GROWTH AND BIOMETRIC RELATIONSHIP OF PEARL OYSTER PINCTADA FUCATA (GOULD)

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ABSTRACT

The Indian pearl oyster, *Pinctada fucata* (Gould) produced in the hatchery and grown at the protected farm at Tuticorin Harbour, attains a dorsoventral length of 47.0, 64.0 and 75.0 mm at the end of 12th, 24th and 36th months and the corresponding averages in weight are 8.3, 31.6 and 45.4 g. The estimated von Bertalanffy growth parameters are $L-\infty = 79.31$ mm, $K = 0.0757$ per month and $t_0 = 0.44$ months.

Relationships between total weight, shell weight, flesh weight and dry weight of flesh and length with depth were found by least square techniques.

INTRODUCTION

Observations on the growth of pearl oyster, *Pinctada fucata* (= *P. vulgaris*) of the Gulf of Mannar have been made based on the spatfall (Herdman, 1903; Devanesen and Chidambaram, 1956; Chacko, 1970) and the initial size of transplantation to the farm (Chellam, 1978). Alagaraja (1962) has found out the lengthweight relationship of the pearl oysters cultured at the Krusadai farm by Devanesan and Chidambaram (1956) in cages. The number of growth rings on the shells formed the basis for the age and growth studies of pearl oyster of the Gulf of Kutch (Gokhale *et al.,* 1954; Narayanan and Michael, 1968; Pandya, 1975). For the first time the growth of pearl oyster is traced from fertilization of the eggs to the age of three years in the present study. The biometric relationships of the hatchery produced spat grown in the protected Tuticorin Harbour farm with reference to age in months have been worked out.

MATERIAL AND METHODS

The pearl oyster spat set when they are around 300 mm in length. They are grown further in the nursery tanks in the hatchery, fed suitably with mixed algae, till they reach a size of 3-5 mm. For this, they take about 30 days. The spat are then transplanted to the farm and grown in net-cages of synthetic velon screen with a mesh size of 1 mm. These nets are inserted into a retrievable bag of old fish net, which provides protection to the spat from predation. Once the spat reach the size of 15-20 mm, they are transferred to box-cages, the webbing of which will be about 10 mm knot to knot. Further rearing is continued in this cage. The size of the box-cage is 40 x 40 x 15 cm. A box-cage of this size will hold 125 oysters of 35-45 mm, 100 oysters of 45-55 mm and 75 oysters of 55-70 mm.

Pearl oyster spat are produced by hatchery method in the Tuticorin Research Centre of Central Marine Fisheries Research Institute (Alagarswami *et al.,* 1983). For the growth study, the spat spawned on 23-2-1983 were used. Every month, they were cleaned of the fouling organisms and measurements of 30-50 animals taken. The length indicated in the study is the dorsoventral measurement (DVM) and the depth is the thickness taken with a Vernier calipers correct to

0.1mm. The modal length and average depth for the oysters in each month were calculated from the above data.

Several batches of oysters, spawned at different dates of the year were grown in the Tuticorin Harbour farm. For total weight, flesh weight, shell weight and dry weight of flesh, 30 animals of the known age ranging from 6 to 36 months were used. After weighing the oyster, the left shell was removed by cutting the adductor muscle of the left side along the shell with a scalpel. The flesh, removed from the right shell and after blotting the water from the flesh and shell, was weighed separately with the help of a triple beam balance. The dry weight of flesh was taken after drying in hot-air oven at 80°C for 24 hours.

AGE AND GROWTH

The monthly dominant modal length of the samples observed during the 36 months period, was taken to describe the growth pattern in the mathematical form using the von Bertalanffy's growth equation (Beverton and Holt, 1957).
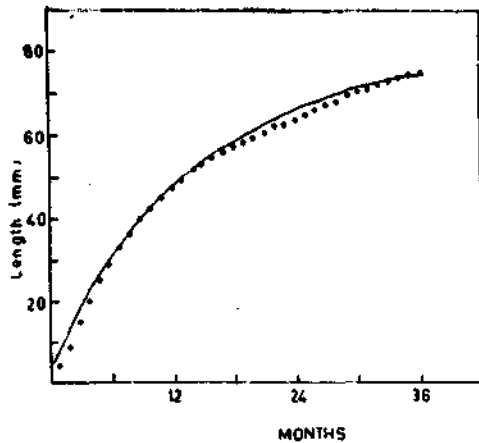

FIG. 1. The von Bertalanffy growth curve in length in the pearl oyster, *Pinctada fucata*.

