



A TAXONOMIC ACCOUNT ON PHYTOPLANKTON OF RUDRASAGAR RAMSAR SITE, TRIPURA (INDIA) : CHLOROPHYTA AND EUGLENOPHYTA

PARTHA PRATIM BARUAH*, HIMAMANI KALITA AND
SOUMIN NATH

Plant Ecology Laboratory, Department of Botany, Gauhati University,
Guwahati-781014, Assam, India

*email: ppbaruah@gauhati.ac.in

Date of online publication: 31st December 2020

DOI:10.5958/2455-7218.2020.00040.6

Explorations made to historic Rudrasagar Ramsar Site of Tripura (India) during 2018-2019 revealed one hundred thirty eight phytoplankton species belonging to Chlorophyta (98) and Euglenophyta (40) for the first time from the water body. Among these, a total of one hundred and six species were reported for the first time from the North East India and, one hundred and twenty seven number of species from the state of Tripura respectively. *Cosmarium* with 23 species was the most dominant genus within the Chlorophyceae members followed by *Scenedesmus* (22) and *Trachelomonas* with 18 species was the dominant genus amongst the Euglenophyceae members.

Keywords: Chlorophyta, Euglenophyta, Phytoplankton, Rudrasagar Ramsar Site, Systematic enumeration

Tripura is one of the small hilly state of North Eastern India and is blessed with 408 wetlands. Rudrasagar is one of them. This lake is situated in the West Tripura district at about 53 km from the state capital Agartala and located between the latitudes 23°30'34'' to 23°50'45'' N and longitudes 91°16'59'' to 91°29'56'' E covering an area of around 240 ha. The lake has constant connection with the Gomati, one of the foremost rivers of Tripura.

The wetland is regularly flooded with more than three times in a year due to heavy rainfall in the region in general and its catchment areas in particular. It is one of the natural reservoirs of commercially important indigenous endemic fishes and also a natural habitat for waterfowls. Fishing is a regular activity in the water body throughout the year with an estimated annual production of more than 25 tons of local breed fishes (Barman *et al.* 2013). Taran and Deb (2017) reported some important crustaceans from the beel. Through the natural process of development, the lake has undergone autogenic succession and attract some marginal, floating or submerged aquatic weeds (Barman *et al.* 2013).

The lake is historically acclaimed too due to the famous 'Water Palace' locally known as 'Neermahal' (Water Palace) constructed by the

King of erstwhile Tripura state, Maharaja Bir Bikram Kishore Manikya Bahadur to be used as summer resort during 1935-1938 almost on the north-east bank of it. It is now one of the prominent tourist destinations of Tripura. Considering its different ecological services viz., flood control, recharge and discharge of ground water in the vicinity, shelter and feeding ground of a good number of residents and migratory birds and above all, a lucrative source of fish protein to the beneficiary people of the locality; Rudrasagar Lake has been proclaimed as one of the prominent Ramsar sites of North East India in the year 2005 (Taran and Deb 2017).

Phytoplankton are the base of any healthy aquatic food chains and thus, they used to provide tremendous ecological benefits to the aquatic organisms including fish. The studies of the phytoplankton thus bear significance to determine the ecological status of any water bodies. A little work has been done on phytoplankton or algal diversity of different fresh water habitats of Tripura (Reddy *et al.* 1986, Singh *et al.* 1997, Das *et al.* 2010, Bharati *et al.* 2020). Das *et al.* (2010) reported one hundred nineteen algal species from different freshwater habitats of Agartala, Udaipur and Sepahijala Wildlife Sanctuaries of Tripura.

Though ecologically fragile and important, little study has so far been undertaken on phytoplankton and its diversity in and around the Rudrasagar Lake of Tripura (Bharati *et al.* 2020). The present study was, therefore, aimed to systematically enumerate the phytoplankton diversity of the Rudrasagar Lake putting special emphasis on Chlorophyceae and Euglenophyceae taxa.

MATERIALS AND METHODS

Phytoplankton samples were collected randomly from different locations of the Rudrasagar Lake using Nansen sampler during 2018-2019. The water collected from the sampling sites were allowed to pass through plankton net of having mesh size of 45µm. 20 liters of water were passed through this plankton net and the residue was directly transferred to the polyethylene bottles in 20 ml of water. The bottles having the phytoplankton samples were marked with collection no. and date and were brought to the Plant Ecology laboratory of Department of Botany, Gauhati University for further analysis. FAA and Lugol's solution were used as preservative.

The algal samples so collected were observed under Euromex Delphi-X Microscope using Image Viewer Software and measurements were taken at appropriate magnifications. Algal taxa were then identified by consulting standard literatures and monographs of Gonzalves (1981), Iyenger & Desikachary (1981), Prasad & Mishra (1992), Prasad & Srivastava (1992), John *et al.* (2005), Perumal & Anand (2009), Yamagishi (2010), Das & Adhikary (2014) and Das & Keshri (2016). Taxonomy was updated with the help of Nominum Algarum and Algaebase, an online taxonomic database of algae which is a worldwide electronic publication of National University of Ireland (Guiry and Guiry 2013) with some modification in conformity with recent literatures and the classification scheme of Lee (1999) was followed to arrange the taxa.

RESULTS

In the present study, altogether 138 algal species were recorded from the Rudrasagar Ramsar site of Tripura belonging to 21 different genera under the phylum Chlorophyta (98) and 5 genera under Euglenophyta (40). List of the recorded species are given below (Fig.1-36), Plate II (Fig.37-71), Plate III (Fig.72-107) and Plate IV (Fig.108-138).

Systematic account of algal species:

Phylum -Chlorophyta

Order - Zygnematales

Family - Mesotaeniaceae

Genus - *Netrium* (Nageli) Itzigsohn *et* Rothe

1. *Netrium digitus* (Brebisson *ex* Ralfs)

Itzigsohn *et* Rothe var. *rectum* (Turner) Krieger (Pl. I, Fig.1)

Das and Keshri 2016, p. 50, pl. II, f. 36

Cells oblong elliptic, broad with convex margins, the end somewhat produced and gradually tapering forming truncated poles; chloroplast single in each semicells having radiating ridges with elongate pyrenoids; cell wall smooth, cells 164-167 µm long, 54-57 µm broad and apex 14-15 µm broad.

Voucher No.R6; Date.22nd July 2018. New to Rudrasagar. New to Tripura.

Order - Desmidiaceae

Family - Desmidiaceae

Genus - *Closterium* Nitzsch *ex* Ralfs

2. *Closterium calosporum* Wittrock var. *maius* West *et* G.S. West (Pl. I, Fig. 2)

Das and Keshri 2016, p.102, pl.16, f.6

Cells are much larger than the specific, but other morphological characters are same as the typical one; outer margin is strongly curved with 120-126 degrees of arc, outer and inner margins are parallel to each other near to the apices but in the middle it is straight, cell slowly attenuated to the sub - acute apices; cell wall is smooth; single chloroplast with a series of 10-12 pyrenoids.

Voucher No.R81; Date. 7th September 2019. New to Rudrasagar. New to Tripura. New to

North East India.

3. *Closterium diana* Ehrenberg ex Ralfs var. *minor* Hieronymus (Pl. I, Fig. 3)

Das and Keshri, 2016, p.71.pl.XIV, f.299, 300
Cells are small, 6-8 times longer than broad; curved moderately, 111° of arc, dorsal margin is more curved than ventral margin, at the apices it forms attenuated rounded poles where it gradually narrowed, axial chloroplast with 2 pyrenoids in each semicells; smooth and colourless cell wall. Length of the cell is $98\ \mu\text{m}$; breadth is $13\ \mu\text{m}$ and apex with $2\ \mu\text{m}$.

Voucher No.R3; Date.22nd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

4. *Closterium ehrenbergii* Meneghini ex Ralfs (Pl. I, Fig. 4)

John *et al.* 2005, p.522, pl. 130, f. B
Cells are robust, usually $60\text{-}100\ \mu\text{m}$ wide and $250\text{-}550\ \mu\text{m}$ long, dorsal margin comprises of variable curvature with an arc of 120° m, swollen in mid region of inner margin which results into the attenuating broad and rounded apices. $10\text{-}18\ \mu\text{m}$ in wide, apical pore is absent; chloroplast is parietal, a series of ridges comes out towards the wall, in face view 5-6 ridges are clearly seen, throughout the chloroplast variable number of pyrenoids are seen; pale brown to colourless smooth walls, the last vacuoles contain number of rhomboidal crystal.

Voucher No.R19; Date. 22nd July 2018. New to Rudrasagar. New to Tripura.

5. *Closterium ehrenbergii* Meneghini ex Ralfs var. *malinvernianum* (De Notaris) Rabenhorst (Pl. I, Fig. 5)

Das and Keshri 2016, p.73, pl. XIII, f.285
Cells are large, five times longer than the broad; curved moderately, 103° of arc; concave ventral margin but midregion is inflated, dorsal wall is strongly convex in shape, attenuated slowly to the rounded poles; chloroplasts are axial with no. of scattered pyrenoids; cell walls are colourless and striated.

Voucher No.R13; Date.22nd July 2018. New to

Rudrasagar. New to Tripura. New to North East India.

6. *Closterium gracile* Brebisson ex Ralfs var. *tenue* (Lemmermann) West et G.S. West (Pl. I, Fig.6)

Das and Keshri 2016, p.74, pl. XXIII, f.392
Cells are medium sized, thin and slender, longer than the broad, curved at an angle of 30° , straight in more than one half of the total length; margins are parallel, slowly curved and narrowed towards the apical region. Obtuse poles, 7 pyrenoids are present at the axile chloroplasts; smooth and colourless cell wall. Voucher No.R12; Date.22nd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

7. *Closterium idiosporum* West et G.S. West (Pl. I, Fig.7)

John *et al.* 2005, p.522, pl. 129, f. G
Cell is spindle shaped which is $8\text{-}12\ \mu\text{m}$ wide, $150\text{-}250\ \mu\text{m}$ long, straight to slightly curved, sigmoid, attenuating from mid region to narrow sub truncate apices with small end pore; gridle bands absent; chloroplasts with 3-4 ridges with axile pyrenoids, colourless wall, smooth, ill-defined terminal vacuole.

Voucher No.R1; Date. 22nd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

8. *Closterium kuetzingii* Breb (Pl. I, Fig.8)

John *et al.* 2005, p.523, pl. 130, fN
Cells are $300\text{-}550\ \mu\text{m}$ long, middle region is spindle shaped which is $20\text{-}25\ \mu\text{m}$ wide, ends are attenuating to each extremity to long narrow, incurved, rounded and sometimes slightly swollen, and apices are $2.5\text{-}3.5\ \mu\text{m}$ wide. End pores are distinct, chloroplasts are present only in the middle region; walls are colourless; vacuoles are sub terminal and they are adjacent to the distal ends of chloroplasts where no. of ovoid crystals are moving.

Voucher No.R54; Date. 24th July 2019. New to Rudrasagar. New to Tripura.

9. *Closterium parvulum* Nageli var. *obtusum*

Croasdale (Pl. I, Fig.9)

Das and Keshri 2016, p.82.pl.XIV, f.299, 300 cells are small in size, 8 times longer than the broad, curved moderately, curvature of 115° angle of arc, concaved mid region of ventral wall, cell wall is smooth and colourless, apical region is attenuated ;bluntly rounded poles; axial chloroplast with 3-5 pyrenoids.

Voucher No.R10; Date.22nd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

10. Closterium subfusiforme Messikommer (Pl. I, Fig.10)

Das and Keshri 2016, p.89, pl.XX, f.361, 362 Cells medium sized, 6 to 7 times longer than the broad, 32° arc, fusiform, nearly equal curved on each margin, tapered to truncate poles; 4 longitudinal ridges on the chloroplasts with several pyrenoids in a series; cell wall smooth and colourless.175-178µm length and 26-27µm breadth.

Voucher No.R8; Date. 22nd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

Genus-Euastrum Ehrenberg ex Ralfs**11. Euastrum denticulatum** (Kirchn.) Gay (Pl. I, Fig.11)

Cell length with spines is 19.2 µm, median diameter is 15.3 µm, Isthmus 3µm; Deep upper margin with three lateral spines and four crescentic lateral markings of each semicells .Apical granules are absent .Undulated apex ,lateral spines and 4 crescentic lateral markings.

Voucher No.R82; Date. 7th September 2019. New to Rudrasagar. New to Tripura.

12. Euastrum dubium Nageli (Pl. I, Fig.12)

Das and Adhikary 2014, p. 94, Pl. 6, f.14 Green and solitary cells, longer than the broad, semicells are trapeziform, broadly rounded basal angles, equally rounded upper and lower lateral margins, broadly rounded apical angles, stout spines in apical angles, apical margin of polar lobe with a “u” shaped invagination in the middle, narrow and linear sinus, cells are

19.1µm long, 14.7 µm broad, isthmus is 3 µm broad.

Voucher No.R42; Date. 24th July 2018. New to Rudrasagar.

