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OYSTER CULTURE—STATUS AND PROSPECTS

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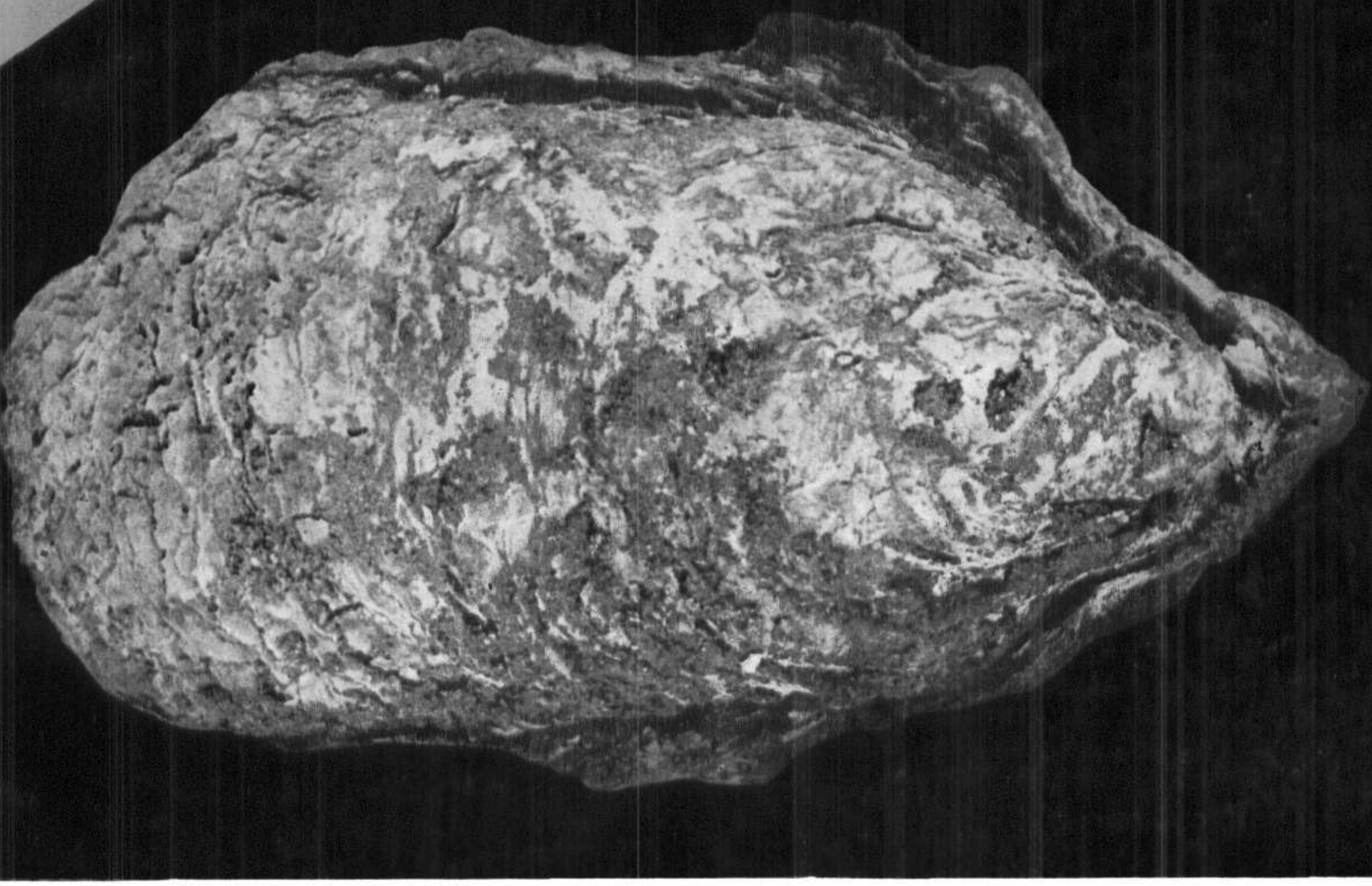

