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# Inventory and Ecology of Macroinvertebrates in Temporary Pools in the Region of Oum El Bouaghi (North-East Algeria)

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**ABSTRACT**

*This work aimed to conduct a systematic study of the macroinvertebrate species of seventeen temporary pools in south of Oum El Bouaghi, in order to bring a contribution to the knowledge of the entomofauna of these ephemeral ecosystems, and analyze their waters for better characterization of their environment where 18 physicochemical parameters were analyzed. Faunal samples were harvested using a surgeon net. The identification of the organisms was done using the determination keys, Tachet et al. (2002), and digital keys. The results of the physicochemical analysis carried out on the 17 stations revealed that the temperature of the water varied between 12.6 ° C and 20.3 ° C, with an average of 17.36 ± 2.13 ° C, the pH of the waters varied between 6.45 and 8.48, with an average of 7.34 ± 0.54. The dissolved oxygen showed an average of 5.81 ± 0.66mg / l, and the electrical conductivity of the waters of the region was large and varied between 966 and 1055 µS.cm-1, with an average value of 1012.1 ± 20.17 µS.cm -1. For pollution elements, only nitrates could present a serious contamination. Faunistic analysis has identified 11 orders, 31 families and 47 species of which 39 were constant, 7 were ubiquitous and only one was accessory. Beetles were the largest numerically important ecological group (41.94%), followed by odonates with 9.68%, followed by orders from Amphipods and Basommatophores with 6.45%, while other orders represented only 3.22% each.*

**Keywords:** *Temporary pools, Quality, Physico-chemical, Macroinvertebrates.*

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## 1. INTRODUCTION

Temporary pools are unique environments, neither really aquatic nor completely terrestrial, of very small watershed. During the year, they present alternating flooding and dewatering phases. They are characterized by a very autonomous hydrological functioning, and a small thickness of soil (Lorenzoni, C., & Paradis, G. 2000; Thiéry, 1987), and they constitute singular habitats of first-rate floristic and biogeographical interest (Laribi et al., 2016).

These habitats are home to remarkable biological communities, which are largely subservient to them and are characterized by numerous rare, endangered and high-value species (Médail et al., 1998; Quézel, 1998). These pools are also home to specialized vegetation such as the Characeae, which is a group of non-vascular macrophytes, and often provide refuge and breeding grounds for various species of the aquatic and benthic fauna (Zouaïdia, 2015).

Temporary pools have remained largely far from the interest of the scientific community in larger wetlands (lakes, sebkhas, etc.) due to their small size and ephemeral nature (Ferchichi, 2014).

In Algeria, the study of the pools goes back to Gauthier (1928), who for several years was interested in zooplankton and macroin vertebrates in a pool complex near Algiers. This work was interrupted for a long period, and the Algerian pools were not the subject of any other scientific study until the end of the 20th century. At the beginning of 1996, a research program for temporary pools in Numidia, in north-eastern Algeria, was set up. This study was initiated by the Samraoui's (2002) team of the University of Annaba, then came Zerguine and Rossaro's (2010) research on the chironomids of Eastern Numidia. To fill this gap, the present investigation focused on a series of temporary pools (17 temporary pools) still unexplored to this day, located in the southern region of Oum El Bouaghi, in north-eastern Algeria, in order to establish a first reference faunistic inventory for these pools.

## 2. MATERIALS AND METHODS

### Study Area

The temporary pools are perched at an altitude of 832 to 836 m, located in the south of the town of Oum El Bouaghi, in the topographic depression between Argoub Kemellal in the north, and Djebel Tarf in the south. Jebel Tarf is composed of Cretaceous (Aptian) limestone sedimentary rocks rich in fossils and microfossils. Argoub Kemellal, on the other hand, consists of a gutter of sands and clays of Pliocene age, covered with quaternary lacustrine limestone bars. The depression is covered with an ancient Quaternary sediment, giving rise to a crust of lacustrine limestones with the power of water storage. This region lies in the eastern extension of the highlands, and is characterized by a semi-arid bioclimate, hot summer and cold winter.

The depth varies between 7 cm and 64 cm, with slightly sandy mud sediment with the presence of algae. This region receives a low rainfall with 321 mm / year. The water temperature of the pools varies between 12.6 and 20.3 ° C, the salinity

between 0% and 0.3%, the dissolved oxygen between 4.2 6.50 mg / l, and the pH between 6.54 and 8.48.

