INTERNATIONAL JOURNAL OF BIOASSAYS
ISSN: 2278-778X
CODEN: IJBNHY
ORIGINAL RESEARCH ARTICLE
OPEN ACCESS

Site preferences for nesting by birds in an educational institution campus in Bengaluru, Karnataka, South India.

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Received: February 02, 2016; **Revised**: March 19, 2016; **Accepted**: March 23, 2016

Abstract: Wildlife conservation in urban habitats is increasingly important due to current urbanization trends. Studying birds in urban landscapes and pointing out the importance of their management and conservation are the needs of the day. Every species has certain habitat requirements for successful nesting and breeding. The increase in anthropogenic activities and the disappearance of native tree populations has raised concerns on avian populations and its nesting behavior. In this study, we observed the nesting success of urban birds in the campus. It is found that nesting failure is not predicted by the density of adult birds. These findings suggest that nesting success determined by nest site availability may drive the distribution of avian species in the urban habitat. The abundance of urban bird species nesting in Christ University campus was studied and the need for planting trees that are more conducive for nesting by birds is recommended.

Key words: Urbanization; Nest Site; Christ University; Anthropogenic Activities; Urban Landscapes

Introduction

The habitat relationships of birds in urban environments have been widely studied (Hooper *et al.,* 1975, Gavareski 1976, Sears and Anderson 1991). Bird abundance trends have been correlated with habitat changes in urban developed areas. As the degree of residential development intensifies (from rural to suburban to urban), three patterns of habitat disturbance emerge, which have the potential to influence avian communities. As residential development progresses in suburban and rural areas: (1) The physical structure of the habitat is altered by replacement of native vegetation with man-made features, such as residences and other buildings, paved and graded roads and parks. Building density becomes higher and land parcels tend to be much smaller, resulting in a lack of continuous space, greater variance in microclimate, and disturbed and compacted soils (Bradley 1995). (2) Plant species composition and structure is altered from its natural state (Whitney and Adams 1980). Non-native vegetation invades disturbed areas, such as road edges and vacant plots, while developers and homeowners establish exotic plants for shade, lawns, windbreaks, and decoration. Native vegetation in undeveloped areas is subjected to increased disturbance, such as trampling and thinning by foot, pet, bicycle, and vehicular traffic. (3) Areas of undeveloped native vegetation in developing areas become increasingly fragmented and insularized, resulting in a patchwork of native habitat fragments in an urban/sub- urban matrix. Remnant habitat patches are of questionable value to native birds (Wilcove 1985, Soule *et al.,* 1988, Bolger *et al.,* 1991).

Study Area

The Christ University campus is spread over 50 acres of land area, located in the heart of Bengaluru city, at height of 910.76 meters above sea level with a Latitude of 12.9347 and Longitude of 77.605, near diary circle, and about 40 Kms from Kempe Gowda international airport, bounded at the North by Hosur Road, South by Christ School road, East by Siddguntepalya road and West by Bannerughatta road. It is a clean and green campus, blessed with several hundreds of flowering trees along with other shrubs and herbs. These trees and shrubs help beautify the atmosphere of the place with their beautiful flowers and glossy leaves. They help in ensuring that the aura of the University always remains vibrant and blissful. Although the University is rich in its flora, a large part of it still remains unidentified.

(Map/drawing of Christ University Campus)

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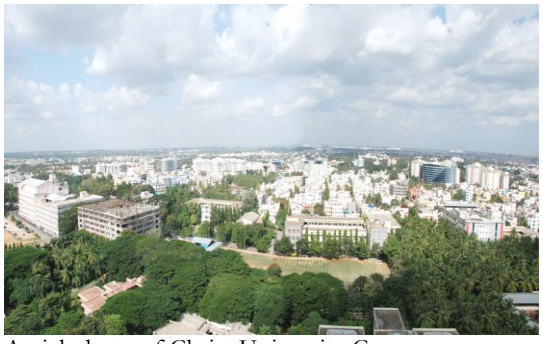


