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Culture of the white-legged shrimp, *Litopenaeus vannamei* in bore- and sea-water fed ponds at Ramathirtham Village, Nellore district, Andhra Pradesh

Myla S. Chakravarty*, P. R. C. Ganesh, D. Amaranth, B. Shanthi Sudha and Y. Naga Sateesh

Department of Marine Living Resources, Andhra University, Visakhapatnam, Andhra Pradesh, India

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ABSTRACT

A comparative study on survival, food conversion ratio (FCR) and production of the white-legged shrimp Litopenaeus vannamei in relation to water parameters (Temperature, pH, Salinity, Dissolved Oxygen, Alkalinity, Hardness, Nitrite- Nitrogen, Ammonia, Calcium, Magnesium, Iron) in culture ponds fed with 2 bore water - and 3 sea water - ponds at Ramathirtham village of Nellore district, Andhra Pradesh was studied. Dissolved oxygen, hardness, nitrite-nitrogen, calcium and iron of sea water showed low values when compared to those of bore water. Temperature, pH, salinity, hardness, alkalinity, ammonia & magnesium of bore-water were lower than sea-water. The stocking density was approximately 4 lakhs/pond and 5 lakhs/pond in sea- and bore-water ponds respectively. The shrimps were fed with an average feed of 10,106 kg in bore water ponds, 8,457 kg in sea water fed ponds. The average survival rate was 68.35% in bore water ponds and 87.64% in sea water ponds. The average FCR was 1.45 in bore water ponds and 1.3 in sea water ponds. The shrimps were harvested at about 50 count in three months and the average production of bore – and sea - water ponds was 6,865 kg and 6,412 kg respectively. Basing on the results it may be concluded that Litopenaeus vannamei can also be cultured in bore waters, besides sea water.

Key words: Shrimp production, Bore- & Sea- water, Nellore

INTRODUCTION

Globally the annual shrimp production by culture has increased from 8 million tons in 1985 to 154 million tons by the end of 2011 [1]. India is one of the major shrimp producing countries in Asia, contributing 9.06 million metric tons and occupying second position next to China [2]. More than 7 million people directly or indirectly depending on shrimp culture industry for their livelihood [3]. Of late, tiger shrimp, *Penaeus monodon* has been replaced by *Litopenaeus vannamei*, an American shrimp in India due to high stocking densities, fast growth, specific pathogen free (SPF) seed [4]. In 2012-13, the production of *L. vannamei* in 22,715 Ha is 1,47,516 MT, out of which the Andhra Pradesh has contributed about 1,33,135 MT per 20,198 Ha [5]. Nellore district of Andhra Pradesh occupies 5th place among coastal districts with 2050 shrimp farms and 7105 Ha of land under culture [6]. Water quality in shrimp ponds is influenced by both environmental and management factors.

Water exchange is a management tool intended to reduce of nutrient loads in a shrimp pond. The organic and inorganic constituents of the sea water and bore-water will be different and they will influence the growth performance of the shrimps in the ponds and ultimately result in survival rate, FCR and performance in culture. Some of the researchers who worked on these aspects are [7-25].

Hence the present study is aimed at comparing hydrographical parameters (Temperature, pH, Salinity, Alkalinity, Hardness, Calcium, magnesium, Ammonia, Nitrite-Nitrogen, Iron and Dissolved Oxygen), survival rate, FCR and production in bore- and sea- water fed shrimp culture ponds at Ramathirtham area of Nellore district.

Fig. 1 Study Area

MATERIALS AND METHODS

Water samples for the analysis were collected from five different shrimp ponds- two bore water and three sea water at Ramathirtham village (14°38'50.98"N; 80°09'14.24"E), Nellore district, Andhra Pradesh (Fig.1). The samples for dissolved oxygen (D.O) were collected in separate bottles and were fixed with 1ml each of Wrinkler's A and B. Surface water temperature of different shrimp ponds was recorded between mornings to mid noon with the help of thermometer. The other parameters were assayed following APHA [26]. The stocking density was 4 lakhs/pond in sea water- fed ponds and 5 lakhs/pond in bore-water ponds. The shrimps of the bore water ponds were given an average feed of 10,106 kg, whereas those of sea water were with 8,457 kg in three months

Survival rate was calculated following the method of Hasan *et al* [27].

