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The Effect of Different Stocking Densities on Growth, Production and Survival rate of Pangas (Pangasius hypophthalmus) Fish in Cemented Tanks at Fish Hatchery Chilya Thatta, Sindh-Pakistan

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Abstract

The effect of stocking density on growth performance, production and survival of Pangas, Pangasius hypophthalmus were evaluated in cemented tanks. Fry of Pangas (1.52 ± 0.03 cm in length and 1.08 ± 0.02 g in weight) respectively were stocked into cemented tanks measuring 15 x 6 x 3 ft. Three treatments with two replicates were used: T_1-100; T_2-150 and T_3-200 fry/ tank. Pangas fry were fed twice daily with formulated feed 35 % protein at 10%, 5%, and 3% body weight for the first, second, and third month, respectively. After 90 days, the Highest growth performances (determined in terms of average weight) were recorded in T_1 (27.5±2.5 g) and T_2 (22.4±2.8 g) while T_3 (18.2±3.5g) recorded the smallest growth. Production differed significantly among treatments ($P<0.05$). Feed conversion ratio (FCR) of 1.0, 1.02 and 1.05 in T_1, T_2 and T_3, respectively were not significantly different ($P>0.05$). Survival was significantly different among treatments ($P<0.01$). Highest survival (100%) was attained in T_1 with lower stocking density, followed by T_2 (96%) and T_3 (90%). Survival was greatly influenced by the stocking densities in all treatments. The water quality parameters and their monthly fluctuations recorded throughout the study period were found within the suitable ranges for the fish culture such as temperature 27.0 to 28.7 °C, dissolved oxygen 5.7 to 6.2 mg/lit, pH 7.2 to 7.5, Ammonia from 0.45 to 0.51mg/L, Hardness 105 to 110 ppm and Nitrite 0.152 to 0.161 mg/L.

Key words: Stocking density, Growth performance, Survival, Pangasius hypophthalmus, Production, cemented tanks.

Introduction

Aquaculture production systems used across the world differ widely depending on the species being cultured and on the geographical location and socio-economic context. The pursuit for an alternate eco-friendly and sustainable aquaculture has led to the recognition of any specie which can be cultured easily on high stocking density in low water volume. Pangus (Pangasius hypophthalmus) is one of the most popular species in aquaculture paralleled to other species[7]. It was introduced for cultivation in some countries because of its notable growth and acceptable proof[40]. Like other cultured catfishes, P. hypophthalmus is well-known for its faster growth, easy culture system, high disease resistance and tolerance of a wide range of environmental parameters[8, 10, and 43]. Pangas Commercially production has improved in recent times because of its recognition in the market, fast growth and omnivorous feeding habits[12, 2, 36, 37].

Stocking density is an important aspect to take into account when ranking families or progeny groups for growth performance. Fish density is a key factor affecting growth and maturation of wild and cultured fish besides food supply and its quality, genetics and environmental conditions[46, 25]. In many cultured species, growth is inversely related to stocking density and this can be attributed to social interactions[19, 18, 28, 20, 11, 21, 42]. Rearing fish at inappropriate stocking densities may impair growth and reduce immune competence due to factors such as social interactions and deterioration of water quality, which can affect both feed intake and conversion efficiency of the fish[14]. Stocking densities and management measures practiced by pond operators in Pakistan are not based on scientific knowledge, thus resulting in poor growth and survival of fry.

Growth and survival of fry and fingerlings in earthen ponds depend on the density of stocking, type and quality of fertilizer applied and supplementary feed provided. To obtain maximum economic return it would be necessary to stock the ponds at optimum stocking densities for desired growth and survival of fry. However, there is no any report are available on the effects of stocking density on the growth and production of Pangasius hypophthalmus in our country. Therefore, the present study was undertaken to determine a suitable stocking density to obtain maximum growth and profit in a monoculture system of outdoor earthen ponds. For the development and rearing techniques of any fish species, stocking density might play a very important role.

A number of research publications are available on the effect of stocking density on growth and survival rate of different fish species reported Sarotherodon niloticus in floating ponds[17], published information on Pangasius pangasius in net cages[38], studied the effect of density in Clarias gariepinus[39], conducted experiment on Clarias batrachus[4], studied effect of stocking density of Amblypharyngodon mola in seasonal ponds[26], calculated the effect of stocking density of Pangasius sutchi in net cages fed with formulated diet[5], Monopterus cuchia from cemented cisterns[33] and studied the effect of stocking of Heteropneustes fossilis in cemented cisterns fed with formulated feed[31] but there is no any research publication reported on stocking density of Pangasius hypophthalmus from Pakistan.

