International Journal of Atmospheric and Oceanic Sciences
2017; 1(1): 21-25
http://www.sciencepublishinggroup.com/j/ijaos
doi: 10.11648/j.ijaos.20170101.14

Effect of Varying Species Ratios of Silver Carp on the Growth Performance of Mrigal and Grass Carp in Semi Intensive Pond Culture System

Farkhanda Asad*, Ammara Behzad

Department of Zoology, Government College University, Faisalabad, Pakistan

Email address:
far_khane@yahoo.com (F. Asad)

*Corresponding author

To cite this article:
Farkhanda Asad, Ammara Behzad. Effect of Varying Species Ratios of Silver Carp on the Growth Performance of Mrigal and Grass Carp in Semi Intensive Pond Culture System. *International Journal of Atmospheric and Oceanic Sciences.* Vol. 1, No. 1, 2017, pp. 21-25.
doi: 10.11648/j.ijaos.20170101.14

Received: January 9, 2017; **Accepted**: March 9, 2017; **Published**: April 12, 2017

Abstract: The present project was conducted to determine whether difference in stocking ratio of silver carps can affect the growth performance of mrigal and grass carp. Fingerlings of *Ctenopharyndon idella, Hypophthalmicthys molitrix* and *Cirrhinus mrigala* were stocked at the ratio of 15:45:45 and 15:45:30 in fertilized experimental pond 1 and 2 with two replicates. Results showed that stocking ratio, species combination and fortnights had significant effect on growth of fish ($P<0.01$). In pond 1, grass carp gained significantly higher body weight, followed by mrigal and silver carp (322g, 282g and 260g), while in pond 2 silver carp gained higher body weight followed by mrigal and grass carp (400g, 299g and 248g). Results showed that, pond 1 stocked with higher ratio of silver carp gave higher production of grass carp while, pond 2 stocked with lower ratio of silver carp produce higher production of mrigal. Overall net fish production of pond 1 (4036.52 kg) and pond 2 (4207.88kg) statistically varied non significant. From the production point of view it was concluded that high stocking of silver carp to grass carp ponds is a better proposition than to add it to mrigal ponds. Most of the ecological parameters showed highly significant seasonal differences but remained favorable during whole period of study.

Keywords: Varying Ratios, Chinese Carps, Growth Performance, Semi-Intensive Pond System

1. Introduction

The most successful system of pond fish culture is the polyculture of three Indian major carp species (catla, rohu and mrigal) along with three Chinese carp (silver carp, grass carp and common carp). The high fish production in this culture results not only through a judicious combination of species, but it also depend on different stocking ratios and appropriate cultural technique including pond fertilization. Growth performance of different species also affected by temperature regimes, latitude and habitat availability. For stocking species selection depends on the nature of soil and primary productivity of that pond water, with this the availability of stocking material and consumers preference are also considered. A sustainable semi intensive pond culture includes major carp species as cash crop and exotic fish species [6]. Stocking density has a direct effect on food supply, water space and water quality. A low stocking decreased pond yield and increase production cost. Stocking density can be increased with improving cultural techniques and careful management. In polyculture, different fish species are stocked according to their different feeding habits and relationship between species [9].

After advancement in aquaculture techniques, the culture of silver carp as well as other carps has spread tremendously. It can be polycultured with some other species due to its specific habitat. Silver carp inclusion in the polyculture is now being considered, because this very efficient filter feeder has a strong impact on pond ecology [7].

In pond polyculture grass carp can be stocked either as the major species or a secondary species together with other carp species (e.g., silver carp, common carp, rohu and mrigal). Grass carp usually account for 60% of the total stocking density (dependent on the level of intensity) in ponds. It stocking density depends mainly on the availability of aquatic weeds. Grass carp can be reared with commercial

feeds or natural food. After silver carp, grass carp currently has the largest production in fresh water aquaculture globally. Mrigal is cultured with two Chinese carps (silver carp and grass carp) and common carp. Being a bottom feeder, mrigal is usually stocked at 20-30 percent of the total species stocked in three fish species culture. However, the growth out culture of mrigal in polyculture system is confined to earthen ponds with socking of fingerlings at a combined density of 4000-10,000 fingerlings/ha, fertilization with organic manure like cattle dung and poultry dropping and inorganic fertilizers. Furthermore, the compatibility of mrigal in polyculture system with regard to habitat preference and feeding habitat is good [10]. Inorganic fertilizers (ammonium nitrate, phosphate and single super phosphate) give their biogenous elements (nitrogen, phosphorus) immediately after application and increase productivity of the pond. Use of organic fertilizer increases the fish production in commercial fish ponds because it has a significant effect on planktonic biomass in the ponds [8].

