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SETTLEMENT OF OYSTERS, *CRASSOSTREA VIRGINICA* (GMELIN, 1791), ON OYSTER SHELL, EXPANDED SHALE AND TIRE CHIPS IN THE JAMES RIVER, VIRGINIA[1]

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ABSTRACT The effectiveness of oyster shell, expanded shale, and tire chips as substrates for settlement of oysters, *Crassostrea virginica* (Gmelin), was compared at four locations in the James River, Virginia, over three two-week time intervals in August and September, 1988. Only differences between substrate were significant ($P < 0.001$). Over all locations and time intervals, a significantly higher ($P < 0.001$) proportion of total oyster settlement occurred on oyster shell (63.8%) than on either tire chips (22.1%) or expanded shale (14.2%).

KEY WORDS: *Crassostrea virginica,* settlement, cultch, spat

INTRODUCTION

The provision of substrate (cultch) to enhance settlement of oysters can be traced to Roman times and the writings of Plinius. Widespread use of planted shell was first used in the United States by oyster growers in New York waters in the mid-nineteenth century. The practice became commonplace within several decades along the entire east coast and remains a continuing activity to this day. Longterm removal of shells associated with prevailing harvesting practices, without subsequent replacement, has resulted in a depletion of shells and has prompted a search for alternative cultch materials.

This communication describes a comparison of expanded shale (natural shale heated to induce cavitation and expansion) and tire chips (shredded tire casings) to oyster shell for suitability as cultch material in an area noted for consistently high levels of natural oyster settlement.

MATERIALS AND METHODS

Mesh bags (1.25 cm) containing 0.1 bu of substrate were deployed at four sites in the James River, Virginia during three consecutive two-week time intervals during August and September, 1988, a period of generally high oyster settlement (Haven and Fritz, 1985). A comparison of substrates based on volume compares favorably with typical mass plantings of substrate, where thickness of application is far from constant. The sites of deployment, chosen to provide good spatial coverage and variability in settlement activity, were Naseway Shoal, Rock Wharf, Wreck Shoal, and Point of Shoals (Fig. 1). One bag of each substrate was hung 0.5 m off the bottom from wooden stakes at each of the locations on August 5, 1988. These were recovered and replaced on August 19. The second set of bags were recovered and replaced on September 2, and the third set of bags was recovered on September 16. A two-week exposure period was chosen to maximize settlement and allow sufficient time for metamorphosed oysters (spat) to grow to observable size, without being overgrown by fouling organisms. After being retrieved, bags of substrate were returned to the laboratory, air-dried, and the number of spat contained in each bag was counted with the aid of a dissecting microscope.

Oyster settlement as a function of substrate over both location and time interval was examined using analysis of variance (ANOVA).

RESULTS AND DISCUSSION

There were obvious temporal and spatial differences in the number of spat found on each of the substrate types (Table 1). Nonetheless, in 11 out of the 12 cases, oyster shell had far greater numbers of spat than either expanded shale or tire chips.

To compare substrate types between locations and exposure periods, settlement was expressed as a percentage of total spat count (Table 1). A three-way ANOVA on these percentages (arc sin transformed) demonstrated that only differences due to substrate were significant ($P < 0.001$). Data were thus pooled and a one-way ANOVA and SNK multiple comparison were used to compare settlement over all locations and exposure periods. This revealed that oyster shell had a significantly higher ($P < 0.001$) percentage of spat than both expanded shale and tire chips (expanded shale and tire chips were not statistically different, $P > 0.05$).

Per unit volume, oyster shell is substantially preferable as a cultch material than either expanded shale or tire chips. This argues for stringent conservation of shell resources.

[1]Contribution No. 1605 from the Virginia Institute of Marine Science, College of William and Mary.

