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# Structure and Biochemical Analysis of Phytoplankton in the Wadi El-Rayan Lakes, El-Fayoum, Egypt.

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## ABSTRACT

Wadi El-Rayan lakes are an important source of irrigation water and fisheries in El-Fayoum Governorate, Egypt. Phytoplankton is an important bioindicator of the physicochemical and biological changes in natural ecosystems including the Wadi El-Rayan lakes. Seasonal and regional variations lead to concomitant changes in the total protein, carbohydrate, and lipid contents of phytoplankton; such changes affect the nutritional quality of food available in the aquatic system. In the present study, these changes were determined in the phytoplankton of Wadi El-Rayan lakes. The maximum protein (27.95 & 11.36 $mgL^{-1}$) contents were detected during summer and winter respectively. The maximum carbohydrate content was detected in autumn and winter (1.76 and 1.12 $mgL^{-1}$ at site 8 and 4 respectively). The maximum lipid content was observed in winter (0.73 $mgL^{-1}$ at site 6). Phytoplankton density was much higher in the upper lake than in the lower lake. In total, 92 species were identified; the phytoplankton community in the two lakes included typical groups such as Chlorophyceae, Cyanophyceae, Bacillariophyceae, Cryptophyceae, Dinophyceae, Chrysophyceae, and Euglenophyceae. The green alga was the dominant group, constituting 44.4%–45.0% of the phytoplankton standing crop across seasons. Cyanophyceae (29%–39%), Bacillariophyceae (9.7%–16.1%), and Dinophyceae (4.0%–9.2%) were the next most abundant classes; Cryptophyceae, Chrysophyceae, and Euglenophyceae were rarely found. The major peak of phytoplankton density ($7684\times10^4$ Cells $L^{-1}$) was observed during winter, whereas the minor peak was detected during summer ($4879\times10^4$ Cells $L^{-1}$). *Cosmarium nitidulum* (Brebisson) Ralfs, *Dictyosphaerium pulchellum* Wood, *Oocystis solitaria* Wittrock, *Gomphosphaeria compacta* (Lammermann) Ström, *Lyngbya* *limnetica* Lemmermann, *Microcystis aeruginosa* Kützing, *Cyclotella meneghiniana* Kutz., and *Syndra ulna* (Nitzsch) Ehr. were the most abundant species identified. More detailed studies on the biochemical structure of phytoplankton are needed to better understand Wadi El-Rayan lakes' response to the many environmental changes.

**Keywords:** Wadi El-Rayan Lakes; phytoplankton; biochemical analysis.

## INTRODUCTION

The Wadi El-Rayan lakes are a natural protected area and important source of irrigation water and fisheries in El-Fayoum Governorate, Egypt. Wadi El-Rayan depression (Southwest of Cairo in the Western desert of Egypt) holds two man-made lakes that receive the wastewater drainage of El-Fayoum depression. Phytoplankton plays an important role in the equilibrium of many aquatic ecosystems. The biochemical content of phytoplankton is an important indicator of their nutritional quality **(Müller-Navarra *et al.*, 2000)**. Seasonal and regional variations lead to changes in the total protein, carbohydrate, and lipid contents of phytoplankton; these changes affect the nutritional quality of food available in the aquatic system (**Boëchat and Giani, 2008).** The water quality of a water body depends on many physical, chemical, and biological indicators **(Poonam *et al.*, 2013**). The health of all living organisms in an aquatic ecosystem is affected by the quality of water **(Doherty *et al.*, 2010)**. Specifically, **Saeed and Ibrahim (2008)** reported that inorganic and organic chemical pollution of the aquatic environment poses a serious threat to the survival of aquatic organisms. In addition, several industrial and agricultural processes cause environmental pollution and contribute to the contamination of water ecosystems **(Mohamed *et al.*, 2017).** Wadi El-Rayan lakes receive agricultural wastewater drainage from the El-Wadi Drain and vary in their physical and chemical characteristics **(Ali *et al.*, 2007)**. According to the evaporation of water from the Wadi El-Rayan lakes, the gradual increase in concentrations of salts, heavy metals, pesticides, and other pollutants is changing their water quality and likely affecting aquatic life **(Mansour and Sidky, 2003; Paleczny *et al.*, 2007)**. Thus, the physicochemical and biological properties of the Wadi El-Rayan lakes have been extensively studied **(Abd El-Karim, 2004; Abdel Hameed *et al.*, 2007; Ali *et al.*, 2007; Abdel-Satar and Goher, 2015)**. In terms of phytoplankton, the upper lake has a more condensed population than the lower one, while maximum and minimum phytoplankton production has been recorded in winter and spring, respectively **(Taha and Farghaly, 1994)**. To build on these previous studies, the current phytoplankton community structure of the Wadi El-Rayan lakes and its biochemical content across seasons were analyzed.

## MATERIALS AND METHODS

### Study area:

Wadi El-Rayan holds two main lakes at different elevations that are connected by a swampy channel. They lie between 30°20´–30°25´E and 29°05´–29°20´N **(Fig. 1)**.

### Samples locations:

Ten stations were chosen to cover the area under investigation. Stations 1–5 and stations 6–10 represent the upper and lower lakes, respectively; and the El-Wadi Drain station **(Fig. 1)**. This study was seasonally conducted from autumn 2019 to summer 2020.

