J. Egypt. Acad. Soc. Environ. Develop., 23 (1):11-26 (2022) (D-Environmental Studies)
E.mail: easedjournal_egypt@yahoo.com ISSN 1110-8770
www.jades.journals.ekb.eg eISSN 2314-5471 (online)

# Effect of physico-chemical parameters on distribution of macrobenthic invertebrates at Rosetta branch the heaviest polluted area of Nile River

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**Received : February 15, 2022**

**Accepted: March 13, 2022**

## ABSTRACT

Rosetta branch considered the most polluted area of Nile River especially the region from Kanater city to kafr Elzayat city. Six stations selected longitudinally at this region for collection of water and macrobenthic invertebrates. Samples were collected during the period from August, 2019 to April, 2020. Some heavy metals were measured to evaluate the degree of pollution in the studied sites. Macrobenthic invertebrates (MBI) comprised 18 species belong to three phyla; phylum Annelida (5 species), phylum Mollusca (10 species), phylum Arthropoda (2 species). Annelida was the abundant group, where it represented 98 % of the total MBI with an annual average of 28887 Org./$m^2$.The highest number of MBI was observed at site 4 (Tamalay) with a value of (8514 Org./$m^2$), while the lowest one (45 Org./$m^2$) was recorded at site 2 due to the effect of El-Rahawy drain. The correlation depending on Principlal Component Analysis and biological indices showed that, water temperature, nitrie, nitrate, pH, transparency and DO had a significant positive correlation with MBI. Cadmium showed a significant positive correlation with the most dominant macrobenthic invertebrates groups and species. The study recommended that, the water discharged from El-Hahawy drain should treated.

**Keywords**: Nile River, macrobenthic invertebrates, heavy metals.

## INTRODUCTION

The river Nile in North of Cairo, is divided into two branches at EL-Qanater EL-Khiria region and flows into the Mediterranean Sea at Rosetta and Damietta (Said, 1962; Osborn and Helmy; 1980). Rosetta River Nile branch extends northwards for about 236 Km on the western Boundary of the Nile Delta from Egypt's Delta Barrage. It has an average width of 180 m and depth from 2 to 4 m (El-Gammal and El-Shazely, 2008). It flows through, El-Giza, El-Menofyia, El-Gharbia, Kafr El-Sheikh and El-Boheira Governorates. It is affected by two important sources of pollution. The first is El-Rahawy drain, which receives all the untreated sewage of El-Giza governorate in addition to agricultural and domestic wastes of El-Rahawy village. The second one is Kafr El-Zayat industrial area (Tayel, 2003).

Macrobenthic 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 (Holme and Mcintry, 1971). Macrobenthos are those forms larger than 1mm and they represented in freshwater by many annelids, insects, crustaceans and molluscans (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). Macrobenthic invertebrates were affected by the discharging of untreated wastes (Saad *et al*., 2015). Therefore, the present work aims to study the effect of physico-chemical parameters in addition to some heavy metals on distribution of macrobenthic invertebrates at Rosetta branch, the most polluted area of Nile River.

## MATERIALS AND METHODS

### 1- The study area:

Seasonal collection of samples (water and macroinvertebrates) from six main stations in Rosetta branch at the Nile River during the period from August, 2019 to April, 2020. Stations include El-QanaterAl Khairiyah, El-Rahawy, Kata, Tamalay, Com Hamada and Kafer ELZayat (Table1& Fig. 1).

**Table (1): Locations of sampling sites in Rosetta branch of River Nile.**

| Sites | Location | Latitude | Longitude |
|---|---|---|---|
| 1 | El-Qanater | 30°12’48.79”N | 31°2’39.26”E |
| 2 | El-Rahawy | 30°12’26.53”N | 31°1’57.84” E |
| 3 | Kata | 30° 13′ 12.93″ N | 30° 58′ 33.77″ E |
| 4 | Tamalay | 30° 30′ 32.32″ N | 30° 49′ 57.29″ E |
| 5 | Kom Hamada | 30° 42′ 52.91″ N | 30° 45′ 44.28″ E |
| 6 | Kafer El-Zayat | 30° 49′ 22.64″ N | 30° 48′ 38.93″ E |

