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Note

Effect of stocking density on shooter formation, growth and survival of Asian seabass *Lates calcarifer* (Bloch, 1790) during nursery rearing

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Abstract

Seabass *Lates calcarifer* is an important brackishwater fish, which thrives and farmed in fresh and saline water environment. Differential growth of this species during larval and nursery rearing phases leads to the formation of shooters, which reduces overall survival due to cannibalism. Therefore, the present experiment was conducted to evaluate the effect of stocking density on shooter formation, growth and survival of seabass. Hatchery produced seabass seed (total mean length 1.76±0.39 cm; mean weight 0.132±0.10 g) were stocked in net cage hapa (2x1x1 m) installed in brackishwater pond, at four different stocking densities, *viz*., T1 (800 nos.), T2 (850 nos.), T3 (900 nos.) and T4 (950 nos.) in triplicates. During the 45 days of nursery raising, fishes were fed with formulated nursery feed (crude protein: 42% and lipid 8%) at 5 to 8% of body weight three times a day. Initially, the fishes were manually graded on 3rd day and later on weekly basis and transferred to separate hapa. Total number of shooters formed during grading periods (S1, S2, S3, S4 and S5) were counted. It was observed that though maximum shooters were obtained from treatment T1 and minimum in treatment T3, the shooter formation among different treatments were not significantly different. The maximum numbers of shooters were obtained during the period from 9 to 21 days of rearing in nurseries in all the treatments. A survival of 60% was recorded during the present study. Based on the results of this study, it is suggested to maintain stocking densities of 400-425 m^{-2} for nursery rearing in hapa. Also, the rearing period from 9 to 21 days is significantly critical for ensuring good survival rate.

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Lates calcarifer (Bloch, 1790) is a euryhaline and catadromous fish species that is commonly called giant sea perch or Asian seabass. It is an economically important food fish in the tropical and subtropical regions of the Pacific and Indian Ocean including Australia, Philippines and countries bordering the Arabian Sea. It is a fast-growing fish cultured extensively in South-East Asian countries and Indo-Pacific region (Greenwood, 1976) and cultivated in brackish as well as freshwater ponds and in marine cages in many south-east Asian countries (MPEDA, 2014). Owing to high market value and increasing demand, there is a growing interest in the culture of seabass. Technology of artificial propagation of the seabass in captivity through induced breeding techniques and larval rearing protocols have been standardised (Lim *et al*., 1986; Thirunavukkarasu *et al*., 2001; Kailasam *et al*., 2007).

In spite of breakthrough in seed production technology, a major constraint in the large scale farming of this species is the availability of hatchery produced stockable size seeds. Therefore, nursery rearing is an important step to produce large size fingerlings. Seabass fry is highly carnivorous and voracious feeder, which is major constraint in seabass farming (Parazo *et al*., 1991; Kailasam *et al*., 2001; Biswas *et al*., 2010; Solanki *et al*., 2014; Kumar *et al*., 2016). According to Kungvankij *et al*. (1986), high mortality is often encountered when uneven sizes of the fish are stocked and at very young age (1-20 cm in length), during the first two months of rearing. Thus, nursery rearing of seabass fry in earthen

ponds, indoor cement tanks (Chougale *et al*., 2015) or hapas and cages to stockable juvenile size is essential since it provides adaptability to pond ecosystem and is a profitable venture of short duration before release into the grow-out ponds by farmers. With this background, present experiment was conducted to evaluate the relationship of stocking densities on periodical shooters formation, growth and survival of seabass fry.

Experiment was conducted at farmer's pond in Lavachha Village of Surat District, Gujarat and was a part of a demonstration programme, at farmers' field. The stocking densities were selected based on the seed received and considering economics. Hatchery produced seabass (*L. calcarifer*) fry of average size 0.8 ± 0.021 cm in length and 0.1±0.012 g weight were collected from ICAR-Central Institute of Brackishwater Aquaculture (ICAR-CIBA), Chennai, India and stocked after acclimatisation in 30 mesh size hapa of 2 m x 1 m x 1 m (2 m^3) and installed in brackishwater pond. Stocking rate based four treatments *viz.,* T1 (800 nos.), T2 (850 nos., T3 (900 nos.) and T4 (950 nos.) per hapa were designed in triplicates. These hapa were cleaned periodically every 3rd day and seabass juveniles were fed with nursery feed (crude protein 42% and lipid 8%) (developed by ICAR-CIBA) at the rate of 5 to 8% of body weight three times a day (09.00 hrs, 13.00 hrs and 19.00 hrs) using feeding trays hung in individual hapas.

