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Descriptive Study of Some Epiphytic Algae (Non diatoms) After Restoration of Mesopotamian Marshes, Southern of Iraq

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Abstract

The present study conducted on epiphytic algae from four host macrophytes *(Phragmites australisTrinex, Typha domengensis Pers, Ceratophyllum demersum L., and Potamogeton pectinatus L.)* in restoring marshes of Mesopotamian marshes, southern Iraq. The study was carried in Al- Hawizah marshes. Three classes, nine orders, twenty three genera and thirty-four species of epiphytic algae were described in the studied restoration marshes.

Keywords; Description study, Epiphytic algae, Wetlands, Mesopotamian marshes**.**

Introduction

The Mesopotamian marshes had been suffered severely drought during the previous period as one of the environmental destroyed by the ex-government's policy despite being the most [1, 2]. Various projects had been carried out on these marshes after the rehabilitation [3, 4]. Previous studies did not focus on the Al-Hawizah marshes in contrast with other Mesopotamian marshes[5, 6 , 7]. Recently a few works on phytoplankton and primary production were published on these marshes [8 , 9], but had no studies carried out on thebenthic algae in previous studies until the current work finish in these marshes, but only one part of the whole epiphytic study had published by the same authors[10]. Mitsch & Gosselink[11] mentioned the importance of the contributions of epiphytic algae in nontidal freshwater marshes. Other authors were explaining the ecological importance of all types of benthic algae in aquatic systems [12 , 13]. Many environmental factors affected the distribution, diversity and abundance of epiphytic algae on macrophytes in marshes; such as light, temperature, type and growth phase of host plant, depth, nutrients, etc. [14 ,15 ,16] . Some studies focused on the qualitative and quantitative changes in population dynamic of epiphytic algae on different host macrophytesin different aquatic systems [17 , 18 , 19 , 20 , 21 , 22 , 23]. The present work aimed to study the systematic account for epiphytic algae on four species of host macrophytes in Al-Hawizah marshes and to fill the knowledge gap in non-diatomic epiphytic algae in marshes for the first time.

Materials and methods

Epiphytic algal Samples were collected from four host macrophytes (*P. australisTrinex*,*T. domengensis* Pers , *C. demersum* L. and *P. pectinatus* L). Samples were taken from under water surface

due to seasonal abundance and uneven local distribution in Al-Hawizah marshes. The plant parts were placed in polyethylene bags and kept wet for laboratory examination. Separation of epiphytic algal community from their host was carried out by scraping and manual shaking for 30 minutes [23]. The epiphytic algal cells were preserved in 4% formalin and mounted in glycerin as (temporally slides) identification. Several references were used for identification of epiphytic algae [24,25,26,27,28,29,30,31,32,33].

Detailed studies of identifications of algae were made under an Olympus microscope with Camera attachment and microns (µm) used to describe the diameter of each examined taxon. All the identified algae were arranged systematically following Prescott [25]. The identification references were listed beside each taxon.

Results and discussions

In this studya thirty –four species of epiphytic algae were identified and described. These species belonged to twenty three genera, four classes and three divisions. All these epiphytic algae is non diatomic species. The diatomic species were alreadydescribed by authors [10] in the same marshes. The morpho-taxonomic description listedwitheach identified taxon in addition of their photography. These divisions and classes were as follows:

Division (1): Chlorophyta

Class: Zygnematophyceae

Class: Chlorophyceae

Division (2): Chrysophyta

Class: Chrysophyceae

Division (3): Cyanophyta

Class: Cynophyceae

3.1.The following are a description of some identified algae :

Class (1): Zygnematophyceae
Order(1): Zygnematales
Family (1): Desmidiaceae
Genus: *Cosmarium*
Species: *Cosmarium botrytis* Meneghinii (pl.1, fig. 1)

[28]882,pl.3 figs.46,47; [31] 94, pl.3, fig.24.
Cell wall warted or granulated, long: 72 µm , wide: 54.6 µm , 15.6 µm wide at isthmus, sinus deep and closed, opening to the isthum; semicell pyramidal with rounded basal and truncate apex; chloroplast with 2-pyrenoids.

Species: *Cosmariumleave* Rabenhorst (pl. 1, fig.2)

[27] 52, pl.5, figs. 80, 81, 85, 86 ; [28] pl. , figs.; [33] 9, pl.1, fig. 8.
Smooth cell wall, long: 18.2 µm , wide: 15.6µm, 5.2µm wide at isthmus; med deep, sinus deep and

closed, opening to the isthmus; semi cell pyramidal with rounded basal and truncate apex; chloroplast with 1-pyrenoid.

