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Broodstock development through regulation of photoperiod and controlled breeding of silver pompano, *Trachinotus blochii* (Lacepede, 1801) in India

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ABSTRACT

The silver pompano, *Trachinotus blochii* is recognised as a promising species for mariculture. In India, broodstock development, controlled breeding and seed production of silver pompano was achieved for the first time at Mandapam Regional Centre of Central Marine Fisheries Research Institute. Sub-adult fishes collected from the wild were grown in circular sea cages of 6 m diameter and 3.5 m depth. Twelve fishes were selected from a sea cage and acclimatized to laboratory conditions. Among these, four fishes (1 female and 3 males) were pre-conditioned to sexual maturity in a 10 t FRP tank with photoperiod control facility (2000 lux; 14 L: 10 D). In about 2 months, the gonads reached right stage for spawning. The brooders were administered human chorionic gonadotropin (hCG) intramuscularly, at a dosage of 350 IU kg body weight^{-1}. A total of 5 experiments were conducted and successful spawnings were obtained resulting in the production of fertilized eggs. The time taken for spawning ranged from 30-36 h. The total number of eggs spawned ranged from 0.08 to 0.184 million. The fertilization percentage varied from 75 to 95. Freshly spawned eggs measured above 900 µ. The success obtained in all the consecutive five experiments indicated that predictable spawnings of pompano could be achieved by employing the techniques developed.

Keywords: Broodstock, Controlled spawning, Photo-period regulation, Silver pompano, *Trachinotus blochii*

Introduction

The silver pompano, *Trachinotus blochii* is well recognised as a promising species for mariculture due to its attractive appearance, fast and uniform growth rate, adaptability to culture environment, acceptability to formulated feed, firm white as well as tasty meat and high domestic and international market demand. Apart from these, pompano is recognised as a premium fish popular in high-end restaurants and has high initial growth rates (Groat, 2002; Chavez *et al*., 2011). The silver pompano is caught only sporadically in the commercial fishery and hence the demand can only be met through aquaculture. The aquaculture of pompano has been successfully established in many Asia –Pacific countries like Taiwan and Indonesia. The farming can be successfully carried out in ponds and floating cages. The species is pelagic, very active and is able to acclimatise and grow well even at a lower salinity of 10 ppt and hence is also suitable for farming in the vast low saline waters of India besides its potential for sea cage farming.

Photo-thermal regulation was successfully employed for the development of broodstock of Florida pompano (*Trachinotus carolinus*) and the seed production as well as farming technology has been well established in the US during 1970s (McMaster *et al*., 2003). India is a late beginner in pompano aquaculture. The Central Marine Fisheries Research Institute (CMFRI) has initiated aquaculture research on pompano at its Mandapam Regional Centre from 2007 and the first successful broodstock development, induced breeding and seed production was achieved in July 2011. This paper reports the results on the development of pompano broodstock, induced spawning and larval production.

Materials and methods

Broodstock development in sea cages

Sub-adult fishes obtained in commercial catches from trap nets were collected and stocked in a circular sea cage of 6 m diameter and 3.5 m depth, installed at a site 300 m away from the shore in the Gulf of Mannar region (N 9°16’8.9" to N 9°16’12.6" and E 79°7’87.8" to

E 79°7’98.1"). The wild caught fishes were initially stocked in the cage without separating the sexes. These fishes were fed once in a day with low value fish (sardines, *Pellona* and *Ilisha* sp.) and squid at about 2.5 % of their body weight. Vitamins and mineral premix packed in 1 g gelatine capsules were also given twice a week along with feed at the rate of 1% of the food ration, in order to take care of the nutritional deficiencies. A total of 50 fishes with initial weight ranging from 250 to 500 g were stocked. The fishes were reared to maturity and when the fishes reached around 1kg size (Fig. 1), they were cannulated, sexed and tagged with passive integrated transponder (PIT) tags after anesthetising.

Fig. 1. Pompano brooder

Pre-conditioning of the selected fishes

After rearing for about one year in the cages, twelve numbers of fishes weighing above 1.5 kg were selected, brought to the hatchery, treated with 100 ppm formalin for 2 – 5 min, quarantined for about 48 to 72 h and stocked in two FRP tanks of 10 t capacity each with flow through system (flow rate 2 t h^{-1}). They were fed *ad libitum* twice a day with squid, shrimp and fish roe along with vitamin pre-mix. After a period of two months, four fishes (1 female and 3 males) were selected based on the gonadal condition and transferred to an FRP tank of 10 t capacity with photoperiod control facility (14L:10D) for pre-conditioning the fishes for sexual maturation (Fig. 2a, b). A compact fluorescent lamp (CFL) of 85 W fixed inside a protective dome was used for maintaining light intensity. The light intensity was recorded as 2000 lux at 1.20 m, measured using an underwater lux meter. The size of the female was 13.8 cm in total length and having a weight of 2.245 kg. The total length of males ranged from 30.7 to 35.7 cm and weight from 1.750 to 2.1 kg. The water quality was maintained by providing a continuous flow-through system. Periodic cannulation (Fig. 3) of the female was carried out to assess the progress of maturity of the fishes.