**Methods**

After *in-situ* measurement of temperature, pH, conductivity, and dissolved oxygen using WTW portable measuring device, the samples were pre-filtered and placed in 1500 mL polyethylene bottles. The water samples were preserved with 2 ml of concentrated hydrochloric acid (pH = 2). The water samples were transported in a cooler at a low temperature (± 4 °C) to stop the metabolic activities of the organisms in the water. Other physicochemical parameters: turbidity, salinity, suspended solids (MES), nitrates ($NO^{3-}$), nitrites ($NO^{2-}$), chlorides ($Cl^{-}$), calcium ($Ca^{2+}$), ammonium ($NH^{4+}$), phosphates ($PO_4^{3-}$), Sulfates ($SO_4^{2-}$), sodium (Na), potassium (K), bicarbonates ($HCO^{3-}$), and magnesium ($Mg^{2+}$) were made at the "RNAMS" laboratory of the University of Oum El Bouaghi in accordance with the AFNOR standards (1983) and the methods recommended by Rodier (1984).

In these bodies of water, where the water was stagnant; the habitats which were considered to be the most biogenic were sampled, namely the banks, the woody debris (trunks, branches) and the submerged parts of the macrophytes. These three habitats were selected because of their stability and productivity (Stark et al., 2001).

In these calm areas, where fine sediments were deposited, monthly withdrawals from November 2013 to March 2016 (after the impoundment of these ephemeral ecosystems) of water and wildlife have been investigated with the help of a "Surber" type sampler (with a surface area of 1/20 $m^2$ (20x25 cm), equipped with a mesh net of 500 µm) which was designed to use in shallow waters. It better adapted to the temporary environments, and their different biotopes (Bouzidi & Giudicelli, 1994).

The stand, most often formed by immature insect larvae which do not characterize temporary pools, has been determined only at the family level.

**Data Analysis**

All the data collected on the waters of the region were the subject of a statistical analysis, and an Ascending Hierarchical Classification (AMP) was carried out using the software XLSTAT 2014. These classification techniques are particularly useful in the framework of the exploratory investigations in order to identify general trends in the data, and suggest future analysis (Kos & Psenicka, 2000).

For the treatment of faunal data, different quantitative parameters of the stands; such as species richness, density and dominance, as well as the Shannon index (H ') and that of equitability (E) were used.

## 3. RESULTS AND DISCUSSION

**Physical chemistry of water**

The results of the physicochemical analysis performed on the 17 temporary pools in the Oum El Bouaghi region have been presented in Table 1. The water temperature varied between 12.6 ° C and 20.3 ° C, with an average of 17.36 ± 2.13 °C. The pH of the water varied between 6.45 and 8.48, with an average of 7.34 ± 0.54. The dissolved oxygen showed an average of 5.81 ± 0.66 mg/L.

Regarding the electrical conductivity of the waters of the region, it varied between 966 and 1055 µS.cm-1, with an average value of 1012.1 ± 20.17 µS.cm- 1. For pollution elements ($NH_4$, $P_2O_5$, $NO_2$, $NO_3$), only nitrates could present a serious contamination whose levels varied between 11 and 68.24 mg / l with an average of 27.95 ± 17.49mg / l.

**Table 1.** Results of physicochemical analysis

| | Descriptive statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Physicochemical parameters | Mean | SD | SE(M) | IQR | CV | Skewness | Kurtosis | Min | Max |
| pH | 7.34 | 0.54 | 0.13 | 0.4 | 0.07 | 0.78 | 0.59 | 6.54 | 8.48 |
| Température [ºC] | 17.36 | 2.13 | 0.52 | 2.7 | 0.12 | -0.88 | 0.14 | 12.6 | 20.3 |
| Dissolved oxygen [mg/L] | 5.81 | 0.66 | 0.16 | 0.8 | 0.11 | -1.15 | 0.63 | 4.2 | 6.5 |
| Electrical conductivity [µs/cm] | 1012.1 | 20.17 | 4.89 | 21 | 0.02 | -0.27 | 1.36 | 966 | 1055 |
| Turbidity [NTU] | 160.4 | 16.67 | 4.04 | 26 | 0.10 | -0.31 | -0.14 | 124 | 188 |
| Phosphorus pentoxide, $P_2O_5$[mg/L] | 0.16 | 0.18 | 0.04 | 0.03 | 1.13 | 3.04 | 9.94 | 0.03 | 0.8 |
| Ammonium [mg/L] | 0.46 | 0.42 | 0.10 | 0.65 | 0.92 | 0.51 | -0.84 | 0 | 1.3 |
| Nitrates [mg/L] | 27.95 | 17.49 | 4.24 | 24.9 | 0.63 | 1.14 | 0.11 | 11 | 68.24 |
| Nitrites [mg/L] | 0.11 | 0.11 | 0.03 | 0.195 | 0.95 | 0.70 | -0.86 | 0 | 0.33 |
| Calcium [mg/L] | 92.47 | 2.34 | 0.57 | 4.3 | 0.03 | 0.13 | -1.39 | 88.6 | 96.1 |
| Salinity [%] | 0.14 | 0.24 | 0.06 | 0.1 | 1.77 | 3.26 | 11.87 | 0 | 1 |
| Chloride [mg/L] | 109.56 | 8.63 | 2.09 | 14.6 | 0.08 | 0.01 | -1.17 | 97.5 | 123.1 |
| Total suspended solids [mg/L] | 38.52 | 3.49 | 0.85 | 5.08 | 0.09 | 0.21 | -1.05 | 33.5 | 45 |
| Magnesium [mg/L] | 3.18 | 0.20 | 0.05 | 0.3 | 0.06 | -0.21 | -1.12 | 2.85 | 3.45 |
| Bicarbonate [mg/L] | 125.59 | 10.81 | 2.62 | 7.6 | 0.09 | 0.78 | 3.27 | 102 | 154.2 |
| Sodium [mg/L] | 52.77 | 2.32 | 0.56 | 3.92 | 0.04 | -0.13 | -0.95 | 48.5 | 56.12 |
| Potassium [mg/L] | 2.63 | 0.31 | 0.08 | 0.27 | 0.12 | 0.70 | 0.03 | 2.11 | 3.3 |
| Sulfates [mg/L] | 93.84 | 2.71 | 0.66 | 3.3 | 0.03 | -0.51 | -0.47 | 88.5 | 97.6 |

