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Scenedesmus Meyen & related genera in foot hills of Eastern Himalaya, India.

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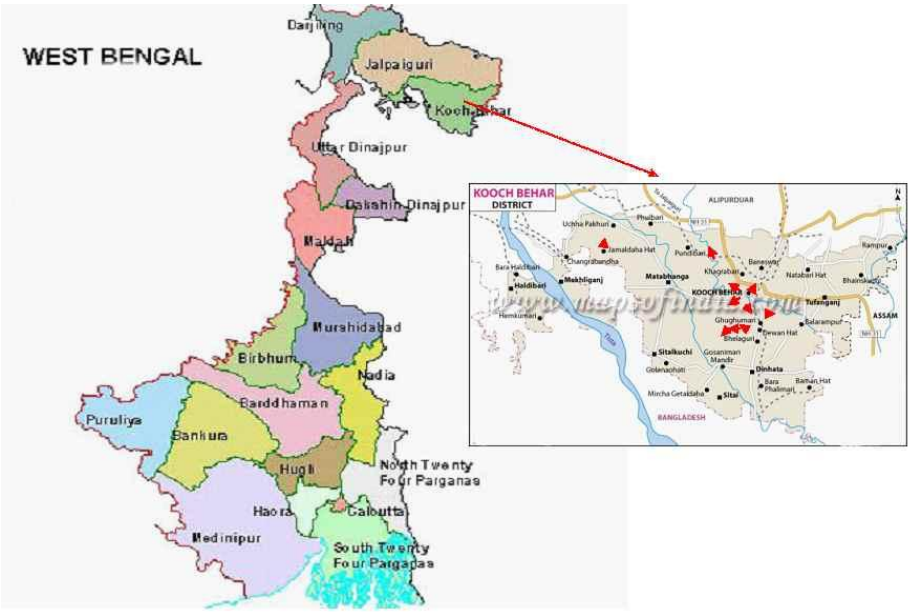
Abstract
Scenedesmus Meyen is a member of Chlorococcales of green algae known as a most ubiquitous genus in eutrophic waters. Taxonomic circumscriptions this genus has been reevaluated from time to time. In this account four genera viz. *Acutodesmus* (Hegewald) Tsarenko, *Desmodesmus* (R.Chodat) An, Friedl & Hegewald, *Scenedesmus* Meyen & *Verrucodesmus* Hegewald have been investigated which were previously included under *Scenedesmus* Meyen. They are ubiquitous in the fresh & brackish water bodies, particularly in nutrient rich conditions all over the globe. They constitute the major part of the phytoplankton and are therefore at the base of trophic structure. Cooch Behar is a district in the foot-hills of eastern Himalaya phycologically completely unexplored. This situation prompted to investigate the phytoplankton flora of the district both from taxonomic and utilitarian point of view. In this context the above mentioned genera have been investigated in the ponds and puddle of the district. During investigation sixteen taxa that include *Acutodesmus* (3), *Desmodesmus* (4), *Scenedesmus* (8) & *Verrucodesmus* (1) have been found. Of them 1 taxa of *Acutodesmus* viz. *A. incrassatulus* (Bohlin) Tsarenko, 4 taxa of *Desmodesmus* viz. *D. denticulatus* (R.Chodat) An, Friedl & Hegewald var. *linearis* (Hansgirg) Hegewald, *D. maximus* (W. & G. S. West) E. Hegewald, *Desmodesmus perforatus* (Lemmermann) Hegewald, *D. magnus* (Meyen) Tsarenko; 7 taxa of *Scenedesmus* viz. *S. arcuatus* (Lemmermann) Lemmermann, S. bicaudatus Dedusenko, S. bijuga (Turpin)Lagerheim var. *alternans* (Reinsch) Hansgirg, *S. bijuga* (Turpin) Lagerheim var. *irregularis* (Wille) G. M. Smith, *S. bijugatus* (Turpin) Kützing var. *flexuosus* Lemmermann, *S. denticulatus* Lagerheim var. *australis* Playfair, *S. quadrispina* R. Chodat & 1 taxa of *Verrucodesmus* viz. *V. parvus* (G.M. Smith) Hegewald have been reported for the first time from West Bengal under new circumscription.
This knowledge will help to explore the real possibilities of fisheries & as source of single cell protein to welfare the local people of the state.
Key words: *Acutodesmus*, *Desmodesmus*, *Scenedesmus*, *Verrucodesmus*, taxonomy, distribution, Eastern Himalaya, foot hills, Cooch Behar, West Bengal, India.

