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SUMMARY

1. There are fewer living oysters on Virginia's Public Oyster Shoals than in previous years. Only one shoal sampled (Horsehead Reef in the James River) has over 1000 living oysters per bushel of bottom material, and only three have over 500 living oysters per bushel.

2. There are commercial quantities of 3" market oysters on Bowler's Rock in the Rappahannock River. Most of these will be harvested during the present season or will die from disease prior to the 1993/94 season. There are some 2.5" market oysters on Ross Rock in the Rappahannock River and Horsehead, Point of Shoals and Long Rock in the James River.

3. Seed oysters remain plentiful in the Horsehead and Point of Shoals region of the James River, as the result of good recruitment in 1990 and 1991. Barring a serious drought, few of these should be lost to disease in the near future and will support limited market and seed harvest for the next year or two. Seed that was plentiful in the Piankatank and Great Wicomico Rivers last year has succumbed to disease.

4. 1992 was a poor year for recruitment, as the maximum number of spat found at any location was 228 per bushel (Haynie Bar, Great Wicomico River).

5. Disease caused by *Perkinsus marinus* has resulted in the mortality of market and seed oysters on all shoals except those noted above. Overall, the prevalence of *P. marinus* found during this survey was higher than in previous years. There is no indication that disease mortality will abate in the near future on the majority of shoals, but there are indications that mortality may be limited at upriver shoals in both the James and Rappahannock Rivers.

INTRODUCTION

Oysters have been harvested from Virginia waters as long as humans have inhabited the area. Depletion of natural stocks in the late 1880's led to the establishment of regulations by public fisheries agencies. A survey of bottom areas in which oysters grew naturally was completed in 1896 under the direction of Lt. Baylor, USN. These areas (over 243,000 acres) were set aside by legislative action for public use and have come to be known as the Baylor Survey Grounds or Public Oyster Grounds of Virginia, and are presently administered by the Virginia Marine Resources Commission (VMRC).

Twice a year the Virginia Institute of Marine Science (VIMS) conducts a survey of selected public oyster bars (shoals) in Virginia waters for the purpose of assessing the status of the resource. Surveys conducted in the spring provide information about over-winter mortality and relative fishing pressure from the current harvesting season[1]. Surveys conducted in the fall provide information about spatfall or recruitment, summer (disease) mortality, and the status of each shoal as a source of seed or market oysters prior to the beginning of the harvesting season.

This report summarizes the findings of the Fall 1992 Oyster Shoal Survey, conducted between 28 September and 10 October, 1992.

METHODS

Three 0.5 bushel (25 quart) samples of bottom material were taken at each shoal using a 24 inch dredge having 4 inch teeth. The shoals sampled are shown in Figure 1. Sampling dates, times, water depths, and Loran coordinates are given in Table I.

The following data were obtained for each sample: number of market (>3" in shell height) oysters, number of small (submarket sized) oysters, number of spat (1991 recruits), number of recent boxes (inside of shells clean; dead a month or less), and number of old boxes (inside of shells dirty; dead a month or more). Surface water samples were obtained at each location for temperature (°C) and salinity (ppt) determination. Where possible, 20-25 oysters were collected for disease analysis (prevalence of *Perkinsus marinus*)[2]. In addition, observations

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[1]Oysters may be harvested from public shoals in Virginia between 1 October and 1 June with the exception of the seaside of the Eastern Shore, where harvesting is restricted to the period from 1 November to 1 April.

[2]More complete disease data, including prevalence and intensity of both MSX and *P. marinus* in Virginia waters, are available from the VIMS disease monitoring program.

were made regarding the condition of the bottom at each shoal: bottom material, predators, and fouling organisms.

Data were summarized for each shoal as the average number of market, small, spat, and total oysters per bushel and percent recent mortality, calculated as : [recent boxes and gapers/live oysters + recent boxes and gapers] x 100.

