



(RESEARCH ARTICLE)



A preliminary survey of the flora and vegetation of an ex-situ conservation area (Hyde Park Zoo Sanctuary and Tropical Gardens Inc., Guyana)

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Abstract

Hyde Park Zoo Sanctuary and Tropical Gardens Inc. is a local ex-situ conservation area located at Land of Canaan, East Bank Demerara, Guyana. It serves to manage and conserve species of wild flora and fauna, boasts several diverse native and exotic species, and hosts a rescue centre for wild captures. Over a six (6) week period, flora & vegetative visual surveys were conducted there to i) identify and classify the species of flora found at accessible parts of the site (according to the official established map of the area), and ii) report these findings in a comprehensive report in order to establish a database of the preliminary findings of the study. Based on the preliminary findings of the study, a total of ninety-nine (99) plant species from twenty (20) families were identified. The largest family group was found to be Arecaceae with 15 species. Leguminosae and Bromeliaceae both contained 6 species each. Other representative families were Apocynaceae, Orchidaceae, Rosaceae and Aracaceae. Seventy-nine species (80.8%) were exotic and nineteen (19.4%) species were found to be native. None of the identified species were found to be under threat, or near extinction. Based on these preliminary findings, it is established that the area has great taxonomic and conservation potential, and with effective management along with strategic planning, the area can serve as an ex-situ conservation model, where both native and exotic species thrive together.

Keywords: Guyana; Flora diversity; Vegetative survey; Ex-situ conservation; Tropical plants

1. Introduction

Globally, there have been several international efforts to conserve biodiversity through the efforts of international conventions and other world summits. Over time, it became evident that establishing a database of the world's biodiversity was of utmost importance, especially since extinction of both plants and animal species was becoming increasingly popular, and many species were under threat. During that time and to present, both natural occurrences and man-made activities have affected biodiversity. Therefore, special attention must be given to plant biodiversity especially since in over the last 50 years, about three quarters of the world's plant diversity has become extinct [1]. In fact, obtaining information about species diversity is important to informing crucial decisions on conservation and protection of species so as to reduce rates of global loss [2]. The Global Strategy for Plant Conservation, adopted in 2002 by the Convention of Parties, recognises that though plants are vital components of the world's biodiversity, there is no complete inventory of the world's plants. Under Objective 1 of the Strategy, plant diversity is the focus. This objective bears three (3) targets including: an established database online of all known plants, disclosed conservation status of these known plants in order to aid conservation efforts, and the use of the latter two (2) targets to promote the Strategy's dissemination and development [3].

The definition of conservation has long held similar and sometimes contradictory views. Broadly accepted, is the belief that conservation is the management (by humans) of the earth's surface occupied by living organisms, so as to not only benefit present use, but to maintain its potential for future generations [4]. It was theorised that the set of varying

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definitions contributed to what he termed the 'patchwork approach' which would possibly result in ineffective individual approaches to conservation. Therefore, conservation should be considered as a precept where actions are actively taken to establish, improve and maintain good relations with nature. These actions are to benefit a variety of entities including nature itself, humans, and natural diversity features of the environment.

In 1992, Guyana signed the United Nations Convention on Biological Diversity (UNCBD), which is a legal framework governing not only the conservation of biodiversity, but its sustainable use and development, and shared benefits emanating from its utilisation. Following this sign-on, Guyana also became a party to the Cartagena Protocol on Biosafety (2008) and the Nagoya Protocol on Access and Benefit Sharing (2014). Both of these focus on equitable access to resources, and the monitoring and reporting of the management of conservation areas [3]. Nationally, Guyana launched the Low Carbon Development Strategy (LCDS) in 2009, to promote the conservation of the country's forests and promote its sustainable management. This Strategy is in tandem with the National Development Strategy (NDS) that hinges on the tourism potential of the country, emanating from the preservation and efficient management of its forest ecosystems and biodiversity [3].

The last 50 years have seen vast global development including growing economies and increased trade efforts [5]. This has led to increased human interaction with plants, and a subsequent reduction in plant biomass by 5%, along with about 40% of species being pressured by extinction. Undoubtedly, plants are the basis for survival so their conservation is essential [6], [7]. Due to these increasing pressures, conservation techniques have become very vital.

Ex-situ conservation, which is the focus of this research, can be achieved through various methods. These fall generally into the following types: Zoos, Captive Breeding and Botanic Gardens. Botanic Gardens are collections of plants, grown either indoors or outdoors. The range of growth habitats includes (but is not limited to) herbariums, museums, laboratories and greenhouses. Botanical gardens may be specific to the growth of a particular family, or of higher taxonomic restrictions, or plants of special interest. These gardens are also useful for awareness, conservation and educational purposes [8]. Public visitors to gardens may also be moved to conserve plant diversity by learning about the benefits and conservation challenges of specific plants. It is noteworthy that ex-situ plant populations are barely represented in botanical gardens [9]. This poses a threat to the conservation of the latter, and therefore means that special efforts have to be made to plan and design methods of their inclusion [8].

