http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 8 (5): 766-770, 2005
ISSN 1028-8880

The Impacts of Compensatory Growth on Food Intake, Growth Rate and Efficiency of Feed Utilization in Thai Pangas (*Pangasius hypophthalmus*)

A.K.M. Rohul Amin, [1]M.A.J. Bapary, [1]M.S. Islam, [2]M. Shahjahan and M.A.R. Hossain
Department of Fisheries Biology and Genetics, [1]Department of Fisheries Technology,
[2]Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

Abstract: An eighteen weeks long experiment was conducted during the month of June to October, 2002 to observed the effect of different period of starvation and subsequent refeeding on growth, daily food demand and food conversion ratio of Thai pangs *Pangasius hypophthalmus*. Fish maintained in four treatments were either: fed to satiation twice a day (control-A), fed every alternate day (1:1-B), starved two days followed by spell of two days feeding (2:2-C) and starved for 5 days following 5-day feeding (5:5-D) at a sticking density of 100 fingerlings per decimal at 28±1.54°C. Thai pangas responded to a change from a restricted to satiation feeding showing a higher daily feed demand compared to their counterparts raised on a liberal feeding regime. The total feed demand of fish in controlled treatments was, however, much higher than the fish in the other three treatments. Nonetheless, fish that fed to satiation on alternate day (1:1) had similar body weights to the controls and were larger than those exposed to 2 or 5 days of feed deprivation (2:2 or 5:5). There was no significant difference in specific growth rate of fish in the treatments A and B over the experimental period. The highest FCR was found in treatment A (control) where fish were fed to satiation twice a day. The study provided evidence that Thai pangas would be cultured in feeding regime with feeding every alternate day without any significant difference in fish size and final production. As farmers have to give less feed in the system they can manage water quality in better way.

Key words: Compensatory growth, *Pangasisus hypophthalamus*, food conversion ratio, condition factor

INTRODUCTION

Stripped cat fish, *Pangasius hypophthalmus* is commonly known as Thai pangas, which belongs to the Family Pangasiidae, under the order Siluriformes. Roberts and Vidthayanon[1] reported that the origin of *Pangasius hypophthalmus* was from the Mekong river of Vietnam to the Chao Phraya River of Thailand and then their distribution was spreaded to other countries such as Malaysia, Indonesia and China. It was initially introduced into Bangladesh in 1990 under the Ministry of Fisheries and Livestock (MOFL) from Thailand. Among the 14 cultivable exotic species in Bangladesh, the Thai pangas has highest growth in all types of water bodies with supplemental feeding.

Thai pangas as a quick growing species can be grown in the fish pond. Because of its year round production, quick growth and high productivity Thai pangas culture has proved itself as a profitable enterprise in a new aspect for our country. Basically Thai pangas culture in the pond is a new technology. For Thai pangas culture, right method should be followed to obtain higher yield. The climate, water and soil condition of our country have proved totally suitable for Thai pangas culture. It is possible to produce Thai pangas fish in the pond where water remains for 4 to 5 months. Within this period the fish gain weight above 500 g and becomes ready for marketing. So, owing to its taste, popularity and large production capacity as compared to *Carp* species only Thai pangas can be a great fulfil the total demand of animal protein of the country.

Compensatory growth is defined as a phase of usually rapid growth, following a period of under nutrition[2,3]. Through this growth spunt, animals subjected to previous nutritional restriction may partially or completely catch up in body size with those that have not undergone food restriction[2,4,5]. Compensatory growth in fish is not only of theoretical interest, but may also have application in aquaculture[3,6,7] as appropriate exploitation of this phenomenon may result in increased growth rate and feed efficiency.

Growth rates of fish may be highly variable and, in many cases, appear to be limited by food availability. Compensatory growth has long been known as existed in a number of fish species. Following a period of either slow growth due to moderate or severe starvation, fish can rapidly re-attain their pre-starvation size and are then able to grow at a similar rate to that of controls which were well

Corresponding Author: M. Shahjahan, Lecturer, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh E-mail: shahjahanm75@yahoo.co.uk

fed. In addition, formerly starved or slow rationed fish always tend to reach a dry weight content during recovery growth which exceeds that of control.

Increased Thai pangas production can help meet the increased domestic demand for fish and also to meet protein availability. Therefore, research work needs to be undertaken on the management of Thai pangas culture which would be helpful in planning and setting up strategies for future development of the country. Unfortunately, commercial pond culture of Thai pangas has become less profitable in present time due to high feed cost. It is found that Thai pangas take very little natural food and depends mainly on artificial feed. Therefore, it is a burning need to develop scientific technique of reducing feed cost to make Thai pangas culture sustainable and profitable in our country. As a result, study of compensatory growth response of Thai pangas is very essential.

