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Distribution and Nest Characteristics of Barbet Species in Margalla Hills National Park, Islamabad, Pakistan

Isma Sheraz[1*], Muhammad Sajid Nadeem[1], Amjad Rashid Kayani[1], Abdul Hadi[1], Sakhawat Ali[2] and Tariq Mahmood[1]

1. Department of Zoology, Wildlife & Fisheries, PMAS- Arid Agriculture University Rawalpindi, Pakistan
2. Islamabad Wildlife Management Board (IWMB), Ministry of Climate Change, Islamabad, Pakistan

***Corresponding author e-mail:**ismasherazraja@gmail.com

SUMMARY

There are 80 species of Barbets, belonging to 11 genera, distributed worldwide. They are part of the family Capitonidae and the order Piciformes, playing important roles in seed dispersion and serving as ecological indicators. This study aimed to document the distribution and nesting characteristics of Barbet species in Margalla Hills National Park, Islamabad. Field surveys were conducted from March 2022 to May 2023, during which nesting areas were marked for observation of nest characteristics throughout the breeding seasons. A total of 12 sampling sites for Barbet species were identified, at elevations ranging from 525 m (Rawal Lake) to 1181 m (Pir Sohawa). Three Barbet species were found in the study area: the Blue-throated Barbet, Coppersmith Barbet, and Great Barbet. The Blue-throated Barbet population was assessed as 373 individuals, with a density of 3.45 birds/km². The Coppersmith Barbet population was estimated as 184 individuals, resulting in a density of 1.70 birds/km². The Great Barbet population was observed to be 36 individuals, with a density of 0.33 birds/km². Barbets typically build their nests in tree cavities, primarily in dead or old branches. The breeding season for the Coppersmith Barbet and Blue-throated Barbet occurs from March to June, while the Great Barbet breeds from April to June.

Keywords: Margalla Hills National Park, Islamabad, Birds, Nests, Barbet

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INTRODUCTION

In avian fauna, the barbet species are known to be an important category consisting of about 80 species found throughout the world (Billerman et al., 2025). Their order is Piciformes, and their family is Capitonidae. They have 11 genera (Skoracki et al., 2024). Barbet species found in Asia are called Asian barbets, and they belong to the Megalaima family, which includes 28 species (Short and Horne, 2001; Short and Horne, 2002). They play an important role in pollination and seed dispersal, as barbets are highly frugivorous. However, they are also capable of consuming large numbers of insects and serve as pest-controlling agents. For reproduction, they prefer the trees of Sembal (*Bombax ceiba*), Jamun (*Syzygium cumini*), Bahera (*Terminalia bellirica*), Harar (*Terminalia chebula*), Rudraksh (*Elaeocarpus ganitrus*), Kadam (*Anthocephalus cadamba*), Amla (*Emblica officinalis*), and snag trees. They usually develop holes in

trees and build their nests (Yahya, 2000; Rashford, 2023). Barbet species that are found in Asia are called Asian barbets and they belong to Megalaima family that includes 28 species (Short and Horne, 2001). They have an important role in pollination and dispersal of seeds, as barbets are highly frugivorous. However, they are capable of consuming large numbers of insects so are pest controlling agent. The barbet species of Europe, Africa and America are most studied groups as compared to the Asian barbets (Archana et al., 2024).

The habitat of Coppersmith barbet (*Psilopogon haemacephela*) is seem to be around the presence of tall trees with enough dead wood in the branches of these trees, that is favorable for mining cavities which is vitally required for nest building additionally for roosting. They are an oriental species that is found in Pakistan and India throughout the Malaysia, Indo Chinese region, southern Yunnan and in the Philippines. It is also found in Sri Lanka. In Punjab it is confined to Indus plains. Coppersmith barbet is a rare species in northern Sindh and is vague from lower Sindh areas, Baluchistan and in KPK. In summer season there is seen some westwards extension or local migration in this barbet species in its range for breeding and nesting, but the majority of the Punjab population is residential and sedentary all over the year. It turns out to be becomes silent in winter months and due to of its inconspicuous habits it usually evades notice. Barbet species are found to be present in Himalayas hooked on southern China and in Indochinese territory and just reaches westward in the ranges of Murree hills and in Azad Kashmir it is extended in Jhelum valley, where this species is resident and do breeding (Short and Horne, 2002; BirdLife-International, 2024b).

