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ABUNDANCE AND DIVERSITY OF NIGER RIVER ROTIFERS IN RELATION TO ENVIRONMENTAL FACTORS

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ABSTRACT

During two periods 8 months of sampling the community of rotifers was inventoried in relationship with 9 Physico-chemical parameters. The objective of this study was to inventory the specific richness of rotifers of the Niger River in Sotuba and to determine the impact of environmental factors on the composition of Rotiferian fauna. A plankton net Nitex 80 µm mesh and 20 cm of openness has been used, practicing the technique of the horizontal line. It was able to identify 35 species of rotifers grouped in 18 families dominated by the family of Brachionidae with 28.57% of genrus. The genus Brachionus dominates this family with 20% of the species. The turbidity, temperature, dissolved oxygen, pH, have been determined in situ. The nitrite, nitrate, ammonium, and ortho-phosphate have been quantified in the laboratory. The results have shown us the seasonality of the stand of rotifers linked to the evolution of the environmental factors which themselves depend on the seasons.

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INTRODUCTION

Mali has a fairly large river system in which the Niger River is the most important in terms of length and socio-economic importance. This river has a fairly diverse biodiversity in vertebrates (Awaïs 2007) and invertebrates (Tachet *et al*., 2010).This biodiversity is affected considerably and continuously by anthropogenic and climatic activities which degrade the quality of the waters and habitats on which plankton depends Plankton are all the animal and plant organisms that float in the water, it is divided into two categories: plant plankton or phytoplankton (autotrophic) and animal plankton or zooplankton (heterotrophic). Zooplankton belongs to an intermediate trophic level and is located between primary producers and higher trophic level organisms (Jouffre, 1989). He transfers more than 60% of primary lake production to fish fry (Haberman 1998).

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Several studies suggest using zooplankton as an indicator of global change (Edwards *et al*., 2001, Beaugrand *et al*., 2002). Zooplankton are crustaceans (cladocerans and copepods) and rotifers. Rotifers are microscopic metazoans widespread in fresh and brackish waters, they are abundant in the benthos and periphyton. Rotifers convert primary production by producing up to 30% of the total biomass of zooplankton (Nogrady *et al*., 1993).

They are a favorite food in shrimp and fry farms (Dhert *et al*., 2001), and serve as bio-indicators of water quality. Very little work is done on rotifers in aquatic ecosystems in Mali, the first (and only) studies to date on rotifers are those of Koste & Tobias, (1989, 1998). Other more general zooplankton studies have been conducted: Pagano *et al*., (2011); Arfi, (2003, 2005); Sako, (2017). The objective of this work is to understand the quantitative and qualitative variation of rotifers in relation to certain environmental factors.

MATERIAL AND METHODS

Study site: Sotuba site (Figure 1) is located on the Niger River in the city of Bamako, with geographical coordinates: 12° 37' 44,5'' N; 07° 56' 10,1'' W; 312,6m Altitude. The depth of the river in Sotuba varies between about 15m in flood and 0,5m in low water, its width of about 800m (in flood) is reduced to about 20m (in low water) and often less than 20m in place(personal estimation). It is characterized by a sandstone bed covered by lateritic formations (Piquouet, 1999), it receives solid and liquid waste from the city of Bamako. Both banks of the river as well as dry season surfaces on the sotuba site are places for daily leaching, bathing, gardening, fishing.. Occult and religious practices are daily on the Sotuba website. A submersible pavement connects the two banks with a thermal power station located on the right bank at the end of the submersible roadway. The Sotuba site is located in the Sudano-Sahelian zone with a pure tropical climate, a rainfall between 700 and 1200 mm with 60 to 80 days of rainfall, the rainy season lasts from June to October (Maïga *et al*., 2001).

without treatment is used for direct observations on the living, while the other half is kept in 5% formalin for counts. A reverse trinocular microscope served the observations of samples at GX100 magnification. Individuals encountered are identified and counted, identifications were made thanks to the literature on the taxonomy of zooplankton such as: Dussart, (1982); Amoros(1984) Korinek, (1999).

