Experiments on Raising Quality Fish Seed in Floating Nursieries and its Role in Aquaculture in India

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In India, cage culture was attempted for the first time for airbreathing fishes in swamps which are marked by low D.O. (Dehadrai *et al.*, 1974) and for major carps in running water in Yamuna and Ganga during 1972-76 at Allahabad. Natarajan (1976) reported that *C. catla* and *C. reba* are especially suited among Indian carps for cage culture in reservoirs and other lentic habitats.

Observations on experiments carried out on raising quality fish seed in floating nurseries and raising fish of marketable size in cages at Jari, Allahabad, during 1976-78 are presented.

EXPERIMENTAL

Objectives

In 1976, the Allahabad Substation of CIFRI launched a programme of cage culture in lentic waters to open new vistas for enchanced fish production by utilizing the already existing culturable waters. The programme had three objectives:

1. To evaluate the feasibility of rearing carp spawn in floating nurseries (cages) in lentic waters to fry stages,

2. To evaluate the feasibility of rearing carp-fry in floating nurseries (cages) in lentic waters to fingerling stage and,

3. To evaluate the feasibility of raising fish of marketable size in floating cages in lentic waters.

Material

Selection of site

A village tank of about 2.5 acres at Jari, 35 km away from Allahabad was selected for the experiments. The tank had a depth of 2.4 to 3 m. Water for the tank was drawn from a nearby canal when needed besides getting rain water from the catchment area. The cages were floated in the deepest area of the tank.

Design and fabrication of cage

(a) For hatchlings, fry and early fingerlings

For rearing of hatchlings, fry and early fingerlings, frames of thick and sturdy bamboos of about 70-100 mm in diameter were made which proved ideal as they were light, durable and could float easily at the required depth. The bamboos, making the frame, were fixed with iron nuts and bolts, enabling easy assembly, dismantling and transport. The dimension of the frames is such that nylon hapas of size 2.20 x 1.60 x 1.45 m could easily be fixed inside. Polythene floats of about 100 mm in diameter were fixed in bunches of 10-12 on each vertical bamboo of the cage frame. The location of floats on bamboo frame was so adjusted as to keep the cages submerged in water to a depth of about 1.10 m to 1.20 m. As required, the number of cages were increased by tying long ropes in between and the extreme two cages were tied to sinkers at the two ends with long thick ropes. This allowed scope for movement of cages.

(b) For advance fingerlings

Advance fingerlings were reared in cages made of wood and tubular iron pipes with galvanized iron mesh of 1/5" around. Cages made from tubular iron pipes proved more handy but required regular enamel painting. The size of these cages was also standardized to 2 x 1.5 x 1.5 m to have a surface area of 3 sq m. Each frame of these cages can be separated before transport by removing the nuts and bolts.

Collection of spawn

Riverine spawn, having a good percentage of major carp was collected from the river Yamuna. The spawn was acclimatized in plastic pools for about a week on artificial feed.

Method

Release of spawn in floating nurseries

The acclimatized spawn was transported to the site and released in floating nurseries prepared

with 1/40" mesh nylon hapas. Two such nurseries were stocked, each with about 30,000 hatchlings. Close observations on the behaviour of spawn in these prepared nurseries was kept and dead hatchlings were removed. Regular feeding with artificial feed was continued the day after the release of spawn. The nylon hapa cages were changed once every forthnight.

OBSERVATION

Growth and survival

Hatchlings/fry

The hatchlings started moving in shoals immediately after their release in cages. The behaviour of hatchlings in these floating nurseries was almost normal and within two to three days, they were conditioned to take feed. The hatchlings of one nursery attained an average length of 45.6 mm within a period of 28 days from an average size of 7.8 mm. The other nursery was stocked later and over 21 days of rearing the fry here attained an average length of 30.2 mm from an average size of 6.5 mm at stocking.