**Ascending Hierarchical Classification Analysis (AHC)**

Figure (1) presents the dendrogram derived from the classification of surface waters of the temporary Pools' area on the basis of their mineralization. This dendrogram highlighted four groupings (high dissimilarity). The first group concerned the indicator elements of the organic pollution of which Nitrogen and phosphorus derivatives were the most important group given the number of variables it included, the second group concerned only the electrical conductivity. The third group consisted of the significant turbidity waters, and the fourth group presented waters whose mineralization was influenced by the action of evaporates.

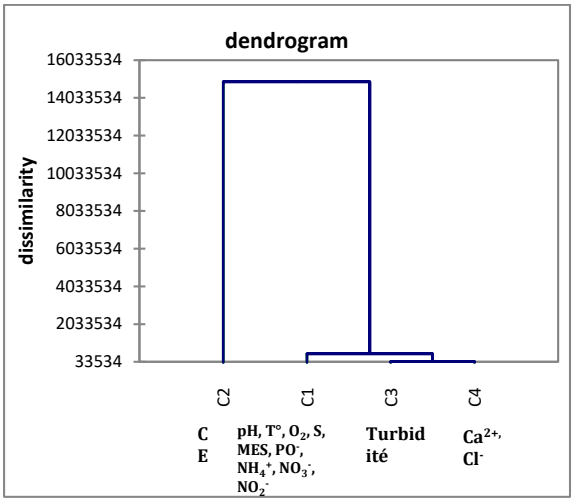


**Figure 1.** Dendrogram of variables grouped into 4 classes.

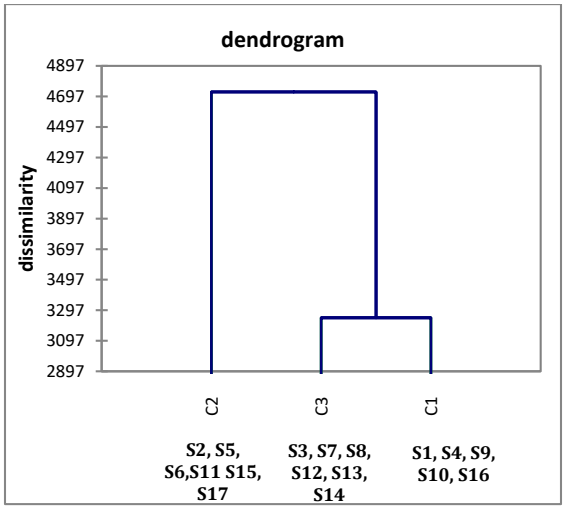


**Figure 2.** Dendrogram of stations grouped into 4 classes

The results obtained (Figure. 2) from the analysis carried out on the sampling sites showed a significant difference between points belonging to the class C2 with respect to C1 and C3. The difference was not significant for the latter two.

**Composition of Invertebrate Macro**

The faunistic analysis of the 17 stations led to the determination of 7871 individuals belonging to 11 orders, 31 families and 47 species, 39 of them were constant, abundant, very frequent, and of a wide ecological valence, 7 were ubiquitous, and only one was accessory. The fact that a large number of species was constant was due to the sampling period that always coincided with the rainy periods because these water bodies have been said to be ephemeral. With a relatively large abundance (7871 individuals), eleven orders were identified (Figure. 3), dominated by Coleoptera which formed the largest digitally significant ecological group (41.94%), followed by that of odonates with 9.68%, then came the orders of the Amphipods and Basommatophores with 6.45%, while the other orders represented only 3.22% each. Figure. 4 represents the occurrence classes.

