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Nest site selection of cavity-nesting birds at Jahangirnagar University campus, Bangladesh

Shamia Farhana Shoma*, Sadia Sultana and Nusrat Jahan Shetu
Department of Zoology, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh

Abstract

Understanding nest site selection by cavity-nesting birds is important for their conservation implications. We examined the preferences and characteristics of nesting trees and cavities used by cavity-nesting birds at Jahangirnagar University (JU) campus from January 2020 to October 2021. A total of 30 tree- cavity nests of 11 species of birds belonging to 4 orders and 7 families were recorded where 36% were primary excavators and 64% were secondary cavity-nesters. Out of 14 species of trees used in cavity-nesting, the most of the nests were built in Mahogany *Swietenia mahagoni* (n=8) followed by White siris *Albizia procera* (n=6) and Rain tree *Samania saman* (n=3). Diameter at breast height (DBH) of the nesting trees varied from 27 cm to 112 cm (52±23.2 cm). The highest mean DBH was recorded in *Samania saman* (85 cm) followed by *Swietenia mahagoni* (67 cm). Common Myna showed the widest selection of nesting tree species (n=9) followed by Black-rumped Flameback (n=4) and Lineated Barbet (n=4). Majority of the nesting trees (87%) were found in roadside (within 1-5 m) vegetation while 60% nesting trees located within 30 m from the nearby water bodies. The cavity-nesting species preferred to nest between 2 m to 12 m (5.2±2.6 m) height from the ground level. The entrance width and the depth of tree holes (n=30) used by cavity-nesters varied from 5 cm to 22 cm (7.5±3.5 cm) and 13 cm to 45 cm (23.2±6.5 cm), respectively. Suitable cavities are critical for reproductive success of cavity-nesting birds and our results highlight the conservation value of cavity-bearing large trees to maintain a healthy population of cavity-nesting birds at JU campus.

Key words: Birds, nest site, nesting trees, cavity-nesters, Jahangirnagar University campus.

INTRODUCTION

Nesting is a crucial reproductive phenomenon of birds. Nest dimensions and nesting behaviour of birds can be species specific. To maximize the reproductive success, they must choose nest site carefully that protects their eggs and nestlings from predators and other environmental threats. A wide range of bird species nest in tree cavities. Cavity nests are more likely to have greater nest success compared to open nests due to lower risk of nest predation and greater thermal regulation inside the cavities (Monterrubio-Rico & Escalante-Pliego, 2005). Primary cavity-nesters such as woodpeckers and barbets can excavate cavities in trees for their nesting. Secondary cavity-nesters (e.g., mynas and starlings, ducks) cannot excavate and use the cavities created by primary excavators or cavities formed through natural decay (Kozma *et al.*, 2014; Bonaparte *et al.*, 2020). Due to the keystone role in providing nesting and roosting resources to other species, primary cavity-nesters often considered as ecosystem engineers in the community (Martin *et al*., 2004; van der Hoek *et al.*, 2017). Moreover, cavity nesters play a significant ecological role in pest control and seed dispersal (van der Hoek *et al*., 2017).

* Corresponding author. Email: sfshoma@juniv.edu

Diversity and abundance of cavity-nesting birds depend on the availability of suitable nesting cavities which is often determined by the presence of larger trees and snags in a habitat (Monterrubio-Rico & Escalante-Pliego, 2005). Nest site selection can also be influenced by other factors like inter- and intraspecific competition for nest cavities among primary and secondary cavity nesters, predation pressure and parasitism (Martin *et. al*., 2004). Thus, studies of cavity-nesters help to understand the species richness, interactions within bird communities and habitat condition as well.

Jahangirnagar university campus is home to about 195 species of birds which comprises about 30% of the total bird species in Bangladesh (Begum, 2016). The diverse habitat features made the campus an attractive nesting and roosting ground for a broad range of bird communities including several species of primary and secondary cavity-nesting birds (Mohsanin & Khan, 2009; Rahman *et al.,* 2019; Shoma & Begum, 2020; Shoma, 2021). However, habitat fragmentation and continuous loss of trees due to growing infrastructure developments may threaten the reproduction and survival of cavity-nesting birds in the campus. Due to the sensitivity of cavity-nesters regarding nesting resources, it is essential to assess the diversity of cavity-nesting birds, interspecific interactions and their nesting preferences in the campus. Use of tree species and cavity occupancy are critical to understanding the population ecology and conserving these cavity-nesting birds (Martin *et. al*., 2004; Bonaparte *et.al*., 2020). Therefore, we examined the variation in preferences and characteristics of nesting trees and cavities used by different species of cavity-nesting birds at Jahangirnagar University campus. The study will provide insight to management and conservation implications of these birds and their nesting habitats as well.

