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PHYSICO-CHEMICAL AND BIOLOGICAL CHARACTERIZATION OF WELLS WATER QUALITY IN BERRICHE REGION (NORTH-EAST ALGERIA)

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ABSTRACT

This study concerns the aquatic fauna of wells in a semi-arid region of north-eastern Algeria. Five wells were selected and seasonal sampling of the aquatic fauna and water of these wells was carried out from September 2017 to June 2018, covering periods of high and low water. Two types of traps were used: the phreatobiological net and baited nets. The physico-chemical analyses of the wells' water showed that the majority of groundwater in this region is of poor quality, undersaturated in oxygen and highly mineralized. The fauna of the wells is composed of 21 taxa and 4562 individuals, dominated by Insects 56% followed by Crustaceans 25%. Only one species was found as a stygobian species *Pseudoniphargus sp*.

KEY WORDS : Groundwater, Stygobian fauna, Diversity, Wells, Algeria.

INTRODUCTION

Groundwater is a hidden, discrete and poorly understood resource, is an essential component of the hydrological cycle and accounts for 95% of the world's freshwater (Messouli, 1984). They play a vital role in water supply and are generally complementary to readily available surface water (Redjaimia *et al.*, 2020). They provide a stable habitat for a rich and diverse biocenosis adapted to these environments. They play an important role in the sustainability of many terrestrial ecosystems, and a crucial role in human life and socio-economic development (Danielopol *et al*., 2003).

In recent years, there has been a lot of research into the underground fauna. The majority of studies focus on ecological research and the relationship between the diversity of aquatic fauna and the quality of water in wells and sometimes springs and research into the origins of this fauna (Boutin, 1996; Hadjab *et al.*, 2018; Khammar *et al.*, 2019).

The aim of this research is therefore to complete the work already carried out in this field, by focusing on the commune of Berriche, through accessible routes such as wells, to contribute to the establishment of an exhaustive list of Algerian stygobian species.

MATERIALS AND METHODS

Choice of study stations

We prospected about ten wells and 5 wells were selected and were periodically the object of a faunistic and physico-chemical study, during the year (2017 /2018), because they were more or less significant and representative.

Fauna sampling

During this study, sampling campaigns were carried out to monitor the aquatic fauna of the 5 stations,

