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Algal study in springs and streams from Shaqlawa district, Erbil Province, Iraq I- Euglenophyta

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Abstract:

In an intensive study of the various species of the Euglenophyceae under different environmental conditions, the algal samples were collected monthly in twelve springs and six related streams from September 2019 to August 2020 within Shaglawa district-Erbil Province in virgin areas for phycolimnological study. Twenty species of Euglenophyceaen are identified as a new record for the algal flora. These taxa consist of ***Colacium vesiculosum***, ***Lepocinclis salina*** and ***L.wangi***, ***Eutreptia viridis***, ***Euglena chlamydophora***, ***E. clavata, E. geniculata, E. intermedia*** **var** ***klebsii***, ***E. limnophila, E. oblonga, E. sociabilis, E. stellate*** **and** ***E. variabilis, Peranema sacculus, Phacus circumflexus, Ph. dangeardii, Ph. peteloti, Petalomonas mediocanella*** **var** ***disomata, Trachelomonas manginii,*** **and** ***T. volvocina*** **var** ***derephora***. All of these new records are described and illustrated as much as possible. According to physicals and chemicals characteristics, water temperature varied from 14.942˚C to 18.475˚C, pH lies on alkaline side of neutrality, electrical conductivity ranged between (627.472-2092.306µs/cm) and high concentration of salinity recorded in Azarian spring.

Keywords: Algae, Erbil, Euglenophyta, Springs, Properties, physic-chemical, Streams**.**

Introduction:

Aquatic systems are considered the main sources to the remaining of life for almost organisms that live in aquatic environment[1].Algalflora is one of the most important organisms that are found in the aquatic ecosystems especially which is the main source of oxygen and food chain. Recently algae entered nano-technology and micro-technology for industrial purposes, antibiotics, toxicity, productivity, water quality assessment and water pollution indicators [2-5]. Euglenophyta is very diverse algae; all species are unicellular, cosmopolitan in distribution living in fresh, saline water and in moist soils or mud rich in organic matter. They are autotrophic species, while a few of them are heterotrophic. Euglenophyta relatively responses to eutrophication [6, 7]. A total number of Euglenoides recorded in Iraq and Kurdistan Region are 54 and 21 taxa respectively[8, 9]. Despite worldwide importance of Euglenophyta; it receives little attention in Iraq. Recently few investigations and survey of Euglenophyta have been done by many authors in Iraq[6, 10, 11]and in Kurdistan Region-Iraq [12-15]. The aim of the present study is to explain more knowledge about Euglenophyta in this area as database in this area, also water quality in addition to their effect on the availability of Euglenophyta.

Materials and Methods:

Description of the study area

Erbil is the capital of Kurdistan Region and its population is about two millions people, situated in the northeast of Iraq at the coordination of 36˚ 11′28″N 44° 0′33″E/ 36˚ 191′11″N 44˚ 0917′17″E, Erbil boundaries extended from latitude 36° 42′ to 36^0 23′ N and longitude 44° 29′ to 44° 08′ E. Information about geology, water resources, climate and soil conditions in the studied area within Erbil Province are described by more authors[15-17]. Both studied sites (Aquban and Sarkand villages) belong to Shaglawa District, located 32 Km northeast of Erbil city. Aquban village area covers various types of shallow springs including sites 1, 2, 3, 4 and 5 distributed among Oak forests in the mountain

areas, rich in some aquatic plants like Salix. Thirteen sites in Sarkand village which distributed as six sites 6, 7, 8, 9, 11 and 14 along stream while the remaining seven sites 10, 12, 13, 15, 16, 17 and 18 are springs located outside of stream flow within high mountain area. The length of area in this study is about 40Km Fig 1 and Tab 1

