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Diversity of planktonic and epiphytic microinvertebrates associated with the macrophyte *Eichhornia crassipes* (Mart.) in River Nile at El-Qanater El-Khiria region, Egypt

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ABSTRACT

The present work aims to study the relationship between some physico-chemical parameters and both planktonic and epiphytic microinvertebrates associated with the floating plant *Eichhornia crassipes* in River Nile at Qanater region. Water samples, planktonic and epiphytic microinvertebrates were collected seasonally from eight sites in the investigated region. The results indicated that the maximum occurrence of planktonic invertebrates (810 org./L) was recorded during Winter. Rotifera formed the highest percentage of zooplankton (96.77 %), followed by Copepoda (1.88 %) and Cladocera (1.10 %). Meroplankton and Protozoa formed the lowest dominant groups. Thirty seven planktonic species were recorded belonging to Rotifera (30 species), Cladocera (2 species), Copepoda (1 species), Protozoa (2 species) and Meroplankton (2 species). On the other hand, the maximum occurrence of epiphytic invertebrates (1612100 org./m^2 plant) was recorded during spring. Forty five species were recorded belonging to Rotifera (27 species), Protozoa (5 species), Cladocera (9 species), Copepoda (2 species) and Oligochaeta (2 species).

The epiphytic microinvertebrates associated with the floating plant *Eichhornia crassipes* in River Nile at Qanater region recorded the highest number of species and groups than planktonic invertebrates. This indicates that the aquatic plant *Eichhornia crassipes* habitats are more diverse and have high species richness. The principal component analysis (PCA) was conducted between physico-chemical parameters and planktonic and microinvertebrates.

Key words: River Nile, physico-chemical characteristics, zooplankton, microinvertebrates, PCA.

INTRODUCTION

The composition of river plankton is quite different from that of lakes. In rivers, zooplankton typically is dominated by rotifers (e.g. *Brachinous, Keratella, Filinia* and *Synchaeta*), with relatively few cladocerans and copepods. In comparison, zooplankton of lakes tends to be dominated by Copepoda and Cladocera (Shiel *et al.*, 1982). Regarding aquatic food webs, microinvertebrates play a vital role because they consume the primary producers and form a major food source for tertiary consumers. Microinvertebrates considered as the basic principal of natural fish feeding for the young and some adults of many fishes which support fish production. Microinvertebrates communities respond quickly to environmental change because most species have short generation times (usually days to weeks). The variation of their distribution based on different environmental factors (Epifanio & Garvine, 2001 ; Kimmel *et al.*, 2006). Microinvertebrates diversity responds rapidly to changes in the aquatic environment. Several microinvertebrates taxa have served as a bioindicators of water pollution (Mola, 2011; Ahmad *et al*., 2012). Rotifers constituted the main food of Cichlid species (Hegab, 2010). Rotifers, especially *Brachionus*, constitute an important link in the food chains of inland waters. They are considered preferred food for many fish larvae (Guerguess, 1993). Also, the rotifers e.g. *Philodina* and *Lecane bulla* species can dominate the biofloc system and playing as a good natural food for fishes (El-Shafiey *et al.*, 2018).

Studies on planktonic composition and their morphometry, physical and chemical characteristics of water bodies are necessary to obtain basic knowledge on planktonic biodiversity (Rajagopal *et al.*, 2010). Planktonic and epiphytic microinvertebrates play an important role in aquatic ecosystem. This role is important economically in fish growth and production (El-Enay, 2004 & 2009). The relative abundance and composition of invertebrate varied depending on type of microhabitate (e.g. plant species, benthic sediments or water column) as mentioned by Difonzo and Campbell (1988). Ali *et al.* (2007) found that water variables have a higher impact on the aquatic macrophytes than on the associated invertebrate population. Also, the macrophytes may have direct benefits of food or indirect ones by providing a large surface area on which epiphytic algae can grow and, manipulate organic matter can settle. Also, Interactions within the food chain are essential to ecosystem ecology (Płaska and Mieczan, 2018). Macrophytes also provide shelter from water turbulence and predators, for many species (Petr, 1968 ; Cattaneo, 1983).

So, the present work aims to study and compare the relationship between some physico-chemical parameters and planktonic and epiphytic microinvertebrates which associated with the floating macrophyte *Eichhornia crassipes* in River Nile at El-Qanater El-Khiria.

MATERIALS AND METHODS

1-The study area:

The study area is located around El-Kanater El-Khairiya region, about 25 km downstream of Cairo. Samples were collected from River Nile at El-kanater El-Khairiya region during the period from August, 2016 to May, 2017. Eight sites were chosen for this study (Table 1 and Fig. 1):

- site 1 at River Nile before branching,
- sites 2 & 5 at Rosetta Branch,
- site 3 at EL-Rayah El-Nassery,
- site 4 at EL-Rayah El-Behery,
- site 6 at EL-Rayah El-Menofy,
- site 7 at EL- Rayah El-Toufeky and
- site 8 Damietta Branch.

Table (1): Locations of sampling sites of River Nile.

