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Nesting plants, nesting height selection and bee flora of *Apis dorsata* Fab. (Hymenoptera, Apidae) in selected districts of south Karnataka, India

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ABSTRACT: *Apis dorsata* is well distributed in the Indian subcontinent for rich availability of floral resources along with suitable nesting structures. Nonetheless, the nesting structures and floral resources vary from hilly regions to plains seasonally. Regular field studies were conducted on major nesting plants, nesting height selection, and major bee flora of *A. dorsata* in the plains of South Karnataka, India, during 2021-2024 at fortnight intervals. The results showed that *A. dorsata* selected 12 major plant species for nesting and among them, a few were *Ficus bengalensis, Terminalia arjuna, Delonix regia, F. religiosa, Samanea saman, and Eucalyptus nilgiris*. Furthermore, *A. dorsata* selected heights range between 10 and 20m above ground level for nesting in greater numbers. Similarly, *A. dorsata* workers gathered pollen and nectar from 43 major bee flora in the study regions. The major pollen flora recorded were coconut, mango, papaya, coriander, etc. Similarly, the major nectar flora identified were eucalyptus, pongamia, drumstick, tamarind, and neem. However, acacia, mustard, pigeon pea, lemon, guava, and jamun produced both pollen and nectar for *A. dorsata* colonies. The study concludes that *A. dorsata* is well adapted to the plains of South Karnataka by nesting on suitable tree plant species at an ideal height for the rich availability of floral resources. Nevertheless, nesting structures and floral resources play a crucial role in the successful establishment of *A. dorsata* colonies.

KEY WORDS: Pollination ecology, colony distribution, tree preference, foraging resources

INTRODUCTION

The common giant honey bee, *Apis dorsata*, Fab., constructs large, single-comb open nests typically on tall trees, rocky cliffs, and on man-made structures (Reddy and Reddy, 1993; Nagaraja, 2023). These colonies significantly contribute to the pollination of crops and wild plants, in addition to providing honey and beeswax across South and Southeast Asia (Crane, 1999; Rehel *et al*., 2024). Honeybee swarms generally decide on a new nest site before moving to the chosen site collectively during the swarming period (Beekman and Oldroyd, 2018). The swarms of *A. dorsata* identify suitable nesting sites on the basis of their quality through repeated dances. Nagaraja (2019) recorded a greater number of *A. dorsata* colonies on buildings in urban regions and trees and rock-cliffs in rural regions. In the semi-arid zones of northwest India, *A. dorsata* build nests preferably on trees compared to buildings (Sihag, 2017). Furthermore, in South Sulawesi, Indonesia, the nest distribution

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was non-random, with specific tree species serving as primary nesting sites (Nagir *et al*., 2016). The bee flora is equally crucial for the successful establishment of bee colonies (Aronne *et al*., 2012). Ramyarani and Nagaraja (2024) found a strong association between thorny shrubs for the establishment of *A. florea* colonies in south Karnataka.

The plains of south Karnataka are characterized by diverse agroecosystems and a mosaic of both wild and cultivated flora, which are likely to influence colony distribution (Basavarajappa, 2010). Information on the availability of suitable nesting plants and floral resources in a region is essential for the establishment of bee colonies for honey production and pollination services (Olroyd and Wongsiri, 2006; Sihag, 2025). The present study was aimed to determine the major nesting plants and nesting height of *A. dorsata* in the plains of South Karnataka, India. Furthermore, knowledge on identifying seasonal bee flora in these regions give insights on arrival and establishment of *A. dorsata* colonies in the plains of south Karnataka.

MATERIALS AND METHODS

Study Area: The present study on the nesting ecology of the *A. dorsata* was carried out from January 2021 to December 2024 across three districts of south Karnataka such as Kolar (13° 07' 48.00" N; 78° 07' 48.00" E), Chikkaballapur (13° 33' 0'' N; 77° 52' 12 E), and Bengaluru Rural (12° 15' and 13° 31' N; 77° 04' and 77° 59', E). These districts fall within the southeast dry agro-climatic zone of Karnataka, characterized by predominantly open deciduous vegetation interspersed with cultivated lands. The study area covered three districts with an area of 2.5 km^2 from each district. Each study area was further subdivided in to five equal sized quadrants (Ramyarani and Nagaraja, 2024).