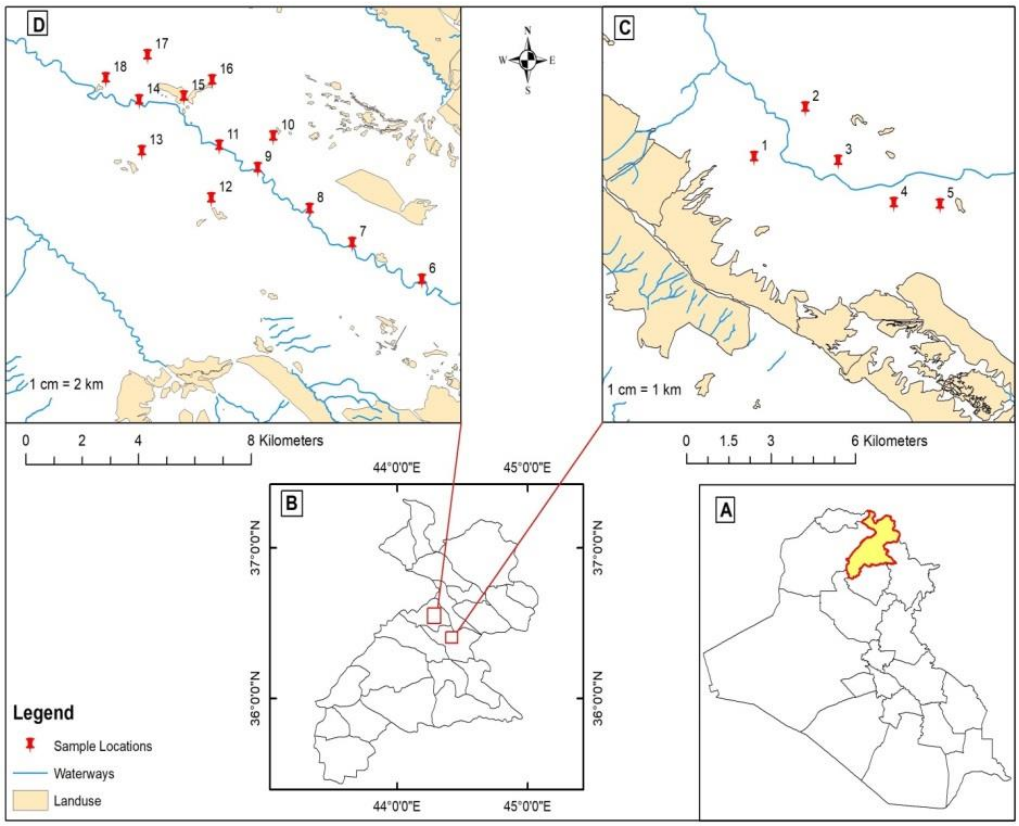

Figure 1. Shown. A- Map of Iraq and Erbil province shaded B- Map of Erbil C- Aquban village D- Sarkand village

Table 1. Shows type and location of the studied area within Shaqlawa District

Site	X_Field	Y_Field	Elevation	Location	Name of Village
1	447065.42	4024114.692	905m	Sard Spring	
2	448620.345	4025272.842	902m	Piawan Spring	
3	449343.633	4023623.880	887m	Zhnan Spring	Aquban
4	450681.287	4022479.770	902m	Darmanawa Spring	
5	452251.64	4022654.189	912m	Mink Spring	
6	439655.001	4031776.001	736m	Stream1	
7	437278.463	4033076.147	709m	Stream2	
8	435814.981	4034419.117	707m	Stream3	
9	434042.001	4035935.001	648m	Stream4	
10	434707.036	4037048.419	713m	Prenga Spring	Sarkand
11	432436.724	4036853.074	669m	Stream5	
12	432416.266	4034657.028	712m	Nawkand Spring	
13	429994.136	4036337.350	651m	Chemma Spring	
14	430060.282	4038321.729	668m	Stream6	
15	431498.957	4038387.875	743m	Sarkand Spring	
16	432287.344	4039126.466	737m	Benwan Spring	
17	430142.964	4039528.893	707m	Azarian Spring	
18	428765.729	4039143.230	595m	Razga Spring	

Sample collection and identification of algae

Algal samples were collected in vials, and then 1 ml of Lugal's solution was added to 100ml of collected both lentic and lotic water sample for persevering until identification[18]. To keep the true color of algae, a few drops of $CuSO_4$ solution was

added [19]. In this study, algal identification was based on the [7,20-23]. Euglenophyta were identified as soon as possible to avoid loss of the taxonomic characters by light Microscope (Hund Wetzel S200) at 10X, 40X magnification. Water temperature was measured immediately in the field by placing a clean mercury thermometer (0-60 °C) graduated up to 0.1 °C inside the water. EC & pH were measured by using (pH-EC-TDS meter, HI 9812, Hanna instrument).

Results and Discussion:

Collected data on water temperature, pH, EC and salinity for each sample of water sites have been represented in Tab2. Via 38 species of Euglenophyceae were identified, among them 20 species are new records in various springs and streams sites, attributed to 8 genera, 4 families, 3 orders and one class Tab 3. In this study ***Euglena*** is considered the dominant genus (19 species, 9 of them are new records. New addition of ***Lepocinclis***, ***Phacus*** and ***Trachelomonas*** are 2, 2, and 3 with 10% 10% and 15% percentage respectively. Only One new record observed for each remaining genera ***Colacium***, ***Peranema, Eutreptia*** and ***Petalomonas*** Tab 4. Generally, most species of Euglenophyceae thrive in warm water, alkaline and neutral pH Tab 2. As shown in results, high species diversity of Euglenophyceae depended on many ecological factors, such as temperatures above 20°C because they prefer warm water[24-26]. The most abundant genera in this study was ***Euglena***, ***Lepocinclis***, ***Phacus*** and ***Trachelomonas*** identified in most sites, while two species ***Lepocinclis salina*** and ***Euglena stellate*** confined with high total dissolved solids and more saline water found in Nawkand, Chemma and Azarian springs. This is in accordance with[27]. In this study Euglenophyceae was observed in summer and autumn a season which was similar to conclusion by [27]. The differences of various species found in sites under study may be due to the geology of the area, depths of sites, seasonal variations and environmental conditions[28].

