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Checklist of Dipteran Visitors of Flower, Fruit and Field Crops in Kargil (Ladakh, U.T.), India

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Abstract: The current investigation focused on dipteran species that visit flowers in the trans-Himalayan region of Kargil district, Ladakh U.T, India. Surveys were conducted on various field and fruit crops across different locations at elevations ranging from 2650 to 4500 ft. A total of 17 dipteran species, encompassing 15 genera, 11 tribes, and 9 subfamilies, were documented during the flowering season of fruit and field crops for more than two years from May 2020 to October 2022 excluding the winter season.

Keywords: Diptera, Flower visitors, Fruit, Field crops, Kargil

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Introduction

Diptera is recognized as one of the largest and most diverse order within the class Insecta. In terrestrial and freshwater environments, flies are common and can be found in all habitats. They show a wide range of feeding habits and life history patterns. Over 160,000 species, 10,000 genera, 150 families, 22-32 superfamilies, 8-10 infraorders, and three suborders in this group are cited in literature (McAlpine and Wood, 1989; Thompson, 2008; Chapman, 2009; Pape and Thompson, 2013; Borkent *et al.*, 2018; Evenhuis and Pape, 2021). Flies are characterized by

varying mouth parts, tongue lengths, sizes, and levels of pilosity.

Numerous Diptera species visit flowers, and their abundance on plants may reflect both their significance as pollinators and the significance of flowers for their nutrition. According to Larson *et al.* (2001), there are at least 71 families of dipteran flies that visit flowers. These flies pollinate more than 100 cultivated plants, including important crops like mango, cashew, tea, cacao, onions, and strawberries (Heath, 1982), cauliflower, mustard,

carrot, apple (Mitra and Banerjee, 2007), leek (Clement *et al.*, 2007) and cassava (Hansen, 1983).

Most dipteran species feed on the nectar and pollen of flowers and in the process pollen sticks to their bodies. It is then carried to other flowers where it gets transferred to the sticky part of the flower i.e. stigma.

The variety of flies that visit flowers is reflected in how well they pollinate. Some flowers attract flies by providing a warm shelter in cold, arctic, and alpine settings. Flies enjoy the warmth, which can be more than 5° C higher than the surrounding temperature (Luzar and Gottsberger, 2001). This keeps their flying muscles warm, allowing them to fly in conditions that would be too cold for other bees. Pollination occurs as a result of their migration between flowers. Fly pollination also benefits a huge number of wild relatives of food plants, fruit plants, various medicinal plants, wild plants and cultivated garden plants.

Klein *et al.* (2007), Ssymank *et al.* (2008) and Rader *et al.* (2016), are among the few investigators who have looked into the potential function of flies in crop pollination. Mitra and Banerjee (2007) identified 70 Diptera species as effective pollinators of 63 plant types in India. Flies visit flowers for a variety of other reasons, including finding mates and oviposition locations (Faegri and Van Der Pijl, 1979; Kevan and Baker, 1983; Kevan, 2002).

In view of this, the Diptera branch of the Zoological Survey of India has initiated a study to gather basic information on flower-visiting flies in India. As a result, 116 dipteran species from 16 families have been identified as floral visitors. However, there is still insufficient research on this order of insects in India regarding their significance as pollinators in the terrestrial ecosystem and there is need to check biodiversity and distribution of flower-visiting dipteran species in the country. The aim of this paper was to examine the diversity of flower-visiting dipteran species in the arid, trans-Himalayan region of district Kargil, Ladakh (U.T.), India.

During field surveys and observations, we recorded 17 species of flower-visiting dipteran flies belonging to 6 families. This is the first investigation of flower visiting dipteran species from this region. The dipteran fauna of Kargil is under studied and has not been compiled previously. Insects begin to visit and feed on flowers in April, when the temperature returns to normal after a cold winter, and these flies emerge and actively visit various flowers during this period.

