

Biodiversity and Bird Friendly Design in Urban Areas for Sustainable Living

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Abstract

Background/Objectives: Birds in urban areas are indicators of biodiversity¹. This paper explores ways of developing a style of architecture that provides spaces for various species of birds, as part of the built and un-built areas in cities. **Methods/Statistical Analysis:** The method adopted is a literature study of different types of birds' nests and a few species habitats to understand how they can be adapted and integrated in buildings. Methods to create natural habitats in urban landscaping, and to make green roofs habitable for wildlife, are studied. The threats faced by birds in urban settings leading to their mortality are studied and solutions for the same are proposed. **Findings:** The outcome is a set of recommendations that can be adapted and used in cities and buildings to make them inviting and also safe for vegetation and wildlife. Avoid fragmentation in city design. Cluster designs give a better solution. Open spaces can come together and they should be connected through a green network. Urban landscapes in parks, campuses, large gardens, road side avenues and medians should follow a semi rustic pattern. All new buildings and old buildings where retrofitting is possible, should have roof gardens which follow a semi rustic environment. Compound walls, Balconies, verandahs and sit outs can be provided with holes for cavity nests or hooks for pendant nests. Projecting decorative elements provide space for platform nests. Courtyards and atria with greenery can be given in buildings which are accessible to birds. Use of plain transparent and reflective glass should be avoided. They can be used with narrow patterns, netting etc. Artificial lighting in open spaces should be just enough for use, avoid light spilling, and preferably use down lighting. In a rapidly urbanizing modern world, ensuring biodiversity in cities is one of the primary responsibilities of the urban designer and the architect. Following the recommendations in the paper is a step towards this direction. **Application/Improvements:** In many developing countries legislation and guidelines are in effect to protect the biodiversity, but in our country they are lacking along with proper documentations regarding species diversity, mortality etc. Some of the outcome of the paper can help formulate guidelines in this direction.

Keywords: Biodiversity, Bird Friendly Design, Bird Species Diversity in Cities, Sustainable Living

1. Biodiversity in Urban Areas

Biodiversity is a basis for sustainable development directly contributing to human well-being in many ways², and is also a critical foundation of the Earth's life support system. Biodiversity is the variety of different types of life found on earth. Protecting all native wildlife in its natural habitat is the best way to secure biodiversity. However growing urbanization has made it impossible to reserve very large areas for natural wildlife. Nevertheless, cities are typically located near large water bodies, rivers and estuaries, or along coastlines. As a consequence, large parks and

reserves in urban areas may support high species diversity because these protected areas are the habitat "fragments" of highly diverse ecosystems. But Architecture and Urban Design mostly concentrate on creating an environment that is comfortable for human beings, and in doing so, end up compromising on several aspects, most important of them being the loss of biodiversity leading to simplified habitats dominated by one or two highly adapted and abundant, mostly non-native species.

Biodiversity is too complex to be fully quantified. However one of the major indicators of biodiversity is the diversity in bird species and population in a place.

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Therefore an attempt at increasing the species diversity of wildlife in general and birds in particular, in turn will be a move towards enhancing the biodiversity of the region. Any toxin in the environment affects birds earlier than it does human beings. Therefore their behavioral variations can be observed for indications of presence of dangerous toxins or chemicals in the atmosphere³.

Apart from that, birds have always been an integral part of human life. Birds consume vast quantities of insects, and control rodent populations by controlling garbage, reducing damage to crops and forests, and helping limit the transmission of diseases such as certain viral diseases, dengue fever, and malaria. Birds play a vital role in regenerating habitats by pollinating plants and dispersing seeds. Birds are an educational experience if observed closely, and they are also a vast economic resource. According to the U.S. Fish and Wildlife Service, bird watching is one of the fastest growing leisure activities in North America, and a multi-billion-dollar industry⁴. Birds have been often used to symbolize cultural values such as peace, freedom, and fidelity, and are delightful to eyes and ears. They are a part of Literature, Arts, Culture and History. Some of the disadvantages due to bird presence in cities are (a) possible and feared health hazards to people (b) bird strikes on air craft (c) decay of monuments caused by birds (e.g. bats) (d) nests blocking gutters and drainpipes, causing water damage to building exteriors etc. Hence the desired outcome of any study on methods of improving bird species diversity in human habitats should consider urban spaces which, while being inviting and friendly to birds, are also having enough features to avoid human-avian conflict. Interestingly, an urban space consciously created for inviting birds, is also likely to become a good public place in its scale, functions, pleasantness etc. The intention of this paper is to look at design solutions, both at building level and urban level, which can invite more diverse species of birds. The strategies and design features given in this paper can be a basis for further experimentation by planners and architects, and can be used to improve the quality of habitation in general, and of urban habitation in particular.

