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## Studies on growth and survival in nursery rearing phase of grey mullet (*Mugil cephalus*) for mariculture

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### Abstract

The study was on the effect of stocking density on growth and survival of grey mullet, (*Mugil cephalus*) in floating net cages in closed bay, Bapatla. Triplicate groups of mullets with an average initial weight of 0.95 gm were randomly stocked in floating net cages (1m×1m×2m) at 20, 40, 60 and 80 fish/m<sup>3</sup> designed as D20, D40, D60 and D80, respectively. Mulletts in the cages were fed with 25% crude protein (CP) formulated diet at 10% of body weight twice daily. Sampling was done weekly. At the end of the experiment, growth in terms of body weight of fish was high in D20 than those in D40, D60 or D80, and in terms of weight gain, and specific growth rate of fish was high in D40 than those in D20, D60 and D80. The analysis of variance for growth performance showed among the treatments at 1% and 5% level of significance and better performance was observed at D20. There was a significant difference in the survival rates of mullets at different stocking densities. However, the survival was recorded at D20 (80%) and lowest at D80 (70%). At the end of the experiment survival rates was high in D20, then those in D40, D60 and D80. Total Feed Conversion Ratio was lower in D20 and D40, followed by D60 and D80. The cages stocked with 20 fish/m<sup>3</sup> have highest growth performance and 80 fish/m<sup>3</sup> showed highest biomass performance. Water quality parameters were at optimum level during study period. Results suggest that 20 fish/m<sup>3</sup> could be recommended for producing better quality mullet fingerlings and 80 fish/m<sup>3</sup> for highest number of seed production.

**Keywords:** Growth, survival, cage, grey mullet, *Mugil cephalus*

### Introduction

The economic importance of mullet as a major farmed fish species, no special feeds are commercially available for them in many countries. Apart from dependence on fry availability, further development of mullet farming depends on the development reliable mass propagation techniques and on the availability of reliable low cost and efficient feeds that could enhance production. However, knowledge of their nutritional requirements is limited [1]. It was found a consistent decrease in growth with increasing stocking density, indicating the possibility of competitively reduced feed utilization [2]. In cage culture finding out the optimal stocking rate becomes an important part because stocking density directly influences the growth rate of the cultured species [3].

Stocking density is one of the most important variables in aquaculture because it directly influences survival, growth, behavior, health, water quality, feeding and production. Increasing stocking density results in stress [4] which leads to enhanced energy requirements causing reduced growth and food utilization [5]. Optimum stocking densities need to be determined for each species and production phase to enable efficient management and to maximize production and profitability [6]. Hence the present study attempted to evaluate the effect of stocking density on growth and survival of grey mullet.

### Statistical analysis

Analysis of variance (ANOVA) was used at 5% significance level to test for significant differences between various treatments on Growth, Weight Gain, Survival.

## Materials and Methods

The study conducted in the closed bay near Suryalanka, Bapatla, Guntur district. It lies between latitude- 15°51' 04.54''N and longitude 80°31'58.87''E (Figure 1). The floating net cages used for experiments were of 20<sup>1</sup>×10<sup>1</sup>. (Hapas of 1m × 1m × 2m size, fine-meshed polyethylene (PE) net cages (1.25 mm) were fixed in the cages). Outer cage made up of high density polyethylene (HDPE) was used as protection from predators (Predatory net). The net cages were fixed to a bamboo raft. The bamboo raft was used for easy movement, feeding and sampling of the experimental fishes on the cage structure. Sealed and air filled plastic drums of 200-liter size were used as cage float for floating of cage structure. Each cage was covered at the top with a piece of small mesh size (2.5 cm) net to prevent escape of fish by jumping and predation of birds. The top of portion of each experimental hapa was covered with a fine mesh net up to 20 cm depth to prevent floating feeds from escaping the hapa and the whole structure was tied with anchors at each corner by nylon rope to make easy movement of floating cages depending on water level and flow. The cages were positioned in closed bay 500 m. The submerged volume of the cages was invariably 1 m<sup>3</sup>.

Prior to start of the experiment, the transported fish were acclimated with the sea environment by rearing them in hapa net for one week. Fish with an average initial weight of 0.95 ± 0.005 gm were randomly stocked in the net cages at 20 fish/m<sup>3</sup>, 40 fish/m<sup>3</sup>, 60 fish/m<sup>3</sup>, 80 fish/m<sup>3</sup> as D20, D40, D60 and D80, respectively, in triplicates. Formulated floating feed with the 25% crude protein was used for feeding (Table 1). A feed ring (0.5 × 0.5 m) was fixed at middle of each cage. Feed rings are enclosures that float at the water surface. They hold floating feeds and prevent the escape of feed out of cage and thus reduce wastage of feed.