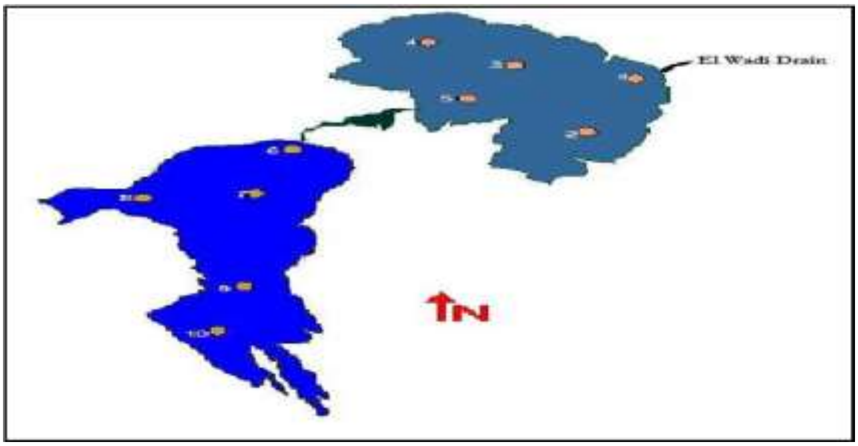


Fig. 1: Map of Wadi El-Rayan lakes showing the samples' locations.

### Qualitative estimation of phytoplankton:

Water samples were collected from the sites described previously; phytoplankton in the sample was concentrated by settling 500 ml water sample in a volumetric cylinder for about 5days after being preserved with Lugol's solution (10 g of pure iodine, 20 g of potassium iodide KI, 200 mL of distilled water, and 20 ml of glacial acetic acid). This solution facilitates the sedimentation and staining of phytoplankton cells. During time phytoplankton organisms were allowed to settle by gravitation **(APHA, 1992)**. The supernatant was then carefully siphoned off with a small plastic tube including a fine net (20µm mesh diameter) until the samples were concentrated to about 50 mL. The remaining volume was adjusted to exactly 50 mL, and the samples were kept at 4º C in a dark plastic vial until microscopic examination. Phytoplankton counts were conducted using a wild inverted microscope (Zeiss

Axiovert 25C); 5 µL of the reduced-volume sample was placed in a counting chamber and examined with a 10× eyepiece and 40× objective. The drop method **(APHA, 1992)** was applied for both the counting and identification of different algal species from different samples. Algal taxa were identified according to standard references including **Kofoid (1911), Kofoid** and **Swez (1921)**, **Lebour** and **Marie (1930)**, **Hannford and Britton (1952), Henedy (1964), Bourrely (1968), Prescott (1978), Mizuno (1990),** and **Krammer** and **Lang Bertalot (1991).**

**Biochemical analysis:**

The total protein content was determined using the biuret method (**David** and **Hazel, 1993)**. The hydrolysis of carbohydrates was conducted using the method of **Myklestad** and **Haug (1972)**, and the carbohydrate content was determined according to the work of **Dubois *et al.*, (1956)**. The total lipid content was determined according to the method of **Chabrol** and **Castellano (1961)**.

**Statistical analysis:**

Relation between phytoplankton and the three biochemical parameters (proteins, lipids, and carbohydrates) was calculated by principal component analysis (PCA), using **XLSTAT (2021)** program.

## RESULTS AND DISCUSSION:

There was a large variation in the biochemical content of phytoplankton among species and locations across the seasons. Generally, total protein was the major biochemical constituent of the phytoplankton community; the protein content of algae is also an important criterion for their use as food **(Fawzy *et al.*, 2017)**. In contrast, the total lipid content was the minor constituent of the biochemical composition of the communities. As shown in **Fig. 2**, the maximum protein (27.95 & 11.36 $mgL^{-1}$) contents were detected in summer and winter respectively. Proteins are important components of all membranes, involved in the transport of other molecules and ions across the membranes. Most enzymes are proteins that organize, construct and receive signals, while the structural proteins maintain the shape of the cell (**Jónasdóttir 2019)**. The maximum carbohydrate content was detected in autumn and winter (1.76 and 1.12 $mgL^{-1}$ at sites 8 and 4 respectively). The maximum lipid content was observed in winter (0.73 $mgL^{-1}$ at site 6). The biochemical content of phytoplankton cannot explain the variation observed in the consumer's growth when fed different phytoplankton types. So, it is necessary to look further into the more detailed structure of the classes.

