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Biodiversity of odonates (Dragonflies and damselflies) in the riparian strip of the Kimpoko River in Kinshasa/DR Congo

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Abstract
Odonates, occupy varied habitats such as forests, farmland, lakes, rivers and other aquatic environments. The present investigation aimed to study the biodiversity of odonates (dragonflies and damselflies) in the riparian strip of the Kimppoko River in Kinshasa/RD Congo. Environmental parameters recorded in the Kimpoko river watershed indicated air temperature, wind speed, humidity, UV index, atmospheric pressure and cloud cover respectively of 29.8±1.5°C; 11.27±1.8 km/h; 68.8±1.5%; 8.9±0.4; 1013.6±0.5mb and 54±1.6%. Seven hundred and seventy-four (774) individuals were captured, divided into 9 families and 53 species. The Libellulidae family was the most diverse, with 30 species out of 53 identified, followed by the Coenagrionidae (9), Lestidae (5), Macromoidae, Gomphidae, Calopterygidae, Chlorocyphidae and Platycnemidae (2 species each) and Aeshnidae (1 species) families. Shanonn-Weaver diversity ranged from H'=3.67 (Kimp3) to H'=3.27 (Kimp2). Hill's index ranged from Hill=0.83 (Kimp2) to Hill=0.71 (Kimp1). Piélou's equitability vacillated between E'=0.94 and E'=0.93. ANOVA revealed a p-value of 0.99 for abundance, species richness and diversity indices between stations, indicating that there was no significant difference between the stations studied. This suggests that environmental conditions have no significant impact on the variability of measurements within this hydrosystem.

Keywords: Odonates, biodiversity, riparian strip, Kimpoko River, Kinshasa

1. Introduction

Freshwater ecosystems represent less than 1% of the earth's surface, and are home to around 10% of all known animal species worldwide (Dudgeon *et al*., 2006) [16], 60% of which are aquatic insects. This diversity currently numbers almost 100,000 described species (Balian *et al.,* 2008) [2]. Aquatic insects could well number over 200,000 species, representing 80% of aquatic animal diversity. It is becoming increasingly clear that the main threats to these ecosystems are anthropogenic in origin (Dijkstra *et al*., 2014) [7, 8, 9, 10, 11, 12, 13].

Odonates, occupy diverse habitats such as forests, farmland, lakes, rivers and other aquatic environments (Rathod *et al.,* 2015) [31]. The number of Odonata species, including damselflies and dragonflies, is estimated at around 5,900 worldwide (Van Tol, 2000) [30]. These insects colonize a wide range of extreme environments, such as hot springs, sulfate, acidic, alkaline and hypoxic waters, as well as ephemeral wetlands, ponds, salt marshes and mangroves.

Odonates play an essential role in maintaining the balance of ecosystems and biodiversity (Monteiro-Júnior *et al.,* 2014 [30]; Siregar and Bakti, 2016) [35]. As larvae, they act as predators in aquatic ecosystems, while as adults they feed on agricultural crop pests, making them agents of biological control (Willigalla and Fartmann, 2012) [40]. Adult dragonflies often lay their eggs in clean water, requiring natural habitats for their survival. They are also used as bioindicators of the quality of forests and aquatic environments (Ilhamdi *et al*., 2020) [18].

Information on the distribution and diversity of flora and fauna in different habitat types at local and regional levels is essential for biodiversity conservation. Several studies have been carried out on dragonfly diversity, particularly in relation to ecosystems and their role as environmental indicators (Dolný *et al.,* 2011; Mapi-ot *et al*., 2013; Kannagi *et al.,* 2016) [15, 27, 21].

In this context, Odonata are the best example, as they are at the top of the trophic chain of benthic macroinvertebrates, which allows us to draw information relating to the faunal richness of the environments colonized and would therefore enable us to detect minute ecosystem disturbances.

However, the characterization of Odonata populations in most of the rivers of the city-province of Kinshasa remains embryonic. Thus, this study is a contribution to the deepening of knowledge on the structure of dragonfly and damselfly populations in the Kimpoko River watershed in the eastern part of this city.

It aims to characterize the structure of the Odonatofauna in the Kimpoko river watershed in order to understand its distribution pattern and explain the elements underlying its structuring. The aim is to characterize the environmental factors structuring Odonata populations in this hydrosystem, to inventory the dragonfly and damselfly fauna inhabiting the watershed, and to assess the diversity of these populations.

2. Study environment

The Kimpoko River is located in the eastern part of the city-province of Kinshasa, forming the natural boundary between the communes of N'sele and Maluku. It rises in the hills to the south of Maluku, and flows from south to north below these hills, before emptying into the Malebo pool, a vast stretch of the Congo River.

The Kimpoko River watershed has soil and geological characteristics typical of humid tropical zones. Soils are nutrient-poor and pronouncedly acidic. They often contain less than 20% clay, with a predominantly sandy-clay texture. This composition results from the weathering of parent rocks such as schisto-limestone and schisto-sandstone, which give rise to yellow clay soils or light-brown clay sands. Kimpoko's geology is marked by the presence of schisto-quartzite formations and alkaline-tending granites.