RESULTS
(Refer to Table II)

James River

Seven shoals were sampled in the James River. Surface temperature ranged from 17.8 °C at Nansemond Ridge to 21.2 °C at Dry Shoal. Salinity was lowest at Horsehead (9.0 ppt) and highest at Thomas Rock and Nansemond Ridge (17.0 ppt).

Market oysters (>3") were most numerous at Point of Shoals and Long Rock where 11 and 10 per bushel were found, respectively. Average counts of market oysters per bushel were 9 at Horsehead, 3 at Dry Shoal, 6 at Wreck Shoal, and 1 at Thomas Rock. Market oysters were not found at Nansemond Ridge. The number of small oysters was greatest at Horsehead, where 1132 per bushel were recovered. At Point of Shoals, Long Rock, Dry Shoal and Wreck Shoal, small oysters averaged between 200 and 700 per bushel, while average counts of 35 and 58 per bushel were found at Thomas Rock and Nansemond Ridge, respectively. Recruitment was greatest at Point of Shoals, where 120 spat per bushel were found. About 85 spat per bushel were counted at Horsehead, 21 at Dry Shoal, and 11 at Long Rock. Fewer than 10 spat per bushel were obtained at Wreck Shoal, Thomas Rock, and Nansemond Ridge.

The number of old boxes ranged from 26 per bushel at Point of Shoals to 123 per bushel at Wreck Shoal, while the number of new boxes ranged from 9 per bushel at Nansemond Ridge to 108 per bushel at Wreck Shoal. Recent mortality ranged from 1.2% at Horsehead to 37.7% and Thomas Rock.

Prevalence of *P. marinus* was 72% at Horsehead, 96% at Point of Shoals, and 100% at Wreck Shoal.

York River

Water temperature (surface) was 22.2 °C at Bell Rock and 22.7 °C at Aberdeen Rock in the York River. Salinity was 12.0 ppt at Bell Rock, the upriver station, and 16.0 ppt at Aberdeen Rock, the downriver station.

No market oysters were found at either station. There were 5 small oysters and 1 spat per bushel at Bell Rock and 3 small oysters and 1 spat per bushel at Aberdeen Rock.

Three old boxes per bushel were counted at both Bell Rock

and Aberdeen Rock. There was 1 new box per bushel at Bell Rock and 2 new boxes per bushel at Aberdeen Rock. Recent mortality was 14.3% at Bell Rock and 33.3% at Aberdeen Rock.

We were unable to determine the prevalence of *P. marinus* in the York River due to the scarcity of living oysters.

Mobjack Bay

Surface temperature was 22.0 °C and salinity was 18.0 ppt at Tow Stake in Mobjack Bay.

At Tow Stake, 1 market oyster per bushel was found; zero were found at Pultz Bar. There was 1 small oyster per bushel at Pultz Bar and 17 per bushel at Tow Stake. Zero spat per bushel were found at Pultz Bar and 3 spat per bushel were found at Tow Stake.

At Pultz Bar there were 9 old and 0 new boxes per bushel, and at Tow Stake 64 old boxes and 1 new box per bushel were found. Resultant recent mortality was 0% at Pultz Bar and 4.5% at Tow Stake.

P. marinus was found in 100% of the oysters sampled from Tow Stake.

Piankatank River

In the Piankatank River, surface temperature was 18.0 °C at Burton Point and 19.0 °C at Ginney Point. Salinity was 15.0 ppt at Ginney Point and 16.0 ppt at Burton Point.

No market oysters were found at either of the stations. There were 69 small oysters per bushel at Ginney Point and 83 per bushel at Burton Point. Spat counts per bushel averaged 27 at Ginney Point and 83 at Burton Point.

There were 156 old boxes and 18 new boxes per bushel at Ginney Point. Recent mortality was 15.8% at Ginney Point.

Prevalence of *P. marinus* was 100% at both Ginney Point and Burton Point.

Rappahannock River

At the eight stations surveyed in the Rappahannock River, surface water temperature ranged from 17.0 °C at Parrot Creek to 18.9 °C at Ross Rock. Salinity generally increased in a downriver direction, from 10.0 ppt at Ross Rock to 16.0 ppt at Broad Creek.