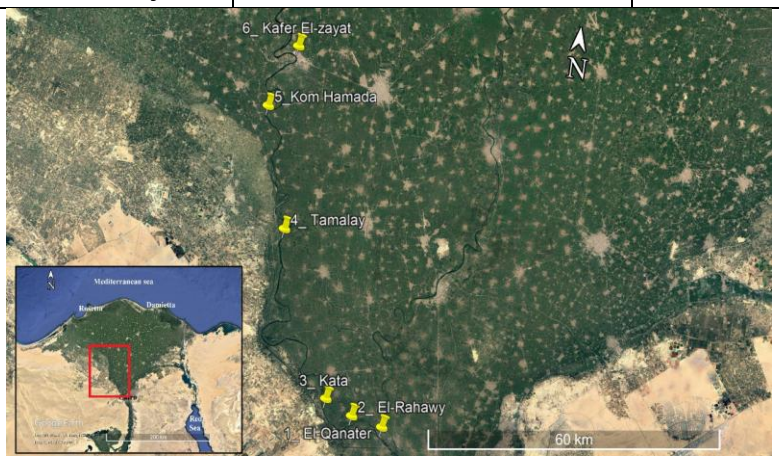


**Fig. (1): Map showing the collected sites at Rosetta branch of the River Nile.**

### 2-Collection and analysis of Samples:

The physico-chemical parameters and heavy metals of the collected water samples were measured according to APHA (2005). Some environmental parameters (Water temperature, pH, electrical conductivity and total solids) were measured in the field by multi-probe portable meter (Crison-Spain MM40$^{+}$), while water transparency was measured by secchi disc.

The macrobenthic fauna were collected by Ekman dredge bottom sampler, covering an area of about 0.02 m$^2$. After collection samples of the bottom fauna were washed thoroughly in a small hand net of bolting silk (0.5 mm mesh size) and preserved immediately in 9 % formalin solution in polyethylene jars. Samples were washed in the laboratory again by tab water.

Identification was conducted by using stereomicroscope, the macrobenthic invertebrates were separated into groups and to species level. Each species was counted and the population density was estimated and expressed as a number of organisms/$m^2$ (Edmondson, 1966; Bishai *et al*., 2000 and Thorp and Covich, 2009).

**3-Statistical analysis**

The correlation depending on Principlal Component Analysis (PCA) between physico-chemical, heavy metals and macrobenthic invertebrates was conducted by using XL State program, 2022.

## RESULTS AND DISCUSSION

**I-Physico-Chemical Parameters**:

The lowest average value of water temperature (19.1 ˚C) in the six investigated sites during the study period was recorded in winter but the maximum average (31.4 ˚C) was recorded in summer (Figs.2 & 3). This agrees with Ghallab (2000) who found that water temperature was high during summer but it was low during winter at River Nile downstream of delta barrage at El-Rahway drain and El-Enany (2009) who reported that, the variations of water temperature showed agreement with air temperature.

The highest average value of Transparency occurred during summer (59.5 cm), but the lowest one (54.67 cm) was listed during autumn. With regard sites, the maximum average value (99.25 cm) was found at site 1 (El-Kanater), but the minimum one (15.75 cm) was recorded at site 2 (El-rahawy) due to the effect of discharged sewage at this area. Similar observations were recorded by Praveen abd Mola (2013), El-Damhogy *et al*. (2017) and Abdel Hamid (2020).

The lowest average value of EC (0.68 mS/cm) was recorded in winter, but the highest average (0.98 mS/cm) was recorded in autumn. With regard sites, the highest average value (1.44 mS/cm) was noticed at site 2 due to the effect of El-Rahawy drain but the lowest one (0.436 mS/cm) was recorded at site 1. This agrees with the results of and Sabae (2013) and Mola *et al*. (2018).

The values of pH showed the highest average value (8.10) at site 1, where the lowest one (6.94) was measured at site 2. This agrees with El Bouraie *et al.* (2011) and Mola *et al.* (2018) who found that pH values were high at Rosetta branch before El-Rahway drain during summer. Also, the present findings agree with Gallab (2000) and Saad *et al*. (2015) who attributed the lowest value of pH to the effect of inflowing industrial wastewater.

Dissolved oxygen (DO) plays an indicator of water condition. DO in the investigated area showed relatively increasing during autumn, winter and spring compared to summer. These results agreed with that of Ghallab (2000), El-Enany (2004) and Abdel-Aziz, (2005). Moustafa *et al.* (2010) stated that DO is considered as an important parameter in the assessment of the degree of pollution in natural water.

The high biological oxygen demand (BOD) values indicate excessive export of biodegradable organic matter increasing the de-oxygenation of water to the level where fish and other aquatic life cannot survive (El Bourie, 2008).

In the current study, the highest average value of BOD (54.1 mg/l) was recorded at site 2, but the lowest one (3.75 mg/l) was recorded at site 1. El-Damhogy *et al*. (2017) and Moustafa *et al.* (2010) concluded that BOD values at Rosetta branch is high compared with other parts of Nile. The obtained result showed an abrupt increase BOD and COD values especially at the

discharging point of El Rahway Drain into Rosetta branch due to the huge amount of different effluents (agriculture, industrial, and domestic wastes).

Ammonia is the important inorganic nitrogen. The highest acceptable concentration is 0.1 mg/l of $NH_3$-N (Meade, 1985). In the present study, the maximum average value of $NH_4$ is 9.142 µg/l was recorded during winter, while the minimum one (5.540 µg/l) was detected during spring. With regard sites, the highest average value (16.49 µg/l) was noticed at site 2. This high concentration attributed to the effect of El-Rahawy drain. Abd El- Rashid (2011) and Abdel Hameed (2020) reported that the increasing ammonia concentration in Lake El-Manzalah was due to the effect of drains.

