Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(6): 849-853

Received: 21-08-2020
Accepted: 02-10-2020

Karuna Ingan
Department of Post Graduate Studies and Research in Zoology, Gulbarga University, Kalaburagi, Karnataka, India

K Vijaykumar
Department of Post Graduate Studies and Research in Zoology, Gulbarga University, Kalaburagi, Karnataka, India

Corresponding Author:
Karuna Ingan
Department of Post Graduate Studies and Research in Zoology, Gulbarga University, Kalaburagi, Karnataka, India

Impact of anthropogenic interference on *apis* species in Kalaburagi district, Karnataka, India

Karuna Ingan and K Vijaykumar

Abstract
To most people, nature's finest farmer is denied of value and to prove its value, the field investigations were carried out to record the wild honeybees population at different ecosystems of Kalaburagi district during 2018-19. The investigations were conducted by employing direct visual count method and on an all out search method to record the impact of man-made activities at different ecosystems of Kalaburagi district. During this investigation data revealed that, the distribution of *Apis dorsata*, *Apis florea* and their colony decline at natural and man-made domain. The colony density, abundance and nesting sites of these species varied significantly between different habitats. The farmers, gardeners, common public and residents were met personally in Kalaburagi region and collected the information about colony hunting, colony burning and uprooting of *Apis dorsata* and *Apis florea* hosted trees. However, due to non-altruistic behavior of local people at different nesting habitats and on the foraging plants, the dwarf honeybees namely *Apis florea* is declining at higher rate in various ecosystems. Therefore, there is an emergence, to conserve this species at different ecosystems.

Keywords: *Apis* species, colony decline, human interference, Kalaburagi, India

1. Introduction
The honeybee is one of the most fascinating species in the animal kingdom. Honeybees collect the nectar from flowers and use it to produce honey as a food for themselves and for their young brood (Atwal 2007) [1]. India is a tropical country bestowed with highly diversified ecosystems inhabited by a variety of bee species. The varied ecological conditions with diversified flora have provided favorable habitat for various honeybee species in India. Several honeybee species *viz*., giant honeybee (*A. dorsata*), Indian bee (*Apis cerana* F.), dwarf bee (*A.florea* F.), and stingless bees (*Trigona* sp. and *Melipona* sp.), were widely distributed across the plains, hills and foothills of both urban and rural areas of Karnataka (Basavarajappa 1998; Reddy and Reddy 1989) [4, 3]. These species pollinate various plants (Bright *et al*. 1998), and produce hive products such as honey, wax, pollen, etc. which are useful to mankind (Shukla and Upadhyay 2007) [14]. While *A. dorsata* and *A. florea* (Hymenoptera: Apidae: Apini) show the strong tendency of migration from place to place (Basavarajappa 2004) [5], *Trigona iridipennis* (Hymenoptera: Apidae: Meliponini), a perennial species, rarely undertakes migration. During emigration and immigration, these bees stay at various human built structures (Basavarajappa 2008) [6], and in the ground, hollow tree trunks, and branches (Raju *et al*. 2009). They share common foraging niche in human inhabited ecosystem, agricultural lands, and scruby vegetation. During their foraging/ nesting at various ecosystems, wild honeybees encounter severe threat by man-made activities (Basavarajappa 1998) [4] which is not understood properly. Honey bee colonies both at natural and man-made ecosystems are frequently attacked by various man-made activities, which cause serious loss to natural honeybee colonies at different parts of the world. The damage caused by man-made activities on honey bee colonies and the extent of loss occurred may vary with the geographical regions (Nagaraja and Rajgopal 2009) [13]. Honey hunting – plundering wild nests of honey bees to obtain honey and bee wax is still widely practiced, where people are poor and living at subsistence level and wild honeybee colonies are still abundant. Honey hunting may be seen as a part of the lives of the world's remaining hunter, gathers often at the margin of farming world. The colonies of honey bees are nesting in the wild and depending on species, may be nesting in tree cavities, in trees or rocks, termite mounds or underground. The present investigation, therefore was undertaken to study anthropogenic interference on honeybee species in Kalaburagi area.