Table 2. Some water properties in study sites during the studied period

Site	Place of Collection name	Habitat type	Water Temperature °C	pH	EC µs.cm-1	Salinity ppt
1	Sard	Spring	14.942	7.233	988.111	0.065
2	Piawan	Spring	15.439	7.249	1124.778	0.056
3	Zhnan	Spring	15.700	7.367	830.111	0.058
4	Darmanawa	Spring	14.108	7.479	1611.667	0.052
5	Mink Spring	Spring	14.039	7.764	627.472	0.059
6	Along Stream	Stream 1	16.211	7.844	786.250	0.072
7	Along Stream	Stream 2	17.517	7.875	785.222	0.071
8	Along Stream	Stream 3	17.381	7.894	782.972	0.076
9	Along Stream	Stream 4	17.272	7.992	764.056	0.078
10	Prenga	Spring	18.231	7.401	810.639	0.059
11	Along Stream	Stream 5	17.397	7.823	841.778	0.077
12	Nawkand	Spring	17.917	7.235	1392.583	0.110
13	Benwan	Spring	18.475	7.309	1419.139	0.085
14	Along Stream	Stream 6	17.542	7.816	911.167	0.080
15	Sarkand	Spring	18.033	7.330	924.972	0.059
16	Benwan	Spring	18.169	7.372	975.639	0.055
17	Azarian	Spring	16.108	7.297	2092.306	0.155
18	Razga	Spring	16.628	7.817	989.222	0.084

Table 3.List of identified species of Euglenophyceae in the study sites during the studied period

Phylum: Euglenophyta	***E. stellate** Stocks 1851
Class: Euglenozoa	**E. variables* G.A.Klebs 1883
Order: Euglenales	*E.viridis*(O.M.Muller) Ehrenberg 1830
Family: Euglenaceae	*Phacus* Dujardin 1841
Colacium Ehrenberg1834	*Ph. acuminatus* A. Stokes 1885
**C. vesiculosum* Ehrenberg 1833	*Ph. caudatus* Hubner 1886
Lepocinalis Perty 1852	**Ph. circumflexus* Pochmann 1942
L. fusiformis (H.J.Carter) Lemmermann	**Ph. dangeardii* Lemmermann 1910
L. playfairiana Deflander 1932	**Ph. peteloti* M.Lefevre 1933
L.ovum Ehrenberg 1932	*Ph. pleuronectes*(O.M.Muller) Nitzsch Dujardin 1841
**L. salina* Fritsch, 1914	*Trachelomonas* Ehrenberg 1834
**L. wangi* Perty, 1966	*T.granulosa* Playfair 1915
Euglena Ehrenberg1830	**T. manginii* Deflandre 1926
E. acus (O.F.Muller) Ehrenberg 1830 synonym of *Lepocinclis acus*	*T. pulchella* Drezepolski 1925
E. adunca Schiller 1956synonym of *Discoplastis adunca*	**T.volvocina*var*derephora*W.Conardo1916
* *E. chlamydophora* Mainx 1928	Class: Peranemaea
**E. clavata* Skuja1948 Synonym of Euglanaria clavata	Order: Peranemida
E. deses Ehrenberg1834	Family: Peranemidae
E. elastica Prescott 1944	*Peranema* Dujardin, 1841
E. gracilis. A. Klebs 1883	**P. sacculus* Christen 1962
**E. geniculata* Dujardin 1841	Order: Eutreptiiida
**E. intermedia* var. *klebsii* Stamer 1910	Family: Eutreptiiida
**E. limnophila* Lemmermann 1898 Synonym of *Phacus limnophilus*	*Eutreptia* Perty 1852
E. magnifica E.G. Pringsheim 1956	**E. viridis* Ehrenberg 1830
**E. oblonga* F.Schmitz 1884	Class: Stavomonada
E. oxyuris Schmarda 1846 Synonym *Lepocinclis oxyuris*	Order: Sphenomonadales
E. polymorpha P. A. Dangeard 1902 Synonym of *Euglena granulata*	Family: Sphenomonaceae
E. proxima P. A. Dangerad 1902	*Petalomonas* F.Stein 1859
**E. socialis* P.A. Dangeard, 1902 Synonym of *Euglenformis proxima*	**P. mediocanella* var. *disomata*

***New Recorded**

Table 4. New records with their percentages in the study sites during the studied period

	Name of Algal species	**Genera**	**Species**	**%**	**Number of Euglenoids species**	**%**
	Division: Euglenophyta Class: Euglenozoa Order: Euglenales Family Euglenaceae					
1	*Colacium* Ehrenberg1834	1	1	2.6	1	5.0
2	*Lepocinalis* Perty 1852	1	5	13.2	2	10.0
3	*Euglena* Ehrenberg1833	1	19	50.0	9	45.0
4	*Phacus* Dujardin 1841	1	6	15.8	3	15.0
5	*Trachelomonas* Ehrenberg 1833	1	4	10.6	2	10.0
	Family:Peranemaceae					
6	*Peranema* Dujardin, 1841	1	1	2.6	1	5.0
	Order: Eutreptiales Family: Eutreptiaceae					
7	*Eutreptia* Perty 1852	1	1	2.6	1	5.0
	Order: Sphenomonadales Family: Sphenomonaceae					
8	*Petalomonas* F.Stein 1859	1	1	2.6	1	5.0
	Total	8	38	100	20	100

