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Noteworthy observations on bee-predators in the Rajaji Tiger Reserve, India

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ABSTRACT

Predators including invertebrates and vertebrates prey on insects in the wild as a natural occurrence for food. Insects such as honeybees, carpenter bees and bumblebees form a major diet of such predators. While certain predators such as bears, skunks and raccoons raid beehives in search of honey, other predators including birds such as Oriental Honey Buzzards and Honeyguides are adapted specifically to feed on beeswax. Bee-eaters (Meropidae) and a few members of Muscicapidae are however specialized in bee-predation. The present article demonstrates notable observations on bee predation along with foraging of beeswax and honey in the Rajaji Tiger Reserve of Uttarakhand, India. The observational records are expected to shed light on the foraging behaviours of birds and mammals that rely on bees as a primary source of food.

Keywords: Bee-Predation, Bee-eater, Honey bee, Shivalik, Uttarakhand

1. INTRODUCTION

Insects are the widely studied groups in the arena of pollination ecology. Among insects that play the ecological role of pollinators, bees are one of the most frequently studied groups (Hung et al., 2018). Owing to their specialized body parts and behaviour, bees collect nectar from flowers for their offspring and inadvertently transfer pollens. Belonging to the order of Hymenoptera, bees play a critical role in pollination, resulting in fertilization and production of seeds. As a result, bees are crucial to the ecosystem in both ecological and economic terms (Byrne and Fitzpatrick, 2009; Kushwaha et al., 2022). Globally, the pollinators are declining at an alarming rate (Potts et al., 2010).

Shifts in native plant communities due to climate change, habitat loss and anthropogenic activities such as the use of pesticides has resulted in the decline of population of pollinators (Newton et al., 2023; Scheper et al., 2014). However, in the wild, bee predation is a natural phenomenon involving predation of different species of bees such as bumblebees, carpenter bees and honey bees by various predators including invertebrates as well as vertebrates. Invertebrate species such as wasps, hornets' viz., *Vespa velutina* and crab spiders are reported to extensively predate on honey bees and reduce their foraging activity (Reader et al., 2006; Sharma et al., 2013; Requier et al., 2019; Laurino et al., 2020).

On the other hand, vertebrates such as amphibians, reptiles, birds and mammals are reported to regularly forage on bees and bring down entire bee-

hives for honey (Kastberger and Sharma, 2000; Kärcher et al., 2008; Ali and Taha, 2012; Goulson et al., 2017; Parveen et al., 2022). In India, most of the studies have been carried out on plant-pollinator interactions and foraging strategies of predators, however, information on the distribution and diversity of predators that forage on bees remains meagre. Nevertheless, a handful of studies have been conducted on bee predation in different parts of the country.

For instance, Sharma et al., (2013) recorded that insects and arachnids were the major pest of honey bees such as *Apis cereana* and *Apis mellifera* in different apiaries of Himachal Pradesh. Furthermore, the authors also recorded molluscs, reptiles, amphibians (*Bufo* sp.), birds and mammals predating on honey bees. A similar study was conducted by Parveen et al., (2022) to understand the potential biotic factors affecting honey bee population in Nainital, Uttarakhand.

Further, in order to understand the role of *Apis dorsata* in response to Blue-bearded bee eater attacks on hives, Kastberger and Sharma, (2000) revealed the importance of inter-colonial defense mechanisms. During recent field explorations in the Rajaji Tiger Reserve (RTR), Uttarakhand, the authors documented unique interactions of bee-predation and foraging on beeswax and honey by vertebrates, particularly birds and mammals.

Study area

Nestled in the Western Himalaya, the state of Uttarakhand is well known for its unique natural heritage it supports due to the distinctiveness of climate, topography and geographical ascents. Owing to its unique flora, the region attracts diverse group of insects such as butterflies, moths & wasps, carpenter bees, bumblebees and honey bees that play a critical role in pollination (Tyagi et al., 2011; Sharma et al., 2012; Jiju et al., 2017; Semwal et al., 2018; Kumar and Srivastava, 2021). Shivalik, the foot hills of the Himalaya are characterized by a series of low-lying hills and valleys with an average elevation of 500-1200 meters. Located in the Shivalik landscape, RTR harbors 44 species of mammals and 369 species of birds https://ebird.org/hotspot/L3231340 (Accessed on 16th June 2023).

2. NOTABLE OBSERVATIONS

Based on the field observations, a total of 19 species (18 species of birds; 1 species of mammal) were observed in RTR (Figure 1). Among avifauna, Muscicapidae (06 species) and Meropidae (04 species) were the abundant families which were observed foraging on honey bees, carpenter bees and other insects. Members of Muscicapidae such as the Dark-sided Flycatcher (*Muscicapa sibrica*), Tickell's Blue Flycatcher (*Cyornis tickelliae*) and Verditer Flycatcher (*Eumyias thalassinus*) exhibited a hawking pattern, mostly using a vantage point or a bare branch to catch the bees in midair and return to the same point. Whereas, Meropidae members such as bee-eaters were mainly observed near bee hives in Chillawali range (30.067653, 77.984583) and Beribara range (30.106158, 77.959003).

