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Effect of some environmental factors on the density of Odonata naiads in the temporary ponds of Basrah Province, South of Iraq.

Huda Kadhim Ahmed[1,2]* Dhia Khalif Kareem[2]

[1] *Department of Marine Biology / Marine Science Center / University of Basrah*

[2] *Department of Biology / College of Education for Pure Sciences / University of Basrah*

*Corresponding author e-mail: **hudamcs@yahoo.com**

Abstract

The environmental effects of some factors (temperature, salinity, pH and dissolve oxygen) were studied to determine the monthly changes on the density of Odonata naiads in three temporary ponds: St.1-Abu Gosra, St.2- Al-Masehab and St.3-Al-Jilal, in Basrah Province, South of Iraq, during the period from December 2017 to November 2018. The results show that the total density of naiads was significantly positive correlation ($p<0.01$) with temperature and salinity, whereas it significantly negative correlation ($p<0.01$) with pH and dissolve oxygen. The highest density 124 ind./ m^3 was recorded for Anisoptera in February at St.2 and 70 ind./ m^3 for Zygoptera in April at St.1, while the lowest density was 3 and 2 ind./m^3 were recorded for Anisoptera and Zygoptera in June at St.1 respectively. Temperature recorded a significant ($P<0.05$) variation, the air temperature ranged between 14- 46 ° C and the water temperature ranged between 12-38° C. The highest value of salinity reached 14 g / L in October at St.2, while the lowest values reached 1.2 g / l during November at St.3, pH values were ranged between 4.5 -8.2 in July at St.1 and in October at St.3 respectively, and the values of dissolved oxygen were ranged between 0.8- 10 mg / l in July at St.1 and January at St.3 respectively.

Key words: Environmental factors, Odonata, Naiads, Temperature, Salinity, Basrah, Iraq.

1-Introduction

Many species of Odonata, which include both dragonflies and damselflies, have been familiar to people in the marshlands of southern Mesopotamia since antiquity (1). They are considered as an important link in the aquatic food chain ecosystems and productive land (2). Recently, Odonata has been much interest in the extent to which insect's species communities can be an indicator of the quality and health of the ecosystem which they are part of that system (3). Actually they are an excellent model and prominent species in preserving the freshwater environment system because they are sensitive to changes in the water and

terrestrial environment, as their larval stages are completely water while the predatory insects and agents of biological control, their naiads feed on a variety of organisms ranging from the first and second instar larval stages to larger organisms such as water fleas, small snails, mosquito larvae that transmit the malaria parasite, and thus reduce the spread of epidemic diseases, and they eat even tadpoles and small fish (5,6). Several environmental studies indicated that the naiads of odonatan live in freshwater environments and a small number of them tolerance the conditions of salt water (7, 8). Studies have shown that the most important factors affecting the evaluation of the presence of naiads in temporary ponds are: changing the parameters of the environment, pollution, the presence of adults are mobile predators between land and air (4). Odonata are important aquatic predators, the lack of water, high temperatures, and increased concentrations of salinity (9, 10). Characteristics of a water body are determinants of naiads community as they have complex environmental requirements (11,12). A few environmental studies on naiads were done in the south part of Iraq, (13) studied the seasonal changes in the abundance and biomass of two species of naiads in Basrah and (14) studied the effect of environmental conditions on annual occurrence of Odonata naiads in different regions of Basrah. Therefore, this study aimed to provide information about the density of Odonata naiads and their relationship with extreme conditions on aquatic environments of Basrah, Iraq.

2-Material and Methods

2.1- Study Areas

A field study was conducted in three small ponds (stations) located in different regions of Basrah Governorate, includes: St.1- Abu Gosra (Abu Al-Kassib district) (30 25 47.1"N 47 56 49"E), St.2 A-l Masehab (Al-Hartha district) (30 38 58.7"N 47 43 58.5"E) and St.3- Al Jilal (Al-Madina district) (30 56 21.7"N 47 14 29.6"E). The ponds were temporary and shallow with a maximum depth of 35-50cm and a surface area of 8-50m length and 3-6m width. A vegetation of *Typha domingensis*, *Alhgi graecarum*, *Suaeda aegyptica* and *Phragmites australis* were distributed over much of the littoral zone. The community of invertebrates represented by two species of gastropods, different species of insects (larva, nymphs and adults).

2.2-Measurements of environmental factors.

