Bull. Iraq nat. Hist. Mus.
(2016) 14 (1): 27-42

THIRTY TWO ALGAE NEW RECORDS REPORTED IN PONDS AT GWER SUB-DISTRICT, ERBIL -KURDISTAN REGION, IRAQ

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ABSTRACT

This study was carried out from February to October 2012 in six semi salty ponds in Gwer sub-district which is the first work in the area. A total of 32 species and 2 genera of algae where reported as the new records. Mostly the non diatoms are belonging to Cyanophyta, Chlorophyta, Euglenophyta, Cryptophyta, Chrysophyceae, while diatoms or Bacilariophyceae are belong to pennals- order.

Keywords: Algae, Erbil, Kurdistan, Iraq, New Records, Region.

INTRODUCTION

One of the main types of microorganisms in aquatic ecosystems is algae including phytoplanktons which are microscopic photosynthetic organisms some of them extremely resistance to unsuitable environmental condition and widely distributed such as Cyanophyta, Algae are living as epipelic, epilithic, epiphytic and free-floating in open or surface waters, they are found in unicellular, colonial, coenobic and filamentous forms (Banyasz, 2011). In Iraqi Kurdistan Region a phycolimnological study were carried out from 1978 to 2012 a total of (1341) species were recorded in algal check list in Kurdistan (Aziz, 2011). While the first paper was that of Maulood and Hinton (1978), and the last one more recently have done (Abdulwahid, 2012; Aziz, 2014 and Aziz *et al*., 2014). The aim of the present work is algal study in parallel with same physical and chemical water parameters of such water ponds to increasing the knowledge about algal distribution and abundance in Iraqi Kurdistan region.

MATERIALS AND METHODS

Study area: The study area is situated in the Iraqi Kurdistan region on the Gwer sub-district in south west of Erbil governorate, between the latitudes 38˚ 03' to 38˚ 11' N and longitudes 44˚ 38' to 44˚ 60' E. The climate of studied area is not departure for Iraqi climate condition may be defined as being subtropical, characterized by a mild winter and dry hot summer. Factors that influence the hydrology of ponds include precipitation, catchment size, ground water flow, surface flow, permeability of sediments (Macdonald *et al*., 1997).

In Gwer sub-district the selected sites consist of different type of ponds, they are shallow rich in aquatic plants, and consequently the sites (1, 3, 4, 5 and 6) within the studied area were man-made ponds, while site 2 was a natural pond. As mentioned by Darbandi (2013), the range of water parameters were as follows: pH (6.7-8.31), EC (965-5667MS.cm), TDS (627-3683mgl$^-$), alkalinity(102-410mg CaCo3l$^-$), acidity 20.01-25.75mgCaCO3l-. Total hardness (100-722 mgl-), Cl-(151-989mgl$^-$), salinity (0.272-10787mgl-). According to Cl^- values the waters of pond No.1 and 6 are brakish.

SAMPLE COLLECTION AND ALGAL IDENTIFICATION

Algae samples were collected in vials and preserved in Lugol's solution (Bony, 1975), also formalin solution (4-10%) was used for algal preservation by adding 3-4 drops to 100ml of sample (Al-Nimma, 1982). Saturated solution of CuSO4 was prepared and adding a few drops of it to the sample for remaining algal true colour (APHA, 1999). Non-diatom algae were identified with the help of available literature (Smith, 1950; Desikachary, 1959; Prescott, 1970; Lind and Brook, 1980; Bold and Whyne, 1985; Bando *et al.*, 1989; Komarek and Anagnostidis, 2005; John *et al*., 2011). Diatoms were identified after cleaning according to many references such as: Patrick and Riemer (1966); Weber (1971); Benson and Rushforth (1975); Hustedt (1985); Witkowski *et al.*, (2000); Krammer (2002, 2003); Lavoi *et al.* (2008) and Komarek and Anagnostidis (2005).

