Production and Grow-out of the Black-Lip Pearl Oyster *Pinctada margaritifera*

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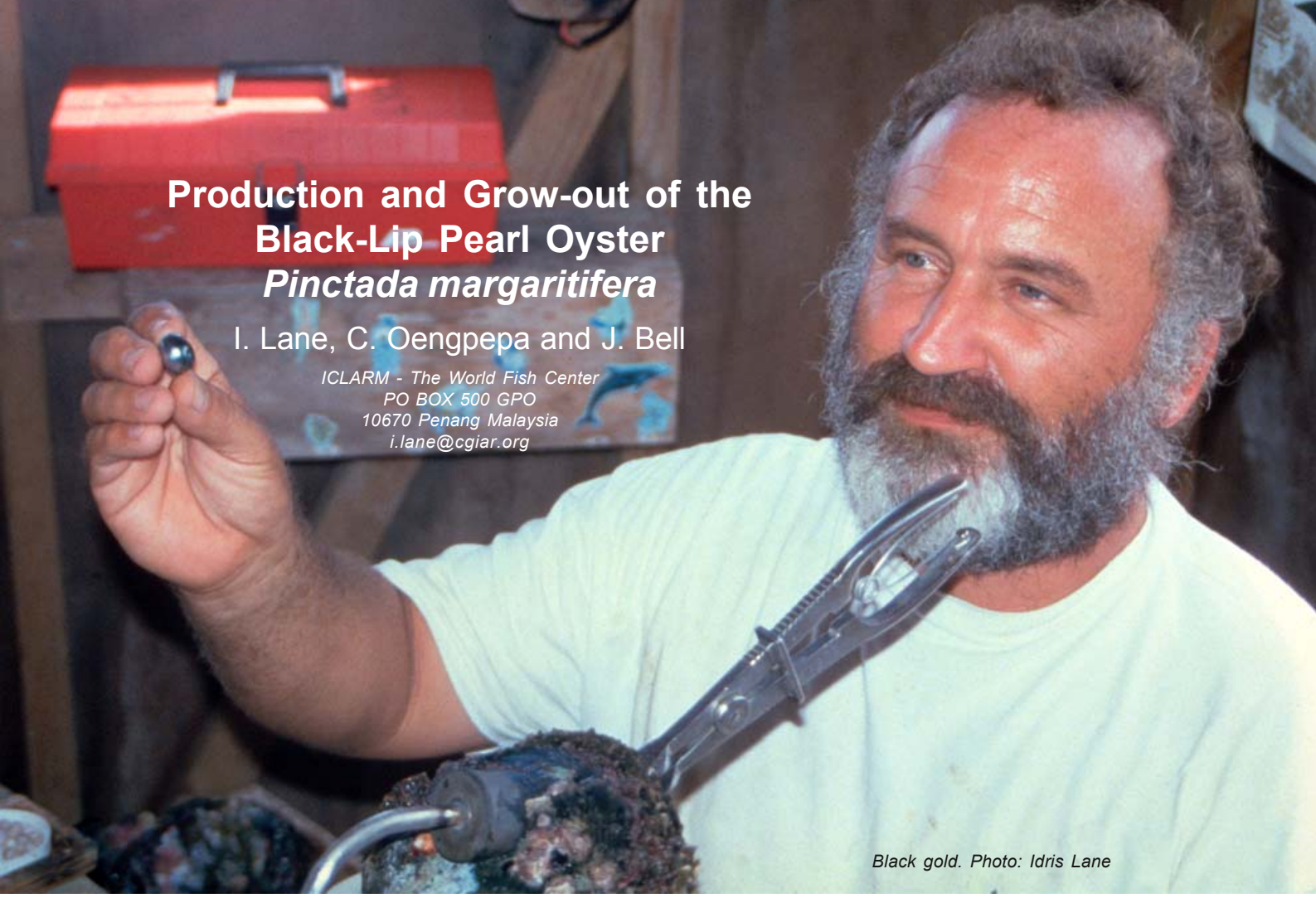

Black gold. Photo: Idris Lane

Black pearls

Black-lip pearl oysters (*Pinctada margaritifera*) are widespread throughout the Indo-Pacific region, where they have traditionally been used for food, ornaments, jewellery, tools and fish hooks. However, the major benefits of black-lip pearl oysters today come from their use in the culture of "black" pearls.

