Evaluation of Different Stocks of Chinese Carps in Bangladesh: Design and Preliminary Results

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Abstract
New stocks of Chinese carps were introduced into Bangladesh from wild populations in China in 1994 and are being held at the DOF NFEP campus, Parbatipur. As part of the evaluation of the performance of these new stocks in comparison to the already existing stocks of these species in Bangladesh, trials are being conducted under the project which is the focus of this workshop. This paper describes the methodology being used for the first of these trials, which uses communal stocking of marked fingerlings from the different stocks, in a range of on-farm and on-station environments. Fin cauterization has been used for batch marking, based on research conducted elsewhere in common carp. The first of these trials has not yet been completed, but some preliminary data are presented.

Introduction

Aquaculture in Bangladesh revolves around the cultivation of endemic and exotic major carps. The commonly used fast growing carp species for composite carp culture in the country are catla, rohu, mrigal, silver carp, bighead carp, common carp

and grass carp. Induced breeding of mainly endemic major carps has been established as a dependable source of fish seeds since the mid 1960's (Ali 1967). Today hatchery-produced fry/fingerlings dominate the overall aquaculture production of the country. The exotic carps play a vital role in carp polyculture to boost fish production of inland waters in Bangladesh. In the last few decades exotic species, including the silver carp, grass carp, bighead carps, common carp and silver barb have become popular because of their quick growth with low cost feed in comparison to indigenous major carps. Due to low market price of both fingerlings and food fish, poor people can afford to eat species like the silver carp rather than the more expensive indigenous carps.

It has been observed that while some of the hatcheries are careful in selection and maintaince of their brood stock, practices followed by others result in inbreeding and genetic deterioration of stocks. Once a hatchery is constructed, the general practice is to stock with whatever broodstock are easiest to acquire. This is a shortsighted and unscientific approach since the pedigree of a farmed stock can be an important determinant of its performance and therefore, of future profitability of the operation. Common practice in small hatcheries often involves the use of a small number of brood fish of each species: the high fecundity of carps allows adequate seed production in this situation. However, over successive generations, low effective population sizes lead to inbreeding depression with reduced growth rates, loss of fecundity and poor survival.

Interspecific hybridization in some carp species has also recently been reported in this country. Either out of scientific interest or because of shortage of adequate hatchery populations (brood stock), hybrids are being produced intentionally or unintentionally by private hatchery operators and sold to nursery operators and farmers. There is widespread concern that mass stocking of such hybrids in the floodplains and other related open water bodies might cause a serious genetic introgression problems in indigenous species that could adversely affect aquaculture and inland open water fish production, while in some cases (e.g. silver carp x bighead carp hybrids) introgressive hybridization in hatchery broodstock is a potential problem. The case for the use of F1 carp hybrids in aquaculture on a positive basis (i.e. due to superior performance), as opposed to their production as a result of constraints (e.g. use of sperm from silver carp males to fertilise bighead carp eggs due to a shortage of bighead carp males), has not been made, despite widespread experimental hybridization trials (e.g. Reddy, 1999).

Hussain and Mazid (2001) summarise the earlier introductions of carps into Bangladesh. In 1994, stocks of silver carp, bighead carp and grass carp from the Yangtze River in China were introduced into Bangladesh, and are held and managed

at the Northwest Fisheries Extension Project (NFEP) campus, Parbatipur. One of the aims of the present DFID-AFGRP funded project was to extend earlier trials on these new stocks to compare them to local stocks in different areas of Bangladesh, since the latter may have diverged in performance since introduction and dissemination (as a result of different management practices, etc). This paper describes the experimental design being used for these trials, and preliminary data from the first such trial, in which silver and bighead carps from the new stocks at Parbatipur and a local hatchery stock in the Mymensingh area were compared. F1 bighead x silver carp hybrids, obtained from a hatchery in the Mymensingh area, were also included to assess their performance relative to the parental species.

