

Birds and trees in an urban context: An ecosystem paradigm for Vasant Vihar, New Delhi, India

Janaki Turaga

Turaga, J., 2015. Birds and trees in an urban context: An ecosystem paradigm for Vasant Vihar, New Delhi, India. *Indian BIRDS* 10 (3&4): 85–93.

Janaki Turaga, G 5, Phase 1, New Palam Vihar, Gurgaon 122017, Haryana, India. E-mail: janakituraga@gmail.com

Manuscript received on 19 August 2013.

Introduction

Avian diversity, and density, in and around urban conglomerations have been the focus of birdwatchers in a selective manner. Bird watching in urban areas has largely been confined, but not limited, to areas that are either protected, or still remain largely natural, such as protected areas, wetlands, ornamental parks, *etc.*, where it is relatively easy to observe large numbers of diverse birds. Sporadic reports of birds observed in residential or commercial urban areas have been reported. However, there is absence of data on avifauna supported by a micro-urban habitat, such as, a residential colony, commercial area, office complex, industrial area, *etc.* In the face of the increasing trends of rapid urbanisation, as well as the decrease and altering of the avifauna support areas in urban areas, it is necessary to know the avifauna supported by each kind of micro-urban habitat in order to obtain a comprehensive overview of avian status across an urban area.

New Delhi is one of the largest urban conglomerations of India, and next to Nairobi, Kenya, supports the largest diversity of birds (Harvey *et al.* 2006). This paper explores, delineates, and presents a broad overview of the bird density, and diversity of an urban residential area—Vasant Vihar (28.5574°N, 77.1590°E)—in New Delhi.

Methods

This paper emerged from my morning walks, in Vasant Vihar a residential colony of New Delhi, in April 2005. Intrigued by the diversity and density of birds that were observed in an urban residential colony, primarily along roadside trees, I undertook a more sustained observation in the month of April, through the following years 2006–2008. Additional observations, incidental to the main period of study, were made throughout the year, whenever I visited the area during 2005–2008. My personal observations over years, of the birds of Jawaharlal Nehru University (on a more sustained basis), and Lodhi Gardens (sporadically), from 1989 onwards, enabled me to roughly compare them with those of Vasant Vihar.

My objective was to arrive at a broad overview of the ground situation by ascertaining the diversity, presence, and the frequency of presence, of the birds, and their ecosystem support. Bird counting was deliberately not undertaken in this study, as the birds were dispersed over a large area, and could easily be re-counted when encountered on another street. The survey period each year was from 08–17 April 2005–2008. April marks the beginning of summer, and these dates corresponded to those of my first observation in 2005. I carried out observations from 0600–0800 hrs. Birds were observed with the aid of 10x50 Bushnell binocular. The data was supplemented by incidental

observations throughout the year over varying times and durations.

The primary areas of the study were the avenue trees, followed by major parks in the colony, sidewalk gardens of the houses, and trees in home gardens (observed from the roadside). Palam Marg, which marks the outer peripheral boundary of Vasant Vihar, was covered from beginning of the intersection of Palam Marg and Nelson Mandela Road, right upto Paschimi Marg of Vasant Vihar. Along this road not only avenue plantations, and avenue trees, but also the central verge (the divider between the two lanes of the road), which was planted with vegetation, and where birds nested, were covered. Within the residential colony, all the major arterial roads were covered, as well as other roads including the linking roads from Vasant Marg to Poorvi Marg, and from Poorvi Marg to Paschimi Marg. Parks on the roads covered were mainly unnamed, except for named parks such as the District Park on Poorvi Marg, the Municipal Corporation of Delhi's nursery on Vasant Marg, as well as the park adjacent to Anuj Vihar. The unnamed parks were observed from the roadside. Of the parks, Vasant Vihar District Park was more closely observed as it had wild as well as cultivated areas. A consolidated list of birds (Annexure 1), and trees (Annexure 2), was generated; I followed Krishen (2006) for the latter. Digital maps from Google Earth, of early 2006, are used as not only is that year closer to the beginning of the study in 2005, but in 2007, the topography of Palam Marg changed due to the construction of flyovers, which decimated its avenue plantations and trees. The data generated was analysed in the conceptual framework of Ecosystem Paradigm and the land use tool (see below).

Conceptual framework: The Ecosystem Paradigm

In order to understand the interlinkage between avenue trees and the birds dependent upon them, the data collected during the course of the walks was analysed through a specifically devised conceptual framework. This conceptual framework is the Ecosystem Paradigm, which is delineated below.

An 'urban ecosystem' has been operationally defined here as consisting of (a) urban systems, that is, built up area of the urban habitat—residential, commercial, and industrial; open spaces—water bodies, parks-gardens, waste management systems, and the resource flows within this system, as well as (b) the natural ecosystems, whether altered or pristine. The natural ecosystem is the template upon which the urban habitat is super-imposed. In the case of Delhi the urban habitat has broken its natural ecosystem, the 'Delhi Ridge', into isolated and fragmented patches. The urban habitat's residential, commercial, and possibly, industrial areas, are located in interlinked multiple micro-habitats and ecosystems, with each having its specific

character. Therefore, a conceptual framework, which links these different micro-habitats and ecosystems in the region from micro- to meso- to macro levels, is more likely to be useful for understanding the avian support system of the area, rather than focusing solely on the area under study. We assume that reasons for avifauna diversity are myriad but interlinked. The Ecosystem Paradigm approach of micro-meso-macro levels locates Vasant Vihar in the larger ecosystem—both regional, and international, the latter from the perspective of migrants that pass through it. The regional ecosystem is critical to understand Vasant Vihar's avian diversity and density. The international ecosystem gains prominence while studying international migrants and the ecosystems that support vast numbers of the birds, such as wetlands along the flyways, e.g., Okhla Bird Sanctuary, the Kolleru Ramsar site, Pulicat Bird Sanctuary, etc. However, the international ecosystem is a conglomeration of numerous regional ecosystems at the macro level, but at the micro- and meso levels is part of the regional ecosystem. Okhla Bird Sanctuary, which is part of the Central Asian Flyway that is one of the International ecosystems of India, can support avian density and diversity only if the regional ecosystem provides the necessary support. Any significant alteration in the regional ecosystems would impact the birds that are part of the international ecosystem. The continued absence of Siberian Cranes at Bharatpur, a Ramsar site, has been attributed to changes not merely in the inadequate support by the Regional ecosystem, but also by other regional ecosystems that are on their migratory path.

The regional ecosystem has been operationally defined as macro, meso, and micro. The ecosystem in which avifauna exist is an interplay of multiple ecosystems: The micro-, which is the geographical area under study; the meso-, which is the neighbourhood ecosystem, and consists of areas that are relevant to the micro-ecosystem; and the macro-ecosystem, within which, both the meso-, and micro-ecosystems are embedded, and defined. In this study, Vasant Vihar residential area is the micro-ecosystem. Its meso-ecosystem comprises the neighbouring areas of Ramakrishna Puram, Munirka, Jawaharlal Nehru University, Shankar Vihar, as well as the altered Ridge ecosystem that intersperses these areas. The macro-ecosystems in the context of Delhi, the natural ecosystems that define it are the Yamuna River, and the Delhi Ridge. Vasant Vihar is located on the Delhi Ridge, which is its macro-ecosystem, which sets its geographic and ecological contexts.