Sites	Location	Latitude	Longitude
1	River Nile before branch	30° 10’.375 ”N	31° 08’.404’’E
2	Rosetta I	30° 10’.523 ”N	31° 07’.711’’E
3	El-Nassery	30° 10’.666 ”N	31° 06’.727’’E
4	El-Behery	30° 10’.816 ”N	31° 06’.290’’E
5	Rosetta II	30° 11’.279 ”N	31° 06’.392’’E
6	El-Menofy	30° 11’.280 ”N	31° 06’.390’’E
7	El-Toufeky	30° 11’.280 ”N	31° 06’.390’’E
8	Damietta branch	30°11’1” N	31° 08’20’’ E

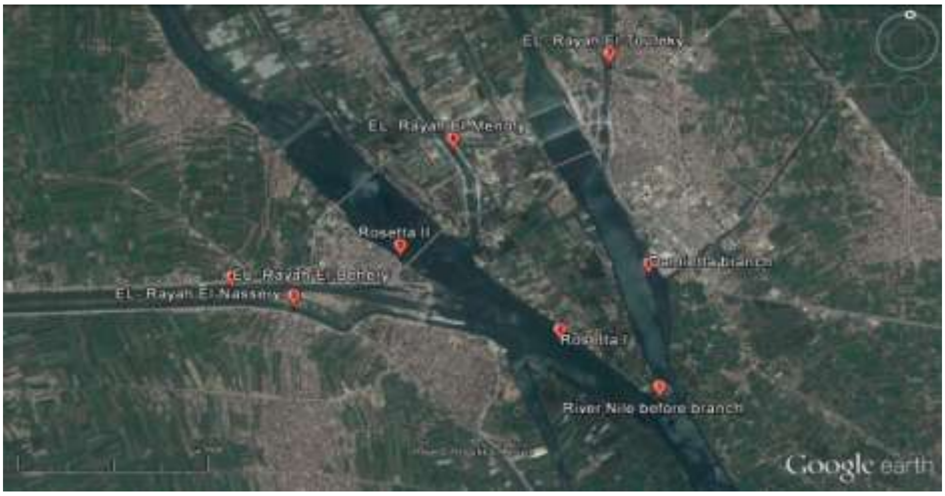


Fig. (1): Map of the investigated sites of River Nile and its branches at El-Kanater Region.

2-Collection and analysis of samples

Water samples were collected from the studied sites to measure physico-chemical characteristic according to (APHA, 2005). The other environmental parameters ware measured in the field. Water temperature, pH, electrical conductivity and total solids were measured by multi-probe portable meter (Crison-Spain $MM40^+$), while water transparency was measured by Secchi disc.

Planktonic microinvetebrates were collected by filtration of 30 Litters from the water column with plankton net (mesh size 55 µm). All samples were fixed with 4 % formalin. For Epiphytic microinvertebrates, the macrophytes within a 0.25 m^2 quadrate were cut and thoroughly shaken and washed in a 500 µm mesh sweep net to remove the large invertebrates. Collections were done from the most abundant species of macrophytes (the floating macrophyte *Eichhornia crassipes*). In the laboratory, samples were washed again. By using Trinuclear microscope, the microinvertebrates were separated into groups and they were identified to different taxa. Each species was counted and the population density was estimated and expressed as a number of organisms/m^2. In the laboratory, the samples were examined, counted, classified, identified and described according to description and keys constructed by Edmondson (1966), Pennak (1978), Shehata *et al.* (1998 a & b) and Dang *et al.* (2015).

3-Statistical analysis

Principal component analysis (PCA) was conducted to correlate physico-chemical parameters in water with the dominant planktonic and Epiphytic microinvertebrate species and groups. It was carried out using XL STAT program (2018).

RESULTS AND DISCUSSION

I-Physico-Chemical Parameters:

Values of the different physico-chemical parameters of water at the investigated sites during different seasons are shown in Tables (2 & 3). Temperature is very important parameter, which influences all physical, chemical and biological transformations in aquatic environment. The lowest value of water temperature was recorded in winter (19.5° C), while the highest one was in summer (30.1 ˚C). This agrees with that stated by Abdel-Star (2005), El-Enany (2009), Saad *et al*. (2015) and El-Damhogy *et al*. (2017).

Transparency attained its highest value (200 cm) in summer, autumn and spring, but its lowest one (70 cm) was recorded in summer. This agrees with that stated by Abdel Gawad and Mola (2014) and Saad *et al*. (2015). The highest value (542 µmhos) of Electrical Conductivity (EC) was recorded in winter but the lowest one (311 µmhos/cm) was measured in spring. This was in agreement with that stated by Abdel Gawad and Mola (2014). But this contradict with that stated by Saad *et al*. (2015) who found that the highest value of Electrical Conductivity (EC) was recorded at El-Kanater El-Khairiya site during winter. This may attributed to the effect of discharged washable water from El-Kanater water sites during washing times.

The highest average value of dissolved oxygen (12.5 mg/l) was recorded at site 5 during winter, but the lowest one (6.1 mg/l) was showed at site 4 during winter. Dissolved oxygen in the investigated area showed relatively increasing during autumn, winter and spring compared to summer. This result agreed with El-Enany (2004) and Abdel-Aziz, (2005). Moustafa *et al.* (2010) mentioned that dissolved oxygen is considered as an important parameter in assessment the degree of pollution in natural water. pH values are in the alkaline side; the highest pH value (8.58) was recorded in winter but the lowest one (7.16) was measured in summer. This agrees with that stated by Saad *et al*. (2015) who found that the lowest values of pH at River Nile was during summer and this might be due to the effect of inflowing industrial wastewater in some discharged points.

Table (2): Variations of Physico-chemical parameters at the different studied sites in River Nile at Qanater region during summer and autumn (2016-2017).

