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DETERMINATION OF THE OPTIMUM COMMERCIAL SIZE FOR THE MANGROVE OYSTER (*CRASSOSTREA RHIZOPHORAE*) IN TODOS OS SANTOS BAY, BRAZIL

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ABSTRACT

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Pilot studies were conducted in 1977—1978 on the cultivation of mangrove oysters in the Jacuruna River estuary at Todos os Santos Bay, Salvador, Brazil. Growth characteristics were studied by comparing the relationships between total live weight, volume of the shell cavity fluid and yield of meat, and dry body weight to size (height). The most economically feasible proposition was production of approximately 7 cm high oysters for the shucked oyster market rather than for the fresh oyster market. The harvesting of oysters less than 4 cm high was not considered desirable because it might reduce reproductive capacity. In oysters higher than 7 cm, growth rate and meat production decreased and did not warrant further cultivation.

INTRODUCTION

Determination of the optimum marketable size of oysters is important for minimizing oyster production costs.

During cultivation, the maximum efficiency ratio is reached when the greatest quantity of meat is obtained from an oyster with the lowest total weight or size (Wakamatsu, 1974). In $W/T = X$, where W is weight of meat and T is total weight, X, therefore has the maximum value. From the practical standpoint, the size (height) appears to be the most useful parameter in predicting other biomass parameters, because of the high coefficient of determination values in relationships that utilize height, and because each measurement takes little time (Dame, 1972).

The relationships of meat weight/total weight or meat weight/size (height) depend on the growth rate, which varies greatly according to the species and environmental conditions. The relationships are also influenced by water temperature and currents, food supply, exposure to light, intertidal exposure and other factors (Medcof, 1961; Quayle, 1969).

C. rhizophorae cultivation has been studied in Cuba (Nikolio et al., 1976) and in Venezuela (Rojas and Ruiz, 1972), but the optimum commercial size was not determined. In Brazil the optimum size is known only for *C. brasiliana* (Wakamatsu, 1974).

The present research was undertaken to determine the optimum size for harvesting *C. rhizophorae* in Todos os Santos Bay.

MATERIAL AND METHODS

Adult mangrove oysters in Todos os Santos Bay normally have two spawning peaks, in March and October (Nascimento, 1978). Immediately before or during the spawning seasons their gonads are distended. The oysters become thinner shortly after release of the gametes. During the spawning period in September—October, 1977, and in the post-spawning period in December 1977—January 1978, two groups of 480 oysters each were collected from the Jacuruna Oyster Farm in Todos os Santos Bay (13°10'S; 38°50'W). At the laboratory the oysters were placed in six size classes between 2 and 8 cm.

Individual oysters were scrubbed with a wire brush to remove fouling organisms, and their whole live weight, volume of the shell cavity fluid, and wet and dry meat weight were determined.

The size (height) was measured to the nearest 0.1 mm. The measurement was made with vernier calipers along the long axis of the shell from the umbo to the opposite edge (Galtsoff, 1964). The oysters were then opened, the shell cavity liquid drained, and its volume determined. The wet weight of meat was measured to the nearest 0.01 g. The meat was then dried to a constant weight in an oven at 90°C and the dry weight was determined to the nearest mg. The yield was calculated as the ratio wet weight of the meat (g)/size (cm) (Lima and Vazzoler, 1963).

The statistical calculations in this study followed the usual methods for determining the correlation coefficient (Sokal and Rohlf, 1969) between the size (height) of the oysters and the following parameters: total weight, wet and dry weight of the meat, volume of the shell cavity fluid, and yield. The computations were carried out on an IBM 1130 computer.

RESULTS AND DISCUSSION

Strong correlations were shown for the total live weight and height in *C. rhizophorae.* The ratios were 0.81 and 0.74 for the spawning and post-spawning periods (Table I), respectively. The relationships between those variables for the two periods are shown in Fig.1. In the spawning period the organisms have a higher average total weight than during the post-spawning period. The weight or volume of meat between two oysters of equal shell dimensions may differ according to the seasonal cycle of their gonadal changes (Quayle, 1969). Thus, the difference in data obtained for *C. rhizophorae* over the two periods may be accounted for by the presence of gametes in the oyster gonads during September and October.

