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Posted Date: 21 April 2025

doi: 10.20944/preprints202504.1717.v1

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Abstract: The environmental challenges of urbanization led to a growing interest in the analysis of biodiversity in cities. So far, the focus was on public green spaces, which are becoming increasingly scarce as governments lose control of urban growth. Therefore, there is growing interest in the as yet little known and documented contribution of private players to the urban biodiversity conservation. This study assesses the biodiversity of Concessions held by catholic Religious' Groups (CRGs) in three cities (Bukavu, Kisangani and Lubumbashi) in the Democratic Republic of Congo (DRC). CRGs are targeted due to the predominance of catholicism in the DRC and its key role in the socio-economic development of the country. This plant structure of CRGs analysis was based on a systematic inventory of the flora present in a total random sample of 70 CRGs. The results show that the average CRG area in Lubumbashi (1.1 ha) is smaller than those in Bukavu (3.7 ha) and Kisangani (5.2 ha). However, there is no link between CRG area and species richness. There is quasi-heterogeneity within and between cities in the CRGs plant composition, with a total of 220 species identified corresponding to 76 families and 185 genera. Plant diversity is dominated by phanerophytes and exotic species. This study highlights the importance of taking private players into account in the urban biodiversity conservation.

Keywords: urban biodiversity; biodiversity conservation; gardening; catholic religious groups; private green space; Democratic Republic of Congo

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1. Introduction

Over the centuries, human societies have significantly influenced the dynamics of land occupation/use through the exploitation of natural resources and the occupation of space, a phenomenon commonly referred to as the anthropization of the landscape[1]. This phenomenon typically leads to two major processes: on one hand, the conversion of natural areas into agricultural land, and on the other hand, a direct conversion into urban areas, resulting in an additional phenomenon known as "urbanization."[1,2]

On a global scale, the process of urbanization is considered a major issue[3]. According to the United Nations, by 2050, more than two-thirds of the world's population will be living in cities[4]. The continuous growth of human populations has fostered urban expansion that is even more significant than population growth in certain regions of the world [5]. The degree of urbanization worldwide today is high, with the number and size of large cities being unprecedented[6]. It is estimated that one in two people now live in a cities, compared to just one in ten at the beginning of the 20th century [7]. The situation is such that while cities play a likely dominant role (as centres of production and consumption) in the global economy, urban growth in developing countries far exceeds the capacity of most cities to provide adequate services to their citizens [8]. Additionally, rural exodus and population explosions exacerbate urban and peri-urban sprawl, with consequences for socio-ecosystem functioning [9]. These consequences include deforestation, the scarcity of green and open spaces in cities, loss of species, air and water pollution, the development of heat islands, erosion, and flooding [10–12]. The impacts of urbanization pressure on ecosystems and biodiversity have profound and multidimensional effects on the well-being of urban and peri-urban residents, who still heavily depend on these services, especially in sub-Saharan Africa [13]. Beyond its contribution to the conservation of biogenetic resources, urban biodiversity is indeed recognized for providing multiple essential services for human well-being. These include regulating microclimates, providing shade and recreational spaces, food, firewood, medicinal products, and contributions to water management, flooding, and erosion control [14–16].

For these reasons, increased attention is being given to the conservation of urban biodiversity, with the development of various initiatives to promote urban forestry and/or horticulture. These initiatives involve diverse public and private stakeholders at various levels and scales (individual, collective, local, national, regional, and/or international). For example, at the international and regional levels, the New Urban Agenda (NUA) was developed and adopted during the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in 2016, along with the African Strategy for Urban Forestry adopted in 2018 [17].

In this context, several studies are being conducted to better understand the biodiversity of urban green spaces [18–22]. However, while many studies focus on public green spaces [23–27], few address those managed by private stakeholders (individual private gardens, businesses, etc.) [28,29]. Yet, like public green spaces, private green spaces play an important role in urban areas and can host significant biodiversity that is still largely unknown[30]. Moreover, in the context of African cities where public authority or the state often loses control over urban growth, leading to the scarcity/spoliation of public green spaces, the contribution of private stakeholders to the development of green spaces in cities deserves attention. Private initiatives in this area indeed represent a promising avenue for the conservation of urban biodiversity and the promotion of eco-citizen awareness [31–33].

As is the case in several African countries, the situation of limited knowledge about urban biodiversity in public and especially private spaces is observed in the Democratic Republic of the Congo (DRC). Studies on urban ecology there are indeed recent[34,35]. Among private stakeholders are Catholic religious' groups that have played and continue to play a crucial role in the socio-economic and even political development of the country [36–38]. These groups have acquired large concessions throughout the country, which they develop for various activities (schools, cultural centers, churches, etc.). For a better understanding of urban biodiversity in DRC cities, the biodiversity associated with

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the concessions managed by Catholic religious' groups deserves particular attention due to their significance. Additionally, whether it concerns sacred forests in traditional religions [39] or the garden where Jesus prayed for the last time in Christianity, a close link between religious practices and vegetation is noted [40]. Furthermore, some authors highlight the greening of Christianity due to the commitment of churches to biodiversity conservation and the development of gardens or green spaces.

Moreover, according to the Central Office of Ecclesiastical Statistics of the Vatican, 49.6% of the Congolese population are Catholics [41]. This shows the majority presence of Catholic religious' confessions compared to other confessions in the country, motivating the particular interest that this study has in these Catholic confessions. Additionally, beyond recognizing the disciplined application and maintenance of these confessions in managing their concessions, including green management, the floristic importance of the vegetation they host remains very little known and documented.

To contribute to a better understanding of the flora hosted by Catholic religious' groups (CRGs) in DRC cities, this study focused on evaluating the biodiversity structure of CRGs in three major cities (Bukavu, Kisangani and Lubumbashi). These three cities were targeted due to the significant influence of Catholic groups in their history as well as in their socio-economic development and the opportunities for data mobilization in these cities [36]. The study in the three targeted cities revolves around the following hypotheses: plant diversity, in quantitative terms (number of species, families and genera) and qualitative terms (types of species, families, genera and life forms), is expected to be more similar among CRGs within the same city than between cities and would depend on the area of the CRGs. Indeed, green management is often greatly dictated by the availability of locally cultivated or planted vegetation, which in turn is dictated by the prevailing climate type and the dominant vegetation formation [42,43]. Furthermore, based on the potential effect of external species contributions, it is specifically expected that floristic diversity would be higher in Bukavu (a border city) compared to Lubumbashi (located 30 km from the border) and compared to Kisangani (an inland city), which would present the lowest diversity. Additionally, it is expected that the CRGs in each city would be characterized by the dominance of a few species, genera and families that would be found in the majority of CRGs within the same city. Indeed, in garden management, the influence of nearby examples on the choice of species is demonstrated [44,45]. The CRGs in the cities mainly consist of exotic species, but the city of Kisangani would have the most native species due to its relative isolation. It is indeed recognized that the flora of cities is often predominantly exotic [46]. Regardless of the city, the CRGs contain species classified as endangered on the International Union for Conservation of Nature (IUCN) Red List, but a majority of species remain unassessed.

2. Materials and Methods

2.1. Study Area

The study is conducted in three cities of the Democratic Republic of the Congo, namely Bukavu in the South Kivu province, Kisangani in the Tshopo province, and Lubumbashi in the Haut-Katanga province (Figure 1).

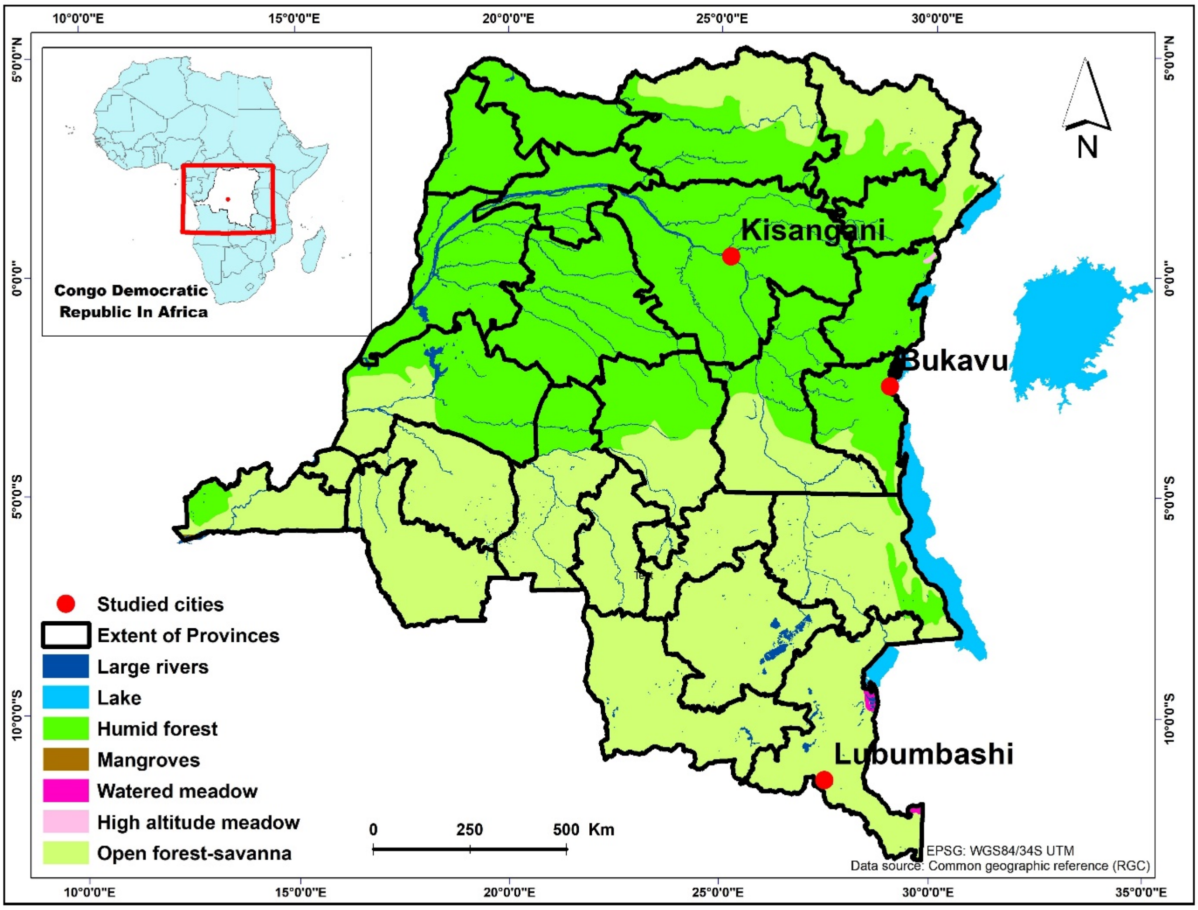

Figure 1. Location of the three cities studied in the Democratic Republic of Congo with the main types of vegetation: Bukavu in the province of Sout-Kivu, Kisangani in the province of Tshopo and Lubumbashi in the province of Haut-Katanga.

