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Seed production of Pearlspot (*Etroplus suratensis*) in natural ponds

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ABSTRACT

Pearlspot (*Etroplus suratensis*) is an indigenous fish endemic to India and Sri Lanka. It is the state fish of Kerala and very popular in the main tourist destinations/cousins in Kerala. It is mainly collected from brackish water creeks and canals for domestic consumption. However, several environmental and ecological problems lead to the significant reduction of pearlspot in natural water bodies. The promotion of Pearlspot farming is the only sustainable solution for this crisis. Nevertheless, one of the main issues in Pearlspot farming is the lack of quality seeds in sufficient quantities to undertake commercial farming. Massive seed production is the only way to meet the ever-increasing demand for Pearlspot seed. Several attempts to produce Pearlspot seed stock under hatchery conditions have been unsuccessful. The present paper reports the methods to achieve the mass-scale seed production using pond based seed production method. In this, two brackishwater ponds, each with dimensions of 40 m × 50 m × 0.9 m and water access from the creek, were selected. Scientific procedures were followed to produce large Pearlspot seeds throughout the year. The technology ensures the production of 50,000 seeds from a single breeding pond of 0.5-acre area, which can meet the seed requirement for above 3 ha area. The present study proved that Pearlspot reproduction in natural ponds could produce seed stock on a commercial scale.

KEYWORDS

Pearlspot; seed; seed production; pond based; Pond breeding; Brackishwater

Introduction

Pearlspot *(Etroplus suratensis)* is an indigenous fish endemic to Indian states such as Kerala, Tamil Nadu, Goa, Andhra Pradesh, Orissa, West Bengal, and Sri Lanka (De Silva, Maitipe, and Cumaranatunge 1984). Pearlspot is naturalized to various fresh and saline water resources after their introduction for farming and ornamental purposes in olden times. They are euryhaline that inhabit mainly brackish water resources such as creeks, ponds, and river mouths, and freshwater resources such as rivers and ponds (Munilkumar et al., 2013). Kerala government declared Pearlspot as the State fish of Kerala in 2011 to accentuate its importance. Various dishes are made from Pearlspot

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is the most attractive marketing tool for most of the tourist destinations in Kerala. They are mainly caught from brackish water creeks and canals for domestic consumption. High prices and demand paved the way to collect pearlspot from natural water bodies by local fishers extensively. Thomas 2014 reported that its current population is decreasing. Padmakumar et al. (2002) said that the availability of pearlspot in natural water bodies significantly reduced during the previous two decades. Abraham et al. (2019) listed it in the Least Concern category in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species™. Overexploitation of Pearlspot from the wild may shortly lead to species extinction (Sodhi, Brook, and Bradshaw 2009).

Apart from overfishing, the other main reason for reducing pearlspot in the wild is the highly reduced population recruitment. The reduction of natural breeding of pearlspot in natural water bodies is mainly due to the destruction of natural breeding grounds. The main reasons are the anthropogenic interventions such as wetland reclamation, unscientific sand mining, indiscriminate dredging, unscientific fishing practices, pollution, Etc. Another ecological incidence of predation of its egg by weed fish, Etroplus maculatus, also fastens this process. In native conditions, competition of exotic fishes such as Oreochromis mossambicus and Trichogaster trichopterus for food and space also possess a significant role in this (Krishnakumar et al. 2009).

Presently pearlspot aquaculture is ultimately relayed on seeds collected from the wild. Farmers source wild-collected seeds for their farming requirements mainly due to the nonavailability of hatchery-produced seeds. Several attempts to commercialize pearlspot seed production have happened across the country, but less success has been achieved (Sukumaran et al. 2017). Some of these are lower fecundity, parental care, difficulty identifying sex, Etc. (Bindu et al., 2006; Joseph et al., 2016). Further, the nonavailability of an optimum starter diet for its larvae in a controlled environment is also an issue in its breeding process. The success of any larvae rearing depends on the quality and availability starter diet (De Graaf and Janssen 1996; Vikas, 2012). In the pond-based seed production method, the natural production of starter diets is a successful practice. The fertilizers such as nitrogen, phosphorus, and potassium have a specific role in breeding ponds to ensure good phytoplankton bloom (Boyd 1976). The objective of the present study is to assess the seed production ability of Pearlspot in natural ponds.

Materials and methods

The pearlspot seed production experiment was done in brackishwater ponds. Two brackishwater ponds (40 m × 50 m × 0.9 m) and having water access from the creek were selected at Karumaloor, Ernakulam district, Kerala, India. In order to set up the breeding experiments, the ponds

were prepared as the first step. Pond preparation began in May by doing the de-watering, excess humus removal, and weed fish eradication using Teaseed cake (Kulakkattolickal 1989) at the rate of 5 g per m2. After that, the pond bottom was sun-dried for 2 days. Subsequently, powdered dolomite was applied at 100 g per m2 as a liming material to correct acidity and enhance phosphorus and carbon contents toward higher phytoplankton production (Boyd 1982). Ponds filled with brackish water creek using a pump through a 200-micron mesh screen to prevent the entry of unwanted fishes/fish eggs.

