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EFFECT OF VARYING SPECIES RATIOS OF SILVER CARP (*Hypophathalmicthys molitrix*) and MRIGAL (*Cirrhinus mrigala*) AT CONSTANT DENSITY ON POND FISHERIES IN COMPOSITE FISH CULTURE

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ABSTRACT

Composite culture of Indian major carps and Chinese carps result in high yield as they better consume the existing natural food resources due to differences in their feeding behavior. Silver carp is a filter feeder, feeding on phytoplankton dominantly while the Mrigal carp is a bottom feeder, living on debris that settle to the bottom. During this project two ponds were stocked with different ratios of Indian major carps viz; *Labeo rohita*, *Cirrhinus mrigala*, *Catla catla*, and Chinese Carps viz; *Hypophathalmicthys molitrix* and *Ctenopharyngodon idella*. NH_4NO_3 and SSP (0.01gm N/cm) were used as inorganic while poultry manure (0.1% N) was used as organic source of fertilizer. Various fish growth parameters such as body weight, total length, fork length of fish and the yield were taken into consideration to assess the effect of varying species ratios. Pond stocked with lower ratio of *Labeo rohita* produced higher production of *Hypophathalmicthys molitrix*. The pond where *Hypophathalmicthys molitrix* were greater in number, the production of *Cirrhinus mrigala* was lower. This indicates that there might have been competition for food resources and so a lower stocking ratio of *Hypophathalmicthys molitrix* is more favorable. Most of the ecological parameters such as temperature, light penetration, dissolved oxygen, pH, alkalinity, carbonates, bicarbonates, chlorides, and total hardness and calcium showed significant seasonal differences.

Keywords: Silver carp (*Hypophathalmicthys molitrix*) and Mrigal (*Cirrhinus mrigala*), fish growth, inorganic, organic fertilizer.

INTRODUCTION

Aquaculture is an important mean of fish food production and valuable economic business throughout the world. Pakistan has vast fisheries resources including rivers, streams, lakes and ponds. Appropriate and widespread combination of fish for composite fish culture in Pakistan is Catla, Mrigala and Rohu, (Chakrabarti, 1998). Explicit interactions between fish variety are essential in the nutrition of any fish culture system and significant investigation have been made on the culture of the mentioned three varieties in diverse systems (Keshavanath *et al*., 2006; Sahu *et al*., 2007).

Fish is an important source of dietary protein in human nutrition (Abbas *et al*., 2010). It also provides vital source of proteins to a vigorous diet since it has little carbohydrate and unsaturated fats, particularly Omega 3 substance (Razvi, 2006). Fish meat is not only rich in protein but also tasty, highly nutritive and easily digestible. The digestibility of these proteins is as high as 85-95% (Rudolf, 1971). Fish also contain minerals e.g.; phosphorus, iron and iodine and is also significant source of vitamin A and D (Gerking, 1966). Recent research also proves it to be anti-cancerous (Hu, 2008). It also minimizes the risk of heart diseases and increases human life expectancy (Barlas, 1986). So adding fish in our daily food could craft a priceless input to any diet that contain mainly of cereals, starchy roots and sugar for the healthy growth (Choo and Williams, 2003; Sandhu, 2005; Salim, 2006; Yildrim *et al*., 2008).

Carp culture requires energy 22-468 kj/gm for protein production, whereas land animals require 550-3400 kj/g (Kumar, 1992). Feed supplementation in pond is an effective way to increase fish growth performance (Khan *et al*., 2012). Fish farming yields more net income i.e., 30, 000 Rs/ha, easily (Agrawal, 1994). For improvement of pond fisheries and to get maximum yield from given fresh water, it is necessary to fertilize the pond water with inorganic as well as organic fertilizers of good quality. Experiments have shown that pond receiving high fertilizer input have high nutrient concentration in water, high primary productivity and high fish production than those treated with low fertilizer inputs (Diana *et al*., 1991). The modern fertilizers containing nitrogen and phosphorus stimulate the growth of primary producers and increase the fish production (Huet, 1975). The choice of fish species is very important in maximizing the productivity both in terms of quantity and quality (Kumar, 1992). Polyculture yields a higher production than single species farming because any single species cannot utilize all the available food because of its specific feeding habits. This culture system is well established result in fish production from 6000-8000 kg/ha/year (Lannan *et al*., 1983). Keeping in view the great importance of composite culture, The project "Effect of varying species Ratios of Silver Carp (*Hypophathalmicthys molitrix*) and Mrigal (*Cirrhinus mrigala*) at constant density on pond fisheries in composite fish culture system was planned to search out

the best combination in composite culture system giving highest fish yield.