Species: *Cosmarium meneghinii* Breb.ex Ralfs (pl. 1, fig. 3)

[31] 94, pl.3, fig.29; [28] 884, pl.4, figs. 74-75 ;[27] 52, pl.6, fig. 84.
Cell wall smooth, long: 16.5 µm ,wide:12.5 µm, wide at isthmus 2.5 µm .

Genus: *Euastrum*
Species: *Euastrum insulare* (Wittr) Roy. (pl. 1 fig. 4)

[28] 882, pl.2, figs. 35-38)
Cell solitary, not very flattened; each semi cell has apical and lateral lobes, median incision not distinct as in ***E .dubium***, cell 30.5 µmlong, 22.5 µm in diameter, isthmus 5.2 µm in diameter.

Genus: *Staurastrum* MeyenexRalfs (pl. 1, fig. 5)
Species: *Staurastrum* sp.

[25] 938 , pl. 6 . fig. 16 ; [29] 377 , fig. 87).
Apex of the cell extended into 3 or more arms or lobes. The arms usually extended radiating so that the cell appears star- shaped or triangular when seen vertical or end view; extended arms at the apical angles; arms in one plane, with two or more small series of spines or verrucae along the arms and on the apex and body of the central axis of the semi cell , Cell 30 µm in diameter ; 40 µm long .

Class (2) : Chlorophyceae
Order(1) : Microsporales
Family : Microsporaceae
Genus: *Microspora*
Species: *Microspora pachyderma* (Wille) Lagerheim (pl. 1, fig. 6 a,b)

[25], 108, pl.8, fig.3).
Plants unbranched; unattached filaments of uniseriately-arranged cylindrical cells 10 µm in diameter; 15 µm long. Cell wall thick and lamellate composed of 2 sections overlapping in the mid region. Chloroplast a folded plate covering most of the cell wall padded parietal plate or net; pyrenoids lacking**.**

Order (2) : Chaetophorales
Family (1): Chaetophoraceae
Genus: *Aphanochaete*
Species: *Aphanochaete repens* A. Braun (pl. 1, fig. 7)

[25] 125 , pl. 17 figs. 2, 3 ; [29] , 322, fig. 2k).
Filaments are creeping or entwind about larger Filamentous such ***Cladophora*** ; uniseriate ; unbranched , cells irregularly , inflatened or sub cylindric, 7-10 µm in diameter , setae without sheathand arising from the upper free walls ; the setae long and very slender , 2-5 µm wide at the base.

Family(2) : Coleochaetaceae
Genus: *Coleochaete*
Species: *Coleochaete scutata* deBrébisson (pl. 1 fig. 8)

[25] , 130 , pl. 18,fig.9 ;[29] , 332, fig. 2,I
Thallus discoid , circular or raniform in out line. Consisting of onlya prostrate system or prostrate and erect systems . Filaments compactly adjoined laterally , radiating from a common center. Cells eachcontain a single parietal plate like chloroplast , one or two large pyrenoids . Cells quadrangular 32.5 µm in diameter and 42.5 µm long .

Order(3) : Cladophorales
Family : Cldophoraceae
Genus: *Pithophora*
Species: *Pithophora varia* Wille (pl. 1, fig. 9)

[25], 140, pl. 24, figs. 5, 6).
Filament with branches about the same diameter 60-97 µm; 124-310 µm long.Akinetes variable within in the same filament; ovate, cylindrical or irregularly ovate; 1-3 in a series; 187 µm in diameter, 82.5 µm long.

Order(4) : Chlorococcales
Family(1) : Coelastraceae
Genus: *Coelastrum*
Species: *Coelastrum microporum*Nügeli (pl. 2, fig. 10)

[26] , 97 , pl. 5. figs.108-112;[34] 274 , pl. 4 . fig. 107;[35] 23, fig. 56 ;[25] 230 , pl. 53. fig. 3.
Coenobium spherical . composed of 10- sheathed ovoid cells , with the narrow end out wardly direction ;Cells inter connected by very short ,scarcely discerniblegelatinous processes , leaving small intercellular space ; Cells 10.4 µm in diameter including the sheath ; Colony 15 µm in diameter.

Family(2) : Hydrodictyaceae
Genus: *Pediastrum*
Species: *Pediastrum boryanum* (Turp.) Meneghinii (pl. 2, fig. 11)

[25] 222, pl. 47, fig.9 , pl. 48, figs 1, 3)
Colony entire; cells 6-sided with smooth or granular walls, peripheral cells with outer margins extended into 2 blunt- tippped processes; cells 11.24 µm in diameter, 12.5-15.6 µm long; 16-celled colony, 49.4 µm wide, 54.6 µm long.