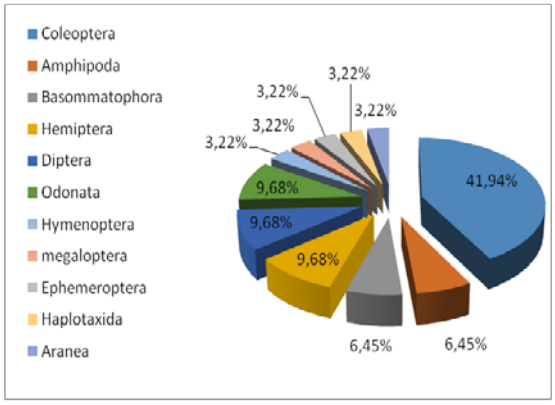


**Figure 3.** Abundance of the different orders

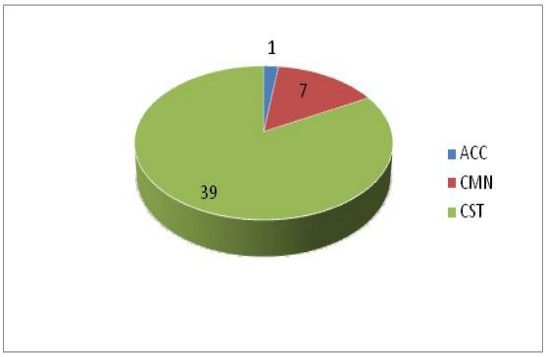


**Figure 4.** The occurrence classes.

**Population Structure**

**Shannon-Wiever Index and Fairness**

The species diversity index (Shannon-Wiener index) was high when taxonomic richness was important, and the distribution of individuals between taxa was balanced. A less diversified stand with dominant species resulted in low values of this index.

The significant variations in species diversity reflected the differences in the distribution of taxon abundance. The two graphs (Figure.5), the Shannon-Wiener index (H '), and the equitability (E) showed the same trend.

The highest values were recorded at station S1 with a value of 3.45. This station had a well-diversified stand where several taxa were numerically represented.

The lowest values were recorded in stations (S4) and (S15). This would be due to the presence of an unbalanced and highly

specialized community represented by a small number of Taxa that have been developed at the expense of other extinct taxa.

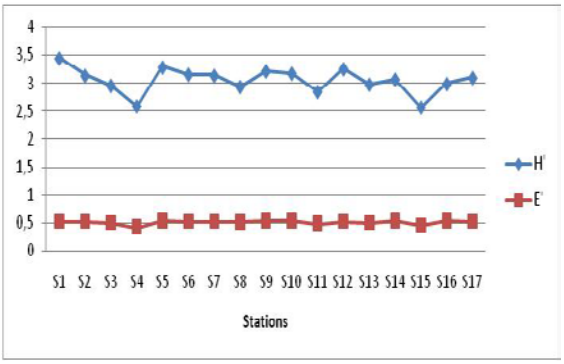


**Figure 5**. Graphical Representation of Shannon and Fairness Indices.

## 4. CONCLUSION

This study was conducted in the southern region of Oum El Bouaghi in eastern Algeria, concerning the knowledge of invertebrate communities in 17 temporary pools for three consecutive years of 2013-2016. Two aspects were studied including the physico-chemical quality of the water and the invertebrate inventory.

Our study sampled 7871 individuals belonging to 11 orders, 31 families and 47 species, 39 of which were constant, abundant, very frequent, and widely ecologically valuable, 7 were omnipresent and only one was accessory.

The obtained results showed that the factors that seemed to govern the spatial distribution of invertebrates were conductivity / salinity, water depth, and hydroperiod.

Depending on the taxonomic categories, the class of insects dominated and was represented mainly by the order Coleoptera. The comparison of the results of this study with those obtained in other Mediterranean regions showed the dominance of this class in all of these regions. Finally, the sum of the obtained results gave a first glimpse of the invertebrate fauna of the studied temporary pools. Disparities concerned the differences in duration and the period of the study in the field; the species used drought adaptation strategies such as recolonization (Frouz et al., 2003).

It seems interesting to further expand this research, because the list of species that has been presented was not exhaustive. In the coming years, it is hoped to increase observation pressure in the field by exploring more sites, at different seasons and with the combination of several sampling techniques for wildlife

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