Captive seed production of pearl spot in backyard hatcheries

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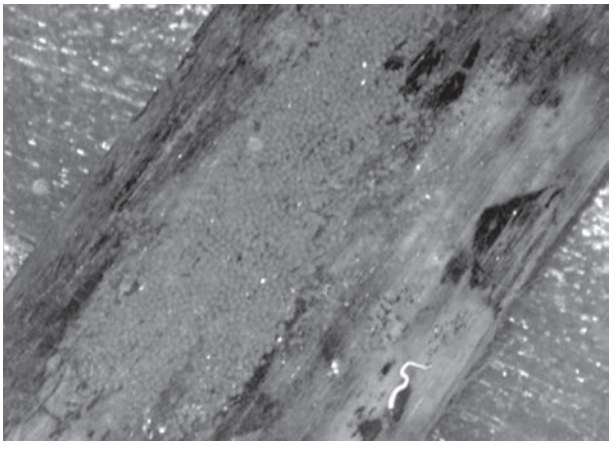
Pearl spot, *Etroplus suratensis,* locally known as *Karimeen*, is one of the most important cultivable finfish in Kerala. In India, wild populations of pearl spot have been recorded from the states of Kerala, Tamil Nadu, Goa, Andhra Pradesh, Odisha and West Bengal. A fully grown fish can reach about 40 cm length and weigh about one and half kilogram. Though a brackishwater fish, it is also found in freshwater reservoirs, lakes and rivers but its breeding is limited in freshwater. It mainly feeds on algae like *Spirogyra* besides plankton, small worms and small prawns. Due to the ever increasing market demand that leads to overfishing and the threats of a deteriorating environment due to pollution, the natural harvest of pearl spot has reduced in recent times from 1252 to 200 tonnes only during the last three decades (Padmakumar *et al.*, 2012, *J. Biosci.*, 37: 925-931). The pearl spot is suitable for culture in confined, fresh and brackish waters. In Kerala it is cultured in the traditional '*Pokkali*' fields as a part of polyculture system along with other fishes like mullets, milk fish etc. However, the pearl spot has been identified as the one of the candidate species for high-density cage culture. With a number of water bodies that are underutilized in the state,cage culture of pearl spot can form an alternative livelihood through aquaculture. For this, production of quality seed on a large scale is needed at the earliest.

Reproductive behavior of *E. suratensis* is complex which includes pairing, nest making, pit nursing and parental care. The fish attains maturity at the end of the first year with visible sexual dimorphism only during the breeding season. A year round breeder in the natural brackishwater systems, off Kochi two peak breeding seasons, February – May and September – December (Boby and Shoji, 2012, *Handbook on Pearl Spot* (in Malayalam), Fisheries Department, Govt. of Kerala p. 22-25) have been identified. It shows 'asynchronous' ovary with the possibility of spawning many times during the breeding season and interventions in the environment are considered more effective than the method of hormonal manipulations for induced breeding (Padmakumar *et al.*, 2012). It is reported that it can be artificially bred in earthen ponds, cement tanks or specialized raceways with provision for artificial substratum. Yet, seed production is most erratic. The number of seeds recruited in nature is found to be very few and unpredictable,



Pearl spot eggs attached to substratum

Pearl spot larvae

mainly because of predation pressure on the delicate larvae as well as inadequate nutrition during early larval stages. The lack of required quantities of pearl spot seeds is the most serious constraint for expansion of cage culture activities. Hence, to develop suitable technology for increased seed production, investigations were carried out and the experience gained is described below.

Brooders collected from the wild were reared in ponds with a depth of 1 to 1.5 m or in tanks with the essential facilities for adequate water exchange and sunlight. The ponds were prepared at least a fortnight in advance, with the eradication of the weed fishes and adding of fertilizers to develop phyto and zoo plankton. The adult fishes weighing about 100 g size were stocked in the ponds at stocking densities between 15 and 20 numbers per cent in a pond of 2.5 cents. The water quality parameters of the pond were maintained as: salinity (around 15 ppt), dissolved oxygen (> 3.5 ppm), pH (7 - 8), temperature (24 - 32 ^{o}C), transparency (> 50cm), ammonia (< 1ppm) as shown in Table 1. Water level was maintained at 4-5' depth. As the fish is omnivorous, the fishes were reared by raising the natural plankton production through additional organic manuring and also by providing supplementary feeds. The food and feeding of the brooders was carefully attended as it is very important for quality seed production. Conventional artificial feed prepared with rice bran 45%, groundnut oil cake 40%, fish meal 15% fortified with vitamin and mineral mix was given @ 5 – 7 % of fish biomass daily either in pelleted or dough form, in feeding trays. Feeding trays were kept suspended

