Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Scholars Research Library

European Journal of Zoological Research, 2013, 2 (6):6-15
(http://scholarsresearchlibrary.com/archive.html)

ISSN: 2278–7356

Nesting attributes of dwarf bee, *Apis florea* F. under urban ecosystem of Manasagangotri campus, Mysore, India

R. Narayanaswamy and S. Basavarajappa*

Apidology Laboratory, DOS in Zoology, University of Mysore, Manasagangotri, Mysore, Karnataka

---

ABSTRACT

Observation on dwarf bee, Apis florea Fabricius 1973 (Hymenoptera: Apidae) was conducted at Manasagangotri campus, Mysore by employing an all out search method (AOSM). Total 139 A. florea normal colonies and 60 abandoned combs were recorded with a ratio 1: 0.43. Highest (36) normal colonies were recorded in February followed by March (31), April (29) and January (23). However, during May and June, the normal colonies were less in number (10 each). Normal colonies exhibited various shapes namely: asymmetrical (82), round (43) and oval (14) and showed significant variation (F=6.78; P>0.01) during different months. Further, A. florea population was not uniform, did varied significantly (F=26.59; P>0.05) during different months. A. florea normal colonies were located interior and on road side, majorities were protected from direct sunlight and the level of visibility did indicated a significant variation (F=6.457; P>0.01) during different months. A. florea built small sized comb at lower elevations that ranged between ground level to up to 50 ft height and did gets attracted for lower elevations i.e., ground level to up to 15 feet height for nesting with northeast-southwest orientations more compared to other orientations. Normally, the comb had 12.52 x 16.77cm length x width with six queen cells, 80 to100 drone cells, hundred of worker cells for brooding and honey storing. There were 24 different plant species which belong to 19 families along with few rough/smooth surfaced human built structures (HBS) selected by A. florea for nesting. Saraca asoca, Bougainvillea spectabilis, Muntinagia calabura, Terminalia catappa were most preferred nesting plants.

Key words: *Apis florea*, nesting attributes, urban ecosystem, Karnataka

---

INTRODUCTION

The dwarf bee, *Apis florea* Fabricius (1787) is a small sized **'**stinging bee' [1], mild in its behaviour in the genus *Apis* [2] and not much ferocious compared to other stinging honeybees. It lives under arboreal wild conditions by constructing a single-comb openly [3] [4]. It is indigenous to Asia, and in India it called 'little honeybee' or 'red dwarf bee'. However, in Karnataka, it is known as 'Kaddi Jenu' [5]. Since, it is a wild species, not readily managed by man and its nests are found attached to a plant twig [6] [7] [8] of small trees or dense bushes [9] in tropical forests, scrubby/bushy vegetation, in farming areas especially orchards and other small trees [10].

[11] has reported that, *A. florea* is native to Thailand. [12] and [6] have reported on various aspects of *A. florea*. [13] has investigated nesting behaviour of *A. florea* and revealed comb building activities in bushes and shrubs. [14] [15] and [16] have published the location of pollen-storage cells, worker-brood cells; drone-brood cells and queen cells in *A. florea* normal comb. [17] have studied the biogeography of *A. florea* from Asia while comparing with *A.*

andreniformis. [18] have recorded the comb morphometrics during dry winter season and revealed the population size of various castes in the colony in northern Thailand. In India, [19] have studied the biology, behavior and economic importance of *A. florea* in Kutch, Gujarat. Further, the pollination behaviour of *A. florea* has been reported by [20] in Nepal. Further, [3] and [21] have enlisted the nesting parameters and comb dimensions of *A. florea* at Hisar, India. Further, [22] and [23] have studied the social defense mechanisms of *A. florea* and reported the shimmering and hissing behaviour during predator's intereferences. [24] and [25] have reported the camouflaged behaviour of *A. florea* nesting with relatively dense foliage. Since, the exposed position of the comb with the honey storage part and brood attracts a range of predatory species, wide array of specific social defense mechanisms expressed by *A. florea* [22], [26], [24] and [23]. [27] opined that, the comb is not only provides shelter to bees, it also provides both cradle for developing young ones and larders for the colony and highlighted the importance of comb is vital to the colonies future survival. However, *A. florea* is a vital pollinator for various plants with medium sized to big sized flowers in tropical ecosystems [28], [29], [30], [31] and [32]. Its pollination service is quite useful to various plants, which occurs at both natural habitats, agro-ecosystems and man-made ecosystems [10]. Although a good amount of information is available on *A. florea*, in India, nothing much has been reported about its presence under urban ecosystems. Being a small sized bee [33], it gathers small amount of honey, usually not exceeding a kg per colony [10]. Perhaps, its poor honey gathering ability might have drawn not more attention around the globe [34]. Indeed, seasonal migration and absconding characteristics of *A. florea* [35] has made difficult to study of its existence. The presence of such useful pollinating honeybees is yet to study in detail under urban ecosystems. In this regard, reports are scanty and hence, the present study was conducted at Manasagangotri campus, Mysore, Karnataka.

MATERIALS AND METHODS

Study area: The University of Mysore main campus, 'Manasagangotri' meaning 'eternal spring of the mind' is aptly named by the National poet and first Jnanpith awardees in Kannada K.V. Puttappa (Kuvempu) in 1960. It is located in the heart of Mysore city (Fig. 1) at 12^0 18^1 28.33^{11}N and 76^0 38^1 21.75^{11}E, and lies in a picturesque area of 739 acres at the western end of the Kukkarahalli Lake [36]. The campus is spread with more than 42 Post-graduate Departments, 10 specialized research and training centers established with modern amenities and comforts amidst avenue trees, lawns and neatly maintained ground vegetation.

