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Evaluating Insects as Bioindicators of the Wetland Environment Quality (Arid Region of Algeria)

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Abstract

The wetland of Naâma situated in the arid region of Alegria offers an important fauna and flora diversity due to its geographical location it constitutes the main resting place in North Africa for migratory birds. Insects are used as bioindicators, due to their sensitivity to environmental conditions which, because of their ecological peculiarities, gives information on the characteristics of terrestrial and aquatic environments. The aim of this study is to know and specify the entomofauna bio-indicator of the quality of the aquatic environment of the wetland Naâma (SW Algeria). The study carried out in the wetland from September 2017 to September 2020. Benthic insects were sampled according to the IBGN protocol (Standard Global Biological Index). Study and statistical analysis of insects communities was based by the use of the structural and statistical index, Correspondence factor analysis (CFA), and The ascending hierarchical classification (C.H.A). The results show that the collected insect 51 species, belong to 9 orders, The Coleoptera order is the most represented with 11 species, followed by the Odonata with six species, Lepidoptera ranks third with five species followed by Diptera with 03 species. The various indicators used, namely the specific richness (51 species), the Shannon index (1.01 bits), and fairness (0.56) show that this environment is characterized by significant fauna biodiversity. The study of the hydro-biological quality of the water courses of this site, assessed by the IBGN method showed a good hydro-biological quality with moderate pollution (IBGN = 14). This pollution is precisely marked by the requirement of Ephemeroptera and the disappearance of Plecoptera. These results lay the foundation for any biomonitoring action of the ecological quality of the waters of this wetland.

Keywords: arid, entomofauna, bioindicator, wetland, Naama

1. Introduction

The arid regions of Algeria undergo total degradation and desertification of environment, due to its geographical location, the Naâma region is also threatened by human actions and locust invasions.

The wetland of Naâma classified as Ramsar, situated in the arid region of Alegria, offers an important fauna and flora diversity due to its geographical

location it constitutes the main resting place in north Africa for migratory birds, animal and plant species, including many endemic species.

Bioindicators are species used to appraise the health conditions of the environment or ecosystem and they are capable of determining the environmental integrity using their functions and populations. Wetlands are fragile ecosystems that perform major functions, such as storage and the restitution of water as well as the natural filtering of mineral and organic matter, they also host a rich biodiversity and particularly adapted to this environment [1].

The insects are responsible for many processes in the ecosystem and its loss can have negative effects on entire ecosystem, Insects are used as bioindicators, because of their sensitivity to environmental conditions which, due to its ecological peculiarities, gives information on the characteristics of the environment in which it is present or on the evolution of this environment under the influence of certain practices are used to detect changes in the environment and the presence of pollution.

Insects are the most abundant animals in almost all ecosystems and can be used to evaluate the impact of environmental change.

Entomofauna studies to furnish information about ecosystems conservation status their productivity and levels of water contamination and pollution. Therefore, bioindicator species identification is essential, due to the important role that these organisms have as transformers and regulators of ecosystems [2].

The aim of this study is:

- study the entomofauna structure in the wetland of Naâma (SW Algeria).
- identify bioindicator species and assess the quality of aquatic environments in the wetland.

2. Materials and methods

2.1 Description of the study area

The resort is a wetland listed by Ramsar, localized at (longitude 0°west and latitude 33°north). The water of wetland concerned two hundred hectares surrounded by several units or peripheral areas; immediate area of water is characterized by *Tamarix* and *Alfa* formation. The gausses diagram and Ombrothermic bagnouls shows the dry period in the Naâma region is longer from April until October during the period (2012–2019). The rainfall climagramme emberger quotient (Q2) show that three stations located in the fresh winter upper arid area (Brahimi et al. 2020) (**Figure 1**).

2.2 Sampling sites

We studied the insects in 5 sampling sites: 3 sites on the water bodies of the hawdh edaira wetland and 2 sites along the lake. The plots covered several types of environmental gradients (water body and wild natural areas (wooded, grassy, rocky and forest areas) Land cover of the sampling sites was classified into 5 types based on Google Earth images and field observation.

Insect field collections were carried out continuously for 36 months from September 2017 to September 2020 to obtain baseline data on insect composition. Inventories were carried out in the middle of each month. The transect method (300 m × 200 m) was used to study insects in open areas.

Figure 1.
 Satellite images and photos of the wetland of Naâma region.

2.3 Sampling technique

Extrapolating sample data from these methods to the square metre could lead to the overestimation of species abundance and diversity at the site due to the generally patchy distribution of invertebrates in streams [3].