The fish were manually graded at every 3rd day with hand net, subsequently on weekly basis and transferred to separate hapa. Total number of shooters formed during grading periods (S1, S2, S3, S4 and S5) were counted. Representative samples were measured for length and weight to the nearest 1.0 mm and 0.1 g using measuring scale and electronic weighing balance respectively and analysed for growth parameters using the following equations:

Survival rate (%) = (No. of fish at a given time/Original no. of fish stocked) x 100

Shooter (%) = (No. of shooters/Total no. of stocked fish) x100

Water quality parameters such as salinity, pH, dissolved oxygen, total alkalinity, total ammoniacal nitrogen and nitrite-N were recorded at fortnightly intervals. Soil quality parameters such as pH, electrical conductivity, organic carbon, available nitrogen, available phosphorous and available potassium were also analysed at the beginning of the experiment. The water and soil analysis was carried out following standard procedures (APHA, 1998).

Seabass fry are highly carnivorous and voracious feeders and as a result a few grow rapidly which are called as shooters and during the larval nursery rearing phases, the population survival rate drastically reduces due to their cannibalistic behaviour (Parazo *et al.,* 1991; Kailasam *et al*., 2002; Biswas *et al*., 2010). Regular grading and optimal feeding have to be adopted in nursery management discretely by grading of the shooters from 3rd day onwards initially and thereafter on weekly basis (Glenn Schipp *et al*., 2007).

In this study, comparing the different treatments, it was observed that the occurrence of shooters was 24.333±2.903, 23.462±2.789, 23.205±2.865 and 23.795±2.980 in T1, T2, T3 and T4 respectively (Table 1). The differences noticed on the shooter formation among different treatments were not statistically significant, indicating that shooter formation is not dependant on stocking densities. This contradicts the results obtained by Katavic *et al*. (1989) in intensively cultured seabass (*Dicentrarchus labrax*) fingerlings. The observations show that age of fish has direct influence on shooter formation (Fig. 1) and average number of shooters at different sampling times (S1, S2, S3, S4 and S5) during the study were; 29.500±2.673, 45.333±1.183; 32.083±1.104, 1.750±0.463 and 3.750±1.393 respectively (Table 1). From the trend in number of shooters during periodical analysis, it can be inferred that the maximum number of shooters was obtained during the period of 9 to 21 days or at the time of S2 (Fig. 2). The soil and water parameters of the nursery pond are depicted in Table 2. The water quality parameter values recorded were: pH (7.9 to 8.2); salinity (22 to 28 ppt); total ammonical nitrogen (0.005 to 0.033 mg l^{-1}), nitrite-N (0.004 to 0.015 mg l^{-1}) and total alkalinity (122.24 to 200.52 ppm) which were found to be the ideal as per the earlier reports on seabass rearing (Solanki *et al*., 2014; Prem *et al*., 2016).

In this study, maximum survival of 60% was obtained after 45 days of rearing at lower stocking density of 800 (T1), which is at par with the stocking density of 850 (T2). At these stocking densities, the fish attained maximum growth of 1.027 ± 0.021 g (3.86 ± 0.150 cm). The survival obtained in this system was comparable with the survival of 60% in tank reported by Chou *et al.* (1994) and higher than 34-51.4% obtained from direct pond stocking (Trino and Bolivar, 1993). But in this case, the authors initiated nursery rearing with bigger size seeds [Chogale *et al*., 2015 (1.65 ± 0.27 g); Philipose *et al*., 2010 (2.01 ± 0.53 g)], which may be the reason for the higher survival. The authors feel and suggest further refining of technology through feed and feeding regimes management for even

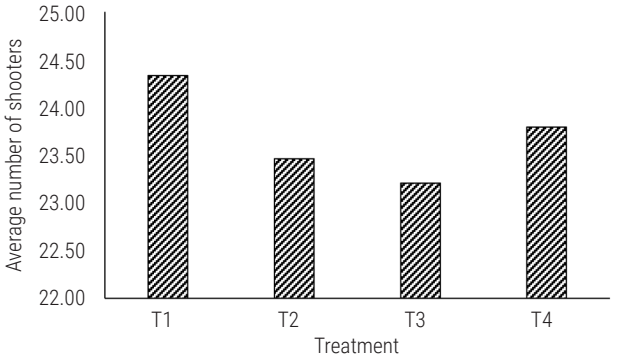

Fig. 1. Shooter formation in different treatments

Table 1. Observed shooters during the different sampling and in different treatments