13. Euastrum lutkemulleri Duceillier (Pl. I, Fig.13)

Das and Keshri 2016, p.137, pl. XXVIII, f.490

Cells are small and truncate, oval in outline which is 1.5 times longer than the broad; semicells truncate and pyramidal ,narrowly rounded basal lobes at the angles, retuse margins which is converging to the apex; scarcely evident polar lobes; bluntly pointed polar lobe, flat apical margin but retuse at the midregion; semicells with a broad and low protuberance ;low and narrow sinus throughout, retuse midregion of lateral margin; Cell wall is smooth. Length of the cell is 12 µm, breadth is 16 µm, isthmus is 7 µm.

Voucher No.R17; Date.22nd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

14. Euastrum subhypochondrum Fritsch et Rich (Pl. I, Fig.14)

Das and Keshri 2016, p.140, pl. XXVIII, f.470 Medium sized cells, longer than the broad; isthmus is deep, v-shaped narrow sinus; rounded basal lobes, basal lobes rounded and produced ,directed horizontally ;in the lateral margins deep ,right angled shoulder like incision between basal and apical lobes ;slightly undulate apical margins ;narrow apical angles, presence of 2 stout blunt spines, basal lobes bears similar spines but greater in numbers; small granules are scatteredly present on the terminal lobes of basal and apical lobes, on either side of each basal lobes a median circle of slightly broad granules in two concentric series and present in two relatively small circular patch of small granules; length of the cell is 50-55 µm ,breadth is 47-50 µm without the processes, isthmus is 14-15µm.

Voucher No.R102; Date. 8th September 2019. New to Rudrasagar. New to Tripura. New to

Plate-1

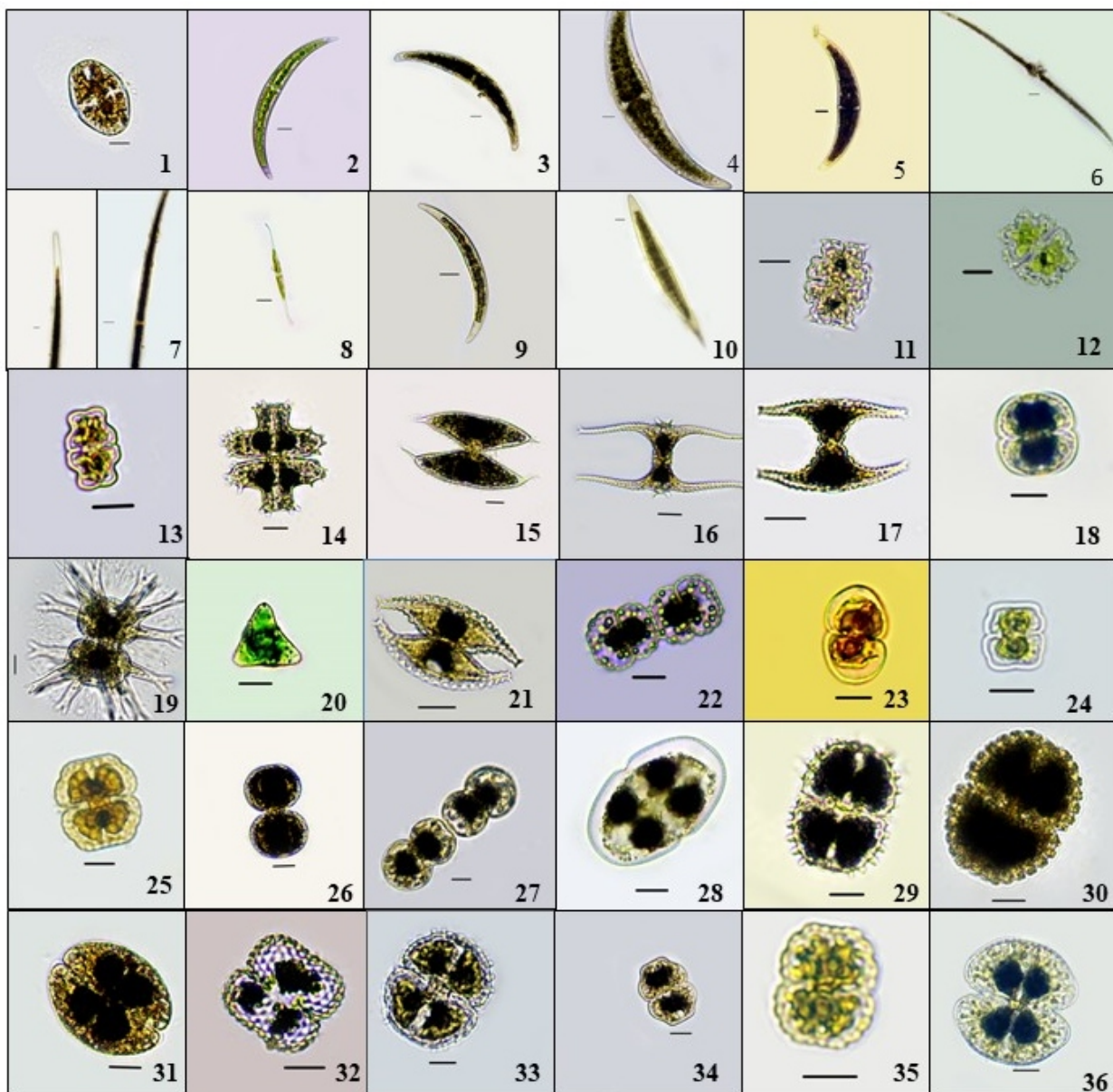


Plate 1 (1-36): 1. *Netrium digitus* var. *rectum* 2. *Closterium calosporum* var. *maius* 3. *Closterium diana* var. *minor* 4. *Closterium ehrenbergii* 5. *Closterium ehrenbergii* var. *malinvernianum* 6. *Closterium gracile* var. *tenue* 7. *Closterium idiosporum* 8. *Closterium kuetzingii* 9. *Closterium parvulum* var. *obtusum* 10. *Closterium subfusiforme* 11. *Euastrum denticulatum* 12. *Euastrum dubium* 13. *Euastrum lutkemulleri* 14. *Euastrum subhypochondrum* 15. *Staurastrum dejectum* var. *patens* 16. *Staurastrum gracile* 17. *Staurastrum longibrachiatum* 18. *Staurastrum orbiculare* var. *minor* 19. *Staurastrum pansum* 20. *Staurastrum punctulatum* var. *subproductum* 21. *Staurastrum sonthalianum* 22. *Staurastrum thangaicum* 23. *Cosmarium awadhense* 24. *Cosmarium baffinense* 25. *Cosmarium crenulatum* 26. *Cosmarium contractum* 27. *Cosmarium contractum* var. *minutum* 28. *Cosmarium cucurbitinum* var. *subpolymorphum* 29. *Cosmarium cycladatum* 30. *Cosmarium cohnii* 31. *Cosmarium dorsitruncatum* var. *psuedoscenedemus* 32. *Cosmarium favum* var. *indicum* 33. *Cosmarium freemanii* var. *verrucosum* 34. *Cosmarium hammeri* var. *hammeri* 35. *Cosmarium impressulum* var. *impressulum* 36. *Cosmarium miscellum* (Scale Bar=10µm)

Plate-2

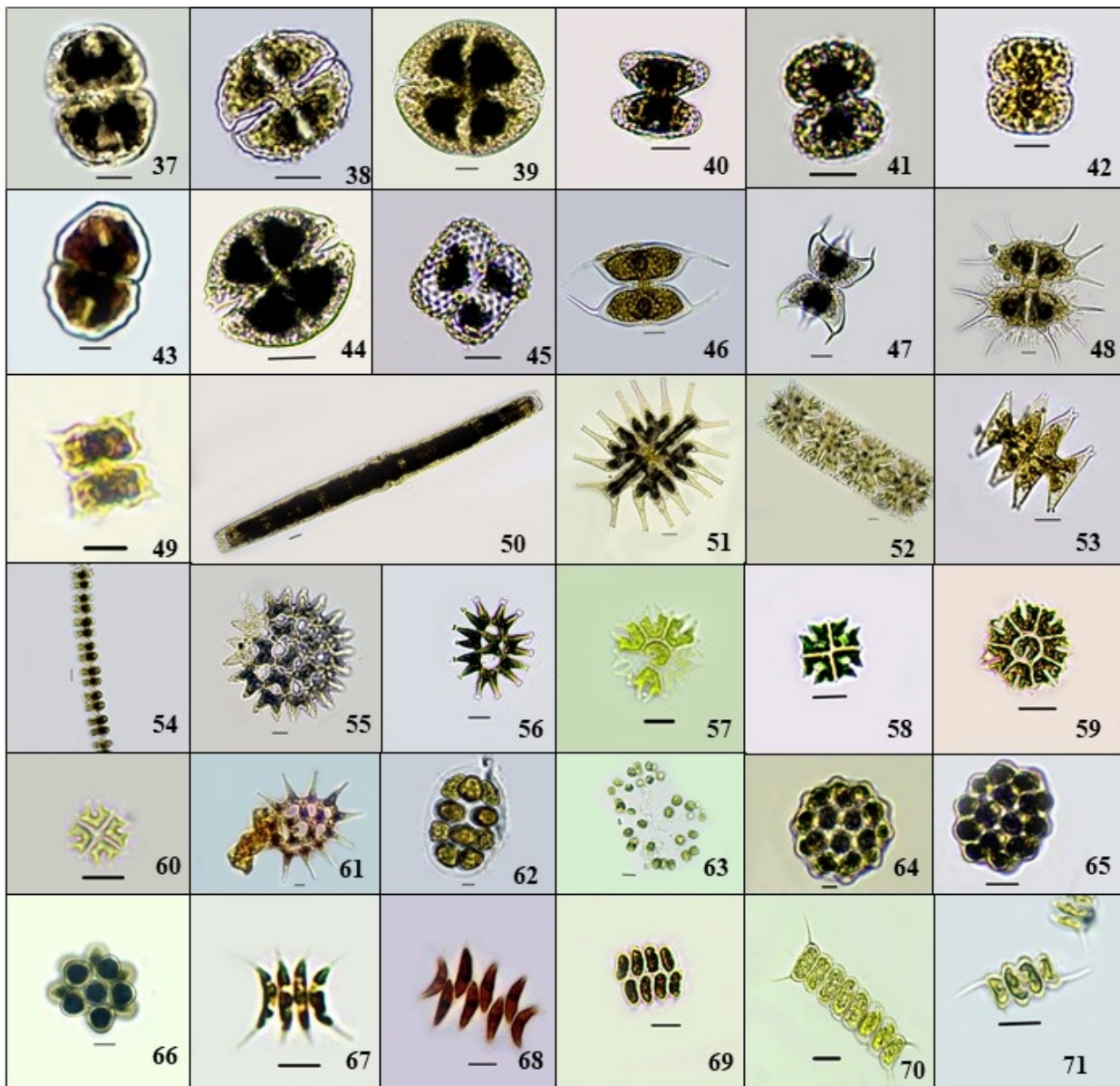


Plate 2 (37-70): 37. *Cosmarium nitidulum* 38. *Cosmarium nudum* 39. *Cosmarium obsoletum* 40. *Cosmarium phaseolus* var. *phaseolus* 41. *Cosmarium porteanum* forma *pseudoporteanum* 42. *Cosmarium reniforme* var. *minor* 43. *Cosmarium retusifforme* 44. *Cosmarium subauriculatum* 45. *Cosmarium quadrifarium* var. *oblonga* 46. *Arthrodesmus convergens* var. *incrassatus* 47. *Staurodesmus dejectus* 48. *Xanthidium antilopaenum* var. *hebridarum* 49. *Xanthidium variabile* 50. *Pleurotaenium ehrenbergii* var. *ehrenbergii* 51. *Microsterias alata* 52. *Microsterias foliaceae* 53. *Microsterias pinnatifida* 54. *Spondylosium nitens* f. *major* 55. *Pediastrum duplex* var. *duplex* 56. *Pediastrum duplex* var. *gracillimum* 57. *Pediastrum tetras* 58. *Pediastrum tetras* var. *excisum* 59. *Pediastrum tetras* var. *tetras* 60. *Pediastrum tetras* var. *tetraodon* 61. *Pediastrum simplex* var. *simplex* 62. *Volvulina steinii* 63. *Dictyosphaerium pulchellum* 64. *Coelastrum pulchrum* 65. *Coelastrum scabrum* 66. *Coelastrum sphaericum* 67. *Scenedesmus acuminates* 68. *Scenedesmus acutus* var. *globosus* 69. *Scenedesmus arcuatus* var. *platydiscus* 70. *Scenedesmus armatus* var. *armatus* 71. *Scenedesmus bicaudatus* (Scale Bar=10µm)

