Effect of Different Feed on the Growth Performance of Thai pangas (*Pangasius hypopthalmus*) at Different Stocking Density

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By

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Effect of Different Feed on the Growth Performance of Thai pangas (*Pangasius hypopthalmus*) at Different Stocking Density

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Declaration

The results submitted in this thesis are entirely of the candidate's own investigations and no part of the results has been accepted for any degree, nor is it being concurrently submitted for any degree.

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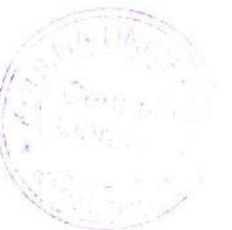
Dedicated To

My Beloved Parents



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Abstract

Thai pangas (*P. hypopthalmus*) is well known for its faster growth, easy culture system, high disease resistance and tolerance of a wide range of environmental parameter. Study on the growth performance of Thai pangas (*p. hypopthalmus*) was conducted in the village Siromony, Thana Khan jahan ali, District Khulna for a period of 4 months (15March to 15 July, 2009). There were three treatments each with three replicates. Average length and weight of 12 cm and 13 g fingerlings were stock at different stocking density 100, 150 and 200 individuals/ decimal in treatment-I, treatment-II, and treatment-III respectively and fed three different but same-cost diets. The water quality parameters were monitored fortnightly and ranges were temperature 30.4-31.8° C, pH 7.2-8.2 and DO 5.3 to 6.3 mg/L was recorded. Weight gain of individual fish in treatment-I was significantly (P<0.05) higher (402.67g) than that of treatment-II (347.00g) and III (199.00g). The highest SGR was obtained in treatment-I (2.89 % day^{-1}). The lowest FCR (1.29) was obtained in treatment-I that significantly (P<0.05) differed from treatment-III (1.40). Protein efficiency ratios ranged from 2.94-2.08 that showed significant difference (P<0.05) among the treatments where treatment-I was the highest. The percent of survival rate was recorded 94.09, 92.25 and 90.14 treatments I, II and III respectively. Highest survival rate (94.00%) in treatment-I significantly (P<0.05) differed with treatment-II (90.66%). A highest positive co-relation between length-weight was observed in treatment-I (r^2= 0.9957) and gradually deceased in treatment-II (r^2= 0.99521) treatment-III (r^2= 0.9911) where the regression lines are $y = 0.0027\ x^{3.3863}$, $0.0027x^{3.34004}$ and $0.0027x^{3.4286}$ for the treatment-I, II and III respectively. However, highest (P<0.05) production obtained in treatment-III (57.20kg/decimal) resembles suitable stocking density in pond culture is 200/dec with 34% protein-rich diet.

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Chapter one

Introduction

Chapter-1

Introduction

Fish and fishery plays a significant role in country of Bangladesh in terms of nutrients, income, employment and foreign exchange earning. The people of Bangladesh largely depend on fish as the principle source of animal protein, which contributes about 70/ of the nation's animal protein intake. Bangladesh which is a subtropical country of an area of 1, 47,570 sq. km (BBS, 1991) has excellent aquaculture potential because of its vast water resources and all these water resources can be utilized for fish culture. The inland fisheries of Bangladesh are the most productive in the world. The inland fishery contribute about 75% of the total fish catch of the country (Sinha and Mazid, 1994)

In Bangladesh vast water resources scattered all over the country in the form of small ponds, beels, lakes, canals, rivers and estuaries covering an area of about 4.34 million ha. The total fish production was estimated at 1.78 million tones in 200-01; of which 1.4 million tones (97%) were obtained from inland waters, and the remaining 0.38 million tones (21%) came from marine water (DOF, 2002). Within the overall agro-based economy of the country, the contribution of fish production have been considered to hold good promise for creating jobs, earning foreign currency and supplying protein. About 97% of the inland fish production is marketed internally for domestic consumption while to the remaining 3% is exported (BCAS, 2001). The inland fisheries of Bangladesh are the most productive in the world and Bangladesh rank third in inland fish production in the world (Islam, 1989). At present the average fish production in cultured pond is 1,175 kg/ha/year (zaher and mazid, 1993).

In spite of having above water resources, aquaculture in this country has not much developed. Yet there is serious shortage of animal protein in our diet and the daily per capita consumption is very low .The per capita fish consumption in Bangladesh was 33g but the present per capita consumption is only 21g (DOF, 1995). The principle causes for this low per capita consumption are the rapid growth of population compounded with a gradual decline in fish production resulting from deterioration of fish habitat due to unplanned construction of flood control dikes and rods, indiscriminate use of insecticides, improper with drawl of water for irrigation purpose, over fishing and lack of proper management techniques and other reasons. Therefore, recently the fisheries scientists are realizing to increase the fish production by applying semi-intensive and intensive aquaculture techniques. In Bangladesh semi-intensive and intensive aquaculture is running to extent with a limited number of fish species, of which Thai pangas (*P. hypopthalmus*) is one of them.

Thai pangas (*P. hypopthalmus*) is newly bought exotic species which was introduced in Bangladesh from Thailand by ministry of fisheries and livestock (MOFL) in 1990 in consideration of its great aquaculture potential .In the past *pangasius pangasius* was abundantly available in Bangladesh. But in recent years this fishery is being depleted partly because of poor management, heavy fishing pressure and increasing water pollution. Usually they breed in rivers but due to pollution and destruction of breeding grounds by siltration probably they can not successfully breed in the riverine environment. For this reason, natural stocks of indigenous *pangasius pangasius* are declining. If these phenomena continues their survival rate and production will decrease consequently, and in near future, pangas fishery will face a threat of extinction. *pangasius pangasius* is difficult to spawn artificially. *So the pangas*

(pangasius pangasius) culture in pond has not been developed in Bangladesh. The culture of thelocal pangus *pangasius pangasius* has not been successful because of the difficulty in producing fry.

