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A Case Study on the Crop Rotation in a Disease Hit Coastal Tide-Fed Shrimp Pond with Silver Pompano, *Trachinotus blochii* (Lacepede, 1801)

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Abstract

Hatchery produced silver pompano, *Trachinotus blochii* were cultured in a typical tide fed coastal pond of 1 ha area, semi-intensive culture of tiger shrimp *Penaeus monodon*was practiced for many years. Owing to two consecutive collapse of shrimp culture due to white spot disease, a crop rotation in the same pond with culture of hatchery produced *T. blochii* was performed sequentially after harvest of diseased hit *P. monodon* stock. Nursery rearing of hatchery produced *T. blochii* carried out in hapa in same pond resulted in a survival of 99.91 %. Growth performance of *T. blochii* and the water quality parameters were monitored monthly over a period of 5 months. Feeding was done with artificial floating pellet feeds with a protein of 45% @ 5-7 % of the body weight twice a day. The fishes reached an average weight of 248.30 ± 0.28 g and average length of 22.82 ± 0.90 cm from 9.65 ± 0.59 g and 5.20 ± 0.24 cm respectively upon harvest after 150 days with a survival of 90%.The absolute growth rate and specific growth rate obtained in the present study was 1.6 g day^{-1} and 2.2 % day^{-1} respectively. The results of the study revealed that *T.blochii* is an ideal species for culture in the low salinity traditional coastal tide fed ponds of Kerala. The study also demonstrates the advantage of crop rotation with fish than continuous culture of shrimp in the shrimp culture ponds and the suitability of culturing. *T.blochii* in polyculture with fish and shrimps.

Key words: *Crop rotation, Polyculture, Trachinotus blochii, Penaeus monodon*

Introduction

Farming of tiger shrimp, *Penaeus monodon* was a promising enterprise in the early part of 1980's in India. However, the intensification of culture practice which resulted from the huge demand and profit margin lead to the collapse of this sector. The widespread occurrence of white spot syndrome virus (WSSV) in *P. monodon* towards late 80'sand other recent disease outbreaks has reduced the popularity among shrimp farmers in India, leading to the decline of farming of this species. At present, out of the8 lakh tons of production from shrimp culture in India, the contribution from farming of *Penaeus monodon*has been restricted to a mere 3 % (MPEDA, 2021). However, the demand and price for the species is ever increasing in the domestic as well as in the international market.

In Kerala, there were many coastal ponds where traditional or scientific/semi-intensive type of farming *P. monodon* was practiced for years. The state also witnessed sharp decline in production as well as area under culture since 2014-15 (MPEDA, 2021) with more and more farmers moving towards the culture of *Litopenaeus vannamei.* The use of inputs to reduce or negate the occurrence of diseases or disease-causing agents may not be economically feasible for a small-scale farmer. Crop rotation is a sanitation practice to reduce the initial inoculum of pathogen to a sufficiently low level (Berger, 1977) and is recognized as an effective disease control in shrimp culture (Paclibare et al. 2002). Crop rotation by culturing different species in *P. monodon* culture pond offers gap in shrimp culture so that the virus responsible for the white spot disease (WSD) will not survive in the systems/or can be eliminated to a considerable extend. Crop rotation by sequentially culturing fish in *P. monodon* pond was shown to be advantageous with increased production as well as better survival and non-occurrence of diseases (Yuvraj *et al*., 2015). Rotational farming with a non-penaeid species in *P. monodon* pond also helped

in overcoming disease problems (Srinivasan et al., 1997). Thus, crop rotation could be a solution to the disease problems in shrimp farms.

Silver pompano, *Trachinotus blochii* (Fig. 1) is a high-value marine finfish, which is of high demand among restaurants and consumers. This fast-growing carangid is relatively still new to the Indian aquaculture sector, although pompano culture has been established in manyAsia-Pacific countries like Taiwan and Indonesia (Gopakumar *et al*., 2012). With the standardized seed production technology by ICAR-CMFRI (Nazar *et al*., 2012), the aquaculture of this species in the country is slowly gaining momentum. *T. blochii* is amenable for farming in ponds, tanks, floating sea cages, and even in salinities as low as 10 ppt (Madhuri et al., 2019) to 15 ppt (Kalidas et al., 2012). The feasibility of culturing *T. blochii* in brackishwater shrimp culture ponds with high survival rate, appreciable FCR andmeat quality has been reported (Jayakumar et al., 2014).