2. Materials and Methods

The Kalaburagi district lies between east longitudes 76° 04' and 77° 42' and north latitudes 16° 12' and 17° 46'. The survey was conducted by employing variable width line transect method (Burnham *et al*. 1980) at different habitats namely agricultural lands, avenue trees, natural ecosystem, trees in the cultivable lands and buildings at residential area to estimate colony density of *Apis dorsata* and *Apis florea* during 2018-2019. In line transect method each sampling sites have various size, where the observer walks through a fixed path by counting the honeybee colonies seen on both sides of the path. An all out search method was employed where the nesting sites were not uniform and vegetation distribution was also not similar in all the selected sites (Basavarajappa, 2008) [6-7]. Direct visual count method was conducted to record the man-made activities to the honeybee colonies. *Apis dorsata* and *Apis florea* colonies were recorded by employing the above outlined methods.

The recorded colonies were photographed with the help of Nikon DSLR camera D3400 with 12X optical zoom. Further, the information on human interference at the vicinity of honeybee colonies in nesting habitat on human built structures were collected.

The statistical analysis was done by using SPSS software. The related data was subjected for suitable statistical analysis. Descriptive statistical analysis was done for mean, variance and standard deviation to know the total honeybee colonies. ANOVA was used to know the one factor or independent variable to analyse the three or more categorical groups of distribution of honeybees which are more prone for man-made activities.

3. Results and Discussion

The honeybee colonies recorded during the year 2018-2019 in Kalaburagi district.

During the year 2018-2019 we have found 52 colonies at different months. It is evident from the data that, the number of *Apis florea* were higher followed by *Apis dorsata*. During the summer season the colonies were found more in number and during the rainy season less colonies were found. The data clearly indicated that the colony density of the honeybees during different months differed significantly (Figure No.1) and (Table No.1).

Distribution of the honeybee colonies at different habitats

***Apis dorsata*:** The distribution of *Apis dorsata* colonies were recorded in different habitat namely, avenue trees, residential areas and non-residential areas (Table No.2). The *Apis dorsata* colonies were observed by using the line transect method. However the *Apis dorsata* colonies were less in avenue trees compared to the residential area and non-residential area (Figure No.2).

Apis florea

The distribution of *Apis florea* were recorded in different habitat namely, avenue trees, residential areas and non-residential areas (Table No.3). The sampling areas were selected by observing the habitat based on water source and bushy shrubs and trees. *Apis florea* colonies were observed by using line transect method. *Apis florea* species were found in the bushes. However the *Apis florea* colonies were less in avenue trees and found high in non-residential area (Agricultural land area) (Figure No.3).

Anthropogenic interference by man-made activities

The incidence of honey harvest was commonly found in Kalaburagi district and other talukas of Kalaburagi district. The honey was harvested by Jenu Kurubas, gardeners, local people and even children as a source of food and also used for commercial purpose. *Apis florea* was found harvested by children in rural areas. The local people and gardeners destroy more *Apis florea* species as they are less furious and have great medicinal properties than *Apis dorsata*. *Apis dorsata* species are harvested by the Jenu Kurubas by smoking method. Jenu Kurubas sell the honey and bee products for commercial purpose.

Incidence of honeybee nest destruction by animals/ birds/ insects were found less as compared to the man-made interference. Anthropogenic interference was recorded by interacting with the local people, farmers and the gardeners. Live incidence of destroying the colonies were recorded, such as - hunting the colonies for commercial purpose, uprooting the trees for construction of buildings, man-made activities by using fire in the fields and application of pesticides

The colonies of *Apis dorsata* were found less in number compared to *Apis florea*, according to (Table No.1 and Fig No.1) recorded in Kalaburagi district. During the month of March and April the *Apis florea* colonies were found abundantly. The colonies of *Apis dorsata* did not exist during the months of October and December.