The identifications were based on observable external morphological characters. Two plastic bottles (1L each) are filled with water from the site and labeled. The content of one of the bottles is used to determine in situ through a portable multiparameter type HANNA parameters such as: temperature, pH, conductivity, dissolved oxygen. Nitrites, nitrates, ammoniumions, orthophosphates were quantified in the laboratory on the contents of the second can with a Perkin Elmer Lambda 40 spectrometer. Zooplankton was analyzed according to the hydrological cycle which includes two periods: a period of low waters from March to July and a period of high water from August to October.

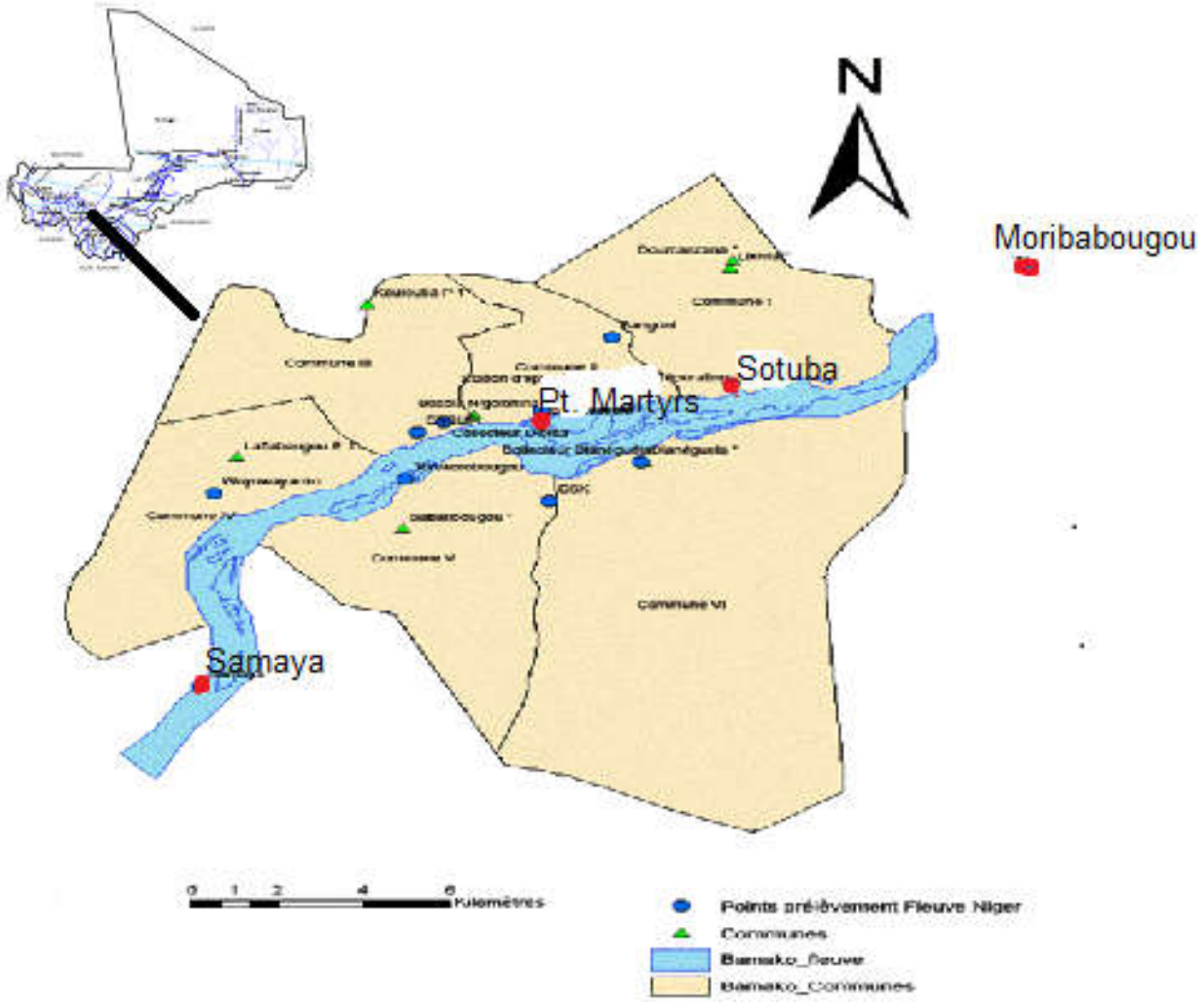

Figure 1. Map showing Sotuba site (Keita 2011)

Sample collection and analysis: Samples were taken in the mornings from March 2017 to October 2017, with a biweekly frequency. A Nitex conical plankton net of 80µm mesh with a 20cm aperture was used to capture zooplankton. The samples took place in the calm places of the river, the net is kept motionless with its opening against the stream of water for 15 minutes. The contents of the net after cleaning, one half