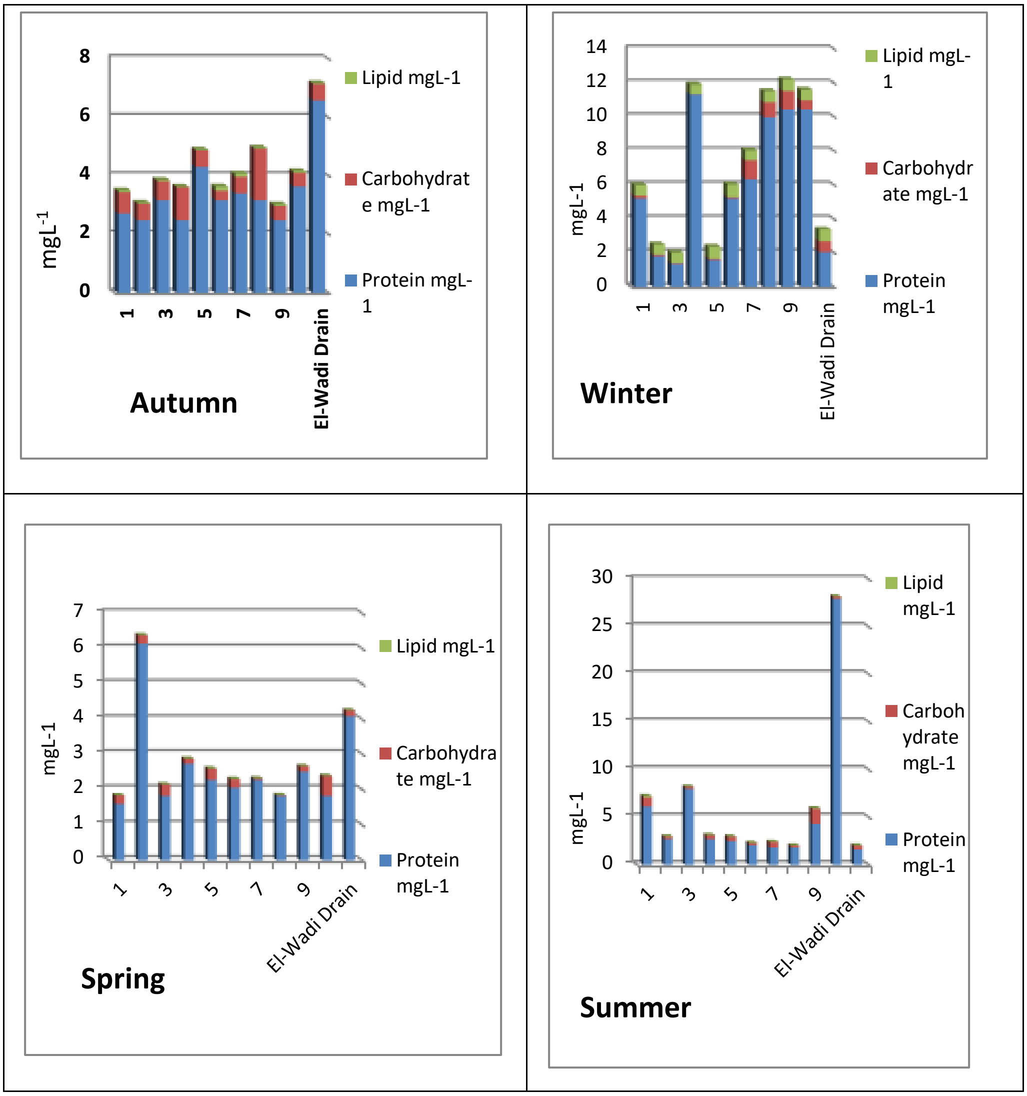


Fig. 2: The biochemical content of phytoplankton in Wadi El-Rayan lakes across the seasons (from autumn 2019 to summer 2020).

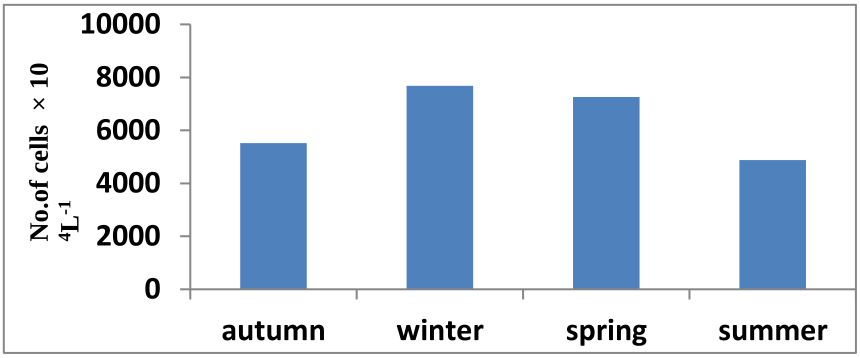


Fig. 3: Seasonal variation in total phytoplankton density ($\times10^4$ Cells $L^{-1}$) in Wadi El-Rayan lakes (from autumn 2019 to summer 2020).

The seasonal distribution of phytoplankton showed two major peaks in density: 7684 and $7260\times10^4$ Cells $L^{-1}$ in winter and spring, respectively. The lowest peak in density was detected in summer ($4879\times10^4$ Cells $L^{-1}$). In the present study, phytoplankton density was much higher in the upper lake than in the lower lake **(Table 1)**; this was likely due to the high nutrient concentrations received by the upper lake from drainage water via the El-Wadi Drain, which is again similar to that reported by **Konsowa (2007).**

In total, 92 species were identified in the present study **(Table 2)**. The phytoplankton community in the lake was composed of typical groups **(Fig. 4 and Table 1)**, e.g., Chlorophyceae, Cyanophyceae, Bacillariophyceae, Cryptophyceae, Dinophyceae, Chrysophyceae, and Euglenophyceae. The green alga was the most dominant class(44.4%–45.0% of the phytoplankton standing crop across seasons), followed by Cyanophyceae (29%–39%), Bacillariophyceae (9.7%–16.1%), and Dinophyceae (4.0%–9.2%). In contrast, Cryptophyceae, Chrysophyceae, and Euglenophyceae were rarely found.