Overall, four species of bee-eaters viz. Asian Green Bee-eater (*Merops orientalis*), Blue-tailed Bee-eater (*Merops philippinus*), Chestnut-headed Bee-eater (*Merops leschenaultia*) and Blue-bearded Bee-eater (*Nyctyornis athertoni*) were recorded on different occasions (Table 1), for instance Asian Green bee-eaters were observed over the longest period of time i.e., from February to June. Typical of the bee-eaters, exhibiting a foraging pattern that it often swings from a vantage point to catch bees in mid-air and strike them against a rough object to kill the prey before feeding on it.

During March-April (peak spring in Shivaliks), Asian-Green Bee-eaters were observed perching on electric fences and wires in a group of 3-4. The water tap installed in order to supply groundwater for the forest staff, attracted large number of *Apis dorsata* from early morning to late evening which served as an important foraging territory for bee-eaters. Furthermore, the half-dead bees were scooped up from the ground and consumed after settling on a safe perch. Similarly, the other species of Meropidae such as the Blue-tailed bee-eaters which breeds during the summer in mud banks were mainly recorded foraging on carpenter bees and honey bees (Figure 2).

Interestingly, a single species of Oriental Honey Buzzard was also observed feeding on beeswax and comb of an *Apis dorsata* hive by scraping with its talons. Interestingly, feeding evidences of Asiatic Black Bear (*Ursus thibetanus*) on an *Apis dorsata* hive was recorded (Figure 3). Evidences of claw marks of the bear on a Haldu Tree (*Adina cordifolia*) along with two bee-hives fallen on the ground were observed at Andheri beat of Chillawalli range (30.13319° N, 77.85978° E).

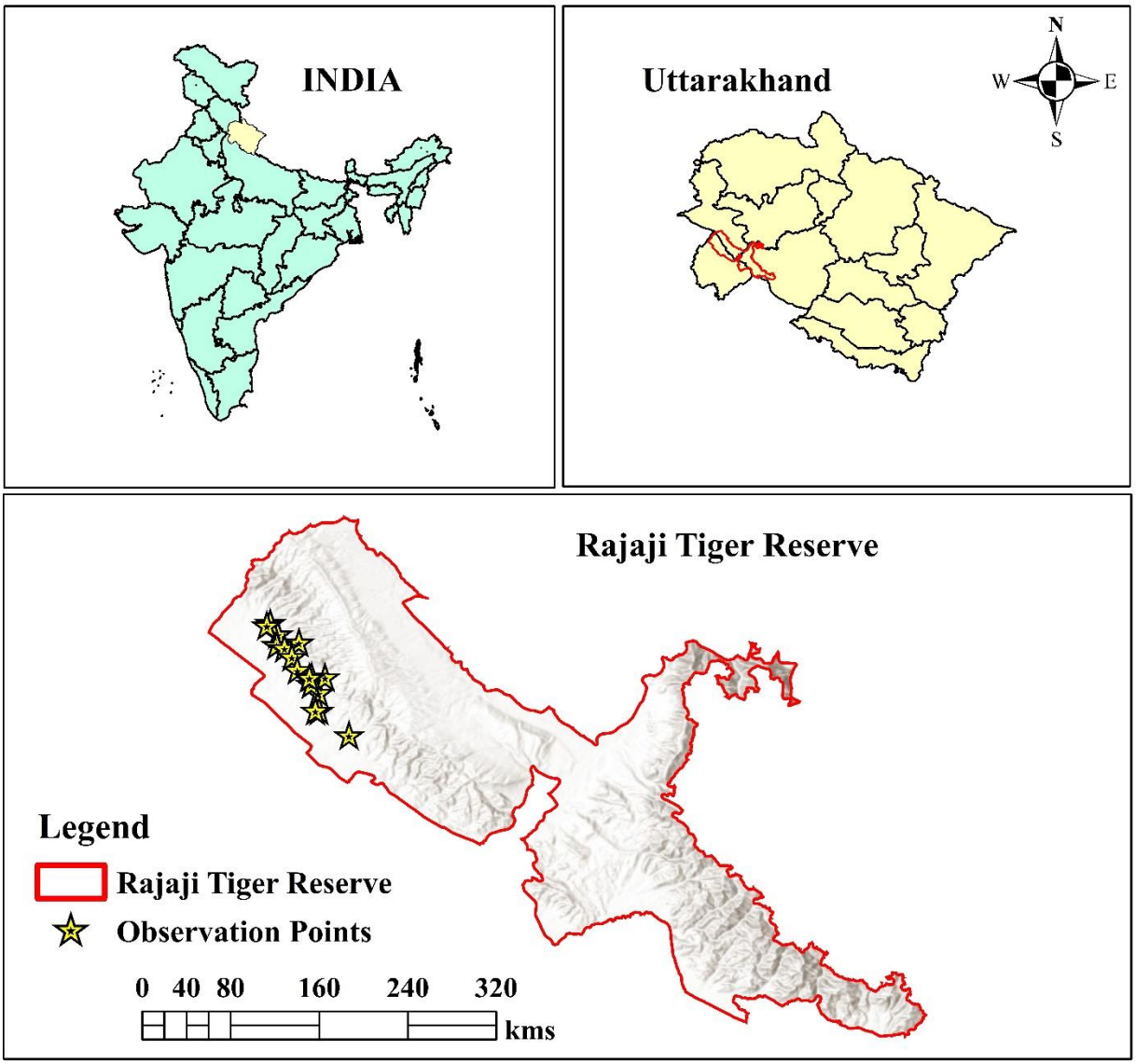

Figure 1 Map showing Rajaji Tiger Reserve along with observation points of bee-predators

