Aquaculture Reports 9 (2018) 18–24

Contents lists available at ScienceDirect

Aquaculture Reports

journal homepage: www.elsevier.com/locate/aqrep

Survival and growth of fish (*Lates calcarifer*) under integrated mangrove-aquaculture and open-aquaculture systems

Shanmugaarasu Venkatachalam[a], Kathiresan Kandasamy[b,*], Ilanchelian Krishnamoorthy[c], Rajendran Narayanasamy[d]

[a] Rajiv Gandhi Centre for Aquaculture (Marine Products Export Development Authority), Sirkazhi, India
[b] Centre of Advanced Study in Marine Biology, Faculty of Marine Sciences, Annamalai University, Parangipettai, 608 502, Tamil Nadu, India
[c] SSS Marine Farm, Sirkazhi, Tamil Nadu, India
[d] Government Arts College, C.Mutlur 608 102, Tamil Nadu, India

ARTICLE INFO

Keywords:
Seabass
Lates calcarifer
Mangroves
Aquaculture
Water quality
Specific growth rate
Survival

ABSTRACT

The potential use of mangrove swamp for fish farming industry is not clearly known. Therefore, current study was conducted to assess the growth performance of the Asian Seabass, *Lates calcarifer* cultivated in integrated mangrove-aquaculture system (IMAS) and open aquaculture system without mangroves (OAS). Fish survival and biomass production were higher by 11% and 12.5% respectively in the IMAS than those in the OAS. The fish growth performance was higher in monsoon than that in other seasons. It was in association with water quality parameters such as, high levels of DO, chlorophylls-a,b, nitrate-N, DOC, TOC; low levels of light intensity, temperature (air, water), SPM, chlorophyll-c, nitrite-N, ammonia, total phosphate, reactive silicate, and POC; as well with moderate salinity. The water quality seemed to be favourable for growth and survival of the fish. Therefore, integrating the mangroves with fish farming of the Asian seabass is beneficial for better fish survival and biomass production.

1. Introduction

Aquaculture is an important source of stock enhancement, employment and profits. Mass production of Seabass juveniles was started by late 1960s in France and Italy (Murillo-Gurrea et al., 2001), and culture technique for the fish was developed in Thailand in 1970 (Williams and Barlow, 1999). The Asian seabass is a commercially important aquaculture species in Australia and south-east Asia. Production of the fish has progressively increased in the past years (Boonyaratpalin and Williams, 2002b; Thirunavukkarasu et al., 2001).

The Asian seabass or 'Barramundi' or giant sea perch, *Lates calcarifer* is an important euryhaline carnivorous fish. It can be cultured in both brackish and freshwater ponds as well as in cages (Boonyaratpalin et al., 1989). The Asian seabass fetches a high market price due to its delicately-flavoured white meat. It has fast growth rate and is suitable for aquaculture. It can be fed with artificial feed or low cost fish (Singh, 2000; Davis and Kirkwood, 1984; Rajendran and Kathiresan, 1999; Barlow et al., 1996; Boonyaratpalin et al., 1998; Sakaras, 1987). Feeding practices (Thirunavukkarasu and Abraham, 2004; Biswas et al., 2011; Glencross et al., 2013) and nutritional requirements for juvenile seabass are well-known (Boonyaratpalin and Williams, 2002a; Catacutan and Coloso, 1997; Boonyaratpalin et al., 1998; Coloso et al., 1999; Thirunavukkarasu and Abraham, 2004; Kathiresan et al., 2011; Murphy and Riley, 1962). The fish is produced on large scale in captivity through induced breeding technique in India (Thampi Samraj, 2015). Larval and nursery rearing techniques have been standardised for better survival and growth (Jobling, 1994; Kailasam et al., 2001). Rajiv Gandhi Centre for Aquaculture, Sirkazhi of the Marine Products Export Development Authority (MPEDA), India set up the first marine finfish hatchery for large scale production of the seabass larvae (Swann, 1992). Improved farming of the fish has gained momentum in recent years using hatchery produced seeds.

Conversion of mangroves to pond aquaculture is a major threat that has resulted in large scale destruction of mangroves especially in southeast Asia. In order to avoid this unsustainable practice, it is suggested to integrate the mangroves with brackishwater aquaculture as a sustainable alternative (FitzgeraldW., 2000). In this regard, current study was conducted to assess the growth performance of the Asian Seabass, *Lates calcarifer* cultivated in integrated mangrove-aquaculture system and open aquaculture system without mangroves.

