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The relationship between macrobenthic invertebrates and those associated with Plants (*Myirophyllum spicatum*) in River Nile at Qanater region, Egypt

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ABSTRACT

The present work aims to study relationship between macrobenthic invertebrates and those associated with the dominant submerged plant (*Myirophyllum spicatum*) in River Nile at Qanater region and comparing between them. Also, some physico-chemical parameters were studied during different seasons at the investigated sites. In addition to, macroinvertebrates it was correlated with some physico-chemical parameters.

The maximum occurrence of macrobenthic invertebrates (2004 org./m^2) was recorded during spring and the minimum (460 org. /$m^{2)}$ occurred during winter. This might be due to the highest number of Annelids (944 org. /m^2) and molluscs (1027 org. /m^2) during spring.

The highest average number of macrobenthic invertebrates associated with the macrophytes (*M. spicatum*) was recorded during spring and it was mainly represented by arthropods populations (3366 org./m^2) with the highest number of Insecta.

The macrobenthic invertebrates comprised the highest number of species (18 species) belong to 3 groups including phylum Annelida (5 species), phylum Mollusca (10 species) and phylum Arthropoda (3 species). On the other hand, the macroinvertebrates associated with *M. spicatum* comprised 16 species belong to 3 groups; phylum Arthropoda (13 species), phylum Annelida (2 species) and phylum Mollusca (1 species).

The present results indicated the presence of high positive correlation between the number of the macrobenthic invertebrates and those associated with the macrophytes (*M. spicatum*).

Key words: Macrobenthic invertebrates, macrophytes, *Myirophyllum spicatum*, River Nile, Qanater region.

INTRODUCTION

The River Nile is considered as one of the longest rivers in the world; it runs about 6,650 km through nine countries from Burundi to Egypt. The last 1,600 km of this journey goes through Egypt. The main part of water resources comes from the Blue Nile in Ethiopia and the rest from the White Nile in Uganda (El-Gohary, 1994). The River Nile is the artery of Egypt, as it provides for more than 96% of the municipal, industrial and irrigation requirements of Egypt (Abdel-Satar, 2005).

Benthic invertebrates are those animals which spend all or part of their life in, on or near the bottom of any aquatic habitat. The information about benthos is required for studying productivity, fisheries and field population on which a long-term work of aquatic benthic communities and its possible indicator species that can make a valuable contribution (Holme and Mcintry, 1971). Benthos is divided according to their size into macro, meio and microbenthos.

Macrobenthos are those forms larger than 1mm and they represented in freshwater by many annelids, insects, crustaceans and molluscs (Merritt et *al*., 2008). Benthic macroinvertebrate assemblages are structured according to physical and chemical parameters that define habitat and other biological parameters that influence their reproductive success (Abd El-salam and Tanida, 2013). These assemblages appear to be strongly influenced by vegetation (Battle *et al*., 2001).

In Egypt, Macroinvertebrates associated with the submerged plants are rich in insects such as Ephemeroptera, Odonata, Hemiptera, Coleoptera, Trichoptera, Lepidoptera and Diptera (Agami, 1989). The macrophytes may be 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. Macrophytes also provide shelter from water turbulence and predators, for many species (Petr 1968; Dvorak & Best 1982; Cattaneo 1983). So, the present work aims to compare and study the relationship between benthic macroinvertebrates and the attached ones with macrophytes in river Nile at El-kanater region.

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, 2014 to May, 2015. Eight sites were chosen for this study, site 1(River Nile before branching), 2 & 5 (Rosetta branch) site 3 (EL- Rayah El- Nassery) site 4 (EL- Rayah El-Behery) site 6 (EL- Rayah El-Menofy) site 7 (EL- Rayah El-Toufeky) and site 8 (Damietta branch) (Table 1 and Fig. 1).