Culture techniques for black pearls were first developed in the Pacific in French Polynesia where the industry grew quickly to create major export earnings estimated at US$200 million in 2000. Cook Islands later developed an industry that is now worth US$5 million. Due to the success of pearl farming in French Polynesia and Cook Islands, other Pacific countries such as Fiji, Tonga, Marshall Islands and Solomon Islands are looking to develop a black pearl industry. Australia has also been attracted to the production of black pearls as a way to increase pearl production that is otherwise restricted through licence limitations that exist for pearls produced from the silver-lip pearl oyster (*Pinctada maxima*).

Recent increases in production of black pearls, particularly in French Polynesia, have caused a decline in prices. Average prices for Tahitian pearls fell from US$77 per gram in 1986 to US$13 per gram in 2000, although prices for the best quality pearls have remained stable. Measures to counter reduced financial returns to growers in French Polynesia include greater emphasis on quality pearl production, and restrictions on the marketing of lower quality product. The industry is also encountering other problems. For example, over-stocking of the major pearl producing atoll in Cook Islands has led to disease. This is now being addressed by limiting the number of oysters that can be stocked in the lagoon. It is now clear that while there are still many places in the Pacific Islands and Australia with the potential to produce black pearls, the size of the market, and local growing conditions, are affecting production. Further increases in production will need to be matched to market demand, and greater emphasis will need to be placed on pearl quality, oyster husbandry and efficiency.

In this paper, we briefly outline the methods that are being used in countries like Solomon Islands to collect and grow black-lip pearl oysters to pave the way for development of black pearl farming.

Supply of juvenile oysters or spat

The cheapest and simplest method of obtaining juvenile blacklip pearl oysters (spat) for grow-out is to collect them from the wild. This is possible if there are sufficient numbers of broodstock on the reefs to produce large numbers of spat. Efficient collection is also dependant on locating aggregations of spat. If wild broodstock are scarce, and / or spat concentrations cannot be found, it is possible to produce the juvenile oysters in a hatchery. This is technically more difficult and expensive than wild spat collection, but can produce large numbers of juveniles. Further details of these two methods of obtaining spat are set out below.

i) Wild spat collection

Spat collectors are placed in the sea to provide a surface for settlement of spat once they complete their pelagic (floating) stage. The collectors can be made from a variety of materials, ranging from old onion bags, rope and shademesh to commercially produced spat collector "ropes". The collectors are attached to a subsurface longline placed at a depth of 3 m, within the general depth range at which spat normally settle on shallow reef areas. Where crabs and *Cymatium* spp. gastropods also settle on the collectors, spat should be removed every three months to minimise losses to these predators. The settlement of spat is seasonal and the most efficient times for collection need to be determined beforehand by a monthly spat collection or gonad sampling programme.

Checking shademesh spat collectors for juveniles oysters. Photo: Idris Lane.

ii) Hatchery spat production

Fecund oysters are induced to spawn by either thermal shock, temporary desiccation, addition of gametes (i.e. sperm) to the water, injection of the gonad with a chemical stimulant or bathing in UV-treated water. Once spawning is initiated, male and female oysters are placed in separate containers for the collection of gametes. Eggs are then fertilised with sperm at a rate of 1-5 sperm per egg.

Inspecting spat collectors on a longline. Photo: Mike McCoy

The fertilised eggs are stocked in indoor culture tanks at 30-50 per ml with aeration, which aids circulation and prevents settlement of eggs at the bottom of the tanks. The tanks should be cleaned and the water changed every second day. This process involves draining the tanks and removing the larvae by sieving. Antibiotics may be required during the incubation period (day 0) to prevent bacterial infections invading the tanks and causing a "collapse" of the larvae culture.

From day 2-18 larvae are fed twice a day with a mixture of 3 or 4 species of cultured micro-algae. At day 3, when the larvae are veligers, stocking density is reduced to 5 per ml. At day 5-6, larvae are moved to larger 2,500-3,000 litre culture tanks and the stocking density reduced to 3 per ml. By day 8-10, the larvae have metamorphosed to the early umbo stage and by day 12 they have a fully developed umbo. At day 16-18, "eye spots" become distinct and spat collectors (the same as are used in the sea) are then hung in the culture tanks. The stocking density is reduced to 1 per ml on day 20, and by day 21-23 the pentigrade stage should be visible on the spat collectors. By day 25-28, the spat collectors with the attached spat are transferred to the sea for grow-out. The collectors are left inside plastic trays or lantern nets and the spat allowed to grow until they are 5mm or greater in length, at which time they enter the juvenile grow-out phase.

