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Phytoplankton Abundance and Seasonal Changes at Sri Anjaneya and Saibaba Temple Pond, Narisipuram, Vizianagaram district, Andhra Pradesh, India

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Abstract | **Original Research Article**

Information collected on microalgal abundance of Sri Anjaneya and Saibaba Temple Pond, Narsipuram, Vizianagaram district, Andhra Pradesh from May 2014 to April 2016. It was revealed that the microalgal population comprises of a total of 105 species belongs to 68 genera and 4 classes. Chlorophyceae comprises of 31genera belongs, 48 species, Bacillariophycee comprises of 18 genera and 27 species. Class, Cyanophyceae comprises of 16 genera and 23species and Euglenophyceae with 3 genera and 7 species. A total 3458 organisms/ml were observed with maximum 472 organisms/ml in March 2016 and minimum 124 organisms/ml in August 2014. The seasonal variations were recorded monthly for of two a period years and correlation studies were conducted among various algal groups and total phytoplankton of the temple pond.

Keywords: Micro algal populations, Seasonal Abundance, Pearson's Correlation Matrix. Sri Anjaneya and Saibaba Temple Pond, Vizianagaram district, Andhra Pradesh.

INTRODUCTION

Algae are the chief primary producers in aquatic ecosystems which show abundant distribution with seasonal diversity. The food chain and food webs are running in the ecosystem to carry out the energy flow in the ecological pyramids (Sukumaran et. al. 2008). Benthic Microalgae exhibit seasonality in abundance that is correlated with bottom water temperature (James L Pickney et.al. 2022). In shallow aquatic ecosystems, or those with large intertidal regions, benthic microalgae are often important contributors to primary production (Lukatelich R.J. Mc Comb A.J. 2023). Water bodies such as ponds, tanks, lakes, streams, rivers are the prime source of algal habitats. In India, temples are focal points of various religious and cultural practices throughout the year.

On festival days thousands of devotees gather at temple ponds and offering worship materials in the form of flowers, garlands, painted pots and idols, oil, earthen lamps different plant branches and turmeric in various forms. This pond water is used for temple purposes, washing legs, holy dips, washing clothes, domestic utilization and sometimes irrigation and fish cultures. Due to all of these anthropogenic activities, the water bodies are subjected to varying degrees of pollution. Several algae produce blooms and the water becomes unfit for domestic and irrigation purposes (Pandey et.al., 1999).

Several investigations have been made on the limnology and algal flora of temple ponds in India (Ganapathi 1940, Maya *et al.* 2000, Prameela *et al.* 2001, Kavitha *et al.* 2005, Sulbha and Prakasam 2006, Baruah and Kakati 2009, Pathmanapan *et al.* 2010, Anuja and Chandra 2012, Pushpam *et al.* 2013, Girish Kumar *et al.* 2014, Sankaran and Thiruneelagandan 2015 and Uma Rani et al. 2017. A few studies were done in freshwater phytoplankton of Andhra Pradesh (Munawar 1970, Kodarkar 1995, Jyothi and Narasimharao 2013 A&B, Bhanu Prakash *et al.* 2014 and Jyotsna *et al.* 2015, Padmaja Rani P. and Narsimha Rao 2020 and Setu Madhavarao and Narsimharao 2020).

The present investigation was undertaken to study the seasonal distribution and abundance of micro algal population at Sri Anjaneya and Saibaba Temple pond, Narsipuram of Vizianagaram district, Andhra Pradesh.

MATERIALS AND METHODS

Study area

Seasonal studies on phytoplankton present in the Sri Anjaneya and Saibaba temple pond were carried out for a period of two years. Temple pond is located at latitudes 18°74"N and with longitude 83°40"E and it is 2 k. m. away from the Parvatipuram town, Vizianagaram district in Andhra Pradesh. Surface area of the water in the pond during the rainy season is around 1.5 hectare and depth is 6 meters. Water spread area in summer is around 1 hectare, with 1.5 meter in depth (Fig. 1).

Sampling collection

The plankton of mesh number 25 of size 60 µs was used for collecting samples. Water samples were collected as close to the surface from 5 points for physicochemical and Phytoplankton analysis every month in a two-year study period and average values were taken (Senthil Kumar and Sivakumar 2008, Sivakumar and Kurupaswamy 2008). A known value of the sample 1 Litre was filtered and added 4% of formalin and a few drops of Lugol's iodine solution at the spot for preservation. The samples were kept in the dark for 48 hours in an unmovable manner to allow the planktonic material comes into sedimentation. After that, the overlying water from the sample bottle was decanted, and the final volume was adjusted in 50 ml. To each 50ml of the solution, 3ml of glycerin was added to prevent the materials from becoming brittle (Transeau 1951).

