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Effects of stocking density on growth and survival of black molly, *Poecilia sphenops* fry in circular plastic tubs

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Abstract
In the study, *P. sphenops* fry with initial length in the range from 1.0 to 1.1 cm and initial weight ranging from 0.0575 to 0.0590 g were reared at four different stocking densities of 0.33 fry L^{-1}, 0.5 fry L^{-1}, 1.0 fry L^{-1} and 2.0 fry L^{-1} for a period of 60 days. For this experiment, the circular plastic tubs (40 L) were used and volume in each tub was maintained up to 36 L. The fry were fed semi-purified flake feed containing 39.48% crude protein at the rate of 10% body weight day^{-1}. The maximum values of length gain (191.46%), weight gain (935.96%), specific growth rate (3.8965%) and survival (100%) were recorded for the fry reared at density of 0.33 fry L^{-1}. The fry reared at densities of 0.33 and 0.5 fry L^{-1} showed significantly ($P<0.05$) better length gain and survival than that of fry reared at densities of 1.0 and 2.0 fry L^{-1}. The fry reared at density of 0.33 fry L^{-1} showed significantly higher weight gain and specific growth rate than those of fry reared at other densities. In the study, growth and survival were decreased with increase in stocking density

Keywords: black molly, stocking density, live bearers, growth performance

Introduction
Ornamental fish keeping is the most popular hobby in the World, hence fish rearing and culturing are growing these days. Considering the nature of domestic market, majority of hobbyist prefer low valued, easily cultivable and attractive species that are harmonious in community aquarium rather than costly ornamental fishes (Tamaru *et al*., 2000) [22]. With this trend, live bearer fish like molly has a potential market value and therefore, there is need to maintain a continuous supply to satisfy the increasing demand from domestic market.
Knowledge on optimal stocking density, nutritional requirements, appropriate feeding methods, optimal water quality and its management along with health management is a pre-requisite for reproduction and culture of ornamental fishes (Whitern, 1983) [24]. Stocking of fry at optimal rates in grow-out system is very important for achieving economical production. Therefore, the present study was carried out to find out the effects of stocking density on growth and survival of fry of black molly, *Poecilia sphenops* in circular plastic tubs. Therefore, aim of this study is to find out the effect of stocking density on growth and survival of black molly, *P. sphenops*, circular plastic tubs.

Materials and Methods
The experiments were conducted in the Wet laboratory of Department of Aquaculture, College of Fisheries, Ratnagiri, Maharashtra. In the present study, *Poecilia sphenops* Valenciennes, 1846 used to study its larval growth and survival.

Experimental procedure
P. Sphenops black molly, were bred in the laboratory.
The experiment was conducted to find out the effects of stocking density on growth and survival of fry of Black molly, *P. sphenops* in circular plastic tubs. The fry with initial length range from 1.0 to 1.1 cm and weight of 0.0575 to 0.0590 g were stocked at different densities such as 0.33 fry L^{-1} (T_1), 0.5 fry L^{-1} (T_2), 1.0 fry L^{-1} (T_3) and 2.0 fry L^{-1} (T_4) equivalent to 12, 18, 36, 72 fry tub^{-1}, respectively. The experiment was conducted for a period of 60 days with five replicates for each stocking density following Completely Randomized Design (CRD). Fry were fed two times daily (10.00 and 17.00 h) at the rate of about 10% of body weight. In the present study, a semi-purified flake feed was formulated to contain 40% crude protein level (Chong *et al*., 2004) [6].
Water quality parameters such as temperature, pH, dissolved oxygen, free carbon dioxide, total alkalinity and total hardness were measured at interval of seven days for each experiment following standard methods given by Boyd (1981) [3] and AOAC (2006) [1] and were maintained throughout experimental period (Table 1).

