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*RESEARCH ARTICLE*

**SPATIAL AND NYCTHEMERAL VARIATIONS OF ZOOPLANKTON IN URBAN AQUATIC ECOSYSTEMS OF DALOA (WEST-CENTRAL OF CÔTE D'IVOIRE)**

**N'DO Bi Boly Valérie, Allouko Jean-Renaud, KOUE Jean-Marie Bertrand and BONY Kotchi Yves**
Laboratory of Biodiversity and Tropical Ecology, UFR Environement, Jean Lorougnon Guédé University, Côte d'Ivoire.

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***Abstract***

Urban aquatic ecosystems are important to many species. But they are more subject to urban anthropization which impacts the organisms living there. This study aims to determine the composition and zooplankton density of urban aquatic ecosystems in Daloa. Zooplankton were sampled in June and October 2020, by filtering 90 liters of water on a 50 µm mesh screen, from three fish ponds, three lakes, three streams and one pool. A total of 57 taxa, consisting of 29 Rotifers (50.88%), 17 Copepods (29.82%) and 11 Cladocerans (19.30%), were inventoried. The richness and density varied, depending on the ecosystems, respectively from 04 to 20 taxa and from 4.44 to 139.99 ind/L. These values were higher during the daytime than at night, and in October than in June. The highest taxonomic richness was obtained at ETPA pond (20 taxa), and the lowest at RUGO creek (04 taxa). The highest densities were obtained in the ponds (139.99 ind/L, 75.56 ind/L and 72.60 ind/L) and the lowest in the creeks (4.44 ind/L) and the pool (17.41 ind/L). Nauplii and copepodites and the cladoceran Alona sp. were most observed at night in the lakes. Redundancy analysis showed that the proliferation of some Rotifers and Copepods is optimal in relatively warm and alkaline water ecosystems. Although zooplankton richness is higher during the daytime, night-time sampling should not be overlooked as a way to expand zooplankton taxonomic databases.



## Introduction:-

Aquatic ecosystems play a key role in the live of many plant and animal species. They are generally used for drinking water supply, recreation and many other activities. However, these ecosystems are often subject to various types of pollution caused by many anthropic activities that undermine their functioning (Allan and Flecker, 1993; Kiblut, 2002). This dysfunction of these aquatic environments is often not without inconvenience to the life of the organisms living there (Bony et al., 2013). This is the case for zooplankton, an essential compartment of the aquatic biocenosis. Indeed, zooplankton serves as a biological indicator of water quality (Mollo and Noury, 2013; Chemli, 2017). It also makes oxygen available to benthic organisms, regulating phytoplankton populations (Mollo and Noury, 2013). It is even used in the control of dengue and malaria (Lardeux et al., 1992 and 2002). In addition, it serves as a source of animal protein for many invertebrates and fish (Dabbadié, 1996; Ouattara et al., 2007; N'doua et al., 2008;

**Corresponding Author:- N'DO Bi Boly Valérie**
Address:- Laboratory of Biodiversity and Tropical Ecology, UFR Environement, Jean Lorougnon Guédé University, Côte d'Ivoire.

Balvay, 2009). Due to its trophic role in the feeding of fish larvae and juveniles, zooplankton is produced in large quantities to be made available to fish farmers around the world.

These various interests that zooplankton has made it a well studied zoological group in the world. The Côte d'Ivoire, located in the West African part, is not in margin of this study. Thus, in this country several works concerning zooplankton have been carried out (Binet, 1976; Arfi et al., 1987; Pagano and Saint-Jean, 1988; Ouattara et al., 2007; N'doua et al., 2008; Aka-Koffi et al., 2010; Etilé, 2012; Monney et al., 2016; Anougbo et al., 2020). This work, essentially devoted to diversity, was mainly carried out in the South in lagoons, rivers and streams, and then in a few rivers and lakes in the North of the country. Limiting the study of zooplanktonic organisms to these areas can provide little information on their diversity. Indeed, Chemli (2017) mentioned in a study conducted in Canada that zooplankton diversity varies among aquatic environments. Therefore, the study of zooplankton in aquatic ecosystems in other regions of Côte d'Ivoire remains a field of exploration. It therefore appeared necessary to conduct a study on the diversity of zooplankton in aquatic ecosystems in the central-western part of the country, mainly in the city of Daloa. Indeed, Daloa is one of the largest areas containing various types of aquatic ecosystems distributed both in urban and periurban areas. The objective of this study is to assess the diversity of zooplanktonic organisms in Daloa.