The Kimpoko river watershed features a diverse vegetation influenced by the climate. The vegetation is characterized by floodplain forests along the river and alluvial plains, grassy savannahs on well-drained soils dominated by grasses and shrubby formations resulting from the degradation of forests or wooded savannahs due to anthropogenic activities such as agriculture and timber exploitation.

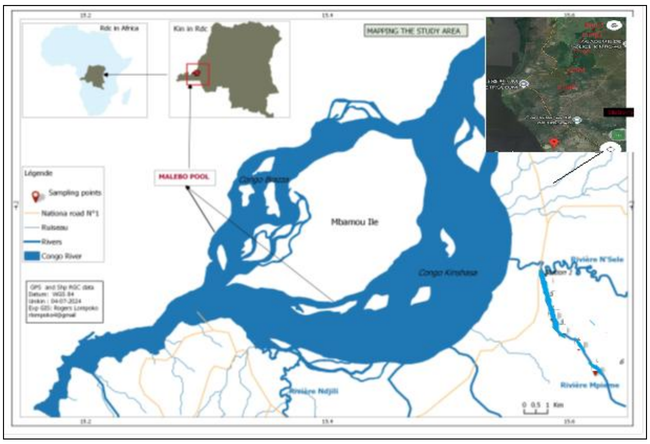

Fig 1: Location of the Kimpoko River and sampling stations

3. Methods

3.1 Sampling

Adult dragonfly sampling was carried out from January to May 2023 in the Kimpoko river watershed. Sampling was carried out along the riparian strip in each component type. For each station, two 100-metre-long linear transects (in both banks) were installed along the watercourse. The transect width was 2 metres: 1 metre on the bank and 1 metre in the water, along the shoreline (Sugiman *et al.,* 2020) [36].

During sampling, several environmental parameters were recorded, including air temperature, humidity, wind speed, ultraviolet index, cloud cover and atmospheric pressure. Temperature and humidity were measured using a thermo-hygrometer (Deko 637 Thermo-hygrometer), the Ultravilot index and cloud cover were taken hourly using a meteorological application installed in the phone (Infinix X612 SMART HD 2021), while wind speed and light intensity were measured with an anemometer and luxmeter respectively (Lutron LM8010 Type K). The coordinates and altitude of the study sites were recorded simultaneously using a GPS (Garmin GPSMAP 78s).

Table 1: Geographical coordinates of sampling stations

Stations	Altitude (m)	East longitude	South latitude
Kimp1	318	04°9'38.0"	015°33'40.1"
Kimp2	314	04°9'03.8"	015°33'40"
Kimp3	304	04°10'27.6"	015°33'24.7"
Kimp4	290	04°10'27.4"	015°33'24.7"
Kimp5	287	04°10'43.7"	015°33'08.4"

Odonate collection was carried out during sunny weather, between 8:00 a.m. and 4:00 p.m., the period during which these insects are most active (Renner *et al*., 2015 [32]; Khan, 2017) [22]. Sampling was carried out fortnightly using insect nets (50 cm in diameter, 85 cm deep) mounted on a 120 cm-long wooden handle. Dragonflies were observed either directly or using telescopes and cameras.

Specimens not identified in the field were captured for later identification. Captured dragonflies were placed in killing flasks containing absorbent paper impregnated with ether. After death, they were immediately removed, dried in the sun, then stored in triangular paper envelopes (5 × 3 cm), wings folded over the body (Koneri *et al.,* 2020) [24].

Specimens were identified on the basis of external morphological features using dragonfly identification guides (Kalkman *et al.,* 2008 [20]; Dijkstra & Clausnitzer, 2014 [7, 8, 9, 10, 11, 12, 13]; Dijkstra, 2024), under stereo-loupe and occasionally using a microscope with a 10X objective for certain precise details.

3.2 Data analysis

Data on dragonfly abundance and richness were compiled for each station. The abundance curve by rank was analyzed using Excel as a percentage of the total number of individuals. The specific richness index (Chao1) was used to estimate the number of species present at each station, using PAST software version 4.03.

3.3 Diversity indices

Species diversity was assessed using richness, diversity and equitability indices:

- Margalef specific richness index (R1) :
  (R1): $R1 = \frac{S-1}{LogN}$
- Shannon-Wiener diversity index (H'):
  $H' = - \sum_{i=1}^{S}(P_i lnP_i)$
- Hill index: Hill= Hill=

$$\text{Hill} = \frac{\frac{1}{D}}{\text{Exp}\,(H)}$$

- Pielou equitability index (E):

$$E = \frac{H'}{lnS}$$

These indices were determined using Past 4.03 software.

3.4 Statistical analysis: Significant differences in individual abundance, species richness, Shannon diversity and dragonfly equitability between the five stations were tested with a one-way analysis of variance (ANOVA) using Past software version 4.03 (Bashir *et al*., 2019 [3]; Ajerrar *et al*., 2020) [1]. Canonical correspondence analysis (CCA) was performed to explore relationships between sloth species and measured environmental factors. CCA was performed using PAST 4.03 software (Cuartas-Hernández and Gómez-Murillo, 2015 [6]; Wakhid *et al*., 2021) [39].