## Growth performance

The growth performance of all the fishes of each floating cages was individually estimated by taking their total body length and weight at 7 days interval.

Weight (gm) = Final body weight (gm) – Initial body weight (gm)

Specific growth rate was calculated by the formula

$[(L_n \text{ FBW} - L_n \text{ IBW})/\text{day}] \times 100$

FBW= Final body weight, IBW = Initial body weight, Ln = Logarithm, Day = duration of experiment.

$\text{Survival (\%)} = \frac{\text{Total number of fish survived}}{\text{Total number of fish stocked}} \times 100$

$\text{Average Daily Weight Gain (ADWG)} = \frac{\text{Final fish weight (gm)} - \text{Initial fish weight (gm)}}{\text{Number of days}}$

## Results

Water quality parameters were at optimum level during the study period. The parameters were in the following range, Temperature: 27.5 - 32.3 °C, Salinity: 21 - 30 ppt, pH: 7.6 - 8.4, DO: 4.1 - 6.5 mg/Lt, Total alkalinity: 135 - 168 mg/Lt, Ammonia: 0.01 - 0.35 mg/Lt, Nitrite: 0.01 - 0.03 mg/Lt, Nitrate: 1.95 - 3.85 mg/Lt (Table 2).

The highest growth performance was recorded at D20 (12.15 gm) and lowest was observed in D80 (10.08 gm) in gery mullet (Figure 2). The analysis of variance for growth

performance showed significant difference among the treatments at 1% and 5% level of significance and better performance was observed at D20. There was a significant difference in the survival rates of gery mullet at different stocking densities. However, highest survival was recorded at D20 (80%) and lowest at D80 (70%). D20 and D40 (2.31) has resulted in lowest FCR while highest was observed in D80 (2.55). D40 has resulted highest SGR (1.75) and D20 showed ADWG (0.177 gm) while lowest SGR (1.63) and ADWG (0.143 gm) recorded in D80 respectively. D80 showed highest biomass (560.5 gm) and lowest biomass (194.4 gm) was recorded in D20.

## Discussion

The present study indicated that in cage aquaculture, fish stocking density has great impact on growth, survival, health, water quality and production. Consequently, optimum stocking densities need to be determined for each species and production phase to enable efficient management and to maximize production and profitability<sup>[7]</sup>.

Temperature fluctuations can be a significant factor in the growth of milkfish in nursery and culture ponds that are small or shallow<sup>[8]</sup>. In the present study temperature is slightly fluctuated with a difference of 1.0 °C to 2.0 °C and no adverse effect on growth and survival. In the present study recorded temperature values (27.2 °C to 32.3 °C) are at acceptable level. Low temperatures (<23 °C) decrease activity, responsiveness, food intake, growth, and development of milkfish fry and juveniles; high temperatures have the opposite effect<sup>[9]</sup>. In the present study temperature is recorded more than the above value (>27.6 °C).

Size and water temperature may also influence the specific growth rate (SGR). In this study, SGR of Grey mullet ranged between 1.63 (SD 80) to 1.75 (SD 40). SGR decreased at the highest stocking density of 80 fish/m<sup>3</sup>. In this study average daily growth rate between 0.177 to 0.143 is recorded in grey mullet. ADGR in the present study was found to be high in low stocking density (SD 20) throughout the study period. Earlier studies have also reported decreased ADGR with increasing stocking densities in largemouth bass, *Micropterus salmoides*<sup>[10]</sup> in seabass<sup>[11]</sup> and in silver perch, *Bidyanus bidyanus*<sup>[12]</sup>. Developing offshore cage farming is not only a matter of pushing mariculture or fishery industry, but it will create significant social-economic influences in future<sup>[13]</sup>. Growth in terms of final weight, and SGR of grey mullet was higher in SD 20 compare to fish in higher stocking densities except the weight gain which is higher in SD 40.

In this study highest survival was recorded in lowest stocking density (SD 20) in grey mullet Survival rate decreased with increasing stocking density (Figure 3). These results are similar with the findings of<sup>[14]</sup> in Thai pangus and in pangasius catfish<sup>[15]</sup>. For the studies on optimum stocking density in nursery rearing of grey mullet in floating net cages, formulated feed with 25% CP was used. Grey mullet stocked at 20 fish/m<sup>3</sup> showed better growth performance than fish stocked at 40, 60 or 80 fish/m<sup>3</sup>. There was significant difference between stocking density and survival rate for all treatments 20 to 80 fish/m<sup>3</sup>.

