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Zooplankton Abundance and Growth of Carps in Farm-Ponds of Different Agro-Climatic Zones of Karnataka

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ABSTRACT

Availability of planktons / natural fish food plays an important role in getting better growth of fish from farm ponds. Study was carried out to evaluate the zooplankton community and growth performance of Carp fishes in farm ponds of coastal and malnad agro-climatic regions of Karnataka. All the ponds were manured with cowdung and poultry manure @ 2000 kg/ha. for the production of planktons. Catla, Rohu and common carp fingerlings were stocked in all the ponds @ 10,000 nos. /ha in 1:1:1 ratio and fishes were fed with groundnut oil cake and rice bran (in 1:1 ratio) @ 5% of the body weight every day. The water samples from all the ponds were collected and filtered for zooplanktons using nylon bolting cloth (60 µm). The growth of fishes in terms of weight was recorded. The analyzed zooplankton planktons were classified into 5 class's viz., Rotifera, Protozoa, Copepoda, Cladocera and Ostracod. Among zooplanktons observed, copepod contributed maximum to zooplankton community followed by rotifers, cladocerans and ostracod. In coastal ponds the average maximum number of zooplankton 10,368 Cells/m^3 and minimum number of 176 Cells/m^3 were observed. In Malnad ponds the average maximum number of zooplankton 21,797 Cells/m^3 and minimum number of 1579 Cells/m^3 were observed. The average maximum growth of Catla, Rohu and Common carp was observed in coastal ponds were 884.42, 640.1 and 692.27 gms respectively and in Malnad farm ponds 1080.71, 954.19 and 1023.18 gms respectively. Use of cowdung and poultry manure in combination was found useful for getting better growth in farm ponds of both the regions.

Keywords Farm ponds, Zooplankton, Catla, Rohu, Common carp, Manure, Growth.

INTRODUCTION

Indian major carps belongs to the second level category in food chain as they feed on plankton, detritus and benthic organisms and hence are particularly suitable for culture in ponds. Carps are the most suitable cultivated fish species in India contributing about 87% of the total freshwater fish production (Shukla *et al.* 2019). For primary productivity in aquaculture ponds with the supplementary feeding is essential for the assistance of higher level of fish biomass production is

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reduced in contaminated water bodies that can impair development, growth, reproduction and survival of cultured species (Banerjee *et al.* 2014).

In water quality estimation, the diversity of zooplankton is one of the most principal ecological parameters for the assessment of productivity in fish ponds. The numerical variation in the peak periods of different groups of zooplankton might be due to different biological parameters and numerical variations in rotifers may be influenced by water quality (Kiran *et al.* 2007). The qualitative and quantitative abundance of plankton and its relation to environmental condition has become a prerequisite for fish production (Dhawan 2002).

The most preferred farm fishes are major carps such as Catla, Rohu and Mrigal because of their fast growth and higher acceptability by the consumers (Ahmad *et al.* 2013). In integrated fish farming systems application of raw cowdung and duck manure is to increase the diversity of the natural food (zooplankton) and for better fish production (Rathor *et al.* 2018). Main objective of the present study was to assess the zooplanktonic biomass and fish growth in selected Agro-Climatic Regions of Karnataka. Keeping in view the importance of biotic factors in primary production and second and tertiary productivity of natural aquatic ecosystems the present research work was carried out to assess the zooplanktonic biomass in fish farm ponds and to correlate planktonic biomass with fish growth.

MATERIALS AND METHODS

The research work was carried out by selecting fish farm ponds of different agro-climatic regions. Fish farm Pond 1 (P1) was an instructional fish pond with cement and earthen bottom condition located in College of Fisheries, Mangaluru in Dakshina Kannada