Materials and Methods

Study area:

The study was conducted in Kargil district of Ladakh U.T located at 34.5539°N, 76.1349°E with average elevation of 2650 meters (Fig. 1). The district's borders are defined by several neighboring regions, including Jammu and Kashmir, a union territory to the west, Gilgit-Baltistan, a Pakistan territory to the north, Leh district of Ladakh to the east, and Himachal Pradesh, a state to the south. Kargil district, situated in the southwestern part of the Himalayas, has a cool and temperate climate. In biogeographic zone, Kargil falls under the trans-Himalaya region. The winters are long and cold, with temperatures dropping as low as -15 °C, and sometimes even -45°C in Drass. The Zaskar valley is even colder. The district spans over 14,086 km² and is home to the Suru river. The average annual temperature is 8.6°C, and precipitation amounts to 318 mm per year, with March being the wettest month and November the driest. July to mid-August are the warmest months, with an average temperature of 23.3°C, while January is the coldest, with an average temperature of -8.8°C. The cold desert of Kargil, Ladakh, has limited vegetation due to its high aridity. The higher regions are rocky and barren, so vegetation, primarily consisting of grasses and shrubs, is mostly found in the lower elevation river valleys. Animals rely on small areas of grass and shrubs for grazing, while willow and poplar trees are found in the valleys. Fruit trees, such as apple, apricot and almond, and field crops like alfalfa,

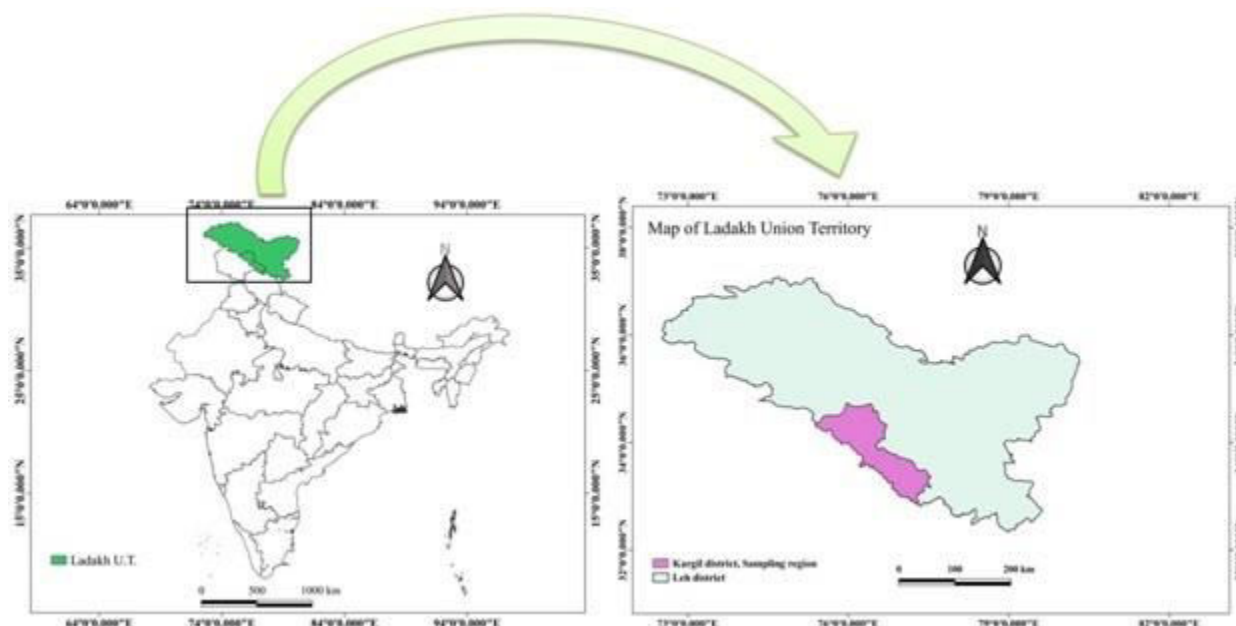


Fig.1: GIS map showing the study area of district Kargil (pink colour) of Ladakh (U.T.), India.

buckwheat, mustard etc. blossom during the spring and summer season.

