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Nesting sites and dietary choices of Indian grey hornbills *Ocyceros birostris* in urban area, Amravati city, Maharashtra, India

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Abstract
The Indian Grey Hornbill (*Ocyceros birostris*) is a common resident species of hornbill in the Indian subcontinent and is well adapted to urban landscapes. In comparison to other hornbill species in the central Indian landscape, the Indian Grey Hornbill is frequently observed in urban areas. This study aimed to investigate the nest site selection, and dietary preferences of Indian Grey hornbills in urban environments.

This study was conducted from 2014 to 2025 in wooded green spaces in Amravati City, Maharashtra, India. Observations were made opportunistically during the morning (06:00-10:00) and evening (04:00-6:00) hours. Six nests of Indian Grey Hornbills were recorded in the Wadali Old and New Garden and its surrounding areas, out of the 19 sampling sites in the city. Five of these nests were located in the cavities of indigenous tree species, whereas one was located in an exotic species. During the breeding season, hornbills preferred fruits from indigenous plantsand also preferred animal matter diet. Nesting was predominantly observed in indigenous species of trees such as *Bombax ceiba, Albizia lebbeck, Millettia pinnata, Azadirachta indica, Erythrina variegata, Mangifera indica* rather than in exotic species. The sightings of Indian Gray Hornbills were consistent throughout the year, with a preference for green spaces and safe areas for nesting and roosting, such as government office Campuses, public parks, university campus, and educational institutions Campus, likely because of reduced disturbances and the presence of old trees.

This study highlights the importance of green spaces in urban area as suitable habitats for Indian gray hornbills, with indigenous tree species being preferred for successful nesting. Therefore, planting more trees belonging to indigenous species is recommended to conserve the Indian Grey Hornbills in urban habitats.

Keywords: Indian Grey Hornbill, *Ocyceros birostris*, Urban landscape, Green spaces, Amravati City, Maharashtra, India

Introduction

Among the nine-hornbill species found in the Indian subcontinent, the Indian Grey Hornbill is a resident of this region (Ali and Ripley, 1987; Rasmussen and Anderton, 2012) [32]. The Indian Grey Hornbill is classified as a species of 'Least Concern' (LC) on the IUCN Red List 2025. It can be found in a range of habitats, including forests, woodlands, scrublands, and rural and urban areas, with substantial tree cover (Grimmett *et al*., 2011) [20]. It has also adapted to the agricultural landscapes of India (Kinnaird *et al*., 2007) [28]. Although it is adapted to the urban environment, it is more commonly observed in urban areas than other hornbill species that inhabit the central Indian landscape (Gopi *et al*., (2011) [19].

Interestingly, the Indian Grey Hornbill is the only hornbill that has been reported in gardens, parks, and forest patches within cities in India, such as Delhi, Mumbai, Pune, Bangalore, Lucknow, and Kanpur, highlighting the importance of these green spaces in the Indian Grey Hornbill populations in urban areas (Datta *et al*., 2018) [11, 12].

The Green spaces have been recognized as important elements in cities with a positive influence on both people and avian populations (Chiesura, A. (2004) [9]. Green spaces in cities increase human well-being and quality of life and provide a place for direct interaction with nature (Wolch *et al.*, (2014) [39]. Urbanization has become a global phenomenon, with cities expanding and encroaching on their natural habitats (McKinney *et al*. 2008) [30]. Rapid urban

sprawl poses many challenges to wildlife, causing habitat loss and fragmentation (Sala *et al.*, 2000) [33]. However, amid jungles and bustling streets, hope exists in the form of urban green spaces. These pockets of nature can serve as sanctuaries when properly managed and conserved, offering refuge to various species, including the Indian Grey Hornbill. Amravati, a city in Maharashtra, India, showcases both the pace of urban development and the potential for harmonious coexistence between urban life and bird conservation. Indian Grey Hornbill, known for its presence in other big cities in India, has found such green spaces in this expanding city of Amravati's in the scattered green spaces.

Indian Grey Hornbill was reported to breed successfully in a cavity in a concrete wall and also recorded feeding bread, biscuits, and rotis (Indian wheat bread) to the incarcerated female and chicks in the nest (Gadikar 2023) [40].

