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INTRODUCTION

Pearls have been considered as one of the nine precious gems all over the world. As of 1996, the Philippine pearl oyster industry is estimated to be worth \$100 million which was obtained through the export of pearls, raw shells, processed shells, shell blanks and shell buttons. Pearls are traditional export commodity and has remained the 8th dollar earner for the country despite the fact that farming areas are limited only to 1,500 hectares.

Pearl culture presents a significant potential for economic development in coastal village communities in the Philippines. The industry requires minimal capital input, yet has wide ranging benefits to farmers, coastal communities and national economies. Pearls are the ideal export commodity because they are nonperishable, shipping costs are negligible and lucrative markets are already established.

Species of Pearl Oysters

The true pearl oysters belong to the Family Pteriidae. The two recognized genera which are commercially exploited throughout the world are the :

a) *Pinctada*

The "pearl oysters" genus *Pinctada* are characterized by a long straight hinge, with the long axis of the shell at right angles to the hinge. The left valve is a little deeper than the right valve and there is a byssal notch on each valve at the base of the anterior lobe.

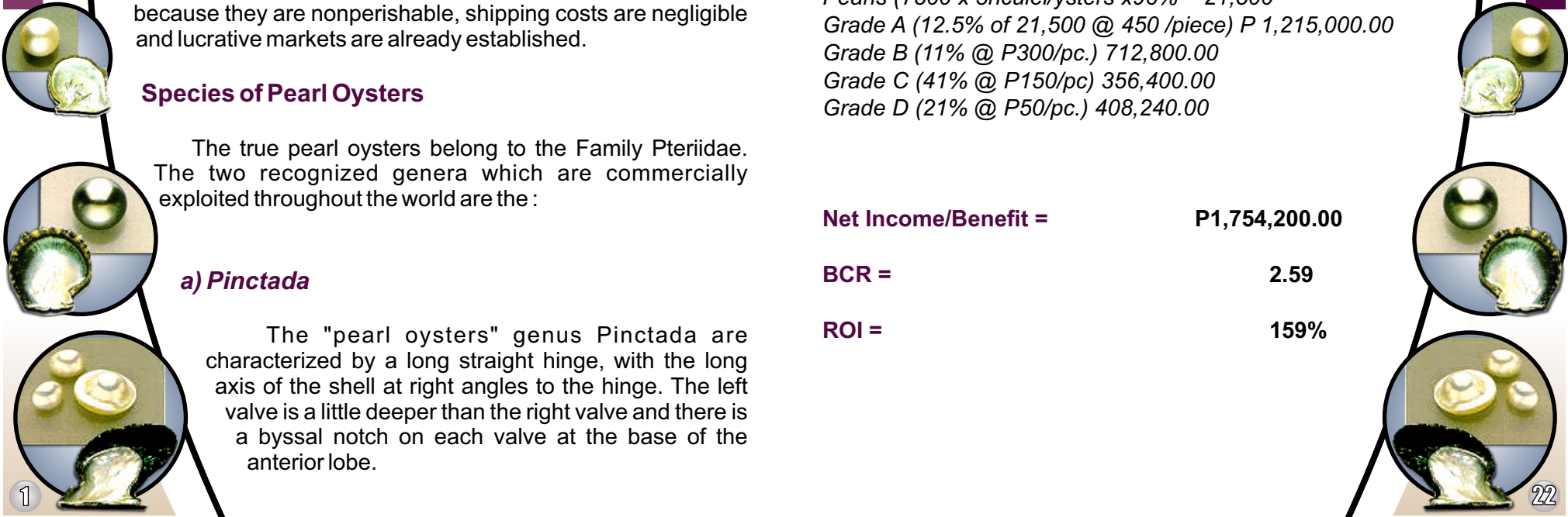
Labor Cost

Installation of oyster plots (35% of MC) 62,642.00
 Labor for nuclei operation (7500x 20/pc) 150,000.00
 Labor for the semi-processing of blister pearls (6,984 x 30/pc) 209,520.00
 Caretaker's salary 168,000.00
 Divers (4 divers at 3,000/mo.) 288,000.00
TOTAL COST P 878,162.00
 Depreciation Cost 44,900.00

INCOME/BENEFIT

Pearls (7500 x 3nuclei/oysters x96% = 21,500
 Grade A (12.5% of 21,500 @ 450 /piece) P 1,215,000.00
 Grade B (11% @ P300/pc.) 712,800.00
 Grade C (41% @ P150/pc) 356,400.00
 Grade D (21% @ P50/pc.) 408,240.00

Net Income/Benefit = P1,754,200.00
BCR = 2.59
ROI = 159%





b) Pteria

The wing oysters, genus *Pteria* are characterized by a more elongate shape than *Pinctada* spp., being longer anterioposteriorly than wide dorsoventrally.