Sampling methods:

For the purpose of observing dipteran flies, two sampling sites were chosen: one is fruit crops and the other is field crops. The observation of flower visiting dipteran species was conducted at these sites, from May 2020 to October 2022, excluding the winter season. The study sites were visited fortnightly from morning (9:30 am) until evening (5:00 pm) during good weather conditions (without heavy rain, strong wind or cloudy day). Adult dipteran species were photographed when they visited on flowers of fruit and field crop, using a DSLR camera (Nikon D3500) and also captured with mobile phone (Redmi note 5 Pro). The collected specimens were killed using ethyl acetate and set onto a stretching board (Thermocol sheet) with the help of entomological pins. These were then dried in an open room at a temperature of 6-15°C for four days. Following this, the dried specimens were labeled tagged with data about their collection location, and carefully placed into wooden insect boxes. They were then

transported to the laboratory for extended preservation and future taxonomic examinations.

Identification of specimens:

Preliminary identification of the specimens was done using relevant literature and keys (Brunetti, 1907, 1908; Mitra *et al.*, 2004, 2004a, 2005; Shah *et al.*, 2005; Banerjee and Mitra, 2006; Parui *et al.*, 2006; Banerjee *et al.*, 2007; Kits *et al.*, 2008; Mitra, 2010; Sengupta *et al.*, 2016, 2019, 2020; O'Hara *et al.*, 2019; Halder *et al.*, 2019). Subsequently these were got confirmed by Dr. Jayita Sengupta, Senior Zoological Assistant, Diptera Section, Zoological Survey of India, Kolkata.

Results and Discussion

Dipterans, such as hoverflies and bee flies, possess specialized mouthparts that allow them to access the floral resources within blossoms. As they move from one flower to another, dipterans inadvertently transfer pollen, aiding in the fertilization of plants. Their unique wing patterns and ability to hover in mid-air make them easily identifiable while flitting from one vibrant bloom to another, contributing to the enchanting and

dynamic tapestry of the floral world.

The trans-Himalayan region is known for its unique and fragile ecosystems, with many endemic and rare plant species. Conservation of flower visitor species is essential for maintaining the delicate balance of these ecosystems, as their decline or loss can disrupt the entire plant-pollinator network. Protecting and preserving the habitats and resources necessary for these visitors is vital to safeguarding the biodiversity and ecological integrity of the trans-Himalayan region. Additionally, promoting awareness and implementing conservation strategies focused on these flower visitors can contribute to the sustainable management and conservation of the region's natural heritage. This investigation represents the first field survey of dipteran species that serve as floral visitors in the cold desert of trans-Himalayan district Kargil, Ladakh U.T. Following are the details of species observed:

1. *Scaeva latimaculata* (Brunetti, 1923):

Material examined: India: Ladakh U.T, district Kargil: Hardass, 2688 m, Shilikchay, 2654 m, Mangbore, 2751, Sarchay Kanoor, 2812 m, and Chutumail, 3020 m (Coll. Ahsan Ali).

Distribution: Himachal Pradesh, Punjab, Rajasthan, Uttar Pradesh and Ladakh U.T, district Kargil (Present study).

Host Plant: Apple, Almond.

2. *Chrysotoxum convexum* (Brunetti, 1915):

Material examined: India: Ladakh U.T, district Kargil: Skambo, 3316 m, Lankarchay, 2942 m, Marpodoks Saliskote, 3072 m and Tambis 2853 m (Coll. Ahsan Ali).

Distribution: Himachal Pradesh, Jammu and Kashmir, Mizoram, Uttar Pradesh, Uttarakhand and Ladakh U.T, district Kargil (Present study).

