Poll Res. 39 (November Suppl. Issue) : S1-S6 (2020)

ISSN 0257–8050

BIODIVERSITY AND ECOLOGY OF SURFACE WATER FAUNA OF OUED YOUKS IN TEBESSA REGION (NORTHEAST OF ALGERIA)

S. BELALA[1,2], R. HADJAB [1,2], H. KHAMMAR [1,2], M. SAHEB [1,2*] AND D. MERZOUG[2]

[1] Laboratory of Functional Ecology and Environment.
[2]Life and Nature Sciences Department, Faculty of Exact Sciences and Life and Nature Sciences, University of "Larbi Ben M'hidi", Oum El bouaghi, 1st November 1954, Oum el Bouaghi 04000, Algeria

(Received 10 June, 2020; accepted 9 July, 2020)

ABSTRACT

We studied for the first time the ecology and biodiversity of surface water in a semi-arid region of the highlands of Eastern Algeria. The results obtained from the investigations of 10 stations from February 2018 to January 2019 at the region of Hammamet (Tebessa) in the Oued Youks showed that this aquatic fauna is composed of 22 taxa (families) and 4064 individuals, and is dominated by Insects (51%) and crustaceans (28%). The knowledge and comparative examination of wildlife diversity in this study area can be used for environmental monitoring and management of surface waters.

KEY WORDS: Biodiversity, Surface Water, Aquatic fauna, Oued Youks, Algeria

INTRODUCTION

Benthic macroinvertebrates are generally used as biological indicators to elucidate the impact of changes in environmental characteristics and the ecological strategies of different species to 'restore' some of these characteristics (Dolédec and Statzner, 1994; Townsend *et al.*, 1994; Vaillant, 1998). This structure is well studied in Europe and North America (Wohl *et al*., 1995; Chaib *et al*., 1995; Guinand *et al*., 1996; Hawkes, 1979; Verneaux, 1982; Jacobsen *et al*., 1997). Nevertheless, the available work on North Africa, generally limited in space and time, is most often devoted to systematics and rarely to their ecology or biogeography (Berthelemy, 1973 ; Boumaiza and Thomas, 1986; Boumaiza and Clergue-Gazeau, 1986; Dakki and Thomas, 1986; Malicky and Lounaci, 1987; Bouzidi and Giudicelli, 1987; Gagneur and Thomas, 1988; Gagneur and Clergue-Gazeau, 1988; Clergue-Gazeau, Lek and Lek, 1991; Moubayed *et al*., 1992; Boumaiza, 1994; Lounaci-Daoudi, 1996; Raviart, 1998; Lounaci *et al.*, 2000; Mebarki, 2001; Arab *et al*., 2004; Lounaci, 2005; Lounaci and Vinçon, 2005). Research on the populations and ecology of invertebrates in Algeria's continental aquatic ecosystems was scarce and incomplete until the 1980s. It was only after the 1980s that several studies were carried out in different regions of the country (Merzoug *et al*., 2010; Arab *et al*., 2004; Belaidi *et al*., 2004). So far, in North Africa, very few studies on the spatial organization and structure of benthic communities have been carried out (Khammar *et al*., 2019). However, this region seems to be very interesting and could, due to the climatic constraints specific to these environments very different from the conditions in southern Europe, induce strong differences. The main objectives of this study are to determine the spatial organization and structure of invertebrate communities according to environmental characteristics.

Study Area

Geographical Location (Hammamet)

The region of El Hammamet (Youks, the baths) has a surface area of 375 km², its geographical coordinates are: 35° 262 543 North, 7° 572 113 East

(Fig.1). The stations of my studies are located between the altitude of 950m to 1050m. It is limited to the North by Morsott, to the East by Tébessa, to the South by Chéria and to the West by Meskiana. The region is characterized by different types of relief: mountains, hills and plains. The study region belongs to the domain of the Eastern Saharan Atlas, on the Algerian-Tunisian borders, precisely the Tebessa Mountains, which constitute the eastern part of the Nemmemcha Mountains. The Saharan Atlas constitutes a chain extended from southwest Algeria to the Tunisian border. The study focussed on the eastern part of this area (eastern Saharan Atlas), in the region of Hammamet. This region belongs to the semi-arid bioclimatic stage, characterized by a cold winter and a very hot summer.