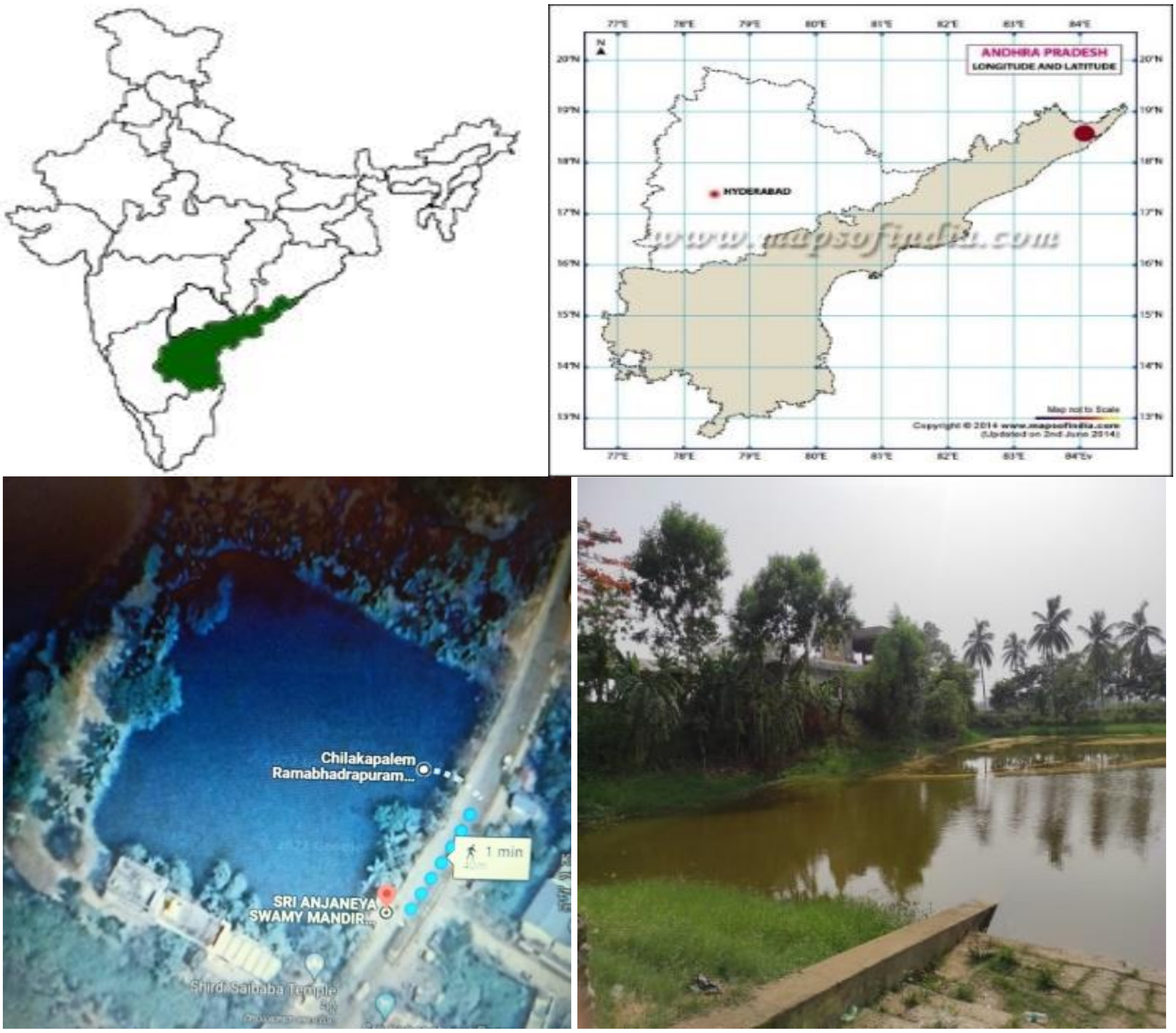


Figure 1: Map and Location of Sri Anjaneya and Saibaba Temple Pond, Narsipuram, A.P., India

Quantitative and qualitative Evaluation of Microalgae

The Phytoplankton consists of various forms like individual cells, colonies and filamentous forms were counted as an individual organism. When colonies of species counted, the average number of cells per colony was counted and the filament form, the average length of the filament, was measured. For the preparation of the temporary and semi-temporary slides for microscopic studies by 10%, glycerin solution was used as mounting fluid. A binocular compound microscope was used to count phytoplankton with different magnifications such as 10x and 40x. They were recorded with photomicrographs under Nikon Coolpix 8400 Digital microscope camera. Identification of various taxa was made, up to species level with the help of standard keys (Desikachary 1959, Randhawa 1959, Philipose 1967, Prescot 1973, Anand 1998, Leela *et al.* 2010, Arulmurugan *et al*. 2010 and Ashok Kumar *et al.* 2011).

The Sedwick Rafter Counting Chamber was used for easier counting processes for the number of organisms in ml of volume (Thakur *et al.* 2013; Wetzel and Likens, 2000). The abundance of phytoplankton groups was calculated according to the following formulae. N = (A x 100) C / L. N = Number of Phytoplankton per litre of original water. A = Average number of phytoplankton in the counting chamber. C = Volume of original concentrate in ml.; L = Volume of water passed through the net.
The results were expressed as organisms/litre.

RESULTS AND DISCUSSION

Phytoplankton act as an efficient bio-indicators of seasonality, abundance, support to dominance of species and to measure the quality of water with pollution indications. They have a short life span and respond quickly to environmental changes (Zebek 2004). The present investigation at Sri Anjaneya and Saibaba temple pond, Narsipuram, Andhra Pradesh, revealed four classes of Phytoplankton identified as members of Chlorophyceae (31genera and 48species), Bacillariophyceae (18 genera and 27species), Cyanophyceae (16genera and 23species) and Euglenophyceae (3genera and 7species). Total 3458 organisms/ml was observed, maximum 472 organisms/ml in the month of March, 2016 and minimum 124 organisms/ml in August 2014 (Fig.2).

Cunqi Lie *et al.* (2010) observed the highest plankton abundance in spring and least in winter. The population density, trends showed a gradual increase during post-monsoon and summer season and attained a peak in the spring season. These results were supported by Brraich and Kaur (2015). Indian climatic conditions due to decreased water levels in summer increase the abundance of phytoplankton by aggregation (Agale *et al*. 2013a, Setu Madhavarao and Narasimharao 2016). In the present investigation, the diversity of phytoplankton was slowly declined during pre-monsoon months and the diversity and abundance were showed the lowest values in the monsoon period in the temple pond (Senthil Kumar and Sivakumar 2008). After the post-monsoon season, the turbidity of waters decreased gradually and the support given by increased transparence for growth of the micro-algal population was enhanced in ponds. Algal productivity was higher in post-winter to summer seasons due to sufficient nutrient enrichment in water and adequate solar radiation (Tarakeshwar *et al.*, 2011). The hierarchy of phytoplankton dominance in this temple pond was like this. The Chlorophyceae was well dominant in the pond's water and followed by Bacillariophyceae, Cyanophyceae and limited genus of Euglenophyceae. Similar observations were made by Tejaswini and Vijaya (2004) and Arulmurugan *et al.* (2010).

Class Chlorophyceae

Chlorophyceae members were maximum contributors to the fresh water planktonic micro algae of Narsipuram temple pond. This group is contributing 47.23% to the total phytoplankton. It was maximum (213organisms/ml) in March, 2016 and minimum (50organisms/ml) in July, 2014. Chlorophyceae members were recorded in maximum number in winter season which could be related to low turbidity, low conductivity and optimum water temperature and sufficient nutritional support. Chlorophyceae is an important group of fresh water algae whose growth are controlled by parameters like transparency, water temperature, dissolved oxygen, pH and nutrients (Rajagopal *et al.*, 2010, Narasimha Rao and Pragada, 2010 and Verma *et al.*, 2014).

In the present study Chlorophyceae was dominant class in the temple pond (Murugan 2008 and Narchonai et. al. 2019,) Chlorophyceae members were belonging to the orders such as Volvocales, Chlorococcales, Ulotricales, Oedogoniales and Conjugales (Fig. 2A).