Plate-3

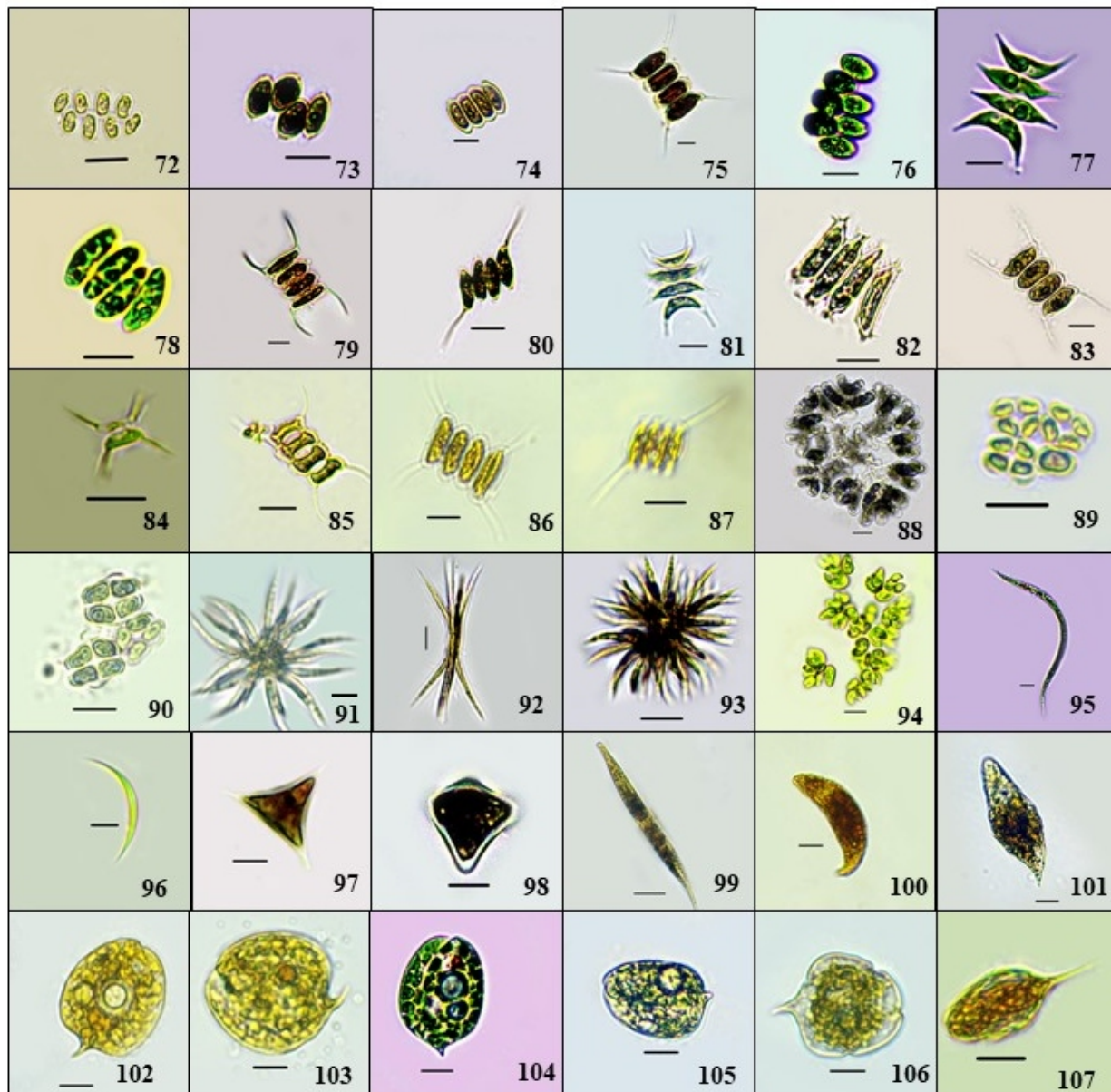


Plate 3 (72-106): 72. *Scenedesmus bijugatus* f. *parvus* 73. *Scenedesmus bijugatus* var. *gravenitzii* 74. *Scenedesmus brasiliensis* 75. *Scenedesmus carinatus* var. *carinatus* 76. *Scenedesmus disciformis* f. *disciformis* 77. *Scenedesmus dimorphus* 78. *Scenedesmus ellipticus* 79. *Scenedesmus humanensis* 80. *Scenedesmus intermedius* 81. *Scenedesmus longispina* 82. *Scenedesmus praetervisus* 83. *Scenedesmus protuberans* 84. *Scenedesmus pseudopoliensis* 85. *Scenedesmus quadricauda* f. *granulatus* 86. *Scenedesmus quadrispina* 87. *Scenedesmus spinosus* 88. *Dimorphococcus lunatus* 89. *Crucigenia rectangularis* 90. *Crucigenia neglecta* 91. *Ankirodesmus bernardii* 92. *Ankirodesmus falcatus* 93. *Ankirodesmus spiralis* var. *fasiculatus* 94. *Kirchneriella lunaris* 95. *Monoraphidium indicum* 96. *Monoraphidium mirabile* 97. *Tetraedron trigonum* var. *gracile* 98. *Tetraedron tumidulum* 99. *Euglena acus* var. *acus* 100. *Euglena limnophila* var. *swirenkoi* 101. *Euglena spathirhynchus* 102. *Phacus acuminatus* var. *acuminatus* 103. *Phacus carinatus* 104. *Phacus heimii* 105. *Phacus mammillatus* 106. *Phacus onyx* var. *onyx* 107. *Phacus pyrum* (Scale Bar=10µm)

Plate-3

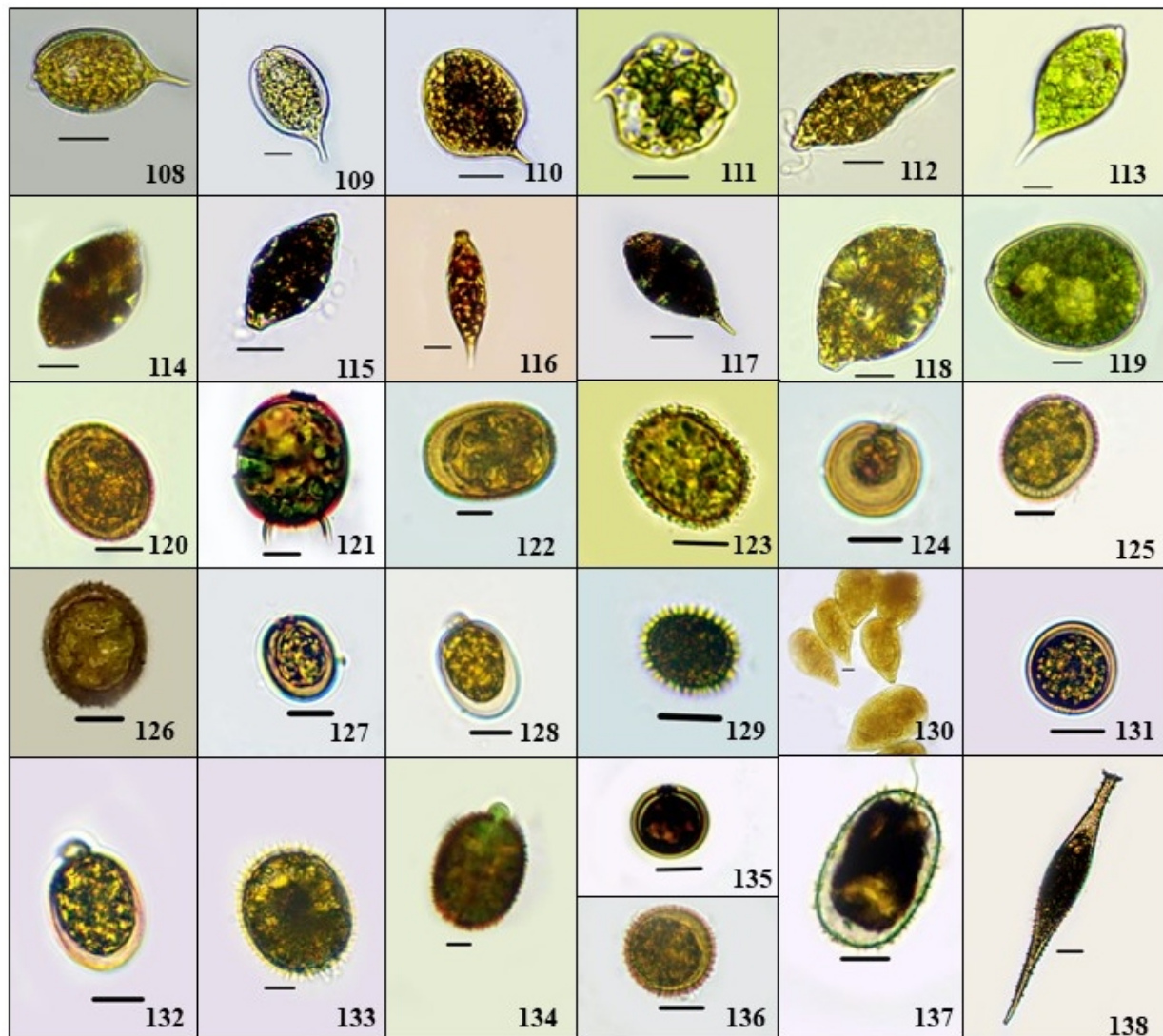


Plate 4 (108-138): 108.*Phacus suecicus* var. *suecicus* 109 .*Phacus suecicus* var. *oidion* 110. *Phacus triqueter* var. *triqueter* 111.*Phacus undulatus* var. *undulatus* 112.*Lepocinclis acuta* 113. *Lepocinclis fusiformis* 114.*Lepocinclis fusiformis* var. *fusiformis* 115.*Lepocinclis fusiformis* var. *minor* 116.*Lepocinclis longistriata* 117. *Lepocinclis ovum* var. *buetschlii* 118. *Lepocinclis ovum* var. *obesa* 119. *Lepocinclis salina* var. *salina* 120. *Trachelomonas acanthostoma* var. *acanthostoma* 121.*Trachelomonas armata* var. *armata* 122.*Trachelomonas australica* var. *rectangularis* 123.*Trachelomonas bacillifera* var. *minima* f. *minima* 124.*Trachelomonas curta* var. *tubigera* 125. *Trachelomonas guttata* 126.*Trachelomonas hispida* var. *crenulatocollis* 127.*Trachelomonas oblonga* var. *truncata* 128.*Trachelomonas planktonica* var. *oblonga* 129.*Trachelomonas robusta* 130.*Trachelomonas schewiakoffii* 131.*Trachelomonas sculpta* var. *sculpta* 132.*Trachelomonas similis* var. *similis* 133.*Trachelomonas superba* var. *superba* 134.*Trachelomonas sydneyensis* var. *sydneyensis* 135.*Trachelomonas volvocina* var. *volvocina* 136.*Trachelomonas woycickii* var. *woycickii* 137.*Trachelomonas zingeri* var. *zingeri* 138.*Strombomonas australica* var. *australica* (Scale Bar=10µm)

North East India.

Genus-*Staurastrum* Meyen Ralfs

15. *Staurastrum dejectum* Brebisson var. *patens* Nordstedt (Pl. I, Fig.15)

Das and Keshri 2016, p.164, Pl.VII, f.236, 238
Cells medium sized, as long as broad, deep median constriction, sinus acute angles, triangular when observed, bowl shaped; convex lateral margins; apical angles which are narrowly rounded are furnished with a very short and diverging spine; straight apical margin, smooth cell wall, cells are in triangular shape in vertical view, slightly convex margin, angles are tumid, narrowly rounded, bearing a stout spine; ; length of the cell is 21-22 μm , breadth is 23-35 μm without the processes, isthmus is 6-8 μm .

Voucher No.R52; Date. 21st July 2018. New to Rudrasagar. New to Tripura. New to North East India.

16. *Staurastrum gracile* Ralfs forma *Iyengar et Vimala Bai* (Pl. I, Fig.16)

Prasad and Misra 1992, p.197, pl.25, f.14, 18
Cells are small which are about 2.7 times longer than the broad, small constriction in the form of an acute notch, slightly broadening towards the convex apex, the upper angles produced into a more or less horizontally forming long process tipped with 3 minute spines and it shows some concentric series of denticulations, axile triangular chloroplast from the top view with one pyrenoid in each semicells; length of the cell is 18.5 μm , breadth is 12 μm without the processes, isthmus is 4.5 μm .

Voucher No.R113; Date. 8th September 2019. New to Rudrasagar. New to Tripura.

17. *Staurastrum longibrachiatum* (Borge) Gutwinski (Pl. I, Fig.17)

Das and Keshri 2016, p.166 Pl.VII, f.229, 230
Medium sized cells with processes, twice as broad and long with processes; slight median constriction, sinus is broad, obtusely rounded apex, bowl shaped semicells, apical processes have two bi- spinate protrusions at the base,

these will become a series of teeth on the ventral margins and also gives margins of the semicells a series of incisions and verrucae, apical angles extended into a long and slender processes which is horizontally directed, tip is bispinate; truncate apical margins, between the processes it was straight and slightly depressed, marginal cells are furnished with a series of verrucae; length of the cell is 32-33 μm , breadth is 59-62 μm , isthmus is 9-11 μm .