The Choice of Biological Sampling Point

We have chosen these quotations according to the objective of the study. To do this, we selected ten (10) points based on their characteristics (flow, flora density, depths, bed width), and then put a small flag as a marker for each station and habitat. Sampling was done from the month of February 2018 to January 2019. Seasonal wildlife samples were carried out with a net collector.

The wildlife harvested during each sampling was fixed in place where 98% pure ethanol was used, and then extracted, sorted, counted and finally identified in the laboratory. The settlement of the origin aboveground, which is usually formed by the larvae of immature insects, so, the wildlife aboveground was determined only at the level of the family.

RESULTS

Global Fauna Composition

The analysis of fauna of 10 stations in the region of the study revealed that these ecotones are home to aquatic fauna which average taxonomic richness is close to 14.8 taxa by the station, but actually varies from 14 to 22 taxa from one station to the other. Four zoological groups were represented in our collections. They include the insects that are most plentiful (51%), crustaceans (28%), molluscs (Gastropods) (18%) and Leeches (3%). (Fig. 2).

Taxonomic Richness

The analysis of figure 3 relating to the spatial distribution of the taxonomic richness, shows a variation of the wealthy taxonomy from one station

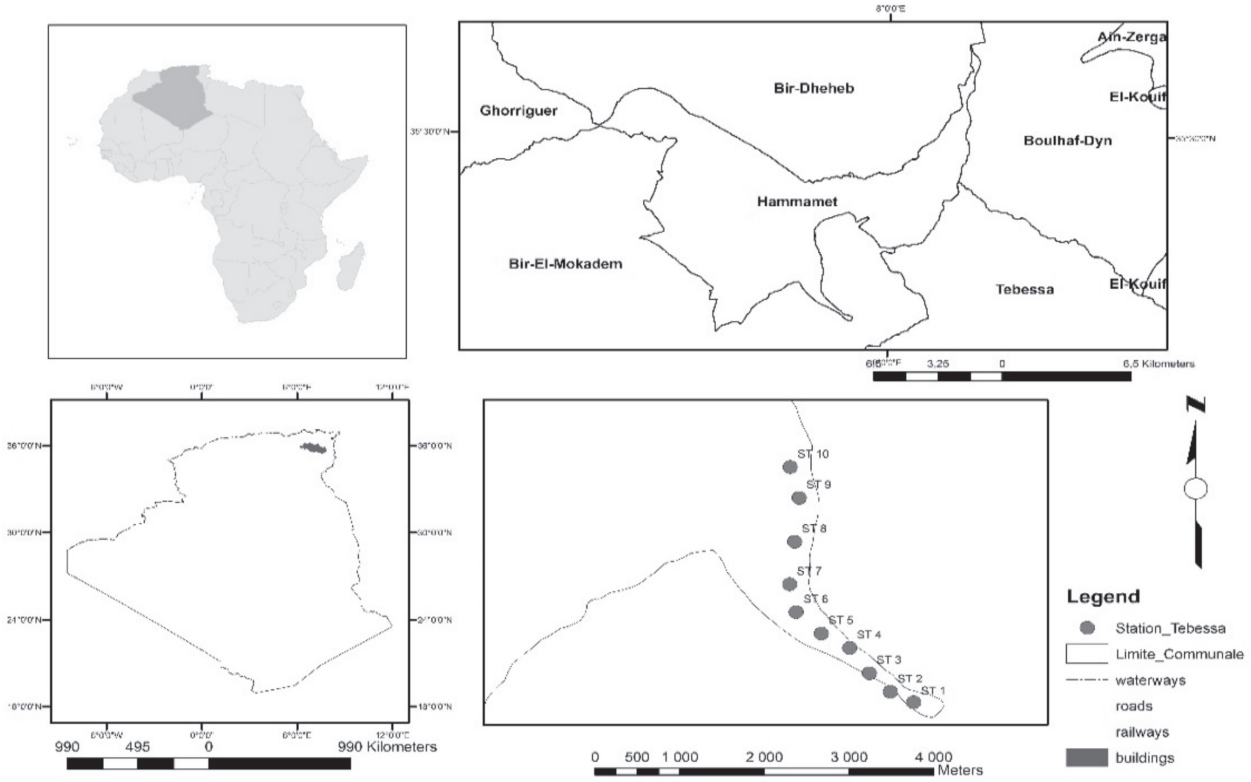

Fig. 1. Geographical location of Ouad Youks.

