



SYSTEMATIC ACCOUNT OF *SCENEDESMUS* MEYEN (CHLOROPHYCEAE, CHLOROCOCCALES) FROM THE KOL WETLANDS OF THRISSUR, KERALA

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The present paper deals with the systematic account of *Scenedesmus* Meyen from the Kol wetlands of Thrissur district, part of Vembanad Kol, a Ramsar site of Kerala. The surface water samples were collected monthly from ten stations during February 2005 to January 2006. Sixteen taxa of *Scenedesmus* have been collected and are described with their distribution in India. *S. acutiformis* Schroeder, *S. quadricauda* (Turpin) Brebisson var. *bicaudatus* Hansgirg and *S. quadricauda* (Turpin) Brebisson var. *longispina* (Chodat) G.M. Smith are new reports to Kerala. Eight taxa namely, *S. acutiformis* Schroeder, *S. bernardii* G.M. Smith, *S. bijugatus* (Turpin) Kuetzing, *S. bijugatus* (Turpin) Kuetzing forma *parvus* (G.M. Smith) Philipose, *S. obliquus* (Turpin) Kuetzing, *S. opoliensis* P. Richter var. *mononensis* Chodat, *S. quadricauda* (Turpin) Brebisson var. *bicaudatus* Hansgirg and *S. quadricauda* (Turpin) Brebisson var. *longispina* (Chodat) G.M. Smith are new reports to Thrissur district, Kerala.

Key words: Chlorococcales, Chlorophyceae, Kerala *Scenedesmus*, Thrissur kol

The present paper deals with the Genus *Scenedesmus* Meyen found in the Kol wetlands of Thrissur district, Kerala. The Thrissur Kol wetlands are distributed in Mukundapuram, Chavakkad and Thrissur taluks of Thrissur district, lies between 10° 20' to 10° 40' North latitudes and 75° 58' to 76° 11' East longitudes (Johnkutty and Venugopal 1993). The Kol wetlands are part of the Vembanad-Kol, a declared Ramsar site of Kerala.

Earlier, Philipose (1967) reported thirty one species of *Scenedesmus* from different parts of India. Jose and Patel (1992) reported ten taxa of *Scenedesmus* from south Kerala. Cherian (2006) reported fourteen taxa of *Scenedesmus* from Thrikkakara, Kerala. Seventeen taxa of *Scenedesmus* were reported by Jose and Francis (2007) from Thodupuzha taluk, Kerala. Recently Arulmurugan *et al.* (2010) reported eight taxa of *Scenedesmus* from the temple tanks of Palakkad and Thrissur districts of Kerala.

Rawla and Rattan (1989) reported twenty two taxa of *Scenedesmus* from different parts of

Punjab, Himachal Pradesh and Chandigarh. From Allahabad, Chadha and Pandey (1977) described seventeen forms of *Scenedesmus*. Kant and Anand (1978) described seventeen taxa of *Scenedesmus* from Jammu.

Andhale and Papdiwal (2010), Ashtekar and Kamat (1980), Jena and Adhikary (2007), Deshmukh and Gunale (2007), Habib (1996), Habib and Chaturvedi (2001), Jha *et al.*, (1985), Kant and Gupta (1998), Pandey and Gangwar (1986), Patel *et al.* (1980), Sarma *et al.* (1983), Singh and Saha (1982), Shukla *et al.* (2007) and Tiwari *et al.* (2001) studied Chlorococcales from different parts of India.