Methodology: Observations were made at all the places in Manasagangotri campus. As the distribution of vegetation was not uniform, an All Out Search Method (AOSM) was followed to record *A. florea* normal colonies and abandoned combs during January to June in the year 2013. In AOSM, an observer walks through a fixed path to see *A. florea* colonies on various places including trees, shrubs and small bushes in and around post-graduate Departments, residential quarters, administrative building, post-graduate hostels, village hostel premises, on the avenues and in lawns. Observations were made at quarterly intervals during 10.00 AM to 5.30 PM by both naked eyes and using a binocular (10 x 50X) by spending 30 minutes per colony. Various nesting attributes namely colony size, shape, protection population strength, location, elevation, orientation and nest host plants were collected. The nest host trees, shrubs and bushes were identified with the help of both photographic pictures, and the herbarium sheets as per [37]. Nesting elevation was measured by following the method of [38]. The comb shape was identified as per [39]. The colony orientation was determined for true north and height of the colony from the ground was recorded as per [40] and [41]. The colony strength was estimated by observing the dwarf bee density on the comb with the help of Olympus Binocular (10 x 50). The nest covered with thick adult bees population (more than four layers of adult bees) was considered as strong colony. And, the nest completely covered with two layers of bees was considered as moderate colony. While, the nest with only one or two layers of bees and the edge of comb remained uncovered to a width of about 5cm was considered as weak colony as per [42] and [43]. The normal colonies, abandoned combs and nest host plants were photographed with the help of Canon Power Shot S21S, 8.0 Mega Pixel Digital Camera with 12x Optical Zoom [10]. The abandoned combs were used to record comb morphometrics such as comb size i.e., length x width, queen, drone and brood cells size, honey storing cells depth and diameter, crest thickness and twig diameter. The collected data was compiled and statistically analyzed by employing various tests as per [44].

RESULTS

Total 139 normal colonies were recorded from January to June and highest (36) normal colonies were recorded during February, followed by March (31) and April (29 colonies) months. However, in May and June the normal

colonies were less (10 each), and on an average 23.2 ± 11.0 normal colonies were occurred during different months at Manasagangotri campus, Mysore (Table 1). Interestingly, normal colonies exhibited different comb shapes namely oval, round and asymmetrical. Of all, asymmetrical shaped colonies were more (82) with a mean 13.6 ± 6.2 compared to round and oval shaped colonies, and there existed a significant variation (F=6.78; P>0.01) between them during different months (Table 1). Further, worker bee population was not dense on all combs. Only 64 colonies had thick curtain of bees with more than four layers and remaining colonies had moderate worker bee population. Accordingly they were designated as strong, medium and weak colonies, their occurrence was 10.6 ± 5.2, 7.7 ± 4.8 and 4.8 ± 2.9 respectively, and indicated a significant variation (F=26.59; P>0.05) between the colony population (Table 1). Thus, dwarf bee population in normal colonies was not constant, fluctuated much during different months.

The normal colonies were located interior (101) and only few (38) colonies were found on road side with a mean 16.8 ± 7.1 and 7.6 ± 3.4 respectively and exhibited a significant difference (F=5.14; P>0.01) between the location during different months (Table 1). Moreover, normal colonies (114) were protected from direct sunlight and covered with shade. However, few (25) colonies didn't had any protection, but they were exposed directly to sunlight. The mean value was 19.0 ± 8.4 and 5.0 ± 3.4 for protected and unprotected colonies and 'F' value was 31.05 (P>0.01) during different months (Table 1). Further, *A. florea* normal colonies orientated at four directions namely north-south (NS), east-west (EW), northeast-southwest (NE-SW), and north west-south east (NW-SE) with a mean value 5.5 ± 2.5, 5.5 ± 3.6, 8.0 ± 3.4 and 4.6 ± 2.2 respectively. Hence, *A. florea* built colonies with different orientations during various months, but it didn't revealed any significant variations (F=1.51; P< 0.05) (Table. 1).

Apis florea selected different elevations during nest establishment and it was ranged between ground level to upto 50ft. The colonies were found on ground level to 5ft, 5.1 to 10ft, 10.1 to 15ft, 15.1 to 20ft, 20.1 to 25ft, 25.1 to 30ft, 30.1 to 40ft, 40.1 to 45ft, 45.1 to 50ft and indicated significant variation (F=60.47; P>0.01) during different months (Table 2). The size of *A. florea* comb during various months at different elevations did indicate the considerable variations. In general, the length and width wise *A. florea* colonies were big in size during March, April, May and June at 25.1 to 30ft elevation and it was followed by 5.1 to 10ft elevation. However, the minimum comb length was 16.3 ± 5.1cm and width was 15.6 ± 4.3 cm respectively during May and April months. The maximum comb length and width was 20.5 ± 0.5 and 19.0 ± 4.3cm respectively during January and February at 5.1 to 10ft elevations. Further, at ground level to up to five feet height, *A. florea* gained good colony size compared to 10.1 to 15ft, 15.1 to20ft, 20.1 to 25ft, 30.1 to 35ft and 45.1 to 50ft elevations (Table 2). Thus, the colony size varied considerably during different months at various elevations under urban conditions. Figure 2 shows the per cent occurrence of normal colonies at different elevations. It is evident from the figure that *A. florea* more preferred lower elevations (i.e., ground level to upto 15ft height) compared to higher elevations. Thirty three per cent normal colonies were found between ground level to five feet height and it was followed by 5.1 to 10ft (23.3%) and 10.1 to 15ft (16.5%). However, *A. florea* didn't preferred much higher elevations (i.e., 15.1ft onwards) for nesting and the nesting preference gradually reduced to less than 10% (Fig. 2).

