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A View of Buzz Pollination by Bumblebee and its Role in the Environment in Various Landscapes of Kashmir

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Abstract: **Understanding animal movement is critical for conservation planning, habitat management, and ecological study. However, our understanding is often limited by methodological constraints. These limitations can be especially problematic in the study of ecologically and economically important pollinators like bumble bees, where several aspects of their biology limit the feasibility of landscape-scale studies. The present study was to examine the pollination potential of bumblebees in relation to their host plants in various landscapes of Kashmir region. The study was conducted from five different altitudes with varied type of vegetation in each site. Ten plant species belonging to seven different plant families were observed as host plants in five localities ranging from 1500 to 2600 meters in altitude. During the study a total of five bumble species were recorded and all species showed significant relation with the environmental variables as shown by Canonical Correspondence Analysis (CCA).**

***Keywords*— Bumblebees, pollination, vegetation, nectar, pollens, Kashmir valley**

I. INTRODUCTION

In a global perspective, roughly half of all land is used by humans for either crop production or as rangelands for cattle [1]. Agricultural practices and management strategies thus directly influence a large part of the earth's surface. In addition, there are indirect influences since farming activities, fields and pastures are not isolated but indeed connected to other habitats [2], e.g. via waterways and winds as well as through dispersal and landscape complementation of organisms [3]. Pollination of flowering plants by animal pollinators is an essential ecosystem function [4]. Among the diverse suite of flower visiting insects, bumblebees (Bombus spp.) are among the most efficient pollinators in the temperate and cold climate zones [5]. Numerous studies on pollination efficiency and pollen dispersal illustrate the outstanding pollination potential of bumblebee workers [6], which well exceeds that of honeybees (Apis mellifera) for many wild and managed plants [7].

The pollinator's action is extremely important in agricultural crops, being directly or indirectly responsible for about 1/3 of the food production consumed by humans worldwide [8].In this context 73 % of cultivated species relies on the action of the bees for pollination. Their action can influence the quality of fruits and seeds produced increase productivity [9], as well as to standardize fruit ripening, which hence avoid crop losses [10]. Around 35% of the world production of crops, fruits and vegetables are indeed dependent on animal pollinators for proper fruit and seed set [8]. In this light, it is interesting that responses of bumblebees to landscape changes imposed by agriculture differ between species. Many species have declined, but some remain common even in very simplified regions [11]. In general, the number of pollinating guild species has declined alarmingly and the main causes are related with agricultural intensification, including the use of agrochemicals [12]. In planting areas, knowledge about interactions between crops and their pollinators, on a local scale, is important to propose management and protection actions to these agents [13]. It is within this scenario that I have studied bumblebees, Bombus spp. in Kashmir valley which is dominated by agriculture.

II. MATERIALS AND METHODS

Fig. 1. View of Baramulla region of state Jammu and Kashmir, India.

The study was carried out from May 2020 to May 2021 from the vegetation rich area of Baramulla district of Kashmir. During the regular field surveys as a part of ecological studies on terrestrial fauna of Kashmir. Baramulla district has rugged and hilly terrain, about 60 percent of the district is mountainous and 40 percent is plain area. Vast proportion of land is characterized with steep slopes, hilly vegetation and rocky outcrop. Baramulla District is sharing border with Badgam District to the East, Kupwara District to the North, Poonch District to the South. Baramulla District occupies an area of approximately 4190

square kilometers. It's in the 1589 meters to 1577 meters elevation range.

Sampling of floral visitors was carried out in the periods of May to October 2020and April to June 2021. Bumblebees were counted seen within a 1m by 200m zone on each side of transects, i.e. one zone lying within the crops or pastures and the other side being the non-crop border habitat. Bumblebees were surveyed on days with predominantly clear skies temperatures above 15°C and no strong winds. Transects were walked at a slow pace and bumblebees seen foraging were determined to species by eye or if necessary, caught with a hand-net and identified using [14].

III. Results and Discussion

Table 1. Locations selected for sampling of Bumblebee species. (- indicates absence and + indicates presence.)

Location	Altitude above sea level	Global Positioning	Major vegetation type
Hyderbiegh	1500 meters	34°8'N and 74°20' E	Mixed vegetation and ornamental Plants
Wanigam	1559 meters	34°10'N and 74°31' E	Hilly apple orchard, weeds
Pattan	1550 meters	34°17'N and 74°57'E	Karewa beds, Mixed vegetation, ornamental plants
Tamgmarg	1577 meters	34°33'N and 74°25'E	Forests, Cherry orchards, Mixed vegetation
Gulmarg	2650 meters	34°5'N and 74°38' E	Dense forests

Table 2. Host plants of Bumblebees, Bombus spp. recorded during the study.

Plant Family	Host plant	Flowering time
Cucurbitaceae	*Cucurbita moschata*	June-July
Verbenaceae	*Lantana camera*	May-July
Leguminoceae	*Phaseolus vulgaris*	April-May
Solanaceae	*Solanum melongena*	July-August
Punicaceae	*Punica granatum*	May-June
Cucurbitaceae	*Cucumis sativus*	March-August
Solanaceae	*Lycopersicon esculentum*	July-August
Rosaceae	*Pyrus communis*	April-May
Verbenaceae	*Lantana camara*	April-August
Compositae	*Bellis perennis*	April-August

Hibernated bumblebees started emerging in March to April, with most prominent appearance observed from plain agricultural fields. Five species of bumblebee were recorded during the entire survey. Recorded bumblebees showed diverse range of its habitat sites with diverse environments and climatic regions providing the successful establishment and survival in nature (Table 1). Their foraging plants mainly included cultivated crops, weeds and ornamentals (Table 2). Ten plant species belonging to seven different plant families were observed as host plants in five localities ranging from 1500 to 2600 meters in altitude (Table 2). The families of plants visited for nectar and pollens belonged to Cucurbitaceae, Verbenaceae, Leguminoceae, Solanaceae, Punicaceae and Rosaceae. The most commonly visited plant included Lantana camara belonging to the family Verbenaceae. Statistical analyses were carried out with the PAST Software Package (Version 4.03).

