Effects of Stocking Density on Growth Performance and Production of Mola, *Amblypharyngodon mola*
(Kesan Ketumpatan Stok dalam Prestasi Pertumbuhan dan Penghasilan Mola *Amblypharyngodon mola*)

M. ASADUJJAMAN, M.A. WAHAB, M.K. FATEMA, M. BELAL HOSSAIN* & A.K.M.S. AZAM

ABSTRACT

An experiment was conducted to determine the effects of stocking density on growth performance and production of Amblypharyngodon mola *during 09 July to 09 October, 2011. There were three treatments, each with three replications in nine earthen ponds with an average depth of 1.5 m. Ponds of three treatments T_1, T_2 and T_3 were stocked with mola at the density of 145000; 73000 and 36500 ind. ha^{-1}. The water temperature, transparency, total alkalinity, pH, dissolved oxygen, nitrate-nitrogen, nitrite-nitrogen, ammonia-nitrogen, phosphate-phosphorus and chlorophyll-a of the ponds water were measured weekly. Among the water quality parameters, significant differences ($p<0.05$) were observed in case of temperature and dissolved oxygen. The lowest PO4-P and chlorophyll-a concentration were observed in T_1. All water quality parameters were in suitable range of fish culture. The number of fishes at harvest were 15633.31±11.5; 84200±4 and 45600±7.21 indi. ha^{-1} in T_1, T_2 and T_3, respectively. The mean weight of mola during harvest decreased significantly ($p<0.05$) with increasing stocking density. The net production of mola was significantly higher in treatment T_3 (43.22±8.66 kg ha^{-1}) than T_2 (34.82±6.53 kg ha^{-1}) and T_1 (32.74±6.53 kg ha^{-1}). Considering the highest net production among the three tested densities, the stocking density applied in T_3 was found the best.*

Keywords: Growth performance; mola; production; stocking density

ABSTRAK

Satu eksperimen telah dijalankan untuk mengetahui kesan ketumpatan stok dalam prestasi pertumbuhan dan penghasilan ikan Amblypharyngodon mola *dari 9 Julai hingga 9 Oktober 2011. Tiga perlakuan dengan tiga replikasi setiap satu telah digunakan dalam kolam berdasar tanah dengan kedalaman 1.5 m. Kolam dengan tiga perlakuan T_1, T_2 dan T_3 telah dimasukkan ikan mola pada ketumpatan 145000; 73000 dan 36500 ind. ha^{-1}. Suhu air, kelutsinaran, kealkalinan jumlah, pH, oksigen terlarut, nitrat-nitrogen, nitrit-nitrogen, ammonia-nitrogen, fosfat-fosforus dan klorofil-a pada air kolam diukur setiap minggu. Antara parameter kualiti air tersebut, perbezaan signifikan ($p<0.05$) diperhatikan pada suhu dan oksigen terlarut. Kepekatan PO_4-P dan klorofil-a paling rendah diperhatikan dalam T_1. Kesemua parameter kualiti air didapati berada pada julat yang sesuai untuk kultur ikan. Ketumpatan ikan semasa penuaian adalah 155633.31±11.5; 84200±4 dan 45600±7.21 indi. ha^{-1} dalam T_1, T_2 dan T_3 masing-masing. Berat min ikan mola semasa penuaian telah menurun secara signifikan ($p<0.05$) dengan peningkatan ketumpatan stok. Penghasilan bersih ikan mola adalah lebih tinggi secara signifikan dalam perlakuan T_3 (43.22±8.66 kg ha^{-1}) daripada T_2 (34.82±6.53 kg ha^{-1}) dan T_1 (32.74±6.53 kg ha^{-1}). Dengan mengambil kira penghasilan bersih antara ketiga-tiga ketumpatan yang diuji, ketumpatan stok yang diperlakukan dalam T_3 didapati paling baik.*

Kata kunci: Ketumpatan stok; mola; penghasilan; prestasi pertumbuhan

INTRODUCTION

The small indigenous fishes occupy an important position in the popular food items of Bangladesh. About 150 species among 260 freshwater fish available in Bangladesh can be considered as small indigenous species (SIS) and they play a vital role in the diet and economy of the rural poor (Rahman 1989). Some of the small fishes have high nutritional value as they contain protein, vitamin-A, iron, calcium and phosphorus (Banu et al. 1985). Among the SIS, *Amblypharyngodon mola* has the highest percentage of vitamin-A with high calcium and iron. Small fish like mola (*A. mola*) is a remarkable source of calcium

