

Review article

Some Classes of Phytoplankton in Iraqi waters

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Abstract.

This review aimed to survey some classes of phytoplankton composition in Iraqi waters. These data were taken from investigations of phytoplankton in Iraq, covering both freshwater and saline waters in many cities. A total of 342 taxa belonging to twelve classes have been recorded in the review. Among these classes, Chlorophyceae presented a larger number of taxa, while Compsopogonophyceae, Conjugatophyceae, [Coccosinodiscophyceae](#) and Trebouxiophyceae presented one taxon only. This study proposes to present a checklist of phytoplankton in Iraq, built on the compilation of preceding surveys.

Keywords: review, phytoplankton, classes, Iraqi water.

Introduction

Numerous Iraqi investigations have been reviewed in regard to the taxa of phytoplankton in waters as marshes, lakes, reservoirs, and rivers. Phytoplanktons are a central factor of all kinds of aquatic systems as they reveal the condition of their environment through the productivity, abundance, and distribution of phytoplankton (1). The studies showed their significance as bioindicators because of the fast response to the alteration in an aquatic system (2, 3). Lately, algae are used like a source for plant fertilizers, antibiotics, and for bio-diesels. The significance of them is rising like creatures for investigators in genetics, nanotechnology, and other applied sciences (4). Phytoplankton can be the heralds of infection or decease. Some of them create biotoxins, making these kinds accountable for blooms or “red tides,” or harmful algal. These toxins can cause irritation in the respiratory system in creatures and other risks (5).

In Iraq, abundant efforts have been used on distribution and identification of phytoplanktons. So, this review offered data of the composition of non-diatom algal taxa in Iraq.

Sources and Methods

Literature review. Data were taken from sixty-eight reference (54 research papers, ten Ph. D. thesis, and four M. Sc. thesis, dealing with the phytoplanktons. Data from the references were gathered to make the current list of phytoplanktons. The references are (6 - 73): Hassan, *et al.* (2007), Abdulameer (2014), Al Azawey (2012), Al Fatlawi (2011), Al Zubaidi, *et al.* (2006), Al Hassany, *et al.*, (2014), Al- Rawi (2013), Al-Araji(1988), Al-Azawi (2004), Al-Handal, *et al.*, (1991), Ali, *et al.*, (2020), Alkam and Abdullah (2013), Alkam and Abdumuneem (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, *et al.* (2009), Al-Saadi, *et al.* (2000), Al-Saadi, *et al.* (1996), Al-Saadi, *et al.* (2008), Al-Saadi, *et al.*

(1995), 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-Saboonchi, *et al.* (1990), Al-Shawi (2010), Al-Zubaidi (1985), Azawy (2006), Aziz and Muhammed (2016), Aziz (2011), Aziz and Rasoul (2016), Hadi and Al-Saboonchi (1989), Hameed (1977), Hassan (2010), Hassan, *et al.* (2008), Hassan, *et al.* (2006), Hassan, *et al.* (2014), Hassan, *et al.* (2010), Hassan, and (1995), Hassan, *et al.* (2007), Huq, *et al.* (1978), Islam and Hameed (1982), Islam and Hameed (1985), Ismail and Saadallah Kadhimi (2005), Kassim, *et al.* (1999), Kassim, *et al.* (1997), Kassim, *et al.* (2001), Kassim, *et al.* (1999), Maulood (1991), Merhoon, *et al.* (2017), Merza, *et al.* (2020), Mohammed. (2007), Mohammed (2012), Salman, *et al.* (2013), Salman, *et al.* (2013), Salman, *et al.* (2012), Salman, *et al.* (2013), Shaban (1980), Slam, *et al.* (2012), Toma (2019), Trifa and Shna (2010).

Results and Discussion

This checklist of non-diatom phytoplanktons taxa has 342 taxa (286 recognized to species level) which vary among twelve classes (table1). The variety of phytoplanktons present in Iraqi waters referred to their diverse limnological characteristics. The factors effect on qualitative of plankton. Uncontaminated ecosystems are recognized via high values of diversity (73, 74, 75). While, the existence and domination of some algae as *Scenedesmus*, *Euglena*, *Oscillatoria*, *Nitzschia*, *Navicula*, referred to organic contamination in the water (76, 77, 78).

