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TECHNOLOGY OF CEPHALOPOD, SCALLOPS AND ABALONE CULTURE

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CEPHALOPODS

Our present knowledge on cephalopod culture is limited to rearing of the squid/cuttlefish from egg to maturity in tanks or ponds and commercial culture is not practised anywhere.

The squid Sepioteuthis lessoniana and the cuttlefishes Euprymna berryi, Sepia esculenta, S. subaculeata and Sepiella maindroni have been experimentally cultured in Japan (Bardach et al., 1972). The eggs occurring in nature in clusters are separated carefully and stocked at a maximum of 3300/m^2 in hatching tanks of the size 195 cm x 115 cm x 60 cm supplied with running sea water at a rate of 6 to 7 litres/minute. The eggs are held in the tank in single layers in plastic mesh baskets. During incubation the tanks are kept in the dark to prevent the growth of diatoms or green algae on the surface of the eggs as this interferes with development. With good sea water supply 95% hatching may be achieved. Larvae and young squids are at times obtained by set nets from the wild. These are transported to the hatchery and cultured in glass tanks supplied with running sea water. The larvae take food 16 to 48 hours after hatching and for the next 40 days live on crustaceans like Mysis. The initial stocking rate is about 1 squid/5 cm^2 which after about 20 days is reduced to 1 squid/10 to 15 cm^2. Under favourable conditions the young reach 20 to 40 mm length in 30-40 days. During this period live food is essential to get the maximum survival rate of 80%. The 20-40 mm squid are stocked in large tanks or ponds at 30 to 50 g/m^2 and fed on shrimp or pieces of fish. Ideally 8 to 10% of the weight of the squid is to be given twice a day as ration. The experiments suggest that it is possible to rear a 4 g animal to marketable size weighing 500 to 700 g within 5 months.

In the United States of America the squid Sepioteuthis sepioidea was successfully reared from egg to maturity in less than 5 months (Bardach et al., 1972). The most crucial factor in its culture is

feeding. The best food for the young squid was found to be the mysid Mysidium columbiae. A daily ration of about 45% of the body weight of the squid gave conversion ratios of 5 to 10:1. The squid attained a maximum length of 105 mm and 77 g weight in 146 days.

The cuttlefish, Sepia officianalis was reared in open system tanks in France (Richard, 1976). In the tanks the water was oxygenated with air compressors and thermostatic electric heating was used to maintain a minimum of 7°C. A layer of fine sand helped the cuttlefish to hide during day time. The optimal stocking density was less than 1/10 (ratio of animals surface to tank surface). Higher density resulted in growth disparity. The cuttlefish prefer live food. In 1-3 days after hatching amphipodes were given as food and as they reached 2-3 cm length they were fed with shrimps, small crabs and fishes in convenient size. A survival rate exceeding 80% was obtained.

In India experimental culture is in progress at the Regional Centre of Central Marine Fisheries Research Institute, Mandapam Camp to culture the squid Sepioteuthis arctipinnis and the cuttlefish Sepia aculeata.

The culture of octopus though attempted in several countries has met with only limited success. At the moment the major constraints for attempting any commercial culture of cephalopods seem to be the cost of feeds, shortage of egg capsules in nature and the difficulty in rearing the larvae.

SCALLOPS

Scallops are one of the most pupular sea foods and are cultured commercially in Japan. The techniques involve spawning and rearing by standard hatchery methods and farming in sandwich cages suspended from raft/rack or culture by long line method. Also the scallops can be cultured in pens close to the shore.

The deep sea scallop, Patinopecten yessoensis is cultured commercially in Japan to a limited extent (Bardach et al., 1972). At Mohne Inlet 1000 litre polyethylene tanks are suspended from a raft in the sea and sea water is pumped to the shore for filtering before being fed to the tanks. As the tanks are immersed in the sea there is no temperature control and hatchery rearing is seasonal, confined to late spring, summer and early fall when the sea water is warm. Solar warming of the circulated water in the tank was found to be adequate to provide the increased temperature for induced spawning. The adults and the larvae reared in the tanks are fed with cultures of unicellular algae grown in the laboratory in enriched media. Organisms now in use include the flagellates Isochrysis galbana and Monochrysis lutheri and the diatom Chaetoceros calcitrans. In the early stages the larvae are fed with falgellates and in later stages with diatoms or a mixture of the two. Also seed from the wild is collected by suspending a variety of cultch materials such as branches of Cyprus, plastic web bags filled with shells etc. The young drifting scallops attach to the collectors by byssus thread (Iverson, 1976). The young seed scallops are grown suspended in the sea from a raft in 0.3 x 1 m rectangular metal frame held in place between layers of loose plant fibre and nylon mesh netting. As the scallops grow the plant fibre is removed from the sandwich frames. Since this method is expensive, alternately, when they reach about 4 cm size they are either planted on the bottom or raised by the long line method (Iverson, 1976). A piece of nylon thread is strung through the 'ear' of the scallop shell and are suspended from a long line tied to a raft. Scallops grown in the sandwich frames and by long line method have reached marketable size of 10-11 cm in 2 years. The cost of labour and materials required are the constraints for expanding the scallop culture on commercial lines in Japan.