2. Reducing Bird Mortality in Cities

Birds occupying urban regions are categorized as urban birds. One of the ways to increase bird population in

cities is by reducing the risk of their mortality. One main reason for bird mortality in developed countries is the bird collision on glass buildings. This happens because birds get confused by reflective glass which reflects the sky and vegetation around and they fly towards it and collide. Similarly transparent glass that shows the other side confuses the birds as an unobstructed passageway and they fly straight towards it. Since tall glass skyscrapers are becoming part of Indian skyline, the guidelines being followed in Europe and USA are to be discussed.

The best way to solve bird collision problem is to introduce elements which can make the glass visible to birds. Windows with screens, latticework, grilles and other devices outside the glass or integrated into the glass, as well as glass treatments can eliminate or greatly reduce bird mortality while minimally obscuring the glass itself. Patterns covering as little as 5% of the total glass surface is observed to deter 90% of strikes under experimental conditions. Most birds do not attempt to fly through horizontal spaces less than 2" high nor through vertical spaces 4" wide or less. This is referred as the "2 x 4" rule. The patterns on glass facades can be designed to follow this rule. Retrofitting existing buildings can often be done by targeting problem areas, rather than entire buildings.

Screens and nets are among the most cost-effective methods for protecting birds, and netting can often be installed so as to be nearly invisible. Functional elements such as balconies and balustrades can act like a façade, protecting birds while providing an amenity for residents. Birds can see into the Ultraviolet (UV) spectrum of light, a range largely invisible to humans. UV-reflective and/or absorbing patterns (transparent to humans but visible to birds) are frequently suggested as the optimal solution for many bird collision problems. To a certain extent angled glasses can help when they are tilted at 20-40 degrees. Placing silhouettes outside the window leaving a 5-10 cm gap is also recommended. Bird feeders should be placed at least 10 cm away from the glazed area. Patterns are often applied to glass to reduce the transmission of light and heat; they can also become an aesthetic design detail.

Another major threat faced by birds is artificial illumination in cities. The illumination of buildings at night, and in the early morning and evening, creates conditions that are particularly hazardous to night time migrating birds. If weather conditions are favorable, nocturnal migrants depend heavily on visual reference to maintain orientation. During inclement weather, these migrants often descend to lower altitudes, possibly in

search of clear sky celestial clues or magnetic references and are liable to be attracted to illuminated areas around buildings. They become disoriented and entrapped while MCIRCLING in the illuminated zone and are likely to succumb to exhaustion, predation, or lethal collision.

In addition to this, overly-lit buildings waste electricity, increase greenhouse gas emissions and air pollution levels- especially if poorly designed or improperly installed outdoor light fixtures are used. Recent studies estimate that over two thirds of the world's population can no longer see the Milky Way, just one of the night time wonders that connect people with nature. Artificial light is increasingly recognized as a negative factor for humans and wildlife as well. Rich and Longcore have gathered comprehensive reviews of the impact of "ecological light pollution" on vertebrates, insects, and even plants⁵. Together, the ecological, financial and cultural impacts of excessive building lighting are compelling reasons to reduce and refine light usage.