Aerial photo of Christ University Campus

Materials and Methods

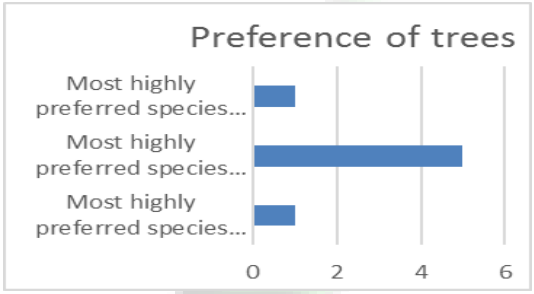
Patterns of habitat use by breeding birds were studied in Christ University campus for duration of one year starting from February 2015 to March 2016. In this study, a hierarchical approach was designed to examine the patterns of habitat used by breeding birds in Christ University campus of Bengaluru. Habitat use was evaluated at three spatial scales: microhabitat (vegetation characteristics in different pockets of the campus), macro habitat (vegetation characteristics of the entire campus such as size, length, and width), and landscape (composition and structure of vegetation and land uses surrounding the campus [matrix habitats]). A series of predictions were addressed that incorporated these different spatial scales. Line transects and random observations were undertaken regularly in the campus to evaluate vegetation use by various species of birds for nesting. An 8 X 40 Nikon binocular, and a 53X, VIXIA Canon HD handy cam were used to document the observations. All trees were selected for the purpose of study. Identification of these trees was done based on the keys for the identification of tree families and species, with special reference to the structure of stem leaves, and flowers. Major focus of the work was given to the systematic identification of the plants based on the given set of botanical keys.

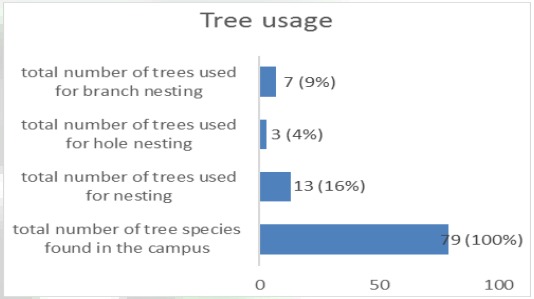
Results

There are 1200 trees belonging to 79 species in Christ University campus. A total of 59 species of birds were identified during the study period. 12 species of trees were found to be used for nesting by 21 species of birds. Most highly preferred species of tree for hole nesting in the campus is African tulip tree (*Spathodea companulata*). Six species of trees were preferred for branch nesting by different species of birds. African tulip tree was found to be utilized both for hole and branch nesting. Total number of trees used for hole-nesting was found to be four. African Tulip tree (*Spathodea companulata*) alone was used by nine different species of birds.

Three species of birds like the Common Pigeon (*Columba livia domesticata*), Black kite (*Milvus migrans*), White-breasted Water Hen (*Amaurornis phoenicurus*) were found to use substructures other than trees like buildings, lamp post and ground burrows respectively for nesting in the University campus.

Percentage of tree preferred for nesting	**16%**
Percentage of trees used for hole nesting	**4%**
Percentage of trees used for branch nesting	**9%**
Percentage of birds nesting in the campus other than tree	**7%**
Percentage of species of birds that preferred one particular tree	**16%**





Conclusions and Recommendations

Out of the total number of trees in the campus only 16% was utilized for nesting by birds. It is interesting to note that just one tree was used by 16% of birds. The African tulip tree which supported 16% of birds was quiet ideal for both hole nests and branch nests. Hole nests made both on the main stem and the branches by White cheeked Barbet (*Megalaima viridis*), exhibited habitat succession with Parakeets (*Psitacularia krameri*) and Spotted owlets (*Athena brahma*) occupying the nest in succession, for nesting. Despite several hole nests made in one African tulip tree, the tree was perfectly fine. Thus from these results it is clear that the number of trees that attract birds for nesting are negligible, hence it is advisable to plant more of such trees in campuses to attract good number of birds.