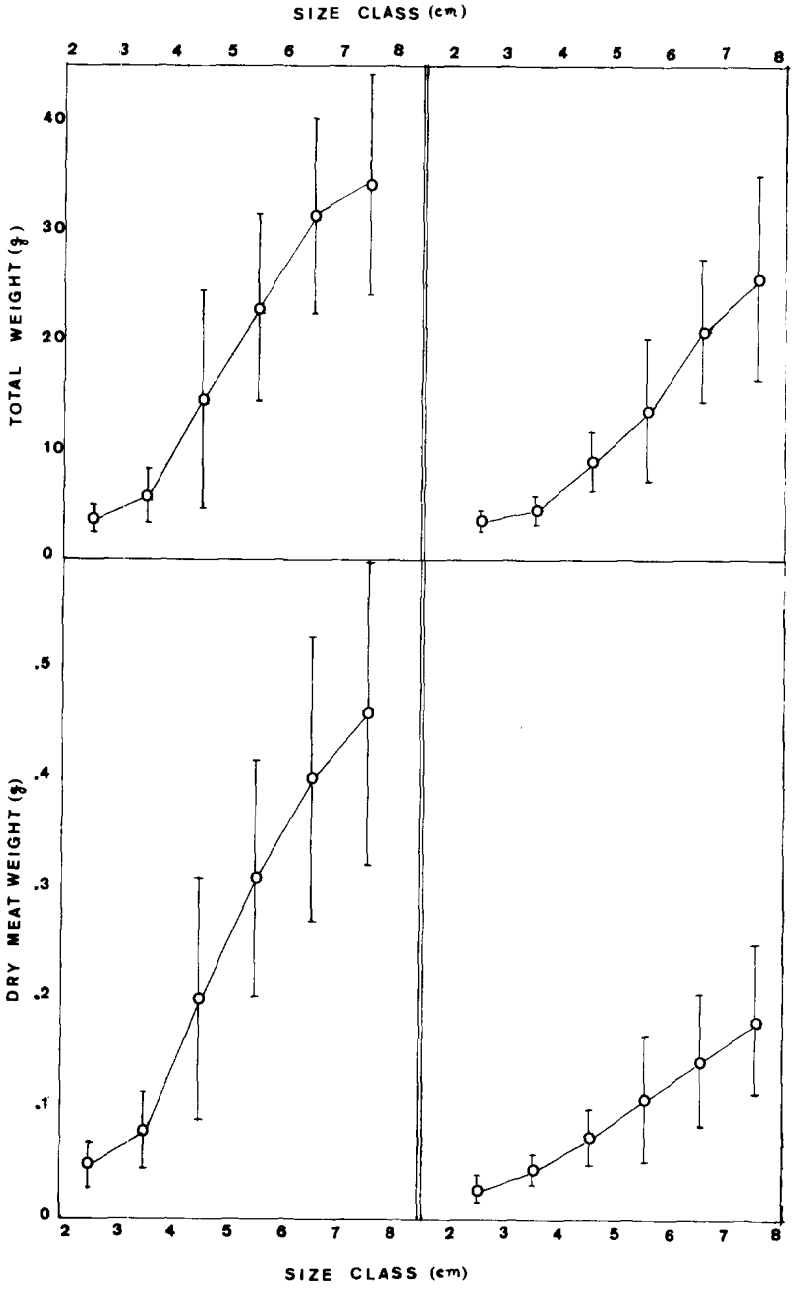

Fig.1. Relationships between total weight (g), dry meat weight (g) and size classes for the mangrove oyster (*Crassostrea rhizophorae*), during the periods of September—October 1977 (at left) and December 1977—January 1978 (at right).

TABLE I

The correlation ratios between selected biological parameters and the size classes for the mangrove oyster *Crassostrea rhizophorae*

Parameters	Time period	
	September—October, 1977	December, 1977—January, 1978
Total weight (g)	0.81	0.74
Dry weight (g)	0.69	0.63
Yield (%)	0.70	0.47
Shell cavity fluid (ml)	0.77	0.75

TABLE II

Average values ± standard deviation of selected biological parameters in each size class for the mangrove oyster *Crassostrea rhizophorae*