There are studies on the status and distribution of the Indian Grey Hornbill (Ali & Ripley, 1987; Rasmussen & Anderton, 2012 [32]; Datta *et al*., 2018) [11, 12], but scanty information is available about the feeding and breeding ecology of the species in urban areas (Singh, 2003 [35, 36]; Charde and Kasambe 2011 [6, 24]; Gadikar 2017 [15]; Borode et.al. 2024) [5]. Hence, this study was conducted to highlight the nesting and feeding of the Indian Grey Hornbill within the wooded green spaces of Amravati city while highlighting the importance of these green spaces as suitable habitats for the species here.

Material and methods

Study Area

Amravati is the second-largest city in the Vidarbha region and the ninth-largest city in central Indi, constituted the study areaa. Amravati City, which is the district's administrative headquarters, lies at a latitude of 20° 56′ north and a longitude of 77° 45′ east (Kathe *et al*., 2024) [25] (Map). It has an average elevation of 343 m (1125 feet). It lies 156 km (97 mi) west of Nagpur and serves as the administrative centre of the Amravati District and Amravati Division. The city is located near the passes through the hills that separate the cotton-growing regions of the Purna Basin to the west and the Wardha Basin to the east. The land area of the city was approximately 183.5 km2.This green space represents a valuable microcosm for urban biodiversity and serves as a habitat for various flora and fauna (Tiwari, & Joshi, 2016) [37].

Amravati has a tropical wet and dry climate with hot, dry summers and mild to cool winters. Summer lasts from March to June, the monsoon season from July to October, and winter from November to February. The average rainfall is 800-1000 mm. The average temperature of the district ranges from a minimum of 10 °C in winter to a maximum of 42 °C in summer, with humidity ranges from to 10-15% to 60-95%. The highest and lowest temperatures ever recorded were and, respectively (Wagh *et al*., 2017) [22].

One of the important green spaces in Amravati is a city garden, namely, Wadali Garden, divided into old and new parts and its adjoining area, located eastern to the city of Amravati, was an important observation site during the study period. Wadali Talao is a water reservoir adjacent to the garden, built on the Amravati-Chandur Railway Road, and is just 3 km away from Amravati city (Fig.1).

Monitoring and Data Analysis: This study was conducted from 2014 to 2025 in 19 wooded green spaces in Amravati City. The point count method was usedat random sampling points in the selected19 potential green spaces twice per month (Table 3). Visual scanning was employed as the primary observation method during point counts. The number of Indian Grey Hornbills were identified and recorded using binoculars. Observations were also recorded about the food preferences of the Indian Grey Hornbill during both the breeding season (March to July) and the non-breeding season (August to February).

To document the nesting ecology of Indian Grey Hornbills, systematically recorded the details of each nest site. This included identifying the tree species, common name, tree condition, tree height, measuring girth at breast height, distance from the nearest water body using a laser tape, and noting the orientation of the nest entrance with a compass. The nest architecture, including cavity dimensions and entrance size, was also documented using photographs. Breeding success was monitored through regular observations throughout the breeding season to ensure minimal disturbance. Success was defined as the presence of at least one fledgling, whereas failure was noted if no chicks were fledged. The number of chicks that were fledged was counted by recording the data in detailed field notes. The study area map was constructed using the QGIS version 3.26.3-Buenos Aires.

