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Impact of Drainage Water on Macrobenthos Structure of Lake Qaroun, El-Fayoum, Egypt

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ABSTRACT

Lake Qaroun is used as a reservoir for agricultural drainage water via El-Bats and El-Wadi drains. Some physico-chemical parameters and macrobenthic invertebrate community structure were seasonally studied at different stations in the lake during 2014 to 2015. The results revealed that the stations in front of El-Bats and El-Wadi drains suffer from low transparency and decrease of its oxygen content. Moreover, the station in front of El-Bats drain recorded the highest values of the biological oxygen demand (BOD) and phosphates as a result of high amount of discharged organic matter. In addition, the station in front El-Wadi drain revealed the highest concentrations of nitrate, copper and iron. Although the structure of macrobenthos assemblage seems to be complex and influenced by many factors, it was remarkable that the station in front El-Wadi drain had an adverse effect on it. Consequently, continuous and increased pollution by the drainage water contaminated with sewage and heavy metals affected severely most of Lake Qaroun organisms. Therefore, sewage and drainage waste water should be treated before discharging into the lake.

INTRODUCTION

Fayoum is a natural depression in the western desert of Egypt. The depression (50 m below Mean Sea Level) is one of the old oases. It consists of two lakes; old reservoir (Lake Qaroun) and man-made Lakes (Wadi El-Rayan). Lake Qaroun was used as a natural reservoir for the Nile water during the flood season. In drought season, the lake was used to supply the northern part of the country with required water (Abd Ellah, 1995). Lake Qaroun was originally freshwater lake, and changed to saline water ecosystem (Mageed, 2000). It covers about 55,000 feddan and lies 83 Kilometers southern west of Cairo, between 29º 25̀ and 29º 34̀ N and 30º 24̀ and 30º 29̀ E (Fishar *et al*., 2005). It is bordered from its northern side by the desert and by cultivated land from its south and south eastern side (Abd Ellah, 1995). Ishak and Abdel Malek (1980) recorded the mean depth of the lake as about 4.2 m, where they found that the western part is deeper than the eastern part and the maximum depth was 8.5 m in the North West of El-Qarn Island, while the shallowest region was at the south eastern part of the lake. The Lake bottom is generally grayish slimy clay (El-Wakeel, 1963). Most of the drainage water reaches the Lake by two great drains; El-Batts Drain (at its north-eastern corner) and El-Wadi Drain (near the midpoint of the southern shore). El-Batts Drain (50.9 Km long) receives agricultural drainage water from the eastern and north eastern side of Fayoum depression. El-Wadi Drain (48.5 Km long) receives water from the middle of Fayoum Governorate. These drains affect negatively the lake’s water quality and consequently affect the lake’s living organisms. That’s why this research was conducted to study the deterioration of Lake Qaroun water quality and its effect on the distribution and biodiversity of the macrobenthic invertebrates.

MATRIALS AND METHODS

The study area:

Eight stations were selected along Lake Qaroun to represent all types of habitats in this ecosystem (Fig.1):

1- In front of El-Bats Drain.
2- In front of El- Auberg.
3- Wasat El- Truse.
4- Khor Maiuf.
5- Wasat El-Magra.
6- In front of El-Wadi Drain.
7- El-Qarn Island.
8- El-Sawah.

Fig. (1): Map of Lake Qaroun showing the selected stations

Collection and analyses:

Water and macrobenthos samples were collected seasonally from Lake Qaroun during 2014 and 2015. Samples were analyzed according to the Standard Methods for Examination of Water and Waste Water (APHA, 2005). Water temperature, EC, pH, salinity, TDS as well as DO were measured in the field using multi-probe portable meter (WTW Model Oxi 197). Water transparency was measured using a standard Secchi disc of 25cm diameter. The water samples were collected from the subsurface layer of the lake using plastic container. The collected water samples were kept in well stoppered polyethylene plastic bottles for most chemical analyses. Brown glass bottles were used for phosphorus samples. Samples collected for heavy metals and cations were preserved by adding concentrated nitric acid to lower the pH<2 to be protected against microbial reactions. All samples were transferred immediately in an ice-box to the laboratory for analysis.

The macrobenthic fauna samples were collected by a square Ekman grab sampler with 225 cm^2 opening area. The samples were taken from the surface layer of the bottom deposits of each station. Each sample was washed immediately to remove any adhering sediments or mud using 500µm mesh net and stored in plastic containers with 5% formalin as a preservative. In the laboratory, the samples were washed and sieved again through a net with 500µm mesh size. Benthic animals were sorted and identified to genera and species levels using a zoom stereomicroscope. Each group was counted and preserved in a glass bottle with 7% formalin. Identification of the collected species was carried out according to Brinkhurst (1971), Brown (1980), Ruffo (1982), El-Shimy (1994) and Ibrahim *et al.* (1999).

Data treatment:

The data from the collected samples were analyzed using one-way analysis of variance (ANOVA) and correlation analysis using SPSS program version 16.0 to study the relationship between biotic and abiotic factors. Species diversity of bottom fauna was calculated and evaluated to assess the impact of pollution on the degradation of species diversity, food chains and eventually the ecosystem using a computer software namely Primer 5 version 5.2.0. The Similarity between the communities of macro invertebrates in the eight stations of the lake was determined using Bray-Curtiz similarity index.

RESULTS AND DISCUSSION

Physical and chemical variables:

Temperature is one of the major factors affecting the aquatic organisms as well as the chemical and physical characteristics of the water (Abdo, 2003). However, in Lake Qaroun temperature lies in the optimal range for most of the aquatic organisms. The water temperature varied between a minimum of 14.56 º C during winter and a maximum of 30.06 º C during summer (Fig. 2); with annual average of 23.84 º C.

Turbidity may limit the light penetration, which in turn affect the photosynthesis and the other vital processes. During the present study, the stations in front of the drains (El-Bats and El-Wadi drains) exhibited the lowest transparency values. On the other hand, the western part of the lake exhibited the highest values of transparency as confirmed by Fishar *et al.* (2005). This result revealed the deteriorating effect of El-Bats and El-Wadi drains.

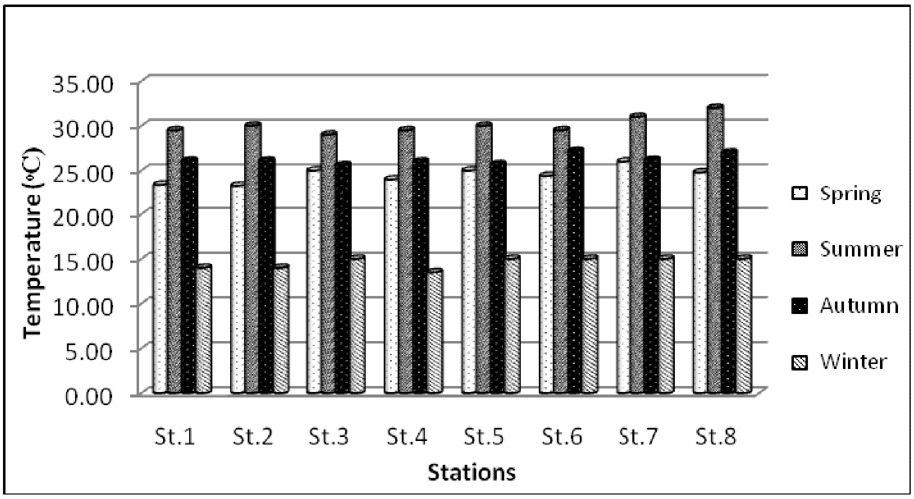

Fig. (2): Seasonal variations of water temperature (◦c) in Lake Qaroun during 2014 – 2015.