Materials and Methods

Experimental design

The experiment was conducted for a period of three months from May to July 2011 in cemented tanks at Fish Hatchery Chilya Thatta, Directorate of Fisheries Sindh, Livestock and Fisheries Department Govt. of Sindh-Pakistan. All experimental tanks were disinfected before stocking with Potassium per magnet ($KMNO_4$) after that tanks were filled with water. Three cemented tanks size (15×6×3 ft.) having 5096.5 liters each capacity were used to conduct the experiment in completely randomized design for testing three different densities 100, 150 and 200 fish/tank were assigned as treatments I, II and III respectively with two replications each. The all experimental fishes were more or less same in size (1.52 ± 0.03 cm, 1.08 ± 0.02 g in length and weight respectively), collected from Fish World Hatchery, District Thatta on flow through system. Before stocking all fry were kept into a hapa for one an half hour for acclimatization. The initial length and weight of fish were recorded individually in 'cm' and 'g' respectively with the help of a measuring scale and a digital electric balance. All tanks were stocked with Pangasius hypophthalmus fry. The length and weight of 10 randomly selected fish were recorded for each tank. Before taking the weight, the excess water of the body of the fish was soaked by soft tissue paper. The tanks were same in structure, design and shape including water supply facilities. The water level was maintained to a maximum of 0.76 m. There was inflow and outflow mechanism to maintain the water level coming from a K.B Feeder irrigation canal.

Preparation of pellet feed

To prepare formulated feed from locally available ingredients such as fish meal, mustard oil-cake (MOC), rice protein), rice bran, wheat bran, wheat flour and vitamin premix were ground thoroughly and sieved to pass through 0.5 mm mesh size. An experimental diet was formulated contain 35% protein. All ingredients were mixed together according to the formulae, and then put into the manually operated pellet machine for the preparation of pellet feed of size 1mm. The composition of pellet feed is shown in (Table-1).

Post stocking management

To describe growth and production of fish following management steps were taken:

i. Feeding

Pangas (Pangasius hypophthalmus) fry (1.09 ± 0.02 g average weight and 1.11 ± 0.005 cm average length) were given the prepared experimental diets at a daily rate of 10% of total biomass during (1st 30-days) then reduced to 5% of total biomass from days 31 to 60 after that reduced to 3% of total biomass till end of the experiment (90-days), while the fish were fed 7 days/week (two times in a day at 9.00 am and 3.00pm). The amount of feed was bi-weekly adjusted according to the changes in body weight throughout the experimental period.

ii. Sampling of the experimental fish

Monthly sampling was done using a seine net to observe the growth of fish and to adjust the feeding rate. Weight of fish in each sampling was measured to the nearest gram while the length of each fish was measured to the nearest centimeter. General tank condition and fish health conditions were monitored regularly during the culture period. During sampling fish were handled carefully.

iii. Water sampling

Water samples were collected from each tank with the help of capped bottles having a volume of 1 liter each, marked with tank number were used to contain the collected water samples.

iv. Water quality parameters

The water quality parameters such as Temperature, pH, Dissolved Oxygen (DO), Alkalinity, Ammonia, Hardness and Nitrite were monitored daily, weekly and fortnightly throughout the experimental period. Water temperature of the tanks was measured with the help of thermometer. Water Oxygen of the tanks was measured by using an oxygen meter (JENWAY 9500 DO2 Meter). A pH meter (EZDO-6011 CE) was used to measure the pH of water. API NH4+/NH3 Ammonium test kit is used to determine the values of Ammonia and Nitrite. Hardness is determine by Hanna (HI3812) Hardness Kit. All analyses were done in the Laboratory of Fish Hatchery Chilya Thatta.

v. Statistical Analysis

One way analysis of variance (ANOVA) was used to determine the effects of stocking density on the growth and survival rate of Pangasius hypophthalmus . This was followed by Duncan's New Multiple Range Test (DNMRT), (Duncan 1995) at 5% level of significance to study any difference among treatment means.