Statistical analysis: In order to study the general structure of populating, the following variables were determined: zooplankton density (ind.m3) was used to compare the densities of different species harvested: Dzoo = MixVr/L or Dzoo = zooplankton density (ind.m3), Mi = mean number of individuals, Vr = volume harvested (mL), L = number of liter filter (m3), dominance (Do) to give the percentage of

individuals of the species in relation to all individuals of all species. The species richness (S) or taxonomic value that represents the number of species present in the sample was determined. Abundance (A) is determined by comparing densities between species.

RESULTS

Physico-chemical analyzes: It can be seen in FIG.1 that river water remained basic over all samples with pH values between 7,7 and 7,31. Oxygenation with values ranging from 6,1 mg/L in July to 4,49 mg/L in September remained quite good.

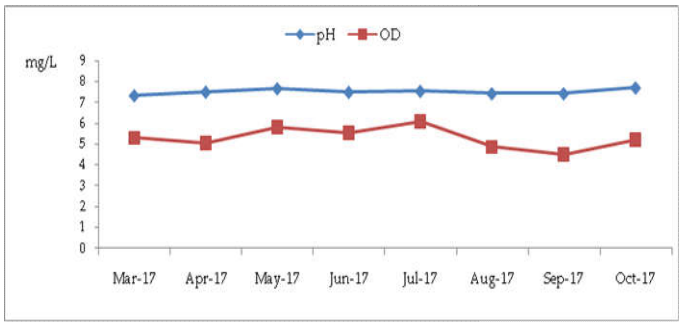

Figure 1. Changes in pH and dissolved oxygen (DO) in Sotuba

Nutrients remained in ranges of: 0,06 mg/L to 0,98 mg/L (nitrite); 0,06 mg/L and 0,93 mg/L (nitrate); 0,04 mg/L and 0,21 mg/L (ammonium ions); and 0,02 mg/L and 0,99 mg/L (phosphate). By analyzing Figure 2 corresponding to the variation of nutrients it is found that the assay gives values moderately higher from the month of May to the beginning of August.

