

An Updated Review of Phytoplankton Taxa in Iraq: Identification and Overview

Feryal Ameen Merza¹, Bent Alhuda Hussein Neamah², Amal Ameen Merza³

¹Department of Biology, Faculty of Sciences, Kufa University, Kufa, Iraq

²Faculty of Medicine, Jabir Ibn Hayyan University for Medical and Pharmaceutical Sciences, Iraq

³Najaf Municipality Directorate, Iraq

Corresponding Author: Feryal Ameen Merza

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ABSTRACT

This updated review aims to survey phytoplankton taxa across various aquatic environments, including lakes, marshes, rivers, and reservoirs in diverse cities in Iraq. 848 taxa belonging to twelve classes have been identified. Among these classes, Bacillariophyceae, Chlorophyceae, and Cyanophyceae exhibited more taxa, whereas Charophyceae and Compsopogonophyceae each had only one taxon. The genera *Nitzschia* and *Navicula* were particularly diverse with 49 and 47 species respectively. This review provides a comprehensive overview of phytoplankton composition, presenting a checklist of phytoplankton in Iraq based on a synthesis of previous studies.

Keywords: Review, genera, Iraq, phytoplankton, taxa

INTRODUCTION

Various investigations have examined the phytoplankton composition in Iraq. These organisms are primary producers and are crucial in many ecosystems as a nourishment source for other organisms. They also supply a significant amount of the air we breathe through their ability to fix CO₂ in photosynthesis. An ecological portrait of the region can be obtained through qualitative and quantitative comparisons of the abundance and

composition of phytoplankton across different locations.^[1] They serve as bioindicators due to their rapid response to environmental changes and they can also function as plant antibiotics or biofuels.^[2-3] However, some species can produce toxins that lead to harmful algal blooms, posing health risks.^[4]

In Iraq, considerable efforts have been dedicated to studying the distribution and identification of phytoplankton. Consequently, this review provides a comprehensive list of these organisms' taxa in the region.

MATERIALS & METHODS

Data were collected from eighty-five references spanning from 1976 to 2023. These references include research papers, MSc. theses, and Ph.D. theses, focusing on phytoplankton. The references are as follows.^[5-89]: Abdulameer (2014), Al Azawey (2012), Albueajee et al. (2020), Al-Essa (2004), Al Fatlawi (2011), Al Zubaidi et al. (2006), Al-Handal (1994), Al Hassany et al. (2014), Al-Hassany and Hassan (2014), Al-Rawi (2013), Al-Araji (1988), Al-Azawi (2004), Al-Handal et al. (1991), Ali and Hassan (2019), Ali et al. (2020), Alkam and Abdullah (2013), Alkam and Abdulmuneem (2012), Al-Khalidi and Al-Asady (2019), Al-Lami (1986), Al-Lami et al. (1996), Al-Mayyah (1990), Al-Mosawi et al. (1990), Al-Mousawi et al. (1994), Al-Obaidi (2006), Al-Obaidi et al. (2009), Al-

Saadi *et al.* (2000), Al-Saeedi and Al-Salman (2022), Al-Saadi *et al.* (1996), Al-Saadi *et al.* (2008), Al-Saadi *et al.* (1995), Al-Saadi *et al.* (2007), Al-Saadii (1993), Al-Saadii (2001), Al-Saadii and Hadi (1987), Al-Saadii *et al.* (1976), Al-Saffar and Al-Obaidi (2008), Al-Hassny and Al-Bueajee (2015), Al-Shawi (2010), Al-Zubaidi (1985), Al-Tae and Mahmoud (2023), Al-Tameme (2006), Azawy (2006), Aziz and Muhammed (2016), Aziz (2011), Aziz and Rasoul (2016), Basim *et al.* (2021), Hassen (1988), Hassan and Shaawiat (2015), Hadi *et al.* (1984), Hadi and Al-Saboonchi (1989), Hameed (1977), Hammadi *et al.* (2007), Hassan *et al.* (2008), Hassan *et al.* (2006), Hassan *et al.* (2014), Hassan *et al.* (2010), Hassan and Al-Saadi (1995), Hassan *et al.* (2007 a, b), Hinton and Maulood (1980), Huq *et al.* (1978), Islam and Hameed (1982), Islam and Hameed (1985), Ismail and Saadallah (2010), Jalal (2023), Kadhim (2005), Kassim *et al.* (1999), Kassim *et al.* (1997), Kassim *et al.* (2001), Maulood (1991), Maulood *et al.* (2013), Maulood and Hassan (2021), Merhoon *et al.* (2017), Merza *et al.* (2020), Mohammed (2007), Mohammed (2012), Salman *et al.* (2013), Salman *et al.* (2013 a, b), Salman *et al.* (2012), Salman *et al.* (2017), Shaban (1980), Slam *et al.* (2012), Talib (2009), Toma (2019).