As a outcome, this review included eleven classes, among these classes, Chlorophyceae was dominant, representing 49.4% of the detected taxa (169 taxa and 137 species), followed via Cyanophyceae (107 taxa and 95 species). Euglenophyceae (24 taxa and 20 species), Dinophyceae (22 taxa and 21 species), while the Charophyceae, Coscinodiscophyceae, Compsopogonophyceae, Conjugatophyceae, and Trebouxiophyceae were represented by two or one taxon as represented in table (2) and figure (1). Almost all surveys verified Chlorophyceae was dominated from non diatom classes (20, 64). Other classes as Cryptophyceae, Cyanophyceae, Dinophyceae, and Euglenophyceae had fewer domination, this may be because they have narrow number of species, likewise they want many nutrients (77, 79, 80).

This review listed 286 species only, because rather insufficient surveys on phytoplanktons from Iraqi waters.

Table 1.List of rotifers that found in Iraq

Class	Taxon
	<i>Acanthosphaera zachariasii</i>
	<i>Actinastrum gracilimum</i>
	<i>Actinastrum hantzschii</i>
	<i>Ankistrodesmus falcatus</i>
	<i>Ankistrodesmus</i> sp.
	<i>Ankistrodesmus spiralis</i>
	<i>Asterococcus superbus</i>
	<i>Asternococcus limneticus</i>
	<i>Basiciadia chelonum</i>
	<i>Bulbochaete</i> sp.
	<i>Botryococcus braunii</i>
	<i>Botryococcus protuberans</i>

Chlorophyceae

<i>Carteria</i> sp.
<i>Carteria Klebsii</i>
<i>Characium</i> sp.
<i>Chlamydomonas dinobryoni</i>
<i>Chlamydomonas globosa</i>
<i>Chlamydomonas epiphytic</i>
<i>Chlamydomonas saline</i>
<i>Chlamydomonas</i> sp.
<i>Chlamydomonas snowiae</i>
<i>Chlorella</i> sp.
<i>Chlorella vulgaris</i>
<i>Cladophora fracta</i>
<i>Cladophora glomerata</i>
<i>Cladophora secunda</i>
<i>Cladophora</i> sp.
<i>Closterium depresum</i>
<i>Closterium ehrenbergii</i>
<i>Closterium parvalum</i>
<i>Closterium microporm</i>
<i>Closterium</i> sp.
<i>Closteriopsis longissima</i>
<i>Coccoid green</i>
<i>Coelastrum astroideum</i>
<i>Coelastrum cambricum</i>
<i>Coelastrum granatum</i>
<i>Coelastrum microporum</i>
<i>Coelastrum reticulatum</i>
<i>Coelastrum leave</i>
<i>Cosmarium botrytis</i>
<i>Cosmarium caelatum</i>
<i>Cosmarium formosulum</i>
<i>Cosmarium hammeri</i>
<i>Cosmarium leave</i>
<i>Cosmarium setuiforme</i>
<i>Cosmarium subcostatum</i>
<i>Cosmarium subtumidium</i>
<i>Cosmarium vexatum</i>
<i>Crucigenia apiealata</i>
<i>Crucigenia fenestrate</i>
<i>Crucigenia tetrapedia</i>
<i>Crucigenia tetrapedin</i>
<i>Cymatopleura elliptic</i>
<i>Cymatopleura</i> sp.
<i>Dactylococcus</i> sp.
<i>Desmidim</i> sp.
<i>Dictyosphaerium pulchellum</i>
<i>Dinobryon divergens</i>

<i>Dispora</i> sp.
<i>Draparnaldia</i> sp.
<i>Excentrosphaera viridis</i>
<i>Geminella</i> spp.
<i>Golenkinia paucispina</i>
<i>Golenkinia</i> sp.
<i>Gonium pectoral</i>
<i>Gonium</i> sp.
<i>Haematococcus lacustris</i>
<i>Hormidium klebsii</i>
<i>Hyrodictyon reticulatum</i>
<i>Kirchneriella contorta</i>
<i>Kirchneriella elongata</i>
<i>Kirchneriella irregularis</i>
<i>Kirchneriella</i> sp.
<i>Kirchneriella obese</i>
<i>Lagerheimia quadriseta</i>
<i>Lagerheimia ciliate</i>
<i>Leptosirci</i> sp.
<i>Micractinium pusillum</i>
<i>Microspora loefgrenii</i>
<i>Monoraphidium caribeum</i>
<i>Monoraphidium contortum</i>
<i>Monoraphidium convolutum</i>
<i>Monoraphidium</i> sp
<i>Mougeotia</i> sp.
<i>Nephrochlamys willeana</i>
<i>Oedogonium cardiacum</i>
<i>Oedogonium gracillius</i>
<i>Oedogonium</i> sp.
<i>Oedogonium microgonium</i>
<i>Oocystis borgei</i>
<i>Oocystis</i> sp.
<i>Oocystis Naegeli</i>
<i>Oonephris palustris</i>
<i>Opephora</i> sp.
<i>Ophiocytium bicuspidatum</i>
<i>Palmodictyon varium</i>
<i>Pandorina morum</i>
<i>Pediastrum boryanum</i>
<i>Pediastrum duplex</i>
<i>Pediastrum integrum</i>
<i>Pediastrum sculptatum</i>
<i>Pediastrum simplex</i>
<i>Pediastrum tetras</i>
<i>Plmella mucosa</i>
<i>Pleurococcus</i> sp.