Each level of ecosystem is defined by its land use, which gives it, its unique character. Land use is an effective tool to understand the micro-ecosystem under study, as well as to build up the ecosystem layers and their inter-relationships. The land use of the micro-ecosystem: natural open spaces, developed spaces, parks, avenue trees, type and density of tree cover, and garbage management systems also influence its avifauna.

Discussion

Avenue trees and birds

Birds were primarily observed on avenue trees, which fact points to the critical dependency of urban birds, on avenue trees, for their biological requirements. This suggests that avenue trees play a critical role in supporting and promoting avifauna in a residential area. Extrapolating from this, given the increasing shrinkage of natural habitat in urban areas, avenue trees play a significant role in supporting and functioning as ecological refuges for urban avifauna. However, though the birds were primarily observed on

avenue trees, it is suggested that these trees play an important role for urban avifauna, in conjunction with the various other urban ecosystems, which are conceptualised in the Ecosystem Paradigm. Birds are dependent upon a variety of ecosystems for their sustenance. Of these, avenue trees, which are found across different kinds of urban land uses, such as commercial, industrial, and residential, play a significant role in providing a support system to urban avifauna.

Ecosystem support for the birds of Vasant Vihar: Ecosystem paradigm and land use

A comparison based on personal observations over several years (from 1989), of the avifaunal diversity supported by Vasant Vihar, shows that it is similar to that of Lodhi Gardens, which is a planned urban green space, and that of Jawaharlal Nehru University (JNU), which latter still has a large area with remnants of the original ridge ecosystem in its campus. Vasant Vihar serves as a 'transit' ecological refuge between the Ridge ecosystem—Southern-, South Central-, and Central Ridges, and the developed urban parks such as Deer Park, Lodhi Gardens, etc. The avenue trees along the roads serve as the critical link between different eco-zones, besides supporting avifauna in each area. They are transit ecological refuges because, we do not know as yet whether avenue trees provide complete support to the birds, and whether they form an independent ecosystem of their own. My observation is that the birds are dependent upon natural areas for their main food, and other biological requirements, and that avenue trees provide only support systems that are significant. The dependence upon avenue trees varies according to the type of trees that are planted—whether ornamental or fruiting—and the decline of traditional ecosystem support. Therefore, it is appropriate to consider avenue trees as 'transit ecological refuge' systems. Ecological corridors are more associated with terrestrial animals such as elephants, which not only provide support systems to them, but also link two main support systems. However, for birds it is difficult to state conclusively whether these are ecological corridors.

What is the ecosystem that supports these birds in Vasant Vihar? The conceptual framework of the Ecosystem Paradigm—where multiple levels of an ecosystem, i.e., macro-, meso-, and micro-ecosystems, are interlinked and combined with the tool of land use of the micro-ecosystem—is used to understand its avian avifaunal diversity and density.

In this ecological paradigm, the *Macro-ecosystem* is the predominant Ridge ecosystem, which defines the Vasant Vihar micro-ecosystem. In Fig. 1, Vasant Vihar is attached to three fragments of the Ridge. On its South-eastern side it is attached to the South Central Ridge through JNU and the adjoining Sanjay Van. On its western, and south-western sides it is attached to the Southern Ridge through the Muradabad Pahari Protected Forest (Anonymous 2013), and the abandoned quarried area (until 2005) with Vasant Kunj, respectively. It is attached in the north to the Central Ridge.

The original Ridge ecosystem has been modified over the years, beginning with the British, who tried to make the Ridge a habitable place not only by 'greening' it, but also by establishing New Delhi, the new capital, across it. Subsequently, after India's Independence, the Ridge was further colonised for human habitation. Only Mangarban, near Delhi, with its original Ridge ecosystem, is currently facing the threat of development initiatives by real-estate developers. While creating New Delhi, its planners

visualised a green area planted with exotic, and indigenous tree species where one road's aesthetic look was defined by one tree species, as seen in Lutyens' Delhi (Krishen 2006). However, the newly created colonies such as Ramakrishna Puram (RKP), Vasant Vihar, etc., did not follow the matrix of Lutyens' Delhi; they created a haphazard mix of all kinds of trees on a single road. While an urban area has isolated fragments of ecological refuge,

the avenue trees are spread all over the city and therefore, form an emerging but significant ecological niche for avifauna, especially given the increasing trend of continued alteration of the land use of the designated green spaces (e.g., Ridge, and green belt areas) in Delhi's master plan that enable increased human colonisation of the Ridge leading to its further fragmentation.

The *Meso-ecosystem* comprises the immediate neighbourhood ecosystem of Vasant Vihar. It is a combination of the wild and modified Ridge ecosystem, as well as the urban colonisation of the Ridge, both of which support avifauna (Fig. 2). Vasant Vihar is bound on its north by the sprawling residential colony of RKP with its 12 sectors; on the south by the disturbed ridge area between Vasant Kunj and Vasant Vihar, of which some part has now been developed into a series of shopping malls and office complexes that are collectively known as Vasant Kunj Malls (92 ha, developed from 2006), and some other comprising the Aravalli Biodiversity Park of 692 ha since 2004 (Anonymous 2015); on the south-eastern side by JNU, which still has tracts of undisturbed ridge ecosystem and is contiguous with the ridge ecosystem of the adjoining Sanjay Van forest of South Central Ridge; on the east by densely populated Munirka complex of the village and the three DDA apartment complexes; and on the west by Muradabad Pahari Forest and woodland area of 50 acres adjoining Anuj Vihar defense complex.

The meso-ecosystem is a mosaic of multiple land uses with varied tree cover that provide different kinds of support to avifauna. The degraded Ridge south of Vasant Vihar, which has now been partially developed into the Aravalli Biodiversity Park (from 2004 onwards), and the wild Ridge ecosystem, such as JNU and Sanjay Van that is so close to the built up area of Vasant Vihar, supports avifauna by providing a natural refuge. Muradabad Pahari Forest and woodland was highly degraded. Near its entrance ornamental flowering plants were planted while rest of the area had Vilaiti Keekar, and the shrub *Adhatoda justifica*, with a sole Bistendu *Diospyros cordifolia* tree.