A number of physical and chemical factors of pond water such as temperature, salinity, pH and dissolved oxygen were measured by Multimeters (Loviband/ Sense direct 150) every month along the period of field work. Sampling Specimens were collected during the period from December 2017 to November 2018, by using a 30 cm sieve and a 1 x 1 mm hole size, with a 150 cm arm according to (15). The sieve was placed under the water near the bottom and pulled for one minute of a distance 25 cm, then raised quickly with a circular motion to get rid of excess water and repeat the method for three times. The naiads were lifted from the sieve using a brush and putted in alcohol with a concentration of 70% in the sealed bottles and recorded the necessary information of location and the dates of samples.

2.3-Statistical Analysis

The Statistical Analysis Program (SPSS) was used to find correlations between environmental factors and the density of naiads and their interactions in the three study stations by an ANOVA two-way analysis, Post Hoc Tests, Multiple Comparisons between stations and Pearson Correlation, at $P<0.01$ and $P<0.05$.

3-Results

3.1-Total monthly density

Figures (1,2 and 3) shows the monthly changes of the total density for Anisoptera

and Zygoptera naiads in three stations in the period from Dec. 2017 to Nov. 2018. In St. 1 (Fig.1), the highest density was 70 ind./m^3 in April, whereas the lowest density 3 and 2 ind./ m^3 in June for Anisoptera and Zygoptera naiads respectively.

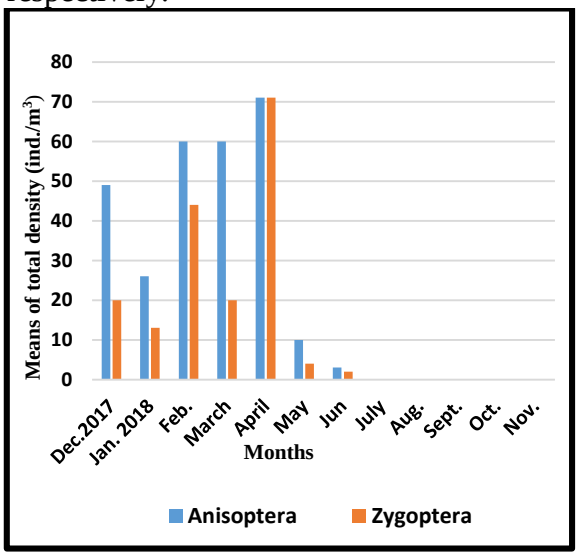

Fig.1. Monthly changes in the total density of Anisoptera and Zygoptera in St.1.

In St.2 (Fig.2), the highest density of 124 and 42 ind./ m^3 were recorded for Anisoptera and Zygoptera naiads in February and January respectively, while the lowest density 12 and 5 ind./ m^3 in July.

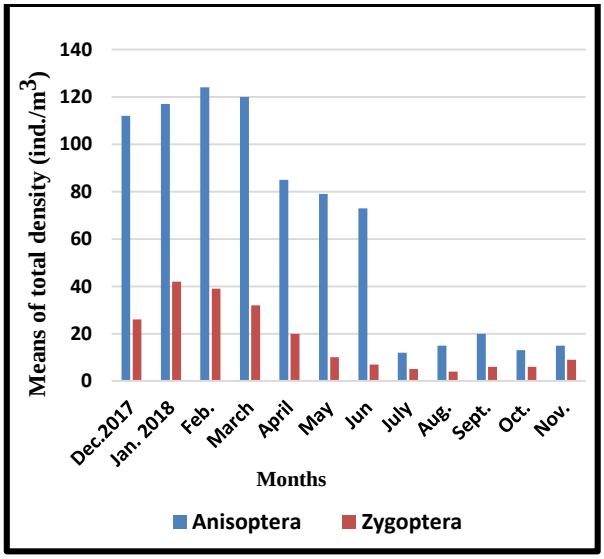

Fig.2. Monthly changes in the total density of Anisoptera and Zygoptera in St.2.

In St.3 (Fig.3), the highest total density 70 and 25 ind./m^3 in February for Anisoptera and Zygoptera naiads, while the lowest density 11 and 2 ind./m^3 in August and September respectively.