The exotic fishes that are introduced for culture purpose in our country within last few years, the Thai pangas (*P. hypopthalmus)* is the best. Bangladesh Fisheries Research Institute (BFRI) produced Thai pangus fry through artificial breeding at 1993 (Sarker, 2000).In recent year Thai pangus is well linked enormously and many thai pangus hatchery have been established all over the country. Depending on the availability of fry, the monoculture system of *P. hypopthalmus* has been widely spread over Bangladesh.The fish farmers all over the country are too much interested to culture thai pangus due to availability of fry.

Thai pangas (*P. hypopthalmus*) considered a great aquaculture potential. Like other cultivated catfishes, *P. hypopthalmus* is well known for its faster growth, easy culture system, high disease resistance and tolerance of a wide range of environmental parameter (Bardach et al., 1972 and Stickney, 1979). It has great advantage over other catfishes because of its high consumer's acceptance and lucrative price. Bardach et *al.* (1972) reported that *P. sutchi, P lanaudi, P. sanitwangsei* has been extensively culture in Thailand, Cambodia and Vietnam both in earthen ponds and in cages, where it reaches upto 3.0 kg in two years. Tavarutmanegul *et al* (1979) reported that *P. sutchi* is one of the most suitable catfishes for rearing in warm water ponds and cages.

Considering the national need of increasing fish production, monoculture of pangas was started because of its higher growth rate. The yield of fish per pond area or per culture unit depends to a large extent on the amount of supplementary feed used. In balanced diet is the prime subject in Thai pangas culture and major expenditure gone in fish feed. To increase fish production it is mostly depend on supplemental feeding.

Chapter Two

Literature Review

Chapter-2

Literature Review

Hannan *et al.* (1988) carried out a preliminary study on the culture of *P. pangasius* for a period of 7 months in a 1970 m^2 pond at the riverine station, Bangladesh Fisheries Reasearch Institute, Chandpur. But they found poor growth as it attained average increment of 196.5 g. The total production was 1472 kg/ha. Lafont and Savoeun (1951) achieved a production of 20 metrict tons of *P. sutchi* and *Pangasius larnaudi* in three cages measuring $9\times4.5\times2m^2$ each, installed in a pond of Cambodia in 8 to 10 months rearing period.

Shoilmari Agro-Complex (2000) conducted a semi-intensive culture of *P. hypopthalmus* with a stocking density of 8,000-10,000/acre with a negligible number (200-300) of carp (catla and rohu). Carp become 1-1.5 kg within 10 months and total production was 8-10 Mt. /acre. David (1962) described *Pangasius Pangasius* as highly tolerant to salinity, pH, dissolve oxygen, turbidity, temperature or even pollution. The culture of this species in ponds was first observed by David in Khulna in the East Bengal during 1945.

Hickling (1962) conducted an experiment with *pangasius* weighting 80 to 100g in floating bamboo cages (40-75m ×2m) installed a river banks with a stocking rate of 46 to 100 fish/m3 which reached 1.0 to 1.2 kg in 8 to 10 months rearing period. Anonymous (Gazi fish farm annual report, 2003) conducted a semi-intensive culture of P. *hypophthalmus* with a stocking density of 8,000-10,000 with a 1000 number

rohu/acre. Carp become 1-1.5 kg within 10 months and total production was 8-10 Mt. /acre.

Aizam *et al.*, (1983) conducted a trial on the growth of *P.sutchi* fingerlings fed on a diet of rice-bran as the control and diets containing 20%, 30% and 40% protein. Satisfactory increase in growth was observed in fingerlings fed at all three levels of protein. However, fingerlings fed with 30% protein showed the best growth. Chaupochuk and pothisong (1983) reared catfish (*P. sutchi*) through feeding with artificial diets of different protein levels and reported that a diet containing 25% protein was best optimum growth.

Rashid *et al.*, (1996) conducted an experiment to prepare a low cost feed for cage culture of *P. sutchi* (Fowler) at BAU. In this study two isonitrogenous diet (about 30% protein) were formulated with locally available ingredients. In feed B about 10% fishmeal was replaced by 10% soybean meal. The cost of two feed were Tk 15.55/kg and Tk 14.05 /kg respectively. In this study the variation in weight gain of fish under different dietary conditions were not statistically significant.

Anonymous (2001) conducted an experiment on low cost feed for culture of Thai pangas in cages at Chadpur Irrigation Project (CIP) canal in Baharia, Chandpur (BERI and BRAC joint venture programs). In that experiment the stocking density was 100/m2 in all the treatment. Three different feeds were selected as three treatments. Formulated feed composed of rich bran (25%), wheat bran (25%), mustard oil cake (30%) and fishmeal (20%). Treatment T1 was 100% formulated feed and treatment T2 was equal mixture of Saudi- bangle pangas feed and formulated feed (50:50) and Saudi- bangle pangas feed 100% was treatment T3. In that experiment the highest mean weight gain 86.5 g was observed after four months culture period in T3 and the

highest total production was also found in T3.But the different among the three was very little and finally they concluded that for pangas culture in cages low cost feed should be developed through broad base research. Golder *et al.* (1996) reported Thai pangas is a hardy fish and can adapt to the freshwater environment, In case of cage culture, the survival of this fish species was reported to above 90%.

