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# Bee flora of Kashmir: The Himalayan biodiversity hotspot

**Shoukat Ara, Zubair Ahmad Rather, Manzoor Ahmad Paray, Rizwana Khursheed and Munaza Yaqoob**

**Abstract**
The Kashmir Himalaya, nestled in the north-western side of the Himalayan biodiversity hotspot, possesses a rich biodiversity of immense potential. Plethora of anthropogenic activities during last few decades has deleteriously affected the biodiversity of this fragile mountain ecosystem, thereby threatening its bio-security. Contextually, conservation of the biota assumes vital importance, for which inventorization and documentation of the biota is essential. Though some work has been done on different aspects of the flora but not on the bee flora of the area. Present study documents the diversity of bee flora from this biodiversity-rich part of the Himalaya. Systematic survey and field observation approach has been used to document the diversity of foraging plants of bees. During the present study, a total 228 plant species belonging to 182 genera and 58 families were recorded, which serve as food source for bees. Overall 77 foraging species were found frequently visited by bees. Annual herbs were found as potential source of pollen and nectar. Majority of plant species were both pollen and nectar-producing and grow as wild in this Himalayan region. A total 37 bee species belonging to 15 genera and 6 families were found visiting the documented flowering plants for their food. Family Apidae was found to be dominant group of bees.

**Keywords:** bee flora, Kashmir, Himalaya, biodiversity, bees, foraging plants

## Introduction
The Himalaya- one of the world's tallest ranges of mountains, located in the Indian subcontinent is one of the global biodiversity hotspots, harbouring in precious biological wealth of great economic value and scientific interest. Lying in its north-western part is the Kashmir Himalaya, which is celebrated for its natural landscape. Beset with considerable topographical, altitudinal and climatic variation, this area depicts great habitat diversity and harbours in rich biodiversity of intangible benefits. The region with its unique environ is an ideal home for vide variety of fauna including diverse insects which are responsible for sustenance and maintaining quality of natural and manmade ecosystems by providing pollination services. In the study area, bees have significance over other insects by way of being abundant and dominating the area in providing the pollination services. Sustenance of this entomo-faunal group depends fully on angiosperms. Angiospermic component of the flora, accounting for 2000 species (Dar *et al*., 2002) [8] blooms in different seasons of the year and provide food for insects including bees. The plant species that provide food to bees constitute bee flora. Research investigations related to taxonomic diversity of bee flora have been carried out in different parts of the world. Ramalho *et al.* (1990) [15] reported 288 plant species which act as pollen and nectar producing plants for stingless bees and "Africanized" honey bees in the Brazilian Neo-tropics. Abdullahi *et al.* (2011) [1] reported 103 potential foraging plants for honeybees from the tropical African country of Nigeria. Bhalchandra *et al.* (2014) [6] recorded 52 plant species, including 29 agricultural crops and 23 wild plants**,** from the biodiversity hotpot region of Western Ghats, India, that were useful to honey bees. Though, number of references are available on different aspects of flora of Kashmir (Dar and Khuroo, 2013 [9]; Ara, 2011 [4]; Anzar *et al*., 2007 [3]; Dar *et al*., 2002 [8]), Ara *et al*., 2018) [5], no extensive work has been done till date on bee flora of Kashmir. Hence the present study.

## Materials and Methods
### Study area
Lying between 33° 20′ to 34° 54′ N latitudes and 73° 55′ to 75° 35′ E longitudes, Kashmir Himalaya represents a biotic province in the bio-geographic zone of the North-Western Himalaya in India.

The region mainly comprises of intermountain Kashmir valley with predominantly temperate climate with wet and cold winters and relatively dry and moderately warm summers. The area marked by well-defined seasonality, winter (December-February), spring (March-May), summer (June-August) and autumn (September-November) inhabits wide variety of flowers interacting with different flower visitors including bees.

**Systematic surveys and field observations**

Systematic surveys and field observations were carried out during 2012- 2017 in Kashmir Himalaya to record data regarding pollen and nectar producing plants and bees visiting them. Field observations were keenly recorded on the basis of visitation rate of flower visitors on the flowers of a particular plant.

The type of foraging plant was recognized on the basis of foraging behaviour of the bees. If the bee stayed at a particular position on a flower especially at the base of petal/ tepal and pierced its proboscis towards position of nectary, the plant was categorized as the nectar producing. If the flower visitor roamed around the flower display near the anthers in different patterns, especially in a ring pattern in bowl-shaped flowers, the plant was categorized as pollen producing plant. When both the foraging behaviours of insect visitors were observed for the flowers of a particular plant, the plant was categorized as pollen-nectar producing plant. The fact was confirmed by consulting the literature as well. Plant specimens were collected and processed using standard herbarium methodology (Bridson and Forman, 1998) [7] and identified on the basis of relevant taxonomic literature (Hook, 1872 [11]; Nasir and Ali, 1970 [13]) and further validated with expert determination. The bees collected by nets were killed in ethyl acetate solution, stretched and pinned. Labels containing field information were appended to each sample. The labeled samples were placed in the boxes specially designed for the purpose and identified following Michener (2007) [12] and further validated with expert determination by Ghorpede Dharwad Agricultural University Bangalore and Alain Pauly Royl Belgian Institute, Belgium. Nectar content of frequently visited plants was determined by Micro capillary method following Abrol (1992) [2]. Flowers about to bloom were bagged before 24 hours to avoid pollinators visit and nectar quantity was measured by calibrated micro capillary tubes. Nectar sugar content was recorded by digital refrectometer and final values were calculated from Brixs conversion table. All the samples of plants and identified insect pollinators have been housed in Research and Training Centre for Pollinators, Pollinizers and Pollination Management, Sher-e- Kashmir University of Agricultural Science and Technology of Kashmir, Srinagar, Jammu and Kashmir (India).

**Results and Discussion**

During the present study 227 flowering and one non flowering plant species belonging to 182 genera and 58 families were recorded as potential foraging plants (Table 1). These species include 178 herbs, 28 shrubs and 22 tree species, contributing about 78, 12 and 10% respectively to foraging plants (Fig 1). Asteraceae contributed largest number (35) of species, followed by Rosaceae and Lamiaceae with 24 and 15 species respectively. On the other hand.

