Journal of Environmental Biology
September 2008, 29(5) 673-676 (2008)

Impact of de-silting of pond on the growth and survival of catla (*Catla catla)* spawn

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(Received: January 01, 2007; Revised received: September 13, 2007; Accepted: October 18, 2007)

Abstract: *Experiments were conducted in non-desilted and de-silted earthen nursery ponds for a period of fifteen days to evaluate the growth and survival of Catla spawn. The fry attained an average weight of 42.03±0.36 and 74.36±72 mg, with a survival rate of 23.44±0.31and 50.91±0.21% in non-desilted and de-silted ponds respectively. Mentioned length data also indicate that growth and survival of Catla spawn was significantly higher in de-silted ponds.*

Key words: *Pond silt, De-silting, Catla spawn, Soil and water quality*
PDF of full length paper is available with author ***(*k_manjappa@rediffmail.com)***

Introduction

Karnataka is one of the richest among the Indian states having inland water resources of varied types (5.03 lakh ha) constituting about 9.3% of Inland water resources of India. At present there are 43 fish seed production and rearing farms under the control of State Department, Zilapanchayath and Fish Farmers Development Agencies and a few in the private sector. The seed requirement of the state is 23.60 crores fingerlings to develop about 50% water resources for fish culture. The present total fish seed production of the state is around 15 to 20 crores fry per annum which is about 1/3rd of the total requirement (Ramakrishna, 2004). Rearing of spawn in nurseries is an important and curial step in fish culture. The adverse conditions and improper management may often lead to severe consequences resulting in mortality of fry to an extent of 90-98%. (Alikhuni *et al.,* 1964). Attempts have been made to improve the survival and growth of carp spawn by several workers (Tripathi, 1975; Jhingran *et al.,* 1979; Swaminathan and Singit. 1982; Basavaraja and Antoney 1997; Jena *et al.,* 1998; Park and Shin, 2007). Since 20 years the Fish Seed Farm at Bhadra reservoir is intensively used for nursery rearing of cultivable carps produced at the farm. Owing to continuous use of earthen nursery ponds for fish seed rearing with organic manures and artificial feeds, the ponds were non-desilted and filled up to the extent of 0.5 m in depth. The average survival of spawn to fry stage is low (25 to 30%) and keeping this in view, the present study was undertaken to evaluate the impact of desilting on growth and survival rate of catla spawn.

Materials and Methods

The study was carried out in Government Fish Seed Production Center located near Bhadra reservoir, Shimoga. Four earthen ponds of 39x14x1.1m were selected for the study. Of the four, two ponds were desilted manually and soil samples drawn up to 8 cm depth from both non-desilted and desilted ponds were air dried, ground, sieved through a 1.60 mm mesh sieve and bottled for analysis of organic carbon and pH. The organic carbon and pH of soil were analyzed as per standard procedure (Jackson, 1973; Jhingran, 1991). The spawn of catla (2.5±0.01 mg) randomly collected from circulatory hatching tank on 4th day soon after yolk sac absorption. The spawn were stocked to the experimental ponds at the rate of 35 lakh ha^{-1}. The average mean initial weight and length of spawn were recorded before stocking. The spawn were fed with conventional feed of ground nut oil cake and rice bran in the ratio of 1:1.

Water quality parameters *viz*., water temperature, pH, dissolved oxygen, free carbon dioxide, total alkalinity and total suspended solids were analysed at five days intervals following standard methods (APHA, 1995). Plankton samples were also collected by filtering 100 liter of water through bolting silk (60 mm mesh size). Dry weight of plankton was determined by drying the sample in a hot air oven at 100°C till a constant weight is obtained (Jhingran *et al.,* 1969). On 16th day, the final harvesting of fry was done with the help of fry collection net. Samples drawn using perforated plastic cup and were counted. Two cups of fry was taken from each pond and were counted individually and the number of fry in cups was determined by taking the average of two cups. Final average mean weight and length (mg and mm respectively) was recorded by taking 500 fry randomly from each pond.

Results and Discussion

The details of stocking, growth and survival of catla spawn showed in Table 1. The water and soil quality parameters are printed in Table 2.