Survival rate = Average no. of shrimps caught/cast net area (m2) ×pond area (m2) × 100/number of post larvae stocked

Food conversion ratio (FCR) was measured as per conventional method [28].

FCR = Total feed consumed (kg)/total yield (kg)

The average production of bore- and sea-water-fed ponds were calculated separately from yield of each pond.

RESULTS AND DISCUSSION

Hydrographical parameters

Temperature was low (26.5 ºC) in pond 5 and high (28ºC) in ponds 1 to 4. The pH of ponds ranged from 7.71 to 7.86. The low pH value was observed in pond 5 and high in ponds 3 and 4. The minimum salinity (1.5 ppt.) was recorded in pond 5 (bore water) and high (15 ppt) in pond 1(sea water). The alkalinity was minimum (210 mg/l) in pond 2 and maximum (280 mg/l) in pond 1. The hardness of shrimp ponds ranged from 2120 mg/l to 3000 mg/l with minimum in pond 3 and maximum in pond 4 of sea water. The levels of ammonia of shrimp ponds ranged from 0.02 mg/l to 1.0 mg/l with minimum at pond 1 and maximum at pond 5. The nitrite-nitrogen was minimum (0.1) in ponds 1 and 2 and maximum (1) in pond 4. The magnesium was minimum (398 mg/l) in pond 3 and maximum (578 mg/l) in pond 4. The levels of calcium ranged from 198 mg/l in pond 3 to 248 mg/l in pond 4. The iron content of water was minimum (0.01 mg/l) in pond 1 and maximum (0.3 mg/l) in pond 3. The dissolved oxygen content varied from 6.2 to 7.4 mg/l with minimum in pond 1 and maximum in pond 4 (Table 1; Fig. 2).

Table 1 Physico- chemical parameters of shrimp culture ponds at Ramathirtham village

