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

Freshwater algae of Laknavaram Lake from Warangal District, Telengana State, India

L.Dup Singh,N.Ella Swamy, B.Kumara Swamy and B.Digamber Rao
Department of Botany,Kakatiya University,Warangal, Telangana State,India-506 009, Mail:*bdr_kuc@yahoo.co.i*

ABSTRACT

The Laknavaram Lake of Warangal District ,Telangana State is an important Eco-tourist place,.,with beautiful rocky hills built by the mighty Kakatiya kings,during the period of 12th century and these water bodies are surrounded by thick forest with rocky hills. The lake Laknavaram is the main source of irrigation and drinking water and it was constructed by Sri Ganapathy Rudradeva of Kakatiya dynasty in the year 1213AD.The lake water body being used for agriculture,drinking and other recreational purposes (swimming,bathing,fishing and boating),an attempt has been made in the study to correlate the periodicity of phytoplanktons in the lake with physic-chemical parameters of the water body under study. The lake under study are important component of water body exposed to varying degrees of cultural eutrophication to some extent and are therefore regarded as more suitable production studies in the scheme of its reclamation. Since the study was undertaken over a period of two years(Sept.2010-Aug.2012) and the changes in chemical composition of water and algal populations were recorded at regular intervals, it may be presumed that the data gives a reasonably accurate basis for the interpretation of the distribution and periodicity of phytoplankton of the waters. In view of this the present study was undertaken to elucidate certain aspects of phytoplanktons of selected lake of Warangal district(Telangana State) with regard to its water quality.

INTRODUCTION

Algae are a large and diverse group of simple, typically autotrophic organisms, ranging from unicellular to multicellular forms . In aquatic ecosystems phytoplankton play an important role in the ecology of water bodies through primary production. Studies on planktonic composition and physico-chemical characteristics of water are necessary to acquire basic knowledge on the biodiversity status of a water body. Algal flora varies from season to season and an important feature of freshwater algal flora is its cosmopolitanism. The phytoplanktonic study is a very useful tool for the assessment of water quality in any type of water quality in any type of water body and also contributes to understanding of the basic nature of lakes (Pawar et al.2006). The necessity of using phytoplankton as effective and appropriate method of biomonitoring for evaluation of water quality has been emphasized (Annalakshmi and Amsath,2012). Considerable work has been done in India about systematic survey ,distribution ,periodicity and ecology of algae in different habitats(Das *et al*., 2009,Adhikary *et al*.2010,Das *et al*.,2010, Bhakta *et al*.,2010, Das and Adhikary, 2012a,b&c and Kumaraswamy *et al*.2013). Recently Mahajan (2005), Jayakumar and Karpaganu (2005), Sanap *et al.*, (2006), Shoba *et al.*, (2006), Harsha Sadanand *et al., (*2006) Mruthunjaya and Rajendra Prasad (2006), Mallishwar *et al.*, 2007, Gupta and Anuj Bhadauriya 2007, Roy Zacharias and Joy (2007), Maya Subramoni, 2007, Kavitha and Rajini Balasingh (2007), Mruthyunjaya *et al.*, 2007. Reshma and Prakasam (2007), Girija Kumari and Abraham (2007), Sanap *et al*., (2008), Mista *et al*,(2008). Murugesan and Shivasubramanian, (2008), Aarti Narsimhan *et al*.(2008), Mista *et al.*, (2009), Latha and Ramachandra Mohan (2010), Leela *et al.*, (2010), Ramadosu and Sivakumar (2010) and Chinnaiah et al.,(2011) studied on various fresh water bodies and described about physico-chemical characteristics along with algal population studies.Hence, the present study was undertaken to know the influence of physic-chemical parameters of water on algal populations and their seasonal changes of Laknavaram lake.

MATERIAL AND METHODS

The water samples collected from the lake in bottles were brought to the laboratory for analysis as per the standard methods described by APHA(1985) and Trivedy and Goel(1986). Four sampling sites were identified almost equidistant on the shore of the lakes to its north, east, west and south.The phytoplanktonic forms were collected by plankton net No. 20 silk bolting cloth. Sometimes samples for quantitative and qualitative analysis of phytoplankton was collected in 1 litre capacity. Pyrex glass bottles where 1ml of Lugol's solution was kept prior to the filling of the bottle by lakes water from below the surface. For sedimentation

of plankton material the bottle was kept undisturbed in the dark for 48 hrs at room temperature. After that the overlying water from the bottle was decanted and the final volume was adjusted in between 10 to 15m1. The latter method was usually used to compare whether there was any demerit of using the other method. No significant difference was observed. After collection the phytoplankton material was transferred to glass preserved permanently in Transeau's solution (Distilled water60m1 or 6 parts**;** Absolute alcohol 30m1 or 3 parts**;** Formaldehyde 10 ml or 1 part**.** To each l00 ml of the above solution 5m1 of glycerine was added to prevent the materials from becoming brittle (Transeau, 1951).

