# GROWTH OF PEARL OYSTER *PINCTADA FUCATA* IN THE PEARL CULTURE FARM AT VEPPALODAI

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## ABSTRACT

Growth of pearl oyster, *Pinctada fucata*, under conditions of raft culture at Veppalodai, Gulf of Mannar, has been studied during the period March 1973-September 1974, with reference to growth of the dorsoventral dimension, hinge line, thickness and weight. The first two dimensions showed positive growth up to a certain period and was followed by growth recession. Thickness increased uniformly throughout the period of study in the younger size groups (30-45 mm) but it showed a stagnation in the older size groups (45-60 mm) during certain times of the year. Weight of oysters increased steadily but showed retardation, except in younger groups (30-40 mm), in a few months. The progress of growth was better in younger size groups than in the older groups. The growth of pearl oysters in the shallow area is considered moderate. Growth was relatively faster during September-January than in other months as observed from the formation of growth processes and growth increments. It has been inferred that the intensity of fouling and boring organisms, besides other factors, might influence the growth of pearl oysters.

## INTRODUCTION

Experiments on pearl culture were started at Veppalodai near Tuticorin in 1972. Although the main aim of the experiments was to develop the techniques for the production of cultured pearls, certain biological and environmental studies were carried out to assess the suitability of the ground for pearl culture (Alagarswami 1974). One of the aspects investigated was the growth of pearl oysters in the area under conditions of raft culture.

Earlier workers have studied the growth of pearl oysters in relation to age groups. The age groups were reckoned either based on the spat fall (Herdman 1903, Devanesen and Chidambaram 1956) or the number of growth rings on the shell (Gokhale et al 1954, Narayanan and Michael 1968, Pandya 1975). In all these studies, the range of sizes within age groups have been noticed to be great. In the present investigations, the age of pearl oyster could not be estimated as the time of spat fall in the natural pearl banks was not known. The oysters from the Gulf of Mannar do not show any clear growth rings as has been observed in the oysters of the Gulf of Kutch by Gokhale et al (1954) and

others. Devanesen and Chidambaram (1956) have also stated that the growth lines are too closely set in the young and are generally abraded in the adult and, hence, their number cannot be relied upon in the determination of age of the pearl oyster (*Pinctada fucata*) of the Gulf of Mannar. Therefore, the growth of pearl oysters in the farm at Veppalodai had to be studied with reference to the initial sizes of the oysters at transplantation. The oysters were divided into 5 mm size groups based on the dorsoventral measurement.

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## Material and methods

Pearl oysters of the species *Pinictada fucata* (Gould) were collected from the pearl banks of the Gulf of Mannar, namely, Tholayiram paar (depth 15.5 m), Pulipundu paar (depth 14.5 m) and outer Kodamuthu paar (depth 19 m) during November 1972-June 1973 (See Alagarswami and Qasim 1973). The oysters were cleaned of all fouling organisms and measured correct to 0.1 mm. The dorsoventral measurement (D.V.M.) is the greatest dimension of the oyster measured at right angles to the hinge line. Hinge length (H.L.) is the distance between the tips of the anterior and posterior ears along the hinge line. Thickness (T) is the maximum distance between the external surface of the two valves when both are closed. Weight (W) was taken correct to 0.5 g with a semi-self-indicating balance. The oysters were arranged in sandwich-type frame nets and suspended from rafts, floated and moored at a depth of 4 m (See Alagarswami and Qasim 1973 for details of rafts and frame nets).

The oysters were periodically removed from the rafts and cleaned of the fouling organisms. After cleaning, the oysters were measured, weighed and re-arranged in the frame nets and suspended again from the rafts. The present study relates to the data on 113 oysters and the growth of each individual was known from the time it was introduced in the farm (March or June 1973) up to September 1974. Besides recording the actual data, observations were made on the presence of growth processes at the distal border of the shell.

### *Growth in D. V. M.*:

The youngest group in the present study included pearl oysters of size group 30-35 mm. The average growth of the dorsoventral dimension was from 34.1 mm in March 1973 to 46.45 mm in June 1974, an average increase of

12.35 mm in one year and four months. The size group 35-40 mm showed an increase of 12.40 mm in one year and seven months (from March 1973 to September 1974). In the case of the older size groups, the growth was relatively very slow and in the size groups 50-55 mm and 55-60 mm, the increase was only 1.82 mm and 1.98 mm respectively from June 1973 to September 1974.

