Fundamental and Applied Agriculture
Vol. 3(3), pp. 586–590: 2018
doi: 10.5455/faa.292100

Fisheries
ORIGINAL ARTICLE

Effects of stocking density on growth and survival of Thai pangas (*Pangasius hypophthalmus* Sauvage, 1878) fry in net cages in a commercial fish farm in Noakhali, Bangladesh

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ARTICLE INFORMATION

Article History
Submitted: 26 Feb 2018
Revised: 18 Jul 2018
Accepted: 24 Jul 2018
First online: 19 Aug 2018

Academic Editor
Tanvir Rahman

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ABSTRACT

The present study was conducted to determine the growth performance of Thai pangas (*Pangasius hypophthalmus*) in the cage culture system ($4.6 \times 1.5 \times 1.4$ m^3) of Globe Fisheries Ltd., at Subornachor under Noakhali, Bangladesh for a period of 45 days. The net cages were divided into three treatment groups at the density of 200 fishes m^{-3}, 400 fishes m^{-3} and 600 fishes m^{-3} for treatment T1, T2 and T3, respectively. The initial weight of *P. hypophthalmus* fry was 0.19 ± 0.007g and stocked the fry in net cage. After acclimatization, the fry fed with formulated diet containing 28% gross protein level twice a day at the rate of 5% body weight. The diet was consisted of fishmeal, mustard oil cake, rice bran, wheat bran, vitamin and salt. The water quality parameters were recorded throughout the study period and temperature, dissolved oxygen and pH were ranged 28.3–32 °C, 8.0–8.5 mg L^{-1} and 7.4–8.3, respectively. The results showed that the growth performance of *P. hypophthalmus* was found higher in low stocking density after 45 days of rearing. Finally, fish attained 0.2 ± 0.007 g, 0.17 ± 0.007 g, and 0.09 ± 0.06 g in mean weight gain and 1.8 ± 0.04 cm, 1.6 ± 0.07 cm, 1.2 ± 0.14 cm in mean length gain, 0.92 ± 0.006, 0.49 ± 0.005, 0.49 ± 0.003 in specific growth rate, 1.93 ± 0.23, 2.23 ± 0.19, and 3.05 ± 0.13 in food conversion ratio and 95 ± 0.02, 85 ± 0.02, and 81 ± 0.02% in survival rate in the treatment T1, T2 and T3, respectively.

Keywords: Stocking density, *Pangasius hypophthalmus*, growth performance, survival rate

Cite this article: Islam A, Habib A, Hossain JM, Tumpa IJ, Haque AT, Hossain Z. 2018. Effects of stocking density on growth and survival of Thai pangas (*Pangasius hypophthalmus* Sauvage, 1878) fry in net cages in a commercial fish farm in Noakhali, Bangladesh. Fundam Appl Agric 3(3): 586–590. doi: 10.5455/faa.292100

1 Introduction

The fisheries sector plays an important role in the agro-based economy of Bangladesh, through providing food and nutrition, alleviating poverty, creating employment opportunities and earning foreign exchange. Fisheries sector contributes 3.69% to the national growth domestic product (GDP) and 23.12%

to the total agricultural GDP (DoF, 2015). The average growth rate of this sector during the last three years was 6.11%. About 11% of the total population is directly or indirectly employed in fisheries sector. Fisheries of Bangladesh have immense prospects and scope of development (DoF, 2015).

Many exotic fishes are now under extensive to intensive culture practices in Bangladesh that has become a good and profitable fishery here. One of them is Thai-pangas, *P. hypophthalmus*. It is an important catfish for its fast growth, high resistance to disease, very good taste, recently increase popularity, fame for its aristocracy and good market demand. Pangas species is dominant in fish farming as it is the main source of fish intake of the country's low and middle income people because of their affordable market value. It has been reported that amongst exotic fish species, *P. hypophthalmus* is the best due to its easy culture system (Sarker, 2000). According to Sarder et al. (1994) pond culture of native pangas (*P. pangasius*) was started in 1945 at Khulna region of Bangladesh.