## Material And Methods:-

### Study area

The area of this study is the city of Daloa. It is located in west-central Côte d'Ivoire, between parallels 6°30'00" and 7°00'00" of northern latitude and meridians 6°00'00" and 6°30'00" of western longitude. According to Diobo et al. (2013), the climate of Daloa is of the Attean type with a transient regime between the equatorial and tropical climate. This climate is characterized by two seasons that are distinguished during the year. These are the rainy season that extends from March to October and the dry season that covers the period from November to February (N'Guessan et al., 2014). In urban as well as periurban ecosystems of Daloa, 10 zooplankton sampling stations, consisting of three lakes (LACG, LABU and LABD), three streams (RUGO, RUMA and RUBC), three fish ponds (ETOS, ETPT, and ETPA), and one pool (MARU), were selected, according to their easy access and their potential to host zooplankton.

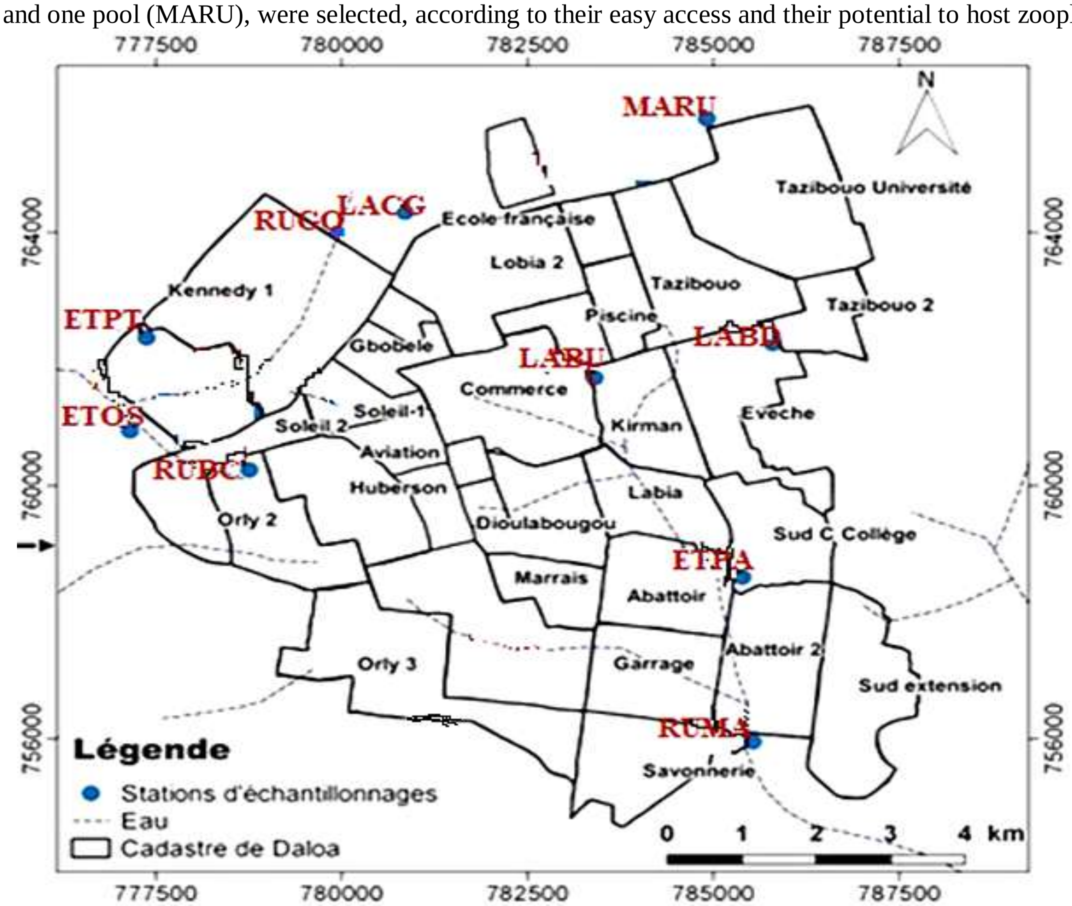


**Figure 1:-** Distribution of sampling stations in the city of Daloa.

**Sampling, identification and counting of zooplankton organisms**
Zooplankton sampling was done seasonally, both day and night, in the months of June and October 2020. During each sampling campaign, temperature, pH, dissolved oxygen, conductivity and turbidity were measured using a portable multi-parameter digital display. Zooplankton were collected by filtering 90 liters of water through a 50 µm mesh screen. At each station, the reject retained by the silk was collected and concentrated to 100 ml with the filtrate water in pillboxes and fixed with 70% alcohol. In the laboratory, subsamples of 10 ml were taken after homogenization and then observed drop by drop between slide and coverslip under an optical microscope. The observed taxa were photographed and then identified using the keys and books of Sladecek (1983), Witty (2004), Aka-koffi et al. (2010), Kay & Hilde (2011), Razouls et al. (2011), Mollo & Noury (2013) and Cieplinski et al. (2016). To avoid losing taxa, the rinse water from the slides and coverslips was filtered, and the collected organisms were returned to the original subsample. The reconstituted subsample was observed under an inverted microscope in a 10 ml sedimentation dish for counting individuals of different taxa.