In the Volvocales, members were maximum (42 organisms/ml) in November, 2015 and minimum (8 organisms/ml) in June, 2014 (Fig.2B). *Chlamydomonas ehrenbergii, C.polypyrenoideum, Chlorogonium euchlorium, Gloeocystis planctonica, Gonium pectoral, Eudorina elegans, Pandorina elegans, Volvox aureus* and *V. tertius* were recorded. *Chlamydomonas ehrenbergii* was the dominant species. The maximum abundance of Volvocales recorded in monsoon season due to increase in pH. (Awadesh Kumar *et al*., 2014). Philipose (1960) observed that alkaline waters with nitrogen promote the growth of Volvocales. Chlorococcales members were maximum (147organisms/ml) in February, 2015 and minimum (17organisms/ml) in August, 2014. *Chorella valgaries, Golenkini radiate, Micractinium pucillum, were belongs to Chlorellaceae, Chlorococcum infusionum, Oocystis crass, O. solitaria, Scoederia indica* were recorded in Chlorococcaceae.

In the family Coelastraceae, *Coelastrumas teridium, Crucigenia rectangularis, Scenedesmus acutus, S. bijugatus, S. arcata, and Tetraedron pusillum, T. trigonium* and *T. minimum* were recorded. In the festival days the *Scenedesmus* genera were abundant. These are pollution tolerant genera. In Hydrodictiyaceae *Actinastrum hantzschii, A. gracillimum* and *Pediastrum simplex, P. duplex, P. ovatum* and *P. tetras* were present in the study. *Dictyosphaerium pulchellum* and *D.*

ehrenbergianum were belongs to family Dictyospermaceae. *Ankistrodesmus convlutus, A. falcatus, Krichneriella lunaris, K. contorta, Monoraphidium tortile, Selenastrum gracile* were belongs to Selenastraceae family recorded. Chlorococcales were maximum in summer and minimum in rainy season. Increased temperature, Mg. and Ca. concentrations are promoted the growth of Chlorococcales (Ashes Tiwari and Chauhan 2006). Present findings were in agreement with Srinivasulu and Damodharam (2016). High temperature with low nitrates and organic matter favor the abundance of Chlorococcales in Santhi Sagar Lake in Karnataka (Hina and Puttaiah).

In this order Conjugales contribute maximum (48organisms/ml) in January 2016 and minimum (11organisms/ml.) in July and August 2014. *Closterium acutum, Cosmarium contractum, C. botrytis, C. hammeri C. broomeii and Staurastrum leptocladium* were Desmideaceae family recorded in the study. *Netrium elongatum* belongs to the family Mesotaeniaceae was also recoded. In the Zygnemataceae family the only member, *Spirogyra pratensis* was observed. In the present study the pond water is not much polluted. The appearance of *Cosmarium botrytis, C. hammeri and Netrium elongatum* in the temple pond was conformed the pond water is not polluted. Desmids and filamentous conjugates are more common and diverse in oligotrophic lakes and ponds (Gerrath 1993). Kiran (2016) reported that phosphate at low concentration trigged the growth of desmids.

The order Ulotricales, family Ulotriceae, single species *Ulotrix zonata* was recorded. Filamentous algae were higher during December to early summer (Ashes Tiwari and Chauhan 2006). In Oedogoniales only one species *Oedogonium capilliformosa* was observed. It is in winter months. High conductivity and dissolved solids promote the growth of Oedogoniales (Jyotsna 2011) (Fig. 2C). The second dominant class was Bacillariophyceae contributes 25% of organisms to planktonic population. It was maximum (144 organisms/ml) in the month of March, 2016 and minimum (18 organisms/ml) in September, 2014. (Fig.2D). Singh and Swarup (1979) reported that higher concentration of calcium promoted the growth of diatoms in the summer. In the order Centrales, family Discoidae, members such as *Aulacosera granulate, Cocconeis pediculus, C. placentula* and *Cyclotella antique* were recoded.

Order Pennales Maximum (115 organisms/ml) was present in March, 2016 and minimum (15 organisms/ml) in August and September, 2014. Acananthaceae, Fragellaropdae, Naviculoidae, Nitzschiaoidae were the comprised families of Pennales. *Acananthes hauckiana, Astrerionella formosa, Diatoma vulgare, Fragellaria rumpens, Synedra ulna, Amphora normanii, Cymbella affinis, C. delicatula, Gophonema anfustatum, G. dicutamum, Gyrosigma acuminatum, Navicula cuspidate, N. viridula, N. purpula, N. subtilis, Nitzschia clostorium,* and *N. commutate,* were recorded members in this class. In the present investigation Diatoms were abundant in summer and pre monsoon period. Kumar *et al.* (2021) noticed that, the Diatoms and Dianoflagellates were abundant season dependent algal taxa in Kuwait waters in summer and more anthropogenic activities promotes the growth of these taxa. The higher temperatures and pH values have reported are the most important factors affecting diatoms growth positively (Kamat 1965 and Nagaraju *et al.*, 2016). Dominance of Bacillariophyceae members in summer season could be related to slightly acidic pH and high temperature which lead to increase in the density of diatom. Patil *et al.*, (2013) reported maximum density of diatom in summer and minimum in post-monsoon in Lotus Lake.

Cyanophyceae members were contributing 20.79% to total plankton. It was maximum (101 organisms/ml) in April, 2016 and minimum (19 organisms/ml) in October, 2014 (Fig. 4E). In the order Choorococcales, *Aphanocapsa biformis, Aphanotheca stagnina, Chroococcus disperses, C. turgidus, Gloeocapsa rupestris, Gomphosphaeria aponina, Microcystis aeruginos, Merismopedia glauca, and M.punctata* were recorded. *Lyngbya majuscule, L. lagerheimii, Planktolyngbya circumcreta, Oscillatoria major, O. limosa, O. princeps, Phormidium inundatum, Spirulina subsalsa, S. major, Anabaena constricta, A. circinalis, Nostoc commune, Rivularia curvata* and *Stigonema mamillosa* were belongs to order Nostocales. Nirmal and Cini (2011) stated that the high temperature favors the luxuriant growth of the blue green algae. Kotadiya and Acharya (2013) recorded the minimum blue green algae during winter season and maximum during summer season, and observed that *Merismopedia* sp. was dominant in Manipur Lake. The growth of the Cynophyceae was triggered in late winter and reached high in summer, but bloom formation members were dominated. Chlorophyceae and Cyanophycean genera are more abundant in winter season than in late summer (Halder *et al.*, 2019).

The class Euglenophyceae contributes 6% to total micro algae (Fig. 2F). It was showed seasonal variation with a maximum abundance during monsoon season and minimum in winter season. *Euglena* and *Phacus* were abundantly occurring due to organic pollution (Anuja and Chandra 2014). *Euglena cunate, E. acus, Phacus acuminatus, P. longicauda Trachelomonas hispida and T. acuminate and T. regulosa* were the members recorded. *Euglena acusa* and *Trachelomonas regulosa* were more in abundance. Euglenophyta members existed more abundantly in polluted water with organic matter (Damtew *et al.* 2018). In present observations *Trachelomonas regulosa* was dominant in this temple pond due to less organic pollution.