4. Results
4.1 Environmental parameters

Table 2: Environmental parameters in the Kimpoko River watershed

Meteorological parameters	Stations					Average
	Kimp1	Kimp2	Kimp3	Kimp4	Kimp5	
Air temperature (°C)	28.8	27.76	30.6	30.3	31.7	29.8±1.5
Wind speed (Km/h)	9.3	9.3	12	13	12.7	11.27±1.8
Moisture content (%)	68.7	70.3	69	69.7	66.3	68.8±1.5
UV index	8.67	9	9.7	9	8.7	8.9±0.4
Atmospheric pressure (mb)	1014.2	1014.1	1013	1013.5	1013.2	1013.6±0.5
Cloud cover (%)	52.4	52.8	54	56.4	54.4	54±1.6

The mean air temperature in the Kimpoko catchment area fluctuated around 29.8±1.5°C. Mean wind speed, mean humidity, mean UV index, mean atmospheric pressure and mean cloud cover fluctuated around 11.27±1.8 km/h; 68.8±1.5%; 8.9±0.4; 1013.6±0.5mb and 54±1.6% respectively.

4.2 Distribution of Odonates collected in the Kimpoko River during the rainy season

Table 3: Distribution of Odonata collected in the Kimpoko River during the 2023 rainy season

Suborders	Families	Species	Stations				
			Kimp1	Kimp2	Kimp3	Kimp4	Kimp5
Anisoptera	Libellulidae	*Acisoma inflatum*	5	1	7	3	3
		Acisoma trifidum	3	0	9	2	2
		Acisoma variegatum	3	0	5	1	3
		Aethiothemis circe	3	2	5	4	7
		Brachythemis leucosticta	3	0	2	1	1
		Palpopleura albifrons	4	2	4	3	7
		Palpopleura lucia	11	5	16	10	18
		Palpopleura portia	17	5	14	8	17
		brachythemis impartita	2	0	4	2	5
		Chalcostephia flavifrons	5	2	8	5	12
		Crocothemis divisa	0	0	0	0	2
		Crocothemis erythraea	3	1	4	2	4
		Crocothemis sanguinolenta	2	0	2	1	2
		Diplacodes lefebvrii	3	0	1	1	2
		Diplacodes luminans	2	3	0	0	1
		Hemistigma albipunctum	3	2	5	2	3
		Orthetrum abbotti	4	1	12	4	7
		Orthetrum africanum	1	0	1	0	2
		Orthetrum caffrum	2	0	5	2	9
		Orthetrum chrysostigma	3	1	3	2	4
		Orthetrum guineense	3	0	6	2	8
		Orthetrum julia	1	3	2	4	2
		Orthetrum stemmale	1	2	3	2	3
		Pantala flavescens	3	1	2	2	4
		Rhyothemis fenestrina	1	0	7	3	4
		Tholymis tillarga	0	0	0	0	2
		Trithemis arteriosa	2	0	3	2	4
		Porpax risi	3	1	6	4	11
		Trithemis donaldsoni	1	0	2	2	4
		Urothemis edwardsii	6	2	4	3	8
	Aeshnidae	*Gynacantha cylindrata*	1	1	2	1	0
	Macromoidae	*Phyllomacromia melania*	0	1	2	1	3
		Phyllomacromia aureozona	1	3	2	1	5
	Gomphidae	*Phyllogomphus coloratus*	2	1	2	2	3
		Phygomphus selysi	0	1	2	0	2
Zygoptera	Coenagrionidae	*Pseudagrion kibalense*	2	4	2	1	5
		Africallagma suntile	1	0	2	1	4

		Africallagma vaginale	4	1	3	1	3
		Ceriagrion corallinum	3	1	11	4	3
		Ceriagrion glabrum	2	6	3	5	4
		Ceriagrion whellani	0	1	3	2	3
		Ceriagrion ignitum	0	0	3	1	0
	Lestidae	*Lestes tridens*	2	1	4	2	6
		Lestes virgatus	2	0	2	1	4
		Lestes amicus	1	0	2	1	3
		Lestes pinheyi	0	0	0	0	2
		Lestes dissimulans	1	0	6	3	3
	Calopterygidae	*Phaon camerunensis*	4	2	4	1	1
		Phaon iridipennis	2	1	2	0	0
	Chlorocyphidae	*Chorocypha curta*	2	4	7	4	15
		Chorocypha aphrodite	1	2	5	5	11
	Platycnemididae	*Allocnemis nigripes*	2	0	3	1	2
		Mesocnemis singularis	0	1	2	2	0
N			133	65	216	117	243
S			45	32	49	46	49

Legend: N = Number of individuals per station; S = Number of taxa per station

Stations Kimp3 and Kimp5 contained the highest number of species (49 each), followed by Kimp4, Kimp1 and Kimp2 with 46, 45 and 32 species respectively.
The census of odonate individuals in the Kimpoko river watershed revealed that 774 individuals were captured in the river. Station Kimp5 yielded the highest number of individuals (243), representing 31.4% of the total number collected. It was followed by Kimp3, Kimp1, Kimp4 and Kimp2, with 216, 133, 117 and 65 individuals respectively.
The Libellulidae family was the most diverse, with 30 species out of 53 identified. It was followed by the families Coenagrionidae with 9 species, Lestidae (5), Macromoidae, Gomphidae, Calopterygidae, Chlorocyphidae and Platycnemidae (2 species each) and Aeshnidae (1 species).