Seasons	Sites	Temp	Trans.	EC	DO	pH	BOD	T.D.S
Summer	St1	28.5	200	400	8.2	8.24	2.3	188
	St2	29.5	150	379	8.5	8.24	2.1	190
	St3	29.8	100	388	8.3	8.21	2	192
	St4	30.1	90	375	9	8.45	3	187
	St5	30	100	370	11	8.4	4	185
	St6	29.3	80	376	8	7.16	6	188
	St7	29.5	100	381	9.1	8.4	2.4	188
	St8	29.9	70	373	8.7	7.16	2.2	187
Autumn	St1	21.2	100	441	10.9	8.31	3.5	282
	St2	21.2	125	439	9	8.2	3	281
	St3	21	102	438	10.5	8.18	2.7	280
	St4	20.9	150	439	9.2	8.23	2.5	281
	St5	20.7	200	432	11.5	8.25	3.2	276
	St6	20.7	100	434	10.3	8.19	4.3	278
	St7	20.9	150	432	11	8.24	4.2	276
	St8	20.8	150	438	9.5	8.08	5.6	281

Table (3): Variations of Physico-chemical parameters at the different studied sites in River Nile at Qanater region during winter and spring (2017).

Seasons	Sites	Temp	Trans.	EC	DO	pH	BOD	T.D.S
Winter	St1	20.3	150	542	10.9	8.61	2.1	350
	St2	20.2	175	430	10.5	8.62	2	282
	St3	20.8	150	392	9.8	8.51	1.9	251
	St4	20	150	386	6.1	8.54	3.5	247
	St5	20.1	75	379	12.5	8.55	2.1	214
	St6	19.5	100	392	12	8.58	1.9	251
	St7	19.8	85	385	11.8	8.6	3	246
	St8	20.8	150	393	11.1	8.27	2.9	252
Spring	St1	28	130	325	10	8.24	5.2	208
	St2	29.6	100	322	8.8	8.21	3.6	206
	St3	28.6	150	316	11.2	8.13	3.2	202
	St4	28	100	317	10.4	8.22	6	203
	St5	28.7	200	319	12	8.35	2.8	204
	St6	28.4	100	311	9.2	8.15	4.4	198.8
	St7	28.7	100	316	11.6	8.33	5.2	202
	St8	28.6	150	313	12.4	7.97	5.2	200

II-Plankteonic microinvertebrates

Planketonic microinvertebrates occupy an important position in pelagic food webs, as they transfer energy produced through photosynthesis from phytoplankton to higher trophic levels (fish) consumed by human. They are also play important role in determining the composition and amount of particles sinking to the benthos, which provides a food source for benthic organisms and participate to burial of organic compounds (Sleem and Hassan, 2010). The structure and function of the planketonic microinvertebrates community with regard to species composition and abundance are affected by several factors. These factors included the nature and availability of food resources, types of predatory interaction in the water environment, physical and chemical aspects of water, and anthropogenic changes (Sipaúba-Tavares *et al.*, 2010).

Planktonic communities (Tables 4 & 5 and Figs. 2,3 & 4) were represented by 49 species in addition to 7 copepod and meroplanktonic larval stages included in 5 groups of zooplankton viz, Rotifera (582 Org. / L), Copepoda (11 Org. / L), Cladocera (7 Org. / L), Protozoa (1 Org. / L) and meroplankton (1 Org. / L). Sleem and Hassan (2010) agreed with our results in number of groups but our groups density were high except Protozoa. Also our results agreed with Gaber (2013) who recorded the same 5 zooplanktonitic groups but disagreed in species number which attributed to the study was collected from the different areas along the River Nile from Aswan to Cairo and its two branches.

Table (4): Average density (Org. / L) and percentage of each zooplankton groups during the study period.

Group	Average ± SD	Relative abundance %
Rotifera	582 ±143	96.77
Copepoda	11 ±5	1.88
Cladocera	7 ±5	1.10
Protozoa	1 ±1	0.11
Meroplankton	1 ±1	0.14
Total	601 ±151	100

Table (5): The abundance of the collected zooplanktonic groups (Org. / L) along the present 8 investigated sites.

Groups / Sites	Rotifera	Copepoda	Cladocera	Protozoa	Meroplankton	Total zooplankton
1	510	11	3	0	0	523
2	622	13	5	3	0	643
3	520	9	5	1	0	535
4	588	7	7	2	1	604
5	607	10	11	0	1	629
6	658	16	8	0	2	684
7	653	12	12	0	3	680
8	495	12	2	0	1	510
Average ±SD	582 ±65	11 ±3	7 ±4	1 ±1	1 ±1	601 ±70

In the present study, zooplankton communities dominants by rotifers followed by copepods, cladocerans, meroplankton and protozoans, contributing 96.77%, 1.88%, 1.10%, 0.14%, 0.11%, respectively. This agreed with Sleem and Hassan (2010). However, Gaber (2013) reported that the main dominant of zooplankton community was rotifers (54.4%) followed by protozoan (16.5%), cladocerans (14.6%), copepods (8.7%) and meroplankton (5.8%).

Planktonic microinvertebrates varied from season to another, the highest average density of zooplankton was recorded during winter, followed by autumn, while the lowest annual average was recorded during summer. This agreed with Sleem and Hassan (2010) but disagreed with Gaber (2013) who recorded that the maximum average population densities of total zooplankton counts in the area of investigation were observed during autumn. The domination of rotifers among the zooplankton community in the River Nile water was recorded by El-Bassat (1995 & 2002); Khalifa (2000); Bedair (2006); Mola (2011) and George (2012). While Guerguess (1979) recorded that Cladocera was the dominant group. As well as these results also disagreed with Aboul Ezz (1984) and El-Enany (2009). They recorded the dominance of Copepoda.