***Pteria penguin* or Wing oyster**



Pearl Produced :
Mabe or Blister Pearl

Mabe pearls are hemispherical cultured pearls grown against the inside shell of an oyster rather than within the oyster's body.

5. Size - Cultured pearls are measured by their diameter in millimeters and varies depending on its origin. The larger the pearl, other factors being equal, the more valuable it will be. The average size pearl sold today is between 7 and 7 1/2 millimeters.



Pearl Grading

There is no internationally accepted grading system for pearls. Pearl dealers use their own systems. These systems often use the same alphabetical nomenclature.

<i>Grade</i>	<i>Description</i>
AAA	Perfect Quality
AA	Superior Quality
A	Fine Quality
AB	Good Quality
B	Medium Quality
C	Low Quality

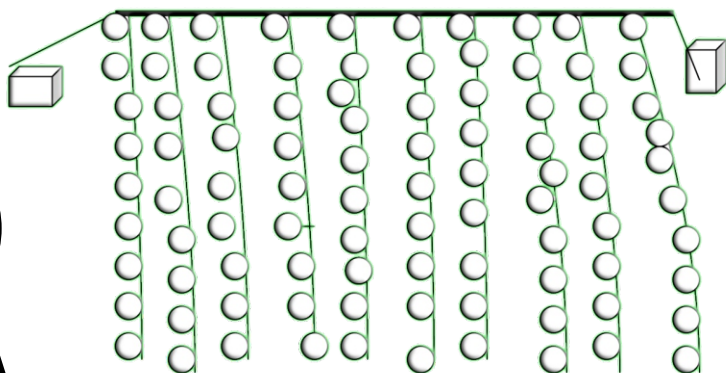
PEARL CULTURE METHOD

I. Bottom Culture Method

This culture method is applied when white-lip or black-lip oysters are used for pearl production. This is to simulate the natural position of these oysters. These oysters are naturally found laying flat on sea bottom or sometimes slightly attached to any form of substrate through their byssus.

Materials :

Polyethylene rope (12 mm diameter) for mainline (10 meters) with 10 loops for attachment of branch lines spaced at 75 to 100 cm.; Polyethylene rope (8mm diamter) for branch line (3.5 meters); Nylon monoline No. 80 ; Hand /electric drill; Pearl oysters; Bouys



A record of stock for both operated and unoperated pearl oysters is necessary for proper farm inventory. If possible, separate each source and batch of oysters received since they may differ in handling stress. A safe practice is to pay for the oysters 5-7 days after it had been delivered to assure you of higher survival rate.

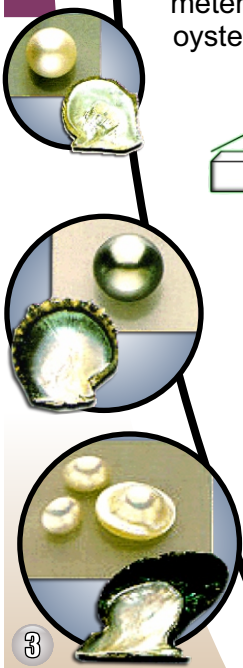
Record of operated pearl oysters should include the initial name of the technician, the kind of oyster, type of nuclei operation, date of nuclei operation, size of nuclei and number of branch line/oyster cage.

Factors which Affect Pearl Quality and Value

1. Luster is a combination of surface brilliance and a deep-seated glow. The more brilliant and reflective the surface of the pearl, the higher its luster and its value. A pearl with very high luster has a sharp contrast between the pearl's brightest area and the shaded area while a pearl with very low luster is dull and the reflection hazy, chalky and non-existent.



2. Surface Perfection refers to the absence of disfiguring spots, bumps or cracks on the surface of a pearl. The cleaner the surface of the pearl, the more valuable.





III. RAFT METHOD

Raft method is considered to be one of the most suitable farming methods in sheltered bays.