Improving lighting design is one possible way to reduce light pollution as well as reduce bird mortality. Most "vanity lighting" is unnecessary. However, when it is used, building features should be highlighted using down lighting rather than up-lighting. Where light is needed for safety and security, reducing the amount of light trespass outside of the needed areas can help by eliminating shadows. Efficient design of lighting systems plus operational strategies to reduce light "trespass" or "spill light" from buildings while maximizing useful light are both important strategies. (Source: U.S. Fish and Wildlife Service guidelines for Bird Friendly Building Design).

3. Habitat Compensation for Birds

Urbanization causes fragmentation of natural reserves resulting in loss of habitats for wildlife and birds. As urbanization grows, birds that can adapt to cities grow in their population, whereas the rest have to fight for nesting places. For e.g., pigeons and vultures survive in a city, whereas a house sparrow cannot. Hence, for an urban planning scheme or individual building design to be bird friendly, it should focus on spaces which will be friendly to the weaker bird species. Reconciliation ecology is the science of modifying human impacted habitats so that they also support designated wild species.

Closely packed clusters of buildings with large open

spaces around them have better potential for increased bird population rather than buildings spaced apart with fragmented open spaces⁶. Planners can help reduce human disturbances to birds in open spaces around clustered housing by giving only limited defined pathways in them. Natural preserve fragments in developed areas should be connected by green bridges and connections thus forming an ecological network. If golf courses are planned in a development, their value to birds can be enhanced by maintaining as much native vegetation as possible and positioning the course so that it is surrounded by open space, or is close to natural wetlands, or nesting and roosting areas. Ecological compensation can also be made by creating islands in lakes. When there is a deepening activity of lake for it to hold more water, a large quantity of silt comes out. Removing this is an expensive process. Instead it can be used to create islands in lakes planted with trees and grass which will make a safe haven for birds⁷.

3.1 Urban and Campus Landscapes

Streets and market places which were formerly a part of the urban pattern used to provide nesting spaces as well as feed for birds. But these are rarely seen in modern cities, leading to a considerable decrease in the urban bird population. In this situation it is important to design urban green areas and open spaces in such a way that these spaces attract a variety of species. Canadian Landscape architect Michael Hough in one of his books 'Cities and Natural process' distinguishes between two types of green spaces in cities- Pedigreed, civic, planned landscape and unplanned, natural landscape⁸. He argues that the former is problematic in many ways- they are universal and do not consider the local ecology or context. They suppress diversity. They remove the natural weeds thus narrowing the range of life. Also their management is resource intensive. Green spaces and large campuses of institutions or corporate offices designed as semi-rustic gardens encourage diversity. Planting trees provide clean air and cool shade, along with giving ample habitats for birds. Many birds take nectar from flowers. Similarly local fruit eating birds tend to eat only small fruits of diameter one centimetre or less. Bats are attracted by scent and visit flowers and fruit trees at night. Parakeets eat tree seeds. Squirrels consume seeds, fruits and nectar.

For a garden to be a good wildlife habitat it is imperative that there needs to be a fair amount of

variation in form and composition of the vegetation. A rustic semi-wild corner with shrubbery, piles of loose stones in small heaps or demarcating walls with holes and gaps create a habitat for small animals like insects and lizards, which birds can feed on. Dripping taps (or drip nozzles encourage bees and birds that come to drink water. Many birds prefer hedges and shrubs to trees. Appropriately chosen climbers on arches, trellises and pergolas create a multidimensional ambience, break the monotony in architectural structures, and also encourage birds to come there to feed and build their nests. Gravel and stone-lined paths enhance seepage of water into the ground. Leaf litter is effective mulch. It helps retain soil moisture, prevents heating up of the soil and provides a good habitat for insects and earthworms. Many birds like mynas and babblers feed on these insects which they get by turning over leaves and searching for them. Similarly damp areas and ponds with a little dripping water can attract bees, other insects and sometimes even birds during dry weather. All ponds and depressions need to have at least half their shoreline with a very gradual slope. This slope should reach up to the very top, so that frogs and toads, shrews, and other small animals that fall into the water can easily climb.