MATERIALS AND METHODS

Study area: The study was conducted at Jahangirnagar University campus, a semi urban area comprised of about 700 acres. The campus is located at 23.5325^{o} N and 90.1682^{o} E with a tropical climate, dry winter and humid summer. The vegetation of the campus is characterized by different fruit yielding plants (e.g., *Ficus bengalensis, Mimusops elengi, Murraya paniculata*), open woodland species (e.g., *Acacia auriculiformis, Swietenia mahagoni, Albizia* spp., *Dalbergia sissoo*), monotypic plantations (e.g., *Gmelina arborea* and *Lagerstroemia speciosa*), grassland dominated by *Imperata cylindrica* and bushes like *Chrysopogon* sp., *Cassia sophera* and *Cassia tora* (Begum, 2016). In addition, water bodies like lakes and ponds, agricultural lands and human settlements with homestead gardens offer breeding and roosting habitats to a wide variety species of birds. The campus is also well known as an important site for seasonal migratory birds particularly in winter.

Data collection: Nests of cavity-nesting birds were discovered by systematic searching from January 2020 to October 2021. We also followed breeding pairs and observed parental behaviour like carrying foods for nestlings to locate the nest cavities. On finding a nest, bird species and nest site characteristics like nesting trees, position of the nest (central stem or branch hole) and tree condition (dead or alive) were recorded. The nest height above ground was measured with the help of digital range finder. Diameter at

Breast Height (DBH) of trees were measured carefully by using a measuring tape. Entrance width and depth of cavities were measured manually by using measuring tape, scale and ladder. The distances of the nesting trees from the nearest roads and water bodies were measured by using digital range finder and measuring tape. We visited the nests twice in a week to examine whether the nests were still active. To reduce potential disturbances, we took nest measurements when the breeding pairs completed their breeding cycle and no fledglings were left in the nests. (Fu *et al.*, 2016). Only active cavity nests were considered for this study to determine the species-specific nests.

Statistical analyses: Data were analyzed by using Microsoft Excel-Version 16.16.25. The study mainly focused on tree-cavity nesting and therefore, cavity nests found in man-made structures were excluded from the analyses. Data are presented as mean ± standard deviation (SD).

RESULTS AND DISCUSSION

Cavity-nesting birds: A total of 30 tree-cavity nests of 11 species of birds belonging to 4 orders and 7 families were recorded in Jahangirnagar University Campus during the study period (Table 1). Among them, 4 species were primary cavity-nesters and 7 species were secondary cavity-nesters. Majority of the nests were found in tree holes and only 8 nests were recorded in man-made structures. The highest number of tree-cavity nests were recorded for Common Myna (n=13) followed by Black-rumped Flameback (n=4) and Lineated Barbet (n=4). Among the secondary cavity nesters, Common Myna, Jungle Myna, Spotted Owlet, Rose-ringed Parakeet and Oriental Magpie-robin were found to use anthropogenic structures like building holes and crevices along with tree cavities for their nesting (Table 1).

Nest-tree selection: A total of 14 species of trees from 10 different families were found to be used by cavity nesters at JU campus (Table 2). The mostly used tree species were *Swietenia mahagoni* (27%), *Albizia procera* (17%) and *Samania saman* (10%), respectively. Other tree species used in hole-nesting included *Cocos nucifera* (7%), *Delonix regia* (7%), *Senna siamea* (7%) *Mangifera indica* (3%), *Sarcomphalus mauritianus* (3%), *Azadirachta indica* (3%), *Ficus benghalensis* (3%), *Mimusops elengi* (3%), *Madhuca longifolia* (3%), *Alstonia scholaris* (3%) and *Moringa oleifera* (3%).

