INVESTIGATATION OF THE GROWTH PERFORMANCE OF MIXED SEX OF *OREOCHROMIS MOSSAMBICUS*

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Abstract: Aquaculture has contributed much to food security and employment in all over the world including India. *Oreochromis mossambicus* was the first tilapia species to be taken up for large scale aquaculture, followed by *Oreochromis niloticus*. The present study aimed to investigate the growth performance of mixed sex of *O. mossambicus* in a reservoir based small cage for inexpensive fish production. The study was conducted in the Man reservoir at Manawar, Dhar from August, 2013 to February, 2014. Fingerlings were stocked in a 5 x 4 x 2 m cage and fed with floating commercial feed for six months. Length-weight of fish and water quality data were collected once every month. The results confirmed that specific growth rate (SGR) was 1.24 %/day, daily weight gain (DWG) 0.87 g, food conversion ratio (FCR) 1.30, condition factor (K) 1.97 and survival rate (SR) 54 %. The highest percent (45 %) of fish harvested weighed 200 – 250 g. The water quality was within up to standard optimal range for fish survival and growth. The outcome indicated satisfactory growth of mixed sex O. mossambicus though the survival was moderately low due to stress-related factors.

Keywords: Growth, mixed culture, mortality and survival, Tilapia

Introduction; Tilapias are well-known to be an important part of fisheries for thousands of years and are being treated as the second most important farmed fish globally next to carps. *O. mossambicus* was introduced in India as early as 1952 with an outlook to filling some unoccupied ecological niches, mainly pond aquaculture and reservoir fisheries. The fish was popularized under government support in the southern States of Tamil Nadu and Kerala, but the overall experience with the species has not been encouraging. The fish turned out to be a prolific breeder, leading to over population and stunted growth in both aquaculture ponds and reservoirs. The fisheries of tilapia has progressively gained expansion in many countries due to its suitability to variety of pond farming conditions, resistance to diseases, high survival and growth rate [1]. Tilapias have positive reproductive strategies that set them apart from the majority of other fish species. [2] The reproductive success has been shown to be of any species including fish is influenced by stocking density, sex ratios, age, size, nutrition and feeding system. [3]. It is well known fact that various water quality parameters can influence the reproductive potential of the fish. [4],[5],[6], [7],[8]. The fish, tilapia grows and reproduces in a broad array of ecological conditions and tolerates stress induced by handling [9].Tilapiines are the easiest and most profitable fish to farm due to their omnivorous diet, mode of reproduction (the fry do not pass through a planktonic phase), tolerance of high stocking density, and rapid growth. But, this capability has unwanted consequences in tilapia like reduction of growth rates, onset of sexual maturity and over reproduction, leading to different sizes of small fish production [10].To overcome this problem in mixed-sex population all-male tilapia or monosex culture [11] is well established for increased production.

In the past small scale fishing in reservoirs contributed significantly to food security, nutritional requirements and economic status of fisherman communities around reservoirs. However, the use of illegal fishing methods, notably the use of mesh sizes smaller than the minimum 2.5 cm and overfishing has resulted in descending trend in fish production from the reservoirs hence the strong need for cage culture. This study aimed to investigate the growth performance of mixed sex of Tilapia mossambicus in a reservoir-based small cage.

Materials and Methods:

Study area: The study was conducted in the Man reservoir at Zeerabad (22°24'35"N 75°3'38"E) in Manawar tehsil of Dhar District, Madhya Pradesh (Western India, Fig.1) Manawar has an average elevation of 180 metres (590 feet) and lies in Narmada Valley. The maximum height of the dam above river bed level is 52.4m and of the earth dam is 33.9m. The mean atmospheric temperature is between 25°C and 39°C.

Cage design: A single-unit of 40 m3 indigenous cage made up of two rectangular frames (5 x 4 m), which formed both the top and base of the cage with a 2 m depth was used for the study purpose. The frames of the cages were constructed from 3.81 cm diameter galvanized pipe and covered with nylon net with mesh size 1.5 cm. The cage was floated by polyvinyl chloride (PVC) pipes of diameter 38.1 cm. All the four corners were anchored using nylon ropes to heavy stones weighing between 10 – 25 kg each placed at the bottom of the reservoir bed. The top part of the cage was covered with 6 x 5 m net (5 cm mesh size) as shown in Figure 2.