The apparent dominance of rotifers in rivers may be due to their relatively short generation time compared to the larger crustacean zooplankton (Mola, 2011). Also, due to their simple parthenogentic reproduction (Herzig, 1983) which in favorable conditions results in high production rates often manifested as very high population densities. On the other hand, the eutrophication affect the composition of zooplankton, shifting the dominance from large species (Copepoda) to smaller species (Rotifer) (Abdel Hameed, 2016).

In the present work the average population densities of rotifers ranged between a maximum value (810 Org. /L) recorded in winter and a minimum value (461Org. /L) in summer season. Saad *et al.*, (2013) mentioned that the highest population density of rotifer was recorded in winter. Rotifer density is typically dominated by only a few species (Gaber, 2013). Also, Egborge and Tawari (1987) found *Keratella cochlaris* and *K. tropica* to be dominant out of the 41 recorded rotifer species. While, Kobayashi *et al.* (1998) found *Keratella, Polyarthra* and *Trichocerca* species to be dominant in the freshwater habitats. This agreed with the present study which stated that rotifers were dominated by the genus *Polyarthra* and *K. cochlaris*, being 15.40%, 15.31% of total rotifer, respectively.

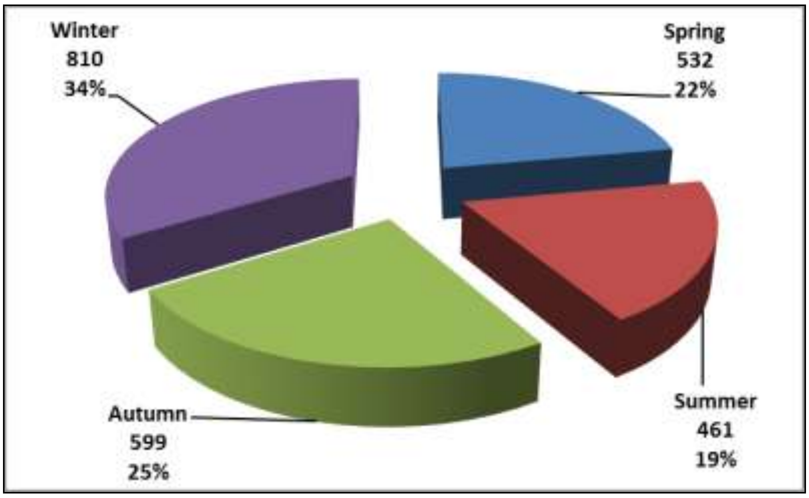


Fig. (2): Seasonal variations (Org. / L) and percentage of zooplankton during the study period.

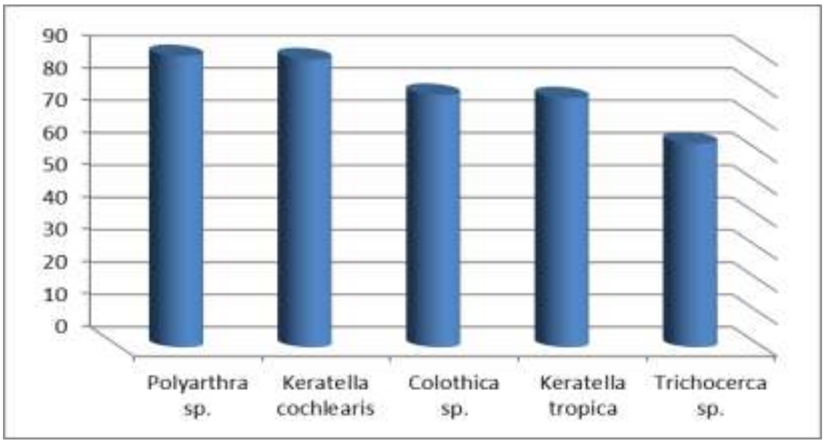
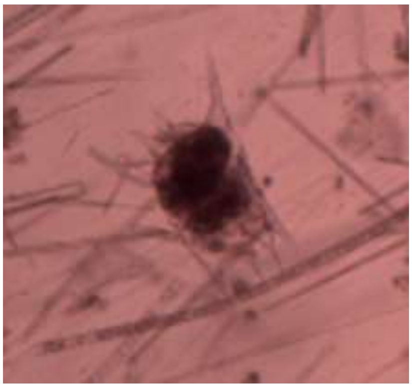
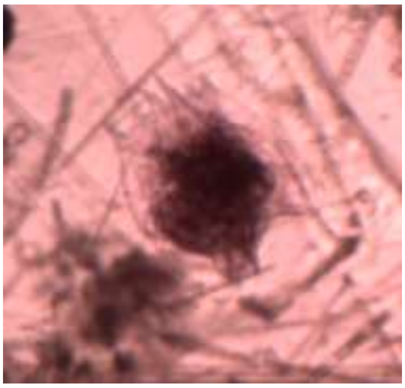


Fig. (3): Annual Average density (Org. / L) of abundant rotifer species during the study period.

