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Diversity of macro-invertebrates in Lake Tonga (northeast Algeria)

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Abstract. The characteristic of polluo-tolerance and polluo-sensitivity allow to benthic aquatic macro-invertebrates the ability of being a good indicator for the health of the aquatic ecosystem. Our study presents an inventory of macro-invertebrates in the shores of Lake Tonga (wetland of international importance – Ramsar Site). The sampling was conducted between January to May 2017 and in three stations (Fad smar, Wadi El Hout and Fad El Alig). They were identified to family level. We provide a checklist and some observations on 20 families belonging to six orders. The taxonomic richness shows fluctuations between the studied stations, 13 families in Fad smar station, 14 in Wadi El Hout station and 17 families in Fad El Alig. Hemeptera, Coleoptera and Gasteropoda are dominant in the area. Factorial analysis of correspondence revealed significantly different macro-invertebrates assemblages among the stations of Lake Tonga.

Keywords: macro-invertebrates, Lake Tonga, wetland, diversity, Ramsar site.

Introduction

Wetlands are zones where the water is the principal factor controls the environment and the associated plant and animal life (Zedler & Kercher 2005). Wetlands ecosystems are providing the water and primary productivity upon which countless species of plants and animals depend for survival, they support high concentrations of birds, mammals, reptiles, amphibians, fish and invertebrate (Parish & Looi 1999). In Algeria a 50 out of 1450 wetlands are classified as a Ramsar site. In 1983, it included the first two sites, Lake Oubeira and Lake Tonga, which are also integral reserves of El Kala National Park, which is one of the main reservoirs of biodiversity in the Mediterranean Basin. Today, Algeria is experiencing serious problems of degradation of these natural zones.

Nature has its own way of indicating the health of the environment through indicator species of plants and animals, generally termed as bio-indicators (Kripa et al. 2013). They are also an important tool for detecting changes in the environment (Parmar et al. 2016). Benthic macro-invertebrates are known by being a good indicator of the health of aquatic ecosystems. These organisms variously spread over different strata of water and have different pollution tolerances; therefore they are characterized by the character of polluo-tolerance and plluo-sensitivity when the absence of sensitive species and presence of tolerant ones indicates water quality deterioration (Sanogo et al. 2014).

In Lake Tonga all the researches are done much more about birds, vegetation but for macro-invertebrates there is not enough research has been done so the purpose of this study is to increase the knowledge about macro-invertebrates and provides more information on the taxonomic richness, abundance and distribution of this fauna.

Materials and methods

Lake Tonga is located between 36°53'N; 08°31'Eand; 8°30.100'E, about 3 km from the Algerian-Tunisian border to the East (Aissaoui et al. 2009). It is about 2700 ha with an average depth of 1.20m. The area has a Mediterranean climate (Khelifa et al. 2016).

We have chosen three stations in ways to meet the requirements (site accessibility: S1, presence or absence of urban agglomerations: S2, existence of agricultural activities: S3). The sampling was conducted between January to May 2017 at the littoral; three samples are taken at each station using a Surber net sampler (0.3 mm mesh). The captured specimens are collected using a flexible entomological forceps, then stored in jars filled with 70% ethanol. At the place of sampling, labeling is essential; we mention the date of capture and the sampling station. Samples are taken back to the Laboratory for sorting, determination and analysis. All specimens were identified in the laboratory, down to family under a binocular loop using books, collections and keys.

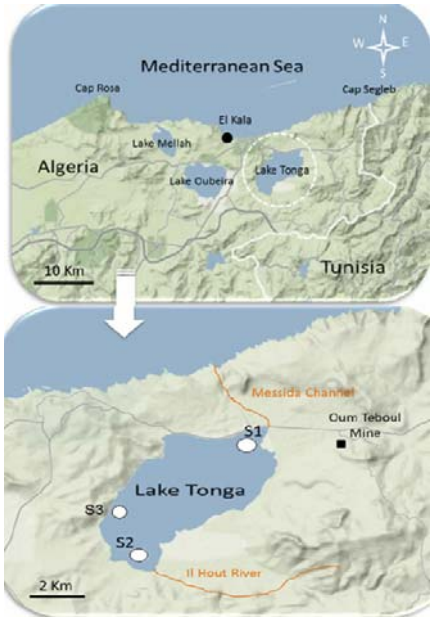

Figure 1. Map of the study area, with locations of sampling stations.