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

Sites	Location	Distance from Cairo	Latitude	Longitude
1	River Nile before branch	25 km	30° 10’.375 ”N	31° 08’.404’’E
2	Rosetta I	26.07 km	30° 10’.523 ”N	31° 07’.711’’E
3	El-Nassery	28.37 km	30° 10’.666 ”N	31° 06’.727’’E
4	El-Behery	28.93 km	30° 10’.816 ”N	31° 06’.290’’E
5	Rosetta II	27.75 km	30° 11’.279 ”N	31° 06’.392’’E
6	El-Menofy	28.08 km	30° 11’.280 ”N	31° 06’.390’’E
7	El-Toufeky	28.03 km	30° 11’.280 ”N	31° 06’.390’’E
8	Damietta branch	26.02 km	30°11’1” N	31° 08’20’’ E

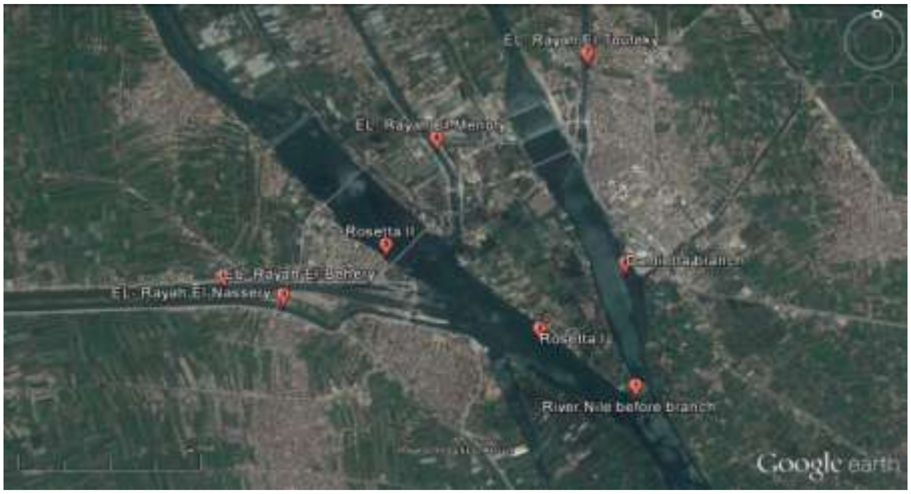

Fig. (1): Map of the investigated sites of River Nile and its branches in El-kanater Region.

2-Collection and analysis of Samples:

Water samples were collected from the studied sites to measure the DO and BOD 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.

The macrobenthic fauna were collected by the Ekman dredge bottom sampler, covering an area of about 0.02 m^2. After collection the bottom fauna were washed thoroughly in a small hand net of bolting silk (0.5 mm mesh size) and picked in and preserved immediately in 10 % neutral formalin solution in polyethylene jars for later examination. For associated macroinvertebrates, the macrophytes within a 0.25 m^2 quadrate were cut and thoroughly shaken and washed in a 500 µm mesh sweep net. Collections were done from the most one abundant species of macrophytes (*Myirophyllum spicatum*) at each site. In the laboratory, samples were washed again. By using stereomicroscope, the macroinvertebrates were separated into groups and they were identified to different taxa and species. Each species was counted and the population density was estimated and expressed as a number of organisms / m^2.

3-Statistical analysis:

Correlation coefficient matrix was carried out on data at selected sites using Microsoft Excel. Diversity indices were carried out on data at selected sites using primer program version 5. These include Richness, Evenness, Shannon and Simpson indices.

RESULTS AND DISCUSSION

Physico-Chemical Parameters:

Values of the different physic-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 in the investigated sites 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), and Saad *et al*. (2015).

Transparency attained its highest value in summer, autumn and spring (200 cm), 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) 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 the site 4 during winter. Dissolved oxygen in the investigated area showed relatively increasing during autumn, winter and spring compared to summer. These results 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. El Bouraie *et al.* (2008) stated that at Nile delta the highest BOD values is an indicator to the excessive export of biodegradable organic matter that increases the de-oxygenation of water to the level where fish and other aquatic life cannot survive.

