

Original Research Article

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Effect of Stocking Density on Growth and Survival of Gold-Spot Mullet, *Liza parsia* (Hamilton-Buchanan, 1822) Fry during Nursery Rearing in Cages

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ABSTRACT

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Liza parsia fry were reared at three different densities in the cages (1 x 1 x 0.5 m⁻³). The experiment was conducted to evaluate the effect of stocking density on growth, survival and biochemical composition during nursery rearing phase. Fry (mean length, 1.3 cm and mean weight, 0.08 g) were stocked at the rate of 50, 100 and 200 nos. m⁻³ for 30 days. The stocking density of 50 nos. m⁻³ was found to be better for rearing of fry of *L. parsia* in cages during nursery practices as it achieved the highest average length of 3.40cm, average weight 0.6125, SGR of 6.01% day⁻¹ and survival of 80.57%. There were marked differences between whole-body compositions among the fish reared at different densities. Stocking density showed inverse relationship with growth (length gain, weight gain and specific growth rate) and survival.

Introduction

In recent years, the Indian aquaculture industry has attempted to select new species of fish in order to diversify its production. In this context, the viability of aquaculture has been studied for some fish species like sea bass (Imelda *et al.*, 2010), pangas (Singh and Lakra, 2012) and tilapia (Chakraborty and Banerjee, 2009). The potential success of a species is based on growth performance, on the availability of juveniles and market preference. The mullet species such as, *Mugil*

cephalus, *Liza parsia*, *L. tade*, *L. troshelli*, and *L. macrolepis* are found along Ratnagiri coast, where *L. parsia* is a dominant species among the mullets (Barve, 1987). *L. parsia* is distributed in many countries, like Southeast Asia, Taiwan, the Mediterranean and Eastern European countries and in many parts of Central and South America and its products also contribute to valuable fishery economics in Japan and Australia (Nash and Shehadah, 1980). Aquaculture of mullets has great potential in brackish waters; its farming is still at infant stage in India compare to rest of

world. Mullet culture is a good alternative to direct towards the intensification of production as it has gained the importance in several countries of South East Asia, because these fishes are considered of high quality priced. The mullet usually occur in coastal waters and estuaries throughout the tropical and subtropical belts of the world and sometimes even in temperate zones. They are known to ascend in schools to the shallow littoral areas and connected creeks, channels etc. with the high tide for feeding purposes and this characteristic habit is utilized while collecting them, using almost similar gears throughout the world. Active gears such as scoop nets, skimming nets and beach seines are commonly used to collect wild fry (Sadek and Mires, 2000; Liao, 1994).

In India the culture of mullets along with other compatible species of fish in brackish water impoundments is an age-old practice in West Bengal, Kerala and Andhra Pradesh. *L. Parsia* fry are available in large quantities in the brackish waters of Ratnagiri coast, but their culture practice is still in infancy stage. The inclusion of a nursery phase in fish culture is necessary to obtain the hardy fingerlings. These fingerlings get acclimatized to the environment they are likely to encounter during the grow-out phase.

Cage culture is an advanced type of aquaculture. Its productivity is 10-20 times higher than that of pond culture. It permits close observation of fish during the rearing stage, feeding and of general health (Feldlitz and Milstein 1999). Stocking density is one of the most important variables in aquaculture because it directly influences survival, growth, behavior, health, water quality, feeding and production. In many studies, a high production of fish has been reported at an optimal stocking density, but decreases occur when stocking density exceeds this optimum (Rowland *et al.*, 2006; Rahman *et*

al., 2006). Under stocking results in failure to make the maximum possible utilization of the space and overstocking may result in stress that may reduce growth and feed utilization (Leatherland and Cho, 1985). Using appropriate stocking densities is the key for success in aquaculture management. The constant supply of fry of mullet is the most essential prerequisite for developing the culture. The wild collected fry of *L. parsia* directly stocked in culture pond leads to high mortality. Therefore, an attempt was made to rear the fry of *L. parsia* in cages.