There is no supply of stockable fry of *P. pangasius*. That's why, culture of *P. pangasius* did not establish in Bangladesh. *P. hypophthalmus* is commonly known as Thai Pangas, which belongs to family Pangasidae of the order Siluriformes. The culture significance of *P. hypophthalmus* in the South East Asian region has gained much attention very recently. In some cases they are preferred over the indigenous carps and other catfishes for aquaculture. The effect of three types of feed on growth of *P. hypophthalmus* and rohu (*Labeo rohita*) in polyculture system and showed a typical increasing trend of final weight and specific growth rate of *P. hypophthalmus* along with the increasing protein level in feed (Sayeed et al., 2008). Although few reports on the growth performance and survival rate of *P. hypophthalmus* in Bangladesh are available, report on the growth performance and survival rate of this species considering different stocking densities under cage culture is scarce. Considering this, present study explored the effects of stocking densities on the growth and survival of *P. hypophthalmus* under cage culture.

2 Materials and Methods

2.1 Study area and experiment site

The present study was carried out in net cages in Globe Fisheries Ltd, Subarnachor under Noakhali district, Bangladesh. The experiment period was 45 days. Six rectangular nylon net cages were prepared to a size of 4.6×1.5×1.4 m^3 with a very fine mashed net. The net cages were built in bamboo structure by using some wire and ropes. All net cages were maintained with a water level of 0.9 m using inlet and outlet of the pond throughout the period of experiment.

2.2 Experimental design

The experimental fish was stocked in different densities in the net cages. The net cages were divided into three treatment groups at different stocking densities i.e. 200 fish m^{-3}, 400 fish m^{-3} and 600 fish m^{-3} for treatment T1, T2 and T3, respectively, having two replicates each. The initial weight and length of fishes were recorded at the time of releasing them in net cage.

2.3 Preparation of supplemental feed

The feed ingredients were collected from Globe Agro Vet Ltd, Noakhali and shown in Table 1. The protein was determined 28% by the feed company.

Table 1. Ingredients used in feed formulation

Ingredients	Amount (%)
Fish meal	33.6
Mustard oil cake	15.0
Wheat bran	15.0
Rice bran	29.4
Wheat flour	5.0
Vitamin	1.0
Salt (NaCl)	1.0
Total	100

2.4 Feeding Procedure

The feed was supplied at the rate of 5% of their weight daily twice in the morning (10:00 AM) and evening (6:00 PM) in two equal halves. The feeding rate was adjusted after every sampling.

2.5 Water quality parameters

The water quality parameters (temperature, dissolved oxygen, pH) were recorded on sampling day at 9:00AM to 10:00AM. The temperature, dissolved oxygen and pH of water were determined using Celsius thermometer, DO meter (Lutron DO- 5509, China) and a portable pH meter (HANNA HI -96107, Portugal), respectively.

2.6 Growth parameters estimation

The following parameters were used to evaluate growth of the *P. hypophthalmus* fry:

$$\text{Length gain (cm)} = FL - IL \tag{1}$$

$$\text{Length gain (\%)} = \frac{FL - IL}{IL} \times 100 \tag{2}$$

where FL and IL designate avegrage final and initial lenght in cm.

$$\text{Weight gain (g)} = FW - IW \tag{3}$$

$$\text{Weight gain (\%)} = \frac{FW - IW}{IW} \times 100 \quad (4)$$

where FW and IW designate avegrage final and initial weight in g.

$$SGR = \frac{\log W_2 - \log W_1}{T_b - T_a} \times 100 \quad (5)$$

where, SGR = specific growth rate (% d^{-1}), W_2 = final live body weight (g) at time T_b (d), W_1 = initial live body weight (g) at time T_a (d), T_b = time at final sampling, and T_a = time at initial sampling.

$$FCR = \frac{\text{Food feed (dry weight)}}{\text{Live weight gain}} \quad (6)$$

where, FCR = food conservation ratio

$$\text{Survival (\%)} = \frac{\text{No. of harvested fish}}{\text{No. of stocked fish}} \times 100 \quad (7)$$

2.7 Statistical analysis

Data was analyzed using SPSS. ANOVA and student t-test were done to find the difference between treatments group.

