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STUDIES ON BIODIVERSITY OF ROTIFERA IN FIVE ARTIFICIAL LAKES IN ALGERIA: SYSTEMATICAL AND ZOOGEOGRAPHICAL REMARKS

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ABSTRACT. This study was carried out to determine freshwater rotifers species in Algerian aquatic ecosystems from 2005 to 2008. Samples of rotifers were collected from five different localities using plankton nets (105 μm mesh size). In order to study the general character of Algerian surface waters, water temperature, pH, conductivity, and oxygen saturation were measured during these field surveys.
As a result of this study, a total of 110 rotifers species belonging to 19 families were identified. Prior to this study, the number of rotifers species in Algeria was 201. This study has increased it to 267.
The list of 66 species cited in this study, mainly represents the first records for Algeria, because only a few studies about rotifers in Algeria had been performed prior to the present one.

Key words: Rotifera, zooplankton, reservoirs, Algeria.

INTRODUCTION

Zooplankton constitutes the food source of organisms. It plays an important role in aquaculture, including being an indicator that determines water quality, pollution, and the state of eutrophication (SALER, 2009).

Rotifers are small pseudocoelomate animals that inhabit a wide variety of aquatic habitats (PEJLER, 1995; WALLACE *et al.*, 2006). They are particularly an important group of the littoral and limnetic micro-invertebrates (SHARMA, 2009). The habitats of rotifers include both, lentic and lotic environments. Pelagic or planktonic forms are common in surface waters

of rivers, lakes or ponds, and they may exhibit cyclomorphosis-variations in body form resulting from seasonal or nutritional changes (WALLACE and SNELL, 2010).

Some rotifers are highly specialized but most are opportunistic feeders since they consume and assimilate different types of food (WALLACE *et al.,* 2006; WALLACE and SNELL, 2010) reaching high population densities and diversities, as well as high tolerances to environmental conditions, thus making them among the most diverse group in environments. Rotifers are very good pollution indicators (SLÁDEČEK, 1983). Besides, rotifers are used as indicators for pollution and eutrophication because of their high reproduction rate and sensitivity to any ecological change in water bodies (LUCINDA et *al.,* 2004).

Early research on Algerian mainland water rotifers was made at the end of the Nineteenth century by MAUPAS (1892), which surveyed four species near Algiers. Other concerns only the inventory of zooplankton fauna such as the work of GAUTHIER (1928) that noted 21 species of rotifers. In 1931, he added to his faunal list *Asplanchnella brightwelli* and *Filinia longiseta*. Similar work was done by BEADLE (1947) on rotifers in fresh and marine waters in several localities. The author pointed out several species of which three were new: *Lecane lamellata*, *L. luna* and *Pleurotocha petromyzon*.

Since that time, very little work has been conducted. The most recent ones being of HONDT's (1973, 1977) who reported four new species: *Encentrum marinum*, *Colurella adriatica*, *Lecane luna* f. *presumpta* and *Trichotria similis*. Expeditions undertaken by the University of Ghent / Gent (Belgium) from 1976 to 1978 identified 128 species (DE RIDDER, 1991) of which 116 were new for Algeria.

The work of SAMRAOUI *et al.* (1998) have treated copepods and rotifers in the East of Algeria (Annaba) and identified nineteen (19) new rotifers species for Algeria. During the faunal inventory in northern Algeria, HAMAIDI *et al.* (2008) identified 27 species of rotifers (belonging to nine families), 12 of which were new for Algeria. Thus increasing the number of freshwater rotifers recorded in Algeria up to 201 species.

In this study, using data resulting from sampling campaigns conducted in the North of Algeria (Tipaza, Ain Defla, Tizi-Ouzou, Bouira and Boumerdes) from spring 2005 to winter 2008, we present an updated inventory of Algerian rotifers based on both, previous (published) and current (unpublished) data.

MATERIAL AND METHODS

This study has done in the 2005-2008 period. The aim was to determine the freshwater rotifer species list for the Algerian lakes.

Five artificial lakes (Boukourdane, Lakhal, Taksebt, Ghrib and Keddara) representing a variety of freshwater habitats in the north of Algeria, were researched. The sampling localities are shown in Figure 1.

Boukourdane dam lake is located in the northern part of the vast western plains of Mitidja, about 1.3 km from Sidi Amar (Tipaza). It receives waters from two major rivers: the Menaceur and Fedjana rivers. The reservoir was built in 1985 in order to supply drinking water to the local population and to irrigate El-Hachem valley.

Lakhal dam lake is 5 km away from the city of Ain-Bessam in the willaya of Bouira and 150 km east of Algiers. It is established at the confluence of two rivers: wadi Lakhal and wadi Fahem.

Taksebt dam lake is located at 10 km south of Tizi-Ouzou and 150 km northeast of Algiers. It is built on wadi Aissi, which drains the northern flank of Mount Djurdjura, having a course through the primary metamorphic mass of the Great Kabylie region and dumping

sediment before flowing into wadi Sebaou. It is a recent dam lake (1998), built exclusively for the supply of drinking water to the towns of Boumerdes, Tizi-Ouzou, and Algiers.

Lake Ghrib is established on one of the longest Algerian river: wadi Cheliff. It was built in 1928, on the edge of the North Tellian Atlas mountain chain at the point where the wadi Cheliff loses its northbound direction to run towards the west. The regime of wadi Cheliff is very irregular but lake Ghrib makes it possible to stabilize its flow. Located at about thirty kilometers south-west of Medea at an altitude of about 435 m, the reservoir is directed southeast-northwest and constitutes the boundary of semi-arid and sub-humid bioclimatic areas. It receives its water from wadi Cheliff, which has its source in the Saharan Atlas Mountains and runs from the south to the north of the highlands of Algiers. Wadi Cheliff receives water from several other streams like Wadi Ouassel, Wadi Sersou, and Wadi Ouerk.

Lake Keddara is located 35 km northeast of Algiers, downstream of the convergence of wadi Keddara and wadi El-Had rivers. This lake receives water from two rivers: wadi Boudouaou and wadi Issers, and the excess of water from the Hamiz and the Beni-Amrane dam lakes. The reservoir was built to supply drinking water to the city of Algiers (with a population estimated at 3 million inhabitants in 2012) and the irrigation of the agricultural land around Algiers.