RESULT AND DISCUSSION

A total of 848 taxa has been recognized, belonging to twelve phytoplankton classes as follows:

- Bacillariophyceae (459 taxa)
- Chlorophyceae (182 taxa)
- Cyanophyceae (111 taxa)
- Euglenophyceae (36 taxa)
- Dinophyceae (21 taxa)
- Conjugatophyceae (17 taxa)
- Chrysophyceae (seven taxa)
- Cryptophyceae (six taxa)
- Xanthophyceae (four taxa)
- Trebouxiophyceae (three taxa)
- Charophyceae and Compsopogonophyceae (each with one taxon)

The variety of algae present in Iraq reflects the diverse limnological characteristics of the region.^[90] Tables (1-12) show lists of the recorded taxa of algal classes in the Iraqi aquatic environment. In most studies, the Bacillariophyceae and Chlorophyceae classes recorded the highest number of species. The dominance of Bacillariophyceae is a well-known phenomenon in Iraqi aquatic ecosystems, due to their ability to withstand changes in ecological conditions and the availability of silica in the Iraqi basins, used in their frustule structure.^[53]

Other classes, such as Cryptophyceae and Dinophyceae, had fewer dominant species, possibly due to their requirement for many nutrients and their narrow range of species.^[91-93] The genus *Nitzschia* had 49 species, the highest number among other genera. This genus is frequently found in polluted waters and prefers relatively alkaline water.^[94-95] The genera *Navicula*, *Cymbella*, *Oscillatoria*, *Scenedesmus*, *Gomphonema**, *Achnanthes*, and *Fragilaria* were recorded with high species counts of 47, 28, 27, 22, 18, 17, and 13 species, respectively.

However, *Nitzschia*, *Achnanthes*, *Navicula*, and *Fragilaria* are typically the dominant algal genera in temperate freshwater wetlands and nutrient-rich waters.^[96] The diatom genera *Cymbella* and *Navicula* have been considered indicators of contamination, appearing or disappearing in response to pollution levels.^[97]

This review lists only 848 taxa due to relatively insufficient surveys on these groups in all Iraqi waters.

Table 1. List of Bacillariophyceae taxa

Class	Taxon	Taxon	Taxon
Bacillariophyceae <i>Bacillariophyceae</i>	<i>Achnanthes affinis</i>	<i>Diatoma elongatum</i>	<i>Navicula similis</i>
	<i>Achnanthes biasoletiana</i>	<i>Diatoma elongtoma</i>	<i>Navicula simplex</i>
	<i>Achnanthes clevi</i>	<i>Diatoma hiemale</i>	<i>Navicula spicula</i>
	<i>Achnanthes conspicua</i>	<i>Diatoma tenue</i>	<i>Navicula tenera</i>
	<i>Achnanthes delicatula</i>	<i>Diatoma vulgare</i>	<i>Navicula trivialis</i>
	<i>Achnanthes exigue</i>	<i>Diatomella sp.</i>	<i>Navicula viridula</i>
	<i>Achnanthes flexella</i>	<i>Dinobryo gomphosphaerla</i>	<i>Neidium affine</i>
	<i>Achnanthes hungarica</i>	<i>Diploneis bombuus</i>	<i>Neidium iridis</i>
	<i>Achnanthes lanceolata</i>	<i>Diploneis elliptica</i>	<i>Neidium productum</i>
	<i>Achnanthes linearis</i>	<i>Diploneis interrupta</i>	<i>Nitzschia acicularis</i>
	<i>Achnanthes longipes</i>	<i>Diploneis ovalis</i>	<i>Nitzschia amphibia</i>
	<i>Achnanthes microcephala</i>	<i>Diploneis pseudovalis</i>	<i>Nitzschia amphicephala</i>
	<i>Achnanthes minutissima</i>	<i>Diploneis smithii</i>	<i>Nitzschia angustata</i>
	<i>Achnanthidium affine</i>	<i>Ditylum brightweellii</i>	<i>Nitzschia bilobata</i>
	<i>Achnanthidium conspicua</i>	<i>Ditylum sol Grun</i>	<i>Nitzschia circumsuta</i>
	<i>Achnanthidium delicatula</i>	<i>Duodenarium bailey</i>	<i>Nitzschia closterium</i>
	<i>Achnanthidium mintussima</i>	<i>Epithema zebra</i>	<i>Nitzschia cluasi</i>
	<i>Actinocyclus octonarius</i>	<i>Epithemia sorex</i>	<i>Nitzschia communis</i>
	<i>Actinocyclus microcephala</i>	<i>Epithemia turgida</i>	<i>Nitzschia commutata</i>
	<i>Actinocyclus mintussima</i>	<i>Eucampia zodiacus</i>	<i>Nitzschia dissipata</i>
	<i>Amphipleura pellucida</i>	<i>Eunotia arcus</i>	<i>Nitzschia dubia</i>
	<i>Amphipleura sp.</i>	<i>Eunotia formica</i>	<i>Nitzschia fasciculata</i>
	<i>Amphiprora alata</i>	<i>Eunotia lunaris</i>	<i>Nitzschia filiformis</i>
	<i>Amphiprora costata</i>	<i>Eunotia pectinalis</i>	<i>Nitzschia fonticola</i>
	<i>Amphiprora coffeaeformis</i>	<i>Eunotia pectinas</i>	<i>Nitzschia frustulum</i>
	<i>Amphora coffeaeformis</i>	<i>Eunotia valida</i>	<i>Nitzschia fruticosa</i>
	<i>Amphora vitrea</i>	<i>Fragilaria acus</i>	<i>Nitzschia gracilis</i>
	<i>Amphora commutata</i>	<i>Fragilaria affinis</i>	<i>Nitzschia granulata</i>
	<i>Amphora normanii</i>	<i>Fragilaria brevistriata</i>	<i>Nitzschia hantzschiana</i>
	<i>Amphora ocellata</i>	<i>Fragilaria capitata</i>	<i>Nitzschia hungarica</i>
	<i>Amphora ovalis</i>	<i>Fragilaria capucina</i>	<i>Nitzschia hustediana</i>
	<i>Amphora pediculus</i>	<i>Fragilaria constrems</i>	<i>Nitzschia hybrida</i>
	<i>Amphora perpusilla</i>	<i>Fragilaria construens</i>	<i>Nitzschia ignorata</i>
	<i>Amphora veneta</i>	<i>Fragilaria crotonensis</i>	<i>Nitzschia inconspicue</i>
	<i>Aneumastus tusculus</i>	<i>Fragilaria fasciculata</i>	<i>Nitzschia incurva</i>
	<i>Anomoeneis exilis</i>	<i>Fragilaria intermedia</i>	<i>Nitzschia intermedia</i>
	<i>Anomoeneis sp.</i>	<i>Fragilaria minuscula</i>	<i>Nitzschia kuetzingiana</i>
	<i>Anomoeoneis sphaerophora</i>	<i>Fragilaria pinnata</i>	<i>Nitzschia linearis</i>
	<i>Asterionella formosa</i>	<i>Fragilaria pulchella</i>	<i>Nitzschia littoralis</i>
	<i>Asterionella japonica</i>	<i>Fragilaria tabulata</i>	<i>Nitzschia longissima</i>
	<i>Asteromphalus sp.</i>	<i>Fragilaria ulna</i>	<i>Nitzschia lorenziana</i>
	<i>Asterolampra sp.</i>	<i>Fragilaria vaucheriae</i>	<i>Nitzschia microcephala</i>
	<i>Aulacoseira ambigua</i>	<i>Fragilaria virescens</i>	<i>Nitzschia obtusa</i>
	<i>Aulacoseira distans</i>	<i>Gomphonema abbreviatum</i>	<i>Nitzschia palea</i>