The survival at this stage was estimated to about 25 percent. The hatchlings during transfer of cages were given 3 percent sodium chloride and 0.1 ppm Acriflavin solution. Aquatic plants such as *Hydrilla* and *Vallisneria* were submerged inside the cages in bunches, with the help of nylon twine. This provided nibbling material to the growing fry and a distraction to the shoaling movement. This method found successful in earlier trials at Getalsud Reservoir by Natarajan (1976) proved effective in controlling the mortality noticed at this stage of fry in cages.

Fry/fingerlings

The young fry were transferred after one month to cages having 1/8" mesh nylon mosquito netting hapa cages. The number of fry of each of the two nurseries was distributed equally into two cages each having about 2,500 fry. Within a period of about 3 months from the young hatchling stage the fry grew to fingerling size attaining an average length of 121.8 mm in one cage and 103.6 mm in the other cage, the actual period of rearing being 89 days and 82 days, respectively.

Table 1. Growth attained by different species in floating cages on 15.11.76. Stock of lot A and lot B reared from spawn stage.

Species	Lot A (89 days rearing)	Lot B (82 days rearing
C. catla	192.0	150.0
C. mrigala	120.5	105.0
L. rohita	116.0	–
L. bata	102.0	90.0
Total average	121.8	103.6

Stock composition

The stock of the two lots collected from river Yamuna on 12-13th August 1976 and 19th August 1976 after rearing in cages up to fingerling stage was analyzed for species composition. Lot A consisted of 40.5 percent major carp and 59.5 percent minor carp (mainly *L. bata)* and lot B, 63.3 percent major carp and 46.7 minor carp (mainly *L. bata).* The percentage of different species among major carps, in the two lots was as follows.

Species	Lot A	Lot B
C. mrigala	89.0 percent	97.2 percent
C. catla	2.3 percent	2.8 percent
L. rohita	4.9 percent	–
L. calbasu	3.8 percent	–

Raising of fish to marketable size

Experiments to raise the fish to marketable size were also made. The major carps of the two lots were segregated in December and distributed in 3 cages of 1/8" mesh mosquito netting hapa at different stocking rates. All minor carps which constituted of *L. bata* mainly were stocked in the 4th cage along with the remaining *C. mrigala.*

Table 2. Stocking rate of fingerlings in different cages

Cage 1.	1500	*(C. mrigala 1330, C. catla 35, L. rohita 80, L. calbasu 55)*
2.	1000	*(C. mrigala 950, C. catla, 50)*
3.	500	*(C. mrigala 500)*
4.	4110	*(L. bata 3500, C. mrigala 600)*

These experiments were set in December with a view to study the effect of different stock densities on growth from April onwards when temperature starts rising and fishes also start picking up growth. The experiments were disrupted in April 1977 as water level of the tank went down and massive myxophyceae bloom appeared resulting in mass mortality of tank fish (Sharma and Mukerjee, 1958). After the stress of killing was over, the experiments were reset in the new tank in June 1977 when a new wire mesh cage of size 2 x 1.5 x 1.5 m was also floated in the tank along with the existing cage. The cages were shifted again to the old tank in August 1977 when the tank became filled with water from the catchment area following monsoon rains. All the fishes numbering about 600 were kept in one cage of 2 x 1.5 x 1.5 m from August 5 to 15 as the other cage was damaged. The fishes were equally distributed into two iron pipe cages from August 16. This set of two cages with 300 fishes each was maintained until April 1978 when finally the cages along with the fishes were shifted to Gulariya reservoir and the Jarica camp was closed. The observations on growth of fingerling until April 1978 are given in Table 3.

Feeding

Resorting to artificial feeding in cage culture is rather inevitable. In the experiments, attempt was made to provide a rich protein diet (32.9 percent) with soya bean powder, groundout oil cake and rice polish mixed in 1:1:1 ratio. For hatchlings, the feed was sprayed in cages in powder form at 30 percent of the body weight for 3-4 days and subsequently to 20 percent. Frequency of feeding was maintained to 4 times a day throughout the experiments. The fry were provided with feed in powder form as well as in small balls made from the dough. Subsequently, only balls were given to fingerlings and the size of ball was increased gradually. The feeding was reduced in phases to 4 percent during winter months and restored to 10 percent during summer months when the temperature of water rose to 28-34°C. Regular and constant observations on feeding were made and on the basis of intake of feed by fishes, the schedule for feeding was formulated month to month. In 1/5" iron mesh cages feed balls were placed on feeding baskets hung inside the cages. Besides artificial feed, the stock in cages received feed in the form of plankton from the tank and periphyton complex that developed on the hapa surface.