Table 3. No of recorded individuals in each month of sampling during the study.

Site		Average Max.-Temp (˚C)	Average Rainfall (mm)	Day-light (Hours)	No. of individuals
Hyderbiegh	*Bombus haemorrhoidalis*	20.5	85	13	56
Wanigam	*Bombus trifaciatus*	24.5	68	13.9	67
Pattan	*Bombus miniatus*	29.6	39	14.4	72
Tangmarg	*Bombus simillimus*	30.1	62	14.2	83
Gulmarg	*Bombus asiaticus*	29.6	76	13.4	45

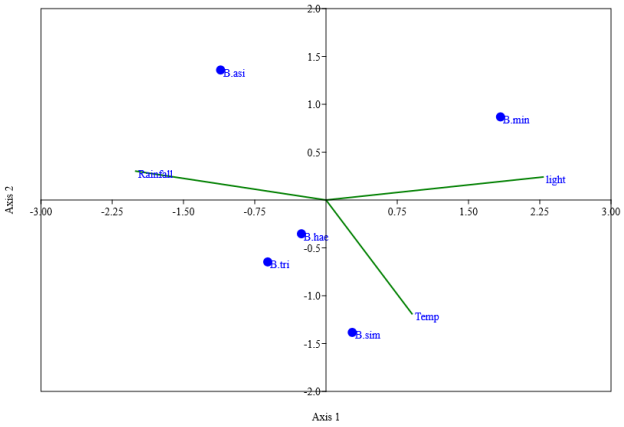

Fig.2. Canonical correspondence analysis (CCA) showing association of bumblebee species with environmental factors. B.hae (Bombus haemorrhoidalis), B.tri(Bombus trifaciatus), B.min(Bombus miniatus), B.sim (Bombus simillimus), B.asi (Bombus asiaticus)

Hierarchical clustering (Bray-Curtis similarity measure) was used to identify natural groupings among the sampled points according to similarities in their species composition. Cluster analysis is the arrangement of samples into groups (Cluster), so that samples within the same cluster are more similar to each other than to samples from different clusters. When species assemblages among the study sites were compared using Bray-Curtis cluster analysis, Pattan supported bumblebee assemblages more similar to wanigam. (Fig.2). which is likely due to similarities in specific microhabitat characteristics.

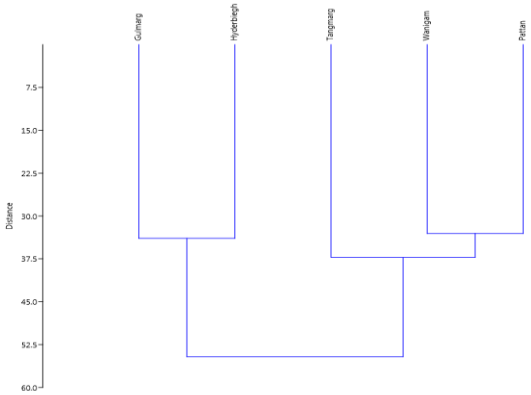

Fig.3 Bray-Curtis group average link cluster analysis in the foraging sites

Fig. 4 : Bumblebees observed foraging for nectar and pollen.

The CCA was performed on insects to check the effect of environmental factors like rainfall, daylight and temperature. All the species except Bombus trifaciatus and Bombus haemorrhoidalis showed a strong association with rainfall, temperature and light. Thus the current study will provide essential base line information of the insect fauna to agronomists in the area. They can take steps to sustain croplands in more efficient manner, which not only lead to increase in crop yield but also stabilize the food webs in the agro-ecosystems of the Kashmir.

Different bee species play vital role in pollination and survival of plant species in nature. Some species have been used for crops pollination and increase in yields to meet their food requirements for humans and the economic value of the crops. The lowest altitude where these bumblebees were observed is around 1500 m altitude which is from the parks of Pattan area. However, another species, Bombus trifaciatus has been widely observed from the high altitude (1600 – 2600m) regions of Tangmarg and Gulmarg, showing their diverse climatic adaptations. These bumblebees have established an interaction with their wild host plants for centuries to meet their pollen and nectar needs. Previously no work has been carried out to show the foraging range of bumblebee species of the present selected area. The collection of the food resources has been considered as important factor for their survival and fecundity [15]. Honeybees and bumblebees keep the record of suitable host plants for food reserves and develop interactive responses with their quick learning abilities [16]. Pollen collected by bumblebees can also help to identify the food supply for these important pollinators. Different environmental factors including temperature, moisture, photoperiod and availability of food are also very important limiting factors for their normal flight activity. Present studies highlighted the importance of bumblebee species of this region observed at different altitudes and habitats. Further detailed studies focusing the floral needs, behavior and rearing conditions are desired for this community of species to serve under controlled farming systems and benefit the cultivated plant species of economic value.

IV. CONCLUSION

Bumblebee's visitation was observed on diverse plant families as floral resources. These floral plants were the main source for provision of nectar and pollens present in wild and managed parks. However, the crop plants with longer available floral resources were visited more than short season flowering. The information provided is the first of its kind from this part of world. The area needs to be continuously monitored and efforts be made to document its unknown floral and faunal wealth and there is essential need to have a vision document on the sustainable development of the region with care and focus on documentation and conservation of its rich biodiversity.

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