It is seen from the Table 1 that in the younger size groups (30-35 mm and 35-40 mm) the growth exhibits a continuous increasing trend whereas in the older groups, after a period of slow growth, the average values show a trend of retardation. Such state of retardation and recession in growth is not uncommon. In the case of Japanese pearl oyster, Kobayashi and Tabota (1949) have recorded a similar phenomenon. Devanesen and Chidambaram (1956) have also noticed decline in length of shell in oysters from the third year. Alagarswami and Qasim (1973) have observed that during shell cleaning operations, if the growth processes got damaged, the growth of the oyster seemed to decline. In the present study, the oysters with damaged shells were removed and only undamaged ones were considered for growth study.

*Growth in H. L*:

The growth in hinge line shows trends similar to those of D.V.M. It has to be noted that in pearl oysters, the growth of hinge line is relatively slower than that of the dorso-ventral axis after reaching a H.L. of about 35 mm (Alagarswami and Chellam MS).

*Growth in thickness*:

Unlike in the case of the above two dimensions, the growth of oysters in thickness has been found to be uniformly progressive. It is seen from Table 1 that the rate of increase in thickness was high in younger groups (30-35 mm, 35-40 mm and 40-45 mm) but it was rather slow in the older groups (45-50 mm, 50-55 mm and 55-60 mm). The rate of growth in thickness was only 2.37 mm in the 55-60 mm group for a period of one year and five months whereas it was 7.07 mm in the case of 35-40 mm group for a period of one year and seven months. Unlike the other dimensions of D.V.M. and H.L., the growth in thickness was better in the farm and never showed a retarded condition throughout the period of observation.

*Growth in weight*:

The younger size groups (30-35 mm, 35-40 mm and 40-45 mm) alone showed a uniform and steady progress of growth in weight. In other groups, although the growth has been generally notable, retardation was also noticed. In these groups, though there was a uniform increase in the first year of observation, retardation was not uncommon in the second year. In the case of molluscs, it is well known that the "condition" of the animal would show a

TABLE 1. *Growth of pearl oyster,* Pinctada fucata, *at the Veppalodai farm. (The values are averages; Except weight* (W) *which is expressed in grams, the linear dimensions are in millimeters* - DVM - *dorsoventral measurehent;* HL - *hinge length;* T - *thickness*).

| Size groups (mm) | Dimensions | 1973 Mar | May | Period observation Jun | Sep | Nov | Dec | 1974 Jan | Feb | Mar | Apr | Jun | Sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30-35 | DVM | 34.10 | — | 34.30 | 40.45 | 43.10 | — | — | 44.65 | — | — | 46.45 | — |
| | HL | 34.90 | — | 37.00 | 47.75 | 38.45 | — | — | 39.45 | — | — | 39.50 | — |
| | T | 10.10 | — | 13.10 | 13.00 | 13.55 | — | — | 13.80 | — | — | 14.15 | — |
| | W | 6.00 | — | 8.50 | 11.25 | 13.75 | — | — | 15.50 | — | — | 16.25 | — |
| 35-40 | DVM | 37.03 | — | 43.05 | 44.82 | 46.93 | — | — | 48.43 | — | — | 49.32 | 49.43 |
| | HL | 35.43 | — | 37.55 | 39.25 | 39.42 | — | — | 40.58 | — | — | 41.07 | 40.40 |
| | T | 11.13 | — | 12.55 | 14.12 | 15.02 | — | — | 16.00 | — | — | 16.88 | 18.20 |
| | W | 8.67 | — | 10.95 | 14.25 | 17.92 | — | — | 20.28 | — | — | 21.25 | 22.23 |
| 40-45 | DVM | 44.00 | 46.35 | — | 35.69 | 27.60 | — | 48.63 | — | 48.63 | — | 49.72 | 49.11 |
| | HL | 36.50 | 39.75 | — | 39.56 | 40.50 | — | 42.59 | — | 42.27 | — | 42.89 | 42.13 |
| | T | 14.05 | 14.45 | — | 16.91 | 16.25 | — | 18.18 | — | 17.70 | — | 18.21 | 18.80 |
| | W | 11.25 | 15.75 | — | 18.53 | 18.00 | — | 23.04 | — | 22.25 | — | 24.44 | 24.33 |
| 45-50 | DVM | — | — | 48.01 | 48.21 | — | 51.21 | — | 52.00 | 52.40 | — | 52.01 | 52.06 |
| | HL | — | — | 44.11 | 44.77 | — | 46.21 | — | 46.57 | 46.52 | — | 45.98 | 46.64 |
| | T | — | — | 17.23 | 18.11 | — | 19.30 | — | 18.95 | 19.62 | — | 19.97 | 20.86 |
| | W | — | — | 20.60 | 22.51 | — | 26.44 | — | 26.50 | 27.46 | — | 26.26 | 27.80 |
| 50-55 | DVM | — | — | 52.51 | 53.15 | — | 54.18 | — | 54.13 | 53.99 | 54.67 | 54.14 | 54.33 |
| | HL | — | — | 45.62 | 46.07 | — | 46.80 | — | 46.39 | 47.26 | 47.01 | 46.61 | 45.86 |
| | T | — | — | 18.46 | 19.23 | — | 19.85 | — | 20.46 | 20.35 | 20.26 | 20.88 | 20.84 |
| | W | — | — | 25.16 | 26.64 | — | 20.09 | — | 30.44 | 30.58 | 29.93 | 31.31 | 30.36 |
| 55-60 | DVM | — | — | 56.46 | 57.44 | — | 57.91 | — | 57.57 | 58.57 | 58.36 | 58.37 | 58.44 |
| | HL | — | — | 49.36 | 49.59 | — | 49.71 | — | 50.13 | 52.33 | 49.38 | 51.12 | 50.30 |
| | T | — | — | 19.32 | 20.25 | — | 21.05 | — | 21.33 | 21.13 | 21.60 | 21.52 | 21.69 |
| | W | — | — | 26.96 | 30.18 | — | 33.91 | — | 31.58 | 34.17 | 36.30 | 35.28 | 32.93 |

