

The diversity and distribution of dragonflies and damselflies (Odonata) in University of Lagos, Akoka, Lagos, south-west Nigeria

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Abstract

The presence of dragonflies and damselflies may be taken as an indication of good ecosystem quality. The greatest numbers of species are found at sites that offer a wide variety of microhabitats. A survey of Odonata fauna inhabiting the University of Lagos, Akoka Lagos, south-west Nigeria was carried out between July and December 2014, with a view of determining its diversity and distribution. Four study sites used were Distance Learning Institute (DLI), Lagoon, Faculty of Science, and High Rise Area. Data collected were subjected to inferential statistics and analysis of variance (ANOVA). Diversity indices were used to compare the odonate species in the study sites. Seven hundred and fifty (750) individuals representing 39 species in 22 genera and four families (Aeshnidae – 3%, Coenagrionidae – 13%, Libellulidae – 81% and Calopterygidae – 3%) were recorded. *Orthetrum* (18%) was the most dominant genus, followed by *Ceragrion* (10%) while *Palpopleura* and *Trithemis* (8%) were the least dominant genera. The site with most diverse Odonata fauna ($H' = 2.70$, $E = 0.27$), was High Rise Area while the least was the Lagoon Area ($H' = 1.97$, $E = 0.27$). Odonata in High Rise Area were significantly lower ($p > 0.0128$) than those in DLI and Science Area which were not significantly different from each other (0.00039 and 0.00368 respectively). The paucity of species with narrow range of adaptation at the university especially at Lagoon Area where they were expected to occur is an indication that the forested part of the campus is under considerable human disturbance. Urgent measures are needed to preserve the natural the natural habitats of these Odonata species.

Keywords: Diversity indices; Odonata; fauna; diversity; distribution; University of Lagos; Nigeria.

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Introduction

Dragonflies and damselflies belong to Order Odonata. They are popular in that they are a good taxon for monitoring forest habitat fragmentation and general environmental degradation (Thompson and Watts, 2006; Osborn, 2005). Some species can tolerate a broad range of conditions while others are very sensitive to their environment (Chovanec, 2000). Their sensitivity to structural habitat quality (e.g. forest cover, water flow and chemistry) and amphibious habits make them well suited for use in evaluating environmental change in the long term (biogeography, climatology) and in the short term (conservation biology), both above and below the water surface (Millers, 1987; Sahle ´n and Ekestubbe, 2001; Clausnitzer, 2003; Osborn, 2005).

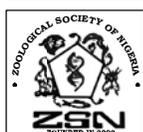
Comparisons between past and present records show that dragonflies have disappeared from numerous water bodies throughout the world (Moore, 1997). Destruction of tropical forests is probably the major threat to global odonate diversity, potentially resulting in the extinction of numerous species. Unfortunately these species are often

poorly known, making it difficult to say whether a species is genuinely rare or merely overlooked (Moore, 1997). Evaluating the conservation status of most naturally rare species is hardly possible. A lot of research on diversity of Odonata have been carried out in many parts of Africa (Dijkstra and Clausnitzer, 2006, 2015), South America (Paulson, 2006) and the Oriental region (Orr, 2006) but very few in Nigeria.

University of Lagos spans approximately 8194.93 m² of land surface, out of which a conservative 21.5% is estimated to be wetlands. It is a representative of rapidly disappearing ecosystem in south-western Nigeria, due to development of infrastructure. There is need to carry out survey of the species diversity and abundance of Odonata in the University of Lagos. It is hoped that the findings in this survey will serve as reference baseline data for conservationist interested in this and similar habitats elsewhere.

Materials and methods

University of Lagos was divided into four (4) sampling stations:



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Distance Learning Institute (DLI, 6.51266°N 3.39162°E) has tall shrubs, grass land, sedges, reeds and a natural pond, a major bridge is also towards the second exit gate of the University of Lagos. Slow flowing water is located below the bridge.

Lagoon Area (6.51892°N 3.40074°E) is characterized by tall trees forming canopies, short grass and the lagoon containing brackish water, rotten woods from fallen trees and few rocks. Fauna found in the habitat includes monitor lizards, reptiles, crabs and molluscs especially on pathway leading to the lagoon which burrows down into the soil. Others include birds, frog, and insects.