The Great barbet (*Psilopogon virens*) species used to found territories in mixed deciduous and coniferous forests in the temperate climate regions at elevation of 2000-8500 feet. In winter season they display some kind of altitudinal migration and may drift into warm snow free regions or zones (Robert, 1992). They become vocal during whole spring and summer season, and the calls become incessantly in the daytime and both the sexes habitually indulge in antiphonal duets. The female barbet is evidently attracted to male barbets by their calls and fly on the trees frequently doing perching in nearby proximity, and they participate in more frequent tail wagging activity from side-side, not up-down, and head bobbing activity as a part of courtship behavior or repertoire. By response of each male call the female barbet produces much short lower pitch squawk. The bonding pair is seen to be a long-lasting pair. Perhaps the pair is being renewed every year if suitable nesting site stay available. Both genders take involvement in nest excavation activity that is a hole in any tree, most commonly in the underneath of slanting branch and they ignore an exposed nest on vertical tree because it is usually selected by woodpecker species. They make nest that is few centimeters and extending vertically by some centimeters prior to bending at right angle and become descending in parallel to the branch. A nesting cavity is reused after some years. Both of the parents take food in the nest for their young ones which are considered to be majorly insectivorous during their very young stage and when chicks are actually small and then supplemented after some days with black or orange berries which is ultimately their main food or diet (Short and Horne, 2001; Short and Horne, 2002; BirdLife-International, 2018).

In blue throated barbet (*Psilopogon asiatica*) both sexes are believed to take part in the construction of nest hole and it is mostly a short and small sized hole in the

underside of sloping branch as well as it is well protected by the harms of weather, and their eggs are rather elongated and oval in shape, with white in color. Both parents share incubation and take food for their young. Their pair bond is entirely monogamous and is usually of long time period with more mutual duets and displays in nearby visual contact by head twisting or bobbing and tail wagging during April-May (BirdLife-International, 2024a).

The limited data is available about the barbet species in Pakistan. Therefore the main objective of the present study was to document the distribution and nesting characteristics of barbet species in Margalla Hills National Park, Islamabad.

MATERIALS AND METHODS

STUDY AREA

The distribution and nest characteristics of barbet species (Figure 1) have been studied in MHNP from March 2022 to May 2023. This park (33° 43'N and 72° 55'E) is adjacent to the Federal Capital Territory, Islamabad, and comprises an area of 17,386 hectares. The temperature ranges from 34.3ºC to 3.4ºC (Shinwari, 1998). The average highest temperature in MHNP is 33.3ºC in summer, while the lower average temperature is -1ºC in winter, and the mean rainfall in this area is 94 centimeters; snowfall is occasional (Mahmood et al., 2021; Iftikhar et al., 2023; Rahman, 2023).

Figure 1: Barbets species in Margalla Hills National Parks, Islamabad Pakistan.

The MHNP is rich in biodiversity. In total, 27 fish species, 6 amphibian species, and 17 reptile species are reported in MHNP. The major mammalian species are *Canis aureus* (Jackal), *Macaca mulatta* (Rhesus Monkey), *Panthera pardus* (Common Leopard), *Sus scrofa* (Wild Boar), and *Muntiacus* (Barking Deer). In total, 250 bird species are reported in Margalla Hills National Park, including a few rare species such as *Falco jugger* (Laggar Falcon), *Gyps fulvus* (Griffon Vulture), and *Falco peregrinus* (Peregrine Falcon), as well as many common species of birds (Hadi et al., 2023). In MHNP, a few common species of plants include *Pinus* species, *Bauhinia variegata*, *Acacia modesta*, *Bombax ceiba*, *Cassia fistula*, *Adhatoda vesica*, *Dodonaea viscosa*, *Woodfordia fruticosa*, and *Ziziphus mauritiana*, which are dominant (Shinwari and Khan, 2000; Rafique et al., 2005).

