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Species Composition, Abundance and Distribution of Freshwater Rotifera at El-Mahmoudia Canal, Egypt

Mohamed B. Sharaf[1,*], Hassan M. M. Khalaf-Allah[1], Abd al_kader M. Hassan[1], Amr F. Zeina[1], Hamdy A. Abo-Taleb[1, 2]

[1]Zoology Department-Faculty of Science, Al-Azhar University, Cairo, Egypt
[2]School of Marine and Atmospheric Science, Stony Brook University, Southampton, NY, USA
[*]**Corresponding Author: mohamedsharaf@azhar.edu.eg**

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ABSTRACT

Zooplankton communities possess a major position in freshwater ecosystems, which are essential in maintaining a biological balance of freshwater habitats. Knowledge about processes and mechanisms for affecting variations in abundance, biomass and diversity of zooplankton is important for maintaining a biological balance of freshwater ecosystems. Rotifera plays an important role in different aquatic food webs. The main objective of this study was to identify the most abundant types of rotifers at sampling stations of El-Mahmoudia Canal. The three sampling stations detected one class of rotifers, including four different orders. These orders were represented by 20 families, including 92 rotifer species with an annual average of 36833 organisms/ m^3. The maximum average counts were recorded during autumn (49000 organisms/m^3), while the minimum average was recorded during spring (24500 organisms/m^3). The highest rotifer average was recorded at El-Mahmoudia City (station III) (37000 organisms/m^3); encounter Damanhour City (station II) characteristics with average counts of rotifers (36625 organisms/m^3). Data in the present study illustrated that transparency (0.23-0.42 m), temperature (19-31.1 ^oC), depth (1.7-2.3 m), salinity (0.1-0.9 ‰), water pH (7.1-8.6) and dissolved oxygen (2.24-7.20 mg/l), which influence the Rotifera distribution and abundance.

INTRODUCTION

Freshwater zooplankton is an important component in aquatic ecosystems, whose main function is to act as primary and secondary links in the food chain. The physical and chemical environment shapes the effect on community structure. These communities are also influenced by biological interactions, predation and inter- and intra-specific competition for food resources (**Neves *et al*., 2003**). The rotifers and Nauplii can escape because they are too small in size or provide a negligible meal if compared with the effort of catching them (**Jeppesen *et al.*, 2007; Zingel & Haberman, 2008**). Ostracods are mainly bottom dwellers of lakes, and they live on detritus and dead phytoplankton. These organisms are the food for fish and benthic macro-invertebrates (**Chakrapani *et al.*, 1996**).

Rotifers are important components of planktonic communities because of their rapid heterogenetic reproduction. They are the first metazooplankters to cause an impact by grazing on phytoplankton. Furthermore, rotifers influence various interactions within the microbial food web at several trophic levels (**Arndt, 1993**). Rotifers are microscopic herbivores, common in the plankton of freshwater habitats, which feed on single-celled algae and bacteria. Where food is abundant, they may exceed 5000 per liter of water (**Wallace & Snell, 1991**). Their abundance reflects eutrophication; for example, *Keratella cochlearis* and *Kellicottia quadrata* increase with an enhanced input of phosphorous (**Edmondson & Litt, 1982**).

Rotifers are the most important soft-bodied metazoans (invertebrates) worldwide distridution, having a very short life cycle among the plankton. Only 100 widely spread rotifer species are planktonic, and their life cycles are influenced by temperature, food and photoperiod (**Ferdous & Muktadir, 2009**). They rapidly increase in large quantities under favorable environmental conditions (**Dhanapathi, 2000)**. Water movement could be important for species immigration and community succession, as well as for enhancing zooplankton diversity. **Zhenbin *et al.* (2008)** reported that, zooplankton community structure changed from eutrophic-indicator species (*Brachionus, Polyarthra, Keratella and thermocyclops*) to species more characteristic of oligotrophic conditions (*Tintinnopsis*, *Acanthocyclops*,, *Lecane ludwigii*, *Gastropus stylifer*) due to the connection between rivers and lakes. **Li *et al.* (2006)** found that the dominant species *Brachionus* spp. and *Keratella* spp. were replaced by *Tintinnopsis* spp. in Xihu Lake, Hangzhou City after drawing water.