Though individual approaches may suffice, a more holistic approach may be needed in order to meet the needs and demands of sub-environments and their niches. This approach is known as integration.

In-situ conservation and ex-situ conservation, when utilised separately, are unable to holistically conserve plants since a variety of techniques are needed to combat the threats that affect their conservation. Even when ex-situ conservation is properly utilised, in-situ conservation is still necessary to preserve plants in the environment that they are best accustomed and suited [10]. Integrated plant conservation is a combined approach where both in situ and ex situ conservation methods are used to support the survival of species and facilitate the success of conservation efforts.

The flora diversity of Guyana is estimated at over 8000 species of which approximately 6500 species are identifiable [3]. There are several important Neotropical families in Guyana including several genera belonging to Orchidaceae, Rubiaceae and Poaceae [11]. The group Legumes covers a variety of families but if combined, would account for the most species rich family in Guyana [12]. Among genera with more than 30 species (considered as species rich genera) is the Orchidaceae family, of which locally popular species *Maxillaria*, *Epidendrum*, and *Pleurothallis* are included. Most tropical ornamental plants were introduced by travellers, who came to South America for religious and economic purposes.

In consideration of the necessity to aid local conservation efforts of plants, and contribute to the worldwide status of known and documented plants, this research sought to investigate tree and vegetative diversity at Hyde Park Zoo and Sanctuary, located at Land-of-Canaan, East Bank Demerara, Guyana. From the inception of the project to date, there were no attempts to document and catalogue the flora diversity within the ex-situ conservation area. The objective of this research was therefore to investigate the diversity of flora at the location, and generate a catalogue of trees and vegetation. The results have formed a part of the baseline data for the ex-situ conservation area. It provides insight into the classifications, naticities and growth forms of the flora found, along with their occurrences and habitat at the smaller sites within the area.

2. Material and Methods

2.1. Site Description

Hyde Park Zoo Sanctuary and Tropical Gardens was established in 2009, to incorporate both conservation and protection of plant and animal life, with the main aim of replenishing the ecosystem. It is located at Plantation Land of Canaan, along the East Bank of Demerara. The focus of HPZ is ex-situ conservation, and the management of floral and faunal species. The sole mission of HPZ is the ex-situ conservation and management of species of wild flora and fauna. There are also several native species appearing readily on site. The study site measures at approximately 200 plus acres of land that is privately owned (Figure 1).



Figure 1 General Layout of Hyde Park Zoo and Sanctuary

2.2. Survey scope

The scope of the survey was to conduct flora and vegetative surveys at the accessible parts of the location, over a six (6) week period.

2.3. Survey objectives

The objectives of the survey were to:

- Identify and classify the species of flora found at accessible parts of Hyde Park, Land of Canaan, East Bank Demerara; and
- Report these findings in a comprehensive report in order to establish a database of the preliminary findings of the study.

2.4. Survey Methodology

Site visits were conducted over a period of four days in 2022 namely January 15, January 22, February 12, and February 19. Surveys and photography were done between 11:30 h and 15:00 h.

The following areas of Hyde Park were surveyed by direct observation: Jaguar Enclosure, Serpentarium, Flamingo Enclosure, Giant Anteater Enclosure, Giant River Otter Enclosure, Capybara Enclosure, Spider Monkey Island & Walkway, Proposed Tea House, Lowland Tapir Enclosure, Recreational area and Giraffe Enclosure.

By direct observation, the following parameters were covered in the study: Names & Classification, Growth Form, Nativity (Native/Exotic), Origin of Species, Conservation/Protection Status and Occurrence of species.

2.5. Species classification and identification

Plants were identified and classified by the following plant ID manuals: The Kew Tropical Plant Families Identification Handbook (Second Edition) [14], Flora of the Guianas [15], Checklist of the plants of the Guianas [16], and Check-list of woody plants of Guyana [17]. PlantNet plant identification App was also used to supplement initial plant photographic identifications.

2.6. Growth Form

All species were assigned a growth form according to their occurrence or occurrences. This was done using the stipulations provided by plant manuals and checklists [18], [19]. Species were classified as either trees, climbers (lianas, and vines), undergrowth (herbs, shrubs) and palms. Where different forms were exhibited, all variations found were stated.

3. Results

3.1. Taxonomic richness

A total of 99 plant species were identified. Ninety-four (94) species were identified up to species level, one (1) species was identified up to genus level and four (4) species [all trees] were not identified, due to similarities rendered from photographic levels. The identification of these trees would require further work. These species could be further analysed using their morphological data in order to aid classification. Therefore, these unidentified trees would only be considered in the total number of species present, and growth forms, but not with the rest of the data. Table 1 presents this information on species identified.