These three cities have specific characteristics presented in Table 1. They are all colonial cities with historical names. This status as colonial cities highlights the significant role that Catholic religious' groups have played and continue to play there [36].

Table 1. Characteristics of the three cities considered in the study [47–50].

City	Old Name	Location	Number of Municipalities	Area (km²)	Population Size in 2024 (Inhabitants)	Altitude	Climate Type	Annual Rainfall (mm/year)	Mean Annual Temperature (°C)	Dominant Soil	Characteristic Plant Formation
Bukavu	Costermansville	2°30'55'' south latitude and 28°50'42'' east longitude	3 municipalities: Kadutu, Ibanda and Bagira	60	1 012 053	Mean: 1.654 m Min: 1.422 m Maxi: 2.190 m	Tropical mountain climate (BWh) Dry season: mid-May to mid-September Rainy season: mid-September to mid-May	1500-2200	20,5	Andosols (Volcanic, clayey, permeable soil belonging to the red clay soil group)	Mountain forest
Kisangani	Stanleyville	0°31' north latitude, 25°11' east longitude	6 municipalities: Makiso, Tshopo, Mangobo, Kabondo Kisangani and Lubunga	1910	1 602 144	Mean: 415 m Min: 378 m Maxi: 503 m	Hot, humid equatorial climate (Af) Two rainy seasons: September to November and March to May Long dry season: January Short dry season: July to August	1500 - 2000	25	Ferrasols (Mostly sandy-clay soils)	Dense rainforest
Lubumbashi	Elisabethville	27°48'61''1 East longitude, 11° 61'55 3'' South latitude	7 municipalities: Lubumbashi, Kenya, Kampemba, Katuba, Kamalondo, Ruashi and Annexe	747	2 096 961	Mean: 1259 m Mini: 1167 m Maxi: 1411 m	CW6 climate Rainy season: November Dry season: May to September to March Transition months: April and October	1200	20	Ferrasols (Ferralitic soils mostly represented by young and red soils)	*miombo* forest

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2.2. Data Collection

Not having a complete list of religious group concessions in the studied cities, a reasoned sample based on accessibility, abundance and the presence of vegetation was surveyed during the periods of full vegetation from 2023 to 2024, with prior authorization from site managers and with the assistance of a group of master's level researchers. This involved 20 Concessions held by catholic Religious' Groups (CRGs) in the city of Bukavu, 40 in Kisangani and 10 in Lubumbashi (Table 2).

Table 2. List of CRGs surveyed by city and coding used.

CRG's code	CRG's name	Area (ha)
Lubumbashi		
CRGL1	Convent of Saint Paul Parish	0.11
CRGL2	Theological Institute - Chaplains of Work	0.32
CRGL3	Tabora University Cultural Center	0.17
CRGL4	Theologicum	1.25
CRGL5	Provincial House of the Franciscans	0.2
CRGL6	Tertiary Capuchin Sisters - Nazareth Homes	0.15
CRGL7	Scholasticate - Chaplains of Work	0.15
CRGL8	Laura House	8.32
CRGL9	Carmelite Sisters	0.58
CRGL10	Mercedarian Missionaries	0.19
Bukavu		
CRGB1	Bukavu Amani Center	0.51
CRGB2	Kasongo Procuracy	6.59
CRGB3	The Corniche	0.24
CRGB4	Xaverian Sisters	5.07
CRGB5	Missionaries of Africa	0.41
CRGB6	Cirezi High School	0.52
CRGB7	Cathedral of Our Lady of Bukavu	1.05
CRGB8	Solidarity	2.89
CRGB9	Saint Joseph Sisters	1.09
CRGB10	Father Vavassori Health Center	3.85
CRGB11	Saint John the Baptist Parish – Cahi	2.37
CRGB12	Antonella School	0.97
CRGB13	Holy Family Parish of Bagira	0.06
CRGB14	Nyakavogo High School	5.13
CRGB15	Nyakavogo Primary School	2.15
CRGB16	Catholic University of Bukavu Bugaboo	1.29
CRGB17	Saint Francis Xavier Parish - Kadutu	0.65
CRGB18	Fundi Maendeleo Technical Institute	14.38
CRGB19	Wima High School	19.71
CRGB20	General Economat	5.64
Kisangani		
CRGK1	Kisangani Little Seminary of Mandombe	3
CRGK2	Saint Peter Parish	3
CRGK3	Saint Albert Chapel	2
CRGK4	Saint Martha Parish	8
CRGK5	Cathedral of Our Lady of the Most Holy Rosary	8
CRGK6	Father Dehonus Scholasticate	8

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CRGK7	Simama Center	3
CRGK8	Servant Sisters of Jesus	10
CRGK9	Sisters of the Holy Family Mediatrix	1
CRGK10	Augustinian Sisters	1
CRGK11	Pastoral House of the Sacred Heart	10
CRGK12	Convent of the Priests of Mont Fortaint	3
CRGK13	Bel Vedere	25
CRGK14	Saint Gabriel Parish	4
CRGK15	Convent of the Priests of the Sacred Heart	2
CRGK16	Sisters of Jesus Educator Station Kis-Bondo	2
CRGK17	Canonical Sisters	3
CRGK18	Sisters Novitiate Holy Family	3
CRGK19	Saint Camille Parish	0.4
CRGK20	Josephites of Kinzambi	0.49
CRGK21	Sisters Holy Family Artisan	0.15
CRGK22	Marist Brothers	2
CRGK23	Formation House Scholasticate	2
CRGK24	Saint Augustine Major Seminary	1
CRGK25	Saint Lawrence Parish	4
CRGK26	Deo Soli/Scholasticate	0.25
CRGK27	Daughters of Wisdom	0.08
CRGK28	Sisters Immaculate Conception	7
CRGK29	Sisters Saint Joseph House	0.32
CRGK30	Saint John Parish	2.5
CRGK31	Blessed Isidore Bakanja Parish	0.49
CRGK32	Blessed Anuarité Parish	2
CRGK33	Deo Soli/Scholasticate 7th Plateau	0.25
CRGK34	Comboni House	0.49
CRGK35	Technical High School Mapendano	7
CRGK36	The Moinnaux	4
CRGK37	Mary Queen of Peace	49
CRGK38	Christ the King Parish	4
CRGK39	Saint Ignatius Parish	3
CRGK40	Saint Joseph Artisan Parish	20

The collected data consisted first of determining the extent of the concession, either in the field or via Google Earth, and second, systematically recording all plant species present by conducting a full-turn of each CRG. This process is justified by the fact that the vegetation of CRGs does not often occupy large continuous areas that would allow for the establishment of inventory plots [51,52].

The names of the inventoried species were subsequently verified while determining their family and origin status (exotic or native) in the available databases, notably the "African Plants Database," "International Plant Names Index (IPNI)," and "The Plant List" websites. Similarly, the life forms of the identified species were established according to Raunkiaer's definition [53], which takes into account the positioning of survival organs. Only the main categories were used, which provide some information on the stratification of vegetation and its persistence during unfavourable periods (such as the dry season): therophytes (Th), hemicryptophytes (Hem), geophytes (Ge), chamaephytes (Ch), epiphytes (Epi), and phanerophytes (Ph). Furthermore, the species conservation status was determined using the International Union for Conservation of Nature (IUCN) Red List database [54]. The observed statuses are extinct (EX), extinct in the wild (EW), critically endangered (CR), endangered (EN), vulnerable (VU), near threatened (NT), least concern (LC), data deficient (DD), and not applicable (NA).

2.3. Data Analysis

The collected data allowed for a quantitative analysis of the extent and plant composition, as well as the biological spectrum or distribution of life forms of the species, through the determination of average and total values of species richness, diversity, or the number of families and genera at the scale of the CRGs and the studied cities. Due to the non-normality of the data, the CRGs of the cities were compared through non-parametric analyses based on Dunn's test for mean comparison, preceded by the Kruskal-Wallis test in Rstudio [55]. The same analysis was also applied to the area of the CRGs. The relationship between the latter and the aforementioned plant composition parameters was explored through Pearson correlation tests, also in Rstudio. Furthermore, the variations in the distribution of life forms of plant species in the CRGs between the studied cities were examined using Fisher's exact test, which is advantageous for small samples [56]. The dominant families and genera in the different cities were determined by relative dominance, which consists of the ratio between the number of identified species of the corresponding taxon and the total species richness of the city.

The analysis of similarity between the CRGs of the same city (intra-city similarity) based on presence-absence data of the identified species, families and genera was conducted in Rstudio through Ascending Hierarchical Classification on Multiple Correspondence Analysis using the Factoshiny package [57]. This same package also allowed for Multiple Correspondence Analysis on the presence-absence data of species, families and genera to analyse the similarity between the three cities (inter-city similarity). Additionally, the relative occurrence frequencies of each taxonomic level in the CRGs were determined for each city to better highlight similarities and differences.

Based on data on the conservation status and origins of plant species from all the CRGs of each studied city, the absolute numbers of each category were determined. Subsequently, Fisher's exact tests were performed to verify the existence of a link between the distribution of species status and the city.

3. Results

***3.1.** Quantification of the Plant Composition and Biological Spectrum of Concessions Held by Catholic Religious' Groups in the Studied Cities and the Effect of Their Areas*

A total of 220 plant species corresponding to 76 families and 185 genera (Appendix 1) was identified across the CRGs of the three studied cities. The results of the mean comparison analysis (Table 3) show that the CRGs of Bukavu and Kisangani are not statistically different in terms of average species richness, average family diversity, and average genus diversity. In contrast, the CRGs of the city of Lubumbashi stand out with statistically higher values, 2 to 3 times more, for the same parameters compared to the other two cities.

Table 3. Results of Dunn's tests for mean comparison following the Kruskal-Wallis test among the three studied cities (Bukavu, Kisangani, and Lubumbashi) for four characteristic parameters of the CRGs. n represents the total sample of CRGs surveyed by city. For the same parameter, values followed by the same letter (a or b) are considered not statistically different (p-value < 0.05). SD = standard deviation.

Cities	Specific Richness			Number of Families			Number of Genera			Area (ha)		
	Mean	SD	Total	Mean	SD	Total	Mean	SD	Total	Mean	SD	Total
Bukavu (n = 20)	9.2^a	4.7	24	6.9^a	3.0	15	8.7^a	4.5	22	3.7^a	5.0	74.6
Kisangani (n = 40)	12.1^a	8.3	72	9.2^a	5.1	36	11.5^a	7.3	56	5.2^a	8.7	209.4
Lubumbashi (n =10)	24.1^b	10.8	152	17.9^b	7.5	60	23.7^b	10.6	137	1.1^b	2.5	11.4

Consequently, the city of Lubumbashi presents the highest total species richness (152 species compared to 67 in Kisangani and 24 in Bukavu), as well as the highest family diversity (60 families compared to 36 in Kisangani and 15 in Bukavu) and the highest genus diversity (137 genera compared to 56 in Kisangani and 22 in Bukavu). Furthermore, within the same city, the high standard deviation values, regardless of the city, suggest a low intra-city homogeneity among the CRGs for the concerned parameters.

