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## Research Article

# STUDIES ON PHYTOCHEMICAL ANALYSIS AND IDENTIFICATION OF ZOOPLANKTON IN RAMARKULAM AND VILAVINARKULAM PONDS, KANYAKUMARI DISTRICT

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### ABSTRACT

Zooplankton were the microscopic animals present in the water bodies. They play a major role in food chain of any ecosystem. The study was carried out in two ponds, namely Ramarkulam and Vilavinarkulam of Agasteeswaram Taluk for a period of six months from September 2017 to February 2018. The physico-chemical parameters such as air and water temperature, pH, dissolved oxygen (DO), biological oxygen demand (BOD), dissolved CO<sub>2</sub> (DCO<sub>2</sub>), chloride, alkalinity and salinity were measured. From the present study, 25 species of zooplanktonic fauna were encountered from Ramarkulam pond. Out of 25 species of zooplankton, 2 species belonged to Protozoa, 13 species to Rotifera, 5 species to Cladocera and 5 species to Copepoda. A total of 29 species were found from Vilavinarkulam pond. Out of 29 species of zooplankton, 2 species belonged to Protozoa, 14 species of Rotifera, 8 species Cladocera, 4 species Copepoda and only 1 species of Ostracoda were found. As the productivity of zooplankton was good, it could be continuously utilized for aquaculture if proper water quality management measures were adopted.

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## INTRODUCTION

Natural resources are the important wealth of our country, water is one of them. Fresh water is the single most important natural resource for human wellbeing, survival and socio-economic development. It is no accident that early human settlements developed near rivers, lakes and other fresh water resources (1). The increased demand for water as a consequence of population growth, agriculture and industrial development has usurped environmentalists to determine the chemical, physical and biological characteristics of natural water resources (2).

Ponds are small water reservoirs which include both plant and animal communities and plankton which were referred to as phytoplankton and zooplankton respectively(3). Growth of vegetation depends on various factors such as physical and chemical nature of the water. The quality of water is linked with quality of environment. The biological components of a freshwater ecosystem are ruled by the physico-chemical conditions (4). An analysis of physico-chemical parameter of water is therefore essential as it has great bearing on the explanation of metabolism of aquatic ecosystem. Factors like pH, temperature, alkalinity, turbidity and dissolved solids along

with the nutrient concentrations are related to the functioning of the biological system of the pond (5).

Zooplankton are the microscopic free floating animalcules of great importance as they act as primary and secondary links in food-chain (6,7). The growth of the zooplankton community is the direct influence of factors such as nutrients, physico-chemical parameters and are the biological interactions, predations and inter specific competition for space and food resources (8).

Annual rainfall differs and the Kanyakumari district receives both southwest and northeast monsoon and there are few summer showers too. Few researchers have reported the biological characters of freshwater environment in this district. Hence, the significance of physico-chemical parameters of water and zooplankton diversity of two ponds of Agasteeswaram Taluk was detected. The aim of this study is to analyse the physico-chemical parameters of the water from the experimental ponds for a period of six months (September 2017 to February 2018) and to identify the zooplankton diversity from two experimental ponds.

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## MATERIAL AND METHODS

### Study area

Kanyakumari district is provided with four taluks namely Vilavancode, Kalkulam, Thovalai and Agastheeswaram. The present study was conducted at the two ponds of Agateeswaram taluk in Kanyakumari district; viz, Ramarkulam (P<sub>1</sub>) and Vilavinarkulam (P<sub>2</sub>) for a period of six months (September 2017 to February 2018). The study encompassed collection of data pertaining to various aspects such as physico-chemical parameters of the water samples and zooplankton analysis. At each sampling pond, surface water depth, transparency, air and water temperature, pH, DCO<sub>2</sub>, dissolved oxygen, BOD, chloride, alkalinity and salinity were measured.