Table 1 Preliminary list of species identified at the study site

S.N	Scientific Name	Family	Common Name	Local Name	Growth Form	Nativity	Conservation status	Abundance
1	<i>Ixxora coccinea</i>	Rubiaceae	Pink Ixora	Ixora	Shrub	Exotic	Not under threat	Common
2	<i>Allamanda cathartica</i>	Apocynaceae	Golden Trumpet, Yellow Bellflower	Buttercup	Shrub	Exotic	Not under threat	Common
3	<i>Conocarpus erectus</i>	Combretaceae	Button Mangrove; Silver-leaf Mangrove	Buttonwood Mangrove	Shrub	Exotic	Not under threat	Scarce
4	<i>Tabebuia rosea</i>	Bignoniaceae	Pink Poui	Poui	Tree	Exotic	Not under threat	Common
5	<i>Colocasia esculenta</i>	Aracaceae	Elephant's ear	Wild eddo	Herb	Exotic	Not under threat	Common
6	<i>Perisicaria virginiana</i>	Polygonaceae	Jumpseed plant	No known name given	Herb	Native	Not under threat	Common
7	<i>Cuphea hyssopifolia</i>	Lythraceae	Mexican Heather	Mexican Heather	Shrub	Exotic	Not under threat	Common
8	<i>Terminalia cattapa</i>	Combretaceae	Tropical Almond	Almond Nut tree	Tree	Exotic	Not under threat	Common
9	<i>Trachycarpus fortuneii</i>	Arecaceae	Chinese windmill palm	Chinese windmill palm	Palm	Exotic	Not under threat	Scarce
10	<i>Pandanus pygmaeus</i>	Pandanaceae	Screw pine	No known name given	Shrub	Exotic	Not under threat	Scarce
11	<i>Annona muricata</i>	Annonaceae	Soursop	Soursop	Tree	Native	Not under threat	Scarce
12	<i>Phoenix dactylifera</i>	Arecaceae	Senegal Date Palm	Date Palm	Palm	Exotic	Not under threat	Scarce
13	<i>Costus sp.</i>	Zingiberaceae	Wild Ginger	No known name given	Herb	Exotic	Not under threat	Scarce
14	<i>Tourenia fournieri</i>	Linderniaceae	Wishbone flower	Wishbone	Shrub	Exotic	Not under threat	Very Common
15	<i>Catharanthus roseus</i>	Apocynaceae	Periwinkle	Periwinkle	Shrub	Exotic	Not under threat	Very Common
16	<i>Bougainvillea spectabilis</i>	Nyctaginaceae	Bougainvillea	Bougainvillea	Shrub/Tree	Exotic	Not under threat	Very Common
17	<i>Rosa gallica var</i>	Rosaceae	Hungarian Rose	Rose plant	Shrub	Exotic	Not under threat	Scarce

18	<i>Lathyrus annus</i>	Leguminosae	Fodder Pea	No known name given	Herb	Exotic	Not under threat	Scarce
19	<i>Ipomoea purpurea</i>	Convolvulaceae	Morning Glory	Morning Glory	Vine	Exotic	Not under threat	Common
20	<i>Crossandra infundibuliformis</i>	Acanthaceae	Firecracker flower	No known name given	Shrub	Exotic	Not under threat	Common
21	<i>Lantana viburnoides</i>	Verbenaceae	Common Lantana	Lantana	Shrub	Exotic	Not under threat	Common
22	<i>Paeonia officinalis</i>	Paeoniaceae	Cottage Peony	Pink Peony	Shrub	Exotic	Not under threat	Scarce
23	<i>Cyrtostachys renda</i>	Arecaceae	Lipstick Palm	Lipstick Palm	Palm	Exotic	Not under threat	Scarce
24	<i>Spathoglottis plicata</i>	Orchidaceae	Philippine Ground Orchid	Ground Orchid	Herb	Exotic	Not under threat	Scarce
25	<i>Phoenix roebelenii</i>	Arecaceae	Roeblinni Palm	Date Palm	Palm	Exotic	Not under threat	Scarce
26	<i>Photinia glabra</i>	Rosaceae	Japanese photinia	No known name given	Tree	Exotic	Not under threat	Scarce
27	<i>Aglaonema sp.</i>	Araceae	Chinese evergreen	Evergreen	Herb	Exotic	Not under threat	Scarce
28	<i>Victoria amazonica</i>	Nymphaea	Victoria Lily	Water lily	Herb	Exotic	Not under threat	Common
29	<i>Elaeis guineensis</i>	Arecaceae	African Oil Palm	Oil Palm	Palm	Exotic	Not under threat	Scarce
30	<i>Citrus limon</i>	Rutaceae	Lemon	Lemon	Tree	Exotic	Not under threat	Scarce
31	<i>Althernanthera brasiliana</i>	Amaranthaceae	Ruby Leaf	Ruby Leaf	Herb	Exotic	Not under threat	Common
32	<i>Kopsia fruticosa</i>	Apocynaceae	Kopsia	Pink Kopsia	Shrub	Exotic	Not under threat	Scarce
33	<i>Heliconia psittacorum</i>	Heliconiaceae	Parakeetflower, False Bird of Paradise	Heliconia	Herb	Native	Not under threat	Very Common
34	<i>Hedychium coronarium</i>	Zingiberaceae	Phillipine Waxflower	Ginger Lily	Herb	Exotic	Not under threat	Scarce
35	<i>Alpina purpurata</i>	Zingiberaceae	Red Ginger Flower	Red Ginger	Herb	Exotic	Not under threat	Scarce
36	<i>Prunus avium</i>	Rosaceae	Cherry	Cherry	Tree	Exotic	Not under threat	Common
37	<i>Geum reptans</i>	Rosaceae	Creeping Avens	Vine	Herb	Exotic	Not under threat	Common
38	<i>Syagrus romanzoffiana</i>	Arecaceae	Giriba palm	Giriba palm	Palm	Exotic	Not under threat	Common

