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Effect of stockig density on the growth of Thai pangas, *Pangasius sutchi* (Fowler) in net cage fed on formulated diet

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Abstract
A three month long experiment was conducted to observe the effect of stocking density on the growth of *Pangasius sutchi* in net cages. The size of each cage was $1m^3$. The three stocking density used were 40, 50 and 60 fishes/m^3 and designated as treatment T_1, T_2 and T_3 respectively. Each treatment had three replicates. All the fishes were of same age group having mean length and weight of 7.13 ± 1.37 cm and 2.46 ± 0.12 g. respectively. The fish in all the net cages were fed a diet containing 34% protein The result of the study showed that fish in the treatment T_1 stocked at the rate of 40 fish / m^3 resulted the best individual weight gain followed by T_2 and T_3 respectively. The specific growth rate (SGR) ranged between 3.51 and 3.09, the food conversion ratio (FCR) values ranged between 1.73 and 2.04 with treatment T_1resulting the lowest FCR. The protein efficiency ratio (PER) values were 1.69, 1.16 and 1.43 for treatment T_1, T_2, and T_3 respectively. There was no significant ($P > 0.05$) variation among the survival rates of fish which ranged between 92 and 95%. The net production in different treatments were 2189, 2343, and 2283g for treatment T_1, $T_2$and T_3 respectively. The result of the present study indicated that the best individual growth of *P. sutchi* was obtained at a density of 40 fish/ m^3 but the highest total production was obtained at a stocking density of 50 fish / m^3 in net cages.

Key words : *P. sutchi*, Cage, Stocking density, Formulated diet

Introduction

Culture of fish in cages is a comparatively new method of aquaculture which has gained much popularity throughout the world due to a number of advantages over the conventional methods of fish farming. Fish cage culture has been defined as the rearing of fish stocks, generally from juvenile to marketable size, in a totally enclosed aquatic environment. In this system of culture fishes are confined in wire meshes, net cage or bamboo splits-made cage which are supported or suspended in open and closed water bodies. Fish in cage are easy to manage, advantageous to rear quality and selective fishes, easy to harvest (Dham 1975). It is easy to eliminate predation and competition, and easier to treat diseases and parasites. It also provides for closer observation of feeding and other behavior of fishes. Fishes could be stocked at a much higher density in cages when compared to other forms of fish culture (Coche

1976). For cage culture or any other intensive culture system, selection of species is also important since all species are not suitable for all culture system. *Pangasius. sutchi* is a suitable fish for cage culture or any other intensive culture system. (Tavarutmanegul *et al.* 1979). Stocking density is an important factor for the production of all fishes as well as *P. sutchi* in cages. There are a number of literature on the culture of fish in cages with different commercial fish species conducted in different parts of the world. Even in Bangladesh some information is available on the culture of carps and other catfishes, but no information is available on the optimum stocking density on the culture of *P. sutchi* in cages. Therefore the present study was undertaken to determine the optimum stocking density of *P. sutchi* in cages fed on formulated diet.

Materials and methods

The experimental cages were set in a brood stock pond of size 0.4 acre at the northern side of the Fisheries Faculty Building, Bangladesh Agricultural University, Mymensingh. The experiment was conducted for three months from 24th August to 24th November'97.

The cages were square shaped made of iron framework and were covered by high density polyethylene (HDPE) net. The size of each cage was 1m x 1m x 1m. The mesh size of the net was 1cm, so that the experimental fish fry could not escape. Iron rods were welded to construct a square shape frame and nets were attached to the rod with the help of nylon twine. One edge of upper side of each cage was kept open which was tied with nylon threads in such a way that it could be opened to deliver feed in the feeding plate.

The cages were installed from several bamboo bars. The frame was fixed with bamboo poles inserted into the pond bottom. The cages were tied fixed with the frame by nylon ropes at the time of suspension, about 1 feet of the upper portion of the cages were always kept above the water level. Care was taken so that the cages did not touch the bottom of the pond. The cages were placed about 10 feet away from the pond bank. A flat form made of bamboo stick/plates installed along side the cages were used for easy feed supply and observation of the cages. For easy management and identification, the cages were numbered as 1 to 9 and were divided into three treatment e.g. T_1, T_2 and T_3 each having three cages.

In each cage, a feeding plate was hung from the four upper corners of the cage with the help of nylon rope. It was placed in such a way that it could be taken out easily for giving food and cleaning regularly. The feeding plates were of earthen plate. They were of about 23 cm in diameter and 6 cm in depth.

The fingerlings of *P. sutchi* locally called "Thai pangas" were collected from local fish traders. All the fish were of same age group having mean length and weight of 7.13 ± 1.37 cm and 2.46 ± 0.12g respectively. The fish were stout and naturally moving . Before the start of the experiment the fingerlings were acclimatized to the new environment in floating cages for seven days . Then the fish were stocked in

experimental cages at a density of 40, 50, 60. fish/cage for treatment T_1, T_2 and T_3 respectively.