Materials and Methods

Trial design

The experimental design was based on communal stocking of the different groups of fish into a series of ponds representing different farming environments. This design allows direct comparison of different stocks in the same environment, and overcomes the problem of finding adequate numbers of "replicate" ponds for comparison in separate stocking (apparently similar ponds may actually differ in many environmental respects, particularly for complex ecosystems like polyculture). However, communal stocking does require reliable batch marking techniques to identify different stocks of the same species, and also requires that the different stocks of fish have very similar mean weights at the start of the trial. Significant differences in mean weight at the start of such trials can often be perpetuated and contribute to differences at the end. It is also possible that competition may exaggerate real differences in growth potential between test stocks, and thus the results may have to be interpreted cautiously in terms of the implications for the potential of the faster growing stocks.

Assessing different stocks of the same species in a variety of farming environments (e.g. different types of ponds, management practices, levels of inputs or species combinations) should allow assessment of genotype-environment interaction (put simply, changes in the ranking of different stocks across a range of environments implies significant GxE interaction, while consistency in rankings implies little or no GxE interaction). This has major implications for selective breeding (a lack of GxE interaction can be taken to imply that an improved line which has been developed in one type of environment should also perform well in the other types of environments, while strong GxE interaction may imply that different lines need to be developed for different environments). Assessing stocks under low input on-farm environments,

rather than only in high-input on-station environments, is important in research aimed at testing, managing or genetically improving stocks for low input aquaculture.

Origin of stocked fish

The silver carp and bighead carp were collected from a private hatchery in the Mymensingh region and NFEP, Parbatipur. The other species (catla, rohu, mrigal, grass carp, silver barb and bighead x silver carp hybrids) were collected from local nursery operators in the Mymensingh region.

Fin Cauterization

Five groups of fish (two stocks of silver carp, two stocks of bighead carp and hybrids) were marked by fin cauterization. The fish weighed 4 to 11 g and were anesthetized in small groups (1-2 drops of clove oil added per litre of water). The blade of a small scalpel was heated using a gas heater until it became red hot. Then the chosen fin of each fish was spread on a flat surface of a plastic board and the red hot scalpel blade was used to cut off the fin at the base, as fast as possible to avoid the heat damaging the surrounding area. The scalpel blade and the body of the fish were angled in opposite directions away from each other. The Mymensingh silver and bighead carp were marked by cutting the right pelvic fin, the Parbatipur silver and bighead carps by cutting the left pelvic fin and the hybrid (silver x bighead) by cutting the anal fin.. The fish then were treated with 250 ppm solution tetracycline to avoid infection. The fish were also dipped in 10 ppm potassium permanganate. The fish were then kept in different on-station ponds to monitor recovery before stocking into growout ponds. Problems were experienced with the Parbatipur silver carp stock, which showed very high mortality after fin cauterization. This stock had to be replaced and added later to the trial ponds, with obvious implications for the performance comparison between the two stocks of silver carp. There were only sufficient fish from this group to stock the on-station ponds.

Stocking of fish

After one week, all the fish were stocked in prepared on-station and on-farm ponds according to design. Three on-station (400 m^2 each) and four on-farm ponds (320-480 m^2) were selected for conducting the experiment. The ponds were prepared through liming @ 250 kg /ha. Three days after liming, the ponds were fertilized with cowdung @ 1000 kg /ha, Triple Super Phosphate and Urea @ 50 kg and 25 kg, respectively. After three days, the ponds were prepared and filled with ground water. The species combination and stocking density of fish are illustrated in Table 1.

Post stocking management

***High input management*:** Experimental fishes in 3 on-station and 2 on-farm ponds were fed with a mixture of rice bran and mustard oil cake (3:1) at the rate of 3% of the estimated fish biomass. In addition, inorganic fertilizers were also applied monthly by following the preparatory doses.

***Low input management*:** Only rice bran was being applied to the rest two on-farm ponds at the rate of 3% of estimated fish biomass.

