Phytoplankton population in relation to physicochemical parameters in an irrigation cum fish culture pond -Valkulam pond, Agasteeswaram in Kanyakumari.

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Abstract

Present study deals with the investigation of phytoplanktons population in Valkulam pond with respect to physicochemical parameters. The water sample were collected in three seasons and analysed for physicochemical parameters and phytoplankton population. Phytoplankton diversity was observed in distinct groups as Cyanophyceae, Chlorophyceae and Bacillariophyceae. Present study reveals high density of phytoplanktons during postmonsoon with increasing concentration of nitrate, phosphate and sodium. pH of the water was found to be neutral. The result indicates the fact that water quality was favouring the zooplankton growth. Therefore, it could be utilized for inland aquaculture practices.

Key words: *Phytoplanktons, Zooplankton, Valkulam pond, Season and Aquaculture*

1. Introduction

Ponds are important wetlands located in and around the human habitations. They are generally semi natural ecosystems constructed by man in landscape suitable for water stagnation. Ecosystem services rendered by these wetlands are innumerable including tangible and non-tangible ones. Besides acting as a source of fresh water, they lower the ambient temperature, raise the water table and increase the diversity of flora and fauna. Interactions of both physical and chemical properties of water play a significant role in composition, distribution and abundance of aquatic organisms (Hulyal *et al.,* 2009). Overall quality of a pond can be determined from its primary productivity, which forms the backbone of the aquatic food chains (Islam *et al.,* 2007). Phytoplanktons represent biological wealth of a pond and they form initial biological components from which the energy is transferred to higher organisms through food chain (Saifullah *et al.,* 2014). Abundance of phytoplanktons has accelerated the growth of zooplanktons which forms the principal source of food for fishes (Prasad *et al.,* 2003). Growth and abundance of planktons varies with season, depth, metrology and water properties, which in turn reflect on diversity of organisms within the ecosystem (Poongodi *et al.,* 2009 and Basu *et al.,* 2010). Since, planktons are sensitive to fluctuation of environmental factors and their population may be used as a tool for bio-monitoring the status of aquatic bodies (Ferdous *et al.,* 2009). Water quality and health of the ecosystem is influenced by various factors like pesticide contamination, extreme temperature, depletion of oxygen, and rise in CO_2, NH_3, NO_2 and influx of sewage (Parnell, 2003). Selected study area is used by the local people for bathing, drinking, washing, aquaculture and agricultural purpose. Therefore, the present study aims to determine water quality parameters which influence phytoplanktons composition of Valkulam pond, Agasteeswaram.

2. Materials and methods

2.1. Study area:

Valkulam Pond is located near Agasteeswaram at Kanyakumari District. The pond leads narrow extend in the south north direction, resembling a tail and hence the name Valkulam. Pond is situated 500m away from Agasteeswaram and 2km away from Kanyakumari and covers an area of about 25.86.5 hect. Selected pond water is used for the irrigation of 70 acre of agricultural area. The pond is separated by a road in to two small ponds and a large pond. The first small pond (Station 1) covers an area of about 2 hect and second small pond (Station 2) covers an area of about 5.075 hect. The large pond (Station 3) covers an area of about 18hect.

Large pond meets with Arabian Sea in the Kovalam after covering the 0.5km distance. Valkulam pond supplies drinking water to 4 Panchayath such as Kovalam, Agasteeswaram, Kanyakumari and Thamaraikulam.

2.2. Sampling

Water Sample were collected fortnightly between 7:00 to 9:00 a.m. from October 2014 to September 2015, representing three seasons, (Postmonsoon (October–January), Premonsoon (February–May) and Monsoon (June–September). The physicochemical parameters like temperature, dissolved oxygen, pH, alkalinity, calcium, sulphate, phosphate, sodium and nitrates were estimated by using standard methods (APHA, 2005). For phytoplanktons analysis, one liter of sample was collected and filtered through silk plankton net of mesh size 20 mm. The sample was immediately preserved in opaque bottles containing 4% formalin and analysed by Sedgwick Rafter counting cell. The identification of phytoplanktons was made with the help of Kumar *et al.,* (2006) and Munshi *et al.,* (2010). Karl Pearson's correlation coefficient was performed to determine the relationship among the physicochemical parameters and phytoplanktons.