Growth of spawn: The final mean growth of catla fry in terms of weight showed better in desilted pond 73.36 mg, when compared to non-desilted pond 42.03 mg. The survival percent also found to be high in desilted pond 50.91 and it was 23.44 in case of non-desilted ponds. The gain in weight / day

Table - 1: Details of stocking, growth and survival of catla spawn in the experimental ponds

Particulars	**Non-desilted ponds**	**De-silted ponds**
Size of ponds	560 m^2	560 m^2
Stocking density	35.0 lakh ha^{-1}	35.0 lakh ha^{-1}
Date of stocking	13.7.2004	13.7.2004
Date of harvesting	28.7.2004	28.7.2004
Initial mean weight of spawn (mg)	2.50 ± 0.01	2.50 ± 0.01
Final mean weight of fry (mg)	42.03 ± 0.36	74.36 ± 0.72
Increase in weight of fry (mg day^{-1})	2.64 ± 0.03	4.79 ± 0.14
Initial mean length of spawn (mm)	5.94 ± 0.14	5.94 ± 0.14
Final mean length of fry (mm)	15.03 ± 0.095	17.54 ± 0.29
Increase in length of fry (mm day^{-1})	0.60 ± 0.04	0.80 ± 0.10
Average number of fry (mm day^{-1})	46,875 ± 625	1,01,825 ± 425
Average survival percent	23.44 ± 0.31	50.91 ± 0.21

Table - 2: Water and soil quality parameters in the experimental ponds

Particulars	**Non-desilted ponds**	**De-silted ponds**
Water parameters		
Temperature (°C)	25.20 - 25.50 (25.40 ± 0.007)	25.2 - 25.60 (25.42 ± 0.08)
pH	6.57 - 6.95 (6.68 ± 0.23)	6.74-7.82 (7.49 ± 0.25)
Dissolved oxygen (mgl^{-1})	3.69 - 4.17 (3.95 ± 0.48)	5.73 - 7.81 (7.09 ± 0.63)
Free carbon dioxide(mgl^{-1})	1.86 - 4.68 (3.45 ± 0.64)	Traces - 1.66 (1.04 ± 0.36)
Total alkalinity (mgl^{-1})	43.86 - 52.72 (49.40 ± 2.92)	59.76 - 88.37 (73.35 ± 5.94)
Dry weight of plankton (mg 100 l^{-1})	1.22 - 18.39 (12.59 ± 3.86)	1.46 - 46.90 (25.29 ± 9.43)
Total suspended solids (mgl^{-1})	81.05 - 102.10 (91.25 ± 4.91)	38.64 - 55.09 (48.95 ± 3.91)
Soil parameters		
Organic carbon (%)	2.69 - 2.73 (2.71 ± 0.02)	0.81 - 0.85 (0.83 ± 0.02)
pH	6.15 - 6.62 (6.38 ± 0.23)	7.51 - 7.64 (7.57 ± 0.06)

followed the trend of growth of fry. Jena *et al* (1996) observed growth rate of catla at 25.6 mm /133.1mg and 16.8 mm/ 49.6 mg in the formulated and conventional diet respectively, when reared in nursery rearing ponds for a period of 16 days.

Water quality parameters: Water temperature recorded during study period ranged between 25.2 -25.5°C and 25.2-25.6°C in non-desilted and desilted ponds respectively. Temperature tolerance limits for Indian major carps and common carp is reported to be 18.3°C and 37.8°C (Jhingran, 1991). The temperature recorded was within the acceptable limit for the species cultured. The mean pH recorded in non-desilted ponds was slightly acidic in nature (6.68) and it was in neutral to alkaline range in desilted ponds (7.49). The increasing trend in pH from 5^{th} day onwards in desilted ponds (Fig.1) was probably due to increased phytoplankton which is a fact that they removed free carbon dioxide from the water during photosynthesis. The low pH in non-desilted ponds was coupled with lower production of plankton. According to Shrivastava and Dwivedi (1979) carp fry showed histopathological changes in the liver and the lung epithelium, muscle layer and connective tissue of guts when pH of water varied between 5.0-7.0. While Doudoroff (1956) and Hodson *et al*. (1978) observed that an acidic environment may affect fish indirectly by way of activation of some toxic substances. Packer and Dunson (1972), Vinogradov *et al.* (1978) indicated that respiratory impairment may cause death of fish in acidic water, further, they revealed that respiratory impairment under severe acidic conditions induce gill mucus get coagulated which interferes with gas exchange leading to asphyxiation. In the present investigation, pH in non-desilted ponds was almost acidic in nature and was unfavourable for the growth of catla spawn. The present study to some extent agrees with work of Shrivastava and Dwivedi (1979).