Chlorophyceae (green algae) was the dominant phytoplankton group, with 34 Chlorophyceae taxa identified. The most common green algal taxa were *Cosmarium nitidulum* (Brebisson) Ralfs, *Oocystis borgei* Snow, *Dictyosphaerium pulchellum* Wood, *Planktonema lauterbornii* Schmidle, and *Oocystis solitaria* Wittrock **(Fig.5)**. The presence of *Tetraedron minimum* (A.Braun) Hansgirg and *Scenedesmus* spp. in the lake water indicated that it was a eutrophic environment (**El-Sheekh *et al*., 2018**).

Cyanophyceae (Blue-green algae) including 17 taxa, was the second major constituent group in the study area; the dominant species were *Gomphosphaeria compacta* (Lammermann) Ström, *Lyngbya limnetica* Lemmermann, and *Microcystis aeruginosa* Kützing. These species can tolerate a wide range of salinity and fluctuations in Wadi El-Rayan water chemistry. These findings are in agreement with those of **Konsowa and Taha (2002)**. In addition, **Konsowa** and **Abd Ellah (2002)** observed *M. aeruginosa* in the first lake during winter and *L. limnetica* in the second lake during summer.

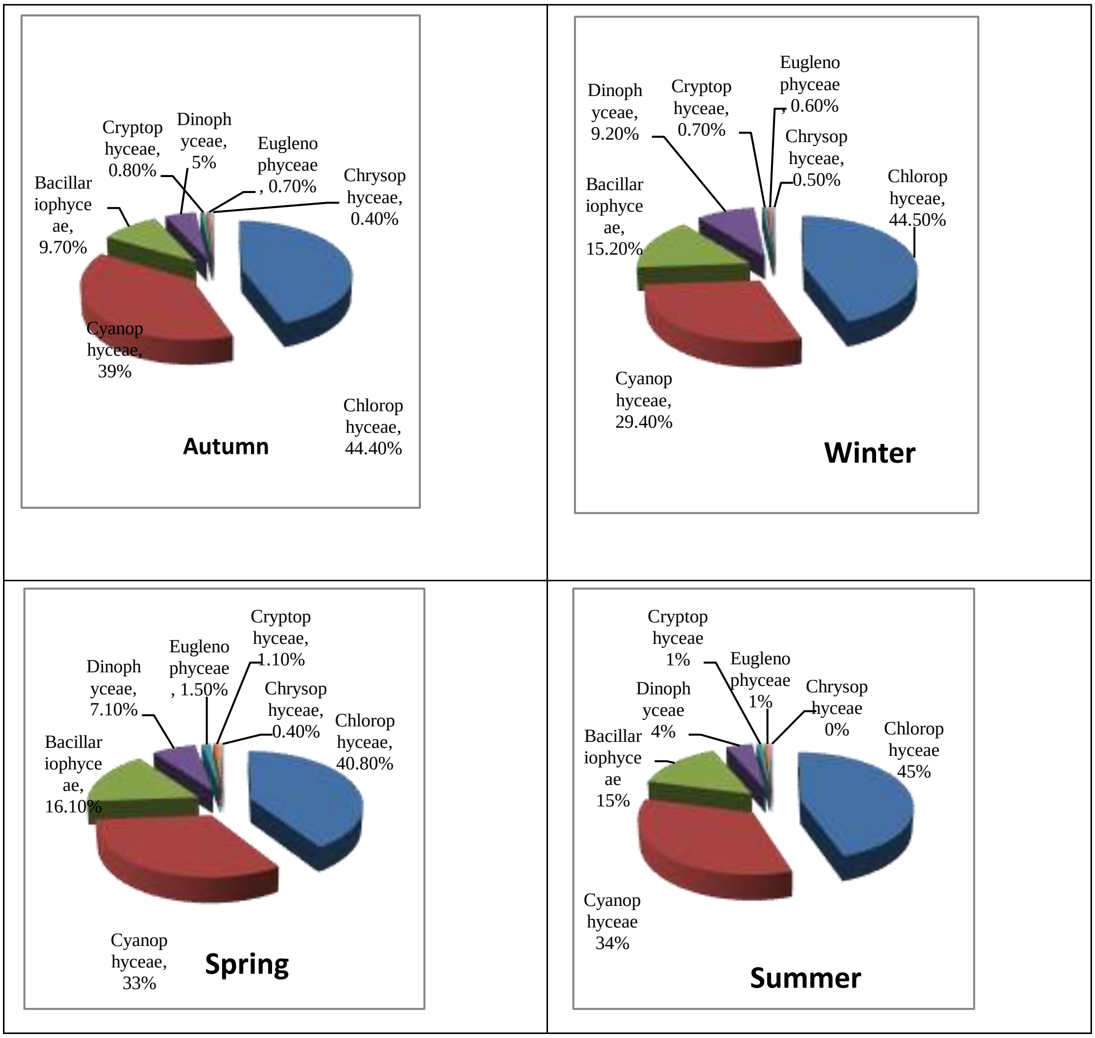


Fig. 4: Phytoplankton community composition across the seasons (from autumn 2019 to summer 2020) in the Wadi El-Rayan lakes.

Bacillariophyceae (Diatoms) was the third most predominant algae after green and blue-green **(Fig. 4)**. In total, 28 taxa related to Bacillariophyta were identified **(Table 2).** The most abundant species of diatoms were *Cyclotella meneghiniana* Kutz., *Nitzschia paleacea* Grum, and *Syndra ulna* (Nitzsch) Ehr. Four phytoplankton classes, Chrysophyceae, Cryptophyceae, Dinophyceae, and Euglenophyceae, were rarely found; thus, their standing crops were low **(Table 2)**. These classes are related to the increase in water salinity in the lower lake **(Konsowa, 2005)**. **Abd Ellah (2016)** stated that the lower lake has faced extreme water loss over the last 20 years due to the extension of agricultural land and fish farms in the depression.