Size of Raft : 5 x 6 meters in size constructed from round timber, GI pipes or lumber with attached floats (empty oil drums or plastic containers of 200 liters capacity) to give buoyancy
Anchors : every corner with polyethylene rope 12 mm diameter
Oyster cages : capacity of 10 pearl oysters

Set raft parallel to the prevailing wind direction.



Half pearl nuclei are most often hemispherical but maybe irregular in shape (teardrops, hearts, oblong, etc.).



Steps in blister pearl operation :

1. Open the oysters by placing a wooden wedge in between the shell to prevent from closing.
2. Lift the mantle from the shell and paste three half-round nuclei (12 millimeter in diameter) with waterproof, quick-drying glue such as cyanoacrylates. Up to six half pearl nuclei may be placed in one oyster depending on the size of the nuclei and the oyster.
3. Take out the wooden wedge after the introduction of the nuclei.
4. Return the oysters to the sea with great care until harvesting time.

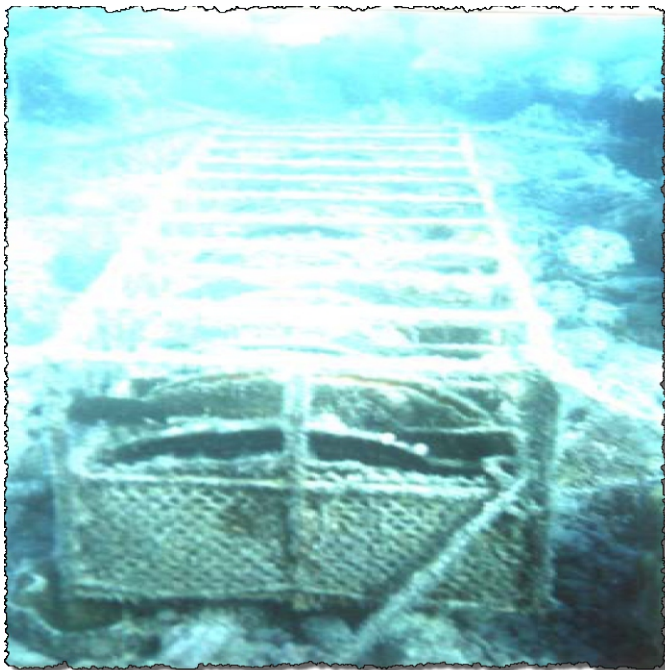




PEARL OPERATION TECHNIQUES

I. ROUND PEARL OPERATION

Round pearl operation is performed best during cooler months when the temperature is less than 26°C. Prior to both round pearl and blister operation, pearl oysters should be conditioned for at least two weeks in oyster trays. Discard oysters with parasite infestations.



such a way that the outer epithelium of the graft tissue is facing the passage. Withdraw the graft carrier

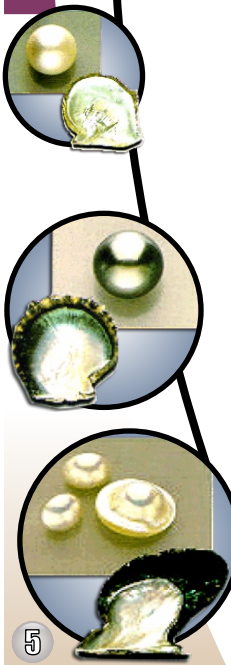
F. Nucleus implantation

Oysters with partially spent gonad should be used for nucleus implantation. The site of implantation is the ventral portion of the gonad. One nucleus of large size can be inserted in the gonad. In double implantation, the smaller second nucleus is inserted into the dorsal region of the gonad.

Size of Nuclei vs. Number of implantations :

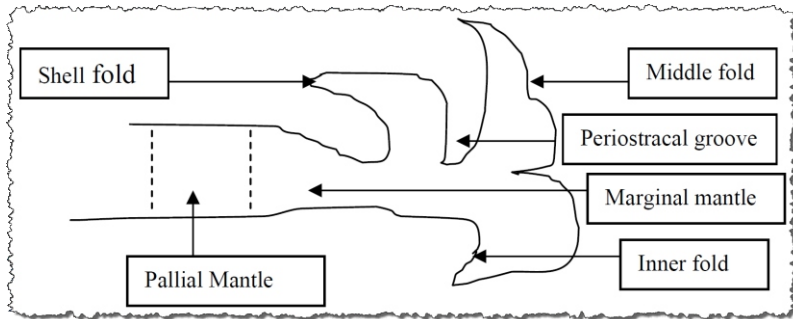
- a) 2-3 mm nuclei size - double and multiple implantations
- b) 5-6 mm size - single implantation
- c) 4-6 mm size - double implantation (large and small nuclei can be used.)

