Seasonal Abundance and Species diversity of Microalgae in Satyavaram Pond, Srikakulam Dist, (Andhra Pradesh), India

Dr. N. Jyotsna

Lecturer in Botany, Govt. Women's College, Srikakulam, Andhra Pradesh, India

Abstract: Seasonal abundance of Microalgae studies were carried out on the Satyavaram pond near Narasanna peta of Srikakulam District, Andhra Pradesh from November 2006 to October 2008. A total of Eighty two species were identified, of which 44 genera belonged to Chlorophyceae, 20 to Cyanophyceae, 15 to Bacillariophyceae and 3 to Euglenophyceae. The Interrelationship between physico-chemical parameters and phytoplankton (Pearson's Correlation matrix) was also studied. The present investigation revealed conservation of microalgal flora which helps for maintenance of ecological and biological balance in fresh water bodies.

Keywords*: Phytoplankton, Seasonal abundance, Physico-chemical parameters*

INTRODUCTION

Phytoplankton is the major primary producers for aquatic systems and is important food source for other organisms. They play an important role in maintaining the biological balance and water quality of water bodies. The oligotrophic nature of water depends upon the presence of desmids and diatoms which act as bioindicators of the freshwater ecological systems. Several authors studied the seasonality of phytoplankton (Laskar and Gupta 2009, Adesalu 2010, Leela Bhosale *et al.* 2010b). Studies on desmid flora in different parts of country was done by Habib and Chaturvedi 2001, Seth *et al.* 2006, Misra *et al.* 2008a&b, Dwivedi *et al.* 2009, Leela Bhosale *et al.* (2010a), Kumawat *et al.* (2010) and Mary Christi *et al.* (2011). India has wide variation in climatic factors in different regions. Climate of a region determines its agriculture, aquaculture as well as its ecology. But very few information is available in the freshwater ponds in the Southern coastal region of this country. Therefore investigations were carried out on Seasonality and Species diversity of Phytoplankton for a 2 years period (2006-08). In the present study an attempt has been made to correlate certain physical and chemical factors with the fluctuations in plankton populations.

MATERIALS AND METHODS

Seasonal studies on abundance of phytoplankton in relation to Physico-chemical parameters were made on Satyavaram pond of Narasannapet mandal of Srikakulam district, A.P., India. Seasonal studies on microalgae were carried out for period of two years (2006-08). Satyavaram pond is located at latitudes of 18 °24'18" and with longitudes of 84° 01' 30". Surface area of the water in the Pond during rainy season is around 4.68 hectares and 3 hectares in the summer months. Water samples were collected from

10 stations at each Pond for chemical studies and phytoplankton analysis.

The mateorological data is collected from the Head office of Meteorological department, Begampet, Hyderabad. The data include atmospheric temperature, rainfall and relative humidity were collected during the study period (2006-08) and average values were taken (Table 1).

Turbidity, temperature, pH and Conductivity were measured with the help of Nephelometer, thermometer, pH meter and conductivity meter. Water samples were also analyzed for D.O, B.O.D., Total alkalinity, dissolved solids, carbonate, bicarbonate, chloride, flouride, silicate, ammonia, nitrate and phosphate (Table 2) was carried out by following the standard methods of APHA (1998). Phytoplankton analysis was done by the following procedure.

PLANKTON ANALYSIS

Collection and Preservation of the Samples:

The plankton net is a field-equipment used to trap plankton. Its structure comprises polyethylene filter of a defined mesh size and a graduated measuring jar attached to the other end. A handle holds the net. Usually, the mesh number 25 of size 60 µm was used for collecting samples. (Senthilkumar and Sivakumar, 2008; Sivakumar and Karuppasamy, 2008; Leela Bhosale, 2010). The “surface samples” are collected as close to the water surface as possible, at 10 stations of two ponds for every 15 days of each month from October 2006- October 2008 in-between 7am to 9 am and average values of two years were taken for study. A known volume of the sample, 2L to 5L is filtered and planktons are filtered and preserved for further analysis. The samples collected into the 100ml polyethylene vials were preserved by adding suitable amounts of 1ml chloroform to act as the narcotizing agent and 2ml of 2% formalin for preservation and analyses.

Ten percent glycerin solution in distilled water was used as mounting fluid for the preparation of temporary and semi permanent slides for microscopic study. Qualitative and quantitative evaluation of plankton was made by Sedgwick Rafter counting cell method. The phytoplankton sample placed into the Sedgwick Rafter Counting chamber is allowed to stand on a flat surface for 20 minutes to enable the phytoplankton to settle. It is then transferred to the stage of an upright light microscope and securely positioned and ready for counting (Hafsa Sultana Laskar and Susmita Gupta, 2009).

The abundance of phytoplankton groups was calculated according to the following formulae (Welch, 1948)

N= (a x 100) C/L

Where N=Number of phytoplankton per litre of original water

A=Average number of phytoplankton in all counts in the counting cells

C=Volume of original concentrate in ml.

L=Volume of water passed through the net

The result was expressed as Unit/litre.

This method was cross checked with Drop count method.

Total plankton count per litre = A * (1/L) * (n/v)

Where, A = number of organisms per drop

L = volume of original sample (l)

n = total volume of concentrated sample (ml)

v = volume of one drop (ml)

RESULTS AND DISCUSSION

Seasonal distribution of phytoplankton in Satyavaram pond: Observations revealed that the dominant members belongs to Chlorophyceae (44 genera) followed by Cyanophyceae (20 genera), Bacillariophyceae (15 genera) and Euglenophyceae (3 genera). During the two years of investigations different algae present in this Pond was Chlorophyceae 60.68%, Cyanophyceae 20.5%, Bacillariophyceae 15.44% and Euglenophyceae with 3.39%.

Chlorophyceae: In the present study, different algal forms reported in the Pond belongs to the orders volvocales, chlorococcales, ulotrichales, oedogoniales and conjugales. Venkateswarlu (1969 b), Singh and Swarup, (1979) and Tripathi and Pandey (1990) reported maximum green algal population during late winter and monsoon. Similar observations were found in present study.

Abundance of algal members belonged to order volvocales

In the present investigation, members of the order Volvocales were abundant in the month of July (18.29%) and minimum (9.31%) in June (Table 3). In the order volvocales, algae belongs to families such as chlamydomonadaceae, tetrasporaceae, sphaerellaceae, palmellaceae and described in family wise. In this present investigation, the members of Chlamydomonadaceae members were maximum in the month of May (81.3%) and minimum (50%) in the month of September (Fig2). In this family, 6 genera were recorded viz. *Carteria*, *Chlamydomonas, Eudorina*, *Gonium*, *Pandorina* and *Pleodorina.* The dominant genus *Eudorina* was represented by *Eudorina illinoiensis*, *E.indica* and *E.elegans. Eudorina* was observed throughout the period of study (Fig2). Sphaerellaceae family was represented by a single genus *Volvox* and single species *Volvox aureus.* Sphaerellaceae members were maximum in the month of July with 9.3% and minimum with 2% in the month of December (Fig1).