Identification of nesting plants: Field surveys were conducted on the natural population of *A. dorsata* colonies found on various nesting plants at fortnightly intervals throughout the year. The observations were made in each quadrant from four compass points by pairs of observers and recorded the number of colonies found on each nesting structure (Oldroyd *et al*., 1997). Direct visual observations were performed using binoculars to detect nests found at higher heights.

Nesting height: The height of each nest above ground was measured using a laser distance meter (iBELL 40 m range, Nikon model) by fixing the instrument on tripod and switching the button to position laser beam on nesting surface at dim day light, the measurement displayed on digital screen were recorded and verified with selected nests using a theodolite (Saliu *et al*., 2021).

Identification of floral resources: The bee flora of *A. dorsata* was identified by recording flowering plants visited by foragers throughout the day. Observations were carried out at fortnight intervals across all study sites throughout the flowering seasons. The bee flora was collected, photographed, and identified (Gamble, 1967). The bee flora was categorized into pollen flora, nectar flora, and both pollen and nectar flora (Abrol, 2012). The data obtained in the study were subjected to statistical analyses with respect to nesting heights and the preference of nesting plants between the study districts using the Chi-square test. All analyses were performed using SPSS.

RESULTS AND DISCUSSION

Nesting plants: A total of 657 *A. dorsata* colonies were documented across the three districts on 12 nesting plants (Table 1). Among them, the banyan tree was the most preferred nesting plant, hosting 43.6 per cent of colonies, followed by the Arjuna tree (13.1%) and Gulmohar (12.3%) (Plate 1). Other important nesting plants includes rain tree and peepal tree (*Ficus religiosa*) (51 colonies). In contrast, plant species such as coconut, mango, and laurel fig supported very few colonies (<9). The distribution of colonies across tree species and districts was statistically significant ($p< 0.001$), indicating strong association of *A. dorsata* with selected tree species. The observations revealed that the banyan tree in Bengaluru Rural, the arjuna tree in Kolar, and the gulmohar in Chikkaballapur districts were major nesting plants, reflecting regional variation in nesting tree preferences.