	Number of shooters			
	Minimum	Maximum	Mean	Standard Error
Treatment				
T1	0.000	55.000	24.333	2.903
T2	0.000	54.000	23.462	2.789
T3	0.000	50.000	23.205	2.865
T4	0.000	55.000	23.795	2.980
Sampling				
S1	20.000	50.000	29.500	2.673
S2	39.000	50.000	45.333	1.183
S3	29.000	43.000	32.083	1.104
S4	0.000	5.000	1.750	0.463
S5	0.000	10.000	3.750	1.393

Table 2. Physico chemical parameters of the pond water recorded during the experimental period

Parameters	Unit	Mean ± SD
Water quality parameters		
pH		8.09 ± 0.12
Salinity (ppt)		23 ± 5.87
CO_3 (ppm)		0.35 ± 0.14
HCO^{-3} (ppm)		169 ± 31.57
Total alkalinity (ppm)		169.35 ± 31.68
NO_2-N (ppm)		0.01 ± 0.004
TAN (Total ammonical nitrogen) (ppm)		0.02 ± 0.009
Soil quality parameters		
pH		8.48 ± 0.12
EC (ds m^{-1})		8.96 ± 3.17
OC (%)		0.66 ± 0.25
Nitrogen (kg ha^{-1})		107.41 ± 41.63
Potassium (kg ha^{-1})		4552.6 ± 569.6
Phosphorus (kg ha^{-1})		84.01 ± 15.76

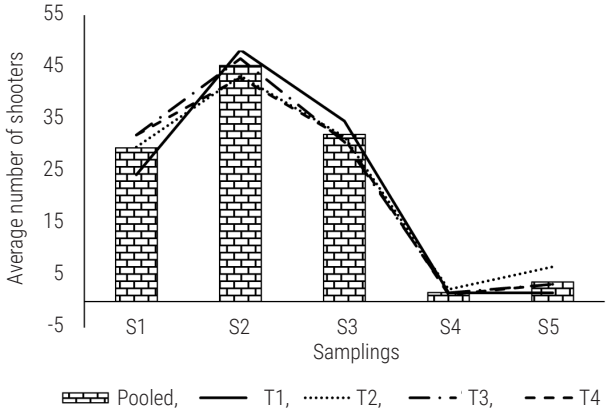

Fig. 2. Trend in shooter formation with respect to time period

better survival and economics. From the study, it is concluded that seabass shooter formation is not dependant on stocking densities, but on the age of the fish. It can be inferred that the ideal stocking densities for nursery rearing in hapa can be 400-425 m^{-2} and the maximum number of shooters can be obtained during the period of 9 to 21 days of seabass rearing.

During the present study, no significant variation was noted in shooter formation between different stocking densities used. It was also observed that at first and second phase of 10 days, shooters formation boomed. So, it could be suggested that for the safe culture and to reduce shooters formation, the stocking density should be reduced and intensive care is required at the initial 10-20 days of nursery rearing.

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References

APHA 1998. *Standard methods for the examination of water and waste water,* 20th edn., American Public Health Association, Washington DC, USA, 1134 p.

Biswas, G., Thirunavukkarasu, A. R., Sundaray, J. K. and Kailasam, M. 2010. Optimization of feeding frequency of Asian seabass (*Lates calcarifer*) fry reared in net cages under brackishwater environment. *Aquaculture,* 305: 26-31 http://dx.doi.org/10.1016/j.aquaculture.2010.04.002.

Chou, R., Lee, H. B. and Lim, H. S. 1994. Fish farming in Singapore: A review of seabass (*Lates calcarifer*), mangrove snapper (*Lutjanus argentimaculatus*) and snub-nose pompano (*Trachinotus blochii*). In: Main, K. L. and Rosenfeld C. (Eds.). *Proceedings of the Workshop on Culture of high value marine finfishes in Asia and the USA,* 08-12 August, 1994. The Oceanic Institute, Honolulu, Hawaii, pp. 57-62.

Chougale, N. D., Bondre, R. D., Sawant, K. S., Singh, H. and Shridhankar, M. M. 2015. Nursery rearing of Asian seabass (*Lates calcarifer*) in indoor cement tanks by using artificial diet. *J. Prog. Agric.,* 6(2): 1-3.

Glenn Schipp, Jerome Bosmans and John Humphrey 2007. *NT Barramundi farming handbook*. www.fisheries.nt.gov.au.in

Greenwood, P. H. 1976. A review of the family centropomidae (Pisces: Perciformes). *Bull. Br. Mus. Nat. His. (Zoology),* 29: 1-81.