MATERIALS AND METHODS

The present paper is based on the algal collections from the Kol wetlands of Thrissur district, Kerala. The surface water samples were collected monthly from ten stations namely Pullur (PR), Muriad (MD), Nambiankavu (NK), Mapranam (MM), Chemmanda (CM), Cherpu (CP), Palakkal (PL), Chettupuzha (CT), Anthikkad (AK) and

Table: 1 Seasonal and spatial variation of *Scenedesmus* in Thrissur Kol wetlands

Sl. No:	Name of algae	SEASONS			STATIONS									
		S i	S ii	S iii	1	2	3	4	5	6	7	8	9	10
1	<i>S. acuminatus</i> (Lagerheim) Chodat	+	-	-	-	-	-	+	-	-	-	-	-	-
2	<i>S. acutiformis</i> Schroeder	-	+	-	-	+	-	-	-	-	-	+	-	+
3	<i>S. arcuatus</i> (Lemmermann) Lemmermann	+	+	+	+	+	+	+	+	+	+	+	-	-
4	<i>S. bernardii</i> G.M. Smith	+	-	-	-	-	-	+	-	-	-	-	-	-
5	<i>S. bijugatus</i> (Turpin) Kuetzing	+	+	+	+	+	+	+	+	+	-	+	-	-
6	<i>S. bijugatus</i> (Turpin) Kuetzing forma <i>parvus</i> (G.M. Smith) Philipose	-	-	+	-	-	-	+	-	-	-	-	-	-
7	<i>S. dimorphus</i> (Turpin) Kuetzing	+	+	+	+	-	+	-	-	-	+	-	-	-
8	<i>S. obliquus</i> (Turpin) Kuetzing	+	-	+	+	+	-	+	-	-	-	-	-	-
9	<i>S. opoliensis</i> P. Richter var. <i>mononensis</i> Chodat	-	-	+	-	-	-	+	-	-	-	-	-	-
10	<i>S. perforatus</i> Lemmermann	+	-	+	+	+	-	+	+	-	-	+	-	-
11	<i>S. perforatus</i> Lemmermann var. <i>major</i> (Turner) Philipose	+	+	-	-	+	-	+	-	-	-	-	+	-
12	<i>S. quadricauda</i> (Turpin) Brebisson	+	+	+	+	-	+	-	+	-	-	-	+	-
13	<i>S. quadricauda</i> (Turpin) Brebisson var. <i>bicaudatus</i> Hansgirg	+	-	-	+	-	-	-	-	-	-	-	-	-
14	<i>S. quadricauda</i> (Turpin) Brebisson var. <i>longispina</i> (Chodat) G.M. smith	+	+	+	-	+	+	-	+	-	-	-	-	-
15	<i>S. quadricauda</i> (Turpin) Brebisson var. <i>quadrispina</i> (Chodat) G.M. Smith	+	-	-	-	-	+	-	-	-	-	-	-	-
16	<i>S. tropicus</i> Crow.	+	-	-	-	+	+	-	-	-	-	-	-	+
		13	7	9	7	8	7	9	5	2	2	4	2	2

+ Present, - Absent, S i pre-monsoon season, S ii monsoon season, S iii post-monsoon season.

Stations: (1) Pullur, (2) Muriad, (3) Nambiankavu, (4) Mapranam, (5) Chemmunda, (6) Cherpu, (7) Palakkal, (8) Chettupuzha, (9) Anthikkad, (10) Enamavu

Enamavu (EM) during February 2005 to January 2006. The samples collected were preserved in 4% formalin solution. The

identifications were based on the ICAR monograph by Philipose (1967) and the Camera Lucida drawings were prepared.