<i>Aulacoseira granulata</i>	<i>Gomphonema acuminatum</i>	<i>Nitzschia paleacea</i>
<i>Aulacoseira italica</i>	<i>Gomphonema angustatum</i>	<i>Nitzschia panduriformis</i>
<i>Aulacoseira roeseana</i>	<i>Gomphonema attenuatum</i>	<i>Nitzschia punctata</i>
<i>Aulacoseira varian</i>	<i>Gomphonema augur</i>	<i>Nitzschia pusilla</i>
<i>Bacillaria paxillifer</i> (also known as <i>Bacillaria paradoxa</i>)	<i>Gomphonema capitatum</i>	<i>Nitzschia romana</i>
<i>Bacteriastrum comosum</i>	<i>Gomphonema constrictum</i>	<i>Nitzschia scalaris</i>
<i>Bacteriastrum delicatulum</i>	<i>Gomphonema gracile</i>	<i>Nitzschia seriati</i>
<i>Bacteriastrum elegans</i>	<i>Gomphonema intracatum</i>	<i>Nitzschia sigma</i>
<i>Bacteriastrum furcatm</i>	<i>Gomphonema intricatum</i>	<i>Nitzschia sigmoidea</i>
<i>Bacteriastrum hyalinum</i>	<i>Gomphonema lanceolatum</i>	<i>Nitzschia spectabilis</i>
<i>Balmella asterlionella</i>	<i>Gomphonema montanum</i>	<i>Nitzschia stagnorum</i>
<i>Bellerochea sp.</i>	<i>Gomphonema olivacea</i>	<i>Nitzschia tryblionella</i>
<i>Biddulphia sp.</i>	<i>Gomphonema olivaceum</i>	<i>Nitzschia umbonata</i>
<i>Biddulphia mobiliensis</i>	<i>Gomphonema parvulum</i>	<i>Nitzschia vermicularis</i>
<i>Biddulphia sinensis</i>	<i>Gomphonema sphaerophorum</i>	<i>Odontella mobiliensis</i>
<i>Brachysira exilis</i>	<i>Gomphonema tergestinum</i>	<i>Odontella sinensis</i>
<i>Caloneis amphisbaena</i>	<i>Gomphonema turris</i>	<i>Ophiocutium sp.</i>
<i>Caloneis bacillum</i>	<i>Geminella crenulato</i>	<i>Palmella sp.</i>
<i>Caloneis permagna</i>	<i>Geminella interrupta</i>	<i>Paralia sulcata</i>
<i>Caloneis silicula</i>	<i>Geminella sp.</i>	<i>Peridinium cinctum</i>
<i>Caloneis ventricosa</i>	<i>Gloeotheca rupestrisl</i>	<i>Petrodictyon gemma</i>
<i>Campylodiscus clypeus</i>	<i>Gomphoneis olivacea</i>	<i>Petroneis sp.</i>
<i>Campylodiscus daemelinus</i>	<i>Gomphotheca sinensis</i>	<i>Picutosigma sp.</i>
<i>Campylodiscus echeensis</i>	<i>Gloeothichia sp.</i>	<i>Pinnularia aleptosome</i>
<i>Campylodiscus ralfsii</i>	<i>Gomplosphaeria lacustris</i>	<i>Pinnularia alpine</i>
<i>Campylodiscus noricus</i>	<i>Gonatozygon sp.</i>	<i>Pinnularia ppendicutata</i>
<i>Cerataulina bargonii</i>	<i>Guinardia blavyana</i>	<i>Pinnularia borealis</i>
<i>Cerataulina pelagioa</i>	<i>Guinardia flaccida</i>	<i>Pinnularia brebissonii</i>
<i>Chaetoceros affnis</i>	<i>Gyrodinium sp.</i>	<i>Pinnularia gentilis</i>
<i>Chaetoceros brevis</i>	<i>Gyrosigma acuminatum</i>	<i>Pinnularia globiceps</i>
<i>Chaetoceros cervisetum</i>	<i>Gyrosigma attenuatum</i>	<i>Pinnularia piagrame</i>
<i>Chaetoceros crinitus</i>	<i>Gyrosigma balticam</i>	<i>Pinuclearia tatarar</i>
<i>Chaetoceros curvisetus</i>	<i>Gyrosigma fasciola</i>	<i>Plagiotropis lepidoptera</i>