**Table 1: Spatial and seasonal variations in the class composition of phytoplankton Count (×$10^4$ Cells $L^{-1}$) in Wadi El-Rayan lakes and their drain.**

| Site | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Drain | Total | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | **Autumn** | | | | | | |
| **Chlorophyceae** | 409 | 540 | 390 | 484 | 229 | 40 | 89 | 91 | 74 | 65 | 44 | 2455 | 223.2 |
| **Bacillariophyceae** | 98 | 10 | 110 | 80 | 76 | 2 | 34 | 38 | 20 | 20 | 50 | 538 | 48.9 |
| **Cyanophyceae** | 492 | 398 | 417 | 281 | 113 | 87 | 151 | 82 | 29 | 8.7 | 90 | 2148 | 195.3 |
| **Dinophyceae** | 20 | 130 | 21 | 24 | 10 | 35 | 4 | 13 | 11 | 10 | 0 | 278 | 25.3 |
| **Cryptophyceae** | 8 | 10 | 4 | 4 | 5 | 4 | 2 | 4 | 2 | 0 | 0 | 43 | 3.9 |
| **Euglenophyceae** | 7 | 0 | 4 | 2 | 8 | 10 | 2 | 2 | 4 | 0 | 0 | 39 | 3.5 |
| **Chrysophyceae** | 2 | 0 | 6 | 0 | 10 | 0 | 1 | 0 | 4 | 0 | 0 | 23 | 2.1 |
| **Total phytoplankton** | 1036 | 1088 | 952 | 875 | 451 | 178 | 283 | 230 | 144 | 104 | 184 | 5524 | 502.2 |
| | | | | | | | **Winter** | | | | | | |
| **Chlorophyceae** | 526 | 502 | 546 | 453 | 220 | 80 | 257 | 141 | 49 | 54 | 590 | 3418 | 310.7 |
| **Bacillariophyceae** | 66 | 85 | 98 | 76 | 106 | 96 | 43 | 50 | 20 | 18 | 508 | 1166 | 106.0 |
| **Cyanophyceae** | 196 | 454 | 468 | 221 | 120 | 77 | 256 | 152 | 66 | 70 | 182 | 2262 | 205.6 |
| **Dinophyceae** | 6 | 40 | 47 | 16 | 80 | 110 | 17 | 14 | 20 | 14 | 340 | 704 | 64.0 |
| **Cryptophyceae** | 2 | 0 | 2 | 8 | 20 | 10 | 2 | 4 | 2 | 0 | 0 | 50 | 4.5 |
| **Euglenophyceae** | 3 | 0 | 2 | 3 | 10 | 0 | 4 | 1 | 2 | 2 | 22 | 49 | 4.5 |
| **Chrysophyceae** | 0 | 0 | 6 | 0 | 10 | 10 | 2 | 0 | 5 | 2 | 0 | 35 | 3.2 |
| **Total phytoplankton** | 799 | 1081 | 1169 | 777 | 566 | 383 | 581 | 362 | 164 | 160 | 1642 | 7684 | 698.5 |

## Con. Table 1:

| Site | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Drain | Total | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | **Spring** | | | | | | | |
| **Chlorophyceae** | 746 | 482 | 415 | 346 | 201 | 161 | 212 | 113 | 123 | 89 | 76 | 2964 | 269.5 |
| **Bacillariophyceae** | 294 | 188 | 118 | 132 | 58 | 68 | 60 | 64 | 56 | 72 | 60 | 1170 | 106.4 |
| **Cyanophyceae** | 620 | 260 | 390 | 297 | 164 | 184 | 188 | 85.7 | 96.9 | 35.4 | 75.4 | 2395 | 217.8 |
| **Dinophyceae** | 126 | 62 | 65 | 64 | 43 | 38 | 24 | 36 | 30 | 16 | 10 | 514 | 46.7 |
| **Euglenophyceae** | 26 | 12 | 14 | 16 | 6 | 4 | 8 | 16 | 10 | 0 | 0 | 112 | 10.2 |
| **Cryptophyceae** | 21 | 14 | 12 | 2 | 6 | 6 | 4 | 4 | 8 | 0 | 0 | 77 | 7.0 |
| **Chrysophyceae** | 10 | 10 | 4 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 28 | 2.5 |
| **Total phytoplankton** | 1843 | 1028 | 1018 | 857 | 482 | 461 | 496 | 319 | 324 | 212 | 221 | 7260 | 660.0 |
| | | | | | | **Summer** | | | | | | | |
| **Chlorophyceae** | 590 | 396 | 337 | 319 | 160 | 32 | 88 | 82 | 66 | 90 | 32 | 2192 | 199.3 |
| **Bacillariophyceae** | 158 | 28 | 121 | 74 | 58 | 20 | 48 | 50 | 40 | 44 | 66 | 707 | 64.3 |
| **Cyanophyceae** | 377 | 275 | 306 | 197 | 94.9 | 87 | 141 | 53.5 | 30 | 21.1 | 93.1 | 1676 | 152.3 |
| **Dinophyceae** | 56 | 30 | 22 | 22 | 24 | 17 | 12 | 9 | 7 | 5 | 5 | 209 | 19.0 |
| **Cryptophyceae** | 13 | 6 | 2 | 6 | 4 | 0 | 4 | 2 | 2 | 0 | 0 | 39 | 3.5 |
| **Euglenophyceae** | 8 | 4 | 8 | 2 | 0 | 2 | 0 | 10 | 4 | 0 | 0 | 38 | 3.5 |
| **Chrysophyceae** | 4 | 2 | 6 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 18 | 1.6 |
| **Total phytoplankton** | 1206 | 741 | 802 | 620 | 341 | 158 | 299 | 207 | 149 | 160 | 196 | 4879 | 443.5 |