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 were recorded during summer and might be due to the effect of inflowing industrial wastewater in some discharged points. On the other hand, Abdel-Satar (2005) reported that the lowest pH value was related to the high bicarbonate (HCO_3) concentration in water as a result of decreased uptake of CO_2 by phytoplankton. The highest and the lowest average values of BOD being 6 and 1.9 mg/l were measured in summer and winter, respectively.

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

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.

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

Macrobenthic Invertebrates:

The maximum occurrence of macrobenthic invertebrates was collected during spring and the minimum ones occurred during winter; being 2004 and 460 Org./$m^{2,}$, respectively. This agrees with the results of Iskaros and El-Dardir (2010). Annelida occupied the highest population density of the total macrobenthic fauna as represented by 54.1 % followed by Mollusca (43.5%) and then Arthropoda (2.3%) (Table 4). The obtained percentages not coincided with Fishar (2005) who mentioned that Mollusca recorded the highest population density of the total macrobenthic fauna**.** The present result agrees with Aboul-Ezz (1988), El-Shabrawy & Khalil (2003), Barbary & El-Shabrawy (2004), El-Shabrawy & Rizk (2005), Fishar (2005) and Saad *et al*. (2015**)**.

The highest seasonal average number of Annelida was observed during spring (944 Org. /m^2) while the lowest was observed during autumn (215 Org. /m^2). Also, Mollusca recorded its highest average number (1027 Org. /m^2) during spring, while the lowest was observed during winter (88 Org. /m^2). This may be due to increasing of *Melanoides turberculata* which the most common Mollusca species in investigated area. It recorded the highest average during summer (229 Org./m^2) and the lowest average during winter (13 org./m^2) and formed (22.62 %) of the total Mollusca .This is in agreement with Abuel Ezz (1984); Abdel Aziz (1987); El Shabrawy (1993); Fishar (1995) and Samaan *et al*., (1995) who stated that summer was the flourishing season. *Limnodrilus* spp. is the most dominant species being 93.24 % of the total Annelida with average of (538 Org. /m^2). This result agrees with Mola and Abdel Gawad (2014) and Saad *et al*. (2015**).** Iskaros and El-Dardir (2010) reported that the predominance of oligochaetes in Lake Nasser. was due to their ability to adapt to various habitats and to their tolerance to low oxygen content or anoxic conditions. The present study is agreed with Bendary (2013), particularly agreed with Zaki (2008), Khalil *et al*. (2013) and Saad *et al*. (2015).

Table (4): Average density (Org./m^2) and percentage of different macrobenthic invertebrates (MBI) and those associated with *M. spicatum* (MY) from River Nile at Qanater region during the study period.

Phylum	MBI		MY	
	Number	%	Number	%
Annelida	577	54.1	756	35.26
Mollusca	464	43.5	3	0.14
Arthropoda	25	2.3	1385	64.60
Total	1066	100	2144	100

Macrobenthos association with Macrophytes (*M. spicatum*):

The macroinvertebrates associated with *M. spicatum* in the investigated sites of river Nile during the study period is shown in Table (5). A total of 16 species of living macroinvertebrates were identified and include 13 species belonging to Insecta, 2 species of Annelida and one species of Mollusca. Insecta occupied most population density of the total macrobenthic fauna with 64.60%, followed by Annelida (35.26%) and Mollusca (0.14%) (Table 4). Arthropoda (Insecta) was the most abundant group in the investigated area.

The highest annual average of Arthropoda population was recorded during spring (3366 Org/m^2), This is mainly due to increase number of Insecta. But the lowest annual average of Arthropoda population was recorded (35 Org/m^2) during autumn. This result agrees with El-Tantawy *et al*. (2003) and Abd EL-Karim et *al.* (2009).