Species: *Pediastrum simplex* (Meyen) Lemmermann (pl. 2, fig. 12)

[25] 227, pl. 50, fig.2; [27] 50, pl.3, figs. 24, 27, 29, 31; [28] 41, pl.4, fig. 29).
Colony 8-16 smooth walled cells; Peripheral cells with the outer free wall extendedto from a single tapering horn like processes; cell 22.5µm long and 12.5-17.5 µm in diameter.

Species: *Pediastrum simplex* var. *Clathratum* (pl. 2, fig. 13)

[35] 261, pl.7, fig. 225, 227; [27] 50, pl.3, figs. 25, 26, 30)
Colony 8-32 cells; cells more deeply emarginated and perforations larger and oval round; Peripheral 20 µm long, 12.5 µm in diameter, inner cells 15 µm long, 10 µm in diameter.

Species: *Pediastrumtetras* (Ehr.) Ralfs (pl. 2, fig. 14)

[25] 227, pl. 50, figs. 3, 6)
Colony entire; inner cells with 4 straight sides but with one margin deeply incised; peripheral cells crenate, with a deep incision in the outerfree margin, their lateral marginsadjoined along 2/3 of their length; cells 9.1 µm in diameter, 10.4 µm long.

Species: *Pediastrum tetras* var. *tetraëdron* (Cord.) Rabenhorst (pl. 2, fig. 15)

[26] pl.6, figs. 129; [26], pl.3, fig. 28;[25] 227, pl. 50, fig 7.
Colony8celled, outer margin of peripheral cells with deep incisions; The lobes extend into sharp, horn-like processes; cells 12-15 µm in diameter, 16-18 µm long.

Family(3) : Scenedesmaceae
Genus: *Scenedesmus*
Species: *Scenedesmus quadricauda* (Turp.) de Brébisson (pl. 2, fig. 16)

[34] 257, pl.6, figs. 189, 196;[26] pl.1, figs. 15, 16; [24] 280, pl.64, fig.2.
Colony composed of 4-cylindrical-ovate cells arranged in a single series; outer cells with along spine at each pole; inner cells with spineless walls; cells 7.5-7.8 µm in diameter, 13-15 µm long.

Species: *Scenedesmus arcuatus* var.*platydisca* G.M. Smith(pl. 2, fig. 17)

[35] pl.5, figs. 140-141; [37] 378, fig. 853 ;[25] 275, pl.62, figs. 10-12) .
Plant composed of 8 cells arranged in a flat, rather than a curved, double series; cells oblong-elliptic, 5 µm in diameter**,** 10 µm long.

Family(4) : Oocystaceae
Genus: *Tetraëdron*
Species: *Tetraëdron minimum* (A. Braun) hansgig (pl. 2, fig. 18)

[26] 101, pl.5, fig. 124; [25] 267, pl.60, figs. 12-15)
Cells small, flat, tetragonal, the angles rounded and without spines or processes, margins of the cell concave with one frequently incised; cells 7.5 µm in diameter.

Species: *Tetraëdron muticum* (A. Braun) Hans. (pl. 2, fig. 19)

[25] 267, pl. 60, figs. 16, 17; [35] 234, pl. 1, figs. 13,14).
Cells small, flat, triangular, the angles without spines or furcations; sides of the cells emarginate or slightly convex; cells 12.5 µm in diameter.

Order(5) : Tetrasporales
Family : Palmellaaceae
Genus*: Asterrococcus*
Species: *Asterrococcus limneticus* G.M.Smith (pl. 2, fig. 20)

[25] 86, pl.4, fig.11)
Cells spherical, arranged at some distance from one another in colonies of 4-16 within a colorless homogeneous investing mucilage; chloroplast stellate shape. Cells 11.25- 17.5 µm in diameter; colonies 50-57.5 µm in diameter.

Division(3) : Chrysophyta
Class : Chrysophyceae
Order: Chrysomonadles
Family : Ochromonadaceae
Genus : *Dinobryon*
Species: *Dinobryon sertularia*Ehrenberg (pl. 3, fig. 21)

[25] 378, pl. 98, fig. 10; [32] 227, pl.1, fig. 80).
Colonies slightly diverging. Lorica as fusiform- campanulate, posterior blunt-pointed; lateral margins smooth, convex, narrowed above the mid region and then slightly flaring to a wide mouth, 10 µm in diameter, 32.5 µm long.