Table 1 Observations on bee-predation, beeswax and honey at RTR, Uttarakhand

Species	Scientific name	Class	Family	Observation period	Interaction
Asiatic Black Bear	*Ursus thibetanus*	Mammalia	Ursidae	January-May	Honey, beehive (*Apis dorsata*)
Asian Green Bee-eater	*Merops orientalis*	Aves	Meropidae	February-June	Honey bee (*Apis dorsata*)
Chestnut-headed Bee-eater	*Merops leschenaultia*	Aves	Meropidae	March-April	Honey bee (*Apis dorsata*), Carpenter Bee (*Xylocopa* sp.)
Blue-tailed Bee-eater	*Merops philippinus*	Aves	Meropidae	March-April	Honey bee (*Apis dorsata*), Carpenter bee (*Xylocopa* sp.), Bumblebee (*Bombus* sp.)
Blue-bearded Bee-eater	*Nyctyornis athertoni*	Aves	Meropidae	February-May	Honey bee (*Apis dorsata*)
Bar-winged Flycatcher-shrike	*Hemipus picatus*	Aves	Vangidae	February-March	Honey bee, Hoverfly
Oriental Honey	*Pernis*	Aves	Accipitridae	April-May	Beeswax

Buzzard	*ptilorhynchus*				
Small Minivet	*Pericrocotus cinnamomeus*	Aves	Campephagidae	January-March	Honey bee
Taiga Flycatcher	*Ficedula albicilla*	Aves	Muscicapidae	December-February	Honey bee
Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*	Aves	Muscicapidae	December-February	Honey bee
Dark-sided Flycatcher	*Muscicapa sibirica*	Aves	Muscicapidae	May-June	Honey bee
Tickell's Blue Flycatcher	*Cyornis tickelliae*	Aves	Muscicapidae	January-March	Honey bee
Verditer Flycatcher	*Eumyias thalassinus*	Aves	Muscicapidae	February-March	Honey bee
Grey Bush Chat	*Saxicola ferreus*	Aves	Muscicapidae	February-March	Honey bee
Little Swift	*Apus affinis*	Aves	Apodidae	March-April	Honey bee
Crested Treeswift	*Hemiprocne coronata*	Aves	Hemiprocnidae	May-June	Honey bee
Cinereous Tit	*Parus cinereus*	Aves	Paridae	February-March	Honey bee
Red-vented Bulbul	*Pycnonotus cafer*	Aves	Pycnonotidae	March-April	Honey bee
Hair-crested Drongo	*Dicrurus hottentottus*	Aves	Dicruridae	February-March	Honey bee

Figure 2 Field observations on bee predation: A) Blue-tailed Bee-eater; B) Asian Green Bee-eater; C) Blue-bearded Bee-eater; D) Oriental Honey-Buzzard, a beeswax eater; and E) Small Minivet; F) Chestnut-headed Bee-eater (Photographs: Rounak Patra and Kallol Mukherjee (A.))

Figure 3 A) Sal Forest in Rajaji Tiger Reserve; B) Asiatic Black Bear observed near a bee hive; C) Apis dorsata hive on *Adina cordifolia*; D) Claw marks of Asiatic Black Bear on *Adina cordifolia*; and E) Bee comb under *Adina cordifolia* tree (Photographs: Rounak Patra)

Additionally, maximum bee predation was recorded on abundant flowering plant species such as *Justicia adhatoda, Schleichera oleosa, Cassia fistula, Butea monosperma*, to name a few. Furthermore, most of field observations on bee predation were recorded adjacent to water source such as water holes, *nalah* (small streams) and puddles. The visitations of bees on flowering plants were observed mainly during spring and early summer.

3. CONCLUSION

The study highlights diverse range of bee predators along with the species interactions in Rajaji Tiger Reserve. The field observations indicate that a major part of the diet of insectivorous birds belong to Muscicapidae and Meropidae. However, it is submitted that robust quantification of diet of these particular group of species would be essential to understand their role in bee-predation. The findings also shed light on the significance of conserving bee populations and their habitats. While bee predation in the wild is natural, the changes in the climatic conditions may significantly impact the predator-prey relationships, hence it is prudent to understand the phenology of flowering plants in the region.

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Author Contributions

RP: Original draft preparation, field observations and photographic documentation; SK: Original draft preparation and field observations; HS: Field Observation and draft preparation; AK: Manuscript writing and review

Informed consent

Not applicable.

Ethical approval

The Animal ethical guidelines are followed in the study for species observation & identification.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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Data and materials availability

All data associated with this study are present in the paper.

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