4.3 Abundance curve by rank
The rank-abundance curve shows the abundances of 53 species within the sample studied, illustrating an uneven distribution of individuals among the different species. The first two species (*P. Portia* and *P. lucia*) stand out for their high abundance, with 61 and 60 individuals respectively.
The curve shows a marked decrease in abundance fro the third species (*C. flavifrons*) onwards, with 32 individuals, followed by the fourth (*C. curta*), also with 32. Then, the fifth (*O. abbotti*) and sixth (*P. risi*) species showed an even lower abundance with 28 and 25 individuals respectively. This indicates a clear hierarchy in species abundance, with a few species largely dominating. It is particularly interesting to note that the last three species (*C. divisa, T. tillarga* and *L. pinheyi*) have an abundance of only 2 each.

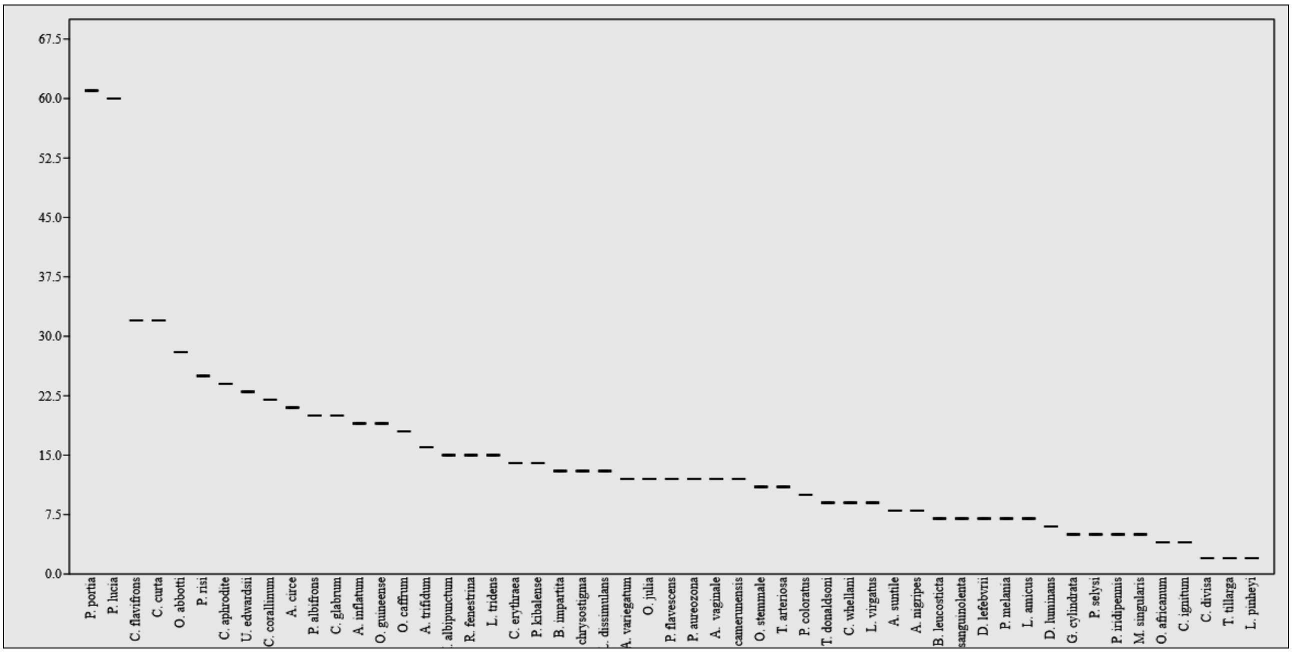

Fig 2: Ranked abundance curve of odonate species in the Kimpoko River

4.4 Odonate population diversity in the Kimpoko during the rainy season

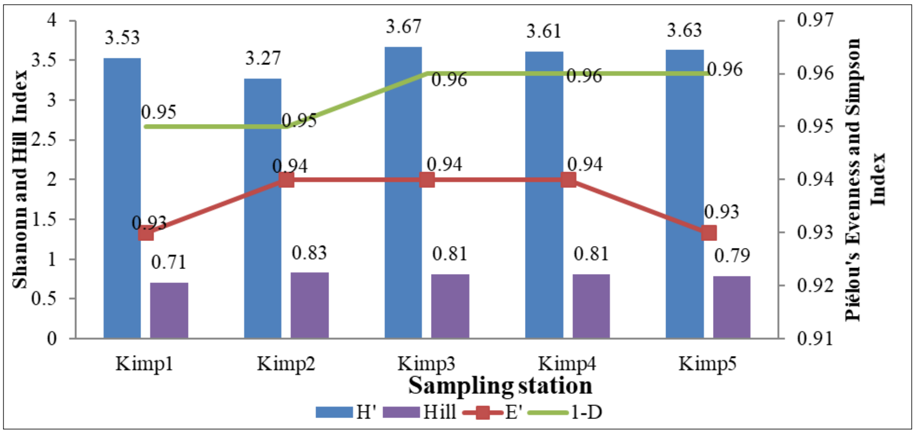

Fig 3: Odonate diversity in the Kimpoko during the 2023 rainy season

The rainy-season Odonatofauna of the Kimpoko River was more diverse at station Kimp3 (H'=3.67) than at stations Kimp5 (H'=3.63), Kimp4 (H'=3.61), Kimp1 (H'=3.53) and Kimp2 (H'=3.27) (figure.3). The highest Hill index was assessed at Kimp2 stations (Hill=0.83). This was followed by stations Kimp3 and Kimp4, (Hill=0.81), Kimp5 (Hill=0.79) and Kimp1 (Hill=0.71). Stations Kimp2, Kimp3 and Kimp4 were better balanced in terms of Odonates (E'=0.94) in the rainy season than stations Kimp1 and Kimp5 (E'=0.93). Analysis of Simpson's index indicated that stations Kimp3, Kimp4 and Kimp5 showed a very high value (1-D=0.96) than stations Kimp1 and Kimp2 (1-D=0.95).

