

# Rapid Assessment of Biodiversity on the Campus of Indian Institute of Technology - Madras



Report of the Study Commissioned by



The Director  
Indian Institute of Technology Madras  
Chennai - 600 036

Submitted by

Care Earth

No 5, 21<sup>st</sup> Street, Thillaiganganagar, Chennai 600 061  
Phone 044-6543 5841  
E-mail: [mail@careearth.org](mailto:mail@careearth.org)

August 2006

# An Urban Wilderness Revisited

India is one of the countries globally recognized for its mega-diversity. India is also a signatory to the United Nations Convention on Biological Diversity and allied Conventions that concern Climate Change, Desertification and Wetlands. Biological Diversity (Biodiversity), which in its most abbreviated sense is the variation in life in and around us, is therefore of national and international importance.

Explosion of human population and the related corollaries of increased pressure on land and water for habitation, and infrastructure development, have rapidly depleted biodiversity throughout the country. A large part of the remnant biodiversity precariously survives within a mere 3-4 per cent of India's land that is under a system of legally Protected Areas.

Outside the system of Protected Areas, India's biodiversity has often found refuge in many private lands. However, such private biodiversity refuges are becoming scarcer by the day. The handful of biodiversity rich and privately managed refuges include the sprawling campuses of education institutions in otherwise ecologically devastated urban landscapes.

Institution campuses that shelter native biodiversity within mega-cities are essentially ecological islands. Sustainable management of these ecological islands is the greatest challenge that is currently faced by biodiversity conservation initiatives.

By and large, the suburbs of south Chennai have sustained some of the last remnants of the natural habitats that typify north-eastern Tamil Nadu in general. The Guindy National Park, Raj Bhavan and IIT-M habitat complex has historically enjoyed a certain degree of protection and hence has continued to support a range of plant and animal biodiversity.

Pressures due to the rapid expansion and development in south Chennai are nevertheless being continuously felt by this habitat complex. The Guindy National Park (GNP) is a Protected Area, while the Raj Bhavan Complex is a high security area thereby allowing only very restricted presence of humans. This ensures that the biodiversity in both these areas is conserved in a rather insulated manner. In contrast, the continuous presence of humans on the campus of IIT-M has warranted a conservation plan that integrates ecology with its long term development and management goals.

To fulfill this objective, a rapid assessment of the biodiversity of IIT-M was undertaken in August 2006 by a team of ecologists and wildlife biologists. The primary output of the assessment is an inventory of non-cultivated plants, butterflies, amphibians, reptiles, birds and mammals. The assessment has also shed light on the extent and quality of the critical habitats that support the biodiversity on the Campus. Based on the assessment, certain ecological indicators have been identified. These indicators are meant to be yardsticks for not only monitoring the health of the biodiversity on the Campus, but also for undertaking remedial measures for restoration and conservation of the IIT-M campus.

The approximate area of 236ha<sup>1</sup> that forms the campus of IIT-M has hitherto been categorized into three zones viz. Academic Zone, Residential Zone and the Hostel Zone. A fourth zone, labeled as Wilderness Zone, has been identified in the current study. This zone includes the major natural areas of the Campus. Each of the four zones is comparable in size (approximately 60ha), although not in shape, configuration or topography. For instance, the Wilderness Zone that occupies the eastern side was more likely the northern limit of the once extensive Pallikaranai Marsh.

It is apparent that the original vegetation of the Campus was of the Southern Thorn Forest type. This forest type is dominated by thorny and cactus-like plants that produced milky latex. The other species of plants, especially trees that frequent such habitats are the *Ficus* which have significant cultural value, Palmyra (direct use value) or *Lannea coromandelica* (non-use value).

Structurally these forests were patchy with grasses and herbs dominating the land that was adorned with widely spaced thickets; a habitat type that was suited to species of animals like the Blackbuck and the Fan-throated Lizard. Such a structure of vegetation no longer exists on the Campus although it is preserved locally in small patches in the adjacent Guindy National Park (GNP).

The predominance of *Ficus* trees (more than 150 mature trees) indicates that the Campus had a long history of human impact. The size of the other common trees suggests that the transformation from the original to the present vegetation type has taken place in the last 50 and 100 years.

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<sup>1</sup>As inferred from the maps provided by IIT-M. The area of the Campus as per the records of IIT-M is approximately 250 ha.

The Campus continues to support a rich diversity of plants and animals. In 12 days and 2 nights of field surveys, 432 species of plants and animals were identified. The following summary highlights the biodiversity of IIT-M:

Selected Groups	Species Observed	Species Expected
Plants	298	350-400
Butterflies	50	50-55
Frogs and Toads	8	9-10
Lizards	8	10-12
Snakes	4	15
Tortoises/Turtles	1	3
Birds	51	60-80
Mammals	12	20-25
<b>Total</b>	<b>432</b>	<b>517-600</b>

Two hundred and ninety eight species of non-cultivated plants were identified on the Campus. When garden plants are added to this list, the number may increase to 350-400 species.

Thirty-six per cent of the non-cultivated plants on the Campus are trees. However, of the trees, only 40 per cent are native. The greatest contribution to the diversity of native flora comes from the grasses (100 per cent), climbers (84 per cent) and herbs (80 per cent).

One hundred and seven species of plants are not native. Of these, 9 species have proved to be invasive. *Prosopis juliflora* is the most invasive plant on the Campus. Fifty to sixty per cent of the trees in the Wilderness Zone may belong to this species.

The diversity of butterflies is remarkable. Fifty species within a small area as IIT-M is comparatively much higher than the 64 species known in the entire British Isles !

A number of species of plants that occur on the Campus (including the garden plants) are food plants for the larvae of butterflies. Many like *Pavetta indica* attract adult butterflies. Notable butterfly species of the campus include the spectacular Common Banded Peacock, Great Orange Tip, Common Jay, Common Bluebottle, Crimson Rose, etc.

Frogs, toads, lizards, snakes and tortoises/turtles are also diverse. There are a number of pools where the frogs are breeding (a very healthy sign indeed). That the Fan-throated Lizard (see photo) continues to survive on the Campus is also remarkable.



Fifty-one species of birds on the Campus suggests that the habitats are not quite suitable for the feathered animals. Even if the migratory and stray visitors are included, the list is not likely to go beyond 80 species. Many species of birds like the Redvented Bulbul, Black Drongo, Common Iora, etc., are in alarmingly low numbers. The absence of the once abundant Redwhiskered Bulbul is even more alarming. Birds have apparently been the most adversely affected by the habitat transformation that the Campus has undergone in recent years.

Twelve species of mammals (including carnivores like the Jackal, Palm Civet and Mongoose) is a good number for a highly human-impacted campus. This number assumes greater significance as it does not include some of the more adaptive and mobile species of rodents and bats that are likely to be found here. Bonnet Macaque and Chital have successfully adapted to the transformed habitats and human presence on the Campus. There are between 130 and 150 Macaques at present that move around the human dominated zones of the Campus in troupes of 10-15 animals. Their ability to adapt to (and exploit) the available habitat and carelessly disposed food will further increase their numbers leading to serious conflicts with people and other species of animals on the Campus.

Unlike the Macaque, the Chital spends more time within the Wilderness Zone. However, the present population size of 93-155 animals translates into a density of 39-65/km<sup>2</sup>. Such a density is 2-3 times higher than what has been observed even in some of the best nature reserves in India. Despite the large density, the sex ratio is more skewed and in favor of females.

The critically endangered Blackbuck has a population size of 12 (4 males and 8 females). The biggest hindrance to its continued survival is the rapid loss of habitat - open scrub and grasslands. Unless the quality of the available habitat is improved and the extent enhanced to cover at least 30ha, the Blackbuck cannot survive on the Campus.

In order to improve the quality of habitats (with the Blackbuck in view as the Flagship) and restore at least some areas into the original vegetation type, the following steps have to be adopted:

- § Systematically weed the open spaces in the Campus of invasive plants such as *Prosopis juliflora* (saplings), *Cassia siamea* (saplings), *Cassia javanica* (saplings), *Cereus peruvianus*, *Antigonon leptopus* and *Croton bonplandianus*.
- § Remove all *Prosopis juliflora* trees and the cactus (*Cereus peruvianus*) from grids A16-G16, H17, K12 and K13 and restore the habitat using native grasses, bamboo and shrubs.
- § Protect the Lake and swamps by planting bamboo along the periphery. This will particularly help in minimizing the pressure on the Lake from people living in areas adjoining the Campus.
- § The space between the newly constructed Boy's Hostel and the Student's Activity Centre (Hostel Zone; grid no L15-M15) that has been cleared and reclaimed *should not be planted* with trees or lawn grass. Instead the empty space should be restored using a combination of native grasses and bamboo.
- § Over-shading by excessive tree growth has been the bane of IIT-M. Curtail the planting of trees on the Campus. Native grasses should be allowed to take-over all open spaces. There are at least 29 species of native grasses on the Campus that can be used for the purpose.

Habitats that are vital to biodiversity of IIT-M have been identified and described as 'critical' (see Map). These habitats include 2 types of grasslands, bogs, swamps, remnant forests and corridors. Exclusive management plans need to be developed for each of these habitats.

Human impact seems to be at its peak only in and around those habitats that are inhabited by the endangered Blackbuck or the resident and migratory birds i.e. the grasslands and the remnant swamps. Any further construction in these areas can only be detrimental.

Littering and improper disposal of waste is a common practice on the Campus. This is amply illustrated by the scattered distribution of a number of packaging material, metal scrap, containers, pipes etc. The Campus is also dotted with a number of abandoned structures and construction material that need to be removed or put to some use that is beneficial to the immediate habitat.

If human impacts have to be minimized, certain strong decisions need to be made. Areas earmarked as conservation/wilderness areas need to be kept exclusive and no human use (even occasional) should be

permitted. For instance, use of the area within grid K16 which is a Blackbuck habitat for parking cars during important events is to be avoided.

Animals do not recognize artificial boundaries and this has to be considered while cordoning off large areas such as school and play grounds with fencing.

The practice of feeding wild animals by humans is detrimental as exemplified by the large troupes of macaques on the Campus, as well as the Chital that thrive by scavenging. Irresponsible disposal of domestic wastes have attracted the otherwise wild animals to the homesteads. The Wilderness Zone bordering the Lake is used as an open toilet by the labourers who visit the Campus. It is unfortunate that Chital are drawn to feeding on human faeces in this habitat.

Metal topping of new roads is to be strictly avoided, particularly for the proposed radial road within the Campus. Roads adjoining the Blackbuck habitat that end abruptly or have no explicit human use need to be reconverted to mud roads.

The 432 species of plants and animals that were identified during the brief survey have only highlighted the potential magnitude of biodiversity on the Campus. Many groups of organisms such as mosses, fungi, worms, snails, spiders, scorpions, millipedes, insects other than butterflies and fishes are apparently very diverse. When inventoried, these organisms are likely to expand the list of species on the Campus by at least another 500.

The estimated 1000 or more species of organisms on the Campus are the products of the mosaics of critical habitats and the corridors that link them. In this regard, it is vital to maintain the connectivity between GNP and the Campus.

In order to sustain the rich biodiversity on the Campus, a system of monitoring the critical habitats and indicator species has to be evolved. Practical guidelines and tools for biodiversity monitoring can be easily devised. We may then build in-house capacities through training and establish specific teams of volunteers, students, faculty, security men, residents and others for the purpose.

## A cknowledgements

We sincerely thank the Director of IIT-M, Professor M S Ananth, for giving us the opportunity to carry out the study, for financial support and for the overall encouragement. We also wish to place on record our appreciation of the cooperation and services extended by the Campus Administration, especially the Office of the Director, Dean (Planning) and the Security Division.

Our sincere thanks are indeed due to Professor Bhaskar Ramamurthi (Dean-Planning), Professor Ravindra Gettu (Chairman, Estates and Works Committee), Col. P V V Vidyasagar (Chief Security Officer), Mr V Sreenivasan (Assistant Executive Engineer-Horticulture) and Mrs Jayashree Ananth for their interest and involvement in the study. We also wish to thank Ms. Sangeetha Sriram and Ms. Subhalaxmi Das Banerjee for their participation in the process.

R J Ranjit Daniels  
Jayshree Vencatesan  
V Ramakantha  
Jean-Philippe Puyravaud  
V S Ramachandran  
R Arumugam  
Anish Andheria  
Archana Bali  
M O Anand  
Jignasu Dholia

# Assessment of Biodiversity

## Background

The suburbs of south Chennai have sustained some of the last remnants of the natural habitats of erstwhile Madras. Two natural to semi-natural habitat complexes of ecological significance are found around rapidly-developing Velachery. These are the Guindy National Park-IIT-M-Raj Bhavan habitat complex in the North and the Pallikarnai-Perungudi marsh habitat complex in the South and South-East.

Pressures due to the rapid expansion and development of Velachery are being felt by both habitat complexes in that the legally protected Guindy National Park (GNP) has been entirely walled and isolated. Similarly, the adjoining campus of IIT-M has also been walled that the once contiguous habitats and communities of plants and animals are practically divided. The splitting of the once contiguous habitat into two differently managed patches has had a range of ecological impacts. However, it is to be stated that this division has not totally isolated the two campuses, for with the probable exception of the blackbuck, most species of animals and plants do move between the two patches.

GNP is a Protected Area and the biodiversity therein is conserved in a rather insulated manner. On the other hand, the continuous presence of humans on the campus of IIT-M has warranted a conservation plan that integrates ecology with its long term development and management goals. It is in this context that the present project report has been prepared.

## Objectives

- § To map the distribution and diversity of selected groups of plants and animals throughout the campus
- § To identify and map zones of natural habitats which are not only representative but are also vital to the continued survival of biodiversity on the campus
- § To identify and map habitats that have been adversely impacted by invasive species
- § To provide baseline data/information on selected groups of plants and animals with which the ecological health of the campus can be periodically assessed/monitored

## Study Methods

The present study is a rapid assessment of biodiversity on the IIT-M campus over a short period of 30 days in August 2006. The procedure therefore involved field surveys of a handful of selected components of biodiversity such as plants, butterflies, amphibians, reptiles, birds and mammals.

Ten professional ecologists and wildlife biologists were involved in the field study (Table 1). Intensive survey methods (including night transects in selected grids) were used involving teams of 2-3 field biologists for 12 days and 2 nights during the month of August 2006. Tree densities were estimated using the Point-Centred Quarter (PCQ) method. In addition to the above, the team walked extensively covering the entire Campus to enumerate different species as and when they were encountered or sighted.

Table 1: The Field Team

Resource person	Affiliation	Role in the project
Dr R J Ranjit Daniels	Founder Associate and Director, Care Earth (Chennai)	Study design and overall coordination
Dr Jayshree Vencatesan	Founder Associate and Joint Director, Care Earth (Chennai); S Ramseshan Fellow (Current Science); Chairperson Pallikarnai Local Area Environment Committee	Project management and human impact assessment
Dr V S Ramachandran	Associate, Care Earth and Reader in Botany, Kongunadu Arts and Science College, Coimbatore	Plant Enumeration and Taxonomy
Dr J-P Puyravaud	Chief Executive Officer, IT Power India Pvt Ltd. 6&8 Romain Rolland Street, Pondicherry 605 001	Grassland Ecology
Dr V Ramakantha IFS	Principal, State Forest College R S Puram, Coimbatore 641 002	Advisor (Forestry and Campus Ecology)
Mr R Arumugam	Associate, Care Earth and Wildlife Biologist, Centre For Ecological Science, Indian Institute of Science, Bangalore 560 012	Wildlife Conservation (Mammals)
Dr Anish Andheria	2, Sagar building, Next to Bombay Mercantile Co-op Bank, V P Road, Andheri (W), Mumbai 400 058	Wildlife Biologist (Amphibians, Reptiles, Birds & Butterflies)
Ms Archana Bali	No 2302, Shuchi Heights, Film City Road, Goregaon (East), Mumbai 400 053	Wildlife Biologist (Mammals & Birds)
Mr Jignasu Dholia	47, Aurobindo Street, Pondicherry 605 001	Wildlife Biologist (Butterflies)
Mr M O Anand	12/1 Fifth Main, Malleswaram, Bangalore 560 003	Wildlife Biologist (Birds)

The map titled 'Layout of Buildings - Indian Institute of Technology, Madras as on 1.1.2004' that was provided has the layout of the Campus divided into grids that are 144m x 144m and into broader zones which are clearly indicated using different colors. Each grid that is defined on the map has an approximate ground area of 2.07ha. Further, each grid can be easily identified using an alphabetical and numerical code; the Gajendra Circle, for instance, will fall within grid H13. Since the Campus has already been divided into equal area grids, the same layout map was retained for survey and sampling.