Voucher No.R15; Date. 22nd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

18. *Staurastrum orbiculare* Meneghini ex Ralfs var. *minor* Prescott (Pl. I, Fig.18)

Das and Keshri 2016, p. 168, pl. VII, f. 235
Cells are small, very slightly broader than long, circular in general outline, deep median constriction, slightly dilated at the apex, linear and closed semicells, sub semicircular; slightly depressed apex but broadly rounded, basal angles rounded; cell wall punctate; cell wall punctate in vertical view, cell triangular, broadly rounded lobes; length of the cell is 20-22 μm , breadth is 20-25 μm , isthmus is 10-11 μm .

Voucher No.R125; Date. 9th September 2019. New to Rudrasagar. New to Tripura.

19. *Staurastrum pansum* Turner (Pl. I, Fig.19)

Das and Adhikary 2014, p.103, pl.7, f.16.
Cells are triangular from top, two long processes at each angles, 3-4 spines present at the tip of the processes, shallow sinus, broadly rounded inner angle, 18 μm in diameter.

Voucher No.57; Date. 21st July 2018. New to Rudrasagar. New to Tripura. New to North East India.

20. *Staurastrum punctulatum* Ralfs var. *subproductum* West et G.S. West (Pl. I, Fig.20)

Das and Keshri 2016, p.169, pl.VII, f.251, 252
Cells are small and longer than the broad, deep median constriction, sinus is acute and open at the apex, elliptical semicells, dorsal margin is

more convex than ventral, whereas ventral margins are diverging directly to the apical angles which are rounded narrowly; concave apical margins, midsector is slightly elevated; cell wall consists of series of concentric granules over the whole lobe, in vertical view cell is triangular, convex margins, narrowly rounded lobes, length of the cell is 30-33 μm , breadth is 29-32 μm , isthmus is 13-15 μm .

Voucher No.R18; Date.22nd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

21. *Staurastrum sonthalianum* Turner (Pl. I, Fig.21)

Das and Keshri 2016, p.169, Pl.VII, f.231, 232
Cells are large in size, longer than the broad cuneiform cells, length of the cell is 70-80 μm and breadth is 35-40 μm , size of the Isthmus is 20 μm deep median constriction, open sinus, broadly cyanthiform semicells, concave vertical margins which was diverging into apical angles which form a very long and tapering downwardly directed spines, processes of the two semicells contact with their apices; apical and dorsal margins are present, apical margins are decorated with a continuous series of low verrucae, process topped with two teeth; smooth wall, length of the cell is 32-34 μm , breadth is 51-52 μm , isthmus is 6-8 μm .

Voucher No.R134; Date.9th September 2019. New to Rudrasagar. New to Tripura. New to North East India.

22. *Staurastrum thangaicum* Bruhl & Biswas (Pl. I, Fig.22)

Das and Adhikary 2014, p.103, pl.5, f.29.
Cells are of medium size, triangular in shape from the top view, narrow and linear sinus, and triangular semicells and semicells having rounded angles, 14-19 μm long, 17-21 μm broad, isthmus is 8-9.5 μm broad.

Voucher No.R7; Date. 22nd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

Genus: *Cosmarium* Ralfs

23. *Cosmarium awadhense* Prasad et

Mehrotra (Pl. I, Fig.23)

Prasad and Misra 1992, p.154, pl.21, f.16

Cells are small which is slightly longer than the broad, constricted deeply, narrow and linear sinus with a dilated extremity subcircular semicells, truncate cell apices which is flat with straight margin, cell wall is smooth, sides of the cell lacks granules having 3-4 crenations, length of the cell is 78-86 μm , 38-42 μm wide, isthmus is 34-38 μm .

Voucher No.R62; Date. 6th September 2019. New to Rudrasagar. New to Tripura.

24. *Cosmarium baffinense* Whelden (Pl. I, Fig.24)

Das and Keshri 2016, p.99, Pl.VI, f.190

Cells small, as long as broad, semicells hexagonal with rounded angles; median constriction deep, sinus closed, linear, lateral walls angularly concave; broad and flat apex; cell wall minutely punctate; length of the cell is 10-11 μm , 10-11 μm wide, isthmus is 4-5 μm .

Voucher No.R65; Date. 6th September 2019. New to Rudrasagar. New to Tripura. New to North East India.

25. *Cosmarium crenulatum* Nageli (Pl. I, Fig.25)

Das and Adhikary 2014, p.109, pl.8, f.8

Cells are longer than the broad, deep constriction, sinus narrowly linear, semicells vertically sub quadrate with triundulate margin, sub-acute undulation, narrow and retuse apex with rounded angles, smooth cell wall, broadly elliptical from top view, chloroplast parietal, cells 25.5-27.8 μm long and 21.3-23.6 μm broad, isthmus 5 μm broad.

Voucher No.R83; Date. 7th September 2019. New to Rudrasagar. New to Tripura.

26. *Cosmarium contractum* Kirchner (Pl. I, Fig.26)

Das and Adhikary 2014, p.103, pl.7, f.16

Cells are solitary, longer than the broad, deeply constricted sinus, widely open, semicells circular with big central pyrenoids, smooth cell wall; cells 23-35 μm long, 6.5 μm broad, isthmus 3.5 μm broad.

Voucher No.R83; Date. 7th September 2019.
New to Rudrasagar.

27. *Cosmarium contractum* Krichner var. *minutum* (Delponte) Coesel (Pl. I, Fig.27)

Das and Keshri 2016, p.102, Pl.IV, f.107, 110
Moderately small cells, 1.2 times larger than the broad, deep median constriction is present, opening of sinus is wide ad sharp angled; broadly rounded semicells with elliptic apex; axial chloroplast with single median pyrenoid; smooth cell wall; length of the cell is 26-28 μm and breadth is 20-23 μm , size of the Isthmus is 7-9 μm ;

Voucher No.R61; Date. 6th September 2019.
New to Rudrasagar. New to Tripura. New to North East India.

28. *Cosmarium cucurbitinum* (Bisset) Lutkemuller var. *subpolymorphum* (Nordstedt) Teiling (Pl. I, Fig.28)

Prasad and Misra 1992, p.157, pl.22, f.4
Cells are of medium size, length is two times longer than the breadth, moderately constricted, isthmus is broad, sub elliptical semicells with slightly narrowed apex, cell wall minutely punctate; chloroplasts having two pyrenoids in each of the semicells, length of the cell 39-41 μm , breadth of the cell is 39-41 μm , isthmus 36 μm .

Voucher No.R85; Date. 7th September 2019.
New to Rudrasagar. New to Tripura. New to North East India.

29. *Cosmarium cycladatum* Turner (Pl. I, Fig.29)

Das and Keshri 2016, p.102, Pl.IV, f.105, 106
Medium sized cells, 49 μm long and 33 μm broad, isthmus 10 μm . 1.5 times longer than the broad; semicircular semicells; deep median constriction, closed sinus; narrow basal angles, lateral walls moderately convex which attenuated to form broadly rounded apex; granulately crenate lateral margins, crenulations broad with two minute spines at two angles each, two series of similar crenulations just below the margins; semicells having a bunch of elongate thickenings

extending below the apex; smooth cell wall.

Voucher No.R105; Date. 8th September 2019.
New to Rudrasagar. New to Tripura.

30. *Cosmarium cohnii* (Nobilis) Keshri et Das (Pl. I, Fig.30)

Das and Keshri 2016, p.100, Pl.V, f.125, 126
Large cells, elongate and cylindrical, 1.5 times longer than the broad, shallow median constriction, widely open notch of sinus; sub-cylindrical semicells, lateral margins evenly convex, slightly tumid to the apex which is broadly rounded, cell wall verrucate, verrucae large, granular, closely arranged, numerous; face of the semicells with similar concentric large granules all over the body; 37 μm long and 44 μm broad, isthmus 14 μm ;

Voucher No.R22; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

31. *Cosmarium dorsitruncatum* (Nordstedt) G.S.West var. *Pseudoscenedemus* (West et G. S West) Krieger et Gerloff (Pl. I, Fig.31)

Das and Keshri 2016, p.104, Pl.VI, f.191, 192
Medium sized cells, 1.3 times longer than the long; deep median constriction, closed sinus; open outwardly; flat trapeziform with rounded basal angles, flatly truncate apex, single axial chloroplast with a median pyrenoid having one semicells each; 25 μm long and 34 μm broad, isthmus 12 μm .

Voucher No.R63; Date. 6th September 2019.
New to Rudrasagar. New to Tripura. New to North East India.

32. *Cosmarium favum* West et. G. S. West var. *indicum* Keshri & Das (Pl. I, Fig.32)

Das and Keshri 2016, p.104, Pl.VI, f.201, 202
Cells are large about 1.2 times broader than long; deep median constriction, dilated sinus at the apex, inflated outwardly but closed basal margins of semicells; rectangular and reniform, convex lateral margins, broadly oval apex; cell wall is ornamented with decussating rows of large granules around each one of which is an oval and circular crease with deep

punctuations.

Voucher No.R71; Date. 6th September 2019. New to Rudrasagar, New to Tripura. New to North East India.

33. *Cosmarium freemanii* West et G. S. West var. *verrucosum* Scott and Prescott (Pl. I, Fig.33)

Ahmed *et al.* 2007, p.234

Length of the cell is 28-40.5 µm, width is 28.3-30.4 µm, median diameter at the base of semicells is 23.0-27.5 µm, width of isthmus is 5.0-8.8 µm. Cell apex 10-15 µm broad, elliptical top view, two parallel rows of small spines encircling cell can be seen from top view, three warts on each side of the semicells at the pole.

Voucher No.R122; Date. 9th September 2019. New to Rudrasagar. New to Tripura. New to North East India.

34. *Cosmarium hammeri* Reinsch var. *hammeri* (Pl. I, Fig.34)

Das and Keshri 2016, p.107, Pl.IV, f.124

Medium sized cells, 1.3 times longer than the broad, deep median constriction, sinus is linear, closed sinus except in the extremities, trapeziform cells in face view, broadly rounded basal and apical angles, slightly concave sides, broad and truncate apex; wall is smooth, single chloroplast in each semicells having a pyrenoid; 27µm long, 20µm broad, isthmus 6 µm.

Voucher No.R1; Date. 7th September 2019. New to Rudrasagar. New to Tripura. New to North East India.

35. *Cosmarium impressulum* Elfving var. *impressulum* (Pl. I, Fig.35)

Das and Keshri 2016, p.108, Pl.VII, f.211, 212

Small cells, 1.6-1.7 times longer than the broad, deeply constricted median incision, sinus closed and dilated at the apex, semicircular elongated semicells, rounded basal angles, nearly parallel lateral margins with 4 undulations, retuse at the apex; face of the semicells smooth; 25µm long and 15µm broad, isthmus 4µm.

Voucher No.R127; Date. 9th September 2019. New to Rudrasagar. New to Tripura. New to North East India.

36. *Cosmarium miscellum* Skuja and Messikommer (Pl. I, Fig.36)

Das and Adhikary 2014, p.114, pl.8, f.25

Cells are longer than the wide, deep constriction, broad sinus, closed, semicells with broad base, narrow towards the apex, cell wall with fine granulation, semicells 40-44 µm long, and 35-37 µm broad, isthmus 16.6 µm broad.

Voucher No.R86; Date. 7th September 2019. New to Rudrasagar. New to Tripura.

37. *Cosmarium nitidulum* De Not. (Pl II, Fig.37)

Prasad and Misra 1992, p.157, pl.22, f.21

Cells are small in size; length is more than the broad, constriction is deep, narrowly linear sinus with slightly dilated apex; semicells are truncate - circular semicells, basal angles are rounded and tapering, apex is flattened with straight margin; minutely punctate; elliptic from top view; chloroplast is monocentric with only one pyrenoid, length of the cell is 33-37.6 µm, breadth is 24-26µm, size of the isthmus is 4.5-6µm.

Voucher No.R11; Date. 22nd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

38. *Cosmarium nudum* (Turner) Gutwinski (Pl. II, Fig.38)

Das and Keshri 2016, p.113, pl.VII, f.207, 208

Medium sized cells, as long as the broad, deeply constricted, 3 undulate sinus, closed at the apex, semicircular semicells with lateral walls having faint undulations, basal angles produced and thickened, broadly rounded apex with thick wall; cell wall smooth; axial chloroplast, 2 in each semicells with single median pyrenoids; 27µm long and 27µm broad, isthmus 6 µm.

Voucher No.R2; Date. 22nd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

39. *Cosmarium obsoletum* (Hantzsch) Reinsch (Pl. II, Fig.39)

Das and Keshri 2016, p.114, pl.VII, f.205, 206
Medium sized cells, 1-1.2 times longer than the broad, deeply constricted, linear sinus, closed except the extremities, semicircular semicells, depressed, apex broadly rounded, mammillately thickened basal angles, slightly convex lateral angles; porous cell wall; axial chloroplast, 2 in each semicells with single centrally placed pyrenoids; 37µm long and 44µm broad, isthmus 14µm.