Limited studies have addressed the distribution of zooplankton in El-Mahmoudia Canal until now such as **Ashour *et al*. (2018)** who found that, the zooplankton community in El-Mahmoudia Canal, represented by Rotifera (27 species), Copepoda (9 forms), Protozoa (6 species), Cladocera (5 species), Molluscan (2 forms), insect larvae (2 types), fish eggs, one of Diplostraca and Ostracod species were observed. Moreover, **El-Feky *et al*. (2018)** studied the zooplankton community structure of El-Mahmoudia Canal and found that the zooplankton community is composed of 6 zooplankton groups (Rotifera, Copepoda, Protozoa, Ostracoda, Nematoda and Chordate).

The present work focused on studying the variability of different Rotifer species in relation to the physicochemical conditions in El-Mahmoudia Canal, and determining the environmental status of the canal and the potentiality to use rotifers as bio-indicators.

MATERIALS AND METHODS

Samples were collected from El-Mahmoudia Canal in 2020 from three stations: station I in El-Mahmoudia City, station II in Zawyet Gazal Town, and station III in Kafr El-Dawar City (Fig. 1).

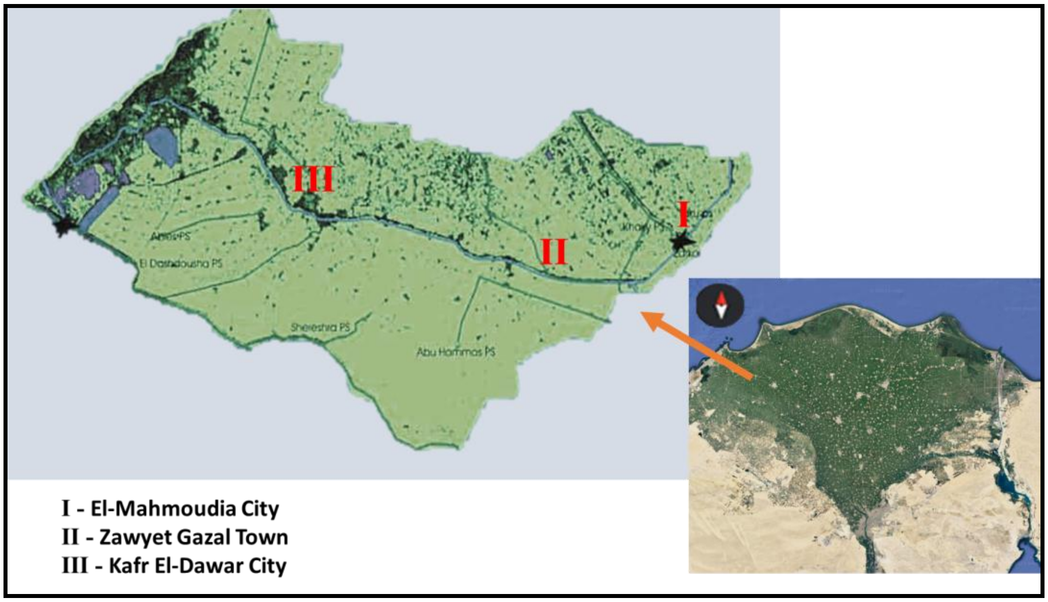


Fig. 1. The location of sampling stations in El-Mahmoudia Canal

Zooplankton abundance

Zooplankton samples were collected during 2020 at three stations by standard plankton net (No. 25) of 55 µm mesh size by filtering 0.2 m^3 from the water surface. The zooplankton organisms retained in the net were then transferred into a small glass bottle and preserved in a 5% neutralized formalin solution, and the sample volume was then adjusted to 100ml. The samples were examined under a binocular research microscope. The identification was undertaken at species levels. To estimate the standing crop, sub-samples of 5ml were transferred to a counting chamber (Bogorov chamber) using a plunger pipette; this operation was performed three times, and the average of the three counts was taken, and the standing crop was calculated and estimated as organisms per cubic meter according to the following formula (**Santhanam & Srinivasan, 1994**):

$$\mathbf{N = (n * v) / (V * c)}$$

$$\mathbf{V = \pi r^2 . d}$$

Where,

N: Total number of zooplankton per cubic meter; **n:** Average number of zooplankton in one ml of the sample; **v:** Volume of concentrated sample (100 ml); **V:** Volume of total filtered water (m^3); **r:** Radius of the net opening; **d:** Length of the net traction (30 m), **c**: Subsample volume (one ml), and **π** is constant (3.14).

Identification of the species

The rotifer identification was undertaken at the species levels as possible by consulting the following books; **Pennak (1953), Edmondson (1959), Berzins (1960), Klimowicz (1961), Hutchinson (1967)** and **Al-Hussaini and Demian (1982)**.