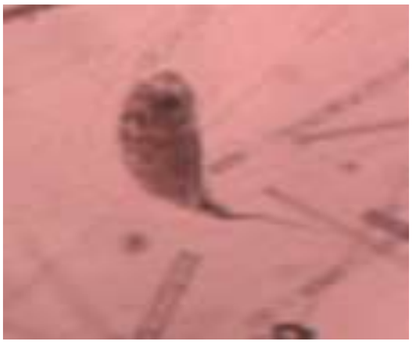
Keratella cochlearis



Brachionus calyciflorus



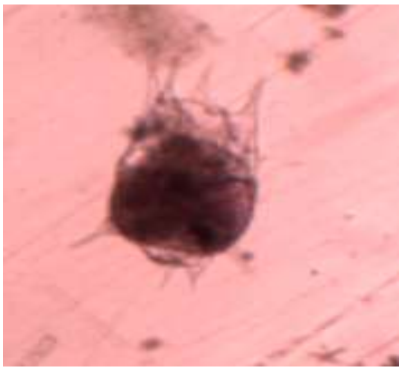
Brachionus quadridentatus



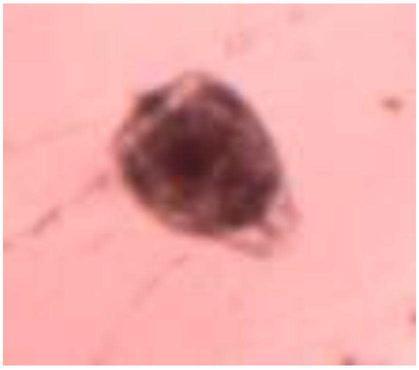
Trichocerca elongata

Keratella tropica (female with egg)

Lecane luna



Brachionus calyciflorus



Philodina sp.

Polyarthra vulgaris

Fig. 4. Zooplankton collected in the study.

III- Epiphytic microinvertebrates

Epiphytic microinvertebrates were represented by 34 species and 5 larval stages involved in 8 main groups of epiphytic microinvetebrates. This includes Rotifera (26 sp.), Copepoda (a single sp. and 2 larval stages), Cladocera (5 sp.), Protozoa (a single sp.), Nematoda (a single sp.), Insecta (a single larval stage), Oligochacta (a single larval stage) and Cercaria (infected stage of *Schistosoma* sp.). Ali *et al.* (2007) concluded that 67 invertebrate species were recorded in Lake Nasser, 37 were exclusively epiphytic, 11 species were collectively planktonic and 19 species were found in both habitats. El-Enanny (2009) reported that Epiphytic microinvertebrates comprise seven main groups; Nematoda, Rotifera, Protozoa, Cladocera, Insecta, Oligochacta and Copepoda. Arora and Mehra (2003) studied the species diversity of planktonic and epiphytic rotifers in the back waters of Delhi segment of the Yamuna River (India) and recorded 110 species belonging to 39 genera of 20 eutrophic families. Protozoa was the dominant group during this study, it forms 65.15% of the total epiphytic microinvertebrates and was represented by a single species of protozoa (*Vortecila* sp.). While El-Enany (2009) recorded 5 species of protozoa as epiphytic microinvertebrates. Rotifers recorded the highest number of species (26) and it represented by 27.53 % of the total epiphytic microinvertebrates count. This agreed with Ali *et al.* (2007) and El-Enany (2009). Also, this highest number of epiphytic rotifera was observed by Sakuma *et al.*, (2002) and Arora and Mehra (2003). That because Rotifera preferred macrophytes which could be predominant body features, e.g. small size and short toes (sessile in nature), to avoid predators and to feed on epiphytic microorganisms (Ali *et al*., 2007).

Rotifera were dominated with *Philodina* sp., *Lecan luna*, *Brachionus quadridentatus, Lecan bulla* and *Polyarthra* sp. (Tables 6 & 7 and Figs. 5,6 & 7). El-Enany (2009) recorded genus *Lecane* with the highest number of species seven species. It was observed by Ali *et al.*, (2007). They recorded high number of genus *Lecane*. Sakuma *et al.* (2002) stated that large number of *Lecane* remained on plant even after shaking 50 times macrophytes. This indicates that these animals were very strongly attached to submerged macrophytes. The relative abundance and composition of microinvertebrate varied depending on type of microhabitat (e.g. plant species, benthic sediments or water column) as mentioned by Difonzo and Campbell (1988). Nematoda, Cladocera, Insecta (Chironomus larvae), Copepoda and Cercaria (infected stage of *Schistosoma* sp.) considered the lowest recorded groups of the epiphytic microinvertbrates. Cladocera was represented by 7 species; genus *Alona* represented 25 % of the total epiphytic Cladocera. The highest number of *Alona* may attribute to this species and can adapt to live near the bottom or on the aquatic plants. This agreed with Iskaros (1993) and Iskaros *et al*. (2008); Mageed (1995) and Mokhtar (2003) where they mentioned that planktonic and epiphytic microinvertebrates play an important role in aquatic ecosystem. This role is important economically in fish growth and production. Cladocera is one of the most preferred species recorded in fish guts (El-Enany, 2009). The different food components generally occurred in a varying degreases during different periods of the year (Azim, 1991). Also, it constitutes the basis for development of a successful fisheries management programme in fish capture and culture (Oso *et al*., 2006).

Table (6): Average density (Org./m^2) and percentage of each epiphytic microinvertbrates group during the study.