Subagia *et al.* (1999) stated that two experiments were carried out at research Institute for freshwater Fisheries, Indonesia, in order to better understand the evolution and causes of mortality of *P. hypopthalmus* larvae from hatching up to 8 days of age and to find measures to improve survival rates. The results indicated that the survival rates of *P. hypopthalmus* larvae was dependent on the initial quality of larvae or eggs and that larval mortality was more a consequence of pathogenic infection than a direct effect of cannibalism..

Powell (1972) reported the harmful effects of higher stocking density on the culture of fish. According to him increased stocking density lead to reduced growth and survival rates and an increase of food conversion ratio. Allen (1974) studied the growth and survival of channel catfish (*Ictalurus punctatus*) at five stocking densities and five water exchange rates in circular tanks containing 1.6 m^3 of water and reported that the net yield increased as stocking density increased up to 540 fish/m^3, then the same declined at higher densities. He also pointed out that water exchange rates of 1.5 ha or greater achieved similar results at stocking densities of 180 and 360 fish /m^3 but at a density of 540 fish/m^3 faster exchange rate of water resulted in increased growth, feed conversion efficiency and survival.

Chaitaiamvong (1977) studied the floating cage culture of *P. sutchi* in Thailand and achieved a production of 60 kg/m^2/year with stocking density of 25-40 fishes/m^2 in floating net cases and 30 to 50 kg/m^2/year from *Tilapia nilotica* with stocking density of 110-120 fishes/m^2. Backiel and Le Cren (1974) concluded that stocking density of fish is an important parameter which directly affected the growth, production and yield of fish.

Chaudhuri *et al.* (1978) reported that fish production by application of composite fish culture technology in ponds, with high stocking density of13320 fingerlings per hectare. The ponds recorded average gross and net productions of 7633.50 and 7444.00 kg /ha/yr , which was about 7 times higher than the normal production of around 1000 kg/ha/yr reported by the ordinary fish farmers.

Ghosh and Singal (1981) studied the digestive enzymes of *P. pangasius* in relation to its food habit and stated that the species is not a predator and can live, even grow, in ponds with low oxygen level. Baily and bhuyan (1982) obtained the highest production of 6000 kg/ha/yr in semi-intensively management ponds in Noakhali district by supplying inorganic fertilizers compost and supplemental feed. Supplemental feed was a mixture of rice bran and oil cake in 1:1 proportion.

Chuapoehuk and pothisoong (1983) reared catfish fry (*P.sutchi*) through feeding artificial diets of different protein levels and reported that a diet containing 25% protein was best for optimum growth. Pathmasothy and Jin (1987) observed lower growth rate of *P.sutchi* lower when fed with pellet feed having 22% crude protein compared to those having 32% crude protein. He observed that *P.sutchi* needs high crude protein content in their food.

Thakur *et al.* (1987) reported that *P. pangasius* , the only species of the genus in India, was an important component of catfish fauna of their major river systems and enjoyed a fishery of considerable commercial value. Its while, creamy flesh with fewer intramuscular bones had a special appeal to the consumers. *P. pangasius* become a useful biological agent for controlling excessive multiplication of mollusks in ponds, thereby checking mollusk-borne disease.

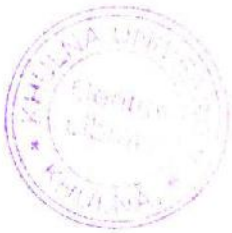
Rahman (1989) conducted an experiment to study the growth performance of *P. pangasius* in ponds on three different feeds. He found that the growth of fish was obtained at 40% protein level in a feed containing cow viscera, mustard oil- cake, wheat bran and rice bran. He also suggested cow viscera an effective substitute of fish meal as a source of dietary protein of *P. pangasius.*

Mollah and Sarder (1991) reported the growth responses and production of *P. pangasius* of 20.2g under two dietary conditions for a six months rearing period in the ponds. Rahman *et al.* (1992) conducted an experiment with two species of riverine catfish, *P. sutchi* and *P. pangasius* of size7.5 ± 0.7 cm in length and 15.5 ± 2.8 g in weight in the freshwater ponds under identical management practices.

Sarder (1992) carried out an experiment on the growth and survival of *P. pangasius* under three different dietary conditions each containing same percentage of protein (30%) in which fish meal was the main protein source. However in diet 1, 7.5% of the total protein was replaced by sesame oil-cake and in diet 2, same percentage was replaced by mustard oil-cake while diet 3 was a commercial feed having same percentage of protein. He observed that the growth and survival rate were higher in case of diet 1 and 2 than 3 but there was no significant difference between diet 1 and 2.

Chapter Three

Materials & Methods



Chapter-3

Materials and Methods

A four months study on the growth performance of Thai pangas (*p. hypopthalmus*) was conducted in the village Siromony, Thana Khan jahan ali, District Khulna. Nine ponds were chosen to conduct the experiment where the average depth of the pond varied from 1.2 m to 1.5 m. The fingerlings, collected from a hatchery in Jessore, same age group fingerlings having an average length and weight of 12 cm and 13 g respectively were stock in the ponds at different stocking density.