Division(3):- Cyanophyta
Class : Cyanophyceae
Order(1) : Chroococcales

Family: Chroococcaceae
Genus:*Gomphosphaeria*
Species: *Gomphosphaeria aponina* var. *cordiformis* wolle (pl. 3, fig.22)

[25] 472, pl.106, fig.6; [37] 32, fig.5;[24] 150, pl.28, figs.1-3.
Cell decidedly cordate, compactly arranged within a thick gelatinousenvelope, individual sheaths distinct; cells 12.5 µm in diameter, 18 µm long.

Genus :*Aphanothece*
Species: *Aphanothece castagnei* (Bréb.) Rabenhorst (pl. 3, fig. 23)

[24] 110, pl.21, fig.8; [25] 467, pl. 105, figs. 5, 6).
Cells ellipsoid or ovate to cylindrical 2.5 µm in diameter, 5-7.5 µm long, densely arranged within a gelatinous, amorphous mass which as olive-green or brownish; cell of various shapes and sizes within the same colony, cell contents finely granular.

Genus : *Colesphaerium*
Species: *Colesphaerium dubium* Grunow. (pl. 3, fig. 24)

[25] 470, pl. 106, figs. 1;[24] 147, pl.28, figs. 10, 11, 14, 15.)
Colony a spherical up to 150µ in diameter or sometimes irregularly shaped with 3-4 colonies placed together up to 300 µm in diameter of spherical cells, or an aggregate of colonies in a common gelatinous envelope; not lamellate up to 8 free floating; cells densely arranged in the colonial envelopes; cell contents homogenous light blue-green; cells 2.5-5 µm in diameter.

Genus: *Microcystis*
Species*: Microcystis aeraginosa* Kützing (pl. 3, fig. 25)

[24] pl.17;[38] 141, pl.1, figs. 1-4 and 10; [39] 76, pl.1, figs 1-2;[25] 456, pl.102, fig. 1-4;) .
An ovate, spherical or irregularly lobed and clathrate colony of numerous spherical cells which are much crowded with distinct hyaline colonial mucilage; cell 3.12-3.75 µm in diameter; spherical generally with gas vacuoles and highly granular.

Family (2) : Synechococcaceae
Genus: *Johannesbaptistia*
Species: *Johannesbaptistia pellucida* (Dickie) Taylor et Drouet (Pl. 3, Fig.26)

[24] 165, pl.32, figs. 14-19;[40] 329, pl.86, fig.1; [18] 81, pl.1, fig.2;[29] 80, fig.6A).
Filaments straight or curved; 12.5-15 µm in diameter round cell at apices of the filaments; short discoid or sphaerico-discoid that are arranged in uniseriate, cylindrical hyaline mucilage filaments; cells 7.5-10 µm in diameter and 2.5-5 µm long.

Order(2): Hormogonales
Family(1) : Oscillatoriaceae
Genus: *Oscillatoria*
Species : *Oscillatoria limnetica* Lemmermann (pl. 3, fig. 27)

[24]226, pl. 37, fig.3 ; [25] 488, pl. 109, fig. 16)
Trichome solitary, straight, not tapering toward the apex, not capitates; cells 2.5 - 6 as long as broad, cells 1.5 µm in diameter, 5 µm long, end cell rounded, calyptras absent.

Species: Oscillatoria limosa (Roth) Agradh (pl. 3, fig. 28)

[24] 206, p. 1-42, fig. 11; [25] 489, pl. 109 fig. 17)
Trichome usually a very dark blue-green to brown or olive-green, more or less straight, tapering little or

not at all toward the apex, apical cell rotund, the outer membrane thickened but without calyptra. Cells 15 µm in diameter, 5 µm long, not constricted at the cross wall, which are granular. Trichomenot infrequently in closed in a homogonous sheath.

Species: *Oscillatoria perornata* Skuja (pl. 3, fig. 29)

[24] 205; pl. 41, figs. 8, 9 , 14;[36] 77, pl. 1, figs. 3-4)
Trichomes erect, apices attenuated and bent or curved, well constricted at the cross-wall, cells 15 µm in diameter and commonly 1/2-1/5 as along as broad, finely granular, end cell depressed.

Species: *Oscillatoria tenuis* Agardh (pl. 3, fig. 30)

[24]222 pl. 42, fig. 15;[39] 78, pl. 1, figs. 18-19; [25] 491, pl. 110, figs. 8, 9 , 14)
Trichomes aggregated to form a blue-green mass, sometimes becoming scattered and appearing singly among other algae. Straight or slightly flexuous, especially at the anterior end, which does not taper; homogonous sheath frequently present. Apical cell convex, smooth, and not capitates; outer membrane sometimes slightly thickened cells 7.5-8.7 µm in diameter, 2.5 µm long; constricted at the cross walls (sometimes only slightly so), which are granular.