Group	Average ± SD	Relative abundance %
Rotifera	171163 ±119371	27.53
Copepoda	13494 ±10683	2.17
Cladocera	4425 ±5566	0.71
Protozoa	405131 ±729884	65.15
Free living nematodes	16363 ±14367	2.63
Chironomus larvae	8881 ±9973	1.43
Oligochaet larvae	1913 ±2467	0.31
Cercaria	450 ±657	0.07
Total	621819 ±673255	100

Table (7): Seasonal variations of epiphytic microinvertbrates (Org./m^2 plant) at each site of EL-Qanater EL-Khiria region during the study.

Seasons / Sites	Summer	Autumn	Winter	Spring	Average ± SD
1	188800	361600	6364800	297600	1803200 ±3041903
2	384000	812000	2786400	384000	1091600 ±1147740
3	0	1017600	176000	154000	336900 ±460505
4	204800	67200	67200	67600	101700 ±68734
5	156800	73600	32000	5400	66950 ±66149
6	145600	800000	3321600	210400	1119400 ±1497361
7	729600	23200	0	18400	192800 ±358006
8	235200	592000	148800	72000	262000 ±229879
Average ± SD	255600 ± 219029	468400 ± 391217	1612100 ±2347505	151175 ± 136955	621819 ± 636626

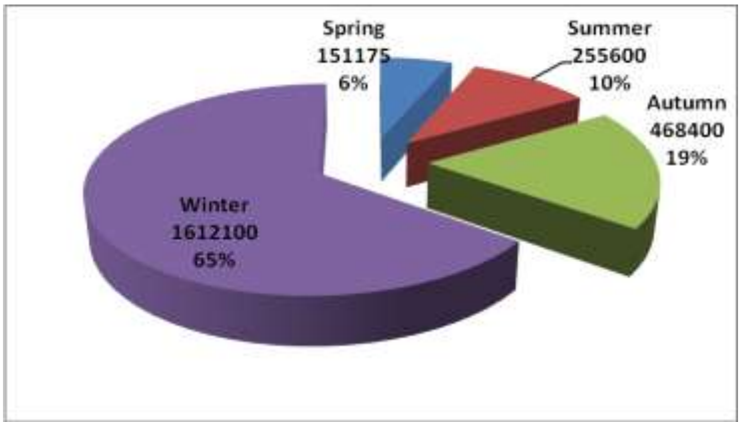


Fig. (5): Seasonal variations of percentage and number (Org./m^{2}plant) of epiphytic microinvertbrates during the study.

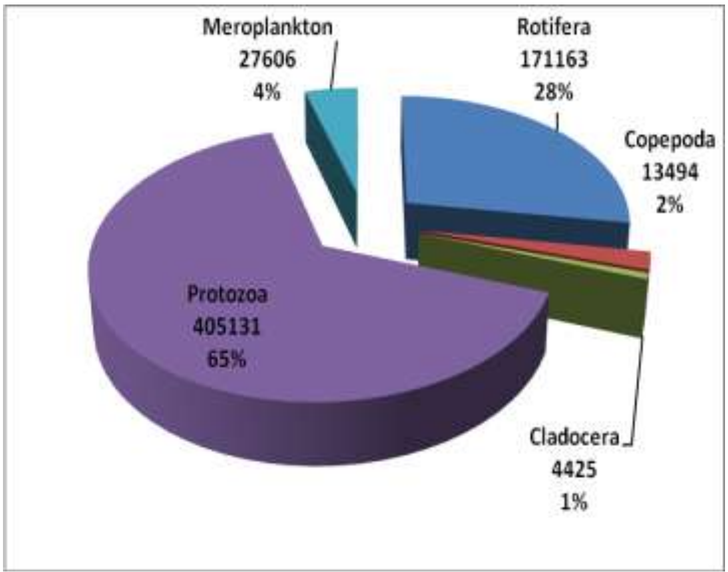
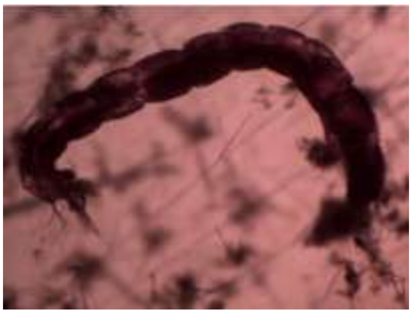
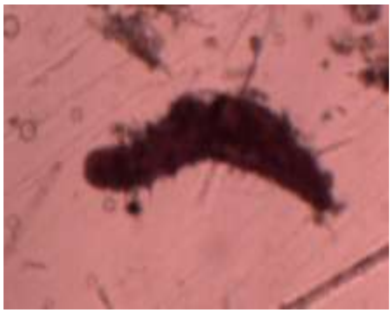


Fig. (6): The percentage and number (Org./m^{2}plant) of each epiphytic microinvertbrates group during the study.