3 Results and Discussion

The temperature, DO and pH in T1, T2 and T3 are presented in Table 2. Reproduction, growth and other activities of fish are largely depends on temperature. Therefore temperature has a marked effect on overall fish production. The temperature of water was found to vary from 28.3 °C to 32 °C. Nirod (1997), Rahman (1999), Kohinoor et al. (1998), Sarker (2000), Hasan (2007), and Maghna (2102) who measured water temperature in ponds of BAU Campus, Mymensingh and found to vary from 21.8 to 31.10 °C, 29.7 to 29.9 °C, 18.5 to 32.9 °C, 19.8 to 22.8 °C, 21 to 32.8 °C and 32 to 34.3 °C, respectively. Chowdhury et al. (2000) recorded the water temperature and dissolved oxygen of the rice cum fish culture during the experimental period ranged from 27.00 to 31.20 °C and 3.80 to 4.50 mg L^{-1}, respectively where the pH values were found to be ranged from 5.95 to 7.10 in the current study; the mean temperature was recorded 31.67 ± 0.47, 30.5 ± 0.67, and 29.3 ± 1.41 °C in T1, T2 and T3, respectively (Table 2). Rahman et al. (2006) recorded the ranges of water temperature (21.1 to 32.2 °C) in the net cages of *Pangasius sutchi*.

The recorded pH of water in the net cage was in the range of 7.4–8.3. Nirod (1997), Rahman (1999), Kohinoor et al. (1998), Sarker (2000), Hasan (2007) and Maghna (2102) who measured pH in ponds of BAU Campus, Mymensingh ranging from 6.5 to 8.5, 4.9 to 5.2, 6.5 to 8.0, 6.8 to 8.3, 6.5 to 7.9 and 7.6 to 8.3, respectively. Begum (2008) recorded pH 7.05 to 8.02 in the research ponds of BAU campus, Mymensingh. The pH values were slightly alkaline which indicated good pH conditions for fry nursing. The dissolved oxygen of a water body is an important factor for fish culture. The dissolved oxygen fluctuation was not same for each of the three treatments in the present study. The dissolved oxygen ranged from 8.0 to 8.5 mg L^{-1}. Rahman (1992) studied that the dissolved oxygen content of a productive pond should be 5 mg L^{-1} or more. Hasan (2007) measured dissolved oxygen 4.62 to 5.75 mg L^{-1}, while Hossain et al. (2007) recorded dissolved oxygen 4.15 to 8.60 mg L^{-1} in the ponds. Mollah and Hossain (1998) recorded 7.85 ± 0.25 mg L^{-1} and 7.90 ± 0.45 DO and pH, respectively in the pond where net cage was setting for rearing of *Clarias gariepinus* fry.

Table 2. Water quality parameters in experimental pond

Parameter	Treatment	Mean ± SD
Temperature (°C)	T1	31.67 ± 0.47
	T2	30.5 ± 0.64
	T3	29.3 ± 1.41
pH	T1	7.8 ± 0.14
	T2	8.15 ± 0.21
	T3	7.8 ± 0.57
Dissolved oxygen (mg L^{-1})	T1	8.0 ± 0.01
	T2	8.40 ± 0.14
	T3	8.35 ± 0.21