The giant honeybees, *Apis dorsata* requires more food, maintains a foraging range of about 800 m to support its large colony, whereas the dwarf honey bee *Apis florea* needs considerably small quantity of food, forages up to 500 m (Anonymous 2005) [2]. If the flora is not adequate within the radius of 500 to 800 m, these honeybees will migrate to other places in search of food as they have great demand for energy to maintain warm conditions inside the comb. Dyer and Seeley (1994) [9] have reported that honeybees resort to migrations whenever they face hostile conditions such as inclement weather conditions and scanty flora during winter months, perhaps this could be the reason for their absence during winter months namely November and December. The distribution of *Apis dorsata* colonies were found large in number in the residential areas compared to Avenue trees and Non- residential areas and the *Apis florea* colonies were distributed abundantly in non- residential areas compared to avenue trees and residential areas. According to the comparison study, it is observed that *Apis florea* colonies are found commonly compared to *Apis dorsata* colonies as they are aggressive.

Man has attracted to *Apis dorsata* colonies due to their huge size, energy rich high-value organic material called honey, brood and pollen as vital nutrients (Hepburn and Radloff 2011) [11]. Farmers tribes, few people living at the vicinity of forest depend on these product from *Apis dorsata* and *Apis florea* colonies and get additional income during odd seasons by which they improve their socio-economic conditions (Bradbear and Reddy 1998) [3]. *Apis florea* choose tall trees and building structures and *Apis florea* choose small to medium sized trees and bushy vegetation. *Apis florea* are more oftenly destroyed by local people (Basavarajappa 1998 and Basavarajappa *et al*. 2009) [4]. *Apis florea* is weak in it's defense which becomes obvious that bees suffer more destruction due to human activities compared to *Apis dorsata* which are strong in its defense and selective nesting habitat.

Application of pesticides in the cropping area and in addition to it change in cropping pattern could have cumulative effect on honey bee colonies. Uprooting the trees, colony hunting for economic purposes are the main reasons for colony decline of honey bees.

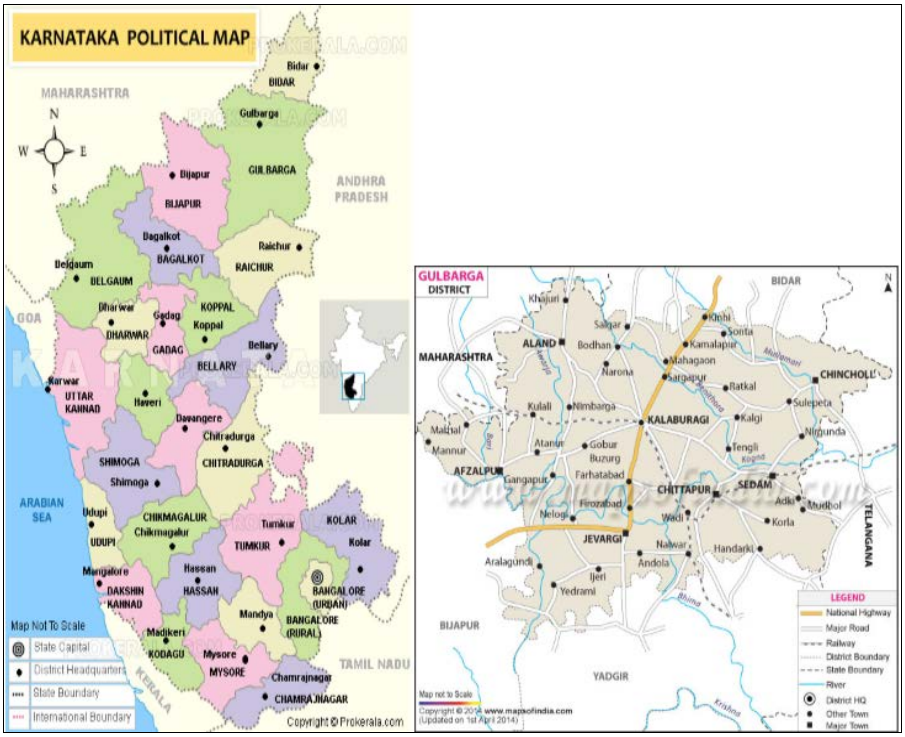


Plate 1: Showing Karnataka state and Kalaburagi (Gulbarga)

Table 1: Honeybee colonies recorded in the year 2018-2019

S. No.	Months	No. of honeybee colonies	
		Apis dorsata	*Apis florea*
1	January	1	2
2	February	2	4
3	March	2	6
4	April	3	8
5	May	2	4
6	June	1	3
7	July	1	2
8	August	2	1
9	September	1	2
10	October	0	1
11	November	1	2
12	December	0	1
	Total	16	36

