Pinctada fucata (Gould, 1850)*

Pralaya Ranjan Behera

IDENTIFICATION

Order	:	**Ostreida**
Family	:	**Pteriidae**
Common/FAO Name (English)	:	**Indian pearl oyster**

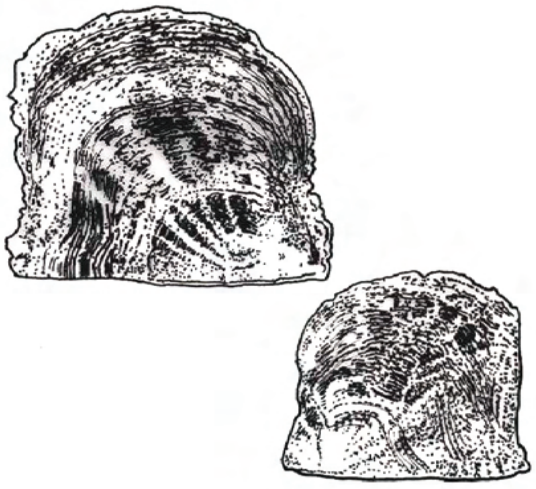
Local names: Muthu chippi (**Tamil and Malayalam**)

MORPHOLOGICAL DESCRIPTION

The Indian pearl oyster has a long hinge which is nearly 0.85 times the maximum width of the shell. The left valve is deeper than the right. Hinge teeth are present in both valves. Anterior ear is larger than the posterior ear and there is a slit-like abyssal notch. The outer shell is reddish or yellowish brown in colour with radial rays of lighter colour. The nacreous layer is thick and has a golden metallic luster.

* *Pinctada imbricata fucata* (Gould, 1850) as per Temkini, 2010.

Source of image : www.conchology.be.



PROFILE

GEOGRAPHICAL DISTRIBUTION

The species is distributed in the Indo-Pacific region from the Red Sea, Persian Gulf, India, China, Korea to Japan and further to the western Pacific Ocean. In India, it is available from both west (Gulf of Kutch, Karnataka and Kerala) and east coasts (Gulf of Mannar and Palk Bay, Tamil Nadu and Andhra Pradesh).

HABITAT AND BIOLOGY

It is a sedentary animal which is found attached to hard substratum including corals, sand grits, rocks and other submerged objects with the help of its byssus threads. In the Gulf of Mannar, it occurs in large numbers on the submerged rocky substrata known as paars. Paars lie at depths of 12 to 25 m off the coast along a stretch of 70 km. In the Palk Bay, it occurs sporadically on loose sandy substratum attached to submerged objects in littoral waters. In the Gulf of Kutch, it is found as stray individuals on the intertidal reefs known as Khaddas. Along the southwest coast of India, off Kerala, large numbers of spat are collected from mussel culture ropes.

It is dioecious. Occasionally, sexual changes are observed between different spawning seasons and protandry is observed. Age at first maturity is usually 2 years. Fast growing individuals mature in 1 year and slow growing individuals in 3 years. Spawning season is usually from June to July in Japan and from winter to spring in Red Sea. In India, maturity is reached within 7-8 months and multiple spawning is reported with dominance of females. Two peak spawning seasons (June-September and November-Decembers) are observed in a year. The mature oysters release their eggs and sperms in the water and eggs get fertilized as soon as they come in contact with the sperms. The fertilized eggs pass through different developmental and larval stages such as blastula, gastrula, trochopore, veliger, umbo, eye spot, pediveliger and plantigrade, before finally settling down as spat.

