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Nesting pattern of *Apis dorsata* F. in urban Nagpur. Maharashtra, India

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ABSTRACT: The purpose of this research was to examine the *Apis dorsata* distribution and nesting habits in urban Nagpur. According to the findings, there were about 75 nests in urban Nagpur. Among these 73 per cent were active nests and 21 per cent were abandoned nests. The nesting preference was found to be among the tall building (60%). Out of these nests, 30 per cent were found shielded from the rain and wind, 57 per cent exposed and 13 per cent partially protected. It was noted that the *A. dorsata*'s habit of building nests was unaffected by the existence of a nearby body of water, as most of the nests were located away from the waterbody.

KEY WORDS: Apini, giant honey bee, rock bee, nests characteristics, nest site preferences, honey bee nests

INTRODUCTION

The members of family Apidae, subfamily Apinae is distinguished in four tribes: Euglossini, Bombini, Meliponini, and Apini (Michener, 2000). Generally, members of the *Apis* genus make up the Apini tribe. The *Apis dorsata* F. of the Apini tribe is also known as the Asian gigantic honeybee, is often found on a range of structures, including towering trees, buildings, rock cliffs, water tanks, and flyovers (Hepburn *et al.,* 2014; Nagaraja 2012; Jerzy Woyke *et al.,* 2012a). Due to migratory behaviour, whenever the environment and floral supplies are favourable, *A. dorsata*, return to its former nesting location (Koeniger and Koeniger, 1980; Neumann *et al.,* 2000; Reddy and Reddy, 1993). Bee colonies appear to be immune to natural diseases and pests due to their yearly migrations, which occur at least twice per year (Liu *et al.,* 2007; Nagaraja and Rajagopal, 2019). The availability of food sources and favourable nesting conditions help the survival of bee colonies in their natural habitat. It also gets its sustenance from nearby farms and wild vegetation (Bawa, 1990; Kahono *et al.,* 1999). Prior studies have examined *A. dorsata* nesting habits in the tropical regions of southeast and south-east Asia (Liu *et al.,* 2007; Neupane *et al.,* 2013; Roy *et al.,* 2011; Ruttner, 2013; Jerzy Woyke *et al.,* 2012a; Jerzy Woyke *et al.,* 2012b; Jerzy Woyke *et al.,* 2016a; Jerzy Woyke *et al.,* 2016b). The study on the nesting behaviour of *A. dorsata* in Urban area of Nagpur was undertaken. Furthermore, also to investigate the impact of urbanization on the nesting pattern of Asian giant honeybees, as well as the key factors determining their nesting preferences.

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MATERIALS AND METHODS

Nagpur City is the state capital, following Mumbai. Its ecosystem is composed of the dry deciduous forest type and tropical dry vegetation (Raut *et al.,* 2022). Known as the geographic centre of the country, it is the third largest city in Maharashtra and the 13th largest urban accumulation in India (Dhyani *et al.,* 2018). Gardens and parks account for 8% of the city's total land area, based on the land use pattern of the city (Dhyani *et al.,* 2021). The natural topography that originally served as the city's limit is now inside the municipal boundaries as a result of recent socioeconomic developments, urbanization, population increase, and administrative boundary expansion (Lahoti *et al.,* 2019). The study was conducted in Nagpur's urban area. The survey method was used to investigate the factors that influence nest distribution and the circumstances surrounding the nests. In addition, a convenient method was employed to track *A. dorsata* nests in metropolitan areas. The following criteria were investigated to better understand the nesting pattern: the nest's state, the substrate to which it was connected, the arrangement of the nest, the presence of a water source near the nest, the number of nests present at one site, the height of the nest from the ground, and site selection. The Epicollect5 app was used to document these traits as well as the nest locations.

The data was downloaded from the Epicollect5 website in 'CSV' format for processing. From January to December 2023, a total of around 75 nests were seen. The average time spent on the observation was three hours. The CSV dataset was uploaded to Google Earth to obtain a GPS map of the nest distribution in the metropolitan region. A pie chart and clustered column charts were used to conduct fundamental analysis of the nests' properties and the factors driving their distribution in Microsoft Excel.

RESULTS AND DISCUSSION

Distribution of nesting site: From 2023 to the present, 75 *Apis dorsata* nests were detected in Nagpur's metropolitan area. The pin on the map reflect the nest locations in Nagpur's urban area (Fig. 1). The *A. dorsata* nest distribution was uneven, clustered, and distributed over the metropolitan region.