RKP's tree-lined roads, houses with gardens and trees, are similar to those of Vasant Vihar. However, RKP's home gardens have numerous fruit trees such as Mango *Mangifera indica*, Bael *Aegle marmelos*, Guava *Psidium guajava*, and Sonjna *Moringa oleifera*, which serve the requirements of its inhabitants. The predominance of these fruiting trees along with its avenue tree mix of native (e.g., Jamun *Syzygium cumini*), and

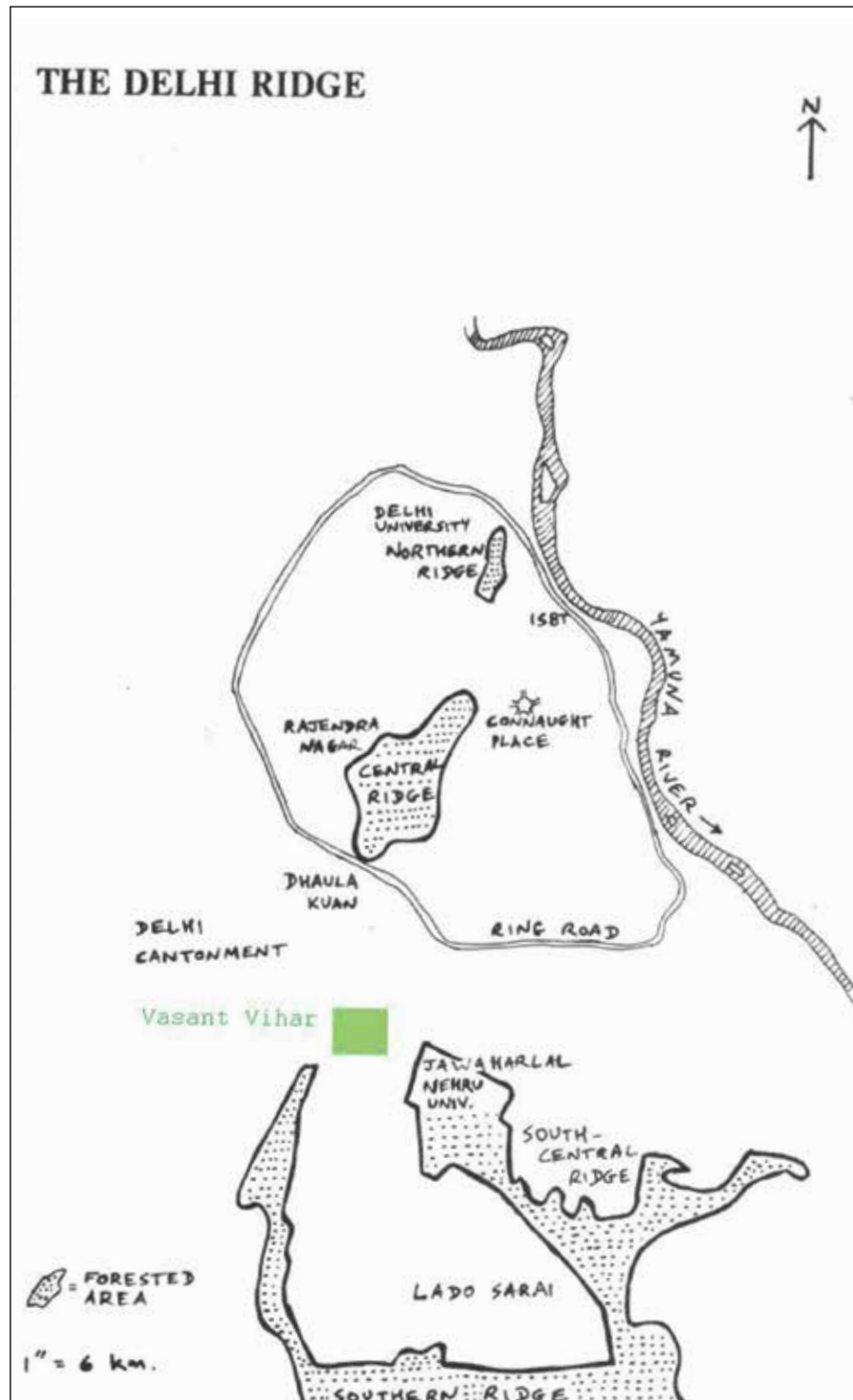


Fig. 1. Macro- ecosystem: The Delhi Ridge with Vasant Vihar whose area is not to scale with the rest of the map.
Source: Adapted from Kalpavriksh 1991

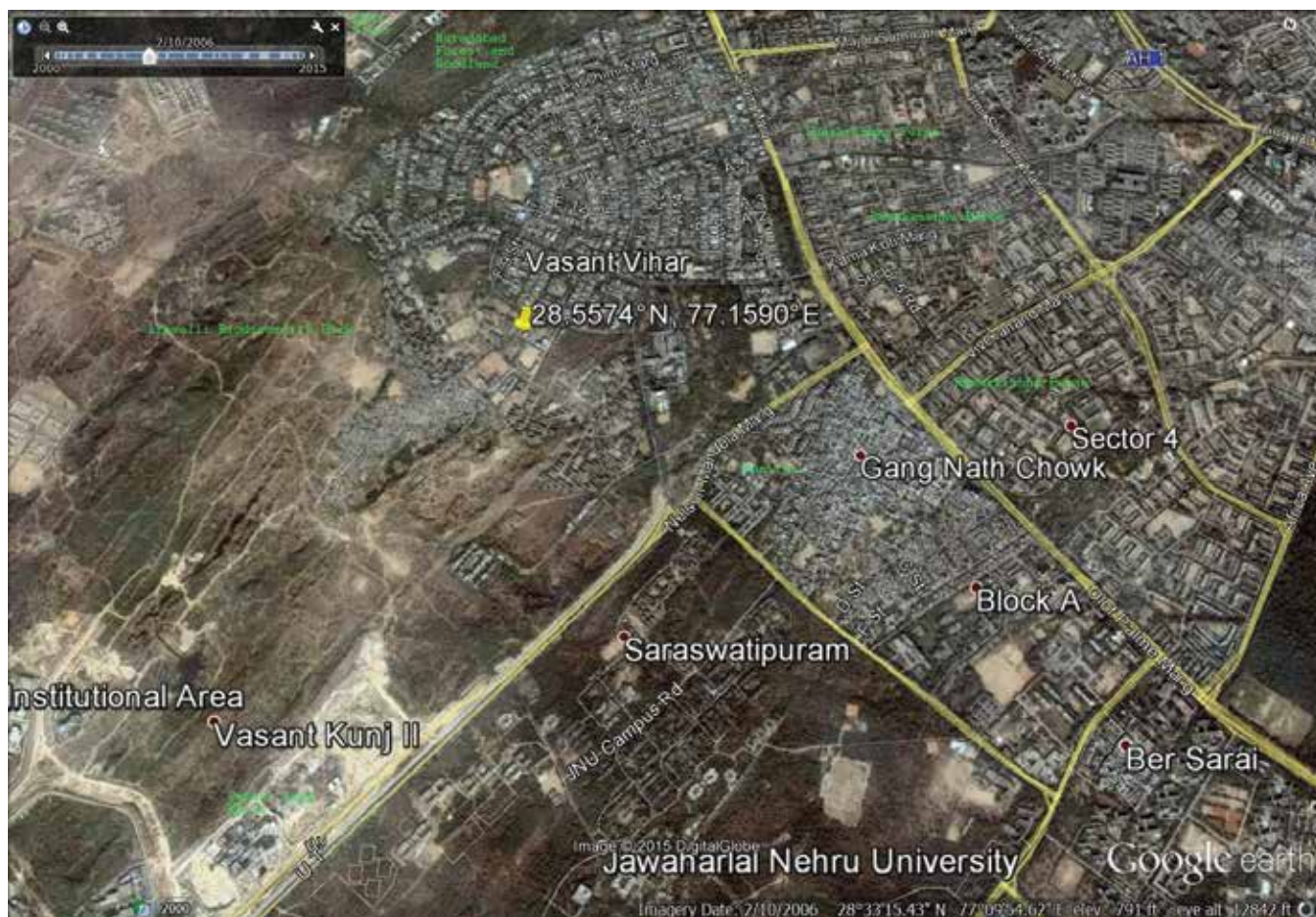


Fig. 2. Meso- ecosystem: Vasant Vihar's neighbourhood ecosystem. Source: Google Earth 2015

exotic trees, provides significant fruit food security to the birds. Decorative trees are few and sparse in these homes, unlike Vasant Vihar. Munirka's avifauna support is minimal due to its sparse tree cover that is mostly seen in its three DDA colonies, while the village is practically devoid of avenue trees and is heavily developed with multi-storey apartments.