Family(2) : Nostocaceae
Genus: *Nostoc*
Species*: Nostoc sphaericum* Vaucher (pl. 3, fig. 31)

[24] 390, pl. 7 ;[25] 525, pl. 12, figs. 6-9).
Thallus free, globose, olive-green colony, when youg becoming flattened somewhat membranous and brown in age; trichome densely entangled; cells globose 5.2 µm in diameter; hetercysts spherical 7.5 µm in diameter.

Genus: *Calothrix*
Species: *Calothrix parietana* (Naeg.) Thuret (pl. 3, fig. 32)

[24] 539-540, pl. 108, figs. 6-8 and pl.115, fig.1; [35] 129,pl.3, figs. 10-13;[37[40, fig,.15;[25] 553, pl. 132, fig.6).
Trichomes solitary or gregarious, forming dark brown patches on submerged substrates, tapering from the base much twisted and contorted, with the basal portion of the trichome, appressed on the substrate; vegetative cell very short, 6.5 µm in diameter, 2.5 µm long; heterocysts 10 µm in diameter, usually basal, quadrate- globose to hemispherical; broader than the cells; sheaths firm, relatively thick and close, not lamellated, becoming yellowish-brown with age.

Genus: *Scytonema* sp. C.A. Agardh. (pl. 4, fig.33 a,b)

[25] 525, pl. 12, figs. 6-9).
A falsely branched, usually thick-sheathed, filament, the false branches ordinarily developing in pairs between heterocysts; forming wooly mats or tangled clots. Trichomes solitary within the sheath, forming hormogonia in the branches. Cells quadrale 3.75 µm in diameter, 3.7µm long. Heterocysts subglobose or quadrangular-globose. Filaments 12.5 µm in diameter, sheath thick 2.5 µm in diameter.

Family(3) : Rivulariaceae
Genus: *Rivularia*
Species:*Rivulariahansgirgii* Schmidle (pl. 4, fig. 34 a,b)

[24] 549, pl. 112, fig. 7.
Trichome unbranched, long, expanded, flat, gelatinous thin, solid, horizontally expanded, generally

intricate and curved; rarely sub parallel, at the end gradually tapering, in the middle 6µm broad, at the apices 2-4 µm ; distinctly torulose; sheath thin, colourless or pale yellow; cells rectangular or subquadrant, at the base than broad; heterocysts basal, single or two together, hyaline, about 7.5 µm diameter.

