

SEASONAL VARIATIONS OF ODONATA DIVERSITY AROUND NAPIÉ DAM LAKE, NORTHERN CÔTE D'IVOIRE, WEST AFRICA

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ABSTRACT

A seasonal diversity of Odonata species are studied in the north of Côte d'Ivoire. The study was carried out during two season (rainy and dry seasons). Odonata species were collected using Sweep-net technique between 9:00 am to 02:00 pm. Thirty three species belonging to 2 suborders (Anisoptera and Zygoptera) and 4 families were recorded. A total of 436 individuals and 365 individuals of Odonata encountered during rainy season and dry season respectively. Significant differences in Odonata specific richness and abundance occurred between rainy and dry seasons. *Brachythemis leucosticta*, *Brachythemis impartita*, *Crocothemis erythraea* and *Palpopleura lucia* recorded the highest abundance in rainy season however *Brachythemis leucosticta*, *Brachythemis impartita* and *Crocothemis erythraea* encountered the most abundance in dry season. Shannon diversity index indicated that rainy season is relatively diverse than dry season

Keywords : *Odonata*, *Shannon-Wiener Index*, *Abundance*.

RÉSUMÉ

Variations saisonnières de la diversité des Odonates autour du lac de barrage de Napié, Nord de la Côte d'Ivoire, Afrique de l'Ouest

La variation saisonnière de la diversité des espèces d'Odonates a fait l'objet d'une étude dans le nord de la Côte d'Ivoire. L'étude a été effectuée pendant deux saisons (saison des pluies et saison sèche). Les espèces d'Odonates ont été collectées à l'aide de la technique du filet fauchoir entre 9h00 et 14h00.

Trente-trois espèces appartenant à 2 sous-ordres (Anisoptère et Zygoptère) et 4 familles ont été récoltées. Un total de 436 individus et 365 individus d'Odonates ont été observés pendant la saison des pluies et la saison sèche respectivement. Des différences significatives dans la richesse spécifique et l'abondance des Odonates sont apparues entre la saison des pluies et la saison sèche. *Brachythemis leucosticta*, *Brachythemis impartita*, *Crocothemis erythraea* et *Palpopleura lucia* ont enregistré la plus grande abondance en saison des pluies, mais *Brachythemis leucosticta*, *Brachythemis impartita* et *Crocothemis erythraea* ont été les plus abondants en saison sèche. L'indice de diversité de Shannon indique que la saison des pluies est relativement plus diversifiée que la saison sèche.

Mots-clés : *Odonates, Indice de Shannon-Wiener, Abondance.*

I - INTRODUCTION

The order Odonata includes the dragonflies and damselflies, globally 5,952 species of Odonata under 652 genera have been reported [1]. Odonata are gorgeous insects with aquatic larval forms. Both adult and larval stages are top predators and important elements of the food web [2, 3]. Odonata serve as an umbrella species in biodiversity conservation [4, 5]. They survive in a wide range of aquatic habitats i.e., lentic to lotic water bodies, some have adapted to urban areas and exploit man-made water bodies [6, 7]. Pre-adult stages of Odonata are aquatic in nature and adjust themselves in both stagnant and running water [8]. Odonata may be taken as an indicator of ecosystem quality. In addition to their direct role as predators in ecosystem, they are also indicators of quality of the biotope [9]. The Odonata of the north of the country were only known by inventories carried out previously for the Côte d'Ivoire in Korhogo [10]. But this study dates back several decades, and our work comes, in complement to this one. A seasonal study on Odonata fauna from Napié dam lake is carried out. Seasonal diversity and abundance of species is studied.

II - MATERIAL AND METHODS

II-1. Study area

The Napié dam lake is located in the commune of Napié, in the Poro region of northern Cote d'Ivoire. This dam lake is located at 25 km of Korhogo on the axis Korhogo-Niakaramadougou. It is precisely located at the following coordinates (09°27'12.8" N, 05°35'9.43" W) (**Figure 1**). Three sites were chosen in the vicinity of the lake. Site 1 (S1) is a biotope whose soil is used

for market gardening (eggplant, maize, onions, lettuce, cabbage etc.). It is located at the following coordinates ($09^{\circ}16'19.11''\text{N}$, $05^{\circ}34'59.4''\text{W}$). Site 2 (S2) is an area with very intense anthropic activities such as the removal of sand and water, fishing and car washing. This site is located at the following coordinates: $09^{\circ}16'25.4''\text{N}$ $05^{\circ}35'13.2''\text{W}$. Site 3 is the least affected by anthropogenic activities. In this site, the vegetation is dominated by grasses, such as *Hyptis suaveolens* and a few rare shrubs. This site has the following coordinates : $09^{\circ}16'05.3''\text{N}$ and $05^{\circ}35'11.8''\text{W}$.