Mounting Fluid:

Ten percent glycerine solution in distilled water was used as mounting fluid for the preparation of temporary and semi permanent slides for microscopic study. Cotton blue and Lacto- phenol were used as mounting fluid and as stain, which facilitated a clean view of the materials under the microscope.

Phytoplanktons were identified by using standard key books (Patrick and Reimer, 1966, Suxena and Venkateshwarlu, 1968; Philipose, 1967, Desikachary, 1959; Prescott, 1951 and Smith, 1933).

Phytoplankton analysis:

The qualitative enumeration of the phytoplankton were carried out with the help of a Sedgwick Rafter counting cell and by drop method.

The counting cell was filled with water to test for any leakage and it was emptied and dried properly. The vials containing the concentrate were shaken properly and 1ml of concentrated sample taken in to the Sedgwick Rafter counting cell. Numerical counts of all members of phytoplanktons were made using the Whipple micrometer. The organisms thus counted, were expressed as units/liter (units/l) of the sample. Seasonal variation and abundance of the dominant algal genera and the groups of phytoplankton were noted.

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

$$N = \frac{(a \times l00)C}{L}$$

N = Number of phytoplanktons per liter 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/liter

RESULT AND DISCUSSIONS

The water temperature varied from 23°C to 31°C. Turbidity of the water ranged from 0.03 to 8.00 NTU, conductivity annual average value varied from 0.74 to 0.89 milli mhos/cm in 2010-2011 and from 0.46 to 0.62 m mhos/cm in 2011-2012. Transparency of water ranged from 18 to 133 cm, TDS from 160.00 to 680.00 mg/l, TSS varied from 160.40 to 580.80 mg/l. The bottom substrata of the lake was of sandy loamy in nature.The pH values varied from 7.0 to 8.4 in two years of study period, while the DO values ranged from 6.5mg/l to 10.0 mg/l. In Primary productivity the GPP values ranged from 0.0045 to 3.6105 mg c/hr/l,

the NPP varied from 0000 to 3.56 185 mg c/hr/l and $Resp^N$ ranged from 0000 to 2.7445 mg c/hr/l. The oxidation-reduction potential (E_h) was shown variation between 0.211 to 0.372, Oxidation-reduction index values ranged from 24.80 to 2745. The Biochemical oxygen demand fluctuated between 3.0 to 21.0 mg/l and the Chemical oxygen demand varied from 0.32 to 0.95mg/l respectively. Silicates, free CO_2. Phosphates, Total Hardness and Chloride, values ranged from 0.0002 to 0.0084mg/l; 4.00 to 47.00 mg/l; 0.04 to 0.82 mg/l; 110 to 330 mg/l and 10.0 to 125.0 mg/l. In total alkalinity the OH alkalinity was recorded only in four months during the period of study and its values varied from 10 to 60mg/l, the phenolphthalein alkalinity ranged from 20 to 300 mg/l and the alkalinity varied from 10 to 260 mg/l. No trace of nitrate, nitrite and ammonia were observed. The monthly analysis of Chromium, Cadmium, Cobalt, Lead, Mercury and Zinc were undertaken and no trace of heavy metals could be detected in the present investigation.

The algal members comprised of 63 genera of which 14 belonged to Bacillariophyceae, 27 to Chlorophyceae, 17 to Cyanophyceae and 5 to Euglenophyceae (**Table-1**). Highest number of individual was represented by green algae (452782) followed by blue- green algae (405130), diatoms (1113908) and the members of Euglenophyceae (32167). A total of 76 forms of phytoplanktons were recorded. The total percentage of phytoplankton community were 78.15% and 21.85% are others. The seasonal abundance of the Laknavaram lake have shown the two most prominent blue greens,*Gloeotrichia natans, Lyngbya majuscule,* two diatoms, *Bacillaria paradosa, Pinnularia viridis.* and green alga, *Pithophora varia*. The compound index of Nygaard algal indices have shown the results in which they varied from 1.4 to 5.8 with the average value of 3.67 under investigation.