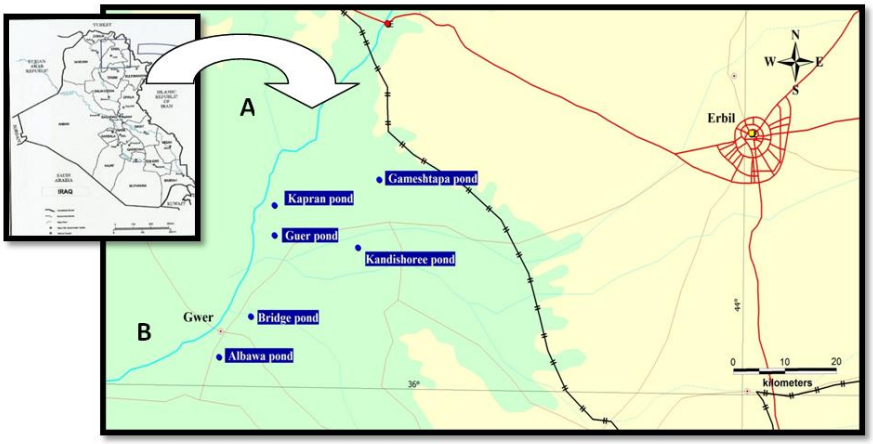

Figure (1): A. Map of Iraq B. Map of studied area shows the sampling sites

RESULTS AND DISSCUTION

It is obviously appear from Table 1 that a total of 292 taxa of algae were identified belong to 85 genera, 43 families, 28 orders, 10 classes and 8 divisions recorded in the study sites, among the total identified algal taxa, 32 species were new records to Iraqi algal flora as a whole. The recording of such new record species contributed to the habitat and nature of the study ponds, which was the first study carried out in the area (Aziz, 2011).

Species composition:

Table (1): Total number of recorded algal species with their percentage % during the studies period.

Division	Classes	Orders	Families	Genera	Species	%
Cyanophyta	1	3	5	22	67	23.44
Chlorophyta	1	9	12	18	62	21.03
Euglenophyta	1	1	1	4	23	7.87
Cryptophyta	1	1	1	1	1	0.29
Pyrrophyta	1	1	2	2	4	1.76
Chrysophyceae	1	1	1	1	1	0.29
Xanthophyceae	1	1	1	1	1	0.29
Bacillariophyceae	3	11	20	36	133	45.54
Total	10	28	43	85	292	100

List (1): Non-diatom species recorded during the studied period :

Division: Cyanophyta
Class: Cyanophyceae
Order: Chroococcales
Family: ChroocSoccaceae
Dactylococcopsis Komerek, 1983
Dactylococcopsis acicsularis Lemm.
Family: Oscillatoriaceae.
Oscillatoria (Vaucher 1803) ex Gomont 1892.
Oscillatoria leavitta after Buell 1938.
Oscillatoria refrringens Gardner.
Family: Phormidiaceae
Subfamily: Formidioideae
Phormidium (Kutzing 1843 Gomont 1892)
Phormidium etevirence Gonzales Guerrero.
Phormidium karakalpakense Starmach.
Family: Pseudanabaenaceae
Subfamily: Pseudanabaenoideae
Romeria Koczwara ex Geitler 1932.
Romeria hieroglyphica Komarek.
Subfamily: Spirulinoideae
Spirulina (Turpin 1829) ex Gomont 1892.
Spirulina corakiana Playfair after Skuja.
Spirulina tenerrima Kutzing ex Gomont.
Order: Nostocales
Family: Nostocaceae
*Anabaen*a Bory, 1822.
Anabaena circinalis var. Crassa Ghose.
Division: Euglenophyta
Class: Euglenophyceae
Order: Euglenales
Family: Euglenaceae
Euglena Ehrenberg 1833.
Euglena geniculata (F. Schmitz) Duj1841.
Euglena spathirhyncha Skuja 1948
Lepocinclis Perty 1852.
Lepocinclis playfairiana Deflander 1932.
Phacus Dujardin 185
Phacus alatus G.A. Klebs 1883.
Phacus pyrum (Ehr.) Stein.
Division: Cryptophyta – cryptomonades
Class: Cryptophyceae
Order: Cryptomonales
Family: Cryptomonaceae
Cryptomonas Ehrenberg 1838.
Cryptomonas marssonii Skuja
Division: Chrysophyta
Class: Chrysophyceae
Order: Chromulinales
Family: Synuraceae
Synuropsis J. Schiller 1929.
Synuropsis janei (Bourrelly) Wujek
Division: Chlorophyta
Class: Chlorophyceae
Order: Oedogoniles
Family:Oedogoniaceae
Oedogonium Link 1820.
Oedogonium gelatinosum after Kamat, 1963.
Oedogonium inclusum Hirn, 1900.
Oedogonium spurim Tiffany 1937.
Order : Sphaeropleales
Family: Selenastraceae
Quadrigula Printz 1915.
Quadrigula closterioides (Bohlin) Printz 1915.
Order: Zygnematales
Family: Zygnemtaceae
Spyrogira Link 1820.
Spyrogira chakiense Kolkwitz & Kriegr
Spyrogira pellucida (Hass.) Kutzing 1849.
Spyrogira pseudoreticulata Krieger 1944.
Spyrogira turfosa Gay 1884.
Family: Desmidiaceae
Cosmarium Ralfs 1848.
Cosmarium sexnotatum var *Tristriatum* Smith.
Staurastrum Ralfs 1848.
Staurastrum laevispinum Biss.
Staurastrum pachrhynchum Nordst.