<i>Chaetoceros decipience</i>	<i>Gyrosigma macrum</i>	<i>Planktoniella sp.</i>
<i>Chaetoceros densus</i>	<i>Gyrosigma peisonis</i>	<i>Planktoniella sol</i>
<i>Chaetoceros diversus</i>	<i>Gyrosigma scalproides</i>	<i>Pleurosigma aestuari</i>
<i>Chaetoceros excentricus</i>	<i>Gyrosigma sinensis</i>	<i>Pleurosigma angulatum</i>
<i>Chaetoceros lorenzianus</i>	<i>Gyrosigma spenceri</i>	<i>Pleurosigma capense</i>
<i>Chaetoceros peruvianus</i>	<i>Gyrosigma stregilii</i>	<i>Pleurosigma delicatulum</i>
<i>Chaetoceros politana</i>	<i>Gyrosigma tenuirostrum</i>	<i>Pleurosigma directum</i>
<i>Chaetoceros subcoronatus</i>	<i>Hantzschia amphioxys</i>	<i>Pleurosigma elongatum</i>
<i>Chrysococcus sp.</i>	<i>Hemiaulus membranaceus</i>	<i>Pleurosigma normanni</i>
<i>Climacodium fruenfeldianum</i>	<i>Hemiaulus hauckii</i>	<i>Pleurosigma obscurum</i>
<i>Cocconeis diminuta</i>	<i>Hemidiscus cuneiformis</i>	<i>Pleurosigma salinarum</i>
<i>Cocconeis disculus</i>	<i>Hemidiscus sinesis</i>	<i>Pseudostaurosira brevistriata</i>
<i>Cocconeis pediculus</i>	<i>Holopedium irregulare</i>	<i>Podosira stelliger</i>
<i>Cocconeis placentula</i>	<i>Hyalodiscus sp.</i>	<i>Rhabdonema adriaticum</i>
<i>Cocconeis scutellum</i>	<i>Lauderia annulata</i>	<i>Rhizoclonium artitspira</i>
<i>Corethron cryophilum</i>	<i>Lauderia borealis</i>	<i>Rhizoclonium hieroglyphicus</i>
<i>Coscinodiscus asteromphalus</i>	<i>Leptocylindrus danicus</i>	<i>Rhizosolenia alata</i>
<i>Coscinodiscus centralis</i>	<i>Leptocylindrus sp.</i>	<i>Rhizosolenia calcar</i>
<i>Coscinodiscus concinnus</i>	<i>licmophora enrenborgii</i>	<i>Rhizosolenia calearavis</i>
<i>Coscinodiscus gigas</i>	<i>Lithodesmium undulatum</i>	<i>Rhizosolenia imricata</i>
<i>Coscinodiscus granii</i>	<i>Mallomonas sp.</i>	<i>Rhizosolenia robusta</i>
<i>Coscinodiscus kuetzingii</i>	<i>Mastogloia braunii</i>	<i>Rhizosolenia setigera</i>
<i>Coscinodiscus lacustris</i>	<i>Mastogloia ellipti</i>	<i>Rhizosolenia shrubslei</i>
<i>Coscinodiscus oculus</i>	<i>Mastogloia elliptica</i>	<i>Rhoicosphenia curvata</i>
<i>Coscinodiscus perforatus</i>	<i>Mastogloia jurgensii</i>	<i>Rhoicosphenia marina</i>
<i>Coscinodiscus radiatus</i>	<i>Mastogloia smithii</i>	<i>Rhopalodia gibba</i>
<i>Coscinodiscus rothii</i>	<i>Melosira ambigua</i>	<i>Rhopalodia gibberula</i>
<i>Cyclotella atomus</i>	<i>Melosira distance</i>	<i>Rhopalodia musculus</i>
<i>Cyclotella comta</i>	<i>Melosira granulata</i>	<i>Rhopalodia parallela</i>
<i>Cyclotella crassa</i>	<i>Melosira italica</i>	<i>Scoliopleura sp.</i>
<i>Cyclotella glomerata</i>	<i>Melosira moniliformis</i>	<i>Skeletonema costatum</i>
<i>Cyclotella katzingiana</i>	<i>Melosira spaerica</i>	<i>Spirotaenia sp.</i>
<i>Cyclotella meneghiniana</i>	<i>Melosira variance</i>	<i>Surirella angusta</i>
<i>Cyclotella ocellata</i>	<i>Melosira varians</i>	<i>Surirella angustata</i>
<i>Cyclotella radiosa</i>	<i>Meridion circulare</i>	<i>Surirella biseriata</i>
<i>Cyclotella stelligera</i>	<i>Navicula acuta</i>	<i>Surirella capronii</i>
<i>Cyclotella striata</i>	<i>Navicula americana</i>	<i>Surirella gemma</i>