Counts of market oysters per bushel were 41 at Bowlers Rock, decreasing to 7 at Ross Rock, 3 at Morattico Bar, 1 at Smokey Point, and 0 at all other stations. Small oysters were most numerous at Ross Rock (111 per bushel), decreasing to 61 per

bushel at Broad Creek, 49 per bushel at Parrot Creek, 31 per bushel at Hog House, and fewer than 10 at all other stations. The number of spat per bushel was greatest at the three downriver stations (38 per bushel at Broad Creek, 21 at Parrot Creek, and 19 at Drumming Ground). No spat were found at Morattico Bar and Bowlers Rock, and 9 spat per bushel were recorded at Ross Rock.

The number of old boxes per bushel ranged from 1 at Ross Rock to 72 at Broad Creek, and the number of new boxes per bushel ranged from 0 at Ross Rock to 24 per bushel at Parrot Creek. Overall, recent mortality ranged from 0% at Ross Rock to 33.3% at Morattico Bar.

Prevalence of *P. marinus* was 24% at Ross Rock, 92% at Broad Creek, 96% at Bowlers Rock, and 100% at all other stations. Even though there has been little if any disease mortality ocurring at Ross Rock, 24% prevalence is considerably higher than the 0% recorded in 1991.

Corrotoman River

At the Middle Ground station in the Corrotoman River, temperature at the surface was 18.8 °C and salinity was 15.0 ppt.

There were 0 market oysters per bushel, 13 small oysters per bushel, and 11 spat per bushel.

An average of 41 old boxes and 9 new boxes per bushel were found. Recent mortality was thus 27.3%.

P. marinus was found in 95% of the oysters sampled.

Great Wicomico River

Temperature at the surface ranged from 18.0 °C to 19.0 °C at the three stations sampled in the Great Wicomico River. Salinity was 16.0 ppt at all stations.

No market oysters were found at any of the stations. The number of small oysters per bushel ranged from 18 at Whaleys East to 33 at Fleeton Point. Spat counts were 45 per bushel at Whaleys East, 51 per bushel at Fleeton Point, and 228 per bushel at Haynie Point.

The average number of old boxes per bushel was 113 at Haynie Point, 86 at Whaleys East, and 192 at Fleeton Point. The average number of new boxes per bushel was 21 at Haynie Point, 27 at Fleeton Point, and 23 at Whaleys East. Recent mortality was 7.8% at Haynie Point, 26.7% at Whaleys East, and 24.3% at Fleeton Point.

The prevalence of *P. marinus* was 87% at both Haynie Point and Whaleys East, and 96% at Fleeton Point.

DISCUSSION

Market Oysters

Market oysters represent the commercially harvestable portion of the population. The greatest concentration of market oysters is presently in the upper James River (Horsehead, Point of Shoals, and Long Rock) and in the upper Rappahannock River (Ross Rock and Bowlers Rock). The average number of market oysters in the James River (9-11 per bushel at Horsehead and Point of Shoals) is about the same as that found in 1991 but lower than in previous years (Figure 2). In the Rappahannock River, the number of market oysters found this year at Bowlers Rock (41 per bushel) was higher than in any year since 1987, but the number of market oysters found at Morattico Bar (3 per bushel) is the lowest ever recorded (Figure 3). Based on these results, market oyster harvest from public grounds in Virginia for the 1992-93 harvest season probably will be similar to the total from 1991-92.

The difference in market oyster production seen over the last 1-2 years between Bowlers Rock and Morattico Bar may be the result of differential disease mortality. Even though the difference in prevalence of *P. marinus* is not great, 96% vs. 100%, the difference in intensity is striking. All but five of the oysters sampled at Morattico Bar had heavy or moderate infections, while only 3 oysters sampled from Bowlers Rock had heavy or moderate infections. This indicates that even though *P. marinus* is prevalent at Bowlers Rock, environmental conditions have prevented it from causing serious mortality. This is supported by the difference in recent mortality at the two shoals (33% at Morattico Bar vs. 7% at Bowlers Rock). A similar situation exists in the James River between Horsehead-Pt. of Shoals and shoals downriver, with the exception that growth to market size is slower than in other rivers.

