

Marine Fisheries Research and Management

Editors

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ABSTRACT

An account of the pearl oyster resources with a brief note on biology, collection methods, seed production and conservation and management in the Indian subcontinent is dealt with in this paper. Both in the Gulf of Kutch and the Gulf of Mannar, the population does not show improvement. Conservation and management of this important resource in the light of the present R & D carried out by the CMFRI is discussed. Enhancement of the wild stock through the production of genetically improved seed in the hatchery and ranching them to selected beds and close monitoring of the physico-chemical and biological factors over a period of time is suggested. Farming of oysters on the natural beds can enhance the pearl quality and may form a breeding reserve.

Introduction

The pearl oysters belonging to the genus *Pinctada* are distributed in almost all the seas of the tropical and subtropical zones. In the Indian subcontinent, they are restricted to the Gulfs of Kutch and Mannar. In the Gulf of Kutch, small scale fisheries had been conducted. The population is very much depleted during the recent past (Pandya, 1974).

In the Gulf of Mannar, there are many productive beds. The pearl oysters had been the monopoly of the then ruling powers. Record shows that the pearl fisheries in the Gulf of Mannar had never been regular. Many reasons have been put forward to explain the erratic nature of the pearl fisheries (Hornell, 1916, 1922; Devanesen and Chidambaram, 1956; Chacko, 1970; Mahadevan and Nayar, 1973). Surveys and studies of the pearl oyster beds of the Gulf of Mannar had been undertaken by experts during different periods of this century (Herdman, 1903; Salvadori, 1960; Mahadevan and Nayar, 1973; Alagarwami *et al.*, 1987, 1988).

Taking into account the present condition of the beds and the fast

development of the harbour and many chemical and allied industries along the coast bordering the Gulf of Mannar, the CMFRI had taken up and succeeded in the production of pearl oyster seed in the hatchery on mass scale (Alagarwami *et al.*, 1987). Attempts were made to sea-ranch the hatchery produced seed in one or two beds and to monitor their survival (Chellam *et al.*, 1987). In this paper, the possibility of an integrated approach combining the production of genetically improved seed in the hatchery and transplanting them to the beds through sea-ranching, thus improving the quality of the wild stock, is suggested to obtain sustained production.

Resources

Gulf of Mannar:

The resource of the Indian pearl oyster *Pinctada fucata* (Gould) is restricted only to the Gulf of Mannar on the southeast coast and the Gulf of Kutch on the northwest coast of the Indian subcontinent. The renowned "oriental pearls" referred to in the ancient history were actually fished from these regions and the Persian Gulf. The pearl fisheries had been in existence in these areas even before 2000 years. The pearl fisheries of the Gulf of Mannar are well recorded only after the 16th century when it came under the full control of the then ruling powers.

The Gulf of Mannar provides an ideal habitat for the pearl oyster settlement and existence. The pearl oyster beds are the submarine plateau of the inshore areas dotted with flat rocky patches lying in 10-20m depth at a distance of 11-16km from the shore. Starting from Pamban in the north and ending with Manapad in the south, in a distance of 160 km, there exist more than 70 well known beds. The extent of these beds in this region is about 770 sq.km. The central zone from Vaipar to Tiruchendur, comprising about 100 sq.km. formed the best bed which provided most of the 27 pearl fisheries in a period of 165 years from 1796 to 1961.

In the Gulf of Mannar from 1663 to 1961, there were only 38 pearl fisheries. The best one was a series of 7 fisheries extending from 1955 to 1961. Excluding this series, the previous ones in the 20th century were during 1900, 1908, 1926, 1927 and 1928. In the last series of pearl fisheries (1955-61), more than 86.255 million pearl oysters were fished and a revenue of Rs.22,12,455 was realised by the Madras State Fisheries Department.

History shows that the pearl fisheries in the Gulf of Mannar had been highly erratic in nature. Hornell (1916) in the early part of the century felt that the only way of making pearl oyster resources of the Gulf of Mannar remunerative was to go in for pearl culture. This was the time when the Japanese were also building up pearl culture industry in their country. Subsequently, the Department of Fisheries of the erstwhile Madras Presidency started a pearl culture experimental Centre at Krusadai Island in the Gulf of Mannar in the year 1933. They could succeed only partially by producing a few half coated blister pearls.

The CMFRI had undertaken an elaborate survey of the pearl oyster beds during the year 1975 to 1986. The beds surveyed extend from Vaipar in the north and Tiruchendur in the south which lay within a depth of 14 to 20 m. The self contained under water breathing apparatus (SCUBA) was used for the survey. During the survey period, a total of 289 survey-cum-collection trips were made and 2,39,025 oysters were collected. The northern group of beds accounted for more number of oysters than the southern group. In this period, the more productive season was 1981-82. It was also noted that all the beds in the southern and northern regions received spatfall simultaneously (Alagarwami *et. al.*, 1988).

Palk Bay :

The pearl oyster beds in the Palk Bay extend from Tondi to Dhanushkodi. The sea-bed did not appear conducive for oyster settlement except for a small stretch of 10km where rocky patches occur at depths ranging from 7-13m. The survey conducted during 1976 revealed that the beds were not productive. Only one pearl fishery was conducted off Todi in 1914.

