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ASSESSMENT OF PLANKTON COMMUNITY ON FRESHWATER FISH PRODUCTION IN WEST GODAVARI DISTRICT, ANDHRA PRADESH

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Abstract

A study was conducted on the seasonal variation in the plankton community and primary productivity was carried out in carp culture ponds in West Godavari district, Andhra Pradesh. The water temperature, DO levels, pH, Alkalinity, Total hardness and Ammonia, Carbon dioxide and transparency were found to vary between 24 0C and 37 0C, 3.0 ppm and 17.5 ppm, 6.0 and 8.0, 200 ppm and 780 ppm, 210 ppm and 800 ppm and 0.01 ppm and 0.04 ppm,6.7ppm and 338 ppm and 21.5cm and 5 cm in the respective farms at different locations. Among phytoplankton, Chlorophyceae (60,350 no./l) was dominated and among zooplankton rotifers (15,380 no./l) are dominated followed by copepods (6,230 no./l). The highest phytoplankton and zooplankton abundance was observed in summer and the lowest was in winter. Phytoplankton and zooplankton are positively correlated (R2= 0.77 and 0.76, respectively) in the different months and the ratio between Phytoplankton to Zooplankton was found to be 2.5: 1 which is favorable fish culture in the region.

Key words: Phytoplankton, Zooplankton, Productivity and fish culture

Introduction

Aquaculture is a vital sector contributing to food production in India. Aquaculture is major contributors responsible for nutritional security of the country. Aquaculture is very important as it provides the world with much needed protein besides providing employment, income and livelihood support to many people in the world. Planktons are very sensitive to the environment they live in and any alteration in the environment leads to the changes in the plankton communities in terms of tolerance abundance, diversity and dominance in the habitat (Mathivonam, 2007). The density and diversity of the plankton are greatly influenced by the

different physicochemical parameters of water (Wetzel, 1975). In nature, most of the organisms subsist on live food consisting of plants and animals obtained from the environment, but some do ingest and possible utilize detritus along with associated organisms. The physico-chemical properties of water determined the quality and quantity of plankton. The plankton community consists of organisms ranging from minute plants to small animals. Other two categories of life in an ecosystem are benthos and nekton. Benthos is the life at the bottom, like aquatic earthworms, insect larvae and certain fishes.

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Neton includes the larger swimming animals like fishes. Plankton is most essential for many fishes as food. The plankton is further divided into two main categories such as phytoplankton and zooplankton. The initial source of food for many larval organisms is phytoplankton. Phytoplankton includes algae, diatoms etc. They occupy the base of the food chain and produce the food material on which other organisms in the ecosystem sustain. The phytoplankton drifts about at the mercy of the wind and water movements (Sarita et al. 2018). Algae consist of three major classes as chlorophyceae, cyanophyceae and bacillariophyceae. In natural water, algae are small and numerous, usually at a level of 102-106 cells/ml. Phytoplankton seems as a very good indicator of pollution of the fresh water. Blue-green algae form the main stay of phytoplankton community in the majority of the man-made reservoirs (Piska, 2000). In late summer, the number of planktons declines as a thermocline develops and nutrients in surface are depleted by phytoplankton. Zooplanktons are abundantly found in the shallow areas of a water body. The zooplankton unlike phytoplankton are particularly distributed horizontally and vertically in an ecosystem. The zooplankton forms an important group as it occupies an intermediate position in the food web. Many of them feeding on algae and bacteria and in turn being fed upon by fishes. They also indicate the trophic status of a water body. Their abundance increased in the eutrophic waters. In the present study conducted to assess the plankton community in the freshwater farms near Kolleru lake in relation to enhancement of fish production.