The maximum average value of $NO_2$ (30.67 µg/l) was calculated during summer but the minimum one (18.03 µg/l) was showed during Winter. Regarding sites, the highest average values (40.18 µg/l) was recorded at site 6, at the same time the lowest one (13.58 µg/l) was measured at site 2. The present results disagreed with Abdel Hameed (2020) who found the maximum average value of $NO_3$ was in winter. Nitrate followed the same trend of nitrite. Deai *et al*. (1991) indicated that the increase of ammonia, nitrite and nitrate was correlated to the depletion of DO.

Bioactive metals play an important role in metabolism, thus in physiology and pathology of fish. Metals like Zn, Cu, or Mn function as a cofactor in several enzyme systems (Bury *et al*., 2003), while Fe is directly involved with haemoglobin formation in fish blood. However, when in excessively high concentrations, these metals may cause serious threats to different metabolic processes. Iron is the most abundant transition element, and probably the most well-known metal in biologic systems (Forstner and Wittmann, 1983). The highest average value of Iron (0.25 mg/l) was noticed at site 2 but the lowest one (0.13 mg/l) was recorded at site 5. This finding is in congruence with that reported by Goher (2002) and disagreed with Medani (2018). On the other hand, the present values of Iron were lower than the permissible limit of WHO (2008) (0.3 mg/l).

The maximum average value of Aluminium (0.49 mg/l) was noticed at site 2 which may attributed to the increasing of discharged waste water rich with Aluminium from El-Rahawy drain.

Manganese, although it is an important trace element, it also sometimes exhibits toxicity (Burger and Gochfeld, 1995). Its concentration lies within the permissible level (0.5 mg/L) according to WHO (1993). The maximum average value of Manganese (0.04 mg/l) was noticed at site 2 due to the effect of El-Rahawy drain. The present results are lower than that mentioned by Medani (2018).

Zinc is one of the most abundant essential trace elements in the human body. It is a constituent of all cells, and several enzymes depend upon it as a cofactor (Forstner and Wittmann, 1983).The maximum average value of Zinc (0.013 mg/l) was noticed at site 1, but the minimum one (0.010 mg/l) was recorded at site 5. This result is in accordance with that reported by Khalil *et al*. (2012) and Medani (2018). According to WHO (2008), the concentration of zinc in domestic water supplies should be below 5 mg/l. This implies that all the studied area still within the accepted permissible limit for Zinc values.

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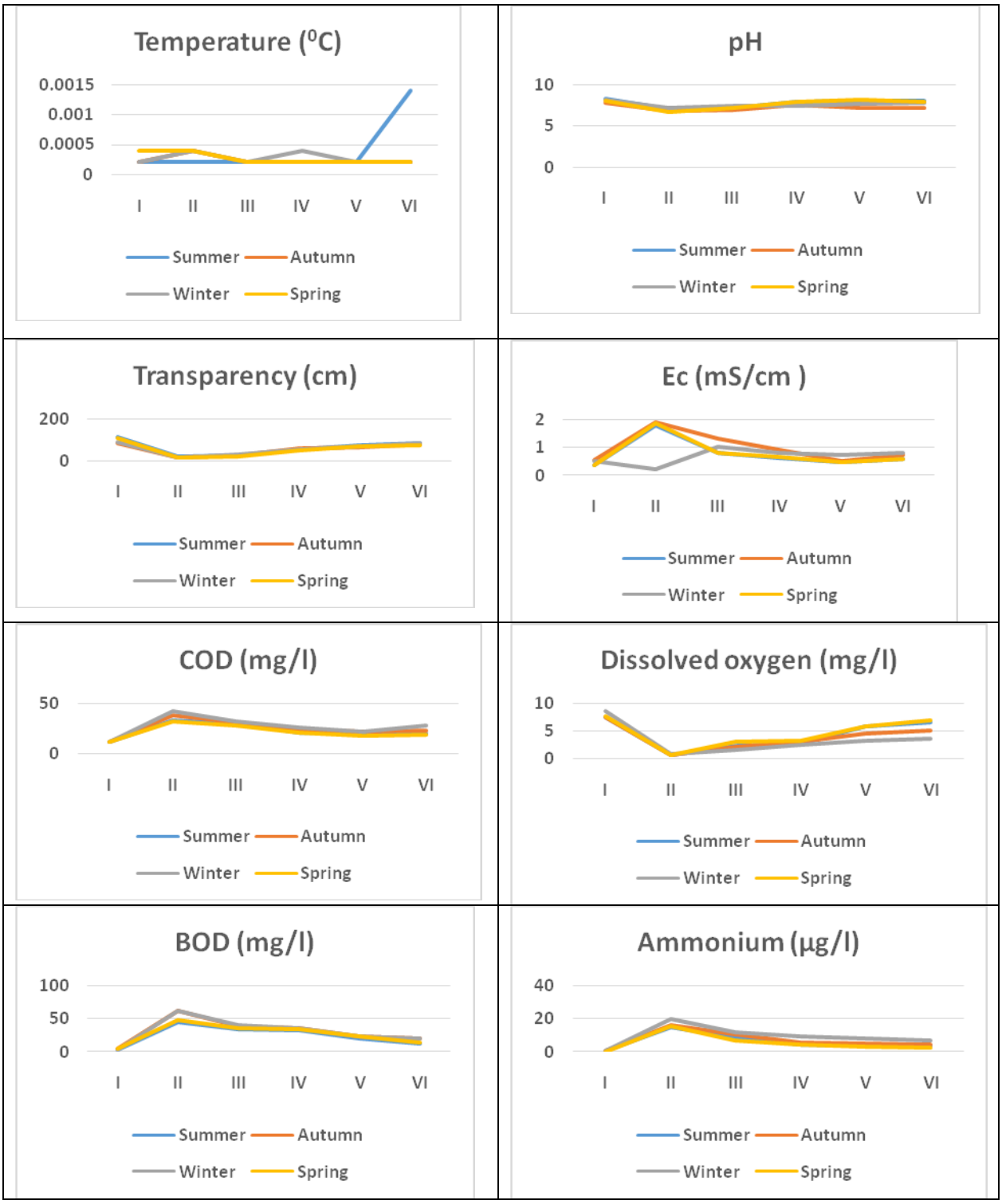