The range of dissolved oxygen fluctuated between 3.69 and 4.17 mg l^{-1} and 5.73-7.81 mg l^{-1} in non-desilted and desilted ponds respectively. A narrow range and decreasing trend of dissolved oxygen has been observed in non-desilted ponds. The minimum dissolved oxygen concentration (3.69 mg l^{-1}) was observed on the 15^{th} day (Fig. 2). The low level of dissolved oxygen in a non-desilted pond, may be due to accumulation of high level of organic matter and facultative bacteria at the bottom. The magnitude of oxygen fluctuated in desilted pond is high (Table 2.) with normal density of plankton. Rouse (1979) opined that fish require adequate concentration of dissolved oxygen for survival and growth and the minimum concentration for fish survival varies with time of exposure. A fish may tolerate low concentration of dissolved oxygen for few hours without ill effect, but will die if exposed to several days. Brown and Gratzek (1980) observed that fish can survive at concentration of less that 4 mgl^{-1} but do not feed and grow properly. Oxygen concentration above 5 mg l^{-1}. It is indicative of productivity, while at lower levels, the water is unproductive (Banerjea, 1967). Oxygen deficiency caused stress in fish which leads to an enhanced excretion of various ions through urine (Hunn, 1969). Fish do not feed or grow when these exposed to low level of dissolved oxygen *i.e.* below 4 or 5 mgl^{-1} (Andrews *et al.,* 1973). Comparing the above work, in the present study it is interesting to note that non-desilted ponds recorded low level of dissolved oxygen indicating their non suitability for fish seed rearing.

Various critical levels of free carbon dioxide in aquatic habitat have been suggested (Boyd, 1979; Zweig, 1989; Sachindananda Murthy *et al.,* 2006). According to Chow (1958) high level of free carbon dioxide is lethal and a concentration of 30-40 mg l^{-1} may kill the fish. Parks *et al.* (1975) indicated that under intensive aquaculture free carbon dioxide levels may fluctuate between 0 mg l^{-1} during noon and around 5-10 mg l^{-1} during dawn without any apparent ill

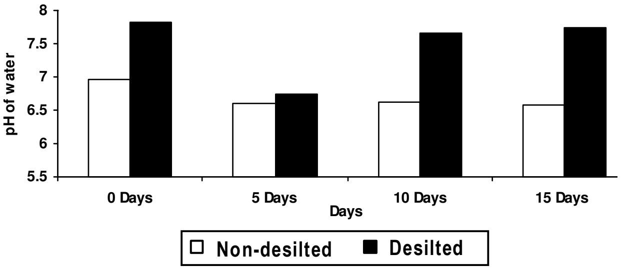

Fig. 1: Fluctuation of pH in non-desilted and desilted ponds

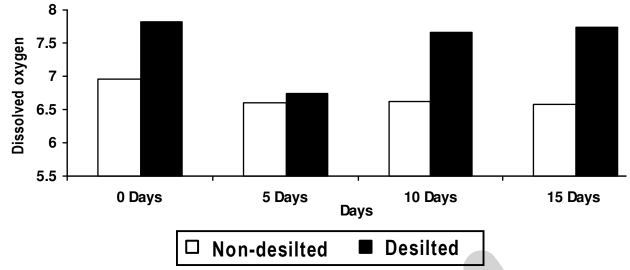

Fig. 2: Fluctuation of dissolved oxygen in non-desilted and desilted ponds

effect on fishes. Cole (1975) noted that free carbon supply rarely limits the growth of phytoplankton. Alternatively, the photosynthetic activity of phytoplankton adopts by utilizing bicarbonates as a source of carbon. In the present study not much variation of free carbon dioxide was recorded in both non-desilted and desilted ponds and it varied between 1.86-4.68 and traces to 1.66 mgl^{-1} in respective ponds. On one occasion (5th day) free carbon dioxide content was nil in desilted ponds which was probably due to abundance of plankton. Welch (1952) correlated the total absence of free carbon dioxide in water to the abundance of phytoplankton.