The ponds were fertilized using dried cow dung (4 Kg/cent), groundnut cake (300 gm/cent), and urea (50 gm/cent). A fermented liquid extract of oil Sardine and Jaggery (1 ml/m^2 at intervals of 15 days) was also applied to induce consistent production of phytoplankton bloom in aquaculture ponds. Water parameters are measured routinely. Pearlspot brooders prefer complex stationary solid objects for egg-laying, especially on those located near bunds (Joseph and Ignatius 2016). Hence mud tiles each of 400 mm length and 150 mm width and wooden poles of 1 m length made up of two different materials such as bamboo and Casuarina were erected vertically to the pond bottom in a line at a constant distance of 1 m from sidewalls of ponds by maintaining pole to pole distance of 2 m.

As birds prey on fish larvae and fry on a massive scale in breeding ponds, the top surface of the ponds was covered with 1.25 mm thick and 60 mm mesh high-density polyethylene (HDPE) nets. The pond-side walls are covered with 2.5 mm wide and 30 mm mesh HDPE nets to prevent Otters' entry, as Sales-Luís et al. (2011) suggested. Dip nets of 4 m × 4 m were designed, fabricated, and erected at four corners of the ponds for periodical seed collection (Figure 1).

Pearlspot fish 200 numbers were collected from local fishermen (130 ± 20 gm and 140 ± 50 mm) and 200 from Pearlspot farms (135 ± 15 gm and 150 ± 35 mm) as a brood fish in the ponds 1 and 2 respectively. Routine visual monitoring was done in the ponds to check the abnormal swimming or aggressive behavior of the brood fishes daily after seven days of stocking till the 30^{th} day. The number of egg deposition instances was noted and recorded.

Randomly selected egg masses were counted manually using a hand lens. Samples of larvae were measured under a stereo zoom microscope (Leica, Wetzlar, Germany) attached with a digital camera (Leica, DFC 290) and image analysis software. Calculated the hatching percentage by counting the unhatched egg numbers after the hatching. Pearlspot seeds were collected from the breeding ponds using a dipnet. Periodically representative bamboo poles were lifted from the ponds and measured the egg laid positions using a scale.

Figure 1. Dip net made of nylon net for tiny size seed (1 to 2 cm) collection from the breeding ponds.

Results and discussion

The study observed the movement of pearlspot brood fishes in pairs around the sides of the ponds seven days after stocking. The study noted the brood fish's kissing behavior and jumping movements around the bamboo substratum for laying eggs. They together cleaned the bamboo substratum by using its mouth. Wild brood fish commenced egg-laying five days before cultured brood and out-performed their cultivated counterparts in nearly every metric assessed Table 2. The delay in laying eggs by the brood fishes collected from the ponds may be due to the delay in pair formation compared to the fishes collected from the wild. Eggs deposited in a wooden substratum are given Figure 2.

Water quality parameters results showed a steady variation during the breeding period. The maximum and minimum values noted are represented in Table 1.

Two types of seeds were collected from the ponds. One is small size (3 to 5 cm) seeds, and the other is fingerling size seeds (6 to 10 cm). Small size seed collection is accessible since they can be collected as a group due to their peculiar movements. Seeds collected from the ponds were recorded regularly and expressed in quarterly production data since a minimum of 90 days is required to reach the seeds to a marketable size. Higher seed production was evident in the first quarter than in the other three quarters (Figure 3). The reduction in seed production after the first three months was due to the presence of predatory weed fishes such as *Etroplus maculatus*. Weed fishes were killed during pond preparation; some of their eggs or larvae might have survived and grown in the ponds.

Preference to egg depositing material is given in Table 3.

Figure 2. Pearlspot eggs in a wooden substratum.

Table 1. Water quality parameters in the breeding ponds.

		Range	
Parameters		*Minimum*	*Maximum*
1	pH	5.3	7.4
2	Salinity	0	27
3	Alkalinity, mg/l	30	215
4	Bicarbonate, mg/l	30	215
5	Hydroxide, mg/l	0	0
6	Calcium, mg/l	22	3400
7	Magnesium, mg/l	110	2790
8	Total hardness, mg/l	140	3120
9	Ammonia, mg/l	0	0.56
10	Nitrite, mg/l	BDL*	0.15
11	Sulfide, mg/l	BDL	BDL

*Below detectable limit

Table 2. Details of egg production, days to first egg deposit, fecundity, hatching time, and hatching percentage of brood fishes from wild and culture ponds.

