Journal of Algal Biomass Utilization
J. Algal Biomass Utln. - Copyright © PHYCOSPECTRUM
ISSN: 2229 – 6905

Seasonal variation of Microalgae in relation to the Physico-Chemical Parameters of Karagam Lake, Srikakulam District, A.P. India.

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Abstract

In the present investigation, some hydrographical and chemical studies were made on Karagam Lake near Narasannapeta of Srikakulam District, Andhra Pradesh. In this study, Seasonal changes in the growth and distribution of phytoplankton along with physico-chemical parameters were studied for a period of two years from November 2006 to October 2008. Water samples were analyzed for Physical and Chemical parameters. The average values of pH, turbidity, conductivity, dissolved oxygen, B.O.D, carbonate, bicarbonate, dissolved solids, chloride, fluoride, ammonia, nitrate, phosphate, silicate for two years were 7.32, 22.16NTU, 805 µMhos, 4.97 mg/lit , 2.65mg/lit, 3.67mg/lit, 201.3mg/lit , 405.75mg/lit, 95.2mg/lit, 0.15mg/lit, 2.59µg/lit , 9.86µg/lit, 2.62µg/lit, 36.3µg/lit respectively. Information on distribution of micro algal flora from Karagam Lake was collected, and data revealed that the dominant members belongs to Chlorophyceae (26 genera) followed by Bacillariophyceae (18 genera), Cyanophyceae (17 genera), and Euglenophyceae (3 genera). During the two years of investigation, different algal forms present in this Pond were Chlorophyceae 39.89%, Cyanophyceae 22.4%, Bacillariophyceae 34.35% and Euglenophyceae 3.36%.

Key words: Karagam Lake, Hydrographical features, Physico-chemical parameters, Phytoplankton, Pearson's Correlation matrix

INTRODUCTION

Physico-chemical parameters of any aquatic ecosystem are necessary because hydrochemistry affects its biota to a great extent. Water quality influences the existence and growth of aquatic organisms. In small ponds, diurnal variations are observed. During summer, the atmospheric temperature reaches up to 27°C, which raises the temperature of upper layers of water to 22°-23°C, whereas for the bottom layers it is as low as only 5° to 22°C. In permanent ponds, a stable community will be found except for seasonal variations. Several studies were undertaken on physico-chemical parameters of water in various geographical regions by Imoobe and Oboh (2003), Atoma (2004), Chaudhari 2009, Suma *et al.* 2010.

India has wide variation in climatic factors in different months in different regions. Climate of the local region determines its agriculture, aquaculture as well as its ecology. Very few information is available in the freshwater ponds in the Southern coastal region of this country. Therefore investigations were carried out on physico-chemical and biological parameters of Karagam pond of Narasannapet mandal, Srikakulam district, for a 2 years period. In this study an attempt has been made to correlate the certain physical and chemical factors with the phytoplankton populations.

MATERIALS AND METHODS

Physico-chemical studies were made on Karagam Lake of Narasannapet mandal of Srikakulam district, A.P., India. Seasonal studies on microalgae present in the water body were carried out for period of two years. Karagam Lake is situated at latitude of 18° 26' 44"and with longitude of 84° 01' 50". During the rainy season, water surface area is 4.72 hectares and water depth is 4 feet. Water samples were collected from 10 stations of the lake for chemical studies and phytoplankton analysis.

Turbidity, temperature, pH and Conductivity were measured with the help of Nephelometer, thermometer, pH meter and conductometer. D.O and B.O.D. were was determined by the modified Winkler's method .Water samples were also analyzed for Total alkalinity, dissolved solids, carbonate, bicarbonate, chloride, flouride, silicate, ammonia, nitrate, phosphate and few heavy metals like cadmium, copper, iron, nickel, lead and zinc (APHA, 1989).

RESULTS AND DISCUSSION

Meteorological and Physico- chemical parameters: Meteorological data collected during study period were presented in Fig1. The Physico-chemical parameters were studied for two years and average values were presented in Table 1&Fig1.