INTRODUCTION

Taxonomic circumscriptions of *Scenedesmus* Meyen & related genera have been reevaluated from time to time (Fott & Komárek 1983, Hegewald & Silva 1988, Tsarenko & Petlevanny 2001, Hegewald et al 2010 & Hegewald et al 2013). They are ubiquitous in the fresh & brackish water bodies, particularly in nutrient rich conditions all over the globe (Philipose 1967, Fott & Komárek 1983, An et al 1999, Graham et al 2009). They constitute the major part of the phytoplankton and are therefore at the base of trophic structure. *Scenedesmus* Meyen can grow in highly polluted water, so it is used as a pollution indicator. Recently they have been projected as agent for microalgal food (Kay & Barton, 1991) & biodiesel production (Makarevičienė et al, 2011 & Prabakaran et al, 2012). Northern part of West Bengal is unexplored phycologically except a few scanty reports. Cooch Behar is completely unexplored except a work on Limnology by Sanigrahi & Mandal (1997) & taxonomy by Das & Adhikary (2014). It is a district in the foot-hills of eastern Himalaya phycologically almost unexplored. This situation prompted to investigate the phytoplankton flora of the district both from taxonomic and utilitarian point of view. In this context the genera have been investigated in the ponds and puddle of the district. During investigation sixteen taxa have been found.

MATERIAL AND METHODS

Algal specimens were collected from different localities of Cooch Behar district, a district located in foot hills of Eastern Himalaya (Map-I). In this investigation the materials were collected from selected areas by frequent visits. The temperature and pH of water were recorded at the respective fields with detailed ecological notes. Freshly collected materials were stored in 5% formalin in polythene bags, tagged and ecological notes recorded in field data book (Table-1). Phytoplankton samples were preserved in Lugol's Iodine in 100:1 ratio. Standard procedure was followed for preparing permanent slides. Small portion of sample was taken on fresh slide with 10% glycerin as mounting medium and covered by cover glass. The cover glass was sealed with synthetic enamel paint and kept for drying. The slides were observed under compound microscope considering suitable identifying character and drawn with the help of drawing prism. Drawings were made during microscopic observation. A standard scale was prepared with the help of stage and ocular meter. Figures were drawn under appropriate magnification with the help of drawing prism. Sealing of slide was done for future reference. Photomicrography was done using Carlziess Axioscope Microscope with Nikon D-60 camera. Identification of the taxa were done using following standard works: Philipose 1967, Fott & Komárek 1983, Hegewald & Silva 1988, Tsarenko & Petlevanny 2001, Hegewald et al 2010 & Hegewald et al 2013 and confirmed from Algaebase (http://www.algaebase.org).



Location map of collection

Table 1. List of the Places, Collection No. & Ecological notes

Place of Collection	Collection No.	Date	P^H	Temperature	Habitat
Sagar dighi, COB	15	3.2.11	5.5	16˚c	Pond Water
Narasingha dighi, COB	28	20.2.11	6	24˚c	Pond Water
Panishala, COB	52	19.10.11	6	30˚c	Small Lotus Pond
Gouranga Bazar, COB	83	20.2.12	6	28˚c	A Big Lake
Gouranga Bazar, COB	84	20.2.12	6	28˚c	A Big Lake
Rajmata Dighi,COB	103	5.8.12	5.5	34˚c	Attached with rock
Rajmata Dighi,COB	105	5.8.12	5.5	34˚c	Attached with aquatic plants
Rajbari Park, COB	130	27.10.12	6	28˚c	Lake Water
Sutunga river, Jamaldah	139	12.11.12	6	24˚c	River Water
Attaronala, Vetaguri	197	4.5.13	6	27˚c	Small Ditch
Maranadir kuthi	254	20.10.13	6	22˚c	Small river, attached With aquatic plant
Bhutkua, vetaguri	313	9.2.14	6	18˚c	Attached with aquatic plant

RESULT & DISCUSSION:

In this investigation following taxa have been recorded:

Acutodesmus dimorphus (Turpin) Tsarenko [PL. I, fig. 11, PL. II, fig. 28]

[Philipose 1967, p. 249, f. 160 a-c; Hegewald & Silva 1988, p. 212 both as *Scenedesmus dimorphus* (Turpin) Kützing]

Colony 8 celled arranged in subalternating series, outer cells are lunate with pointed apices; Cells are 12.12 µm – 23.46 µm long and 3.03 µm – 4.70 µm wide.

Collection No: 103, 105, 197, 313.

