

## BIODIVERSITY CONSERVATION THROUGH URBAN GREEN SPACES: A CASE STUDY OF GUJARAT UNIVERSITY CAMPUS IN AHMEDABAD

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### Abstract

*The present study deals with the phytodiversity of Gujarat University campus and the surrounding region which forms an important green space in the urban environment of Ahmedabad city in Gujarat state, India. The extensive field surveys were carried out in the vast study area during 2004 to 2006 covering four different seasons viz. summer, winter, monsoon and spring to cover annual, biennial and perennial plants. A total of 451 species of flowering plants belonging to 338 genera and 101 families were recorded in the study area. Along with these three pteridophytes, two gymnosperms and the algae and fungi group appearing mostly in the monsoon season were also recorded in the study. Among the flowering plants, the herbs were found to be dominant, indicating they favored the climatic factors like less rainfall and high temperature in the study area. Raunkier's biological life forms revealed the dominance of therophytes and phanerophytes, indicating 'Thero-Phanerophytic' phytoclimate in the region. The urban green spaces with such rich plant diversity need to be conserved, especially with the help of the local population, in order to maintain a good environment and biodiversity, thereby improving the overall quality of life.*

**Keywords:** Gujarat University; urban; biodiversity; green space.

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### Introduction

Biodiversity refers to the different genera and species of organisms present in a particular area which varies from one ecosystem to the other. India is a very rich country in terms of the rich flora and fauna present in the natural ecosystems. However, as the human civilizations expanded and as the population increased, many natural ecosystems came under the axe of widespread urbanization. Over the past several decades the rapid and widespread urban sprawls have resulted in the loss of natural vegetation and fragmentation of open green spaces which facilitate environmental and ecological functions [1]. The various large and small cities which have developed for sustaining human populations represent a heterogeneous mixture of remnant natural, semi natural, modified or newly created habitats [2]. The components of natural and cultural realms determine the mixture of introduced and indigenous vegetation of urbanized areas [3-5]. The floristic compositions of various green belts in the cities are closely associated to the human activities [6].

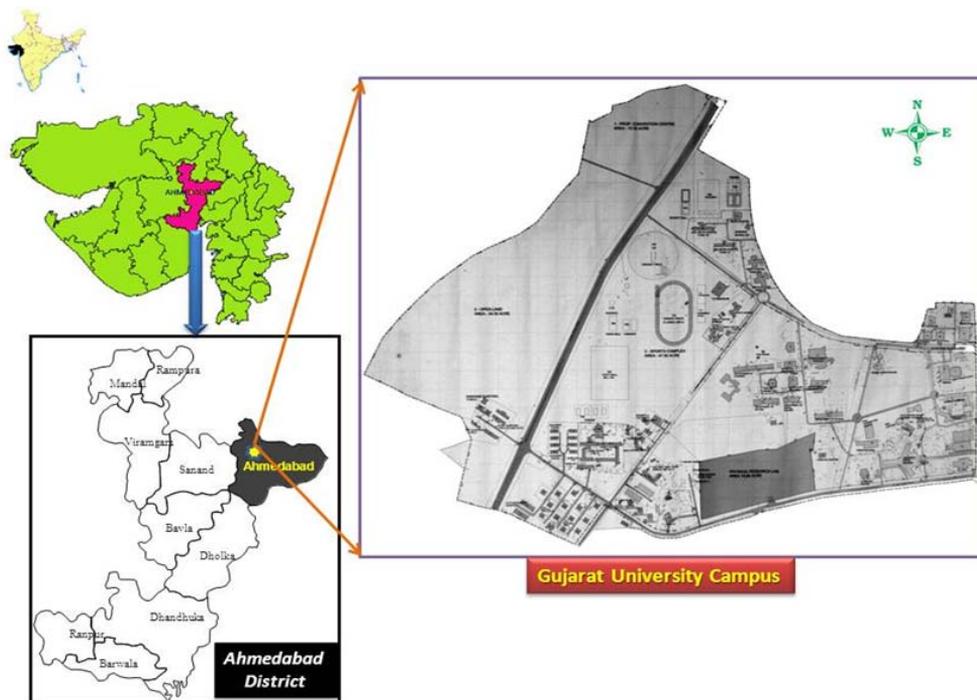
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Ahmedabad being the largest city and former capital of Gujarat state occupies an important position in the overall development of the state. It is regarded as a ‘Mega City’ and is galloping on the road to become a fully developed ‘Metro City’ soon. However, the rapid development and sprawl of the city in different directions has engulfed many chunks of green spaces including agricultural lands. The green spaces in the urban areas are unevenly distributed and not kept primarily for the ecological aspects [7]. The green spaces in Ahmedabad are mostly restricted to college and university campuses, parks and gardens, wetlands and river bank and the open unused lands in the outer fringes of the city. The flora of Gujarat state has been well documented by the monumental works of various researchers [8-11]. In spite of this, there has been a deficit in the studies pertaining to the green cover of important cities like Ahmedabad and the green spaces associated with them. The education institutes contribute significantly to the green cover of urban areas. Recently, there have been few studies focusing on the floral diversity of educational institutes in Ahmedabad like Gujarat Arts and Science College [12] and M. G. Science College [13]. This study mainly focuses on the floristic diversity of the vast campus of Gujarat University and its surrounding region in Ahmedabad city.