<i>Cyclotella Stylorum</i>	<i>Navicula anglica</i>	<i>Surirella ovalis</i>
<i>Cymatopleura elliptica</i>	<i>Navicula apiculata apiculata</i>	<i>Surirella ovata</i>
<i>Cymatopleura solea</i>	<i>Navicula atomus</i>	<i>Surirella ovatis</i>
<i>Cymbella affinis</i>	<i>Navicula bacillum</i>	<i>Surirella recedens</i>
<i>Cymbella amphicephala</i>	<i>Navicula bryophila</i>	<i>Surirella robusta</i>
<i>Cymbella angustata</i>	<i>Navicula buccella</i>	<i>Surirella striatula</i>
<i>Cymbella aspera</i>	<i>Navicula cincta</i>	<i>Stauroneis phenicenteron</i>
<i>Cymbella caepitosa</i>	<i>Navicula crucicula</i>	<i>Stauroneis smithii</i>
<i>Cymbella cesutii</i>	<i>Navicula cryptocephala</i>	<i>Stauroneis sp.</i>
<i>Cymbella cistula</i>	<i>Navicula cuspidata</i>	<i>Stephanodiscus astrea</i>
<i>Cymbella creptocyphala</i>	<i>Navicula decussis</i>	<i>Stephanediscus dubius</i>
<i>Cymbella cymbiformis</i>	<i>Navicula dicephala</i>	<i>Stephanodiscus hantzschii</i>
<i>Cymbella differta</i>	<i>Navicula fusca</i>	<i>Stephanediscus tenuis</i>
<i>Cymbella gracilis</i>	<i>Navicula gastrum</i>	<i>Streptotheca tamesis</i>
<i>Cymbella helvetica</i>	<i>Navicula gibbula</i>	<i>Striata anipunctat</i>
<i>Cymbella hustedtii</i>	<i>Navicula gracilis</i>	<i>Striatella unipunctata</i>
<i>Cymbella lanceolata</i>	<i>Navicula graciloides</i>	<i>Synedra acus</i>
<i>Cymbella leptoceros</i>	<i>Navicula gregaria</i>	<i>Synedra affinis</i>
<i>Cymbella leptoris</i>	<i>Navicula grinumei</i>	<i>Synedra capitata</i>
<i>Cymbella microcephala</i>	<i>Navicula halophila</i>	<i>Synedra fasciculata</i>
<i>Cymbella obtusiuscula</i>	<i>Navicula hungarica</i>	<i>Synedra nana</i>
<i>Cymbella parva</i>	<i>Navicula hustdtii</i>	<i>Synedra pulchella</i>
<i>Cymbella perpusilla</i>	<i>Navicula inflata</i>	<i>Synedra rumpens</i>
<i>Cymbella prostrata</i>	<i>Navicula lanceolata</i>	<i>Synedra tabulate</i>
<i>Cymbella pusilla</i>	<i>Navicula mutica</i>	<i>Synedra ulna</i>
<i>Cymbella sinuate</i>	<i>Navicula oblonga</i>	<i>Synedra vaucheria</i>
<i>Cymbella sinuta</i>	<i>Navicula parva</i>	<i>Tabellaria dinobryon</i>
<i>Cymbella tumida</i>	<i>Navicula perrotettii</i>	<i>Tabellaria flocculosa</i>
<i>Cymbella tumidula</i>	<i>Navicula phyllepta</i>	<i>Tabellaria sp.</i>
<i>Cymbella turgida</i>	<i>Navicula placentula</i>	<i>Thalassiosira anguster</i>
<i>Cymbella ventricosa</i>	<i>Navicula pseudohalophila</i>	<i>Thalassiosira decipiens</i>
<i>Cylindrotheca closterium</i>	<i>Navicula pseudotuscula</i>	<i>Thalassiosira fluyiatilis</i>
<i>Cylindrotheca gracilis</i>	<i>Navicula pupula</i>	<i>Thalassiosira hyalina</i>
<i>Dandorina sp.</i>	<i>Navicula pygmaea</i>	<i>Thalassiosira leptopa</i>
<i>Denticula degens</i>	<i>Navicula radiosa</i>	<i>Thalassiosira weissflogii</i>
<i>Denticula elegans</i>	<i>Navicula radiosa</i>	<i>Thalassionema nitzschiioides</i>
<i>Denticula rainierensis</i>	<i>Navicula rhychocephala</i>	<i>Thalassiothrix fruenfeldii</i>
<i>Denticula sp.</i>	<i>Navicula salinarum</i>	<i>Tropidoneis lepidoptera</i>
<i>Diatoma dongatum</i>	<i>Navicula schroeteri</i>	<i>Tryblionella debilis</i>

Table 2. List of Charophyceae taxa

Class	Taxon
Charophyceae	Nitella sp.