The lake's transparency exhibited stations 6 and 1 recorded the lowest values (50.25 and 57.50 cm, respectively), while stations 7 and 8 recorded the highest values (92.25 and 89.75 cm, respectively). On the other hand, summer recorded the highest transparency (81.88 cm) and spring recorded the lowest transparency (65 cm) with an annual average of 74 cm (Fig. 3). Fishar *et al.* (2005) confirmed this result and attributed the result mainly to the dissolved organic matter discharged by the drains.

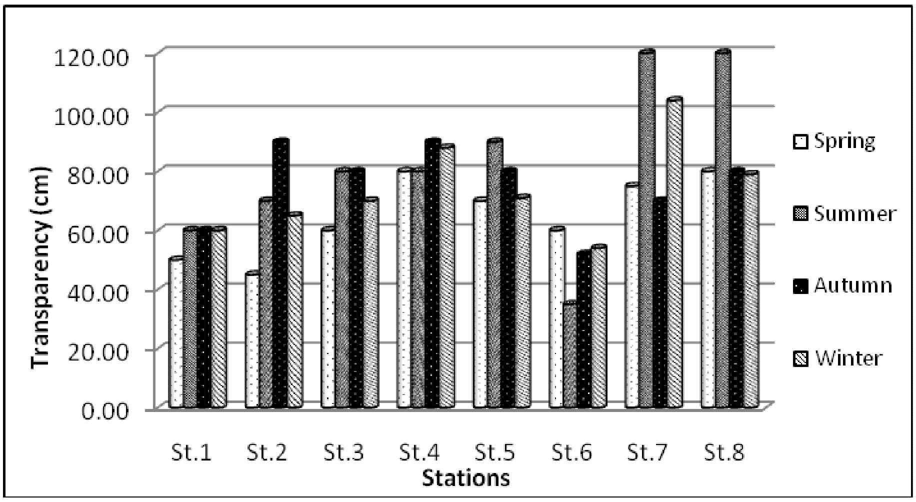

Fig. (3): Seasonal variation of water transparency (cm) in Lake Qaroun during 2014 – 2015.

Although pH usually has no direct impact on consumers, it is one of the most important operational water quality parameters (WHO, 2003). The pH of the lake lies in the alkaline side with no significant spatial variation ($p > 0.05$), however a significant seasonal variation was recorded ($F = 35.458$ and $p = 0.000$), where the lowest average value (8.14) was recorded during autumn and the highest (8.49) was recorded during summer (Fig. 4). Therefore, there is no obvious negative effect of the drains on the lake.

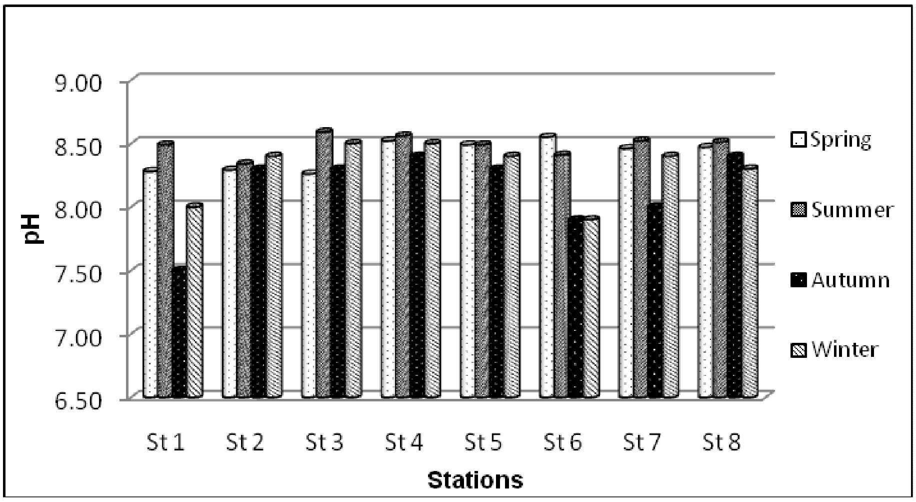

Fig. (4): Seasonal variation of pH in Lake Qaroun during 2014 – 2015.

The dissolved oxygen of the lake exhibited a peak value at station 8 (8.04 mg/l) and the lowest values (6.08 and 6.25 mg/l) were recorded at stations 1 and 6, respectively. Concerning the seasonal variation, the highest DO value was recorded during spring (8.34 mg/l), while the lowest value was recorded during summer (5.49 mg/l) as shown in Figure (5). However, there is no significant spatial variation of DO values during the present study ($p > 0.05$); the stations in front El-Bats and El-Wadi drains revealed a slight decrease in its oxygen content. On the other hand, the western part of the lake exhibited the highest peaks especially during winter which in turn reflect the purity of its water.

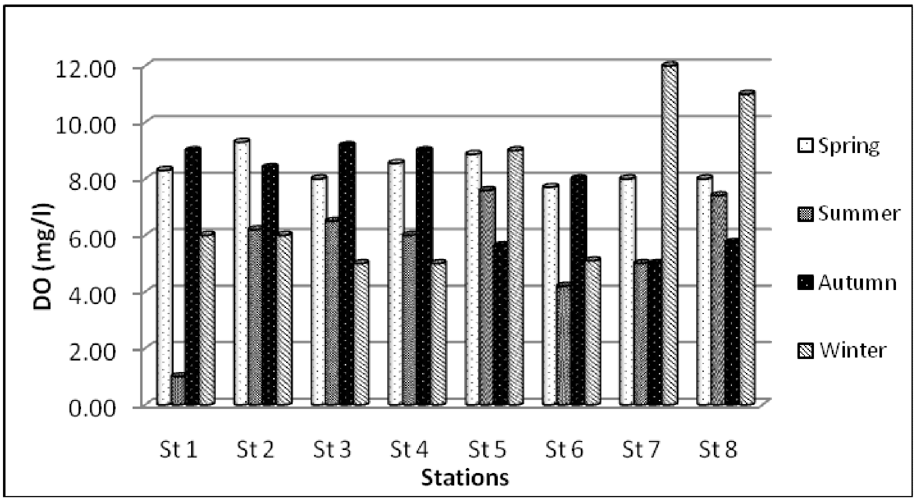

Fig. (5): Seasonal variation of DO (mg/l) in Lake Qaroun during 2014 – 2015.

The biological oxygen demand (BOD) values of Lake Qaroun revealed that station 1 recorded the highest average value (12.25 mg/lin front of El-Bats drain which is mainly attributed to the high amount of discharged organic matter, while station 8 recorded the lowest (3.75 mg/l). On the seasonal basis, summer recorded the highest BOD value (11.38 mg/l) and autumn recorded the lowest value (2.75 mg/l) with an annual average of 7.28 mg/l (Fig. 6). This result is in coincidence with that of Mageed (2005).