The ponds were fertilized with cowdung, Triple Super Phosphate and Urea, applied monthly at half of the initial dose. Ground water was added to only the on-station ponds at weekly intervals. Fifteen to twenty percent of fish of each species were sampled through seine netting at monthly intervals to assess their growth, health condition and to adjust the feeding ration.

Table 1. Details of stocking combination and ratio of different fish species in polyculture management under on-farm and on-station conditions. SC = silver carp, BH = bighead carp, Hybrid = bighead x silver cross, (P) = Parbatipur stock, (M) = Mymensingh hatchery stock.

Trial environment	Species stocked/ha										
	SC (P)	SC (M)	BH (P)	BH (M)	Hybrid (M)	Grass carp	Catla	Rohu	Mrigal	Rajpunti	Total
On-station	375	750	750	750	750	250	500	500	1000	1500	7125
On-farm	-	750	750	750	750	250	500	500	1000	1500	6750
Mean weight (g±S.D.)	4.1 ±1.2	10.0 ±2.2	10.1 ±1.7	6.9 ±0.9	11.4 ±2.1	12.2 ±2.3	15.8 ±3.1	14.9 ±2.5	6.5 ±0.8	7.1 ±0.8	

Results

Observation of fin cauterization

As the trial had not yet been completed before this paper was prepared, and thus data was not yet available on all of the fish, it was not possible to make an accurate assessment of the fin cauterization technique. From the monthly sampling, silver and bighead carp appeared to show approximately equal response to pelvic fin cauterization. In some individuals of both species, the cauterized fins had not regenerated. Others showed a shorter and/or fringed pelvic fin, which was also identifiable. There were also some fish that had normal fins, with no sign of marking. These fins appeared to have regenerated quickly, within a month, and the fish were not identifiable. The retention rates appeared to be higher in the second batch of Parbatipur silver carp (see M&M), with the improvement being due to greater experience with the technique. For some of the hybrid fish, the cauterized anal fin also regenerated within a month and looked like a normal fin, whereas some of them are also showing an identifiable cut-line. So in this event it is very difficult to identify the cauterized fin. However, the regenerated anal fin edges are softer and also smooth in comparison to the normal fin of hybrids.

Water quality parameters

The water quality parameters such as temperature, dissolved oxygen and pH of the ponds of on-station condition were recorded weekly in each experimental pond and the ranges were: temperature 18.8 to 30.20°C, dissolved oxygen 5.25 to 7.61 mg/L and pH 6.88 to 8.45. The observed water quality parameters are within the suitable range for fish culture.

Growth of fish

The sampling weights of the different species of fish after three months of culture in on-station and on-farm management are shown in Table 2. Given the significantly lower initial mean weight of the Mymensingh bighead carp compared to the Parbatipur stock, it is not surprising that the Parbatipur bighead carp are larger at this stage. Likewise, the delayed stocking and smaller initial size of the Parbatipur silver carp stock have resulted in these being smaller than the Mymensingh stock at this stage.

Comparison of the Mymensingh silver carp and the hybrids (which did not differ significantly in weight at the time of stocking) in the on-farm and on-station environments shows that the hybrids performed better than the silver carp in the on-farm ponds, but the situation was reversed in the on-station ponds (Fig. 1: Parbatipur bighead carp growth curve included for comparison as the initial mean weight of this group did not differ significantly from the other two groups shown here).

The ranking of the weight of the grass carp and silver barbs relative to the other species changed between the on-farm and on-station, being much higher in the on-station ponds and much lower in the on-farm ponds.

Table 2. Average sampling weights of different species of fish (g) in on-station and on-farm (high and low input) conditions after 3 months of culture period. SC = silver carp, BH = bighead carp, Hybrid = bighead x silver cross, (P) = Parbatipur stock, (M) = Mymensingh hatchery stock.