Appendix

Table 1: showing trees of Christ University campus, Bangalore

S.No.	Common Name	Botanical Name	Remarks
1	Java Cassia, Pink Shower	*Cassia javanica*	3 tree
2	Dividivi	*Caesalpiniacoriaria*	3 tree
3	Copperpod tree	*Peltophorumpterocarpum*	33 trees
4	Rain Tree Saman	*Albizia saman*	32 trees
5	Gliricidia	*Gliricidia sepium*	2 trees
6	Barbados flower-fence	*Parkinsonia aculeata*	1 tree
7	Bombay blackwood	*Senna siamea*	2 trees
8	Royal Poinciana, Gulmohar	*Delonix regia*	28 trees
9	Champa, Champaka	*Michelia champacaa*	7 trees
10	Biota, Book-leaf pine	*Platycladis orientalis*	44 trees
11	White lead tree	*Leucaena leucocephala*	2 trees
12	Scrambled egg plant	Senna *surattensis*	3 shrubs
13	Colville's Glory.	*Colvillea racemosa*	13 trees
14	Coral reef araucaria, Cook pine	*Araucaria columnaris*	14 trees
15	Acacia	*Albizia procera*	14 trees
16	Tamarind tree	*Tamarindus indica*	1 tree
17	Sugar apple	*Annona squamosa*	1 tree
18	False Ashoka, the Buddha Tree,	*Polivathia longifolia*	152 tree
19	Trumpet tree, Yellow trumpet	*Tabebuia argentea*	16 trees
20	Frangipani, Templetree	*Plumeria rubra*	9 trees
21	Custard apple	*Annona reticulata*	1 tree
22	Devil Tree	*Alstonia scholaris*	1 tree
23	Buddha's coconut	*Pterygota alata*	1 tree
24	Giant Crape-myrtle, Pride of India.	*Lagerstroemia speciosa*	5 trees
25	Pomegranate	*Punica granatum*	4 trees
26	Mango Tree.	*Mangifera indica*	158 trees
27	Badminton Ball Tree.	*Parkia biglandulosa*	15 trees
28	Bell Bean Tree, Nile Tulip Tree	*Markhamia lutea*	9 trees
29	Jacaranda, Blue jacaranda, Black	*Jacaranda mimosifolia*	18 trees
30	Trumpet tree, pink trumpet tree	*Tabebuia impetiginosa*	16 trees
31	Fountain tree, African tulip tree	*Spathodea companulata*	13 trees
32	Chestnut leaf, trumpet leaf	*Tecoma castanifolia*	2 trees
33	Spanish cherry, Bullet wood	*Mimusops elengi*	6 trees
34	Sapota, Chickoo	*Achras sapota*	47 trees
35	Indian Mahua tree	*Madhuca longifolia*	2 trees
36	Indian goose berry, amla	*Emblica officianalis*	5 trees
37	Bilimbi, cucumber tree	*Averrhoa bilimbi*	2 trees
38	Rose Apple	*Syzygium samarangense*	1 tree
39	Guava	*Psidium guajava*	31trees
40	Weeping Bottlebrush	*Callistemon lanceolatus*	13 trees
41	RaiJamun	*Syzygium nervosum*	2 trees
42	Black plum	*Syzygium cumini*	2 trees
43	Eucalyptus	*Eucalyptus tereticornis*	9 trees
44	Malabar Plum	*Syzigium jambos*	1 tree
45	Citron	*Citrus medica*	1 tree
46	Bael fruit tree	*Aegle marmalos*	1 tree
47	Lemon	*Citrus limon*	3 trees
48	Pomello	*Citrus maxima*	3 trees
49	Curry Leaf	*Murraya koenigii*	Numerous
50	Neem	*Azardirachta indica*	3 trees
51	Mahogany	*Swietenia mahagoni*	24 trees
52	Jacktree, Jak, Kanthal, Pilapalam	*Artocarpus heterophyllus*	22 trees
53	Breadfruit	*Artocarpus altilis*	2 trees
54	Aiyinipila, Anjili	*Artocarpus hirsutus*	1 tree
55	Fig, Cluster Fig, Country Fig	*Ficus racemosa*	98 trees
56	White Frangipani	*Plumeria alba*	4 trees
57	Rubber bush, Indian rubber plant	*Ficus elastica*	1 tree
58	Peepal, sacred fig, bodhi	*Ficus religiosa*	2 trees
59	Banyan, Bengal fig, Indian fig	*Ficus benghalensis*	1 tree
60	Sandalwood, Indian sandalwood	*Santalum album*	12 trees
61	Avocado	*Persea americana*	1 tree
62	Truecinnamon,Ceylon cinnamon	*Cinnamomum verum*	1 tree
63	Fragrant manjack, snotty gobbles	*Cordia dichotoma*	1 tree
64	Nutmeg, jathipala	*Myristica fragrans*	1 tree
65	Tiger's claw, Indian coral tree	*Erythrina indica*	1 tree
66	Adina cordifolia, Kadambu	*Haldina cordifolia*	1 tree
67	Indian Walnut, Candlenut	*Aleurites moluccana*	1 tree
68	Singapore almond	*Terminalia catappa*	16 trees
69	Silver oak, southern silky oak	*Grevillea robusta*	12 trees
70	Drumstick tree, horseradish tree	*Moringa oleifera*	2 trees
71	Singapore cherry	*Muntingia calabura*	26 trees
72	Teak, Sagon, Sagwan, Indian-Oak	*Tectona grandis*	37 trees

