Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2021; 9(1): 1351-1353

Received: 16-11-2020
Accepted: 18-12-2020

V Durai
Aquaculture Technical Expert, Thiruvallur, Tamil Nadu, India

P Prabhakaran
M. F. Sc, Department of Fish Processing Technology, Fisheries College and Research Institute, Tamil Nadu Fisheries University, Thoothukudi, Tamil Nadu, India

A Karthy
Fisheries College and Research Institute, Thoothukudi, Tamil Nadu, India

Corresponding Author:
P Prabhakaran
M. F. Sc, Department of Fish Processing Technology, Fisheries College and Research Institute, Tamil Nadu Fisheries University, Thoothukudi, Tamil Nadu, India

Growth and survival of amur carp and pangasius at floating cages in Stanley reservoir

V Durai, P Prabhakaran and A Karthy

Abstract
Cage culture is the most efficient potential system of the farming practices, to utilize the untapped water bodies. Here, an ideal species selection is imperative to achieve the better growth that ensure to achieve higher economic return. Therefore, present study was aimed to evaluate the growth and survival of amur carp and pangasius at floating cages at Stanley reservoir, Tamil Nadu. The larval fish of carp and pangasius were obtained from the local hatcheries, and socked into 12 HDPE cages (5 x 5 x 4 m) at stocking density of 50 m^{-3} (9832 numbers) and 40m^{-3} (14158 number) respectively. The estimated specific growth was of 2.063% day^{-1} for amur carp and 2.278% $day^{-1}$for pangasius and the survival rate was about 50% for the both the species. Water quality parameters were within limited of fish culture as recommended BIS/ICMR. The data of the study suggesting that both the species are ideal for culture and not affected the water quality parameters remarkably. It is advocates that we needed to consider the local price of fish to obtain the high economics return.

Keywords: Cage culture, catfish, growth rate, grow out culture

Introduction
Aquaculture offers the cheapest source of animal protein to 13% of world population [1]. It anticipated that aquaculture is going to meet the global deficit of fish protein due to stagnant marine fish landing. Here, cage culture has been identified as a most efficient and potential system of the farming practices, to utilize the untapped water bodies. Cage is generally raising the fish in an enclosure of netting supported with rigid frames, positioned in water with anchors and floats. The China was contributed about 68.4% (704254 tons) to the global freshwater cage culture and followed by Vietnam (12.2%), Indonesia (6.6%) and Philippines (5.9%). Today, around 70 species have been experienced in freshwater cage culture globally. In this Pangasius accounted 133594 tons (41.1%) followed by 26.7% of *Oreochromis niloticus*, 6.6% of *Cyprinus carpio*, 5.1% *Oreochromis* spp., 4.1% of *Oncorhynchus mykiss*, 3.7% of *Salmo* spp. [2]. In India, freshwater cage farming was initiated for air breathing fishes in swamps and for Indian Major Carps in the rivers of Yamuna and Ganga at Allahabad. The cyprinids, perches, snakehead, and catfish are the dominants group of species were cultured in cages [3]. Later on, as importance, cage farming was promoted in the name of National Mission for Protein Supplements (NMPS) by Government of India in many states including Tamil Nadu. Despite, the insufficiency of published information about the growth rate of amur carp and Pangasius in cages and variation in the data existing. Therefore, this paper presents the growth performance of amur carp and pangasius in floating cages in the reservoir.

Material and methods
There were 12 number of High-Density Polyethylene (HDPE) cages were installed (5 x 5 x 4 m) in Stanley reservoir, Mettur which is located 50 km away from Salem, Tamil Nadu. The outer and inner dimension of the cages were about 5m x 5m and 4m x 4m, respectively. The nylon knotless square net was used 4m x 4m x 3m (L x W x D) and the mesh size ranged 12-15 mm. The amur carp and pangasius were obtained from the Government fish farm, Krishnagiri and private fish farm, Vellore respectively and reared them in the cages at stocking density of 50 m^{-3} (9832 numbers) and 40m^{-3} (14158 number) respectively. Both the seeds amur carp, and pangasius initially fed with mash feed, later the commercial floating pellet diet (Himalayan Aquatech, Thanjavur, Tamil Nadu) were used couple of times (9.00 – 9.30 am and 4.00 – 4.30 pm) at 5% of the body weight entire study periods.