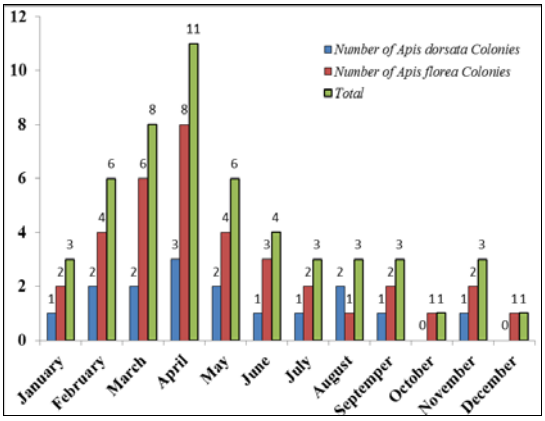


Fig 1: Honeybee colonies during the year 2018 - 2019 in Kalaburagi district.

Table 2: Distribution of *Apis dorsata* colonies at different habitats in Kalaburagi district

S. No.	Months	Avenue trees	Residential area	Non-Residential area
1	January	0	1	1
2	February	1	2	0
3	March	0	3	2
4	April	1	3	2
5	May	1	2	0
6	June	0	2	1
7	July	0	1	0
8	August	1	0	1
9	September	0	2	0
10	October	1	1	0
11	November	0	2	2
12	December	0	1	0
	Total	5	20	9

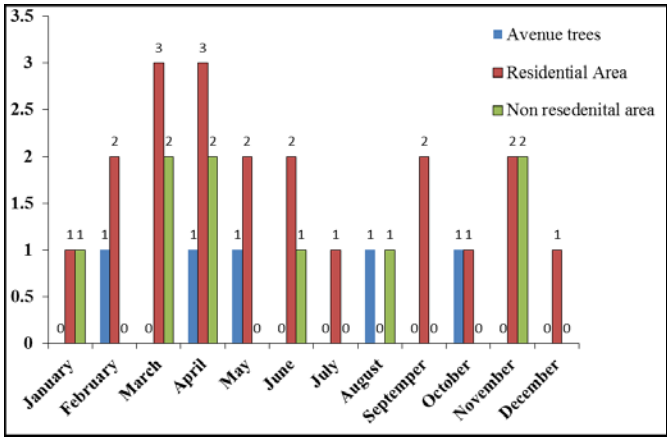


Fig 2: Distribution of *Apis dorsata* colonies at different habitats in Kalaburagi district.

Table 3: Distribution of *Apis florea* colonies at different habitat in Kalaburagi district

S. No.	Months	Avenue trees	Residential area	Non-Residential area
1	January	0	2	2
2	February	1	3	4
3	March	0	3	4
4	April	2	5	6
5	May	3	4	5
6	June	1	3	2
7	July	0	2	2
8	August	0	2	1
9	September	1	1	0
10	October	0	2	1
11	November	1	1	2
12	December	1	2	3
	Total	10	30	32