STUDY DESIGN

The study area was divided into 6 grids, each having two transects. In total, twelve (N=12) sampling sites were selected (Table 1). Barbet species were observed by direct

sight and by acoustic signals. From the nesting areas, the geographical coordinates and further characteristics were noted, and photographs were taken of barbet species. The nests were studied in order to collect data on nest characteristics such as tree species, tree preference, tree height, tree diameter, dominant vegetation around the nest, tree count within 100 meters of the nest, size of the nest, height of the nest from ground level, and trunk diameter at the nesting hole level. The material of the nest, number of eggs, and chicks were also studied. The photographs were taken with the help of a camera (Nikon D7200 with Tamron 150-600 G2 lens of 24 megapixels), and species were identified by following the field guides by Grimmett et al. (2008) and Mirza and Wasiq (2007) on the basis of body color, body length, and plumage pattern.

STATISTICAL ANALYSIS

Data were analyzed and graphs were designed with the help of MS Excel and Past Statistical Software.

Table 1: Distribution and occurrence of barbet species in Margalla Hills National Park (MHNP), Islamabad (2022-2023).

Study area	Latitude N	Longitude E	Elevation(m)
Shahdra	33.7766	73.1738	691
Ramli	33.7713	73.1358	715
Damn-e-koh	33.7562	73.0593	731
Rawal lake	33.7026	73.1261	525
Talhar	33.7603	73.0656	930
Darrajanglan	33.7461	73.0855	630
Pirsohawa	33.7849	73.1141	1181
Trail 4	33.7378	73.0486	677
Trail 7	33.7137	72.9490	885
Jabbi	33.7546	73.14432	615
Said pur	33.7427	73.0678	620
Shah Allah dita	33.7215	72.9154	708

RESULTS AND DISCUSSIONS

DISTRIBUTION AND POPULATION

During the study three barbet species (Blue throated barbet *Psilopogon asiaticus*, Coppersmith barbet, *Psilopogon haemacephalus* and Great barbet *Psilopogon virens*) are observed (Figure 1) from the study area. The Coppersmith Barbet and Blue-throated Barbet are found at 10 (i.e. Pirsohawa, Daman-e-koh, Saidpur, Talhar, Shah Allah dita, Jabbi, Ramli, Shahdara, Dara janglan, Trail 4 and Rawal lake) and 11 sites (i.e. Pirsohawa, Daman-e-koh, Shah Allah dita, Jabbi, Saidpur, Ramli, Talhar, Shahdara, Dara janglan and Trail 4) respectively. The Great Barbet is documented only at PirSohawa and Talhar, perhaps at a higher elevation (930-1181m) (Figure 2).