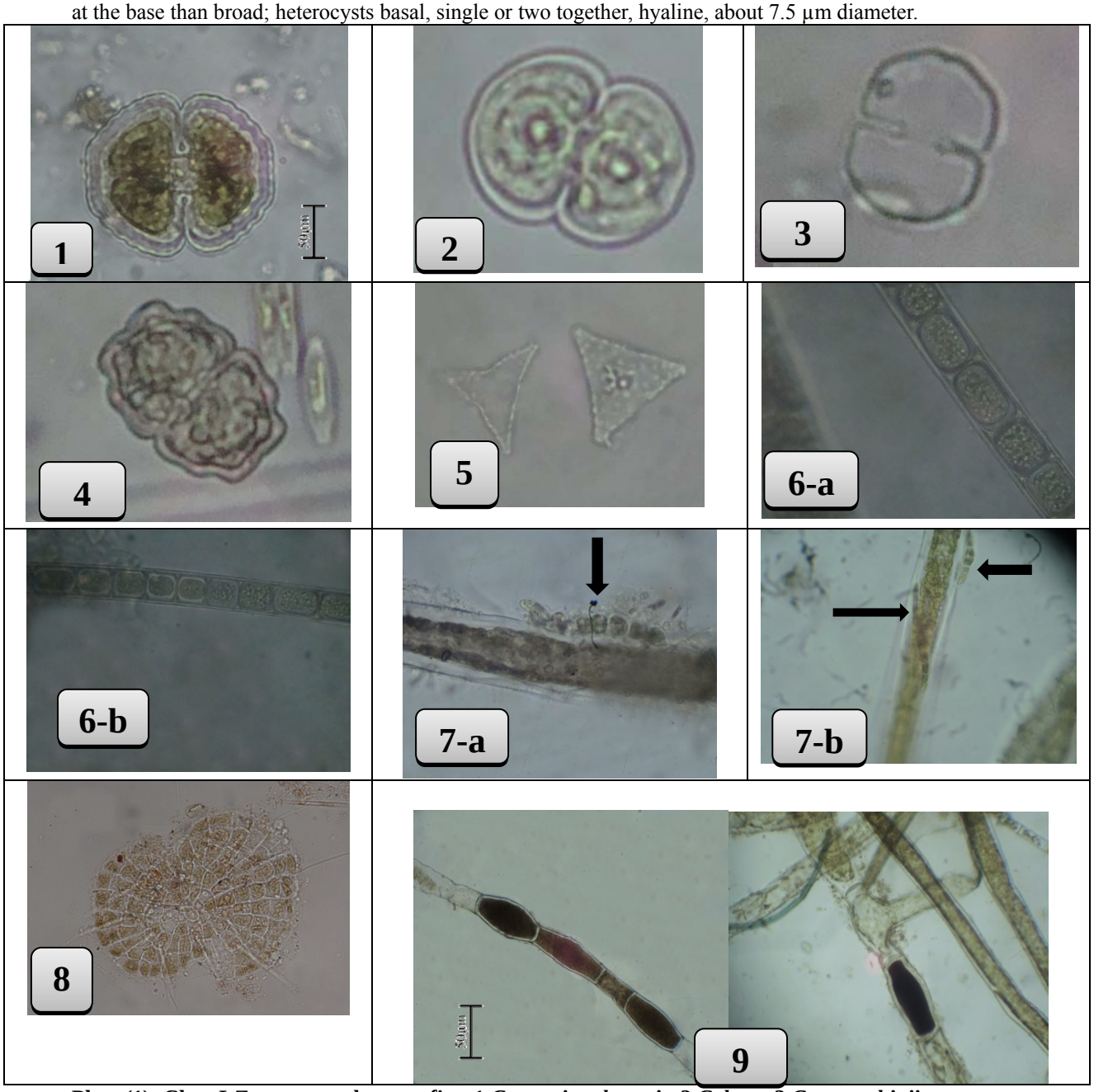

Plate (1): Class I:Zygnematophyceae: figs. 1.*Cosmarium botrytis*, 2.*C. leave*,3.*C. meneghinii*, 4.*Euastruminsulare*, 5.*Staurastrum*sp, Class II: Chlorophyceae ,6. (a,b)*Microsporapachyderma*,7. (a,b) *Aphanochaeterepens*, 8.*Coleochaetescutata*, 9.*Pithophoravaria*(each scale 10µm except figs.1, 9)