Seasonal abundance of the prominent phytoplanktons of Lakhnavaram lake has also been studied in which the two most prominent blue green algae *Gloeotrichia natans*, *Lyngbya majuscule* two important diatoms,*Pinnularia viridis, Bacillaria paradosa.* and green-alga *Pithiphora varia* in the year 2010-2011. Of the two most prominent Cyanophyceae members *G.natans* was found to be dominant in March 8.0 units 1^{-1} X $l0^4$ and minimum in January 2.0 units 1^{-1} X $l0^4$. *Lyngbya majuscule* has been shown to be dominant in February 5.4 units 1^{-1} X $l0^4$ and lowest in October 0.2 units 1^{-1} X $l0^4$. The Bacillariophyceae members of *Bacillaria paradosa,* was observed more dominantly in the month of March 8.0 units 1^{-1} X $l0^4$ and the lowest in the month of September 1.0 units 1^{-1} X $l0^4$. *P.viridis,* was maximum in March 7.2 units 1^{-1} X $l0^4$, with minimum in September 3.2 units 1^{-1} X $l0^4$. The green algae,*Pithiphora varia* was the only genus observed most dominantly in July 4.9 units 1^{-1} X $l0^4$ and least in 0.4 units 1^{-1} X $l0^4$ in the month of October under study.During the observation period between September 20011 - August 2012, the seasonal abundance of most prominent phytoplanktons were exhibited with two members of Cyanophyceae (*Gloeotrichia natans* and *Lyngbya majuscule*), two members of diatoms (*Bacillaria paradosa*, and *Pinnularia viridis*,) and one genus of *Chlorophyceae* member, *Pithophora varia*. *Gloeotrichia natans* was maximum in March 6.4 units 1^{-1} X $l0^4$ and minimum in August 1.8 units 1^{-1} X $l0^4$,*Lyngbya majuscule* was observed dominantly in the month of February 6.0 units 1^{-1} X $l0^4$ and lowest in August 0.8 units 1^{-1} X $l0^4$. The diatom member *Bacillaria paradosa.,* was found to be maximum in March, 9.8 units 1^{-1} X $l0^4$ and minimum in August 1.9 units 1^{-1} X $l0^4$, *Pinnularia viridis* was found more in March 7.8 units 1^{-1} X $l0^4$ and less in August 1.9 units 1^{-1} X $l0^4$. Of the one prominent green alga available *Pithophora varia* was found maximum in August 5.0 units 1^{-1} X $l0^4$ and minimum in April 0.5 units 1^{-1} X $l0^4$. All the members of Cyanophyceae, Bacillariophyceae and Chlorophyceae were found in almost all the seasons and in every month of 2011-2012. The phytoplankton populations of the lake varied with the seasonal variations and the maximum phytoplankton production coincided with the optimum water depth of one meter under study.

Table-1, Phytoplankton species found in the Laknavaram Lake

Sl. No.	**BACILLARIOPHYCEAE (14 forms)** **14 genera**
1)	*Actinastrum sp.*
2)	*Amphora sp.*
3)	*Bacillaria paradosa*
4)	*Cocconeis sp.*
5)	*Diatoma sp.*
6)	*Gomphonema gracile*
7)	*Gyrosigma sp.*
8)	*Navicula exigna*
9)	*Nitzchia sp.*
10)	*Pinnularia viridis*
11)	*Tabellaria sp.*
12)	*Gyrosigma scalproides*
13)	*Neidium gracile*

14)	*Diadesmis confervacea*
	EUGLENOPHYCEAE(5 forms) **5 genera**
15)	*Euglena caudata*
16)	*Phacus sp.*
17)	*Trachelomonas curta*
18)	*Menoidium sp.*
19)	*Lepocinalis fusiformis*
	CYANOPHYCEAE (19 forms) **17 genera**
20)	*Anabaena iyengarii*
21)	*Anabaenopsis sp.*
22)	*Aphanocapsa litorales*
23)	*Arthrospira sp.*
24)	*Chroococcus minutus*
25)	*Gloeocapsa atrata*
26)	*Gloeotrichia natans*
27)	*Hydrococcus sp.*
28)	*Microcystis aeruginosa*
29)	*Nostoc sphaerium*
30)	*Oscillatoria formosa*
31)	*O. tenuis*
32)	*O. rubescens*
33)	*Phormidium molle*
34)	*Synechococcus sp.*
35)	*Trichodesmium sp.*
36)	*Lyngbya ceylanica*
37)	*Planktothrix compressa*
38)	*Homoeothrix janthiana*
.	**CHLOROPHYCEAE (38 forms)** **27 genera**
39)	*Ankistrodesmus falcatus*
40)	*Bulbochaete sp.*