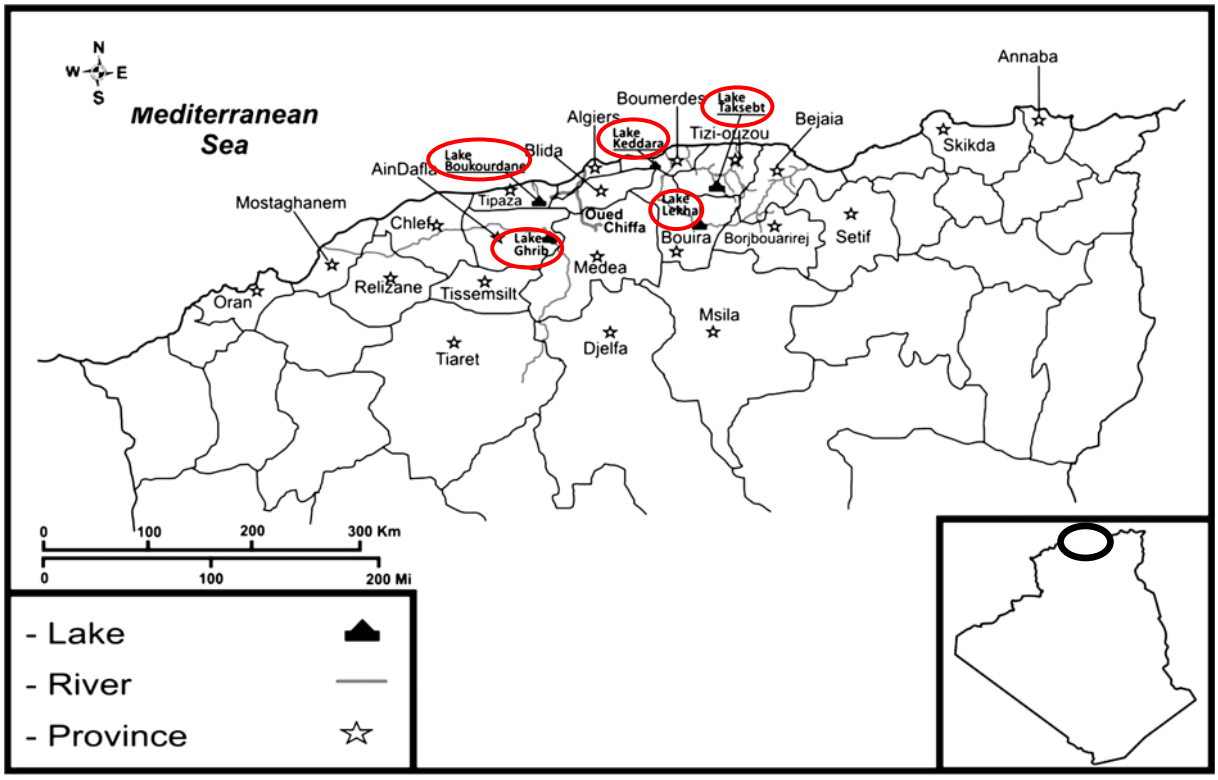

Figure 1. - Locations of the study sites in Algeria.

Samples were collected from different stations in these five lakes by using only horizontal sampling with simple plankton net (105 µm mesh size). Table 1 provides a summary of the locality names and the main physical and chemical conditions of the sampling sites.

Water samples were fixed in 4% formalin. Rotifer species were examined under the microscope. Using diluted sodium hypochlorite, trophi were isolated from some specimens and were prepared. Identification of rotifers was done with the help of standard keys RUTTNER-KOLISKO (1974), KOSTE (1978), PONTIN (1978), POURRIOT and FRANCEZ (1986), KOSTE and SHIEL (1987, 1989, 1990), NOGRADY *et al.* (1993) and SEGERS (1995a).

Table 1. – The morphometrical and physico-chemical characteristics of the sites studied (the data represent mean values with standard error SE)

Parameters	Study sites				
	Boukourdane	**Lakhal**	**Taksebt**	**Ghrib**	**Keddara**
Altitude (m)	420	600	655	435	300
Depth (m)	40	45	70	65	89
Area (km^2)	156	189	448	280	93
T (°C)	19.87 ± 1.05	19.33 ± 1.29	17.93 ± 1.67	18.98 ± 1.14	19.87 ± 1.34
pH	7.63 ± 0.07	7.78 ± 0.07	7.45 ± 0.12	7.72 ± 0.07	7.74 ± 0.06
Conductivity ($mS.cm^{-1}$)	0.70 ± 0.02	0.68 ± 0.02	0.36 ± 0.02	2.86 ± 0.06	1.29 ± 0.02
Oxygen saturation (%)	88.57 ± 3.80	81.51 ± 3.56	75.16 ± 6.57	80.42 ± 3.00	83.42 ± 4.66

RESULTS AND DISCUSSION

As a result of the examination of rotifer samples taken from five locations in northern Algeria between 2005 and 2008, a total of 110 rotifer species belonging to the class of Monogononta and two orders (order of Ploimidae and order of Floscullariaceae represented by a total of 19 families) have been identified (see Table 2).

Table 2. - Number of species for each family identified in this study.

Families	Number of species
Asplanchnidae	1
Brachionidae	27
Notommatidae	6
Colurellidae	5
Lepadellidae	8
Dicranophoridae	1
Euchlanidae	7
Epiphanidae	1
Lecanidae	11
Gastropodidae	3
Trichotriidae	4
Mytilinidae	9
Synchaetidae	5
Trichocercidae	6
Testudinellidae	10
Conochiliidae	1
Hexarthridae	4
Collothecidae	3
Filiniidae	2

The species name is followed by two letters in accolades, indicating the location of the taxon: {BO} for Boukourdane lake, {LE} for Lakhal, {TA} for Taksebt, {GR} for Ghrib and {KE} for Keddara.

The list of rotifers, identified in this study, is classified by families according to REMANE (1923-1933) and amended according to KOSTE (1978). This list includes the names of species, synonyms according to SEGERS (2007), geographical distribution (with the following abbreviations: AFR for Afrotropical region, ANT for Antarctic region, AUS for Australian region, NEA for Nearctic region, NEO for Neotropical region, ORI for Oriental region, PAC for Pacific region, and PAL for Palearctic region).

The 66 species of Rotifera marked with an asterisk (*) are mentioned for the first time in Algeria.