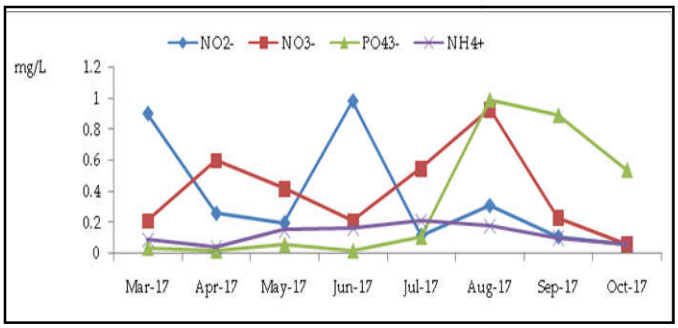

Figure 2. Nutrient variation in Sotuba

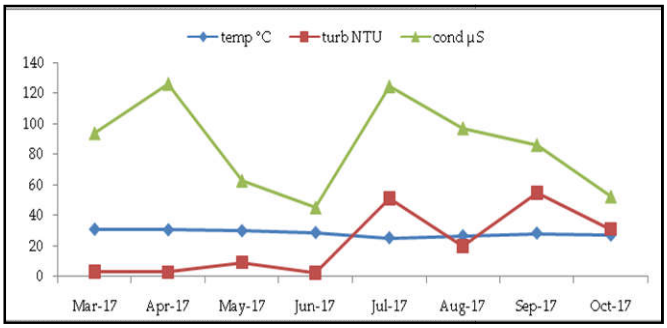

Figure 3. Temperature, turbidity and conductivity variation in sotuba

Figure 3 shows the variation of the temperature with an average on the whole of the samples which remained equal to 28,48°C this average is higher during period of the low water with 29,15°C against 27,37°C in high waters. The more conductible waters during low water periods with 126 µS (April) and 124,32 µS (July) are less conducible in high water with values between 52,12µS (October) and 97µS (August), on the other hand they remained more turbid during the high water period (35,26 NTU) compared to the low water period (13,61 NTU) or even Figure 3.

Diversity of the zooplankton community: During these samplings in the Sotuba site after inventory, 35 taxa were identified, which can be divided as follows in the following table. Figure 4 gives the photos of some species of rotifers caught on the Niger River and identified in the laboratory of environmental sciences and techniques of FST of Bamako.

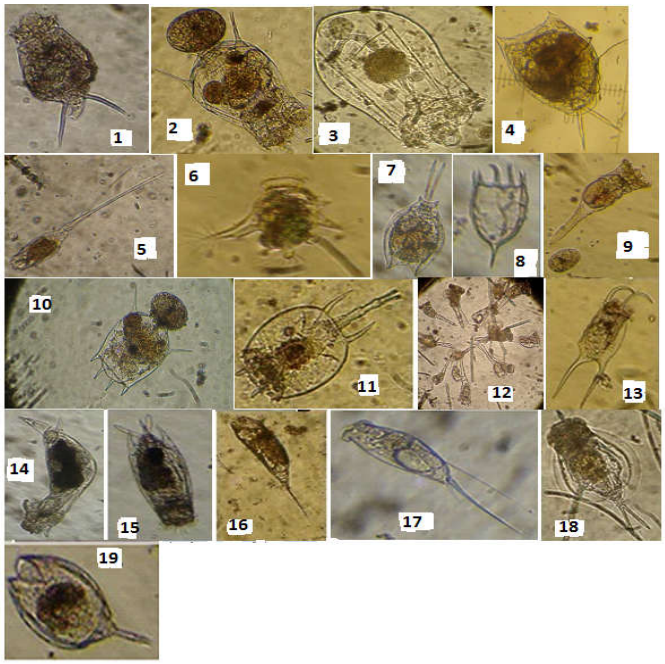

Figure 4. Rotifer species caught on the river in Bamako (from Sako 2017) 1 : Brachionus caudatus, 2 : Brachionus sp., 3 : Asplanchna sp. 4 : Lecane flexilis, 5 : Scaridium sp., 6 : Hexarthra sp. , 7 : Lecane sp., 8 : Keratella cochlearis, 9 : Rotaria sp, 10 : Brachionus sp, 11 : Platyias sp., 12 : Conochilus sp., 13 : Brachionus falcatus, 14 : Notommata sp., 15 : Mitylina sp., 16 : Trichocerca ornate, 17 : Filinia opalensis, 18 : Euchlanis dilatata, 19 : Lecane sp.)

