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THE PHYSIOGRAPHY AND EXTENT OF PUBLIC OYSTER GROUNDS IN POCOMOKE SOUND, VIRGINIA

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ABSTRACT Public oyster grounds in Pocomoke Sound, Virginia, were charted in 1978 using an electronic positioning system to locate areas of oysters, shell, sand or mud. Over five thousand stations were occupied and 1,267 samples of the substrate were taken with hydraulically operated patent tongs. The information was used to draw large scale charts showing shorelines, depths, bottom types and outlines of public grounds. Substrates, elevations, slopes, oyster densities and spatfall levels were analyzed.

INTRODUCTION

This paper describes the location, extent, and bottom characteristics of the oyster-producing areas in Pocomoke Sound, a sub-estuary in Chesapeake Bay, Virginia. The data are related to data from similar observations made in the James River, Virginia and in other areas, and to the James River's geologic history during the recent Holocene.

The present study utilized data obtained during an extensive bay wide investigation lasting from 1976 to 1981 (Haven et al. 1981)[1]. A portion of this study dealing with the James River has been published (Haven and Whitcomb 1983) and reference may be made to the original report and the latter publication for additional details on sampling and survey techniques.

Pocomoke Sound is a large embayment shared by Maryland and Virginia on the eastern side of Chesapeake Bay. The portion discussed here is bounded on the north by the Maryland-Virginia border, on the east by the headlands of the Eastern Shore, and on the west by Watts Island. The southern boundary is slightly south of a line from Watts Island to Onancock Creek.

In the past, Pocomoke Sound was said to be enormously productive for oysters but reliable data are unavailable. During the mid 1860's the entire Pocomoke Sound area (Maryland and Virginia) supported combined efforts of hundreds of dredge boats but by 1879 intense harvest from both states had depleted the area to the point where dredging was not profitable (Ingersoll 1881). Other areas in Virginia were being overfished during the late 1800s by boats equipped with dredges and, as a remedial measure, all of the naturally productive oyster grounds in Virginia were set aside by legislative action in 1894 for public use. Dredging on these bottoms was prohibited except for a very few areas (Baylor 1894, Code of Va. 1950).

In Pocomoke Sound approximately 27,142 acres (10,984 ha) were designated in 1894 as public bottom or Baylor Ground (after Lt. Baylor who directed the survey). The Baylor Survey, using straight lines, simply outlined the broad reaches of productive bottom. (Figure 1). Consequently, much unproductive bottom was included (Moore 1911, Haven et al. 1981).

Hydrography

The circulation of water masses, and their salinity and temperature characteristics have received much study in Chesapeake Bay and many of its sub-estuaries (Pritchard 1951,1954; Nichols 1972; Hass 1977; Kennedy 1980; Boicourt 1982; and others). Similar studies, however, are lacking for the Pocomoke Sound area, which is located just to the east of the bay's north-south transition zone (Pritchard 1952). That is, Pritchard (op. cit.) considers the bay north of the mouth of the Potomac (38°11') as an estuary of the Susquehanna. To the south of this junction, the bay may be classed as a composite estuary based on the fresh water inflow of all systems.

Salinity data collected in the Pocomoke Sound from 1949 to 1961 show average fall salinities ranging from about 20 to 22‰ over the north-south range. In the spring, over a similar area they ranged from about 16 to 18‰ (Stroup and Lynn 1963). Data collected along the main longitudinal axis of Chesapeake Bay just above the study area indicate that these waters were often stratified with respect to salinity and temperature as they are in many other locations in the bay (Schubel 1972).

MATERIALS AND METHODS

The study was conducted during 1978. The survey vessel was navigated at a speed of about 3 knots within the bounds of the Baylor Grounds along a series of hyperbolic transect lines delineated by the Raydist^{R} electronic positioning grid system (manufactured by Teledyne Hastings Corp., Hampton, VA), referenced to latitude and longitude with a precision of ± 2 m. While traversing these transects, the bottom was probed with a 2.5 cm diameter