### Studies on physico-chemical parameters

For the present study, water samples were collected for hydrological studies using one litre capacity plastic bottles. Sampling was carried out between 6.00 am to 8.00 am. During the study period (September 2017 to February 2018) of six months the hydrological parameters from the two ponds were monitored carefully. Water samples were collected once in every month and physico-chemical parameters viz. water temperature and air temperature(9), pH, salinity, dissolved oxygen and free carbondioxide, BOD, chloride, alkalinity were estimated as per standard methods of APHA. The collected samples were immediately taken to the laboratory to analyze the physico-chemical parameters. The measurement of depth was made from the bottom of pond vertically upto the upper surface of water by a meter rod. The transparency of the water was noted by sechi disc of 20 cm in diameter (painted black and white on the upper surface) and computed using the formula [9].

$$T = \frac{X+Y}{2}$$

Where, T= Transparency in cms

X= Depth at which the disc became invisible and Y= Depth at which the disc reappeared while pulling the rope upward.

### Zooplankton Analysis

For the present study, monthly sampling was done for the qualitative analysis of zooplankton by filtering water through plankton net (made of bolting silk with mesh size 70um). 50 liters of water was filtered through planktonic net and the filtrate was collected in 100 ml plastic bottles and preserved in 5% formalin. The identification was done using the standard books and manuals viz. Edmondson (10, 11, 12). The quantitative estimation was done by using the formula  $N = A * 1/L * n/V$

Where: N=Zooplankton no. per litre of water, A=Total no. of zooplanktons counter per drop.

V=Volume of a drop (ml)

L=Volume of original sample in litres

n= Total volume of concentrated sample

Statistical analysis was also done using SPSS programme

## RESULTS & DISCUSSION

The physico-chemical parameters of water like depth, transparency, air and water temperature, pH, DCO<sub>2</sub>, dissolved oxygen, BOD, chloride, alkalinity and salinity contents of

water was analyzed by suitable method and the results are given below (Table 1 and 2).

In P<sub>1</sub>, the depth ranges from 26 cm to 35 cm where as in P<sub>2</sub>, it ranges from 70 cm to 100 cm. So the transparency of the pond also varies from P<sub>1</sub> to P<sub>2</sub> and it showed month wise variation. Temperature influences the growth and distribution of plankton. Air temperature was always higher than the water temperature and showed direct effect on water temperature. Temperature is a physical factor that alters the water characteristics and considered as an important factor in controlling the fluctuation of plantation and functioning of aquatic ecosystem (13). In the present investigation, it was maximum during the month of September and minimum during the month of December. This result was accordance with the findings of Govindasamy *et al.* 2007. In the summer months the temperature remained high because of the bright and long duration of solar radiation, low water levels and consequent high atmospheric temperature (15).

The pH of water is a precious indication of its quality and provides an important piece of information in many types of geochemical equilibrium or solubility calculations (16). The pH of surface water varied in the two experimental ponds and the values ranged from 7.2 to 8.0 in pond 1 and 7.2 to 8.1 in pond 2. The maximum pH reported in the present study was 8.1 (September) and minimum 6.6 (October) during the study periods. Similar findings were reported by Salam *et al.* (2000). The high pH values also indicate the high productive nature of the pond (19).

Among the physico – chemical parameters like dissolved oxygen is very important for the existence of plants and animals in the aquatic environment and determines water quality (20). Dissolved Oxygen is very important for the existence of plants and animals in the aquatic environment and also the quality of water is determined. Dissolved Oxygen content in Pond 1 ranged from 3.6 to 8.0 whereas it ranged from 2.0 to 8.4 in pond 2 The result of present study showed that highest peak value of dissolved oxygen was recorded during the month of September (8.4mg / L) and least in the month of December (2.0 mg /L).This was similar to the result of Ramula and Banarjee, 2013. In general higher planktonic biomass also raised the level of dissolved oxygen (22).

