Growth comparison between post-larvae from cultured and wild spawners of Indian white shrimp, *Penaeus indicus,* in commercial farms in north Persian Gulf, Bushehr, Iran

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Received: March 2009 Accepted: December 2009

Abstract

Post larvae of wild and cultured spawners of the Indian white shrimp *(Penaeus indicus,* Milne Edwards, 1837) were reared to market size, in commercial ponds of shrimp farming site of Helleh, in Bushehr Province, during a six months period. Environmental factors, management process and the diet used to feed shrimps were almost similar for both treatments. Averages of the weight, length, specific growth rate, food conversion ratio and survival rate were measured and compared between the two treatments at harvesting time. Results indicated that, the post larvae of wild spawners had better growth, higher survival rate, and lower food conversion ratio. Weight gain of abdominal portion of the body, was higher in wild post larvae ($P<0.01$), which was in contrast to cephalothorax weight ($P<0.01$). Length-weight relationship measurements illustrated that, cultured post larvae obtained from wild spawners had similar size and were more acceptable for the market. Broodstock background could be the main reason for given differences, in which, those captured from the sea, had better condition due to receiving appropriate food with higher genetic diversity. To produce high quality post larvae for the expanding shrimp farming industry as an economic activity in the country, it is suggested that broodstocks to be obtained either from the sea as sub-adults or matured spawners, or to be provide from culturing shrimps, raised in conditions closest to the nature (*i.e.,* ambient factors, prepared diets) and also with appropriate genetic diversity.

Keywords: Shrimp culture, *Penaeus indicus*, Wild broodstocks, Cultured broodstocks, Persian Gulf

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[DOR: 20.1001.1.15622916.2010.9.3.11.7]

Introduction

Indian white shrimp, *Penaeus indicus,* has been considered as the main endemic culture species in southern coasts of Iran over the two past decades. Although sustainable production of *P. indicus* is greatly desired, it has been constrained by the current dependency on wild-caught broodstock. More over limitations, such as reduction in the population of broodstocks due to overfishing, lack of freshwater, changes of temperature and salinity, and food quality, are the main problems for shrimp culture in Iran. From given problems, providing good broodstocks which can produce high quality post larvae is one of the entanglements of developing shrimp industry in Iran (Kakoolaki et al., 2010). In order to have sustainable development, it was decided to do experiments to provide spawners in the farm. From 2000 up to 2003, over 95 percent of needed post larvae were provided from cultured shrimps in Bushehr Provience (Iranian Fisheries Organization, 2005) and it became the main way of producing spawner in other farms. Despite of this, captured spawners are not superior in some aspects, due to some difficulties on lower fecundity because of their smaller size (Menasveta et al*.,* 1994; Cavalli et al., 1997; Browdy, 1998; Palacios et al., 2000; Preston et al., 2001; Marammazy, 2003). However when comparing shrimp of similar sizes, some studies reported lower fecundity for pond-reared shrimp, while others obtained similar values for both origins (Menasveta et al., 1994; Preston et al., 2003; Peixoto et al., 2004, 2008). Spawning frequency has also been reported to be lower for pond- reared shrimp (Cavalli et al., 1997; Palacios and Racotta, 1999). This could be also related to the size, because no differences were observed when using spawners of similar sizes from wild and cultured groups (Menasveta et al., 1994). Fertilization rates have been reported to be comparable (Browdy et al., 1986; Menasveta et al., 1994; Palacios et al., 2000) or higher for pond-reared shrimp (Cavalli et al., 1999; Marammazy, 2003) or for wild spawners (Ramos et al., 1995; Mendosa, 1997). Hernandez-Herrera, et al*.* (1999) mentioned that post larvae, stage 12 of pond cultured Indian white shrimp spawners, had higher resistance to ammonia and salinity stress, and also higher survival rate.

In addition to the mentioned cases, comparison of growth rate between post larvae of wild and cultured spawners during culture processes in earthen ponds has great importance. Research has shown that *P. japonicus* post larvae obtained from cultured spawners had a higher growth rate in controlled conditions (Hetzel et al*.,* 2000). No comparing report was found for Indian white shrimp. Therefore, this study aimed to compare survival and growth rate between post larvae of wild and cultured spawners of the Indian white shrimp in commercial rearing ponds.

Materials and methods

In a six months period, May to October 2004, two groups of post larvae were reared in earthen ponds until harvesting size, under similar conditions (*i.e.,* ambient factors, management processes and feeding diets). First treatment called

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G_1, were post larvae of spawners collected from coastal waters of Jask Port, located in Hormozgan Province. Second treatment called G_2, were second generation progenies of high–growth cultured broodstocks, reared in controlled condition. Post larvae of both treatments were transferred to two different nearby farms in Helleh shrimp farming site in Bushehr Province, north of the Persian Gulf. In each farm, three ponds of approximately one hectare size were selected, as three replicates for each treatment. All were stocked with equal numbers of post larvae stage 12 (PL_{12}) (Table 1).Similar management processes were practiced in all ponds including water exchange (5-20% every day),

Table 1: Size of the ponds, stage and stocking number of post larvae per square meter

Factors	First treatment (G_1)			Second treatment (G_2)		
	Pond 1	Pond 2	Pond 3	Pond 1	Pond 2	Pond 3
Pond surface in ha	0.8	0.8	0.8	1.2	1.2	1.2
Post larvae stage	12	12	12	12	12	12
No. PL/m^2	21	21	21	25	20	25

fertilization, aeration (partial/continuous aeration, particularly at the end of the culturing period), feeding (manufactured feed produced by Havoorash Co.) and other necessary activities.