Dip the nuclei carrier in water and press it against a nucleus. The nucleus will stick to the nuclei carrier and gently insert the nucleus through the incision and leave it at the site by a slight deflection from the incision towards the site of the graft tissue. Withdraw the nuclei carrier gently.





D.1 Graft tissue preparation :

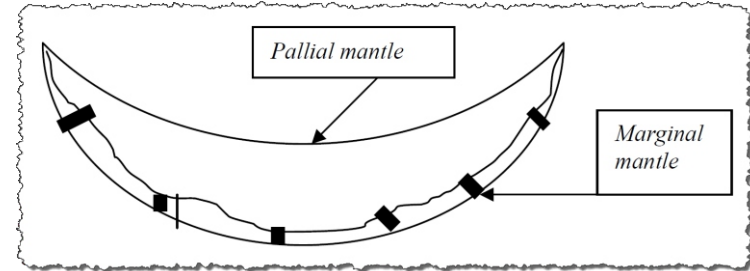


The donor oyster is cut open as follows :

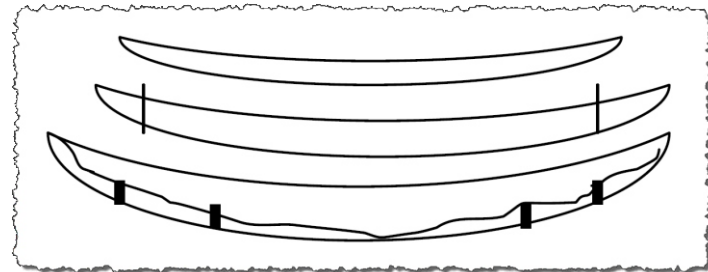
1. Hold the oyster facing the dorsal side down and the posterior side facing the technician.
2. Insert the curved end of the oyster cutting knife between the two valves from the posterior side of the oyster. Push the tip of the knife to the anterior end.
3. Press the knife straight downward to cut through the adductor muscle. Open the valves, separate them from the hinge. The mantle lobes are removed from the shell as follows.
 - (i) Brush aside the gills gently with the tip of the spatula. Expose the mantle without touching the mantle lobe.
 - (ii) Cut the mantle with the graft cutting knife from the posterior to the anterior margin.
 - (iii) Lift the mantle gently with the forceps and place it on a clean, wet wooden block without turning the side of the mantle.

D.2 Processing of the graft tissue :

1. Stretch gently the tissue, end to end.
2. Gently wipe the mucus and dirt with a wet sponge.
3. Cut away the folds of the marginal mantle with pigmentation with the graft cutting knife.



4. Cut and remove the inner muscular portion of the mantle.



5. By holding one end of the ribbon, reverse the side and place it in the block. Now the outer epithelial portion faces up.
6. Wipe the mucus and dirt gently with a clean wet sponge.

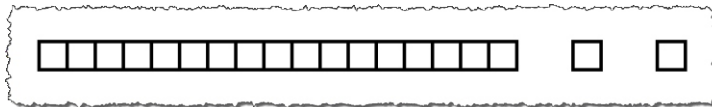




7. Trim the margins with the graft knife. Now the width of the ribbon maybe 3 mm.



8. Cut the ribbon sharply into small bits of 2-3 mm.



9. Keep the graft bits moist till they are used.

The size of the graft tissue must be in proportion to the nucleus size. The graft should cover one third of the nucleus surface. Being live, the graft should be used for operation within 30 minutes of its preparation to get good results.

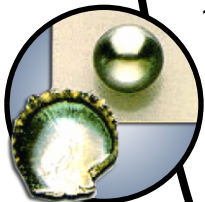
Precautions :

1. Use only filtered, clean, sterilized seawater for this operation.
2. All instruments should be washed in freshwater and sundried.
3. Use only clean and wet sponges for wiping the tissue.
4. Use only clean, smooth, moist wooden blocks. Glass plates can also be used instead of wooden blocks.
5. Use only the mantle of healthy oysters. Shrunken mantles are difficult to handle.