Small Oysters

Small oysters are over 1 year old but are too small to be harvestable. They represent oysters that are potentially harvestable next year or the year after, depending on survival and growth rates. The upper James River (Horsehead, Point of Shoals and Long Rock) had between 515 and 1132 small oysters per bushel. Ross Rock in the Rappahannock River had 111 small oysters per bushel. In the James River in particular, the large number of small oysters found in 1992 is correlated with a large number of spat in 1990 and 1991. These areas are presently the best "seed"[3] areas in the state and have the best chance of producing market oysters in the next two years.

Movement of seed oysters has to be done with careful

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[3]Seed oysters are small oysters that are moved to other areas (usually private grounds) for growout.

consideration of the potential for transporting disease along with seed. In general, seed oysters should never be moved to an area of lower *P. marinus* prevalence than from where they came. Also, the survival rate of seed oysters to market size will be determined to a large extent by resident disease activity at the growout site. For example, even though *P. marinus* is now resident at all shoals within the state, as pointed out previously, mortality to date has not been severe in the James River above Dry Shoal and in the Rappahannock River at Bowlers Rock or above.

Spat

Spat are juvenile oysters that have been recruited into the population within the last spawning season (few months). They are potentially important as seed oysters (in 1-3 years) and market oysters (in 3-5 years), depending on growth and survival. Overall, recruitment was very poor compared to 1991 and 1990. The highest number of spat found anywhere was 120 per bushel at Point of Shoals in the James River. Speculation as to why 1992 was such a poor recruiting year might begin with the fact that the summer was unusually cool and wet, which may have inhibited gamete production and spawning.

Mortality and Disease

Prediction of future seed and market harvests is difficult due to differential mortality rates caused by predators such as crabs and the pathogens MSX and *P. marinus*. Mortality caused by predators is usually quite high for small oysters (spat), but decreases as oysters become larger. Mortality caused by disease becomes important in the second and third years of growth, particularly as oysters are reaching market size.

Overall, prevalence, intensity, and distribution of *P. marinus* is the greatest it has ever been. *P. marinus* is resident at all oyster shoals in the state. The impact the disease caused by this parasite is having can be seen in the box counts from this survey. For example, there were over 100 boxes per bushel at Wreck Shoal in the James River, Ginney Point in the Piankatank River, and Haynie Point and Fleeton Point in the Great Wicomico River. Recent mortalities of over 25% were found at Wreck Shoal and Thomas Rock in the James River, Aberdeen Rock in the York River, Morattico Bar, Hog House, and Parrot Creek in the Rappahannock River, Middle Ground in the Corrotoman River, and Whaleys East in the Great Wicomico River. The threat posed by oyster pathogens, especially *P. marinus*, makes any attempt to rehabilitate depleted oyster populations extremely difficult.