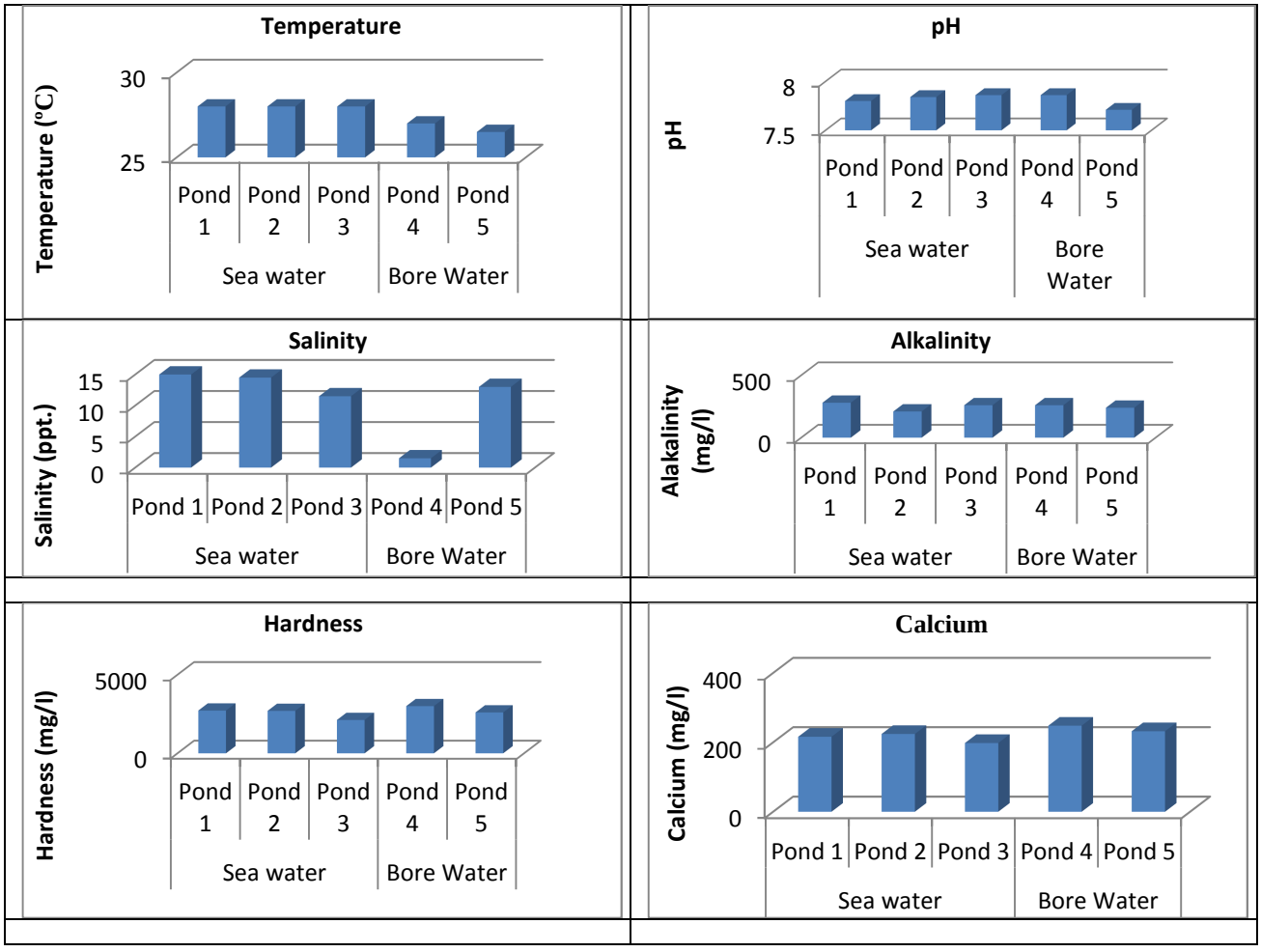
S. No	Ponds	Water Source	Temperature (°C)	pH	Salinity (ppt.)	Alkalinity (mg/l)	Hardness (mg/l)	Calcium (mg/l)	Magnesium (mg/l)	Ammonia (mg/l)	Nitrite (mg/l)	Iron (mg/l)	Dissolved Oxygen(mg/l)
1	Pond 1	Sea Water	28	7.8	15.0	280	2720	216	529	0.02	0.1	0.01	6.2
2	Pond 2	Sea Water	28	7.84	14.5	210	2700	224	520	0.04	0.1	0.25	6.4
3	Pond 3	Sea Water	28	7.86	11.5	260	2120	198	398	0.02	0.3	0.3	6.8
4	Pond 4	Bore Water	27	7.86	1.5	260	3000	248	578	0.03	1.0	0.25	7.4
5	Pond 5	Bore Water	26.5	7.71	13.0	240	2600	232	490	1.0	0.3	0.1	7.1

Survival rate

The survival rate was 86%, 84.12% and 92.8% in three ponds of sea water with an average of 87.64%. In bore water ponds it was 75% and 61.7% in the ponds and the average was 68.35% (Fig.3).

FCR

The FCR was 1.2, 1.3 and 1.4 respectively in three ponds of sea water with an average of 1.3 and it was 1.4 and 1.5 in bore water ponds with average of 1.45 (Fig.4).