Kailasam, M., Thirunavukkarasu, A. R., Mathew Abraham, Kishore Chandra, P. and Subburaj, R. 2002. Influence of size variation and feeding on cannibalism of Asian seabass, *Lates calcarifer* (Bloch) during hatchery rearing phase. *Indian J. Fish*., 49(2): 107-113.

Kailasam, M., Thirunavukkarasu, A. R., Selvaraj, S. and Stalin, P. 2007. Effect of delayed initial feeding on growth and survival of Asian seabass *Lates calcarifer* (Bloch) larvae. *Aquaculture*, 271(1-4): 298-306. http://dx.doi.org/10.1016/j.aquaculture.2007.05.005.

Kailasam, M., Kishore Chandra, P., Muralidhar, M., Thirunavukkarasu, A. R. and Mathew Abraham 2001. Survival and growth of seabass, *Lates calcarifer* (Bloch) fry reared at different stocking densities. In:: Menon, N. G. and Pillai, P. P. (Eds.), *Perspectives in mariculture*, ICAR-Central Marine Fisheries Research Institute, Kochi, India, pp. 311-332.

Katavic, I., Jug-dujakovic, J. and Glamuzina, B. 1989. Cannibalism as a factor affecting the survival of intensively cultured seabass (*Dicentrarchus labrax*) fingerlings. *Aquaculture*, 77: 135-143. https://doi.org/10.1016/0044-8486(89)90197-X.

Kumar, P., Kailasam, M., Mahalakshmi, P., Borichangar, R. V., Vanza, G. J. and Gopal, C. 2016. Length-weight relationship, condition factor and cannibalism in Asian seabass *Lates calcarifer* (Bloch, 1790) reared in nursery. *Indian J. Fish.,* 63(3): 131-134 http://dx.doi.org/10.21077/ijf.2016.63.3.47062-20.

Kungvankij, P., Tiro, L. B., Pudadera, B. J. and Potestas, I. O. 1986. Biology and culture of seabass (*Lates calcarifer*), *Aquaculture extension manual; No. 11,* Food and Agriculture Organisation of the United Nations, Rome, Italy,.70 p.

Lim, L. C., Heng H. H. and Lee, H. B. 1986. The induced breeding of seabass, *Lates calcarifer* (Bloch) in Singapore. *Singapore J. Prim. Ind.,* 14(2): 81-95.

MPEDA 2014. *Marine products export: item-wise export of marine products from India*. Marine Products Export Development Authority, Kochi, India.

Parazo, M. M., Avila, E. M. and Reyes, D. M. Jr. 1991. Size and weight dependent cannibalism in hatchery-bred seabass (*Lates calcarifer* Bloch). *J. Appl. Ichthyol*., 7: 1-7. https://doi.org/10.1111/j.1439-0426.1991.tb00588.x.

Philipose K. K., Krupesha Sharma S. R., Sadhu N., Vaidya N. G. and Syda Rao G. 2010. Some aspects of nursery rearing of the Asian seabass (*Lates calcarifer*, Bloch) in indoor cement tanks. *Indian J. Fish.,* 57(4): 61-64.

Prem Kumar, Kailasam, M. and Mahalakshmi, P. 2016. Length-weight relationship, condition factor and cannibalism in Asian seabass

Lates calcarifer (Bloch, 1790) reared in nursery. *Indian J. Fish.,* 63(3):131-134. https://doi.org/10.21077/ijf.2016.63.3.47062-20.

Solanki, H. G., Prem Kumar, Bhatt, J. H., Pillai, S. M., Patil, R. G. and Arasu, A. R. T. 2014. Length-weight relationship of Asian seabass *Lates calcarifer* Bloch, 1790 reared in pond. *Ind. J. Fish*., 60(3): 131-133.

Thirunavukkarasu, A. R., Kailasam, M., Kishore Chandra, P., Shiranee, P., Mathew Abraham, Charles, A. V. K. and Subburaj, R. 2001. Captive broodstock development and breeding of seabass *Lates calcarifer* (Bloch) in India. In: Menon, N. G. and Pillai P. P. (Eds.), *Perspectives in mariculture*, ICAR-Central Marine Fisheries Research Institute, Kochi, India, pp. 111-124.

Trino, A. T. and Bolivar Mec 1993. Effect of stocking density and feed on the growth and survival of seabass fry *Lates calcarifer* (Bloch). *Int. J. Trop. Agric.*, 11: 163-167.