Thirty days after stocking, growth was monitored every 10 days and was continued up to harvest time. In each sampling period, depending on the size of shrimps, sub- samples were taken from feeding trays or by cast net in each pond. Samples were gently blotted to remove surface moisture and weighed by a digital balance to nearest 0.01 gram. At the end of the experiment, total and cephalothorax lengths were measured using slide calipers. In addition of total weight, carapace and abdomen-tail weights were also measured. Water temperature, pH, dissolved oxygen, salinity and transparency were measured two times a day, before noon (am) and after noon (pm).

All the variables recorded were first analyzed for all individuals within each group using one way ANOVA in which samples were treated as replicates. The hypothesis that biological indices including total weight, total length, specific growth rate, survival rate and food conversion ratio differ among the two treatments, non- parametric Kruscal-Wallis test was used.

Results

During the course of the project, there was no significant difference in environmental parameters among six ponds. Water temperature ranged from 20.1 to 36.2C°, salinity ranged from 36 to 54 ppt, average of dissolved oxygen concentration at 2 am was 4.95±0.54 (mg/lit) and at 4 am was 3.93±0.01 (mg/lit) and 5.83±0.68 (mg/lit) in 11 pm, and the average in water transparency was 62.82±1.95 (cm).

Mean weight at harvesting time for each treatment, G_1 and G_2, and yield (kg/ha) in each pond were summarized in Table 2. No significant difference was observed in average weight for the first measuring time, but it was significant in

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the last measurement. Average weight after 30 days of stocking and in harvesting time, were given in Table 3. Weight gain of G_1 group, was 21 percent higher than G_2 group which was significantly different ($P < 0.05$; Table 3).

Table 2: Mean weight±S.E. of individuals and total yield of each pond at the harvesting time

Factors	First treatment (G_1)			Second treatment (G_2)		
	Pond 1	Pond 2	Pond 3	Pond 1	Pond 2	Pond 3
DOC	156	153	146	158	142	159
Mean weight±S.E.(g) at harvesting time	20.50± 0.45	18.56± 0.34	19.15± 0.21	16.69± 0.25	13.55± 0.76	17.31± 0.54
Yield±S.E.(kg/ha)	3307.5± 3.67	3500.0± 3.87	3446.2± 2.54	3116.7± 4.86	1666.0± 3.97	2727.5 ±2.65

DOC: Days of Culturing Period

Average weight of abdomen – tail at harvesting time was also higher in G_1 group ($P<0.01$) while it was reversed for cephalothorax ($P<0.01$) (Table 3). Figure 1 indicates that the growth rate of post larvae of G_1 group was higher throughout the culturing period. Specific growth rate was higher for G_1 group and had

Table 3: Average±S.E. of weight gain, abdomen- tail and cephalothorax weights of the two treatments, G_1 and G_2, during the culturing period

Treatments	Average weight (g) in day 30	Average weight (g) in harvesting time	Average weight (g) gain	Abdomen-tail weight (g)	Cephalothorax weight (g)
First treatment (G_1)	1.66± 0.24	19.40 ±0.99^a	17.74 ±0.90^a	11.68±1.560^a	7.72±1.187^a
Second treatment (G_2)	1.84 ±0.12	15.85 ±2.02^b	14.01±2.12^b	9.51±1.442^b	6.34±0.884^b

Within each column, the same superscripts were significantly different ($p<0.05$)

significant difference with G_2 group (Table 4). Average total length at harvesting time was significantly higher for G_1 group. For post larvae of wild stocks, it was 18.32 percent higher than post larvae of cultured stocks (Table 5).

Table 4: Average ± S.E. of specific growth rate, survival rate and food conversion ratio of the two treatments G_1 and G_2

Treatments	Average specific growth rate	Survival rate	Food conversion ratio
First treatment (G_1)	2.028±0.197^a	87.81±7.308^a	1.53±0.167^a
Second treatment (G_2)	1.745±0.023^b	66.40±7.221^b	1.84±0.251^b

Within each column, the same superscripts were significantly different ($p<0.05$)