Indian Distribution: Filter beds, Bengal (Brühl & Biswas 1922), Loktak Lake, Manipur (Brühl and Biswas, 1926), Madras, Tamilnadu (Philipose 1940, 1967; Iyengar & Venkataraman 1951), Barrackpur, West Bengal (Philipose 1967), Bhopal, Madhya Pradesh (Philipose 1967), Balasore, Odisha (Philipose 1967), Azhicode, Kerala (Philipose 1967), Kotdwar, Garhwal (Habib *et al*. 1998); Nagpur (Tarar & Bodkhe, 1998) Bhopal (Garg & Garg, 2002); Pune (Jafari et al., 2006); Daspalla reservoir, Wardha, Maharashtra (Dalal *et al.* 2012); Nandurbar, Maharashtra (Jaiswal *et al*., 2012), Chilika Lagoon (Mohanty *et al.*, 2013); Ranchi (Das Guru *et al.*, 2013); Hydrabad (Motlagh, 2013); Warangal, Andhra Pradesh (Kumaraswamy *et al*., 2013); Nashik (Beherepatil & Beore, 2013); Raigad, Maharashtra (Prajapati *et al*., 2014); Sangli (Deshmukh & Gonjari, 2014) [all as *Scenedesmus dimorphus* (Turpin) Kützing].

Daspalla reservoir, Surada reservoir, Rengali reservoir, Odisha (Das & Adhikary, 2014); Jamuna bandh, Bishnupur, W. B.; Wards lake, Shillong (Das & Adhikary, 2014); Agartala, Tripura (Das & Adhikary, 2014); Kangla, Manipur (Das & Adhikary, 2014); Jor pukhuri, Dimapur, Nagaland (Das & Adhikary, 2014); Kalisayar, Santiniketan, W. B. (Das & Adhikary, 2014) [all as *Acutodesmus dimorphus* (Turpin) Tsarenko].