Materials and methods

Water samples were collected from the selected fish culture farms near Kolleru lake in west Godavari district of Andhra Pradesh. The collected samples were brought to the laboratory and analyzed immediately. All the parameters were analysed using APHA Standard Procedures (1998). Water temperature was measured by Mercury thermometer. pH measured by pH meter. Alkalinity and hardness measured by standard titremetric methods. And total Ammonia determined by kit method and Transparency was determined by Sechi Disc method

Plankton was collected from surface water by plankton net and sample was fixed in 5% formaldehyde and Lugol's solution for zooplankton and phytoplankton respectively. The plankton samples were stored in plastic bottles and observed under compound microscope for identification. The plankton and algae were identified with the help of various keys e.g. Needham (1962), Cramar (1984), Plaskitt (1997), Sinha and Naik (1997) and APHA (1989). Quantitative analysis of plankton was done by Sedgwick Rafter cell. Qualitatively analysed by species wise.

Results and Discussion

Water quality measurements that were recorded in the present study and presented month wise for each designated parameter (Table-1). Water temperature was found consistent throughout the year (2018) in three culture systems with of 24.12±0.88°C. Dissolved oxygen of 3.42±0.08 mg/litre has been recorded in experimental ponds extending over different seasons. Highest DO of 6.31 mg/litre was recorded in carp culture systems during monsoon season. Lowest Do of 1.32 mg/litre was recorded during pre-monsoon months. Potential hydrogen (pH) in experimental ponds did not exhibit significant variation with respect to culture system as also seasonal variation. pH in experimental ponds was found

to be consistent with value of 7.78±0.0.05 throughout the year. Total alkalinity as a measure of Na2CO3 reflected consistent values of (154.19±0.15) mg/litre during various seasons in carp culture ponds. Similar trend could be noticed with regard to Total Hardness (CaCO3) recorded highest water hardness levels of 287.62±17.92 and 288.34±18.64 mg/litre respectively during post-monsoon months. Ammoniacal nitrogen (NH3-N) as a function of fish excretion as also insitu decomposition was a consistent parameter during the sampling period through various seasons (0.02±0.01 mg/l). Similar trend could be recorded in nitrite nitrogen (NO2-N) trend which exhibited mean values (±SD) of 0.02±0.01mg/l, 0.02±0.01mg/l and 0.01±0.01mg/l during pre-monsoon, monsoon and post-monsoon respectively. Nitrate nitrogen (NO3-N) in experimental ponds ranged from 0.31±0.005 mg/l during post-monsoon months to 0.58±0.003 in monsoon season. Ammoniacal (NH3-N), Nitrite (NO2-N) and Nitrate (NO3-N) forms of nitrogen followed similar trend in the present study. Phosphate in experimental ponds did not vary significantly during different seasons and recorded 0.08±0.01mg/l, 0.07±0.01 mg/l and 0.06±0.01 mg/l during pre-monsoon, monsoon and post-monsoon seasons respectively.

Table 1. Physico chemical water quality parameters observed in the study

Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water temperature (ºC)	25.5	25.9	29.6	30.3	31.5	32.6	29.9	29.2	28.8	27.2	26.9	26.2
Dissolved oxygen (mg/l)	1.6	1.8	4.5	4.8	5.2	5.8	2.6	2.7	2.8	4.5	1.9	2
pH	7.6	7.5	7.7	7.9	8	7.8	7.7	7.6	7.9	8	7.7	7.8
Total alkalinity (mg/l as $CaCO_3$)	85.6	86.6	204.6	205.2	206.8	207.2	163.6	164.9	166.2	168.2	92.6	98.5
Total hardness (mg/l as $CaCO_3$)	94.2	95.6	202.5	204.2	204.6	205.8	196.2	196.7	197.3	198.2	95.9	96.8
Ammonia-N (mg/l)	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.01	0.01	0.01
Nitrite-N (mg/l)	0.01	0.02	0.02	0.01	0.03	0.03	0.02	0.02	0.03	0.02	0.02	0.01
Nitrate-N (mg/l)	0.39	0.41	0.32	0.34	0.35	0.41	0.41	0.44	0.46	0.55	0.41	0.41
Phosphate (mg/l)	0.05 1	0.05 9	0.06 2	0.06 8	0.06 9	0.07 1	0.07 2	0.07 6	0.07 8	0.08 3	0.05 7	0.05 8

