



AN ATTEMPT TO EXPLORE BUMBLE BEES IN NAGALAND

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ABSTRACT

A survey was conducted in five districts of Nagaland viz., Dimapur, Peren, Kohima, Phek and Kiphire to know the presence of bumble bees and their diversity. A total of 93 bumble bees were collected from forest and cultivated areas. These were got identified and their flora was recorded along with their activity. Bumble bees were observed in Khonoma region in Kohima and Pfutero in Phek district, while these were not observed in Dimapur, Kiphire and Peren district of Nagaland. *Bombus orientalis* Smith was the species observed, with some differences in their morphology. Morphometrics revealed difference in various studied parameters of queens and workers.

Key words: *Bombus orientalis*, survey, bee flora, foraging activity, abundance, morphology, morphometrics, queen, workers rearing, brood

Bumble bees (*Bombus* spp.) are efficient pollinators, especially under protected cultivation (Velthuis and Doorn, 2006; Shipp et al., 1994; Chauhan, 2011) considered as alternate pollinators to the honeybees. These belong to order Hymenoptera, tribe Bombini and genus *Bombus* having more than 250 species in temperate, sub-temperate and sub-tropical regions. The behaviour, physiology and morphology of bumble bees make them ideal pollinators because of the speed at which they transfer pollen, the efficiency with which they gather pollen within various crops, and the increased endurance to fly in adverse weather for longer periods of time (Corbet et al., 1988; Erikson and Buchmann, 1983). The bumble bee also has the ability to buzz pollinate the flower for pollen, a pollination technique not reported in honeybees. Buzz pollination occurs by bumble bees vibrating the flower by pumping their wings at a certain frequency, to dislodge pollen. These are widely used for the pollination of greenhouse crops in Holland, New Zealand, China, Japan, Bulgaria, UK and Germany (Free, 1993; Stanghellini et al., 1997).

Different species of bumble bees like *Bombus haemorrhoidalis* Smith, *B. trifasciatus* Smith, *B. rufofasciatus* Richards, *B. monticolans* Richards, *B. simillimus* Smith, *B. eximius* Smith, *B. mimeticus* Richards, *B. tunicatus* Smith, *B. orichalceus* Fries, *B. oculatus* Frison, *B. waterstoni* Richards are reported from different parts of Himachal Pradesh, Utra-Khand, North Bengal and North Eastern India especially Meghalaya and Arunachal Pradesh but till

now no attempt was made to explore the bumble bees in Nagaland. *Bombus haemorrhoidalis* is a dominant species in Himachal Pradesh found mainly under sub-tropical and subtemperate region (Chauhan and Thakur, 2014; Yankit et al., 2018; Taye et al., 2021). Artificial rearing methods for this bumble bee species has been developed for round the year rearing (Chauhan et al., 2014) but still the efforts to commercialize this species is not yielding expected outcomes from last two decades. Knowing the importance of bumble bees and hindrances in commercialization of *Bombus haemorrhoidalis* Smith in spite of regular efforts by researchers, attempts are required to explore other species of bumble bees from other regions in India for domestication and their utilization for the pollination of crops commercially. Keeping in view the importance of bumble bees, and the problems in commercialization of bombiculture in the country, present study observed the dominant bumble bee fauna in Nagaland.

MATERIALS AND METHODS

A survey was conducted in five different districts of Nagaland during October- December 2019 and 2020, varying in their altitudes from 370 to 2100 masl. Foraging bees were collected during early morning hours (0530 hr) till late evening (1630 hr) from various wild, fruit, vegetable and ornamental plants. The bees were identified in the field on the basis of their big size, black thorax with coloured yellow and orange banded abdomen. Samples were collected with insect nets and then shifted in plastic vials (3.5 x 9 cm) with perforated

