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AQUATIC INSECTS IN THE GARAAT DJAMAL AL-TARF OF NORTHEASTERN ALGERIA

Habiba Gacem[1,2], Imene Khafallah[1,3]* and Rabah Chaouch[1,3]

[1]Higher Normal School of Technological Education of Skikda, 21000, Algeria
[2]Laboratory of Biology, Water and Environment (LBEE), University May 8, 1945 Guelma, Algeria
[3]Laboratory of Physical, Chemistry and Biology of Materials, HNSTE-Skikda 21300
*Email: mi-mene@live.fr (corresponding author): ORCID ID 0000-0002-1392-2245

ABSTRACT

In this study, we want to know the quality of surface water at our study site, as we divided it into three stations. To evaluate the distribution of these insects, a statistical study was conducted and physical and chemical indicators of the water were measured between October 2022 and March 2023. The results showed a group of 4,986 individuals whose concentrations varied significantly between the three stations. Five genera have been recognized. The five varieties collected are very hardy and highly adaptable to different environmental conditions. These statistics were subjected to three tests. Finally, we found that the distribution of aquatic insect species is related to their physical and chemical characteristics, and therefore their distribution varies depending on the water temperature. And the insects themselves influence each other's existence.

Key words: Aquatic insects, physicochemical, distribution, environment, stations, ecosystem, Gaarat Djamel, methods, biological control, conductivity, temperature, pH

The concept of environment is defined as the natural environment that includes biotic and abiotic natural elements. It is also the space in which a person carries out his various life activities (Ahmed, 2021). It can also be described as a group of systems interconnected with each other to the degree of complexity (Manisalidis et al., 2020). Insects represent more than 70% of the known biodiversity of the animal kingdom, and chemical control, especially using synthetic chemical pesticides, remains the main means of disease vector control (Ayilara et al., 2023). However, side effects of pesticides or environmental damage have encouraged the search for alternative methods, such as biological control (Baker et al., 2020). So it is necessary to know the distribution of insects for their conservation. The role of insects in nature is well established because they play an important role in the functioning of aquatic ecosystems and the preservation of biodiversity (Samways et al., 2020). Invertebrate and vertebrate organisms have been used in the biological control of harmful mosquitoes in order to preserve biodiversity and avoid toxic effects and ecotoxicological risks (Karami and Kamkari, 2019; Brüehl et al., 2020).

Insects are excellent witnesses to the quality of the aquatic environments in which they gather and are used as biological indicators of water quality (Wallace and Merritt, 2019). It has been noted that environmental factors have a significant impact on the spatiotemporal distribution of living organisms. This work has received attention for such environmental studies, as our study aimed to evaluate the water quality of Lake Gaarat Djamel through the distribution of aquatic insects using environmental indicators and physical and chemical standards and identifying environmental factors affecting its diversity. This is done by counting the numbers of aquatic insect genera and conducting physicochemical analysis of water samples from the various study stations to determine whether there is a relationship between these factors and the presence of aquatic insects and the extent to which these characteristics affect their distribution. Statistics are discussed using three tests. The first test aims to find out the differences between the measured variables. The second test aims to determine the extent to which the and presence of each type of aquatic insect is related to another and the extent to which each physical and chemical characteristic is related to another, while the third test shows the physical, chemical and biological composition of the three stations, respectively.

MATERIALS AND METHODS

Garaate Djamel is located in northeastern Algeria (36°.88 N, 07°.90. E). This body of water does not flow into the sea, which reduces its fluctuation under the influence of currents. This lake is influenced by the Mediterranean climate and the dry period can last

from four to six months (Gacem, 2023). Samples were collected from three stations located on the outskirts of Garaate Djamel. During six field trips, one trip each month in the period from October 2022 to March 2023, we throw the bucket tied to the rope at the stations and take a quantity of water from it, which is emptied into sealed bottles and transported to the laboratory, where it will be systematically sorted and identified under laboratory conditions (Gacem, 2023) Physical and chemical analyzes of water from different stations relate to three factors that are performed monthly in the laboratory (Senouci et al., 2023). We measured pH, conductivity, and temperature, and then recorded census results for the number of individuals of each aquatic insect species present in the study area. Aquatic insects were identified after blanching specimens in a 10% NaOH solution for two to three days (Saucier et al., 2022). Results are presented (m± SD). Comparisons and significance testing between different series were performed using a test to check the presence or absence of possible differences between the coefficients of the studied factors using 1-way ANOVA and the Tuckey test, followed by the Kruskal-Wallis test (Khasawneh et al., 2019).

RESULTS AND DISCUSSION

Show results for the number and type of aquatic insects. With regard to the types of aquatic insects, the Daphnia insect was present throughout the study period, followed in second place by the Hydracarines insect, which was found during the months of October, November, December, January and March. Then in third place are mosquito larvae, which are found in three months: October, December, and January. Then in fourth place is the Coleoptera insect during the months of October and November, while the Heteroptera insect is in last place, which is found in the month of October only. What we always noticed was the presence of Hydracariens and mosquito larvae in the first station and Coleoptera and Heteroptera in the second station. Daphnia insect was present in all stations except for the months of October and November, where it was present in the first and third stations (Fig. 1). While the results of the physical and chemical properties obtained during six field trips within the scope of the study to three stations, there is a slight difference in the pH level of the three stations during the months of the study, and this is due to the difference in environmental factors that affect the pH level from one month to another. As for the difference between stations in the same month, it does not exist, and this is due to the proximity of the stations to each other. As for the conductivity, it is somewhat high during the months of October and January, while for the rest of the months it is low compared to the months mentioned previously.