The normal comb had 12.5 x 16.77cm measurement. Further, comb width was 17. 6 ± 3.2, 18.4 ± 1.9 and 14.3 ± 2.0cm at upper, middle and bottom regions respectively. Similarly, the length at left, right and at the centre of comb was 12.5 ± 2.5, 11.6 ± 2.6 and 13.5 ± 2.3cm respectively. On an average, six queen cells and 80 to 100 drone cells were recorded per comb (Table 3). The length and depth of queen cell was almost same 1.3 ± 0.3 each with 1.4 ± 0.5cm diameter. Further, the depth and diameter of drone cells was 1.1 ± 1.1 and 2.1 ± 0.2 respectively. Similarly, the worker cells had 0.8 ± 0.1 and 1.0 ± 0.2cm depth and diameter. However, the depth and diameter of honey storing cells was slightly more i.e., 2.5 ± 1.8 and 1.1 ± 0.04cm respectively (Table 3). Further, 24 plants belong to 19 plant families were selected for nesting (Table 4). Among them, *A. florea* nested on 3.0 ± 0.4cm in diameter sized twig (Table 3). *Saraca asoca*, *Bougainvillea spectabilis*, *Muntiagia calabura*, *Terminalia catappa* were most preferred for nesting compared to others. But, there was no significant variations (F=1.92; P<0.05) existed between them (Table. 5). Table 4 shows the plants, their families and per cent preference for nesting by *A. florea*. Highest (19.4) per cent colonies were recorded on *Saraca asoca* followed by *Bougainvillea spectabilis* (18%), *Terminallia catappa* (10.1%), *Muntingia calabura* (8.6%), *Croton tiglium* (4.3%) and *Pouteria sapoto* (3.6%) at Manasagangotri campus. Other plant species were preferred less (3% only) for nesting. Interestingly, *Saraca asoca*, *Bougainvillea spectabilis*, *Terminalia catappa*, *Muntingia calabura* and *Croton tiglium* have preferred continuously during January to June for nesting by *A. florea* (Table 5). Hence, they were referred as 'potential nesting plants'. Further, herbs were also selected by *A. florea* for nesting but, their dependence was only 8.3%. Interestingly, quiet a good number

of normal colonies (14) were built by *A. florea* on human built structure (Table. 5). Figure 3 shows the per cent dependence of *A. florea* normal colonies on different plant species and HBS during nesting.

DISCUSSION

A. florea locally so called 'Kaddi Jenu' [5] prefers to live under wild conditions, not readily managed by man [2]. [6], [7], [9], [8] and [10] have reported *A. florea* colonies on a twig of small trees or dense bushes, scrubby vegetation in farming areas under tropical conditions. While nesting, *A. florea* critically see the available foraging source (i.e., nectar and pollen plants), water source and safe place which are free from predators and enemies [10]. Moreover, it shows high degree of mobility [20], migrates to various places [35] in search of good forage, shelter, protection and favorable microclimate [45]. However, the forage abundance was not uniform along with fluctuating weather during different months under urban ecosystem [10] and [46]. Perhaps, all these fluctuating factors might have influenced the uneven distribution of colonies during different months (Table 1) at Manasagangotri, Mysore. Similar types of observation were reported by [20] and [35] at Nepal and other tropical ecosystems. Further, *A. florea* select peripheral regions on the plant branches [10], build variously shaped, small sized comb that differ slightly from the comb of other *Apis* species. Although, shape of colony is evidently not of vital importance for dwarf bees, the question still remains as to why they construct different shaped colonies at different places. During colony construction, it usually attaches the comb crest to small sized (ex. 2.96cm in dia.) twigs or branches. The hexagonal cells form a regular pattern of three diagonal rows set at 60^0 to each other [47], which undergoes an orderly process of growth and development [27]. This might shape the colony structure [48]. As the sun light, water and flora are not evenly distributed at various places, these sources are very much essential to colony members and developing brood. Perhaps, to avail existing resources, to avoid human associated disturbances, to have effective flight path, to get required sun light and other environmental factors, *A. florea* might have accustomed to construct different shaped colonies at its nesting niche. Like other *Apis* species, comb acts as 'shelter' to queen, drones and workers; it had six queen cells and 80 to 100 drone cells and innumerable honey storing cells. Comparatively, the comb had more length at its centre than that of left and right sides.