**Table 1**: Diversity of bee flora in Kashmir Himalaya

| S. No. | Plant species | Family | English name | Purpose | Bee visitor genus | Reward |
|---|---|---|---|---|---|---|
| 1. | *Abelia grandiflora* Rehd. | Caprifolaceae | Glossy abelia | Ornamental | *Apis, Bombus, Xylocopa* | PN |
| 2. | *Abelmoschu s esculentus* Moench | Malvaceae | Ladies Finger | Olericulture | *Apis, Bombus, Xylocopa* | PN |
| 3. | *Aconitum laeve* Royle | Ranunculacea e | Grape-leaved Monkshood | Wild | *Apis, Bombus* | PN |
| 4. | *Aconogonu m molle* Hara | Polygonaceae | Sikkim Knotweed | Wild | *Apis* | PL |
| 5. | *Actinidia deliciosa* Liang and Ferguson. | Actinidiaceae | Kiwi | Horticulture/ Ornamental | *Apis* | PN |
| 6. | *Aesculus indica* Hook. | Sapindaceae | Indian horse Chestnut | Wild | *Apis* | PN |
| 7. | *Ageratum houstonianu m* Mill. | Asteraceae | Floss Flower | Ornamental | *Apis, Bombus, Athalia* | PL |
| 8. | *Agrimonia pilosa* Ledeb. | Rosaceae | Hairy Agrimony | Wild | *Apis, Lasioglossum* | PN |
| 9. | *Ailanthus altissima* Swingle | Scrophulariac eae | Tree of Heaven | Social Forestry | *Apis* | PL |
| 10. | *Albizia julibrissin* Durazz. | Fabaceae | Silk tree mimosa | Landscape | *Apis,* | PL |
| 11. | *Alcea rosea* L. | Malvaceae | Hollyhock | Ornamental | *Apis, Bombus* | PN |
| 12. | *Allium cepa* L. | Alliaceae | Onion | Agriculture | *Apis, Ceratina, Lasioglossum, Halictus, Megachile* | PL |
| 13. | *Allium sativum* L. | Alliaceae | Garlic | Agriculture | *Apis, Ceratina. Lasioglossum,* | PL |
| 14. | *Anaphalis busua* DC., | Asteraceae | | Wild | *Halictus, Megachile* *Apis* | PL |
| 15. | *Anemone obtusiloba* Don | Ranunculacea e | Himalayan thimble weed | Wild | *Apis, Lasioglossum* | PN |
| 16. | *Anemone tetrasepala* Royle | Ranunculacea e | Four Petal anemone | Wild | *Apis, Lasioglossum* | PN |
| 17. | *Anthemis cotula* L. | Asteraceae | Sticking Chamomile | Wild | *Apis* | PL |
| 18. | *Antirrhinum majus* L. | Scrophulariac eae | Dog Flower | Ornamental | *Apis, Bombus, Xylocopa, Ceratina.* | PN |
| 19. | *Aquilegia fragrans* Benth. | Ranunculacea e | Fragrant Columbine | Wild | *Apis* | PN |
| 20. | *Arabis glabra* Bernh. | Brassicaceae | Tower Mustard | Wild | *Apis, Lasioglossum* | PN |
| 21. | *Arctium lappa* L. | Asteraceae | Greater Burdock | Wild | *Apis, Xylocopa, Ceratina.* | PL |
| 22. | **Artemisia absinthium* L. | Asteraceae | Wormwood | Wild | *Apis* | PL |
| 23. | *Aster thomsonii* Clarke | Asteraceae | Blue aster | | *Lasioglossum* | PN |
| 24. | *Astragalus candolleanu s* Royle ex. Benth. | | | | | |

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|---|---|---|---|---|---|---|
| | | Fabaceae | Spiny Milk- Vetch | Wild | *Apis, Amegilla, Andrena, Xylocopa* | PN |
| 25. | *Astragalus grahamianu s* Benth. | Fabaceae | Milk- Vetch | Wild | *Apis, Amegilla, Andrena, Xylocopa* | PN |
| 26. | *Bellis perennis* L. | Asteraceae | | Wild | *Apis, Andrena, Lasioglossum* | PN |
| 27. | **Berberis* | Berberidaceae | Indian barberry | Wild | *Apis* | PN |

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| | *Lyceum* Royle | | | | | |
| 28. | **Bergenia ligulata* Engl. | Saxifragaceae | Winter Begonia | Wild | *Apis, Bombus* | PN |
| 29. | *Bidens tripartita* L. | Asteraceae | Marigold bur | Wild | *Apis* | PL |
| 30. | *Brassica compestris* L. | Brassicaceae | Mustard | Olericulture | *Apis, Andrena, Lasioglossum* | PN |
| 31. | *Brassica rapa* L. | Brassicaceae | Raddish | Olericulture | *Apis, Andrena, Lasioglossum, Xylocopa* | PN |
| 32. | *Buddleja davidii* Franch. | Scrophulariac eae | Butterfly brush | Ornamental | *Apis* | PL |
| 33. | *Calendula officinalis* L. | Asteraceae | Common Marigold | Ornamental | *Apis, Bombus* | PN |
| 34. | *Caltha alba* Cambess. | Ranunculacea e | White Marsh Marigold | Wild | *Apis,Lasioglossum* | PN |
| 35. | *Campanula cashmerian a* Royle | Campanulace ae | Kashmir Bellflower | Wild | *Apis, Bombus* | PN |
| 36. | *Campanula rotundifolia* L. | Campanulace ae | Alpine bluebell | Wild | *Apis, Bombus* | PN |
| 37. | *Campsis grandiflora* Schum. | Bignonaceae | Trumpet | Ornamental | *Apis, Bombus, Xylocopa.* | NC |
| 38. | *Capsella bursa- pastoris* Medik. | Brassicaceae | Shepherd's Purse | Wild | *Andrena, Lasioglossum, Megachile* | PN |
| 39. | *Carduus edelbergii* Rech.f. | Asteraceae | Thistle | Wild | *Apis, Andrena, Bombus, Ceratina, Xylocopa* | PN |
| 40. | *Carya illinoinensis* Koch | Juglandaceae | Pecan nut tree | Horticulture | *Apis* | PL |

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| 41. | *Castanea sativa* Mill. | Fagaceae | Chestnut | Horticulture | *Apis* | PL |
| 42. | *Centaurea cyanus* L. | Asteraceae | Corn flower | Ornamental | *Apis* | PL |
| 43. | *Centaurea iberica* Spreng. | Asteraceae | Iberian star Thistle | Wild | *Apis, Andrena, Megachile* | PN |
| 44. | *Cercis canadensis* L. | Fabaceae | Eastern Redbud | Wild | *Apis, Bombus, Lassioglossum Xylocopa* | NC |
| 45. | *Chenopodiu m album* L. | Amaranthacea e | Bathua | Wild | *Apis* | PL |
| 46. | *Chrysanthe mum coronarium* Spach. | Asteraceae | Crown Daisy | Ornamental | *Apis, Andrena, Lassioglossum, Heriades* | PN |
| 47. | *Cichorium intybus* L. | Asteraceae | Chicory | Wild | *Apis, Bombus* | PN |
| 48. | *Cirsium arvense* Scop. | Asteraceae | Wool bearing Thistle | Wild | *Apis, Andrena, Bombus, Xylocopa.* | PN |
| 49. | *Cirsium falconeri* Petr. | Asteraceae | Falconer's Thistle | Wild | *Apis, Bombus, Xylocopa.* | PN |
| 50. | *Cirsium vulgare* Ten. | Asteraceae | Thistle | Wild | *Apis, Bombus, Ceratina, Xylocopa.* | PN |
| 51. | *Clematis montana* DC. | Ranunculacea e | Anemone clematis | Wild | *Apis, Bombus,* | PN |
| 52. | *Codonopsis ovata* Benth. | Campanulace ae | Kashmir Bonnet Bellflower | Wild | *Apis, Lasioglossum.* | PN |
| 53. | *Colchicum luteum* L. | Colchicaceae | Yellow Colchicum | Wild | *Apis, Halictus* | PN |
| 54. | *Conium maculatum* L. | Apiaceae | Poison hemlock | Wild | *Apis, Athalia* | PL |
| 55. | *Convolvulus* | Convolvaceae | Field Bindweed | Wild | *Apis* | PN |