BREEDING IN CAPTIVE CONDITIONS

The broodstock development, breeding and larval rearing of *Pinctada fucata* was successfully carried out on an experimental basis at Tuticorin R. C. of CMFRI. Brooders were collected from wild and stocked in 1 t capacity tank with 750 l water. For round-the-year availability of spawners, it was kept at temperatures of less than 25 °C and was fed with mixed culture of algae, mostly *Chaetoceros* spp. Supplementing diet with raw corn flour at 30 mg/oyster/day was also effective for maturation. It spawned naturally and was also induced by chemical and thermal induction. Hydrogen peroxide (H_2O_2), tris buffer (hydroxymethyl amino methane), sodium hydroxide (NaOH) and ammonium hydroxide (NH_4OH) were used for spawning induction with varying degrees of success. However, the most preferred and suitable technique for inducing oysters to spawn was by thermal induction. The oysters kept at room temperatures of less than 25 °C in an air conditioning room were quickly changed to water having 5 to 6 °C higher temperature. This change stimulated the oysters to spawn. In all cases, the male oyster responded to the induction first and initiated spawning. The presence of sperms in the water column stimulated the females to respond within 30 min. After spawning was completed, oysters were removed and the water was left undisturbed for about 2 h to allow complete fertilization. The fertilized eggs settled down on the bottom. The water was filtered through a 20 µm nylon bolt sieve and the eggs collected were washed in filtered sea water. Early embryonic development started after 45 min of fertilization and the eggs metamorphosed into veliger larvae within 20 h of spawning. The veliger larvae measured on an average 62.5 µm.

LARVAL REARING

The larvae were transferred to larval rearing tanks. A stocking density of 1 million larvae/t of sea water was maintained. Water exchange was done on alternate days. Details of feeding protocol during larval rearing were as follows.

1st day, Veliger = 5,000 cells/larvae/day → 10-12th day, Umbo = 10,000 cells/larvae/day → 15th day, Eye spot = 15,000 cells/larvae/day ↓

18th day, Pediveliger = 20,000 cells/larvae/day ← 24th day, Spat = 25,000 cells/larvae/day ← Upto 60th day, Spat = 50,000 cells/larvae/day ↓

Upto 90th day, 2-3 mm Spat = Mixed culture of Chaetoceros sp. → Farm

NURSERY REARING

Hatchery reared spats were stocked in outdoor nursery tanks. The spat density maintained was 5,000/m^2. Seawater was exchanged at a minimum rate of 10 % daily and the oysters were fed with a mixture of *Chaetoceros calcitrans*, *Isochrysis galbana* and *Nannochloropsis salina*. Concentration of algal cells fed was increased from 10,000 cells/ml to 75,000 cells/ml till the oysters reached adulthood (> 45 mm). On attaining adulthood, stocking rate was reduced to 50-60 oysters/m^2.

GROW-OUT

Farming is essentially for growing the wild collected/hatchery produced spats to implantable sized oysters and to grow the nucleated oysters for pearl production. Selection of farm site is of paramount importance. Congenial conditions such as protection, water current, clarity, optimum temperature and salinity regimens are considered while selecting the farm site, apart from the site being free from any kind of pollution. A deep sheltered bay/protected water bodies with sea conditions not too rough offers excellent sites for pearl oyster farming. In India, three different types of farming practices are adopted. Rack culture system is suitable for areas of shallow depths ranging from 2-5 m. A rack of 30 m^2 holds about 100 cages. Raft culture system is most suitable for farming in the sheltered bays with considerable depth. Rafts are generally almost square in shape. Long line culture system is practiced in the open sea where depth is more. This system is more suitable to withstand the high wind and wave action. In the onshore rearing technique developed at Visakhapatnam, seeds of 5.00 mm size were reared in cement tanks ranging in size from 250-500 m^2. A water level of 1 m was maintained. Oysters were held above the bottom; through a grid system constructed using PVC pipes. A stocking density of 125 nos./m^2 was maintained. Stocked oysters were fed with *Chaetoceros* spp. at a cell concentration of 75,000 cells/ml. Daily, 25 % of water was exchanged. Average growth of 50 mm in 6-7 months of stocking was achieved.

FOOD AND FEEDING

It is a filter feeder. Unicellular organisms including infusorians, foraminiferans and radiolarians form the major food of pearl oysters. However, minute embryos, larvae of various animals, algal filaments, spicules of alcyonarians and sponges are also seen in the stomach contents. Flagellates measuring less than 10 µm (*Isochrysis galbana*) are ideal food for pearl oyster larvae.

