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COMPARATIVE NESTING PATTERNS AND SUCCESS OF MYNAS AND STARLINGS (AVES: STURNIDAE) INHABITING JAHANGIRNAGAR UNIVERSITY CAMPUS, BANGLADESH

Shamia Farhana Shoma* and Sajeda Begum

Department of Zoology, Jahangirnagar University, Savar, Dhaka-1342 Dhaka, Bangladesh

Abstract: Nesting patterns of four species of mynas and starlings, Common Myna (*Acridotheres tristis*), Jungle Myna (*Acridotheres fuscus*), the Asian-pied Starling (*Gracupica contra*) and Chestnut-tailed Mtarling (*Sturnia malabarica*) were studied in Jahangirnagar University campus from March to September in 2016. Nests were searched systematically throughout the study area and nesting parameters like nest dimensions, nest-site selection, tree species preference, nesting materials, clutch size and nesting success were examined. A total of 101 nests were recorded where 31 nests were of Common Myna, 10 of Jungle Myna, 49 of the Asian-pied Starling and 11 nests were of Chestnut-tailed Starling. Overall, the sturnids preferred nesting on trees (n=84) to anthropogenic structures (n=17). Common myna showed maximum variation in nest-site selection using tree holes (n=12), tree branches (n=10) and building cornices, holes or crevices (n=9) whereas Chestnut-tailed Starling nested only in tree cavities (n=11). Jungle Myna built nests both in tree holes (n=4) and in building holes and crevices (n=6). The Asian-pied Starlings built their domed nests mostly on tree branches (n=47) where 69% nests were peripheral and 31% were central in position. Out of 20 species of trees utilized for nesting purpose, the majority of nests were built on Whites iris *Albizia procera* (n=18) followed by Neem *Azadirachta indica* (n=10) and Mahogany *Swietenia mahagoni* (n=10). The nests were constructed between 2 and 18m (8±3.8m) from the ground level. Among 19 types of nesting materials recorded, twigs, leaves, straws, grasses, feathers, plastics and polythene were frequently used by all four species while the Asian-pied starling used more rubbish materials than other species. Highest nesting success (80%) was recorded in Common Myna whereas the Asian-pied Starling, Chestnut-tailed Starling and Jungle Myna had 77.8%, 75% and 66.7% of nesting success respectively. Adaptions to using different nesting sites in Common Myna and comparatively higher nesting height in the Asian-pied Starling may have facilitated the greater nesting success.

Key words: Bangladesh, Jahangirnagar University, Myna, Nesting ecology, Starling, Sturnids

*Author for corresponding: <sfshoma2016@gmail.com>
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INTRODUCTION

Mynas and Starlings are medium sized passerine birds belonging to the Sturnidae family. They are native to the Old World (i.e. Asia, Europe, Africa), but have also been introduced to many parts of the world (Craig and Feare 2010). Among 114 sturnid species worldwide, 12 species are native to Bangladesh and distributed throughout the country (Khan 2018). These birds are gregarious and commonly found in open country, all types of wooded and agricultural lands. They are mostly omnivorous and preferred to eat insects, fruits, grains etc. They are usually monogamous and breed during March to September (Khan 2008, Craig and Feare 2010, IUCN Bangladesh 2015). Most sturnids are secondary cavity nesters, though many have expanded their nest-site preferences to include anthropogenic substrates like crevices or cracks associated with buildings near human settlements(Craig and Feare 2010, Jackson 2019).

Jahangirnagar University (JU) campus is well known for avian diversity. Diverse habitats of the campus provide a potential breeding ground for many resident birds. There are six species of mynas and starlings recorded in the JU campus to date. Among them, Bank Myna (*Acridotheres ginginianus*) is occasionally found. Brahminy Starling (*Sturnia pagodarum)* was recorded in 2002 and non-breeding here. The remaining four species: Common myna (*Acridotheres tristis*), Jungle myna (*Acridotheres fuscus*), the Asian-pied Starling (*Gracupica contra*) and Chestnut-tailed Starling (*Sturnus malabarica*) are resident in the campus (Mohsanin and Khan 2009). They are commonly found in all the year round and share the same feeding and breeding habitat in the campus (Rahman *et al.* 2019).