Fig. 1. Silver pompano, *Trachinotus blochii*, an ideal candidate for tide fed traditional shrimp pond

In the present study, a coastal tide fed *P. monodon* culture pond hit by WSD twice during the same season was stocked with silver pompano for crop rotation involving the participation of the farmer. The study was aimed to evaluate the growth and culture potential of *T. blochii* in the coastal ponds of Kerala. The study mainly focused on the feasibility of using this species for crop rotation in the disease affected shrimp ponds and its implications on shrimp culture.

Materials and methods

The present case study was carried out in a shrimp culture pond of 1 ha area affected by WSSV for 2 consecutive crops during November to January, at South Kochi, near Tripunithura, Kerala, India (9°55'39.85'' N, 76° 20' 17.40'' E) (Fig. 2). The water intake to the culture pond was from the open water system through sluices depending on the tides. The salinity varied from 4-19 ppt and the average water pH ranged from 6.8-8.26, which were in the ideal range for pompano farming.

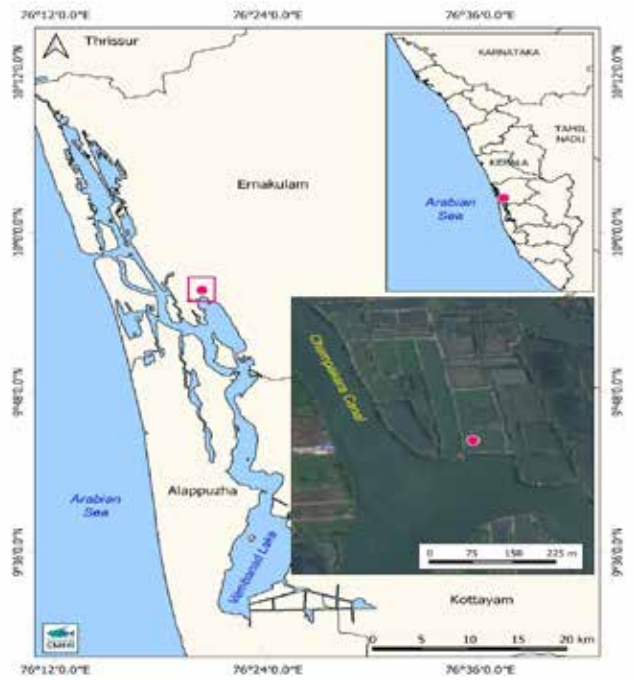

Fig. 2. GIS map of the study area

Water Quality Management

Plankton bloom is essential for early stages of pompano (until 100 grams) culture and therefore good plankton bloom was maintained in the pond. Algal bloom in the pond was maintained by adding a mixture of organic (10-30 kg/ha) and inorganic fertilizers (1-3 kg/ha). Sufficient water level was maintained in the ponds to reduce risks of the heavy growth of benthic algae. The water depth in the shallowest part of the pond was maintained minimum at 1 m.

Procurement of seeds, stocking, nursery rearing and culture

Hatchery produced seeds (8000 numbers) of silver pompano, *T. blochii*, procured from the Mandapam marine hatchery of ICAR-CMFRI were stocked in the pond which were initially prepared scientifically for shrimp farming. The transportation of the seeds was done in oxygen packs in a mini truck in the late afternoon to night hours and stocking during early morning hours. Initially nursery rearing of fishes were done in hapas' for 60 days and were released into the ponds after attaining 9-13 g. About 500 numbers (2–4 cm) of hatchery produced silver pompano fingerlings were stocked in each hapaof size 2 m x 2 m x 1.5 m. The initial hapa of 4 mm mesh size was changed with 8mm mesh after 30 days. The fishes were fed with floating pellets and chopped trash fishes in hapas'. Survival of the fishes after transportation and nursery rearing was 99.91%. The 7993 numbers of hatchery produced silver pompano which survived transportation and nursery rearing were released into shrimp ponds. They were fed with artificial floating pellet feeds with a protein of 45% @ 5-7 % of the body weight twice a day. Sampling of fishes was done by cast netting during feeding and were released back to the pond carefully without causing stress.