Mateorological and Physico- chemical parameters: Mateorological data collected during study period were expressed in Table.1. The Physico-chemical parameters were studied for two years and average values were expressed in Table.2

In the family tetrasporaceae, only two genera with two species were observed. They are *Apiocystis brauniana* and *Pseudotetraspora marina*. Maximum members of Tetrasporaceae were reported in the month of June, October with 19% and minimum 3.1% in the month of July (Fig2). Palmellaceae members were maximum in the month of July and August with 28.1% and minimum (3.1%) in the month of May (Fig2). The algal members reported were *Asterococcus superbus* and *Gloeocystis gigas.*

Abundance of algal members belonged to order Chlorococcales

In the present investigation, members of the order chlorococcales were abundant with 22.9% in November and minimum (11.74%) in May (Table 3). In this order 26 species were reported which belongs to six families. Chlorococcaceae members were maximum in the month of November with 22% and minimum (5.6%) in the month of September (Fig2).

In this family 3 genera such as *Oocystis, Echinosphaerella and Golenkinia* were reported.

In Chlorellaceae members, only one species *Chlorella vulgaris* was reported and it was found from the month of November to April and totally absent in waters from May to October (Fig2). In Selenestraceae family 4 genera such as *Dactylococcus, Actinastrum, Ankistrodesmus, Selenastrum were reported.* Selenestraceae members were maximum in the month of December with 15% and minimum (4%) in the months of November and July (Fig2). In the family Dictyosphaeriaceae only one species *Dictyosphaericum ehrenbergianum* was reported and it was not found in the months of May and August but seen in remaining months (Fig2). Temperature of 30.5^0C were responsible for minimum growth of Chlorococcales during May. This correlated with the work of Satyamohan (1980).

In the family Hydrodictyaceae, only one genus *Pediastrum* was reported. Members of Hydrodictyaceae were found maximum in the month of May with 23% and found minimum with 7.7% in the month of July (Fig2). Coelastraceae members were maximum in the month of July with 73.1% and minimum (33.3%) in the month of November (Fig2). In this family 5 genera such as *Crucigenia, Coelastrum, Scenedesmus, Tetraedron* and *Westella* were reported.

Ulotrichales and Oedogoniales

In this present investigation, members of ulotrichales were maximum (7.24%) in June and minimum in the month of July with 2.29% (Table 3, Fig3). In the family Ulotrichaceae, 3 genera such as *Ulothrix, Microspora* and *Uronema* were reported. Members of oedogoniales were maximum (3.4%) in the month of November, minimum (1.32%) in August and absent in the months of May and July (Table 3, Fig3). In this order only one family oedogoniaceae with 2 species *Oedogonium plusiosporum* and *O.princeps* were reported were reported. In Pond A, this order was found maximum with a single family Oedogoniaceae. This was in turn represented by a single genus *Oedogonium.*

Conjugales

Members of Conjugales were maximum (71.59%) in the month of May and minimum (52.34%) in the month of November (Table 3). This order was represented by families Mesotaeniaceae, Zygnemataceae, Gonatozygaceae and Desmidiaceae. Similar findings were reported by Venkateswarlu and Reddy (1985). They found abundance of green algal flora like Zygnema and Spirogyra in less polluted spots which correlated with the present work. Mesotaeniaceae members were maximum (4.55%) in the month of December and minimum (0.53%) in the month of February (Fig4). In the family Mesotaeniaceae, genera such as *Mesotaenium, Netrium and Cylindrocystis* were reported. In this study, Zygnemataceae members were maximum (10.45%) in the month of April and minimum (0.49%) in the month of January (Fig4). In the family Zygnemataceae, genera such as *Zygnema* and *Spirogyra* were reported.

The members of Gonatozygaceae were reported maximum (5.5%) in the month of June, minimum (1.1%) in May and nil in July two species such as *G.brebisonii* and *G.kinhanii* were reported (Fig4). Members of Desmidiaceae were found maximum with 94.7% in the month of July and minimum in the month of August with 83.1% (Fig4). In the family Desmidiaceae, 8 genera such as *Closterium,*

Actinotaenium, Cosmarium, Desmidium, Euastrum, Micrasterias, Penium, Staurastrum were reported. 15 species of *Closterium and* 33 *Cosmarium* species were reported which comprises the highest number of species among all algae reported.

Bacillariophyceae

In the present study, Bacillariophyceae members reported maximum (18.75%) in the month of December and minimum (11.63%) in the month of June (Table 3). In Satyavaram Pond, higher values of P^H, bicarbonates, silicates, may promote the growth of Bacillariophyceae. Lower values of these parameters leads to low abundance of phytoplankton.

The algae belong to Pennales were abundant during the period of study (Table 3). In the order Pennales, algae belongs to divisions such as Fragilarioidae, Naviculoidae, Epithemoidae and Nitzchioidae were reported. Algae belongs to Fragilarioidae were maximum (28.3%) in the month of September and minimum (4.17%) in the month of July (Fig.6). In this study, algae belong to Fragilarioidae such as *Asterionella, Meridion, Synedra* were reported. In this study, algae belong to Naviculoidae were reported máximum (70.1%) in April and mínimum (41.3%) in the month of August(Fig.6). *Amphora, Cymbella, Frustulia, Gyrosigma, Navicula, Pinnularia, Pleurosigma* were reported in Naviculoidae. Epithemoideae division shows presence of only 2 species such as as *Denticula kuetzingi* and *Rhopalodia gibba.*

In the division Nitzchioideae, a single genus Nitzschia was reported maximum (37.5%) in July and a minimum (16.9%) in the month of April (Fig.6). Leela Bhosale *et al.* (2010) observed that summer season shows more diatoms whereas rainy season has Chlorophyceae and Euglenophyceae members. *Cymbella, Navicula, Nitzchia, Pinnularia, Synedra* are of common species.

The occasional species belongs *Cosmarium, Scenedesmus, Licmophore, Surirella* and *Gomphonema.* Similar findings found in this study. Diatoms dominant in oligotrophic waters. (Canter-Lund and Lund, 1995). Patrick *et al.* (1969) reported a reduction in diatoms when the water temperatures were between 35 and 40°C. Similar trend was observed in present investigation. Appa rao (1992) found peak Growth of diatoms in mansoon which correlated with present work.

Cyanophyceae

Maximum (27.52%) number of Cyanophyceae members was reported in the month of June and minimum (9.64%) in the month of September (Table 3). In the class Cyanophyceae, algae belong to orders Chroococcales and Nostocales were reported. In Chroococcales order, algae belong to a single family Chroococcaceae were reported. 10 genera such as *Aphanocapsa, Aphanothece, Chroococcus, Coelosphaericum, Dactylococcopsis, Gloeocapsa, Merismopedia, Microcystis, Pelogloea, snechocystis* were reported. They were maximum (46.28%) in the month of April and minimum (25%) in the month of September (Fig.7). Dwivedi *et al.* (2005a) reported 45 species of 21 genera of fresh water blue green algae from Uttar Pradesh. He found physico-chemical parameters like P^H, temperature, DO, Electrical conductivity, nitrate, nitrite and rainfall play an important role in the periodicity of blue green algae. A positive correlation observed between DO-Species diversity, electrical conductivity - TDS. Padmavathi and Veeraiah (2008) reported that summer season promoted the growth of *Microcystis*. They noticed a

positive correlation between total alkalinity and blue green algae. Similar observations were reported in the present investigation.

In the order Nostocales, the algae belongs to families such as Oscillatoriaceae, Nostocaceae and Scytonemataceae were reported. They were maximum (75%) in the month of September and minimum (54%) in the month of April (Table 3). In the family Oscillatoriaceae, algae were reported maximum (94%) in the month of March and minimum (70%) in the month of December (Fig.8). In this family 7 genera such as *Oscillatoria*, *Phormidium*, *Spirulina*, *Arthrospira*, *Lyngbya*, *Microcoelus* and *Michrochaete* were reported.