List (2): Recorded diatom species during the period of the study:

Division : Bacillariophyta
Class: Bacillariophyceae
Order: Bacillariales
Family: Nitzschiaceae
Nitzschia Hassal, 1845.
Nitzschia reversa W. Smith.
Order: Cymbellales
Family: Cymbellaceae
Cymbella Agardh, 1830.
Cymbella excise Kutzing 1894.
Encyonema Kutzing 1849.
Encyonema silesiacum Rabenhorst
Family: Gomphonemataceae
Didmosphenia Schmidt 1899.
Didmosphenia geminata (Lyngbye) W.M.
Gomphonema Ehrenberg, 1831.
Gomphonema micropus Kutzing.
Order: Naviculales.
Navicula rostellata Kutzing 1844.
Class: Fragilariophyceae
Ordre: Fragilariales
Family: Fragilariaceae
Diatoma Decandandolle, 1805.
Diatoma moniliformis Kutzing.

Descriptions of new recorded algae:
Non diatoms:
Dactylococcopsis acicularis Lemm. 1900, Ber. (Pl. 1, Fig. a).

Periphyton solitary acicular or straight cells and pointed poles, in gelatinous envelope; cells 2-3µm in diameter, 45-60 µm in long. (Presscot, 1970; Pl. 105, Fig. 2).

Ocillatoria refringens Gardner, 1927 (Pl. 1, Fig. b).

Cells bright green 9-10 µm wide, cells shorter than wide, not constricted cells somewhat enlarged, rounded with thickened outer cell wall, freshwater and marin among water plant. (Komarek and Anagnostidis, 2005; Fig. 901, P. 601).

Ocillatoria leavittae Buell 1938 (Pl. 1, Fig. c).

Trichomes straight, tapering toward ends, greenish grey to violet, 7.5 – 11.5 µm, wide, constricted, apical cells flattened, not capitates. (Komarek and Anagnostidis, 2005; Fig. 897, P608).

Phormidium etevirence Gonzalez Guerrero (Pl. 1, Fig.d)

Cells bright blue-green, trichomes long, cells 3-4 µm long; 2.5-3µm wide, not attenuated towards ends, but apical cells longer, conical, pointed and hyaline. (Komarek and Anagnostidis, 2005; Fig. 566, P. 404).

Phormidium karakalpakense Muzaffarov (Pl. 1, Fig. e)

Trichome solitary, pale blue-green, cells 4.5-5µm wide, 1-2.5 µm long, apical cells capitat. (Komarek, and Anagnostidis, 2005; Fig. 555., P. 402).

Romeria hieroglyphica (Komarek and Anagnostidis, 2005; Pl. 1, Fig. f)

Trichomes solitary, floating, usually with 12 – 24 cells, constricted with narrow, diffuse, envelop colorless, irregularly and intensely wavy and zig-zag coiled; cells cylindrical, pale greyish blue-green, 4.5-9-2µm long, 1-1.3µm wide.(Komarek and Anagnostidis, 2005; Fig. 30. P. 598).

Spirulina corakiana Playfair (Pl. 1, Fig. g.)

Trichomes solitary, pale blue green, (0.5) 0.7- 0.8 µm wide, short, loosely regularly spirally coiled, attenuated, 25-70 µm long, with left – handed rotation, coils sinistral, 1.5-2.5 µm wide, (2.8 – 3.5) 4-10 µm high (i.e., distance between coils). Apical cells rounded. (Komarek and Anagnostidis, 2005; Fig. 169).

Spirulina tenerrima Kutzing (Pl. 1, Fig. h)

Trichomes solitary, pale bright blue- green, 0.3-0,6µm wide, densely spirally coiled, with intense right- handed rotation, coils dextral, 1.2- 1.7 µm wide, distance between coils 0.8- 1 (1.2 -2)µm. Apical cells rounded. (Komarek and Anagnostidis, 2005; Fig. 166, P. 144).

Anabaena circinalis var. crassa Ghose (Pl. 1, Fig. i)

Trichome free-swimming, semi-circular, cells spherical, shorter than broad, 5-7µm in diameter, heterocysts globos up to 8 µm broad: spores not seen, (Deskachary, 1959; Pl. 77, Fig. 5).

Euglena spathirhyncha Skuja (Pl. 1, Fig.j)

Cells (12-)16-20µm wide, 66-85µm long, spindle –shaped frequently flattened in middle part, looks like a spinning top, cell slightly truncate at anterior end; tapering and passing into a thin, sharp tail-piece at posterior end.(John *et al.*, 2011;Pl. 48A,B, P. 193).