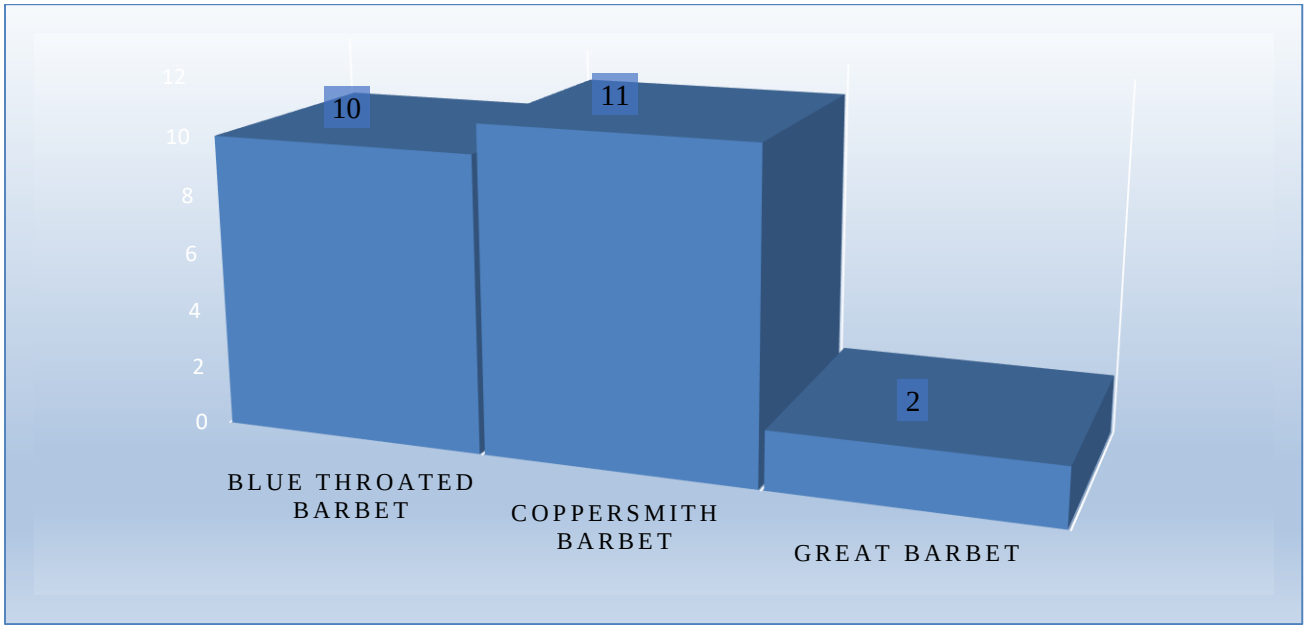

Figure 2: Number of Barbets reported from the sites of MHNP, Islamabad, Pakistan.

Roberts (1991) reported that the Great Barbet is a bird of mixed coniferous and deciduous forest in the temperate zone, occurring between 600m and 2600m elevation. It is sparsely distributed in the sub-tropical dry deciduous zone of the Margalla Hills and Murree foothills. The Blue-throated Barbet is a resonant species of the Himalayan foothills, found between 450m and occasionally 1675m. The Coppersmith Barbet is primarily present in the Indus plains of Punjab and locally migrates in the Margalla Hills. It is sympatric with the Blue-throated Barbet. In study area (Figure 3), the population of the Blue-throated Barbet was estimated as 373 with an overall density of 3.45 birds/km² (Table 2).

Table 2: Population distribution and estimates on Blue throated barbet in different localities of Margalla Hills National Park 2022-2023.

Localities	Area km²	Number of birds observed	Density per km²	Total area (Km²)	Estimated population
Shahdara	2	12	6	15	90
Ramli	2	8	4	12	48
Daman-e-koh	2	2	1	20	20
Talhar	2	9	4.5	5	23
Trail 4	2	24	12	8	96
Rawal lake	2	0	0	8.8	0
Dara janglan	2	12	6	5	30
Pirsohawa	2	1	0.5	4	2
Trail 7	2	0	0	5	0
Jabbi	2	6	3	7.2	22
Saidpur	2	6	3	6	18
Shah Allah dita	2	3	1.5	12	18
Total	24	83	3.45	108	373

O'Neill et al. (2000) studied that generally barbet species move across the tree's canopy inconspicuously and were seen quiet or may give only soft calls. They do foraging by their characteristic sluggish moves, at best when they are on fruiting trees, and they seldom change perches. Even though their sluggishness, the barbet species are easy to locate because of their distinctive whirring sound or noise which is produced by their wings during the flight. They stay near the crown of trees as in groups even when they travel with any other species. They observed a group of six barbet species that were on reddish berries fruit trees. They found that a bird stayed on a perch for greater than 5 minutes at a time. Barbet species do forage quietly in the shady interior of tree canopy. They do forage 15 meters above the ground and 5 meters below the canopy. Moyle (2004) noted that this birds usually keep diagonal posture during their perches and the tail held around 30° below the horizontal.

In study area, the population of coppersmith barbets was estimated as 184 (Figure 3), with an overall density of 1.70 birds/Km².The highest density (4 birds/Km²) was observed at Rawal Lake, with an estimated population of 35 birds. The lowest density (1 bird/Km²) was observed at Damn-e-Koh, Tahar, Pir Sohawa, and Saidpur (Table 3).

