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Diversity of Aquatic insects in Eastern Al- Hammar Marsh, Basrah Province, South of Iraq.

[1]Zahraa Abdulbaky Laftah [2]Shurooq Abdullah Najim
Department of Ecology- College of Science-University of Basrah
shurooq.najim@uobasrah.edu.iq

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Abstract

The aim of this study was to assess the presence and biodiversity of aquatic insects in four stations of Eastern Al-Hammar Marsh in 2021. The study measured abiotic factors such as Electric Conductivity, pH, air and water temperature, turbidity, and wind speed monthly. Statistical analysis ANOVA indicated significant differences among the study stations regarding Electric Conductivity and pH. However, no significant differences were observed in air and water temperature, turbidity, and wind speed among the stations. Eight species of aquatic insects belonging to four taxonomic orders were recorded during the study period. The order Diptera had the highest relative abundance (38%), while the order Odonata had the lowest relative abundance (10%). The genus Culex spp. (Larva) had the highest annual abundance of genera and species for all study stations. Environmental evidence showed that Al-Seddah station had the highest spatial diversity value of 1.8, while Al-Mansoury station had the highest evenness index value of 0.89. The richness index value of 1.33 was recorded in Al-Seddah station. The highest dominance index value of 0.5 was recorded in Al-Manthoury station. The temporal diversity index Shannon and Wiener recorded the highest value of 1.9 in Al-Seddah station during May, while the highest value of the richness index was 2.2 in Al-Mansoury station during May. The highest value of dominance was recorded in November and December and was 1 for all stations. The study concluded that the community of aquatic insects in Eastern Al-Hammar Marsh is moderate in diversity, semi-disordered in richness, and has a balanced evenness.

Keywords: Al-Hammar marsh, aquatic insects, diversity, Basrah, Iraq.

Introduction

Insects are one of the most important taxonomic ranks belonging to this phylum, of which there are more than 75,100 known species, which constitute 75% of all known animal species on the surface of the earth (Majumder *et al.*, 2013).

Some of these species were inhabiting the aquatic ecosystem, as 3% of insects go through aquatic stages in some of their life cycles (Ward, 1992). Aquatic insects are defined as those insects that spend all their life or some of their stages inside the water, while semi-aquatic insects are those that spend one of their life roles on the water. (Pennak, 1978; Arimoro and Ikomi, 2008).

Aquatic insects are characterized by their great environmental importance to the habitats in which they reside, as their presence inside the water body is useful for several purposes, including that they are a source of food for fish and other invertebrates, and some of them are vectors of diseases for both humans and animals (Chae *et al*, 2000), and the important thing is aquatic insects are a good guide to water quality because they have different tolerance levels to

environmental disturbances (Arimoro and Ikomi,2008), they are also characterized by their ecological importance, as they represent an important group for aquatic organisms through their vital role in the formation and recycling of nutrients by distinguishing them into special groups in nutrition, such as shredders , filter-feeding or predatory insects (Lamberti and Moore, 1984).

There were many local studies conducted on aquatic insects in Basrah province, Abdul-Karim (1987) recorded twenty-four species of the Dytiscidae aquatic beetle family in Eastern Al-Hammar marsh.

Ali *et al*. (2002) studied the presence and density in Eastern Al-Hammar marsh of two types of naiad of the species *Ishnura brachythemis*.

Al-Eidani (2014) conducted a taxonomic study of aquatic insects in Basrah Governorate, and it showed the presence of nine species of the semi-aquatic of order Hemiptera, six of the true water bugs Nepomorpha, and three of the semi-aquatic bugs Gerromorpha. A study was conducted by Karim (2015) for some types of insects. Four species of Dytiscidae family, Cybister *tripuncututus*, *Eretes sticticus*, *Laccophilus hyaline* and *Agabus guttatus*, were recorded in six areas of the Basrah Governorate, which are the Marshes of Al-Suwaib, Al-Hammar, Karmat Ali, Al-Tanuma, Al-Siba, Abu Al-Khasib, three species of Odonata and one species of Hemiptera orders, he explained that the parkland nymphs are the most abundant in all study areas. Khalaf *et al*. (2017) recorded in their study of the community of aquatic insects in different aquatic ecosystems represented by the tidal and non-tidal marshes, 36 taxonomic orders for aquatic insects that belong to six orders: Diptera, Lepidoptera, Coleoptera, Hemiptera, and Trichophyton.

Ahmed (2020) studied seasonal changes in the diversity and relative abundance of nymphs from temporary ponds in Basrah Governorate. In a study of insects survey in some of the marshes of Iraq AL-Saffar and Augul (2021), recorded 109 species under 77 genera belonging to 32 families and 7 orders were included species as: Coleoptera (44), Diptera (7), Ephymeroptera (2), Hemiptera (14), Hymenoptera (11), Lepidoptera (2), and order Odonata (29).

Materials and Methods

- Description of study area

The current study was conducted in Eastern Al-Hammar Marsh, north of Basrah, four stations were selected : 1- Al-Barga: It is an open marsh, the depth of water in it does not exceed 0.5 meters 2- Al-Mansoury: It is a canal marsh , water depth 1.5 meters 3- Al-Saddah: It is a cannal marsh, water depth 4 meters 4- Al-Manthoury: It is a cannal marsh, water depth (1-1.5) meters , Figure 1, the coordinates were recorded through the GPS Navigation program, Table 1.

