

COMPARISON OF OYSTER DREDGE TOW TIMES TO MONITOR
OYSTER ABUNDANCE

by

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Page 1. Introduction. First paragraph:

Quast et al. 1989 should be Quast et al. 1988.

Page 4. Literature Cited.

Quast, W. D., T. S. Searcy, and H. R. Osburn. 1989 should be 1988.

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ABSTRACT

Number of Eastern oysters (Crassostrea virginica) collected in 30-second oyster dredge tows was compared with number of Eastern oysters collected in 1-minute tows in Galveston, Matagorda, East Matagorda, San Antonio, Aransas, and Corpus Christi Bays, and the lower Laguna Madre during March 1987. Overall, number of spat (5-25 mm shell length) and small oysters (26-75 mm) caught were comparable between times although significant deviations were found in individual bays. Market oysters (≥ 76 mm) were more abundant than expected in the 30-second tows suggesting that the dredge may be filling up before completion of the 1-minute tows. Therefore, 1-minute tows probably underestimate Eastern oyster relative abundance, especially when abundance is extremely great.

INTRODUCTION

The Eastern oyster (Crassostrea virginica) supports a commercial fishery in Texas with reported landings in 1987 of 1.3 million kg and ex-vessel value of \$6.8 million (Quast et al. 1989). The fishery historically has been located primarily on public reefs and private leases located in Galveston Bay (Hofstetter 1977, Osburn et al. 1987). The oyster fishery is regulated by the Texas Parks and Wildlife Commission which imposes size and bag limits, cargo limits, gear restrictions, and season adjustments. The Texas Parks and Wildlife Department (TPWD) has monitored relative abundance and size of oysters on selected reefs in Galveston Bay since the early 1950's (Hofstetter 1977, 1983). From the early 1950's until 1973 an all-steel 12-tooth commercial style dredge about 61.0 cm wide, 30.5 cm high and 50.8 cm deep was used to sample oysters. During 1973-1975 the TPWD sampled oysters with an 11-tooth "Texas style" dredge (Hofstetter 1977). From 1976-1984 an 8-tooth "Biloxi style" dredge was used (Hofstetter 1983, Benefield et al. 1986). Each of these dredges had a capacity of about 35.2 liters. From 1984 to present the TPWD has used a 9-tooth "Biloxi or Louisiana" style dredge.

Early sampling procedures consisted of pulling a standard dredge until 35.2 liters (one bushel) of unculled oysters and shell had been collected. Fixed stations on public reefs in Galveston Bay were sampled on a quarterly basis; the number of sample sites varied from year to year. Beginning in 1976, five 1-minute timed tows were also made at ten sites on Redfish Bar in central Galveston Bay during September or October prior to the usual 1 November opening of the oyster season. Five 1-minute timed tows were added at selected sites in the East Matagorda, Matagorda, San Antonio, and Aransas Bay systems during September-October of 1984 and 1985 (Benefield et al. 1986, Hammerschmidt and McEachron 1986).

Current sampling procedures utilize 30-second tow times. There were two reasons for reducing tow time from 1 minute to 30 seconds. The first reason was that before a 1-minute tow was completed the dredge would sometimes fill to capacity when oysters were numerous or would begin to fish inefficiently when large clumps of oysters were encountered (TPWD unpublished data). The second reason was to accommodate the increase in samples being collected and the wider area of coverage of the sampling program within allotted budget and manpower constraints. The 30-second tow time allows more samples to be collected and avoids potential problems associated with inefficient fishing of the dredge. A concern caused by reducing tow time was whether these data were comparable to data collected in 1-minute tows (Matlock and Hofstetter 1986). The objectives of the present study were to determine if 30-second tows provide data equivalent to those collected in 1-minute tows and if interpretation of the data is affected.