Table 1. List of cavity-nesting birds recorded at JU campus during the study period. P = Primary cavity-nesting species and S = Secondary cavity-nesting species

Common name	Scientific name	Family	Order	Type of nester	No. of nests found in tree cavities (in anthropogenic structure)
Common Myna	*Acridotheres ginginianus*	Sturnidae	Passeriformes	S	13 (2)
Black-rumped Flameback	*Dinopium benghalense*	Picidae	Piciformes	P	4
Spotted Owlet	*Athene brama*	Strigidae	Strigiformes	S	1 (2)
Jungle Myna	*Acridotheres fuscus*	Sturnidae	Passeriformes	S	1 (2)
Chestnut-tailed Starling	*Sturnia malabarica*	Sturnidae	Passeriformes	S	2
Rose-ringed Parakeet	*Psittacula krameri*	Psittaculidae	Psittaciformes	S	1 (1)
Oriental Magpie-robin	*Copsychus saularis*	Muscicapidae	Passeriformes	S	2 (1)
Lineated Barbet	*Megalaima lineata*	Megalaimidae	Piciformes	P	4
Barn Owl	*Tyto alba*	Tytonidae	Strigiformes	S	1
Grey-capped pygmy Woodpecker	*Dendrocopos canicapillus*	Picidae	Piciformes	P	1
Streak-throated Woodpecker	*Picus xanthopygaeus*	Picidae	Piciformes	P	1

Table 2. Nesting trees used by cavity-nesting birds at JU campus. Origin of tree species was extracted from Khan *et al.* (2021) where E = Exotic species and N = Native species

Local name	Scientific Name	Family	Origin	DBH in cm (mean±sd)	Total nests found	Bird species
Aam	*Mangifera indica*	Anacardiaceae	E	46.4	1	Lineated Barbet
Sil Koroi	*Albizia procera*	Fabaceae	N	45±5.3	5	Common Myna, Oriental Magpie-robin, Rose-ringed Parakeet
Narikel	*Cocos nucifera*	Arecaceae	E	26±1.7	2	Common Myna, Black-rumped Flameback
Boroi	*Sarcomphalus mauritianus*	Rhamnaceae	N	28.6	1	Common Myna
Krishnachura	*Delonix regia*	Caesalpiniaceae	E	34.8±4.7	2	Barn Owl, Common Myna
Mehagoni	*Swietenia mahagoni*	Meliaceae	E	66.8±23.8	8	Lineated Barbet, Common Myna, Black-rumped Flameback, Grey-capped Pygmy Woodpecker, Streak-throated Woodpecker, Oriental Magpie-robin
Neem	*Azadirachta indica*	Meliaceae	N	28	1	Chestnut-tailed Starling
Bot	*Ficus benghalensis*	Moraceae	N	79.9	1	Common Myna
Bokul	*Mimusops elengi*	Sapotaceae	N	39.8	1	Black-rumped Flameback, Lineated Barbet
Mohua	*Madhuca longifolia*	Sapotaceae	N	74.2	1	Common Myna
Chhatim	*Alstonia scholaris*	Apocyanaceae	N	47.7	1	Common Myna
Minjiri	*Senna siamea*	Ceasalpiniaceae	E	29.2±3.1	2	Common Myna, Chestnut-tailed Starling
Shirish	*Samania saman*	Fabaceae	E	84.7±16.8	3	Lineated Barbet, Spotted Owlet, Jungle Myna
Shajna	*Moringa oleifera*	Moringaceae	E	25.4	1	Black-rumped Flameback

The widest selection of tree species for cavity-nesting was found in Common Myna (n=9), followed by Black-rumped Flameback (n=4) and Lineated Barbet (n=4). Chestnut-tailed Starling and Oriental Magpie-robin each used 2 species of trees for the nesting purpose while only single nest-tree species were recorded for the rest of the species (Table 2). In terms of origin of trees (native or exotic), 7 species of native trees and 7

species of exotic trees were used by the cavity-nesting birds at JU campus for nesting purposes (Table 2).

The most of the cavity nests were built in trees with greater diameter at breast height (DBH). DBH of the nesting trees varied from 27 cm to 112 cm (52±23.2 cm). The highest mean DBH was recorded in *Samania saman* (85 cm) followed by *Swietenia mahagoni* (67 cm) (Fig. 1).