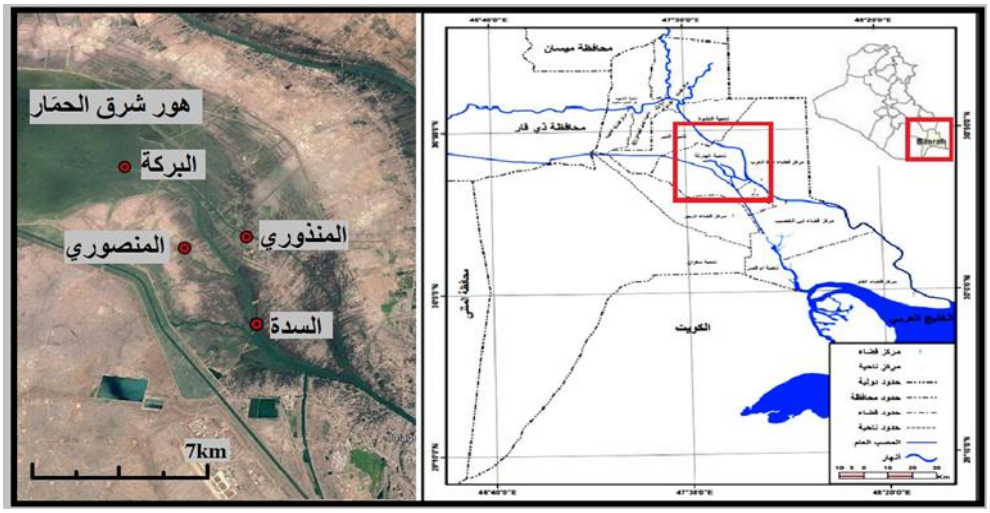


Figure 1: Distribution of study stations in Eastern Hammar marsh

Table 1: Coordinates of study stations.

Eastern Hammar Marsh	
Stations	Coordinates
1-Al- Barga	N: 30°41'16.25" E: 47°35'39.80"
2- Al-Mansoury	N: 30°38'48.70" E: 47°37'57.76"
3- Al-Saddah	N: 30°36'44.04" E: 47°40'20.63"
4- Al-Manthoury	N: 30°39'8.52" E: 47°39'42.85"

- Samples and Specimens collecting

Samples were collected from the study stations monthly (ones in a month) with three replications at daylight hours during 2021.The water net (D-Frame net) was used to collect samples from the water, and it was in the form of a square with a side length of 35 cm.

Insect specimens were isolated and diagnosed using a dissecting microscope. Depending on several taxonomic keys, (Bouchard, 2004) ,Thyssen (2010), (Ribera, *et al.*, 2008), and Staniczek (2011) , for each of the existing orders, and after diagnosis it was preserved in 80% alcohol.

The physical and chemical factors were measured monthly during 2021, and included Air and Water temperature, Wind measurements, Electric conductivity, Turbidity, pH, and Dissolved Oxygen.

The composition of the aquatic insect community

The qualitative structure was done by diagnosing insects according to the taxonomic keys, then the individuals were counted for all the taxonomic ranks, and the relative abundance was also calculated according to the Odum (1971).

Ra(%)=N/Ns*100

Since: = Ra = relative abundance.

N = the number of individuals of one species in the sample.

Ns = total number of populations in the sample.

Ecological indices

Ecological indices from Diversity, Richness, Equitability and Dominance were calculated using PAST version 3

1- Diversity index

Calculate the value of the index of diversity from the equation.

$H= - \sum Pi \ln Pi$ (Shannon, 1949).

where H = value of diversity

Pi = the ratio of the number of individuals of each species to the total number.

2- Richness index

The richness values were calculated according to the equation:

D=S-1/lnN (Margalefe,1968).

Since D is the value of richness, S is the number of species, N is the total number of individuals in the sample.

3- Pielou evenness index

The values of this equitability were calculated using the Pielou equation (1977), which was adopted by krebs (2014).

J= H`/S

H' = Shannon and Wiener Diversity Index

S = total number of species in the sample.

4- Dominance index

The values of dominance were calculated by the equation developed by Berger and Barker (1979(

And as follows: d=Nmax/N

d = dominance index

Nmax = number of prevalent individuals

N = the total number of people in the sample.

Statistical analysis

Statistical analysis was performed using SPSS statistics version 20.

Results

Ecological factors

The abiotic factors were measured in Eastern Al-Hammar Marsh stations monthly during the study period 2021, as follows:

Air temperature

The annual average values ranged between 31.09 C° in Al-Barga station and 28 C° in Al-Saddah station, Table 2, and between its highest average in August 45 C° and its lowest rate in January 16 C° (Table 3). The results of the statistical analysis indicated that, there were no significant differences between the study stations (F = 0.16, P = 0.93, df =23), and there were a significant difference at the level of probability P = 0.05 between the months of the study (F = 59.737, P = 0.00 ,df = 11).

water temperature

The values of the annual average water temperature ranged between 24.94 C° in Al-Barga station and 24 C° in Al-Saddah station, Table 2, and between its highest average in August 35.5 C° and its lowest average in January 15.3 C° (Table 3), The statistical analysis indicated that there were no significant differences between the study stations (P=0.130, F= 0.88, df=12), and that there were a significant differences at the probability level of P = 0.05 between the months of the study .

Wind speed

The annual average for wind speed ranged between 11.54 km/h in Al-Barga station and 10 km/h in Al-Saddah station (Table 2). Wind speed values ranged between the highest average of 16 km/h in June and the lowest rate of 7 km/h in July, (Table 3). The results of the statistical analysis indicated that there were no significant differences between the stations (P = 0.442, F = 0.915, df = 3), while the results of the statistical analysis showed the presence of significant differences between the months (p = 0.000, F = 7.5, df = 11).

Electric Conductivity

The annual average values ranged between 8.2 mS/cm in Al-Barga station and 6 mS/cm in Al-saddah station (Table 2) and between its highest average in August 12 mS/cm and its lowest in March and April 4 mS/cm Table 3, and the results of the statistical analysis indicated that there were significant differences between study stations (P = 0.028, F = 3.347, df = 3), and there were significant differences at the level of probability P= 0.05 between the months of the study (P = 0.00, F = 7, df = 11).