41)	*Chara vulgaris*
42)	*Chlorella vulgaris*
43)	*Closterium tumidum*
44)	*Cl. porrectum*
45)	*Cladophora glomarata*
46)	*Cl. crispata*
47)	*Cosmarium botrytis*
48)	*C. auriculatum*
49)	*C. granatum*
50)	*Euastrum verrucosum*
51)	*Microspora sp.*
52)	*Mougeotia sp.*
53)	*Oedogonium borisianum*
54)	*O. grande*
55)	*Oocystis gigas*
56)	*Pediastrum duplex*
57)	*Pithophora varia*
58)	*Protococcus sp.*
59)	*Rhizoclonium hieroglyphicum*
60)	*Scenedesmus denticulatus*
61)	*S. quadricauda*
62)	*S. dimorphus*
63)	*S. obliquus*
64)	*Spirogyra acanthospora*
65)	*S. discoidea*
66)	*S. formosa*
67)	*Stigeoclonium tenue*
68)	*Staurastrum pinnatum*
69)	*Tetraedron quadratum*
70)	*Ulothrix sp.*
71)	*Zygnema czurde*
72)	*Z. areolatum*
73)	*Zygnemopsis sp.*
74)	*Radiococcus nimbatus*
75)	*Characium ambiguum*
76)	*Anthrodesmus curvatus*

BACILLARIOPHYCEAE:

Among the recorded 14 genera with 14 forms of diatoms only a few (*Actinastrum sp., Amphora sp.,Bacillaria paradosa,Cocconeis sp., Diatoma sp.,Diadesmus confervacea, Gomphonema gracile., Gyrosigma sp., Gyrosigma scalproides, Navicula exigna, Neidium gracile,Nitzchia sp.,Pinnularia viridis, Tabellaria sp.*) was found to be well adapted to the concerned habitats of the lake. Throughout the period of study the water body of the have showed the highest abundance of diatom (1113908 cells/l) under investigation. Among the recorded genus of diatom species diversity was exhibited by the genus *Gyrosigma sp*.,(2 sps.) respectively. (Table-1).

CHLOROPHYCEAE:

The generic diversity of Chlorophycean members were maximum with 27 genera with 38 forms during the period of study in the lake under investigations(**Table-1)**. Such as *Ankistrodesmus falcatus, Anthrodesmus curvatus,Bulbochaete sp.,Chara vulgaris, Chlorella vulgaris, Characium ambiguum,Closterium tumidum,Cl.porrectum,Cladophora glomarata, Cl. crispata, Cosmarium botrytis,C.auriculatum,C.granatum, Euastrum verrucosum,Microspora sp., Mougeotia sp., Oedogonium borisianum,O.grande, Oocystis gigas, Pediastrum duplex, Pithophora varia,Protococcus sp., Radiococcus nimbatus,Rhizoclonium hieroglyphicum, Scenedesmus denticulatus,S.quadricauda, S. dimorphus, S. obliquus, Spirogyra acanthospora,S.discoidea, S. formosa, Stigeoclonium tenue,Staurastrum pinnatum, Tetraedron quadratum, Ulothrix sp., Zygnema czurde,Z.areolatum, and Zygnemopsis sp.,* were recorded as the major dominant genus in the sampling lake under investigation.. Throughout the period of study the water body have shown the highest recorded abundance (452782 cells/l) of green algae, *Scenedesmus* was the genus which exhibited the maximum (4 species) diversity followed by , *Spirogyra* (3 species),*Cosmerium sp*.(3) *Closterium* (2 species) and *Oedogonium*, *Pediastrum*,*Tetraedron* and *Zygnema*(2 species) respectively. Throughout the sampling period peaks of green algae were recorded in monsoon months and lower abundance in summer months.