Moreover, the mean comparison analysis on the area of the CRGs shows that the area of the CRGs in Lubumbashi (1.1 ha) is on average smaller than those in Bukavu (3.7 ha) and Kisangani (5.2 ha). However, the latter two are not statistically different. Beyond this, the results of the correlation analyses reveal that there is no significant relationship between CRG area and their diversity in species (t = -0.63189, df = 68, p-value = 0.5296), families (t = -0.72088, df = 68, p-value = 0.4735) and genera (t = -0.65989, df = 68, p-value = 0.5116).

Regarding the biological spectrum of the CRGs, it was revealed by Fisher's exact test that it depends on the city considered. Although in each of the three cities, the biological spectrum is dominated by phanerophytes, that of Lubumbashi is the widest with 5 life forms present compared to 2 in Bukavu and 1 in Kisangani (Figure 2).

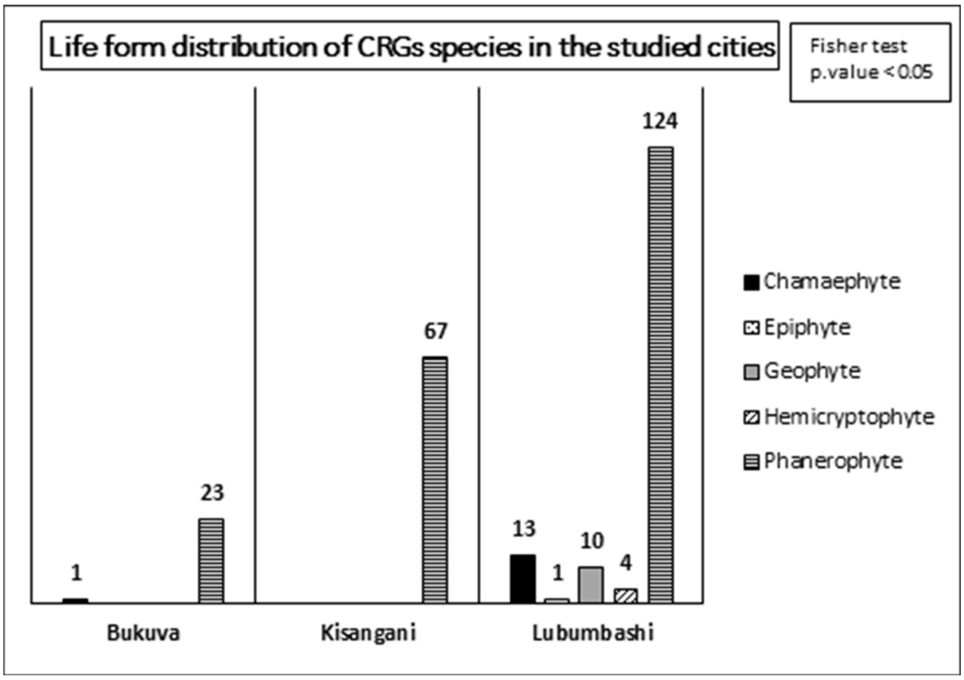

Figure 2. Biological spectrum or distribution of life form numbers of plant species in all CRGs in each of the three cities studied. Values represent absolute numbers of species identified in all CRGs per city. The result of the Fisher test shows that there is a relationship between the biological spectrum and the city.

Considering the top three values of the dominance index of the families and genera comprising the species of the CRGs in each of the cities (Table 4), it appears that the dominant families and genera are relatively different from one city to another. In Bukavu, the Bigoniaceae, Fabaceae, and Rutaceae are the families with the highest relative dominance (RD) (12.5% each), and the genus Citrus has the highest RD (12.5%). In Kisangani, the taxa with the highest RDs are the Fabaceae family (15.3%) and the genera Acacia and Citrus (5.6%). In contrast, in Lubumbashi, the taxa with the highest RDs are the Araceae family (8.6%) and the genera Cyperus and Euphorbia (2%).

Table 4. Families and genera of the species making up the CRGs of the cities studied with the three highest relative dominance values (RD). RD here is the ratio of the number of species of the same family or genus to the total species richness (Rs). *The mention "all others" means that the rest of the complete list of the corresponding taxon has the same RD value in the corresponding city.

Cities	Taxa	Parameters
	Family	**Relative Dominance**
Bukavu (Rs = 24)	Bignoniaceae	12.5%
	Fabaceae	12.5%
	Rutaceae	12.5%
	Anacardiaceae	8.3%
	Myrtaceae	8.3%
	Rosaceae	8.3%
	All others*	4.2%
Kisangani (Rs = 67)	Fabaceae	15.3%
	Moraceae	9.7%
	Anacardiaceae	5.6%
	Myrtaceae	5.6%
	Rutaceae	5.6%
Lubumbashi (Rs = 152)	Araceae	8.6%
	Arecaceae	7.2%
	Asparagaceae	6.6%
	Genus	Dominance relative
Bukavu (Rs = 24)	Citrus	12.5%
	All others*	4.2%
Kisangani (Rs = 67)	Acacia	5.6%
	Citrus	5.6%
	Albizia	4.2%
	Ficus	4.2%
	Terminalia	4.2%
Lubumbashi (Rs = 152)	Cyperus	2.0%
	Euphorbia	2.0%
	Tradescantia	2.0%
	All others*	1.3%

3.2. Comparative Plant Composition Between Concessions Held by Catholic Religious' Groups and Studied Cities

The results of intra-city similarity analyses in terms of plant composition through hierarchical classifications (Figures 3, 4, and 5) reveal that, regardless of the taxonomic level considered (species, family or genus), only the CRGs of Kisangani are predominantly similar (40 CRGs classified into three groups, one of which contains 38 CRGs regardless of the taxon). Those of Lubumbashi are less similar (10 CRGs classified into 5 groups regardless of the taxon), and those of Bukavu are even less so (20 CRGs classified into 10 groups for species composition, and into 7 groups for family and genus composition).

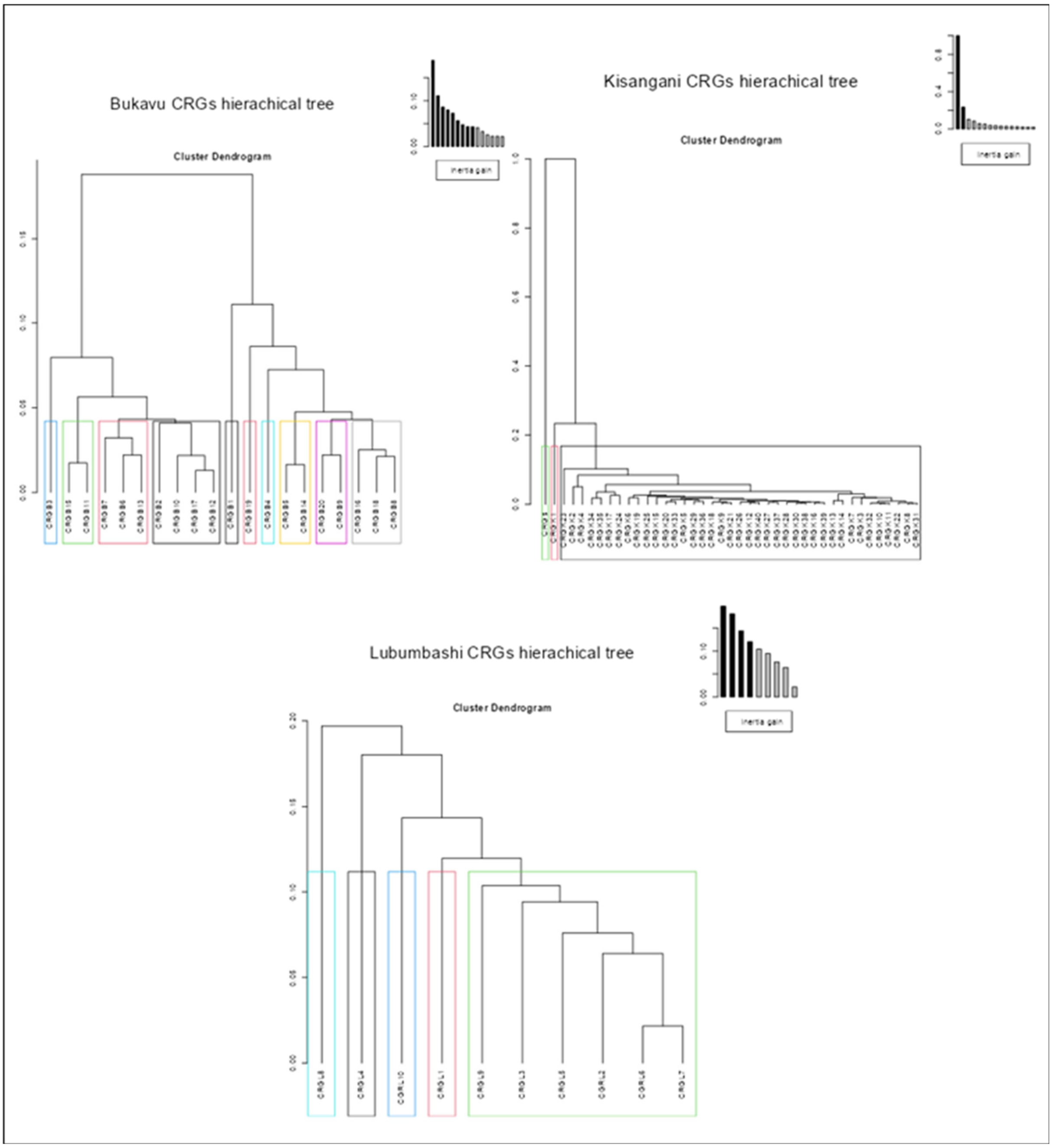

Figure 3. Results of a hierarchical ascending classification based on multiple correspondence analysis of the CRGs of each of the three cities studied on the basis of presence-absence data for the species identified.