Turbidity

The annual average values ranged between 50.33 NTU in Al-Barga station and 36 NTU in Al-Saddah station (Table 2), and its highest average was in August 83.4 NTU and its lowest in April was 22.5 NTU Table 3. The results of the statistical analysis indicated that there were no significant differences between study stations (P=0.105, F=2.17, df=3), and there were significant differences at the probability level of P=0.05 between the months of the study (P=0.00, F=8.33, df= 11).

pH

The annual average values ranged between 8.29 in Al-Barga station and 7.75 in Al-Manthoury station (Table 2), and between its highest average of 9.3 in July and August and its lowest rate of 7.1 in January, March and December (Table 3), and the results of the statistical analysis indicated that there were a significant differences between

study stations (P = 0.02 , , F = 3.634, df = 3), and there were a significant differences at the probability level of P = 0.05 between the months of the study (P = 0.00 , F = 5.77, df = 11).

Dissolved Oxygen

The annual dissolved oxygen average values ranged between 8 mg/l in Al-Saddah station and 6.21 mg/l in Al-Mansoury station, Table 2, and between its highest average of 9.3 mg/l in May and its lowest rate of 3.2 mg/l in August , Table 3, and the results of the statistical analysis indicated that , there were no significant differences between the study stations (P = 0.07 , F = 2.518, df = 3), and there were a significant differences at the probability level of P = 0.05 between the months of the study (P = 0.00 , F = 9.33, df = 11).

Table 2: Environmental factors rates measured for the stations during the study period (Mean±SD).

Parameters	Al- Barga	Al-Mansoury	Al- Saddah	Al-Manthoury	average
Air temperature	31.09±0	29.12±0.17	28±0	28.43±0	29.16±1.27
Water temperature	24.94±0	24.86±0.19	24±0	24.63±0	24.61±0.40
Wind speed	11.54±0	11.02±0.03	10 ±0	10.46±0	10.76±0.62
Electric Conductivity	8.2±0	6.1±0.19	6.0±0	6.4±0	6.7±0.96
Turbidity	50.33±0	42.83±0.24	36 ±0	42.67±0	42.96±5.41
pH	8.29±0	7.84±0.23	8 ±0	7.75±0	7.97±0.24
Dissolved Oxygen	6.50±0	6.21±0.29	8 ±0	6.55±0	6.81±0.75

Table 3: Average rates for environmental factors measured for the months during the study period (Mean±SD).

	Air T.	Water T.	Wind	Cond.	Turbidity	pH	D.O
Jan.2021	17.8±2.1	15.0±0.6	10.5±1.2	4.9±0.6	35.8±9.2	7.6±.0.6	7.4±0.5
Feb.	22.6±2.1	18.8±1.1	10.5±1.3	4.6±0.4	36.8±8.1	7.9±0.4	7.0±0.9
March	23.5±2	19.6±0.4	10.5±1.2	4.6±0.3	35.9±	7.5±0.3	7.7±0.9
Apr.	29.2±3.2	23.9±1.1	10.3±1.6	4.5±0.2	32.0±10.8	7.4±0.2	7.7±0.9
May	33.7±3	31.5±2.0	11.3±1.4	6.3±0.8	30.5±4.1	7.5±0.8	7.9±0.9
June	37.3±2.1	30.7±1.2	14.5±1.2	8.0±0.7	44.0±9.1	8.5±0.7	6.1±1.3
July	39.9±2.9	33.9±1.0	8.3±1.2	9.1±0.5	57.3±4.8	9.0±0.5	5.4±1.0
Aug.	43.0±2.1	34.1±0.8	7.8±0.9	10.6±1.0	75.6±8.1	9.1±1.0	3.5±0.2
Sep.	31.8±1.1	27.0±2.2	12.0±1.2	7.1±0.5	36.5±8.9	8.1±0.5	6.7±0.3
Oct.	29.3±2.0	23.9±0.9	10.6±1.4	5.8±0.4	39.2±8.0	8.2±0.4	6.7±0.5
Nov.	22.2±1.5	20.0±1.3	12.3±1.0	5.0±0.6	35.4±8.6	8.1±0.6	7.8±0.6
Dec.	21.2±1.8	18.5±0.9	12.0±0.8	4.6±0.6	42.7±8.7	7.3±0.6	8.1±0.6
Average	29.3±8.0	24.7±6.5	10.9±2.1	6.3±2.0	41.8±14.5	8.0±2.0	6.8±1.5

The composition of aquatic insects in Eastern Al-Hammar marsh

In this study, eight species of aquatic insects were recorded in Eastern Al-Hammar marsh, including three species of insects belonging to

Hemiptera, two species of insects belonging to Coleoptera, two species belonging to Diptera, and one species belonging to the order Odonata. (Figure 8).

The species *Sigara lateralis* (Order: Hemiptera) of the family Corixidae (water boats). The species *Aquarius nebularis* of the family Gerridae. The species *Rhantus suturalis*, the genus *Laccophilus* spp. of Coleoptera, Dytscidae (diving beetle) family, and the genus *Culex* spp. (Larva) of Diptera in all study stations.

And the genus *Ischnura* spp. was recorded in each of the stations of Al-Siddah, Al-Mansoury and Al-Manthoury.

While the species *Sigara rubyi* and the genus *Ephydra* spp. (pupa) (of the order Diptera) were recorded only in Al-Saddah station, during the study period, (Table 4 and 5).

Table 4: Species of aquatic insects in Eastern Al-Hammar marsh stations during the study period (January 2021-December 2021).