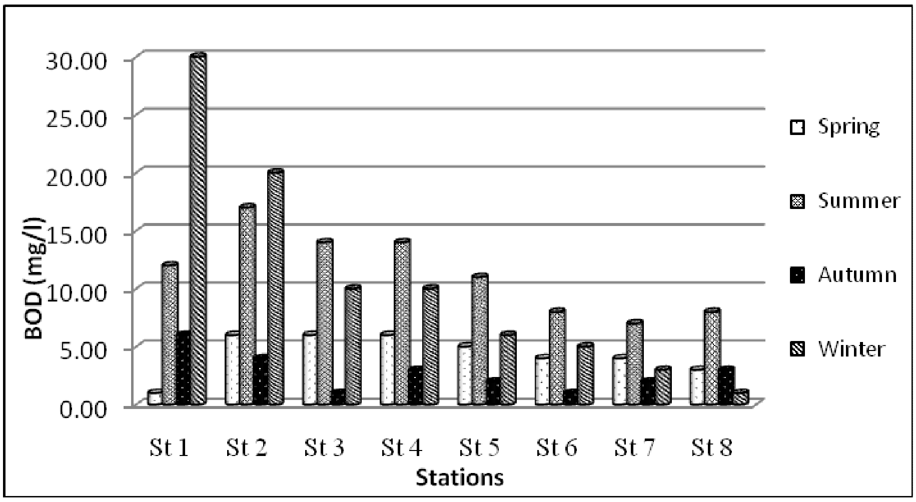

Fig. (6): Seasonal variation of BOD (mg/l) in Lake Qaroun during 2014 – 2015.

Salinity of the lake's surface water revealed the lowest values at stations 1 and 6 (14.13 and 18.80 g/l, respectively). On the other hand, spring and summer (the hot seasons) exhibited the highest salinity values (27.88 and 27.55 g/l, respectively) while winter and autumn (cold seasons) exhibited the lowest values (22.5 and 23.63 g/l, respectively) as shown in Figure (7). Salinity of the western part of the lake was generally higher than the eastern and middle parts. This is mainly attributed to the dilution effect of El-Bats and El-Wadi drains. Taha and Ibrahim (1995) mentioned that high salinity has deterioration effects on the metabolic activities of phytoplankton, which in turn affects the whole food chain.

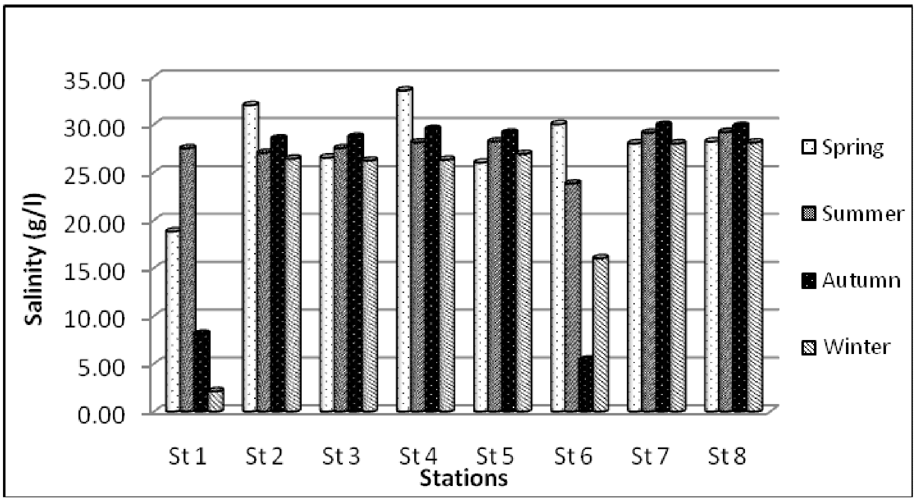

Fig. (7): Seasonal variation of salinity (g/l) in Lake Qaroun during 2014 – 2015.

During the present study, the nutrients of Lake Qaroun were represented by nitrate and phosphate. Nitrate concentrations exhibited special peaks in the western part of the lake (Fig. 8). Regarding its seasonal variation, the highest value was recorded during spring (46.29 mg/l), while the lowest (8.09 mg/l) was recorded during summer (Fig. 9). The nitrate concentrations exhibited two peaks in front of El-Wadi drain during winter and spring (62.00 and 59.32 mg/l, respectively). According to Fishar *et al.* (2015) who reported that nitrate values greater than 1.5 mg/l is an indicator of bad water quality, it could be concluded that Lake Qaroun suffers from eutrophication due to the effluents of El-Wadi drain.

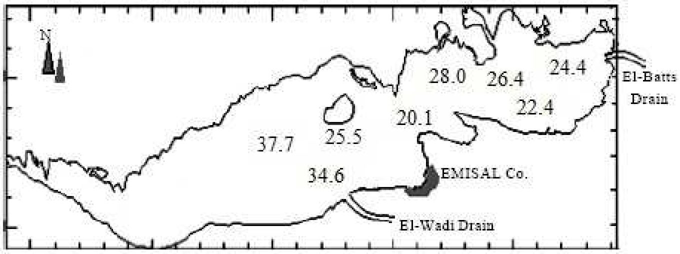

Figure (8): Spatial variation of nitrate (mg/l) in Lake Qaroun during 2014 – 2015.

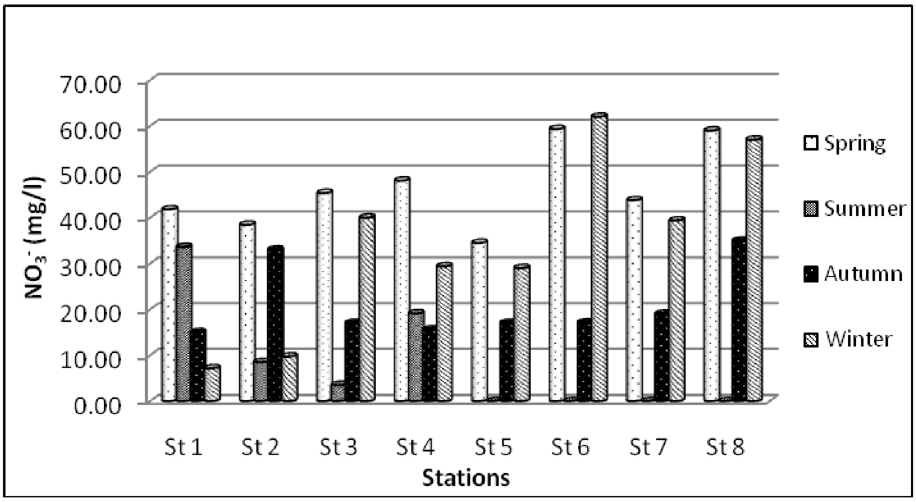

Fig. (9): Seasonal variations of NO_3 (mg/l) in Lake Qaroun during 2014 – 2015.

On the other hand, Peavy *et al.* (1986) mentioned that high concentrations of phosphate may indicate the presence of pollution and are largely responsible for eutrophic conditions. In the present study, the highest average value (0.23 mg/l) was recorded in front of El-Bats drain and gradually decreased towards the western side of the lake with a slight increase in front of EL-Wadi drain (Fig. 10). Therefore, it could be concluded that the eastern part of the lake is considered as hypereutrophic basin, which is in accordance with Khalil (1978), Abdel Malek and Ishak (1980) and Mageed (1998). Autumn and winter did not detect any phosphate traces in the lake during the current study with higher concentration in summer than spring (Fig. 11).

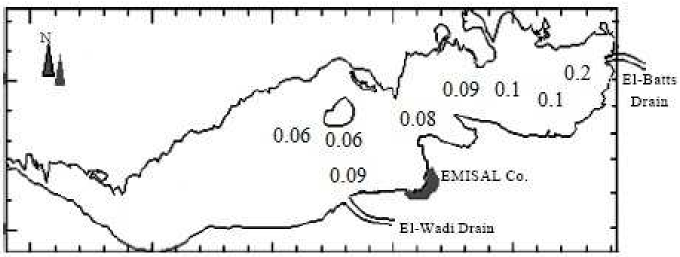

Figure (10): Spatial variation of phosphate (mg/l) in Lake Qaroun during 2014 – 2015.