A total of 0.35 tons of mash feed and 9.647 tons of floating pellet feed were used in entire cage operation for both species. The individual length and weight of both the fish were sampled for both the specie to calculate the growth and is specified below

Absolute growth (g) = $W_2 - W_1$

Absolute growth rate (g/day) = $(W_2 - W_1) / (t_2 - t_1)$

Relative growth = $(W_2 - W_1) / W_1$

Relative growth rate = $(W_2 - W_1) / W_1(t_2 - t_1)$

Instantaneous growth rate (g/day) = $(\ln W_2 - \ln W_1) / (t_2 - t_1)$

Specific growth rate (% / day) = $100 * (\ln W_2 - \ln W_1) / (t_2 - t_1)$

Whereas W_1=initial wet weight of fish at stocking, W_2=final wet weight of fish;

t_1= age at stocking, t_2= age at end of grow out period.

The survival, Food Conversion Ratio, and Gross revenue were calculated as follows

Survival rate (%) = (No of fish stocked – No of fish mortality) / no of fish stocked *100

Food Conversion Ratio = total amount of feed given(g) / total quantity of body weight gain(g)

Gross revenue = quantum of fish produced (kg) x price per kg of the fish

Water quality parameters

The water samples were collected from the cage to examine the commercial important water parameters. The water temperature was measured using the mercury thermometer in the filed itself. dissolved oxygen (DO), pH, hardness, Total alkalinity, Biological oxygen demand (BOD) Chemical oxygen demand (COD), nitrate (NO3), nitrite (NO2), ammonia (NH3) and phosphate (PO4) Sulphate (SO4) and Chlorophyll was examined in analytical laboratory following the standing protocol [4].

Results and Discussion

The growth performance particulars of fish that reared in cages were measured at the end of the experiment. The initial stocking size varied amidst species – 1.5 g for amur carp and 15g for pangasius – owing to non-availability of seed at this time. An average growth weight gain or absolute growth of 658 g was registered for pangasius during 313 days of the culture periods: whilst 45.5 g for amur carp during the culture period of 167 days. The amur carp had higher absolute growth (535 to 670 g) rather than common carp (320 to 365 g) in government fish seed farm [5]. Growth for amur carp was lower in monoculture (258 g) and higher in polyculture (557 g) for seven month rearing period [6]. The lesser growth in amur carp is related to lowland culture area and irregular water flow. Whereas, the pangasius had the absolute growth of 512 g which obtained in 78 culture days with an initial stocking size of 190 g [7]. It varies with stocking densities; maximum absolute growth was found to be at the stocking density of 40 m^{-3} than 50 m^{-3} and 60 m^{-3} owing to lesser caring capacity and adequate amount of feed [8].

The specific growth rate was not varied considerably between both the species – 2.062 for amur carp and 2.277 for pangasius. The finding of the present study was higher than the Thai pangasius (2.062%), and Rohu (0.94%). And all other estimated growth such as the relative growth rate (g/day), and instantaneous growth rate (g/day) were higher in pangasius than amur carp. The estimated best FCR noticed for amur carp was of 1.545 and higher was of 1.865 for pangasius. The calculated FCR was efficient in this study than other reported FCR of pangasius (2.0 – 2.2) [9, 10] but similar finding was reported [6, 8]. The FCR also varied with stocking densities and highest was found to be in 40 m^{-3} rather than 50 m^{-3} and 60 m^{-3} [8]. The survival was around 50% for both species, which due to stocking of small size results. The growth performance was found to be lower in cages compared to grow–out culture in ponds [11, 12] owing to non-availability of natural biota as food [11]. Studies also reported that stocking density negatively influences the absolute growth, survival rate, daily weight gain and FCR in cages [8, 9]. But the 15% amur carp has been an ideal for polyculture with an improved the FCR [13]. A total of 227.1kg of amur carp and 5178.9 kg of pangasius were reaped from the cages which sold through tender method (K.K.98 MDFCMS Society, Mettur dam) and realized an average price of ₹ 101 and ₹ 61.89 kg^{-1}, respectively. A total income of ₹344,052 was generated by selling both species amur carp and pangasius.