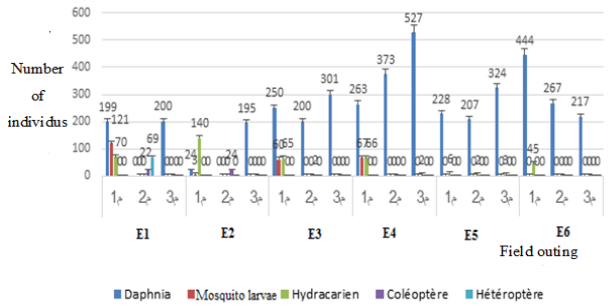

Fig. 1. Aquatic insects (from six field trips to the three stations) (E: Exit)

But there is always a slight difference between the same stations. For example, during the months of November, December and February, there is a clear difference between the three stations. Regarding temperatures, there is always a difference in the water temperature measured during the study months, with the highest temperatures recorded during October and the lowest temperatures during February, but between the stations there are always slight differences, and this is always due to the fact that the three stations are located in same area. The results of statistical tests on all of these data were obtained through six field outputs for three. The Kruskal-Wallis test showed the relationship between the distribution of numbers of aquatic insect genera and the physical and chemical characteristics at each station within the study area. This test showed very large differences for Hydracariens and mosquito larvae, as well as for Coleoptera. However, no statistically significant differences were observed for all other aquatic insect genera (Fig. 1). As for the season factor, this test indicated that there were very large differences

Table 1. Aquatic insects
(from six field trips to the three stations) (E: Exit)
Relationships- distributionvs. physicochemical characteristics

	Station (ddl=2)		Variable Factor	
	Value de P	Observation	Value de P	Observation
PH	0.964	ns	0.041	*
T	0.970	ns	0.009	**
CON	0.434	ns	0.024	*
HYD	0.001	**	0.941	ns
DAP	0.554	ns	0.026	*
COL	0.034	*	0.635	ns
HET	0.368	ns	0.416	ns
0.009	0.778	ns	-	L_M

NB: *p ≤0,05), ** (p ≤0,01), *** (p ≤0,001), ns (p>0,05)

in the degree of Temperature and also very large differences in conductivity, and the test also showed very clear differences in pH. No statistically significant differences were shown for the other variables.

This test shows us the relationship between the distribution of numbers of aquatic insect genera and the physical and chemical properties measured at the level of each station. It depends on the seasonal factor P, which when it is less than 0.05 indicates the presence of large differences in the measured variables: we found that there are large differences in each measurement, and this indicates that these characteristics control the distribution of aquatic insect species (Godoy et al., 2019). Temperature plays an important role in the life cycle of most aquatic insects and can also affect species location and density (Dallas et al., 2015). It also plays a role in dissolving salts and thus has an effect on electrical conductivity and determining pH (Younesi et al., 2015). This confirms the effect of pH on aquatic life. Regarding conduction, it is the property of water to enhance the passage of electric current. This is due to the presence of ions in the water (Vepsäläinen et al., 2020). Each insect has a suitable conductivity in which it can exist, and therefore conductivity is a physical and chemical property that affects the distribution of insect species (Adu et al., 2019).

On the other hand, this test showed positive correlations between mosquito larvae and Hydracarines, and this is what we found through our field results, as the first station always contained mosquito larvae accompanied by Hydracarines, as well as Coleoptera and Heteroptera (Gacem, 2015). At the second station in October, the two insects were present in large numbers, and this indicates their positive relationship according to this test. Some insects decrease when the temperature decreases, such as mosquito larvae, and some of their genera have completely disappeared, such as Heteroptera (González□Tokman et al., 2020). This indicates that the distribution of this insect is not related to temperature, but is affected by conductivity. As a recent study of insect populations in Bryn ponds showed (Bryan et al., 2022). Recent work carried out in Switzerland (Al-Saffar and Ogul, 2021) shows that in ponds and ponds, aquatic beetles represent approximately 50% of aquatic species compared to barely 10% for flat species and less than 10% for Trichoptera (Reisdorf et al., 2017 ; Ramadan et al., 2018). Biological monitoring is considered a way to evaluate water and overall environmental quality (Kuklina et al., 2013).

There are many works in which aquatic insects have been used as bioindicators (Mahmoud et al., 2020), but most studies were at the river level, and A few of them are conducted in lakes such as Lake Side. Muhammad Bin Ali and other works through which they concluded that human economic development and various activities affect water quality, nutrient levels, and macroinvertebrate communities (Sinoussi et al., 2023), and agricultural and domestic waste and animal waste are also among the main causes of pollution risk in lakes. This was confirmed by (Scheren et al., 2000; Al-Badawi 2015; Boun Salah et al., 2017). Our study focused on calculating the numbers of aquatic insect genera and the extent to which their distribution is affected by physical and chemical characteristics. We concluded that the distribution of aquatic insects is related to these characteristics. These stations constitute a reserve for biodiversity, which tends to disappear little by little under the influence of human activities. Therefore, a public awareness campaign must be implemented in cooperation with local authorities in order to preserve these important ecosystems. Benefiting from biological uses and the use of aquatic insects remains a relatively economical alternative, and the use of these species or biomarkers may be the solution or the ideal option, thanks to their effectiveness and credibility.

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AUTHOR CONTRIBUTION STATEMENT

H G conceived and designed research. R C and H G conducted experiments. H G, I K and R C analyzed data. H G and I K wrote the manuscript. All authors read and approved the manuscript.

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CONFLICT OF INTEREST

No conflict of interest.

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