(Rahman 1989). Alam (1985) reported that mola and dhela contain high quantity of vitamin-A, which can prevent xeropthalmia of growing children. *A. mola*, locally known as mola, once found abundantly in the rivers, canals, ponds and ditches (Ahmed 1981; Rahman 1989) is not available as in the past. Talwar and Jhingran (1991) reported that this species attains a length of 20 cm at its maturity. It is generally a surface feeder. It may take unicellular algae, protozoa, rotifers and crustaceans as food (Bhuiyan 1964). This fish spawns during May to October (Rahman 1989). A female of this species lays about 500 eggs during spawning season (Bhuiyan 1964).

The production of small indigenous fish species has been declined despite their ability to reproduce at short intervals and can withstand poor environmental conditions. IUCN (2001) also reported that some SIS are critically endangered or in endangered condition due to the environmental modification and manmade interventions and require immediate attention for their conservation. The number of fish species culture at a time in a pond may be designated as monoculture and polyculture. Monoculture is the cultivation of only a single type of fish species in a pond. In monoculture, high stocking densities can be used, low operational cost and least management require in this system. It has low probability of diseases. Polyculture is the cultivation of two or more species of fishes in a pond to obtain high production per unit area. Several different species of fast growing and compatible species of fish of different feeding habit may be cultured together in polyculture.

Stocking density is an important parameter in fish culture. It has direct effects on the growth and survival of fish and the development and rearing techniques of any fish species. A number of research publications are available on the effect of stocking density on growth and survival rate of different fish species. Kohinoor et al. (1998) provided a preliminary observation on the effect of stocking density of *A. mola* in seasonal ponds. So, the present study was initiated to find out the effects of stocking density of mola on water quality and production of fish per-unit area.

MATERIALS AND METHODS

STUDY AREA AND PERIOD

The experiment was conducted for a period of 90 days during 9 July to 9 October 2011 at the Fisheries Field Laboratory complex, under the Faculty of Fisheries, Bangladesh Agricultural University (BAU), Mymensingh, Bangladesh.

EXPERIMENTAL DESIGN AND CULTURE TECHNIQUE

The experiment was undertaken with 3 treatments each with 3 replicates. Nine similar sized (100 m^2) ponds with water depth of 1.5 m were used under three replications for this experiment. Ponds were prepared 10 days before fish stocking. All predatory and small fish species were removed from the experimental pond by repeated netting and rotenone (10%) at the rate of 25 g/decimal was used for complete eradication of all the undesirable species. The ponds were prepared properly with lime at the rate of 1 kg per decimal and after 4 or 5 days later initial fertilization with urea, TSP and cow dung at the rate of 0.3 kg, 0.3 kg and 5 kg per decimal, respectively. Fingerlings of mola were collected from the homestead pond of local farmers of Ishwarganj Upazila, Mymensingh. Three treatments T_1, T_2 and T_3 were stocked with mola at the density of 145000; 73000 and 36500 indi. ha^{-1}. The mean initial weight of mola was 1.5 g, in treatment T_1, T_2 and T_3, respectively.

Initially rice bran was used as supplementary feed for seven days at the rate of 10% body weight of fish. After that fish were feed (nursery feed-1, Aftab feed) twice daily at the rate of 8% body weight throughout the experiment. Throughout the experimental period, water transparency (cm), temperature (°C), pH and dissolved oxygen (mg L^{-1}) were measured every week at sunrise (07:00 am) and sunset. Ammonia-nitrogen (mg L^{-1}), Nitrate-nitrogen (mg L^{-1}), Phosphate-phosphorous (mg L^{-1}), Chlorophyll *a* (mg L^{-1}) were measured monthly at Water Quality and Pond Dynamics Laboratory at the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh. After 90 days of culture, fish was harvested and counted for total number separately from each treatment to evaluate the survival rate and other analysis.