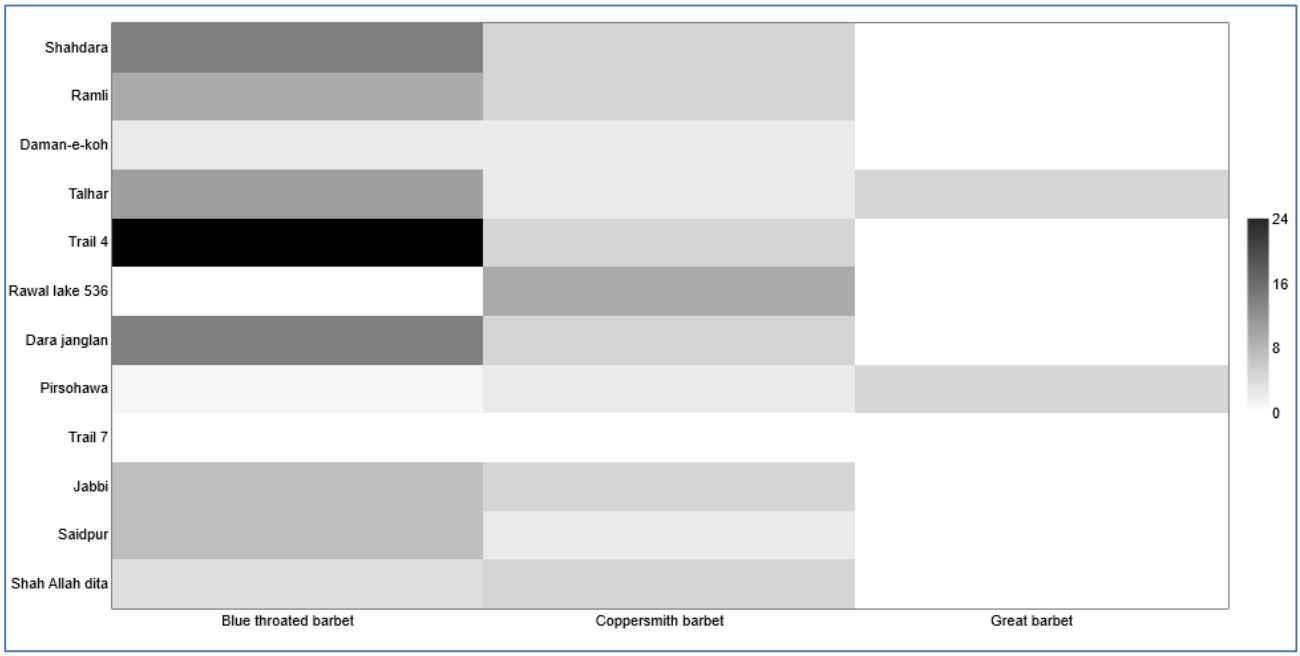

Figure 3: Population of Barbet species in different sites of MHNP, Islamabad.

BirdLife-International (2024b) and Joshi and Bhatnagar (2018) reported that normally the individuals of Coppersmith barbet do not seen in close forest places, while they are present in those places where there is clearing in forest as of logging, but they are very well adapted to live sideways of woodland, forest edges, gardens and scrubs and are very common throughout this range. Due to this adaptation this species is entirely capable to spread its range uniformly throughout the areas where other barbet species are seen to be unable, or they had reduced their range owing to the clearance of forest.

Table 3: Population distribution and estimates on Coppersmith barbet in different localities of Margalla Hills National Park 2022-2023.

Localities	Area km^2	Number of birds observed	Density per km^2	Total area (Km^2)	Estimated population
Shahdara	2	4	2	15	30
Ramli	2	4	2	12	24
Daman-e-koh	2	2	1	20	20
Talhar	2	2	1	5	5
Trail 4	2	4	2	8	16
Rawal lake	2	8	4	8.8	35
Dara janglan	2	4	2	5	10
Pirsohawa	2	2	1	4	4
Trail 7	2	0	0	5	0
Jabbi	2	4	2	7.2	14
Saidpur	2	2	1	6	6
Shah Allah dita	2	4	2	12	24
Total	24	41	1.70	108	184

In study area (Table 4), the population of Great Barbets was estimated as 36individuals, resulting in an overall density of 0.33 birds per km². The densities were recorded as 2 birds' per km², at Talhar and Pir Sohawa, with estimated populations of 10 and 8 birds, respectively. Other sites showed no presence of Great Barbets.