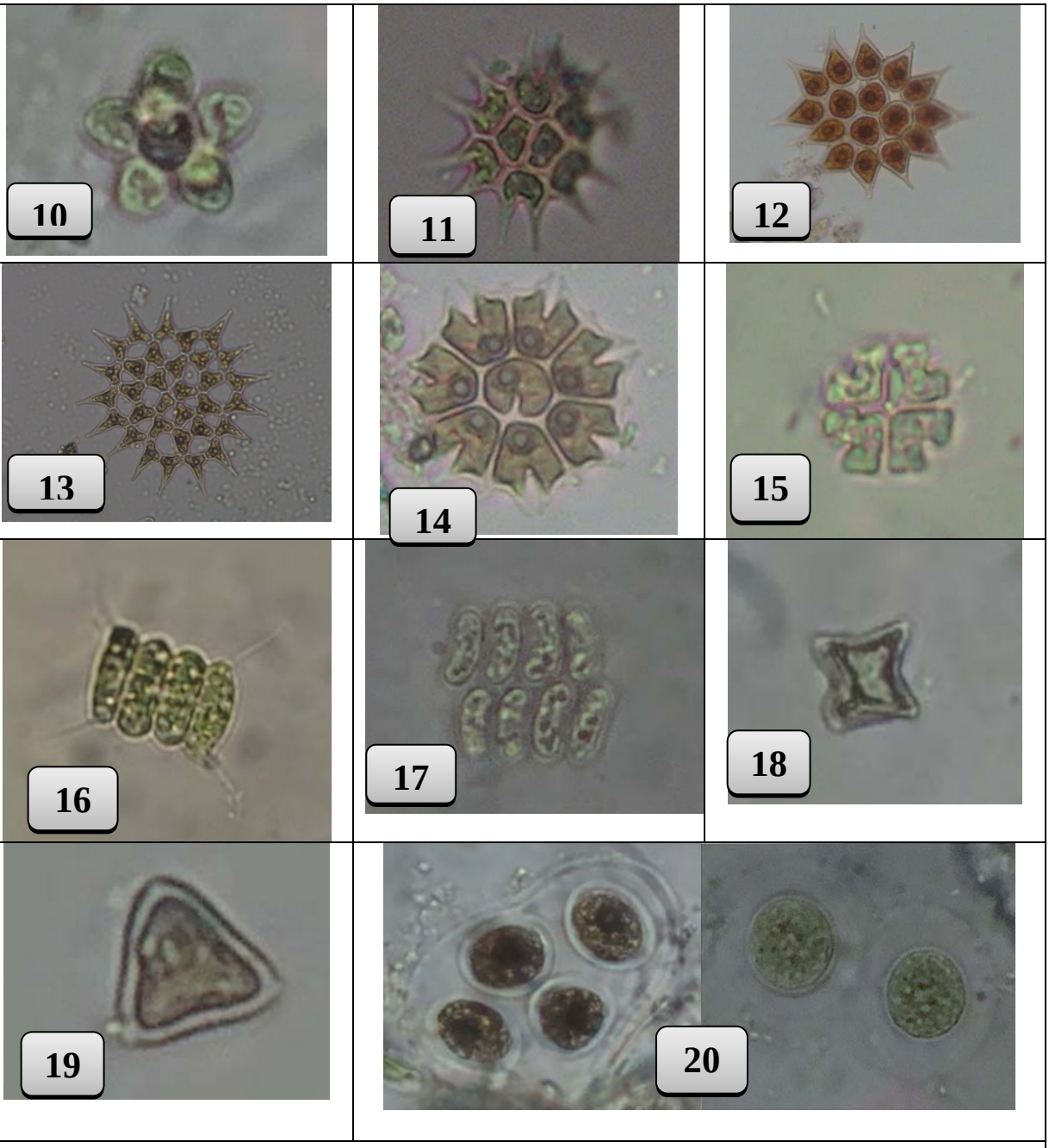

Plate (2): ClassII:Chlorophyceae: figs. 10.*Coelastrummicroporum*, 11.*Pediastrumboryanum*, 12. *P.simplex*,13.*P.simplex* var. *Clathratum*,14. *P.tetras*,15.*P. tetras* var. *tetraëdron*,16.*Scenedesmusquadricauda*, 17.*S. arcuatus*var.*platydisca* ,18.*Tetraëdron minimum*, 19.*T .muticum*, 20.*Asterrococcuslimneticus* .