Euglena geniculata (F. Schmitz) Dujardin (Pl. 1, Fig. k)

Cells 9.5 -12.5 (22) µm wide, 50-85 µm long, nearly cylindrical to bluntly spindle shaped; anterior end rounded, posterior end narrowing to a sharp tail – piece; pellicle very finely and closely striated, chloroplast 2, pyrinoid present, eye spot small, but visible, nucleus between 2 chloroplast groups euglenoid movment occurs and cells sometime twist, (John *et al.*, 2011; Pl. 47C, P. 192).

Lepocinclis playfairiana Deflander (Pl. 1, Fig. 1)

Cells 19-26 µm wide, 32-49µm long, widely spindle-shaped, anterior end slightly narrowed into a slender tip or point (rostrate), posterior end with a tail- piece 7-12µm long; pellicle smooth; paramylon body 2, long circular or oval rings (John *et al.*, 2011; Pl. D,E 50, P. 200).

Phacus alatus G.A. Klebs *(*Pl. 1, Fig. m)

Cells 19 -34 µm wide, 24 -45µm long, widely oval, with 2 unequal halves, wing-like in appearanc posterior end terminating in a short, tail-piece, pellicle longitudinally striated, paramylon bodies large, 2 in each cell. (John *et al.*, 2011; Pl. 52E, P. 206).

*Phacus pyrum (*Ehrenb.) Stein (Pl. 1, Fig. n)

Cells ovoid, posteriorly narrowed, finely pointed caudus; rounded anteriorly, periplast spirally ribbed; paramylon bodies 2 ring-like plates, cells (7)-15.5-21µm long. (Prescott, 1970; Pl. U, V788, Fig. 22).

Cryptomonas marssonii Skuja (Pl. 2, Fig. a).

Cells (10-)13- 45 µm long, (5-) 6-17 µm wide, ovoid –ellipsoid, convex in dorsal margin in, flagella equal or sub equal, shorter than cell; chloroplast 2 per cell, very variable in colour but never blue-green, without eyespot (John *et al.*, 2011; Pl. 63E, P. 248).

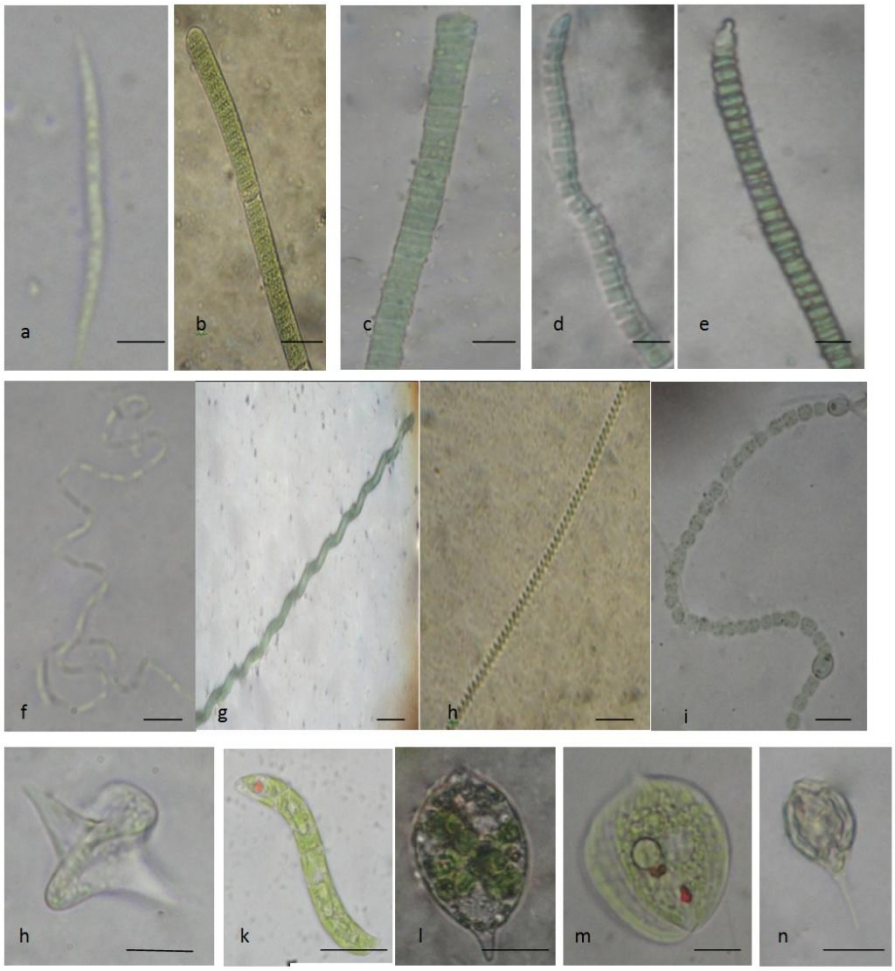

Plate (1): a. *Dactylococcopsis acicularis*. b. *Ocillatoria refrringens.*
c.*Ocillatoria leavitta janei.* d. *Phormidium etevirence*.
e. *Phormidium karakalpakens.* f. *Romeria heroglyphic*.
g. *Spirulna corakiana*. h. *Spirulna tenerrima*.
i. *Anabaena circinalis* var. crassa. h. *Euglena spathirhyncha.*
k. *Euglena geniculata* l. *Lepocinclis playfairiana.*
m. *Phacus alatus.* n. *Phacus pyrum*
(40x).