3.1 Pond preparation

After selecting the ponds were properly prepared before stocking the fingerlings. In brief, the dikes and holes were repaired, all kind of aquatic vegetation were removed manually and the predatory and undesirable fishes were eradicated by netting repeatedly and cleaned by poisoning with rotenone at the rate of 5ppm. Liming was done immediately at the rate of 250 kg/ha. Before applying lime, it was mixed with water carefully and finally spread over the surface of the mud in a soluble form. Three days after liming, all the ponds were fertilized with cow dung at the rate of 2900 kg/ha. After 5 days of applying cow dung chemical fertilizers viz. urea and TSP were applied in all the ponds at the rate of 22kg/ha and 15 kg/ha respectively.

3.2 Design of experiment

The experiment was conducted in three treatments (treatment-I, treatment-II, treatment-III) each having three replicates, where ponds were selected randomly to

avoid biasness. The fingerlings were released at three stocking densities of 100, 150 and 200 individuals/ decimal in the ponds of treatment-I, treatment-II, and treatment-III respectively. Prior to the releasing of the fingerlings in the ponds, it was well acclimatized to overcome the initial shock.

3.3 Feed

Three different iso-priced diets comprising of different ingredients in different proportions were used for the experiment (Table1 and Table2). The feed ingredients were collected from the local market and the proximate composition was calculated according to National Research Council (1983).The costing and proximate composition of the different feed ingredients is given bellow:

Table 1. Costing and proximate composition of different feed ingredients.

Ingredients	**Cost (Tk/kg)**	**Proximate Composition**				
		CP	EE	CF	Ash	NFE
Mustard oil cake	12	37	1.7	12	6.8	42.5
Wheat bran	11	13.9	8.3	13.1	4.6	60.1
Rice bran	9	12.4	16.7	12	14.1	44.8
Fish meal	26	44.1	11	0	44.9	0
Soybean meal	20	47.5	6.4	5.1	6.4	34.6
Wheat flour	10	13.1	3.5	6.8	3.7	72.9
Vitamins	155	0	0	0	0	0
Salt	10	0	0	0	100	0

Table 2. Formulation, price and proximate analysis of different experimental diets.

Ingredient	Feed-1	Feed-2	Feed-3
Mustard oil cake	10	15	25
Wheat bran	20	15	15
Rice bran	30	25	10
Fish meal	35	25	10
Soybean meal	0	15	35
Wheat flour	4.7	4.7	4.7
Vitmins	0.1	0.1	0.1
Salt	0.2	0.2	0.2
Cost(Tk/kg)	**15.85**	**15.85**	**15.80**
Proximate analysis			
CP	26.25	29.50	34.23
EE	10.85	9.55	6.84
CF	7.74	7.85	8.27
Ash	21.92	17.79	10.90
NFE	33.14	35.21	39.66
Digestible energy (kcal/100g)	311	322	336

CP= Crude protein, EE=Ether extracts, CF=Crude fiber, NFE= Nitrogen free extracts.

DE (Digestible energy kcal/100g) was calculated assuming the value of protein= 4.5 kcal/g, Ether extracts= 8.0 kcal/g and carbohydrates= 3.2 kcal/g. (Halved, 1989)

3.4 **Feeding rate**

The feed was supplied at a rate of 10% body weight of fish at the beginning of the experiment. Then it was adjusted to 8% after 2nd sampling and gradually it was readjusted to 7% and 6% of their body weight, after the 4th and 6th sampling respectively.

3.5 **Sampling procedure**

Sampling was done in fortnight intervals. In each sampling 10% fish from each pond was caught by hand lift net .The total length was measured by using ordinary scale and weight was taken by a electric balance. Finally complete harvesting was done by netting.

3.6 **Water quality parameters**

The water quality parameters such as temperature, dissolved oxygen and pH were recorded on each sampling dates at 9.00 to 10.00 am. The temperature and dissolved oxygen was determined by DO meter (YSI Model-58, USA) and pH was recorded by pH meter (HANNA, Model445, UK)

3.7 **Growth parameters**

Different growth parameter were calculated using following formula

3.7.1**Weight gain**

Weight gain was calculated as:

Weight gain (g) = Mean final weight –mean initial weight

3.7.2 **Specific growth rate (SGR, % day)**

Specific growth rate is the instantaneous change in weight of fish calculated as the percentage in increase in body weight per day over given time interval. Growth in terms of weight was calculated by subtracting the initial weight of fish from final weight of the same after. The specific growth rate was calculated from the following formula:

$$SGR = \frac{\text{Ln } W_2 - \text{Ln } W_1}{T_2 - T_1} \times 100$$

Where, W_1= the initial live body weight (g) at time T_1 (day)

W_2= the final live body weight (g) at time T_2 (day)

3.7.3 **Food conversion ratio (FCR)**

Food conversion ratio is the amount of dry feed fed per unit of live weight gain. It was determined by the following formula:

$$\text{Food conversion ratio (FCR)} = \frac{\text{Weight of dry food fed}}{\text{Live weight gain}}$$

3.7.4 **Protein efficiency ratio (PER)**

Protein efficiency ratio is a measure of the weight gain per unit protein fed and is a useful method to compare protein sources in a single experiment.

$$\text{Protein efficiency ratio (PER)} = \frac{\text{Weight gain (g)}}{\text{Protein fed (g, dry weight basis)}}$$

3.7.5 **Survival rate**

The survival rate of fishes of each species for each treatment was calculated as

$$\text{Survival rate} = \frac{\text{No of fish harvested}}{\text{No of fish stocked}} \times 100$$

3.8 **Statistical analysis**

Statistical analysis of the data obtained during the investigation was tested to observe whether the influence of stocking densities and different feed on the growth performance of Thai pangas (*P. hypopthalmus*) were significant or not.