Faculty of Science Area (6.51674°N 3.40492°E) has tall and small buildings and open gardens with few trees. An artificial pond also is found adjacent the building that has walk-way bridge (Indomie Bridge), and it surrounded by slow flowing water.

High rise Area (6.50885°N 3.39162°E) is the residential part of the University of Lagos, where it is characterized by tall buildings, few trees and vegetation. Gardens are found inside or outside the residential homes.

Data collection and analysis

Odonata samples were collected between 10.00 am and 4.00 pm twice a week for six months (July to December 2014) using a sweep net with 150 cm long handle and orifice, 25 cm in diameters. Collections were made in different microhabitats – grasses, reeds, over open still water, sticks, among trees and on walls. Captured odonates were photographed, immersed in acetone for 12 hours and air-dried afterwards before storing in Ziploc[®] envelopes (Corbert, 1999). Each envelope was labelled with a number, location, time, and date. They were identified with appropriate keys (Vick, 2003; Clausnitzer and Dijkstra, 2011) and cross-referenced with over 3,000 images of Afrotropical Odonata species on the World Wide Web (www.african-dragonfly.net/global/results).

Data collected were statistically analysed using inferential statistics and analysis of variance (ANOVA). Means were separated using Duncan's Multiple Range Test. Diversity indices were used to determine the diversity and richness of dragonflies and damselflies in the selected study sites.

Results

Distribution pattern of odonates

A total of 750 species of Odonata were recorded at the sites representing 39 species, 22 genera and 4 families (Libellulidae, Aeshnidae, Coenagrionidae, and Calopterygidae). There were more dragonflies than damselflies in the sites. Most of the species collected belong to family Libellulidae (81%) while the family with the least number of species was the family Aeshnidae and Calopterygidae (3%) (Figure 1). The most dominant genus was *Orthetrum* (18%) followed by *Ceriagrion* (10%),

Palpopleura (8%), and *Trithemis* (8%). The most abundant species in DLI and Lagoon Area were *Ceriagrion glabrum*; *Orthetrum julia* and *Palpopleura lucia* respectively. *Orthetrum trinacria*, *Palpopleura portia* and *Themochoria equivocate* were the most abundant species in High Rise. Eight (8) species commonly found in the four sites were *Chalcostephia flavifrons*, *Crocothemis divisa*, *Orthetrum coerulescens*, *Palpopleura albitrons*, *Palpopleura lucia*, *Pantala flavescens*, *Trithemis annulata* and *Urothemis venata*. The most dominant species was *Orthetrum julia* (122 individuals) and the least with only one species were *Atoconeura eudoxia*, *Ceriagrion tricrenaticeps*, *Hemistigma albipunctum*, *Macrodiplax cora*, *Orthetrum machadoi*, *Sympetrum fonscolombii*, *Trithemis hartwigii* and *Urothemis luciana* (Table 1).

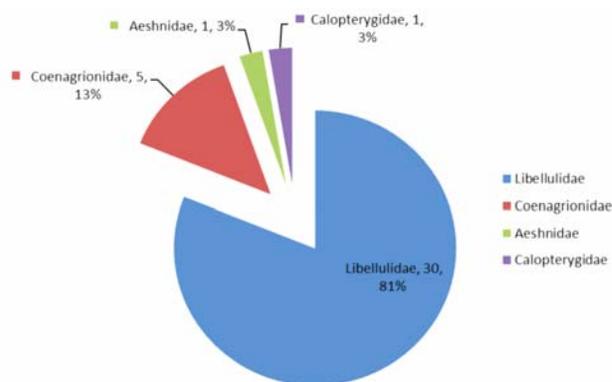


Figure 1: Percentage composition of Odonata families in University of Lagos, Nigeria.

Diversity indices

Table 2 shows the diversity indices of Odonata. Faculty of Science had the highest number of species (31) followed by Lagoon (30), then DLI (29) and lastly High Rise Area (27). High Rise Area had the most diverse species ($H' = 2.7010$), followed by Faculty of Science ($H' = 2.3650$), DLI ($H' = 2.2320$), and Lagoon Areas (1.9730) in that order. The area that was most evenly distributed was High Rise area ($E = 0.7445$) followed by Faculty of Science ($E = 0.4256$) and the least was Lagoon ($E = 0.2663$). Highest degree of concentration of the species was also found in High Rise Area (0.9177) and least concentration was found at Lagoon Area (0.8513).