Nesting is a common phenomenon in breeding behaviour of birds and plays a vital role in protection and survival of the species. Nest building pattern of all birds are species-specific and perfect design of the nests are exerted through the process of natural selection (Hansell 1984, Sethi *et al.* 2010). A number of studies has been done on ecology and activity pattern of birds in JU campus (Begum *et al.* 1993, Begum *et al.* 1994, Sultana *et al.* 2004, Akhter *et al.* 2007, Begum *et al.* 2011, Jahan *et al.* 2016, Nahid *et al.* 2016a, Nahid *et al.* 2016b, Jahan *et al.* 2018, Rahman *et al.* 2019). However, to the best of our knowledge, no detailed comparative study focusing on nesting of mynas and starlings has been documented. Therefore, the present study aimed to investigate the nesting patterns of four sturnid species in JU campus including their nesting sites, nesting trees, nest height, shape and size of the nests, nesting materials, clutch size and nesting success. This study will provide insight about the use of nesting resources of these sympatric species and will help in future conservation and management of these birds and their habitat as well.

MATERIAL AND METHODS

Study area: The study was conducted in Jahangirnagar University (JU) campus, located 32 km northwest of Dhaka city in central Bangladesh. Geographically the campus is located at 23°52.764′ N latitude and 90°16.068′ E longitude and about 280hectares in area. This area is a part of Bhawal and Madhupur Tract (Mahanta *et al.* 2014). The surface area of the campus is little undulating with highly iron rich soil of deep brown to yellowish red. The climate of the campus characterized by three main seasons: summer (March to May), monsoon (June to October) and winter (November to February). The university campus comprises of different ecological habitats and vegetation types including bushes, grasslands, woodlands, wetlands, marshy areas and agricultural lands (Begum 2016).

Nesting data: Nesting patterns of four species of myans and starlings were studied during their breeding season in 2016 from March to September(Khan 2008). Nests were searched systematically throughout the study area between dawn to dusk by using a pair of binoculars. Majority of the nests were located by observing the behaviour of birds such as nest construction, incubation and provisioning of nestlings. Once discovered, nest type (open or hole) and nest-site characteristics such as location (natural or anthropogenic), nesting tree species (tree with active nest), nest position on tree (periphery or central) and condition of the tree (dead or alive) were recorded. Height of nests above ground level were visually estimated (Wesolowski 2002). Nest dimensions like entrance width and depth of nest were measured with the help of measuring tape and centimeter scale in case of accessible nests. In order to determine the clutch size and the nesting success, accessible nests were visited twice a week with a ladder, small torch light and mirror. While checking nest contents, observers were aware to minimize possible influences of their activities on a nest's outcome, and no birds and nests were harmed during the study. A nest has been defined as successful if there is at least one fledgling (i.e., a fully feathered chick leaving the nests willingly for the first time) in the nest (Steenhof and Newton 2007). Number of nests which were disappeared, remained incomplete or destroyed were also recorded through careful observation. Predation was presumed when all eggs or nestlings disappeared or their remains were found in and around the nest (Wesolowski 2002, Cockle *et al.* 2015).Nest materials were examined by collecting nests after the completion of breeding cycle (Jahan *et al.* 2018).

Statistical analyses were done by using Microsoft Excel-Version 16.16.25. Monthly variations in nest number, nesting site use, tree species used for cavity nesting, nest height, clutch size and nesting success of mynas and starlings were compared. Graphical analysis of nest height was done by using R Studio-Version 1.0.153. Results are shown as mean± standard deviation (SD).

RESULTS AND DISCUSSION

A total of 101 nests of four sturnid species were recorded in JU campus during the study period. The highest number of nests (n= 49) were recorded for the Asian-pied Starling while lowest (n=10) was for Jungle Myna. In case of Common Myna, 31 nests were recorded followed by Chestnut-tailed Starling (n=11). The number of nests found in different months varied in four species. The highest number of nests for each species was recorded in May(n=34) (Fig. 1).

