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Biodiversity study of Crustaceae in Bahr Al-Najaf Depression in Winter

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Abstract

The current study was conducted to evaluate the water of Bahr Al-Najaf depression Using evidence of the biological diversity of crustaceans, it was considered the first study to evaluate the diversity of the crustacean in this depression, Samples were collected from November 2019 to January 2020. Six species of crustaceans were diagnosis belonging to four orders , *Metapenaens affinis* showed clear dominance, and it is abundance reached 92% in the first Site . The two species *Metapenaes affinis* and *Potamon mesopotamicum* were recorded for the first time in Bahr Al- Najaf depression. The total density of the crustacean ranged between 9-88 individual / 20 liters with the highest value recorded of *Candona candida* in January. The most Constancy index were recorded with *Calanoid sp.* , *Harpacticoide sp.* , *Candona candida* and *Parthyalella sp.* among crustaceans species in the Bahr Al-Najaf, The values of the richness index ranged between the lowest value (zero) in November at the fifth site, to the highest value (4.8) in November at sixth site . The Shannon-Wiener Index showed the highest value (0.37) in the fourth site in November and the lowest value (zero) in the fifth site for the same month, The values of species uniformity index ranged between (0.06) in the fourth site for November and (zero) in the fifth site for the same month.

Keywords: Bahr Al-Najaf, diversity of the crustacean , Biological Indicators

INTRODUCTION

Crustaceae is an aquatic invertebrate, either in fresh or salt water, but some species have adapted to wildlife (Rosa and Barracco , 2011).It plays an important role in the food chain of both fish and other aquatic organisms(Kotpal , 1996), Its constitute a large proportion of aquatic invertebrates, which ivolving 67 known species (Hickman *et al*, 2011).

Aquatic invertebrates have received the bulk of the biodiversity studies in various countries of the world and are considered among the best indicators of the health of the aquatic ecosystem (Karuppasamy and Perumal,2000).

It is possess a different methods to exist and live in special environments, including morphological and behavioral adaptations that enable them to overcome changes in the physical and chemical properties of these environments.(John *et al* ., 2004)

Crustaceans are of great importance in the human food such as shrimp, crab and lobster, it is valuable source of calcium, iodine, amino acids, fats, fatty acids, and minerals, as well as enzymes, also, some crustaceans constitute great harm to other animals, as they parasitize fish or other invertebrates, such as some types of, Copepoda, others are used as an intermediate host for some parasites, such as the *Cyclops sp*. it is used as the intermediate host of tape worm *Diphyllobothrium Lactum* (Hickman *et al*., 2011).

The study of crustaceans is an important, especially for the ecosystem. there distribution is useful in certain environmental aspects such as food richness, pollution, global warming, and long-term changes such as environmental disorder (Soberman *et al*, 2000). It is also considered as Bioindicators of great interest in the results of the shortness of their lives and their rapid response to environmental changes (Boltovoskoy, 1999).Some species of crustaceans can also be used for life control, such as the Copepoda that is used to control mosquito larvae (Jennings *et al*., 1994).

Because Bahr Al-Najaf depression forms an integrated ecosystem, attention has to paid to biological diversity of aquatic invertebrates, including crustaceans, so the current study was conducted to aim at the objectives of diagnosing crustaceans species , and application of biodiversity laws, include Relative abundance index (Ra), Constancy index (S), species richness index (D) , Shanon Weiner diversity index (H) , homogeneity index of species and species uniformity index (E) to see the health of the waters of the Bahr Al- Najaf depression.

MATERIALS AND METHODS

Description of Study area :

The study area was conducted at Bahr Al-Najaf depression which having water body, it is located in the west and south-west of Holy Al-Najaf governorate the length and width of depression was about (75- 45) kilometer , and the area is about 435 Km^2; it is surrounded by desert and some grove of lands, it has standing water seasonally depending on precipitation levels. Six sites were chosen for the study and mentioned in Figure (1); and the geographical coordinates of the studied sites were taken (Table 1). using the Geographical Positioning System (GPS) device as follows:

First site: locally called the opening at The end of the grove located in the eastern of depression , abounds with Cane many palm and trees Many crustaceans, such as Crab, shrimps, and different types of birds. **Second site**: locally called the tongue located eastern the depression which is abounded with algae, some water plants, a lot of water chicken and different types of birds. **Third site** : locally called the area opposite to Al-Hawli street located

southern of Bahr Al-Najaf depression , a region containing algae and a number of different birds. **The fourth site** : which is called locally versus the crematorium western the Bahr Al-Najaf , an area where birds, algae and aquatic plants abound as well.**Finally, the Fifth and Sixth sites**: which are locally known as the area opposite to al-Tar and adjacent to the main street respectively, and these two regions abound in birds, algae, water plants, and others which were located in the Northern of depression (Figure 1)

Samples Collection and diagnosis

Monthly specimens were taken from six sites during the period from November 2019 to January 2020 in Bahr Al-Najaf depression (Figure 1).

Table (1) GPS values of study sites.in the Bahr Al-Najaf depression.

Site No.	Longitude (East)	Latitude (North)
Site 1	44°16'49.3"E	32°00'01.1"N
Site 2	44°14'53.2"E	32°01'24.6"N
Site 3	44°11'49.7"E	32°02'40.4"N
Site 4	44°12'28.6"E	32°00'39.9"N
Site 5	44°13'22.4"E	31°58'46.4"N
Site 6	44°15'25.4"E	31°57'57.9"N

Large crustacean samples were collected by a network of 30 cm radius and 2 mm in diameter from areas close to plants and from a depth of 1 m. The samples were preserved in a plastic container and marked according to the collection area , date and time of collection and preserved in formalin 10% ,It was brought to the laboratory for dignosis (Al-Maliki, 2010), The phytoplankton, were collected by connecting the network of with a 200 micrometer in diameter behind the boat in the water for 10 minutes.

After that, we empty the sample in a glass bottle and put the preservation solution (70% alcohol) in the field and transfer the samples to the laboratory for diagnosis and calculation (Ahmed, 1975; Frandsen, 1983).

Crustacean Diagnosis

Crustaceans species were diagnosed using dissecting microscope and independ on the references, Edmondson, (1959). Also the samples collected were sent to the Center for Marine Sciences / University of Basra and diagnosed by Professor Dr. Ibtisam Mahdi Abdel-Sahib, the isolated species were documented through the image mentioned in the results chapter.

Biological indicators

Five biological indicatorswere approved for the studied samples, as follows:

Relative abundance index (Ra):

This was calculated through the derivative formula proposed by Omori and Ikeda (1984), for the calculation of relative abundance:

Ra = N/Ns × 100

N = individuals' total number per taxonomic unit in the specimens.

Ns = individuals' total number in the sample.

Where (R) rare less than 10% ,(La)less abundant10-40%, (A) abundant species 40 - 70 % and dominant species (D) appearing as more than 70%.

Constancy Index (S)

This index enables determining the frequency occurrence of a given species, (Serafim *et al.*, 2003).

S = n / N×100

n = number of collections containing the group or species

N = total number of samples

The species groups were considered constant when they were recorded as more than 50% of the samples, accessory when present as 25 to 50% of the samples; accidental when recorded as less than 25% of the specimen.

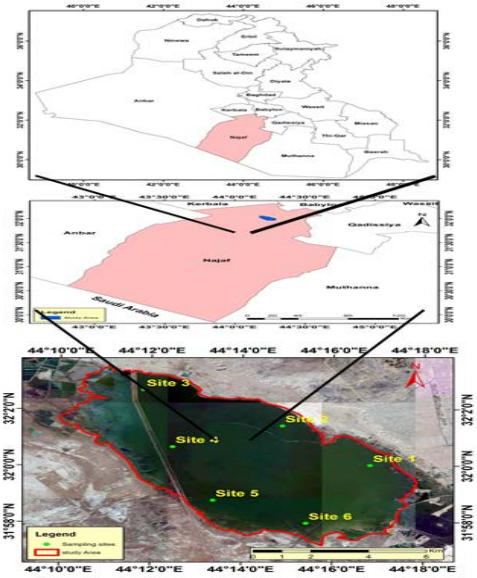


Figure (1) Geographical sites which samples were collected in the Bahr Al-Najaf depression

Shannon-Weiner Diversity Index (H):

This was monthly calculated by the formula of Shannon-Weiner as explained in (Floder and Sommer, 1999).