3. Result and Discussion

Physicochemical parameters and phytoplanktonic populations of three sampling stations of Valkulam pond were shown in table 1 and figure 1. Water temperature plays an important role in phytoplankton populations. All metabolic and physiological activities such as feeding, reproduction, movements and distribution of aquatic organisms are greatly influenced by water temperature. Maximum (30.75 ± 1.87^0C) temperature was observed in premonsoon and it was minimum (27.75 ± 1.29^0C) in monsoon. Increase in temperature during premonsoon may be influenced by low level of water, clear atmosphere and greater solar radiation. It enhanced the rate of decomposition by which water was enriched with nutrient. This would lead to the growth of phytoplanktons. Low temperature might be due to monsoonal rain, cloudy sky, cold weather and humidity of air. It led to low phytoplanktons growth. A positive correlation was observed between temperature and phytoplanktons in the selected study area. The above finding was supported by Sondergaard *et al.,* (1979) and Spencer *et al.,* (1989).

Dissolved oxygen is sole physicochemical parameters of water which need to keep organisms alive and health of the freshwater ecosystem (Madhusudhana *et al.,* 2013). A maximum of 4 mg/lit of dissolved oxygen was recommended for healthy growth of fish and planktonic populations. Dissolved oxygen varied from 1.92±0.267mg/lit to 4.47±0.686mg/lit in S1, 2.54±0.196mg/lit to 4.47±0.686mg/lit in S2 and 2.91±0.588mg/lit to 5.35±0.875 mg/lit in S3. High dissolved oxygen was recorded in postmonsoon at all the sites. It might be due to high photosynthetic rate of phytoplankton communities in clear water that resulted in high values of dissolved oxygen. Low concentration of O_2 was observed in the S1 might be attributed to the people washing clothes in this place caused the problem of pollution by detergents and organic wastes. The detergents apparently killed the phytoplanktons that led to the depletion of O_2 in S1. Seasonally low O_2 concentration was observed in the premonsoon. This might be due to high solar radiation, absence of rain and evaporation which enhanced the decomposition of macrophytes inhabiting in the pond. Decomposition process consume considerable amount O_2 that results in low O_2 concentration. Similar findings were also made by Kodarkar (1999); Ramachandran and Narayanan (1999); Jayasree (2002) and Rani *et al.,* (2011),

pH is the important factor that regulate the presence of chlorophyceae in aquatic medium. In the present study, pH of water bodies was not much marked fluctuation and it was slight alkaline in three seasons. It is suitable for high primary productivity and also planktonic growth. pH in the pond was maximum in the premonsoon (7.85±0.250) and minimum in monsoon (7.4±0.100). The low pH in monsoon might be due to fresh water discharge, rainfall and decomposition of organic matter would resulted in the production of large quantity of CO_2, consequently reducing pH. Maximum pH correlated with the rise of temperature, increase in rate of photosynthetic activity of the phytoplanktons and also the production of freshwater fishes. Similar observation was recorded by Siddhartha *et al.,* (2013); Kumar and Prabhahar, (2012).

Maximum alkalinity (89.25±1.299mg/l) was reported at S1and S2 in monsoon and it was minimum (68±1.581mg/l) at S3 in premonsoon. Maximum concentration might be due to high rate of decomposition where high rate of CO_2 was released. This CO_2 reacted with water to form HCO-3 and thereby increasing the total alkalinity which helped to maintain buffering capacity of water. Similar findings were made by Manjare *et al.,* (2010). In the present study, concentration of calcium ranged from 70.5±1.118 to 80.5±7.297mg/l at S1, 60.5±1.118 to 73±1.225mg/l at S2 and 63.25±1.229 to 66.25±1.090mg/l at S3. Maximum concentration was observed in the monsoon and it was low in premonsoon. Similar findings were reported from the Haraz River, Iran (Jafari *et al.,* 2011). Maximum concentration of phosphate was recorded (0.66±0.038mg/l) in monsoon and minimum (0.41±0.046mg/1) in premonsoon. Maximum (7.91±0.420mg/l) concentration of sodium was recorded at S2 and minimum (6.21±0.579mg/l) at S3. Nitrogen is essential for organisms as an important constituent of proteins, including genetic material. Plants and microorganisms convert inorganic nitrogen to

