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Report on insect visitors on dandelion (*Taraxacum officinale*) flower in cold desert at Kargil, Ladakh, India

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Abstract
The dandelion (*Taraxacum officinale*) is an herbaceous plant that emerges in early spring, following the winter season. These plants are commonly found in diverse fields. Upon entering the anthesis stage, these flowers attract numerous insects seeking nectar and pollen. During field investigations, conducted in the Kargil district of Ladakh, India, it was observed that the primary visitors to dandelion flowers included butterflies, with a recorded count of 12 species, followed by hymenopterans with 7 species, dipterans with 4 species, and a single species of Coleoptera. This herb is very more important both for humans and other animals in the ecosystem. However, due to lack of knowledge about its significance, people often regard it as weed.

Keywords: Dandelion, insect visitor, herb, diversity, Kargil

Introduction

Insects that play the role of pollinators confront a multitude of threats from anthropogenic activities that could imperil their vital ecosystem service to both cultivated crops and native flora [1-3].The resilience of these pollinator communities and the valuable service they furnish is governed by the intricate patterns of ecological connections formed through interactions between pollinator and plant species [4-5]. Grasping these networks holds significance in anticipating the potential hazards posed by factors that endanger pollinators [2]. Examination of plant-pollinator networks has yielded insights into their structure and potential durability when confronted with actual or simulated alterations in the environment, such as species extinctions [6-7] shifts in climate conditions [8] modifications in habitats [5, 9] and ecological disturbance [10].

Dandelion (*Taraxacum officinale*) is a self as well as cross pollinated weed and vegetables in this region. With early spring the flower bloom and provides immense benefits to the bees, butterflies, flies, beetles and many other animals in the form of nectar, pollen, and food for many organisms.

The English term "dandelion" originates from the old French phrase "dent de lion" or "tooth of the lion," alluding to the serrated structure of the dandelion's leaves. The yellow dandelions flowers due to early blossoming and extended blooming serve as an important nectar source for bees and butterflies at a time when other flowers have not yet opened. These pollinators play a crucial role in aiding the reproduction of vegetable plants and annual flowers as the summer progresses. Dandelions could be classified as untamed greens. In a database detailing with between plants and pollinators, records indicate that dandelion flowers have been visited by insects, leading to a compilation of 90 distinct bee species, 62 hoverfly species, and 25 butterfly species [11].

The present paper report about the insect visitors of dandelion (*Taraxacum officinale*) from the cold desert of trans-himalayan region at Kargil, Ladakh.

Materials and methods

Study area

Kargil is the one of the districts of Ladakh which is a union territory in India (34.55˚63’35N, 76.13˚25’07E). The study area was segmented into 13 distinct sites, and corresponding maps were generated using QGIS software (version 3.8.2 Zanzibar) and Google Earth (refer to Figure 1). Detailed data on Global Positioning System (GPS) coordinates and elevation, for each study site can be found in Table 1, Figure 1. Dandelion (*Taraxacum officinale* L.) insect pollinators were collected from this region in the months of April-June during the year of 2021, 2022, and 2023 (Figure. 2). The local name of this herb dandelion in Kargil, Ladakh is “Khorma”.

Table 1: Physiographic information about the study sites of Kargil district and its sub regions

Sl.no.	Study site	Name of sampling areas	GPS coordinates	Elevation
1	S1	Batalik	34°39’23"N 76°20’16"E	2782m
2	S2	Tumail Colony and Kurbathang	34°32’14"N 76°09’33"E	2926m
3	S3	Hardass and Karkitchu	34°36’16"N 76°05’46"E	2660m
4	S4	Minjee and Sarchay	34°28’28"N 76°04’37"E	2796m
5	S5	Skamboo	34°27’30"N 76°14’40"E	3224m
6	S6	Wakha	34°22’21"N 76°22’49"E	3313m
7	S7	Akchamal and Chutumail	34°33’18"N 76°10’53"E	3753m
8	S8	Shilikchay	34°34’20"N 76°07’27"E	2661m
9	S9	Chicktan Hagnis	34°23’05"N 76°30’50"E	3446m
10	S10	Sankoo	34°17’18"N 75°57’34"E	2993m
11	S11	Lankerchay	34°19’08"N 75°57’28"E	2954m
12	S12	Tambis and Kanoor	34°24’44"N 76°02’54"E	2838m
13	S13	Purtikchay	34°15’55"N 76°01’56"E	3193m