39	<i>Wodyetia birfurcata</i>	Arecaceae	Foxtail palm	Foxtail palm	Palm	Exotic	Not under threat	Common
40	<i>Roystonea regia</i>	Arecaceae	Cuban Royal Palm	Royal Palm	Palm	Exotic	Not under threat	Common
41	<i>Ptychosperma macarthurii</i>	Arecaceae	McArthur Feather Palm	Feather Palm	Palm	Exotic	Not under threat	Common
42	<i>Gardenia jasminoides</i>	Rubiaceae	Gardenia	Jasmine	Shrub	Exotic	Not under threat	Scarce
43	<i>Emilia fosbergii</i>	Compositae	Florida tasselflower	Weed	Herb/Vine	Native	Not under threat	Common
45	<i>Stenotaphrum secundatum</i>	Poaceae	Pimento grass	Grass	Grass	Native	Not under threat	Very Common
46	<i>Bismarckia nobilis</i>	Arecaceae	Silver palm	Silver Palm	Palm	Exotic	Not under threat	Common
47	<i>Dypsis decaryi</i>	Arecaceae	Triangle palm	Fan Palm	Palm	Exotic	Not under threat	Common
48	<i>Saraca indica</i>	Leguminosae	Asoka tree	Ashoka	Tree	Exotic	Not under threat	Very Common
49	<i>Murraya koenigii</i>	Rutaceae	Curryleaf tree	Sweet Neem, Neem	Shrub	Exotic	Not under threat	Scarce
50	<i>Fraxinus americana</i>	Oleaceae	Whiteash	No name known	Tree	Native	Not under threat	Scarce
51	<i>Combretum indicum</i>	Combretaceae	Madhumalti	No name known	Shrub	Native	Not under threat	Scarce
52	<i>Eupatorium capillifolium</i>	Compositae	Dog fennel	Wild flower	Herb	Native	Not under threat	Scarce
53	<i>Casuarina equisetifolia</i>	Casuarinaceae	Australian beefwood	No name known	Tree	Exotic	Not under threat	Scarce
54	<i>Clibadium surinamense</i>	Asteraceae	Jackass breadnut	Jackass breadnut	Shrub	Native	Not under threat	Common
55	<i>Chrysobalanus icaco</i>	Chrysobalanaceae	Coco Plum	Fat poke	Tree	Native and Exotic	Not under threat	Common
56	<i>Dendrobium chrysotoxum</i>	Orchidaceae	Golden bow orchid; Fried egg orchid	Golden Orchid	Epiphyte	Exotic	Not under threat	Scarce
57	<i>Guzmania plumieri</i>	Bromeliaceae	Guzmania	Bromeliad,	Herb	Exotic	Not under threat	Scarce
58	<i>Epidendrum ibaguense</i>	Orchidaceae	Crucifix Orchid	Crucifix Orchid	Herb	Exotic	Not under threat	Scarce
59	<i>Tillandsia anceps</i>	Bromeliaceae	Air Plant	Bromeliad,	Herb	Exotic	Not under threat	Scarce