4.5 One-way analysis of variance (ANOVA)

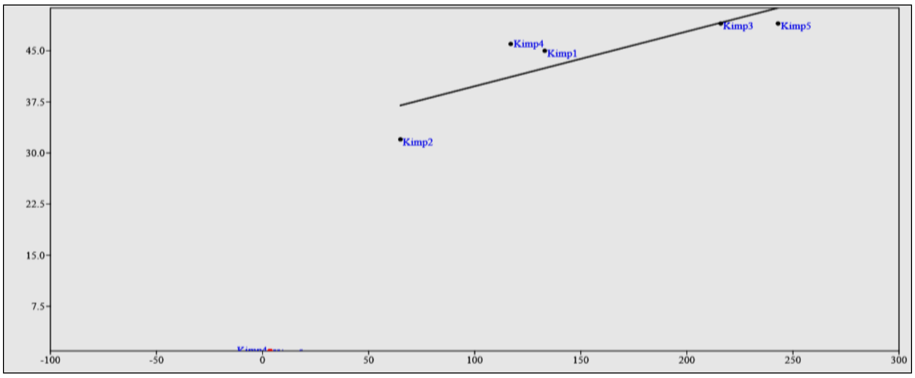

Fig 4: One-way analysis of variance (ANOVA) between gross abundance, species richness and Shannon-Weaver diversity and equitability indices between stations.

One-way analysis of variance (ANOVA) between raw odonate abundance, species richness and Shannon-Weaver diversity and equitability indices between the stations studied revealed a p-value of 0.99, indicating that there was no significant difference between the stations studied in the Kimpoko River. This suggests that environmental conditions at the stations had no significant impact on the variability of measurements between stations in this hydrosystem.

4.6 Canonical Correspondence Analysis

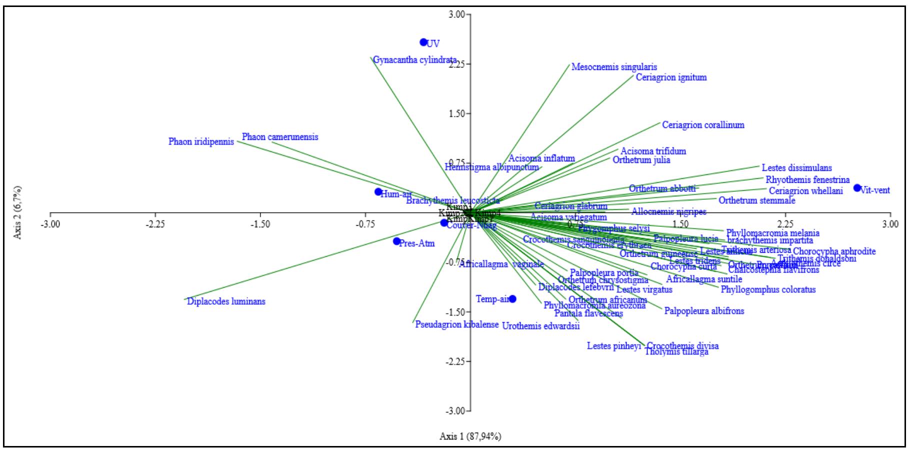

Fig 5: Correlation between odonate species in the Kimpoko River and meteorological parameters

The first two axes were selected as they explain 94.64% of the variability. Canonical Correspondence Analysis indicated that the species *M. singularis, C. igntum, A. inflatum, A. trifidum, O. Julia, O. abotti, L. Dissimulans, R. fenestrina, C. whellani, O. stemmale, A. nigripes, C. grabrum, A. vetiegatum, P. selysi, P. melania B. impartia C. aphrodite, T. donaldsoni, P. lucia, L. Tridens, T. arteriosa, P. coloratus* and *A. suntile* showed positive correlations with wind speed.