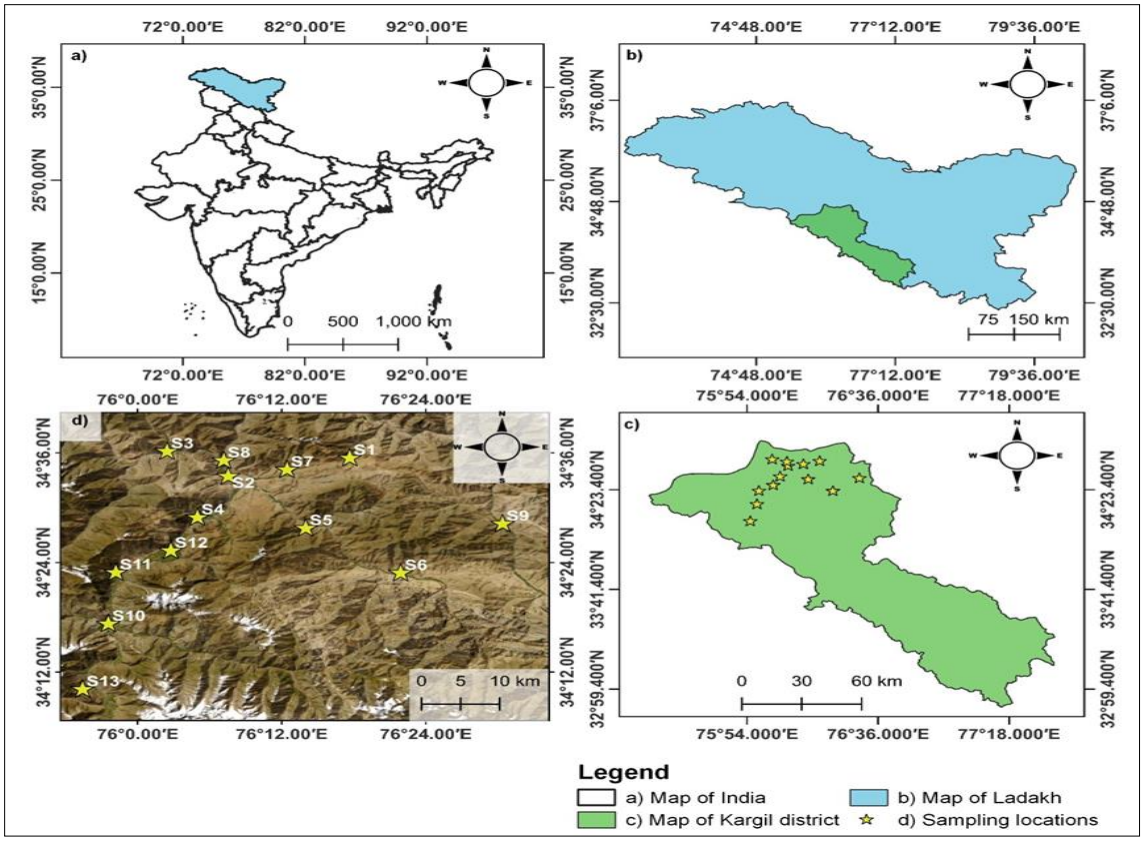

Fig 1: In QGIS map showed the sampling sites of dandelion (*Taraxacum officinale* L.) flower visitors

A **B**

Fig 2: A. Field photographs of dandelion (*Taraxacum officinale* L.). **B.** *Bombus tunicatus* busy in collection of pollen and nectar

Insects collection

During the collection process in the field, an insect hand net and was used. It was swept across dandelion flowers to capture various insects. Once captured, these insects were placed into a fumigated jar containing ethyl acetate to render them inactive. They were left in this jar for a duration of 10-15 minutes. Following this, the immobilized insects were carefully removed from the jar individually and mounted on a thermocol sheet where they are properly stretched. Once the pinning and stretching were completed, the thermocol sheet with the stretched insects was placed in a dry, well-ventilated room for complete drying of the specimens. The dried, specimens were transferred into insect boxes and labeled suitably. All the collected specimens are kept the Zoology department of Panjab University, Chandigarh.