Generally, the normal colonies were big in size (both length and width wise) during March, April, May and June at 25.1 to 30ft height (Table 2). However, combs were small in size (16.3 ± 5.1cm length and 15.6 ± 4.3cm width) during May and April. Thus, comb morphometrics varied considerably at different elevations. Furthermore, in normal colonies, worker bee's population was not uniform and presented significant variation among strong, medium and weak colonies (Table 1). [43] and [42] have reported the colony strength is based on the worker bee density in *A. dorsata*. The comb covered with thick adult bee population (more than four layers) was considered as strong colony. While comb with three layers of bees was considered as moderate colony and with only one or two layers of bees and the edges of comb remained uncovered to a width of about five centimeter was considered as weak colony [43] and [42]. Similar type of observations was recorded in *A. florea* during different months (Table 1). In Mysore, the pre-monsoon starts during June and it is characterized by heavy rainfall accompanied by lower temperature and increased relative humidity. The prevailed uncongenial climate and scanty flora during late summer (i.e., in May) and early rainy season (i.e., in June) might have discouraged the brooding activity of *A. florea* and resulted poor colony strength. Owing to this non-conducive weather, *A. florea* might have under gone migration. This would corroborate the occurrence of less number of colonies during May and June compared to January to April. Thus, the colony number, population strength mostly depended on the proportion of floral abundance and favorable weather conditions. Our observations are in conformity with the observations of [43], [46] and [42]. *A. florea* nesting location is unique, not easily accessible to animals including mankind that could help avoid animals including human intereferences and vehicular traffic. Accordingly, *A. florea* built its colony at interior side that was away from the road. *A. florea* availed various plant species including human built structures for nesting under shady places on the twig/branches. Shady places help protect the colony members from bright light, strong winds and inclement weather conditions. Even though, *A. florea* nests ranged between ground level to upto 50ft, it preferred ground level to upto 15ft height more. [49] and [7] have reported *A. florea* colonies at lowlands of Asia. [34] have recorded at the Middle East and other parts of China to Thailand and also in Oman, Iran, Pakistan, India and Sri Lanka at lower elevations. Having small sized body, build small sized colonies, it showed very elegant behaviour while selecting lower elevation for nesting. Preferring lower elevations for nesting, *A. florea* exhibited a unique behaviour that is very common during different months. But, higher elevations are found as part of the defense strategy in other *Apis* species [10] and [39]. Perhaps, selecting lower elevation for nesting would likely to use minimum energy while attending various colony activities. Thus, our observations agree with the earlier reports of [50] and [39]. Further, *A. florea* more preferred different orientations (Table 1) that may help avail required amount

of prevailed ecological factors for maximum usage during different seasons. Since, the directional preference while establishing the nest openly under arboreal conditions with specific orientation may attribute to prevailing weather. Similar type of observation was made by [40]. Interestingly, *A. florea* depended on various plants for nesting. Fabaceae family members have supported highest (14.8%) colonies (Table 3), followed by Moraceae family (74%) (Table).

Table-1. Nesting attributes of dwarf bee, *Apis florea* under urban ecosystem

Sl. No.	Month	*Apis florea* wild colonies														
		No.	Shape			Population			Location		Shaded	Unshaded	Orientation			
			O	R	A	S	M	W	RS	I			NS	EW	NE-SW	NW-SE
1.	January	23.0	03	08	12	11	08	04	05	18	16	07	05	05	08	05
2.	February	36.0	05	13	18	15	16	05	10	26	27	09	09	10	10	07
3.	March	31.0	03	08	20	17	05	09	10	21	25	06	08	05	12	06
4.	April	29.0	03	07	19	12	10	07	10	19	27	02	05	08	10	06
5.	May	10.0	-	03	07	04	03	03	03	07	10	-	03	01	05	01
6.	June	10.0	-	04	06	05	04	01	-	10	09	01	03	01	03	03
Total		139.0	14	43	82	64	46	29	38	101	114	25	33	30	48	28
Mean ± SD		23.2 ± 11.0	3.5 ± 1.0	7.1 ± 3.5	13.6 ± 6.2	10.6 ± 5.2	7.7 ± 4.8	4.8 ± 2.9	7.6 ± 3.4	16.8 ± 7.1	19.0 ± 8.4	5.0 ± 3.4	5.5 ± 2.5	5.5 ± 3.6	8.0 ± 3.4	4.6 ± 2.2
'F' value		-	**6.78S**			**26.59S**			**5.140S**		**31.05S**		**1.51NS**			

Note: Each value is a mean of three observations
O: Oval; R: Round; A: Asymmetrical; S: Strong; M: Medium; W: Weak; RS: Road Side; I: Interior;
NS: North-South; EW: East-West; NE-SW: Northeast-Southwest and NW-SE: Northwest-Southeast