Chemical Factors

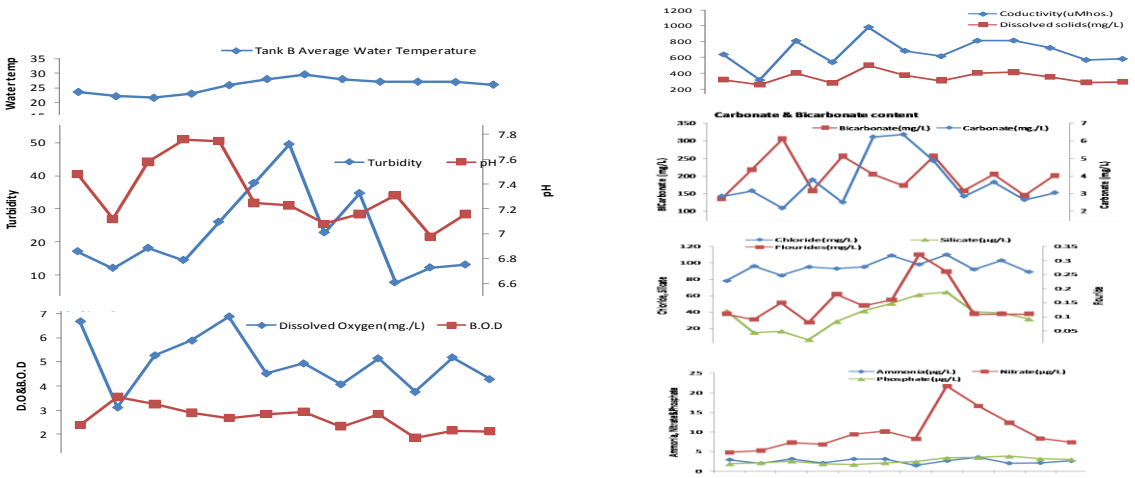
The maximum carbonate values recorded in July (6.35mg/l) and minimum values in March (2.18mg/l). Bicarbonates reported maximum in the month of March (305mg/l) and minimum values observed in the month of January (136mg/l. The Maximum Dissolved Solids found in Karagam Lake was 598mg/l in July and minimum 270mg/l in February. Similarly Chloride value of Karagam Lake was 110mg/l in September and lowest was 78 mg/l in January. The maximum Floride, Ammonia, Nitrate values were 0.32mg/l in August, 3.56µg/l in September and 21.6µg/l in August respectively. Similarly the minimum values of Floride, Ammonia, Nitrate values were 0.08mg/l in the months of November and April, 1.49µg/l in July and 4.82µg/l in January. The maximum Phosphate and Silicate values were recorded as 3.84µg/l in October and 64.3 µg/l in September respectively and the minimum values were recorded as 1.68 µg/l in May and 6.35 µg/l in April respectively.

Heavy Metals: Analysis of Heavy metals such as Cadmium, Copper, Iron, Nickel and Lead Was conducted only twice in a year i.e. in September and March for Karagam Lake. The values of Cadmium, Copper, Iron, Nickel and Lead reported in September were 1.06µg/l, 6.87µg/l, 43.12µg/l, 3.54µg/l and 3.54µg/l respectively. These values were 0.34µg/l, 4.35µg/l, 18.36µg/l, 0.38 µg/l, and 0.54µg/l respectively in March.