Creating a wildlife-friendly area does not mean that the planting scheme needs to be devoid of aesthetics. The arrangement could accommodate designs which look good and at the same time serves to attract wildlife. Manicured lawns require herbicides, pesticides and fertilizers, to maintain a verdant green. These chemicals then get washed into the soil by liberal watering and are carried to ground water resources causing serious problems including cancer. So naturally growing uncut grass, just trimmed and intermixed with other smaller plants makes a much better lawn. The grass with its other plant community could effectively support many little animals, like butterflies and birds, which find food from these plants and add color and charm to the environment⁹.

3.2 Green Roofs

In the vernacular building traditions, there were a number of building elements which were used by birds to establish their nesting areas, such as rafters in a sloping roof, attic spaces or lofts, holes, wooden beams, window sills, projecting decorations on building facades, ledges etc. But the modern building designs with their large, flat, glass facades do not offer such spaces. Hence additional features should be sought to encourage wildlife habitats in cities.

Green roofs- a technology with a long tradition however, today are considered one of the most innovative developments for urban greening and constitute an opportunity for creating additional habitat for wildlife in the cities¹⁰. Green roofs provide water and food mainly through insects, berries and seeds for feeding birds. There are some considerations for the green roof to be a real 'living' roof with diverse species population. The depth of the soil substrate should vary in order to hold water and to provide humidity. Rocks and woods are to be provided for perching of birds. Some of the habitat types that can be replicated in a roof are grasslands, rocky areas, logs and branches of woods, shrubs etc. Figure 1 and Figure 2 show ways of creating a roof for the birds. (Source: Kelley Brenner, Metrofieldguide)¹



Figure 1. Green roofs can mimic natural habitats by varying substrate depth and introducing habitat elements.

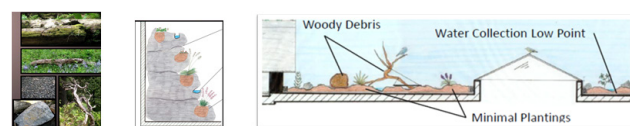


Figure 2. Various habitat features on green roofs.

3.3 Types of Bird Nests and Their Adaptation in Buildings

Birds use nests to protect eggs and nestlings from predators and adverse weather. To minimize predation, birds may use or build nests that are inaccessible, hidden, or camouflaged. There are different nest types used by different species. Urban birds readily nest near humans. Sometimes birds nest on top of downspouts, windowsills, doors and lights. This is one problem why people are reluctant to have birds near their buildings. To solve this, and to ensure bird presence, it is a good idea to entice them to nest in other areas. Creating features for birds to nest does not cause additional costs, and it can many a times be a decorative element- educational and recreational as well. It is necessary to ensure that the feature is compatible with any bird's nest found in nature. Figure 3 shows the various nest types.

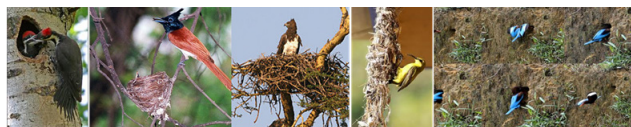


Figure 3. Various nest types: Cavity, Cup, Platform, Pendant and Ground.

Cavity nests or Hole nests are nests in tree hollows and in wall cavities, used by Parrots, Owls, House Sparrows, Woodpeckers, Indian rollers, Kingfishers, Small bee-eaters, Oriental Magpie robin, Indian robin, Hornbills, Barbets, Brahminy starling, common Mynah and some waterfowl. Cavities are normally excavated on the downward-facing side of a branch, presumably to make it more difficult for predators to access the nest, and to reduce the chance that rain floods the nest. The typical woodpecker nest has a short horizontal tunnel which leads to a vertical chamber within the trunk. The size and shape of the chamber depends on species, and the entrance hole is typically only as large as is needed to allow access for the adult birds¹².