H' = -Σ (Ni /N) Ln (Ni /N)

H = the Shannon diversity index

Ni= number of individual species

N=total number of individuals of all species.

< Low Diversity, (–) Moderate Diversity, > High Diversity (Porto-Neto, 2003).

Species Richness Index (D)

This index was calculated from Magurran (2004) as follows:

D =(S −)/ Log N

S = number of species

N= Total number of species

Species

uniformity index (E)

The species uniformity index

was measured according to Neves *et al.*, (2003).

E =H/lnS

H= Shannon–Weiner index value.

S= number of species in the station.

Considered values greater than 0.5 as equal or uniformity in appearance.

RESULTS :

Six different species of crustaceans, belonged four order were diagnosed the first order , Decapoda, which is consist of two species .

the first one , *Metapenaes affinis*, which was recorded for the first time in the Bahr Al- Najaf depression , It is appearance light gray in color, and the head area is covered with a shield, which extends to the front of the snout, which is 10 mm in length . The snout covered with 8-12 teeth, depending on the size of the crustacean individual , the portable eyes are located on a short leg and are clearly prominent.

The chest also bears a number of appendix, represented by the jaw and clamps feet and walking feet, and the average length of the chest was (22 mm) ,the abdominal area, was distinguished by several rings, and at the back of the body possesses tail fan, which was separated into two parts with an average length 5 mm.

The second species *Potamon mesopotamicum* also recorded for the first time in Bahr Al-Najaf deprssion . It is appeared in a light brown color in the dorsal area, but the ventral side was whiteish-yellow, the shield length ranged between (40-50 mm), while the width ranged between (50-60), the length of the forceps ranged (40-60 mm). In the other hand , four species were diagnosed belonged to three orders . They are Isopoda, Ostracoda and Copepoda which were include *Parthlyalellasp,Candona candida* and both *Clanoid sp.* and *Harpacticoidsp*. Respectively . (Table 2 Figure 2)

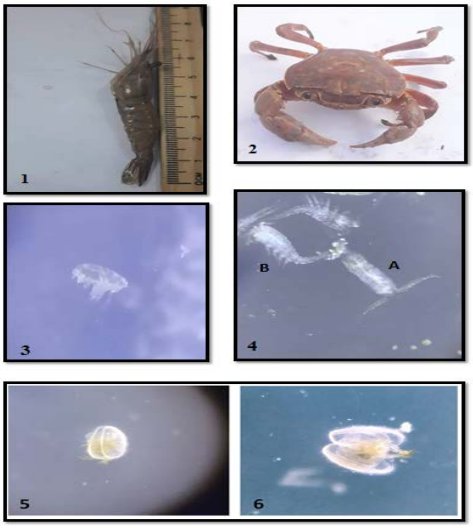


Figure (2) Crustaceans species isolated from Bahr Al-Najaf depression during the winter

1-*Metapenaes affinis* 2–*Potamonmesopotamicum*

3- *Parthlyalella sp* 4 A-*Calanoid sp.* B- *Harpacticoid sp* 5-6*Candona candida*

Density and biological indicators:

The total density of the crustacean ranged between 9-88 individual / 20 liters with highest density recorded in January and the *Candona candida* was the most dense among study site for crustaceans. This density ranged from the complete disappearance of samples to 101 individuals / 20 liters in January.(Figure 3 and 4)