MATERIALS AND METHODS

The following line of work was adopted to attain the purpose defined for study.

Selection of ponds

The experiment was conducted by using two earthen ponds each having dimensions 33 m x 16 m x 1.8 m located at Fisheries Research Farms University of Agriculture, Faisalabad, Pakistan.

Water level

Both the ponds were filled with tube-well water up to level of 1.2-1.5 m and this level was maintained throughout the experimental period. The inlets of the ponds were properly screened with gauze of fine mesh to avoid the entry of any intruder into or exit of fish from the ponds.

Stocking density and ratios

Pond-1 was stocked with 40 grass carp, 80 silver carp, and 40 catla, 40 rohu and 40 mrigal. Pond-2 was stocked with 40 grass carp, 40 silver carp, 40 catla, 40 rohu and 80 mrigal.

Use of fertilizers

Inorganic fertilizer was added on the basis 0.01gm N/cm of fish total length daily in both the ponds. Ammonium nitrate and single super phosphate were used as fertilizer. Poultry manure was used as organic fertilizer and its dose was calculated on the basis of 0.1% N of fish wet weight daily.

Measurement of growth parameters

At the time of stocking, the growth parameters, such as body weight, total length, fork length of fish was measured and recorded. Netting was done at fortnightly intervals to get a random sample of fishes by using nylon drag net. After recording the said growth parameters, the fish was released back into respective ponds.

Water analysis

After every fortnight various physiochemical parameters of water i.e., temperature, light penetration, dissolved oxygen, pH, total alkalinity, carbonates, bicarbonates, total hardness, calcium, magnesium, chlorides, total solids, total dissolved solids and planktonic biomass were estimated fortnightly for the whole study period.

Statistical analysis

The data was subjected to statistical analysis, adapted from Steel and Torrie (1986). Comparison of mean values of various parameters was made by using Analysis of Variance and Duncan's Multiple Range Test (DMR) with repeated sampling. Correlation analysis was performed to find out the relationships among various water quality characteristics.

RESULTS

Important ecological parameters are dissolved oxygen, pH, alkalinity, total hardness, nitrates, phosphate and dry weight of planktonic biomass. A proper range of these factors is necessary for fish culture. These properties were recorded at fortnight intervals and the results obtained are presented in Table-1.

Both the ponds remained similar and inter pond differences were also non-significant. Dissolved oxygen is considered an important ecological factor of the natural waters. Table-1 shows that dissolved oxygen contents of the two ponds remained similar. However, the seasonal differences were significant. The dissolved oxygen concentration remained close to the optimal values required the fish life throughout the study period. Water pH is also an important ecological factor. Variations in pH values are linked with the life processes of animals and plants (Jhingran, 1982). Fluctuations in pH values usually related to the photosynthetic activity of phytoplanktons and other higher aquatic plants (Khan *et al*., 1978). pH remained alcoholic throughout the study period in both the ponds, probably little bit beyond the optimal limits by the fish as the water fluctuated safely between 8 to 9 during the experimental period. Inter pond differences were non-significant while seasonal differences were highly significant. Higher values of total alkalinity were observed throughout the experimental period. Total alkalinity positively correlates with the total hardness in most natural water (Boyd, 1976). Similar trend between total alkalinity and bicarbonate correlation was clearly established in both the ponds. Hardness of the water body is the measure of Ca and Mg ions in terms of $CaCO_3$. Very high values were recorded for the whole study period which might have disturbed the fish growth. Total hardness showed significant fluctuations over the whole duration. Inter pond variations were found to be non significant and this result resemble with the finding of Chaudhry (1994). Highly significant positive correlation of total hardness was observed with magnesium in both the ponds. Electrical conductivity was positively and significantly correlated with pH and bicarbonate values in Pond 1.

Table-1. Showing values of different physicochemical parameters during experimental period.