MATERIALS AND METHODS

To improve upon TPWD monitoring procedures, the routine sampling design for Eastern oysters was changed in September 1984. Coordinates were used in

each bay system to generate 1-minute longitude by 1-minute latitude grids. Each grid was subdivided into 144 5-second "gridlets". Each bay was stratified into reef grids (grids in which oysters form charted reefs that are ≥ 0.2 m higher than adjacent bottom for a continuous distance of ≥ 91.4 m long and 0.4 m wide and are in water ≥ 1 m deep) and non-reef grids (remaining bay bottom ≥ 1 m deep). Beginning in October 1984, 80 reef grids and 20 non-reef grids in Galveston Bay were randomly selected each month. Oyster dredge sampling sites were then randomly selected from among all gridlets within a grid that contained the respective reef and non-reef area within the selected grid. No station was duplicated in a month. The oyster dredge was dragged in a straight line for 30 seconds within each selected gridlet (Benefield et al. 1986). Beginning in January 1986 routine monitoring of oysters was initiated in all bay systems. The number of samples to be collected in each bay was based on information from Galveston Bay (Matlock and Hofstetter 1986). Current TPWD sampling is 56 reef grid samples/mo from each of Galveston and Aransas Bays, 26 samples/mo from each of Matagorda, East Matagorda, San Antonio, and Corpus Christi Bays, and two reef grid samples/mo in each of Sabine Lake and lower Laguna Madre. Stations were duplicated no more than twice each month except in Sabine Lake and lower Laguna Madre where five replicate tows were made in each grid. Twenty different non-reef grid sites/mo are sampled in each bay system.

In this study, ten historical sampling sites on Redfish Bar in Galveston Bay and five randomly selected reef grids in each of the Sabine Lake, Matagorda, East Matagorda, San Antonio, Aransas, Corpus Christi, and lower Laguna Madre Bay systems were sampled during the last 2 weeks of March 1987 (Appendix A). Samples were collected with a 9-tooth Louisiana style oyster dredge (49.5 cm wide, 24.1 cm high with a 35.6 cm deep bag) with a capacity of approximately 35 liters. This is the same dredge used in 30-second routine monitoring tows and for the 1-minute tows (Hammerschmidt and McEachron 1986). Initially, the dredge was towed at each sample site for 30 seconds. Timing started as the dredge began to drag and ended 30 seconds later. After emptying the dredge, the procedure was repeated on a line immediately adjacent and parallel to the line of the first tow and timed for 1 minute. Eastern oysters from each tow were measured (nearest mm) along the dorsoventral axis of the right valve, counted and categorized by three size groups: spat (5-25 mm), small (26-75 mm), and market (≥ 76 mm).

No oysters were collected in Corpus Christi Bay or in the lower Laguna Madre (Appendix B). Only one market oyster was collected in Aransas Bay. No spat were counted in the 1-minute tows from Sabine Lake. Therefore, these bays were eliminated from the respective analyses.

A binomial test of proportions by bay system and aggregate total was performed on oyster counts in each size group. If a 30-second tow gives abundance information equivalent to a 1-minute tow, then of the total number (N) of oysters captured in both the 30-second and 1-minute tows combined, $1/3$ should be the number caught in the 30-second tow (n_1). The null hypothesis of $n_1/N = p = 1/3$ was tested using a z or X^2 statistic (where $z^2 = X^2$) (Snedecor and Cochran 1980).

The statistic was computed as:

$$z = \frac{|n_1 - (1/3)N| - (1/2)}{\sqrt{(1/3)(2/3)N}}$$

RESULTS

The proportion of market oysters collected in the 30-second tow was significantly ($P < 0.01$) greater than the $1/3$ proportion expected for the aggregated data, but no difference from the $1/3$ proportion was detected for spat or small oysters (Table 1). In Sabine Lake and San Antonio Bay, the proportion of market oysters significantly ($P < 0.05$) exceeded $1/3$ of the total caught. In Matagorda Bay, the proportion was significantly less than $1/3$. No difference from the $1/3$ proportion was detected in Galveston and East Matagorda Bays.

Significant deviations from the $1/3$ proportion for small oysters were found in Galveston, East Matagorda and San Antonio Bays; the actual proportion was greater than the expected proportion. In Aransas Bay there was a significant deviation from $1/3$ but the actual proportion was not greater than the expected proportion.

Significant deviations for spat were found in Galveston, East Matagorda and Aransas Bays. Both East Matagorda and Aransas Bays' catches of spat in the 30-second tow were greater than the expected $1/3$ proportion.