C. curta, C. flavifrons, P. albifeons, O. Chrysostigma, L. Virgatus, O. africanum, P. aureozona, P. flavescens, C. Erytreae, C. sanguilenta, O. guinensis, D. Lefebvrn, L. pinheyi, C. divisa, T. tillarga and *U. edwrdsii* showed positive affinities with air temperature;

Specimens of *A. vaginale, P. Kibalense* and *D. luminans* correlated strongly with atmospheric pressure and cloud cover.

Specimens of *P. iridipennis, P. cameeunensis, G. cylindrimata, H. albipunctum* and *B. leucostica* showed positive correlations with air humidity and UV index.

Discussion

Dragonflies and damselflies (Odonata) are insects closely linked to aquatic ecosystems, such as rivers and wetlands. Their presence and diversity are strongly influenced by local environmental conditions (Biffi, 2017) [4].

Environmental parameters surveyed in the Kimpoko River watershed, east of the city-province of Kinshasa reflected a tropical climate characterized by high temperatures and moderate relative humidity (68.8 ± 1.5%). The mean temperature of 29.8°C was in line with climatic conditions in the city of Kinshasa, where the mean annual temperature is around 24.4°C (Ditona *et al.,* 2022) [14]. This relatively high temperature is favorable to insect activity, including dragonflies and damselflies. High temperatures t favor reproduction and larval development (Harrison *et al*., 2010) [17]. Humidity levels are typical of tropical zones and can affect thermal comfort and heat perception. Relatively high humidity levels are beneficial for these aquatic insects in that they promote larval survival in aquatic environments and influence adult flight behavior (Suh *et al*., 2009) [33, 37].

A wind speed of 11.27 km/h is considered moderate and can influence evapotranspiration and flight behaviour in dragonflies and damselflies. Smaller species may find it more difficult to move around in windy conditions, which could affect their ability to hunt or reproduce (Corbet, 1999) [5]. This explains the low abundance of damselfly species.

A UV index of 8.9 indicates a very high level of ultraviolet radiation. A high UV index indicates high exposure to ultraviolet radiation. Although some dragonfly species may have adaptations to resist the harmful effects of UV radiation, prolonged exposure could affect their survival and reproduction (Kumar *et al*., 2016) [26]. However, dragonflies have protective mechanisms, such as cuticular pigmentation, but prolonged exposure to high levels of UV radiation can be harmful (Koch *et al*., 2020) [23].

The 54% cloud cover suggested alternations between sunny and cloudy periods, influencing brightness and ground temperature and moderating daytime temperatures and reducing UV exposure, creating more favorable conditions for dragonflies. This cloud cover played a role in regulating temperature and humidity levels. It also affected the diurnal activity schedules of dragonflies and damselflies by reducing light intensity during certain periods.

Environmental conditions in the Kimpoko watershed appear to be generally favorable for dragonflies and damselflies in this wetland. Warm temperatures and high humidity are conducive to their larval development in aquatic environments. However, it is crucial to monitor the potential impact of climate change on these parameters, which could influence aquatic insect populations.

The predominance of specimens belonging to the Libellulidae family, with 30 species, is consistent with trends observed in other tropical regions, where this family is most often diversified (Kalkman *et al*., 2008) [20]. The well-represented Coenagrionidae and Lestidae are also typical of tropical wetlands. Low species richness in the Lestidae, Macromiidae, Gomphidae, Calopterygidae, Chlorocyphidae and Platycnemididae families indicates a more restricted diversity in these groups. This may be due to specific environmental factors limiting their habitat or reproduction (Suh *et al.,* 2009) [33, 37]. The presence of less diverse families, such as the Aeshnidae, may be explained by specific ecological preferences or less adaptability to local conditions, or by particular conditions or environmental pressures.

The Libellulidae family is generally well represented in aquatic environments, often due to their ability to adapt to diverse habitats. Their diversity may indicate a healthy ecosystem with a variety of ecological niches available (Matsuki *et al*., 2018) [29].

Coenagrionidae, often called damselflies, are also well adapted to aquatic environments. Their presence suggests the availability of suitable habitats for their reproduction and larval development (Dijkstra *et al*., 2013).

The rank-abundance curve presents the abundances of 53 species within the studied stand, illustrated an uneven distribution of individuals among the different species.

The species *P. Portia* and *P. lucia* stand out for their high abundance, with 61 and 60 individuals respectively. This high representation suggests that they play a key role in the ecosystem, potentially due to their adaptability to the vegetated aquatic habitats offered by this hydrosystem and their efficient hunting and breeding strategy. The marked decline in abundance starts with *C. flavifrons*, with 32 individuals, followed by *C. curta*, also with 32. Next, the species *O. abbotti* and *P. risi* show an even lower abundance with 28 and 25 individuals respectively. This indicates a clear hierarchy in species abundance, with a few species largely dominating. The last three species (*C. divisa*, *T. tillarga* and *L. pinheyi*), with an abundance of only 2 each, highlight the presence of rare species within this community, which may indicate a rich biodiversity but also potential vulnerability to environmental change. The rank-abundance curve reveals a complex dynamic within the aquatic ecosystem studied, characterized by a strong dominance of a few species and the presence of a number of rare species.