PH		Carbonates		Total solids		Bicarbonates		Electrical conductivity		Dissolved oxygen	
Pond 1	Pond 2	Pond 1	Pond 2	Pond1	Pond 2	Pond 1	Pond 2	Pond1	Pond 2	Pond 1	Pond 2
8.1	8.1	1863	1962	180	120	300	460	2.80	3.27	9.3	12.8
7.9	7.9	1899	1856	100	80	500	548	2.97	2.90	6.9	8.5
6.5	6.5	1856	1936	100	84	440	440	2.71	3.01	5.1	7.5
8.2	8.2	1986	1899	68	72	482	488	2.95	2.90	4.7	4.8
8.1	8.1	1869	2000	86	60	514	520	3.01	2.90	10	9.7
7.8	7.8	1842	1798	94	66	566	574	3.01	2.99	8.1	9.2
8.1	8.1	1900	1955	78	82	542	538	3.07	2.98	7.3	7.1
8.3	8.3	1698	1154	68	76	512	494	2.98	3.01	9.3	8.2
7.9	7.9	1726	1823	84	66	540	514	3.48	2.98	8.3	8.1
8.1	8.1	1562	1736	68	62	532	538	3.01	3.24	8.4	9.2
7.9	7.9	1498	1625	60	90	460	570	2.96	2.07	13	7
8.1	8.1	1602	1726	100	90	400	500	2.97	2.91	6	8.0
8.1	8.1	1652	1436	180	120	300	460	2.80	3.27	9.8	9.3
7.8	7.8	1620	1498	70	70	404	450	2.98	2.79	6.5	4.2
8.1	8.1	1836	1628	100	50	320	500	2.95	2.99	9.7	8.9
8.0	8.0	1870	1756	90	70	460	430	2.99	2.85	9.2	9
7.937	7.937	1767.43	1736.93	95.37	78.62	448.25	495.25	2.97	2.94	8.22	8.21

Fish production

Results of this experiment showed that gross production of the fish species i.e., *Labeo rohita*, *Cirrhinus mrigala*, *Catla catla*, *Hypophathalmicthys molitrix* and *Ctenopharyngodon idella* were 23600 kg, 21440 kg, 27880 kg, 39360 kg and 22720 kg for pond 1 and these were 24920 kg, 38560 kg, 17960 kg, 30400 kg and 23360 kg for experimental ponds 2, respectively (Table-2).

Net fish production per acre per year was 90625.69 kg, 77831.52 kg, 36783.3 kg, 150322.12 kg and 68235.85 kg for *L. rohita*, *C. mrigala*, *C. catla*, *H. molitrix* and *C. idella* respectively in experimental pond 1, and 169524 kg, 24755 kg, 74953 kg, 177520 kg and 19108 kg for pond 2.

Average body weight

The initial average weight of five fish species in both the experimental ponds were 21 gm, 49 gm, 51.1 gm, 6.2 gm and 101.5 gm for *Labeo rohita*, *Cirrhinus mrigala*, *Catla catla*, *Hypophathalmicthys molitrix* and *Ctenopharyngodon idella*, respectively. While The final average weights were 300.7 gm, 293.8 gm, 260.7 gm, 335.5 gm and 276.2 gm in experimental pond-1, and 305 gm, 274 gm, 380.4 gm, 318.4 gm and 427.3 gm in experimental pond-2.

Fork length

The initial average fork length of five fish species viz; *Labeo rohita*, *Cirrhinus mrigala*, *Catla catla*, *Hypophathalmicthys molitrix* and *Ctenopharyngodon idella* in both the experimental ponds were 10.4 cm, 13.3 cm, 13.1 cm, 7.7 cm and 17.9 cm, respectively. As regards the increase in average fork length, it varied from a minimum of -1.04 cm to 3.8 cm for *Labeo rohita*, for *Cirrhinus mrigala* minimum increase was observed as -0.38 cm and a maximum of 2.81 cm. For *Catla catla* the minimum increase was -1.2 cm and maximum was 3.92 cm, for *Hypophathalmicthys molitrix* minimum increase value was -0.9 cm and maximum was 5.64 cm, for *Ctenopharyngodon idella* the minimum and maximum increase were -1 cm and 3.32 cm, respectively in experimental pond 1. In the experimental pond 2 the minimum and maximum increase in average fork length recorded for *Labeo rohita* were -1 cm and 4.81 cm. These values for *Cirrhinus mrigala* remained -2.96 cm and 1.91 cm. These values for *Catla catla* were recorded as -0.5 cm and 3.34 cm these values for *Hypophathalmicthys molitrix* were remained as -0.3 cm and 4.11 cm and for *Ctenopharyngodon idella* were noted as -2.84 and 5.36 cm.

Total length

The initial average total length of five fish species viz; *Labeo rohita*, *Cirrhinus mrigala*, *Catla catla*, *Hypophathalmicthys molitrix* and *Ctenopharyngodon idella* in ponds 1 and 2 were 11.7 cm, 15 cm, 15.3 cm, 8.8 cm and 19.9 cm. The final average total length of the five fish species in pond 1 were 26.4 cm, 28.1 cm, 25.4 cm, 30

cm and 29.3 cm respectively, and in experimental pond 2 these were 26.5 cm, 27.3 cm, 27.2 cm, 30.3 cm and 31.9 cm, respectively.