60	<i>Bromelia plumieri</i>	Bromeliaceae	Plumier's bromelia	Bromeliad	Herb	Exotic	Not under threat	Scarce
61	<i>Cynodon dactylon</i>	Poaceae	Bermuda grass	Grass	Grass	Native	Not under threat	Very Common
62	<i>Acalypha wilkesiana</i>	Euphorbiaceae	Copper leaf	Copper leaf	Shrub	Native	Not under threat	Very Common
63	<i>Crinum asiaticum</i>	Amaryllidaceae	Poison Bulb	Poisonleaf	Shrub	Exotic	Not under threat	Scarce
64	<i>Inga edulis</i>	Leguminosae	No known local name	Leguminosae	Shrub	Exotic	Not under threat	Scarce
65	<i>Vanda perplexa</i>	Orchidaceae	Vanda orchid	Pink Vanda	Epiphyte	Exotic	Not under threat	Scarce
66	<i>Ficus religiosa</i>	Moraceae	Sacred fig	No known name given	Tree	Exotic	Not under threat	Scarce
67	<i>Caladium bicolor</i>	Araceae	Caladium, Heart of Jesus	Wild eddo	Herb	Native	Not under threat	Common
68	<i>Sterculia tragacantha</i>	Malvaceae	Stercularia	No known name given	Shrub	Native	Not under threat	Common
69	<i>Cocos nucifera</i>	Arecaceae	Coconut palm	Coconut	Palm	Exotic	Not under threat	Scarce
70	<i>Delonix regia</i>	Leguminosae	Gulmohar	Flambouyant	Tree	Exotic	Not under threat	Common
71	<i>Caesalpinia pulcherrima</i>	Leguminosae	Pride of Barbados	Pride of Barbados	Tree	Exotic	Not under threat	Scarce
72	<i>Jatropha integerrima</i>	Euphorbiaceae	Peregrina	Jatropha	Shrub	Exotic	Not under threat	Scarce
73	<i>Nerium oleander</i>	Apocynaceae	Oleander	Oleander	Shrub	Exotic	Not under threat	Scarce
74	<i>Cordyline fruticosa</i>	Asparagaceae	Broadleaf palm-lily	Broadleaf palm-lily	Shrub	Exotic	Not under threat	Scarce
75	<i>Plumeria rubra</i>	Apocynaceae	Frangipani	Frangipani	Tree	Exotic	Not under threat	Common
76	<i>Hyophorbe lagenicaulis</i>	Arecaceae	Bottle Palm	Bottle Palm	Palm	Exotic	Not under threat	Scarce
77	<i>Solanum torvum</i>	Solanaceae	Pea eggplant	No known name given	Shrub	Native	Not under threat	Common
78	<i>Cosmos caudatus</i>	Compositae	Cosmos	No known name given	Herb	Exotic	Not under threat	Scarce
79	<i>Guzmania monostachia</i>	Bromeliaceae	West Indian tufted airplant	Bromeliad	Epiphyte	Exotic	Not under threat	Scarce

80	<i>Nidularium billbergioides</i>	Bromeliaceae	Blushing Bromeliad	Bromeliad	Epiphyte	Exotic	Not under threat	Scarce
81	<i>Vachellia gerrardi</i>	Leguminosae	Grey-hair acacia	Acacia	Tree	Exotic	Not under threat	Scarce
82	<i>Cycas circinalis</i>	Cycadaceae	Queen Sago	Sago Palm	Tree	Exotic	Not under threat	Common
83	<i>Phoenix sylvestris</i>	Arecaceae	Wild date palm	Date Palm	Palm	Exotic	Not under threat	Common
84	<i>Jacaranda mimosifolia</i>	Bignoniaceae	Jacaranda	Jacaranda	Tree	Exotic	Not under threat	Common
85	<i>Anthurium scherzerianum</i>	Araceae	Pigtail Plant	Anthurium	Herb	Exotic	Not under threat	Scarce
86	<i>Agave sisalana</i>	Asparagaceae	Mescal	No know name given	Shrub	Exotic	Not under threat	Scarce
87	<i>Neoregelia farinosa</i>	Bromeliaceae	Bromeliad	Bromeliad	Shrub	Exotic	Not under threat	Scarce
88	<i>Casuarina glauca</i>	Casurinaceae	Brazilian Beefwood	Christmas tree plant	Tree	Exotic	Not under threat	Scarce
89	<i>Phymatosorus scolopendria</i>	Polypodiaceae	Monarch fern	Fern	Shrub	Exotic	Not under threat	Scarce
90	<i>Eryngium foetidum</i>	Apiaceae	Culantro	No know name given	Shrub	Exotic	Not under threat	Scarce
91	<i>Sansevieria trifasciata</i>	Asparagaceae	Snake Plant	Snake Plant	Shrub	Exotic	Not under threat	Common
92	<i>Tagetes minuta</i>	Compositae	Aztec Marigold	No known name given	Tree	Exotic	Not under threat	Scarce
93	<i>Duabanga grandiflora</i>	Lythraceae	Indian idol	No known name given	Tree	Exotic	Not under threat	Scarce
94	<i>Erythroxylum coca</i>	Erythroxylaceae	Coca	No known name given	Tree	Exotic	Not under threat	Scarce
95	<i>Bamboo vulgaris</i>	Poaceae	Bamboo	Bamboo	Grass	Exotic	Not under threat	Very Common

3.2. Families and Species

A total of twenty (20) families were found from the identified species (Figure 2). The largest family group was found to be Arecaceae with 15 species and totalling 16% of the total number of species classified. Leguminosae and Bromeliaceae both contained 6 species each, resulting in 6.4% each of the total percentage of families. Other representative families were Apocynaceae (5.3% with 5 representative species), Orchidaceae (4.3% [4 species]), Rosaceae (4.3%), and Aracaceae (4.3%) (Figure 3).