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12

PESTS AND PREDATORS OF OYSTERS

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INTRODUCTION

In all aquaculture practices the detrimental effects of cohabiting organisms are either by predation, competition, disease or parasitism. Hanson (1974) stated that limited predation can serve to weed out some diseased members of a crop and also help in controlling epizootic infections. But large-scale mortalities result in economic loss by reduction in the tended stock. Control of predation also means additional expense on the production cost (Mackenzie, 1970a). While evolving culture methods for fish or shellfish, identifying and proper use of methods to prevent and control numerous predators of cultivable organisms is absolutely essential to maximise production. In spite of having evolved control measures in oyster culture, developed countries like N. America, Britain and France still face periodical predator problems of serious threat to the stock under culture. In India, while conducting a series of experiments in the culture of oysters by rack and tray method at Tuticorin during 1977—1984 we have come across some problems of predation and competition in the oyster farm. Very often several transplanted oysters of size ranging from 25-85 mm were found dead in the growing trays in which were found large numbers of live gastropods (Pl. I a) later identified as *Cymatium cingulatum* (Lamarck). This led us to suspect the possibility that these might have been responsible for the mortality of oysters. Subsequent observations confirmed this.

This chapter chiefly describes the predatory role played by *Cymatium* and the extent of damage done to the tended stock.

BRIEF REVIEW OF COMMON PESTS AND PREDATORS

Among algae, *Gracilaria* sp. grows densely on the oyster cages kept in the farm which indirectly affects the regular water flow inside the cages. Boring sponges and clams are very rare and mortality of oysters due to these are not seen at Tuticorin. Occurrence of polyclad turbellarians on the spat settled on cultches and inside dead oyster spat are also noticed in the farm. But the intensity of its predation in Tuticorin Bay is negligible. Lunz (1947) found that oysters heavily infested with *Polydora* sp. were often poor in quality. Medcof (1946) confirmed that such infection does not noticeably decrease the condition of oyster but affects the market value in half-shell trade because of mud-blisters giving disagreeable appearance. *Polydora ciliata* and *P. armata* have been noticed in Athankarai estuary. Such a possibility at Tuticorin was effectively overcome by resorting to off-bottom culture and also periodical cleaning of oyster shell surface. Since it was feared that *Balanus* spp. settled on oysters and teak poles of the racks would compete with oysters for food and space, periodical cleaning helped to minimise the settlement. Slipper-shell *Crepidula fornicata*, notorious for causing mortality among young oysters, was totally absent in the farm area.

Lunz (1947) identified crabs as one of the most probable serious predators of oysters in 5 to 30 mm size. In the oyster farm at Tuticorin though some of the spat settled on tiles and rens were destroyed by crabs *Scylla serrata* and *Pagurus* sp. the loss due to this was negligible. The presence of commensal crabs among the oysters grown at Tuticorin was negligible.

Predation by starfish also was not noticed at Tuticorin Bay, apparently there is no population of sea stars in the surroundings. Mackenzie (1970 b) stated that if starfishes are present more than $1/m^2$ the oyster stock would be reduced to non-commercial level. Predation by fishes and birds did not arise in the bay area perhaps due to the non-occurrence of these predators in considerable numbers in the bay.

Predatory gastropods known as oyster drills are considered as the deadliest among the enemies of oysters. In this country *Thais radolphii* has been

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noticed to bore young oysters at Athankarai estuarine region (CMFRI, 1974). In the oyster farm at Tuticorin, *Cymatium cingulatum* caused 13% of mortality of farm oysters (Thangavelu and Muthiah, 1983). Therefore pointed attention was paid to tackle this problem.

MODE OF ATTACK

The gastropod gains entry into the trays and by remaining near the oysters or sometimes on the oyster shell, it introduces the proboscis when the valves are slightly open. The pleurembolic proboscis, having permanent sheath, functions due to muscles of the wall best suited to feeding on 'material not immediately accessible'. The jaws consist of two thin chitinous subtriangular plates (Pl. I b) having numerous longitudinal rows of scales. The jaws are lateral and appear to aid in opening the proboscis during feeding. An anaesthetizing fluid is injected on to the tissues of the unwary prey. Houbrick and Fretter (1969) found that the fluid which is exuded from the mouth of *C. nicobaricum* is acidic (pH 2.0). Day (1969) reported that the pH of pure secretion from proboscis gland of cymatiid *Argobuccinum argus* is 1.1. The acidic secretions poured into the oyster may create optimal conditions for certain enzymatic activities. In this case also a toxin similar to neurotoxin tetramine found in cymatiid *Fusitriton* (Russell, 1965) might have been employed by *C. cingulatum* in narcotising the oysters. Later the flesh is torn due to action of radula. Day (1969) pointed out that presence of calcium carbonate dissolving mechanism in cymatiids indicated that they are also able to drill the shell for feeding on bivalves.

