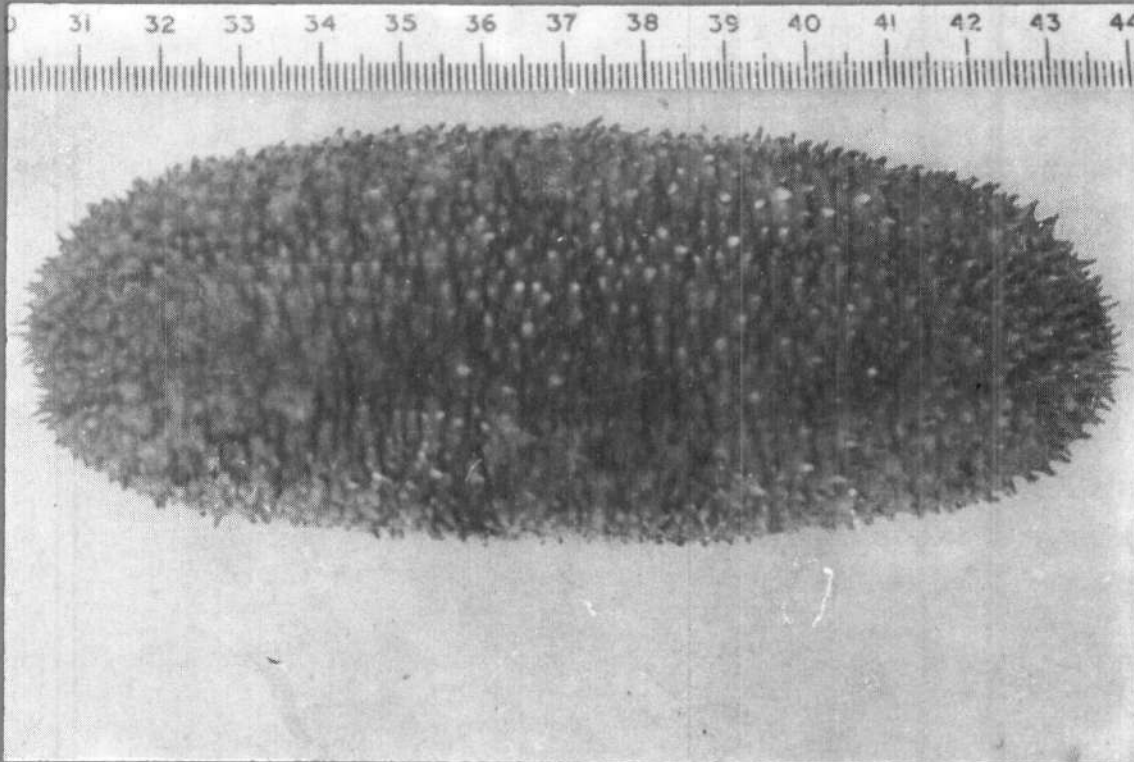




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# COLOUR AND THICKNESS OF NACRE IN FOUR GENERATIONS OF INDIAN PEARL OYSTER, *PINCTADA FUCATA* (GOULD) PRODUCED IN THE HATCHERY

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## Introduction

In 1973 the Central Marine Fisheries Research Institute achieved a breakthrough in the production of cultured pearls from the pearl oyster *Pinctada fucata* and in 1983 succeeded in breeding the species and producing its spat in the hatchery. The colour of the pearls produced in *P. fucata* is yellow or pinkish-yellow or white. Yellow coloured pearls are much preferred, followed by pinkish-yellow and white pearls. Besides the colour, the thickness of the nacre in the pearl is an important factor that determines the value of the pearl. The senior author has suggested selective breeding to improve the qualities of the hatchery-produced pearl oysters in India. Based on the studies on pearl production in relation to the graft tissue in *P. fucata*, it was observed that some oysters have a single black lamellar band on the external surface of the shells and these oysters have either pinkish-yellow, yellow or white nacre. This prompted the authors to carry out selection experiments with respect to the colour of nacre in pearl production. This type of study will help to develop breeding programmes for producing pearl oysters having desired nacre colour.

The broodstock were collected from the natural stock of pearl oysters from pearl banks off Tuticorin and they formed the parent stock of the first generation. They were placed in a spawning tank, and if natural spawning did not occur, they were stimulated to spawn either by manipulating the water temperature or by adding chemicals. The spat produced from such spawning were reared. From the first generation of oysters thus obtained, only those with a single black lamellar band on the external surface of the shell valves were selected to raise the next generation and this selection continued till the fourth generation. The first to fourth generations are denoted as G-1, G-2, G-3 and G-4 respectively. The length of the oyster is expressed as dorso-ventral measurement (DVM).