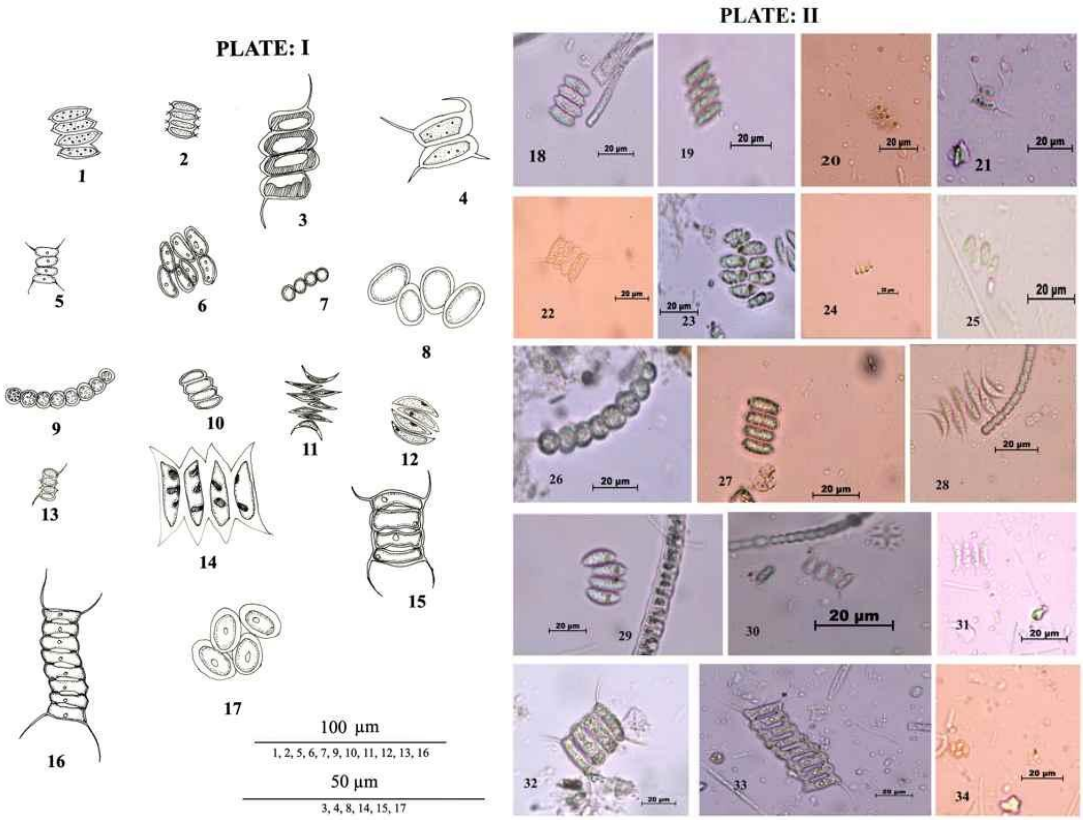


PLATE: I. Fig 1: ***Scenedesmus denticulatus*** Lagerheim var. ***australis*** Playfair**.** Fig2: ***Desmodesmus denticulatus* (R.Chodat) An, Friedl & Hegewald** var. ***linearis*** (Hansgirg) Hegewald**.** Fig 3: ***Scenedesmus bicaudatus*** Dedusenko **.** Fig 4: ***Scenedesmus quadrispina*** R. Chodat **.** Fig 5: ***Desmodesmus maximus*** (W. & G. S. West) E. Hegewald**.** Fig 6: ***Scenedesmu arcuatus*** (Lemmermann) Lemmermann. Fig 7: ***Scenedesmu bijugatus*** (Turpin) Kützing**.** Fig 8: ***Scenedesmu bijuga*** (Turpin) Lagerheim var. ***alternans*** (Reinsch) Hansgirg. Fig 9: ***Scenedesmu bijugatus*** (Turpin) Kützing var. ***flexuosus*** Lemmermann. Fig 10: ***Scenedesmu***. ***bijuga*** (Turpin) Lagerheim var. ***irregularis*** (Wille) G. M. Smith**.** Fig 11: ***Acutodesmus dimorphus*** (Turpin) Tsarenko**.** Fig 12: ***Acutodesmus incrassatulus*** (Bohlin) Tsarenko**.** Fig 13: ***Desmodesmus magnus*** (Meyen) Tsarenko. Fig 14: ***Acutodesmu obliquus*** (Turpin) Hegewald & Hanagata**.** Fig 15: ***Desmodesmus perforatus*** (Lemmermann) Hegewald**.** Fig 16: ***Desmodesmus perforatus*** (Lemmermann) Hegewald**.** Fig 17: ***Verrucodesmus*** Hegewald ***parvus*** (G. M. Smith) Hegewald

PLATE: II. Fig 18: ***Scenedesmus denticulatus*** Lagerheim var. ***australis*** Playfair**.** Fig19: ***Desmodesmus denticulatus* (R.Chodat) An, Friedl & Hegewald** var. ***linearis*** (Hansgirg) Hegewald**.** Fig 20: ***Scenedesmus bicaudatus*** Dedusenko. Fig 21: ***Scenedesmus quadrispina*** R. Chodat**.** Fig 22: ***Desmodesmus maximus*** (W. & G. S. West) E. Hegewald**.** Fig 23: ***Scenedesmu arcuatus*** (Lemmermann) Lemmermann. Fig 24: ***Scenedesmu bijugatus*** (Turpin) Kützing**.** Fig 25: ***Scenedesmu bijuga*** (Turpin) Lagerheim var. ***alternans*** (Reinsch) Hansgirg. Fig 26: ***Scenedesmu bijugatus*** (Turpin) Kützing var. ***flexuosus*** Lemmermann. Fig 27: ***Scenedesmu***. ***bijuga*** (Turpin) Lagerheim var. ***irregularis*** (Wille) G. M. Smith**.** Fig 28: ***Acutodesmus dimorphus*** (Turpin) Tsarenko**.** Fig 29: ***Acutodesmus incrassatulus*** (Bohlin) Tsarenko**.** Fig 30: ***Desmodesmus magnus*** (Meyen) Tsarenko. Fig 31: ***Acutodesmu obliquus*** (Turpin) Hegewald & Hanagata**.** Fig 32: ***Desmodesmus perforatus*** (Lemmermann) Hegewald**.** Fig 33: ***Desmodesmus perforatus*** (Lemmermann) Hegewald**.** Fig 34: ***Verrucodesmus*** Hegewald ***parvus*** (G. M. Smith) Hegewald

A. incrassatulus (Bohlin) Tsarenko [PL. I, fig. 12, PL. II, fig. 29]
[Philipose 1967, p. 252, f. 163; Hegewald & Silva 1988, p. 268, f. 433 both as *Scenedesmus incrassatulus* Bohlin]
Colony 4 celled arranged in a linear to sub-alternating series, the outer side of the cells is convex and inner side concave, the end portions of cells are with apical nodules; cells are 24.24 µm long and 6.06 µ broad.
Collection No: 139
Indian Distribution: Nashik (Beherepatil 2013) as *Scenedesmus incrassatulus* Bohlin.
This is an uncommon taxon and is reported for the first time from West Bengal.