Voucher No.R129; Date. 9th September 2019.
New to Rudrasagar. New to Tripura. New to North East India.

40. *Cosmarium phaseolus* Brebisson ex Ralfs var. *phaseolus f. minus* Boldt (Pl. II, Fig.40)

Das and Keshri 2016, p.115, Pl.V, f.143
Small cells, long as the broad, deeply constricted median incision, narrow sinus, dilated at the apex; narrowly reniform semicells, smooth cell wall; axial chloroplast, single pyrenoid in each semicells; 23µm long and 26µm broad, isthmus 3 µm;
Voucher No.R29; Date. 23rd July 2018; New to Rudrasagar Lake. New to Tripura. New to North East India.

41. *Cosmarium porteanum* W. Archer forma *pseudoporteanum* Keshri & Das (Pl. II, Fig.41)

Das and Keshri 2016, p.116, Pl.VI, f.187, 188
Cells are small, elongated than the typical one, 1.5 times longer than the broad, deep median constriction, broadly open sinus with rounded extremities; circular semicells, granulate, rounded granulates are arranged in 7 vertical series in face view; single axial chloroplast with one pyrenoid.
Voucher No.R107; Date. 8th September 2019.
New to Rudrasagar. New to Tripura. New to North East India.

42. *Cosmarium reniforme* (Ralfs) Archer var. *minor* Ireneé-Marie (Pl. II, Fig.42)

Das and Keshri 2016, p.123, Pl.V, f.154, 155

Medium sized cells, length of the cell is 23µm and breadth is 19 µm, size of the Isthmus is 4 µm; 1.3 times longer than the broad; deep median constriction, narrow and closed sinus; shape of the semicells are reniform; granulate cell wall, solid and rounded granules, obliquely decussating series, margins of the semicells having 16 granules.

Voucher No.R73; Date. 6th September 2019.
New to Rudrasagar. New to Tripura. New to North East India.

43. *Cosmarium retusiforme* (Wille) Gutwinski (Pl. II, Fig.43)

Das and Keshri 2016, p.123, Pl.V, f.154, 155
Cells are small in size, 1.3-1.4 times longer than the broad; median constriction is deep, narrow sinus, sub pyramidal semicells with truncate apex; broadly rounded basal angles, slightly convex lateral margins, retusely pointed towards the pole; smooth cell wall; axial chloroplasts, each semicell having a pyrenoid.

Voucher No.R18; Date. 22nd July 2018. New to Rudrasagar. New to Tripura.

44. *Cosmarium subauriculatum bogoriense* (Bern.) Burrelly in Bour. and Manguin (Pl. II, Fig.44)

Ahmed *et al.* 2007, p.276
Cells are 47.19 µm long, median diameter at the base of semicells 58.08µm, width of isthmus is 23.89µm, cell apex is 11-12µm broad.

Voucher No.R32; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

45. *Cosmarium quadrifarum* var. *oblonga* Kant and Gupta (Pl. II, Fig.45)

Das and Adhikary 2014, p.116, pl.8, f.26
Cells oblong, sub cylindrical, almost spherical semicells, smooth cell wall, deeply constricted medium isthmus, small plate like chloroplast, one in each semicells; cells 18-20µm long and 10µm broad, isthmus 5.5µm broad.

Voucher No.R84; Date. 7th September 2019.
New to Rudrasagar. New to Tripura. New to

North East India.

Genus- *Arthrodesmus* Ehrenberg ex Ralfs

46. *Arthrodesmus convergens* Ehrenberg ex Ralfs var. *incrassatus* Gutwinski (Pl. II, Fig.46)

Das and Keshri 2016, p.60, Pl.III, f.68, 69 Medium sized cells, 1.3 times longer than the broad without spines; deep median constriction, widely open sinus with rounded extremities; transversely sub elliptic semicells, convex basal margins.

Voucher No.R86; Date. 7th September 2019. New to Rudrasagar. New to Tripura. New to North East India.

Genus- *Staurodesmus* Teiling

47. *Staurodesmus dejectus* (Brebisson ex Ralfs) Teiling (Pl. II, Fig.47)

John *et al.* 2005, p.579, pl.142, f.I

Cells are triradiate, 16-27 μm wide, 10-27 μm long, widely open sinus, rounded internally or v-shaped, slightly elongate isthms, 5-10 μm wide; cup shaped semicells with short and slightly divergent spines.

Voucher No.R25; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

Genus- *Xanthidium* Ehrenberg ex Ralfs

48. *Xanthidium antilopaeum* var. *hebridarum* West et G.S. West (Pl. II, Fig.48)

Das and Adhikary 2014, p.123, pl.9, f.14

Cells are medium sized, deeply constricted, broadly open sinus, transversely elliptic semicells, three spines on each side in the lateral margins, one apical, one sub-apical, one median spine curved upwards, median almost horizontal, cell wall punctate, cells 51-58 μm long and 40 μm broad, isthmus 9-11 μm broad.

Voucher No.R27; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

49. *Xanthidium variabile* (Nordstedt) West et G.S. West (Pl. II, Fig.49)

John *et al.* 2005, p.585, pl.142, f.I

Small cells, without spines, 18-23 μm wide and

20-26 μm long, deeply constricted with acutely angles, open sinus, rectangular semicells, straight apex, and rounded angles. 1-5 spines. strongly protuberant central area.

Voucher No.R33 Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

Genus- *Pleurotaenium* Nageli

50. *Pleurotaenium ehrenbergii* (Ralfs) Delponte var. *ehrenbergii* (Pl. II, Fig.50)

Das and Keshri, 2016, p.155, Pl.VII, f.211, 212

Cells are large, 13-15 times longer than the broad, slightly constricted, semicells with basal conspicuous basal inflation and usually with one or two smaller swelling beyond; margins of the semicells slightly tapered to a rounded-truncate apex where there are 6 rounded tubercles visible in face view; wall punctate; chloroplasts in longitudinal, 4 parietal bands in face view, with many pyrenoids, cells 621-626 μm long and 23-30 μm broad, isthmus 23-25 μm broad.

Voucher No.R35; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

Genus- *Micrasterias* Wallich

51. *Micrasterias alata* Wallich (Pl. II, Fig.51)

Das and Keshri 2016, p.146, Pl. XXIX, f.505

Medium sized cells, length of the cell is 104-145 μm and breadth is 111-133 μm , Isthmus having size 16-18 μm ; sinus is deep, closed in inner quarter and then open in wide; divided lateral lobes, simple lower member, divisions deep; swollen lobules at the base. narrowly tapering tridentate extremities, vertically extending upper margin of the upper membrane, parallel to the polar lobe, separated by a deep and narrow incision, polar lobes are slender having parallel sides; two slender diverging processes are abruptly branching at apex; smooth cell wall present.

Voucher No.R24; Date. 23rd July 2018. New to Rudrasagar. New to Tripura.

52. *Micrasterias foliaceae* Bailey ex Ralfs

(Pl. II, Fig.52)

Das and Keshri 2016, p.147, Pl. XXIX, f.499,500

Moderate sized rectangular cells, cells are slightly longer than the broad; length of the cell is 51-94 μm and breadth is 58-77 μm , size of the Isthmus is 15-22 μm ; sometimes present singly or it may be united in filaments where the polar lobes are interlocking, sub linear sinus; lateral lobes are divided in a fashion of second and third order, horizontal lower lobules and diverging upper lobules, upper part is reduced to become a conical projection; distinctive polar lobes, basal narrow part having erect parallel sides, greatly expanded upper three quarters lobe, broad and deep sub rectangular excavation; stout angles which is ending in two widely divergent teeth is present in the middle of apex; in the depressed portion of the apex two stout unequal spines on each side is available, narrowly fusiform semicells in vertical view, obliquely rhomboidal central part, unequal apical spines are present.

Voucher No.R23; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

53. *Micrasterias pinnatifida* Ralfs (Pl. II, Fig.53)

Das and Keshri 2016, p.149, Pl. XXX, f.515, 516

Cells are small and slightly longer than the broad; length of the cell is 50-63 μm and breadth is 58-61 μm , size of the Isthmus is 7-9 μm constriction is deep, sinus is closed; undivided, conical, horizontally extended single lateral lobes, just before the bifid extremity, horizontally spreading polar lobes, slightly convex apex, smaller polar extensions than the lateral lobes, extremities bifid; deep semicircular sub polar incision; wall is smooth; chloroplasts are having erect and curved lamellae with few pyrenoids.

Voucher No.R26; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

Genus- *Spondylosium* Brebisson ex Kutzing

54. *Spondylosium nitens* f. *major* Turner (Pl.

II, Fig.54)

Das and Keshri 2016, p.149, Pl. XXX, f.515, 516

Cells small, almost as long as broad, deeply constricted, sinus open and U shaped; cells united to form a long filament; semicells flatly triangular to oblong, apical and lateral angles rounded; cell wall smooth; chloroplast axial with single pyrenoid per semicell, cells 24-29 μm long and 22-25 μm broad, isthmus 7-8 μm .

Voucher No.R37; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

Order- Chlorococcales

Family- Hydrodictyaceae

Genus: *Pediastrum* Meyen

55. *Pediastrum duplex* Meyen var. *duplex* (Pl. II, Fig.55)

Yamagishi 2010, p.155, pl.60, f.1

Colonies with large perforations; flat, curved, quadrangular marginal cells, with two narrow or stout, long horn like processes having obtuse or truncate ends; inner cells nearly like to the marginal cells but without long processes; smooth cell wall; cells 6-21 μm broad and 6-30 μm long with the process.

Voucher No.R64; Date. 6th September, 2019. New to Rudrasagar.

56. *Pediastrum duplex* Meyen var. *gracillimum* West et G.S. West (Pl. II, Fig.56)

Yamagishi 2010, p.155, pl.60, f.5

Cells are narrow; large perforations with colonies, 2 long horns like processes having truncate apex on the marginal cells; smooth cell wall; cells 9-22 μm broad, 12-32 μm long with the process.

Voucher No.R30; Date. 23rd July 2018. New to Rudrasagar.

57. *Pediastrum tetras* (Ehr.) Ralfs (Pl. II, Fig.57)

Prasad and Misra 1992, p.11, pl.1, f.9

Colonies 8 celled, circular, 22-24.6 μm in diameter, cells without intercellular spaces, marginal cells divided into 2 lobes with a deep single linear incision, inner cells 4-6 sided with

a single linear incision, cells 6.3-6.6 μm in diameter.

Voucher No.R87; Date. 7th September, 2019. New to Rudrasagar.

58. *Pediastrum tetras* var. *excisum* (Rabenh.) Hansg (Pl. II, Fig.58)

Prasad and Misra 1992, p.12, pl.1, figs.12

Colonies are of 4 celled, adjacent lobes to incision are more or less deeply concave, cell walls are smooth; colonies 24-27 μm , length of the cell 12-14 μm , breadth of the cell is 10-11.5 μm .

Voucher No.R31; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

59. *Pediastrum tetras* (Ehrenberg) Ralfs var. *tetras* (Pl. II, Fig.59)

Yamagishi 2010, p.157, pl.62, f.8

Colonies are without perforations; basal area of the marginal cells are triangular or trapezoid, deep incisions results into 2 triangular processes; outer side of the processes is deeply concave; inner cells are five to seven angled having a deep incision; smooth cell wall; marginal cells are 12 μm broad and 8 μm long; inner cells are 14 μm broad and 8 μm long.

Voucher No.R14; Date. 22nd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

60. *Pediastrum tetras* var. *tetraodon* (Corda) Hansgirg (Pl. II, Fig.60)

Das and Adhikary 2014, p.140, pl.11, f.14

Colonies 4 celled, outer margins of the peripheral cells with deep incisions, the lobes extended into horn like processes, cells 7-8 μm long and 9-10 μm broad.

Voucher No.R89; Date. 7th September 2019. New to Rudrasagar. New to Tripura. New to North East India.

61. *Pediastrum simplex* Meyen var. *simplex* (Pl. II, Fig.61)

Yamagishi 2010, p.156, pl.62, f.5.

Colonies with large perforations; flat, curved, quadrangular marginal cells, slender horn like

process; inner Y shaped young colonies; triangular to trapezoid adult colony; marginal cells 6-30 μm broad and 12-52 μm long; inner cells 7-26 μm broad and 7-35 μm long.

Voucher No.R39; Date. 23rd July 2018. New to Rudrasagar Lake.

Order- Volvocales

Family- Volvocaceae

Genus- *Volvulina* Playfair

62. *Volvulina steinii* Playfair (Pl. II, Fig.62)

Yamagishi 2010, p.141, pl.54, f.14

Ellipsoid to spherical colonies, 16 celled, all cells are of same size; hemispherical to lenticular cells, peripherally and separately arranged in a gelatinous conical envelope, distinct or indistinct individual cell envelope; single and cup shaped chloroplasts with a single pyrenoid.