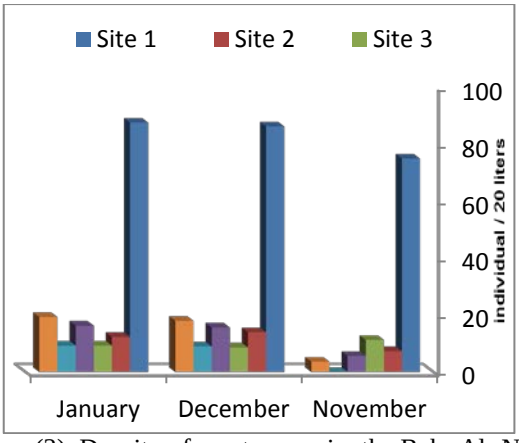
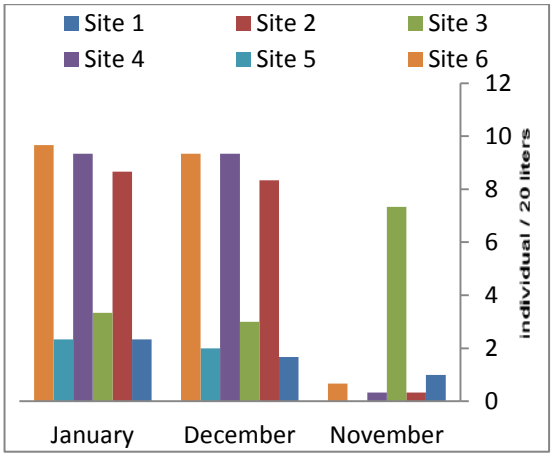


Figure (3) Density of crustaceans in the Bahr Al- Najaf depression during the study period in winter .



Fugir (4) Density of *Candona candida* in Bahr Al- Najaf depression during the winter

The results reavelead the *Metapenaens affinis* is the most abundant among the species of crustaceans in the first site 92%, While *Candona candida* were in the first rank in the second, third , fourth and sixth site which were 51%,47%,50% and 48 % resectively , On the fifth site, *Calanoid sp*. The highest percentage is 56%, followed by *Harpacticoidsp*. (Figure 5)

The Constancy index, was shown in Table (2) that the number of species diagnosed in this study, which belonged to the crustacean, were 6 species , where the stability index indicated that each of *Calanoid sp*. And *Harpacticoid sp*. And *Candona candida* and *Parthyalella sp*. were the most stable of crustaceans in Baher Al-Najaf deprssion .

On the other hand, the values of the species Rhichnees index for crustaceans ranged between the lowest value (zero) was recorded in the October at fifth site and highest value (4.8) in the November at sixth site (Figure 6)

The results of the Shannon -Wiener Index revealed a variation from the highest value (0.37) in November at fourth sites to lowest value (zero) in November at fifth site (Figure 7) . Finally, the values of Species uniformity index for crustaceans ranged between (0.06) in November at fourth site, and (zero) in November at fifth site (Figure 8)

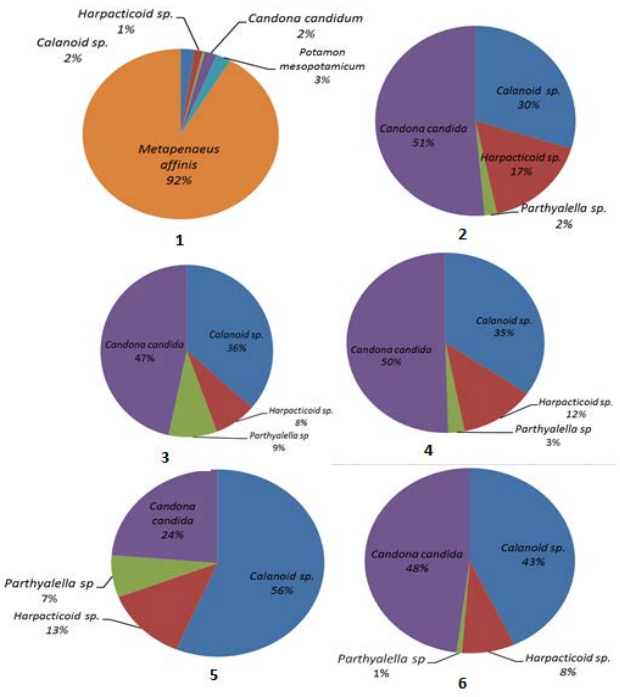


Figure (5) Relative abundance Index of crustaceans species in six site of Bahr Al- Najaf depression during the winter