Trial environment	Average sampling weight of fish (g±S.D.)									
	SC (P)	SC (M)	BH (P)	BH (M)	Hybrid (M)	Grass Carp	Catla	Rohu	Mrigal	Rajpunti
On-station	49.5 ±10.7	121.9 ±23.9	145.3 ±12.4	92.1 ±20.4	77.5 ±18.2	323.0 ±63.3	114.2 ±7.1	101.9 ±29.0	72.4 ±12.4	140.7 ±12.2
On-farm (high input)	-	127.6 ±21.5	200.3 ±72.0	166.1 ±27.6	139.9 ±22.2	114.3 ±33.5	113.2 ±50.9	78.7 ±20.2	85.0 ±18.4	49.8 ±19.0
On-farm (low input)	-	96.4 ±18.7	152.3 ±18.0	105.5 ±31.8	112.3 ±13.0	58.0 ±22.6	98.9 ±35.2	86.1 ±14.0	68.0 ±33.9	34.0 ±10.5
On-farm mean	-	112.0	176.3	135.8	126.1	86.2	106.1	82.4	76.5	41.9

Discussion

Although the results of these trials will be compromised by the initial problems (caused by obtaining the fingerlings later than initially intended and thus not being able to equalise the size at stocking through careful nursing), the basic design appears to be adequate for the purpose of comparing the different stocks of Chinese carps (it has been used for several years for comparisons of different stocks of common carp in India – see Basavaraju *et al.*, this volume). However, the performance of the hybrids relative to the silver carp changed from on-farm to on-station ponds. The stocking density of silver carp varied between these two sets of ponds (Parbatipur stock silver carp were absent from the on-farm ponds), and this may have been responsible for the difference in the hybrid performance. However, other factors also varied (e.g. water was exchanged on-station but not on-farm , and towards the last sampling period reported the water level was lower in the on-farm ponds), and the

grass carp and silver barbs also showed changes in performance between the two situations (perhaps due to less access to bankside vegetation in the on-farm ponds).

Future trials will incorporate Chinese carps obtained from a wider variety of sources and include grass carp as well as silver carp and bighead carp. The fish will also be obtained as fry and reared on-station to ensure minimal size differences at the time of stocking.

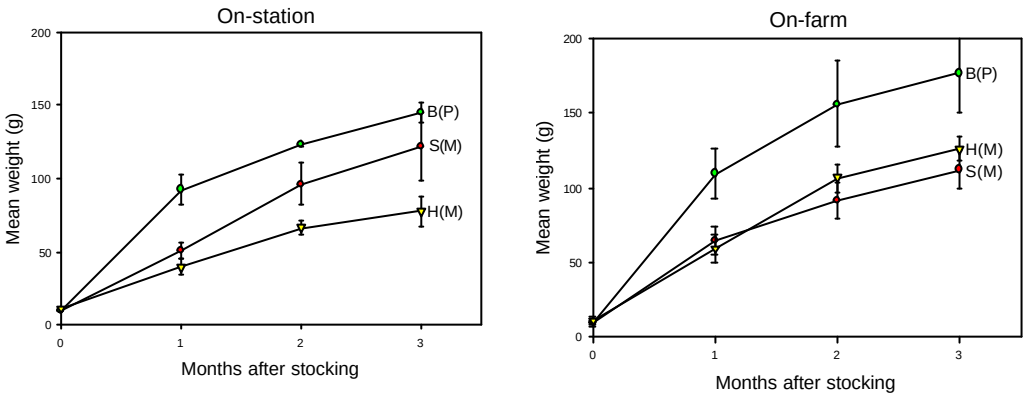

Figure 1. Growth of Mymensingh silver carp, S(M), and Mymensingh bighead x silver carp hybrids, H(M), under on-station and on-farm conditions (the latter shows the mean of high and low input on-farm conditions). The growth curve for the Parbatipur bighead carp, B(P), is also included for comparison (these three groups of fish did not show significant differences in weight at the start of the trial – see Table 1).

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