The L_∞, the asymptotic length and K, the growth parameter, were estimated from the Ford-Walford plot (Ford, 1933; Walford, 1946) of Lt + 1 against Lt. By carrying

out regression analysis by least square method, the L_∞ was found to be 79.31mm which is close to the maximum observed size (80.0 mm) in the course of mother oyster culture in the Tuticorin farm. It is found that the points are well fitted by the straight line and the r^2 value is 0.999. The growth parameter k is found to be 0.0757 per month. The value of t_0 was found to be 0.44 month from age/length data. The growth curve of the pearl oysters cultured at the farm at the Tuticorin Harbour, obtained by using the estimated parameters is presented in the Fig. 1. The growth curve fits well with the observed modal lengths of the growth period of 36 months.
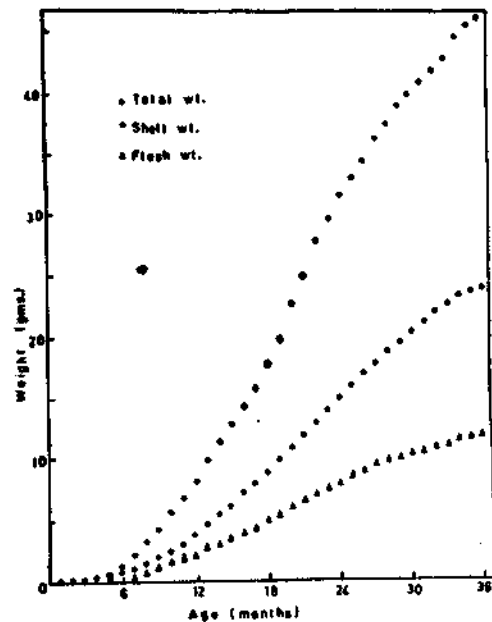

FIG. 2. Growth in total weight, shell weight and flesh weight in the pearl oyster, *P. fucata*.

In Fig. 2 the increase in total weight, shell weight and flesh weight are depicted for the corresponding age in months. In the 12th month, the pearl oyster attained an average weight of 8.3 g wherein shell weight was 3.9 g and flesh weight 2.3 g only. But in the 24th month, it reached an average weight of 31.6 g which was nearly four times increase

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in weight. The corresponding shell weight and flesh weight were 15.0 g and 8.1 g which were nearly 4 and 3.5 times higher respectively. At the end of the third year, the pearl oyster attained an average weight of 45.4 g which was 1.4 times more than in the second year end. The shell weight increased to 24.0 g which was 1.6 times more than in the end of the second year and the corresponding flesh weight was 11.8 g which was 1.4 times more than in the end of second year. Fig. 2 shows that in the second year, rapid increase in body weight of pearl oysters is taking place.
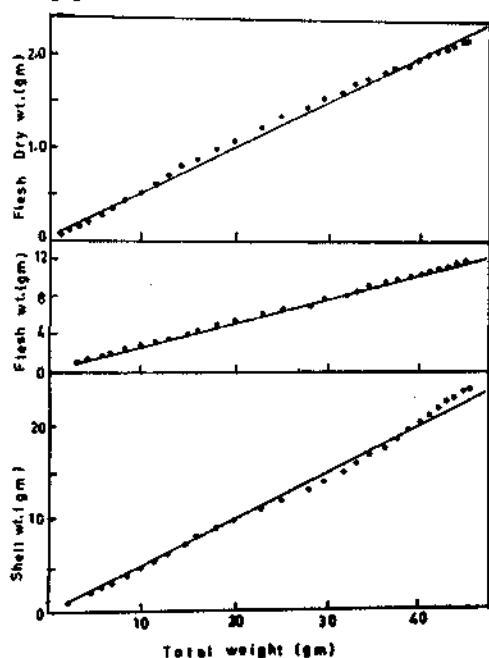

