Diversity of apoidea (Hymenoptera) from Grassland ecosystem of Jammu (UT of Jammu and Kashmir)

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Abstract
Grasslands are a dynamic ecosystem which is extremely important worldwide as they support variety of flora, fauna and in turn humans. They have been origin point of many cultivated food grains, provide forage for livestock, biogeochemical cycling, provide ideal habitat for variety of species for breeding, migrating and flourishing. Hymenoptera play an important role in pollination. They are a diverse and species rich group abundantly found in grasslands. Hymenoptera plays a pivotal role in grasslands ecosystem as they aid in pollination of various wild flora. They prey upon various insect pest species and are themselves preyed upon by insectivorous animals hence helping in completing the food chain. Grasslands of Jammu (in the union territory of Jammu and Kashmir) were surveyed for a period of two years and a total of 13 species of Apoidea under 6 genera and 9 subgenera have been identified. Their distribution records along with their material examined are provided. Two species are recorded as new records from Union territory of Jammu and Kashmir.

Keywords: Apoidea, Grasslands, biodiversity, identification

Introduction
According to Ecological Society of America (1952) Grasslands are defined as a terrestrial ecosystem dominated by grasses or grasses like plants consisting of mainly herbs and shrubs. Various factors like fire, precipitation, draught, grazing, and temperature play crucial role in maintenance of grasslands. Moule [1] emphasised upon the importance of grasslands. Grasslands cover approximately 45 million square areas in the temperate, alpine and tropical regions throughout the world (Shantz [2]). According to Rawat and Adhikari [3] approximately 24% of geographical land is under grassland cover in India. The Indian Council of Agricultural Research classified the grasslands of India into five major types after conducting grasslands surveys between 1954 to 1962. The five categories included (Dibadghao & Shankarnarayan [4]):

a) **Sehima-Dichanthium** type covering Central India plateau between 300-1200m
b) **Dichanthium-Cenchrus-Lasiurus** type covering Delhi, Punjab, Aravalli, Gujarat, Rajasthan between 150-300m.

- **Phragmites-Saccharum-Imparata** type covering Punjab, Haryana, Gangetic plains, Brahmaputra valley between 300- 500 m.
- **Themeda-Arundinella** type covering Assam, J&K, Manipur, W. Bengal between 350-1200m.
- **Temperate and alpine cover** covering cold and temperate deserts of J&K, Himachal Pradesh, north east, Uttar Pradesh between 2100m and higher altitude.

Jammu and Kashmir was given the status of Union territory in October 2019. It lies to the north of Himachal Pradesh, Punjab and west of Ladakh. Grasslands of Jammu and Kashmir varies from tropical to subtropical to temperate and alpine, cover between 2100m and higher altitude. Singh et al. [5] reported that a total of 9595 km² area accounting for 4.32% of total geographical area is under protective grasslands in Jammu & Kashmir. The main physical regions of the union territory (33°17’ - 37°20’ N; 73°25’ - 80°30’ E) are the outer Himalayas in which prevails the intermediate and sub-tropical climate representing Jammu region, lesser Himalayas where temperate climate prevails representing Kashmir region (Wani and Wani [6]). Climate and rainfall of this union territory varies with altitude. As elevation increases, rainfall and temperature decreases resulting in variation of climate from sub-tropical to temperate to sub-arctic (Wani et al. [7]).
In Union territory of Jammu and Kashmir, grassland density is maximum between 1500m to 4500m (Singh et al. [5]). The total share of alpine grasslands of Union territory of Jammu and Kashmir is 77% of total Himalayan alpine grasslands, however the state of grasslands is not very good as they are continuously diminishing due to human interference, habitat fragmentation, over grazing and economic exploitation. Researchers (Karl-Olof et al. [6]) at Linköping University and the Swedish University of Agricultural Sciences (SLU) in Uppsala reported that grasslands present in close association with forests have more species diversity as compared to grassland present close to agricultural fields. They found that surrounding landscape plays important role for species diversity of fauna.

Materials and Methods

Study area: The present study was undertaken at various spots marked as the grasslands of Jammu and Kashmir for a period of years from 2017 to 2019. Survey tours were organised by ZSI, Solan official collection teams headed by Dr. A.K.Sidhu and Dr.T. Kubendran. As the grasslands are dominated by grasses with many agrestals, the fauna present in these landscapes are typical and rare. Hymenoptera play an important role in pollination in these grasslands. During present studies various areas in grasslands of Union territory of Jammu and Kashmir were surveyed and diversity of Hymenoptera in them. The areas covered were Katra, Raesi (32°59’30.01” N, 74°55’55.02” E); Birma Nala, Udhampur (32°54’59.52”N, 75°19’52”E); Hiranagar, Kathua (32°27’0.00” N 75°16’12.00” E); Malahar, Udhampur (32.69° N, 75.66° E); Jasrota, Kathua (32°22’9.88” N 75°19’52” E). 13 species of Apoidea under 6 genera and 9 subgenera have been identified. Two species are recorded as new records of Hymenoptera.