Identification of species

Butterflies were got identified from parent department and Forest Research Institute (F.R.I), Dehradun. During identification literature was also consulted. Bumble bee species confirmation was done from the "Desert Regional Centre, Zoological Survey of India" located in Jodhpur, Rajasthan. Non A*pis* bees species were identified and confirmed through taxa specialist in the Department of Entomology, College of Agriculture and Sericulture, University of Agriculture Sciences, Bengaluru. Dipteran flowers visitor got identified from Diptera section of Zoological Survey of India, Kolkata.

Statistical analysis

Data analysis of the results was done with the help of the following diversity indices.

a. Shannon-Wiener Diversity Index: To quantify species diversity, used the Shannon-Wiener Diversity Index (H) Shannon and Wiener, [12].

H = -Σ (Ni/N) ln (Ni/N) i=1

Where: **Ni** = Number of individuals of species i

N = Total number of individuals across all species

b. Evenness Index: The Evenness Index, as described by Hill[13] calculated as follows:

E = H / ln S

Where: **S** = Total number of species

N = Total number of individuals across all species

H = Diversity Index

c. Margalef's Index: For a straightforward assessment of species richness, Margalef 's [14] index, was utilized: Margalef's Index = **(S-1) / ln N**

Where: **S** = Total number of species

N = Total number of individuals in the sample

ln = Natural logarithm

d. Simpson index of diversity (1-D): Simpson's Diversity Index, introduced by Simpson [15] is a widely used and straightforward method for estimating the likelihood that two randomly selected entities from a given dataset belong to the same category or type. The Simpson index takes into account both the number of different categories (species) and their respective levels of dominance within the dataset. The resulting index value ranges from 0 to 1. When the value approaches 0, it indicates a low level of diversity, whereas values near or above 1 suggest high diversity.

D = ∑ $n_i(n_i-1)/N (N-1)$

D = Simpson's diversity

Ni = total number of individuals of a particular species

N = total number of individuals of all species

Results

During field study 24 different insect species visitors were recorded on dandelion (*Taraxacum officinale*) flowers (Table. 2). Based on the species composition, Lepidoptera was richest (50%), followed by Hymenoptera (29%), Diptera recorded by (17%) and Coleoptera (4%) (Figure 3). With respect to family composition in each recorded order, the highest number was shown by Hymenoptera (42%) followed by Lepidoptera (25%), Diptera (15%) and Coleoptera (8%) (Figure.4). the highest number of genera was recorded by Lepidoptera (10 genus) and second was Hymenoptera (6 genus) followed by Diptera (3 genus) while a single genus was recorded for Coleoptera (Figure. 5). In diversity calculation, Shannon index was highest for Lepidoptera (2.24) followed by Hymenoptera (1.81), and least recorded by Diptera (1.09). Highest species richness was recorded by Lepidoptera (1.96) followed by Hymenoptera (1.15) and least for Diptera (0.38). Highest species evenness value was recorded by Diptera (0.99) followed by Hymenoptera (0.93) and then Lepidoptera (0.90). In case of Simpson index the highest value was obtained for Lepidoptera (8.19), then Hymenoptera (0.83) and least for Diptera (0.66) (Table 3.).

Table 2: List of dandelion (*Taraxacum officinale* L.) insect pollinators recorded from Kargil, Ladakh