The intensity of survey and sampling varied with the component of biodiversity that was in focus. Plants being the most diverse component of biodiversity were surveyed rather extensively covering the 3 zones that have been specifically denoted in the map (Table 2). These are the

1. Academic Zone (the southwestern end of the Campus)
2. Hostel Zone (the southeastern side of the Campus)
3. Residential Zone (a rather long north-south segment along the western side of the Campus that borders the GNP)

In addition, although not named in the map, we have identified the north-south segment that begins at the Main Gate of the Campus and runs along the eastern side till the Hostel Zone (including the 2 oxidation ponds) as the 'Wilderness Zone'. The Wilderness Zone includes the major natural areas of the Campus including the lake, swamps and the prime Blackbuck and Chital habitats.

Within each of the 4 zones, certain grids were visited and surveyed for plants. The number of grids covered during the survey of plants and the specific identify of the grids are provided below (Table 2):

**Table 2: The major zones on the IIT-M campus and the grids in which plants were surveyed**

Zone (and number of grids covered); approximate area	Grid numbers
Academic Zone (10); 60ha	A15, A16, B14, B15, B16, C13, C14, C15, F16, G16
Hostel Zone (5); 58ha	K15, K16, K17, L15, M15
Residential Zone (11); 56ha	K7, K10, L4, L5, L6, L7, M2, M3, N2, N3, N4
Wilderness Zone (18); 62ha	J11, J14, K10, K11, K12, K13, K14, L10, L11, L14, N2, N3, N4, N5, O2, O3, O4, O5

As with all urban campuses, IIT-M has many species of garden and cultivated plants within the built areas, especially in the Academic and Residential Zones. We have ignored these plants and listed only the 'non-cultivated plants' that include those species that are *native* to the landscape, those introduced accidentally or deliberately from other landscapes (including from other continents) and are *naturalized* and thriving on the Campus and trees that have been *planted*.

## Results of the Study

### Major Zones

The IIT-M campus is spread over an approximate area of 236ha (as estimated from the map) that has been classified into 4 broad zones viz., Academic Zone, Hostel Zone, Residential Zone and Wilderness Zone (Table 2). Within this spread, the two Zones that occupy the largest area are the Wilderness Zone (c. 62ha) and the Academic Zone (c. 60ha). Interestingly, despite the differences in the shape, configuration and topography, the area that each of the 4 Zones has occupied is rather comparable (56-62ha).

### Vegetation Type

There have been speculations about the original vegetation type that covered the IIT-M campus. It is widely believed that the adjacent GNP was originally covered with a type of vegetation that belongs to the 'Tropical Dry Evergreen Forest' biome (Raman, 1993; Raman *et al*, 1995; Raman *et al*, 1996), a biome that is spread across Sri Lanka, northeastern Thailand, southwest China, Jamaica and the Bahamas (Mani and Parthasarathy, 2006).

From the descriptions provided in Champion and Seth (1968), Meher-Homji (1973), Gadgil and Meher-Homji (1986), Venkateswaran and Parthasarathy (2005) and Mani and Parthasarathy (2006), it is apparent that within this biome (as in tropical rainforests) there are many types of vegetation that vary from those being dominated by cactus-like *Euphorbia antiquorum* to the evergreen *Manilkara hexandra* or the deciduous *Albizia amara*.

Based on the vegetation structure and species composition, Gadgil and Meher-Homji (1986) described 3 broad types of forests that represent the Tropical Dry Evergreen Forest biome in southern India. More recently, Mani and Parthasarathy (2006) have described a fourth type. These forests are rather low in height (maximum height of 12m) and may locally have a very dense and continuous canopy as seen along

the coasts (Venkateswaran and Parthasarathy, 2005; Mani and Parthasarathy, 2006). The 4 types of southern Indian forests thus identified are:

1. *Acacia planifrons*-*Albizzia amara* type (Southern Thorn Forest; widespread in the Deccan Plateau of Karnataka and Andhra Pradesh and eastern Tamilnadu)
2. *Manilkara-Chloroxylon* type (Stunted Evergreen Forest; coastal Tamilnadu and Andhra Pradesh)
3. *Albizzia amara-Chloroxylon-Anogeissus latifolia* type (Deciduous Forest; widespread in the southern Peninsula)
4. *Memecylon umbellatum-Drypetes sepiaria-Pterospermum canescens* type (Semi-Evergreen Forest; coast to about 50km inland in Tamilnadu)

The Southern Thorn Forest that Champion and Seth (1968) had described is a heterogeneous vegetation type consisting of a mosaic of woodland, scrub, savanna (grasslands) and discontinuous thickets (Meher-Homji, 1973; Gadgil and Meher-Homji, 1986). Such a vegetation type can locally be seen within the campus of the neighboring GNP (in patches bordering IIT-M; see photo), Theosophical Society (especially the Scout Camp Site) in Adyar and elsewhere along the East Coast Road, closer to Mahabalipuram.



While the scrub and thickets are varied in species composition, the woodlands in these sites are often dominated by well-grown banyan trees (*Ficus benghalensis*), wild date (*Phoenix sylvestris*) and palmyra (*Borassus flabellifer*) palms and *Lannea coromandelica*. The scrub and thickets often tend to surround the larger trees, locally creating dense islands of vegetation. Between these islands, the vegetation is more often dominated by grasses. The fact that there is a large number of widely separated mature banyan trees (date and others) on the Campus (especially in the areas closer to GNP) leads us to the notion that the original vegetation type was that which showed a greater affinity to the Southern Thorn Forests.

*Albizia amara* does not seem to exist on the Campus. *Acacia planifrons* was occasionally found during the present study, but nowhere as a dominant (abundant) species. One degenerate individual of *Chloroxylon sweitenia* was also observed. The others, *Memecylon umbellatum*, *Drypetes sepiaria*, *Pterospermum canescens*, *Manilkara hexandra* and *Anogeissus latifolia* were not found even as saplings during the surveys, suggesting that these plants had not occurred on the Campus in recent times.

Further, contrary to the observations of Venkateswaran and Parthasarathy (2005) that the coastal evergreen forests are dominated by trees that belong to families Rubiaceae, Euphorbiaceae and Ebenaceae, 26 per cent of the native tree species that are found on the campus are leguminous (Caesalpiniaceae, Fabaceae and Mimosaceae). Local abundance and dominance of the evergreen species of trees and shrubs including *Atlantia monophylla*, *Murrya paniculata*, *Glycosmis mauritiana* and the naturalized *Rauvolfia tetraphylla* are more likely the result of greater shade created on the Campus in recent times due to the enhanced tree cover. These and the other evergreen species such as *Carissa spinarum*, *Mimusops elengi*, *Capparis zeylanica*, *Leptadenia reticulata*, *Toddalia asiatica*, etc., although frequent on the Campus, amount to less than 5 percent of the species of non-cultivated plants that were enumerated during the present study (see Appendix 1 for a complete list of plants identified during the study).

The apparent high density of under-storey shrubs and trees that are evergreen has prompted speculations that the original forest on the Campus was of an evergreen type. Evergreen under-storey trees such as *Atlantia monophylla*, *Pamburus missionis*, *Garcinia spicata*, *Ixora pavetta*, etc., are also found widely in Chingleput district and quite far away from the coast. They are common in Vedanthangal (a marshland) as well as Thandrai (near Thirukalukundram). They are also patchily found in Marakkanam, around Pondicherry and probably also in Pulicat and Vedaranyam (Gadgil and Meher-Homji, 1986).

Whether these plants are remnants of the once widespread coastal forests or merely an opportunistic assemblage of shade and moisture loving species that have adapted to local micro-climatic conditions cannot be conclusively said. Evergreen understorey trees that are found in the coasts have fleshy fruits which are dispersed by birds and mammals. About 69 percent of such species of plants in the coasts are dispersed by Jackals, Civets, Bats and Rodents (Mani and Parthasarathy, 2006).

To theorize that the present vegetation type is the result of development and isolation that the Campus has experienced during the past 30 to 50 years after this part of GNP was designated to be an educational

institution (between 1961 and 1977) and the Campus was isolated from GNP by a wall that was built 20-25 years ago, since the latter was designated as a National Park in 1978 (Raman *et al*, 1996) is unconvincing.

A comment on the vegetation type of GNP is not being offered since the current team has not undertaken a specific study of the same. However, from the description provided in Raman *et al* (1996) it has been inferred that the vegetation in GNP is also a transformed state of the Southern Thorn Forest type wherein the dense woodlands are dominated by *Acacia planifrons* and the open scrub is dominated by *Borassus flabellifer* and thorny shrubs.

The basic structure and floristic composition of the vegetation of IIT-M is also similar to that described by Champion and Seth (1968) as Southern Thorn Forest; a type of vegetation that is widely distributed east of the Western Ghats in the plateau region where the annual rainfall is around 100cm. In fact, due to the ubiquitous nature and local dominance of *Albizzia amara*, Meher-Homji (1973) treated all the south Indian forests that are found east of the Western Ghats as those that belong to a single 'community'.

### Age and History of the Vegetation

Assessing the age of the present vegetation cover of IIT-M is not simple. One plausible indicator is the age of the largest trees on the Campus which suggest that the present vegetation cover is not quite old. The oldest trees are represented by a handful of species including *Borassus flabellifer*, *Tamarindus indica*, *Eucalyptus sp*, *Prosopis juliflora*, *Lannea coromandelica*, *Ficus sp*, *Limonia acidissima*, *Acacia*



*leucophloea* and *Samanea saman*. Occasionally, a very large and old *Pongamia pinnata* (see photo) and *Wrightia tinctoria* were observed. Judging by the girth of the trunk and architecture, it is apparent that the oldest trees are likely to be in the age class of 50 to 100 years.

What is of interest is that with the exception of *Samanea saman*, *Prosopis juliflora* and *Eucalyptus sp* (the 3 introduced species), the species in which the oldest trees are found are also those that are widely protected by people for their multiple use value or those that are generally spared due to the cultural or non-use value that they possess. In the forests of southern Western Ghats, people spare the *Ficus* trees as they clear the

forests for habitation and agriculture. Forests that are thus degraded tend to be dominated by one or more species of *Ficus* (Vencatesan, 2003).

Little needs to be said on the usefulness of *Borassus flabellifer* (Palmyra), *Tamarindus indica* (Tamarind) and *Limonia acidissima* (Wood Apple). *Acacia leucophloea* and *Pongamia pinnata* too have a range of uses that they are often nurtured locally by people. On the other hand, people generally spared *Lannea coromandelica* and *Wrightia tinctoria* trees as they were of little use to them. *Lannea coromandelica* that was earlier known by the scientific name *Odina odier*, derives its name from the vernacular 'odhiyan maram' a word that could literally mean 'useless'. As the tree has very little timber or fuel wood value, it has been popular as an avenue tree. Throughout south India, including in parts of the Western Ghats, this tree is often the most common species in the highly degraded forests. Similarly, *Wrightia tinctoria* is locally known as 'paala maram' due to the white latex it bears. Early Tamil societies had identified 5 cultural landscapes (of which one typifies degraded landscapes) that were characterized by nominate plants and animals. It is widely believed that the most degraded and desert-like stage of the plains has been named "paala" after *Wrightia tinctoria* that dominates such landscapes. It is also believed that Palakkad (Palghat) in Kerala got its name due to the predominance of *Wrightia tinctoria* trees in the drier forests.

Another aspect of interest is the nature of these trees. None of these are evergreen species. Further, they have a canopy or crown structure (that is much taller than the average 7m observed in coastal forests by Mani and Parthasarathy, 2006) permitting a considerable amount of light penetration favoring the growth of grasses, herbs and shrubs underneath. Given this background, it can be inferred that the vegetation cover that is seen on the Campus at present came into existence recently, and in stages, as outlined below:

- § More than 100 years ago, a highly human impacted vegetation type wherein tall trees of *Ficus spp*, *Lannea coromandelica*, *Borassus flabellifer*, *Pongamia pinnata*, *Wrightia tinctoria*, etc., prevailed and dominated the landscape of what is currently south Chennai. Such a habitat (appropriately described as Southern Thorn Forest) had favored grazing animals like the Blackbuck and reptiles such as the Fan-throated Lizard.
- § During the past 50-100 years exotic species of trees such as *Eucalyptus*, *Prosopis*, etc were first introduced.
- § Soon after this, *Prosopis juliflora* being a naturally invasive plant has apparently over-run the otherwise open and sparsely wooded landscape; especially in the eastern half of the Campus (the Wilderness and Hostel Zones) that is a low-lying northward extension of the Pallikarnai Marsh.

- § As *Prosopis juliflora* reclaimed the marsh and created more shade, it encouraged the recovery of moisture-loving, animal dispersed evergreen species of under-storey trees like *Atlantia monophylla*, *Garcinia spicata*, *Ixora pavetta*, etc.
- § After this, when species of *Cassia* were introduced as avenue trees, they not only enhanced the shade but also contributed immensely to the under-shrub density of the vegetation.
- § The shift from an open (partly marshy) and sparsely wooded, grass-dominated vegetation type to a canopied dense 'forest' has further encouraged the proliferation of shade-loving plants like *Glycosmis mauritiana*, *Murraya paniculata* and *Rauvolfia tetraphylla*. The end product of this rather rapid evolution of a vegetation type is what is seen today on the campus of IIT-M.

### Species Composition of the Vegetation

Two hundred and ninety-eight species of non-cultivated plants were identified on the Campus during the present study. These plants represent 68 families. The families with the largest number of species are Poaceae (the family of grasses; 29 species) and Euphorbiaceae (24 species). The largest taxonomic group however is that of legumes including families Caesalpiniaceae, Fabaceae and Mimosaceae that together contribute 15 per cent of the non-cultivated plant species richness of the Campus. Nineteen per cent of the species are latex bearing plants (a characteristic of human impacted and thorn forests). These plants belong to the families Apocynaceae, Asclepiadaceae, Euphorbiaceae, Moraceae and Sapotaceae (Appendix 1).

Thirty-six per cent of the non-cultivated plants species are trees. Excluding cultivated trees such as papaya, lime, sapota, etc., that are rarely found outside gardens and homesteads, 107 species of trees are present on the IIT-M campus. The greater presence of tree species has rendered the vegetation type as a forest (Table 3).

Table 3: The habits of the non-cultivated plants on the Campus

Habit	Number of species	Percent
Grasses (and Sedges)	36	12
Herbs	72	24
Shrubs	40	13
Climbers	38	13
Palms (and Bamboo)	5	2
Trees	107	36
<b>Total</b>	<b>298</b>	<b>100</b>

Twenty-four per cent of the species are herbs. Grasses/sedges, shrubs and climbers vary between 12 and 13 percent, while species of palms and bamboo are a mere 2 percent. The non-cultivated plants that were identified have been classified into three broad categories viz., native, naturalized and planted, based on the origin of each species. The majority (64 percent) of the species is apparently native to the Campus (Table 4).