Table 1: Water quality parameters in the broodstock pond during the peak seasons

Parameters/months (Season 1)	**September**	**October**	**November**	**December**
Size of the brooders (g)	110 - 130	115 - 135	118 -137	120 -140
Stocking density/cent	15 to 20	15 -20	15 - 20	20 -23
Salinty (psu)	8 -9	10 -11	10 -12	12 - 14
pH	7.3- 8.1	7. 5- 8.7	7.8 – 8.8	7.8 - 8.9
Temperature (°C)	22 – 26	24 - 28	23 -28.5	22 - 29
Dissolved Oxygen (ppm)	3.6 – 5.2	4.8 – 5.3	4.6 – 5.1	4.1 – 4.7
Ammonia (ppm)	0.03 – 0.9	0.06 – 0.5	0.07 – 0.7	0.06 – 0.7
Transparency (cm)	40 - 50	50 - 55	50 - 58	60 - 65
Egg mass observed (numbers)	16	17	15	14
Egg mass collected (numbers)	7	5	7	9
Parameters/months (Season 2)	**February**	**March**	**April**	**May**
Size of the brooders (g)	145 - 150	147 - 152	150 -155	156 -164
Stocking density / cent	20 - 25	20 - 25	20 - 25	22 - 28
Salinity (psu)	16 -17	17 -18	17 -19	18 -19
pH	7.6- 8.5	7 – 8.5	7.5 – 8.8	7.8 - 8.9
Temperature (°C)	24 – 30	26 - 31	27 -31.5	28 - 32
Dissolved Oxygen (ppm)	4 – 5.5	3.8 – 5.2	3.6 – 5.1	3 – 4.5
Ammonia (ppm)	0.01 – 0.7	0.07 – 0.8	0.09 – 0.9	0.04 – 0.8
Transparency (cm)	40 - 60	50 - 70	60 - 70	40 - 50
Egg mass observed (numbers)	11	14	17	13
Egg mass collected (numbers)	5	6	5	7

in the corners of the pond just above the bottom. Excess feeding should be avoided and trays were cleaned every day to avoid eutrophication in the ponds. Pairing started over a period of two weeks to one month which is the first step in the breeding process. After the pair formation the breeding pair moved along the side of the pond in search of a suitable site for nesting in shallow areas with enough sunlight. In most cases, the three sides of the nesting sites were protected either by bunds or some other structures so that the protection of the eggs and larvae were ensured. This was followed by cleaning of dirt and attached algae from the substratum with both male and female actively engaged in nest preparation. This took 3 – 5 days depending on the sites. The female fish lays its eggs on any type of hard materials such as coconut husk, leaves, bamboo poles, stones, PVC pipes, bricks etc. Therefore, such material was made available on the pond bottom and along sides to function as the substratum when broodstock ponds were prepared. As the gonads mature, the female releases the eggs. These sticky eggs were attached carefully on to the nest surface one by one in different layers. After the extrusion of a batch of eggs, the male releases milt over it and fertilize them instantly. The female then repeats the process of egg extrusion followed by the release of milt by male until the whole process of spawning is completed, a process that extends from 40 minutes to 1 hour. The number of eggs per brood varies depending on the size and condition of the brooders. The eggs were oblong in shape, about 2 mm in diameter and attached at one end to the nesting object by means of a short stalk. The newly laid eggs were yellowish in colour and as the embryo developed, the yolk sac became pigmented and colour became brownish.

These eggs attached to substrates were collected carefully from the broodstock ponds and transported to the hatchery for artificial hatching and larval rearing in the tanks. Here the mortality due to predation can be fully avoided and larvae can be reared in optimum conditions by giving them nutritious supplementary feed and other favourable conditions. While collecting the eggs care should be given to avoid the contact of eggs with air to minimize the physical or other stress to the eggs. For this, small containers can be used to transport the attached eggs along with the substrate. In the hatcheries, hatching tanks have to be set in advance with proper aeration, light and suitable bottom sand / soil in a thickness of about 2 to 3 inches. The water quality parameters like salinity, pH and temperature have to be set in almost the same conditions as the broodstock pond from where the eggs were collected. Water should be clean, clear and devoid of any contaminants and pollutants. The eggs with the substrates have to be carefully placed in the water (with minimum disturbance like shaking), facing eggs to the light. A small water flow is essential during incubation period to keep the eggs in oxygenated and slowly moving condition. This prevents settling of debris or dirt on egg surface which attract microbial infections when there are no parents to make water circulation in the tanks. In nature, after the eggs are laid, they are diligently guarded and aerated by the parent fishes with their continuous rhythmic fanning movement of the pectoral fins. The guarding female occasionally places its mouth gently against the eggs and sucks away adhering particles to clean these eggs. In hatcheries, this artificial water circulation can be effected using aerators or aquarium pumps of proper capacity.