Fertilization rates and their conversion efficiencies in two experimental ponds

Fertilization of the two ponds was done by the NH_4NO_3 and SSP (N:P; 1:1) at the rate of 0.005 to 0.01 gm N/cm of fish length daily and organic manure was added at the rate of 0.05 to 0.1 of live fish weight daily.

The fortnightly increase in total weight (240 fish) varied from -2468 gm to 10560 gm in experimental pond 1, and 700 gm to 13604 gm in experimental pond 2. Total nitrogen added per fortnight ranged between 285.2 gm to 1533.8 gm for the two ponds. Nitrogen incorporation efficiencies (NIE) varied from -5.26 to 11.74 for the experimental pond 1 and 45 to 15.66 for pond 2. Nitrogen conversion efficiencies (NCE) altered from -0.15 to 0.46 for pond 1 and from -0.07 to 0.45 for pond 2.

Table-2. Fish production in Pond 1 and Pond 2.

	Pond 1					Pond 2				
	L. rohita	***C. mrigala***	***C.catla***	***H. molitrix***	***C. idella***	***L. rohita***	***C. mrigala***	***C. catla***	***H. molitrix***	***C. idella***
No. of fishes stocked	40	40	40	80	40	40	80	40	40	40
Survival rate	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Initial average weight	420	390	628	351	440	305	250	308.4	427	225.55
Final average weight (g)	590	536	67	492	568	623	482	449	760	584
Gain in average weight (g)	170	146	69	141	128	318	232	140.6	333	359
Initial body weight (g) total	16800	15600	25120	28080	1760	12200	20000	12336	17080	9022
Gross fish production/pond/210 days	23600	21440	27880	39360	22720	24920	38560	17960	30400	23360
Gross fish production/pond/365 days	41019.04	37264.76	48458.09	68411.42	39489.52	43314	67021	31217	52389	40602
Gross f production/acre/365days(g)	379.519	344.7835	371565.5	524563	302796.58	332117	513901	239359	405151	31132
Gross fish production/ha/ 365 days(g)	776875.75	7 05771.96	917766.85	1295670.83	74707.57	820309	1269336	591216	1000722	76897
Net fish production/pond/ 210 days(g)	68	5840	276	11280	5120	12720	18560	5624	13320	14360
Net fish production/pond/ 365 days(g)	11819.04	10 1 50.476	4797.14	19605.714	8899.047	22109	32260	9775	23152	24921
Net fish production/acre /365 days(g)	90625.69	77831.52	36783.3	15332.12	68235.85	169524	247355	74953	177520	19108
Net fish production/ha /365 days(g)	223845.4	192243.86	9854.92	371320.3	168542.55	418723	610967	185133	438473	47198

DISCUSSIONS

Fish are used as an efficient and easily digestible source of food since pre historic period. Fish are regarded a perfect food because fish flesh contains all the essential amino acids in the right proportion needed for human consumption (Ashraf et al., 2011). Fish flesh has been an increasingly favourite food of humans across the world in the recent years. However, due to over exploitation of fish in natural resources, scientists were forced to adopt various methods for fish production. Fish farming, or cultivating fish under artificially designed controlled environment, is an important and cheap source of fish food production. For rapid and healthy growth of fish a composite culture is preferred. In composite culture, different fish species are used in combination in a single fish pond. These species are selected on the basis of their feeding habits so that they do not compete for food among themselves. Composite culture of Indian major carps and Chinese carps result in high yield as they better consume the existing natural food resources due to differences in their feeding behavior. Silver carp is a filter feeder, feeding on phytoplankton dominantly while the Mrigal carp is a bottom feeder, living on debris that settle to the bottom. During this project two ponds were stocked with different ratios of Indian Major Carps i.e., *Labeo rohita*, *Cirrhinus mrigala*, *Catla catla*, and Chinese Carps viz; *Hypophathalmicthys molitrix* and *Ctenopharyngodon idella*. NH_4NO_3 and SSP (0.01gm N/cm) were used as inorganic while poultry manure (0.1% N) was used as organic source of fertilizer. Various fish growth parameters such as body weight, total length, fork length of fish and the yield were taken into consideration to assess the effect of varying species ratios. Pond stocked with lower ratio of *Labeo rohita* produced higher production of *Hypophathalmicthys molitrix*. The pond where *Hypophathalmicthys molitrix* were greater in number, the production of *Cirrhinus mrigala* was lower. This indicates that there might have been competition for food resources and so a lower stocking ratio of *Hypophathalmicthys molitrix* is more favorable. Most of

the ecological parameters such as temperature, light penetration, dissolved oxygen, pH, alkalinity, carbonates, bicarbonates, chlorides, and total hardness and calcium showed significant seasonal differences.

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