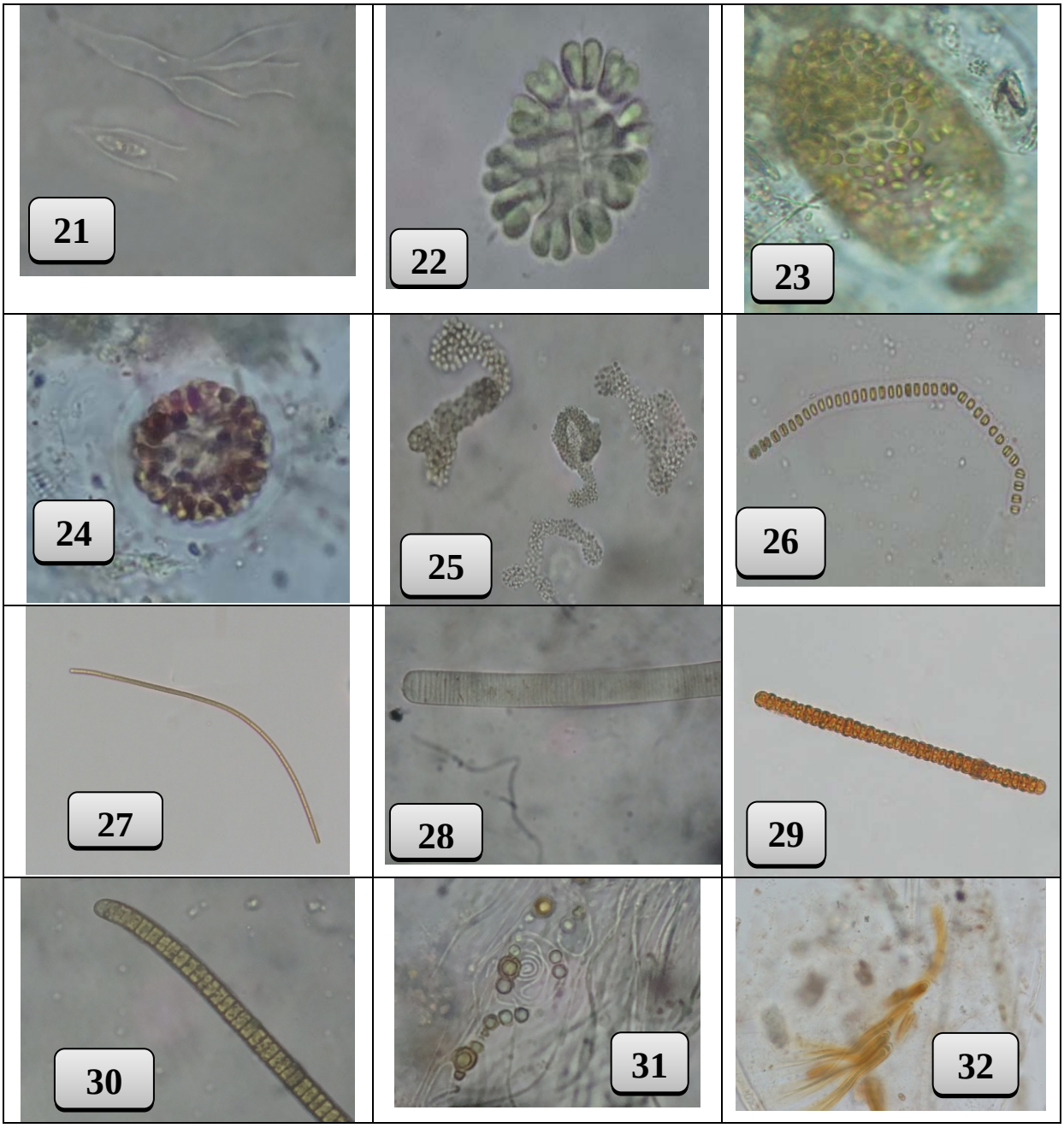

Plate (3): Class III:Chrysophyceae: figs. 21.*Dinobryonsertularia*,Class IV : Cyanophyceae: figs.22.*Gomphosphaeriaaponina* var. *cordiformis*, 23.*Aphanothececastagnei*, 24.*Colesphaeriumdubium*, 25. *Microcystisaeraginosa*, 26.*Johannesbaptistiapellucida*, 27.*Oscillatorialimnetica*,28.*O. limosa*, 29.*O. perornata*,30. *O. tenuis* , 31. *Nostocsphaericum*, 32. *Calothrixparietana*

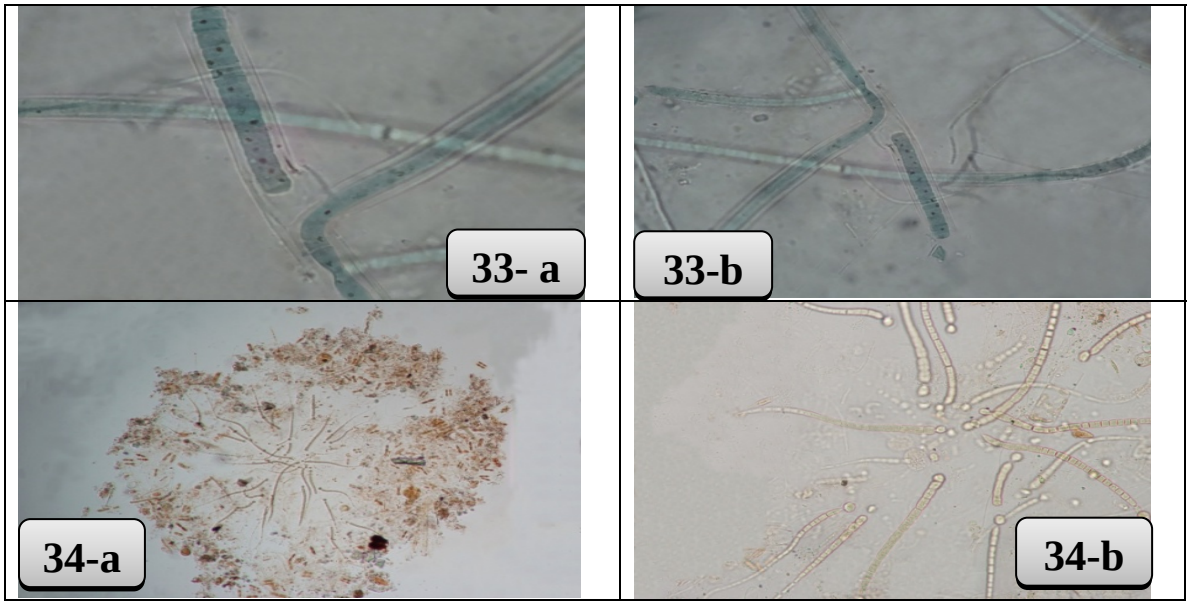

Plate (4): Class IV :Cyanophyceae: figs.33.(a,b)*Scytonema*sp., 34. (a,b) *Rivulariahansgirgii*

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