The Shannon-Weaver index and the equitability index indicate high diversity in this ecosystem. A value of 3.53 is considered very good and suggests a balanced distribution (similar proportions) of the species present, and that resources are shared efficiently between the different odonate species without excessive domination by a single species. This means that the number of individuals per species is relatively equitable, which is a positive sign for ecosystem health (Magurran, 2004) [26]. The Hill index oscillating between these values also shows good specific diversity and an equitable distribution between species. These indices confirm that the Kimpoko River watershed is species-rich and maintains a good level of ecological balance.

Conclusion

The study of the biodiversity of odonates (dragonflies and damselflies) in the riparian strip of the Kimppoko River in Kinshasa/RD Congo was carried out from January to May 2023. Environmental parameters recorded in the Kimpoko river watershed indicated air temperature, wind speed, humidity, UV index, atmospheric pressure and cloud cover respectively of 29.8±1.5°C;11.27±1.8 km/h; 68.8±1.5%; 8.9±0.4; 1013.6±0.5mb and 54±1.6%.

These results highlight how different species react to different environmental factors. It is crucial to take these correlations into account when assessing the potential impacts of environmental changes, such as climate change, which could alter the conditions to which these species are adapted. In addition, this information can help guide conservation efforts by identifying critical habitats for each species based on their ecological preferences.

The results showed that the Kimpoko River watershed has a rich biodiversity of odonates, particularly Libellulidae and Coenagrionidae. Diversity indices indicate a healthy ecosystem with good equitability between the species present. This can be attributed to the quality of the available habitats and the absence of major environmental disturbances.

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Références

1. Ajerrar A, El Ghazali I, Znari M, Yahyaoui A. Diversity and distribution of Odonata in the wetlands of the Middle Atlas, Morocco. Int J Odonatol. 2020;23(3):245-258.
2. Balian EV, Segers H, Lévêque C, Martens K. The Freshwater Animal Diversity Assessment: An overview of the results. Hydrobiologia. 2008;595(1):627-637.
3. Bashir NH, Mir TA, Chishti MZ. Diversity and distribution of Odonata (Insecta) in relation to habitat variables in Kashmir Himalaya, India. J Asia-Pacific Biodiversity. 2019;12(1):50-58.
4. Biffi M. Influence environmental factors and biotic interactions on the selection of habitat and diet of the Pyrenees DESMAN, *Galemys Pyrenaicus*. Doctorate Thesis University Toulouse 3 Paul Sabatier (UT3Paul Sabatier). 2017, 270.
5. Corbet PS. Dragonflies: Behavior and ecology of Odonata. Aquatique Insects. 1999;23(1):83.
6. Cuartas-Hernández S, Gómez-Murillo L. Odonata (Insecta) assemblages in different aquatic systems of the Colombian Andes: diversity and conservation status. Caldasia. 2015;37(1):169-188.
7. Dijkstra K-DB, Clausnitzer V. The Dragonflies and Damselflies of Eastern Africa: Handbook for all Odonata from Sudan to Zimbabwe. (Studies in Afrotropical Zoology, Vol. 298). Royal Museum for Central Africa, Tervuren. 2014, 263.
8. Dijkstra K-DB, Lewington R. Field Guide to the Dragonflies of Britain and Europe. 1st. Bloomsbury Publishing, London, UK. 2013, 336.
9. Dijkstra KDB, Bechly SM, Bybee RA, Dow HJ, Dumont G, Fleck R, *et al*. The classification and diversity of dragonflies and damselflies (Odonata). Zootaxa. 2013;3703(1):36-45.
10. Dijkstra K-DB, Kalkman VJ, Dow RA, Stokvis FR, van Tol J. Redefining the damselfly families: A comprehensive molecular phylogeny of Zygoptera. Syst Entomol. 2013;39(1):68-96.
11. Dijkstra K-DB, Monaghan MT, Pauls SU. Freshwater biodiversity and aquatic insect diversification. Annu Rev Entomol. 2014;59:143-163.
12. Dijkstra K-DB. African Dragonflies and Damselflies Online. 2024 [cited 2024 May 5]. Available from: http://addo.adu.org.za/.
13. Dijkstra K-DB, Clausnitzer V. The dragonflies and damselflies of eastern Africa: handbook for all Odonata from Sudan to Zimbabwe. Tervuren: Royal Museum for Central Africa. 2014, 264.
14. Ditona DM, Bongo NG, Ilunga SK. Characterization of the urban climate of the city of Kinshasa (DR Congo) using meteorological and satellite data. Climatology. 2022;19:134-152.
15. Dolný A, Harabiš F, Mižičová. Odonates as a tool for habitat quality assessment. Ecol Indicators. 2011;11(3):634-640.
16. Dudgeon D, Arthington AH, Gessner MO, Kawabata Z-I, Knowler DJ, Lévêque C, *et al*. Freshwater biodiversity: importance, threats, status and conservation challenges. Biol Rev. 2006;81(2):163-182.
17. Harrison AD, Hynes HBN, Wallace ID. Freshwater biology: Ecology of aquatic insects. In: Hynes HBN, editor. The Ecology of Running Waters. University of Toronto Press. 2010, 153-198.
18. Ilhamdi ML, Al Idrus A, Santoso D, Hadiprayitno G. Short Communication: Community structure and diversity of Odonata in Suranadi Natural Park, West Lombok Indonesia. Biodiversitas. 2020;21(2):718-723.
19. Jost L. Entropy and diversity. Oikos. 2006;113(2):363-375.
20. Kalkman VJ, Clausnitzer V, Dijkstra K-DB, Orr AG, Paulson DR, van Tol J. Global diversity of dragonflies (Odonata) in freshwater. Hydrobiologia. 2008;595(1):351-363.
21. Kannagi A, Sivakumar V, Santhi V. Diversity of Dragonflies (Insecta: Odonata) in a Deciduous Forest of Thoothukudi District, Tamil Nadu, South India. Int J Environ Prot Policy. 2016;4(3):58-63.
22. Khan MKA. A checklist of the dragonflies and damselflies (Insecta: Odonata) of Bangladesh. Zootaxa. 2017;4324(1):1-89.
23. Koch RL, Venette RC, Hutchison WD. Understanding insect responses to UV radiation: Adaptation and vulnerability in a changing climate. J Insect Physiol. 2020;122:104027.
24. Koneri R, Mofu W, Kaligis J, Walalangi D. Diversity and distribution of dragonflies (Odonata) in the urban green spaces of Manado, North Sulawesi, Indonesia. Biodiversitas. 2020;21(3):1054-1061.
25. Kumar A, Prasad M, Singh R. Effect of ultraviolet radiation on aquatic insect populations with reference to Odonata. Int J Environ Sci. 2016;7(1):45-52.
26. Magurran AE. Measuring Biological Diversity. Blackwell publisher, Oxford, UK. 2004.
27. Mapi-ot EF, Taotao AU, Nuñeza OM, Villanueva RJT. Adult Odonata diversity in wetlands of Misamis Occidental, Philippines. AACL Bioflux. 2013;6(4):421-432.
28. Matsuki M, Yamasaki S, Matsuoka S. Habitat