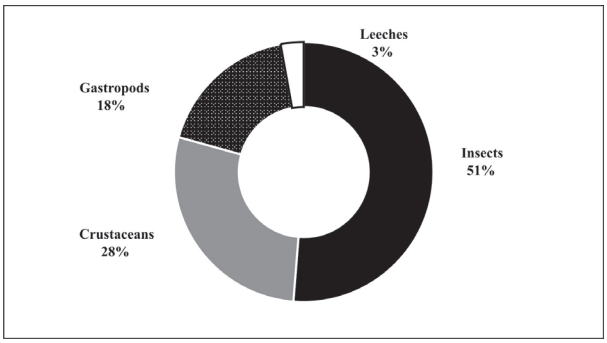

Fig. 2. General Structure of Zoological groups.

to another. There were a total of 22 taxa, the number of taxa fluctuated between a minimum of 14 taxa collected in the station ST6 and ST8, a maximum of 22 taxa collected in station ST1. The majority of the stations have delivered more than 19 taxa (ST1, ST2, ST3, ST4, ST5 and ST9). Others have delivered only 14 to 19 taxa like the ST6, ST7, ST8 and ST10.

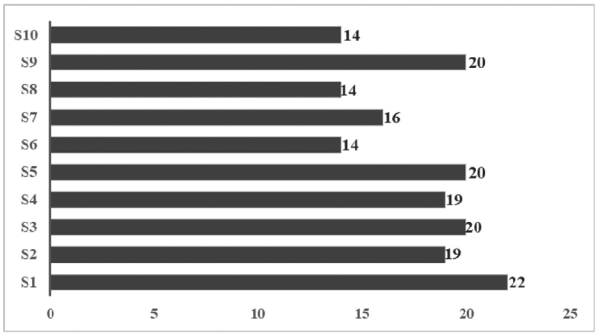

Fig. 3. Spatial Variation of the taxonomic richness of wildlife harvested in the different resorts.

Abundance

The Ephemera Heptageniidae is the taxon dominant in these habitats with 616 individuals. However, the molluscs (Gastropods) Planorbidae ranked second with a population of 600 individuals, finally, the amphipods Echinogammaridae: "*Echinogammarus haraktis*" and *Echinogammarus n.sp*, can be found in all of the studied stations, it presented some resistance to pollution with 562 and 533 individuals for e ach. (Fig. 4).

Diversity Index

The analysis of the diversity (Fig. 5) between the different stations measured by the Shannon Index, shows a variation between 2.09 and 2.71, the highest value was marked in station S4. This shows that the groupings described within this station are more diversified in species, while the lowest value was

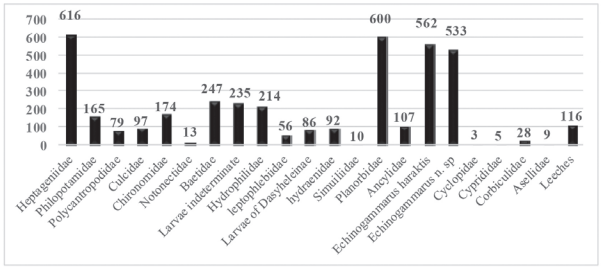

Fig. 4. Spatial Variation in the number of individuals of wildlife harvested in the different stations.

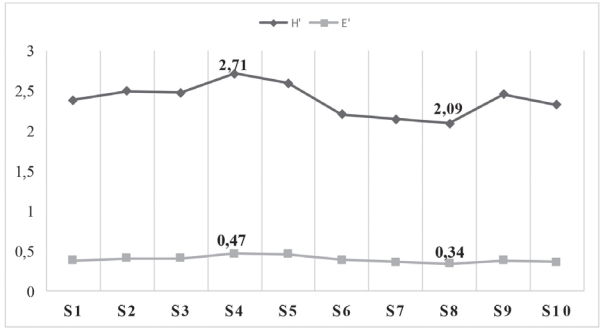

Fig. 5. Variation in diversity and equitability of wildlife harvested .

recorded in station S4 shows a low species richness. Equitability Index varies between 0.34 in ST4 and 0.47 in S4. These results show that station S4 is the most diversified and balanced in the set of stations studied.