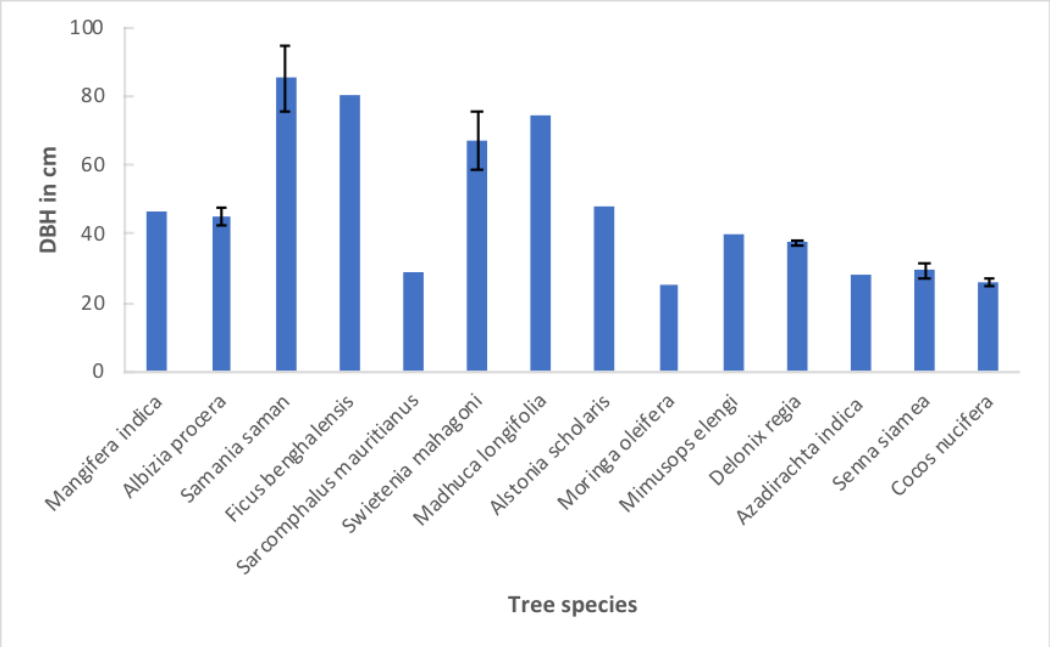

Fig. 1. Mean DBH of nesting trees of cavity-nesting birds at JU campus

The study revealed that most of the cavity-nesting birds preferred roadside trees for their nesting placement. The distance of nesting trees from the nearby roads varied from 1 m to 10 m. During the study period, 87% of the nesting trees were found in roadside vegetations which were located between 1 m and 5 m from the nearby roads (Fig. 2).

The most of the nesting trees (60%) located within 30 m from the nearby water bodies whereas 40% nest bearing trees were relatively distant from water bodies.