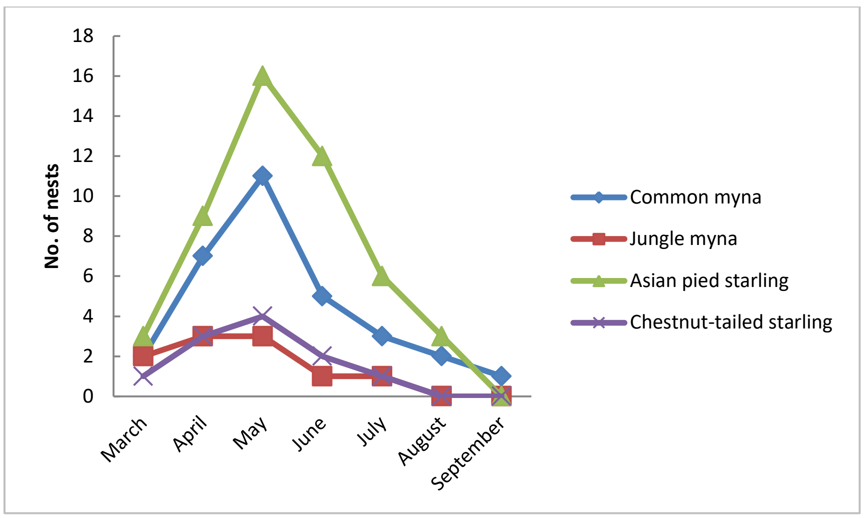

Fig.1.Number of nests of mynas and starlings found in different months

Nesting sites: Nests of mynas and starlings were mostly found in open woodlands, close to human habitations and their immediate neighborhoods. Out of 101 nests, 84 were observed in trees and 17 were in anthropogenic structures. Common Myna and Jungle Myna were found to nest in various sites like trees, cornices and walls of buildings. The Asian-pied Starling nested on trees and electric poles while Chestnut-tailed starling were found to nest on trees only. Common Myna built nests mostly in tree holes (39%, n=12) followed by tree branches (32%,n=10)and building cornices, holes or crevices (29%, n=9). Most of the nests of Jungle myna were found in building holes and crevices (60%, n=6) rather than tree holes (40%, n=4). All of the nests of Chestnut-tailed Starling were built in tree holes (100%, n=11). The Asian-pied Starling mostly built nests (96%, n=47) on tree fork and branches while only 2 (4%) nests were built on electric poles (Fig. 2).

Nest site selection is considered to be a crucial factor for potential reproductive success in birds' species. Birds are likely to prefer nest sites that protects their nests from predators and comes up with greater food supply (Liebe zeit and George 2002, Marshall and Cooper 2004, Ali and Santhanakrishnan 2015). Except Chestnut-tailed Starling, other three sturnid species in JU campus used more than one nesting site. Choosing of diverse nesting sites of sturnid species including human settlements indicates their high adaptability with urbanization. The flexibility in nesting site preference of Common myna (Holzapfel *et al.* 2006, Begum 2011, Dhandhukia and Patel 2012, Kaur and Khera 2014, Jahan *et al.* 2018), Jungle myna (Jahan *et al.* 2018) and the Asian-pied Starling (Jahan *et al.* 2018, Sethi and Kumar 2018) has also been reported in previous studies. While nesting on trees, the Asian-pied Starling mostly built nests on peripheral branches (69%) rather than centre of the trees (31%) which could be a strategy of the species to minimize predation pressure as well as human disturbances. On the other hand, the characteristic of cavity nesting (e.g. tree holes, building holes) in Common Myna, Jungle Myna and Chestnut-tailed Starling facilitates them by providing suitable microclimatic condition for eggs and chicks and reduces predation risks to nests (Nilsson 1986, Ali and Santhanakrishnan 2015).