Al-Manthoury	Al-Saddah	Al-Mansoury	Al-Barga	Species	Genus	Family	Order
0	8	0	0	*Sigara rubyi* (Hungerford,1928)	*Sigara*	Corixidae	Hemiptera
6	21	5	3	*Sigara lateralis* (Leach,1817)			
12	26	8	1	*Aquarius nebularis* (Dark and Hottes, 1925)	*Aquarius*	Gerridae	
17	47	15	11	*Rhantus suturalis* (MacLeay, 1825)	*Rhantus*	Dytiscidae	Coleoptera
3	14	3	2	-	*Laccophilus* (Leach, 1815)		
0	4	0	0	-	*Ephydra* (Fallen, 1810)	Ephydridae	Diptera
57	65	17	6	-	*Culex* (Linnaeus,1758)	Culicidae	
10	23	4	0	-	*Ischnura* (Charpentier,1840)	Coenagrionidae	Odonata

The results of the study showed that the highest number of species recorded in Eastern Al-Hammar Marsh was in May 2021 at Al-Seddah station, and it amounted to 8 species, while the lowest number of species was recorded in July, reaching 0 species in Al-Barga station. Table 5.

Table 5: The number of species recorded in Eastern Hammar marsh stations for all months during the study period.

Months/Stations	Al- Barga	Al-Mansoury	Al- Saddah	Al- Manthoury
Jan.2021	1	1	3	3
Feb.	1	2	4	3
Mar.	2	3	7	5
Apr.	5	6	7	6
May	4	6	8	6
June	2	3	7	3
July	0	1	4	2
Aug.	1	1	1	2
Sep.	1	1	1	2
Oct.	1	1	1	2
Nov.	1	1	1	1
Dec.2021	1	1	1	1

Relative abundance

The relative abundance of orders of aquatic insects recorded in the Eastern Al-Hammar Marsh

The order Diptera recorded the highest relative abundance among the orders of aquatic insects recorded in the Eastern Al-Hammar marsh stations, as its abundance reached 0.38, followed by the Coleoptera 0.29, then the Hemiptera 0.23,for all stations during the study period, Figure 2. The high relative abundance of Diptera over the rest of the orders recorded in , the study is consistent with the findings of Khalaf (2016), and Amri *et al.* (2014), where those studies indicated that the relative abundance of the Diptera outperformed the rest of the orders , and this may be due to have opportunistic systems and physiological and behavioral adaptations that enable them to continue to survive in the state of environmental stresses (Raveenthiranth, 1990).

Annual relative abundance of species in study stations

The results showed that the highest relative abundance was for the genus *Culex* spp.*) Larva*) in Al-Seddah station, and it rechead to 0.17 during the study period, while the lowest relative abundance was recorded for the species *Sigara rubyi* in Al-Barga, Al-Mansoury and Al-Manthoury stations, which reached to 0 (Fig. 3).

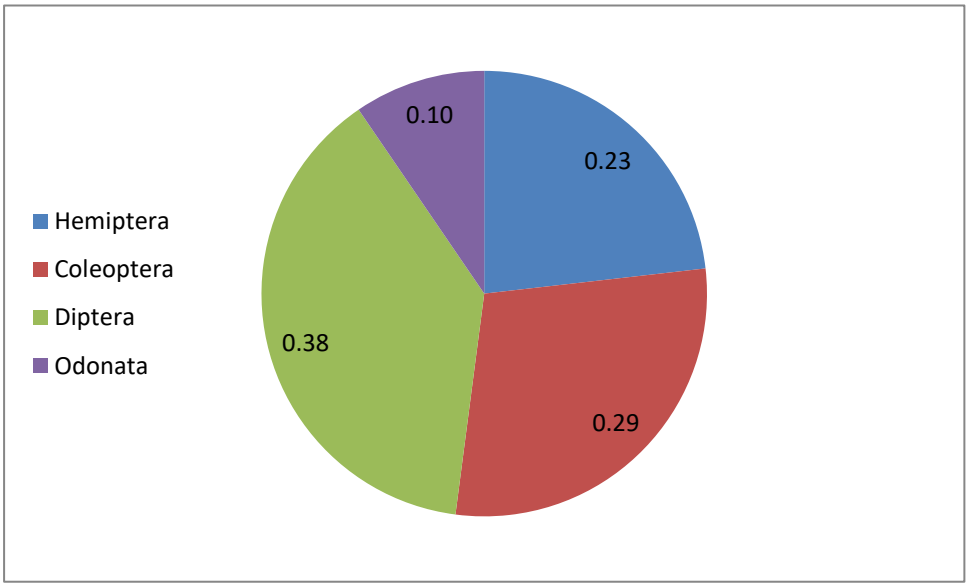


Figure2: The relative abundance of aquatic insect orders for the study stations in Eastern Al-Hammar marsh.

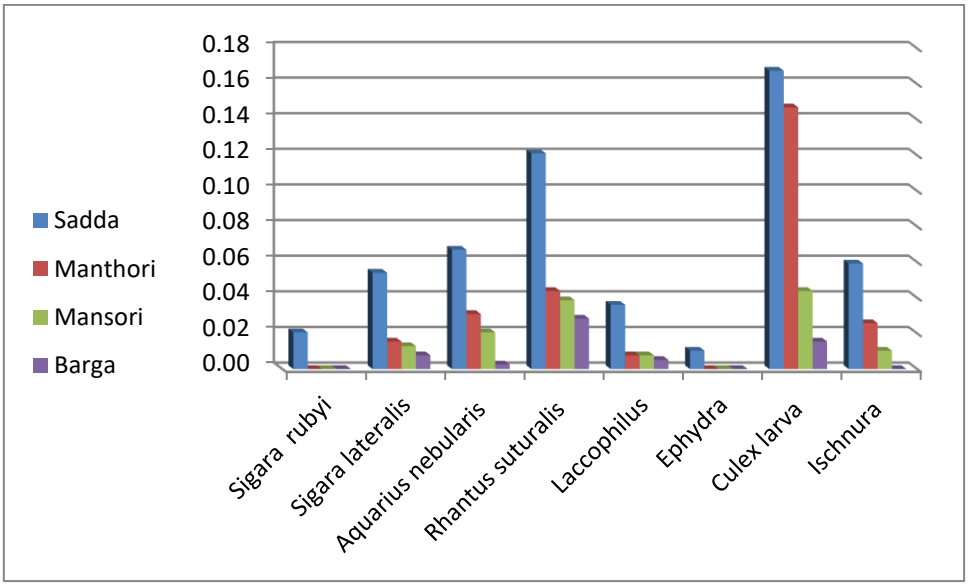


Figure 3: The annual relative abundance of species in the study sites.