**Fig.2.physico-chemical parameters of the studied area of Rosetta branch, Nile River.**

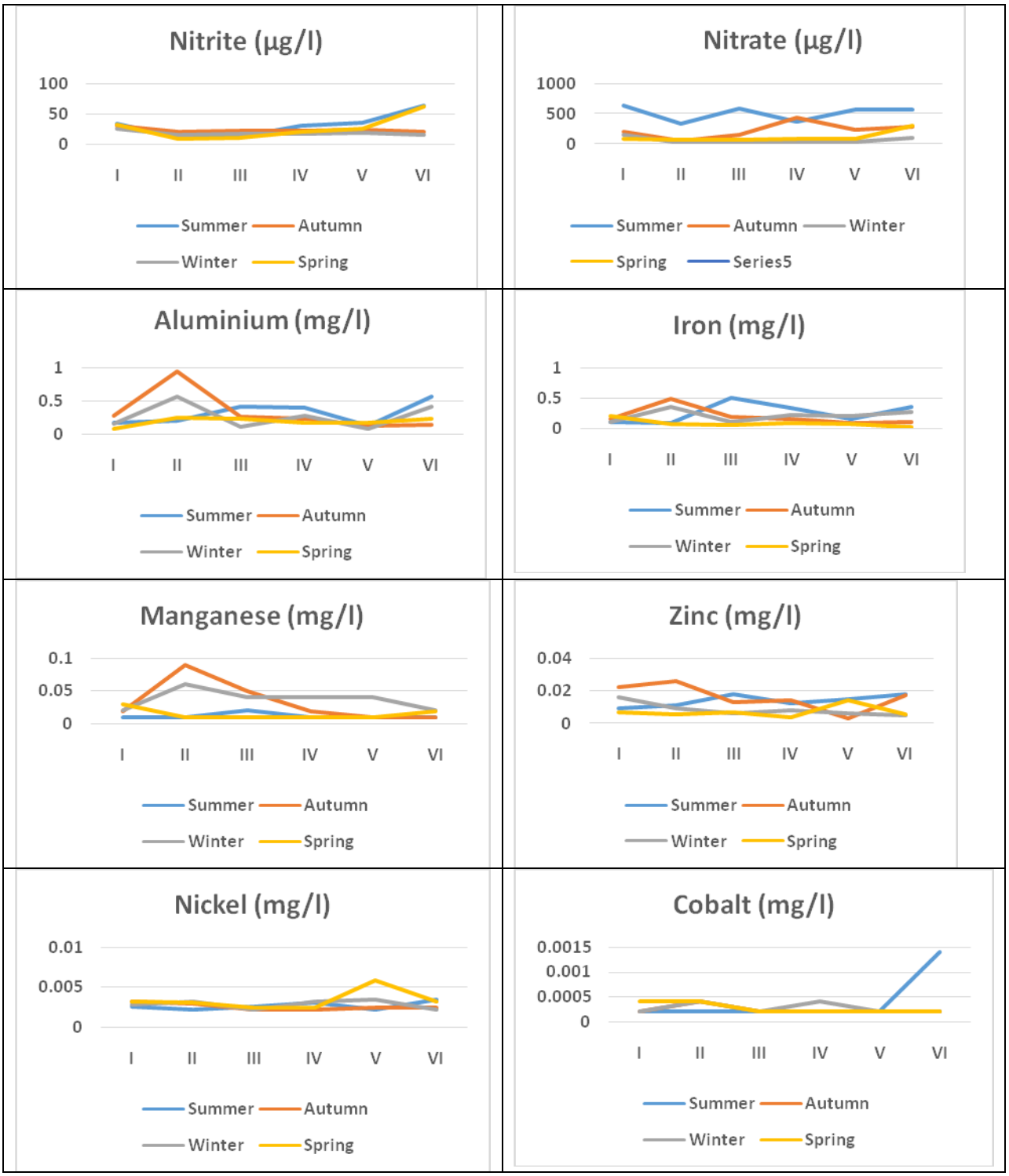


**Fig.3.Nitrite, nitrate and heavy metalsof the studied area of Rosetta branch, Nile River.**

**Effect of physico-chemical parameters on distribution of macrobenthic invertebrates at Rosetta branch the heaviest polluted area of Nile River**