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| | *arvense* L. | | | | | |
| 56. | *Coriandrum sativum* L. | Apiaceae | Coriander | Olericulture | *Apis, Andrena, Lassioglossum.* | PL |
| 57. | *Corydalis cashmerian a* Royle | Papaveraceae | Kashmir Corydalis | Wild | *Apis* | NC |
| 58. | *Corydalis diphylla* Wall. | Papaveraceae | Two leaved corydalis | Wild | *Apis* | PN |
| 59. | *Crepis tectorum* L. | Asteraceae | Narrow-leaved Hawk's-beard | Wild | *Apis* | PL |
| 60. | *Cucumis melo* L. | Cucurbitaceae | Wild Melon | Olericulture | *Apis* | PN |
| 61. | *Cucumis sativus* L. | Cucurbitaceae | Cucumber | Olericulture | *Apis* | PN |
| 62. | *Cucurbita maxima* Duchesne | Cucurbitaceae | Giant pumpkin | Olericulture | *Apis* | PN |
| 63. | *Cucurbita pepo* L. | Cucurbitaceae | Pumpkin | Olericulture | *Apis* | PN |
| 64. | *Cydonia oblonga Miller* | Rosaceae | Quince | Horticulture | *Apis, Lassioglossum.* | PN |
| 65. | *Cynodon dactylon* Pers. | Poaceae | Bermuda grass | Wild | *Apis* | PL |
| 66. | *Cynoglossu m glochidiatus* Wall. | Boraginaceae | | Wild | *Apis* | PN |
| 67. | **Datura stramonium* L. | Solanaceae | Jimsonweed | Wild | *Apis* | PN |
| 68. | *Daucus carota* L. | Apiaceae | Carrot | Horticulture | *Apis* | PL |
| 69. | *Delphinium roylei* Munz | Ranunculacea e | Royle's Larkspur | Ornamental | *Apis, Bombus* | PN |
| 70. | *Descurainia sophia* | Brassicaceae | Herb sophia/ Fix weed | Wild | *Apis* | PN |

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| 71. | *Digitalis purpurea* L. | Scrophulariac eae | Foxgloves | Ornamental | *Apis* | PN |
| 72. | *Dipsacus inermis* Wall. | Dipsacaceae | Himalayan teasel | Wild | *Apis, Bombus* | PN |
| 73. | *Doronicum falconeri* Hook. | Asteraceae | leopard's bane | Wild | *Apis* | PN |
| 74. | *Echium plantagineu m* L. | Boraginaceae | Purple Viper's Bugloss | Ornamental | *Apis* | PN |
| 75. | *Epilobium hirsutum* L. | Onagraceae | Hairy Willow herb | Wild | *Apis* | PN |
| 76. | *Epilobium parviflorum* Schreb. | Onagraceae | Small flowered willow herb | Wild | *Apis* | PN |
| 77. | *Epilobium royleanum* Hausskn. | Onagraceae | Royle's Willow herb | Wild | *Apis* | PN |
| 78. | *Eremurus himalaicus* Baker. | Liliaceae | Himalayan Desert Candle | Wild | *Apis, Lassioglossum* | PN |
| 79. | *Eriobotyria japonica* Lindl. | Rosaceae | Loquat | Horticulture | *Apis, Bombus, Xylocopa. Lassioglossum* | PN |
| 80. | *Erysimum hieraciifoliu m* L. | Brassicaceae | European wallflower | Wild | *Apis, Lassioglossum* | PN |
| 81. | *Eschscholzi a californica* Cham. | Papaveraceae | California Poppy | Ornamental | *Apis* | PN |
| 82. | *Euonymus hamiltonian us* Wall. | Celastraceae | Himalayan Spidle tree | Wild | *Apis* | PN |
| 83. | *Euphorbia helioscopia* L. | Euphorbiacea e | Sun Spurge | Wild | *Apis* | PN |

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| 84. | *Euphorbia wallichii* Hook.f. | Euphorbiacea e | Wallich Spurge | Wild | *Apis* | PN |
| 85. | *Foeniculum vulgare* Mill. | Apiaceae | Fennel | Olericulture | *Apis* | PN |
| 86. | *Forsythia viridissima* Lindl. | Oleraceae | Golden bells | Ornamental | *Apis,Xylocopa, Megacile, Halictus* | PN |
| 87. | *Fragaria ananassa* Duchesne | Rosaceae | Strawberry | Horticulture | *Apis, Lassioglossum* | PN |
| 88. | *Fragaria nubicola* Lacaita | Rosaceae | Himalayan strawberry | Wild | *Apis, Lassioglossum.* | PN |
| 89. | *Fumaria indica* Pugsley | Papaveraceae | Indian Fumitory | Wild | *Apis* | NC |
| 90. | *Galinsoga parviflora* Cav. | Asteraceae | Quick weed | Wild | *Apis* | PL |
| 91. | *Gentiana cachemirica* Decne. | Gentianaceae | Dwarf Willow Gentian | Wild | *Apis, Bombus* | PN |
| 92. | *Geranium nepalense* Sweet | Geraniaceae | | Wild | *Apis, Lassioglossum.* | PN |
| 93. | *Geranium pratense* L | Geraniaceae | Meadow Geranium | Wild | *Apis, Lassioglossum.* | PN |
| 94. | *Geranium wallichianu m* Don | Geraniaceae | Wallich Geranium | Wild | *Apis, Lassioglossum.* | PN |
| 95. | *Geum roylei* Wall. | Rosaceae | Royle's Avens | Wild | *Apis* | PN |
| 96. | *Gladiolus hortulanus* Bailey | Iridaceae | Garden Gladiola/ Sword lily | Ornamental | *Apis, Bombus* | PN |
| 97. | *Hackelia uncinata* Fisch. | Boraginaceae | Hooked stickseed | Wild | *Apis* | PN |