Table 1: Water quality parameters maintained experimental period of 90 days

Water Quality Parameters	Mean observed value
Temperature (°C)	27.01 ± 0.49
pH	7.5 ± 0.60
Total hardness (mg L^{-1} as $CaCO_3$)	189.29 ± 0.98
Total alkalinity (mg L^{-1})	81.15 ± 0.18
Dissolved oxygen (mg L^{-1})	3.69 ± 0.47
Free carbon dioxide (mg L^{-1})	8.64 ± 0.81

Values expressed as ± S.E. of mean.

Growth parameters

At the start of the experiment and end of the experimental period, the fishes were counted from each replicate and their individual length and weight were recorded. Sampling was carried out at interval of 15 days to observe the growth of fishes. At the time of sampling, 75% fishes from each experimental tank were randomly collected for recording the length and weight of fishes. Everyday tanks were observed for the presence of dead fishes to record the mortality. At the end of the experiment, the survived fishes from each experimental tank were counted to calculate the survival of the fry fishes. The average value of length and weight were calculated for each replicate of each treatment of the experiment for analysis of growth parameters. The growth parameters, such as length gain, weight gain, specific growth rate (SGR) along with survival (%) were calculated by using the following formulae as given by Hari and Kurup (2003) [9].

Total length of fry, fish was measured from tip of mouth to tip of caudal fin with the help of foot ruler having a least count of 0.5 mm. Weight of each fry was taken on mono-pan electric (Sartorius, BS 224S) balance having an accuracy of 0.01 mg. For this, each fry was kept on blotting paper in order to remove excess moisture from the body. Then each blotted fry was taken on pre-weighed petri dish and weight was recorded.

1. $$\text{Length gain (\%)} = \frac{(\text{Final length} - \text{Initial length})}{\text{Initial length}} \times 100$$

2. $$\text{Weight gain (\%)} = \frac{(\text{Final weight} - \text{Initial weight})}{\text{Initial weight}} \times 100$$

3. $$\text{Specific Growth Rate (\%)} = \frac{(\ln W_t - \ln W_o)}{dt} \times 100$$

Where, W_t = Final weight; W_o = Initial weight; dt = Rearing period in days

4. $$\text{Survival (\%)} = \frac{(\text{Intial number of fishes} - \text{Final number of fishes})}{\text{Intial number of fishes}} \times 100$$

Statistical analysis

The experiment was designed as per the Completely Randomised Design with five replicates for each of the four treatments. Average length gain (%), weight gain (%), average Specific growth rate (%) and survival (%) of the fry of *P. sphenops* for each replicate were calculated. Data obtained from the experiments for growth parameters and survival were analysed by one-way ANOVA. Significant difference was indicated as $P < 0.05$. Student's Newman Keul multiple range test was used to determine the significant difference between the treatments (Zar, 2005) [25].

Results and Discussion

The average length gain, weight gain, Specific growth rate (SGR%) and survival (%) of fry are shown in Table 2.

In the present study the effects of stocking density on growth and survival of fry of black molly in tubs was evaluated. The rearing of molly fish fry is mainly carried out in aquarium tanks, tubs, cement culture tanks, plastic pools, fiberglass tanks, polythene lined ponds, earthen ponds, etc. Similar studies have been made by Feldlite and Milstein (1999) [8], Kailasam *et al.* (2001) [10], Stone *et al.* (2003) [21], Rema and Gouveia (2005) [17], Samad *et al.* (2005) [19], Priestly *et al.* (2006) [15], Salama (2007) [18], and Rahman and Marimuthu (2010) [16] for rearing of food fishes and ornamental fishes.

The stocking density varies with species, size, culture period and intensity of culture. Considering the used stocking density of 1 fry L^{-1} that is frequently followed in Konkan region, in present study the fry were reared at the densities of 2 fry L^{-1}, 1 fry L^{-1}, 0.5 fry L^{-1} and 0.33 fry L^{-1} for a period of 60 days. In similar studies carried out by Priestly *et al.* (2006) used stocking density of 1, 4, 8 and 12 fish tank $^{-1}$ for *Carassius auratus* in tanks (50 L) for a period of 8 weeks and 1, 4, 8 and 16 fish tank $^{-1}$ for *Gymnocorymbus ternetzi* in tanks (50 L) for a period of 12 weeks.. The stocking densities of 100, 200 and 400 fry m^{-3} were used for rearing of *Carassius auratus* fry for a period of 30 days (Chandan kumar, 2008) [5]. Sawant (2008) [20] used stocking density of 10, 20, 30, 40, 50 and 60 fry tank $^{-1}$ for *Carassius auratus* fry reared in glass tank (52 L) for a period of 60 days.