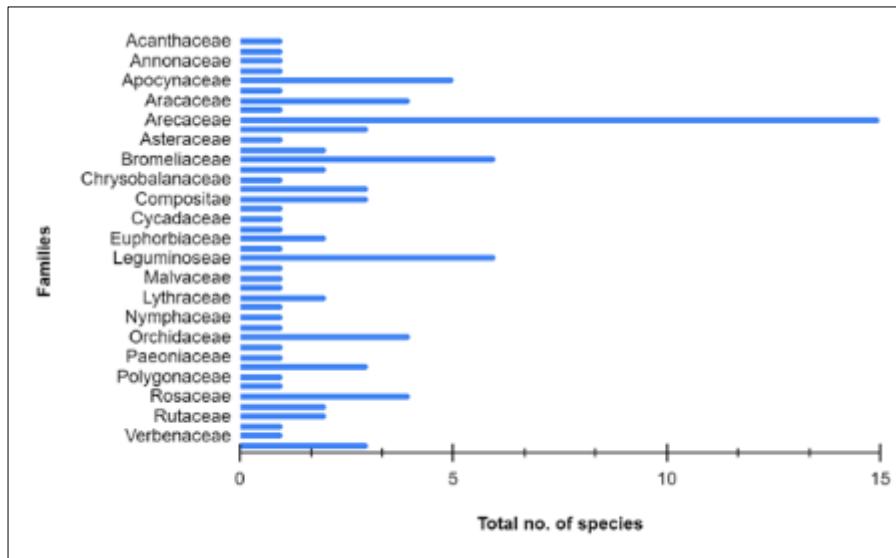


Figure 2 Bar Graph showing distribution of total no. of species among families

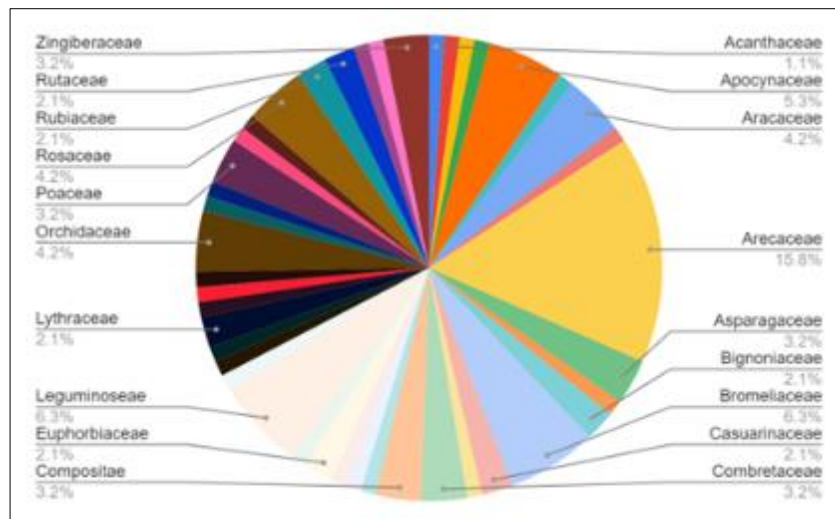


Figure 3 Pie Chart showing percentage distribution of species belonging to different families

No new or endemic species were identified or recorded.

3.3. Growth Forms

Shrub and tree were the dominant growth forms among plants, followed by herb and palm respectively. About 53% of plant species were shrubs and vines while herb accounted for 21% of growth forms and palms were approximately 14% (Figure 4). Underrepresented growth forms were vine, grass and epiphyte collectively accounting for nine (9) species only.