The results revealed that the genus *Culex* spp. (Larva) is the most abundant in all study stations, possibly because this genus is the most widespread and abundant among mosquito species in the tropics and subtropics, and some of its species are linked to sewage systems as well as the nature Vegetation (Subra, 1981).

The nature of the habitats from which mosquito larvae were collected represented suitable breeding places for adults, as the stations of Al-Seddah and Al-Manthoury were characterized by

the presence of small subsidiary rivers, in which human activity increased, and many houses were erected on their banks, which dumped sewage water into those rivers.

In addition to the presence of animal pens such as cows and buffaloes close to these habitats, which are an important source of nutrition for adult females, in addition to the availability of prominent plants, which are a source of nutrition for adult males, as well as a habitat for the larvae to hide, and perhaps the reason is also due to the lack of some Predators such as diving beetles or Odonata at these stations.

Ecological Indices

1- Spatial diversity

The values of spatial diversity were recorded, Table 6, and the highest diversity value of aquatic insects was in Al-Seddah station for Shannon and Wiener (1949) index, it reached 1.82, followed by Al-Mansoury station, and the lowest value of diversity was in Al-Barga station reached 1.32.

The highest value of the dominance index was recorded during the study period in Al-Manthoury station, which was 0.5, followed by Al-Barga station, and the lowest value was in Al-Seddah station, with a value of 0.31.

The highest value of the equitability index (Pielou) was recorded in Al-Mansoury station and it reached to 0.89, and the lowest value of this index was recorded in Al-Manthoury station, which reached to 0.76, and the highest value of the richness index Margalef (1968) was recorded in Al-Seddah station, which amounted to 1.31, followed by Al-Mansoury station, which recorded the lowest value for the richness of species in Al-Manthoury station, it reached 1.07, Table 6. The high levels of richness and diversity are due to the stability of the environment and the high degree of complexity in food webs (Van Duineu *et al*., 2003).

Table 6: Spatial diversity of aquatic insects during the study period.

Indices	**Al-Barga**	**Al-Mansoury**	**Al-Saddah**	**Al-Manthoury**
number of species	5	6	8	6
number of individuals	23	52	208	105
diversity index/Shannon-Wiener	1.32	1.6	1.82	1.36
Richness index/ Margalef	1.28	1.27	1.31	1.07
Equitability index / Pielou	0.82	0.89	0.87	0.76
Dominance index/ Berger- Barker	0.48	0.33	0.31	0.54

2- Temporal diversity

The monthly changes were calculated in the indices of diversity, equitability, richness, and dominance for the aquatic and semi-aquatic insects recorded in the Eastern Al-Hammar marsh stations**.**

Richness index

The results showed that the highest value of the richness index was recorded in May in Al-Mansoury station reached to 2.2, while the lowest value was recorded in Al-Barga station in January, February, July, August, September, October, November and December, July it was 0 (Figure 4).

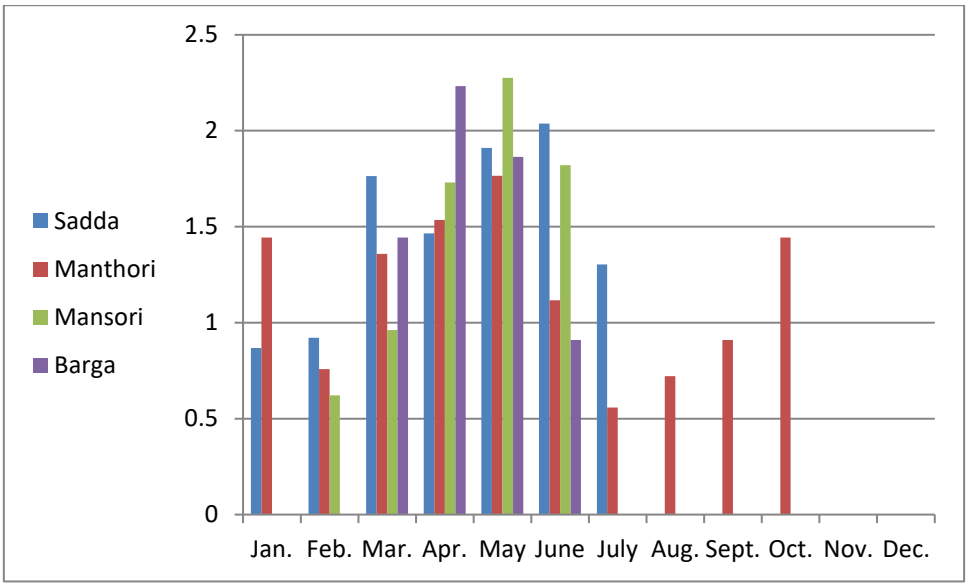


Figure 4: Monthly variations in values of the richness Index recorded in Eastern Al-Hammar marsh stations.

The low value of the richness index in Al-Barga station may be due to the nature of the environmental conditions in this station, as the highest values of Electrical Conductivity, Temperature, pH and Turbidity were recorded, and the lowest values of Dissolved Oxygen rates for the rest of the stations, as this station is the furthest station from the source of water supply. It is an open water area unlike the rest of the stations, which are canal marshes, and it contains many narrow waterways that are characterized by an abundance of vegetation cover of banks and prominent plants, which are places of food and breeding for many species of aquatic insects.