Table 2. Comb size of *Apis florea* recorded during different months

Sl. No.	Colony Elevation	Colony size (cm) during												'F' value
		January		February		March		April		May		June		
		L	W	L	W	L	W	L	W	L	W	L	W	
1.	Ground level to 5 ft.	17.5 ± 5.8	14.8 ± 4.5	16.4 ± 6.4	14.3 ± 5.1	15.9 ± 7.6	13.9 ± 6.2	14.4 ± 6.3	13.9 ± 6.7	14.0 ± 6.5	12.3 ± 6.6	15.5 ± 4.6	14.6 ± 4.9	60.47
2.	5.1 to 10 ft	20.5 ± 0.5	16.5 ± 2.5	18.7 ± 4.0	19.0 ± 4.3	18.4 ± 4.9	16.8 ± 2.4	16.5 ± 5.3	15.6 ± 4.3	16.3 ± 5.1	18.3 ± 3.7	18.5 ± 7.7	17.0 ± 4.2	
3.	10.1 to 15 ft	12.4 ± 5.1	12.9 ± 6.2	12.2 ± 4.5	10.4 ± 5.0	14.7 ± 5.5	12.2 ± 6.7	13.5 ± 5.0	10.7 ± 5.5	15.5 ± 6.3	14.7 ± 6.3	10.0 ± 0.2	8.0 ± 0.0	
4.	15.1 to 20 ft	9.5 ± 3.5	13.5 ± 2.0	15.1 ± 10.0	18.5 ± 8.7	14.6 ± 3.6	15.9 ± 1.3	14.4 ± 6.5	14.4 ± 7.8	19.0 ± 0.0	20.0 ± 0.0	-	-	
5.	20.1 to 25 ft	8.5 ± 0.0	7.5 ± 0.0	15.8 ± 6.5	13.1 ± 5.0	23.5 ± 6.0	16.5 ± 0.7	22.0 ± 11.2	15.7 ± 0.4	-	-	-	-	
6.	25.1 to 30 ft	20.3 ± 2.0	16.2 ± 1.2	18.1 ± 4.6	18.0 ± 8.1	19.0 ± 0.0	27.1 ± 0.0	20.0 ± 0.0	29.0 ± 0.0	21.0 ± 0.0	30.0 ± 0.0	22.1 ± 0.0	30.0 ± 0.0	
7.	30.1 to35 ft	14.7 ± 3.9	16.2 ± 10.0	12.0 ± 0.0	10.0 ± 0.0	-	-	-	-	-	-	-	-	
8.	35.1 to 40 ft	9.1 ± 0.0	8.0 ± 0.0	9.1 ± 0.0	8.0 ± 0.0	14.0 ± 0.0	13.0 ± 0.0	-	-	-	-	-	-	
9.	40.1 to 45 ft	-	-	-	-	-	-	-	-	-	-	-	-	
10.	45.1 to 50 ft	-	-	-	-	13.0 ± 0.0	9.1 ± 0.0	13.0 ± 0.0	9.0 ± 0.0	-	-	-	-	

Note: Each value is a mean of 15 observations; L: Length; W: Width

Saraca asoca, *Bougainvillea spectabilis*, *Muntiagia calabura*, *Terminalia catappa* were more preferred for nesting. Tree were more preferred (35.2%) followed by shrubs (21.6%) for nesting. Further, nests were also found on human built structures. Trees, shrubs and herbs at Manasagangotri campus might have extended suitable nesting niche during different months. The selected plant species had necessary attributes such as height (2-30 ft) to have suitable flight range, foliage thickness and thickly interspersed slender branches covered with foliage. Since, thick foliage

may provide protective curtain over the comb, this avoid direct visibility from predators and enemies and inturn protect the colony from them. Being a low land species [9], *A. florea* exhibited several strategies [19] and [4] in response to environmental fluctuations and high risk of predation [4]. Moreover, nesting site selected by *A. florea* is related with temperature and sunlight [21] and [40] and comb should have minimum threshold height under arboreal conditions [51] and thus demonstrated elite behavior while availing suitable trees with thickly interspersed branches and foliage. Thus, *A. florea* selected diversified sites for nesting. Thus, *A. florea* used different sites for nesting on en route while seasonal migration [4]. Sometimes, it nests on the objects which fall on the ground. *A. florea* is a wild bee, stay at urban ecosystems during their migration. As it provides free ecosystem service to several plant species under urban conditions, produce honey and wax [10] that provide important linkages to the biological resources under urban ecosystem to mankind. Therefore, its preservation helps save local flora [53] under threatened urban ecosystems.

Table 3. *Apis florea* comb morphometrics

Sl. No.	Comb characters	Measurements (cm)
1.	Overall comb length x width	12.52 x 16.77
2.	**Comb width**	
	Upper	17.6 ± 3.2
	Middle	18.4 ± 1.9
	Bottom	14.3 ± 2.0
3.	**Comb Length**	
	Left side	12.5 ± 2.5
	Right side	11.6. ± 2.6
	At centre	13.5 ± 2.3
4.	**Queen cell**	
	Numbers/comb	06
	Length	1.3 ± 0.3
	Depth	1.3 ± 0.3
	Diameter	1.4 ± 0.5
5.	**Drone cell**	
	Number/comb	80-100
	Depth	1.1 ± 1.1
	Diameter	2.1 ± 0.2
6.	**Worker cell**	
	Depth	0.8 ± 0.1
	Diameter	1.0 ± 0.2
7.	**Honey storing cell**	
	Depth	2.5 ± 1.8
	Diameter	1.1 ± 0.04
8.	**Crest**	
	Length	14.4 ± 9.14
	Width	4.67 ± 2.68
9.	Comb attached twig diameter	3.0 ± 0.4