RESULTS AND DISCUSSION

Boyd (1982) indicated that 15 to 40 cm transparency range is good for fish culture. Kohinoor et al. (2000) recorded transparency ranged from 15 to 58 cm from the ponds in BAU campus. The mean values of transparency were 45.62 ± 8.08, 45.10 ± 4.07, 44.38 ± 5.86 cm in treatments T_1, T_2 and T_3, respectively, in the present study, which were within the suggested values. The result was more or less similar with the reported results of Uddin (2002), recorded ranging from 11-63.5 cm from the ponds in BAU campus. The transparency values of different treatment in the present study indicated that pond water was within the productive range for mola fish culture. In the present study, water temperature of experimental ponds was found to vary from 25.20 to 29.62°C, 24.67 to 28.42°C and 24.30 to 29.76°C with the mean values of 26.97 ± 1.41, 26.57 ± 1.22 and 26.71 ± 1.78°C during the experiment in T_1, T_2 and T_3 treatments, respectively. The highest mean temperature was recorded on the first week of September (28.09°C) in T_1 treatment and the lowest mean temperature was recorded on the last week of August (24.30°C) in T_2 treatment. This result is more or less similar to Rahman (2005) and Kunda et al. (2008) who recorded temperature ranges from 26.0 to 35.0 and 22 to 34°C, respectively. The water pH6.5 to 9.0 is suitable for pond fish. The range of pH was found to fluctuate from 7.89 to 8.83, 7.86 to 8.56 and 7.89 to 9.13 with mean values 8.22 ± 0.23, 8.32 ± 0.21 and 8.47 ± 0.31 during the experiment in treatments T_1, T_2 and T_3, respectively. Huq et al. (2004) conducted an experiment on production performance of freshwater prawn in monoculture versus polyculture systems and found the pH values ranges from 7.5 to 8.5 and 7.1 to 8.5 which were similar to the present study. Dissolved oxygen (DO) concentration was found to vary from 5.63 to 7.78, 5.85 to 7.08 and 5.45 to 7.25 mg L^{-1} with the mean values of 6.48 ± 0.62, 6.58 ± 0.44, 6.43 ± 0.52 mg L^{-1} in treatments T_1, T_2 and T_3, respectively, throughout the study period. The highest mean dissolved oxygen concentration (7.78 mg L^{-1}) was recorded in the last week of August in treatment T_3 and the lowest mean DO concentration (5.80

mg L^{-1}) was recorded in the 3rd week of October during the experiment. The concentration of dissolved oxygen in the present study was more or less similar to the findings of Ahmed (2004), Asaduzzaman (2005) and Kohinoor (2000) who recorded dissolved oxygen ranged from 2.0 to 7.04, 3.4 to 8.1 and 1.2 to 7.2 mg L^{-1}, respectively. In the present study, total Alkalinity was found to vary from 72.14 to 19397.48 to 252 and 50 to 200.52 mg L^{-1} with the mean values of 140.71 ± 28.99, 145.67 ± 32.97, 133.24 ± 33.25 mg L^{-1} during the experiment in treatments T_1, T_2 and T_3, respectively, which are more or less similar to the findings of Hoq et al. (1996) and Kunda et al. (2008) who recorded 84 to 185 mg L^{-1} and 52 to 198 mg L^{-1}. Therefore, it can be concluded that total alkalinity in the present experiment might be considered as a suitable range for fish culture. Ammonia nitrogen (NH$_3$-N) concentration was found to vary from 0.006 to 0.49, 0.078 to 0.34 and 0.001 to 0.55 mg L^{-1} with mean abundance 0.23 ± 0.13, 0.19 ± 0.13 and 0.37 ± 0.19 mg L^{-1} during the experiment in T_1, T_2 and T_3 treatments, respectively, which are more or less similar to Rahman (2005) and Asaduzzaman et al. (2006) who recorded ammonia-nitrogen value ranged from 0.01 to 0.82 and 0.203 to 0.569 mg L^{-1}, respectively. So, in the present study ammonia-nitrogen value was suitable for mola culture. Nitrate-nitrogen (NO$_3$-N) was found to vary from 0.002 to 0.75, 0.001 to 0.59 and 0.008 to 0.45 mg L^{-1} where mean values 0.03 ± 0.02, 0.03 ± 0.01 and 0.03 ± 0.02 mg L^{-1} in treatments T_1, T_2 and T_3, respectively, during the investigational period. The range of NO$_3$-N from 0.20 - 3.0 mg L^{-1} were found in pond waters by Azim et al. (1995), Dewan et al. (1991), Kohinoor (2000) and Wahab et al. (1995) which are more or less similar to the present study. Nitrite-nitrogen (NO$_2$-N) concentration was found to vary from 0.001 to 0.009, 0.002 to 0.007 and 0.002 to 0.01 mg L^{-1} in treatments T_1, T_2 and T_3, respectively. The mean values of NO$_2$-N were 0.0051 ± 0.004, 0.0047 ± 0.004, 0.0052 ± 0.003 mg L^{-1} in treatments T_1, T_2 and T_3, respectively. Alim (2005) recorded nitrite-nitrogen concentration ranging from 0.00 to 1.021 mg L^{-1}. So, nitrite-nitrogen concentration in present study was within good range for mola culture. Phosphate-phosphorous (PO$_4$-P) concentration was found

