

Performance evaluation of mud crab *Scylla serrata* (Forsk., 1775) in monoculture, monosex culture and polyculture

G. Venugopal*, S.S.H Razvi¹, P. P. Suresh Babu¹, P. Rami Reddy¹, K. Murali Mohan¹, P. Srinivasa Rao¹ and R. Ravishankar Patnaik¹

National Research Centre on Meat, Chengicherla, Uppal, Hyderabad -500039

¹Central Institute of Fisheries Education, Kakinada Centre, Beach road, Kakinada - 533007 (A.P.).

*Correspondence e-mail: venugopal.g.cife@gmail.com

Received: 09 Dec 2011, Accepted: 30 July 2012, Published: 8 Oct 2012

Original Article

Abstract

Performance evaluation of the mud crab *Scylla serrata* in three different culture practices namely, monoculture, monosex culture and polyculture has been carried out in earthen ponds. In one set of experiment, a monoculture trial with three different stocking densities (0.5, 0.75 and 1/m²) were attempted and in the second set of experiment, an all male, all-female, mixed and polyculture with milkfish were evaluated at a stocking density of 0.5/m². All the experiments were conducted using wild seed of *S. serrata* and fed with low cost marine fish. Monoculture experiments revealed that lower stocking densities (0.5/m²) yield better survival (47%), growth and production (663 kg/ha/crop). Growth rate of males were found higher than females at all stocking densities. Culture trial of mono-sex culture (all - male and all - female) has also yielded significantly higher ($P < 0.05$) production and survival compared to the mixed culture. The results of polyculture of crabs with milkfish have exhibited an additional yield of milkfish without affecting the production.

Keywords: Mud crab, performance evaluation, monoculture, monosex culture, polyculture.

Introduction

Crabs gained lot of commercial importance recently owing to the increase in live crab demand in south east Asian countries.

Crab industry is gaining momentum in India as many of the private entrepreneurs have taken up the commercial farming of mudcrab. Patterson and Samuel (2005) reported the success story of a Women Self help Group (SHG) in crab fattening from India. Sathiadhas and Najmudeen (2004) reported that economic indicators such as net profit, rate of return, pay back period and breakeven price indicate that crab fattening/culture is much more profitable than any other coastal aquaculture practices in India.

Reports on systematic culture of mud crabs are scanty in Indian aquaculture even though preliminary reports on the pond culture of this species are available (Marichamy *et al.*, 1980; 1986; Bensam, 1986). The present study is an attempt to evaluate the performance of mud crab in monosex culture and polyculture system. The polyculture trial of crab with milkfish is carried out in order to evaluate the compatibility of crabs in commercial polyculture practices in brackishwater aquaculture.

Material and methods

All the experiments were conducted at the brackishwater fish farm of Central Institute of Fisheries Education, Kakinada centre, Andhra Pradesh in three replicates in earthen ponds of 810 m². Nylon net (5 cm mesh size and 1.2 m height)

was fixed using casuarina poles on pond periphery to prevent escape of the crabs. Hide outs in the form of concrete pipes (150 mm diameter) were provided in the ponds. Fresh tidal water from an adjacent creek was used for farming after treating with 10 ppm available chlorine. No fertilization or manuring was practiced. Crablets of 40-60 g in weight range (Carapace width 5.2 to 6.8 cm) collected from Koringa backwaters, Andhra Pradesh, India (a natural resource) were used as the stocking material.

Experiments were conducted in two phases. In the first phase (October–January, 2005) performance of crabs at three different stocking densities were evaluated, while in the second phase (November–March, 2006) a monosex culture was conducted to compare the performance of crabs in all-male and in all-female culture against mixed population and a separate trial of polyculture of crabs with milkfish was also conducted. In the monoculture experiment, the crablets were stocked at three different densities (0.5, 0.75 and 1/ m²) in triplicates and cultured for four months periods. In the monosex culture trials, three different stocking strategies such as all-male culture, all-female culture and mixed culture (Male and Female in 1:1 ratio) were evaluated at a uniform stocking density of 0.5/m². Similarly, in the polyculture trial also, the crabs were stocked at 0.5/m² along with *Chanos chanos* fingerlings of 20-30 g at a stocking density of 0.25/m². Each treatment was maintained in three replicates and reared for five months.