Gulf of Kutch :

There are 42 known pearl oyster reefs totalling an area of 24,000 ha, scattered along the southern part of the Gulf of kutch, bordering the coastline of Jamnagar District. The beds are not continuous, separated by creeks, mudflats, mangroves and sand bars. A typical pearl oyster bed consists of hard bottom of coral and sand stones with sand and mud. The beds are situated in the intertidal zone at a distance of 1-5 km from the coastline.

Fishery was conducted on days of good ebb tides during the southwest

The pearl oysters

monsoon, generally after one or two good showers. The fishermen could walk through the beds and pick-up oysters with bare hands. The density of population was very thin and the average number taken annually was 30,000. After 1938, the fisheries were held after a gap of 3-5 years. The best fishery was in 1966-67.

The recent survey in 1971-72 and 1972-73 showed that the density of population was from 1-6 oysters per hectare. A trend of depletion in population was observed (Pandya, 1974).

Coastal areas :

Periodic settlement of spats of several species of pearl oyster was reported in the Vizhinjam Bay in the southwest coast of India. This may be the result of the drifting of the larvae away from the natural beds due to strong wind and wave action at the time of spawning and settlement may be effected when a suitable substratum is provided in the bay. The CMFRI had collected spat by suspending spat collectors in the columnar water 2m below surface. The collected spats were raised and a farm was established in the Vizhinjam Bay in 1976.

Andaman and Nicobar Islands :

An indicative survey conducted by the CMFRI at the Andaman and Nicobar Islands during 1978 showed the availability of the black-lip pearl oyster *Pinctada margaritifera* in many of the islands viz. Smith Island, Sir William Peel Island, Havelock Island, Neil Island (middle Andamans), North Bay, Phoenix Bay, Abardeen, Sesostris Bay, Ross Island, Rutland Island, Hut Bay (Little Andamans) and Comorta in the Nicobar Group. The size of the oyster ranged from 32 to 109 mm in dorsoventral measurement (DVM) and 9 to 191 g in total weight. The population of these oysters occurred in the reef flat upto a depth of about 10m. They were found attached to live and dead corals, block corals and large boulders. They were also seen occasionally in crevices. They were found attached to pillars of piers and jetties in good numbers (10 oysters/m²). The population of these oysters in the intertidal reef flat ranged from 0.25 oysters to 2 oysters per m². The other species of pearl oysters found in stray numbers were *P. fucata*, *P. sugillata* and *P. anomoides* (Alagarwami, 1983).

Lakshadweep Islands:

The CMFRI had undertaken a survey of the fauna and flora of the seas around the islands of Lakshadweep during 1987. The survey indicated that the population of pearl oysters in the islands comprised of flat type. These oysters found in few numbers were attached to the corals and boulders on the intertidal reef flats. The size of these oysters ranged from 5.2 - 28.6 mm in length. These oysters grew to a size of 38-42mm and weight of 8-9.5 g in a period of 2 1/2 to 3 years. They were found to have slow growth, smaller size, flat shells and poor quality of nacre (Algarswami *et al.*, 1989).

The density of the population of oysters among the islands varies. The Islands of Androth (3 oysters/100m²), Kavaratti, Bangaram and Bitra (1 oyster / 100m²), Kalpeni, Suhell (2 oysters/100m²), Kadamat, Kiltan and Chetlat (very few) were found to have pearl oyster resource (Appukuttan *et al.*, 1989).

Biology

Food and feeding

The pearl oysters are filter feeders. They mainly feed on the unicellular organisms including infusorians, foraminifers and radiolarians found on the bottom. The stomach is found to contain minute embryos, larvae of various animals, algal filaments, spicules of alcyonarians and sponges (Herdman, 1903). Presence of diatoms, flagellates, larvae of lamellibranchs, gastropods, heteropods, crustacean nauplii, appendages of copepods, unidentified spores, detritus and sand particles were also noted. Under farm conditions, the presence of straight-hinge larvae and umbo larvae were also found in the stomach in addition to other organisms.

Age and growth

In the natural beds of the Gulf Mannar, the growth was 45 mm at the end of one year, 55 mm at the end of two years, 60mm at the end of three years, 65mm at the end of four years and 70mm at the end of five years. The corresponding weight of the oyster was 10g, 30g, 45g, 60g and 70g for the years one to five (Devanesen and Chidambaram, 1956; Chacko, 1970).

Under farm conditions, Chellam (1989) found that the rate of growth was faster when compared to the growth in the natural bed oysters. The

hatchery produced spat, farmed inside the Tuticorin Harbour had attained a modal size of 47mm at the end of one year, 64.5mm at the end of two years and 75mm at the end of three years. The corresponding weights at ages one to three years were 8.3g, 31.6g and 45.4g respectively.