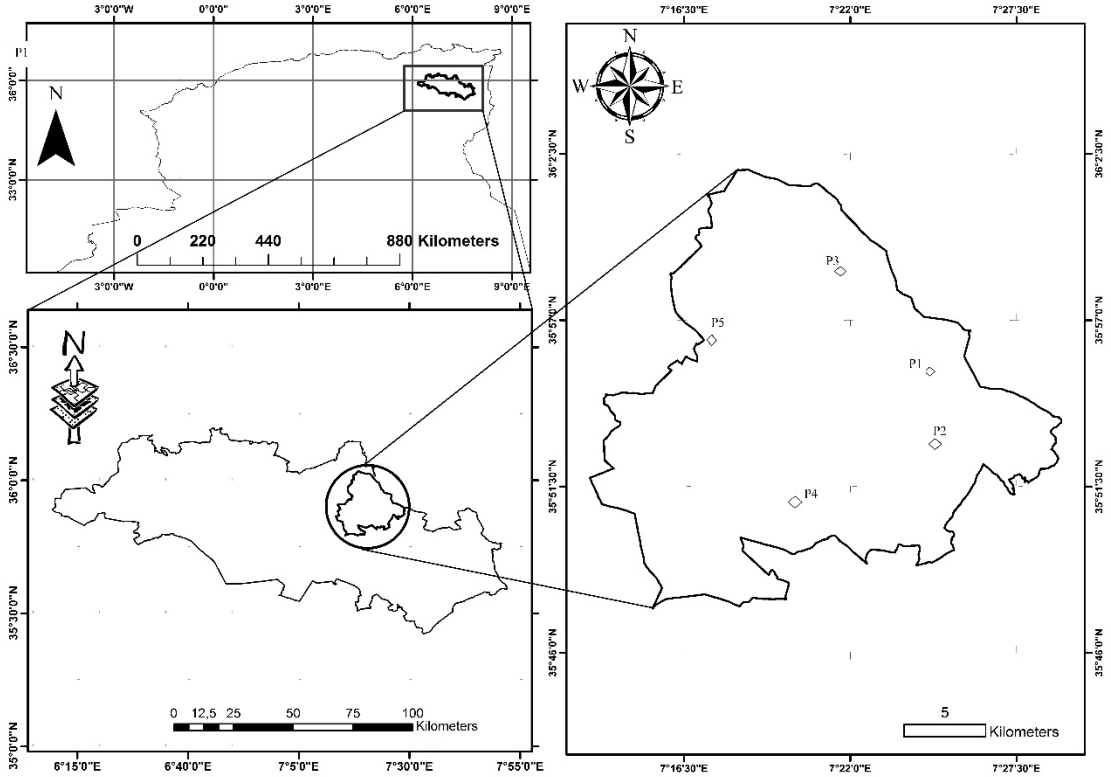

Fig. 1. Geographical positions of wells in the study area.

covering periods of high and low water.

Two methods of sampling the aquatic fauna of the wells were adopted. These were:

The phreatobiological net according to the model designed by Cvetkov (1968), (Bou, 1974) (Fig. 2).

- baited traps are often more effective in capturing creeping fauna (Fig. 3).

Sample processing

The samples are placed in jars and preserved in 70% ethanol. They were then transported to the laboratory, where they were sorted under a

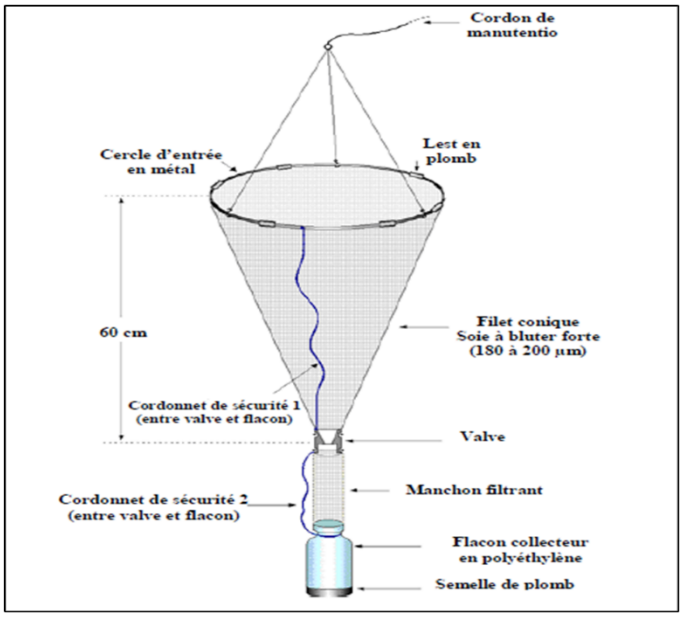

Fig. 2. Schematic of the phreatobiological net

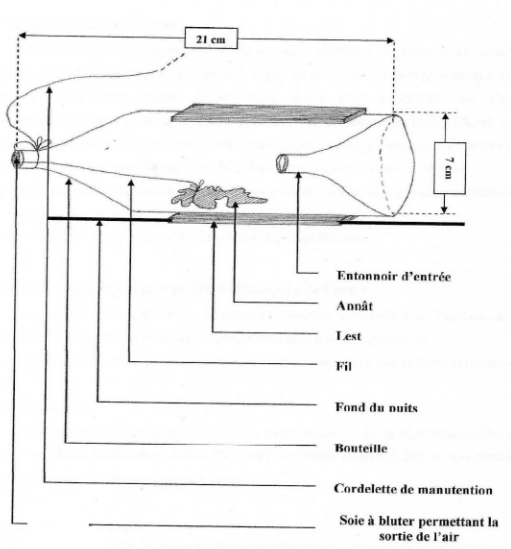

Fig. 3. Drawing of the baited trap

binocular loupe. All specimens were sorted and counted and then preserved in 70% ethanol before being identified. Determinations were made using the aquatic macroinvertebrate determination keys (Tachet *et al.,* 1980; Tachet *et al.,* 2000; Piscart, 2013 and Pinkster, 1993).