73	Cannonball tree, Boskalebas	*Couroupita guianensis*	3 trees
74	Coconut, coconut palm	*Cocos nucifera*	433 trees
75	Solitary fishtail palm, toddy palm	*Caryota urens*	1 tree
76	Asoka tree	*Saraca asoca*	3 trees
77	Cotton tree	*Bombax ceiba*	1 tree
78	Flame of the Forest	*Butea monosperma*	1 tree
79	Lantern Brownea	*Brownea coccinea*	4trees

Table 2: showing birds of Christ University campus, Bangalore

S.No.	Common Name	Scientific Name
1	Coppersmith Barbet	*Megalaima haemacephala*
2	White-cheeked Barbet	*Megalaima viridis*
3	Little Green Bee-eater	*Merops orientalis*
4	Red-vented Bulbul	*Pycnonotus cafer*
5	Red-whiskered Bulbul	*Pycnonotus jocosus*
6	Indian Cormorant/Indianshag	*Phalacrocorax fuscicollis*
7	Greater Coucal/crow pheasant	*Centropus sinensis*
8	House Crow	*Corvus splendens*
9	Thick-billed Crow/thick-billed raven	*Corvus macrorhyncus*
10	Common Hawk Cuckoo	*Hierococcyx varius*
11	Spotted Dove	*Spilopelia chinensis*
12	Ashy Drongo	*Dicrurus leucophaeus*
13	Black Drongo	*Dicrurus macrocercus*
14	Spot billed Duck	*Anas poecilorhyncha*
15	Cattle Egret	*Bubulcus ibis*
16	Great Egret	*Ardea alba*
17	Intermediate Egret	*Mesophoyx intermedia*
18	Little Egret	*Egretta garzetta*
19	Pale-billed Flowerpecker/Tickell'sflowerpecker	*Dicaeum erythrorhynchos*
20	Asian Brown Flycatcher	*Muscicapa latirostris*
21	Asian Paradise Flycatcher	*Terpsiphone paradisi*
22	Black-crowned Night Heron	*Nycticorax nycticorax*
23	Indian Pond Heron/paddybird	*Ardeola grayii*
24	Black-headed Ibis/Oriental white ibis	*Threskiornis melanocephalus*
25	Common Kingfisher	*Alcedo atthis*
26	White-throated Kingfisher	*Halcyon smyrnensis*
27	Black Kite	*Milvus migrans*
28	Brahminy Kite	*Haliastur indus*
29	Asian Koel	*Eudynamys scolopaceus*
30	Red-wattled Lapwing	*Vanellus indicus*
31	Scaly-breasted Munia/spotted munia	*Lonchura punctulata*
32	Common Myna	*Acridotheres tristis*
33	Jungle Myna	*Acridotheres fuscus*
34	Indian Golden Oriole	*Oriolus kundoo*
35	Barn Owl	*Tyto alba*
36	Spotted Owlet	*Athene brama*
37	Rose-ringed Parakeet	*Psittacula krameri*
38	Common Pigeon	*Columba livia domestica*
39	Indian Pitta	*Pitta brachyura*
40	Ashy Prinia/Ashy wren-warbler	*Prinia socialis*
41	White-breasted Water Hen	*Amaurornis phoenicurus*
42	Oriental Magpie-Robin	*Copsychus saularis*
43	Green Sandpiper	*Tringa ochropus*
44	Brown Shrike	*Lanius cristatus*
45	House sparrow	*Passer domesticus*
46	Purple-rumped Sunbird	*Leptocoma zeylonica*
47	Purple Sunbird	*Cinnyris asiaticus*
48	Brahminy Starling / Brahminy myna	*Sturnia pagodarum*
49	Rosy Starling	*Pastor roseus*
50	Barn Swallow	*Hirundo rustica*
51	Red-rumped Swallow	*Cecropis daurica*
52	Little Swift	*Apus affinis*
53	Common Tailor Bird	*Orthotomus sutorius*
54	Cinereous Tit/Great Tit	*Parus cinereus*
55	Grey Wagtail	*Mota cillacinerea*
56	White-browed Wagtail/ large pied wagtail	*Motacilla maderaspatensis*
57	Blyth's Reed-Warbler	*Acrocephalus dumetorum*
58	Oriental White-eye	*Zosterops palpebrosus*
59	Shikra	*Accipiter badius*