Table 4: Status of the non-cultivated plants on the Campus

Status	Number of species	Percent
Native	190	64
Naturalized	64	21
Planted	44	15
<b>Total</b>	<b>298</b>	<b>100</b>

However, if we consider the proportion of native species in each habit type, the actual status of non-cultivated plants on the Campus becomes more evident (Table 5). Sixty per cent of the tree species and 52 per cent of the shrub species are not native. Alternately, sixty-seven per cent of the 190 species that are native to the Campus are grasses, herbs and climbers.

Table 5: Habit type and status of non-cultivated plants

Habit	No. species	No. native species	Percent native species
Grasses (and Sedges)	36	36	100
Herbs	72	57	80
Shrubs	40	19	48
Climbers	38	32	84
Palms (and Bamboo)	5	2	40
Trees	107	42	40

### Native Trees

Forty-two species of trees found on the Campus are native. The common species of native trees are *Lannea coromandelica*, *Cassia fistula*, *Pongamia pinnata*, *Azadirachta indica*, *Acacia leucophloea*, *Ficus benghalensis*, *Streblus asper*, *Syzigium cumini*, *Morinda coreia*, *Atlantia monophylla*, *Limonia acidissima*, *Murraya paniculata*, *Ixora pavetta* and *Pamburus missionis*. Some of the rarer species of native trees are *Litsea glutinosa*, *Sapindus emarginatus*, *Garcinia spicata*, etc (Table 6).

Table 6: Tree species that are native to the Campus

1.	<i>Alangium salviifolium</i>	Alangiaceae
2.	<i>Lannea coromandelica</i>	Anacardiaceae
3.	<i>Wrightia tinctoria</i>	Apocynaceae
4.	<i>Bauhinia racemosa</i>	Caesalpiniaceae
5.	<i>Cassia fistula</i>	Caesalpiniaceae
6.	<i>Delonix elata</i>	Caesalpiniaceae
7.	<i>Capparis divaricata</i>	Capparaceae
8.	<i>Crateva adansonii subsp odoratissa</i>	Capparaceae
9.	<i>Cordia gharaf</i>	Cordiaceae
10.	<i>Drypetes roxburghii</i>	Euphorbiaceae
11.	<i>Butea monosperma</i>	Fabaceae
12.	<i>Pongamia pinnata</i>	Fabaceae
13.	<i>Garcinia</i>	Guttiferae
14.	<i>Listea glutinosa</i>	Lauraceae
15.	<i>Strychnos nux-vomica</i>	Loganiaceae
16.	<i>Thespesia populniodes</i>	Malvaceae
17.	<i>Azadirachta indica</i>	Meliaceae
18.	<i>Acacia ferruginea</i>	Mimosaceae
19.	<i>Acacia leucophloea</i>	Mimosaceae
20.	<i>Acacia nilotica subsp indica</i>	Mimosaceae
21.	<i>Acacia planifrons</i>	Mimosaceae
22.	<i>Albizia lebbek</i>	Mimosaceae
23.	<i>Dichrostachys cinerea</i>	Mimosaceae
24.	<i>Ficus amplissima</i>	Moraceae
25.	<i>Ficus benghalensis</i>	Moraceae
26.	<i>Ficus racemosa</i>	Moraceae
27.	<i>Streblus asper</i>	Moraceae
28.	<i>Syzygium cumini</i>	Myrtaceae
29.	<i>Ziziphus mauritiana</i>	Rhamnaceae
30.	<i>Benkara malabarica</i>	Rubiaceae
31.	<i>Morinda coreia</i>	Rubiaceae
32.	<i>Ceriscoides turgida</i>	Rubiaceae
33.	<i>Ixora pavetta</i>	Rubiaceae
34.	<i>Pavetta indica</i>	Rubiaceae
35.	<i>Atlantia monophylla</i>	Rutaceae
36.	<i>Chloroxylon sweitenia</i>	Rutaceae
37.	<i>Limonia acidissima</i>	Rutaceae
38.	<i>Murraya paniculata</i>	Rutaceae
39.	<i>Pamburus missionis</i>	Rutaceae
40.	<i>Santalum album</i>	Santalaceae
41.	<i>Sapindus emarginatus</i>	Sapindaceae
42.	<i>Madhuca indica</i>	Sapotaceae

## Native Grasses

Twelve per cent of the non-cultivated plant species that were found on the Campus are grasses (family Poaceae) and sedges (family Cyperaceae; see Appendix 1). All these are native species (Table 5). The 29 species of native grasses are listed in Table 7. This is a conservative number as many species that were not in bloom could not be identified during the survey. It is expected that not less than 10 other species of native grasses can be added to the list if the grasses are specifically surveyed during the flowering season (which is one-two months after the monsoon). The two species of tall grasses are *Chrysopogon orientalis* and *Saccharum spontaneum*. All other species are moderate or short.

Table 7: Species of grasses that are native to the Campus

1. *Aeluropus lagopoides*
2. *Aristida hystrix*
3. *Aristida setacea*
4. *Bothriochloa pertusa*
5. *Brachiaria distachya*
6. *Brachiaria ramosa*
7. *Chloris barbata*
8. *Chloris montana*
9. *Chrysopogon orientalis*
10. *Cynodon barberi*
11. *Cynodon dactylon*
12. *Dactyloctenium aegyptium*
13. *Desmostachya bipinnata*
14. *Digitaria longiflora*
15. *Eleusine indica*
16. *Eragrostis japonica*
17. *Eragrostis tenella*
18. *Eragrostis viscosa*
19. *Eragrostis riparia*
20. *Heteropogon contortus*
21. *Iseilema anthephoroides*
22. *Iseilema laxum*
23. *Oplismenus compositus*
24. *Perotis indica*
25. *Saccharum spontaneum*
26. *Sporobolus coromandelianus*
27. *Sporobolus maderaspatanus*
28. *Sporobolus tremulus*
29. *Zoysia matrella*

## Naturalized and Invasive Plants

Species of plants that have adapted to a new habitat and have successfully colonized it are treated as naturalized. Many of the naturalized species of plants have also proved to be invasive. Sixty-four species of plants are naturalized of which 19 (31 percent) are leguminous plants (families Caesalpiniaceae, Fabaceae and Mimosaceae) (Table 8). The genus of plants with the largest number of invasive species is *Cassia*.



*Cassia occidentalis* and *Cassia tora* along with *Croton bonplandianus* had proved to be detrimental to the grasslands of GNP (Raman *et al*, 1995). In IIT-M, the two *Cassia* species are not presently invasive. However, dense growth of *Croton bonplandianus* (see photo) in parts of the excavated open areas within the Wilderness Zone has suggested that the species has the potential of being an invasive on the Campus.



Naturalized plants that have already become invasive on the Campus are mainly trees such as *Prosopis juliflora*, *Cassia siamea*, *Cassia javanica* and *Polyalthia longifolia*. Amongst the shrubs, *Antigonon leptopus*, *Cereus peruvianus* and *Rauvolfia tetraphylla* (see photo) are invasive. Of these, the former two species have been identified as invasive in GNP too, where their spread is apparently favoured by shade (Raman *et al*, 1995). *Rauvolfia tetraphylla*, a shrub that bears

attractive red berries, has similarly invaded parts of the Campus taking advantage of the shade. *Parthenium hysterophorus* is generally considered an invasive. This plant that is more adapted to cool and dry habitats in south India is not an immediate threat within the IIT-M Campus. Scattered individuals found on the Campus can be manually removed and composted.

Table 8: List of plants that are naturalized on the Campus

Species	Family	Habit
<i>Aerva lanata</i>	Amaranthaceae	Herb
<i>Alternanthera parochynoides</i>	Amaranthaceae	Herb
<i>Amaranthus viridis</i>	Amaranthaceae	Herb
<i>Gomphrena celosioides</i>	Amaranthaceae	Herb
<i>Mangifera indica</i>	Anacardiaceae	Tree
<i>Annona squamosa</i>	Annonaceae	Tree
<i>Polyalthia longifolia</i>	Annonaceae	Tree
<i>Rauvolfia tetraphylla</i>	Apocynaceae	Shrub
<i>Catharanthus roseus</i>	Apocynaceae	Shrub (small)
<i>Thevetia peruviana</i>	Apocynaceae	Tree
<i>Pistia stratiotes</i>	Araceae	Herb (aquatic)
<i>Blumea bifoliata</i>	Asteraceae	Herb
<i>Parthenium hysterophorus</i>	Asteraceae	Herb
<i>Tridax procumbens</i>	Asteraceae	Herb
<i>Millingtonia hortensis</i>	Bignoniaceae	Tree
<i>Tecoma stans</i>	Bignoniaceae	Tree (small)
<i>Cereus peruvianus**</i>	Cactaceae	Shrub
<i>Opuntia sp</i>	Cactaceae	Shrub
<i>Cassia alata</i>	Caesalpiniaceae	Shrub
<i>Cassia occidentalis*</i>	Caesalpiniaceae	Shrub
<i>Parkinsonia aculeata</i>	Caesalpiniaceae	Shrub
<i>Cassia tora*</i>	Caesalpiniaceae	Shrub (small)
<i>Bauhinia purpurea</i>	Caesalpiniaceae	Tree
<i>Cassia javanica</i>	Caesalpiniaceae	Tree
<i>Cassia siamea</i>	Caesalpiniaceae	Tree
<i>Delonix regia</i>	Caesalpiniaceae	Tree
<i>Peltophorum pterocarpum</i>	Caesalpiniaceae	Tree
<i>Tamarindus indicus</i>	Caesalpiniaceae	Tree
<i>Caesalpinia pulcherrima</i>	Caesalpiniaceae	Tree (small)
<i>Quisqualis indica</i>	Combretaceae	Climber
<i>Ipomoea hederifolia</i>	Convolvulaceae	Climber
<i>Evolvulus nummularius</i>	Convolvulaceae	Herb
<i>Dioscorea bulbifera</i>	Dioscoreaceae	Climber
<i>Muntingia calabura</i>	Elaeocarpaceae	Tree
<i>Euphorbia serpens</i>	Euphorbiaceae	Herb

Species	Family	Habit
<i>Phyllanthus amarus</i>	Euphorbiaceae	Herb
<i>Croton bonplandianus</i> *	Euphorbiaceae	Shrub
<i>Jatropha gossypifolia</i>	Euphorbiaceae	Shrub
<i>Pedilanthus tithymaloides</i>	Euphorbiaceae	Shrub
<i>Euphorbia tirucalli</i>	Euphorbiaceae	Tree (small)
<i>Clitoria ternatea</i>	Fabaceae	Climber
<i>Crotalaria pallida</i>	Fabaceae	Shrub
<i>Crotalaria retusa</i>	Fabaceae	Shrub (aquatic)
<i>Erythrina variegata</i>	Fabaceae	Tree
<i>Malvastrum coromandelianum</i>	Malvaceae	Shrub
<i>Melia azedarach</i>	Meliaceae	Tree
<i>Acacia auriculiformis</i>	Mimosaceae	Tree
<i>Adenanthera pavonia</i>	Mimosaceae	Tree
<i>Leucaena leucocephala</i>	Mimosaceae	Tree
<i>Pithecellobium dulce</i>	Mimosaceae	Tree
<i>Prosopis juliflora</i> *	Mimosaceae	Tree
<i>Samanea saman</i>	Mimosaceae	Tree
<i>Artocarpus heterophyllus</i>	Moraceae	Tree
<i>Ficus religiosa</i>	Moraceae	Tree
<i>Psidium guajava</i>	Myrtaceae	Tree
<i>Bougainvillea glabra</i>	Nyctaginaceae	Climber
<i>Antigonon leptopus</i> **	Polygonaceae	Climber
<i>Mitracarpus verticillatus</i>	Rubiaceae	Herb
<i>Murraya koenigii</i>	Rutaceae	Tree
<i>Datura innoxia</i>	Solanaceae	Shrub (small)
<i>Guazuma ulmifolia</i>	Sterculiaceae	Tree
<i>Typha angustata</i>	Typhaceae	Herb
<i>Lantana camara</i>	Verbenaceae	Shrub

Note: Plants shown in bold are those that have proved to be invasive on the Campus; \* identifies the plants that Raman et al (1995) have listed as invasive in the grasslands and \*\* as invasive in the shaded parts of GNP

Using PCQ methods, 60 trees were sampled at 15 random points within the Wilderness Zone. These trees included species such as *Prosopis juliflora*, *Cassia siamea*, *Cassia javanica*, *Borassus flabellifer*, *Pongamia pinnata*, *Polyalthia longifolia*, *Tamarindus indica*, etc. Of the trees, 33 individuals belonged to *Prosopis juliflora* suggesting that more than 50 per cent of the trees within the Wilderness Zone could be of this invasive species.

## *Ficus* species and their Significance

In ecology, the term keystone is used to describe a species of plant or animal that plays a role that is disproportionately larger than its actual biomass in an ecosystem. Wild fig trees (*Ficus* species) are often considered as keystone species. Most tropical fig trees are rather long-lived, large in size and have very complex branching patterns that they physically offer shelter to a number of different species of organisms. They also produce edible fruits that are a source of food to insects, birds and mammals. The most interesting trait in wild fig trees is their rather sporadic and non-synchronized pattern of flushing leaves and fruiting. Such a pattern guarantees a rather non-seasonal (and continuous) supply of food to those organisms that depend on them.

Many species of Indian wild figs are considered as sacred trees. Apart from the magnificent structure and longevity, it is the milky latex that these trees bear that has attracted the most attention from human beings. As a result, in almost all habitat types, *Ficus* trees are spared, making them the most numerous and often the only trees in landscapes that have been heavily impacted by people (Vencatesan, 2003).

Six species of *Ficus* were identified on the Campus during the present study. These include 3 native species viz., *Ficus benghalensis*, *Ficus amplissima* and *Ficus racemosa* (occasional), 1 naturalized (*Ficus religiosa*) and 2 planted species (*Ficus elastica* and *Ficus benjamina*). Of these, the banyan (*Ficus benghalensis*) is the most numerous followed by the rather similar looking *Ficus amplissima*. 152 mature trees of *Ficus benghalensis* were enumerated on the Campus which is an average density of 1.2 trees for every 2ha. In other words, if the banyan trees were evenly distributed, the population is adequate to dot every grid on the Campus with at least one tree.

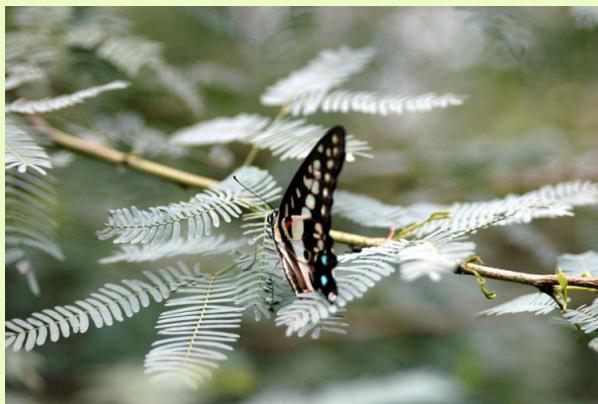


On ground the distribution is rather uneven and clumped in that, the chance of finding a mature banyan tree in any grid within the Academic Zone is the highest and that of finding one within the Hostel Zone is close to zero. After the Academic Zone, the Residential Zone has the highest density of mature banyan trees. About 57 per cent of all mature banyan trees on the campus is found within the Academic Zone where each grid, on an average,

may hold as many as 3 trees (a maximum of 13 in grid G13). The second major concentration of the banyan is in the Residential Zone where 38 per cent of the mature trees are found. The average density of mature banyan trees per grid however is just 1.