Synuropsis janei (Bourrelly) Wujek (Pl. 2, Fig. b)

Cells pear to club shaped, 9 µm in width and to 21 µm long in spherical colonies of about 60 cells; chloroplasts parietal and 2 per cell, often with an eyespot. (John *et al.*, 2011; Pl. D, Pl.79, P. 304).

Quadrigula closterioides (Bohlin) Printz, 1915 (Pl. 2, Fig. c)

Cells long, straight, margin slightly curved, cylindrical, in the mid-region, tapering to sharply rounded apices, arranged in longitudinal bundles of 4 within a fusiform colonial envelop; chloroplast parietal, with a median notch; 1 pyrenoid; cells 4-6µm in diameter, 22-35-(45) µm long (Presscot, 1970; Pl. 58, Fig.9).

Staurastrum laevispinum Bissett (Pl. 2, Fig. d)

Cells small, sinus obtuse and nearly rectangular, with a minute excavation at its apex; semi cells somewhat lunate, angle produced into thick, slightly attenuated, cells 25-30 µm long and 32-39µm wide, while, breadth of isthmus 9µm. (West and West, 1908; Pl. CXLI, Fig. 18 from West and West, 1971a).

Staurastrum pachyrhynchum Nordst (Pl. 2, Fig. e)

Cells somewhat small, as long as broad, constricted, sinus open, sub rectangular or acute-angled; semicells or elliptic sub-rectangular, dorsal margin sub-truncate, sides concave, angles rounded obtuse, cells 28-45µm long and 22-45µm wide, isthmus 8-15µm. (West and West, 1912; Pl. CXXI, Fig. 9 from West and West, 1971a).

Cosmarium sexnotatam Gutw. (Pl. 2, Fig. f)

Cells small, almost 1 times as long as broad, constricted, sinus narrowly linear; semi cells sub semicircular with a flat base, apex sub truncate and 4-crenate, with a single series of small granules in the margin, side view of semi cell sub circular, chloroplast axile, with a central pyrenoid. Cell 25µm long, breadth 19 µm wide of isthmus 5 µm, (West and. West, 1908; Pl. 10, Fig. 7 from West and West,1971b).

Oedogonium inclusum Hirn (Pl. 2, Fig. g1, 2)

Cells cylindrical or somewhat capitellate, 8-12.9µm in diameter, (33)-62.9-150µm long. Oogonia solitary; oblong-ellipsoid or fusiform, with lateral walls much thickened; operculate opening superior; 24- 30 µm in diameter, 48-55-(62)µ long. (Prescott, 1970; Fig. 5, P. 730).

Oedogonium gelatinosum Kam. (Pl. 2, Fig. h1, 2)

Cells capitellate, those of female filaments 20- 30µm long; Oogonia single or up to 6-seriate, globose-ellipsoid, 45-60µm in diameter, 55-60µm long operculate, Oospore ellipsoid, filling the oogonium 42-58µ in diameter, 56-58µ long. (Gonzalves,1981; Fig. 272)

Oedogonium spurum Hirn.Acta (Pl. 3, Fig. i1, 2)

Vegetative cells capitellate, 7-13µ in diameter, 20 -55 µ long; basal cell elongate; terminal cell obtuse or truncate, Oogonium single, 26-30 µm in diameter, 23-33µm long. (Gonzalves, 1981; Fig. 20, P. 157).

Spirogyra Chakiense Kolkwitz & Krirger (Pl. 3, Fig. a1,2)

Vegetative cells 93 – 104 × 80 – 116 µm; end walls plane; chloroplasts 4-8, conjugation scalariform; zygospores ellipsoidal with more or less rounded ends 50-66 × 73-122µm; (Randhawa, 1959; Fig. 338, P. 340).

Spirogyra pellucida (Hassall) Kutzing (Pl. 3, Fig. b1, 2)

Cells 40–50×100–400 µm, with plane end walls; 3-4 chloroplasts straight, or making 0.5 to 4 turns. Conjugation scalariform, zygospores lenticular 77-86 µm in diameter. (Randhawa, 1959; Fig. 488, P. 408).