Dissolved CO<sub>2</sub> is essential for photosynthesis and its concentration affects the aquatic fauna and its productivity. The accumulation of DCO<sub>2</sub> ranged from 6 to 10 in pond 1 and 5 to 12 mg/l in pond 2. BOD values of the pond water 1 ranged from 1.5 to 4.5 mg/l. BOD values of pond 1 was higher in September 2017 and lower in December 2017 and January 2018. In the same way, at the pond 2 the BOD values ranged from 1.5 to 6.2 mg/l. The value was higher in November 2017 and lower in December 2017.

BOD is an important parameter that indicates the magnitude of water pollution by oxidisable organic matter. In the present investigation, BOD levels were minimum of 1.0 mg / l (December) to the maximum of 2.7 mg / l during March. The high BOD content during summer may be due to the high rate of organic decomposition, influenced by high temperature(23). Heavy load of sewage mixing and organic matter in the ponds may also raise the levels of BOD (24).

In the water body, the alkalinity is imparted by number of bases viz, carbonates, bicarbonates, hydroxides, phosphates, silicates, nitrates, borates etc. The total alkalinity ranged from 75.64 ppm to 220.24 ppm in pond 1 and ranged from 200.08 ppm to 410.56ppm in pond 2. The salinity of the water sample showed fluctuations during the period of study. It has been found that salinity was maximum (201 ppm) in December and minimum (96 ppm) in September at pond 1. In the same way, maximum salinity of 262 ppm was found in December and minimum of 172 ppm in September at pond 2. Minimum of 7 ppm chlorine was found in the month of October and maximum of 45 ppm was found in December at pond 1. Also a minimum of 22 ppm was found in October and maximum of 79 was found in December at pond 2. Zooplankton provides main food for fishes at all the stage of life and can also be used as indicators of the trophic status of water body. In the present study the concentration of zooplankton was recorded to be minimum in August and maximum in May. Similar results were noticed by George (1970) and Adoni (1975). In the present study, the total density, seasonal variation in density and correlation with various physico-chemical and biological parameters are dealt and discussed.

In the aquatic ecosystem, zooplankton plays a critical role by not only being primary consumers but also they themselves serve as a source of food for higher organizations. Zooplankton provides main food for fishes at all the stages of life and can also be used as indicators of the trophic status of water body (27 and 28). From the present study, a total 25 species of zooplanktonic fauna were encountered from Ramarkulam pond. Out of 25 species of zooplankton, 2 species belonged to Protozoa, 13 species Rotifera, 5 species Cladocera and 5 species Copepoda. A total of 29 species were found from Vilavinarkulam pond. Out of 29 species of zooplankton, 2 species belonged to Protozoa, 14 species Rotifera, 8 species Cladocera, 4 species Copepoda and only 1 species Ostracoda.

When critically analysed for each class the qualitative study showed the most common species, Diffflugia and Centropyxis in the class Protozoa, Brachionus caliciflorus, Brachiobnus caudatus, Brachionus quadridentatus, Keratella tropica, Philodina, Filinia longiseta, Filinia opoliensis and Testudinella were dominant Rotifera and Cladocera. Mesocyclops leuckarti and Nauplius were recorded during most of the seasons among Copepoda. Class Ostracoda had only one representative, Onchocypris pustulata throughout the study period that also only in Vilakinarkulam pond (Table 3). Comparative analysis among two ponds indicates high species richness in Vilavinarkulam pond which may be attributed to plentiful organic matter and detritus in this pond was due to more anthropogenic stress along with rich macrophytic vegetation which provide food and shelter for the planktons [29, 30, 31, 32 and 33]

The presence of Diffflugia sp., Brachionus falcatus, Keratella cochlearis, Keratella tropica, Lecane lung, Bosmina sp., Chydorus sphaericus, Daphnia sp. and Mesocyclops leuckarti in both the ponds indicates the higher trophic status of the pond as these species are indicator of eutrophication. [34, 35]

Sehgal. et.al., 2015 reported the similar results in different seasons in the selected Dimbhe reservoir. The physico-chemical parameters of zooplankton communities together

form a comprehensive ecosystem and there is interaction between the zooplankton and phytoplankton. These interactions are directly or indirectly subjected to the complex influences. George and Adoni et al., 2000 reported maximum of zooplankton population during summer. Similar results have also been reported to various seasonal fluctuation of zooplankton at various water bodies at different districts in India. The season wise zooplankton analysis showed that the number of population was highest during summer, followed by monsoon and lowest during winter. In the present study, group of organisms at two stations were more or less similar.