**Data analysis**
The biological data obtained from the count were translated into taxonomic richness, occurrence, and density (ind/L). These indices were used to determine the composition and structure of the zooplankton population. Percentage occurrence of taxa was calculated to determine taxa based on their constancy in the ecosystem according to the following relationship: %Occ = (Pa/P) x 100 with Pa = total number of removals containing the taxon under consideration; P = the total number of removals made. Dajoz's (1982) key was used to classify taxa into constant taxa (%Occ ≥ 50%), accessory taxa (25% < %Occ < 50%), and accidental taxa (%Occ ≤ 25%). Of the incidental taxa, those with less than 5% occurrence are considered rare taxa. The density of individuals was calculated with the following formula, used by Agadjihouèdé et al. (2010): D = (n/v1) x (v2/v3) with n = number of individuals counted, v1 = volume of filtrate collected (10 mL), v2 = volume of concentrated filtrate (100 mL), v3 = volume of filtered water (90 L).

**Statistical processing of data**
**ReDundancy Analysis (RDA)**
The ReDundancy Analysis (RDA) was performed to know the relationship between physicochemical parameters and abundances of zooplanktonic taxa in the sampling stations. For this purpose, two matrices of taxon-station and physico-chemical parameter-station data were constituted. This analysis highlights the environmental preferences of the populations (Ter Braak and Smilauer, 2002). The Monte Carlo test was performed to select the physico-chemical parameters that best explain the distribution of organisms in the ecosystems (Manly, 1994). This analysis was performed under the CANOCO 4.5 software (Canonical Community Ordination, version 4.5).

**Comparative data analyses**
Comparisons of abiotic and biotic variables were made using the Kruskal-Wallis test (for multiple comparisons) and the Mann-Whitney U test (for two-sample comparisons). Taking into account the p-value, the significant difference between the variables compared exists if this p-value is lower than the significance threshold of 0.05, and when this probability value is higher than 0.05, this significant difference does not exist between the variables compared. These different comparison tests were carried out using STATISTICA V 7.2 software.

## Results:-

**Physico-chemical parameters**
The median values of the physico-chemical parameters obtained during the day and at night in the different sampling stations are presented in table 1. Overall, the values of these parameters vary little from one station to another. The nycthemeral variations of these physico-chemical parameters show that there is no significant difference between the daytime values and those measured at night (Mann-Whitney U test, $p > 0.05$). However, the daytime values are higher than the night-time values.

