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First record of Genus *Bombus* Latreille (Hymenoptera: Apidae, Bombini) in Naran Kaghan valley of Pakistan and their floral host range

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Abstract

Five species of the Genus *Bombus* Latreille (Hymenoptera: Apidae, Bombini) have been reported from the Naran Kaghan valley, KPK province of Pakistan. All of these species has been reported for the first time from this geographical area with their locality records supported by their identification characters and world distribution. *Bombus haemorrhoidalis* was restricted to altitude less than 6000 feet whereas other four were observed above that range. Host plants of all these species were also reported for the first time from this area. Floral host plants belonged to ten different plant families and comprised of twenty four floral plants. Such ecological information is important to get their possible utilization in further biological experimentation, commercial pollination services and environmental conservation.

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Introduction

Naran and Kaghan valley is situated in Northern Pakistan having capacity of a great variety of flora and fauna due to its diverse range of altitude, latitude and climate. It is surrounded by the regions where the earth's biological assets are most unique and wealthy (Malcolm *et al.*, 2002). From 5700 species of floral resources in Pakistan, nearly 8-16 percent vascular plants including wild weeds occur in the Northern mountain regions of Pakistan (Khan *et al.*, 2009). Bumblebees as pollinators play key role in ecological service in Northern Pakistan (Sabir *et al.*, 2008) observed on 160 floral host plants during their foraging activity in Himalayan region (Raina, 2011). These bees are important pollinators of cultivated as well as wild flowering plants in the high altitude region of Himalaya (Williams, 1991).

Genus *Bombus* comprise about 250 known species worldwide (Williams *et al.*, 2008). The majority of these species are true bumblebees having social worker caste. These bees have ability to pollinate at high speed by opening the pollen sacs with vibration as buzzing behavior. They are important and competent pollinators (Abak *et al.*, 2000; Semida, and Elbanna, 2006) with ability to forage in unfavorable weather conditions being unsuitable to honeybees and other solitary bees. Their efficiency to forage at low temperature and light makes them the most reliable and efficient pollinators both in enclosed and field cultivated crops (Heinrich, 1979). Thirteen indigenous species has been reported from Northern Pakistan ranging from 2291 to 5344m above the sea level (Sabir *et al.*, 2009) which may have some interaction with their existed diversity at altitude stratum and possible floral searching behavior to a certain limit (Cannani *et al.*, 2006).

Number of bumblebee species and their size depends on floral resources and their variation with diverse flower shape and structure. These are also dependent to variation of altitude with plant diversity and abundance (Saini *et al.*, 2012b). Their critical role in ecosystem conservation makes them important living

organisms like other pollinators (Corbet *et al.*, 1991; Banaszak, 1992; Barbattini, 1994). Their richness deserves thorough understanding of their interaction with their native environment and flora of that particular region making them indispensable for different habitats. Knowing about indigenous bumblebees is important to improve their services in pollination of our cultivated crops and native plants (Sabir *et al.*, 2008).

Species richness, abundance and their floral host plants information plays key role in their further utilization for pollination in commercial field and enclosed farm crops of high economic value. These also highlight their important role and stress for the practices to get adopted for their long term conservation and habitat richness. These stressed to look for available indigenous bumblebee species from this diverse landscape having plant diversity. Present study was conducted from five different locations of Naran Kaghan valley having the altitudinal distribution ranging from 4000-10000ft.

Materials and methods

A survey was conducted during 2013 from different localities of Naran valley district Mansehra, Khyber Pakhtunkhwa (KPK) province of Pakistan (Fig. 1). The entire area is formed by high spurs of mountains on either side of the River Kunhar which flows in a northeast to southwest direction. The study area lied between 4000 to 10000 feet elevation from sea level with diverse topography and floral resources. These locations differ in type of landscapes, altitude and diversity of flora for bumblebees. Entomological hand nets were used to collect the foraging bumblebees from different landscapes and floral host plants. Collection was made from 8 to 11 am in sunny days to observe maximum bees and their host plants on monthly basis from April to September. Collected specimens were killed in poison bottle including potassium cyanide and plaster of paris. After killing all specimens were pinned and preserved as dry specimens in wooden boxes for morphologically identification. Samples of host plants of foraging bees

were also collected and identified at species level (Williams, 1991). Garmin e-trex 10 GPS device was used to record longitude, latitude and altitude of the collection sites. Bumblebees sample were identified up to species level with the help of Swift sm-80

binocular microscope. All the studied specimens were deposited in the Department of Entomology, Pir Mehr Ali Shah Arid Agriculture University Rawalpindi, Pakistan. The morphological terminology used in this study follows Williams (1991).



Fig. 1. General Map of Naran-Kaghan valley KPK Province Pakistan.