Growth parameters and water quality parameters

Random monthly sampling of 30 fishes were done monthly to determine growth and to adjust feed. Daily weight gain and specific growth rate was calculated as per the following equations

Absolute growth rate, AGR= (Final weight – Initial weight)/culture duration

Specific growth rate,SGR= [(Ln Final weight-Ln Initial Weight) x 100]/culture duration, Where Ln is natural log

Physico-chemical parameters such as temperature, pH and salinity were measured using a mercury thermometer, pH pen and refractometer respectively. Dissolved oxygen was analyzed following standard method (APHA, 1965).

Results and Discussion

The water quality parameters were analyzed before stocking the fishes viz., temperature 28-30°C, salinity 7-15ppt, pH 7.8-7.96 and dissolved oxygen 5 - 6.26 ppm and was found to be conducive for fish culture. During the culture period also, water quality parameters was found to be suitable and is presented in Table1. The temperature recorded in the present study was found to be optimum for growth (Main et al.2007). The salinity levels in the pond during the culture period of *T. blochii* was similar to earlier reports (Chavez et al., 2011; Jayakumar et al., 2012; Kalidas et al., 2012). The values of pH and dissolved oxygen were also with in the ranges as found suitable for pompano culture (Moe Jr et al., 1968; Chavez et al., 2011).

Table 1. Water quality parameters in pond during culture period

Day of Culture	Salinity (ppt)	Temperature (°C)	DO (ppm)	pH
0	14.1± 0.67	28.63± 0.64	5.27	7.86
30	18.3± 0.35	28.38± 0.87	4.45	6.95
60	19.1± 0.77	29.81± 0.25	4.14	6.82
90	17.0± 0.48	30.01± 0.92	5.13	7.34
120	10.3± 0.93	27.69± 0.53	5.98	7.96
150	4.8 ± 0.67	26.01± 0.38	6.26	8.26

The stocked fishes were very active and could be seen in different groups swimming very fast through the sides of the ponds and were feeding on periphytons and floating algal masses. It was also observed that the zooplankton populations, eggs and juveniles of many weed fishes, molluscs and crustaceans in the ponds were found to be

plenty and constituted as the initial feed for the juveniles. It is reported that juvenile pompano are opportunistic feeders (Pattillo et al., 1997), utilizing the most readily available food resources in within the habitat they forage (Wheeler et al., 2002). *T. blochii* was harvested after 5 months due to heavy monsoon rains when the salinity dropped drastically to 4 ppt. The fishes reached an average weight of 248.30 ± 0.28 g and average length of 22.82 ± 0.90 cm from 9.65 ± 0.59 g and 5.20 ± 0.24 cm respectively upon harvest after 150 days (Fig. 3).