Two qualitative sampling tools (D-frame net and square net) and a quantitative sampling tool (Surber sampler) were used to collect the aquatic insects the wetland of Naâma. A D-frame net with a 1.2-m-long handle and a 60 cm long cone-shaped net with 0.3 mm mesh and a diameter of 0.38 m was used in this study. A square frame net with a 0.5 m × 0.5 m opening, a 90 cm cone shaped net with 0.3 mm mesh, and a 1.2 m long handle were used to collect samples. A sampling tool's efficiency is also determined by the time required to process the samples [4].

Other techniques have been used namely; – Butterfly net - Catching insects by hand - Pheromone insect trap.

2.4 Study of plants

The species inventory is essential for the structural analysis of a station.

The harvest of the plant in the field is the prospecting which aims to know the totality of the flora of the region of Naâma. In this case, it is essential to visit the sites during all seasons to collect the maximum number of plants of different species. In the course of surveys, plastic bags are used. The collected samples are then dried and placed in paper folders with a label, mentioning the date, place, and other interesting observations. All the species have been kept in a herbarium.

The determination of the plant species was carried out using the two guides; Nouvelle Flore d'Algérie of QUÉZEL and SANTA S and the Flore du Sahara of Paul Ozenda.

2.5 Ecological indices

Total and average Richness: Is the number of species that make up a population. It is one of the fundamental characteristics of a settlement. In this study, two types of wealth are calculated, namely total wealth and average wealth [5].

Shannon-Weaver Diversity Index H': According to Ramade [5], (H') translated by a determined abundance distribution, closely related that of specific diversity:

$$H' = -\sum ((n_i/n) * \log_2 (n_i/n))$$

n_i : number of individuals of a given species, i ranging from 1 to S (total number of species).

n : total number of individuals.

Equitability (Fairness E): The knowledge of H' and H' max makes it possible to determine E . E varies between 0 and 1, E tends to 0 when the quasi-totality of the populations corresponds to a single species of the stand, E tends to 1 when each species is represented by the same number of individuals [5].

Dispersion index: The knowledge of the distribution mode is useful during a density evaluation population by sampling [6].

$$S^2 = \Sigma (x - m)/n - 1$$

n : collection set; m : the average number of individuals in each sample; x : number of individuals from each sample. If: $S^2 = 0$: the distribution is uniform or regular; $S^2 < m$: the distribution is contagious .

The relative frequency: According to Dajoz [7], The principle consists of noting the presence or absence of species in the records, it is expressed as follows:

$$F(i) = n_i/N \times 100$$

$F(i)$: Relative frequency of the species contained in the statement as a percentage.

n_i : The number of times the insect (i) are present.

N : Total number of individuals.

2.6 Statistic study

The Shapiro–Wilks test: The Shapiro–Wilks test for normality is one of three general normality tests designed to detect all departures from normality. It is comparable in power to the other two tests.

$$b = \sum_{i=1}^m a_i (x_{n+1-i} - x_i)$$

2.7 Descriptive statistics of a numeric variable

Descriptive statistics are the first pieces of information used to understand and represent a dataset. Their goal, in essence, is to describe the main features of numerical and categorical information with simple summaries. These summaries can be presented with a single numeric measure, using summary tables, or via graphical representation. Here, I illustrate the most common forms of descriptive statistics for numerical data but keep in mind there are numerous ways to describe and illustrate key features of data.

2.8 Student's t test for single sample

The t test tells you how significant the differences between groups are; In other words it lets you know if those differences (measured in means) could have happened by chance.

2.9 Factorial Correspondence Analysis (CFA)

Factorial correspondence analysis is a descriptive method. It aims at the representation with the minimum loss of information in a space with n dimension [2].

The purpose of this analysis is to realize several graphs from data table. The observation of the graph can give an idea of the interpretation of the factors and show which variables are responsible for the proximity between this or that observation. CFA is a method that consists of summarizing the information contained in a table with n rows (the stations in this case) and p columns or variables (Orthoptera species). In addition, a technique has for describing in particular in a graphical form the maximum of the information contained in a rectangular array of data.

2.10 Logiciels Statistique

The key to determining insects order Plecoptera, Ephemera and Odonata, is performed by the software Xper3, This key is based on a list of taxa and associated descriptors, such as morphological characters.

Factorial correspondence analysis (CFA) was studied by minitab version 19 software.

Student's t test for single sample, Descriptive statistics of a numeric variable and The Shapiro–Wilks test have been studied by R++ statistics software.