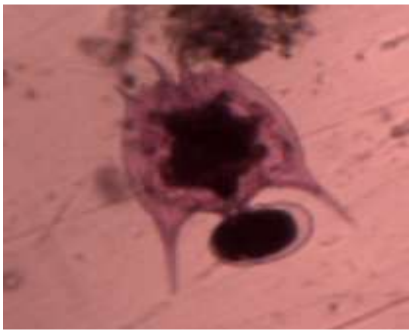


Chironomus larvae

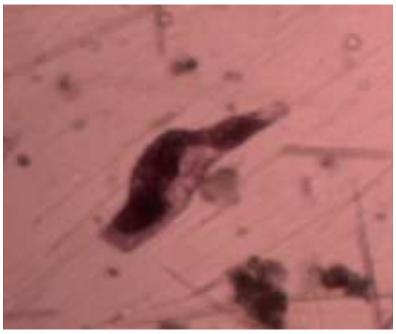
***Vorticella* sp.**



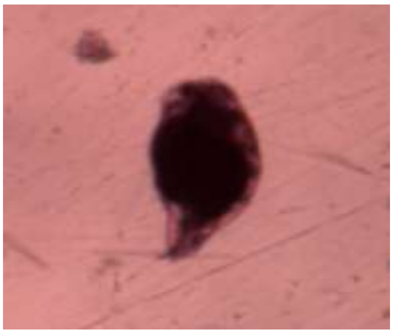
Oligochaet larvae



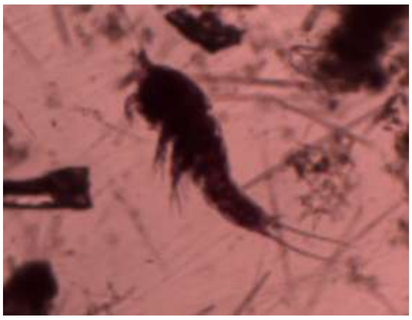
***Brachionus falcatus* (Female with egg)**



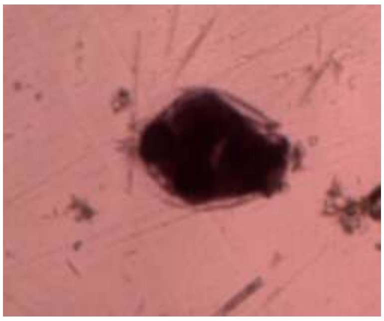
Philodina sp.



Cephalodell sp.



Cyclopoid sp.



Lecan luna

Nematoda

Fig. 7. Epiphytic Microinvertebrates associated with the floating plant *Eichhornia crassipes* in River Nile at Qanater region .

IV-Statistical analysis:

The principal component analysis (PCA) was conducted between physico-chemical parameters and planktonic microinvertebrates (Fig. 8). Water temperature showed a significant positive correlation with *Polyarthra* sp. While it showed a significant negative correlations with the rotifer *Keratella cochlearis* and *Keratella tropica* andthe cladocern *Bosmina longirostris*. This indicated that, water temperature play an important role in distribution of the dominant planktonic species.

Dissolved oxygen were located at the centre of the PCA ordination diagram so it showed non-significant relationship with all planktonic microinvertebrates. This indicated that, these dominant planktonic species can adapt to the low concentration of dissolved oxygen in water. These observations contracted with Krzyzanek (1986) which stated that dissolved oxygen have a lesser influences of the distribution of the epiphytic microinvertebrates, in *vice versa* to zooplankton which showed high positive correlation to dissolved oxygen.

On the other hand, PCA was conducted between physico-chemical parameters and epiphytic microinvertebrates (Fig. 9) and showed a significant negative correlations between EC and the cladoceran *Chydorus sphericus* and BOD with *Polyarthra* sp. While, the highest positive correlation was observed between EC and the cladoceran *Alona affinis.* These observations agreed with Ali *et al*. (2007) and El-Enany (2009).

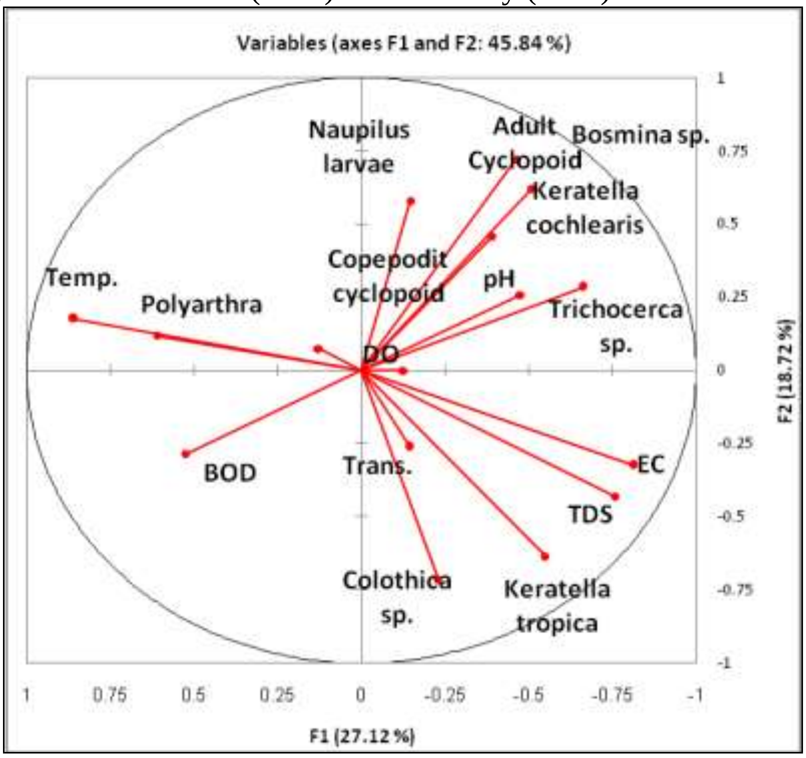


Fig. (8): The principal component analysis (PCA) was conducted between physico-chemical parameters and planktonic microinvertebrates