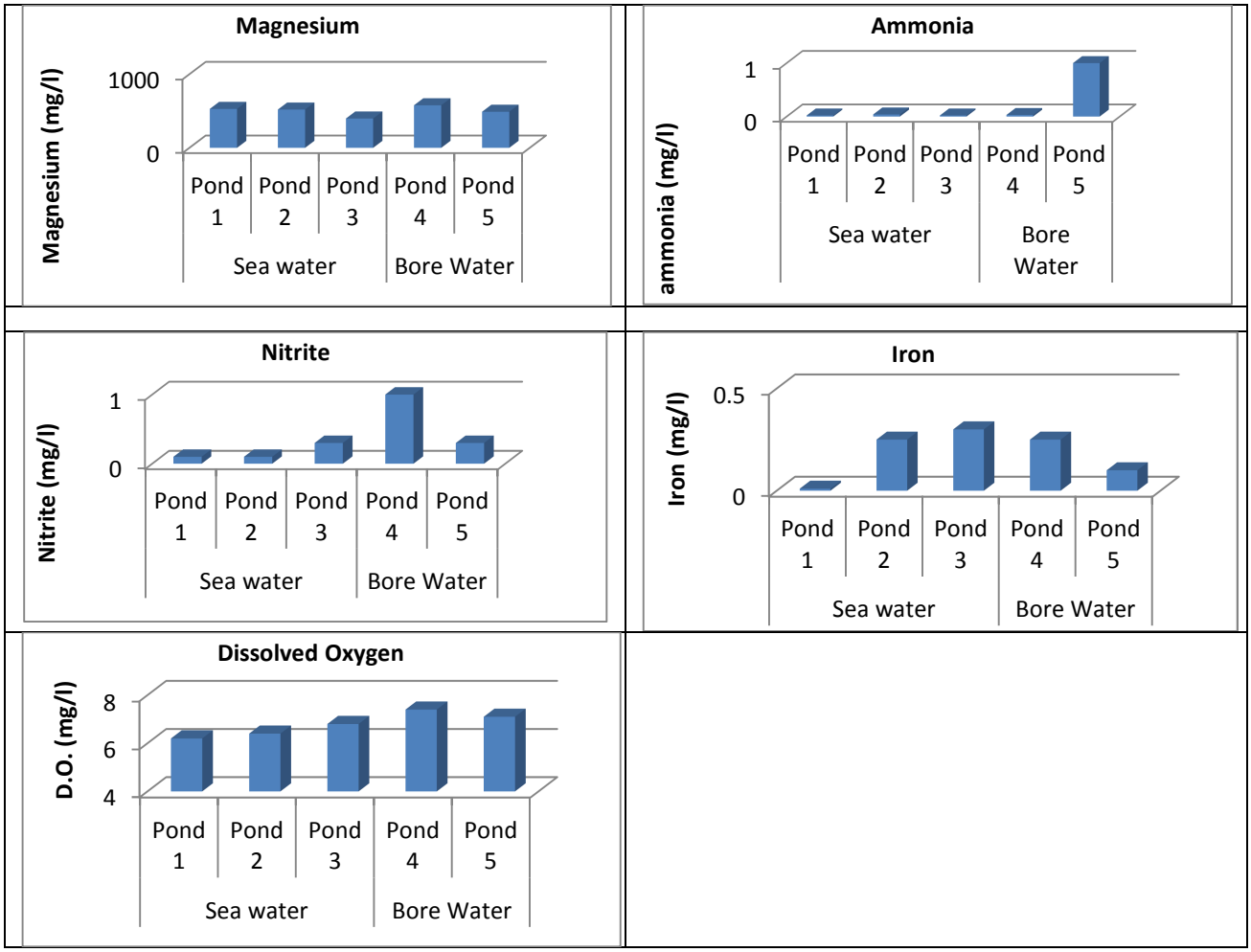


Fig. 2 Hydrographical parameters of pond waters at Ramathirtham village

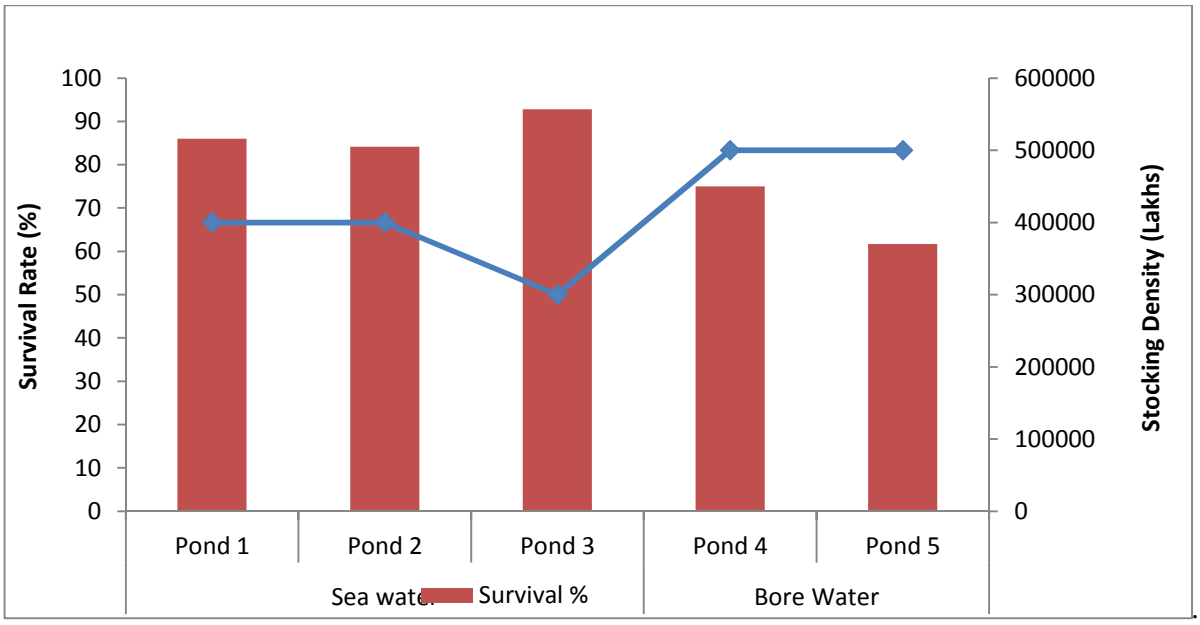


Fig. 3 Survival rate of shrimps in pond waters at Ramathirtham village

Production

The production in three ponds of sea water was 6,938kg, 6,730 kg and 5,568kg respectively and the average was 6,412kg in sea water fed ponds whereas it was 7,500kg and 6,170kg respectively in two bore water ponds with an average of 4085kg.

Brackish water shrimp farming is gaining rapid attention because of irregular production by capture fishery and heavy demand for shrimp both in the domestic as well as in the export markets. So, many entrepreneurs have been taking up shrimp culture because of high returns on investment despite heavy losses at times.

Temperature is one of the most important factors controlling growth of marine shrimp. In the present study, the temperature was recorded between 26.5 to 28.0 ºC. The average pH of the bore water ponds is 7.78, whereas that of sea water is 7.83. The permissible limit of pH in culture ponds is 7.5 to 8.5 [5]. The salinity among the ponds ranged from 1.5 – 15ppt and the normal range of salinity required for brackish water shrimp culture is 10-35 ppt [5]. Subrahmanyam [29], Verghese *et al.*, [30] and Chakraborthi *et al.* [31] observed a direct influence of salinity on the survival, growth and production of *Penaeus monodon* in culture ponds. The total ammonia has ranged between 0.02 to 1 mg/l which is within the optimal limits [5]. The hardness of water in the present study showed a variation between 2120 to 3000mg/l which is out of the ideal range. The dissolved oxygen content ranged from 6.2 to 7.4 ml/l. Increase in dissolved oxygen concentration might have been resulted from high primary production by phytoplankton. According to Varadaraju *et al* [9] there is a correlation between pH, dissolved oxygen, temperature and shrimp production. The studies conducted by Brahmbhatt *et al* [32] on physico-chemical characterization of shrimp ponds of Gujarat have also showed the same results.