Water quality parameters

The water quality parameters of the fish caged site in Stanley reservoir are presented in Table 1. The pH is negative logarithmic of hydrogen ions which acidic or alkaline measure is. It varied due to intake and release of CO_2 in respiration and photosynthesis. It affects the metabolism and physiological process. The excess pH leads to raises ammonia in the water bodies [14, 15]. The estimated pH was about 7.9. The optimum pH is 6.5 to 8.5 (BIS). Temperature and dissolved oxygen affect the fish health, feeding behaviour, growth, mortality, survival, and reproduction of the fish. The recorded temperature in the fish caged site was 30.9°C. The atmosphere air and photosynthesis are the primary sources of dissolved oxygen. The maximum dissolved oxygen 9.26 mg l^{-1} was recorded in January 2015, and the minimum 7.33 mg l^{-1} in December 2014 with a mean value of 7.91 mg l^{-1}. It was within the desirable limit 5 mg l^{-1} (BIS) for fish culture. However, Pangasius is an air breathing fish which can survive lower dissolved oxygen.

Alkalinity is the total concentration of base and ability to change the pH. The recorded alkalinity was about 74 mg l^{-1} and also fallen under the recommend level of 200 mg l^{-1} (BIS). The water hardness is the measure of alkaline earth metals, in particular, the calcium and magnesium. The moderate hard water noticed inside the fish caged area. But this was not deviated from the optimum limit 300 as $CaCo_3$ mg l^{-1} (BIS). Another important parameter is total ammonia; it comprises of ionized ammonia and unionized ammonia. The ionized ammonia more toxic to fish which affect the central nervous system of the fish. The pH and temperature parallel line to the ammonia concentration. It was found to be higher during November 2014 of 0.6033 µg.at.NH_3-N l^{-1} and the lower during December 2014 of 0.001 µg.at.NH_3-N l^{-1} with a mean of 0.50 µg.at.NH_3-N l^{-1}. It mainly sourced from the fish excretion and uneaten feed in cages. Similar kind of finding was reported in other studies of cage culture [16]. The recorded concentration of Phosphate was 5.45 µg.at.PO_4-P l^{-1} and the chlorophyll 20.1µg l^{-1}. The observed water quality parameters in the present study was within the desirable limit of water quality parameters for fish culture [14, 16].

Table 1: water quality parameters from the cage culture in Stanley reservoir

Parameters	Fish caged site Mean - S. E	Desirable level	Recommended agency
pH	7.98 - 0.17	6.5 – 8.5	ICMR /BIS
Temperature °C	30.93 - 0.66		
Dissolved Oxygen (mg l^{-1})	7.91 - 0.89	5	ICMR /BIS
Biological Oxygen Demand (mg l^{-1})	4.64 - 0.71	5	ICMR
Chemical Oxygen Demand (mg l^{-1})	2.19 - 0.73		
Total Alkalinity (mg l^{-1})	74 - 18.26	200 mg/l	BIS
Total Hardness (mg l^{-1} as $CaCO_3$)	148.55 - 19.5	300 mg/l	ICMR /BIS
Sulphate (mg l^{-1} as SO4)	0.51 - 0.23	200 mg/l	BIS
Ammonia (µg.at.NH_3-N l^{-1})	0.50 - 0.24		
Nitrite (µg.at.NO_2-N l^{-1})	1.32 - 0.44		
Nitrate (µg.at.NO_3-N l^{-1})	1.82 - 1.55	45mg/l	ICMR /BIS
Phosphate (µg.at.PO_4-P l^{-1})	5.45 - 2.23		
Chlorophyll (µg l^{-1})	20.1 - 3.89		

Data are presented as mean and standard error.

Conclusion

Results of the study suggesting that both species ideal for culture in cages and did not affected the water quality parameters. It is important to consider the local market price of the fish before stating the cage farming practices to achieve higher profit.

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