Sl. No.	Common name	Scientific name	Family	Order
1	Bumble bee	*Bombus tunicatus* (Smith, 1852)	Apidae	Hymenoptera
2		*Andrena* sp.	Andrenidae	Hymenoptera
3	Horned-faced bee	*Osmia* sp. (Radoszkowski, 1887)	Megachilidae	Hymenoptera
4	Digger wasp	*Sphex* sp.	Sphecidae	Hymenoptera
5		*Podalonia* sp.	Sphecidae	Hymenoptera
6	Ant	*Formica fusca* (Linnaeus, 1758)	Formicidae	Hymenoptera
7	Ant	*Formica cunicularia* (Latreille, 1798)	Formicidae	Hymenoptera
8	Bee fly	*Anthrax aperta* (Walker, 1852)	Bombyliidae	Diptera
9	Drone fly	*Eristalis tenax* (Linnaeus, 1758)	Syrphidae	Diptera
10	Drone fly	*Eristalis cerealis* (Fabricius, 1805)	Syrphidae	Diptera
11		*Myopa tastacea* (Linneaus (1767)	Conopidae	Diptera
12	Brime stone	*Gonepteryx rhamni* (Linnaeus, 1758)	Pieridae	Lepidoptera
13	Cabbage butterfly	*Pieris brassicae* (Linnaeus, 1758)	Pieridae	Lepidoptera
14	Himalayan Pearl White butterfly	*Euchloe daphalis* (Moore, 1865)	Pieridae	Lepidoptera
15	Eastern pale clouded yellow butterfly	*Colias erate* (Esper, 1805)	Pieridae	Lepidoptera
16	Dark clouded yellow butterfly	*Colias fieldi fieldi* (Ménétriés, 1855)	Pieridae	Lepidoptera
17	Painted lady butterfly	*Vanessa cardui* (Linnaeus, 1758)	Nymphalidae	Lepidoptera
18	Comma butterfly	*Polygonia c-album* (Linnaeus, 1758)	Nymphalidae	Lepidoptera
19	Indian tortoiseshell butterfly	*Aglais caschmirensis(Kollar, 1844)*	Nymphalidae	Lepidoptera
20	Common copper butterfly	*Lycaena phlaeas* (Linnaeus, 1761)	Lycaenidae	Lepidoptera
21	Common Blue butterfly	*Polyommatus icarus* (Rottemburg, 1775)	Lycaenidae	Lepidoptera
22	Common Meadow Blue butterfly	*Polyommatus stoliczkana* (Smith, 1989)	Lycaenidae	Lepidoptera
23	Hill Hedge Blue butterfly	*Celastrina argiolus kollari* (Westwood,1852)	Lycaenidae	Lepidoptera
24	Blister beetle	*Mylabris pustulata* (Fabricius, 1775)	Meloidae	Coloeptera

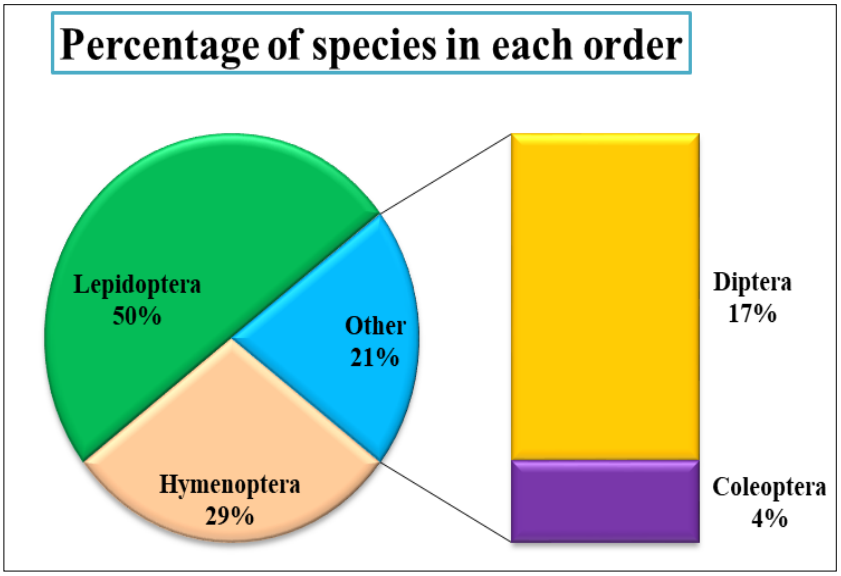

Fig 3: In pie chart showed the percentage of species in each order

Table 3: Dandelion (*Taraxacum officinale* L.) insect visitors diversity parameters in Kargil region

Order	No. of family recorded	No. of species	Species diversity	Species evenness	Species richness	Simpson index
Hymenoptera	5	7	1.81	0.93	1.15	0.83
Diptera	3	4	1.09	0.99	0.38	0.66
Lepidoptera	3	12	2.24	0.90	1.96	8.19
Coleoptera	1	1				