Great barbetperforms roosting as alone or may be in groups or pairs. They spend a long duration of day in roosting. Young individuals do roosting with their parents and get protection by parents. Usually, they are associated in pairs in whole summer season but they become solitary when feeding, fairly secretive, through repeatedly heard, difficult to see or observe, their green color and plumage become well blending with tree foliage (BirdLife-International, 2018).

Table 4: Population distribution and estimates on Great barbet in different localities of Margalla Hills National Park 2022-2023.

Localities	Area km^2	Number of birds observed	Density per km^2	Total area (Km^2)	Estimated population
Shahdara	2	0	0	15	0
Ramli	2	0	0	12	0
Daman-e-koh	2	0	0	20	0
Talhar	2	4	2	5	10
Trail 4	2	0	0	8	0
Rawal lake	2	0	0	8.8	0
Dara janglan	2	0	0	5	0
Pirsohawa	2	4	2	4	8
Trail 7	2	0	0	5	0
Jabbi	2	0	0	7.2	0
Said pur	2	0	0	6	0
Shah Allah dita	2	0	0	12	0
Total	24	8	0.33	108	36

NEST CHARACTERISTICS

In this study, most of the coppersmith barbet nests were found near trails, pathways, buildings, roads, and picnic points. The nests were made in tree trunks, which are usually dead and soft. The average nest size was 2.5 inches (Table 5). The shape of the nest was oval. The mean tree height on which nests were constructed was 13.14 feet, and the average width of the trees was 55.52 inches. The average height of the nest in the tree was 10.21 feet from the ground; they mostly build their nests on paper mulberry trees. Nesting material included dry grass, pine needles, leaves, and plastic and cloth were also observed. It was almost the same in all the observed nests. Their average clutch size was 2.5 (range: 2-3), and the average number of chicks was 1.58 (range: 1-2). This species is found in deciduous shrub forests, near water bodies, as well as picnic spots and areas with human activities. Out of 12 observed nests, 9 were found on paper mulberry species, and 3 were found on Ficus trees. Robert (1991) reported the height of the nest of the coppersmith barbet as 7-15m and a clutch size of 3 eggs, with occasionally 4 eggs. The incubation period is believed to be 14 days, and the fledging period is almost 35 days.

In this study, blue-throated barbet nests were found in deciduous shrub forests, near trails, pathways, water sources, and areas with moderate anthropogenic activities. The nests were made in dead and soft tree trunks; the average nest size was 3 inches (Table 5). The shape of the nests was oval. The mean tree height on which nests were constructed was 11.49 feet, and the average width of the trees was 57 inches. The average height of the nest on the tree was 8.72 feet from the ground. They mostly build their nests on paper mulberry, banyan trees, fig trees, and lebbek trees. Nesting material was found to be dry grass, pine needles, leaves, and plastic. Nesting material was almost similar in all nests. Their average clutch size was 2.5 (range: 2-3), and the average number of chicks hatching was 1.41 (range: 1-2). Robert (1991) reported a clutch size of 3 to 4 eggs of the blue-throated barbet, which are oval-shaped. The incubation period is about 2 weeks, and both parents contribute to nest construction and bringing food for the young ones.

Two nests of great barbets were found at PirSohawa on a tall dead tree; their average nest size was 3.3 inches. Two nests were found at Talhar on tall pine trees. The shape of the nests was oval. The average tree height was 22.5 feet, and the average nest location on the tree was at 13 feet, with a tree width of 58 inches (Table 5). The favored tree preferred by great barbets was pine trees, and the nesting material consisted of grass, pine needles, and dry leaves. The average clutch size was 1 to 2, and the chicks' range was also from 1 to 2. Robert (1991) reported that the great barbet has a clutch size of three eggs, with incubation periods believed to be 13-15 days, and a fledging period of 38 days, which is slightly longer than those of the other two species of barbets. Both parents carried food for the young ones.