GROWTH RATE

Along south-east coast of India, mean dorso ventral mantle (DVM) length was 45 mm, 50 mm and 60 mm in the first, second and third year and 72 mm in 6 years. Higher growth rates to the tune of 56.17 mm in first year and 72.11 mm in second year from Visakhapatnam have also been reported. Largest individual recorded from natural beds of Gulf of Mannar was 75 mm (80 g) in about 72 months and from Gulf of Kutch was 86 mm in about 84 months. In native stocks from Arabian Sea, growth was faster and after one year it reached 62.5 mm. Record growths of about 105 mm and 110 g was achieved under onshore system in 3 years in Visakhapatnam. Oysters attained a length (DVM) of 29-48

mm and a weight of 8-10 g after six months. It reached a DVM length of 45-65 mm and a weight of 10-29 g after one year. At the end of second year, DVM length varied between 55-85 mm with a corresponding weight of 26-76 g. It reached a DVM length range of 65-105 mm and a corresponding weight range of 50-110 g after three years.

DISEASES AND CONTROL MEASURES

The occurrence of protozoan parasite, *Perkinsus olseni* in the wild and farmed pearl oyster is reported from the south-east coast of India. Copepod parasite, *Tylocephalum* sp. has also been reported. Mortality of farmed pearl oyster due to fouling organisms like barnacles, bryozoans, spats of molluscs, *Avicula* sp. and *Crassostrea* sp. and shell boring organisms like spionid polychaetes, Polydora ciliate and Clionid sponges, *Cliona celata* and *Cliona vastifica* has been reported from Gulf of Mannar and Tuticorin. Mass mortality of pearl oysters due to incidence of red tide caused by *Heterocapsa circularisquama* has been reported in Ago Bay of Japan in 1992.

The most effective method of controlling fouling growth is by cleaning the oysters, cages and farm materials regularly. In addition, periodical exposure of the oysters to sunlight for a few hours results in death of the larvae of most undesirable settlers. Fresh water, brine and chemical treatment are also found to be effective. The peak spawning and settlement season of major fouling organisms are avoided by properly timing the introduction of the new spat stocks in the farms. The boring polychaetes are easily killed by immersing the oysters in freshwater for about 6 h. The oyster shell valves infested with boring organisms can also be brushed with 1 % formalin, dipped in freshwater and returned to the sea. The above treatment is found to be effective against sponges and *Martesia* sp. and partly against *Polydora* sp. At a concentration of 78 g/l, brine kills all polychaete species within 8 h.

PRODUCTION, MARKET AND TRADE

PRODUCTION

Information not available

MARKET AND TRADE

Indian pearl oyster, *Pinctada fucata* is the major species for production of marine akoya pearl. Aquaculture of pearl oysters is an expanding multimillion dollar industry in the tropical marine environment of many countries, including Australia, French Polynesia, the Middle East, China, south-east Asia and Japan. Two major cultured akoya pearl producing countries are Japan and China. In 2004, they together constituted 22 % of the world supply, valued at 135 million US $. Marine akoya pearl produced has good demand in domestic markets also.

CHALLENGES TO MARICULTURE

Techniques for breeding and seed production, farming and mother oyster development, nucleation and pearl production have already been developed in India. To make this technique more viable and economically feasible, it is imperative to make critical analysis of the various technicalities involved in the culture strategy. Production of mother oysters for nucleation and pearl production on a continuous and commercial scale are big challenges for mariculture.

Pearl farming on commercial scale failed to catch the interest of entrepreneurs because the returns were very low. Reasons attributed were ecological condition of the seas around Indian coast, scarcity of protective bays, roughness and heavy wave actions in the open sea, heavy siltation and the absence of high primary production. The high rate of rejection of nucleus and low survival rate of implanted oysters make pearl farming less remunerative. Large pearls have superior value. The quality and size of pearls now produced in India do not fetch a very high price in the international market.