Diversity index (Shannon and Weiner)

The results of Diversity Index showed that the highest value of diversity was in May at Al-Seddah station, which amounted to 1.9, and the lowest value of diversity was in November and December, which amounted to 0, Fig 5.

The highest values of Shannon and Weiner's diversity index for aquatic insects were recorded in the Eastern Al-Hammar marsh during spring months, as these months were characterized by high levels of Dissolved Oxygen values, a decrease in Wind speed, heat and Turbidity values, and the rates of Air and Water temperatures were appropriate for the presence of aquatic insects.

The high values of diversity in these months reflect the preference shown by these insects to the environmental conditions during that period. Seasonal variation affected the numbers of aquatic invertebrates, especially in the southern marshes (Geraci *et al*., 2011).

The superiority of the Al-Seddah station in diversity values may be due to the high relative abundance of this station in May. The numerical abundance of individuals during this month was high, and the distribution of individuals among the species in this month was almost equal, so there was no dominance of one species over another. The number of individuals during this month is less than it was in April, where the number of individuals in May was 39 individuals, while the number of individuals in April was 60 individuals, but the dominance of the species *Aquarius nebularis* in April over the rest of the species led to a decrease in the value of the evidence of diversity in this month.

Samway and Steytler (1996) indicated that the biological diversity of invertebrates is related to abundance and environmental factors.

As Vellend (2001) emphasized, the spacing of the distance between two sites influences diversity, and it became clear through the results of the study that there is a slight difference between the study stations, and this

may be due to the convergence of the stations and the fact that they belong to one habitat.

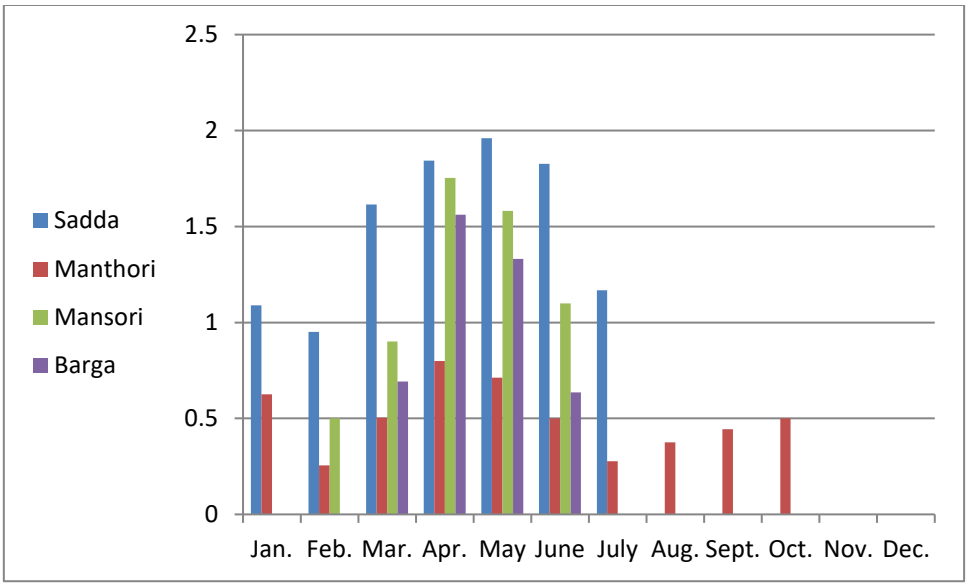


Figure 5: Monthly variations in the diversity index values recorded in Eastern Al-Hammar marsh stations.

Dominance index

The results of the Barker-Barker index showed that the highest value was recorded in November and December in all stations, reaching 1, while the lowest value was recorded in Al-Mansoury station in April, which amounted to 0.2, Figure 6.

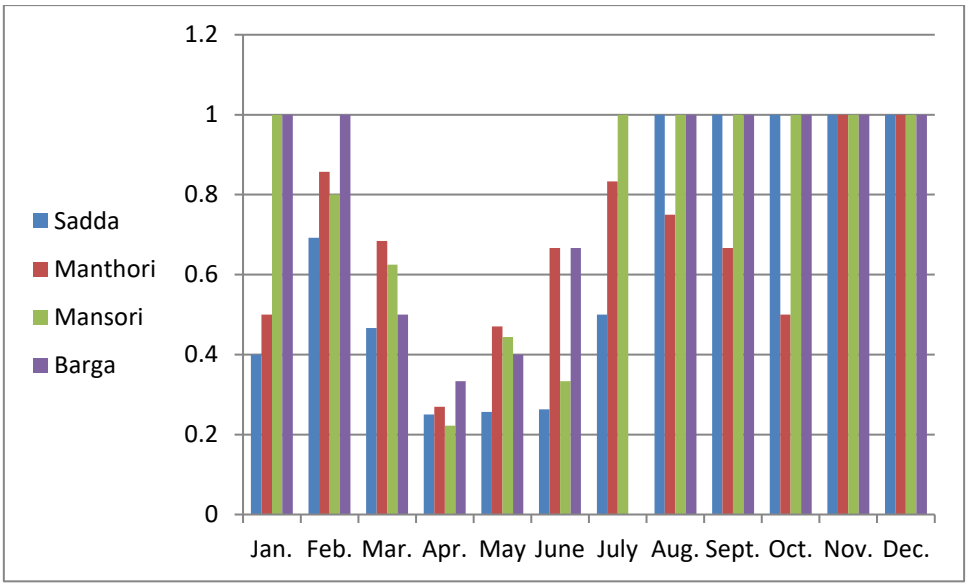


Figure 6: Monthly variations in the values of dominance index recorded in Eastern Al-Hammar marsh stations.

The highest values of the dominance index and for all stations during the months of November and December, due to the dominance of the species *Rhantus suturalis* over the rest of the

species, while the low values of this evidence indicate the presence of all species with almost the same numerical abundance.