Voucher No.R36; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

Family- Botryococcaceae

Genus- *Dictyosphaerium* Nageli

63. *Dictyosphaerium pulchellum* Wood (Pl. II, Fig.63)

Yamagishi 2010, p.141, pl.54, f.14

Cells are spherical, attached to the radiately elongated thread from colonial center, 3-10 μm in diameter.

Voucher No.R28; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

Family- Scenedesmaceae

Genus- *Coelastrum* Nageli

64. *Coelastrum pulchrum* Schmidle (Pl. II, Fig.64)

Yamagishi 2010, p.145, pl.52, f.13

Cells spherical to ovoid, with a single low process at the outer face, connected to one another by a single, thick strand radially projected from the basal portion of the cell; cells 6-16 μm in diameter

Voucher No.R34; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

65. *Coelastrum scabrum* Reinsch (Pl. II, Fig.65)

Das and Adhikary, 2012, p.152, pl.12, f.8
Colonies spherical, 16 celled, cells angular globose with three or more truncate processes from the outer surfaces, cells 7.5-8.5 μm in diameter.

Voucher No.R40; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

66. *Coelastrum sphaericum* Naegeli (Pl. II, Fig.66)

Yamagishi 2010, p.145, pl.52, f.13
Cells ovoid to cone-shaped, with truncate free ends, connected to one another by short gelatinous processes at basal portion of each cell; cells 6-25 μm in diameter.

Voucher No.R38; Date. 23rd July 2018. New to Rudrasagar. New to Tripura.

Genus-*Scenedesmus* Meyen**67. *Scenedesmus acuminates* (Lagerheim) Choda** (Pl. II, Fig.67)

John *et al.*, 2005, p.388, pl.97.f.A
Single coenobia with 2 to 4 row, linearly or alternately arranged cells, curved and semicircular which is often surrounded by mucilage, cells are 2-5.5 μm wide and 9.2-34.5 μm long, spindle shaped, sigmoid and arc like to sigmoid, concave outermost side, tapering towards the extend apices.

Voucher No.R20; Date. 22nd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

68. *Scenedesmus acutus* var. *globosus* Hortobagyi (Pl. II, Fig.68)

Das and Adhikary 2014, p.159, pl.12, f.33
4 celled coenobia, broadly elliptical cells, acute tip, cells 15-17 μm long and 4-6 μm broad.

Voucher No.R131; Date 9th September 2019. New to Rudrasagar. New to Tripura. New to North East India.

69. *Scenedesmus arcuatus* var. *platydiscus***G.Smith** (Pl. II, Fig.69)

Das and Adhikary 2014, p.159, pl.12, f.34
Coenobia 4-8 celled, arranged in a flat curved, double series; cells oblong-elliptic; 4-6 μm in diameter and 10-12 μm long.

Voucher No.R92; Date. 7th September 2019. New to Rudrasagar. New to Tripura. New to North East India.

70. *Scenedesmus armatus* var. *armatus* Chodat (Pl. II, Fig.70)

Das and Adhikary 2014, p.159, pl.2, f.50
Coenobia 8 celled, arranged in a linear series, a long spine from each of the terminal cell only; cells 17.2 μm long and 5.3 μm broad.

Voucher No.R91; Date. 7th September 2019; New to Rudrasagar.

71. *Scenedesmus bicaudatus* Dedussenko (Pl. II, Fig.71)

Das and Adhikary 2014, p.155, pl.12, f.20
Coenobia 4 celled, cells 16.9-17.5 μm long and 5.4-5.8 μm broad, a long spines from one of the poles of the terminal cells only, the spines of two terminal cells alternating with each other.

Voucher No.R103; Date. 8th September 2019; New to Rudrasagar.

72. *Scenedesmus bijugatus* f. *parvus* G.M.Smith (Pl. III, Fig.72)

Das and Adhikary 2014, p.159, pl.12, f.34
Coenobia of 4 celled, linearly arranged, and oblong to ovoid, smooth cell wall, cells are 10.5-13 μm long and 3 μm broad.

Voucher No.R115; Date 8th September 2019; New to Rudrasagar. New to Tripura. New to North East India.

73. *Scenedesmus bijugatus* var. *gravenitzii* Bernard (Pl. III, Fig.73)

Das and Adhikary 2014, p.160, pl.12, f.37
Eight celled colonies, ellipsoid to obtuse poles, arranged in alternating series with adjacent cells in contact only along a short portion of the length, cells 12.7-13.3 μm long and 3.8-4.5 μm broad.

Voucher No.R4; Date. 22nd July 2018. New to Rudrasagar. New to Tripura. New to North East

India.

74. *Scenedesmus brasiliensis* Bohlin (Pl. III, Fig.74)

Das and Adhikary 2014, p.156, pl.12, f.22

Coenobia 4 celled, cells cylindrical or slightly ellipsoid with attenuated apices, longitudinal ridge from pole to pole on each side of the cell with 1-3 small teeth, 10-25µm long and 2-7µm broad.

Voucher No.R90; Date. 7th September 2019. New to Rudrasagar. New to Tripura.

75. *Scenedesmus carinatus* (Lemmermann) Chodat var. *carinatus* (Pl. III, Fig.75)

Yamagishi 2010, p.149, pl.64, f.1

Cells are fusiform with beaked ends, appears in a linear series; distinct longitudinal ridge on each side having forked teeth on each of the end; distinct long spine on each end of the outer cells; cells are of 3-8µm broad, 8-28µm long.

Voucher No.R93; Date. 7th September 2019. New to Rudrasagar. New to Tripura. New to North East India.

76. *Scenedesmus disciformis* (Chodat) Fott & Komarek f. *disciformis* (Pl. III, Fig.76)

Yamagishi 2010, p.149, pl.54, f.13.

Cells are curved to long ovoid having rounded ends, cells are arranged communicating with closely the sides and ends are in double series in 8 celled colony, sometimes 4 celled from connecting in a linear series; cells are 3µm broad, 8µm long.

Voucher No.R72; Date. 6th September 2019. New to Rudrasagar. New to Tripura. New to North East India.

77. *Scenedesmus dimorphus* (turpin) Kuetzing (Pl. III, Fig.77)

Prasad and Misra 1992, p.37, pl.5, f.3,4

Colonies having 4-8 cells, arranged in linear or alternate fashion, cells are fusiform in shape, inner cells are straight but the outer cells are lunate and strongly curved acute and sharp apices.

Voucher No.R114; Date. 8th September 2019. New to Rudrasagar. New to Tripura.

78. *Scenedesmus ellipticus* Corda (Pl. III, Fig.78)

Das and Adhikary 2014, p.160, pl.12, f.39

4 celled coenobia, arranged cells in linear manner, elliptical to cylindrical with obtuse end; 18.8 - 21.2 µm long and 7 µm broad in size.

Voucher No.R3; Date. 23rd July 2018. New to Rudrasagar.

79. *Scenedesmus humanensis* Jao (Pl. III, Fig.79)

Yamagishi 2010, p.151, pl.65, f.9

Cells are long and ellipsoid to cylindrical, acute ends and longitudinal ridges on each of the side, contacting with each other they are arranged linearly, without a perforation between the cells; cell wall minute and granulate; cells are of 5-7µm broad and 12-22 µm long.

Voucher No.R66; Date. 6th September 2019. New to Rudrasagar. New to Tripura. New to North East India.

80. *Scenedesmus intermedius* Chodat (Pl. III, Fig.80)

Das and Adhikary 2014, p.156, pl.12, f.24

Coenobia 4 celled, cell elliptical with rounded end, cell arranged linearly, but inner cells in alternating positions, outer cells with spines on each pole, but inner cells in alternating positions, outer cells with spines on each pole, cells 12-13.5 µm long and 3-4 µm broad

Voucher No.R41; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

81. *Scenedesmus longispina* Chodat (Pl. III, Fig.81)

Das and Adhikary 2014, p.151, pl.12, f.41

Coenobia 4-8 celled, elliptic cells arranged linearly, apices slightly arcuate; present on each cell of the terminal cells, spines longer than the cell length, cells 13-17µm long and 4-6 µm broad.

Voucher No.R45; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

82. *Scenedesmus praetervisus* Chodat (Pl. III, Fig.82)

Yamagishi 2010, p.151, pl.65, f.9

Cells are cylindrical to long –ovoid ,with narrowly rounded ends, arranged contactly with the sides in a linear series; inner cells with a lateral longitudinal ridge on both sides; terminal cells with 2-3 ridges ;all cells with 1-3 short teeth at both ends; cells 3-8 μm broad,8-18 μm long.

Voucher No.R44; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

83. *Scenedesmus protuberans* Fritsch and Rich (Pl. III, Fig.83)

Das and Adhikary 2014, p.158, pl.2, f.50

Coenobia of 4 celled, cells are attached laterally except at the ends, cells 7.5-8.5 μm long and 2.5-3 μm broad, very long spines present at each pole of the terminal cell, the spines much longer than the length of the cell, spines 13.5 μm long.

Voucher No.R93; Date. 7th September 2019. New to Rudrasagar.

84. *Scenedesmus pseudopoliensis* Hortobagyi (Pl. III, Fig.84)

Das and Adhikary 2014.p.162, pl.12, f.46

2 celled coenobia, present in a linear series, oblong cells with slightly truncate ends, long spines at the each pole of terminal cells, curved spines,11.8-13 μm long and 3.6-4.5 μm broad.

Voucher No.R126; Date. 9th September 2019. New to Rudrasagar. New to Tripura.

85. *Scenedesmus quadricauda* f. *granulatus* Hortobagyi (Pl. III, Fig.85)

Das and Adhikary 2014, p.162, pl.12, f.46

Coenobia 4-8 celled, cells elliptical with obtuse end, terminal cells with spines on each poles, outer margin of the two outer cells slightly convex, cells 10-13 μm long and 3.5-5 μm broad.

Voucher No.R132; Date.9th September 2019. New to Rudrasagar. New to Tripura. New to North East India.

86. *Scenedesmus quadrispina* Chodat (Pl. III, Fig.86)

Das and Adhikary 2014, p.163, pl.12, f.48

Coenobia 4 celled cells 4-5.5 μm broad and 16-18 μm long, obtuse end, short spines present on both the poles of the terminal cells, cells are cylindrical.

Voucher No.R94; Date. 7th September 2019. New to Rudrasagar. New to Tripura. New to North East India.

87. *Scenedesmus spinosus* Chodat (Pl. III, Fig.87)

Das and Adhikary 2014, p.158, pl.12, f.30

Coenobia 2-4 celled, cells oblong –ellipsoid arranged in a linear series, single short spine arising at each pole of terminal cell, straight, one spine at the middle of terminal cell, spines 4-8 μm long, cells 1.5-4 μm broad and 7-10 μm long.

Voucher No.R67; Date. 6th September 2019. New to Rudrasagar. New to Tripura. New to North East India.

Genus- *Dimorphococcus* Braun**88. *Dimorphococcus lunatus* Braun** (Pl. III, Fig.88)

Yamagishi 2010, p.142, pl.55, f.8

Group of 4 cells, syncoenobia upto 64 cells,32-150 μm wide,4.5-25 μm wide and 9-25 μm long, outer cells are kidney shaped, elongated inner cells, bridge like connections with adjacent cells, broadly rounded apices with bluntly truncated cells, wall thickenings are thick like.

Voucher No.R46; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

Genus- *Crucigenia* Morren**89. *Crucigenia rectangularis* (Naegeli) Gay** (Pl. III, Fig.89)

Yamagishi 2010, p. 146, pl.54, f.9

Colonies of 4 cells, rectangular in outline; cells ovoid to long-ovoid, with narrowed outer ends; cells 4-9 μm in broad,6-14 μm long,

Voucher No.R74; Date. 6th September, 2019. New to Rudrasagar. New to Tripura. New to

North East India.

90. *Crucigenia neglecta* Fott & Ettl (Pl. III, Fig.90)

Yamagishi 2010, p.146, pl.54, f.9

Colonies of 4 cells, rectangular in outline; cells straight cylindrical, sometimes slightly bent outward, with rounded ends; cells 3-5 μm in broad, 5-9 μm long,

Voucher No.R93; Date.7th September, 2019.New to Rudrasagar. New to Tripura. New to North East India.

Family-Ankistrodesmaceae

Genus-Ankistrodesmus Corda

91 *Ankistrodesmus bernardii* Komarek (Pl. III, Fig.91)

Yamagishi 2010, p.122, pl.51, f.4

Cells are narrow, long and fusiform, slightly sigmoidally curved, united each other with their middle part and helicoidally twisted each other with in the center of the colony; cells 1-3 μm in diameter, 36-68 long.

Voucher No.110; Date. 8th September, 2019. New to Rudrasagar. New to Tripura. New to North East India.