However, the objectives of this experiment were to study the effect of growth compensation in Thai pangas culture and;

a) To reduce the food cost
b) To obtain the same or better result using less feed
c) To obtain the harvestable size of fish in expected time when demand and price are high
d) To prepare fish for facing natural feed shortage or deprivation period incase of releasing fish seed to the open water bodies for stock enhancement
e) To increase resistance power of fish for survival in food scarce and
f) To prepare fish for facing natural feed shortage or deprivation period in case of releasing fish seed to the open water bodies for stock enhancement

MATERIALS AND METHODS

Eight earthen ponds situated at the field laboratory of the Faculty of Fisheries, Bangladesh Agriculture University, Mymensingh, were used for this experiment. The area of each pond was 1.5 decimal with an average depth of about 1.5 m. All ponds were similar with shape, size, depth, contour and bottom type. The ponds were free from aquatic vegetation, completely independent and well exposed to sunlight. The main source of the water of ponds were rainfall but had facilities to supply water from a deep tube-well using a flexible plastic pipe where ever it was felt necessary.

The experiment was carried out for a period of 18 weeks between 20 June to 5 October, 2002 each with two replications. The experiment commenced with the establishment of groups of fish held according to the following feeding regime.

Treatments:
A: No deprivation. Hand fed to satiation twice per day
B: 1 day deprivation, 1 days feeding
C: 2 days deprivation, 2 days feeding
D: 5 days deprivation, followed by 5 days feeding

Growth and production of fish: The measurement of body dimensions were Total Length (TL) and Weight (W). Fifteen fish from each pond were sampled individually for TL (cm) and weight (g) in every 15-day interval. Specific growth rate (G) was calculated according to the formula: $G = (e^{g}-1) \times 100$ where g represents $(\ln (W_2)-\ln (W_1)) \times (t_2-t_1)^{-1}$ and W_2 and W_1 are individuals weights at days t_2 and t_1, respectively. The condition factor (F_c) was defined as: $F_c = 100 \times W L^{-3}$[8] where, W is the weight (g) of fish and L (cm) is the corresponding total length.

Statistical analysis: One way ANOVAs were used to test the effect of feeding schedule on growth, survival and production of fish. Wherever a significant F resulted from the analysis of variance the Tuky's test was applied to locate difference among treatments and the means were ranked using a computer program (SPSS 10.0 for Windows). Differences were regarded significant when $p<0.05$.

RESULTS

Growth of fish: The initial mean weights were not significantly different ($p>0.05$) among the treatment groups. The mean weight started to differ significantly from second week. The weekly weight increases among treatments A and B were not significantly different over the experimental period except in week 4 and 6. From the 8th week, there were visible and highly significant difference in weight gain between treatments A and B and treatments C and D. At the end of the experiment, mean body weight of the fish that were feed at alternative days (Treatment B) was still numerically lower than that of the controls (Treatment A), but the difference was not significant. (Table 1).

Total lengths in the treatments were not significantly different over the experimental period although there was a tendency of numerically lower growth in fish in treatments C and D than fish in treatments A and B from week 8 until the end of the experiment (Fig. 1).

Specific growth rate: In general, specific growth rates were higher in fish from treatments A and B than the fish from treatments C and D. In treatment A, the SGR decreased gradually with some fluctuations. In other treatments, SGRs fluctuated over the experimental period (Table 2). During Week 10 and 18, growth rate were significantly higher in treatment D than other treatments.

Table 1: Mean individual weight (g) of Thai pangas, *P. hypophthalmus* in four treatments over the experimental period

Treatments/Week	A	B	C	D
0	38.76	40.48	37.34	37.48
2	63.82	62.30	51.82	54.44
4	92.05^{e}	78.71^{b}	75.60^{b}	62.75^{a}
6	124.07^{c}	111.23^{c}	98.88^{b}	80.81^{a}
8	180.08^{c}	165.28^{c}	115.14^{b}	84.66^{a}
10	225.93^{b}	212.34^{b}	146.06^{a}	139.76^{a}
12	323.78^{d}	275.23^{c}	241.88^{b}	180.72^{a}
14	410.13^{b}	390.34^{b}	273.44^{a}	235.34^{a}
16	523.45^{c}	489.09^{c}	313.19^{b}	251.15^{a}
18	575.13^{c}	525.36^{c}	346.43^{b}	288.23^{a}