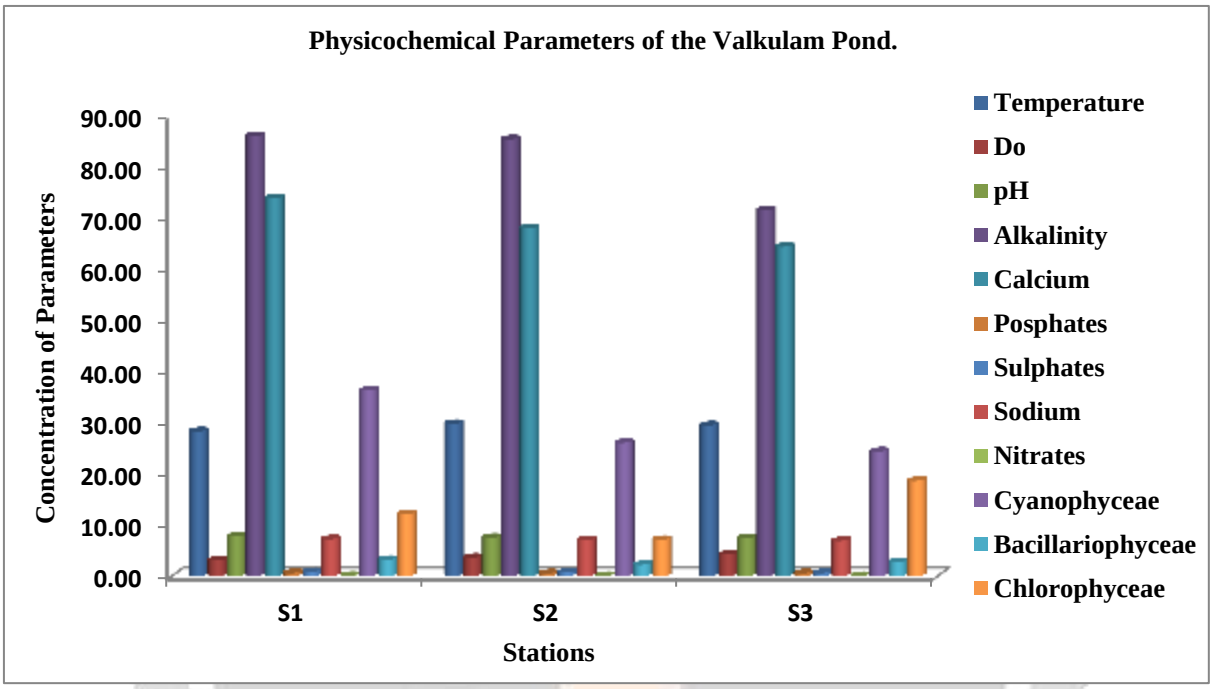
organic forms. Maximum concentration (0.11±0.128mg/1) of nitrates was recorded at S1 and minimum (0.03±0.002 mg/1) at S3. Seasonally maximum concentration of nitrates and sulphates were observed during monsoon, when the pond was flooded and received high amount of debris and agricultural runoffs from watershed. Nitrate and phosphate content present in water bodies showed direct relationship with growth of phytoplanktons. Similar findings were reported by Kannel *et al.*, (2007), Rani *et al.*, (2011) and Kushwaha *et*

Table: 1 Physicochemical and planktonic population of the Valkulam Pond.

