. Only 36% of the boats were from Louisiana.

The harvest was 5147 m³ (6732.3 yd³) (44,517 bbls) yielding 440,747 kg (971,682 lb) of shucked meat. January, rather than November was the peak harvest month.

1975-76 Season: The number of oyster boats remained low, averaging 29 per day. No more than 30% were from Louisiana. The harvest increased to 8860 m³ (11,588.9 yd³) (76,630 bbls) yielding 785,016 kg (1,730,664 lb) of shucked meat. The peak monthly harvest was reported in February, much later than usual.

1976-77 Season: More boats worked the reefs, averaging 49 per day. Although most boats were observed working in December (93/day), the peak harvest month was November. Louisiana boats were common (40%) early in the season.

The harvest was large; 13,702 m³ (17,922.2 yd³) (118,519 bbls) providing 1,126,180 kg (2,482,802 lb) of shucked meat. This was about equal to the combined harvests of the previous two seasons and the largest since 1972-73.

1977-78 Season: Oyster boats decreased in number, averaging 33 per day. Most worked in December (56/day) and January (49/day). Few Louisiana boats (10 at most) participated, chiefly during November.

The harvest was 7845 m³ (10,261.3 yd³) (67,848 bbls) yielding 548,300 kg (1,208,774 lb) of meat, about half that of the previous season.

1978-1979 Season: On opening day 23 oyster boats, including 10 from Louisiana, worked the reefs. Twelve boats worked the second day. By the following week 9 boats (including 1 Louisiana) remained. In early December 4 Texas boats were still dredging oysters.

By action of the Texas Parks and Wildlife Commission, oystering in Chambers and Galveston Counties was prohibited effective 15 December 1978. This action was taken because market oysters were scarce and small seed oysters, which could be damaged by dredging, were plentiful.

Slightly more than 127 m³ (166.1 yd³) (1000 bbls) were harvested during the 45 day season, yielding 9737 kg of meat (19,261 lb).

Oyster Harvests Along the Texas Coast

Oyster harvests from each bay during 1973-79 are shown in Table 6. Usually the Galveston Bay harvest was dominant. However, in mid-season 1976-77, the production in Aransas and San Antonio Bays began to increase as members of the Galveston Bay oyster fleet moved to those areas. This shift continued through 1978-79. Many Galveston Bay fishermen moved to the mid-coastal bays when Galveston Bay was closed to oystering. The harvest of 359,500 kg (792,700 lb) of oyster meat set a new record for San Antonio Bay.

Private Oyster Leases

The legislative moratorium on leases in coastal waters, including oyster leases, expired in 1973. The number of active leases rose from 9 in 1973 to 28 in 1978 and hectares under lease increased almost threefold, from 22.3 ha. (552 acres) to 625.3 ha. (1545 acres) (Table 7). All leases were located in Galveston Bay.

During 1961-72 the annual harvest from private leases averaged 1850 m³ (196.2 yd³) (16,000 bbls) and ranged 1041-3931 m³ (1361.6-5141.7 yd³) or 9000 to 34,000 barrels (Hofstetter 1977). In 1976 a record harvest of 5861 m³ (7666.2 yd³) (50,691 bbls) was produced from 18 leases covering 392.5 ha. (970 acres). This record was broken in 1977 when 25 leases covering 567.8 ha. (1403 acres) produced 7261 m³ (9497.4 yd³) (62,803 bbls).

But, as the supply of oysters for transplanting diminished, so did lease production. By 1978, 28 leases covering 625.3 ha. (1545 acres) produced only 3249 m³ (4249.7 yd³) (28,098 bbls). Unusual mortality not associated with predation was found on a number of leases in summer 1978. These deaths may have been due to the parasite Labyrinthomyxa marina based upon past history, but no substantiating evidence was obtained.

The abundant 1978 spatfall repopulated reefs in closed water and by late summer large numbers of seed oysters were available to the lease holders. By the end of the year leases generally held adequate numbers of small oysters but fewer market oysters.

When the Parks and Wildlife Commission closed Galveston Bay to oystering on 15 December 1978, private oyster leases were included. Harvesting on the leases was permitted, by Commission action, in February 1979.

DISCUSSION

Quarterly Trends in Oyster Abundance, 1973-78

Oyster sampling on a reduced scale was carried on in 1973-75 to provide information on flood damage and recovery. Quarterly trends in abundance of oysters at stations in central Galveston Bay are shown in Figure 2. These stations were sampled more consistently in all years and indicate the availability of oysters within the major harvest area.

Light spat sets through the first 5 years, and particularly in 1975, 1976, and 1977 are readily apparent. However, sets in 1973 and 1974 were sufficient to reverse the downward trend in small oyster abundance shown in 1973 and produce a relatively abundant population in late 1974 and early 1975. But the downward trend resumed in 1976, reaching the lowest level ever recorded by spring 1978. During that period, the number of small oysters was often lower than the number of market oysters. Market oysters were abundant in winter 1973 (due to recruitment of the good 1971 set) but dropped steadily through summer as a result of the flood. Recruitment of the 1973 and 1974 spat set led to increasing abundance in late 1975 with a peak of 1976. The 1976-77 harvest contributed to the reduction in number of market oysters in winter 1977.

Poor recruitment of the 1975-77 year classes continued the decline and, by summer 1978, market oysters were at the lowest level observed in 23 years. The 1974 class continued to provide most of the harvest from 1976 through 1979.

The abundant set in 1978 when oyster populations were at the lowest level, and the subsequent increase in number of small oysters, was an indication of the ability of oyster populations to recover rapidly when conditions again became favorable.

The prohibition of oystering, effective 15 December 1978, marked the first time in 20 years that such action had been necessary. It was the first time that all oystering was prohibited. In past closures sport oystering was not affected and commercial tonging was allowed.

Annual Oyster Population Trends, 1956-78

Annual population trends have been based upon samples from three stations across Redfish Bar. These reflect the influence of Trinity River flooding as well as harvesting, and are most representative of conditions within the primary oystering area.

Heavy spat sets, which had been common in the 1950's, were absent in the 1970's (Figure 3). Peak sets in the later period were within the range of the low sets in the 50's. Small oyster abundance essentially followed spat setting trends. However, the 1967 set produced fewer seed oysters than did the smaller 1971 set due to mortality caused by the 1968 flood. Small oyster populations at the index stations fell to the lowest level in 1977.

Market oyster populations were highest in 1963 due to recruitment of the large 1960 and 1961 sets. This was followed by a gradual but steady decline through 1969, reflecting the effects of flooding in 1968 and 1969 upon the 1967 year-class. Then a gradual increase occurred culminating in a peak in 1972. Stocks were continuing to rise in winter 1973 as the 1971 year class was recruited, but the 1973 flood reversed the trend. Recruitment of the 1974 year class resulted in a 1976 peak, approaching the level of 1963. Setting failures in subsequent years caused market oyster abundance to fall to the lowest level recorded in 1978.

Five-Year Trends in Redfish Bay Oyster Populations

Annual fluctuations in the Redfish Bay indices have been smoothed by 5-year averages from 1956-60 through 1971-75, and by a 3-year average for the remaining years 1976-78. These data are shown in Figure 4.

There has been a marked decline in abundance of spat and small oysters since the late 1950's. Spat setting diminished sharply between 1956-60 and 1961-65. The abundance of small oysters dropped between 1961-65 and 1966-70, but was most pronounced between 1971-75 and 1976-78. However, there was no direct relationship between the abundance of spat and seed oysters and that of market oysters, which remained relatively stable throughout the years. Market oysters were most abundant in 1961-65 but varied slightly in other periods. Until 1963 the legal market size had been 38.9 mm. However, in this report, those 76.2 mm and over were considered market size, thus including some that could not be legally harvested in earlier periods. Reducing the legal size had no apparent effect upon the abundance of market oysters.

While spat setting tended to diminish over the years, survival to seed and market oyster size increased. During 1956-60 the ratio of small oysters to market oysters was 6.5 to 1. In 1971-75 the ratio was about 3 to 1 and, by 1976-78, about 1.5 to 1. Better survival of the smaller number of seed oysters helped maintain market oyster stocks.

In 1976 and 1977 market oysters outnumbered both spat and small oysters. If this trend had continued through 1978, oyster populations would have fallen below the legal depletion level (5 bbls per 23.23 m²).

Possible Reasons for Changes in Oyster Population Levels

Flooding on the Galveston Bay watershed most often occurs in early spring, depressing salinity values during May and June when oyster spawning and setting should be at a peak (Hofstetter 1977). Since low salinity inhibits spawning and setting (Butler 1949), the severity and duration of the spring floods play an important role in determining the ultimate quantity of the spat set.