Results

The growth parameters of Pangasius hypophthalmus in different treatments in terms of mean weight gain, weight gain, Daily weight gain, SGR, FCR, survival (%) production (kg/m/90 days) and Total Yield (kg) were calculated and are presented in Table 2. Growth of Pangas Pangasius hypophthalmus, in cemented tanks indicated that the growth rate varied in different stocking densities. Treatment I (100 fry/ tank) showed significantly ($p<0.05$) highest growth and survival rate among the treatments. The net length and weight gain of individual fish in T_1 was higher (41.36 cm and 27.5 g) than those of T_2 (33.63 cm and 22.4 g) and (27.4 cm and 18.2 g) in T_3 respectively. The survival and specific growth rates were also found highest in T_1 (100% and 1.4 respectively) followed by T_2 (96% and 1.3), while significantly ($p<0.05$) lowest survival rate and SGR was recorded (90% and 1.2) in T_3. The daily weight gain (DWG) was 0.31 in T_1, 0.24 in T_2 and T_3 0.20 respectively, FCR was best in all treatments T_1 1.0, T_2 1.02 and 1.05 in T_3 respectively. Table 2 shows that the values obtained for feed conversion ratio were not significantly different among treatments ($P>0.05$). Total production of Pangas, Pangasius hypophthalmus were 2.64, 3.07 and 3.08 kg/m^3/90 days in T_1, T_2 and T_3 respectively. Overall production of T_2 and T_3 was significantly higher than T_1.

The mean values of the water parameters are shown in Table 3. All water quality parameters measured had no significant differences among treatments ($P>0.05$). Mean temperature ranged from 27.0 to 28.7 ºC. Concentrations of dissolved oxygen ranged from 5.7 to 6.2 mg/L, pH from 7.2 to 7.5 mg/L, Ammonia from 0.45 to 0.51mg/L, Hardness 105 to 110 ppm and Nitrite from 0.152 to 0.161 mg/L. Water parameters were within tolerable range throughout the experimental period.

Discussion

The effect of stocking density on growth and survival of Pangas, Pangasius hypophthalmus was conducted and observed that the growth rate of Pangs in cemented tanks varied in different stocking densities. T_1 (100 fry/ tank) showed significantly ($p<0.05$) highest growth among the treatments. The net length and weight gain of individual fish in T_1 was higher (41.36 cm and 27.5 g) than those of T_2 (33.63 cm and 22.4 g) and (27.4 cm and 18.2 g) in T_3 respectively. The present results match with the findings of[3,16,24] who achieved best growth at lower stocking densities. It is well-known fact that growth rate progressively increases as the stocking density decreases and vice-versa. This is because a relatively less number of fish of similar size in a pond could get more space, food, less competition and dissolved oxygen etc. reported by various authors[23,44,1,16,21,9,31,30,45].

The percentage of survival as recorded in the present study was 100, 96 and 90% for treatment 1, 2 and 3 respectively these results are similar with the findings of[27,41,47,]. Survival was found to be negatively influenced by stocking densities. It might be due to the high competition and space among the fishes. Lower density gave larger size and higher survival rate in Clarias macrocephalus[29]. Lower stocking density showed higher survival of Clarias angullaris[22], Survival rates were higher in the larvae of Clarias batrachus raised at the stocking densities of 2, 4 and 8 fish per liter as compared to those obtained 16 fish/liter[6]. Researchers reported that highest weight gain and survival rate of Heteropneustes fossilis in lower stocking density[30, 31], highest weight gain and survival rate of Trachinotus blochii on lower stocking density[45]. The above findings support the results of the present study. Significantly ($P<0.05$) higher net production was obtained from the T_2 and T_3 (3.07 kg/m^3/ 90 days, 3.08 kg/m^3/ 90 days) in the present study. It might be due to higher numbers of fry stocked (150 fry/ tank and 200/ fry/ tank) respectively. The present result agreed with the findings of[6,13,22,29,30,31,45] they obtained highest production from higher stocking density.

The water quality parameters were recorded throughout the study period and were within the acceptable ranges for fish culture as reported by[6,31,32,33,35,37,45]. The results of the present study indicated that a stocking density of (100 fry/ tank or 13 fry/ m^3) might be suitable for the culture of Pangas, Pangasius hypophthalmus in tank or pond and give best growth as well.