## Butterflies

Fifty species of butterflies were identified. They represent five families viz., Papilionidae (Swallowtails; 14 per cent), Pieridae (Whites and Yellows; 22 per cent), Nymphalidae (Brushfoots; 40 per cent), Lycaenidae (Blues; 16 per cent) and Hesperidae (Skippers; 8 per cent; Table 9). The most numerous species were Common Mormon,



Common Crow, Common Jay, Common Emigrant, Lime, Lemon Pansy and Lime Blue. Of these, the Common Jay (see photo) is a species that is generally associated with dense forests (Kunte, 2000).

The fifty species of butterflies vary in size, shape and color. The largest butterfly on the Campus is the Great Orange Tip and the smallest is the Grass Jewel. Incidentally, the Grass Jewel which has a wingspan of 15mm is the smallest Indian butterfly.

**Table 9: List of Butterflies identified during the August 2006 Survey**

[Note: Names are after Kunte (2000)]

S. No	Family & Common English Name	Scientific Name
1.	Papilionidae Common Rose	<i>Pachliopta aristolochiae</i>
2.	Crimson Rose	<i>Pachliopta hector</i>
3.	Common Bluebottle	<i>Graphium sarpedon</i>
4.	Common Jay	<i>Graphium doson</i>
5.	Lime	<i>Papilio demoleus</i>
6.	Common Mormon	<i>Papilio polytes</i>
7.	Common Banded Peacock	<i>Papilio crino</i>
	Pieridae	
8.	Common Emigrant	<i>Catopsilia pomona</i>
9.	Mottled Emigrant	<i>Catopsilia pyranthe</i>
10.	Common Jezebel	<i>Delias eucharis</i>
11.	Psyche	<i>Leptosia nina</i>
12.	Small Grass Yellow	<i>Eurema brigitta</i>

S. No.	Family & Common English Name	Scientific Name
13.	Common Grass Yellow	<i>Eurema hecabe</i>
14.	Common Gull	<i>Cepora nerissa</i>
15.	Pioneer	<i>Anaphaeis aurota</i>
16.	Yellow Orange Tip	<i>Ixias pyrene</i>
17.	Great Orange Tip	<i>Hebomoia glaucippe</i>
18.	Common Wanderer	<i>Pareronia valeria</i>
.	Nymphalidae	
19.	Common Evening Brown	<i>Melanitis leda</i>
20.	Common Bush Brown	<i>Mycalesis perseus</i>
21.	Tawny Coster	<i>Acraea violae</i>
22.	Common Leopard	<i>Phalanta phalantha</i>
23.	Baronet	<i>Euthalia nais</i>
24.	Angled Castor	<i>Ariadne ariadne</i>
25.	Common Castor	<i>Ariadne merione</i>
26.	Yellow Pansy	<i>Junonia hierta</i>
27.	Blue Pansy	<i>Junonia orithya</i>
28.	Lemon Pansy	<i>Junonia lemonias</i>
29.	Peacock Pansy	<i>Junonia almana</i>
30.	Grey Pansy	<i>Junonia atlites</i>
31.	Chocolate Pansy	<i>Junonia iphita</i>
32.	Danaid Eggfly	<i>Hypolimnas misippus</i>
33.	Glassy Tiger	<i>Parantica aglea</i>
34.	Blue Tiger	<i>Tirumala limniace</i>
35.	Plain Tiger	<i>Danaus chrysippus</i>
36.	Striped Tiger	<i>Danaus genutia</i>
37.	Common Indian Crow	<i>Euploea core</i>
38.	Black Rajah	<i>Charaxes dolon</i>
	Lycaenidae	
39.	Common Pierrot	<i>Castalius rosimon</i>
40.	Indian Cupid	<i>Everes lacturnus</i>
41.	Dark Grass Blue	<i>Zizeeria karsandra</i>
42.	Zebra Blue	<i>Leptotes plinius</i>
43.	Lime Blue	<i>Chilades laius</i>
44.	Grass Jewel	<i>Freyeria trochilus</i>
45.	Gram Jewel	<i>Euchrysops cnejus</i>
46.	Common Caerulean	<i>Jamides bochus</i>
	Hesperiidae	
47.	Common Banded Awl	<i>Hasora chromu</i>
48.	Brown Awl	<i>Badamia exclamationis</i>
49.	Indian Skipper	<i>Spialia galba</i>
50.	Rice Swift	<i>Borbo cinnara</i>

The butterflies on the Campus are dependent on a number of plant species which they feed on as larvae and adults. Since the larvae are not as mobile as the adults, the presence of their food plants in the Campus is of greater significance. The food plants of the various species of butterfly larvae that are found on the Campus are listed in Table 10.

Table 10: List of Food Plants of Butterfly Larvae in IIT-M

Butterfly Species	Food Plants
Common Rose	None observed
Crimson Rose	None observed
Common Bluebottle	<i>Polyalthia longifolia</i>
Common Jay	<i>Polyalthia longifolia</i>
Common Banded Peacock	<i>Chloroxylon sweitenia</i>
Lime*	<i>Murraya koenigii</i> , <i>Chloroxylon sweitenia</i> (rare)
Common Mormon*	<i>Murraya koenigii</i> , <i>Murraya paniculata</i>
Common Emigrant	<i>Bauhinia racemosa</i> , <i>Butea monosperma</i> , <i>Cassia fistula</i> , <i>Cassia siamea</i> , <i>Cassia tora</i>
Mottled Emigrant	<i>Cassia fistula</i> , <i>Cassia occidentalis</i> , <i>Cassia tora</i>
Common Jezebel	None observed
Psyche	<i>Capparis zeylanica</i> , <i>Cleome viscosa</i> , <i>Crateva adansonii</i>
Small Grass Yellow	None observed
Common Grass Yellow	<i>Cassia fistula</i> , <i>Cassia tora</i> , <i>Pithecellobium dulce</i>
Common Gull	<i>Capparis zeylanica</i>
Pioneer	<i>Capparis zeylanica</i>
Yellow Orange Tip	None observed
Great Orange Tip	<i>Crateva adansonii</i>
Common Wanderer	<i>Capparis zeylanica</i>
Common Evening Brown	<i>Oplismenus compositus</i>
Common Bush Brown	<i>Oplismenus compositus</i>
Tawny Coster	None observed
Common Leopard	None observed
Baronet	None observed
Angled Castor	<i>Tragia involucrata</i>
Common Castor	<i>Tragia involucrata</i>
Yellow Pansy**	None observed
Blue Pansy**	None observed
Lemon Pansy**	None observed
Peacock Pansy**	<i>Phyla nodiflora</i>
Grey Pansy**	None observed
Chocolate Pansy	None observed

Butterfly Species	Food Plants
Danaid Eggfly**+	<i>Portulaca oleracea</i>
Glassy Tiger	<i>Calotropis gigantea, Tylophora indica</i>
Blue Tiger	<i>Calotropis gigantea, Tylophora indica, Wattakaka volubilis</i>
Plain Tiger	<i>Calotropis gigantea</i>
Striped Tiger	None observed
Common Indian Crow	<i>Ficus benghalensis, Ficus religiosa, Hemidesmus indica, Ichnocarpus frutescens, Nerium oleander, Streblus asper, Tylophora indica</i>
Black Rajah	<i>Tamarindus indica</i>
Common Pierrot	<i>Ziziphus mauritiana</i>
Indian Cupid	None observed
Dark Grass Blue	<i>Amaranthus viridis</i>
Zebra Blue	<i>Albizia lebbek</i>
Lime Blue*	None observed
Grass Jewel	None observed
Gram Jewel	<i>Butea monosperma</i>
Common Caerulean	<i>Abrus precatorius, Butea monosperma, Pongamia pinnata, Saraca indica</i>
Common Banded Awl	<i>Pongamia pinnata</i>
Indian Skipper+	None observed
Brown Awl	None observed
Rice Swift	<i>Eragrostis spp</i>

Source: Kunte (2000); \*Also feed on *Citrus* spp; \*\*Also feed on garden plants like *Barleria* spp; +Also feed on *Hibiscus* spp.

The numerically dominant butterflies such as the Common Emigrant and Common Crow have a number of plant species within the Campus on which their larvae feed. On the other hand, known larval host plant species of the rarer butterflies like the Common Jezebel and Tawny Coster (see photo) are rather scarce or absent on the Campus. Larvae of the Pansy butterflies, for instance, are known to feed on garden plants like *Barleria* spp (*disambar poo*). Also in Table 10, wherever it has been mentioned 'none observed', it is quite likely that the larvae feed on close relatives of plants that are reported as larval food.



## Amphibians and Reptiles



Nine to ten species of amphibians are found in and around the waterlogged Velachery (RJR Daniels, personal observation) and hence it was expected that all these species would be found within the Campus. Only eight species of amphibians were found during the surveys. Notable in their absence were the Common Indian Toad *Bufo melanostictus* and the Painted Frog *Kaloula taprobanica*.

The most common species of amphibian was the Orate Narrow-mouthed Frog (see photo). This frog was not only sighted but also heard rather distinctly both during the day and night. There were also many tadpoles of this species in the shallow, clear puddles and pools. The other two species of amphibians that were frequently encountered were the Paddy Field Frog and Common Tree Frog (see photo).



Amongst reptiles, the most commonly encountered reptile was the Garden Lizard (see photo). Besides the Garden Lizard, the following reptiles were also sighted: Bronzed Skink, Indian Fan-throated Lizard (along GNP wall) and Geckoes (Table 11; see photo). In contrast, the number of snakes sighted was low: Rat Snake was sighted on two instances, and the Checkered Keelback (Water Snake) and the Green Vine Snake were seen just once.



Snakes being shy animals can easily evade sampling. At least 15 species are likely to be found on the Campus including 5 species viz., the Spectacled Cobra (*Naja naja*), Common Krait (*Bungarus caeruleus*), Russell's Viper (*Daboia russelli*), Saw-scaled Viper (*Echis carinatus*) and Slender Coral Snake (*Callophis melanurus*), that are venomous. All these snakes are known to occur in GNP and Velachery (RJR Daniels, personal observation). As there are enough passages for the movement of snakes between the neighboring areas, their presence on the Campus cannot be ruled out. The presence of the Russell's Viper was inferred from the remains (part of the lower jaw) that were found within a hollow tree close to the Velachery Gate and GNP wall.

The marshes and the lake in IIT-M should be an ideal habitat for the Black Pond Turtle (*Melanochelys trijuga*) and the Indian Flapshell Turtle (*Lissemys punctata*). Although these were not sighted during the survey, in view of the fact that these are rather common in the adjoining area of Velachery it is being presumed that they are found on the Campus. Hundreds of Starred Tortoises (*Geochelone elegans*) have been released into GNP over the years. There is an indication that some of these have colonized the IIT-M campus. Interestingly, a burrow of the Common Monitor Lizard was found within the Academic Zone. The species exists in very small numbers and there are signs that the giant lizard is being poached from within the Campus.

Table 11: List of Amphibians and Reptiles Identified During the August 2006 Survey

Common English Name	Scientific Name
Paddy Field Frog	<i>Fejervarya limnocharis</i>
Indian Pond Frog	<i>Euphlyctis hexadactylus</i>
Indian Skipping Frog	<i>Euphlyctis cyanophlyctis</i>
Ornate Narrow-mouthed Frog	<i>Microhyla ornata</i>
Red Narrow-mouthed Frog	<i>Microhyla rubra</i>
Jerdon's Bull Frog	<i>Hoplobatrachus crassus</i>
Southern Burrowing Frog	<i>Tomopterna rolandae</i>
Common Tree Frog	<i>Polypedates maculatus</i>
Bark Gecko	<i>Hemidactylus leschenault</i>
Termite Hill Gecko	<i>Hemidaiictylus triedrus</i>
Southern House Gecko	<i>Hemidactylus frenatus</i>
Spotted Gecko	<i>Hemidactylus brooki</i>
Little Skink	<i>Mabuya macularius</i>
Garden Lizard	<i>Calotes versicolor</i>
Indian Fan-throated Lizard	<i>Sitana ponticeriana</i>
Rat Snake	<i>Ptyas mucosa</i>
Common Vine Snake	<i>Ahaetulla nasutus</i>
Checkered Keelback	<i>Xenocrophis piscator</i>
Russell's Viper	<i>Daboia russelli</i>
Common Monitor Lizard	<i>Varanus bengalensis</i>
Starred Tortoise	<i>Geochelone elegans</i>

Note: Names are after Daniels (2005), Das (1997), Whitaker (1978) and Daniel (1983)

## Birds

One hundred and fifty species of birds have been recorded (over the years) in the adjacent GNP (Raman *et al*, 1995). Elsewhere, urban campuses are known to support as high a bird species richness (or even higher) as GNP (Daniels, 1992). It is hence natural to assume that all species found in GNP are also present on the Campus. However, contrary to expectation, there is apparently a much lower number of species of birds on the Campus; 51 species were observed which included 18 species of songbirds (35 percent; Table 12). The two most abundant birds on the Campus are the House Crow and the Common Myna. Both these species are quite adapted to human habitations and thrive as scavengers. They are also aggressive and often tend to out-compete other species of birds and animals wherever they occur.

It is apparent that many species of birds (especially the songbirds) have disappeared from the Campus in recent years. The most obvious absentee is the Redwhiskered Bulbul. In the 1980s, this bird used to be quite numerous on the Campus and was practically seen everywhere (RJR Daniels, personal observation). Similarly, the Black Drongo, Common Iora and Redvented Bulbul that were frequent in IIT-M during the 1990s seem to have declined in numbers drastically. They were observed only along the periphery of the Campus especially along GNP wall.

Other resident birds may have also joined the unfortunate exodus. To conclude that these birds are locally extinct is not in the interest of conservation since there are chances that these birds will re-colonize the Campus from the adjacent Velachery and GNP, when the local environment is made conducive. However, the fact that the once numerous and common birds were not seen during the present survey is indeed an indication that these species have drastically declined in numbers.

That the bulbuls are no longer common enough to be seen by a casual observer is surprising given the high density of shrubs (*Glycosmis*, *Murraya*, *Rauvolfia*, etc) that bear small fleshy fruits. The probable reason for their decline (along with others like the Common Iora) is not the lack of food, but the lack of appropriate nesting sites. Many of our smaller birds are known to nest at low heights (often within homesteads) preferring shrubs that are woody and well branched (see photo). Such



shrubs are not scarce on the Campus. However, the high density of nest predators such as the Bonnet Macaque, Three-striped Palm Squirrel, Mongoose, Palm Civet, House Crow, Myna, House Rat and even Domestic Cat throughout the Campus (especially closer to human habitation) has probably been the reason for the apparent decline of these once common birds.

In fact, in Chennai where predator pressure at the lower heights is rather high, the Yellowbilled Babbler, another species that nests at rather low heights, has been observed nesting among the crowns of tall coconut palms (RJR Daniels, personal observation). Being social birds, the Babbler also has well evolved predator warning and defense strategies. While the other low-nesting birds have practically disappeared from the Campus, the Babbler has prevailed probably due to the adaptation.

Birds that are vulnerable include aquatic birds that are resident on the Campus. The remnant marshes (now in the form of swamps) and the adjoining oxidation ponds are home to the Purple Moorhen, Indian Moorhen, Whitebreasted Waterhen and Little Grebe. Whereas the Waterhen and Grebe are quite nomadic, the Moorhen are not. They are low-flying birds with a rather weak flight and hence are not good dispersers. Further, the Purple Moorhen is a bird that is locally cherished by people for its meat.

Hérons, Storks and Cormorants used to be common on the Campus till a few years ago. The large communal roost behind the Student's Activity Centre (grids L14 & L15; clearly marked by the dead trees) where these birds rested seasonally had no birds during the survey. Just one Little Cormorant in the lake, a few Night and Pond herons in the swamp and a single Striated Heron (around the lake) were sighted during the survey. The occurrence of the Striated Heron on the Campus is rather unusual as it has not been earlier reported from either here or the neighboring Pallikarnai Marsh. Openbill Stork and Cattle Egret were not seen during the survey.