* Corresponding author.
E-mail address: kathiresan57@gmail.com (K. Kandasamy).

https://doi.org/10.1016/j.aqrep.2017.11.004
Received 19 May 2017; Received in revised form 26 October 2017; Accepted 30 November 2017

Fig. 1. A view of fish culture in open aquaculture system and integrated mangrove aquaculture system.

2. Materials and methods

2.1. Site description

This study was carried out in a private marine farm (Lat. 11°21′14.34"N; Long. 79°49′17.56"E) at Puliyanthurai village located at Coleroon backwaters of Sirkazhi taluk, Nagapattinam District, Tamil Nadu, southeast coast of India (Fig. 1). The Asian seabass (*Lates calcarifer*) was cultivated in a grow-out pond integrated with mangroves in natural tide-fed system in the total area of 0.8 ha, with 0.4 ha artificially developed mangroves and water spread area of 0.4 ha. For comparison, another normal earthen aquaculture pond in the area of 0.8 ha, nearer to the experimental pond was also selected. Initially in the mangrove-integrated pond, inlet and outlet were fixed with stainless steel mesh for avoiding the entry of predatory fishes and also for allowing tidal water inside during high tide through inlet, and residing the water during low tide in the pond. In the same way, open pond also was well prepared after sun-drying and the water level of 1 m was maintained through pumping throughout the period of culture.

2.2. Experimental set up

The fish fingerlings of 13.8 ± 1.12 cm total length even size with an average body weight of 32.4 ± 2.98 g were selected and brought from Central Institute of Brackishwater Aquaculture, Chennai, India. The fish fingerlings were stocked at the rate of 1 number of fingerling in 2 m^{-3} and a total of 2000 numbers in each of the experimental ponds. The fingerlings were fed with pellet feed of 2.5 mm size at the rate of 7% of the total body weight initially, and then reduced to 2% when the fish weight increased to about 600 g. Correspondingly the fish were fed with 3 times a day initially and then reduced to 2 times in the morning and evening. Total duration of culture period was for nine months (321 days). Physicochemical parameters were measured in both the ponds during culture period.

The water samples were drawn from six points of each pond for three hours interval on the days of fullmoon and newmoon in the months of August, October, February and May representing respectively for premonsoon, monsoon, postmonsoon and summer seasons in both the experimental ponds during culture period. The samples were analysed in the field itself for temperature (air and water) using a thermometer with 0.5 °C accuracy; Hydrogen ion concentration using a pH meter with platinum electrode with an accuracy of ± 0.1, (pH 315i/SET, Wissenschaftlich Technische Werkstatten, Germany) calibrated with standard buffer solution prior to use; Redox potential (Eh) by using a milli voltmeter with platinum electrode; Salinity with the help of a hand refractometer (Atago hand refractometer, Japan); and, Light intensity using a lux meter (TES 1332A, digital lux meter, Taiwan). The water samples were then transferred to laboratory immediately in sterile pre-cleaned polypropylene container and analysed for Electric conductivity (EC) and Total Dissolved Solids (TDS) by using EC-TDS analyzer (CM 183, Elico Pvt. Ltd, India); and, Dissolved oxygen (DO) by using a DO meter (Deep Vision 801E, Chennai). The levels of chlorophylls (a,b,c), Dissolved Organic Carbon (DOC), Particulate Organic Carbon (POC), Total Organic Carbon (TOC), Total Dissolved Solid (TDS), Suspended Particulate Matter (SPM), alkalinity, reactive silicate, nitrate-nitrogen and nitrite-nitrogen and ammonia of water (Sirikul, 1982) and total phosphate (Moretti et al., 1999) were estimated.

2.3. Evaluation of growth rate

Twenty fish samples were drawn from each pond for three hours interval on the days of fullmoon and newmoon in the months of August, October, February and May representing respectively the seasons of premonsoon, monsoon, postmonsoon and summer during culture period. The fish samples were analysed for survival and wetweight and then the following parameters were calculated by using the formulae (Biswas et al., 2011).

Survival (%) = [Number of fish harvested/Number of fish stocked] x 100;

Biomass production (g/fish) = Final mean body weight − initial mean body weight;

Specific Growth Rate (% body weight/day) = [(ln Final mean body weight − ln Initial mean body weight)/No of days] X 100.

2.4. Statistical analysis

Statistical analysis (SPSS 11.5) was made to assess the significance level of 0.05 for each variable between aquaculture systems, or lunar days or season of analysis for both fish performance and water quality, and also diurnal variations for water quality parameters.

3. Results

3.1. Fish growth performance

The fish biomass, specific growth rate and survival varied significantly ($p < 0.05$) between the two aquaculture systems. The values varied significantly ($p < 0.05$) between lunar days and also between seasons (Table 1). Fish biomass production was higher