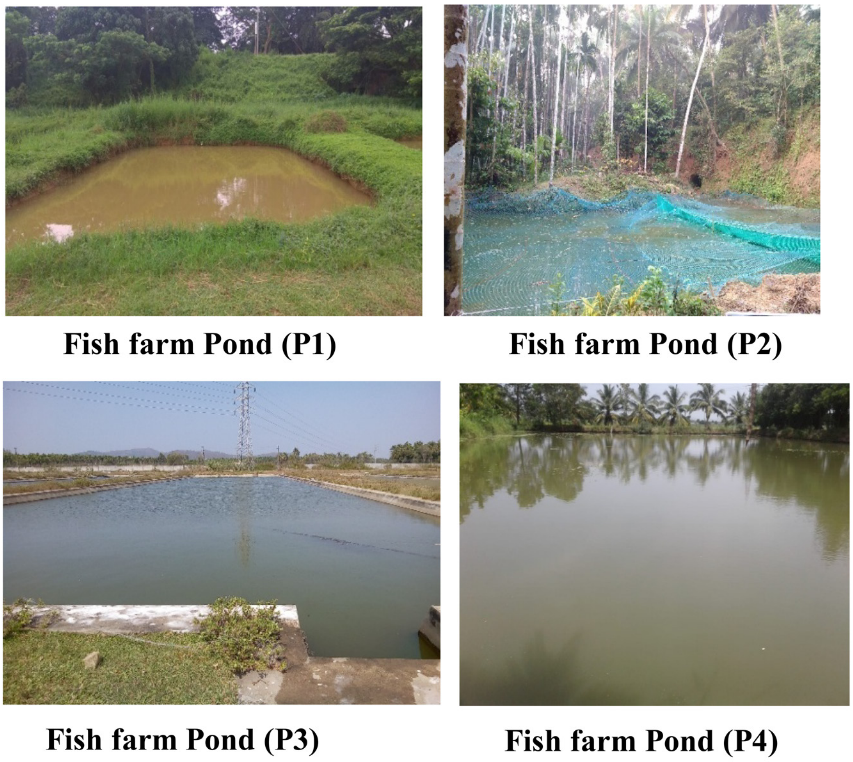

Fig. 1. Photographs showing the selected fish farm ponds from Dakshina Kannada (Pond P1 and P2) and Shivamogga district (Pond P3 and P4).

district. Fish farm Pond 2 (P2) was a farmer pond located in Agri-horticulture farm at Kairangala, Bantwal taluk, Dakshina Kannada district. Fish farm Pond 3 (P3) was a Government pond located at Western Ghats range obstructed by the dam near Lakkavalli near Bhadra reservoir in Shivamogga district. Fish farm Pond 4 (P4) was a private owner's pond situated in agriculture field at Bilaki cross in Bhadravathi taluk, Shivamogga district were showed in Table 1 and Fig. 1.

Sampling methods

Plankton analysis

Both phytoplankton and zooplankton from all the experimental ponds were collected using plankton net made of nylon bolting cloth (60 µm) fitted to a metallic frame with a mouth area of 0.0625 m^2. Straight away after the collection of the plankton samples, they were preserved in 4% formaldehyde solution. For the counting of planktons, Sedgwick-Rafter instrument was used. Planktons (phytoplankton and zooplankton) were identified up to their generic level and they were revealed in No./m^3 with aid of plankton identification key and monographs.

Fish growth studies

During the monthly sampling, the fishes from experimental tanks were caught by using cast net and nylon net. From each fish pond 30 fishes were taken to record the average growth of fish in terms of length and weight.

Length-weight relationship

The regression equation was used for analysis of length-weight relationship data collected for experimental fishes Catla, Rohu and Common carp. The formula used for this purpose was: W= aLb

Where, W= Total weight (g), L= Total length (mm), b = Well-being of an organism and a= Intercept.

The fingerlings of Indian major carps such as Catla (*Catla catla*) and rohu (*Labeo rohita*) and Common carp (*Cyprinus carpio*) in the ratio 1:1:1 were used for stocking in all four selected farm ponds. Stocking was done @ 10,000 Nos./ ha. Fishes stocked in different ponds (P1, P2, P3 and P4) were fed with conventional type of feed comprising the mixture of GOC and rice bran in 1:1 ratio. Feeding was done @ 5% of the body weight. During the monthly sampling, the fishes from experimental ponds were caught by using cast net and nylon net. From each pond 30 fishes were taken to record the average growth of fishes in terms of length and weight.

RESULTS AND DISCUSSION

Zooplankton observed in four farm-ponds were belonging to 5 classes viz., Rotifera, Protozoa, Copepoda, Cladocera and Ostracod. Among them, copepod contributed maximum to zooplankton community followed by rotifers, cladocerans and ostracod. The abundance of zooplankton ranged from 176 to 10368 Cells/m^3 in farm ponds (P1 and P2) and in (P3 and P4) it ranged from 1579 to 21797 Cells/m^3 (Table 2).