The relationship in the occurrence of Odonata genera at University of Lagos

The relationships that exist among the Odonata genera sampled at the University Campus are shown in the multivariate (cluster) analysis (Figure 2). Three major clusters and a chunk (genus *Ceriagrion*) were observed in the dendrogram. The chunk (*Ceriagrion*) is the highest branch point in the dendrogram. The greater the height (distance), the greater the difference. Next to this is the

Table 1: Distribution pattern of *Odonates* at the University of Lagos.

Taxa	DLI	LG	SCI	HR	Total
<i>Acisoma panorpoides</i> Rambur, 1842	50	1	0	0	51
<i>Atoconeura eudoxia</i> (Kirby, 1909)	1	0	0	0	1
<i>Brachythemis lacustris</i> (Kirby, 1889)	10	1	1	0	12
<i>Bradinopyga cornuta</i> Ris, 1911	0	1	3	1	5
<i>Chalcostephia flavifrons</i> Kirby, 1889	33	4	1	1	39
<i>Crocothemis divisa</i> Baumann, 1898	5	1	1	1	8
<i>Crocothemis erythraea</i> (Brulle, 1832)	0	1	4	0	5
<i>Hemistigma albipunctum</i> (Rambur, 1842)	0	0	1	0	1
<i>Macrodiplax cora</i> (Brauer, 1867)	0	1	0	0	1
<i>Neodythemis klingi</i> (Karsch, 1890)	1	0	1	0	2
<i>Orthetrum africanum</i> (Selys, 1887)	0	1	0	1	2
<i>Orthetrum chrysostigma</i> (Burmeister, 1839)	0	3	1	0	4
<i>Orthetrum coeruleescens</i> (Faricius, 1798)	1	5	1	1	8
<i>Orthetrum Julia</i> Kirby, 1900	1	91	30	0	122
<i>Orthetrum machadoi</i> Longfield, 1955	0	0	1	0	1
<i>Orthetrum stemmale</i> (Burmeister, 1839)	0	3	1	4	8
<i>Pantala flavescens</i> (Fabricius, 1789)	20	7	6	3	36
<i>Orthetrum trinacria</i> (Selys, 1841)	0	1	0	7	8
<i>Palpopleura albifrons</i> Legrand, 1979	20	45	13	2	80
<i>Palpopleura lucia</i> (Drury, 1773)	10	70	30	2	112
<i>Palpopleura Portia</i> (Drury, 1773)	0	1	0	7	8
<i>Sympetrum fonscolombii</i> (Selys, 1840)	0	0	0	1	1
<i>Thermochoria equivocata</i> Kirby 1889	1	3	0	7	11
<i>Tholymis tillarga</i> (Fabricius 1798)	0	5	4	5	14
<i>Tramea basilaris</i> (Palisot de Beauvois, 1805)	0	1	2	0	3
<i>Trithemis annulata</i> (Palisot de Beauvois, 1805)	1	1	1	1	4
<i>Trithemis arteriosa</i> (Burmeister, 1839)	0	0	5	1	6
<i>Trithemis hartwigi</i> Pinhey, 1961	0	0	1	0	1
<i>Urothemis assignata</i> (Selys, 1872)	3	1	21	1	25
<i>Urothemis luciana</i> (Balinsky, 1961)	-	-	1	-	1
<i>Urothemis veneta</i>	5	2	1	1	9
<i>Agriocemis paloeforma</i> Pinhey, 1959	4	6	0	3	13
<i>Agriocemis zerafica</i> Le Roi, 1915	1	0	0	5	6
<i>Ceriagrion glabrum</i> (Burmeister, 1839)	80	4	1	0	85
<i>Ceriagrion suave</i> Ris 1921	48	0	1	0	49
<i>Ceriagrion tricrenaticeps</i> Legrand 1984	1	0	0	0	1
<i>Ceriagrion corallinum</i> Campion, 1914	3	0	0	0	3
<i>Gynacanthan bispina</i> (Rambur, 1842)	0	1	0	1	2
<i>Phaon iridipennis</i> (Burmeister, 1839)	1	1	0	0	2
<i>Total and % Total (in parenthesis)</i>	300(40)	262(35)	133(18)	55(7)	750(100)

Abbreviation: DLI: Distance Learning Institute, LG: Lagoon, SCI: Science, HR: High Rise Area.

first cluster, containing *Orthetrum* and *Palpopleura*. The second cluster housed *Chalcostephia*, *Pantala*, and *Acisoma* (*Acisoma* is a chunk of the second cluster). The third cluster include *Atoconeura*, *Neodythemis*,

Macrodiplax, *Phaon*, *Hemistigma*, *Gynacanthan*, *Sympetrum* and *Urothemis*. *Urothemis* is a chunk within the third cluster.