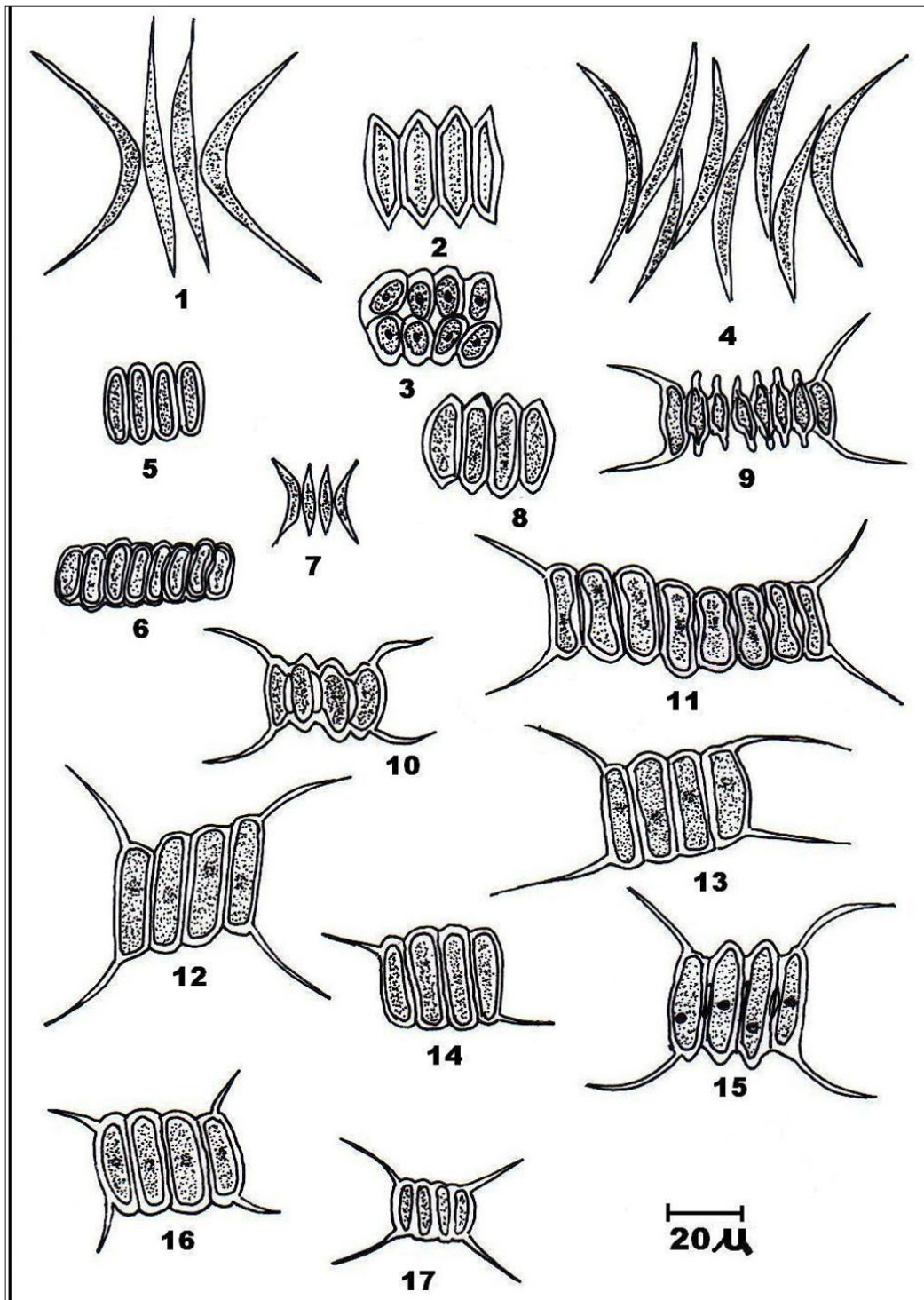


Plate 1 (Figures. 1-17)

(1). *S. acuminatus* (Lagerheim) Chodat (2). *S. acutiformis* Schroeder (3). *S. arcuatus* (Lemmermann) Lemmermann (4). *S. bernardii* G.M. Smith (5). *S. bijugatus* (Turpin) Kuetzing (6). *S. bijugatus* (Turpin) Kuetzing forma *parvus* (G.M. Smith) Philipose (7). *S. dimorphus* (Turpin) Kuetzing (8). *S. obliquus* (Turpin) Kuetzing (9). *S. opoliensis* P. Richter var. *mononensis* Chodat (10). *S. perforatus* Lemmermann (11). *S. perforatus* Lemmermann var. *major* (Turner) Philipose (12&13). *S. quadricauda* (Turpin) Brebisson (14). *S. quadricauda* (Turpin) Brebisson var. *bicaudatus* Hansgirg (15). *S. quadricauda* (Turpin) Brebisson var. *longispina* (Chodat) G.M. Smith (16). *S. quadricauda* (Turpin) Brebisson var. *quadrispina* (Chodat) G.M. Smith (17). *S. tropicus* Crow

RESULTS

During the course of the present study on the algal flora of Thrissur Kol wetlands, sixteen taxa of *Scenedesmus* were collected and are described with their distribution in India.