Fig. 2a. Broodstock tank with photoperiod control

Fig. 2b. Analog timer

Fig. 3. Cannulation of brooder

Induction of spawning

When the intra-ovarian egg diameter reached above 500 μ (Fig. 4), the female fish was administered with hCG by intra-muscular injection below the dorsal fin (Fig. 5), at a dosage of 350 IU per kg of body weight. The same dosage was given to the male brooders also. The flow-through of seawater was stopped from 1700 to 0600 hrs in order to prevent escape of the spawned eggs. Vigorous aeration was provided throughout the experiment. Occurrence of spawning was monitored periodically by examining the presence of eggs in the water column. The fertilized and floating eggs were collected using a 500 μ mesh-size net (Fig. 6) and stocked in a 2 t FRP tank. The fertilized eggs (Fig. 7) were incubated in the same tank with mild aeration. Total number of eggs and fertilization

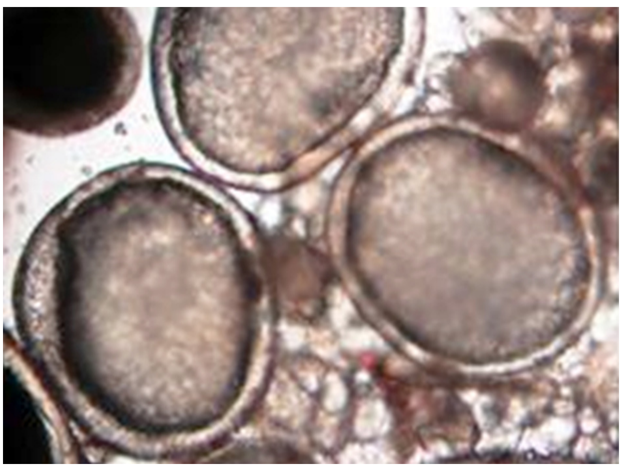

Fig. 4. Intra-ovarian eggs

Fig. 5. Administration of hormone

percentage were determined from 3 one-litre aliquots. The brooders after each spawning were maintained under the same photoperiod regulation throughout the experiments. A total of 5 controlled breeding experiments were conducted during July- December 2011.

Results

The pre-conditioning of fishes carried out under photoperiod control, for a period of two months, accelerated the development of intra-ovarian eggs from <100 μ size to

Fig. 6. Eggs sieved from the spawning tank

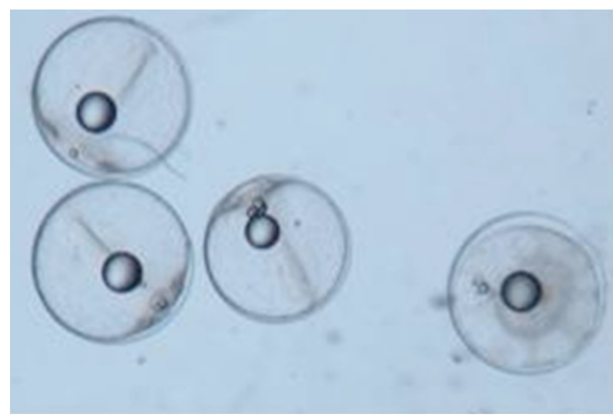

Fig. 7. Fertilized eggs

> 500 μ, which is the right stage for spawning induction. Similarly, the male gonad also matured to the right stage for inducing spawning within the same period. The same set of brooders was employed in all the five experiments. The results of the experiments on induced spawning are summarised in Table 1.

The female and males stopped taking feed 24 h prior to spawning. The males were found to swim closely with the female. The time taken for spawning ranged from 30 to 36 h of post-induction. Total number of eggs spawned ranged from 80,000 to 184,000. The number of fertilized eggs ranged from 60,000 to 175,000 and the fertilization rate varied between 75 – 90 %. The freshly spawned eggs measured 900 to 1000 μ and were yellowish with one prominent oil globule.

The ranges of water quality parameters recorded during the experiment were Temperature: 26.5 to 29 ºC; dissolved oxygen: 5.4 to 6 mg l^{-1}; salinity: 34-35 ppt and pH: 7.8 to 8. The interval between successive spawnings in the present experiments ranged from 27 to 39 days which

Table 1. Details of induced breeding experiments carried out in pompano

Experiment no.	Month of spawning in year 2011	Time taken for spawning after induction (h)	Total no. of eggs spawned (in thousands)	No. of fertilized eggs (in thousands)	% of fertilization
1.	July	36	171	137	80
2.	August	30	80	60	75
3.	September	35	94	75	80
4.	October	34	184	175	95
5.	November	36	139	125	90

indicated that several spawnings could be achieved from the same brooders.