Although heavy spat sets in past years have not always been associated with high salinity, poor sets have most often been associated with low spring salinity. This is apparent in 1959, 1966, 1968, 1969, 1973, 1975, 1976 and 1977 (Figure 5). But heavy sets were observed in 1957 and 1958 when salinity values were low (below 10 o/oo). And one of the poorer sets was observed in 1972 when salinity values were high (16-34 o/oo).

Over the 23-year sampling period, a close relationship can be found between spring salinity values and the subsequent spat set. When spring salinities range 1-8 o/oo the average set has been 60 spat/bushel. As the spring salinity range increases to 9-16 o/oo, the average set rises to 81 spat/bushel. At salinity ranges of 17-24 o/oo the average set has been 102 spat/bushel.

The influence of salinity appears to have had more impact on the setting rate in the 1970's. During 1973-78, spring salinity values ranged 9-16 o/oo once (1974) and 17-24 o/oo once (1978). Setting was moderate to heavy these years. When spring salinity values were low a substantial set did not normally occur. Increased salinity in summer and fall had little effect. For example, setting was very low in 1977 even though summer salinity values rose above 20 o/oo.

Although flooding inhibits spatfall, the resulting low salinity often increases survival of the older oysters by reducing oyster drill predation and inhibiting the spread of parasites such as Labyrinthomyxa. When salinities are low survival of seed and market oysters in the central bay area is enhanced.

In 1978, higher salinity values, which favored spatfall, also favored the oyster drill and the oyster parasite. Drill predation was limited to the Dollar Reef and Hanna Reef areas and along the channel spoil below Beacon 63-64. One oyster lease near Dollar Reef suffered heavy mortalities from drills. Higher salinity also favored infection by the Labyrinthomyxa. No sampling was done to determine presence of the parasite. However, mortality on some of the leased beds was higher than could be accounted for by predation alone. Such mortality could have resulted from additional stress placed upon the oysters transplanted in hot, summer weather, but the oyster parasite was certainly responsible for some degree of loss.

Changing Patterns in the Distribution of Oyster Spat

In the 1950's and 1960's spat setting appeared to be well distributed and limited only by the normal salinity gradient. That is, spat could be found anywhere that the salinity range was suitable. Since 1968 (essentially wet years) a different distribution pattern was noted. Throughout much of Trinity Bay setting was poor and reefs which had produced large oyster populations in the past (such as Dow, Beezley, Fisher and Vingtune) became depleted--dead reefs supporting very few oysters. Reefs in upper Galveston Bay, west of the Houston Ship Channel (such as Scott, Red Bluff and Yacht Club) supported relatively large populations of old oysters. Apparently survival of the irregular spat sets was very good leading to oyster populations consisting almost entirely of oysters well over the legal size limit. Predators, such as oyster drills and stone crabs (Menippe mercenaria), have never been found in this area and killing floods seldom affect it.

In areas where setting had normally been good such as Todd's Dump, the sets in the 1970's were irregular, unevenly dispersed across the reef, and often light. Nearby at Switchover Reef off Redfish Island and at Eagle Point Reef and San Leon Reef, setting was often abundant. Some of the best sets ever recorded were found at San Leon Reef in 1973, 1974, 1976, and 1978. The Dickinson Bay reefs also received good sets.

Setting irregularities and a decline in setting intensity are not confined to Galveston Bay. Studies of the Chesapeake Bay in Maryland and Virginia point to reduced spatfall. In Maryland waters two periods of decline in spatfall were noted in samplings taken since 1935 (Krantz and Meritt 1977). The first period occurred in 1952-60 and was followed by 5 years of high spat sets. The second period of depressed setting occurred from 1966 to 1975. During the last period the spat set was the lowest ever recorded. In Virginia waters there was an 18-year decline (1961-78) in all rivers with a resulting decrease in numbers and density of seed oysters (Haven, Hargis and Kendall 1978).

Reasons for these declines were not fully understood. Factors such as overfishing, increased fouling, low levels of dissolved oxygen and increased hydrogen sulfide, increased turbidity, disease, herbicides, pesticides, PCB and other chemicals were suspected, either by themselves or in synergistic action with others. Chlorine and chlorine compounds were implicated in death of larvae at very low concentrations (0.005 ppb). Some of these factors might also be responsible for the decreased setting intensity in Galveston Bay.

Implications for Oyster Management

Success of the annual spatfall is a key factor in determining future oyster harvest abundance on public reefs and private beds alike. Therefore, continued studies of setting rates and distribution of spat are essential. Monitoring oyster populations remains necessary to follow

short-term trends (such as the quantity of market oysters available through one harvest season) and to detect long-term trends (such as the increase or decrease in population levels over several years) which might be related to subtle environmental changes.

The extent of consistently productive oyster reefs has diminished over the past few decades. East Bay reefs, which supplied much of the harvest in past years, are now marginally productive. Trinity Bay reefs have not produced oysters in quantity since 1972. Under such conditions better control of the harvest will be necessary.

Fishing pressure varies from season to season depending upon factors other than the condition of the oyster reefs. If shrimping is poor, more Texas fishermen may turn to oystering. If the Louisiana oyster harvest is poor, more Louisiana fishermen may come to Texas. Usually there has been a small core of consistent oyster fishermen along with a large number of "part-time" fishermen who work only a few days each month. Predictions on the size of the oyster fishery are difficult to make. Surveillance of the oyster fleet is necessary to detect areas where overfishing--or underfishing--occur.

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Table 1. Oyster sample stations in Galveston Bay 1973-78^{a,b}.

Reef	Year sampled					
	1973	1974	1975	1976	1977	1978
<u>Trinity Bay</u>						
1. Dow	x			x	x	x
2. Beezley	x	x	x	x	x	x
3. Fisher	x			x	x	x
4. Trinity	x	x	x	x	x	x
5. Clamshell	x	x	x	x	x	x
6. Vingtune				x	x	x
7. Spoonbill	x			x	x	x
8. Lost					x	x
9. Dry Hole	x	x	x	x	x	x
10. Tern	x	x	x	x	x	x
11. Lonesome	x	x	x	x	x	x
<u>Central Galveston</u>						
12. Eagle Point	x	x	x	x	x	x
13. Todd's Dump	x	x	x	x	x	x
14. Switchover		x	x	x	x	x
15. Experimental		x	x	x	x	x
16. North Redfish	x	x	x	x	x	x
17. South Redfish	x	x	x	x	x	x
18. Central Redfish				x	x	x
19. East Redfish	x	x	x	x	x	x
20. Bart's Pass	x	x	x	x	x	x
21. Gaspipe	x	x	x	x	x	x
<u>East Bay</u>						
22. Frenchy	x	x	x	x	x	x
23. Moody	x	x	x	x	x	x
24. Deep Hanna					x	x
25. Bull Hill		x	x	x	x	x
26. Catfish	x	x				
<u>West Shore</u>						
27. Morgan Point					x	x
28. Yacht Club					x	x
29. Red Bluff				x	x	x
30. Bent Pipe					x	x
31. Scott				x	x	x
32. Halfway	x	x		x		
33. Bayview				x	x	
34. San Leon				x	x	x
35. April Fool	x	x		x	x	x
36. Dickinson			x	x	x	x
37. Levee				x	x	x
38. Dollar	x	x	x	x	x	x

^aSee Figure 1 for location of reefs.

^bX=station sampled; blank = station not sampled.

Table 2. Percent mortality among small and market size oysters on public reefs in Galveston Bay during May-July 1973 due to flooding.

Reef	Mortality									
	May			June			July			Total
	Small	Market	Total	Small	Market	Total	Small	Market	Total	
<u>Trinity Bay</u>										
Trinity	0	21	15	-	-	-	100	100	100	100
Beezley	0	4	3	26	21	23	100	100	100	100
Dry Hole	5	0	3	16	41	31	82	90	86	86
Tern	-	-	-	-	-	-	100	100	100	100
Lonesome	-	-	-	-	-	-	100	100	100	100
Clamshell	0	2	1	71	78	74	100	100	100	100
<u>Central Galveston</u>										
Eagle Point	-	-	-	-	-	-	15	12	14	14
Todd's Dump	-	-	-	19	18	19	38	30	34	34
North Redfish	-	-	-	9	6	8	13	18	15	15
South Redfish	-	-	-	-	-	-	37	38	37	37
East Redfish	-	-	-	-	-	-	16	23	19	19
Bart's Pass	-	-	-	8	17	12	100	96	98	98
Gaspipe	-	-	-	-	-	-	13	24	16	16
<u>East Bay</u>										
Frenchy	-	-	-	-	-	-	50	33	40	40
Moody	-	-	-	-	-	-	39	35	37	37
Catfish	-	-	-	-	-	-	9	20	14	14
<u>West Shore</u>										
Halfway	-	-	-	-	-	-	14	15	15	15
Dickinson	-	-	-	-	-	-	18	49	34	34

- = No sample

Table 3. Trends in the abundance of oysters in quarterly samples from public reefs in Galveston Bay, 1973-78.