Spirogyra subreticulata Fritsch (Pl. 3, Fig. c1, 2)

Vegetative cells 50-54x150-400µm, with plane end walls; 3-4 chloroplasts, making 0.5 to 3 turns. Conjugation scalariform; tubes formed by both gametangia; zygospores ellipsoid to somewhat ovoid, 42-54 x 60-124µm, (Randhawa, 1959; Fig. 30, P. 336).

Spirogyra turfosa Gay (Pl. 3, Fig. d1,2)

Vegetative cells 68 –78 × 68–350 µm; end walls plane; chloroplasts 3-4 making 1.5 to 4 turns, conjugation scalariform, tubes formed by both gametangia, zygospors ellipsoid, pointed, 65 –75 × 120-140µm.(Randhawa, 1959; Fig. 297, P. 329).

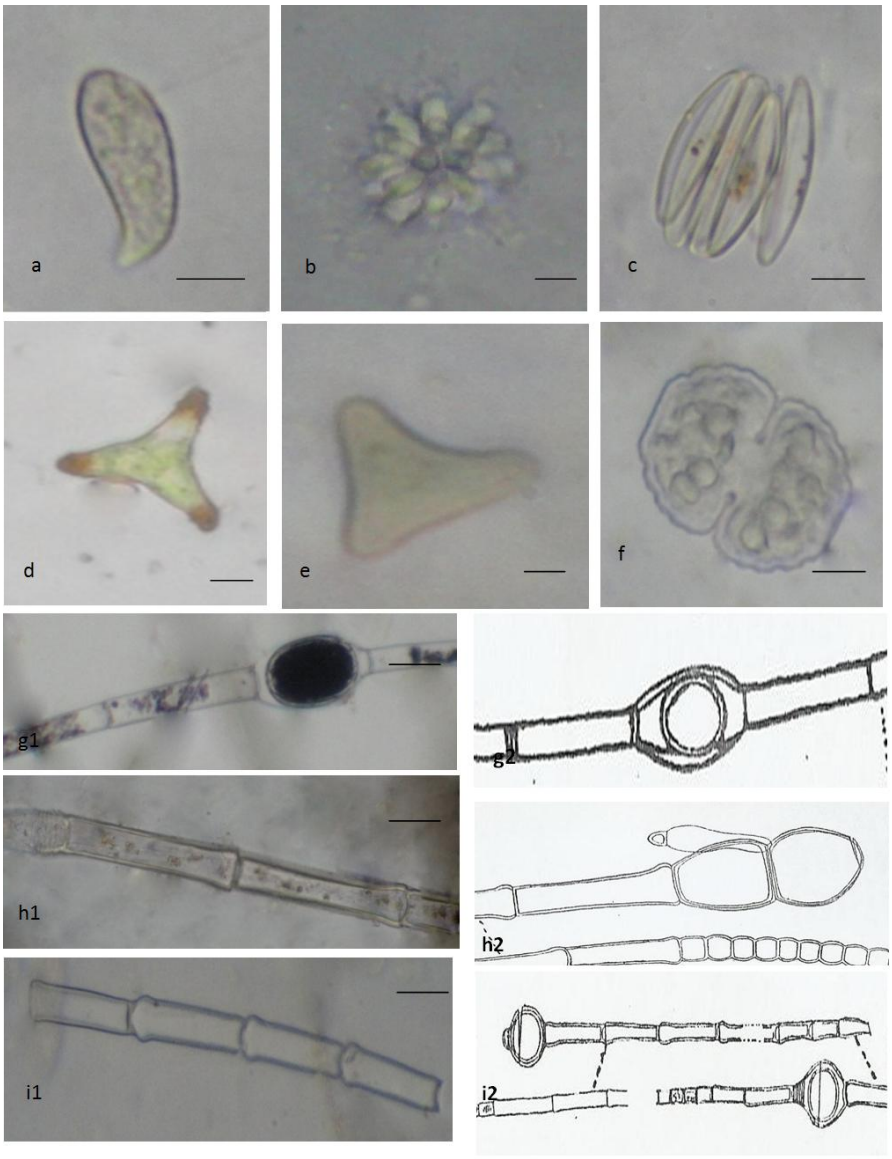

Plate (2): a. *Cryptomonas marssonii* *b*. *Synuropsis janei*
c. *Quadrigula closterioides* d.*Staurastrum laevispinum*
e.*Staurastrum pachyrhynchum* f. *Cosmarium sexnotatum*
g1. 2-*Oedogonium inclusum* h1.h2-*Oedogonium gelatinosum*
i1. 2-*Oedogonium spurum.* (40x)