August is just the beginning of the migratory season and hence, most of the migrant birds were not found on the Campus. However, early visitors like the Eurasian Golden Oriole, Barn Swallow and the Oriental Turtle Dove were seen in small numbers. Another 20 species of migratory birds are likely to visit the Campus as the season progresses into winter.

Table 12: List of Birds Identified During the Survey in August 2006

S.No.	Common English Name	Scientific Name
1.	Little Grebe	<i>Tachybaptus ruficollis</i>
2.	Little Cormorant	<i>Phalacrocorax niger</i>
3.	Indian Pond Heron	<i>Ardeola grayii</i>
4.	Striated Heron	<i>Butorides striatus</i>
5.	Blackcrowned Night Heron	<i>Nycticorax nycticorax</i>
6.	Black Kite	<i>Milvus migrans</i>
7.	Oriental Honey Buzzard	<i>Pernis ptilorhynchus</i>
8.	Shikra	<i>Accipiter badius</i>
9.	White-eyed Buzzard	<i>Butastur teesa</i>
10.	Whitebreasted Waterhen	<i>Amauornis phoenicurus</i>
11.	Common Moorhen	<i>Gallinula chloropus</i>
12.	Purple Moorhen	<i>Porphyrio porphyrio</i>
13.	Redwattled Lapwing	<i>Vanellus indicus</i>

S.No.	Common English Name	Scientific Name
14.	Blackwinged Stilt	<i>Himantopus himantopus</i>
15.	Eurasian Thick-knee	<i>Burhinus oedicnemus</i>
16.	Rock Pigeon	<i>Columba livia</i>
17.	Oriental Turtle Dove	<i>Streptopelia orientalis</i>
18.	Spotted Dove	<i>Streptopelia chinensis</i>
19.	Roseringed Parakeet	<i>Pittacula krameri</i>
20.	Common Hawk-Cuckoo	<i>Cuculus varius</i>
21.	Asian Koel	<i>Eudynamys scolopacea</i>
22.	Greater Coucal	<i>Centropus sinensis</i>
23.	Spotted Owlet	<i>Athene brama</i>
24.	Little Swift	<i>Apus affinis</i>
25.	Asian Palm Swift	<i>Cypsiurus batasiensis</i>
26.	Common Kingfisher	<i>Alcedo atthis</i>
27.	Whitethroated Kingfisher	<i>Halcyon smyrnensis</i>
28.	Pied Kingfisher	<i>Ceryle rudis</i>
29.	Little Green Bee-eater	<i>Merops orientalis</i>
30.	Bluetailed Bee-eater	<i>Merops philippinus</i>
31.	Eurasian Hoopoe	<i>Upupa epops</i>
32.	Coppersmith Barbet	<i>Megalaima haemacephala</i>
33.	Blackrumped Flameback	<i>Dinopium benghalense</i>
34.	Barn Swallow	<i>Hirundo rustica</i>
35.	Common Myna	<i>Acridotheres tristis</i>
36.	Rufous Tree Pie	<i>Dendrocitta vagabunda</i>
37.	House Crow	<i>Corvus splendens</i>
38.	Largebilled Crow	<i>Corvus macrorhynchos</i>
39.	Eurasian Golden Oriole	<i>Oriolus oriolus</i>
40.	Black Drongo	<i>Dicrurus macrocercus</i>
41.	Common Iora	<i>Aegithina tiphia</i>
42.	Redvented Bulbul	<i>Pycnonotus cafer</i>
43.	Whitebrowed Bulbul	<i>Pycnonotus luteolus</i>
44.	Yellowbilled Babbler	<i>Turdoides affinis</i>
45.	Plain Prinia	<i>Prinia inornata</i>
46.	Ashy Prinia	<i>Prinia socialis</i>
47.	Common Tailorbird	<i>Orthotomus sutorius</i>
48.	Oriental Magpie Robin	<i>Copsychus saularis</i>
49.	White-browed Wagtail	<i>Motacilla maderaspatensis</i>
50.	Purplerumped Sunbird	<i>Nectarinia zeylonica</i>
51.	Longbilled Sunbird	<i>Nectarinia lotenia</i>

Note: Names are after Daniels (1997)

## Mammals

Twelve species of mammals were observed during the survey (Table 13). Others, including the Small Indian Civet and Black-naped Hare which are known to occur in GNP (Raman *et al*, 1996) and hence likely to be found in the Campus were not observed. Obviously, the most common mammals are the Chital and Bonnet Macaque. However, in numbers, rodents may be more on the Campus. While it was possible to observe the Three Striped Palm Squirrel, other rodents (rats, mice and bandicoots) were not seen; the presence of the Large Bandicoot Rat was inferred by the active burrows that we saw. Similarly, very little could be done to precisely estimate the number of species and abundance of bats on the Campus. Our observations suggest that there are at least 4 species. Fruit bats provide important ecosystem services as pollinators of flowers and dispersers of seeds. The Flying Fox (with a wing span of 1.2m) for instance, may wander over 25km each night in search of food. In the process, it carries and disperses seeds far and wide. Roosts of the Flying Fox wherever observed should be protected.

Table 13: List of Mammals Identified During the Survey in August 2006

Common English Name	Scientific Name
Indian Flying Fox	<i>Pteropus giganteus</i>
Short-nosed Fruit Bat	<i>Cynopterus sphinx</i>
Mouse-tailed Bat/Mouse-tailed Bat	<i>Rhinopoma sp/Tadardia sp</i>
Least Pipistrelle	<i>Pipistrellus tenuis</i>
Bonnet Macaque	<i>Macaca radiata</i>
Golden Jackal	<i>Canis aureus</i>
Common Palm Civet	<i>Paradoxurus hermaphroditus</i>
Grey Mongoose	<i>Herpestes edwardsii</i>
Chital	<i>Axis axis</i>
Blackbuck	<i>Antilope cervicapra</i>
Indian Palm Squirrel	<i>Funambulus palmarum</i>
Large Bandicoot Rat	<i>Bandicota indica</i>

Note: Names are after Nameer (1998)

The Common Palm Civet or Toddy Cat was sighted on three occasions while on night transects. In addition to the direct sightings, there were several scats (droppings/excreta) that were noticed. This mammal is apparently common on the Campus as highlighted by the information in Table 14. Chances of encountering

the Common Palm Civet are higher in the Academic Zone wherein two were actually seen in K12, and excreta was found in F16 and G11. Elsewhere, the highest density of the Palm Civet could be in the northern limits of Wilderness Zone and the Residential Zone closer to the main gate of the Campus. Specific information on population size and range was obtained for Bonnet Macaque, Chital and Blackbuck.

Table 14: Density and Distribution of the Common Palm Civet

Grid Number	Scat Density	Number Sighted
F16	1	0
G11	1	0
K12	0	2
M2	1	0
M3	1	0
N2	3	0
N3	2	0
N3-N4	5	0
N9	1	0
N10	0	1
O2	1	0
<b>11 Grids</b>	<b>16</b>	<b>3</b>

Bonnet Macaques have practically proliferated on the Campus due to enhanced tree cover and the continuous supply of food (including domestic and canteen wastes). Almost all the adult females observed during the survey were carrying new born or young babies. Further, the overall age structure of each troupe that was observed suggests that the Macaque breeds throughout the year on the Campus. Individual troupes varied in size between 9 and 27 macaques. Most common size of a troupe was however between 10 and 15 (Table 15).



Table 15: Distribution and Size of Bonnet Macaque Troupes

Zone/Grid No	Troupe Size
Academic Zone/E12	16
Hostel Zone/I14	12
Academic Zone/H14	14
Hostel Zone/I13	10
Wilderness Zone/N12	9
Residential Zone/I10	21
Academic Zone/G16	15
Residential Zone/L7	27
Hostel Zone/K17	11

It is quite evident from Table 15 that density of Bonnet Macaque is at its highest within built areas where there is considerable human activity (and food). The troupe size is also larger in these Zones. The two largest troupes observed were within the Residential Zone; the largest of 27 being within the Vana Vani School limits. Since macaque troupes range within specific territories, it is supposed that each one of these 8 troupes is independent. If that be the case, a conservative estimate of the population of Bonnet Macaque on the Campus is 130-150 animals.

### Chital

Chital were seen more or less throughout the Campus. Although the Chital were in herds of 2 or more in most instances, there were solitary animals seen on occasions. As with the Bonnet Macaque, the age structure of the herds and the condition of antlers of males suggest that the Chital may be breeding throughout the year. Secondary signs of activity of the Chital including marks made on tree trunks and branches by rubbing antlers, hoof impressions left on the ground during sparring (and probably courtship) were locally concentrated. Grids in which high levels of activity were inferred from these secondary signs include K11, K12, K13, K14, L11, N2, O2 (Wilderness Zone) and I15 (Hostel Zone).



Table 16: Distribution, Structure and Size of Chital Herds

Zone/Grid no	Herd Size	Males	Females	Fawns
Academic/A15	2	0	1	1
Academic/A16	4	0	2	2
Academic/C15	1	1	0	0
Academic/C16	5	?	?	?
Academic/G16	4	1	3	0
Hostel/I14	1	1	0	0
Hostel/I15	7	0	7	0
Residential/J11	5	2	3	0
Wilderness/J12	1	0	1	0
Hostel/J16	3	3	0	0
Residential/K9	2	1	1	0
Wilderness/K10	11	8	3	0
Wilderness/K12	5	?	?	?
Wilderness/K13	9	3	5	1
Wilderness/K14	22	9	11	2
Wilderness/L10	4	?	?	?
Wilderness/L11	3	2	1	0
Wilderness/L12	10	?	?	?
Residential/M5	7	1	6	0
Residential/M7	6	3	3	0
Wilderness/M12	5	?	?	?
Wilderness/M13	3	?	?	?
Wilderness/N5	2	0	2	0
Residential/N6	12	1	10	1
Wilderness/N5, O5	9	3	6	0
Wilderness/O6	3	1	2	0
Wilderness/N8	1	0	1	0
Wilderness/N9	3	1	2	0
Wilderness/N10	5	0	4	1
Total	155	41	74	8

The estimate of population size provided in Table 16 is rather rudimentary as it did not adopt any specific strategy to avoid recounting of animals. The estimate is based on counts taken on 2 consecutive days with minimal overlap in the grids visited. Taking the lower limit as 93, the higher of the 2 counts, it seems that a reasonable estimate of the population size of the Chital on the Campus could be between 93 and 155. What is of interest however, is the sex ratio, which suggests that there are nearly 2 females to every male.

Another point of interest is that despite the tendency to scavenge domestic waste, the general concentration of the Chital is within the Wilderness Zone. Number of herds that were encountered was higher within the Wilderness Zone. Also, more than 50 percent of the Chital that were counted was in the Wilderness Zone. The higher rate of encounter, the larger herd sizes and the greater intensity of secondary signs of activity within the Wilderness Zone do suggest that the Chital utilize this zone more than the Bonnet Macaque.

One of the early (widely cited) studies of Chital ecology in India is that by George B Schaller in the Kanha National Park in the 1960s (Schaller, 1998). Schaller has described the Chital as 'the most primitive of Cervid deer; a medium-sized animal with males that weigh between 65 and 86kg and females that weigh around 56kg. The first antlers are in the form of spikes that are about 12-13cm long and as the males grow older, their antlers may well grow to be 1m in length, when measured along the outer edge. First antler shedding takes places around the age of two years. A female Chital may give birth to as many as 3 fawns at a time although 2 are more common'. And regarding its habitat choice, Schaller has said, "It is an animal of deciduous forests. It needs water, shade and a terrain that is not high and rugged and grass for forage. Chital are found more in landscapes where the annual rainfall is not less than 75cm".

According to Schaller (1998) ideal sex ratio is in the order of 70 males to every 100 females (c. 1.4 females to every male). When compared to this, the sex ratio on the Campus is slightly more tilted in favour of females. Further, a population of 93-155 Chital in a Campus, that is about 2.36km<sup>2</sup>, amounts to a density of 39-65 per square kilometer. Estimates of Chital population densities in both Kanha and Keoladeo Ghana National Park (Bharatpur) are much lower and in the range of 18-23/km<sup>2</sup> (Schaller, 1998). Elsewhere in Karnataka, the density of the Chital in Bandipur and Nagarhole National Parks is in the order of 40-50/km<sup>2</sup> (Raman *et al*, 1996). Considering the fact that the entire Campus is not available to the Chital, it may be concluded that the present population density is 2-3 times higher than that in most nature reserves in the Country. The average herd size that was observed hovered around 5; comparable to the 5-10 reported by Schaller (1998).

Chital graze as well as browse on a number of species of plants. Although grasses constitute a major portion of their diets, they also eat the leaves and fruits of other plants. A list of plants found on the Campus that is potential food for the Chital is provided in the Table 17. While there is a fair diversity of food plants, the Chital have taken to feeding on domestic and other organic wastes that are found on the Campus.

Chital in the Sunderbans are known to feed on crabs (Schaller, 1998). A shift in feeding behavior as seen in the Sunderbans may be due to the saline environment and the seasonal non-availability of palatable plants. However, the shift in the Campus and in the neighborhood to feeding on domestic and organic wastes is more likely an adaptation to highly human-impacted habitats. What is unfortunate though, is that the Chital on the Campus were observed (at least on one occasion) feeding on human faeces.

**Table 17: Food Plants of the Chital reported from Kanha National Park that are represented by the same (shown in bold) or closely related species on the Campus of IIT-M, Chennai**

<i>Acacia sp</i>	<i>Ficus racemosa</i>
<i>Blumea sp</i>	<i>Ficus spp</i>
<i>Bombax ceiba*</i>	<i>Fimbristylis sp</i>
<i>Bothriochloa sp</i>	<i>Heteropogon contortus*</i>
<i>Cassia fistula</i>	<i>Iseilema laxum</i>
<i>Chloris sp</i>	<i>Phoenix sp</i>
<i>Crotalaria sp</i>	<i>Saccharum spontaneum</i>
<i>Cyperus sp</i>	<i>Sporobolus sp</i>
<i>Dendrocalamus sp</i>	<i>Syzigium cumini</i>
<i>Digitaria sp</i>	<i>Terminalia arjuna</i>
<i>Dioscorea bulbifera</i>	<i>Wrightia tinctoria</i>
<i>Emblica officinalis*</i>	<i>Zizyphus mauritiana*</i>

Source : Schaller (1998); \* also eaten by the Blackbuck

## Blackbuck

Blackbuck is the sole Indian representative of the genus *Antelope*. There are 4 subspecies of the Blackbuck known in India and that which occurs in southern India is *Antelope cervicapra cervicapra*. Male Blackbucks weigh between 33 and 43kg while the females are 32-38kg in weight. Unlike the Chital, there is not much difference in weight between the male and female Blackbuck. Adult males sport horns that are about 70cm long. In healthy herds, male to female ratio is 70:100; rather similar to the Chital. Female Blackbucks mature at the age of 14 months (sometimes at 30-36 months) and give birth to 1 or 2 fawns at a time. However, a single fawn is more commonly the case (Schaller, 1998).



Blackbucks are generally grazing animals and tend to feed more on grasses than on other plants. Table 18 provides the list of plants that the Blackbuck is known to eat. Herds have a home range of 80-140ha. An adult male may defend a territory of 8ha (Schaller, 1998).



Seven blackbucks were seen on August 4, 2006, grazing in the habitat within grid K14. This herd was



comprised of 1 adult male and 6 adult females. Further, on August 11, 2006 a lone young male was sighted in grid K15 and a solitary sub-adult male in grid F16. On yet another occasion (August 16, 2006) there were 5 blackbucks in K16, including one adult male, 3 adult females and one young female. On the same day, another herd of 4 including one adult male, a sub-adult male (probably the same that was observed on August 11, 2006), one adult female and a young female

were observed grazing within the basketball and volleyball courts (F16 and G16). Based on the above sightings and the overall differences in the observed animals, it has been estimated that the population size of the blackbuck in IIT-M Campus is 12; comprising of 2 adult males, 1 sub-adult male, 1 young male, 6 adult females and 2 young females. The male to female ratio is 1:3.

