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Studies on the impact of man-made activities on *A. dorsata* population in south-western Karnataka, India

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Abstract

Field investigations were conducted by employing direct visual count method (VCM) and an all out search method (AOSM) to record the impact of man-made activities to *A. dorsata* colonies at south-western Karnataka during 2010 to 2012. Farmers, residents and common public were met personally at arid, semi-arid and malnad regions and collected the information about trimming of tree limbs, colony hunting, colonies burning, uprooting of *A. dorsata* hosted trees with the help of pre-tested questionnaire. Total 27 visits were made to record the prevalence of man-made activities on *A. dorsata* colonies during rainy, winter and summer seasons separately. The interference due to trimming of tree limbs was more (6.5%) and other activities namely colony hunting, colonies burning, uprooting of *A. dorsata* nested trees at/in the garden or croplands and clearing of normal colonies have claimed *A. dorsata* colonies less than 4% at south-western Karnataka. Analysis of variance of the data demonstrated the significant variation ($F=3.988$; $P<0.05$) existed between different man-made activities and the Pearson's correlation analysis indicated positive correlation between man-made activities and the abandonment of *A. dorsata* colonies at south-western Karnataka. *A. dorsata* nest big sized colonies, attracted the attention of man for its sweet, energy rich high-value organic material called 'honey', 'brood' and 'pollen'. And, also due to fear of *en mass* attack and venomous sting of *A. dorsata*, its population in the wild is under threat. Therefore, its conservation is need of the hour as it is one of the major pollinator, its conservation is essential to restore local biodiversity.

Key words: *Apis dorsata,* man-made impact, Karnataka, India

Introduction

All living organisms are subjected to interference or attack either by natural enemies or predators or human beings and honeybees of the genus *Apis* are no exception to it. Honeybee 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 to honeybee colonies, and the extent of loss occurred may vary with the geographical regions (Nagaraja and Rajagopal, 2009). Few reports are available on the anthropogenic intereferences on wild honeybees (Basavarajappa, 2010). *A. dorsata* is one of the 'wild bees' nest openly at arboreal conditions (Seeley *et al*., 1982). Its open colonies are easily seen by man, stimulated him to harvest hive products *viz*., honey, pollen and beeswax) and results interference or hive attack at its nesting niche (Viraktamath *et al*., 2005 and Basavarajappa *et al*., 2009). The openly nested colonies offer concentrated high-value organic material *i.e.,* honey (Hepburn and Radloff, 2011), pollen and beeswax (Basavarajappa, 2010). Honey hunters target different parts of bee hive and snatch hive contents (e.g. honey or pollen or beeswax), while others extract significant part of the hive (e.g. brood). All these interference brings considerable damage to the colony population and in turn causes economic loss to beekeeping industry. In addition to this, man-made activities also threaten the welfare of *A. dorsata* population considerably (Basavarajappa, 2010). Unscientific way of honey hunting, beeswax and pollen harvest from the hive becomes a prominent threat to the colonies of *A. dorsata* in the wild. However, reports are available on predators, parasites, pests which cause severe damage to *A. dorsata* colonies at different parts of India and other countries (Abrol, 2003; Nagaraja and Rajagopal; 2011; Morse and Laigo, 1969). Although, *A. dorsata* colonies under arboreal conditions in the wild are free for frequent hunting but, various man-made activities interfere often with its population (Raghunandan, 2015). These activities have created problems to *A. dorsata* colonies at various regions of India and other parts of the world. The published reports on such intereferences to *A. dorsata*

colonies are sparse and only few reports are available in India and other parts of the world (Raghunandan, 2015). Since, south-western Karnataka is one of the premier multifloral honey producing regions, information on the intereferences amidst agri-horticultural ecosystems and at residential areas at this part of the state is scanty. Moreover, intensity of all these problems occurred during seasons is fragmentary. There is a lacuna of information on such type of studies at this part of the State. Therefore, present investigation was made to record the impact of man-made activities on *A. dorsata* population.

Materials and Methods

During the years 2010 to 2012, field observations were conducted by employing direct visual count method (DVCM) and an all out search method (AOSM) to record the impact of man-made activities to *A. dorsata* colonies at different parts of south-western Karnataka. Farmers, residents and common public were met personally at different places located at arid, semi-arid and malnad regions and collected the information by interviewing them with the help of pre-tested questionnaire. In each sampling place, minimum three to maximum four study sites were earmarked randomly. Different lengthen (i.e., minimum 100 meter to one kilometer) variable width (i.e., minimum 10 meter to 100 meters) line transects (VWLT's) were earmarked on roads to record incidences of man-made activities to *A. dorsata* colonies hosted trees on road side by traveling in a car at a speed of 20 kilometers per hour. At residential areas and agri-horticultural ecosystems, AOSM was adopted, where there was uneven distribution of trees and man-made structures which hosted the *A. dorsata* colonies were observed by normal walking. Total 27 visits were made to record the prevalence of man-made activities on *A. dorsata* colonies during rainy, winter and summer seasons separately. Information on *A. dorsata* colony burning, colonies hosted tree uprooting, tree limbs clearance, honey hunting were collected as per the method of Abrol (2002 and 2003), Nagaraja and Rajagopal (2011), Hepburn and Radloff (2011) and Basavarajappa (2012). Per cent intereferences of different man-made activities occurred at *A. dorsata* nested sites were calculated by using standard formula as follows.