Table 1.KARAGAM LAKE– PHYSICOCHEMICAL DATA

Karagam Lake- Physicochemical parameters																				
	Turbidity	pH	Dissolved Oxygen(mg/L)	B.O.D	Coductivity(uMhos.)	Dissolved solids(mg/L)	Carbonate (mg/L)	Bicarbonate(mg/L)	Chloride(mg/L)	Flourides(mg/L)	Silicate(µg/L)	Ammonia (µg/L)	Nitrate(µg/L)	Phosphate(µg/L)	Cadmium(µg/L)	Copper(µg/L)	Iron (µg/L)	Nickel(µg/L)	Lead (µg/L)	Zinc (µg/L)
Jan	17.14	7.48	6.66	2.39	626	314	2.86	136	78	0.11	41.35	2.96	4.82	1.87						
Feb	12.13	7.12	3.12	3.56	543	270	3.16	218	96	0.09	15.12	2.05	5.28	2.13						
Mar	18.16	7.58	5.26	3.25	826	414	2.18	305	84.5	0.15	16.72	3.14	7.32	2.54	0.34	4.35	18.36	0.38	0.54	9.68
Apr	14.52	7.76	5.87	2.89	825	310	3.78	158	95	0.08	6.35	2.14	6.85	1.85						
May	26.05	7.75	6.86	2.68	1030	514	2.51	256	93	0.18	28.46	3.12	9.42	1.68						
Jun	37.82	7.25	4.52	2.85	786	432	6.21	205	95	0.14	41.23	3.12	10.12	2.13						
Jul	49.52	7.23	4.93	2.95	1025	598	6.35	173	109	0.16	50.45	1.49	8.25	2.43						
Aug	22.85	7.08	4.07	2.33	802	458	4.85	256	98	0.32	61.05	2.65	21.63	3.38						
Sep	34.72	7.16	5.14	2.84	1036	516	2.85	158	110	0.26	64.32	3.56	16.62	3.48	1.06	6.87	43.12	3.54	3.54	15.62
Oct	7.73	7.31	3.76	1.86	826	412	3.65	205	92	0.11	40.19	2.06	12.35	3.84						
Nov	12.25	6.98	5.18	2.16	6.98	315	2.65	145	103	0.11	39.08	2.15	8.35	3.15						
Dec	13.12	7.16	4.28	2.11	642	316	3.05	201	89	0.11	31.56	2.64	7.35	3.01						

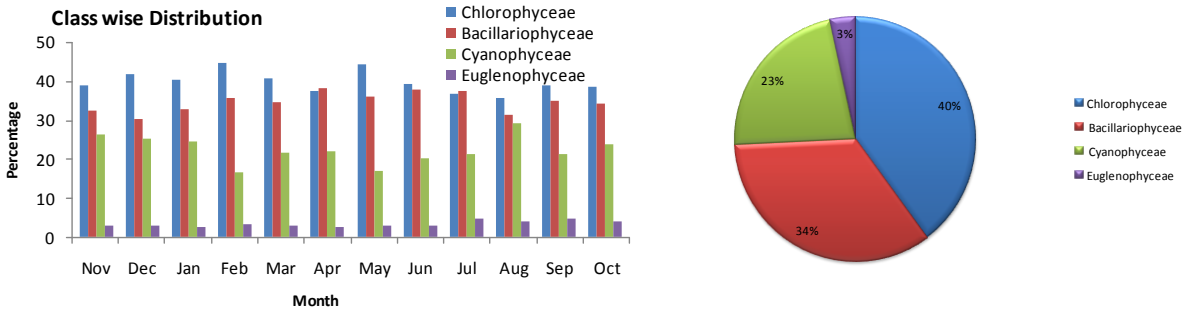
Fig1. KARAGAM LAKE– PHYSICOCHEMICAL DATA



Phytoplankton

The Observations revealed that the dominance of Chlorophycean members in karagam Lake. Members of Bacillariophyceae ranked second in the Karagam Lake. While Cyanophyceae ranked third in Karagam Lake. And, Euglenophyceae ranked 4th position. Information on occurrence and distribution of micro algal flora Karagam Lake was collected, and data indicates that the dominant members belongs to Chlorophyceae (26 genera) followed by Cyanophyceae (17 genera), Bacillariophyceae (18 genera) and Euglenophyceae (3 genera). During the two years of investigation, the abundance of different algal forms present in this Pond was reported as Chlorophyceae 39.89%, Cyanophyceae 22.4%, Bacillariophyceae 34.35% and Euglenophyceae 3.36% (Fig 2).