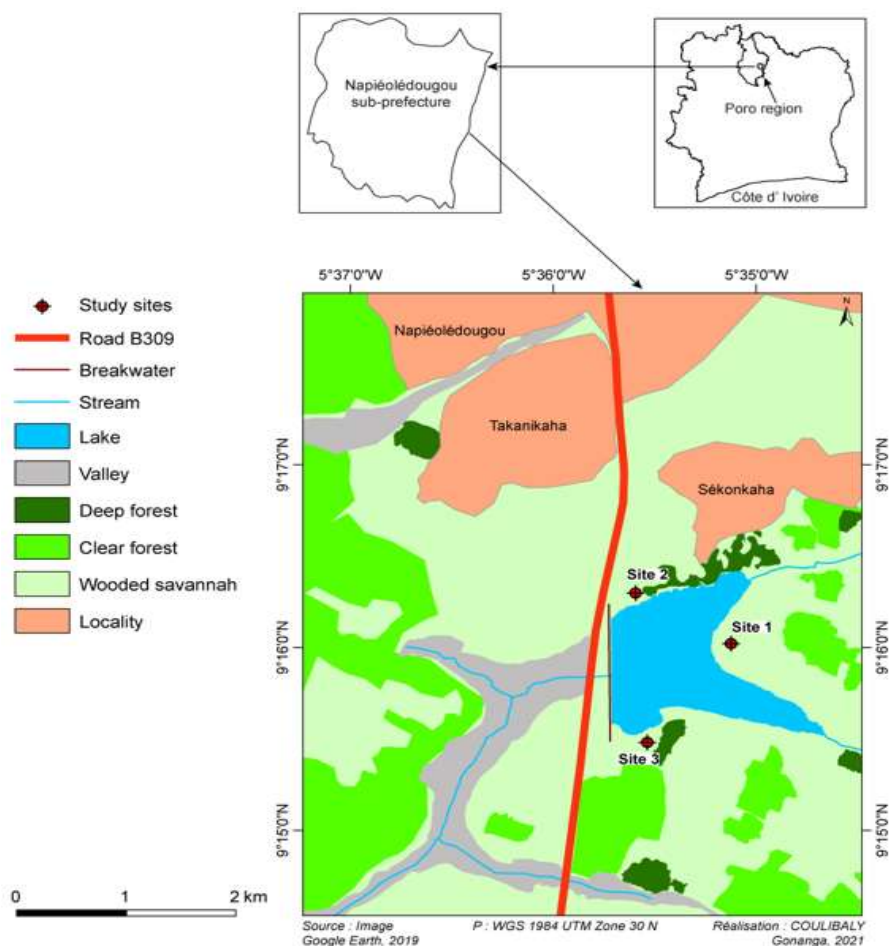


Figure 1 : Location of the sampling sites

II-2. Sampling procedure

We sampled adult individuals of Odonata species with a sampling protocol of 2 researchers per hour per sampling site [11]. Field investigations consisted of walking the perimeter of each site as well as its immediate

vicinity where imagos hunt and mature as recommended by Grand and Boudot [12]. The dam lake was visited monthly over a period of eight months, four months during the rainy season (July 2020 to October 2020) and four months during the dry season (January 2020 to April 2020). All visits and collection were conducted between 9:00 am to 02:00 pm. Sweep-net technique was followed in the sampling. At the different sites, adult Odonata were captured using a swath net. Temperature and humidity were also recorded monthly. Specimens collected were identified using the field guide of Dijkstra and Clausnitzer [13] and the African Dragonflies and Damselflies Online (ADDO) [14].

II-3. Data Analysis

Prior, the data on species richness and abundance are subjected to the Shapiro-Wilk normality test. Then the Mann-Whitney test was performed. Data were statistically analyzed relative to Odonata diversity and species richness. These were measured by Shannon's index, Margalef's index and Evenness index. Biodiversity indices were calculated by Primer 5.0 software. The Mann-Whitney test was performed using Statistica 7.1 software.

III - RESULTS

III-1. Odonata diversity

A total of 33 species belonging to 2 suborders (Anisoptera and Zygoptera) and 4 families were recorded in this study (**Table 1**). The families were Libellulidae, Gomphidae, Coenagrionidae and Plactycnemididae. Among the species, 31 were recorded in rainy season and only 17 species were collected in dry season. Few species of Odonata such as *Urothemis assignata* and *Urothemis edwardsii* were not observed in rainy season. Significant differences ($U = 313,5$; $Z = -3.832$; $p < 0.05$) in Odonata specific richness occurred between rainy and dry seasons. Fifteen species were observed throughout the two seasons.