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| 98. | *Halianthus annus* L. | Asteraceae | Common sunflower | Ornamental | *Apis, Xylocopa.* | PN |
| 99. | ***Heracleu m candicans* Wall. | Apiaceae | White leaf Hogweed | Wild | *Apis* | PL |
| 100 | *Hibiscus rosa- sinensis* L. | Malvaceae | China rose | Ornamental | *Apis, Bombus, Xylocopa.* | PN |
| 101 | *Hypericum hookerianu m* Wight and Arn. | Hypericaceae | Johnswort | Ornamental | *Apis* | PN |
| 102 | *Hypericum perforatum* L. | Hypericaceae | Perforate Johns Wort | Wild | *Apis* | PL |
| 103 | *Iberis amara* L. | Brassicaceae | Rocket Candytuft | Ornamental | *Apis* | PN |
| 104 | *Impatiens glandulifera* Royle | Balsaminacea e | Himalayan balsam | Wild | *Apis, Bombus* | PN |
| 105 | *Indigofera heterantha* Wall | Fabaceae | Himalayan indigo | Wild | *Apis* | PN |
| 106 | *Inula royleana* Clark | Asteraceae | | Wild | *Apis* | PN |
| 107 | ***Inula racemosa* Hook. | Asteraceae | Pushkarmool | Wild | *Apis* | PN |
| 108 | *Ipomoea tricolor* Cav. | Convolvaceae | Common glory | Wild | *Apis* | PN |
| 109 | *Iris decora* Wall. | Iridaceae | Graceful Himalayan Iris | Ornamental | *Apis, Andrena, Lassioglossum., Xylocopa,* | PN |
| 110 | *Iris hookeriana* Foster | Iridaceae | Hooker's Iris | Ornamental | *Apis, Andrena, Lassioglossum., Xylocopa,* | PN |
| 111 | *Lactuca dolichophyll* | Asteraceae | Long-leaved lettuce | Wild | *Apis.* | PL |

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| | *a* Kitam. | | | | | |
| 112 | *Lagotis cashmerian a* Rupr. | Scrophulariac eae | Kashmir Lagotis | Wild | *Apis, Bombus* | PN |
| 113 | *Lamium album* L. | Lamiaceae | White dead nettle | Wild | *Apis* | PN |
| 114 | *Lavandula officinalis* L. | Lamiaceae | Lavender | Ornamental | *Apis* | PL |
| 115 | ***Lavatera cashmiriana* Cambess. | Malvaceae | Tree Mallow | Ornamental | *Apis, Bombus, Xylocopa.* | PN |
| 116 | *Leonurus cardiaca* L. | Lamiaceae | Motherwort | Wild | *Apis* | PN |
| 117 | *Ligularia fischeri* Turcz. | Asteraceae | leopard plant | Wild | *Apis, Bombus* | PN |
| 118 | *Lindelofia longiflora* Baill. | Boraginaceae | Himalayan lungwort | Wild | *Apis, Bombus, Xylocopa.* | PN |
| 119 | *Lonicera japonica* Thunb. | Caprifoliacea e | Honey suckle | Ornamental | *Apis* | NC |
| 120 | *Lotus corniculatus* L. | Fabaceae | Common birds foot trefoil | Wild | *Apis* | PN |
| 121 | *Lycopersico n esculentum* Mill. | Solanaceae | Tomato | Olericulture | *Apis, Bombus* | PN |
| 122 | *Magnolia grandiflora* L. | Magnoliaceae | Bull Bay/Southern Magnolia | Ornamental | *Apis* | PN |
| 123 | *Mahonia borealis* Takeda | Berberidaceae | | Wild | *Apis* | PN |
| 124 | *Malus domestica* Borkh. | Rosaceae | Apple | Horticulture | *Apis, Amegilla, Andrena. Anthidium, Bombus, Ceratina,* | PN |

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| | | | | | *Halictus, Heriades, Megachile, Mellitina, Osmia, Sphecodes, Lassioglossum., Xylocopa* | |
| 125 | *Malva neglecta* Wallr. | Malvaceae | Common Mallow | Wild | *Apis, Ceratina* | PN |
| 126 | *Malva sylvestris* L. | Malvaceae | High Mallow | Wild | *Apis* | PN |
| 127 | *Marrubium vulgare* L. | Lamiaceae | Horehound | Wild | *Apis* | PN |
| 128 | *Meconopsis latifolia* Prain | Papaveraceae | Blue Poppy | Wild, Medicinal | *Apis, Bombus* | PN |
| 129 | *Medicago lupulina* L. | Fabaceae | Black medic | Wild | *Apis* | PL |
| 130 | *Mentha arvensis* L. | Lamiaceae | Field Mint | Olericulture | *Apis* | PL |
| 131 | *Mentha longifolia L.* | Lamiaceae | Horse Mint | Wild | *Apis* | PL |
| 132 | *Morino longifolia* DC. | Morinaceae | Nepalese Whorl flower | Wild | *Apis, Bombus* | NC |
| 133 | *Myosotis arvensis* L. | Boraginaceae | Forget me not | Wild | *Apis* | PN |
| 134 | *Myosotis caespitosa* Schultz | Boraginaceae | | Wild | *Apis* | PN |
| 135 | *Nepeta erecta* Benth. | Lamiaceae | Erect Catmint | Wild | *Apis* | PN |
| 136 | *Narcissus poeticus* L. | Liliaceae | Daffodil | Ornamental | *Apis* | PN |
| 137 | *Nasturtium officinale* Aiton | Brassicaceae | Watercress | Wild | *Apis* | PN |
| 138 | *Nelumbo* | Nelumbonace | Lotus | Wild | *Apis* | PN |