**Table 1:-** Median values of physico-chemical parameters of the sampling stations (June and October 2020).

| Sampling stations | Code | Temperature (°C) | | Ph | | Dissolved oxygen (mg/l) | | Conductivity (µS/cm) | | Turbidity (ppm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Day | Night | Day | Night | Day | Night | Day | Night | Day | Night |
| **Pool MARU** | MARU | 26,64 | 26,41 | 7,10 | 6,64 | 3,67 | 3,58 | 113,05 | 103,84 | 55,76 | 51,15 |
| **Lake LACG** | LACG | 28,53 | 27,59 | 7,15 | 6,75 | 4,24 | 3,89 | 76,49 | 72,21 | 37,66 | 35,57 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Creek RUGO** | RUGO | 27,32 | 26,66 | 7,09 | 6,66 | 4,38 | 3,88 | 130,43 | 118,04 | 64,32 | 58,15 |
| **Lake LABU** | LABU | 28,20 | 27,47 | 7,96 | 7,20 | 3,99 | 3,50 | 165,96 | 139,34 | 81,75 | 68,64 |
| **Lake LABD** | LABD | 28,64 | 27,47 | 7,61 | 7,15 | 3,95 | 3,62 | 133,98 | 118,62 | 65,99 | 58,43 |
| **Pond ETPA** | ETPA | 27,22 | 26,54 | 8,49 | 7,35 | 5,02 | 4,01 | 153,80 | 123,29 | 75,69 | 60,73 |
| **Creek RUMA** | RUMA | 27,36 | 26,74 | 7,50 | 6,80 | 3,53 | 3,30 | 158,31 | 128,46 | 78,06 | 63,28 |
| **Pond ETPT** | ETPT | 27,10 | 26,45 | 8,02 | 6,92 | 5,25 | 4,38 | 153,54 | 137,78 | 75,58 | 67,87 |
| **Pond ETOS** | ETOS | 26,50 | 26,21 | 8,41 | 7,45 | 5,95 | 5,17 | 149,47 | 131,00 | 73,60 | 64,53 |
| **Creek RUBC** | RUBC | 27,56 | 26,97 | 8,30 | 7,75 | 6,28 | 5,62 | 252,81 | 239,74 | 124,59 | 118,10 |

**Composition of the planktonic fauna**

During this study period, 57 zooplanktonic taxa were inventoried. Among these taxa, 29 taxa of Rotifers (50.88%), 17 taxa of Copepods (29.82%) and 11 taxa of Cladocerans (19.30%) were distinguished (Table 2). Taxonomic richness varied by aquatic environment (04 to 20 taxa) and sampling periods (00 to 11 taxa). The highest taxonomic richness (20 taxa) was obtained at the ETPA pond, and the lowest at the RUGO stream (04 taxa). These 57 taxa are distributed between 21 families and 09 orders. The most diversified family is the Brachionidae (12 taxa). It is followed by the family Cyclopidae (08 taxa). The nycthemeral variation of taxonomic richness shows that zooplankton is more diverse during the day (37 taxa) than at night (21 taxa) except in the ETPA pond (Mann-Whitney U test, $p > 0.05$). Also, some taxa of Copepods (Nauplius and Copepodites) and Cladocerans (Alona sp.) are essentially observable only at night.

**Densities of the planktonic fauna**

The zooplanktonic population sampled during this study is characterized by a maximum density of 139.99 ind/L, with a dominance of Rotiferans (53%), followed by Copepodites (36%), then Cladocerans (11%). Zooplankton were densest at the ETPA (139.99 ind/L), ETOS (75.56 ind/L) and ETPT (72.60 ind/L) fish ponds. While ETPA is characterized by a density of 133.33 ind/L of Rotifer, and ETOS by a density of 56.6 ind/L of Copepods, ETPT concentrates 39.63 ind/L of Copepods and 17.78 ind/L of Cladoceran. On the other hand, the lowest densities were recorded in RUGO creek (4.44 ind/L) and MARU pool (17.41 ind/L). The densities of zooplankton sampled at our different stations are higher in the dry season (October) than in the rainy season (June). Nycthemeral variations indicate higher densities during the day with a preponderance of Rotifers, than at night where Copepods are more abundant.

**Occurrence of taxa**

In total, 5 taxa representing 8.62% of the total richness are constant. These are the Rotifera Anuraeopsis fissa, Brachionus urceolaris, Lecane bulla and Asplanchna priodonta, and the Copepod Mesocyclops sp. The Rotifers Brachionus caudatus, Trichocerca longiseta, Trichocerca pusilla, Asplanchna sieboldi and Conochilus hippocrepis, as well as the copepods Acanthocyclops vernalis, Tropocyclops extensus, Mesocyclops leuckarti, Tropocyclops prasinus, Pseudodiaptomus incisus, and the Cladoceran Moina macrocopa constituting 18.97% of the taxonomic composition appeared as accessories. The other 42 taxa, with a proportion of 72.41% of the richness of this zooplanktonic population, were incidental.