Physicochemical parameters

Water temperature was measured directly by traditional, manual, digital or environmental thermometer (0.1ºC), while water transparency was measured using a white enameled Secchi disc with a diameter of 30cm, and a refractometer measured the water salinity. Determination of the dissolved oxygen was carried out according to Winkler's method (**Strickland & Parsons, 1972**), and the pH values of the water were measured in the field using a pocket digital pH meter (model Oyster, inspected 82738, Extech instruments, Germany).

Statistical analysis

All collected data in the present study were tabulated and appropriate graphs have been illustrated to determine the biodiversity and distribution of fauna through the year among the different inspected stations which were computed by Microsoft Excel 365.

RESULTS

The water transparency of the canal was relatively low most of the year, fluctuating between a minimum of 0.23m at station I during autumn and a maximum of 0.42 m at the same station during summer. In contrast, the water temperature at El-Mahmoudia canal showed wide variations from a minimum of 19°C at station III during winter to a maximum of 31.1°C at station II during summer (Tables 1, 2).

The depth of El-Mahmoudia canal varied seasonally and spatially. The maximum depth was 2.3 m at station III during winter, while the minimum was 1.7 m at station II during spring. Water salinity at the canal varied from a minimum of 0.1 ‰ at station I during winter to a maximum of 0.9 ‰ at station III during spring. The average pH values varied seasonally, ranging from 7.37±0.15 during autumn to 8.37±0.25 during spring. The minimum pH value (7.10) was recorded at station I during summer and increased to a maximum value (8.60) at station III during spring. Additionally, the canal's water dissolved oxygen (D.O.) showed wide variations, fluctuating between 2.24 mg/L at station II during summer and 7.20 mg/L at station III during spring (Tables 1, 2).

The total Rotifera in the study area represented an average of 36833 organisms/m^3. The total number of species recorded in the study area was 93, belonging to 1 class, four orders and 20 families divided to 40 genera.

The spatial distribution of rotifers (Tables 3, 4) shows the variation of rotifers density at the various stations; station III recorded the highest annual average (37000 organisms/m^3), followed by station I (36875 organisms/m^3). In contrast, the minimum average value was recorded at station II (36625 organisms/m^3). For the diversity, station I showed the maximum diversity (65 species), followed by station II (61 species), and station III recorded the lowest count of diversity (57 species) (Fig. 2).

Regarding the seasonal distribution, the maximum density of rotifers was recorded during uutumn (49000 organisms/m^3) with high diversity (58 species), while the lowest densities were recorded during spring and winter (24500 and 32500 organisms/m^3), respectively, with species diversity of 34 and 48 species (Tables 3, 4 & Fig. 3).

Table 1. Water characteristics of El-Mahmoudia Canal in different seasons during the year 2020 (SD: Standard deviation).

Variable		Winter	Spring	Summer	Autumn
Visibility (m)	Mean ± SD	0.35±0.05	0.31±0.05	0.39±0.02	0.28±0.04
	Range	0.30-0.40	0.25-0.35	0.37-0.42	0.23-0.31
Temperature ºC	Mean ± SD	20.33±1.52	26.3±0.26	30.77±0.49	28.2±0.26
	Range	19-22	26-26.5	30.2-31.1	28-28.5
Depth (m)	Mean ± SD	2.17±0.15	1.83±0.15	2±0.10	1.9±0.10
	Range	2.0-2.3	1.7-2.0	1.9-2.1	1.8-2.0
Salinity (‰)	Mean ± SD	0.63±0.47	0.57±0.30	0.37±0.15	0.23±0.05
	Range	0.1-1	0.3-0.9	0.2-0.5	0.2-0.3
pH	Mean ± SD	7.6±0.17	8.37±0.25	7.4±0.36	7.37±0.15
	Range	7.4-7.7	8.1-8.6	7.1-7.8	7.2-7.5
DO (mg/l)	Mean ± SD	3.97±0.85	4.73±2.13	2.73±0.60	3.98±0.77
	Range	3.1-4.8	3.5-7.2	2.24-3.4	3.1-4.5

Table 2. Spatial distribution of water characterstics at El-Mahmoudia Canal during the year 2020 (SD: Standard deviation)