Keeping in view the role of stocking ratio on growth performance, the present project "Effect of varying species ratio of silver carp on the growth performance of mrigal and grass carp in semi intensive pond culture system" had been planned to search out the best stocking ratio of Chinese and Indian carp in semi-intensive ponds culture system to achieve highest fish yield.

2. Materials and Methods

The experiment was conducted for the period of six months in two earthen ponds with two replicates. Fingerlings of *Ctenopharyngodon idella and Hypophthalmicthys molitrix* and *Cirrhinus mrigala* were purchased from Government Fish Seed Hatchery, Satiana, Road, Faisalabad. Earthen ponds used for the stocking were of dimensions 22m x 7.5m x 1.8m (length x width x depth). Before fish stocking, the earthen ponds were disinfected and the pH was stabilized by liming with CaO [5]. Precautory measures were taken to screen the water inlets to avoid the entry of intruders into or exit of fish out of ponds. After one week of these steps, each pond was filled with tube well water up to the level of 1.5m. After one week of ponds preparation, both ponds were stocked with *C.mrigala, C.idella and H.molitrix* in the ratio of 15:45:45 in pond 1 and 15:45:30 in pond 2. Before stocking growth parameters, average body weight and length of three species was also recorded as initial data. Ponds were fortnightly fertilized with organic manure poultry dropping @ the rate of 0.05 to 0.1% of live fish weight daily. Moreover inorganic fertilizers (ammonium nitrate and single super phosphate) were added @ the rate of 0.005 to 0.01g N/cm of fish total length daily.

Growth Parameters:

The cultured fish stock was captured randomly by using nylon drag net on fortnightly basis and after measuring and recording the growth parameters including increase or decrease in wet body weight and total length were released back into the respective ponds.

Limnological studies of ponds:

After every 15 days, for the study of physicochemical parameters of pond, the water samples were collected and analyzed for electrical conductivity, total hardness, carbonates, bicarbonates, total alkalinity, calcium and magnesium for a period of 180 days, following the methods of APHA [2]. Water temperature and pH of each pond was recorded with HANNA-HI 1943, while dissolved oxygen was monitored with HANNA-HI 9032 digital meter.

Statistical Analysis:

The experimental data thus obtained was subjected to statistical analysis [11]. The comparison of mean values of various parameters was computed by using the Analysis of Variance (ANOVA) and Duncan's Multiple Range Test with repeated sampling. The correlation was also performed to find out relationships among characteristics.

3. Results and Discussions

After six months of experimental trial (180 days) both ponds were dried out and all fish species were harvested from the pods. In both experimental ponds (1 and 2) survival rate of all fish species was recorded 100%. Statistical analysis showed that the stocking ratio of three species (grass carp, silver carp and mrigal) and fortnights had significant effects on fish growth parameters in terms of body weight and total body length (Table 3). Results obtained from the growth performance of three fish species in both experimental ponds showed that the initial average body weight recorded by mrigal, grass carp and silver carp in pond 1 was 45g, 98.54g and 42.81g respectively, while in pond 2, 41.2g, 95.40g and 27.07g was recorded respectively. The highest final average body weight in pond 1 was recorded by grass carp (372g) followed by mrigal (282.3g) and silver carp (260g) while, in pond 2 silver carp (400.5g) showed the highest final average body weight followed by grass carp (367.3g) and mrigal (299.2g), respectively (Table 1 and figure 2). These results are in line with the findings of Milstein *et al*, (2006) who stated that mrigal harvesting biomass and survival were not affected by silver carp but its harvesting weight, growth and yield decreased in its presence. Whereas in case of second growth parameter, higher values of average total body length were recorded by silver carp followed by grass carp and mrigal in both experimental pond 1 (29.8cm, 29.6cm and 29.0cm) and pond 2 (33.8cm, 32cm and 30.5cm), respectively (Table 2 and figure 1). Statistical analysis showed highly significant differences in gain in body weight on fortnightly and species basis while, these results showed non significant difference among the pond treatments (Table 3). These similar results were reported by Abbas [1]. The highest gross fish production/pond/6 months was recorded by grass carp followed by silver carp and mrigal in pond (1) 16.65kg, 11.70kg and 4.23kg respectively, while in pond (2) 15.84kg, 12.01kg and 4.50kg respectively, were recorded by these fish species (Table 5).