The population size, structure and the available habitat of the Blackbuck on the Campus suggests that the species is vulnerable to local extinction. A population of comparable size and structure (13 animals; 5 males and 8 females) that was found in the Kanha National Park in the 1960s apparently disappeared shortly thereafter (Schaller, 1998). Unlike the Chital, the Blackbuck is timid, less adaptive and a less prolific breeder. Presently, the antelope exists as two rather segregated populations; one around the Hostel Zone and the other in the Academic Zone.

The total extent and quality of habitat that is available on the Campus at present is not adequate for the Blackbuck. For instance, the habitat within grids J14 and K14 that is designated for the Blackbuck is hardly 2.0ha in extent. The space within the play ground complex in the Academic Zone (grids F16, G16 & H16; see Table 19) would together add to another 2.5ha or so. Considering the 4 males that are found in IIT-M at present, and a territory size of 8ha for each male, there should be a minimum of 32ha of grasslands (of the short grass type) on the Campus if the Blackbuck has to survive.

Restoring Blackbuck habitat on the Campus is not a Herculean task. The required minimum extent of 32ha can be created and managed if the following steps are followed.

- § Continuously weed out the invasive species such as, saplings of *Prosopis juliflora*, *Cassia siamea*, *Cassia javanica* and all plants of *Croton bonplandianus* from the Blackbuck habitat in K14.
- § Do not replant the pits in the middle of habitat in K14 where the planted trees are dead.
- § The trees on the southern boundary (between the habitat in K14 and the swimming pool) can remain as a screen to avoid disturbance to the grazing Blackbuck. However, *Prosopis juliflora* trees should be removed (manually) along the northern boundary of the habitat and through grids K13 and K12 to create a wide grazing area along the eastern border of the cricket ground (where the Blackbuck graze) and towards the southwestern limit of the lake. The entire habitat will be within the Wilderness Zone.
- § Keep the grasslands in grids D16, E16, F16 and G16 (in and around the playgrounds within the Academic Zone) and K15-K16 (within the Hostel Zone) free of all invasive plants.
- § Connect grids A16-G16 and H17 by creating wide corridors after selectively removing (manually) some *Prosopis juliflora* trees and the invasive cactus, *Cereus peruvianus*.
- § The space between the newly constructed Boy's Hostel and the Student's Activity Centre (Hostel Zone; grid no L15-M15) that has been cleared and reclaimed *should not be planted* with trees or lawn grass. Instead, the empty space should be restored using a combination of native grasses and bamboo.
- § It is time that the planting of trees on the Campus is curtailed. Native grasses should be allowed to take-over all open spaces. As shown in Table 7, there are at least 29 species of native grasses on the Campus.
- § The above steps are indicative. If these are adopted, nearly 30ha can be restored into Blackbuck habitat without much effort. Depending on the impact of this intervention, a second phase of Blackbuck habitat restoration and conservation can be planned.

Table 18: Food Plants of the Blackbuck reported from India and Texas that are represented by the same (shown in bold) or closely related species on the Campus of IIT-M, Chennai

<i>Abutilon spp</i>	<i>Eleusine sp</i>
<i>Acacia leucophloea</i>	<i>Emblica officinalis</i>
<i>Acacia nilotica</i>	<i>Eragrostis spp</i>
<i>Acacia spp</i>	<i>Euphorbia serpens</i>
<i>Acalypha spp</i>	<i>Euphorbia spp</i>
<i>Aeluropus lagopoides</i>	<i>Heteropogon contortus</i>
<i>Aristida spp</i>	<i>Hybanthus sp</i>
<i>Azadirachta indica</i>	<i>Mimusops sp</i>
<i>Bauhinia racemosa</i>	<i>Peltophorum pterocarpum</i>
<i>Bombax ceiba</i>	<i>Phyllanthus spp</i>
<i>Bothriochloa spp</i>	<i>Physalis sp</i>
<i>Caesalpinia sp</i>	<i>Prosopis juliflora</i>
<i>Calotropis gigantea</i>	<i>Prosopis spp</i>
<i>Capparis spp</i>	<i>Sida sp</i>
<i>Cassia spp</i>	<i>Sporobolus spp</i>
<i>Cassia spp</i>	<i>Terminalia spp</i>
<i>Cassia tora</i>	<i>Tragia sp</i>
<i>Chrysopogon sp</i>	<i>Trianthema sp</i>
<i>Cocculus sp</i>	<i>Wrightia tinctoria</i>
<i>Commelina spp</i>	<i>Xeromphis/Randia sp</i>
<i>Crotalaria sp</i>	<i>Zizyphus mauritiana</i>
<i>Cyperus sp</i>	<i>Zizyphus spp</i>

Source of information: Daniel (1967); Dharmakumarsinghi (1967); Mirza and Waiz (1973); Krishnan (1972); Oza (1976); Mungall (1978); Schaller (1998)

## Endangered Species

Many species of plants and animals are listed as endangered throughout the world. Amongst the Indian plants that have been listed as endangered, at least 3 species occur on the Campus. These are *Santalum album*, *Saraca indica* and the gymnosperm *Cycas circinalis*. Whereas *Santalum album* (Sandalwood) is native, the other two are planted.

Three species of endangered butterflies (Danaid Eggfly, Common Pierrot and Crimson Rose) that are listed under Schedule I (Part IV) of the Wildlife (Protection) Act, 1972, were observed during the survey. Amongst reptiles, the Monitor Lizard is listed under Schedule I (Part II) of the Wildlife (Protection) Act, 1972.

Apart from the Monitor Lizard, the Indian Flapshell Turtle is also listed in Schedule I (Part II), whose presence in the campus is conclusive despite not having observed during the current survey. The Starred Tortoise is not listed as endangered. However, it is an Indian reptile that is being severely exploited due to the demand in international trade. The thousands of baby tortoises that are being confiscated at Chennai airport from time to time testify this. If the species wanders in from GNP and colonizes the Campus, it should be protected.

The Blackbuck is the only other species of endangered animal on the Campus. The antelope is also listed under Schedule I (Part I) of the Wildlife (Protection) Act, 1972. This species shares a National conservation status with the Tiger, Elephant, Rhino, Lion and other critically endangered Indian mammals.

### Critical Habitats

Habitats that are critical to the survival of certain rare and endangered species such as the Blackbuck are rather localized on the Campus. Some of the critical habitats are listed in Table 19 and marked on the Map. As is evident, the majority of the critical habitats are located within the Wilderness Zone.

Table 19: Critical habitats and their distribution

Habitat type	Zone & grid where located
Grassland Type 1 (short grasses)	Wilderness Zone; J14-K14 Hostel Zone; K15-K16 Academic Zone; F16, G16, H16
Grassland Type 2 (tall grasses)	Wilderness Zone; J12-J14, K10-K11, L11 Academic Zone; B15, C14, D13-D14, D16, E13, E16
Swamp	Wilderness Zone; L13-L14, M13-M14, N13-N14 Hostel Zone; L14-L15; M15
Bog	Wilderness Zone; N3-O3, N4-O4
Remnant forest	Residential Zone; K8-K9, L8, L9-L10, M2-M3, M9 Academic Zone; D13-E13 Wilderness Zone; J12, N3, O3
Corridors	Academic Zone; C16-E16 Residential Zone; I10, J9, J10, K8, K9, L7, L8

## Grassland Type 1

Short grasses are found in the newly created Blackbuck habitat that is within the grids J14 and K14 in the Wilderness Zone. The entire habitat within grids J14 and K14 is around 1.5ha in extent. However, it contributes to at least 35 per cent of the non-cultivated plant species richness of the Campus. Short grasses are also found in the Hostel Zone (grids K15 and K16) and the Academic Zone (grids F16, G16 and H16).



The Blackbuck habitat within grids J14 and J15 is very rich in species of grasses and herbs and is bordered by shrubs and trees. The trees within the grassland are planted. A total of 88 species of plants (including 17 species of native grasses) were identified within the habitat (see Appendix 2 for full list). This is being considered an underestimate for two reasons: the first is the non-representation of the ephemeral plants (short-lived, seasonal plants) that emerge after the

monsoon rains, and secondly, the entire area of habitat was not traversed to avoid disturbing the Blackbucks that were grazing.

This habitat is critical to the survival of the Blackbuck on the Campus. There are however invasive species including *Prosopis juliflora*, *Cassia spp* and *Croton bonplandianus* both along the periphery and within the habitat. Unless the further spread of these invasive plants is checked, the grassland will be soon over-run by the invasives.

On August 4, 2006, 7 Blackbucks (1 adult male; 6 adult females) were observed grazing in the habitat. This herd is apparently the single largest herd present on the Campus. Six Blackbucks were observed in the same habitat on August 16, 2006. This herd included an adult male, 4 adult females and one sub-adult female. In general, this is the habitat in which the Blackbuck is seen on most instances.

Short grass is also found in the grids around the playgrounds on the southwestern end of the Campus. The grids F16, G16 and H16 are apparently frequently used by Blackbucks. The third short grass habitat of significance is that which is found in the Hostel Zone in grids K15 and K16. This patch of habitat, despite being closely planted with trees, continues to attract grazing Blackbuck herds.

## Grassland Type 2

This type of grassland is predominantly of *Chrysopogon orientalis*. In wetter patches, small clumps of *Saccharum spontaneum* were observed. Both species grow to about 1m or more in height. Although the grasses grow in high densities, this type of grassland is rather fragmented and localized within the Wilderness Zone and Academic Zone (Table 19). Patches are more contiguous within the Wilderness Zone



(for example the one along the western margin of the cricket ground within grids J12-J14) than in the Academic Zone. The overall extent of many patches though is very small.

This type of grassland is utilized largely by the Chital that not only feeds on it but also rests amongst the clumps of grasses. Further, where there are dense patches, there is generally a much lower incidence of invasive species. In few grids, as an exception, *Croton bonplandianus* is competing for space.

## Swamp

The eastern half of the Campus was originally the northward extension of the Pallikarnai marsh. Over the years, most part of the marsh has been over-run by *Prosopis juliflora*. The resultant habitat is one that is more of a swamp. Continued reclamation of waterlogged areas, both within and outside the Campus,

has not only reduced the overall extent of the swamp but also isolated it (except during the rainy season) from the Lake (that is a northward extension) and the oxidation ponds (eastern limits) (Table 19).

The swamp is part of the wetland complex on the Campus. However, due to its varied habitat structure, it contributes much more to the wetland biodiversity than the lake or the oxidation ponds. Birds such as the Indian Moorhen and Purple Moorhen are restricted to the swamp. Through appropriate management, the swamp can be restored to accommodate the large number of storks, herons, egrets and cormorants that visit the Campus. The grids L13 and L14 are vital in this regard.



## Bog

This is a small habitat located within the Wilderness Zone closer to the northeastern boundary of the Campus (Table 19). The source of the bog could not be discerned during the survey but it is likely that it drains into the lake during the rains. The habitat is of significance due to the presence of certain plants that were not found elsewhere on the Campus. One of the interesting plants found in the bog is the fern *Ceratopteris thalictroides*. This is an aquatic fern that is widely known in southern India where it occurs in cool and wet habitats. It is also popular (worldwide) as an aquarium plant that is traded as 'Indian Fern'. Whether its occurrence on the Campus is a result of escape from the aquarium remains to be confirmed. But the fact that this plant has not been recorded earlier in Chennai has to be noted. The only other evidence of the presence of this fern on the Campus was when one plant was found in the swamp a few years ago (R J R Daniels, personal observation).



Besides the fern, there were other localized aquatic plants such as *Ludwigia* sp and *Crotalaria quinquafolia*. These plants were not found anywhere else within the Campus. The bog is also a breeding habitat for frogs (a clear indication that the water is not polluted). Large number of tadpoles of the Ornate Narrow-mouthed Frog was found here during August 2006. Further, during the night walks many freshly metamorphosed frogs were observed in the habitat.

### Remnant Forests

These are patches of canopied vegetation on the Campus that are not over-run by *Prosopis juliflora*, *Cassia siamea* and *Cassia javanica*. These are rather fragmented and found in all zones except the Hostel Zone (Table 19). Very often, these patches are characterized by the presence of large *Ficus benghalensis* and *Ficus amplissima* trees. Although remnant forests are patchily found within the Wilderness Zone, the



majority of the patches are in the Residential Zone where some of the oldest trees are also present. Moreover, these patches are the last habitats that are available for the many species of native evergreen trees and shade loving shrubs.

### Corridors

Corridors do not belong to any specific vegetation type. The major corridors identified lie within the Academic Zone and Residential Zone (Table 19). Of these, the one within the Residential Zone is a forest corridor. The corridor in the Academic Zone is more open (the playgrounds) bordered by a dense growth of *Ficus benghalensis*. If properly managed, this corridor will not only improve the connectivity, but also add to the overall extent of Blackbuck habitats within the Academic Zone. The open spaces along the wall of GNP are also corridors that are critical to the maintenance of biodiversity on the Campus.

### Human Impacts

The purpose of this section is not to discuss those impacts that are already under review and introspection, such as garbage disposal, etc., but to highlight the moderate to severe impacts that are being imposed upon the different habitats within the Campus.



As discussed elsewhere in the report, the Campus can be broadly divided into four overlapping zones, of which three have a significant resident human pressure. The fourth zone, viz. the Wilderness Zone, not only serves the purpose of keeping the Campus 'green' but in many ways is the area where collateral human requirements are being met through the lake, oxidation ponds, temples, etc. Of the other three zones, it is evident that the residential zone would be subjected to a lesser degree of expansion and thereby impact, in comparison to the Academic and Hostel zones. The Residential Zone is typified by intermittent patches of large trees and shrubs, with some parts having home gardens. The initiative of IIT-M to reorient fences around residential complexes is to be commended.

Whether by design or accident, human impact seems to be at its peak only in and around those habitats that are inhabited by the Blackbuck or the resident and migratory birds i.e. the grasslands and the remnant swamps, which accommodate the Hostel and Academic zones. Any further construction in these areas can only be detrimental. Even the ongoing construction of hostels is leading to portions of the swamp being reclaimed. Further aggravating this situation is the unregulated dumping of construction material within the building area and the high presence of laborers within the Campus. 'Landscaping' the area adjoining the newly constructed hostel buildings is a sure way of destroying the Campus.

Emerging rather significantly is the manipulation of habitats by initiatives such as creating lawns, planting of trees in grasslands, etc., which needs to be curtailed. The notion that near-natural and natural habitats can be more aesthetic needs to percolate into all wings/departments of IIT-M. It is also to be emphasized that such areas are not risk-prone or dangerous to humans. In many ways, littering and improper disposal of waste is more dangerous. This is amply illustrated by the scattered distribution of the packaging material, metal scrap, containers, pipes etc. The Campus is dotted with a number of abandoned structures (see photo) and construction material that need to be removed or put to some use that is beneficial to the immediate habitat.

If human impacts have to be minimized, certain strong decisions need to be made. Areas earmarked as conservation/wilderness areas have to be kept exclusive and no human use (even occasional) should be permitted. For instance, use of the area within grid K16 which is a Blackbuck habitat for parking cars during

important events has to be avoided. Similarly, removal of native undergrowth to facilitate the creation of lawns or play and recreation areas needs to be avoided.



Fortunately, animals do not recognize artificial boundaries and this has to be considered while cordoning off large areas such as school grounds with fencing. For example, the fencing around the playgrounds of the Vana Vani School can be removed while leaving the concrete poles intact so that the boundaries are recognized and children do not venture out into the adjoining areas.