ACKNOWLEDGEMENTS

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TABLE I

Station Locations and Dates Sampled - Fall 1992

Station	Date	Time	Depth	Loran Coordinates	
James River					
Horsehead	30 Sept.	0930	5.8′	27346.0	41333.2
Pt. of Shoals	30 Sept.	1245	7.3′	27344.0	41310.6
Long Rock	30 Sept.	1100	9.0′	27338.4	41312.9
Dry Shoal	29 Sept.	0925	5.0′	27332.5	41302.3
Wreck Shoal	29 Sept.	1055	10.0′	27326.0	41301.8
Thomas Rock	10 Oct.	0940	12.0′	27302.8	41287.3
Nansemond Ridge	10 Oct.	1110	8.5′	27280.6	41218.8
York River					
Bell Rock	28 Sept.	1005	12.0′	27424.7	41596.8
Aberdeen Rock	28 Sept.	0910	5.3′	27368.3	41501.2
Mobjack Bay					
Pultz Bar	28 Sept.	1310	15.0′	27310.6	41534.6
Tow Stake	28 Sept.	1345	15.0′	27316.9	41521.5
Piankatank River					
Ginney Point	1 Oct.	1110	7.5′	27347.2	41659.6
Burton Point	1 Oct.	1000	8.5′	27326.4	41652.3
Rappahannock River					
Ross Rock	6 Oct.	1255	5.5′	27496.8	41897.8
Bowlers Rock	6 Oct.	1125	8.5′	27472.4	41847.3
Morattico Bar	6 Oct.	1035	14.0′	27447.0	41820.0
Smokey Point	6 Oct.	0945	15.0′	27418.1	41779.9
Hog House	7 Oct.	1410	16.0′	27398.3	41725.8
Drumming Ground	7 Oct.	1250	12.0′	27377.8	41738.1
Parrot Creek	7 Oct.	1135	11.0′	27361.9	41710.4
Broad Creek	7 Oct.	1020	14.0′	27329.0	41698.0
Corrotoman River					
Middle Ground	7 Oct.	1320	14.0′	27386.2	41763.0
Great Wicomico River					
Haynie Point	4 Oct.	1135	5.0′	27366.4	41881.4
Whaleys East	2 Oct.	1100	14.0′	27361.0	41866.7
Fleeton Point	2 Oct.	1010	9.4′	27358.2	41868.1

TABLE II

Results of Public Oyster Shoal Survey - Fall 1992

STATION	TEMP. (°C)	SAL. (ppt)	AVERAGE NO. OYSTERS PER BUSHEL Market	Small	Spat	Total	BOXES Old	New	% REC. MORT.	Perkinsus (% Prev.)
James River										
Horsehead	20.0	9.0	9	1132	85	1226	27	15	1.2	72
Pt. of Shoals	19.5	10.0	11	642	120	773	26	11	1.4	96
Long Rock	20.0	10.0	10	515	11	536	41	23	4.1	
Dry Shoal	21.2	12.0	3	236	21	260	69	29	10.0	
Wreck Shoal	20.4	15.0	6	301	2	309	123	108	25.9	100
Thomas Rock	18.1	17.0	1	35	2	38	74	23	37.7	
Nansemond Rdg	17.8	17.0	0	58	8	66	45	9	12.0	
York River										
Bell Rock	22.2	12.0	0	5	1	6	3	1	14.3	
Aberdeen Rock	22.7	16.0	0	3	1	4	3	2	33.3	
Mobjack Bay										
Pultz Bar	----	----	0	1	0	1	9	0	0.0	
Tow Stake	22.0	18.0	1	17	3	21	64	1	4.5	100
Piankatank River										
Ginney Point	19.0	15.0	0	69	27	96	156	18	15.8	100
Burton Point	18.0	16.0	0	83	83	166	---	---	---	100

TABLE II, continued

STATION	TEMP. (°C)	SAL. (ppt)	AVERAGE NO. OYSTERS PER BUSHEL Market	Small	Spat	Total	BOXES Old	New	% REC. MORT.	Perkinsus (% Prev.)
Rappahannock River										
Ross Rock	18.9	10.0	7	111	9	127	1	0	0.0	24
Bowlers Rock	17.8	14.0	41	11	0	52	29	4	7.1	96
Morattico Bar	18.1	16.0	3	3	0	6	31	3	33.3	100
Smokey Point	17.3	15.0	1	8	1	10	52	2	16.7	100
Hog House	18.1	15.0	0	31	3	34	63	12	26.1	100
Drumming Gnd	18.3	15.0	0	9	19	28	33	3	9.7	
Parrot Creek	17.0	15.0	0	49	21	70	61	24	25.5	100
Broad Creek	17.6	16.0	0	61	38	99	72	7	6.6	92
Corrotoman River										
Middle Ground	18.8	15.0	0	13	11	24	41	9	27.3	95
Great Wicomico River										
Haynie Point	19.0	16.0	0	21	228	249	113	21	7.8	87
Whaleys East	18.5	16.0	0	18	45	63	86	23	26.7	87
Fleeton Point	18.0	16.0	0	33	51	84	192	27	24.3	96