The data obtained from different treatments were tabulated and analyzed using one way ANOVA followed by Duncans Multiple range Test (DMRT) using SPSS®12.0 suited for Windows®. Microsoft Word and Excel for Windows® were used to tabulate data.

Chapter Four

Results

Chapter-4

Results

The results of the experiment that was carried out for a period of four months to evaluate the effect of different feeds on the growth performances of Thai pangas (*P. hypopthalmus)* at different stocking densities in ponds are given below:

Water quality parameters

The water quality parameters such as temperature, pH and dissolved oxygen of all the treatments were recorded fortnightly during the experimental period and the results are shown in table 3.

Temperature

The mean values of water temperature in different ponds during the study period varied from 30.4 to 31.8^0 c. The minimum (30.4° C) and maximum (31.8° C) temperature was recorded on 15 March and 15 July respectively.

pH

The mean value of water pH in different ponds during the study period varied from 7.2 to 8.2. The maximum pH (8.2) in treatment-III and minimum pH (7.2) in treatment-I were observed.

Dissolved oxygen

The mean value of dissolved oxygen in different treatments during the study period varied between 5.3 to 6.3 mg/l. The maximum dissolved oxygen (6.3) was recorded 31 May in all the ponds and the minimum dissolved oxygen (5.3) was recorded on 31 March in treatment-III.

Table 3. Water quality parameters of different treatments.

Treatments		15 March	31 March	15 April	30 April	15 May	31 May	15 June	31 June	15 July
T-I	Temperature(°C)	30.4	30.6	30.9	31.1	31.2	31.3	31.4	31.6	31.8
	Dissolved oxygen (mg/l)	5.60	5.40	5.60	6.00	5.80	6.30	6.00	5.90	5.80
	pH	7.80	7.90	7.60	7.90	8.00	7.80	7.40	7.20	7.50
T-II	Temperature(°C)	30.4	30.6	30.9	30.1	31.2	31.3	31.4	31.6	31.8
	Dissolved oxygen (mg/l)	5.60	5.40	5.50	6.00	5.80	6.30	6.00	5.90	5.80
	pH	7.80	7.90	7.60	8.00	8.00	7.80	7.40	7.30	7.50
T-III	Temperature(°C)	30.4	30.6	30.9	30.1	31.2	31.3	31.4	31.6	31.8
	Dissolved oxygen (mg/l)	5.60	5.30	5.60	6.00	5.80	6.30	6.00	5.90	5.80
	pH	7.80	7.90	7.60	8.00	8.20	7.80	7.40	7.30	7.50

Values are the mean of the triplicates.

Growth performances

Data on the growth performance of *P. hypopthalmus* in terms of length and weight gain under three different treatments for a period of 4 months (15March to 15 July, 2009) has been presented in Appendix I. The growth performance of fish in different treatments were evaluated in terms of initial weight, weight gain, specific growth rate (SGR%/day), food conversion ratio(FCR), protein efficiency ratio(PER) and survival rate(%) are shown in Table 4.

Table 4. Growth performance of *P. hypopthalmus* at different treatments.

Growth parameters	Treatment		
	T-I	T-II	T-III
stocking density	100	150	200
Initial weight (g)	13.00[a]	13.00[a]	13.00[a]
Weight gain (g)	402.7 ± 2.08 [a]	347.0 ± 3.60 [b]	299.0 ± 2.00 [c]
Specific growth rate (%day)	2.89 ± 0.005 [a]	2.77 ± 0.005 [b]	2.65 ±0.005 [c]
Food conversion ratio (FCR)	1.29±0.02 [b]	1.34 ± 0.02 [a b]	1.40 ± 0.05 [a]
Protein efficiency ratio (PER)	2.94 ± 0.04 [a]	2.51 ± 0.04 [b]	2.08 ± 0.07 [c]
Survival rate (%)	94.00 ±0.73 [a]	90.66 ± 1.33 [b]	91.66 ± 1.26 [ab]
Production (kg/decimal)	39.07±0.87 [c]	48.96 ± 0.97 [b]	57.20 ± 1.15 [a]

Value in the same raw having different superscripts show significant difference ($P<0.05$); value are the mean ± standard deviation of triplicates.

Weight gain

The weight gain of fish showed significant ($P<0.05$) difference among the treatments. The highest weight-gain obtained in treatment-I (402.7 g) and a gradual decrease in weight observed in treatment-II and treatment-III. The lowest weight gain was observed (299.00 g) in treatment III.

Specific growth rate (SGR)

The specific growth rate of pangas also showed significant (P <0.05) difference among the treatments. The highest SGR was obtained in treatment-I (2.89 % day^{-1}) and a gradual decrease in values were observed in treatment-II and treatment-III respectively. The lowest was observed (2.65% day^{-1}) in treatment-III.

Food conversion ratio (FCR)

The food conversion ratio varied from 1.29 to 1.4. The lowest FCR (1.29) was obtained in treatment-I that significantly (P<0.05) differed from treatment-III (1.40), the highest. Treatment-II did not show any difference with either treatment-I or treatment-III.