**II-Macrobenthic Invertebrates (**MBI**):**

In the present study MBI comprised 18 species belong to 3 groups; phylum Annelida (5 sp.), phylum Mollusca (10 sp.), phylum Arthropoda (2 sp.) The number of each species in the 6 investigated sites is shown in Table (2).

It was obvious from Tables (2, 3, 4) and Figure (4) that Annelida was the abundant group, where it represented 98 % of the total MBI with an annual average of 28887 Org. /$m^2$. Arthropoda and Mollusca contributed 2 % of the total MBI with a respective annual average of 422 and 172 Org./$m^2$. The maximum occurrence of bottom micromenthos in the investigated sites was recorded during spring and the minimum occurred during winter, being 2004 and 460 Org. /$m^2$, respectively (Table 5). This agreed with the results of Iskaros and El-Dardir (2010).

**Table (2). Spatial distribution of the recorded species of MBI.**

| **species/ Taxa** | **I** | **II** | **III** | **IV** | **V** | **VI** |
|---|---|---|---|---|---|---|
| Phylum: Annelida | | | | | | |
| *Branchiura sowerbyi* | 0 | 0 | 0 | 0 | 0 | 11 |
| *Limnodrilus hoffmeisteri* | 222 | 0 | 83 | 1865 | 233.25 | 217 |
| *Limnodrilus spp* | 1188 | 45 | 366 | 6027 | 3874 | 2525 |
| *Limnodrilus udekemianus* | 155 | 0 | 0 | 178 | 78 | 78 |
| *Helobdella conifera* | 11 | 0 | 11 | 0 | 0 | 0 |
| Phylum: Mollusca | | | | | | |
| *Pristina sp.* | 22 | 0 | 22 | 56 | 11 | 33 |
| *Melanoides tuberculata* | 389 | 0 | 6 | 0 | 33 | 0 |
| *Bellamya unicolar* | 89 | 0 | 0 | 0 | 44 | 55 |
| *Clatura sp.* | 0 | 0 | 0 | 0 | 17 | 0 |
| *Cleopatra bulimoides* | 67 | 0 | 0 | 0 | 11 | 11 |
| *Corbicula consobrina* | 144 | 0 | 0 | 0 | 0 | 22 |
| *Lanistis carinatus* | 22 | 0 | 0 | 0 | 0 | 0 |
| *Eupera ferruginea* | 0 | 0 | 0 | 0 | 0 | 22 |
| *Melanoides granivira* | 0 | 0 | 0 | 0 | 17 | 78 |
| *Mytella sp.* | 33 | 0 | 33 | 0 | 11 | 0 |
| Phylum: Arthropoda | | | | | | |
| Chironomus *sp.* | 55 | 0 | 0 | 366 | 355 | 1732 |
| *Proclides larve* | 0 | 0 | 0 | 0 | 11 | 11 |
| Total MBI | 2397 | 45 | 521 | 8492 | 4695 | 4795 |
| species numbers | 12 | 1 | 6 | 5 | 12 | 12 |

In the present study, Annelida occupied the highest population density (P.D.) of total macrobenthic fauna as represented by 54.1 % followed by Mollusca (43.5%) and then Arthropoda (2.3%) of the total number of macrobenthic fauna. The obtained percentages not coincided with Fishar (2005) who mentioned that Mollusca recorded the highest population density of total macrobenthic fauna as represented by 60.79% followed by Annelida (24.05%)

and then Arthropoda (14%). In the present study, Annelida are the most important organisms recorded from the bottom of the River Nile**.** This result agreed with Saad *et al*. (2015**).**

Arthropods considered the lowest dominant group of bottom fauna. This result agrees with, Aboul-Ezz (1988), El-Shabrawy and Khalil (2003), Barbary and El-Shabrawy (2004), El-Shabrawy and Rizk (2005), Fishar (2005) and (Mola and Farhat, 2015).

MBI recorded the highest average density at site 4 with a value of (8514 Org./$m^2$) but sites 2 recorded the lowest value (45 Org./$m^2$) due to the effect of El-Rahawy drain as mentioned by El Sayed *et al*. (2020).