**Table 2:-** Inventory of zooplankton organisms collected in urban aquatic environments in Daloa

| | | | | | SAMPLING STATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ETOS | | ETPA | | ETPT | | LABD | |
| **CLASSES** | **ORDERS** | **FAMILIES** | **TAXA** | **Code** | **Da** | **Ni** | **Da** | **Ni** | **Da** | **Ni** | **Da** | **Ni** |
| Rotifers | Ploimida | Brachionidae | Brachionus falcatus | Brfa | | | x | | | | | |
| | | | Anuraeopsis fissa | Anfi | | | x | | | x | | |
| | | | Keratella quadrata | Kequ | | | | | | | | |
| | | | Keratella cruciformus | Kecr | | | | x | | | | |
| | | | Keratella tropica | Ketr | | | | | | | | |
| | | | Brachionus angularis | Bran | | | x | | | | | |
| | | | Brachionus calyciflorus | Brca | | | | | | | x | |
| | | | Brachionus caudatus | Brau | | | x | | x | | | |
| | | | Brachionus forficula | Brfo | | | x | | | | | |
| | | | Brachionus kostei | Brko | | | | | | | | |
| | | | Brachionus quadridentatus | Brqu | | | | | | | | |
| | | | Brachionus urceolaris | Brur | x | | x | | | | | |
| | | Lecanidae | Lecane aculeata | Leac | | | x | | | | | |
| | | | Lecane bulla | Lecu | | | | x | x | | x | |
| | | | Lecane leontina | Lele | | | | | | | x | |
| | | | Lecane lunaris | Lelu | | | | | | | | |
| | | Trichocercidae | Trichocerca capucina | Trca | | | | | | | | |
| | | | Trichocerca longiseta | Trlo | | | x | | | | | |
| | | | Trichocerca pusilla | Trpu | | | | | | | x | |
| | | Asplanchnidae | Asplanchna priodonta | Aspr | x | | x | | | | | |
| | | | Asplanchna sieboldi | Assi | | | x | | | | | |
| | | Euchlanidae | Euchlanis dilatata | Eudi | | | | | | | | |
| | | | Euchlanis incisa | Euin | | | | | | | | |
| | | Colurellidae | Colurella uncinata | Coun | | | x | | | | | |
| | | Dicranophoridae | Dicranophorus hanerianus | Diha | | | | | | | | |
| | | Notommatidae | Enteroplea lacustris | Enla | | | | | | | | |
| | Bdelloidea | Habrotrochidae | Habrotrocha sp. | Hach | | | | | | | | |
| | Flosculariacea | Conochilidae | Conochilus hippocrepis | Cohi | | | | | | x | | |
| | Gnesiotrocha | Filiniidae | Filinia longiseta | Filo | | | | x | | | | |
| Copepods | Cyclopoida | Cyclopidae | Acanthocyclops vernalis | Acve | x | | | x | | | | |
| | | | Afrocyclops gibsoni | Afgi | | | | | | | x | |
| | | | Diacyclops bicuspidatus | Dibi | x | | | | | | | |
| | | | Ectocyclops hirsutus | Echi | | | | | | | | |
| | | | Tropocyclops extensus | Trex | | | | | x | | x | |
| | | | Mesocyclops leuckarti | Mele | x | | | | x | | | |
| | | | Mesocyclops sp. | Mesp | x | | | | | | x | |
| | | | Tropocyclops prasinus | Trpr | x | | | | x | | | |
| | | Oithonidae | Limnoithona sinensis | Lisi | | x | | | | x | | |
| | Calanoida | Diaptomidae | Pseudodiaptomus incisus | Psin | | | | | | | | |
| | | | Allodiaptomus mieni | Almi | | | | | x | | | |
| | | | Topodiaptomus lateralis | Trla | | | | | | | | |
| | | | Tropodiaptomus lateralis | Trol | | | | | x | | | |
| | | Centropagidae | Sinocalamus laevidactylus | Sila | | | | | x | | | |
| | Harpacticoida | Cantocamptidae | Afrocamptus uncinatus | Afun | | | | | | | | |
| | | | Copépodites | Codi | | | | | | | | x |
| | | | Nauplius de copepode | Nape | | | | | | | | x |
| Cladocers | Anomopoda | Chydoridae | Pleuroxus laevis | Plla | x | | | | | | | |
| | | | Alona guttata | Algu | | | | x | | | | |
| | | | Alona intermedia | Alin | | | | | | | | |
| | | | Alona sp. | Alsp | | | | x | | | | x |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Daphniidae | Daphnia pulex | Dapu | | | | | | | x | |
| | | | Simocephalus serrulatus | Sise | | | | | x | | | |
| | | | Simocephalus vetulus | Sive | | | | x | | | | |
| | | Macrothricidae | Macrothrix spinosa | Masp | | | | | | | x | |
| | | Moinidae | Moina macrocopa | Moma | x | | | | x | | | |
| | Ctenopoda | Sididae | Sida crystallina | Sicr | | | | x | | | x | |
| | | | Diaphanosoma sarsi | Disa | | | | | | | | |
| **Total** | **09** | **21** | **57** | | **09** | **01** | **11** | **09** | **10** | **03** | **10** | **03** |
| | | | | | **10** | | **20** | | **13** | | **13** | |