92. *Ankistrodesmus falcatus* (Corda) Ralfs (Pl. III, Fig.92)

Yamagishi 2010, p.123, pl.51, f.7

Cells are needle shaped, slightly twisted or curved, joined each other radially each other with their middle part; cells 2-6 μm in diameter, 25-65 μm long.

Voucher No.R108; Date. 8th September, 2019. New to Rudrasagar. New to Tripura.

93. *Ankistrodesmus spiralis* (Turner) Lemm var. *fasiculatus* G. M. Smith (Pl. III, Fig.93)

Prasad and Misra 1992, p.27, pl.4, f.8

Curved or sigmoid cells, towards acute apices attenuated in the middle, in the median portion one is twisted to another in the colonies having 34-39 cells, free apical portion; 36-40 μm long and 2-4 μm broad, diameter of the colonies 30 μm

Voucher No.R72; Date. 6th September, 2019.New to Rudrasagar. New to Tripura. New

to North East India.

Genus: *Kirchneriella* Schmidle

94. *Kirchneriella lunaris* (Krichner) Moebius (Pl. III, Fig.94)

Yamagishi 2010, p.127, pl.57, f.7

Cells are crescent in shape, compressed, curved strongly, tapering into sharp ends; roundly convex in outer sides, inner sides are V or U shaped, cells 7 μm broad, 14 μm long.

Voucher No.R12; Date. 7th September, 2019. New to Rudrasagar

Genus: *Monoraphidium* Komarkova-Legnerova

95. *Monoraphidium indicum* Hindak. (Pl. III, Fig.95)

Yamagishi 2010, p.130, pl.58, f.6

Cells are thin and long and fusiform, bowed arcuately, and twisted to some extent, slowly tapering towards the pointed ends, cells are 4 μm broad, 86 μm long.

Voucher No.R75; Date. 6th September, 2019.New to Rudrasagar. New to Tripura. New to North East India.

96. *Monoraphidium mirabile* (West et G.S. West) Pankow (Pl. III, Fig.96)

Yamagishi 2010, p.130, pl.58, f.7

Cells are long, cylindrical and fusiform, slightly twisted, tapering gradually towards the thin pointed ends; cells are 3 μm broad, 76 μm long.

Voucher No.R116;

Date.8th September,2019.New to Rudrasagar. New to Tripura.New to North East India.

Family-Neochloridaceae

Genus-*Tetraedron* Kutzing

97. *Tetraedron trigonum* (Naegeli) Hansgirg var. *gracile* (Reinsch) De Toni (Pl. III, Fig.97)

Yamagishi 2010, p.121, pl.67, f.11

Flat cells, triangular or rarely tetrahedral; slightly concave sides; angles tapering into a stout and straight spine; cell sides are 8-22 μm long and spines 8-12 μm long.

Voucher No.R47; Date. 23rd July 2018. New to

Rudrasagar. New to Tripura. New to North East India.

98. *Tetraedron tumidulum* (Reinsch)

Hansgirg (Pl. III, Fig.98)

Yamagishi, 2010, p.121, pl.68, f.2

Cells are pyramidal in shape, triangular, hardly quadrangular; sides are concave; angles barely rounded; spines are absent; cells 10-18 μ m in diameter.

Voucher No.R47; Date. 23rd July 2018. New to Rudrasagar.

Phyllum-Euglenophyta

Class-Euglenophyceae

Order-Euglenales

Family-Euglenaceae

Genus- *Euglena* Ehrenberg

99. *Euglena acus* Ehrenberg var. *acus* (Pl. III, Fig.99)

Yamagishi 2010, p.37, pl.15, f.1

Cells are long and fusiform, truncate anterior ends; a long spine like cauda at the posterior end; paramylon bodies are long and rod shaped; cells are 8 μ m in diameter, 99 μ m long with the cauda.

Voucher No.R51; Date. 23rd July 2018. New to Rudrasagar.

100. *Euglena limnophila* Lemmermann var. *swirenkoi* (Arnoldi) T.G. Popova (Pl. III, Fig.100)

John *et al.* 2005, p.153, pl.34.f.D, E

Cells 7.5-12 μ m wide, 24-48 μ m long, spindle shaped or broadly spindle shaped, sometimes bent; apically truncate anterior end; posterior end tapering to a sharp tail piece, curved usually; slightly striated pellicle; numerous chloroplast, small disc shapes without pyrenoids; paramylon bodies, ring like or rod shaped, several flagellum shorter than cell length, eyespot small, located towards end of canal.

Voucher No.R48; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

101. *Euglena spathirhynchus* Skuja (Pl. III,

Fig.101)

Das and Adhikary 2014, p.115, pl.2, f.57

Cells are forming spindle like appearance, 40-62 μ m long and 18-19.5 μ m broad, cells are terminating towards a hyaline acute tail part which is 11.1-17.4 μ m broad, it is having the tendency to widen up the middle portion; numerous chloroplasts are present.

Voucher No.R56; Date. 23rd July 2018. New to Rudrasagar. New to Tripura.

Genus- *Phacus* Dujardin

102. *Phacus acuminatus* Stokes var. *acuminatus* (Pl. III, Fig.102)

Yamagishi 2010, p.47, pl.21, f.1

Shapes of the cells are subcircular to ovoid; narrowly rounded anterior ends and bilobed; at the posterior end broadly rounded cauda is present; caudae short and blunt straight; two paramylon bodies, plates are circular; cells are 26 μ m in diameter, 35 μ m with the cauda.

Voucher No.R53; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

103. *Phacus carinatus* Pochmann (Pl. III, Fig.103)

Yamagishi 2010, p.49, pl.22, f.1

Broad to ovoid and subcircular; high and longitudinal blunt ridge in entire place, narrowly rounded anterior end; broadly rounded posterior end with a thin and short curved cauda; ring like paramylon bodies; cells 30-36 μ m long without the cauda; cauda is 6-8 μ m long.

Voucher No.R59; Date. 23rd July. New to Rudrasagar. New to Tripura. New to North East India.

104. *Phacus heimii* Lefevre (Pl. III, Fig.104)

Yamagishi 2010, p.53, pl.24, f.6

Cell are asymmetric ovoid, constituting longitudinal ridges on the dorsal side, one of the lateral margin is near to straight and the other lateral margin is to some extent swelled; Anterior end is narrow and deeply bilobed; ends of the posterior side are abruptly and truncately rounded which results into conical

cauda; caudae is short and pointed, base is triangular, two paramylon bodies, circular in shape; cells 26 μm in diameter, 39 μm long with the cauda.

Voucher No.R55; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

105. *Phacus mammillatus* Philipose (Pl. III, Fig.105)

Yamagishi 2010, p.55, pl.27 f.1

Asymmetric and triangular cells, twisted, broadly rounded corners; asymmetric lateral sides, broadly swelled and straight one side; longitudinal furrow on dorsal and ventral face, asymmetrically pyriform shape, asymmetrically narrowed anterior end, bilobed and rounded, concaved at the center, three paramylon bodies, ring like; cells are 29-31 μm long.

Voucher No.R4; Date. 22nd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

106. *Phacus onyx* Pochmann var. *onyx* (Pl. III, Fig.106)

Yamagishi 2010, p.57, pl.27 f.1

Broad to ovoid cells; narrow anterior ends, broadly rounded posterior ends, short and slightly curved inward cauda; broadly swelled lateral sides; notch in one side with two bulgs.5-6 μm long cauda.

Voucher No.R58; Date.23rd July. New to Rudrasagar. New to Tripura. New to North East India.

107. *Phacus pyrum* (Ehrenberg) F.Stein (Pl. III, Fig.107)

John *et al.* 2005, p.167, pl.40, f. K, L

Cells are 7 μm wide,27-30 μm long, spindle to ovoid in shape, a little bit of flattened ;broadly rounded anterior end, posterior end bears a long and pointed tail piece, spirally ribbed pellicle, ring like paramylon bodies, small and numerous chloroplasts are present; non prominent eye spot.

Voucher No.R2; Date. 22nd July 2018. New to Rudrasagar. New to Tripura. New to North East

India.

108. *Phacus suecicus* (Lemmermann) Lemmermann var. *suecicus* (Pl. IV, Fig.108)

Yamagishi 2010, p.61, pl.29, f.3

Broad to ovoid cells; narrow and truncately rounded anterior end with a distinct papilla; broadly rounded posterior end with a curve cauda; longitudinally striated granules; two paramylon bodies in the lateral side, cells are 22 μm in diameter, caudae 6-8 μm long, without the cauda it is 30-40 μm .

Voucher No.R5; Date. 22nd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

109. *Phacus suecicus* (Lemmermann) Lemmermann var. *oidion* Pochmann (Pl. IV, Fig.109)

Yamagishi 2010, p.57, pl.27 f.1

Cells long, broad ellipsoid; cells 19-28 μm in diameter, long without the cauda, caudae 6-12 μm long.

Voucher No.R50; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

110. *Phacus triqueter* (Ehrenberg) Dujardin var. *triqueter* (Pl. IV, Fig.110)

Yamagishi 2010, p.62, pl.30 f.1

Cells broad and ovoid, but not symmetrical; slightly swelled ,usually broadest below the median line; dorsal surface with a high longitudinal ridge ,and low triangular in apical view; narrowly rounded anterior ends ;posterior ends abruptly ,asymmetrically narrowed ,with a cauda; caudae thin, long, inwardly curved; two paramylon bodies ;large ring like circular plate; cells 30 μm in diameter,68 μm long without the cauda, caudae 13 μm long.

Voucher No.R68; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

111. *Phacus undulatus* (Skvortzov) Pochmann var. *undulatus* (Pl. IV, Fig.111)

Yamagishi 2010, p.63, pl.30, f.7

119. *Lepocinclis salina* Fritsch var. *salina* (Pl.IV, Fig.119)

Yamagishi 2010, p.44, pl.20, f.4

Cells are ovoid; narrow and rounded anterior ends, in times slightly bilobed; broad and rounded posterior ends, lacks cauda; cytoplasm contains large spherical nucleus and various discoid chloroplasts; numerous paramylon bodies, small ovoid shaped grains are present, cells 24µm in diameter, 43µm long.

Voucher No.R95; Date. 7thSeptember, 2019. New to Rudrasagar. New to Tripura. New to North East India.

Genus-*Trachelomonas* Ehrenberg emend. Deflandre**120. *Trachelomonas acanthostoma* Stokes var. *acanthostoma*** (Pl. IV, Fig.120)

Yamagishi 2010, p.76, pl.38, f.3

Tests are subglobose to short broad and ellipsoid; narrowly rounded anterior ends; broadly rounded posterior ends; flagellum apertures without a collar, but encircled by irregular short blunt spines; densely punctate walls; tests 22-28 µm in diameter, 26-37 µm long.

Voucher No.R98; Date. 7thSeptember, 2019. New to Rudrasagar. New to Tripura. New to North East India.

121. *Trachelomonas armata* (Ehrenberg) Stein var. *armata* (Pl. IV, Fig.121)

Yamagishi 2010, p.76, pl.37, f.1

Ovoid to broad ellipsoid tests; considerably rounded and narrowed anterior ends; broadly rounded posterior ends; absence of collar in the flagellum aperture, sometimes surrounded by thickening of wall; roughly beset with stout and long spines at the posterior end, wall is punctate all over; the test is 22-29 µm in diameter, 29-37 µm long.

Voucher No.R7; Date. 7th September, 2019. New to Rudrasagar.

122. *Trachelomonas australica* (Playfair) Deflandre var. *rectangularis* Deflandre (Pl. IV, Fig.122)

Yamagishi 2010, p.79, pl.44, f.19

Tests are cylindrical; anterior and posterior ends angularly rounded; lateral sides straight and parallel; flagellum apertures without a collar, but surrounded by a circular of short spines; wall densely covered with short and blunt spines, tests 18-20 µm in diameter, 31-36 µm long.

Voucher No.R88; Date. 7thSeptember, 2019. New to Rudrasagar. New to Tripura. New to North East India.

123. *Trachelomonas bacillifera* var. *minima* f. *minima* (Pl. IV, Fig.123)John *et al.* 2005, p.173, pl. 42, f. I.

The size of the lorica is 18-26µm wide, ellipsoidal to subspherical in shape; blunt rod like spines on the wall of whole lorica, dark brown to greenish in colour; collar is absent on the apical pore.

Voucher No.R77; Date. 6th September, 2019. New to Rudrasagar.

124. *Trachelomonas curta* Da Cunha var. *tubigera* Deflandre (Pl. IV, Fig.124)

Yamagishi 2010, p.83, pl.39, f.15

Tests compressed globose; flagellum apertures with a cylindrical collar extending inwardly to the test cavity; wall thick, smooth; tests 24-28 µm in diameter, 20-24 µm long.

Voucher No.R80; Date. 6thSeptember, 2019. New to Rudrasagar. New to Tripura. New to North East India.