2.11 Study of the quality of aquatic environment

2.11.1 Global Normalized Biological Index IBGN

Benthic insects are one of the most famous organism groups used for rivers biomonitoring surveys.

The use of IBGN is especially indicated for disturbances that induce a modification of the nature of the substrate and the organic quality of the water: rejection urban predominantly organic, pollution by suspended matter, side effects of certain types of rejection (organic, metallic) and eutrophication. In addition, the IBGN reflecting the structure of a biocenosis made up of organisms long-term integrators are especially sensitive to chronic disturbances or well to disturbances of the intermittent type but sufficiently intense to cause a immediate mortality.

- Class 1A blue in color which indicates excellent water quality
- Class 1B green in color which indicates good quality water (with pollution moderate)
- Class 2 yellow in color which indicates average water quality (with a clear Pollution)
- Class 3 orange color which indicates poor quality water (with pollution important)
- Excluding class 4 red which indicates poor quality (with pollution excessive)

2.11.2 Faunistic analysis and interpretation (IBGN)

After identifying the macroinvertebrates, a list faunistic is established, listing all the taxa found by faunistic groups, and indicating the total number of taxa. The index is calculated from the table “IBGN values according to type and the taxonomic variety of macrofauna. We first determine the taxonomic variety (Σt), i.e. the total number of taxa identified (the number of individuals per taxon is not taken into account). Then look for the faunistic indicator group (GI) in the list provided

IBGN	Class 1A > ou = à17	Class 1B 16–13	Class 2 12–19	Class 3 8–5	Class 4 < ou = à 4
color	blue	green	yellow	orange	Red

Table 1.
Reference values of the IBGN.

and select the taxon that has the highest degree of pollutant sensitivity of the full sample of the station studied.

The index can then be read in the table of values of the IBGN: it is at the intersection of the column for the taxonomic variety and the row for the indicator faunistic group (**Table 1**).

3. Results

3.1 Data description

The insect species recorded are divided into 9 orders; Ephemeroptera, Coleoptera, Orthoptera, Hymenoptera, Lepidoptera, Hemiptera, Odonata, Diptera and Plecoptera. From this present work, 27 insect families were found. The most represented order is Coleoptera with six families and 11 species Orthoptera represent 5 families and 20 species. The Hemiptera, Plecoptera and Ephemeroptera represent only one family and one species for each order (**Table 2**).

3.2 Shannon-Weaver diversity, maximum diversity and Equitability

The Shannon-Weaver diversity index obtained in the study area is 2.24bit, maximum diversity is 1.89. Equitability is of the order of 0.56. These values indicate that the wetland is characterized by a very important entomofauna diversity, these results show a great diversity of insects in the naama wetland (**Figure 2**).

3.3 Dispersion index and The relative frequency

The study of the Dispersion index and The relative frequency of each species identified in the hawdh ed. दौर wetland of Naâma allowed to know the frequency and the type of distribution of each species;distribution uniform, regular or contagious (**Table 2**). This information is necessary for the monitoring and control of these species over time (**Figure 3**).

3.4 Shapiro: Wilk normality test

In this study the calculation of the Shapiro-Wilk normality test is equal:

W = 0.6428, p-value = 1.842e-07.

this value means, the p-value is greater than 0.05, the data of this study are normally distributed.

3.5 Descriptive statistics of a numeric variable

the calculation of the Descriptive statistics of a numeric variable of insect species in the Naâma wetland show that the population insects are normally distributed with a Standard deviation equal 3.4345 (**Table 3**).