**Materials and Methods**

The Gujarat University is located in the Navrangpura area of Ahmedabad city, with a campus spread over an area of 260 acres (Fig. 1). It was founded in the year of 1949 and was incorporated under the Gujarat University act of state government.



**Fig. 1.** The Study area

It is the largest university in the state and caters to the needs of higher education of more than two lakh students scattered over 235 colleges, 15 recognised institutions and 24 approved institutions. The survey of floral diversity was conducted in the campus of Gujarat University, also including H L College of Commerce, L D College of Engineering, Ahmedabad Textile Industries Research Association (ATIRA) and Indian Institute of Management. The climate of the area is extremely dry, with a hot summer in the months of May – June and a mild winter in the months of November – February. The southwest monsoon brings rainfall and a humid climate in the months of July – September.

The study area being large, it was divided into smaller sites and extensive field survey was carried out in different seasons at each site, from February 2004 to March 2006, to record the plant diversity.

The identification of the plants was done as much possible in the field with the help of standard floras [11-16] and voucher specimen photographs were also taken. In the case of plants which could not be identified in the field, they were brought into the laboratory and identified with the help of available monographs, herbariums and other available publications. Notes were also taken on their habits, habitats, life forms and associated diversity.

## Results and Discussions

The results revealed the presence of 451 species of angiosperm plants, belonging to 338 genera and 101 families in the Gujarat University campus and the surrounding areas. Plants belonging to Papilionaceae family dominated the study area, with 36 species, followed by plants of Euphorbiaceae, Asteraceae, Poaceae, Malvaceae, Caesalpinaceae, Mimosaceae, Acanthaceae, Verbenaceae, Convolvulaceae, Amaranthaceae and Solanaceae (Fig. 2).

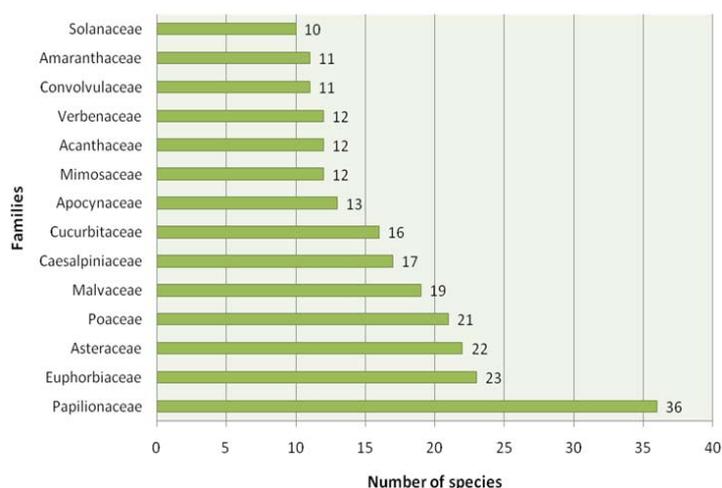


Fig. 2. Dominant plant families in the study area

At the generic level, species belonging to genus *Cassia* were found to be dominating the area, with 9 species, followed by *Euphorbia*, *Sida*, *Ipomoea*, *Hibiscus*, *Alysicarpus*, *Heliotropium*, *Clerodendrum* and *Ficus* (Fig. 3).