Table 2: Diversity statistics for four sites at the University of Lagos.

Data	DLI	Lagoon	Science	High Rise
Number of individuals	300	262	133	55
Number of species	29	30	31	27
Number of families	3	4	2	3
Shannon Weiner Index (H')	2.2320	1.9730	2.3650	2.7010
Simpson's Dominance Index, (C)	0.8513	0.7754	0.8569	0.9177
Margalef Index, (d)	3.6820	4.6690	4.9080	4.7410
Evenness Index, (E)	0.4236	0.2663	0.4256	0.7445
Mean Total Collection for 6 Months	7.6923	6.7179	3.4102	1.4102

Table 3: Eleven most abundant species of Odonata in each four sample sites.

S/N	DLI	LG	SCI	HR
1.	<i>Ceriagrion glabrum</i>	<i>Orthetrum Julia</i>	<i>Orthetrum julia</i>	<i>Orthetrum trinacria</i>
2.	<i>Acisoma panorpoides</i>	<i>Palpopleura lucia</i>	<i>Palpopleura lucia</i>	<i>Palpopleura portia</i>
3.	<i>Ceriagrion suave</i>	<i>Palpopleura albitrons</i>	<i>Urothemis assignata</i>	<i>Thermochoria equivocata</i>
4.	<i>Chalcostephia flavifrons</i>	<i>Pantala flavescens</i>	<i>Pantala flavescens</i>	<i>Agriocemis zerafica</i>
5.	<i>Palpopleura albitrons</i>	<i>Agriocemis –paloeforma</i>	<i>Trithemis arteriosa</i>	<i>Tholymis tillarga</i>
6.	<i>Pantala flavescens</i>	<i>Orethrum coerulescens</i>	<i>Tholymis tillarga</i>	<i>Orethrum temmale</i>
7.	<i>Brachythemis lacustris</i>	<i>Tholymis tillarga</i>	<i>Crocothemis erythraea</i>	<i>Agriocemis paloeforma</i>
8.	<i>Palpopleura lucia</i>	<i>Ceriagrion glabrum</i>	<i>Bradinopyga cornuta</i>	<i>Palpopleura albitrons</i>
9.	<i>Crocothemis divisa</i>	<i>Orethrum chrysostigma</i>	<i>Treamea basilaris</i>	<i>Palpopleura lucia</i>
10.	<i>Urothemis edwardii</i>	<i>Thermochoria equivocata</i>	<i>Brachythemis lacustris</i>	<i>Bradinopyga cornuta</i>
11.	<i>Agriocemis zerafica</i>	<i>Urothemis edwardii</i>	<i>Bradinopyga cornuta</i>	<i>Chalcostephia flavifrons</i>

Abbreviation: DLI: Distance Learning Institute, LG: Lagoon, SCI: Science, HR: High Rise Area.

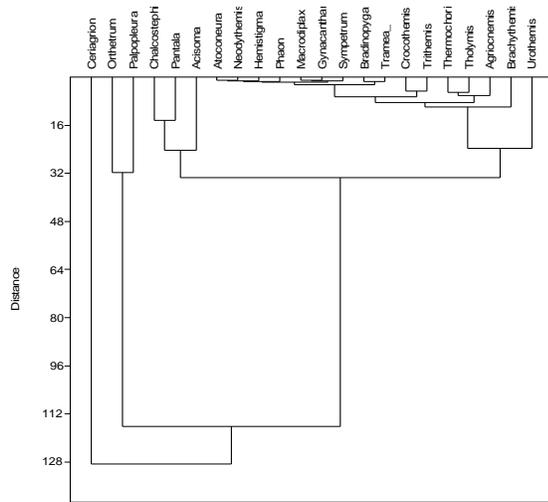


Figure 2: Cluster analysis showing relationships that exist among the Odonata genera sampled at the University Campus.