The present observation on phytoplankton of the selected ponds indicated that the communities of Cyanophyceae, Chlorophyceae, Bacillariophyceae and Euglenophyceae constitute the phytoplankton bulk in the present study (Table 2). The phytoplankton population

mainly consisted of Chlorophyceae, Cyanophyceae, Bacillariophyceae, Euglenophyceae and others like Dinophyceae, Chrysophyceae and Xanthophyceae. Zooplankton was represented by Rotifera, Cladocera and Copepods. Among the plankton Rotifer was dominated and followed by Copepods and Cladocerans (Table 3).

In the aquatic ecosystem plankton play a critical role not only in converting plant food to animal food but also serves as source of food for their organisms (Rajashekhar et al., 2010). The present study indicated that a total of 16 zooplankton species were recorded in the study pond comprising of 7 Rotifera, 4 Cladocera and 3 Copepods. Srivastava (1985) reported that among plankton, Ceratium was

the most dominating and the forms commonly seen were Peridium, Stanrastam, Synedra, Batryococus, Aphanocapsia, Pediastrum, Nitrocystos, Chrysamoebas along with some algal filaments. He has also reported the dominance of phytoplankton in summer.

Table 2. Phytoplankton characteristics at selected ponds

Pond	Cyanophyceae x 10^3	Chlorophyceae x 10^3	Bacillariophyceae x 10^3	Euglenophyceae x 10^3	Total x 10^3
1	60.6	10.5	17.4	13.0	101.5
2	58.6	11.2	19.2	15.1	104.1
3	56.4	11.3	22.0	14.2	103.9
4	52.4	12.7	21.0	13.2	99.3
5	48.9	19.2	18.0	18.6	104.7
6	61.0	15.4	18.0	12.0	106.5
7	53.0	13.4	24.0	13.5	103.9
8	55.2	12.5	22.0	14.2	103.9
9	62.5	11.0	17.5	15.5	106.0
10	59.6	13.2	18.2	16.5	107.5

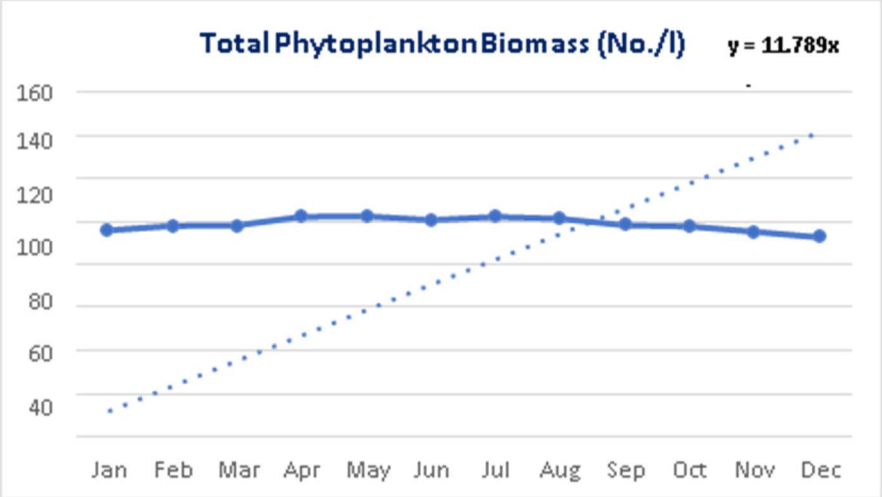

Fig. 1. Total phytoplankton biomass at selected ponds from January to December

The present study revealed that the fluctuations of phytoplankton were similar to the fluctuation of physico-chemical parameters like temperature, pH, alkalinity, nitrates and phosphates. The seasonal fluctuation of the phytoplankton organisms with the fluctuation of physico-chemical condition of water had been reported by Rao (2005). Phytoplankton and zooplankton are positively correlated (R2= 0.77 and 0.76, respectively) in the different months and the ratio between Phytoplankton to Zooplankton was found to be 2.5: 1 (Fig. 1 and 2). The results presented in the study in agreement with Yaswanth Kumar et al. (2020).