Descriptions of new records:

***Colacium vesiculosum* Ehrenberg1834 (Pl.1, Fig.1)**

Cell spindle-shaped, sometimes pear appeared, free swimming cells when solitary[21].Cells 8-19µm in width, long varied from 18 to 29µm.Found in Piawan in December-2019(Water temp15°C, pH 7.5, Conductivity 1305 µs/cm, Salinity 0.054ppt) and Chemma springs in May-2020 (water temp 20 °C, pH 7.5, Conductivity

1312µs/cm, Salinity 0.097ppt) .(P211, Pl54, Fig T-U).

***Lepocinclis salina* Fritsch (Pl.1, Fig.2)**

Cells of green color, ovoid in shape, short projection found in the anterior end, chloroplast marginal, numerous and discoid [29]. Cell 30-43.3µm long and 22 to 34.2 µm wide .Identified in Nawkand in March-2020 and Chemma springs in May-2020 respectively(Water temp16 ˚C and 20 °C, pH 7.05 and 7.11, Conductivity 1394 µs/cm and1592 µs/cm, Salinity0.093ppt,0.097ppt). (P69, Pl, 3 Fig. 1).

***Lepocinclis wangi* Chu and Perty1966 (Pl.1, Fig.3)**

Cells body less or more ovo-cylindrical, pellicle spirally striated,spinus projection see in the posterior end only or may tapered at very small tail , while round shape found in the anterior end, sometimes stigma present , chloroplast take discoid form[29]. Cell 21-27.3µm width, 42-70µm length. Only recorded in along Stream 2 in June-2020.(23°C, pH 7.8, Conductivity795 µs/cm, Salinity 0.057ppt)(P69,Pl, 3 Fig. 2).

***Euglena chlamydophora* Mainx 1928(Pl. 1, Fig. 4)**

Cell spindly in shaped, anterior end is rounded, narrowing to a tail at posterior end, numerous discoid chloroplasts, pyrenoids absent [21] .cells9-20µm in width and 32.2-45-54 in long. Found in Stream 2,3 and 6 in August-2020 (Water temp 24°C, 23°C, pH 7.7,7.8,7.3, conductivity 880 µs/cm,820 µs/cm,910 µs/cm, Salinity 0.086,0.072,0.072)and in Chemma spring in July-2020.(Water temp 20˚C; pH 7.3; conductivity 1313 µs/cm, Salinity 00.101ppt) (P188, Pl45, Fig. I, J).

***Euglena clavata*Skuja1948 (Pl.1, Fig.5)**

Cell is dark green color, fusiformis, ovoid and spindly in shaped, anterior end was conically to elliptical, taped to tail in posterior end, chloroplast was many, small and round in shape[30]. Cell 40-80 µm length and 15- 30 µm width. Found in Stream 4, 5 in 7-2020 (23.8°C, 24.2°C, pH8.4, 8.00, Conductivity 782 µs/cm,1010 µs/cm, Salinity 0.054ppt) respectively.