Class	Order	Family	Species	Relative frequencies	Dispersion index
Insect	Coleoptera	Coccinellidae	<i>Coccinella septempunctata</i> (Linnaeus, 1758)	11.98	8.51
		Tenebrionidae	<i>Blaps lethifera</i> (Marsham, 1802)	7.85	3.73
			<i>Gnaptor spinimanus</i> (Pallas, 1781)	9.22	9.22
			<i>Pimelia bipunctata</i> (Fabricius, 1781)	12.16	9.14
		Carabidae	<i>Iophrya flexuosa</i> (Fabricius, 1787)	13.22	8.13
			<i>Poecilus</i> sp (Schaller 1783)	14.22	9.65
		Cantharidae	<i>Cantaris fuxa</i> (Linnaeus, 1758)	6.34	3.33
		Geotrupidae	<i>Geotrupes</i> sp (Latreille, 1796)	19.34	9.65
		Meloidae	<i>Mylabris variabilis</i> (Pallas, 1781)	2.77	1.22
			<i>Mylabris quadripunctata</i> (Linnaeus, 1767)	2.87	1.39
			<i>Mylabris</i> sp (Pallas, 1781)	1.92	0.43
	orthoptera	Acrididae	<i>Chorthippus</i> sp (Fieber, 1852)	1.34	0.87
			<i>Acrotylus fischeri</i> (Fieber, 1853)	6.03	0.75
			<i>Oedipoda fuscocincta</i> (Lucas 1849)	15.47	12.3
			<i>Oedipoda miniata</i> (Lucas 1849)	6.41	9.63
			<i>Sphingonotus rebescens</i> (Walker, 1870)	14.13	3.25
			<i>Sphingonotus octofasciatus</i> (Serville, 1838)	4.15	1.2
			<i>Sphingoderus carinatus</i> (Saussure, 1888)	4.52	0.23
			<i>Sphingonotus lucasii</i> (Saussure, 1888)	3.01	2.05
			<i>Calliptamus barbarus</i> (Costa 1836)	4.15	5.36
			<i>Calliptamus wattenwylianus</i> (Pantel, 1896)	1.88	1.11
			<i>Pezotettix giornai</i> (Rossi, 1794)	0.67	0.13
			<i>Anacridium aegyptium</i> (Linnaeus, 1774)	6.79	4.7
			<i>Omocestus lepineyi</i> (Chopard, 1937)	3.39	0.27
			<i>Omocestus lecerfi</i> (Chopard, 1937)	4.15	1.03
		Pyrgomorphidae	<i>Pyrgomorpha conica</i> (Olivier 1791)	1.88	0.17

Class	Order	Family	Species	Relative frequencies	Dispersion index
Insecta	Hymenoptera	Pamphagidae	<i>Tmethis marocanus</i> (Bolívar, 1908)	15.84	7.4
			<i>Tmethis cisti</i> (Bolívar, 1908)	1.13	1.54
			<i>Ocneridia volxemii</i> (Bolívar, 1878)	5.28	1.9
		Gryllidae	<i>Melanogryllus desertus</i> (Pallas, 1774)	0.75	0.16
		Tettigonidae	<i>Tettigonia albifrons</i> (Fabricius, 1775)	0.75	0.16
		Vespidae	<i>Polistes dominula</i> (Christ, 1791)	3.87	2.26
		Pompilidae	<i>Arachnospila</i> sp (Kohl, 1898)	4.74	2.37
		Apidae	<i>Apis mellifera</i> (Linnaeus, 1758)	9.76	8.14
		Formicidae	<i>Dinoponera</i> sp (Guérin-Méneville, 1838)	3.98	1.92
	Lepidoptera	Nymphalidae	<i>Issoria</i> sp (Doherty, 1886)	3.65	1.72
			<i>Vanessa atalanta</i> (Linnaeus, 1758)	0.23	1.23
		Pieridae	<i>Pieris</i> sp (Schrank, 1801)	0.83	0.11
		Sphingidae	<i>Agrius convolvuli</i> (Linnaeus, 1758)	1.98	1.10
		Noctuidae	<i>Acronicta</i> (Linnaeus, 1758)	3.99	0.11
	Diptera	Muscidae	<i>Musca domestica</i> (Linnaeus, 1758)	6.87	4.84
		Calliphoridae	<i>Calliphora vicina</i> (Robineau-Desvoidy, 1830)	2.65	1.56
		Sarcophagidae	<i>Sarophage carnaria</i> (Linnaeus, 1758)	1.88	0.82
	Odonata	Libellulidae	<i>Orthetrum brunneum</i> (Fonscolombe, 1837)	1.09	0.17
			<i>Orthetrum coerulescens</i> (Fabricius, 1798)	3.87	0.88
			<i>Portecoupe holartique</i> (Charpentier, 1840)	1.73	0.27
		Coenagrionidae	<i>Enallagma civile</i> (Hagen, 1861)	2.54	1.88
			<i>Ceriagrion tenellum</i> (Villers, 1789)	0.54	1.36
Insecta	Hemiptera	Pyrrhocoridae	<i>Pyrrhocoris apterus</i> (Linnaeus, 1758)	2.77	1.02
	Plecoptera	Leuctridae	<i>Leuctra</i> sp (Klapálek, 1905)	6.58	3.71
	Ephemeroptera	Baetidae	<i>Baetis rhodani</i> (Pictet, 1843)	3.84	1.77

Table 2.
Summary of insect species identified in the wetland of Naâma.

Figure 2
Distribution of insect orders by families and species in the study area.