Size class	Sample size	Parameters			
		Total weight (g)	Shell cavity fluid (ml)	Yield (%)	Dry meat weight (g)
September—October 1977					
2—3	20	3.51 ± 1.33	0.32 ± 0.20	8.19 ± 3.25	0.05 ± 0.019
3—4	100	5.80 ± 2.49	0.52 ± 0.32	10.30 ± 3.83	0.08 ± 0.035
4—5	28	14.42 ± 9.87	1.46 ± 1.15	19.67 ± 10.51	0.20 ± 0.110
5—6	92	22.85 ± 8.49	2.72 ± 1.20	25.21 ± 8.55	0.31 ± 0.110
6—7	120	31.18 ± 8.67	3.64 ± 1.16	28.74 ± 8.31	0.40 ± 0.130
7—8	120	34.12 ± 10.02	4.08 ± 1.46	31.25 ± 9.21	0.46 ± 0.143
December 1977—January 1978					
2—3	36	3.43 ± 0.93	0.35 ± 0.17	4.92 ± 2.08	0.02 ± 0.013
3—4	84	4.62 ± 1.25	0.50 ± 0.21	5.92 ± 2.20	0.04 ± 0.015
4—5	48	9.13 ± 2.79	1.29 ± 0.66	8.41 ± 3.24	0.07 ± 0.024
5—6	72	13.66 ± 6.50	1.93 ± 0.99	10.55 ± 5.34	0.11 ± 0.056
6—7	120	20.86 ± 6.66	3.38 ± 1.25	12.36 ± 4.55	0.14 ± 0.061
7—8	120	25.67 ± 9.38	3.63 ± 1.43	14.21 ± 5.97	0.18 ± 0.071

The observed values for the total live weight of each size class of oysters are presented in Table II. As the oysters grow in size from 2 to 6 cm, their total weight also increases rapidly. However, the total weight does not increase as rapidly after the oysters reach 7 cm in size.

The relationships involving total live weight are not the best indicators of standard commercial size for oysters. The total live weight includes the shell weight, which varies depending on the water chemistry, tidal range and wave action, even varies in similar environments (Dame, 1972). The other parameter that had to be considered was the variation of the shell cavity fluid.

The correlation coefficients between the volume of the shell cavity fluid and the size were 0.77 and 0.75, respectively, for the periods September—October 1977 and December 1977—January 1978 (Table I). The observed averages for the volume of the shell cavity fluid in each size class are represented in Fig.2 for the spawning and post-spawning periods. The curves referring to these periods are very similar. Thus the volume of the shell cavity fluid may not interfere in the relationships of the total live weight and size (height), considering the curves representing the relationships between total weight and size for those two periods are different.

The increase in weight of the oyster meat is calculated as the yield (weight of meat) (g) X 100/size(cm). The data related to the ratio of yield to size are shown in Fig.2. The values are higher during September—October, when the oysters have gonads full of spawn which fill the shell cavity more completely than during December—January. The correlation between yield and size was high (0.70) during the first period (September—October 1977) but less marked (0.47) during the second one (December 1977—January 1978).

The observed values for yield in all the size classes are shown in Table II. The increase in the rate of the yield values from one size class to the next was lower with oysters larger than 6.0 cm in the first period. Data referring to the second period show the oyster body has a lower percentage of meat during the post-spawning period.

The yield data for *C. rhizophorae* were lower than those for *Ostrea arborea* from Sitio das Caipiras, São Paulo, Brazil, but similar to those for the same species from Ilha das Palmas (Lima and Vazzoler, 1963).

The ratio of dry weight to size is supposed to indicate the standard commercial size for oysters better than the other relationships. Since a larger proportion of the nutrients and energy available to the secondary consumers in the oyster food web is contained within the body of the oyster, this parameter is important in productivity studies (Dame, 1972). The correlation ratios (Table I) between dry weight (g) and size (cm) were 0.69 and 0.63 for the spawning and post-spawning periods respectively. The curves based on the observed data for the two periods are shown in Fig.1. The values for September—October are higher. According to Nascimento (1978), during the spawning period the gonads are full of gametes. This is verified by the greater dry meat weight during this period. Data for the two periods (Table II) indicate that beyond 6.0—7.0 cm size, the oysters do not substantially increase the values for dry weight with growth. Therefore, their commercialization is not advisable above 7 cm.

The average dry weight value in the spawning period was 0.40 g for oysters 6.0—7.0 cm in size. This value is the same obtained for *C. rhizophorae* in Baía de Mochima, while in Laguna Grande this value was doubled (0.80 in oysters measuring 70 mm). The differences between the oysters from the two regions in Venezuela was explained by the greater availability of food in Laguna Grande (Rojas and Ruiz, 1972).

According to Medcof (1961), in Canada the legal size limit for the fresh oyster market is at least 3 inches; this size is also accepted in European areas.