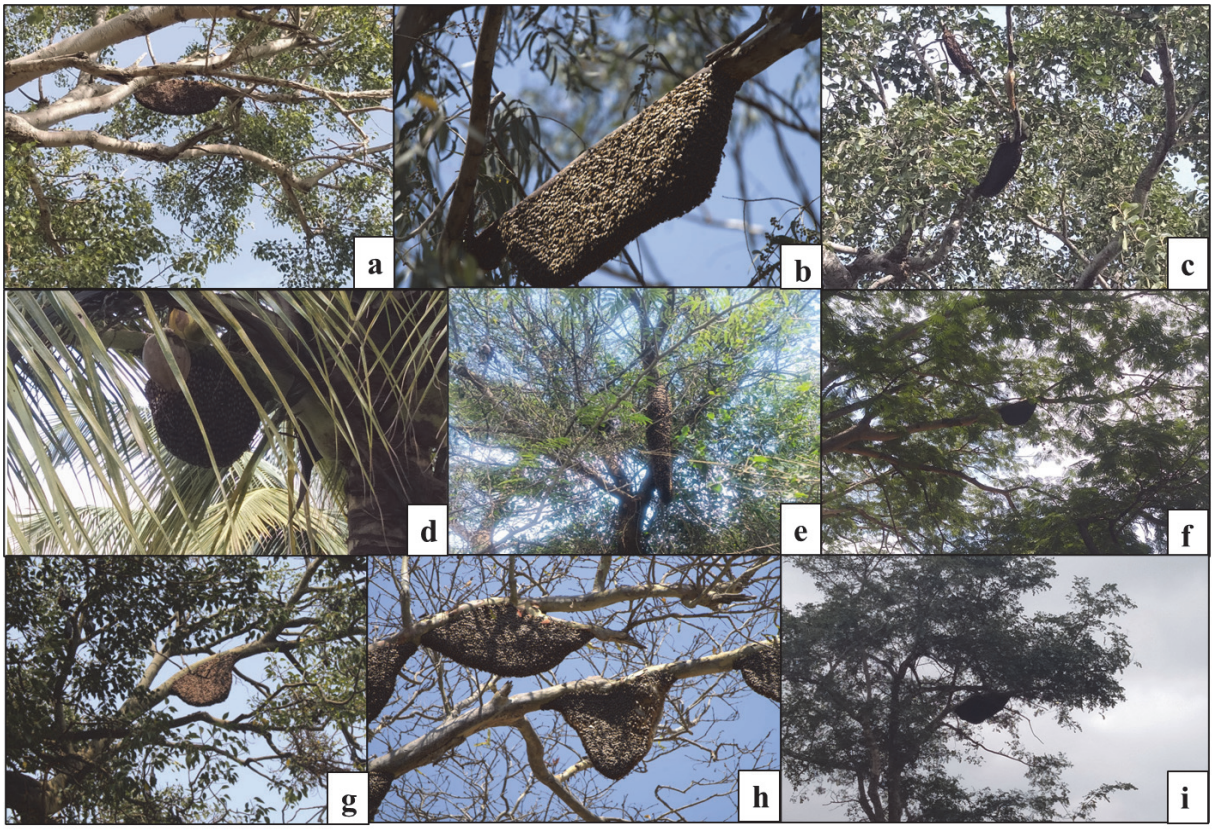

Plate 1. Nests of *Apis dorsata* on different trees: a) Peepal tree, b) Eucalyptus, c) Banyan, d) Coconut, e) Acacia, f) Earpod tree, g) Laurel fig, h) Arjun tree, i) Cutch tree

The banyan tree with its wide-spreading branches and strong structure provide a stable support for large combs, while its evergreen canopy offers shade and protection of *A. dorsata* colonies (Basavarajappa, 2010). Similar observations were made by Roy *et al*. (2011). where *A. dorsata* preferentially nest on large, mature trees with expansive canopies. Regional variation in preference, of nesting plants, reflects of suitable nesting plants availability and tree morphology (Ramyarani and Nagaraja, 2025). These findings are consistent with previous studies reporting that nesting choice is determined by ecological and landscape heterogeneity (Ramyarani and Nagaraja, 2024; Rehel *et al*., 2024).

Nesting height: The vertical distribution of *A. dorsata* colonies at different heights revealed significant variation (Fig. 1). The observations showed that the majority of nests were located at 15-20m (45.4%) and 10-15m (34.0%), together accounting for nearly 80 per cent of all observed colonies. In contrast, a few nests were found at 0-5m (2.0%) and 20-25m (3.4%), while 5-10m supported a moderate number of nests (11.3%). A Chi-square goodness-of-fit test indicated that the distribution of colonies across height classes was highly non-uniform (< 0.001). These results demonstrate a strong preference for mid-height ranges (10-20m), suggesting that nest site selection is strongly influenced by height, possibly due to reduced predation, microclimatic stability, and foraging efficiency. Sihag (2017) reported that nearly 70 per cent of colonies in northwest India occurred between 14-17 m, while Roy *et al.* (2011) documented similar clustering in the Nilgiri Biosphere Reserve. Nesting at such heights likely reduces vulnerability to ground-level disturbances and human interference while optimizing microclimatic conditions for brood development

Table 1. Major nesting plants with number of colonies of *A. dorsata* in different districts of south Karnataka (N= 657)

Scientific name	Common name	Number of colonies found			
		Kolar	Chikkaballapur	Bengaluru rural	Total
Albizia lebbeck	Siris	10	07	12	29
Cocos nucifera	Coconut	03	00	06	09
Delonix regia	Gulmohar	17	44	20	81
Eucalyptus nilgiris	Eucalyptus	27	01	00	28
Ficus bengalensis	Banyan	92	67	128	287
Ficus microcarpa	Laurel fig	08	00	01	09
Ficus religiosa	Peepal tree	31	02	18	51
Mangifera indica	Mango	04	00	05	09
Samanea saman	Rain tree	08	23	11	42
Tamarindus indica	Tamarind	14	03	00	17
Terminalia arjuna	Arjuna tree	86	00	00	86
Quercus subur	Cork oak	09	00	00	09

(Seeley *et al*., 1982). The selection of these elevations also enhances foraging efficiency by minimizing flight costs between nest and floral resources (Nagir *et al*., 2016). The low occurrence of nests at <5 and >20m suggests that both extremes expose colonies to higher risks of predators and human disturbance at lower levels, and exposure to wind Wardhe and Ghonmode (2024) reported mesting preference of *A. dorsata* in urban Nagpur, where in it was stated that the tall buildings were more preferred.