A. obliquus (Turpin) Hegewald & Hanagata [PL. I, fig. 14, PL. II, fig. 31]
[Philipose 1967, p. 248, f. 159 a-c; Hegewald & Silva 1988, p. 334 both as *Scenedesmus obliquus* (Turpin) Kützing]
Colony 4 celled arranged in a linear series, cells fusiform in shape, outer cells concave; cell wall smooth; cells are 17 µm long and 3.4 µm broad.
Collection No: 103
Indian Distribution: N. E. India (Turner, 1892); Sadia, Assam (Carter, 1926); Burdwan, West Bengal (Brühl and Biswas, 1922); Bombay (Gonzalves and Joshi, 1946); Allahabad, Uttar Pradesh (Mitra, 1957); Barrackpur, Srerampore (West Bengal), Cuttack, Madras (Philipose, 1967); Mansar Lake, Jammu (Anand, 1975); Patna (Laal, 1976); Nagpur (Frietas *et al*., 1976); Aurangabad (Ashtekar & Kamat, 1980); Allahabad (Pandey, 1980); Patiala (Sarma *et al.*, 1983); Karnataka (Somashekhar, 1984); Govindsagar, Himachal Pradesh (Jha *et al.*, 1885); Bareilly (Pandey & Gangwar, 1986); Calcutta (Santra, 1987); Hydrabad (Satya Mohan, 1987); Ambikapur (Agarkar *et al*., 1991); Kerala (Josh & Patel, 1992); Nagpur(Tarar & Bodkhe, 1998); Pune (Jafari & Gunale, 2006); Silchar, Assam (Jena *et al*., 2007); Wardha, Maharashtra (Dalal *et al*., 2012); Ranchi, Jharkhand (Kumar & Sahu, 2012); Nashik (Beherepatil & Deore, 2013), Bhopal, MP (Shivhare *et al*., 2014) [all as *Scenedesmus obliquus* (Turpin) Kützing].
Lal dighi, Sagar dighi, Cooch Behar, W. B. (Das & Adhikary, 2014);Poka banh, Bishnupur, W. B. (Das & Adhikary, 2014); Kalisayar, Santiniketan, W. B. (Das & Adhikary, 2014); Deepar beel, Goalpara, Assam (Das & Adhikary, 2014); Agartala, Sepahijala wildlife sanctuary lake, Udaipur, Kamalasagar lake, Chinabagan lake, Tripura (Das & Adhikary, 2014); Manshu lake, Sikkim (Das & Adhikary, 2014); Hirakud reservoir, Kausalyaganga fish pond, Odisha (Das & Adhikary, 2014); PTSO lake 4, Sangey stream, Arunachal Pradesh (Das & Adhikary, 2014); Bishnupur, Kangla pat lake, Imphal,Manipur (Das & Adhikary, 2014); Cherrapunjee, Meghalaya (Das & Adhikary, 2014); Jor pukhuri, Dimapur, Nagaland (Das & Adhikary, 2014) [all as *A. obliquus* (Turpin) Hegewald & Hanagata].

Desmodesmus denticulatus (R.Chodat) An, Friedl & Hegewald var. ***linearis*** (Hansgirg) Hegewald [Pl. I, fig. 2, PL. II, fig. 19]

[Philipose 1967, p. 270, f. 176 d-e; Hegewald & Silva 1988, p. 205, f. 323A both as *Scenedesmus denticulatus* Lagerheim var. *linearis* Hansgirg]

Colony 4 celled arranged in a linear series, cells are ovoid to oblong with 2 teeth in each pole, cells 23.46 µm long and 3.91 µm wide; spine 1.5 µm long.
Collection No: 130
Indian Distribution: Allahabad (Pandey *et al*., 1980); TamilNadu (Mahendraperumal & Anand, 2008); Thrissur, Kerala (Arulmurugan *et al.*, 2010); Warangal, A.P. (Kumaraswamy *et al*., 2013); Nashik (Beherepati & Deore, 2013) (All as *Scenedesmus denticulatus* Lagerheim var. *linearis* Hansgirg.
This is the first report of the taxon from West Bengal.

D. maximus (W. & G. S. West) E. Hegewald [PL. I, fig.5, PL. II, fig. 22]
[Philipose 1967, p. 286, f. 187 h-i; Hegewald & Silva 1988, p. 467, f. 755 both as *Scenedesmus quadricauda* (Turpin) Brébisson var. *westii* G. M. Smith]
Colony 4 celled arranged in linear series, cells are oblong to fusiform, spine appears each pole of terminal cells; cells 12.12 µm long and 4.55 µm broad with 6.06 µm long spine.
Collection No: 313
Indian Distribution: Cuttack & Puri, Odisha (Philipose 1967), Azhicode, Kerala (Philipose 1967), (Kotdwar, Garhwal (Habib *et al.*, 1998); Wardha, Maharashtra (Dalal *et al*., 2012); Nashik (Beherepatil & Deore, 2013); Jalgaon, Maharashtra (Patil 2013). [All as *Scenedesmus quadricauda* (Turpin) Brébisson var. *westii* G. M. Smith]
This is the first report of the taxon from West Bengal.