Total alkalinity varied from 43.86-52.72 (49.40 mg l^{-1}) and 59.76-88.37 mgl^{-1}, (73.35 mg l^{-1}) in non-desilted and de-silted ponds respectively. Banerjea (1967) observed that water with alkalinity above 50 mgl^{-1} favorable for fish culture. According to Phillipose (1959) a range of 40-50 mg l^{-1} is indicative of low productivity, 50-100 mg l^{-1} high for productivity. Jhingran (1991) opined that water with very clayey bottom usually have low total alkalinity. The value observed in present non-desilted ponds clearly indicate that they are less productive.

The average fluctuation in dry weight of plankton observed in non-desilted pond was low (12.59 mg 100 l^{-1}) when compared to desilted ponds (25.29 mg 100 l^{-1}). The decrease of plankton production in general, was poor in non-desilted ponds, which coincided with increased organic matter in the soil (Table. 2). Alikhuni (1952) opined that nursery rearing ponds which sustained algal blooms during the period of rearing fry recorded lower rate of survival as compared to nurseries which had an abundance of zooplankton. Further, he noticed that the extensive fluctuation in the physico-chemical condition of water due to the presence of algal blooms make unfavourable to the normal feeding activities and growth of tender carp fry.

The total suspended solids (TSS) ranged between 81.05 to 102.10 mg l^{-1} (91.25) and 38.64 to 55.09 mg l^{-1} (48.95) in non-desilted and desilted ponds respectively. Lower concentrations of suspended solids (<25 mg l^{-1}) are desirable for fish culture as high level of TSS affects photosynthetic process and high particulate matter clogs fish gills, (Maitland, 1990). While, Gour (1997) opined that total suspended solids caused clogging of fish gills and impaired respiration. He also observed that they will reduce the penetration of light and increases heat absorption and lower the rate of photosynthesis. According to Alabaster and Lloyed (1980) maintenance of moderate to good fisheries is possible in water containing 25 to 80 mgl^{-1} suspended solid particles while TSS value of 80-400 mgl^{-1} and above do not support good fisheries. According to the above view, in the present study on desilted ponds could be treated as moderate to good in which the TSS value varied between 38.64-55.09 mg l^{-1}.

Soil quality parameters: Organic carbon is most important factor determining the fertility status of soil. In the present study, it ranged between 2.69 to 2.73% (2.71%) and 0.81 to 0.85% (0.83) in non-desilted and de-silted ponds respectively. Positive correlation has been obtained between fish production and organic carbon by Banerjea (1967). He opined that organic content of less than 0.5% to 1.5% average production, while 1.5% - 2.5% appeared to be optimal and above 2.5% are undesirable for a pond soil. In the present study it is clear that continuous accumulation of organic substance, residual feed and fecal matter over many year has impacted directly on the quality of pond health. The soil pH varied between 6.15-6.62 and 7.15-7.64 with an average values (6.38 and 7.57) in non-desilted and desilted ponds respectively. The soil pH in non-desilted ponds was slightly acidic in nature when compared to desilted ponds. Banerjea (1967) stated that as in water, pH of soil also dependent on various factors. In mud layers, not well aerated when the oxygen supply falls short, the decomposition of organic matter become slow and reduce the rate of bacterial action, ultimately leading to low productivity of pond soil. In the present study of non-desilted ponds goes well with the study of Banerjea (1967) which probably affected the growth and survival of carp spawn in non-desilted ponds.

It is clear from the hitherto study, that good soil and water quality parameters had direct positive effect on the growth survival of catla spawn. Further, it could be concluded that the accumulation of organic matter influences over the soil and water quality parameters. The continuous accumulation of non-desilt reduces the pond hygine resulting in poor survival and growth of carp seed in nursery rearing ponds. As evidenced in the present study, the improvement of soil and water quality in the desilted ponds were apparent giving a clear indication that desilting once in 2 or 3 years is desirable. It is suggested that the under any circumstances desilting should not be delayed beyond 4 to 5 years. However, for drawing conclusive remarks further studies are required.

Acknowledgments

The authors are express their sincere thanks to the Director of Fisheries, Karnataka and the Associate Director of Research, Zonal Agriculture Research Station, Navile-Shimoga for their constant encouragements and facilities provided.

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