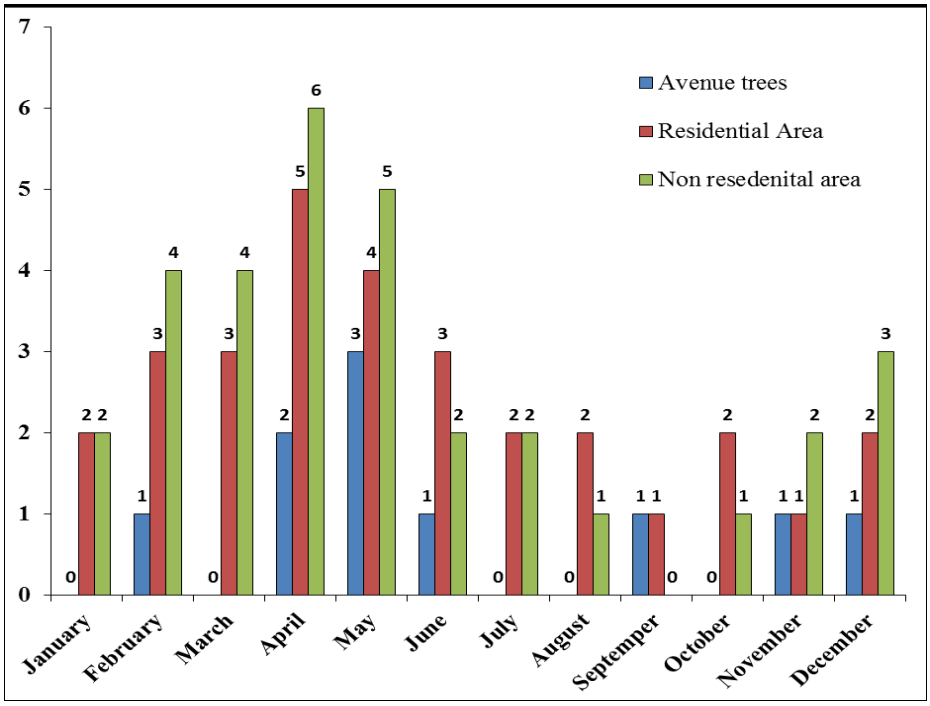
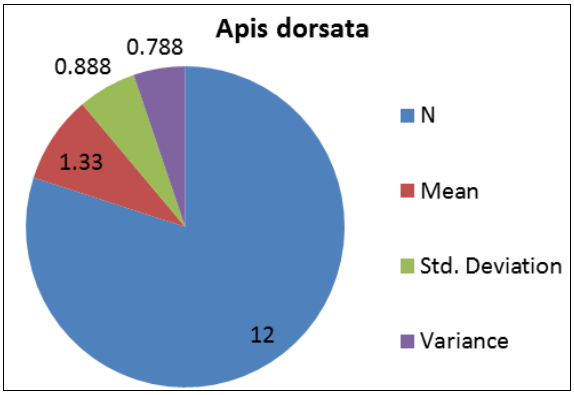


Fig 3: Distribution of *Apis florea* colonies at different habitat in Kalaburagi district.

4. Statistical Analysis

- **According to Table no: 1**

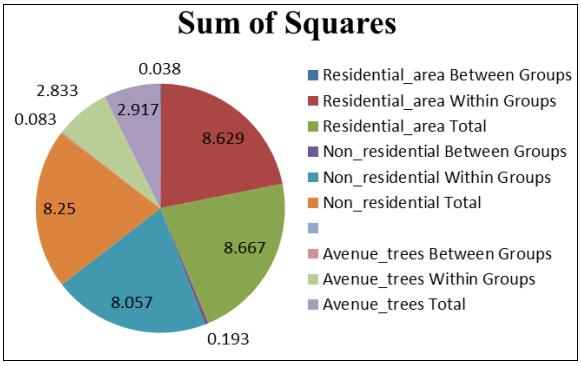
Descriptive Statistics for Honeybee colonies				
	N	Mean	Std. Deviation	Variance
Apis_dorsata	12	1.33	.888	.788
Apis_florea	12	3.00	2.174	4.727
Valid N (listwise)	12			



- **According to Table no: 2 and 3.**

ANOVA for Distribution of *Apis dorsata* colonies and *Apis florea* at different habitats in Kalaburagi district						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Residential area	Between Groups	.038	1	.038	.044	.838
	Within Groups	8.629	10	.863		
	Total	8.667	11			
Non residential	Between Groups	.193	1	.193	.239	.635
	Within Groups	8.057	10	.806		
	Total	8.250	11			
Avenue trees	Between Groups	.083	2	.042	.132	.878
	Within Groups	2.833	9	.315		
	Total	2.917	11			

df = Degree of freedom.
F = F- test
Sig = Significant coefficient (p-value)



4. Acknowledgements

- I, Karuna Ingan wish to express my sincere gratitude to the Chairman, Department of Zoology, Gulbarga University, Kalaburagi for his valuable guidance and advise provided throughout my work.
- I, Karuna Ingan thank Gulbarga University, Kalaburagi for the financial support and for providing good laboratory facilities.

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