<i>Protococcus</i> sp.
<i>Protococcus tetras</i>
<i>Pyrobotrys gracilis</i>
<i>Rhizoclonium</i> sp.
<i>Rhodomonas ldcustris</i>
<i>Scenedesmus abundans</i>
<i>Scenedesmus acuminatus</i>
<i>Scenedesmus acutus</i>
<i>Scenedesmus arcuatus</i>
<i>Scenedesmus armatus</i>
<i>Scenedesmus bijuga</i>
<i>Scenedesmus brasiliensis</i>
<i>Scenedesmus denticulatus</i>
<i>Scenedesmus dimorphus</i>
<i>Scenedesmus longus</i>
<i>Scenedesmus magnus</i>
<i>Scenedesmus obliquus</i>
<i>Scenedesmus opoliensis</i>
<i>Scenedesmus quadricauda</i>
<i>Scenedesmus serratus</i>
<i>Scenedesmus subtumidum</i>
<i>Schoederia antillarum</i>
<i>Schroederia formosa</i>
<i>Schroederia setigera</i>
<i>Selanastrum gracile</i>
<i>Selanastrum minutum</i>
<i>Selanastrum</i> sp.
<i>Spirogyra affinis</i>
<i>Spirogyra fluviatilis</i>
<i>Spirogyra proticalis</i>
<i>Spirogyra subsalsa</i>
<i>Spirogyra weberi</i>
<i>Sorstrum spinulosum</i>
<i>Staurastrum bohlinianum</i>
<i>Staurastrum gracile</i>
<i>Staurastrum natator</i>
<i>Staurastrum paradoxum</i>
<i>Staurastrum vestitum</i>
<i>Staurastrum</i> sp.
<i>Staurodesmus cuspidatus</i>
<i>Stigeoclonium attenutum</i>
<i>Stigeoclonium curvirostrum</i>
<i>Stigeoclonium</i> sp.
<i>Strastrum gracile</i>
<i>Synedra</i> sp.
<i>Tetradron caudautm</i>
<i>Tetraedron duospinum</i>

	<i>Tetraedron hastatum</i>
	<i>Tetraedron minimum</i>
	<i>Tetradron muticum</i>
	<i>Tetraedron regulare</i>
	<i>Terpsinoe</i> sp.
	<i>Tetradron trigonum</i>
	<i>Tetradron pentaedricum</i>
	<i>Treubaria setigera</i>
	<i>Uronema gigas</i>
	<i>Ulothrix acqualis</i>
	<i>Ulothrix cylindricum</i>
	<i>Ulothrix subtilissima</i>
	<i>Ulothrix variabilis</i>
	<i>Westellopsis linearis</i>
	<i>Zygnema chalybeospermum</i>
	<i>Zygnema</i> sp.
Cryptophyceae	<i>Chilomonas paramecium</i>
	<i>Chroomonas nordstedtii</i>
	<i>Chroomonas</i> sp.
	<i>Cryptomonas</i> sp.
Cyanophyceae	<i>Anabaena affinis</i>
	<i>Anabaena asterlonella</i>
	<i>Anabaena flos- aquae</i>
	<i>Anabaena planktonica</i>
	<i>Aphanocapsa biformis</i>
	<i>Aphanocapsa littorals</i>
	<i>Aphanocapsa rivularis</i>
	<i>Aphanothece</i> sp.
	<i>Aphanothece clathrata</i>
	<i>Anabaenopsis</i> sp.
	<i>Arthrospira</i> sp.
	<i>Arthrospira platansis</i>
	<i>Aulosira fertilissima</i>
	<i>Calothrix</i> sp.
	<i>Calothrix fusca</i>
	<i>Calothrix stangale</i>
	<i>Chamaesiphon</i> sp.
	<i>Chroococcus dispersus</i>
	<i>Chroococcus giganticus</i>
	<i>Chroococcus limneticus</i>
	<i>Chroococcus</i> sp.
	<i>Chroococcus pallidus</i>
	<i>Chroococcus minor</i>
	<i>Chroococcus minutus</i>
	<i>Chroococcus turgidus</i>
	<i>Chroococcus minor</i>
	<i>Chroococcus various</i>