Parameters		Postmonsoon	Premonsoon	Monsoon
		Mean±SD	Mean±SD	Mean±SD
Temperature	1	29.5±3.041	30±1.871	28±0.707
	2	29.5±1.118	30.75±1.299	28.5±0.707
	3	29.75±1.785	30.75±1.299	27.75±1.299
Do	1	3.45±0.805	1.92±0.267	4.47±0.686
	2	3.74±0.859	2.54±0.196	4.47±0.686
	3	4.22±1.059	2.91±0.588	5.35±0.875
pH	1	7.6±0.07	7.85±0.250	7.43±0.130
	2	7.18±0.192	7.78±0.286	7.43±0.130
	3	7.6±0.187	7.58±0.286	7.4±0.100
Alkalinity	1	86.25±0.829	88.5±7.890	89.25±1.299
	2	85.25±1.785	81.5±1.118	89.25±1.299
	3	70.5±1.118	68±1.581	72±0.707
Calcium	1	79.25±0.829	70.5±1.118	80.5±7.297
	2	70.5±1.118	60.5±1.118	73±1.225
	3	66.25±1.090	63.5±1.118	63.25±1.299
Posphates	1	0.49±0.104	0.41±0.046	0.66±0.038
	2	0.48±0.116	0.43±0.058	0.58±0.038
	3	0.48±0.06	0.52±0.019	0.61±0.111
Sulphates	1	0.83±0.164	0.72±0.147	0.75±0.112
	2	0.68±0.083	0.6±0.173	0.75±0.112
	3	0.6±0.122	0.53±0.109	0.55±0.112
Sodium	1	7.19±0.147	6.74±0.806	7.81±0.420
	2	6.68±0.353	7.91±0.420	6.68±0.377
	3	6.34±0.372	6.21±0.579	7.81±0.377
Nitrate	1	0.11±0.128	0.08±0.011	0.11±0.005
	2	0.9±0.005	0.05±0.019	0.04±0.005
	3	0.04±0.002	0.03±0.020	0.03±0.008
Cyanophyceae	1	25.75±12.95	25.25±12.296	21.75±6.610
	2	30.5±13.388	26.5±7.566	21±16.66
	3	42.5±17.642	33.75±9.230	32±21.25
Chlorophyceae	1	9.25±1.785	6.5±1.785	5.5±3.279

	2	14.5±6.801	13±3.536	8.75±2.165
	3	22.25±7.155	21.5±6.344	12±3.082
Bacillariophyceae	1	4.25±1.299	3.5±1.118	2.25±0.433
	2	2.5±1.1181	2.75±2.291	2.5±1.803
	3	4.25±1.29914	2.75±1.785	2.5±1.803

Figure: 1



al., (2014) from some freshwater ecosystem. Thus, the overall trend of physicochemical parameters in the study area revealed that the S1 is rich in nutrients and low O_2 concentration may be due to high anthropogenic activities.

3.1. Phytoplanktons population

Twenty two species of phytoplanktons were recorded in the Valkulam pond represented by three major groups as Cyanophyceae (6 species) Chlorophyceae (7 species) and Bacillariophyceae (6 species). Maximum density of phytoplanktons was recorded in postmonsoon. It was revealed that the compositions of phytoplanktons were different in three sites might be due to variations in physicochemical parameters between the sites. Sharma *et al.* (2007) also reported high density of phytoplanktons during postmonsoon in Chandrabhaga River, Garhwal Himalayas.

3.1.1. Cyanophyceae

Cyanophyceae has been recorded as the most dominant group followed by Chlorophyceae and Bacillariophyceae in the Valkulam pond. It contributed 42.86% consisting of *Anabaena ambigua*, *Nostoc commune*, *Phormidium sp*., *Oscillatoria tenuis*, *Spirullina sp*., and *Microcystis sp.* Cyanophyceae was maximum at S3 and minimum at S1. The study area is rich in nitrates, phosphates and sodium which favoured the growth of Cyanophyceae. This might be due to influx of sewage and agricultural runoff from nearby area owing to monsoonal flood. The present observation was confirmed by (Tas *et al.,* 2007).