FUTURE PROSPECTS

Technology for culture of marine pearls and farming of pearl oyster in open sea and in shore-based systems has been developed. The demand for cultured pearls will not diminish in the near future and this provides a good opportunity for fish farmers to improve their livelihoods through pearl oyster culture. A tie-up of large corporate houses with small scale farmers can also go a long way in making the venture successful.

SUGGESTED READING

Chellam, A. 1988. Growth and biometric relationship of pearl oyster, *Pinctada fucata* (Gould). Indian J. Fish., 35(1): 1-6.

Devanesan, D. W. and Chidambaram, K. 1956. Results obtained at the pearl oyster farm, Krusadai Island, Gulf of Mannar and their application to problems relating to pearl fisheries in the Gulf of Mannar. Contribution from the Marine Fisheries Biological Station, Krusadai Island, Gulf of Mannar, 4, p. 1-89.

Gokhale, S. V., Easwaran, C. R. and Narasimhan, R. 1954. Growth rate of the pearl oyster (*Pinctada fucata*) in the Gulf of Kutch with a note on the pearl fishery of 1953. J. Bomb. Nat. Hist. Soc., 52: 124-136.

http://filaman.geomar.de/summary/speciessummary.php?id=83837

http://www.fao.org/docrep/field/003/ab726e/AB726E02.htm

http://www.marinespecies.org/aphia.php?p=taxdetails&id=397170

https://books.google.co.in/books?isbn=0080931774

Jagadis, I. 2009. Seed production and farming of Indian pearl oyster *Pinctada fucata*. In: Madhu, K. and Madhu, R. (Eds.), Winter School on Recent Advances in Breeding and Larviculture of Marine Finfish and Shellfish, CMFRI, Cochin, p. 192-200.

Jones, J. B. 2007. Review of pearl oyster mortalities and disease problems, In: Bondad-Reantaso, M. G., McGladdery, S. E. and Berthe, F. C. J. (Eds.), Pearl oyster health management: A manual. PAD Fisheries Technical Paper, No. 503, FAO, Rome, p. 61-70.

Mohamed, K. S., Kripa, V., Velayudhan, T. S. and Appukuttan, K. K. 2006. Growth and biometric relationships of the pearl oyster, *Pinctada fucata* (Gould) on transplanting from the Gulf of Mannar to the Arabian Sea, Aquacult. Res., 37: 725-741.

Rao, G. S. 2007. Growth and biometric relationship of the Indian pearl oyster, *Pinctada fucata* (Gould) under long term onshore rearing system. J. Mar. Biol. Assoc. India, 49 (1): 51-57.

Sanil, N. K. and Vijayan, K. K. 2011. Diseases and Parasites of Bivalves. Training on green mussel farming. CMFRI - NFDB, p. 56-63.

Sanil, N. K., Vijayan, K. K., Kripa, V. and Mohamed, K. S. 2010. Occurrence of the protozoan parasite, *Perkinsus olseni* in the wild and farmed Pearl Oyster, *Pinctada fucata* (Gould) from the Southeast coast of India. Aquacult., 299: 8-14.

Velayudhan, T. S., Menon, N. R., and Pillai, V. K. 2011. A study on the induced maturation of the Indian pearl oyster *Pinctada fucata* (Gould) at Tuticorin, Tamil Nadu, India. Indian J. Fish., 58(2): 23-27.

Venkatesan, V. and Mohamed, K. S. 2015. Bivalve classification and taxonomy. Summer School on Recent Advances in marine Biodiversity Conservation and Management, CMFRI, Cochin, p. 42-48

Victor, A. C. C., Kandasamy, D., Jagadis, I., Boby, I., Chellam, A., Chitra, G., Villan, P. and Rajkumar, M. 2001. Hatchery seed production and nursery rearing of Indian pearl oyster, *Pinctada fucata* (Gould) under onshore and offshore conditions at Mandapam, Tamil Nadu. Perspectives in Mariculture. J. Mar. Biol. Assoc. India, p. 241-250.

Virabhadra, R. K. and Rao, K. S. 1975. VI. Pearl Oysters. In: Nair, R. V. and Rao, K. S. (Eds.), CMFRI Bulletin, Cochin, No 25: 84- 105.