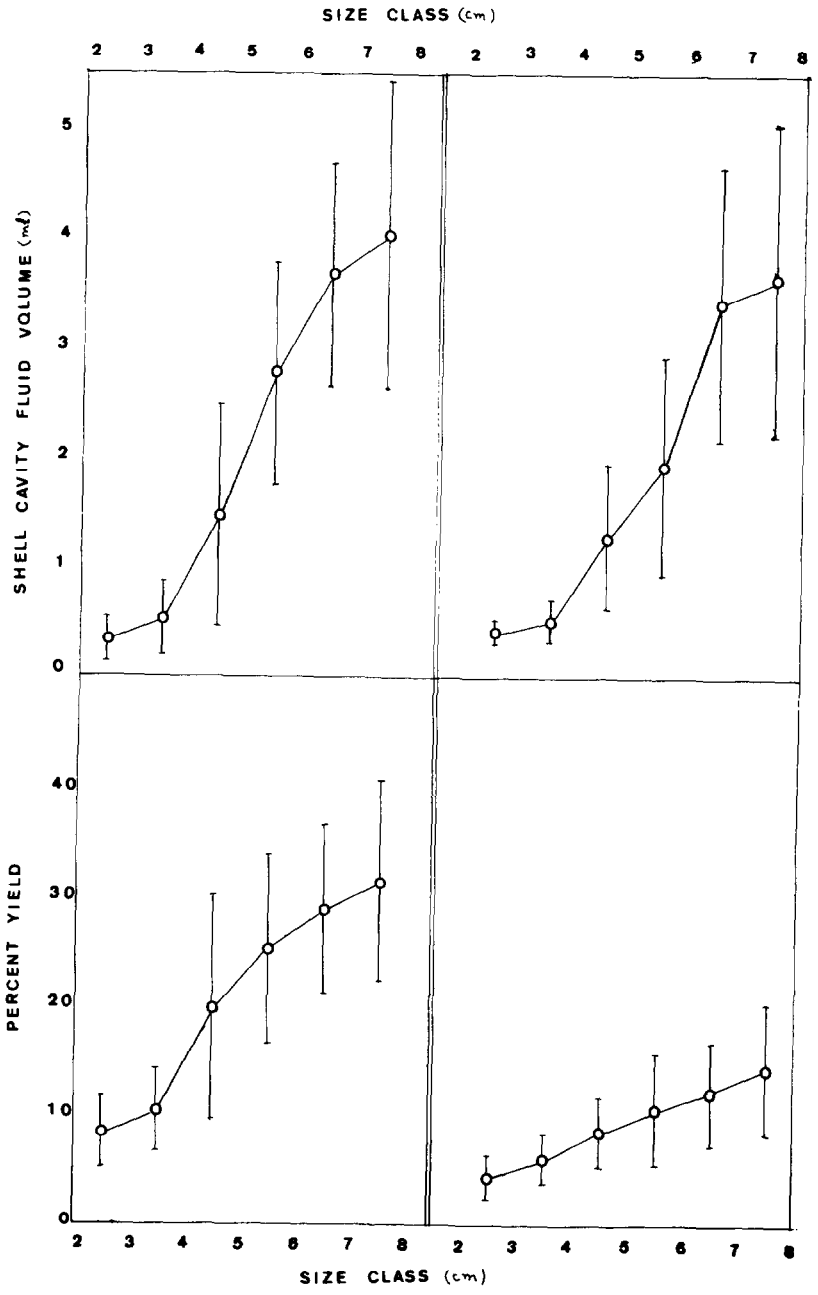

Fig. 2. Relationships between shell cavity fluid volume (ml), percent yield and size classes for the mangrove oyster (*Crassostrea rhizophorae*), during the periods of September—October 1977 (at left) and December 1977—January 1978 (at right).

C. rhizophorae cultivated in Todos os Santos Bay and sold at approximately 7 cm height could be suitable for the shucked oyster market in Brazil. This would minimize the production costs, since the oysters would need less time to reach that size. The data indicate that the oysters have a higher percentage of meat in relation to the total weight during the spawning periods. Taking into account that in the natural environment the preservation of oysters up to 4 cm would guarantee normal reproduction (Nascimento, 1978), the commercialization of oysters between 4.0 and 7.0 cm would not impair species propagation.

CONCLUSIONS

The biological parameters (total weight, volume of the shell cavity fluid, yield, and dry meat weight) studied in relation to the size of mangrove oysters show a correlation ratio between 0.47 and 0.81, and were useful in determining the standard commercial size for *C. rhizophorae.*

The values for all the relationships were higher during the spawning periods than in the post-spawning period.

All the parameter values increase rapidly as the oysters grow from 2.0 to 6.0 cm. However this increase rate slows down when the oysters grow from 6.0 to 7.0 cm.

These results indicate that it would be advisable to cultivate mangrove oysters only for the shucked oyster market, because cultivation produced little increase in growth beyond 6 cm and larger oysters are required to compete in the fresh oyster market.

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