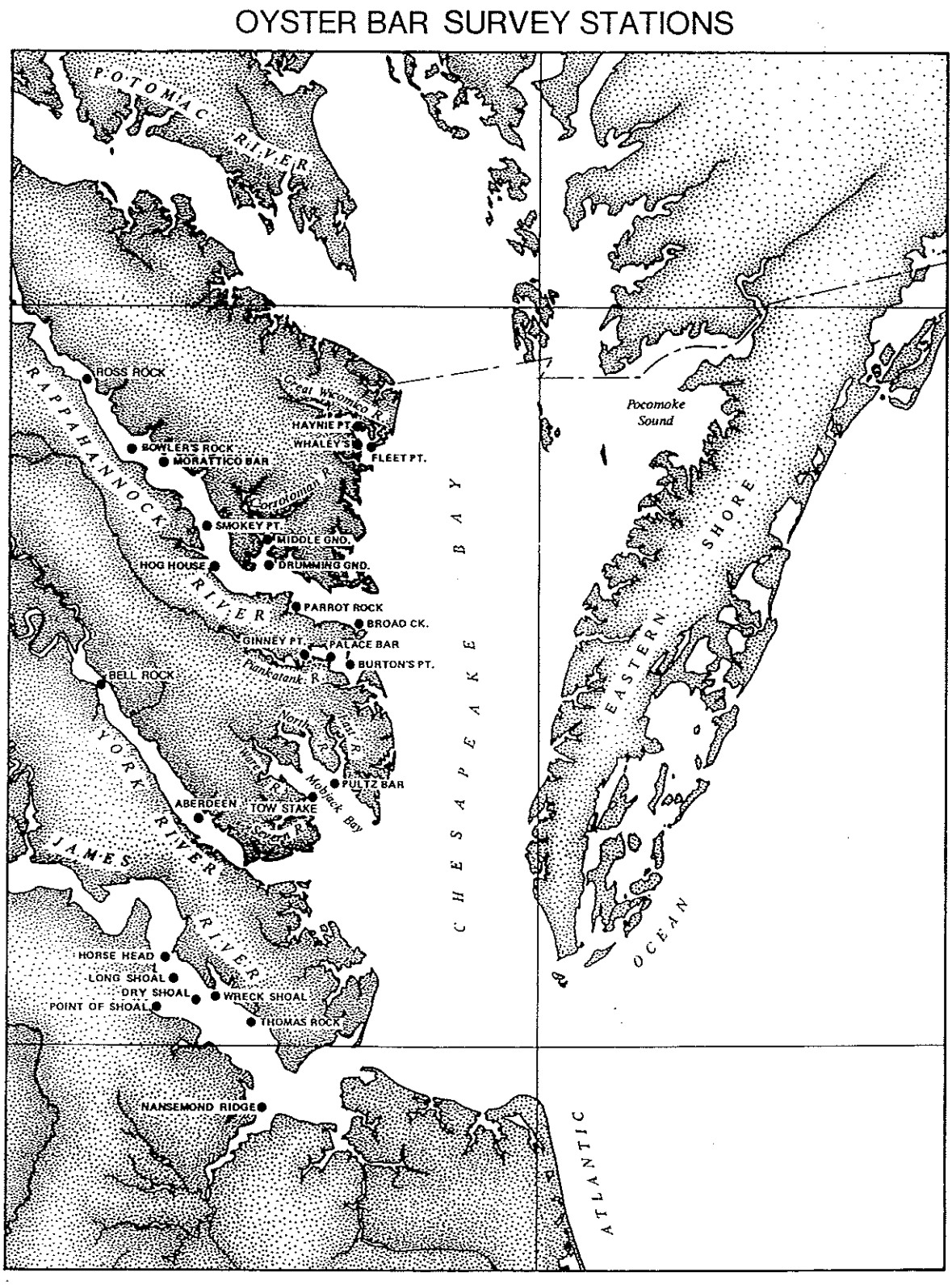

Figure 1. Location of oyster shoals sampled for Fall 1992 Survey.