Bee flora: A total of 43 plant species from 21 families were identified as bee flora of *A. dorsata* in the study regions (Table 2). Among these, species from the Fabaceae (e.g., *Albizia lebbeck, Cajanus cajan, D. regia*) and Cucurbitaceae (e.g., *Cucurbita moschata, Lagenaria siceraria*) families were the most frequently utilized. Of the recorded plants, 17 species provided both nectar and pollen, 17 plant species provided only pollen, and 9 species supplied only nectar. This wide resource base indicates that *A. dorsata* is a generalist forager, utilizing both cultivated crops (e.g., *Brassica nigra, Cicer arietinum*) and wild flora (e.g., *Tridax procumbens, Ageratum conyzoides*). Such floral diversity is crucial for sustaining colonies in the dry agro-climatic zone, where seasonal variability in floral abundance is high. Previous melittopalynological studies from Kolar confirmed that *A. dorsata* honey contained pollen from over 50 plant species, highlighting its wide dietary breadth (Gopal, 2021). Similarly, Rehel *et al*. (2024) demonstrated that *A. dorsata* exploited nearly one-third of available flowering plants in the Nilgiris, often overlapping with other bees. This reflects its ecological flexibility as a generalist forager (Aronne *et al*., 2012). By diversifying floral resources, colonies buffer against seasonal gaps, ensuring continuous nectar and pollen intake. The reliance on both wild and cultivated plants underscores the role of *A. dorsata* in pollination services. Cultivated crops such as coriander, onion, sunflower, and pigeon pea, as well as wild plants like *Tridax procumbens* and *Ageratum conyzoides*, benefit significantly from its pollination, contributing to both agricultural productivity and ecosystem health (Abrol, 2012). The adaptability

Table 2. Bee flora of *Apis dorsata* in plains of south Karnataka, India

No.	Scientific name	Common name	Family	Floral Resource
1.	*Acacia leucophloea*	Whitebark Acacia	Fabaceae	Pollen + Nectar
2.	*Acacia polyacantha*	Acacia	Fabaceae	Pollen + Nectar
3.	*Ageratum conyzoides*	Billy goat weed	Asteraceae	Nectar
4.	*Albizia lebbeck*	Siris	Fabaceae	Nectar
5.	*Allium cepa*	Onion	Amaryllidaceae	Pollen + Nectar
6.	*Azadirachta indica*	Neem	Meliaceae	Nectar
7.	*Brassica rapa*	Turnip	Brassicaceae	Pollen + Nectar
8.	*Brassica nigra*	Mustard	Brassicaceae	Pollen + Nectar
9.	*Cajanus cajan*	Pigeon pea	Fabaceae	Pollen + Nectar
10.	*Capparis grandis*	Tree caper	Capparaceae	Pollen
11.	*Carica papaya*	Papaya	Caricaceae	Pollen
12.	*Cicer arietinum*	Chickpea	Fabaceae	Pollen + Nectar
13.	*Citrus limon*	Lemon	Rutaceae	Pollen + Nectar
14.	*Cocos nucifera*	Coconut	Arecaceae	Pollen + Nectar
15.	*Coriandrum sativum*	Coriander	Apiaceae	Pollen
16.	*Cucumis melo*	Musk melon	Cucurbitaceae	Pollen + Nectar
17.	*Cucumis sativus*	Cucumber	Cucurbitaceae	Pollen + Nectar
18.	*Cucurbita moschata*	Pumpkin	Cucurbitaceae	Pollen + Nectar
19.	*Dalbergia sissoo*	Indian rosewood	Fabaceae	Pollen
20.	*Delonix regia*	Gulmohar	Fabaceae	Pollen
21.	*Eucalyptus* spp.	Eucalyptus	Myrtaceae	Nectar
22.	*Foeniculum vulgare*	Fennel	Apiaceae	Pollen
23.	*Helianthus annuus*	Sunflower	Asteraceae	Pollen + Pollen
24.	*Ixora congesta*	Malayan ixora	Rubiaceae	Pollen
25.	*Lagenaria siceraria*	Bottle gourd	Cucurbitaceae	Pollen + Nectar
26.	*Leucaena leucocephala*	Subabul	Fabaceae	Pollen + Nectar
27.	*Mangifera indica*	Mango	Anacardiaceae	Pollen+ Nectar
28.	*Mimosa pudica*	Touch-me-not	Fabaceae	Pollen
29.	*Momordica charantia*	Bitter gourd	Cucurbitaceae	Pollen + Nectar