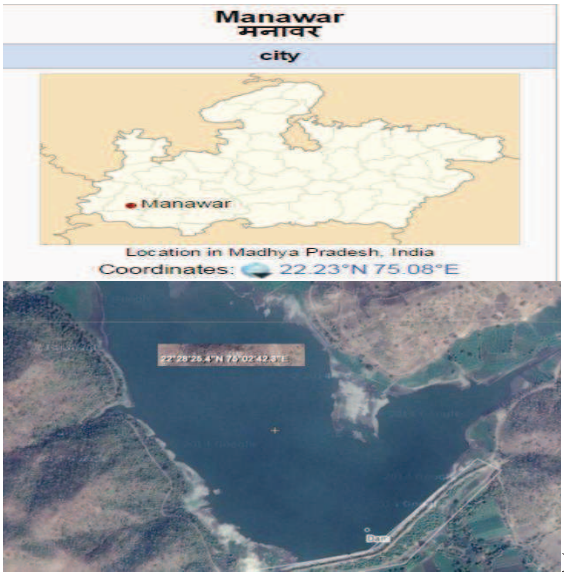

Fig.1. Study area of Man reservoir at Manawar, Dhar

Stocking of cage: The cage was stocked with 2,500 fingerlings of mean weight 19 ± 0.18 g. The female population was 70 % and that of the male population was 30 %. The stocking density was 58 fish per m^3.

Feeding: Fishes were provided with commercial food for 6 months. Food was given in the form of floating pellets with 33 % crude protein level. Feeding was made two times daily between the hours of 8:00 - 9:00 AM and 16:00-17: 00 PM. The daily quota of food was generally divided into two equal parts and given to fish by spreading. The percent fish body weight adopted for feed estimation for the six months (from 1st month to 6th month) were 8 %, 7 %, 6 %, 4 %, 3 % and 1.5 %. The feeding rate was calculated as = Feeding rate=% Fish body weight × Fish weight (g).

Growth parameters and mortality: About 30 to 50 fish was sampled monthly and growth parameters recorded. The standard and total length was measured to the nearest ± 0.1 cm and the weight of fish measured to the nearest ± 0.1 g. Mortality of fish was recorded daily by handpicking and counting. Growth parameters such as specific growth rate (SGR), daily weight gain (DWG), feed conversion ratio (FCR) and survival rate (SR) were calculated according to guidelines given by Ricker [12] and condition factor, K according to Gomiero and Braga. [13]

SGR (% day-1) = (In final weight – In initial weight) $(days)$ × 100

DWG (g day-1) = (mean final weight (g) – mean initial weight (g) $days$

FCR = total amount of dry feed consumed (g) wet weight gain of fish (g)

SR = final number of fish initial number of fish× 100

K = $WL3$ × 100; where W = weight of fish (g), L = Total length of fish (cm)

Physico-chemical parameters: Water quality parameters like dissolved oxygen (DO), temperature, pH, and total ammonia-nitrogen of reservoir water were monitored on monthly basis in three different locations (upstream, midstream (close to the cage) and downstream) of the reservoir. Temperature and pH were measured on the spot using the glass thermometer and digital pH meter (systronics) respectively, Total ammonia-nitrogen and dissolved oxygen were measured by methods given by APHA [14]. (2005).

Data analysis: Microsoft Excel 2007 was used for the analysis. Water quality parameters were summarized in table to display the extents of physico-chemical parameters.