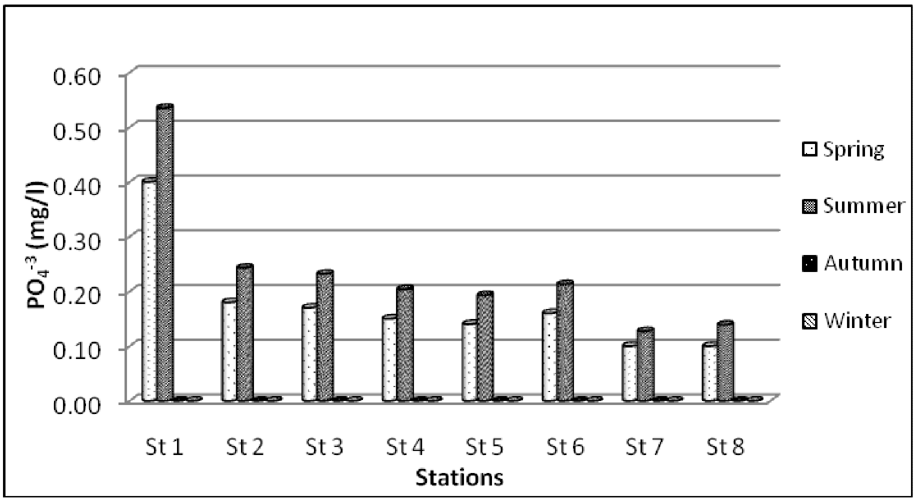

Fig. (11): Seasonal variation of Phosphate (mg/l) in Lake Qaroun during 2014 – 2015.

Copper is essential element for fish and aquatic life, but it induces marked hepatic lipidosis in *Oreochromis niloticus* at high concentrations (Harhash, 2011). Chen *et al.* (1958) suggested a level of < 25 µg/l has no adverse effect on fishes. Copper concentration in Lake Qaroun surface water revealed high values at stations 7 and 6 (0.53 and 0.43 mg/l, respectively). On the other hand, spring recorded the highest copper concentrations (Fig. 12). There was a remarkable significant positive correlation between copper and nitrate (r= 0.505). Iron exhibited the highest value at station 6 (0.344 mg/l), while the lowest was at station 2 (0.052 mg/l). Regarding its seasonal variation, spring showed the highest values, while autumn and winter did not detect iron (Fig. 13). Arsenic, cadmium, cobalt and antimony were not detected during the investigated period.

During the period of investigation, the highest copper values were recorded in front of El-Wadi drain which is mainly attributed to the drain effluents. On the other hand, the western side of the lake recorded the lowest average value (0.26 mg/l). Furthermore, iron exhibited the highest average value (0.344 mg/l) in front of El-Wadi drain. This result indicates the adverse effect of El-Wadi drain on Lake Qaroun.

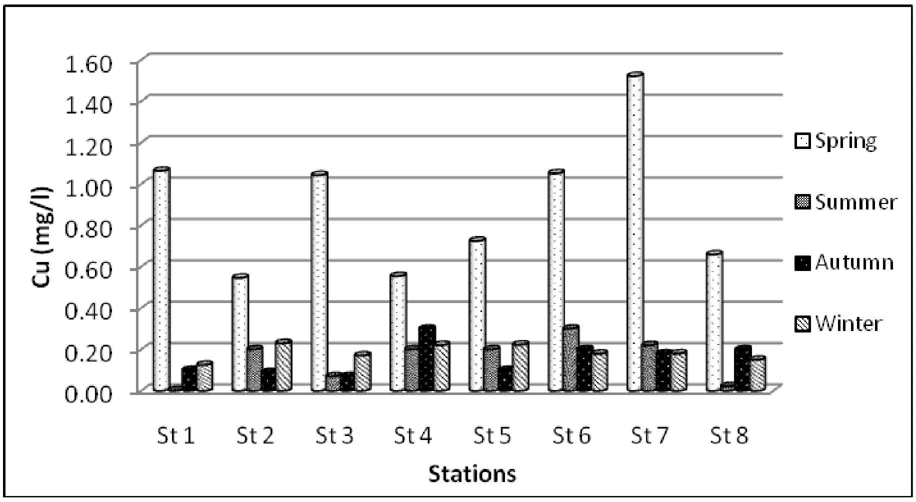

Fig.(12): Seasonal variation of Cu(mg/l) in Lake Qaroun during 2014 – 2015.

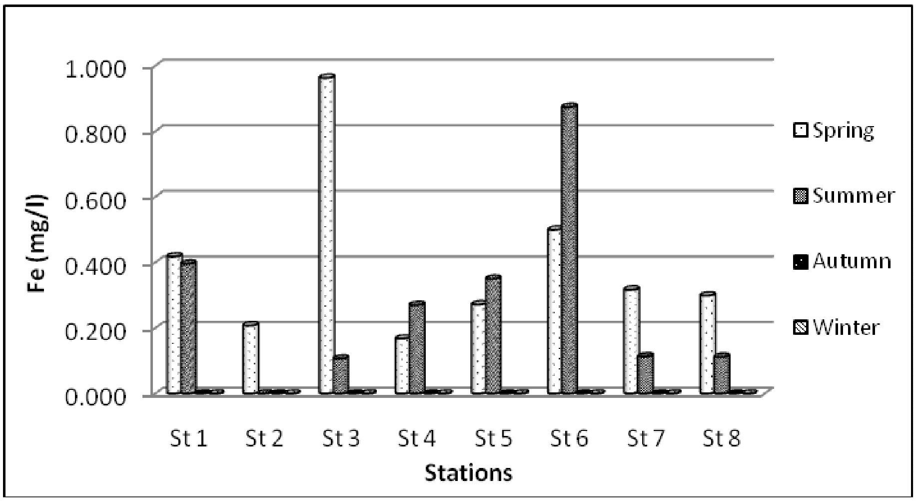

Fig. (13): Seasonal variation of Fe (mg/l) in Lake Qaroun during 2014 – 2015.

Macrobenthos:

The structure of macrobenthos assemblages is complex and seems to be strongly influenced by site-specific processes and condition, as well as interspecific interactions (Lui *et al.*, 2002). Nature of the bottom has a selective influence on the quality of benthos (El-Shabrawy and Gohar, 2006).

During the present investigation 18macrobenthic species were recorded in Lake Qaroun, representing four phyla namely; Arthropoda, Annelida, Mollusca and Coelentrata (Fig. 14). The average total macrobenthos density was 4874 org./m^2, with the highest population at station 6 due to the dominance of *Corophium acherusicum*, while stations 1 and 2 exhibited the lowest population densities (Fig. 15). Regarding seasonal variation, autumn recorded the highest density with an average of 8186 org./m^2 and spring recorded the lowest density with an average of 1522 org./m^2 (Fig. 16).

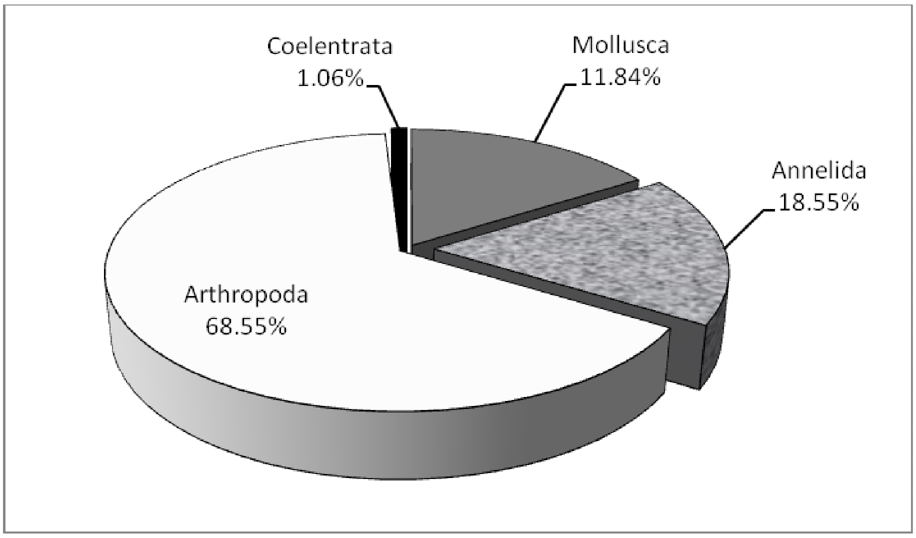

Fig. (14): Community structure of macrobenthos in Lake Qaroun during 2014 – 2015.