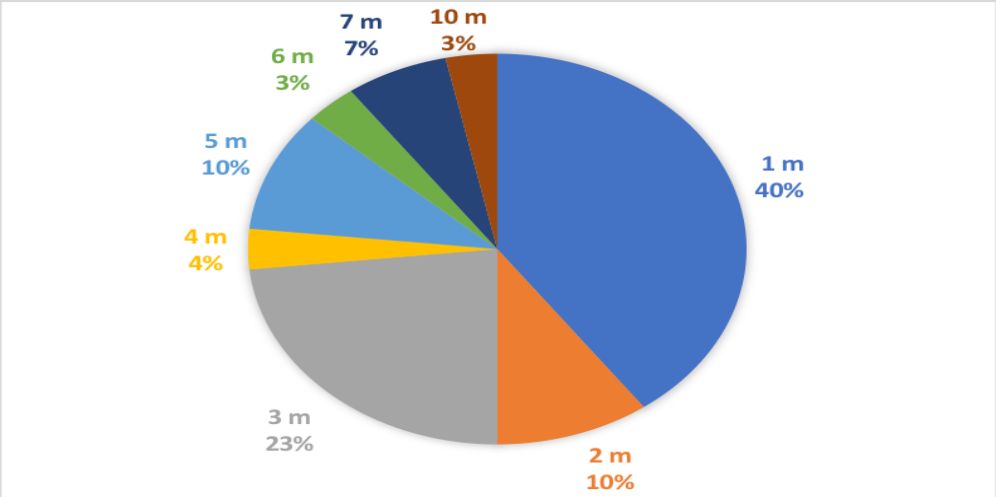

Fig. 2. Distance of nesting trees from nearby roads

Cavity-nesting species prefer larger (> 30 cm in DBH) and taller trees for nesting (Lehmkuhl *et al*., 2003; Nyirenda *et al*., 2016). In our study, more than 50% of total nest cavities were found in three species of trees (*Swietenia mahagoni*, *Abizia procera* and *Samania saman*) of > 42 cm in DBH. Earlier studies also showed that these trees are commonly found at JU campus and provide nesting resources to a wide variety of birds including cavity nesters (Jahan *et al.* 2018; Shoma & Begum, 2020; Shoma, 2021). Cavity-nesters at the campus nested in both native and exotic trees. However, the number of nests placed in exotic trees (n=19) outnumbered the nests found in native trees (n=11) in this study. This is because large exotic trees are more dominant and frequently found in road side plantations and trees of greater DBH are more likely to provide suitable cavities to cavity-nesting species. Moreover, nest-tree selection depends on tree species, cavity abundance, and whether tree is dead or alive (Nyirenda *et al*., 2016). We found that cavity-nests were more prevalent in central stem (56%) than in tree branches (44%). Although dead trees are an important source of nesting sites for cavity-nesters, most of the nests found at JU campus were in live trees while 20% cavities were formed in dead trees and branches. Living trees could be advantageous in providing better concealment of cavities and in protecting from extreme climatic conditions (Cockle *et al.*, 2015).

Nest characteristics: Cavity size and height preferences varied among the species. Tree-cavities used by cavity-nesting birds were 7.5±3.5 cm in entrance diameter (range: 5-22 cm, n=30), 23.2±6.5 cm deep (range: 13-45 cm, n=30) and 5.2±2.6 m above ground (range: 2-12 m, n=30) (Table 3). Common Myna built the nest at maximum height (12 m) from the ground with an average nest height of 6.14±3.2 m (n=13) while a nest of Spotted Owlet was recorded at 7.6 m height from the ground. On the other hand, Jungle Myna was found to nest at the least height of 2.4 m from the ground (Table 3).

Life history traits of cavity-nesting species relate to cavity measurements like cavity size and height above ground. Cavity height and entrance size can influence the risk of predation and internal volume of cavity may impact fecundity and reproductive success

(Martin *et al.*, 2004). Cavities with smaller entrance may deter the number of potential predators while larger cavities may help in better thermoregulation and maximize brood space and thus minimize competition among fledglings (Martin *et al.*, 2004; Kozma *et al*., 2014). Nest selection by cavity-nesting birds largely depends on entrance area, depth of cavity and body size of bird species (Carlson *et al*., 1998; Kosiński & Ksit, 2007; Mumthaz & John, 2017; Nyirenda *et al.*, 2016). In our study, the largest cavity was recorded in Barn Owl with an entrance size of 22 cm and cavity depth of 45 cm (Table 3). Birds from owl group used relatively larger cavity as they are larger in size than the other cavity-nesters at JU campus.

Nest height above ground plays a significant role in nest protection and therefore, nest site selection is often influenced by cavity height along with surrounding vegetations (Fisher & Wiebe, 2005; Nyirenda *et al.*, 2016). Nests placed at lower height are more prone to predation and it is evident from previous studies that nest disappearance and destruction through anthropogenic disturbances are more frequent in nests at under 5 m (Jahan *et al*., 2018; Shoma & Begum 2020). Average nest height of cavity-nesting birds at JU campus was above 5 m which could be advantageous in minimizing predation risk and in reducing human interference.

Table 3. Nest height and cavity dimensions of cavity-nesters at JU campus

Bird species	Entrance width (cm)	Cavity depth (cm)	Nest height (m)
Common Myna	6.7±0.7	24±5.6	6.14±3.2
Black-rumped Flameback	6.9±2.9	23.8±0.9	4.19±2.9
Spotted Owlet	18	35	7.6
Jungle Myna	6	22	2.4
Chestnut-tailed Starling	6±1.4	17.5±2.1	4.4±1.5
Rose-ringed Parakeet	8	30	4.6
Oriental Magpie-robin	6	17.5±3.5	2.9±0.2
Lineated Barbet	6±0.8	17.8±3.7	4.3±3.3
Barn Owl	22	45	4.6
Grey-capped Pygmy Woodpecker	7	18	7.6
Streak-throated Woodpecker	8	19	6

Conclusion: Sustainable management of nesting trees is important to maintain a healthy population of cavity-nesting birds at JU campus. The findings of this study have important implications for the conservation of roadside larger trees as they provide suitable cavities and nesting facilities to cavity-nesting species. Retention of larger trees and recruitment of young plants are critical to maintain abundance and diversity of tree species which could eventually promote the reproductive success of cavity-nesting birds. Our results emphasized variations in nest-tree preferences and nest characteristics of cavity-nesters, however, collection of nesting data was interrupted due to COVID-19 pandemic. Further studies should be directed focusing on community structure and population of cavity-nesting birds, effects of tree loss on their reproduction and interspecific interactions to improve our understanding to managing and conserving cavity-nesting birds at JU campus.