Nest boxes are very good retrofitting features in buildings to encourage nesting of cavity dwellers. A recent Indian experiment to install manmade nest boxes for house sparrows in houses as well as in market areas has yielded good results in increasing population of these birds¹³. Nest boxes are available in a variety of shapes, sizes and materials. Architects can incorporate these boxes in their building designs- deciding where to place them and what can be done to protect them from predators. Also provisions for cavities and holes can be made as part of the building itself. Sizes of a commonly used nest box (although they vary per design) is 15 cm(l)X13 cm(b)X24 cm(d). They are solid and treated with the waterproof and termite proof chemical coating. The rusting of nails due to humid climate makes them more tightened to the plywood. Drainage hole at the bottom help in case the eggs are broken. The nest box installation height causes no effect on the nesting, if sufficient quantities of insects are available in the area for raising their broods. Successful Nesting was observed from 3 meter to 21 meter heights, which was an important aspect in the modern residential apartment. Ideal height was found to be around 6 meters, with no restriction of directions.

Some design features can be provided even as integrated parts of buildings, as part of the architecture. Built in cavities is one such detail. Here, the size of the cavity and entrance slit, height from the ground, visibility,

protection from predators, ease of cleaning once the fledglings have left (not necessary if the nest is not too near to human habitation), safety from chances of bird colliding with windows, proximity to garden or open space or an open navigation route for the birds to spot the hole, ease for birds to come and go frequently as needed and distance from human habitation area if required by the client are all factors that will affect the location and detailing of the cavities.

Swifts feed, sleep and even mate in the air and are also entirely dependent on buildings for nest sites¹⁴. Swifts prefer to nest at least 4m above the ground with a clear flight path with no obstruction from trees or other buildings. Nest sites can be provided by opening up or incorporating slots and holes into the eaves to allow birds to nest just inside on top of the closed cavity, the solid brickwork ledge or within the soffit board. Swifts are clean, leaving few droppings. Swifts require a 'letterbox' entrance 65 mmX30 mm which will deter access by other birds. Hollow spaces in roof eaves are preferred by many birds too. Depending on the design of the eaves, the aim should be to create a small hole to allow access for nesting birds but to prevent them being able to access to the roof void. House sparrows require a minimum gap of 32 mm while starlings need a minimum of 45 mm to allow access, Figure 4, shows the Cavity nests and their adaptations.

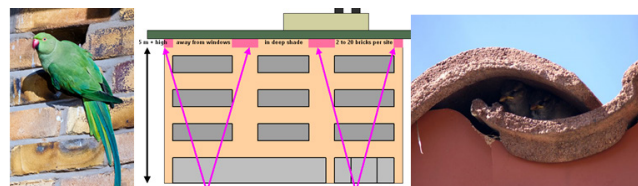


Figure 4. Cavity nests and their adaptations.

In the case of apartments, these can be given on balconies. If a tiny patch of green can be added to the balcony, with a little dripping water, it will attract birds. But such balconies should not be used for cloth hanging. So the architect has to plan ahead on where to hang cloths. If cloth hanging is a must, either it can be done leaving a clear route for the bird, or the nest cavity can be on the outer wall near to and accessible from the balcony. The detail for the compound wall are shown in Figure 5(a) is very interesting. Compound walls in particular can make good nesting spaces as they are separated from living areas. Instead of the bottles they can be small PVC pipe pieces, in which birds can nest. Creepers can be grown also.



Figure 5(a). Compound wall detail with bottles help cavity nesting (b) Drain pipe as nest (c) Nesting tiles-custom made.

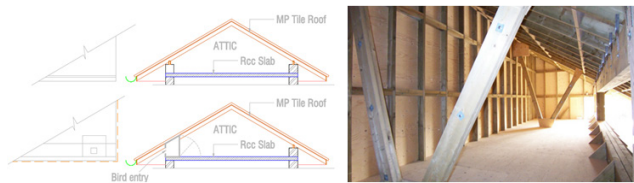


Figure 6. Attic space acting as nesting place.

Figure 6 shows the Attic space acting as nesting place. Cup nest is smoothly hemispherical inside, with a deep depression to house the eggs. Most are made of pliable materials—including grasses—though a small number are made of mud or saliva. These are used by White breasted waterhen, Paddyfield pipit, Common wood shrike, Red vented bulbul, Commonia, Common babbler, Ashy prinia, Common tailorbird, Black headed munia, Black Drongo etc.