CYANOPHYCEAE:

Throughout the period of study sharp peaks of Cyanophycean members were exhibited in summer months and they exhibited with 17 genera with 19 forms only a few of them were found to be the dominant in the sample lake, these are *Anabaena iyengarii,,Anabaenopsis sp., Aphanocapsa littorales, Arthrospira sp.,Chroococcus minutes, Gloeocapsa atrata, Gloeotrichia natans,Hydrococcus sp., Microcystis aeruginosa, Nostoc sphaerium, Oscillatoria formosa, O.tenuis,O.rubescens, Phormidium molle, Synechococcus sp., Trichodesmium sp., and Lyngbya ceylanica*,*Planktothrix compressa* and *Homoeothrix janthiana*, respectively. Blooms of cyanophycean algae were recorded during the summer season.The blooms of *Microcysties aeruginosa* and *Lyngbya ceylanica* were reported from Laknavaram lake. During the period of study the lake was expressed with higher abundance of blue-green algae under observation (405130 cells/l).Among the observed members of Cyanophyceae maximum species diversity was exhibited by the *Oscillatoria* (3 species) only.

EUGLENOPHYCEAE:

The recorded 5 genera with 5 forms in Euglenophyceae (*Euglena caudata, Phacus sp,Lepocinclis fusiformis,Menoidium sp. and Trachelomonas curta*) were found to be well adapted to the concerned habitats under study. The Laknavaram lake was showed abundance of Euglenoides (32167 cells/l)with large peaks of Euglenoid population were reported in winter months, while small peaks were found in summer months. No species diversity was found the Euglenoids under study.

The average percentage of algae during the period of Sep. 2010-Aug 2012:

In the lake of Laknavaram, the phytoplankton community represents the presence of 30.49% of Bacillariophyceae, 42.59% of Chlorophyceae, 24.27% of Cyanophyceae and 2.65% of Euglenophyceae. The Chlorophyceae members were dominant over other members.

REFERENCES

Aarti Narasimhan Sumathi P and **Sivasubramanian, V . 2008**. Algal treatment (phycoremediation) to improve water quality. ***Indian Hydrobiology***.**11**(1):173-184.

Adhikary S P, Das S K , Khilar D and **Samad L K.2010**.Algal Flora of Mizoram,India.***J.Indian Bot.Soc***..89**(3&4):415-423.

Annalakshmi G and **Amsath A**.**2012** .Studies on the hydrobiology of river Cauvery and its tributaries Arasalar from Kumbakonam region with reference to phytoplankton.**IJPAES**,**2**(2)pp 37-46.

APHA. 1995. *American Public Health Association. Standard methods for the examination of water and waste water*, 19th edition, Washington.

Bhakta Das S K and **Adhikary S P**.**2010**. Freshwater algae of Sikkim. ***J.Indian.Bot.Soc***. **89** (1&2:169-184.

Chinnaiah B Ramesh Babu M and **B.Digamber Rao**.**2011**.Phycoplankton diversity and population dynamics of Ramappa Lake,(A.P) ***India.Ad.Plant.Sci***.**24**(II):527-529.

Das S K and **Adhikary S.P**.2012.Algal diversity in the reservoirs of Odisha state,India.***Indian Hydrobiology***,**15**(1):17-41.

Das S K, Samad,L K, Ramanujam,P and **Adhikary,S.P**. 2009.***J.Indian Bot.Soc***. **88**(1&2):102-118.

Das S.K. and **Adhikary,S.P**.**2012**.Diversity of Freshwater algae in Arunachal Pradesh and their distribution in different altitudes.***J.Indian.Bot.Soc***.**91**(1-3):160-182.

Das S K.and **Adhikary S P**.2012.Freshwater algae of Nagaland.**J.*Indian.Bot.Soc*..91**(1-3): 99-123.

Das S K, Bhakta S and **Adhikary S P**. **2010**. Algal of Tripura.***J.Indian Bot.Soc***.89**(3&4):334-357.

Desikachary T V. **1959**. ***Cyanophyta,*** ICAR, Monographs on Algae. New Delhi, 686.

Girijakumari S and **Nelson P Abraham.2007**. Composition and distribution of phytoplankton in Sasthakotta Lake, Kollam , Kerala. ***Indian Hydrobiology***.**10**(2):377-380.

Gupta R K and **Anuj Bhadauriya. 2007**. Phytoplankton (BGA) Diversity in relation to physico-chemical properties of river water.***Indian Hydrobiology***.**10**(1):117-122.