The principal components of a collection (PCA) were performed on the data from the maximum values of the abundance of the species of each well and the source (the total number of individuals collected in each of the stations during the study), appearing in Table 1. The data has been processed using software ADE4 (Doledec and Chessel, 1992).

RESULTS

Physico-chemical quality of the water

The seasonal variations of the parameters measured in the well water are very low throughout the year so that it is relevant to characterize each of the stations by the average of the values measured during the study, for each of the parameters considered.

Group G1: includes the two wells P3 and P5. The water from these wells has high mineralization and very high hardness. They are normally less oxygenated and are affected by ions indicating organic pollution. The water in these wells can therefore be considered to be of poor quality (Fig. 4).

Group G2: also made up of two wells, P1 and P2, the water in these wells is slightly alkaline and rich in oxygen, which hardly exceeds 7 mg/l. The water is indeed low in organic pollution indicator ions. The water from these wells can therefore be considered to be of relatively good quality, with average mineralization (Fig. 4).

Group G3: it isolates well P4, the water of this well is characterized by a low mineralization, of the order of 1055 µs/cm, and the total absence of probable contamination. (Fig.4)

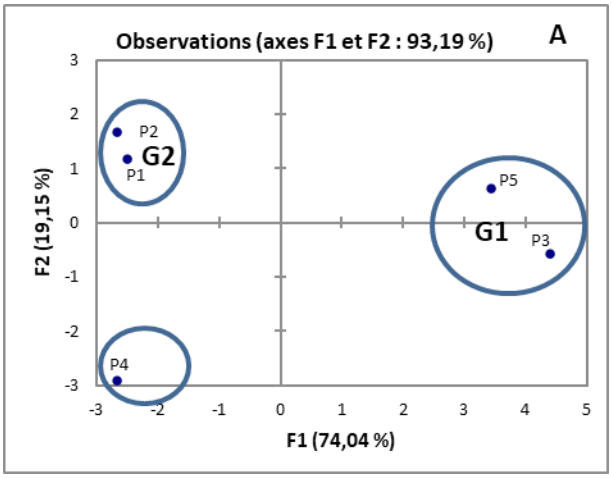

Fig. 4. A: Projection of the 5 wells as they are divided into 3 groups, following the PCA well/physico-chemical characteristics of the water and a hierarchical classification of the stations; B: Projection of the physico-chemical parameters analysed in the water of the 5 stations studied, on the plane of the first two factorial axes of the PCA of a matrix of stations/physico-chemical parameters.

Spatio-temporal variation

There were 21 taxa in 5 stations. The distributions are represented in two coordinate system axes (Fig.

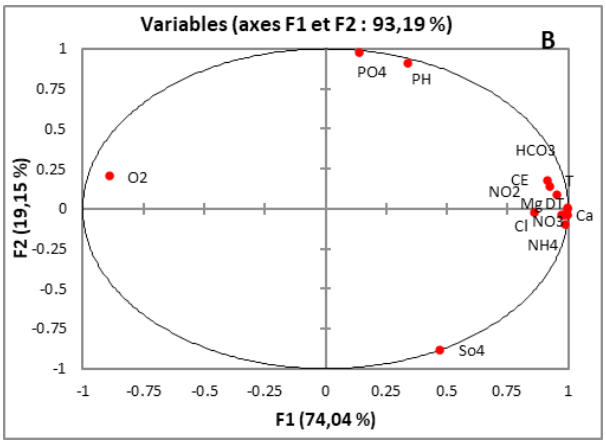

Fig. 5. Graphical presentation of principal components of a collection (PCA) showing the distribution of taxa throughout different stations in the region.