FIG. 3. The relationships between total weight -shell weight, total weight-flesh weight and total weight-dry flesh weight in the pearl oyster, *P. fucata.*

BIOMETRIC RELATIONSHIPS

Regression analyses were done to find out the relationship of the shell weight, flesh weight and dry flesh weight respectively with the total weight by the least square method using the mean weight and corresponding shell weight, flesh weight and dry weight of flesh of samples of different age

groups indicating 36 months of growth period. The scatter diagrams with the fitted lines shown in Fig. 3 indicate high correlation between the concerned variables.

The equation derived are given below:
Shell weight (Y) on Total weight (X)
$$Y = -0.1397 + 0.5113 \ X$$
Flesh weight (Y) on Total weight (X)
$$Y = 0.0187 + 0.2611 \ X$$
Dry weight of flesh (Y) on Total weight (X)
$$Y = 0.0344 + 0.0491 \ X$$

Thus the pearl oyster contains an average of 51% shell weight, 26% flesh weight and the dry weight of flesh is 5% of its total weight.
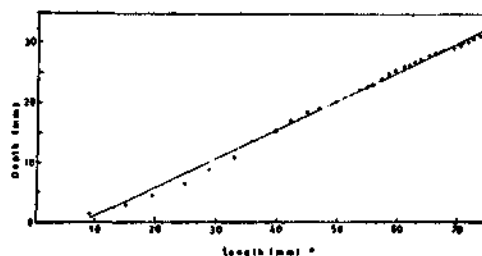

FIG. 4. Length-depth relationship in the pearl oyster, *P. fucata.*

The linear regression between the length and depth of the pearl oyster presented in Fig. 4 is found to be:

Depth (Y) on Length (X)

$$Y = -3.5747 + 0.4722 \ X.$$

The depth of oyster increases at the rate of 0.47 time with that of dorsoventral measurement (DVM).

The regression equation describing the length-total weight relationship is given below.

Log Y = -3.3242 + 2.6043 Log X

where X = dorsoventral measurement (length) in mm and Y = total weight in g.

The depth-total weight relationship is described by the following equation:

Log Y = -1.0427 + 1.6778 Log X

where X = depth (thickness) in mm and Y = total weight in g.

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TABLE 1. *Growth of pearl oyster,* Pinctada fucata *in the Tuticorin Harbour farm, Gulf of Mannar* *(April,* 1983 *to March,* 1986*)*

Date of sampling	Age in months	No. of oysters	Range in length (DVM) (mm)	Modal length (mm)	Mean weight (g)
1	2	3	4	5	6
30- 4–83	1	50	3.0–11.2	4.5	0.1
30- 5–83	2	50	9.0–17.8	9.0	0.2
23- 6–83	3	50	12.0–24.0	15.0	0.4
23- 7–83	4	50	19.0–28.3	19.5	0.5
25- 8–83	5	50	22.0 35.2	25.0	0.7
29- 9–83	6	30	27.0-36.0	29.0	1.5
3–11–83	8	50	31.7–47.0	36.0	3.4
8–12–83	9	50	35.0–45.0	40.0	4.4
19- 1–84	10	30	41.5–52.8	42.5	5.8
12- 2–84	11	50	42.0–55.6	45.0	7.0
2- 4–84	12	50	43.2–56.0	47.0	8.3
11- 5–84	14	30	46.0–56.5	52.0	11.6
7- 6–84	15	50	47.0- 57.0	53.5	13.0
13- 7–84	16	50	44.0–58.0	55.0	14.4
16- 8–84	17	40	47.0–59.0	56.0	16.0
15- 9–84	18	40	48.0–59.0	57.5	18.0
13–11–84	20	40	51.0–61.2	59.5	22.8
14–12 84	21	40	49.0–62.0	61.0	25.0
21- 1–85	22	30	52.4–62.5	62.0	27.8
28- 2–85	23	30	54.0–65.5	63.0	29.6
31- 3–85	24	30	54.0–66.0	64.0	31.6
30- 4–85	25	32	54.0–66.5	65.5	33.0
28- 5–85	26	30	56.0–67.0	66.5	34.4
29- 6–85	27	30	56.0–67.5	67.5	36.2
16- 8–85	29	35	56.5–69.5	69.5	38.8
20- 9–85	30	28	56.2–70.5	70.5	40.0
30–10–85	31	23	57.3–71.5	71.0	41.0
28–11–85	32	23	59.0–72.0	72.0	42.0
4- 1–86	33	23	57.0–73.0	73.0	43.0
30- 1–86	34	23	61.0–74.0	74.0	43.8
25- 3–86	36	22	63.4–76.0	75.0	45.4