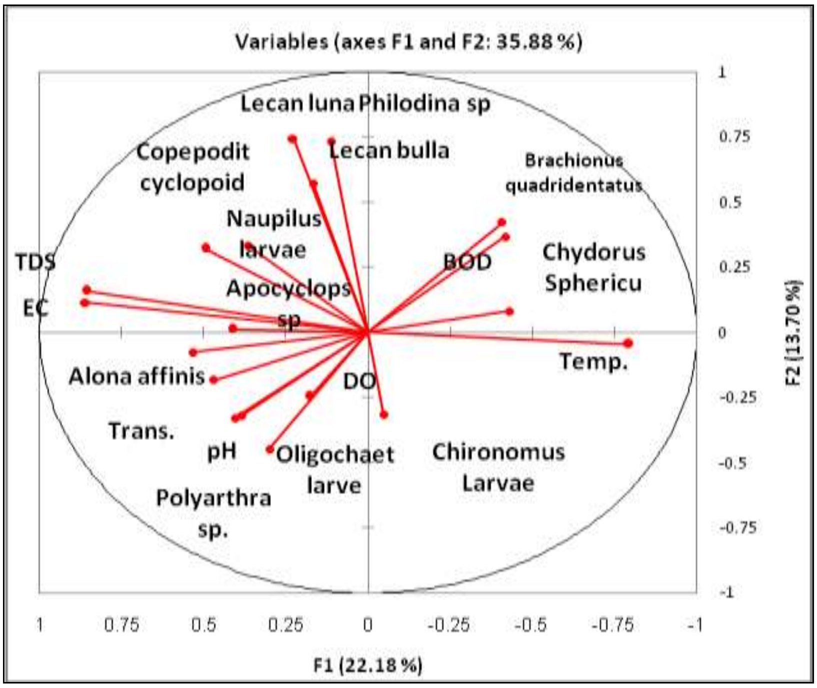


Fig. (9): The principal component analysis (PCA) was conducted between physico-chemical parameters and epiphytic microinvertebrates

Conclusion

Epiphytic microinvertebrates recorded the highest number of species and groups than planktonic one. This indicates that the aquatic plant *Eichhornia crassipes* habitats are more diverse and high species richness. The principal component analysis (PCA) showed that water temperature was the most effective parameter on planktonic microinvertebrates distribution while EC was the most effective parameter on Epiphytic microinvertebrates species.

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تنوع اللافقاريات الدقيقة الهائمة والملتصقة على نبات ورد النيل فى نهر النيل منطقة القناطر الخيرية مصر

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المستخلص

يهدف هذا البحث الى دراسة العلاقة بين بعض الخصائص الفيزيوكيماوية واللافقاريات الدقيقة الهائمة و تلك الملتصقة بنبات ورد النيل فى نهر النيل بمنطقة القناطر الخيرية .تم تجميع عينات من المياه وال هائمات الحيوانية واللافقاريات الدقيقة الملتصقة بنبات ورد النيل من ثمانى مواقع مختلفة خلال الفترة من اغسطس 2016 الى مايو 2017 معبرة عن المواسم الاربعة للعام وقد سجلت اللافقاريات الدقيقة الهائمة اعلى قيمها خلال موسم الشتاء 810 كائن/ اللتر بينما سجلت أقل الاعداد 461 كائن/ اللتر خلال فصل الصيف كما كونت (الروتيفرا) أعلى نسبة فى جميع المجموعات المسجلة مكونة نسبة قدرها 96.77 % تلتها مجدافيات الارجل 1.88 % ثم متفرعات القرن بنسبة قدرها 1.10% بينما كونت الاوليات والهائمات الجزئية بنسب قليلة جدا المجموعات الاقل تواجدا.

تم تسجيل 37 نوع من الهائمات الحيوانية تنتمي الى الروتيفرا (30 نوع)- متفرعة القرن(2 نوع) ومجدافيات الارجل (1 نوع) - الاوليات (2 نوع) – الهائمات الجزئية (2 نوع). كما تم تسجيل سبع مجموعات من اللافقاريات الدقيقة الملتصقة بنبات ورد النيل وهى (الروتيفرا- مجدافيات الارجل- الاوليات- الديدان الاسطوانية – قليلات الاشواك- الحشرات- متفرعات القرن) وكانت أعلى قيمة قد سجلت خلال فصل الشتاء بنسبة قدرها 1612100 كائن /متر المربع من النبات وأقل قيمة قد سجلت خلال موسم الربيع بنسبة قدرها 151175 كائن للمتر المربع من النبات. تم تسجيل 45 نوع من الهائمات الحيوانية الملتصقة بالنباتات تنتمي الى الروتيفرا (27 نوع) - الاوليات (5 نوع)- متفرعة القرن(9 نوع)- ومجدافيات الارجل(2 نوع)- قليلات الاشواك (2 نوع).

لذا فقد سجلت اللافقاريات الدقيقة الملتصقة بالنباتات أعلى عدد فى الانواع والمجموعات أكثر من الكائنات الدقيقة الهائمة فى المياة مما يعطي دلالة على ان بيئات النباتات المائية هى الأغنى والأكثر تنوعا من اللافقاريات الدقيقة الهائمة فى الماء. وقد تم إجراء التحليل الاساسى متعدد الاوجه وذلك لتوضيح العلاقة بين الخصائص الفيزيوكميائية واللافقاريات الدقيقة الهائمة والملتصقة بالنباتات.