III-2. Abundance

The number of Odonata encountered during rainy season were 436, which decreased to 365 individuals in dry season. Significant differences ($U = 346$; $Z = -2.573$; $p < 0.05$) in Odonata abundance occurred between rainy and dry seasons. Significant differences ($U = 376$; $Z = -2.643$; $p < 0.05$) in Odonata abundance occurred between rainy and dry seasons at site 1 and any significant difference were observed between the two seasons at site 2 and site 3.

Table 1 : List of Odonata species collected around Napié dam lake.
x: Presence; -: Absence

Families	Species	Sampling Sites		
		S1	S2	S3
Gomphidae	<i>Gomphidia gamblesi</i> Gauthier, 1987	x	-	-
	<i>Ictinogomphus ferox</i> Rambur, 1842	x	x	-
Libellulidae	<i>Acisoma inflatum</i> Selys, 1882	x	-	x
	<i>Brachythemis impartita</i> Karsch, 1890	x	x	x
	<i>Brachythemis lacustris</i> Kirby, 1889	x	x	-
	<i>Brachythemis leucosticta</i> Burmeister, 1839	x	x	x
	<i>Crocothemis erythraea</i> Brullé, 1832	x	x	x
	<i>Hadrothemis scabrifrons</i> Ris, 1910	x	-	-
	<i>Hadrothemis infesta</i> Karsch, 1891	x	x	x
	<i>Hemistigma albipunctum</i> Rambur, 1842	x	-	-
	<i>Palpopleura albifrons</i> Legrand, 1979	x	x	x
	<i>Palpopleura deceptor</i> Calvert, 1899	-	-	x
	<i>Palpopleura lucia</i> Drury, 1773	x	x	x
	<i>Palpopleura portia</i> Drury, 1773	x	x	x
	<i>Parazyxomma flavicans</i> Martin, 1908	x	-	x
	<i>Orthetrum icteromelas</i> Ris, 1910	x	x	x
	<i>Orthetrum guineense</i> Ris, 1910	x	x	x
	<i>Orthetrum chrysostigma</i> Burmeister, 1839	x	x	x
	<i>Orthetrum trinacria</i> Selys, 1841	-	-	x
	<i>Orthetrum monardi</i> Schmidt, 1951	-	-	x
	<i>Trithemis annulata</i> Palisot de Beauvois, 1807	x	x	x
	<i>Trithemis hartwigi</i> Pinhey, 1970	-	x	-
<i>Urothemis assignata</i> Selys, 1872	-	x	-	
<i>Urothemis edwardsii</i> Selys, 1849	-	-	x	
<i>Trithetrum congoense</i> Aguesse, 1966	x	x	x	
Coenagrionidae	<i>Ceriagrion glabrum</i> Burmeister, 1839	x	x	x
	<i>Ceriagrion sakejii</i> Pinhey, 1963	x	x	-
	<i>Pseudagrion deningi</i> Pinhey, 1961	-	-	x
	<i>Pseudagrion sublacteum</i> Karsch, 1893	x	x	-
	<i>Pseudagrion hamoni</i> Fraser, 1955	x	x	-
	<i>Pseudagrion nubicum</i> Selys, 1876	x	x	x
Platycnemididae	<i>Pseudagrion glaucum</i> Sjöstedt, 1899	x	x	x
	<i>Mesocnemis singularis</i> Karsch, 1891	x	-	x

Brachythemis leucosticta, *Brachythemis impartita*, *Crocothemis erythraea* and *Palpopleura lucia* recorded the highest abundance in rainy season however *Brachythemis leucosticta*, *Brachythemis impartita* and *Crocothemis erythraea* encountered the most abundance in dry season.

III-3. Seasonal distribution of Odonata

In rainy season, total 168 individuals were observed at site 1 of the dam lake, 144 individuals at site 2 and 124 at site 3. The dragonfly, *Brachythemis leucosticta* was the most dominant species which constituted 16.28 % of the total individuals followed by *Palpopleura lucia* (14.45 %), *Brachythemis impartita* (13.05 %) and *Crocothemis erythraea* (12.38 %) (**Figure 2**). Twenty four, 19 and 21 species were recorded respectively at site 1, site 2 and site 3 of the dam lake. In dry season, total 118 individuals were recorded at site 1, 125 individuals at site 2 and 122 at site 3. *Brachythemis leucosticta*, *Crocothemis erythraea* and *Brachythemis impartita* were the most abundant species in dry season representing respectively 30.41 %, 20.82 % and 18.63 % of the total individuals (**Figure 2**). Eleven species were observed at site 1 while 12 and 13 species were collected at site 2 and site 3 respectively.