Higher diversity value in spring and comparatively low in summer could be due to change in pH, transparency and dissolved oxygen due to entry of runoff from the surroundings. Entry of runoff with organic matter and nutrients prevented the rapid growth of algae (Shylla and Ramanujam, 2014).

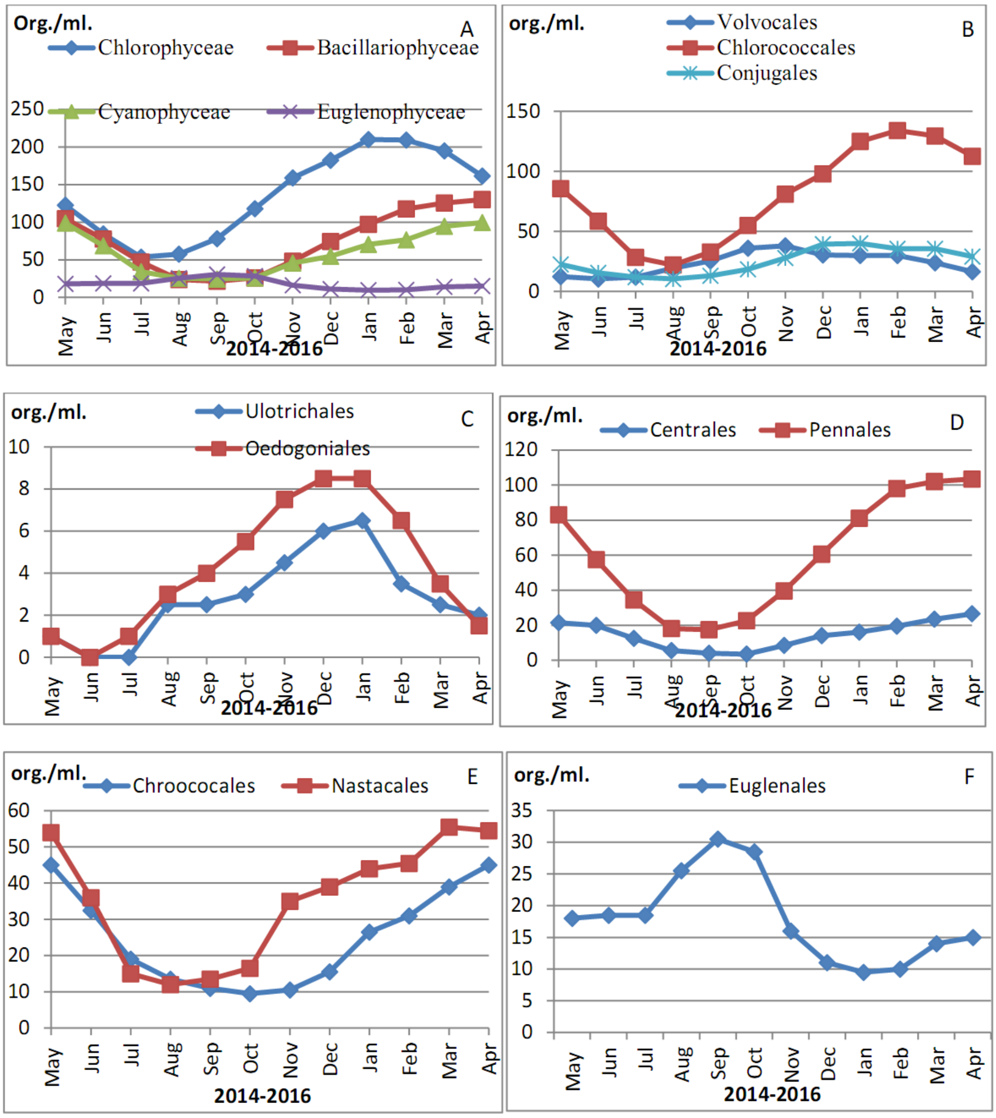


Fig. 2 A & B Seasonal Abundance of Total Phytoplankton and Chlorophyceae, C & D Ulotrichales, Oedogoniales (Chlrophyceae) & Centrales & Pennales (Bacillariophyceae) E & F Choorococales & Nostacales (Cyanophyceae)& Euglenophyceae of Sri Anjaneya and Saibaba Temple Pond, Narsipuram, A.P., India, during 2014 – 2016

Correlation Matrix

The correlation between physicochemical parameters and phytoplankton abundance was in Sri **Anjaneya and Saibaba** Temple Pond during May 2014 to April 2016 (Table 1). Total phytoplankton was showed strong positive correlation with transparency (r= 0.91), total alkalinity (r= 0.86), total hardness (r= 0.78), potassium (r=0.68), calcium (r=0.68), Chlorophyceae (r= 0.89), Bacillariophyceae (r= 0.94) and Cyanophyceae (r= 0.89). It was showed negative correlation with total suspended solids (r= -0.75) and Euglenophyceae (r= -0.81). Baruah and Kakati (2012) noticed a positive correlation with pH, total alkalinity, chlorides and nitrogen.

Chlorophyceae was showed strong positive correlation with transparency (r= 0.82), total alkalinity (r= 0.61) Bacillariophyceae (r= 0.70), and Cyanophyceae (r= 0.59), while strong negative correlation with total suspended solids (r= -0.90) phosphates (r= - 0.60) and Euglenophyceae (r=-0.78). Aarti Devi and Neha Antal (2013) studied a positive correlation between Chlorophyceae and calcium, magnesium and pH and while negative correlation with phosphates. Bacillariophyceae was showed strong positive correlation with transparency (r=0.80), total alkalinity (r= 0.90), total hardness (r= 0.88), chlorides (r= 0.75), calcium (r=0. 87), potassium (r= 0.79) and Cyanophyceae (r= 0.96), while negative correlation with total suspended solids (r= -0.51) dissolved oxygen (= -0.28) and Euglenophceae (r= -0.77). Ajayan et al.