Zooplankton species were generally higher in pond P4. During summer months high population density of zooplankton were recorded compare to winter months. Zooplankton abundance frequently reaches their peak during wet and dry season in ponds. The observed variation in zooplankton density among the ponds could be related to strategy of pond management. Fertilization is a common practice in cultural whereas it is little or not practiced in household and unused pond. It was reported about zooplankton abundance in different water bodies of the Rajshahi University Campus (Rahman and Hussain 2008). The summer season zooplankton population was found to be higher, it might be attributed to favorable environmental conditions and availability of food

Table 1. Location of the selected farm ponds for the experiment.

Name of the pond	Size of the pond (m^2)	Avg depth of the pond (m)	Location of the pond Latitude	Longitude
Fish farm (P1)	75	1.829	12°85'41.4"N	74°86'51.2"E
Kairangala (P2)	310	1.829	12°79'45"N	74°94'24"E
BRP (P3)	1250	1.829	13°70'14.0"N	75°63'64.0"E
Bilaki (P4)	3035	1.829	13°52'33.5"N	75°39'45.4"E

Table 2. Abundance of zooplankton in different farm ponds.

Pond Months	Jan-17	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
P1	4275	2239	2385	2336	838	10368	5562	6079	3067	6275	2826	2960
P2	2225	1827	1306	643	636	176	3957	2783	3527	777	2395	1464
P3	3782	3424	2120	2065	2316	1579	2476	5969	8400	6652	1615	4565
P4	14575	10989	11913	13217	21797	2682	1586	6209	3715	9239	15544	3755

Table 2. Continued.

Months pond	Jan-18	Feb	Mar	Apr	May
P1	5506	5118	5933	7504	2716
P2	1301	500	1095	3060	1449
P3	10936	3873	7956	16473	2340
P4	14259	9319	14748	18676	4818

(phytoplankton) in the lake ecosystem. Also, rich nutrient loading may support the high phytoplankton production which can ultimately support to zooplankton abundance/population (Manickam *et al.* 2014). All metabolic and physiological activity and life processes, such as feeding, reproduction, movements and distribution of aquatic organisms are greatly influenced by water temperature (Bhavan *et al.* 2015).

Fish growth : Average length and weight of fishes (Catla, Rohu and Common carp) from coastal farm ponds varied from 37.17 cm and 884.42 g, 38.63 cm and 684.26 g and 37.90 cm, 764.34 g respectively. In Malnad farm ponds it varied from 48.53 cm and 1080.71 g, 44.40 cm and 954.19 g, 46.28 cm and 1023.18 g respectively. The Catla, Rohu and Common carp had the maximum average length of 52.75, 44.57 and 48.43 cm and the maximum average body weight recorded were 1080.71, 954.19 and 1023.18 g respectively in pond P4. The maximum average body weight was noticed in Catla with input of cowdung + supplementary feed. Maximum growth was observed in Catla in pond P4 was due to the higher growth potential than the other two species reared.

Table 3. Variation of *'b'* value of *Catla catla* from different farm ponds during the study period.

Pond	P1				P2				P3				P4			
Months	a	*b*	SE	r	a	*b*	SE	r	a	*b*	SE	r	A	*b*	SE	r
Jan 17	0.024	2.921	0.013	0.765	0.029	2.932	0.018	0.758	0.043	2.931	0.015	0.764	0.032	2.928	0.015	0.762
Feb	0.025	2.943	0.017	0.897	0.025	2.936	0.012	0.789	0.026	2.939	0.014	0.779	0.0253	2.939	0.014	0.822
Mar	0.028	2.951	0.018	0.921	0.021	2.947	0.019	0.942	0.031	2.951	0.017	0.938	0.0267	2.950	0.018	0.934
Apr	0.026	2.984	0.012	0.934	0.022	2.956	0.011	0.929	0.028	2.947	0.013	0.935	0.0253	2.962	0.012	0.933
May	0.029	2.935	0.009	0.953	0.024	2.936	0.017	0.955	0.024	2.931	0.018	0.956	0.0257	2.934	0.015	0.955
Jun	0.027	2.942	0.015	0.938	0.028	2.948	0.019	0.945	0.034	2.951	0.011	0.949	0.0297	2.947	0.015	0.944
Jul	0.024	2.912	0.018	0.944	0.022	2.919	0.015	0.929	0.027	2.915	0.015	0.933	0.0243	2.915	0.016	0.935
Aug	0.026	2.919	0.023	0.981	0.021	2.921	0.028	0.988	0.035	2.927	0.028	0.981	0.0273	2.922	0.026	0.983
Sep	0.028	2.956	0.032	0.921	0.027	2.949	0.029	0.919	0.032	2.951	0.029	0.914	0.0290	2.952	0.030	0.918
Oct	0.036	2.976	0.021	0.788	0.038	2.968	0.024	0.698	0.042	2.966	0.024	0.686	0.0387	2.970	0.023	0.724
Nov	0.021	2.982	0.027	0.954	0.031	2.978	0.031	0.960	0.029	2.981	0.031	0.951	0.0270	2.980	0.030	0.955
Dec	0.024	2.969	0.019	0.972	0.023	2.973	0.013	0.977	0.028	2.981	0.013	0.976	0.0250	2.974	0.015	0.975
Jan 18	0.018	2.999	0.041	0.956	0.014	2.996	0.048	0.947	0.018	2.988	0.048	0.951	0.0167	2.994	0.046	0.951
Feb	0.016	2.985	0.033	0.942	0.018	2.989	0.029	0.958	0.011	2.991	0.029	0.963	0.0150	2.988	0.030	0.954
Mar	0.023	2.967	0.029	0.933	0.028	2.962	0.032	0.928	0.032	2.958	0.032	0.919	0.0277	2.962	0.031	0.927
Apr	0.024	2.992	0.016	0.957	0.026	2.998	0.016	0.962	0.0337	2.992	0.016	0.969	0.0279	2.994	0.016	0.963
May	0.031	2.979	0.022	0.928	0.033	2.982	0.027	0.934	0.040	2.979	0.027	0.929	0.0347	2.980	0.025	0.930