Structure and seasonal dynamics: Of the 35 identified taxa (grouped in 18 families) during this work, the Brachionidae family is the most widely represented with 28,57% of the rotiferian species richness. Philodinidae follow with 11,42%; Notommatidae and Dicranophoridae come respectively with 8,57% and 5,71%. The other 14 remaining families each have values below 3% of species richness (Figure 5)

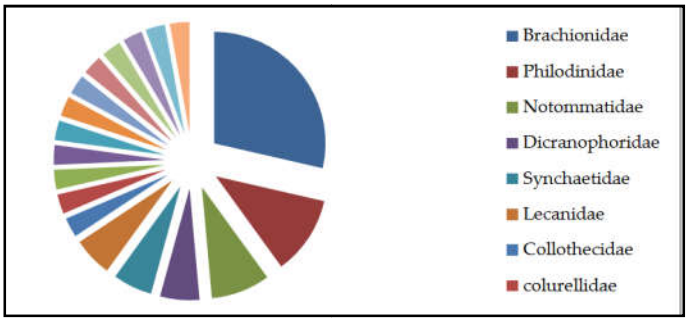

Figure 5. Representation of proportions of rotifer families identified in Sotuba

Table of rotifer species identified in Sotuba and their systematic positions

Class	Order	Family	Kind - species
Rotifera	Monogononta	Asplanchnidae	*Asplanchna sp.*
		Brachionidae	*Playias sp*
			Brachionus caudatus (Barois,1894)
			Brachionus falcatus (Pallas 1766)
			Brachionus plicatilis (Müller 1786)
			Brachionus quadridentatus (Hermann,1783)
			Brachionus calyciflorus (Pallas 1766)
			Brachionus angularis (Gosse,1851)
			Brachionus rotundatus (Rousselet, 1907)
			Keratella tropica (Apstein,1907)
		Trichocercidae	*Trichocerca longiseta (Schrank, 1802)*
		Dicranophoridae	*Dicranophorus sp.*
		Euchlanidae	*Encentrum plicatum (Eyferth, 1885)*
		Collothecidae	*Euchlanis dilatata. (Ehrb, 1832)*
		Colurellidae	*Colletheca ornata (Ehrb, 1838)*
		Epiphanidae	*Colurella uncinata (O.F.Müller,1773)*
		Filiniidae	*Epiphanes sp.*
		Hexarthridae	*Eudactylota sp.*
		Trichotriidae	*Filinia opoliensis (Zacharias, 1898)*
		Mytilinidae	*Hexarthra sp.*
			Macrochaetus sp.
		Philodinidae	*Mitylina sp.*
			Mnioba sp.
			Rotaria neptunia (Ehrenberg, 1832)
			Rotaria sp.
			Philodinia sp.
			Polyarthra sp.
		Synchaetidae	*Synchaeta pectinata (Ehrb 1832)*
		Testudinellidae	*Testudinella patina (Hermann, 1783)*
			Lecane flexilis (Gosse, 1886)
		Lecanidae	*Lecane lunaris (Ehrenberg 1832 (G))*
			Notommata sp.
		Notommatidae	*Cephalodella gibba (Ehrb, 1832)*
			Monommata sp.
		Scaridiidae	*Scaridium sp.*

When analyzing this species richness over the two periods, we note that 13 species or 37,14% are permanent species with occurrences greater than 75% during the period of low water. These species are: *Brachionus plicatilis, Cephalodella gibba, Brachionus falcatus, Brachionus caudatus, Keratella tropica, Rotaria sp., Asplanchna sp., Philodinia sp., Brachionus angularis, Trichocerca longiseta, Lecane flexilis, Lecane lunaris, Polyarthra sp.*. On the other hand, the following species with less than 25% of occurrence during low water are qualified as rare species: *Eudactylota sp., Testudinella patina, Hexarthra sp., Macrochaetus sp., Notommata sp., Encentrum plicatum.* It is noted that during the period of high water or flood the number of species with high occurrences decreases considerably is from 13 to 4 species: *Philodinia sp., Cephalodella gibba, Keratella tropica, Testudinella patina.* It is observed that Testudinella patina weakly present in low water is part of the permanent species in high water. The dominant species numerically are mainly Brachinidae with the following values: *Brachionus falcatus* (2,84*%), Brachionus plicatilis* (3,29%), *Epiphanes sp.* (3,27%), *Keratella tropica* (3,34%), *Philodinia sp.* (3,16%). Species that are numerically in high densities in water proportions are: *Epiphanes sp.* 15,53 ind/L, *Keratella tropica* 12,86 ind/L, *Brachionus falcatus* 11,72 ind/L, *Brachionus caudatus* 9,79 ind/L.