DISCUSSION

Oued Youks is a very complex watercourse seen that this one is located between 2 rocky mounts of djebel Bouakous (more than 1300 metres of altitude) of major importance which constitutes a reservoir of faunistic and floristic biodiversity with species of various biogeographical origins.

In addition, the main causes of pollution are the dissolution of organic matter in water, animal dejected that live on the banks of the wadi, fertilizers and chemicals used in the gardens near the wadi, organic pollution that comes from plant or animal waste, or that is caused by the dissolution of organic matter in water or by natural phenomena.

The studies carried out through the sampling of 10 Youks wadi stations, allowed us to identify a wide range of macroinvertebrates. The global biodiversity contains 22 taxa and 4064 individuals collected during this study. The richness studied in the stream of the study area remains lower than that recorded in the region of Greater Kabylia (Lounaci,

1987), as well as that obtained in the region of Béchar (Hamzaoui, 2015), but it is higher than that recorded in the Tafna region (Sifi, 2014) and that recorded in the Soummam watershed (Zouggaghe and Moali, 2009). This high number of taxa is probably the result of the increase in the number of species collected in the sampling efforts which are mostly of surface origin. These were mainly aerial fauna. The studies carried out through sampling included groups of insects that represent the majority of taxa collected such as: Ephemeroptera, Diptera and Coleoptera, Trichoptera and Hemiptera. After insects, we find amphipods, such as Gammares, to a lesser extent Cyclopidae and Cyprididae. Molluscs are poorly represented by the Planorbidae, Ancylidae and Corbiculidae, and finally come the leeches.

17 most frequent families are presented in most of the stations especially Heptageniidae, Planorbidae, Gammares, the 5 other families such as Simuliidae, Cyclopidae, Cyprididae and Asilidae appear in 2 to 5 stations.

The presence of these species depends on the structural diversity of the biotopes, the substrate is quite varied along the longitudinal profile but very little diversifïed within the station, and also the influence of some environmental factors (altitude; geomorphology of the rivers; anthropic action) on the biodiversity of these environments.

Although insects represent the majority of taxa collected (51.50%), the order Ephemeroptera (43.90%) are more abundant, where the dominant family is Heptageniidae with a relative abundance of 67.02 %, which are remarkably native to mountainous areas, they generally live on and under a hard substratum (stones, pebbles, boulders), the large number of specimens captured is probably due to a strong vegetation cover in stations S1,S2, S8,S9,S10 followed by Diptera (25.08%) which have a great capacity to colonize polluted and unpolluted biotopes (Khammar *et al*., 2019), They are invertebrates known for their tolerance to pollution and generally prefer high temperatures (Sabrina, 2011), which is what we have observed that they are abundant.mainly in the summer period, the family Diptera is the most dominant family Chironomidae, with an abundance of 33.14%, At the time of emergence and reproduction, adults often form at the edge of the wadi, Chironomidae is found in the larval stage in almost all stations including in tree cavities, decaying vegetation, soil. In addition, some species of epigenetic origin are present in the majority of the stations studied, such as Diptera larvae (44.76%). Coleoptera present in abundance (18.73%), Hydrophilidae 54.59% are found in stations S1, S2, S3, S4, S8, S9, S10 but absent in stations S5, S6, S7 because they prefer areas with high vegetation cover, followed by Trichoptera (11.66%) which are adapted to life in fresh water. Philopotamidae are found in abundance (67.62%) in all stations, living among the rocks, they feed exclusively on plants (Noyes, 1914; Nielsen, 1942; Jones, 1949). And finally, the order of Hemiptera present by a small number Only the family Notonectidae which does not adapt to this type of environment.