to vary from 0.074 to 1.49, 0.64 to 1.31 and 0. 54 to 1.37 mg L^{-1} with the mean values of 0.58 ± 0.37, 0.61 ± 0.40, 0.69 ± 0.32 mg L^{-1} during the experiment in treatments T_1, T_2 and T_3, respectively, which are more or less agreeable with the findings of Wahab et al. (1995) who found phosphate-phosphorus range from 0.09 to 5.2 mg L^{-1}. The concentration of phosphate-phosphorus in the present study was appropriate for mola mono culture on the basis of the findings of the above authors. The concentration of chlorophyll- a was found to differ from 96.68 to 168.87, 125.45 to 171.25 and 121.09 to 173.18 µg L^{-1} with mean values 143.54 ± 17.42, 148.39 ± 11.13, 148.21 ± 16.17 µg L^{-1} in T_1, T_2 and T_3 treatments, respectively. The present findings are more similar to Hasan (1998) and Paul (1998) who found chlorophyll a in pond water ranging from 10 to 200 µg L^{-1}. These values showed that all ponds were highly productive.

The total productions of mola vary among three treatments, which indicated that there were an effects of stocking density on the growth performance and production of mola. In the present study, mean net production of mola was 32.74 ± 6.53, 34.82 ± 6.53 and 43.22 ± 8.66 kg ha^{-1} in T_1, T_2 and T_3, respectively. Yield of mola recorded by Chowdhury et al. (2000) was 7.92 – 12.5 kg ha^{-1} in polyculture with carp, which was lower than the yield obtained in the present finding. In the present study the net production of mola was 43.22 ± 8.66 kg ha^{-1}, observed highest in T_3, where mola was stocked at a low density of 7.1 ind. /m^2. Kohinoor (2000) reported that average production of carp in polyculture without mola was 1479 ± 79.13 kg ha^{-1}, whereas the average production of carp with mola was 1274 ± 73.70 kg ha^{-1}. The growth performance and production of mola in three treatments are shown in Table 1.

The total production was 16.06% lower where mola was introduced. The net production mola was significantly higher in the treatment T_3 rest of two (T_1 and T_2) where stocking density was comparatively low. But the stocking number of mola was higher in T_1 where production was low from other treatments. It might be concluded that T_3 was a better stocking density for mola monoculture.

TABLE 1. Growth performance (Mean ± SD) of mola in three treatments

Treatments	T_1	T_2	T_3	ANOVA Sig.
Stocking no. (indi. h^{-1})	145000	73000	36500	
Average harvest no. (indi. h^{-1})	155633.31±11.5	84200±4	45600±7.21	NS
Survival (%)	107.33±0.79[c]	115.34±0.55[b]	124.93±1.98[a]	*
Average weight gain (%)	14.89±4.02[b]	26.00±5.29[b]	63.33±13.68[a]	*
SGR (% body wt/day)	0.154±0.039[b]	0.256±0.0462[b]	0.543±.093[a]	*
Gross production (kg. ha^{-1})	268.19±8.77[a]	159.11±5.96[b]	111.62±7.61[c]	*
Net Production (kg. ha^{-1})	32.74±6.53	34.82±6.53	43.22±8.66	NS