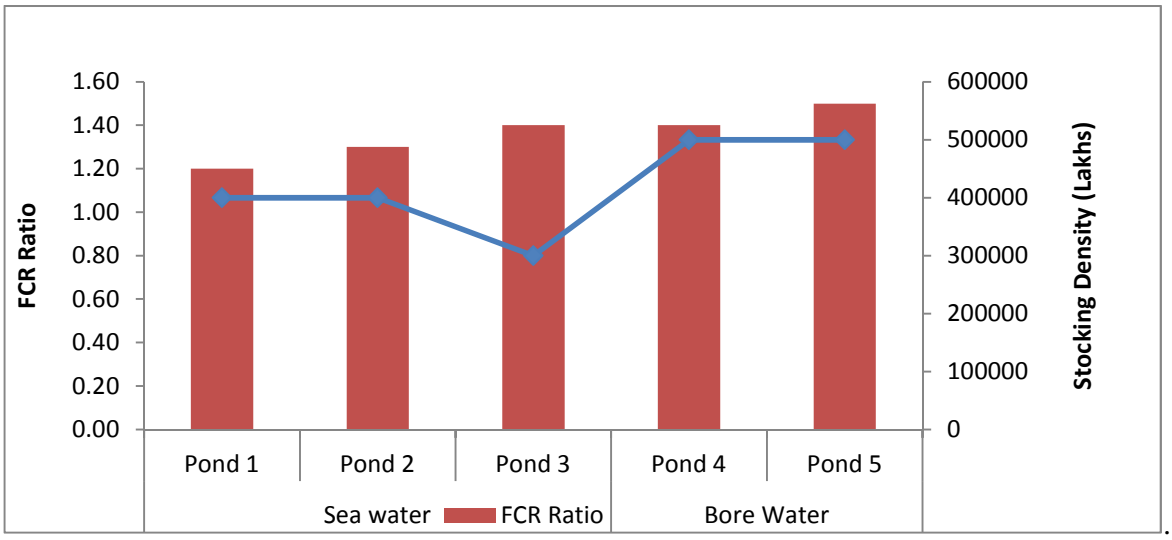


Fig. 4 FCR ratio of pond waters at Ramathirtham village

Pankaj Kumar *et al* [33] have found positive correlation between water temperature and salinity, salinity and primary productivity, primary productivity and dissolved oxygen, dissolved oxygen and nitrate, nitrate and total available phosphorous at four stations of Patelwadi village, Diu. Devi *et al* [20] have suggested ill effects caused by imbalance in the quality of water and soil of fish ponds for survival of aquatic animals are to be and monitored and controlled. Hassan *et al* [25] have found higher DO, salinity, ammonia, nitrite-nitrogen, phosphates and are significant ($p<0.05$) in culture ponds at mafia Island, Tanzania.

Gunalan Balakrishnan *et al* [12] have observed the survival rates as 82, 92, 81, and 80 %; FCR was 1.4, 1.34, 1.38, and 1.35, the average production was 8750, 9813, 8138, and 8591 kg/ha in four culture ponds of *L. vannamei* respectively with different stocking densities at Bhimavaram, West Godavari district, Andhra Pradesh. Abdol Mohammad Abedian and Amin [14] have found the survival rate and FCR as 93.33% and 2.8 respectively in the culture of *L. vannamei* at Bosher, Iran. Suciyono Andayani and Mahmudi [15] have noticed the survival rate at 75% and FCR at 1.34 and the production at 4182.9 kg/pond in intensive shrimp culture for 98 days at Lemah Kembar village, East Java. Danya Babu and Jagadish [4] have found the survival rate at 86%, 88% and 90%, FCR at 1.78, 1.81 and 1.82 and the production at 8337, 8932and 9450kg of *L. vannamei* in three brackish water culture ponds respectively in summer at Chinaganjam Village. But in rainy season the same have been 84%, 86% and 88%; 1.64, 1.51 and 1.71 and 6248, 6633 and 6945kg [22].

According to Suresh Babu *et al* [21] the survival, FCR and production of *L. vannamei* in brackish water farms at Kakinada, Andhra Pradesh have shown considerable variation probably due to environmental conditions, natural productivity, nutrient cycles etc. Sookying *et al* [34] also reported similar observations in farming trials at Gulf shores Alabama. Praveen Kumar and Krishna [24] have determined the survival (%), FCR and production in five low saline semi intensive ponds at Gangapatnam of Nellore district, Andhra Pradesh as 84.5, 83.5, 82.5, 79.5 and 69.12; 2.04, 2.12, 2.24, 2.76, 2.92 and 2.63; 2401.49, 3434.49, 4307.62, 4942.91 and 4043.5kg respectively.

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