The crabs were fed with chopped marine fish twice a day, in the morning and evening. Low value fishes as feed were procured from Kakinada fishing harbour at weekly intervals and stored

in deep freezer. Feeding rate was 7% of average body weight (ABW) for 1st fortnight and was reduced subsequently to 5% of ABW.

Water exchange was done during full moon and new moon tides and also water pumping was done as and when required. Water samples collected at weekly intervals were analyzed for pH, dissolved oxygen, and salinity following standard methods (APHA, 1998). Lime (CaO) was applied @ 50 kg/ha every fortnight to maintain the pH.

Sampling of crabs for growth studies was done once in a month. The individual weight of crabs was measured using a top loading balance. During the final harvest, details such as total production, survival, average weight of individual crabs and specific growth rates were assessed. The statistical analysis was carried out by employing paired t- test using MS Excel software.

Results

The salinity of culture medium was in the range of 14-18 ppt, pH 8-8.5 and dissolved oxygen level was in the range of 5.6 -6.2 ppm throughout the experiment.

Details of the final harvest for the crab culture experiment with different stocking densities are given in Table 1. Percentage survival and total production (kg/ha/crop) were significantly higher ($P < 0.05$) in lower stocking density. Percentage survival was almost double in lowest stocking density (46.6%) compared to the highest stocking density (27.3%). However, final average body weight and specific growth rate were not

Table 1. Harvest details of monoculture experiment at different stocking densities

Stocking rate (per m ²)	0.5	0.75	1
Survival (%)	46.6 ± 2.4 a	33.3 ± 1.5 bc	27.3 ± 1.9 bc
Production (kg/ ha/ crop)	663 ± 13.4 a	592 ± 15.4 b	489 ± 12.5 c
Final average body weight (g)	259 ± 6.4 a	243 ± 9.3 a	252 ± 1.9 a
Specific growth rate (g/day)	1.33 ± 0.02 a	1.32 ± 0.04 a	1.27 ± 0.02 a

*values with different superscripts differ significantly ($P < 0.05$)

Table 2. Harvest details of the monosex and polyculture experiments

	All – male culture	All – female culture	Mixed culture	Polyculture with milkfish
Crab Production (kg/ha/ crop)	427 ± 18.4 a	308 ± 3.1 b	222 ± 17.1 c	292 ± 6.7 bd
Milkfish production (kg/ha/crop)	-	-	-	462.5 ± 4.8
Survival (%)	33 ± 1.1 a	36 ± 1.2 ab	22 ± 1.5 c	28 ± 1.2 acd
Final average body weight (g)	229 ± 12.7 a	174 ± 4.1 b	228 ± 11.4 ac	218 ± 6.9 acd
Specific growth rate (g/day)	1.22 ± 0.029a	0.92 ± 0.02 b	1.12 ± 0.03 ac	1.11 ± 0.021 acd

*values with different superscripts differ significantly ($P < 0.05$)

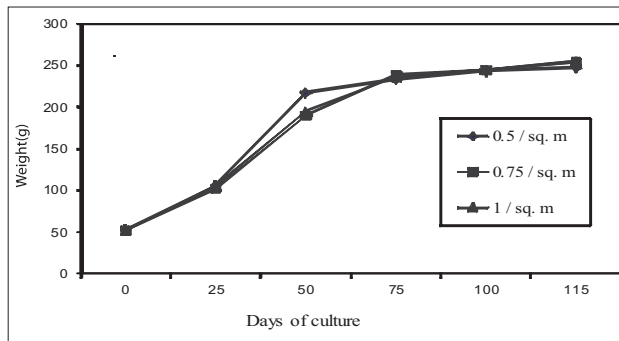


Fig.1 Growth details of crabs in crab culture experiment with different stocking densities

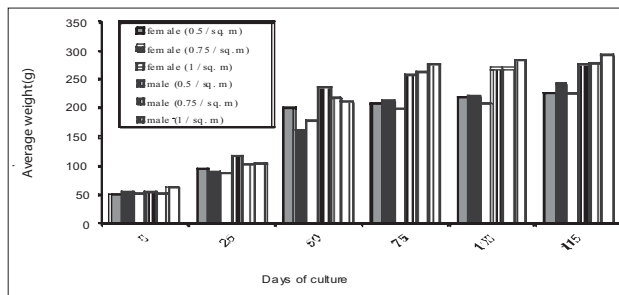


Fig.2 Growth details of males and females in crab culture experiment with different stocking densities

varying much among different stocking densities ($P > 0.05$). The growth rates of individual crabs (Fig.1) indicates that the stocking densities did not influence the growth rate of individual crabs, whereas, the growth performances analysed separately for males and females from different stocking densities (Fig. 2) indicate that males were growing faster than females in all stocking densities.