One of the major problems that zoos, wildlife tourist areas and forests adjacent to human habitations experience is the practice of feeding wild animals by humans, a gesture that is considered as being compassionate and noble. This gesture, despite its well-meaning nature can often prove detrimental as exemplified by the large troupes of macaques on the Campus, as well as the Chital that thrive by scavenging (see photo). Pressure from people living in areas adjoining the Campus is also noticeable, especially in and around the lake.

Although making every part of the Campus accessible by road is justified, for reasons of ensuring habitat improvement, metal topping of new roads is to be strictly avoided, particularly for the proposed radial road. Roads adjoining the Blackbuck habitat that end abruptly or have no explicit human use need to be reconverted to mud roads.

## End Note

The 432 species of plants and animals that were identified during the brief survey have only highlighted the potential magnitude of biodiversity on the Campus. Many groups of organisms such as bryophytes, fungi, worms, snails, spiders, scorpions, millipedes, insects other than butterflies and fishes are apparently very diverse. When inventoried these organisms are likely to extend the list of species on the Campus by at the least another 500.

The estimated 1000 or more species of organisms on the Campus are the products of the mosaics of critical habitats and the corridors that link them. For instance, the connectivity between GNP and the Campus through the rather porous western wall (the grill gates, flood water outlets, low height in some points, etc) has encouraged movement of animals between the two otherwise isolated spaces. It is important to maintain this connectivity.

In order to sustain the rich biodiversity on the Campus, a system of monitoring the critical habitats and indicator species has to be evolved. Practical guidelines and tools for biodiversity monitoring can be easily devised. We may then train and establish specific teams of volunteers, students, faculty, security men, residents and others for the purpose.

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## Appendices

### 1. Complete List of Non-cultivated Plants Identified on the Campus of IIT-M Chennai during August 2006

Scientific name	Family	Habit	Status
<i>Dipteracanthus prostratus</i>	Acanthaceae	Herb	Native
<i>Justicia prostrata</i>	Acanthaceae	Herb	Native
<i>Rungia repens</i>	Acanthaceae	Herb	Native
<i>Glinus lotoides</i>	Aizoaceae	Herb	Native
<i>Glinus oppositifolius</i>	Aizoaceae	Herb	Native
<i>Mollugo nudicaulis</i>	Aizoaceae	Herb	Native
<i>Mollugo disticha</i>	Aizoaceae	Herb	Native
<i>Mollugo pentaphylla</i>	Aizoaceae	Herb	Native
<i>Trianthema portulacastrum</i>	Aizoaceae	Herb	Native
<i>Trianthema triquetra</i>	Aizoaceae	Herb	Native
<i>Alangium salviifolium</i>	Alangiaceae	Tree	Native
<i>Achyranthes aspera</i>	Amaranthaceae	Shrub (small)	Native
<i>Aerva lanata</i>	Amaranthaceae	Herb	Naturalized
<i>Alternanthera parochynoides</i>	Amaranthaceae	Herb	Naturalized
<i>Amaranthus viridis</i>	Amaranthaceae	Herb	Naturalized
<i>Gomphrena celosioides</i>	Amaranthaceae	Herb	Naturalized
<i>Curculigo orchioides</i>	Amaryllidaceae	Herb	Native
<i>Lannea coromandelica</i>	Anacardiaceae	Tree	Native
<i>Mangifera indica</i>	Anacardiaceae	Tree	Naturalized
<i>Annona reticulata</i>	Annonaceae	Tree	Planted
<i>Annona squamosa</i>	Annonaceae	Tree	Naturalized
<i>Polyalthia longifolia</i>	Annonaceae	Tree	Naturalized
<i>Alstonia scholaris</i>	Apocynaceae	Tree	Planted
<i>Carissa spinarum</i>	Apocynaceae	Shrub	Native
<i>Catharanthus roseus</i>	Apocynaceae	Shrub (small)	Naturalized
<i>Ervatamia divaricata</i>	Apocynaceae	Shrub	Planted
<i>Ichnocarpus frutescens</i>	Apocynaceae	Climber	Native
<i>Nerium oleander</i>	Apocynaceae	Tree (small)	Planted
<i>Plumeria rubra</i>	Apocynaceae	Tree	Planted
<i>Rauvolfia tetraphylla</i>	Apocynaceae	Shrub	Naturalized
<i>Thevetia peruviana</i>	Apocynaceae	Tree	Naturalized
<i>Vallis solanacea</i>	Apocynaceae	Climber	Native
<i>Wrightia tinctoria</i>	Apocynaceae	Tree	Native

Scientific name	Family	Habit	Status
<i>Aponogeton natans</i>	Aponogetonaceae	Herb (aquatic)	Native
<i>Colocasia esculenta</i>	Araceae	Herb	Native
<i>Pistia stratiotes</i>	Araceae	Herb (aquatic)	Naturalized
<i>Theriophonum minutum</i>	Araceae	Herb	Native
<i>Theriophonum sp</i>	Araceae	Herb	Native
<i>Cocos nucifera</i>	Arecaceae	Palm	Planted
<i>Borassus flabellifer</i>	Arecaceae	Palm	Native
<i>Caryota urens</i>	Arecaceae	Palm	Planted
<i>Phoenix sylvestris</i>	Arecaceae	Palm	Native
<i>Hemidesmus indicus</i>	Asclepiadaceae	Climber	Native
<i>Leptadenia reticulata</i>	Asclepiadaceae	Climber	Native
<i>Oxystelma esculentum</i>	Asclepiadaceae	Climber	Native
<i>Pentatropis capensis</i>	Asclepiadaceae	Climber	Native
<i>Pergularia daemia</i>	Asclepiadaceae	Climber	Native
<i>Telosma minor</i>	Asclepiadaceae	Climber	Native
<i>Tylophora indica</i>	Asclepiadaceae	Climber	Native
<i>Wattakaka volubilis</i>	Asclepiadaceae	Climber	Native
<i>Blumea bifoliata</i>	Asteraceae	Herb	Naturalized
<i>Blumea obliqua</i>	Asteraceae	Herb	Native
<i>Eclipta alba</i>	Asteraceae	Herb	Native
<i>Launaea sarmentosa</i>	Asteraceae	Herb	Native
<i>Parthenium hysterophorus</i>	Asteraceae	Herb	Naturalized
<i>Tridax procumbens</i>	Asteraceae	Herb	Naturalized
<i>Vernonia cinerea</i>	Asteraceae	Herb	Native
<i>Araucaria sp</i>	Araucariaceae	Tree	Planted
<i>Kigelia africana</i>	Bignoniaceae	Tree	Planted
<i>Millingtonia hortensis</i>	Bignoniaceae	Tree	Naturalized
<i>Tabebuia rosea</i>	Bignonaceae	Tree	Planted
<i>Tecoma stans</i>	Bignoniaceae	Tree (small)	Naturalized
<i>Bombax ceiba</i>	Bombacaceae	Tree	Planted
<i>Ceiba pentandra</i>	Bombacaceae	Tree	Planted
<i>Coldenia procumbens</i>	Boraginaceae	Herb	Native
<i>Heliotropium curassavicum</i>	Boraginaceae	Herb	Native
<i>Cereus peruvianus</i>	Cactaceae	Shrub	Naturalized
<i>Opuntia sp</i>	Cactaceae	Shrub	Naturalized
<i>Bauhinia racemosa</i>	Caesalpinaceae	Tree	Native
<i>Bauhinia purpurea</i>	Caesalpinaceae	Tree	Naturalized
<i>Caesalpinia coriaria</i>	Caesalpinaceae	Tree	Planted
<i>Caesalpinia pulcherrima</i>	Caesalpinaceae	Tree (small)	Naturalized

Scientific name	Family	Habit	Status
<i>Cassia alata</i>	Caesalpiniaceae	Shrub	Naturalized
<i>Cassia fistula</i>	Caesalpiniaceae	Tree	Native
<i>Cassia javanica</i>	Caesalpiniaceae	Tree	Naturalized
<i>Cassia occidentalis</i>	Caesalpiniaceae	Shrub	Naturalized
<i>Cassia pumila</i>	Caesalpiniaceae	Herb	Native
<i>Cassia siamea</i>	Caesalpiniaceae	Tree	Naturalized
<i>Cassia tora</i>	Caesalpiniaceae	Shrub (small)	Naturalized
<i>Delonix elata</i>	Caesalpiniaceae	Tree	Native
<i>Delonix regia</i>	Caesalpiniaceae	Tree	Naturalized
<i>Parkinsonia aculeata</i>	Caesalpiniaceae	Shrub	Naturalized
<i>Peltophorum pterocarpum</i>	Caesalpiniaceae	Tree	Naturalized
<i>Pterolobium hexapetalum</i>	Caesalpiniaceae	Shrub	Native
<i>Saraca indica</i>	Caesalpiniaceae	Tree	Planted
<i>Tamarindus indica</i>	Caesalpiniaceae	Tree	Naturalized
<i>Capparis divaricata</i>	Capparaceae	Tree	Native
<i>Capparis zeylanica</i>	Capparaceae	Climber	Native
<i>Cleome viscosa</i>	Capparaceae	Herb	Native
<i>Crateva adansonii subsp odoratissa</i>	Capparaceae	Tree	Native
<i>Casuarina equisetifolia</i>	Casuarinaceae	Tree	Planted
<i>Quisqualis indica</i>	Combretaceae	Climber	Naturalized
<i>Terminalia arjuna</i>	Combretaceae	Tree	Planted
<i>Terminalia catappa</i>	Combretaceae	Tree	Planted
<i>Commelina benghalensis</i>	Commelinaceae	Herb	Native
<i>Cyanotis cristata</i>	Commelinaceae	Herb	Native
<i>Cuscuta sp</i>	Convolvulaceae	Climber	Native
<i>Evolvulus alsinoides</i>	Convolvulaceae	Herb	Native
<i>Evolvulus nummularius</i>	Convolvulaceae	Herb	Naturalized
<i>Hewittia sublobata</i>	Convolvulaceae	Climber	Native
<i>Ipomoea hederifolia</i>	Convolvulaceae	Climber	Naturalized
<i>Ipomoea sepiaria</i>	Convolvulaceae	Climber	Native
<i>Ipomoea staphylina</i>	Convolvulaceae	Climber	Native
<i>Carmona retusa</i>	Cordiaceae	Shrub	Native
<i>Cordia gharaf</i>	Cordiaceae	Tree	Native
<i>Coccinia grandis</i>	Cucurbitaceae	Climber	Native
<i>Mukia maderaspatana</i>	Cucurbitaceae	Climber	Native
<i>Trichosanthes tricuspidata</i>	Cucurbitaceae	Climber	Native
<i>Thuja sp</i>	Cupressaceae	Tree	Planted
<i>Cycas circinalis</i>	Cycadaceae	Shrub	Planted
<i>Bulbostylis barbata</i>	Cyperaceae	Sedge	Native

Scientific name	Family	Habit	Status
<i>Cyperus rotundus</i>	Cyperaceae	Sedge	Native
<i>Fimbristylis argentea</i>	Cyperaceae	Sedge	Native
<i>Fimbristylis bisumbellata</i>	Cyperaceae	Sedge	Native
<i>Fimbristylis tetragona</i>	Cyperaceae	Sedge	Native
<i>Kyllinga nemoralis</i>	Cyperaceae	Sedge	Native
<i>Mariscus paniceus</i>	Cyperaceae	Sedge	Native
<i>Dioscorea bulbifera</i>	Dioscoreaceae	Climber	Naturalized
<i>Diospyros peregrina</i>	Ebenaceae	Tree	Planted
<i>Muntingia calabura</i>	Elaeocarpaceae	Tree	Naturalized
<i>Acalypha indica</i>	Euphorbiaceae	Shrub (small)	Native
<i>Chrozophora rottleri</i>	Euphorbiaceae	Herb	Native
<i>Croton bonplandianus</i>	Euphorbiaceae	Shrub	Naturalized
<i>Drypetes roxburghii</i>	Euphorbiaceae	Tree	Native
<i>Euphorbia corrogoloides</i>	Euphorbiaceae	Herb	Native
<i>Euphorbia elegans</i>	Euphorbiaceae	Herb	Native
<i>Euphorbia hirta</i>	Euphorbiaceae	Herb	Native
<i>Euphorbia rosea</i>	Euphorbiaceae	Herb	Native
<i>Euphorbia serpens</i>	Euphorbiaceae	Herb	Naturalized
<i>Euphorbia tirucalli</i>	Euphorbiaceae	Tree (small)	Naturalized
<i>Flueggea leucopyrus</i>	Euphorbiaceae	Shrub	Native
<i>Jatropha gossypifolia</i>	Euphorbiaceae	Shrub	Naturalized
<i>Manihot glaziovii</i>	Euphorbiaceae	Tree	Planted
<i>Micrococca mercurialis</i>	Euphorbiaceae	Herb	Native
<i>Pedilanthus tithymaloides</i>	Euphorbiaceae	Shrub	Naturalized
<i>Phyllanthus amarus</i>	Euphorbiaceae	Herb	Naturalized
<i>Phyllanthus emblica</i>	Euphorbiaceae	Tree	Planted
<i>Phyllanthus maderaspatensis</i>	Euphorbiaceae	Herb	Native
<i>Phyllanthus reticulatus</i>	Euphorbiaceae	Shrub	Native
<i>Phyllanthus tenellus</i>	Euphorbiaceae	Herb	Native
<i>Phyllanthus virgatus</i>	Euphorbiaceae	Herb	Native
<i>Sebastiania chamaelea</i>	Euphorbiaceae	Herb	Native
<i>Tragia plukenetii</i>	Euphorbiaceae	Herb	Native
<i>Tragia involucrata</i>	Euphorbiaceae	Climber	Native
<i>Abrus precatorius</i>	Fabaceae	Climber	Native
<i>Alysicarpus monilifer</i>	Fabaceae	Herb	Native
<i>Butea monosperma</i>	Fabaceae	Tree	Native
<i>Clitoria ternatea</i>	Fabaceae	Climber	Naturalized
<i>Crotalaria pallida</i>	Fabaceae	Shrub	Naturalized
<i>Crotalaria quinquaefolia</i>	Fabaceae	Shrub	Native

Scientific name	Family	Habit	Status
<i>Crotalaria retusa</i>	Fabaceae	Shrub (aquatic)	Naturalized
<i>Crotalaria verrucosa</i>	Fabaceae	Shrub	Naturalized
<i>Dalbergia lanceolaria</i>	Fabaceae	Tree	Planted
<i>Desmodium triflorum</i>	Fabaceae	Herb	Native
<i>Erythrina variegata</i>	Fabaceae	Tree	Naturalized
<i>Indigofera linnaei</i>	Fabaceae	Herb	Native
<i>Indigofera tinctoria</i>	Fabaceae	Shrub	Native
<i>Pongamia pinnata</i>	Fabaceae	Tree	Native
<i>Teramnus labialis</i>	Fabaceae	Vine	Native
<i>Calophyllum inophyllum</i>	Guttiferae	Tree	Planted
<i>Garcinia spicata</i>	Guttiferae	Tree	Native
<i>Leucas aspera</i>	Lamiaceae	Herb	Native
<i>Leucas indica</i>	Lamiaceae	Herb	Native
<i>Plectranthus caninus</i>	Lamiaceae	Herb	Native
<i>Listea glutinosa</i>	Lauraceae	Tree	Native
<i>Couroupita guianensis</i>	Lecythidaceae	Tree	Planted
<i>Lemna perpusilla</i>	Lemnaceae	Herb (aquatic)	Native
<i>Gloriosa superba</i>	Liliaceae	Climber	Native
<i>Iphigenia indica</i>	Liliaceae	Herb	Native
<i>Strychnos nux-vomica</i>	Loganiaceae	Tree	Native
<i>Lagerstroemia reginae</i>	Lythraceae	Tree	Planted
<i>Hibiscus rosa-sinensis</i>	Malvaceae	Tree (small)	Planted
<i>Malvastrum coromandelianum</i>	Malvaceae	Shrub	Naturalized
<i>Sida cordata</i>	Malvaceae	Shrub	Native
<i>Sida cordifolia</i>	Malvaceae	Shrub	Native
<i>Thespesia populniodes</i>	Malvaceae	Tree	Native
<i>Azadirachta indica</i>	Meliaceae	Tree	Native
<i>Melia azedarach</i>	Meliaceae	Tree	Naturalized
<i>Swietenia macrophylla</i>	Meliaceae	Tree	Planted
<i>Swietenia mahogani</i>	Meliaceae	Tree	Planted
<i>Cocculus hirsutus</i>	Menispermaceae	Climber	Native
<i>Pachygone ovata</i>	Menispermaceae	Climber	Native
<i>Tinospora cordifolia</i>	Menispermaceae	Climber	Native
<i>Acacia auriculiformis</i>	Mimosaceae	Tree	Naturalized
<i>Acacia ferruginea</i>	Mimosaceae	Tree	Native
<i>Acacia leucophloea</i>	Mimosaceae	Tree	Native
<i>Acacia nilotica subsp indica</i>	Mimosaceae	Tree	Native
<i>Acacia planifrons</i>	Mimosaceae	Tree	Native
<i>Adenanthera pavonia</i>	Mimosaceae	Tree	Naturalized