## Spawning protocol

The effective breeding population size has been

calculated as  $N_e = 4 N_m N_f / (N_m + N_f)$ , and the values were 17.68, 18.20, 32.94 and 10.18 respectively for first to fourth generations. The succeeding generation was raised from the offspring of the preceding one.

## Grow-out

The pearl oyster larvae were reared in 50-litre FRP tanks with ration of the live algae, *Isochrysis galbana*. The spat were also grown in similar tanks and fed with mixed culture of live micro-algae. At 2-3 mm length they were transferred to the pearl oyster farm and reared in box-type cages of the size 40 cm × 40 cm × 10 cm, covered with 1mm mesh velon screen, at a density of 1,000 spat/cage. The cages were again covered with nylon fishing net of 1-1.5 cm mesh to protect the spat from predators. In the farm, the cages were suspended from raft moored in the Tuticorin Harbour at 5 m depth. When the spat attained 15-20 mm length they were transferred to box-type net cages (40cm × 40 cm × 10 cm) having 1 cm mesh and reared at a density of 250 spat/cage. Further rearing of oysters was continued in these cages at different concentrations according to the size of oysters: 35-45 mm oysters at the rate of 125 nos./cage, 46-55 mm at 100 nos./cage and 56-70 mm at 75 nos./cage.

The first generation (G-1) (Fig. 1 b) was raised on 23.2.1983, for which the oysters from the natural bed formed the base stock (Fig. 1a). Succeeding generations G-2, G-3 and G-4 were produced on 16.8.1984 and 22.4.1987 (Figs. 1,2,3 and 4) respectively and for this, the oysters of G-1, G-2 and G-3 were the respective parents. For studying the colour of the shell nacre, samples were collected at random from the base stock, and from G-1, G-2, G-3 and G-4. One year old oysters of 1-4 generations attained average length and valve thickness (depth when both the valves were close together) of 45.90 mm and 17.10 mm, 47.40 mm and 16.50 mm, 45.03 mm and 16.00 mm and 40.40 mm and 14.15 mm respectively. A total of 177 pearl oysters from base stock, 40 from G-1, 19 from G-2, 22 from G-3 and 20 from G-4 were examined for nacre colour. The thickness of shell nacre in the right valve was

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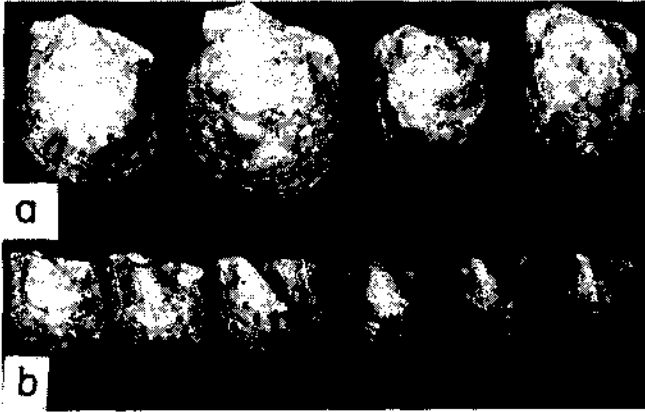


Fig. 1. a. Parent oysters collected from the wild. b. Hatchery produced oysters showing different shell characters of first generation.



Fig. 2. Six month old oysters with black band produced from first generation (b in Fig. 1).



Fig. 3. Third generation of oyster showing inner view of right shell with nacre and outer view of left shell with black band.