To prepare the feed for feeding the experimental fish, sesame meal, fish meal, mustard oil cake, rice bran, wheat bran, wheat flour and were ground thoroughly and sieved to pass through 0.5 mm mesh size. Before formulation of diets, all ingredients were analyzed for their proximate composition. The result of proximate composition analysis is shown in (Table. 1). An experimental diet was formulated to contain 35% protein. All the ingredients well mixed together according to the formula (Table 2) and then put in to the pellet machine for the preparation of pelleted feed of size 1mm. The feeds were supplied twice daily once in the morning (at 9: 00 am) and in the evening (at 4: PM) at a rate of 10% of the body weight during the 1st month and then the feeding rate was reduced 8 and 6% for the 2nd and 3rd month respectively. For the 1st 15 days the feeds were supplied in dough form and rest of the study period pelleted feeds were used. Fortnightly sampling was done to adjust the feeding rate by measuring the weight of fish and observed the health condition of fish.

Table1. Proximate composition (% dry matter basis) of different feed ingredient

Ingredients	Dry matter	Protein	Lipid	Ash	Fibre	NFE[1]
Fish meal	90.30	59.07	17.98	15.70	1.17	6.08
Sesame meal	91.35	33.29	8.35	14.87	24.02	19.47
Mustard oil cake	92.97	36.51	11.29	9.19	11.63	31.46
Rice bran	89.97	12.62	16.52	13.62	16.34	40.91
Wheat bran	88.50	18.21	4.40	4.77	14.01	58.61
wheat flour	87.12	15.12	7.20	5.77	15.31	56.60

[1]*Nitrogen free extract calculated as 100-% (moister + protein + lipid + crude fibre + ash)*

Table 2. Formulation and price of experimental diet

Ingredients	% Inclusion	Quantity (g/kg)	Price of ingredients (Tk/kg)	Price of feed (Tk)
Fish meal	30	300	29.00	8.70
Sesame meal	18	180	7.00	1.26
Mustard oil cake	2	20	6.00	0.72
Rice bran	25	250	4.50	1.125
Wheat bran	10	100	6.00	0.60
Wheat flour	5	50	10.00	0.50
Total	100	1000		12.90/kg

Proximate composition of the dietary ingredients, feed and fish were determined in triplicate according to (AOAC 1980). and the results are shown in Table 3.

Table 3. Analyzed proximate composition of the experimental diet (% dry matter basis)

Composition	Percentage (%)
Dry matter	92.18
Protein	34.11
Lipid	8.74
Ash	18.74
Crude fibre	14.03
NFE[1]	24.35

[1]*Nitrogen free extract calculated as 100-% (moister + protein + lipid + crude fibre + ash)*

One way analysis of variance (ANOVA) followed by Duncan;s multiple range test (DMRT) was done to determine the significance of variation among the treatment means. Standard error (SE) of treatment means were calculated from the residual mean square in the analysis of variance.

Results

Growth performance of *P. sutchi* in terms of initial weight, final weight, weight gain, %weight gain, specific growth rate (%day), food conversion ratio (FCR), protein efficiency ratio (PER), apparent net protein utilization (ANPU), survival rate, production(g/m^3), cost of production and net production are shown in (Table 4). The initial average weight 2.46 g reached a final weight of 58.09, 52.04 and 40.04g in treatment T_1, T_2 and T_3 respectively. The maximum weight gain was in treatment T_1 (55.63g) and the minimum gain in weight in treatment T_3 (37.58g) (Table 4). The significantly ($P<0.05$) highest weight gain of fish was obtained with treatment T_1 followed by T_2 and T_3. The specific growth rate (SGR) of fish in different treatment groups ranged between 3.51 and 3.09. Treatment T_1 produced significantly ($P<0.05$). The highest SGR (3.51), while the treatment T_3 produced the lowest SGR (3.09).

Table 4. Growth and feed utilization of *Pangasius sutchi* during the experimental period

Parameters	Treatments			
	T_1	T_2	T_3	± S.E[2]
Initial weight (g)	2.462[a1]	2.462[a]	2.462[a]	0.048
Final weight (g)	58.096[a]	51.043[b]	40.046[c]	0.531
Weight gain (g)	55.634[a]	48.581[b]	37.584[c]	0.546
% weight gain	2259.7[a]	1970.67[b]	1526.56[a]	51.942
Specific growth (SGR %day)	3.51[a]	3.37[b]	3.09[c]	0.026
Food conversion ratio (FCR)	1.73[a]	1.81[b]	2.04[c]	0.012

Protein efficiency ratio (PER)	1.69[a]	1.61[b]	1.43[c]	0.033
Apparent net protein utilization. (ANPU %)	41.82[a]	32.06 b	24.28 c	0.487
Survival rate (%)	94.16[a]	92.00[b]	94.97[a]	0.052
Production (g/m^3)	2189.01	2343.00[b]	2282.85[c]	1.575

[1]*Figures in the same row with the same superscripts are not statistically different P>0.05).*
[2]*Sndard error of treatment means calculated from the residual mean square in the analysis of variance.*

The mean Food Conversion Ratio (FCR) values in different treatments varied between 1.7 and 2.04. The highest FCR values (2.04) was recorded in treatment T_3 and the lowest (1.73) in treatment T_1. The values of FCR in three different treatment are significantly (P>0.05) different from each other. The PER values ranged between1.43 to 1.69. Treatment T_1 had the highest PER (1.69) and treatment T_3 had the lowest PER (1.43). The values of PER in three different treatments are significantly (P>0.05) different from each other.