Protein efficiency ratio (PER)

Protein efficiency ratios ranged from 2.94-2.08 that showed significant difference (P<0.05) among the treatments where treatment-I was the highest and gradually it decreased in treatment-II and treatment-III.

Survival rate (%)

The survival rate of pangas was lowest (90.66%) in treatment-II significantly (P<0.05) differed with treatment-I (94.00%). No significant (P>0.05) difference in survival rate observed either between treatment-I and treatment-III or treatment-II and treatment-III

Length-weight relationship

A comparison of total length and weight gain among the treatments was done. The maximum length and weight gain was observed in treatment-I and it decreased gradually in treatment-II and III (Figure 1 and 2).

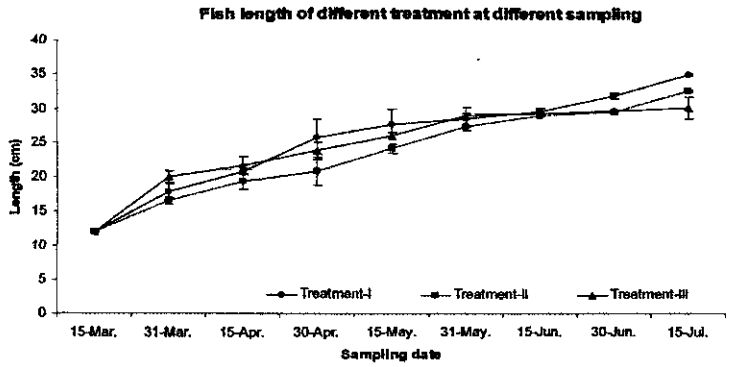


Figure 1: Total length of *P. hypopthalmus* at different sampling dates

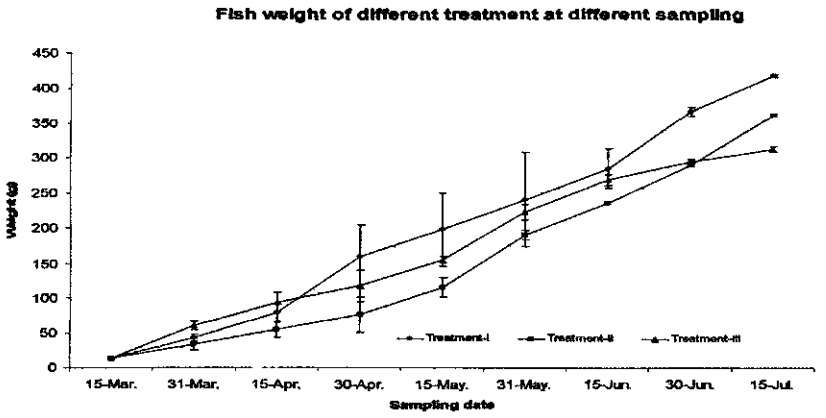


Figure 2: Weight gain of *P. hypopthalmus* at different sampling dates.

A highly positive co-relation between length-weight was observed in all treatments although highest relation observed in treatment-I (r^2= 0.9957) and gradually deceased in treatment-II (r^2= 0.99521) treatment-III (r^2= 0.9911) where the regression lines are

$y = 0.0027\ x^{3.3863}$, $0.0027x^{3.34004}$ and $0.0027x^{3.4286}$ for the treatment-I, II and III respectively (Figure 3).