Systematic descriptions:

Class: Chlorophyceae

Order: Chlorococcales

Family: Scenedesmaceae

Subfamily: Scenedesmoideae

Genus: *SCENEDESMUS* Meyen

1. *Scenedesmus acuminatus* (Lagerheim) Chodat (Pl. 1, Fig. 1)

Philipose, 1967. p. 251, fig. 161.

Colonies 4 celled, cells fusiform with sharp pointed ends, 4.9-7.8 μm broad, 23.3-31.1 μm long. (Locality/Month: MM/Mar).

Distribution in India: Kerala (Philipose 1967, Cherian 2006, Jose and Francis 2007, Arulmurugan *et al.* 2010), Uttar Pradesh (Habib 1996), Maharashtra (Deshmukh and Gunale 2007).

2. *Scenedesmus acutiformis* Schroeder (Pl. 1, Fig. 2)

Philipose 1967. p. 260, fig. 169.

Colonies 4 celled, cells 4.9-6.8 μm broad, 13.6-16.5 μm long. (Locality/Months: MD/Jul; CT/Aug, Sep; EM/Sep).

Distribution in India: Andhra Pradesh and Madhya Pradesh (Philipose 1967), Punjab (Sarma *et al.* 1983, Rawla and Rattan 1989), Jammu and Kashmir (Kant and Gupta 1998).

3. *Scenedesmus arcuatus* (Lemmermann) Lemmermann (Pl. 1, Fig. 3)

Philipose, 1967. p. 256, fig. 166.

Colonies 8 celled, cells 6.8-7.8 μm broad, 9.8-10.7 μm long. (Locality/Months: PR/Mar, May, Sep; MD/May, Aug; NK/Feb; MM/Jan; CM/Feb; CP/Jul; PL/Jun, Aug; CT/Sep).

Distribution in India: Andhra Pradesh, Assam, Orissa, Karnataka (Philipose 1967), Kerala (Philipose 1967, Jose and Francis 2007), Uttar

Pradesh (Chadha and Pandey 1977), Himachal Pradesh (Jha *et al.* 1985), Punjab (Rawla and Rattan 1989), Jammu and Kashmir (Kant and Anand 1978, Kant and Gupta 1998), Maharashtra (Ashtekar and Kamat 1980, Andhale and Papdiwal 2010).

4. *Scenedesmus bernardii* G.M. Smith (Pl. 1, Fig. 4)

Philipose, 1967. p. 251, fig. 162.

Colonies 8 celled, cells 2-4.9 μm broad, 29.2-40.9 μm long. (Locality/Month: MM/Mar).

Distribution in India: Orissa (Philipose 1967), Jammu and Kashmir (Kant and Anand 1978, Kant and Gupta 1998), Punjab (Rawla and Rattan 1989), Kerala (Sheeba and Ramanujan 2005).

5. *Scenedesmus bijugatus* (Turpin) Kuetzing (Pl. 1, Fig. 5)

Philipose, 1967. p. 252, fig. 164 c,e,f.

Colonies 4 celled, cells 2.9-4.9 μm broad, 11.7-15.6 μm long. (Locality/Months: PR/Feb-May, Jul-Sep, Nov-Jan; MD/Feb, May, Aug, Oct, Jan; NK/Feb, Mar, Oct, Dec; MM/Mar; CM/Feb, Aug; CP/Sep; CT/Sep, Dec).