After insects come the amphipods with a wide distribution in all stations with a relative abundance of 27.14% where we find the Gammares (99.27%) are more numerous at the edge of fresh water and occupy all types of habitats: from lotic to lentic. In our study region, all species were found in Algeria, only *Echinogammarus haraktis* was caught at all stations and a lack of a few families at most of the stations studied that do not prefer this type of environment such as Cyprididae and Cyclopidae. It should also probably be pointed out that a new species is found in cohabitation with *E.haraktis*, is an Echinogammarus belonging to the Echinogammarus-simoni group (Ayati *et al*., 2019). And after amphipods we find molluscs which prefer this type of water very rich in oxygen, and are never abundant in continental aquatic environments. Calcium content and the nature of the substrate are the predominant factors of proliferation (Ghamizi, 1998; Koramoko, 2009). Only 17.81% are represented in our crops. The family Planorbidae with an abundance of 85.22%, followed by Ancylidae and Corbiculidae, their rarity would be related to the sampling methods (Haicha, 2012), or the disturbances observed in the areas of these stations result in a modification of the substrate, that is why the number of species is low.

Finally, leeches live in freshwater environments, their abundance is 2.85%, which is very low and is due to sampling methods.

The frequency of the fauna in the stations of the study area can indicate that the water quality is good, and this explains to us that these species are bioindicators, especially the great richness in families of the Gammares and Ephéminoptères are naturally synonymous that proves the very good quality of the environment in which they are found.

In these study environments the diversity of

fauna is maximal, and this horizontal distribution is a response to the various feeding patterns and differences in association with the surface environment and different life cycles, where this type of permanent streams remains relatively well fed. Indeed, this Wadi offers a great biological diversity, a high density of taxa and shelters most of the taxa sensitive to pollution. It is more interesting to maintain this living environment for a continuity of biodiversity and environmental quality.

REFERENCES

Arab, A., Lek, S., Lounaci, A. and Park, Y.S. 2004. Distribution patterns of benthic macroinvetebrates in an intermittent river. *Annls. Limnol.* 40 (4): 317-327.

Belaidi, N., Taleb, A. and Gagneur, J. 2004. Composition and dynamics of hyporheic and surface fauna in a semi-arid stream in relation to the management of a polluted reservoir. In *Annales de Limnologie-International Journal of Limnology*. 40 (3) : 237-248). EDP Sciences.

Berthélemy, C. 1973. Données préliminaires sur les Plécoptères de Tunisie : Avec un tableau dans le texte. Internationale Vereinigung für theoretische und angewandte *Limnologie: Verhandlungen*. 18 (3): 1544-1548.

Boumaiza, M. 1994. Recherches sur les eaux courantes de Tunisie. Faunistique, Ecologie et Biogéographie. Insecta, Plecoptera. Thèse de doctorat d'Etat es-Sciences Biologiques. *Fac. Sc. Tunis.* 191-202.

Boumaiza, M. and Clergue-Gazeau, M. 1986. Le peuplement simulidien de la Tunisie : I. Inventaire faunistique et biogéographie (Diptera-Nematocera). In *Annales de Limnologie-International Journal of Limnology*. 22(1) : 31-39. EDP Sciences.

Boumaïza, M. and Thomas, A. G. B. 1986. Répartition et écologie des Ephéméroptères de Tunisie (1ère partie) (Insecta, Ephemeroptera). *Archives de l'Institut Pasteur de Tunis*. 63 (4) : 567599.

Bouzidi, A. and Giudicelli, J. 1987. Contribution à l'étude faunistique et écologique des simulies (Diptera, Simuliidae) du Maroc. II. Simulium (Obuchovia) marocanum n. sp. et les espèces méditerranéennes d'Obuchovia Rubzov. In: *Annales de Limnologie-International Journal of Limnology*. 23(3) : 185-195. EDP Sciences.

Chaib, N., Samraoui, B., Marziali, L. and Rossaro, B. 2011. Chironomid taxocenosis in a South Mediterranean wadi, the Kebir-East (Algeria). *Studi Trent. Sci. Nat.* 89 : 29-34 29

Clergue-Gazeau, M. and Lek, S. 1991. Les Simulies d'Afrique du nord: nouvelles données sur la répartition de la faune du Maroc et biogéographie des espèces maghrébines (Diptera, Simuliidae). *Revue d'Hydrobiologie Tropicale.* 24 (1) : 47-59.