The ANPU % values for all treatments ranged between 24.28 and 41.82 (Table 4) The highest ANPU % value was obtained in treatment T_1 and the lowest value was obtained in treatment T_3. The value of ANPU% in three different treatments are significantly (P<0.05) different from each other.

The survival of fish in different treatment ranged between 92.00 and 94.79 %. There was no significant (P<0.05) difference between the survival rates of fish in treatment $T_1$and T_3. The highest fish production was recorded in treatment T_2 and the lowest was recorded in treatment T_1. Fish production in three treatments were significantly (P<0.05) different from each other.

Discussion

In the present study the effect of stocking densities on the growth of *P. sutchi* in cages was observed. The results indicated that the growth rate of *P. sutchi* (Flower) varied in different stocking densities. Treatment T_1 (40 fishes/m^3) showed the best result in terms of growth and feed utilization. Ahmed (1982) reported that the stocking rate of *Labeo rohita,*10 fishes/m^3 in floating ponds gave the best result in terms of individual growth followed by 20 and 30 fishes/m^3 respectively. The highest growth in terms of net yield/m^3 was obtained with the stocking rate of 30 fishes/m^{3}and the lowest relative growth 385.18% was obtain at the high stocking density 500fish/m^3. Haque *et al.* (1994) found that in case of *Cyprinus carpio* cultured in floating ponds the best growth was recorded at lowest density (5fishes/m^3) and least growth was recorded at highest density (20 fishes/m^3) . But the stocking densities of 15 fishes/m^3 gave the highest net yield/m^3. Dimitrov (1976) observed that low stocking densities 20 fishes/m^3 gave the highest production of carps in net cages compared to the high densities 80 and 150 fishes/m^3. Chaitiamvong (1977) found a production of 65 kg/m^3 of *P.Sutchi* with a stocking density of 25-40 fish / m^3 in floating cage in Thailand. Haque *et al.* (1984) observed lower production in java

tilapia when stocked at higher densities in cages. Thiemmedh (1961) obtained a production of 180 to 240 kg/m^3 from Pangas in a year when stocked at a rate of 113 fishes/m^3

In the present study although the best individual growth of fish was observed at stocking densities of 40 fishes/m^3, the over all highest production was observed in treatment T_2 with a stocking density 0f 50 fish/m^3.

Level of crude protein and other necessary elements in the diets and the mode of feed presentation influenced the growth rate of the fish (Khan 1997). In the present study, optimum level of dietary protein (34.11%) enhanced the growth of *P. sutchi*. The present findings are in agreement with those reported by Islam *et al.* (1983) who recorded highest growth rate of *Catla catla* fingerling in cages by feeding with the diet containing 32.59% protein. Deyoe and Tiemeier (1968) observed that a diet containing 25% crude protein and animal sources with a minimum amino acid level gave the best growth in channel catfish fingerlings. It has been demonstrated that supplemental feeds containing 20 to 50% crude protein in different combination gave significant growth of different fishes cultured in cages. (Hasan *et al.* 1985)

The SGR values in the present study is more or less similar to the values of (3.3) reported for common carp when fed a prepared diet using rice bran, groundnut, oil cake and fish meal at the rate of 3% fish biomass in natural tanks (Sehgal and Toor 1991) but higher than the values (1.24) reported by Sumagaysay *et al.* (1991) for *Chanos chanos.* Wee and Ngamsnae (1987) reported a much lower SGR values of 1.27 to 1.85 in *P. gonionotus* feed varying protein levels (15 to 55 %) under laboratory condition.

The FCR values obtained in this study were satisfactory. The FCR values obtained in the present study were lower than the values(4.45) Reported by Rashid (1997) for *P. Sutchi* in cage feed diet containing 29.98% protein.

The temperature ranged between 22.4 and 29.7°C in the experimental cages. *P. sutchi* is an endemic fish of south east Asia where the temperature varies from 28 to 32°C all the year round. Thus the low temperature during the last month of the experiment probably slowed down the growth. Brown (1957) reported that temperature altered the rates of metabolic process and could be expected to have a considerable effect on the growth of poikilothermous animals. The percentage of mortality of the stocked fish in different treatments were not significant, which indicated that mortality of fishes in cages were not influenced by the stocking density (Pennington and Strawn 1977).

The result of the study indicated that the best individual growth of *P. sutchi* was obtained at a density of 40 fishes/m^3 but the highest total production was obtained at stocking density of 50 fish/m^3 in net cages. Thus, for better production a stocking density of 50 fish/m^3 could be used for *P. Sutchi* cage culture in Bangladesh.

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