Year	Quarter	Average number per bushel											
		Spat				Small oysters				Market oysters			
		TB	GB	EB	WS	TB	CB	EB	WS	TB	GB	EB	WS
1973	W	0	10	0	-	64	51	50	-	49	29	90	-
	Sp	2	3	-	-	26	48	-	-	24	30	-	-
	S	0	2	1	-	26	40	16	-	19	20	17	-
	F	25	42	2	-	6	56	18	-	0	29	21	-
1974	W	-	-	-	-	-	-	-	-	-	-	-	-
	Sp	4	4	2	-	30	72	23	-	0	17	18	-
	S	18	124	82	-	73	99	29	-	1	26	16	-
	F	-	65	-	-	-	96	-	-	-	20	-	-
1975	W	2	4	-	-	50	111	-	-	3	29	-	-
	Sp	-	2	0	-	-	47	10	-	-	20	25	-
	S	-	-	-	-	-	-	-	-	-	-	-	-
	F	-	28	23	-	-	60	22	-	-	34	14	-
1976	W	0	1	0	4	5	39	20	51	5	36	12	72
	Sp	6	28	1	1	5	34	28	30	6	45	12	79
	S	6	22	41	36	6	44	12	20	7	57	16	75
	F	5	22	2	12	8	38	22	42	7	50	23	82
1977	W	2	4	1	4	10	35	27	24	9	35	22	69
	Sp	1	1	1	1	8	30	13	16	6	27	13	62
	S	8	9	3	6	12	24	14	19	6	27	20	62
	F	3	12	13	25	11	25	14	19	6	29	13	58
1978	W	0	7	2	4	9	21	12	12	10	23	6	51
	Sp	0	88	2	27	6	25	9	15	8	17	5	45
	S	108	259	142	277	22	68	52	121	5	16	7	36
	F	7	52	32	37	45	171	59	218	21	19	12	27

TB = Trinity Bay samples

GB = Central Galveston Bay samples

EB = East Bay samples

WS = West Shore samples

- = No sample

Table 4. Average number of oyster dredge boats per day observed on public oyster reefs in Galveston Bay during November-April 1973-79.

Season	Oyster boats per bay						Mean
	N	D	J	F	M	A	
1973-74	67	32	nd	nd	14	nd	
1974-75	25	31	30	nd	18	nd	
1975-76	30	29	nd	27	37	24	29
1976-77	71	93	40	44	24	20	49
1977-78	30	56	49	19	28	14	33
1978-79	10	4 ^a	a	a	a	a	

^a Season closed by Commission action on December 15, 1978.

Table 5. Oyster harvest from public reefs in Galveston Bay, 1973-74 through 1978-79 seasons.

Month	Season					
	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79
<u>Cubic meters</u>						
N	2,244	864	1,139	4,103	1,439	88
D	962	866	1,524	3,705	1,531	39 ^a
J	770	1,162	1,831	2,017	1,602	a
F	187	790	1,858	1,813	1,186	a
M	564	810	1,425	1,004	1,274	a
A	532	655	1,083	1,060	813	a
Total	5,259	5,147	8,860	13,702	7,845	127
<u>Kilograms of shucked meat</u>						
N	192,600	74,188	81,868	352,240	96,494	6,054
D	90,182	81,765	130,759	286,232	105,512	2,683 ^a
J	71,877	109,649	172,872	173,380	111,461	a
F	11,534	74,605	171,354	155,392	91,605	a
M	38,697	55,613	135,230	86,148	87,440	a
A	36,586	44,936	92,945	72,807	55,788	a
Total	441,476	440,756	785,028	1,126,199	548,300	8,737

^a Oystering prohibited by Commission action

Table 6. Oyster harvest^a (shucked meat) along the Texas coast, 1973-74 through 1978-79 seasons.

Bay area	Kilograms x 1000					
	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79
Galveston	441.5	440.8	785.0	1,126.2	548.3	8.7
Matagorda	54.9	179.6	146.7	69.4	72.7	54.2
San Antonio	21.0	121.5	53.4	222.6	193.1	359.5
Aransas	1.1	2.8	1.4	2.7	0.8	0.8
Total	520.1	750.8	997.5	1,454.2	840.9	483.4

^aIncludes harvest from private oyster leases

Table 7. Oyster production from private oyster leases in Galveston Bay, 1973-78

Year	No. leases		No. acres		Annual production	
	Total	Active	Total	Active	M ³	Bbls ^a
1973	17	9	903	552	2,560	22,138
1974	21	7	1,020	335	1,733	14,991
1975	26	11	1,387	473	1,509	13,052
1976	28	18	1,500	970	5,861	50,691
1977	32	25	1,832	1,403	7,261	62,803
1978	35	28	1,965	1,545	3,249	28,098

^aOne barrel = approximately 7.95 kg of oyster meat

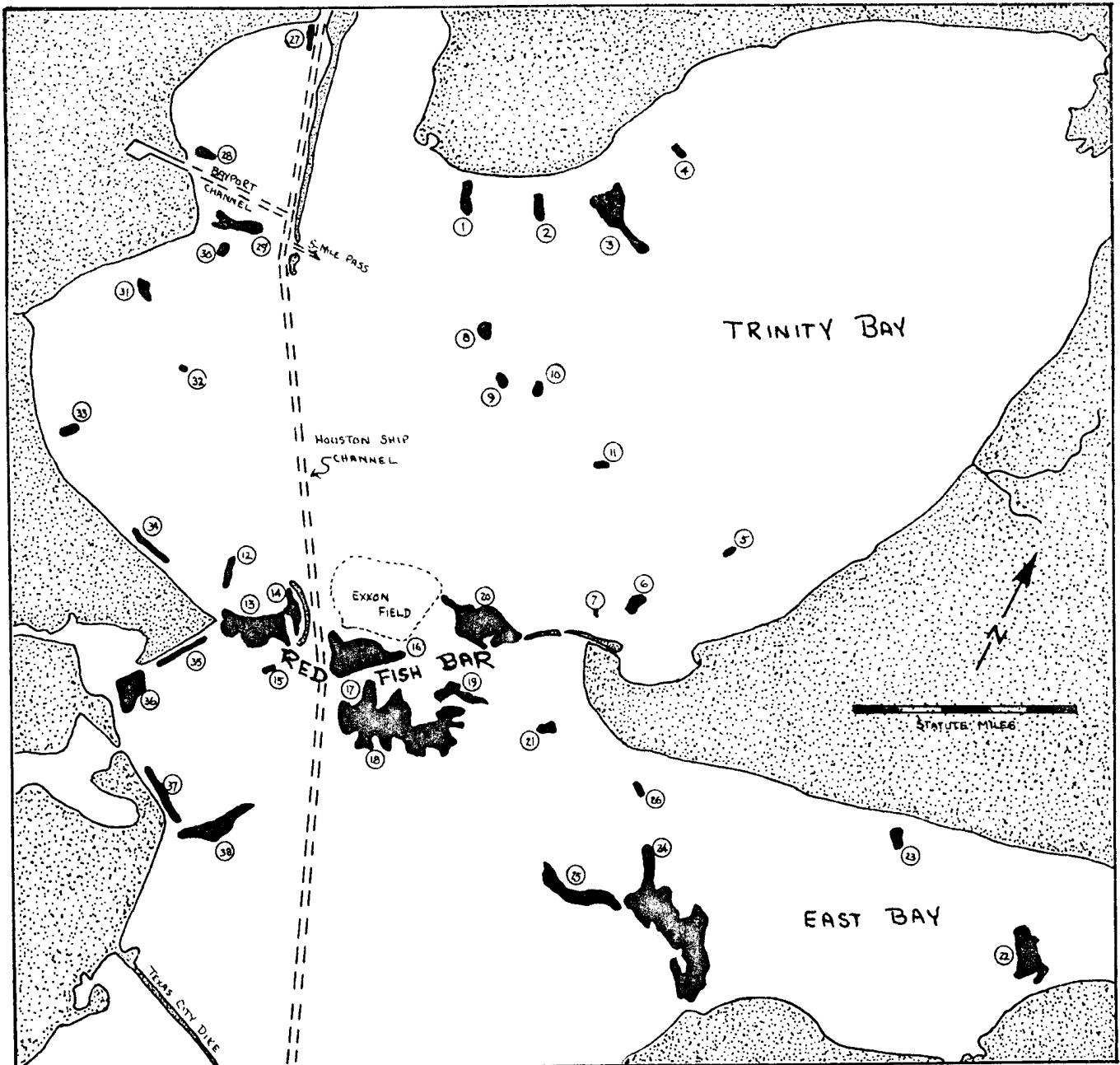


Figure 1. Oyster sample stations in Galveston Bay.