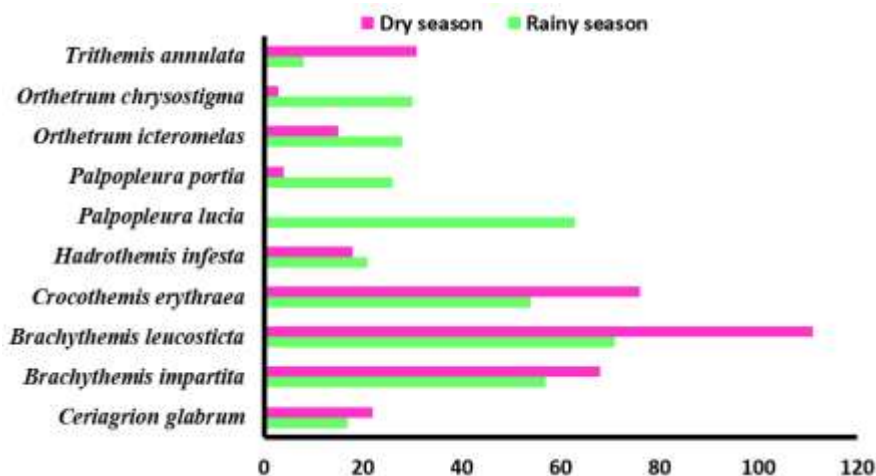


Figure 2 : Seasonal variation of the main species according to their abundance

III-4. Diversity indices

Diversity indices show that the diversity of Odonata at three sites of Napié dam lake area in dry season is less as compared to rainy season (**Figure 3**).

IV - DISCUSSION

Thirty one species were recorded in rainy season and only 17 species were collected in dry season. The high richness of Odonata during the rainy season could be due to the emergence of several species during this season. Abundance of Odonata was higher in rainy season compared to dry season. Higher Abundance can be attributed to high rainfall and humidity (80 %-81 %)

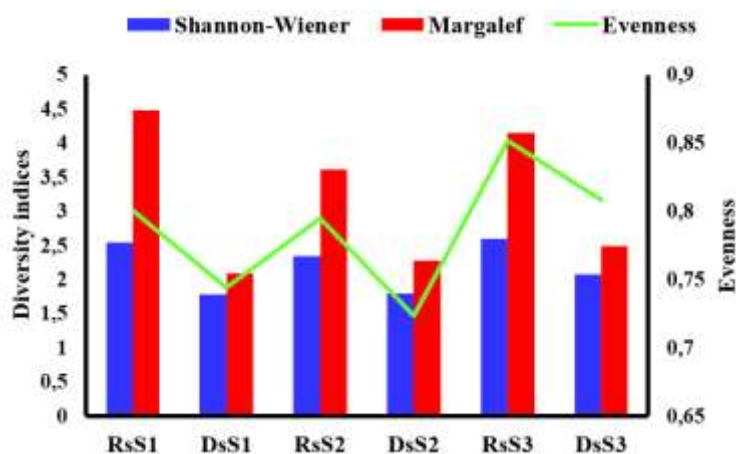


Figure 3 : Seasonal variation of the diversity indices. Rs = rainy season ; Ds = dry season; S1 = Site 1; S2 = Site 2 and S3 = Site 3

with temperature range of 28°C to 31°C, during rainy season. Similar results were observed in previous studies [15, 16]. Indeed, the rainy season corresponds to the good development of plants and crops around the dam lake. This development rhymes with the abundance of phytophagous insects and crop pests that are the potential prey of Odonata. To this end, the abundance during this season could be attributed to the availability of food resources. According to Corbet [17], seasonality plays an important role in Odonata development, mainly because there are changes in habitat and food availability. The high abundance observed in the rainy season would also be related to the high richness during this season at the expense of the dry season. Indeed, among the 31 species collected during the rainy season, many species have a remarkable abundance which is not the case during the dry season. Significant differences in abundance and specific richness occurred between rainy and dry seasons. Indeed, there was a small increase in the abundance and richness in Odonata settlement in rainy season. That can generate information about adaptation, behavior, survivorship, and consequently potential biodiversity [18, 19].

V - CONCLUSION

Species abundance was highest during the rainy season and lowest during the dry season. The most abundant family was Libellulidae (Anisoptera). *Brachythemis leucosticta*, *Crocothemis erythraea* and *Brachythemis impartita* quantitatively dominated the settlement in both the rainy and dry seasons. Further studies are needed to use this group of insects in monitoring environmental change.