preferences of dragonflies in a river system: Implications for conservation strategies in riverine ecosystems. Freshwater Biology. 2018;63(6):668-680.
29. Matsuki Y, Yajima T, Tsubaki Y. Habitat heterogeneity maintains species richness and functional diversity of Odonata. Ecological Research. 2018;33(4):733-741.
30. Monteiro-Júnior CS, Juen L, Hamada N. Effects of urbanization on stream habitats and associated adult dragonfly and damselfly communities in central Brazilian Amazonia. Landscape and Urban Planning. 2014;127:28-40.
31. Rathod DM, Patel JR, Mistry VS, Parasharya BM, Talmale SS. Odonate diversity of dang forest, a Westerne ghat extension of Gujarat, India. Adv Life Sci. 2016;5(1):5302-5310.
32. Renner SC, Päckert M, Albrecht J, Lorenz W, Schleuning M, Böhning-Gaese K. Functional diversity and trait composition of bird communities change along a land-use gradient in tropical Africa. Ecol Appl. 2015;25(4):1155-1167.
33. Suh AN, Samways MJ, Simaika JP. Dragonflies and damselflies (Odonata) in urban landscapes: A review. African Entomology. 2009;17(2):133-147.
34. Samways MJ, McGeoch MA, New TR. Insect Conservation: A Handbook of Approaches and Methods, Techniques in ecology/& conservation. Oxford University, Oxford, UK. 2020;441 [cited 2024 Jun 22].
35. Siregar AZ, Bakti D. Diversité des odonates en relation avec les écosystèmes et l'utilisation des terres dans le nord de la péninsule malaise. J Ilmiah Pertanian Kultura. 2016;40(2):106-116.
36. Sugiman S, Sutrisno H, Perwira Y. Diversity and habitat preferences of Odonata in the riparian zones of the Ciliwung River, West Java, Indonesia. J Entomol Zool Stud. 2020;8(2):123-130.
37. Suh S, Kim C, Lee C-H. Effects of humidity on flight activity and survival of the dragonfly *Sympetrum depressiusculum*. Ecol Entomol. 2009;34(6):706-712.
38. Van Tol J. The odonata of Sulawesi and adjacent islands. Part 5. The genus *Protosticta* Selys (Platystictidae). Tijdschrift voor Entomologie. 2000;143(1-2):221-266.
39. Wakhid A, Sutrisno H, Huda N. Species diversity and distribution of Odonata in relation to environmental variables in the riparian zones of the Brantas River, East Java, Indonesia. Biodiversitas. 2021;22(4):1890-1898.
40. Willigalla C, Fartmann T. Patterns in dragonfly diversity in cities across Central Europe. Eur J Entomol. 2012;109(2):235-245.