fluctuating trend depending largely upon the phase of the reproductive cycle (Alagarswami 1964). The fluctuations noticed in the growth of pearl oysters in the older age groups (45-50 mm, 50-55 mm and 55-60 mm) would have probably been due to this factor. However, this has to be corroborated with actual observations on the condition index of the oysters.

*Growth processes*:

Development of growth processes on the distal margins of the valves of the oysters was periodically noticed. The frequencies of the presence of the growth processes from July 1973 to October 1974 are given in the following table.

| Month | No. of oysters examined | Percentage frequency | | |
|---|---|---|---|---|
| | | Oysters with no growth process | Oysters with newly sprouting growth process | Oysters with well developed growth processes |
| 1973 | | | | |
| Jul | 768 | 83.7 | 12.8 | 3.5 |
| Sep | 736 | 100.0 | — | — |
| Nov | 89 | 98.9 | 1.1 | — |
| Dec | 614 | 45.4 | 29.2 | 25.4 |
| 1974 | | | | |
| Jan | 325 | 42.4 | 30.5 | 27.1 |
| Feb | 248 | 87.1 | 12.5 | 0.4 |
| Mar | 113 | 92.9 | 6.2 | 0.9 |
| Apr | 283 | 100.0 | — | — |
| Jun | 272 | 88.3 | 8.8 | 2.9 |
| Sep | 437 | 76.9 | 3.4 | 19.7 |
| Oct | 261 | 57.9 | 22.2 | 19.7 |

It is seen from the above table that from 42.5% to 100% of the oysters had no developing growth processes in different months during the period of observation. The percentage of oysters with developing and well-developed growth processes was high in December 1973, January and October 1974. It has to be noted that in seasons of heavy fouling by barnacles and bryozoans the development of growth processes is either inhibited or the growth processes get damaged during the cleaning of shells.

From the observations, it would appear that the growth of pearl oysters in the shallow waters (depth 4 metres) off Veppalodai has only been moderate.

The environmental conditions at the site of culture are different from those obtaining at the natural pearl banks, particularly with regard to depth and clarity of water. Both the south-west and north-east monsoons create turbulent sea conditions and the clarity at its best is limited to about 1.5 m at the raft site. The problem of fouling and boring has been notable and this has been one of the probable causes of mortality of pearl oysters observed during different periods (Algarswami and Chellam. MS). The boring polychaete *Polydora* sp. and the sponge *Cliona celata* also play a part in adversely affecting the normal growth of oysters. Hornell (1922) observed that the growth of pearl oysters is distinctly retarded after the third year and attributed it to the great abundance of encrusting organisms, especially sponges and polyzoans.