Chironomus larvae were the most dominant species of Arthropoda (96.97 % of total Arthropoda) with an annual average density of 1344 Org. /m^2. The highest average density (3331 Org. /m^2) during spring while the lowest average density (2046 Org. /m^2) was recorded during winter. This result agree with Stahl (1986) mentioned that these larvae are wide spread and abundant in all kinds of inland in lakes. Wirth and Stone (1968) stated that *Chironomus* larvae are most abundant in lakes, ponds and streams favored by growth of aquatic plants. This partially agrees with the other various studies which stated that the peak of chironomus larvae was recorded during winter and spring (Samaan and Aleem, 1972; Samaan, 1977; Iskaros, 1988; Fishar, 1995 and Abdel Gawad, 1993).

Limnodrilus sp. was the most dominant species while it is rare or disappear in association with submerged plants of macrobenthic which attributed to its nature in adaptation with the bottom. Contributed 99.21 % of the total Arthropoda. It recorded the highest average density (2055 Org. /m^2) during autumn. But the lowest one (18 Org. /m^2) was recorded during winter. This observation agrees with El-Tantawy *et al*. (2003), Ibrahim and Mageed (2005), Abd EL-Karim *et al.* (2009), Khalil *et al*. (2013), Mola and Abdel Gawad (2014) and Saad *et al*. (2015). Also, Iskaros and El-Dardir (2010) reported that the predominance of oligochaetes in Lake Nasser. was due to their ability to adapt to various habitats and to their tolerance to low oxygen content or anoxic conditions which is suitable for these species (Fishar, 1995; Abdel Salam and Tanida, 2013), to their ability to adapt to various habitats and their tolerance to oxygen depletion related to excess decomposable organic matter present in the environment (Rashid and Pandit, 2014). This observations agreed with the present study which showed negative correlation between dissolved oxygen and *Limnodrilus* sp. (-0.25).

Table (5): List of recorded macrobenthic invertebrates taxa associated with *M. spicatum* from River Nile at Qanater region during the study period.

Phylum	Classe	Order	Family	Species
Arthropoda	Insecta	Diptera	Chironomidae	Chironomus larvae (Meigan, 1803)
				Pupa of *chironomidae* (Meigan, 1803)
				Larvae of Microtendipes sp.
		Coleoptera	Psephenidae	*Psephenidae* sp. (0, 1854)
		Trichoptera		*Trichoptera* sp. (Kirby, 1813)
		Coleoptera	Dytiscidae	*Dytiscidae* sp. (Leach, 1815)
		Hemiptera	Corixidae	Adult of *Micronecta plicuta* (Costa, 1875)
		Ephemeroptera	Caenidae	*Caenis* sp. (Stephens, 1835)
		Odonata	Coenagrionidae	*Ischnura* sp. Charpentier, 1840
				Nymph of *Enallagma* sp. (Charpentier, 1840)
			Corduliidae	Nymph of *Neurocordulia* sp. (Selys, 1871)
			Libellulidae	*Perithemis* sp. Hagen, 1861
	Crustacea	Decapoda	Atyidae	*Cardina nilotica* (P.Roux, 1833)
Annelida	Oligochaeta	Haplotaxida	Tubificidae	*Limnodrilus* sp. (Claparede, 1862)
	Hirudinea	Rhynchobdellida	Glossophonidae	*Helobdella conifer* (Moor, 1933)
Mollusca	Gastropoda	Basommatophora	Physidae	*Physa acuta* (Draparnaud, 1805)

Statistical analysis:

Diversity Indices:

Data in Table (6) indicated that the highest number of species among the collected macrobenthic invertebrates was 13 at site 2, while lowest one (S= 3) at site 3. The highest value of the species richness was recorded for macrobenthic invertebrates at site 2 (SR=1.35), while the lowest value was recorded at site 3 (SR= 0.24). The highest evenness (E = 0.88) was recorded at site 8 but the lowest (E = 0.29) was recorded at site 3. The highest Shannon (H =

1.75) was recorded at site 7 but the lowest (H = 0.20) was recorded at site 3. The highest Simpson (λ = 0.79) was recorded at site 7 but the lowest (λ = 0.10) was recorded at site 3.