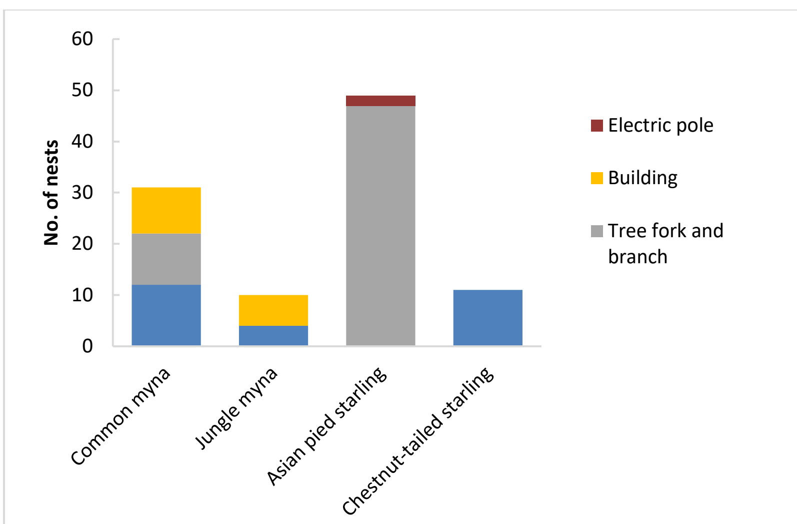

Fig. 2. Different nesting sites of mynas and starlings found in JU campus

Nesting trees: A total of 20 species of plants in JU campus was recorded as nesting trees for mynas and starlings (Table 1). The highest diversity in tree species preference was found in the Asian-pied starling. Of the 20 hosting tree species, 15 were used by the Asian-pied Starling for nesting. Nine species of trees were used by Common Myna whereas Jungle Myna and Chestnut-tailed starling used only three and four species of trees for their nesting respectively. The highest number of nests were recorded in Whites iris *Albizia procera* (21.4%, n=18) followed by Neem *Azadirachta indica* (12%, n=10). Both trees were used by all four mynas and starlings. Mahogany *Swietenia mahagoni* (12%, n=10) was used by three sturnid species except Jungle myna. *Albizia procera* Jahan *et al.* (2018) also reported that these tree species are common in JU campus and frequently used by birds for nesting. Although mynas and starlings were seen to nest on man-made structures, 83% of nests recorded in trees including 27% nests placed in tree cavities. Out of the nine species of trees used for cavity nesting, most of the nests were found in Whites iris, *Albizia procera* (n=8) and Neem, *Azadirachta indica* (n=8) (Fig. 3). In JU campus, starlings and mynas used the nests mostly excavated by woodpeckers and barbets. Cavity abundance is influenced by different species of trees, position on the trunk, and whether the tree is alive or dead (Carlson *et al.*1998). Although snags or dead trees provide a major source of nesting sites to cavity-nesting birds (Archawaranon 2006), mynas and starlings of study site preferred to nest in live trees since only 11% of cavity nests were recorded in dead trees. Cavity-nesting birds often experience intra-specific competition due to the factors like low availability of cavities and competition for vantage points (Czeszczewik and Walankiewicz 2003).Furthermore, anthropogenic disturbances drive cavity nesters to select or abandon the cavities in breeding seasons (Richardson and Miller 1997).Increasing of anthropogenic activities such as clearing of woods for infrastructure development like road and building construction in campus may reduce the number of cavities below a critical threshold for the persistence of cavity-nesting birds. Therefore, plantation and conservation of the nest host trees in JU campus are important for the conservation and management implications of avian community including sturnid species.

Nest height: The nest height of mynas and starlings varied from 2-18m (8±3.8m) from the ground level (Fig. 4). Common Myna nested between 2-9m (5.8 ± 1.8m) while the nests of Jungle Myna were constructed between 3-9m (6 ± 1.9m) above the ground. The Asian-pied starling constructed their nests between 4-18m (10.2±3.5m) above the ground. Nest height of Chestnut-tailed starling ranged from 3-10m (5.6 ± 2.4m). The choice of nest sites by cavity-nesting birds is often influenced by height above the ground along with surrounding vegetation cover (Fisher and Wiebe 2005).Nest height plays an important role to

Table 1. Nest host tree species of mynas and starlings in JU campus

Nesting trees			Number of nests			
Common name	Scientific name	Family name	Common myna	Jungle myna	Asian-pied starling	Chestnut-tailed starling
Jackfruit	*Artocarpus heterophyllus*	Moraceae	–	–	2	–
Areca palm	*Areca catechu*	Arecaceae	1	–	2	–
Mahogany	*Swietenia mahagoni*	Meliaceae	3	–	5	2
White siris	*Albizia procera*	Fabaceae	4	1	10	3
North Indian rosewood	*Dalbergia sissoo*	Fabaceae	1	–	2	–
Teak	*Tectona grandis*	Lamiaceae	–	–	4	–
Earleaf acacia	*Acacia auriculiformis*	Fabaceae	–	1	3	–
Pride of India	*Lagerstroemia speciosa*	Lythraceae	–	–	2	–
Ipil-ipil	*Leucaena leucocephala*	Fabaceae	–	–	2	3
Gmelina	*Gmelina arborea*	Lamiaceae	–	–	7	–
Mango	*Mangifera indica*	Anacardiaceae	–	–	2	–
Coconut	*Cocos nucifera*	Arecaceae	2	–	–	–
Neem	*Azadirachta indica*	Meliaceae	4	2	2	2
Asian palmyra palm	*Borassus flabellifer*	Arecaceae	3	–	–	–
Fish tail palm	*Caryota urens*	Arecaceae	2	–	–	–
Rain tree	*Samanea saman*	Fabaceae	–	–	1	–
Royal poinciana	*Delonix regia*	Fabaceae	–	–	2	–
Drumstick tree	*Moringa oleifera*	Moringaceae	1	–	–	–
Charcoal tree	*Trema orientalis*	Cannabaceae	–	–	–	1
False ashoka	*Polyalthia longifolia*	Annonaceae	1	–	1	–