Table 4. Variation of '*b*' value of *Labeo rohita* from different farm ponds during the study period.

Pond		P1				P2				P3				P4		
Months	a	*b*	SE	r	a	*b*	SE	r	a	*b*	SE	r	A	*b*	SE	r
Jan 17	0.021	2.928	0.022	0.879	0.023	2.923	0.012	0.943	0.022	2.926	0.017	0.911	0.022	2.924	0.014	0.927
Feb	0.018	2.935	0.001	0.925	0.021	2.899	0.016	0.921	0.020	2.917	0.009	0.923	0.019	2.908	0.012	0.922
Mar	0.024	2.946	0.006	0.929	0.027	2.931	0.018	0.953	0.026	2.939	0.012	0.941	0.025	2.934	0.015	0.947
Apr	0.014	2.981	0.017	0.944	0.020	2.945	0.014	0.924	0.017	2.963	0.016	0.934	0.017	2.954	0.015	0.929
May	0.017	2.940	0.012	0.923	0.018	2.928	0.019	0.956	0.018	2.934	0.016	0.940	0.017	2.931	0.017	0.947
Jun	0.020	2.937	0.003	0.968	0.029	2.958	0.011	0.949	0.025	2.948	0.007	0.959	0.024	2.953	0.009	0.954
Jul	0.013	2.904	0.010	0.954	0.028	2.921	0.020	0.919	0.021	2.913	0.015	0.937	0.020	2.916	0.017	0.928
Aug	0.021	2.911	0.011	0.911	0.021	2.943	0.025	0.948	0.021	2.927	0.018	0.930	0.021	2.935	0.021	0.938
Sep	0.024	2.949	0.002	0.931	0.031	2.951	0.031	0.918	0.028	2.950	0.017	0.925	0.027	2.950	0.023	0.921
Oct	0.025	2.968	0.009	0.978	0.045	2.926	0.026	0.932	0.035	2.947	0.018	0.955	0.035	2.936	0.021	0.943
Nov	0.027	2.976	0.013	0.974	0.034	2.963	0.034	0.949	0.031	2.970	0.024	0.962	0.030	2.966	0.028	0.955
Dec	0.031	2.961	0.011	0.962	0.025	2.982	0.016	0.965	0.028	2.972	0.014	0.964	0.028	2.976	0.014	0.964
Jan 18	0.022	2.991	0.008	0.946	0.016	2.971	0.038	0.957	0.019	2.981	0.023	0.952	0.019	2.976	0.030	0.954
Feb	0.024	2.979	0.018	0.949	0.019	2.969	0.027	0.951	0.022	2.974	0.023	0.950	0.021	2.971	0.024	0.95
Mar	0.017	2.962	0.014	0.931	0.029	2.931	0.037	0.921	0.023	2.947	0.026	0.926	0.023	2.938	0.031	0.923
Apr	0.018	2.988	0.006	0.953	0.023	2.955	0.018	0.958	0.021	2.972	0.012	0.956	0.020	2.963	0.015	0.956
May	0.019	2.970	0.010	0.924	0.038	2.968	0.021	0.932	0.029	2.969	0.016	0.928	0.028	2.968	0.018	0.930