Variable		I	II	III
Visibility (m)	Mean ± SD	0.33±0.08	0.32±0.05	0.35±0.05
	Range	0.23-0.42	0.25-0.37	0.29-0.40
Temperature ºC	Mean ± SD	26.2±4.40	26.88±3.80	26.13±5.17
	Range	20-30.2	22-31.1	19-31
Depth (m)	Mean ± SD	1.98±0.13	1.95±0.20	2±0.22
	Range	1.8-2.1	1.7-2.2	1.8-2.3
Salinity (‰)	Mean ± SD	0.2±0.08	0.55±0.31	0.6±0.31
	Range	0.10-0.30	0.30-1	0.20-0.90
pH	Mean ± SD	7.58±0.57	7.65±0.34	7.83±0.58
	Range	7.10-8.40	7.30-8.10	7.20-8.60
DO (mg/l)	Mean ± SD	3.84±1.02	3.29±0.87	4.43±1.89
	Range	2.55-4.80	2.24-4.34	3.10-7.20

Table 3. Spatial distribution of rotifers standing crop (organisms/m3) at El-Mahmoudia Canal during 2020

Station	Winter	Spring	Summer	Autumn	Average
I	43500	23000	39000	42000	36875
II	24000	23500	45000	54000	36625
III	30000	27000	40000	51000	37000
Average	32500	24500	41333	49000	36833

Table 4. Spatial distribution of rotifers diversity (No. of species) at El-Mahmoudia Canal during 2020

Station	Winter	Spring	Summer	Autumn	No. of species
I	25	14	44	32	65
II	20	20	28	37	61
III	25	22	22	32	57
No. of species	48	34	53	58	

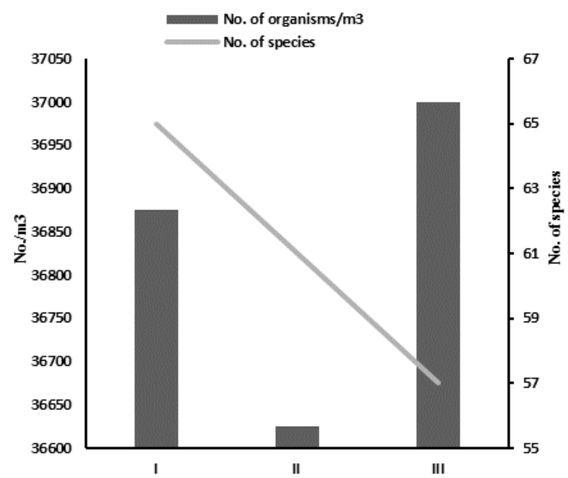


Fig. 2. Spatial distributions of Rotifera in El-Mahmoudia Canal.

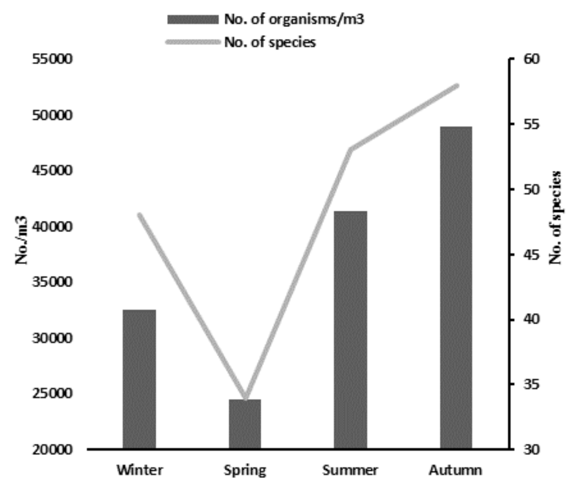


Fig. 3. Seasonal distributions of Rotifera in El-Mahmoudia Canal.

Brachionus calyciflorus represented the most dominant rotifers species, forming 16.29 %, followed by *Brachionus caudatus* (8.60), *Keratella cochlearis* (7.24), *Testudinella patina* (6.67), *Brachionus angularis* (4.52), *Asplanchna periodont* (3.62) *Epiphanes clavulata* (3.05), *Filinia terminalis* (2.26) and *Asplanchna herricki*, which represented 2.15 % of the total rotifers (Table 6).