The incubation period is 82 to 100 hours (3 – 4 days) after which the eggs hatch and larvae come out. During hatching, the egg membrane bursts first over the head of the larvae, which is at the free end, and this continues along the upper side by the waving of the tail. Water temperature, water movement and clarity of the water affect the hatching in the tanks. If the night temperature is very low, the incubation period extends and is not good for the larvae. In such cases, water temperature has to be adjusted to around 26-28 ^{o}C using aquarium heaters. These hatchlings are fully equipped with egg yolk for their nutrition. The newly hatched larvae, or the‘wrigglers’, are found to sink to the tank bottom. They congregate on the tank

floor by themselves by some natural instinct. The larvae are sluggish and without mouth opening, eye or fins for swimming. The larvae starts swimming only 4 – 6 days after hatching. Till then they remain at the bottom of the tank in a group and move very little by wriggling movements as a mass. They feed on the stored yolk during these days. As the yolk is fully utilized, in a week, the wrigglers develop the free swimming abilities and gradually come to the water surface. The early larval stage thus lasts for 7 days during which the larvae develops into a free-swimming individual. Now the eyes are opened and they can search for the food. The larvae feed on small live zooplankton and in the hatchery the larvae can be fed with *Artemia* nauplii. After one week, larvae can be transferred from the hatching tanks if needed. The larvae have to be fed at least twice a day @ 20 – 30 *Artemia nauplii*/ larvae for about two weeks. If *Artemia* is not available and the larval rearing system is near the ponds, small live zooplankton can be collected using zooplankton nets and fed to the larvae.

After two weeks the larvae can be fed with small particulate feeds. *Artemia* can be gradually reduced and finally stopped in one month when the larvae attain a size of about 1.5 – 2 cm. The larval mortality was negligible during the first month especially when *Artemia* nauplii was given as feed. In the late larval stage, though free swimming, larvae were quite different from the adult. Their tail remains long and the caudal fin is continuous with dorsal and anal fins. After a fortnight, the primary chromatophores on the back disappear and permanent colour bands begin to appear. At this time, the larvae measure about 18 mm and assume the form of adult at which larval mortality is relatively high. Hence the larval density has to be reduced if rearing is continued in tanks. Otherwise, they should be transferred to a bigger nursery pond for further rearing. The fry accepts supplementary feeds comprising ground nut oil cake, rice bran and commercial feed pellets.The young ones feed almost exclusively on zooplankton, the advanced fry on aquatic insect larvae, filamentous algae, vegetable matter and planktonic organisms. Worms, shrimps and insect larvae also form part of its food. Growth will be more in the pond systems during this stage. The nursery ponds have to be prepared well in advance for the growth of phytoplankton, zooplankton and filamentous algae. When they reach about 5 – 6 cm they can be considered as seed and sold to farmers through local seed banks. The seeds of pearl spot are always in demand due to its limited supply with no commercial hatcheries functioning for pearl spot seed production and seeds which are presently collected from wild are very limited in numbers. The scarcity of the seeds is mainly due to very low survival during its larval stages due to predation in spite of the parental care exhibited by these fishes. In nature, the fecundity of pearl spot normally varies from 750 to 3000 but the number of seeds produced from a single pair will be only 300 – 400 per spawning. However, through the captive seed production technology developed, it is possible to reduce the problems of predation and effectively produce more seeds as about 70% of the larvae can be reared to seeds without much problems (Table 2).

Table 2. Parameters of reproductive success during different spawning seasons

Parameters/Seasons	Sep - Dec	Feb - May
Fecundity (Numbers)	780 – 2955	820 – 2463
Hatching (%)	94 – 96	88 – 92
Larval survival (%)	86 – 90	92 – 94
Juvenile survival (%)	66 – 72	76 – 85
Seed produced (%)	68 – 70	64 - 69

In 2010 the fisheries minister of Kerala declared *Karimeen* as the official fish of Kerala state. The period 2010-2011 was observed as 'The Year of the *Karimeen*' with promotion of pearl spot farming through the Matsya Kerala programme of the Fisheries Department leading to a surge in pearl spot seed requirements of the fish farmers. Adequate sized (>20 mm) healthy seed supply on a steady basis is demanded by fish farmers.The advantages of this seed production technology over the existing routine pond seed production method is that the seed production per breeding can be

Pearl spot juveniles

Pearl spot seed

easily increased without extra infrastructure. It can be done by any pearl spot farmer who can periodically collect egg masses from their own ponds or farms. This collection of eggs saves the parent fishes from extending parental care which in turn enables the next spawning in a shorter gap of time which increases the total seed production from a pair of brooders. In certain parts of Kerala there is a targetted fishery for *Etroplus* (mainly the guarding parents) during the breeding season using indigenous gears since they will not move away from their nests after spawning, even if their life is in danger. The fishers who take advantage of this parental care habit of *Etroplus* to fish it during night hours thereby destroy large quantities of potential eggs and larvae in these areas. If these fishers are instead trained to collect the egg masses as well as small larvae in large numbers and do the nursery rearing it will enable conservation as well as seed production in a healthier way. In pond breeding programmes for pearl spot, the most difficult part is the collection of the seeds from the ponds which is mainly by cast netting or by pond drying. Both the methods are again expensive and cause mortality in a considerable quantity. In this aspect also the present method of captive seed production is a better alternative.