In the family Nostocaceae, genera such as *Nostoc* and *Anabaena* were reported. In this family, algae reported maximum (22%) in the month of December and minimum (1.5%) in the month of March (Fig.8). In Scytonemataceae family, maximum (11.29%) algal forms reported in the month of November and minimum (1.82%) in the month of January with 2 species *Scytonema simplex* and *S.hofmanii* (Fig.8).

Euglenophyceae

In this class, *Euglena acus* ,*E.gracillus*, *E.oxyuris* and *E. polymorpha* were maximum (50%) in the months of February and July and reported minimum (25%) in the month of October (Fig.10). *Phacus acuminatus*, *P.anacoelus*, and *P.curvicauda*,were maximum (36.36%) in the month of August and minimum (14.29%) in the month of December (Fig.10). *Trachelomonas hispida* , *and T.horrida* were reported maximum (50%) in the month of October and minimum (23.53%) in the month of April (Fig.10). Similar studies were reported by Saha and Wujek (1989), Chinnaswamy *et al.* 2007, Shehata et al. (2008), Ramanujam and Siangbood (2009) and Thiruganamoorthy and Selvaraju (2009).

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

Alkaline nature high in summer (r=0.98) and minimum in winter. Similar trend was reported by Kadam *et al.* 2007, Narayana *et al.* 2008, Reddy Vasumathi *et al.* 2009, Shinde *et al.* 2011. Conductivity showed significant positive correlation with TDS and turbidity. This correlated with the work of Salve and Hiware 2006, Narayana *et al.* 2008, 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 (Nirmal Kumar 2005, Chouhan 2007, Narayana *et al.* 2008, Reddy Vasumathi 2009, Shinde *et al.* 2011). Similar trend was observed in this study period. In the present investigation, cyanophyceae members were reported maximum when nutrients and turbidity was high. Similar findings were reported by Chellappa *et al.* (2004). 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). Cyanophyceae have show very close positive relation with temperature and phosphate (Wilk-Wozniak 1998, Harsha and Mallammanavar 2004). Similar findings were found in present investigation.

Bacillariophyceae members have shown significant positive relation with temperature, chlorine and phosphate (Sadguru prakash 2001, Chitra and Meer 2004). Bacillariophyceae members have shown

significant positive relation with temperature, chlorine and phosphate (Sadguru prakash 2001, Chitra and Meer 2004).

CONCLUSION

Phytoplankton play an important role in maintaining the biological balance and water quality of water bodies. The oligotrophic nature of water depends upon the presence of desmids and diatoms which act as bioindicators of the freshwater ecological systems. In the present work, more number of desmids and diatoms revealed the oligotrophic nature of the fresh water pond. The abundant presence of blue green algae has an antagonistic effect on the occurrence of desmids (Hosmani and Vasanth kumar (2000). In the present investigation, the maximum green algal population was observed during late winter and monsoon which correlated with the work of Tripathi and Pandey, 1990. High rainfall, high nitrate content, high temperature, maximum relative humidity; bicarbonates promoted the maximum growth of Chlorophyceae members. In the present investigation, Cyanophyceae members were reported maximum when nutrients and turbidity was high. Similar findings were reported by Chellappa *et al.* (2004). The presence of various microalgae in this investigation helps for maintenance of ecological balance in the fresh water bodies.

REFERENCES

Adesalu, T.A. (2010). Phytoplankton dynamics of river Oli in Kainji Lake National Park, Nigeria during dry season. *International Journal of Botany*, 6: 112-116.

Canter Lund, H. and Lund, J.W.G. (1995). Fresh water Algae. Their Microscopic world explored. Biopress Ltd.

Chellappa, S.L., Marinho, I.L., Chellappa, N.T. (2004). Freshwater phytoplankton assemblages and the bloom of toxic cyanophyceae of Campo Grande reservoir of Rio Grande do Norte State of Brazil. *Indian Hydrobiology*, 7: 151-171.

Chinnasamy, M., Gangadharan, M., Ramaswamy,V., Annamalai, P., and Nooruddin, T. (2007). Cyanobacterial biodiversity from different fresh water ponds of Thanjavur, Tamilnadu (India). *Acta Botanica Malacitana*, 32: 17-25.

Chitra P and Meer, S.B. (2004). Flora of temporary water bodies along the semi coastal line. Chackai to Shangumugham in Tiruvananthapuram. India *Hydrobiology*, 7(1&2):47-51.

Chouhan, C.S. and K.C.Sharma,(2007).Limno-Biotic of a religious Lake Budha Pushkar near Ajmer,Rajasthan,NSL:227-230.

Dwivedi, S., Misra, P.K., Rai, U.N., Tripathi, R.D., Suseela, M.R., Sinha, S., Baghel, V.S., Pal, A. and Dwivedi, C.P. (2005). Fresh water blue green algae from three agroclimatic zones of Uttar Pradesh, India: distribution pattern with seasonal variation. *J.Environ.Biol.*, Jan; 26(1): 21-30.

Dwivedi, R.K., Shukla, C.P., Misra, P.K., Shukla, S.K. and Seth, M.K. (2009). On desmids of Southern Himachal Pradesh of Indo-Western Himalaya. *Feddes Repertorium*, 120: 236-249.

Habib, I. and Chaturvedi, U.K. (2001). Contribution to the knowledge of desmid of Kumaon in Himalaya. *J. Indian bot. Soc.*, 80: 177-182.

Harsha, T.S. and Mallammanavar, S.G. (2004). Assessment of phytoplankton density in relation to environmental variable in Gopalswamy pond at

Chitradurga, Karnataka. *Journal of environmental Biology*, 25(1):113-116.

Hosmani and Vasanth kumar (2000). Biochemical aspects of water pollution in two lakes of Mysore city. *Lake*, Section 6- Limnology, watershed Hydrology and Monitoring- Paper 3.

Jawale, A.K. and Patil, S.A. (2009). Phytoplankton abundance and physico-chemical parameters of Mangrul Dam, Dist-Jalgaon, Maharastra. *Indian Hydrobiology*, 12(1): 74-79.

Kadam, M.S., Pampatwar, D.V. and Mali, R.P. (2007). Seasonal variations in different Physico-chemical characteristics in Masoli Reservoir of Parbhani district, Mahastra. *J.Aqua.Biol*., Vol. 22(1): 110-112.

Kumawat, D.A., Jayashri Patil and Rane, H.E. (2010). The Algal genus Pediastrum Meyen from North Maharastra. *J.Phytol.Res.,* 23(1): 109-112.

Laskar, H. and Gupta, S. (2009). Phytoplankton diversity and dynamics of Chatla flood plain lake, Barak valley, Assam, north east India. *Journal of Environmental Biology*, 30(6):1007-1012.

Leela J Bhosale., Surekha N Dhumal. and Anjali B. Sabale. (2010a). Phytoplankton diversity of four lakes in Satara district, Maharastra state. The *Bioscan*, 5(3): 449-454.

Leela J. Bhosale, Surekha N. Dhumal and Anjali B. Sabale. (2010b). Seasonal variations in occurrence of Phytoplankton and primary productivity of some selected lakes in Maharastra. *The Bioscan*, Special issue, vol.2; 569-578.