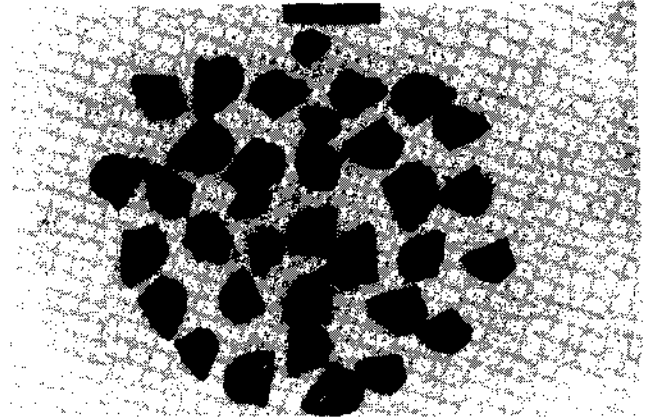
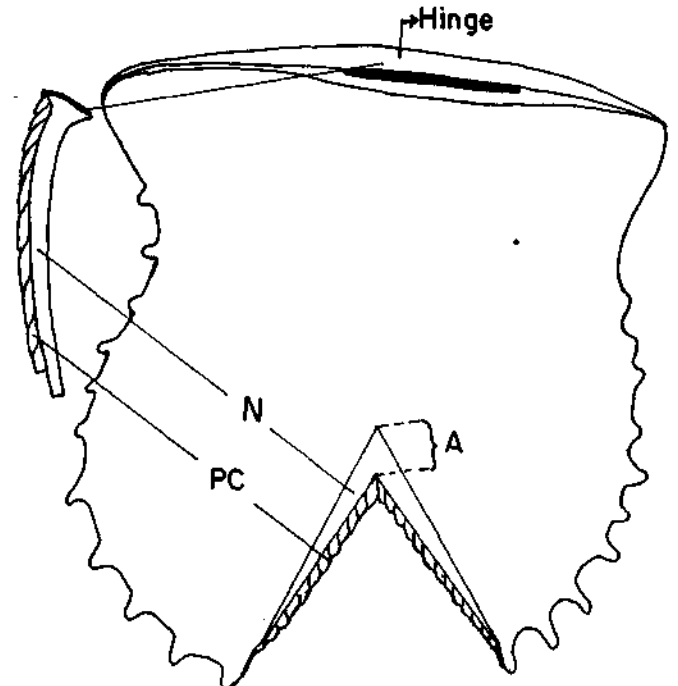


Fig. 4. One year old oyster of fourth generation with black band.

measured in the same oysters in G-2 to G-4 as for colour when the oysters attained the age of one year. After cutting the shell at area marked as 'A' (Fig. 5), the periostracum was scraped off thoroughly and the thickness of the nacre was measured with a vernier caliper corrected to 0.02 mm.

**Observations**

In the base population, 5% of the oysters have black band on the outer shell while in the first to fourth generations this character has been ob-



A - Area of thickness of nacre measured  
 N - Nacre, PC - Periostracum

Fig. 5. Inner view of left shell of the pearl oyster cut portion (diagrammatic). A. Area measured for thickness, N. Nacre, PC. Periostracum.

TABLE 1. Percentage of increase in the nacre colour of 4 generations of pearl oyster *Pinctada Fucata* (Gould) starting from the base population from the natural pearl oyster beds

	Pinkish - yellow (%)				Yellow (%)				White (%)						
	Whole population examined	Selected parents	Offsprings	SR	SD	Whole population examined	Selected parents	Offsprings	SR	SD	Whole population examined	Selected parents	Offsprings	SR	SD
Natural Vs G-1	26	29.2	40	10.80	3.20	16.00	18.00	25.00	6.90	2.10	58.00	52.70	35.00	-17.70	-5.30
G-1 Vs G-2	31	40.00	31.58	-8.42	9.06	22.00	25.00	31.58	6.58	3.00	47.00	35.00	36.84	1.84	-12.00
G-2 Vs G-3	30	31.58	45.45	13.87	1.58	21.00	31.58	40.91	9.33	10.58	49.00	36.84	13.64	-23.20	-12.60
G-3 Vs G-4	33	45.45	65.00	19.55	12.45	22.00	40.91	30.00	-10.91	18.91	45.00	13.64	5.00	-8.64	-31.36
Natural Vs G-4	26	29.2	65.00	35.80	3.20	16.00	18.10	30.00	11.90	2.10	58.00	52.70	5.00	-47.70	-5.30

G-1 to G-4 (Generation 1-4). Natural (base stock from the natural beds), SR (selection response), SD (selection differential).