NS = Values are not significantly different (*p> 0.05*)

* = Values with different superscripts in the same row indicate a significant variation

CONCLUSION

The experiment was conducted to evaluate the effects of stocking density on growth performance and production of mola at the Fisheries Field Laboratory complex under the faculty of Fisheries, BAU, Mymensingh. The water quality parameters were observed regularly at Water Quality and Pond Dynamics Laboratory of the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh. The ponds in treatments T_1, T_2 and T_3 were stocked with mola at the density of 145000; 73000 and 36500 indi.ha^{-1}, respectively, and the mean harvesting no. were 155633.31 $\pm$ 11.5; 84200 $\pm$ 4 and 45600 $\pm$ 7.21 indi. ha^{-1}. The highest mean harvesting weight (2.45 $\pm$ 0.21 g) was found in the treatment T_3, it varies significantly with other treatments T_1 (1.72 $\pm$ 0.06 g) and T_2 (1.89 $\pm$ 0.08g). The mean specific growth rates (SGR) of mola was 0.15 $\pm$ 0.04, 0.26 $\pm$ 0.05, 0.54 $\pm$ 0.09% body weight d^{-1} and survival rates of mola were 107.33 $\pm$ 0.79, 115.34 $\pm$ 0.55 and 124.78 $\pm$ .98% in treatments T_1, T_2 and T_3, respectively. The mean gross productions of mola were 268.19 $\pm$ 8.77, 159.11 $\pm$ 5.96 and 111.62 $\pm$ 7.61 kg ha^{-1} while mean net production of mola was 32.74 $\pm$ 6.53, 34.82 $\pm$ 6.53 and 43.22 $\pm$ 8.66 kg ha^{-1} in treatments T_1, T_2 and T_3, respectively. SIS contributes approximately 10% of the total fish production of Bangladesh. There is a great opportunity for mola monoculture. Farmers can develop an appropriate culture technique of mola with a little input over short period with supplementary feed.

REFERENCES

Ahmed, H. 2004. Promotion of small indigenous fish species (SIS)-mola based carp polyculture technology at Gazipur area of Bangladesh. M.S. dissertation, Dept. of Fisheries Management, Bangladesh Agricultural University, Mymensingh. p. 85 (unpublished).

Ahmed, K. 1981. Nutritional blindness in Bangladesh. *In Touch: VHSS Newsletter* No. 45 (Feb): 12.

Alam, A.K.M.A. 1985. *Mini pond*. CARITAS Bangladesh, Dhaka.

Alim, M.A. 2005. Developing a fish polyculture technique for farmers' consumption and cash crop. Ph.D. Dissertation, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh. pp. 153 (unpublished).

Asaduzzaman, M. 2005. The potentials of organic farming of giant freshwater prawn (*Macrobrachium rosenbergii*) in Bangladesh. M.S. dissertation, Dept. of Fisheries Management, Bangladesh Agricultural University, Mymensingh. p. 125 (unpublished).

Asaduzzaman, M., Salam, M.A., Wahab, M.A., Kunda, M. & Rahman, M.B. 2006. Effects of control of C/N ratio by low-cost carbohydrate addition on water quality and pond ecology in freshwater prawn *Macrobrachium rosenbergii* post-larve nursing system. *Bangladesh J. Fish. Res.* 10(2): 121-130.

Azim, M.E., Talukder, S.S., Wahab, M.A., Haque, M.M. & Haque, M.S. 1995. Effect of liming and maintenance of total hardness level in fish production in fertilized ponds. *Progress. Agric.* 6(2): 4-14.

Banu, C.P., Nahar, B., Begum, M. & Ahmed, K. 1985. Studies of the protein, riboflavin and iron contents of some freshwater fish and a prawn of Bangladesh. *Bangladesh J. Zool.* 13(1): 25-28.

Bhuiyan, A.L. 1964. *Fishes of Dacca*. Asiatic Society of Pakistan, Dacca.

Chowdhury, M.T.H., Dewan, S., Wahab, M.A., Uddin, M.J. & Thilsted, S.H. 2000. Water quality parameters of the rice fields used for rice cum fish culture. *Bangladesh J. Fish.* 23(1): 25-29.