$$\text{Per cent Incidences of Man-Made Activities (PIMMA)} = \frac{\text{Incidence of man-made activities at/nearby } A.dorsata \text{ colonies}}{\text{Total number of nest sites visited}} \times 100$$

Impact on solitary colonies, colony aggregates and abandoned combs were considered and photographed with the help of Canon-power Shot S21S, 8.0 Mega Pixels Digital Camera with 12X optical zooms. Collected data was complied and analyzed by using analysis of variance (ANOVA) and Pearson's correlations with the help of digital images and MS-EXCEL and SPSS software (ver 14.0, Chicago Inc., USA).

Results

Occurrence of various man-made activities during different seasons at south-western Karnataka is given in Table 1. In general, per cent occurrence of tree limbs trimming, colony hunting, burning, uprooting of *A. dorsata* colonies hosted trees and clearance of normal colonies are depicted in Figure 1. Of all, interference due to trimming of tree limbs was more (6.5%) and other activities such as colony hunting, colonies burning, uprooting of *A. dorsata* nested trees at/in the garden or croplands and clearing of normal colonies have claimed *A. dorsata* colonies less than 4% at south-western Karnataka (Fig. 1). Analysis of variance of the data demonstrated the significant variation ($F=3.988$; $P<0.05$) existed between different man-made activities (Table 1). Further, Pearson's correlation analysis indicated positive correlation between man-made activities and the abandonment of *A. dorsata* colonies at arid, semi-arid and malnad regions (Table 2). In malnad, man-made activities impact was very high (i.e., around 99%) on *A. dorsata* colonies and it was followed by arid region, where the impact was 60%. However, at semi-arid region, man-made activities impact was moderate (50%) compared to malnad and arid regions of south-western Karnataka (Table 2).

Discussion

Apis dorsata is an open nester (Seeley *et al*., 1982), nest big sized colonies from which multifloral honey, pollen and beeswax are harvested for human advantage (Basavarajappa, 2010). Man has attracted to *A. dorsata* colonies due to their big size, sweet and energy rich high-value organic material called 'honey', 'brood' and 'pollen' as vital nutrients (Hepburn and Radloff, 2011). Farmers, tribes, few people living at the vicinity of forest depend on these products from *A. dorsata* colonies and get additional income during odd seasons by which they improve their socio-economic conditions (Bradbear and Reddy, 1998). However, *A. dorsata* not only help improve the socio-economic conditions of people by providing hive products but, it also help pollinate several plants which survive for its pollination service in the nature (Raghunandan and Basavarajappa, 2014). Interestingly, *A. dorsata* colonies at arboreal conditions in the wild are free from hunting by man and animals. Despite its safe arboreal life, certain anthropogenic activities such as giant tree branches trimming, tree limbs clearing, uprooting *A. dorsata* colony hosted trees, removing fronds in coconut tree, weeds burning in croplands, unscientific way of hive products harvest, burning live colonies due to fear of *en mass* attack and venomous sting by farmers and local honey hunters have curtailed the *A. dorsata* colonies at various regions of south-western Karnataka. All these activities become major trouble shooters to *A. dorsata* population in the wild (Basavarajappa, 1998). Obviously, there was a positive correlation existed between man-made activities and the decline of *A. dorsata* colonies (Basavarajappa, 2010) at different regions of south-western Karnataka. Thus, man acted as one of the natural enemies to *A. dorsata* population, his various activities amidst different regions of south-western Karnataka has affected the colony integrity, altered the colony strength and encouraged the process of colony desertification; finally it led to the colony abandonment (Basavarajappa, 2010). However, the intensity of all these activities varied considerably at different regions of south-western Karnataka. Since, *A. dorsata* form a considerable part of the diet for several species of animals including man (Raghunandan, 2015). Moreover, it is one of the keystone pollinators of various plants, its presence is essential to restore local biodiversity (Solomonraju, 2002; Raghunandan and Basavarajappa, 2014). Otherwise, man has to loose several plant species, which requires *A. dorsata* for their pollination service. And, also people who get additional income by harvesting hive products from *A. dorsata* colonies are to face difficulty to earn money during odd seasons. Our reports are in conformity with the earlier reports of Basavarajappa (1998), Solomonraju (2002), Abrol (2003), Nagaraja and Rajagopal (2011), Hepburn and Radloff (2011) and Viraktamath *et al*. (2005) and others at different parts of the world.