Materials and Methods

Experimental fish

Fry of *L. parsia* were collected during low tide with the help of dragnet from the Kasarveli creek, situated at Sakhartar, Ratnagiri, Maharashtra State, Republic of India (16° 59' 10" N and 73° 16' 25" E). Collected fry was transported to the laboratory in plastic containers (20 litre capacity). Fry of *L. parsia* were identified by using the taxonomic key (Barve, 1987). The cages were installed in a brackish water pond located at College of Fisheries, Shirgaon, Ratnagiri campus. Area of the pond was 450 m² (30 m x 15 m). During high tides, the depth of pond water was upto 110 cm while 90 cm at low tides. Rectangular shaped cages were constructed for the fry of *L. parsia* as described by Yu *et al.*, (1979). Cage with dimension of 1 m (L) x 1 m (B) x 0.5 m (H) was with volume of 0.5 m³. Mosquito net cloth of polyamide (PA) with 24 mesh inch⁻¹ mesh size was used for preparation of cage bag. Two loops were attached at each corner of the cage bag to fix the bag with the bamboo. Loops were made from the extra mosquito net material; each loop was 6 cm in length. The top cover was connected with the cage bag for opening or closing the cage for feeding and maintenance. The cage was fixed by submersing 3/4th part in water.

Experimental Design

Fry with average initial length of 1.3 ± 0.2 mm and average initial weight of 0.08 ± 0.03 mg were stocked at the rate of 50, 100 and 200 nos. m^{-2} for 30 days with seven replicates each. Diet was given twice a day (9:00 h and 17:00 h) directly into cages. No special feeding area was provided in the cage.

Diet Formulation

Diet was formulated containing about 30% protein by using different ingredients as given by Sawant *et al.*, (2005). The ingredients and proximate composition of the test diets are given (Table 1). The moisture, crude protein, lipid and ash content in the test diets were analysed, according to standard procedures of Association of Official Analytical Chemist (AOAC, 1995).

Water quality analysis

Water parameters such as temperature, pH, salinity, dissolved oxygen, carbon dioxide and alkalinity were analyzed every week outside and inside the cages according to standard methods APHA (2005).

Statistical analysis

All data on growth and survival were analysed by one-way ANOVA followed by Least Significant Difference (LSD) test. Differences were considered significant at $P < 0.05$ according to standard statistical methods by (Zar, 2004).

Results and Discussion

Water quality

The physio-chemical parameters of water during the experiment were maintained within the tolerance range for most teleost species

used in aquaculture, as reported by several authors (Boyd, 1990; Boyd and Tucker, 1998). The water characteristics did not present any significant difference among fish densities or the two points monitored in reservoir. Water temperatures ranged from 28.4 to 30.2 °C (mean 29.3 °C), pH 7.4 to 8.0 (7.7), salinity 26 to 29 g/L (27 mg/L), DO 3.5 to 4.7 mg/L (4.1 mg/L), CO₂ 8.2 to 9.4 mg/L (8.8mg/L), and alkalinity 120 to 138 mg/L (127.5 mg/L).

Fish survival

Survival was significantly affected by stocking density ($P < 0.05$). Mean survival rates were 80.57, 72.42% and 60.14% in cages at 50, 100 and 200 fish/ m^3 , respectively (Table 2). Survival was similar to that observed for gold spotted mullet reared under laboratory conditions according to Sawant (2002). Similarly, Chavan, (2002) many studies have found significant effects of density on survival. Diseases are a potential problem in the cage culture of fish. Apparently, the mortalities of *L.parsia* fry were not associated to diseases. Mortality was observed only at the beginning of the experiment in low and intermediate stocking densities as compare to high stocking density 200 fish/ m^3 . This was probably the result of low acceptance of some fish to the formulated diet and high stocking density, since dead fish presented clear signals of emaciation. Therefore, mortality rates were related to stocking density as might be expected. Similarly, mortality of silver perch, *Bidyanus bidyanus*, reared in the cages was dependent upon the stocking density Rowland *et al.*, (2006).