3.1.2. Chlorophyceae

The second most abundant group of phytoplankton recorded during the present study was Chlorophyceae. It contributes 35.71`% of the total phytoplanktons population which includes *Cladophora glomerata*, *Hydrodictyon sp*., *Microspora amoena*, *Spirogyra sp*. *Volvox aureus*, *Chlorella variegates* and *Chlorococcum humicola.* Maximum population was recorded at S3 followed by S2 and S1. It was high in

postmonsoon and low in monsoon. It may be due to high dissolved oxygen and utilization of nutrients. Tiwari *et al.,* (2006) also reported maximum abundance of Chlorophyceae during winter season in Kitham Lake, Agra,India.

3.1.3. Bacillariophyceae

Diatoma vulgaris, Fragilaria pinnata, F. arcus, Navicula confervacea, N. radiosa, and *Pinnularia sp.,* was observed during the study period. Bacillariophyceae population was maximum at S3 and minimum at S1. Seasonally it was maximum in postmonsoon and minimum in monsoon. Minimum population in monsoon might be due to influx of turbid water in to the pond from river and adjoining canals owing to monsoon. Less

Table : 2 Correlation inter-matrix between physicochemical parameters and phytoplanktonic population

Parameters	Temperature	Do	pH	Alkalinity	Calcium	Posphates	Sulphates	Sodium	Nitrates	Cyanophyceae	Bacillariophyceae	Chlorophyceae
Temperature	**0.000**											
Do	**-0.572**	**0.000**										
pH	**+0.123**	**-0.704**	**0.000**									
Alkalinity	**-0.386**	**-0.173**	**0.555**	**0.000**								
Calcium	**0.106**	**-0.313**	**0.407**	**0.032**	**0.000**							
Posphates	**0.462**	**-0.905**	**0.676**	**0.062**	**0.109**	**0.000**						
Sulphates	**-0.440**	**-0.319**	**0.749**	**0.856**	**0.311**	**0.157**	**0.000**					
Sodium	**-0.863**	**0.647**	**-0.021**	**0.366**	**-0.247**	**-0.610**	**0.324**	**0.000**				
Nitrates	**-0.165**	**-0.163**	**0.282**	**-0.225**	**0.436**	**-0.013**	**0.242**	**0.153**	**0.000**			
Cyanophyceae	**0.251**	**0.315**	**-0.690**	**-0.687**	**-0.643**	**-0.146**	**-0.815**	**-0.051**	**-0.044**	**0.000**		
Bacillariophyceae	**0.281**	**0.156**	**-0.594**	**-0.200**	**-0.183**	**-0.287**	**-0.369**	**-0.317**	**-0.409**	**0.302**	**0.000**	
Chlorophyceae	**0.469**	**0.205**	**-0.785**	**-0.780**	**-0.439**	**-0.110**	**-0.831**	**-0.458**	**-0.291**	**0.794**	**0.702**	**0.000**

turbid water enhances photosynthesis during postmonsoon resulting in high population of phytoplanktons. Low population density was found at S1, this station is used by the people for the purpose of washing activities. The detergents from the washing activities mixing up of the water and killed the phytoplanktons. Similar findings were reported by Negi *et al.,* (2012) from the River Ganga and Sharma *et al.,* (2007) from Chandrabhaga River of Garhwal Himalayas.

3.2. Karl Pearson's correlation coefficient

Karl Pearson's correlation coefficient was calculated between various physicochemical parameters and phytoplanktonic populations have been given in Table 2. Water temperature have positive correlation with pH (r= 0.123) and Bacillariophyceae (r=0.281). Nitrates have negative correlation with Chlorophyceae (r= -0.291) and Bacillariophyceae (r= -0.409). Phosphates also have negative correlation with the density of Chlorophyceae (r= -0.110) and Bacillariophyceae (r= -0.287). Similar correlation was reported from Tungabhadra River (Suresh *et al.,* 2013).

4. Conclusion

The selected Valkulam pond in our place is highly useful for domestic, agriculture, and fishing and for creating natural environment. The present study concluded that the sediments are not so much abundant because the selected pond is periodically desilted by local people. The successful development and maintenance of biological population depend upon the harmonious ecological balance between environmental conditions and tolerance of organism to variations in one or more of these factors. The pond should be properly maintains by public and government authorities.

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