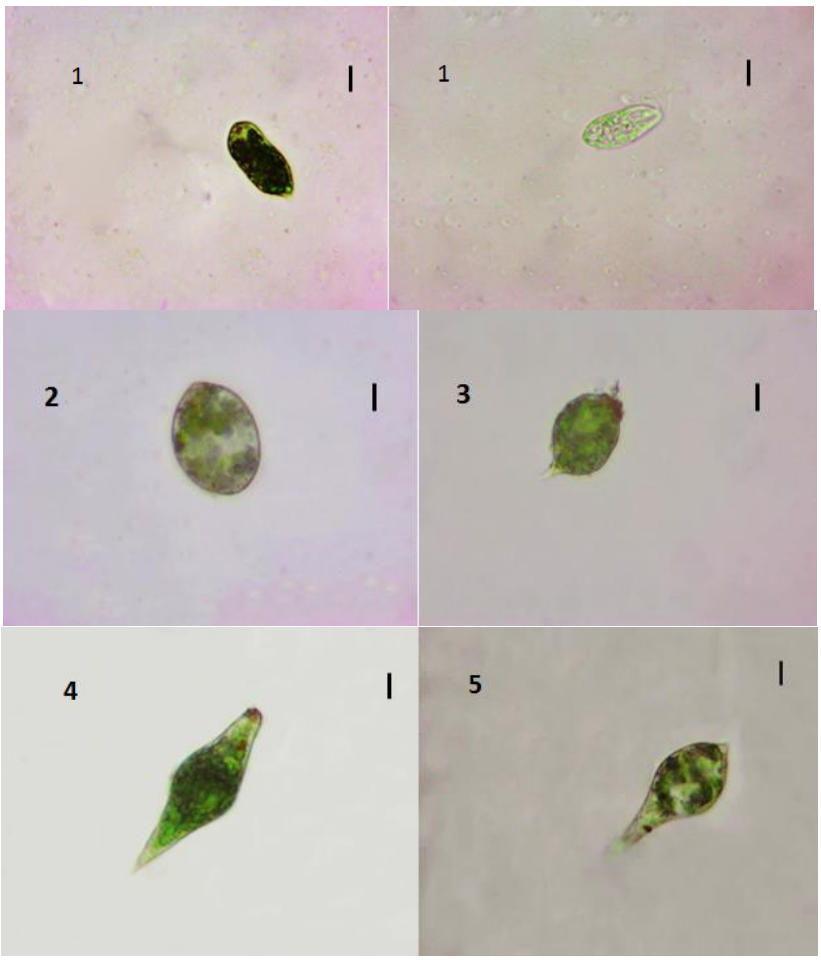

Plate 1. Photomicrographs of Algae species recorded in the study area: 1. *Colacium vesiculo*sum, 2. *Lepocinclis salina,* 3. *Lepocinclis wangi,* 4. *Euglena chlamydophora,* 5. *Euglena clavata*. Scale bar=10µm

***Euglena geniculata* (F. Schmitz)** Dujardin 1841**(Pl.2, Fig.1)**

Cell approximately cylindrica to blunt shape, both ends different in shapes, round in anterior end and narrow to sharped tail in posterior end, with two star shaped chloroplast, small eye spot[21]. Length of cell was 50-85 µm while width was 9.5-12.5-22 µm. This species were identified in Razga spring in July-2020 (Water temp 24.8°C, pH7.5, Conductivity1250 µs/cm, Salinity 0.072 ppt)(P192, Pl 47, Fig. C).

Euglena deses* var *intermedia G.A.Klebs 1883**(Pl.2, Fig.2)**

Anterior end was long and cylindrica, narrow and round at apex to short and small tail at posterior end, numerous, lens to disc chloroplast shaped. Paramylon rod shapes and short [21]. Cells 5-6-8-15µm in width and 45-54-100-130µm length. This species was present in Razga spring in July-2020(Water temp24.8°C, pH7.5, Conductivity1250 µs/cm, Salinity 0.072 ppt) (P192, Pl 47, Fig K).

Euglena limnophila Lemmermann 1898 **(Pl. 2, Fig.3)**

Shape of cells changes from cylindrica to spindle or spindle form, anterior end was slightly truncate and tapered to sharped end at posterior end, numerous of disc and small chloroplast, paramylon bodies was elongated and large[21] .Cell 40-90µm length and 7.5-12-13.6µm width. Only found in stream in July and August-2020(Water temp24°C, pH7.7, Conductivity 900 µs/cm, salinity 0.086ppt) (P 199, Pl49, Fig. B).

Euglena oblonga Schmitz 1884 **(Pl.2, Fig. 4)**

Cells green in color, cylindrical to fusiform or elongated, anteriorly tapered into round at the end, in the posterior end see broad and blunt [21]. Cells 45-54-79µm long a11-30 µm width. Presented in Prenga spring septemer-2019 (Water temp 22°C, pH7.4, Conductivity 810 µs/cm, Salinity 0.050ppt) and Benwan spring in August-2020 (Water temp 19.2°C, pH 7.2, Conductivity 1080 µs/cm, salinity 0.050ppt)(P191, Pl 46, Fig. H).

Euglena sociabilis Dangeard, 1902**(Pl .2, Fig.5)**

Cell color is of deep green, shaped as spindly or ellipsoidal, conical form in anterior end and tapered tail or process at the posterior end, chloroplast numerous[20]. Cell 50-80µm long and 20-30 their wide found in stream 4, 5 in 8-2020(Water temp 22°C, pH7.7,6.9, Conductivity 900 µs/cm,930 µs/cm, Salinity 0.090,0.080ppt) (P85, Pl 8, Fig. 15).