E. Pick a piece of prepared graft tissue with a graft lifter and gently insert it through the incision and leave the graft piece at the implantation site in

Steps in round pearl oyster surgery

- A. Insert the end of the speculum (shell opener) or bamboo wedge through the postero-ventral corner of the oyster and open it very slowly by sliding backward the gap-regulator ring. Care should be taken not to open the oyster too much as the adductor muscle may snap and kill the oyster. The shells and the mantle lobes should not be damaged due to the insertion of the speculum
- B. Mount the oyster with the speculum in between the plates of the oyster mounting clamp/shell holder.
- C. Make a shallow but sharp opening at the base of the foot with the incision knife or oval knife.
- D. Prepare mantle graft tissue taken from a donor oyster. The choice of mantle graft is critical to the eventual quality of the pearl. The graft is taken from a healthy, unconditioned oyster with desirable nacre color, as the donor tissue influences the color of the nacre of the recipient pearl. The mantle is cut from each valve of the donor, cleaned of mucus and the thicker outer edge.





G. Smoothen the incision with nuclei carrier so that the air inside the passage will come out and the two margins of the incision come in contact.

H. Remove the oyster from the shell holder, withdraw the bamboo wedge or speculum to close the oyster.

Precautions

Always remember that you are doing a surgery on a live animal. Concentration, skill and patience are the main requirements in a successful surgery.

1. Before and after use, wash the instruments quickly in clean sea water.
2. Make the incision to the correct size of the nucleus
3. Do not use maturing/matured oysters for nucleus implantation
4. Remember that the orientation of the graft tissue is important in pearl formation

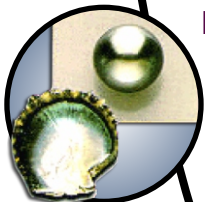
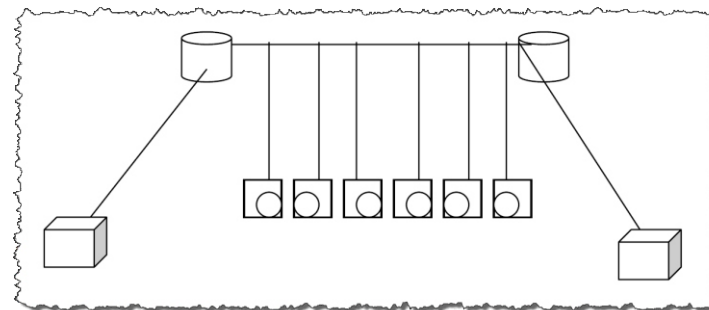
II. BLISTER PEARL FORMATION

Wing oyster (*Pteria penguin*) is used solely for production of half "mabe" pearls producing "rainbow" half pearls of a very high quality. *P. maxima* and *P. margaritifera* are also used for half pearls. Half pearls are less valuable than round pearls but maybe a useful source of income for firms without the services of seeding technicians.

Oysters that have rejected their nuclei or are too old or unsuitable for further spherical pearl operation will often be seeded for half pearls.

IV. LONG LINE METHOD

This method is good for open sea areas that uses spherical or cylindrical floats which are connected by horizontal polyethylene rope (main line) Both ends of each plot are anchored to coral heads made of concrete blocks. Oyster cages are tied to the horizontal rope and are suspended in water column at a desired depth. Another method of hanging oyster is that a hole is drilled near the hinge of the pearl oyster and a nylon monoline (80 lbs test) is put through the hole, which is then tied to a branch line (polyrope 8 mm diameter). The branch line is then tied to the main line. Setting the long line is made parallel to the prevailing water current.





PEARL FARM MANAGEMENT

Health Management

The control of fouling and boring organisms is critical for promoting good growth and quality of both the pearl and pearl oyster. Regularity of cleaning depends on the degree of fouling. This is done by manual or mechanical scrubbing of oyster with stiff brushes or high pressure water jets.

<i>Pests/Diseases/Predators</i>	<i>Control Measures</i>
1. Polychaetes and sponges	Submerge in saturated salt solution for 15 to 40 minutes
	Submerge oyster in freshwater for 6 - 10 hours
2. Boring Organisms	Brush with 1% formalin, dipped in freshwater and returned to sea
3. Predatory Organisms	Periodic monitoring of culture facilities
	Manual removal of predators