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| | *Nucifera* Gaertn. | ae | | | | |
| 139 | *Nerium indicum* Mill. | Apocynaceae | Oleander | Ornamental | *Apis* | PN |
| 140 | *Nymphaea alba* L. | Nymphaeacea e | Water Lily | Wild | *Apis, Lasioglossum* | PN |
| 141 | *Nymphoides peltata* Kuntze | Menyanthace ae | Fringed water lily | Wild | *Apis* | PN |
| 142 | *Oxalis corniculatus* L. | Oxalidaceae | Sleeping beauty | Wild | *Apis* | PN |
| 143 | *Oxytropis cashmerian a* Cambess. | Fabaceae | locoweed | Wild | *Apis* | NC |
| 144 | *Paparver dubium* L. | Papaveraceae | Long headed Poppy/ Blind eyes | Wild | *Apis* | PN |
| 145 | *Papaver somniferum* L. | Papaveraceae | Opium Poppy | Olericulture | *Apis* | PN |
| 146 | *Parthenium hysterophor us* L. | Asteraceae | Carrot grass | Wild | *Apis* | PL |
| 147 | *Pedicularis pyramidata* Benth. | Orobanchacea e | Pyramid Lousewort | Wild | *Apis* | PN |
| 148 | *Petunia alba* Ferguson and Ottley | Solanaceae | Petunia | Ornamental | *Apis* | PN |
| 149 | *Phaseolus vulgaris* L. | Fabaceae | Beans | Horticulture | *Apis, Andrena, Bombus, Xylocopa.* | PN |
| 150 | *Philadelphu s incanus* Koehne | Hydrangeacea e | Dogwood | Wild | *Apis, Xylocopa.* | PN |
| 151 | *Phlomis bracteosa* Benth. | Lamiaceae | Purple Jeruselum Sage | Wild | *Apis* | PN |
| 152 | *Physalis philadelphic a* Lam. | Solanaceae | Ground cherry | Horticulture | *Apis, Bombus* | PN |
| 153 | *Pinus wallichiana* A.B.Jacks. | Pinaceae | Himalayan Pine | Wild | *Bombus* | PL |
| 154 | *Plantago lanceolata* L. | Plantaginacea e | Ribwort Plantain | Wild | *Apis* | PL |
| 155 | *Plantago major* L. | Plantaginacea e | Broad leaf Plantain | Wild | *Apis* | PL |
| 156 | *Plectranthu s rugosus* Benth. | Lamiaceae | Wrinkled leaf isodon | Wild | *Apis, Bombus* | PN |
| 157 | *Poa annua* L. | Poaceae | Annual Bluegrass | Wild | *Apis* | PL |
| 158 | ***Podophyl um haxandrum* Royle | Berberidaceae | Himalayan May Apple | Wild | *Apis, Lasioglossum* | PN |
| 159 | *Polygonum amphibium* L. | Polygonaceae | Water smartweed | Wild | *Apis* | PL |
| 160 | *Polygonum amplexicaul e* Don | Polygonaceae | Red Mountain Fleece flower | Wild | *Apis* | PL |
| 161 | *Potentilla argyrophyll a* Lehm. | Rosaceae | Silver leaved cinquefoil | Wild | *Apis, Lassioglossum.* | PN |
| 162 | *Potentilla reptans* L. | Rosaceae | Creeping cinquefoil | Wild | *Apis, Lassioglossum.* | PN |
| 163 | *Prunella vulgaris* L. | Lamiaceae | Common Self-heal | Wild | *Apis* | PN |
| 164 | *Prunus armeniaca* L. | Rosaceae | Apricot | Horticulture | *Apis, Xylocopa., Lassioglossum* | PN |
| 165 | *Prunus avium* L. | Rosaceae | Cherry | Horticulture | *Apis, Lassioglossum* | PN |
| 166 | *Prunus domestica* L. | Rosaceae | Plum | Horticulture | *Apis, Andrena, Bombus, Lassioglossum.Meg achile, Xylocopa* | PN |
| 167 | *Prunus persica* Batsch | Rosaceae | Peach | Horticulture | *Apis, Lassioglossum* | PN |
| 168 | *Pseudomart ensia nemorosa* Stewart and Kazmi | Boraginaceae | Forest Alpine Bluebell | Wild | *Apis, Bombus* | PN |
| 169 | *Pteracanthu s urticifolius* Bremek. | Acanthaceae | Blue nettle | Wild | *Apis* | PN |
| 170 | *Punica granatum* L. | Lythraceae | Pome granate | Horticulture | *Apis* | PN |
| 171 | *Pyrus communis* L. | Rosaceae | Pear | Horticulture | *Apis, Andrena, Bombus Lassioglossu, Mega chile, Xylocopa* | PN |
| 172 | *Pyrus pyrifolia* Nakai | Rosaceae | Pear | Horticulture | *Apis, Andrena, Bombus Lassioglossum, Megachile, Xylocopa* | PN |
| 173 | *Ranunculus arvensis* L. | Ranunculaceae | Corn Buttercup | Wild | *Apis* | PN |
| 174 | *Ranunculus laetus* Wall. | Ranunculaceae | Cheerful Buttercup | Wild | *Apis, Lassioglossum* | PN |
| 175 | *Ranunculus scleratus* L. | Ranunculaceae | Cursed Buttercup | Wild | *Apis* | PN |
| 176 | *Raphanus sativus* L. | Brassicaceae | Turnip | Olericulture | *Apis* | PN |
| 177 | *Rhododendr on campanulat um* D. Don | Ericaceae | Bell Rhododendron | Wild | *Apis, Bombus* | PN |
| 178 | *Robinia pseudoacacia* L. | Fabaceae | Black Locust | Social forestry | *Apis* | NC |
| 179 | *Rorippa islandica* Borbas | Brassicaceae | Marsh yellow cress | Wild | *Apis* | PN |
| 180 | *Rosa brunonii* Lindl. | Rosaceae | Himalayan Musk Rose | Wild | *Apis, Andrena, Bombus, Xylocopa, Lassioglossum* | |
| 181 | *Rosa canina* L. | Rosaceae | Dog Rose | Wild | *Apis, Bombus, Xylocopa Lassioglossum* | PN |
| 182 | *Rosa indica* L. | Rosaceae | Rose | Wild | *Apis, Bombus, Xylocopa* | PN |
| 183 | *Rubus elipticus* Sm. | Rosaceae | Yellow Himalayan Raspberry | Wild | *Apis, Ceratina* | PN |
| 184 | *Rubus fruticosus* L. | Rosaceae | Blackberry | Wild | *Apis, Ceratina.* | PN |
| 185 | *Rubus niveus* Thunb. | Rosaceae | Raspberry | Wild | *Apis, Ceratina* | PN |
| 186 | *Rubus occidentalis* L. | Rosaceae | | Wild | *Apis, Ceratina* | PN |
| 187 | *Rubus ulmifolius* Schott | Rosaceae | Elm leaf blackberry | Wild | *Apis,Ceratina.* | PN |
| 188 | *Rudbeckia hirta* L. | Asteraceae | Black eyed Susan | Ornamental | *Apis, Bombus* | PN |
| 189 | *Rumex acetosa* L. | Polygonaceae | Common Sorrel | Wild | *Apis* | PL |
| 190 | *Salix alba* L. | Salicaeae | Willow | Social Forestry | *Apis, Lasioglossum* | PL |
| 191 | *Salix caprea* L. | Salicaceae | Goat willow | Landscape | *Apis* | PL |
| 192 | *Salvia hians* Benth. | Lamiaceae | Himalayan Blue Sage | Wild | *Apis, Bombus* | PN |
| 193 | *Salvia moocroftian* | Lamiaceae | Moorcroft's Sage | Wild | *Apis, Bombus, Lasioglossum.* | PN |