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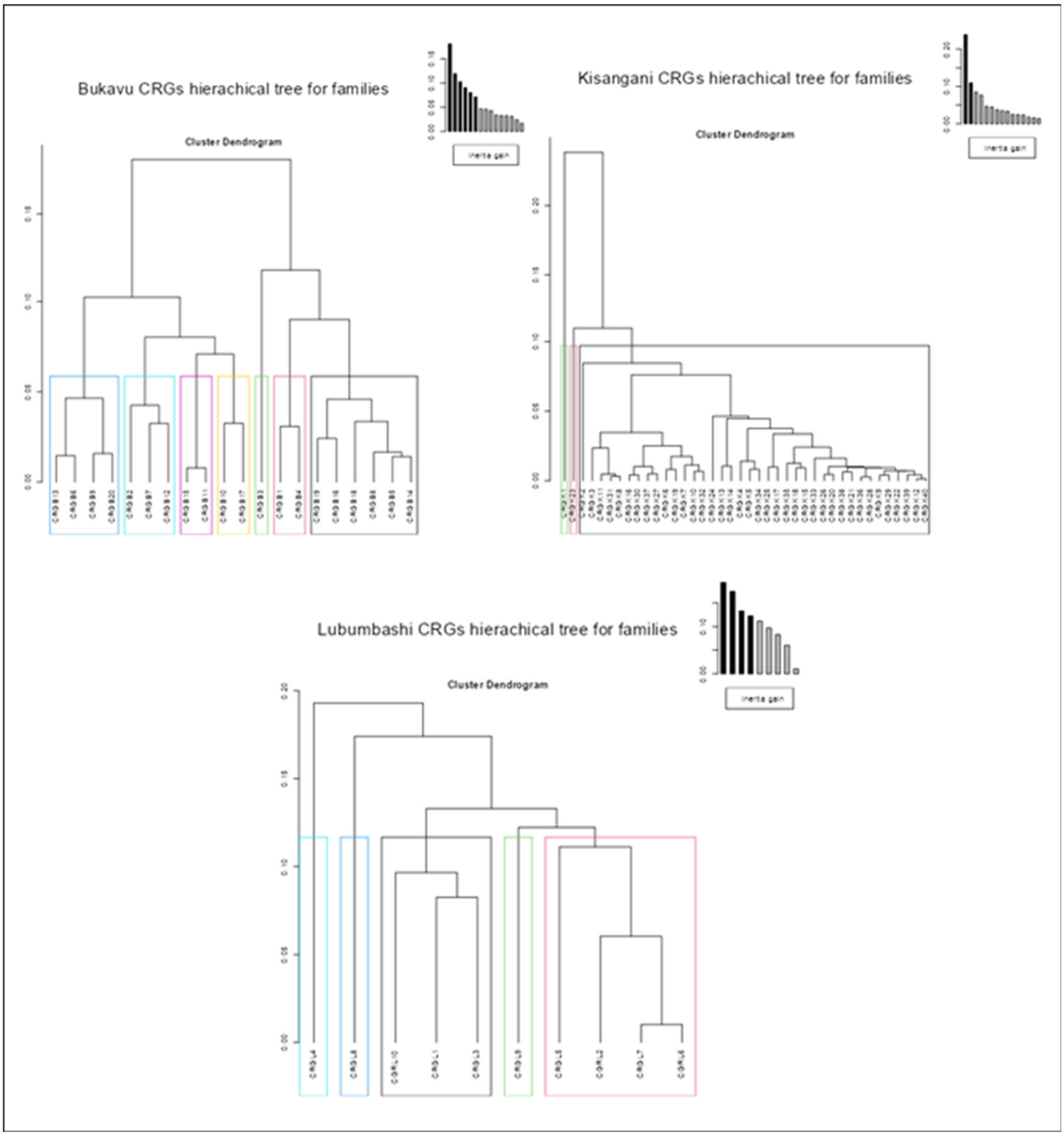

Figure 4. Results of a hierarchical ascending classification based on multiple correspondence analysis of the CRGs of each of the three cities studied, based on the presence-absence data of the families identified.

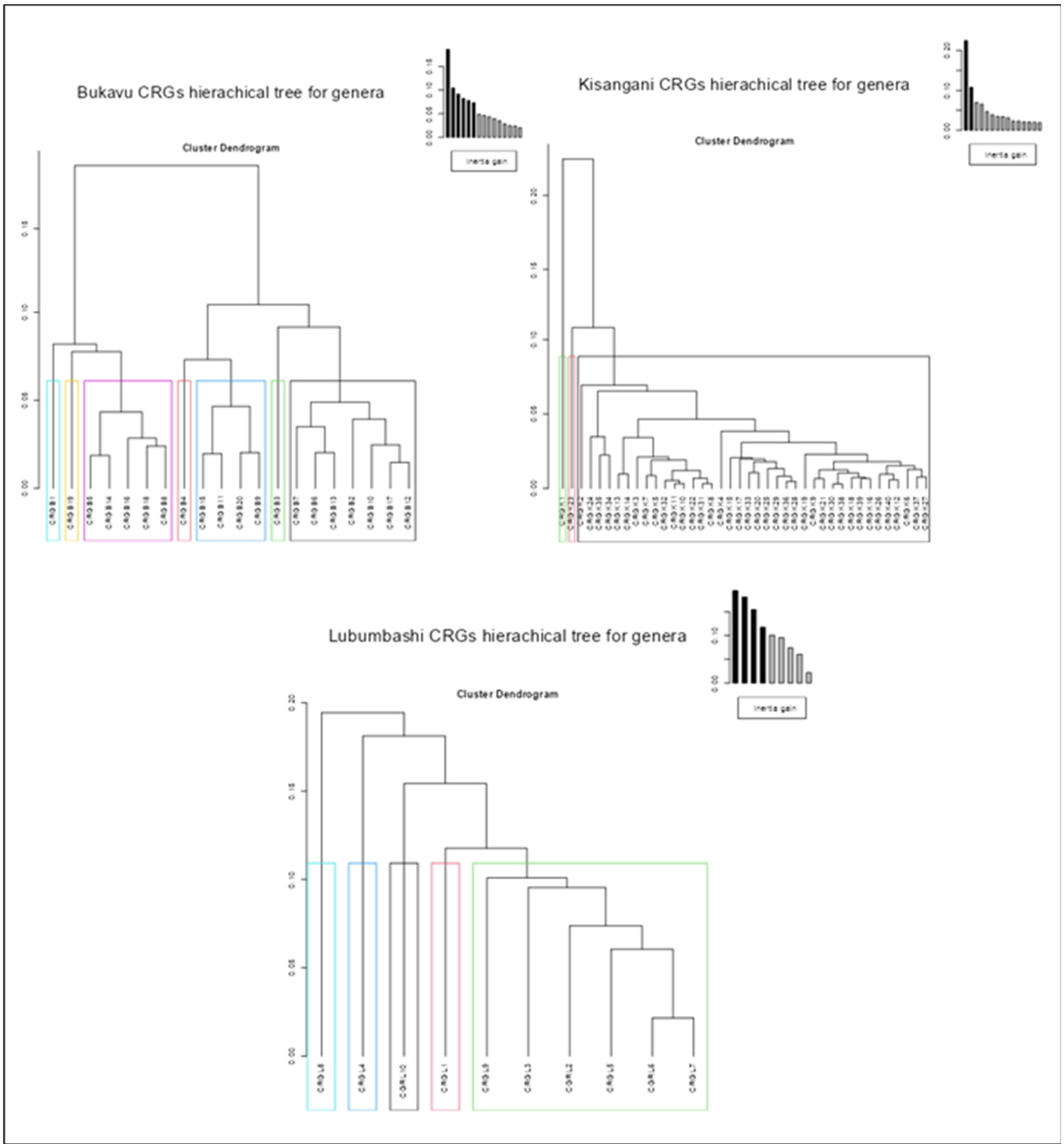

Figure 5. Results of ascending hierarchical classification on multiple correspondence analysis of CRGs in each of the three cities studied, based on presence-absence data for the genera identified.

Furthermore, the results of multiple correspondence analysis (Figure 6) indicate that, regardless of the taxonomic level considered, the inter-city similarity regarding the plant composition of the CRGs is low. More specifically, the cities of Bukavu and Kisangani, although relatively dissimilar, share more taxa in common with each other compared to Lubumbashi, which is still very dissimilar to them.

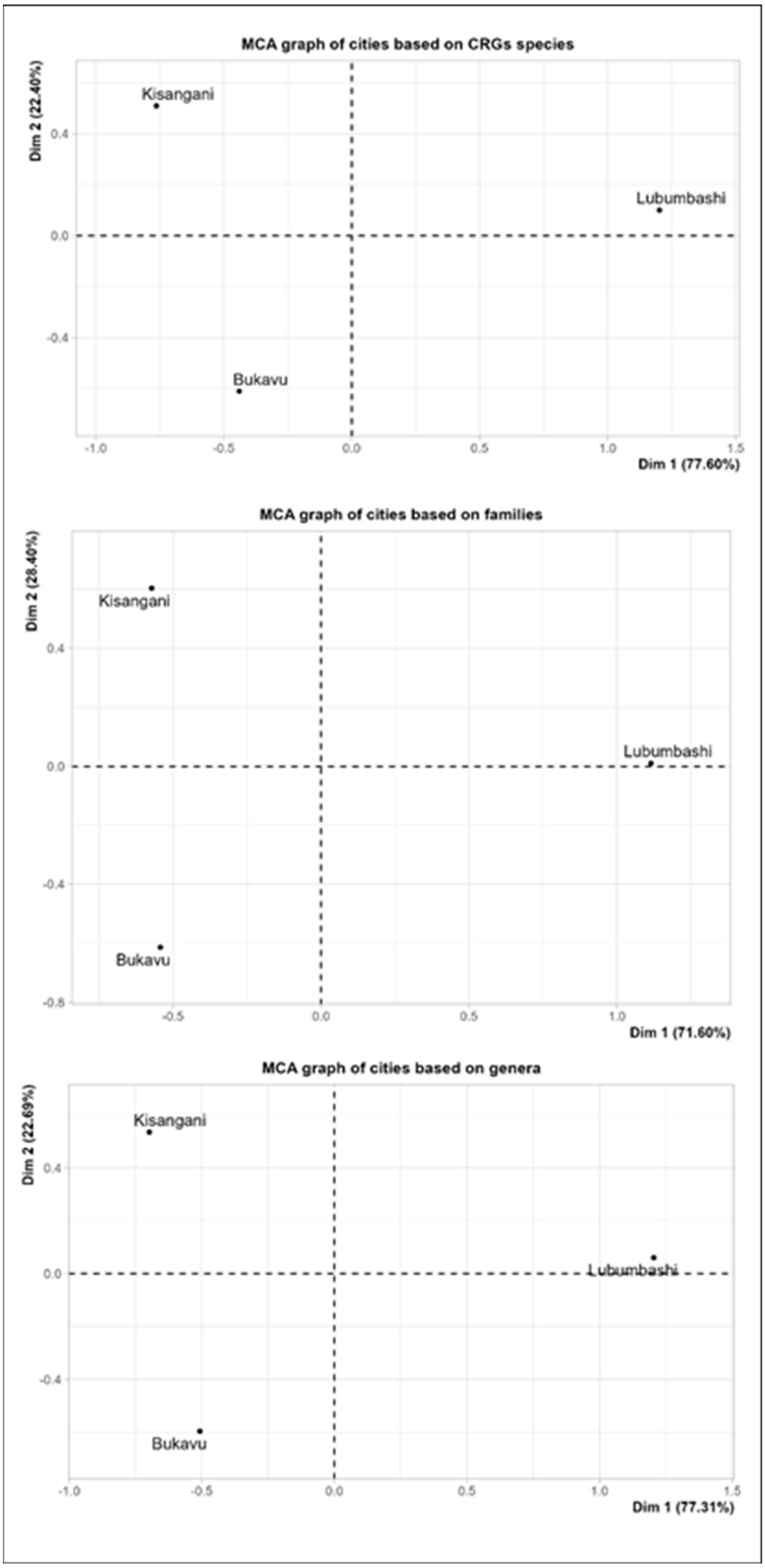

Figure 6. Results of multiple correspondence analysis between the three cities studied on the basis of the composition of their CRGs in identified species, families and genera.