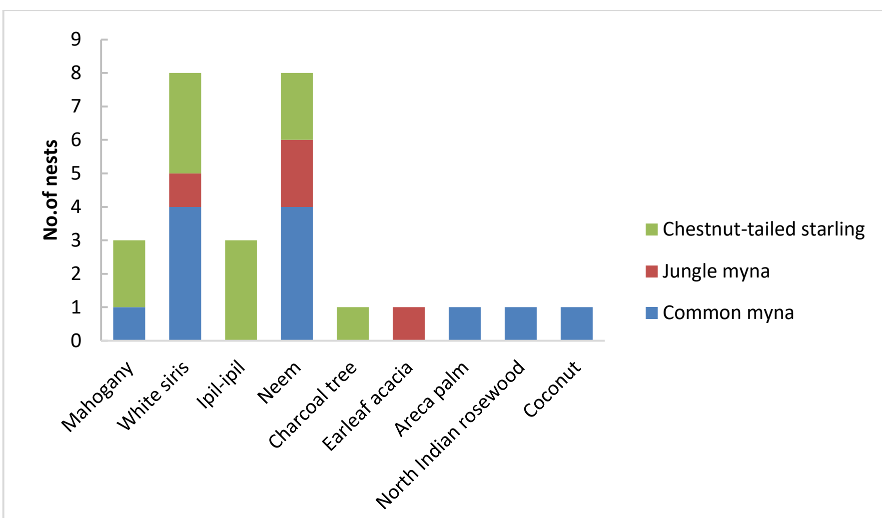

Fig. 3. Tree species used for cavity nesting by mynas and starlings in JU campus

protect nests from predation. Nest placed in lower height is vulnerable to predation and human disturbance. It was observed that most of the nests disappeared and destroyed by human activities were at under 5m. Jahan *et al.* (2018) estimated twice predation risk and disturbance for the nests placed under 5m than above. Nests built in the immediate vicinity of human habitation particularly open nests were more vulnerable to disturbance. Open nests are more visible than hole nests which makes them more prone to predation when at low height. In case of Common Myna, Chestnut-tailed Starling and Jungle Myna, most of the nests in tree cavities were likely at less risk of predation than open nests despite being built at a lower height. In the present study, mean nest height of the Asian-pied Starling was higher than other sturnids (Fig. 4) and this might be to minimize predation and accessibility.