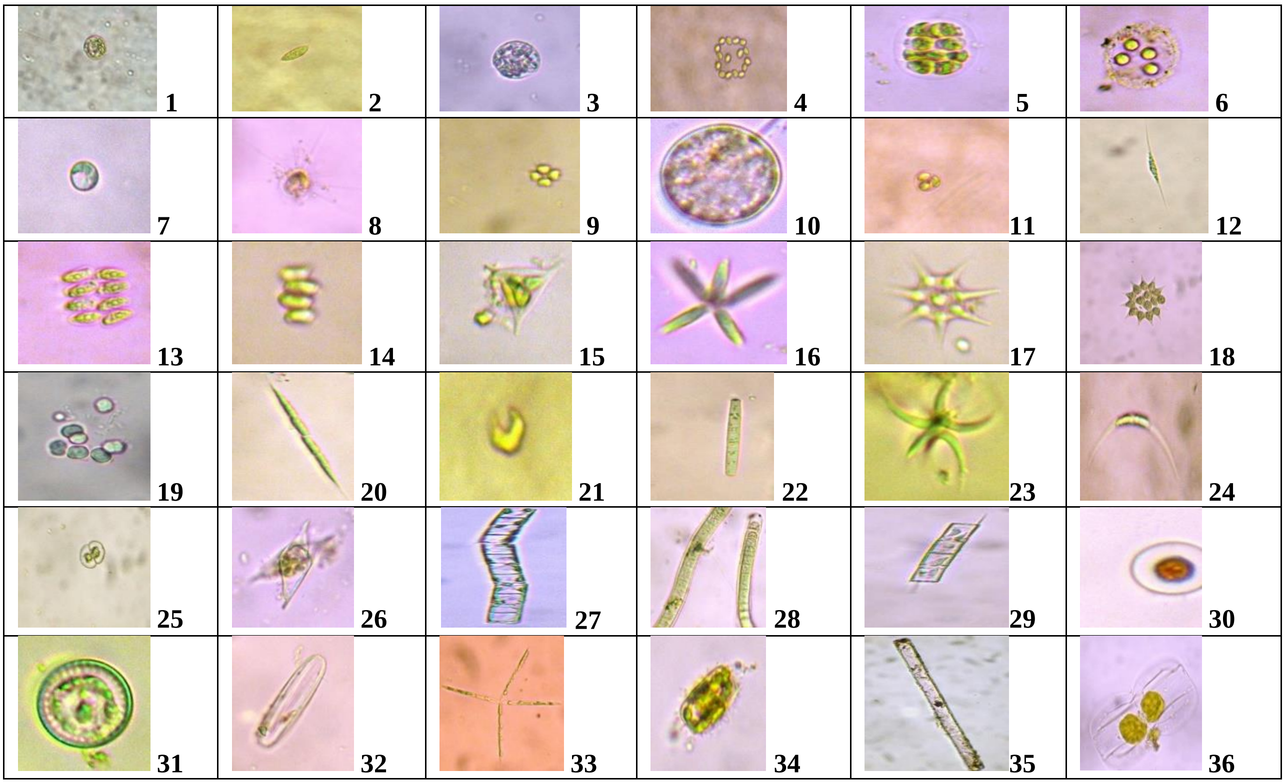
(2013) recorded a positive correlation between COD, TA, and chloride and Bacillariophyceae.

Cyanophyceae was showed positive correlation with temperature (r= 0.42) transparency (r= 0.84), total dissolved solids (r= 0.43) pH (r= 0.65), total alkalinity (r= 0.95), total hardness (r= 0.95), chlorides (r= 0.85), potassium (r= 0.83), calcium (r = 0.90), sodium (r= 0.70), magnesium (r=0.70), nitrates (r= 0.45), while negative correlation with TSS (r= -0.47), DO (r= -0.44), Euglenophyceae (r= -0.66). Ajayan et al. (2013) noted a positive correlation between temperature, BOD, COD, TA, and chloride. Padmavati and Veeraiah (2008) noticed a positive correlation between total alkalinity and blue green algae. Physical factors such as total alkalinity, pH and nitrates are responsible for the abundant growth of blue green algae (Michael, 1969). Aarti Devi and Neha Antal (2013) studied a positive correlation between Cyanophyceae with temperature, chlorides, phosphates and nitrates. Euglenophyceae showed positive correlation with water temperature (r= 0.33), phosphates (r= 0.17) and total suspended solids (r= 0.64) while negative correlation with total alkalinity (r= -0.73), transparency (r= -0.62) potassium (r= -0.67) calcium (r= -0.59). Ajayan et al. (2013) recorded a positive correlation between phosphates.

Table 1: Correlation Matrix among the physicochemical variables with phytoplankton abundance of Sri Anjaneya and Saibaba Temple Pond, Narsipuram, A.P., India, during May 2014 to April 2016

Name of the Parameter	AT	WT	Tra	Ec	TSS	TDS	pH	DO	TA	TH	Cl	Ca	Mg	K	Na	NO_3	PO_4	Chl	Bac	Cya	Eug	Tot
AT	1.00																					
WT	0.98	1.00																				
Tra	0.38	0.34	1.00																			
Ec	0.86	0.83	0.42	1.00																		
TSS	0.64	0.67	-0.37	0.53	1.00																	
TDS	0.73	0.79	0.36	0.80	0.42	1.00																
pH	0.69	0.67	0.58	0.64	0.23	0.73	1.00															
DO	-0.91	-0.88	-0.50	-0.82	-0.46	-0.67	-0.75	1.00														
TA	0.63	0.53	0.35	0.56	0.34	0.38	0.69	-0.57	1.00													
TH	0.92	0.86	0.42	0.89	0.55	0.66	0.75	-0.91	0.80	1.00												
Cl	0.83	0.77	0.58	0.69	0.38	0.59	0.86	-0.82	0.64	0.78	1.00											
Ca	0.59	0.58	0.66	0.47	0.10	0.47	0.84	-0.77	0.60	0.69	0.73	1.00										

Tot	Eug	Cya	Bac	Chl	PO4	NO3	Na	K	Mg
-0.08	0.12	0.51	0.18	-0.54	0.60	0.83	0.23	0.63	0.74
-0.19	0.17	0.41	0.10	-0.62	0.66	0.82	0.14	0.53	0.78
0.48	-0.31	0.59	0.46	0.29	-0.29	0.43	0.64	0.44	0.41
-0.13	0.18	0.40	0.09	-0.51	0.51	0.85	0.15	0.52	0.48
-0.45	0.35	0.03	-0.18	-0.75	0.82	0.40	-0.28	0.24	0.40
-0.13	0.07	0.32	0.10	-0.47	0.67	0.76	0.05	0.37	0.58
0.49	-0.47	0.84	0.68	0.07	0.44	0.57	0.56	0.85	0.74
-0.11	0.06	-0.64	-0.34	0.34	-0.48	-0.85	-0.47	-0.72	-0.68
0.35	-0.43	0.71	0.52	-0.02	0.42	0.39	0.23	0.75	0.65
0.08	-0.11	0.63	0.33	-0.38	0.56	0.79	0.30	0.76	0.70
0.40	-0.22	0.81	0.59	-0.04	0.34	0.63	0.61	0.84	0.66
0.56	-0.60	0.86	0.73	0.17	0.29	0.58	0.65	0.79	0.74
0.09	-0.21	0.52	0.31	-0.28	0.50	0.46	0.20	0.58	1.00
0.64	-0.56	0.94	0.81	0.22	0.30	0.46	0.71	1.00	
0.77	-0.56	0.78	0.76	0.56	-0.26	0.22	1.00		
-0.06	0.05	0.42	0.18	-0.45	0.53	1.00			
-0.81	0.61	-0.54	-0.66	-0.82	0.64				
0.79	-0.69	0.93	0.86	0.48					
0.88	-0.74	0.42	0.68	1.00					
0.94	-0.88	0.92	1.00						
0.80	-0.72	1.00							
-0.87	1.00								