The highest average density of Annelida was recorded during spring (7807 Org./$m^2$), while decreased during summer to 762 Org./$m^2$. The lowest annual average of total Annelida was recorded during autumn (171 Org./$m^2$). Annelida recorded the highest average density at site 4 with a value of (8125 Org./ $m^2$) but site 2 recorded the lowest value (45 Org./ $m^2$). *Limnodrilus* spp. is the most dominant annelid species. This result agrees with Mola and Abdel Gawad (2014) and Saad *et al*. (2015**).**

**Table (3).The abundance of the recorded macroinvertebrate groups at 6 sites during this study.**

| Group / Site | Annelida | Mollusca | Arthropoda | Total |
|---|---|---|---|---|
| 1 | 1598 | 710 | 55 | 2364 |
| 2 | 45 | 0 | 0 | 45 |
| 3 | 483 | 6 | 0 | 488 |
| 4 | 8125 | 22 | 366 | 8514 |
| 5 | 4196 | 138 | 366 | 4700 |
| 6 | 2875 | 156 | 1743 | 4773 |
| Average | 2887 | 172 | 422 | 3480 |

**Table (4). Average density (Org./$m^2$) and percentage of different macrobenthic groups during the study.**

| **Groups** | **Average** | **Relative abundance %** |
|---|---|---|
| **Annelida** | 28887 | 98 |
| **Mollusca** | 172 | 1 |
| **Arthropoda** | 422 | 1 |
| **Total** | 29481 | 100 |

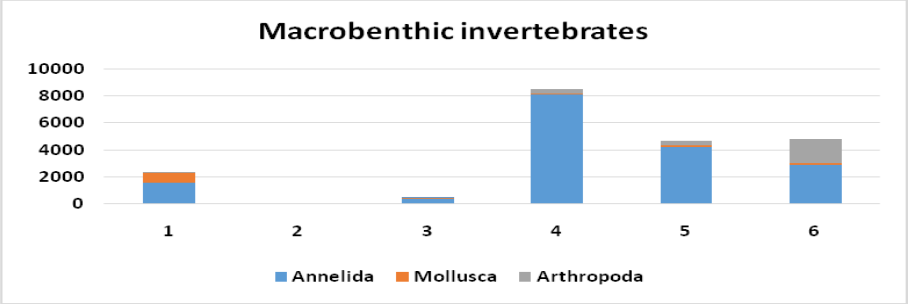


**Fig. 4. Distribution of macrobenthic invertebrates (Org. /$m^2$) in 6 investigated sites.**

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**Table (5). Distribution and seasonal variation of bottom fauna (Org./m$^2$) groups at studied area.**

| Site | Group | Summer | Autumn | Winter | Spring | Average |
|---|---|---|---|---|---|---|
| 1 | **Annelida** | 621 | 1110 | 1909 | 2753 | 1598 |
| | **Mollusca** | 2175 | 222 | 266 | 177 | 710 |
| | **Arthropoda** | 44 | 0 | 133 | 44 | 55 |
| 2 | **Annelida** | 0 | 0 | 89 | 89 | 45 |
| | **Mollusca** | 0 | 0 | 0 | 0 | 0 |
| | **Arthropoda** | 0 | 0 | 0 | 0 | 0 |
| 3 | **Annelida** | 221 | 644 | 0 | 1065 | 483 |
| | **Mollusca** | 0 | 22 | 0 | 0 | 6 |
| | **Arthropoda** | 0 | 0 | 0 | 0 | 0 |
| 4 | **Annelida** | 621 | 5639 | 1376 | 24864 | 8125 |
| | **Mollusca** | 0 | 89 | 0 | 0 | 22 |
| | **Arthropoda** | 0 | 488 | 89 | 888 | 366 |
| 5 | **Annelida** | 1155 | 1554 | 4617 | 9457 | 4196 |
| | **Mollusca** | 0 | 287 | 177 | 89 | 138 |
| | **Arthropoda** | 0 | 933 | 133 | 399 | 366 |
| 6 | **Annelida** | 1953 | 533 | 399 | 8613 | 2875 |
| | **Mollusca** | 133 | 0 | 400 | 89 | 156 |
| | **Arthropoda** | 177 | 44 | 89 | 6660 | 1743 |

El-Damhogy *et al.* (2017) found that, 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 *Melanoidesturberculata* which the most common Mollusca species in the area investigated recorded from all types of bottom. 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 .

In the present data, the highest average density of total Mollusca was recorded during summer (385 Org./m$^2$), while the lowest average recorded during spring (59 Org./m$^2$) (Table 4 ). Mollusca recorded the maximum average density (710 Org./m$^2$) at site 1, while the minimum one (6 Org./m$^2$) recorded at site 3 it completely disappeared in site 2 due to the effect of El-Rahawy drains. This indicated that Moullsca preferring the clean water. This is in agreement with AbuelEzz (1984); El Shabrawy (1993); Fishar (1995) and Samaan *et al*. (1995) who stated that summer was the flourishing season.