Harvest details of the crab culture experiments with different stocking strategies are given in Table 2. Monosex culture (all-male and all-female) has shown maximum production (427 and 308 kg/ha/crop respectively) and survival rates (33 and 36 % respectively) compared to mixed culture and polyculture. Specific growth was highest among all-male culture. In polyculture, the production was better (292 kg/ha/crop) than mixed culture (222 kg/ha/crop) and an additional yield of milkfish (462 kg/ha/crop) also obtained. The growth rate of crabs under different culture strategies, clearly indicates that all-female culture yielded the lowest growth rate in all the treatments (Fig.3).

Discussion

The water quality parameters and the culture conditions were found to be uniform in all the ponds during the entire culture period and were considered conducive for crab culture as reported by Trino *et al.* (1999). In monoculture experiments with

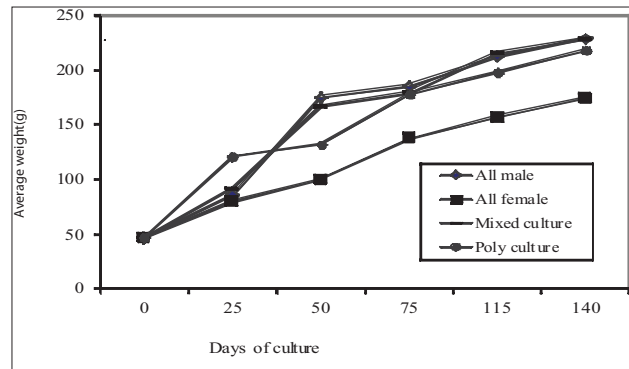


Fig.3 Growth rate of the crabs in different stocking strategies

different stocking densities, survival was found to decrease with increasing stocking density and a significantly higher survival was obtained in the lower stocking rate of $0.5/m^2$. Since crabs show severe cannibalism in their early life stages, the reduction in survival in higher stocking rates is attributed to overcrowding as reported by Baliao, *et al.*, (1981). Total production was found to be more in lower stocking densities owing to the higher survival rate and higher body weight. There was no significant difference in the final average body weight of harvested crabs. Specific growth rate also did not differ significantly. This study also indicate that the growth rates of individual crabs was not influenced by stocking rates, whereas the growth performances of males were faster than females in all stocking densities. Poovachiranon (1992) and Jayamane (1992) also indicated that male mud crabs gain more weight than females. Thus the present study reveals clearly that by adopting lower stocking density, better survival and better production can be attained in crab culture.

The monosex culture such as all-male, all-female against mixed population and polyculture with a uniform stocking density of $0.5/m^2$ revealed interesting results. Production was found to be the highest in all-male culture. Polyculture production was also significantly higher than that of the mixed population, but, in all-female it was the lowest. Trino *et al.* (1999) also reported that the final average body weight of individual crabs was higher in all-male culture than all-female culture. The higher production in control (mixed culture) than all-female in the present study could be attributed to the higher growth rate contribution by male population. Final average body weight and specific growth rate were maximum in all-male culture and were almost similar in the control and polyculture; but those of all-female culture was significantly lower which may be due to the presence of growth dimorphism in crab similar to that of freshwater prawns (Cohen *et al.*; 1988). Survival was found to be significantly better in all-female culture followed by all-male culture and that of mixed population. Similar results were reported by Trino and Rodriguez, (2001) which showed that higher survival rates can be obtained in monosex

ponds than in mixed culture pond. According to Cholik and Hanafi, (1992) mixed culture may lead to the enhancement of cannibalism among the stocks of crabs. The different growth rate of crabs among different culture strategies confirms that females are having the lowest growth rate as observed in the monoculture trials with different stocking densities. Polyculture also exhibited better performance in terms of production and survival than mixed culture with an additional yield from milkfish production. Previously Marichamy *et al.*, (1980) also reported the possibility of obtaining additional income from polyculture of crab with other brackishwater finfishes.