Results and discussion

Bombus (Orientalibombus) haemorrhoidalis Smith, 1852

Identification Characters

Ocello-ocular distance shorter than basal breadth of

mandibles; Clypeus usually with large punctures in flattened area; pubescence of thoracic dorsum entirely black; individuals large and with dark winged; pubescence short and very even, terga I-II bright yellow, III-V orange-red).

Table 1. Collection sites and altitude information five observed bumblebee species in Pakistan.

Location	Global positioning	Altitude	Major vegetation type
Paras	34° 39' 52.59" N 73° 27' 49.08" E	4452 Ft	Subtropical pine forest and wild weeds
Mahandri	34° 41' 40.56" N 73° 34' 27.09" E	5491 Ft	Subtropical pine forest, agricultural crops and weeds
Kaghan	34° 46' 40.81" N 73° 31' 31.80" E	6874 Ft	Dense forest and weeds
Naran	34° 54' 23.11" N 73° 38' 55.87" E	8173 Ft	Forest, agricultural crops and weeds
Lalazar	34° 55' 25.86" N 73° 46' 00.99" E	9097 Ft	Agricultural crops, dense forest, weeds and grasses

Material Examined

Paras: 18-VIII-13, 14♀. 19-VIII-13, 16♀. 13-IX-13, 18♀. 14-IX-13, 12♀. Mahandri: 19-VIII-13, 6♀. 20-VIII-13, 8♀. 14-IX-13, 4♀. 15-IX-13, 5♀.

Global distribution

India, Pakistan, Nepal, Bhutan, Myanmar, Tibet, Southwestern China, Laos Thailand, Vietnam (Williams, 2004; Williams *et al.*, 2010).

Bombus (Melanobombus) rufofasciatus Smith, 1852
Identification Characters

Boss on tergum VI nearly circular and evenly convex; pubescence of head entirely black, thoracic dorsum and tergum I with white pubescence.

Material Examined

Kaghan: 21-VIII-13, 7♀. 16-IX-13, 11♀. 19-IX-13, 13♀.

Naran: 21-VIII-13, 8♀. 17-IX-13, 8♀. 18-IX-13, 15♀.
 Lalazar: 23-VIII-13, 12♀. 18-IX-13, 11♀. 19-IX-13, 9♀.

Distribution

India, Pakistan, Nepal, Bhutan, Myanmar and Tibetan plateau and southwestern China (Williams, 2004; Williams, *et al.*, 2010).

Table 2. Geographical distribution of five *Bombus* species from Naran-Kaghan valley Pakistan.

Bumblebees	Geographical distribution				
	Paras	Mohandari	Kaghan	Naran	Lalazar
<i>Bombus haemorrhoidalis</i>	+	+	-	-	-
<i>Bombus rufofasciatus</i>	-	-	+	+	+
<i>Bombus trifasciatus</i>	-	-	+	+	+
<i>Bombus kashmirensis</i>	-	-	+	+	+
<i>Bombus subtypicus</i>	-	-	+	+	+

Bombus (Megabombus) trifasciatus Smith, 1852

Identification Characters

Clypeus with large punctures; antennal segments 4 just shorter than broad and less than three-quarter of length of segment 5; pubescence of gaster with some orange-red. (Subgenus *Diversobombus*, pubescence of thoracic dorsum black, terga I-II bright yellow, III-V predominantly orange-red.

Distribution

Himalaya, Malaysia, Thailand, Vietnam, Taiwan, Pakistan, Nepal, Tibet (Williams *et al.*, 2010).

Material Examined

Kaghan: 21-VIII-13, 4♀. 16-IX-13, 3♀. 19-IX-13, 6♀.
 Naran: 21-VIII-13, 3♀. 17-IX-13, 4♀. 18-IX-13, 2♀.
 Lalazar: 23-VIII-13, 7♀. 18-IX-13, 5♀. 19-IX-13, 4♀.

Bombus (Alpigenobombus) kashmirensis Friese, 1909.

Identification Characters

Clypeus with large puncters throughout; apex of mandible with six teeth; ocular molar distance about half of basal breadth of mandibles; pubescence long, with a broad black band between wings, terga III-V always with radish hairs, reminder gray-white, yellow or black.

Material Examined

Kaghan: 21-VIII-13, 2♀. 16-IX-13, 3♀. 19-IX-13, 1♀.
 Naran: 21-VIII-13, 2♀. 17-IX-13, 5♀. 18-IX-13, 9♀.
 Lalazar: 23-VIII-13, 6♀. 18-IX-13, 3♀. 19-IX-13, 11♀.

Distribution

India, Pakistan, Nepal, Sikkim, Bhutan, Tibet, Gansu, and China (Williams *et al.*, 2010).

Bombus (Pyrobombus) subtypicus Skorikovi, 1914.

