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Field Studies of Comparative Settlement of Oyster Larvae on Oyster Shell, Expanded Shale and Tire Chips

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by

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Period of Field Studies: August 5, 1988, through September 16, 1988.
Site of Field Studies: James River, VA
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Introduction

Following the presentation of the report prepared by Dr. R. J. Byrne to the July meeting of the Virginia Marine Resources Commission, a request was made to the Virginia Institute of Marine Science (VIMS) to evaluate expanded shale (Solite) and tire chips as alternative cultch to oyster shell. This evaluation has three components: laboratory (flume) testing of mobility, laboratory studies of settlement using cultured oyster larvae, and field studies of settlement. This document describes the protocol and results for the field study component of the evaluation.

Protocol

Present monitoring activity utilizes oyster shells threaded on metal wire. The expanded shale substrate is not suitable for drilling and threading; therefore, the materials were exposed in plastic mesh, one tenth bushel volume "tubes". Rather than attempt to quantify settlement as oysters per unit area, we compared settlement per unit packed volume of substrate. In mass "planting" of substrate this would, effectively, be the comparative yardstick anyway, so the approach is meaningful. The tubes were 18" in circumference and had a mesh size of 1".

"Tubes" were deployed in the James River, Virginia, on the following dates: August 5, August 19 and September 2, 1988. This coincides with the

period of generally high oyster settlement in the James. The sites of deployment were Naseway Shoal, Rock Wharf, Wreck Shoal and Point of Shoals. These sites were chosen to provide good spatial coverage to cover possible variability in intensity of settlement.

At each of the 4 stations six "tubes" were deployed, two containing each of shell, expanded shale and tire chips, in early August. At three of the stations the "tubes" were hung from newly placed stakes. At the fourth station (Naseway) we used an old pound net pole. Stakes were placed and "tubes" deployed on August 5, 1988. Two weeks later the "tubes" were retrieved and replaced with further, previously unexposed tubes. A third deployment and retrieval followed the second as continued settlement was observed in the James on the adjacent "shellstring" monitoring station. Retrieved material was dried and subsequently examined microscopically for presence of settled and metamorphosed oyster larvae. A two-week deployment was chosen rather than a one-week deployment in order to:

(1) maximize settlement per unit cultch while still remaining sufficiently short to minimize growth of fouling organisms;

(2) to allow sufficient time for spat to grow to facilitate observation; and

(3) eliminate the need to maintain the "tube" after retrieval for a "grow out" period when spat mortality or accidental further settlement (through the sea water supply) may occur.

Results

Data are expressed as oyster spat per unit (0.1 bushel) volume of packed cultch for each station and deployment period in the accompanying table. The numbers are then expressed as a percentage of the total spat count for all substrates at that site for that collection date. To allow statistical comparison of settlement between the substrates within a single site and date the percentage values were arcsin transformed. Comparisons were then made using analysis of variance (ANOVA).

Overall the shell was, by far, the preferred substrate. In 11 of 12 replicate comparisons shell had the highest proportion of settled spat. For the entire experiment setting on shell was significantly greater than on other substrates. The ranking of the substrates varied statistically with time even though the general trend was consistent as shell>tire>shale. For the first time period (8/5-8/19) setting on shell was significantly higher than both shale and tires. For the second time period (8/19-9/2) setting on shell was significantly greater than shale but not statistically greater than tire. For the third time period (9/2-9/16) significant differences were observed for all substrates (shell>tire>shale). Although differences were observed between stations this was considered due to spatial variation in settlemement throughout the river, something that is well documented. The relevent comparisons are at a single station within a single time period between different substrates.

In summary, shell is a better substrate than tire chips, both are better substrates than shale.

Comparative Settlement of Oyster Spat on Three Substrates in the James River, Virginia during August - September, 1988. All spat numbers are per 0.1 bushel. Percentages are of total for all substrates at that location for that period.

exposure period	station	substrate: shale spat	shale %	shale arcsin	tire spat	tire %	tire arcsin	shell spat	shell %	shell arcsin
8/5-8/19	Naseway Shoal	87	20.1	26.6	77	17.8	24.9	269	62.1	52.0
	Wreck Shoal	138	18.7	25.6	194	26.3	30.8	406	55.0	47.9
	Rock Wharf	92	11.6	19.9	187	23.6	29.1	514	64.8	53.6
	Point of Shoal	46	24.6	29.7	32	17.1	24.4	109	58.3	49.8
8/19-9/2	Naseway Shoal	27	27.6	31.7	23	23.5	29.0	48	48.9	44.4
	Wreck Shoal	21	26.9	31.2	34	43.6	41.3	23	29.5	32.9
	Rock Wharf	12	9.4	17.8	44	34.6	36.0	71	55.9	48.4
	Point of Shoal	14	16.3	23.8	22	25.6	30.4	50	58.1	49.7
9/2-9/16	Naseway Shoal	8	1.7	7.5	45	9.4	17.8	426	88.9	70.5
	Wreck Shoal	5	7.9	16.3	11	7.5	24.7	47	74.6	59.7
	Rock Wharf	12	2.7	9.5	47	10.4	18.8	393	86.9	68.8
	Point of Shoal	2	2.6	9.3	12	15.4	23.1	64	82.0	64.9

ANOVA Results: nsd denotes no statistically significant difference

(1) 1 way comparing substrates, all dates: $F = 45.1$, $P < 0.00001$
shell > tire, tire and shale are nsd.

(2) 1 way comparing substrates, 8/5 - 8/19: $F = 72.67$, $P < 0.00001$
shell > tire, tire and shale are nsd.

(3) 1 way comparing substrates, 8/19 - 9/2: $F = 7.03$, $P < 0.001$
shell and tire are nsd, tire and shale are nsd, but shell > shale.

(4) 1 way comparing substrates, 9/2 - 9/16: $F = 211.4$, $P < 0.00001$
shell > tire > shale.

(5) 1 way comparing dates, shell only: $F = 12.2$, $P < 0.003$
period 1 and period 2 are nsd, but both are < period 3

(6) 1 way comparing dates, tire only: $F = 9.72$, $P < 0.0056$
period 1 and period 3 are nsd, but both are < period 2