Characteristics of Nests sites: The nests of *A. dorsata* were classified as abandoned, active, or damaged based on their status. Around 73 per cent nests were active and in good shape, with unaffected combs and a solid construction. Twenty one per cent nests were dry, discolored, with hollow chambers, and devoid of bees, hence the name abandoned nests. Damaged nests were those that were damaged, infested, or loosely attached. Some sites had both active and damaged nests.

The surfaces to which the nests connected were classified according to the substrate, which included concrete, wood, metal surfaces and granite. *A. dorsata* indicated that concrete was the preferred substrate. Approximately 90.54 per cent nests were affixed to concrete, with only one attached to granite. The wood and metal had 4.05 and 2.70 per cent nest, respectively.

The arrangement of *A. dorsata* nests to guard against external factors such as gusts of high wind, rainfall, storms, and bright sunlight was also investigated. Nests that were protected by trees, walls, pillars, or other structures were designated as protected on the basis of coverage from the four sides i.e. front, back and both sides. Nests that were covered on three or all sides were classed as protected nest arrangement. Approximately 29.73 per cent of the nests were built in a protected manner. Similarly, nests which were protected by two sides were classed as semi-protected and the nest which were open and not covered from any sides are noted as unprotected. Under unprotected there were 56.76 per cent, whereas in semi-protected it was 13.51 per cent. *A. dorsata* selected nesting sites that include buildings, a metro line, a water tank, and trees. Buildings are the most common (60.81%), followed by metro lines (28.38%) and the trees and water tank least chosen (5.41%).

Some nest locations contain more than one nest. There were 14 sites with two nests next to each other, 57 sites with only one nest, and three sites

with three or more nests. *A. dorsata* nests have varying heights from ground level. The heights were measured by the floors of the buildings (approx. 9 ft) and the Haga altimeter. There were 26 nests found at an altitude of more than 40 feet, 12 nests at an altitude of more than 60 feet, and four nests at more than 20 feet, 80 feet, and 90 feet. Nine nests were discovered at both 50 and 70 feet. The lowest nests, six in number, were found at more than 20 feet.

In the study of water body near the nesting site, showed that 63.51 per cent of nests were established with no water body nearby and 36.49 per cent were built near a water body. In addition, the nesting direction was investigated. The nests directions also differed. Out of 75 nests, 28 are in the east, four in the west, and nine and fifteen in the south and north, respectively. Three nests were found in the northeast and northwest, while 7 and 5 nests were found in the southeast and southwest directions.

The current study presents a fresh direct calculation of the *A. dorsata* nest distribution and effect of external influences on the nesting pattern of the bees. *A. dorsata* colonies were discovered to be establishing nests on multi-story structures and metro lines. The study's findings revealed a variation in nest site selection and a preference for building and metro lines as nest construction sites. As in wild *A. dorsata* prefer tall trees and rocks for nesting however due to the scarcity of tall rocks and deforestation in urban area they have adapted to preferring concrete as their nesting base. The increasing predilection for buildings and metro lines as nesting sites can be attributed to the number of suitable locations. This is supported by Nagaraja (2017), that buildings are the favoured nesting sites in Bengaluru's metropolitan areas. *A. dorsata* never built nests on ancient structures, weak branches, or dead trees because it was not robust enough to hold the weight of the nest (Neupane *et al.,* 2013).

The placement of the nests suggested that they were constructed in an unprotected setting rather than a protected and subsequently semi-protected environment. It was discovered that as *A. dorsata* adapted to the urban environment, bees were driven to make nests in relatively vulnerable locations. This layout made the nests vulnerable to the wind, severe rains, and sunshine. Sattigi and Kulkarni (2001) found that appropriate protection from the wind, slashing rains, and sunlight resulted in a greater distribution of nests on buildings in urban areas. Crane (1999) discovered that *A. dorsata* swarms