Methodology: Collections of group Apoidea was done with the help of collection nets when the examples were foraging on the flora during warm summer days. Collected examples are killed with ethyl acetate vapours in charged bottle and then kept in labelled envelops. These previously collected examples were stretched and properly preserved in fumigated insect boxes. Keys given by Saini et al. [9], Bingham [10], Michener [11, 12] were used to identify the bees.

Results and Discussions

Systematic List

Family Apidae

Subfamily Apini Latreille

Genus Apis Linnaeus

Subgenus Apis Linnaeus

1. Apis cerana Fabricius, 1793

Apis cerana Fabricius 1793, Ent. Syst. Suppl., p.274.

Apis indica Fabricius 1798: 274.

Apis socialis Latrielle 1804a: 390.

Apis peroni Latrielle 1804b: 173.

Apis gromovii Guiliou 1841: 323.


Apis nigrocincta Smith 1861: 93.

Apis indica Skorikov 1929b: 251.


Material Examined: Katra, Raesi, (J&K), 5ex, 16.xi.2018; Katra, Raesi, (J&K), 9ex, 18.xi.2018; Birma Nala, Udhampur, 2ex, 27.xi.2018; Birma Nala, Udhampur, 1ex, 16.ix.2018

Distribution in India: Himachal Pradesh, Punjab, Haryana, Jammu & Kashmir, Sikkim, Central India

Distribution Elsewhere: China, Indonesia, Sri Lanka, Nepal

Remarks: This species is abundant in its distribution in Southeast Asia.

2. Apis dorsata Fabricius, 1793


Apis bicolor Klug 1807: 264

Apis nigripennis Lepel. Hym. i., 1807: 403

Apis testacea Smith 1858: 49.

Apis zonata Smith 1859: 8

Material Examined: Hiranagar, Kathua, (J&K), 2ex, 31.iii.2019

Distribution in India: Throughout India

Distribution Elsewhere: Nepal, China, Java, Pakistan, Sri Lanka

Remarks: This species is a ferocious bee with open bee hives made far above the ground. It is the largest honey bee commonly found in plains of India and South east Asia.

3. Apis mellifera Linnaeus, 1761


Apis gregaria Geoffroy, 1762

Apis cerifera Scopoli, 1770

Apis mellifica germanica Pollmann, 1879

Apis mellifica nigrita Lucas, 1882

Apis mellifica mellifica lehzeni Buttel-Reepen, 1906 (Unav.)

Apis mellifica mellifica silvarum Goetze, 1964 (Unav.)

Material Examined: Katra, Raesi, (J&K), 2ex, 18.xi.2018

Distribution in India: Throughout India

Distribution Elsewhere: throughout world except Antarctica

Remarks: This bee was introduced in India and is abundant throughout world.

Tribe Bombini Latreille

Genus Bombus Linnaeus

Subgenus Megabombus Dalla Torre

4. Bombus trifasciatus Smith, 1852


Bombus trifasciatus Smith 1878: 168.

Bombus montivagus Smith 1878: 168.

Bombus wilemani Cockrell 1911b:100.

Bombus maxwelli Cockrell 1911b: 100.

Bombus mimeticus Richards 1931: 529.

Bombus malaise Skorikov 1938a:2

Material Examined: Katra, Raesi, J&K, 2 ex, 17.xi.2018

Distribution in India: Himachal Pradesh, Kashim, Uttarakhand, Arunachal Pradesh, Sikkim, Manipur, West Bengal.

Distribution Elsewhere: Myanmar, Thailand, South China, Taiwan, Pakistan, Nepal

Remarks: It is an Oriental species commonly found in the
5. Bombus haemorrhoidalis Smith, 1852
Bombus orientalis Smith 1879: 132.
Bombus buccinatoris Smith 1879: 132.
Bombus assamensis Bingham 1897: 550.
Bombus cinnameneus Tkalcu 1989: 47.
Bombus montivolans Richards 1929: 382.
Bombus orientalis Richards 1929a: 384.
Orientalibombus montivolans Tkalcu 1968:10.
Orientalibombus haemorrhoidalis Tkalcu 1989:47.
Material Examined: Birma Nala, Udhpamur, 1ex, 16.xi.2018;
Distribution in India: Himachal Pradesh, Kashmir, Sikkim, Meghalaya, Uttarakhand, West Bengal.
Distribution Elsewhere: Pakistan, Nepal, Bhutan, Myanmar, Thailand, Vietnam
Remarks: It is a large sized Himalayan bee species distributed between 1000 to 2700 m.
Subgenus Sibricobombus Vogt

B. tibetanus Friese, 1913: 86
Material Examined: Katra, Reasi, 3 ex. 18.xi.2019
Distribution in India: Sikkim.
Distribution Elsewhere: Nepal, Pakistan, Afghanistan, Southwest China, Kazakhstan
Remarks: This species was recorded for the first time from the studied area. Its previous records are from Sikkim.
Family Apidae
Subfamily Xylocopinae
Genus Xylocopa Latreille
Type species: Xylocopa Latreille, 1802
Subgenus Copoxyla Maa, 1954