Checklist of rotifer species in five artificial lakes in Algeria
(Synonyms and comment in brackets taken from Segers, 2007)

PHYLUM: ROTIFERA Cuvier, 1817
CLASS: MONOGONONTA Plate, 1889

ORDER: PLOIMIDA Hudson et Gosse, 1886

Family: Asplanchnidae H. M., 1926

Asplanchna priodonta Gosse, 1850
Syn.: *Asplanchna priodonta sirakabana* Sudzuki, 1964
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {LE, TA, BO, KE}

Family: Brachionidae Ehrenberg, 1838

***Anuraeopsis fissa* Gosse, 1851**
Syn.: *Anuraeopsis hypelasma* Gosse, 1886
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {GR}

***Brachionus bidentatus bidentatus* Anderson, 1889**
Syn.: *Brachionus bidentatus* var. *crassispinus* Hauer, 1963
Syn.: *Brachionus furculatus* Thorpe, 1891
Syn.: *Brachionus furculatus inermis* Rousselet, 1906
Syn.: *Brachionus furculatus testudinarius* Jakubsi, 1912
Syn.: *Brachionus furculatus* var. *jirovci* Bartos, 1946.
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAL.
Loc. {BO}

***Brachionus budapestinensis* Daday, 1885**
Syn.: *Brachionus similis* Leissling, 1914
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {TA}

***Brachionus calyciflorus calyciflorus* Pallas, 1766**
Syn.: *Brachionus amphiceros* Ehrenberg, 1838
Syn.: *Brachionus dorcas* Gosse, 1851
Syn.: *Brachionus gillardi* Hauer, 1966
Syn.: *Brachionus gillardi* Hauer, 1966

Syn.: *Brachionus pala* Ehrenberg, 1838
Syn.: *Brachionus pala anuraeiformis* Brehm, 1909
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAL
Loc. {BO}

***Brachionus dimidiatus* Bryce, 1931**
Syn.: *Brachionus inermis* Schmarda, 1894
Geographical distribution: AFR, AUS, NEO, ORI, PAL
Loc. {TA}

***Brachionus quadridentatus quadridentatus* Hermann, 1783**
Syn.: *Brachionus ancylognathus* Schmarda, 1859.
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAL.
Loc. {TA, BO}

****Brachionus sericus* Rousselet, 1907**
Geographical distribution: AFR, AUS, PAL
Loc. {TA}

****Brachionus urceolaris urceolaris* Müller, 1773**
Syn.: *Brachionus urceolaris semicircularis* Sudzuki, 1989
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAL
Loc. {LE, BO}

****Kellicottia longispina* (Kellicott, 1879)**
Syn.: *Anuraea longispina* Kellicott, 1879
Syn.: *Notholca longispina heterospina* Olofsson, 1917
Syn.: *Notholca longispina taymirica* Grese, 1955
Geographical distribution: AFR, NEA, NEO, ORI, PAL
Loc. {TA}

****Keratella americana* Carlin, 1943**
Syn.: *Keratella gracilenta* Ahlstrom, 1943
Syn.: *Keratella lenzi caudata* Koste, 1972
Geographical distribution: ANT, NEA, NEO (PAL and AFR)
Loc. {LE, GR, KE}

***Keratella cochlearis cochlearis* (Gosse, 1851)**
Syn.: *Anuraea cochlearis recurvispina* Jägerskiöld, 1894
Syn.: *Anuraea stipitata* Ehrenberg, 1838
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAL
Loc. {LE, TA, GR, KE}

****Keratella cochlearis*.var *hispida* (Lauterborn, 1900)**
Syn.: *Keratella cochlearis* (Gosse, 1851)
Syn.: *Anuraea cochlearis* Gosse, 1851
Syn.: *Keratella cochlearis cochlearis* (Gosse, 1851)
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAL.
Loc. {LE, TA, BO, KE}

****Keratella irregularis* (Lauterborn, 1898)**
Syn.: *Anuraea irregularis* Lauterborn, 1898
Syn.: *Anuraea cochlearis* var. *irregularis* Lauterborn, 1898
Geographical distribution: NEA, PAL (its presence is doubtful in AFR)
Loc. {TA}

***Keratella lenzi* Hauer, 1953**
Geographical distribution: AFR, NEA, NEO, ORI
Loc. {TA}

***Keratella hiemalis* Carlin, 1943**
Geographical distribution: NEA, PAL
Loc. {BO}

***Keratella mixta* (Oparina-Charitonova, 1924)**
Syn.: *Anuraea mixta* Oparina-Charitonova, 1924
Syn.: *Anuraea cochlearis* var. *mixta* Oparina-Charitonova, 1924
Syn.: *Keratella mixta ahlstromiella* Berzins, 1961
Geographical distribution: NEA, ORI, PAL
Loc. {LE, TA, BO}

***Keratella paludosa* (Lucks, 1912)**
Syn.: *Anuraea paludosa* Lucks, 1912
Geographical distribution: AFR, NEA, PAL
Loc. {TA, GR}

***Keratella procurva* (Thorpe, 1891)**
Syn.: *Anuraea procurva* Thorpe, 1891
(Geographical distribution absent from Segers, 2007)
Loc. {TA}

***Keratella quadrata quadrata* O.F.Muller, 1786**
Syn.: *Anuraea aculeata* Ehrenberg, 1832
Syn.: *Keratella quadrata neali* Berzins, 1961
Syn.: *Keratella quadrata valgoides* Edmonson and Hutchinson, 1934
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL.
Loc. {LE, TA, GR, BO, KE}

***Keratella reducta* (Huber-Pestalozzi, 1929)**
Syn.: *Anuraea reducta* Huber-Pestalozzi, 1929
Syn.: *Keratella tetracera* Hutchinson, 1961
Geographical distribution: AFR
Loc. {LE, TA}

***Keratella testudo* (Ehrenberg, 1832)**
Syn.: *Anuraea testudo* Ehrenberg, 1832
Syn.: *Anuraea brevispina* Gosse, 1854
Geographical distribution: AFR, NEA, PAL
Loc. {TA}

***Keratella ticinensis* (Callerio, 1921)**
Syn.: *Anuraea ticinensis* Callerio, 1921
Syn.: *Anuraea aculeata* var. *ticinensis* Callerio, 1921
Geographical distribution: NEA, PAL, AFR
Loc. {TA, BO, KE}

***Keratella tropica* (Apstein, 1907)**
Syn.: *Anuraea tropica* Apstein, 1907
Syn.: *Keratella quadrata valga asymmetrica* Ueno, 1938
Syn.: *Anuraea valga* var. *tropica* Apstein, 1907
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL

Loc. {LE, TA}

***Keratella valga* (Ehrenberg, 1834)**
(Commonly confused with *K. tropica*)
Syn.: *Anuraea valga* Ehrenberg, 1834
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAL
Loc. {TA}

***Notholca foliacea* (Ehrenberg, 1838)**
Syn.: *Anuraea foliacea* Ehrenberg, 1838
Geographical distribution: AFR, AUS, NEA, NEO, PAL
Loc. {LE, TA, BO}