Stock Inspection, Inventory and Recordkeeping

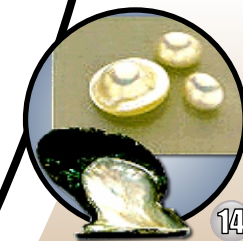
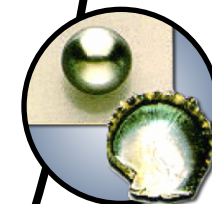
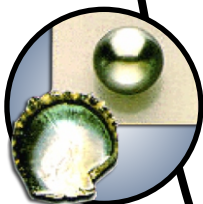
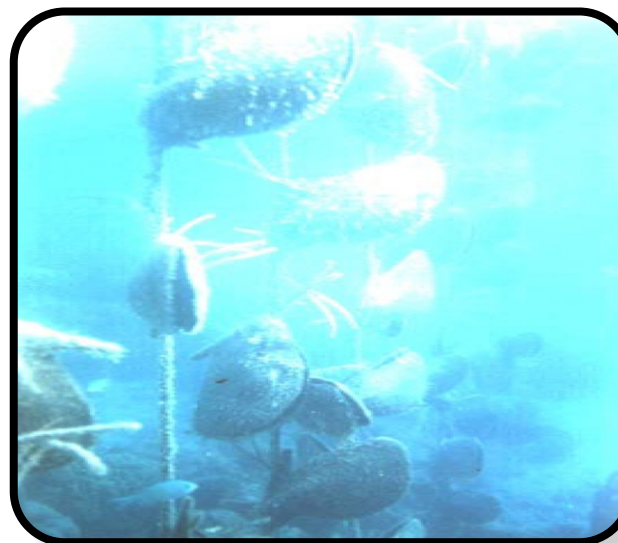
Oyster stock both operated for pearl production and unoperated should be inspected daily, if possible. This enables the recovery of dead shells without being beach rolled and will therefore give higher market value for the shell. This will also give earlier detection of disease and predation. Setting pearl oysters by tens in oyster plots and cages and providing individual tag in every branch line or cage will make inventory easier.

II. HANGING CULTURE METHOD

This culture method is applied when wing oyster is used for pearl production. This is done to simulate the natural position of wing oyster. This oyster is naturally found attached to gorgonian corals through its strong byssus.

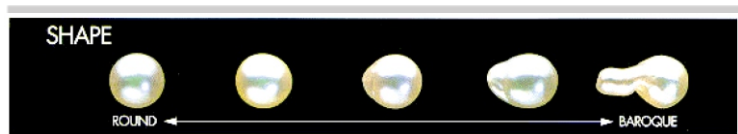
Materials :

Polyethylene rope (12 mm diameter) for mainline (10 meters) (2 mainlines) with 10 loops for attachment of branch lines at a space of 75 to 100 cm per loop. ; Polyethylene rope (8mm diameter) for branch line (3.5 meters) with a capacity of 10 wing oysters); Nylon monoline No. 80; Hand/electric drill; Pearl oysters; Plastic tags; Bouys; Posts

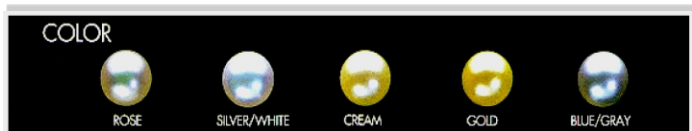




3. Shape in pearls is divided into three categories : spherical, symmetrical and baroque. The rarest and most valuable is the spherical or round pearl ; these are judged on their degree of sphericity or roundness. Pearls with shapes such as the teardrop or pear-shape are symmetrical pearls, and are judged on their outline, proportion and good symmetry. Baroque pearls, which are asymmetrical in shape can be lustrous and appealing, and often cost less than the round and symmetrical pearls.

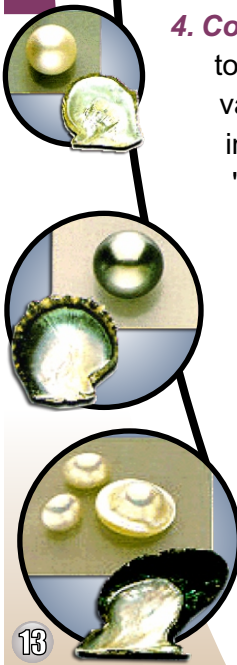


4. Color - Cultured pearls come in a variety of colors from rose to black and just about every color in between. The most valuable color of cultured pearls tends to be rose/white, but in general, color is a matter of personal preference. The "body color" refers to the basic color, i.e. white, cream, yellow. The "overtone" refers to the presence of a secondary color (its "tint", usually a pinkish, greenish or blue tint).