Map showing the study area

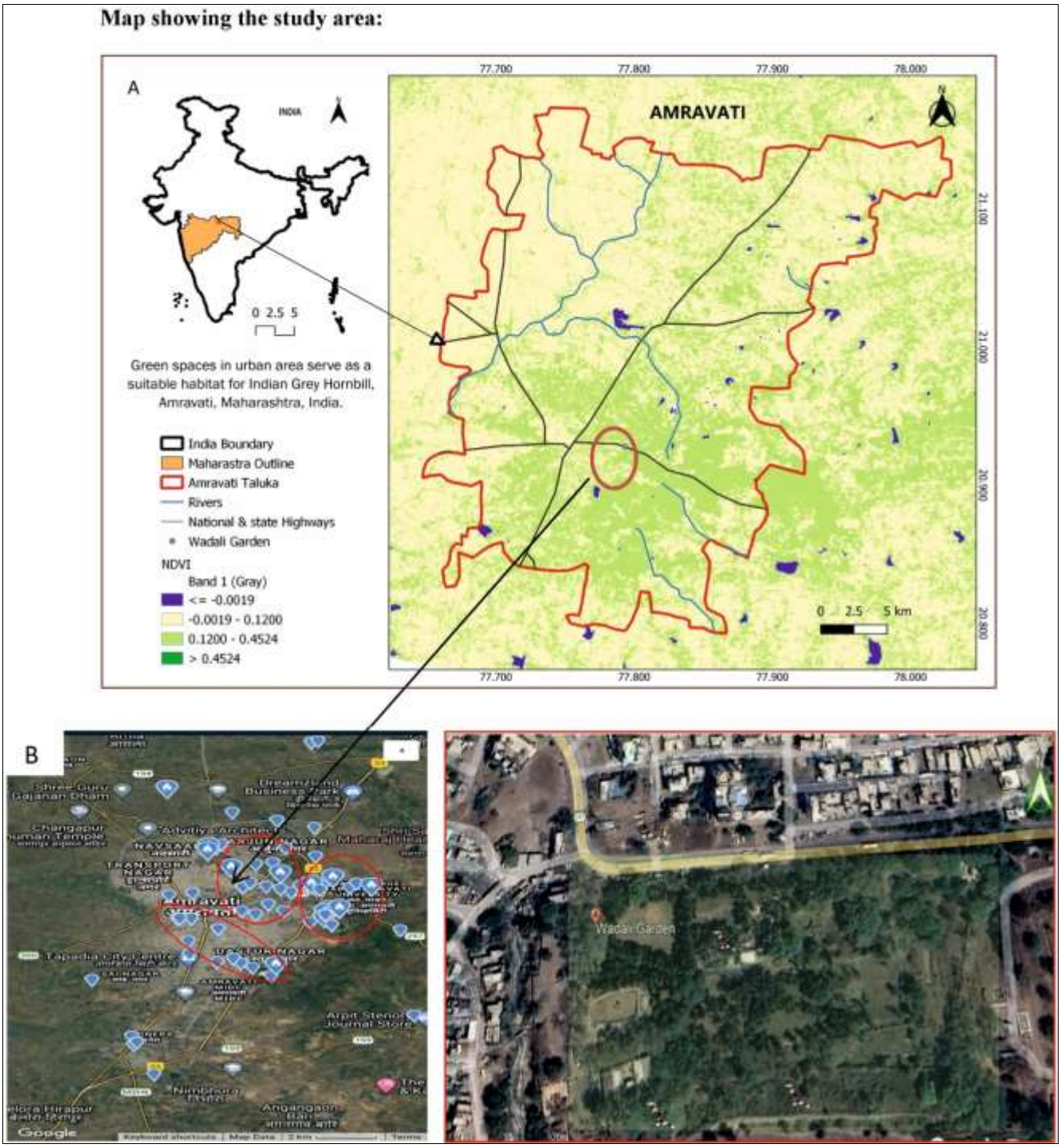

Fig 1: A) Map showing wooded green spaces in Amravati city, Maharashtra, India B) Satellite map showing random sampling point with in the Wadali Garden (old and new).

Results

Surveys conducted in19 wooded green areas within Amravati City recorded a total population of 41Indian Grey Hornbills. The highest IGH population (7 individuals) was recorded at Shivneri Colony, Jail Road. Moderate populations (2-4 birds) were found in Wadali Garden, Bamboo Garden, SGBAU campus, and Circuit House area. Minimal populations (1 individual) were observed in fragmented or isolated spaces such as Oxygen Park, RTO Office, and Lokhande Layout. The presence of IGHs in 17 of 19 surveyed areas (89.5%) highlights their urban adaptability and the importance of green spaces.