RELATION BETWEEN SIZE OF *CYMATIUM* AND THE RADULA

The radula is of taenioglossan type (Pl. I c). In *C. cingulatum* of size ranging from 21 mm to 72.5 mm in shell length, the radula varies from 2.07 to 5.35 mm in length and 247 μ to 600 μ in width. The study disclosed that within the size range of 21 to 73 mm increase in shell length was accompanied by a proportionate increase in radular dimensions. There is a close correlation between the length of radula and the shell length (r=1) eventhough radular dimensions vary sometimes among the individuals of the same shell length.

SIZE RELATIONSHIP BETWEEN *CYMATIUM* AND OYSTERS PREYED

Cymatium cingulatum attacked oysters of size 25 to 85 mm and the modal size of oysters killed was 53.3 mm (Thangavelu and Muthiah, 1983). Nearly 75% of mortality occurred in the size group of 40-65 mm. In order to find out the relationship between size of oysters preyed and size of *Cymatium*, 100 oysters of size 35 to 88 mm with *C. cingulatum* of known size were put in 12 box-type cages. Each cage was observed at fifteen days interval. From Table 1, it could be seen that 45 mm *C. cingulatum* preyed upon oysters of 39 to 64 mm with a mean size of 49.7 mm. The mean size of oyster increased to 68.5 mm for the *Cymatium* of 74 mm in shell length. The correlation coefficient (r=0.5) shows fair degree of relationship between the size of gastropod and the size of oysters preyed upon.

TABLE 1. *Relationship of size of Cymatium and mean size of oysters preyed*

Size of *Cymatium* (mm)		Range of oysters Preyed (mm)	Mean size of oysters (mm)
45.0	..	39.0—64.0	49.7
52.0	..	34.0—64.0	48.6
52.0	..	39.0—65.0	56.2
52.5	..	49.0—84.0	59.4
58.3	..	53.0—86.0	68.0
58.5	..	49.0—84.0	69.4
63.2	..	41.0—84.0	54.4
64.0	..	39.0—70.0	55.0
65.6	..	42.0—83.0	63.8
69.0	..	37.0—68.0	54.0
72.5	..	35.0—80.0	64.7
74.0	..	47.0—88.0	68.5

RELATION BETWEEN OYSTER STOCK AND PREDATOR POPULATION

During 1978, totally 320 *C. cingulatum* were removed when the oyster stock in the farm was about 3,00,000. During 1980, when the stock increased to 6,00,000 the number of this predatory triton in the farm area swelled to 4,500 (Table 2). As Hanson (1974) pointed out the predators are appearing to be increasingly attracted with the prey abundance, thus aggravating the problem of predation.

TABLE 2. *Number and Size of C. cingulatum collected from Oyster farm in* 1980

Month		Number	Size (mm) Min.	Size (mm) Max.	Mean (mm)	Mode (mm)
July	..	20	9.0	39.6	23.5	21.6
August	..	1497	7.5	71.2	34.22	38.45
September	..	2315	6.5	80.5	30.2	27.0
October	..	238	19.5	65.5	42.69	42.83
November	..	146	16.4	68.0	40.0	42.9
December	..	29	18.2	65.0	47.5	45.0