Da=Day Ni=Nigth

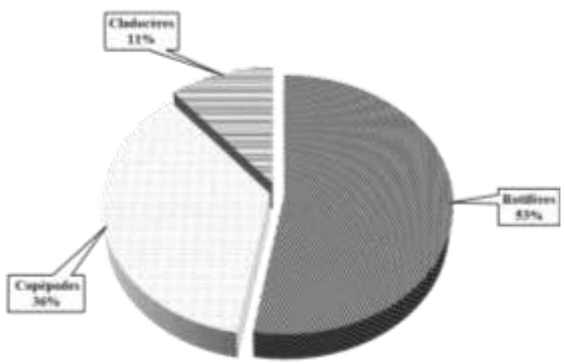


**Figure 2:-** Abundances of zooplankton groups

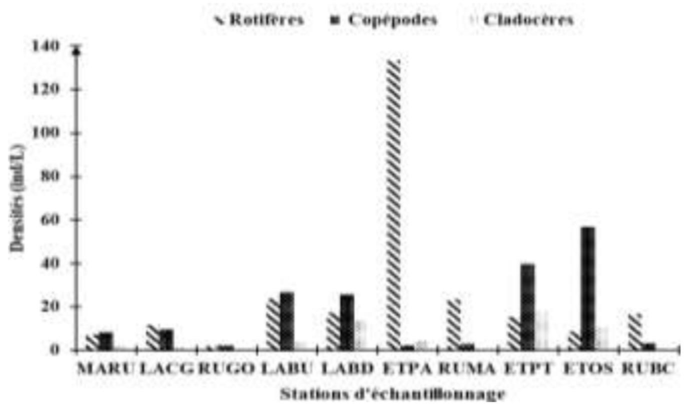


**Figure 3:-** Densities and structure of zooplankton settlement

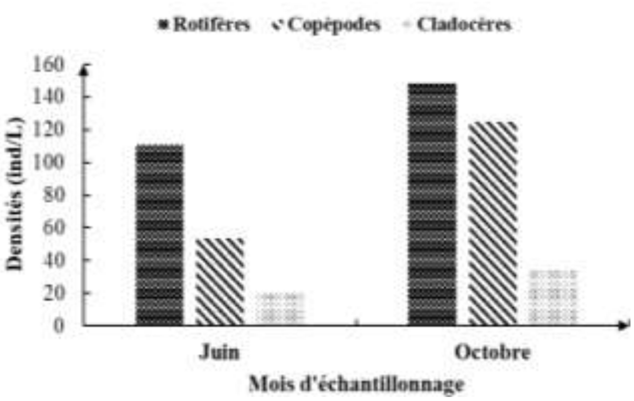


**Figure 4:-** Monthly zooplankton densities

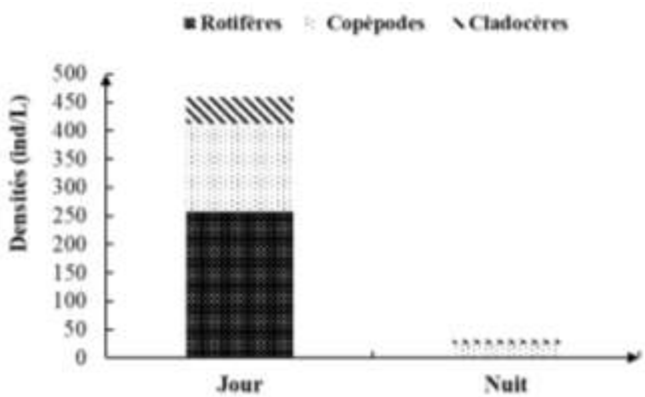


**Figure 5:-** Nycthemeral zooplankton density

**Influence of environmental variables on the distribution of zooplankton taxa**

The results of the redundancy analysis performed between physico-chemical parameters and the main taxa (constant taxa in our samples) at the different sampling stations specify Temperature and pH influence more the distribution of zooplankton in the different sampling stations.