The present investigation revealed that monoculture experiment at lower stocking densities (0.5/m²) yields better survival and production in crab culture. Growth rate of males was higher than females at all stocking densities. Among the different culture strategies, all-male culture was more productive with better survival and higher specific growth rate. All-female culture also was better in survival but contribution to gross production was lower than mixed culture. The scope for monosex culture and its significant production potential was glaringly visible to make crab farming more profitable. The study also revealed the possibilities and potential of polyculture of crabs with other brackishwater fishes to enhance the economic returns as indicated by the crab - milkfish integration.

References

- APHA. 1998. *Standard methods for the examination of water and waste water, 19th edition*. American Public Health Association and Water pollution Control Federation, Washington DC, USA, 1328 pp
- Baliao, D.D., E.M. Rodriguez and D.D. Gerochi. 1981. Culture of the mud crab *Scylla serrata* (Forsk.) at different stocking densities in brackishwater ponds. *SEAFDEC Aquaculture Department Quarterly Research Report* 5:10-14
- Bensam. P. 1986. A culture experiment on the crab, *Scylla serrata* (Forsk.) at Tuticorin during 1975-77 to assess growth and production. In: *Proc. Symp. on Coastal Aqua. Part 4: The Marine Biological Association of India, Cochin*, 1183-1189.
- Cholik F. and A. Hanafi. 1992. A review of the status of the mud crab (*Scylla sp*) fishery and culture in Indonesia. In: Angell, C.A. (Ed.) *The Mud Crab. Report of the Seminar on Mud Crab Culture and Trade*. Bay of Bengal Programme, Madras, India, p. 13-28.
- Cohen, D. A. Sagi, Z. Ra'anana. and G. Zohar 1988. The production of *Macrobrachium rosenbergii* in monosex population. III. Yield characteristics under intensive monoculture conditions in earthen ponds. *Israeli J. Aquacult.*, 40: 57-63.
- Jayamane, S.C. 1992. The mud crab fishery in Sri-Lanka. In: Angell, C.A. (Ed.) *The Mud Crab. Report of the Seminar Mud Crab Culture and Trade*. Bay of Bengal Programme, Madras, India, p. 31-36.
- Marichamy. R. S. Shanmugam and S. Rajapackiam. 1980. Polyculture experiment in coastal waters at Tuticorin. *Proc. Sem. on Coastal and Inland fish culture in Tamil Nadu*. Fish. College. TNAU, Tuticorin. p. 241-248.
- Marichamy. R.. M. Manickaraja. and S. .Rajapackiam. 1986. Culture of the mud crab *Scylla serrata* (Forsk.) in Tuticorin Bay. *Proc. Symp. Coas. Aqua. culture*. Part 4: The Marine Biological Association of India, Cochin, 1176 -1182.
- Patterson, J. and V. D., Samuel, 2005. Participatory approach of fisherwomen in crab fattening for alternate income generation in Tuticorin, Southeast coast of India. *Asian Fisheries Science* 18: 153 -159.
- Poovachiranon, S. 1992. Biological studies of the mud crab *Scylla serrata* (Forsk.) of the mangrove ecosystem in Andaman Sea. In: Angell, C.A. (Ed) *The Mud Crab*. Report of the Seminar on Mud Crab Culture and Trade. Bay of Bengal Programme, Madras, India, p. 41-48.
- Sathiadas, R. and T.M. Najmudeen 2004. Economic evaluation of mud crab farming under different production systems in India. *Aqua. Eco. & Mgmt.* 8: 99 - 110
- Trino, A. T. and E. M. Rodriguez. 2001. Mud Crab fattening in Ponds. *Asian Fish. Sci.* 14: 211 -216.
- Triño, A.T., O.M. Millamena, and C. Keenan. 1999. Commercial evaluation of monosex pond culture of the mud crab *Scylla* species at three stocking densities in the Philippines. *Aquaculture* 174:109-118.