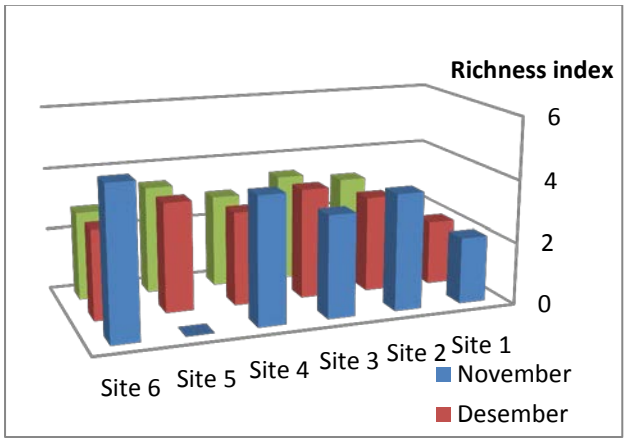


Figure (6): Species Richness index of Crustacean in different study sites in Bahr Al-Najaf depression in winter

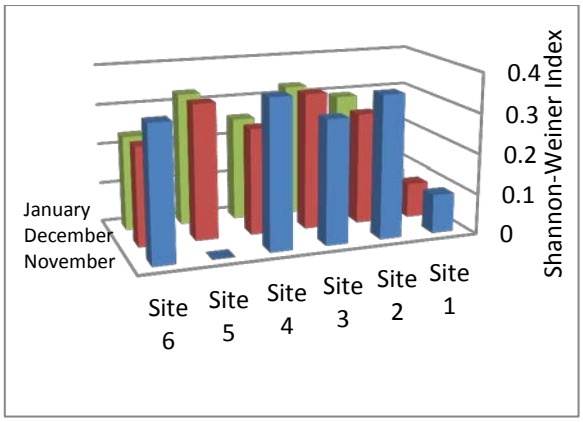


Figure (7): Shannon-Weiner index of Crustacean in different study sites in Bahr Al-Najaf depression in winter

Table (2) Constancy Index for crustaceans species and their frequency in Baher Al- of Najaf deprssion during the winter

Study Sites						Crustacean Species
Site 6	Site 5	Site 4	Site 3	Site 2	Site 1	
						Calanoid sp.
						Harpacticoid sp.
						Parthyalella sp.
						Candna candida
						Potamon mesopotamicum
						Metapenaeus affinis
White color not recorded			Blue color additive species			Green color constant species

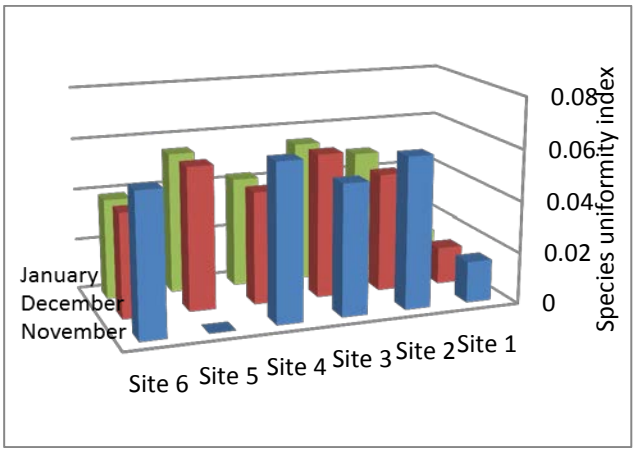


Figure (8): Species uniformity index (E) of Crustacean in different study sites in Bahr Al-Najaf depression

DISCUSSION:

Our Results showed a new registry of crustaceans species involved *Metapenaeus affinis* and *Potamon mesopotamicum* both belonging of Decapoda.

The current study revealed that the Varying density for *Metapenaeus affinis*, the highest value was recorded in the first site in November.

The is may be due to the presence of some plants which is used as feed such as cane, that is exists in abundant and this is consistent with a study (Al-Maliki, 2010; Al-Ghurabi, 2014). Also, no density was recorded in other sites, and the reason may be due to the contamination of this area with waste and other pollutants.