Axis 1 with 48% of the information is negatively correlated with high pH values, and to a lesser extent with turbidity and conductivity. Axis 2 with 12% of the information is positively correlated with high temperature values and negatively correlated with dissolved oxygen. Axis 1 parameters influenced the distribution of the rotifers Asplanchna priodonta and Anuraeopsis fissa and the copepod Mesocyclops sp. These rotifers, strongly correlated with axis 1, seem to be determined by turbidity and conductivity as well as high pH values at the ETPA station. The copepod, on the other hand, although correlated to axis 1, is determined rather by the low values of these physico-chemical parameters at the MARU station. The taxa Brachionus urceolaris and Lecane bulla are positively correlated to axis 2, and are found respectively at stations ETOS and LABD. Brachionus urceolaris seems to be determined by high dissolved oxygen values and Lecane bulla by high temperature values.

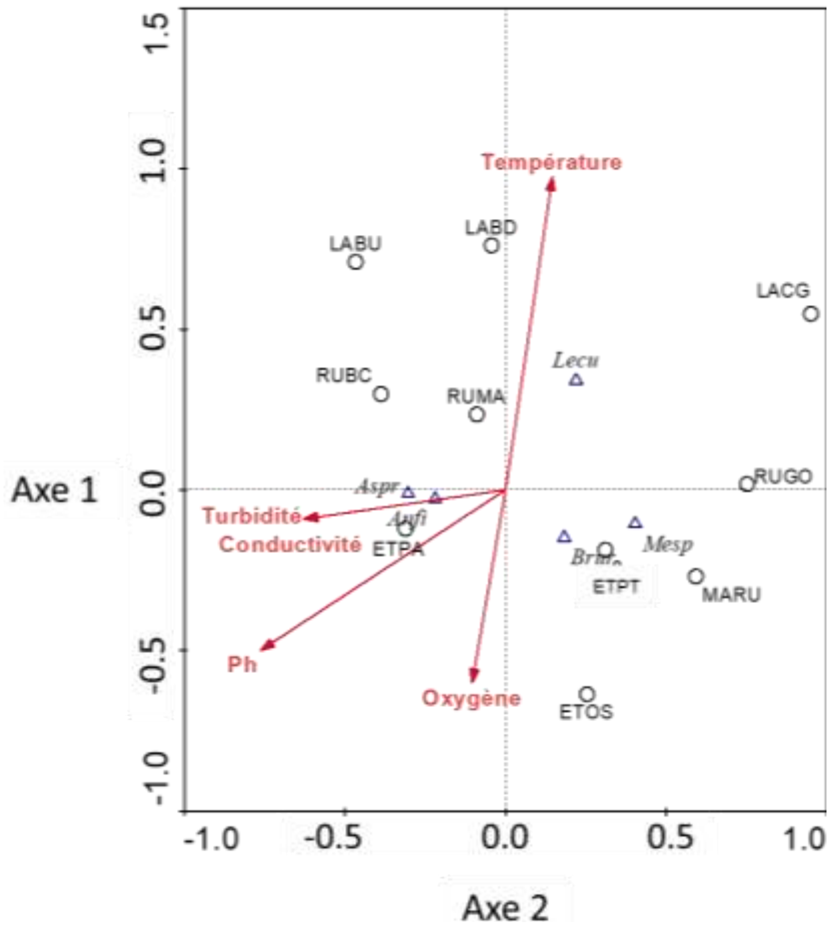


**Figure 6:-** Redundancy analysis (RDA) of the main zooplanktonic taxa of some urban aquatic environments of Daloa according to 339arbou-chemical parameters. Legend: ETOS, ETPA, ETPT, LABD, LABU, LACG, MARU, RUBC, RUGO and RUMA are the codes of the sampling stations and Aspr, Lecu, Anfi, Mesp and Brur are the codes of the main taxa.