D. perforatus (Lemmermann) Hegewald [PL. I, fig. 15, PL. II, fig. 32]
[Philipose 1967, pg. 280, f. 186 a,b,g; Hegewald & Silva 1988, pg. 388, f. 625 both as *Scenedesmus perforatus* Lemmermann]
Colony 4 celled arranged in linear series, outer cell with convex side and inner cell with concave side, lenticular perforations present between two adjacent cells, long spine present at the pole of terminal cells; cell 28.79µm long & 7.58 µm – 10.61 µm broad; length of spine 15.15 µm & perforations 3.03 µm broad.
Collection No: 52
Indian Distribution: Puri, Balasore (Odisha) (Philipose 1967), Azhicode, Kerala (Philipose 1967); Kanshi Ram Nagar, U. P. (Sharma & Saxena, 2012); Jalgaon, Maharashtra (Patil 2013); Sagli (Deshmukh & Gonjari, 2014) all as *Scenedesmus perforatus* Lemmermann.
This is the first report of the taxon from West Bengal.

D. perforatus (Lemmermann) Hegewald [Pl. I, fig. 16, PL. II, fig. 33]
[Turner 1892 p. 161, pl. 20, f. 19 b-c as *Scenedesmus quadricauda* f. *major* Turner, Brühl & Biswas 1922 p.11-12, pl. 3, f. 19a-d Philipose 1967, p. 282, f 186 f, h-j both as *Scenedesmus perforatus* Lemmermann; Hegewald & Silva 1988, p. 392, as *Scenedesmus perforatus* Lemmermann f. *major* (Turner) Philipose]
Colony 8 celled arranged in a linear series. Spine is present at the poles of terminal cell. Linear perforations are present between two adjacent cells. Pyrenoid one in each cell. Cells are 23.46 µm long and 4.55 µm broad. Spine 23.46 µm and perforations are 1.5 µm.
Collection No: 313
Indian Distribution: West Bengal (Brühl & Biswas, 1922); Thrissur, Kerala (Arulmurugan et al 2010) both as *Scenedesmus perforatus* Lemmermann f. *major* (Turner) Philipose].
This taxon has morphological similarity with the *Scenedesmus perforatus* Lemmermann f. *major* (Turner) Philipose which has been considered synonymous to *Desmodesmus perforatus* (Lemmereman) Hegewald.

D. magnus (Meyen) Tsarenko [PL. I, fig. 13, PL. II, fig. 30]
[Philipose 1967, p. 274, f. 180 b-c, g-I as *Scenedesmus longus* Meyen var. *naegelii* (Brébisson) G. M. Smith; Hegewald & Silva 1988, p. 306 as *Scenedesmus longus* Meyen var. *minutus* G. M. Smith]
Colony 4 celled arranger in linear manner, cells are oblong to cylindrical in shape, one long spine present in each pole of terminal cell and a short spine on other pole, inner cells with short spine at both poles; cells 11.73 µm long and 4.55 µ broad.
Collection No: 197
Indian Distribution: Filter beds, Bengal (Brühl & Biswas, 1922), Dumdum, West Bengal (Philipose1967), Balasore, Cuttack, Odisha (Philipose 1967), Raipur, Chattishgarh (Philipose 1967), Srikakulum, Andhra Pradesh (Philipose 1967), Visakhapatanam, Andhra Pradesh (Philipose 1967), Allahabad (Pandey *et al*., 1980); Kotdwar, Garhwal (Habib et al 1998); Nashik (Beherepatil & Deore, 2013), Palakkad, Kerala (Arulmurugan *et al*., 2010) [All as *Scenedesmus longus* Meyen var. *naegelii* (Brébisson) G. M. Smith].

Scenedesmus arcuatus (Lemmermann) Lemmermann [PL. I, fig. 6, PL. II, fig. 23]
[Philipose 1967, pg. 256 f. 166 a-e; Hegewald & Silva 1988, p. 78]
Colony 8 celled which are arranged in two linear series. Cells are angularly oblong to ovoid. Cell wall smooth. Cells are 9.78 µm – 15.15 µm long and 4.54 µm – 7.5µm wide.
Collection No: 84, 313
Indian Distribution: Ahmedabad (Kamat, 1962); Orissa, Bihar, Kerala (Philipose, 1967); Aurangabad (Ashtekar & Kamat, 1980); Govindsagar, Himachal Pradesh (Jha *et al.* , 1985); Nagpur (Tarar & Bodkhe, 1998); Kotdwar, Garhwal (Habib *et al*., 1998); Namchi, Sikkim (Kumar & Rai, 2005); Bhubaneswar, Orissa (Samad & Adhikary, 2008); Pathanamthitta, Kerala (Panikkar *et al.,* 2012); Kangra, Himachal Pradesh (Kumar *et al.,* 2012); Kolli hills (Suresh *et al.,* 2012); Jalgaon, Maharashtra (Patil, 2013); Nashik (Beherepatil & Deore, 2013)
This is the first report of the taxon from West Bengal.