Results showed that the three fish species (grass carp, silver carp and mrigal) behaved similarly in two experimental ponds in

all the growth parameters statistically. However, the net individual production of mrigal, silver carp were different in both ponds which were only due to the difference in stocking ratio of silver carp in both treatments. The pond where silver carp was greater in number, the production of mrigal was lower and of grass carp was higher. This indicates there might have been a sort of competition in food resources and a lower stocking ratio of silver carp in bit more favorable. Similar results were recorded by Chattha [3] who obtained lower growth of mrigal in the presence of silver carp. Both ponds remain similar and seasonal differences were also non-significant. However values remained high throughout the experimental period which might have affected the fish growth.

Statistical results on physicochemical variables of both experimental ponds are shown in (Table 4). Most of the ecological parameters such as temperature, light penetration, electrical conductivity, dissolve oxygen, pH, alkalinity, carbonates, bicarbonates, chlorides, total hardness and magnesium showed highly significant seasonal differences ($P<0.01$). However, inter pond differences were mostly non-significant. The pH value of the ponds fluctuated in alkaline range (7-8) throughout the study period in both the ponds. During the whole experimental period the water temperature remained close to the optimal limits of growth i.e., 26C to 32C.

Table 1. *Fortnightly increases in average body weight (gm) of three fish species in pond P1 and P2.*

		Cirrhinus mrigala				***Ctenopharyngodon idella***				***Hypophthalmicthys mlitrix***			
No. of Obs.	**Date of Obs.**	**P_1**		**P_2**		**P_1**		**P_2**		**P_1**		**P_2**	
		Av.wt.	**In.wt.**	**Av.wt.**	**In.wt.**	**Av.wt.**	**In.wt.**	**Av.wt.**	**In.wt.**	**Av.wt.**	**In.wt.**	**Av.wt.**	**In.wt.**
1	30/4/03	45	-	41.2	-	98.54	-	95.40	-	42.81	-	27.07	-
2	14/5/03	78.4	33.4	45.6	4.4	178.9	80.36	178	82.6	74	31.19	36	8.93
3	28/5/03	87.3	8.9	57.2	11.6	209.8	30.9	213.6	35.6	119.8	45.8	90	54
4	11/6/03	89	1.7	14.7	89.8	210	0.7	232	18.4	164.2	44.4	161	71
5	25/6/03	127	3.8	151.5	4.5	275.4	65.4	250	18	197.2	33	224.4	63.4
6	9/7/03	177.6	50.6	204	52.5	280	4.6	262	12	225	27.8	308.4	83.93
7	23/7/03	199.33	21.73	230	26	289	9	297	35	229	4	354.1	45.77
8	6/8/03	219.5	20.17	253	23	266	-23	311	14	238.25	9.25	372.75	18.65
9	20/8/03	291	71.5	262	9	362	96	355	44	259.17	20.92	375	2.25
10	3/9/03	280	-11	263	1	378	16	367.3	12.3	250	9.17	378.25	3.25
11	17/09/03	282.3	2.3	299.2	36.2	322	-56	284	-83.3	260	10	400.5	22.23

Av.wt= Average weight., In.wt= Initial weight.