The examination of the species, families and genera with the three highest relative frequencies per city (Table 5) clearly shows that, regardless of the taxon, the situation varies from one city to another

Table 5. Taxa making up the CRGs of the cities surveyed with the three highest relative frequency values (Fr). Fr is the ratio of the number of CGRs in which the taxon is identified to the total number (n) of CRGs surveyed in the city.

Cities	Taxa	Parameters
	Species	**Relative Frequence**
Bukavu (n =20)	*Pinus patula* Schltdl. & Cham., 1831	75.0%
	Eucalyptus globulus Labill., 1800	70.0%
	Citrus limon (L.) Osbeck, 1765	65.0%
	Psidium guajava L., 1753	65.0%
	Mangifera indica L., 1753	60.0%
	Markhamia lutea (Benth.) K. Schum.	60.0%
	Persea americana Mill., 1768	60.0%
Kisangani (n =40)	*Persea americana* Mill., 1768	82.5%
	Elaeis guineensis Jacq., 1763	75.0%
	Mangifera indica L., 1753	67.5%
Lubumbashi (n=10)	*Cordyline fruticosa* (L.) A.Chev., 1919	80.0%
	Musa acuminata Colla, 1820	60.0%
	Acalypha wilkesiana Müll.Arg., 1866	50.0%
	Carica papaya L., 1753	50.0%
	Citrus limon (L.) Osbeck, 1765	50.0%
	Codiaeum variegatum (L.) Rumph. ex A.Juss., 1824	50.0%
	Families	Relative Frequence
Bukavu (n=20)	*Myrtaceae*	90.0%
	Anacardiaceae	75.0%
	Bignoniaceae	75.0%
	Pinaceae	75.0%
	Rutaceae	65.0%
Kisangani (n =40)	*Arecaceae*	85.0%
	Lauraceae	82.5%
	Fabaceae	77.5%
Lubumbashi	*Asparagaceae*	100.0%
	Arecaceae	90.0%
	Euphorbiaceae	90.0%
	Lamiaceae	80.0%
	Genera	Relative Frequence
Bukavu (n=20)	*Pinus*	68.2%
	Eucalyptus	63.6%
	Citrus	59.1%
	Psidium	59.1%

Kisangani (n =40)	*Persea*	82.5%
	Elaeis	75.0%
	Mangirefa	67.5%
Lubumbashi (n=10)	*Cordyline*	80.0%
	Citrus	60.0%
	Musa	60.0%
	Acalypha	50.0%
	Carica	50,0%
	Codiaeum	50,0%
	Dracaena	50,0%
	Tradescantia	50,0%

3.3. Distribution of the Vegetation of the CRGs in the Studied Cities According to Their Origin and Conservation Status

The results of the independence tests applied to the distribution of origin and conservation status of species across the cities reveal that the distribution of status depends on the cities (Figures 7 and 8). Indeed, regarding the origin status of the species, although all cities are characterized by a majority of exotic species, Bukavu stands out due to the absence of native species, while Kisangani and Lubumbashi present 4 and 1 native species, respectively.

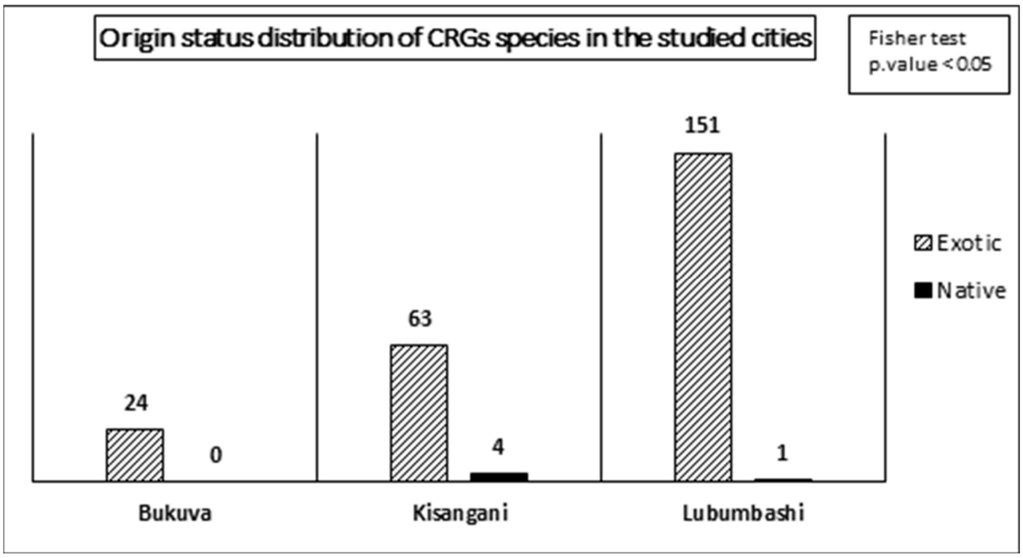

Figure 7. Distribution of the number of plant species in the CRGs of each of the three cities studied. The values represent the absolute number of species identified in the CRGs by city. The result of the Fisher test reveals that the distribution of origin status depends on the city.

In relation to conservation status, the status LC, NA, and DD are in the majority regardless of the city. Bukavu is notable for having only one species classified as CR (*Leucaena leucocephala* (Lam.) De Wit, 1961). On the other hand, Kisangani has the highest number of species in the high-threat categories, including 1 species classified as CR (*Leucaena leucocephala* (Lam.) De Wit, 1961); 4 species classified as EN (*Autranella congolensis* (De Wild.) A. Chev.; *Coffea arabica* L., 1753; *Millettia laurentii* De Wild; and *Tectona grandis* L.f., 1782) and 2 species classified as NT (*Artocarpus camansi* Blanco, 1837 and Milicia excelsa (Welw.) C.C.Berg, 1982). The city of Lubumbashi, for its part, presents 2 species classified as CR (*Hyophorbe lagenicaulis* (L.H.Bailey) H.E.Moore, 1976 and *Leucaena leucocephala* (Lam.) De Wit, 1961), 2

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species classified as EN (*Coffea arabica* L., 1753 and *Kalanchoe daigremontiana* Raym.-Hamet & H.Perrier, 1914), and 1 species classified as NT (*Dypsis lutescens* (H.Wendl.) Beentje & J.Dransf., 1995).

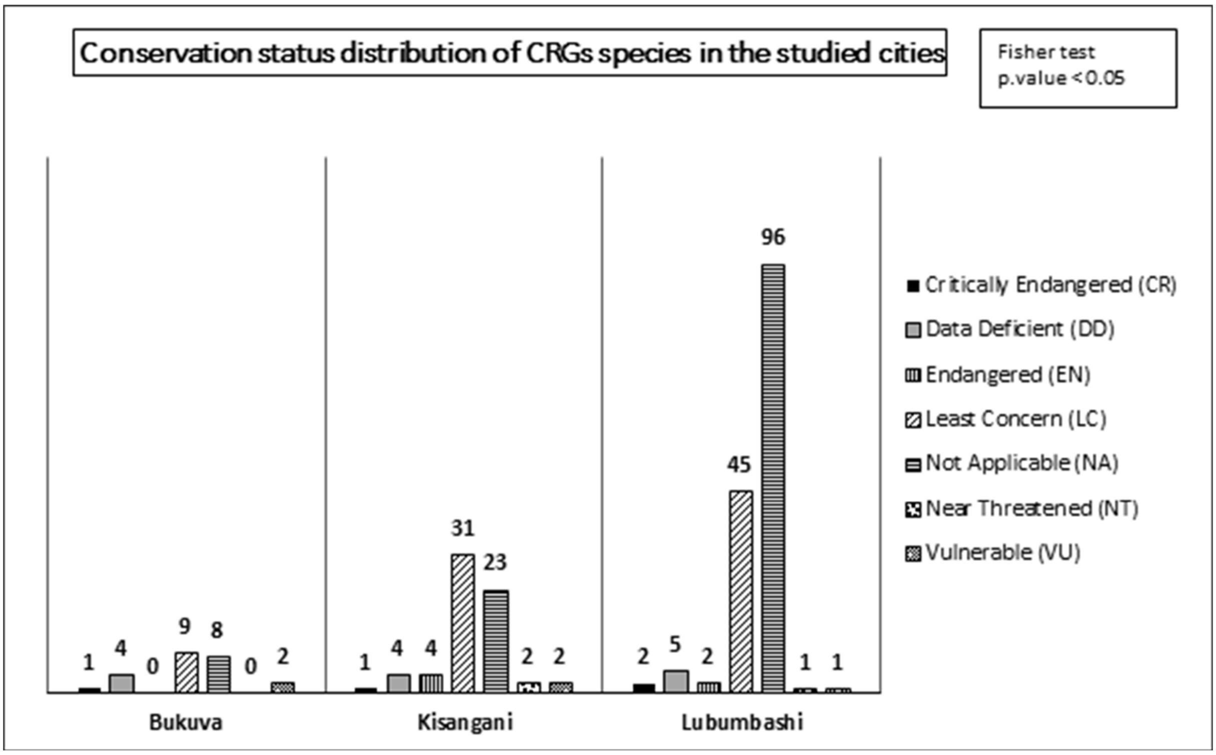

Figure 8. Distribution of plant species conservation status for the CRGs of each of the three cities studied, according to the IUCN Red List. The values represent the absolute number of species identified in all CRGs per city. The result of the Fisher test reveals that the distribution of conservation status depends on the city.

4. Discussion

4.1. Discussion of the Methodological Approach

The study was based on a systematic floristic inventory of the vegetation present in the concessions held by catholic Religious' Groups (CRGs). This approach was necessitated by the nature of the areas to be inventoried, which are of the garden type, i.e. they consist of discontinuous areas within the CRGs containing both low and high vegetation. This full-turn inventory approach is not new; it is most often used to study gardens. [58–60].

Moreover, the samples of CRGs surveyed by city are not equal, which may call into question the comparisons made. The size of the samples in each city was dictated by the accessibility and abundance of CRGs. However, due to the lack of a complete list of CRGs in the cities, it remains difficult to assert the full representativeness of the sample. The reliability of the comparisons was ensured by preferring non-parametric analyses suitable for all sample sizes. Additionally, it was found that plant diversity does not depend on the surveyed area. Furthermore, contrary to expectations, the city of Lubumbashi, which has the smallest sample, is where the highest number of species was recorded (Table 3).

4.2. The Near Heterogeneity Intra and Inter City in the Plant Composition of CRGs

The various results obtained allow us to refute the hypothesis of similarity among CRGs within the same city. Indeed, apart from the city of Kisangani, which showed a relatively strong similarity in the composition of CRGs in terms of species types, families, and genera, there was a low similarity for all other characteristics of the plant composition of CRGs within the same city and across all three studied cities. The openness of the cities of Bukavu and Lubumbashi to the country and the world, due to their easy accessibility and proximity to borders, allows for the introduction of a diversity of species and variation in green spaces influenced by contact with a variety of gardens. Several studies on the determinants of gardening practices indeed highlight the significant role of contact with nature and lived experiences [44,61,62].