To evaluate the species abundance, species diversity and the differences in community composition and structure at each site, data were analyzed using XLSTAT software (Version 2014.5.03). The indexes used to examine macro-invertebrates community were: species richness (S), relative abundance (RA), Shannon diversity index (H), Simpson Diversity index (1-D), Equitability (E), Margalef index, the correspondence factor analysis (CFA) and the Chi-square test. These indices are useful for comparison between populations of three sites of Lake Tonga.

Results

A total of 426 individuals representing six orders categorized under 20 families were collected from three sampling stations in Lake Tonga. 77 % of the total fauna belongs to class insect, the most abundance order were Hemiptera (33%), Coleoptera (18%), Diptera (17%), Ephemeroptera (8%), Odonata (1%), and 23% of the class Gastropoda (Basommatophora).

Macro-invertebrates compositions and diversity indices are illustrated in Table 1 and Table 2. The species diversity of benthic macro-invertebrates of the first station (Fad Smar) constituted 5 orders, 8 families when we recorded 5 orders and 10 families from the second station (Wadi El Hout). The third station (Fad El Alig) was represented by 6 orders under 14 families.

Hemiptera was the most abundant quantitatively of the total fauna of Lake Tonga (61%) especially in the first and the second stations, it was represented by 4 families Naucoridae, Pleidae, Notonectidae, Corixidae, while it was absent in the third station. Naucoridae showed the highest numerical abundance which was presented in the both stations followed by Pleidae. Corixidae and Notonectidae were shown only in the second station with a low percentage.

Basommatophora was rich in number too (23%) and it was the most common order in the three stations by 3 families: Physidae, Liminidi, Planorbidae. This last was the most common family, which was shown in three stations followed by Physidae in the first and the second station and then Liminidi in only the first station.

Coleoptera was the most diverse order of the total fauna (18%). It was represented by 05 families: Dytiscidae, Hy-

Table 1. The family list found at the sites at Lake Tonga.

Branch	Class	Order	Family	S1	S2	S3
Arthropoda						
	Insecta					
		Diptera				
			Culicidae	*	*	*
			Chaobridae		*	*
		Hemiptera				
			Pleidae	*	*	*
			Corixidae		*	
			Notonectidae		*	
			Naucoridae	*	*	*
		Odonata				
			Lestidae			*
			Coenagrionidae			*
			Aeshnidae			*
		Ephemeroptera				
			Baetidae		*	
			Siphlonuridea			*
			Caenidae	*		
		Coleoptera				
			Dytiscidae	*	*	*
			Hydrophilidae		*	*
			Haliplidae			*
			Elmidae			*
			Hydraenidae		*	
Mollusca						
	Gastropoda					
		Basommatophora				
			Physidae	*	*	*
			Liminidi	*		
			Planorbidae	*	*	*

Table 2. Diversity indexes of macro-invertebrates of the three stations at Lake Tonga.

Diversities	Stations		
	Fad smar (S1)	Wadi El Hout (S2)	Fad El Alig (S3)
Richness	8	12	14
Individuals	128	142	156
Simpson (1-D)	0.6984	0.8635	0.7309
Shannon (H)	1.548	2.138	1.744
Margalef	1.443	2.22	2.574
Equitability (E)	0.7446	0.8603	0.661

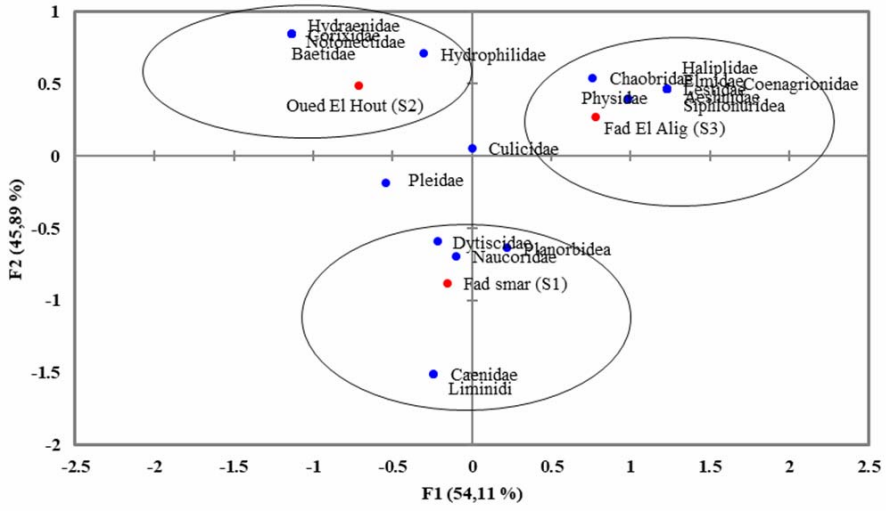

Figure 2. Correspondence Factor analysis (CFA) in the Lake Tonga.

draenidae, Haliplidae, Elmidae, Hydrophilidae, this last was the most abundant quantitatively in the second and the third station followed by Hydraenidae, then Elmidae when Dytiscidae was the common family in the three stations.