S. bicaudatus Dedusenko [PL. I, fig. 3, PL. II, fig. 20]
(Philipose 1967 as *Scenedesmus qudricauda* (Turpin) Brébisson var *bicaudatus* Hansgirg p. 284, f. 187 k-l; Hegewald & Silva 1988, p. 115, f. 180 as *Scenedesmus bicaudatus* Dedusenko)

Colony 4 celled arranged in a linear series, long spine present in one pole of terminal cell, spine of one terminal cell appear opposite angle to the other terminal cell; cells 9.4 µm – 11.76 µm long and 4.12 µm broad with 8 µ long spine.
Collection No: 105
Indian Distribution: Cuttack, Odisha (Philipose 1967), Visakhapatnam, Andhra Pradesh (Philipose 1967), (Wardha, Maharashtra (Dalal *et al.,* 2012); Nashik (Beherepatil & Deore, 2013); Ranchi (Das *et al*. 2013) all as *Scenedesmus qudricauda* (Turpin) Brébisson var. *bicaudatus* Hansgirg.
This is the first report of the taxon from West Bengal.

S*. *bijuga (Turpin) Lagerheim var. ***alternans*** (Reinsch) Hansgirg [PL. I, fig. 8, PL. II, fig. 25]
[Philipose 1967, p.254, f. 164 g as *Scenedesmus bijugatus* ((Turpin) Kutzing var. *alternans* (Reinsch) Hansgirg; Hegewald & Silva 1988, p. 121]
Basionym: *S. alternans* Reinsch
Colony 8 celled arranged in an alternating series, cell ellipsoidal or ovoid with rounded ends. Cells are 10.58µm – 15.64 µm long & 5.87 µm – 7.82µm broad.
Collection No: 83, 103
Indian Distribution: Cuttack, Odisha (Philipose 1967), Kangra, Himachal Pradesh (Kumar *et al*., 2012), Nashik (Beherepatil & Deore, 2013).
This is the first report of the taxon from West Bengal.

S*. *bijuga (Turpin) Lagerheim var. ***irregularis*** (Wille) G. M. Smith [PL. I, fig. 10, PL. II, fig. 27]
[Philipose 1967, pg. 253, f. 163 i, m as *Scenedesmus bijugatus* ((Turpin) Kützing var. *irregularis* Wille; Hegewald & Silva 1988, p. 125, f. 204]
Colony 4 celled arranged in an irregular or sub-alternating manner. Cells are oblong-ellipsoidal to oval in shape. Cells 15.15 µm long and 4.55 µm broad.
Collection No: 254
Indian Distribution: Madras, Tamilnadu (Philipose 1967), Puri, Odisha (Philipose 1967), Nagpur (Tarar & Bodkhe, 1998); Jalgaon, Maharashtra (Patil 2013), Nashik (Beherepatil & Deore, 2013), Chilika (Mohanty *et al.*, 2013), Ranchi (Das *et al*., 2013)
This is the first report of the taxon from West Bengal.

S*. *bijugatus (Turpin) Kützing [PL. I, fig. 7, PL. II, fig. 24]
[Philipose 1967, p. 252, f. 164 c,e,f]
Colony 4 celled arranged in a linear single line, cells fusiform, elongate or ovate, 6.06µm – 12.12 µm long and 2.55 µm – 4.54 µm broad.
Collection No: 15, 84, 139.
Indian Distribution: Fiter beds, Bengal (Brühl & Biswas 1922), Sadiya, Assam (Carter 1926), Borvali, Bombay (Maharashtra) (Dixit 1937), Banaras, Uttar Pradesh (Venkataraman 1957), Dibrugarh, Assam (Philipose 1967), Cuttack, Odisha (Philipose 1967), Bhopal, Madhya Pradesh (Philipose 1967), Hyderabad, Andhra Pradesh (Philipose 1967), Allahabad (Pandey *et al.*, 1980), Bhopal (Garg & Garg 2002); Kanpur (Diwedi, 2010), Wardha, Maharashtra (Dalal *et al.*, 2012), Agasthiyar falls, Gudalur (Suresh *et al.*, 2012), Nandurbar, Maharashtra (Jaiswal *et al.,* 2012), Jalgaon, Maharashtra (Patil 2013), Nashik (Beherepatil & Deore, 2013), Chilika (Mohanty *et al.,* 2013), Ranchi (Das *et al.*, 2013), Sangli (Desmukh, 2014), Ujani reservoir, Maharashtra (Mahdik & Jadhav 2014).