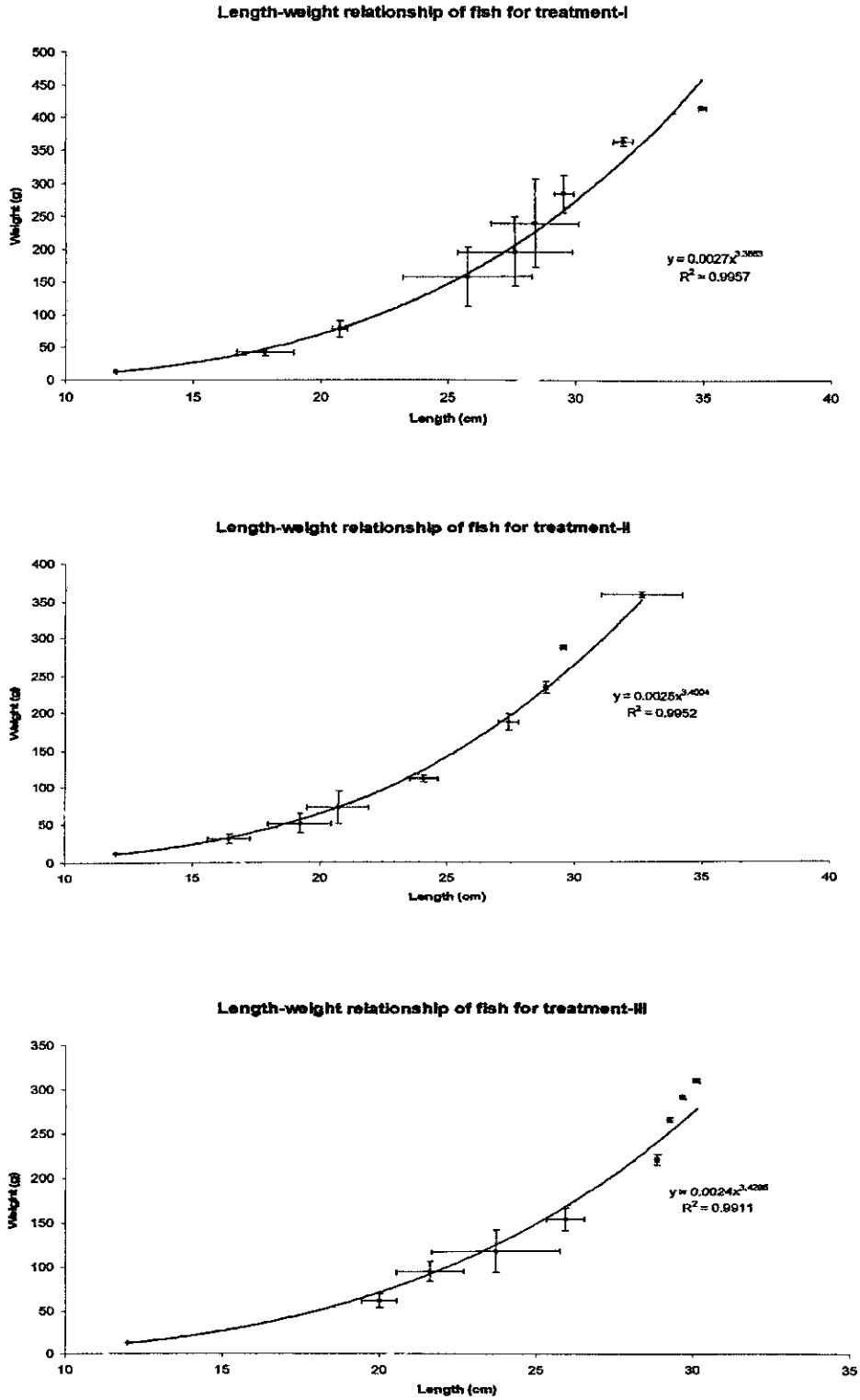


Figure 3: Length (cm)-weight (g) relationship of *P. hypopthalmus* for three treatments.

Chapter Five

Discussion

Chapter-5

Discussion

Water quality parameters play an important role in fish production. The physico-chemical parameters of water did not fluctuate much among the treatments and were within the limit congenial for the growth of fish (Table 3.).

A little variation in temperature among the treatments observed throughout the experimental period that ranged from 30.4-31.8° C. Generally 25-30° C ranges are considered to be optimum for worm water fish culture (Sarker, 2000). Pangas stop their consumption of feed below the temperature 11° C and also decrease 50% feed consumption above 35° C (DOF, 2001). The ranges of temperature values in this study were suitable for pangas culture

The mean value of water pH in different ponds during the study period varied from 7.2 to 8.2. Sarker (2000) observed that the range of pH value 7-8.5 is suitable for fish culture but fish died when pH reached more than 11. Andrew *et al.* (1972) stated that waters having a pH range from 6.7 to 8.6 are generally support a good fish population. The ranges of dissolved oxygen (DO) level at surface water in different treatments varied between 5.3 to 6.3 mg/L. Mckee *et al.* (1963) stated that DO for warm water fish should not be less than 5.0 mg/L, at least 16 hour of any day.

Growth of *P. hypopthalmus* in ponds was investigated in this experiment. The results indicated that the growth rate varied in different stocking densities and feed (Table2, Table 4.). Stocking density and feed protein (%) and energy (DE, kcal/100g) for treatment-I, II and III were 100, 26.25 and 3111; 150, 29.50 and 322 and 200, 34.23

and 336 respectively. Treatment-I showed the significantly ($P<0.05$) highest growth performance than treatment-II and III. The present experiment showed the highest growth rate in treatment-I where the stocking density was the lowest. On the other hand the lowest growth was obtained in treatment-III with high stocking density (200/fish/decimal). The Present result is similar to that of the findings of Alikunhi (1957), Kawamoto *et al.* (1957) and Haque *et al.* (1984) who achieved best growth from a lower stocking density. In contrary, Weatherly (1976) stated that there was no general certainty that fish would grow more rapidly in the lower population density. The only probable explanation is that the fishes could take feed properly without competition. Rahman (1989) found similar result from the study of growth performance of *Pangasius pangasius* in ponds on three different feeds. He observed that the growth of *Pangasius pangasius* increased with the increment of protein concentration and highest growth of fish was obtained at 40% protein level in feed containing cow viscera, mustard oil cake, wheat bran and rice bran. The findings of his study differ with the present experiment. However, it is not clear whether stocking density or protein level affected the growth of this species.

The net weight gain of individual fish in treatment-I was higher (402.67g) than those of treatment-II (347.00g) and III (199.00g). Bardach *et al.* (1972) observed in Thailand that, *Pangasius larnandi* attained an average weight of 0.45 kg on the termination of one year and 1.0 kg in two years when stocked at 25 fish /m^3, while *P. sutchi* attained 4.0 kg in two years. Sarder (1992) obtained a production of 588.72 to 1901.79 g /m^2 of Pangas (*Pangasius Pangasius* Ham.) in six months when stocked at a rate of 3-6 fishes / m^2.

Protein efficiency ratios ranged from 2.94-2.08. Treatment-I showed the highest and gradually it decreased in treatment-II and treatment-III. Azimuddin (1998) found that the growth of *P. sutchi* ranged between 1.43 to 1.69 in three months cage culture.