- | | | | |
|--------------|---------------------|------------------|----------------|
| 1. Dow | 11. Lonesome | 21. Gaspipe | 31. Scott |
| 2. Beezley | 12. Eagle Point | 22. Frenchy | 32. Halfway |
| 3. Fisher | 13. Todd's Dump | 23. Moody | 33. Bayview |
| 4. Trinity | 14. Switchover | 24. Deep Hanna | 34. San Leon |
| 5. Clamshell | 15. Experimental | 25. Bull Hill | 35. April Fool |
| 6. Vingtune | 16. North Redfish | 26. Catfish | 36. Dickinson |
| 7. Spoonbill | 17. South Redfish | 27. Morgan Point | 37. Levee |
| 8. Lost | 18. Central Redfish | 28. Yacht Club | 38. Dollar |
| 9. Dry Hole | 19. East Redfish | 29. Red Bluff | |
| 10. Tern | 20. Bart's Pass | 30. Bent Pipe | |

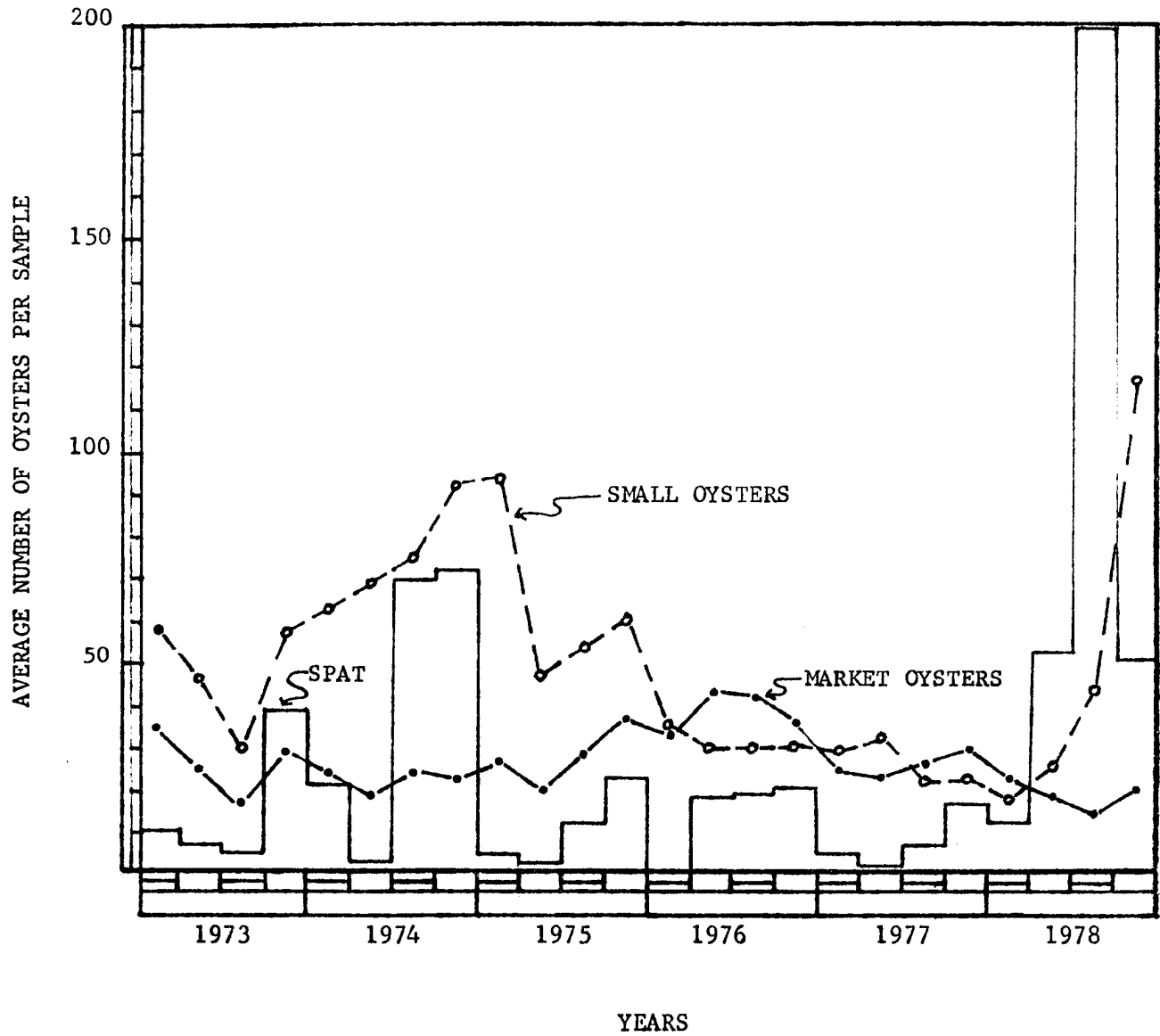


Figure 2 . Average number of oysters in quarterly samples from public reefs in central Galveston Bay 1973-78.

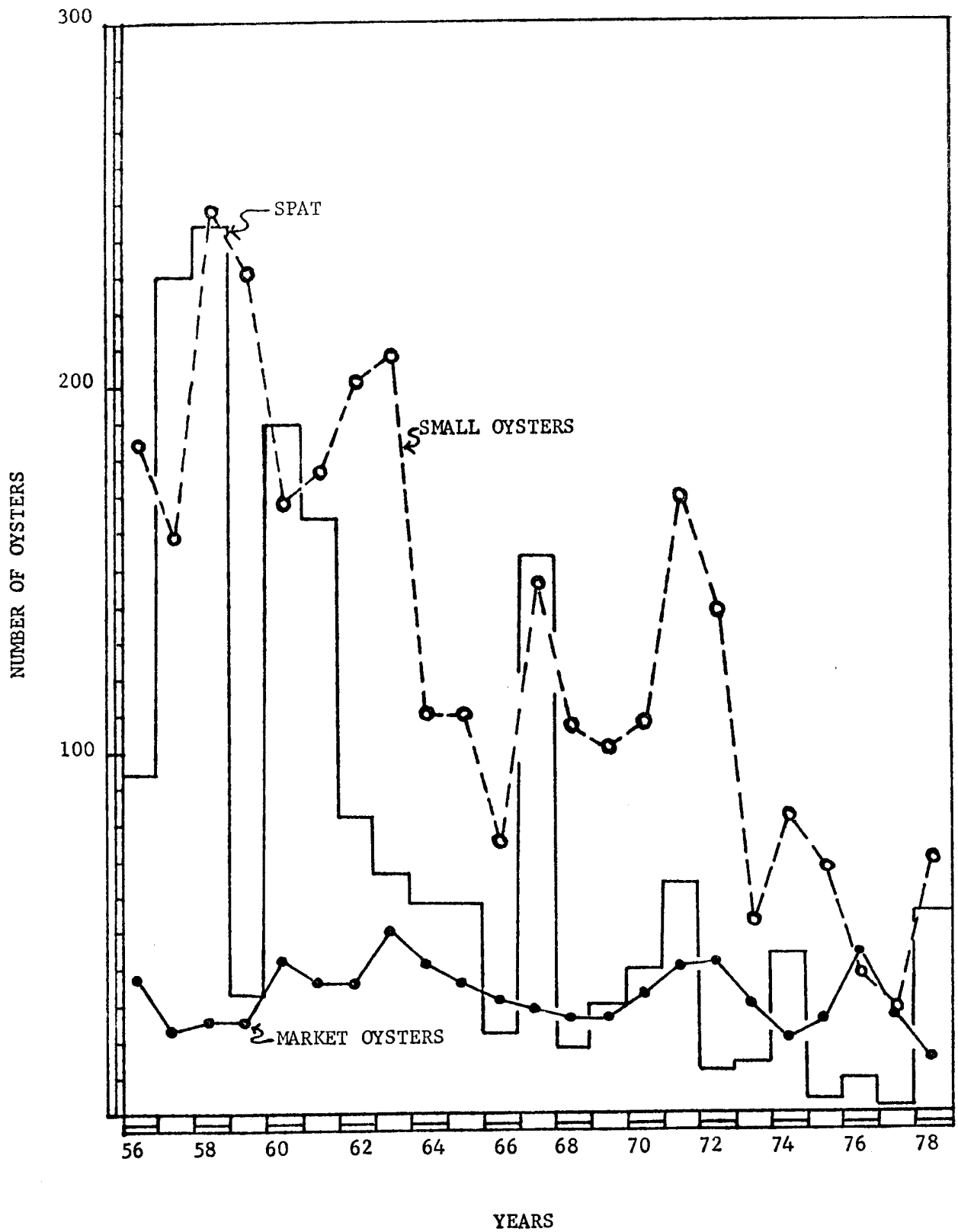


Figure 3. Average number of oysters in samples from Redfish Bar stations 1956-78.