CONCLUSION

The experiments conducted by setting up floating nurseries, proved successful in terms of (a) rearing carp spawn in floating nurseries (cages) in lentic waters to fry stage and (b) rearing carp fry in floating nurseries (cages) in lentic waters to fingerling stage.

We started our experiments with 30,000 hatchlings/cage of 3.5 sq m area which comes to 8,500 hatchlings/sq m, i.e., 85,000/ha. Even after allowing for escape and mortality, this is about three times more, in terms of stocking rate, than has been reached in pond nursery management. The growth is also comparable to any pond rearing stock as within 28 days advance fry measuring about 46 mm were available. For fry, a maximum density of 2,500/cage or 700/sq m area (7,000,000/ha) was tried. This is about 35 times more than the stocking density achieved for fry rearing in ground nurseries. The fingerlings in our experiments attained stocking size of over 100 mm by the middle of November. The third phase of the experiment, i.e., raising of fish to marketable size, needs improvement in the technique as the size of the fish attained after 12 months of rearing was definitely on the lower side. Considering the high density maintained in the cages, the production estimates are quite high. We have been able to achieve a production of 22.5 kg/cage (35 sq m area) in the 1st year of rearing from spawn stage which works out to 75 tonnes on a per hectare basis under the stocking density of 300/cage. If the production for the total period of growing of about 20 months is taken into consideration, a yield of 55.6 kg/cage in cage 1 and 51.9 kg/cage in cage 2 could have been achieved. On a hectare basis, it works out to 185 tonnes for cage 1 to 173 tonnes for cage 2 under the same stocking density of 300/cage.

It is significant to note that the diverse and scattered character of ponds, tanks and reservoirs in India reinforces the need for floating nursery as this not only dispenses with elaborate nursery management but renders each pond, tank, etc. a production unit without the paraphernalia of nursery, rearing pond, etc.

SUMMARY

One of the important constraints encountered in the development of fisheries in ponds, tanks, reservoirs and lakes in India is limited availability of nurseries for raising major carp stocking material.

Table 3. Showing growth of *C. catla* and *C. mrigala* in 1/5'' iron mesh cages.

Date of sampling	Species	Av. length in mm	Range in mm	Av. weight in g	Range in g	Increment length in mm	Increment weight in g
2.8.77 (12 months rearing)	*C. catla*	320.2	300-373	519.0	385-830		
	C. mrigala	178.1	157-210	62.0	50-95		
						(In 91 days)	
1.11.77	*C. catla*	365.7	340-400	767.5	550-980	45.5	248.5
	C. mrigala	243.5	231-275	150.0	110-205	65.4	88.0
	Cage 1						(In 151 days)
1.4.78 (20 months rearing)	*C. catla*	371.0	360-382	780.0	470-990	5.3	12.5
	C. mrigala	250.8	221-286	167.0	100-245	7.3	17.0
	Cage 2						
	C. catla	346.5	328-365	610.0	460-760		
	C. mrigala	248.7	232-263	161.0	120-190		

The floating nurseries composed of units of floating cages (made of wooden framework and internal lining of nylon cloth of 1/40 mesh/inch appears to hold great promise as reflected by studies carried in a large tank at Allahabad and Getalsud reservoirs. The nylon mesh of 1/40 mesh/inch was used for rearing hatchlings to fry, 1/8 mesh/inch from fry to fingerlings. For further rearing 1/5 mesh/inch was used. The feed was made of soya bean powder, ground nut oil cake and rice polish in 1:1:1 ratio. The stocking rate was 10,000/m^2 for spawn to fry, 2,800/m^2 for fry to fingerlings and 300/m^2 for further sizes. The material used for the study was *Catla catla, L. rohita, C. mrigala, and L. bata. C. catla* shows great promise for culture in cages.

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