It was obvious from Table (6) that for macrobenthic invertebrates associated with macrophytes (*M. spicatum*), site 1 has the highest number of species (S =11), while sites 2 & 4 & 5 have the smallest number of the species (S=5) during the whole period of study. The value of species richness was found in site 3 (SR=1.12), while the lowest value was recorded at site 2 (SR=0.51). The highest evenness (E = 7.06) was recorded at site 6 but the lowest (E = 0.11) was recorded at site 8. The highest Shannon (H = 0.91) was found at site 5 but the lowest (H = 0.10) was recorded at site 2. The highest Simpson (λ = 7.29) was found at site 8 but the lowest (λ = 0.14) was recorded at site 7.

Table (6): Diversity of macrobenthic invertebratesat bottom and those association with macrophytes (*M. spicatum*) in the sampling sites of the River Nile during the study period (from August, 2014 to May, 2015).

Sites	S (No. of species)		Richness		Evenness		Shannon		Simpson	
	MBI	MY	MBI	MY	MBI	MY	MBI	MY	MBI	MY
1	10	11	1.05	1.12	0.44	5.98	0.96	0.14	0.43	4.21
2	13	5	1.35	0.51	0.44	6.29	1.05	0.10	0.43	3.2
3	2	10	0.24	1.12	0.29	5.91	0.20	0.13	0.10	4.17
4	8	5	0.94	0.68	0.74	0.39	1.43	0.63	0.70	0.28
5	8	5	0.62	0.77	0.47	0.56	0.75	0.91	0.46	0.45
6	9	8	1.20	0.85	0.69	7.06	1.52	0.14	0.68	4.61
7	11	9	1.22	0.99	0.76	0.17	1.75	0.38	0.79	0.14
8	7	6	0.73	0.59	0.88	0.11	1.59	0.21	0.78	7.29

MBI = Macrobenthic invertebrates. MY= macroinvertebrates associated with *M. spicatum.*

The Correlation coefficient:

Correlation coefficient matrix between physic-chemical parameters and the dominant species of bottom fauna is shown in Table (7). Data showed negative correlation between *Melanoides tuberculata* and total dissolved solids and electric conductivity (r = - 0.25 and - 0.14), respectively. On the other hand, a positive correlation coefficient matrix were between *M. tuberculata* and temperature, (r = 0.30 respectively). *Limnodrillus* sp. showed positive correlation with temperature and biological oxygen demand (r = 0.26 and 0.21) but it appears negative correlation with biological oxygen and total dissolved solids (r =- 0.26 and - 0.20). Also, matrix of Correlation coefficient between macrobenthic invertebrates and those associated with *M. spicatum* during different seasons (Table, 8) showed a positive correlations being 0.42, 0.52, 0.15 and 0.07 during summer, autumn, winter and spring, respectively.

Table (7): Correlation coefficient matrix between physico chemical patamters and bottom fauna during the present study.

Parameters	PH	TDS	Temp	EC	Trans	DO	BOD	Moll.	Annel.	Arthro.	*Melan.*	*Theo.*
PH	1.00											
TDS	0.34	1.00										
Temp	-0.43	-0.87	1.00									
EC	0.20	0.83	-0.68	1.00								
Trans	-0.59	-0.34	0.37	-0. 07	1.00							
DO	0. 31	0.20	-0.26	-0.05	-0.33	1.00						
BOD	-0.38	-0.17	0.25	-0.38	0.10	0.02	1.00					
Moll.	0.10	0.32	0.41	0.52	0.13	0.29	0.58	1.00				
Annel.	-0.20	-0.13	0.20	-0.15	0.10	-0.25	0.44	0.13	1.00			
Arthro.	-0.05	0.13	-0.06	0.03	-0.11	0.05	0. 31	0.12	0.39	1.00		
Melan.	-0.11	-0.25	0.30	-0.14	0. 05	-0.14	-0.02	0.25	0.19	-0.08	1.00	
Theo.	-0.07	-0.24	0.24	-0.17	0. 06	0.24	0.13	0.27	-0.07	0.24	-0.13	1.00
Limnodrilus spp.	-0.07	-0.20	0.26	-0.16	0.10	-0.26	0.21	0.12	0.82	0.06	0.49	-0.12

Temp= Temperature, Moll.= Mollusca, Annel.= Annelida, Arthro.= Arthropoda, Melan.= Melanoides sp., *Theo.= Theodoxus* sp.