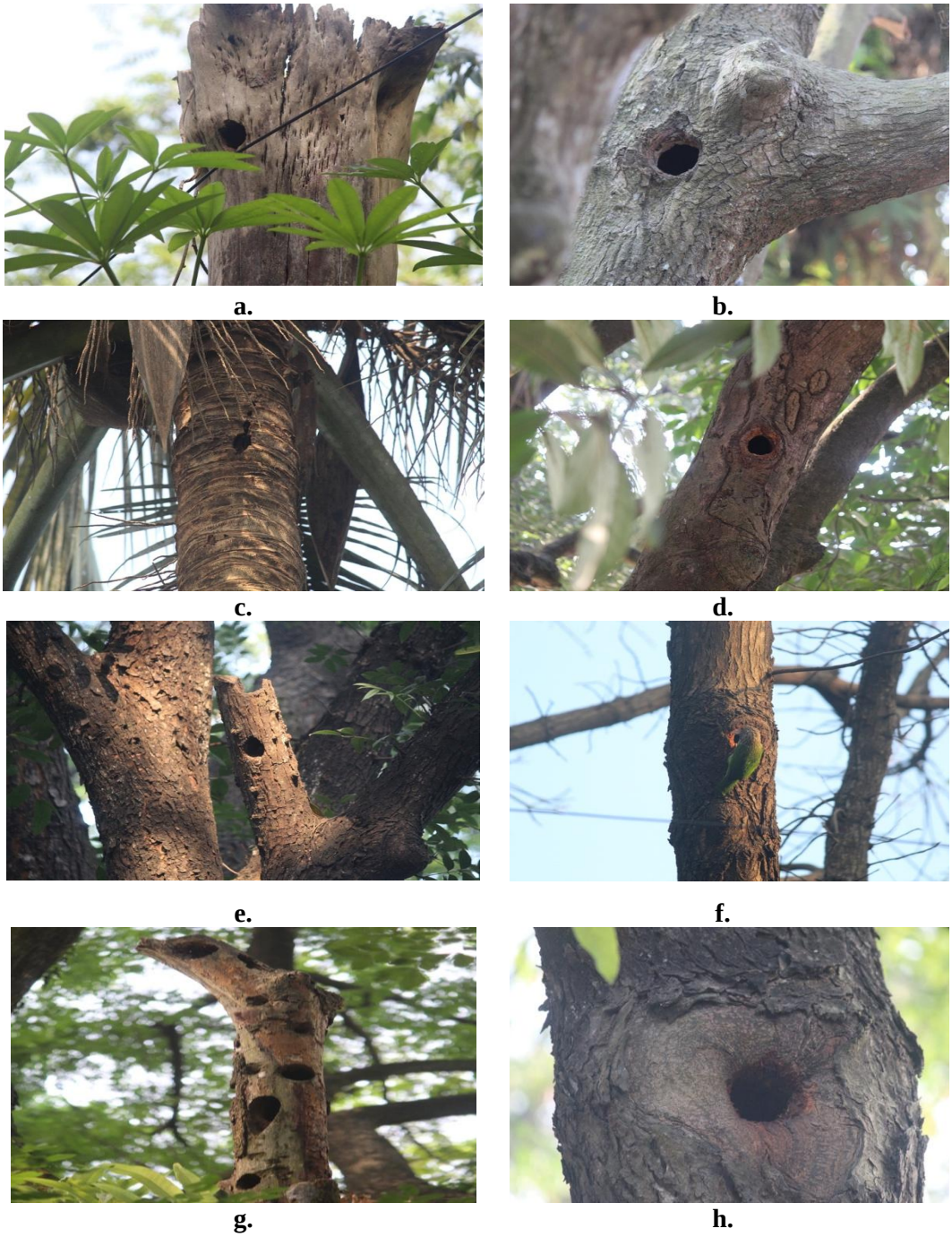

Fig. 3. Tree-cavities used by different species of cavity -nesters at JU campus, a. *Alstonia scholaris,* b. *Mimusops elengi,,* c. *Cocos nucifera,* d. *Madhuca longifolia,* e. *Swietenia mahagoni,* f. *Swietenia mahagoni,* g. *Samania saman,* h. *Swietenia mahagoni*

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