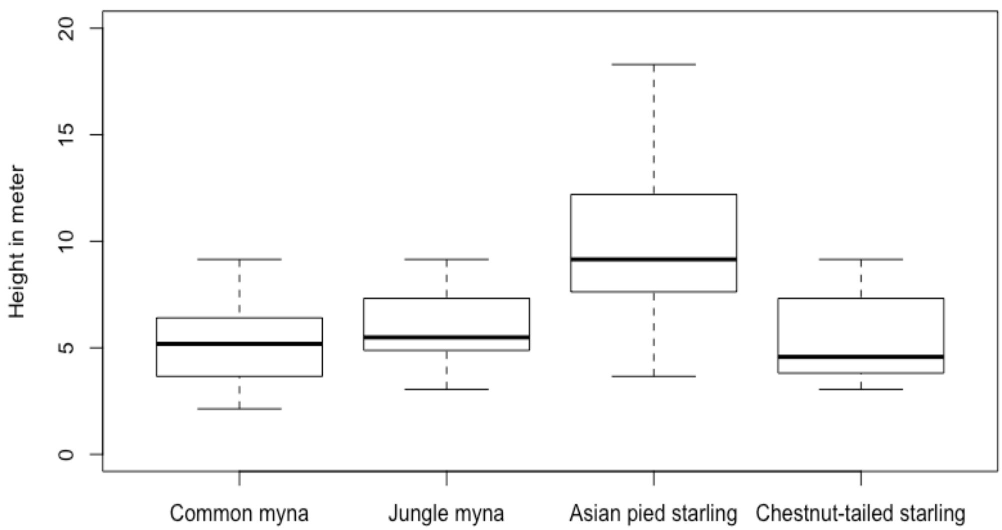

Fig. 4. Box plotsrepresenting the distribution ofnest heights fordifferent sturnidspecies in JU campus. Each box shows interquartile range, horizontal lines within the boxes represents median and whiskers extend to the most extreme data points.

Nest shape and size: Nest shape and size of mynas and starlings varied on the basis of type and site of the nests. Common Myna had shallow cup type of nests while building nests on tree branches. In case of tree hole nesting, they used the natural cavity of branches of dead tree trunks and the nests previously excavated by other cavity nesters like woodpecker and barbet. Cavity-nesting birds occupy old cavities and thus save time and energy (Pakkala *et al.* 2017).The entrance width and the depth of trees holes (n=6) used by Common Myna varied from 5-7 cm (5.83±0.75 cm) and 10-35 cm (18±9.12 cm) respectively. In case of open cup shaped nests in tree branches (n=5), the width and depth of nests varied from 15-18 cm (16.2±1.3cm) and 7-13 cm (9.8±2.16 cm) respectively while in building holes and crevices (n=5), the entrance width and depth ranged from 10-14 cm (11.4±1.6 cm) and 20-31 cm (26.6±5.1 cm) respectively. The nests of the Asian-pied Starling were massive, domed and roughly globular but often merely a shapeless mass of straw and rubbish. These were loosely constructed with an entrance on the side. The nest depth of the Asian-pied Starling (n=9) varied from 12-29cm (20±5.7 cm) with entrance width ranging from 6-10 cm (7.9±1.3 cm). Most of the nests of Jungle Myna built in building holes were not accessible to measure. While nested in tree holes (n=3), entrance width varied from 6-9 cm (7.3±1.5 cm) and depth varied from18-48 cm (29.3±16.2 cm). Chestnut-tailed starling was absolute tree hole nester and the width and depth of the holes (n=5) varied from 4.5-7 cm (5.6±1.1 cm) and 8-18 cm (13±4 cm) respectively. However, the shape and size of the nest chamber depends on species and the entrance hole varies depending on the size of the birds (Kosiński and Ksit 2007, Mumthaz and John 2017).

Nesting materials: The mynas and starlings used wide varieties of materials to construct their nests. Of 19 types of materials recorded in the present study, twigs were the most frequently used materials to outline the nests in Common Myna (n=5), Jungle Myna (n=2) and Chestnut-tailed starling (n=3) while the irregular outer shape of the Asian-pied Starling's nests (n=6) were mostly made up of straw. Dead leaves, grasses and feathers were found in all nests and mostly used for inner lining of nests. Other materials used by starlings and mynas included plastics (e.g. chocolate wrapper, pieces of biscuits and chips packets, shampoo pouch), polythene, clothes, cotton, paper, metal wire, rope, net, barks strips, grass roots, human hair, wool and rubbish. Snake slough was also found in a nest of Common Myna. Similar types of findings were also reported in previous studies (Dhandhukia and Patel 2012, Jahan *et al.* 2018, Sethi and Kumar 2018). It was observed that the Asian-pied Starling used comparatively more rubbish and miscellaneous materials than other sturnids. On the other hand, hole nesters used more man-made products when nesting on man-made structures like building crevices. The relative proportion of materials used in nests seems to depend on their availability and abundance around the nesting sites (Dhandhukia and Patel 2012, Jahan *et al.* 2018).