Spawning and spawning seasons

The development of gonad was a continuous process and no time lag was observed in the transformation from one stage to another. A small percentage of animals with maturing, matured, partially spent and spent gonads were seen throughout the year. The peak spawning period in the farm in the Tuticorin Harbour was found to be November-February and June-September which correspond to northeast and southwest monsoon periods. During March-May and September-October most of the oysters were in the active gametogenic stages with more percentages of maturing gonads. The temperature and salinity together play a role in the gonad development and spawning. A slight reduction in temperature was found to trigger the spawning (Chellam, 1987).

Sex ratio and fecundity

In oysters upto 55mm, the male dominated (60%) whereas in oysters above 55mm, the female dominated (57%). The overall sex ratio was 57 : 43 of male and female. The fecundity of oysters was very high. An adult oyster with ripe gonad can produce eggs over 50 million. The oysters spawned partially and even after spawning, many eggs remained in the gonad. They were re-absorbed in course of time if the condition for further spawning was unfavourable (Chellam, 1987).

Age at first maturity

Juvenile oysters of thumb-nail size (16-20mm) were found to have matured eggs and sperms in the gonad. This size is normally obtainable in 8-9 months time. They spawned in their ninth month.

Collection methods

In the Gulf of Mannar, as the pearl oyster beds are lying at a depth ranging from 12 to 20m, collection of the oysters is done by diving. Both skin and SCUBA diving methods are employed for collection of oysters from the

bed. A skin diver can remain underwater to a maximum of one and half minutes and can collect oysters according to the availability at the diving site. With SCUBA the diving time extends from 45 to 60 minutes depending upon the depth of diving.

Seed production

The CMFRI, at its Tuticorin Research Centre, has a well established hatchery where production of pearl oyster seeds is going on since 1982. The technologies of induced breeding, larval rearing, live feed production, spat settling and nursery rearing of juveniles in the hatchery are standardised. The CMFRI, at present is depending only on the seed produced in the hatchery for its research related to the experimental pearl production. With the existing facilities, three runs, each of 1 million seed, can be produced and supplied for the R & D activities on pearl culture.

Conservation and management

The post-fishery (1956-61 series) condition of the pearl oyster beds of the Gulf of Mannar was precarious (Mahadevan and Nayar, 1973). The intensive survey conducted by CMFRI during 1975-86 showed that there were wide fluctuations in the pearl oyster settlement between years. Only in one season (1981-82), the number of spat/oysters in the beds exceeded 35 per diving minute in the northern sector of the central division. In the southern sector, the number never exceeded 4.5 per diving minute (Alagarwami *et al.*, 1987). Also the average size of the oysters collected from the beds during these years was less than 50 mm.

Although physico-chemical and biological factors are considered to be responsible for the low production of oysters in the natural beds (Herdman, 1903; Hornell, 1916; Devanesen and Chidambaram, 1956; Salvadori, 1960; Mahadevan and Nayar, 1973; Chellam *et al.*, 1983), (i) the enormous increase in the bottom trawl fishing on and around the oyster beds in recent years, (ii) the increase in the ship movements due to the construction of the Tuticorin Harbour, and (iii) the installation of different types of chemical industries and the thermal power station along the coastline which let out their effluents into the sea to pollute the water, are other factors responsible for further deterioration in the settlement of spat and growth to adult size on the beds.

For conservation of the population, Herdman (1903), Hornell (1916),

and Mahadevan and Nayar (1973) have suggested some measures. Based on the recent developments in this part of the country, the conservation of the resources can be made on the following lines:

- i. Marking the important productive beds and protecting them from trawling.
- ii. Establishment of oyster farms in the vicinity of these beds both for pearl production and as breeding reserve.
- iii. Intensive collection of spat by suspending spat collectors around these beds at appropriate seasons.
- iv. Sea-ranching of the seed produced in the hatchery in these beds.

Future research priorities and conclusion

A concerted and more effective research is required to find out the causes of non-productive condition of the beds. Though during certain seasons spatfall is observed on some beds, the oysters did not live long enough to reach 4-5 years age. Till today the reasons are not precisely known. This is possible only through a continuous intensive and close observation of the physico-chemical and biological changes taking place on the beds over a period of time. For this study, one or two beds known for their oyster production in the past can be selected, marked and protected from trawl fishing.

A close study of the spatfall, their survival and reasons for their mortality on the beds can be taken up so that the factors responsible for the non-revival of the resource on the beds in the Gulf of Mannar can correctly be understood. Preventive measures are possible only if the causative factors are known.

Mass production and sea-ranching of the seed of pearl oysters on the identified beds and monitoring their survival can be taken up.

Effecting genetic improvement of the stock through selective breeding and sea-ranching them on the beds needs thrust. By this, seed of high survival, faster growth with desired characters can be transplanted to the natural beds.

An attempt to produce cultured pearls in the natural beds is worthwhile.

This can be done by culturing the implanted oysters on the beds, demarcated for this purpose and protected from human interference.

In conclusion, at the present condition, an integrated research, combining mass production of genetically improved seed in the hatchery, sea-ranching them on identified productive beds and monitoring their growth and survival in the beds, is required. Once this system is established, cultured pearl production on the natural beds can be taken up to produce good quality pearls. This type of farming and pearl production on the natural beds can act as a breeding reserve for the revival of the pearl oyster population on the beds of the Gulf of Mannar.

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