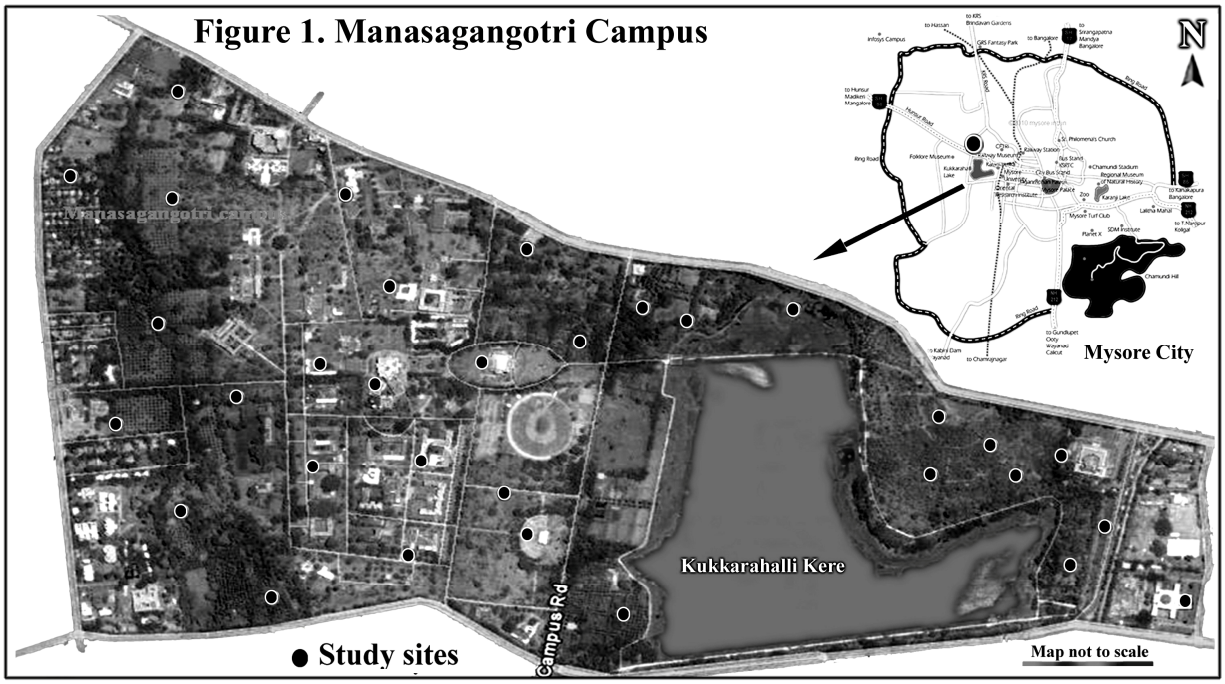
Note: *Each value is a mean of 15 observations*

Table 4. Nest host plants of *Apis florea* in Manasagangotri Campus, Mysore

Sl. No.	Common Name	Scientific Name	Plant Type	Family	No. of species	% contribution
1.	Ashoka tree (Mast Tree)	*Saraca asoca*	T	Fabaceae	04	16.7
2.	Hongae mara	*Pongamia pinnata*	T			
3.	Powder puff plant	*Calliendar haematocephala*	H			
4.	Basavana pada	*Bauhinia variegata*	T			
5.	Banyan tree	*Ficus benghalensis*	T	Moraceae	02	8.3
6.	Jack fruit	*Artocarpus heterophylus*	T			
7.	Jamaican Cherry	*Muntingia calabura*	T	Muntingiaceae	01 each	4.1 each
8.	Rush foil	*Croton tiglium*	S	Euphorbiaceae		
9.	-	*Terminallia catappa*	T	Combretaceae		
10.	Neem tree	*Azadirachta indica*	T	Meliaceae		
11.	Paper flowering plant	*Bougainvillea spectabilis*	S	Nycteginaceae		
12.	Yellow trumpet bush	*Tecoma stans*	S	Bignoniaceae		
13.	Custered Apple plant	*Annona squomosa*	S	Annonaceae		
14.	-	*Dendrophthoe falcata*	T	Loranthaceae		
15.	Duranta plant	*Duranta erecta*	S	Verbenaceae		
16.	Coconut tree	*Cocos nucifera*	T	Palmae		
17.	Chickku (Sapota) plant	*Pouteria sapoto*	S	Sapotaceae		
18.	Nerale mara	*Syzigium cumini*	T	Myrtaceae		
19.	China rose plant	*Hibiscus rosa-sinensis*	S	Malvaceae		
20.	Mango tree	*Mangifera indica*	T	Anacardiaceae		
21.	Citrus plant	*Citrus* sp.	S	Rutaceae		
22.	-	*Hamuliapatens* sp.	-	-		
23.	Wild water lemon	*Psaciflora foetida*	H	Passifloraceae		
24.	Tamarind	*Tamarindus indica*	T	Caesalpiniaceae		
Overall	H: Herb - 2 (8.3%), S: Shrub – 8 (33.3 %), T: Tree – 13 (54.2%) and unknown – 1 (4.2%)					

Table 5. Occurrence of *Apis florea* colonies on different nesting plants during various months

Sl. No.	Nesting plant	Month						Total	% Occurrence
		Jan	Feb	March	April	May	June		
1.	*Muntiagia calabura*	03	03	01	02	02	01	12	8.6
2.	*Saraca asoca*	07	08	05	05	01	01	27	19.4
3.	*Croton tiglium*	01	01	01	01	01	01	06	4.3
4.	*Azadirchta indica*	01	02	-	-	-	-	03	2.2
5.	*Ficus benghalensis*	01	01	-	-	-	-	02	1.4
6.	*Bougainvillea spectabilis*	01	05	08	07	02	02	25	18.0
7.	*Annona squomosa*	01	01	-	-	-	-	02	1.4
8.	*Tecoma stans*	01	01	02	-	-	-	04	2.9
9.	*Terminalia catappa*	04	04	03	01	01	01	14	10.1
10.	*Dendrophthoe falcate*	01	01	01	01	-	-	04	2.9
11.	*Duranta erecta*	-	01	01	-	-	-	02	1.5
12.	*Cocus nucifera*	-	01	01	01	-	-	03	2.2
13.	*Pouteria sapoto*	-	01	01	01	01	01	05	3.6
14.	*Artocarpus hetrophylus*	-	-	02	-	-	-	02	1.5
15.	*Syzygium cumini*	-	-	01	01	-	-	02	1.5
16.	*Calliandra haematocephala*	-	-	-	01	-	-	01	2.2
17.	*Pongamia pinnata*	-	-	-	02	-	-	02	1.4
18.	*Hibiscus rosa-sinensis*	-	-	-	01	-	-	01	0.7
19.	*Mangifera indica*	-	-	-	01	-	-	01	0.7
20.	*Citrus* sp.	-	-	-	-	-	01	01	0.7
21.	*Psaciflora foeitda*	-	01	-	-	-	-	01	0.7
22.	*Bauhinia variegate*	-	01	-	-	-	-	01	0.7
23.	*Hamelia patens*	01	01	-	-	-	-	02	1.4
24.	*Tamarindus indica*	-	01	01	-	-	-	02	1.4
25.	Human Built Structures	-	03	03	05	02	01	14	10.1
Total		22	37	31	30	10	09	139	
Mean ± SD		2.0 ± 1.9	1.9 ± 1.8	2.2 ± 2.0	2.0 ± 1.7	1.3 ± 0.4	1.1 ± 0.3	5.3 ± 6.9	100
'F'		**1.92NS**							