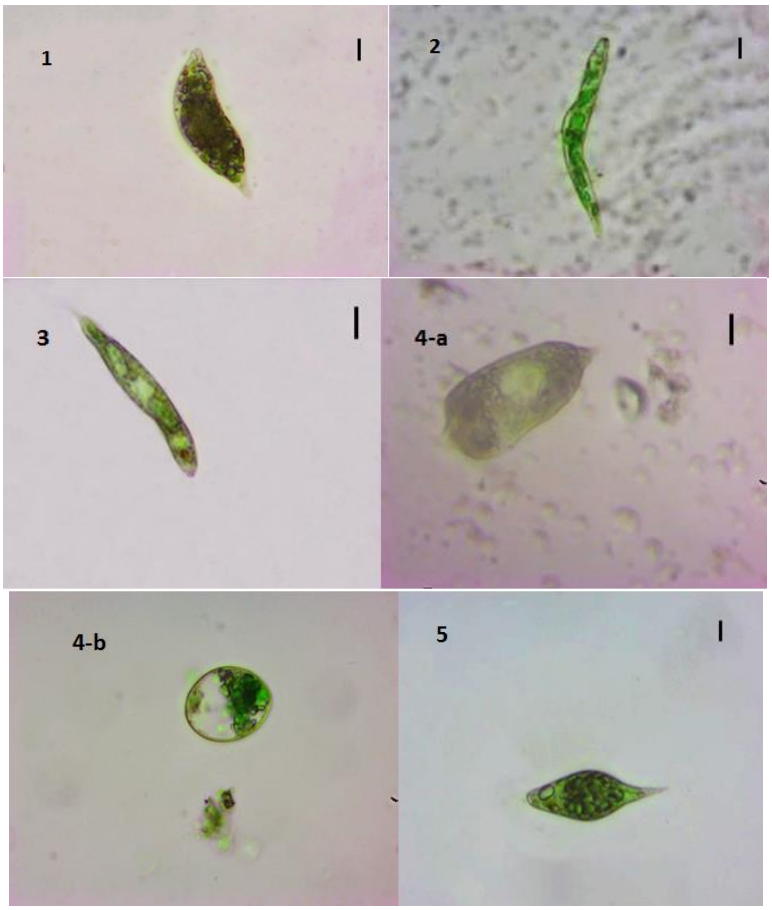

Plate 2. Photomicrographs of Algae species recorded in the study area: 1.*Euglenas geniculata,* 2. *Euglena deses* var. *intermedia,* 3. *Euglena limnophila*, 4.a*Euglena oblonga,* 4.b- *Euglena oblonga* (Cyst) 5. *Euglena sociabilis*, Scale bar=10µm

Euglena stellate Mainx, 1926 **(Pl.3, Fig.1)**

Cells spindly and broader in shaped, chloroplast was many aggregated, cells (25-50 µm) long and (8-14 µm) in wide [31]. Identified only in Nawkand spring in May and June-2020 (Water temp 17°C, 18.8°C, pH 7.05, 7.10, Conductivity1395 µs/cm, 1383 µs/cm, Salinity 0.075, 0.079ppt) respectively (P87, Pl7, Fig. 5).

Euglena variabilisG.A.Klebs1883 **(Pl.3, Fig.2)**

Cells shape ovoid to short cylindrical, round broadly in the anterior end, tapering to a blunt at posterior end with short tail, chloroplast many and disc in shaped [20]. Cell 25-31-46µm length and 7-9-15-20µm width. Present in Darmanawa , Mink and Sarkand springs(Water temp 16.5°C, 17.0°C, 18.9°C, pH 7.4,7.7, 7.1, Conductivity1200 µs/cm,650 µs/cm, 984 µs/cm, Salinity 0.082ppt, 0.072ppt, 0.068ppt), also in River 2 and 3 in July and August-2020 (Water temp, 23.5°C,24°C, pH,7.7,7.8, Conductivity 845 µs/cm,830 µs/cm,sainity 0.054, 0.058ppt)respectively (P77, Pl4, Fig. 8, 9).

Phacus circumfleuxs Pochmann1942 **(Pl.3, Fig.3)**

Cells ovoid and broader, posterior end twisted and terminate with medium shape tail. Cell70-93µm length and 32-45µm width [20]. Presented in Sard, Piawan, Chemma and Sarkand Springs in February and August-2020 respectively(Water temp 13-15°C,14-16 °C,16.5-20°C,17.2-18.2 °C, pH 7.10-7.02,7.15-6.95,7.33-7.42, 7.6-7.15, Conductivity 1113-980 µs/cm,1065-1060 µs/cm,1335-1310 µs/cm,853-980 µs/cm,0.072-0.079,0.046-0.063,.0.086-0.072,0.054-0.043ppt)(P 91, Pl 11, Fig 6).

Phacus dangeardii Lemmermann 1910 **(Pl.3, Fig.4)**

Cell ovoid shape, 1-2 ring of paramylon appears[20].Cells 6-14µm width, 17-25 µm length. Found in Piawan spring in February 2020. (Water Temp14°C, pH 7.15, Conductivity 1065, 0.046ppt) (P95, Pl 13, Fig. 4).

Phacus peteloti **M.Lefevre 1933(Pl. 3, Fig.5)**

Cell ovoid to orbicular shaped, boarder in posterior end and attenuated in other end[20]. Cell 25-35µm length and 20-30µm width. This genus recorded in Benwan spring in August-2019(Water temp19.2 °C, pH7.18, Conductivity 1080 µs/cm, 0.050ppt) (P 93, Pl 12, Fig. 3).

Trachelomonas manginii Deflandre 1926 **(Pl. 3, Fig.6)**

Lorica ellipsoid and broad, smooth wall, contain spine was very minute but not visible[21].Cells 20.5-26.5µm length and 14-20µm width. This genus found in Azarian spring in July-2020 (Water temp 20.5°C, pH 6.9, Conductivity 2110 µs/cm, 0.144ppt) (P221, Pl 55, Fig. V).