Discussion

Some sampled species are those that preferred open places and shaded environment. Among them are *Orthetrum stemmale*, *Orthetrum julia*, *Trithemis arteriosa*, *Trithemis annulata*, *Palpopleura lucia* and *Palpopleura portia*. They are ubiquitous and are pioneers of temporary or degraded landscape (Dijkstra and Clausnitzer, 2005). The architecture of vegetation associated with tropical lowland forest are constantly being depleted by human activities such as logging. This explains the abundance of ubiquitous species of families Libellulidae and Coenagrionidae as observed at the University of Lagos. Most of the Libellulidae collected at the University of Lagos have been recorded in other parts of West Africa, such as Gulf of Guinea Island (Dijkstra and Clausnitzer, 2005), upper Guinea forest (Dijkstra and Lempert, 2003) and south-western Nigeria (Adu and Ogbogu, 2011, 2013). Four families (Libellulidae, Coenagrionidae, Aeshinidae and Calopterygidae), twenty two (22) genera and thirty nine (39) species of odonate species were identified in the University of Lagos. In his study, Adu and Ogbogu (2013) found nine (9) families (Aeshinidae, Coenagrionidae,

Calipterygidae, Chlorocyphidae, Cordullidae, Gomphidae, Libellulidae, Platycnemididae and Protoneuridae), one hundred and twenty three (123) species in three genera. Moreover, studies by Adu *et al* (2014) in Owena forest in Ondo State, Nigeria recorded a total of 19 species in their three years study. Moreover, *Ceriagrion glabrum* was widespread at the sites, *Palpopleura portia* and *Palpopleura lucia* were abundant while *Mesocnemis singularis* and *Congothemis dubia* were dominant. In this study however, *Palpopleura lucia* was widespread while *Orthetrum julia* was the most abundant.

The dominance of the two families Libellulidae and Coenagrionidae at the University of Lagos was in agreement with studies conducted by Adu, and Ogbogu, 2011; Samways, 2003; Vick, 1999; Clausnitzer and Dijkstra, 2005. These two families (Libellulidae and Coenagrionidae) are believed to be the largest Odonata fauna on earth (Clausnitzer and Dijkstra, 2005).

University of Lagos has lost most of the characteristics of a tropical rain forest. In some part of its environment it however has the right vegetation architecture required for Odonata to survive. The Lagoon provides the needed biotope for the survival of many Afrotropical species such as *Acisoma panorpoides* and *Orthetrum julia*. In some area, trees with crowns provide the right roosting spots for the adult while the undergrowth and shrub provide perching spots for low flying adults. Moreover, there are fragmented openings within University of Lagos which serve as mating rendezvous for mature adults. Odonata displays two behavioural characteristics which is a function of the habitat selection of the species. In between these two are the temperate-centered species, that are neither eurytopic nor stenotopic (Corbet, 1999). Habitat occupied by Odonata may sometimes be unconventional for its type. For example, *Phaon iridipennis*, a forest Odonata was found in University of Lagos (DLI and Lagoon), an environment that is experiencing regular human disturbances. The diversity shows that Odonata exhibits heterogeneity in habitat selection, especially when the best desired habitat is not available (Corbet, 1999). The most abundant species at University of Lagos forest was *Orthetrum julia* and *Palpopleura lucia*. *Urothemis* is the chunk of the third cluster. The genus was fairly represented at the campus. Two out of the five known species occurred

at all the sampling stations. The two species *Urothemis assignata* and *U. edwardii*) are common dragonflies at open swamps and ponds (Dijkstra and Clausnitzer, 2015) Based on the dominance of some species in the selected sites in University of Lagos in terms of occurrence and distribution, it can be speculated that the habitat of University of Lagos is disturbed.

Conclusion

Most forest stenotopic species of Odonata appeared to survive while the ubiquitous species were found roaming about in open areas within the area of study. The absence of some of *Odonata* species at High Rise is a call for urgent action which should be taken to preserve the natural resources in the environment. Moreover, the survival of the remaining species is doubtful in a few years to come if no action is taken to preserve the environment's biodiversity. With the situation on ground one can conclude that University of Lagos is not protected. This situation is detrimental to the assemblage of localized Odonata species and perhaps other organism inhabiting the forest. There is need to preserve the Odonata community of the University of Lagos, which of course will lead to the preservation of other fauna occupying the environment.

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