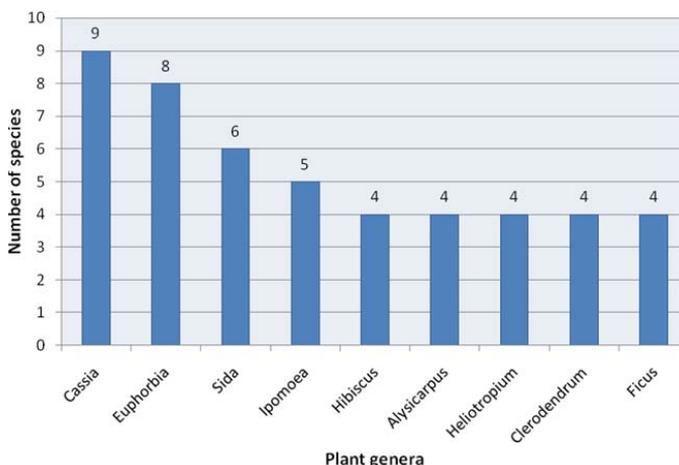


Fig. 3. Dominant plant genera in the study area

Along with the flowering plants, two gymnosperms – *Cycas circinalis* (Cycadaceae) and *Thuja orientalis* (Coniferaceae) and three pteridophytes – *Azolla pinnata* (Azollaceae), *Marsilea minuta* (Marsileaceae) and *Nephrolepis* sp. (Dryopteridaceae) were also present in the study area. During a good monsoon season many wetlands including ponds and ditches appear in the university campus and the surrounding areas, which support luxuriant growth of algae like *Spirogyra* sp., *Chara* sp., *Nitella* sp. and *Hydrodictyon* sp., along with hydrophytes like *Vallisneria*, *Ceratophyllum*, *Nymphaea* and *Hydrilla*. During such moist and humid environments, one can also find fungi, like mushrooms, *Polyporus* sps., geasters, puffballs, *Polystichus*, *Erysiphe* and *Capnodium* growing in various parts of the campus and its surroundings. The plants recorded in the study were broadly divided into trees, shrubs, climbers and twiners, herbs and geophytes. The herbs dominated in the campus (41%), followed by trees, shrubs, climbers and geophytes (Fig. 4). The higher percentage of herbs in the study area can be attributed to edaphic and climatic conditions, such as reduced rainfall and high temperatures. During summers the temperature becomes severe and the soil becomes intolerable for the plants. As a result, only short-living plants, like annual herbs are favored, as they can complete their life cycle before the commencement of the dry season and set seed during summer [15].

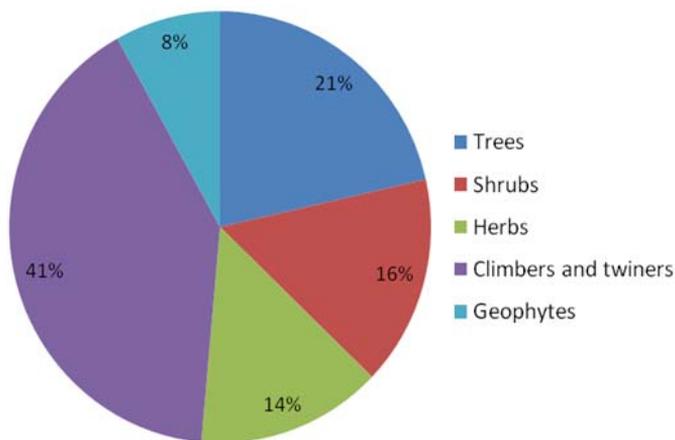


Fig. 4. Percentage composition of different plant habits in the study area

The plants of the university campus were further divided into Raunkier's biological life forms. Raunkier (1934) proposed the term 'Biological Spectrum' to express the life form distribution in a flora and the phytoclimate, under the influence of which these life forms evolved. Among the four life forms represented in the study area, therophytes were dominant with 40.48% , followed by phanerophytes, chamaephytes and geophytes (Fig. 5).

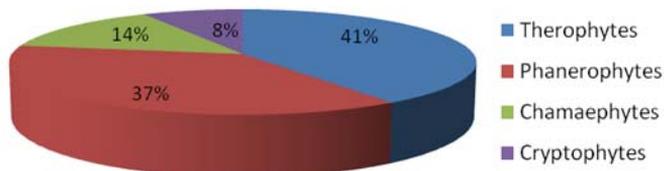


Fig. 5. Percentage distribution of Raunkier's life forms in the study area

The therophytes (mostly annuals) are drought evaders and the whole plant sheds during the unfavorable conditions. The higher percentage of therophytes and phanerophytes compared to other life forms in the study area, seem to be a response to the hot and dry climate, topographic variations and human interferences [15]. The chamaephytes and geophytes (under the category of cryptophytes) were poorly represented in the study area. On comparing the percentage of the life-form classes in Gujarat University with that of the Normal Biological spectrum of Raunkier, we observed that the percentage of therophytes in the former is three times higher than in the latter. The phanerophytes formed the second largest class, with 37.20% in the study area in contrast to the normal biological spectrum, where it forms the largest class with 46%. Overall, the biological spectrum of Gujarat University indicated having a 'Thero-Phanerophytic' phytoclimate, as these two classes show the greatest divergence from the normal biological spectrum proposed by C. Raunkier. [17].