Table 2: Specific growth rates in fish from four treatments over the experimental period

Treatments/Week	A	B	C	D
2	3.63^{b}	3.13^{b}	2.37^{a}	2.70^{a}
4	2.65^{c}	1.68^{b}	2.73^{c}	1.02^{a}
6	2.15^{a}	2.50^{b}	1.94^{a}	1.82^{a}
8	2.70^{c}	2.87^{c}	1.09^{b}	0.33^{a}
10	1.63^{a}	1.81^{a}	1.71^{a}	3.65^{b}
12	2.60^{b}	1.87^{a}	3.67^{c}	1.85^{a}
14	1.70^{b}	2.53^{c}	0.88^{a}	1.90^{b}
16	1.76^{b}	1.62^{b}	0.97^{a}	0.47^{a}
18	0.67^{a}	0.91^{b}	0.72^{a}	0.99^{b}

Table 3: Condition factor (F_c) in fish from four treatments over the experimental period

Treatments/Week	A	B	C	D
0	0.97	1.01	1.00	0.99
2	0.98^{b}	0.99^{b}	0.86^{a}	0.88^{a}
4	0.92	0.87	0.90	0.84
6	1.14^{b}	1.06^{b}	0.86^{a}	0.76^{a}
8	1.04^{bc}	1.13^{c}	0.92^{b}	0.77^{a}
10	1.06^{bc}	1.12^{c}	0.84^{a}	0.99^{ab}
12	1.14^{bc}	1.19^{c}	1.04^{a}	1.02^{a}
14	1.31^{b}	1.41^{b}	1.04^{a}	0.96^{a}
16	1.42^{b}	1.45^{b}	1.11^{ab}	0.91^{a}
18	1.45^{b}	1.44^{b}	1.04^{a}	0.96^{a}

Mean values with the same letter(s) are not significantly different at $p<0.05$

Table 4: Average production and amount of feed used in each of the 1.5 decimal pond under four treatments

Treatments	A	B	C	D
Fish weight (kg)	69.15	66.52	40.69	34.32
Feed used (kg)	114.11	75.26	59.01	39.16

Condition factors (F_c): Condition factors of pangas were not significantly different initially and until six weeks of the experiment progressed (Table 3). From week 6, treatments C and D showed lower condition factors until the end of the experiment. On the other hand, from week 6 onward, fish in treatment B showed comparatively higher condition factor than the fish in treatment A except in week 18, when the condition factor in two treatments were equal.

Food Conversion Ratio (FCR) and feed used: FCRs varied significantly among the treatments (ANOVA n= 4, $F(3,12) = 11.63$ and $P = 0.73 \times 10^{-3}$) (Fig. 2). The highest FCR (1.65±0.07) was found in the fish in treatment A followed by treatment C and there were no difference in FCR of the fish from treatments B and D.

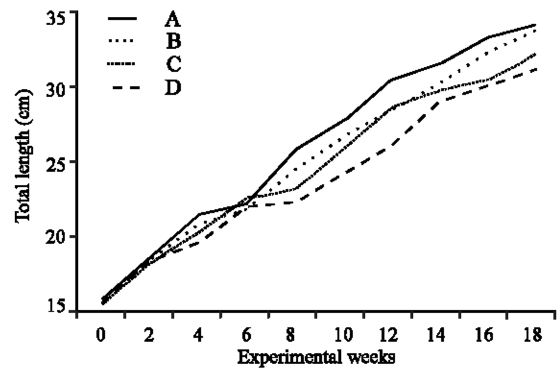

Fig. 1: Mean total length (cm) of Thai pangas *P. hypophthalmus* in four treatments over the experimental period

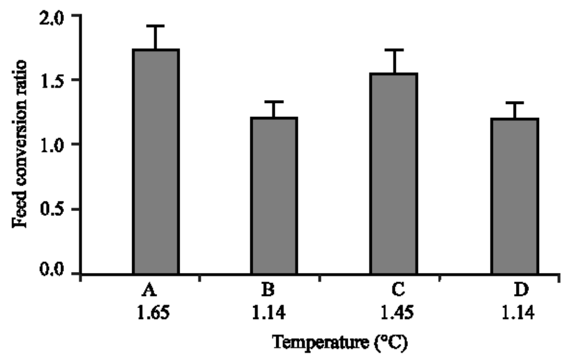

Fig. 2: Feed conversion ratios in four treatments over the experimental period.