	<i>Cyanaus hamiformis</i>
	<i>Chroococcus turgidus</i>
	<i>Dactylococcopsis smithii</i>
	<i>Gloeocapsa aeruginosa</i>
	<i>Gloeocapsa punctat</i>
	<i>Gloeocapsa turgidus</i>
	<i>Gomphosphaeria aponina</i>
	<i>Gomphosphaeria lacustris</i>
	<i>Gloetrichia pisum</i>
	<i>Goelosphaerium sp.</i>
	<i>Holopedium lagerheim</i>
	<i>Hormothamnion enteromorp</i>
	<i>Hormothamnion</i> <i>enteromorphoide</i>
	<i>Komvophoron constrictum</i>
	<i>Leptolyngbya perelegans</i>
	<i>Lyngbya aestuarii</i>
	<i>Lyngbya aeruginea</i>
	<i>Lyngbya bipunctata</i>
	<i>Lyngbya contora</i>
	<i>Lyngbya limnetica</i>
	<i>Lyngbya martensiana</i>
	<i>Lyngbya majuscula</i>
	<i>Lyngbya major</i>
	<i>Lyngbya mesotrica</i>
	<i>Lyngbya taylorii</i>
	<i>Leptolyngbya perelegans</i>
	<i>Merismopedia convolute</i>
	<i>Merismopedia carteria</i>
	<i>Merismopedia elegans</i>
	<i>Merismopedia glauca</i>
	<i>Merismopedia minima</i>
	<i>Merismopedia punctata</i>
	<i>Merismopedia tenuissima</i>
	<i>Microcoleus acutissimus</i>
	<i>Microcoleus paludosus</i>
	<i>Microcystis aeruginosa</i>
	<i>Microcystis flos-aquae</i>
	<i>Microcystis robusta</i>
	<i>Nostoc sp.</i>
	<i>Nostoc calcicola</i>
	<i>Oscillatoria actissimd</i>
	<i>Oscillatoria acuminata</i>
	<i>Oscillatoria agardhii</i>
	<i>Oscillatoria amphibia</i>
	<i>Oscillatoria amoena</i>
	<i>Oscillatoria anguina</i>

	<i>Oscillatoria angustissimum</i>
	<i>Oscillatoria articulata</i>
	<i>Oscillatoria chalybea</i>
	<i>Oscillatoria curviceps</i>
	<i>Oscillatoria earlei</i>
	<i>Oscillatoria formosa</i>
	<i>Oscillatoria geitleri</i>
	<i>Oscillatoria granulate</i>
	<i>Oscillatoria jasorvensis</i>
	<i>Oscillatoria limnetica</i>
	<i>Oscillatoria limosa</i>
	<i>Oscillatoria minima</i>
	<i>Oscillatoria princeps</i>
	<i>Oscillatoria proteus</i>
	<i>Oscillatoria sancta</i>
	<i>Oscillatoria splanidida</i>
	<i>Oscillatoria subbervis</i>
	<i>Oscillatoria tenuis</i>
	<i>Oscillatoria tunis</i>
	<i>Phormidium amphibium</i>
	<i>Phormidium inundatum</i>
	<i>Phormidium sp.</i>
	<i>Phormidium retezii</i>
	<i>Phormidium tenue</i>
	<i>Rivularia sp.</i>
	<i>Rivularia haematites</i>
	<i>Scytonema leptobasis</i>
	<i>Scytonema sp</i>
	<i>Spirulina laxa</i>
	<i>Spirulina major</i>
	<i>Spirulina subsalsa</i>
	<i>Spirulina menenghiniana</i>
	<i>Stichosiphon sansibaricus</i>
	<i>Tolypothrix sp.</i>
	<i>Euglena acus</i>
	<i>Euglena Convoluta</i>
	<i>Euglena gracilis</i>
	<i>Euglena oxyuris</i>
	<i>Euglena Minuta</i>
	<i>Euglena polymorpha</i>
	<i>Euglena proxima</i>
	<i>Euglena triperis</i>
	<i>Heteronema acus</i>
	<i>Lepocinclis acuta</i>
	<i>Lepocinclis fusiformis</i>
	<i>Lepocinclis sp.</i>