The *Micro-ecosystem* comprises Vasant Vihar residential colony. This posh residential colony was planned and came up in the 1960s. Vasant Vihar's land use is a mosaic of residential, and commercial business complexes; a patch of protected forest, ornamental parks, and avenue trees, as well as waste management systems (Figs. 3 & 4). It is bound in the north by Palam Marg, in the south by Aravalli Diversity Park and abandoned mined Ridge area towards Vasant Kunj, in the east by Nelson Mandela Road, and in the west by Muradpur Pahari Forest and Woodland.

Vasant Vihar's habitat and land use

The micro-habitat of Kohi, which is the hilly tract of the Ridge, defines Vasant Vihar. It is this template that has been urbanised. The colony's original design was of bungalows with gardens. Since 2000 this has seen a gradual, accelerated conversion into a congestion of multi-storeyed residential apartments. In addition, over the years, there has been a gradual conversion of a primarily residential colony, into a commercial office area. This residential area buzzes with activity as there are schools (11), offices, and

commercial centers, which serve every block. Traffic is high around the commercial centers, and during school opening and closing time. The only 'water body' in Vasant Vihar is the drain that flows north-south, i.e., from RKP's Indira Market, into Vasant Vihar towards Basant Lok. This drain goes beyond, towards Vasant Kunj, and collects the storm water from the Palam Marg, and the Vasant- and Poorvi Margs of Vasant Vihar. The colony is relatively clean, as garbage is not disposed off haphazardly. There are numerous garbage dump points from where garbage is collected on a regular basis, but which provide avifauna support, e.g., Basant Lok's garbage dump adjoining Vasant Vihar District Park had a large concentration of Common Myna *Acridotheres tristis*, Bank Myna *A. ginginianus*, Black Kite *Milvus migrans*, House Crows *Corvus splendens*, etc. The tree cover is examined in the following sections.

The tree cover template of Vasant Vihar

The colony contains about 14 parks, most of which are ornamental. It has a protected forest—the District Park of 20 acres, a biodiversity park—the Aravalli Biodiversity Park, and a nursery of the Municipal Corporation of Delhi (MCD), which maintains tree cover in Vasant Vihar's parks and on its roads. However, in order to understand the avifauna support given by the tree cover, we need to deconstruct the multiple tree cover layers of Vasant Vihar.

Given the paucity of historical accounts and records about the vegetative cover of the area that was developed into Vasant

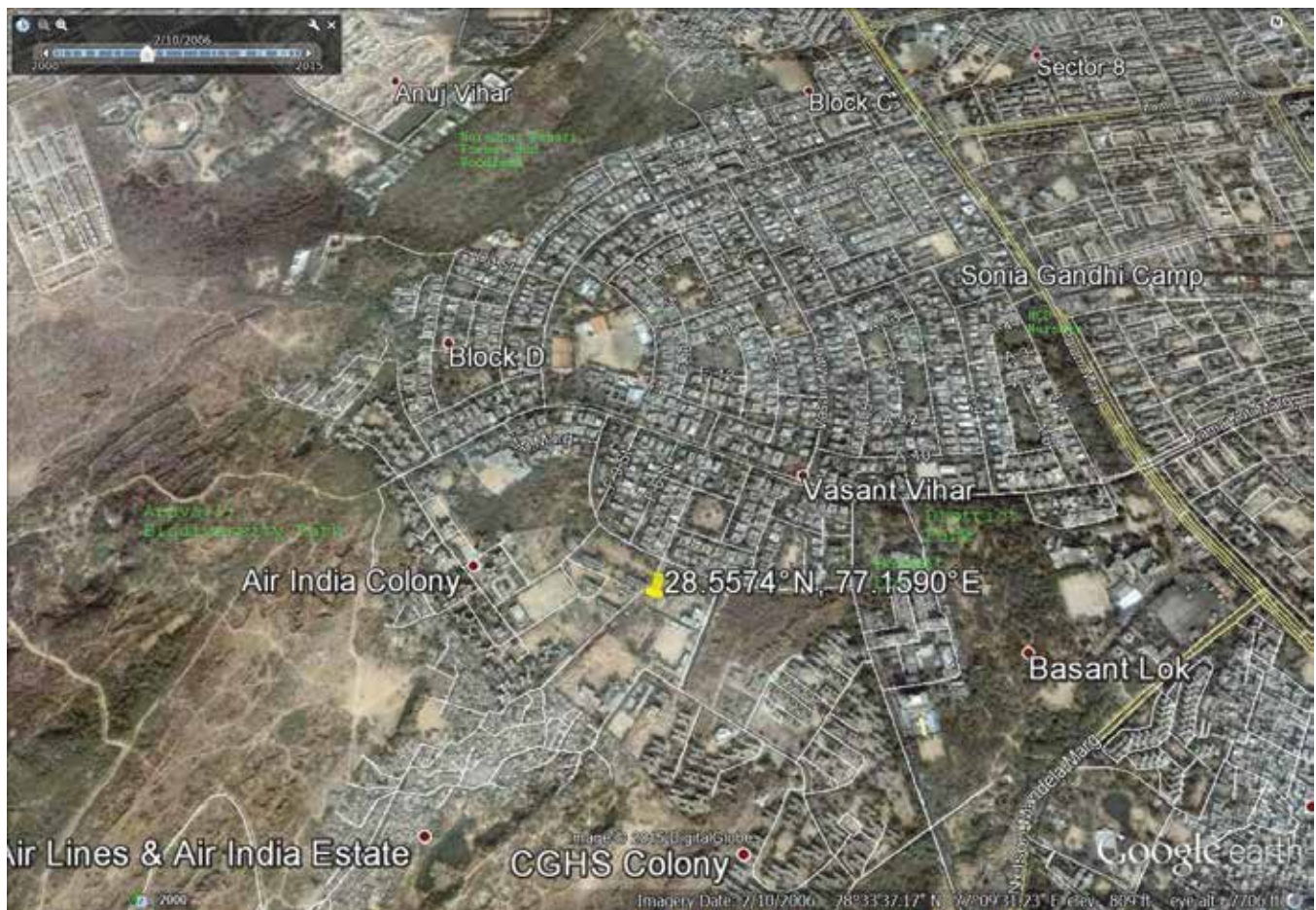


Fig. 3. Micro-ecosystem: Vasant Vihar and its Land use Source: GoogleEarth 2015

Vihar, we can attempt a partial reconstruction of its original Kohi vegetation, through documenting the existence of some scattered relics from the Ridge—a lone Hingot *Balanites roxburghii* tree, a few Ronjh *Acacia leucophloea* trees, and Babool *Acacia nilotica indica* trees. But the predominant vegetative layer is the result of the Delhi government's perspective of creating a beautiful residential colony, that is profusely planted with flowering trees drawn from the nearby region, the rest of India, and from other countries as widely scattered as Myanmar, Africa, Mexico, and Brazil. The government nursery run by Municipal Corporation of Delhi supplies plants to Vasant Vihar.