Fig 2: SEASONAL DISTRIBUTION OF PHYTOPLANKTON IN KARAGAM LAKE



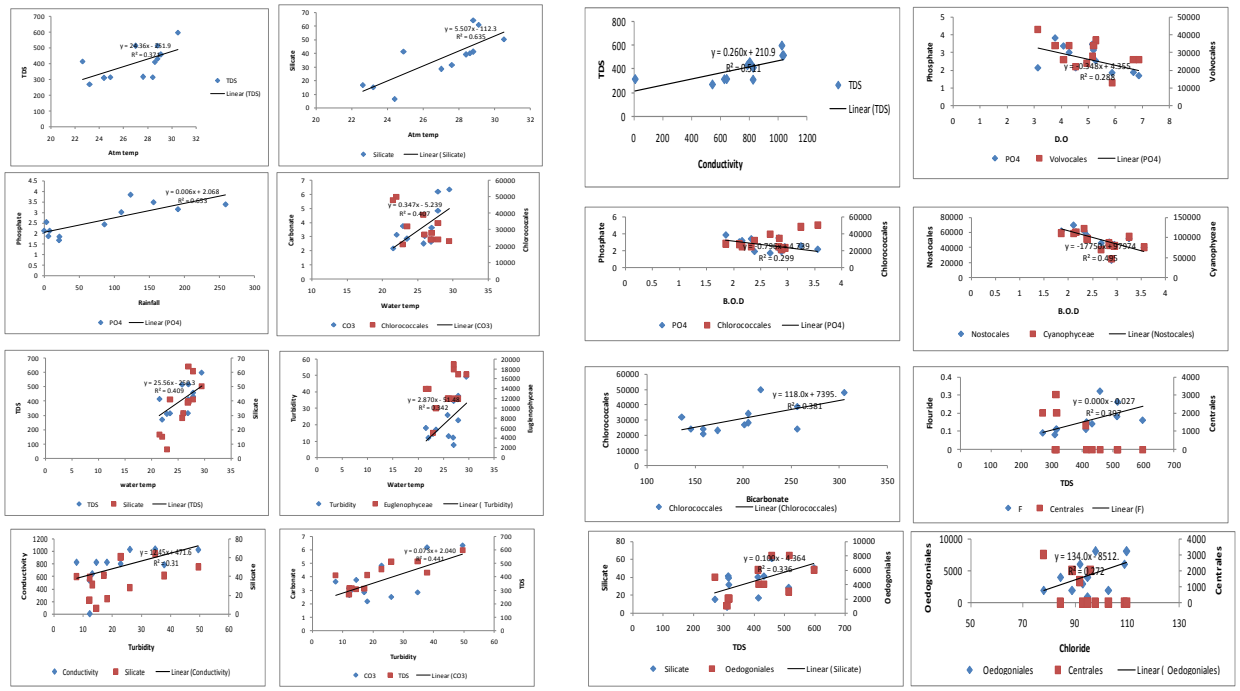
Interrelationship between environmental, physico-chemical parameters and phytoplankton (Pearson's Correlation matrix)

Atmospheric temperature showed positive correlation with rainfall (r=0.6493), water temperature (r=0.9943), TDS (r=0.6095), chloride (r=0.622), silicate (r=0.7972) and negative correlation with Chlorophyceae members (r=-0.6831). Rainfall showed positive correlation with RH (r=0.7968), water temperature (r=0.6081), nitrate (r=0.7690), phosphate (r=0.808), silicate (r=0.6864), Cyanophyceae (r=0.644) and showed negative correlation with Chlorophyceae (r=-0.6268).RH showed positive correlation with chloride (r=0.5128), nitrate (r=0.6732), phosphate (r=0.7572), silicate (r=0.5027) and negative correlation with Chlorophyceae (r=-0.6191). Water temperature showed significant positive correlation with carbonate (r=0.6385), TDS (r=0.6397), silicate (r=0.7832). But showed negative correlation with Chlorococcales (r=-0.636). Turbidity showed positive correlation with carbonate (r=0.6643), TDS (r=0.8143) (Table 2, Fig 3).