Table 2. *Fortnightly increases in average body length (cm) of three fish species in pond P^1 and P^2.*

		Cirrhinus mrigala				***Ctenopharyngodon idella***				***Hypophthalmicthys mlitrix***			
No. of Obs.	**Date of Obs.**	**P_1**		**P_2**		**P_1**		**P_2**		**P_1**		**P_2**	
		Av.Tl.	**In.Tl.**	**Av.Tl.**	**In.Tl**	**Av.Tl**	**In.Tl**	**Av.Tl**	**In.Tl**	**Av.Tl**	**In.Tl**	**Av.Tl**	**In Tl.**
1	30/4/03	12.14	-	12.77	1-	18	-	16.6	-	13.92	-	14.81	-
2	14/5/03	17.1	4.96	16.9	4.13	19.5	1.6	20	3.4	15.6	1.68	19.6	4.76
3	28/5/03	17.5	0.4	20.6	9.7	25.4	5.8	24	4	21.8	6.2	20.3	0.7
4	11/6/03	18.33	0.83	22.3	1.7	25.4	0	26	2	25	3.2	23.2	2.9
5	25/6/03	21.3	2.97	23.5	1.2	25.6	0.2	27	1	26.4	1.4	27.2	4
6	9/7/03	24.66	3.36	24.66	1.16	26.95	1.35	28	1	27	0.6	30	2.8
7	23/7/03	25.11	0.45	25	0.34	27	0.05	31	3	28	1	30.91	0.91
8	6/8/03	25.5	0.39	27.25	2.25	28.75	1.75	32	1	28.5	0.9	32	1.09
9	20/8/03	27.20	1.7	29	1.75	31	2.25	33	1	29	0.1	33	1
10	3/9/03	29	1.8	30	1	31.5	0.5	33	0	29.6	0.6	33.6	0.6
11	17/09/03	29.0	0.5	30.5	0.5	29.6	0.9	32	-1	29.8	0.2	33.8	0.2

Av.Tl= Average total length., In.Tl= Initial total length

Table 3. *Analysis of variance of wet body weight (g) and total body length (cm) of three fish species showing the effect of various parameters.*

Mean squares			
S.O.V	**D.F**	**Average weight**	**Average total length**
Species	2	399.154*	0.476
Treatments	1	336.445^{ns}	1.045
Species x Treat	2	483.143	0.215
Fortnights	9	2055.877**	7.144
Species x Fort	18	1484.44**	1.608
Treat x Fort	9	961.280*	0.725
Error	18	311.258	2.190

** = Significant at $p < 0.01$ * = Significant at $p < 0.05$ NS = Non significant.

Table 4. *Comparison of mean values of physicochemical variables of both ponds in semi intensive pond culture system.*

Fortnights	Tem°C	D.O	pH	T.Al	Car.Al	B.Al	Cl	T.Hd	Mg^{++}
1	27.7Q	4.11B	8.05D	440G	160D	280D	148O	189E	41.8CD
2	28Q	4.45B	8.55CD	740EF	130D	610BC	199BC	194E	41.0CD
3	28Q	4.52B	9.60AB	850ED	160D	690B	150D	209D	44.3C
4	29.5Q	5.17B	9.3ABC	860CD	250C	610BC	164D	244C	52.2B
5	30.1A	8.83B	9.1ABC	940ABC	230C	710B	149D	265AB	57.5A
6	28.0Q	9.26A	10.1A	910BCD	250C	660BC	174D	257BC	51.3B
7	29.5BC	8.57A	9.0BC	1010AB	300B	710B	196CD	273A	58.6A
8	31.50A	8.75A	8.05D	980ABC	460A	520C	181BC	274A	59.7A
9	32.05A	9.96A	7.60D	730F	130D	600AC	208BCD	136F	27.7E
10	30.50A	10.18A	7.95D	1060A	150D	910A	305B	135F	26.6E
11	31.0A	9.45A	9.10BC	950ABC	310B	640BC	301A	182E	38.8D
12	30.0A	10.12A	8.21D	860CD	230A	630BC	198BC	210AB	45.4D

Tem= Temperature, D.O=Dissolved oxygen, T.Al=Total alkalinity, Car.Al= Carbonate alkalinity, B.Al=Bicarbonate alkalinity, Cl= Chloride, T.Hd=Total hardness and Mg= Magnesium.