The third tree layer, is the home owners' own preferences of trees that they plant within their home gardens and the sidewalk gardens—exotics like the Royal Palm *Roystonea regia* jostle with Sonjna and Bael trees, as well as the seasonal flowering plants and bushes that mark their borders. Of late, decorative and hybrid plants are increasingly preferred as they beautify the apartment complexes and fit into cramped spaces. Vasant Vihar's vegetation is an interesting mix of native, regional, Indian, and exotic trees (Annexure 2). Unlike Lutyens' Delhi, there was no straitjacket scheme of tree planting for Vasant Vihar. Whatever was available was planted, and it created an interesting treescape with ornamental and non-ornamental trees where both Moulmein Rosewood *Millettia peguensis* and Goolar *Ficus racemosa*, figure in the scheme of avenue trees of Vasant Vihar. This hodge-podge of native, regional, pan-Indian, and exotic trees has provided not merely an aesthetic look to the human habitation, but more

critically, food security for birds, and insects too, and a year long supply of nectar, and fruits, besides nesting and roosting facilities. We will now examine the tree cover template from the periphery to the core, that is, from Palam Marg towards the colony itself.

Palam Marg's tree cover consisted of avenue plantations, avenue trees, and the central verge. Palam Marg had a very high traffic density throughout the day and night. Its avenue plantations were located in few places such as at the intersection with Nelson Mandela Road, at the intersection of Poonvi Marg and Palam Marg, etc. Its avenue trees were located all along Palam Marg except for few isolated patches. The tree cover of both consisted Kassod *Senna siamea*, Forest Red Gum *Eucalyptus tereticornis*, Maharukh *Ailanthus excelsa*, Anjeeri *F. palmata*, Bakain *Melia azedarach*, Karanj *Pongamia pinnata*, Kosam *Schleichera oleosa*, Siris *Albizia lebbek*, Shisham *Dalbergia sissoo*, Pilkhan *Ficus virens*, Jodi *Ficus amplissima*, Semal *Bombax ceiba*, Acacia species—Vilayati keekar *Prosopis juliflora* and Babool, Ber *Ziziphus mauritana*, and Neem *Azadirachta indica*. Yellow Oleander *Thevetia peruviana*, and Oleander *Nerium oleander* were commonly planted. On the central verge, Neem, Karanj, Yellow oleander, Oleander, Vilaiti Keekar, Shisham, etc., provided nesting sites for birds.

However, post-2005, the construction of a series of flyovers on Palam Marg destroyed the avenue plantations and trees, which provided support to birds. The central verge, which provided nesting support to birds, has now ceased to exist. The

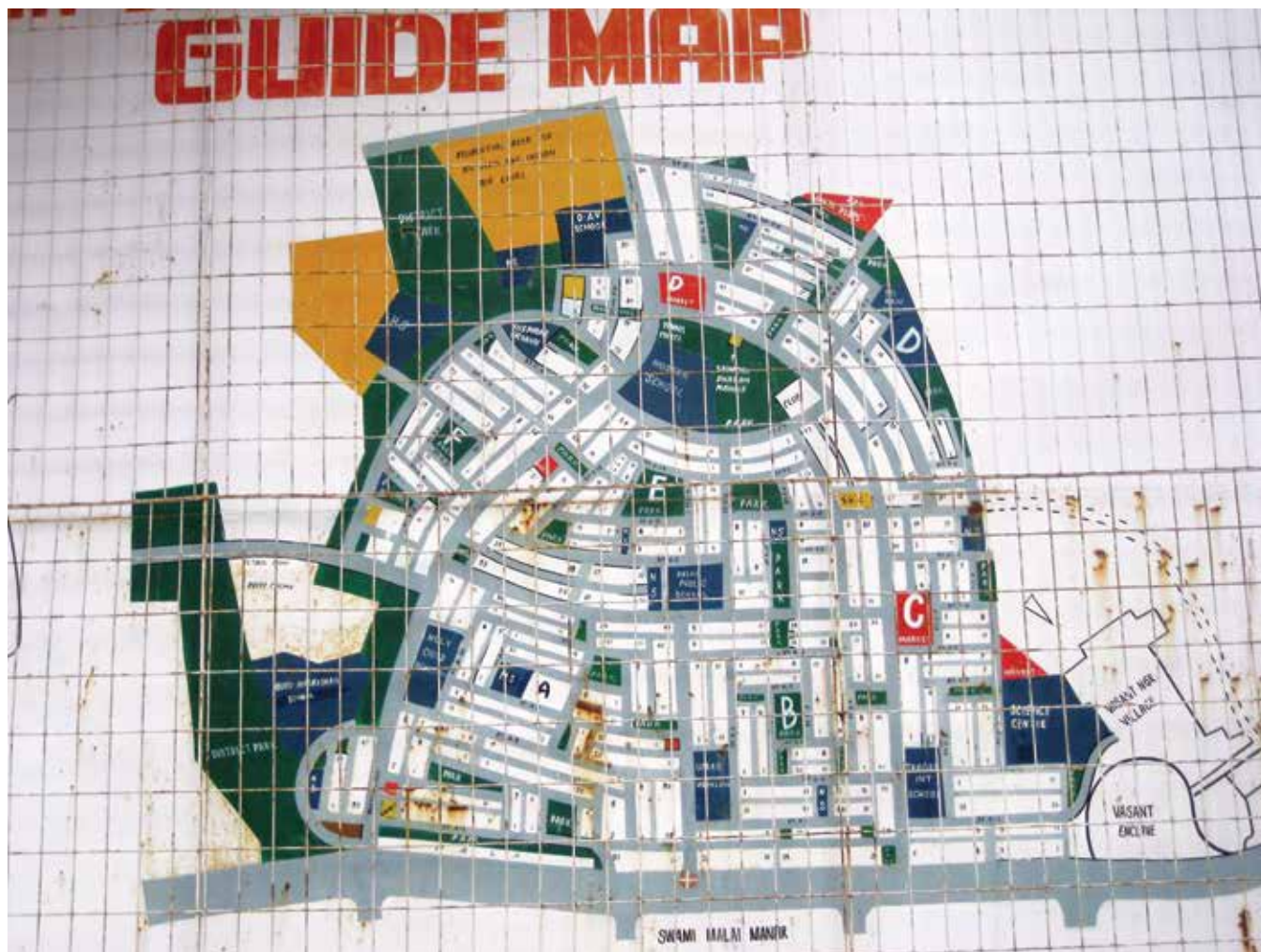


Fig. 4. Micro-ecosystem: Vasant Vihar and its Land use Source: Vasant Vihar Welfare Association Guide Map Signboard. Undated.

loss of such bird support areas should be factored in the study of a micro-ecosystem, where in some cases they play a critical role as bird support areas.