lids, and fed with 50% sugar solution to keep them alive. These were brought to the laboratory at School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema. The dead bees were transferred to 70% ethyl alcohol in plastic vials. The flora was also recorded while collection with foraging activity recorded on dahlia at Khonoma village under Kohima district and lupin flowers at Pfutsero village area under Phek district, every two hours interval consecutively for 3 days. Seven samples each of small and large size bumble bees were used for morphology and morphometric studies. Samples were got identified by the Division of Entomology, IARI, New Delhi. Five large size bumble bees (supposed as new queens) were shifted in separate wooden box and rearing experiments were laid as per Chauhan et al. (2014). The bumble bee queens were kept in incubator at $27 \pm 1^\circ\text{C}$ fed with 50% sugar solution and corbicular pollen. The sucrose solution was replaced every day while the pollen was replaced thrice in a week. Feeding was given in bottle lids (2.5x 1.75 cm). The queens were observed daily

in night time for growth and development. The data obtained was subjected to statistical analysis.

RESULTS AND DISCUSSION

A total of 93 bumble bee samples were collected from five districts viz., Dimapur, Peren, Kohima, Phek and Kiphire. Of the districts, bumble bee samples were obtained only in hilly areas of Kohima ($25^\circ 40' 18.147''$ N, $94^\circ 0' 54.837''$ E; $25^\circ 39' 14.106''$ N, $94^\circ 1' 21.331''$ E) and Phek districts ($25^\circ 33' 45.681''$ N, $94^\circ 8' 44.447''$ E and $25^\circ 34' 15.6''$ N, $94^\circ 18' 3.6''$ E, 901- 2133 masl). The major flora observed include- *Lupinus* sp., *Rosa macrophylla*, *Dahlia* sp., *Calendula* sp., and *Dombeya spectabilis* (Table 1). During the month of October, the foraging bees were collected from *Cosmos bipinnatus*, *Dahlia* sp., *Lupinus* sp., *Dombeya spectabilis* and *Costus speciosus*. Similarly, in the month of November, the bees were caught while foraging on *Ziziphus mauritiana*, *Lageneria vulgaris*, *Dombeya spectabilis*, *Lupinus* sp., *Dahlia* sp., *Calendula* sp., *Binicasa hispida*, *Averrhoa carambola*,

Table 1. Important flora for collection of bumble bee, *B. orientalis* Smith

Month	Botanical Name	Common name	Place of collection
October	<i>Cosmos bipinnatus</i> ,	Aster	Khonoma and Pfutsero
	<i>Dahlia</i> sp.,	Dailia	
	<i>Lupinus</i> sp.,	Lupin	
	<i>Dombeya spectabilis</i>	Pink ball	
	<i>Costus speciosus</i>	Crepe ginger	
	<i>Chrysanthemum</i> spp.	Asters	
	<i>Lupinus</i> sp.	Lupin	
November	<i>Ziziphus mauritiana</i> ,	Ber	Khonoma and Pfutsero
	<i>Lageneria vulgaris</i> ,	Bottle gourd	
	<i>Dombeya spectabilis</i> ,	Pink ball	
	<i>Lupinus</i> sp.,	Lupin	
	<i>Dahlia</i> sp.,	Dailia	
	<i>Calendula</i> sp.,	Ruddles	
	<i>Binicasa hispida</i> ,	Ash gourd	
	<i>Averrhoa carambola</i> ,	Star fruit	
	<i>Aeginetia indica</i>	Forest ghost flower	
	<i>Rosa macrophylla</i>	Wild rose	
December	<i>Prunus cerasoides</i> ,	Wild cherry	Khonoma and Pfutsero
	<i>Dombeya spectabilis</i> ,	Pink ball	
	<i>Lycopersicon esculentum</i> ,	Tomato	
	<i>Rosa macrophylla</i> ,	Rose	
	<i>Cajanus cajan</i> ,	Red gram	
	<i>Calendula</i> sp.	Ruddles	
	<i>Allium hookeri</i> ,	Wild onion	
	<i>Euphorbia</i> sp.	Poinsettia	
	<i>Prunus persica</i>	Peach	
	<i>Carica papaya</i>	Papaya	

Table 2. Foraging activity of bumble bees, honey bees/ other pollinators on *Dahlia* sp. and *Lupinus* sp.