Six nests of Indian Grey Hornbills were consistently observed each year within the green spaces of old and new Wadali Garden and its adjoining area in Amravati City. Of these, five nests were located in the cavities of indigenous tree species, whereas one was found in an exotic species. The data indicated a clear preference for indigenous plant species, such as, *Albizia lebbeck, Azadirachta indica,Mangifera indica* and *Millingtonia hortensis*, over exotic species (*Spathodea campanulata*) for successful nesting. Tree height ranged from 6.57 m to 12.3 m, while girth at breast height ranged from 1.5 m to 3.49 m.All trees were in live conditionaccept one and were located 68-213 meters away from the nearest water body.(Table 1andPlate 1). Of the recorded nests, six hornbill chicks were successfully fledged. This success was confirmed by detailed field notes, in which at least one fledgling was observed per successful nest, indicating effective nesting and

chick rearing during the study period.

Food items consumed by the Indian Grey Hornbill were documented during the breeding season (March to July) and the non-breeding season (August to February), allowing for a comparison of their diets across different periods of the year. Indian Grey Hornbills were observed feeding on a variety of fruiting trees, comprising both *Ficus* and *non-Ficus* species. Ficus species formed a major dietary component, including *Ficus benghalensis* (Banyan), *F. religiosa* (Peepal), *F. racemosa* (Cluster Fig), *F. variegata* (Pakhad), and *F. hispida (Katumbar)*. Among non-Ficus fruiting trees, Jamun (*Syzygium cumini*), Khirni (*Manilkara hexandra*), and Putranjiva (*Putranjiva roxburghii*) were frequently consumed. Pods of exotic tree *Pithecellobium dulce* (Vilayati Chinch) was also noted in the diet. This indicates a broad frugivorous diet, with a strong preference for native fig species (Plates 2 and 3).

We also observed animal matter in the diet of Indian Grey Hornbills, including insects from various orders such as Mantodea (mantises), Orthoptera (grasshoppers), Odonata (dragonflies), Coleoptera (beetles), and Lepidoptera (caterpillars). Additionally, a few reptile species from the orders Squamata (lizards) and Gekkonidae (geckos) was observed in their diets. During 2023, an unusual feeding behavior was observed in Indian Grey Hornbills, where adult male hornbills was recorded delivering pieces of chapatis (Indian flatbread) to their female and chicks, suggesting omnivorous foraging behavior supplementing their frugivory (Tables 2; Plate 4 and 3).

Discussion

The Indian Grey Hornbill was observed throughout the year in the green spaces of Amravati City, demonstrating a preference for urban areas characterized by the presence of indigenous old-growth trees and minimal human disturbance. These birds predominantly utilized areas such as government offices campus, university campus, public parks, and educational institute premises for nesting, roosting, and foraging where old trees are found in good numbers. Such locations offer relatively safer and undisturbed microhabitats within urban environments, which are crucial for their reproductive success and survival (Khera *et al*. 2009) [27].

However, signs of urban-induced stress are becoming apparent. Of the six nests recorded in the study area, three nests were inactive over the past two breeding seasons. This inactivity may be attributed to increased anthropogenic disturbances and habitat modification in the vicinity of the nesting sites. Similar trends have been noted in urban avifaunal studies, where the size and quality of green spaces significantly influence bird richness and activity (Gavareski 1976 [17]; Garaffa *et al*. 2009 [16]; Khera *et al*. 2009) [27]. These findings suggest that not only the presence of green cover but also its size, native composition, and connectivity are critical determinants in supporting urban hornbill populations.

The species' nesting preferences align with those reported in earlier works. Indian Grey Hornbills were observed to exclusively use cavities in live trees for nesting, mirroring the cavity selection behavior reported by Mudappa and Kannan (1997) [31] for the Malabar Grey Hornbill and by Datta and Rawat (2004) [10] for other large forest hornbills such as the Great Hornbill (*Buceros bicornis*), Wreathed Hornbill (*Aceros undulatus*), and Oriental Pied Hornbill (*Anthracoceros albirostris*). Nest-site fidelity in hornbills is well documented, with many species returning to the same cavity over successive years (Kemp 1995) [26], a behaviour also observed in the current study.

The breeding success of Indian Grey Hornbills is closely linked to habitat quality and availability of safe and suitable nesting trees with nesting cavities. In urban and semi-urban areas, hornbills show strong nest-site fidelity, often reusing the same tree cavities each year (Kemp 1995) [26]. Long-term observations in Indore have shown consistent breeding success, including in artificial cavities like concrete wall holes, with fledging rates comparable to natural sites (Gadikar 2024) [14]. However, a decline in active nests in some areas, likely due to habitat disturbance, suggests that even adaptable species like *O. birostris* require stable, tree-rich environments for successful breeding. Ensuring the protection of mature trees in cities and minimizing urban pressures is therefore vital for sustaining their breeding populations.