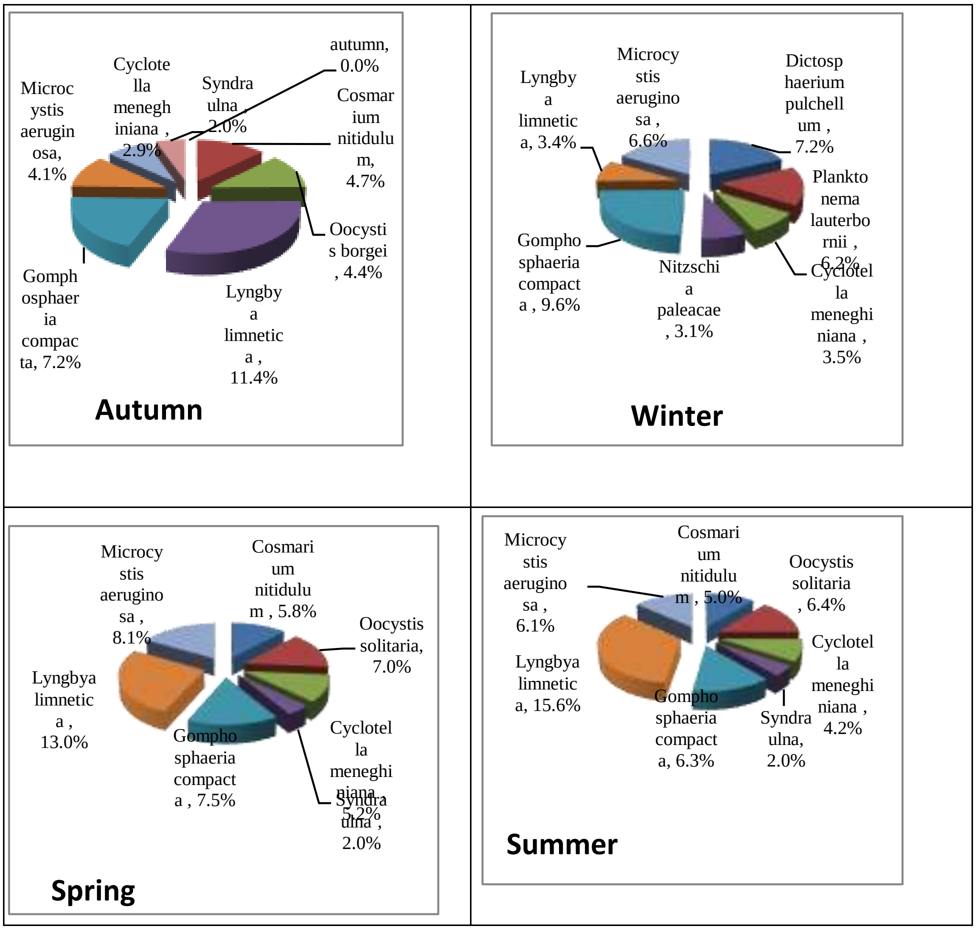


Fig. 5: Percentage abundance of the most common species of phytoplankton in Wadi El-Rayan lakes.

As shown in **Fig. 6**, the principal component analysis indicated that total phytoplankton was directly related to Chlorophyceae, Cyanophyceae, and *L. limnetica*, while Bacillariophyceae had high lipid levels relative to protein and carbohydrate levels. Overall, these results suggest that the biochemical content of phytoplankton can be a good indicator of their nutritional value.