Mary Christi, R., Selvin Samuel, A., Renuka Bai, N. and Christy Kala, T. (2011). Diversity of Chlorococcales with respect to Physico-chemical parameters in three selected perennial ponds of Agasteeswaram taluk, Kanyakumar district, (Tamilnadu), India. *Plant Archives*., Vol.11(1): 17-20.

Misra P.K., Shukla M. and Prakash J. (2008). Some fresh water algae from Eastern Uttar Pradesh. *Indian Hydrobiology*, 11:121-132.

Misra, P.K., Misra, P., Shukla, M. and Prakash, J. (2008). Some desmids from Garhwal Region of Uttarakhand, India. *Algae*, 23: 177-186.

Muthukumar, C., Muralitharan, G. and Vijayakumar, R. (2007). Cyanobacterial biodiversity from different fresh water ponds of Thanjavur, Thamilnadu. *Acta Botanica Malacitana*, 32.17-25.

Narayana, J., Puttaiah, E.T. and Basavaraja, D. (2008). Water quality characteristics of anjanapura reservoir near Shikaripur, District Shimoga, Karnataka. *J.Aqua.Biol.*, 23(1): 59-63.

Ngearapat, N. and Peerapornpisal, Y. (2007). Application of desmid diversity in assessing the water quality of 12 freshwater resources in Thailand. *J. Applied Phycol*., 19: 667-674.

Nirmal Kumar, Kumar,J.I. and Bhatt,I. (2005).Study of cultural eutrophication in relation to plant diversity of Wetland: Ratheshwar in central Gujrat.*Aquatic biodiversity* in Indian: The present Scenario, pp:243-284.

Padmavathi, P. and Veeraiah, K. (2008). Studies on the influence of *Microcystis aeruginosa* on the ecology and fish production of carp culture ponds. *African Journal of Biotechnology*, vol. 8(9): 1911-1918.

Patrick, R., Crum, B. and Coles, J. (1969). Temperature and manganese as determining factors in the presence of diatoms or bluegreen algal floras in streams. *Proc. Nat. Acad. Sci.,* USA. 64: 472- 478.

Ramanujam, P. and Hygina Siangbood, (2009). Diversity of Algal communities in Umiew River, Meghalaya. *Journal of Indian Hydrobiology*, 12(1): 53-57.

Reddy Vasumathi, K., Laxmi Prasad, K., Swamy, M. and Ravinder Reddy (2009). Physico-chemical parameters of Pakhal Lake of Warangal district, Andhra Pradesh, India. *J.Aqua.Biol*., 24 (1): 77-80.

Saha, L.C. and Wujek. (1989). Phytoplankton distribution in an oligotrophic pond and a eutrophic pond. *Actahydrochimica et hydrobiologica*. Vol.17(4): 407-416.

Salve, B.S. and Hiware, C.J. (2006). Studies on water quality parameters of a minor reservoir, Nadergul, Rangareddy district, Andhra Pradesh. *J.Aqua.Biol*., Vol.22(1): 118-122.

Senthilkumar, R. and Sivakumar, K. (2008). Studies on phytoplankton diversity in response to abiotic factors in veeranam lake in the Cuddalore district of Tamilnadu. *Journal of Environmental Biology.*, 29(5): 747-752.

Seth, A., Seth, M.K. and Misra, P.K. (2006). A review of literature on algal flora of Himachal Pradesh. *Phytotaxonomy*, 5: 35-57.

Shehata, S.A., Badr, S.A., Ali, G.H., Ghazy, M.M., Moawad, A.K. and Wahba, S.Z. (2008). Assessment of Nile water Quality via Phytoplankton changes and toxicity Bioassay Test, *Journal of Applied Science Research.*, 5(12): 2083-2095.

Shinde, S.E., Pathan, T.S., Raut, K.S. and Sonawane, D.L. (2011). Studies on the Physico-chemical parameters and correlation coefficient of Harsool-savangi Dam, District Aurangabad, India. *Middle-East Journal of Scientific Research*., 8(3): 544-554.

Singh, S.R. and Swarup, K.(1979). Limnological studies on Suraha Lake (Ballia) II. The periodicity of phytoplankton. *J.Indian.Bot.Soc.*, 58: 319-329.

Sivakumar, K. and Karuppasamy, R. (2008). Factors Affecting Productivity of Phytoplankton in a Reservoir of Tamilnadu, India. *American-Eurasian Journal of Botany.*, 1(3): 99-103.

Thiruganamoorthy, K. and Selvaraju, M. (2009). Phytoplankton diversity in relation to physico-chemical parameters of Gnanapekasam temple pond of Chidambaram in Tamilnadu, India. *Recent Research in Science and Technology*, Vol 1(5).

Tripathi, A.K. and Pandey, S.N.(1989). Studies on algae of polluted ponds of Kanpur II. Qualitative, quantitative and periodical occurance of blue green algae of chandrai pond. *Res. J. Pl. Environ.*, 5 (1): 89-93.

Venkateswarlu, V.(1969b). An ecological study of the algae of the river Moosi, Hyderabad (India) with special reference to water pollution.II. Factors influencing the distribution of algae. *Hydrobiol.*, 33: 352-363.

Wilk-Woznaik, E.(1998). Late autumn mass development of *woronichinia nageliana* (cyanophyceae) in a dam reservoir in southern Poland. *Biologia Bratislava*, 53(1):1-5.

Table1. Meteorological Data for Satyavaram Pond

Meterological Data (Average Calculations for 2 years i.e Nov 2006-Oct 2008)																						
		Temperature Maximum				Temperature Minimum					Rainfall				Relative Humidity rh_1				Rlative humidity rh_2				
S.No.	Month	2006	2007	2008	Average	2006	2007	2008	Average	Average Temperature(°C)	2006	2007	2008	Average Rainfall(Cm)	2006	2007	2008	Average	2006	2007	2008	Average	Average Relative Humidity(%)
1	Nov	29.2	29.49	0	29.3	21.02	19.9	0	20.5	24.9	10.8	1.2	0	6	79.97	76.43	0	78.2	75.06	68.5	0	71.8	75
2	Dec	28.78	27.79	0	28.3	17.94	18.2	0	18.1	23.2	0	0	0	0	81.4	75.97	0	78.7	70.6	68.77	0	69.7	74
3	Jan		28.24	27.82	28		17.5	16.66	17.1	22.6		0	6.3	3.2		85.25	81	83.1		71.32	69.35	70.3	77
4	Feb		29.86	27.84	28.9		19.1	20.42	19.8	24.4		0.2	43.3	21.8		79.53	87.89	83.7		70.32	81.31	75.8	80
5	Mar		31.12	31.39	31.3		23.35	21.76	22.6	27		1.1	41.4	21.3		79.29	75.61	77.5		76.29	75.83	76.1	77
6	Apr		32.39	32.7	32.5		25.58	24.7	25.1	28.8		0	15.6	7.8		73.67	77.47	75.6		81.03	79.46	80.2	78
7	May		34.03	34.42	34.2		26.94	26.55	26.7	30.5		45.6	126.6	86.1		75.42	77.45	76.4		79.45	79.55	79.5	78
8	Jun		32.09	31.59	31.8		26.65	25.89	26.3	29.1		429	89.1	259.1		85.23	83.9	84.6		84.83	83.86	84.3	84
9	Jul		31.71	31.47	31.6		26.32	25.46	25.9	28.8		89.5	222.8	156.2		82.5	85.39	83.9		82.7	83.48	83.1	84
10	Aug		31.58	31.24	31.4		25.82	25.81	25.8	28.6		123.4	123.4	123.4		83.16	87.23	85.2		83.58	85.13	84.4	85
11	Sep		30.67	31.91	31.3		25.47	25.26	25.4	28.4		277.2	105	191.1		88.13	84.66	86.4		86.56	84.03	85.3	86
12	Oct		30.91	32.12	31.5		23.58	23.74	23.7	27.6		137.7	82.6	110.2		74.45	81.06	77.8		74.45	74.87	74.7	76