***Notholca squamula* (Müller, 1786)**
Syn.: *Brachionus squamula* Müller, 1786
Syn.: *Notholca lapponica* Ruttner Kolisko, 1966
Syn.: *Notholca striata striata frigida* Rylov, 1922
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAL
Loc. {BO, KE}

***Notholca* sp.**
Loc. {BO, KE}

Family: Notommatidae Hudson et Gosse, 1886

***Cephalodella catellina* (Müller, 1786)** (includes the infrasubspecific variant *minor* Zawadovsky, 1926)
Syn.: *Cercaria catellina* Müller, 1786
Syn.: *Cephalodella armata* Rudescu, 1960
Syn.: *Cephalodella botezati* Rodewald, 1935
Syn.: *Cephalodella catellina natans* Berzins, 1976
Syn.: *Cephalodella myersi* Wiszniewski, 1934
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAL
Loc. {BO}

***Cephalodella gibba* (Ehrb, 1832)**
Syn.: *Furcularia gibba* Ehrenberg, 1830
Syn.: *Cephalodella microdactyla* Koch-Althaus, 1963.
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAC, PAL.
Loc. {BO, KE}

***Cephalodella intuta intuta* Myers, 1924**
Geographical distribution: AUS, NEA, NEO, ORI, PAC, PAL
Loc. {BO}

***Cephalodella nana* Myers, 1924**
Geographical distribution: AUS, NEA, NEO, PAC, PAL
Loc. {BO}

***Scaridium longicaudum* (Müller, 1786)**
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {BO}

***Wierzejskiella sabulosa* (Wiszniewski, 1932)**
Syn.: *Encentrum sabulosum* Wiszniewski, 1932
Geographical distribution: PAL
Loc. {BO}

Family: Colurellidae Bartos, 1959

***Colurella adriatica* Ehrenberg, 1831** (includes the infrasubspecific variants *angusta* Donner, 1964, *lata* Donner, 1964 and α, β, γ Hauer (1924) marine and cold waters).
Syn.: *Monura bartonia* Gosse, 1887
Syn.: *Colurus caudatus* Ehrenberg, 1834
Syn.: *Monura dulcis* Ehrenberg, 1838
Syn.: *Colurus leptus* Gosse, 1887
Syn.: *Colurus navalis* Lord, 1884
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAC, PAL.
Loc. {LE}

***Colurella colurus* (Ehrenberg, 1830)**
Syn.: *Monura colurus* Ehrenberg, 1830
Syn.: *Colurella colurus colurus* (Ehrenberg, 1830)
Syn.: *Colurus amblytelus* Gosse, 1886
Syn.: *Colurus grallator* Gosse, 1887
Syn.: *Monura loncheres* Gosse, 1887
Syn.: *Colurella longidigita* Mola, 1930
Syn.: *Colurus rotundatus* Daday, 1890
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAL (marine and freshwaters)
Loc. {LE, BO, KE}

****Colurella dicentra* (Gosse, 1887)**
Syn.: *Colurus dicentrus* Gosse, 1887
Geographical distribution: NEA, NEO, PAL
Loc. {BO}

****Colurella uncinata uncinata* (Müller, 1773)**
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {LE}

***Colurella* sp.**
Loc. {BO, KE}.

Family: Lepadellidae Harring, 1913

***Lepadella (Lepadella) acuminata* (Ehrenberg, 1834)**
Syn.: *Metopidia acuminata* Ehrenberg, 1834
Syn.: *Lepadella chorea Berzins*, 1982
Syn.: *Lepadella sexcostata* Bartos, 1955
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {BO}

****Lepadella (Lepadella) adjuncta* Donner, 1943**
Geographical distribution: PAL
Loc. {TA, BO}

***Lepadella (Lepadella) ovalis* (Müller, 1786)**
Syn.: *Brachionus ovalis* Müller, 1786
Syn.: *Metopidia affinis* Bergendal, 1892
Syn.: *Metopidia lepadella* Ehrenberg, 1832
Syn.: *Mytilina lepidura* Bory de St. Vincent, 1826
Syn.: *Lepadella rotundata* Dujardin, 1841
Syn.: *Metopidia solidus* Gosse, 1851

Syn.: *Lepadella velazmedrani* Pardo, 1934
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {TA, BO}

***Lepadella* (*Lepadella*) *patella* (Müller, 1773)**
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {BO}

****Lepadella (Lepadella) quadricarinata* (Stenroos, 1898)** (includes the infrasubspecific variants *octocarinata* Wulfert, 1939, *sexcarinata* Klement, 1959, *procera* Klement, 1959)
Syn.: *Metopidia quadricarinata* Stenroos, 1898
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {BO}

****Lepadella (Lepadella) triba* Myers, 1934**
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {BO}

***Lepadella* sp.**
Loc. {BO}

****Lepadella (Heterolepadella) heterodactyla* Fadeew, 1925** (absent of the checklist of the rotifers Segers, 2007)
Loc. {BO}

Family: Dicranophoridae Harring, 1913

***Dicranophorus caudatus* (Ehrenberg, 1834)** (absent of the checklist of the rotifers Segers, 2007)
Loc. {LE}

Family: Euchlanidae Ehrenberg, 1838

****Euchlanis callimorpha* Berrzins, 1957**
Geographical distribution: AFR
Loc. {TA}.

***Euchlanis dilatata dilatata* Ehrb, 1832**
Syn.: *Euchlanis hipposideros* Gosse, 1851
Syn.: *Euchlanis uniseta* Leydig, 1854
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAC, PAL.
Loc. {BO}

****Euchlanis deflexa* (Gosse, 1851)**
Syn.: *Dapidia deflexa* Gosse, 1851
Syn.: *Euchlanis calpidia* Myers, 1930
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {BO}

***Euchlanis dilatata lucksiana* (Hauer, 1930)**
Syn.: *Euchlanis dilatata crassa* Myers, 1938
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL.
Loc. {TA}

***Euchlanis incisa incisa* Carlin, 1939** (includes the infrasubspecific variant *mucronata* Ahlstrom, 1934)
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAC, PAL.
Loc. {BO}