Equitability index (Pielou index)

It was found through the results that the highest value of the equitability index was in Al-Mansoury in June, Al-Barga in March and Al-Manthoury in October and it reached 1 and the lowest value was in November and December and for all stations it reached 0 (Fig7).

The increase in the equitability index values in Al-Mansoury station in June may be because the individuals of the species *S. lateralis*, *A. nebularis*, *Rhantus suturalis*, *Ischnura spp.*, and *Ephydra spp.*, were distributed evenly and with the same number during this month. As for the similar values of the index in each of April, May and June, due to the presence of the species, Rhantus *suturalis*, *Ischnura* spp.(naiad), *Ephydra* spp. (pupa), *S. lateralis*, *A. nebularis*, with almost the same numerical abundance.

This means that there is no dominance of one or a few species over the rest of the species, as Brich (1981) explained, that equivalence represents the ratio between the true diversity and the maximum possible diversity of species theoretically, which we obtain if all species exist in the same numerical abundance. Roultedge (1983), mentioned that the equivalence value remains constant if all species maintain their abundance ratios even if the total abundance changes, because the equivalence values depend on the change in the ratios and abundance of each species and not on the change in the total abundance.

The lowest value of this evidence was recorded in November and December in all stations, due to the dominance of the species *Rhantus suturalis* over the rest of the species and in all stations.

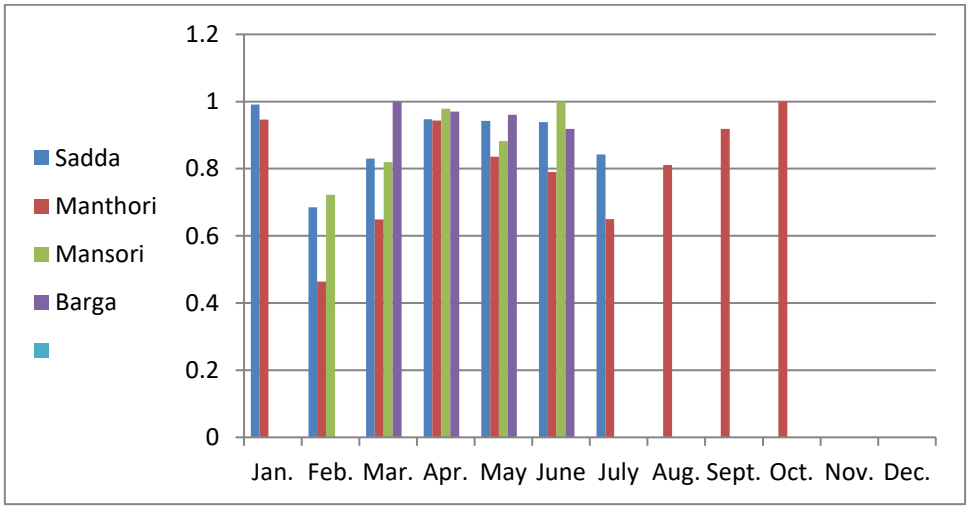
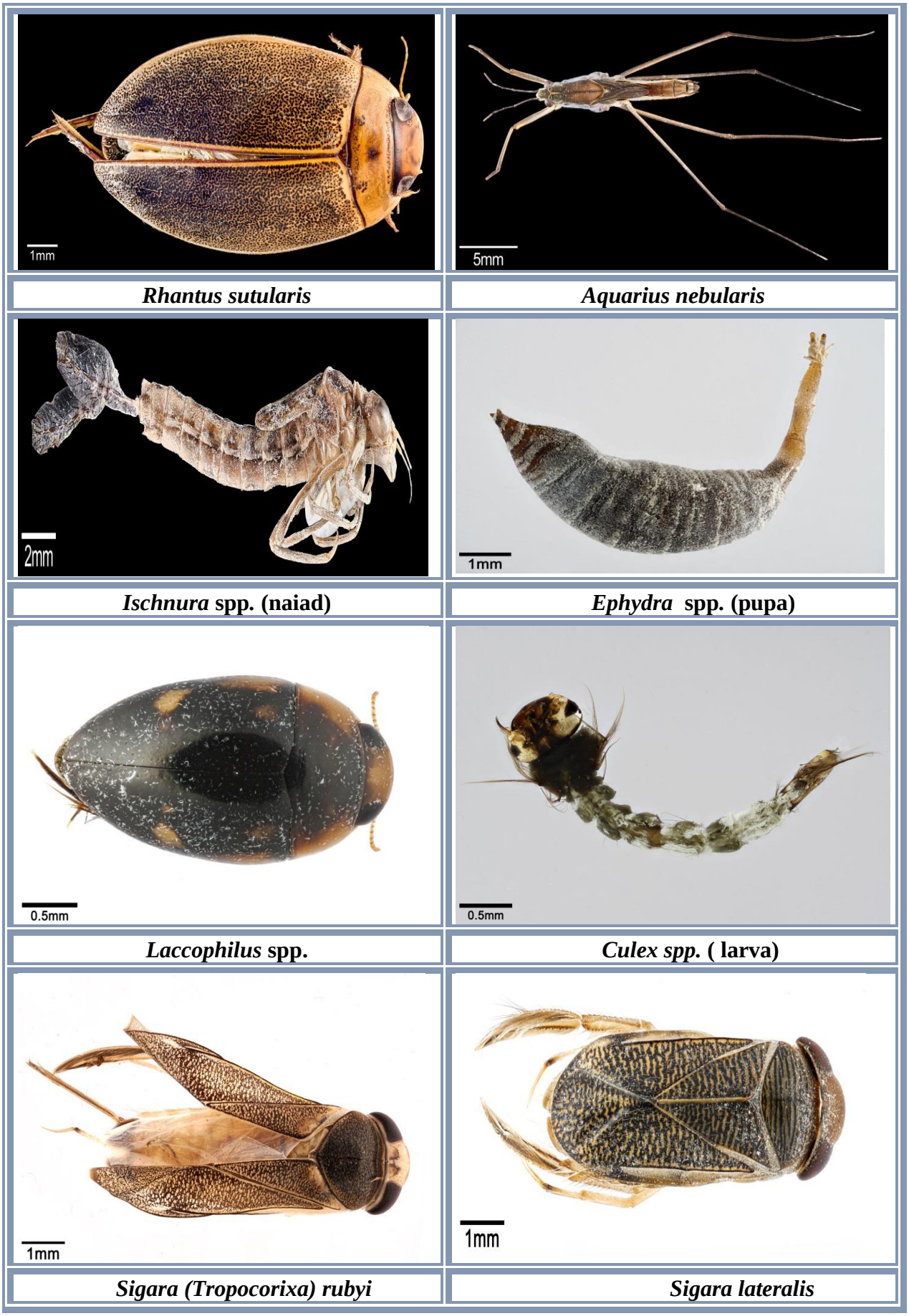