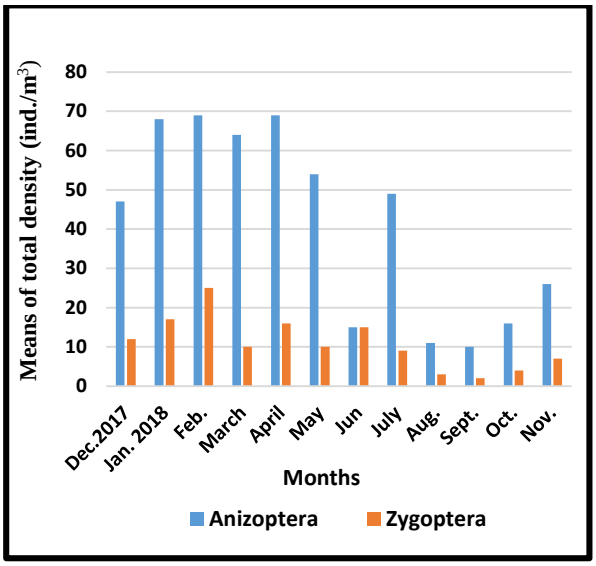

Fig.3. Monthly changes of total density of Anisoptera and Zygoptera in St.3.

3.2-Environmental factors

3.2.1-Air and water temperature

Figures 4 & 5. Illustrate the values of air and water temperature which they significantly variation ($p<0.05$), the air temperature ranged between 14 - 46 °C and the water temperature ranged between 12- 38° C. The highest values were recorded in July and August at St.3 and St.1 respectively, while the lowest temperatures in January at St.3, and the annual average reached 30° C and 25 ° C respectively.

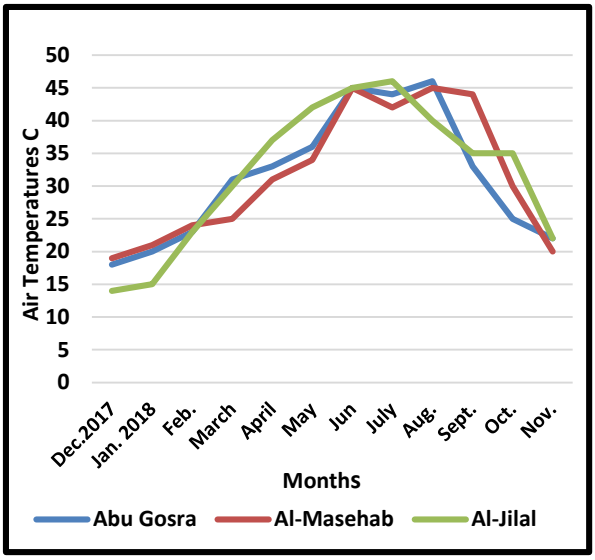

Fig.4.Monthly changes of air temperatures in the three stations of Basrah.

3.2.2-Salinity

Fig.6. Show the salinity concentrations increased significantly in St.1 and St.2 and the highest values reached 12 and 14 g/l in July and October at St.1 and St.2 respectively, while the lowest 1.2 g /L in November at St.3.

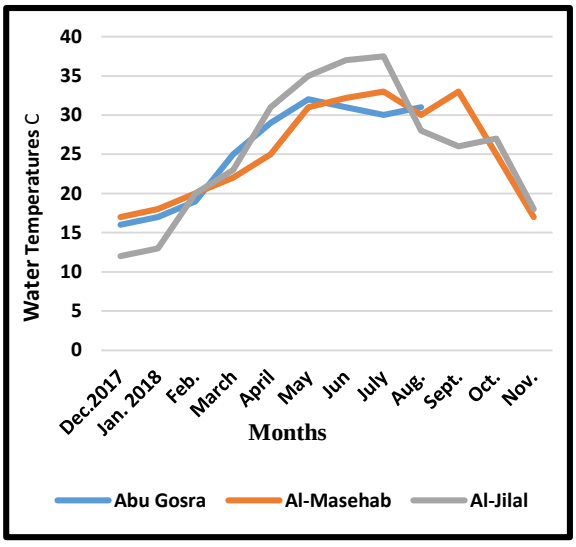

Fig.5. Monthly changes of water temperature in three stations of Basrah.

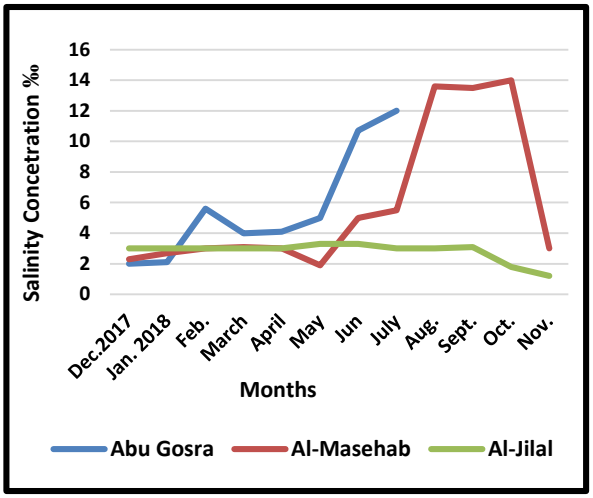

Fig. 6. Monthly changes of salinity in the three stations of Basrah.