***Euchlanis lyra* Hudson, 1886**
Syn.: *Euchlanis myersi* Kutikova, 1959
Geographical distribution: AFR, AUS, NEA, NEO

Loc. {BO}

***Euchlanis triquetra* Ehrb, 1838**
Syn.: *Euchlanisbrahmae* Dhanapathi, 1976
Syn.: *Dapidia carinata* Carlin-Nilson, 1934
Syn.: *Dapidia lata* Carlin-Nilson, 1934
Syn.: *Euchlanis longobardica* Manfredi, 1927
Syn.: *Euchlanis pellucida* Harring, 1921
Syn.: *Euchlanis triquetra pterigoidea* Grese, 1955
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL.
Loc. {TA, BO}

Family: Epiphanidae Harring, 1913

***Epiphanes clavulata* (Ehrenberg, 1832):**
Syn.: *Notommata clavulata* Ehrenberg, 1832
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {LE}

Family: Lecanidae Remane, 1933

***Lecane bulla bulla* (Gosse, 1851)**
Syn.: *Monostyla bipes* Stokes, 1896
Syn.: *Monostyla bulla constricta* Sudzuki, 1992
Syn.: *Monostyla bulla dentata* Sudzuki, 1992
Syn.: *Lecane bulla diana* Abdullaev, 1989
Syn.: *Lecane bulla kutikovae* Naberezhniyi et Irmasheva, 1975
Syn.: *Monostyla goniata* Harring and Myers, 1926 (synonymous occasionally considered as infrasubspecific variant of *L. bulla*)
Syn.: *Monostyla ozolini Berzins*, 1943
Syn.: *Lecane physalis* Wulfert, 1939 (incl. *L. styrax longistyla* (Weisig, 1928)
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {TA, BO, KE}

***Lecane closterocerca* (Schmarda, 1859)**
Syn.: *Monostyla closterocerca* Schmarda, 1859
Syn.: *Monostyla brodskii* Muraveisky, 1935
Syn.: *Lecane closterocerca amazonica* Koste, 1978
Syn.: *Monostyla eichsfeldica* Künne, 1926
Syn.: *Monostyla latvica* Berzins, 1943
Syn.: *Lecane wulferti* Hauer, 1956
Geographical distribution : AFR, ANT, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {BO}

***Lecane crenata* (Harring, 1913)**
Syn.: *Monostyla crenata* Harring, 1913
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {BO}

***Lecane doryssa* Harring, 1914**
Geographical distribution: AFR, AUS, NEO, ORI, PAL.

Loc. {LE, KE}

***Lecane lamellata* (Daday, 1893)**
Syn.: *Monostyla lamellata* Daday, 1893
Syn.: *Monostyla appendiculata* Skorikov, 1898 (*non* Levander (1894))
Geographical distribution: NEA, PAL
Loc. {BO}

***Lecane hamata* (Stokes, 1896)**
Syn.: *Monostyla hamata* Stokes, 1896
Syn.: *Lecane hamata victoriensis* Koste and Shiel, 1980
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {KE}

***Lecane punctata* (Murray, 1913)**
Syn.: *Monostyla punctata* Murray, 1913
Syn.: *Lecane aguessei* De Ridder, 1960
Syn.: *Monostyla harringi* Ahlstrom,
Geographical distribution: AFR, NEA, NEO, ORI, PAL.
Loc. {LE, TA, BO}

***Lecane quadridentata* (Ehrenberg, 1830)**
Syn.: *Monostyla quadridentata* Ehrenberg, 1830
Syn.: *Monostyla bicornis* Daday, 1897
Syn.: *Lecane quadridentata arthrodactyla* Berzins, 1982
Syn.: *Monostyla sexidentata* Van Oye, 1926
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {BO}

***Lecane luna* (Müller, 1776)**
Syn.: *Cercaria luna* Müller, 1776
Syn.: *Lecane dorsicalis* Arora, 1965
Syn.: *Lecane jobloti* Bory de St. Vincent, 1827
Syn.: *Lecane luna balatonica* Varga, 1945
Syn.: *Lecane submagna* De Ridder, 1960.
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAC, PAL.
Loc. {TA, BO, KE}

***Lecane lunaris* (Ehrenberg, 1832)**
Syn.: *Monostyla lunaris* Ehrenberg, 1832
Syn.: *Monostyla constricta* Murray, 1913
Syn.: *Lecane lunaris arthrodactyla* Berzins, 1982
Syn.: *Lecane lunaris australis* Berzins, 1982
Syn.: *Monostyla lunaris obserata* Steinecke, 1916
Syn.: *Monostyla quennerstedti* Bergendal, 1892
Syn.: *Monostyla sylvatica* Harring, 1913
Syn.: *Monostyla virga* Harring, 1914
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {LE, BO, KE}

***Lecane monostyla* (Daday, 1897)**
Syn.: *Monostyla monostyla* Daday, 1897
Syn.: *Monostyla* sp.*inifera* Idelson, 1924
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAC, PAL

Loc. {LE, BO, KE}

Family: Gastropodidae Remane, 1933

***Ascomorpha ecaudis* Perty, 1850**
Syn.: *Ascomorpha germanica* Leydig, 1854
Syn.: *Ascomorpha helvetica* Perty, 1852
Syn.: *Sacculus viridis* Gosse, 1851
Geographical distribution: AFR, AUS, NEA, ORI, PAL
Loc. {LE}

***Ascomorpha ovalis* (Bergendal, 1892)**
Syn.: *Anapus ovalis* Bergendal, 1892
Syn.: *Sacculus cuirassis* Hood, 1894
Syn.: *Chromogaster testudo* Lauterborn, 1893
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {LE, TA}

***Gastropus stylifer* (Imhof, 1891)**
Syn.: *Notops stylifer* Imhof, 1891
Syn.: *Sacculus orbicularis* Kellicott, 1897
Syn.: *Hudsonella picta* Zacharias, 1893
Syn.: *Hudsonella pygmaea* Zacharias, 1894
Syn.: *Notops pygmaeus* Calman, 1892
Syn.: *Hudsonia ruber* Hood, 1893
Geographical distribution: AFR, AUS, NEA, NEO, PAL
Loc. {LE, GR, BO, KE}

Family: Trichotriidae Harring, 1913

***Macrochaetus* sp.**
Loc. {KE}

***Trichotria tetractis similis* (Stenroos, 1898)**
Syn.: *Dinocharis tetractis similis* (Stenroos, 1898)
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL.
Loc. {TA}

***Trichotria tetractis tetractis* (Ehrenberg, 1830)**
Syn.: *Dinocharis pauper* Ehrenberg, 1830
Syn.: *Dinocharis quadrangularis* Stirnemann, 1926
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {TA, BO}

***Trichotria* sp.**
Loc. {BO}

Family: Mytilinidae Bartos, 1959

***Mytilina bisulcata* (Lucks, 1912)**
Syn.: *Diplax bisulcata* Lucks, 1912
Geographical distribution: AFR, AUS, NEO, ORI, PAL
Loc. {BO}