Regarding the hypothesis of inter-city dissimilarity, our results confirm it. Indeed, even though in quantitative terms (average number of species, families and genera and average area of CRGs), the cities of Bukavu and Kisangani are similar, they are less so in all other aspects of plant composition considered, and even less so with the city of Lubumbashi. While some studies report similarities between private gardens in different regions of the same country, as is the case in Bangladesh [63], this is not necessarily true in the Democratic Republic of Congo (DRC). The marked climatic and environmental differences between regions in the DRC may be an important explanatory factor [64]. In this specific case, the particularity of the city of Lubumbashi compared to the other two cities reinforces the idea of the significant effect of climatic differences. The choice of species in CRGs would therefore be more influenced by climatic conditions favourable to the development of a given flora than by religious preferences.

The confirmation of intra and inter-city dissimilarity also allows us to deduce that the common Catholic belief among the compared entities does not evidently have a homogenizing effect on the green arrangements of CRGs, at least in terms of plant composition. These results underline facts noted by other authors, notably the complexity of interactions between human and nature, which vary according to individuals, regions, traditions and cultures. [65–68].

The observed independence between plant diversity and the area of CRGs, regardless of the city, is not the systematic outcome expected. It is often anticipated that species richness increases with area [69,70]. As is often the case in garden design, it's possible to grow several species in a very small space, especially when it comes to herbaceous plants. This also explains how cities that cover only a small proportion of the Earth's surface can host rich biodiversity [61]. Consequently, even the smallest identifiable green space is important and must be taken into consideration in the context of biodiversity conservation, particularly in urban environments.

Furthermore, the marked dominance of phanerophytes in the plant composition of CRGs across all cities corroborates its expected dominance under tropical climates [71]. This dominance is also linked to the general conditions favourable to forest vegetation in the landscapes where the studied cities are located [72]. The same applies to the dominant taxa (species, families, and genera) in each city. This dominance of phanerophytes also indicates a preference in CRGs for tall and perennial vegetation, which is less demanding in terms of maintenance effort. This contrasts with the results of a recent study on the floristic composition of private gardens in Lubumbashi, which noted the dominance of herbaceous, thus low vegetation [31].

4.3. The Importance of Phyto-Biodiversity Hosted by CRGs

The total CRGs in the studied cities host a total of 220 species. This species richness is close to that reported for private gardens in Lubumbashi (232 species)[31] and the city of Amman (223 species), the capital of Jordan in the Middle East [33]. However, it is high, compared to the species richness reported (103 species) for private gardens in the cities of Ouidah and Cotonou in Benin [52] and low, compared to that reported for the city of Tlokwe in South Africa (835 species) [32]. The species richness of biodiversity in cities is therefore variable and strongly depends on local gardening dynamics.

The analysis of the origin status of the species reveals that the majority of species are exotic, regardless of the city. This is a phenomenon observed in several other cities [32,33,52]. The city of Kisangani has the most native species, with 4 species. This confirms our hypothesis in this regard and aligns with the conclusions of studies on urban biodiversity in tropical countries [46]. Although exotic species include several acclimatized species, it clearly highlights the challenge of promoting native species. Indeed, the introduction or promotion of exotic species carries potential risks of invasion and thus threatens local phytogenetic diversity [32].

Moreover, it has been confirmed that CRGs contain species classified as threatened on the IUCN Red List. Indeed, this is one of the contributions to biodiversity conservation in private gardens highlighted by several authors [65,73,74]. The presence of a large majority of non-assessed species in GCRs further underlines their importance as biodiversity reservoirs.

4.4. Implications for Urban Biodiversity Management and Research Perspectives

This study focused on a specific private actor, namely Catholic groups, and the rich biodiversity revealed, confirms the importance of considering the role of private actors in urban biodiversity conservation. The study reinforces the idea of the city as a reservoir of biodiversity [16,69]. Unlike rural landscapes, urban biodiversity is scattered over disparate areas and is maintained by a variety of actors. It is therefore essential to keep in mind this diversity of actors and spaces when inventorying urban biodiversity.

The dominance of exotic species calls for raising awareness among stakeholders about the preference for native species. The positive effects of promoting native species in cities are indeed well documented [16]. Developing catalogs of native species and documenting their potential for green spaces would be a beneficial incentive approach to reverse current trends.

Furthermore, the comparisons made in this study focused solely on the affiliation of sites to a Catholic religious group due to the limitation of data collected from this single perspective. It could be considered, following a more extensive and resource-intensive data collection, to explore comparative perspectives related to the nature of activities held in Concessions held by catholic Religious' Groups (CRGs) and other types of religious groups present in the country, such as Methodists, Protestants, and Kimbanguists. A better appreciation of the contribution of CRGs to biodiversity conservation could be envisaged through subsequent comparative analyses with public green spaces or other private actors.

5. Conclusions

This study aimed to assess the plant biodiversity maintained in the CRGs of three cities (Bukavu, Kisangani and Lubumbashi) through systematic inventories. The study confirms the hypothesis of low inter-city similarity in terms of CRGs flora and, to a lesser extent, intra-city similarity, with only the CRGs of Kisangani being the most similar to each other. It also appears that there is no relationship between the CGRs area and their specific richness and that exotic species are predominant.

A total of 220 plant species corresponding to 76 families and 185 genera were identified across all cities. Each city is characterized by the plant composition of its CRGs, and outside of Kisangani, where intra-city similarity of CRGs is stronger, the other two cities show greater intra-city dissimilarity among CRGs. The plant diversity and the presence of endangered species in CRGs highlight their importance in biodiversity conservation. However, the predominance of exotic species calls for the promotion of native species.

This study reinforces and illustrates the importance of private actors in urban biodiversity conservation and opens a pathway for investigation for various identifiable private actors.

Author Contributions: Conceptualization, L.M.P. and K.R.S.; methodology, L.M.P. and K.R.S.; software, L.M.P.; validation, K.R.S., Y.U.S. and J.B.; formal analysis, L.M.P. and K.R.S.; investigation, L.M.P., ABN, JMT, Y.U.S; J.P.P.M.T.H. resources, SMM, DP, JMT, Y.U.S. and J.P.P.M.T.H.; data curation, L.M.P.; D.P.; writing—original draft preparation, L.M.P., S.M.M. JBB, and K.R.S.; writing—review and editing, L.M.P., K.R.S., Y.U.S., J.B. and K.R.S.; visualization, L.M.P. and K.R.S.; supervision, K.R.S., JM, JFB, Y.U.S. and J.B.; project administration, J.B.; funding acquisition, L.M.P. and J.B. All authors have read and agreed to the published version of the manuscript.

 doi:10.20944/preprints202504.1717.v1

Funding This research was funded by Académie de Recherche pour l'Enseignement Supérieur (ARES–CCD, Belgium), B-MOB scholarship program of Liège University.

Institutional Review Board Statement: Ethical review and approval were waived for this study due to this reason: the study does not affect human health or well-being of human.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available upon request from the corresponding author.

Acknowledgments: The authors would like to thank all the field interviewers who contributed to the data collection.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Appendix A.1

Table A1. List of species inventoried in the concessions of Catholic religious groups in three cities (Bukavu, Kisangani, Lubumbashi) of the Democratic Republic of Congo (DRC). - = absent from town; + = present in town, Ex = Exotic, Na = Native.

N°	Scientific name	Family	Conservation status	Life form	Origin status	Bukavu	Kisangani	Lubumbashi
1	Acacia auriculiformis A.Cunn. ex Benth., 1842	Fabaceae	LC	Ph	Ex	-	+	-
2	Acacia nilotica (L.) Willd. ex Delile	Fabaceae	LC	Ph	Ex	-	-	-
3	Acalypha wilkesiana Müll.Arg., 1866	Euphorbiaceae	NA	Ph	Ex	-	-	+
4	Agave americana L.	Asparagaceae	LC	Ch	Ex	-	-	+
5	Agave attenuata Salm-Dyck, (1834	Asparagaceae	NA	Ch	Ex	-	-	+
6	Aglaonema commutatum Schott, 1856	Araceae	NA	Hem	Ex	-	-	+
7	Albizia chinensis (Osbeck) Merr., 1916	Fabaceae	NA	Ph	Ex	-	+	-
8	Albizia gummifera (J.F.Gmel.) C.A.Sm., 1930	Mimosaceae	LC	Ph	Ex	-	+	-
9	Albizia julibrissin Durazz., 1772	Fabaceae	NA	Ph	Ex	-	+	-
10	Alocasia macrorrhizos (L.) G.Don, 1839	Araceae	NA	Ge	Ex	-	-	+
11	Aloe arborescens Mill., 1768	Asphodelaceae	LC	Ge	Ex	-	-	+
12	Aloe vera (L.) Burm.f., 1768	Asphodelaceae	NA	Ge	Ex	-	-	+
13	Alternanthera brasiliana (L.) Kuntze, 1891	Amaranthaceae	NA	Ph	Ex	-	-	+
14	Amaranthus hybridus L., 1753	Amaranthaceae	NA	Ch	Ex	-	-	+
15	Annona muricata L., 1753	Annonaceae	LC	Ph	Ex	-	-	+
16	Annona senegalensis Pers., 1806	Annonaceae	LC	Ph	Ex	-	+	-
17	Anonidium mannii (Oliv.) Engler & Diels , 1901	Annonaceae	LC	Ph	Ex	-	+	-
18	Anthocleista schweinfurthii Gilg, 1893	Loganiaceae	LC	Ph	Ex	-	+	-
19	Antigonon leptopus Hook. & Arn., 1838	Polygonaceae	NA	Ch	Ex	-	-	+
20	Araucaria cunninghamii Aiton ex D. Don,1837	Araucariaceae	LC	Ph	Ex	-	-	+
21	Archontophoenix alexandrae H.Wendl. & Drude, 1875	Arecaceae	LC	Ph	Ex	-	-	+
22	Aristaloe aristata Adrian Hardy Haworth, 1825	Xanthorrhoeaceae	NA	Ge	Ex	-	-	+
23	Artocarpus altilis (Parkinson) Fosberg, 1941	Moraceae	NA	Ph	Ex	-	+	-
24	Artocarpus camansi Blanco, 1837	Moraceae	NT	Ph	Ex	-	+	-
25	Artocarpus heterophyllus Lam., 1789	Moraceae	NA	Ph	Ex	-	-	+