Harsha Sadanand T S, Yamakanamardi M and **Mahadevaswamy M**.**2006**. Physico- chemical (Environmental) study of Lotic ecosystem of main river cauvery and its four down stream tributaries in Karnataka state, India. ***Indian Hydrobiology*** . **9**(2):269-294.

Jayakumar S and **Karpagam S**. **2005**. Factors affecting productivity of Phytoplankton in a reservoir of Cuddalore district , Tamilnadu. ***Indian Hydrobiology.*** **8** (2):187-192.

Kumaraswamy B , Dup Singh L, Ramesh Babu M and **Digamber Rao B.2013**.Study of Algae from Freshwater reservoirs of Warangal(A.P),India.***Nature Environment and Pollution Technology***.**12**(4):577-584.

Leela Bhosale J , Patil S M , Sureka Dumal N and **Anjaiah Sabale B.2010**. Occurrence of Phytoplankton in the Lakes in and around Kolhapur city (Maharashtra*).* ***Indian Hydrobiology*** . **12**(2):133-142.

Mahajan S K. **2005**. Algal flora of a recently constructed dam on river Dalki in West Nirmal district of M.P ***Indian Hydrobiology.*****8(2):113-116.**

Malliswar V N S , Krupanidhi D S and **Chandra S. 2007**.Algal biodiversity in a man made water body. ***Indian Hydrobiology***. **10**(1): 87-91.

Maya Subramoni.**2007**.A study on the algal diversity of Vamanapuram river of south Kerala, in relation to certain water quality parameters. ***Indian Hydrobiology***.**10**(1):157-163.

Mista P K Madhulika Shukla and **Jai Prakash. 2008**. Some fresh water algae from Eastern Uttar Pradesh. ***Indian Hydrobiology*** . **11**(1): 121-132.

Mruthunjaya T B , Mruthunjaya T B, Hosmoni S P, Rajendraprasd N R and **Sudeep B M** .**2007**.Diversity and distribution pattern of Chlorococcales with respect to physico-chemical charecteristics of three water bodies, ***Indian Hydrobiology***.**10**(2):293-300.

Murugesan S and **Sivasubramanian V**.**2008**. Fresh water diatoms from porur lake Chennai, ***Indian Hydrobiology.*** **11**(1):149-154.

Patrick R. **1961**. A study of the number and kinds of species found in rivers in Eastern United States ***Proc.Acad.Nat.Sci****.Philadelphia.* **113**: 215-258.

Philipose M T.1967.***Chlorococcales***,ICAR,New Delhi,365pp.

Prescott G W. 1951. ***Algae of the Western Great Lakes Area***. Pub. Otto Koeltz Science Publisher Michigan University . 1-977.

Ramadosu A and **Siva Kumar K**.**2010**. Seasonal variation of phytoplankton in relation to physico-chemical characteristics at perumal lake, Tamilnadu. ***Indian Hydrobiology***. **12**(2):149-158.

Reshma S and **Prakasam V R. 2007**. Potential of ponds as source of drinking water in Mayyanad panchayat, Kerala. ***Indian Hydrobiology***.**10**(2):319-323.

Sanap R R , Mohite A K, Pingle S D and **Gunale V R** .**2006**.Water quality assessment of Godavari river at Nasik (M.S)India with special reference to Phytoplankton study. ***Indian Hydrobiology***. **9** (2) :187-191.

Sanap R R, Pingle S B , Gunale V R and **Mohite A K.2008**. Chlorophyceae from Godavari river at Nasik (M.S), India. ***Indian Hydrobiology*** . **11**(1):91-97.

Shoba V, Anuradha Rammohan Santhosh S and **Chandrathara J**.**2006**.Impact assessment of retting activity on Phytoplankton productivity of Kadinamkulam lake, Southern Kerala ***Indian Hydrobiology***.**9**(2):239-246.

Smith G 1950.***The Freshwater algae of the United States***.Mc.Graw Hill Book Co.,New York.

Suxena M R and **Venkateshwarlu V**. **1968**. Desmids of Andhra Pradesh IV from Dharmasagar Lakes, Warangal II J. Osmania University (Science) Golden Jubilee Special. 179-201.

Trivedy R K and **Goel P K 1986.** Chemical and Biological Methods for Water Pollution Studies. Envir media publications. Karad,Maharashtra.,1-248.

Welch E B. **1948**. ***Limnological methods***. Blakiston philadelphia. USA. 381.