Very little success was achieved in the culture of the European scallop, Pecten maximus. In France this species was reared to the veliger stage (Bardach et al., 1972). In the U.S.A. Sastry (1968)

has shown that apart from the temperature, food supply is also a controlling factor in gonadal maturation of the bay scallop Aequipecten irradians. By manipulating these two factors he was able to spawn A. irradians out of season. He successfully reared the larvae to sub-adult stage. The bay scallop can be grown to marketable size in pens close to the shore in 9 months (Iverson, 1976). In Russia Mizuhopecten yessoensis and Spisula sachalinensis were cultivated by providing suitable fibrous seed collectors either suspended from a raft at depths of 1-3 m or placed on the bottom (Milne, 1972). The seeds were transplanted to Nylon mesh bags suspended from raft/rack for further growth.

In our country the scallops are not well represented and they neither form a fishery nor cultured at present. They are all generally small except Amussium pleuonectes which occurs along the Orissa Coast (Hornell, 1951).

ABALONES

Among the edible gastropods the abalones have reputation of a gourmet food with fine flavour. They are slow moving herbivores, inhabiting rocky shores. Important abalone fisheries occur in China, Japan, Mexico, U.S.A. and Australia. Their culture has been undertaken only in Japan and California (Bardach et al., 1972). The culture practice involves induced spawning, hatchery production of seed and on bottom culture of abalones to marketable size.

Among the abalones, Haliotis discus, H. diversicolor, H. gigantea and H. seiboldi are commercially important in Japan and much success was achieved in the culture of H. discus (Bardach et al., 1972). The abalones mature fast if the water temperature is raised to 20°C. In mature females the gonads are green in colour and milky white in males. Mature males and females at 1:4 ratio are placed in 2 x 2 x 0.5 m outdoor concrete tanks and subjected to thermal shock. From 20°C the water temperature is raised by 3 to 7°C for 30 to 60 minutes and brought back to original temperature. If need be the procedure is

repeated. Also a short exposure to air which is warmer than water or an abrupt change in the pH were also known to induce spawning.

The fertilised eggs are placed in deeper tanks, of size 2 x 1.4 x 1.4 m at a density of about 1,00,000/tank for 8-11 days to complete the larval stage. The water in the rearing tanks is not changed and the swimming larvae either feed on natural plankton available in the tanks or are provided with specially cultured flagellates and diatoms. When they are ready to metamorphose and settle, 50 cm square corrugated plastic sheets previously immersed in running water to develop a film of benthic diatoms are placed vertically in the tanks. Once the abalone have settled on these collectors they are placed in 10 x 10 x 2 m outdoor tanks supplied with running sea water. In each tank 1000 collectors, each with approximately 10,000 abalone are placed. Until they reach a length of 2-3 mm, diatoms serve as food and later fed with soft brown alga, Undaria sp. every 2-3 days. Undaria is often scarce and finely chopped pieces of green alga Ulva or artificial diet comprising protein in insoluble calcium jel is substituted. Survival from larvae to juveniles suitable for stocking is only about 1% and the poor survival is believed to be due to lack of food, particularly soon after settling. In Japan hatchery production of young abalone for stocking is estimated at 10,000,00 per year and 10% survival was obtained after stocking in the farms. Market size is generally reached at about 4 years when they are about 15 cm (Iverson, 1976). H. discus was experimentally grown in off bottom cages made of plastic waste baskets covered with cloth netting and suspended in the sea from a raft. They are stocked at 5 mm length, fed on Ulva and Laminaria until they reached the marketable size of 10 cm in 4 years.

In California, USA the red abalone Haliotes rufescens is being cultured (Bardach et al., 1972). The tank method of spawning followed in Japan was most effective. Feeding the larvae is problematic and in a month it reaches 5 mm in length with a survival rate of 10-20%.

Spawning, larval rearing and growing the seed upto 30 mm length takes one year and is done in indoor tanks. They are transferred to outside reservoirs for further growth. At various stages of culture they are fed on a variety of algal species and supplied with sand filtered sea water. The major constraints for intensive abalone culture are to provide suitable food at different stages, particularly to the juveniles and the slow growth of the abalones. The Japanese found that young abalones grow 4 to 5 times faster in warm water from coastal power stations than those grown in natural habitat (Iverson, 1976).

In India the abalones do not form a fishery and their culture is not yet attempted.