***Mytilina mucronata* (Müller, 1773)**
Syn.: *Brachionus mucronatus* Müller, 1773
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL

Loc. {BO}

***Mytilina ventralis ventralis* (Ehrenberg, 1830)**
Syn.: *Salpina ceylonica* Daday, 1896
Syn.: *Salpina cortina* Thorpe, 1891
Syn.: *Salpina eustala* Gosse, 1886
Syn.: *Salpina macracantha* Gosse, 1886
Syn.: *Salpina similis* Stokes, 1896
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {BO}

***Lophocharis oxysternon* (Gosse, 1851)**
Syn.: *Metopidia oxysternon* Gosse, 1851
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAL
Loc. {BO}

***Lophocharis salpina* (Ehrenberg, 1834)**
Syn.: *Lepadella salpina* Ehrenberg, 1834
Syn.: *Lophocharis lepadelloides* Rodewald, 1935
Syn.: *Lophocharis parvidentata* Hauer, 1937
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {LE, BO}

***Polyarthra euryptera* Wierzejski, 1891**
Syn.: *Polyarthra latiremis* Imhof, 1891
Geographical distribution: NEA, ORI, PAL
Loc. {TA, BO}

***Polyarthra dolichoptera* Idelson, 1925**
Syn.: *Polyarthra platyptera*.
Geographical distribution: AFR, AUS, NEA, ORI, PAC, PAL
Loc. {LE, TA, GR, BO, KE}

***Polyarthra remata* Skorikov, 1896**
Syn.: *Polyarthra platyptera*
Geographical distribution: AUS, NEA, NEO, ORI, PAL
Loc. {LE, TA, GR, BO, KE}

***Polyarthra vulgaris* Carlin, 1943**
Syn.: *Polyarthra trigla*
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {LE, TA, BO}

Family: Synchaetidae Hudson and Gosse, 1886

***Synchaeta oblonga* Ehrenberg, 1832**
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {LE}

Family: Trichocercidae Remane, 1933

***Trichocerca cylindrica* (Imhof, 1891)**
Syn.: *Mastigocerca cylindrica* Imhof, 1891
Syn.: *Mastigocerca elegans* Meissner, 1902
Syn.: *Mastigocerca hamata* Zacharias, 1897
Syn.: *Mastigocerca hamata bologonensis* Minkiewicz, 1900

Syn.: *Mastigocerca setifera* Lauterborn, 1893
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {LE, BO}

***Trichocerca collaris* (Rousselet, 1896)**
Syn.: *Rattulus collaris* Rousselet, 1896
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {BO}

***Trichocerca elongata* (Gosse, 1886)**
Syn.: *Mastigocerca elongata* Gosse, 1886
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {LE}

***Trichocerca ruttneri* Donner, 1953**
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {LE, BO, KE}

***Trichocerca stylata* (Gosse, 1851)**
Syn.: *Monocerca stylata* Gosse, 1851
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {LE, BO}

***Trichocerca tigris* (Müller, 1786)**
Syn.: *Trichoda tigris* Müller, 1786
Syn.: *Heterognathus macrodactylus* Schmarda, 1859
Geographical distribution: AFR, ANT, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {LE, BO}

ORDER: FLOSCULARIACEA Harring, 1913

Family: Testudinellidae Harring, 1913

****Ptygura mucicola*** (Kellicott, 1888)
Syn.: *Oecistes mucicola* Kellicott, 1888
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL.
Loc. {BO, KE}

***Pompholyx sulcata* Hudson, 1885**
Geographical distribution: AFR, NEA, NEO, ORI, PAL
Loc. {LE, TA}

***Pompholyx complanata* Gosse, 1851**
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {LE, TA}

***Pompholyx triloba* Pejler, 1957**
Geographical distribution: NEA, PAL
Loc. {TA, BO}

***Testudinella caeca* (Parsons, 1892)** (includes the infrasubspecific variants *lermaensis* Ahlstrom, 1932 and *haueri* Wiszniewski, 1954)
Syn.: *Pterodina caeca* Parsons, 1892
Geographical distribution: AFR, NEA, NEO, PAL
Loc. {BO}

***Testudinella emarginula* (Stenroos, 1898)**
Syn.: *Pterodina emarginula* Stenroos, 1898

Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {TA, BO}

***Testudinella incisa* (Ternetz, 1892)**
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {BO}

***Testudinella patina* (Hermann, 1783)** (includes the infrasubspecific variant *lindbergi* Berzins)
Syn.: *Brachionus patina* Hermann, 1783
Syn.: *Pterodina intermedia* Anderson, 1889
Syn.: *Testudinella pseudoelliptica* Bartoš, 1951
Syn.: *Testudinella sculpturata* Bartoš, 1951
Syn.: *Pterodina trilobata* Anderson and Shephard, 1892
Syn.: *Testudinella trilobata haterumensis* Sudzuki, 1992
Syn.: *Testudinella trilobata triangularis* Sudzuki, 1992
Syn.: *Pterodina valvata* Hudson, 1871
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {LE, TA, GR, BO, KE}

***Testudinella truncata* (Gosse, 1886)**
Syn.: *Pterodina truncata* Gosse, 1886
Syn.: *Pterodina stenroosi* Rundström, 1909
Geographical distribution: AFR, NEA, PAL
Loc. {TA}

***Trochosphaera solstitialis* Thorpe, 1893**
Geographical distribution: AFR, NEA, ORI, PAL
Loc. {KE}

Family: Conochilidae Remane, 1933

***Conochilus (Conochilus) hippocrepis* (Schrank, 1803)**
Syn.: *Linza hippocrepis* Schrank, 1803
Syn.: *Conochilus volvox* Ehrenberg, 1834
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {TA, BO}

Family: Hexarthridae Bartos, 1959

***Hexarthra fennica* (Levander, 1892)**
Syn.: *Pedalia fennica* Levander, 1892
Geographical distribution: AFR, AUS, NEA, NEO, ORI
Loc. {LE, GR, BO}

***Hexarthra intermedia brasiliensis* Hauer, 1953**
Geographical distribution: AFR, NEO
Loc. {TA, KE}

***Hexarthra mira* (Hudson, 1871)**
Syn.: *Pedalion mira* Hudson, 1871
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAC, PAL
Loc. {TA}