Many plants, especially trees and shrubs (including natural and planted), were present in the campus, which enhance the beauty of the area, with their beautiful flowers and they also provide nutritious fruits. The important fruit trees in the campus include *Annona squamosa* (Custard Apple), *Limonia acidissima* (Wood apple), *Moringa oleifera* (Drumstick tree), *Tamarindus indicus* (Tamarind tree), *Mangifera indica* (Mango tree), *Psidium guajava* (Guava tree), *Carica papaya* (Papaya tree), *Punica granatum* (Pomegranate tree), *Achras zapota* (Sapota fruit tree) and *Embllica officinalis* (Amla tree). Some of the important plants which enhance the beauty of the campus with their colorful and scented flowers include *Hibiscus rosa-sinensis*, *Callistemon lanceolatus*, *Pongamia pinnata*, *Plumeria rubra*, *Delonix regia*, *Lawsonia innermis*, *Ixora parviflora*, *Bougainvillea spectabilis*, *Jasminum multiflorum*, *Nerium indicum*, *Cassia* sps., etc. Moreover, a significant number of plants having ethnobotanical and medicinal values are also distributed in various parts of the study area. Some of the well known medicinal plants with high therapeutic importance, like *Azadirachta indica*, *Althea rosea*, *Embllica officinalis*, *Tribulus terrestris*, *Terminalia chebula*, *Calotropis procera*, *Gymnema sylvestre*, *Ocimum sanctum*, *Ficus religiosa*, *F. benghalensis*, *Aloe vera*, etc. are well represented in the study area. Table 1 lists some of the important fruiting, flowering and medicinal plants in the Gujarat University campus. The University authorities have developed some open spaces in the campus as Medicinal plant gardens, where extensive plantation of medicinal and ethnobotanical plants is carried out, especially with the help of students from various departments. Additionally, the plantation of trees on a large scale is also practiced on various occasions in order to sensitize the people about the importance of green spaces, especially in mega cities like Ahmedabad. Care is also being taken to monitor the growth of the plants in the campus and protect them from any kind of disturbance or destruction by students or outsiders.