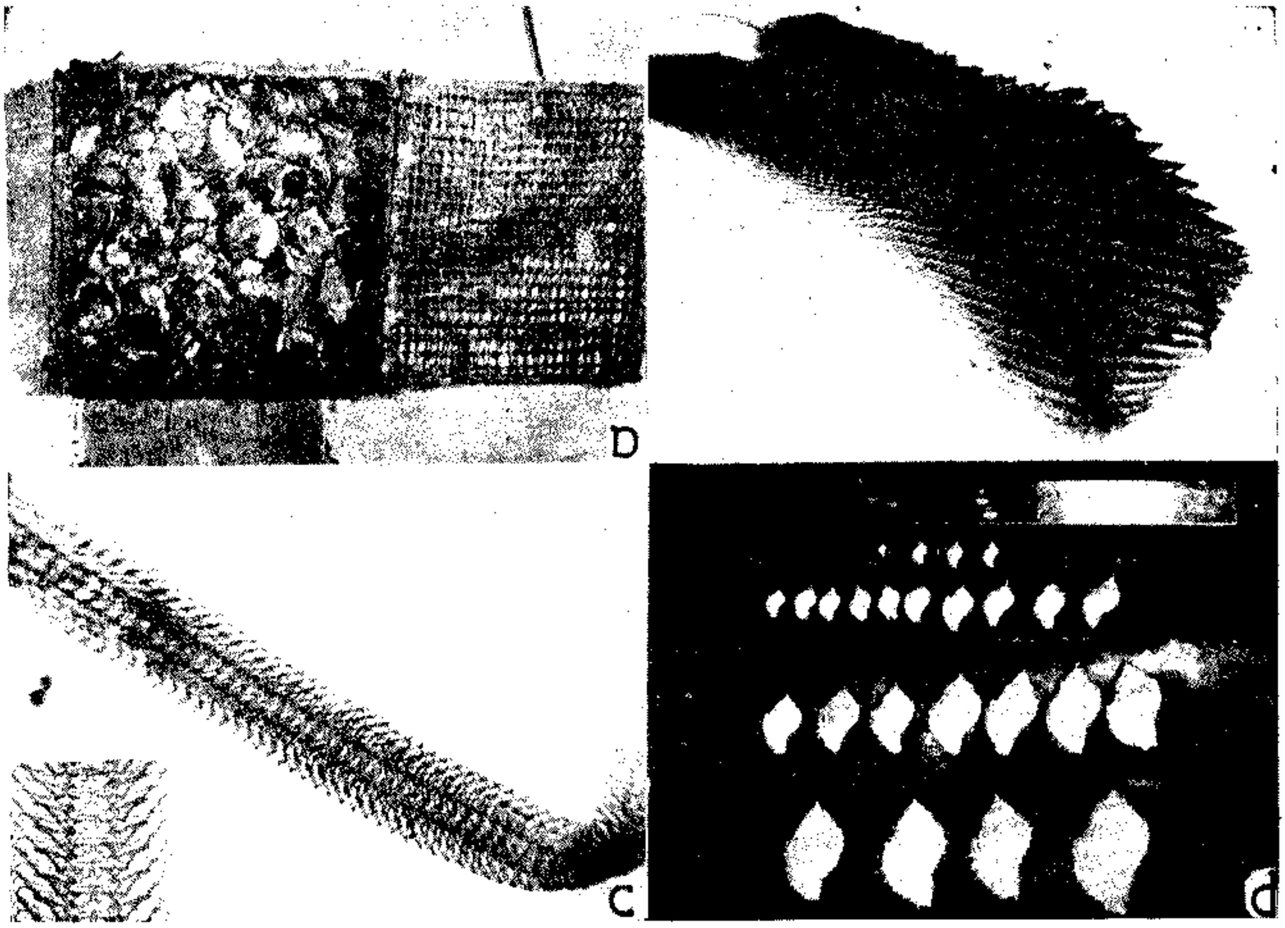

PLATE I. *a Cymatium cingulatum* inside oyster rearing cage; *b* Jaw plate; *c* Radula with portion enlarged; *d* Different sizes of *C. cingulatum*.

Growth Rate

The period of occurrence starts from late July to the end of December. The number increased from 20 in July, 1980 to 2,315 in September and decreased to 29 in December, 1980. Size ranges, mean and mode for *C. cingulatum* collected from the oyster cages during the months of July to December, 1980 are presented in Table 2. From this, it may be observed that the mode for July, 1980 was 21.6 mm which increased to 38.45 mm in August. In September it decreased to 27 mm and in the subsequent month it reached 45 mm. The size distribution curve (Fig. 1) was drawn from the measurements taken on the individuals occurring at the same site. The irregular progression of mode indicates that at most more than one year group is present. Because of their cannibalistic behaviour, the individual growth rate is difficult to follow. The wide range of size (Pl. I d) possibly suggests an extended breeding season as Thomson (1973) noticed in *Morula marginalba.* The maximum size of *C. cingulatum* collected from the farm was 80.5 mm, higher than *C. nicobaricum* (7.6 cm) recorded by Howbrick and Fretter (1969). The growth of *C. cingulatum* seems to be more rapid than *Urosalpinx cinerea* observed by Cole (1942) and growth of *M. marginalba* reported by Thomson (1973).

General Remarks

Drills can be controlled by treatment with chlorinated benzenes which are toxic to drills (Loosanoff *et al*, 1960 a, b). Mackenzie (1970 a) standardized the polystream (a mixture of polychlorinated benzenes) treatment at the rate of 9.5 kl/ha. Since the chemical treatment does not appear practical in the farm, elimination by handpicking was resorted to. During the season of its occurrence, all cages were constantly examined by employment of labour task force and the predators were removed. While future research should develop methods for economical and non-labour intensive treatment emphasis should also be paid on ways to prevent predation.