doi:10.20944/preprints202504.1717.v1

26	Aspidistra elatior Blume, 1834	Asparagaceae	NA	Ph	Ex	-	-	+
27	Asplenium nidus L., 1753	Aspleniaceae	NA	Hem	Ex	-	-	+
28	Autranella congolensis (De Wild.) A. Chev.	Sapotaceae	EN	Ph	Na	-	+	-
29	Averrhoa carambola L., 1753	Oxalidaceae	DD	Ph	Ex	-	+	-
30	Bambusa vulgaris Schrad. ex J.C.Wendl., 1810	Poaceae	NA	Ph	Ex	+	-	+
31	Bauhinia variegata Carl von Linné, également connu sous le nom de Carl Linnaeus, 1753	Fabaceae	LC	Ph	Ex	-	-	+
32	Begonia rex Jules Antoine Adolph Henri Putzeys, 1856	Begoniaceae	NA	Epi	Ex	-	-	+
33	Bellucia pentamera Naudin	Melastomataceae	LC	Ph	Ex	-	+	-
34	Borassus flabellifer L., 1977	Arecaceae	NA	Ph	Ex	-	-	+
35	Bougainvillea glabra Philibert Commerson, 1760	Nyctaginaceae	LC	Ph	Ex	-	-	+
36	Breynia disticha J.R.Forst. & G.Forst., 1775	Euphorbiaceae	NA	Ph	Ex	-	-	+
37	Caladium bicolor (Aiton) Vent., 1801	Araceae	NA	Ch	Ex	-	-	+
38	Callistemon citrinus (Curtis) Skeels, 1913	Myrtaceae	NA	Ph	Ex	-	-	+
39	Callistemon viminalis (Sol. ex Gaertn.) G.Don, 1830	Myrtaceae	NA	Ph	Ex	-	-	+
40	Cananga odorata Albert Schwenger, 1860	Annonaceae	LC	Ph	Ex	-	+	-
41	Canna indica L., 1753	Cannaceae	NA	Ph	Ex	-	-	+
42	Carica papaya L., 1753	Caricaceae	DD	Ph	Ex	+	+	+
43	Cascabela thevetia (Pers.) K. Schum,1895	Apocynaceae	LC	Ph	Ex	-	-	+
44	Casimiroa edulis La Llave & Lex, 1825	Rutaceae	LC	Ph	Ex	-	-	+
45	Cassia siamea (Lam.) H.S.Irwin & Barneby, 1982	Fabaceae	LC	Ph	Ex	-	+	-
46	Catharanthus roseus (L.) G.Don, 1837	Apocynaceae	NA	Ph	Ex	-	-	+
47	Celosia cristata L., 1753	Amaranthaceae	LC	Ph	Ex	-	-	+
48	Cestrum nocturnum L., 1753	Solanaceae	LC	Ph	Ex	-	-	+
49	Chamaedorea cataractarum Mart., 1849	Arecaceae	NA	Ph	Ex	-	-	+
50	Chamaerops humilis L., 1753	Arecaceae	LC	Ph	Ex	-	-	+
51	Chelidonium majus L., 1753	Papaveraceae	NA	Ph	Ex	-	-	+
52	Chlorophytum comosum Jacques, 1862	Asparagaceae	NA	Hem	Ex	-	-	+
53	Citrus aurantium L., 1753	Rutaceae	NA	Ph	Ex	-	-	+
54	Citrus limon (L.) Osbeck, 1765	Rutaceae	NA	Ph	Ex	+	+	+
55	Citrus maxima (Burm.) Merrill, 1917	Rutaceae	NA	Ph	Ex	+	+	-
56	Citrus reticulata Blanco, 1837	Rutaceae	NA	Ph	Ex	-	+	-
57	Citrus sinensis (L.) Osbeck, 1765	Rutaceae	NA	Ph	Ex	+	+	-

58	Clerodendrum thomsoniae Balf., 1862	Lamiaceae	NA	Ph	Ex	-	-	+
59	Clivia miniata William J. Burchell en 1815	Amaryllidace ae	NA	Ph	Ex	-	-	+
60	Cocos nucifera L., 1753	Arecaceae	NA	Ph	Ex	-	+	-
61	Codiaeum variegatum (L.) Rumph. ex A.Juss., 1824	Euphorbiacea e	LC	Ph	Ex	-	-	+
62	Coffea arabica L., 1753	Rubiaceae	EN	Ph	Ex	-	+	+
63	Cola acuminata (P.Beauv.) Schott & Endl., 1832	Malvaceae	LC	Ph	Ex	-	+	-
64	Coleus amboinicus Lour., 1790	Lamiaceae	NA	Ph	Ex	-	-	+
65	Coleus scutellarioides (L.) Benth., 1830	Lamiaceae	NA	Ph	Ex	-	-	+
66	Colocasia esculenta (L.) Schott, 1832	Araceae	LC	Ph	Ex	-	-	+
67	Cordyline fruticosa (L.) A.Chev., 1919	Asparagaceae	LC	Ph	Ex	-	-	+
68	Cornus drummondii C.A.Mey., 1845	Cornaceae	LC	Ph	Ex	-	-	+
69	Cupaniopsis anacardioides (A.Rich.) Radlk., 1879	Sapindaceae	LC	Ph	Ex	-	-	+
70	Cuphea hyssopifolia Kunth, 1823	Lythraceae	NA	Ph	Ex	-	-	+
71	Cupressus macrocarpa Hartw., 1847	Cyperaceae	NA	Ph	Ex	-	-	+
72	Cycas revoluta Carl Peter Thunberg, 1782	Cycadaceae	NA	Ph	Ex	-	-	+
73	Cyperus alternifolius Carl von Linné, 1767	Cyperaceae	NA	Ph	Ex	-	-	+
74	Cyperus esculentus L., 1753	Cyperaceae	NA	Ph	Ex	-	-	+
75	Cyperus papyrus Linné, 1753	Cyperaceae	NA	Ge	Ex	-	-	+
76	Dacryodes edulis [G.Don] H.J.Lam, 1832	Burseraceae	NA	Ph	Ex	-	+	-
77	Dianella ensifolia (L.) Redouté, 1802	Asphodelace ae	NA	Ph	Ex	-	-	+
78	Dieffenbachia seguine (Jacq.) Schott, 1829	Araceae	NA	Ph	Ex	-	-	+
79	Dillenia indica (L.), 1753	Dilleniaceae	LC	Ph	Ex	-	-	+
80	Dodonaea viscosa Jacq., 1760	Sapindaceae	LC	Ph	Ex	-	-	+
81	Dracaena fragrans (L.) Ker Gawl., 1808	Asparagaceae	LC	Ph	Ex	-	-	+
82	Dracaena reflexa Lam., 1786	Asparagaceae	NA	Ph	Ex	-	-	+
83	Duranta erecta L., 1753	Verbenaceae	LC	Ph	Ex	-	-	+
84	Dypsis lutescens (H.Wendl.) Beentje & J.Dransf., 1995	Arecaceae	NT	Ph	Ex	-	-	+
85	Elaeis guineensis Jacq., 1763	Arecaceae	LC	Ph	Ex	+	+	+
86	Entandrophragma candollei Harms, 1896	Meliaceae	VU	Ph	Ex	-	+	-
87	Epipremnum aureum (Linden & André) Bunting, 1964	Araceae	NA	Ch	Ex	-	-	+
88	Erythrina abyssinica Lam. ex DC., 1825	Fabaceae	NA	Ph	Ex	+	-	-
89	Eucalyptus globulus Labill., 1800	Myrtaceae	LC	Ph	Ex	+	-	-
90	Eucharis amazonica Linden ex Planch., 1857	Liliaceae	NA	Ge	Ex	-	-	+

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91	Euphorbia cotinifolia L., 1753	Euphorbiaceae	NA	Ph	Ex	-	-	+
92	Euphorbia resinifera O.Berg, 1863	Euphorbiaceae	NA	Ph	Ex	-	-	+
93	Euphorbia royleana E. Ursch et J. D. Léandri, 1954	Euphorbiaceae	NA	Ph	Ex	-	-	+
94	Ficus benjamina L., 1767	Moraceae	LC	Ph	Ex	-	-	+
95	Ficus mucuso Welw. ex Ficalho, 1884	Moraceae	LC	Ph	Ex	-	+	-
96	Ficus vallis-choudae Delile, 1843	Marantaceae	NA	Ph	Ex	-	+	-
97	Fragaria vesca L., 1753	Rosaceae	LC	Ch	Ex	-	-	+
98	Goeppertia makoyana (É.Morren) Borchs. & S.Suárez, 2012	Marantaceae	NA	Ch	Ex	-	-	+
99	Goeppertia zebrina (Sims) Nees, 1831	Marantaceae	NA	Ph	Ex	-	-	+
100	Graptophyllum balansae Heine, 1976	Acanthaceae	NA	Ph	Ex	-	-	+
101	Grevillea robusta A.Cunn. ex R.Br., 1830	Proteaceae	LC	Ph	Ex	+	+	-
102	Harungana madagascariensis Lam. ex Poir., 1804	Hypericaceae	LC	Ph	Ex	-	+	-
103	Hemerocallis fulva (L.) L., 1762	Asphodelaceae	NA	Ph	Ex	-	-	+
104	Hevea brasiliensis (Willd. ex A.Juss.) Mull.Arg., 1865	Euphorbiaceae	LC	Ph	Ex	-	+	-
105	Hibiscus rosa-sinensis L., 1753	Malvaceae	NA	Ph	Ex	-	-	+
106	Hibiscus tiliaceus L., 1753	Malvaceae	NA	Ph	Ex	-	+	-
107	Hydrocotyle verticillata Thunb., 1798	Araliaceae	LC	Ge	Ex	-	-	+
108	Hymenocallis littoralis (Jacq.) Salisb., 1812	Amaryllidaceae	NA	Ph	Ex	-	-	+
109	Hyophorbe lagenicaulis (L.H.Bailey) H.E.Moore, 1976	Arecaceae	CR	Ph	Ex	-	-	+
110	Ipomoea indica (Burm.) Merr., 1917	Convolvulaceae	DD	Ph	Ex	-	-	+
111	Iresine diffusa Humb. & Bonpl. ex Willd., 1806	Amaranthaceae	NA	Ph	Ex	-	-	+

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112	Iris pseudacorus L., 1753	Iridaceae	LC	Ph	Ex	-	-	+
113	Jacaranda mimosifolia D.Don, 1822	Bignoniaceae	VU	Ph	Ex	+	-	-
114	Kalanchoe daigremontiana Raym.-Hamet & H.Perrier, 1914	Crassulaceae	EN	Ph	Ex	-	-	+
115	Lagerstroemia indica L., 1759	Lythraceae	LC	Ph	Ex	-	-	+
116	Lannea discolor (Sond.) Engl.,	Anacardiaceae	LC	Ph	Ex	+	-	-
117	Lantana camara L., 1753 s.s.	Verbenaceae	NA	Ph	Ex	-	-	+
118	Lavandula angustifolia Mill., 1768	Lamiaceae	LC	Ph	Ex	-	-	+
119	Leucaena leucocephala (Lam.) De Wit, 1961	Fabaceae	CR	Ph	Ex	+	+	+
120	Leucanthemum maximum (Ramond) DC., 1837	Asteraceae	NA	Ph	Ex	-	-	+
121	Ligustrum sinense Lour., 1790	Oleaceae	NA	Ph	Ex	-	-	+
122	Liriope muscari (Decne.) L.H.Bailey, 1929	Asparagaceae	NA	Ge	Ex	-	-	+
123	Livistona chinensis (Jacq.) R.Br. ex Mart., 1838	Arecaceae	NA	Ph	Ex	-	-	+
124	Malus domestica (Suckow) Borkh., 1803	Rosaceae	NA	Ph	Ex	+	-	-
125	Malvaviscus arboreus Cav., 1787	Malvaceae	LC	Ph	Ex	-	-	+
126	Mangifera indica L., 1753	Anacardiaceae	DD	Ph	Ex	+	+	+
127	Manihot esculenta Crantz, 1766	Euphorbiaceae	DD	Ph	Ex	-	-	+
128	Markhamia lutea (Benth.) K. Schum.	Bignoniaceae	LC	Ph	Ex	+	-	-
129	Melissa officinalis L., 1753	Lamiaceae	LC	Ph	Ex	-	-	+
130	Milicia excelsa (Welw.) C.C.Berg, 1982	Moraceae	NT	Ph	Ex	-	+	-