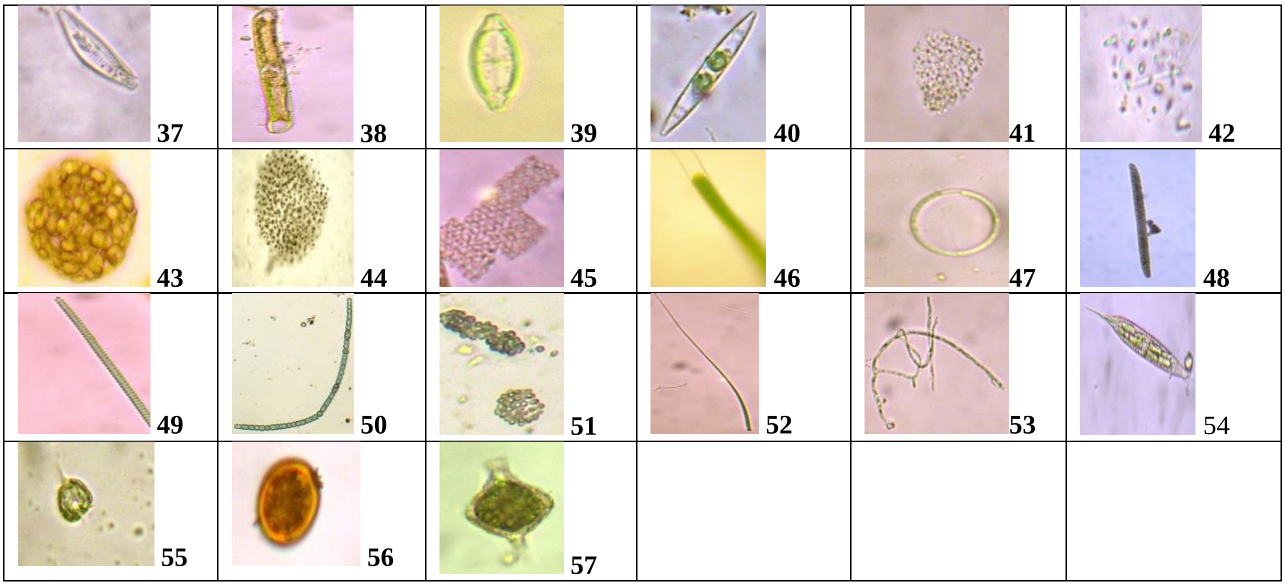


Figure 3: 1. Chlamydomonas ehrenbergii, 2. Chlorogonium euchlorum, 3. Gleocystis planctonica, 4. Gonium pectorae, 5. Eudorina elegans, 6. Volvox tertius, 7. Chlorella valgaris, 8. Golenchiana rediata,, 9. Microtenium pucellum, 10. Chlorococcum infusionum, 11. Oocystis solitaria, 12. Scorideria indica, 13. Scenedesmus arcuatus, 14. S. bijugatus, 15. Tetraedron trigonium, 16. Actinastrum gracillium, 17. Pediastrum simplex, 18. Pediastrum ovatum, 19. Dictyosphaerium ehrenbergianum, 20. Ankistrodesmus convolutes, 21. Kircheneriella lunaris 22. Monoraphadum tortile, 23. Selensatrum gracile, 24. Closterium acutum, 25. Cosmarium contractum, 26. Staurestrum leptocladium, 27. Ulotrix zonata, 28. Oedogonium capilliformae, 29. Aulacosera granulate, 30. **Coccuneis pediculus, 31. Cyclotella antique, 32. Acnanthes hauckiana, 33. Asterionella formosa, 34. Diatoma valgare, 35. Synedra ulna, 36. Amphora normanii, 37. Cymbella affinis, 38. Gyrosigma accuminatum, 39. Navicula cuspidate, 40. Nitzschia closterium, 41. Aphanocapsa biformes, 42. Aphanitheca stignina, 43. Chroococcus turgidus**, **44. Microcystis aeruginosa, 45. Merismopedia punctate, 46. Lyngbya lagerhamii , 47. Planktolyngbya circumcreta, 48. Oscillatoria major, 49. Spirulina major. 50. Anabaena circinalis, 51. Noctoc communis, 52. Rivularia curvata, 53. Stigonema mamillosum, 54. Euglena acus, 55. Phacus longicauda,, 56. Traclomonas hispida, 57. T. accuminata.**

CONCLUSION

In the present investigation at Sri Anjaneya and Saibaba Temple Pond, Narsipuram, A.P., A total of 105 Species, which belongs to 68 genera and 4 classes of Phytoplankton identified as members of Chlorophyceae (48 species), Bacillariophyceae (27 species), Cyanophyceae (23 species) and Euglenophyceae (7 species). Total 3458 organisms/ml was observed, maximum 472 organisms/ml in the month of March 2016 and minimum 124 organisms/ml in August 2014. The correlation matrix also recorded and calculated as per standard calculations.