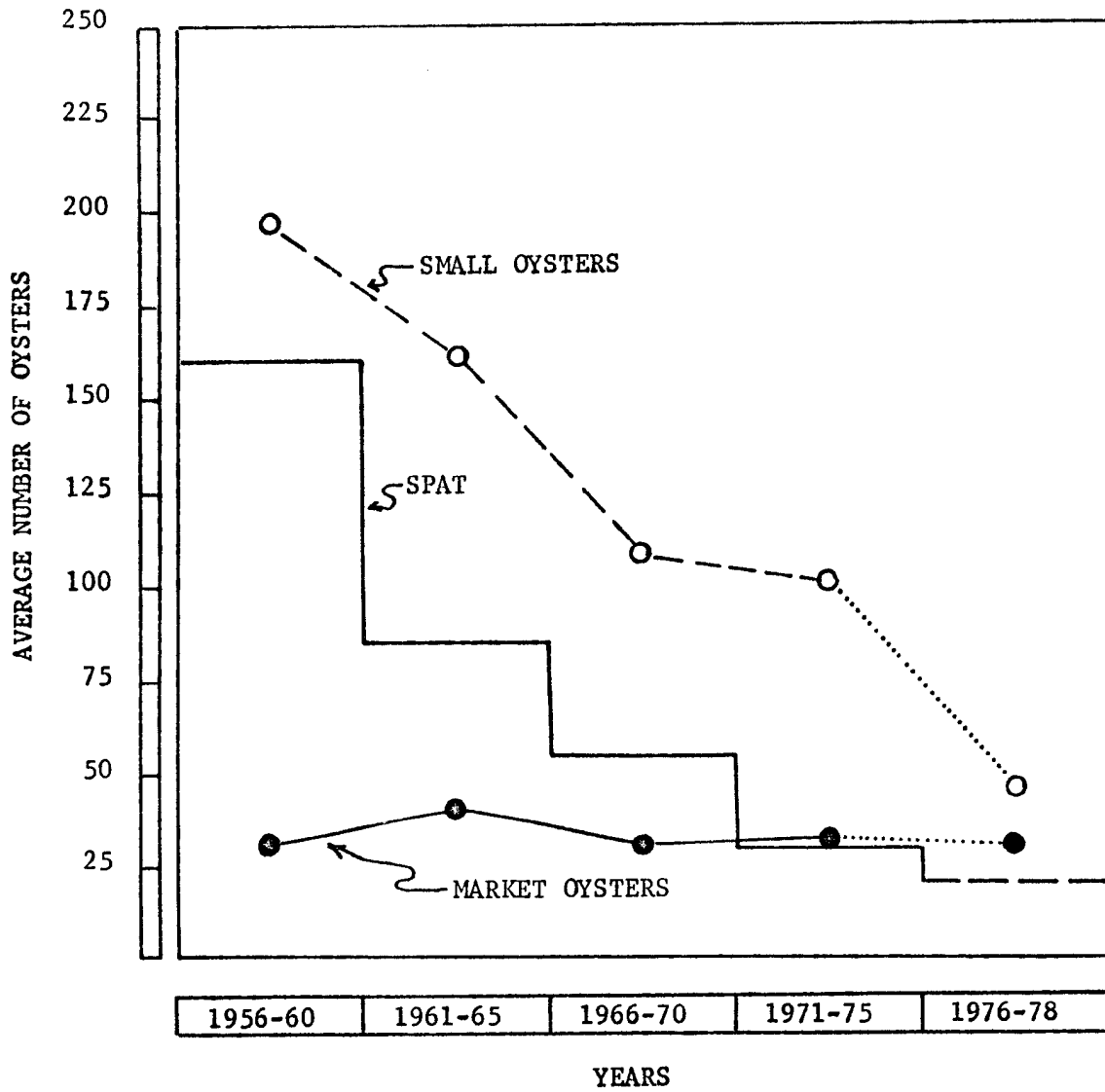


Figure 4. Trends in abundance of oysters in Redfish Bar samples over 5-year (1956-75) and 3-year (1976-78) intervals.

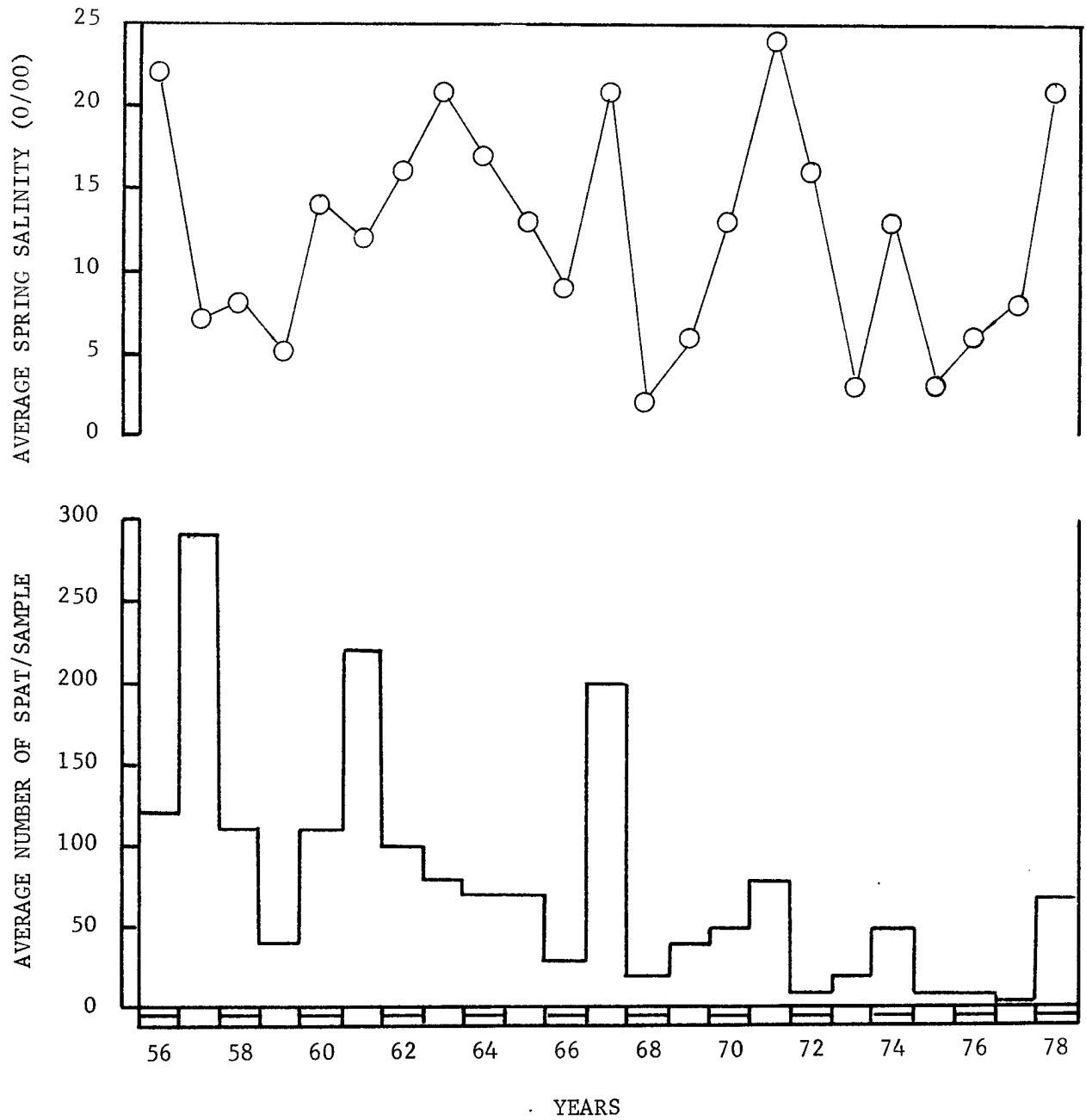


Figure 5. Average annual spatfall at Redfish Bar stations in relation to the average spring salinity.