Table 2. Physico-chemical Data of Satyavaram Pond

Months	Average Water Temperature(°C)	Turbidity(NTU)	pH	Coductivity(uMhos.)	Dissolved Oxygen(mg./L)	B.O.D(mg./L)	Carbonate(mg./L)	Bicarbonate(mg/L)	Dissolved solids(mg/L)	Chloride (mg/L)	Flouride (mg/L)	Ammonia(µg/L)	Nitrate(µg/L)	Phosphate(µg/L)	Silicate (µg/L)	Cadmium(µg/L)	Copper(µg/L)	Iron (µg/L)	Nickel(µg/L)	Lead (µg/L)
Jan	23	16.77	7.52	638	6.82	3.77	2.36	158	318	110	0.21	3.12	5.25	2.46	32.85					
Feb	21.5	14.26	7.07	315	4.73	3.15	2.58	205	256	96	0.11	1.56	4.61	1.14	10.23					
Mar	21.2	7.32	7.32	810	6.54	3.56	2.36	210	402	93	0.13	2.18	6.59	2.11	15.64	0.25	3.46	15.62	0.28	0.35
Apr	23.2	12.36	7.71	540	6.58	3.54	4.38	175	276	104	0.05	1.15	5.68	1.26	4.28					
May	23.9	15.46	7.71	983	7.35	3.98	2.31	214	498	782	0.26	2.25	7.65	1.25	22.31					
Jun	27.2	26.72	7.05	683	4.26	3.21	5.24	170	372	574	0.16	2.28	8.65	1.85	32.65					
Jul	29.1	31.11	6.87	615	8.46	5.23	4.12	156	306	115	0.21	9.21	6.28	1.125	38.38					
Aug	28	23.51	6.87	812	5.82	3.42	4.23	201	402	101	0.25	1.85	11.32	2.15	42.35					
Sep	27.2	32.56	7.28	814	6.35	3.26	3.85	165	412	128	0.15	2.18	12.24	2.56	48.35	0.58	4.35	22.34	1.26	2.28
Oct	26.8	19.16	7.02	721	5.18	2.27	3.21	210	354	103	0.12	1.78	10.45	3.56	42.38					
Nov	26.5	11.46	7.02	568	6.56	3.28	1.26	120	284	114	0.08	1.08	7.68	2.85	35.62					
Dec	25.9	10.12	7.13	582	5.35	2.58	1.15	187	289	104	0.09	2.16	5.98	2.68	25.62					

Table 3. Abundance of Phytoplankton in satyavaram pond

		Chlorophyceae														Bacillariophyceae				Cyanophyceae						Euglenophyceae		
S.No.	Months	Volvocales	%	Chlorococcales	%	Ulotricales	%	Oedogoniales	%	Conjugales	%	Chlorophyceae	%	Centrales	%	Pennales	%	Bacillariophyceae	%	Chroococcales	%	Nostocales	%	Cyanophyceae	%	Euglenophyceae	%	GRAND TOTAL
1	Nov	36000	15.32	54000	22.98	14000	5.96	8000	3.4	123000	52.34	235000	56.22	0	0	71000	100	71000	16.99	39000	38.61	62000	61.39	101000	24.16	11000	2.63	418000
2	Dec	49000	15.31	68000	21.25	18000	5.63	9000	2.81	176000	55	320000	55.56	2000	1.85	106000	98.15	108000	18.75	55000	41.04	79000	58.96	134000	23.26	14000	2.43	576000
3	Jan	48000	13.64	75000	21.31	16000	4.55	9000	2.56	204000	57.95	352000	61.32	1000	0.94	105000	99.06	106000	18.47	46000	45.54	55000	54.46	101000	17.6	15000	2.61	574000
4	Feb	49000	14.71	72000	21.62	15000	4.5	7000	2.1	190000	57.06	333000	60.66	2000	2.22	88000	97.78	90000	16.39	45000	40.91	65000	59.09	110000	20.04	16000	2.91	549000
5	Mar	46000	12.85	62000	17.32	24000	6.7	7000	1.96	219000	61.17	358000	63.25	2000	2.7	72000	97.3	74000	13.07	53000	44.92	65000	55.08	118000	20.85	16000	2.83	566000
6	Apr	49000	12.93	80000	21.11	23000	6.07	7000	1.85	220000	58.05	379000	63.7	1000	1.28	77000	98.72	78000	13.11	56000	46.28	65000	53.72	121000	20.34	17000	2.86	595000
7	May	32000	12.12	31000	11.74	12000	4.55	0	0	189000	71.59	264000	63.46	0	0	57000	100	57000	13.7	35000	44.3	44000	55.7	79000	18.99	16000	3.85	416000
8	Jun	27000	9.31	53000	18.28	21000	7.24	6000	2.07	183000	63.1	290000	56.2	1000	1.67	59000	98.33	60000	11.63	56000	39.44	86000	60.56	142000	27.52	24000	4.65	516000
9	Jul	32000	18.29	26000	14.86	4000	2.29	0	0	113000	64.57	175000	63.18	0	0	48000	100	48000	17.33	14000	33.33	28000	66.67	42000	15.16	12000	4.33	277000
10	Aug	32000	10.6	52000	17.22	19000	6.29	4000	1.32	195000	64.57	302000	58.64	0	0	75000	100	75000	14.56	45000	38.79	71000	61.21	116000	22.52	22000	4.27	515000
11	Sep	34000	15.18	36000	16.07	9000	4.02	7000	3.13	138000	61.61	224000	67.47	0	0	60000	100	60000	18.07	8000	25	24000	75	32000	9.64	16000	4.82	332000
12	Oct	32000	12.44	52666	20.47	10667	4.15	10666	4.14	151335	58.81	257334	61.76	667	1.1	60000	98.9	60667	14.56	37332	45.16	45338	54.84	82670	19.84	16000	3.84	416671
										Grand Total		3489334	60.68					887667	15.44					1178670	20.5	195000	3.39	5750671
										Average total		290777.8	60.68					73972.25	15.44					98222.5	20.5	16250	3.39	479222.6