Vasant Vihar District Park had wilder vegetation, and beautiful old Ronjh trees along with 'beautifying' trees such as the Weeping bottlebrush *Callistemon viminalis*, etc. Except for two venues, a park adjacent to the MCD nursery, and the nursery itself, which have interesting and unique plant specimens, such as Ylang ylang *Cananga odorata*, Quickstick *Gloricidia sepium*, Krishna Fig *Ficus benghalensis* var. *Krishnae*, and the pink and yellow flowered *Tabebuias*, rest of the parks had decorative trees and plants. The trees alongside the drain and the nursery on Vasant Marg (the road running parallel to Palam Marg) contributed to the 'wooded' nature of the area.

The sidewalk garden fronts of houses, which are planted and nurtured by the residents, had an interesting mix of exotic trees, such as palms, border bush plants, etc. The residential gardens had not only exotics such as Royal Palm, but also trees such as Bael, Sonjna, Mango, etc. In addition, seasonal flowering garden plants were common. These residential, and sidewalk gardens, form an interesting and contiguous tree cover along with the avenue trees, and government parks.

The preference for 'beautifying' the roads and the residential colony has resulted in a haphazard schema of a mix of indigenous

and exotic trees. The focus on beautiful flowering trees has skewed the tree mix more towards flowering trees rather than edible fruit trees, which ensured a fairly long flowering period, and provided nectar security to the birds, as well as insects, and bats. Only one solitary Imli *Tamarindus indica* avenue tree was found which indicated the planners' preference for creating an aesthetic environment. Though traditionally, Imli was a preferred avenue tree as it provided shade, shelter and cooling fruit to the weary travellers. Many old Grand Trunk Roads had Imli trees lining them, which today are rare to find on the modern highways.

On the interlinkages between birds and the trees in Vasant Vihar

Nature of birds found

At the micro-ecosystem level, avifauna diversity and density is the culmination of factors such as land use, tree and vegetation diversity and density, water bodies such as drains, tanks, etc., garbage and waste management, parks, and various types of buildings. Known avenue tree birds like the Indian Grey Hornbill *Ocyrceros birostris*, and the Yellow-legged Green Pigeon *Treron phoenicoptera* (Ali 1988), were rarely seen on avenue trees. Instead, they were found more in parks and gardens. This slight 'shift' could be possible due to the change in the composition

of avenue trees, from *Ficus*, Mango, Neem, Tamarind, Jamun, etc., to exotic species, and flowering trees. This, in addition to the pressure of high volume traffic, with the resultant atmospheric, and noise pollution was, possibly, not conducive for the habitation of the traditional roadside tree bird species such as the Indian Grey Hornbill. The decisive factor in tilting the balance in favour, or against, attracting birds is the composition of avenue trees.

Both native and international migrants were found in Vasant Vihar. The migratory birds were few; four species were spotted. One pair of Long-tailed Minivet *Pericrocotus ethologus* was observed chasing and calling to each other in the canopy of avenue trees in April 2005. Common Chiffchaff *Phylloscopus collybita*, and Lesser Whitethroat *Curruca curruca* were regularly spotted in the District Park. A Pied Bushchat *Saxicola caprata* pair was spotted only once in April 2007 when they were chasing each other in the canopy of avenue trees.

Palam Marg's avenue trees provided nesting sites for birds, plus diverse avifauna were seen—Ashy Prinia *Prinia socialis*, Purple Sunbird *Cinnyris asiaticus*, Black Kite (nesting on Eucalyptus trees), House Crow, Oriental White-eye *Zosterops palpebrosus*, Coppersmith Barbet *Psilopogon haemacephala*, Brown-headed Barbet *P. zeylanicus*, Black Drongo *Dicrurus macrocercus*, Common Myna, Asian Pied Starling *Gracupica contra*, Brahminy Starling *S. pagodarum*, Bank Myna, Red-vented Bulbul *Pycnonotus cafer*, etc. Despite the high traffic, and noise, the birds appeared oblivious to the din, and went about their business. The vulnerability of the nesting sites located on central verge, on trees with low heights with overhanging branches on the road, that could easily be demolished by passing vehicles, or predated upon, did not deter the birds from building their nests. Such a continual, and persisting, presence of birds on busy roads raised the question of the impact of the high levels of air and noise pollution on the birds and their young.

Most trees were flowering and fruiting, and diverse bird species were found, in good numbers, to be feeding, nesting, resting, etc., in them. Many avenue trees in Vasant Vihar had nesting holes of Common Mynas, Coppersmith Barbets, and Oriental Magpie Robins *Copsychus saularis*. Birds were present more in the avenue trees than in homes and parks.

The data for the breeding seasons of the birds is taken from Harvey *et al.* (2006). The breeding season of the resident native birds stretches from March through September, i.e., for seven months through spring, summer, and monsoon seasons. The second longest stretch is from December to October for 11 months covering winter to autumn. Year-round breeders are Grey Francolin *Francolinus pondicerianus*, Rock Pigeon *Columba livia*, House Sparrow *Passer domesticus*, and Brown Rock Chat *Oenanthe fusca*. Other birds with long breeding periods are Eurasian Collared Dove *Streptopelia decaocto*, House Crow (winter–autumn), Coppersmith Barbet, Large-billed Crow *C. macrorhynchos* (autumn–summer), and Rose-ringed Parakeet *Psittacula krameri* (winter–monsoon). This fairly diverse, and extended, breeding period of birds also relies on the food security that is provided by the micro-ecosystem of Vasant Vihar, which is now examined. At first, the nature of trees is delineated followed by the food security that the avenue trees of Vasant Vihar provide to the birds.

The most common avenue species were *Ficus*: Pilkhan, Banyan, and Peepal *F. religiosa*; Neem, Katsagon *Fernandoa adenophyllum*, Kassod, Karanj, Shahtoot *Morus alba*, Amaltas, Jamun, and Gulmohar *Delonix regia*. The predominance of keystone species such as *Ficus* (Gadgil & Guha 1992) provided

significant refuge and support to the bird life in that residential area. Some of the houses too had old trees, comprising *Ficus*, and others.

Vasant Vihar had an interesting heterogeneity of trees. But how did this work as a support system for birds? Nesting and roosting functions were common. Many birds nested and roosted here, from Black Kites to Coppersmith Barbets to the prinias. The food requirements of the birds fall broadly into two categories: the broad-spectrum omnivores, and the specialised insectivores, nectarivores, and frugivores. The tree cover of Vasant Vihar provided food security to cover both categories, especially nectar, of which a nearly year long supply is assured. The ficus trees also provided food for the birds for nearly seven months of the year, from February to October. The foliage also supported diverse insect species, which provided a steady supply of insects throughout the year. The garbage dumps provided food for the scavengers and omnivores.