DISCUSSION

The highly variable nature of oyster sampling data is evident in the numbers collected in individual samples and in the significant deviations found when individual bay systems were examined. However, the analyses support the hypothesis that information on small oysters and spat obtained in 30-second tows is equivalent to that obtained in 1-minute tows. Overfilling of the dredge or inefficient fishing for market oysters may be occurring in 1-minute tows. This is supported by the fact that the 30-second tows contained greater numbers than the expected $1/3$ proportion. These findings suggest that estimates of relative abundance of market oysters based on 1-minute tows may be conservative (biased low). The 30-second tow strategy is more sensitive to fluctuations in oyster abundance than the 1-minute tow strategy and should be used by the TPWD to monitor relative abundance of Eastern oysters. Closure recommendations, based on a defined low level of relative market oyster abundance, would be more likely to occur using estimates from 30-second tows than estimates from 1-minute tows.

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Table 1. Number of Eastern oysters caught in 30-second (n_1) and 1-minute (n_2) tows in Texas bays during March 1987, and associated binominal test statistic (z) for the hypothesis that the proportion of the total (N) caught in 30-second tows is $1/3$. ND = no data.

| Bay system | Spat (5-25 mm) | | | | Small (26-75 mm) | | | | Market (≥ 76 mm) | | | |
|----------------|----------------|-------|-----|---------|------------------|-------|-----|---------|------------------------|-------|-----|--------------|
| | n_1 | n_2 | N | z | n_1 | n_2 | N | z | n_1 | n_2 | N | z |
| Sabine Lake | ND | ND | ND | ND | 6 | 4 | 10 | 1.45 | 25 | 13 | 38 | 4.07** |
| Galveston | 25 | 232 | 257 | -8.09** | 37 | 47 | 84 | 1.97* | 22 | 26 | 48 | 1.68 |
| Matagorda | 47 | 64 | 111 | 1.91 | 47 | 118 | 165 | -1.40 | 11 | 48 | 59 | -2.53* |
| East Matagorda | 195 | 281 | 476 | 3.48** | 87 | 125 | 212 | 2.31* | 37 | 54 | 91 | 1.37 |
| San Antonio | 4 | 13 | 17 | -1.11 | 54 | 53 | 107 | 3.66** | 25 | 27 | 52 | 2.11* |
| Aransas | 59 | 31 | 90 | 6.37** | 44 | 179 | 223 | -4.38** | 1 | 0 | 1 | ^a |
| TOTAL | 330 | 621 | 951 | 0.86 | 275 | 526 | 801 | 0.56 | 121 | 168 | 289 | 3.02** |

* $P < .05$

** $P < .01$

^anot determined due to 0 catch in n_2 .

Appendix A. Oyster dredge reef sites sampled in Texas bays during March 1987.

Table A.1. Oyster dredge reef sites sampled in Texas bays during March 1987.

| Bay system | Grid No. ^a | Latitude | Longitude |
|----------------|-----------------------|-----------|-----------|
| Sabine Lake | 156 | 29°47'05" | 93°54'15" |
| | 156 | 29°47'05" | 93°54'55" |
| | 156 | 29°47'05" | 93°54'30" |
| | 156 | 29°47'10" | 93°54'50" |
| | 156 | 29°47'50" | 93°54'50" |
| Galveston Bay | 279 | 29°32'15" | 94°49'50" |
| | 315 | 29°31'00" | 94°47'51" |
| | 345 | 29°30'42" | 94°49'43" |
| | 371 | 29°29'33" | 94°50'01" |
| | 370 | 29°29'58" | 94°51'09" |
| | 343 | 29°30'50" | 94°51'68" |
| | 368 | 29°29'33" | 94°53'08" |
| | 341 | 29°30'08" | 94°53'09" |
| | 341 | 29°30'83" | 94°53'26" |
| 340 | 29°30'50" | 94°54'84" | |
| East Matagorda | 98 | 28°38'20" | 95°57'05" |
| | 85 | 28°40'25" | 95°52'55" |
| | 91 | 28°39'15" | 95°56'45" |
| | 83 | 28°40'15" | 95°54'15" |
| | 84 | 28°40'10" | 95°53'25" |
| Matagorda | 158 | 28°38'35" | 96°14'40" |
| | 108 | 28°39'25" | 96°35'20" |
| | 297 | 28°34'55" | 96°33'55" |
| | 44 | 28°42'00" | 96°38'15" |
| | 61 | 28°41'20" | 96°38'30" |
| San Antonio | 178 | 28°12'55" | 96°47'20" |
| | 170 | 28°13'50" | 96°42'35" |
| | 139 | 28°15'35" | 96°43'00" |
| | 101 | 28°17'05" | 96°47'25" |
| | 80 | 28°19'50" | 96°45'00" |
| Aransas | 141 | 28°06'30" | 97°06'10" |
| | 142 | 28°06'20" | 97°05'55" |
| | 163 | 28°05'40" | 97°09'15" |
| | 614 | 28°05'50" | 97°08'50" |
| | 166 | 28°05'45" | 97°06'15" |
| Corpus Christi | 180 | 27°45'25" | 97°20'55" |
| | 84 | 27°50'25" | 97°20'45" |
| | 73 | 27°51'40" | 97°15'55" |
| | 88 | 27°50'15" | 97°16'10" |
| | 88 | 27°50'15" | 97°16'25" |