Results and Discussion: **Physico-chemical status of the reservoir**: The water quality of the reservoir in terms of physico-chemical characteristics was good. The mean temperature (℃), pH, DO (mg/l) and NH_3-N (mg/l) were 24.5 ± 0.49, 7.0 ± 0.11, 7.2 ± 0.17 and 0.2 ± 0.07 respectively as shown in Table 1. All the water quality parameters of the reservoir in the culture area where the cage was located were within the acceptable optimal range for fish culture. [15], [16]

Parameter	**Range Mean ± S.D**
Temperature, ℃	24 – 28 ± 0.49
pH, units	6.8 – 7.1 ± 0.11
Dissolved Oxygen, mg/l	7.2 – 7.4 ± 0.17
Total Ammonia-Nitrogen, mg/l	0.1 – 0.2 ± 0.07

Table 1. Physico-chemical parameters of the reservoir with standard deviation (± S.D)

Growth of mixed sex tilapia: The results of the growth of mixed sex of tilapia cultured under the reservoir-based small cage system were presented in Table 2.results indicate that the survival rate was fairly low (64 %). But the other parameters for specific growth rate, daily weight gain, and condition factor and food conversion ratio were acceptable.

Parameter	**Value**
Survival rate (SR), %	64.00
Specific growth rate (SGR), %/day	1.24
Daily weight gain (DWG), g	0.87
Condition factor (K)	1.97
Food conversion ratio (FCR)	1.30

Table 2. Growth parameters of mixed sex Oreochromis mossambicus in a reservoir

The survival rate of mixed sex of Oreochromis mossambicus stocked in 40 m3 cage in the Man reservoir was comparatively low (64%) as 36% of the fish died at the time of harvest. Our results are in contradict with the results of Ofori *et al.* [17] who pointed out that survival rate in smallholder tilapia cage culture is typically in the range of 70 - 80%.The low survival rate in our study may be due to excess stocking densities (70 fish per m3) and severe stress due to delays in transportation of fingerlings to the study site. The high growth recorded for the fish possibly suggests that, the fish grows fast in the cage system due to efficient water exchange and less interest in reproduction. This is marked in the food conversion ratio (1.30) and specific growth rate (1.24 %/day) achieved which point out efficient food utilization. Our results are similar with previous workers [18], [19], in which increase in growth rate of fish in cages was found. The condition factor (K) achieved in this study was higher than 1 (Table 2) indicating that fish were in healthy and in good condition. It can be incidental from this study that the growth of mixed sex Oreochromis mossambicus in the cage was good as condition factor has been used as an index for growth studies. [20]

Monthly weight: The results disclosed a fairly constant increase in mean weight from stocking (August, 2013) to harvest (February, 2014). Thus, the mean weight was 19.00 g at stocking, 27.50 g in the 1st month, 51.20 g in the 2rd month, 72.30 g in the 3rd month, 132.56 g in the 4th month, 140.31 g in the 5th month and 176.00 g in the last month as presented in Figure 3.The result at harvest revealed the greatest number (45%) of fish in the size category of 200 – 250 g followed by < 200 g (40%) and least was 15% for the size category of >250 g (Figure 3).The results showed increase in fish weight from stocking to harvest (Figure 2). There was consistent growth pattern – that is considerable weight gain was observed from stocking with fingerlings to maturity (over a period of six month). However, from December, 2013 (132.56 g) to January, 2014 (140.31 g) the monthly increase in weight was small (7.75 g); growth almost retarded. This could be as a result of feed shortage which occurred during the study leading to poor rationing of feed.

The results showed satisfactory growth of mixed sex of tilapia. Fish size of 200 g and above is generally preferred by consumers. Therefore majority of the fish at harvest fell within the acceptable size range. However, Guerrero [21] observed a size of 300–400 g in both mixed or monosex of Nile tilapia within a culture period of 6 months in either cages or ponds using a stocking density of 80 fish per m3. This big difference in fish weight could be credited to the difference in feed nutrient, strains and water quality.

Relationship between fish weight and mortality: The relationship between mortality and weight of fish is presented in Figure 4. High fish mortality was observed in the first month with a subsequent mean weight of 36 g of the individual. Consequently, mortality reduced at an increasing weight until harvest. Relationship between mean weight and mortality of mixed sex of Oreochromis mossambicus reared in a reservoir-based small cage

The early high mortality evidenced during the study could be due to stress induced by handling and poor feeding practices. [22]. [23].

Conclusions: This study has shown that mixed sex of Oreochromis mossambicus can efficiently grow to acceptable market-size in cages for consumption. It can not only provide the employment but also provide additional income to local fishers. Our results have clearly indicated opportunities for further proliferation of this fish in this reservoir.

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