Dewan, S., Wahab, M.A., Beveridge, M.C.M., Rahman, M.H. & Sarker, B.K. 1991. Food selection, electivity and dietary overlap among planktivorous Chinese and Indian major carp fry, fingerling grown in extensively managed rainfed ponds in Bangladesh. *Aquaculture and Fisheries Management* 22: 1188-1190.

Hasan, M.A. 1998. Development of carp polyculture techniques with small indigenous fish species mola (*Amblepharyngodon mola*), chela (*Chela cachius*) and punti (*Puntius sophore*). M.S. dissertation, Dept. of Fisheries Management, Bangladesh Agricultural University, Mymensingh. p.71 (unpublished).

Hoq, M.E., Islam, M.M. & Hossain, M.M. 1996. Polyculture of freshwater prawn, *Macrobrachium rosenbergii* with Chinese and Indian carps in farmer's pond. *J. Aquacult. Trop.* 2(11): 135-141.

Huq, K.A., Manir, S.M.I., Rahman, M.M. & Ferdous, K.S. 2004. Production performance of *Macrobrachium rosenbergii* (De Man) in monoculture versus Polyculture system. *J. Bangladesh Agril. Univ.* 2(1): 141-149.

IUCN. 2001. *Red Book of Threatened Fishes of Bangladesh*. IUCN- The World Conservation Union.

Kohinoor, A.H.M. 2000. Development of culture technology of three small indigenous fish-mola (*Amblepharyngodon mola*), punti (*Puntius sophore*) and chela (*Chela cachius*) with notes on some aspects of their biology. Ph.D. Thesis, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh. pp. 363 (unpublished).

Kohinoor, A.H.M., Islam, M.L., Wahab, M.A. & Thilsted, S.H. 1998. Effect of mola (*Amblypharyngodon mola*) on growth and production of carps in polyculture. *Bangladesh J. Fish.* 2(2): 119-126.

Kunda, M., Azim, M.E., Wahab, M.A., Dewan, S., Roos, N. & Thilsted, S.H. 2008. Potential of mixed culture of freshwater prawn (*Mascrobrachium rosenbergii*) and self-recruiting small species mola (*Amblypharyngodon mola*) in rotational rice-fish/prawn culture systems in Bangladesh. *Aquaculture Research* 39: 506-517.

Paul, S. 1998. Comparison between carp polyculture system with silver carp (*Hypophthalmichthys molitrix*) and with small indigenous fish mola (*Amblypharyngoedon mola*). M. S. Thesis, Department of Fisheries Management, BAU, Mymensingh. p. 85 (unpublished).

Rahman, A.K.A. 1989. *Freshwater Fishes of Bangladesh*. Zoological Society of Bangladesh. Department of Zoology, University of Dhaka, Dhaka-1000.

Rahman, S.M.S. 2005. Effect of stocking density of gift strain of nile tilapia (*Orechromis niloticus*) and freshwater prawn (*Macrobrachium rosenbergii*) in periphyton based production system. M.S. dissertation, Dept. of Fisheries Management, Bangladesh Agricultural University, Mymensingh. p. 84 (unpublished).

Talwar, P.K. & Jhingran, A.G. 1991. *Inland Fishes of India and Adjacent Countries*. Volume 1. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, Calcutta.

Uddin, M.M. 2002. Effects of addition of small fish on pond ecology and production in polyculture. M.S. thesis, Department of Fisheries Management, BAU, Mymensingh. p. 99 (unpublished).

Wahab, M.A., Ahmed, Z.F., Islam, M.A. & Rahmatullah, S.M. 1995. Effects of introduction of common carp, *Cyprinus carpio* (L.) on the pond ecology and growth of fish in polyculture. *Aquaculture Res*. 26(9): 619-628.

M. Asadujjaman, M.A. Wahab, M.K. Fatema & A.K.M.S. Azam
Faculty of Fisheries
Bangladesh Agricultural University, Mymensingh
Bangladesh

M. Belal Hossain*
Department of Biology, FOS
Universiti Brunei Darussalam, 1413
Brunei

M. Belal Hossain*, Fisheries and Marine Science
Noakhali Science and Technology University
Bangladesh

*Corresponding author; email: mbhnstu@gmail.com