7. Xylocopa cyanescens Brulle, 1832
Xylocopa minuta Lepeletier, 1841, Syn.
Xylocopa taurica Erichson, 1841, Syn.
Xylocopa virescens Gistel, 1857, Homo. (nec Lepeletier, 1841)
Xylocopa canuta Rondani, 1874, Syn.
Xylocopa virescens Strand, 1917, Syn., replacement for virescens Gistel.
Material Examined: Malhar, Udhpamur, 3 ex, 30.iii.2019
Distribution in India: Jammu Kashmir, Himachal Pradesh, Punjab
Distribution Elsewhere: Western Africa, Burma, Ceylon, Malaysia
Remarks: Subgenus Koptortosoma Gribodo, 1894

8. Xylocopa aestivalis aestivalis (Linnaeus)
Apis leucothorax DeGeer, 1773
Xylocopa confusa Perez, 1901
Material Examined: Tatilnala, Udhpamur, 2ex, 16.xi.2018
Distribution in India: Punjab, Himachal Pradesh, Kashmir, Orrisa, Assam, Gujarat, Maharashatra
Distribution Elsewhere: Sri Lanka, Nepal, Africa
Remarks: This is a large bee species widely distributed in South east Asia.
Subgenus Mesotrichia Westwood, 1838

9. Xylocopa latipes (Drury)
Apis giga DeGeer, 1773, Syn.
Mesotrichia (Platynopoda) latipes basilotetera Cockerell 1917
Material Examined: Birma Nala, Udhpamur, 1ex, 16.ix.2018
Distribution in India: Jammu Kashmir, Himachal Pradesh, Uttarakhand
Distribution Elsewhere: China, Malaysia, Myanmar
Remarks: This bee species are commonly found in warm tropical climates where the bees make nests burrowing in wood.
Subgenus Zonamegilla

10. Amegilla zonata Brooks, 1988
Anthophora zonata (Bingham, 1897; Friese, 1918)
Anthophora zonata var. putatalama (Strand, 1913)
Amegilla (Zonamegilla) zonata (Brooks, 1988)
Material Examined: Jassrota, Kathua, 1 ex, 12.xi.2018
Distribution in India: Jammu Kashmir, Himachal Pradesh, Uttarakhand,
Distribution Elsewhere: Throughout India, Nepal, Sri Lanka, Myanmar, Australia, China, Taiwan
Remarks: This species is widely distributed in South East Asia.
Family Vespidae
Subfamily Vespiinae
Genus Vespa Linnaeus, 1758

11. Vespa velutina Lepeletier, 1836
Vespa auraria Smith, 1852
Vespa fruhstorferi Stadelmann, 1894
Vespa immuculata Morawitz, 1889
Material Examined: Tatilnala, Udhpamur, 2ex, 16.xi.2018; Birma Nala, Udhpamur, 11 ex, 16.xi.2018; Katra, Raesi, 3ex, 18.xi.2018; Katra, Raesi, 1 ex, 18.xi.2018; Katra, Raesi, 3 ex, 22.xi.2018
Distribution in India: Himachal Pradesh, Punjab, Haryana, Uttarakhand, West Bengal, Assam, Sikkim, Jammu.
Distribution Elsewhere: Bhutan, China, Pakistan, Afghanistan, Taiwan, Burma, Thailand
Remarks: This species predates upon other bee species and is widespread in Asia.
Family: Scoliidae
Subfamily: Campsomerinae
Genus: Campsomeris

12. Campsomeris trifasciata (Saussure)
Dielis trifasciata (Fabricius, 1793), Mel. Hym., p. 46.
Material Examined: Katra, Raesi, 3 ex., 22.xi.2018
Distribution in India: Punjab, Himachal Pradesh, Maharashatra, Gujarat, West Bengal
Distribution Elsewhere: Greater Antilles, Bahama Islands, Florida, Iran, Sri Lanka
Remarks: This species was recorded for the first time in studied area.
Family: Megachilidae
Subfamily: Megachilini
Genus: Megachile Latrielle
Subgenus Eutricharaea Thomson

13. Megachile femorata Smith
Megachile femorata Smith 1879, New Sp. Hym. B. M., p. 68
Megachile femorata Dalla Torre 1894a
Megachile femorata Bingham 1897

Material Examined: Hiranagar, Kathua, (J&K), 2ex., 31.iii.2019

Distribution in India: Punjab, Jammu Kashmir, West Bengal, Gujarat, Madhya Pradesh

Distribution Elsewhere: China, Nepal, Central Asia, Sri Lanka

Remarks: This species belongs to solitary bees group so are not as abundant as social bees.

Conclusion
It is important to properly map and study the grassland ecosystems to understand the patterns and dynamics of endemic and introduced species of flora and fauna. Two species i.e. Bombus mirus (Tkalcu, 1968) and Campsomeris trifasciata (Saussure) are new records for the studied area. These species are being recorded for the first time from the studied areas.

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References
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