Table 2: PEARSON'S CORRELATION MATRIX OF PHYSICO-CHEMICAL PARAMETERS OF KARAGAM POND

	Atm temp	Rainfall	Relative humidity	Water temp	Turbidity	pH	Conductivity	D.O	B.O.D	CO3	HCO3	TDS	Cl	F	NH4	NO3	PO4	Silicate	Chlorophyceae	Bacillariophyceae	Cyanophyceae	Euglenophyceae	Total phytoplankton
Atm temp	1																						
Rainfall	**0.64938**	1																					
RH	**0.551444**	**0.796832**	1																				
Water temp	**0.994339**	**0.608193**	**0.503282**	1																			
Turb	**0.535653**	-0.01544	-0.07359	**0.585507**	1																		
pH	0.073682	0.100791	-0.26373	0.041078	-0.22569	1																	
Conduct	0.147983	-0.19708	-0.16394	0.164959	**0.556768**	-0.11727	1																
D.O	-0.14903	-0.30776	-0.15236	-0.15295	0.156779	-0.19351	0.17053	1															
B.O.D	**-0.52129**	**-0.57958**	**-0.53354**	-0.46922	0.327465	-0.34431	0.261575	-0.03784	1														
CO3	**0.579813**	0.09389	0.036382	**0.638548**	**0.664279**	-0.14079	0.287905	-0.29933	0.061447	1													
HCO3	-0.27382	-0.10616	-0.19941	-0.22331	-0.05969	-0.00173	0.310198	-0.18976	0.273073	-0.11009	1												
TDS	**0.609501**	0.211086	0.207055	**0.639722**	**0.814348**	-0.27445	**0.714809**	0.161264	0.071989	0.438513	0.215604	1											
Cl	**0.622233**	**0.502414**	**0.512833**	**0.613233**	**0.545121**	-0.21193	0.115347	-0.25159	0.132571	0.38942	-0.27007	**0.516495**	1										
F	0.452241	**0.615145**	0.398093	0.456366	0.440495	-0.18274	0.421274	-0.02881	-0.05043	0.178963	0.310174	**0.630559**	0.395157	1									
NH4	-0.14019	-0.10611	-0.0737	-0.15184	0.103897	0.026022	0.262915	0.372907	0.059111	-0.36062	0.258585	0.128267	-0.26558	0.417439	1								
NO3	**0.569897**	**0.769046**	**0.673211**	**0.554057**	0.231398	-0.16219	0.310362	-0.25579	-0.29405	0.239962	0.212541	**0.493809**	0.437829	**0.892835**	0.264432	1							
PO4	**0.501398**	**0.808267**	**0.757225**	0.44663	-0.16553	0.166483	-0.1152	**-0.53679**	**-0.54731**	-0.03456	-0.00762	0.141385	0.347954	0.393547	-0.04901	**0.643129**	1						
Silicate	**0.797214**	**0.68646**	**0.502765**	**0.783231**	**0.508007**	-0.08512	0.179652	-0.09534	-0.39934	0.358514	-0.22159	**0.580325**	0.466756	**0.726512**	0.200582	**0.72141**	**0.568167**	1					
Chlorophy	-0.17375	-0.05643	-0.22656	-0.16622	-0.27251	0.200453	-0.22363	-0.36366	0.02552	-0.40919	0.464454	-0.11814	-0.25647	-0.02558	0.215579	-0.08852	0.217361	0.001384	1				
Bacillario	0.016181	-0.06061	-0.09364	0.045812	0.03473	-0.10176	-0.03772	-0.43049	0.142939	-0.09668	0.470679	0.181259	-0.03752	0.077953	0.145256	0.038225	0.265264	0.16312	**0.890115**	1			
Cyanophy	0.291183	**0.644185**	0.393896	0.272792	-0.28842	0.271205	-0.39083	-0.3582	**-0.60853**	-0.13153	0.181362	-0.06729	-0.15097	0.307886	0.068363	0.397813	**0.72272**	0.485097	**0.494889**	0.416426	1		
Eugleno	**0.507366**	**0.513813**	0.382056	0.502726	0.324804	-0.12133	0.294812	-0.48887	-0.08158	0.168753	0.23703	**0.592415**	0.4591	**0.596236**	0.031807	**0.615319**	**0.698375**	**0.692831**	0.444993	**0.646941**	0.493999	1	
Tot phytoplank	0.045254	0.188426	0.010531	0.052243	-0.19025	0.140837	-0.22501	-0.45201	-0.14036	-0.25586	0.441673	0.015362	-0.1546	0.145245	0.171855	0.132566	0.457945	0.247403	**0.94066**	**0.911023**	**0.713922**	**0.632577**	1