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REFERENCES

- [1] - M. SCHORR and D. PAULSON, "World Odonata List". Electronic Database accessible at academic-resources/slater-museum/biodiversity-resouces/dragonflies/world-odonata-list2/, (2013), Accessed 12 November 2013
- [2] - D. MISHRA, V. K. SHARMA and A. PAL, "Diversity of Odonates at Sirpur Pond, Indore". *Int. J. Zool. Appl. Biosci.*, Vol. 4, N°1 (2019) 1 - 4
- [3] - M. BABOSOVA, J. L. PORHAJASOVA and D. ERNST, "Dragonflies (Odonata) of Botanical Garden's Pond of SUA in Nitra". *Acta fytotechn Zootechn*, Vol. 22, N°4 (2019) 110 - 113
- [4] - R. F. NOSS, "Indicators of monitoring biodiversity : A hierarchical approach". *Conserv. Biol*, Vol. 4, (1990) 355 - 364
- [5] - R. J. LAMBECK, "Focal species : A multispecies umbrella for nature conservation". *Conserv. Biol*, Vol. 11, N°4 (1997) 849 - 856
- [6] - T. R. MITRA, "Geographical Distribution of Odonata (Insecta) of Eastern India". *Memories of the Zoological Survey of India*, Vol. 19, N° 1 (2002) 17
- [7] - M. N. HARISHA, "Evaluation of Status and Diversity of Odonates of Kondajji Lake, Kondajji Village, Harihar Taluk, Davanagere District, Karnataka, India". *J. Entomol. Zool. Stud*, Vol. 4, N° 4 (2016) 384 - 388
- [8] - A. TIPPLE and K. CHANDRA, Dragonflies and damselflies (Insecta, Odonata) of Madhya Pradesh and Chhattisgarh states, central India. *J. Care 4 Nature*, Vol. 1, N°1 (2013) 1 - 10
- [9] - K. A. SUBRAMANIAN, *Nature watch. Resonance*, Vol. 7, (2002) 69 - 78

- [10] - R. P. LINDLEY, "The dragonflies of Korhogo, Ivory Coast". Bull. Inst. Fond. Afr. Noire (A), Vol. 36, (1974) 682 - 698
- [11] - I. SEIDU, A. C. NSOR, E. DANQUAH, P. TEHODA and K. S. OPPONG, "Patterns of Odonata Assemblages in Lotic and Lentic Systems in the Ankasa Conservation Area, Ghana". *Int. J. Zool*, (2019) 1 - 14, <https://doi.org/10.1155/2019/3094787>
- [12] - D. GRAND, J. P. BOUDOT, "Les libellules de France, Belgique et Luxembourg". Ed. Biotope, Mèze, (Collection Parthénope), (2006) 480 p.
- [13] - K.-D. B. DIJKSTRA, V. CLAUSNITZER, "The Dragonflies and Damselflies of Eastern Africa : Handbook for All Odonata from Sudan Zimbabwe", (2014) 263 p.
- [14] - C. THOMAS, J. TOM, A. P. ZECHARIA and N. P. ABRAHAM, "Dragonfly Species Diversity along the waterside of Kallar river base of Pathanamthitta district, Kerala". *Int. j. res. anal. rev.*, Vol. 5, N° 4 (2018) i900 - i903
- [15] - K.-D. B. DIJKSTRA, "African dragonflies and damselflies online," <http://addo.adu.org.za>, (2016)
- [16] - Y. Y. NU and S. S. H. BU, "Seasonal occurrence, abundance and flight activities of Anisopterous dragonflies". *MOJ Ecol. Environ. Sci.*, Vol. 4, N° 4 (2019) 141 - 151
- [17] - P. S. CORBET, "Dragonflies : behaviour and ecology of Odonata". Colchester : Harley, (1999) 829 p.
- [18] - A. K. M. SALCEDO, "Variação temporal e espacial e importancia ecológica de macroinvertebrados aquáticos num córrego periurbano do Distrito Federal". [Doctoral dissertation, Dissertação de mestrado]. Universidade de Brasília-DF, (2006) 86 p.
- [19] - A. H. V. BOAS and F. D. V. CAMARGO, Avaliação rápida da qualidade da água utilizando invertebrados bentônicos, através dos índices bióticos BMWP' e ASPT no ribeirão São Bernardo, Piranguçu, sul de Minas Gerais. *CES Revista*, Vol. 31, N° 1 (2017) 7 - 25