Table A.1. (Cont'd.)

| Bay system | Grid No. | Latitude | Longitude |
|--------------------|----------|-----------|-----------|
| Lower Laguna Madre | 385 | 26°01'35" | 97°11'30" |
| | 385 | 26°01'36" | 97°11'30" |
| | 385 | 26°01'37" | 97°11'30" |
| | 385 | 26°01'38" | 97°11'30" |
| | 385 | 26°01'39" | 97°11'30" |

^aMarine Resource Monitoring Operations Manual. 1987. Unpublished memorandum. Texas Parks and Wildlife Department, Coastal Fisheries Branch. Austin, Texas.

Appendix B. Number of Eastern oysters caught in each tow of 30 seconds and 1 minute duration on reef sites in Texas bays during March 1987.

Table B.1. Number of Eastern oysters caught in each tow of 30 seconds and 1 minute duration on reef sites in Texas bays during March 1987. ND = no data.

| Bay system | Spat (5-25 mm) | | Small (26-75 mm) | | Market (≥ 76 mm) | |
|----------------|----------------|----------|------------------|----------|------------------------|----------|
| | 30 seconds | 1 minute | 30 seconds | 1 minute | 30 seconds | 1 minute |
| Sabine Lake | 11 | ND | 2 | 1 | 5 | 3 |
| | 0 | ND | 2 | 2 | 5 | 4 |
| | 25 | ND | 1 | 0 | 9 | 0 |
| | 10 | ND | 0 | 0 | 3 | 2 |
| | 0 | ND | 1 | 1 | 3 | 4 |
| Galveston | 0 | 0 | 4 | 4 | 2 | 4 |
| | 0 | 5 | 22 | 6 | 10 | 3 |
| | 0 | 101 | 0 | 13 | 0 | 3 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| | 9 | 10 | 0 | 0 | 0 | 0 |
| | 16 | 83 | 3 | 7 | 2 | 4 |
| | 0 | 33 | 7 | 9 | 6 | 4 |
| Matagorda | 0 | 0 | 1 | 8 | 2 | 8 |
| | 6 | 5 | 0 | 4 | 0 | 0 |
| | 1 | 0 | 5 | 21 | 1 | 5 |
| | 6 | 0 | 16 | 35 | 0 | 7 |
| | 34 | 32 | 21 | 39 | 6 | 23 |
| East Matagorda | 0 | 27 | 4 | 19 | 4 | 13 |
| | 31 | 26 | 18 | 17 | 0 | 0 |
| | 18 | 22 | 9 | 21 | 3 | 8 |
| | 75 | 73 | 9 | 31 | 19 | 15 |
| | 39 | 147 | 40 | 37 | 10 | 17 |
| San Antonio | 32 | 13 | 11 | 19 | 5 | 14 |
| | 0 | ND | 6 | 5 | 2 | 5 |
| | 10 | ND | 2 | 2 | 8 | 6 |
| | 0 | ND | 24 | 18 | 9 | 6 |
| | 0 | 0 | 0 | 1 | 0 | 0 |
| Aransas | 4 | 13 | 22 | 27 | 6 | 10 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| | 59 | 31 | 4 | 35 | 1 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| | 40 | ND | 40 | 144 | 0 | 0 |

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