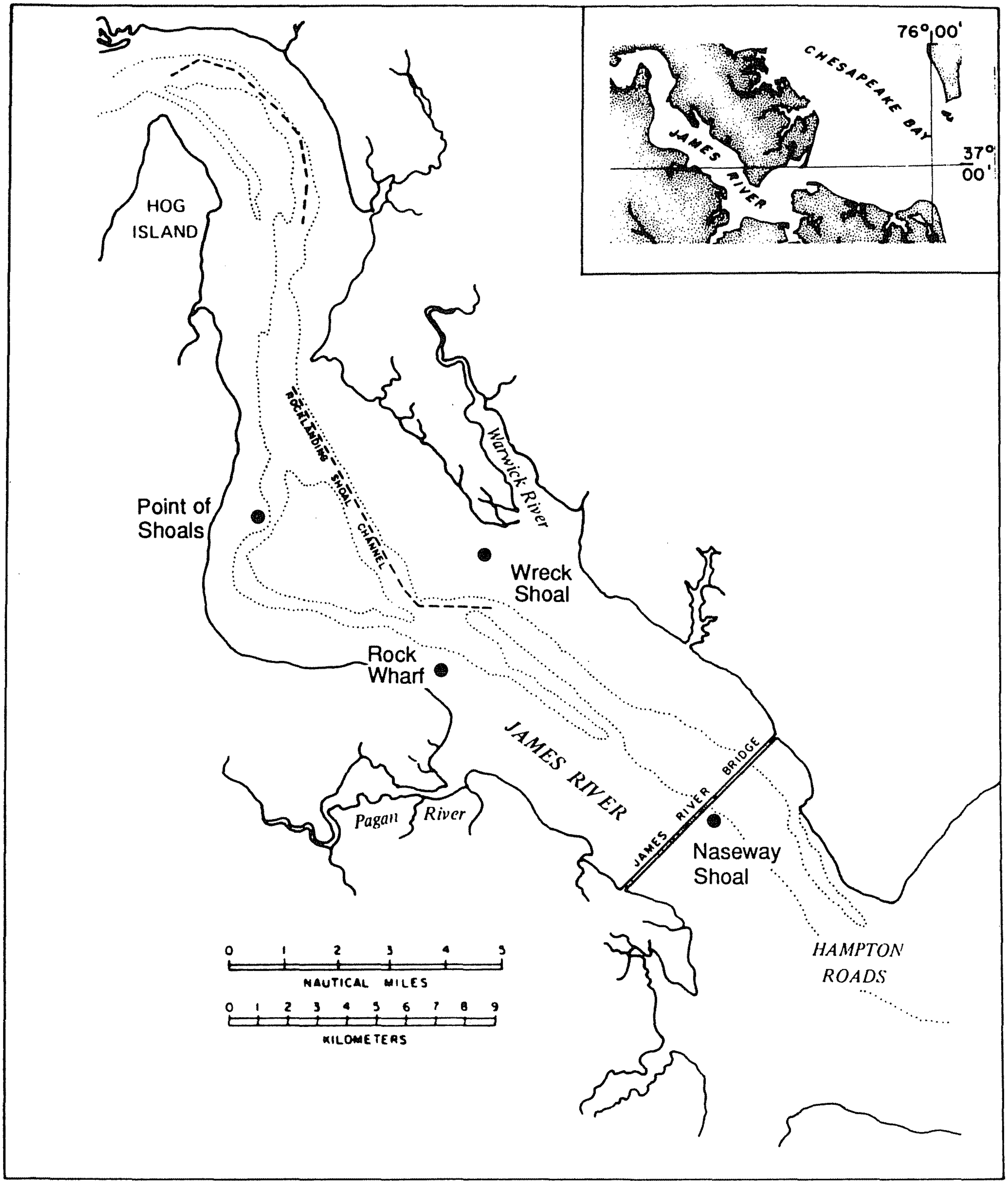

Figure 1. Sites of substrate deployment in the James River, Virginia.

TABLE 1.

Comparison of oyster spat settlement on three substrates at four sites in the James River, Virginia, for three exposure periods during 1988. Settlement expressed as number of spat and as a percentage of total spat for that location and exposure period.

		Shale		Substrate Tire		Shell	
Exposure Period	**Location**	**Spat**	**%**	**Spat**	**%**	**Spat**	**%**
8/5–8/19	Naseway Shoal	87	20.1	77	17.8	269	62.1
	Wreck Shoal	138	18.7	194	26.3	406	55.0
	Rock Wharf	92	11.6	187	23.6	514	64.8
	Pt. of Shoals	46	24.6	32	17.1	109	58.3
8/19–9/2	Naseway Shoal	27	27.6	23	23.5	48	48.9
	Wreck Shoal	21	26.9	34	43.6	23	29.5
	Rock Wharf	12	9.4	44	34.6	71	55.9
	Pt. of Shoals	14	16.3	22	25.6	50	58.1
9/2–9/16	Naseway Shoal	8	1.7	45	9.4	426	88.9
	Wreck Shoal	5	7.9	11	17.5	47	74.6
	Rock Wharf	12	2.7	47	10.4	393	86.9
	Pt. of Shoals	2	2.6	12	15.4	64	82.0

Tire chips, besides being less effective as cultch material, are prone to being dispersed by currents and wave action (Gibbons et al., 1989). Expanded shale, the least effective cultch material, has potential value in stabilizing marginal oyster bottom, prior to shell planting.

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REFERENCES

Haven, D. S. & L. W. Fritz. 1985. Setting of the American oyster *Crassostrea virginica* in the James River, Virginia, USA: temporal and spatial distribution. *Mar. Biol.* 86:271–282.

Gibbons, M. C., R. Mann & L. D. Wright. 1989. Laboratory and field studies of oyster larvae settlement on three substrates, oyster shell, tire chips, and expanded shale, and the relative mobility of the three substrates. *Marine Resources Report No. 89-3,* Virginia Institute of Marine Science, Gloucester Point, VA.