| | | | | | | |
|---|---|---|---|---|---|---|
| | *a* Benth. | | | | | |
| 194 | *Sambucus wightiana* Wight and Arn. | Caprifoliacea e | Kashmir Elder | Wild | *Apis, Lasioglossum.* | PL |
| 195 | *Sanvitalia procumbens* Lam. | Asteraceae | Creeping zinnia | Ornamental | *Apis, Bombus* | PL |
| 196 | ***Saussure a costus* Lipsch. | Asteraceae | Costus | Wild | *Apis, Bombus* | PN |
| 197 | *Senecio chrysanthe moides* DC. | Asteraceae | Cheerful Senecio | Wild | *Apis* | PL |
| 198 | *Sibbaldia cuneata* Kunze | Rosaceae | Wedge leaf Sibbaldia | Wild | *Apis* | PN |
| 199 | *Sisymbrium irio* L. | Brassicaceae | Rocket Mustard | Wild | *Apis* | PN |
| 200 | *Sium latijugum* Clarke | Apiaceae | Squirrel tail | Wild | *Apis* | PN |
| 201 | *Skimmia anquetilia* Shaw | Rutaceae | | Wild | *Apis, Andrena.* | PN |
| 202 | *Solanum melongena* L. | Solanaceae | Bringal/ Egg plant | Olericulture | *Apis, Bombus* | PN |
| 203 | *Solanum nigrum* L. | Solanaceae | Black Nightshade | Wild | *Apis, Bombus* | PN |
| 204 | *Solanum tuberosum* L. | Solanaceae | Potato | Olericulture | *Apis, Bombus* | PN |
| 205 | *Sonchus oleraceus* L. | Asteraceae | Milk or sow thistle | Wild | *Apis* | PL |
| 206 | *Sophora japonica* L. | Fabaceae | | Wild | *Apis, Xylocopa.* | PN |
| 207 | *Stachys floccose* Benth. | Lamiaceae | Woolly Woundwort | Wild | *Apis* | PN |
| 208 | *Stellaria media* Vill. | Carophyllacea e | Chickweed | Wild | *Apis, Lasioglossum.* | PN |
| 209 | *Sternbergia lutea* Spreng. | Liliaceae | Lily of the Field | Ornamental | *Apis* | PN |
| 210 | *Syringa emodi* Royle | Oleraceae | Himalayan Lilac | Wild | *Apis* | PL |
| 211 | *Tagetes patula* L. | Asteraceae | French Marigold | Ornamental | *Apis, Bombus* | PL |
| 212 | *Tanacetum vulgare* L. | Asteraceae | Tancy | Wild | *Apis, Bombus* | PL |
| 213 | *Taraxacum officinale* Wigg. | Asteraceae | Dandelion | Wild | *Apis, Andrena, Ceratina, Halictus, Lassioglossum* | PN |
| 214 | *Thymus linearis* Benth. | Lamiaceae | Linear Leaved thyme | Wild | *Apis* | NC |
| 215 | *Thymus serphyllum* L. | Lamiaceae | Shepherd's thyme | Wild | *Apis* | NC |
| 216 | *Trifolium pratense* L. | Fabaceae | Red Clover | Wild | *Apis, Andrena, Bombus, Lasioglossum* | PN |
| 217 | *Trifolium repens* L. | Fabaceae | White Clover | Wild | *Apis, Andrena, Bombus, Lasioglossum,* | PN |
| 218 | *Tulipa stellata* Hook. | Liliaceae | Himalayan White Tulip | Wild | *Apis,Lasioglossum, Halictus* | PN |
| 219 | *Valeriana hardwickii* Wall. | Caprifoliacea e | Indian valerian | Wild | *Apis* | PN |
| 220 | *Verbascum thapsus* L. | Scrophulariac eae | Great mullein | Wild | *Apis* | PN |
| 221 | *Veronica arvensis* L. | Scrophulariac eae | Speedwell | Wild | *Apis, Andrena, Lasioglossum* | PN |
| 222 | *Veronica Persica* Poir. | Scrophulariac eae | Persian speedwell | Wild | *Apis, Andrena, Lasioglossum* | PN |
| 223 | *Viburnum grandifloru m* Wall. Ex DC. | Adoxaceae | Grand Viburnum | Wild, | *Apis* | PN |
| 224 | *Viola biflora* L. | Violaceae | Yellow wood violet | Wild | *Apis, Anthidium* | NC |
| 225 | *Viola odorata* L. | Violaceae | Wood violet | Wild | *Apis, Anthidium, Halictus* | NC |
| 226 | *Weigela floribunda* C.A.Mey. | Caprifoliacea e | | Ornamental | *Apis* | PN |
| 227 | *Zea mays* L. | Poaceae | Maize | Wild | *Apis* | PL |
| 228 | *Zinnia elegans* L. | Asteraceae | Zinnia | Ornamental | *Apis, Bombus Xylocopa.* | PN |

*=Vulnerable **= Endangered PN = Pollen and nectar PL = Pollen NC = Nectar

28 families contributed only single plant species. Majority of these foraging plants (97) were annual herbs, followed by 74 perennial herbs, 28 shrubs, 22 trees and 07 biennial herbs Nearly two-third (153) of the recorded foraging plant species were wild and the remaining 75 species were cultivated for different purposes: floriculture (37 species), agriculture (19), horticulture (15) and social forestry (04) (Fig 2). Bee flora includes 9 threatened medicinal plant species, 4 of vulnerable and 5 of endangered status. The foraging plants were found to provide three types of rewards to the insect visitors. It was revealed that 169 plant species provide both nectar and pollen as reward, 47 species exclusively provide pollen and 12 species provide nectar to the flower visitors. Pollen producing species includes *Pinus wallichiana* A.B. Jacks.-a gymnospermic species, which was found to provide pollen to different species of *Bombus*. Overall 77 foraging species were found frequently visited by bees (Table 2). Investigations revealed that these species are either rich in nectar content or have high nectar sugar. This is in conformity with Singh *et al.* (2016) [16]. Who reported that high nectar volume and higher nectar sugar concentration is preferred by bees in their flight ranges to avoid wastage of energy and time. Highest nectar content (23 µl /flower) was recorded in *Campsis grandiflora* followed by *Cucurbita maxima* (20 µl/flower)**,** *Prunus amygdalus* (18 µl /flower), *Lavatera cashmeriana* (14 µl/flower), *Salvia hians* (12.86), *Robinia pseudoacacia* (12 µl /flower), *Plectranthus rugosus*, *Salvia macrooftaina*, *Iris hookeriana* (11 µl /flower) *Aesculus indica* and *Eriobotyronica japonica* (10 µl /flower).

Highest nectar sugar content was found in *Lonicera japonica* (37.81gm/ l), *followed by Mentha longifolia (35.18* gm/ l*), Cynodia oblonga (34.83* gm/ l*), Dahlia daenranthema (34.03* gm/ l), *Campsis grandiflora (33.69* gm/ l*), Rosa indica (32.86* gm/ l), *R. canina*.