Distribution in India: Orissa (Philipose 1967), Jammu and Kashmir (Kant and Anand 1978, Kant and Gupta 1998), Gujarat (Patel *et al.* 1980), Maharashtra (Ashtekar and Kamat 1980, Deshmukh and Gunale 2007), Bihar (Singh and Saha 1982), Punjab (Sarma *et al.* 1983, Rawla and Rattan 1989), Himachal Pradesh (Jha *et al.* 1985), Uttar Pradesh (Tiwari *et al.* 2001), Kerala (Jose and Francis 2007), Uttaranchal (Shukla *et al.* 2007).

6. *Scenedesmus bijugatus* (Turpin) Kuetzing forma *parvus* (G.M. Smith) Philipose (Pl. 1, Fig. 6)

Philipose, 1967. p. 256, figs. 164 h,j.

8 celled colony, cells 11.7 μm long, 3.9 μm broad. (Locality/Month: MM/Oct).

Distribution in India: West Bengal (Philipose 1967), Himachal Pradesh (Jha *et al.* 1985),

Kerala (Jose and Patel 1992, Cherian 2006), Jammu and Kashmir (Kant and Gupta 1998), Maharashtra (Andhale and Papdiwal 2010).

7. *Scenedesmus dimorphus* (Turpin) Kuetzing (Pl. 1, Fig. 7)

Philipose, 1967. p. 249, fig. 160ac.

Colonies 4 celled, cells 4.9-5.8 μm broad, 12.6-15.6 μm long. (Locality/Months: PR/May, Aug, Sep, Jan; PL/Feb, Mar; NK/Mar, Apr).

Distribution in India: Andhra Pradesh, Orissa, Karnataka, West Bengal and Madhya Pradesh (Philipose 1967), Kerala (Philipose 1967, Sheeba and Ramanujan 2005, Cherian 2006), Jammu and Kashmir (Kant and Anand 1978), Gujarat (Patel *et al.* 1980), Maharashtra (Ashtekar and Kamat 1980, Deshmukh and Gunale 2007), Punjab (Sarma *et al.* 1983, Rawla & Rattan 1989), Himachal Pradesh (Jha *et al.* 1985, Rawla and Rattan 1989), Uttar Pradesh (Chadha and Pandey 1977, Pandey and Gangwar 1986, Tiwari *et al.* 2001, Habib and Chaturvedi 2001, Shukla *et al.* 2007).

8. *Scenedesmus obliquus* (Turpin) Kuetzing (Pl. 1, Fig. 8)

Philipose, 1967. p. 248, fig. 159.

Colonies 4 celled, 15.6-23.3 μm broad, cells 4.9-6.8 μm broad, 15.6-16.5 μm long. (Locality/Months: PR/May, Oct; MD/Oct; MM/Jan, Feb).

Distribution in India: Orissa, Tamil Nadu and West Bengal (Philipose 1967), Jammu and Kashmir (Kant and Anand 1978), Maharashtra (Ashtekar and Kamat 1980), Punjab (Sarma *et al.* 1983), Himachal Pradesh (Jha *et al.* 1985), Chandigarh and Punjab (Rawla and Rattan 1989), Kerala (Jose and Patel 1992, Maya *et al.* 2000, Sheeba and Ramanujan 2005, Cherian 2006, Jose and Francis 2007), Assam (Jena and Adhikary 2007), Uttar Pradesh (Pandey and Gangwar 1986, Shukla *et al.* 2007).

9. *Scenedesmus opoliensis* P. Richter var.

mononensis Chodat (Pl. 1, Fig. 9)

Philipose, 1967. p. 276, figs. 181 c, d.

Colonies 4 celled, cells 3.9-6.8 μm broad, 27.2-34 μm long. (Locality/Month: MM/Jan).

Distribution in India: Jammu and Kashmir (Kant and Anand 1978, Kant and Gupta 1998), Uttar Pradesh (Pandey and Gangwar 1986), Kerala (Jose and Patel 1992, Cherian 2006), Maharashtra (Andhale and Papdiwal 2010).