Table 5. List of the recorded rotifer species

Phylum: Rotifera	*Filinia terminalis* Plate, 1886
Adineta barbata Janson, 1893	*Gastropus hyptopus* Ehrenberg, 1838
Adineta cuneata Milne, 1916	*Gastropus stylifer* Imhof, 1891
Adineta gracilis Janson,1893	*Habrotrocha cf reclusa* Milne, 1886
Adineta vaga Davis, 1873	*Habrotrocha constricta* Dujardin, 1841
Anuraeopsis congolensis Evens, 1947	*Habrotrocha roeperi* Milne, 1889
Anuraeopsis fissa Gosse, 1851	*Harringia rousseleti* De Beauchamp, 1912
Anuraeopsis navicula navicula Rousselet, 1911	*Hexarthra mira* Hudson, 1871
Argonotholca foliacea Ehrenberg, *1838*	*Horaella brehmi* Donner, 1949
Ascomorpha ecaudis Perty, 1850	*Keratella cochlearis* Gosse, 1851
Ascomorpha ovalis Bergendal, 1892	*Keratella quadrata* Müller, 1786
Ascomorpha saltans Bartsch, 1870	*Keratella taksinensis* Chittapun, pholpunthin & Sugers, 2002
Asplanchna brightwellii Gosse, 1850	
Asplanchna girodi de Guerne, 1888	*Keratella tecta* Gosse, 1851

Asplanchna herricki de Guerne, 1888
Asplanchna priodonta Gosse, 1850
Asplanchnopus multiceps Schrank, 1793
Atrochus tentaculatus Wierzejski, 1893
Brachionus angularis Gosse, 1851
Brachionus bennini Leissling, 1924
Brachionus bidentata Anderson, 1889
Brachionus budapestinensis Daday, 1885
Brachionus calyciflorus Pallas, 1776
Brachionus caudatus Barrois and Daday, 1894
Brachionus falcatus Zacharias, 1898
Brachionus isigakiensis Sudzuki, 1992
Brachionus leydigii Zernov, 1901
Brachionus manjavacas Fontaneto, Giordani, Melone & Serra, 2007
Brachionus platyias patulus O.F. Muller, 1786
Brachionus plicatilis Müller, 1786
Brachionus postcurvatus Kuczynski, 1991
Brachionus quadridentats Hermann, 1783
Brachionus rotundiformis Tschugunoff, 1921
Brachionus rubens Ehrenberg, 1838
Brachionus urceolaris Müller, 1773
Colurella adriatica Donner, 1964
Conochilus unicornis Rousselet, 1892
Cupelopagis vorax Leidy, 1857
Dicranophorus grandis Ehrenberg, 1832
Dicranophorus sigmoides Wulfert, 1951
Encentrum putorius Wulfert, 1936
Epiphanes brachionus spinosa Rousselet, 1901
Epiphanes clavulata Ehrenberg, 1832
Epiphanes macroura Barrois & Daday, 1894
Esophora anthadis Herring and Myers, 1921
Filinia longiseta Ehrenberg, 1834
Filinia passa O.F. Muller, 1786
Keratella tropica Apstein, 1907
Keratella valga Ehrenberg, 1834
Lecane curvicornis Murray, 1913
Lecane luna Müller, 1776
Lepadella heterostyla Murray, 1913
Notholca squamula Muller, 1786
Paranuraeopsis quadriantennata Koste, 1974
Pedalion oxyure Zernov, 1903
Philodina aculeata Ehrenberg, 1832
Philodina aroseola Ehrenberg, 1832
Philodina megalotrocha Ehrenberg, 1832
Philodina vorax Janson, 1893
Pleuretra brycei Weber, 1898
Pleurotrocha sigmoidea Skorikov, 1896
Ploesoma triacanthum Bergendal, 1892
Polyarthra dolichoptera Idelson, 1925
Polyarthra remata Skorikov, 1896
Polyarthra vulgaris Carlin, 1943
Pompholyx complanata Gosse, 1851
Proales fallaciosa Wulfert, 1937
Proales sordida Gosse, 1886
Ptygura velata Gosse, 1851
Rotaria citrina Ehrenberg, 1838
Rotaria macrura Ehrenberg, 1832
Rotaria neptunia Ehrenberg,1830
Rotaria rotatoria Pallas, 1766
Rotaria tardigrada Ehrenberg, 1830
Testudinella patina Hermann, 1783
Testudinella truncata Gosse, 1886
Trichotria cornuta Myers, 1938
Trichotria tetractis Bory De St. Vincent, 1827
Trochosphaera aequatorialis Semper, 1872
Trochosphaera solstitialis Thorpe, 1893
Vanoyella globosa Evens, 1947