REFERENCES

- Agale, M. C., Patil J. V., & Patel, N.G. (2013). Study of seasonal variations of Phytoplankton and their correlation with physico-chemical parameters of Budaki Medium Irrigation Tank, Shirpur. Dist. Dhule (M.S.) India. *European J. of Zool. Res.*, 2 (3), 8-16.
- Anand, N. (1998). Indian Fresh water Microalgae. Bishen Singh Mahendrapal Singh, 23-A Cannaught Place Dehra Dun, India Pp. 94.
- Anuja, J., & Chandra, S. (2012). Study on fresh water algae in relation to chemical constituents of Thiruneermalai Temple Tank near Chennai, India. *International Journal of Current Science* 4, 21-29.
- Anuja, J., & Chandra, S. (2014). Pollution Indicating Algae of Thiruneermalai Temple Tank, Pallavaram, Chennai. *A Journal of Science and Technology*, 3 (1), 2349-5456.
- Radha, A. P., & Uma Rani, V. (2018). Studies on the Algal Flora of Arulmigu Kasi Viswanathar Swamy Temple tank, Tirunelveli district, Tamil Nadu, India. *International Journal of Current Science*, *22*(6), 8-16.
- Arulmurugan P., Nagaraj, S., & Anand. N., (2010). “Biodiversity of fresh water algae temple tanks of Kerala” . *Recent research in Science and technology*, 2, 58-71.
- Tiwari, A., & Chauhan S.V.S. (2006). Seasonal Phytoplankton Diversity of Kitham Lake, Agra. *J. of Environ. Bio*. 27(1), 35-38.
- Ashok Kumar, N. (2011). A preliminary report on Planktonic Algae of Temple tank of Kancheepuram District, Tamil Nadu, India. *Int. J. of Curr. Res.* 3 (12), 404-415.
- Baruah, P.P., & Kakati, B. (2009). Studies on phytoplankton community in a high-land temple pond of Assam, India. *Indian J. of Environ Ecoplan*, 16(1), 17-24.
- Bhanu Prakash, M., Jyothi, K., & Narasimha Rao, G. M. (2014). Seasonal variations of phytoplankton community structure in relation to Physico-chemical factors in Lake Kolleru, Andhra Pradesh. *Ind. J. Algal Biomass Utln*, *5*(3), 1-7.
- Brraich O.S., & Kaur, R. (2015). Phytoplankton Community Structure and Species Diversity of

Nagal Wetland, Punjab, India. *Int. Res. J. of Biol. Sci.* 4 (3), 76-83.

- Dirborne, C. M., & Ramanujam, P. Cyanobacteria and algae in biological soil crust of East Khasi Hills, Meghalaya.
- Liu, C., Liu, L., & Shen, H. (2010). Seasonal Variations of Phytoplankton Community Structure in relation to Physico-chemical factors in Lake Baiyangangdain, China. *Int. Soc. for Environ, Infor. Sci. 2010 Annual. Conf. (ISEIS).*
- Damtew E., Roman N., & Lule W. (2018). Seasonal variation of Micro Algae diversity in Lake Abaya, Ethiopia. *Int. J. of Oceanograpy & Aquaculture. ISSN 2577-4050, 2*(5), 1-8.
- Desikachary, T.V. (1959). *Cyanophyta*. Indian Council of Agricultural Research, New Delhi.
- Ganapathi S.V. (1940). The Ecology of Temple Lake containing a permanent bloom of Microcystis aeruginosa (Kuetz) Henfer. *J. Bomb. Nat. Hist. Soc*. 42, 65-77.
- Gerrath, J.F. (1993). The Biology of Desmids: a Decade of Progress. In: Round F.E., Chapmen D.J. (eds). *Progress in Physiological Research. Bristol: Biopress*, 79-192.
- Girish Kumar, E., Rekha, C., Pradeep Kumar, G., Sasikala, K., & Sivadasan K.K. (2014). Diversity of Planktonic Algae of selected temple ponds of Mahe (U.T. of Puducherry), India. *Int. Sci. J.* 1(3), 48-53.
- Halder, P., Debnath, M., Ray, S. (2019). Occurrence and diversity of microalgae in phytoplankton collected from freshwater community ponds of Hooghly District, West Bengal, India. *Plant Science Today*, 6 (1), 8-16.
- Kousar, H., & Puttaiah, E.T. (2008). Dynamics of certain Physicochemical and Biological Charecterstics of Santhi Sagar Lke- The largest Lake in Karnataka State. Proceedings of Tall 2007: the 12th World Lake Conf: 1678-1686.
- Pickney, J.L., Sarah, Z., Susen, L., Alicia, W., & Angela, K. (2022). Seasonality in Benthic Micro algae community abundance in Shallow Shelf Waters. ELSEVIER, *Continental Shelf Research.* 244, 104797.
- Jyothi, K., & Narasimha Rao, G.M. (2013a). Seasonal Distribution of Phytoplankton in Riwada Reservoir, Visakhapatnam, Andhra Pradesh, India. *Nat. Sci. Biol*. 5 (3), 290-295.
- Kaparapu, J., & Geddada, M. N. R. (2015). Seasonal dynamics of phytoplankton and its relationship with the environmental factors in Meghadrigedda Reservoir of Visakhapatnam, Andhra Pradesh, India. *India. J. Algal Biomass utln, 6*(4), 60-67.
- Jyotsna, N. (2011). Some Ecological Studies on Micro Algae of Two fresh water ponds at Narasannapeta Mandal , Srikakulam District, (A.P.), India. Ph. D. thesis submitted to Andhra University. 1 - 227.
- Jyotsna, N., Subba, G. R., & Rao, M. G. N. (2015). A Contribution to the Seasonal Distribution and Biodiversity of Fresh Water Phytoplankton of Karagam Lake, Srikakulam, Andhra Pradesh, India. *International Journal of Environment*, *4*(1), 82-100.
- Kamat N.D. (1965). Ecological notes on the algae of Kolhapur. *J. of Bio. Sci.* 8, 47-54.
- Kavitha, A., Regini Balasingh, G. S., & Raj, A. D. S. (2005). Ecology of two temple ponds of Kanyakumari District. *Indian Hydrobiology*., 8 (1), 61-65.
- Kiran, B.R. (2016). Distribution and occurrence of desmids in Bhadra Reservoir Karnataka. *Int. J. of Res. in Envnl. Sci. 2* (3),16-23.
- Kodarkar, M.S. (1995). Conservation of lakes. *Indian Association of Aquatic Biologists (IAAB) Hyderabad publication*, 3,1-82.
- Kotadiya, N.G., & Acharya, C.A. (2013). Comparative study of Phytoplankton Diversity in two fresh water body of rural area of Ahmedabad. *Life Sci. Leaflets*. 4, 85-91.
- Kumar, V., Al Momin, S., Kumar, V. V., Ahmed, J., Al-Musallam, L., Shajan, A. B., ... & Al-Zakri, W. M. (2021). Distribution and diversity of eukaryotic microalgae in Kuwait waters assessed using 18S rRNA gene sequencing. *Plos one*, *16*(4), e0250645.
- Leela, J.B., Patil, S.M., Suresh, N.D., & Sathe, S.S. (2010). Occurrence of Phytoplankton in the water bodies of Miraj Tahasil of Maharashtra. *The Ecoscan.* 4(1), 73-76.
- Lukatelich, R.J. Mc Comb, A. J. (2023). Distribution and abundance of benthic micro algae in a shallow South Western Australian Estuarine System. *Marine Ecology - Progress Series.* 27, 287-297.
- Maya, S., Prammela, S.K., & Menon, S. V (2000). A preliminary study on the algae flora of Temple Tank of Southern Kerala, *Phykos*., 39, 77-83.
- Munawar, M. (1970). Limnological studies on freshwater ponds of Hyderabad, India. The Biosense distribution of unicellular and colonial Phytoplankton in polluted and unpolluted environments. *Hydrobiol*. 36(1), 105-138.
- Parisara, N., & Narayana, J. (2016, December). Euglenoids Distribution In Relation To Water Quality Of Konandur Pond, Thirthahalli Taluk, Karnataka. In *Lake 2016: Conference on Conservation and Sustainable Management of Ecologically Sensitive Regions in Western Ghats, India* (pp. 28-30).
- Narchonai, G., Arutselvan, C., Lewis, O. F., & Thajuddin, N. (2019). Deciphering the microalgal diversity and water quality assessment of two urban temple ponds in Pondicherry, *India Biocatalysis and Agri. Biotech.*, 22, 1-9.
- Nirmal, J. I., & Oommen, C. (2011). Phytoplankton composition in relation to Hydrochemical properties of tropical community, wetland Kanewal, Gujarat, India. *App. Eco. And Environ. Res.* 9 (3), 279-292.
- Padmaja Rani, P., & Narasimha Rao, G.M. (2020). Seasonal distribution of Micro Algae in relation to