## Conclusion

The results of this study indicate that cage culture of grey mullet (*M. cephalus*) in the sea can provide significant advantages in terms of faster growth and effective utilization of water volume as compared to pond systems thus making it an alternative culture approach to enhance production.

**Table 1:** Proximate composition of the feed ingredients (% on dry matter basis)

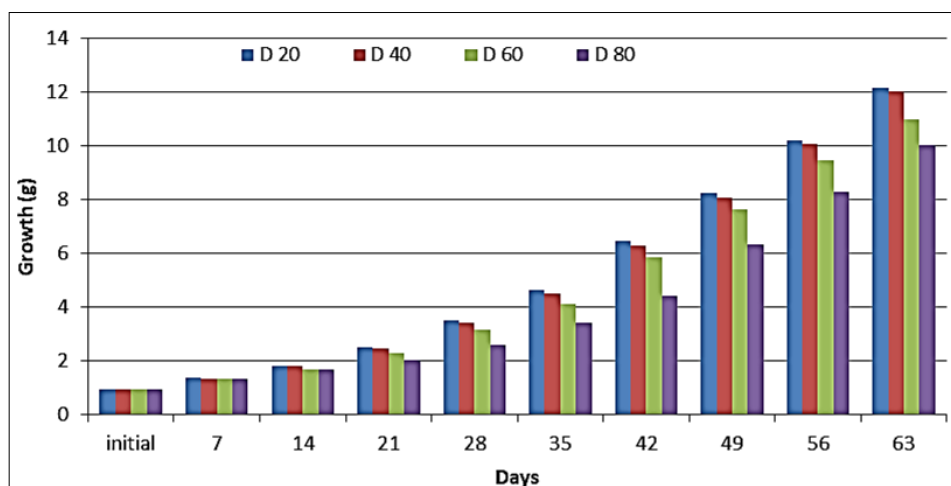
Ingredients Composition	Fish meal	Groundnut cake (GNC)	De-oiled rice bran	Wheat flour
Moisture	7.04	8.80	8.20	5.72
Crude Protein	55	38.40	12.50	11.30
Crude fibre	3.70	7.30	22.40	00.60
Ether extract	4.03	7.20	3.90	4.02
Total ash	3.46	5.60	15.80	01.55
Acid insoluble ash	5.60	7.60	8.20	4.50



**Fig 1:** Experimental site at Suryalanka in Guntur district

**Table 2:** Water quality parameters in floating net cages with grey mullet for different stocking densities (D20 to D80)

Parameters days	Temperature (°C)	Salinity (ppt)	pH	DO (mg/l)	Total alkalinity (mg/l)	Ammonia (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)
initial	28.5	24	8.2	6.5	137	0.02	0.02	2.25
7	27.9	22	8.1	5.1	140	0.25	0.01	2.15
14	32.3	21	7.9	4.9	145	0.01	0.02	1.95
21	29.4	24	7.8	4.5	154	0.01	0.03	3.85
28	27.8	26	8.4	5.6	138	0.25	0.02	3.65
35	30.2	30	8.0	5.8	135	0.01	0.01	3.50
42	27.6	29	7.6	4.9	150	0.25	0.02	2.85
49	29.5	30	8.3	5.2	168	0.24	0.02	1.95
56	27.5	27	8.2	4.1	160	0.02	0.02	3.50
63	28.9	28	8.0	4.4	154	0.35	0.03	3.65