## Discussion:-

This study reveals that the urban aquatic environments of Daloa 339arbour mainly Rotiferans, Copepods and Cladocerans with a dominance of Rotifers over the other groups. These same results have already been observed in the work of Monney et al. (2016), carried out on four coastal rivers in the southeast of Côte d'Ivoire. The same observation had also been made through the study conducted by Aka (1998) in small water reservoirs in the north of the country. The dominance of Rotifer in the zooplanktonic population, revealed in these different studies, shows that these organisms represent the most important zooplanktonic group in fresh water, as pointed out by Margalef (1983). Indeed, Rotiferans are able to proliferate in eutrophic ecosystems as is the case of most aquatic ecosystems in the urban area of Daloa, exposed to all kinds of pollution. According to Djéné (2020), the urban hydrosystems of Daloa, whose state of integrity he evaluated, suffer from a poor ecological quality. And this high representation of Rotifer in the aquatic ecosystems of Daloa can be considered as a biological indicator of a high trophic level. As well as Rotifer, the density of Copepod and Cladocer was greater in October, when rainfall is reduced, than in June when the basins and beds of aquatic ecosystems are overflowing with water. These results support those of Monney et al. (2016) who observed higher zooplankton densities, in four coastal rivers in southeastern Côte d'Ivoire, during flood periods than during flood periods. This situation would be linked to the planktonic life that characterizes this compartment of the aquatic biocenosis. Indeed, zooplanktonic organisms cannot oppose the current that is created in the water mass with the increase in the quantity of water in the aquatic ecosystems. In such situations, these animals cannot proliferate (Ouattara et al., 2007). The zooplanktonic population sampled in the aquatic ecosystems of Daloa has a taxonomic richness (57 taxa) significantly higher than those obtained by Monney et al. (2016) (28 taxa) and by Aka (1998) (30 taxa). This difference of nearly 50% may be due to several reasons. Indeed, these authors used a plankton net with a mesh size of 64 µm as opposed to 50 µm in the present study. In addition, the environments visited in the present study are numerous and varied in type. Even better, zooplankton sampling was done during the day as well as at night, which increases the chances of obtaining a high taxonomic richness (Pagano et Saint-Jean, 1988). According to McQueen et al (1986), while some taxa migrate to the water surface during the day, others prefer to perform this movement at night, in search of food. This taxonomic richness was highest in the ETPA fish pond (20 taxa), which is routinely fertilized with poultry droppings, in contrast to other fish ponds that do not receive fertilizers. This result is in addition to those of Agadjihouede et al. (2010), Akodogbo et al. (2014), Elégbe et al. (2016), Elégbe et al. (2017), Amian et al. (2018), Anougbo et al. (2020), in fish ponds fertilized with inorganic and/or organic feed. The achievement of high taxonomic richness in these fertilized ponds is thought to be due to the availability of nutrients generated by the decomposing fertilizers. According to Seyer (2002), this material increases phytoplanktonic development which, in turn, stimulates zooplanktonic production. Abou et al. (2010) argue that taxon richness is high in fertilized fish ponds. These authors state that fertilizers stimulate the development of algae, bacteria, and protozoa, which Rotifers and Cladocerans feed on to proliferate. However, this taxonomic richness did not vary nycthemerally from one sampling station to another. At all stations visited, taxonomic richness was higher during the day than at night. This would be due to the fact that most zooplankton organisms, being herbivores, come to the surface during the day to graze on phytoplankton. However, other zooplanktonic organisms such as that Nauplii and Copepodites and the cladoceran Alona sp. are more planktonic than benthic at night. This is because these organisms, being the prey of the youngest fish stages (Balvay, 2009), flee from fish predation during the day and only come to the water surface at night, when the fish descend to rest (McQueen et al., 1986). Unfortunately, predation is not the only factor in the distribution of zooplanktonic organisms in the urban aquatic environments of Daloa. Some rotifers (Asplanchna priodonta and Anuraeopsis fissa) proliferate best under high turbidity, conductivity and Ph. The opposite is true for the copepod Mesocyclops sp. which grows better if the values of these parameters are low. The proliferation of other rotifers is rather conditioned by dissolved oxygen and temperature. Thus, Brachionus urceolaris reproduces abundantly in well oxygenated environments, and Lecane bulla in relatively warm waters.

## Conclusion:-

At the end of this study, it should be noted that the urban aquatic ecosystems of Daloa are essentially home to Rotifers, Copepods and Cladocerans. 57 taxa of these organisms have been inventoried in these waters. These taxa are dominated by the Rotifer group. The zooplanktonic population is more important in the fish ponds. However, these organisms were observed more during the day than at night, both in quality and quantity, in all the aquatic ecosystems visited. The distribution of zooplankton in these aquatic environments is influenced more by temperature and Ph, whose relatively high values during the day allow a good taxonomic richness. However, nocturnal collections of zooplankton would increase this taxonomic richness.

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