3.2.3-PH

Fig.7Show . the highest value 8.2 was recorded during October at St.3, and the lowest value of 4.5 were recorded in July at St.1.

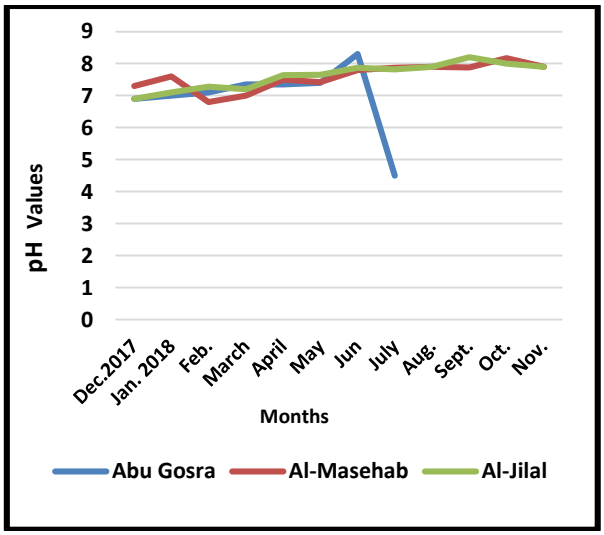

Fig.7. Monthly changes of pH values in the three stations of Basrah.

3.2.4- Dissolved oxygen

In Fig.8. The highest value of dissolved oxygen 10 mg/ l recorded in January at St.3, while the lowest was 0.8 mg/ L. in July at St.1.

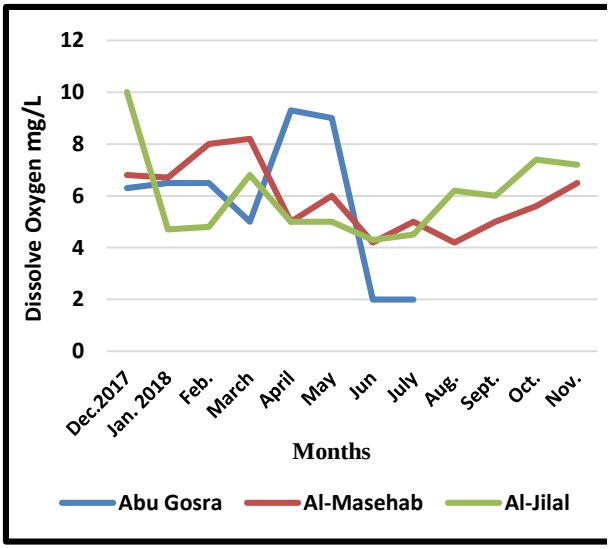

Fig.8. Monthly changes of dissolve oxygen on three stations of Basrah.

Table (1) shows the significant differences of the total density between stations at ($P<0.05$), and in Table (2) the results of significant, correlations and the interactions between the total density and environmental factors, density were significantly negative correlation with air and water temperatures and salinity, whereas, they significantly positive correlation with pH and dissolve oxygen at $P<0.01$, the environmental factors significantly positive correlation with each other at $p<0.05$.

4-Discussion

Environmental conditions are the bedrock of the existence of different types of living organisms that have adapted according to their nature of living within environments characteristics which suitable for their reproduction and distribution (16). In the current study, stations were varied in their environmental specifications in terms of size, depth, surface area, and the amount of water entering, as well as they varied in their locations and vegetation. They are temporary ponds with shallow depths which make it often unstable and drought-prone environments during hot months. The results of field trips to collect specimens, showed the difficulty of finding ponds with environmental specifications especially for Odonata naiads, therefor we recorded their presence in very few temporary and shallow water ponds at different regions of Basrah. In the south of Iraq, the arid climate is dominant during most months of the year, as a result, the length of summer caused high evaporation and drains of ponds (1).