served in 35,70,80 and 95% of oyster respectively. Similarly the increase in the percentage of shells with pinkish-yellow and yellow has been from 29.2 to 65% and 18.1 - 30% in G1 to G4 respectively. There is a considerable increase of 35.8% in pinkish-yellow, 11.9% in yellow and a decrease of 47.7% in the white nacre in the fourth generation (Table 1). A steep increase in the percentage of thickness was observed in pinkish-yellow at 19.55 in the fourth generation followed by yellow at 9.33 in the third generation and white nacre at 1.84 in the second generation (Table 2). Thickness of the pinkish-yellow nacre in the right shell at  $0.482 \pm 0.001$ , yellow at  $0.486 \pm 0.001$  and white nacre at  $0.481 \pm 0.028$  mm was observed in the second generation. Of all the right shells examined, the highest thickness of 0.873 mm was observed in the third generation for yellow nacre (Table 2). There was a considerable decrease in the nacre thickness in the fourth generation in all the nacre colour when compared to the third generation. But the thickness of nacre was still greater than the thickness of the second generation. The percentage of oysters with pinkish-yellow and yellow nacre increased considerably from 29.2 and 18.1 in the base stock to 65 and 30% respectively in the fourth generation (Fig. 6). However, the white nacre decreased from 52.7 in the base stock to 5% in the fourth generation. The genetic correlation between the oysters with a single black lamellar band on the outer side of the shells and nacre colouration comprising, pinkish-yellow and yellow has led to the increase in their numbers in the population

TABLE 2. Mean nacre thickness and standard deviation of one year old *Pinctada fucata* (Gould) for pinkish-yellow, yellow and white for three generations of response in each generation

Generation	Right (flat shell) thickness in mm		
	Pinkish-yellow	Yellow	White
2. Total	2.897	2.916	3.370
Average	0.482	0.486	0.481
SD	$\pm 0.006$	$\pm 0.0014$	$\pm 0.0282$
n (19)	(6)	(6)	(7)
3. Total	8.705	7.864	2.606
Average	0.870	0.873	0.868
SD	$\pm 0.0158$	$\pm 0.0389$	$\pm 0.0152$
n (22)	(10)	(9)	(3)
4. Total	6.317	2.922	0.484
Average	0.485	0.487	0.484
SD	$\pm 0.0103$	$\pm 0.0126$	—
n(20)	(13)	(6)	(1)
Response 3 Vs 2 %	0.388	0.387	0.387
	80.490	79.620	80.460
Response 4 Vs 3 %	-0.385	-0.386	-0.384
	-55.680	-55.780	-44.240
Response 4 Vs 2 %	0.003	0.001	0.003
Parameters	0.620	0.210	0.620

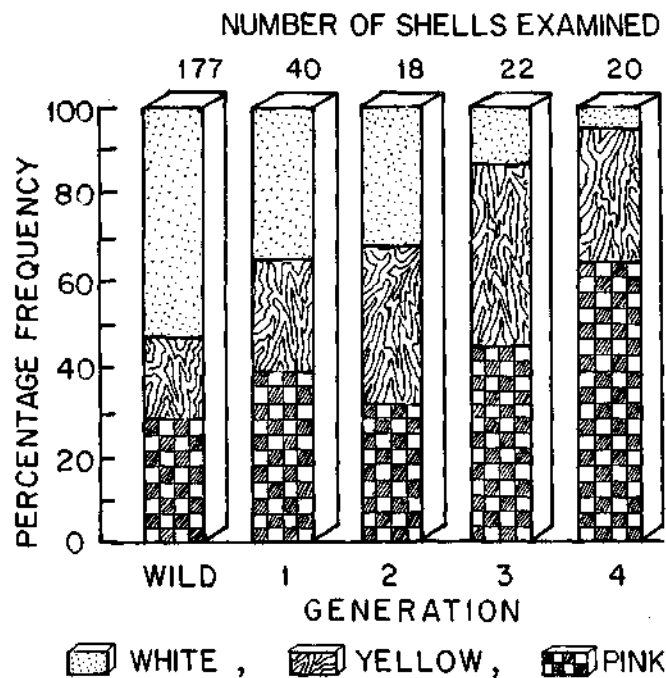


Fig. 6. Percentage frequency of nacre colour in the parents (wild) and offspring during the first year in four generations of pearl oyster.

through selective breeding of the oysters with black band on the shells.

#### Remarks

In the case of the Japanese pearl oyster, *Pinctada fucata martensii*, the frequency of shells with white nacre has increased to 80% in the third generation from 20% in the base population by selective breeding. In this study an increase in the percentage of thickness in pinkish-yellow (19.55), yellow (9.33) and white nacre (1.84) respectively was observed in the fourth, third and second generations respectively when compared with the first generations respectively when compared with the first generation. According to Wada (1986) the yellow coloured pearls produced from the oysters of second generation were heavier than the white ones. In the present study, the maximum thickness of nacre of yellow and pinkish-yellow colours was observed in the oysters produced in almost all generations. Based on this study it is suggested that the quality of pearls and nacre thickness of shells could be improved through selective breeding.