The bulk of these birds are those found in urban areas and commensal with man. The associates of man such as Bank Myna, Common Myna, and House Crow appeared to be doing well and in fact thriving, but the House Sparrow was less visible. Food for the omnivorous House Sparrow was abundant in Vasant Vihar, but surprisingly the House Sparrow was not more commonly visible, while an insectivore like the Ashy Prinia, with a diet of insects, was thriving and was very common.

The flowering periods of all the tree species was spread throughout the year. The peak flowering season was summer, but a nearly year round supply of nectar was available from March to September, covering spring, summer and the monsoon. Many trees had a second flush (burst of flowering) during monsoon. Therefore, for seven months of the year, a continuous supply of nectar was available for the birds.

While there was a steady supply of nectar that was not the case with fruits, as most of the fruits were inedible for birds. Only some trees had fruits that were edible to birds. Some trees, like the Sausage tree *Kigelia africana*, have fruit that is edible for elephants in Africa, however, it is not known which birds consume them in Delhi. Trees with inedible fruit for birds are Copperpod *Peltophorum pterocarpum*, Siris, Harshingar *Nyetanthes arbor-tristis*, Forest Red Gum, Semal, White Silk Floss Tree *Ceiba insignis*, Caribbean Trumpet Tree *Tabebuia aurea*, Jarul *Lagerstroemia speciosa*, Saptaparni *Alstonia scholaris*, Chir Pine *Pinus roxburghii*, Kanak Champa *Pterospermum acerifolium*, etc. Fruit (both edible and inedible for birds) was produced throughout the year, though the peak fruiting season was summer. Edible fruit—both ficus and non-ficus—was available for birds throughout the year. The ficus species trees such as Peepal, Banyan, Pilkhan, Jodi, Goolar, Laurel Leaf Fig *F. microcarpa*, Weeping Fig *F. benjamina*, Anjeeri, etc., provided fruits not only during their peak season of Spring–Summer (March, April, May, June), but for most of the year that is from February to October. The non-ficus species trees such as Shahtoot, Mango, Guava, Chamrod *Ehretia laevis*, Neem, Jamun, Ber, Maulsari *Mimusops elengi*, Oleanders, and others, with their specific fruiting seasons altogether, provide fruits throughout the year. It was a common sight to see Plum-headed Parakeets *P. cyanocephala* along with Rose-ringed Parakeets feasting on the fruits of Shahtoot avenue tree.

Vasant Vihar ecosystem linkage with meso- and macro-ecosystems

Vasant Vihar is nested in a multi land use meso-ecosystem that

resonates with its own land use. These varied ecosystems are linked to each other as they are selectively connected with each other. The basic template of the Ridge, which is present both in meso- and macro-ecosystems, is present in Vasant Vihar as a patchy degraded remnant. Though every planned area's greenery is not the same as seen in limited tree cover in the Munirka DDA Flats complex when compared with Vasant Vihar and RKP, Vasant Vihar's planned greenery resonates with RKP's planned greenery. However, avenue trees are common elements and all pervasive. Therefore, the avifauna observed in Vasant Vihar is dependent on the support of varied ecosystems within and around Vasant Vihar. Vasant Vihar itself provides diverse support system for its avifauna. Its District Park is a degraded remnant of the Ridge, which is linked with the remnant ridge patches in its meso-ecosystem Vasant Kunj and JNU. Its ornamental parks and house gardens resonate with RKP colony's ornamental parks and house gardens. Its avenue trees link it with its meso-ecosystem's avenue trees and beyond that as avenue trees are across the urban area.

Birds as ecosystem indicators

Some areas that merit concern in future are reflected in the following questions: Can these birds be indicators of an urban ecosystem, such as the Common Sparrows are? Should we begin to get worried if these birds get sparse or disappear or there is a boom in their populations? Are they indicators of human lifestyle and habitat sustainability or unsustainability? Given that the Vasant Vihar Bird list has primarily birds, which are associated with man, how much significance can be attached to their adaptive nature? What is the extent of their capability to adapt to changing nature of human lifestyle and habitations? Would a change in the urban habitat such as a major shift from bungalows with gardens to multi-storeyed apartments impact bird density and diversity? Would urban concrete jungles support this common urban avifauna? Given the increasing shrinkage of natural green spaces and the increase in the built up area, what kinds of ecosystem support do resident, and migrant, avifauna need?

Conclusion

As Vasant Vihar, in terms of species diversity, was nearly equivalent to areas rich in birds such as Lodhi Gardens and JNU, the Ecosystem Paradigm and land use tool were used to understand the reasons for avifauna presence in Vasant Vihar. Though the land use of Vasant Vihar did provide significant support to the avifauna, it is unclear whether this is sufficient for the birds and whether this could be a stand-alone ecological refuge. However, it is very likely that meso-ecosystem, which is both residential area, mimicking that of Vasant Vihar, and part of the 'natural' ridge ecosystem, provides necessary support.

Vasant Vihar serves as a 'transit' ecological refuge between the Ridge ecosystem-South Central and South Ridges and the developed urban parks such as Deer Park, Lodhi Gardens, etc. The tree-lined roads serve as a continuous, but, critical link between different eco-zones besides supporting avifauna in each area, and are the more diffuse, 'invisible', and widespread areas supporting birds.

Avenue trees are 'ecological refuge' areas for birds in urban areas. Common urban avifauna is those associated with human beings and native tree species such as the Keystone *Ficus* species.

A well-planned tree cover for a residential area not only adds to the aesthetics of the area but supports avifauna, so very

integral to the urban ecosystem. With good vegetative cover—especially on roads and parks and house gardens—an urban neighbourhood can provide good support for diverse avifauna. The tree species should lean more on the regional and Indian, especially on keystone species such as *Ficus* and non-*Ficus* fruits which are consumable by birds, instead of exotics whose value lies mainly in providing nectar. Hence, urban planners should pay attention to the role of avenue trees in planning for urban areas, with special focus on *Ficus* trees, Neem, Jamun, Amaltas *Cassia fistula*, Babool, etc., and the local trees of the local and regional ecosystem which support local and regional avifaunas.

Acknowledgements

I thank Bill Harvey, Nikhil Devasar, Otto Pfister, Kanwar B Singh, and Vijayalakshmi Shankar for their inputs.

References

- Ali, S., 1988. *The book of Indian birds*. 11th Revised and enlarged (Reprint) ed. Bombay: Bombay Natural History Society. Pp. i-xlvii+1, 1–187.
- Anonymous. 2013. Website: http://delhi.gov.in/wps/wcm/connect/doit_forest/Forest/Home/Forests+of+Delhi/Recorded+Forest. [Accessed on 18 August 2013.]
- Anonymous. 2015. Website: <http://www.dda.org.in/greens/biodiv/aravalli-biodiversity-park.html>. [Accessed on 28 July 2015.]
- Gadgil, M., & Guha, R., 1992. *This fissured land: An Ecological History of India*. 1992. New Delhi: Oxford University Press.
- Harvey, B., Devasar, N., & Grewal, B., 2006. *Atlas of the birds of Delhi and Haryana*. 1st ed. New Delhi: Rupa & Co. Pp. 1–352.
- Kalpavriksh. 1991. *The Delhi Ridge forest: Decline and conservation*. New Delhi: Kalpavriksh.
- Krishen, P., 2006. *Trees of Delhi: A field guide*. New Delhi: Dorling Kindersley. Pp. 1–360.