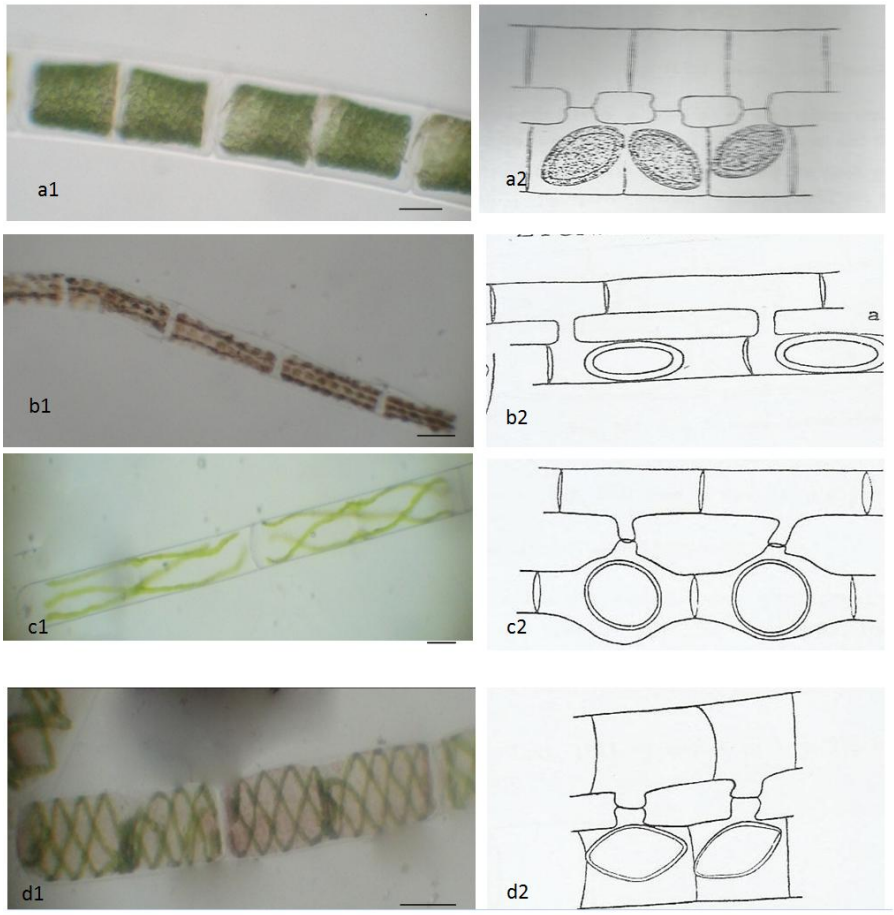

Plate (3): a1. 2-*Spirogyra chakiense*. b1. 2-*Spirogyra pellucid*.
c1. 2-*Spirogyra subreticulata*. d1. 2-*Spirogyra turfosa*. (40x)

Diatoms

Navicula rostellata Kutzing (Pl. 4, Fig. a)

Valves are lanceolate with well defined sub-rostrate apices, valve length 34-50 µm, Valve width 7-10 µm, number of striae 11-15 in 10 µm. Raphe fissures hooked over the apices,striae is clearly radiated over most of the valve, (Lavoie *et al.*, 2008; pl. 21, P. 106).

Gomphonema micropus (Kutzing) (Pl. 4, Fig. b)

Valves symmetrical to transapical axis (heteropolar), symmetrical to apical axis, cells only slightly wedge-shaped in girdle view, 25-43 µm long, 6-9 µm wide. Apices broadly sub-rostrate (occasionally rostrate, raphe slightly sinuous, striae coarse, central area with one short absent stria (Lavoie *et al.*, 2008; pl. 40, P. 144).

Nitzschia reversa W.Smith (Pl. 4, Fig. c)

The valves are spindle shaped, with parallel margins and abruptly tapering apices with the ends turned in opposite directions, 79 µm long, and 4-5 µm wide. The fibulae are small and evident along the length of the valve, with a density of 14-20 in 10 µm. (Lavoie *et al*., 2008; Pl. 61, P. 186).

Didmosphenia geminata (Lyngbye) W.M. Schmidt (Pl. 4, Fig. d)

Valves slightly asymmetric to the apical plane, transapically more or less twice constricted, capitate ends, 60-135 µm long, and 25- 43 µm wide, raphe almost in the middle line of the valves moderately wide; terminal nodules distant from the ends, transapical striae about 10 in 10 µm, radial, coarsely punctata, 9-14 puncta in 10 µm. (Lavoie *et al*., 2008; Pl. 43, P. 150).

Diatoma moniliformis (Kutzing) (Pl. 4, Fig. e)

Valves are 10-40 µm in length and 2.5-6.0 µm in width, frustules are rectangular in girdle view, valves are elliptical to lanceolate with rounded to subrostrate apices, transapical ribs number 6-11 in 10 µm, striae are uniseriate, 50-60 in 10 µm, axial area is linear, narrow, (Lavoie *et al.*, 2008; pl. 2, p. 68).