	Brood fish from wild	Brood fish from culture ponds
1 Egg colonies deposited per year per 2000 m^2	80	70
2 Days to first deposit	10	15
3 Fecundity per female	1420	1410
4 Hatching time (hours)	96	96
5 Hatching percentage	82	82

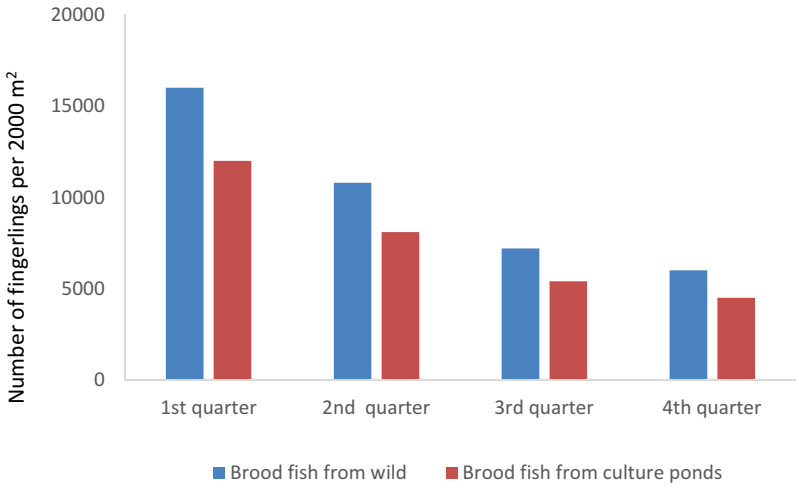

Figure 3. Variation in the number of pearlspot (Etroplus suratensis) fingerlings produced from river and cultured ponds over 365 days.

Table 3. Egg deposition percentage of brood fish collected from wild and culture ponds in different substrata.

Brood fish source	Mud tile	Bamboo pole	Casurina pole
Collected from wild	22	65	13
Collected from culture ponds	20	70	10

The pearlspot brood fishes preferred bamboo poles for laying eggs substratum. From the breeding experiment, pearlspot fry's (3 to 5 cm) 48,000 numbers and fingerling (6 to 8 cm) 4000 numbers could produce from 50 cent pond area. At the same time, it was 36,000 and 3000 respectively in the pond two with brood fishes used from culture ponds. Significant reduction in seed production using the pearlspot collected from the culture ponds is yet to be studied in detail.

The study reports that egg-laying was done in the bamboo poles 30 cm above mud level. Interestingly, the fishes prefer depositing eggs on the same surface only after a time gap of 2.5–3.0 months.

The study also recorded a steady color change pattern in the fertilized eggs. The yellow fertilized eggs changed into black on the fourth day just before hatching. The study observed that 90–96 hours of incubation is necessary to get the eggs hatched. The average fry hatched from a single batch of eggs was 900 to 950. The average hatching percentage was 82%. Small pits were noticed in the pond bottom.

The study noticed a continuous color change of eggs before hatching. After the fertilization, the egg's color was yellow, which changed to brown, dark brown, and black. The results showed that 90–96 hours of incubation is necessary to hatch eggs. The average number of fries hatched from a single batch of eggs was 900 to 950. The average hatching percentage was 82%. The

Table 4. Expenditure, income, and BC ratio of pearlspot seed production in 2000 m^2 pond.

		Amount (Rs.)
(a)	Capital cost	55,000/-
(b)	Operational cost	1,31,788/-
(c)	Total cost (a + b)	1,86,788/-
(d)	Gross revenue	4,02,500/-
(e)	Net operating income (d-b)	2,70,712/-
(f)	Net profit (d-c)	2,15,712/-
(g)	BC ratio	2.15

brooders in and around the egg attaching substratum made uniform-sized pits (10 cm in diameter and 5 cm in depth). A detailed observation revealed that these pits were made to safely collect and keep the small hatchlings to safeguard them from predators, as reported by Balshine (2012). The broodfishes move these seeds from one pit to another at different intervals.

No external feed is necessary for the pond breeding method for the frys (800 ± 40 µm) during the first two days due to sufficient yolk sac in the fry. After the reabsorption of yolk-sac, the frys (1500 ± 90 µm) started to come upwards for active feeding. During this time, they feed on zooplankton available in the pond.

The fry assumes a spherical shape while moving during the first month of hatching, which may be a natural defensive mechanism to scare the predatory fishes.

The cost of production, including pond preparation, protection nets, seed collection gear, packing unit, brood fish, feeds, workforce, E*tc*., is estimated to be Rs.5.0/- per fingerling at an overall cost-benefit-cost ratio is 2.15. Detailed cost economics is provided in Table 4.

Conclusion

The present study proved that pearlspot reproduction in natural ponds could produce seeds on a commercial scale. This current system can make around 50,000 seeds/ 2000 m2. The cost of production per fingerling will be Rs.5.0/- at the prevailing market price (June 2022) by controlling the water quality, providing protection from predators, and eliminating weed fishes.

The benefit-cost ratio of 2.15 indicates that pearlspot seed production in natural ponds is a viable enterprise that can prevent the wild sourcing of seeds toward a healthy environment.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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