Table 3. List of Chlorophyceae taxa

Class	Taxon	Taxon
Chlorophyceae	<i>Acanthosphaera zachariasii</i>	<i>Odegonium gracillius</i>
	<i>Actinastrum gracilimum</i>	<i>Oedogonium</i> sp.
	<i>Actinastrum hantzschii</i>	<i>Oedogonium microgonium</i>
	<i>Ankistrodesmus convolutes Corda</i>	<i>Oocystis borgei</i>
	<i>Ankistrodesmus falcatus</i>	<i>Oocystis</i> sp.
	<i>Ankistrodesmus</i> sp.	<i>Oocystis Naegeli</i>
	<i>Ankistrodesmus spiralis</i>	<i>Oonephris palustris</i>
	<i>Asterococcus superbus</i>	<i>Opephora</i> sp.
	<i>Asternococcus limneticus</i>	<i>Ophiocytium bicuspidatum</i>
	<i>Basicladia chelonum</i>	<i>Palmodictyon varium</i>
	<i>Bulbochaete</i> sp.	<i>Pandorina morum</i>
	<i>Botryococcus braunii</i>	<i>Pediastrum boryanum</i>
	<i>Botryococcus protuberans</i>	<i>Pediastrum braunii</i>
	<i>Carteria</i> sp.	<i>Pediastrum duplex</i>
	<i>Carteria Klebsii</i>	<i>Pediastrum integrum</i>
	<i>Characium</i> sp.	<i>Pediastrum sculptatum</i>
	<i>Chlamydomonas dinobryoni</i>	<i>Pediastrum simplex</i>
	<i>Chlamydomonas globosa</i>	<i>Pediastrum tetras</i>
	<i>Chlamydomonas epiphytic</i>	<i>Plmella mucosa</i>
	<i>Chlamydomonas saline</i>	<i>Pleurococcus</i> sp.
	<i>Chlamydomonas</i> sp.	<i>Protococcus</i> sp.
	<i>Chlamydomonas snowiae</i>	<i>Protococcus tetras</i>
	<i>Chlorella</i> sp.	<i>Pyrobotrys gracilis</i>
	<i>Chlorella vulgaris</i>	<i>Scenedesmus acuminata</i>
	<i>Cladophora fracta</i>	<i>Scenedesmus acutus</i>
	<i>Cladophora glomerata</i>	<i>Scenedesmus bijuga</i>
	<i>Cladophora secunda</i>	<i>Scenedesmus dimorphus</i>
	<i>Cladophora</i> sp.	<i>Scenedesmus intermedus</i>
	<i>Closterium acutum</i>	<i>Scenedesmus obligus</i>
	<i>Closterium cornu</i>	<i>Scenedesmus quadricauda</i>
	<i>Closterium costatum</i>	<i>Scenedesmus abundans</i>
	<i>Closterium depresum</i>	<i>Scenedesmus acuminatus</i>
	<i>Closterium diana</i>	<i>Scenedesmus arcuatus</i>
	<i>Closterium ehrenbergii</i>	<i>Scenedesmus armatus</i>
	<i>Closterium parvalum</i>	<i>Scenedesmus bijuga</i>
	<i>Closterium microporm</i>	<i>Scenedesmus brasiliensis</i>
	<i>Closterium</i> sp.	<i>Scenedesmus denticulatus</i>
	<i>Closteriopsis longissima</i>	<i>Scenedesmus dimorphus</i>
	<i>Cocoid green</i>	<i>Scenedesmus longus</i>
	<i>Coelastrum astroideum</i>	<i>Scenedesmus magnus</i>
	<i>Coelastrum cambricum</i>	<i>Scenedesmus obligus</i>
	<i>Coelastrum granatum</i>	<i>Scenedesmus opoliensis</i>
	<i>Coelastrum microporum</i>	<i>Scenedesmus quadricauda</i>
	<i>Coelastrum reticulatum</i>	<i>Scenedesmus serratus</i>
	<i>Coelastrum leave</i>	<i>Scenedesmus subtumidum</i>
	<i>Cosmarium botrytis</i>	<i>Staurastrum minimum</i>
	<i>Cosmarium caelatum</i>	<i>Kirchneriella irregularis</i>
	<i>Cosmarium formosulum</i>	<i>Rhizoclonium</i> sp.
	<i>Cosmarium hammeri</i>	<i>Rhodomonas ldcustris</i>
	<i>Cosmarium leave</i>	<i>Schoederia antillarum</i>
<i>Cosmarium setuiforme</i>	<i>Schroederia formosa</i>	
<i>Cosmarium subcostatum</i>	<i>Schroederia setigera</i>	

	<i>Cosmarium subtumidium</i>	<i>Selanastrum gracile</i>
	<i>Cosmarium vexatum</i>	<i>Selanastrum minutum</i>
	<i>Crucigenia apicalata</i>	<i>Selanastrum</i> sp.
	<i>Crucigenia fenestrata</i>	<i>Spirogyra affinis</i>
	<i>Crucigenia tetrapedia</i>	<i>Spirogyra fluviatilis</i>
	<i>Crucigenia tetrapedin</i>	<i>Spirogyra proticalis</i>
	<i>Cymatopleura elliptica</i>	<i>Spirogyra subsalsa</i>
	<i>Cymatopleura</i> sp.	<i>Spirogyra weberi</i>
	<i>Dactylococcus</i> sp.	<i>Sorstrum spinulosum</i>
	<i>Desmidium</i> sp.	<i>Staurastrum bohlinianum</i>
	<i>Dictyosphaerium pulchellum</i>	<i>Staurastrum gracile</i>
	<i>Dispora</i> sp.	<i>Staurastrum natator</i>
	<i>Draparnaldia</i> sp.	<i>Staurastrum paradoxum</i>
	<i>Excentrosphaera viridis</i>	<i>Staurastrum vestitum</i>
	<i>Geminella</i> spp.	<i>Staurastrum</i> sp.
	<i>Golenkinia paucispina</i>	<i>Staurodesmus cuspidatus</i>
	<i>Golenkinia</i> sp.	<i>Stigeoclonium attenuatum</i>
	<i>Gonium pectoral</i>	<i>Stigeoclonium curvirostrum</i>
	<i>Gonium</i> sp.	<i>Stigeoclonium</i> sp.
	<i>Haematococcus lacustris</i>	<i>Strastrum gracile</i>
	<i>Hormidium klebsii</i>	<i>Synedra</i> sp.
	<i>Hyrodictyon reticulatum</i>	<i>Tetradron caudatum</i>
	<i>Kirchneriella contorta</i>	<i>Tetraedron duospinum</i>
	<i>Kirchneriella elongata</i>	<i>Tetraedron hastatum</i>
	<i>Kirchneriella irregularis</i>	<i>Tetraedron minimum</i>
	<i>Kirchneriella</i> sp.	<i>Tetradron muticum</i>
	<i>Kirchneriella obesa</i>	<i>Tetraedron regulare</i>
	<i>Lagerheimia quadriseta</i>	<i>Terpsinoe</i> sp.
	<i>Lagerheimia ciliate</i>	<i>Tetradron trigonum</i>
	<i>Leptosirci</i> sp.	<i>Tetradron pentaedricum</i>
	<i>Micractinium pusillum</i>	<i>Treubaria setigera</i>
	<i>Microspora loefgrenii</i>	<i>Uronema gigas</i>
	<i>Monoraphidium caribeum</i>	<i>Ulothrix acqualis</i>
	<i>Monoraphidium contortum</i>	<i>Ulothrix cylindricum</i>
	<i>Monoraphidium convolutum</i>	<i>Ulothrix subtilissima</i>
	<i>Monoraphidium</i> sp.	<i>Ulothrix variabilis</i>
	<i>Mougeotia</i> sp.	<i>Westellopsis linearis</i>
	<i>Nephrochlamys willeana</i>	<i>Zygnema chalybeospermum</i>
	<i>Oedogonium cardiacum</i>	<i>Zygnema</i> sp.