The largest size obtained during this study was (80 - 90 mm), and it is appeared in light gray, This is may be due to the effect of the environment on the external appearance, and this is consistent with the study of Ali , (1997) and (Salman et al.1990),

Potamon mesopotamicum was also registered for the first time in the Bahr Al-Najaf depression and southern regions

of Iraq ,Therefore, the results obtained in this study cannot be compared with previous studies in Iraq,Yes, it was isolated in southern Iran, so these results are consistent with what Naser. (2009) and Farhadi and Harlıoğlu, (2018).

Potamon mesopotamicum recorded the highest value of density in January and November at the first site ,

This is consistent with what Farhadi and Harlıoğlu found (2018).

Also, it has not recorded any appearance in other locations, the reason may be due to the contamination of this region with organic pollutants

Three order were diagnosed: Isopoda, Copepoda and Ostracoda, and Ostracoda recorded the highest percentage, it reached 50% of the total, while Copepoda was 30% of the total, and 20% Isopoda.

Two types of Copepoda were diagnosed at all study sites, namely *Calanoid sp.* and *Harpacticoid sp*. Of the genera that recorded the highest density, *Calanoid sp*. This is consistent with the study of Alvarez et al. (2000) and Ara (2001)

Density of Crustaceae

The current study recorded a decrease in the total density of crustaceans in the Baher Al- Najaf depression , ranging from 9-88 individuals / 20 liters, And the decrease may be due to the lack of primary productivity

Rabi` and Al-Abayji (2009) indicated that the reason for the high total density of zooplankton in the Tigris and Euphrates rivers is due to several reasons, the most important of which is the high primary productivity in water

Al-Kanani and Al-Mukhtar (2014) also indicated a positive relationship between the density of crustaceans on the one hand and the water temperature of the Tigris and Diyala rivers on the other.

This was recorded by a decrease in the water temperature in the Bher Al-Najaf during the winter.

The failure to record high values of the abundance index, which the current study showed, indicates that the dominant species in the current study are not able to reach complete dominance over other species.

This gives evidence of the absence of environmental pressures in Bahre Al- Najaf that allow certain species tolerating these pressures to achieve complete sovereignty over other species, as Rabee pointed out in (2007)

The registration of *Ostracoda sp*., *Harpacticoid sp*., *Calanoid sp*., With high frequency at all study sites, reached the degree of stability in Baher Al- Najaf commensurate with what was indicated by many previous studies.

Which that recorded a high frequency of these species in the Iraqi environment (Rabei and Al-Abaiji, 2009, Al-Badiri, 2012, Khazali, 2012, Al-Kanani and Al-Mukhtar, 2014, Al-Salami, 2015, Al-Khafaji and his group, 2015).

The recording of low values of crustacean abundance in most of the studied sites in Baher Al-Najaf depression during the study period is due to the same reasons that led to its low density.

Also, recording low values for the Shannon Wiener index less than 1 bit / indivual is considered a little diversity .

The current study recorded six species of crustaceans, and this differs from many previous Iraqi studies

Rabi` and Al-Abayji (2009) recorded 24 species belonging to the crustacean class, while Mirza and Nshaat (2019) recorded approximately 7.819 bits / indivual .

This is evidence of environmental pressures and high pollution, causing death or migration of sensitive species.

Also (2019) AL-zurfi et al indicated that the waters of Baher Al- Najaf deplete with some heavy elements. Which may explain why the Shannon Wiener index declined in the current study

With regard to the index of homogeneity of species, the results indicate that crustaceans are considered heterogeneous in their appearance, as the values were less than 0.5, and This is further evidence of environmental pressures in Baher Al- Najaf depression

The cause of environmental stresses and the lack of zooplankton may be due to the presence of water currents in Baher Al- Najaf

This is consistent with what Neves *et al* (2003) indicated that static water leads to a group of factors that help the abundance of phytoplankton and thus the abundance of phytoplankton.

Abbas (2010) also indicated that the lack of environmental conditions necessary for biological diversity on which large crustaceans feed may contribute to lowering the values of the biodiversity guide in those areas.

Some Iraqi studies also recorded the abundance of large crustaceans during the spring and autumn seasons, and their decrease during the winter season, as a result of their association with the appropriate period for mating and laying eggs (Al-Maliki, 2002, Akbar, 2013).

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