Temperature is play as a critical factor for survival by effected on respirations of organisms and their tolerant ranges which effected on occurrence and distributions of aquatic insect, this was followed by other important factors such as salinity, pH, dissolved oxygen and others that have a direct impact on the continuation of wild and marine life on the world (17). Our results of the total density of Anisoptera and Zygoptera naiads were significantly negative correlation ($P<0.01$) with air and water temperatures and salinity, whereas they significantly positive correlation ($p<0.01$) with pH and dissolve Oxygen. This results agree with several studies, such as (11 ,18, 19 and 20), which indicated to the changes of aquatic insect density depending on environmental factors and that the density was increased in winter and spring, while it decreased in the summer and autumn seasons. (8) show that the density of naiads is decrease because of they are hiding in the plants or digging and drilling in the sediments during hot months. However, size of the temporary water body considered as a determine factor of Odonata abundance, and with limited quantitative samples in the stations, a relative difference in the density Zygoptera were showed, compared to Anisoptera naiads. (21) has shown that naiads of Dragonflies possess a wide ability to spread, so they appear abundant when collecting samples from temporary water bodies, especially in the tropics, as they adapt to a wide range of different environments (22&23), while the availability of damselflies (Zygoptera) were reduced due to their limited ability to

spread (24). The results found that these insects are able to withstand high levels of salinity, and have a wide ranges of salt tolerance due to the seasonal variation, and this agree with (19), and (26) mentioned that the salinity of the waters decreases when diluted with fresh water coming from the spring flood of Shatt Al- Arab, and the salinity increases during the summer due to the evaporation of water from static water bodies .

Potential Environmental Risks of Odonata in Basrah Province.

Several years ago, extremist environmental changes occurred in Basrah (26)and , that emerged dangerously during 2018 and led to an unprecedented disaster, as the aquatic environments in Basrah was exposed to high concentrations of water salinity in winter, specifically in February, as a result of the salt tide coming from the Arabian Gulf (Personal communications), which negatively affected on the branches of Shatt al-Arab, from Al-Fao in the south of Basrah to Al-Hartha in the north, therefore, temporary water bodies which are the most important natural habitats of aquatic organisms have become extinct (Field observations). As a result, Abu Gosra stations in Abu-Khassib distract was exposed to sharply decrease in waters levels (during the sampler period) during June and began to drought in August, this was accompanied with increased of salinity, decreased of pH and dissolved oxygen and disappear of Odonata naiads. (27 and 28) had given an importance role of Odonata as an indicator for the health of ecosystems, therefor it is possible to predict a significant improvement in the quality of aquatic bodies when the fresh water level increased.

Iraqi water has been classified internationally as base water (29), and the results of the current study showed that the pH values ranged from (4.5 - 8.2) for all study stations and were significantly negative related ($r = -0.579$, $r = -0.624$ and $r = -0.858$ at $p<0.01$) of water, air temperatures and salinity. (30) showed that the values of pH decreases with increasing temperatures due to the increased decomposition of organic matter, and this was recorded by (19) in the pools of Basrah. (31) mentioned that pH scale is important in determining the water quality, as it affects the solubility of the elements and their degree of toxicity. In this study the highest values were recorded in Al-Jilal during January due to lower temperatures and the high density of plants at the site. These results are consistent with many studies, as (18). The dissolve oxygen represents a special challenge for aquatic insects even when the water is saturated with oxygen, its percentage remains much lower than the percentage of oxygen in the terrestrial environment, and the seasonal and spatial variation in the concentration of dissolved oxygen greatly reduces the density and diversity of insects in aquatic environments (32). The values of dissolved oxygen in the current study were varied due to the differences in the environmental characters of the ponds sites, and the sources of their waters supply. During the study period, the level of Shatt al-Arab was fell sharply during summer season, which affected reduce the water supply to sub-rivers and ponds (Field observations). The values of dissolved oxygen in our results reached the highest value of 10 mg / l during January at Al-Jilal station, due to the flowing of water from the source by the pump as well as lower temperatures in winter, while the lowest value was 0.8 mg / l during July at Abu Gosra which exposed to drought due to high temperature and the interruption of water from the source of water supply. Statistical result of Correlation ($r= - 0.747$ and $r= -0. 871$ at $p<0.01$) of dissolved oxygen were negatively related to temperature and salinity respectively. (33) showed that aquatic insects can be found where the values of dissolved oxygen fluctuate between 2.6 -14.

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Table. 1. Multiple Comparisons dependent on the variables of total density of naiads between stations in Basrah.