The influence of environmental factors: The variation of the values obtained on all the samples is related to certain environmental factors. The species richness and the densities observed during periods of low water or receding are mainly due to the enrichment of the river in mineral elements as a result of the accumulation of cumulated waste on the banks and in the effluents towards the river (which explains the turbidity high water). The first rains resulting in the river these mineral elements which under the effect of high temperatures will be hydrolyzed which explains the rise in nutrient values during periods of low water (and explains the high conductivity). The enrichment of the river in mineral elements, the favorable ambient temperature and a current of not too strong water are factors that first cause the proliferation (a bloom) in our case of phytoplankton and bacteria. These changes in the environment become favorable for the proliferation of zooplankton, which intensively graze phytoplankton and bacteria. Conversely during the flood period the flow of water and the volume of water very high (unfavorable to the development of zooplankton) make the waters more fluid add to them the effect of increased grazing of zooplankton end up depleting the nutrient medium. These conditions lead to a decrease in numerical densities and species richness.

DISCUSSIONS

The results obtained during this work indicate that the species richness with 35 taxa identified belonging to 18 families is quantitatively high and qualitatively diversified. These results confirm those of Sako,(2017), Oueda *et al*.,(2007), Pagano *et al*.,(2011), Koste and Tobia,(1989, 1998). This Rotiferian fauna largely dominated by the family Brachinidae and the genus Brachionus is noted by many authors who worked on freshwater in Africa: Togouet *et al*.,(2005), Sellami *et al*.,(2008) Ka *et al*.,(2011). In addition, we have described the seasonal variation in the population of rotiferian communities in this study in Sotuba, the same observation was made by some of our predecessors Aka,(2003), Pagano,(2011), Arfi *et*

al., (2003, 2006). The basicity of the river, the good oxygenation, the high temperatures and the small fluctuations of these values are in accordance with the results of several authors having carried out similar works on the Niger River: Pagano *et al*., (2011), Keita, (2011), Koné,(2014), Sako, (2017). The work of De Villers *et al*., (2005) and Onea and Cast, (2004) cited by Oueda, (2009), Eby *et al*.,(2006), Alhou, (2007) confirm the weak mineralization of the river water reported in our results and an increase in the values of mineral elements during low water periods (March-June). Our values of the physicochemical parameters obtained during this study allow us to qualify the waters of the river of oligotrophic medium, these values are consistent with those obtained during this work on the biological parameters (zooplankton). Indeed, on all our samples, our zooplankton densities remained below 30 ind/L, and according to Pourriot, (1965), Karr, (2006) the waters are qualified as oligotrophs if the densities change between 200 and 500 ind/L and the species richness little diversity.

Conclusion

These results show that the values of density and species richness of rotifers in Sotuba evolve seasonally and in parallel with those of physicochemical parameters. The Rotiferian community is diversified specifically with low numerical densities, this community is largely dominated by the family Brachinidae and the genus Brachionus. These values of physicochemical and biological parameters allowed us to describe the river as an oligotrophic medium. The results of these studies should be used by researchers and structures in charge of the river baseline study of the river ecosystem given the importance of rotifers. The difficulties of identifying taxa has greatly limited us in the quantification of species. Similar work must be carried out on several water regions of Mali as part of hydro-ecological monitoring of the Niger River, which will make it possible to apprehend the problems related to ichtyo fauna and climate variations.

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