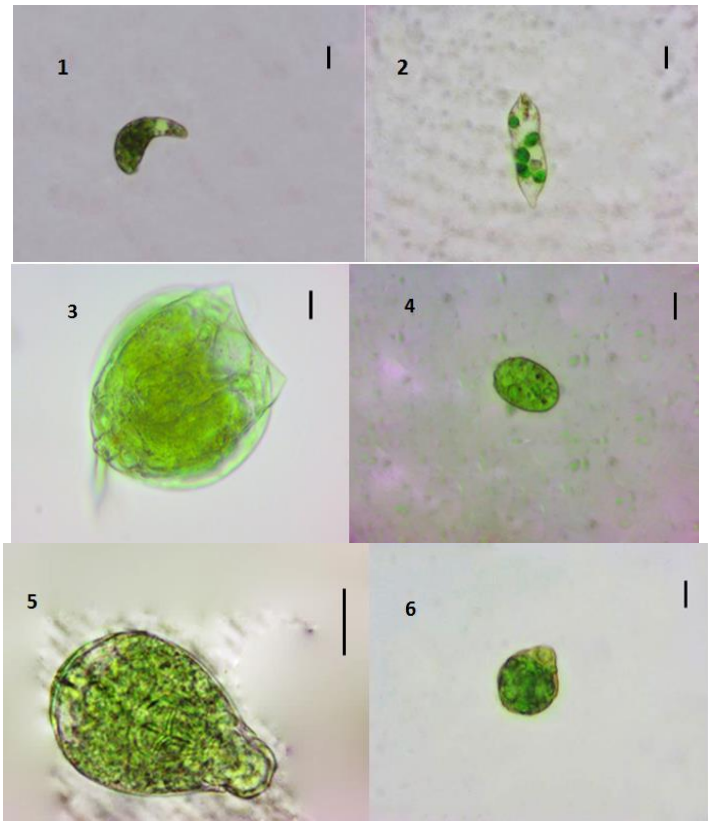

Plate 3. Photomicrographs of Algae species recorded in the study area: 1. *Euglena stellate*, 2. *Euglena variabilis*, 3. *Phacuscircumfleuxs*, 4. *Phacus dangeardii*, 5. *Phacus peteloti*, 6. *Trachelomonas.manginii*, Scale bar=10µm

Trachelomonas volvocina var ***derephora*** W.Conrad 1916 **(Pl. 4, Fig.1)**

Lorica spherical, smooth seen, pore in apical surrounded by small collar[21]. Cell 11-21µm diameter. Found in Sarkand spring in June and July-2020(Water temp18.9°C, pH 7.10, Conductivity 990µs/cm, 0.065-0.097ppt). (P 225, Pl 57, Fig. B).

Petalomonas mediocannellata **var. *dismata* (A.Stoks) Lemmermann 1910(Pl.4, Fig.2)**

Cells ovoid to fusiformis, posterior end was rounded; anterior end was attenuated with one flagella. Enumerate chloroplast and like disc shape[20]. Cell 15-25µm length and 5-12µm width. Identified in Darmanawa Spring in September-2019(Water temp 20.6 °C, pH7.2, Conductivity 2663µs/cm,0.072ppt) (P103, Pl17, Fig. 10).

Eutreptia viridis **Perty 1852 (Pl.4, Fig. 3)**

Cell broadly spindle, rounded in the anterior end, and narrow in the posterior end, Chloroplast disc like and small in size[21]. Cell55-75µm length and 5-25µm width. Recorded in in Sarkand and Benwan Springs in July and August-2020(Water temp18.9°C -18.0°C,19.6-19.2°C, pH7.1, 7.3, Conductivity990,1090 µs/cm,0.065-0.050ppt (P149, Pl34, Fig C).

Peranema cf. sacculus **Christen 1962 (Pl.4, Fig.4)**

Cell slightly elongate, posterior end was broad round, and pointed to anterior end[20]. Cell 20-30µm length, 12-20µm width. Found in Sarkand spring in July-2020(Water temp18.9°C, pH 7.1, Conductivity 990 µs/cm, 0.097ppt. (P105, Pl18, and Fig. 11).