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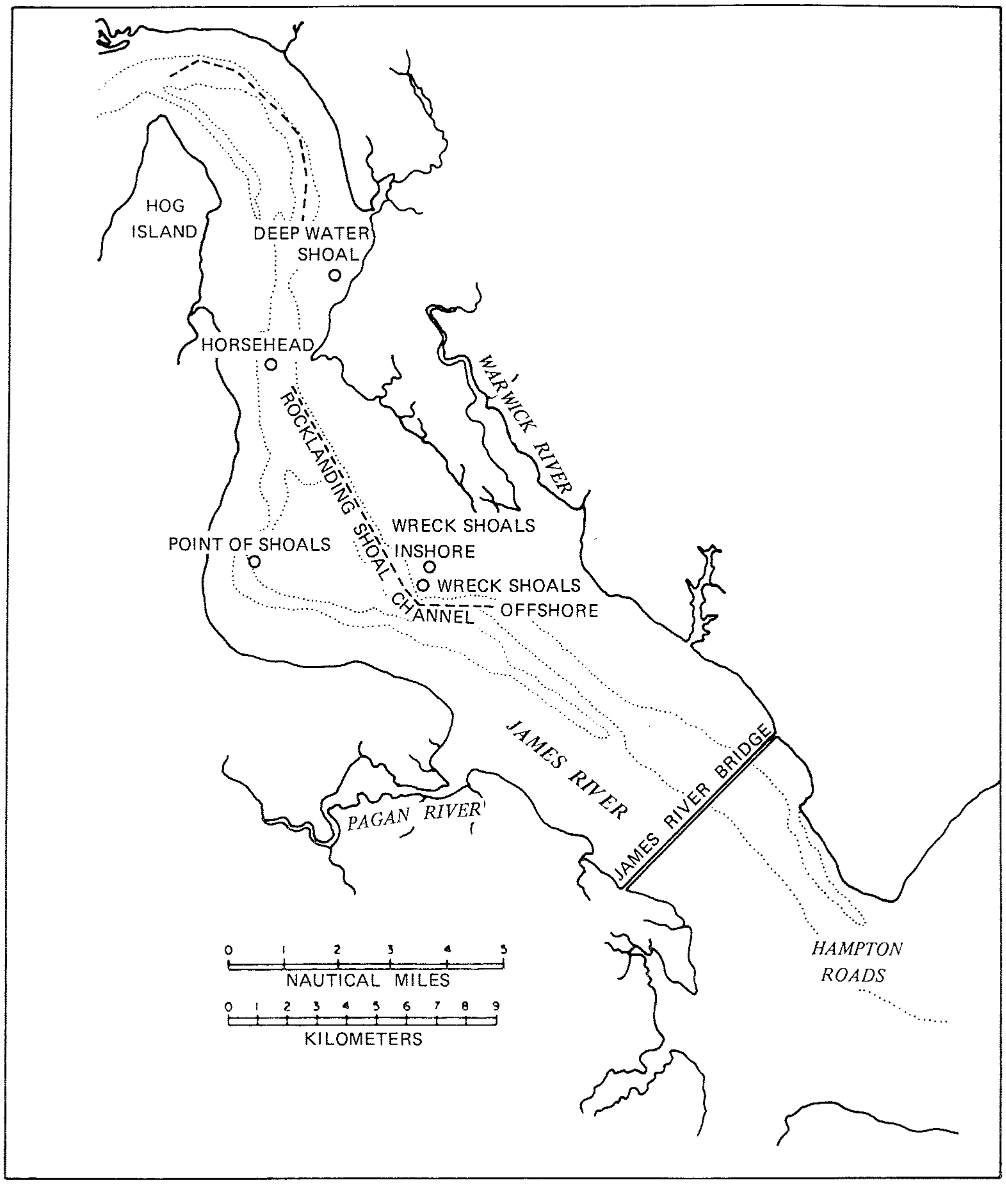

Figure 1. Locations of sampling stations in the James River, Virginia where shell and slate was planted.

spat and spat scar density and their lengths are based on randomly collected subsamples of the slate and shell; 25 to 50% of the total material collected was examined. This was necessitated by the large number of spat and spat scars in the samples. Subsequent counts are based on an examination of all material collected.

The percent mortality of spat during the setting season was not calculated because of the interaction between recruitment and mortality. While spat scar numbers were recorded, they are considered as unreliable indicators of long term mortality due to the difficulty in recognizing them after 2–4 weeks. Mortalities were calculated after setting ceased for the 23 November 1984 to 15 July 1985 period on the basis of changes (percent) in numbers of live oysters between the two dates.

Statistical studies compared numbers of spat m^2 and spat lengths in mm for various locations, dates, and substrate types. Comparisons of spat density were made for the post setting period for October, November, January and March, but not for July (low sample numbers). Lengths were compared for the final two sampling periods in March and July 1985. Data sets being compared were first tested for homogeneity of variance ($p = 0.05$) by a variance ratio (F) test. Later, mean spat lengths and mean number of spat were tested for significant differences between the various variances by a two-sample t-test with Cochrans t approxima-

TABLE 1.

Mean numbers of oyster spat and spat scars per .093 m^2 (one ft^2) and mean lengths of spat and spat scars on oyster shell, slate, at two location on Wreck Shoals in the James River, Virginia, and on adjacent natural bottoms.