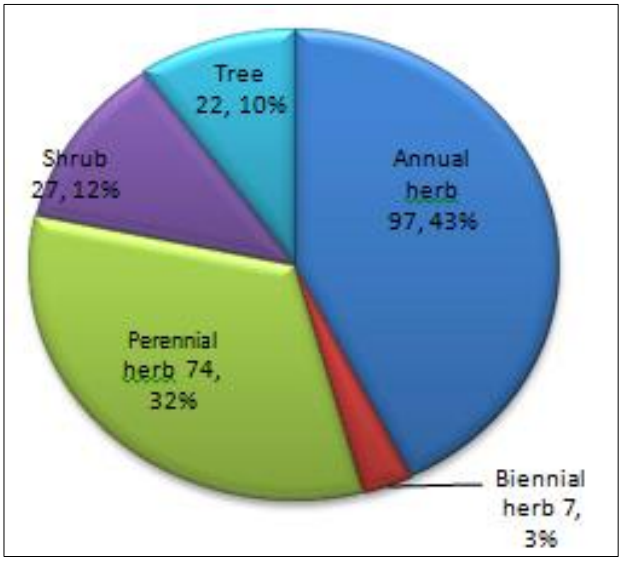


**Fig 1:** Contribution of different growth-forms in bee flora

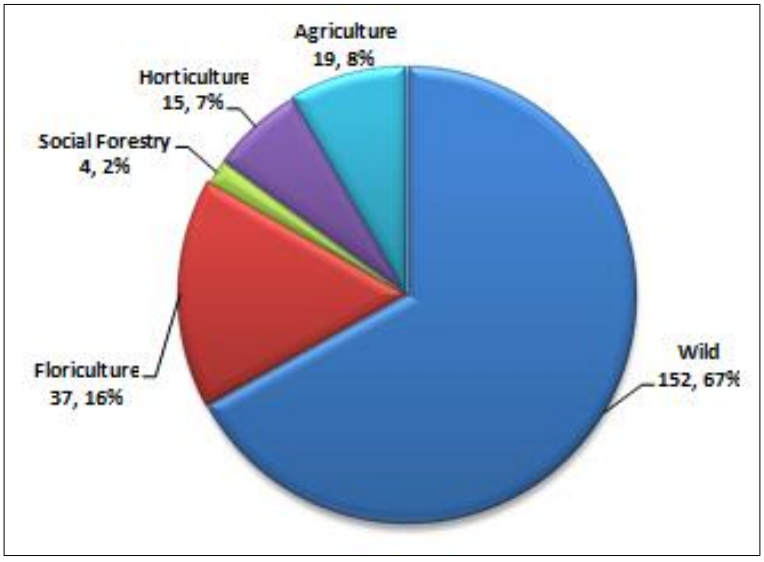


**Fig 2:** Status of bee flora

(*31.63* gm/ l) and *Eriobotyria japonica (31.46* gm/ l). Nectar resource diversity helps in framing flower visitor community structure (Potts *et al.*, 2004). A total of 37 bee species belonging to 15 genera and 6 families were found visiting flowers for their food (Table 3). Family Apidae was the dominant group of bees with 13 species followed by Halictidae (11 species). Paray *et al*. (2014) [14] while focusing on distributional diversity of insect pollinators on single plant species of apple (*Malus domestica*) reported the diversity of

**Table 2**: Frequently visited bee flora of Kashmir Himalaya.

| Serial No. | Plant species | Nectar content (µl/flower) | Nectar sugar content (gm/ l ) |
|---|---|---|---|
| | *Abelia grandiflora* | 2.00 | 18.54 |
| 2. | *Accacia* spp. | 9.30 | 25.26 |
| 3. | *Actinidia deliciosa* | 9.50 | 24.34 |
| 4. | *Aesculus indica* | 10.00 | 22.81 |
| 5. | *Alcea rosea* | 9.50 | 21.23 |
| 6. | *Antirrhinum majus* | 1.80 | 28.55 |
| 7. | *Arabis glabra* | 1.45 | 25.08 |
| 8. | *Astragalus candolleanus* | 1.85 | 18.03 |
| 9. | *Berberis lycium* | 3.00 | 28.08 |
| 10. | *Brassica compestris* | 1.35 | 26.54 |
| 11. | *B. oleracea* var. *capitata* | 2.00 | 25.02 |
| 12. | *B. rapa* | 1.15 | 25.92 |
| 13. | *Campsis grandiflora* | 23.00 | 33.69 |
| 14. | *Circis siliquastrum* | 4.00 | 25.60 |
| 15. | *Circium arvense* | 0.45 | 24.34 |
| 16. | *Colchicum luteum* | 2.70 | 28.07 |
| 17. | *Convolvulus arvense* | 0.70 | 23.23 |
| 18. | *Cucumus sativus* | 2.87 | 18.81 |
| 19. | *Cucurbita maxima* | 20.00 | 15.56 |
| 20. | *Cynodia oblonga* | 1.45 | 34.83 |
| 21. | *Dahlia daenranthema* | 0.45 | 34.03 |
| 22. | *Descuriania Sophia* | 7.56 | 23.32 |
| 23. | *Epilobium royleanum* | 1.50 | 25.08 |
| 24. | *Eriobotyria japonica* | 10.00 | 31.46 |
| 25. | *Eschscholzia californica* | 3.00 | 25.06 |
| 26. | *Forsythia suspense* | 2.35 | 23.55 |
| 27. | *F. viridisim* | 3.50 | 22.86 |
| 28. | *Gladiolus hybrid* | 8.58 | 26.08 |
| 29. | *Hibiscus rosa-sinensis* | 5.00 | 26.34 |
| 30. | *Hibiscus trionum* | 4.70 | 26.08 |
| 31. | *Iberis amara* | 1.85 | 18.19 |
| 32. | *Iris decora* | 9.00 | 29.09 |
| 33. | *I. hookeriana* | 11.00 | 27.98 |
| 34. | *Lavandula officinale* | 0.32 | 26.08 |
| 35. | *Lavatera cashmeriana* | 14.00 | 17.08 |
| 36. | *Lonicera japonica* | 04.00 | 37.81 |
| 37. | *Lotus corniculatus* | 1.05 | 18.00 |
| 38. | *Magnolia grandiflora* | 2.50 | 23.55 |