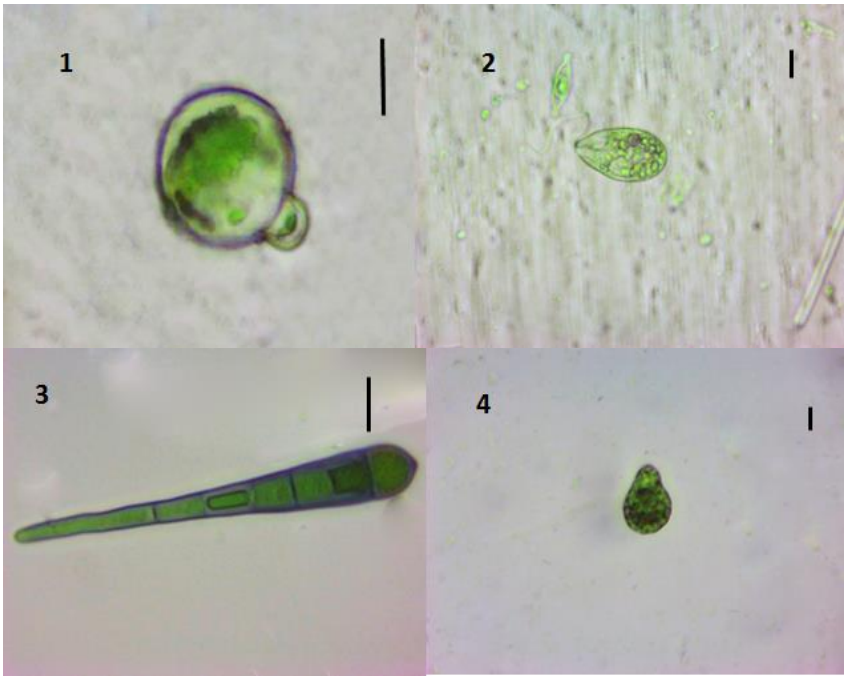

Plate 4. Photomicrographs of Algae species recorded in the study area: 1.*Trachelomonas volvocina* var *derephora*, 2.*Petalomonas* mediocannellata var. *disomata*, 3.*Eutreptia viridis*, 4.*Peranema sacculus.* Scale bar=10µm

Conclusions:

Thirty-eight species of Euglenozoa phylum are identified. In general, they were found in stagnant water and running water, twenty of them were first recorded in Iraq and Kurdistan Region. They are more abundance and have high diversity in warmer months of the year; they are favorable for their growth and development. Genus of *Euglena* considered most abundance one than other genus present within this study, while *Colacium*, *Peranema* and ***Petalomonas*** considered rare genera recorded in this study. Water temperature in this survey never increased more than18.475°C, pH values never below than 7 and high electrical conductivity found in Azarian spring was 2092µs/cm.

Authors' declaration:

- Conflicts of Interest: None.
- We hereby confirm that all the Figures and Tables in the manuscript are mine ours. Besides, the Figures and images, which are not mine ours, have been given the permission for re-publication attached with the manuscript.
- Ethical Clearance: The project was approved by the local ethical committee in Salahaddin University.

Authors' contributions statement:

F.H. Aziz and J.J. Toma both participated in the development of the idea of the search. F. Aziz developed the theory and performance the computation. J. Toma has done all the identification of Euglenophyta and other physicals and chemicals analysis but with supervising and encouragement by F. A. Aziz. Both authors participated to discuss the results to contribute to the final manuscript to become in better form.

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دراسة الطحالب في الينابيع والجداول في قضاء شقلاوة ،محافظة اربيل، العراق 1- الطحالب اليوغلينية

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الخلاصة:

تمت دراسة مكثفة لانواع مختلفة من الطحالب اليوغلينية تحت ظروف بيئية مختلفة. تم جمع الطحالب شهريا من اثني عشر موقع لليانبيع وست مواقع في الجداول من شهر أيلول-2019 الى أب-2020 ضمن قضاء شقلاوة-أربيل في منطقة لم يتم دراستها مسبقامن الناحية اللمنولوجية والطحلبية. شخص عشرون نوعا من الطحالب اليوغلينية تعد اضافة جديدة لقائمة الطحالب المسجلة في العراق . تتالف من هذه الانواع كالاتي كولاسيوم فيسكيولاسم ، ليبوسينكليس ساالينا، ل وانكي، يوتريبتيا فيريديدس، يوغلينيا كلاميديوفورا، ي كلافاتا، ي جينكيولاتا، ي انترميديا فار كليبسي، ي لمنوفيليا، ي اوبلونكا، ي سوشيابليس، ي ستيليت و ي فاريابيل، بيرانيما ساكلس، فاكس سركيومفيليكس، فاكس دانجيردي، فاكس بيتيلوتي، بيتالومونس ميديوكانيلا فار ديسماتا، تراكيلوموناس مانجيني و تراكيلوموناس فولفوسينا فار ديريفورا . كل هذه الطحالب المشخصة او المسجلة حديثا في العراق تم وصفها وتوضيحها قدر الامكان. بالنسبة للعوامل الفيزيائية والكيمياوية، حيث درجة حرارة المياه تتباين من م°14.942 الى 18.475م° ، الاس الهيدروجيني كان قاعديا، التوصيل الكهربائي تراوح بين (627.472-2092.306 مايكروسمنس لكل سنتميتر) وحيث اعلى تركيز للملوحة سجل في عين ازريان.

الكلمات المفتاحية: طحالب، أربيل ، يوغلينوفايتا ، ينابيع، الخصائص، الفيزياوية والكيمياوية، جداول .