Growout of juveniles

The wild or cultured spat are put into intermediate grow-out systems i.e. glued into plastic trays, placed in panel nets etc., and are cleaned regularly to reduce fouling and remove predators. Once the oysters are 50-60 mm shell length, they are removed from the trays/panel nets and transferred to the main grow-out system. This usually involves one of several methods, including ear-hanging on rope chaplets, or placing the oysters in panel or pocket nets, suspended from either surface or subsurface longlines. The oysters may need to be cleaned of fouling organisms at 4-6 weekly intervals, although at some sites there is minimal fouling and the oysters will not require cleaning. The density of oysters should be reduced as they grow by increasing the spacing on and between the rope chaplets or panel nets. When the oysters reach 90-120 mm they can be "seeded" with the shell nucleus and a graft of mantle tissue to create a cultured pearl.

Black-lip oyster juveniles glued into tray. Photo: Idris Lane

Seeding of adults

Suitable adult oysters should be conditioned, i.e. mildly stressed, to remove excess gametes during the 5-6 weeks before seeding to improve the success of the grafting operation. Immediately before the seeding, fouling organisms are removed from the oyster's shell and the oyster is "pegged" open to create room for the technician to do the operation, which involves the use of a "graft" of mantle tissue and a shell "nucleus". The graft is cut from a sacrificed oyster that has good inner shell colour(s). The nucleus is a round

bead made from the shell of a freshwater mussel. The operation itself consists of making an incision in the gonad of the oyster and then inserting a piece of mantle followed by the nucleus (placed on top of the graft). In a successful operation, the cut heals and the grafted mantle tissue grows around the nucleus to form a "pearl sack". Mother-of-pearl (nacre) is then deposited on the nucleus. Consecutive layers of mother-of-pearl result in a cultured pearl after 18-24 months.

After the operation, the shells are kept ventral edge down and handled carefully with each oyster being placed in a catch bag. The oysters are then either ear-hung on ropes or placed in panel nets and carefully transferred to grow-out lines as soon as possible. After 4-6 weeks, the oysters are checked to see if they have "vomited" the nucleus (which is caught by the catch bag). The catch bags are then removed. Any oysters that have vomited the nucleus, or are dead after the operation, are removed from the grow-out system. The 4-6 weekly cleaning cycle is resumed (if necessary) for the next 18-24 months, after which there is a second operation to remove the pearl. At this time, suitable oysters, i.e. those that have produced good pearls, may be re-seeded with another nucleus to produce another pearl. For this second operation, there is no need for a graft of mantle tissue as the pearl sack has already formed and will continue to produce mother-of-pearl to coat the new nucleus.

Overview

The culture of black pearls has great potential to create new livelihoods for coastal communities adjacent to coral reef habitats in the Indo-Pacific. The non-perishable and small size of the high-value product makes this form of aquaculture suitable for even the most remote locations, as demonstrated by the success of the industry in French Polynesia and Cook Islands.

However, the high costs involved in employing pearl-seeding technicians means that farms need to produce the required percentage of high quality pearls to be successful. Enterprises that do not pay attention to pearl quality are doomed to failure. Another factor that needs to be considered when assessing the opportunities to create livelihoods through pearl farming is that farms need to produce sufficient oysters to attract technicians to do the seeding operation. The minimum number of oysters needed to attract and engage a good technician is around 5,000-10,000. Farms of this size are often beyond the means of small-scale operators and so the development of an industry in the first instance will usually involve attracting an investor prepared to operate a medium to large scale farm. Coastal villagers will then benefit by collecting spat, growing them to adult size, and selling them to the main farm. Over time, once technicians have begun to visit a large farm regularly, smaller farms can then be established by local entrepreneurs who are able to make additional contracts with the technicians servicing the major farm(s).

Pearl in situ in dissected back-lip oyster. Photo: Idris Lane

Suggested reading

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Diver checking catch bags on black-lip oyster longline. Photo: Idris Lane