SITE SELECTION

- 1) Ideal locations for pearl farm: sheltered bays
- 2) Temperature: 19 to 32 °C Temperature determines the rate of deposition of nacre both on shells and on nuclei. With lower temperature, the quality of lustre is improved although the growth of pearls is reduced.
- 3) Optimum depth: 15 m. At greater depths, if the rate of nacre deposition is slower, pearls of high quality with a pinkish coloration are obtained.
- 4) Salinity: 25-30 ppt Higher salinities produce pearls with golden tint.
- 5) Select sites with gravelly bottom and avoid sandy or muddy bottoms.
- 6) Repeated culture on the same ground leads to some extent of deterioration of pearl quality. The chemical and physical state of the sea bottom is affected by the organic substances discharged from the oysters and fouling organisms.
- 7) Tide amplitude and currents must be sufficient in order to allow replenishment of oxygenated water and fresh plankton and flush away waste materials. In strong water currents, the formation of the nacreous layer is faster, but the quality of pearls is inferior.
- 8) Select areas with clear waters and away from industrial, agricultural and domestic pollution.
- 9) Accessibility to transport.
- 10) Availability of labor and materials
- 11) Access to market.

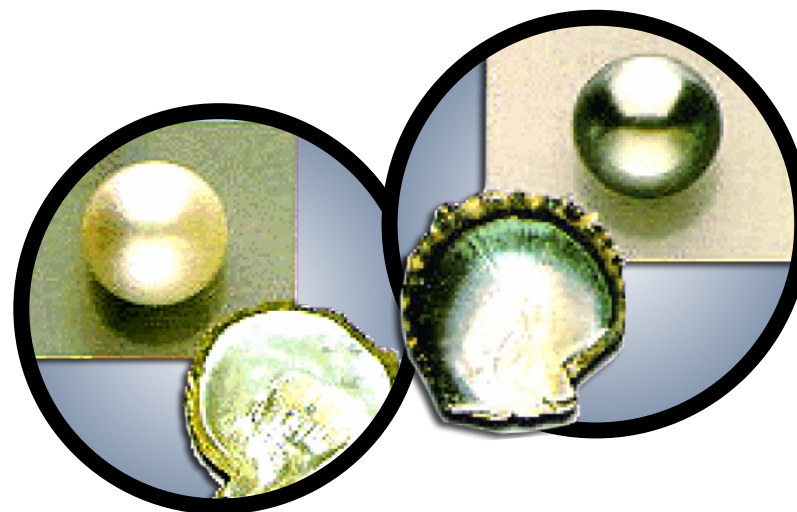




In the Philippines, we have the following grading system for blister pearls :

Grades	Description
A	Blister pearl has a perfect half-round shape with thick nacre coating and excellent luster.
B	Blister pearl has thick nacre coating with excellent luster but its shape is adversely affected by minor impurities or unbalanced nacre coating
C	Blister pearl has thick nacre coating with excellent luster but its shape is adversely affected by the presence of prominent impurities or unbalance coating of nacre.
D	Blister pearl has thin nacre coating that the nucleus is conspicuous. Shape has an unbalanced nacre coating and lacks luster.
Lg	Blister pearl has very thin nacre coating. The shape may be deformed or has a very dull color.
R	Blister pearl cannot be used for jewelry due to deformed shape caused by impurities.

Two species are commonly cultured in the Philippines:



COST AND RETURNS IN BLISTER PEARL PRODUCTION

(1,500 kg oysters)

OPERATING EXPENSES/COST

Cost of Materials

Wing oysters (5 pcs/kg x P40/kg)	P 60,000.00
Nuclei (7,500 x 3 nuclei/oyster x P5/pc)	112,500.00
Paste (50bot. X P45/bot)	2,250.00
Nylon monoline no. 80 (10 kgxP150/kg)	1,500.00
Gasoline (20 liters x P11/liter)	2,200.00
Lubricating oil (12 lit x P44/liter)	528.00
TOTAL COST	P 178,978.00

<i>Pinctada maxima</i> (Gold-lip or White-lip oyster)	<i>Pinctada margaritifera</i> (Black-lip oyster)
Size : largest species of the genus; a pair of valves attaining a weight of 6.3 kgs and a diameter of 30.5 cm.	Size : Maximum size of 25 cm
Pearl Produced : White South Sea Pearl.	Pearl Produced : South Sea Black
Size : ranging from 10 mm to 20 mm	Size : ranging from 10 mm to 20 mm