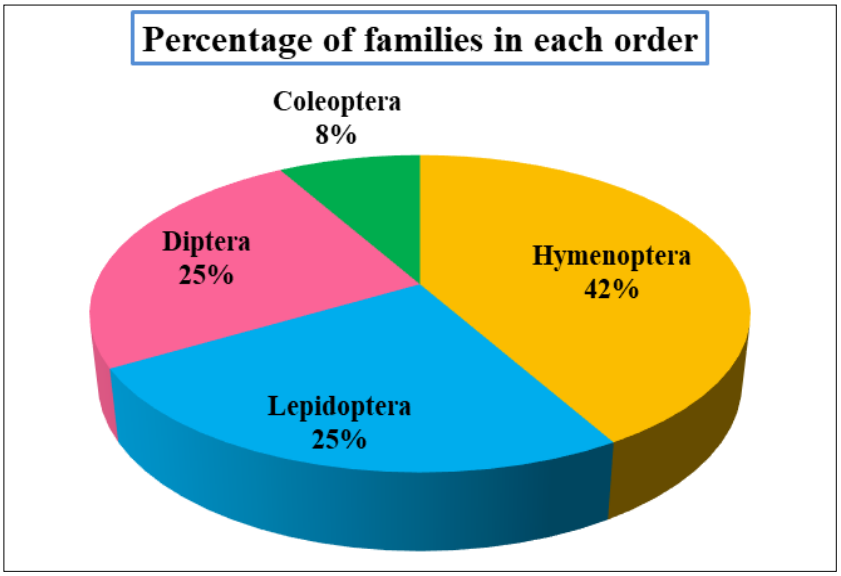

Fig 4: In this pie chart showed the percentage of dandelion visitors families of insect in each recorded order

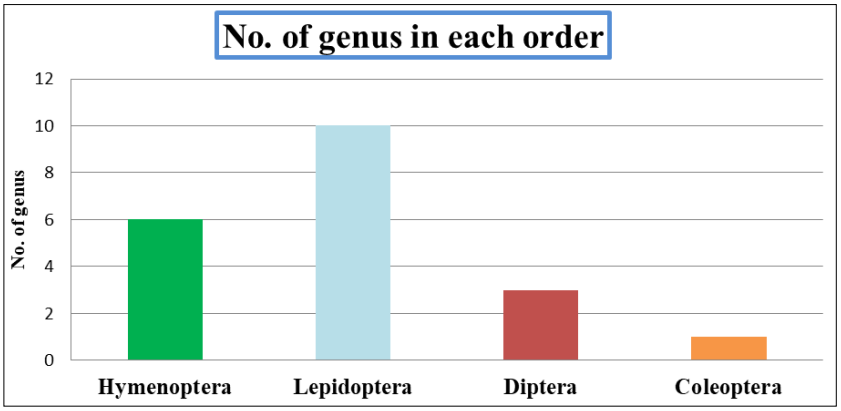

Fig 5: Indicated the number of genus in each recorded order of dandelion flower visitors

Discussion

Dandelion (*Taraxacum officinale*) mostly depends on insect pollination. Wind pollination also helps in pollen transfer from flower to flower. The visitation pattern of a plant by its pollinators, which is influenced by factors such as search behavior, foraging range, and diet preferences, may be impacted by the size of the floral neighborhood. Pollinators that fly cover greater distances, ranging from hundreds of meters to several kilometers. Consequently, the distribution of flowers at the landscape level plays a role in shaping the behavior of these pollinators, as suggested [16-19].

The region under study, butterflies were the dominant visitors of dandelion flowers. Dandelion is very useful as vegetable as their green leaves are used as food and medicine for several diseases. Conservation of biodiversity of dandelion in cold desert is very important as it is a beneficial field herb.

It is important to note that the specific pollinators present in a mountain region can vary based on factors such as altitude, climate, and the availability of suitable habitats. Additionally, changes in pollinator populations due to factors like habitat loss, pesticide use, and climate change can have implications for dandelion populations and their ability to reproduce.

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