(I) Stations	(J) Stations	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-46.76*	6.126	.000	-61.55	-31.98
	3	-22.82*	6.126	.001	-37.60	-8.03
2	1	46.76*	6.126	.000	31.98	61.55
	3	23.94*	6.126	.000	9.16	38.73
3	1	22.82*	6.126	.001	8.03	37.60
	2	-23.94*	6.126	.000	-38.73	-9.16

Based on observed means.

The error term is Mean Square(Error) = 1351.189.

*. The mean difference is significant at the .05 level.

Table.2. The correlations and the interactions between the total density of Anisoptera and Zygoptera naiads and some environmental factors.

Correlations						
		Air Tempt	**Water tempt.**	**Salinity**	**pH**	**DO**
Air_tempt	Pearson Correlation	1	.967**	.613**	-.579**	-.696**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	36	36	36	36	36
Water_tempt	Pearson Correlation	.967**	1	.646**	-.624**	-.747**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	36	36	36	36	36
Salinity	Pearson Correlation	.613**	.646**	1	-.858**	-.822**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	36	36	36	36	36
pH	Pearson Correlation	-.579**	-.624**	-.858**	1	.871**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	36	36	36	36	36
DO	Pearson Correlation	-.696**	-.747**	-.822**	.871**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	36	36	36	36	36
Density of Zygoptera Naiads	Pearson Correlation	-.454**	-.414*	-.364*	.422*	.528**
	Sig. (2-tailed)	.005	.012	.029	.010	.001
	N	36	36	36	36	36
Density of Anisoptera Naiads	Pearson Correlation	-.519**	-.471**	-.535**	.549**	.620**
	Sig. (2-tailed)	.001	.004	.001	.001	.000
	N	36	36	36	36	36

****. Correlation is significant at the 0.01 level (2-tailed).**

***. Correlation is significant at the 0.05 level (2-tailed).**

تأثير بعض العوامل البيئية على كثافة حوريات الرعاشات في البرك المؤقتة لمحافظة البصرة ـ جنوب العراق

هدى كاظم احمد*[1] ضياء خليف كريم[2]

[1]قسم الاحياء البحرية/ مركز علوم البحار/ جامعة البصرة

[2]قسم علوم الحياة/ كلية التربية للعلوم الصرفة/ جامعة البصرة

الخلاصة

تضمنت الدراسة معرفة تأثير العوامل البيئية (درجة الحرارة و الملوحة والآس الهيدروجيني والاكسجين المذاب) على التغيرات الشهرية على كثافة حوريات الرعاشات في ثلاث برك مؤقتة في مناطق مختلفة من محافظة البصرة شملت: محطة(1)- أبو كوصرة ومحطة(2)- المسحب ومحطة(3)- الجلال ، للفترة من كانون الأول 2017 ولغاية تشرين الثاني 2018. أظهرت النتائج وجود ارتباط معنوي سالب بين كثافة الحوريات ودرجات حرارة الهواء والماء والملوحة، في حين أظهرت ارتباط معنوي موجب مع قيم الآس الهيدروجيني والاوكسجين المذاب ($P< 0.01$). بلغت اعلى كثافة 124 فرد/م^2 لحوريات متباينة الاجنحة في شباط في محطة (2)، وبلغت اعلى كثافة 70 فرد/ م^2 لحوريات متماثلة الاجنحة خلال شهر كانون الثاني في محطة (1)، في حين بلغت ادنى كثافة 3 و2 فرد/م^2 لحوريات متباينة الاجنحة و متماثلة الاجنحة على التوالي خلال شهر حزيران. سجلت العوامل البيئية المدروسة تبايناً معنويا ($P<0.05$) اذ تراوحت درجات حرارة الهواء بين 14- 46 م□، ودرجات حرارت الماء تراوحت بين 12- 38 م□، وسجلت الملوحة اعلى تركيز 14 غم/لتر خلال شهر تشرين الاول في محطة (2)، في حين سجلت ادني تركيز ملوحة 1.2 غم/لتر خلال شهر تشرين الثاني في محطة (3). اما قيم الاس الهيدروجيني فقد تراوحت بين 4.5- 8.2 ، اذ سجلت اعلى قيمة خلال تشرين الأول في محطة (3) وادنى قيمة في تموز في محطة (1)، وتراوحت قيم الاوكسجين المذاب بين 0.8- 10 ملغم/لتر اذ سجلت خلال اشهر تموز وكانون الثاني في محطتي (1) و (3) على التوالي.