During this study, the male Indian Grey Hornbill was documented delivering pieces of Chapati (Indian Wheat flatbread) to the female and its chicks during the breeding season (Plate 5). This is a notable behavioural adaptation documented in urban populations of *Indian Grey Hornbills*. Recent studies, including a long-term monitoring project in Indore, Madhya Pradesh, revealed adult hornbills provisioning their chicks with human-derived food items such as pieces of roti (Indian bread) and biscuits. This feeding behaviour, captured via CCTV at nest sites over multiple breeding seasons, indicates a significant dietary shift, likely in response to the scarcity of native fruiting trees such as *Ficus religiosa* and *Ficus benghalensis* or the easy availability of the *rotis*. While this behaviour highlights the hornbill's dietary flexibility and resilience in urban ecosystems, it also raises concerns regarding the nutritional adequacy of processed foods for the growing chicks. The potential health implications of these dietary changes underscore the need for further investigation (Gadikar 2024) [14].

These findings collectively underscore the importance of maintaining and restoring native vegetation in urban landscapes. The replacement of native fruit-bearing trees with exotic or ornamental species, coupled with increasing human encroachment, threatens the ecological balance required for species like the Indian Grey Hornbill to thrive. Conservation efforts must emphasize sustainable urban planning that integrates biodiversity conservation, particularly by preferential planting of native fruiting trees, preserving mature native trees and minimizing disturbances in green spaces (Santhoshkumar and Balasubramanian 2015 [34]; Kasambe *et al*. 2011) [24].

Plate 1: IGHN1-6 nests IGHlocated in thewooded green spaces in Amravati city

Plate 2: (Image E-F) The Indian Grey hornbill providing plant-based food to incarcerated female and its chick at nesting sites.

Plate 3: Photographic documentation (Image G-R) of the Indian Grey Hornbill Provisioning animal matter diet to incarcerated female and its chicks at nest.

Plate 4: (Image S, T, U) Indian Grey Hornbill with a piece of dry Chapati (Wheat Flat bread) at the IGHN1 Nest.

Table 1: Characteristics of nesting trees with GPS locations of nests of Indian Grey Hornbill in urban green spaces of Amravati City.

Variables	IGHN 1	IGHN 2	IGHN 3	IGHN 4	IGHN5	IGHN6
Trees Family	Bignoniaceae	Fabaceae	Bignoniaceae	Meliaceae	Fabaceae	Anacardiaceae
Trees Name	*Millingtonia hortensis*	*Albizia lebbeck*	*Spathodea campanulata*	*Azadirachta indica*	*Albizia lebbeck*	*Mangifera indica*
Trees Common name	Indian Cork Tree	Indian Siris	African Tulip Tree	Neem	Indian Siris	Mango tree
Trees status	Live	Live	Live	Live	Dry	Live
Nest height	6.70m	6.57m	7.62m	6.7m	7.1m	11.3m
Girth at Breast height (GBH)	1.6m	1.73m	1.55m	1.98m	1.69m	4.49m
Distance from nearest water source	213m	75m	113m	68m	150m	100m
Orientation of nests	SE119°	SW218°	SE157°	S190°	SW238°	E180°
GPS Location	N 20°92′84″ E 77°79′31″	N 20°55′46″ E 77°47′16″	N 20°55′39″ E 77°47′37″	N 20°92′71″ E 77°79′36″	N 20°92′16″ E 77°79′52″	N 20°91′89″ E 77°79′27″
Tree origin	Indigenous	Indigenous	Exotic	Indigenous	Indigenous	Indigenous

*IGH- Indian Grey Hornbill, IGHN- Indian Grey Hornbill Nest.

Table 2: Plant-based (Ficus and Non-Ficus), animal matter, and unusual dietary components recorded in the diet of Indian Grey Hornbill in urban green spacesof Amravati city.