Table 4. List of Chrysophyceae taxa

Class	Taxon	Taxon
Chrysophyceae	<i>Dinobryon divergens</i>	<i>Peridinium cinictum</i>
	<i>Dinobryon cylindricum</i>	<i>Peridinium</i> sp.
	<i>Dinobryon sertularia</i>	<i>Rhizochry limnetica</i>
	<i>Dinobryon sirtularia</i>	

Table 5. List of Compsopogonophyceae taxa

Class	Taxon
Compsopogonophyceae	<i>Compsopogon occidentalis</i>

Table 6. List of Conjugatophyceae taxa

Class	Taxon	Taxon
Conjugatophyceae	<i>Coelastrum astroideum</i>	<i>Monoraphidium convolutum</i>
	<i>Coelastrum microporum</i>	<i>Monoraphidium contortum</i>
	<i>Coelastrum intermedium</i>	<i>Monoraphidium minutum</i>
	<i>Cosmarium granatum</i>	<i>Tetraedon minimum</i>
	<i>Cosmarium hammeri</i>	<i>Tetraedon regulare</i>

	<i>Cosmarium laeve</i>	<i>Tetraedon trigonum</i>
	<i>Cosmarium meneghinii</i>	<i>Zygnema cruciatum</i>
	<i>Cosmarium subcrenatum</i>	<i>Mougeotia genuflexa</i>
	<i>Hyalotheca dissiliens</i>	

Table 7. List of Cryptophyceae taxa

Class	Taxon	Taxon
Cryptophyceae	<i>Chilomonas paramecium</i>	<i>Cryptomonas erasa</i>
	<i>Chroomonas nordstedtii</i>	<i>Cryptomonas ovata</i>
	<i>Chroomonas sp. Chroomonas nordstedtii</i>	<i>Rhodomonas fusulinus</i>

Table 8. List of Cyanophyceae taxa

Class	Taxon	Taxon
Cyanophyceae	<i>Anabaena affinis</i>	<i>Merismopedia elegans</i>
	<i>Anabaena asterlonella</i>	<i>Merismopedia glauca</i>
	<i>Anabaena flos- aquae</i>	<i>Merismopedia minima</i>
	<i>Anabaena planktonica</i>	<i>Merismopedia punctata</i>
	<i>Aphanocapsa biformis</i>	<i>Merismopedia tenuissima</i>
	<i>Aphanocapsa endophytica</i>	<i>Microcoleus acutissimus</i>
	<i>Aphanocapsa littorals</i>	<i>Microcoleus paludosus</i>
	<i>Aphanocapsa rivularis</i>	<i>Microcystis aeruginosa</i>
	<i>Aphanothece sp.</i>	<i>Microcystis flos-aquae</i>
	<i>Aphanothece clathrata</i>	<i>Microcystis robusta</i>
	<i>Anabaenopsis sp.</i>	<i>Nostoc granulare</i>
	<i>Arthrospira sp.</i>	<i>Nostoc calcicola</i>
	<i>Arthrospira platansis</i>	<i>Oscillatoria actissimud</i>
	<i>Aulosira fertilissima</i>	<i>Oscillatoria acuminata</i>
	<i>Calothrix sp.</i>	<i>Oscillatoria agardhii</i>
	<i>Calothrix fusca</i>	<i>Oscillatoria amphibia</i>
	<i>Calothrix stangale</i>	<i>Oscillatoria amoena</i>
	<i>Chamaesiphon sp.</i>	<i>Oscillatoria anguina</i>
	<i>Chroococcus dispersus</i>	<i>Oscillatoria angusitssimum</i>
	<i>Chroococcus giganticus</i>	<i>Oscillatoria articulata</i>
	<i>Chroococcus limneticus</i>	<i>Oscillatoria chalybea</i>
	<i>Chroococcus sp.</i>	<i>Oscillatoria curviceps</i>
	<i>Chroococcus pallidus</i>	<i>Oscillatoria earlei</i>
	<i>Chroococcus minor</i>	<i>Oscillatoria formosa</i>
	<i>Chroococcus minutus</i>	<i>Oscillatoria geitleri</i>
	<i>Chroococcus turgidus</i>	<i>Oscillatoria granulate</i>
	<i>Chroococcus minor</i>	<i>Oscillatoria jasorvensis</i>
	<i>Chroococcus various</i>	<i>Oscillatoria limnetica</i>
	<i>Cyanaus hamiformis</i>	<i>Oscillatoria limosa</i>
	<i>Chroococcus turgidus</i>	<i>Oscillatoria minima</i>
	<i>Dactylococcopsis smithii</i>	<i>Oscillatoria nodulosa</i>
	<i>Gloeocapsa aeruginosa</i>	<i>Oscillatoria princeps</i>
	<i>Gloeocapsa punctat</i>	<i>Oscillatoria proteus</i>
	<i>Gloeocapsa turgidus</i>	<i>Oscillatoria rubescens</i>
	<i>Gomphosphaeria aponina</i>	<i>Oscillatoria sancta</i>
	<i>Gomphosphaeria lacustris</i>	<i>Oscillatoria splanidida</i>
	<i>Gloetrichia pisum</i>	<i>Oscillatoria subbervis</i>
	<i>Goelosphaerium sp.</i>	<i>Oscillatoria tenuis</i>
	<i>Holopedium lagerheim</i>	<i>Oscillatoria tunis</i>
	<i>Hormothamnion enteromorp</i>	<i>Phormidium amphibium</i>
	<i>Hormothamnion enteromorhoide</i>	<i>Phormidium inundatum</i>
<i>Komvophoron constrictum</i>	<i>Phormidium sp.</i>	
<i>Leptolyngbya perelegans</i>	<i>Phormidium retezii</i>	
<i>Lyngbya aestuarii</i>	<i>Phormidium tenue</i>	
<i>Lyngbya aeruginea</i>	<i>Rivularia sp.</i>	