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Annexure

Table 1. Man-made activities on *Apis dorsata* colonies at south-western Karnataka

Sl. No.	Man-made activities	Season			Total
		Rainy	Winter	Summer	
1.	Trimming of tree limbs	8	10	14	32
2.	Normal colonies hunting	2	5	10	17
3.	Normal colonies burning	1	4	7	12
4.	Clearing of colonies	1	3	7	11
5.	Uprooting of nest hosted trees	-	2	4	6
Total		**12**	**24**	**42**	**78**
'F' value		**3.988* (P<0.05)**			**-**

Note: Each value is a mean of 27observations.
* Value is significant.

Table 2. Pearson's correlation ('r') for man-made activities and *Apis dorsata* colonies abandonment at south-western Karnataka

Sl. No.	Man-made activities	Region		
		Arid	Semi-arid	Malnad
1.	Trimming of tree limbs	0.639	0.500	0.997
2.	Normal colonies hunting	0.602	0.458	0.997
3.	Normal colonies burning	0.428	0.327	0.992
4.	Clearing of colonies	0.639	0.500	0.997
5.	Uprooting of nest hosted trees	0.482	0.327	0.992

Note: Data is based on Table 1.

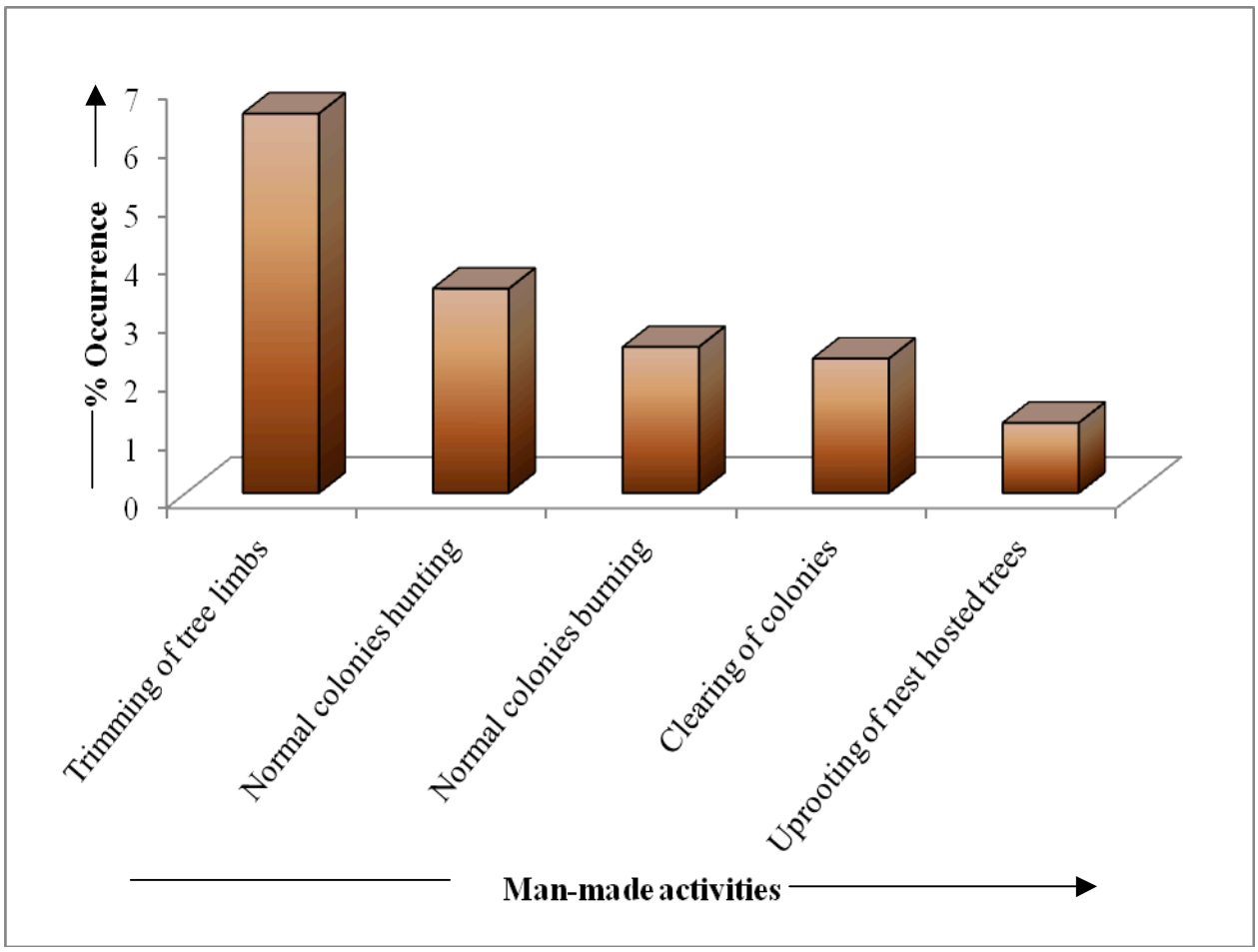

Figure 1. Intereference of man-made activities to *Apis dorsata* colonies in south-western Karnataka