All the workers who have investigated the growth of pearl oysters in the Indian waters, have found the growth of the oysters is fast upto the second or third year and thereafter it is retarded (Hornell 1922, Gokhale et al 1954, Devanesen and Chidambaram 1956, Narayanan and Michael 1968). A similar trend of growth has been reported for the pearl oysters of Sri Lanka waters (Herdman 1903). Since the age of the oysters of the present study could not be determined as already stated, it is not possible to draw any inferences on the retardation of growth noticed in the farm with reference to the age of the oysters. However, it is clear that the younger size groups show a more progressive growth than the older groups.

Gokhale et al (1954) assumed that the pearl oysters of the Gulf of Kutch grew vigorously in winter months (November to February) when the temperature varied from 23°C to 27°C and growth ceased in summer. However, they could not justify the assumption as the difference between the winter and summer temperature was not so great. The growth curves of oysters from Veppalodai farm do not show any remarkable seasonal differences. Nevertheless, it could be noticed that the growth increments are greater from September to January than in other periods. The frequency of occurrence of growth processes, which is relatively high in October, December and January, also shows that the oysters show better growth during this period. The quarterly mean temperature and salinity at Veppalodai were 29.93°, 29.24°, 27.25° and 28.47 C, and 34.30‰, 34.4‰, 33.3‰ and 31.48‰ respectively from the first through fourth quarters of the calender year 1973.

It is likely that more than these two parameters, factors such as the suspension of sediments, velocity of currents and availability of food influence the growth of the pearl oysters besides the fouling and bring organisms. Despite the moderate growth of pearl oysters observed here, the rate of success of production of cultured pearls in *Pinctada fucata* has been found to be high at Veppalodai and the growth of pearls has been observed to be fast (Alagarswami MS).

## REFERENCES

ALAGARSWAMI, K. 1966. Studies on some aspects of biology of the Wedge-clam, *Donax faba* Gmelin from Mandapam coast in the Gulf of Mannar. *J. mar. biol. Ass. India.* 8 (1): 56-75.

ALAGARSWAMI, K. 1974. Development of cultured pearls in India. *Curr. Sci.*, 43 (7): 205-207.

ALAGARSWAMI, K. AND S. Z. QASIM. 1973. Pearl culture its potential and implications in India. *Indian J. Fish.*, 20 (2): 533-550.

DEVANESEN, D. W. AND K. CHHIDAMBARAM. 1956. Results obtained at the pearl oyster farm, Krusadai Island, Gulf of Mannar, and their application to problems relating topearl fisheries in the Gulf of Mannar-1. Contribution from the Marine Fisheries Biological Station, Krusadai Island, Gulf of Mannar, No. 4, 89 pp.

GOKHALE, S. V., C. R. ESWARAN AND R. NARASIMHAN. 1954. Growth rate of the pearl oyster *Finctada pinctada* in the Gulf of Kutch with a note on the pearl fishery of 1953. *J. Bombay nat. Hist. Soc.*, 52 (1): 124-136.

HERDMAN, W. A. 1903. *Report to the Government of Ceylon on the pearl oyster fisheries of the Gulf of Mannar*, Part 1. Roy. Soi., London 307 pp.

HORNELL, J. 1922. The Indian pearl fishery of the Gulf of Mannar and Palk Bay. *Madras Fish. Bull.*, 16: 1-188.

KOBAYASH, S. AND M. TOBOTA. 1949. Studies on culture pearl, II. Activity of pearl-oyster in winter (1). *Bull. Jap. Soc. Sci., Fish.*, 14 (4): 196-199 (In Japanese with Synopsis in English).

NARAYANAN, K. R. AND M. S. MICHAEL. 1968. On the relation between age and linear measurements of the pearl oyster, *Pinctada vulgaris* (Schumacher), of the Gulf of Kutch. *J. Bombay nat. Hist. Soc.*, 65 (2): 441452.

PANDYA, J. R. 1975. Age and growth of the pearl oyster, *Pinctada vulgaris* (Schumacher), of the Gulf of Kutch. *J. Indian Fish. Ass.*, 2(1&2) (1972): 47-54.