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 pennis- 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 governmate, 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 (627-3683mg/l), alkalinity(102-410mg CaCo3/l), acidity 20.01-25.75mgCaCO3/l. Total hardness (100-722 mg/l), Cl-(151-989mg/l), salinity (0.272-10787mg/l). According to Cl values the waters of pond No.1 and 6 are brakish.
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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).

RESULTS AND DISCUSSION

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.

<table>
<thead>
<tr>
<th>Division</th>
<th>Classes</th>
<th>Orders</th>
<th>Families</th>
<th>Genera</th>
<th>Species</th>
<th>%</th>
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<td>Cyanophyta</td>
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<td>5</td>
<td>22</td>
<td>67</td>
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<td>Euglenophyta</td>
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<td>1</td>
<td>4</td>
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<td>1</td>
<td>1</td>
<td>1</td>
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<td>1.76</td>
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<tr>
<td>Chrysophyceae</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0.29</td>
</tr>
<tr>
<td>Xanthophyceae</td>
<td>1</td>
<td>1</td>
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<td>1</td>
<td>1</td>
<td>0.29</td>
</tr>
<tr>
<td>Bacillariophyceae</td>
<td>3</td>
<td>11</td>
<td>20</td>
<td>36</td>
<td>133</td>
<td>45.54</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>28</td>
<td>43</td>
<td>85</td>
<td>292</td>
<td>100</td>
</tr>
</tbody>
</table>
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List (1): Non-diatom species recorded during the studied period:

Division: Cynophylla
Class: Cynophylaceae
Order: Cynophytales
Family: Cynophyceae
Dactylocladus Komarek, 1983
Oscillatoria (Vanhier 1803) ex Gomont 1892
Oscillatoria leonina var. Buell 1938
Oscillatoria refringens Gardner.
Subfamily: Phormidiaceae
Family: Phormidiaceae
Phormidium (Kützing 1843 Gomont 1892)
Phormidium evertens (Gonzales Guerrero)
Phormidium paralepis (Stamach)
Family: Pseudanabaenaceae
Pseudanabaena Romeris (Geezaw 1932)
Romeris hiarkophilica Komarek.
Subfamily: Spirulinaceae
Spirulina (Turep 1829) ex Gomont 1892
Spirulina corallina Playfair after Skuja.
Spirulina tenerimis Kützing ex Gomont.
Order: Nostocales
Family: Nostocaceae
Anabaena Bory, 1822.
Anabaena circinalis var. Crass Ghone.
Division: Euglenophyta
Class: Euglenophyceae
Order: Euglenales
Family: Euglenaceae
Euglena Ehrenberg 1833.
Euglena geniculata (Ehrenberg) Duj 1841.
Euglena sp.$^{2}$ Skuja $^{1}$ 1948
Lepocinclis Perty 1852.
Lepocinclis platychelia Deflandre 1932.
Phacus Buellini 1855
Phacus alatus N.G. Klebs 1883.
Phacus pyrrhus (Ehr.) Stein.
Division: Cryptophyta – cryptomonadaceae
Class: Cryptophyceae
Order: Cryptomonadales
Family: Cryptomonaceae
Cryptomonas Ehrenberg 1838.
Cryptomonas marssonii Skuja
Division: Chrysophyta
Class: Chrysophyceae
Order: Chromulinales
Family: Synuroaceae
Synurospis 1. Schiller 1929.
Synurospis jani (Bourrelly) Vuijek

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

Division: Chlorophyta
Class: Chlorophyceae
Order: Oedogoniales
Family: Oedogoniaceae
Oedogonium Link 1820.
Oedogonium gelatinosum (Gomont 1892).
Oedogonium inclusion (Him) 1890.
Oedogonium sp.
Order: Sphaerotheca
Family: Seleniothecaceae
Quadrigula Pintz 1915
Quadrigula cisternoides (Boehlin) Pintz 1915.
Order: Zygnematales
Family: Zygnemataceae
Spongogora Link 1820.
Spongogora chadicae Kolkwitz & Krieger
Spongogora pollucida (Has) Kützing 1849.
Spongogora pseudobellulae Krieger 1944.
Spongogora sp.$^{2}$
Family: Desmidaceae
Cosmarium Ralfs 1848.
Cosmarium saxatilum var. Tristratum Smith.
Staurastrum Ralfs 1848.
Staurastrum laevigatum Braun.
Staurastrum pachyrhynchum Nord.

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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, 1.2-2.5 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, 1.1-1.3μm 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 sinastral, 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 globo 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).
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*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, pyrinioid present, eye spot small, but visible, nucleus between 2 chloroplast groups euglenoid movement 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).
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(40x).
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*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. (We st 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, Oospor 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 & Krirge (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).
Thirty two algae new records

*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 x 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. 2-Oedogonium spurum. (40x)  
i1. 2-Oedogonium gelatinosum  
h2. Oedogonium gelatinosum

**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).
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*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 silesiicum*  
Scale bars: 10μm
LITERATURE CITED


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 تسجيل اثنان وثلاثون نوعا جديداً من الطحالب في برك قصبة الكوير في محافظة اربيل/إقليم كوردستان العراق

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الخلاصة

تم إجراء هذا البحث اعتباراً من شهر التشرين الثاني/تشرين الأول 2012 في ستة برك مائية صغيرة شبه مالحة من قصبة الكوير وهو أول بحث يجري في المنطقة. حيث تم تسجيل اثنان وثلاثون (32) نوعاً مع جنسين من الطحالب لأول مرة في العراق. وأن أغلبية الطحالب الجديدة المسجلة تعود إلى الطحالب الخضراء المزرقة والوغيرينة والكريباتية والصفراء والخضراء. فيما يخص الدايتومات فإنها تعود إلى الطحالب غير الدائرية.

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