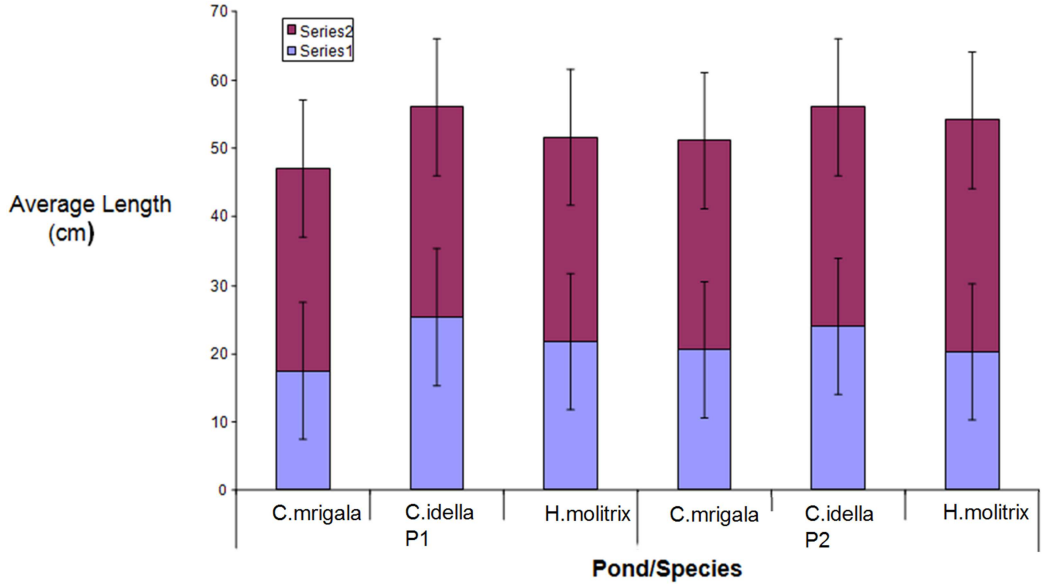

Figure 1. *Comparison of gain in body total length of three fish species in pond 1 and 2.*

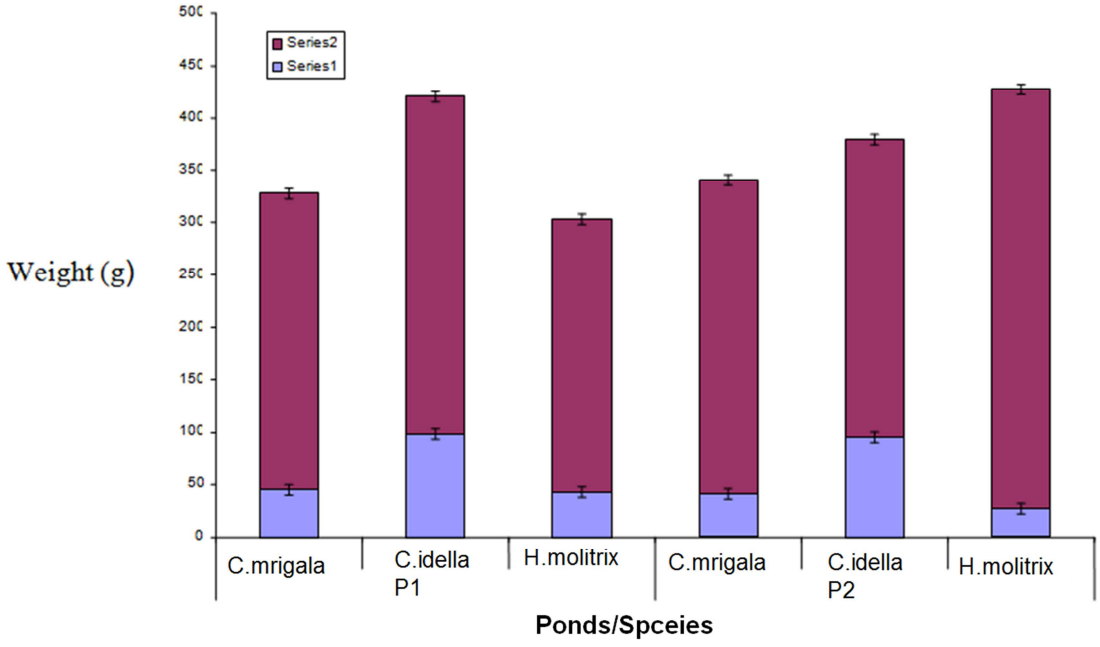

Figure 2. *Comparison of gain in body weight of three fish species in pond 1 and 2.*