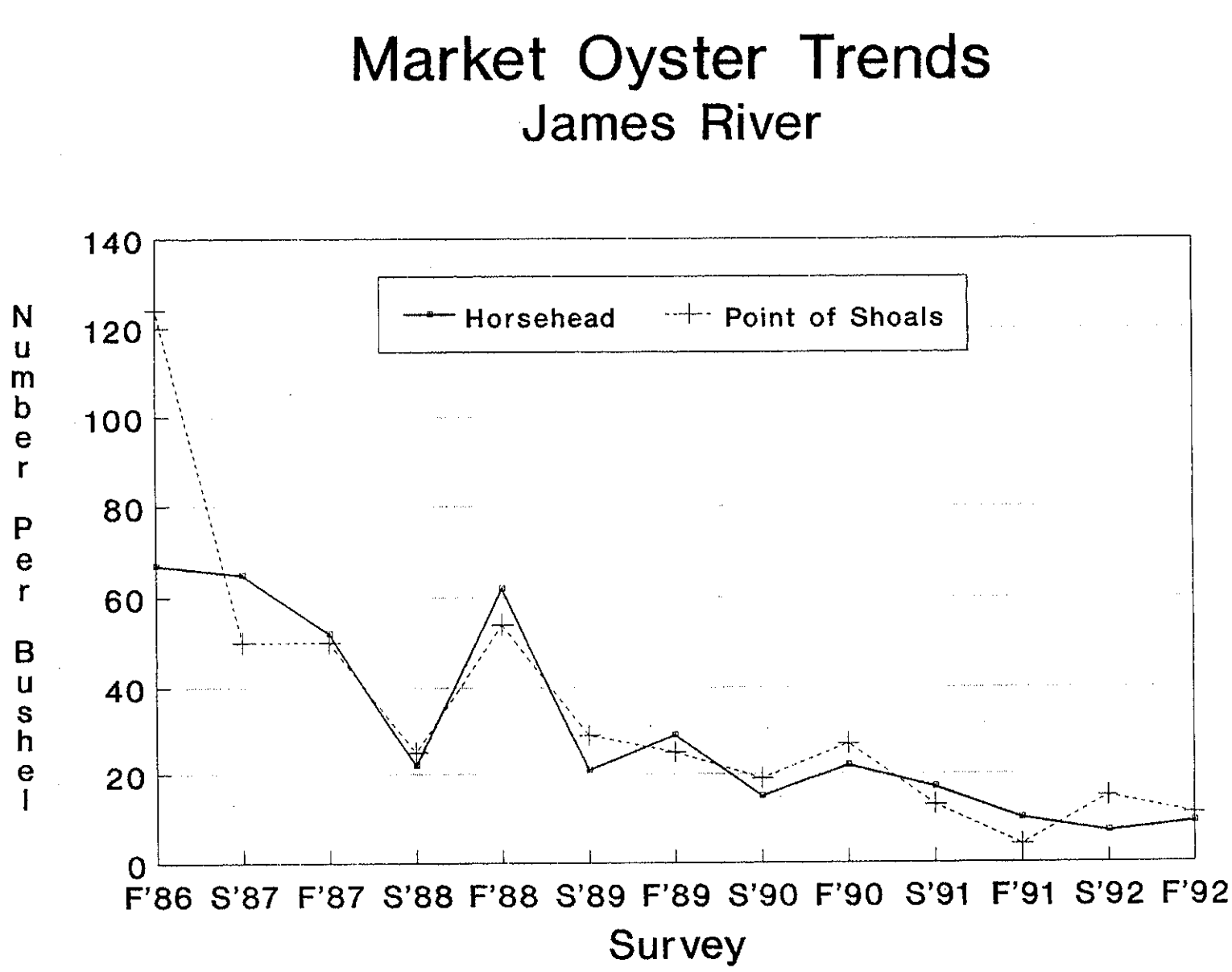

Figure 2. Average number of market oysters per bushel at Horsehead and Point of Shoals, James River, Virginia