Cup nests perched on walls (Swift's nest) either provides full artificial cup nest, or provide wooden/frictional surfaces for bird to fix the cup nest and provide slippery dado around to prevent predator access.

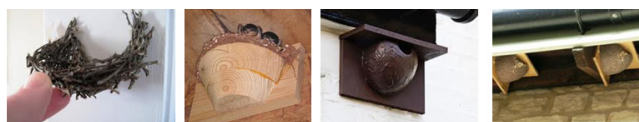


Figure 7. Cup nests, adaptations and providing space for cup nests.

Figure 7 represents the Cup nests; adaptations and providing space for cup nests. Platform nest as name suggests is built like a flat surface, and is usually larger than other types. It is often many times the size of the (typically large) bird which has built it. Depending on the species, these nests can be on the ground or elevated -on the tops of rooted vegetation, buildings or debris in shallow water. Blue rock pigeon, Spotted dove, House crow, Jungle crow, Bald Eagle and many wetland birds nest on platforms.

Trees in the garden, loft spaces, window sills and roof can accommodate platform nesting birds. Shade from the sun, safety from predators and access to nesting

materials are the aspects to be considered. Since the birds themselves choose the nesting area, there is not much a designer can do apart from providing shaded accessible spaces. Planting big trees in and near wetlands and marshes will help birds—both native and migratory—to build their platforms. A special robin-nesting platform which provides firm support and overhead protection from rain will encourage Robins to platform nest.

The pendant nest is an elongated sac woven of pliable materials such as grasses and plant fibers and suspended from a branch. Orioles, Weavers and Sunbirds are among the species that weave pendant nests. A hook hanging from a balcony or a veranda safe from predators will be used by the birds. Also garden plants and bushes with thick growth are used. Since the bird completely builds the nest on its own, providing a space safe from predators with proximity to nesting materials is enough.

Ground nests are burrow like nests excavated on the ground. Common kingfisher and many sea birds build their nests as tunnels. Small mounds in gardens, sloping roof gardens, ponds in garden into which ground is sloping etc. will be used for burrow nesting. House martins traditionally build their own nest out of mud under the eaves but can also be encouraged to do so by the provision of artificial nests which sit beneath the eaves. These need to be carefully located to ensure droppings do not fall on windows, doors or paths below. Figure 8 shows the Platforms for nests and hooks for pendant nests.



Figure 8. Platforms for nests and hooks for pendant nests.



Figure 9(a). Ground nesting birds nest on green roofs (b) Patio with greenery connects people more to nature. Also the leftover food from dining can be given to birds.

Figure 9(a). Ground nesting birds nest on green roofs (b) Patio with greenery connects people more to nature. Also the leftover food from dining can be given to birds.

Roost sites for birds can easily be incorporated into new buildings and requirements for birds should be included in the architect's brief. There are many ways of enhancing the building for birds, like bird bricks in the external walls, bird boxes incorporated into the eaves, specially designed roof tiles, wooden cladding etc. Purpose built bird lofts/attic with access bricks or tiles as part of the design, easily accessible for the birds but protected from predators.

4. Conclusion

In a rapidly urbanizing modern world, ensuring biodiversity in cities is one of the primary responsibilities of the urban designer and the architect. This is a difficult job, as it does not give any direct compensation to the professional, and the resistance they might face will be large as humans- the clients- prefer to keep cities and houses and gardens clean and manicured. Nevertheless, with effort, the architect can introduce elements and features in design which will encourage species diversity of birds, which will not be in conflict with the clients' desires. Also the urban designer and architect can be careful about the areas in which they build, to ensure that the existing species presence is protected as much as possible. This is necessary for human wellbeing as well. In many developing countries legislation and guidelines are in effect to protect the biodiversity, but in our country they are lacking along with proper documentations regarding species diversity, mortality etc. Therefore it is high time that responsible professionals take up the job upon them and proceed with planning and designs which ensure a city design in harmony with nature and the environment.

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