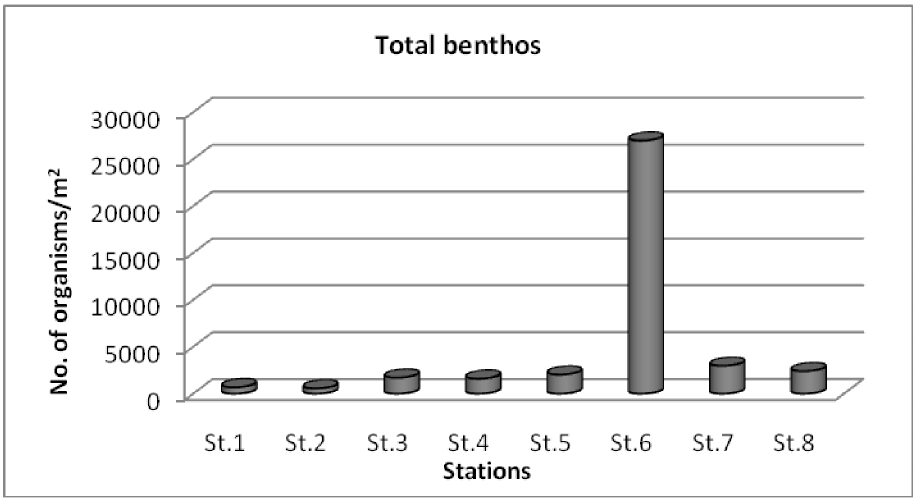

Fig. (15): Spatial distribution of total benthic invertebrates in Lake Qaroun during 2014 – 2015.

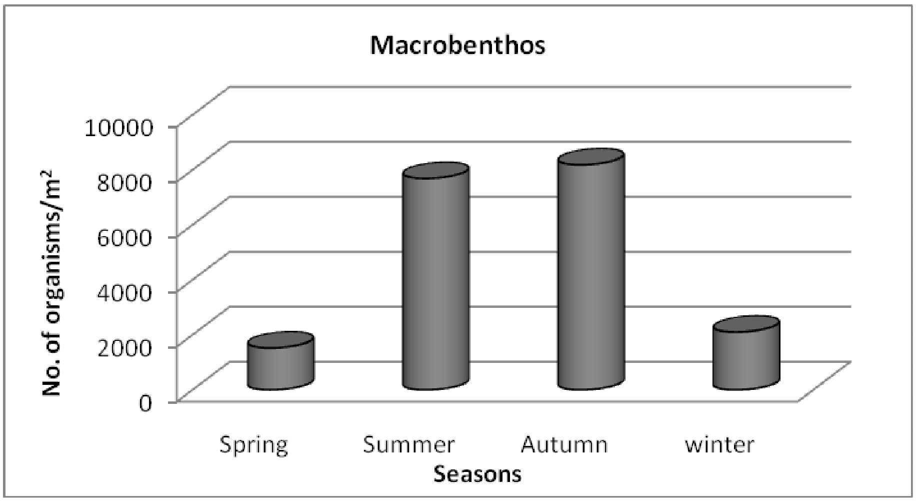

Fig. (16): Seasonal distribution of total benthic invertebrates in Lake Qaroun during 2014 – 2015.

Arthropoda was the most dominant benthos represented by six species with the dominance of *Corophium acherusicum* and *Gammarus aequicauda.* On the other hand, *Balanus pallidus*, *Chironomus* larvae, *Sphaeroma serratum* and *Brachynotus sexdentatus* were recorded sporadically. As shown in Figure (17), station 6 exhibited the highest density (23351 org./m^2), while station 2 exhibited the lowest (7 org./m^2). Regarding seasonal variation (Fig. 18), summer revealed the highest population density (6696 org./m^2) and spring revealed the lowest population density (364 org./m^2).

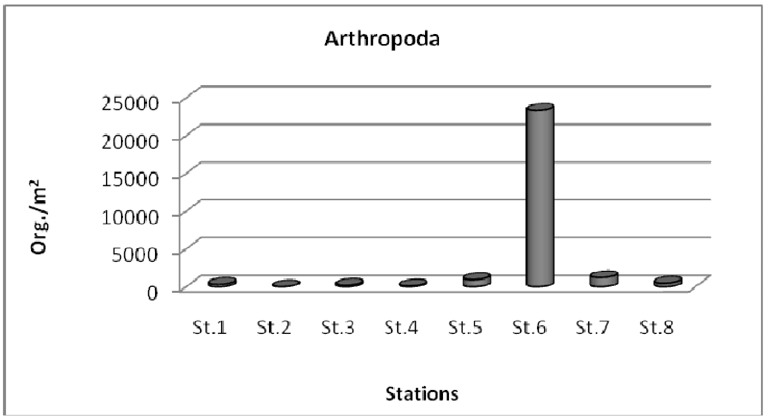

Fig. (17): Spatial distribution of Arthropoda in Lake Qaroun during 2014 – 2015.

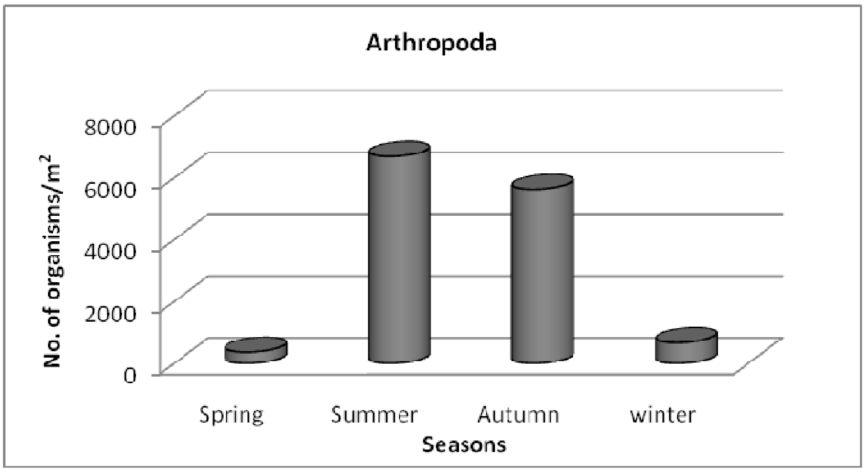

Fig. (18): Seasonal distribution of Arthropoda in Lake Qaroun during 2014 – 2015.

Annelida was represented by four species; *Ficopomatusenigmaticus*, *Limnodrillus* sp., *Polydorahoplura* and *Nereisdiversicolor* with the dominance of the first two. Although ANOVA revealed no significant spatial variation, station 6 exhibited the highest population density with an average of 2515 org./m^2 and station 2 was the poorest one with an average of 37 org./m^2(Fig. 19). Concerning seasonal variation (Fig. 20), autumn revealed the maximum density (1474 org./m^2) and spring revealed the minimum density (424 org./m^2).