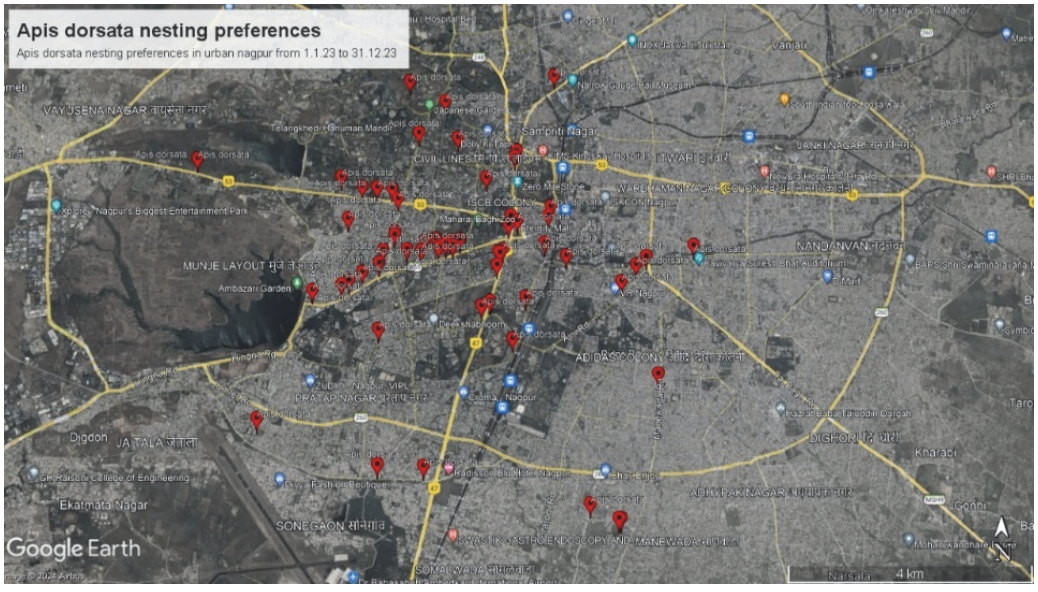

Fig. 1 Distribution of *Apis dorsata* nests in Urban Nagpur

frequently chose nest sites that were partially protected and not immediately exposed to wind currents. In contrast, Starr (1987) found that *A. d. dorsata* prefer to build their nests in open areas and keep them clean with liane plants. Weihmann *et al.* (2014) also revealed that *A. d. dorsata* prefers to build nests in open areas where predators can easily see them.

According to Sharma *et al.* (2015), *A. dorsata* exhibits migratory behaviour. *A. d. dorsata* migrated at least twice per year. It was caused by poor environmental factors, such as weather conditions, limited availability of food, and parasite-eating larvae and pupae (Makinson *et al.,* 2014; Momose *et al.,* 1998; Paar *et al.,* 2004; Rattanawannee and Chanchao, 2011; Sharma *et al.,* 2015; Woyke *et al.,* 2004).

Wild honey bees will return to their old nesting site and establish a nest if the environment is not altered (Neumann *et al.,* 2000). The empty combs provided clues for identifying past nest sites that would be reoccupied by arriving colonies (Thapa, 1998). This is the primary explanation for the abandoned and shattered nest discovered during surveying. The abandoned nests were the result of migratory bees, while the split and damaged ones were caused by honey hunters. There are also sites where there are more than two nests, some of which are abandoned or injured, while others remain active.

A. dorsata favoured a height of 40 feet for making nests. The highest nest was found 120 feet above the ground. Ten percent colonies of *A. d. binghami* were found at the height of less than 10 meter from ground surface and more than 90% nests were within 10 meters height from ground (Nagir *et al.,* 2016). Kahono *et al.,* (1999) also reported that *A. dorsata* nests were discovered at a height of less than 10 meters from the ground surface throughout a two-year period. According to Weihmann *et al.,* (2014), *A. dorsata* prefers lofty trees for nesting. Previous studies also reported that *A. dorsata* prefer areas with a height of more than 10 meters to build nests (Hadisoesilo, 2001; Kahono *et al.,* 1999; Starr, 1987).

All nesting locations were discovered near water sources (Sharma *et al.,* 2015). Water is used to cool the nest on the honeycomb (Ruttner, 2013). It was also discovered that *A. d. binghami* workers were at the closest water source (Nagir *et al.,* 2016). According to H Randall Hepburn and Radloff (2011), the scarcity of water supplies will force bee colonies to relocate. During field observations, it was revealed that the majority of the nests were constructed in the absence of a nearby significant waterbody.

Small sources of water are available in metropolitan areas, making it easier even if there is no presence of a water body as a source of water because modern infrastructure provides a plentiful supply of water. Throughout the survey, it was discovered that nests preferred the East direction for their nesting site, but no clear reason for this preference was identified. In the future, the significance of the direction on the nesting location of *A. dorsata* can be investigated. The results indicated that *A. dorsata* is well distributed in Urban area of Nagpur. The bees have adapted effectively to urbanization and have evolved nesting conditions appropriate for urban areas. The only criterion that was hard to comprehend and interpreted was the orientation of the nesting site. More observation and inquiry are required to better understand the role of nesting orientation in the nesting pattern.

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