DISCUSSION

Devanesan and Chidambaram (1956) reared the pearl oysters collected from the natural pearl oyster beds and from spatfall at Krusadai farm (Gulf of Mannar) and found them to grow to a length of 45 mm, 50 mm and 60 mm at the end of first, second and third years and 72 mm in six years. When compared to the present rate of growth of pearl oysters at Tuticorin Harbour farm, the growth rate of oysters of the Krusadai farm is slow. But the Krusadai farm oysters attained weights of 10, 30 and 45 g at the end of 12th, 24th and 36th months which is comparable to the present observations on the increase in weight of 8.3, 31.6 and 45.4 g at the end of 12th, 24th and 36th months.

In the inshore pearl culture farm at Veppalodai near Tuticorin, Chellam (1978) found a growth of 12 mm for the oysters of the

size group 30-35 mm in 15 months, 12 mm for the size group 35-40 mm in 18 months, 5 mm for the size group 40-45 mm in 18 months, 4 mm for the size group 45-50 mm in 14 months and 2 mm for the size groups 50-55 mm and 55-60 mm in 14 months. These growth rates are much lower than the present rate of growth.

The pearl oysters of the Gulf of Kutch attained a growth of 21.8 mm in thickness during the second year and 25.0 mm in thickness in the third year (Gokhale *et al.*, 1954) but in the present observations the thickness is 19.0, 27.1 and 31.8 mm at the end of first, second and third years. Narayanan and Michael (1968) reared pearl oysters in the Gulf of Kutch and found the rate of growth to be 44.05 mm, 61.68 mm and 76.20 mm at the end of first, second and third years which is more or less similar to the present rate of growth (Fig. 5).
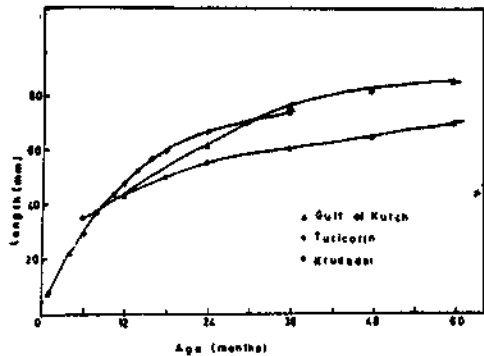

FIG. 5. Growth curves in the pearl oyster, *P. fucata* grown at different places like Krusadai, Tuticorin (Gulf of Mannar) and Gulf of Kutch.

Alagaraja (1962) found the length-weight relationship of oysters ranging in length from 48-76 mm by linear equation. But Galtsoff (1931) and Alagarswami and Chellam (1977) found a curvilinear relationship expressed by the equations.

$$W = 0.04209 \ L^{3.31539}$$

$$W = 0.00001447 \ L^{3.04282}$$

for Hawaiian pearl oyster ranging in length from 2-26 cm and Indian pearl oyster ranging

in DVM (length) from 15-70 mm from Thollayiram paar of Gulf of Mannar respectively. The length-weight relationship of oysters measuring more than 48 mm in length, is more or less linear. Alagaraja used the oysters which were more than 48 mm in length, for the length-weight studies and found only straight line relationship. If the smaller oysters are also taken into consideration in deriving the relationship, it is a curvilinear one as in the case of fishes and it is found that a single equation fits for the entire length range.

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