The percent of survival recorded was 94.09, 92.25 and 90.14 treatment I, II and III respectively. Azimuddin (1998) found the range of survival range of *P. hypopthalmus* monoculture was 94%-96% in case 92%-95%. Hossain (2001) also reported similar survival rate (90.14 to 94.09) for Thai-pangas (*P. hypopthalmus*) with best growth was achieved when fed them 30% protein based supplemental diet with a stocking density of 100 fish/ decimal.

Weight-length relation for the treatment-I, II and III was $y = 0.0027\ x^{3.3863}$, $0.0027x^{3.34004}$ and $0.0027x^{3.4286}$ respectively (Figure 3.). This result is in agreement of the general rule of growth of fin-fish (Halver, 1989). High production was obtained in treatment-III (57.2 kg/dec) which might be due to higher number of fish (Table 4.). Shoilmari Agro-Complex (2000) conducted a semi-intensive culture of *P. hypopthalmus* with a stocking density of 8,000-10,000/acre with a negligible number (200-300) of carp (catla and rohuand obtained a total production of 8-10 Mt. /acre. The present result is also in supports of the findings of Dimitrov (1976) who achieved the best production from stocking densities (80 fish/m^3).

Chapter Six

Conclusion

The highest SGR was obtained in treatment-I (2.89 % day^{-1}). The food conversion ratio varied from 1.29 to 1.4. The lowest FCR (1.29) was obtained in treatment-I and the highest Treatment-II did not show any difference with either treatment-I or treatment-III. Protein efficiency ratios ranged from 2.94-2.08. Treatment-I was the highest and gradually it decreased in treatment-II and treatment-III. The percent of survival rate recorded was 94.09, 92.25 and 90.14 treatment I, II and III respectively. Highest survival rate (94.00%) in treatment-I significantly ($P<0.05$) differed with treatment-II (90.66%).

The maximum length and weight gain among the treatments were observed in treatment-I than treatment-II and treatment-III and highest strong positive co-relation between length-weight was observed in treatment-I ($r^2= 0.9957$) than treatment-II ($r^2= 0.99521$) and treatment-III ($r^2= 0.9911$).So Treatment-I showed the significantly ($P<0.05$) highest growth performance than treatment-II and III where the stocking density was the lowest. However highest production was achieved in treatment-III where the stocking density was highest. The study shows that Thai-pangas is a suitable species for pond culture with practical diet. High density culture does not affect the survival of this species. The suitable stocking density would be 200 individuals /decimal with a satisfactory higher production.

Chapter Seven

References

Chapter-7

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Chapter Eight

Appendix

Chapter-8

Appendix -I

Length weight data of *Pungasius hypopthalmas*																			
Sampling		15-Mar		31-Mar		15-Apr		30-Apr		15-May		31-May		15-Jun		30-Jun		15-Jul	
Treatment		L (cm)	Wt. (g)	L (cm)	Wt. (g)	L (cm)	Wt. (g)	L (cm)	Wt. (g)	L (cm)	Wt. (g)	L (cm)	Wt. (g)	L (cm)	Wt. (g)	L (cm)	Wt. (g)	L (cm)	Wt. (g)
	1	12	13	16.8	38	20.4	63	22.8	106	25	136	26.4	161	29.1	252	32.1	370	34.8	414
T-1	2	12	13	17.7	41	20.8	84	27	179	28.9	222	29.4	278	29.7	296	31.4	357	35.1	418
	3	12	13	19	48	21	87	27.4	190	28.9	232	29.4	279	29.8	305	32	368	34.9	415
	1	12	13	17.4	40	20.5	69	22	99	24.6	119	27.8	200	28.8	243	29.4	286	31.5	359
T-2	2	12	13	15.9	28	18	43	19.6	56	23.5	110	27	178	28.9	228	29.6	293	31.8	364
	3	12	13	16	31	19.1	49	20.5	70	24	113	27.3	187	28.9	233	29.6	289	34.4	357
	1	12	13	20.5	68	22.8	106	25.5	142	26.5	167	28.9	229	29.2	269	29.6	292	30	310
T-3	2	12	13	19.4	52	20.7	83	21.5	92	25.3	140	28.8	217	29.3	270	29.7	296	30.1	312
	3	12	13	20.1	59	21.4	91	24.2	115	26	152	28.8	220	29.2	265	29.6	293	30.2	314

Appendix -II

Growth parameter of different treatments												
		Stocking	Harvest	Final wt	wt. gain(kg)	Total wt.gain	Feed(kg)	protein(kg)	SGR	FCR	PER	Survival
	1	100	92	414	0.401	36.892	48.6	12.7575	2.8840972	1.317358777	2.891789144	92
T-1	2	100	95	418	0.405	38.475	49.18	12.90975	2.8921101	1.278232619	2.980305583	95
	3	100	95	415	0.402	38.19	49.05	12.87563	2.8861076	1.284367636	2.966069608	95
	1	150	138	359	0.346	47.748	64.18	18.9331	2.7653109	1.344140069	2.521932489	92
T-2	2	150	136	364	0.351	47.736	63.4	18.703	2.7768371	1.328138093	2.55231781	90.66666667
	3	150	134	357	0.344	46.096	63.01	18.58795	2.7606554	1.366929885	2.479886163	89.33333333
	1	200	181	310	0.297	53.757	78.01	26.70282	2.6430191	1.451159849	2.013157935	90.5
T-3	2	200	183	312	0.299	54.717	77.04	26.37079	2.6483782	1.407971928	2.07490924	91.5
	3	200	186	314	0.301	55.986	75.8	25.94634	2.653703	1.353909906	2.157760979	93