Appendix A. Number of oysters in quarterly samples from public reefs in Galveston Bay 1973-78.

Table 1. Number of oyster spat (≤ 25 mm) in quarterly samples from public reefs in Galveston Bay, 1973-75.

Reef	Number per bushel											
	1973				1974				1975			
	W	SP	S	F	W	SP	S	F	W	SP	S	F
<u>Trinity Bay</u>												
Dow	-	-	-	7	-	-	-	-	-	-	-	-
Beezley	0	0	0	9	-	4	3	-	2	-	-	-
Fisher	-	-	-	36	-	-	-	-	-	-	-	-
Trinity	-	0	-	6	-	2	3	-	0	-	-	-
Clamshell	0	1	0	6	-	1	11	-	1	-	-	-
Vingtune	-	-	-	-	-	-	-	-	-	-	-	-
Spoonbill	-	-	-	1	-	-	-	-	-	-	-	-
Lost	-	-	-	-	-	-	-	-	-	-	-	-
Dry Hole	0	3	1	88	-	8	21	-	0	-	-	-
Tern	-	-	0	24	-	9	7	-	3	-	-	-
Lonesome	0	-	1	17	-	2	60	-	9	-	-	-
<u>Central Galveston</u>												
Eagle Point	-	-	1	-	-	-	298	63	1	-	-	-
Todd's Dump	0	5	10	33	-	-	11	47	1	3	-	8
Switchover	-	-	-	-	-	-	-	16	0	-	-	-
Experimental	10	-	-	-	-	-	-	81	-	-	-	-
North Redfish	7	4	2	33	-	3	5	51	3	2	-	4
South Redfish	40	-	11	49	-	5	55	131	8	1	-	29
Central Redfish	-	-	-	-	-	-	-	-	-	-	-	-
East Redfish	3	-	0	32	-	4	91	74	10	1	-	60
Bart's Pass	2	0	0	47	-	2	188	57	3	2	-	16
Gaspipe	-	-	0	59	-	-	221	-	-	-	-	53
<u>East Bay</u>												
Frenchy	0	-	1	2	-	0	25	-	-	0	-	0
Moody	0	-	1	2	-	1	138	-	-	0	-	0
Deep Hanna	-	-	-	-	-	-	-	-	-	-	-	-
Bull Hill	-	-	-	-	-	-	-	-	-	-	-	-
Catfish	-	-	2	22	-	1	66	-	-	-	-	-
<u>West Shore</u>												
Morgan Point	-	-	-	-	-	-	-	-	-	-	-	-
Yacht Club	-	-	-	-	-	-	-	-	-	-	-	-
Red Bluff	-	-	-	-	-	-	-	-	-	-	-	-
Bent Pipe	-	-	-	-	-	-	-	-	-	-	-	-
Scott	0	-	-	-	-	-	-	-	-	-	-	-
Halfway	0	-	-	20	-	0	-	12	-	-	-	-
Bayview	-	-	-	-	-	-	-	-	-	-	-	-
San Leon	-	-	-	-	-	-	-	-	-	-	-	-
April Fool	-	-	0	-	-	3	-	61	-	-	-	-
Dickinson	-	-	-	-	-	-	-	-	-	1	-	4
Levee	-	-	-	-	-	-	-	-	-	-	-	-
Dollar	-	-	-	49	-	5	-	715	-	-	-	28

- = No sample

Table 2. Number of oyster spat (≤ 25 mm) in quarterly samples from public reefs in Galveston Bay, 1976-78

Reef	Number per bushel											
	1976				1977				1978			
	W	SP	S	F	W	SP	S	F	W	SP	S	F
<u>Trinity Bay</u>												
Dow	0	0	-	1	0	0	3	0	0	0	10	4
Beezley	0	0	-	7	0	0	6	0	0	0	2	0
Fisher	2	1	-	3	1	0	0	1	0	0	1	1
Trinity	0	-	-	1	0	0	2	0	0	0	1	0
Clamshell	0	0	-	10	2	2	1	1	0	1	58	12
Vingtune	0	0	-	8	0	0	-	3	1	1	47	5
Spoonbill	-	0	-	14	3	0	1	16	4	0	147	11
Lost	-	-	-	-	0	-	8	2	0	0	199	14
Dry Hole	0	15	-	-	3	1	9	5	2	0	167	12
Tern	0	7	-	3	2	1	9	5	0	0	318	8
Lonesome	0	6	-	6	3	0	21	5	1	0	97	10
<u>Central Galveston</u>												
Eagle Point	-	33	6	-	1	0	1	9	2	47	644	49
Todd's Dump	1	22	8	6	1	0	3	4	3	132	95	21
Switchover	0	26	9	9	0	0	4	2	1	83	420	23
Experimental	-	-	15	23	4	9	36	3	4	288	207	64
North Redfish	1	13	8	30	4	3	2	3	5	110	163	60
South Redfish	0	20	13	37	12	4	13	24	20	51	272	113
Central Redfish	3	58	40	-	1	0	30	60	12	65	205	70
East Redfish	0	36	57	23	4	2	15	42	29	21	412	40
Bart's Pass	0	1	9	8	5	1	2	12	2	0	51	21
Gaspipe	0	39	52	-	6	1	11	58	34	83	456	61
<u>East Bay</u>												
Frenchy	0	0	6	1	0	0	1	7	2	0	198	48
Moody	0	-	16	1	0	0	5	2	3	0	20	24
Deep Hanna	-	-	-	-	-	-	21	82	4	3	411	34
Bull Hill	0	1	83	-	2	1	4	30	2	5	360	23
Catfish	-	-	-	-	-	-	-	-	-	-	-	-
<u>West Shore</u>												
Morgan Point	-	-	-	-	7	-	-	16	1	1	268	24
Yacht Club	-	-	-	-	1	-	-	0	1	2	177	5
Red Bluff	1	0	0	-	1	0	12	-	0	4	110	7
Bent Pipe	-	-	-	-	-	0	4	-	1	31	71	1
Scott	0	0	0	-	0	0	1	-	0	4	38	0
Halfway	3	-	-	1	-	-	-	-	-	-	-	-
Bayview	-	1	37	4	0	1	-	3	0	-	-	-
San Leon	-	0	14	5	2	0	-	2	2	47	615	50
April Fool	-	0	39	10	3	2	-	8	7	1	87	32
Dickinson	2	0	81	8	0	0	-	37	1	130	449	86
Levee	-	0	28	14	0	1	-	126	25	41	829	136
Dollar	14	0	88	41	22	5	-	28	9	9	129	32

- = No sample

Table 3. Number of small oysters (26-75 mm) in quarterly samples from public reefs in Galveston Bay, 1973-75.

Reef	Number per bushel											
	1973				1974				1975			
	W	SP	S	F	W	SP	S	F	W	SP	S	F
<u>Trinity Bay</u>												
Dow	-	-	-	1	-	-	-	-	-	-	-	-
Beezley	11	13	15	0	-	11	27	-	44	-	-	-
Fisher	-	-	-	14	-	-	-	-	-	-	-	-
Trinity	-	7	-	0	-	1	37	-	4	-	-	-
Clamshell	78	63	44	0	-	13	28	-	8	-	-	-
Vingtune	-	-	-	-	-	-	-	-	-	-	-	-
Spoonbill	-	-	-	12	-	-	-	-	-	-	-	-
Lost	-	-	-	-	-	-	-	-	-	-	-	-
Dry Hole	55	23	23	28	-	64	129	-	73	-	-	-
Tern	-	-	22	0	-	54	97	-	88	-	-	-
Lonesome	111	-	24	0	-	30	73	-	85	-	-	-
<u>Central Galveston</u>												
Eagle Point	-	-	57	-	-	-	272	237	204	-	-	-
Todd's Dump	37	67	40	35	-	-	66	76	100	67	-	73
Switchover	-	-	-	-	-	-	-	78	100	-	-	-
Experimental	18	-	-	-	-	-	-	59	-	-	-	-
North Redfish	96	63	56	79	-	89	103	118	98	34	-	52
South Redfish	49	-	30	97	-	127	106	125	125	57	-	102
Central Redfish	-	-	-	-	-	-	-	-	-	-	-	-
East Redfish	66	-	26	61	-	61	41	73	94	36	-	40
Bart's Pass	42	13	0	13	-	11	59	68	55	42	-	38
Gaspipe	-	-	74	48	-	-	47	-	-	-	-	55
<u>East Bay</u>												
Frenchy	30	-	1	7	-	0	18	-	-	12	-	2
Moody	70	-	10	11	-	18	21	-	-	11	-	27
Deep Hanna	-	-	-	-	-	-	-	-	-	-	-	-
Bull Hill	-	-	-	-	-	50	49	-	-	-	-	36
Catfish	-	-	37	36	-	30	25	-	-	-	-	-
<u>West Shore</u>												
Morgan Point	-	-	-	-	-	-	-	-	-	-	-	-
Yacht Club	-	-	-	-	-	-	-	-	-	-	-	-
Red Bluff	-	-	-	-	-	-	-	-	-	-	-	-
Bent Pipe	-	-	-	-	-	-	-	-	-	-	-	-
Scott	5	-	-	-	-	-	-	-	-	-	-	-
Halfway	42	-	49	18	-	19	-	103	-	-	-	-
Bayview	-	-	-	-	-	-	-	-	-	-	-	-
San Leon	-	-	-	-	-	-	-	-	-	-	-	-
April Fool	-	-	-	-	-	62	-	331	-	-	-	-
Dickinson	-	-	26	-	-	-	-	-	-	317	-	135
Levee	-	-	-	-	-	-	-	-	-	-	-	-
Dollar	-	-	-	32	-	22	-	141	-	-	-	93