Hydrographical features of water streams at Punyagiri Hills, Vizianagaram District, Andhra Pradesh. *J. Algal Biomass Utln*. e-ISSN: 2229-6905, 11 (1), 34-37.

- Pandey, J., Pandey, U., & Tyagi, H. R. (1999). The relation of algal productivity to the nature of physic-chemical environment of a fresh water tropical lake. *Ecol. Environ. Cons.*, 5(4), 365-368.
- Papiya, H., Manojit, D., & Ray, S. **(**2019**).** Occurrence and diversity of microalgae in phytoplankton collected from freshwater community ponds of Hooghly District, West Bengal, India. *Plant Science Today*, 6 (1), 426
- Arulmurugan, P., Nagaraj, S., & Anand, N. (2010). Biodiversity of fresh water algae from temple tanks of Kerala. *Recent Research in Science and Technology*, *2*(6).
- Patil, S. S., & Ghorade, I. B. (2013). Assessment of physicochemical characteristics of Godavari river water at Trimbakeshwar and Kopargaon, Maharashtra (India). *Environment*, *3*(3), 149-152.
- Philipose, M.T. (1967). *Chlorococcales*. Indian Council of Agricultural Research, New Delhi, India. Pp. 345.
- Prameela, S.K., Maya, S., & Menon, S. V. (2001). Phytoplankton Diversity of Temple tanks of four coastal district of Kerala. Proceedings of 13th Science Congress. Thrissur, Kerala, India. Pp 203-204.
- Prescott, G.W. (1973). Algae of the Western Great Lakes Area Wm C. Brown Co Inc. Iowa, USA, pp 234-246.
- Pushpam, P. M., Bhagan, V. U., & Kumaraswamy, A. (2013). Comparative Analysis of Physicochemical Parameters of Two Famous Temple Tanks in Kanyakumari District, S. India. *International Journal of Latest Trends in Engineering and Technology (IJLTET)*, *2*(2), 235-240.
- Randhawa, M.S. (1959). Zygnemaceae, *Indian Concil of Agricultural Research, New Delhi*, 317 – 318. PP.
- Sankaran, B., & Thiruneelagandan, E. (2015). Microalgal Diversity of Parthasarathy Temple Tank, Chennai, India. *Int. J. of Current Microbiol. and App. Sci.*, 4(4), 168-173.
- Senthilkumar, R., & Sivakumar, K., (2008). “Studies on phytoplankton diversity in response to abiotic factors in Veeranam lake in the Cuddalore district of Tamil Nadu”. *J. of Environ Biol*, 9, 747-752.
- MadhavaRao, D. S., & Rao, G. N. (2016). Seasonal Abundance of Phytoplankton in Relation to Physico-Chemical features of Venkammacheruvu Veeraghattam, Sriakulam (Dist.) AP, India. *IOSR J. of Pharmacy and Biological Sci*, *11*, 91-98.
- Setu Madhavarao, D., and Narsimharao, G.M. (2020). Diversity of Micro algal populations at Sri Mani Nageswar Temple Pond, Kallepalli, Srikakulam, Andhra Pradesh, India. *J. Algal Biomass Utln*. e-ISSN: 2229- 6905, 11 (2), 1-12.
- Shylla, O., & Ramanujam, P. (2014). Algal diversity in selected lentic bodies of Meghalaya with emphasis on productivity and nutrient value. Ph.D. Thesis. North-Eastern Hill University, Shillong, India.
- Singh, B.N., and Swarup, K. (1979). Limnological studies of Suraha Lake. *J. Inland. Bot. Sco. India. Middle-East, J, of Sci. Res.*, 8 (3), 544-554.
- Sivakumar, K., & Karuppaswamy, R. (2008). Factors effecting productivity of phytoplankton in reservior of Tamilnadu, India, American- Eurasian *J. of Botany*. 1(3), 99-103.
- Srinivasulu, K., & Damodharam, T. (2016). The study of Limnological and its Physico- chemical Characteristics of water of Bogolucheruvu (Tank), Andhra Pradesh, India. *Int. Res. J. of Env. Sci*. 5(4), 18-32.
- Sukumaran, M., Brintha, M., & Mathavanpillai, M. (2008). Species composition and diversity of Phytoplankton of Pechiparai Dam. India. *J. of Theor. And Expl. Bio.,* 4 (4), 157-161.
- Sulabha, V., & Prakasam, V. R. (2006). Limnological features of Thirumullavaram temple pond of Kollam municipality, Kerala *J. of Environ. Biol*, 7 (2), 449- 451.
- Senapati, T., Ghosh, S., & Mandal, T. (2011). Variation in phytoplankton diversity and its relation with physicochemical parameters of a semi lentic water body of Golapbag, West Bengal, India. *International Journal of current research*, *3*(7), 053-055.
- Thakur, R.K., Jindal, R., Singh, U.B., & Ahluwalia, A.S. (2013). Plankton diversity and water quality assessment of three fresh water lakes of Mandi (Himachal Pradesh, India) with special reference to planktonic indicators. *Environ. Monit. Assess,* 185 (10), 8355 – 73.
- Transeau, E.N. (1951). Zygnemaceae. Ohioi State University Press. Columbus. USA. 26.
- Uma Rani, V., Palanivel, S., & Elaya Perumal, U. (2017). Algal Diversity of Arumigu Sri Thiyagaraja swamy Temple Tank Thiruvottiyur, Chennai, Tamil Nadu, India. *Indian J. of Sci. and Tech.* 10 (13), 1-7.
- Wetzel, R.G., & Likens, G.E. (2000). Limnological Analyses. 3rd ed. Verlag, New York, Inc. N.Y.