	<i>Lyngbya bipunctata</i>	<i>Rivularia haematites</i>
	<i>Lyngbya contora</i>	<i>Scytonema leptobasis</i>
	<i>Lyngbya limnetica</i>	<i>Scytonema sp</i>
	<i>Lyngbya martensiana</i>	<i>Spirulina laxa</i>
	<i>Lyngbya majuscula</i>	<i>Spirulina major</i>
	<i>Lyngbya major</i>	<i>Spirulina subsalsa</i>
	<i>Lyngbya mesotrica</i>	<i>Spirulina menenghiniana</i>
	<i>Lyngbya taylorii</i>	<i>Spirulina princeps</i>
	<i>Leptolyngbya perelegans</i>	<i>Stichosiphon sansibaricus</i>
	<i>Merismopedia convolute</i>	<i>Tolypothrix sp.</i>
	<i>Merismopedia carteria</i>	

Table 9. List of Dinophyceae taxa

Class	Taxon	Taxon
Dinophyceae	<i>Ceratium aphanizomenon</i>	<i>Prorocentrum minimum</i>
	<i>Ceratium hirundinella</i>	<i>Prorocentrum micans</i>
	<i>Ceratium furca</i>	<i>Peridinium cinctum</i>
	<i>Ceratium hirundinella</i>	<i>Peridinium pusillum</i>
	<i>Ceratium trichaios</i>	<i>Peridinium excentricum</i>
	<i>Ceratium tripos</i>	<i>Proto-peridinium sp.</i>
	<i>Dinophysis argus</i>	<i>Pyrocystis obtuse</i>
	<i>Dinophysis caudata</i>	<i>Pyrophocus horologium</i>
	<i>Dinophysis hastata</i>	<i>Ornithoceros quadratus</i>
	<i>Glenodinium quadridens</i>	<i>Ornithoceros splendidus</i>
	<i>Gonyaulax brevisulcatum</i>	

Table 10. List of Euglenophyceae taxa

Class	Taxon	Taxon
Euglenophyceae	<i>Euglena acus</i>	<i>Phacus acuminatus</i>
	<i>Euglena Convoluta</i>	<i>Phacus acutus</i>
	<i>Euglena elastica</i>	<i>Phacus caudate</i>
	<i>Euglena gracilis</i>	<i>Phacus caudatus</i>
	<i>Euglena oxyuris</i>	<i>Phacus chloroplastes</i>
	<i>Euglena Minuta</i>	<i>Phacus curvicuda</i>
	<i>Euglena polymorpha</i>	<i>Phacus gigas</i>
	<i>Euglena proxima</i>	<i>Phacus longicauda</i>
	<i>Euglena triperis</i>	<i>Phacus orbicularis</i>
	<i>Heteronema acus</i>	<i>Phacus nordstedtii</i>
	<i>Lepocinclis acuta</i>	<i>Phacus pleuronectes</i>
	<i>Lepocinclis fusiformis</i>	<i>Phacus orbicularis</i>
	<i>Lepocinelis glabra</i>	<i>Phacus pseudowirenkoi</i>
	<i>Lepocinelis playfairiana</i>	<i>Phacus suecicus</i>
	<i>Lepocinelis sphagnophila</i>	<i>Phacus spirogyra</i>
	<i>Lepocinclis ovum</i>	<i>Phacus totus</i>
	<i>Longicorner aciborski</i>	<i>Petalomonas sp.</i>
	<i>Peranema trichophorum</i>	<i>Trachelomonas fusiformis</i>

Table 11. List of Xanthophyceae taxa

Class	Taxon
Xanthophyceae	<i>Meringosphaera spinosa</i>
	<i>Pleurogaster lunaris</i>
	<i>Vaucheria sp.</i>
	<i>Vaucheria geminate</i>

Table 12. List of Trebouxiophyceae taxa

Class	Taxon
Trebouxiophyceae	<i>Nephroclytium agardhianum,</i>
	<i>Oocysts parva</i>
	<i>Oocysts crassa</i>

CONCLUSION

This review lists only 848 taxa due to relatively insufficient surveys on these groups in all Iraqi waters.

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