***Hexarthra* sp.**
Loc. {LE, BO, KE}

Family: Collothecidae Harring, 1913

***Collotheca ambigua* (Hudson, 1883)**
Syn.: *Floscularia ambigua* Hudson, 1883
Syn.: *Floscularia algicola* Hudson, 1886
Syn.: *Floscularia minor* Hudson, 1886
Geographical distribution: AFR, AUS, NEA, NEO, PAL
Loc. {TA, KE}

***Collotheca stephanochaeta* Edmondson, 1936**
Geographical distribution: NEA, PAL
Loc. {BO, KE}

***Collotheca pelagica* (Rousselet, 1893)**
Syn.: *Floscularia pelagica* Rousselet, 1893
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {KE}

Family: Filiniidae Bartos, 1959

***Filinia longiseta* (Ehrenberg, 1834)**
Syn.: *Triarthra longiseta* Ehrenberg, 1834
Syn.: *Filinia longiseta intermedia* Buchholz, 1952
Syn.: *Filinia longiseta minor* Evans, 1949
Geographical distribution: AFR, AUS, NEA, NEO, ORI, PAL
Loc. {GR, BO}

***Filinia pejleri* Hutchinson, 1964**
Syn.: *Filinia terminalis kergueleniensis* Lair and Koste, 1984
Geographical distribution: AFR, ANT, AUS, NEO, ORI, PAL
Loc. {BO}

The physicochemical parameters measured in Algerian lakes vary as follows: temperature from 17.93 ± 1.67 to 19.87 ± 1.34˚C, pH from 7.45 ± 0.12 to 7.78 ± 0.07, conductivity from 0.36 ± 0.02 to 2.86 ± 0.06 mS cm^{-1}, oxygen saturation from 75.16 ± 6.57 to 88.57 ± 3.80 % (Table 1).

Rotifers have a wide range of tolerance for extreme temperatures (AHLSTROM, 1933). Various studies (SALER and SUN, 2002; SCHÖLL and KISS, 2008; SULAHRIA and MALIK, 2012) have shown that a significant positive correlation existed between zooplankton including rotifers and water temperature. This correlation might possibly be due to enhanced rate of population growth at higher temperatures (GALKOVSKAYA, 1987).

Measured pH values show that freshwaters in Algeria are alkaline. The rotifers prefer pH in the range of 6.5 to 8.5 (BARNES, 1974; BĒRZIŅŠ and PEJLER, 1987; NESCHUK *et al.*, 2002; SIPAUBA TAVARES and ROCHA, 2003). In this study, pH ranged from 7.45 ± 0.12 and 7.78 ± 0.07 which falls close to the recorded preference.

Although electrical conductivity is lower in Taksebt, and also in Lakhal and Boukourdane lakes, it was found significantly higher in Keddara and much more in Ghrib reservoirs (Fig. 2) (Kruskal-Wallis test, $p<0,001$). TOLEDO *et al.* (2003) and HULYAL and KALIWAL (2007) noted that moderate electrical conductivity (about 40 µS cm^{-1}) can favor the growth and even the dominance of rotifers.

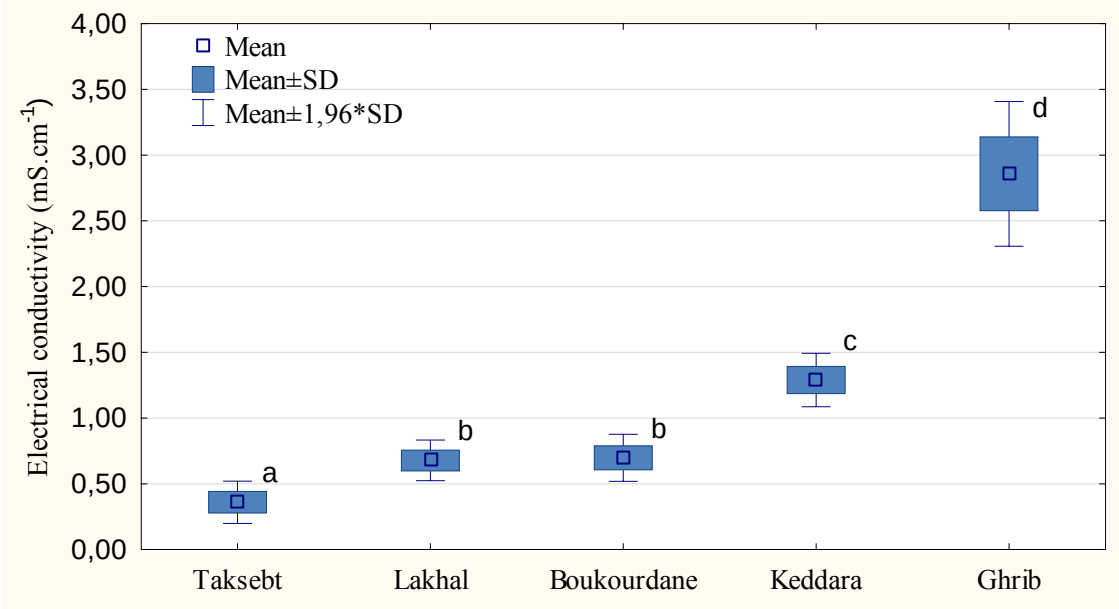

Figure 2. - Electrical conductivity (mS cm^{-1}) of the studied sites
(different letters show mean values statistically different in post hoc tests).

Zooplankton abundance is also affected by the oxygen concentration in water (ALLAN, 1976; WETZEL, 1983; SULAHRIA and MALIK, 2012). According to KITCHELL (1998), oxygen concentration is often a significant limitation for aquatic organisms.

Examining the oxygen saturation values shows that the amount of dissolved oxygen in lakes is related to the increase in phytoplankton density due to the increase of the water temperature during the spring.

The number of species known in Algeria in 1991 was 133 (DE RIDDER, 1991). Geographically 61% are cosmopolitan, 20% are with thermophilic distribution and 12% are subtropical. This number of species increased for 19 species by the work of SAMRAOUI *et al.* (1998). Then HAMAIDI *et al.* (2008), in a study on the Rotifera of the wadi Chiffa, increased the number of known species to 201.

The present study adds 66 new species (see the List) and increases the total number of known rotifer species in Algeria to 267. Biodiversity observed so far is certainly not definitive, given the short sample period considered in this work; other campaigns are needed to complete this List of species.

In this inventory of rotifer species, 57.2% are cosmopolitan species, 30.8% are of African origin-AUS-NEA-NEO-ORI-PAL, 7.7% are AFR-AUS-NEO-ORI-PAL, 5.5% are NEA-PAL, 4.4% are AFR-NEA-PAL, 3.3% are AFR-AUS-NEA-NEO-PAL or AFRI-NEA-NEO, ORI-PAL, 2.2% are NEA-ORI-PAL or AFR-NEA-NEO-ORI or African origin and 1.1% of Palearctic origin or AFR-AUS-PAL. These observations are similar to those obtained by DE RIDDER (1987).