The highest average density of total *Arthropoda* was recorded during spring (1332 Org./m$^2$), while the lowest average recorded during summer (37 Org./m$^2$). Mollusca recorded the maximum average density (1743 Org./m$^2$) at site 6, while the minimum one (55 Org./m$^2$) recorded at site 1 it completely disappeared in site 2&3.*Arthropoda*represented by *Chironomus larvae* only. It recorded the highest average density (1325 Org./m$^2$) during spring. In vice versa, *Chironomus* larvae was the most dominant species contributed 94.40% of the total Arthropoda as mentioned by El-Damhogy *et al.* (2017). Previous results agreed with Stahl (1986) who 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 favoured by growth of aquatic plants. The increase of *Chironomus* is often an indication of polluted conditions.

In the present study, the highest density of *Chironomus* larvae was observed during spring. This result disagrees with AboulEzz (1984) and Samman *et al*.,(1995) stated that the highest density of *Chironomus* larvae was observed during summer and winter. Also, disagree with Saad *et al.* (2015) which found the highest density of *Chironomus* larvae during autumn.

**III-Effect of Physico-chemical Factors on Macrobenthic invertebrates**

Water temperature, Nitrie, nitrate, pH, transparency and DO showed a significant positive correlation (at the same direction) with the most dominant macrobenthic invertebrates depending on PCA diagram, while it showed a significant negative correlations with EC, COD and ammonium which located at the opposite side (Fig. 5&6). El-Damhogy *et al.* (2017) found a positive correlation($r = 0.41$) between total Mollusca and water temperature.

Cadmium showed a significant positive correlation (at the same direction) with the most dominant macrobenthic invertebrates groups and species especially Annelida (*Limnodrilus udekemianus, Limnodrilus hoffmeisteri* and *Limnodrilus* spp). PCA diagram showed significant negative correlations for the dominant macrobenthic invertebrates with the other heavy metals. These observations are in congruence with that reported by saad *et al*. (2015) and Medani (2018).

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 disagreeing with Abdel Gawad *et al*., (2012). The present study is agreed with Fishar (1995), Bendary (2013), Ibrahim and Mageed (2005), Zaki (2008), Abd EL-Karim *et al.*(2009), Khalil *et al*. (2013), Abdel Salam and Tanida (2013), Rashid and Pandit (2014), Mola and Farhat (2015) and Saad *et al*. (2015) who indicated that predominance of oligochaetes (*Limnodrellus* spp. ) can be referred to their ability to adapt to various habitats and their tolerance to oxygen depletion related to excess decomposable organic matter present in the environment.

There is a strong positive correlation coefficient between pH and the total Arthropods ($r = 0.99$). On the other hand, strong negative correlation coefficient with total mcrobenthic molluscs and pH is present ($r = - 0.91$.

The discharged point of El-Rahawy drain at site 2 showed zero for all the diversity indices. On the other hand, site 1 at El-Qanater El-khiria recoded the highest diversity indices and considered as control and healthy station. In addition, the lowest similarity index was observed between Site 2 and all the other Sits. El-Damhogy *et al.*, (2017) found that, the lowest numbers of macrobenthic invertebrates were observed at sites Rosetta and the other sites after dames this might be due to the effect of strong water current which decrease and prevent macroinvertebrates from association with substrates.

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 insects. But the lowest annual average of Arthropoda population (35 Org/$m^2$) was recorded 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./$m^2$) was during spring, while the lowest average density (2046 Org./$m^2$) was recorded during winter. This result agree with Stahl (1986) who mentioned that these larvae are widespread and abundant in all kinds of inland lakes. However, it is not common for polluted streams to have abundant *Chironomus* population as well (McCulloch,

1986). *Limnodrilus* spp. was the most dominant species 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. Also, they disappeared during spring. This result agrees with Mola and Abdel Gawad (2014), El-Tantawy *et al*. (2003).

The correlation depending on principal component analysis (PCA) and biological indices showed that, water temperature, nitrie, nitrate, pH, transparency and DO showed a significant positive correlation with macrobenthic invertebrates. Cadmium showed a significant positive correlation with the most dominant macrobenthic invertebrates groups and species. Similar observations were observed by Saad *et al*. (2015) who stated that, the highest positive correlation was recorded between Arthropoda and iron and zinc, while iron recorded a negative correlation with Mollusca and Annelida. Also, it showed that the most dominant annelid *Limnodrilus* spp. had a positive correlation with cadmium and negative correlation with all other heavy metals. This indicates that this species can resist the high concentrations of cadmium.

So, we can conclude that, the discharged water from El-Rahawy drain play a dangerous role in killing all macrobenthos in this area and should treated.