- = No sample

Table 4. Number of small oysters (26-75 mm) in quarterly samples from public reefs in Galveston Bay, 1976-78.

Reef	Number per bushel											
	1976				1977				1978			
	W	SP	S	F	W	SP	S	F	W	SP	S	F
<u>Trinity Bay</u>												
Dow	6	3	-	3	10	6	8	8	6	2	6	10
Beezley	2	12	-	10	3	9	18	18	18	9	15	18
Fisher	1	0	-	2	3	2	3	4	4	1	2	10
Trinity	2	1	-	1	0	0	3	5	3	3	4	6
Clamshell	1	0	-	0	3	3	0	2	0	0	4	10
Vingtune	1	4	-	2	2	10	12	13	13	2	17	83
Spoonbill	-	5	-	18	11	7	11	14	12	2	23	162
Lost	-	-	-	-	17	15	13	6	4	15	97	60
Dry Hole	8	6	-	17	23	11	30	11	16	12	12	19
Tern	26	16	-	19	20	14	16	28	16	12	33	80
Lonesome	0	3	-	6	21	14	18	16	10	11	26	41
<u>Central Galveston</u>												
Eagle Point	-	56	63	50	37	18	19	17	16	16	132	478
Todd's Dump	41	28	43	24	19	17	18	19	16	15	26	117
Switchover	40	36	75	42	35	36	15	17	25	6	192	275
Experimental	-	-	59	40	35	31	22	28	21	17	36	98
North Redfish	44	26	31	27	23	49	20	19	17	20	50	142
South Redfish	51	60	62	54	43	55	36	38	17	45	77	174
Central Redfish	49	36	62	54	47	34	45	40	35	39	37	95
East Redfish	41	33	17	22	36	25	22	35	26	35	47	79
Bart's Pass	3	5	4	28	22	19	14	5	12	17	18	71
Gaspiper	42	30	27	38	49	14	26	36	27	37	64	180
<u>East Bay</u>												
Frenchy	2	2	2	2	5	3	1	6	5	4	26	80
Moody	-	-	0	6	2	2	3	3	3	2	28	29
Deep Hanna	-	-	-	-	-	-	2	18	26	10	54	36
Bull Hill	45	54	27	48	70	43	54	40	23	19	102	90
Catfish	-	-	-	-	-	-	-	-	-	-	-	-
<u>West Shore</u>												
Morgan Point	-	-	-	-	41	44	48	51	31	19	43	134
Yacht Club	-	-	-	-	3	3	4	4	8	5	49	146
Red Bluff	18	16	14	-	4	7	8	-	11	8	35	89
Bent Pipe	-	-	-	-	-	3	8	-	10	5	28	91
Scott	40	18	3	-	2	4	2	-	0	0	22	53
Halfway	37	-	-	32	-	-	-	-	-	-	-	-
Bayview	-	11	11	10	11	11	-	6	7	-	-	-
San Leon	-	29	17	28	32	9	-	25	8	14	637	545
April Fool	-	31	24	67	60	31	-	24	21	23	96	180
Dickinson	92	49	34	122	47	37	-	55	22	21	164	518
Levee	-	46	42	91	33	21	-	21	14	46	129	414
Dollar	67	41	14	18	8	8	-	0	3	7	4	9

- = No sample

Table 5. Number of market oysters (over 76 mm) in quarterly samples from public reefs in Galveston Bay, 1973-75.

Reef	Number per bushel											
	1973				1974				1975			
	W	SP	S	F	W	SP	S	F	W	SP	S	F
<u>Trinity Bay</u>												
Dow	-	-	-	1	-	-	-	-	-	-	-	-
Beezley	44	26	0	0	-	0	0	-	1	-	-	-
Fisher	-	-	-	0	-	-	-	-	-	-	-	-
Trinity	-	15	-	0	-	0	0	-	0	-	-	-
Clamshell	37	36	0	0	-	0	0	-	0	-	-	-
Vingtune	-	-	-	-	-	-	-	-	-	-	-	-
Spoonbill	-	-	-	0	-	-	-	-	-	-	-	-
Lost	-	-	-	-	-	-	-	-	-	-	-	-
Dry Hole	49	21	3	1	-	2	7	-	13	-	-	-
Tern	-	-	30	0	-	0	1	-	3	-	-	-
Lonesome	67	-	60	0	-	0	0	-	2	-	-	-
<u>Central Galveston</u>												
Eagle Point	-	-	35	-	-	-	19	20	47	-	-	-
Todd's Dump	44	32	33	25	-	-	32	27	36	14	-	23
Switchover	-	-	-	-	-	-	-	19	22	-	-	-
Experimental	0	-	-	-	-	-	-	8	-	-	-	-
North Redfish	57	44	27	54	-	28	30	31	32	20	-	58
South Redfish	9	-	5	6	-	13	20	22	32	43	-	44
Central Redfish	-	-	-	-	-	-	24	-	-	-	-	-
East Redfish	31	-	20	46	-	26	25	25	33	16	-	24
Bart's Pass	33	15	1	12	-	0	14	4	3	6	-	34
Gaspipe	-	-	17	30	-	-	38	-	-	-	-	19
<u>East Bay</u>												
Frenchy	79	-	4	23	-	15	26	-	-	34	-	9
Moody	101	-	15	15	-	28	16	-	-	16	-	20
Deep Hanna	-	-	-	-	-	-	-	-	-	-	-	-
Bull Hill	-	-	-	-	-	1	6	-	-	-	-	13
Catfish	-	-	33	25	-	22	24	-	-	-	-	-
<u>West Shore</u>												
Morgan Point	-	-	-	-	-	-	-	-	-	-	-	-
Yacht Club	-	-	-	-	-	-	-	-	-	-	-	-
Red Bluff	-	-	-	-	-	-	-	-	-	-	-	-
Bent Pipe	-	-	-	-	-	-	-	-	-	-	-	-
Scott	8	-	-	-	-	-	-	-	-	-	-	-
Halfway	35	-	50	47	-	26	-	39	-	-	-	-
Bayview	-	-	-	-	-	-	-	-	-	-	-	-
San Leon	-	-	-	-	-	-	-	-	-	-	-	-
April Fool	-	-	-	-	-	81	-	66	-	-	-	-
Dickinson	-	-	25	-	-	-	-	-	-	15	-	50
Levee	-	-	-	-	-	-	-	-	-	-	-	-
Dollar	-	-	-	0	-	0	-	2	-	-	-	34

- = No sample

Table 6. Number of market oysters (over 76 mm) in quarterly samples from public reefs in Galveston Bay, 1976-78.