**Table 1** POND 1 Physico-chemical parameters of Ramarkulam pond during 2017-2018

Parameters	Unit	Months (September 2017 – February 2018)					
		Sept	Oct	Nov	Dec	Jan	Feb
Depth	Cm	30	26	35	35	33	33
Transparency	Cm	27	26	30	32	31	31
Air temp.	C	29	27	19.5	16	21	20
Water temp.	C	30	29	20	17	17	17.5
PH		7.9	7.9	8.0	7.7	7.5	7.2
DCO <sub>2</sub>	mg/l	10	6	6	8	9	9.4
Alkalinity	mg/l	75	120	150	200	205	220
DO	mg/l	8.0	6	5.2	3.6	5.2	6.0
BOD	mg/l	4.5	4.1	3.2	1.5	1.5	3.1
Chloride	mg/l	21	7	20	45	25	29

**Table 2** POND 2 Physico – chemical parameters of Vilakinarkulam pond during 2017-2018

Parameters	Unit	Months (September 2017 – February 2018)					
		Sept	Oct	Nov	Dec	Jan	Feb
Depth	Cm	100	70	86	82	80	82
Transparency	Cm	50	40	60	62	63	55
Air temp.	C	29	27.8	26.5	18.5	24	22
Water temp.	C	27.5	27	21	16	18	19
PH		8.1	6.6	7.5	7.4	7.2	7.4
DCO <sub>2</sub>	mg/l	9	5	10	12	6	10
Alkalinity	mg/l	200.08	258	291	410	350	375
DO	mg/l	8.4	6.4	6.8	2.0	3.6	4.2
BOD	mg/l	3.3	4.3	6.2	1.5	1.7	2.5
Chloride	mg/l	38	22	52	79	58	60
Salinity	mg/l	172	250	260	262	238	253

**Table 3** List of various zooplankton present in Ramarkulam and Vilakinarkulam pond (+sign: presence and –sign: absence)

Zooplankton	Pond	
	Ramarkulam	Vilakinarkulam
Protozoa		
Centropyxis hemisphaerica	-	+
Centropyxis ecornis	+	+
Diffflugia labes	+	-
Rotifera		
Brachionus caliciflorus	+	+
Branchionus angularis	-	+
Branchionus caudatus	+	+
B. quadridentatus	+	+
Brachionus rubens	-	+
B. Flacatus	+	-
B. forficula	+	-
Keratella tropica	+	+
k. cochlearis	+	-
Asplanchna intermediate	+	-
Philodina sp.	+	+
Euclanin sp.	-	+
Testudinella sp.	+	+
Filinia longiseta	+	+
Filinia opoliensis	+	+
Lecane inopinoata	-	+
platyas quadricornis	-	+
Polyarthra sp	+	-
Monostyla sp	+	-

Cladocera		
Cerodaphnia reticulata	+	+
Cerodaphnia cornuta	-	+
Alona retangula	-	+
A.Guttata	+	-
Chydorus sps	+	+
Daphnia pulex	-	+
Daphnia similis	-	+
Daphnia magna	-	+
Daphnia sp.	+	+
Leydigia sps	+	-
Copepoda		
Mesocyclops Leukarti	+	+
Tropocyclops sp	+	+
Cyclops sps	+	-
Eucyclops sps	+	-
Heliodiaptomus sp.	-	+
Nauplius sp	+	+
Ostracoda		
Onchocypris Pustulata	-	+

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