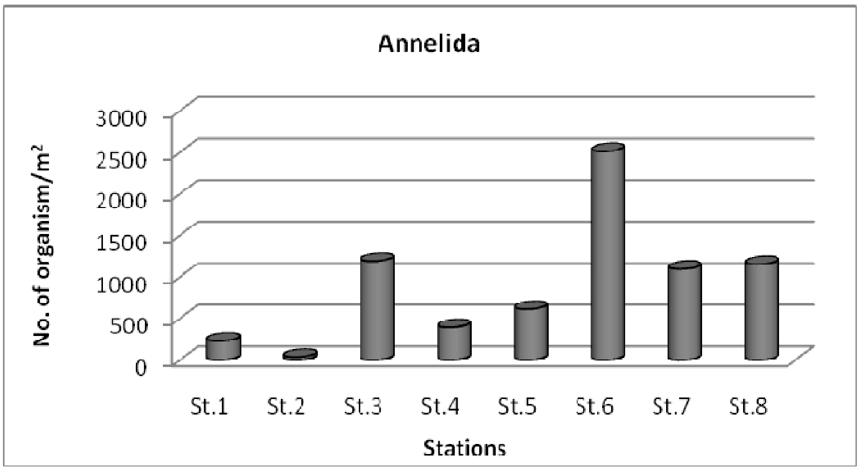

Fig. (19): Spatial distribution of Annelida in Lake Qaroun during 2014 – 2015.

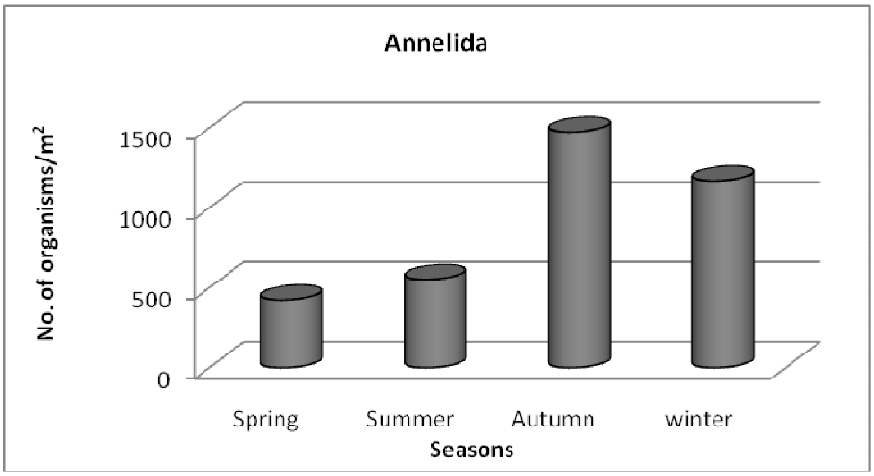

Fig. (20): Seasonal distribution of Annelida in Lake Qaroun during 2014 – 2015.

Mollusca occupied the third rank in the benthic fauna of Lake Qaroun and were represented by seven species; four of them were gastropods and three species were bivalves. *Cerastoderma glaucum* and *Pirenella conica* were the most dominant molluscan species. Although ANOVA test revealed no significant spatial variation ($p > 0.05$), station 4 recorded the highest population density with an average of 1047 org./m^2, while station 1 recorded the lowest with an average of 129 org./m^2 (Fig. 21). Furthermore, ANOVA revealed no seasonal variation ($p > 0.05$) however autumn exhibited the highest population density with an average of 951 org./m^2 and winter exhibited the lowest population density with an average of 235 org./m^2 (Fig. 22).

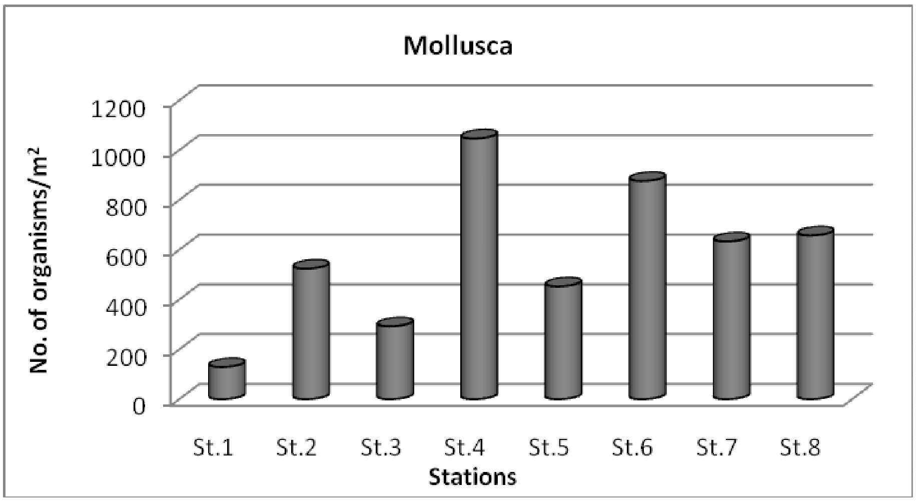

Fig. (21): Spatial distribution of Mollusca in Lake Qaroun during 2014 – 2015.

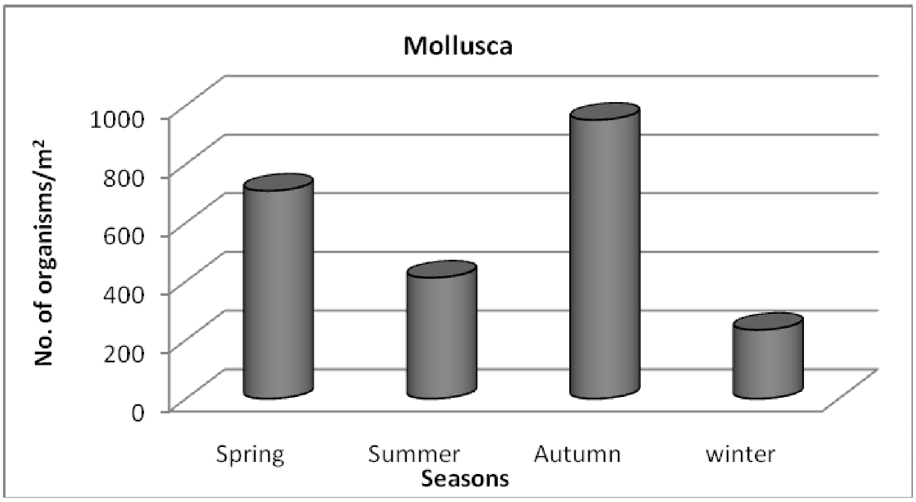

Fig. (22): Seasonal distribution of Mollusca in Lake Qaroun during 2014 – 2015.

The participation of Coelentrata in macrobenthos density was small (1.06%), represented only by one species (*Apitasiogenton cf comatus)*. It was endemic at station 6 representing the highest density with an average of 241 org./m^2, while stations 1 and 2 did not record any specimen at all (Fig. 23). On the other hand, autumn showed the highest population density with an average of 131 org./m^2 and winter recorded the lowest population density with an average of 23 org./m^2 (Fig. 24).