Table 3: showing tree preferences of birds in Christ University campus

S.No.	Tree	Scientific name	Bird/s	Scientific name
1	Gulmohar	*Delonix regia*	Rose ringed Parakeet	*Psittacula krameri*
			Black kite	*Milvus migrans*
2	Rain tree	*Albizia saman*	House crow	*Corvus splendens*
			Jungle crow	*Corvus macrorhyncus*
			White cheeked barbet	*Megalaima viridis*
			Spotted owlet	*Athene brama*
3	African Tulip	*Spathodea companulata*	Rose ringed Parakeet	*Psittacula krameri*
			House crow	*Corvus splendens*
			Jungle crow	*Corvus macrorhyncus*
			Black kite	*Milvus migrans*
			Common Myna	*Acridotheres tristis*
			Asian Koel (brood parasite)	*Eudynamys scolopaceus*
			Rock pigeon	*Columba liviadomestica*
4	Yellow trumpet	*Tabebuia argentea*	Purple rumped sunbird	*Leptocoma zeylonica*
5	False badam	*Terminalia catappa*	Tailor bird	*Orthotomus sutorius*
6	False ashoka	*Polivathia longifolia*	Spotted Dove	*Spilopelia chinensis*
7	Cluster fig	*Ficus racemosa*	Black kite-	*Milvus migrans*
			White cheeked barbet-	*Megalaima viridis*
			Cinerous tit	*Parus cinereus*
8	Coffee plant	*Coffea spp*	Red whiskered bulbul-	*Pycnonotus jocosus*
9	Bougainville	*Bougainvillea spp.*	Purple rumped sunbird	*Leptocoma zeylonica*
10	Badminton ball tree	*Parkia biglandulosa*	White cheeked barbet	*Megalaima viridis*
			Red whiskered bulbul	*Pycnonotus jocosus*
11	Reeds	*Typhal atifolia*	Blyth's reed warbler	*Acrocephalus dumetorum*
			Ashy Prinia	*Prinia socialis*
12	Pink trumpet	*Tabebuia pallida*	Shikra	*Accipiter badius*

Table 4: showing site preferences of birds for nesting other than trees in Christ University campus

S.No.	Site	Bird	Scientific name
1	Buildings	Common Pigeon	*Columba livia domestica*
2	Lamp post	Black kite	*Milvus migrans*
3	Ground (cultivation area)	White-breasted Water Hen	*Amaurornis phoenicurus*

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Cite this article as:
Ganesh. S, P. U. Antoney, "Site preferences for nesting by birds in an educational institution campus in Bengaluru, Karnataka, South India". *International Journal of Bioassays* 5.5 (2016): 4528-4533.

Source of support: Nil
Conflict of interest: None Declared