**Table 1.** Some important and well represented plants of Gujarat University campus

No.	Botanical Name	Family	Common Name	Habit
<b>Important fruit bearing plants</b>				
1.	<i>Annona squamosa</i> L.	Annonaceae	Custard apple	Tree
2.	<i>Limonia acidissima</i> L.	Rutaceae	Wood apple	Tree
3.	<i>Mangifera indica</i> L.	Anacardiaceae	Mango	Tree
4.	<i>Moringa oleifera</i> Lam.	Moringaceae	Drumstick	Tree
5.	<i>Cicer arietinum</i> L.	Papilionaceae	Chana	Shrub
6.	<i>Tamarindus indica</i> L.	Caesalpinaceae	Tamarind	Tree
7.	<i>Terminalia catappa</i> L.	Combretaceae	Badam	Tree
8.	<i>Eugenia jambolana</i> Lam.	Myrtaceae	Jamun	Tree
9.	<i>Punica granatum</i> L.	Punicaceae	Pomegranate	Tree
10.	<i>Carica papaya</i> L.	Caricaceae	Papaya	Tree
11.	<i>Achras zapota</i> L.	Sapotaceae	Chikoo	Tree
12.	<i>Capsicum annuum</i> L.	Solanaceae	Mirchi	Herb
13.	<i>Kigelia pinnata</i> (Jacq.) DC.	Bignoniaceae	Cucumber tree	Tree
14.	<i>Morus alba</i> L.	Moraceae	Shetur	Shrub
15.	<i>Cocos nucifera</i> L.	Palmaceae	Coconut	Tree
16.	<i>Phoenix sylvestris</i> (L.) Roxb.	Palmaceae	Khajuri	Tree
<b>Important flowering plants</b>				
17.	<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	Jasud	Shrub
18.	<i>Hiptage benghalensis</i> (L.) Kurz.	Malphiaceae	Madhavi Lata	Climber
19.	<i>Impatiens balsamina</i> L. var. <i>coccinea</i>	Balsaminaceae	Balsam	Herb
20.	<i>Bauhinia purpurea</i> L.	Caesalpinaceae	Devkanchan	Tree
21.	<i>Caesalpinia pulcherrima</i> (L.) Swartz	Caesalpinaceae	Galtoro	Shrub
22.	<i>Cassia fistula</i> L.	Caesalpinaceae	Garmalo	Tree
23.	<i>Cassia nodosa</i> L.	Caesalpinaceae	Pink cassia	Tree
24.	<i>Delonix regia</i> Raf.	Caesalpinaceae	Gulmohar	Tree
25.	<i>Albizia lebbek</i> (L.) Bth.	Caesalpinaceae	Pilo shirish	Tree
26.	<i>Quisqualis indica</i> L.	Combretaceae	Madhumalti	Climber
27.	<i>Callistemon lanceolatus</i> DC.	Myrtaceae	Bottle brush	Tree
28.	<i>Ixora parviflora</i> Vahl.	Rubiaceae	Nevari	Shrub
29.	<i>Ixora coccinea</i> L.	Rubiaceae	Ishwaku	Shrub
30.	<i>Jasminum multiflorum</i> (Burm. f.) Andr.	Oleaceae	Jui	Climber
31.	<i>Nerium indicum</i> Mill.	Apocynaceae	Karen	Shrub
32.	<i>Plumeria rubra</i> L.	Apocynaceae	Champo	Tree
33.	<i>Jaquemontia violacea</i> Choisy	Convolvulaceae	Jaxini	Twiner
34.	<i>Duranta plumeri</i> Jacq.	Verbenaceae	Damyanti	Shrub
35.	<i>Bougainvillea spectabilis</i> Willd.	Nyctaginaceae	Bouganvel	Climber
36.	<i>Antigonon leptopus</i> Hk. & Arn.	Polygonaceae	Ice-cream flower	Climber
37.	<i>Canna indica</i> L.	Cannaceae	Bajarbattu	Herb
<b>Important medicinal plants</b>				
38.	<i>Polyalthia longifolia</i> (Sonn) Thw.	Annonaceae	Asopalav	Tree
39.	<i>Cocculus hirsutus</i> (L.) Diels	Menispermaceae	Vevdi	Climber
40.	<i>Argemone mexicana</i> L.	Papaveraceae	Darudi	Herb
41.	<i>Tribulus terrestris</i> L.	Zygophyllaceae	Gokharu	Herb
42.	<i>Azadirachta indica</i> A. Juss	Meliaceae	Neem	Tree
43.	<i>Abrus precatorius</i> L.	Papilionaceae	Chanothi	Twiner
44.	<i>Butea monosperma</i> (Lam) Taub	Papilionaceae	Khakhro	Tree
45.	<i>Pongamia pinnata</i> (L.) Pierre	Papilionaceae	Karanj	Tree
46.	<i>Terminalia chebula</i> Retz.	Combretaceae	Herde	Tree
47.	<i>Eclipta alba</i> (L.) Hassk	Asteraceae	Bhangro	Herb
48.	<i>Vinca rosea</i> L.	Apocynaceae	Barmasi	Herb
49.	<i>Rauwolfia serpentina</i> L.	Apocynaceae	Sarpgandha	Shrub
50.	<i>Calotropis procera</i> (Ait) R. Br.	Asclepiadaceae	Ankdo	Shrub
51.	<i>Gymnema sylvestre</i> (Retz.) Schult	Asclepiadaceae	Madhnashi	Climber
52.	<i>Withania somnifera</i> (L.) Dunal	Solanaceae	Ashwagandha	Shrub
53.	<i>Adhatoda vasica</i> (L.) Nees	Acanthaceae	Ardusi	Shrub
54.	<i>Vitex negundo</i> L.	Verbenaceae	Nagod	Small Tree
55.	<i>Ocimum sanctum</i> L.	Lamiaceae	Tulsi	Herb
56.	<i>Ocimum basilicum</i> L.	Lamiaceae	Damro	Herb
57.	<i>Achyranthes aspera</i> L.	Amaranthaceae	Anghedi	Herb
58.	<i>Emblica officinalis</i> Gaertner	Euphorbiaceae	Amla	Tree
59.	<i>Ficus religiosa</i> L.	Moraceae	Peepal	Tree
60.	<i>Aloe vera</i> L.	Liliaceae	Kunvar Pathu	Herb

## Conclusions

The presence of a rich plant diversity in the Gujarat University campus and the surrounding regions make it one of the important green belts of Ahmedabad city and it helps keeping the area pollution free, to a great extent. Due to unplanned and uncontrolled urban sprawl, the natural ecosystems get fragmented and have patchy distribution in the form of small and large green spaces in the urban landscape. Hence, it is necessary to link the various green spaces of urban areas, which are otherwise fragmented, to form green corridors. The public should also be involved in various activities related to environment awareness and protection, as well as in the development of green spaces in and around cities. Such activities, in association with sustainable urban planning will help increase biodiversity in the cities and improve the quality of life for all residents.

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