Euglenophyceae	<i>Lepocinclis ovum</i>
	<i>Longicorner aciborski</i>
	<i>Peranema trichophorum</i>
	<i>Phacus acutus</i>
	<i>Phacus caudate</i>
	<i>Phacus gigas</i>
	<i>Phacus longicauda</i>
	<i>Phacus orbicularis</i>
	<i>Phacus sp.</i>
	<i>Phacus pleuronectes</i>
	<i>Petalomonas sp.</i>
	<i>Trachelomonas sp.</i>
Chrysophyceae	<i>Dinobryon divergens</i>
	<i>Dinobryon sertularia</i>
	<i>Dinobryon sirtularia</i>
	<i>Peridinium cinictum</i>
	<i>Peridinium sp.</i>
	<i>Rhizochry limnetica</i>
Dinophyceae	<i>Ceratium aphanizomenon</i>
	<i>Ceratium hirundinella</i>
	<i>Ceratium furca</i>
	<i>Ceratium hirundinella</i>
	<i>Ceratium trichaios</i>
	<i>Ceratium tripos</i>
	<i>Dinobryon divergens</i>
	<i>Dinobryon sertularia</i>
	<i>Dinophysis argus</i>
	<i>Dinophysis caudata</i>
	<i>Dinophysis hastata</i>
	<i>Glenodinium quadridens</i>
	<i>Gonyaulax brevisulcatum</i>
	<i>Prorocentrum minimum</i>
	<i>Prorocentrum micans</i>
	<i>Peridinium cinctum</i>
	<i>Peridinium pusillum</i>
	<i>Protoperidinium sp.</i>
	<i>Pyrocystis obtuse</i>
	<i>Pyrophocus horologium</i>
Xanthophyceae	<i>Meringosphaera spinosa</i>
	<i>Pleurogaster lunaris</i>
	<i>Vaucheria sp.</i>
	<i>Vaucheria geminate</i>
Charophyceae	<i>Nitella sp.</i>
	<i>Dinobryon divergens</i>

Coscinodiscophyceae	<i>Stephanodiscus astrea</i>
Compsopogonophyceae	<i>Compsopogon</i> sp.
Trebouxiophyceae	<i>Nephrocytium agardhianum</i> ,
Conjugatophyceae	<i>Hyalotheca dissiliens</i>

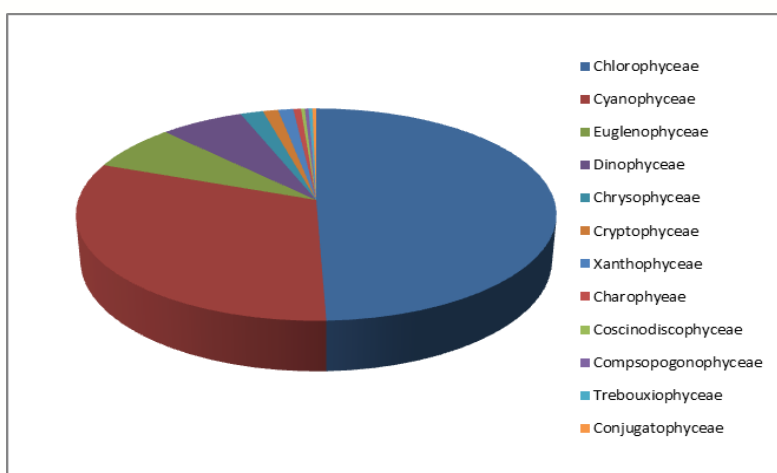


Figure1.The percentage of classes in this review.

Table2: Number of species and taxa within classes of phytoplanktons

Class	Species	Taxa	Class	Species	Taxa
Chlorophyceae	137	169	Xanthophyceae	3	4
Cyanophyceae	95	107	Charophyceae	1	2
Euglenophyceae	20	24	Coscinodiscophyceae	1	1
Chrysophyceae	5	6	Compsopogonophyceae	0	1
Dinophyceae	21	22	Trebouxioophyceae	1	1
Cryptophyceae	2	4	Conjugatophyceae	1	1

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