3.6 Student's t test for single sample

The calculation of the student test for the identified insect population in the Naama wetland shows that the test statistic would follow a normal distribution. The sample mean is equal to the population mean with a Standard deviation equal 3.4345 and Student's t test equal 4.26 (Table 4).

3.7 Correspondence factor analysis (CFA); CFA of insect order species

The initial table (1) corresponding to 20 surveys show the presence of species in the stations according to the type of environment; plants environment, rocky environment and aquatic environment An AFC conducted on this matrix allowed to build a hierarchical classification calculated from the coordinates of species. Dendrogram clearly differentiates three groups of species of unequal size:

Group A: It is mainly represented in the plants environment.

Group B: It includes species specific to degraded and rocky environment.

Group C: species specific to aquatic environment(*Portecoupe sp*, *Orthetrum sp*, *Orthetrum sp*, *Pieris sp*, *Vanessa sp*, *Issoria sp*) (Figure 4).

3.8 The ascending hierarchical classification (C.H.A)

From the Euclidean distances based on the scores of the three factors A.F.C (Figure 2), it is possible to recognize three groups: **Group A:** It is mainly represented in the plants environment.

Group B: It includes species specific to degraded and rocky environment.

Group C: species specific to aquatic environment.

The ascending hierarchical classification (C.H.A) confirm our results of Correspondence factor analysis (Figure 5).

3.9 CFA of orthoptera order species

In the plants and rocky environment., very high faunal diversity of orthoptera (locust)species was recorded; this is supported by the fact that high environmental quality usually correlates with the greatest species richness and diversity.

Group A: It is mainly represented in the plants environment.

Group B: It includes species specific to degraded and rocky environment.

Figure 3.
Dispersion index and The relative frequency of insect species order in the wetland of Naâma.

Minimum	Quartile 1	Median	Mean	Quartile 3	Maximum	Standard deviation
1	1	1	3.065	3	12	3.4345

Table 3.
Descriptive statistics of a numeric variable of insect species in the Naâma wetland.

t	Df	p-value	Confidence interval, 95%
4.268	51	2.55e-05	[1.8047, 4.3243]
Size		Average	Standard deviation
Variable	51	3.0645	3.4345

Table 4.
Student's *t* test for single sample of insect species in the Naâma wetland.

Figure 4.
Factorial analysis of the correspondence of insect species in the wetland of Naâma.

Figure 5.
Hierarchical ascending classification of insects species in the wetland of Naâma.

Figure 6.
Factorial analysis of the correspondence of Orthoptera species of Naâma (Algeria).

The first entity in the right of the projection is the largest as it includes 75% of species. It represents the species caught in plants environment (*Oedipoda fuscocincta*, *Sphingonotus*, *Oedipoda miniata*, *Omocestus*, *Tmethis*, *Calliptamus*, *Anacridium* and *Sphingonotus octofasciatus*. *Pyrgomorpha*, *Melanogryllus*, *sp*, *Sphingonotus* and *sp*.). The second entity includes species which are found in rocky environment (**Figure 6**).

3.10 The Normalized Global Biological Index

The IBGN is organized in rows 9 faunal indicator groups and in columns 14 classes of taxonomic varieties. For this, we successively determine:

- The taxonomic variety of the sample (Σt) which is equal to the total number of taxa collected even if they are represented by only 1 individual.
- The faunistic indicator group (GI) by taking into account only the indicator taxa represented in the sample by 3 individuals or 10 individuals depending on the taxa. The determination of GI is carried out by prospecting the columns of the table from top to bottom and by selecting the taxon which represents the highest degree of pollutant sensitivity of the entire sample of the station studied. Then the IBGN value be read by crossing the taxonomic variety column and the indicator faunal group row. Depending on the taxonomic diversity of the OglatedDaira station and the presence or absence of indicator taxa, a variant hydrobiological quality score is assigned from 1 to 20.

We see that the study area has good hydrobiological quality with moderate pollution (IBGN = 14: the taxonomic variety ST = 51 and an indicator group (GI = 9) (**Table 1**).

3.11 Study and analysis of the structure flora in the wetland of naama

The diversity analysis by Shannon index (H'), shows that the most important diversity is marked in the wetland of Ain Ben Khelil with ($H' = 2.43$). the maximum diversity is equal 3.13.

Equitability is equal 0.77, which is usually taken as an indicator of a balanced population and which reflects the stability of the environment.