10. *Scenedesmus perforatus* Lemmermann (Pl. 1, Fig. 10)

Philipose, 1967. p. 280, figs. 186 a, b, g.

4 celled colonies, cells 5.8-7.8 μm broad, 13.6-16.5 μm long. (Locality/Months: PR/Nov; MD/May; MM/Mar; CM/Feb, May; CT/Dec).

Distribution in India: Kerala and Orissa (Philipose 1967).

11. *Scenedesmus perforatus* Lemmermann var. *major* (Turner) Philipose (Pl. 1, Fig. 11)

Philipose, 1967. p. 282, fig. 186 c-f, h-j.

Colonies 4 or 8 celled, cells 8.8-11.7 μm broad, 23.3-31.1 μm long. (Locality/Month: MD/May; MM/Feb; AK/Jun).

Distribution in India: Jammu and Kashmir (Kant and Gupta 1998), Kerala (Jose and Francis 2007, Arulmurugan *et al.* 2010).

12. *Scenedesmus quadricauda* (Turpin) Brebisson (Pl. 1, Figs. 12, 13)

Philipose, 1967. p. 283, fig. 187 a.

Colonies 4 celled, cells 4.8-7.8 μm broad, 16.5-19.5 μm long. (Locality/Months: PR/Feb-May, Jan; NK/Mar, May, Jan; CM/Feb, Nov, Jan; AK/Aug).

Distribution in India: Kerala (Philipose 1967, Suxena *et al.* 1973, Maya *et al.* 2000, Sheeba and Ramanujan 2005), Gujarat (Patel *et al.* 1980), Maharashtra (Ashtekar and Kamat 1980, Deshmukh and Gunale 2007), Punjab (Sarma *et al.* 1983), Himachal Pradesh (Jha *et al.* 1985), Uttar Pradesh (Pandey and Gangwar 1986, Jammu and Kashmir (Kant and Gupta 1998), Tiwari *et al.* 2001), Uttaranchal (Shukla *et al.* 2007).

13. *Scenedesmus quadricauda* (Turpin) Brebisson var. *bicaudatus* Hansgirg (Pl. 1, Fig. 14)

Philipose, 1967. p. 284, fig. 187 k, l.

Colonies 4 celled, cells 3.9-4.9 µm broad, 12.6-20.4 µm long, terminal cells with a spine from one pole. (Locality/Month: PR/May).

Distribution in India: Andhra Pradesh (Philipose 1967), Uttar Pradesh (Chadha and Pandey, 1977, Pandey and Gangwar 1986), Gujarat (Patel *et al.* 1980), Bihar (Singh and Saha 1982), Jammu and Kashmir (Kant and Gupta 1998), West Bengal (Jena and Adhikary 2007), Maharashtra (Andhale and Papdiwal 2010).

14. *Scenedesmus quadricauda* (Turpin) Brebisson var. *longispina* (Chodat) G.M. smith (Pl. 1, Fig. 15)

Philipose, 1967. p. 285, fig. 187 b, c.

Colonies 4 celled, cells 3.9-5.8 µm broad, 11.7-15.5 µm long. (Locality/Months: MD/Feb, Oct; NK/Mar, Apr; CM/Feb, Apr, May, Aug, Sep, Nov, Jan).

Distribution in India: Orissa and Tamil Nadu (Philipose 1967), Uttar Pradesh (Chadha and Pandey 1977, Pandey and Gangwar 1986), Gujarat (Patel *et al.* 1980), Maharashtra (Ashtekar and Kamat 1980, Andhale and Papdiwal 2010), Himachal Pradesh (Jha *et al.* 1985), Punjab (Rawla and Rattan 1989).

15. *Scenedesmus quadricauda* (Turpin) Brebisson var. *quadrispina* (Chodat) G.M. Smith (Pl. 1, Fig. 16)

Philipose, 1967. p. 285, fig. 187 d, j.