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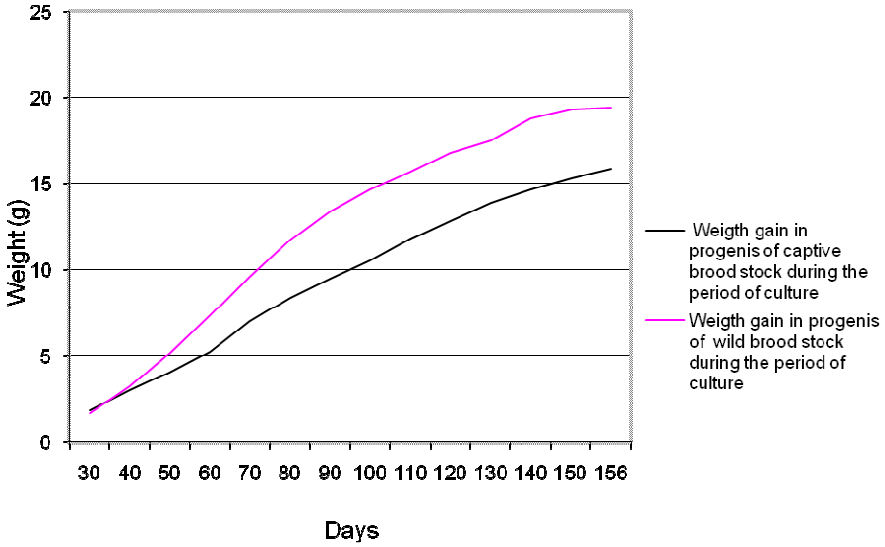

Figure 1: Growth comparison of post larvae of Indian white shrimp, provided from wild and captive broodstocks.

Table 5: Average ±S.E. of total and cephalothorax length of the two treatments G_1 and G_2

Treatments	Total length (cm)	Cephalothorax length (cm)
First treatment (G_1)	14.63± 0.744 [a]	3.168±0.227[a]
Second treatment (G_2)	11.94±0.601[b]	2.568±0.173[b]

Within each column, the same superscripts were significantly different ($p<0.05$)

Average total cephalothorax length was 18.93 percent higher in G_1 group with a significant difference ($P<0.01$; Table 5).

The relationship between total weight and total length were measured for both treatments at harvesting time. Coefficient of correlation was computed for both treatments (r^2 G_2 = 0.667, and r^2 G_1= 0.5202). Post larvae of wild broodstocks demonstrated less dispersion than the average and were approximately similar in size.Food conversion ratio was lower for post larvae of wild broodstocks with a high significant difference of $P<0.01$ (Table 4).

Survival rate was higher in those of wild broodstocks, with a significant difference of $P<0.05$. Table 4 shows the differences.

Discussion

The results of this study demonstrated that *P. indicus* post larvae obtained from wild broodstocks perform better than post larvae obtained from captive broodstocks in commercial pond environments. According to available references and applied research, optimum temperature and salinity for propagation and culture of Indian white shrimp, are 22 to 33C° and 15 to 25 ppt, respectively (Pillay, 2005). In this experiment, despite of higher

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ranges of temperature and salinity, post larvae of wild broodstocks showed better growth and survival rates, comparing to those of cultured broodstocks. By providing better condition particularly lower salinity, growth and survival rate will be higher for both treatments.

Better growth and higher quality of the post larvae provided from wild broodstocks, are mainly related to the living conditions of spawners, including ambient factors, genetic diversity and food quality (Hetzel et al., 2000; Palacios et al., 2000; Marammazy 2003; Racotta et al., 2003_b; Peixoto et al., 2008). Cultured broodstocks were raised in conditions much different from their natural habitat, with higher salinity and temperature, lower oxygen concentration and received low quality man made food along with limited choice of genetic variations. These factors had great effects on their egg quality and later on their post larvae. As Peixoto et al., (2008) demonstrated that n-3 HUFA may play an important role in offspring quality.

High fecundity, higher fertilization and hatching rates, and also high survival rates, are the main goals of propagators in hatcheries, and majority of researches are focused on these criteria. Bray and Lawerence (1991) believed that hatching rate could be a predictive criterion for further larvae performance. In this study, higher growth was performed among post larvae obtained from wild spawners with higher fecundity (200000-450000), compared with cultured spawners with lower fecundity (75000-120000) (Iranian Fisheries Organization, 2004). Interestingly, Racotto et al., 2003, did not find any relationship between fecundity or fertilization and higher growth rate in larvae.Although shrimps of both treatments could tolerate physical and chemical fluctuations of water, survival rate of G_1 group was significantly higher than that in G_2 group. According to previous studies nutritional status and probably genetic variations should also be taken into account (Racotta et al., 2003a; Preston et al., 2003; Peixoto et al., 2008). Therefore, further research is required to have a better understanding of the higher survival rate in G_1 group. Taking advantage of rearing young sea shrimps in ponds with optimum ambient factors could be a reliable way for producing good broodstocks for expanding shrimp culture in the country. In this case, genetic variations could remain constant, and they could be also nourished by high quality food contain optimum levels of *n-3*HUFA.

These observations have shown that post larvae obtained from wild broodstocks, showed better performance and moreover, from economical point of view, results indicated that culture of post larvae obtained from wild broodstocks, were more lucrative, provided shrimps of similar sizes, were easier for grading and packing, and could have better international acceptance.With expanding shrimp culture in the country, it would be certainly impossible to provide enough spawners from the sea because of the overfishing impacts. Either Indian white shrimp spawners or other endemic or exogenic broodstocks were used, it is necessary to raise them in the culturing ponds with optimum ambient factors and supply them with high quality nutrients.

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