Fig 3: SIMPLE LINEAR REGRESSION BETWEEN ENVIRONMENTAL, PHYSICO-CHEMICAL AND PHYTOPLANKTON IN KARAGAM LAKE



DISCUSSION

In Karagam Lake, turbidity was maximum in July and minimum in October. Maximum D.O. values were reported in June and minimum in the month of February. Results of present study correlate with the observations of Welch (1980) and Tripathi (1989). The Maximum nitrate value found in this lake was 21.6µg/L in August and minimum was 4.82µg/L in January. In August, rainfall recorded was 123.4cm, RH 85%, conductivity of 802 µMhos, dissolved solids 458 mg/L and fluoride content of 0.32L. Siva Kumar and Karuppa Swamy (2008) observed maximum nitrate in August may be due to rainy season and can be attributed to the nitrate fertilizer leached from agricultural fields. Nitrate in the present investigation is found to be within permissible limit (45mg/l) and correlated with the findings of Ganeshan and Sultana (2009).

Atmospheric temperature, rainfall and RH showed positive correlation with nitrate, phosphate and silicate. This correlated with the findings of Salve and Hiware 2006 and Kadam *et al.* 2007 and Chaudhari 2009. Turbidity reported high in monsoon due to influx of rain water from catchments area, washes, silt, sand and organic matter. This decreases the total phytoplankton (Reddy Vasumathi *et al.* 2009, Shinde *et al.*2011). In the present study, P^H showed significant positive relationship with water temperature. Alkaline nature was high in summer (r=0.98) and minimum in winter. Similar trend was reported by Reddy Vasumathi *et al.* 2009, Shinde *et al.* 2011. Conductivity showed significant positive correlation with TDS and turbidity in both ponds. This correlated with the work of Jawale and Patil 2009 and Shinde *et al.* 2011.Chlorine showed significant positive correlation with water temperature, alkalinity, TDS. It was reported maximum in summer (Reddy Vasumathi 2009, Shinde *et al.* 2011). Similar trend was observed in both ponds during the study period. Phosphate showed significant positive relation with silicate (Vidya Pradhan *et al.* 2011). Similar finding was found in the present investigation.

In the present investigation, cyanophyceae members were reported maximum when nutrients and turbidity was high. Similar findings were reported by Chellappa *et al.* (2004). Low amount of D.O. reduced the cyanobacterial population. This correlated with the works of Pingale and Deshmukh 2005, Rani *et al.* 2005). Cyanophyceae have shown very close positive

relation with temperature and phosphate (Harsha and Mallammanavar 2004). Similar findings were found in present investigation.

Bacillariophyceae members have shown significant positive relation with temperature, chlorine and phosphate (Chitra and Meera 2004). The domination of bluegreen algae, observed frequently when there are low numbers of diatoms and green algae, is an indicator of eutrophication which correlated with the present work (Elzbieta Zebek 2005). Muthukumar *et al.* (2009) studied correlation co-efficient of physicochemical properties of water samples and cyanobacterial species and found significant positive correlation between dissolved oxygen (r=0.9803), bicarbonate (r=0.9928) and carbonate (r=0.941).

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