Colonies 4 celled, cells 6.8-9.7 µm broad, 15.6-23.3 µm long. (Locality/Months: NK/Mar-May).

Distribution in India: Andhra Pradesh, Orissa and Madhya Pradesh (Philipose 1967), Uttar Pradesh (Chadha and Pandey 1977, Pandey and

Gangwar 1986), Gujarat (Patel *et al.* 1980), Maharashtra (Ashtekar and Kamat 1980, Andhale and Papdiwal 2010), Punjab (Rawla and Rattan 1989), Jammu and Kashmir (Kant and Gupta 1998), Kerala (Cherian 2006, Arulmurugan *et al.* 2010).

16. *Scenedesmus tropicus* Crow. (Pl. 1, Fig. 17)

Philipose, 1967. p. 279, fig. 185.

4 celled colonies, cells 6.8-7.8 µm broad, 21.4-24.3 µm long. (Locality/Month: NK/Apr; MD/May; EM/Apr, May).

Distribution in India: Kerala and Andhra Pradesh (Philipose 1967).

Seasonal and spatial variation:

In Mapranam (Station 4) nine taxa of *Scenedesmus* was found followed by Muriad (Station 2) with eight taxa. At Pullur (Station 1) and Nambiankavu (Station 3) seven taxa of *Scenedesmus* were distributed. The seasonal biodiversity analysis in the study area shows that thirteen taxa of *Scenedesmus* were found during pre-monsoon (Feb-May), nine during post-monsoon (Oct-Jan) and seven during monsoon (Jun-Sep) season (Table 1).

DISCUSSION

S. acutiformis Schroeder, *S. quadricauda* (Turpin) Brebisson var. *bicaudatus* Hansgirg and *S. quadricauda* (Turpin) Brebisson var. *longispina* (Chodat) G.M. smith are new reports to Kerala.

Of these sixteen taxa, Philipose (1967) reported *Scenedesmus arcuatus* (Lemmermann) Lemmermann, *Scenedesmus dimorphus* (Turpin) Kuetzing, *Scenedesmus perforatus* Lemmermann and *Scenedesmus tropicus* Crow from Azhikode, Thrissur district, Kerala. *Scenedesmus acuminatus* (Lagerheim) Chodat, *Scenedesmus perforatus* Lemmermann var. *major* (Turner) Philipose and *Scenedesmus quadricauda* (Turpin) Brebisson var.

quadrispina (Chodat) G.M. Smith are reported by Arulmurugan *et al.* (2010) from Thrissur district, Kerala. *Scenedesmus quadricauda* (Turpin) Brebisson was reported from Cranganore (Suxena *et al.*, 1973), Azhikode and Chalakudy (Philipose 1967), Thrissur district, Kerala.

S. acutiformis Schroeder, *S. bernardii* G.M. Smith, *S. bijugatus* (Turpin) Kuetzing, *S. bijugatus* (Turpin) Kuetzing forma *parvus* (G.M. Smith) Philipose, *S. obliquus* (Turpin) Kuetzing, *S. opoliensis* P. Richter var. *mononensis* Chodat, *S. quadricauda* (Turpin) Brebisson var. *bicaudatus* Hansgirg and *S. quadricauda* (Turpin) Brebisson var. *longispina* (Chodat) G.M. Smith are additions to the algal flora of Thrissur district, Kerala.