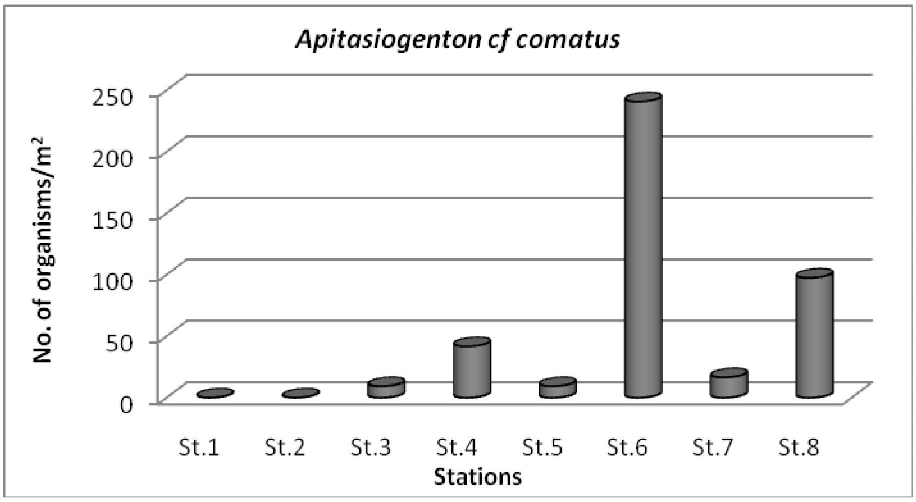

Fig. (23): Spatial distribution of *Apitasiogenton cf comatus* in Lake Qaroun during 2014 – 2015.

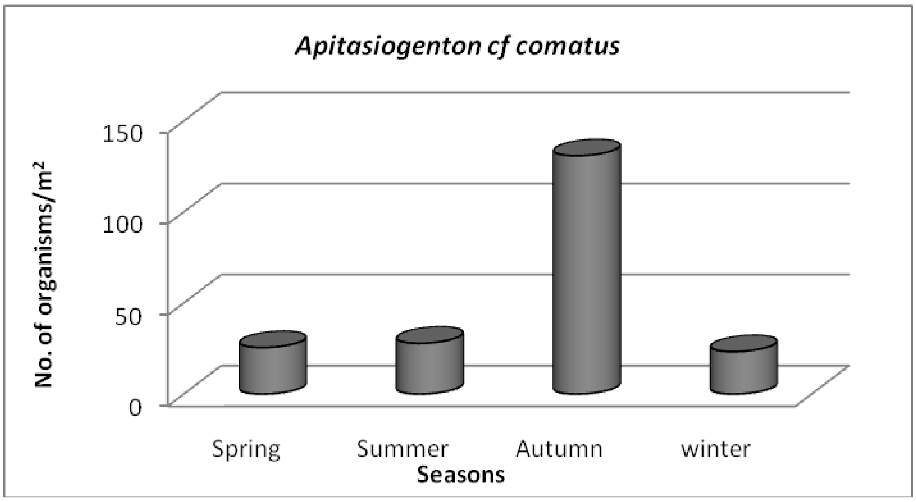

Fig. (24): Seasonal distribution of *Apitasiogenton cf comatus* in Lake Qaroun during 2014 – 2015.

During the present investigation, the highest population density of macrobenthos was recorded in front of El-Wadi drain due to the dominance of *Corophium acherusicum* which prefer clayey soil (Fishar and Abdel-Regal, 1998). Same result was recorded by EEAA (2013). On the other hand, stations in front of El-Auberg and El-Bats drain recorded the lowest population density which is confirmed by Fishar *et al.* (2005). Furthermore, El-Shabrawy (2001) reported a positive correlation of organic matter with the macrobenthos. Therefore, this result revealed the high content of organic matter discharged by El-Wadi drain. On the other hand, the dominance of *Chironomus* larvae (pollution indicator) in front of El-Wadi drain and close to El-Qarnis land revealed the adverse effect of El-Wadi drain. In addition, the dominance of annelids, especially *Limnodrillus,* in front of El-Wadi drain is attributed to the pollution and high content of organic matter discharged from the drain (Slavevska-Stamenkovic′ *et al.*, 2010 and Wissa, 2012).

Macrobenthos diversity:

The decreased species number is considered as loss of biodiversity in polluted ecosystem that leads to habitat destruction. According to the present study, the biodiversity of macrobenthos revealed that station 7 recorded the highest species richness and Shannon Weaver index values (Table 1). Furthermore, similarity index revealed that stations 5 and 8 recorded the highest similarity value. Furthermore, the similarity dendrogram (Fig. 25) showed that station 7 was close to stations 5 and 8.

Moreover, stations 3 and 4 represented a close group. On the other hand, station 6 recorded the least similarity.

Table (1): Species diversity of macrobenthic invertebrates in different stations during the period of the study (2014-2015).

Station	S	N	d	J`	H`(loge)	1-lambda`
1	12	697	1.680214	0.678272	1.685441	0.737442
2	8	569	1.103426	0.443972	0.923213	0.387417
3	15	1719	1.879321	0.61894	1.676119	0.751602
4	13	1605	1.625823	0.834077	2.139365	0.833254
5	16	2045	1.96769	0.729699	2.023156	0.810555
6	17	26985	1.568161	0.45733	1.295712	0.62603
7	17	2982	1.999913	0.807988	2.289203	0.857838
8	14	2403	1.669991	0.826838	2.182073	0.860399

S: Species No., N: Total individuals, d: Species richness (S-1/log N), J`: Evenness, H`: Shannon index (diversity index)

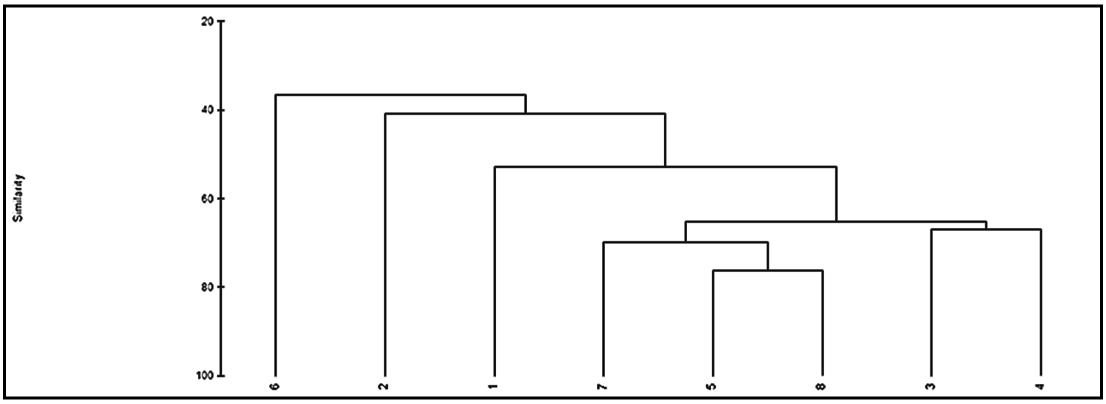

Fig. (25): Dendrogram showing similarity among 8 stations in Lake Qaroun according to macrobenthos community structure.

CONCLUSION

In conclusion, the present study proved the adverse effect of El-Bats and El-Wadi drains on Lake Qaroun water quality as well as on the structure of macrobenthos and in turn on the lake's food web and consequently on the fish production. Therefore, obligatory treatment of the drains effluents before its discharging is recommended to avoid the deterioration of Lake Qaroun.

REFRENCES

Abd Ellah R. G. (1995). Physical limnology of Fayoum depression and their budgets. M.Sc. Physics Dep., Faculty of Science, South Valley University.

Abdel Malek, S. A. and Ishak, M. M. (1980). Some ecological aspects of Lake Qaroun, Fayoum, Egypt. Part II. Production of plankton and benthic organisms. Hyd., 75 (3): 201- 208.

Abdo, M. H. (2003). Physico-chemical characteristic of Abu Zabaal ponds, Egypt. Egypt. J. Aquat. Res., 31 (2): 1- 15.