Table (8): Correlation coefficient matrix between macrobenthic invertebrates (MBI) and those associated with *myriophyllum spicatum* (MY) during different seasons from the investigated sites.

	Spring MBI	Summer MBI	Autumn MBI	Winter MBI	Spring MY	Summer MY	Autumn MY	Winter MY
Spring MBI	1.00							
Summer MBI	0.18	1.00						
Autumn MBI	0.18	0.14	1.00					
Winter MBI	0.17	-0.25	-0.44	1.00				
Spring MY	0.07	0.33	-0.25	-0.35	1.00			
Summer MY	0.53	0.42	0.60	0.13	-0.15	1.00		
Autumn MY	0.67	-0.25	0.52	-0.24	0.14	0.42	1.00	
Winter MY	0.89	-0.04	-0.10	0.15	0.35	0.17	0.66	**1.00**

Conclusion

The highest average numbers of Aquatic invertebrates were recorded at the sites before dams due to the stability of water environment in each bottom and submerged plants, while the lowest numbers were observed in sites at Rosetta and the other sites after dames and this might be due to the effect of strong water current which decrease and prevent macroinvertebrates from association with aquatic plant. Also, we can conclude that, the increase in macrobenthic invertebrates is accompanied with increasing of macroinvertebrates associated with macrophytes (*M. spicatum*). This was confirmed by the high positive correlations between them.

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العلاقة بين اللافقاريات القاعية واللافقاريات الملتصقة بالنباتات لنبات الميروفيليم اسباكيتم فى نهر النيل فى منطقة القناطر، مصر

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المستخلص
يهدف هذا البحث الى دراسة العلاقة بين اللافقاريات القاعية واللافقاريات الملتصقة بالنباتات لنبات الميروفيليم فى منطقة القناطر والذى يعتبر أكثر النباتات المائية المغمورة شيوعا فى نهر النيل بالاضافة الى تاثير بعض الخصائص الفيزوكيميائية. حيث وجد أن أعلى تواجد عددى للافقاريات القاعية تم تسجيله فى فصل الربيع بينما أقلها تواجدا فى فصل الشتاء مسجلة 2004 كائن /م^2 و 460 كائن /م^2 على التوالى ويرجع ذالك الى العدد الكبير من الحلقيات الموجود خلال الربيع 944 كائن /م^2 وقد سجلت الرخويات أعلى عددا فى الربيع ايضا 1027 كائن /م^2 .وكذالك اللافقاريات الملتصقة بنبات الميروفيليم سجلت اعلى قيمها ايضا 3366 كائن /م^2 فى فصل الربيع ويرجع ذالك الى الزيادة الهائلة فى أعداد الحشرات. اللافقاريات القاعية سجلت أعدادا أعلى من الكائنات 18 نوع تنتمى الى 3 مجموعات رئيسية وهى الحلقيات 5 أنواع والرخويات 10 أنواع ومفصليات الارجل 3 أنواع , بينما سجلت اللافقاريات الملتصقة بالنباتات عدد أنواع اقل 16 نوع تنتمى معظمها الى مفصليات الارجل 13 نوع والحلقيات نوعان ونوع واحد من الرخويات . وقد خلصت الدراسة الى أن الزيادة فى عدد اللافقاريات القاعية يكون مصحوبا بزيادة فى عدد اللافقاريات الملتصقة بالنباتات فى نفس الوقت وقد تاكد ذالك بعلاقة الارتباط القوية بين اللافقاريات القاعية والملتصقة بالنباتات.