Figure7: Monthly variations in the equitability index values recorded in Eastern Al-Hammar Marsh.

For description of the nature of the aquatic insect's community in the East Al-Hammar marsh stations, descriptive and numerical values of environmental indicators developed by Hussain *et al.* (2012), and modified from Jorgensen *et al.* 2005, were used for the purpose of facilitating environmental monitoring. According to the results of this study, it was found that the diversity of the community of aquatic insects is average in the Eastern Al-Hammar marsh, and the results of the evaluation also indicated that the community is rich, semi-disordered, and it is also balanced. These results are close to what Khalaf (2016) and Ahmed (2020) found, taking into account the different study sites.



Rhantus sutularis	***Aquarius nebularis***
***Ischnura* spp. (naiad)**	***Ephydra* spp. (pupa)**
***Laccophilus* spp.**	***Culex spp.* (larva)**
Sigara (Tropocorixa) rubyi	***Sigara lateralis***

Figure 8: Genera and species of aquatic insects in the Eastern Al-Hammar marsh stations during 2021.

Conclusion:

Heat, oxygen, and salinity are specific factors that determine the abundance and diversity of aquatic insects in many groups of aquatic insects recorded in the current study. The absence of floating and submerged aquatic plants had a negative impact on insect diversity in Al-Hammar East marsh compared to before 2018, when those plants were present according to previous studies. These plants provide a place for insects to protect themselves from predators and to lay eggs. It was also observed that human activity was one of the most influential factors in the appearance and presence of aquatic insects. Additionally, the species *Sigara rubyi* was recorded for the first time in the Iraqi marsh environment. Based on descriptive values and numerical evidence, the aquatic insect community in Al-Hammar East marsh is poor in diversity, and the community is almost disturbed with balanced equitability.

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تنوع الحشرات المائية في هور الحمار الشرقي- محافظة البصرة –جنوب العراق.

زهراء عبد الباقي لفتة و شروق عبدالله نجم
قسم البيئة – كلية العلوم - جامعة البصرة
shurooq.najim@uobasrah.edu.iq

المستخلص

هدفت الدراسة الحالية الى دراسة التواجد والتنوع الحيوي لمجموعة الحشرات المائية في أربع محطات من هورالحمار الشرقي هي البركة والمنصوري والسدة والمنذوري ، للمدة من كانون الثاني 2021 الى كانون الاول 2021. تضمنت الدراسة قياس بعض العوامل اللاحيوية شهرياً خلال مدة الدراسة وقد دلت نتائج التحليل الاحصائي ANOVA الى جود فروقات معنوية بين محطات الدراسة بالنسبة للتوصيلية الكهربائية والأس الهيدروجيني، في حين لم تسجل فروقاً معنوية بين المحطات فيما يخص درجة حرارة الهواء والماء وسرعة الرياح والعكارة والاوكسجين المذاب. سجل خلال الدراسة ثمان أنواع من الحشرات المائية تعود الى أربع رتب تصنيفية هي، رتبة نصفية الأجنحة Hemiptera ، رتبة غمدية الأجنحة Coleoptera ، رتبة ثنائية الأجنحة Diptera ، رتبة الرعاشات Odonata . سجلت أعلى وفرة نسبية لرتبة ثنائية الأجنحة وبلغت 38% ، وادنى وفرة نسبية لرتبة الرعاشات بلغت 10% و أعلى وفرة سنوية للأجناس والأنواع فقد سجلت للجنس *Culex* SPP. (Larva) ، ولجميع محطات الدراسة. وبالنسبة للأدلة البيئية فقد سجل التنوع المكاني أعلى قيمة 1.8 في محطة السدة، وأعلى قيمة لدليل الغنى 1.33 في محطة السدة أيضاً، وأعلى قيمة لدليل التكافؤ 0.89 في محطة المنصوري ، وأعلى قيمة لدليل السيادة سجلت في محطة المنذوري وبلغت 0.5. أمّا بالنسبة للتنوع الزماني فقد سجل دليل التنوع شانون-وينر أعلى قيمة له 1.9 في محطة السدة خلال شهر آيار، وأعلى قيمة لدليل الغنى 2.2 في محطة المنصوري خلال شهر آيار ، وأعلى قيمة للسيادة سجلت في تشرين الثاني وكانون الأول بلغت 1 ولجميع المحطات. قيمت الدلائل البيئية حسب القيم الوصفية والرقمية، إذ دلت إنَّ مجتمع الحشرات المائية في هور الحمار الشرقي يعد متوسطاً من حيث التنوع، وشبه مضطرب من حيث الغنى، وذو تكافؤ متزن.

كلمات مفتاحية: هور الحمار، حشرات مائية، تنوع، البصرة، العراق