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REFERENCES

- Arulmurugan P, Nagaraj S & Anand N 2010 Biodiversity of freshwater algae from temple tanks of Kerala. *Recent research in science and technology* **2**(6) 58-71.
- Andhale SB & Papdiwal PB 2010. Some Chlorococcalean algae from Jayakwadi bird sanctuary of Maharashtra. *J. Indian bot. Soc.* **89**(1 & 2) 185-188.
- Ashtekar PV & Kamat ND 1980 Chlorococcales of Aurangabad, Maharashtra *Phykos* **19**(1) 115-119.
- Chadha A & Pandey DC 1977 Additions to the algal flora of Allahabad, I Genus *Scenedesmus*. *Phykos*, **16**(1 & 2) 69-75.
- Cherian TT 2006 A systematic study of *Scenedesmus* spp. and vars. in the Poyyachira pond at Thrikkakara, Kerala. *Ind. J. Bot. Res.* **2**(2) 191-194.
- Deshmukh BS & Gunale VK 2007 A systematic account of Chlorococcales from Ahmednagar district, Maharashtra. *Indian Hydrobiology* **10**(2) 359-369.
- Jena M & Adhikary SP 2007 Chlorococcales (Chlorophyceae) of Eastern and North-eastern States of India. *Algae* **22**(3) 167-183.
- Jha BC, Kaushal DK & Rao YR 1985 Chlorococcales of Gobindsagar re-servoir Himachal Pradesh, India. *Phykos* **24** 27-32.
- Johnkutty I & Venugopal VK 1993 *Kole lands of Kerala*. Kerala Agricultural University, Thrissur. pp. 68.
- Jose John & Francis MS 2007 Investigation in the algal flora of Thodupuzha Thaluk, Kerala. *Indian Hydrobiology* **10**(1) 79-86.
- Jose L & Patel RJ 1992 A systematic account of Chlorococcales new to Kerala. *Phykos* **31**(1&2) 95-101.
- Habib I 1996 A systematic account of Chlorococcales from Najibabad (U.P.) India. *J. Econ. Tax. Bot.* **20**(3) 681-684.
- Habib I & Chaturvedi UK 2001 A systematic account of Chlorococcales from Mahoba, India. *Phykos* **40**(1 & 2) 107-113.
- Kant S & Anand VK 1978 New records of *Scenedesmus* spp. from Jammu (J & K). *Phykos* **17**(1 & 2) 81-85.
- Kant S & Gupta P 1998 Algal flora of Ladakh. *J. Econ. Tax. Bot.* Additional series **15** pp. 341.
- Maya S, Kumari Prameela S & Sarojini Menon V 2000 A preliminary study on the algal flora of temple tanks of southern Kerala. *Phykos* **39**(1 & 2) 77-83.
- Pandey UC & Gangwar FC 1986 Chlorococcales of Bareilly I. *Phykos* **25** 144-147.
- Patel RJ, Isabella George & Daniel JK 1980 Algae of fish ponds in Gujarat, India 1 Chlorococcales. *Phykos* **19**(1) 83-88.
- Philipose MT 1967 *Chlorococcales*, Indian Council of Agricultural Research, New Delhi, India. pp. 365.
- Rawla GS & Rattan RS 1989 *Scenedesmus* species from Punjab, Himachal Pradesh and Chandigarh. *J. Indian bot. Soc.* **68** 287-293.
- Sarma TA, Malhotra J & Dhillon NPS 1983 New records of Chlorococcales from Punjab. *Phykos* **22** 23-25.
- Sheeba S & Ramanujan N 2005 Phytoplankton composition and distribution in Ithikkara river, Kerala. *Indian Hydrobiology* **8**(1) 11-17.
- Shukla SK, Misra PK & Shukla CP 2007 Chlorococcalean algae from the foothills of Western Himalaya. *J. Indian bot. Soc.* **86**(3 & 4) 80-85.
- Singh NK & Saha LC 1982 Chlorococcales of Bhagalpur 1, Bihar. *J. Econ. Tax. Bot.* **3** 197-200.
- Suxena MR, Venkateswarlu V, Subba Raju N & Rao VS 1973 The algae and testacea of Cranganore, Kerala State-India. *J. Indian bot. Soc.* **52** 316-341.
- Tiwari A, Ravi Upadhyay & Chauhan SVS 2001 A systematic account of Chlorococcales from Kitham Lake, Agra. *Phykos* **40**(1 & 2) 103-105.