30.	*Moringa oleifera*	Drumstick	Moringaceae	Nectar
31.	*Morus alba*	Mulberry tree	Moraceae	Pollen + Nectar
32.	*Phyllanthus emblica*	Amla	Euphorbiaceae	Pollen
33.	*Pongamia pinnata*	Indian beech tree	Fabaceae	Nectar
34.	*Prosopis juliflora*	Mesquite plant	Leguminosae	Nectar
35.	*Psidium guajava*	Guava	Myrtaceae	Pollen + Nectar
36.	*Raphanus sativus*	Radish	Brassicaceae	Nectar
37.	*Sida cordifolia*	Heart-leaf sida	Malvaceae	Pollen
38.	*Syzygium cumini*	Jamun	Myrtaceae	Pollen + Nectar
39.	*Tamarindus indica*	Tamarind	Fabaceae	Nectar
40.	*Terminalia* spp.	Terminalia	Combretaceae	Pollen
41.	*Tridax procumbens*	Tridax weed	Asteraceae	Pollen

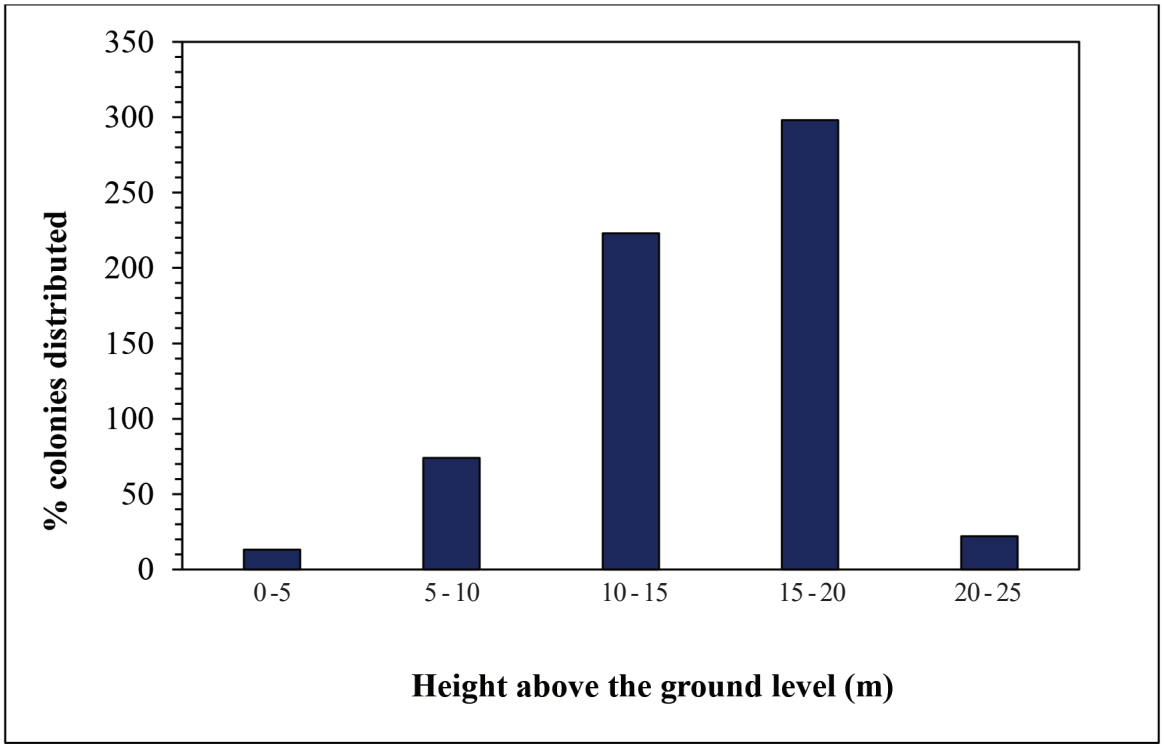

Fig. 1 Vertical Distribution of *Apis dorsata* colonies on trees at different elevation

of *A. dorsata* to forage across diverse landscapes ensures its persistence in human-dominated agroecosystems. However, the felling of nesting trees and loss of bee flora could severely affect colony sustainability (Sihag, 2025).

The study revealed that *A. dorsata* colonies in south Karnataka exhibit clear nesting preferences, with the majority located at moderate-heights (10-20 m) and predominantly on structurally suitable tree species such as *F. benghalensis* and *T. arjuna*. *A. dorsata* also utilized a wide diversity of floral resources, highlighting its role as a generalist forager and key pollinator. These findings emphasize the importance of conserving large nesting trees in these regions. Nonetheless, integration of ecological insights is essential for sustainability of *A. dorsata* populations in plains of south Karnataka, India.

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