Table.4. Pearson's Correlation Matrix of seasonality of phytoplankton of Satyavaram 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	Volvocales	Chlorococcales	Ulotrichales	Oedogoniales	Conjugales	Chlorophyceae	Centrales	Pennales	Bacillariophyceae	Chroococcales	Nostocales	Cyanophyceae	Euglenophyceae	Total phytoplankton
Atm temp	1																															
Rainfall	**0.64938**	1																														
RH	**0.551444**	**0.796832**	1																													
Water temp	**0.980981**	**0.687805**	**0.578738**	1																												
Turb	**0.702963**	0.290677	0.274659	**0.724797**	1																											
pH	**-0.56838**	**-0.58045**	-0.35302	**-0.64467**	-0.42838	1																										
Conduct	0.28954	0.197563	0.274047	0.212558	0.220964	0.227553	1																									
D.O	0.122176	0.021629	-0.00093	0.08604	0.113565	0.278046	0.30049	1																								
B.O.D	0.119838	-0.18858	-0.27173	0.112657	0.337081	0.099473	0.120359	**0.811697**	1																							
CO3	0.301966	-0.01779	0.165722	0.384729	**0.697146**	-0.14406	0.121436	-0.09969	0.243625	1																						
HCO3	-0.34953	-0.23217	-0.28153	-0.37263	-0.22128	0.168287	0.300185	-0.28651	-0.27124	0.035867	1																					
TDS	0.182275	0.069337	0.143758	0.0907	0.244489	0.232199	**0.946972**	0.160461	0.099292	0.166961	0.43987	1																				
Cl	0.157057	-0.33629	-0.21215	0.016029	0.118169	0.359094	**0.504303**	-0.01608	0.152171	0.155388	0.213391	**0.63431**	1																			
F	0.327369	0.096824	-0.12459	0.256825	0.463993	-0.02313	**0.612026**	0.358106	**0.509195**	0.222784	0.220961	**0.659844**	0.459469	1																		
NH4	0.407939	-0.06679	-0.23051	0.422098	**0.520265**	-0.29676	-0.00212	**0.617717**	**0.782138**	0.239361	-0.2279	-0.07321	-0.05223	0.410956	1																	
NO3	**0.608513**	**0.681055**	**0.771088**	**0.613964**	**0.573255**	-0.35832	**0.598405**	-0.16495	-0.28173	0.381885	0.0712	**0.570954**	0.083185	0.271074	-0.17628	1																
PO4	0.263191	**0.494032**	**0.564427**	0.265311	-0.08027	-0.28432	0.165417	-0.30267	**-0.67141**	-0.32977	-0.13442	0.00735	-0.33683	-0.23339	-0.3491	0.478049	1															
Silicate	**0.812398**	**0.679771**	**0.598022**	**0.803375**	**0.691319**	**-0.57415**	0.394494	0.067653	-0.02312	0.170545	-0.31059	0.291308	-0.06339	0.412975	0.270113	**0.749323**	**0.571799**	1														
Volvo	**-0.79653**	-0.4065	**-0.53068**	**-0.74705**	**-0.68493**	0.41612	**-0.5409**	-0.03753	-0.15257	-0.47816	0.085864	**-0.54927**	**-0.49178**	-0.4989	-0.24568	-0.71196	-0.11241	**-0.68955**	1													
Chloro	**-0.70052**	-0.31706	-0.30669	**-0.6232**	**-0.64844**	0.290573	**-0.58311**	-0.44974	-0.45684	-0.21524	0.043957	**-0.58912**	-0.4201	-0.57404	**-0.53428**	**-0.51525**	0.091139	**-0.59237**	**0.800636**	1												
Ulotri	**-0.58721**	-0.26684	-0.21077	**-0.51518**	**-0.58029**	0.319574	-0.06793	-0.44317	-0.34955	0.028821	0.228491	-0.05681	-0.00976	-0.32346	**-0.59983**	-0.22675	-0.04477	**-0.56943**	0.436269	**0.713685**	1											
Oedogo	-0.29964	0.033213	0.172927	-0.24384	-0.37855	-0.03721	-0.37358	**-0.57935**	**-0.79726**	-0.29653	-0.08937	-0.44088	**-0.52091**	**-0.66559**	**-0.57691**	0.002031	**0.718676**	-0.00759	0.44109	**0.686682**	0.344528	1										
Conju	**-0.7531**	**-0.5003**	-0.48545	**-0.72539**	**-0.52292**	**0.596005**	0.05104	-0.26013	-0.16851	0.048323	**0.538745**	0.127546	0.117953	-0.00195	-0.472	-0.3296	-0.27114	**-0.66724**	**0.529306**	**0.65195**	**0.821851**	0.144053	1									
Chlorophy	**-0.82127**	-0.46204	-0.45466	**-0.76635**	**-0.66038**	**0.516597**	-0.2372	-0.35858	-0.32591	-0.11246	0.357441	-0.19801	-0.14762	-0.30033	-0.55004	-0.45877	-0.11325	**-0.70812**	**0.740389**	**0.880831**	**0.857446**	0.427282	**0.928687**	1								
Centrales	**-0.71707**	**-0.56477**	**-0.64593**	**-0.66443**	**-0.60011**	0.126455	-0.47707	-0.48988	-0.38816	-0.29965	0.372409	-0.39738	-0.24491	-0.49098	-0.26575	**-0.59195**	-0.0461	**-0.64405**	**0.738616**	**0.714629**	**0.577165**	0.487255	**0.562154**	**0.715058**	1							
Pennales	**-0.50635**	-0.13303	-0.43684	-0.47709	**-0.56429**	0.205133	-0.44956	-0.28072	-0.36221	**-0.52508**	0.002249	-0.47652	-0.39219	-0.26814	-0.35454	**-0.49903**	0.175804	-0.3369	**0.805973**	**0.797174**	0.441852	**0.552513**	0.474148	**0.686874**	**0.621582**	1						
Bacillario	**-0.52366**	-0.15405	-0.45297	**-0.49292**	**-0.57487**	0.204967	-0.45795	-0.29436	-0.36913	**-0.5236**	0.018487	-0.48067	-0.39201	-0.28218	-0.35632	**-0.51107**	0.1689	-0.35573	**0.815901**	**0.806296**	0.454834	**0.558484**	0.485575	**0.699081**	**0.648075**	**0.999412**	1					
Chroooco	**-0.53052**	-0.342	-0.34059	**-0.49431**	**-0.69517**	0.257229	-0.2498	**-0.52152**	-0.41868	-0.13657	0.253444	-0.23906	0.050776	-0.33334	**-0.53179**	-0.42982	-0.00448	**-0.60412**	0.458909	**0.775231**	**0.886835**	0.387964	**0.745259**	**0.824724**	**0.656464**	**0.555554**	**0.568846**	1				
Nosto	-0.2969	-0.13143	-0.24278	-0.24659	**-0.50403**	-0.03848	-0.29482	**-0.65056**	-0.43776	-0.06623	0.115955	-0.25907	0.064021	-0.29631	**-0.49738**	-0.27814	0.013018	-0.41361	0.278933	**0.643131**	**0.826389**	0.32785	**0.554471**	**0.641937**	**0.567026**	**0.498263**	**0.509233**	**0.919144**	1			
Cyanophy	-0.41096	-0.23142	-0.29298	-0.36613	**-0.60274**	0.097335	-0.28011	**-0.60438**	-0.43799	-0.1001	0.181867	-0.25518	0.059225	-0.31954	**-0.52355**	-0.35396	0.005204	**-0.51016**	0.36784	**0.717443**	**0.871383**	0.362393	**0.654064**	**0.739641**	**0.620057**	**0.535022**	**0.547291**	**0.975483**	**0.983301**	1		
Eugleno	0.041861	-0.03852	0.002976	0.087553	0.279198	-0.05454	0.253901	**-0.5773**	-0.23161	**0.676369**	0.383967	0.374911	0.367866	0.273413	-0.30999	0.390764	-0.12296	0.029317	-0.33106	0.093989	**0.504838**	-0.04967	**0.490281**	0.31276	0.047311	-0.11368	-0.10845	0.388073	0.487479	0.451625	1	
Total	**-0.70869**	-0.37539	-0.44391	-0.65476	**-0.6776**	0.369906	-0.30438	-0.47993	-0.40836	-0.17007	0.28534	-0.27323	-0.12582	-0.32157	**-0.56796**	-0.46318	-0.03831	**-0.64443**	**0.690323**	**0.899132**	**0.885764**	0.467924	**0.862129**	**0.964345**	**0.73994**	**0.754078**	**0.765506**	**0.917004**	**0.80496**	**0.873349**	0.34499	1