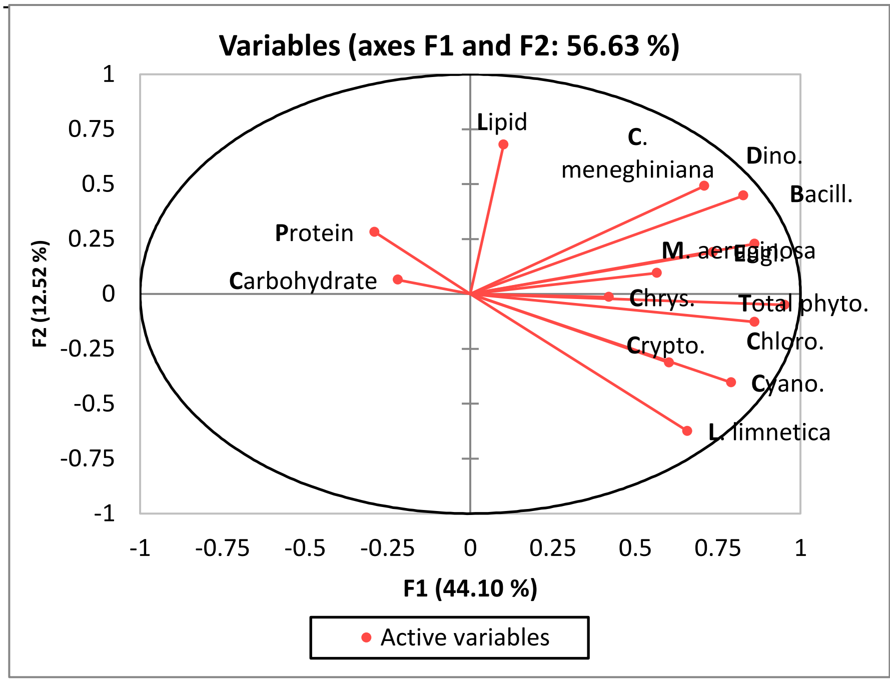


Fig. 6: Principal component analysis of biochemical and biological variables measured at the various stations of Wadi El-Rayan lakes and drain. Chloro, Chlorophyceae; Bacill, Bacillariophyceae; Cyano, Cyanophyceae;Cryp, Cryptophyceae; Chrys, Chrysophyceae; Eugl, Euglenophyceae; Dino, Dinophyceae; Total Phyto, Total phytoplankton; *M. aeruginosa*, *Microcystis aeruginosa*; L. *limnetica*, *Lyngbya limnetica; C. meneghiniana*, *Cyclotella meneghiniana*.

**Table 2: List of phytoplankton species in the Wadi El-Rayan lakes and drain.**

| Chlorophyceae | |
|---|---|
| *Actinastrum hantzschii* var. *fluviatile* J.B.L.Schröder | *Nephrocytium subsolitaria* |
| *Ankistrodesmus falcatus* (Corda) Ralfs | *Oocystis borgei* Snow |
| *Ankistrodesmus falcatus* v. *acicularis* (Braun.) West | *Oocystis elliptica* W. West |
| *Ankistrodesmus fusiformis* Corda | *Oocystis gigas* var. *minor* West & G.S.West. |
| *Chlamydomonas globosa* Snow | *Oocystis parva* W.&G.S. West |
| *Cosmarium amgulosum* Brebisson | *Oocystis solitaria* Wittrock |
| *Cosmarium depressum* | *Planktonema lauterbornii* Schmidle |
| *Cosmarium nitidulum* (Brebisson) Ralfs. | *Scenedesmus bicudatus* Dedusenko |
| *Dictosphaerium pulchellum* Wood | *Scenedesmus dimorphus* ( Turpin ) Küzing |
| *Elakatothrix gelatinosa* Wille | *Scenedesmus ecornis* ( Ehrenberg ) Chodat |
| *Gonium sociale* (Dujardin) Warming | *Scenedesmus opoliensis* P.G.Richter |
| *Keratococcus suecicus* Hindák | *Scenedesmus quadricauda* ( Turpin ) Brébisson |
| *Kirchneriella* contorta (Schmidle) Bohlin | *Scenedesmus quadricauda* v. *quadrispina* (Chod.) Smith |
| *Kirchneriella contorta* var. *elegans* (PLAYFAIR) KOMÁREK | *Staurastrum chaetoceras* |
| *Kirchneriella irregularis* (Petyk.) Printz | *Staurastrum paradoxum* Meyen ex Ralfs |
| *Legerheimia ciliata.* (Lag.) Chodat. L. | *Tetraëdron minimum* (A.Braun) Hansgirg |

| | |
|---|---|
| *Monoraphidium contortum* (Thuret) Komárková-Legnerová | *Treubaria triappendiculata* C.Bernard |

# Con. Table 2:

| | |
|---|---|
| **Bacillariophyceae** | |
| *Amphora coffeaeformis* Kutz. | *Fragillaria capucina* Desm |
| *Bacillaria paradoxa* Gemelin | *Gomphonema parvulum var. longenula* Ktz. |
| *Chaetoceros curvesetus* Cleve | *Navicula confervacea* (Kützing) Grunow |
| *Cocconies placentula Ehr.* | *Navicula cryptocephala* Kützing |
| *Cosinodiscus divisis Grun.* | *Navicula festiva* Krasske |
| *Cyclotella bodanica* Eulenstein ex Grunow | *Nitzschia closterium* (Ehrenberg) W.Smith |
| *Cyclotella glomerata* Bachmann | *Nitzschia filiformis (W.Smith) Van Heurck* |
| *C. kutzingiana Thwait.* | *Nitzschia frustulum (Kützing) Grunow* |
| *Cyclotella ocellata* Pant | *N. gracilis Hantz* |
| *Cyclotella operculata* (Ag.) kutz. | *N. palea (Kutz.) W. Smith* |
| *Cyclotella meneghiniana* kutz. | *N. tryblionellae* Hant |
| *C. stelligera* Cleve & Grun. | *Stephanodiscus astraea* (Ewhren.) Grun |
| *Cymbella microcephala* Grunow in Van Heurck | *Synedra tabulata var. acuminata* ( Grun) Hust. |
| *Epithemia proboscidea* Kützing | *Syndra ulna* (Nitzsch) Ehr. |
| **Cyanophyceae** | |
| *Chroococcus minutus* (Kützing) Nägeli | *Microcystis flosaquae* (Wittrock) Kirchner |
| *Cylindrospermopsis raciboroskii* Woloszynska | *Microcystis grevillei* (Hassall) Elenkin |
| *Gomphosphaeria compacta* (Lammermann) Ström | *Oscillatoria brevis* (Kutz.) Gom. |
| *Gomphosphaeria fusca* Skuja | *Phormidium interruptum* Kutz |
| *Limnococcus limneticus* (Lemmermann) Komárková | *phormedium frigidum* Fritsch |
| *Lyngbya limnetica* Lemmermann | *Phormidium laminosum* Gomont ex Gomont |
| *Lyngbya profundalis* Lindstedt | *Pseudanabaena papillaterminata* (Kisselev) Kukk |
| *Merismopedia elegans* A.Braun ex Kützing | *Rhabdoderma lineare* Schmidle & Lauterborn |
| *Microcystis aeruginosa* Kützing | |