APHA, (2005). American Water Works Association, Water Environment Federation. Standard Methods for the Examination of Water and Wastewater, 21th ed. American Public Health Association, Washington, DC.

Brinkhurst, R. O. (1971). A guide for identification of British aquatic oligochaetae. Freshwater Biological Association, Scientific Publication No. 22, 55 pp.

Brown, D. S. (1980). Freshwater snails of Africa and their medical importance. Taylor and Francis. London, 487 pp.

Chen, J. C.; Ting, Y. Y.; Lin, H. and Lian, T. C. (1985). Heavy metal concentrations in sea water from grass prown hatcheries and the coast of Taiwan. J. Wor. Maricul.Soc., 16: 316- 332.

EEAA (2013): The second annual report (2012-2013) for environmental monitoring program of Lake Qaroun (In Arabic).

El-Shabrawy, G. M. (2001). Ecological studies on macrobenthos of Lake Qarun, El-Fayoum, Egypt. J. Egypt. Acad. Soc. Environ. Develop., (B-Aquaculture) 1 (2): 29-49.

El-Shabrawy, G. M. and Gohar, M. (2006). Influence of organic matter, nutrients and type of sediment on macrobenthos structure in some fish farms at El-Fayoum province, Egypt. Egypt. J. Aquat. Res., 32 (2): 239 – 253.

El-Shimy, N. A. (1994). A contribution to some leech fauna (Hirudinea) in the Middle East. J. Egyptian German Society of Zoology, 14: 13-27.

El-Wakeel, S. K. (1963). A Study of the bottom deposits of Lake Qarun, Egypt. Part I: Mechanical Analysis. Bull. Fac. Sc. Alex. Univ., 5: 33- 60.

Fishar, M. R. and Abdel-Regal, R. M. (1998). Macrobenthic invertebrates in relation to sediment properties in some fish farms. Egypt. J. Aquat. Biol. Fish., 2(2): 87- 100.

Fishar, M. R.; El-Mageed, A. A.; Elwa, S. E.; Al-Ebiary, A. S. and Bendary, R. E. (2005). Environmental factors affecting life cycle of benthic invertebrates in Lake Qaroun, Egypt. J. Egypt. Acad. Soc. Environ. Develop., (D-Environmental Studies). 6 (2): 9- 32.

Fishar, M. R.; El-Damhogy, K. A.; Mola, H. R.; Hegab, M. H. and Abd El-Hameed, M. S. (2015). Applying some biotic indices of macrobenthic invertebrates to assess water quality of Lake Manzala, Egypt. Egypt. J. Aquat. Biol. & Fish., 19 (2): 29-41.

Harhash, K. A. M. (2011). Ecological studies on *Oreochromis niloticus* cultured in Qaroun and Wadi El-Rayan protected areas, Egypt. Ph.D. Thesis. Fac. Sci., Cairo University.

Ibrahim, A. M.; Bishai, H. M. and Khalil, M. T. (1999). Freshwater mollusca of Egypt. Egyptian Environmental Affair Agency, publication of national biodiversity, unit number 10.

Ishak, M. M. and Abdel-Malek, S. A. (1980). Some ecological aspects of Lake Qaroun, Fayoum, Egypt. Part I. Physico-Chemical Environment. Hydrobiologia, 74: 173- 178.

Khalil, M. T. (1978). Ecological and biological studies on zooplankton of Lake Qarun in Fayoum with special reference to Crustacea. M.Sc. Fac. Science. Ain Shams University.139 pp.

Lui, T. H.; Lee, S. Y. and Sadovy, Y. (2002). Macrobenthos of a tidal impoundment at the Mai Po Marshe Natural Reservoir, Honk Kong. Hydrobiologia 468: 193-212.

Mageed, A. A. (1998). Zooplankton of Lake Qaroun (Fayoum-Egypt) during 1996. Bull. Nat. Inst. Oceanogr. Fish., A. R. E. 24: 161- 177.

Mageed, A. A. (2000). Bathymetrical distribution, biometrical characteristic and length - dry weight relationships of *Acartia (Paracartia) latisetosa* (Copepoda - Crustacea) of Lake Qaroun. Egypt. J. Aquat. Biol. & Fish., 4 (2): 117- 136.

Mageed, A. A. (2005). Effect of some environmental factors on the biodiversity of holozooplankton community in Lake Qarun, Egypt. Egypt. J. Aquat. Res., 31 (1): 230- 250.

Peavy, H. S.; Rowe, D. R. and Georgy, T. (1986). Environmental Engineering. McGraw-Hill Book Co., Singapore.

Ruffo, M. (1982). The Amphipoda of the Mediterranean. Mem. Del. Inst. Oceano., Monaco. Part I: Gammaridae.

Slavevska-Stamenkovic′, V.; Smiljkov, S.; Prelic′, D.; Paunovic′, M.; Atanackovic′, A. and Rimcheska, B. (2010). Structural characteristic of benthic macroinvertebrate in the Mantovo Reservoir (South-East Part of the R. Macedonia). BALWOIS 2010-Ohrid, Republic of Macedonia.

Taha, O. E. and Ibrahim, E. A. (1995). Effects of natural salts on growth and metabolic activities of some freshwater chlorophytes. Egypt. J. Appl. Sci., 10 (8): 711- 731.

Wissa, J. B. (2012). Ecological studies on benthic invertebrates as indicators of organic pollution in El-Rahawey Region, Giza, at River Nile, Egypt. Ph.D. Thesis, Fac. Sci., Ain Shams Univ., 249 pp.

World Health Organization (WHO) (2003). pH in drinking-water. Background document for preparation of WHO Guidelines for drinking-water quality. Geneva, World Health Organization (WHO/SDE/WSH/03.04/12).

ARABIC SUMMARY

تأثير مياه الصرف علي التركيب النوعى لحيوانات القاع الكبيرة في بحيرة قارون، الفيوم، مصر

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تُعد بحيرة قارون من البحيرات الداخلية و التي لا تتصل بالبحر، و تحاط البحيرة بالاراضي الزراعية من الجنوب و الصحراء من الشمال و يغذي البحيرة مصرف البطس و مصرف الوادي. تم دراسة بعض العناصر الكيميائية و الفيزيائية و حيوانات القاع الكبيرة من محطات مختلفة بالبحيرة موسمياً خلال الفترة ٢٠١٤ إلي ٢٠١٥. و قد دلَّت النتائج علي أن المحطات المقابلة لمصرفي البطس و الوادي تُعاني من تلوث عضوي حيث سجلت أقل قيم للشفافية و الاكسجين الذائب هذا بالاضافة إلي أن المحطة المقابلة لمصرف البطس سجلت أعلي قيم للاكسجين المستهلك حيوياً و أعلي قيم للفوسفات نتيجة للكميات الكبيرة من المواد العضوية التي تصب فى البحيرة. بالاضافة إلي أن المحطة المقابلة لمصرف الوادي سجلت أعلي قيم لتركيزات الحديد و النحاس و النترات. و بالرغم من أن التركيب النوعي لحيوانات القاع الكبيرة قد تأثر بعوامل كثيرة إلا أنه كان من الملاحظ أن المحطة المقابلة لمصرف الوادي لها تأثير سلبي واضح علي هذه الكائنات و بالتالي استمرارية التلوث بمياه الصرف الصحي و العناصر الثقيلة لها تأثير سلبي علي الكائنات التي تعيش ببحيرة قارون و لذلك فإن الدراسة قد أوصت بضرورة معالجة مياه الصرف الصحي و الصرف الزراعي قبل صرفها في البحيرة.