Identification Characters

Labral lamella broad, more than one third of breadth of labrum; pubescence short, longest hairs of anterior margin of hind tibia only as long as its distal breadth, longest hairs of face only two third as long as segment 1(scape) of antenna; pale pubescence of thoracic dorsum yellow, with black hairs between wing bases.

Material Examined

Kaghan: 21-VIII-13, 1♀. 16-IX-13, 4♀. 19-IX-13, 1♀.
 Naran: 21-VIII-13, 3♀. 17-IX-13, 4♀. 18-IX-13, 2♀.
 Lalazar: 23-VIII-13, 4♀. 18-IX-13, 7♀. 19-IX-13, 9♀.

Distribution

India, Afghanistan, Pakistan, Northwestern China, Kazakhstan, Kyrgyzstan.

Tajikistan (Williams, 2004 and Williams *et al.*, 2010).

General Remarks

Bumblebee specimens collected from Naran valley of KPK province were compared with description given

by Williams (1991) and found similar. Morphological characters like head, antennae, proboscis, thorax, abdomen, forewing, hind-wing and all three legs were compared using measurements (in mm) for separating the species in addition to identification characters (Table 4).

Table 3. Bumblebee species and their floral host plants from Naran Kaghan Valley during 2013.

Bumblebees	Host Plants	Scientific Name	Family
<i>Bombus haemorrhoidalis</i>	Milk thistle	<i>Silybum marianum</i>	Asteraceae
	Wild daisy	<i>Bellis perennis</i>	Asteraceae
	Dahlia	<i>Dahlia variabilis</i>	Asteraceae
	saw-wort	<i>Saussurea spp</i>	Asteraceae
	Rock rose	<i>Cistaceae sp</i>	Cisteraceae
	Lupin flower	<i>Lupinus sp</i>	Fabaceae
	Sage	<i>Salvia officinalis</i>	Lamiaceae
	Siri	<i>Cana indica</i>	Cannaceae
	Rose	<i>Rosa sp.</i>	Rosaceae
	Yellow Oleander	<i>Thevetia peruvians</i>	Apocynaceae
<i>Bombus rufofasciatus</i>	Dead-nettle white	<i>Lamium sp</i>	Lamiaceae
	Rock rose	<i>Cistaceae sp</i>	Cisteraceae
	Wild mint	<i>Mentha longifolia</i>	Lamiaceae
	Himalayan Blackberry	<i>Rubus armeniacus</i>	Rosaceae
	Basil	<i>Ocimum basilicum</i>	Lamiaceae
	Chervil	<i>Anthriscus cerefolium</i>	Apiaceae
	Milk thistle	<i>Silybum marianum</i>	Asteraceae
	Cosmos	<i>Cosmos bipinnatus</i>	Asteraceae
	Tarragon	<i>Artemisia dracunculus</i>	Asteraceae
	Milk thistle	<i>Silybum marianum</i>	Asteraceae
<i>Bombus trifasciatus</i>	Saw-wort	<i>Saussurea spp</i>	Asteraceae
	Blue bugle	<i>Ajuga reptans</i>	Lamiaceae
	Wild mint	<i>Mentha longifolia</i>	Lamiaceae
	Himalayan Blackberry	<i>Rubus armeniacus</i>	Rosaceae
	Basil	<i>Ocimum basilicum</i>	Lamiaceae
	Milk thistle	<i>Silybum marianum</i>	Asteraceae
<i>Bombus kashmirensis</i>	Chinese Trumpet Vine	<i>Campsis grandiflora</i>	Bignoniaceae
	Stachys	<i>Stachys sp</i>	Lamiaceae
	Saw-wort	<i>Saussurea spp</i>	Asteraceae
	Wild mint	<i>Mentha longifolia</i>	Lamiaceae
	Blue bugle	<i>Ajuga reptans</i>	Lamiaceae
	Saw-wort	<i>Saussurea spp</i>	Asteraceae
<i>Bombus subtypicus</i>	Milk thistle	<i>Silybum marianum</i>	Asteraceae
	cornflower	<i>Centaurea cyanus</i>	Asteraceae
	Wild mint	<i>Mentha longifolia</i>	Lamiaceae
	Rock rose	<i>Cistaceae sp</i>	Cisteraceae
	Self-heal	<i>Prunella vulgaris</i>	Lamiaceae
	Honeysuckle	<i>Lonicera periclymenum</i>	Caprifoliaceae

Out of 5 species, *Bombus haemorrhoidalis* was only distributed in two localities (Paras and Mohandari) while other four species (*B. rufofasciatus*, *B. trifasciatus*, *B. kashmirensis*, *B. subtypicus*) were reported from Naran, Kaghan and Lalazar at altitude ranging from 4452 to 9097 ft from weeds, grasses,

agricultural crops and pine forests (Table 1,2). Previously, no record has been observed from this Naran Kaghan Valley and reported for the first time for this region. *B. (Orientalibombus) haemorrhoidalis* Smith is a Himalayan and South East Asian species (Williams, 1991) recorded from