Majority of the rotifers are cosmopolitan because the same species occur all over the world (RICCI and MELONE 2000; SEGERS 2008; WALLACE *et al.* 2008) and only a few are restricted in distribution (SEGERS *et al.,* 1993; SEGERS 1995b). However, rotifers may show cryptic speciation (SCHRÖDER and WALSH 2007; WALSH *et al.,* 2009) which means specimens, from nearby sites or even distant sites, may look very much alike but they are genetically very different. The universal distribution of rotifers is usually based on the fact that, in dry conditions, the dormant eggs and the adults are readily blown about or carried by animals and may survive for long periods under adverse conditions (HYMAN, 1951).

In the sampled material, three families (Brachionidae, Lecanidae and Testudinellidae) are dominant by the number of species. The total of 27 taxa belongs to the family Brachionidae. This fact is similar with the findings of numerous studies in other parts of the world (FERNANDO, 1980; ARCIFA, 1984; SENDACZ, 1984; EDBORGE and CHIGBU, 1988; AKINBUWA and ADENIYI, 1991). The genus *Keratella* (15 species), is the most representative of both characteristics of the pelagic areas and littoral areas (vegetation zones). This observation has been confirmed by the work of PENNAK (1966).

A total of 11 taxa were recorded for the group of Lecanidae. This type of rotifers is mainly confined to littoral environments, although some are frequently found in the pelagic zone of lakes. The presence of 11 species in the sites sampled in this study confirms the diversity and ecological success of such widespread as was already discussed in various studies. Thus, SEGERS (1993) also found in six lakes, four rivers, rice fields and ponds in the region of the Niger Delta, the largest species diversity among *Lecane*. This family reaches its greatest diversity in tropical and subtropical regions, where communities can contain up to 40 different species (PEJLER and BĒRZIŅŠ, 1994; SEGERS, 1995a). There are 163 species from this genus distributed worldwide. The water bodies analyzed in this study contained more than 17.93% of the total fauna of *Lecane*, which is very high for a temperate climate.

Some species such as *Lecane bulla, L. luna, L. closterocerca, L. lunaris* are among the most common in reservoirs and African ponds. Other species *L. hamata, L. monostyla, L. crenata* are cosmopolitan and eurytopiques. *L. crenata, L. doryssa, L. lamellata* and *L. punctata* are rare (SEGERS, 1995b).

The third group that has an impact on the taxonomic structure of the community of Rotifera in the study sites is composed by Testudinellidae. The Testudinellidae is a small family of three genera of which only *Testudinella* is a kind of the most species-rich (40 species) cited in the recent list of rotifers by SEGERS (2007). This is a genre-benthic periphyton, living mainly in microphage forms in the littoral zones of freshwater lakes and ponds (DE SMET, 2009). We identified ten species (three taxa in DE RIDDER, 1991), seven of which were collected at the reservoir of Boukourdane lake. The richness of these taxa can be explained by the fact that the majority of these species are found in coastal areas as already described by DE SMET (2009).

Many authors have noted that *Lecane*, *Brachionus* and *Trichocerca* are often present in large numbers in tropical wildlife (LOPEZ and OCHOA, 1994; SEGERS, 1995b; MEDINA-JUNIOR, 2000; LUCINDA, 2001; SEGERS, 2001). These same types were also collected in this study.

This study collected only six species from Trichocercidae, what represents only 11.53% of the number collected in the PEJLER and BĒRZIŅŠ (1993) study. Most of our six species were observed in the littoral zone.

The other genera of rotifers were represented by only a few species.

Referring to the classification of PENNAK (1966) on the affinities of the Rotifer habitats, we found the following (Fig. 3):

- 30.4% species were planktonic
- 40% of littoral species
- 22.4% may be littoral or planktonic species and
- 7.2% are species without preference for any habitat.

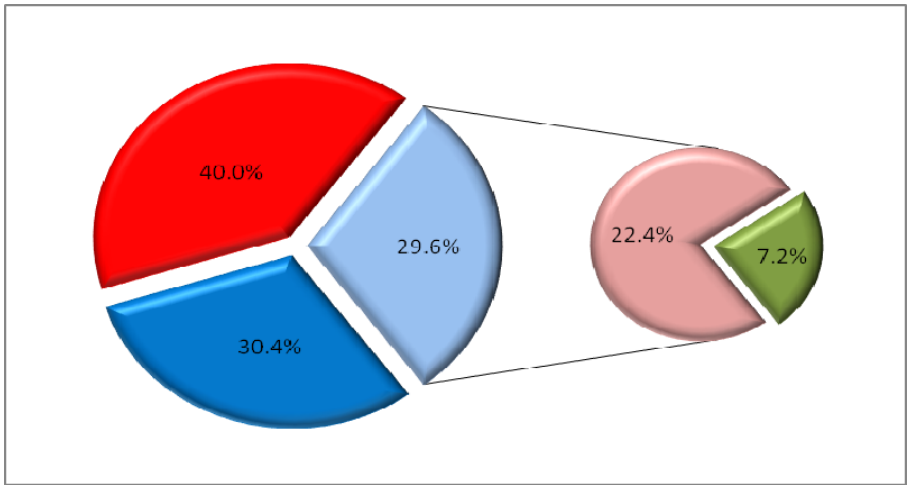

Figure 3. - Classification of the affinities of the rotifer to the habitats in this study.

The presence of vegetation is very important for the species richness at the site of material sampling. It provides refuge against predation, and valuable food sources (especially in the roots). Another important source of food brought by aquatic macrophytes is organic detritus. Much of this biomass produced by aquatic macrophytes is transferred to other trophic levels of the chain. Similar findings were made by ESTEVES and BARBIERI (1983) and more recently by PIECZYNSKA (1990) and ROCHA *et al.* (1995).

CONCLUSION

This study indicates the possibility of the existence of higher rotifer species diversity in Algerian waters than was previously thought. There is no doubt that further faunistical studies of this region will increase the number of recorded species and will also provide more information about Algerian rotifer biogeography. More sampling campaigns are needed to enrich our knowledge about the diversity of Rotifera in the various habitats, to obtain a truly comprehensive picture of the rotifer fauna for Algeria, and to contribute to a better understanding of the distribution patterns and biogeography of Rotifera at a global level.

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