Fig.1 Seasonal distribution of phytoplankton in Satyavaram pond: Different families in the order volvocales

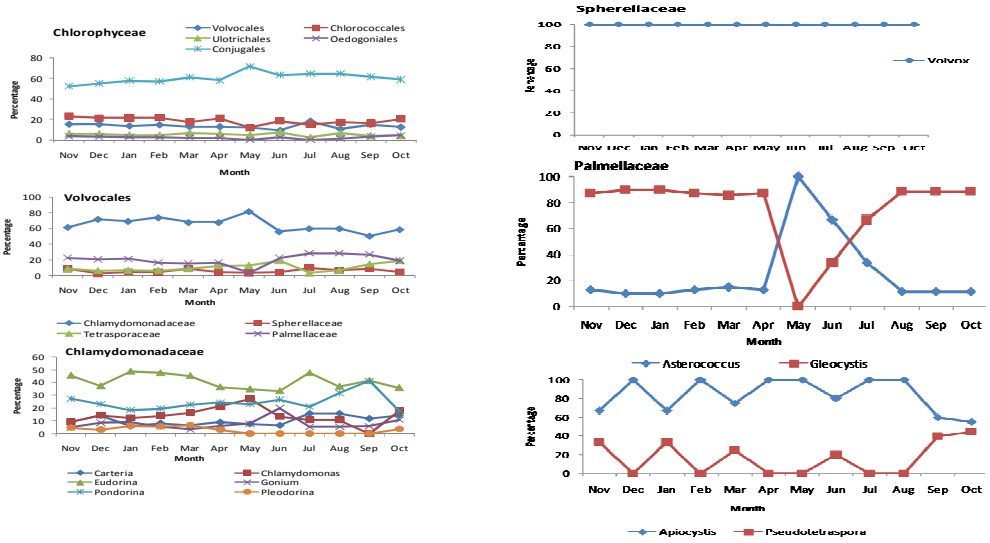

Fig 2. Seasonal distribution of phytoplankton in Satyavaram pond: Different families in the order Chlorococcales

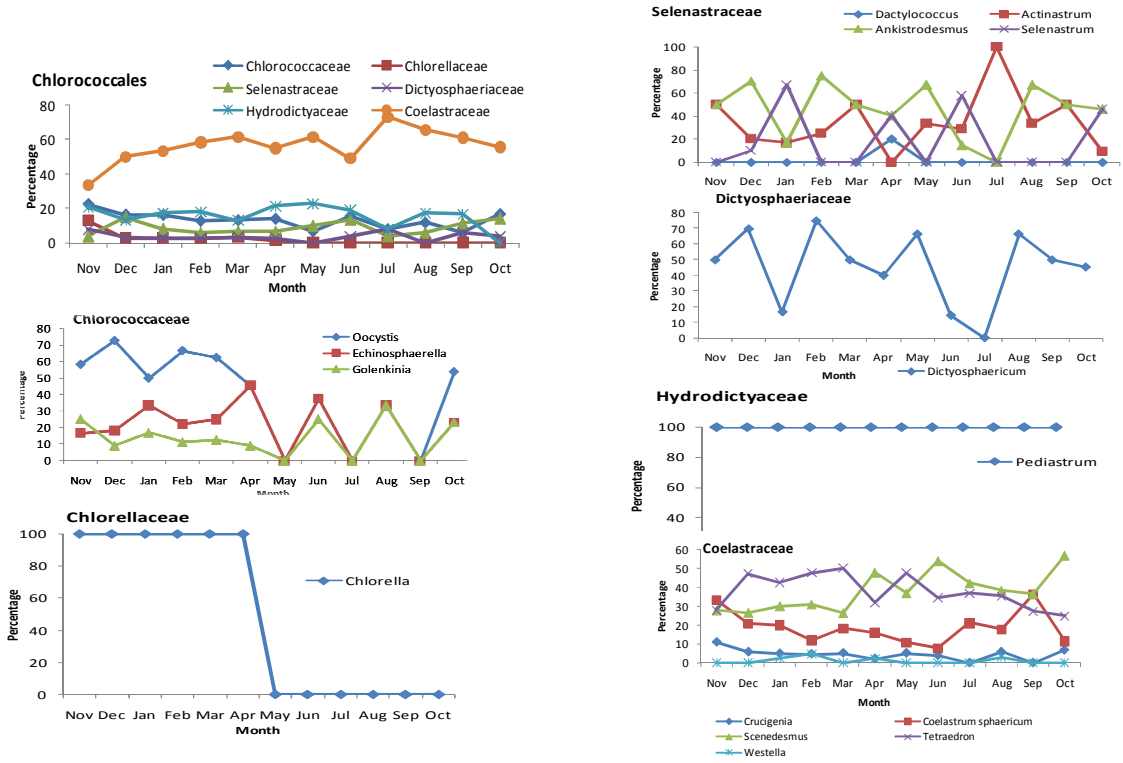

Fig 3. Seasonal distribution of phytoplankton in Satyavaram Pond: Different families in the order Ulotrichales and Oedogoniales

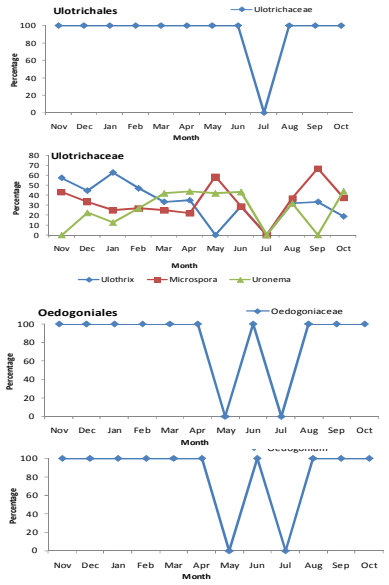

Fig.4. Seasonal distribution of phytoplankton in Satyavaram Pond : Different families in the order Conjugales