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Table 1. Ingredients of formulated feed with 35 % gross protein level.

S. No	Ingredient	Actual protein	% used	Protein (%)
1.	Fish Meal	60 %	28.5	17.1
2.	Rice Protein	42 %	23.5	9.9
3.	Wheat Brawn	12 %	16	1.9
4.	Rice Brawn	13 %	13	1.7
5.	Mustered Oil Cake	30 %	13	3.9
6.	Wheat Flour (as binder)	10 %	5	0.5
7.	Vitamin & mineral Premix		1	
	Total		**100 %**	**35.0**

Table.2. Growth parameters of Pangus, Pangusius hypophthalmus with different stocking densities reared in cemented tanks for 90 days fed with formulated feed.

S.No	Parameters	T1 (100 fry/ tank)	T2 (150 fry/ tank)	T3 (200 fry/ tank)
1.	Average initial weight (g)	1.08 ± 0.09	1.07 ± 0.08	1.11 ± 0.08
2.	Average final weight (g)	27.5 ± 2.5	22.4 ± 2.8	18.2 ± 3.5
3.	Average initial length (cm)	1.49 ± 0.14	1.51 ± 0.14	1.56 ± 0.14
4.	Average final length (cm)	41.36 ± 1.93	33.63 ± 2.7	27.4 ± 3.5
5.	Weight gain	26.42 ± 1.3	21.33 ± 2.8	17.09 ± 3.54
6.	Daily weight gain (DWG)	0.31 ± 0.1	0.24 ± 0.07	0.20 ± 0.2
7.	Feed conversion ratio (FCR)	1.0.0± 0.00	1.02 ± 0.00	1.05 ± 0.00
8.	Survival rate (%)	100 ± 0.0 (100)	96 ± 0.0 (144)	90 ± 0.0 (180)
9.	Condition Factor	0.04 ± 0.00	0.06 ± 0.00	0.09 ± 0.00
10.	Specific growth rate (SGR)	1.4 ± 0.00	1.3 ± 0.00	1.2 ± 0.00
11.	Fish Production (kg/m3/90 days)	2.64 ± 0.00	3.07 ± 0.00	3.08 ± 0.00
12.	Total Yield (kg)	2642 ± 0.00	3071.1.2 ± 0.00	3079 ± 0.00

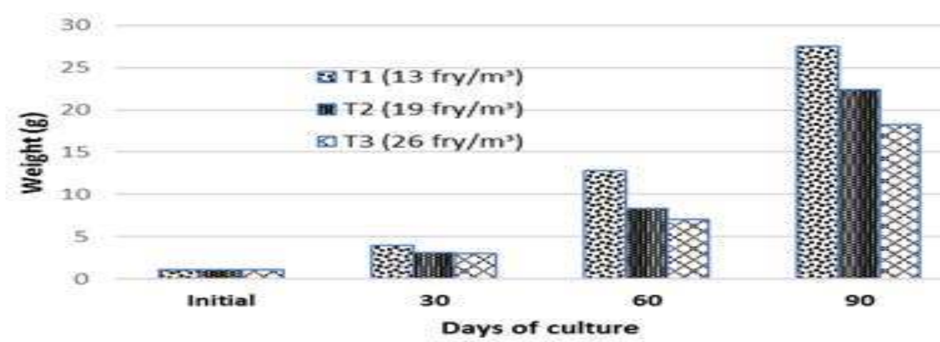

Figure 1: Weight Gain of Pangas, Pangasius hypophthalmus in Three Different Treatments during Study Period.

Table 3. Showed month-wise variation in water quality parameters in cemented tanks throughout the study period.

Months	**Parameters**					
	Temperature(° C)	**Dissolve Oxygen (mg/L)**	**pH**	**Ammonia (mg/L)**	**Hardness (ppm)**	**Nitrite mg/L**
April	27 ± 0.20	6.2 ± 0.11	7.2 ± 0.15	0.45 ± 0.03	105 ± 2.0	0.152 ± 0.005
May	28 ± 0.17	5.8 ± 0.25	7.4 ± 0.20	0.48 ± 0.02	110 ± 2.6	0.157 ± 0.002
June	28.7 ± 0.14	5.7 ± 0.26	7.5 ± 0.15	0.51 ± 0.03	108 ± 2.4	0.161 ± 0.004