Reef	Number per bushel											
	1976				1977				1978			
	W	SP	S	F	W	SP	S	F	W	SP	S	F
<u>Trinity Bay</u>												
Dow	2	5	-	2	3	2	7	10	12	19	17	45
Beezley	0	0	-	0	0	0	1	0	10	5	2	18
Fisher	0	0	-	0	0	0	0	0	1	0	0	6
Trinity	0	0	-	0	0	0	0	0	2	2	3	0
Clamshell	0	0	-	0	0	0	0	0	0	0	0	0
Vingtune	0	0	-	0	1	0	0	0	7	4	1	34
Spoonbill	1	1	-	2	2	2	1	2	7	0	2	26
Lost	-	-	-	-	22	15	8	25	22	18	9	23
Dry Hole	23	28	-	34	37	23	31	10	24	19	12	20
Tern	24	28	-	35	39	20	18	20	22	14	6	42
Lonesome	1	0	-	0	0	0	0	1	3	5	6	17
<u>Central Galveston</u>												
Eagle Point	-	39	112	90	68	38	27	17	28	18	11	17
Todd's	41	60	70	32	27	26	32	8	19	13	21	22
Switchover	55	52	63	59	38	32	25	18	16	14	12	24
Experimental	-	-	65	71	38	31	28	27	23	11	12	14
North Redfish	37	45	42	69	32	23	28	47	20	12	7	18
South Redfish	50	67	58	44	21	13	28	30	20	19	10	7
Central Redfish	43	56	63	54	46	25	43	43	29	21	27	30
East Redfish	32	35	21	12	21	20	27	44	36	42	28	32
Bart's Pass	6	7	20	23	24	35	15	19	21	7	9	21
Gaspape	20	42	56	46	37	28	13	38	14	12	16	18
<u>East Bay</u>												
Frenchy	7	5	11	9	9	5	7	9	2	1	5	8
Moody	-	-	8	23	16	18	8	10	2	2	6	3
Deep Hanna	-	-	-	-	-	-	5	0	4	1	2	0
Bull Hill	16	18	29	36	42	16	58	32	17	17	15	36
Catfish	-	-	-	-	-	-	-	-	-	-	-	-
<u>West Shore</u>												
Morgan Point	-	-	-	-	76	-	-	60	74	76	68	28
Yacht Club	-	-	-	-	28	-	-	52	34	23	26	28
Red Bluff	35	24	48	-	54	70	65	-	42	34	44	31
Bent Pipe	-	-	-	-	-	64	61	-	44	41	37	33
Scott	65	54	43	48	53	65	63	-	31	36	33	33
Halfway	96	-	-	89	-	-	-	-	-	-	-	-
Bayview	-	16	19	20	30	20	-	12	9	-	-	-
San Leon	-	95	84	91	88	81	-	69	94	38	33	19
April Fool	-	92	103	113	111	98	-	102	84	66	61	53
Dickinson	105	160	150	129	121	61	-	83	82	74	50	35
Levee	-	107	94	134	118	80	-	65	68	58	48	14
Dollar	60	85	59	66	27	29	-	11	2	1	6	0

- = No sample

Appendix B Salinity Values (o/oo) at oyster sample stations in Galveston Bay 1973-78.

Table 1. Salinity values (o/oo) at oyster sample stations in Galveston Bay, 1973-75.

Reef	Salinity											
	1973				1974				1975			
	W	SP	S	F	W	SP	S	F	W	SP	S	F
<u>Trinity Bay</u>												
Dow	10	2	10	4	5	9	13	8	7	1	6	13
Beezley	10	1	9	3	4	9	13	7	2	1	4	12
Fisher	12	1	9	2	4	8	11	7	1	1	3	12
Trinity	12	1	6	1	3	8	15	7	1	1	2	12
Clamshell	14	0	6	1	-	6	13	7	2	1	2	14
Vingtune	14	1	7	3	8	12	14	9	1	3	3	16
Spoonbill	14	1	8	3	7	12	15	10	-	4	-	16
Lost	-	-	-	-	-	-	-	-	-	-	-	-
Dry Hole	-	1	-	10	-	12	18	-	8	-	-	-
Tern	-	1	-	9	-	9	17	-	7	-	-	-
Lonesome	14	1	4	8	6	8	16	-	4	3	3	13
<u>Central Galveston</u>												
Eagle Point	-	-	10	-	-	-	18	-	13	-	-	-
Todd's Dump	16	3	14	13	7	15	18	16	13	6	18	19
Switchover	-	-	-	-	-	-	18	-	12	6	-	-
Experimental	-	-	-	-	-	-	-	-	-	-	-	-
North Redfish	-	3	12	-	-	13	18	-	10	3	-	21
South Redfish	-	-	13	-	-	14	18	-	10	3	-	19
Central Redfish	-	-	-	-	-	-	-	-	-	-	-	-
East Redfish	-	-	11	-	-	12	17	11	9	2	-	19
Bart's Pass	14	-	8	-	7	12	16	17	6	1	9	12
Gaspip	16	2	13	13	7	13	22	-	-	6	8	15
<u>East Bay</u>												
Frenchy	14	4	4	8	-	11	16	16	4	-	-	-
Moody	14	4	4	9	-	-	13	16	-	8	6	12
Deep Hanna	-	-	-	-	-	-	-	-	-	-	-	-
Bull Hill	19	5	11	17	7	18	25	19	9	9	10	20
Catfish	-	5	10	12	-	12	-	-	8	-	-	-
<u>West Shore</u>												
Morgan Point	13	6	16	17	12	8	17	15	13	2	18	17
Yacht Club	-	-	-	-	-	-	-	-	-	-	-	-
Red Bluff	16	4	-	19	12	10	17	17	15	4	-	14
Bent Pipe	-	-	-	-	-	-	-	-	-	-	-	-
Scott	16	3	7	9	14	7	16	12	9	6	8	14
Halfway	-	-	9	8	-	7	17	-	-	-	-	-
Bayview	-	-	-	-	-	-	-	-	-	-	-	-
San Leon	-	-	-	-	-	-	-	-	-	-	-	17
April Fool	-	-	-	-	-	19	19	-	-	-	-	-
Dickinson	13	4	7	8	6	17	19	14	9	6	13	17
Levee	-	-	-	-	-	-	-	-	-	-	-	-
Dollar	14	3	9	9	6	22	19	14	9	10	16	20

- = No sample

Table 2. Salinity values (o/oo) at oyster sample stations in Galveston Bay, 1976-78.

Reef	Salinity											
	1976				1977				1978			
	W	SP	S	F	W	SP	S	F	W	SP	S	F
<u>Trinity Bay</u>												
Dow	17	3	-	14	11	8	15	21	13	19	16	18
Beezley	14	2	-	13	8	8	13	21	12	16	14	21
Fisher	13	2	9	12	7	6	10	20	9	15	13	20
Trinity	10	-	-	11	8	6	8	19	8	13	12	19
Clamshell	16	0	9	10	12	2	10	18	9	16	12	18
Vingtune	17	1	9	10	11	6	13	18	10	17	14	18
Spoonbill	19	1	11	11	11	6	13	18	11	19	16	18
Lost	-	-	-	14	17	3	18	19	16	18	14	17
Dry Hole	18	4	-	14	17	3	18	19	16	18	16	18
Tern	18	2	6	14	16	3	17	19	16	18	14	17
Lonesome	18	2	-	12	15	2	16	20	12	17	12	18
<u>Central Galveston</u>												
Eagle Point	-	7	17	-	17	9	22	23	16	22	20	22
Todd's Dump	21	8	16	18	18	11	21	22	18	22	22	22
Switchover	21	8	14	17	19	10	20	23	18	22	21	22
Experimental	-	7	17	18	18	10	22	23	18	23	23	22
North Redfish	21	7	16	18	17	8	18	26	17	21	20	21
South Redfish	20	9	17	18	16	9	22	27	15	22	22	21
Central Redfish	20	6	17	19	16	6	23	26	15	22	22	21
East Redfish	20	4	14	17	14	4	19	26	13	21	20	19
Bart's Pass	18	3	10	16	13	4	15	23	13	19	19	19
Gaspipe	18	2	5	16	16	3	20	23	13	20	20	19
<u>East Bay</u>												
Frenchy	-	-	13	-	13	12	16	21	17	22	21	21
Moody	18	-	13	-	12	10	16	20	14	21	18	18
Deep Hanna	22	-	13	-	-	-	20	22	18	22	21	21
Bull Hill	-	-	13	11	16	6	17	23	20	22	21	19
Catfish	-	-	-	-	-	-	-	-	-	-	-	-
<u>West Shore</u>												
Morgan Point	19	-	18	18	14	-	18	26	17	17	19	17
Yacht Club	-	-	-	16	16	-	19	23	17	17	18	19
Red Bluff	20	5	12	17	16	9	22	24	17	18	19	21
Bent Pipe	-	-	-	17	16	9	19	24	17	18	19	20
Scott	20	5	-	18	16	9	19	23	17	18	19	20
Halfway	20	5	18	18	-	-	-	-	-	-	-	-
Bayview	21	6	16	-	16	9	19	23	17	-	-	-
San Leon	21	7	16	-	18	10	18	24	16	22	19	19
April Fool	22	8	17	-	18	11	19	22	20	22	20	21
Dickinson	22	10	18	9	18	12	20	22	20	23	20	21
Levee	-	10	18	-	22	15	22	23	20	24	21	21
Dollar	21	12	19	18	23	10	22	23	20	23	23	22

- = No sample

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