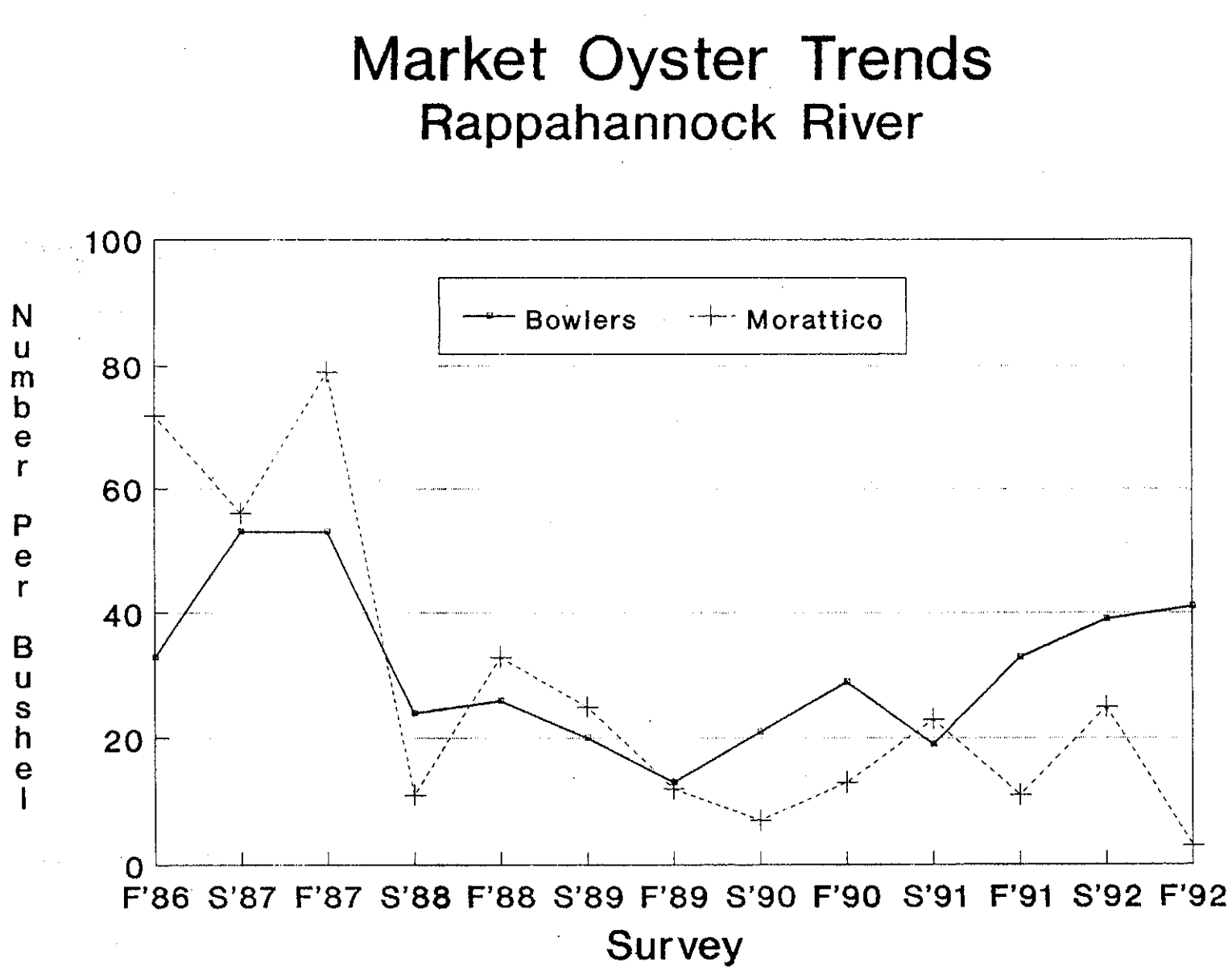

Figure 3. Average number of market oysters per bushel at Bowlers Rock and Morattico Bar, Rappahannock River, Virginia