3.12 Overall recoveries of plant species recorded in the wetland of Naâma

In the wetland of Naama, *Stipa tenacissima* is the species most representative, it covers more than 50%. Against in the wetland of Ain Ben Khelil, *Stipa tenacissima*, *Tamarix gallica*, *Lygeum spartum*, *Ziziphus lotus* are the representative species of this station.

3.13 The relative abundance of plant species recorded in the wetland of Naâma

15 families are present in the wetland of Naama, the most representative families are Asteraceae with a relative abundance of 17.39%, followed by the Amaranthaceae and Poaceae with 13.04%.

3.14 Biological type of plant species recorded in the wetland of Naâma

The biological type leads to the natural form of the plant that is one of the basic criteria for classifying species in biological types, composed of perennial species, woody or herbaceous and annual species. The specific aspect of the form obtained is dependent on environmental variations.

In our study area, therophytes dominate other biological types with 40.62% followed by chamaephytes with 31.25%, hemicryptophytes remain in third with 15.62%.

4. Discussion

This study was carried out in the arid region of Naâma, this region characterized by steppe formations dominated by *Stipa tenacissima*, According to Tormo [8], Woody species play a key role in *Stipa tenacissima* steppes, they affect ecosystem functioning, facilitate establishment of other plants and increase plant richness.

The insect species recorded are divided into 9 orders; Ephemeroptera, Coleoptera, Orthoptera, Hymenoptera, Lepidoptera, Hemiptera, Odonata, Diptera and Plecoptera. From this present work, 27 insect families were found. The most represented order is Coleoptera with six families and 11 species Orthoptera represent 5 families and 20 species. The Hemiptera, Plecoptera and Ephemeroptera represent only one family and one species for each order. Invertebrates are more severely and quickly affected than other taxa by changes in the landscape. The insects are responsible for many processes in the ecosystem and its loss can have negative effects on entire communities. Thus, a strong understanding of insect responses to human activity is necessary both to support policy decisions for conservation and to evaluate functional consequences of human disturbance on ecosystems [6].

many diversity indices have been developed to describe responses of a community to environment variation, combining the three components of community structure, namely richness (number of species present), Shannon-Wiener Index [9].

The Shannon-Weaver diversity index obtained in the study area is 2.24bit, maximum diversity is 1.89. Equitability is of the order of 0.56. These values indicate that the wetland is characterized by a very important fauna diversity.

Orthoptera (locust) are able to threaten arid ecosystems, human health and resistant to pesticides, a study was carried by (Brahimi et al., 2020) on the chemical mechanism of locust resistance in the arid region of Naama. Hardersen [10] reported the potential of aquatic insects as indicators of water quality. Several other species of the families Gyrinidae, Dytiscidae, Hydrophilidae (Coleoptera), Notonectidae, Veliidae (Heteroptera) and Plecoptera and Ephemeroptera Orders have high adaptive capacity, colonizing most of the environments and occurring throughout the year, reflecting ecological and geographical changes, and hence their conservation status.

Davis [11] confirm beetles species (Coleoptera: Scarabaeidae) have a high potential as environmental indicators in forest area .

In this study an important diversity of beetles (coleoptera) was recorded in this area, beetles play an essential role as decomposers of organic matter in the balance of ecosystems. Beetles from Order Coleoptera and Family Carabidae are important predators. They participate of biological control, biological monitoring of pollution from oil, sulfur, herbicides, CO₂, insecticides and radioactive phosphorus. The moths and butterflies (Lepidoptera), besides having basic requirements, have ecological faithfulness in temperate and tropical regions and are very sensitive to changes in the environment [12]. the trapping methods used have a great importance to better collect the species in quantity and quality. This explains the differentiation from other orders in number of species.

According to Rizo-Patrón et al. [13], group of macroinvertebrates (*Baetis sp.*, *Fallceon sp.*, *Leptohyphes sp.*, *Tricorythodes sp.*, *Farrodes sp.*, *Phyllogomphoides sp.*, *Hydroptila sp.*, *Mayatrichia sp.*, *Neotrichia sp.*, *Oxyethira sp.*, *Nectopsyche sp.1*, *Nectopsyche sp.2*, *Oecetis sp.*) can be used as a bioindicators of water quality in management practices agroecosystems.

In this study we noticed a scarcity of pollinating species, this scarcity is due to the uncontrolled and anarchic use of phytosanitary products and insecticides in the action of the Locust control. Pollinators, especially honeybees (*Apis mellifera*), are considered reliable biological indicators because they show environment chemical impairment due to high mortality rate and intercept particles suspended in air or flowers. These substances can then be detected using methods of analysis [14]. Among these organisms, the insects may contribute to a practical assessment of the sustainability degree [15].