Annexure 1

Bird List for the years 2005–2008

Indian Peafowl *Pavo cristatus*
 Grey Francolin *Francolinus pondicerianus*
 Rock Pigeon *Columba livia*
 Eurasian Collared Dove *Streptopelia decaocto*
 Spotted Dove *S. chinensis*
 Laughing Dove *S. senegalensis*
 Yellow-legged Green Pigeon *Treron phoenicopterus*
 Greater Coucal *Centropus sinensis*
 Asian Koel *Eudynamis scolopaceus*
 Indian Pond Heron *Ardeola grayii*
 Cattle Egret *Bubulcus ibis*
 Red-wattled Lapwing *Vanellus indicus*
 Shikra *Accipiter badius*
 Black Kite *Milvus migrans*
 Spotted Owllet *Athene brama*
 Indian Grey Hornbill *Ocyrceros birostris*
 Lesser Golden-backed Woodpecker *Dinopium benghalense*
 Yellow-crowned Woodpecker *Dendrocopos mahrattensis*
 Brown-headed Barbet *Psilopogon zeylanicus*
 Coppersmith Barbet *P. haemacephalus*
 Green Bee-eater *Merops orientalis*
 Plum-headed Parakeet *Psittacula cyanocephala*
 Alexandrine Parakeet *P. eupatria*
 Rose-ringed Parakeet *P. krameri*
 White-throated Kingfisher *Halcyon smymensis*
 Long-tailed Minivet *Pericrocotus ethologus*
 Black Drongo *Dicrurus macrocercus*
 Rufous Treepie *Dendrocitta vagabunda*
 House Crow *Corvus splendens*
 Large-billed Crow *C. macrorhynchos*
 Purple Sunbird *Cinnyris asiaticus*
 Indian Silverbill *Euodice malabarica*

House Sparrow *Passer domesticus*
 Yellow-throated Sparrow *Gymnoris xanthocollis*
 White-browed Wagtail *Motacilla maderaspatensis*
 Ashy Prinia *Prinia socialis*
 Common Tailorbird *Orthotomus sutorius*
 Red-whiskered Bulbul *Pycnonotus jocosus*
 White-eared Bulbul *P. leucotis*
 Red-vented Bulbul *P. cafer*
 Common Chiffchaff *Phylloscopus collybita*
 Lesser Whitethroat *Curruca curruca*
 Oriental White-eye *Zosterops palpebrosus*
 Common Babbler *Argya caudata*
 Jungle Babbler *Turdoides striata*
 Asian Pied Starling *Gracupica contra*
 Brahminy Starling *Sturnia pagodarum*
 Common Myna *Acridotheres tristis*
 Bank Myna *A. ginginianus*
 Indian Robin *Saxicoloides fulicatus*
 Oriental Magpie Robin *Copsychus saularis*
 Pied Bushchat *Saxicola caprata*
 Brown Rock Chat *Oenanthe fusca*

Annexure 2

Tree List for the years 2005–2008
 African Tulip Tree *Spatodea campanulata*
 Alii Fig *Ficus binnejdikii*
 Amaltas *Cassia fistula*
 Anar *Punica ranatum*
 Anjeeri *Ficus palmata*
 Arjun *Terminalia arjuna*
 Arnatto *Bixa ovellana*
 Ashok *Polyalthia longifolia*
 Babool *Acacia nilotica indica*
 Bael *Aegle marmelos*
 Bakain *Melia azedarach*
 Banyan *Ficus benghalensis*
 Ber *Ziziphus mauritiana*
 Bistendu *Diospyros cordifolia*
 Caribbean Trumpet Tree *Tabebuia aurea*
 Chamrod *Ehretia laevis*
 Chandni *Taberaenamontana divaricata*
 Chikrassy *Chukrasia tabularis*
 Chir Pine *Pinus roxburghii*
 Copperpod *Peltophorum pterocarpum*
 Dhak *Butea monosperma*
 Fiddleleaf Fig *Ficus lyrata*
 Floss-Silk Tree *Ceiba speciosa*
 Forest Red Gum *Eucalyptus tereticornis*
 Frangipani *Plumeria rubra*
 Goolar *Ficus racemosa*
 Guava Tree *Psidium guajava*
 Gulmohur *Delonix regia*
 Harshingar *Nyctanthes arbor-tristis*
 Hingot *Balanites roxburghii*
 Imli *Tamarindus indica*
 India Rubber Tree *Ficus elastica*
 Indian Coral Tree *Erythrina variegata*
 Indian Tulip Tree *Tespesia populnea*
 Jacaranda *Jacaranda mimosifolia*
 Jadi *Ficus amplissima*
 Jaggery Palm *Caryota urens*
 Jamun *Syzygium cumini*
 Jarul *Lagerstroemia speciosa*
 Jerusalem Thorn *Parkinsonia aculeata*
 Jungle Jalebi *Pithecellobium dulce*
 Kachnar *Bauhinia variegata*
 Kadi Patta *Bergera koenigii*
 Kamini *Murraya paniculata*
 Kanak Champa *Pterospermum acerifolium*
 Kaniar *Bauhinia purpurea*

Karanj *Pongamia pinnata*
 Kassod *Senna siamea*
 Katsagon *Fernandoa adenophyllum*
 Kosam *Schleichera oleosa*
 Krishna Fig *Ficus benghalensis* var. *Krishnae*
 Laurel Fig *Ficus microcarpa*
 Maharukh *Ailantus excelsa*
 Mango Tree *Mangifera indica*
 Maulsari *Mimusops elengi*
 Morpankhi *Platycladus orientalis*
 Moulmein Rosewood *Milletia peguensis*
 Mysore Fig *Ficus drupacea* var. *pubescens*
 Neem *Azadirachta indica*
 Oleander *Nerium oleander*
 Peepal *Ficus religiosa*
 Pilkan *Ficus virens*
 Pink Trumpet Tree *Tabebuia impetiginosa*
 Putranjiva *Drypetes roxburghii*
 Quickstick *Gliricidia sepium*
 Rai Jamun *Syzygium nervosum*
 Ronjh *Acacia leucophloea*
 Royal Palm *Roystonea regia*
 Saptarni *Alstonia scholaris*
 Sausage Tree *Kigelia africana*
 Semal *Bombax ceiba*
 Shahtoot *Morus alba*
 Shisham *Dalbergia sissoo*
 Silky Oak *Grevillea robusta*
 Siris *Albizia lebbek*
 Sonjna *Moringa oliefera*
 Subabool *Leucaena leucocephala*
 Thor *Euphorbia nerifolia*
 Vilaiti Keekar *Prosopis juliflora*
 Weeping Bottlebrush *Callistemon viminalis*
 Weeping Fig *Ficus benjamina*
 White Floss-Silk Tree *Ceiba insignis*
 White Frangipani *Plumeria obtusa*
 Yellow Bells *Tecona stans*
 Yellow Oleander *Thevetia peruviana*
 Ylang ylang *Cananga odorata*