In a 1.5 decimal pond under treatment A, it took 114.11 kg feed to grow 69.15 kg of Thai pangas whereas in treatment B, only 75.26 kg of feed needed to produce 66.52 kg of fish (Table 4). Although the FCRs obtained from treatments B and D were not significantly different, final production from treatment B was much higher than treatment D. Production from treatment C was in the third position, however FCR in this treatment was much higher than That found in treatment D. Therefore, comparative production cost was highest in this treatment.

DISCUSSION

Growth: One day feed deprivation appears to be readily overcome by juvenile Thai pangas upon realimentation. Weight lost during the 1-day period of feed deprivation was recovered such that weight gain of restricted and regular-fed fish was the same after the end of the experiment. However, this present show that the Thai pangas used in this study were unable to attain the equal weight to control or 1-day starved fish in more extended feed deprivation period.

The body weight of fish used in Treatment C that were subjected to 2-day starvation and 2-day feeding and in treatment D (5-day starvation and 5-day feeding) were significantly lower than fish in control treatment (treatment A) and in treatment B which were daily fed or fed in alternative day over the experimental period. Complete compensation was recorded within 3 weeks of refeeding in minnows *Phoxinus phoxinus* (bw 1–2 g) after a 16-day deprivation[4] and in adult rainbow trout (very wide size range 6–120 g) after a 3-week deprivation[6]. The inability of Thai pangus deprived for 2 and 4 days to catch up in body weight probably resulted from the relatively weak capacity for compensatory growth coupled with greater weight losses during deprivation. One more explanation could be the period of deprivation was too long for the small size of juveniles used in this experiment. Kim and Lovell[5] observed that adult channel catfish held in ponds could recoup mass loss and attain final weights equivalent to control, satiate-fed fish when deprived of feed for 3 weeks then full fed for 3 weeks, but more extended feed deprivation prohibited the channel catfish from attaining a final weight equal to control fish. A similar finding has been reported for the same species by Gaylord and Gatlin[9]. Hybrid tilapia (4.34±0.03 g) deprived for 1 week had similar body weights to the controls, whereas fish deprived for 2 and 4 weeks had significantly lower body weights than the controls[10]. It is not known whether Thai pangus that were deprived for 2 and 5 days in the present study would eventually catch up in body size with the controls and treatment B with the extension of the refeeding period.

Bilton and Robins[11] found that recovery growth in sockeye salmon fry, *Oncorhynchus nerka*, fully fed after three weeks starvation, was similar to that of fully fed (unstarved) controls. During subsequent recovery growth on full rations, following food deprivation, rainbow trout (6.9-11.6 cm fork length, maintained at 12°C) grew at approximately the same rate as fully fed controls, which had not suffered food deprivation, as regards body weight and condition factor (k), but tended to surpass (exceed) controls in % dry weight[12]. Reimers *et al.*[13] found that second sea winter salmon deprived wholly of their food supplies for as long as two months were able to recover body weight. The growth of starved fish was faster than the unrestricted controls in the month after starvation period, despite a similar ration i.e., the former had the greater feed conversion factor. Pastoureaud[14] observed the compensatory growth in sea bass refed after starvation. In Arctic charr, *Salvelinus alpinus*, the restriction of satiation feeding levels after a period of feed restriction led to sustained hyperphagia[15].

Length of Thai pangas increased regularly irrespective of the effects of treatments. With the trials progressed, fish from treatments C and D became thin to thinner. This confirmed that, when in an adverse situation like feed deprivation, body muscle stops to grow, skeleton, however grows in a normal manner. Nonetheless, as Fig. 1 shows, towards the end of the experiment, the individual length of fish from treatments C and D became gradually lower than that of the fish in treatments A and B.

Specific Growth Rate (SGR) was never negative in this experiment. In addition, in some cases the SGRs in fish from treatments C and D were much higher than the fish in treatments A and B which proved that Thai pangas responded positively in compensatory growth.

From weeks 6 fish in treatments A and B showed gradually increasing condition factor. In case of fish in treatments C and D, condition factors decreased gradually until the week 10 and then again it increased gradually with some fluctuation. However, condition factors were always lower in treatments C and D than in treatments A and B. It proved the fish in control treatment and alternate day treatment were much healthier than fish in other treatments. When condition factors are compared between treatments A and B, they are indifferent throughout the experimental period. It is further prove of the ability of the fish in treatment B to overcome the1-day starvation easily.

Feed Conversion Ratios: The highest FCR found in control treatment where fish were fed twice a day regularly proved that lot of feed wastage in this treatment. Unfortunately this is the common practice in fish culture all over the country. It needed approximately 50% more feed in case control treatment than the feed needed in alternate day feeding (treatment B) to produce almost same amount of fish. As feed is the most expensive item in rural aquaculture, all concerned people should think twice about following the commonly practiced two or three times feeding a day.