Dakki, M. and Thomas, A. G. B. 1986. Rhithrogena ayadi n. sp., Ephéméroptere nouveau du Moyen Atlas marocain (Heptageniidae). In *Annales de Limnologie-International Journal of Limnology.* 22(1): 27-29. EDP Sciences.

Doledec, S. and Statzner, B. 1994. Theoretical habitat templets, species traits, and species richness: 548 plant and animal species in the Upper Rhône River and its floodplain. *Freshwater Biology.* 31(3) : 523-538.

Gagneur, J. and Clergue-Gazeau, M.1988. Les Simulies d'Algérie (Diptera: Simuliidae). I. Premières données biogéographiques et écologiques sur les espèces de l'Ouest-Algérien. In *Annales de Limnologie-International Journal of Limnology*. 24 (3) : 275-284. EDP Sciences.

Gagneur, J. and Thomas, A. G. B. 1988. Contribution à la connaissance des Ephéméroptères d'Algérie. I. Répartition et écologie (1ère partie) (Insecta, Ephemeroptera). *Bulletin de la Société d'Histoire naturelle de Toulouse.* 124 : 213-224.

Ghamizi, M. 1998. *Les Mollusques des eaux continentales du Maroc: Systématique et Bioécologie.* Doctorate Diss, Marrakech.

Guinand, B. Ivol, J. M. and Tachet, H. 1996. Longitudinal distribution of Trichoptera in the Loire River (France): simple ordination methods and community structure. *Hydrobiologia.* 317 (3) : 231-245.

Haicha, 2012. Contribution à la connaissance de la stygofaune d'Algérie. Etude de la faune des puits de la nappe alluviale de la basse Tafna. [Thèse. Magistèr]. Univ. Tlemcen, Algeria.

Hamzaoui, D. 2015. Etude de la répartition des macroinvertébrés benthiques de l'oued Saoura (wilaya de Béchar) (Doctoral dissertation).

Hawkes, H.A. 1979. Invertebrates as indicators of water quality. In : Biological indicators of water

Jacobsen, D. Schultz, R. and Encalada, A. 1997. Structure and diversity of stream invertebrate assemblages: the influence of temperature with altitude and latitude. *Freshwater Biology.* 38(2) : 247-261.

Jones (J. R. E.). 1949. A further ecological study of the calcareous streams in the « Black Mountain » district of South Wales. *J. Anim. Ecol.* 18 : 142-159.

Karamoko, M. 2009. Étude de la biologie, de l'écologie et du comportement d'un escargot terrestre d'intérêt économique, Limicolaria flammea Müller, 1774, en milieu d'élevage. (Thèse de doctorat unique). Université de Cocody-Abidjan, Ivory Coast.

Khammar, H., Hadjab, R. and Merzoug, D. 2019. Biodiversity and distribution of groundwater fauna in the Oum-El-Bouaghi region (Northeast of Algeria). *Biodiversitas Journal of Biological Diversity.* 20(12).

Khaoula, A., Ramzi, H., Hichem, K., Sonia, D., Christophe, P. and Ezzeddine, M. 2019. Origin, diversity and distribution of freshwater epigean amphipods in

Maghreb. In *Annales de Limnologie-International Journal of Limnology*. 55 : 13. EDP Sciences.

Lounaci, A. 1987. Recherches hydrobiologiques sur les peuplements d'invertébrés benthiques du bassin de l'oued Aissi (Grande Kabylie) (Doctoral dissertation, Alger).

Lounaci, A. 2005. Recherche sur la faunistique, l'écologie et la biogéographie des macroinvertébrés des cours d'eau de Kabylie (Tizi-Ouzou, Algérie) (Doctoral dissertation, Thèse de doctorat d'état en biologie. Université Mouloud Mammeri de Tizi-ouzou (Algérie).

Lounaci, A. and Vinçon, G. 2005. Les Plécoptères de la Kabylie du Djurdjura (Algérie) et biogéographie des espèces d'Afrique du Nord (Plecoptera). Article in French]. *Ephemera.* 6 : 109-124.