Table 3. Zooplankton characteristics at selected ponds

Pond	Rotifera x 10^3/l	Cladocera x 10^3 /l	Copepoda x 10^3/l	Ostracoda x 10^3/l	Total x 10^3/l
1	1.368	0.211	0.588	0.156	2.323
2	0.998	0.241	0.641	0.141	2.021
3	1.121	0.198	0.654	0.168	2.141
4	1.032	0.175	0.444	0.182	1.833
5	1.120	0.122	0.541	0.143	1.926
6	1.661	0.156	0.542	0.176	2.535
7	1.320	0.211	0.412	0.201	2.144
8	1.155	0.214	0.312	0.114	1.795
9	1.264	0.148	0.258	0.108	1.778
10	1.355	0.199	0.520	0.119	2.193

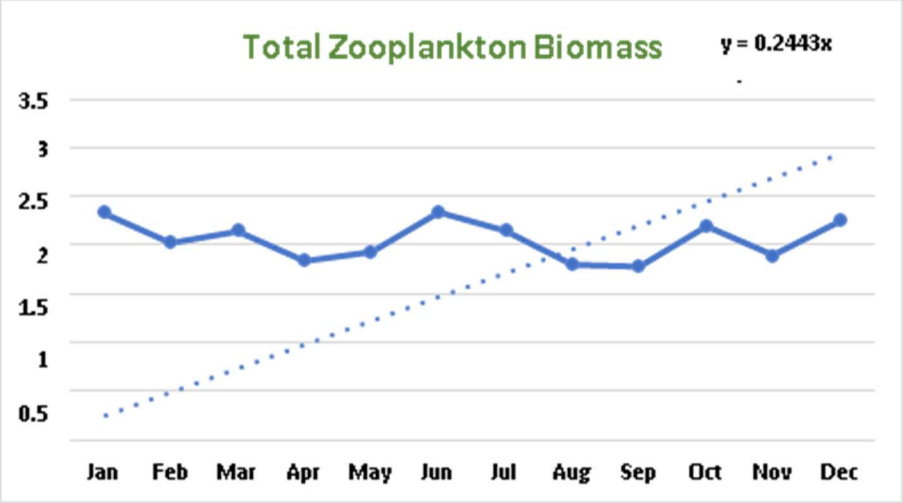

Fig. 2. Total Zooplankton biomass at selected ponds from January to December

Phytoplankton and zooplankton and other natural food organisms significantly contribute to the nutrition of the fish. Plankton is the natural feed for aquatic organisms. They enhance the immunity of the aquatic organisms (shell fish and fin fish). The water quality of the aquatic ponds is highly influenced by the plankton existence. They regulate transparency, dissolved oxygen, temperature and decreasing accumulation of CO2, NH3, NO2 and H2S in water. Even NH4+ and heavy metals are also highly influenced by their existence. Thus, the pond water quality will be sterilized by lowering the content of toxic compounds. The existence of plankton in aqua ponds lessens the cost of production, especially in the feed investment, almost to half the amount of investment is lessened. Hence the aqua farmers regularly monitor the existence of plankton in aquatic ponds as they play a key role in survival, growth, cost of production and potentiality of the water body.

Conclusion

The finds in this study highlights the environmental controlled freshwater system and ecological relations in between the water quality and fish (major carp fishes). The physicochemical and biological observations during pre-monsoon strongly suggests the change in environmental due to the increase water temperature leads to the increase in total alkalinity, total hardness and total dissolved oxygen which can be interlinked with increase in rate of photosynthesis and evaporation obviously. However, the consistency in fish growth was observed along with the period of study. Overall, this study indicates the importance of significant variations in the plankton community with respect to the seasonal variations.

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