Host Plant: Mustard.

3. *Eupeodes (Metasyrphus) luniger* (Meigen, 1822):

Material examined: India: Ladakh U.T, district Kargil: Skambo, 3316 m, Skinmarchay Thovina, 2901 m, Saliskote, 3072 m (Coll. Ahsan Ali).

Distribution: Himachal Pradesh, Punjab and Ladakh U.T, district Kargil (Present study).

Host Plant: Buckwheat and Mustard.

4. *Eristalis (Eoseristalis) cerealis* (Fabricius, 1805):

Material examined: India: Ladakh U.T, district Kargil: Lankarchay, 2942 m, Skambo, 3316 m

Distribution: Tamil Nadu, West Bengal and Ladakh U.T, district Kargil (Present study)

(Coll. Ahsan Ali).

Host plant: Buckwheat, Mustard.

5. *Episyrphus (Episyrphus) balteatus* (De Geer, 1776):

Material examined: India: Ladakh U.T, district Kargil: Shilikchay, 2654 m, Sarchay Kanoor, 2812 m, Chutumail, 3020 m. Zanskar, 3600 m (Coll. Ahsan Ali).

Distribution: widely distributed through all the states of India and Ladakh U.T, district Kargil (Present study).

Host plant: Apple, Almond, Alfalfa and Mustard.

6. *Eristalis (Eristalis) tenax* (Linnaeus, 1758):

Material examined: India: Ladakh U.T, district Kargil: Chutumail, 3020 m, Thovina, 2871 m, Skambo, 3316 m, Shilikchay, 2654 m, and Wakha, 3359 m (Coll. Ahsan Ali).

Distribution: Chandigarh, Himachal Pradesh, Jammu and Kashmir, Punjab, Uttarakhand and Ladakh U.T, district Kargil (Present study).

Host plant: Apple, Apricot, Almond, Dandelion, Buckwheat, Alfalfa, Mustard.

7. *Syrphus (Syrphus) ribesii* (Linnaeus, 1758):

Material examined: India: Ladakh U.T, district Kargil: Chutumail, 3020 m, Pashkum Thang 2925 m.

Distribution: Himachal Pradesh, Jammu and Kashmir, Uttarakhand and Ladakh U.T, district Kargil (Present study).

Host plant: Alfalfa.

8. *Volucella zonaria* (Poda, 1761):

Material examined: India: Ladakh U.T, district Kargil: Marpodoks Saliskote, 3072 m (Coll. Ahsan Ali).

Distribution: Ladakh U.T, district Kargil (Present study).

Host plant: Buckwheat.

9. *Myopa testacea* (Linnaeus, 1767):

Material examined: India: Ladakh U.T, district Kargil: Shilikchay, 2654 m, Kurbathang, 2826 m, Hardass, 2688 m, Shilikchay, 2654 m, Chutumail, 3020 m, Mangbore Akchamal, 2751 m (Coll. Ahsan Ali).

Distribution: Jammu and Kashmir and Ladakh U.T, district Kargil (Present study).

Host plant: Apricot, Apple and Dandelion.

10. *Physocephala aurantiaca* (Brunetti, 1923):

Material examined: India: Ladakh U.T, district Kargil: Skambo, 3316 m, Thovina, 2871 m, Sarchay Kanoor, 2812 m (Coll. Ahsan Ali).

Distribution: Bihar and Ladakh U.T, district Kargil (Present study).

Host plant: Mustard and Buckwheat.

11. *Bombylius erectus* (Brunetti, 1909):

Material examined: India: Ladakh U.T, district Kargil: Shilikchay, 2654 m, Chutumail, 3020 m, Shilikchay, 2654 m, Mangbore Akchamal, 2751 m (Coll. Ahsan Ali).

Distribution: Karnataka, Maharashtra, Ladakh U.T, district Kargil (Present study).

Host plant: Apple, Apricot, Dandelion.