S*. *bijugatus (Turpin) Kützing var. ***flexuosus*** Lemmermann [PL. I, fig. 9, PL. II, fig. 26]
[Philipose 1967, pg. 254, f. 164 k-l; Hegewald & Silva 1988, p. 124, f. 202]
Colony 8 celled arraned in spiral manner. Cells are rounded to oval in shape and 7.57 µm – 10.60 µm long and 6.06 µm – 7.57 µm wide.
Collection No: 84
Indian Distribution: Cuttack, Odisha (Philipose 1967), Moosi River, Hyderabad (Kumari et al., 1991); Mahanadi river, Madhya Pradesh (Unni & Pawar., 2000); Namchi, Sikkim (Kumar and Rai, 2005), Kangra, Himachal Pradesh (Kumar *et al* 2012), Nandurbar, Maharashtra (Jaiswal *et al*., 2012), Jalgaon, Maharashtra (Patil 2013).
This is the first report of the taxon from West Bengal.

S*. *denticulatus Lagerheim var. ***australis*** Playfair [PL. I, fig. 1, PL. II, fig. 18]

[Philipose 1967, pg. 271, f. 176 f-h; Hegewald & Silva 1988, p. 195, f. 307]
Colony 8 celled arranged in a single series, cell oblong and with one tooth from the poles of the cells, cells 9.09 µm long and 4.55 µm wide, spine 6.06 µm long.
Collection No: 313
Indian Distribution: Loktak Lake, Manipur (Brühl and Biswas, 1926 as *Scenedesmus annandalei* Brühl et Biswas); Madras, Tamilnadu (Philipose 1940 as *Scenedesmus denticulatus* var. *linearis* Hansgirg), Kadavur, Kerala (Panikkar *et al*., 2012): Kangra, Himachal Pradesh (Rakesh Kumar *et al.,* 2012); Nashik (Beherepatil & Deore, 2013).
This is the first report of the taxon from West Bengal.

S. quadrispina R. Chodat [PL. I, fig. 4, PL. II, fig. 21]

[Philipose 1967, p. 285, f. 187 d, j as *Scenedesmus qudricauda* (Turpin) Brébisson var. *quadrispina* (Chodat) G. M. Smith; Hegewald & Silva 1988, p. 469, f. 758]
Colony 2 celled, cells transversely elliptical, short recurved spine present in each pole of terminal cell, cells are 9.09 µm long and 4.55 µm broad, spine 3.03 µm - 6.06 µm long.
Collection No: 28
Indian Distribution: Visakhapatnam, Andhra Pradesh (Philipose, 1967); Cuttack, Odisha (Philipose, 1967); Jabalpur, Madhya Pradesh, (Philipose, 1967); Thrissur, Palakkad, Kerala (Arulmurugan *et al.,* 2010); Kangra, Himachal Pradesh (Kumar *et al.,* 2012).
This is the first report of the taxon from West Bengal.

Verrucudesmus parvus (G. M. Smith) Hegewald [PL. I, fig. 17, PL. II, fig. 34]
[Hegewald et al 2013, p. 151]
Colony 4 celled arranged in sub-alternating manner. Cells are 8.82 µm long and 5.88 µm broad.
Collection No: 103
Indian Distribution: Nashik (Beherepatil & Deore, 2013 as *Scenedesmus bijugatus* (Turpin) Kützing forma. *parvus* (G. M. Smith) Philipose.
This is an uncommon taxon and is reported for the first time from West Bengal.

CONCLUSION

Scenedesmus Meyen & related genera are ubiquitous in Indian water although have not been investigated properly. In this investigation a thorough field study was made in the foot hills of Eastern Himalaya located in the district of Cooch Behar (Map-I). Distribution pattern of different taxa has been recorded (Graph-I). From this account it appears that *Acutodesmus dimorphus* (17%) appears to be most dominant taxon followed by *Scenedesmus bijugatus* (12%), S. *arcuatus* (8%) and *S. bijuga* var. *alternans* (8%). Rest of the taxa occurs more or less in equal proportion (4%). It is interesting to note that 13 taxa have been recorded for the first time from West Bengal in spite of the extensive work of Philipose (1967) & Das & Adhikary (2014). From this account it appears that the biodiversity of *Scenedesmus* & related genera are much more than it is expected. It also continues the real possibilities of these taxa to be exploited in fisheries, oil production & as source of single cell protein in foot hills of Eastern Himalaya.

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