The present study observed that the Great Barbet prefers to nest in taller trees compared to the other two species (Table 5). The average height of the nest from the ground is also greater for the Great Barbet. Additionally, the hatching success rate for the Great Barbet was higher as 75%, followed by the Coppersmith 63.3% and the Blue-throated Barbet 56.65%. All three species used the same nesting materials, but the entrance size of the cavity was slightly larger for the Great Barbet, followed by the Blue-throated and Coppersmith Barbets.

The eggs of all species were oval-shaped and whitish in color. The average clutch size for barbets was three eggs (BirdLife-International, 2018; Joshi and Bhatnagar, 2018; BirdLife-International, 2024b,a). The nest tunnel ends in a distended, unlined chamber that may extend 20 to 40 centimeters down from the branch of the nesting tree. The nest opening measured between 2.5 inches and 3 inches. They primarily excavate in dead or decaying wood, and the nesting cavity features a remarkably small orifice measuring 7 centimeters in diameter. The clutch size for Coppersmith (BirdLife-International, 2024b) and Blue-throated Barbets (BirdLife-International, 2024a) typically ranges from 3 to 4 eggs. The number of chicks per nest for these barbet species ranged from 1 to 2.

Table 5: Nest characteristics of Blue throated, Coppersmith and Great barbet

Characteristics	Blue-throated barbet	Coppersmith barbet	Great barbet
No of active nests	12	12	4
Mean size of the nest	3.0	2.5	3.3
Shape of the nest	Oval	Oval	Oval
Mean height of the nest on the tree (Feet)	8.72	10.21	13
Mean height of the tree (Feet)	11.49	13.14	22.5
Mean stem width (inches)	57	55.52	58
Mean distance of nest from water source (m)	14.4	7.50	8.75
Average tree no around 100 m of nest 3.1 ha	35.4	32.91	34.75
No of total eggs	30	30	8
Mean clutch size	2.5	2.5	2
No of eggs hatched	17	19	6
Hatching percentage	56.6	63.3	75
Nesting material	Grass, pine needles, dry leaves, plastic, cloth	Grass, pine needles, dry leaves, cloth	Grass, pine needles, dry leaves

In the present study of the breeding biology of barbet species, it was found that the breeding season starts in early March for the coppersmith and blue-throated barbets, but in the great barbet, it starts in early April. The excavation process lasted for 7 days in the coppersmith barbet, followed by 6 days in the blue-throated barbet, and9 days in the great barbet, which had the highest excavation rate. The incubation process was 16 days for the coppersmith barbet, while it was 15 days for both the blue-throated and great barbets. After hatching, the next step was the fledging of the young, which occurred in July for the coppersmith and blue-throated barbets, and in August for the great barbet. Fledging requires 38 days for the coppersmith barbet, followed by 36 days

for the blue-throated barbet and 39 days for the great barbet (Table 6). Mostly, the blue-throated barbet starts nesting in April and lays eggs in May. The incubation period for coppersmith barbets is known tobe 2 weeks during April-May (Fleming et al., 1976). The great barbet initiates nesting in April, and the young can fly in late August (Grimmett et al., 2008). The incubation period for barbets is 13 to 15 days, and the fledging period for barbets is approximately 38 days.

Table 6: Breeding biology of barbet species in Margalla Hills National Park

Breeding biology	Coppersmith barbet	Blue throated barbet	Great barbet
Start of breeding season	March	March	April
Excavation process	7 days	6 days	9 days
Incubation	16 days	15 days	15 days

CONCLUSION

There are three barbet species present in MHNP, Islamabad: the Coppersmith barbet, the Blue throated barbet, and the Great barbet. These are cavity-nesting birds. The Coppersmith barbet prefers populated areas as its habitat, while the Blue throated and Great barbets prefer intact forests. Their reproductive period is from March to June.

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Authors' contributions:Sheraz has designed this project, Nadeem has supervised, while Sheraz, Kayani, Hadi and Ali have collected data and written this article; andfinalyNaddem and Mahmoodhave have critically analyzed this article and approved as final.