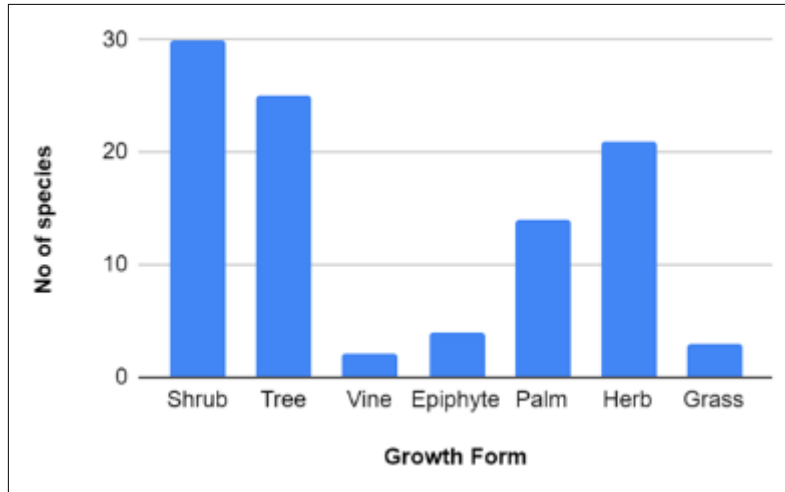


Figure 4 Bar Graph showing growth form distribution among species

3.4. Nativity

Seventy-nine species (80.8%) were exotic and nineteen (19.4%) species were found to be native (Figure 5). Most of the surveyed plants were therefore otherwise obtained from an initial habitat and planted at the Hyde Park Zoo Sanctuary and Tropical Gardens.

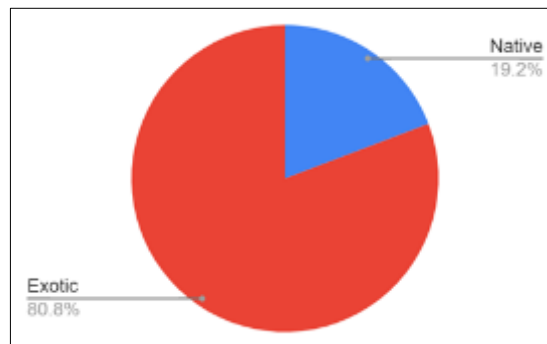


Figure 5 Pie Chart showing nativity of species

3.5. Conservation status

None of the species were found to be under threat.

3.5.1. Abundance

Fifty-eight (58) species were found to be scarce, while thirty-two (32) were found to be common, and the remaining nine (9) were very common (Figure 6).

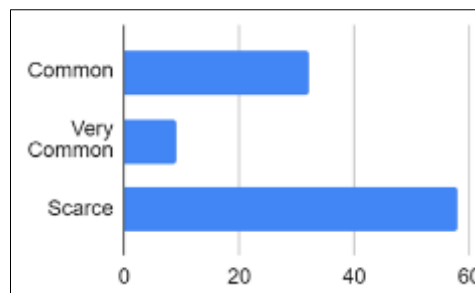


Figure 6 Abundance of species

4. Discussion

The families that were found at Hyde Park were very similar to those found on checklists for plants locally in Guyana and also in the Guianas. Arecaceae, Leguminosae, Bromeliaceae, Arecaceae, Apocynaceae, Orchidaceae, and Rosaceae were the families with the top five highest number of species in our research. In comparing these families with the top fifteen (15) families on the Checklist for plants of Guyana, all the families were present on both lists. Orchidaceae ranks first on the list for the top families of Guyana, but was placed in fifth position on our list, while Arecaceae was placed in first position on our list. Orchidaceae ranks very high on Neotropical checklists so its overall ranking on our list is not surprising [11]. However, not much is known about the phylogeny of this family, so much more work is required for species recognition and diversity [13]. On the local list of top families in Guyana, Arecaceae is placed at number twenty-four (24). This wide gap in placements between the two lists could likely be attributed to the fact that many palm trees were deliberately sourced for their aesthetic and landscaping potential, to lend variability at the vast location under study. Leguminosae ranked second in our findings. Leguminosae, along with its three (3) sub-families, ranks first on the list of plant families of the Guianas [13]. The three (3) sub-families include Caesalpiniaceae, Fabaceae, and Mimosaceae. These sub-families were considered individually for the local list compilation. However, from our research, none of the three (3) sub-families were found. Chrysobalanaceae is considered as typical of Guiana's lowlands [12] with about 220 species [15], and is a major contributor to diversity in the Neotropics. At Hyde Park, only one (1) of these species was found, commonly referred to as 'fat poke' and scientifically called *Chrysobalanus icaco*. As expected, this species was quite common in several areas around the location. All species of Orchidaceae, Arecaceae, and Bromeliaceae were not native to the area. Popular local flowering plants that were found included Ixora, Yellow Bellflower, Poui, Morning Glory, and Frangipani. These plants existed mostly as shrubs and their distribution was mostly common and very common. Local fruit trees that are popular locally and were found at Hyde Park include lemon, mango, cherry, and soursop. Their distributions were very common (cherry) and scarce for the other three species. The preliminary findings have therefore shown that the area surveyed has great taxonomic richness and conservation potential.