Cymbella excise Kützing (Pl. 4, Fig. f)

Valves lanceolate-lunate, dorsal margin convex, ventral margin slightly concave to straight, striae uniseriately punctate, slightly radiate, dimension: 7-16 × 20-70 µm, striae 7-12 in 10. (Lavoie *et al*., 2008; Pl. 33, P. 130).

Encyonema silesiacum (Bleisch in Rabenhorst) (Pl. 4, Fig. g)

Valves dorsiventral and symmetrical to the transapical axis, dorsal margin arched ventral margin straight, valves are 10-39 µm in length and 5-9µm in width striae 12-14 in 10, Raphe more-or-less straight. (Lavoie *et al*., 2008; Pl. 32, P.128).

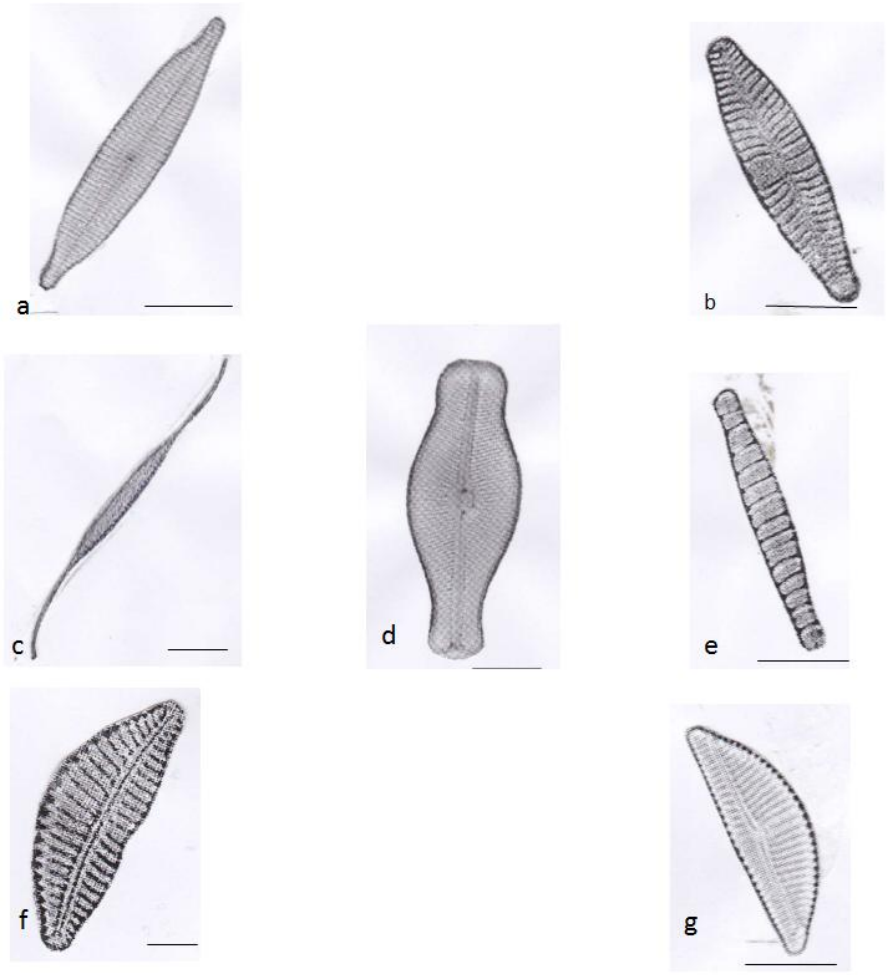

Plate (4): a. *Navicula rostellata* b. *Gomphonema micropus*
c. *Nitzschia reversa* d. *Didmosphenia geminate*
e. *Diatoma moniliformis* f. *Cymbella excise.*
g. *Encyonemo silesiocum*
Scale bars: 10µm

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(2016) 14 (1): 27-42

تسجيل اثنان وثلاثون نوعا جديدا" من الطحالب في برك قصبة الكوير في محافظة اربيل/ اقليم كوردستان العراق

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الخلاصة

تم اجراء هذا البحث اعتبارا من شهر التشرين الثاني التشرين الاول ٢٠١٢ في ستة برك مائية صغيرة شبه مالحة من قصبة الكوير وهو اول بحث يجري في المنطقة. حيث تم تسجيل اثنان و ثلاثون (٣٢) نوعا مع جنسين من الطحالب لاول مرة في العراق. وان اغلبية الطحالب الجديدة المسجلة تعود الى الطحالب الخضراء المزرقة واليوغلينة والكريباتية و الصفراء والخضراء. فيما يخص الدايتومات فأنها تعود الى الطحالب غير الدائرية.

الكلمات الدالة: الطحالب، انواع جديدة، منطقة كردستان،اربيل، العراق.