The data of growth increment, FCR and survival rate are presented in Table 3. The higher weight and length gain were found in T1 followed by T2 and T3. The specific growth rate of *P. hypophthalmus* in different treatments ranged 0.49 to 0.92. The final weight of fish was lower in T2 and T3 that's why calculated SGR was lower comparing to T1. Azimuddin et al. (1999) studied the effect of stocking density on the growth of *P. sutchi* in net cages and concluded that the best individual growth of *P. sutchi* was observed at a density of 40 fish m^{-3} and the highest total production was obtained at 50 fish m^{-3} in net cages. Sarder and Mollah (1991) studied the effects of supplemental feed on growth and production of pangas (*P. pangasius*, Hamilton) in ponds, and reported that supplemental feeds containing 20–30% crude protein in different combinations gave significant growth of this species cultured in cages and ponds. Hussain et al. (2000) and Hasan et al. (1982) reported a weight gain of about 0.42 g for *Oreochromis niloticus* in on-farm ponds for a culture period of 6 months fed rice bran at 5-6% of their body weight. The mean initial weight *P. hypophthalmus* in the three treatments were same 0.19 ± 0.007g. At the end of the study, the mean final weight of stockable *P. hypophthalmus* was 0.39 ± 0.007 g, 0.36 ± 0.007 g and 0.28 ± 0.06 g in treatments T1,

Table 3. Growth and survival of *Pangasius hypophthalmus* observed in different treatments

Parameter	T1	T2	T3
Mean Initial Length	2.1 ± 0.03	2.05 ± 0.07	2.1 ± 0.04
Mean Final Length (cm)	3.9 ± 0.02	3.65 ± 0.07	3.3 ± 0.14
Mean length gain (cm)	1.8 ± 0.04	1.6 ± 0.07	1.2 ± 0.14
% length gain	85.71 ± 5.02**	78.05 ± 6.07	57 ± 4.14
Mean initial weight	0.19 ± 0.007	0.19 ± 0.007	0.19 ± 017
Mean final weight	0.39 ± 0.09*	0.36 ± 0.017	0.28 ± 0.06
Mean weight gain	0.20 ± 0.87	0.17 ± 0.07	0.09 ± 0.06
% weight gain	105.26 ± 10.01**	89.47 ± 8.00	47.36 ± 6.06
SGR %/day	0.92 ± 0.06*	0.49 ± 0.05	0.49 ± 0.03
FCR	1.93 ± 0.23	2.23 ± 0.19	3.05 ± 0.13
Survival (%)	95 ± 3.02*	85 ± 4.02	81 ± 4.20

T2 and T3, respectively. The mean weight gains of *P. hypophthalmus* at the end of the experiment were 0.20 ± 0.007g, 0.17 ± 0.007 g and 0.09 ± 0.006g in T1, T2 and T3, respectively. The growth rate was slow as fry was collected from the commercial hatchery. It may be the cause of inbreeding problem in their hatchery. In T3, the growth of fish was lower as density of fish was higher (600 m^{-3}), consequently weight gain was lower.

This result coincided with results of Mollah and Hossain (1998). Food conversion ratio (FCR) values among the treatments were 1.93, 2.33 and 3.05 for T1, T2 and T3, respectively. Ahmed et al. (2013) found that Food Conversion Ratio (FCR) was 1.51 and 1.40, respectively in homemade and commercial feed treatments in *O. niloticus*. Hossain et al. (2004) found FCR value for *O. niloticus* fed on formulated diet (30.09% protein) was 1.71–1.77 which was almost similar to the present study. The survival rate (%) was 95%, 85% and 81% in T1, T2 and T3, respectively. Barua (1990) reported that the survival rates were higher in the larvae raised at the stocking densities of 2, 4 and 8 fish L^{-1} compared to those obtained 16 fish L^{-1}. *C. gariepinus* fry at different densities and found significantly higher growth rate in lower stocking density. While survival rate was comparable in all different densities (Mollah and Hossain, 1998; Hossain et al., 1996).

4 Conclusions

It was found that the individual fish growth decreased with the increasing of stocking density. At the end of the study, T1 showed the highest specific growth rate and survival rate at lower stocking density. Based on the experiment, farmers could be suggested to culture of *P. hypophthalmus* at lower stocking density to get higher benefit in the short period of time.

Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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The Official Journal of the **Farm to Fork Foundation**
ISSN: 2518–2021 (print)
ISSN: 2415–4474 (electronic)
http://www.f2ffoundation.org/faa