Table 5. *Growth Fish Production of three fish species in Pond 1 and Pond 2.*

	Pond 1			**Pond 2**		
	C.mrigala	***C.idella***	***H.molitrix***	***C.mrigala***	***C.idella***	***H.molitrix***
No. of fish stocked	15	45	45	15	45	30
Survival rate	100	100	100	100	100	100
Initial avg. wt.(gm)	45	98.54	42.81	41.2	95.40	27.07
Final avg. wt. (gm)	282.3	370	260	300.1	352	400.5
Grain in avg. wt. (gm)	237.3	271.46	217.19	258.9	256.6	373.43
Initial body wt. (gm)	675	4434.3	1926.45	618	4293	27.07
Gross fish production/ pond/180 days (kg)	4.234	16.650	11.700	4.501	15.840	12.015
Gross fish production/ pond/365 days (kg)	11.039	43.406	30.501.9	11.735	41.294	31.323
Gross fish production/ acre/365 days (kg)	270.870	10650.59	748.420	287.94	1013.245	768.569
Gross fish production/ hec/365 days (kg)	669.050	2630.697	1848.598	711.236	2502.717	1898.367
Net fish production/ pond/180 days (kg)	3.559	12.215	9.773	3.883	11.547	11.202
Net fish production/ pond/365 days (kg)	9.280	31.848	25.481	10.124	30.104	29.207
Net fish production/ acre/365 days (kg)	4227.682	781.373	625.162	248.406	738.600	716.590
Net fish production/ hec/365 days (kg)	562.375	1929.993	1544.151	613.565	1824.343	1769.978

Table 5. *Continued.*

	P1	**P2**
Total gross fish production/hec/year of all species.	5148.34 kg	5112.32 kg
Net fish production/hec/year of all species.	5112.32 kg	5112.32 kg

Avg=Average; wt=Weight; hec=Hectare

References

[1] Abbas, K., I. Ahmed, M. H. Rehman and S. Kanwal. 2004. Effect of rice bran and maize gluten on the growth performance of major carps in fertilized ponds. Indus. J. of plant Sci., 3 (4): 391-395.

[2] A. P. H. A. 1998. Standard Methods for the Examination of Water and Waste Water. (20th Ed). American Public Health Association, the American Water Works Association and the Water Environment Federation. 1220pp.

[3] Chattha, F. A. 1994. Comparative study of growth rate of silver carp under the influence of inorganic fertilizer applied at 0.1 gm/100gm of body weight and 0.01 gm/cm of body length daily. M.Sc Thesis.

[4] Diana, J. S., C. K. Lin and P. J. Schnerbeiger. 1991. Relationship among nutrients, inputs, water nutrient concentration, primary production and yield of *Oreochromis niloticus* in ponds. Aquaculture, 92 (4): 323-341.

[5] Hora, S. L and T. V. R. Pillay. 1962. Hand book of Fish Culture in the Indo Pacific Region. FAO and Fish Biol., 14: 204.

[6] Milstein, A., A. F. Ahmad, O. A. Masud, A. Kadir and M. A. Wahab. 2006. Effect of the filter feeder silver carp and the bottom feeder mrigal and common carp as small Indigenous fish species and pond ecology. Aquaculture, 258: 439-451.

[7] Milstein, A., A. Kadir and M. A. Wahab. 2008. The effect of partially substituting Indian carps for adding silver carp on polyculture including small indigenous fish species. Aquaculture, 279: 92-98.

[8] New, M. and Fedoruk. 2003. Report of CIFRI on the Regional Workshop on Aquaculture Planning in Asia, Bangkok, Thailand 1-17. October 1975. ACDP/REP/76/2, 154 P.

[9] Piska, R. S. and A. M. Rao. 2005. Impact of juvenile stocking size on the major carp production in a minor reservoir, Bibinagar, India. Reviews in Fish Biology and Fisheries, 15: 167-173.

[10] Sayeed, M. A., M. T. Alam, S. Sultan, M. S. Ali, M. S. Azad and M. A. Islam. 2007. Effect of inorganic fertilizer on the fish growth and production in polyculture system of Bangladesh. J. Zool. Rajshahi Univ, 26: 77-80.

[11] Steel, R. G. D and J. J. Torrie. 1986. Principles and Procedures of Statistics. McGraw Hill Book Co. Inc. New York, 633 pp.