12. *Anthrax aperta* (Walker, 1852)

Material examined: India: Ladakh U.T, district Kargil: Thovina, 2871 m, Sarchay Kanoor, 2812 m, Farooona 2895 m (Coll. Ahsan Ali).

Distribution: East India

Host plant: Buckwheat.

13. *Sarcophaga pernix* (Harris, 1780):

Material examined: India: Ladakh U.T, district Kargil: Marpodoks Saliskote, 3072 m, Thovina, 2871 m, Skinmarchay Thovina, 2901 m, Saliskote, 3072 m (Coll. Ahsan Ali).

Distribution: Andhra Pradesh, Arunachal Pradesh (Dunn Bridge), Bihar (Postoita), Himachal Pradesh (Chamba, Dalhousie, Kufri, Manali, Manikaran, Shimla), Jammu and Kashmir (Jhelum valley, Kogyar, Tangmarg), Uttarakhand (Badrinath, Mussoorie, Naini Tal, Sahastradhara, Tehri) and Ladakh U.T, district Kargil (Present study).

Host plant: Buckwheat, Mustard and Alfalfa.

14. *Chrysomya phaonis* (Seguy, 1928):

Material examined: India: Ladakh U.T, district Kargil: Thovina, 2871 m, Sarchay Kanoor, 2812 m, Marpodoks Saliskote, 3072 m (Coll. Ahsan Ali).

Distribution: Uttarakhand (Mussorie), Uttar Pradesh (Varanasi) and Ladakh U.T, district Kargil (Present study).

Host plant: Buckwheat and Mustard.

15. *Tachina fera* (Linnaeus, 1761)

Material examined: India: Ladakh U.T, district Kargil: Sarchay Kanoor, 2812 m, Marpodoks Saliskote, 3072 m, Skambo, 3316 m, Thovina, 2871 m (Coll. Ahsan Ali).

Distribution: Ladakh U.T district Kargil (Present study).

Host plant: Buckwheat and Mustard.

16. *Tachina ursina* (Meigen, 1824):

Material examined: India: Ladakh U.T, district Kargil: Farooona 2895 m, Thovina, 2871 m (Coll. Ahsan Ali).

Distribution: Ladakh U.T, district Kargil (Present study).

Host plant: Buckwheat.

17. *Thyridanthrax* sp. (Osten-Sacken, 1886):

Material examined: India: Ladakh U.T, district Kargil: Thovina, 2871 m, Sarchay Kanoor, 2812 m, Marpodoks Saliskote, 3072 m (Coll. Ahsan Ali).

Distribution: Maharashtra, Orissa, Tamil Nadu, Punjab and Ladakh U.T, district Kargil (Present study).

Host plant: Buckwheat.

Conclusion

The study of dipteran flower visitors in the Kargil district of Ladakh has provided valuable insights into the diversity and distribution of these crucial pollinators in a unique and challenging environment. 17 species of flower-visiting dipterans, belonging to different genera and families, highlighted the rich insect fauna present in this cold desert trans-Himalayan district. This investigation marks an important milestone as the first field survey of flower visiting dipteran species in the area. Understanding the interactions between flower visitors and plants in this region is of utmost significance for conservation efforts. These flower visitors play a vital role in pollination, ensuring the reproduction and survival of plant species, especially in the face of changing environmental conditions. Protecting the habitats and resources necessary for these flower visitors is crucial for preserving the unique biodiversity and ecological balance of the Kargil-Ladakh region. Moreover, further exploration and research are needed to fully comprehend the insect fauna and its importance in this cold and semi-arid ecosystem, which will aid in formulating effective conservation strategies and promoting sustainable management practices. It is important to note that the specific insects found in Kargil may vary based on the local ecosystem, altitude, and other factors. Additionally, the availability of flowering plants in cold desert regions can be

limited, which may affect the abundance and diversity of insect populations compared to more temperate regions.

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