5), which quite explain 70% of the total variance. There were three separate groups:

The first group: Includes wells P1and P5 which are wells without cover, so not protected, have delivered a fauna that is both diverse and abundant (with 14 taxa), generally characterized by insects such as the Culicidae that are dominant in number, Ostracods (Daphinidae) that are indicators of the presence of organic matter.

The second group: This group includes a set of two wells P2 and P4, which are protected from the wind, but located quite far from inhabited areas. whose fauna is more diversified (16 taxa). This fauna is presented mainly by amphipods (*Echinogamarus haraktis*) which show a certain resistance to the agents of contamination. The fauna of this group is revealed by the presence of the stygobia fauna (Pseudoniphargus) which is an indicator of good water quality.

The third group : The third group is represented by a single well, P3, which is unprotected from wind contributions, but located quite far from inhabited areas. The fauna of this group is clearly revealed by the presence of pollution-resistant macroinvertebrate fauna.

DISCUSSION

Most of the wells studied are located far away from the city in fields or pasture areas. Therefore, the main causes of water pollution in these wells are most probably related to the discharge of raw sewage into small canals that are often used for irrigation, or more simply to evacuate sewage away from the houses; in all cases, this sewage can seep down to the water table, which is usually not very deep (Hadjab *et al.*, 2018). Thus, the infiltration of wastewater leads to low oxygen levels, particularly in well P5, which is located near the final discharge of wastewater. Finally, the lack of protection of a greater number of wells contributes to the enrichment of the water in organic matter due to the aeolian contributions of leaves and other plant debris which will decompose on site (Khammar *et al.*, 2019).

The study carried out on the wells in the area has enabled us to qualify the water of this aquifer, which is characterized by a high level of mineralization with a maximum at well P5 (conductivity, 2087 µS/cm). This area is characterized by the interference of the final wastewater discharge from the commune of Berriche. As was highlighted by (Ouis, 2012; Hadjab *et al.*, 2018). This mineralization is linked to the high content of chloride ions, but also the high content of sulphate recorded during this study.

The chemical characteristics of the well water can be explained by the dissolution of the calcareous, saline and gypsum rocks of the terrain (Guardia, 1975). Also, anthropic action would be added to the natural action. Indeed, agricultural practices influence the majority of wells. The same observations are reported by Aït Boughrous (2007) in wells dug in the wastewater spreading zone.