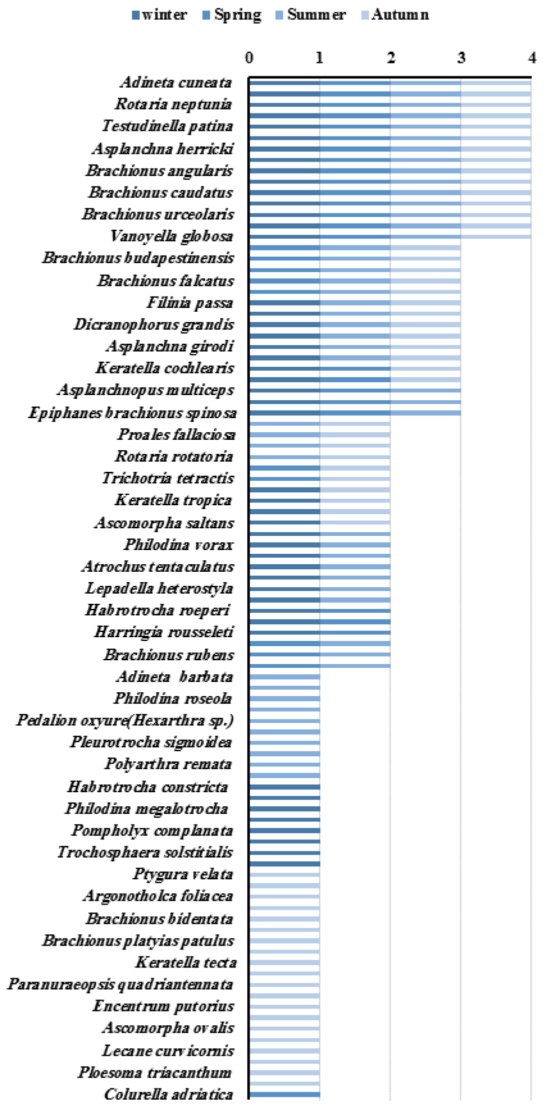
Table 6. The most dominant rotifers species (organisms/m3) and their percentages to total rotifers

Species	Average (organisms/m^3)	Relative contribution (%)
Brachionus calyciflorus	6000±3574	16.29
Brachionus caudatus	3167±4356	8.60
Keratella cochlearis	2667±4438	7.24
Testudinella patina	2458±2158	6.67
Brachionus angularis	1667±1599	4.52
Asplanchna periodont	1333±1115	3.62
Epiphanes clavulata	1125±1653	3.05
Filinia terminalis	833±749	2.26
Asplanchna herricki	792±782	2.15

Results of the seasonal occurrence of rotifer species are displayed in Fig. (4**)**. The frequency of occurrence of rotifer species varied from season to season during the entire study period, where the higher percentage of occurrence 100 % was recorded for 15 species, namely, *Adineta cuneata*, *A. vaga*, *Rotaria neptunia*, *Conochilus unicornis*, *Testudinella patina*, *Filinia terminalis*, *Asplanchna herricki*, *A. periodont*, *Brachionus angularis*, *B. calyciflorus*, *B. caudatus*, *B. quadridentats*, *B. urceolaris*, *Epiphanes clavulata* and *Vanoyella globose*. While, sixteen species were restricted only to 3 seasons and represented 75% of occurrence percentage. They were *Brachionus plicatilis*, *B. budapestinensis*, *B. falcatus, B. isigakiensis*, *B. rotundiformis*, *Anuraeopsis fissa*, *Filinia passa*, *Trochosphaera aequatorialis, Dicranophorus grandis*, *Asplanchna girodi*, *Polyarthra vulgaris*, *Keratella cochlearis, K. quadrata*, *Asplanchnopus multiceps*, *Cupelopagis vorax* and *Epiphanes brachionus spinosa*.

Twenty-three species were presented during two seasons of the study period and represented 50 % of the occurrence percentage; in contrast, the remaining species (39 species) represented 25 % of occurrence during the study period, as shown in **Figure 4**.

Results of the spatial distribution of species presented in **Figure 5** showed that 35 species were recorded at all stations with a frequency of occurrence of 100 %. In contrast, 38 species were restricted only to one station, with an occurrence value of 33.3 % of the study area. Concerning the frequency of occurrence, with a percentage of 66.7 % of the canal, twenty species were recorded at two stations.