Lounaci, A., Brosse, S., Thomas, A. and Lek, S. 2000. Abundance, diversity and community structure of macroinvertebrates in an Algerian stream: the Sébaou wadi. In *Annales De Limnologie-International Journal of Limnology*. 36(2) : 123-133). EDP Sciences.

Lounaci-Daoudi, D. 1996. Travaux sur la faunistique, l'écologie et la biogéographie des insectes aquatiques du réseau hydrographique du Sébaou (Doctoral dissertation, Thèse de Magister, Université de Tizi-Ouzou).

Malicky, H. and Lounaci, A. 1987. Beitrag zur Taxonomie und Faunistik der Köcherfliegen von Tunesien, Algerien und Marokko (Trichoptera). Opuscula Zoolog. Fluminensia.

Mebarki, M. and Lounaci, A. 2001. Etude hydrobiologique de trois réseaux hydrographiques de Kabylie (parc National du Djurdjura, Oued Sébaou et Oued Boghni) [ressource textuelle, sauf manuscrits] : faunistique, écologie et biogéographie des macroinvertébrés benthiques.

Merzoug, D. Khiari, A. Boughrous, A. A. and Boutin, C. 2010. Faune aquatique et qualité de l'eau des puits et sources de la région d'Oum-El-Bouaghi (Nord-Est algérien). *Hydroécologie Appliquée.* 17 : 77-97.

Moubayed, J., Ait-Mouloud, S. and Lounaci, A. 1992. Les Chironomidae (Diptera) d'Algérie. I : Bassin de l'Oued Aissi (Grande Kabylie). *Nachrichtenblatt der Bayerischen Entomologen.* 41 (1) : 21-29.

Nelson, S.M. and Lieberman D.M. 2002. The influence of flow and other environmental factors on benthic invertebrates in the Sacramento River, USA. *Hydrobiologia.* 489 : 117-129

Nielsen, A. 1942. Uber die Entwicklung und Biologie der Trichopteren mit besonderer Beriicksichtigung der Quelltrichopteren Himmerlands. *Arch. Hydrobiol. Suppl.* 17 : 255-631.

Noyés, A. 1914. The Biology of the net spinning trichoptera of cascadilla creek. *Ann. Ent. Soc. Am.* 7 (4): 251-272 + 3 pl. quality. T.A. Evison (ed.), J. Wiley and Sons, London, pp 2: 1-2.45.

Raviart, P. A., Thomas, J. M., Ciarlet, P. G. and Lions, J. L. 1986. Introduction à l'analyse numérique des équations aux dérivées partielles (Vol. 2). Paris : Dunod.

Sabrina, H. 2011. Recherches sur la faunistique et l'écologie des macroinvertébrés des cours d'eau de Kabylie. Universite de Tizi Ouzou, Algeria.

Sifi, A. 2014. La dynamique de la faune aquatique dans une zone de source cas de l'Oued Chouly.

Thomas, A.G.B. 1998. A provisional checklist of the Mayflies of North Africa (Ephemeroptera). *Bull. Soc. Hist. Nat. Toulouse.* 134 : 13-20.

Townsend, C.R. and Hildrew, A.G. 1994. Species traits in relation to a habitat temple for river systems. *Freshwater Biology*. 31 : 265-275.

Vaillant, F. 1955. Recherches sur la faune madicole de France, de Corse et d'Afrique du Nord. Mem. Mus. *Hist. Nat., Paris (Zool.).* 11 : 258.

Verneaux, J. Coll. 1982. Une nouvelle methode pratique d'evaluation de la qualite des eaux courantes. Un indice biologique de qualite generale (IBG). *Ann. Sc. Univ. Franche-Comte Besancon, Biol. Anim.* 4(3): 11-21.

Wohl, D. L., Wallace, J. B. and Meyer, J. L. 1995. Benthic macroinvertebrate community structure, function and production with respect to habitat type, reach and drainage basin in the southern Appalachians (USA). *Freshwater Biology*. 34 (3) : 447-464.

Zouggaghe, F. and Moali, A. 2009. Variabilité structurelle des peuplements de macro-invertébrés benthiques dans le bassin versant de la Soummam (Algérie, Afrique du Nord). Revue d'écologie.