Plant based diet (Ficus and Non-Ficus).		
Sr. no.	**Common Name**	**Scientific Name**
1	Banyan	*Ficus benghalansis*
2	Peepal	*Ficus religiosa*
3	Cluster Fig	*Ficus recemosa*
4	Pakhad	*Ficus variegata*
5	Jamun	*Syzygium cumini*
6	Khirni	*Manilkara hexandra*
7	Putranjiva	*Putranjiva roxburghii*
8	Indian Sandalwood	*Santalum album*
9	Vilayati Chinch	*Pithecellobium dulce*
10	Kathumbar	*Ficus hispida*
Animal matter diet		
1	Insects	Mantis (Family Mantidae)
2		Grasshoppers (Family Acrididae)
3		Dragonflies (Sunorder Anisoptera)
4		Beetles (Family Coleoptera)
5		Caterpillars (Family Lepidoptera)
6	Reptiles	Garden Lizard (*Calotes versicolor*)
7		Gecko (Family Gekkonidae)
8		Skink (FamilyScincidae)
Unusual diet		
9	Dry chapatti (Indian Wheat Flat bread)	

Table 3: Wooded Green spaces in Amravati City with survey locations and Indian Grey Hornbill Count.

Sr. No.	Wooded Green Spaces in Amravati City included in the study	Survey stations Coordinates	Average Population
1	Wadali Garden Old	20° 55.68' N, 77° 47.58' E	4
2	Bamboo Garden Amravati	20° 55.08' N, 77° 47.64' E	3
3	Sant Gadge Baba university	20° 56.16' N, 77° 48.30' E	3
4	Government Vidarbha institute of Science and Humanities (GVISH)	20° 57.06' N, 77° 45.30' E	2
5	Government College of Engineering, Amravati	20° 57.60' N, 77° 35.40' E	3
6	Shri Shivaji college of Agricultural biotechnology, Amravati	20° 56' 21" N, 77° 46' 1" E	1
7	Shri Shivaji Science College, Amravati	20° 56' 20" N, 77° 45' 0" E	1
8	Circuit House,Camp Road, Amravati	20° 56' 31" N, 77° 48' 0" E	2
9	Maltekdi area, Amravati	20° 55' 44" N, 77° 46' 23" E	1
10	Chhatri lake area, Amravati	20° 53' 53" N, 77° 46' 37" E	2
11	Lokhande Layout Near Rahatgaon, Amravti	20° 58' 41" N, 77° 45' 54" E	1
12	Vidyapith Colony, MIDC road	20° 53' 53" N, 77° 38' 24" E	2
13	District court, Amravati	20° 56' 10" N, 77° 46' 44" E	2
14	Shivneri Colony, Jail road, Amravati	20° 56' 10" N, 77° 47' 2" E	7
15	Oxygen Park area, Amravati	20° 55' 30" N, 77° 46' 48" E	1
16	District Collector Quarters area, Amravati	20° 56' 49" N, 77° 46' 48" E	1
17	RTO office area, Amravati	20° 56' 28" N, 77° 46' 41" E	1
18	VYWS Dental College and Hospital, Amravati	20° 56' 02" N, 77° 47' 28" E	2
19	Other green Spaces in Amravati	-	2

Conclusion

The resent study revealed that green spaces serve as suitable habitats for Indian Grey Hornbill. Because of the presence of old and indigenous tree species like *Albizia lebbeck*, *Azadirachta indica*, *Mangifera indica*being preferred for successful nesting, Trees of fig species like *Ficus benghalansis*, *Ficus sreligiosa*, *Ficus recemosa*, and *Ficus variegata*, as well as non-fig species like *Syzygium cumini*, *Manilkara hexandra*, *Putranjiva roxburghii*, and *Pithecellobium dulce*, *Santalum album* are preferred for

feeding. Hence, more indigenous plant species are needed for the conservation of Indian Grey Hornbill and other frugivore bird species in urban habitats.

The data will guide urban planners and policymakers to incorporate preferred indigenous tree species into green spaces to support the Indian Grey Hornbill habitat and enhance overall avian biodiversity. This informed approach aids in developing conservation strategies, raising public awareness, formulating policies for sustainable urban ecosystems, and enhancing the ecological value of green spaces in urban areas.

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Conflict of interest

The author declares that there is no Conflict of Interest.

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