5. Conclusion

Based on the preliminary findings of the initial survey and given that no species under threat were found, follow-up research can be done using a phased approach beginning with the economic and medicinal value of species present, followed by the potential role of palms in the Hyde Park ecosystem, and the phylogeny of the orchids found on site, since, generally, not much is known about Orchidaceae. Any additions or corrections to the preliminary list should also be done as more information becomes available. Over time, another survey should be done to determine if any additional species are present, as possibly based on recruitment factors in the area. As Hyde Park continues to develop, another useful area for research would be the impact of human traffic on the existing diversity of plants at the various sites within the facility. Finally, it can be concluded that through the implementation of *ex situ* conservation, the area is species rich with a high diversity of families, exhibiting great research potential, now and in the future.

Compliance with ethical standards

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References

- [1] FAO. The Year of Biodiversity. FAO; 2010.
- [2] Mittermeier, C.G., Turner, W.R., Larsen, F.W., Brooks, T.M., Gascon, C. Global biodiversity conservation: the critical role of hotspots. In: Zachos FE, Habel JC (eds) Biodiversity Hotspots: Distribution and Protection of Priority Conservation Areas (pp 3-22). Springer-Verlag:Berlin; 2011.
- [3] CBD. Local biodiversity outlook 2. Companion Publication to Global Biodiversity Outlook; 2020.
- [4] IUCN. The IUCN red list of threatened species. Version 2020-1; 2020.
- [5] Díaz, S., Settele, J., Brondízio, E. S., Ngo, H. T., Agard, J., Arneth, A., et al. Pervasive human-driven decline of life on Earth points to the need for transformative change. Science 366. 2019.

- [6] Bar-On Y.M., Phillips R. & Milo R. The biomass distribution on Earth. *Proc. Nat. Acad. Sci. U.S.A.* 2019; 115:6506-6511.
- [7] Lughadha N., Walker E., Canteiro. The use and misuse of herbarium specimens in evaluating plant extinction risks. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 2019.
- [8] Blackmore S., Gibby M., Rae D. Strengthening the scientific contribution of botanic gardens to the second phase of the global strategy for plant conservation. *Bot. J. Linn. Soc.* 2011;166:267–281.
- [9] Brütting, Christine & Hensen, I & Wesche, Karsten. Ex situ cultivation affects genetic structure and diversity in arable plants. *Plant biology (Stuttgart, Germany)*. 2013; 15.
- [10] Breman, E., Ballesteros, D., Castillo-Lorenzo, E., Cockel, C., Dickie, J., Faruk, A., O'Donnell, K., Offord, C.A., Pironon, S., Sharrock, S., Ulian, T. Plant diversity conservation challenges and prospects—the perspective of botanic gardens and the millennium seed Bank. *Plants*. 2010; 10, 2371.
- [11] Gentry, A. H. (1990). Floristic Similarities and Differences between Southern Central America and Upper and Central Amazonia. In A. H. Gentry (Ed.), *Four Neotropical Rainforests*. New Haven, CT: Yale University Press; 1990. (pp. 141-157).
- [12] Ter Steege, H. *Plant Diversity in Guyana; With Recommendations for a National Protected Areas Strategy*. Tropenbos Series Number 18; Stichting Tropenbos: The Netherlands, Wageningen; 2000.
- [13] Funk, V., T. Hollowell, P. Berry, C. Kelloff, and S. N. Alexander. Checklist of the Plants of the Guiana Shield (Venezuela: Amazonas, Bolivar, Delta Amacuro; Guyana, Surinam, French Guiana). *Contributions from the United States National Herbarium*, volume 55:1992.
- [14] *The Kew Tropical Plant Families Identification Handbook: Second Edition*. Royal Botanic Gardens, Kew; 2020.
- [15] Boggan, John K., Funk, Vicki Ann, Kelloff, Carol L., Hoff, M., Cremers, G., and Feuillet, Christian. *Checklist of the Plants of the Guianas (Guyana, Surinam, French Guiana)*, 2nd Edition. Smithsonian Institution: 1997.
- [16] Mennega, E.A., W.C.M. Tammen - de Rooij and M.J. Jansen Jacobs (eds.). *Checklist of Woody Plants of Guyana*. Tropenbos Technical Series 2. The Tropenbos Foundation, Ede, The Netherlands: 1988.
- [17] Delprete, Piero. *Flora of the Guianas*: 2019.
- [18] Hubbell, S.P. & R.B. Foster. Structure, dynamics and equilibrium status of old-growth forest on Barro Colorado Island, In A.H. Gentry (eds.). *Four Neotropical Rain Forests*. Yale University; 1990. p 522-541.
- [19] Gentry, A.H. and Dobson, C.H. Contribution of Non-Tree Species Richness of a Tropical Rain Forest. *Biotropica*, 19.1987,19: 149-156.