Courtesy : Website

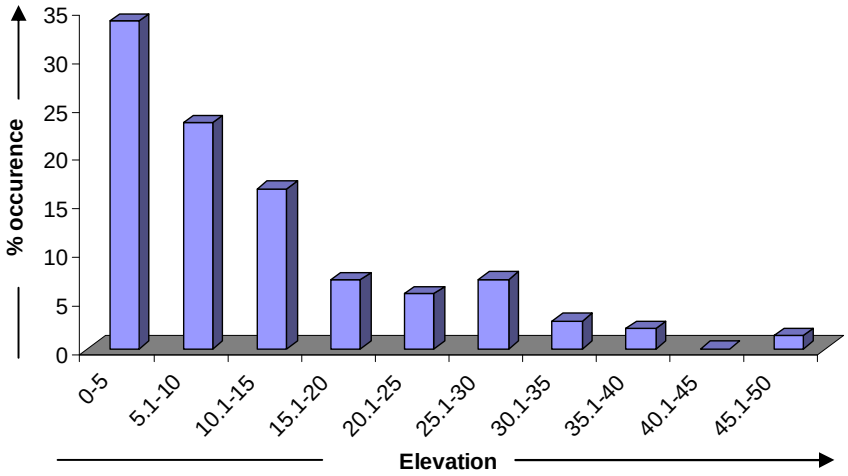


Fig. 2. Occurrence of *Apis florea* colonies at different elevations

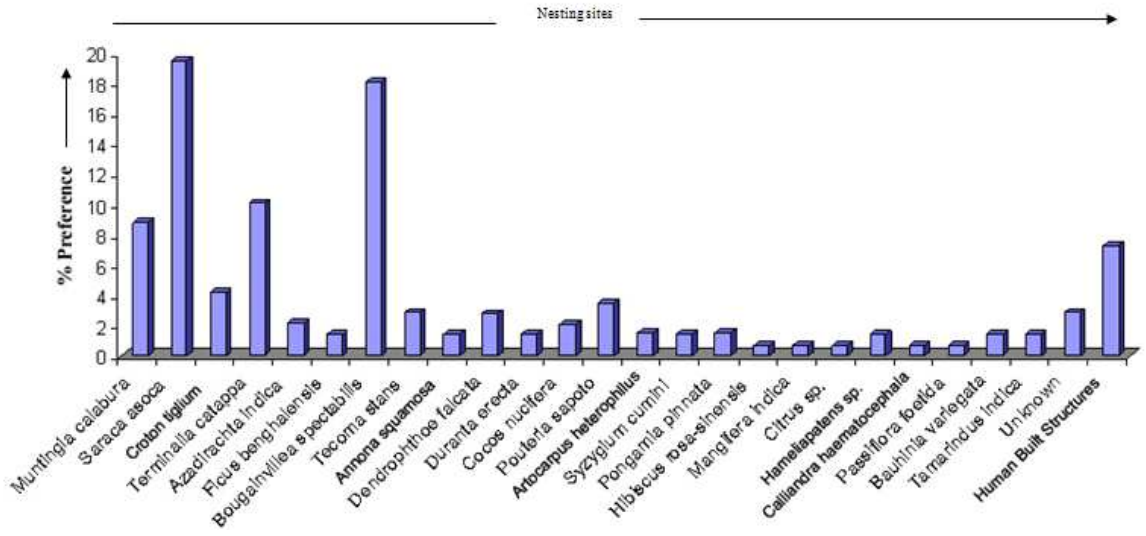


Fig. 3. Plants and Human Built Structures offered for nesting by *Apis florea*

Acknowledgement
Authors thankful to The Chairman, DOS in Zoology, University of Mysore, Manasagangotri, Mysore for the facilities extended during the conduct of this work.