Scientific name	Family	Habit	Status
<i>Albizia lebeck</i>	Mimosaceae	Tree	Native
<i>Dichrostachys cinerea</i>	Mimosaceae	Tree	Native
<i>Leucaena leucocephala</i>	Mimosaceae	Tree	Naturalized
<i>Parkia biglandulosa</i>	Mimosaceae	Tree	Planted
<i>Pithecellobium dulce</i>	Mimosaceae	Tree	Naturalized
<i>Prosopis glandulosa</i>	Mimosaceae	Tree	Planted
<i>Prosopis juliflora</i>	Mimosaceae	Tree	Naturalized
<i>Samanea saman</i>	Mimosaceae	Tree	Naturalized
<i>Artocarpus heterophyllus</i>	Moraceae	Tree	Naturalized
<i>Ficus amplissima</i>	Moraceae	Tree	Native
<i>Ficus benghalensis</i>	Moraceae	Tree	Native
<i>Ficus benjamina</i>	Moraceae	Tree	Planted
<i>Ficus elastica</i>	Moraceae	Tree	Planted
<i>Ficus racemosa</i>	Moraceae	Tree	Native
<i>Ficus religiosa</i>	Moraceae	Tree	Naturalized
<i>Hura corpitus</i>	Moraceae	Tree	Planted
<i>Streblus asper</i>	Moraceae	Tree	Native
<i>Callistemon citrinus</i>	Myrtaceae	Tree	Planted
<i>Psidium guajava</i>	Myrtaceae	Tree	Naturalized
<i>Syzygium cumini</i>	Myrtaceae	Tree	Native
<i>Eucalyptus sp</i>	Myrtaceae	Tree	Planted
<i>Boerhavia diffusa</i>	Nyctaginaceae	Herb	Native
<i>Bougainvillea glabra</i>	Nyctaginaceae	Climber	Naturalized
<i>Nymphaea pubescens</i>	Nymphaeaceae	Herb (aquatic)	Native
<i>Olax scandens</i>	Oleaceae	Climber	Native
<i>Jasminum angustifolium</i>	Oleaceae	Climber	Native
<i>Ludwigia sp</i>	Onagraceae	Shrub	Native
<i>Pedaliium murex</i>	Pedaliaceae	Herb	Native
<i>Aeluropus lagopoides</i>	Poaceae	Grass	Native
<i>Aristida hystrix</i>	Poaceae	Grass	Native
<i>Aristida setacea</i>	Poaceae	Grass	Native
<i>Bambusa arundinacea</i>	Poaceae	Bamboo	Planted
<i>Bothriochloa pertusa</i>	Poaceae	Grass	Native
<i>Brachiaria distachya</i>	Poaceae	Grass	Native
<i>Brachiaria ramosa</i>	Poaceae	Grass	Native
<i>Chloris barbata</i>	Poaceae	Grass	Native
<i>Chloris montana</i>	Poaceae	Grass	Native
<i>Chrysopogon orientalis</i>	Poaceae	Grass	Native
<i>Cynodon barberi</i>	Poaceae	Grass	Native

Scientific name	Family	Habit	Status
<i>Cynodon dactylon</i>	Poaceae	Grass	Native
<i>Dactyloctenium aegyptium</i>	Poaceae	Grass	Native
<i>Desmostachya bipinnata</i>	Poaceae	Grass	Native
<i>Digitaria longiflora</i>	Poaceae	Grass	Native
<i>Eleusine indica</i>	Poaceae	Grass	Native
<i>Eragrostis japonica</i>	Poaceae	Grass	Native
<i>Eragrostis tenella</i>	Poaceae	Grass	Native
<i>Eragrostis viscosa</i>	Poaceae	Grass	Native
<i>Eragrostis riparia</i>	Poaceae	Grass	Native
<i>Heteropogon contortus</i>	Poaceae	Grass	Native
<i>Iseilema anthephoroides</i>	Poaceae	Grass	Native
<i>Iseilema laxum</i>	Poaceae	Grass	Native
<i>Oplismenus compositus</i>	Poaceae	Grass	Native
<i>Perotis indica</i>	Poaceae	Grass	Native
<i>Saccharum spontaneum</i>	Poaceae	Grass	Native
<i>Sporobolus coromandelianus</i>	Poaceae	Grass	Native
<i>Sporobolus maderaspatanus</i>	Poaceae	Grass	Native
<i>Sporobolus tremulus</i>	Poaceae	Grass	Native
<i>Zoysia matrella</i>	Poaceae	Grass	Native
<i>Polygala jacobi</i>	Polygalaceae	Herb	Native
<i>Polygala arvensis</i>	Polygalaceae	Herb	Native
<i>Antigonon leptopus</i>	Polygonaceae	Climber	Naturalized
<i>Portulaca oleracea</i>	Portulacaceae	Herb	Native
<i>Portulaca quadrifida</i>	Portulacaceae	Herb	Native
<i>Ziziphus oenoplia</i>	Rhamnaceae	Climber	Native
<i>Ziziphus mauritiana</i>	Rhamnaceae	Tree	Native
<i>Benkara malabarica</i>	Rubiaceae	Tree	Native
<i>Borreria hispida</i>	Rubiaceae	Herb	Native
<i>Ceriscoides turgida</i>	Rubiaceae	Tree (small)	Native
<i>Ixora coccinea</i>	Rubiaceae	Shrub	Planted
<i>Ixora pavetta</i>	Rubiaceae	Tree (small)	Native
<i>Mitracarpus verticillatus</i>	Rubiaceae	Herb	Naturalized
<i>Morinda coreia</i>	Rubiaceae	Tree	Native
<i>Oldenlandia alata</i>	Rubiaceae	Herb	Native
<i>Oldenlandia biflora</i>	Rubiaceae	Herb	Native
<i>Oldenlandia corymbosa</i>	Rubiaceae	Herb	Native
<i>Pavetta indica</i>	Rubiaceae	Tree (small)	Native
<i>Atlantia monophylla</i>	Rutaceae	Tree	Native
<i>Chloroxylon sweitenia</i>	Rutaceae	Tree	Native

Scientific name	Family	Habit	Status
<i>Clausena dentata</i>	Rutaceae	Shrub	Native
<i>Limonia acidissima</i>	Rutaceae	Tree	Native
<i>Glycosmis mauritiana</i>	Rutaceae	Shrub	Native
<i>Murraya koenigii</i>	Rutaceae	Tree	Naturalized
<i>Murraya paniculata</i>	Rutaceae	Tree	Native
<i>Pamburus missionis</i>	Rutaceae	Tree	Native
<i>Toddalia asiatica</i>	Rutaceae	Climber	Native
<i>Santalum album</i>	Santalaceae	Tree	Native
<i>Filicium decipiens</i>	Sapindaceae	Tree	Planted
<i>Sapindus emarginatus</i>	Sapindaceae	Tree	Native
<i>Madhuca indica</i>	Sapotaceae	Tree	Native
<i>Madhuca longifolia</i>	Sapotaceae	Tree	Planted
<i>Mimusops elengi</i>	Sapotaceae	Tree	Planted
<i>Solanum trilobatum</i>	Solanaceae	Climber	Native
<i>Datura metel</i>	Solanaceae	Shrub (small)	Native
<i>Datura innoxia</i>	Solanaceae	Shrub (small)	Naturalized
<i>Physalis minima</i>	Solanaceae	Herb	Native
<i>Solanum melongena var. insanum</i>	Solanaceae	Shrub	Native
<i>Solanum surattense</i>	Solanaceae	Shrub	Native
<i>Guazuma ulmifolia</i>	Sterculiaceae	Tree	Naturalized
<i>Pterospermum acerifolium</i>	Sterculiaceae	Tree	Planted
<i>Sterculia foetida</i>	Sterculiaceae	Tree	Planted
<i>Corchorus aestuans</i>	Tiliaceae	Shrub	Native
<i>Typha angustata</i>	Typhaceae	Herb	Naturalized
<i>Clerodendrum inerme</i>	Verbenaceae	Shrub	Native
<i>Gmelina asiatica</i>	Verbenaceae	Shrub	Native
<i>Phyla nodiflora</i>	Verbenaceae	Herb	Native
<i>Lantana camara</i>	Verbenaceae	Shrub	Naturalized
<i>Tectona grandis</i>	Verbenaceae	Tree	Planted
<i>Hybanthus enneaspermus</i>	Violaceae	Herb	Native
<i>Cissus quadrangularis</i>	Vitaceae	Climber	Native
<i>Cissus vitiginea</i>	Vitaceae	Climber	Native

2. List of Plants Identified during August 2006 within the approximately 1.5ha Blackbuck Habitat (grids J14 & K14)

S.No	Name of species	Family
1.	<i>Justicia prostrata</i>	Acanthaceae
2.	<i>Rungia repens</i>	Acanthaceae
3.	<i>Glinus lotoides</i>	Aizoaceae
4.	<i>Glinus oppositifolius</i>	Aizoaceae
5.	<i>Mullugo nudicaulis</i>	Aizoaceae
6.	<i>Alternanthera parochynoides</i>	Amaranthaceae
7.	<i>Amaranthus viridis</i>	Amaranthaceae
8.	<i>Gomphrena celosioides</i>	Amaranthaceae
9.	<i>Polyalthia longifolia</i>	Annonaceae
10.	<i>Alstonia scholaris</i>	Apocynaceae
11.	<i>Cartharanthus roseus</i>	Apocynaceae
12.	<i>Plumeria rubra</i>	Apocynaceae
13.	<i>Vallis solanacea</i>	Apocynaceae
14.	<i>Theriophonum minutum</i>	Araceae
15.	<i>Phoenix sylvestris</i>	Arecaceae
16.	<i>Tylophora indica</i>	Asclepiadaceae
17.	<i>Blumea obliqua</i>	Asteraceae
18.	<i>Vernonia cinerea</i>	Asteraceae
19.	<i>Millingtonia hortensis</i>	Bignoniaceae
20.	<i>Coldenia procumbens</i>	Boraginaceae
21.	<i>Heliotropium curassavicum</i>	Boraginaceae
22.	<i>Cassia fistula</i>	Caesalpiniaceae
23.	<i>Cassia occidentalis</i>	Caesalpiniaceae
24.	<i>Cassia tora</i>	Caesalpiniaceae
25.	<i>Cleome viscosa</i>	Capparaceae
26.	<i>Capparis zeylanica</i>	Capparidaceae
27.	<i>Hewittia sublobata</i>	Convolvulaceae
28.	<i>Ipomoea sepiaria</i>	Convolvulaceae
29.	<i>Ipomoea staphylina</i>	Convolvulaceae
30.	<i>Coccinia grandis</i>	Cucurbitaceae
31.	<i>Bulbostylis barbata</i>	Cyperaceae
32.	<i>Cyperus rotundus</i>	Cyperaceae
33.	<i>Fimbristylis argentea</i>	Cyperaceae
34.	<i>Kyllinga nemoralis</i>	Cyperaceae
35.	<i>Mariscus paniceus</i>	Cyperaceae
36.	<i>Chrozophora rottleri</i>	Euphorbiaceae

S.No	Name of species	Family
37.	<i>Croton bonplandianus</i>	Euphorbiaceae
38.	<i>Euphorbia hirta</i>	Euphorbiaceae
39.	<i>Euphorbia rosea</i>	Euphorbiaceae
40.	<i>Euphorbia serpens</i>	Euphorbiaceae
41.	<i>Phyllanthus amarus</i>	Euphorbiaceae
42.	<i>Phyllanthus maderaspatensis</i>	Euphorbiaceae
43.	<i>Phyllanthus tenellus</i>	Euphorbiaceae
44.	<i>Tragia involucrata</i>	Euphorbiaceae
45.	<i>Alysicarpus monilifer</i>	Fabaceae
46.	<i>Desmodium triflorum</i>	Fabaceae
47.	<i>Indigofera tinctoria</i>	Fabaceae
48.	<i>Pongamia pinnata</i>	Fabaceae
49.	<i>Teramnus labialis</i>	Fabaceae
50.	<i>Leucas indica</i>	Lamiaceae
51.	<i>Plectranthus caninus</i>	Lamiaceae
52.	<i>Azadirachta indica</i>	Meliaceae
53.	<i>Acacia leucophloea</i>	Mimosaceae
54.	<i>Adenantha pavonia</i>	Mimosaceae
55.	<i>Prosopis juliflora</i>	Mimosaceae
56.	<i>Samanea saman</i>	Mimosaceae
57.	<i>Ficus amplissima</i>	Moraceae
58.	<i>Ficus benghalensis</i>	Moraceae
59.	<i>Ficus benjamina</i>	Moraceae
60.	<i>Syzygium cumini</i>	Myrtaceae
61.	<i>Boerhavia diffusa</i>	Nyctaginaceae
62.	<i>Pedaliium murex</i>	Pedaliaceae
63.	<i>Aeluropus lagopoides</i>	Poaceae
64.	<i>Aristida hystrix</i>	Poaceae
65.	<i>Aristida setacea</i>	Poaceae
66.	<i>Bothriochloa pertusa</i>	Poaceae
67.	<i>Brachiaria distachya</i>	Poaceae
68.	<i>Chloris montana</i>	Poaceae
69.	<i>Chrysopogon orientalis</i>	Poaceae
70.	<i>Cynodon barberi</i>	Poaceae
71.	<i>Dactyloctenium aegyptium</i>	Poaceae
72.	<i>Eleusine indica</i>	Poaceae
73.	<i>Eragrostis riparia</i>	Poaceae
74.	<i>Eragrostis tenella</i>	Poaceae
75.	<i>Eragrostis viscosa</i>	Poaceae
76.	<i>Saccharum spontaneum</i>	Poaceae

S.No	Name of species	Family
77.	<i>Sporobolus coromandelianus</i>	Poaceae
78.	<i>Sporobolus maderaspatanus</i>	Poaceae
79.	<i>Zoysia matrella</i>	Poaceae
80.	<i>Portulaca quadrifida</i>	Portulacaceae
81.	<i>Mitracarpus verticillatus</i>	Rubiaceae
82.	<i>Oldenlandia alata</i>	Rubiaceae
83.	<i>Oldenlandia corymbosa</i>	Rubiaceae
84.	<i>Mimusops elengi</i>	Sapotaceae
85.	<i>Datura metel</i>	Solanaceae
86.	<i>Solanum melongena var. incanum</i>	Solanaceae
87.	<i>Solanum surattense</i>	Solanaceae
88.	<i>Phyla nodiflora</i>	Verbenaceae