Fish stocking density must also be such that a constant population of zooplankton can be maintained (Kloskowski 2011). The regression equation method was used for analysis of length-weight relationship data collected for experimental fishes. As the fish grow, the use of supplementary feeding becomes increasingly common and the importance of zooplankton is often neglected. Recent studies, however, highlight the importance of monitoring zooplankton biomass and adjusting the quantity of supplementary feeds added to fishponds accordingly. In this way, fish farmers and pond managers reduce costs associated with supplementary feeding (Schlott *et al.* 2011). The 'a' value was significantly larger or smaller than b=3.0 which showed allometric growth (Chakrabarty 2009). b=3.0 which indicate that the fish becomes heavier for its length as it grows. In the present study, for catla, rohu and common carp the value of 'B' ranged from

Table 5. Variation of '*b*' value of *Cyprinus carpio* from different farm ponds during the study period.

Pond		P1				P2				P3				P4		
months	a	*b*	SE	r	a	*b*	SE	r	a	*b*	SE	r	A	*b*	SE	r
Jan 17	0.022	2.925	0.017	0.822	0.026	2.927	0.015	0.850	0.032	2.928	0.016	0.838	0.027	2.926	0.015	0.845
Feb	0.021	2.939	0.009	0.911	0.023	2.917	0.014	0.855	0.022	2.928	0.011	0.851	0.022	2.924	0.013	0.872
Mar	0.026	2.949	0.012	0.925	0.024	2.939	0.018	0.947	0.028	2.945	0.014	0.940	0.025	2.942	0.016	0.940
Apr	0.020	2.983	0.014	0.939	0.021	2.950	0.012	0.926	0.022	2.955	0.014	0.935	0.021	2.958	0.013	0.931
May	0.023	2.938	0.010	0.938	0.021	2.932	0.018	0.955	0.020	2.933	0.016	0.948	0.021	2.933	0.015	0.951
Jun	0.023	2.940	0.009	0.953	0.028	2.953	0.015	0.947	0.029	2.949	0.009	0.954	0.027	2.950	0.012	0.949
Jul	0.018	2.908	0.014	0.949	0.025	2.920	0.017	0.924	0.023	2.914	0.015	0.935	0.022	2.916	0.016	0.932
Aug	0.023	2.915	0.017	0.946	0.021	2.932	0.026	0.968	0.028	2.927	0.023	0.955	0.024	2.929	0.023	0.961
Sep	0.026	2.953	0.017	0.926	0.029	2.950	0.030	0.918	0.029	2.951	0.022	0.919	0.028	2.951	0.026	0.920
Oct	0.030	2.972	0.015	0.883	0.041	2.947	0.025	0.815	0.038	2.957	0.020	0.821	0.037	2.953	0.022	0.834
Nov	0.024	2.979	0.020	0.964	0.032	2.970	0.032	0.955	0.030	2.975	0.027	0.956	0.029	2.973	0.029	0.955
Dec	0.027	2.965	0.015	0.967	0.024	2.977	0.014	0.971	0.028	2.976	0.013	0.970	0.026	2.975	0.014	0.970
Jan 18	0.020	2.985	0.024	0.951	0.015	2.983	0.043	0.952	0.018	2.985	0.035	0.951	0.017	2.995	0.037	0.953
Feb	0.020	2.982	0.025	0.945	0.018	2.979	0.028	0.954	0.016	2.983	0.025	0.957	0.018	2.980	0.027	0.952
Mar	0.020	2.965	0.021	0.932	0.028	2.946	0.034	0.924	0.027	2.952	0.028	0.923	0.025	2.950	0.031	0.925
Apr	0.021	2.990	0.011	0.955	0.024	2.976	0.017	0.960	0.027	2.982	0.014	0.962	0.023	2.979	0.015	0.959
May	0.025	2.975	0.016	0.926	0.035	2.970	0.024	0.933	0.034	2.974	0.021	0.929	0.031	2.974	0.022	0.930

2.912 to 2.999, 2.899 to 2.991 and 2.908 to 2.995 respectively (Table 3, 4-5).

These ranges of '*b*' showed isometric and allometric growth for Catla, Rohu and Common carp respectively. Regression coefficient for '*b*' has a value almost equal to b=3.0. According to Dhanasekaran *et al* (2017) '*b*' value in the present study ranged from 2.5 to 3.5 is valid for fish culture.

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