REFERENCES

[1] C Gillot, *In: Entomology, 2nd edition*, **1995,** 324-345.
[2] BP Oldroyd, KE Osborne and M Mardan, *Insects Soc.* **2000,** 47, 94-95.
[3] LA Halling, BP Oldroyd, W Wattanachaiyingcharoen, AB Barron, P Nanork and S Wongsiri, *Behavior Ecol. Sociobiol*, **2001,** 49, 509-513.
[4] SM Sharma, S Fuchs, C Werber and J Tautz, *J. Zoology.* **2002,** 105, 215-223.
[5] C Madegowda, *Economic Political Weekly*, **2009,** 64, 65-69.
[6] TE Rinderer, S Wongsiri, B Kuang, J Liu, BP Oldroyd, HA Sylvester, and L Guzman, *J. Apicult. Res.***1996.** 35, 19-26.
[7]S Wongsiri, C Lekprayoon, R Thapa, K Thirakupt, TE Rinderer, HA Sylvester, BP Oldroyd and U Boocham, *Bee World.* **1997,** 78, 23-25.
[8] P Nanork, J Paar, NC Chapman, S Wongsiri and BP Oldroyd, *Nature*, **2005,** 437:829.
[9] R Thapa, *Bee World,* **2001,** 82, 139-141.
[10] S Basavarajappa, *Animal Biol.* **2010.** 60, 437-447.
[11] F Smith, *Bee World*, **1958**, 39, 29-36.
[12] S Wongsiri, K Limbipicahi, P Tangkanasing, M Mardan, TE Rinderer, HA Sylvester, G Koeniger and G Otis, *Apidologie*, **1990,** 21, 47-52.
[13] P Akratanakul, *Ph.D., Thesis, Cornell Univ., Ithaca, New York.* **1977,** 10-60.
[14] TD Seeley, *Ecology*, **1985,** 31-35.
[15] GW Otis, *In: Social insects and environment*, **1990,** 725-726.
[16] S Wongsiri, TE Rinderer and HA Sylvester, *Prachachon Publishers*, Bangkok. **1991,** 50-63.
[17] HR Hepburn, SE Radloff, GW Otis, S Fuchs, LR Verma, T Ken, T Chaiyawong, G Tahmasebi, R Ebadi and S Wongsiri, *Apidologie***, 2005,** 36, 359-376.
[18] DM Burgett and M Titayavan, *Proc. 8th Int. Conf. Tropical Bees.* **2004**, 46-64.
[19] AG Soman and SS Chawda, *Indian Bee J.* **1996,** 58, 81-88.
[20] R Thapa and S Wongsiri, *Proc. Inter. Symp. Biopest. Phitsanulok*, **1996,** 82-86.
[21] MS Khan, HD Kaushik and HR Rohilla, *Indian Bee J.*, **2002,** 64, 12-19.
[22] CG Butler, *Collins Publishers*, **1954,** London, 25-60.
[23] CWW Pirk, R Hepburn, SE Radloff and J Erlandsson, *Apidologie*, **2002,** 33, 289-294.

[24] S Wongsiri, C Lekprayoon, R Thapa, K Thirakupt, T Rinderer, H Sylvester and B Oldroyd, *Bee World,* **1996,** 77, 25-35.
[25] HR Hepburn and SE Radloff, *Springer, Berlin,* **2011,** 80-95.
[26] P Akratanakul, *American Bee J.* **1976,** 116, 120-121.
[27] SC Pratt, *Apidologie,* **2004,** 35,193-205.
[28] SE McGregor, *Agricultural Handbook,* **1976,** 496.
[29] K Pyramarn and S Wongsiri, *J. Sci. Res.* **1986,** 11, 95-103.
[30] E Crane, *Acta Horticultural.* **1991.** 288, 29-48.
[31] JB Free, *Academic Press,* **1993,** 684.
[32] U Partap and LR Verma, *J. Apicult. Res.* **1994,** 33, 237-241.
[33] Engel, *JBNHS.* **2002,** 99, 3-7.
[34] HR Hepburn and C Hepburn, *Apidologie,* **2005,** 36, 377-378.
[35]O Duangphakdee, SE Radloff, CWW Pirk and R. Hepburn, *J. Insect Physiol.* **2009,** 55, 1009-1012.
[36] US Kamath, *Karnataka State Gazetteer,* **2001,** 1-500.
[37] JS Gamble, *Botanical Survey of India,* 1967, 15-150.
[38] HR Krishnamurthy, *Vignana Sangaathi,* **2001,** 11.
[39] MG Manjunath and S Basavarajappa, *Pro. Impact Climatic Factors & Insect abundance,* **2008,** 70.
[40] MS Khan, HD Kaushik and HR Rohilla, *Indian Bee J.,* **2007,** 69, 8-12.
[41] S Basavarajappa, *Indian Bee J.* **1998,** 60, 143-146.
[42] AD Vaudo, JD Ellis, GA Cambray and M Hills, *J. South Africa,* **2012**, 59, 323-642.
[43] J Woyke, J Wilde and M Wilde, *Proc. 7th Int. Conf. On tropical bees,* **2001,** 183-187.
[44] TK Saha, *Biostatistics in Theory and Practice,* **1992,** 1-60.
[45] S Deowanish, W Wattanachaiyingcharoen, S Wongsiri, BP Oldroyd, S Leepitakrat, TE Rinderer and HA Sylvester, *In: 7th International Conf. Tropical Bees.* **2001,** 97-103.
[46] MG Manjunath, *M. Phil., Dissertation,* **2008,** 1-103.
[47] I Shumakova and A Konissar, *J. Apis. Sci.* **2006,** 50, 33-38.
[48] N Perrin and RM Sibly, *Annu. Rev. Ecol. Syst.* **1993,** 24, 379-410.
[49] GW Otis, *Honeybee Sci.,* **1991,** 15, 167-170.
[50] DW Roubik, *Apidologie,* **2006,** 37, 124-143.
[51] MS Reddy, *6th AAA. Inter. Conf. and World APIEXPO,* **2002,** 152.
[52] CC Reddy, S Reddy and SP Rajesh, *Indian Bee J.* **1986,** 48, 57-58.
[54] RC Sihag, *Proc. 6th AAA Inter. Conf. and World APIEXO,* **2002,** 190.