Diptera was contributed by 2 families with (17%) of the total fauna; the families were representing Culicidae, Chaobridae. The three stations were colonized by Culicidae with a high percentage while Chaobridae was presented in only the second and the third station by a low percentage.

Ephemeroptera represented 8 % of the total fauna of Lake Tonga by 3 families: Baetidae was the most abundant; it was shown only in the second station followed by Caenidae where it characterized the first station, and the third station was contributed by Siphlonuridea.

Odonata was the lowest order in term of quantity (1%); it was represented by 3 families Lestidae, Coenagrionidae, Aeshnidae, where they were shown only in the third station.

The highest value of Shannon index was recorded in station 2 with 2.14 bits correspond to a species diversity of 12 and workforce of 142 individuals with Equitability (E), Simpson index (D), Margalef index respectively: 0.86, 0.86, 2.22. These show that the groups described in this station were well represented. While we recorded in station 3: 1.74 bits with E: 0.66, D: 0.73 and Margalef index: 2.57 despite it had the highest species diversity (14) and workforce of 156, this shows that in this group exist 2 abundant taxa which they were Basommatophora and Diptera. The lowest values were observed in station 1; H: 0.69 bits, E: 0.74, D: 0.69, Margalef index: 1.44. These low values are consequence of a low number of taxa (8) with 128 individuals and the dominance of Hemiptera with 61% of the total fauna of the station.

Figure 2 shows the spatial distribution of macro-invertebrates from Lake Tonga by using FAC performed on the matrix (stations x species). Considering the species assemblage, the ordination diagram allowed three main groups to be distinguished and statistically identified by the Chi-square test X^2= 355.5, df = 42 and p<0.0001, there is a highly significant difference between stations and distribution of aquatic macro-invertebrates. The CFA shows, on the plan formed by the first two factors (100% of eigenvalues), dispersion clearly wider for Fad El Alig (S3) samples compared with Fad smar (S1) / Wadi El Hout (S2) ones. Fad El Alig samples are characterized mainly by Physidae (72% of contribution on the factorial plan 1 – 2). The most characteristic family of Fad smar (S1) station is Naucoridae (64% of contribution on the factorial plan 1–2) and Hydrophilidae family (24%) in Wadi El Hout (S2).

Discussion

During our study we found that the macro-invertebrates community in this ecosystem is different in the three sample sites because the type of habitats and the anthropic impact. After analyzing the relationship between the number of individuals and the species diversity at each station we found that Fad El Alig meets both the highest number of species and the highest number of individuals. Ephemeroptera, Odonata, and Diptera were only present in the water in their larval form, while Hemiptera and Coleoptera use the aquatic habitat in the adult state (Zacharias et al. 2007). Hemipterans are among the most abundant taxa at the end of the hydro period (Florencio et al. 2009; Karaouzas et al. 2015; Saoudi et al. 2018). The order Diptera shows a large degree of tolerance to extremes of pH and tolerance of other chemical stress (Bartoo 1978) and they are characteristic to water rich in organic content (Cupșa & Marian 2012). The Coleoptera species are present with low abundances. According to Cupșa & Marian (2012), the Coleoptera species are not typically benthic because they can swim in the body of the water.

The Ephemeropterans were found with very low densities. They have a high sensitivity to various contaminants, including metals ammoniac and other chemicals (Beketov 2004). The Odonata species have very low abundances and they were found accidentally in Fad El Alig (S3). The low representation of Odonata in Lake Tonga is related to the sampling period. According to the work of Khelifa et al. (2016), the times of sampling are between June-August, the light season of the Odonata.

The most abundance of Gastropod species which are scrappers shows a well developed periphytic community especially on muddy substrate where they are present

mostly on the submerged vegetation (Cupşa et al. 2009).

The Simpson Diversity index, Margalef indices illustrates an important number of species and the Shannon index values indicate a moderate diversity of macro-invertebrates at the three sites in Lake Tonga. The distribution of specimens over species is equitable. The significant fluctuation in the composition of macro-invertebrates is likely to be determined to a large extent by the hydrology of Lake Tonga. The Mediterranean wetlands reported that variation of community composition depends on the length of water permanence.

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