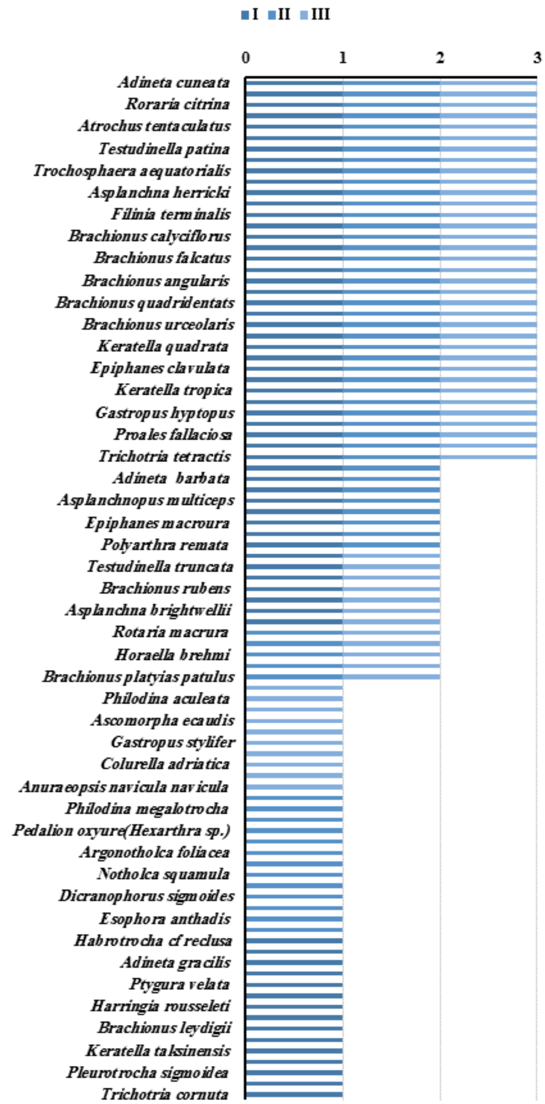


Fig. 4. Histogram showing the frequency of occurrence of Rotifera during different seasons in El-Mahmoudia Canal**.**

Fig. 5. Histogram showing the frequency of occurrence of Rotifera at different stations at El-Mahmoudia Canal.

DISCUSSION

Rotifers are mostly of freshwater origin, and the most common species are recorded in Egyptian inland waters. They have constituted an important link in the food chain of inland waters. Rotifers and their eggs are preyed upon by *Mugil* species fries in Lake Manzalah (**Guerguess, 1979**). Rotifers are also important components in nutrient cycling and secondary production in lakes. They are the preferred first food of various fish larvae and important agents in transferring energy from primary producers to higher trophic levels (**Stemberger, 1990**). The size of the different rotifer species falls in a wide range from 0.1 to 0.37 mm (**Halim & Guerguess, 1981**), which allows their population to feed efficiently on food particles of different sizes.

The sensitivity of rotifer and other zooplankton species to some physical and chemical conditions allows using them as bio-indicators of aquatic ecosystem quality. An ecological study of many planktonic groups, such as rotifers indicated that some rotifers are considered pollution bio-indicators and can exist in polluted waters (**Abo-Taleb *et al.*, 2016)**. The most famous examples of pollution bio-indicator and/or serve as trophic nature indicators of the environment are *Brachionus* and *Polyarthra* species (**Klimowicz, 1961; Aboul Ezz *et al*., 1996; Abo-Taleb, 2010**; **Abdel-Aziz *et al.*, 2011)**.

The flourishing of rotifer species such as *Keratella cochlearis, Brachionus* spp., and *Filinia* spp. in any fresh or brackish water body is considered to be an indicator of eutrophy (**Pejler, 1983**), while *Filinia longiseta* is considered among pollution bio-indicators (**El-Bassat, 1995**). All these species were recorded in El-Mahmoudia Canal during the current study, confirming the canal classified as a highly eutrophic and polluted water body. In addition, **Sousa *et al*. (2008)** mentioned that *Brachionus calyciflorus, Thermocyclops* sp. and *Argyrodiaptomus* sp. were good indicators of eutrophic condition, and *B. dolabrotus, Keratella tropica* and *Hexarthramira* were good indicators of high turbidity due to suspended sediments.

The domination of some rotifer species, such as *Brachionus* and *Filinia* are considered eutrophic bio-indicators. The present results agree with **Mola (2011)** who concluded that, rotifers, especially *Brachionus* spp. are the major component of zooplankton in eutrophic lakes; these species' presence in high composition indicates the eutrophication of the lake. **Zhenbin *et al*. (2008)** reported that zooplankton community structure includes eutrophic-indicator genera such as *Brachionus, Polyarthra* and *Keratella.* The level of eutrophication illustrates wide variations along the Egyptian coasts and interlards according to the type, volume and composition of the discharged wastes; this agrees with the findings of **Abdullah and Hussona (2014)** who reported that, the water quality of Al-Mahmoudia Canal exhibited high pollution levels released from the Zarcon drain and Rosetta branch, which create health risks at present and indicate unsafe levels of pollution for direct use in drinking water, irrigation and fisheries.