The size of the fish seed at the time of stocking in grow-out systems varies with species. The black molly fry of average length of 1.0341 ± 0.041 cm and weight of 0.0582 ± 0.0018 g were used. Stone *et al.* (2003) [21], Chandan kumar (2008) [5], Sawant (2008) [20], used the fry of *Carassius auratus* (0.21 g), *C. auratus* (2.55 cm and 1.36 g), and *C. auratus* (2.634 cm and 1.34 g) respectively.

In the present study, among the selected stocking densities the maximum length gain (191.46%), weight gain (935.96%) and SGR (3.8965%) of *P. sphenops* fry was observed at the lowest stocking density (0.33 fry L^{-1}). The decreasing trend of length gain was observed with increasing stocking densities. Similar results were also observed by Kailasam *et al.* (2001) [10], Celikkale *et al.* (2005) [4], Priestly *et al.* (2006) [15], Chandan kumar (2008) [5], Kupren *et al.* (2008) [12], Sawant (2008) [20], Mollah *et al.* (2009) [13] and Rahman and Marinuthu (2010) [16]. The reduced growth rate with increasing density was found by Trzebiatowski *et al.* (1981) [23], Cruz and Ridha (1991) [7], Bombeo *et al.* (2002) [2], Kumariah and Rao (2002) [11], Samad *et al.* (2005) [19], Priestly *et al.* (2006) [15], Chandan kumar (2008) [5], Sawant (2008) [20], Mollah *et al.* (2009) [13] and Rahman and Marinuthu (2010) [16].

The survival of the present study was found to be decreased with increase in stocking density. The negative effect of increased stocking densities on the survival of the several fish species were reported by Cruz and Ridha (1991) [7], Fedlite and Milstein (1999) [8], Bombeo *et al.* (2002) [2], Kumariah and Rao (2002) [11], Stone *et al.* (2003) [21], Celikkale *et al.* (2005) [4], Samad *et al.* (2005) [19], Chandan kumar (2008) [5], Osofero *et al.* (2009) [14], Mollah *et al.* (2009) [13] and Rahman and Marinuthu (2010) [16].

However, the variation in the survival observed in the present study and the other studies may be because of variation in the species, size, stocking densities, feed composition, feed type, feeding frequency and rate, culture period and culture system. However, the survival of fishes in all the studies decreased with the stocking density and this is in agreement with the results of the present study.

Table 2.: Average length & weight gain, Specific growth rate (SGR%) and survival (%) of fry of *T. leerii* reared at different densities

Particulars	**T_1**	**T_2**	**T_3**	**T_4**
Average length gain (%)	191.46 ± 0.61^a	186.23 ± 0.74^a	159.77 ± 0.89^b	127.12 ± 0.45^c
Average weight gain (%)	935.96 ± 0.73^a	855.95 ± 0.60^b	684.96 ± 0.69^c	564.18 ± 0.92^d
SGR (%)	3.89 ± 0.0011^a	3.73 ± 0.0010^a	3.43 ± 0.0014^b	3.43 ± 0.0023^b
Survival (%)	100 ± 0.00	100 ± 0.00	77.77 ± 3.62	76.94 ± 1.78

Mean values in similar row with different letters are significantly different (SNK, $P < 0.05$).

Conclusion

It was found that the growth parameters and survival decreased with the increase in stocking density. A stocking density of 0.33 fry L^{-1} among the investigated densities was found to be suitable for achieving better growth and survival of *P. sphenops* fry during the culture period of 60 days in tubs.

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