An important factor in the spread of diseases and predators in cultured shellfish population is through transfer of seed stock to growing areas. Japanese oyster drills *Ocenebra japonica* and carnivorous flat worms were imported to United States (Galtsoff 1964, Hanson 1974). Korringa (1942) described how *Crepidula* sp. was brought to Europe. Werner (1948), Chapman and Banner (1949) described the introduction of *Crepidula* sp. along with import and relaying of oysters in Germany and America respectively. These studies point out that very often spread of predators is unwarily done due to import of seed stock from one geographic area to another.

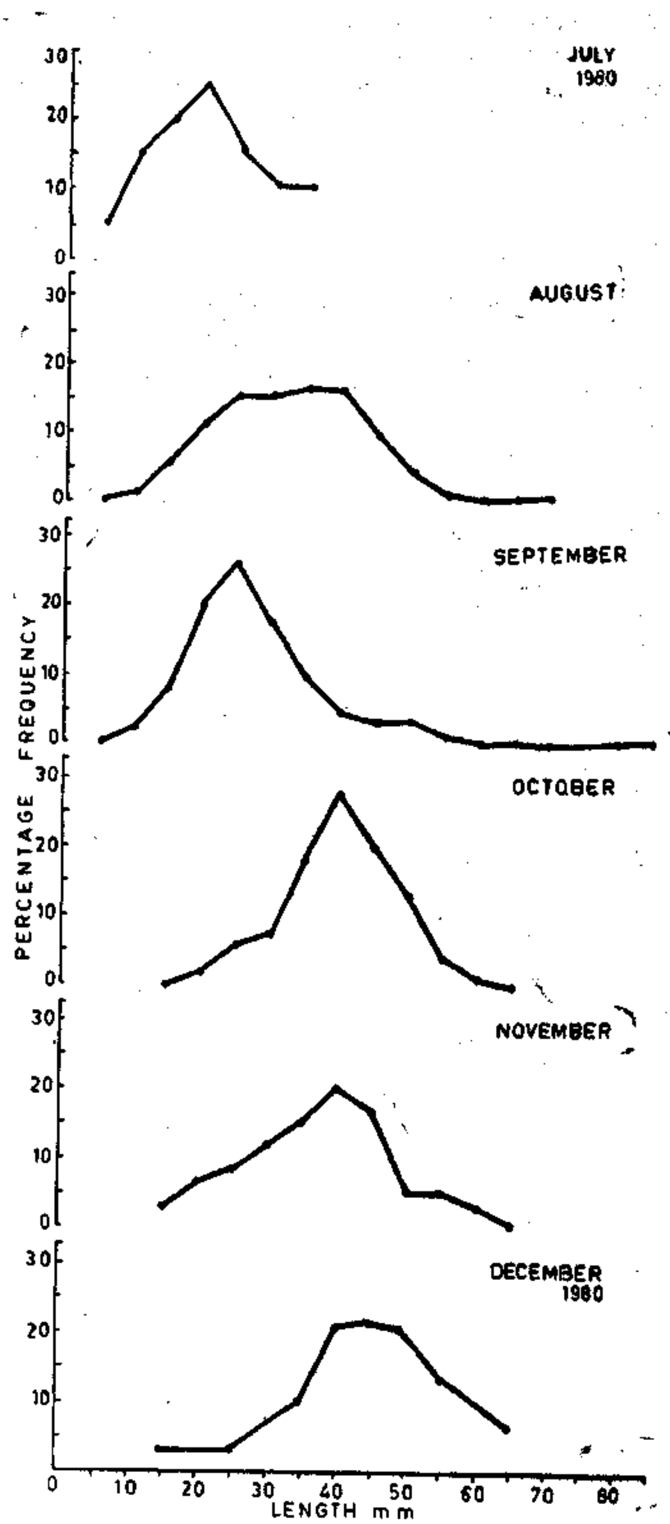

Fig. 1. Size distribution of *Cymatium cingulatum*

Controlling of predators means additional cost in the production of oysters. Mackenzie (1970a) gave that average cost of treating one acre of bottom with polystream for eradication of predatory gastropods was about $ 40 a year. In culture operations which involves crowding the animals, density problems of this nature are bound to arise and it becomes unavoidable to earmark a portion of the capital investment in extensive culture systems to achieve maximum production.

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