	Inshore − $\bar{x}$				Offshore − $\bar{x}$			
Date	no. spat	length spat	no. scars	length scars	no. spat	length spat	no. scars	length scars
				OYSTER SHELL				
10 Aug 84	63.2	—	—	—	98.9	—	—	—
30 Aug 84	80.8	5.0	21.0	3.8	27.3	3.8	14.2	2.5
8 Oct 84	228.9	8.2	19.4	7.9	26.1[1]	7.7	3.4	8.3
23 Nov 84	185.2	10.8	33.5	8.7	73.3	7.9	25.8	6.7
8 Jan 85	99.9	10.8	—	—	57.4	10.2	—	—
11 Mar 85	128.4	10.9	—	—	15.0	7.4	—	—
15 Jul 85	35.0	18.7	—	—	11.6	21.9	—	—
				SLATE				
10 Aug 84	5.0	—	—	—	1.6	—	—	—
30 Aug 84	42.1	4.8	16.8	3.0	27.8	3.9	16.9	2.1
8 Oct 84	33.5	7.5	30.2	7.5	22.3	7.9	13.6	7.9
23 Nov 84	45.2	9.6	16.2	6.3	23.6	7.6	12.8	5.8
8 Jan 85	31.6	11.1	—	—	26.0	9.2	—	—
11 Mar 85	17.2	9.1	—	—	11.2	9.9	—	—
15 Jul 85	8.4	16.9	—	—	2.2	16.3	—	—
				NATURAL BOTTOM				
23 Nov 84	2.4	11.0	—	—	—	—	—	—
8 Jan 85	3.4	12.6	—	—	1.2	12.3	—	—
15 Jul 85	1.4	24.0	—	—	0.4	—	—	—

[1] This low value may be anomalous.

tion, which depends on the homogeneity of variance (Guenther 1964). All statistical tests were made at the 95% confidence level or $p = 0.05$.

RESULTS

An inspection of the planted areas by a diver showed that slate and shell had not been evenly distributed at planting. On the Inshore plot, the slate formed an area about 6.1 × 6.1 m in extent, and the adjacent shell plot, about 3 m away, covered an area about 6.1 × 10 m in size. On the offshore plots, the slate had been deposited in the form of an oval about 3.0 × 5.0 m in extent, and the shelled area about 3 m away formed a 4.6 × 4.6 m square.

On the slate plots the diver observed that sedimentation began shortly after planting to form a thin veneer of fine sediment 1–2 mm thick, and it covered an increasing percentage of the clean surfaces with each monitoring period. By 8 October 1984 the slate was about 90–100% covered with fine sediment; the voids between the particles were relatively small or completely filled, and only the upper 2–3 cm were exposed to the water. On areas where shell had been planted there was also the initial fine layer of sediment 1–2 mm thick on 80–90% of the shell, but the remaining surfaces appeared relatively free of silt and biofouling. Moreover, there were still some voids between the shells to a depth of about 4–5 cm. On 11 March 1985 a slight reduction in sediment thickness on both plots was noted and conditions remained relatively similar to the end of the study.

On the inshore plots, there were significantly more spat on shell substrate than on slate for October and November 1984 and March 1985 ($P < 0.05$). No difference was shown for January 1985. A similar comparison for the offshore plots showed no significant difference in mean number of spat on the two substrate types for any month (Table 1).

Spat density on shells on the inshore area was significantly higher than shells offshore for the months of October and November 1984 and for March 1985 ($P < 0.05$). On slate, spat density on the inshore plot was also significantly greater than offshore ($P < 0.05$) during October and November 1985.

During the setting season, which extended to early October 1984, there was an increase in numbers of spat on the shell and slate. This increase was not always linear due to continuing recruitment and heavy but irregular mortalities as evidenced by the occurrance of numerous spat scars in all areas (Table 1). After the setting period, the following percent mortalities were calculated from Table 1 for the 23 November 1984 to 15 July 1985 period: Shell Inshore—81%; Shell Offshore—84%; Slate Inshore—81%; and Slate Offshore—91%.

At the end of the study on the inshore plots for March and July 1985, spat were longer ($P < 0.05$) on shell than on slate. On the offshore area, however, spat on shell were significantly larger ($P < 0.05$) only during July, but the differences cited were not large (Table 1).

While slate was less effective than shell in collecting spat, slate consistantly had more spat per unit area than the oysters and oyster shells on natural bottoms (Table 1). Differences calculated from that source showed that the slate had from 5.5 to 6.0 times more spat per unit areas than the natural bottom on 15 July 1985.

DISCUSSION

The cause(s) of the high mortality observed during the study are unknown, but deaths due to xanthiid mud crabs, blue crabs (*Callinectes sapidus*) and flat worms (*Stylochus ellipticus*) were most certainly involved. These predators often cause excessive oyster mortalities in Chesapeake Bay (Webster and Medford 1961, Krantz and Chamberlin 1978). Siltation was also involved and the fact that its initial coverage was greater on the slate plots may be the cause of much of the observed difference in numbers of spat between slate and shell (Mackenzie 1970).

The reason for the higher setting on shell and slate on the inshore areas in comparison to that observed offshore is not apparent. Depths of the two locations were the same and they were only 825 m apart. Differences in factors such as hydrography, the chemical differences between the two substrates, and available food and predator density were not studied. While our study favors oyster shell over slate as a setting medium, it is emphasized that at the end of the study, slate still had more spat than old shells and oysters growing on adjacent natural bottoms. It is suggested that accumulated biofouling on the latter substrate might have been responsible for the mortalities.

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