| | |
|---|---|
| **Cryptophyceae** | **Chrysophyceae** |
| *Cryptomonas obovata* Ehrenberg | *Mallomonas heterospina* |
| *Cryptomonas phaseolus* Skuja | **Euglenophyceae** |
| *Chroomonas salina* (Wills.) Butch | *Euglena pisciformis* Klebs |
| **Dinophyceae** | *Euglena proxima* P.A.Dangeard |
| *Gymnodinium biconica* Skuja | *Phacus pleuronectes* (O. F. Muller) Dujardin |
| *Peridinium bipes* Stein | |
| *Peridinium penardii* (Lemm.) Lemm. | |
| *Prorocentrum micans* Ehr | |

*Protoperidinium brevipes* (Paulsen) Balech
*Prorocentrum dentatum* Stein

## CONCLUSION

The phytoplankton communities, and the biochemical content of these communities, can be considered ecosystem biomarkers at different sites in Wadi El-Rayan lakes. The biochemical composition of phytoplankton could be a valid integrator of surrounding environments in which phytoplankton grow and can be a good indicator of their nutritional value.

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# التركيب والتحليل الحيوى الكيميائي للعوالق النباتية في بحيرات وادي الريان ، الفيوم، مصر.

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## الملخص العربي

تعتبر بحيرات وادي الريان مصدرا هاما لمياه الري والثروة السمكية في محافظة الفيوم ، مصر. وتعتبر العوالق النباتية مؤشرًا حيويًا مهمًا للتغيرات الكيميائية والبيولوجية في النظم البيئية الطبيعية بما في ذلك بحيرات وادي الريان. تؤدي الاختلافات الموسمية والإقليمية إلى تغييرات في محتوى البروتين والكربوهيدرات والدهون في العوالق النباتية. تؤثر هذه التغييرات على الجودة الغذائية في النظام المائي. في هذه الدراسة تم تحديد هذه التغيرات في العوالق النباتية لبحيرات وادي الريان. تم الكشف عن أقصى محتوى من البروتين (27.95 و 11.36 ملغم لتر $^{-1}$) في الصيف والشتاء على التوالي. وكان الحد الأقصى لمحتوى الكربوهيدرات في الخريف والشتاء (1.76 و 1.12 ملغم لتر$^{-1}$ في المواقع 8 و 4 على التوالي) .ولوحظ الحد الأقصى لمحتوى الدهون في الشتاء (0.73 ملغم لتر$^{-1}$ في الموقع 6). كانت كثافة العوالق النباتية أعلى بكثير في البحيرة العليا منها في البحيرة السفلى. تم تحديد 92 نوعًا من العوالق النباتية ؛ تضمنت العوالق النباتية في البحيرة 7 مجموعات وهي Chlorophyceae و Cyanophyceae و Bacillariophyceae و Cryptophyceae و Dinophyceae و Chrysophyceae و Euglenophyceae. كانت الطحالب الخضراء (Chlorophyceae)هي الصنف السائد وشكلت 44.4٪ -45.0٪ من المحصول الكلي للعوالق النباتية عبر الفصول.ومثلت الطحالب الخضراء المزرقة (Cyanophyceae ) النسبة 29 -39 ٪، وكانت نسبة الدياتومات (Bacillariophyceae)9.7 - 16.1 ٪ والسوطيات (Dinophyceae) 4.0-9.2 ٪ من المجموع الكلي للعوالق النباتية. نادرًا ما تم العثور على Cryptophyceae و Chrysophyceae و Euglenophyceae. لوحظت اعلي كثافة للعوالق النباتية (7684 × $10^4$ خلايا لتر$^{-1}$) في الشتاء . كانت الأنواع الأكثر وفرة التي تم تحديدها هي *Cosmarium nitidulum* (Brebisson) Ralfs و *Oocystis solitaria* Wittrock و *Dictyosphaerium pulchellum* Wood و *Lyngbya limnetica* و *Gomphosphaeria compacta* (Lammermann) Ström و Lemmermann *Cyclotella meneghiniana* و *Microcystis aeruginosa* Kützing و Kutz *Syndra ulna* (Nitzsch) Ehr. يتضح مما سبق ان هناك حاجة إلى مزيد من الدراسات التفصيلية حول التركيب الكيميائي الحيوي للعوالق النباتية لفهم استجابة بحيرات وادي الريان بشكل أفضل للتغيرات البيئية العديدة.

**الخلاصة:**

يمكن اعتبار مجتمعات العوالق النباتية ، والمحتوى الكيميائي الحيوي لها، من المؤشرات الحيوية للنظام البيئي في مواقع مختلفة في بحيرات وادي الريان. ويمكن أن يكون التركيب الكيميائي الحيوي للعوالق النباتية مؤشرًا جيدًا على قيمتها الغذائية.