Feed cost is perhaps the largest operational cost in all kind of aquaculture. Moreover, in Bangladesh, use of complete artificial diet to get better yield is not possible for most farmers due to a lack of necessary credit. Furthermore, around 50% of the supplied feed is practically lost to environment as reported by many authors. Therefore, farmers can not utilize the full growth potential of fishes and are not getting expected yield from their ponds. This alternative biological and technical phenomena by which better growth and production can be obtained are exploiting some biological events rather than using more feeds in ponds. Compensatory growth in fishes is perhaps the best utilizable phenomena in this regard, which can ensure a great reduction of feed loss and an effective use of supplied feed. Successful application of compensatory growth in this commercially important fish can reveal the achievement of its full growth potential and at the same time, can reduce the production cost to a great extent which will eventually help the economy of Bangladesh-one of the poorest nations of third world.

According to the final result of the experiment, it can be concluded that Thai pangas could easily be cultured in feeding regime with feeding in alternate day without any significant differences in fish size and final production. This will reduce Thai pangas production cost in a great extent and will make the fish culture more profitable both for the rural small scale and commercial Thai pangas farmers.

REFERENCES

1. Roberts, T.R. and C. Vidthayanon, 1991. Systematic revision of the Asian catfish family Pangasiidae, with biological observations and descriptions of three new species. Proc. Acad. Natl. Sci. Philad, 143: 97-144.
2. Dobson, H.S. and R.M. Holmes, 1984. Compensatory growth in the rainbow trout, *Salmo gairdneri* Richardson. J. Fish. Biol., 25: 649-656.
3. Hayward, R.S., D.B. Noltie and N. Wang, 1997. Use of Compensatory growth to double hybrid Sun fish growth. Trans. Am. Fish. Soc., pp: 316-322.
4. Russell, N.R. and R.G. Wootton, 1992. Appetite and growth compensation in the European minnow *Phoxinus phoxinus* (Cyprinidae) following short period of food restriction. Environ. Biol. Fish, 34: 277-285.
5. Kim, M.K. and R.T. Lovell, l995. Effect of restricted feeding regimes on compensatory weight gain and body tissue changes in channel catfish in ponds. Aquaculture, pp: 285-293.
6. Quinton, J.C. and R.W. Blake, 1990. The effect of feed cycling and ration level on the compensatory growth response in rainbow trout, *Oncorhynchus mykiss*. J. Fish. Biol., 37: 33-41.
7. Jobling, M., O.H. Moloy, J. dos Santos and B. Chistiansen, 1994. The compensatory growth response of the Atlantic cod. Effects of nutritional history. Aqualt. Intl., 2: 75-90.
8. Bolger and P.L. Connoly, 1989. The selection of suitable indices for the measurement and analysis of fish condition. J. Fish Biol., 34: 171-182.
9. Gaylord, T.G. and D.M. Gatlin, 2000. Assesment of compensatory growth in Channel cat fish (*Ictalurus punctatus*). J. World. Aqualt. Soc., 31: 326-336.
10. Wang, Y., Y. Cui, Y. Yang, F. Cai and F.S. Cai, 2000. Compensatory growth in hybrid tilapia (*Oreochromis mossambicus O. niloticus*) reared in sea water. Aquaculture, 189: 101-108.
11. Bilton, H.T. and G.L. Robins, 1973. The effect of starvation and subsequent feeding on survival and growth of Fulton channel sockeye salmon fry (*Oncorhynchus nerka*). J. Fish. Res. Bd. Can., 30: 1-5.
12. Weatherley, A.H. and H.S. Gill, 1981. Recovery growth following periods of restricted ration and starvation in rainbow trout, *Salmo gairdneri* Richardson. J. Fish. Biol., 18: 195-208.
13. Reimers, E., A.G. Kjorrefjord and S.M. Stavostrand, 1993. Compensatory growth and reduced maturation in second sea winter farmed Atlantic salmon following starvation in February and March. J. Fish. Biol., 43: 805-810.
14. Pastoureaud, A., 1991. Influence of starvation at low temperatures on utilization of energy reserves, appetite recovery and growth character in sea bass, *Dicentrarchus labrux*. Aquaculture, 99: 167-178.
15. Miglavs, I. and M. Jobling, 1989. Effect of feeding regime on food consumption, growth rates and tissue nuclei acids in juvenile Artic charr, *Salvelinus alpinus*, with respect to compensatory growth. J. Fish. Biol., 34: 947-957.