125. *Trachelomonas guttata* Middelhoek (Pl. IV, Fig.125)

Yamagishi 2010, p.86, pl.41, f.14

Tests broad, ovoid to ellipsoid; broadly rounded anterior ends, without a collar; posterior ends broadly rounded; wall micropuncts to shallowly scrobiculate; tests 18-22 µm in diameter, 23-29 µm long.

Voucher No.R78; Date. 6thSeptember, 2019. New to Rudrasagar. New to Tripura. New to North East India.

126. *Trachelomonas hispida* (Perty) Stein var. *crenulatocollis* (Maskell) Lemmermann (Pl. IV, Fig.126)

Cells are broad and ovoid ;narrowly rounded anterior ends, bilobed; rounded posterior ends, short and curved cauda; irregular notches at the lateral side ;one paramylon body, plate circular; cells are 32 μm in diameter,33 μm long without the cauda;6 μm long caudae
Voucher No.R60; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

Genus- *Lepocinclis* Perty

112. *Lepocinclis acuta* Prescott (Pl. IV, Fig.112)

Das and Adhikary 2014, p.196, pl.15, f.16
Cells are club shaped,31-34 μm long and 13.3-15.7 μm broad, slightly narrowed at the anterior end .extended at the posterior end into sharp cauda, pellicle right handed striated, paramylon bodies 2 ,plate shaped and bend.
Voucher No.R43; Date. 23rd July 2018. New to Rudrasagar. New to Tripura. New to North East India.

113. *Lepocinclis fusiformis* (H.J.Carter) Lemmermann (Pl. IV, Fig.113)

John *et al.* 2005, p.159, pl. 38, f. I
Cells are 15-32.5 μm wide and 35-42.5 μm long, look like lemon shaped, oval in shape, conically narrowed anterior end with a small cavity at the apex, ,in the posterior end a short narrow and conical tail piece ;left handed striae pellicle, light yellow or colourless, numerous minute chloroplasts , disc shaped large one or more paramylon bodies.
Voucher No.R75; Date. 7th September, 2019. New to Rudrasagar.

114. *Lepocinclis fusiformis* (Carter) Lemmermann var. *fusiformis* (Pl. IV, Fig.114)

Yamagishi 2010, p.41, pl.18, f.8
Cells broad fusiform, nearly truncate anterior end, posterior end with a short caudal process; cells 12-39 μm in diameter, 25-51 μm long.
Voucher No.R70;Date. 6th September, 2019. New to Rudrasagar. New to Tripura. New to North East India.

115. *Lepocinclis fusiformis* (Carter)

Lemmermann var. *minor* Chu (Pl. IV, Fig.115)

Yamagishi 2010, p.41, pl.18, f.10
Cells broad fusiform, with a small short caudal process; cells 10-14 μm in diameter, 12-20 μm long.
Voucher No.R75; Date. 6th September, 2019. New to Rudrasagar. New to Tripura. New to North East India.

116. *Lepocinclis longistriata* Chu (Pl. IV, Fig.116)

Yamagishi 2010, p.42, pl.19, f.4
Fusiform cells, narrowly round anterior end, bilobed at one side, narrow posterior end with a short cauda; longitudinally striated periplast, two ring like paramylon bodies,13-16 μm in diameter.
Voucher No.R69; Date.6th September, 2019. New to Rudrasagar. New to Tripura. New to North East India.

117. *Lepocinclis ovum* (Ehrenberg) Lemmermann var. *buetschlii* (Lemmermann) Conrad (Pl. IV, Fig.117)

Yamagishi 2010, p.43, pl.19, f.8
Cells ovoid to broad ellipsoid; narrowly rounded anterior ends ,narrowly rounded posterior end with a straight short cauda having swelling at the base, paramylon bodies two, ring like plate, ,cells 17-24 μm in diameter, 34-42 μm long with the cauda; caudae 2-3 long.
Voucher No.R93; Date. 7thSeptember, 2019. New to Rudrasagar. New to Tripura. New to North East India.

118. *Lepocinclis ovum* (Ehrenberg) Lemmermann var. *obesa* Chu (Pl. IV, Fig.118)

Yamagishi 2010, p.44, pl.19, f.10
Cells globose to ovoid, anterior end slightly conically projected and bilobed; posterior ends narrowed, with a short cauda; caudae 2-8 μm long.
Voucher No.R95; Date. 7thSeptember, 2019. New to Rudrasagar. New to Tripura. New to North East India.

John *et al.* 2005, p.176, pl. 42, f. F

The size of lorica is 15-25µm wide and 23-37 µm long, broadly oval in shape, wall is covered with minute sharp spines and very small punctuate or brown punctuate, apical pore is surrounded by toothed collar.

Voucher No.R111;

Date. 8th September, 2019. New to Rudrasagar. New to Tripura. New to North East India.

127. *Trachelomonas oblonga* Lemmermann var. *truncata* Lemmermann (Pl. IV, Fig.127)

Yamagishi 2010, p.91, pl.42, f.13

Tests cylindrical oblong, anterior ends and posterior ends truncately rounded, flagellum apertures without a collar; lateral sides nearly straight; wall smooth; tests 9-11 µm in diameter, 12-16 µm long.

Voucher No.R78; Date. 7thSeptember, 2019. New to Rudrasagar. New to Tripura. New to North East India.

128. *Trachelomonas planktonica* Swirenko var. *oblonga* Drezepolski (Pl. IV, Fig.128)

Yamagishi 2010, p.92, pl.43, f.4-5

Tests are oblong to broad-ellipsoid; anterior and posterior ends broadly rounded; lateral sides straight and parallel; flagellum apertures with short, cylindric collar: wall densely punctate; tests 17-20 µm in diameter, 21-28 µm long without the collar; collars 3-4 µm long.

Voucher No.R117; Date. 8thSeptember, 2019. New to Rudrasagar. New to Tripura. New to North East India.

129. *Trachelomonas robusta* Swirenko emend. Deflandre (Pl. IV, Fig.129)

John *et al.* 2005, p.174, pl.42, f. K

Lorica 15.5-25 µm wide, 20-32 µm long, ellipsoidal to broadly ovoid; walls only rarely with strong spines, smooth or punctate, yellowish brown; apical pore surrounded by a circle of spines; chloroplasts 8-10 in each cell.

Voucher No.R79; Date. 7thSeptember, 2019. New to Rudrasagar. New to Tripura. New to North East India.

130. *Trachelomonas schewiakoffii*

Skvortzov (Pl. IV, Fig.130)

Yamagishi 2010, p.95, pl.44, f.11

Tests broad and ellipsoid; anterior ends conically rounded; posterior ends narrowly produced into a blunt apex; flagellum apertures with short and cylindrical collar; wall micropunctate; but, tests 20-22 µm in diameter, 34-38µm long without the collar; collar 2-3 µm long.

Voucher No.R98; Date. 7thSeptember, 2019. New to Rudrasagar. New to Tripura. New to North East India.

131. *Trachelomonas sculpta* Balech var. *sculpta* (Pl. IV, Fig.131)

Yamagishi 2010, p.95, pl.44, f.10

Tests globose; flagellum apertures without a collar, but surrounded by an annular thickening; wall with closely, distributed, polygonal depressions; tests 18-21 µm in diameter.

Voucher No.R133; Date. 9thSeptember, 2019. New to Rudrasagar. New to Tripura. New to North East India.

132. *Trachelomonas similis* Stokes var. *similis* (Pl. IV, Fig.132)

Yamagishi 2010, p.96, pl.44, f.19

Tests broad, ovoid to ellipsoid; anterior and posterior ends broadly rounded; flagellum apertures with a cylindric, curved collar; wall punctate; tests 16-21 µm in diameter, 20-26 µm long without the collar, collars 3-4 µm long.

Voucher No.R99; Date. 7thSeptember, 2019. New to Rudrasagar. New to Tripura. New to North East India.

133. *Trachelomonas superba* Swirenko emend. Deflandre var. *superba* (Pl. IV, Fig.133)

Yamagishi 2010, p.98, pl.45, f.11

Tests broad, ellipsoid to sub globose; flagellum apertures without a collar, but surrounded by a circular of short spines around the mouth; wall thick, punctuated all over and covered with short and long spines, tests 30-36 µm in diameter, 38-45µm long.

Voucher No.R100; Date. 7thSeptember, 2019.

New to Rudrasagar. New to Tripura. New to North East India.

134. *Trachelomonas sydneyensis* Playfair var. *sydneyensis* (Pl.IV, Fig.134)

Yamagishi 2010, p.98, pl.46, f.1

Tests are broad ellipsoid or long ovoid; broadly rounded posterior and anterior ends; flagellum aperture constitutes a low collar which is surrounded by a circle of sharp spines around the mouth; tests are 22-26µm in diameter, 32-45µm long.

Voucher No.R117; Date.8th September,2019; New to Rudrasagar.New to Tripura. New to North East India.

135. *Trachelomonas volvocina* Ehrenberg var. *volvocina* (Pl.IV, Fig.135)

Yamagishi 2010, p.100, pl.46, f.5

Tests are globose to subglobose; collar is absent at the flagellum aperture which is surrounded by a ring like thickening; wall is exceptionally punctate, smooth; tests are 19-25µm in diameter.

Voucher No.R121; Date.9th September, 2019. New to Rudrasagar.New to Tripura.New to North East India.

136. *Trachelomonas woycickii* Kochzwarra var. *woycickii* (Pl. IV, Fig.136)

Yamagishi 2010, p.102, pl.47, f.2

Tests are globose; flagellum apertures without a collar; but sometimes with a slightly raised rim around the aperture; wall covered with fine short spines; test 20-30 µm in diameter.

Voucher No.R110;

Date.8th September,2019.New to Rudrasagar. New to Tripura. New to North East India.

137. *Trachelomonas zingeri* Roll var. *zingeri* (Pl.IV, Fig.137)

Yamagishi 2010, p.102, pl.47, f.3-5

Cylindrical shaped tests; truncately rounded anterior ends; broadly rounded posterior ends; nearly straight and parallel lateral sides; flagellum aperture is without collar; dense and sparse puncts in the wall with sharp spines; tests are 22-26µm in diameter, 48-60µm long

Voucher No.R118; Date.8th September, 2019.New to Rudrasagar. New to Tripura.New to North East India.

Genus-*Strombomonas* Deflandre

138. *Strombomonas australica* (Playfair) Deflandre var. *australica* (Pl.IV, Fig.138)

Yamagishi 2010, p.64, pl.32, f.1-3

Long tests, sometimes slender fusiform or broadly fusiform; gradually narrowed anterior ends into a long and cylindrical neck with flared and serrated mouth; a long cauda at the posterior end; walls are rough with granules densely; 17-18µm broad tests and 64-90 µm with the neck and cauda.

Voucher No.R112; Date.8th September, 2019. New to Rudrasagar.New to Tripura.New to North East India.

DISCUSSION

During the exploration, altogether 138 phytoplankton taxa belonging to Chlorophyta (98) and Euglenophyta (40) were identified from Rudrasagar Ramsar site of Tripura. Out of which, a total of 106 species belonging to the groups Chlorophyta (69) and Euglenophyta (37) were recorded for the first time from the North East India and 127 number of species from the state of Tripura.

Among the members of Chlorophycean algae, *Cosmarium* with 23 species was the most dominant genus followed by *Scenedesmus* (22), *Closterium* (9), *Staurastrum* (7), *Pediastrum* (7), *Euastrum* (4), *Coelastrum* (3), *Micrasterias* (3), *Ankistrodesmus* (3), *Xanthidium* (2), *Crucigenia* (2), *Monoraphidium* (2), *Tetraedron* (2), *Netrium* (1), *Arthrodesmus* (1), *Staurodesmus* (1), *Pleurotaenium* (1), *Spondylosium* (1), *Volvulina* (1), *Dictyosphaerium* (1), *Dimorphococcus* (1) and *Kirchneriella* (1) respectively. The genus *Trachelomonas* with 18 species was the dominant amongst the Euglenophycean members which was followed by *Phacus* (10), *Lepocinclis* (10), *Euglena* (3) and *Strombomonas* (1) respectively.

Dominance of Chlorophycean taxa always indicates the healthier condition of a water body (Kshirsagar 2013) as they suppose to help in maintaining the ecological balance of any freshwater bodies (Palmer 1980). In contrast, presence of the different genera like *Trachelomonas*, *Phacus*, *Euglena* belonging to Euglenophyta along with *Scenedesmus*, *Closterium* and *Staurastrum* under Chlorophyta in Rudrasagar lake indicated its vulnerability to organic pollution. Expansion of agricultural land in the vicinity, intensive farming and fishing in and around the lake and increasing number of visitors could be attributed to its organic pollution and subsequent increase of Palmer's organic pollution tolerant genera in the lake. For the sustainability of the lake as well as the maintenance of the natural food web, biomonitoring of the lake using algae as tool is suggested.

The authors are thankful to MoEF & CC (Govt. of India) for providing financial assistance to undertake the work. They are also thankful to Head, Department of Botany, Gauhati University for providing laboratory facilities developed under DST-FIST, UGC-SAP to carry out the research work.

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