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131	Millettia laurentii De Wild	Fabaceae	EN	Ph	Ex	-	+	-
132	Millettia novo-guineensis Kaneh. & Hatus.	Fabaceae	NA	Ph	Ex	-	+	-
133	Monstera deliciosa, Liebn., 1849	Araceae	NA	Ph	Ex	-	-	+
134	Moringa oleifera Lam.	Moringaceae	LC	Ph	Ex	+	+	-
135	Morus alba L., 1753	Moraceae	NA	Ph	Ex	-	-	+
136	Musa acuminata Colla, 1820	Musaceae	LC	Ph	Ex	-	+	+
137	Musa basjoo Siebold ex Iinuma, 1830	Musaceae	LC	Ph	Ex	-	-	+
138	Musanga cecropioides R. Br. ex Tedlie, 1819	Urticaceae	LC	Ph	Ex	-	+	-
139	Myrianthus arboreus P. Beauv., 1804-1805	Cecropiaceae	LC	Ph	Na	-	+	-
140	Nephrolepis cordifolia (L.) C.Presl, 1836	Nephrolepidaceae	NA	Ph	Ex	-	-	+
141	Nephrolepis exaltata (L.) Schott, 1834	Nephrolepidaceae	LC	Ph	Ex	-	-	+
142	Nerium oleander L., 1753	Apocynaceae	LC	Ph	Ex	-	-	+
143	Newbouldia laevis (P. Beauv.) Seem.	Bignoniaceae	LC	Ph	Ex	-	+	-
144	Olea europaea L., 1753	Oleaceae	DD	Ph	Ex	+	-	-
145	Oxalis griffithii Edgew. & Hook.f.	Oxalidaceae	NA	Ch	Ex	-	-	+
146	Passiflora edulis Sims, 1818	Passifloraceae	NA	Ph	Ex	-	-	+
147	Peltandra virginica (Linnaeus) Schott & Endlicher	Araceae	NA	Ph	Ex	-	-	+
148	Peperomia obtusifolia (L.) A.Dietr., 1831	Piperaceae	NA	Ch	Ex	-	-	+
149	Persea americana Mill., 1768	Lauraceae	NA	Ph	Ex	+	+	+

150	Persicaria microcephala Seikei Zusetsu, 1804	Polygonaceae	NA	Ph	Ex	-	-	+
151	Petersianthus macrocarpus (P. Beauv.) Liben	Lecythidaceae	LC	Ph	Ex	-	+	-
152	Petunia sp Wijsman, 1990	Solanaceae	NA	Ph	Ex	-	-	+
153	Phoenix canariensis Chabaud, 1882	Arecaceae	LC	Ph	Ex	-	-	+
154	Phyllostachys viridiglaucescens (Carrière) Rivière & C.Rivière, 1878	Poaceae	NA	Ph	Ex	-	+	-
155	Pinellia pedatisecta Schott	Araceae	NA	Ph	Ex	-	-	+
156	Pinus patula Schltdl. & Cham., 1831	Pinaceae	VU	Ph	Ex	+	-	-
157	Pittosporum tobira (Murray) W. T. Aiton	Pittosporaceae	NA	Ph	Ex	-	-	+
158	Plumeria rubra L., 1753	Apocynaceae	LC	Ph	Ex	-	+	+
159	Polyscias scutellaria (Burm.f.) Fosberg, 1948	Araliaceae	NA	Ph	Ex	-	-	+
160	Prunus caroliniana (Mill.) Aiton	Rosaceae	LC	Ph	Ex	-	-	+
161	Prunus domestica L., 1753	Rosaceae	DD	Ph	Ex	+	+	-
162	Pseudospondias microcarpa (A. Rich.) Engl., 1883	Anacardiaceae	LC	Ph	Ex	-	+	-
163	Psidium guajava L., 1753	Myrtaceae	LC	Ph	Ex	+	+	+
164	Pteris vittata L., 1753	Pteridaceae	LC	Ph	Ex	-	-	+
165	Pycnanthus angolensis (Welw.) Warb. Notizbl. Königl. Bot. Gart, 1895	Myristicaceae	LC	Ph	Na	-	+	-
166	Ravenala madagascariensis Sonn., 1782	Strelitziaceae	LC	Ph	Ex	-	-	-
167	Ribes aureum Pursh, 1813	Grossulariaceae	NA	Ph	Ex	-	+	-
168	Ricinodendron heudelotii (Baill.) Pierre ex Heckel, 1898	Euphorbiaceae	LC	Ph	Na	-	-	+

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169	Rosa multiflora Thunb., 1784	Rosaceae	NA	Ph	Ex	-	-	+
170	Rosa chinensis Jacq., 1768	Rosaceae	NA	Ph	Ex	-	-	+
171	Roystonea regia (Kunth) O.F.Cook, 1900	Arecaceae	LC	Ph	Ex	-	+	-
172	Rudbeckia laciniata L., 1753	Asteraceae	NA	Ph	Ex	-	-	+
173	Ruellia simplex C.Wright, 1870	Acanthaceae	NA	Ph	Ex	-	-	+
174	Sabal palmetto (Walter) Lodd. ex Schult. & Schult.f., 1830	Arecaceae	NA	Ph	Ex	-	-	+
175	Saccharum officinarum L., 1753	Poaceae	NA	Ph	Ex	-	-	+
176	Saintpaulia ionantha Rubra, 1896	Gesneriaceae	VU	Ge	Ex	-	-	+
177	Salix alba L., 1753	Salicaceae	LC	Ph	Ex	-	-	+
178	Sambucus canadensis L., 1753	Adoxaceae	NA	Ph	Ex	-	-	+
179	Sanchezia speciosa Leonard, 1926	Acanthaceae	NA	Ph	Ex	-	-	+
180	Sansevieria trifasciata Prain 1903	Asparagaceae	NA	Ge	Ex	-	-	+
181	Schefflera arboricola (Hayata) Merr.	Araliaceae	NA	Ph	Ex	-	-	+
182	Senna occidentalis (L.) Link, 1829	Fabaceae	LC	Ph	Ex	-	+	-
183	Senna siamea (Lam.) H.S.Irwin & Barneby, 1982	Fabaceae	LC	Ph	Ex	+	-	-
184	Spathiphyllum wallisii Regel, 1877	Araceae	NA	Ph	Ex	-	+	-
185	Spathodea campanulata P.Beauv., 1805	Bignoniaceae	LC	Ph	Ex	-	-	+
186	Sphagneticola trilobata (L.) Pruski, 1996	Asteraceae	NA	Ch	Ex	+	-	-
187	Spondias dulcis Parkinson, 1773	Anacardiaceae	NA	Ph	Ex	-	-	+

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188	Spondias mombin L., 1753	Anacardiaceae	LC	Ph	Ex	-	+	-
189	Strelitzia reginae Banks, 1788	Strelitziaceae	NA	Ph	Ex	-	+	-
190	Syagrus romanzoffiana (Cham.) Glassman, 1968	Arecaceae	NA	Ph	Ex	-	-	+
191	Symphyotrichum novi-belgii (L.) G.L.Nesom, 1995	Asteraceae	NA	Ph	Ex	-	-	+
192	Symphyotrichum salignum (Willd.) G.L.Nesom, 1995	Asteraceae	NA	Ph	Ex	-	-	+
193	Syngonium podophyllum Schott, 1851	Araceae	NA	Ph	Ex	-	-	+
194	Syzygium cumini (L.) Skeels, 1912	Lamiaceae	NA	Ph	Ex	-	-	+
195	Syzygium jambos (L.) Alston, 1931	Lamiaceae	NA	Ph	Ex	-	+	-
196	Syzygium manii (King) N. P. Balakrishnan	Lamiaceae	NA	Ph	Ex	-	+	-
197	Tabernaemontana divaricata (L.) R.Br. ex Roem. & Schult., 1819	Apocynaceae	NA	Hem	Ex	-	-	+
198	Tagetes erecta L., 1753	Asteraceae	NA	Ch	Ex	-	-	+
199	Tectona grandis L.f., 1782	Lamiaceae	EN	Ph	Ex	-	+	-
200	Terminalia catappa L., 1767	Combretaceae	LC	Ph	Ex	+	+	+
201	Terminalia ivorensis A.Chev., 1909	Combretaceae	VU	Ph	Ex	-	+	-
202	Terminalia superba Engl. & Diels, 1899	Combretaceae	NA	Ph	Ex	-	+	-
203	Theobroma cacao L., 1753	Malvaceae	NA	Ph	Ex	-	+	-
204	Thyrsacanthus tubaeformis (Bertol.) Nees, 1847	Acanthaceae	NA	Ph	Ex	-	-	+
205	Tithonia diversifolia (Hemsl.) A.Gray, 1883	Asteraceae	NA	Ph	Ex	-	-	+
206	Tradescantia fluminensis Vell., 1829	Commelinaceae	NA	Ch	Ex	-	-	+

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207	Tradescantia pallida (Rose) D.R.Hunt, 1976	Commelinaceae	NA	Ch	Ex	-	-	+
208	Tradescantia zebrina hort. ex Bosse, 1849	Commelinaceae	NA	Ph	Ex	-	-	+
209	Treculia africana Decne. ex Trécul	Moraceae	LC	Ph	Ex	-	+	-
210	Uapaca esculenta A. Chev. ex Aubrév. & Leandri	Phyllanthaceae	LC	Ph	Ex	-	+	-
211	Umbellularia californica (Hook. & Arn.) Nutt., 1842	Lauraceae	LC	Ph	Ex	-	-	+
212	Vachellia karroo (Hayne) Banfi & Galasso	Fabaceae	LC	Ph	Ex	-	+	-
213	Vernonia amygdalina Delile	Asteraceae	NA	Ph	Na	-	+	-
214	Vitex trifolia L., 1753	Lamiaceae	NA	Ph	Ex	-	+	-
215	Volkameria inermis L., 1753	Lamiaceae	NA	Ph	Ex	-	-	+
216	Yucca gigantea Lem., 1859	Asparagaceae	DD	Ph	Ex	-	-	+
217	Zamioculcas zamiifolia (Lodd.) Engl., 1905	Araceae	NA	Ph	Ex	-	-	+
218	Zantedeschia aethiopica (L.) Spreng., 1826	Araceae	LC	Ph	Ex	-	-	+
219	Zephyranthes longifolia Hemsl.	Amaryllidaceae	NA	Ph	Ex	-	-	+
220	Zinnia elegans Jacq., 1792	Asteraceae	NA	Ph	Ex	-	-	+

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