Discussion

It is well understood that for commercialization of aquaculture of any species, the vital requirement is the availability of technology for large scale seed production. The first step towards this direction is the development of healthy broodstock. Hoff *et al*. (1972, 1978a, b) reported the first successful hormone-induced spawning of Florida pompano in 1970s using voluntary as well as strip spawning methods. In the Florida pompano, spawnable fishes were produced by keeping adult pompano in a building where environmental parameters (light cycle and water temperature) could strictly be controlled (McMaster *et al*., 2003).

Photoperiod regulation is widely employed as a tool for controlling the maturation and spawning in many marine fishes (Migaud *et al.,* 2006; Norberg *et al.,* 2001; 2004; Howell *et al.,* 2003). In the present experiment, the fishes maintained with photoperiod regulation reached spawning stage, whereas the fishes maintained without any photoperiod control remained with an ova diameter of around 200 µ. Hence, it is felt that photoperiod regulation can be effectively utilised for spawning the fish throughout the year. In the present study, only the photoperiod was controlled. However, a combination of water temperature control along with photoperiod regulation in a recirculation system could further speed up the maturity and may prove to be very useful in a commercial broodstock development system.

Successful spawning of silver pompano was reported in Batam, Indonesia (Juniyanto *et al*., 2008). They employed 10 m^3 spawning tank with 10 fishes at 1:1 male: female ratio. Spawning was stimulated by hormonal treatment and hCG was administered by injection at 250 IU kg^{-1} along with fibrogen (50 IU kg^{-1}) and was done twice across a two day period. In Florida pompano, Hoff *et al*. (1972) administered two different doses of hCG for females to induce spawning, the first dose at 550 IU kg^{-1} and the second at 275 IU kg^{-1} after 24 to 48 h of first injection. Main *et al*. (2007) reported the usage of a single dose of hCG at 1000 IU kg^{-1} body weight for females and 250 IU kg^{-1} body weight for males of Florida pompano. In the present study, only a single dose of 350 IU of hCG per kg body weight was used for both males and female to induce spawning, and fibrogen was not used. Single dosage was given to reduce the stress from repeated injections and the dosage was standardized based on earlier trials.

In Florida pompano, Hoff *et al*. (1972) reported spawning at 30 to 40 h after the first injection at a temperature of 23.3 ºC. In the same species, McMaster *et al.* (2003) reported spawning within 36 h of induction. In silver pompano, Juniyanto *et al*. (2008) reported spawning after 48 h of the first injection at 29-31 °C. In the present study, spawning occurred within 30 to 36 h post-induction at a temperature range of 26.5 to 29 ºC. Main *et al*. (2007) reported a fertilization percentage of 19.3 to 48.2 in Florida pompano whereas Juniyanto *et al*. (2008) observed a fertilization percentage of 60-70 in silver pompano. Generally, the male: female sex ratio was maintained as 1:1 (McMaster *et al*., 2003; Main *et al*., 2007; Juniyanto *et al*., 2008). In the present study, the fertilization percentage ranged from 75 – 90. Higher fertilization percentage in the present study could be attributed to the employment of more males in the ratio of 3 males:1 female. The size of the fertilized eggs was slightly larger in the present study *i.e.,* 900-1000 µ when compared to reports of McMaster *et al*. (2003) in Florida pompano and Juniyanto *et al.* (2008) in silver pompano.

All the consecutive five experiments conducted with the same brooders in the present study resulted in successful spawnings and production of fertilized eggs which indicated that predictable spawnings could be achieved under captivity by employing this methodology. It also revealed the possibility of using the same brooders successfully for several spawnings. Even though the natural spawning period of the Florida pompano was spring season, spawnable pompano were produced by manipulating light cycle and water temperature, and hence it was possible to produce two spawning cycles per year (McMaster *et al*., 2003). The information on spawning biology of silver pompano in Indian waters is rather scanty. It appears from the gonadal condition of the captive fish that the spawning season is protracted and the peak season is extending from March to November. Further, McMaster *et al*. (2003) reported average fecundity in *T. carolinus* as 0.1 million eggs per female and stated that the fecundity could vary in a year. Similarly, we also noticed variations in fecundity during the different spawnings which ranged from 0.08 to 0.184 million.

Silver pompano has already been proved as an ideal species for pond and cage farming. Farming of silver pompano in marine floating cages showed promising results considering the feed conversion ratio (FCR), survival rate and viable economic returns (McMaster *et al*., 2003 and Chavez *et al*., 2011). Hence, it is felt that silver pompano has great potential for mariculture in India. The present success achieved in the broodstock development and controlled breeding of silver pompano in India can be considered as a milestone towards the development of pompano aquaculture in the country.

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