According to Eggleton et al. [16], termites are important decomposers in land ecosystems. Its activity increases soil infiltration capacity, leading to water retention and soil productivity. Read and Anderson [17] showed The value of ants as bio-warning indicators in the Australian arid rangelands.

According to Nummelin et al. [18], A study of the heavy metal concentrations of different predatory insects (Gerridae), dragon fly larvae (Odonata), anteater larvae (Myrmeleontidae) and ants (Formicidae) showed higher metal concentrations and that these groups of insects can be used as indicators of heavy metals.

Goncharov et al. [19] indicates that using the density index of Ephemeroptera Plecoptera-Trichoptera (EPT); showed a capacity for regeneration of these indicator groups under unfavorable conditions. Cortelezzia [20] indicates that In some taxa of chironomids, their potential as a bioindicator increased as the taxonomic level decreased (eg, Chironominae). However, in other taxa, this potential as a bio-indicator of water quality remains at the subfamily level. The Ephemeroptera and Plecoptera larvae are recognized as good bioindicators of eutrophication in running water due to their sensitivity to oxygen depletion. The pollution indicators can be attributed by the disappearance of certain more or less sensitive species or, on the contrary, by the appearance of other so-called resistant species. The specific river environment sampled may influence the proliferation of certain taxa and the specific behaviours of those taxa in certain habitats [21].

5. Conclusion

The insect species recorded are divided into 9 orders; Ephemeroptera, Coleoptera, Orthoptera, Hymenoptera, Lepidoptera, Hemiptera, Odonata, Diptera and Plecoptera. From this present work, 27 insect families were found. The most represented order is Coleoptera with six families and 11 species Orthoptera represent 5 families and 20 species. The Hemiptera, Plecoptera and Ephemeroptera represent only one family and one species for each order. by this study we noticed a scarcity of pollinating species, this scarcity is due to the uncontrolled and anarchic use of phytosanitary products and insecticides in the action of the Locust control.

The Shannon-Weaver diversity index obtained in the study area is 2.24bit, maximum diversity is 1.89. Equitability is of the order of 0.56. These values indicate that the wetland is characterized by a very important fauna diversity. Statistical study of the entomofauna identified in the Naama wetland show that the population insects are normally distributed in this environment.

The study of the hydrobiological quality in the wetland of Naama, assessed by the IBGN method, showed good hydrobiological quality with moderate pollution (IBGN = 14). This pollution is precisely marked by the requirement of Ephemeroptera and Plecoptera. Ephemeroptera are polluo-resistant species in polluted aquatic environments, unlike stoneflies which are polluo-sensitive species. These two orders are used as good biological indicators of polluted aquatic environments.

This study concluded that the Class Insecta has many potential representatives that can be used as environmental bioindicators, among which are some species from the Coleoptera, Diptera, Lepidoptera, Hymenoptera, Hemiptera, Isoptera Orders and others.

These data constitute a first database on the structure of the entomofauna in the wetland classified by Ramsar Hawdh ed. दौर of arid region ofAlgeria, the results obtained also make it possible to control and monitor pollution in this wetland, in order to protect these fragile and arid ecosystems. Threatened by desertification and human actions .

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Declaration of competing interest

The authors declare that they have no conflict of interest.