| | | | |
|---|---|---|---|
| 39. | *Malus domestica* | 1.05 | 23.34 |
| 40. | *Malva neglecta* | 0.70 | 26.34 |
| 41. | *Malva sylvestris* | 1.20 | 26.08 |
| 42. | *Mentha arvensis* | 0.45 | 33.06 |
| 43. | *M. longifolia* | 0.45 | 35.18 |
| 44. | *Narcissus poeticus* | 1.30 | 19.87 |
| 45. | *Oxalis corniculatus* | 0.89 | 26.08 |
| 46. | *Petunia alba* | 2.00 | 28.92 |
| 47. | *Phaseolus vulgaris* | 2.50 | 28.05 |
| 48. | *Plectranthus rugosus* | 11.00 | 32.14 |
| 49. | *Podophylum haxandrum* | 1.89 | 17.08 |
| 50. | *Potentilla repetans* | 1.05 | 17.81 |
| 51. | *Prunella vulgaris* | 0.30 | 26.03 |
| 52. | *Prunus amygdalus* | 18.00 | 28.32 |
| 53. | *P. armeniaca* | 5.50 | 26.06 |
| 54. | *P. avium* | 7.00 | 21.82 |
| 55. | *P. persica* | 4.00 | 26.08 |
| 56. | *Punica granatum* | 1.10 | 23.45 |
| 57. | *Pyrus communis* | 7.80 | 28.19 |
| 58. | *P. pyrifolia* | 7.30 | 28.00 |
| 59. | *Ranunculus reptans* | 1.00 | 17.81 |
| 60. | *Raphanus sativus* | 2.00 | 24.89 |
| 61. | *Robinia pseudoacacia* | 12.00 | 26.34 |
| 62. | *Rosa canina* | 05.00 | 31.63 |
| 63. | *R. indica* | 06.00 | 32.86 |
| 64. | *Rubus almifolis* | 1.50 | 30.05 |
| 65. | *R. niveus* | 2.23 | 30.89 |
| 66. | *Salvia hians* | 12.86 | 21.09 |
| 67. | *S. macrooftaina* | 11.00 | 22.08 |
| 68. | *Sisymbrium irio* | 0.60 | 25.05 |
| 69. | *Stellaria media* | 1.3 | 28.05 |
| 70. | *Sternbergia lutea* | 2.70 | 26.33 |
| 71. | *Thymus linearis* | 0.10 | 26.81 |
| 72. | *Trifolium pretense* | 0.20 | 25.44 |
| 73. | *T. repense* | 0.25 | 23.38 |
| 74. | *Veronica persica* | 0.60 | 15.81 |
| 75. | *Viburnum grandiflorum* | 0.50 | 23.01 |
| 76. | *Vinca major* | 4.50 | 15.01 |
| 77. | *Zinnia elegans* | 0.50 | 28.56 |

Halicted bees surpassing other pollinators in the Kashmir valley. Present study revealed *Bombus* and *Lassioglossum* as the diversified genera with 7 species each, followed by *Andrena* with 4 species. Our findings substantiate Parey *et al.* (2014) and Ganie *et al*. (2013) [10], who reported *Lassioglossum* of halictid bees as highly diversified and abundant genus.

The titanic diversity seen in the flowering plants, in addition to other factors, is accredited to the interactions between flowers and insects that visit them. The plant species that support several insect visits are potentially priceless forage plants as they provide rewards in the form of pollen and nectar (food) to insects which sustain their race by carrying pollen for their successive pollination and reproduction. Such a sort of socialistic mutualism is particularly vital in the maintenance of natural as well as cultivated ecosystems and the assets of economic goods they provide.

**Table 3:** Taxonomic conspectus of bees in Kashmir Himalaya

| Family | Genera | Species |
|---|---|---|
| Apidae | *Xylocopa* | *Xylocopa valga* Gerstaecker, 1872 |
| | | *Xylocopa violacea* Linnaeus, 1758 |
| | *Bombus* | *Bombus simillmus* Smith,1859 |
| | | *Bombus tunicatus* Smith, 1852 |
| | | *Bombus trifasciatus* Smith,1852 |
| | | *Bombus rufofasciatus* Smith, 1852 |
| | | *Bombus asiaticus* Morawitz, 1875 |
| | | *Bombus pyrosoma* Morawitz, 1890 |
| | | *Bombus miniatus* Bingham, *1897* |
| | *Amegilla* | *Amegilla fallax* Smith, 1879 |
| | *Mellitina* | *Mellitina harrietae* Bingham, |
| | *Apis* | *Apis cerana* Fabricius, 1793 |
| | | *Apis mellifera* Linnaeus, 1761 |
| Halictidae | *Lassioglossum* | *Lassioglossum himalayense* Bingham, 1898 |
| | | *Lassioglossum nursei* Bluthgen,1926 |

| | | |
|---|---|---|
| | | *Lassioglossum rugolatum* Smith, 1853 |
| | | *Lassioglossum polyctor* Bingham, 1908 |
| | | *Lasioglossum marginatum* Brulle, 1832 |
| | | *Lasioglossum sublaterale* Bluthgen, 1931 |
| | | *Lasioglossum leucozonium* Schrank, 1781 |
| | *Halictus* | *Halictus constrictus* Smith, 1853 |
| | | *Halictus propinquus* Smith, 1853 |
| | *Sphecodes* | *Sphecodes tantalus* Nurse, 1903 |
| | | *Sphecodes lasimensis* Bluthgen, 1927 |
| Andrenidae | *Andrena* | *Andrena patella* Nurse, 1903 |
| | | *Andrena cineraria* Linnaeus, 1758 |
| | | *Andrena floridula* Smith, 1878 |
| | | *Andrena flavipes* Panzer, 1799 |
| Ceratidae | *Ceratina* | *Ceratina hieroglyphica* Smith, 1854 |
| | | *Ceratina lepida* Smith, |
| | | *Ceratina propinqua* Cameron, 1897 |
| Megachalidae | *Anthidium* | *Anthidium conciliatum* Nurse, 1903 |
| | *Megachile* | *Megachile conjuncta* Smith, 1853 |
| | | *Megachile rotundata* Fabr., 1793 |
| | *Osmia* | *Osmia* sp. |
| | *Heriades* | *Heriades* sp. |
| Tenthredinidae | *Athalia* | *Athalia proxima* Klug, 1915 |

Vital contribution of bees in pollination and ecosystem maintenance is an established fact, as out of about hundred insect pollinated crops which make up most of the food supply, 15% are pollinated by domestic bees only. Hence for the sustenance of this entomo- faunal group conservation of their foraging species –Bee flora, is obligatory. Due to mounting anthropogenic activities including habitat degradation, deforestation, urbanization overgrazing and overexploitation of some economically important species, phytobiodiversity of the Kashmir Himalaya has suffered which is confirmed by 9 threatened bee floral plant species documented in the present study. The results from this study offer novel insights regarding further studies and conservation of these species.

## Conclusions

A total 228 plant species belonging to 182 genera and 58 families were recorded, which serve as foraging plants for different types of bees. Annual herbaceous plants were found as abundant source of pollen and nectar for bees followed by perennial herbs, shrubs, trees and finally by biennial herbs. Asteraceae was found to be dominant family of pollen and nectar producing plants in Kashmir Himalaya. Wild flora was found to be dominant source of pollen and nectar. Majority of pollen and nectar producing plants were found to act as the source of both pollen and nectar (bi-dimensional) as compared to pollen or nectar only (uni-dimensional).

In total 37 bee species belonging to 15 genera and 6 families were found visiting the foraging plants. Family Apidae was the dominant group of bees. This type of research can form a scientific platform for future research in the field of plant insect interaction, pollinator food, pollen and nectar producing plants, pollination biology, organismic interaction, diversity and co-extinction of biodiversity in this Himalayan region. The results obtained can provide baseline biodiversity information framework for conservation of plant insect interaction and can help to cope with currently pressing problem of biodiversity loss.

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