**Fig 2:** Growth performance in (gm) grey mullet in different stocking densities fed with 25% curd protein

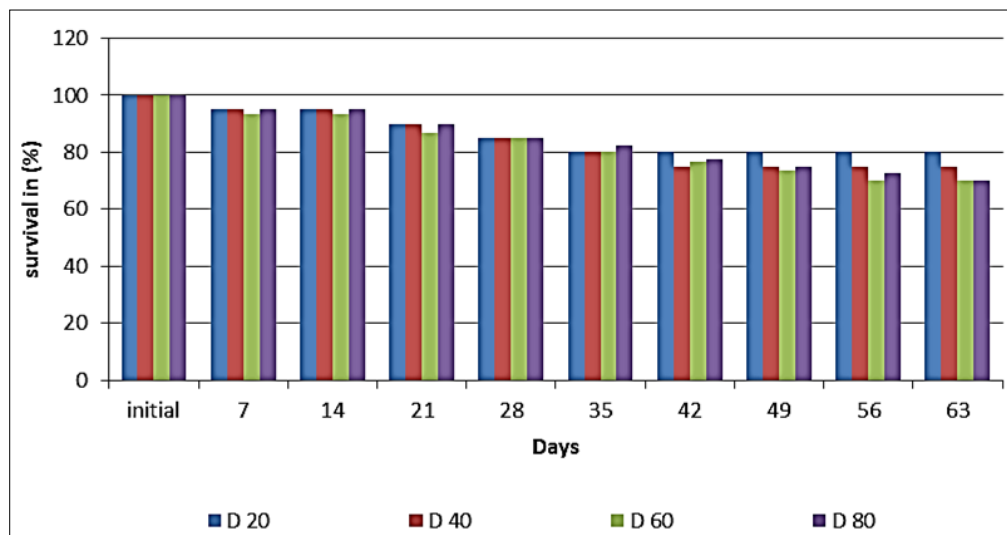


Fig 3: Survival rate of grey mullet at different stocking densities fed with 25% curd protein

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### References

- Karapanagiotidis IT, Karalazos V, Kougioumtzis N, Tsiamis V, Tsiara V, Neofitou C, Karacostas I *et al.* Growth and Feed Utilization by Golden Grey Mullet (*Liza aurata*) in a Coastal Lagoon Ecosystem, Fed Compound Feeds with Varying Protein Levels. The Israeli Journal of Aquaculture-Bamidgeh 2014;2014;56-57.
- Anderson D, Saoud IP, Davis DA. The effects of stocking density on survival, growth, condition, and feed efficiency of bluegill juveniles. North American Journal of Aquaculture 2002;64(4):297-300.
- Kilambi RV, Adams JC, Brown AV, Wickizer WA. Effects of stocking density and cage size on growth, feed conversion, and production of rainbow trout and channel catfish. The Progressive Fish-Culturist 1977;39(2):62-66.
- Leatherland JF, Cho CY. Effect of rearing density on thyroid and inter renal gland activity and plasma hepatic metabolite levels in rainbow trout, *Salmo gairdneri*, Richardson. Journal of Fish Biology 1985;27:583-592.
- Hengsawat K, Ward FJ, Jaruratjamorn P. The effect of stocking density on yield, growth and mortality of African catfish (*Clarias gariepinus* Burchell 1822) cultured in cages. Aquaculture 1997;152:67-76.
- Oliveira de EG, Pinheiro AB, de Oliveira VQ, da Silva Ju'nior ARM, de Moraes MG, Rocha I'RCB *et al.* Effects of stocking density on the performance of juvenile pirarucu (*Arapaima gigas*) in cages. Aquaculture 2012;370:96-101.
- Costa C, Menesatti P, Rambaldi E, Argenti L, Bianchini ML. Preliminary evidence of colour differences in European sea bass reared under organic protocols. Aquaculture Engineering 2013;57:82-88.
- Lin LT. My experience in artificial propagation of milkfish-studies on natural spawning of pond-reared brood stock. In Reproduction and culture of milkfish 1985, P185-203.
- Villaluz AC, Unggui A. Effects of temperature on behavior, growth, development and survival of young milkfish, *Chanos chanos* (Forsskal). Aquaculture 1985;35:321-330.
- Petit G, Beauchaud M, Buisson B. Density effects on food intake and growth of Largemouth bass (*Micropterus salmoides*). Aquaculture Research 2001;32:495-497.
- Philipose KK, Sharma SR, Sadhu N, Vaidya NG, Rao GS. Some aspects of nursery rearing of the Asian seabass (*Lates calcarifer*, Bloch) in indoor cement tanks. Indian Journal of Fisheries 2010;57(4):61-64.
- Rowland SJ, Allan GL, Hollis M, Pontifex T. Production of silver perch (*Bidyanus bidyanus*) fingerlings at three stocking densities in cages and tanks. Aquaculture 2004;229:193-202.
- Chen J, Guang C, Xu H, Chen Z, Xu P, Yan X, Wang Y *et al.* Marine fish cage culture in China. The future of mariculture: a regional approach for responsible development in the Asia-Pacific region 2006, P285.
- Sayed MAB, Hossain GS, Mistry SK, Huq KA. Growth performance of Thai pangus (*Pangasius hypophthalmus*) In polyculture system using different supplementary feeds. University Journal of Zoology 2008;27:59-62.
- Cremer MC, Jian Z, Enhua Z. Pangasius catfish production in ponds with soy-based feeds. Results of ASA/China. Feeding Trial 2002, P253.