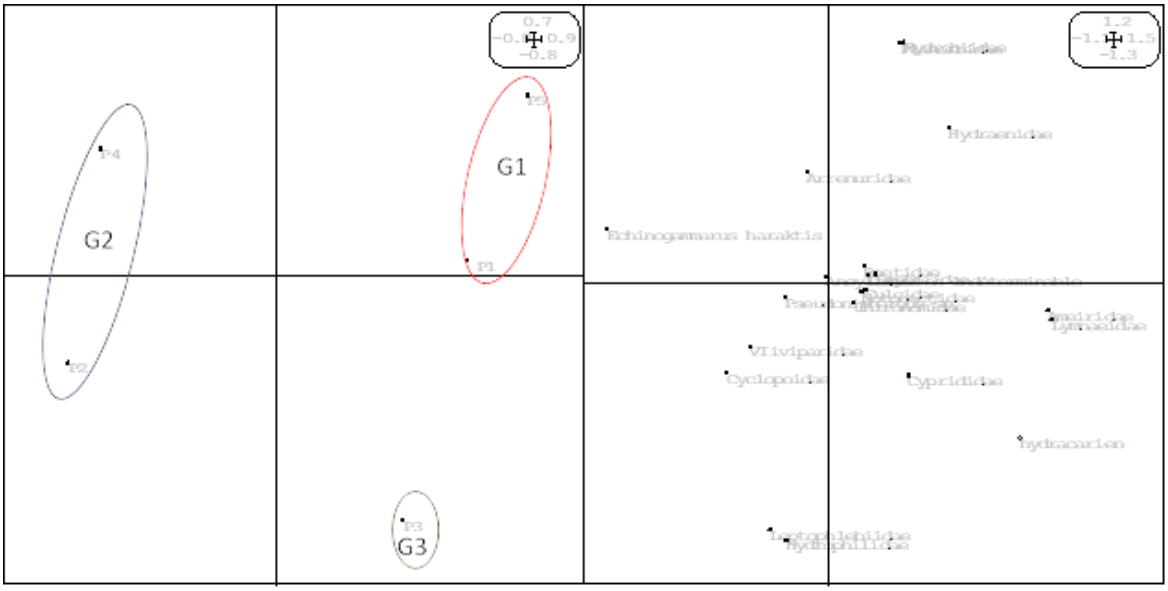

Fig. 5. Graphical presentation of principal components of a collection (PCA) showing the distribution of taxa throughout different stations in the region.

In terms of fauna, the fauna collected in all 5 wells surveyed is made up of species of subterranean origin and largely of epigenetic species. Their presence in the subterranean biotope may be accidental, due to rain, wind or flooding, which brings exogenous matter in the form of organic substances or living organisms to the subterranean environment; but this presence may also be active and result from a voluntary movement of epigeous animals towards the subterranean environment (Creuzé des Chatelliers and Poinsart, 1991). The well is an ecotone where both epigeous and hypogeous species cohabit (Dalmas, 1972; Ginet and Decou 1977).

The taxonomic richness observed in the wells of the two study regions is lower than in the other regions surveyed in Algeria. Only 21 taxa and 4562 individuals were collected during this study. This richness remains lower than that recorded in the 12 wells dug in the alluvial aquifer of the Oued Tafna (Belaidi *et al*., 2011) and in the 16 wells in the region of Oum-El-Bouaghi, in north-eastern Algeria (Merzoug *et al.,* 2010) and in the 17 wells in the alluvial aquifer of the lower Tafna (Haicha *et al.,* 2012), but it remains higher than in the 16 wells in the region of Mascara (Lakhdari, 2014). This high number of taxa is probably the result of a higher sampling effort (Hadjab *et al.,* 2018).

The stygofauna of the studied aquifer are represented by a Crustacea. This crustacean representation has been observed in the groundwater of all the regions studied (Racovitza, 1912; Nourisson, 1956 and Ghlala *et al.,* 2009). In our region, out of 37 stygobian species found in Algeria, only *Pseudoniphargus sp* were captured in wells P1, P2, P3 and P4. This number remains largely inferior to that recorded in the middle Tafna (Belaidi *et al.,* 2011) and in the region of Oum El Bouaghi (Merzoug *et al.,* 2010). The scarcity of stygobia fauna in the wells of the study region could indicate degradation of well water quality given their role as bioindicator species (Belaidi *et al.,* 2004). In our case, the low specific richness of the stygofauna would be linked to the contamination of the water table in most of the wells studied by infiltration water, in particular, the agricultural fertilizers widely used in the region (Hadjab *et al.,* 2018).

Overall, there is heterogeneity in the distribution of the aquatic fauna in the wells. The influence of the groundwater table, which determines to a large extent the stability or otherwise of the phreatic habitat through hydraulic exchanges (Bruno *et al.,* 2001). According to Merzoug *et al.* (2010), the differences between populations are more related to hydrological linkage than to geographical distance.

Finally, according to Dole and Chessel (1986), the regular pumping of water from wells, especially for agricultural purposes, causes an artificial change in the piezometric level, which leads to the disappearance or migration of fauna from the wells as a result of the destruction of the interstices.

The wells studied are used for agricultural purposes, so the groundwater in the region is exploited using the wells as a means of access. They are drained by various traditional and modern techniques used to extract groundwater for field irrigation. While traditional wells, whether motor pumped or not, are frequently used for drinking water supply.

CONCLUSION

The results obtained in this work highlight the need to increase the number of surveys and the spatial extent, given the spatial and temporal heterogeneity of the faunal composition. To more understand the qualitative study of groundwater and its influence on the stygofauna, a more important sampling effort should be undertaken with a complete physico-chemical characterization and an analysis of pollution indicators such as BOD5 and nutrients. This will provide an important step in establishing the role of these variables in determining the diversity and structure of the subterranean fauna and the absence of hypogean species.

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