Kashmir and other regions of Pakistan (Richards, 1929; Frison, 1933). *B. (Alpigenobombus) kashmirensis* is Tibetan species known from Kashmir-the Hindu Raj, Ladakh, Zanskar, Great Himalaya and Pir Panjal ranges (Williams, 1991). *B. (Melanobombus) rufofasciatus* Smith is a pri-Tibetan also know from Kashmir-Hindu Raj, Great Himalaya, Pir Panjal ranges, Great Himalaya range and Batakush (Williams, 1991). *B. (Pyrobombus) subtypicus* Skorikov is a central Asian species (Williams, 1991) known from Kashmir (Williams,

1985) and Pakistan (Tkalců, 1989). These five observed species (*B. trifasciatus*, *B. rufofasciatus*, *B. kashmirensis*, *B. subtypicus* and *B. haemorrhoidalis*) were previously recorded from other Northern Pakistan (Sabir, 2011). These bumblebee species varies on their color patterns and other morphological characters (Williams, 1991), however, they can be split up into two major classes on the basis of the proboscis or tongue length which is considered as important factor in selection of floral resources (Williams, *et al.*, 2010).

Table 4. Comparative morphometry of *Bombus* species from Naran Kaghan Valley during 2013.

Appendage		<i>B.harmo-rrhoidalis</i>	<i>B.rufo-fasciatus</i>	<i>B.tri-fasciatus</i>	<i>B.kashmiriensis</i>	<i>B.sub-typicus</i>
Head	Length	6	4.5	5	5	4.5
	Width	4	3	4	4	3.5
Thorax	Length	8	8.5	9	8.5	9
	Width	6.5	7	7	7	7
Abdomen	Length	10.5	10	10	11	11.5
	Width	8.5	8	8	8.5	9.5
Forewing	Length	15	14	14	14	15
	Width	7	5	5	5	5.5
Hind wing	Length	9	9	9	9	9
	Width	4	3.5	3	3.5	3.5
Fore leg	Length	13	8	9	8	8
	Width	1.5	1	1.5	1	1.5
Mid leg	Length	15	10	14	14	13.5
	Width	2	1.5	2	1.5	2
Hind leg	Length	18	16	16	16.5	16
	Width	2.5	2	2.5	2	2.5
Antenna	Length	8	8	7	7	6.5
Proboscis	Length	8.5	6	6	5.5	6

Pollen sources comprise a diverse source for this protein necessary to build the cells, breed their young ones and use as a food (Teper, 2004). However, abundance of flowers per unit area is regarded as a better predictor of bumble bee richness and activity than plant species richness (Hegland and Boeke, 2006). Sucrose concentration in flowers also distinguish the classification of floral visitation rate as minor, medium or major source of visitation to decrease their foraging time with maximum reward

(Cnaani *et al.*, 2006). All species foraged floral plants mainly were of Asteraceae family extensively followed by that of Lamiaceae in all surveyed localities. As whole they visited 24 different host plants belonging to 10 different families.

Present study revealed *B. haemorrhoidalis* foraged eleven different floral plants of seven plant families with most diverse floral range as compared to other observed bumblebee species. *B. rufofasciatus* visited

eight floral plants of five families, and *B. typicus* on seven floral plants of four families. *B. trifasciatus* and *B. kashmirensis*, both foraged six floral plants of three plant families, however, the floral plants differ in their foraging pattern. Their foraging preference areas included sloppy regions with floral plants rather than densely covered wild trees with flowers beneath and bilaterally symmetrical flowers were preferred over asymmetrical flowers (Moller and Sorci, 1998). *Cana indica*, *Dahlia variabilis*, *Rosa sp.*, *Thevetia neirifolia*, *Saussoria lappa* and *Tamarix gaelic* were the main visited floral plants by these bumblebees in other Northern Pakistan (Sabir, 2011). A total of 23 plant species from 13 families were recorded with four major plant families (Asteraceae, Lamiaceae, Papilionaceae, Ranunculaceae) mostly visited by bumblebees (Sabir, 2011). Asteraceae is major host plant family for *B. haemorrhoidalis* in lower northern Pakistan (Sheikh *et al.*, 2014). The first two families were responsible to attract around 70 percent bumblebees in crop area within agricultural habit (Suhail *et al.*, 2009).

Diversity of indigenous bumblebees with information of their floral host plants and foraging range are considered important for their services identification to manage the diverse plant families. They play vital role in conservation of natural floral resources.

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