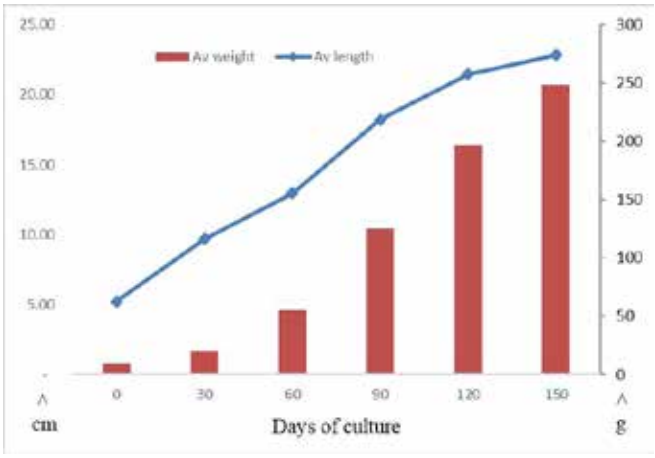

Fig. 3. Growth details of *T. blochii* in tide-fed shrimp pond

It was observed, however long-term low salinity (around 10 ppt for approximately 45 days) exposure did not have any negative effects on the farmed silver pompano. *T. blochii*is reported to grow well at salinity of about 10 ppt (Gopakumar et al., 2012) while other species of pompano have observed to grow at salinity as low as 9 ppt (Allen and Avault, 1970).The AGR and SGR obtained were in the present study was 1.6 g day^{-1} and 2.2 % day^{-1}respectively, which was comparable to *T. blochii* culture in brackish water shrimp ponds at a similar stocking density (Jayakumar et al., 2014).A total of production of 1785.6 kg of *T. blochii* was harvested from 1 ha pond. The maximum size recorded was 23.5 cm and 368 g and the minimum size was 13.5 cm and 98 g. The survival rate was recorded in the present study at 90 %, which was similar to reports of pond culture of silver pompano in shrimp ponds (Jayakumar et al., 2014, Divu et al., 2019). No signs of any disease were observed in the cultured fishes except the depression in front of dorsal fin in few fishes as reported in hatchery produced *T. blochii* (Samal et al., 2014).

In addition to the stocked *T. blochii*, a considerable quantity of other fishes and shrimp species viz. *Metapenaeus dobsonii*, *Feneropenaeus indicus, P. monodon, M. monoceros*, mud crabs and fishes like *Etropluss uratensis*, mullets, milk fish etc. were also caught from the pond which entered along with the water intake through the sluices (Fig. 4). The harvestable shrimps and other fishes were caught from the pond second month onwards during the full moon and new moon periods using filtration nets connected to sluices gates, which served as a revenue to the farmer during the growing phase of stocked *T. blochii*. The higher survival rate, comparable growth rates and non-occurrence of diseases in *T. blochii* make it suitable for traditional tidal fed shrimp ponds, where water exchange could be done to maintain water quality and filtration could be done to catch other fishes and shrimps.

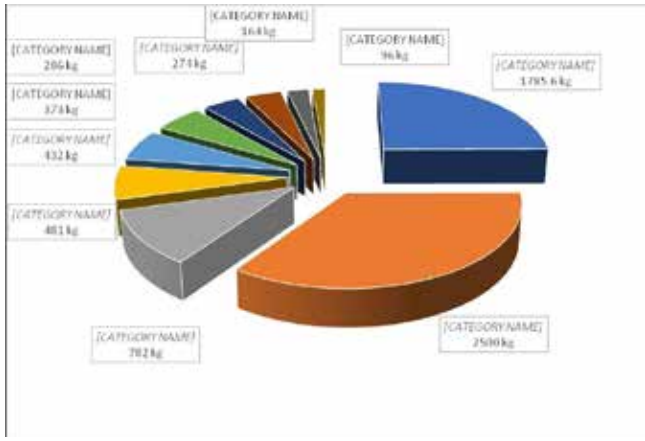

Fig. 4. Total production from 1ha tide fed culture pond

It was also observed that shrimps including *P. monodon* caught in the filtration nets were healthier and without WSD or any other bacterial diseases. *T. blochii*is carnivorous and predate on the weak shrimps in the ponds affected by disease or stress, thereby avoiding the spread diseases. The scavenging nature of pompano on organic waste also reduces the bacterial disease outbreak in the culture system (Divu et al., 2019).Crop rotation by stocking *T. blochii* might have also helped to break the lifecycle of the viruses that attack the shrimp, thereby avoiding shrimp mortality and ultimately increasing

production during the shrimp farming phase. Shrimp survival and production was found to be more in the pond after crop rotation with fishes than the control pond (Yuvaraj *et al*., 2015).

Conclusions

In Kerala, carangids are considered as highly predatory fishes in traditional shrimp ponds and are discarded at an early juvenile stage itself. The results of our case study have shown that crop rotation with silver pompano is beneficial to the shrimp culture ponds after shrimp farming or where the shrimp crop fail due to diseases. It is also noteworthy to point out that *T. blochii* promises to be a candidate species for low saline traditional coastal tide fed ponds were intermitant harvest of non-cultured species can be carried out during suitable moon phases. Although *T. blochii* is predatory, species is also ideal for poly culture with slightly large sized fishes as they cannot prey on them with its small mouth size and even along with shrimps, if fish is fed *ad libitum*. The results of the study would also considerably expand the aquaculture production of this table size fish and provide the brackish water shrimp farmers with an alternative species in their abandoned farms which were hit by frequent outbreaks of diseases.

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