El-Feky *et al*. (2018) reported that, Rotifera was the highest population recorded in El-Mahmoudia Canal and estimated by 16716 org./m3 and represented 49.8% of the total zooplankton community. Genus *Brachionus* expressed by eight species formed about 11148 org./m3 (33.2% of total zooplankton and 67% of total rotifer community). **Ashour *et al*. (2018)** recorded that, 27 species represented Rotifera in order to several forms of rotifers metamorphoses, which represented 49.8% of the total recorded species. While, n the dominance of Rotifera in El-Mahmoudia Canal agrees with that previously reported in the study of **Ndawula *et al*. (2005**) at upper Victoria Nile; **Bedair (2006)** and **Aboul Ezz (2008)** in the northern part of River Nile in addition to the finding of **El-Feky (2017)**.

Zakaria *et al.* (2007) stated that, Rotifera formed the leading group in the mixed land drainage water type, constituting 85.75 % of the total zooplankton community. **Sukumaran and Das (2004)** mentioned that the high rate of degradation of the organic matter in the aquatic ecosystem supports a dense load of the bacterial population, which in turn, forms the chief components of the food of the rotifers. *Brachionus Urceolaris* and *Filinia longiseta* were the dominant species contributing 68.39 % and 14.63 % to the total rotifer population. These two species were recorded as the most common rotifer species in Lake Maryout **(Abdel-Aziz & Aboul Ezz, 2004)**.

Brachionus was the most dominant rotifer genus in the canal and had an annual mean of 15000 individuals/m^3. It is a worldwide genus recorded from the African Lakes (Lake Edward, Lake Albert, Lake George, Lake Kyoga and Lake Victoria) as reported by **Green (1960, 1967**). Species from genus *Brachionus* are the most common rotifers among the Egyptian inland waters, including Delta Lake, comprised of Lake Menzalah (**Guerguess, 1979**), Lake Edku (**Soliman, 1983; Aboul Ezz and Soliman, 2000; Aboul Ezz, 2008; Sharaf, 2018**) and Lake Mariot (**Abd El-Aziz, 1987**). Moreover, such species are the most common rotifers in Rosetta and Damietta estuaries (**Zaghloul, 1976, 1988b; Helal, 1981; Abo-Taleb, 2010**), the coastal Egyptian Mediterranean waters (**Aboul Ezz *et al.*, 2014**). **Abo-Taleb *et al.* (2016)** noticed that, large numbers of the genus *Brachionus* were always synchronous with the presence of a eutrophication problem.

The abundance of zooplanktonic groups recorded their minimum values during winter. These results agree with those of **Aboul Ezz and Soliman (2000)**. In addition, increased human activities in aquatic habitats influence the species composition and abundance of the local communities or species sorting **(Xiong *et al.*, 2016)**.

The herbivorous rotifers dominated the zooplankton community in Lake Edku; *B. calyciflorus*, *B. angularis* and *B. urceolaris* **(Abo-Taleb *et al*., 2017)**. This may be attributed to their special characteristics and the high availability of phytoplanktonic food due to the increased eutrophication and the absence of their predators **(Aboul Ezz & Soliman, 2000; Zaghloul & Hussein, 2000; Hobaek *et al.*, 2002; Ali *et al.*, 2007; Lijing *et al.*, 2012**; **Bielan´ska-Grajner *et al.*, 2014)**. Further, **Sainty (1985)**, **Dunn (1985)** and **Uku and Mavuti (2001)** reported that, rotifers are less preferred than Cladocera and Copepoda by the fish *Oreochromis*, which represent 82 % of the total fish in Lake Edku. Furthermore, the dominance of rotifers may be due to the decreased heterogeneity of the studied ecosystem and its dominance by organically polluted water.

CONCLUSION

Mahmoudia water quality was low in acceleration of water eutrophication problem. This bad condition enhanced the flourishing of rotifer species, consequently the densities and abundance of rotifers could be used as pollution bio-indicator. On the other hand, the following recommendations are necessary: 1-Periodical environmental monitoring and sustainable development of the canal, 2-Controling agriculture and sewage water discharged into El-Mahmoudia Canal.

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