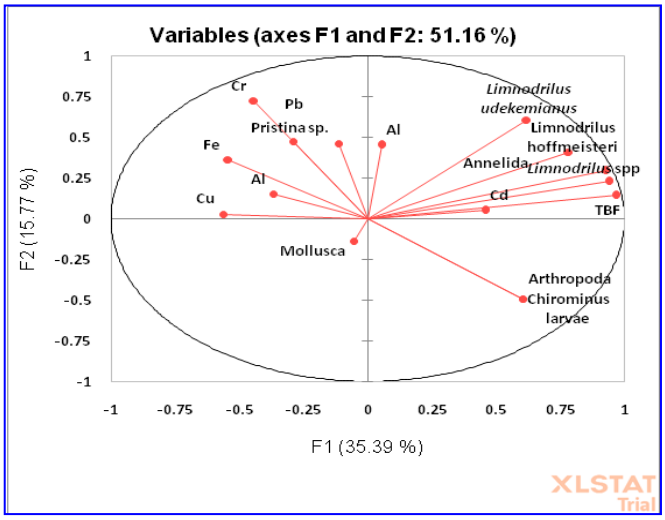


**Fig. (5).The principal component analysis (PCA) diagram between Macrobenthic invertebrates and physico-chemical parametersparameters.**

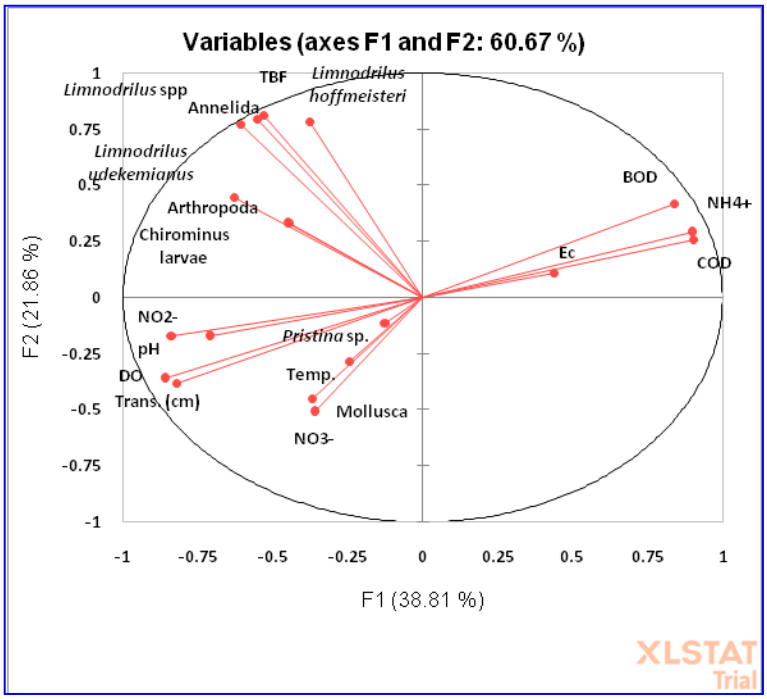


**Fig. (6).The principal component analysis (PCA) diagram between Macrobenthic invertebrates and heavey metals**.

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# تاثير الخصائص الفيزوكيميائية علي توزيع اللافقاريات القاعية الكبيرة في منطقة شديدة التلوث في نهر النيل

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**المستخلص**

يعتبر فرع رشيد من اكثر المناطق الملوثة في نهر النيل وخصوصا فى المنطقة مابعد القناطر وحتي كفر الزيات تم خلال الدراسة دراسة 6 محطات تم اختيارها طوليا في هذه المنطقة وتم تجميع عينات مياه وعينات اللافقاريات القاعية الكبيرة. تم تجميع العينات خلال الفترة من اغسطس 2019 حتي ابرايل 2021وتم قياس بعض العناصر الثقيلة لتقدير درجة التلوث في المنطقة المدروسة. تم تسجيل 18 نوع تنتمي الي 3 مجموعات رئيسية وهي الحلقيات Annelida(خمس أنواع) , الرخويات Mollusca ( 10 انواع) وشعبة مفصليات الارجل Arthropoda( نوعين) كانت الحلقيات Annelida هي اكثر الانواع شيوعا حيث مثلت اكثر من 98% من المجموع الكلي للافقاريات القاعية الكبيرة بحوالي 2887 ( كائن/م$^2$). سجلت المحطة رقم 4 (منطقة طملاي) أعلي عدد من اللافقاريات القاعية الكبيرة حوالي 8514 ( كائن/م$^2$) بينما سجلت منطقة الرهاوي أقل عدد 45 ( كائن/م$^2$) وهذا نتيجة تاثيرمصرف الرهاوي.أوضحت دراسة التحليلي الاحصائي المتعدد الاوجه ان درجة الحرارة والنترات والنيتريت ودرجة الاس الهيدروجينى والشفافية والاكسجين الذائب كانت ذات تاثير ايجابي علي توزيع اللافقاريات القاعية الكبيرة كما اوضح هذا التحليل ان الكاديوميوم هو اكثر العناصر الثقيلة تاثيرا ايجابيا في توزيع اللافقاريات القاعية الكبيرة لذلك اوصت الدراسة بمعالجة مياه مصرف الرهاوي قبل نزولها الي النيل.