Clutch size: Clutch size of Mynas and starlings varied from 2 to 6eggs (n=26) and there was no significant variation in mean clutch size among the species. Meanclutch sizes recorded for Common Myna and the Asian-pied Starling were 4.1±0.7 (n=10) and 4.1±1.3 (n=9) respectively while for Jungle Myna and Chestnut-tailed Starling were 3.3±0.6 (n=3)and 3±0.8(n=4) (Table 2). The present findings for clutch size of sturnids are comparable to that of existing literatures. In a study in JU, Jahan (2010) reported the clutch size of 4-6 eggs for Common Myna, 4 eggs for Jungle Myna, the Asian-pied Starling and Chestnut-tailed Starling. Begum (1992) reported the clutch size of 3-6 eggs for the Asian-pied Starling. In India, clutch sizes of Common Myna and the Asian-pied Starling varied from 4-5 eggs (Kaur and Khera 2014, Sethi and Kumar 2018).However, clutch size varies among species, even within a species, largely geographically, seasonally and annually. Clutch size in most species is determined by heredity, as consequences of natural selection and usually covaries with biological characters like body size, nestling development and nest type (Klomp 1970, Perrins and Jones 1974, Jetz *et al*. 2008).Clutch size is central phenomenon to avian reproductive effort and can influence the nesting success as well as breeding success of a species(Slagsvold1984).

Nesting success: The highest nesting success was recorded in Common Myna (80%, 8 out of 10 nests) followed by the Asian-pied Starling (77.8%, 7 out of9). Chestnut-tailed starling had 75% (3 out of 4) nesting success while Jungle Myna showed lowest nesting success of 66.7% (2 out of 3) (Table 2). Nesting success of birds depends on various factors including inter and intraspecific competition, position of nests, quality of nest sites, predation pressure etc. (Mitrus and Soćko 2008, Singh *et al.* 2016). Besides, a nest of the Asian-pied Starling was found with dead nestlings attacked by insect parasites and death of young from an accidental falling from the nest was observed in Jungle Myna. Under natural conditions, predation has been reported as the leading cause of nest loss (Singh *et al.* 2016). Nest predation commonly involves depredation of eggs and nestlings by natural predators like tree climbing reptiles and mammals, and raptorial birds (Wilson *et al*. 1998). No predation was directly observed in the study site during the study period. It has been reported that nest predation in JU campus is extremely high and the most likely predators are crows (*Corvus* spp.), Rufous Treepie (*Dendrocitta vagabunda*) and Bengal monitor (*Varanus bengalensis*) (Nahid *et al*. 2016a).However, predation was assumed as common reason of nest failure in different bird species in JU campus (Nahid *et al*. 2016b). Predation occurred mostly in the nests accessible to human. Loss of nest was more likely caused by human interferences since eggs and nestlings were often collected by children for fun and pleasure. Predation is a kind of disturbance that impacts the choice of nest sites by cavity-nesting birds (Wesolowski 2002).Cavities provide better protection from nest predators and ornithologists generally admit that cavity-nesting birds have greater nesting success than open-nesting birds (Johnson and Kermott1994). In the present study, most of the nests particularly of Jungle Myna and Chestnut-tailed Starling were inaccessible to observe and that limits us to compare the nesting success of open-nesting and cavity-nesting mynas and starlings. However, adaptions to using different nesting sites in Common Myna and higher nest height in the Asian-pied Starling may have facilitated the better nesting success.

Table 2. Clutch size and nesting success of mynas and starlings

Species	No. of nests observed	Average nest height (m)	Clutch size		No. of nests successful	Nesting success
			Range	Mean ± SD		
Common Myna	10	5.1	3-5	4.1 ± 0.7	8	80%
Jungle Myna	3	4.4	3-4	3.3 ± 0.6	2	66.7%
Asian-pied Starling	9	7.5	2-6	4.1 ± 1.3	7	77.8%
Chestnut-tailed Starling	4	4	2-4	3 ± 0.8	3	75%

Nesting success between open-nesters and cavity-nesters in a variety of communities would be of interest. The abundance and diversity of tree species may influence the availability of tree cavities to hole-nesting birds. Human impacts with developmental activities in the campus that reduce abundance and diversity of trees may have a negative effect on nesting birds. Therefore, nesting success of birds are also influenced by the extent of human disturbance in the bird habitats. However, nesting facilities of these species can be effectively protected by increasing plantation through suitable policies and sustainable land use practices and public awareness creation. Although too few data on the nesting success of cavity-nesters and open-nesters, but additional research is required to investigate further the impacts of human activities on bird species, predation pressure and also the impacts of environmental factors on the nesting of birds.

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