Day hour (hr)	Relative abundance (number/ 10min/ m ²)							
	Bumble bees		Honey bees		Other insects		Mean	
	Dahlia	Lupin	Dahlia	Lupin	Dahlia	Lupin	Dahlia	Lupin
0530	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0730	2.24	2.00	1.67	1.11	0.00	0.00	1.30	1.03
0930	6.63	4.67	7.33	4.11	1.67	1.00	5.21	3.26
1130	7.33	8.33	9.36	4.33	3.22	1.33	6.63	4.66
1330	5.67	5.46	6.66	2.33	3.67	2.33	5.33	3.37
1530	2.33	3.11	2.33	0.00	1.00	0.00	1.88	1.03
1630	1.33	0.00	0.00	0.00	0.00	0.00	0.44	0.00
Mean	3.65	3.37	3.91	1.70	1.37	0.67		

CD_{p=0.05}: Day hour: 0.43; Pollinator: 0.51; Pollinator x Day hour: 0.91

Aeginetia indica and *Rosa macrophylla*. In the month of December, *Prunus cerasoides*, *Dombeya spectabilis*, *Lycopersicon esculentum*, *Rosa macrophylla*, *Cajanus cajan*, *Calendula* sp., *Allium hookeri*, *Euphorbia* sp., *Prunus persica* and *Carica papaya* etc., were the sources of bumble bee samples collection. Earlier, different researchers (Saini and Ghattor, 2007; Kashyap, 2008; Chauhan et al., 2010; Chauhan, 2011; Chauhan and Thakur, 2014; Chauhan et al., 2014; Chauhan, 2015; Chauhan et al., 2016a, b; Nayak, 2018; Yankit et al., 2018; Sharma et al., 2018; Nayak et al., 2022) also observed the bumble bees on different flora and altitudes and concluded that the bumble bees can be collected while foraging for pollen and nectar. The activity of bumble bees started at 0605 hrs in the morning and ceased at 1623 hr on *Dahlia* sp. at Khonoma while the activity of bumble bees initiated at 0625hr and ceased at 1538 hr on *Lupinus* sp. during the month of November. The maximum activity of bumble bees was observed in late morning hours (1000-1300 hrs) and the minimum activity was recorded in early morning and late evening hours of the day at both locations (Table 2). Kashyap (2007); Chauhan (2011); Nayak (2018); Nayak et al. (2020); Nayak et al. (2022) observed maximum activity of *Bombus haemorrhoidalis* during late morning hours of the day and minimum activity was recorded in late evening hours in same species.

The morphological characters revealed that bumble bees were bigger in size as compared to honey bees, with black and yellow bands on the abdomen; abdomen covered with hairs, but less so on ventral side; thorax was also covered with hairs. Head and face elongate, slightly pubescent, space between eyes and base of mandibles and the clypeus was bare and shining, mesosoma and metasoma were densely pubescent. Head, thorax, upper parts of the legs and third abdominal segment clothes with black, basal two segments bright

yellow and the apical three segments having brick red pubescence. Morphometrically, body, tongue, antenna, mandible, femur of hind leg, forewing and hind wing of small ones measured 19.78 mm ± 0.33, 10.44 mm ± 0.11, 5.95 mm ± 0.09, 1.53 mm ± 0.07, 4.14 mm ± 0.10, 15.64 mm ± 0.14, 10.56 mm ± 0.14, respectively. But for large size ones it was 25.49 mm ± 0.13, 12.84 mm ± 0.18, 6.89 mm ± 0.07, 2.24 mm ± 0.05, 5.96 mm ± 0.12, 21.11 mm ± 0.14 and 14.52 mm ± 0.11, respectively. *Bombus haemorrhoidalis* and *B. rufofasciatus* described by Chauhan et al. (2016a,b) differs with these, which were identified as *Bombus orientalis* Smith. Large size bumble bees kept in incubator did not secrete wax and eggs were not laid in any of the domicile. Jie et al. (2005) described methods for successful rearing of bumble bees, and revealed ambient temperature and humidity are important factors. Chauhan (2015) stated that unmated queens do not survive in winters.

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