Fish growth

Final weight was significantly ($P < 0.05$) influenced by stocking densities (Table 2). Various studies with *L.parsia* fry report

similar results according to the type of culture. El-Sayed (2002) observed increase in stocking density resulted in significantly poor growth rates. Similar observations were also made during the present investigation. Weight gain of 508.46% for fry of *L. parsia* reared at 50 numbers m⁻² was significantly higher

($P < 0.05$) than other stocking densities for 30 days. Prasadam *et al.*, (1988) observed maximum weight gain for fingerlings of *M. cephalus* and *L. macrolepis* at 40000 number ha⁻¹ in cages for 6 months and showed inverse relationship with the stocking density which was similar to the present study.

Table.1 Proportion of ingredients and proximate composition of diet used in rearing of *L. parsia* in cages

Proportion of ingredients	
Ingredients	Quantity (%)
Wheat flour	12.18
Rice bran	12.18
Whole poultry egg	37.82
Mustard Oil Cake	37.82
Proximate composition	
Crude Protein (%)	31.57
Crude Fat (%)	9.61
Moisture	8.91
Ash (%)	5.82
Carbohydrate* (%)	44.09
Gross energy (kcal g ⁻¹)**	450.43

*Carbohydrate (%) = (100 %) – [(% Protein) + (% Fat) + (% Moisture) + (% Ash)] ... (Woods and Aurand, 1977).

**Gross energy (Kcal g⁻¹) = (Crude protein x 5.65) + (Crude fat x 9.5) + (Carbohydrate x 4.1) ... (El – Sayed, 2002).

Table.2 Effects of stocking densities on growth and survival of *L. parsia* fry in cages

Stocking Density (fry m ⁻²)	Final length (cm)	Length gain (g)	Final weight (g)	Weight gain (g)	SGR*	Survival (%)
50	3.40	2.12	0.6125	0.5325	6.0101	80.57
100	2.75	1.43	0.5042	0.4242	5.4085	72.42
200	2.46	1.16	0.4055	0.325	4.7742	60.14

Table.3 Water quality parameters during the experiment

Weeks	Temperature (°C)	pH	Salinity (g L ⁻¹)	DO (mg L ⁻¹)	CO ₂ (mg L ⁻¹)	Alkalinity (mg L ⁻¹)
1	29.6	7.4	26	4.0	9.4	135
2	30.2	8.0	27	3.5	8.6	120
3	28.4	7.5	27	4.4	8.4	138
4	29.8	7.6	29	3.8	8.2	132

Specific growth rate was significantly affected by stocking densities ($P < 0.05$). SGR of 6.01% was recorded at 50 fry m^{-2} for 30 days which was reasonably higher than other stocking densities. Sawant (2002) reported specific growth rate of 3.45% for *L. parsia* for rearing period of 90 days. Narvekar & Chavan (2002) recorded specific growth rate of 3.55% and 3.52% respectively for *L. parsia* for rearing period of 90 days. The higher specific growth rate for fry of *L. parsia* in present study as compared to above referred studies may be due to rearing in the cages and phase of rearing. According to Rahman *et al.*, (2006) reported that specific growth rate decreased with increase in stocking density. Similar trend was observed during the present study.

Better growth performance is always the aim of aquaculture farmers. According to the result of present study, stocking density of *L. parsia* fry @ 50 nos. m^{-3} can be reared in the cage (1 x 1 x 0.5 m^{-3}). Thus, commercial mullet farmers could obtain the fastest growth rate and improved survival as it permits close observation of fish during the nursery rearing stage, feeding and of general health. This information can be utilized by farmers for various freshwater as well as brackishwater species to maximize commercial productivity.

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