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References

- [1] Delaunay M.2016. Clé d'identification numérique des insectes aquatiques d'Ile-de-France: un outil pour les acteurs de terrain. Conference: 7èmes Recontres Naturalistes .
- [2] Brown, K. 1991.Conservation of neotropical environments: Insects as indicators. The conservation of insects and their habitats. Collins N.J. Thomas. Chap. 14, p. 350- 420.
- [3] Che Salmah MR, Al-Shami SA, Madziatul Rosemahanie M, Abu Hassan A. 2013. Biological and ecological diversity of aquatic macroinvertebrates in response to hydrological and physicochemical parameters in tropical forest streams of Gunung Tebu, Malaysia: Implications for ecohydrological assessment. *Ecohydrology*.;7(2):496–507. [Google Scholar].
- [4] Taylor BW, McIntosh AR, Peckarsky BL. Sampling stream invertebrates using electroshocking techniques: Implications for basic and applied research. *Canadian Journal of Fisheries and Aquatic Sciences*. 2001;58 (3):437–445. [Google Scholar].
- [5] Ramade F.2003. Eléments d'écologie – Ecologie fondamentale. № 03, Ed. DUNOD, Paris, 690p.
- [6] Nicholasa, E. Larsenb, T. Spectora, S. Davise, A. L. Escobarc, F. Favilad, M. Vulinece, K. 2007.Global dung beetle response to tropical forest modification and fragmentation: A quantitative literature review and meta-analysis. *Biologic. Conserv.* v. 137, p. 1– 19.
- [7] Dajoz R .1970. Précis d'écologie. Ed. Dunod, Paris,). 357 pp.
- [8] Tormo J a, Amat B b, Cortina J b. 2020.Litter as a filter for germination in semi-arid *Stipa tenacissima* steppes *Journal of Arid Environments*. <https://doi.org/10.1016/j.jaridenv.2020.104258>.
- [9] Li Li, Binghui Z, Lusan L .2010. Biomonitoring and Bioindicators Used for River Ecosystems: Definitions, Approaches and Trends .*Procedia Environmental Sciences* 2 1510– 1524International Society for Environmental Information Sciences. Annual Conference (ISEIS) .Elsevier . Ltd.Open access under. CC BY-NC-ND license.
- [10] Hardersen, S. 2000. The role of behavioural ecology of damselflies in the use of fluctuating asymmetry as a bioindicator of water poppution. *Ecolog. Entomol.*, v. 25, p. 45 – 53.
- [11] Davis, A 2000. Does reduced-impact logging help preserve biodiversity in tropical rainforest? A case study from Borneo using dung beetles (Coleoptera: Scarabaeoidea) as indicators. *Environ. Entomol.*, v. 29, n.3, p. 469-473.
- [12] Da Rocha J R M, Almeida J R, Lins G A, Durval A.2010. Insects as indicators of environmental changing and pollution: a review of appropriate species and their monitoring. *HOLOS Environment*, v.10 n.2, 2010 - P. 250.
- [13] Rizo-Patrón F V. Anjali Kumar, Michael B. Colton M .2013. Macroinvertebrate communities as bioindicators of water quality in conventional and organic irrigated rice fields in Guanacaste, Costa Rica *Ecological Indicators*. Volume 29, June 2013, Pages 68-78. ELSEVIER.
- [14] Ghini, S. Fernández, M. Picó, Y . marín, R. Fini, F. Mañes, J. Girotti, S. 2004.Occurrence and distribution of pesticides in the province of Bologna, Italy, using honeybees as bioindicators. *Arch. Environ. Contam.Toxicol.*, v. 47, p. 479–488.
- [15] Lopes, B. G. C. 2008.Levantamento da entomofauna bioindicadora da

qualidade ambiental em diferentes áreas do Alto Jequitinhonha – Minas Gerais. 2008. 47f. Trabalho de Conclusão de Curso - Escola Agrotécnica Federal de Inconfidentes. Inconfidentes, Minas Gerais.

[16] Eggleton, P, Williams, P. H, Gaston, K. J. 1994. Explaining global termite diversity: productivity or history? *Biodivers. Conserv.*, v. 3, p.318–330,

[17] Read J L. Andersen N..2000.The value of ants as early warning bioindicators: responses to pulsed cattle grazing at an Australian arid zone locality *Journal of Arid Environments* Volume 45, Issue 3, July, Pages 231 251 <https://doi.org/10.1006/jare.2000.0634>

[18] Nummelina M, Lodenius M, Tulisalo E, Hirvonena H, Alankob T. 2007. Predatory insects as bioindicators of heavy metal pollution *Environmental Pollution* Volume 145, Issue 1, January 2007, Pages 339-347 Elsevier. <https://doi.org/10.1016/j.envpol.2006.03.002>.

[19] Goncharov A.V., Baturin N.S, Maryinskyc V.V., Kausd A.K., Chalova S.R.2020.Ecological assessment of the Selenga River basin, the main tributary of Lake Baikal, using aquatic macroinvertebrate communities as bioindicators. *Journal of Great Lakes Research*. Volume 46, Issue 1, February 2020, Pages 53-61. <https://doi.org/10.1016/j.jglr.2019.11.005>

[20] Cortelezzia A, Simoya M, Sirib A, Donatob M, Cepedaa R, Marinellia C, Berkunskya I .2020 .New insights on bioindicator value of Chironomids by using occupancy Ecological Indicators modelling. *Volume 117*, October 2020, 106619 Elsevier. <https://doi.org/10.1016/j.ecolind.2020.106619>.

[21] Merritt RW, Cummins KW. 1996. An introduction to the aquatic insects of North America. 3rd ed. Iowa, USA: Kendall/Hunt Publishing Company; [Google Scholar]