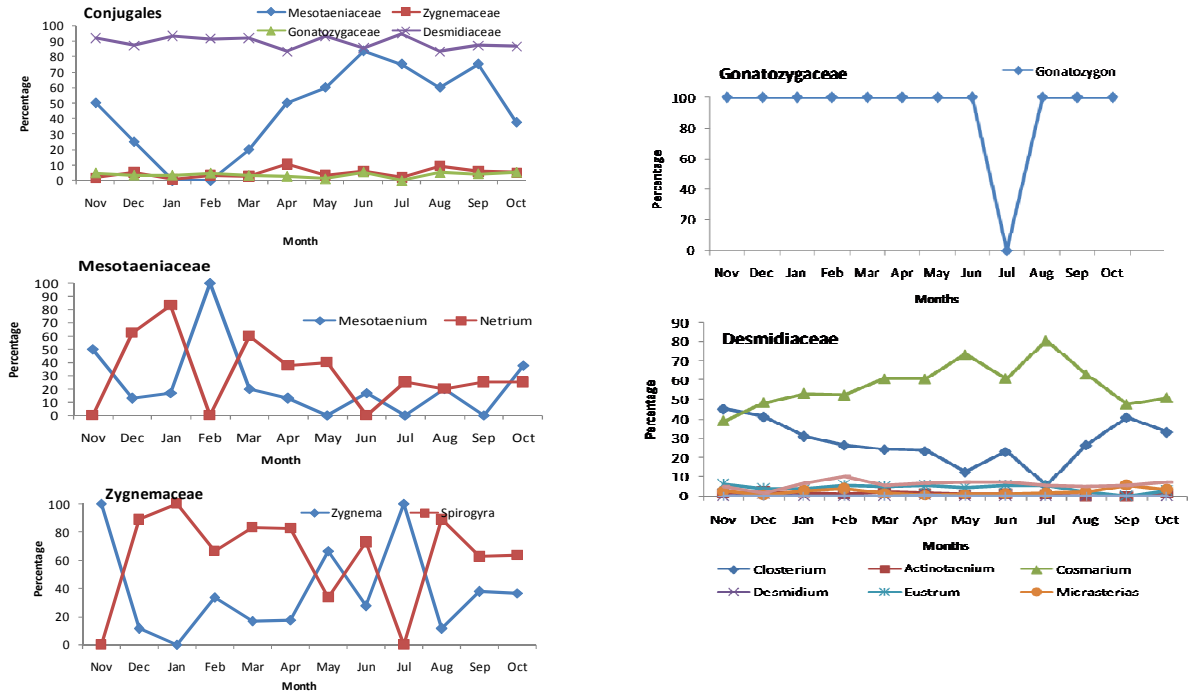

Fig 5. Seasonal distribution of phytoplankton in Satyavaram Pond : Different families in the orders Centrales

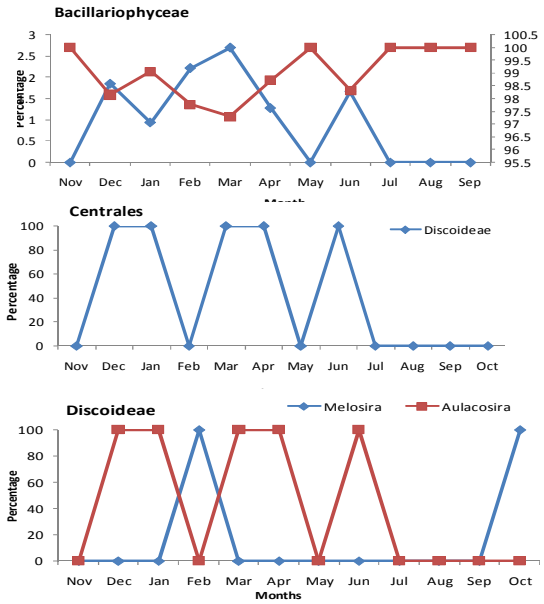

Fig 6. Seasonal distribution of phytoplankton in Satyavaram Pond : Different families in the order Pennales

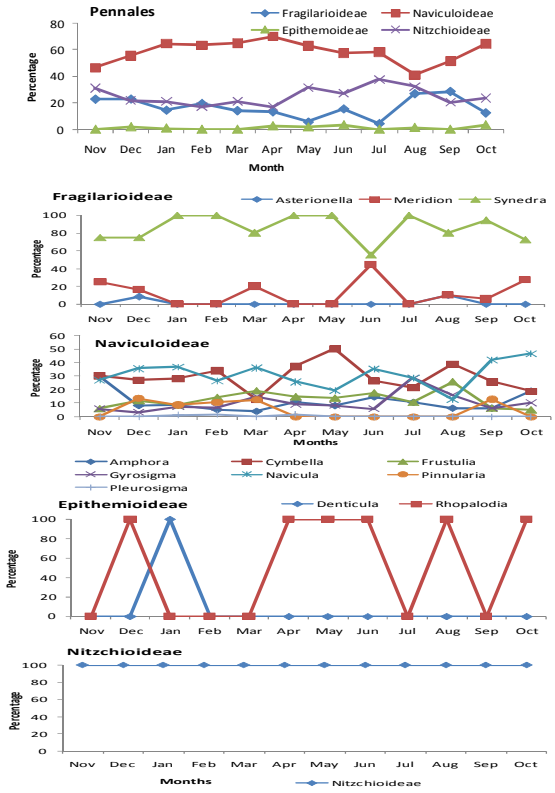

Fig. 7.Seasonal distribution of phytoplankton in Satyavaram Pond : Different families in the order Chroococcales

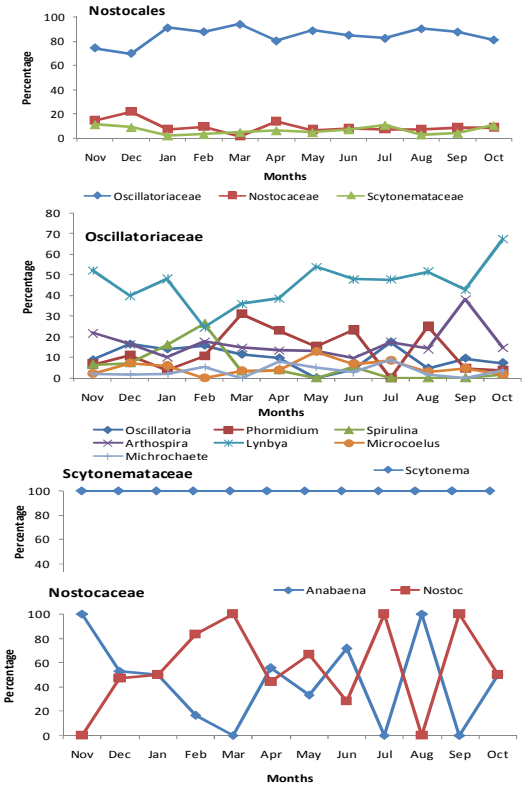

Fig. 8. Seasonal distribution of phytoplankton in Satyavararam Pond : Different families in the order Nostocales

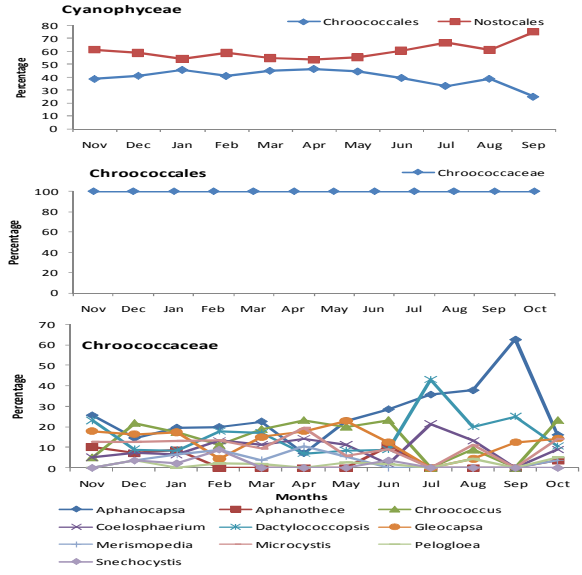

Fig.9. Seasonal distribution of phytoplankton in Satyavaram Pond : Different families in the class Euglenophyceae